CONSTRUCTION OF RESIDENTIAL FLATS, SBILD & OTHER COMMERCIAL OUTFITS AT HINJEWADI, PUNE, MAHARSHTRA, IN EPC MODE

PART E: CHAPTER A (CIVIL)

SBI

muralage

STATE BANK OF INDIA

TENDER DOCUMENT

Tender No.: SBI/……

Name of the work:

CONSTRUCTION OF RESIDENTIAL & COMMERCIAL OUTFITS

AT HINJEWADI, PUNE in EPC Mode.

Part- E

TECHNICAL SPECIFICATIONS

Client:
Assistant General Manager (P&E)
State Bank of India
Premises & Estate Department
Local Head Office, Maharashtra Circle
'Spandan', 15th Floor,
Plot No. 3/2 & AM-3, M.I.D.C.,
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TECHNICAL SPECIFICATIONS

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TECHNICAL SPECIFICATIONS(GENERAL)

CHAPTER -A

BRIEF OF REQUIREMENT OF THE WORK:

1. Introduction:

The scope of work relates to **CONSTRUCTION OF RESIDENTIAL & COMMERCIAL OUTFITS AT HINJEWADI, PUNE, MAHARASHTRA**. in EPC Mode. The work is to be executed Design, Engineering, Procurement & Construction (EPC) basis as laid down in the Master Plan, Concept plans, Design Brief Report and tender drawings including Operation & Maintenance of buildings/services after completion and handing over in phases and up to the expiry of the defect liability period of complete project.

The scope of work shall also include Electrical works, Mechanical works, Electronic works, Plumbing, Sanitary, Sewerage, Storm water drainage, & Fire-Fighting works etc. including maintenance during defect liability period including & preparation of all detailed drawings, obtaining approval from all local authorities, electrical inspector, water, sewer, drainage, electricity connection from local bodies, fire & environmental clearance, consent to establish & operate from Maharashtra Pollution Control Board, permission / approval for tree replantation etc. to be executed as integral part of the project. As CLIENT, SBI aims at getting IGBC Platinum & Net Zero Building Certification (Energy) prospective bidders are required to provide adequate documentation & all other requirements relevant to enable CLIENT/SBI in achieving these objectives as referred above. The following are the salient features of the Works:

a. Foundations & other works like underground water tanks.
b. Retaining wall
c. Sub structure RCC framed structure
d. Super structure RCC framed with PT Beams & Slabs structure with AAC Blocks & Fly-ash Blocks.
e. Monolithic (Mivan) Construction with RCC Shear Walls in Residencial Block.
f. Water proofing treatment including basement, podium, wet areas inside the building, UGT, OHT, Terrace & above terrace works.
g. UPVC door and windows, etc.
h. Façade System (Energy Efficient Performance Envelope), Zinc Sheet cladding, Aluminum Louvers, Structural glazing work, Texture paint, (columns, mouldings, cornices, wall cladding, curtain walls, GRC Jali) etc. as per elevation drawings.
i. Anti-termite chemical treatment
j. Internal and External water supply, Sewerage, Storm water drainage, Rain Water Harvesting.
k. Infrastructure Development I.e. RCC Roads (Rigid Pavement) , Parking, Pathways, Kerb Stone, Kerb Channel, Landscape & Horticulture etc.
l. Electrical Installation (External)
m. Fire Fighting System

n. Fire Alarm & PA System

o. IBMS (Integrated Building Management System)

p. Substation Equipment's (HT&LT Pannel with all HT & LT Cabling)

q. DG Sets with AMF

r. PV Rooftop Solar Power Plant

s. Solar Water Heating System

t. Lifts & Pressurization System

u. WTP, STP, Centralized R.O System

v. Signages

w. Landscape & Horticulture Works, Hard Landscaping in Courtyards, water bodies etc.

x. Boundary wall with Entry/Exit gates and Security cabins, etc.

y. Boom Barriers

2. General

i. The work shall in general confirm to the **Latest CPWD Specifications** (corrected up to the last date of submission/uploading of bid) as mentioned in Schedule 'F' of the General Conditions of Contract (GCC). Work under this Contract shall consist of furnishing all labour, materials, equipment, tools & plants and appliances necessary and required.

ii. Wherever CPWD Specifications are silent, the latest BIS Codes/Specifications, National Building Code-2016, Manufacturers Specifications, Sound Engineering practices or well-established local construction practices as decided by the SBI/PMC in-charge shall be followed

iii. These Technical Specifications are to be read with the Technical Specifications mentioned in Schedule–F of the General Conditions of Contract. In case of any discrepancy, these technical specifications shall prevail.

iv. The Contractor shall conduct his work, so as not to interfere with or hinder the progress or completion of the work being performed by other Contractor(s) or by the SBI/ PMC / Engineer in charge and shall as far as possible arrange his work and shall place and dispose of the materials being used or removed, so as not to interfere with the operations of other Contractor simultaneously working or he shall arrange his work with that of the others in an acceptable and coordinated manner and shall perform it in proper sequence to the complete satisfaction of others,

v. Regarding testing of civil & electrical & other materials, the testing of materials shall be conducted in Govt. Laboratory/ Govt. Engineering Colleges/ IITs/ NITs/NABL/BIS approved laboratory from the laboratory as approved by SBI/ PMC / Engineer in charge. The charges of testing of materials in approved laboratory shall be borne by the Contractor.

vi. No payment shall be made for any damage caused by rain, snowfall, flood or any other natural calamity, whatsoever during the execution of the work. The Contractor shall be fully responsible for any damage to the SBI/Govt. Property/ any other adjacent properties and work for which the payment has been advanced to him under the contract and he shall make good the same at his risk and cost. The Contractor shall be fully responsible for safety and security of his Labour, materials, T&P, Machinery brought to the site by him.

The Contractor shall comply with the Safety procedures, norms and guidelines (as

applicable) as outlined in the document Part 7 Constructional practices and Safety- 2016, National Building code of India, Bureau of Indian Standards. A copy of all pertinent regulations and notices concerning accidents, injury and first-aid shall be prominently exhibited at the work site. Depending upon the scope & nature of work, a person qualified in first-aid shall be available at work site to render and direct first-aid to causalities. A telephone may be provided to first-aid assistant with telephone numbers of the hospitals displayed. Complete reports of all accidents and action taken thereon shall be forwarded to the competent authorities.

vii. The Contractor shall ensure the following activities for construction workers safety, among other measures:

a. Guarding all parts of dangerous machinery.

b. Precautionary signs for working on machinery

c. Maintaining hoists and lifts, lifting machines, chains, ropes, and other lifting tackles in good condition.

d. Durable and reusable formwork systems to replace timber formwork and ensure that formwork where used is properly maintained.

e. Ensuring that walking surfaces or boards at height are of sound construction and are provided with Safety rails or belts.

f. Provide personal protective equipment (PPE); helmets etc.

g. Provide measures to prevent fires. Fire extinguishers and buckets of sand to be provided in the fire-prone area and elsewhere.

h. Provide sufficient and suitable light for working during night time.

viii. The Contractor shall provide for adequate number of garbage bins around the construction site and the workers facilities and will be responsible for the proper utilization of these bins for any solid waste generated during the construction. The Contractor shall ensure that the site and the workers facilities are kept litter free. Separate bins should be provided for plastic, glass, metal, biological and paper waste and labeled in both Hindi and English with suitable symbols. All wastes to be properly segregate and disposed off as per Govt Norms.

ix. Contractor should spray curing water on concrete structure and shall not allow free flow of water. Concrete structures should be kept covered with thick cloth/gunny bags and water should be sprayed on them. Contractor shall do water ponding on all sunken slabs using cement and sand mortar.

x. Water used for construction and curing purposes shall conform to the requirements specified in the relevant BIS standards (IS 456:2000 – Clause 5.4 and IS 3025 series for water testing). The water shall be clean and free from deleterious materials such as salts, oils, acids, alkalis, organic matter, or any other impurities that may adversely affect the designed quality, strength, or durability of concrete and reinforcement.

xi. The Contractor shall remove from site all rubbish and debris generated by the Works and keep Works clean and tidy throughout the Contract Period. All the serviceable and non-serviceable (malba) material shall be segregated and stored separately. Malba, rubbish & other waste materials shall be disposed off as directed/ approved by SBI/ PMC / Engineer in charge and necessary documentations shall be submitted to SBI/ PMC / Engineer in charge. In this regard directives of National Green Tribunal or any other authority shall be a binding on Contractor.

xii. In the event any technical specification related to the scope of work is not explicitly provided in the tender documents but is reasonably expected to be part of the work, the EPC contractor shall adopt **CPWD specifications**, **prevailing market standards**, and **relevant IS codes**. Such assumed specifications must be clearly indicated in the proposal and submitted for approval to the Employer/PMC prior to execution. Unless specifically excluded in the tender, any essential item shall be deemed to be included within the contractor's scope and quoted price.

xiii. **Approved Makes**:

Specification/brands names of materials to be used as per the scope of work are listed in the bid documents. The efforts should be made by the Contractor to use indigenous products. The Contractor should also consider the availability of spares parts/ components for maintenance purposes while proposing any brand/ manufacturer. The materials of any other brand/manufacturer may be proposed for use by the Contractor in case the brands specified below are not available in the market and/or Contractor intends to use some other brand better than the brands mentioned in this list. The alternate brand can be used only after the approval of SBI/ PMC / Engineer in charge. The list of approved makes is appended to this document.

Brands and makes specified in the list of approved makes are indicative in nature and serve to establish the minimum desired standards for quality and performance. As the project is targeted for **IGBC Platinum and Net Zero - Energy certification**, where specific green-compliant products are not explicitly listed, the **EPC contractor shall assume high-performance, premium-grade, or top-rated brands** conforming to relevant sustainability standards while quoting. Final selection of all **finishes, materials, and equipment** shall be subject to **review and approval by SBI/PMC**

xiv. **Method Statement**:

The Contractor shall submit a 'Methods statement' for each important activity for the approval of the SBI/ PMC / Engineer in charge soon after the award of work to him. The 'Methods statement' is a statement by which the construction procedures for any activity of construction are formulated and stated in chronological order. The 'Methods statement', should have a description of the item with elaborate procedures in steps to implement the same, the specifications of the materials involved, their testing and acceptance criteria, equipment to be used, Precautions to be taken, etc.

3. Setting Out

i. The Contractor shall carry out survey of the whole work area, setting out the layout of building in consultation with the SBI/ PMC / Engineer in charge & proceed further. Any discrepancy between the Approved Architectural drawings and actual layout at site shall be brought to the notice of the SBI/ PMC / Engineer in charge. It shall be responsibility of the Contractor to ensure correct setting out of alignment. Total station survey instruments only shall be used for layout, fixing boundaries, and Centrelines, etc.

ii. The Contractor shall establish, maintain and assume responsibility for grades, lines, levels and benchmarks. He shall report any errors or inconsistencies regarding grades, lines, levels, dimensions etc. to the SBI/ PMC / Engineer in charge before commencing work. Commencement of work shall be regarded as the Contractor's acceptance of such grades, lines, levels, and dimensions and no claim shall be entertained at a later date for any errors found.

iii. If at any time, any error appears due to grades, lines, levels and benchmarks during the progress of the work, the Contractor shall, rectify such error, if so required, to the satisfaction of the SBI/ PMC / Engineer in charge.

iv. Though the site levels are indicated in the drawings the Contractor shall ascertain and confirm the site levels with respect to benchmark from the concerned authorities. The Contractor shall protect and maintain temporary/ permanent benchmarks at the site of work throughout the execution of work. These benchmarks shall be got checked by the PMC/SBI/ PMC / Engineer in charge or his authorized representatives. The work at different stages shall be checked with reference to bench marks maintained for the said purpose.

v. The approval by the SBI/ PMC / Engineer in charge, of the setting out by the Contractor, shall not relieve the Contractor of any of his responsibilities and obligation to rectify the errors/ defects, if any, which may be found at any stage during the progress of the work or after the completion of the work.

vi. The Contractor shall be entirely and exclusively responsible for the horizontal, vertical and other alignments, the level and correctness of every part of the work and shall rectify effectively any errors or imperfections therein. Such rectifications shall be carried out by the Contractor to the entire satisfaction of the SBI/ PMC / Engineer in charge.

vii. The Contractor(s) shall carry out soil/geotechnical investigation and should satisfy himself about complete characteristics of soil and other parameters at site. The details w.r.t soil strata, bearing capacity etc. given in the DBR are indicative and no claim on the alleged inadequacy or incorrectness of the soil data supplied by the department shall be entertained. The intending Contractor shall conduct soil investigations on their own, and shall be responsible for the adequacy of the design.

4. Coordinated Drawings

i. Before taking up the work, the Contractor shall prepare shop drawings for the works listed below for various civil and electrical & other services showing details of lay out in plan including sections & elevations & large-scale details and Contractor shall plan and mobilize his resources as per these drawings and as per actual site conditions to facilitate convenient execution, installation as well as maintenance of these items.

ii. Shop Drawings:

The scope of work, technical specifications and drawings together shall be considered as a tender requirement and the work shall be carried out as per Good for Construction (GFC) drawings, prepared & submitted by the Contractor and duly approved by SBI/ PMC / Engineer in charge. The Contractor shall study the GFC drawings and taking into account actual site conditions and selected material and requirements, shall prepare shop drawings as fully coordinated drawings. Such drawings shall be prepared for the works, not limited to the following works:

a. Upvc works & Structural glazing.
b. Expansion joint work
c. Stone cladding work
d. Zinc sheet cladding work
e. Suspended ceiling work, coordinated with all ceiling related services.
f. Marble, granite, vitreous, ceramic, tile work, terrazzo, engineered wood, carpet
g. Acoustical materials (ceiling & wall)
h. Boom Barriers
i. All Electrical work
j. All Sanitary work
k. Lifts
l. Horticulture
m. Electric Sub-station
n. STP, WTP

o. Fire Alarm system
p. Pumps & Solar panels.
q. Signage

The shop drawings shall be prepared and submitted for approval well in advance to achieve the milestones provided.

iii. Within the time frame agreed with the SBI/ PMC / Engineer in charge, the Contractor shall prepare shop drawings using latest version of Auto CAD. Shop drawings shall show all layouts, details in plans & sections showing all connections, junctions, bends, supports, clearances. Fixing arrangements with dimensions' room, etc. shall be prepared by the Contractor on Auto-CAD based on the architectural drawings and site measurements. All measurable items quantities shall be mentioned on each shop drawing being submitted for approval by the Contractor. 3 sets of shop drawings (soft copy also) shall be submitted for approval and Seven sets of final shop drawings after approval by SBI/ PMC / Engineer in charge shall be submitted by the Contractor along with the soft copy. The shop drawings shall be prepared as per agreed schedule.

iv. Technical submittals of manufacturer's catalogues and technical data shall be submitted for approval. The Contractor shall designate an Engineer responsible for issue and preparation of shop drawings and control of GFC drawings.

5. Scale of Amenities: -

The doors and windows/flooring shall be provided as per the requirements indicated in the finishing schedules/tender drawings/ CPWD Norms for commercial buildings and technical specifications. In case of variance, the decision of SBI/ PMC / Engineer in charge shall prevail.

CHAPTER B

TECHNICAL SPECIFICATIONS – CIVIL WORKS

1 GENERAL

1.1. The work shall be carried out in accordance with the Design Basis Report, Architectural drawings and structural drawings (proof checked/vetted by IIT's) as prior approval by the SBI/ PMC / Engineer in charge. The Technical Specifications are to be read with and in general confirming to the Latest CPWD Specifications.

1.2. Contractor(s) shall provide permanent bench marks, flag tops and other reference points for the proper execution of work and these shall be preserved till the end of the work. All such reference points shall be in relation to the levels and locations, given in the Architectural and plumbing drawings. On completion of work, the Contractor(s) shall submit required number of prints of "as built" drawings to the SBI/ PMC / Engineer in charge.

1.3. Before commencement of any item of work the Contractor shall correlate all the relevant Architectural and Structural Drawings, and Specifications etc. and satisfy himself that the information available is complete and unambiguous. The Contractor alone shall be responsible for any loss or damage occurring by the commencement of work based on any erroneous and or incomplete information and no claim whatsoever shall be entertained on this account.

1.4. The Contractor (s) should engage approved, licensed plumbers for the work and get the materials (fixtures/fittings) tested, by the municipal Body /Corporation authorities wherever required, at his own cost. The Contractor(s) shall submit for the approval of the SBI/ PMC / Engineer in charge, the name of the plumbing Contractor proposed to be engaged by him.

1.5. The Contractor shall give performance test of the entire installation(s) as per the specifications in the presence of the SBI/ PMC / Engineer in charge or his authorized representative before the work is finally accepted and nothing extra what-so-ever shall be payable to the Contractor for the test.

1.6. The work of services will be executed simultaneously. The Contractor shall minimize the scope of making recesses, holes, opening etc. as the same shall be planned in advance and necessary grooves/niches shall be provided in shuttering of RCC.

1.7. Sample of building materials, fittings and other articles required for execution of work shall be got approved from the SBI/ PMC / Engineer in charge before use in the work. The quality of samples brought by the Contractor shall be judged by standards laid down in the relevant CPWD/ BIS specifications. All materials and articles brought by the Contractor to the site for use shall confirm to the samples approved by the SBI/ PMC / Engineer in charge which shall be preserved till the completion of the work.

1.8. BIS marked materials except otherwise specified shall be subjected to quality test at the discretion of the SBI/ PMC / Engineer in charge besides testing of other materials as per the specifications described for the item/material. Wherever BIS marked materials are brought to the site of work, the Contractor shall, if required, by the SBI/ PMC / Engineer in charge, furnish manufacturer's test certificate or test certificate from approved testing laboratory to establish that the material / procured by the Contractor for incorporation in the work satisfies the provisions of specifications / BIS codes relevant to the material and / or the work done.

1.9. The Contractor shall procure the required materials in advance so that there is sufficient time to testing of the materials and clearance of the same before use in the work. The Contractor shall provide at his own cost suitable weighing and measuring arrangements at site for checking the weight / dimensions as may be necessary for execution of work.

1.10. Contractor shall submit "Quality Assurance" plan (QAP) as referred under Clause 22 of

GCC, PART-B, of Tender document:

1.11. The Contractor shall ensure that no construction leachate (e.g. cement slurry etc.), is allowed to percolate into the ground. Adequate precautions are to be taken to safeguard against this including, reduction of wasteful curing processes, collection, basic filtering and reuse. The Contractor shall follow requisite measures for collecting drainage water run-off from construction areas and material storage sites and diverting water flow away from such polluted areas. Temporary drainage channels, perimeter dike/swale, etc. shall be constructed to carry the pollutant- laden water directly to the treatment plant or facility (municipal sewer line).

1.12. In case the make or brand of any item, fitting, fixture, finish, equipment or material is not specifically mentioned in the tender documents, the Contractor shall propose makes of only premium, reputed, and ISI/ASTM/BS/EN certified brands, subject to prior approval of the SBI/ SBI/ PMC / Engineer in charge/PMC. Under no circumstances shall substandard, unbranded, or locally fabricated items be used. The cost for such premium items shall be deemed included in the quoted contract price and no extra claim shall be entertained on this account. In case of discrepancies in specifications of any items within this document, the premium specification shall prevail.

2 CHECK-LIST FOR EXECUTION OF WORK:

i. As and when any important item is taken up for execution, the Contractor shall submit the specifications and develop a Checklist and Pour card. This sample Checklist should be got approved from the SBI/ PMC / Engineer in charge and should be used at site. This check list should be shown to the SBI/ PMC / Engineer in charge or his Authorized representative during inspection. This procedure is to be followed for all hidden items, CC/RCC work, Steel- reinforcement, shuttering, Cast-in-situ mosaic flooring, Doors & Windows, Plumbing, including Water supply pipe lines, Roof treatment, Earth filling etc.

ii. The Contractor shall render all help and assistance in documenting the total sequence of this project by way of photography, slides, audio-video recording, Drone Video etc. nothing extra shall be payable to the Contractor on this account.

3 EARTH WORK:

3.1 Site Clearance

Before the earth work is started, the area coming under cutting and filling shall be cleared of shrubs, rank vegetation, grass, brushwood, trees and saplings of girth up to 30cm measured at a height of one metre above ground level and rubbish removed up to a distance of 50 metres outside the periphery of the area under clearance. The roots of trees and saplings shall be removed to a depth of 60cm below ground level or 30 cm below formation level or 15 cm below sub grade level, whichever is lower, and the holes or hollows filled up with the earth, rammed and leveled.

The trees of girth above 30 cm measured at a height of one metre above ground shall be cut only after permission of the SBI/ PMC / Engineer in charge is obtained in writing. The roots of trees shall also be Removed payment for cutting such trees and removing the roots shall be made separately.

Existing structures and services such as old buildings, culverts, fencing, water supply pipe lines, sewers, power cables, communication cables, drainage pipes etc. within or adjacent to the area if required to be diverted/removed, shall be diverted/dismantled as per directions of the Engineer-in- Charge and payment for such diversion/dismantling works shall be made separately.

In case of archaeological monuments within or adjacent to the area, the contractor shall provide necessary fencing alround such monuments as per the directions of the Engineer-in -Charge and protect the same properly during execution of works. Payment for providing fencing shall be made separately.

Lead of 50 m mentioned in the 'Schedule Of Quantities' is the average lead for the disposal of excavated earth within the site of work. The actual lead for the lead for the disposal of earth may be more or less than the 50 m for which no cost adjustment shall be made in the rates.

Disposal of Earth shall be disposed off at the specified location or as decided by the Engineer in- Charge. The contractor has to take written permission about place of disposal of earth before the earth is disposed off, from SBI/ PMC / Engineer in charge.

JUNGLE CLEARANCE

Jungle clearance shall comprise uprooting of rank vegetation, grass, brushwood, shrubs, stumps, trees and saplings of all girth measured at all height above the ground level.

Uprooting of Vegetations

The roots of trees and saplings shall be removed all depth below ground level or below formation level or below sub-grade level, whichever is lower. All holes or hollows formed due to removal of roots shall be filled up with earth rammed and levelled. Trees, shrubs, poles, fences, signs, monuments, pipe lines, cable etc., within or adjacent to the area which are not required to be disturbed during jungle clearance shall be properly protected by the contractor.

Stacking and Disposal

All useful materials obtained from clearing and grubbing operation shall be stacked in the manner as specified. Trunks and branches of trees shall be cleared of limbs and tops and stacked neatly at places. The materials shall be the property of the Government. All unserviceable materials shall be removed up to a distance of 50 m outside the periphery of the area under clearance. It shall be ensured by the contractor that unserviceable materials are disposed off in such a manner that there is no likelihood of getting mixed up with the materials meant for construction.

Clearance of Grass

Clearing and grubbing operation involving only the clearance of grass include removal of rubbish upto a distance of 50 m outside the periphery of the area under clearance.

3.2 Excavation

All excavation operations manually or by mechanical means shall include excavation and 'getting out' the excavated materials. In case of excavation for trenches, basements, water tanks etc. 'getting out' shall include throwing the excavated materials at a distance of at least one metre or half the depth of excavation, whichever is more, clear off the edge of excavation. In all other cases 'getting out' shall include depositing the excavated materials as specified. The subsequent disposal of the excavated material shall be either stated as a separate item or included with the items of excavation stating

lead. During the excavation the natural drainage of the area shall be maintained. Excavation shall be done from top to bottom. Undermining or undercutting shall not be done.

In firm soils, the sides of the trenches shall be kept vertical upto a depth of 2 metres from the bottom. For greater depths, the excavation profiles shall be widened by allowing steps of 50 cms on either side after every 2 metres from the bottom. Alternatively, the excavation can be done so as to give slope of 1:4 (1 horizontal : 4 vertical). Where the soil is soft, loose or slushy, the width of steps shall be suitably increased or sides sloped or the soil shored up as directed by the Engineer-in- Charge. It shall be the responsibility of the contractor to take complete instructions in writing from the

SBI/ PMC / Engineer in charge regarding the stepping , sloping or shoring to be done for excavation deeper than 2 metres.

The excavation shall be done true to levels, slope, shape and pattern indicated by the Engineer in- Charge. Only the excavation shown on the drawings with additional allowances for centering and shuttering or as required by the SBI/ PMC / Engineer in charge shall be measured and recorded for payment.

In case of excavation for foundation in trenches or over areas, the bed of excavation shall be to the correct level or slope and consolidated by watering and ramming. If the excavation for foundation is done to a depth greater than that shown in the drawings or as required by the Engineer-in -Charge, the excess depth shall be made good by the contractor at his own cost with the concrete of the mix used for levelling/ bed concrete for foundations. Soft/defective spots at the bed of the foundations shall be dug out and filled with concrete (to be paid separately) as directed by the SBI/ PMC / Engineer in charge.

While carrying out the excavation for drain work care shall be taken to cut the side and bottom to the required shape, slope and gradient. The surface shall then be properly dressed. If the excavation is done to a depth greater than that shown on the drawing or as required by the SBI/ PMC / Engineer in charge, the excess depth shall be made good by the contractor at his own cost with stiff clay puddle at places where the drains are required to be pitched and with ordinary earth, properly watered and rammed, where the drains are not required to be pitched. In case the drain is required is to be pitched, the back filling with clay puddle, if required, shall be done simultaneously as the pitching work proceeds. The brick pitched storm water drains should be avoided as far as possible in filled-up areas and loose soils.In all other cases where the excavation is taken deeper by the contractor, it shall be brought to the required level by the contractor at his own cost by filling in with earth duly watered, consolidated and rammed.

In case the excavation is done wider than that shown on the drawings or as required by the SBI/ PMC / Engineer in charge, additional filling wherever required on the account shall be done by the contractor at his own cost.

The excavation shall be done manually or by mechanical means as directed by Engineer-incharge considering feasibility, urgency of work, availability of labour /mechanical equipments and other factors involved. Contractor shall ensure every safety measures for the workers. Neither any deduction will be made nor any extra payment will be made on this account.

EXCAVATION IN ORDINARY/HARD ROCK

All excavation operations shall include excavation and ‘getting out’ the excavated matter. In case of excavation for trenches, basements, water tanks etc. ‘getting out’ shall include throwing the excavated materials at a distance of at least one metre or half the

depth of excavation, whichever is more, clear off the edge or excavation. In all other cases 'getting out' shall include depositing the excavated materials as specified. The subsequent disposal of the excavated material shall be either stated as a separate item or included with the item of excavation stating lead.

During the excavation, the natural drainage of the area shall be maintained. Excavation shall be done from top to bottom. Undermining or under cutting shall not be done.

Where hard rock is met with and blasting operations are considered necessary, the contractor shall obtain the approval of the Engineer-in- Charge in writing for resorting to the blasting operations. Blasting operations shall be done as specified in para 2.6 and chiseling shall be done to obtain correct levels, slopes, shape and pattern of excavation as per the drawings or as required by the Engineer-in- Charge and nothing extra shall be payable for chiseling.

Where blasting operations are prohibited or are not practicable, excavation in hard rock shall be done by chiseling.

In ordinary rock excavation shall be carried out by crowbars, pick axes or pneumatic drills and blasting operation shall not be generally adopted. Where blasting operations are not prohibited and it is practicable to resort to blasting for excavation in ordinary rock, contractor may do so with the permission of the SBI/ PMC / Engineer in charge in writing but nothing extra shall be paid for this blasting.

If the excavation for foundations or drains is done to a depth greater than that shown in the drawings or as required by the SBI/ PMC / Engineer in charge. The excess depth shall be made good by the contractor at his own cost with the concrete of the mix used for levelling/ bed concrete for foundations. Soft/ defective spots at the bed of foundations shall be dug out and filled with concrete (to be paid separately) as directed by the SBI/ PMC / Engineer in charge.

In all other cases where the excavation is taken deeper by the contractor, it shall be brought to the required level by the contractor at his own cost by filling with earth duly watered, consolidated and rammed.

In case the excavation is done wider than that shown on the drawings or as required by the SBI/ PMC / Engineer in charge, filling wherever required on this account shall be done by the contractor at his own cost.

Only the excavation shown on the drawings or as required by the SBI/ PMC / Engineer in charge shall be measured and recorded for payment except in case of hard rock, where blasting operations have been resorted to, excavation shall be measured to the actual levels, provided the SBI/ PMC / Engineer in charge is satisfied that the contractor has not gone deeper than what was unavoidable.

The excavation shall be done manually or by mechanical means as desired by Engineer-in- Charge considering feasibility, urgency of work, availability of labour /mechanical equipments and other factors involved Contractor shall ensure every safety measures for the workers. Neither any deduction will be made nor any extra payment will be made on this account.

EXCAVATION IN TRENCHES FOR PIPES, CABLES ETC. AND REFILLING

This shall comprise excavation not exceeding 1.5 mts in width or 10 sqm in plan and to any depth trenches for pipes. Cables etc. and returning the excavated material to fill the trenches after pipes, cables etc. are laid and their joints tested and passed and disposal of surplus excavated material upto 50 m lead.

Width of Trench

(a) Upto one metre depth the authorized width of trench for excavation shall be arrived

at by adding 25 cm to the external diameter of pipe (not socket/ collar) cable, conduit etc. Where a pipe is laid on concrete bed/ cushioning layer, the authorized width shall be the external diameter of pipe (not socket/ collar) plus 25 cm or the width of concrete bed/ cushioning layer whichever is more.

(b) For depths exceeding one metre, an allowance of 5 cm per metre of depth for each side of the trench shall be added to the authorized width (that is external diameter of pipe plus 25 cm) for excavation. This allowance shall apply to the entire depth of the trench. In firm soils the sides of the trenches shall be kept vertical upto depth of 2 metres from the bottom. For depths greater than 2 metres, the excavation profiles shall be widened by allowing steps of 50 cm on either side after every two metres from bottom.

(c) Where more than one pipe, cable, conduit etc, are laid, the diameter shall be reckoned as the horizontal distance from outside to outside of the outermost pipes, cable, conduit etc.

(d) Where the soil is soft, loose or slushy, width of trench shall be suitably increased or side sloped or the soil shored up as directed by the SBI/ PMC / Engineer in charge. It shall be the responsibility of the contractor to take complete instructions in writing from the SBI/ PMC / Engineer in charge regarding increase in the width of trench. Sloping or shoring to be done for excavation in soft, loose or slushy soils.

Refilling

Filling in trenches shall be commenced soon after the joints of pipes, cables, conduits etc. have been tested and passed. The space alround the pipes, cables conduits etc. shall be cleared of all debris, brick bats etc. Where the trenches are excavated in hard/ soft soil, the filling shall be done with earth on the side and top of pipes in layers not exceeding 20 cm in depth. Each layer shall be watered, rammed and consolidated. All clods and lumps of earth exceeding 8 cm in any direction shall be broken or removed before the excavated earth is used for filling. In case of excavation trenches in ordinary/ hard rock, the filling upto a depth of 30cm above the crown of pipe, cable, conduits etc. shall be done with fine material like earth, moorum or pulverized/ decomposed rock according to the availability at site. The remaining filling shall be done with boulders of size not exceeding 15cm mixed with fine material like decomposed rock, moorum or earth as available to fill up the voids, watered, rammed and consolidated in layers not exceeding 30cm. Excavated material containing deleterious material, salt peter earth etc. shall not be used for filling. Ramming shall be done with iron rammers where feasible and with blunt ends of crow bars where rammers cannot be used. Special care shall be taken to ensure that no damage is caused to the pipes, Cables, Conduits etc. laid in the trenches.

EXCAVATION IN WATER. MUD OR FOUL POSITION

All water that may accumulate in excavations during the progress of the work from springs, tidal or river seepage, broken water mains or drains (not due to the negligence of the contractor), and seepage from subsoil aquifer shall be bailed, pumped out or otherwise removed. The contractor shall take adequate measures for bailing and/or pumping out water from excavations and/or pumping out water from excavations and construct diversion channels, bunds, sumps, coffer dams etc. as may be required. Pumping shall be done directly from the foundation trenches or from a sump out side the excavation in such a manner as to preclude the possibility of movement of water through any fresh concrete or masonry and washing away parts of concrete or mortar. During laying of concrete or masonry and for a period of at least 24 hours thereafter, pumping shall be done from a suitable sump separated from concrete or masonry by effective means.

Capacity and number of pumps, location at which the pumps are to be installed, pumping hours etc. shall be decided from time to time.

Pumping shall be done in such a way as not to cause damage to the work or adjoining property by subsidence etc. Disposal of water shall not cause inconvenience or nuisance in the area or cause damage to the property and structure nearby.

To prevent slipping of sides, planking and strutting may also be done.

Classification

The earth work for various classification of soil shall be categorized as under:

(a) ***Work in or under water and/or liquid mud:*** Excavation, where water is met with from any of the sources specified in 2.21.1 shall fall in this category. Steady water level in the trial pits before the commencement of bailing or pumping operations shall be the sub-soil water level in that area.

(b) ***Work in or under foul position:*** Excavation, where sewage, sewage gases or foul conditions are met with from any source, shall fall in this category.

FILLING IN TRENCHES, PLINTH, UNDER FLOOR ETC.

Earth

Normally excavated earth from same area shall be used for filling. Earth used for filling shall be free from shrubs, rank, vegetation, grass, brushwood, stone shingle and boulders (larger than 75mm in any direction), organic or any other foreign matter. Earth containing deleterious materials, salt peter earth etc. shall not be used for filling. All clods and lumps of earth exceeding 8 cm in any direction shall be broken or removed before the earth is used for filling**.**

Filling

The space around the foundations and drains in trenches shall be cleared of all debris, brick bats etc. The filling shall be done in layers not exceeding 20 cm in depth. Each layer shall be watered, rammed and consolidated. Ramming shall be done with iron rammers where possible and with blunt end of crow bars where rammers cannot be used. Special care shall be taken to ensure that no damage is caused to the pipes, drains, masonry or concrete in the trenches. In case of filling under floor, the finished level of filling shall be kept to the slope intended to be given to the floor.

SAND FILLING IN PLINTH

Sand

Sand shall be clean and free from dust organic and foreign matter and its grading shall be within the limits of grading zone IV or V specified

Filling

Sand filling shall be done in a manner similar to earth filling in plinth . except that consolidation shall be done by flooding with water. The surface of the consolidated sand filling shall be dressed to the required level or slope and shall not be covered

EARTH WORK BY MECHANICAL MEANS

Earth work by mechanical means involves careful planning keeping in view site conditions i.e. type of soil, nature of excavation, distances through which excavated soil is to be transported and working space available for employing these machines. The earth moving equipment should be accordingly

selected. The earth moving equipment consists of excavating and transporting equipment. Excavating equipments may be further classified as excavators and tractor based equipments.

PLANKING AND STRUTTING

When the depth of trench in soft/loose soil exceeds 2 metres, stepping, sloping and/ or planking and strutting of sides shall be done. In case of loose and slushy soils, the depths at which these precautions are to be taken, shall be determined by the SBI/ PMC / Engineer in charge according to the nature of soil.

Planking and strutting shall be 'close' or 'open' depending on the nature of soil and the depth of trench. The type of planking and strutting shall be determined by the SBI/ PMC / Engineer in charge. It shall be the responsibility of the contractor to take all necessary steps to prevent the sides of trenches from collapse. SBI/ PMC / Engineer in charge should take guidance from IS: 3764 for designing the shoring and strutting arrangements and specifying the profile of excavation.

Close Planking and Strutting

Close planking and strutting shall be done by completely covering the sides of the trench generally with short upright, members called 'poling boards'. These shall be 250x38 mm in section or as directed by the SBI/ PMC / Engineer in charge.

The boards shall generally be placed in position vertically in pairs**.** One boards on either side of cutting. These shall be kept apart by horizontal wallings of strong wood at a maximum spacing of 1.2 metres cross strutted with ballies, or as directed by SBI/ PMC / Engineer in charge. The length and diameter of the ballies strut shall depend upon the width of the trench.

Where the soil is very soft and loose, the boards shall be placed horizontally against the sides of the excavation and supported by vertical 'wallings' which shall be strutted to similar timber pieces on the opposite face of the trench. The lowest boards supporting the sides shall be taken in the ground for a minimum depth of 75 mm. No portion of the vertical side of the trench shall remain exposed. The withdrawal of the timber members shall be done very carefully to prevent collapse of the trench. It shall be started at one end and proceeded systematically to the other end. Concrete or masonry shall not be damaged while removing the planks. No claim shall be entertained for any timber which cannot be withdrawn and is lost or buried, unless required by the SBI/ PMC / Engineer in charge to be left permanently in position.

Open Planking and Strutting

In case of open planking and strutting, the entire surface of the side of the trench is not required to be covered. The vertical boards 250 mm wide & 38 mm thick, shall be spaced sufficiency apart to leave unsupported strips of 50 cm average width. The detailed arrangement, sizes of the timber and the distance apart shall be subject to the approval of the Engineer-in- Charge. In all other respect, specifications for close planking and strutting shall apply to open planking and strutting.

3.3 Setting Out and Making Profiles

A masonry pillar to serve as a bench mark will be erected at a suitable point in the area, which is visible from the largest area. This bench mark shall be constructed and connected with the standard bench mark as approved by the SBI/ PMC / Engineer in charge. Necessary profiles with strings stretched on pegs, bamboos or 'Burjis' shall be made to indicate the correct formation levels before the work is started. The contractor shall supply labour and material for constructing bench mark, setting out and making profiles and connecting bench mark with the standard bench mark at his own cost. The pegs, bamboos or 'Burjis' and the bench mark shall be maintained by the contractor at his own cost during the excavation to check the profiles.

The ground levels shall be taken at 5 to 15 metres intervals (as directed by the Engineer-in- Charge) in uniformly sloping ground and at closer intervals where local mounds, pits or undulations are met with. The ground levels shall be recorded in field books and plotted on plans. The plans shall be drawn to a scale of 5 metres to one cm or any other suitable scale decided by the Engineer -in-

Charge. North direction line and position of bench mark shall invariable be shown on the plans. These plans shall be signed by the contractor and the SBI/ PMC / Engineer in charge or their authorized representatives before the earth work is started. The labour required for taking levels shall be supplied by the contractor at his own cost.

3.4 Earth Work

i. Earth work, by mechanical and manual means in Excavation for Foundation, Basement, Roads, Footpaths, Drains and Trenches etc. in all kind of soil/strata/ordinary rock/ hard rock as per terrains and drawings. Boring for pile (if required) as per structural drawings. In case of very hard rock where excavation using machinery is not possible or taking lot of time, hydraulic splitters or chemical can be used for rock fragmentation for which nothing extra shall be paid.

ii. For all excavation operations executed manually or by mechanical means, irrespective of the stipulations in the relevant CPWD Specifications or elsewhere in the Contract. The excavated earth shall be put to use in the areas related to the work and thereafter the extra earth shall be used in filling up the low-lying areas of the total plot, at his own cost. If there is any surplus excavated earth thereafter, the same shall be disposed off by the Contractor at his own cost to the place as directed by SBI/ PMC / Engineer in charge and/or permitted by the local authority after obtaining written permission of the Engineer – in- charge and no payment will be made by the SBI for disposal of this excavated earth.

iii. Filling with excavated earth shall be done in regular horizontal layers each not exceeding 20 cm in depth. All lumps and clods exceeding 8 cm in any direction shall be broken. Each layer shall be watered and consolidated with steel rammer or ½ tonne roller. Where specified, every third and top must layer shall also be consolidated with power roller of minimum 8 tonnes. Wherever depth of filling exceeds 1.5 metre vibratory power roller shall be used to consolidate the filing unless otherwise directed by SBI/ PMC / Engineer in charge. The top and sides of filling shall be neatly dressed. The contractor shall make good all subsidence and shrinkage in earth fillings, embankments, traverses etc. during execution and till the completion of work unless otherwise specified or as specified in CPWD specifications.

iv. Any other excavation or filling required at open areas other than building like landscaping, horticultural works, road works etc. for completion of work as per approved drawings shall be in the scope of work.

v. Black cotton soil (if present) shall be removed at all places where permanent structure will be constructed.

vi. The Contractor shall make, at his own cost, all necessary arrangements for maintaining water level low enough in the area where works are under execution, so as not to cause any harm to the works or problems in carrying out with the execution and the rates for all items of work shall be considered as inclusive of pumping out or bailing out water, if required, for which no extra payment shall be made. This will include water coming from any source, such as rains, accumulated rain water, floods, leakages from sewer and water mains subsoil water table being high or due to any other cause whatsoever. The Contractor shall make necessary provision of pumping, dredging, and bailing out water coming from all the above sources and excavation and other works shall be kept free of water by providing suitable system approved by the SBI/ PMC / Engineer in charge.

vii. Any other type of earthwork not specifically mentioned herein up to the completion of project shall be in the scope of work.

viii. Handling of C&D Waste: -The debris / building rubbish waste and the like (Construction & Demolition waste commonly known as C & D waste) generated from the work, should be taken out to be disposed it off the campus in a legal and environmental friendly way to the "declared dumping/Land fill sites" where the facility of re-cycling of C&D waste are available. The documentary proof with respect to disposal of all C&D waste generated out of work shall be submitted to SBI/ PMC / Engineer in charge on weekly basis.

3.5 Shoring

The Contractor shall be responsible for the design of shoring for the proper retaining of the sides of trenches, pits etc with due consideration to any traffic or other superimposed loads. Shoring shall be of sufficient strength to resist the pressure and ensure safety from slips and to prevent damage to work and property and injury to persons. Any shoring shall be removed after the items for which it is required are completed. Should slips occur, the slipped material shall be removed and slope dressed to a modified stable slope.

3.6 Dewatering

The Tenderer shall keep excavations clear of water. Contractor to dispose off discharged water and sludge away from site in proper manner without affecting the adjacent properties.

3.7 Clean Up

Upon completion of the work in this section, all rubbish and debris shall be removed from the site. All construction equipment and implements shall be removed and the entire area shall be left in a neat, clean and acceptable condition.

3.8 Disposal of Excavated Material

Materials suitable for re-use obtained from the excavation shall be properly stored in a convenient place that will not obstruct the free movement of materials, workers and vehicles or encroach on the area required for constructional purposes. The stacking height of the stored material shall not exceed 3 meters. Materials shall be used to the extent required to completely backfill excavations to the finished groundlevel.

Surplus and unsuitable materials shall be disposed of off-site as per local authority direction & approval. The Royality charges to be paid by EPC Contractor.

3.9 Excavation Dewatering

Continuous operation of dewatering systems shall be required to complete all portions of the works where dewatering is necessary to prevent inflow and collection of surface water or groundwater, or to protect adjacent properties or constructions from damage resulting from a rise or fall in groundwater levels.

Dewatering systems shall effectively intercept and remove water from the strata and thus enable the excavations to be kept dry till the all-substructure work has been completed at place when necessary.

The Contractors shall provide and operate all pumps, engines and machinery necessary to keep excavations clear of water. The pumping shall be continued until after the execution of any portion of the work and continued afterwards as necessary

3.10 Anti-termite treatment:

Both the Pre and Post construction Anti-termite treatment shall be got done through approved specialized agencies only with prior approval of the SBI/ PMC / Engineer in charge or his representative. During the execution of work, if any damage shall occur to the treatment already done, either due to rain or any other circumstances, the same shall be rectified and made good to the entire satisfaction of the SBI or his representative by the Contractor at his costs and risks.

The Contractor shall submit a (5-10 Years) guarantee bond for the anti-termite work executed under the contract in the specified format.

Supplying, Diluting and Injecting chemical (as per I.S.6313 (Part-II) for anti-termite treatment and creating a chemical barrier for termite as per cpwd specification and as per direction of EIC.

Sub-terranean termites are responsible for most of the termite damage in buildings. Typically, they form nests or colonies underground. In the soil near ground level in a stump or other suitable piece of timber in a conical or dome shaped mound. The termites find access to the super-structure of the building either through the timber buried in the ground or by means of mud shelter tubes constructed over unprotected foundations. Termite control in existing as well as new building structures is very important as the damage likely to be caused by the termites to wooden members of building and other household article like furniture, clothing, stationery etc. is considerable. Anti-termite treatment can be either during the time of construction i.e. pre- constructional chemical treatment or after the building has been constructed i.e. treatment for existing building. Prevention of the termite from reaching the super-structure of the building and its contents can be achieved by creating a chemical barrier between the ground, from where the termites come and other contents of the building which may form food for the termites. This is achieved by treating the soil beneath the building and around the foundation with a suitable insecticide.

Materials

Chemicals: Any one of the following chemicals in water emulsion to achieve the percentage concentration specified against each chemical shall be used:

(i) Chlorphriphos emulsifiable concentrate of 20%

(ii) Lindane emulsifiable concentrate of 20%

Anti-termite treatment chemicals are available in concentrated form in the market and concentration is indicated on the sealed containers. To achieve the specified percentage of concentration, Chemical should be diluted with water in required quantity before it is used. Graduated containers shall be used for dilution of chemicals with water in the required proportion to achieve the desired percentage of concentration. For example, to dilute chemicals of 20% concentration. 19 parts of water shall be added to one part of chemical for achieving 1% concentration. Engineer -in-Charge shall procure the chemical of required concentration in sealed original containers directly from the reputed and authorized dealers, chemicals shall be kept in the custody of the SBI/ PMC / Engineer in charge or his authorized representatives and issued for use to meet the day's requirements. Empty containers after washing and concentrated chemical left unused at the end of the day's work shall be returned to the SBI/ PMC / Engineer in charge or his authorized representative.

Treatment

Once the termites have ingress into the building, they keep on multiplying and destroy

the wooden and cellulosic materials, and as such it becomes essential to take measures for protection against termites. Anti termite measures described below are necessary for the eradication and control of termites in existing building. To facilitate proper penetrations of chemical in to the surface to be treated, hand operated pressure pump shall be used. To have proper check for uniform penetration of chemical, graduated containers shall be used. Proper check should be kept so that the specified quantity of chemical is used for the required area during the operation. Chemical treatment for the eradication and control of sub-terranean termites in existing building shall be done as per IS 6313 (Part III). Treatment shall be got done only from the approved specialized agencies using reputed and authorized dealers.

(i) ***Treatment along outside of foundations:*** The soil in contact with the external wall of the building shall be treated with chemical emulsion at the rate of 7.5 litres per square metre of vertical surface of the sub-structure to a depth of 300 mm. To facilitate this treatment, a shallow channel shall be excavated along and close to the wall face. The chemical emulsion shall be directed towards the wall at 1.75 litres per running metre of the channel. Rodding with 12 mm diameter mild steel rods at 150 mm apart shall be done in the channel. If necessary, for uniform dispersal of the chemical to 300 mm depth from the ground level. The balance chemical of 0.5 litre per running metre shall then be used to treat the backfill earth as it is returned to the channel directing the spray towards the wall surface.

If there is a concrete or masonry apron around the building, approximately 12 mm diameter holes shall be drilled as close as possible to the plinth wall about 300 mm apart, deep enough to reach the soil below and the chemical emulsion pumped into these holes to soak the soil below at the rate of 2.25 litres per linear metre.

In soils which do not allow percolation of chemicals to desired depth, the uniform disposal of the chemical to a depth of 300 mm shall be obtained by suitably modifying the mode of treatment depending on site condition.

In case of RCC foundations the soil (backfill) in contact with the column sides and plinth beams along with external perimeter of the building shall be treated with chemical emulsion at the rate of

7.5 litres/sqm. of the vertical surface of the structure. To facilitate this treatment, trenches shall be excavated equal to the width of the shovel exposing the sides of the column and plinth beams upto a depth of 300 mm or upto the bottom of the plinth beams, if this level is less than 300 mm. The chemical emulsion shall be sprayed on the backfill earth as it is returned into the trench directing the spray against the concrete surface of the beam or column as the case may be.

(ii) ***Treatment of Soil under Floors :*** The points where the termites are likely to seek entry through the floor are the cracks at the following locations:

(a) At the junction of the floor and walls as result of shrinkage of the concrete;

(b) On the floor surface owing to construction defects;

(c) At construction joints in a concrete floor, cracks in sections; and

(d) Expansion joints in the floor.

Chemical treatment shall be provided in the plinth area of ground floor of the structure, wherever such cracks are noticed by drilling 12 mm holes at the junction of floor and walls along the cracks on the floor and along the construction and expansion joints at the interval of 300 mm to reach the soil below. Chemical emulsion shall be squirted into these holes using a hand operated pressure pump to soak the soil below until refusal or upto a maximum of one litre per hole. The holes shall then be sealed properly with cement mortar 1:2 (1 cement: 2 coarse sand) finished to match the existing floors. The cement mortar applied shall be cured for at least 10.

(iii) ***Treatment of Voids in Masonry:*** The movement of termites through the masonry wall may be arrested by drilling holes in masonry wall at plinth level and squirting chemical emulsions into the holes to soak the masonry. The holes shall be drilled at an angle of 45 degree from both sides of the plinth wall at 300 mm intervals and emulsion squirted through these holes to soak the masonry using a hand operated pump. This treatment shall also be extended to internal walls having foundations in the soil. Holes shall also be drilled at wall corners and where door and window frames are embedded in the masonry or floor at ground. Emulsion shall be squirted through the holes till refusal or to a maximum of one litre per hole. Care shall be taken to seal the holes after the treatment.

(iv) ***Treatment at Points of Contact of Wood Work :*** The wood work which has already been damaged beyond repairs by termites shall be replaced. The new timber shall be dipped or liberally brushed at least twice with chemical in oil or kerosene. All existing wood work in the building which is in contact with the floor or walls and which is infested by termites, shall be treated by spraying at the points of contacts with the adjoining masonry with the chemical emulsion by drilling 6 mm holes at a dowonward angle of about 45 degree at junction of wood work and masonry and squirting chemical emulsion into these holes till refusal or to a maximum of half a litre per hole. The treated holes shall then be sealed.

Infested wood work in chaukhats, shelves, joints, purlins etc., in contact with the floor or the walls shall be provided with protective treatment by drilling holes of about 3 mm diameter with a downward slant to the core of the wood work on the inconspicuous surface of the frame. These holes should be at least 150 mm centre to centre and should cover in entire frame work. Chemicals shall be liberally infused in these holes. If the wood is not protected by paint or varnish two coats of the chemicals shall be given on all the surfaces and crevices adjoining the masonry.

LIST OF BUREAU OF INDIAN STANDARD CODES

S. No.	I.S. No.	Subject
1	IS 632	Gamma – BHC (Lindane) emulsifiable concentrates
2	IS 1200 (Pt 1)	Method of measurement of earth work
3	IS 1200 (Pt-27)	Method of measurement of earth work (by Mechanical Appliances)
4	IS 4081	Safety code for Blasting and related drilling operation
5	IS 4988 (Part IV)	Excavators
6	IS 6313 (pt-II)	Anti Termite measures in buildings (pre -constructional)

7	IS 6313(pt.-III)	Anti Termite Measures in Buildings for existing buildings
8	IS 6940	Methods of test for pesticides and their formulations
9	IS 8944	Chlorpyrifos emulsifiable concentrates
10	IS 8963	Chlorpyrifos – Technical specifications
11	IS 12138	Earth moving Equipments

OTHER SPECIFICATIONS:

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

PLAIN CEMENT CONCRETE (PCC), REINFORCED CEMENT CONCRETE WORK (RCC) AND DAMP PROOF CONCRETE (DPC):

4.1 Stone Aggregate:

Stone aggregate used in the work shall be of hard broken stone to be obtained from approved source (Quarries to be approved by the SBI/ PMC / Engineer in charge) and shall confirm to relevant provision in the Latest CPWD Specifications for works.

Coarse Aggregate

Aggregate most of which is retained on 4.75 mm IS Sieve and contains only as much fine material as is permitted in IS 383 for various sizes and grading is known as coarse aggregate. Coarse aggregate shall be specified as stone aggregate, gravel or brick aggregate and it shall be obtained from approved/ authorized sources.

(a) *Stone Aggregate:* It shall consist of naturally occurring (uncrushed, crushed or broken) stones. It shall be hard, strong, dense, durable and clean. It shall be free from veins, adherent coating, injurious amounts of disintegrated pieces, alkali, vegetable matter and other deleterious substances. It shall be roughly cubical in shape. Flaky and elongated pieces shall be avoided. **Aggregates from other than natural resources shall comply with the requirements of IS 383.**

(b) *Gravel:* It shall consist of naturally occurring (uncrushed, crushed or broken) river bed shingle or pit gravel. It shall be sound, hard and clean. It shall be free from flat particles of shale or similar laminated material, powdered clay, silt, loam, adherent coating, alkali, vegetable matter and other deleterious substances. Pit gravel shall be washed if it contains soil materials adhering to it. These shall conform to IS 383 unless otherwise specified.

(c) *Brick Aggregate:* Brick aggregate shall be obtained by breaking well burnt or overburnt dense brick/ brick bats. They shall be homogeneous in texture, roughly cubical in shape and clean. They shall be free from unburnt clay particles. Soluble salt, silt, adherent coating of soil, vegetable matter and other deleterious substances. Such aggregate should not contain more than one percent of sulphates and should not absorb more than 10% of their own mass of water, when used in cement concrete. It shall conform to IS 306 unless otherwise specified.

(d) Light weight aggregate such as sintered fly ash aggregate may also be used provided the SBI/ PMC / Engineer in charge is satisfied with the data on the proportion of concrete made with them.

Deleterious Material: Coarse aggregate shall not contain any deleterious material, such as pyrites, coal, lignite, mica, shale or similar laminated material, clay, alkali, soft fragments, sea shells and organic impurities in such quantity as to affect the strength or durability of the concrete. Coarse aggregate to be used for reinforced cement concrete. Coarse aggregate to be used for reinforced cement concrete shall not contain any material liable to attack the steel reinforcement. Aggregates which are chemically reactive with alkalies of cement shall not be used. The maximum quantity of deleterious material shall not be more than five percent of the weight of coarse aggregate when determined in accordance with IS 2386.

Size and Grading

(i) Stone aggregate and gravel: It shall be either graded or single sized as specified. Nominal size and grading shall be as under:-

(a) Nominal sizes of graded stone aggregate or gravel shall be 40, 20, 16, or 12.5 mm as specified. For any one of the nominal sizes, the proportion of other sizes as determined by the method.

Graded Stone Aggregate or Gravel

IS Sieve Designation	Percentage passing (by weight) for nominal size of			
	40 mm	20 mm	16 mm	12.5 mm
80 mm	100	-	-	-
63 mm	-	-	-	-
40 mm	95 to 100	100	-	-
20 mm	30 to 70	95 to 100	100	100
16 mm	-	-	90 to 100	-
12.5 mm	-	-	-	90 to 100
10 mm	10 to 35	25 to 55	30 to 70	40 to 85
4.75 mm	0 to 5	0 to 10	0 to 10	0 to 10

Nominal sizes of single sized stone aggregate or gravel shall be 63, 40, 20, 16, 12.5 or 10 mm as specified. For any one of the nominal size, the proportion of other sizes as determined by the method prescribed

Single Sized (Ungraded) Stone Aggregate or Gravel

IS Sieve Designation	Percentage passing (by weight) for nominal size of					
	63 mm	40 mm	20 mm	16 mm	12.5 mm	10 mm
80 mm	100	-	-	-	-	-
63 mm	85-100	100	-	-	-	-
40 mm	0-30	85-100	100	-	-	-
20 mm	0- 5	0-20	85-100	100	-	-
16 mm	-	-	-	85-100	100	-
12.5 mm	-	-	-	-	85-100	100
10 mm	0-5	0-5	0-20	0-30	0-45	85-100
4.75 mm	-	-	0-5	0-5	0-10	0-20
2.36 mm	-	-	-	-	-	0-5

(a) When stone aggregate or gravel brought to site is single sized (ungraded), it shall be mixed with single sized aggregate of different sizes in the proportion to be determined

by field tests to obtain graded aggregate of specified nominal size. For the required nominal size, the proportion of other sizes in mixed aggregate as determined by method prescribed. Recommended proportions by volume for mixing of different sizes of single size (ungraded) aggregate to obtain the required nominal size of graded aggregate are given in Table

Stacking: Aggregate shall be stacked on a hard, dry and level patch of ground. When stack piling, the aggregate shall not form pyramids resulting in segregation of different sized materials. It shall be stacked separately according to nominal size of coarse aggregates. Stacking shall be done in regular stacks, of height not exceeding 100 cm.

Fine Aggregate

Aggregate most of which passes through 4.75 mm IS sieve is known as fine aggregate. Fine aggregate shall consist of natural sand, crushed stone sand, crushed gravel sand stone dust or marble dust,fly ash and broken brick (Burnt clay) . It shall be hard, durable, chemically inert, clean and free from adherent coatings, organic matter etc. and shall not contain any appreciable amount of clay balls or pellets and harmful impurities e.g. iron pyrites, alkalies, salts, coal, mica, shale or similar laminated materials in such form or in such quantities as to cause corrosion of metal or affect adversely the hardening, the strength, the durability or the appearance of mortar, plaster or concrete. The sum of the percentages of all deleterious material shall not exceed 5%. Fine aggregate must be checked for organic impurities such as decayed vegetation humps, coal dust etc.

IS Sieve	*Percentage passing for*			
	Grading Zone I	*Grading Zone II*	*Grading Zone III*	*Grading Zone IV*
10 mm				
4.75 mm	90-100	90-100	90-100	95-100
2.36 mm	60-95	75-100	85-100	95-100
1.18 mm	30-70	55-90	75-100	90-100
600 microns	15-34	35-59	60-79	80-100
300 microns	5-20	8-30	12-40	
150 microns	0-10	0-10		

Note 1: For crushed stone sands, the permissible limit on 150 micron sieve is increased to 20 per cent. This does not affect the 5 per cent allowance permitted in 3.1.3.4 (e) (1) applying to other sieves.

Note 2: Allowance of 5% permitted in 3.1.3.4 (e) (1) can be split up, for example it could be 1% on each of three sieves and 2% on another or 4% on one sieve and 1% on another.

Note 3: Fine aggregate conforming to Grading Zone IV shall not be used in reinforced cement concrete unless tests have been made to ascertain the suitability of proposed mix proportions.

Note 4: Sand requiring use for mortar for plaster work shall conform to IS 1542 and for masonry work shall conform to IS 2116.

4.2 Sand

Sand to be used for the work shall be of as specified in CPWD Specifications 2019. Sand shall be obtained from the source to be got approved by the SBI/ PMC / Engineer in charge and washed if required, with appropriate equipment to bring down the chemical, inorganic and organic impurities within the permissible limits as per the direction of the SBI/ PMC / Engineer in charge. The same shall consist of hard siliceous materials.

Note: Where only one variety of sand is available the sand will be sieved for use in finishing work as directed by the SBI/ PMC / Engineer in charge in order to obtain smooth surface and nothing extra will be paid on this account.

4.3 Cement

The cement used shall be any of the following grade and the type selected should be appropriate for the intended use.
(a) 33 grade ordinary Portland cement conforming to IS 269-2013.
(b) 43 grade ordinary Portland cement conforming to IS 8112-2013.
(c) 53 grade ordinary Portland cement conforming to IS 12269-2013.
(d) Rapid hardening Portland cement conforming to IS 8041-1990, Reaffirm Apr 2014
(e) Portland slag cement conforming to IS 455-1989, Reaffirm Apr 2014.
(f) Portland Pozzolana cement (flyash based) conforming to IS 1489 (Part 1)-1991, Reaffirm Apr 2014.
(g) Portland Pozzolona cement (calcined clay based) conforming to IS 1489 (part 2) 1991, Reaffirm Apr 2014.
(h) Hydrophobic Portland cement conforming to IS 8043-1991, Reaffirm Apr 2014.
(i) Low heat Portland cement conforming to IS 12600-1989, Reaffirm Apr 2014.
(j) Sulphate resisting Portland cement conforming to IS 12330-1988, Reaffirm Apr 2014.
(k) White cement conforming to IS 8042-1989, Reaffirm Apr 2014.
Different types of cement shall not be mixed together. In case more than one type of cement is used in any work, a record shall be kept showing the location and the types of cement used.

i. The Contractor shall procure 43/53 grade Ordinary Portland cement confirming to IS 8112 / Portland Pozzolana Cement confirming to IS 1489 (Part I) as required in the work, from manufacturers as per list of approved makes or from any other reputed cement manufacturer having a production capacity not less than one million tons per annum, in case the cement is not available from manufacturers as per list of approved makes. The bidders may also submit a list of names of cement manufacturers which they propose to use in the work. The bid accepting authority reserves right to

accept or reject name(s) of cement manufacturer(s) which the bidder proposes to use in the work.

ii. The supply of cement shall be taken in 50 kg. bags/silos bearing manufacturer's

name and ISI marking. Samples of cement arranged by the Contractor shall be taken by the SBI/ PMC / Engineer in charge and got tested in accordance with provisions of relevant BIS codes. In case the test results indicate that the cement arranged by the Contractor does not confirm to the relevant BIS codes, the same shall stand rejected, and it shall be removed from the site by the Contractor at his own cost within a week's time of written order from the SBI/PMC in-charge to do so. Supply of cement shall be taken in 50-kg bags bearing manufacturer's name, or his registered trademarks if any and grade and type of cement as well as ISI marking. The packing of the cement bags shall be as per CPWD specifications 2009.

iii. The cement shall be brought at site in bulk supply of approximately 50 tons or more as decided by the PMC/SBI/ PMC / Engineer in charge. The cement godown of adequate capacity to store the cement shall be constructed by the Contractor at site of work.

iv. The cement godown shall always be accessible for the SBI/ PMC / Engineer in charge or his representative.

v. The cement shall be got tested by the SBI/ PMC / Engineer in charge and shall be used on the work only after satisfactory test results have been received. The Contractor shall supply free of charge the cement required for testing including its transportation cost to testing laboratories. The cost of tests shall be borne by the Contractor/Department in the manner indicated below:

   a. By the Contractor, if the results show that the cement does not confirm to relevant BIS codes.

   b. By the Department, if the results show that the cement confirms to relevant BIS codes.

vi. The actual issue and consumption of cement on work shall be regulated and proper accounts maintained as provided in clause 10 of the contract. The theoretical consumption of cement shall be worked out as per procedure prescribed in Clause 38 of the GCC and shall be governed by conditions laid therein. In case the cement consumption is less than theoretical consumption including permissible variation, recovery at the rate so prescribed shall be made. In case of excess consumption, no adjustment shall be made.

vii. The cement brought to the site and the cement remaining unused after completion of the work shall not be removed from site without the written permission of the SBI/PMC in charge.

viii. The damaged cement shall be removed from the site immediately by the Contractor on receipt of a notice in writing from the PMC/SBI/ PMC / Engineer in charge. If he does not do so within 3 days of receipt of such notice, the PMC/SBI/ PMC / Engineer in charge shall get it removed at the cost of the Contractor.

4.4 Fly-ash

Fly-ash confirming to grade 1 of IS 3812 (Part 1) may be used as part replacement of OPC provided uniform blending with cement is ensured in accordance with clauses 5.2 and 5.2.1 of I.S.456-2000 in the items of BMC and RMC. However, this shall not override the provisions of the respective items.

4.5 Chemical Admixtures

When required, admixtures of approved quality shall be mixed with concrete, as specified. The admixtures shall conform to IS 9103 and as specified in Chapter 5 - R.C.C. CPWD SPECIFICATIONS.

Admixtures may be any one of the following classes for use in concrete:-
(a) Water Reducing Admixtures
(b) Retarding Admixtures
(c) Accelerating Admixtures.
(d) Water Reducing and Retarding Admixtures.
(e) Water Reducing and Accelerating Admixtures.
(f) Permeability Reducing (water proofing) Admixtures.

Liquid Admixtures: Admixtures introduced into the concrete as liquids generally fall into the
following categories.
(a) Air Entraining.
(b) Water Reducing.
(c) Water Reducing Retarders.
(d) Retarders.
(e) Water Reducing Accelerators.
(f) Accelerators.

Dosage of these admixtures may vary according to manufacturers specification.

Two or more admixtures may not be compatible in the same solution. It is therefore mandatory that when two admixtures manufactured by the same manufacturers is being used simultaneously, the manufacturer shall certify their compatibility. In case the two or more admixtures are produces by different manufacturers, then, before their use in concrete, test shall be performed by the manufacturer to establish their compatibility, all such test reports shall be furnished to the SBI/ PMC / Engineer in charge for his approval before their use in concrete.

Some admixture may be in the form of powder, particle or high concentration liquids which may require mixing with water prior to dosing. Under these conditions water in solutions shall be considered as part of total water content in the batch in order to maintain the water-cement ratio.
Admixture manufacturers' recommendations shall be carefully followed so as to ensure complete solution of the product or to prepare a standard solution of uniform strength for easier use.
Certain admixtures may contain significant amounts of finely divided insoluble materials or active ingredients which may or may not be readily soluble. It is essential for such admixtures that precautions be taken to ensure that these constituents be kept in a state of uniform suspension before actual batching. When relatively small amounts of powered admixtures are to be used directly, these shall be pre-blended with cement.
Admixtures are sold under various trade names and may be in the form of liquids or powders. The proprietary name and the net quantity of content shall be clearly indicated

in each package or container of admixtures. The admixtures shall be uniform within each batch and uniform between all
batches.
No admixtures shall be accepted for use in concrete unless these are tested in accordance with IS 9103 and the test results are approved by the SBI/ PMC / Engineer in charge.

4.6 Centering Shuttering and Scaffolding:

All Scaffolding centering for RCC shall be properly designed system and brought to site in sufficient quantity well in advance so that the progress of the work is not hampered for non-availability of thesame.

4.7 SHUTTERING / FORM WORK: -

The work shall be done in accordance with CPWD Specifications - 2009 - Vol.I & Vol. II

Form work shall include all temporary or permanent forms or moulds required for forming the concrete which is cast-in-situ, together with all temporary construction required for their support.

Design & Tolerance in Construction

Form work shall be designed and constructed to the shapes, lines and dimensions shown on the drawings with the tolerance given below.

	Deviation from specified dimension of cross section of columns and beams	**+10 mm** **-5 mm**
	Deviation from dimensions of footings	
	(i) Dimension in Plan	(+ 50 mm
	(ii) Eccentricity in plan	0.02 times the width of the footing
	(iii) Thickness	**+50mm** **Or** **± 0.05 times the specified thickness Whichever is less**

(**Note**- These tolerance apply to concrete dimensions only, and not to positioning of vertical steel or dowels).

General Requirement

It shall be strong enough to withstand the dead and live loads and forces caused by ramming and vibrations of concrete and other incidental loads, imposed upon it during and after casting of concrete. It shall be made sufficiently rigid by using adequate number of ties and braces, screw jacks or hard board wedges where required shall be provided to make up any settlement in the form work either before or during the placing of concrete.

Form shall be so constructed as to be removable in sections in the desired sequence, without damaging the surface of concrete or disturbing other sections, care shall be taken to see that

no piece is keyed into the concrete.

Material for Form Work

(a) Propping and Centering : All propping and centering should be either of steel tubes with extension pieces or built up sections of rolled steel.

(b) Centering/Staging : Staging should be as designed with required extension pieces as approved by SBI/ PMC / Engineer in charge to ensure proper slopes, as per design for slabs/ beams etc. and as per levels as shown in drawing. All the staging to be either of Tubular steel structure with adequate bracings as approved or made of built up structural sections made form rolled structural steel sections. In case of structures with two or more floors, the weight of concrete, centering and shuttering of any upper floor being cast shall be suitably supported on one floor below the top most floor already cast.

(c) Form work and concreting of upper floor shall not be done until concrete of lower floor has set at least for 14 days.

Removal of Form work (Stripping Time) : In normal circumstance and where various types of cements are used, forms, may generally be removed after the expiry of the following periods:

Type of Form work	*Minimum period Before Striking Form work for OPC 33 grade*	*Minimum period Before Striking Form work for OPC 43 grade*	*Minimum period Before Striking Form work for PPC*
(a) Vertical form work to columns, walls, beams	16-24 h	16-24 h	24-36 h

Type of Form work	*Minimum period Before Striking Form work for OPC 33 grade*	*Minimum period Before Striking Form work for OPC 43 grade*	*Minimum period Before Striking Form work for PPC*
(b) Soffit form work to slabs (Props to be refixed immediately after removal of formwork)	3 days	3 days	4 days
(c) Soffit form work to beams (Props to be refixed immediately after removal of formwork	7 days	7 days	10 days
Props to slabs: Spanning upto 4.5m Spanning over 4.5m	 7 days 14 days	 7 days 14 days	 10 days 20 days
Props to beams and arches: Spanning upto 6m Spanning over 6m	 14 days 21 days	 14 days 21 days	 20 days 30 days

Note 1: For other types of cement, the stripping time recommended for ordinary Portland cement may be suitably modified. Generally If Portland Pozzolana or low heat cement or OPC with direct addition of fly ash has been used for concrete, the stripping time will be 10/7 of the period stated for OPC with 43 grade cement above.

Note 2: The number of props left under, their sizes and disposition shall be such as to be able to safely carry the full dead load of the slabs, beam or arch as the case may be together with any live load likely to occur during curing or further construction.

Note 3: For rapid hardening cement, 3/7 of above periods for OPC 33 grade will be sufficient in all cases except for vertical side of slabs, beams and columns which should be retained for at least 24 hours.

Note 4: In case of cantilever slabs and beams, the centering shall remain till structures for counter acting or bearing down have been erected and have attained sufficient strength.

Note 5: Proper precautions should be taken to allow for the decrease in the rate of hardening that occurs with all types of cement in cold weather and accordingly stripping time shall be increased.

Note 6: Work damaged through premature or careless removal of forms shall be reconstructed within 24 hrs.

Inspection of Form Work

The completed form work shall be inspected and approved by the SBI/ PMC / Engineer in charge before the reinforcement bars are placed in position. Proper form work should be adopted for concreting so as to avoid honey combing, blow holes, grout loss, stains or discoloration of concrete etc. Proper and accurate alignment and profile of finished concrete surface will be ensured by proper designing and erection of form work which will be approved by SBI/ PMC / Engineer in charge. Shuttering surface before concreting should be free from any defect/ deposits and full cleaned so as to give perfectly straight smooth concrete surface. Shuttering surface should be therefore checked for any damage to its surface and excessive roughness before use.

Erection of Form Work (Centering and shuttering): Following points shall be borne in mind while checking during erection.

(a) Any member which is to remain in position after the general dismantling is done, should be clearly marked.

(b) Material used should be checked to ensure that, wrong items/ rejects are not used.

(c) If there are any excavations nearby which may influence the safety of form works, corrective and strengthening action must be taken.

(d) (i) The bearing soil must be sound and well prepared and the sole plates shall bear well on the ground.

(ii) Sole plates shall be properly seated on their bearing pads or sleepers.

(iii) The bearing plates of steel props shall not be distorted.

(iv) The steel parts on the bearing members shall have adequate bearing areas.

(e) Safety measures to prevent impact of traffic, scour due to water etc. should be taken. Adequate precautionary measures shall be taken to prevent accidental impacts etc.

(f) Bracing, struts and ties shall be installed along with the progress of form work to ensure strength and stability of form work at intermediate stage. Steel sections (especially deep sections) shall be adequately restrained against tilting, over turning and form work should be

restrained against horizontal loads. All the securing devices and bracing shall be tightened.

(g) The stacked materials shall be placed as catered for, in the design.

(h) When adjustable steel props are used. They should:

1. be undamaged and not visibly bent.

2. have the steel pins provided by the manufacturers for use.

3. be restrained laterally near each end.

4. have means for centralizing beams placed in the forkheads.

(i) Screw adjustment of adjustable props shall not be over extended.

(j) Double wedges shall be provided for adjustment of the form to the required position wherever

any settlement/ elastic shorting of props occurs. Wedges should be used only at the bottom end

of single prop. Wedges should not be too steep and one of the pair should be tightened/

clamped down after adjustment to prevent shifting.

(k) No member shall be eccentric upon vertical member.

(l) The number of nuts and bolts shall be adequate.

(m) All provisions of the design and/or drawings shall be complied with.

(n) Cantilever support shall be adequate.

(o) Props shall be directly under one another in multistage constructions as far as possible.

(p) Guy ropes or stays shall be tensioned properly.

(q) There shall be adequate provision for the movements and operation of vibrators and other construction plant and equipment.

(r) Required camber shall be provided over long spans.

(s) Supports shall be adequate, and in plumb within the specified tolerances.

Guidelines for Multistage Certering: The proper handling the situation of multistage centering in buildings or where height of casting of concrete is higher than normal height of 3.5 M or where higher loadings are coming during casting of concrete or large span structures and in situations of casting of some special structures like Domes, Vaults etc. In all situations, centering/scaffolding/staging for casting of these structures should be properly designed by a qualified and experienced person/agency having past experience in design of false work (centering) for concrete structures and should be proof checked by similar experienced person/ agency and it should be properly approved and issued to contractor by SBI/ PMC / Engineer in charge. The provisions of clause 7 of IS:14687 may be referred for design of false work (centering). A method statement for erection and dismantling of the centering/scaffolding/staging and process of concreting shall be prepared by contractor and submitted to SBI/ PMC / Engineer in charge for approval and the work shall be commenced only after approval of method statement by SBI/ PMC / Engineer in charge. The provisions of clause 9 of IS:14687 may be referred for erection of false work (centering), safety precautions and other site operations, pertaining to false work (centering). Experienced form watcher shall be engaged during erection, concreting and dismantling for early detection of any movement or instability in the system. The field engineers shall ensure that CPWD specifications and provisions of BIS codes are strictly followed. A detailed programme of field safety inspection of centering/scaffolding/form work of such structures during different stages should be chalked out and strictly followed. Provision of safety net, fall arresting system including other safety

gears, for workers, working over these structures shall be made in contract and should be followed strictly.

MIVAN SHUTTERING

Customized Aluminium form work for monolithic construction on RCC members with repetitive usage made up of aluminium sheets/plates of minimum 4 mm thickness and grade 6061 (Type-6). The formwork comprises of (a) wall panel, roccker, kicker and internal soffit corner, external soffit corner, external corner, internal corner etc., (b) beam components i.e, beam side panel, prop head for soffit beam, beams soffit panel, beam soffit bulk head and (c) deck components i.e. deck panel, deck prop, prop length, deck mid, soffit length, deck beam bar. The panels are held in position by a simple pin and wedge system that passes thorugh holes in the out side rib of each panel. The tolerance of finished panel shall not be less than (-1 mm) and shall conform to IS : 14987-1999. Pins and wedges to be made of high grade hot dipped galvansied mild steel. This form work also comprises of M.S. angle iron, "Z" shaped brackets braced diagonally at 0.90 to 1.00 metre centre to centre on extrenal wall face just the level below on which to lay M.S. square tube panels (Challis) and guard railing supports to form working platform and 40 mm dia G.I./M.S. telescopic adjustable props to support deck formwork and beam soffit panels including de-shuttering the formwork from odd/even level to be shifted/lifted to next alterante odd/even level before which the points and shuttering surface to be thoroughly cleaned , pins greasing and shuttering surface oiling propoerly before fixing all complete including sealing of gap between kicker plates of wall panel and floors (if any) as per design of formwork as provided by shuttering supplier and as per direction of the SBI/ PMC / Engineer in charge including filling and finishing the holes of varied sizes and shapes (left by keys/pins of aluminium form work shuttering while deshuttering) with GP-2 cementitious polymer compound mixed with water in ratio prescribed by manufacturer to form consistent workable enough for pushing it in the holes upto full depth of wall using appropriate tools and finishing smooth all complete as per directions of the Engineer-incharge.

The Aluminium Form Work For Monolithic Construction (Mivan Shuttering) Shall be provided on RCC members except the are areas where the Mivan Work is unable to execute as per SBI/ PMC / Engineer in charge.

- Form work including centering, shuttering, propping, staging shall be strong enough to withstand the dead and live loads and forces caused by ramming and vibrations of concrete and other incidental loads, imposed upon it during and after casting of concrete. It shall be made sufficiently rigid by using adequate number of ties and braces, screw jacks or hard board wedges where required shall be provided to make up any settlement in the form work either before or during the placing of concrete. Form work shall be properly designed for self weight, weight of reinforcement, weight of fresh concrete, and in addition, the various live loads likely to be imposed during the construction process (such as workmen, materials and equipment). In case the height of centering exceeds 3.50 meters, the prop may be provided in multi-stages. It is important to note here that Designing of formwork/shuttering as per CPWD specifications/relevant IS codes for RCC work i.e column/wall/beam/slab at all heights and level as shown in GFC drawing is the responsibility of contractor and if any mishap happens during execution of RCC work due to design/workmanship fault etc, then it will be the sole responsibility of Contractor.

4.6.1 Workmanship:

Contractor shall account for all material and labour etc. to achieve the required finishes to the satisfaction of the SBI/ PMC / Engineer in charge:

- The shuttering plates shall be cleaned properly with electrically driven sanders to remove any cement slurry or cement mortar or rust. Proper shuttering oil or debonding compound shall be applied on the surface of the shuttering plates in the requisite quantity before assembly of steel reinforcement.
- The joint filler shall be resilient closed cell expanded polyethene and non-tainting as manufactured by Supreme Industries Ltd or equivalent.
- Providing joint filler of required thickness in position to substrate using either double sided foam adhesive tape or neoprene synthetic rubber adhesive. When forming expansion joint with the Board in in-situ concrete, joint sealing slots can be readily formed in the following matter

  a) Before installing, simply cut off a strip of the required depth. Then install the filler flush with the finished surface.

  b) Prior to sealing, the top strip can then be pulled easily from the joint to provide an uncontaminated sealing slot ready for preparation and sealing.
- Form shall be so constructed as to be removable in sections in the desired sequence**,** without damaging the surface of concrete or disturbing other sections, care shall be taken to see that no piece is keyed into the concrete.
- Shuttering surface before concreting should be free from any defect/ deposits and fully cleaned so as to give perfectly straight smooth concrete surface. Shuttering surface should be therefore checked for any damage to its surface and excessive roughness before use.
- Suitable camber shall be provided in horizontal members of structure, especially in cantilever spans to counteract the effect of deflection. The form work shall be so assembled as to provide for camber. The camber for beams and slabs shall be 4 mm per metre (1 to 250) or as directed by the E-I-C, so as to offset the subsequent deflection, for cantilevers the camber at free end shall be 1/50th of the projected length or as directed by the SBI / PMC / SBI/ PMC / Engineer in charge.
- Erection of form work may be from pre-moulded, pre-fabricated, pre-assembled plates or forms reasonable enough to transport and erect at site to correct line and level as set out at site. Supports shall be firm and maintained in position by nails, cross bracings, tie rods, locking bolts and nuts. It shall be rigid and stiff so as to retain its shape during and after concreting. The tie rods shall be terminated at least 40mm inside the finished surface.
- Joints shall be water-tight and no cement slurry shall be allowed to slip through. In joints foamed tapes shall be used.
- Pre-fabricated or site forms shall be assembled, so as to deshutter without any jerk to the green concrete. For this double wedge shall be used. Wedges shall be nailed, the heads reasonably left out, allowing easy removal while deshuttering.
- Pre-fabricated or on site fabricated forms shall be of sufficient thickness and with the required supporting runners in either direction. Supporting runners

shall be standardised in size for easy replacement and universal use at site.

- In repeated use, panels shall be clearly marked for using at defined locations

Formwork for exposed concrete surfaces: -

- Where it is specifically shown on the GFC drawings to have Expose concrete finish or original fair face finish of concrete surface without any rendering of plastering, 12 mm thick BWP grade type 3 film faced plywood of CSFF designation confirming to IS: 4990 for form finished/ fair faced concrete surface as per acceptance criteria where ever required as per the Architectural GFC drawing. The BWP type 3 ply to be used can have maximum 3 repeatation only.
- The forms shall be constructed so as to produce a uniform and consistent texture and pattern on the face of the concrete. The formwork shall be placed so that all horizontals are constructed of lumber and are not paneled and the formwork joints shall be staggered.
- To achieve a finish which shall be free of board marks, the formwork shall be faced with plywood or equivalent material in large sheets. The sheets shall be arranged in an approved pattern. Whenever possible, joints between sheets shall be arranged to coincide with architectural feature, sills, window heads or change in direction of surface. All joints between panels shall be vertical or horizontal unless otherwise directed. Suitable joints shall be approved between sheets. The joints shall be arranged and fitted so that no blemish or mark is imparted to the finished surfaces.
- Forms for exposed concrete surfaces shall be constructed with grade strips (the underside of which indicate top of pour) at horizontal constructions joints, unless the use of groove strips is specified on the drawings. The reset forms shall be tightened against the concrete so that the forms will not be spread and permit abrupt irregularities or loss of mortar. Supplementary form ties shall be used as necessary to hold the reset forms tight against the concrete.
- For fair faced concrete, the position of through bolts will be restricted and generally as indicated on the drawings.
- Plywood used in the formwork for obtaining exposed surfaces shall be got approved from SBI/ PMC / Engineer in charge on each use. However, no forms will be allowed for reuse if it is doubtful to produce desired texture of exposed concrete.
- Cement of only approved shade shall be used preferably of single lot to achieve integrity of texture.

4.7 Reinforcement:

General Requirements

Steel conforming to para 5.1.3 for reinforcement shall be clear and free from loose mill scales, dust, loose rust, coats of paints, oil or other coating which may destroy or reduce bond. It shall be stored in such a way as to avoid distortion and to prevent deterioration and corrosion. Prior to assembly of

reinforcement on no account any oily substance shall be used for removing the rust.

Assembly of Reinforcement: Bars shall be bent correctly and accurately to the size and shape.. Preferably bars of full length shall be used. Necessary cutting and straightening is also included. Overlapping of bars, where necessary shall be done. The overlapping bars shall not touch each other and these shall be kept apart with concrete between them by 25mm or 11/4 times the maximum size of the coarse aggregate whichever is greater. But where this is not possible, the overlapping bars shall be bound together at intervals not exceeding twice the dia. of such bars with two strands annealed steel wire of 0.90 mm to 1.6 mm twisted tight. The overlaps/ splices shall be staggered. But in no case the overlapping shall be provided in more than 50% of cross sectional area at one section.

Bonds and Hooks Forming End Anchorages: Reinforcement shall be bent and fixed in accordance with procedure specified in IS 2502, code of practice of bending and fixing of bars for concrete reinforcement. The details of bends and hooks are shown below for guidance.

(a) U-Type Hook

In case of mild steel plain bars standard U type hook shall be provided by bending ends of rod into semicircular hooks having clear diameter equal to four times the diameter of the bar.

Note: In case of work in seismic zone, the size of hooks at the end of the rod shall be eight times the diameter of bar or as given in the structural drawings.

(b) Bends

Bend forming anchorage to a M.S. plain bar shall be bent with and internal radius equal to two times the diameter of the bar with a minimum length beyond the bend equal to four times the diameter of the bar.

Anchoring Bars in Tension : Deformed bars may be used without end anchorages provided, development length equipment is satisfied. Hooks should normally be provided for plain bars in tension. Development length of bars will be determined as per IS: 456.

Anchoring Bars in Compression : The anchorage length of straight bar in compression shall be equal to the 'Development length' of bars in compression as specified in IS: 456. The projected length of hooks, bend and straight lengths beyond bend, if provided for a bar in compression, shall be considered for development length.

Binders, stirrups, links etc. : In case of binders, stirrups, links etc. the straight portion beyond the curve at the end shall be not less than eight times and nominal size of bar.

Welding of Bars

Wherever facility for electric arc welding or gas pressure welding is available, welding of bars shall be done in lieu of overlap. The location and type of welding shall be got . Welding shall be as per IS 2751 and 9417.

Placing in Position

Fabricated reinforcement bars shall be placed in position. The bars crossing one another shall be tied together at every intersection with two strands of annealed steel wire 0.9 to 1.6 mm thickness twisted tight to make the skeleton of the steel work rigid so that the reinforcement does not get displaced during deposition of concrete.

Tack welding in crossing bars shall also be permitted in lieu of binding with steel wire

The bars shall be kept in correct position by the following methods:

(a) In case of beam and slab construction pre-cast cover blocks in cement mortar 1:2 (1 cement : 2 coarse sand) about 4x4 cm section and of thickness equal to the specified cover shall be placed between the bars and shuttering, so as to secure and maintain the requisite cover of concrete over reinforcements.

(b) In case of cantilevered and doubly reinforced beams of slabs, the vertical distance between the horizontal bars shall be maintained by introducing chairs, spacers or support bars of steel at 1.0 mere or at shorter spacing to avoid sagging.

(c) In case of columns and walls, the vertical bars shall be kept in position by means of timber templates with slots accurately cut in them: or with clock of cement mortar 1:2 (1 cement: 2 coarse sand) of required size suitable tied to the reinforcement to ensure that they are in correct position during concreting.

(d) In case of other R.C.C. structure such as arches, domes, shells, storage tanks etc. a combination of cover blocks, spacers and templates

Tolerance on Placing of Reinforcement : Unless otherwise specified by the Engineer-in- Charge, reinforcement shall be placed within the following tolerances:

Tolerance in spacing

(a) For effective depth, 200 mm or less +10 mm

(b) For effective depth, more than 200 mm + 15 mm

Bending at Construction Joints : Where reinforcement bars are bent aside at construction joints and afterwards bent back into their original position care should be taken to ensure that at no time the radius of the bend is less than 4 bar diameters for plain mild steel or 6 bar diameter for deformed bars. Care shall also be taken when bending back bars to ensure that the concrete around the bar is not damaged.

Cross Sections Area and Mass of Steel Bar

Nominal Size mm	*Cross sectional Area Sq.mm*	*Mass per metre Run Kg.*

6	28.3	0.222
8	50.3	0.395
10	78.6	0.617
12	113.1	0.888
16	201.2	1.58
20	314.3	2.47
25	491.1	3.85
28	615.8	4.83
32	804.6	6.31
36	1018.3	7.99
40	1257.2	9.86

Design & Tolerance in Construction

Form work shall be designed and constructed to the shapes, lines and dimensions shown on the drawings with the tolerance given below.

(a)	Deviation from specified dimension of cross section of columns and beams	**+10 mm** **-5 mm**
(b)	Deviation from dimensions of footings	
	(i) Dimension in Plan	(+ 50 mm (**-10 mm**
	(ii) Eccentricity in plan	0.02 times the width of the footing in the direction of deviation but not more than 50 mm.
	(iii) Thickness	**+50mm** **Or** **± 0.05 times the specified thickness** **Whichever is less**

(Note- These tolerance apply to concrete dimensions only, and not to positioning of vertical steel or dowels).

Chemical composition of reinforcement bars shall be as per Table as follows:-

Constituent	*Maximum Per cent*			
	Fe 415	*Fe 415 D*	*Fe 500 D*	*Fe 550 D*
Carbon	0.30	0.25	0.25	0.25
Sulphur	0.060	0.045	0.040	0.040
Phosphorus	0.060	0.045	0.040	0.040
Sulphur and Phosphorus	0.110	0.085	0.075	0.075

i. The contractor shall procure TMT bars of Fe550D grade or more. The TMT bars procured from primary producers shall conform to manufacture's specifications/ BIS specifications.

ii. The specifications of TMT bars procured from primary producers shall meet the provisions of IS 1786: 2008 pertaining Fe 550D grade or more of steel as specified in the tender.

iii. The contractor shall have to obtain and furnish factory test certificates to the Engineer -

in-charge in respect of all supplies of steel brought by him to the site of work.

iv. The steel reinforcement bars shall be brought to the site in bulk supply of 20 tonnes or more, or as decided by the Engineer -in-charge.

v. The steel reinforcement bars shall be stored by the contractor at site of work in such a way as to prevent their distortion and corrosion, and nothing extra shall be paid on this account. Bars of different sizes and lengths shall be stored separately to facilitate easy counting and checking.

vi. Coating of aqueous exhibitor.

(i) By the contractor if the results show that steel does not conform to relevant BIS Codes.

(ii) By the Department if the results show that steel confirms to relevant BIS Codes.

i. The actual issue and consumption of steel on work shall be regulated and proper accounts maintained as provided in the contract. The theoretical consumption of steel shall be worked out as per procedure prescribed in clause 42 of the contract and shall be governed by conditions laid therein. In case the consumption is less than theoretical consumption including permissible variations recovery at the rate so prescribed shall be made. In case of excess consumption, no adjustment shall to be made.

ii. The steel brought to site and the steel remaining unused shall not be removed from site without the written permission of the SBI/ PMC / Engineer in charge.

iii. For the purpose of payment, the actual weight of steel reinforcement / structural steel sections/ plates / bolts and nuts shall be measured as below:

(i) *Unit weight for reinforcement bars:* The actual weight per meter of the reinforcement of various diameters shall be measured for three random samples collected (for each diameter of steel reinforcement) from each lot of particular diameter of steel reinforcement brought to the site for use in the work. For this, each sample (one sample consisting of three specimens) for each diameter of steel reinforcement shall be cut to require lengths and weighed and average weight calculated and recorded. The average weight for each type of steel section and steel reinforcement of each diameter shall be taken as the actual weight per metre for that steel section and that diameter of steel reinforcement.

(ii) In case actual unit weight is less than standard unit weights mentioned in CPWD specifications 2009 Volume 1, but within variation, in such cases payment shall be made on the basis of actual unit weight. However, if actual unit weight is more than standard unit weights mentioned in CPWD specifications 2009 Volume 1, then payment shall be made on the basis of standard unit weight in such cases. In such case nothing extra shall be paid for difference in actual weight and standard weight approval. The RCC work should commence only after getting the BBS approved and signing of pour card by SBI/ PMC / Engineer in charge.

(iii) Contractor to submit Bar Bending Schedule (BBS) for reinforcement steel work.

(iv) The work shall be carried out as per the CPWD specifications.

4.8 Concrete Work

All concrete work will be strictly done by automatic computerized batching plant of suitable capacity installed at site or RMC as per approval of SBI / PMC/SBI/ PMC / Engineer in charge. No concrete work will be permitted without automatic batching plant unless specifically approved in writing by SBI/ PMC/SBI/ PMC / Engineer in charge.

The concrete shall be in grade designated as under:

. Grades of Concrete

Group	Grade Designation	Specified characteristic compressive strength of 150 mm Cube at 28 Days in N/mm^2
(1)	(2)	(3)
Ordinary Concrete	M10	10
	M15	15
	M20	20
Standard Concrete	M25	25
	M30	30
	M35	35
	M40	40
	M45	45
	M50	50
	M55	55
High Strength Concrete	M60	60
	M65	65
	M70	70
	M75	75
	M80	80

Notes :

1. In the designation of concrete mix M refers to the mix and the number to the specified compressive strength of 150 mm size cube at 28 days, expressed in N/mm2.
2. For concrete of compressive strength greater than M55, design parameters given in the standard may not be applicable and the values may be obtained from specialized literatures and experimental results.

The characteristic strength is defined as the strength of material below which not more than 5 percent of the test results are expected to fall.

Concrete Mix Proportioning

The determination of the proportion of cement, aggregate and water to attain the required strength shall be made as follows:

(a) By designing the concrete mix: such concrete shall be called 'Design mix concrete', for details reference may be made to RCC Chapter.

(b) By adopting nominal concrete mix: such concrete shall be called 'Nominal mix concrete'.

Design mix concrete is preferred to nominal mix. If design mix concrete cannot be used for any reason on the work for grades of M20 or lower, nominal mixes which, however, is likely to involve a higher cement content.

Nominal Mix Concrete: Nominal Mix Concrete may be used for concrete of M20 or lower. The proportions of materials for nominal mix concrete

The cement content of the mix specified for any nominal mix shall be proportionately increased if the quantity of water in the mix has to be increased to overcome the difficulty or placement and compaction, so that the water cement ratio as specified is not exceeded.

Proportions for Nominal Mix Concrete

Grade of Concrete	Total Quantity of Dry Aggregates by Mass per 50 kg of cement, to be taken as the Sum of the Individual Masses of Fine and Coarse Aggregates, Kg.	Proportion of Fine Aggregate to Coarse Aggregate (by Mass)	Quantity of Water per 50 kg of Cement, max Ltr.
(1)	(2)	(3)	(4)
M5	800	Generally 1:2 but subject to an upper limit of 1: 1 ½ and a lower limit of	60
M7.5	625		45
M10	480		34
M15	330		32
M20	250		30

Note : - The proportion of the fine to coarse aggregate should be adjusted from upper limit progressively as the grading of fine aggregate becomes finer and the maximum size of coarse aggregate becomes larger. Graded coarse aggregate shall be used.

Note : - Quantity of water required from durability point of view may be less than the value given above.

Mixing

Concrete shall be mixed in mechanical batch type concrete mixers conforming to IS 1791 having two blades and fitted with power loader (lifting hopper type). Half bag mixers and mixers without lifting hoppers shall not be used for mixing concrete. In exceptional circumstances, such as mechanical break down of mixer, work in remote areas or power breakdown and when the quantity of concrete work is very small, hand mixing may be done to adding 10% extra cement. When hand mixing is permitted, it shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the concrete is uniform in colour and consistency. Before mixing the brick aggregate shall be well soaked with water for a minimum period of two hours and stone aggregate or

gravel shall be washed with water to remove, dirt, dust and other foreign materials. For guidance, the mixing time may be 11/2 to 2 minutes, for hydrophobic cement it may be taken as 21/2 to 3 minutes.

Mixing Efficiency: The mixer shall be tested under normal working conditions in accordance with the method specified in IS 4643 with a view to check its ability to mix the ingredients to obtain concrete having uniformity within the prescribed limits. The uniformity of mixed concrete shall be evaluated by finding the percentage variation in quantity (mass in water) of cement, fine aggregate and coarse aggregate in a freshly mixed batch of concrete.

The percentage variation between the quantities of cement, fine aggregate and coarse aggregates (as found by weighing in water) in the two halves of a batch and average of the two halve of the batch shall not be more than the following limits:

Cement	8%
Fine aggregate	6%
Coarse aggregate	5%

Machine Mixing: The mixer drum shall be flushed clean with water. Measured quantity of coarse aggregate shall be placed first in the hopper. This shall be followed with measured quantity of fine aggregate and then cement. In case fine aggregate is damp, half the required quantity of coarse aggregate shall be placed in the hopper, followed by fine aggregate and cement. Finally the balance quantity of coarse aggregate shall be fed in the hopper, & then the dry materials are slipped into the drum by raising the hopper. The dry material shall be mixed for atleast four turns of the drum. While the drum is rotating, water shall be added gradually to achieve the water cement ratio as specified or as required by the SBI/ PMC / Engineer in charge. After adding water, the mixing shall be continued until concrete of uniform colour, uniformly distributed material and consistency is obtained. Mixing shall be done for atleast two minutes after adding water. If there is segregation after unloading from the mixer, the concrete should be remixed.

The drum shall be emptied before recharging. When the mixer is closed down for the day or at any time exceeding 20 minutes, the drum shall be flushed cleaned with water.

4.9 Transportation, Placing and Compaction of Concrete

i. Transportation of the mix concrete shall be done through Transit Mixers and concrete pumped through suitable concrete pumps and pipes arrangement and vibrated by vibration machines, materials lifts shall also be provided at site as and where required.

ii. Mixed concrete from the batching plant shall be transported to the point of placement by transit mixers or through concrete pumps or steel closed bottom buckets capable of carrying 6 cum concrete. In case the concrete is proposed to be transported by transit mixer, the mixer speed shall not be less than 4 rev/ min. of the drum nor greater

than a speed resulting in a peripheral velocity of the drum as 70 m / minute at its largest diameter. The agitating speed of the agitator shall be not less than 2 rev / min. nor more than 6 rev / min. of the drum. The number of revolutions of the mixing drum or blades at mixing speed shall be between 70 to 100 revolutions for a uniform mix, after all ingredients, have been charged into the drum. Unless tempering water is added, all rotation after 100 revolutions shall be at agitating speed of 2 to 6 rev / min. and the number of such rotations shall not exceed 250. The general construction of transit mixer and other requirements shall confirm to IS: 5892.

iii. In case concrete is to be transported by pumping, the conduit shall be primed by pumping a batch of mortar / thick cement slurry through the line to lubricate it. Once the pumping is started, it shall not be interrupted (if at all possible) as concrete standing idle in the lineis liable to cause a plug. The operator shall ensure that some concrete is always there in the pump-receiving hopper during operation. The lines shall always be maintained clean and shall be free of dents.

iv. Materials for pumped concrete shall be batched consistently and uniformly. Maximum size of aggregate shall not exceed one-third of the internal diameter of the pipe. Grading of aggregate shall be continuous and shall have sufficient ultra- fine materials (materials finer than 0.25mm). Proportion of fine aggregates passing through 0.25mm shall be between15 & 30% and that passing through 0.125 mm sieve shall not be less than 5% of the total volume of aggregate. When pumping long distances and through hot weather, set- retarding admixtures may be used. Admixtures to improve workability can be added. Suitability of concrete shall be through pumping shall be verified by trial mixes and by performing pumpingtests.

Transportation and Handling : Concrete shall be transported from the mixer to the place of laying as rapidly as possible by methods which will prevent the segregation or loss of any of the ingredients and maintaining the required workability.

During hot or cold weather, concrete shall be transported in deep containers, other suitable methods to reduce the loss of water by evaporation in hot weather and heat loss in cold weather may also be adopted.

Placing

The concrete shall be deposited as nearly as practicable in its final position to avoid rehandling. It shall be laid gently (not thrown) and shall be thoroughly vibrated and compacted before setting commences and should not be subsequently disturbed. Method of placing shall be such as to preclude segregation. Care shall be taken to avoid displacement of reinforcement or movement of form work and damage due to rains. As a general guidance, the maximum free fall of concrete may be taken as 1.5 metre.

Compaction

Concrete shall be thoroughly compacted and fully worked around embedded fixtures and into corners of the form work. Compaction shall be done by mechanical vibrator of appropriate type till a dense concrete is obtained. The mechanical vibrators shall conform to IS 2505, IS 2506, IS 2514 and IS 4656. To prevent segregation, over vibration shall be avoided.

Compaction shall be completed before the initial setting starts. After compaction

the top surface shall be finished even and smooth with wooden trowel before the concrete begins to set.

4.10 Damp Proof Course

Damp proof course shall be with minimum (50 mm thick cement concrete 1:2:4 (1cement: 2 coarse sand: 4 graded stone aggregate 12.5mm nominal size)) mixed with approved water proofing compound painted at top with a coat of residual petroleum bitumen of grade VG-10 of approved quality at 1.7 kg/sqm.

Cement Concrete Layer

This shall consist of cement concrete of specified proportions and thickness. The surface of brick or stone masonry work shall be levelled and prepared before laying the cement concrete. Edge of damp proof course shall be straight, even and vertical. Side shuttering shall consist of steel forms and shall be strong and properly fixed so that it does not get disturbed during compaction and the mortar does not leak through. The concrete mix shall be of workable consistency and shall be tamped thoroughly to make a dense mass. When the sides are removed, the surface should come out smooth without honey- coming. Continuity shall be maintained while laying the cement concrete layer and laying shall be terminated only at the predetermined location where damp proof course is to be discontinued. There shall be no construction joints in the Damp Proof Course.

Curing

Damp proof course shall be cured for at least seven days, after which it shall be allowed to dry.

Application of Hot Bitumen

Where so directed, hot bitumen in specified quantity shall be applied over the dried up surface of cement concrete, properly cleaned with brushes and finally with a piece of cloth soaked in kerosene oil. Bitumen of penetration A 90 or equivalent where used shall be heated to a temperature of 160º ± 5ºC. The hot bitumen shall be applied uniformly all over, so that no blank spaces are left anywhere.

Water Proofing Materials

Where so specified, water proofing material of approved quality shall be added to the concrete mixture in accordance with the manufacturer's specification stating the quantity of water proofing material in litres or kg per 50 kg or cement

OTHER SPECIFICATIONS:

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

LIST OF MANDATORY TESTS

Material	Clause	Test	Field/ Laboratory	Test procedure	Min. qty of Material for Carrying out test	Frequency of Testing
1	2	3	4	5	6	7
Stone aggregate	4.1.2.2	(a) Percentage of soft or deleterious material	Field or Laboratory- Test as required	IS 2386- Part II	As required by Engineer-in-charge	For all quantities
	4.1.2.3	Particle size	Field/ Lab	Appendix 'A'	45 cum	For every 45 cum or part thereof for RCC Work only. For rest of items as decided by Engineer-in-charge
	4.1.2.5	(a) Estimation of organic impurities	Field/ Lab	IS 2386- Part II	10 cum	For every 40 cum or part thereof
		(b) Surface moisture	Field/ Lab	IS 2386	10 cum	-do-
		(c) Determination of 10% fine	Field/ Lab	IS 2386	10 cum	-do-
		(d) Specific gravity	Field/ Lab	IS 2386	10 cum	-do-
		(e) Bulk density	Field/ Lab	IS 2386	10 cum	-do-

		(f) Aggregate crusing strength	Field/ Lab	IS 2386	10 cum	-do-
		(g) Aggregate impact value	Field/ Lab	IS 2386	10 cum	-do-
Concrete	4.2.2	Slump test	Field	Appendix 'D'	10 cum	15 cum or part thereof

LIST OF BUREAU OF INDIAN STANDARDS CODES

S. No.	I. S. No.	Subject
1.	IS 383	Specification for coarse and fine aggregate from natural sources for concrete.
2.	IS 456	Plain and reinforced concrete - Code of practice
3.	IS 516	Method of test for strength of concrete
4.	IS 1199	Method of sampling and analysis of concrete
5.	IS 1200 (Part II)	Method of measurement of building and civil engineering work (concrete work)
6.	IS 1322	Specification for bitumen felt for water proofing and damp proofing.
7.	IS 1791	General requirements for batch type conrete mixers
8.	IS 2386	Method of test for aggregates for concrete
		(a) Part I - Particle size and shape
		(b) Part II - Estimation of deleterious materials and organic impurities
		(c) Part III - Specific gravity, density, voids absorption and bulking.
		(d) Part IV - Mechanical properties.
		(e) Part V – Soundness
9.	IS 2505	General requirements for concrete vibrators - immersion type.
10.	IS 2506	General requirements for concrete vibrators - screed board concrete vibrators
11.	IS 2645	Specification for integral water proofing compounds for cement mortar and concrete
12.	IS 3068	Specification for broken brick (burnt clay) coarse aggregate for use in concrete.
13.	IS 3812	Specification for flyash for use as pozzolana and admixture in cement mortar and concrete.
14.	IS 4656	Specification for form vibrators for concrete.

15.	IS 7861 (Part-I)	Code of practice for extreme weather concreting (Part-I) recommended practice for hot weather concreting.
16.	IS 7861 (Part–II)	Code of practice for extreme weather concreting (Part-II) recommended.
17.	IS 9103	Specification for concrete admixtures

4.11 RCC Work (Concrete Mix Design) GENERAL: -

The RCC work shall be done with RMC of Design Mix Concrete, unless otherwise specified in the nomenclature of items, wherever letter M has been indicated, the same shall imply for the Design Mix Concrete. The Ready-Mix Concrete shall be as per IS: 4926 and as per CPWD Specification and guide lines. For the nominal mix in RCC, CPWD specification shall be followed. The Design Mix Concrete will be designed based on the principles given in IS: 456, 10262 and SP 23. The contractor shall carry out design mixes for each class of concrete indicating that the concrete ingredients and proportions will result in concrete mix meeting requirements specified. The cement shall be actually weighed as presumption of each bag having 50 kg shall not be allowed. In case of use of admixture, the mix shall be designed with these ingredients as well. The specification mentioned herein below shall be followed for Design Mix Concrete.

Scope of RCC Work

Reinforced Cement Concrete (RCC) shall be used extensively throughout the project for the following structural components:

Basements

RCC shall be used for basement retaining walls, basement floor slabs, and basement columns. The design shall consider hydrostatic pressure and provide adequate waterproofing treatment.

Retaining Walls

All peripheral and internal retaining walls shall be constructed in RCC as per structural design to resist lateral earth pressure and ensure long-term stability.

Ramps

RCC shall be used for vehicular and pedestrian access ramps, including sloped slabs, side walls, and parapets, designed for applicable live load and gradient as per standards.

Substructure

RCC shall be used for all substructure elements, including:

- Footings and pile caps
- Columns and pedestals below plinth level
- Plinth beams and tie beams

Superstructure

RCC construction shall be adopted for:

- Columns, beams, slabs, partition wall and shear walls above the plinth level as per approved structural drawings.
- Cantilevers, balconies, and lintels
- Staircases and landings

Miscellaneous RCC Works

- Water tanks (UG & OH), lift pits, sump tanks
- Core walls, duct slabs, and other service-related RCC structures
- Boundary walls and parapet walls wherever applicable.

All RCC works shall conform to the latest IS codes and relevant BIS standards, ensuring high quality, durability, and compliance with the approved structural drawings and design parameters.

INGREDIENTS

i) Coarse Aggregate: - As per CPWD Specifications

ii) Fine Aggregate: - As per CPWD Specifications.

iii) Water: - As per requirements laid down in IS 456-2000 and CPWD specifications.

iv) Cement: Cement arranged by the contractor will be PPC (in bags) conforming to IS: 1489: Part-I.

4.12 Preparation of mixes as per approved design mix and conducting confirmatory test at field lab.

(i) The contractor shall make the cubes of trial mixes as per approved Mix design at site laboratory for all grades, in presence of SBI/ PMC / Engineer in charge using sample of approved materials proposed to be used in the work prior to commencement of concreting and get them tested in his presence to his entire satisfaction for 7 days and 28 days. Test cubes shall be taken from trial mixes as follows.

For each mix, a set of six cubes shall be made from each of the three consecutive batches. Three cubes from each set of six shall be tested at age of 7 days and remaining three cubes at age of 28 days. The cubes shall be made, cured, transported and tested strictly in accordance with specifications. The average strength of nine cubes at age of 28 days shall exceed the specified target mean strength for which design mix has been approved, the evaluation of test results will be done as per IS:456-2000.

4.13 WORK STRENGTH TEST SPECIMEN

Work strength test shall be conducted in accordance with IS: 516 on random sampling. Each test shall be conducted on six specimens, three of which shall be tested at 7 days and remaining three at 28 days. Additional samples shall be prepared, if required, as per direction of SBI/ PMC / Engineer in charge for testing samples cured by accelerated method as described in IS: 9103.

TEST RESULTS OF SAMPLE

The test results of the sample shall be the average of the strength of three specimens. The individual variation shall not be more than + - 15 percent of the average. If more, the test results of the sample are invalid. 90% of the total tests shall be done at the laboratory established at site by the contractor and remaining 10% in the laboratory of Government Engineering colleges, or in any other approved laboratory as directed by the SBI/ PMC / Engineer in charge.

4.14 STANDARD FOR ACCEPTANCE

i) Standard of acceptance shall be same as specified in clause 16 of IS456-2000.

ii) In order to keep the floor finish as per direction of SBI/ PMC / Engineer in charge and as per Architectural drawings and to provide required thickness of the flooring as per specification, the level of top surface of RCC shall be accordingly adjusted at the time of its centering, shuttering

and casting for which nothing extra shall be paid to the contractor.

4.15 Ultrasonic Pulse Velocity Method of Test for RCC

i) The underlying principle of assessing the quality of concrete is that comparatively higher velocities are obtained when the quality of concrete in terms of density, homogeneity and uniformly is good. The consistency of the concrete as regards its general quality gets established. In case of poorer quality lower velocities are obtained. If there are cracks, voids or flaws inside the concrete which come in the way of transmission of pulse, lower velocities are obtained.

ii) The quality of concrete in terms of uniformity, incidence or absence of internal flaws, cracks and segregation etc. indicative of the level of workmanship employed, can thus be assessed using the guidance given in table below, which have been evolved for characterizing the quality concrete in structure in term of the ultrasonic pulse velocity.

Velocity criterion for Concrete Quality Grading.

Sl. No.	Pulse velocity by Cross Probing (km/sec)	Concrete Quality Grading
1	Above 4.5	Excellent
2	4.5 to 3.5	Good
3	3.5 to 3.0	Medium
4	Below 3.0	Doubtful

Note: In Case of "doubtful" quality it may be necessary to carry further tests.

iii) Pulse velocity method of test of concrete is to be conducted for CPWD works as a routine test. The acceptance criteria as per the above table will be applicable which is as per IS 13311 (part-1): 1992. From the above "Good" and "Excellent" grading is acceptable and below these grading the concrete will not be acceptable.

iv) 5% of the total number of RCC members in each category i.e. beam, column, slab and footing may be tested by UPV test method for establishing quality of concrete. It is suggested that test be conducted on RCC beam near joint with column, on RCC column near joint with beam, on RCC footings and rafts. On RCC rafts a suitable grid can be worked out for determining number of tests. In addition, doubtful areas such as honeycombed locations, locations, where continuous seepage is observed, construction joints and visible loose pockets will also be tested.

v) The test results are to be examined in view of the above acceptance criteria "Good" and "Excellent" and wherever concrete is found with less than required quality as per acceptance criteria, repairs to concrete will be made. Honeycombed areas and loose pockets will be repaired by grouting using Portland Cement Mortar/Polymer Modifies Cement Mortar /Epoxy Mortar, etc. after chipping loose concrete in appropriate manner. In areas where concrete is found below acceptance criteria and defects are not apparently visible on surface ,injecting approved grout in appropriate proportion using epoxy grout /acrylic Polymer modified cements slurry made with shrinkage compensating cement / plain cement slurry etc will be resorted to for repairs.(refer relevant chapters from CPWD Hand Book on Repairs and Rehabilitation of RCC

Buildings).Repair to concrete will be done till satisfactory results are obtained as per the acceptance criteria by retesting of the repaired area. If satisfactory results are not obtained dismantling and relaying of concrete will be done.

4.16 PRECAST REINFORCED CONCRETE

i. General Requirements - Precast reinforced concrete units such as columns, sills, shelves, slabs, louvers etc. shall be of grade of mix as specified and cast in forms or moulds. The forms/ moulds shall be of fiber glass or of steel sections for better finish. Provision shall be made in the forms and moulds to accommodate fixing devices such as nibs, clips, hooks, bolts and forming of notches and holes. The contractor may precast the units on cement or steel platform which shall be adequately oiled provided the surface finish is of the same standard as obtained in form. Each unit shall be cast in one operation.

ii. Concrete used for precasting the units should be well proportioned, mixed, placed and thoroughly compacted by vibrations or tamping to give a dense concrete free from voids and honey combing.

iii. Precast articles shall have a dense surface finish showing no coarse aggregate and shall have not cracks or crevices likely to assist in disintegration of concrete or rusting of steel or other defects that would interfere with the proper placing of the units. All angle of the precast units with the exception of the angles resulting from the splayed or chamfered faces shall be true right angles. The arises shall be clean and sharp except those specified or shown to be rounded. The wearing surface shall be true to the lines. On being fractured, the interior of the units should present a clean homogeneous appearance.

iv. The longitudinal reinforcement shall have a minimum cover of 12 mm or twice the diameter of the main bar, whichever is more, unless otherwise directed in respect of all items except fencing posts or electric posts where the minimum cover shall be 25 mm.

v. Curing - After having been cast in the mould or form the concrete shall be adequately protected during setting in the first stages of hardening from shocks and from harmful effects of frost, sunshine, drying winds and cold. The concrete shall be cured at least for 7 days from the date of casting.

vi. The precast articles shall be matured for 28 days before erection or being built in so that the concrete shall have sufficient strength to prevent damage to units when first handled.

vii. Marking - Precast units shall be clearly marked to indicate the top of member and its location and orientation in the structure.

viii. The precast articles shall be matured for 28 days before erection or being built in so that the concrete shall have sufficient strength to prevent damage to units when first handled.

ix. Marking - Precast units shall be clearly marked to indicate the top of member and its location and orientation in the structure.

x. Precast units shall be stored, transported and placed in position in such as manner that they will not be overstressed or damaged.

CONCRETING

The concrete shall be as specified under chapter 4 concrete work. The proportion by volume or by the weight of ingredients shall be as specified.

Consistency

The concrete which will flow sluggishly into the forms and around the reinforcement without any segregation of coarse aggregate from the mortar shall be used. The consistency shall depend on whether the concrete is vibrated on or hand tamped, it shall be determined by slump test as prescribed in sub-head "concrete" under workability – requirement.

Placing of Concrete

Concreting shall be commenced only after Engineer-in-Charge has inspected the centering, shuttering and reinforcement as placed and passed the same. Shuttering shall be clean and free from all shavings, saw dust, pieces of wood, or other foreign material and surfaces shall be treated as prescribed in 5.2.4.

In case of concreting of slab and beams, wooden plank or cat walks of chequerred MS plated or bamboo chalies or any other suitable material supported directly on the centering by means of wooden blocks or lugs shall be provided to convey the concrete to the place of deposition without disturbing the reinforcement in any way. Labour shall not be allowed to walk over the reinforcement.

5.4.2.3 In case of columns and wall, it is desirable to place concrete without construction joints. The progress of concreting in the vertical direction, shall be restricted to one metre per hour.

The concrete shall be deposited in its final position in a manner to preclude segregation of ingredients. In deep trenches and footings concrete shall be placed through chutes or as directed by the Engineer-in-Charge. In case of columns and walls, the shuttering shall be so adjusted that the vertical drop of concrete is not more than 1.5 metres at a time.

During cold weather, concreting shall not be done when the temperature falls below 4.50C.

The concrete placed shall be protected against frost by suitable covering. Concrete damaged by frost shall be removed and work redone.

During hot weather precaution shall be taken to see that the temperature of wet concrete does not exceed 38ºC. No concrete shall be laid within half an hour of the closing time of the day, unless permitted by the Engineer-in-Charge.

It is necessary that the time between mixing and placing of concrete shall not exceed 30 minutes so that the initial setting process is not interfered with.

Compaction

It shall be as specified in sub-head of Concrete Work of this specification.

Concrete shall be compacted into dense mass immediately after placing by means of mechanical vibrators designed for continuous operations complying with IS 2505, IS 2506, IS 2514 and IS 4656. The Engineer- in- Charge may however relax this condition at his discretion for certain items depending on the thickness of the members and feasibility of vibrating the same and permit hand compaction instead. Hand compaction shall be done with the help of tamping rods so that concrete is thoroughly compacted and completely worked around the reinforcement, embedded fixtures, and into corners of the form. The layers of concrete shall be so placed that the bottom layer does not finally set before the top layer is placed. The vibrators shall maintain the whole of concrete under treatment in an adequate state of agitation; such that de-aeration and effective compaction is attained at a rate commensurate with the supply of concrete from the mixers. The vibration shall continue during the whole period occupied by placing of concrete, the vibrators being adjusted so that the centre of vibrations approximates to the centre of the mass being compacted at the time of placing.

Concrete shall be judged to be properly compacted, when the mortar fills the spaces between the

coarse aggregate and begins to cream up to form an even surface. When this condition has been attained, the vibrator shall be stopped in case of vibrating tables and external vibrators. Needle vibrators shall be withdrawn slowly so as to prevent formation of loose pockets in case of internal vibration. In case both internal and external vibrators are being used, the internal vibrator shall be first withdrawn slowly after which the external vibrators shall be stopped so that no loose pocket is left in the body of the concrete. The specific instructions of the makers of the particular type of vibrator used shall be strictly complied with. Shaking of reinforcement for the purpose of compaction should be avoided. Compaction shall be completed before the initial setting starts, i.e. with 30 minutes of addition of water to the dry mixture.

In case of roof slabs the top surface shall be finished even and smooth with wooden trowel, before the concrete begins to set. Sprinkling of dry cement while finishing shall not be resorted to.

Curing

After the concrete has begun to harden i.e. about 1 to 2 hours after its laying, it shall be protected from quick drying by covering with moist gunny bags, sand, canvass Hessian or any other material approved by the Engineer-in-Charge. After 24 hours of laying of concrete, the surface shall be cured by ponding with water for a minimum period of 7 days from the date of placing of concrete in case of OPC and at least 10 days where mineral admixtures or blended cements are used. The period of curing shall not be less than 10 days for concrete exposed to dry and hot weather condition.

Rectification of Surface defects of Minor nature

Immediately on removal of forms, the R.C.C. work shall be examined by the Engineer-in-Charge, before any defects are made good.

(a) The work that has sagged or contains honey combing to an extent detrimental to structural safety or architectural concept shall be rejected as given in para 5.4.9.4 for visual inspection test.

(b) Surface defects of minor nature may be accepted. On acceptance of such a work by the Engineer-in-Charge, the same shall be rectified as follows:

1. Surface defects which require repair when forms are removed, usually consist of bulged due to movement of forms, ridges at form joints, honey-combed areas, damage resulting from the stripping of forms and bolt holes, bulges and ridges are removed by careful chipping or tooling and the surface is then rubbed with a grinding stone. Honey-combed and other defective areas must be chipped out, the edges being cut as straight as possible and perpendicularly to the surface, or preferably slightly under cut to provide a key at the edge of the patch.
2. Shallow patches are first treated with a coat of thin grout composed of one part of cement and one part of fine sand and then filled with mortar similar to that used in the concrete. The mortar is placed in layers not more than 10mm thick and each layer is given a scratch finish to secure bond with the succeeding layer. The last layer is finished to match the surrounding concrete by floating, rubbing or tooling on formed surfaces by pressing the form material against the patch while the mortar is still plastic.
3. Large and deep patches require filling up with concrete held in place by forms. Such patches are reinforced and carefully dowelled to the hardened concrete.
4. Holes left by bolts are filled with mortar carefully packed into places in small amounts. The mortar is mixed as dry as possible, with just enough water so that it will be tightly compacted when forced into place.

5. Tiered holes extending right through the concrete may be filled with mortar with a pressure gun similar to the gun used for greasing motor cars.
6. Normally, patches appear darker than the surrounding concrete, possibly owing to the presence on their surface of less cement laitance. Where uniform surface colour is important, this defect shall be remedied by adding 10 to 20 percent of white Portland cement to the patching mortar, the exact quantity being determined by trial.
7. The same amount of care to cure the materials in the patches should be taken as with the whole structure. Curing must be started as soon as possible, after the patch is finished to prevent early drying. Damp Hessian may be used but in some locations it may be difficult to hold it in place. A membrane curing compound in these cases will be most convenient.

(c) **Whenever required**, The exposed surface of R.C.C. work shall be plastered with cement mortar 1:3 (1 cement : 3 fine sand) of thickness not exceeding 6 mm to give smooth and even surface true to line and form. Any RCC surface which remains permanently exposed to view in the completed structure, shall be considered exposed surfaced for the purpose of this specification.

(d) The surface which is to receive plaster or where it is to be joined with brick masonry wall, shall be properly roughened immediately after the shuttering is removed, taking care to remove the laitance completely without disturbing the concrete. The roughening shall be done by hacking. Before the surface is plastered, it shall be cleaned and wetted so as to give bond between concrete and plaster.

RCC work shall be done carefully so that the thickness of plaster required for finishing the surface is not more than 6 mm.

(e) The surface of RCC slab on which the cement concrete or mosaic floor is to be laid shall be roughened with brushes while the concrete is green. This shall be done without disturbing the concrete.

Strength of Concrete

The compressive strength on the work tests for different mixed shall be as given in Table 5.5 below:-

TABLE 5.5

Concrete Mix (Nominal Mix on Volume basis)	*Compressive Strength in (Kg/ sq cm)*	
	7 days'	*28 days'*
1:1:2	210	315
1:1.5:3	175	265
1:2:4	140	210

Testing of Concrete

Regular mandatory tests on the workability of the fresh concrete shall be done to achieve

the specified compressive strength of concrete. These will be of two types
(a) Mandatory Lab, Test
(b) Mandatory Field Test
Results of Mandatory Field Test will prevail over mandatory Lab. Test.
Cube Test for Compressive Strength of Concrete - Mandatory Lab Test : Mandatory tests shall be carried out as prescribed in Appendix A of Chapter 5.
Additional Test *:* Additional test, if required, shall be carried out as prescribed in Appendix B of Chapter 5.
Slump Test : This test shall be carried out as prescribed in sub-head 4 of concrete.
Visual Inspection Test : The concrete will be inspected after removal of the form work

The concrete is liable to be rejected if:
(i) It is porous or honeycombed as per para 5.4.7.2 (a).
(ii) Its placing has been interrupted without providing a proper construction joint.
(iii) The reinforcement has been displaced beyond tolerance specified or construction tolerances have not been met.
However, the hardened concrete may be accepted after carrying out suitable remedial measures to the satisfaction of the Engineer-in-Charge at the risk and cost of the contractor.

Standard of Acceptance – for Nominal Mix
Mandatory Lab. Test : For concrete sampled and tested as prescribed in Appendix A of Chapter 5, the following requirement shall apply.
Out of six sample cubes, three cubes shall be tested at 7 days and remaining three cubes at 28 days.

7 days' Tests
Sampling: The average of the strength of three specimen shall be accepted as the compressive strength of the concrete provided the variation in strength of individual specimen is not more than + 15% of the average. Difference between the maximum and minimum strength should not exceed 30% of average strength of three specimens. If the difference between maximum and minimum strength exceeds 30% of the average strength, then 28 days' test shall have to be carried out.
Strength: If the actual average strength of sample accepted in para 'sampling' above is equal to or higher than specified strength upto +15% then strength of the concrete shall be considered in order.
In case the actual average strength of sample accepted in the above para is lower than the specified or higher by more than 15% then 28 days' test shall have to be carried out to determine the compressive strength of concrete cubes.

28 days' Test
(a) The average of the strength of three specimen be accepted as the compressive strength of the concrete provided the strength of any individual cube shall neither be less than 70% nor higher than 130% of the specified strength.
(b) If the actual average strength of accepted sample exceeds specified strength by more than 30% the Engineer-in-Charge, if he so desires, may further investigate the matter. However, if the strength

of any individual cube exceeds more than 30% of specified strength, it will be restricted to 130% only for computation of strength.

(c) If the actual average strength of accepted sample is equal to or higher than specified strength upto 30% then strength of the concrete shall be considered in order and the concrete shall be accepted at full rates.

(d) If the actual average strength of accepted sample is less than specified strength but not less than 70% of the specified strength, the concrete may be accepted at reduced rate at the discretion of Engineer-in-Charge (see para 5.4.13.2).

(e) If the actual average strength of accepted sample is less than 70% of specified strength, the Engineer-in-Charge shall reject the defective portion of work represented by sample and nothing shall be paid for the rejected work. Remedial measures necessary to retain the structure shall be taken at the risk and cost of contractor. If, however the Engineer-in-Charge so desires, he may order additional tests (See Appendix B of Chapter 5) to be carried out to ascertain if the structure can be retained. All the charges in connection with these additional tests shall be borne by the contractor.

Acceptance Criteria of Field Test (Additional Test – Not Mandatory)

(A) Preparation of Standard Test Cubes for calibration of Rebound Hammer at site

(a) In the beginning the standard test cubes of the specified mix shall be prepared by field units before undertaking any concrete work in each project.

(b) At least 18 standard cubes necessary for formation of one specimen of specified mix, shall be cast by site staff well in advance. From these 18 cubes any 3 cubes may be selected at random to be tested for crushing strength of 7 days. The crushing strength obtained should satisfy the specified strength for the mix as per specification or agreement. If the strength is satisfactory then the remaining cube will form the standard samples for calibration of rebound hammer. In case of failure, the site staff should totally reject the samples and remove them also and then make another set of samples by fresh mixing or alternatively, out of the remaining 15 cubes, 3 cubes will be tested on 28 days. If the 28 days' tests are found satisfactory then remaining 12 cubes will form the standard sample for calibration at 28 days' strength otherwise all samples shall be rejected and whole procedure repeated to form a fresh specimen. All the results shall be recorded in a register.

(c) No concreting will be allowed unless the standard specimen cubes are obtained. The criteria for acceptance and calibration of hammer will be 28 days' strength. The 7 days' strength is only to facilitate the work to start.

(d) No work (for the concrete cast between 8th and 28th day) shall be allowed to be paid unless 28 days' cube strength is obtained. For the concrete cast between 8th and 28th day, the decision to make the payment may be taken by the Engineer-in-charge on the basis of existing criteria. Concrete work will be rejected if 28 days' strength falls short as per acceptance criteria. No further work will be allowed till the acceptable standard cubes are obtained.

e) Frequency: it will be once in each quarter or as per the direction and discretion of Engineer-in-Charge. Whenever the acceptance criteria is changed or concrete mix or type of cement is changed or Engineer-in-Charge feels it necessary for recorded reasons with the approval of the authority according to technical sanction, fresh specimen shall be prepared.

(B) Calibration of Hammer

(a) Simultaneously, same three cubes to be tested on 28 days as referred in para A (b) above shall be used to correlate the compressive strength of their concrete with rebound number as per procedure described in para 5.2 of the IS 13311 (Part 2) "Indian standard for non-destructive testing of concrete Method of test by rebound hammer which is given below in para B (b). The average of values of the rebound number (minimum readings) obtained in respect of same three cubes passing on 28 days' work test shall form the datum reference for remaining cubes for the strength of cubes.

(b) The concrete cubes specimens are held in a compression testing machine under a fixed load, measurements of rebound hammer taken and then compressive strength determined as per IS 516. The fixed load required is of the order of 7 N/mm2 when the impact energy of the hammer is about 2.2 NM.

If the specimen are wet cured, they should be removed from wet storage & kept in the laboratory atmosphere for about 24 hours before testing. Only the vertical faces of the cubes as cast should be tested for rebound number. At

least nine readings should be taken on each of the three vertical faces accessible in the compression testing machine when using rebound hammers. The points of impact in the specimen must not be nearer than 20 mm from the edge & should not be less than 20 mm from each other. The same points must not be impacted more than once.

(c) The rebound number of hammer will be determined on each of the remaining (18-3- 3=12) cubes. Whenever the rebound number of hammer of any individual cube varies by more than +25% form the datum readings referred to in para B (a) above, that cube will be excluded and will not be considered for standard specimen cubes for calibration. It must be ensured that at least 8 cubes out of 12 that is 66.67% are within the permissible range of variation of rebound number i.e. +25% or otherwise whole procedure shall have to be repeated and fresh specimen prepared.

These 8 cubes will form one standard sample in the beginning before commencement of work and shall be kept carefully for the visiting officers who will calibrate their hammers on these cubes.

(d) This calibration will be done by field staff with their hammer and then chart of calibration giving the details of the average readings, date & month of casting, mix of the concrete etc. shall be prepared and signed by Engineer-in-Charge and will be duly preserved for future reference as and when required.

(C) Preservation of Cubes at site

Standard sample cubes cast shall be carefully preserved at site under the safe custody of AE or his representative for making them available together with the charts, to the officers of QCTA/CTE or any other senior departmental officer, during their inspection of the work. They will calibrate their hammer on these cubes if required.

DESIGN MIX

Definition

Design mix concrete is that concrete in which the design of mix i.e. the determination of proportions of cement, aggregate & water is arrived as to have target mean strength for specified grade of

concrete. The minimum mix of M25 shall be used in all structural elements in both load bearing & RCC framed construction.

Mix Design and Proportioning

Mix proportions shall be designed to ensure that the workability of fresh concrete is suitable for conditions of handling and placing, so that after compaction it surrounds all reinforcement and completely fills the formwork. When concrete is hardened, it shall have the stipulated strength, durability and impermeability.

Determination of the proportions by weight of cement, aggregates and water shall be based

As a trial the manufacturer of concrete may prepare a preliminary mix according to provisions

of SP: 23. Reference may also be made to ACI 211.1-77 for guidance.

Mix design shall be tried and the mix proportions checked on the basis of tests conducted at a recognized laboratory approved by the Engineer-in-Charge.

All concrete proportions for various grades of concrete shall be designed separately and the mix proportions established keeping in view the workability for various structural elements, methods of placing and compacting.

Before using an admixture in concrete, its performance shall be evaluated by comparing the

properties of concrete with the admixture and concrete without any admixture. Chloride content of admixture should be declared by the manufacturer of admixture and shall be within limits stipulated by IS:9103.

Standard Deviation

Standard deviation calculations of test results based on tests conducted on the same mix design for a particular grade designation shall be done in accordance with IS 456.

Acceptance Criteria for Design Mix

Compressive Strength : The concrete shall be deemed to comply with the strength

requirements when both the following condition are met:

(a) The mean strength determined from any group of four consecutive test results complies with the appropriate limits in col 2 of Table 5.6.

(b) Any individual test result complies with the appropriate limits in col. 3 of Table 5.6.

5.8.3.2 ***Flexural Strength :*** When both the following conditions are met, the concrete complies with the specified flexural strength.

(a) The mean strength determined from any group of four consecutive test results exceeds the specified characteristic strength by at least 0.3 N/mm2 .

(b) The strength determined from any test result is not less than the specified characteristic

strength/ 0.3 N/mm2.

Quantity of Concrete Represented by Strength Test Results : The quantity of concrete

represented by a group of four consecutive test results shall include the batches from which the first and last samples were taken together with all intervening batches.

For the individual test result requirements given in col 3 of Table 5.6 or in item (b) of 5.8.3.2. Only the particular batch from which the sample was taken shall be at risk.

Where the mean rate of sampling is not specified the maximum quantity of concrete that four

consecutive test results represent shall be limited to 60 m3.

If the concrete is deemed not to comply pursuant to 5.8.3 the structural adequacy of the parts affected shall be investigated and any consequential action as needed shall be taken.
Concrete of each grade shall be assessed separately.
Concrete is liable to be rejected if it is porous or honey-combed, its placing has been interrupted without providing a proper construction joint, the reinforcement has been displaced beyond the tolerances specified, or construction tolerances have not been met. However, the hardened concrete may be accepted after carrying out suitable remedial measured to the satisfaction of the Engineerin-Charge.

Cement Content of Concrete

For all grades of concrete manufactured/produced, minimum cement content in the concrete shall be 330 kg per cubic metre of concrete. Also, irrespective of the grade of concrete the maximum cement content shall not be more than 500 kg per cubic metre of concrete. These limitations shall apply for all types of cements of all strengths.

Actual cement content in each grade of concrete for various conditions of variable shall be established by design mixes within the limits specified in para 5.8.4.1 above.

Water Cement Ratio and Slump

In proportioning a particular mix, the manufacturer/ producer/ contractor shall give due consideration to the moisture content in the aggregates, and the mix shall be so designed as to restrict the maximum free water cement ratio to less than 0.5.
Due consideration shall be given to the workability of the concrete thus produced. Slump shall be controlled on the basis of placement in different situations. For normal methods of placing concrete, maximum slump shall be restricted to 100 mm when measured in accordance with IS 1199.

TABLE 5.6
Characteristic Compressive Strength Compliance Requirement
(Clause 5.8.3.1 and 5.8.3.3)

Specified Grade	*Mean of the Group of 4 Non-Overlapping Consecutive Test Results in N/mm^3*	*Individual Test Results in N/mm^3*
(1)	*(2)*	*(3)*
M15 and above	≥ fck + 0.825 x established standard deviation (rounded off to nearest 0.5 N/mm^2) or fck + 3 N/mm^2 whichever is greater	≥ fck-3 N/mm^2

NOTE –
In the absence of established value of standard deviation, the values given in Table may be assumed, and attempt should be made to obtain results of 30 samples as early as possible to establish the value of standard deviation.

(e) **For concrete of quantity up to 30 m^3 (where the number of samples to be taken is less than four as per frequency of sampling given in 5.11.5(d), the mean of test results of all such samples shall be fck + 4 N/mm^2, minimum**

Approval of Design Mix

The producer/ manufacturer/ contractor of concrete shall submit details of each trial mix of each grade of concrete designed for various workability conditions to the Engineer-in-Charge for his

comments and approval. Concrete of any particular design mix and grade shall be produced/ manufactured for works only on obtaining written approval of the Engineer-in-Charge.
For any change in quality/ quantity in the ingredients of a particular concrete, for which mix has been designed earlier and approved by the Engineer-in-Charge, the mix has to be redesigned and approval obtained again.

Guiding Technical specification for Self compacting concrete.

The specification, performance and conformity requirements for structural concrete are given in IS 456-2000 Annex - J. Test methods. The filling ability and stability of self-compacting concrete in the fresh state shall be defined by four key characteristics like flow ability viscosity, passing ability & Segregation resistance. Each characteristic shall be addressed by one or more test methods:

Grade	*M30 & above*
Cementitious content	*400 – 600kg / m3*
Admixtures	*PCE based & Viscosity Modifiers or as per design mix*
Flow	*550 – 850 mm*
T 50 time	*Time of 2-5 seconds*
V-Funnel	*Time Max 25 seconds*
L – Box ratio	*0.8 – 1.0*
Compressive Strength	*As per Specification of IS 456.*

Characteristic	**Preferred test method(s)**
Flow ability	Slump-flow test
Viscosity (assessed by rate of flow)	T500 Slump-flow test or V-funnel test
Passing ability	L-box test

READY MIXED CONCRETE (as per IS 4926)

Materials

Selection and Approval of Materials : Materials used should satisfy the requirements for the safety, structural performance durability and appearance of the finished structure, taking full account of the environment to which it will be subjected. The selection and use of materials shall be in accordance with IS 456. Materials used shall conform to the relevant Indian Standards applicable. Where materials are used which are not covered by the provisions of the relevant Indian Standard, there should be satisfactory data on their suitability and assurance of quality control. Records and details of performance of such materials should be maintained. Account should be taken of possible interactions and compatibility between IS 4926 and materials used. Also, prior permission of the purchaser shall be obtained before use of such materials.

Cement : Cement used for concrete shall be in accordance with the requirements of IS 456.

Mineral Admixtures : Use of mineral admixtures shall be permitted in accordance with the provisions of IS 456.

Aggregates : Aggregates used for concrete shall be in accordance with the requirement of IS 456. Unless otherwise agreed testing frequencies for aggregates in plant shall be as given IS 4926.

Chemical Admixtures

(i) Use of chemical admixtures shall be permitted in accordance, with the provisions of IS 456 and IS 9103.

(ii) It shall be the responsibility of the producer to establish compatibility and suitability of any

admixture with the other ingredients of the mix and the determine the dosage required to give the desired effect.

(iii) Admixtures should be stored in a manner that prevents degradation of the product and consumed within the time period indicated by the admixture supplier. Any vessel containing an admixture in the plant or taken to site by the producer shall be clearly marked as to its content.

(iv) When offering or delivering a mix to a purchaser it should be indicated if such a mix contains an admixture or combination of admixtures or not. The admixtures may be identified generically and should be declared on the delivery ticket.

(v) The amount of admixture added to mix shall be recorded in the production record. In special circumstances, if necessary, additional dose of admixture may be added at project site to regain the workability of concrete with the mutual agreement between the producer and the purchaser.

Water : Water used shall be in accordance with the requirement of IS 456. Unless otherwise agreed, the testing frequencies for water shall be as given in Annex A.

The use of re-cycled water is encouraged as long as concrete of satisfactory performance can be produced and steps are taken to monitor the build up of chlorides in any recirculated water and that any subsequent adjustments to the mix design are made to ensure that any overall limit on chloride contents is satisfied. The addition of any recycled water shall be monitored and controlled to meet these requirements.

The total amount of water added to the mix shall be recorded in the production record. The water content of concrete shall be regulated by controlling its workability or by measuring and adjusting the moisture contents of its constituent materials. The producer's production staff and truck -mixer, drivers shall be made aware of the appropriate responses to variations in concrete consistency of a particular mix caused by normal variations in aggregate moisture content or grading.

Sampling and Testing of Ready-Mixed Concrete

Point and Time of Sampling **:** For the assessment of compliance of ready-mixed concrete, the point and time of sampling shall be at discharge from the producer's delivery vehicle or from the mixer to the site or when delivered into the purchaser's vehicle. It is critical that the sampling procedure and equipment used enables as representative a sample as possible to be taken of the quantity of concrete delivered (see Annex A).

The sampling may be carried out jointly by the purchaser and the supplier with its frequency mutually agreed upon. However, it will not absolve the supplier of his responsibility from supplying in concrete as per the requirement given in this standard or otherwise agreed to where so permitted in the standard.

Workability : The test for acceptance is to be performed upon the producer's delivery vehicle discharge on site or upon discharge into the purchaser's vehicle. lf discharge from the producers' vehicle is delayed on site due to lack of preparedness on behalf of the purchaser then the responsibility passes to the purchaser after a delay of more than 30 min.

The workability shall be within the following limits on the specified value as appropriate:

Slump ± 25 mm or 1/3 of the specified value, whichever is less.

Compacting factor : ± 0.03, where the specified value is 0.90 or greater,

± 0.04, where the specified value is less than 0.90 but more than 0.80,

± 0.05, where the specified value is 0.80 or less.

Flow table test may be specified for concrete, for very high workability (see IS 9103)
Acceptance criteria for spread (flow) are to be established between the supplier and the purchaser.

Specified Strength

(i) Compliance shall be assessed against the requirements of IS 456 or other agreed Indian Standard. The purchaser may perform his sampling and testing or may enter into an arrangement with the producer to provide his testing requirements.

(ii) Unless otherwise agreed between the parties involved, the minimum testing frequency to be applied by the producer in the absence of a recognized ready- mixed concrete industry method of production control should be one sample for every 50 m
3 of production or every 50 batches, whichever is the greater frequency. Three test specimens shall be made up for each sample for testing at 28 days (see also IS 456).

In order to get a relatively quicker idea of the quality of concrete, optional test on beams for modulus of rupture at 72 ± 2 h or at 7 days or compressive strength test at 7 days may be carried out in addition to 28 days compressive strength test. For this purpose the value should be arrived at based on actual testing. In all cases 28 days compressive strength shall alone be the criteria for acceptance or rejection of the concrete.

(iii) The purchaser shall inform the producer if his requirements for sampling and testing are higher than one sample every 50 m 3 or 50 batches, whichever is the greater frequency.

PLACING CONCRETE BY PUMPING

General

Concrete conveyed by pressure through either rigid pipes or flexible hoses and discharged directly into the desired area is termed as pumped concrete. Method of applying pressure to concrete is by pumps. Pumps to be used shall be either of the two types as mentioned below:-

(A) Piston type pumps

(B) Squeeze pressure type pumps.

Compressed air pressure pumps shall not be used in the works.

Pumping Equipments

5.10.2.1 ***Piston Pumps*** : Piston pump to be used in the works shall consist of a receiving hopper for mixed concrete, an inlet valve, an outlet valve, and the pump shall be a twin-piston pump. The two pistons shall be so arranged that one piston retracts when the other is moving forward and pushing concrete into the pipe line to maintain a reasonably steady flow of concrete. Single piston pumps shall not be acceptable.

Inlet and outlet valve shall be any one of the following types:-

- Rotating plug type
- Sliding plate type
- Guided plunger type
- Swing type
- Flapper type
- Or any combination of the above.

The pistons shall be mechanically driven using a crank or chain or hydraulically driven using oil or water. The receiving hopper shall have a minimum capacity of 1.0 cum and the hopper shall be fitted with remixing rotating blades capable of maintaining consistency and uniformity of concrete. The primary power for pumps may be supplied by gasoline, diesel, or electric motors. The primary power

unit and the pump unit may be truck, trailer or skid mounted.

Squeeze Pressure Pumps : Squeeze pressure pumps shall consist of a receiving hopper fitted with re-mixing blades. Re-mixing blades shall be such that these can push the concrete into the flexible hose connected at the bottom of the hopper.
The flexible hose shall pass through a metal drum around the inside periphery of the drum and come out through the top part of the drum. The drum shall be maintained under a very high degree of a vacuum during operation. The drum shall be so fitted with hydraulically operation metal rollers., which when rotating, create a squeeze pressure on the flexible hose carrying concrete and forces the concrete out into the pipe line.

Effective Range and Discharge of Pumps : Effective range of pumps to be used in the work shall be decided after studying the site conditions. However, the minimum horizontal range shall not be less than 150 metres and minimum vertical range shall not be less than 50 metres. Selection of pumps bases on discharge capacity shall be decided after studying the requirements for the project. Discharge capacity shall be worked out by the contractors and approval obtained from the Engineer-in-Charge. As a guide line figure the contractor may assume a discharge capacity of 15 cubic metre/hour/pump.

Pipe Lines : All concrete carrying pipe lines shall generally be rigid pipe lines. Flexible pipe lines may only be used at bend curves in lines or at discharge ends if required. Placements of flexible units shall be done judiciously and connected to the pipe lines only when it meets the approval of the Engineer-in-Charge.
(i) ***Rigid Line/ Hard Line/ Slick line :*** Such lines shall be made either of steel or plastic. Aluminum alloy pipes shall not be used.
Minimum pipeline diameter shall be 100 millimeters and shall have normal maximum length of 3 metre in each section connected through couplers.
(ii) ***Flexible Pipe Line*** *:* Flexible lines shall be made out of rubber or spiral wound flexible metal or plastic. The pipe shall again be such that they are in sections of 3 metre length each and connected through couplers. These pipes shall be such that they are interchangeable with rigid lines. While installing flexible units, care shall be taken that there are no links in the pipeline, which is a normal tendency with these pipes having diameter 100 mm and above.
Couplers : Couplers to be used for connecting pipe line sections (either hard or flexible) shall have adequate strength to withstand stresses due to handling, misalignments, poor support to pipe lines etc. For horizontal runs of pipes and for vertical run upto 30 metre height the couplers shall be rated for a minimum pressure of 35 kg/ cm square. Couplers used for rising runs between 30 metre and 50 metre heights shall have a minimum pressure rating of 50 kg/cm square. Couplers shall be designed to allow for replacement of any pipe section without displacing other sections. These shall provide for the full internal cross section. These shall provide for the full internal cross section with no constructions or service. Which may disrupt the smooth flow of concrete. For pipelines of size 150mm and above, double togged type coupler with a thick rubber gasket and secondary wedge-take-up is recommended. Types of couplers that may be used shall be any of the following:-
- Grooved end coupler
- One piece extended lever swing type couplers

- And full flow oil line type couplers.

Other Accessories : Other accessories which shall be catered for, are as under:-

(a) Back up pump of rigid and flexible pipes of varying lengths of similar rating/specifications

(b) Curved sections of rigid pipes

(c) Swivel joints and rotary distributors

(d) Pin and gate valves to prevent back flow in pipe lines

(e) Switch valves to direct the flow into another pipe line

(f) Connection devices to fill forms from the bottom up

(g) Splints, rollers, and other devices for protection of conduit over rock concrete Reinforcing steel and form and to provide lifting and lashing points in the pipe line.

(h) Transitions for connecting different sizes of pipe sections

(i) Air vents for downward pumping.

(j) Clean out equipment.

For concreting of columns, walls and scattered small placement, recommendation is made for special cranes or power controlled booms carrying pipe lines with a pendant type concrete delivery hose.

Lubricating of Pipe Line

Before pumping concrete into the pipeline, the line shall be lubricated with a properly designed mortar/grout lubricant. This shall be ensured by starting the pumping operation with a properly designed mortar, or with a batch of regular concrete with the coarse aggregate omitted. The quantity of mortar required as lubricant is dependent on the smoothness and cleanliness of the pipelines. As a guide line, for a 100 mm diameter pipe line of 100 metre length, 0.08 cum to 0.10 cum of mortar should normally be adequate, but this shall not be taken as specified, and the contractor shall establish his requirements.

The quantity of mortar that comes out of the delivery end of the pipeline shall not be used in place of the concrete work. However, with the approval of Engineer-in -Charge, this mortar may be used as bedding mortar against construction joints. The rest of the mortar shall be wasted. Lubrication shall be maintained as long as the pumping of concrete continues.

4.17 PT SLAB

Providing, laying, stressing and finishing Post-Tensioned Reinforced Cement Concrete (PT RCC) Slab of thickness as shown in the approved structural drawings, using approved post-tensioning system comprising high tensile low-relaxation seven-wire strands conforming to IS 14268 and relevant international standards. The work shall include design, supply, installation, stressing, grouting, testing and all incidental works complete in accordance with approved structural drawings, PT shop drawings, manufacturer's specifications and relevant IS codes.

The work shall consist of providing HDPE sheathing/ducts, anchorage assemblies, wedges, trumpets, couplers, bursting reinforcement, anti-burst reinforcement, end block reinforcement and all accessories required for the post-tensioning system. Tendons shall be accurately positioned and securely fixed to maintain the specified profile during concreting. Chairs, supports and spacers shall be provided at required intervals to prevent displacement of ducts and tendons.

Concrete for PT slabs shall be of grade not less than M35 or as specified in the structural design,

produced through approved batching plant, machine mixed, transported, placed, compacted using mechanical vibrators and cured as per specifications. Formwork and staging shall be designed to withstand construction loads, wet concrete pressure and post-tensioning forces without excessive deflection. Formwork shall be properly aligned, levelled and adequately braced to achieve the required surface finish and dimensional accuracy.

Ordinary reinforcement consisting of HYSD/TMT bars of specified grade shall be provided as detailed in structural drawings, including distribution reinforcement, temperature reinforcement, top reinforcement over supports, punching shear reinforcement, edge reinforcement, trimming bars around openings and all additional reinforcement required for anchorage zones and stress concentration areas.

After achieving the specified minimum concrete strength, tendons shall be stressed using calibrated hydraulic jacks and pressure gauges under the supervision of qualified PT specialists. Stressing operations shall be carried out in the prescribed sequence and to the specified elongation and jacking force. Complete records of tendon elongation, jacking pressure and stressing results shall be maintained and submitted for approval.

Upon completion of stressing and approval of stressing records, ducts shall be pressure-grouted using cement grout prepared from Ordinary Portland Cement with approved admixtures where required. Grouting shall be carried out using mechanical grout pumps to ensure complete filling of ducts without voids. Grout shall be tested for flowability, bleed and strength in accordance with relevant standards. Anchorage recesses shall be cleaned and sealed with non-shrink cementitious mortar or concrete after completion of grouting.

The contractor shall provide all labour, materials, machinery, hydraulic jacks, stressing equipment, grout pumps, testing instruments, scaffolding, shuttering, consumables and skilled personnel necessary for execution of the work. The contractor shall also arrange for calibration of stressing equipment, testing of strands, grout and concrete, quality control checks, preparation of shop drawings and obtaining approvals from the Engineer-in-Charge.

The finished PT slab shall be true to line, level and dimensions shown in the drawings, free from honeycombing, cracks and defects, and capable of carrying the design loads safely. The rate shall include cost of concrete, reinforcement, PT strands, ducts, anchorages, wedges, couplers, grouting, stressing, formwork, staging, testing, curing, wastages, transportation, loading, unloading, quality control, supervision and all incidental works complete in all respects as per specifications, drawings and directions of the Engineer-in-Charge.

Construction joints

Joints are a common source of weakness and, therefore, it is desirable to avoid them. If this is not possible, their number shall be minimized. Concreting shall be carried out continuously up to construction joints, the position and arrangement of which shall be indicated as directed by SBI/ PMC / Engineer in charge.

In case of columns the joints shall be horizontal and 10 to 15 cm below the bottom of the beam running into the column head. The portion of the column between the stepping off level and the top of the slab shall be concreted with the beam.

When stopping the concrete on a vertical plane in slabs and beams, and approved stop board

shall be placed with necessary slots for reinforcement bars or any other obstruction to pass the bars freely without bending. The construction joints shall be keyed by providing a triangular or trapezoidal fillet nailed on the stop board. Inclined or feather joints shall not be permitted. Any concrete flowing through the joints of stop board shall be removed soon after the initial set. When concrete is stopped on a horizontal plane, the surface shall be roughened and cleaned after the initial set.

When the work has to be resumed, the joint shall be thoroughly cleaned with wire brush and loose particles removed. A coat of neat cement slurry at the rate of 2.75 kg of cement per square metre shall then be applied on the roughened surface before fresh concrete is laid.

Expansion Joints

Expansion joints shall be provided as shown in the structural drawings or as indicated in Fig. 5.10 to 5.25 or as directed by SBI/ PMC / Engineer in charge, for the purpose of general guidance. However, it is recommended that structures exceeding 45 m in length shall be divided by one or more expansion joints. The filling of these joints with bitumen filler, bitumen felt or any such material and provision of copper plate, etc. shall be paid for separately in running metre. The measurement shall be taken two places of decimal stating the depth and width of joint.

EXPANSION JOINT/SEISMIC JOINT

Gap of the expansion joints shall be provided as proposed in the structural design of the building. Specifications of the Expansion joints shall be as per DBR, PART-D and as per CPWD Specifications. Brief specifications are given below:

FLOOR JOINT

The expansion joint system will be of extruded aluminum base members, self aligning /self centering arrangement and support plates etc. as per ASTM B221-02. The system shall be such that it provides floor to floor/ floor to wall expansion control system for various vertical locations in load application areas that accommodate multi directional seismic movement without stress to its components. The system shall consist of metal profiles with universal aluminum base member designed to accommodate various project conditions and finish floor treatments. The cover plate shall be designed of width and thickness required to satisfy projects movement and loading requirements and secured to base members by utilizing manufacturer's pre-engineered self centering arrangement that freely rotates/ moves in all directions. The self-centering arrangements shall exhibit circular sphere ends that lock and slide inside the corresponding aluminum extrusion cavity to allow freedom of movement and flexure in all directions including vertical displacement. Provision of moisture barrier membrane in the joint system to have water tight joint is mandatory requirement. The scope of work includes all labour, materials, equipments and services and perform all operations required for complete installation of expansion joint system.

WALL JOINT

The expansion joint system related with wall joint (internal/ external) shall be of extruded aluminum base members, self aligning / centering arrangement and support plates as per ASTM B221-02. The material shall be such that it provides an Expansion joints systems suitable for vertical wall to wall/ wall to corner application, both new and existing construction in office buildings & complexes with

no slipping down tendency amongst the components of the joint system. The Joint System shall utilize light weight aluminum profiles exhibiting minimal exposed aluminum surfaces mechanically snap locking the multicellular to facilitate movement. (Material shall confirm to ASTM 6063)

ROOF JOINT

The expansion joint system for various roof locations shall be of extruded aluminum base members with, self aligning and self centering arrangement support plates as per ASTM B221-02. The system shall be such that provides that is capable to accommodating multidirectional seismic movement without stress to its components. System shall consist of metal profile that incorporates a universal aluminum base member designed to accommodate various project conditions and roof treatments. The cover plate shall be designed of width and thickness required to satisfy movement and loading requirements and secured to base members by utilizing manufacturer's pre-engineered self-centering arrangement that freely rotates/ moves in all directions. The self centering arrangement shall exhibit circular sphere ends that lock and slide inside the corresponding aluminum extrusion cavity to allow freedom of movement and flexures in all directions including vertical displacement. The joint system shall resists damage or deterioration from the impact of allying ice, exposure to UV, airborne contaminants and occasional foot traffic from maintenance personnel. Provision of moisture barrier membrane in the joint system to have water tight joint is mandatory requirement.

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a. The treatment of Seismic / mechanical expansion joints shall be carried out strictly as per the specifications mentioned herein. In the absence of specifications of any material, relevant I.S. specifications shall be followed and in case any material is not covered up in the specifications; PMC/SBI/ PMC / Engineer in charge's instructions shall be followed. No deviation shall be permissible unless specifically approved by the PMC/SBI/ PMC / Engineer in charge.

b. The work shall be carried out as per CPWD specifications and directions of PMC/SBI/ PMC / Engineer in charge.

c. The work shall be carried out as per site requirement. The Contractor shall submit detailed drawing/shop drawing for each type of joint within three days from the date of award and shall be got approved from PMC/SBI/ PMC / Engineer in charge before execution of the work.

d. The Contractor shall make minor modification in the samples as per site requirement with the approval of PMC/SBI/ PMC / Engineer in charge if required and nothing extra shall be paid for this modification.

e. The Contractor shall submit the test reports of the product of the manufacturers.

f. Manufactures: - All seismic/mechanical expansion joints shall be designed and manufactured by the approved manufacturers.

g. Guarantee: - All the joints shall be guaranteed at least for the period of 5years when installed by the certified applicator in the prescribed performa.

h. Installation: - Installation shall be in strict accordance with manufacture's technical specifications, details and installation instructions. The work shall be carried out through the specialized agencies as approved by the PMC/SBI/ PMC / Engineer in charge.

i. Protection: - The system and its component should be protected during construction and after work is complete, the exposed surface and adjacent areas

should be cleaned by suitable cleaner to the satisfaction of PMC/SBI/ PMC / Engineer in charge.

j. Sample for joints: -The agency shall supply sample of minimum one-meter length of all types of expansion joints and the same shall be fixed at site at appropriate location and the same shall be approved by the competent authority which shall be duly intimated by Engineer–in–Charge. The agency shall place the order for procurement of mechanical expansion joint from the parent company for supply only after obtaining approval from PMC/SBI/ PMC / Engineer in charge.

k. Materials: -

i. EPDM (Ethylene Propylene Dinine membrane) water resistant membrane shall be as per manufacturers specifications and shall be of best quality. The EPDM membrane shall be pasted with approved adhesive to the surface.

ii. S.S. screw shall be of canon or equivalent make approved by PMC/SBI/ PMC / Engineer in charge.

iii. Aluminum sheet shall be of approved make and shall generally confirm to IS: 737-1986. The powder coating on aluminum sheet shall be 50-60 microns. The slots on the aluminum sheet shall be made by lath machine with smooth and uniform finish.

l. For any discrepancy in item and corresponding drawing, the decision of SBI/PMC in-charge shall be final and nothing extra shall be paid on that account.

LIST OF MANDATORY TESTS

Material	*Clause*	*Test*	*Field/ labor-atory test*	*Test proce-dure*	*Min, quantity of material for carrying out the test*	*Frequency of testing*
1	*2*	*3*	*4*	*5*	*6*	*7*

Reinforced cement concrete (Nominal Mix)	5.4.1	(a) Slump test	Field/Lab	Appen-dix 'D' of Chapter 4	(i) 5 cum in case of column (ii) 20 cum for slabs, beams and connected columns (iii) 20 cum for other R.C.C. work for all other small items and where R.C.C. done in a day is less than 5 cum test may be carried out as required by Engineer-in-Charge	(i) Every 5 cum of part thereof (ii) Every 20 cum or part thereof (iii) -Do-

	5.4.9.1	(b) Cube Test	Lab	Appen-dix 'A'	(i) 5 cum in case of column (ii) 20 cum for slabs, beams and connected columns (iii) 20 cum for other R.C.C. work for all other small items and where R.C.C. done in a day is less than 5 cum test may be carried out as required by Engineer-in-Charge	(i) Every 5 cum or part thereof (ii) Every 20cum or part thereof (iii) -Do-
1	*2*	*3*	*4*	*5*	*6*	*7*
Reinforced Cement Concrete (Design Mix)	Coarse Aggre-gates				50 cum or part thereof & also on each change of source	
	Fine Aggre-gates				50 cum or part thereof & also on each change of source	
	Cement				50 MT or on each change of source	

	Fresh Concrete	(a) Slump test	Field	Appen-dix 'D' of Chapter 4	10 cum	50 cum for R.C.C. work including in all other small location. R.C.C. done in a day is less than 50 cum test may be carried out as required by
	Fresh Concrete	(b) Cube Test	Lab	Appen-dix 'A'	10 cum or part thereof	50 cum or 10 batches of 5-7 cum each for R.C.C. work in all location taken together. R.C.C. done in a day is less than 50 cum test may be carried out as required by SBI/
Reinforced Cement Concrete (Ready Mix)	Coarse Aggre-gates				50 cum or part thereof & also on each change of source	
	Fine Aggre-gates				50 cum or part thereof & also on each change of source	
	Cement				50 MT or on each change of source	
	Fresh Concrete	(a) Slump test	Field/Lab	Appendix 'D' of Chapter 4	10 cum	50 cum for R.C.C. work including in all other small location. R.C.C. done in a day is less than 50 cum test may be carried out as required by SBI/ PMC / Engineer
1	*2*	*3*	*4*	*5*	*6*	*7*

	Fresh Concrete	(b) Cube Test	Lab	Appen-dix 'A'	10 cum or part thereof	50 cum or 10 batches of 5-7 cum each for R.C.C. work in all location - taken together. R.C.C. done in a day is less than 50 cum test may be carried out as required by Engineer-	
Steel for Reinforced cement concrete	5.1.3	(A) Physical Test and chemical tests				(a) For consign-ment below 100 tonnes (i) under 10 mm dia, one sample for each 25 tonnes or part thereo f (ii) 10 mm to 16 mm dia one sample for each 35 tonnes or part thereof (iii) over 16 mm dia one sample for each 45 tonnes	(b) For consign-ment over 100 tonnes (i) Under 10 mm dia, one sample for each 40 tonne s or part thereo f (ii) 10 mm to 16 mm, one sample for each 45 tonnes or part thereo f (iii) over 16 mm dia

LIST OF BUREAU OF INDIAN STANDARDS CODES

Sl. No.	*I.S. No.*	*Subject*

1.	IS 226	Structural Steel
2.	IS 432 (Part I)	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement part-I mild steel and medium tensile steel bars.
3.	IS 432 (Part II)	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement – Part-II hard drawn steel
4.	IS 456	Code of Practices for plain and Reinforced concrete.
5.	IS 516	Method of test for strength of concrete.
6.	IS 716	Specification for pentachlorophenol
7.	IS 1199	Methods of sampling and analysis of concrete.
8.	IS 1200 (Part II)	Method of measurement of building and civil engineering work – concrete work
9.	IS 1200 (Part V)	Method of measurement of building and civil engineering work – concrete work (Part 5- Form work)
10.	IS 1566	Specification for hard drawn steel wire fabric for concrete requirement.
11.	IS 1599	Method for bend test
12.	IS 1343	Code of Practice for Prestressed Concrete
13.	IS 1608	Method for tensile testing of steel products
14.	IS 1786	Specification for high strength deformed steel and wires for concrete reinforcement.
15.	IS 1791	Specification for batch type concrete mixes
16.	IS 2502	Code of practice for bending and fixing bars for concrete reinforcement.
17.	IS 2751	Recommended practice for welding of mild steel plain and deformed bars for reinforced construction.
18.	IS 4925	Batch plants specification for concrete batching and mixing plant
19.	IS 4926	Ready – Mixed Concrete
20.	IS 6523	Specification for precast reinforced concrete door, window frames
21.	IS 10262	Recommended guidelines for concrete mix design
22.	IS 13311 (Part I)	Indian standard for non-destructive testing of concrete. Method of test for ultrasonic pulse velocity
23.	IS 13311 (Part II)	Indian standard for non-destructive testing of concrete. Method of testing by rebound hammer.

OTHER SPECIFICATIONS:

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

4.18 Cover/Spacer Block

The Contractor shall provide approved type of support for maintaining the bars in position and ensuring required spacing and correct cover of concrete to reinforcement as called for in the drawings, spacer blocks of required shape and size. Chairs and spacer bars shall be used in order to ensure accurate positioning of reinforcement. Spacer blocks shall be cast well in advance with approved proprietary pre-packed free flowing mortars of high early strength and same colour as surrounding concrete, Pre-cast cement

mortar/concrete blocks/blocks of polymer shall not be used as spacer blocks unless specially approved by the PMC/SBI/ PMC / Engineer in charge.

5 MASONRY WORK

Masonry work shall be carried out in confirmity of Latest CPWD Specifications for works.

5.1 BRICK WORK:

Bricks used in the masonry may be of the following type.

The Common Burnt Clay Bricks shall conform to IS:1077 and shall be hand moulded or machine moulded. They shall be free from nodules of free lime, visible cracks, flaws warpage and organic matter, have a frog 100 mm in length 40 mm in width and 10 mm to 20 mm deep on one of its flat sides. Bricks made by extrusion process and brick tiles may not be provided with frogs. Each brick shall be marked (in the frog where provided) with the manufacturer's identification mark or initials.

Fly Ash Lime Bricks (FALG Bricks) : The Fly Ash Lime Bricks (FALG Bricks) shall conform to IS 12894. Visually the bricks shall be sound, compact and uniform in shape free from visible cracks, warpage, flaws and organic matter. The bricks shall be solid and with or without frog on one of its flat side. *Fly Ash:* Fly ash shall conform to IS 3812

Clay Fly Ash Bricks: The clay fly ash bricks shall conform to IS 13757. The bricks shall be sound, compact and uniform in shape and colour. Bricks shall have smooth rectangular faces with sharp and square corners. The bricks shall be free from visible cracks, flaws, warpage, nodules of free lime and organic matter, the bricks shall be hand or machine moulded. The bricks shall have frog of 100 mm in length 40 mm width and 10 to 20 mm deep on one of its flat sides. If made by extrusion process may not be provided with frogs. Fly Ash shall conform to grade I or grade II of IS 3812.

AUTOCLAVED AERATED CONCRETE BLOCK MASONRY WORK

For the purpose of, Autoclave Aerated Concrete Block masonry work, the following definitions shall apply

1. Autoclaved -Steam curing of concrete Products, sand lime bricks, asbestos cement products, hydrous calcium silicate insulation Products, or cement in an autoclave at maximum ambient temperatures generally between 1700C to 2150C.

2. Block - A concrete masonry unit, any one of the external dimensions of which is greater than the corresponding dimension of a brick as specified in IS : 3952-1978 and of such size and mass as to permit it to be handled by one man. Furthermore, to avoid confusion with slabs and Panels, the height of the block shall not exceed either its length or six times its width.

3. Block Density - The density calculated by dividing the mass of a block by the overall volume, including holes or cavities and end recesses..

4. Drying Shrinkage - The difference between the length of specimen which has been immersed in water and then subsequently dried to constant length, all under specified conditions; expressed as a percentage of the dry length of the specimen.

5. Gross Area-The total area occupied by a block on its loading face, including areas of the cavities and end recesses.

6. Height -The vertical dimension of the exposed face of a block, excluding any tongue or other device designed to provide mechanical keying

7. Length - The horizontal dimension of the exposed face of a block excluding any tongue or other device designed to provide mechanical keying.

8. Width -The external dimension of a block at the bedding plane, measured at right angles to the length and height of the block.

The normal dimension of the concrete block shall be as follows:-

Length : 400, 500 or 600 mm

Height : 200, 250 or 300 mm

Width : 100, 150, 200 or 250 mm

In addition, Autoclave Aerated Concrete Block shall be manufactured in half length of 200, 250 or 300 mm correspond to the full length.

	Density in oven dry condition (Kg/m2)	**Compressive Strength (Min)**		**Thermal Condition in Air dry condition (W/m. k)**
		Grade -I (N/mm2)	**Grade -II (N/mm2)**	
	451 to 550	**2.00**	**1.50**	**0.21**
	551 to 650	**4.00**	**3.00**	**0.24**
	651 to 750	**5.00**	**4.00**	**0.30**
	751 to 850	**6.00**	**5.00**	**0.37**
	851 to 1000	**7.00**	**6.00**	**0.42**

LIST OF MANDATORY TESTS

Sl. No.	Material	Clause	Test	Field/ laboratory Test	Test Procedure	Minimum Qty. of material for carrying out test

(i)	Bricks/ Brick Tiles	6.1.3, 6.1.4, 6.1.5	Testing of Bricks/Brick Tiles for dimensions, Compressive strength, Water absorption and efflorescence	Laboratory	Appendix A, B, C & D of Chapter 6	As per Table 6.3 and 6.4
(ii)	Sewer Bricks	6.1.4	Dimensions, Compressive strength, Water absorption and	Laboratory	Appendix A, B, C & D of Chapter 6	As per Table 6.3 and 6.4
(iii)	Burnt clay perforated building bricks	6.1.5	--do--	-- do --	-- do--	-- do--

LIST OF BUREAU OF INDIAN STANDARDS CODES

S. No.	IS. No.	Subject
1.	IS 712	Specification for building limes.
2.	IS 1077	Common burnt clay building bricks.
3.	IS 1200 (Part 3)	Method of measurements of brick works
4.	IS 2212	Code of practice for brick work. (1st Revision)
5.	IS 2222	Specification for burnt clay perforated building bricks.
6.	IS 2849	Specification for non load bearing gypsum partition blocks, (Solid and hollow types)
7.	IS 3495	Method of test for burnt clay building bricks.
8.	IS 3812	Specification for fly ash for use as pozzolana and admixture.

9.	IS 4139	Specification of calcium silicate bricks
10.	IS 4885	Specification for sewer brick
11.	IS 5454	Methods of sampling of clay building bricks.
12.	IS 12894	Pulverized fuel ash lime bricks specification,
13.	IS 13757	Specification of burnt clay fly ash bricks.

6 CLADDING WORKS:

GENERAL
Marble shall be hard, sound, dense and homogeneous in texture with crystaline texture as far as possible. It shall generally be uniform in colour and free from stains, cracks, decay and weathering.

Marbles are metamorphic rocks capable of taking polish, formed from the re-crystalization of lime stones or dolomitic lime stones and are distinguished from lime stone by even visibly crystalined nature and nonflaggy stratification.

CLASSIFICATION
The marble blocks, slabs and tiles shall be classified broadly in the following two categories:

White Marble
Raj Nagar (plain white) Marble:
It shall be plain white marble with coarse grains predominantly showing mica particles giving reflection in light.

Coloured Marble

(i) Plain Black Marble

Black marble sawn along veins locally known as 'Peta Pasu sawing' available at Bhainslana.

(ii) Black Zebra Marble

(a) *Bhainslana Black Zebra Marble:* Black marble having grey or white veins available at Bhainslana.

(b) *Kishangarh Black Zebra Marble:* Black marble with grey and/or white veins available at Kishangarh.

(c) *Abu Black Zebra Marble:* Black marble having white patches and streaks available at Abu.

(d) *Narnaul Black Zebra Marbles:* Black marble with thin white veins available at Narnaul.

(e) *Makrana Dhobi Doongri Zebra Marble:* Greyish black marble with white flowery pattern available at Dhobi Doongri.

(iii) Green Marble

(a) *Baroda Green Marble:* Dark green marble with flowery pattern available at Baroda.

(b) *Abu Green Marble:* Light green marble with green and/or brown streaks on white ground available at Ambaji.

(c) *Falna Green Marble:* Green marble with prominent yellowish pattern available at Falna.

(d) *Bundi Green Marble:* Green marble with pinkish shades available at Umar, (Bundi).

(iv) Grey Marble

(a) *Kumari Grey Marble:* Grey marble having light blue shades available at Makrana.

(b) *Bundi Grey Marble:* Grey Marble with pink or green or black streaks available at Umar (Bundi).

(v) Brown Marble

(a) Bar Brown Marble/Brown Marble with light and dark brown shades available at Bar.

(b) Narnaul Brown Marble

Brown marble having teak wood shades available at Narnaul.

Granite Stone

It shall be of any colour and size. Granite shall be plain machine cut and mirror polished. The stone shall be smooth and of even surface without holes or pits.

SAMPLING

In any consignment all the blocks/slabs/tiles of the same group, size and finish shall be grouped together to constitute a lot. Sample shall be selected and tested separately for each lot for determining its conformity or otherwise to the requirements of the specification. The number of blocks/slabs/tiles to be selected for the samples shall depend upon the size of the lot and shall be in accordance.

MARBLE/GRANITE WORK - TABLE RUBBED AND POLISHED (PLAIN WORK)

Marble work in steps, jambs, columns and other plain work shall be as specified below:
Joints in staircase treads, kitchen platforms shall be permitted only at curvature or when width/length is more than 0.6/2 mtrs. respectively. Number of joints in each direction shall not be more than one number for every 2 mtrs. length beyond the initial 2.00 m length. Additional joints due to curvature or for providing fixture shall be provide judiciously

Dressing, Cutting and Rubbing

Every marble/ granite stone shall be gang saw/machine cut to the required size and

shape, chisel dressed machine finished on all beds and joints, so as to be free from any waviness and to give truly vertical, horizontal, radial or circular joints as required. The exposed faces and sides of stones forming joints upto 6mm. from the face shall be fine tooled machine cut such that a straight edge laid along the face of the stone is in contact with every point on it. All window sills, tread of steps, counters vanities moulding edges etc. shall be machine cut & polished to give high gloss mirror finish. These surfaces shall then be rubbed smooth. All visible angles and edges shall be true, square and free from chipping. Beyond the depth of 6 mm from face, the joints shall be dressed with a slight splay so that the thickness of joint increases, in an inverted V shape as shown in Fig. below. The surfaces of the stones coming in contact with backing need not be chisel dressed.

A sample of dressed and rubbed stone shall be prepared for approval and it shall be kept on worksite.

Mortar

The mortar used for jointing shall be as specified.

Laying

All marble stones shall be wetted before placing in position. These shall then be floated on mortar and bedded properly in position with wooden mallets without the use of chips or under pinning of any sort.

The walls and pillars shall be carried up truely in plumb or battered as shown in the drawings. All courses shall be laid truely horizontal and all vertical joints shall be truely vertical.

In case of work without backing of brick work or coursed rubble masonry, face stone shall be laid in headers and stretchers alternatively unless otherwise directed. The headers shall be arranged to come as nearly as possible in the middle of stretchers above and below. Stone shall be laid in regular courses of not less than 15 cm in height and all courses shall be of the same height unless otherwise specified.

For work facing with backing of brick work or coursed rubble masonry, face stone shall be laid in alternate courses of header and stretchers unless otherwise directed. Face stone and bond stone courses shall have break joint on the face of atleast half the height of the standard course and the bond shall be carefully maintained through out. All the connected masonry in a structure shall be carried up nearly at one uniform level throughout but where breaks are unavoidable the joints shall be made in good long steps so as to prevent cracks developing between new and old work.

When necessary jib crane or other mechanical appliances shall be used to hoist the heavy pieces of stones and place these in to correct positions, care being taken that the corners of the stone are not damaged. Stone shall be covered with gunny bags, before putting chain or rope is passed over it, and it shall be handled carefully. No piece which has been damaged shall be used in work. The matching of grains shall be carried out.

Joints

The depth of joints 6 mm from the face shall be uniform and as fine as possible but shall

be not more than 1.5 mm thick on the exposed face. Beyond the depth of 6 mm from face, the thickness of joints shall increase in an inverted V shape so as to give good mortar bond between two stones. The inverted portion of the joints shall be filled with bedding mortar and the face 6 mm portion with pointing mortar.

Curing

The work shall be kept constantly moist on all faces for a period of atleast seven days.

Finishing

After the marble work is cured, it shall be rubbed with carborandum stone of different grades no. 60, 120 and 320 in succession or with electrical rubbing machines rubbed with carborandum items 0 to 6 nos.in succession, so as to give a plane true and highly smooth surface. It shall then be cleaned with a solution of oxalic acid, washed and finished clean.

Protection

Green work shall be protected from rain by suitable coverings. The work shall also be suitably protected from damage during construction.

Scaffolding

Double scaffolding having two sets of vertical supports shall be provided where necessary. The supports shall be sound and strong, tied together by horizontal pieces over which the scaffolding plank shall be fixed.

WALL LINING/VENEER WORK

Unless and otherwise specified in the nomenclature of the item, the marble slabs used for wall lining/veneer work shall be gang saw cut (polished & machine cut) and conform to dimensions given in Table 8.1 above.

Back shall not be polished/ cut in order to ensure a good grip with the hearting of backing. The cut slabs shall be of the thickness as specified with a tolerance permissible under para 8.2 above. The tolerance in wall lining when straight edge of 3 m length is placed should not be more than 2 mm.

Laying

The stone shall be wetted before laying. They shall then be fixed with mortar in position without the use of chips or under pinning of any sort. Care shall be taken to match the grains of veneer work. For purpose of matching the grains, the marble slabs shall be selected judiciously having uniform pattern of veins/streaks. Preferably the slabs shall be those got out of the same block from the quarry. The area to be veneered shall be reproduced on the ground and the marble slabs laid in position and arranged in the manner to give the desired matching of grains. Any adjustment needed for achieving the best results shall be then carried out by replacing or interchanging the particular slabs. Special care shall be taken to achieve the continuity of grains between the two slabs one above the other along the horizontal joints.

For the facing of the columns also the same procedure as mentioned above shall be followed.

Where so desired, the adjoining stones shall be secured to each other by means of copper pins 75 mm long and 6 mm diameter or as specified.

Marble/Granite Slab Urinal Partitions

The partitions shall be of marble/granite slab embedded in the wall. The size and shape of the marbles slab. The finished thickness shall be 18 mm. The specifications for marble/granite stone work, in general, shall be as specified. The marble granite stone shall be cut into slabs of required thickness and shall be one piece.

Finishing

The partition of the slab to be embedded in the masonry shall be rough dressed. Dressing and rubbing of the exposed portion of the slab shall be as described. The dressed slab shall be of the thickness as specified with a tolerance of + 1.5mm.

Fixing

Shall be as specified except that the recess shall be 7.5 cm wide. Fixing shall be done by cutting chase with chase cutter/fine tools in a recess of 7.5 cm X 7.5 cm filled with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 6mm nominal size). Fixing can also be done by epoxy grout in a chase of 2.0 X 7.5 cm.

CERAMIC TILES IN SKIRTING AND DADO

The tiles shall be of approved make and shall generally conform to IS 15622. The tiles shall be pressed ceramic covered by a glaze thoroughly matured and fitted to the body. The tiles shall be sound, true to shape, flat and free from flaws and other manufacturing defects affecting their utility.

The top surface of the tiles shall be glazed. The underside of the tiles shall not have glaze on more than 5% of the area in order that the tile may adhere properly to the base. The edges of the tiles shall be free from glaze, however, any glaze if unavoidable shall be permissible on only up to 50 per cent of the surface area of edges.

The glaze shall be free from welts, chips, craze, specks, crawling or other imperfections detracting from the appearance when viewed from a distance of one meter. The glaze shall be either glossy or matt as specified. The glaze shall be white in colour except in the case of coloured tiles when colours shall be specified by the SBI/ PMC / Engineer in charge. There may be more than one colour on a tile.

Dimensions and Tolerances

Glazed pressed ceramic tiles shall be made square or rectangular in sizes Table 1, 3, 5 & 7 of IS 15622 give the modular sizes and table 2, 4, 6 & 8 of IS 15622 gives the sizes of non-modular tiles. The tiles shall conform to IS 15622 for dimensional tolerance, physical and chemical properties.

Half tiles for use as full tiles shall have dimensions which shall be such as to make the half tiles when jointed together (with 1 mm joint) match with dimensions of full tiles. Tiles may be manufactured in sizes other than those specified above.

The thickness of the tiles shall be 5 mm or 6 mm or as specified.

The dimensions of fittings associated with the glazed tiles namely cover base, round edge tile, angles corner cups, ridge and legs, cornices and capping beads shall be of the shape and dimensions as required and the thickness of fittings shall be the same

as the thickness of tiles given above.

Preparation of Surfaces

The joints shall be raked out to a depth of at least 15 mm in masonry walls.

In case of concrete walls, the surface shall be hacked and roughened with wire brushes. The surface shall be cleaned thoroughly, washed with water and kept wet before skirting is commenced.

Laying

12 mm thick plaster of cement mortar 1:3 (1 cement: 3 coarse sand) mix of as specified shall be applied and allowed to harden. The plaster shall be roughened with wire brushes or by scratching diagonal at closed intervals.

The tiles should be soaked in water, washed clean, and a coat of cement slurry applied liberally at the back of tiles and set in the bedding mortar. The tiles shall be tamped and corrected to proper plane and lines. The tiles shall be set in the required pattern and jointed. The joints shall be as fine as possible. Top of skirting or dado shall be truly horizontal and joints truly vertical except where otherwise indicated. Odd size/cut size of tile shall be adjusted at bottom to take care of slope of the flooring.

Skirting and dado shall rest on the top of the flooring. Where full size tiles cannot be fixed these shall be cut (sawn) to the required size and their edges rubbed smooth. Skirting /dado shall not project from the finished “surface of wall” by more than the tile thickness, undulations if any shall be adjusted in wall.

Curing and Finishing

The joints shall be cleaned off the grey cement grout with wire/coir brush or trowel to a depth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigments if required to match the colour of tiles. The work shall then be kept wet for 7 days.
After curing, the surface shall be washed and finished clean. The finished work shall not sound hollow when tapped with a wooden mallet.

GRANITE IN SKIRTING AND DADO

The granite shall be provided and installed for use in counters, window sills, skirting, and lift facias, ensuring precise measurements, high-quality finishes, and a durable, aesthetically pleasing result in accordance with the approved color, texture, and design specifications.

Providing and fixing 18 mm thick gang saw cut, mirror polished, premoulded and prepolished, machine cut for kitchen platforms, vanity counters, window sills, facias and similar locations of required size, approved shade, colour and texture laid over 20 mm thick base cement mortar 1:4 (1 cement : 4 coarse sand), joints treated with white cement, mixed with matching pigment, epoxy touch ups, including rubbing, curing, moulding and polishing to edges to give high gloss finish etc. complete at

Providing edge moulding to 18 mm thick marble stone counters, Vanities etc., including machine polishing

to edge to give high gloss finish etc. complete as per design approved by SBI/ PMC / Engineer in charge. fixing marble /granite stone, over and above corresponding basic item, in facia and drops of width upto 150 mm with epoxy resin based adhesive, including cleaning etc. complete. Extra for providing opening of required size & shape for wash basin/ kitchen sink in kitchen platform, vanity counter and similar location in marble/ Granite/ stone work, including necessary holes for pillar taps etc. including moulding, rubbing and polishing of cut edges etc. complete.

1. Preparation and Procurement:
    - Granite Selection: Choose the 18 mm thick granite slabs based on the approved color, shade, and texture as per the design requirements. Ensure the granite is gang saw cut, mirror polished, premoulded, and prepolished.
    - Site Measurement: Accurately measure the required sizes and dimensions for the kitchen platforms, vanity counters, window sills, facias, and similar locations.
2. Surface Preparation:
    - Cleaning the Substrate: Ensure the surface where the granite will be fixed (such as the base slab, wall, or counter) is clean, dry, and free from any debris, dust, or grease.
    - Preparing the Cement Mortar: Prepare a 20 mm thick base cement mortar mix with a ratio of 1 part cement to 4 parts coarse sand. Mix thoroughly to ensure an even consistency.
3. Laying of Cement Mortar:
    - Application: Spread the prepared cement mortar uniformly on the surface where the granite will be fixed. Ensure the mortar layer is level and smooth.
    - Positioning the Granite: Carefully position the granite slabs over the mortar base, ensuring proper alignment and spacing between slabs for joints.
4. Granite Fixing:
    - Pressing and Securing: Gently press the granite slabs into the mortar bed, ensuring that they adhere firmly without any voids. Use a rubber mallet to tap the slabs into place and ensure good contact with the mortar.
    - Joint Treatment: After placing the granite, the joints between the slabs should be treated with white cement mixed with a matching pigment to blend with the granite color. This helps ensure a seamless and aesthetically pleasing joint appearance.

5. Finishing the Edges:
    - Edge Moulding: Mould the edges of the granite slabs to the desired shape and finish. The edges should be smooth and uniform.
    - Polishing the Edges: Polish the edges of the granite to a smooth, high-gloss finish, ensuring they are free from any sharpness or roughness.
6. Epoxy Touch-Ups:
    - Touch-Up Application: Any minor surface imperfections or joint gaps should be filled with an epoxy-based filler for a smooth and flawless surface. After filling, allow it to cure as per the manufacturer's instructions.
    - Polishing After Touch-Ups: Once the epoxy is fully cured, the surface should be rubbed and polished to a high-gloss finish, matching the existing granite surface.
7. Curing:
    - Curing the Mortar: Allow the mortar base to cure for at least 24-48 hours before further work is carried out to ensure the mortar has hardened and bonded properly with the granite.
8. Final Polishing:
    - Final Touch: After the mortar and epoxy curing process, the entire surface of the granite should be polished once more to achieve a high-gloss, mirror-like finish.

- Cleaning: Clean the entire area to remove any dust, debris, or excess cement. Ensure the granite is completely dry and spotless.

9. Inspection and Handover:
   - Quality Check: Perform a thorough inspection to ensure that all granite surfaces are properly fixed, polished, and finished. Check for uniformity in color, texture, and overall appearance.
   - Final Approval: Once the installation is complete and all standards are met, hand over the project for final approval. Ensure that all surfaces are aesthetically pleasing and structurally sound.

This methodology ensures that the granite is properly fixed and finished with a high-quality, durable result, suitable for kitchen platforms, vanity counters, window sills, facias, and similar applications.

OTHER SPECIFICATIONS:

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications

7 WALL FINISHES & PAINTING:

EXTENT AND INTENT

The Contractor shall furnish all materials, labour, scaffolding, equipment, tools, plant and incidentals necessary and required for the completion of all plaster and wall finishes. The Contractor shall be responsible to take proper precautions to protect already installed work from damage.

GENERAL

Plaster as herein specified shall be applied to all internal and external surfaces where called for. Glazed tile dado, Stone dado, and other wall finishes are to be provided as per schedules. Areas called for on drawings and typical shall be considered to apply to appropriate, adjoining areas whether shown on same drawings or not and whether indicated or not. All plaster work and other wall finishes shall be executed by skilled workmen in a workmanlike manner and shall be of the best workmanship.

PLASTER WORK

The primary requirements of the plaster work shall be to provide an absolutely water tight enclosures, dense, smooth and hard and devoid of cracks on the interior and exterior. The Contractor shall do all that is necessary to ensure this result. All plastering shall be finished to true plane, without imperfections and square with adjoining work and shall form proper foundations for finishing materials such as paint etc.

Masonry and concrete surfaces to which plaster is to be applied shall be clean, free from efflorescence, damp and sufficiently rough and keyed to ensure proper bond.

Wherever directed all joints between concrete frames and masonry in-filling shall be expressed by a groove cut in the plaster. Said groove to exactly coincide with the joint beneath.

Where grooves are not called for the joints between concrete members and masonry in-filling shall be covered by 245 gauge galvanised chicken mesh strips 40mm wide or as shown, installed before plastering.

CEMENT PLASTER

The cement plaster shall be 12 mm, 15 mm or 20 mm thick as specified in the item.

Scaffolding

For all exposed brick work or tile work double scaffolding independent of the work having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with

horizontal pieces over which scaffolding planks shall be fixed. For all other work in buildings, single scaffolding shall be permitted. In such cases the inner end of the horizontal scaffolding pole shall rest in a hole provided only in the header course for the purpose. Only one header for each pole shall be left out. Such holes for scaffolding shall, however, not be allowed in pillars/columns less than one metre in width or immediately near the skew backs of arches. The holes left in masonry works for scaffolding purposes shall be filled and made good before plastering.

Note : In case of special type of brick work, scaffolding shall be got approved from Engineer-incharge

in advance.

Preparation of Surface

The joints shall be raked out properly. Dust and loose mortar shall be brushed out. Efflorescence if any shall be removed by brushing and scrapping. The surface shall then be thoroughly washed with water, cleaned and kept wet before plastering is commenced. In case of concrete surface if a chemical retarder has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that none of the retarders is left on the surface.

Mortar

The mortar of the specified mix using the type of sand described in the item shall be used. It shall be as specified in Subhead 3.0. For external work and under coat work, the fine aggregate shall conform to grading IV. For finishing coat work the fine aggregate conforming to grading zone V shall be used.

Application of Plaster

Ceiling plaster shall be completed before commencement of wall plaster.

Plastering shall be started from the top and worked down towards the floor. All putlog holes

shall be properly filled in advance of the plastering as the scaffolding is being taken down. To ensure even thickness and a true surface, plaster about 15 × 15 cm shall be first applied, horizontally and vertically, at not more than 2 metres intervals over the entire surface to serve as gauges. The surfaces of these gauged areas shall be truly in the plane of the finished plaster surface. The mortar shall then be laid on the wall, between the gauges with trowel. The mortar shall be applied in a uniform surface slightly more than the specified thickness. This shall be brought to a true surface, by working a wooden straight edge reaching across the gauges, with small upward and side ways movements at a time. Finally the surface shall be finished off true with trowel or wooden float according as a smooth or a sandy granular texture is required. Excessive troweling or over working the float shall be avoided.

All corners, arrises, angles and junctions shall be truly vertical or horizontal as the case may be and shall be carefully finished. Rounding or chamfering corners, arrises, provision of grooves at junctions etc. where required shall be done without any extra payment. Such rounding, chamfering or grooving shall be carried out with proper templates or battens to the sizes required.

When suspending work at the end of the day, the plaster shall be left, cut clean to line both horizontally and vertically. When recommencing the plastering, the edge of the old work shall be scrapped cleaned and wetted with cement slurry before plaster is applied to the adjacent areas, to enable the two to properly join together. Plastering work shall be closed at the end of the day on the body of wall and not nearer than 15 cm to any corners or arrises. It shall not be closed on the body of the features such as plasters, bands and cornices, nor at the corners of arrises. Horizontal joints in plaster work shall not also occur on parapet tops and copings as these invariably lead to leakages. The plastering and finishing shall be completed within half an hour of adding water to the dry mortar. No portion of the surface shall be left out initially to be patched up later on. The plastering and finishing shall be completed within half an hour of adding water to the dry mortar.

Thickness

Where the thickness required as per description of the item is 20 mm the average thickness of the plaster shall not be less than 20 mm whether the wall treated is of brick or stone. In the case of brick work, the minimum thickness over any portion of the surface shall be not less than 15 mm while in case of stone work the minimum thickness over the bushings shall be not less than 12 mm.

Curing

Curing shall be started as soon as the plaster has hardened sufficiently not to be damaged when watered. The plaster shall be kept wet for a period of at least 7 days. During this period, it shall be suitably protected from all damages at the contractor's expense by such means as the SBI/ PMC / Engineer in charge may approve. The dates on which the plastering is done shall be legibly marked on the various sections plastered so that curing for the specified period thereafter can be watched.

13.1.7 Finish The plaster shall be finished to a true and plumb surface and to the proper degree of smoothness as required. The work shall be tested frequently as the work proceeds with a true straight edge not less than 2.5 m long and with plumb bobs. All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb bob as the work proceeds.

13.1.8 Precaution Any cracks which appear in the surface and all portions which sound hollow when tapped, or are found to be soft or otherwise defective, shall be cut out in rectangular shape and redone as directed by the SBI/ PMC / Engineer in charge.

(i) When ceiling plaster is done, it shall be finished to chamfered edge at an angle at its junction with a suitable tool when plaster is being done. Similarly when the wall plaster is being done, it shall be kept separate from the ceiling plaster by a thin straight groove not deeper than 6 mm drawn with any suitable method with the wall while the plaster is green. (ii) To prevent surface cracks appearing between junctions of column/beam and walls, 150 mm widechicken wire mesh should be fixed with U nails 150 mm centre to centre before plastering the junction. The plastering of walls and beam/column in one vertical plane should be carried out in

one go. For providing and fixing chicken wire mesh with U nails payment shall be made separately.

Measurements

Length and breadth shall be measured correct to a cm and its area shall be calculated in square metres correct to two places of decimal. Thickness of the plaster shall be exclusive of the thickness of the key i.e. grooves, or open joints in brick work.

The measurement of wall plaster shall be taken between the walls or partitions (the dimensions

before the plaster shall be taken) for the length and from the top of the floor or skirting to the ceiling for the height. Depth of coves or cornices if any shall be deducted.

The following shall be measured separately from wall plaster.

(a) Plaster bands 30 cm wide and under

(b) Cornice beadings and architraves or architraves moulded wholly in plaster.

(c) Circular work not exceeding 6 m in radius.

Plaster over masonry pilasters will be measured and paid for as plaster only.

A coefficient of 1.63 shall be adopted for the measurement of one side plastering on honey comb

work having 6 x 10 cm. opening.

Moulded cornices and coves.

(a) Length shall be measured at the centre of the girth.

(b) Moulded cornices and coves shall be given in square metres the area being arrived at by multiplying length by the girth.

(c) Flat or weathered top to cornices when exceeding 15 cm in width shall not be included in the girth

but measured with the general plaster work.

(d) Cornices which are curved in their length shall be measured separately. Exterior plastering at a height greater than 10 m from average ground level shall be measured separately in each storey height. Patch plastering (in repairs) shall be measured as plastering new work, where the patch exceed 2.5 sqm. extra payment being made for preparing old wall, such as dismantling old plaster, raking out the joints and cleaning the surface. Where the patch does not exceed 2.5 sqm in area it shall be measured under the appropriate item under sub head 'Repairs to Buildings.'

Deductions in measurements, for opening etc. will be regulated as follows:

(a) No deduction will be made for openings or ends of joists, beams, posts, girders, steps etc. upto 0.5 sqm in area and no additions shall be made either, for the jambs, soffits and sills of such openings.The above procedure will apply to both faces of wall.

(b) Deduction for opening exceeding 0.5 sqm but not exceeding 3 sqm each shall be made for reveals,

jambs, soffits sills, sills, etc. of these openings.

(i) When both faces of walls are plastered with same plaster, deductions shall be made for one face only.

(ii) When two faces of walls are plastered with different types of plaster or if one face is plastered and other is pointed or one face is plastered and other is unplastered, deduction shall be made from the plaster or pointing on the side of the frame for the doors, windows etc. on which width of reveals is less than that on the other side but no deduction shall be made on the other side. Where width of reveals on both faces of wall are equal, deduction of

50% of area of opening on each face shall be made from area of plaster and/or pointing as the case may be.

(iii) For opening having door frame equal to or projecting beyond thickness of wall, full deduction for opening shall be made from each plastered face of wall.

(c) For opening exceeding 3 sqm in area, deduction will be made in the measurements for the full opening of the wall treatment on both faces, while at the same time, jambs, sills and soffits will bemeasured for payment.

In measuring jambs, sills and soffits, deduction shall not be made for the area in contact with the frame of doors, windows etc.

CEMENT PLASTER WITH A FLOATING COAT OF NEAT CEMENT

The cement plaster shall be 12, 15 or 20 mm thick, finished with a floating coat of neat cement, as described in the item.

Specifications for this item of work shall be same as described in 13.1 except for the additional floating coat which shall be carried out as below.

When the plaster has been brought to a true surface with the wooden straight edge it shall be uniformly treated over its entire area with a paste of neat cement and rubbed smooth, so that the whole surface is covered with neat cement coating. The quantity of cement applied for floating coat shall be 1 kg per sqm. Smooth finishing shall be completed with trowel immediately and in no case later than half an hour of adding water to the plaster mix.

WHITE WASHING WITH LIME

Scaffolding

Wherever scaffolding is necessary, it shall be erected on double supports tied together by horizontal pieces, over which scaffolding planks shall be fixed. No ballies, bamboos or planks shall rest on or touch the surface which is being white washed.

For all exposed brick work or tile work, double scaffolding having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed.

Note: In case of special type of brick work, scaffolding shall be got approved from Engineer-in-Charge in advance.

Where ladders are used, pieces of old gunny bags shall be tied on their tops to avoid damage or scratches to walls.

For white washing the ceiling, proper stage scaffolding shall be erected.

Preparation of Surface

Before new work is white washed, the surface shall be thoroughly brushed free from mortar droppings an foreign matter.

Preparation of Lime Wash

The lime wash shall be prepared from fresh stone white lime (Narnaul or Dehradun quality). The lime shall be thoroughly slaked on the spot, mixed and stirred with sufficient water to make a thin cream. This shall be allowed to stand for a period of 24 hours and then shall be screened through a clean coarse cloth. 40 gm of gum dissolved in hot water, shall be added to each 10 cubic dicimetre of the cream. The approximate quantity of water to be added in

making the cream will be 5 litres of water to one kg of lime.

Indigo (Neel) upto 3 gm per kg of lime dissolved in water, shall then be added and stirred well. Water shall then be added at the rate of about 5 litres per kg. of lime to produce a milky solution.

Application

The white wash shall be applied with moonj brushes to the specified number of coats. The operation for each coat shall consist of a stroke of the brush given from the top downwards, another from the bottom upwards over the first stroke, and similarly one stroke horizontally from the right and another from the left before it dries.

Each coat shall be allowed to dry before the next one is applied. Further each coat shall be inspected and approved by the SBI/ PMC / Engineer in charge before the subsequent coat is applied. No portion of the surface shall be left out initially to be patched up later on.

For new work, three or more coats shall be applied till the surface presents a smooth and uniform finish through which the plaster does not show. The finished dry surface shall not show any signs of cracking and peeling nor shall it come off readily on the hand when rubbed.

Protective Measures

Doors, windows, floors, articles of furniture etc. and such other parts of the building not to be white washed, shall be protected from being splashed upon. Splashings and droppings, if any shall be removed by the contractor at his own cost and the surfaces cleaned. Damages if any to furniture or fittings and fixtures shall be recoverable from the contractor.

Measurements

Length and breadth shall be measured correct to a cm. and area shall be calculated in sqm correct to two places of decimals.

Measurements for Jambs, Soffits and Fills etc. for openings shall be as described in 13.1.9.

Corrugated surfaces shall be measured flat as fixed and the area so measured shall be increased by the following percentages to allow for the girthed area. Corrugated non-asbestos cement sheet 20% Semi corrugated non-asbestos cement sheet 10%

Cornices and other such wall or ceiling features, shall be measured along the girth and included in the measurements.

The number of coats of each treatment shall be stated. The item shall include removing nails, making good holes, cracks, patches etc. not exceeding 50 sq. cm. each with material similar in composition to the surface to be prepared.

SATNA LIME WASHING

Satna lime wash shall be used as a base coat where so specified. The specifications for ‘white washing with lime’ shall apply except that Satna or Katni quality lime shall be used in place of Narnaul or Dehradun quality lime and the wash will be mixed to a thicker consistency.

WHITE WASHING WITH WHITING

Preparation of Mix

Whiting (ground white chalk) shall be dissolved in sufficient quantity of warm water and thoroughly stirred to form a thin slurry which shall then be screened through a clean coarse cloth. Two kg of gum and 0.4 kg of copper sulphate dissolved separately in hot water shall be added for every cum of the slurry which shall then be diluted with water to the consistency of milk so as to make a wash ready for use.

PAINTING

EXTENT AND INTENT

The contractor shall supply all materials, labour, tools, ladders, scaffolding and other equipment necessary for the completion and protection of all painting work. Painting, as herein specified shall be applied to all surfaces requiring painting throughout the interior and exterior of the buildings as given in the schedule of finishes or elsewhere. The painting shall be carried out by a specialist, approved by the Consultant.

STORAGE

Storage of materials to be used on the job shall be only in a single place. Such storage place shall not be located within any of the buildings included in the contract.

MATERIALS

Materials used in the work shall be of manufacture approved. Ready mixed paints, varnishes, enamels, lacquers, stains, paste fillers, distempers and other materials must be delivered to the job site in the original containers, with the seals unbroken and labels intact. Each container shall give the manufacturer's name, type of paint, colour of paint and instructions for reducing. Thinning shall be done only in accordance with directions. Remove rejected materials immediately from the premises.

COLOUR

All colours, as provided in the colour schedule. The contractor shall as far as possible use pre-mixed manufacturer's colours and shall prepare painted samples of the colours selected. No work is to proceed until the Consultant has given his approval, preferably in writing, of the colour samples.

COMMENCEMENT OF WORK

Painting shall not be started until the surfaces to be painted are in a condition fit to receive painting.

Painting work shall be taken in hand only after all other builders work is completed.

Buildings where painting work is to be commenced shall be thoroughly swept and cleaned up before commencement of painting.

SCAFFOLDING

Only double scaffolding having two sets of vertical supports shall be provided for all painting work. The supports shall be tied together with horizontal pieces over which the scaffolding planks shall

be fixed.

All the vertical and horizontal members of the scaffolding shall be placed sufficiently away from the surfaces to be painted to ensure proper and uninterrupted application.

WORKMANSHIP

The workmanship shall be of the very best, all materials evenly spread and smoothly flowed as without runser sags, using good quality tools, brushes, etc., as required. Only skilled painters shall be employed. A properly qualified foreman shall be constantly on the job whilst the work is proceeding. All surfaces to be painted shall be cleaned free of all loose dirt and dust before painting is started. All work where a coat of material has been applied must be inspected and approved before application of the succeeding specified coat. Each undercoat shall be distinct shade of the approved colour.

Before painting, remorse hardware, accessories, plates and similar items or provide sample protection to all such items. Upon completion of each space, replace all fixtures removed. Remove doors if necessary to paint bottom edge. Use only skilled mechanics for the removal and replacement of above items.

CONCEALED SURFACES

All interior and exterior trim, door frames, doors, shelving, cabinet work shall be thoroughly and carefully back painted as all surfaces and edges which will be concealed when installed. Such surfaces shall be clean, dry, sanded and properly prepared to receive the paint. Tops, bottom and edges of doors shall be finished same as the rest of the door.

PROTECT AND CLEAN

Contractor shall protect not only his own work at all times, but shall also protect all adjacent work and materials by suitable covering during progress of his work. Upon completion of his work, he shall remove all paint and varnish spots from floors, glass and other surfaces. Any defaced surfaces shall be cleaned and the original finish restored. He shall remove from the premises all rubbish and accumulated material and shall leave the work in clean, orderly and acceptable conditions.

PREPARATION OF SURFACES

WOOD: Sand paper to a smooth even surface and then dust off and wipe clean. Touch up all knots and pit pockets with shellac on interior wood and without desealer on exterior work. After priming coat has been applied thoroughly fill all nail holes, irregularities and cracks. Use plaster wood filler for stained or natural finish and putty for painted work.

PLASTER WORK:

Fill all holes, cracks and abrasions with plaster of paris, properly prepared and applied and smoothed off to match adjoining surfaces. Do not use sand paper on plaster surfaces. Plaster shall be allowed to dry for at least 12 (twelve) weeks before the application of paint.

STEEL AND IRON:

All surfaces shall be washed with mineral spirits to remove any dirt or grease before applying paint. Where rust or scale is present, it shall be wire brushed and sand papered clean. All cleaned surfaces shall be given one coat of approved phosphate before prime coat in accordance with the manufacturer's instructions. Shop coats of paint that have become marred shall be cleaned off,

wire brushed, and spot primed over the affected areas.

GALVANISED METAL :

Galvanised metal shall be thoroughly cleaned with naphta and treated with a solution consisting of 5 gallons of 36% accetic acid, 1.36 kg of blue vitriol and 1.36 kg of powdered alum dissolved in 225 litres of water, prepared in a wooden container and applied with a brush. Allow to dry thoroughly and brush off before applying paint.

APPLICATION

The paint shall be continuously stirred in the container so that its consistency is kept uniform throughout.

The painting shall be laid on evenly and smoothly by means of crossing and laying off, the latter in the direction of the grain of the wood. The crossing and laying off consists of covering the area with paint, brushing the surface hard for the first time and then brushing alternatively in opposite directions, two or three times and then finally brushing lightly in a direction at right angles to the same. In this process no brush marks shall be left after the laying-off is finished. The full process of crossing and laying off will constitute one coat.

Where so stipulated, the painting shall be carried out using spray machines suited for the nature and location of the work to be carried out. Only skilled and experienced workmen shall be employed for this class of work. Paints used shall be brought to the requisite consistency by adding a suitable thinner. Spraying shall be carried out only in dry conditions. No exterior painting shall be done in damp foggy or rainy weather. Surface to be painted shall be clean, dry, smooth and adequately protected from dampness. Each coat shall be applied in sufficient quantity to obtain complete coverage, shall be well brushed and evenly worked out over the entire surface and into all corners, angles and crevices allowed to thoroughly dry. Second coat shall be of suitable shade to match final colour, and shall be approved by the Consultant before final coat is started. Allow at least 48 hours drying time between coats for interior and 7 days for exterior work, and if in the judgments of the Consultant more time is required it shall be allowed. Finished surfaces shall be protected from dampness and dust until completely dry. Finished work shall be uniform, of approved colour, smooth and free from runs, sags, defective brushing and clogging. Make edges of paints adjoining other materials of colours sharp and clean, without overlapping.
In order to achieve a superior finished surface, putty paste fillers shall be used on, all surfaces to be painted, to fill pores, dents, etc. The putty/paste fillers shall be approved quality and manufacture and shall be applied to the surface with a knife or other sharp edged tools after the priming coat as well as after each undercoat. The surface, after filling with putty/paste filler, shall be rubbed down with fine sand paper and dusted off before the application of the subsequent coat.

Paste wood filler. When set, shall be wiped across the grains of the wood and then with the grain to secure a clean surface. Surface to be stained shall be covered with a uniform coat of stain wiped off if required.

FINISH:

The painted surfaces shall be finished to required texture. Matt finish shall be achieved by use of sponge rollers or stippling brushes as called for.

TYPES OF PAINT FINISHES

Enamel Paint:

a) **Wood or Plastered Surfaces**: Pigmented priming coat followed by one undercoat and two more finishing coats of enamel paint. Paste filler to be applied after every coat excepting the final finishing coat and sanded.

b) **Non-Galvanized Steel Surfaces**: Coat of red oxide primer after phosphating followed by the three or more coats of synthetic enamel paint. Paste filler to be applied after every coat excepting final finishing coat and sanded.

c) **Galvanized Steel Surfaces**: Priming coat of galvanized metal primer after washing with galvanized metal cleaner, followed by three or more coats of synthetic enamel paint. Paste filler to be applied after every coat excepting final finishing coat and sanded.

Plastic Emulsion Paint:

Pigmented priming coat (emulsion thinned with water) followed by three or more finishing coats of plastic emulsion paint. Paste filler to be applied after every coat excepting the final finishing coat and sanded.

Oil Bounded Distemper

Pigmented primer (cement primer) coat followed by three of more finishing coats of oil bound distemper. Paste filler to be applied after every coat excepting the final finishing coat and sanded.

Oiling

Three coats of linseed oil (conforming to IS:75-1950) applied with brushes. Each coat to be applied after the previous coat is thoroughly dried. Grains to be filled with approved powder and surface rubbed smooth before oiling.

SPIRIT POLISHING

Polish: Polishing material shall be prepared by dissolving pure shellac, varying in shade from pale orange to lemon yellow, free from dirt and other materials, in methylated spirit at the rate of 0.15 kg. shellac to 1 liter of spirit. Suitable pigment to achieve the required shade of polish .

Preparation of Surface: The surface, cleaned of all dirt, etc., shall be rubbed down smooth with sand paper and well dusted. Knots if visible shall be covered with a preparation of red lead and glue size laid on while hot. Holes and indentations shall be stopped with glazier's putty. The surface shall then be given a coat of wood filler made by mixing whiting (ground chalk) in methylated spirit at the rate of 1.5 kg of whiting to one liter of spirit. The surface shall again be rubbed down perfectly smooth with fine sand paper and wiped clean.

Application: Three or more coats of polish shall be applied over the above surface, to achieve a finish. The polish shall be applied with a pad of woolen cloth covered by a fine cloth. The pad moistured with polish shall be rubbed hard on the wood surface in a series of overlapping movements, applying the material uniformly over the entire area to give an even finish. Subsequent coats shall be applied in a similar manner after the previous coat is allowed to dry. The finishing shall be done with a fresh piece of clean fine cloth, damped with methylated spirit and applied by light rubbing. The finished surface shall have a uniform texture and high gloss.

WAX POLISHING

Wax polishing shall be done with ready made wax polish of approved brand and manufacture.

Preparation of Surface: The surface to be polished shall have been finished smooth. Knots, cracks and holes on the surface shall be cleaned and filled with wood putty (fine saw dust mixed with bees wax). The fittings when dry shall be rubbed down with a carpenter's file and then the entire surface shall be rubbed down perfectly smooth and wiped clean. In no case shall sand papers be rubbed across the grains so that even fine marks are not seen on the surface.
Application: The polish shall be applied evenly with a clean soft pad of cotton cloth in such a way that the surface is completely and fully covered. The surface is then continuously rubbed for half an hour. When the surface is quite dry a second and third coat shall be applied in the same manner and rubbed continuously until the surface is dry.

The final coat shall then be applied and rubbed for two hours more until the surface has assumed a uniform gloss and is dry, showing no sign of stickiness. The finished surface shall have a uniform glossy finish.

PAINTING OF PLUMBING, HEATING AND ELECTRICAL EQUIPMENT

All exposed unfinished plumbing; heating, electrical equipment shall receive a painted finish as specified above.

CLEANING

All rubbish waste or surplus material shall be removed from time to time, and all wood work, hardware, floors, or other adjacent work shall be cleaned.

All glass throughout shall have all paint or varnish spots and brush marks removed and upon completion of the painting work, shall be washed and polished on both sides. All glass that is scratched and damaged by contractor's work, or while cleaning off the paint from the glass shall be replaced by the contractor at his cost.

Hardware and other unpainted surfaces shall be cleaned using lacquer thinner or paint remover.

The contractor shall apply the final coat of paint to all internal walls and other surfaces just before the expiry of the defects liability period.

Powder coat Paint - Base coat

Powder coating is sprayed with an electrostatic spray gun with a potential difference of about 270 Volts (approx.) after this the subtrait/object is kept in an oven at a temperature of 180 degree C. for 30 minutes.

EXTERIOR PAINTING ON WALL

Material

The paint shall be (Textured exterior paint/Acrylic smooth exterior paint/premium acrylic smooth exterior paint) of approved brand and manufacture. This paint shall be brought to the site of work by the contractor in its original containers in sealed condition. The material shall be brought in at a time in

adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the contractor and the SBI/ PMC / Engineer in charge. The empty containers shall not be removed from the site of work till the relevant item of work has been all completed.

Preparation of Surface

For new work, the surface shall be thoroughly cleaned off all mortar dropping, dirt dust, algae, fungus or moth, grease and other foreign matter of brushing and washing, pitting in plaster shall make good, surface imperfections such as cracks, holes etc. should be repaired using white cement. The prepared surface shall have received after inspection before painting is commenced.

Application
Base coat of water proofing cement paint

All specifications in respect of base coat of water proofing cement paint shall be as described under 13.21.

Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its container, when applying also the paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform. Dilution ratio of paint with potable water can be altered taking into consideration the nature of surface climate and as per recommended dilution given by manufacturer. In all cases, the manufacturer's instructions & directions shall be followed meticulously. The lids of paint drums shall be kept tightly closed when not in use as by exposure to atmosphere the paint may thicken and also be kept safe from dust.

Paint shall be applied with a brush on the cleaned and smooth surface. Horizontal strokes shall be given, First and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks.

PAINTING

Scope of work:

The work covered under these specifications consists of furnishing the various types of paints and also the workmanship for these items, in strict compliance with the specifications.

Materials:

Paints, oils varnishes etc. of approved brand and manufacture shall be used. Ready mixed paints as recovered from the manufacturer without any admixture shall be used. If for any reason, thinning is necessary in case of ready mixed paint, the brand of thinner recommended by the manufacturer or as instructed by the SBI/ PMC / Engineer in charge shall be used. Approved paints, oils or varnishes shall be brought to the site of work by the contractor in their original containers in sealed condition.

The contractor shall associate the chemist of paint manufacturers before commencement of work, during and after the completion of work who shall certify the suitability of the surface to receive painting and the paint before use etc.

Commencing Work:

Scaffolding:

Wherever scaffolding is necessary, it shall be erected on double supports ties together by horizontal pieces, over which scaffolding planks shall be fixed. No bellies, bamboos or planks shall rest on or touch the surface which is being painted. Were ladders are used; pieces of old gunny bags shall be ties on their tops to avoid damage or scratches to walls.
For painting of the ceiling, proper stage scaffolding shall be erected.

Preparation of Surface:

The surface shall be thoroughly cleaned. All dirt, rust, scales, smoke and grease shall be thoroughly removed before painting is started. Minor patches if any in plastered / form finished surfaces shall be repaired and finished in line and level in C.M/ 1:1 and cracks and crevices shall be filled with approved filler, to the full satisfaction of the Engineer- In - Charge. The prepared surface shall have received the approval of the SBI/ PMC / Engineer in charge after inspection, before painting is commenced.

Application:

Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its containers. When applying also, the paint shall be continuously stirred in the smaller containers so that consistency is kept uniform.

The external surfaces of the buildings under reference including the R.C.C. Jali, fins and the panels above and the panels above and below the window etc. shall be finished with colours of approved shade. The contractor will make suitable samples at site for approval before taking up the work in hand and they will be allowed to proceed with the work only after getting approval for the same.

The painting shall be laid on evenly and smoothly by means of crossing and laying off, the later in the direction of the grain in case of wood. The crossing and laying off consists of covering the area with paint, brushing the surface hard for the first time and then brushing alternately in opposite directions two or three time and then finally brushing lightly in direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying will constitute one coat.

Where so stipulated, the painting shall be done with spraying. Spray machine used may be (a) a high pressure or (b) a low pressure (large air gap), depending on the nature and location of work to be carried out. Skilled and experienced workmen shall be employed for this class of work. Paints used shall be brought to the requisite consistency by adding a suitable thinner. Spraying should be done only when dry condition prevails.

Each coat shall be allowed to dry cut thoroughly and rubbed smooth before the next coat is applied. This should be facilitated by thorough ventilation.

Each coat except the last coat shall be tightly rubbed down with sand paper or fine pumice stone and cleaned of dust before the next coat is laid.

No left over paint shall be put back into the stock tins. When not in use, containers shall be kept properly closed.

The final painted surface shall present a uniform appearance and no streaks, blisters, hair marks from the brush or clogging of paint puddles in the corners of panels, angles of moldings

etc. shall be left on the work. In case of cement based paints / primers, the absorbent surfaces shall be evenly damped so as to give even suction. In any weather, freshly painted surfaces shall be kept damp for at least two days.

In painting doors and windows, the putty around the glass panes must also be painted, but care must be taken to see that no paint stains etc. are left on the glass. Tops of shutters and surfaces in similar hidden locations shall not be left out while painting. Prospect covers of electrical switch boxes have to be painted from inside by removing them. Care shall be taken while removing them in position after painting with respective approved paints. In painting steel work, special care shall be taken while painting over bolts, nuts, rivets, overlaps etc.

Any damage caused during painting work to the existing works / surfaces shall be made good by the contractor.

Painting, except the priming coat, shall generally be taken in hand after all other builders work, practically finished.

Precautions:

All furniture, lightings, fixture, sanitary, fittings, glazing, floors etc. shall be protected by covering and stains, smears, splashing, if any shall be removed and any damage done shall be made good by the contractor.

PAINTING, PRIMING COAT ON WOOD, IRON OR PLASTERED SURFACES

The primer for wood work, iron work or plastered surface shall be as specified in the description of the Indicative item/specification/drawing.

Primer for wood work / Iron & Steel / Plastered / Aluminium surfaces shall be as specified below:-

Sl.No.	Surfaces	Primer to be used
a)	Wood work (hard and soft wood)	conforming to IS 3536 – 1966
b)	Resinous wood and ply wood	Aluminium Primer
c)	Iron & Steel, aluminium and galvanized steel Work :	Zinc chromate primer conforming to IS 104-1962
d)	Plastered surfaces, cement brick work, Asbestos surfaces for oil bound	Cement primer

The primer shall be ready mixed primer of approved band and manufacture.

Preparation of Surface

Wood work:

The wood work to be painted shall be dry and free from moisture.

The surface shall be thoroughly cleaned. All unevenness shall be rubbed down smooth with sand paper and shall be well dusted. Knots, if any, shall be covered with preparation of red lead made by grinding red lead in water and mixing with strong glue sized and used hot. Appropriate filler material with same shade as paint shall be used where so desired by the SBI/

PMC / Engineer in charge.

The surface treated for knotting shall be dry before painting is applied. After the priming coat is applied, the holes and indentation on the surface shall be stopped with glaziers putty or wood putty (for specifications for glaziers putty and wood putty – refer as mentioned herein before). Stopping shall not be done before the priming coat is applied as the wood will absorb the oil in the stopping and the latter is therefore liable to crack.

Iron and Steel Work:

All rust and scales shall be removed by scrapping or by brushing with steel wire brushes. Hard skin of oxide formed on the surface of wrought iron during rolling which becomes loose by rusting, shall be removed.

All dust and dirt shall be thoroughly wiped away from the surface.

If the surface is wet, it shall be dried before priming coat is undertaken.

Plastered Surface:

The surface shall ordinarily not be painted until it has dried completely. Trial patches of primer shall be laid at intervals and where drying is satisfactory, painting shall be taken in hand. Before primer is applied, holes and undulations, shall be filled up with plaster of Paris / putty and rubbed smooth.

a) Application:

The primer shall be applied with brushes, worked well into the surface and spread even and smooth. The painting shall be done by crossing and laying off as described herein before.

b) Other details:

The specifications for Painting (General) shall hold good so far it is applicable.

FRENCH SPIRIT POLISHING:

a) Polish:

Pure shellac varying from pale orange to lemon yellow colour, free from resin or dirt shall be dissolved in methylated spirit at the rate of 140 gm. of shellac to 1 liter of spirit. Suitable pigment shall be added to get the required shade.

Preparation of surface:

The surface shall be cleaned. All unevenness shall be rubbed down smooth with sand paper and well dusted off. Knots if visible shall be covered with a preparation to red lead and glue size laid on while hot. Holes and indentations on the surface shall be stopped with glaziers putty. The surface shall then be given a coat of wood filler made by mixing whiting (ground chalk) in methylated spirit, the surface shall again be rubbed down perfectly smooth with glass paper and wiped clean.

Application:

The number of coats of polish to be applied shall be as described in the Indicative item/specification/drawing. A pad of wooden cloth covered by fine cloth shall be used to apply the polish and shall be moistened with the polish and rubbed hard on the wood, in a series of overlapping circles applying the mixture sparingly but uniformly over the entire area to give an even level surface. A trace of linseed oil on the face of the pad facilitates this operation. The surface shall be allowed to dry and the remaining coats applied in the same way. To finish off, the pad shall be covered with a fresh piece of clean fine cotton cloth, slightly damped with methylated spirit and rubbed lightly and quickly with circular motions. The finished surface shall have a uniform texture and high gloss.

WHITE WASHING WITH LIME

Preparation of surface:

Before work which is to white washed, the surface shall be thoroughly brushed free from mortar dropping and foreign matter.

Preparation of lime wash:

The wash shall be prepared from fresh lime stone white lime. The lime shall be thoroughly slaked on the spot, mixed and stirred with sufficient water to make a thin cream. This shall be allowed to stand for a period of 24 hours and then shall be screened through a clean coarse cloth. 40 gm. of gum dissolved in hot water or Binder which shall be added to each 10 cubic decimeter of the cream. The approximate quantity of water to be added in making the cream will be 5 liters of water to one kg. of lime. Indigo (Robin Blue) up to 3 gm per kg of lime dissolved in water, shall then be added and wash stirred well. Water shall then be added at the rate of about 5 liters per kg. of lime to produce a milky solution. The lime shall be tested in a chemical laboratory and test certificate submitted, to conform the quality of lime with regard to its physical and chemical properties.

Application of White washing:

The white wash shall be applied with brushes or by spray in the specified number of coats. The operation for each coat in the case of brush application shall consist of a stroke of the brush given from the top downwards, another from the bottom upwards over the first strike, and similarly one stroke horizontally from the right and another from the left before it dries.

Each coat shall be allowed to dry before the next one is applied. No portion of the surface shall be left out initially to be patched up later on.

The finished dry surface shall not show any sign of cracking and peeling nor shall it come off readily on the hand when rubbed.

DISTEMPERING

Acrylic Distemper

As per (IS 428-1969) of approved brand and manufacture, colour and required shade shall be used. The primer where used as on new work shall be cement primer or distemper primer as specified in the Indicative item/specification/drawing. These shall be of the same manufacture as distemper. The distemper shall be diluted with water or any other prescribed thinner in a manner recommended by manufacture. Only quality of distemper required for days work shall be prepared.

Preparation of surfaces

The surface shall be prepared as described herein before for painting work in so far as it is applicable and approved putty / filler shall be applied to the entire area to get uniform and smooth surface before application of primer.

Application

The cement primer or distemper primer shall be applied by brushing and not by spraying. Hurried priming work shall be avoided, particularly on absorbent surfaces. The surfaces shall be finished as uniformly as possible leaving no brush marks, priming coat shall be allowed to dry for at least 48 hours. Before applying distemper, the surface shall be lightly sand prepared to make it smooth for receiving, the oil bound distemper, taking care not to rub out the priming coat. A time interval of at least 24 hours shall be allowed between consecutive coats to permit the proper drying of the preceding coat. Two or more coats of distemper as are found necessary shall be applied over the priming coat to obtain an even shade.

All paints have to be low VOC paints and certificates of the same should be provided by the contractor.

WALL PAINTING WITH PLASTIC EMULSION PAINT

The plastic emulsion paint is not suitable for application on external, wood and iron surface and surfaces which are liable to heavy condensation. These paints are to be used on internal surfaces except wooden and steel.

Plastic emulsion paint as per IS 5411 of approved brand and manufacture and of the required shade shall be used.

Painting on New Surface

The wall surface shall be prepared as specified in 13.31.

Application *:* The number of coats shall be as stipulated in the item. The paint will be applied in the usual manner with brush, spray or roller. The paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hard and the next coat can be applied. The time of drying varies from one hour on absorbent surfaces to 2 to 3 hours on nonabsorbent surfaces.
The thinning of emulsion is to be done with water and not with turpentine. Thinning with water will be particularly required for the under coat which is applied on the absorbent surface. The quantity of water to be added shall be as per manufacturer's instructions.
The surface on finishing shall present a flat velvety smooth finish. If necessary more coats will be applied till the surface presents a uniform appearance.

Precautions
(a) Old brushes if they are to be used with emulsion paints, should be completely dried of turpentine or oil paints by washing in warm soap water.
Brushes should be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the paint from hardening on the brush.
(b) In the preparation of wall for plastic emulsion painting, no oil base putties shall be used in filling cracks, holes etc.
(c) Splashes on floors etc. shall be cleaned out without delay as they will be difficult to remove after hardening.
(d) Washing of surfaces treated with emulsion paints shall not be done within 3 to 4 weeks of application.

Other details shall be as specified in 13.23 as far as they are applicable.

PAINTING WITH SYNTHETIC ENAMEL PAINT
Synthetic enamel paint (conforming to IS 2932) of approved brand and manufacture and of the required colour shall be used for the top coat and an undercoat of ordinary paint of shade to match the top coat as recommended by the same manufacturer as far the top coat shall be used.

Painting on New Surface
Preparation of surface shall be as specified in 13.25.1.1 as the case may be.

Application : The number of coats including the undercoat shall be as stipulated in the item.

(a) Under Coat : One coat of the specified ordinary paint of shade suited to the shade of the

top coat, shall be applied and allowed to dry overnight. It shall be rubbed next day with the finest grade of wet abrasive paper to ensure a smooth and even surface, free from brush marks and all loose particles dusted off.
(b) Top Coat : Top coats of synthetic enamel paint of desired shade shall be applied after the undercoat is thoroughly dry.

STONE BASED TEXTURED PAINT

Weather and Ultravoilet Resistant, Water Repellent, Dust, Dirt and Stain Resistant, Fungus and Algae Resistant natural none pigmented crushed granite Chips (100% natural crushed Granite chips/powder) of approved make with final coat of texture with stone chips (attainable thickness: 0.70 to 0.90mm to offer grooved finish) applied with Spray over a coat of texture without chips (attainable thickness: 0.50 to 0.70mm to offer smooth surface as base coat) over a repair check with exterior grade cement mixed with acrylic primer over a coat of acrylic primer mixed with wall sealer in the ratio of 1:1 complete as approved by SBI/ PMC / Engineer in charge. Finally one coat of water base acrylic protection coat applied with roller and brush to make surface streak resistance.Thickness 1.5- 1.8mm.

100% Natural crushed Granite Spray Thickness 1.25mm- 1.5 mm
Acrylic aggregate textured non pigmented wall finish coating in 100% natural / non pigmented Crushed Granite stone finish as per sample approved by SBI/ PMC / Engineer in charge on the exterior walls of the building.
The first coat shall be of low VOC Acrylic primer mixed with wall sealer (Ratio 1:1)at the rate of 0.15- 0.20 ltr per sqm. The texture material shall be applied at the rate of average 2.0- 2.5 kg / square meter and average 1.25- 1.5 mm thickness on the exterior walls. Any Flaking, Plaster of Paris, Gypsum or other absorbent material surfaces should be brushed and removed. All undulations, broken edges, irregularities should be rectified before application of the textured layer. The textured layer shall be applied in two layers, first with with special plaster spray gun with a pressure 2bhp to achieve a uniform texture and the second coat with same process as repeat & Finishing walls with a clear coat in two coats that incorporate hitech-fluorocarbon resin which act as protective shield against ultraviolet rays , it will further enhance & protect all surface coating as recommended by the manufacturer and as per the direction of SBI/ PMC / Engineer in charge. as per the approved sample complete to the satisfaction of SBI/ PMC / Engineer in charge upto all floor height levels as per drawings.

Application Process

1. Applying Priming coat of acrylic Primer mixed with wall sealer & water in the ratio of (1:1).
2. Repair check of plaster surface with Exterior grade cement mixed with Primer.
3. One coat of sealent in approved shade for masking grooves
4. First coat to obtain highly dense smooth appearance of 0.5 to .7 mm thick by applying over the primer. to be applied with spray / trowel depends upon the surface
5. Second coat of 100% natural crushed granite material 0.8 to .9 mm thick by applying a spray gun with a pressure of 2bhp to achieve desired finish.
6. two coat of water base Protective

TEXTURE PAINT
(Work to be carried out as per Manufacturer Specification)

Material

The paint shall be textured exterior paint of required shade : (Two or more coats applied @ 3.28 ltr/10 sqm) over and including priming coat of exterior primer applied @ 2.20kg/10 sqm) of approved brand and manufacture.

This paint shall be brought to the site of work by the contractor in its original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the contractor and the SBI/ PMC / Engineer in charge. The empty containers shall not be removed from the site of work till the relevant Indicative item/specification of work/drawing has been completed and permission obtained from the SBI/ PMC / Engineer in charge.

Preparation of Surface

For new work, the surface shall be thoroughly cleaned off all mortar dropping, dirt dust, algae, fungus or moth, grease and other foreign matter of brushing and washing, pitting in plaster shall make good, surface imperfections such as cracks, holes etc. should be repaired using white cement. The prepared surface shall have received the approval of the SBI/ PMC / Engineer in charge after inspection before painting is commenced.

Application

Base coat of water proofing cement paint. All specifications in respect of base coat of water proofing cement paint shall be as describe.

Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its container, when applying also the paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform. Dilution ratio of paint with potable water can be altered taking into consideration the nature of surface climate and as per recommended dilution given by manufacturer. In all cases, the manufacturer's instructions & directions of the SBI/ PMC / Engineer in charge shall be followed meticulously.

The lids of paint drums shall be kept tightly closed when not in use as by exposure to atmosphere the paint may thicken and also be kept safe from dust. Paint shall be applied with a brush on the cleaned and smooth surface. Horizontal strokes shall be given, First and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks. The specifications in respect of scaffolding and protective measures shall be as described.

External Texture finish of approved makes as per approved design and pattern. Texture finish shall be applied over the plastered surface with required thickness shall 2 to 2.5 mm thickness to form the necessary approved design by using trowel / putty blade and it should be allowed for drying minimum 12 hrs., before the application of top painting, 2 coats or more of external weather proof water based emulsion shall be applied over this and a coat of primer may be applied based on the approved texture pattern. Including surface preparation like through cleaning, pre wetting & removal of loose mortars, etc.

Painting Steel work

Finishing with Deluxe Multi surface paint system for interiors and exteriors using Primer as per manufacturers specifications : Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/10 Sqm over an under coat of primer applied @ 0.80 ltr/10 Sqm of approved brand and manufacture.

PLASTER OF PARIS PUTTY

Providing and applying plaster of paris putty of 2 mm thickness over plastered surface to prepare the surface even and smooth complete

DELUXE MULTI SURFACE PAINT

Finishing with Deluxe Multi surface paint system for interiors and exteriors using Primer as per manufacturers specifications : Painting wood work with Deluxe Multi Surface Paint of required shade. Two or more coat applied @ 0.90 ltr/10 sqm over an under coat of primer applied @0.75 ltr/10 sqm of approved brand and manufacture

ACRYLIC EMULSION PAINT

Wall painting with acrylic emulsion paint, having VOC (Volatile Organic Compound) content less than 50 grams/ litre, of approved brand and manufacture, including applying additional coats wherever required, to achieve even shade and colour.

ACRYLIC DISTEMPER

Distempering with 1st quality acrylic distemper (ready mixed) having VOC content less than 50 gram/litre, of approved manufacturer and of required shade and colour all complete to achieve even shade and colour:

EPOXY PAINT

Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete.

OIL BOUND WASHABLE DISTEMPER

Distempering with oil bound washable distemper of approved brand and manufacture to give an even shade. New work (Two or more coats applied @ 3.28 ltr/10 sqm) over and including priming coat of exterior primer applied @ 2.20kg/10 sqm

CHICKEN WIRE MESS

Providing & fixing galvanished chicken wire mesh in 125 mm wide strip with average width of aperture 1.18 mm and nominal dia of wire 0.556 mm at acs junctions of R.C.C column, beam with Brick work before plaster work.

QUALITY ASSURANCE

For Quality Assurance the Contractor shall ensure that color and texture of finish coats, shall match the approved sample. Also,

i) Color of priming coat shall be lighter than bodycoat.

ii) Color of body coat shall be lighter than finish coat.

iii) Color prime and body coats as required so as not to show through the finish coat and to mask surface imperfections.

iv) Before starting application of each type of paint, the Contractor shall apply the paint to a specimen area, not to exceed 10 square meter and get finish and texture approved and shall use it as a sample for the remainder of the work.

6.1 Antibacterial Paint

i. The Antibacterial Paint shall be able to provide anti-Microbial Protection:

ii. The scope of work includes providing & applying approved makes anti- Microbial Paint on wall surfaces as per manufacturer's specifications complete in all respect & as directed by PMC/SBI/ PMC / Engineer in charge. Following are the desired characteristic of the paint:

a. The product hygiene coatings to start the biocidal action as soon as the microorganism land on the surface, and prevents the growth of mould, bacteria and yeasts for at least 5 years.

b. The unparalleled durability of hygiene coatings should help to extend the maintenance cycle and to minimize all related material, labour and shut down costs.

c. The hygiene coatings should be highly resistant to abrasives, detergents and weak acids and alkalis used in cleaning regimes. Furthermore, they can be regularly steam cleaned without any loss of performance or adhesion to the substrate.

OTHER SPECIFICATIONS:

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

7.1.1 **Hardware**

a. All hardware for doors and windows shall be of Stainless Steel or as specified. All hardware shall be installed using routers and counter sunk screws. Panic hardware will be provided in all staircase and fire escape doors. Drawer slides with steel roller ball- bearings and drawer locking system with master keying option is to be provided for all built in cabinetry work and drawer units.

b. The Contractor shall procure all the hardware and the fixing shall be done in the best workmanship like manner and in accordance with that employed for fixing hardware.

EXTENT AND INTENT

The intention of the contract is that the building as shown shall be completely equipped with required hardware. Any required item not noted or listed shall be finished in a grade equal to and in harmony with similar item listed.

The contractor shall furnish all labour, materials, tools, appliances and incidentals required to complete the hardware work specified herein or listed in the schedule of hardware, or as may be required by the actual conditions at the building. Include the necessary screws, special screws, bolts, expansion bolts and other devices

necessary shall be of sufficient size to securely and permanently fix the hardware in place. No steel or iron screws shall be used. Screws shall match material and finish of article being fastened.

GENERAL

All hardware shall be of the best quality of its type and strictly in conformity with the materials and finish described in schedule of hardware. If called upon to do so the contractor shall arrange to get hardware specially manufactured to the design, requirements and standards.

SAMPLES

Samples of each different item of hardware including screws or any particular item of hardware shall be submitted for approval.

QUALITY

All hardware shall be of perfect fit, uniform in finish and free from imperfections that affect serviceability or mar the appearance.

INSTALLATION

All hardware shall be installed by skilled workmen, equipped with proper and adequate tools. The hardware shall be installed true, plumb and square in accordance with the hardware schedule and the manufacturer's instructions.

PROTECTION

Hardware shall not be installed earlier than necessary and it shall be the responsibility of the contractor to protect all hardware, removing some when necessary for protection and deliver all in good working order and unblemished. Any defective or marred items shall be made good to the satisfaction

GUARANTEE

The contractor shall be responsible for the proper working of all hardware, for a period of one year from the date of the completion and acceptance of the building.

OTHER SPECIFICATIONS:

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

7.2. WOOD WORK, P.V.C. WORK AND OTHER MISCELLEANIOS WORK

M.S. Tubular frames for doors Materials

Steel door frames shall be manufactured from commercial mild steel sheet of 1.60 mm thickness, conforming to IS 2062 and 4351. Steel door frames shall be made in the profiles as per drawings and/or as directed by the SBI/ PMC / Engineer in charge.

Construction

Each door frame shall consist of hinge jamb, lock jamb, head and if required angle threshold. These shall be welded or rigidly fixed together by mechanical means. Where no angle threshold is

required, temporary base tie shall be screwed to the feet of frames in order to form a rigid unit. Where so specified base ties shall be pressed mild steel 1.60 mm thick adjustable to suit floor thickness of 35 or 40 mm and removable, or alternatively, threshold of mild steel angle of section 50 x 25 mm, minimum shall be provided for external doors frames.

Fabrication

The M.S hollow rectangular steel door frames shall be got fabricated in an approved workshop as approved by the Chief Engineer.

Fixing Lugs :

There shall be three adjustable lugs with split end tail to each jamb. The head of the fixing lug shall be 120 mm long and made up flat steel strip 25 mm wide and 1.60 mm thick.

Hinges :

100 mm mild steel butt hinges shall be used. Floor door frames 80 cm wide and under, three hinges shall be rigidly fixed to one jamb and for frames of door above 80 cm wide, four higes shall be rigidly fixed to one jamb, if it is single shutter. Where the height of door shutter exceeds 2.15 metres, one additional hinge shall be provided for every 0.5 m or part thereof of the additional height.

In all cases the hinges shall be so fixed that the distance from the inside of the head rebate to the top of the upper hinge is 20 cm and the distance from the bottom of the door frame to the bottom of the bottom hinge is also kept about 200 mm. The middle hinges shall be at equal distance from lower and upper hinges or as agreed to between the purchaser and the supplier. Hinges shall be made of steel 2.5 mm thick with zinc coated removable pin of 6 mm diameter. The space between the two leaves of the hinge when closed shall be 3 mm and the leaf that is not welded to the frame shall have four counter sunk holes to take Number-10 cross recessed head wood screws.

Aldrops, Sliding Bolts and Tower Bolts : Provisions shall be made for aldrops, sliding bolts and tower bolts in the frames as per the positions given by the purchaser. Necessary mortar guards/metallic or nylon bushes shall be provided inside the frames for aldrops, sliding bolts and tower bolts.

Lock Strike Plate : Provision shall be made to fix lock stricke plates of mortise locks or latches, complying with the relevant Indian Standards. A slot suitable for lock stricke plate shall be pierced into the rebate of the frame and necessary fixing arrangement and mortar guard from the inside of the frame shall be provided.

Shock Absorbers : For side- hung door there shall be not less than three buffers of rubber or other suitable material inserted in holes in the rebate and one shall be located at the centre of the lock jamb of frame and other two shall be 300 mm from top and bottom of the frame. For double leaf doors two buffers shall be provided.

Finishing

The surface of door frame shall be thoroughly cleaned, free of rust, mill –scale dirt, oil etc. either by mechanical means, for example sand or shot blasting or by chemical means such as picking. After pretreatment of the surface one coat of approved primer i.e. red oxide zinc chrome primer conforming to IS 2074. Two coats of paints as directed by the SBI/ PMC / Engineer in charge shall be applied to the exposed surface.

Fixing Frames shall be fixed up right in plumb and plane. To avoid sag or bow in width during fixing or during construction phase, temporary struts across the width preventing sides bulging inwards may be provided. Wall shall be built solid on each side and grouted at each course to ensure solid contact with frame leaving no voids behind the frame.

Three lugs shall be provided on each jamb with spacing not more than 75 cm the temporary struts should not be removed till the masonry behind the frame is set. In case screwed base tie is provided, this should be left in position till the flooring is laid when it can be removed. After pretreatment of the surface one coat of steel primer and two coats, of paint, as directed by SBI/ PMC / Engineer in charge shall be applied to the exposed surface.

Measurements

The length shall be measured in running metre correct to a cm. along the centre line of the frames.

Teak/Sal Wood Door Frame

Teak Wood (Tectona Grandis):- It is of outstanding merit in retention of shape and durability. The heart wood is one of the most naturally durable woods of the world. It usually remains immune to white ant attack and insect attack for very long
periods. It is, however, not always immune from fungus attack (rot). Taken as a whole, good quality teak is very durable, it is relatively easy to saw and work. It can be furnished to a fare surface and takes polish well. It is generally used for making furniture and all important timber construction. ***Superior Class Teak Wood such as Balarsha, Malabar and Dandeli :*** Individual hard and sound knot shall not be more than 12 mm in diameter and the aggregate area of all the knots shall not exceed one half per cent of the area of the piece. It shall be close grained.

Sal is about 30 per cent heavier than teak, 50 per cent harder, and about 20 to 30 per cent stronger. In shock resistance it is about 45 per cent above teak. Its heart wood is a naturally durable wood, and usually remains immune to attack by white ants and fungi for a long period, while its sapwood is very perishable and should not be used. Well dried sal is not a really easy wood to saw and work. It is a rough constructional wood than a carpentary timber. No individual hard and sound knot shall exceed 25 mm in diameter and the aggregate area of all the knots shall not exceed 1% of the area of the piece.
It can be used for a variety of purposes, such as for beams, rafters, flooring, piles, bridging, tool handles, picker arms and tent pegs , Door Frames, etc.

FLUSH DOOR SHUTTERS

Flush door shutters shall have a solid core and may be of the decorative or non-decorative (Paintable type as per IS 2202 (Part I). Nominal thickness of shutters may be 25, 30 or 35 mm. Thickness and type of shutters shall be as specified.

All four edges of the shutters shall be square. The shutter shall be free from twist or warp in its plane. The moisture content in timbers used in the manufacture of flush door shutters shall be not more than 12 per cent when tested according to IS 1708.

Core

The core of the flush door shutters shall be a block board having wooden strips held in a frame constructed of stiles and rails. Each stile and rail shall be a single piece without any joint. The width of the stiles and rails including lipping, where provided shall not be less than 45 mm and not more than 75 mm. The width of each wooden strip shall not exceed 30 mm. Stiles, rails and wooden strips forming the core of a shutter shall be of equal and uniform thickness. Wooden strips shall be parallel to the stiles.

End joints of the pieces of wooden strips of small lengths shall be staggered. In a shutter, stiles and rails shall be of one species of timber. Wooden strips shall also be of one species only but it may or may not be of the same species as that of the stiles and rails. Any species of timber may be used for core of flush door. However, any non-coniferous (Hard wood) timber shall be used for stiles, rails and lipping.

Face Panel

The face panel shall be formed by gluing, by the hot-press process on both faces of the core, either plywood or cross-bands and face veneers. The thickness of the cross bands as such or in the plywood shall be between 1.0 mm and 3.0 mm. The thickness of the face veneers as such or in the plywood shall be between 0.5 mm and 1.5 mm for commercial veneers and between 0.4 mm and 1.0 mm for decorative veneers, provided that the combined thickness of both is not less than 2.2 mm. The direction of the veneers adjacent to the core shall be at right angles to the direction of the wooden strips. Finished faces shall be sanded to smooth even texture. Commercial face veneers shall conform to marine grade plywood and decorative face veneers shall conform to type I decorative plywood in IS 1328.

Lipping

Lipping, where specified, shall be provided internally on all edges of the shutters. Lipping shall be done with battens of first class hardwood or as specified of depth not less than 25 mm. For double leaved shutters, depth of the lipping at meeting of stiles shall be not less than 35 mm. Joints shall not be permitted in the lipping.

Rebating

In the case of double leaves shutters the meeting of stiles shall be rebated by 8 mm to 10 mm. The rebating shall be either splayed or square type where lipping is provided. The depth of lipping at the meeting of stiles shall not be less than 30 mm.

Opening for Glazing

When required by the purchaser opening for glazing shall be provided and unless otherwise specified the opening for glazing shall be 250 mm in height and 150 mm or 200 mm in width unless directed otherwise. The bottom of the opening shall be at a height of 1.4 m from the bottom of the shutter. Opening for glazing shall be lipped internally with wooden batten of width not less than 25 mm. Opening for glazing shall be provided where specified.

Venetian Opening

Where specified the height of the venetian opening shall be 350 mm from the bottom of the shutter. The width of the opening shall be as directed but shall provide for a clear space of 75 mm between the edge of the door and venetian opening but in no case the opening shall extend beyond the stiles of the shutter. The top edge of the opening shall be lipped internally with wooden battens of width not less than 25 mm. Venetian opening shall be provided where specified or shown in the drawing.

Tolerance

Tolerance on width and height shall be + 3 mm and tolerance on nominal thickness shall be ± 1.2 mm. The thickness of the door shutter shall be uniform throughout with a permissible variation of not more than 0.8 mm when measured at any two points.

Adhesive

Adhesive used for bonding various components of flush door shutters namely, core, core frame, lipping, cross-bands, face veneers, plywood etc. and for bonding plywood shall conform to BWP type, phenol formaldehyde synthetic resin adhesive conforming to IS 848.

Tests

Samples of flush door shutters shall be subjected to the following tests:

(a) End Immersion Test
(b) Knife Test
(c) Glue Adhesion Test

One end of each sample shutter shall be tested for End Immersion Test. Two specimens of 150 x 150 mm size shall be cut from the two corners at the other end of each sample shutter for carrying out Glue Adhesion Test. Knife Test shall be done on the remaining portion of each sample shutter.

TABLE-1
Dimensions and Tolerances of Components of Door Shutters

Sl. No.	Description	Width mm	Thickness mm DOOR SHUTTERS
(a)	Vertical Stile, top and freeze rail	100 ± 3	35 ± 1 or 40 ± 1
(b)	Lock rail	50 ± 3	35 ± 1 or 40 ± 1
(c)	Bottom rail	200 ± 3	35 ± 1 or 40 ± 1
(d)	Muntin	100 ± 3	35 ± 1 or 40 ± 1
(e)	Glazing bar	40 ± 3	35 ± 1 or 40 ± 1

Size and Types : Size and types of the timber panels and glazed shutters shall generally conform to modular sizes specified in Table-2 below.

TABLE-2
Dimension of Door Shutters

Sl. No.	Designation of Doors	Width mm	Height mm
(i)	8DS 20	700	1905 (1945)
(ii)	8DS 21	700	2005 (2045)
(iii)	9DS 20	800	1905 (1945)
(iv)	9DS 21	800	2005 (2045)
(v)	10 DS 20	900	1905 (1945)
(vi)	10 DS 21	900	2005 (2045)
(vii)	12 DT 20	11001)	1905 (1945)
(viii)	12 DT 21	11001)	2005 (2045)

Notes :-

(1) The designation refers to modular sizes of door openings. First number stands for width and the last for height in modules (M = 100 mm). Alphabet D refers to doors, 'S' to single and 'T' to double leaf shutter.
(2) Standard sizes of door frames are covered in IS 4021 and IS 4351.
(3) The standard widths and heights for panel doors are arrived at as shown in Fig. 6 of IS 1003 (Pt. 1).

In case the modular height is taken from the finished floor level, the height of the door shall be the one given in bracket. In the case of double leave shutters, the rebate in the shutter shall be as given in 6.15 of IS 1003 (Pt. 1).

Sample Size

Shutters of decorative and non-decorative type from each manufacturer, irrespective of their thickness, shall be grouped separately and each group shall constitute a lot. The number ofshutters (sample size) to be selected at random from each lot for testing shall be as specified in below Table. If the total number of shutters of each type in a work (and not the lot) is less than twenty five, testing may be done at the discretion of the
shutter provided the sample does not fail in any of the test specified.

For knife test, glue adhesive test, slamming test, the end immersion test, the number of shutters shall be as per col. 4 of below Table.

TABLE
Sample Size and Criteria for Conformity

Lot Size	*Sample Size*	*Permissible no. of defective*	*Sub. Sample size*
[1]	**[2]**	**[3]**	**[4]**
Upto 26 to 50	8	0	1
51 – 100	13	1	2
101 – 150	20	1	2
151 – 300	32	1	3
301 – 500	50	2	4
501 and above	80	2	5

Criteria for Conformity

All the sample shutters when tested shall satisfy the requirements of the tests laid down as specified. The lot shall be declared as conforming to the requirements when numbers of defective sample does not exceed the permissible number given in col. 3 of table above. If the number of sample shutters found unsatisfactory for a test IS one, twice the number of samples initially tested shall be selected and tested for the test. All sample shutters so tested shall satisfy the requirement of the test. If the number of samples found unsatisfactory for a test is two or more, the entire lot shall be considered unsatisfactory.

Fixing

This shall be as per CPWD Specifications.

Shelves

Shelves and vertical partitions of cupboards shall be of timber planks fiber board, particle board, block board or veneered particle board as specified. Thickness and type of planks or boards shall be as specified. Each shelf shall be a single piece and vertical partitions between two consecutive shelves shall be without any joint. Exposed edges of boards having particle board core shall be sealed with 3 mm thick single piece teak

wood strips of width equal to the thickness of board with headless pins. The arrangement of shelves and vertical partitions shall be as per drawings or as directed by the Engineer-in- Charge.

Fixing

Planks for shelves shall be planned on all faces and edges. In case of boards they shall be sawn to the required size truly straight and square. Timber battens 25 x 40 mm unless otherwise specified shall be planed smooth and fixed inside the cupboard with wooden plugs and screws. Shelves shall be fixed to the battens and vertical portions shall be held in position by fixing them to the battens and shelves using screws. Teakwood strips for edge sealing of the boards shall be planed smooth and fixed with headless nails. Tolerance in width shall be ± 1.5 mm and in thickness 1 mm.

Hold Fasts

These shall be made from mild steel flat 40 × 5 mm size conforming to IS 7196 without any burns or dents. 5 cm length of M.S. flat at one end shall be bent at right angle and one hole 11 mm dia shall be made in it for fixing to wooden frame with 10 mm dia nut bolt. The bolt head shall be sunk into the wooden frame, 10 mm deep and plugged with wooden plug. At the other end 10 cm length of the hold fast flat shall be forked and bent of length as specified at right angle in opposite direction and embedded in cement concrete block of size 30 x 10 x 15 cm of mix 1:3:6 (1 cement : 3 coarse sand
: 6 graded stone aggregate, 20 mm nominal size) or as specified.

Fittings

Fitting shall be of mild steel brass, aluminium or as specified. Some mild steel fittings may have components of cast iron. These shall be well made, reasonably smooth, and free from sharp edges and corners, flaws and other defects. Screw holes shall be counter sunk to suit the head of specified wood screws. These shall be of the following types according to the material used.

(a) **Mild Steel Fittings:** These shall be bright finish black stone enameled or copper oxidized (black finish), nickel chromium plated or as specified.

(b) **Brass Fittings:** These shall be finished bright satin finish or nickel chromium plated or copper oxidized or as specified.

(c) **Aluminium Fittings:** These shall be anodized to natural matt finish or dyed anodic coating not less than grade AC 10 of IS 1868.

(d) **Stainless Steel Fittings:** These shall be of SS grade 316.

The fittings generally used for different type of doors and windows are indicative and shall be used as specified. The fittings to be actually provided in a particular work shall, however, be decided by the SBI/ PMC / Engineer in charge.

Screws used for fittings shall be of the same metal, and finish as the fittings. However, chromium plated brass screws or stainless steel screws shall be used for fixing aluminium fittings.

Fittings shall be fixed in proper position as shown in the drawings or as directed by the SBI/ PMC / Engineer in charge. These shall be truly vertical or horizontal as the case may be. Screws shall be

driven home with screw driver and not hammered in. Recesses shall be cut to the exact size and depth for the counter sunking of hinges.

Butt Hinges

These shall be of the following types according to the material used.

(a) Mild steel butt hinges (Medium).
(b) Cast brass butt hinges light/ordinary or heavy.
(c) Extruded aluminium alloy butt hinges.
(d) Stainless steel Grade 316

Mild Steel (Medium): These shall be medium type manufactured from M.S. sheet.
These shall be well made and shall be free from flaws and defects of all kinds. All hinges shall be cut clean and square and all sharp edges and corners shall be removed. These shall generally conform to IS 1341.

Hinge Pin: Hinge pin shall be made of mild steel wire. It shall fit inside the knuckles firmly and riveted head shall be well formed so as not to allow any play or shake, and shall allow easy movement of the hinge, but shall not cause looseness.

Knuckles: The number of knuckles in the hinges of different sizes shall be as per IS 1341. The size of knuckles shall be straight and at right angle to the flap. The movement of the hinges shall be free and easy and working shall not have any play or shake.

Screw Holes*:* The screw holes shall be clean and counter sunk. These shall be suitable for counter sunk head wood screws and of the specified size for different types, and sizes of hinges. The size of the holes shall be such that when it is counter sunk it shall be able to accommodate the full depth of counter sunk head of the wood screws. The nos. of screw holes shall as specified in IS 1341.

Sampling and Criteria for Conformity*:* The number of butt hinges to be selected from a lot shall be depend on size of lot and shall be in accordance with Table below. Butt hinges for testing shall be selected at random from at least 10 per cent of the randomly selected packages subjected to minimum of three equal number of hinges being selected from each package. All butt hinges selected shall be checked for dimensions and tolerance requirements. Defects in manufacture and finish shall also be checked and lot shall be considered conforming to the requirement of this specification, if the number of defective hinges among those tested does not exceed the corresponding number given in Table.

TABLE
Scale of Sampling and Criteria for Conformity

Sl. No.	Lot size	Sample Size	Permissible No. of Defective hinges
1.	Upto 150 5 0	5	0
2.	151 to 300 20 1	20	1
3.	301 to 500 32 2	32	2
4.	501 to 1000 50 3	50	3
5.	1001 and above 80 5	80	5

Cast Brass*:* These shall be light/ordinary or heavy as specified. These shall be well made and shall be free from flaws and defects of all kinds. These shall be finished bright or chromium plated or oxidized or as specified. These shall generally conform to IS 205.

Hinge Pin: Hinge pin shall be made of brass or of stainless steel. The hinge pins shall be firmly riveted and shall be properly finished. The movement of the hinge pin shall be free, easy and square and shall not have any play or shake.

Knuckles: The number of knuckles in each hinge shall not be less than five. The number of knuckles in case of sizes less than 40 mm shall be three. The sides of the knuckles shall be straight and at right angle to the flap. The movement of the hinge pin shall be free and easy and working shall not have any play or shake.

Screw Holes*:* The screw holes shall be clean and counter sunk and of the specified size for different types and size of hinges. The size of the holes shall be such that when it is counter sunk it shall be able to accommodate the full depth of counter sunk head of wood screw specified.

Extruded Aluminium Alloy*:* These shall be manufactured from extruded sections. These shall be well made and free from flaws and defects of all kinds. These shall generally conform to IS 205.

Hinge Pin: Hinge pin shall be made of mild steel (galvanized or aluminium alloy). The aluminium alloy hinge pin shall be anodized. The hinge pin shall be finally riveted and shall be properly finished. The movement of hinges shall be free easy and square and shall not have any play or shake.

Knuckles: Number of knuckles in each hinge pin shall not be less than 5. The number of knuckles in case of sizes less than 40 mm be straight and at right angle to the flap. The movement of the hinge pin shall be free and easy and working shall not have any play or shake.

Screw Holes*:* The screw holes shall be suitable for counter sunk head wood screws, and of specified sizes for different type of hinges. The size of the holes shall be such that when it is counter sunk it shall be able to accommodate the full depth of counter sunk head of wood screw specified.

Sampling and Criteria for Conformity*:* The number of butt hinges to be selected from a lot shall depend on the size of lot and shall be in accordance with below Table. Butt hinges for testing shall be taken at random from at least 10 per cent of the package subject to a minimum of three, equal number of hinges being selected from each package. All butt hinges selected from the lot shall be checked for dimensional and tolerance requirements. Defects in manufacture and finish shall also be checked. A lot shall be considered conforming to the requirements of this specification if the number of defective hinges among those tested does not exceed the corresponding number given in Table.

TABLE
Scale of Sampling and Criteria for Conformity

Sl. No.	*Lot size*	*Sample size*	*Permissible No. of defective hinges*
1	Upto 200	15	0
2	201 to 300	20	1
3	301 to 500	30	2
4	501 to 800	40	2
5	801 and above	55	3

Note: Any hinge which fails to satisfy the requirements of any one or more of the characteristics shall be considered as defective hinge.

Parliament Hinges

These shall be of SS/ mild steel cast brass or as specified, and shall generally conform to IS 362. The size of parliament hinges shall be taken as the width between open flanges. Mild steel parliament hinges shall be copper oxidized (thick finish) or as specified. The brass parliament hinges shall be finished bright, chromium plated or oxidized or as specified.

The hinge pin shall be made of mild steel in the case of brass hinges. The hinge pin shall be mild steel (galvanized) in the case of aluminium alloy hinges. The hinge pin shall be firmly riveted and shall be properly finished. The movement of the hinges shall be free, easy and square, and shall not have any play or shake. All screw holes shall be clean and counter sunk to suit the counter sunk head of wood screws specified.

Sampling Criteria for and Conformity*:* The number of parliament hinges to be selected from a lot shall depend on the size of lot and shall be in accordance with Table below. Parliament hinges for testing shall be taken at random. All hinges selected from the lot shall be checked for dimensional and tolerance requirements. Defects in manufacture and finish shall also be checked. A lot shall be considered conforming to the requirements of this specification if the number of defective hinges among those tested does not exceed the corresponding number given in Table below.

Lot Size	*Sample Size*	*Permissible No. of Defective hinges*
Upto 150	13	0
151 to 300	20	1
301 to 500	32	2
501 to 1000	50	3
1001 and above	80	5

Note: Any hinge which fails to satisfy the requirements of any one or more of the characteristics shall be considered as defective hinge.

Spring Hinges (Single or double acting)

These shall be single acting when the shutter is to open on one side only or double acting when the shutter opens on both sides. These shall be made of SS/ M.S. , brass or as specified, and shall generally conform to IS 453.

Hinges shall work smoothly and shall hold the door shutter truly vertical in closed position. Each double-acting spring hinge shall withstand the following tests which shall be carried out after fixing it to a swing door in the normal manner.

(a) When the door is pushed through 90° and released 2000 times on each side in quick succession the hinge shall show no sign of damage or any appreciable deterioration of the components during or on completion of the test.

(b) The door shall require a force of 2.0 ± 0.5 kg for 100 mm hinges and 3.0 ± 0.5 kg for 125 mm and 150 mm hinges at a distance of 45 cm from the hinge pin to move the door through 90º.

The size of spring hinge shall be taken as the length of the plate.

Mild Steel *:* The cylindrical casing shall be made either from M.S. sheet of 1.60 mm thickness, lap jointed and brazed, welded and riveted, or from solid drawn tube of thickness not less than 1.60 mm; or from mild sheet of 1.60 mm thickness pressed to from the two casing and the distance piece. It shall be stove enameled black or copper oxidized or as specified.

Cast Brass*:* The cylindrical casing shall be made either from brass sheet of 1.60 mm thickness, lap jointed and brazed, or from solid drawn brass tube of not less than 1.60 mm thickness. It shall be satin, bright nickel plated or copper oxidized or as specified.

Sampling: The number of spring hinges shall be selected from the lot and this number shall depend on the size of the lot and shall be in accordance with Table below.

TABLE

Lot size	Sample size	Permissible No. of defective spring hinges
Upto 100	13	0
101 to 300	20	1
301 to 500	32	2
501 to 1000	50	3
1001 and above	80	5

Rising Hinges

These shall be made of brass, finished bright or chromium plated or oxidized or as specified. Its shape and pattern shall be approved by the SBI/ PMC / Engineer in charge. The size of the rising hinge shall be taken as the length of its plate.

Continuous Piano Hinges

These shall be made from Stainless steel / mild steel or aluminium alloy sheet, these shall generally conform to IS 3818. All screw holes shall be clean and counter sunk. Piano hinges shall be fixed in the entire length of the cupboard shutters. Its size will be the width of the two flaps when open.

M.S. Piano Hinges

These shall be made from 1 mm or 0.80 mm thick M.S. sheets and shall be protected with anti- corrosive treatment, such as bright polished, chromium plated or oxidized finish.

Hinge pin shall be of galvanized mild steel. It shall fit in the knuckle firmly so as not to allow any play or shake and shall allow easy movement of hinge, but shall not cause looseness.

The sides of the knuckles shall be straight and at right angles to the flap. The movement of the hinge shall be free and easy and working shall not have any play and shake.

Aluminium Piano Hinges*:* These shall be made of aluminium alloy sheet and shall be anodized or as specified. The anodic coating shall not be less than the grade AC 15 of IS 1868.

Hinge pin shall be made of aluminium alloy with anodic coating not less than the grade of AC-15 of IS 1868. The hinge pin shall fit in the knuckle firmly so as not to allow any play or shake and shall allow easy movement of hinge but shall not cause looseness.
The sides of the knuckles shall be straight and at right angles to the flap. The movement of the hinge shall be free and easy, and working shall not have any play and shake.

Sampling and Criteria for Conformity: It shall be same as specified in CPWD Specifications.

Tee Hinges

These shall be made from M.S. sheets and shall be either bright finished or stove enameled black or as specified. These shall generally conform to IS 206 (Tee hinges shall be well made, free from burrs, flaws, and defects of any kind. The movement shall be square, and the working shall be free and easy without any play or shake. The hole for the hinge shall be central to the bore and shall be square.

The hinge pin shall be firm and riveted over, so that the heads are well formed. All screw holes shall be clear and counter sunk and shall be suitable for the counter sunk head of wood screws.

2.31.16.25.1 Sampling and Criteria for Conformity*:* It shall be same as specified in clause

Sliding Door Bolts

These shall be of SS / mild steel, cast brass, aluminium or as specified, and shall be capable of smooth sliding action.

M.S. Sliding Door Bolts*:* These shall be made of M.S. sheets and M.S. rods and shall generally conform to IS 281. M.S. sliding door bolts shall be copper oxidized (black finish) or as specified.

Cast Brass Sliding Door Bolts: These shall be made from rolled brass and shall generally conform to IS 2681. The hasp shall be of cast brass and secured to the bolt. Alternatively, the hasp and the bolt may be cast in one piece. The fixing and staple bolts shall be cast with 6 mm studs. Bolts shall be finished to shape and have threaded ends and provided with robs washers and nuts of square or hexagon type. All components shall be finished smooth and polished before assembly.

Cast brass sliding bolts shall be finished bright or chromium plated or oxidized or as specified.

Aluminium Sliding Door Bolts*:* These shall be made of aluminium alloy and shall generally conform to IS 2681. Aluminium sliding door bolts shall be anodized. All screw holes shall be counter sunk to suit the counter sunk head of screws of specified sizes. All edges and corners shall be finished smooth. In case of single leaf door, when iron socket plate or a brass or aluminium fixing bolts (or sliding door bolt) cannot be fixed, hole of suitable size shall be drilled in the door frame and an iron or brass plate cut to shape shall be fixed at the face of the hole. The leading dimensions of the sliding door bolts are illustrated.

Hydraulic Door Closer:- Providing and fixing aluminium extruded section body tubular type universal hydraulic door closer (having brand logo with ISi, IS : 3564, embossed on the body, door weight upto 36 Kg to 80 Kg and door width from 701 mm to 1000 mm), with double speed adjustment with necessary accessories and screws etc. complete.

Aluminium Sliding Door Bolts:- Providing and fixing aluminium sliding door bolts, ISI marked anodised (anodic coating not less than grade AC 10 as per IS : 1868), transparent or dyed to required colour or shade, with nuts and screws etc. complete : 250x16 mm or more as per SBI/ PMC / Engineer in charge

Aluminium Tower Bolts:- Providing and fixing aluminium tower bolts, ISI marked, anodised (anodic coating not less than grade AC 10 as per IS : 1868) transparent or dyed to required colour or shade, with necessary screws etc. complete : 250x10 mm or more as per SBI/ PMC / Engineer in charge

Aluminium Handles:- Providing and fixing aluminium handles, ISI marked, anodised (anodic coating not less than grade AC 10 as per IS : 1868) transparent or dyed to required colour or shade, with necessary screws etc. complete : 125 mm or more as per SBI/ PMC / Engineer in charge

Aluminium Hanging Floor Door Stopper:- Providing and fixing aluminium hanging floor door stopper, ISI marked, anodised (anodic coating not less than grade AC 10 as per IS : 1868) transparent or dyed to required colour and shade, with necessary screws etc. complete. Twin rubber stopper

Sampling and Criteria for Conformity*:* The number of sliding door bolt to be selected from a lot shall depend on the size of lot and shall be in accordance with Table given below. For testing shall be taken at random from at least 10 percent of the package subject to a minimum of three, equal number of door bolts being selected from each package. All door bolts selected from the lot shall be checked for dimensional and tolerance requirements. Defects in manufacture and finish shall also be checked. A lot shall be considered conforming to the requirement of this specification if the number of defects sliding door bolts among those tested does not exceed the corresponding number given in Table below.

TABLE

Lot. size	Sample Size	Permissible speed Decorative sliding door bolts
Upto 150	5	0
151 to 300	20	1
301 to 500	32	2
501 to 1000	50	3
1001 and above	81	5

Tower Bolts

These shall generally conform to IS 204 (Part. I) & IS 204 (Part. II). Tower bolts shall be well made and shall be free from defects. The bolts shall be finished to the correct shape and shall have a smooth action. All tower bolts made with sheet of 1.2 mm thickness and above shall have counter sunk screw holes to suit counter sunk head of wood screws. All sharp edges and corners shall be removed and finished smooth.

The height of knob of tower bolt when the door, window etc. is in closed position from the floor level shall be not more than 1.9 meter.

Tower bolts shall be of the following types :-

(a) Aluminium barrel tower bolts with barrel and bolt of extruded sections of aluminium alloy. The knob shall be properly screwed to the bolt and riveted at the back.

(b) Brass tower bolts with cast brass barrel and rolled or cast brass bolt. Or

Brass tower bolts with barrel of extruded sections of brass and rolled or drawn brass bolt.

The knobs of brass tower bolts shall be cast and the bolt fixed with knob, steel spring and ball shall be provided between the bolt and the barrel.

(c) Mild steel barrel tower bolts with mild steel barrel and mild steel bolt. or
Mild steel tower bolts with mild steel barrel and cast iron bolts.

(d) Stainless steel barrel tower bolts with mild SS barrel and SS steel bolt. or
Stainless steel tower bolts with SS barrel and SS bolts of specified grades.

The plates and straps after assembly shall be firmly riveted or spot welded. The rivet head shall be properly formed and the rivet back shall be flush with the plate. These shall be made in one piece.

Unless otherwise specified bolt shall have finish as given below :-

(a) Mild steel tower bolts (Types 1 and 2) Bolts bright finished or plated as specified and barrel and socket stove enameled black.

(b) Brass tower bolts (type 3 to 5) Bolt and barrel polished or plated as specified.

(c) Aluminium alloy tower bolts (type 6) Bolt and barrel anodized.

The anodic film may be either transparent or dyed as specified. The quality of anodized finish shall not be less than grade AC-10 of IS 1868.

Sampling and Criteria for Conformity*:* It shall be same as specified.

M.S. Locking Bolt with Holes for Pad Locks

This shall conform to IS 7534.

This shall be of mild steel polished bright or copper oxidized batch electro galvanized or stove enameled. In case of stove enameled locking bolts, the bolt may be finished bright.

Pull Bolt Locks

These shall be of M.S. cast brass or aluminium as specified. M.S. pull bolt locks shall be copper oxidized (black finish) or as specified.

Brass pull bolt locks shall be finished bright, chromium plated or oxidized as specified.
Aluminium pull bolt locks shall be anodized and the anodic coating shall not be less than grade. A.C. 10 of IS 1868. The bolt shall be 10 mm in diameter and the fixing plate 3 mm thick. The stop block shall be screwed to the fixing plate by a small ball and spring over which the bolt shall slide.

The fixing plate shall have four holes for fixing it to the door leaf, two of which shall be square to receive 6 mm dia. bolts with round heads, the remaining two shall receive machine screwed with lock nuts. The receiving plate shall be of the same width and thickness as the fixing plate and shall have 3 counter sunk holes.

Where the bolt slides into wooden members, like the chowkhat, which have a rebate, the receiving plate shall also be correspondingly shaped so as to fit into the rebate. The screws and bolts shall have the same finish as the main bolt. The leading dimensions of pull bolt locks are given in the drawing. The denominating size of the pull bolt locks shall be length of the fixing plate between guides plus the thickness of the guides.

Door Latch

This shall be of mild steel, cast brass, or as specified and shall be capable of smooth sliding action. In case, of mild steel latch, it shall be copper oxidized (black finish) or as specified and in case of brass, it shall be finished bright, chromium plated or oxidized or as specified. The size of door latch shall be taken as the length of the latch.

Indicating Bolt (Vacant/Engaged*)*

These shall be of SS, cast brass finished bright chromium plated, or oxidized or as specified. The shape and pattern shall be approved by the SBI/ PMC / Engineer in charge.

Mortice Lock and Latch

This should generally conform to IS 2209.

The size of the mortice lock shall be denoted by the length of the body towards the face and it shall be 65 mm, 75 mm and 100 mm as specified. The measured length shall not vary more than 3 mm from the length specified.

Non-interchangeable Keys*:* Testing of non-interchangeable keys shall be as per IS 2209.

The clear depth of the body shall not be more than 15 mm. The fore end shall be firmly fitted to the body suitably by counter sunk head screw. The latch bolt shall be of specified material and of section not less than 12 x 16 mm for all sizes of locks. If made of two piece construction both parts shall be riveted. Ordinary lever mechanism with not less than two levers shall be provided. False levers shall not be used. Lever shall be fitted with one spring of phosphor bronze or steel wire and shall withstand the tests as provided in IS 2209.

Locking bolts, spring and strike plate shall conform to IS 2209.

Handles: ***These shall conform to IS 4992.***

Keys: Each lock shall be provided with two keys.

Sampling, Criteria for Conformity*:* It shall be the same as specified.

Tests: The finally assembled locks shall be tested as prescribed.

Mortice Latch (with Locking Bolt)

These are generally used in doors of bath rooms, WC's and private rooms.

Mortice latch shall, in respect of shape, design and mechanism of the latch and its components parts, generally conform to IS 5930. The material used for the different component parts of the latch shall comply with Tables 1 and 2 of IS 5930, unless otherwise specified.

The size of the latch shall be denoted by the length of the body towards the face and shall be 65 mm, 75 mm or 100 mm as specified. The depth of the body shall not be more than 15 mm.

The latch shall be of size 10 × 18 mm of shape as shown in Fig. 1 of IS 5930. The locking bolt shall be of section not less than 8 x 25 mm for all size of locks. The mechanism of the latch bolt, its spring, striking plate etc. shall be as described in IS 5930. The handles provided shall conform to IS 4992.

Mortice Lock and Latch (Rebated)

These are slightly different from mortice lock described in 2.30.16.40 and are designed for use in double leaved doors. These should generally conform to IS 6607.

Handles, Keys, Sampling, Criteria for Conformity and Test*:* These shall be same as specified.

Mortice Night Latch

This is a mortice lock having a single spring bolt withdrawn from the outside by using the key and from inside by turning the knob and with an arrangement whereby the lock can be prevented from being opened by its key from outside while the night latch is used from inside the room.

This should generally conform to IS 3847.

It shall be cast or sheet brass, cast or sheet aluminium alloy or Mild steel as specified and of best quality of approved make. These shall be bright finished or copper oxidized (black) finish as specified. Nominal size of the latch shall be denoted by the length of the face over the body in millimeters. These shall have not less than two levers. False (Dummy) levers shall not be allowed.

Keys: Each latch shall be provided with two keys which should work smoothly and without any appreciable friction in the lock.

Kicking Plates

This shall be of brass (finished bright or chromium plated or oxidized) bronze, stainless steel, aluminium or as specified. Aluminium kicking plates shall be anodized and the anodic coating shall not be less than grade AC-10 of IS 1868. It shall be made from a plate of minimum thickness 3.0 mm & 1.5 mm in case of stainless steel. Shape of the plate shall be as specified. This shall have beveled or straight edges and shall be fixed by means of counter sunk or rounded screws of the same material and finish as that of the plate. The shape and pattern shall be according to the drawings and as approved by the SBI/ PMC / Engineer in charge.

Door Handles (Doors and Windows)

These should generally conform to IS 208. The door handles shall be well made and free from defects. These shall be finished correct to shape and dimensions. All edges and corners shall be removed and finished smooth so as to facilitate easy handling. Cast handle shall be free from casting defects. Where the grip portion of the handle is joined with the base piece by mechanical means, the arrangement shall be such that the assembled handle shall have adequate strength comparable to that of integrally cast type handles.

Door handles shall be of the following types according to the material used:

(a) **Cast or Sheet Aluminium Alloy Handles*:*** These shall be of aluminium of specified size, and of shape and pattern as approved by the SBI/ PMC / Engineer in charge. The size of the handle shall be determined by the inside grip of the handle. Door handles shall be of 100 mm size and window handles of 75 mm size unless, otherwise specified. These shall be fixed with 25 mm long wood screws of designation No. 6. Aluminium handles, shall be anodized and the anodic coating shall not be less than grade AC 15 – IS 1868 as specified. The finish can be bright natural, matt or satin or dyed as specified.

(b) **Cast Brass Handles*:*** These shall be of cast brass of specified size and of the shape and pattern as approved by the SBI/ PMC / Engineer in charge. The size of the handle shall be determined by the inside grip of the handle. Door handles shall be of 100 mm size and window handles of 75 mm size, unless otherwise specified. These shall be fixed with 25 mm long wood screws of designation No 6. Brass handles shall be finished bright satin or nickel chromium plated or copper oxidized or as specified.

(c) **Mild Steel Handles*:*** These shall be of mild steel sheet, pressed into oval section. The size of the handles will be determined by the inside grip of the handle. Door handles shall be 10 mm size and window handles of 75 mm size unless otherwise specified. These shall be fixed with 25 mm long wood screws of designation No. 6., Iron handles shall be copper oxidized (black finish) or stove enameled black or as specified.

Sampling and Criteria for Conformity*:* The number of handles to be selected from a lot shall depend on the size of lot and shall be in accordance with below Table. Handles for testing shall be selected at random for at least 10 percent of packages. Subject to a minimum 3, equal number of door handles being selected from each such package. All door handles shall be checked for dimensional requirement and finish. Any door handle which fails to satisfy the requirement of dimensions or finish or both shall be considered as defective.

A lot shall be considered as conforming to requirement of this specification, if the number of defective handles among those tested does not exceed the corresponding number of defectives is greater than or equal to rejection number given in column 4 of Table below, the lot shall be deemed as not meeting the requirements of this specification.

TABLE
Scale of Sampling and Criteria for Conformity

Lot size	Sample size	Acceptance no.	Rejection no.
[1]	[2]	[3]	[4]
Upto 50	**8**	**0**	**1**
51 to 90	**13**	**1**	**2**
91 to 150	**20**	**1**	**2**

151 to 280	**32**	**2**	**3**
281 to 500	**50**	**3**	**4**
501 to 1200	**80**	**5**	**6**
1201 and above	**125**	**7**	**8**

Floor Door Stopper

The floor door stopper shall conform to IS 1823. This shall be made of cast brass of overall size as specified and shall have rubber cushion. The shape and pattern of stopper shall be approved by the SBI/ PMC / Engineer in charge. It shall be of brass finished bright, chromium plated or oxidized or as specified.

The size of floor stopper shall be determined by the length of its plate. It shall be well made and shall have four counter sunk holes for fixing the door stoppers to the floor by means of wood screws. The body for housing of the door stopper shall be cast in one piece and it shall be fixed to the cover plate by means of brass or mild steel screws and cover plate shall be of casting or of sheet metal. The spring shall be fixed firmly to the pin. Tongue which would be pressed while closing or opening of the door shall be connected to the lower part by means of copper pin. On the extreme end a rubber piece shall be attached to absorb shock. All parts of the door stopper shall be of good workmanship and finish, burrs and sharp edges removed. It shall be free from surface and casting defects. Aluminium stopper shall be anodized and anodic film shall not be less than grade AC-10 of IS 1868.

Sampling and Criteria for Conformity*:* The number of floor door stoppers to be selected from each lot shall depend on the size of the lot and shall be in accordance with col. 1 and 2 of Table below.

These stoppers shall be selected at random from at least 10 percent of the randomly selected packages subject to a maximum of three equal number of stoppers being selected from each such package.

All the floor stoppers selected shall be checked for dimensional requirement, material, manufacture and finish. Any of door stopper which fails to satisfy any one or more of these requirement shall be considered as defective door stopper.

A lot shall be considered as conforming to the requirements of this specifications if the number of defective floor door stoppers among these tested does not exceed the corresponding number given in col. 3 of Table-A below. Otherwise it shall be considered as not conformity to the requirements of this specification.

TABLE-A
Scale of Sampling and Criteria for Conformity

Lot Size	Sample Size	Permissible number of defective floor Door stoppers
[1]	**[2]**	**[3]**
Upto 100	5	0
101 to 300	0	1
301 to 500	32	2
501 to 1000	50	3

1001 and above	80	5

Particulars	*Requirements*	*Testing Procedure*
Relative density Max.	1.3	IS 3400 (Part IX)
Hardness	60 + 5	IS 3400 (Part 2)
Ageing for 24 hours at 100°C ±	(a) Change in initial hardness (b) Shall not develop brittleness + 5, – 0	IS 3400 (Part II) -do-

Hanging Rubber Door Stopper

These shall be of cast brass, finished bright, chromium plated or as specified. Aluminium stopper shall be anodized and the anodic coating shall not be less than grade AC-10 of IS 1868. The size and pattern of the door stopper shall be approved by the SBI/ PMC / Engineer in charge. The size shall be determined by its length.

Universal Hydraulic Door Closer (Exposed Type)

These shall be made of cast iron/aluminium alloy/zinc alloy and of shape and pattern as approved by the SBI/ PMC / Engineer in charge. These shall generally conform to IS Specifications for door closers (Hydraulically regulated) IS 3564. The door closers may be polished or painted and finished with lacquer to desired colour. Aluminium alloy door closer shall be anodized and the anodic coating shall not be less than grade AC 15 of IS 1868. All dents, burrs and sharp edges shall be removed from various components and they shall be pickled, scrubbed and rinsed to remove grease, rust, scale or any other foreign elements. After pickling, all the M.S. parts shall be given phosphating treatment in accordance with IS 3618. The nominal size of door closers in relation to the weight and the width of the door size to which it is intended to be fitted shall be given in Table-C below.

TABLE-C
Type and Designation of Door Closers

Designation of closers	Mass of the door (kg)	Width of the door(mm)	Remarks
1.	Upto 35	Upto 700	For light doors such as double leaved and toilet doors.
2.	36 to 60	701 to 850	Interior doors, such as of bed rooms, kitchen and store
3.	61 to 80	851 to 1000	Main doors in a building, such as entrance doors

Sampling and Criteria for Conformity*:* All the door closer of the same nominal size and shape and from the same batch of manufacture, in one consignment shall constitute a lot. The number of door closers to be taken at random from a lot shall depend upon the size of the lot. The sample shall be tested for construction, finish, dimensions, interchangeability of parts and performance in accordance of Table below. Any door closer failing in any one or more of these characteristics shall be considered as defective. If in the first sample, the number of defective door closer is less than or equal to corresponding acceptance number, the lot shall be declared as conforming to the requirement of these characteristics. If the number of defective door closer is greater than or equal to the rejection number, the acceptance number but less than the rejection number, lot shall be deemed as not meeting with requirements of these characteristics. If the number of defectives is greater than the acceptance number, but less than the rejection number, a second sample of the size equivalent to that of the first shall be taken to determine the conformity or otherwise of the lot. The

number of defective door closers found in the first and the second sample shall be combined and if the combined number of defective thus obtained is less than or equal to the corresponding acceptance number, the lot shall be declared as conforming to the requirements of these characteristics.

Endurance Test- Two door closer in case of lot size 280 or less and five door closers in case of lot size more than 280 shall be selected from those already found satisfactory. These door closers shall be tested for the endurance test. If all the door closers tested for endurance test satisfy the requirement of this standard, the lot shall be deemed as having satisfied the requirements of endurance test, otherwise not.

TABLE

No. of door closers in the lot	Sample	Sample size	Cumulative sample size	Acceptance Number	Rejection Number
Upto 50	First Second	8 8	8 16	0 1	2 2
51 to 90	First Second	13 13	13 26	0 1	2 2
91 to 150	First Second	20 20	20 40	0 3	3 4
151 to 280	First Second	32 32	32 64	1 4	4 5
281 to 500	First Second	50 50	50 100	2 6	5 7
501 to 1200	First Second	80 80	80 160	3 8	7 9
1201 to 3200	First Second	125 125	125 250	5 12	9 13
3201 and above	First Second	200 200	200 400	7 18	11 19

Performance Requirements *:* After being fitted in its position when the door is opened through 90°, the same should swing back to angle of 20° ± 5° with nominal speed but thereafter, the speed should get automatically retarded and in case of doors with latches, it should be so regulated that in its final position the door smoothly negotiates with the latch.

Panelling

The panel inserts shall be either framed into the grooves or housed in the rebate of stiles and rails. Timber, plywood, and particle board panels as given under sub head and shall be fixed only with grooves. The depth of the groove shall be 12 mm and its width shall accommodate the panel inserts such that the faces are closely fitted to the sides of the groove. Panel inserts shall be framed into the grooves of stiles and rails to the full depth of the groove leaving space of 1.5 mm. Width and depth of the rebate shall be equal to half the thickness of stiles and rails. Glass panels, asbestos panels wire gauze panels and panel inserts of cupboard shutters shall be housed in the rebates of stiles and rails.

Timber Panels*:*

Timber panels shall be preferably made of timber of large width; the minimum width and thickness of the

panel shall be 100 mm, and 15 mm respectively. When made from more than one piece, the pieces shall be jointed with a continuous tongued and grooved joint glued together and reinforced with headless nails at regular intervals not exceeding 100 mm. Depth and thickness of such joint shall be equal to one-third of thickness of panel. The panels shall be designed such that no single panel exceeds 0.5 square metre in area. The grains of timber panels shall run along the longer dimensions of the panels. All panels shall be of the same species of timber unless otherwise specified.

Plywood Panels:

Plywood boards used for panelling of shutters shall be BWP type or grade as specified. Each panels shall be a single piece of thickness, 9 mm for two or more panel construction and 12 mm thickness for single panel construction unless otherwise specified.

Veneered Particle Board Panels:

Veneered Particle board used for panelling of shutters shall be Exterior Grade bonded with BWP type synthetic resin adhesive as specified. Each panel shall be a single piece of thickness 12 mm unless otherwise specified.

Fiber Board Panels*:*

Fiber board used for panelling of shutters shall be Exterior Grade bonded with BWP type synthetic resin adhesive, each fiber board panel shall be a single piece unless otherwise specified.

Wire Gauze Panels:

Wire Gauze used for panelling of shutters shall be woven with 0.63 mm dia galvanized mild steel wire to form average aperture size of 1.40 mm as specified. Wire gauze shall be securely housed into the rebates of stiles and rails by giving right angles bend turned back and fixed by means of suitable staples at intervals of 75 mm and over this wooden beading shall be fixed. The space between the rebate and the beading shall be fixed with putty to give a neat finish. Each wire gauze panel shall be a single piece, and the panels shall be so designed that no single panels exceeds 0.5 sqm in area. However, care shall be taken to prevent sagging of wire gauge, of panel by providing and fixing 20 x 20 mm square or equivalent beading to the external face to the required patterns as decided by the SBI/ PMC / Engineer in charge.

Glass Panels:

Glass panelling (Glazing) shall be done as specified. Glazing in the shutters of doors, windows and ventilators of bath, WC and Lavatories shall be provided with frosted glass the weight of which shall be not less than 10 kg/sqm. Frosted glass panes shall be fixed with frosted face on the inside. Glass panels shall be fixed by providing a thin layer of putty conforming to IS 419 applied between glass pane and all along the length of the rebate and also between glass panes and wooden beading.

Putty can be prepared by mixing one part of white lead with three parts of finely powdered chalk and then adding boiled linseed oil to the mixture to form a stiff paste and adding varnish to the paste at the rate of 1 liter of varnish to 18 kg of paste. Fixing of glass panes without beading shall not be permitted. Glazing shall be done after the shutters have been primed and prepared for painting, so that wood may not draw oil out of putty.

Glazed Shutters for doors

Providing and fixing panelled or panelled and glazed shutters for doors, windows and clerestory windows, fixing with butt hinges of required size with necessary screws, excluding panelling which will be paid for separately, all complete as per direction of SBI/ PMC / Engineer in charge. (Note: Butt hinges and necessary screws shall be paid separately) Second class teak wood, 35 mm thick shutters

DECORATIVE HIGH PRESSURE LAMINATED SHEET

Providing & Fixing decorative high pressure laminated sheet of plain / wood grain in gloss / matt/ suede finish with high density protective surface layer and reverse side of adhesive bonding quality conforming to IS : 2046 Type S, including cost of adhesive of approved quality. 1.0 mm thick.

WPC (WOOD POLYMER COMPOSITE) FRAME

Providing and fixing factory made single extruded WPC (Wood Polymer Composite) solid door/window/Ceosetory windows & other Frames/Chowkhat comprising of virgin PVC polymer of K value 58- 60 (Suspension Grade), calcium carbonate and natural fibers (wood powder/ rice husk/wheat husk) and non toxic additives (maximum toxicity index of 12 for 100 gms) fabricated with miter joints after applying PVC solvent cement and screwed with full body threaded star headed SS screws having minimum frame density of 750 kg/ cum, screw withdrawal strength of 2200 N (Face) & 1100 N (Edge), minimum compressive strength of 58 N/mm2, modulus of elasticity 900 N/mm2 and resistance to spread of flame of Class A category with property of being termite/borer proof, water/moisture proof and fire retardant and fixed in position with M.S hold fast/lugs/SS dash fasteners of required dia and length complete as per direction of Engineer-In-Charge. (M.S hold fast/lugs or SS dash fasteners shall be paid for separately).Note: For WPC solid door/window frames, minus 5mm tolerance in dimensions i.e depth and width of profile shall be acceptable. Variation in profile dimensions on plus side shall be acceptable but no extra payment on this account shall be made. Frame size 50 x 100 mm or more as per drawings & engineer-incharge

WPC (WOOD POLYMER COMPOSITE) SOLID PLAIN FLUSH DOOR SHUTTER

Providing and fixing factory made single extruded WPC (Wood Polymer Composite) solid plain flush door shutter of required size comprising of virgin polymer of K value 58-60 (Suspension Grade), calcium carbonate and natural fibers (wood powder/ rice husk/wheat husk) and non toxic additives (maximum toxicity index of 12 for 100 gms) having minimum density of 650 kg/cum and screw withdrawal strength of 1800 N (Face) & 900 N (Edge), minimum compressive strength 50 N/mm2, modulus of elasticity 850 N/mm2 and resistance to spread of flame of Class A category with property of being termite/ borer proof, water/moisture proof and fire retardant and fixing with stainless steel butt hinges of required size with necessary full body threaded star headed counter sunk S.S screws, all as per direction of Engineer-In- Charge. (Note: stainless steel butt hinges and necessary S.S screws shall be paid separately) 30 mm thick or more as per drawings & engineer-incharge

UPVC- DOOR FRAMES

Material

Polyvinyl chloride Resin suspension grade is the basic raw material for forming PVC compound. PVC resin then is mixed with chemicals like Calcium, Stearate, Hydrocarbon Wax, Titanium Dioxide, Calcium Carbonate, Acrylic processing aids. Further, additives like impact modifiers, pigments, epoxy plasticizer, UV stabilizer, lubricants, chemical blowing agent etc. are added. The purpose of adding the chemicals and additives is to impart cellular structure, strength, surface finish, colour and resistance to fading by light rays. These chemicals are mixed in the desired proportion and shall be used in the formulation of PVC material and for free and smooth extrusion of PVC profiles.

Providing and fixing factory made uPVC glazed/wire mesh windows/ doors comprising of lead free uPVC multi chambered frame, sash and mullion/coupler (where ever required) extruded profiles having minimum wall thickness of 1.70 mm for Series R1 and R2 profiles and 2.10 mm for Series R3 and R4 profiles conforming to EN: 12608 in any shape, colour and design duly reinforced with galvanized mild steel section made of required shape & size as per CPWD Specification, uPVC extruded glazing beads, interlocks and lnline sash adaptor (whereever required) of appropriate dimension, EPDM gasket, hardware, SS 304 grade fasteners of minimum 8 mm dia with countersunk head, comprising of matching polyamide PA6 grade sleeve for fixing frame to finished wall as per IS 1367 : Part 1 to 14, plastic packers, plastic caps and necessary stainless steel screws etc. Profile of frame, sash & mullion (if required) shall be mitred cut and fusion welded/mechanically jointed duly sealed at all comers, including drilling of holes for fixing hardware and drainage of water etc. After fixing frame the gap between frame and adjacent finished wall shall be filled with weather proof silicon sealant over backer rod of approved size and quality, all complete as per approved drawing conforming to CPWD specification & direction of SBI/ PMC / Engineer in charge. Section of steel reinforcement and cross sections of uPVC profiles to be as per design approved by SBI/ PMC / Engineer in charge. Wire mesh I Glazing of plain/ toughened/laminated/ double glass unit
with I without high performance coatings as per design requirements and conforming to IS: 3548 & IS: 16231 shall be paid separately. Note:- Structural design proof checked from a Government
Engineering Institute, to be provided by the manufacturer for :
(i) Sites with basic wind speed > 45 m/sec as per IS 875 - Part 3
(ii) Sites with structure height more than 20m for all wind speeds.

a) Three track three panels sliding window with two glazed & one wire mesh panels with Aluminium channel for roller track, wool pile, nylon rollers with SS 304 body. Using R3 series with frame (98 mm & above) x (40 mm & above) & both glazed and fly screen sash (30 mm & above) x (55 mm & above with zinc alloy (zamak) powder coated handle on every glazed panel along with multi-point locking system. (Height upto 1.8m).
b) Fixed window I ventilator with mullion I transom. Using R1 series with frame (33 mm & above) x (35 mm & above) & mullion (33 mm & above) x (50 mm & above). {Height upto 0.90 metre)
c) Fixed window I ventilator with mullion I transom. Using R3 series with frame (55 mm & above) x (45 mm & above) & mullion (55 mm & above) x (65 mm & above). (Height upto 2.5 metre)
d) Casement cum fixed panel window having one single casement panel & one fixed panel with S.S 304 friction hinges as per size and weight of sash, multi-point locking system, zinc alloy (zamak)

powder coated handle. ing R3 series with frame (55 mm & above) x (45 mm & above) & sash (55 mm & above) x (65 mm & above) & mullion (55 mm & above) x (65 mm & above). (Height upto 1.8 metre; each openable shutter upto 0.8m width)

e) Casement door single panel with zinc alloy (zamak) 3D hinges, multi-point locking system with cylinder, zinc alloy (zamak) powder coated handles on both sides. Using R3 series with frame (55 mm & above) x (50 mm & above) & sash (55 mm & above) x (85 mm & above) (Height upto 2.5 metre).

UPVC Door Frame

UPVC door frame shall be made of PVC material conforming to IS 10151. The door frame shall be made from extruded UPVC section having overall dimensions of 48 x 40 mm or 42 x 50 mm having wall thickness of 2.0 mm $\pm$ 0.2 mm. Corners of the door frame to be jointed by M.S. galvanized brackets. Joints mitred and plastic welded. The hinge side vertical outer frames shall be reinforced by galvanized M.S. Tube of size 19 x 19 mm of wall thickness 1 mm $\pm$ 0.1 mm and a tie rod shall be provided at the bottom of the frame. The frame shall be fabricated in factory

Fixing of Frames

The frames are to be fixed in prepared openings in the walls. All civil work and tiling should be completed before the fixing of the frames. The frames are to be fixed directly on the plastered wall. In case tiling is to be done in the place the frames are to be fitted, a 50 mm strip should be left untiled at the location where the frames are to be fitted. The frames are erected in the prepared opening such that the vertical members of the door frame are embedded 50 mm in the floor. The frame shall be fitted truly in plumb. A minimum of three anchor bolts or screws of size 65/100 shall be used to fix each vertical member. One bolt shall be fixed at 200 mm from the top member and one bolt shall be fixed at 200 mm from the floor. The third anchor bolt shall be fixed in the center. The top horizontal member shall be fixed using two 65/100 size anchor bolts or screws at a distance of 200 mm from both the corners.

PVC DOOR SHUTTERS

The shutters shall be fabricated at factory. Shutter shall be made of PVC material conforming to IS 10151.

UPVC Window

Providing and fixing factory made uPVC white colour casement/casement cum fixed glazed windows comprising of uPVC multi-chambered frame, sash and mullion (where ever required) extruded profiles duly reinforced with 1.60 ± 0.2 mm thick galvanized mild steel section made from roll forming process of required length (shape & size according to uPVC profile), uPVC extruded glazing beads of appropriate dimension, EPDM gasket, stainless steel (SS 304 grade) friction hinges, zinc alloy (white powder coated) casement handles, G.I fasteners 100 x 8 mm size for fixing frame to finished wall, plastic packers, plastic caps and necessary stainless steel screws etc. Profile of frame & sash shall be mitred cut and fusion welded at all corners, mullion (if required) shall be also fusion welded including drilling of holes for fixing hardware's and drainage of water etc. After fixing frame the gap between frame and adjacent finished wall shall be filled with weather proof silicon sealant over backer rod of required size and of approved quality, all complete

Casement window double panels with top fixed with S.S. friction hinges (350 x 19 x 1.9 mm) made of (small series) frame 47 x 50 mm, sash 47 x 68 mm & mullion 47 x 68 mm all having wall thickness of 1.9 ± 0.2 mm and single glazing bead of appropriate dimension.
Casement window single panel with S.S. friction hinges (400 x 19 x 1.9 mm) made of (big series)frame 67 x 60 mm & sash 67 x 80 mm both having wall thickness of 2.3 ± 0.2 mm and single glazing bead / double glazing bead of appropriate dimension. (
Casement window double panels with S.S. friction hinges (350 x 19 x 1.9 mm) made of (big series)frame 67 x 60 mm & sash / mullion 67 x 80 mm both having wall thickness of 2.3 ± 0.2 mm and single glazing bead/ double glazing bead of appropriate dimension.
Casement cum fixed panel window having both end single casement panel, middle fixed panels and at top completely fixed ventilator with S.S friction hinges (350 x 19 x 1.9) made of (big series) frame 67 x 60 mm , sash 67 x 80 mm & mullion 67 x 80 mm all having wall thickness of 2.3 ± 0.2 mm and single glazing bead/double glazing bead of appropriate dimension.

Providing and fixing factory made uPVC white colour casement/ Casement cum fixed glazed door comprising of uPVC multi-chambered frame, sash and mullion (where ever required) extruded profiles duly reinforced with 1.60 ± 0.2 mm thick galvanized mild steel section made from roll forming process of required length (shape & size according to uPVC profile), uPVC extruded glazing beads of appropriate dimension, EPDM gasket, zinc alloy (white powder coated) 3D hinges and one handle on each side of panels along with zinc plated mild steel multi point locking having transmission gear, cylinder with keeps and one side key, G.I fasteners 100 x 8 mm size for fixing frame to finished wall and necessary stainless steel screws, etc. Profile of frame & sash shall be mitred cut and fusion welded at all corners, mullion (if required) shall be also fusion welded including drilling of holes for fixing hardware's and drainage of water etc. After fixing frame the gap between frame and adjacent finished wall shall be filled with weather proof silicon sealent over backer rod of required size and of approved quality, all complete. (Single / double glass panes and silicon sealent shall be paid separately).
Casement door with top hung ventilator with 3D and S.S. friction hinges (400 x 19 x 1.9 mm) made of (big series) frame 67 x 64 mm, sash 67 x 110 mm & mullion 67 x 80 mm all having wall thickness of 2.3 ±. 0.2 mm and single glazing bead / double glazing bead of appropriate dimension.(Area of door upto 2.50 sqm)

Providing and fixing factory made uPVC white colour sliding glazed door comprising of uPVC multi-chambered frame with in-built roller track and sash extruded profiles duly reinforced with 1.60 ± 0.2 mm thick galvanized mild steel section made from roll forming process of required length (shape & size according to uPVC profile), appropriate dimension uPVC extruded glazing beads, uPVC extruded interlock and uPVC extruded Inline sash adaptor (if required), EPDM gasket, wool pile, zinc alloy (white powder coated) handle with key on one side of extreme panels along with zinc plated mild steel multi point locking having transmission gear with keeps, zinc alloy (white powder coated) cresent lock (if required), stainless steel (SS 304 grade) body with adjustable double nylon rollers (weight bearing capacity to be 120 kg), G.I fasteners 100 x 8 mm size for fixing frame to finished wall and necessary stainless steel screws etc. Profile of frame & sash shall be mitred cut and fusion welded at all corners, including drilling of holes for fixing hardware's and drainage of water etc. After fixing frame the gap between frame and adjacent finished wall shall be filled with weather proof silicon sealent over backer rod of required size and of approved quality, all complete.
Two track two panels sliding door made of (big series) frame 67 x 50 mm & sash 46 x 82 mm both having wall thickness of 2.3 ± 0.2 mm and single glazing bead / double glazing bead of appropriate dimension.

FIRE RESISTANT DOOR FRAME SHUTTER AND GLAZING

A:-Providing and fixing fire resistant door frame of section 50 x 60 mm on horizontal side & 35 x 60 mm on vertical sides having built in rebate made out of 1.6 mm thick GI sheet (Zinc coating not less than 120gm/m²) suitable for mounting 120 min Fire Rated Glazed Door Shutters. The frame shall be filled with Mineral wool Insulation having density min 96Kg/m³ . The frame will have a provision of G.I. Anchor fastners 14 nos (5 Each on vertical style & 4 on horizontal style of size M10 x 80) suitable for fixing in the opening along with Factory made Template for SS Ball Bearing Hinges of Size 100x89x3mm for fixing of fire rated glazed shutter . The frame shall be finished with a approved fire resistant primer or Powder coating of not less than 30 micron in desired shade .

Providing and fixing 60 mm thick glazed fire resistant door shutters of 120 min Fire Rating confirming to IS:3614 (Part II) or EN1634-1:1999, tested and certified as per laboratory approved by SBI/ PMC / Engineer in charge, with suitable mounting on door frame, consisting of vertical styles, top rail & side rail 60 mm x 60 mm wide and bottom rail of 110 mm x 60 mm made out of 1.6mm thick G.I. sheet (zinc coating not less than 120gm/m²) duly filled mineral wool insulation having density min 96 Kg/m³ and fixing with necessary stainless steel ball bearing hinges of size 100x89x3mm of approved make, including applying a coat of approved fire resistant primer or powder coating not less than 30 micron etc all complete .

Providing and fixing glazing in fire resistant door shutters, fixed panels & partitions etc., with G.I. beading made out of 1.6 mm thick G.I. sheet (zinc coating not less than 120 gm/m²) of size 20 x 33 mm screwed with M4 x 38 mm SS screws at distance 75 mm from the edges and 150 mm c/c , including applying a coat of approved fire resistant primer/ powder coating of not less than 30 micron on G.I. beading, & special ceramic tape of 5 x 20 mm size etc complete in all respect as per NBC 2016, IS 16231 (Part 3):2016 and as per direction of Engineer-incharge with glass of required thickness having 120 minutes of fire resistance both integrity & radiation control (EW120) and minimum 20 minutes of insulation (EI20). The manufacturer have to give test report/certification of fire glass and the glass should have the stamp showing the value of E, EW & EI. The glass shall be tested in approved NABL accredited lab or by any other accreditation body which operates in accordance with ISO/IEC 17011 and accredits labs as per ISO/IEC 17025 for testing and calibration scopes shall be eligible. The maximum glazing size shall not be more than 1100x2200 mm (w x h) or 2.42 sqm.

b:-Providing and fixing factory made ISI marked partially insulated metal fire rated doorset assembly, for staircase / exit pathway and refuge areas applications, consisting of galvanized iron steel frame and double leaf shutter including necessary hardware accessories, conforming to FD 120 PI classification of IS 3614:2021

with fire rating of 120 minutes integrity and 30 minutes insulation. The door frame and shutter shall be made out of minimum 1.20 mm thick GI Sheet with minimum 120 GSM Zinc coating as per IS: 277. The entire fire rated doorset assembly shall be tested as per IS 17518 (Part -1): 2022

Frame:

The frame shall be of minimum size 90 x 60 mm with grooved profile to take appropriate fire rated smoke seal, having mitred cut joint (self tab/screwed assembled at site) and provided with appropriate reinforcement suitable for taking hardware and flush fixing as per IS 4351. The smoke seal material shall be of EPDM or any other material tested in accordane with BS 476 (Part-22) ASTM E-84 of minimum size 10 x 4mm, fixed within the inbuilt groove or stuck with adhesive on the entire perimeter of the frame. The door frame shall be fixed to the three sides to masonary wall opening with CSK headed fastner of minimum 8 mm dia size and minimum 80mm long hot dip galvanized with 8mm dia Polyamide sleeves 5 number at each on vertical sides and 3 number on top side.

Door shutter:

The double skinned double leaf partially insulated door shutters shall be consisting of minimum 50 mm thickness and having box like structure, slots cut and holes punched, for fixing of hardwares with stiffners as per IS: 16074 including resin bonded mineral wool/ceremic wool infill material of minimum density 96 kg/cum. Each door leaf shall be provided with vision panel, having maximum area of 0.06 sqm, of 120 minute fire rated minimum 6 mm thick clear borosilicate glass pane fixed with clip-on arrangement and fire rated ceramic tape having minimum size 13x2 mm to be fixed all around the glass on both the sides. The intumescent seal of minimum size 15x1.5 mm or of size as per test evidence shall be fixed on all the three edges of the door leaves. Integral astragals to be provided for double leaf door on the meeting style each on active and inactive leaf. The door shutters shall be mounted on the frame with SS 304 grade ball bearing hinges as per EN 1935: 2002 or butt hinges as per IS 12817, of minimum size 100x75x3 mm 5 numbers hinges upto 2400mm height or as per test evidence, whichever is more. fixed with M6 25 screws. All doors shall be factory prepared for receiving appropriate hardware and provided with necessary reinforcement for hardware accessories.

Accessories Hardware:

Fire doorset assembly shall be provided with one number of single point panic push bar (cross bar) for active leaf and one number double point panic push bar (cross bar) of desired finish with verticle shoot bolts on top and bottom for inacitvie leaf of double leaf door as per EN 1125, one number external trim with half cylinder 42 mm long with one side key as per EN 1125, two number heavy duty door closers of size 3-5 with standard arm with of desired finish (suitable for 1250 mm wide door leaf) conforming to IS 3564/EN 1154, and one number surface mounted door coordinator with integral shock absorber.

Finishing:

Both frame and door shutters shall be factory finished with polyester powder coating of minimum 50 microns thick and shall have passed salt spray test as per IS: 13871 of approved colour and shade all complete as per manufacturer's specifications and as per direction of the SBI/ PMC / Engineer in charge.

Installation: The hollow space in the door frame shall be filled with fire rated self extinguishing type polyurethane foam (PUF) after installation at site of work. The rate shall be inclusive of complete door assembly, supply and installation by the approved manufacturer. Double leaf partially Insulated metal fire rated doorset of FD 120 PI classification with 120 minutes integrity and 30 minutes insulation as per IS 3614:2021 for Staircase/ Exit pathway / Refuge area etc

C:- Providing and fixing factory made ISI marked un-insulated metal fire rated doorset assembly for all egress areas like utility rooms and service areas consisting of galvanized iron steel frame and double leaf shutter including necessary hardware accessories, conforming to FD 120 classification of IS 3614:2021 with fire rating of 120 minutes integrity. The door frame and shutter shall be made out of minimum 1.20 mm thick GI Sheet with minimum 120 GSM Zinc coating as per 15: 277. The entire fire rated doorset assembly shall be tested as per IS 17518 (Part-1): 2022.

Frame:

The frame shall be of minimum size 90 x 60 mm with grooved profile to take appropriate fire rated smoke seal, having mitred cut joints (self tab/screwed assembled at site) and provided with appropriate reinforcement suitable for taking hardware and flush fixing as per IS: 4351. The smoke seal material shall be of EPDM or any other material tested in accordance with BS 476 (Part-22)/ASTM E-84 of minimum size 10x4 mm, fixed within the inbuilt groove or stuck with adhesive on the entire perimeter of the frame. The door frame shall be fixed in all three sides to masonry wall opening with CSK headed fasteners of minimum 8 mm dia size and minimum 80 mm long hot dip galvanized with 8mm dia polyamide sleeves 5 numbers at each on vertical side and 3 numbers on top side.

Door shutter:

The double skin double leaf door shutter shall be consisting of minimum 46 mm thick and having box like structure, slots cut and holes punched for fixing of hardware with stiffener as per IS 16074 including Resin bonded honey comb paper core infill material of density 5 kg/cum. Each door leaf shall be provided with vision panel, having maximum area of 0.12 sqm, of 120 minute fire rated minimum 6 mm thick clear borosilicate glass pane fixed with clip-on arrangement and fire rated ceramic tape having minimum size 13x2mm to be fixed all around the glass on both the sides. Integral astragals to be provided for double leaf doors on the meeting style each on active and inactive leaf. The door shutters shall be mounted on the frame with SS 304 grade ball bearing hinges as per EN 1935: 2002 or butt hinges as per IS 12817 both, of minimum size 100x75x3 mm 5 numbers hinges per door leaf upto 2400 mm height or as per test evidence, which ever is more, fixed with M6 25 screws. All doors shall be factory prepared for receiving appropriate hardware and provided with necessary reinforcement for hardware accessories.

Hardware Accessories:

Fire doorset shall provided with one number fire rated SS 304 grade Mortise dead lock, 50-80 mm Back Set, minimum 20 mm Square forend with allen key Escutcheon of Stainless Steel, and 65/70 mm cylinder with both side key conforming to EN12209/IS: 3614:2021, two pair of D type Pull handle of SS 304 grade of minimum 22 mm dia Centre to centre distance of 300 mm back to back fixing with spindle, one number 300 mm long Concealed lever action flush bolt (Dye-Cast Stainless Steel Finish) at bottom with SS dust proof socket and one number 600 mm long Concealed lever action flush bolt (Dye-Cast Stainless Steel Finish) on top of inactive leaf of double door. Two number fire rated surface mounted heavy duty door closer of size 2-4 with standard arm, of desired finish conforming to IS 3564/EN 1154.

Finishing:

Both frame and door shutters shall be factory finished with polyester powder coating of minimum 50 microns

thick and shall have passed salt spray test as per IS:13871 of approved colour and shade all complete as per manufacturer's specifications and as per direction of the SBI/ PMC / Engineer in charge

Installation: The hollow space in the door frame shall be filled with fire rated self extinguishing type polyurethane foam (PUF) after installation at site of work. The rate shall be inclusive of complete door assembly, supply and installation by the approved manufacturer.
Double leaf un-insulated metal fire rated doorset of FD 120 classification with 120 minutes integrity only as per IS 3614:2021-For egress application like utility and service area.

Test

The door shutters shall be subjected to the following tests in accordance with IS 4020 (Part 1 to 16).

(a) *Dimension and Squareness Test :* Door shutters when tested in accordance with IS 4020 (Part 2) the dimensions of nominal width and height will be within a limit of ± 5 mm. The door shutter shall not deviate by more than 1 mm on a length of 500 mm. The thickness of the door shutter shall be uniform throughout with the permissible variation of not more than 0.8 mm between any two points. The nominal thickness of the shutter shall be within a limit of ± 1.5 mm.

(b) *General Flatness Test :* Door shutter, when tested in accordance with IS 4020 (Part 3) the twist, cupping and warping shall not exceed 6 mm.

(c) *Local Planeness Test :* Door shutters, when tested in accordance with IS 4020 (Part 4), the depth of deviation measured at any point shall not be more than 0.5 mm.

(d) *Impact Indentation Test :* Door shutters, when tested in accordance with IS 4020 (Part 5), shall have no defects such as cracking, tearing or delamination and the depth of indentation shall not be more than 0.2 mm.

(e) *Edge Loading Test :* Door shutters, when tested in accordance with IS 4020 (Part 7) the deflection of the edge at the maximum load shall not be more than 5 mm. On removal of the loads, the residual deflection shall not be more than 0.5 mm, failing which the test may be repeated on the other edge in the reverse direction. Also there shall be no lateral buckling by more than 2 mm during loaded condition and no residual lateral buckling after removal of the load.

(f) *Shock Resistance Test :* Door shutters, when tested in accordance with 2.1 of IS 4020 (Part 8) , there shall be no visible damage in any part of the door after twenty five blows on each end.

(g) *Buckling Test :* Door shutters, when tested in accordance with IS 4020 (Part 9), shall not show any deterioration and any residual deformation more than 5 mm after 15 min. of unloading and the initial deflection also shall not be more than 50 mm.

(h) *Slamming Test :* Door shutters, when tested in accordance with 2.1 of IS 4020 (Part 10), shall not have any damage in any part of the door at the end of successive impacts.

Door shutters, when tested in accordance with 3.1 of IS 4020 (Part 10), shall not have any visible damage in part of the door at the end of 100 successive impacts.

(i) *Misuse Test :* Door shutters, when tested in accordance with IS 4020 (Part 11), there shall not be any permanent deformation of the fixing or any other part of the door set in hindering its normal working after the test.

(j) *Screw Holding Test :* Door shutters, when tested in accordance with IS 4020- Part 16, the load shall not be less than 1000 N.

(k) *End Immersion Test :* Door shutters, when tested in accordance with IS 4020- Part 13, the shutter shall not show any delamination.

(l) *Knife Test :* Door shutter, when tested in accordance with IS 4020 – Part 14, the grading shall be standard & excellent.

(m) *Glue Adhesion Test :* Door shutters shall be tested in accordance with IS 4020 – Part 15. There should be no delamination.

Fixing of Shutters

PVC door shutter shall be side hung on three bolt hinges of size 100 mm, one at the centre and the other two at 200 mm from the top and bottom of the shutter. The flat of the hinges shall be neatly counter sunk in to the recesses cut out to the exact dimensions of the hinge flap. The door shall be drilled on the thickness to fit hinges. Screws for fixing the hinges shall be screwed in with screwdrivers and not hammered. The length of the screws should be 8 mm/30 mm. The hinges used should be of stainless steel.

Tolerance

The tolerance on the width and the height of the door shall be $\pm$ 5 mm and the tolerance on the nominal thickness of the door shall be $\pm$ 2 mm.

Fittings

Fittings shall be provided as per schedule of fittings. In moisture prone areas M.S. fittings and screws should not be used. Hardware such as handles, tower bolt, stopper, buffer etc. should be directly screwed (not pre-drilled) and fitted on the door.

PVC DOOR FRAME

Solid PVC door frame and shutter

Solid PVC Door Frames consisting of section 50 x 47 mm shall be fabricated from 5 mm PVC sheet having density of 600 kg./cum. The sheet used may be in plain colour, printed design or prelam veneer shade as approved by the SBI/ PMC / Engineer in charge. The weight per running metre of the door frame including reinforcement should be a minimum of 1.5 kg./sq. mtr. The depth of the rebate of door frame shall be 10 mm. Frames shall have smooth surface, without any warping or bending in any member. All the parts of the door frame are to be joined to each other using solvent adhesive conforming to IS 14182. A tolerance of $\pm$ 3 mm shall be permitted in the specified dimension of PVC section in the door frames.

The solid PVC door frames shall be fabricated in factory as per nomenclature of the item and directions of the SBI/ PMC / Engineer in charge.

PANEL PVC DOOR SHUTTER

Panel PVC Shutters are factory made shutter and shall be brought to site fully

assembled. The Solid Panel PVC Door shall be fabricated from 5 mm PVC sheet. The sheets used may be in plain colour, printed design or prelam veneer shade. The shutters shall be fabricated at factory as per nomenclature of the item and directions of the SBI/ PMC / Engineer in charge.

(a) 30 mm thick panel PVC door shutters

Fixing of Shutters

In addition, it may be ensured that while fixing hinges the screws pass through the two opposites surfaces of the M.S. reinforcement.

WIRE GAUZE FLY PROOF SHUTTERS

Specified timber shall be used, and it shall be sawn in the direction of the grains. Sawing shall be truly straight and square. The timber shall be planed smooth and accurate to the full dimensions, rebates, roundings and mouldings, before assembly. Patching or plugging of any kind shall not be permitted except as provided.

Stile and Rails

The Specifications shall be as described. The stiles and rails shall be given a rebate to receive the wire gauze which shall form the panels.

Wire Gauze

This shall be unless specified otherwise conform. The wire gauze shall be bent at right angles in the rebates of stiles and rails, turned back and fixed tight with blue tacks at about 75 mm centres, fixed alternately in the two faces of the rebates. Over this, wooden beading shall be fixed with brads or small screws at about 75 mm centres.

The space between the beading and rebates, where the wire gauze is bent, shall be neatly finished with putty, so that the end of the wire gauze may not be visible.

6MM THICK HIGH PERFORMANCE TOUGHENED GLASS

Providing and fixing 6mm thick High Performance Toughened Glass having properties of visible Light transmittance (VLT) 28%, ER 27%, IR 10 %, Solar Heat Gain Coefficient (SHGC) 0.30 and U-value 3.7 W/m2 degree-K etc. The performance values declared should be tested by third party as well. The thickness/ combination of the glass can vary as per the architects/consultants' suggestions after checking structural stability of the finalized glass panel.

Fixing Fittings, Wooden cleats, blocks and Measurement shall be as specified.

ROLLING SHUTTERS

Supplying and fixing rolling shutters of approved make, made of required size M.S. laths, interlocked together through their entire length and jointed together at the end by end locks, mounted on specially designed pipe shaft with brackets, side guides and arrangements for inside and outside locking with push and pull operation complete, including the cost of providing and fixing necessary 27.5 em long wire springs manufactured from high tensile steel wire of adequate strength conforming to IS: 4454 - part 1 and M.S. top cover of required thickness for rolling shutters. Providing and fixing ball bearing for rolling shutters.

Rolling shutters shall conform to IS 6248. These shall include necessary locking arrangement
and handles etc. These shall be suitable for fixing in the position as specified i.e. outside or inside on
or below lintel or between jambs of the opening. The door shall be either push and pull type or operated with mechanical device supplied by the firm. Shutters upto 10 sq. metre shall be of push and pull type and shutters with an area of over 10 sq. metre shall generally be provided with reduction gear operated by mechanical device with chain or handle, if bearings are specified for each of operation, these shall be paid for separately.

Shutter : The shutter be built up of inter locking lath section formed from cold rolled steel strips. The thickness of the sheets from which the lath sections have been rolled shall be not less than 0.90 mm for the shutters upto 3.5 m width. Shutters above 9 metres width should be divided in 2 parts with provision of one middle fixed or movable guide channel or supported from the back side to resist wind pressure. The lath section shall be rolled so as to have interlocking curls at both edges and a deep corrugation at the centre with a bridge depth of not less than 12 mm to provide sufficient curtain of stiffness for resisting manual pressures and normal wind pressure. Each lath section shall be continuous single piece
without any welded joint. When interlocked, the lath sections shall have a distance of 75 mm rolling centers. Each alternate lath section shall be fitted with malleable cast iron or mild steel clips securely riveted at either ends, thus locking in the lath section at both ends preventing lateral movement of the individual lath sections. The clips shall be so designed as to fit the contour of the lath sections.

Spring : The spring shall be of coiled type. The spring shall be manufactured from high tensile spring steel wire or strips of adequate strength conforming to IS 4454- Part I .

Roller and Brackets : The suspension shaft of the roller shall be made of steel pipe conforming to heavy duty as per IS 1161. For shutter upto 6 metre width and height not exceeding 5 metre, steel pipes of 50 mm nominal bore shall be used. The shaft shall be supported on mild steel brackets of size 375 x 375 x 3.15 mm for shutters upto a clear height of 3.5 metre. The siz of mild steel brackets shall be 500 x 500 x 10 mm for shutters of clear height above 3.5 m and upto 6.5 m. The suspension shaft clamped to the brackets shall be fitted with rotatable cast iron pulleys to which the shutter is attached. The pulleys and pipe shaft shall connected by means of pretensioned helical springs to counter balance the weight of the shutter and to keep the shutter in equilibrium in any partly open position.
When the width of the opening is greater than 3.5 mtr. The cast iron pulleys shall be interconnected with a cage formed out of mild steel flats of at least 32 x 6 mm and mild steel dummy rings made of similar flats to distribute the torque uniformly. Self aligning two row ball bearing with special cast iron casings shall be provided at the extreme pulley and caging rings shall have a minimum spacing of 15mm and at least 4 number flats running throughout length of roller shall be provided. In case of shutters of large opening with mechanical device for opening the shutter the roller shall be fitted with a purion wheel at one end which in contact with a worm fitted to the bracket plate, caging and pulley with two ball bearing shall be provided.

Guide Channel : The width of guide channel shall be 25 mm the minimum depth of guide channels shall be as follows: *Clear width of shutters Depth of guide channel* Upto 3.5 m 65 mm 3.5 m upto 8 m 75 mm 8 m and above 100 mm The gap between the two legs of the

guide channels shall be sufficient to allow the free movement of the shutter and at the same time close enough to prevent rattling of the shutter due to wind. Each guide channel shall be provided with a minimum of three fixing cleats or supports for attachment to the wall or column by means of bolts or screws. The spacing of cleats shall not exceed 0.75 m. Alternatively, the guide channels may also be provided with suitable dowels, hooks or pins for embedding in the walls. The guide channels shall be attached to the jambs, plumb and true either in the overlapping fashion or embedded in grooves, depending on the method of fixing.

Cover : Top cover shall be of mild steel sheets not less than 0.90 mm thick and stiffened with angle or flat stiffeners at top and bottom edges to retain shape.

Lock plates with sliding bolts, handles and anchoring rods shall be as per IS 6248.

Fixing

The arrangement for fixing in different situations in the opening shall be as per IS 6248.

Brackets shall be fixed on the lintel or under the lintel as specified with rawl. Plugs and screws

bolts etc. The shaft along with the spring shall then be fixed on the brackets.

The lath portion (shutter) shall be laid on ground and the side guide channels shall be bound

with ropes etc. The shutter shall then be placed in position and top fixed with pipe shaft with bolts and nuts. The side guide channels and cover frames shall then be fixed to the walls through the plate welded to the guides. These plates and bracket shall be fixed by means of steel screws bolts, and rawl plugs concealed in plaster to make their location invisible. Fixing shall be done accurately in a workmen like manner that the operation of the shutter is easy and smooth.

ROLLING GRILLS – SHUTTERS

Rolling grill shutter is meant to provide visibility or ventilation or both, the degree of protection

and safety is less as compared to a rolling shutter. The situations where a certain amount of ventilation combined with safety is required rolling shutter-cum-grill may be provided in which the rolling shutter may have a rolling grill portion either at the top or at the bottom or at both places. In addition, the rolling grill portion may also be provided in the middle of the shutter. The total height of the grill portion in all the segments of rolling shutter- cum-grill shall not exceed 1.0 m and the height of the grill portion in any individual segment shall not be more than 0.5 m. Rolling grills shutters are similar in design, construction and operation to rolling shutters and all the provisions of Para 10.8 shall be applicable to rolling grills shuters except in respect of the shutter portion, and shall conform to IS 6248.

Shutters

Rolling grill shutter and the rolling grill portion of the rolling shutter-cum-grill shall be fabricated with 8 mm diameter mild steel round bars. Straight bars and bars bent to the required profile are placed alternatively and held in position with 20 mm wide and 5 mm thick mild steel flat links. Straight bars shall be spaced not exceeding 150 mm centre to centre and the bars bent to required profile shall be placed symmetrically between two consecutive straight bars. Unless otherwise specified or directed by the SBI/ PMC / Engineer in charge, bars placed alternatively with straight bars shall be bent to form a corrugated profile such that the pitch of the corrugation is 100 to 120 mm and the depth of corrugation is 80 to 100 mm. all the bent bars shall have uniform profile. Straight bar along with the adjoining ben bars on it both sides shall be held in position by passing the bars through holes in the links. Each link shall have

three holes and the length of the links shall be such that the distance from the centre of th hole to the nearest edge of the flat is not less than the diameter of the hole. The corner of the links shall be rounded. All links shall be of uniform size and shape. The spacing of the links measured along the straight bar shall be the same as centre to centre distance between two consecutive crests/ troughs of the bars bent to the required profile. Each bar and link shall be continuous single piece without any joint.

24mm DGU (6mm Edge Natura Toughened Glass+ 12mm Air Gap+ 6mm AIS Clear Toughened Glass

24mm DGU (6mm Toughened Glass+ 12mm Air Gap+ 6mm AIS Clear Toughened Glass having properties of visible Light transmittance (VLT) 25%, ER 28%, IR 16%, Solar Heat Gain Coefficient (SHGC) 0.24 and U-value 2.0 W/m2 degree-K etc. The performance values declared should be tested by third party as well. The thickness/ combination of the glass can vary as per the architects/consultants' suggestions after checking structural stability of the finalized glass panel.

6mm thick Heat strengthened performance glass with reflective soft coating at face # 2 of silver shade on Clear Substrate of approved make having properties as visible Light transmittance (VLT) of 20 %, Light reflection internal 26%, light reflection external 31 %, Solar heat gain coefficient (.28), shading coefficient (0.33) and U value of 3.5 W/m2 degree K ,CRI value 92ra(d65). (VLT) of 20 %, Light reflection internal 26%, light reflection external 31 %, Solar heat gain coefficient (.28), shading coefficient (0.33) and U value of 3.5 W/m2 degree K ,CRI value 92ra(d65)

Windows Roller Blinds:-

Manual roller blinds with Blackout or Sunscreen fsbric 5% or 10%. Control clutch drive unit engineered heavy duty chain drive pulley operating system consisting of gear clutch housing and locking plug containing 6 ribs and flexible to be inserted in 37mm or 50mm Roller tube. It is self lubricating exclusive clutch with safety pins for secure bracket installation and unlocking pin for quick manual removal. Universal clutch is most convenient for large windows down to the smallest windows. It shall be driven by a ball chain pulley with plastic ball chain and can be universally positioned either Right hand or Left hand side of the shade. Clutch gear ratio 1.75:1for reduced operating force on larger blinds. Tube bearing plug Idler: Exclusive self lubricating spring loaded plastic bearing end plug with positive locking wheel allows for adjustment and provides for a secure installation and removal of shade. Tube bearing plug contains 6 ribs and flexible to be inserted in 37mm or 50mm roller tube. Mounting Hardware Brackets: Universal brackets including end plug bracket with lock down retainer device. Brackets finish of powder coated Aluminium installation brackets made of stamped and hardened steel with 46mm projection for wall, ceiling and side fitting with screws and end cap covers. Valance Systems: Flat extruded valance alloy 6060 and temper T66 EN755 size of 5.6mm * 84.5mm and wall thickness 1.6mm with standard powder coat white finish. Valance systems protect and hide the front of the fabric on the tube, creating a more sleek look. Roller Tube: Circular-shaped aluminium tube extruded from alloy 6060 and temper T66 - EN755 of 37mm inside diameter and outside diameter 40.2mm extruded tube to have a 1.6mm wall thickness with standard anodized natural finish. Heavily reinforced with minimum six internal ribs providing additional deflection strength and allows for secure placements of clutch and end plug. Bottom Rail: Flat-shaped extruded aluminium from alloy 6060 and temper T66 - EN755 of dimension 13mm * 30mm and wall thickness of

|1.5mm and weight more than 350g/m providing additional stability to avoid swaging and damage of shade fabric. Rail standard finish of powder coat white colour and provided end cover. Ball Chain: Shall be 2mm diameter cord with 4.5mm diameter acetal balls moulded coaxially to it on 11.8mm pitch to form an endless ball chain. It is used for raising or lowering action of the shades. Plastic parts: All plastic components are UV-stable compounds available white colour. Screen Fabric having Following Specification Composition: 24% PES+76% PVC Openness factor: Approx 5% Thickness: 0.56±5% mm Weight per :445 ±5% g/m2Weave: Basket Weave 2 x 1 Fire resistance: NFPA 701 Color fastness: AATCC16 Grade 4-5 Health/Safety certificate: Oekotex/GreenGuard Blackout fabric having following specifications: Composition- 100% fiberglass with PVC coated or equivalent. washable Openness factor- opaque Weight (gram/sqm)- min 407 g/sqm Thickness- min 0.51 mm Fire Classification- NFPA-701 or equivalent Fastness to light-6-7/8 or higher Indoor Air Quality- GreenGuard / Eco-Codice Certified.

WOODEN FIRE ACOUSTIC DOOR - W/O VISION PANEL:- Providing and fixing of Fully Insulated Non Metalic Fire cum Acoustic Wooden fire doors as per IS 3614:2021, for 120 min integrity & insulation. The door is manufactured made out of thoroughly seasoned hard wood. The moisture content of wood material used at the time of construction of wooden composite fire door sets comprises of both frame and shutter shall not be more than 15% approx. in accordance with IS 287. The fire door must carry a successful test evidence fire door design from CBRI , Roorkee / IPIRTI / NABL accrediated lab which operates in accordance with ISO/IEC 17025 for its fire rating. The offered door must carry acoustic properties certification test evidence. To achieve Acoustic prooperties, the shutter thickness should be minimum 77mm.

Door and frame should be factory finished with fire retardent primer FR880. All accressesories like hardware, vision panel, fire seal etc to be supplied by Fire door manufacturer only as per the guidelines laid down in IS 3614:2021. Every door must carry a label confirming to type of door & its fire rating. Door frame shall be Single rebate profile of section 140 x 90 mm made out of Ivory Coast (2nd Class)having density of 550-600 kg/m3 with factory made groove of suitable size so as to accomodate Fire seal of size 20x4mm of SEALz MAKE. An EPDM seal also to be provided in the frame to check spread of smoke.The frame must be primed with Fire retardant primer FR880 .

The frame to be fixed to fire exit opening with minimum 10 nos. 10 mm dia and minimum 120 mm long HDG (hot dip galavanized) CSK Philps headed screws with polyamide sleeves. Wooden shutter must be of minimum 77mm of thickness finished with 6mm thick commercial ply on both faces. The Shutter should be provided with 6mm thick commercial ply along with 1mm thick laminate on both faces . The composite thickness of the core insulation will be 63mm consists of minimum 10mm thick Calcium Silicate boards of Hilux / Pamtech make and treated wool Insulation material . The calcium silicate board must have Density not more than 900kg/m3 , having thermal conductivity 0.15W/mK . The shutter should be provided with heat activated intumescent fire seal strip of size 20mm x 4 mm mounted in the suitable grooves all three sides except bottom provided on Exposed OR concealed wooden lipping .

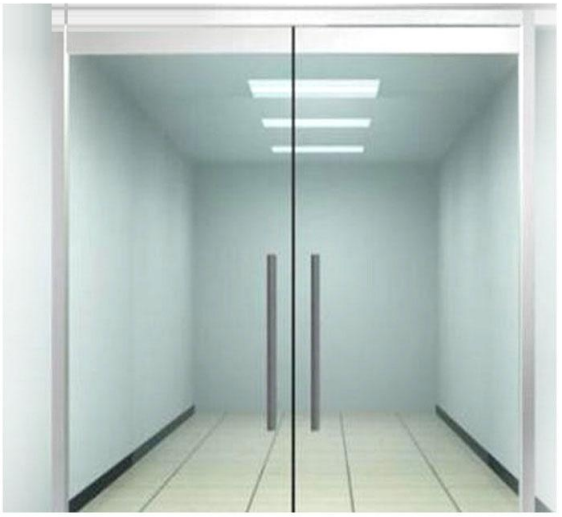
To achieve apporx. 32db properties necessary Acoustic seal set needs to be provided both in frame and shutter such as Perimeter seal in rebate of the main frame , Automatic drop down seal in bottom of the shutter and for double leaf application Artragal seal needs to be provided . These seals along with all hardware will be payable in extra items.

The shutters shall be mounted to the frame with SS 304 grade ball bearing type hinges of size 100x 89x3 mm alongwith all suitable hardware(Payable in extra item).DOUBLE LEAF WITH PANEL-WOODEN ACOUSTIC FIRE WITH FIXED ACOUSTIC WOODEN PANEL - MORICE DEAD LOCK + D TYPE PULL HANDLE 2400X4550 MM (DOOR SIZE - 2400X2400MM & Fixed Panel Size -

2400x2150mm) complete:- (S S BALL BEARING HINGES,DOOR CLOSER, DOOR STOPPER,MORTICE DEAD LOCK with 100 BSK,S S D TYPE HANDLE,CONCEALED FLUSH BOLT - WOODEN,AUTOMATIC DOOR BOTTOM SEAL,EPDM PERIMETER SEAL,FIRE SEAL,ASTRAGAL SEAL,FASTENER)

Frameless Glass Doors

12 mm thick frameless toughened glass door shutter of approved brand and manufacture, including providing and fixing top & bottom pivot & double action hydraulic floor spring type fixing arrangement and making necessary holes etc. for fixing required door fittings, all complete as per direction of Engineer-in charge including all fittings Door handle, lock and stopper etc. complete.



Frameless Glass Door

OTHER SPECIFICATIONS:

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

UPVC -General

The scope of work includes the design, fabrication, supply, and installation at site of all types of uPVC (unplasticized Polyvinyl Chloride) windows, doors, and ventilators in accordance with the approved architectural drawings and technical specifications.The supply and erection shall include all necessary components such as frames, sashes, glazing beads, hinges, locking mechanisms, handles, reinforcement profiles (GI/steel), gaskets, drainage holes, mosquito mesh shutters (if specified), and all associated hardware and accessories, whether or not specifically mentioned, but required to complete the work in all respects.

All uPVC units shall be factory-fabricated to fit the finished clear openings at site. The contractor shall verify all dimensions at site prior to fabrication. All works shall be carried out as per the drawings and to the satisfaction of the SBI/ PMC / Engineer in charge.

Materials

i. UPVC profiles shall be extruded from unplasticized polyvinyl chloride resin, with additives for UV resistance, impact resistance, and weather resistance. The profiles shall comply with ISO 12608-1 (uPVC Profiles for Windows and Doors – Classification, Requirements and Test Methods) and IS: 1661/IS: 14856/IS: 16061 or equivalent standards.

ii. The uPVC compound used for the profiles shall be lead-free and RoHS compliant. The formulation shall ensure long-term color stability, impact resistance, and dimensional stability under varying weather conditions.

iv. The minimum wall thickness of outer walls of profiles shall not be less than 2.5 mm, unless otherwise specified, and shall conform to Class B or Class A as per relevant standards.

v. All reinforcements used inside uPVC profiles shall be galvanized steel of minimum thickness 1.2 mm (for windows) and 1.5 mm (for doors), factory-fitted within profiles and properly fixed.

Finishing

i. Profiles shall have smooth and glossy surfaces free from defects.

ii. uPVC profiles shall be available in standard white, off-white, or laminated color finishes (wood-grain, anthracite grey, etc.) as per the architectural design. The lamination or foil finish shall be UV resistant and conform to quality standards.

iii. Any surface lamination or finish shall meet relevant standards and shall be accompanied by a manufacturer's test certificate.

Fabrication

i. Before commencement of fabrication, detailed shop drawings shall be submitted for approval, showing window/door details including profiles, reinforcements, opening types, locking arrangements, gaskets, joints, fixing methods, etc.

ii. All corners shall be fusion-welded for airtight joints. Mullions and transoms shall be reinforced and securely connected.

iii. All frames and sashes shall be reinforced internally with galvanized steel sections, properly anchored with screws as per manufacturer's guidelines.

iv. All fabricated components shall be dimensionally accurate, square, and free of twist or deformation. Profiles shall be cut with precision machines and fabricated in clean, dust- free

environment.

v. All joints shall be watertight and airtight. Provision shall be made for drainage holes with appropriate end caps or weep hole covers.

vi. The frames shall be fixed to the structure using anchor fasteners, screws, and silicone sealant or PU foam as required, ensuring firm installation and thermal insulation. Fixing shall be done using appropriate brackets, fasteners, and chemical sealants.

vii. Before fixing at site, all materials shall be adequately protected with masking film/tape to avoid scratches or surface damage. The protective tape shall be removed only after final cleaning and handing over.

Glazing

i. Glazing shall be carried out using toughened and thickness as per DBR, PART-D, or tender drawings. The glass shall be fitted using appropriate glazing beads and EPDM gaskets to ensure vibration-free, leakproof fit.

ii. All glass edges shall be polished or chamfered before fixing. Double glazing units (DGUs) shall be used wherever specified.

iii. All glass must conform to IS 2553 (Part 1): 2018 and relevant standards.

Hardware

i. All hardware (hinges, handles, locks, friction stay arms, etc.) shall be of uPVC-compatible material such as stainless steel (SS 316), aluminium alloy, or powder-coated zinc alloy of approved make.

ii. All exposed hardware shall be corrosion-resistant and shall conform to ISO 9227 (Salt Spray Test), tested for minimum 500 hours of corrosion resistance.

iii. Multipoint locking systems shall be provided for doors and casement windows. Sliding windows shall be fitted with suitable interlock systems, bearing rollers, and handles as per operational requirement.

Fly Proof Mesh

Fly proof stainless steel mesh made of SS grade 316 shall be provided in sliding/mosquito shutter frames, as specified in tender drawings. The mesh shall have an aperture of 1.4 mm × 1.4 mm and wire thickness not less than 0.50 mm. The mesh shall be fixed using EPDM gaskets or bead system, with provision for easy cleaning or replacement.

Grills (if specified)

In windows/doors where security grills are required, uPVC-compatible powder-coated aluminium or galvanized iron grills of approved pattern and finish shall be fixed using stainless steel screws at 200 mm c/c. All cut-outs for hardware operation and mesh fitting shall be neatly finished and aligned with architectural drawings.

Quality Assurance & Testing

i. All uPVC profiles and components shall be accompanied by manufacturer's test certificates conforming to applicable standards.

ii. Site installation and fabrication shall be checked and certified by the Engineer-in-Charge.

iii. The complete installation shall be water tested (for joints/seals) and air infiltration tested.

iv. All works shall conform to CPWD norms.

7.3. WPC DOORS

General

i. The WPC (Wood Plastic Composite) door shutters shall be made of a solid extruded core composed of wood fiber (or sawdust), thermoplastic polymer (PVC/PE/PP), and

additives including stabilizers, lubricants, and colorants. The material shall be factory- made, homogenous, termite-proof, waterproof, corrosion-resistant, and suitable for both wet and dry areas. All WPC doors shall comply with relevant standards and be approved by the SBI/ PMC / Engineer in charge.

ii. WPC doors shall be free from warping, delamination, swelling, or rotting under humid and wet conditions and shall be suitable for use in bathrooms, kitchens, or general- purpose internal applications. The Contractor shall submit product brochures, test certificates, and samples for approval before procurement and installation.

Material Standards and Composition

i. The WPC door shutters shall be manufactured using virgin or partially recycled wood fibers (or other cellulosic material) and thermoplastic resins (PVC or equivalent), with necessary additives.

ii. The WPC material must conform to ISO 16616:2015 – Plastics — Wood-plastic recycled composites (WPRC) and IS 4020 (Parts 1 to 16) for flush door testing standards.

iii. The density of the WPC door shall not be less than 600 kg/m³, and the material shall be free from voids, blowholes, or internal defects. It shall meet Class 1 fire retardant classification, wherever specified.

iv. The door core shall be solid, homogeneous, and without hollow sections unless otherwise specified. Profiles or designs, if any, shall be factory-molded.

iv. Manufacturer's test certificate must to beincluded

Sizes and Thickness

i. The standard door thickness shall be as per design or drawings.
ii. Door heights and widths shall conform to finished clear openings as per site measurement and drawings.
iii. Any variation in size for toilet, shaft, or service area doors shall be accommodated as per architectural drawings.

Finishing and Lamination

i. WPC door shutters shall be provided either plain (ready-to-paint), pre-laminated with PVC/laminate film, wood-grain textured, or factory finished with heat-pressed decorative laminated sheet, depending on the finish schedule and tender drawings.

ii. Laminated or pre-finished surfaces must be UV-resistant and scratch-resistant. Decorative laminates shall comply with IS 2046:1995 (or equivalent ISO standard).

iii. Edges of the door shall be banded with matching WPC strips or edge bands using hot melt adhesive. Alternatively, edges may be integral if door is single-piece molded.

Fabrication and Installation

i. Fabrication shall be done in factory-controlled environment. Doors shall be properly cut, machined, and edge-finished before dispatch to the site.

ii. All hardware cutouts shall be made using precision routers to avoid cracking. Pilot holes must be drilled before fixing screws to avoid splitting.

iii. Site installation shall be carried out using stainless steel screws and compatible sealants or PU foam. Hinges, locks, and other hardware must be compatible with the screw-holding capacity of WPC material.

iv. The Contractor shall ensure proper fitting and alignment of shutter within the frame and maintain uniform gaps for expansion and ease of movement. Gaps shall be sealed using weather-strips if specified.

Frames (if included)

i. WPC frames, if used, shall be of matching composition and color, with density not less than 650 kg/m³, and shall have provision for receiving screws and hinges.

ii. Frames shall be fixed using SS holdfasts, anchor bolts, and filled with PU foam. All frame-to-masonry joints shall be sealed with silicone sealant.

Hardware

i. All hardware used shall be of stainless steel (SS 316), compatible with WPC material. Hinges, locks, handles, tower bolts, and door closers shall be of heavy-duty type and approved make.

ii. All fasteners shall be fixed with pre-drilled pilot holes. Screws used shall be corrosion- resistant and counter-sunk neatly.

Quality Control and Testing

i. Each batch of WPC doors shall be accompanied by factory test certificates confirming physical and mechanical properties as per ISO and IS standards.

ii. The SBI/ PMC / Engineer in charge reserves the right to get any door sample tested in an approved laboratory. All defective doors shall be removed from site at the Contractor's cost.

iii. Tolerance in dimensions shall be as per IS 4020 / ISO 16929 (or equivalent for flat panels).

7.4 Aluminium Works

a. General

i. The scope of the work is the fabrication, supply and erection at site of all types of Aluminium glazed doors, windows and ventilators in accordance with the drawings and specifications.

ii. The supply and erection will include all parts such as but not restricted to frames, tracks, guides, mullions, styles, rails, couplers, transoms, rails, plates glazing bars, glass, hinges, arrangement, spring catches, cord and pulley arrangements, spring catches, cord and pulley arrangements door closers floor springs etc., required for the whole work whether the parts/ items are individually and specifically referred to in the schedules/ specifications/drawings or not provided that the supply and installation of such parts can be inferred there from and are necessary to make the work complete, unless separate provision is made in the bills of quantities for supply to such parts/items.

iii. The doors, windows, ventilators, will be fabricated to suit the finished clear openings in the building/structure which the tenderer will himself measure.

b. Materials: -

i. The members will be made out of aluminum alloy corresponding to IS:733 and will consist of extruded sections and of other shapes, and to sized gauges as shown in the drawings/ described in accordance with the relevant IS codes. The members shall be chosen to provide strength/ stability and maximum resistance to wear and tear.

ii. The Sections will be as per approved makes, extruded sections. As indicated in the

drawings the tenderer should specifically mention which sections he is using.

iii. The IS specifications are to be strictly adhered.

iv. The extruder using recycled materials may be preferred.

v. The alloy of extruded aluminum should be BS or IS 733, Alcon 50 SWP. to this effect test certificate has to be provided for the extruder.

c. Finishing:

i. The extruded aluminum section has to be mechanically finished to remove all scratches; extrusion marks etc and subsequently thoroughly cleared in all alkali baths prior to anodizing.

ii. The polyester powder coating/powder coating, as required, as per item of work, shall be of desired shade with minimum average thickness to 50 microns or other shades as required and to this effect the tenderer must have to produce test certificate from authorized institutions Bureau of Indian Standard.

iii. The polyester powder coated/powder coated material should be properly wrapped in gummed tape before fabrication to avoid scratches during fabricated and erection shall be kept protected till handing over.

d. Fabrication:

i. Before commencing the fabrication, the Contractor shall submit to the PMC / Engineer – in - charge for their approval detailed shop drawings, based on the approved Architectural drawings and corresponding specification showing junctions, fittings, accessories such as hinges flush bolts, locks, latches, latching arrangements, peg stays, rotor arms, anodize pivots gaskets rubber packing door felts, mastic, sealant etc., including fixing and sealing arrangements. Type and method of scaffolding he intends to use, Fabrication is to be taken up only after approval by the Engineer – in - charge and in accordance with the approved drawings. Sections for fabrication of door/ window/ventilators etc. shall be as per architectural drawings or as approved by the Engineer – in - charge.

ii. A sample of finished door / windows/ ventilator railing etc. shall be fabricated as per the shop drawings approved by the Engineer – in - charge for final approval before under taking mass production/ fabrication,

iii. The doors, window, ventilators and partitions shall be as per thickness given in the approved shop drawings, Polyester Powder coating / Powder coating shall be as specified in the item specifications.

iv. All materials shall confirm to relevant IS. Codes and in the absence of IS code, they should correspond to the best engineering practice; decision of the Engineer – in - charge shall be final and binding on the Contractor.

v. Fabrication shall be done true to the drawing/ sample approved and in correspondence to the finished openings at the site. All joints shall be mitered at the corners, true right angles, and joints to be finished neatly to hairlines, with concealed fasteners, wherever possible joints shall be made in concealed locations.

vi. All fabricated/finished items shall be packed and carted properly to site to prevent any damage in transit. On receipt at site they shall be carefully stacked in protected storage to avoid distortion/damage.

vii. Site installation shall be with concealed screws, self-tapping or other approved fasteners or may be by welding, due precautions shall be taken to avoid any distortion/ discoloration /damage to the finished items.

viii. Wood work faces /parts coming in contact with masonry shall before shifting to the site be given a heavy coat of alkali resistance bitumen paint. Steel items coming in contact with other incompatible materials shall be given a thick coat of zinc chromate primer.

e. Glazing**:**

The glazing shall be as specified in DBR, PART-D & tender drawings or as per CPWD specifications keeping into consideration the size of opening or panels of the glass.

f. Hardware:

All hardware for doors and windows shall be of Powder coated aluminum or as specified in DBR / tender drawings

g. Fly proof SS wire mesh: Fly proof stainless steel grade 316 wire gauge mesh to be provided in windows and Main Doors entrance doors as specified in Finishing schedule/ tender drawings shall with average width of aperture 1.4 mm in both directions with wire of dia. 0.50 mm all complete

h. Aluminum Grills: Powder Coated Aluminium grill (minimum 50 micron) of approved design/pattern, with approved standard section shall be fixed to the window frame / Door Frame with stainless steel screws @ 200 mm centre to centre, including cutting the grill to proper opening size for fixing and operation of handles and fixing approved aluminium standard section around the opening, all complete as per requirement as specified in Finishing schedule/ tender drawings and direction of PMC/SBI/ PMC / Engineer in charge.

Aluminium Sections

Aluminium sections used for fixed/openable windows, ventilators, partitions, frame work & doors etc. shall be suitable for use to meet architectural designs to relevant works and shall be subject to approval of the SBI/ PMC / Engineer in charge for technical, structural, functional and visual considerations. The aluminium extruded sections shall conform to IS 733 and IS 1285 for chemical composition and mechanical properties. The stainless steel screws shall be of grade AISI 304.

The permissible dimensional tolerances of the extruded sections shall be as per IS 6477 and shall be such as not to impair the proper and smooth functioning/ operation and appearance of door and windows.

Aluminium glazed doors, windows etc. shall be of sizes, sections and details as shown in the drawings. The details shown in the drawings may be varied slightly to suit the standards adopted by the manufacturers of the aluminium work, with the approval of Engineer-In-

Charge. Before proceeding with any fabrication work, the contractor shall prepare and submit, complete fabrication and installation drawings for each type of glazing doors, windows, ventilators and partition etc. for the approval of the SBI/ PMC / Engineer in charge. If the sections are varied, the contractor shall obtain prior approval of Engineer-in- Charge.

Powder Coating

Material: The powder used for powder coating shall be Epoxy/polyester powder of make approved by the

SBI/ PMC / Engineer in charge. The contractor shall give detailed programme for powder coating in advance, to facilitate the inspection by SBI/ PMC / Engineer in charge or his authorized representative.

Pre-treatment: Each aluminium alloy extrusion or performed section shall be thoroughly cleaned by alkaline or acidic solutions under the conditions specified by chemical conversion coating supplier and then rinsed. A chemical conversion coating shall be applied by treatment with a solution containing essentially chromate ions or chromate and phosphate ions as the active components as applicable. The amount of the conversion coating deposited depends on the type used by the conversion coating chemical supplier. The conversion coating shall be thoroughly rinsed either with the solution specified by the conversion coating chemical supplier or with de-mineralized water and then dried at the temperature for the time specified by the conversion coating chemical supplier. The contractor shall submit the detail specifications and application procedure for application of conversion coating for approval of SBI/ PMC / Engineer in charge. The metal surface after the conversion coating pretreatment and prior to the application of the coating shall be free from dust or powdery deposits.

Process: The polyester powder shall be applied by electrostatic powder spray method. Before start of powder coating the contractor shall submit detail specification for application of polyester powder from manufacturer of the polyester powder for approval of Engineer-In- Charge. The powder coating shall be applied as per the specification approved by Engineer- In-Charge.

Thickness: The thickness of the finished polyester powder coating measured by micron meter shall not be less than 50 micron nor more than 120 micron at any point.

Performance Requirements for the Finish

(i) Surface appearance: The finish on significant surfaces shall show no scratches when illuminated and is examined at an oblique angle, no blisters, craters; pinholes or scratches shall be visible from a distance of about 1 m. There shall not be any visible variation in the colour of finished surfaces of different sections and between the colours of different surfaces of same section.

(ii) Adhesion: When a coated test piece is tested using a spacing of 2 mm between each of the six parallel cuts (the cut is made through the full depth of powder coating so that metal surface is visible) and a piece of adhesive tape, approximately 25 mm x 150 mm approved by the SBI/ PMC / Engineer in charge is applied firmly to the cut area and then removed rapidly by pulling at right angles to the test area, no pieces of the finish other than debris from the cutting operation shall be removed from the surface of the finish.

Protection of Powder Coated / Anodizing Finish: It is mandatory that all aluminium members shall be wrapped with self-adhesive non-staining PVC tape, approved by Engineer- In-Charge.

Aluminium Frame:- Providing and fixing aluminium work for doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing / paneling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of SBI/ PMC / Engineer in charge. (Glazing, paneling and dash fasteners to be paid for separately) Powder coated aluminium (minimum thickness of powder coating 50 micron)

Shutters

For shutters of doors, windows & ventilators including providing and fixing hinges/ pivots and making provision for fixing of fittings wherever required including the cost of EPDM rubber / neoprene gasket required

Glazing In Aluminium

Providing and fixing glazing in aluminium door, window, ventilator shutters and partitions etc. with EPDM rubber / neoprene gasket etc. complete as per the architectural drawings and the directions of SBI/ PMC / Engineer in charge . (Cost of aluminium snap beading shall be paid in basic item)

Filling the gap in between aluminium/ stone/ wood frame and adjacent RCC/ Brick/ Stone/ wood/ Ceramic/ Gypsum work by providing weather/structural non sag elastomeric PU sealant over backer rod of approved quality as per architectural drawings and direction of SBI/ PMC / Engineer in charge complete, complying to ASTM C920, DIN 18540-F & ISO 11600

Providing and fixing 12 mm thick prelaminated particle board flat pressed three layer or graded wood particle board conforming to IS: 12823 Grade l Type ll, in panelling fixed in aluminum doors, windows shutters and partition frames with C.P. brass / stainless steel screws etc. complete as per architectural drawings and directions of SBI/ PMC / Engineer in charge. Pre-laminated particle board with decorative lamination on both sides

7.5 Fire Check Doors (Including Fire- Door Position Switch): -

i) SCOPE

This specification covers the design, supply of materials, Manufacture and installation of factory made special type of approved make steel fire doors of 2 Hrs rating.

ii) CODES AND STANDARDS

All standards, specifications, acts, and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions.

List of certain important Indian Standards, Acts and Codes applicable to this work is given below. However, the applicable standards and codes shall be as per but not limited to the list given below:

IS : 277	Galvanised steel sheet (plain and corrugated)
IS : 3614(Part-2) 1992	Metallic and non-metallic fire check doors – Resistance test and Part – 2 performance criteria.

iii) GENERAL

Test Report of the Prototype: The door frames and shutters shall be fabricated from approved manufacturers with materials and specifications identical to those for the prototype test report in accordance with IS:3614 (Part-2) 1992 submitted to the SBI/ PMC / Engineer in charge, and execution of the work shall commence only after obtaining his approval in writing. The test report shall include the information prescribed in clause 10 of IS:3614(Part2) 1992.

Testing: The SBI/ PMC / Engineer in charge may select, out of the fire door and shutter, assemblies brought at site, random samples for testing. The contractor shall make all arrangement for testing of the sample as per IS: 3614(Part2) 1992 and submit the test result to SBI/ PMC / Engineer in charge.

In case the test result is satisfactory testing charges (which includes the cost of sample and transportation) shall be paid by Engineer- in-charge. If the test result indicates that the fire door assembly does not conform to the requirement of IS:3614 (Part2) 1992 for FD/60/120/180, the entire lot of the material shall be rejected. In later case, no testing charges shall be paid.

The Contractor shall furnish all materials, labour, operations, equipment, tools & plant, scaffolding and incidentals necessary and required for the completion of all metal work in connection with steel doors, as called for in the drawings, specifications and bill of quantities which cover the major requirements only. Anything called for in the tender documents shall be considered as applicable to the items of work concerned. The supply and installation of additional fastenings, accessory features and other items not specifically mentioned, but which are necessary to make a complete functioning installation shall form a part of this contract.

All metal work shall be free from defects, impairing strength, durability and appearance and shall be of the best quality for purposes specified made with structural proprieties to withstand safety strains, stresses to which they shall normally be subjected to.

All fittings shall be of high quality and as specified and as per approval.

The Contractor shall strictly follow, at all stages of work, the stipulations contained in the Indian Standard Safety Code or its Equivalent British Standard and the provisions of the safety code and the provision of the safety rules as specified in the General Conditions of the Contract for ensuring safety of men and materials.

Any approval, instructions, permission, checking, review, etc., whatsoever by the Engineer-in- charge shall not relieve the Contractor of his responsibility and obligation regarding adequacy, correctness, completeness, safety, strength, quality, workmanship, etc.

The fire check doors shall satisfy:

a. Stability: The fire check door should not collapse during the rated period of fire under the specified fire conditions. The fire check doors provide safe access to the escape route in the building namely protected corridors and staircase.

b. Integrity: The fire check door should not allow the passage of hot gases or the flames through the rebate or the gap between the door frame and shutters for the duration of its fire rating.

c. Insulation: The mean temperature of the fire door on the unexposed side should not exceed 140 degrees C above ambient temperature for the duration of its fire rating. The fire/smoke check door assembly being offered shall be as prototype tested by CBRI, Roorkee or any other approved laboratory for the prescribed fire rating as per BS:476 part20/22, IS:3614 part-II. A test report from CBRI Roorkee shall be submitted for approval before executing the work. The fire/smoke check doors should also have Tarriff Advisory Committee approval as admissible. The tenderer shall employ specialized agency or manufacturer of the fire check door assembly having their own manufacturing facility and such agency shall be got approved by the Engineer- in-charge. Door frame and shutter shall in general be

fabricated as per the nomenclature of the item of the work and recommendations of the specialized agencies as approved by the SBI/ PMC / Engineer in charge.

d. Fire check doors shall be 2 hour or as specified fire rated and shall satisfy the three performance criteria of stability, integrity and insulation as per BS:476 part20/22, IS:3614 part-II.

e. One door assembly shall be got tested from CBRI Roorkee or any other test laboratory approved by Engineer- in-charge as per the nomenclature of the item for the same.

f. The tenderer shall be responsible for obtaining 'No Objection Clearance' from local fire authority for the executed work.

g. Guarantee Bond: The work shall be guaranteed for a period of five years from the date of N.O.C. issued by the local fire authority. The security deposit against this item of work shall be in addition to the security deposit mentioned in Schedule-F. The contractor shall execute the necessary guarantee bond against any structural defect, faulty materials, workmanship and defective finish. In addition, 5% (five percent) of the cost of this item of work shall be retained as security deposit and the amount so withheld would be released after five years from the date of completion of the entire work under the agreement, if performance of the work is found satisfactory. If any defect is noticed during the guarantee period, it shall be rectified by the contractor along with any incidental repairs to the structure, flooring, finishing, fixtures and any other related damaged work within fifteen days of receipt of intimation of such defects in the work. If the defects pointed out are not attended to within the specified period, the same shall be got done from another agency at the risk and cost of the contractor and the cost of the attending such repairs shall be deducted from any dues payable to the contractor. However, the security deposit deducted may be released in full against bank guarantee of equivalent amount in favour of SBI/ PMC / Engineer in charge in the prescribed proforma.

7.6 Fire Check Glazed Doors & Windows: -

7.6.1 Composition of the Doors & Windows

All materials, items, hardware etc. shall be subjected to approval by Engineer-In-Charge. Necessary documentation/ test certificates shall be furnished by the Contractor for such approval. FCD & FCW shall be fabricated only after approval of materials etc, by SBI/ PMC / Engineer in charge.

Each FCD & FCW shall be provided with a small metal identification plate in suitable location indicating Fire rating, name of the Manufacturer, date of installation and approval of approved test house.

Each vision panel shall carry a stamp of the manufacturer.

Unless otherwise mentioned elsewhere, all FCD & FCW shall be of two hours (120 Mins.) and all door integrity and thermal insulation). For glazed fire rated door it should exhibit integrity , stability and radiation control for 120 mins and insulation for the first 30 mins. The glazed fire doors shall be manufactured as per the nomenclature of the item an as per the manufacturers specification as per the best engineering practice and as per the drawing and direction of SBI/ PMC / Engineer in charge.

The glass panels shall be double glazed with thickness as specified clear, interlayered, 120 min. rated, non wired toughened glass of approved make complies to BS476 Part22 or (EN-1634-1:1999). The glass shall be complied to Class 1B1 Category of Impact Resistance to EN:12600 safety Glazing Material. The system should be tested as per EN:1364 Part-1-1999 or equivalent standard.

7.7 Fire Check Glazed Partition: -

Fire Check Glazed Partition with galvanized steel frame 120-minute fire rated – fully glazed non

load bearing fixed partition shall be of proprietary design of the manufacturers as per the valid fire test certificate from /EN/BS from National or international test lab. Frames and glass panels shall be as per the nomenclature of the item.

7.7.1 **INSTALLATION**

Shop drawings of the doors, windows and partitions in accordance to the prototype profiles used to obtain fire test certificate by approved national or international test house shall be prepared and submitted for approval by the SBI/ PMC / Engineer in charge. The shop drawings shall include all details of construction, anchoring, connections, fastenings etc. Any suitable modification in fittings, fixtures as required for project specific installations shall have to be incorporated in door profile and approval obtained prior to the installation of the door.

i. Vision Panel: -

The Fire Rated Glass shall be minimum 11 mm thick interlayered , 120 minutes fire Rated (EW120, EI 15 minutes) Non Wired, Toughened Interlayered Glass of approved make which can also withstand thermal shock upto 800 degree centigrade shall be used as a glazing (Vision Panel Top/side fixed glazing) and is to be fixed in between the glass beading by using ceramic fiber in accordance with BS: 476 Part 22/ EN 1363 EN 1364 for stability and integrity of size 300 mm x 500mm (Clear vision) and the manufacturer should have tested the glass of similar or bigger size with any type of door framing. The Location of the Fire Glass will be as per the directions of PMC/SBI/ PMC / Engineer in charge.

ii. Finish: -

The door frame and door shutter shall be finished with minimum two or more coats of thermo setting acrylic paint for scratch resistance and durability on hard wooden surface (@3.5 sq.mtr. per ltr., per coat) including preparation of base surface as per recommendation of manufacturer to make the surface fire retardant. The paint shall be of approved brand and quality.

iii. Ironmongry Hinges: -

Fire rated SS Ball Bearing Hinges with SS Screws (4 Nos per panel)

b. Metal Fire Doors & Frames: - These shall confirm to CPWD specifications.

i. Door Frames**:** -

Door frame shall be double rebate profile of requisite sections made out of 1.60mm (16gauge) minimum thick galvanized steel sheet. NDRF requisite size Frames shall be Butt jointed and field assembled with self-bolted. The frames should be finished with Thermosetting Powder Coating in desired RAL Shade. All provision should be mortised, drilled and tapped for receiving appropriate hardware. Frames should be provided with back plate bracket and anchor fasteners for installation on a finished plastered masonry wall opening. The frame shall be fixed with 8 nos. suitable size metal dash fasteners of approved brand and manufacture as per direction of PMC/SBI/ PMC / Engineer in charge.

ii. Door Shutter: -

The Door Shutter shall be of requisite thickness fire resistant door shutters of 120 minutes fire rating confirming to IS:3614 (Part-II), tested and certified as per laboratory approved by PMC/SBI/ PMC / Engineer in charge, with suitable mounting on door frame, consisting of vertical styles, lock rail, top rail 100 mm wide, bottom rail 200 mm wide, made out of 16 SWG G.I. sheet (zinc coating not less than 120 gm/m2) duly filled FR insulation

material and fixing with necessary stainless steel ball bearing hinges of approved make, including applying a coat of approved fire resistant primer etc. all complete as per direction of PMC/SBI/ PMC / Engineer in charge

iii. Vision Panel: -

The Fire Rated Glass shall be minimum 11 mm thick interlayerd , 120 minutes fire Rated (EW120, EI 15 minutes) Non Wired, Toughened Interlayered Glass of approved make which can also withstand thermal shock upto 800 degree centigrade shall be used as a glazing (Vision Panel Top/side fixed glazing) and is to be fixed in between the glass beading by using ceramic fiber in accordance with BS: 476 Part 22/

EN 1363 EN 1364 for stability and integrity of size 300 mm x 500mm (Clear vision) and the manufacturer should have tested the glass of similar or bigger size with any type of door framing from CBRI Roorkee . The Location of the Fire Glass will be as per the directions of PMC/SBI/ PMC / Engineer in charge.

iv. Finish: -

The door frame and door shutter shall be finished with minimum two or more coats of thermosetting acrylic paint for scratch resistance and durability on hard wooden surface (@3.5 sq.mtr. per ltr., per coat) including preparation of base xsurface as per recommendation of manufacturer to make the surface fire retardant. The paint shall be of approved brand and quality.

v. Ironmongry Hinges: -

SS Ball Bearing Hinges of size 100 x 75 x 3mm complete with SS Screws of BB1953 Becker F.S / 3090F DORMA / 8011008 GEZE Make (4 Nos per panel) or equivalent approved by SBI/PMC in charge

c. **Fire Resistant Glazed Doors, Windows & Partitions:**

i. General

The Fire Resistant Glazed Doors (hereinafter termed as FRGD), Fire resistant Glazed windows (hereinafter termed as FRGW) and Fire Resistant Glazed Partition (hereinafter termed as FRGP) shall not collapse during the rated period of fire under the specified fire conditions and shall provide safe access to the escape route.

ii. Codes & Specifications

All materials, items, hardware etc. shall be subjected to approval by SBI/PMC in charge Necessary documentation/ test certificates shall be furnished by the Contractor from the manufacturer before supply of material for approval by PMC/SBI/ PMC / Engineer in charge. Each Door/Window and Partition shall be provided with a small metal identification plate in suitable location indicating Fire rating, name of the Manufacturer, date of installation and details of approved test house. Each Glazing pane shall carry a permanent stamp of the manufacturer.

The complete assembly of the doors i.e. frame, shutter, vision glass and hardware shall have fire rating as required and shall confirm to:

			Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware - Part 1: Fire resistance test for door and shutter assemblies and openable windows
			Fire resistance tests for non-load bearing elements –Part 1: Walls
			Determination of luminous and solar characteristics of glazing.

			Glass in Buildings – Pendulum test – Impact test and classification for flat glass

iii. Testing& Certification

The FRGD, FRGW & FRGP shall be supplemented with appropriate certification by fire test lab, for applicable or higher dimension with complete description of the architectural components and hardware for FRGD, FRGW and FRGP for which the approval is given. Along with the material tests, the complete system along with the framing shall be tested in accordance with the criteria of EN1634-1 for door/ window and EN1364-1 for partition. The installation of the fire rated system shall confirm to requirement of test evidence. The choice of hardware and/or glazed accessories shall be as per test evidence.

iv. Frame for Fire Resistant Glazed Door / Windows

Frame for Door/Window of 120 min fire rating shall be made of section 50 x 60 mm on horizontal side & 35 x 60 mm on vertical sides having built in rebate made out of 1.6 mm thick GI sheet (Zinc coating not less than 120gm/m^2) suitable for mounting 120 min Fire Rated Glazed Door Shutters. The frame shall be filled with Mineral wool Insulation having density min 96Kg/m^3. The frame will have a provision of G.I. Anchor fasteners
14 nos (5 each on vertical style & 4 on horizontal style of size M10 x 80) suitable for fixing in the opening along with Factory made Template for SS Ball Bearing Hinges of Size 100x89x3mm for fixing of fire rated glazed shutter . The frame shall be finished with a approved fire resistant primer or Powder coating of not less than 30 micron in desired shade as per the directions of Engineer - in- charge. (Cost of SS ball bearing hinges is excluded).

v. Frame for Fire Resistant Glazed Partitions

Frame for non-load bearing fixed fire resistant glazed Partition for 120 min Fire Rating shall be made out to a profile of dimension 60mm x 70 mm of 1.6 mm thick galvanised steel sheet

as per test evidence suitable for fixing fire rated glass for 120 min of both integrity & radiation control (EW120) & minimum 15 min of insulation (EI15).The profile has to be fixed to the supporting construction by means of anchor fasteners of size M10 x 80, every 150 mm from the edges and every 500 mm (approx) c/c. The frame shall be filled with mineral wool insulation of density min 96kg/m³. and finished with a approved fire resistant primer or Powder coating of not less than 30 micron in desired shade as per the directions of Engineer - in- charge.

vi. Shutter for Fire Resistant Doors/Windows

Glazed fire resistant door shutters 60 mm thick of 120 min Fire Rating shall be confirming to IS:3614 (Part II) or EN1634-1:1999, tested and certified as per laboratory approved by PMC/SBI/ PMC / Engineer in charge, with suitable mounting on door frame, consisting of vertical styles, top rail & side rail 60 mm x 60 mm wide and bottom rail of 110 mm x 60 mm made out of 1.6mm thick G.I. sheet (zinc coating not less than 120gm/m²) duly filled mineral wool insulation having density min 96 kg/m³ and fixing with necessary stainless steel ball bearing hinges of size 100x89x3mm of approved make, including applying a coat of approved fire resistant primer or powder coating not less than 30 micron etc all complete as per direction of PMC/SBI/ PMC / Engineer in charge.

vii. Fire Resistant Glass for Doors/Windows and Partitions

Glazing to be fixed in fire resistant doors/window shutters and fixed Partitions with G.I. beading made out of 1.6 mm thick G.I. sheet (zinc coating not less than 120 gm/m²) of size 20 x 33 mm screwed with M4 x 38 mm SS screws at distance 75 mm from the edges and 150 mm c/c , including applying a coat of approved fire resistant

primer/powder coating of not less than 30 micron on G.I. beading, & special ceramic tape of 5 x 20 mm size etc complete in all respect as per direction of PMC/SBI/ PMC / Engineer in charge. The glass should be clear, toughened, interlayered, non- wired fire resistant having 11 mm minimum thickness of approved brand with 120 minutes of fire resistance both integrity & radiation control (EW120) and minimum 15 min of insulation (EI15) and having a sound reduction of more than 35dB and LT of 85%. Glass shall be compliant to class 2B2/1B1 category of Impact Resistance as per EN 12600. The glass should be manufactured in UL & TUV audited Facility and including UL-EU Certification. The maximum glazing size cannot be more than 1100 mm x 2200 mm (w x h) or 2.42 sq mts in total area. The test report for the complete system (Glazed Door or Partition) will be considered valid only if it contains the stamp and signature of the authorized signatory from the glass manufacturer.

The complete assembly shall satisfy the given criteria of fire resistance - stability, fire integrity, radiation control and insulation as per above mentioned rating required.

viii. Vision Panel for Fire Door Specifications for glass for Vision panels for Fire Rated Door shall be as per para iv above. The size of glass to be used for vision panels shall be as per tender drawings.

d. Fire Doors Fittings

All work is to be carried out in accordance with relevant IS Code and specification for Fire Door & fitting as per IS: 3614 (Part I) – 1966 and direction of SBI/ PMC / Engineer in charge. Door shall be fixed with fire rated hinges 5 Knuckle, 2 bearing butt hinges size 4" x 3" x 3mm, in SS 316 and in satin stainless steel, as per EN 1935, CE Marked.

i. Mortice Lock: 2 hrs., fire rated mortice lock with lever handle tested in accordance with BS: 476 Part 22. A minimum one-year warrantee shall be provided. Mortice sash lock with internal thumb turn and external key operation with lever handles shall be provided.

ii. Flush Bolts (For Double Door): - 300mm concealed extended lever action flush bolts satin

finish, fixed to top and bottom of the inactive blade shall be provided.

iii. Automatic Door Closer: - Dual adjustable speed automatic door closer with rack and pinion method, in confirmance with BS:476 Part 22 (for fire rating) and BS EN1154 shall be provided. The door closer shall have minimum of one-year warrantee.

iv. Pull Handle: 300mm long stainless steel grade 316 D type pull handle shall be fixed with necessary screws etc. complete. A minimum one-year warrantee for the product shall be provided.

v. Fire Rated Panic exit device: - It shall be suitable for door weights up to 120kgs. The Panic bar as per door leaf (SINGLE LEAF/DOUBLE LEAF) shall consist of Main Panic Latch component, End Component, Push bar, Striker Kit, end caps in Silver finish. Complete set with screws & fixing accessories, External trim, having fire rated door closer TS 71/68 rack and pinion door closer EN size 3/4, with std. arm and with two independent closing valves and latching speed adjustable by arm. Full plastic cover. Silver finish. As per EN 1154 life cycle 500,000 with seals and door stopper. The device shall be complete in all respect and fixed as recommended by the manufacturers. A minimum one-year warrantee for the product shall be provided.

vi. Smoke Seals: - Heavy duty smoke seals for smoke check doors shall be provided.

vii. Acoustic Seals: - Acoustic seals of appropriate design duly fixed in shutter as well as door frame shall be provided.

e. **Detail of Fire rated Door/Window/Partition**

i. Door frames and leaf: 1.6 mm thick GI sheet.

ii. Glazing bead: 1.6 mm thick GI sheet.

iii. Stiffeners: 1.6 mm thick GI sheet.

iv. Glass: Clear toughened interlayer fire rated glass.

v. Beading screw: M4x35 mm @ 150mm (approx.) C/C.

vi. SS ball bearing butt hinges 100x89x3 mm.

vii. Ceramic wool infill (Density – 96 kg/m3)

f. Deliverables by the Contractor

Following documentation/ drawings shall be furnished along with the Doors/ window/ partition.

1) Prototype Test Certificate by national/international test house

2) Shop drawings

3) Specification/ Manufacturer's literature, Test certificates and other documentation for materials and items intended to be used.

4) Certificate indicating that design and installation of Doors and hardware confirms to norm laid down by approved national/international test house.

5) Test report to be attested by Fire rated glass manufacturer.

6) The Fire rated glass applicator has to be approved by Fire rated Glass Manufacturer has to submit the approved applicator certificate.

7.8 Automatic Sliding Door Operator

Providing and fixing automatic bi-parting sliding doors with 12mm clear toughened glass

shutter.

Automatic sliding door operator shall be as per approved dwg., Compliant with European standards and produced according to the guidelines for power-operated windows, doors and gates, BGR 232, the UVV and the VDE regulations. TÜV design tested, tested according to the low voltage guidelines, fulfils DIN 18650 standards for Pedestrian Safety, TUV Design Tested for Durability of 1 Million Cycles. The track profile should be separate from the main profile for enabling reduction in vibration insulation. Operator length = 6250 mm, Maximum clear passage opening width = 3000 mm, maximum clear passage height = 2500 mm, includes microprocessor controlled drive unit, with self-learning mechanism, program selector with knob, motion detector (eagle 6 radars, 02 nos), mechanical components, toothed belt, cover profile, floor guide for frameless glass (02 nos), glass clamping rail (02 nos), safety device-light barrier (01 pair). Body finish: standard silver anodised operator profile, electromechanical lock with 12 mm plain toughened frameless glass for complete elevation - 2 moving panels. UPS of 750 VA shall be provided, which will give power backup of 20 min. Only & if the duration of power cut to the operator is more than 30 min, then separate arrangement needs to be done for the same as automatic operator requires uninterrupted stabilized power supply. The above work complete in all respect as per approved shop drawings and to the satisfaction of SBI/ PMC / Engineer in charge / architect consultant.

7.9 Glass Block

Glass Blocks (transparent / colour) of approved make of size 190mm x 190mmx 80mm (approximate weight 2.0-2.5 kg per block) with 10 mm joint to achieve a 200 mm module with mortar grout of white cement and marble powder in proportion of 1: 2 respectively including 6mm dia steel reinforcement bars to be laid in horizontal and vertical joints as per manufacturers specification.

Glass block panels shall be supported on all sides by fabricated powder coated (minimum thickness of powder coating 60 micron) aluminium frames of nominal dimension 80mm x 40mm x 2mm size, and block should rest on top of the cement mortar 1:3 (1 cement: 3 sand). Aluminium frames shall not be load-bearing and shall be fixed to the surrounding structure.

The joints between the blocks to be sealed with transparent / colour Silicone Gel sealant of approved make complete as per manufacturer specification, as per drawing and instructions of the Architect.

Location: Glass block shall be provided at various location & levels as per GFC architectural drawing.

7.10 Hardware for Glazed Partition single or double leaf doors

Providing & fixing stainless steel grade 316 patch fitting in frameless glass single or double leaf door shutters which include Top pivot, Top patch, Bottom patch, Corner lock with EPC, lock keeper plate and 'H' shape pull handle (450 mm x 25 mm) SS 316 grade and floor spring with adjustable spring strength, suitable for door leaf weight upto 120 kgs, max leaf width 1100mm and Tested for durability of 500,000 cycles & other accessories including the cost of screw & all other incidentals complete as per detailed drawings & approved shop drawings.

7.11 Frameless Door

Providing & fixing manual frameless double leaf glass doors with 12 mm clear toughened glass and S/S patch fitting (PT standard) of grade 316: such as Top pivot, Top patch, Bottom patch, Corner lock with EPC, lock keeper plate & stainless steel grade 316 handles 38 mm dia and 600 mm long or as approved by the SBI/ PMC / Engineer in charge and floor spring

conforming to DIN EN1154 with adjustable spring strength EN (1-4) and Tested for durability of 500,000 cycles. The above work complete in all respect as per approved shop drawings and to the satisfaction of SBI/ PMC / Engineer in charge.

7.12 Glazing with Patch Fittings

a. General

i. The Contractor shall be responsible for design, fabrication, supply, installation, test and guarantee of all items including taking all measures that may be required to complete the work as per Architectural concept drawings and specifications details.

b. The scope of work shall include:

i. Design, preparation of shop drawings, calculations, engineering data and test reports.

ii. Fabrication and installation of Glass Entrances and Glazing with Patch Fittings system.

iii. All anchors, fixings, attachments, reinforcements, steel reinforcing for mullions and transoms required for a complete installation, except those specifically indicated as being provided by other trades.

iv. Exposed Architectural mullions and other support members.

v. Finishes, protection coatings and treatments.

vi. Sealing with approved sealants within and around the perimeter.

vii. All thermal insulation, fire-safety etc. including supports and/or backing.

viii. All caulking, sealing, electrometric and metal flashing, and gaskets including sealing at junctions with roof, ground-floor waterproofing and building expansion joints between structures.

ix. Electrical bonding and ear thing of all metal cladding elements.

x. Provisions to receive electrical outlets and cutouts for conduits and other electrical work.

xi. Glass and glazing.

xii. Transportation, storage, handling, protection and cleaning.

c. Submittals

i. Product Data: Include construction details, material descriptions, dimensions of individual components, profiles and finishes.

ii. Shop Drawings

d. Fabrication and installation details, including followings

i. Plans, elevations and sections.

ii. Details of fittings and glazing.

iii. Hardware quantities, locations and installation requirements.

e. Sample for verification, for each type of exposed finish required for

i. Metal finish: 150mm long section of patch fittings, rails and other items.

ii. Glass: 150mm square, showing exposed edge finish.

f. Materials

i. **Glass**

- Glass shall be as specified in drawing or as per design requirement. It shall be hard coated reflective bronze and heat strengthened glass. It shall be of approved make.
- In toughening of Glass, rolling direction shall be parallel to the width of the glass panel such that waviness if any is parallel to the horizontal and no waviness parallel to the vertical and to ensure that such waviness is of negligible order.

ii. **Components**

- Patch fittings: Stainless steel clad aluminium
- Floating Transom Bar: Steel cladded in metal matching fittings and in sizes recommended by manufacturer for application indicated. Include stainless steel support rods, lateral adjustment and ceiling channel. Support fins to be metal, finished to match transom bar.
- Rails: Stainless steel clad aluminium.
- Accessory Fittings: Matching with patch fittings and rails metal and finish for overhead door stop, Centre hosing lock, glass support fin brackets and other as shown in drawing.
- Anchors and fastenings: Concealed
- Weather stripping: Sweep type

iii. **Hardware**

- Hardware should be heavy duty in matching finish
- Concealed Floor Closer and Top Pivots
- Centre hung; BHMA A156.4, Grade 1; including cases, bottom arm, top walking beam pivots, plates, and accessories required for complete installation.
- Swing: Double acting; Positive dead stop, concealed with hold open angle Delayed action closing
- Concealed Overhead Holder: Grade 1, with dead stop setting coordinated with concealed floor closer.
- Push-pull set: Stainless steel finish
- Lock set of approved make.

g. **Fabrication**

i. Provide holes and cutouts in glass to receive hardware, fittings, rails and accessories before tampering glass. Fully temper glass using horizontal (roller- hearth) process and fabricate so, when installed, roll wave distortion is parallel with bottom edge of door or tile.

ii. Factory assembled components and factory installed hardware to greatest extent possible.

h. **Execution**

i. Examine areas and condition for compliance with requirements for installation tolerances and other conditions affecting performance of work.

ii. Install all glass system and associated components according to manufacturer's written instructions.

iii. Set units in level and plumb.

iv. Maintain uniform clearances between adjacent components.

v. Lubricate hardware and other moving parts according to manufacturer's written instructions.

vi. Set, seal and grout floor closer cases as required suiting hardware and substrate indicated.

i. **Cleaning**

i. The Contractor shall ensure that all actions are taken during installation to eliminate the effects of corrosive substances on the finishes.

ii. The Contractor shall clean both internal and external surfaces to remove corrosive substances, dust or cement / mortar dropping during the installation as may be directed and instructed by the Engineer – in - charge.

iii. The internal surfaces of glass and aluminum frame are to be cleaned with compatible cleaning agents prior to the installation of the internal protective sheeting.

iv. The Contractor shall provide written verification that cleaning agents are compatible with aluminum, stainless steel, glass coatings, granite, glazing materials and sealants. In no case shall alkaline or abrasive agent be used to clean the surface. Care shall be taken during cleaning to avoid scratching of the surface by grit particles.

v. Prior to snagging inspections the Contractor shall, remove the internal protection sheets and carry out a thorough cleaning of all glass and aluminum.

vi. The Contractor shall also make good any physical damage to the structure including scratches, dents, abrasions, pitting, etc. to the satisfaction of the Engineer – in - charge.

vii. Manufacturer's delivery or job markings on glass and adhesive for manufacturer's labels shall be either a neutral or slightly acidic material. In no case shall such material be alkaline; any staining of glass by alkaline material will be cause for rejection of the glass.

viii. After the installation of each pane of glass all markings and labels shall be carefully and completely removed from the panes. Thereafter no markings or labels of any sort shall be placed on the glass.

ix. Glazed openings shall be identified by suitable warning tapes or flags attached with a non-staining adhesive or other suitable means to the framing of the opening. Tapes or flags shall not be in contact with glass.

x. As soon as it is practically possible after the issuance of the occupation Permit for the Building, the Contractor is to carry out a complete cleaning of the external face.

j. **Performance Guarantee:**
The Contractor shall offer a minimum of 10-year Performance Warranty for the entire installation carried out.

8 FAÇADE WORKS:

8Aluminium Louvers system

Aluminium 50 BD Ventilated Façade / Louver System

Panel dimensions: 50mm wide x 100mm depth x 0.5mm thick, Panel length up to 5mtrs. Coil coated on a continuous paint line double baked. Roll formed from enamelled corrosion resistance Aluminium Alloy AA3005 / AA5050. Back cover matching panel length with end caps. Mounted in a module of 175mm on a mullion profile grooved by Locking Clip and Pop Rivet, Slotted Fastening Profile fixed at 200mm from panel ends and 1200mm centre to centre across panel span. Slotted Fastening Profile fixed to suitable sub-structure. Chromatised for maximum bond between metal and paint enamelled twice under high temperature. One side with full primer and finish coat (exterior), the other side with a primer coat (inner side),

Green-pro certification for LEED certification by Indian Green Building Council (IGBC), ISO 9001:2015 Quality Management System Certification In-house Powder Coating line with Nano technology & catalytic converter in India Five (5) times cleaning process with Nano Technology for better adhesion and corrosion protection.

- **GRC JALI**:- Glass Reinforced Concrete (G.R.C) Screens casted with 'Spray Mix' concrete design in approved size, pattern, thickness of 50mm on the outer Border & 25-30mm for Internal Member or overall thickness of 40mm and shade. The Screens should be made from '43 grade' Portland Cement. White Quartz fine graded seive Silica Sand, Alkali Resistant Glass Fiber, Super Plasticizers, Polymers and U.V resistant Synthetic inorganic pigments should be used for pigmentation manufactured by 'Phenochem industries or equivalent. The Screens casting shall take place with layering methodology using- Direct Power Spray machines.The GRC Screens flexural strength average L.O.P should be above or equivalent to 6 N/mm2 & M.O.R should be above or equivalent to 12 N/mm2 for tests done on 28 days cured samples. The fixing of Screens should be done using 'Dry fixing' method onto structural support members i.e. R.C.C, Brick work MS Framework. MS Galvanized CLAMPS & PINS also if required fasteners to be used of Wurth, Hilti & Fischer or equivalent. All cast in Socket to be epoxy primer coated, electrodes to be used of advani, mangalam, esab or victor brand or equivalent,. Vendor shall submit shop drawings of same, the drawings to be dully approved from SBI/ PMC / Engineer in charge at site.

- ZINC INTERLOCK CLADDING SYSTEM (FOR Wall Cladding):- Supply and fixing of Zinc Titanium cladding system made with 0.8mm/1mm thickness Zinc Titanium Alloy (Conforming to EN 988) comprising of the following layers: 1) TOP LAYER - Top Layer: Zinc titanium Interlocking panels wall cladding system (thickness: 0.8mm/1mm) of upto 350mm width as per manufacturer recommendation X upto 3000 mm length interlocking wall cladding panels in Pre-weathered Finish / Organic Mineral Pigment finish of approved makes. Interlocking panels are rainscreen system with available pan width of panels of upto width 350mm Centre to Centre Panels are attached to supports/substrates using stainless screws located under edges of the panels. Interlocking Panels to be installed over Aluminium framework. The material properties shall be as follows: Ultimate tensile strength: minimum 150 N/mm2, 0.2% Proof Stress: min 100 N/mm2, Modulus of elasticity: 90,000 N/mm2 Panels shall be fixed to the substructure using Stainless Steel clips fixing & sliding clips of suitable height with spacing as required for the wind loads. The zinc manufacturer shall have all the required standing seam machines/tools & design assistance in India & should have supplied zinc roofing/ cladding in projects in India. The zinc roofing sheets shall have a protective coating at the underside of the sheet. 2) Framework (2.0 mm thick) : 25 mm X 50 mm Aluminum Box section installed over the Main Structure / Masonry plastered surface. Zinc Interlocking panels shall be fixed over the aluminum box section substructure using stainless screws/fasteners as approved. All screws/fasteners shall be of authentic stainless steel 304 series or higher in order to prevent corrosion / galvanic action with the components fastened.

- Perforated Metal Screen:- Perforated Screen Panel Cladding fixed system manufactured . The Screen panels of various sizes maxing to 900mm x 4200mm as per design requirement shall be manufactured from high corrosion resistant aluminium alloy of 2.00mm thickness which shall be fixed to a suitable and rigid sub structure which will be paid separately. Screen panels will have customized perforation as per architect's design shall be done on CAD/CAM 5 station auto indexing PIVATIC perforation line with integrated leveler. The leveler shall be of 6 High configuration ARKU technology to achieve super flatness of the panels to avoid waviness/bulging. Panels shall be coated on visible side with Exterior Grade Architectural Bronze Finish of approved color minimum 10 years warranty through in-house high precision

powder coating unit. The Powder Coating line shall be with Nano technology & catalytic converter for superior powder coating finishes, automatic electrostatic robotic coating technology for uniform coating and Five (5) tank cleaning process for better adhesion and corrosion protection.
The panels of required length and height shall be fixed to sub structure (which will be paid separately). Panels shall be bending from all four sides and shall have extended flanges to accommodate clamps. Client shall provide sub frame made from Al./Steel/Gl. The Panels shall be fixed to a suitable structure (which will be paid separately) by means of fixing side extrusion fixed to the panel at appropriate centers to proprietary metal clamp as per the proprietary HDI design to a support system taking into account the relevant live loads and a dead load. The Panels shall be bend on all four sides and shall have extended flanges with Kidney slots to accommodate the clamps. Installation shall be carried out as per manufacturer recommendation. Green-pro certification: For LEED certification by Indian Green Building Council (IGBC) and ISO 9001: 2008 Quality
Management System Certification. Seismic Zone V compliance - Metal facade should be Tested for Seismic Zone V compliance as per IS 1893 part 1-2016"
Coating-In-house Powder Coating line with Nano technology & catalytic converter in India: For superior powder coating finishes with automatic electrostatic robotic coating technology for uniform coating and Five (5) times cleaning process with Nano Technology for better adhesion and corrosion protection.

9 RAILING, GRILL WORK AND FENCING:

Railing, Grill & Fencing shall be as specified in the PART-D, Design Basis Report/Finshing Schedule or as specified in the Tender drawings. The work to be carried out as per latest CPWD Specifications. Brief Technical specifications of these works are as given below:

9.4 Grill Work:

a. MS Grills shall be provided in the windows made out of mild steel sections or as specified in the tender drawings.

b. All steel grills shall be according to the detailed drawings and shall confirm to Latest CPWD Specifications.

c. On MS grills an approved quality priming coat of zinc chromate shall be applied over and above a shop coat of primer and finished with two or more coats of low VOC synthetic enamel pain of approved make and shade/ powder coating as specified.

9.5 Railing:

The scope of the work includes preparation of the shop drawings (based on the tender / architectural drawings), fabrication, supply, installation and protection of the stainless steel railing till completion and handing over of the work.

a. MS Railing: To be provided as per CPWD specifications as specified in tender drawings and DBR including painting & primier coat complete.

b. Stainless Steel Railing

i. The stainless steel work shall be got executed through specialized fabricator having experience of similar works. The Contractor shall submit the credentials of the fabricator for the approval of the PMC/SBI/ PMC / Engineer in charge.

ii. The Contractor shall submit shop drawings, for approval of the SBI/PMC in charge, for fabricating stainless steel railing with detailing of M.S. stiffener frame work backing along with the fixing details of the M.S. frame work to the R.C.C columns. The details of the joints in the stainless steel railing including location, etc. shall also be shown in the shop drawings.

iii. The Contractor shall procure and submit to the PMC/SBI/ PMC / Engineer in charge, samples of various materials for the railing work, for approval. After approval of samples, the Contractor shall prepare a mock up for approval of PMC/SBI/ PMC / Engineer in charge / SBI. The material shall be procured and the mass work taken up only after the approval of the mock up by the PMC/SBI/ PMC / Engineer in charge / SBI. The mock-up shall be dismantled and removed by the Contractor as per the directions of the PMC/SBI/ PMC / Engineer in charge. Nothing extra shall be payable on this account.

iv. The stainless steel shall be of grade 316 with brushed steel satin finish and procured from the approved manufacturer. It shall be without any dents, waviness, scratches, stains etc.

v. The required joints in the railing provided as per the architectural drawings, shall be welded in a workmanlike manner including grinding, polishing, buffing etc. all complete and compacted. The temporary clamps provided and fixed to hold the stainless steel railing, in position shall be removed after the concrete has set properly. The junction of the flooring and the cladding shall be neatly filled with weather silicone sealant of approved colour and shade. Nothing extra shall be payable on this account.

vi. One test (three specimens) for each lot shall be conducted for the stainless steel pipe in the approved laboratory. Therefore, the material shall preferably be procured in one lot from one manufacturer.

vii. The finished surface shall be free of any defects like dents, waviness, scratches, stains etc. and shall have uniform brushed steel satin finish. Any defective work shall be rejected and redone by the Contractor at his own cost. The finished surface shall therefore be protected using protective tape which shall be removed at the time of completion of the work. The surface shall then be suitably cleaned using nonabrasive approved cleaner for the material. Nothing extra shall be payable on this account.

viii. The item includes the cost of all inputs of labour, materials (including stainless steel pipes, welding, brazing, concrete, protective film, weather silicone sealant etc including cost of providing and fixing M.S. frames), T & P other incidental charges, wastages etc. The items also included providing and fixing stainless steel anchor fasteners for fixingrailing.

ix. The railing shall be fixed in position using stainless steel pipes, stainless steel posts of required diameters and thickness as shown on drawing and polished to satin finish including cutting, welding, grinding, bending to required profile and shape, hoisting, butting, polishing etc.

x. The item includes the cost of all inputs of labour, materials, T&P, other incidental charges, wastage etc. The entire work shall be carried out to the satisfaction of PMC/SBI/ PMC / Engineer in charge.

9.6 Glass Railing: Balustrade & Handrail system:- Modular (weld free Components base) Balustrade & Handrail system, 50.8 mm dia x 1.6mm thick handrail fixed to the Balustrade of 50 .8 mm dia x 1.6 mm thick with top adapter(neck) type

fixed with 2nos of M4x10mm Allen CSk Screw. The balustrade fixed to Top of the straight or staircase with Base plate with M12 x120mm long anchor fastener. The balustrade C/C 900 to 1000mm, The Ht. of the handrail 1200mm from FFL. Glass infill of 6,8 &10 mm thick toughened monolithic Glass or 13.52 thick laminated toughened glass is Fixed to the Balustrade with Glass Clamp (Four per balustrade) by M8 avdel insert & M8 x25mm Allen cap screw , Complete with all End cap, Mid Span Sleeve, Elbows. All the material of handrail, balustrade and components should be of SS 304 grade satin finish.

10 STRUCTURAL STEEL

a. General

i. This specification covers the fabrication and transportation to site and erection on prepared foundations and structural steel work consisting of beams, columns, purlins, vertical trusses, bracings, shear connections etc.

ii. Fabrication, erection and approval of steel structures shall be in compliance with General Specifications mentioned in CPWD specifications with up to date correction slips and IS: 800 – 2007. For the guidance on general fabrication and erection of structural steel work, Chapter 11 of IS: 800 (1984) must be followed. As far as safety is concerned guidance could be obtained from Indian safety code for structural steelwork IS: 7205(1974). Before the commencement of the erection, all the erection equipment tools, shackles, ropes etc. should be tested for their load carrying capacity. Such tests if needed may be repeated at intermediate stages also.

iii. Providing shop primer coat for steel structures. Grouting of holding-down bolt pockets and below base plates where required.

b. Scope

The fabrication and erection of the steel work consists of accomplishing of all jobs here- in enumerated including providing all labour, tools and plant all materials and consumables such as welding electrodes, bolts and nuts, oxygen and acetylene gases, oils for cleaning etc. of approved quality as per relevant IS. The work shall be executed according to the drawings, specifications, relevant codes etc. in an expeditious and workman like manner, as detailed in the specifications and the relevant Indian Standard Codes and Standard Practice and to the complete satisfaction of the PMC/SBI/ PMC / Engineer in charge.

c. Fabrication Drawings

i. The Contractor shall prepare all fabrication and erection drawings on the basis of approved design drawings and shall submit the same in triplicate to the SBI/PMC in charge for review, PMC/SBI/ PMC / Engineer in charge shall review and comment, if any, on the same. Such review, if any, by the PMC/SBI/ PMC / Engineer in charge, does not relieve the Contractor of any of his required guarantees and responsibilities. The Contractor shall however be responsible to fabricate the structural strictly confirming to specifications and reviewed drawings.

ii. Fabrication drawings shall include but not limited to the following:

- Member sizes and details
- Types and dimensions of welds and bolts
- Shapes and sizes of edge preparation for welding
- Details of shop and field joints included in assemblies.
- Quality of structural steels, welding electrodes, bolts, nuts and washers etc. to be used.
- Erection assemblies, identifying all transportable parts and sub- assemblies, associated with special erection instructions, if required.
- Calculations where asked for approval.

iii. Connections, splices etc. other details not specifically detailed in design drawings shall be suitably given on fabrication drawings considering normal detailing practices and developing full member strengths. Where asked for calculations for the merit shall also be

submitted for approval.PMC/SBI/ PMC / Engineer in charge review shall not absolve the Contractor of his responsibility for the correctness of dimensions, adequacy of details and connections. One copy will be returned reviewed with or without comments to the Contractor for

necessary action. In the former case further three copies of amended drawings shall be submitted by the Contractor for final review.

iv. The Contractor shall supply three prints each of the final reviewed drawings to the PMC/SBI/ PMC / Engineer in charge within a week since final review.

v. If any modification is necessary in the approved drawing during the course of execution of the job, revised fabrication drawings will be prepared by the Contractor, incorporating the changes and the revised fabrication drawings shall be duly got reviewed as per the above Clauses.

d. Materials

i. Rolled Sections

Structural steel will generally be of standard quality confirming to IS: 226/IS: 2062. Whenever welded construction is specified plates of more than 20 mm thickness will generally confirm to IS: 2062.

ii. Welding Materials

Welding electrodes shall confirm to IS: 814 and approval of welding procedures shall be as per IS: 823.

iii. Bolts, Nuts & Washers

Bolts and nuts shall be as per IS: 1367 and tested as per IS: 1608. It shall have a minimum tensile strength of 44 Kg/mm2 and minimum elongation of 23% on a gauge length of 5.65 (A-Original cross sectional area of the gauge length). Washers shall be as per IS: 2016.

iv. All materials shall confirm to their respective specifications. The use of equivalent or higher grade or alternate materials will be considered only in very special cases subject to the approval of the PMC/SBI/ PMC / Engineer in charge in writing.

v. Receipt & Storing of Materials

- Steel materials supplied by the Contractor must be marked for identification and each lot should be accompanied by manufacturer's quality certificate, confirming chemical analysis and mechanical characteristics.
- All steel parts furnished by supplier shall be checked, sorted out, straightened, and arranged by grades and qualities in stores.
- Structural with surface defects such as pitting, cracks, laminations etc. shall be rejected if the defects exceed the allowable tolerances specified in relevant standards or as directed by the chief PMC/SBI/ PMC / Engineer in charge.
- Welding wire and electrodes shall be stored separately by qualities and lots inside a dry and enclosed room, in compliance with IS: 816 - 1969 and as per instructions given by the PMC/SBI/ PMC / Engineer in charge. Electrodes shall be perfectly dry and drawn from an electrode even, if required.

vi. Checking of quality bolts of any kind as well as storage of same shall be made confirming to relevant standards.

- Each lot of electrodes, bolts, nuts, etc. shall be accompanied by manufacturer's test certificate.

- The Contractor may use alternative materials as compared to design specification only with the written approval of the PMC/SBI/ PMC / Engineer in charge.

Material Tests

- The Contractor shall be required to produce manufacturer's quality certificates for the materials supplied by the Contractor. Notwithstanding the manufacturer's certificates, the PMC/SBI/ PMC / Engineer in charge may ask for

  testing of materials in approved test houses. The test results shall satisfy the requirements of the relevant Indian Standards.

- Whenever quality certificates are missing or incomplete or when material quality differs from standard specifications the Contractor shall conduct all appropriate tests as directed by the PMC/SBI/ PMC / Engineer in charge at no extra cost.

- Materials for which test certificates are not available or for which test results do not tally with relevant standard specifications, shall not be used.

vii. Fabrication

The Contractor will submit the credential with full particulars about work completed by fabricator to be deployed for this work for approval of PMC/SBI/ PMC / Engineer in charge. After written approval is communicated in respect of fabricator, then only the jobs should be assigned to him. Fabrication shall be in accordance with IS: 800 Section V in addition to the following:

- Fabrication shall be done as per approved fabrication drawings adhering strictly to work points and work lines on the same. The connections shall be welded or bolted as per design drawings. Work shall also include fabricating built up sections.
- Any defective material used shall be replaced by the Contractor at his own expense, care being taken to prevent any damage to the structure during removal.
- All the fabricated and delivered items shall be suitably packed to be protected from any damage during transportation and handling. Any damage caused at any time shall be made good by the Contractor at his own cost.
- Any faulty fabrication pointed out at any stage of work shall be made good by the Contractor at his own cost.

a. Preparation of Materials

Prior to release for fabrication, all rolled sections warped beyond allowable limit shall be pressed or rolled straight and freed from twists, taking care that an uniform pressure is applied. Minor warping, corrugations etc. in rolled sections shall be rectified by cold working. The sections shall be straightened by hot working where the PMC/SBI/ PMC / Engineer in charge so direct and shall cooled slowly after straightening. Warped members like plates and flats may be used as such only if wave like deformation does not exceed L/1000 but limited to 10 mm (L- Length). Surface of members that are to be jointed by lap or fillet welding or bolting shall be even so that there is no gap between overlapping surfaces.

b. Marking

Marking of members shall be made on horizontal pads, of an appropriate racks or supports in order to ensure horizontal and straight placement of such members. Marking accuracy shall be at least + 1 mm.

c. Cutting

Members shall be cut mechanically (by saw or shear or by oxyacetylene flame). All sharp, rough, or broken edges, and all edges of joints which are subjected to tensile or oscillating stresses, shall be ground. No electric metal arc cutting shall be allowed. All edges cut by oxyacetylene process shall be cleaned of impurities prior to assembly. Cutting tolerances shall be as follows:

a) For members connected at both ends + 1 mm.

b) Elsewhere + 3 mm.

The edge preparation for welding of members more than 12 mm thick shall be done by flame cutting and grinding. Cut faces shall not have cracks or be rough. Edge preparation shall be as per IS: 823 - 1964.

d. Drilling

Bolts holes shall be drilled. Drilling shall be made to the diameter specified in drawings. No enlarging of holes filling, by mandrolling or oxyacetylene flame shall be allowed. Allowed variations for holes (out-of-roundness, eccentricity, plumb-line deviation) shall be as per IS: 800.

- Maximum deviation for spacing of two holes on the same axis shall be + 1 mm.
- Two perpendicular diameters of any oval hole shall not differ by more than 1 mm.

e. Drilling faults in holes may be rectified by reaming the holes to the next upper diameter, provided that spacing of new hole centres and distance of hole centres to the edges of members are not less than allowed and that the increase of hole diameter does not impair the structural strength. Hole reaming shall be allowed if the number of faulty holes does not exceed 15% of the total number of holes for one joint.

f. Welding**:**

i) Preparation of Members for Welding

- All welding in mild steel work shall be done with electrodes and / or by methods recommended by the suppliers of the metals being welded in accordance with corresponding Indian Standards. Type, *size* and spacing of welds, shall be as specified. All welding consumables shall be in accordance with the I.S. standards.
- Welds behind finished mild steel surfaces shall be so done as to eliminate distortion and / or discoloration on the finished side.
- Weld spatter and welding oxides on finished surfaces shall be removed by descaling and / or grinding. Plug, puddle or spot welding shall not be permitted. If weld beads are visible on exposed finished surfaces, the surfaces shall be ground and polished to match and blend with finish on adjacent parent metal.
- Structural welds shall be made by certified welders and shall confirm to

I.S. code. The welds shall be tested by the Contractor to ensure quality and integrity of the structural welds. However, welding tests shall be carried out as below: and the Contractor shall maintain records for Visual testing – 100 % of the welds for size and quality. Fillet weld testing- 30 % of the welds for MPI or Dye penetration test

- Dirt grease, lubricant, or other organic material shall be removed by vapor degreasing or suitable solvent.
- Joints rejected because of welding defects may be repaired only by re welding. Defective welds shall be removed by chipping or machining. Flame cutting shall not be allowed.

ii) Assembly of structural members

Assembly of structural members shall be made with proper jigs and fixtures to ensure correct positioning of members (angles, axes nodes etc.) Sharp edges, rust of cut edges, notches, irregularities and fissures due to faulty cutting shall be chipped or ground or filled over the length.

iii) Weld Inspection

The weld seams shall satisfy the following:

- shall correspond to design shapes and dimensions.
- shall not have any defects such as cracks, incomplete penetration and fusion, under-cuts, rough surfaces, burns, blow holes and porosity etc. beyond permissible limits.

During the welding operation and approval of finished elements, inspections and tests shall be made

as shown in Annexure-B. The mechanical characteristics of the welded joints shall be as in IS: 823.

iv) Preparation of Members for Bolting

The members shall be assembled for bolting with proper jigs and fixtures to sustain the assemblies without deformation and bending. Before assembly, all sharp edges, shavings, rust dirt, etc. shall be removed. Before assembly, the contacting surfaces of the members shall be cleaned and given a coat of primer as per IS: 2074.The members which are bolt assembled shall be set according to drawings and temporarily fastened with erection bolts (minimum 4 pieces) to check the co-axiality of the holes. The members shall be finally bolted after the deviations have been corrected, after which there shall not be gaps. Before assembly, the members shall be checked and got approved by the PMC/SBI/ PMC / Engineer in charge. The difference in thickness of the sections that are butt assembled shall not be more than 3% or maximum 0.8 mm whichever is less. If the difference is larger, it shall be corrected by grinding or filling. Reaming of holes to final diameter or cleaning of these shall be done only after the parts have been check assembled. As each hole is finished to final dimensions (reamed if necessary) it shall be set and bolted up. Erection bolts shall not be removed before other bolts are set.

v) Bolting up

Final bolting of the members shall be done after the defects have been rectified and approval of joints obtained. The bolts shall be tightened starting from the centre of joint towards the edge.

vi) Planing of Ends

Planing of ends of members like column ends shall be done by grinding when so specified in the design. Planning of butt welded members shall be done after these have been assembled, the spare edges shall be removed with grinding machines or files. The following tolerances shall be permitted on member that has been planed.

- On the length of the member having both ends planed, maximum + 2 mm with respectto design.
- Level differences of planed surfaces, maximum 0.3mm.
- Deviation between planed surface and member's axis maximum1/1500.

vii) Holes for Field Joints

Holes for field joints shall be drilled in the shop to final diameters and tested in the shop, with trial assemblies. When three-dimensional assembly is not possible in the shop, the holes for field joints may be drilled in shop and reamed on site after erection, on approval by the PMC/SBI/ PMC / Engineer in charge. For bolted steel structures, trial assembly in shop is mandatory. The tolerance for spacing of holes shall be + 1 mm.

viii) Marking for Identification

All elements and members prior to dispatch from the fabrication yard for erection shall be shop marked. The members shall be visibly marked with a weather proof light coloured paint. The size and thickness of the numbers shall be chosen as to facilitate the identification of members. For the small members that are delivered in bundles or crates, the required marking shall be done on small metal tags securely tied to the bundle, while the crates shall be marked directly. Each bundle or crate shall be packed with members for one and the same assembly; in the same bundle or crate, general utility members such as bolts, quests etc. may be packed. List of materials showing weight, quality and dimension of contents shall be placed in the crates.

The members shall be marked with a durable paint, in a visible location, preferably at one end of the member so that these may be easily checked during storage and erection. All members shall be marked in the shop before inspection and acceptance. When the member is being painted, the marking area shall not be painted but bordered with white paint. The marking and job symbol shall be registered in all shop delivery documents (transportation, for erection etc.)

ix) Shop Test Pre-assembly

For steel structures that have the same type of welding the shop test pre- assembly shall be performed on one out of every 10 member's minimum. For bolted steel structures, shop test pre-assembly is mandatory for all elements as well as for the entire structure in confirmity with previous Clause.

g. Shop Inspection and Approval

i) General

The PMC/SBI/ PMC / Engineer in charge or their representative shall have free access at all responsible times to the Contractor's fabrication shop and shall be afforded all reasonable facilities for satisfying himself that the fabrication is being undertaken in accordance with drawings and specifications. Technical approval of the steel structure in the shop by the PMC/SBI/ PMC / Engineer in charge is mandatory. The Contractor shall not limit the number and kinds of tests, final as well as intermediate once, or extra tests required by the PMC/SBI/ PMC / Engineer in charge. The Contractor shall furnish necessary tools, gauges, instruments etc. and technical non-technical personnel for shop tests by the PMC/SBI/ PMC / Engineer in charge, free of cost.

ii) Shop Acceptance

The PMC/SBI/ PMC / Engineer in charge shall inspect and approve at the following stages:

- The following approvals may be given in shop:

- Intermediate approvals of work that cannot be inspected later.
- Partial approvals
- Final approvals

- Intermediate approval of work shall be given when a part of the work is preformed later:

- Cannot be inspected later
- Inspection would be difficult to perform and results would not be satisfactory.

- Partial approval in the shop is given on members and assemblies of steel structures before the primer coat is applied and includes:

- Approval of materials
- Approval of field joints
- Approval of parts with planed surfaces
- Test erection
- Approval of members
- Approval of markings
- Inspections and approvals of special features, like Rollers, loading platform mechanism etc.

During the partial approval, intermediate approvals as well as all former approvals, shall be taken in to consideration.

iii) Final approval in the Shop

The final approval refers to all elements and assemblies of the steel structures, with shop primer coat, ready for delivery from shop to be loaded for transportation, or stored.

The final approval comprises of:

- Partial approvals
- Approval of shop primer coat
- Approval of mode of loading and transport
- Approval of storage (for materials stored)

h. Painting and Delivery

i) Preparation of parts for shop painting:

Painting shall consist of providing at least one coat of red oxide zinc chromate primer to steel members before dispatch from shop. Primer coat shall not be applied unless:

- Surface have been wire brushed, cleaned of dust, oil, rust or sand blasted as per the requirement and direction of PMC/SBI/ PMC / Engineer in charge etc.
- Erection gaps between members, spots that cannot be painted or where moisture or other aggressive agents may penetrate, have been filled with an approved type of oil and putty.
- The surface to be painted is completely dry.
- The parts where water of aggressive agents may collect (during transportation, storage, erection and operation) are filled with putty and provided with holes for drainage of water.
- Members and parts have been inspected and accepted
- Welds have been accepted.

The following are not to be painted or protected by any other product:

- Surface which are in the vicinity of joints to be welded at site.
- Surfaces bearing markings
- Other surfaces indicated in the design.

The following shall be given a coat of hot oil or any approved resistant lubricant only.

- Planed surfaces
- Holes for links

The surfaces that are to be embedded or in contact with the concrete shall be given a coat of cement wash. The surfaces which are in contact with the ground, gravel or brick work and subject to moisture shall be given bituminous coat. The other surfaces shall be given a primer coating. Special attention shall be given to locations not easily accessible, where water can collect and which after assembly and erection cannot be inspected, painted and maintained. Holes shall be provided for water drainage and in accessible box type sections shall be hermetically sealed by welds.

The Contractor shall paint further coats of red-oxide after erection and placing in position of the steel structures as directed by the SBI/PMC in charge.

ii) Packing, transportation, delivery:

After final shop acceptance and marking, the item shall be packed and loaded for transportation. Packing must be adequate to protect item against warping during loading and unloading. Proper lifting devices shall be used for loading, in order to protect items against warping. Slender projecting parts shall be braced with additional steel bars, before loading, for protection against warping during transportation. Loading and transportation shall be done in compliance with transportation rules. If certain parts cannot be transported in the lengths stipulated in the design, the position and type of additional splice joints shall be approved by the PMC/SBI/ PMC / Engineer in charge. Items must be carefully loaded on platforms of

transportation means to prevent warping, bending or falling during transportation. The small parts such as fish-plates, quests etc. shall be securely tied with wire to their respective parts. Bolts, nuts and washers shall be packed and transported in crates. The parts shall be delivered in the order stipulated by the PMC/SBI/ PMC / Engineer in charge and shall be accompanied by document showing:

- Quality and quantity of structure or members
- Position of member in the structure
- Particulars of structure
- Identification number job symbol.

i. Field Erection

- The erection work shall be permitted only after the foundation or other structure over which the steel work will be erected is approved and is ready for erection.
- The Contractor shall satisfy himself about the levels, alignment etc. for the foundations well in advance, before starting the erection. Minor chipping etc. shall be carried out by the Contractor on his expense.
- Any faulty erection done by the Contractor shall be made good at his own cost.
- Approval by the PMC/SBI/ PMC / Engineer in charge or their representatives at any stage of work does not relieve the Contractor of any of his required guarantees of the contract.
- Storage and preparation of parts prior to erection

The storage place for steel parts shall be prepared in advance and got approved by the PMC/SBI/ PMC / Engineer in charge before the steel structures start arriving from the hop. A platform shall be provided by the Contractor near the erection site for preliminary erection work. The Contractor shall make the following verifications upon receipt of material at site.

- For quality certificates regarding materials and workmanship according to these general specifications and drawings.
- Whether parts received are complete without defects due to transportation, loading and unloading and defects, if any, are well within the admissible limit.

For the above work sufficient space must be allotted in the storage area which will be arranged by the Contractor without any extra cost to the department. Steps shall be taken to prevent warping of items during unloading. The parts shall be unloaded, stored and stored so as to be easily identified. The parts shall be stored according to construction symbol and markings so that these may be taken out in order or erection. The parts shall be at least 150 mm clear from ground on wooden or steel blocks for protection against direct contact with ground and to permit drainage of water. If rectification of members like straightening etc. are required, these shall be done in a special place allotted which shall be adequately equipped. The parts shall be clean when delivered for erection.

j. Erection & Tolerances

Erection in general shall be carried out as required and approved by the PMC/SBI/ PMC / Engineer in charge. Positioning and levelling of the structure, alignment and plumbing of the stanchion and fixing every member of the structure shall be in accordance with the relevant drawings and to the complete satisfaction of the PMC/SBI/ PMC / Engineer in charge.

The following checks and inspection shall be carried out before during and after erection.

- damage during transportation
- accuracy of alignment of structures

- erection according to drawings and specifications
- progress and workmanship.

There may be any deviations regarding positions of foundations or anchor bolts, which would lead to erection deviations, the PMC/SBI/ PMC / Engineer in charge shall be informed immediately. Minor rectifications in foundations, orientation of bolts holes etc. shall be carried out as part of the work, at no extra cost. The various parts of the steel structure shall be so erected so to ensure stability against inherent weight, wind and erection stresses. The structure shall be anchored and final erection joints completed after plan and elevation positions of the structural members have been verified with corresponding drawings and approved by the PMC/SBI/ PMC / Engineer in charge. The bolted joints shall be tightened so that the entire surface of the bolt heads and nuts shall rest on the member. For parts with sloping surfaces tapered washers shall be used.

k. Final acceptance and handing over the structure

(i) At acceptance, the Contractor shall submit the following documents:

- Shop and erection drawings – four sets soft copy and hard copies 4 copies of each of the following:
- Shop acceptance documents quality certificate for structurals, plates, etc. (electrodes, welding wire, bolts, nuts, washers etc.)
- List of certified welders who worked on erection of structures.
- Acceptance and intermediate control procedure of erection operations.

(ii) Approval by the PMC/SBI/ PMC / Engineer in charge at any stage of work does not relieve the Contractor of any of his required guarantees of the contract.

l. Grouting of Pockets

(i) Grouting of pockets and under base plates will be done only after the steel work has been levelled and plumbed and the bases of stranchions are supported by steel shims. The space below the base plate and pockets shall be thoroughly cleaned.

(ii) The mortar used for grouting shall not be leaner than 1:2 (1 cement: 2 sand) (grade 300 in case of concrete) or as is specified and shall be mixed to the minimum consistency required. It shall be poured under suitable head and tamped until the space has been completely filled.

m. Tolerances allowed in the erection of building without cranes

The maximum tolerances for line and level of the steel work shall be + 3.00 mm on any part of the structure. The structure shall not be out of plumb more than 3.5 mm on each 10 M. section of height and not more than 7.0 mm per 30
M. section. These tolerances shall apply to all parts of the structure unless the drawings issued for erection purposes state otherwise.

n. Contractor to submit shop drawing for all structural steel work for approval. The work at site should commence only after getting the shop approved.

o. Contractor to get erection scheme approved before commencement of erection of trusses.

STEEL WORK IN SINGLE SECTION FIXED INDEPENDENTLY WITH CONNECTING PLATE

The steel work in single section of R.S. joists, flats, Tees Angles fixed independently with or without

connecting plate, is described in these clauses.

Fabrication

The steel sections as specified shall be straightened and cut square to correct lengths and measured with a steel tape. The cut ends exposed to view shall be finished smooth. No two pieces shall be welded or otherwise jointed to make up the required length of member.

All straightening and shaping to form, shall be done by pressure. Bending or cutting shall be carried out in such a manner as not to impair the strength of the metal.

Painting

All surfaces which are to be painted, oiled or otherwise treated shall be dry and thoroughly cleaned to remove all loose scale and loose rust. Surfaces not in contact but inaccessible after shop assembly, shall receive the full specified protective treatment before assembly. This does not apply to the interior of sealed hollow sections. Part to be encased in concrete shall not be painted or oiled. A priming coat of approved steel primer such as Red Oxide/Zinc Chromate primer conforming to IS 2074 shall be applied before any member of steel structure are placed in position or taken out of workshop.

Erection

Steel work shall be hoisted and placed in position carefully without any damage to itself and other building work and injury to workmen. Where necessary mechanical appliances such as lifting tackle winch etc. shall be used. The suitability and capacity of all plant and equipment used for erection shall be upto the satisfaction.

STEEL WORK IN BUILT UP SECTIONS (RIVETED AND BOLTED)

The steel work in built up section (Riveted and bolted) such as trusses, framed work etc. is specified in this clause.

Laying Out

A figure of the steel structure to be fabricated shall be drawn on a level platform to full scale. This may be done in full or in parts. Steel tape shall be used for measurements.

Fabrication

Fabrication shall generally be done as specified in IS 800. In major works or where so specified, shop drawings giving complete information for the fabrication of the component parts of the structure including the location, type, size, length and details or rivets, bolts or welds, shall be prepared in advance of the actual fabrication. The drawings shall indicate the shop and field rivets, bolts and welds. The steel members shall be distinctly marked or stenciled with paint with the identification marks as given.

Great accuracy shall be observed in the fabrication of various members, so that these can be assembled without being unduly packed, strained or forced into position and when built up, shall be true and free from twist, kinks, buckles or open joints.

Wooden or metal sheet templates shall be made to correspond to each member, and position of rivet holes shall be marked accurately on them and holes drilled. The templates shall then be laid on the steel members, and holes for riveting and bolting marked on them. The ends of the steel members shall also be marked for cutting as per required dimensions. The base of steel columns and the positions of anchor bolts shall be carefully set out at the required location.

The steel section shall be straight or to be straightened or flattened by pressure unless required to be of curvilinear form and shall free from twists. These shall be cut square either by shearing or sawing to correct length and measured by steel tape. No tow pieces shall be welded or joined to make up for the required length of member.

ELECTRODES

Electrodes shall be best heavy coated type and shall be in accordance with IS:814 - "Specification for Covered Electrodes for Metal Arc Welding of Mild Steel".

FABRICATION:

Shop Drawings:

The contractor shall prepare, wherever necessary, detailed shop drawings giving complete information necessary for the fabrication of the structures. All information shall be clearly given and the drawings shall be in conformity with the best modern practice. A marking diagram allotting distinct identification marks to each separate piece of steel work shall be prepared in sufficient detail to ensure convenient assembly and erection. Symbols for welding, used in the drawings, shall be in accordance with IS:813 "scheme of symbols for welding". The contractor shall prepare comprehensive bill of materials sheets for each shop drawing giving therein all the items shown on the drawing together with their weights, mark numbers, cutting lengths etc. Three copies of all working drawings and bill of material sheets shall be submitted for the approval of the Consultant.

Fabrication shall not commence until the approval of the relevant drawings has been obtained from the Consultant. While the shop drawings prepared by the Contractor and approved by the Consultant, are deemed to be done, the Contractor is not relieved of responsibility for accuracy of detailed dimensions shown thereon.

Templates

All fabrication shall be in accordance with IS: 800 “Code of Practice for use of Structural Steel in General Building Construction” and IS:1915 “Code of Practice for Steel Fridges”. Extensive use of templates shall be made. The templates shall be steel bushed where considered necessary by the Consultant. In case actual members are used as templates for drilling similar pieces, it will be at the discretion of the Consultant to decide whether such pieces are fit to be incorporated in the finished structure. The Contractor shall arrange for corresponding parts of each unit manufactured from the same drawings to be inter-changeable, as far as economic manufacturing conditions permit, and shall seek approval of the Consultant, of the precise agreements made in this respect.

Straightening

All material shall be straight and, if necessary shall be straightened and/or flattened by pressure, unless required to be of curvilinear form and shall be free from twists. Heating of rolled sections and plates for purposes of straightening will not be permitted. Limited straightening may, however, be effected by local applications of heat with a gas torch.

Cutting

Gas cutting shall preferably be done by machine. Gas cut edges shall be free of gauges; any gauges that remain after cutting shall be removed by grinding. Gas cutting shall, normally, only be permitted for mild steel. Gas cutting of high tensile steel may also be permitted, provided special care is taken to leave sufficient metal to be removed by machining so that all metal that has been hardened by flame is removed. Hand flame cutting may only be permitted. Rolled sections shall be sheared or cropped to size. Sawing, shearing and cropping shall be clean and free from any distortion; if necessary, the edges shall be ground afterwards.

Holing

Where punching is permitted, the hole shall be punched 3mm less in diameter than the required size and reamed after assembly to the full size. In any case, the thickness of material punched shall not be greater than 16mm.

Holes through more than one thickness of material or members, such as compound stanchions and girder flanges shall be drilled after the members are assembled and tightly clamped or bolted together. They shall be separated and the burrs removed.

Holes for bolts shall not be more than 1.5mm/2.0mm (as the case may be depending upon whether the diameter of bolt is less than or more than 25mm) larger in diameter than the nominal diameter of bolt. Holes for bolts shall in no event be formed by gas cutting.

Assembly

All steel work, which is bolted together shall be in close contact over the whole surface. Drifting done during assembly shall not distort the metal or enlarge the holes. Holes that must be enlarged due to mismatching shall be reamed. Poor matching of holes shall be cause for rejection. The component parts shall be assembled in such a manner that they are neither twisted nor otherwise damaged and shall be so prepared that the specified cambers, if any, are provided.

Bolting

All bolts shall be provided with washers under the nuts and the washers shall be tapered on the insides of the flanges of R.S. Joists and channels. Bolts and studs shall project not less than one full thread through the nut after tightening. Unless otherwise specified, the ends of the bolts shall be burred after erection to prevent the removal of the nuts.

WELDING

Welding, where called for on the drawing shall be metal are welding conforming to IS:816-1969.

Unless otherwise specified, all welds shall be 6mm, single fillet welds.

The welding shall be carried out by workmen skilled in the trade. The Contractor shall employ a certified welding to ensure that the standard of workmanship shall comply with the best practices of the trade.

Preparation of Surfaces: Surfaces which are to be welded shall be free from loose mill scale, rust, paint, grease, gas cutting burns or any other foreign matter.

Workmanship: Welds shall be made in the flat position wherever practicable.

Are length, voltage and amperage shall be suited to the type of electrode and nature of work.

Before commencing welding the various members shall first be brought together and firmly held in position by spot welds at specified distance. The spot welds shall be strong enough to hold the parts accurately in place without any disturbance. Freedom of movement of one member of the joint shall be allowed wherever possible.

The sequence of welding shall be such that where possible the members which offer the greatest resistance to compression are welded first.

The electrode manipulation during welding shall ensure:

1. The base metal is in a fused state when filler metal makes contact with it.

2. The filler metal does not overflow upon any unused base metal.

3. The base metal is not under-cut along the weld edges.

4. The welds shall be free from cracks, discontinuity and other defects such as under size, under cutting and over-cutting etc.

The welding of the joint shall be so arranged that the resulting tensile and compressive stresses produced by each portion of the weld tend to balance each other.

The step back method of welding shall be adopted for continuous runs. Fusion faces shall be cut by shearing, chipping, machining or machine gas cutting. Hand cutting by gas may be permitted under special circumstances, provided the cutter shall be adequately guided so that the cut edge is clean and uniform. If the fusion face is rough it shall be dressed by chipping, filing or grinding to an approved finish.

All slag shall be removed from each run before a subsequent run is superimposed. When cold the final run shall be protected with clean boiled linseed oil and shall not be painted

All exposed welds shall be ground smooth. All welds which have not been ground shall be scrubbed with a 10% solution of hydrochloric acid which shall be washed off with water before painting is applied. All welds shall be subject to the inspection. The welded joints shall be tested by the Dye Penetration or other methods to detect any inherent defect in welding. Any defects noticed as a result of above test shall be rectified including replacement of the components/members which might get damaged in the process of tests.

SHOP ERECTION

Steel work shall be temporarily shop erected completely, so that the accuracy of fit may be checked before dispatch. The parts shall be assembled with a sufficient number of parallel drifts to bring and keep the components in place. In the case of parts drilled or punched through steel jigs with holes resulting in similar parts being interchangeable for portions of the steel work, trial assembly shall be carried out to the extent required by IS:1915.

MATCH-MARKING

All erection marks shall be die-stamped and also distinctly stenciled in paint. The marking shall be as per the marking diagram.

DESPATCH OF MATERIALS

The Contractor shall deliver the fabricated steel work to place of erection as far as possible, in the same sequence as that of erection. Dispatches should be scheduled to avoid cluttering up of the site. The bolts required for erection shall be bagged according to size prior to dispatch.

ERECTION

Erection drawings

The Contractor shall prepare comprehensive erection drawings for the structural steel work. The drawings should be made in sufficient details to ensure convenient assembly and speedy and proper erection at site. The drawings should indicate, in detail, the sequence of erection that is proposed to be followed and the method being adopted

Plant and Equipment

The suitability and capacity of all plant and equipment used for erection

Stacking and Handling

The Contractor shall ensure that steel work is not damaged due to careless or haphazard stacking. All structural steel work should be so stored and handled at the site that the members are not subject to excessive stresses. The steel work shall be stacked at site in such a manner that it shall be free from dirt.

Stacking shall, as far as practicable, be done in the sequence of erection but heavy members shall not be stacked on top of light ones. Arrangements shall always be made at the time of handling; the damaged piece will be rejected

Method of Erection

All structural steel work shall be erected in accordance with IS:800 and IS:1915.

The steel work shall be erected true and plumb and temporary bracing or staging shall be introduced wherever necessary, to ensure that the structure is not overstressed and to take care of all erection loads. attachment of such temporary steel work to the permanent steel work shall only be done . Temporary steel work, like bracing and staging, shall remain in position until the structure is stable and self-supporting and all the joints making the structure stable and self-supporting are permanently bolted. After removal of temporary steel work the permanent

structure shall be made good, to the complete. No riveting, permanent bolting or welding shall be done until proper alignment has been obtained. Erection of the parts with any moderate amount of reaming, chipping or cutting. The steel work shall be rejected

Erection Tolerances

Unless otherwise specified, the underside of base plates of steel members shall be within plus or minus 3mm from the elevations shown on the drawings. The lateral deviations of the base plates shall not exceed 5mm from the theoretical centre line.

Alignment of individual beams, girders, etc. shall not deviate more than plus minus 5mm

PAINTING

Painting i.e. the preparation of surfaces, phosphating, application of primer and finishing coats and other details shall be carried out in accordance with the requirements laid down under "Painting".

Shop Painting

The structural steel work shall be thoroughly cleaned, phosphated and painted with one coat of red oxide primer in the fabrication shop. Where two surfaces are to be in permanent contact after assembly and fabrication, each surface shall be thoroughly cleaned, phosphated and painted with one coat of red oxide primer.

9.2 **Final Painting**

Where called for, three coats of enamel paint of approved shade shall be applied to all steel work after erection. Particular care shall be taken to clean, wire brush, spot prime welded and other areas where priming coat has been marred during the course of erection before application of final painting.

LIST OF MANDATORY TESTS

Material	*Clause*	*Test*	*Field/ laboratory test*	*Test procedure*	*Min. quantity of material fo*	*Frequency of testing*
1	*2*	*3*	*4*	*5*	*6*	*7*
Steel if arranged	10.1.1	(a) Tensile strength (b) Bend test	Laboratory	IS 1599	20 tonne	Every 20 tonne o

Steel tubular pipes	10.13	(a) Tensile Test (b) Bend Test (c) Flattening	Laboratory	IS 1608 IS 2329 IS 2328	Every 8 tonne or part thereof	Every 8 tonne or part thereof

LIST OF BUREAU OF INDIAN STANDARDS CODES

Sl. No.	*Code No.*	*Subject*
1	IS 63	Whiting for paints and putty
2	IS 198	Varnish gold size
3	IS 228	Structural steel (Standard quality)
4	IS 277	Specification for galvanized steel sheets (Plain and corrugated)
5	IS 800	Code of practice for use of structural steel in general in steel construction
6	IS 806	Code of practice for use of steel Tubes in general building construction
7.	IS 808	Dimensions for Hot rolled steel beams, columns, channel and angle sections
8.	IS 812	Glossary of terms relating to welding and cutting metals
9.	IS 813	Scheme of symbols for welding
10	IS 814	Covered electrodes for manual metal arc welding of carbon and carbon manganese steel
11	IS 816	Code of practice for use of metal arc welding for general construction in mild steel
12	IS 817	Code of practice for training and testing of metal arc welders
13	IS 818	Code of practice for safety and healthy requirements in electric and gas welding and cutting operations
14	IS 822	Code of procedure for inspection of welds
15	IS 823	Manual for metal arc welding in mild steel
16	IS 1038	Steel doors, windows and ventilators
17	IS 1081	Code of practice for fixing and glazing of metal (Steel and aluminium) doors, windows and ventilators
18	IS 1148	Hot rolled steel rivet bars (upto 40 mm diameters) for structural purposes
19	IS 1161	Steel tubes for structural purposes
20	IS 1182	Recommended practice for radiographic examination of fusion welded butt joints in steel plates
21	IS 1200- (Pt. VIII)	Method of measurements of steel work and iron works
22	IS 1363 Part I	Haxagon head bolts, screws, and nuts of product grade C (Hexagon Head bolt)
23	IS 1363 Part II	Haxagon Head Bolts, screws and nuts of product Grade 'C'
24	IS 1363 Part-III	Haxagan Head Bolts, screws and Nuts of product grade 'C'
25	IS 1367	Technical supply conditions for threaded steel fasteners
26	IS 1599	Method for bend test
27	IS 1608	Metallic materials – Tensile Testing at Ambient Temperature.
28	IS 1821	Dimensions for clearance holes for bolts and screws
29	IS 1852	Rolling and cutting tolerance for hot rolled steel products
30	IS 1894	Method for tensile testing of steel tubes
31	IS 1977	Structural steel (ordinary quality)
32	IS 2062	Hot Rolled low, medium and high tensile structural steel
33	IS 2074	Ready mixed paint, air drying redoxide zinc chrome priming
34	IS 4351	Specification for steel door frames
35	IS 4454 (Part I)	Steel wires for mechanical springs. Cold drawn unalloyed steel wire.
36	IS 4711	Methods for sampling of steel pipes, tube and fittings.
37	IS 4736	Hot – dip zinc coating on mild steel tubes
38	IS 4923	Hollow Steel Sections for Structural Use - Specification
39	IS 6248	Metal rolling shutters and rolling grills

40	IS 7452	Specification for hot rolled steel sections for doors, windows and ventilators.

STAINLESS STEEL KITCHEN SINK

Stainless steel kitchen sink shall be of sizes as specified and shall be conforming to IS 13983. The kitchen sink shall be of one piece construction with or without rim but without overflow.

They shall be Stainless steel of best quality and shall be supported on necessary brackets. Each sink shall be provided with waste coupling, waste pipe, wall flanges, connection pipe, angle valve, long nose bibcock etc. including all the fixing materials.

STAINLESS STEEL RAILINGS AND STAINLESS STEEL SHUTTER WITH STAINLESS STEEL JALI FABRICATION

a) The scope of the work includes preparation of the shop drawings (based on the architectural drawings), fabrication, supply, installation and protection of the stainless steel railing and Stainless Steel shutter with stainless steel Jali till completion and handing over of the work.

b) The stainless steel work shall be got executed through specialized fabricator having experience of similar works. The Contractor shall submit the credentials of the fabricator for the approval of the SBI/ PMC / Engineer in charge.

c) The Contractor shall submit shop drawings, for approval of the Engineer-in- Charge, for fabricating stainless steel railing and Stainless Steel shutter with stainless steel Jali with detailing of M.S. stiffener frame work backing along with the fixing details of the M.S. frame work to the R.C.C columns or

frame. The details of the joints in the stainless steel work including location, etc. shall also be shown in the shop drawings.

d) The Contractor shall procure and submit to the SBI/ PMC / Engineer in charge, samples of various materials for the railing work and jali Shutter with its fixtures, for approval. After approval of samples, the Contractor shall prepare a mock up for approval of SBI/ PMC / Engineer in charge. The material shall be procured and the mass work taken up only after the approval of the mock up by the SBI/ PMC / Engineer in charge. The mock-up shall be dismantled and removed by the contractor as per the directions of the SBI/ PMC / Engineer in charge.

e) The stainless steel shall be of grade 316 with brushed steel satin finish and procured from the approved manufacturer. It shall be without any dents, waviness, scratches, stains etc.

f) The required joints in the S. S Work shall be provided as per the architectural drawings, shall be welded in a workmanlike manner including grinding, polishing, buffing etc. all complete and compacted. The temporary clamps provided and fixed to hold the stainless steel

railing, in position shall be removed after the concrete has set properly. The junction of the flooring and the cladding shall be neatly filled with weather silicone sealant of approved colour and shade.

g) One test (three specimens) for each lot shall be conducted for the stainless steel pipe in the approved laboratory. Therefore, the material shall preferably be procured in one lot from one manufacturer.

h) The finished surface shall be free of any defects like dents, waviness, scratches, stains etc. and shall have uniform brushed steel satin finish.

Any defective work shall be rejected and redone by the Contractor. The finished surface shall therefore be protected using protective tape which shall be removed at the time of completion of the work. The surface shall then be suitably cleaned using nonabrasive approved cleaner for the material.

i) The item includes all inputs of labour, materials (including stainless steel pipes, welding, brazing, concrete, protective film, weather silicone sealant etc. including providing and fixing M.S. frames), T & P other incidental items, wastages etc. The items also included providing and fixing stainless steel anchor fasteners for fixing railing.

j) The railing shall be fixed in position using stainless steel pipes, stainless steel posts of required diameters and thickness as shown on drawing and polished to satin finish including cutting, welding, grinding, bending to required profile and shape, hoisting, butting, polishing etc. The Jali shutter shall be fixed in position using stainless steel rectangular pipes of required thickness and size and SS Jali as shown in the drawing, including hinges, latching and locking arrangements, and polished to satin finish including cutting, welding, grinding, bending to required profile and shape, hoisting, butting, polishing etc.

k) The item includes all inputs of labour, materials, T&P, other incidental items, wastage etc. The entire work shall be carried out to the satisfaction of SBI/ PMC / Engineer in charge.

Providing and fixing stainless steel (Grade 304) railing made of Hollow tubes, channels, plates etc., including welding, grinding, buffing, polishing and making curvature (wherever required) and fitting the same with necessary stainless steel nuts and bolts complete, i/c fixing the railing with necessary accessories & stainless steel dash fasteners , stainless steel bolts etc., of required size, on the top of the floor or the side of waist slab with suitable arrangement as per approval of SBI/ PMC / Engineer in charge, (for payment purpose only weight of stainless steel members shall be considered excluding fixing accessories such as nuts, bolts, fasteners etc.).

M.S. WORK

M.S. RAILING:

Steel work welded in built up sections/framed worK including cutting hoisting, rixing in position and applying a priming coat of approved steel primer using structural steel, etc. as required:

In stringers, treads, landings etc. of stair cases, including use of chequered plate wherever required, all complete AND In gratings, frames, guard bar, ladders, railings, brackts. gates & similar works. Steel work welded in built up sections/ framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer using structural steel etc. as required. In gratings, frames, guard bar, ladder, railings, brackets, gates and similar works

M.S. ANGLE FRAME:

Providing and fixing angle iron frames for doors, windows and ventilators of mild steel Angle sections of size 35x35x5 mm, joints mitred and welded by angle iron 35x35x5 mm or 35x 5 mm flat pieces to the existingT-iron frame or to the wall with dash fastener, including fixing of necessary butt hinges and screws and applying a priming coat of approved steel primer, all complete as per the direction of SBI/ PMC / Engineer in charge.

Providing M.S. foot rests including fixing in manholes with 20x20x10 cm cement concrete blocks 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size) as per standard design

: With 20x20 mm square bar.

M.S. TUBULAR FRAME:

Providing and fixing M.S. Tubular frames for doors, windows, ventilators and cupboard with rectangular/ L-Type sections, made of 1.60 mm thick M.S. Sheet, joints mitred, welded and grinded finish, with profiles of required size, including fixing of necessary butt hinges and screws and applying a priming coat of approved steel primer.

Fixing with 15x3 mm lugs 10 cm long embedded in cementconcrete block 15x10x10 cm of C.C. 1:3:6 (1 Cement : 3 coarsesand : 6 graded stone aggregate 20 mm nominal size).

FIXING:

Providing and fixing carbon steel galvanised (minimum coating 5 micron) dash fastener of 10 mm dia double threaded 6.8 grade (yield strength 480 N/mm2), counter sunk head, comprising of 10 m dia polyamide PA 6 grade sleeve, including drilling of hole in frame , concrete/ masonry, etc. as per direction of SBI/ PMC / Engineer in charge: 10 x 60 mm EACH.

M.S. FOOTREST:

Providing M.S. foot rests including fixing in manholes with 20x20x10 cm cement concrete blocks 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size) as per standard design

: With 20x20 mm square bar.

PRECAST RCC COVER:

Providing and fixing in position pre-cast R.C.C. manhole cover and frame of required shape and approved quality- H D – 20, Circular shape 560 mm internal diameter.

M.S. SHEET DOOR

Providing and fixing 1mm thick M.S. sheet door with frame of 40x40x6 mm angle iron and 3 mm M.S. gusset plates at the junctions and corners, all necessary fittings complete, including applying a priming coat of approved steel primer. Using M.S. angels 40x40x6 mm for diagonal braces

STEEL WORK IN BUILT UP TUBULAR FRAME

Steel work in built up tubular (round, square or rectangular hollow tubes etc.) trusses etc., including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer, including welding and bolted with special shaped washers etc. complete. Hot finished welded type tubes.

- Structural steel work in single section, fixed with or without connecting plate, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer all complete.
- Steel work in built up tubular (round, square or rectangular hollow tubes etc.) trusses etc., including cutting, hoisting, fiXing in position and applying a priming coat of approved steel primer, including welding and bolted with special shaped washers etc. complete. Hot finished seamless type tubes
- Providing and fixing 1mm thick M.S. sheet door with frame of 40x40x6 mm angle iron and 3 mm M.S. gusset plates at the junctions and corners, all necessary fittings complete, including applying a priming coat of approved steel primer. Using M.S. angels 40x40x6 mm for diagonal braces
- Providing and fixing bolts including nuts and washers complete.
- Steel work welded in built up sections/ framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer using structural steel etc. as required. In gratings, frames, guard bar, ladder, railings, brackets, gates and similar works
- Frame work for partitions/ wall lining etc. made of 50x50x1.6 mm hollow MS tube, placed along the walls, ceiling and floor in a grid pattern with spacing @ 60 em centre to centre both ways (vertically & horizontally) or at required spacing near opening, with necessary welding at junctions and fixing the frame to wall/ ceiling/ floors with steel dash fasteners of 8 mm dia, 75 mm long bolt, including making provision for opening for doors, windows, electrical conduits, switch boards etc., including providing with two coats of approved steel primer etc. complete, all as per direction of SBI/ PMC / Engineer in charge.
- Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approved steel primer. M.S. tube
- Carbon steel galvanised (minimum coating 5 micron) dash fastener of 10 mm dia double threaded 6.8 grade (yield strength 480 N/mm2), counter sunk head, comprising of 10 m dia polyamide PA 6 grade sleeve, including drilling of hole in frame , concrete/ masonry, etc. as per direction of SBI/ PMC / Engineer in charge. 10x 160 mm

- Stainless steel (Grade 304) railing made of Hollow tubes, channels, plates etc., including welding, grinding, buffing, polishing and making curvature (wherever required) and fitting the same with necessary stainless steel nuts and bolts complete, i/c fixing the railing with necessary accessories & stainless steel dash fasteners , stainless steel bolts etc., of required size, on the top of the floor or the side of waist slab with suitable arrangement as per approval of SBI/ PMC / Engineer in charge, (for payment purpose only weight of stainless steel members shall be considered excluding fixing accessories such as nuts, bolts, fasteners etc.).
- **Balustrade & Handrail system:-** Modular (weld free Components base) Balustrade & Handrail system, 50.8 mm dia x 1.6mm thick handrail fixed to the Balustrade of 50 .8 mm dia x 1.6 mm thick with top adapter(neck) type fixed with 2nos of M4x10mm Allen CSk Screw. The balustrade fixed to Top of the straight or staircase with Base plate with M12 x120mm long anchor fastener. The balustrade C/C 900 to 1000mm, The Ht. of the handrail 1200mm from FFL. Glass infill of 6,8 &10 mm thick toughened monolithic Glass or 13.52 thick laminated toughened glass is Fixed to the Balustrade with Glass Clamp (Four per balustrade) by M8 avdel insert & M8 x25mm Allen cap screw , Complete with all End cap, Mid Span Sleeve, Elbows. All the material of handrail, balustrade and components should be of SS 304 grade satin finish.

OTHER SPECIFICATIONS:

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

11 FLOORING:

The flooring in the building shall be as per the approved finishing schedule appended in DBR, PART-D/ Tender drawings and laid in such a way that limits in floor levels would not exceed the limits provided in the latest CPWD specifications or manufactures specifications.

a. In order to keep the floor finish as per direction of PMC/SBI/ PMC / Engineer in charge and as per Finishing Schedule/ Architectural drawings and to provide required thickness of the flooring as per specification, the level of top surface of RCC shall be accordingly adjusted at the time of its centering, shuttering and casting. Alternatively, for maintaining the floor finish, grading with cement concrete with nominal mix 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 10mm nominal size) shall be provided.

b. Wherever Vitrified Tile flooring is done, it shall be with 1st Quality multi-grade/multi- range tiles.

c. Slope in floors shall be provided as per architectural drawings, else the levels at any place when checked over a distance of one meters in any direction should not show variation in floor level more than 3 mm.

d. Protective layer to be provided of all types of flooring.

e. The grouting of the joints shall be with white cement and matching pigment.

The edges of steps in the staircases, counters, kitchen platform, window sills, facias and similar location shall be edge moulded as required.

MARBLE STONE IN RISERS OF STEPS AND SKIRTING

Marble Stone Slabs and Dressing of Slabs shall be as specified in 11.19.1 and 11.19.2 except that the thickness of slabs shall be 18 mm. A tolerance of + 3% mm shall be allowed, unless

otherwise specified

Preparation of Surface

It shall be as specified in 11.18.2 where necessary, the wall surface shall be cut uniformly to the requisite depth so that the skirting face shall have the projection from the finished face of wall. In no case the skirting should project by more than thickness of stone.

Laying

The risers of steps and skirting shall be in grey or white cement admixed with or without pigment to match the shade of the stone, as specified in the description of the item, with the line of the slab at such a distance from the wall that the average width of the gap shall be 12 mm and at no place the width shall be less than 10 mm, if necessary, the slabs shall be held in position by temporary M.S. hooks fixed into the wall at suitable intervals. The skirting or riser face shall be checked for plane and plumb and corrected. The joints shall thus be left to harden then the rear of the skirting or riser slab shall be packed with cement mortar 1:3 (1 cement : 3 coarse sand) or other mix as specified in the description of the item. The fixing hooks shall be removed after the mortar filling the gap has acquired sufficient strength.The joints shall be as fine as possible but not more than 1 mm. The top line of skirting and risers shall be truly horizontal and joints truly vertical, except where otherwise indicated.

The risers and skirting slab shall be matched

Curing, Polishing and Finishing

It shall be as specified as far as applicable, except that cement slurry with or without pigment shall not be applied on the surface and polishing shall be done only with hand. The face and top of skirting shall be polished.

KOTA STONE FLOORING

Kota Stone Slabs

The slabs shall be of selected quality, hard, sound, dense and homogeneous in texture free from cracks, decay, weathering and flaws. They shall be hand or machine cut to the requisite thickness. The slabs shall have the top (exposed) face polished before being brought to site, unless otherwise specified. The slabs shall conform to the size required. Before starting the work the contractor shall get the samples of slabs .

Dressing

Every slab shall be cut to the required size and shape and fine chisel dressed on the sides to the full depth so that a straight edge laid along the side of the stone shall be in full contact with it. The sides (edges) shall be table rubbed with coarse sand or machine rubbed before paving. All angles and edges of the slabs shall be true, square and free from chippings and the surface shall be true and plane.

The thickness of the slab after it is dressed shall be 20, 25, 30 or 40 mm as specified in the description of the item. Tolerance of ±2 mm shall be allowed for the thickness. In respect of length and breadth of slabs Tolerance of ± 5 mm for hand cut slabs and ± 2 mm for machine cut slabs shall be allowed.

Preparation of Surface and Laying

The specification shall be as described in 11.19.3 except that the edges of the slabs to be jointed shall be buttered with grey cement, with admixture of pigment to match the shade of the slab.

The thickness of the joints should be minimum as possible. In any location, it shall not exceed 1 mm.

Polishing and Finishing

The specifications shall be as described except that (a) first polishing with coarse grade carborundum stone shall not be done, (b) cement slurry with or without pigment shall not be applied on the surface before polishing.

KOTA STONE IN RISERS OF STEPS, SKIRTING AND DADO

Kota Stone Slabs and Dressing shall be as specified in 11.21.1 and 11.21.2 except that the thickness of the slabs shall be 25 mm or as specified in the description of the item. The slabs may be of uniform size if required. Preparation of surface shall be as specified in 11.20.2. Laying shall be as specified in 11.20.3 except that the joints of the slabs shall be set in grey cement mixed with pigment to match the shade of the slabs. Curing, Polishing and Finishing shall be as specified in 11.20.4 except that first polishing with coarse grade carborundum stone shall not be done.

Anti-Skid Grooves for Staircase Treads and Ramps

Tread: Provide 3 Nos. 5mmx5mm grooves with a gap of 25mm centre to centre at a distance of 50mm from nosing of the tread.Pedestrian Ramp: Provide 5mm x 5mm groove throughout the length of the pedestrian ramp with a gap of 100mm centre to centre.

FIXING OF TILE FLOORING WITH CEMENT BASED HIGH POLYMER MODIFIED QUICK SET ADHESIVE (WATER BASED)

When tile flooring is to be laid over the existing flooring without dismantling old flooring it can be laid with adhesive. The old flooring shall be thoroughly cleaned and checked for undulations, if any shall be rectified with cement mortar 1:3 (1 cement: 3 coarse sand). Old cement concrete surface shall be hacked and cleaned off to have proper bond with the old surface. High polymer modified quick set tile adhesive (conforming to IS 15477) shall be thoroughly mixed with water and a paste of zero slump shall be prepared so that it can be used with in 1.5 to 2 hours. It shall be spread over an area not more than one sqm at one time. Average thickness of adhesive shall be 3 mm The adhesive so spreaded shall be combed using suitable trowel. Tiles shall be pressed firmly in to the position with slight twisting action checking it simultaneously to ensure good contact gently being tapped with wooden mallet till it is properly backed with adjoining tiles. The tiles shall be fixed within 20 minutes of application of adhesive. The surplus adhesive from the joints, surface of the tiles shall be immediately cleaned. The surface of the flooring shall be frequently checked during laying with straight edge of above 2m long so as to attain a true surface with required slope. Where spacer lugs tiles are provided these shall be filled with grout with lugs remaining exposed. Where full size tile can not be fixed these shall be cut (sawn) to the required size and edges rubbed smooth to ensure straight and true joints. Tiles which are fixed in floor adjoining to wall shall enter not less than 10 mm under plaster, skirting or dado.

MARBLE STONE FLOORING

Dressing of Slabs

Every stone shall be cut to the required size and shape, fine chisel dressed on all sides to the full depth so that a straight edge laid along the side of the stone shall be fully in contact with it. The top surface shall also be fine chisel dressed to remove all waviness. In case machine cut slabs are used, fine chiesel dressing of machine cut surface need not be done provided a straight edge laid any where along the machine cut surfaces is in contact with every point on it. The sides and top surface of slabs shall be machine rubbed or table rubbed with coarse sand before paving. All angles and edges of the marble slabs shall be true, square and free from chippings and the surface shall be true and plane.

The thickness of the slabs shall be 18, 30 or 40 mm as specified in the description of the item. Tolerance of + 3% shall be allowed for the thickness. In respect of length and breadth of slabs a tolerance of + 2% shall be allowed. vitrified floor tiles in different sizes (thickness to be specified by the manufacturer) with water absorption less than 0.08% and conforming to IS: 15622, of approved make, in all colours and shades, laid on 20mm thick cement mortar 1:4 (1 cement : 4 coarse sand), jointing with grey cement slurry @ 3.3 Kg/ Sqm including grouting the joints with white cement and matching pigments etc., The tile must be cut with zero chipping diamond cutter only, laying of tile will be done with the notch trowel, plier, wedge, clips of required thickness, Levelling system and rubber mallet for placing the tiles gently and easily.

Double Charge Vitrified Tile of Polished finish of size
Glazed Vitrified tiles Matt/Antiskid finish of size

Grouting the joints of flooring tiles having joints of 3 mm width, using epoxy grout mix of 0. 70 kg of organic coated filler of desired shade (0.1 0 kg of hardener and 0.20 kg of resin per kg), including filling I grouting and finishing complete as per direction of SBI/ PMC / Engineer in charge.

Laying

Base concrete or the RCC slab on which the slabs are to be laid shall be cleaned, wetted and mopped. The bedding for the slabs shall be with cement mortar 1:4 (1 cement : 4 coarse sand) or as given in the description of the item.

The average thickness of the bedding mortar under the slab shall be 20 mm and the thickness at any place under the slab shall be not less than 12 mm. The slabs shall be laid in the following manner: Mortar of the specified mix shall be spread under the area of each slab, roughly to the average thickness specified in the item. The slab shall be washed clean before laying. It shall be laid on top, pressed, tapped with wooden mallet and brought to level with the adjoining slabs. It shall be lifted and laid aside. The top surface of the mortar shall then be corrected by adding fresh mortar at hollows. The mortar is allowed to harden a bit and cement slurry of honey like consistency shall be spread over the same at the rate of 4.4 kg of cement per sqm. The edges of the slab already paved shall be buttered with grey or white cement with or without admixture of pigment to match the shade of the marble slabs as given in the description of the item. The slab to be paved shall then be lowered gently back in position and tapped with wooden mallet till it is properly bedded in level with and close to the adjoining slabs with as fine a joint as possible. Subsequent slabs shall be laid in the same manner. After each slab has been laid, surplus cement on the surface of the slabs shall be cleaned off. The flooring shall be cured for a minimum period of seven days. The surface of the flooring as laid shall be true to levels, and, slopes as instructed by the SBI/ PMC / Engineer in charge. Joint thickness shall not be more than 1 mm. Due care shall be taken to match the grains of slabs which shall be selected judiciously having uniform pattern of Veins/streaks or as directed by the SBI/ PMC / Engineer in charge. The slabs shall be matched as shown in drawings or as instructed by the SBI/ PMC / Engineer in charge. Slabs which are fixed in the floor adjoining the wall shall enter not less than 12 mm under the plaster skirting or dado. The junction between wall plaster and floor shall be finished neatly and without waviness. Marble slabs flooring shall also be laid in combination with other stones and/or in simple regular pattern/design as described in item of work and/or drawing.

Polishing and Finishing

Slight unevenness at the meeting edges of slabs shall then be removed by fine chiselling and finished in the same manner as specified in 11.10.3 except that cement slurry with or without pigments shall not be applied on the surface before each polishing.

Measurements

Marble stone flooring with different kind of marble shall be measured separately and in square metre correct to two places of decimal. Length and breadth shall be measured correct to a cm before laying skirting, dado or wall plaster. **In the case of radially dressed or circular stone used in the work, the**

dimensions of the circumscribing rectangle of the dressed stone, shall be measured correct to a centimeter. No deduction shall be made nor extra paid for voids not exceeding 0.20 square metre. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square metre. Nothing extra shall be paid for laying the floor at different levels in the same room. Steps and treads of stairs paved with marble stone slabs shall also be measured under the item of Marble Stone flooring. Extra shall, however, be paid for such areas where the width of treads does not exceed 30 cm. Nosing for treads shall be measured in running metre and paid for extra. The width of treads shall be measured from the outer edge of the nosing, as laid, before providing the riser.

MARBLE STONE IN RISERS OF STEPS AND SKIRTING

Marble Stone Slabs and Dressing of Slabs shall be as specified in 11.19.1 and 11.19.2 except that the thickness of slabs shall be 18 mm. A tolerance of + 3% mm shall be allowed, unless otherwise specified in the description of the item.

Preparation of Surface

It shall be as specified in 11.18.2 where necessary, the wall surface shall be cut uniformly to the requisite depth so that the skirting face shall have the projection from the finished face of wall as shown in drawings or as required by the SBI/ PMC / Engineer in charge. In no case the skirting should project by more than thickness of stone.

Laying

The risers of steps and skirting shall be in grey or white cement admixed with or without pigment to match the shade of the stone, as specified in the description of the item, with the line of the slab at such a distance from the wall that the average width of the gap shall be 12 mm and at no place the width shall be less than 10 mm, if necessary, the slabs shall be held in position by temporary M.S. hooks fixed into the wall at suitable intervals. The skirting or riser face shall be checked for plane and plumb and corrected. The joints shall thus be left to harden then the rear of the skirting or riser slab shall be packed with cement mortar 1:3 (1 cement : 3 coarse sand) or other mix as specified in the description of the item. The fixing hooks shall be r emoved after the mortar filling the gap has acquired sufficient strength. The joints shall be as fine as possible but not more than 1 mm. The top line of skirting and risers shall be truly horizontal and joints truly vertical, except where otherwise indicated.

The risers and skirting slab shall be matched as shown in drawings or as instructed by the SBI/ PMC / Engineer in charge.

Curing, Polishing and Finishing

It shall be as specified in 11.11.4 as far as applicable, except that cement slurry with or without pigment shall not be applied on the surface and polishing shall be done only with hand. The face and top of skirting shall be polished.

CEMENT CONCRETE FLOORING

Cement Concrete

Cement concrete of specified mix grade shall be used and it shall generally conform to the specifications.

Base Concrete

Flooring shall be laid on base concrete where so provided. The base concrete shall be provided with the slopes required for the flooring. Flooring in verandah, Courtyard, kitchens & baths shall have slope ranging from 1 : 48 to 1 : 60 depending upon location and as decided by the Engineer-In- Charge.

Floors in water closet portion shall have slope of 1:30 or as decided by the SBI/ PMC / Engineer in charge to drain off washing water. Further, necessary drop in flooring in bath, WC, kitchen near floor traps ranging from 6 mm to 10 mm will also be provided to avoid spread of water. Necessary margin to

accommodate this drop shall be made in base concrete. Plinth masonry off set shall be depressed so as to allow the base concrete to rest on it.The flooring shall be commenced preferably within 48 hours of the laying of base concrete. The surface of the base shall be roughened with steel wire brushes without disturbing the concrete.
Immediately before laying the flooring, the base shall be wetted and a coat of cement slurry @ 2 kg of cement spread over an area of one sqm so as to get a good bond between the base and concrete floor.

If the cement concrete flooring is to be laid directly on the RCC slab, the top surface of RCC slab shall be cleaned and the laitance shall be removed and a coat of cement slurry @ 2 kg of cement spread over an area of one sqm so as to get a good bond between the base and concrete floor.

Thickness
The thickness of floor shall be as specified in the Indicative item/specification/drawing.

Laying

Panels: Flooring of specified thickness shall be laid in the pattern including the border as given in the drawings or as directed by the SBI/ PMC / Engineer in charge. The border panels shall not exceed 450 mm in width and the joints in the border shall be in line with panel joints. The panels shall be of uniform size and no dimension of a panel shall exceed 2 m and the area of a panel shall not be more than 2 sqm.

The joints of borders at corners shall be mitred for provision of strips.

Laying of Flooring with Strips:
Normally cement concrete flooring shall be laid in one operation using glass/ aluminium/PVC/brass strips/stainless steel strips or any other strips as required as per drawing or instructions of the SBI/ PMC / Engineer in charge, at the junction of two panels. This method ensures uniformity in colour of all the panels and straightness at the junction of the panels. 4 mm thick glass strips or 2 mm PVC strips or 2 mm aluminium or brass strips shall be fixed with their tops at proper level, giving required slopes. Use of glass and metallic strips shall be avoided in areas exposed to sun.

***C*oncreting:**
Cement concrete shall be placed in the panels and be levelled with the help of straight edge and trowel and beaten with thapy or mason's trowel. The blows shall be fairly heavy in the beginning but as consolidation takes place, light rapid strokes shall be given. Beating shall cease as soon as the surface is found covered with a thin layer of cream of mortar. The evenness of the surface shall be tested with straight edge. Surface of flooring be true to required slopes. While laying concrete, care shall be taken to see that the strips are not damaged/disturbed by the labourers. The tops of strips shall be visible clearly after finishing with cement slurry.

Laying of Flooring without Strips:

The laying of cement concrete flooring in alternate panels may be allowed by the SBI/ PMC / Engineer in charge in case strips are not to be provided.

Shuttering:
The panels shall be bounded by angle iron or flats. The angle iron/flat shall have the same depth as the concrete flooring. These shall be fixed in position, with their top at proper level giving required slopes. The surface of the angle iron or flats, to come in contact with concrete shall be smeared with soap solution or non-sticking oil (Form oil or raw linseed oil) before concreting. The flooring shall butt against the unplastered masonry wall.

Concreting:

The concreting shall be done in the manner as described below.

The angle iron/ flats used for shuttering, shall be removed on the next day of the laying of cement concrete. The ends thus exposed shall be repaired, if damaged with cement mortar 1: 2 (1 cement: 2 coarse sand) and allowed to set for minimum period of 24 hours. The alternate panels shall then be cleaned of dust, mortar, droppings etc. and concrete laid. While laying concrete, care shall be taken to see that the edges of the previously laid panels are not damaged and fresh mortar is not splashed over them. The joints between the panels should come out as fine straight lines.

Finishing

The finishing of the surface shall follow immediately after the cessation of beating. The surface shall be left for some time, till moisture disappears from it or surplus water can be mopped up. Use of dry cement or cement and sand mixture stiffening the concrete to absorb excessive moisture shall not be permitted. Excessive trowelling shall be avoided.

Fresh cement shall be mixed with water to form a thick slurry and spread @ 2 kg of cement over an area of one sqm of flooring while the flooring concrete is still green. The cement slurry shall then be properly processed and finished smooth.

The edges of sunk floors shall be finished and rounded with cement mortar 1:2 (1 cement: 2 coarse sand) and finished with a floating coat of neat cement.
The junctions of floor with wall plaster, dado or skirting shall be rounded off where so specified.

The men engaged on finishing operations shall be provided with raised wooden platform to sit on so as to prevent damage to new work.

Curing

The curing shall be done for a minimum period of ten days. Curing shall not be commenced until the top layer has hardened. Covering with empty gunnies bag shall be avoided as the colour of the flooring is likely to be bleached due to the remnants of cement dust from the bags.

Precautions
Flooring in lavatories and bath room shall be laid only after fixing of water closet and squatting pans and floor traps. Traps shall be plugged while laying the floors and opened after the floors are cured and cleaned. Any damage done to W.C.'s squatting pans and floor traps during the execution of work shall be made good.

During cold weather, concreting shall not be done when the temperature falls below 4°C. The concrete placed shall be protected against frost by suitable covering. Concrete damaged by frost shall be removed and work redone. During hot weather, precautions shall be taken to see that the temperature of wet concrete does not exceed 38° C. No concreting shall be laid within half an hour of the closing time of the day, unless permitted by the SBI/ PMC / Engineer in charge. To facilitate rounding of junction of skirting, dado and floor, the skirting/dado shall be laid along with the border or adjacent panels of floor.

TILE FLOORING

Ceramic Tile Flooring

Ceramic Tiles
The tiles shall be of approved make and shall generally conform to IS 15622. They shall be flat, and true to shape and free from blisters crazing, chips, welts, crawling or other imperfections detracting from their

appearance. The tiles shall be tested as per IS 13630. Classification and Characteristics of ceramic tiles shall be as per IS 13712.

The tiles shall be square or rectangular of nominal size. Table 1, 3, 5, and 7 of IS 15622 give the modular preferred sizes and table 2, 4, 6 and 8 give the most common non modular sizes. Thickness shall be specified by the manufacturer. It includes the profiles on the visible face and on the rear side.

Manufacturer/supplier and party shall choose the work size of tiles in order to allow a nominal joint width up to 2mm for unrectified floor tiles and up to 1mm for rectified floor tiles. The joint in case of spacer lug tile shall be as per spacer. The tiles shall conform to table10 of IS 15622 with water absorption 3 to 6% (Group BII).

The top surface of the tiles shall be glazed. Glaze shall be either glossy or matt as specified. The underside of the tiles shall not have glaze on more than 5% of the area in order that the tile may adhere properly to the base. The edges of the tiles shall be preferably free from glaze. However, any glaze if unavoidable, shall be permissible on only up to 50 per cent of the surface area of the edges.

Preparation of Surface and Laying

Base concrete or the RCC slab on which the tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tile shall be with cement mortar 1:4 (1 cement: 4 coarse sand) or as specified. The average thickness of the bedding shall be 20 mm or as specified while the thickness under any portion of the tiles shall not be less than 10 mm.

Mortar shall be spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer a fairly rigid cushion for the tiles to be set and to enable the mason to place wooden plank across and squat on it.

Over this mortar bedding neat grey cement slurry of honey like consistency shall be spread at the rate of 3.3 kg of cement per square meter over an area up to one square meter. Tiles shall be soaked in water washed clean and shall be fixed in this grout one after another, each tile gently being tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be kept as thin as possible and in straight lines or to suit the required pattern.

The surface of the flooring during laying shall be frequently checked with a straight edge about 2 m long, so as to obtain a true surface with the required slope. In bath, toilet W.C. kitchen and balcony/verandah flooring, suitable tile drop or as shown in drawing will be given in addition to required slope to avoid spread of water. Further tile drop will also be provided near floor trap.

Where full size tiles cannot be fixed these shall be cut (sawn) to the required size, and their edge rubbed smooth to ensure straight and true joints. Tiles which are fixed in the floor adjoining the wall shall enter not less than 10 mm under the plaster, skirting or dado.

After tiles have been laid surplus cement slurry shall be cleaned off.

Pointing and Finishing

The joints shall be cleaned off the grey cement slurry with wire/coir brush or trowel to a depth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigment if required to match the colour of tiles. Where spacer lug tiles are provided, the half the depth of joint shall be filled with polysulphide or as specified on top with under filling with cement grout without the lugs remaining exposed. The floor shall then be kept wet for 7 days. After curing, the surface shall be washed and finished clean. The finished floor shall not sound hollow when tapped with a wooden

mallet.

Vitrified Tile Flooring

Vitrified Tiles

The tiles shall be of approved make and shall generally conform to IS 15622. They shall be flat, and true to shape and free from blisters crazing, chips, welts, crawling or other imperfections detracting from their appearance. The tiles shall be tested as per IS 13630. Classification and Characteristics of Vitrified tiles shall be as per IS 13712.

The tiles shall be square or rectangular of nominal size. Table 12 of IS 15622 give the modular preferred sizes (Tiles with water absorption E ≤ 0.08 per cent Group B1a) and the joint thickness in flooring shall not be more than 1mm Thickness shall be specified by the manufacturer. It includes the profiles on the visible face and on the rear side.

Manufacturer/supplier and party shall choose the work size of tiles in order to allow a nominal joint width shall not be more than 1mm for rectified floor tiles. Table 12 of IS 15622 give the modular preferred sizes (Tiles with water absorption E ≤ 0.08 per cent Group B1a) and the joint thickness in flooring shall not be more than 1mm.

The top surface of the tiles shall be glazed. Glaze shall be either glossy or matt as specified. The underside of the tiles shall not have glaze on more than 5% of the area in order that the tile may adhere properly to the base. The edges of the tiles shall be preferably free from glaze. However, any glaze if unavoidable, shall be permissible on only up to 50 per cent of the surface area of the edges.

Preparation of Surface and Laying

Base concrete or the RCC slab on which the tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tile shall be with cement mortar 1:4 (1 cement: 4 coarse sand) or as specified. The average thickness of the bedding shall be 20 mm or as specified while the thickness under any portion of the tiles shall not be less than 10 mm. Mortar shall be spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer a fairly rigid cushion for the tiles to be set and to enable the mason to place wooden plank across and squat on it.

Over this mortar bedding neat grey cement slurry of honey like consistency shall be spread at the rate of 3.3 kg of cement per square meter over an area up to one square meter. Tiles shall be soaked in water washed clean and shall be fixed in this grout one after another, each tile gently being tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be kept as thin as possible and in straight lines or to suit the required pattern.

The surface of the flooring during laying shall be frequently checked with a straight edge about 2 m long, so as to obtain a true surface with the required slope. In bath, toilet W.C. kitchen and balcony/verandah flooring, suitable tile drop or as shown in drawing will be given in addition to required slope to avoid spread of water. Further tile drop will also be provided near floor trap.

Where full size tiles cannot be fixed these shall be cut (sawn) to the required size, and their edge rubbed smooth to ensure straight and true joints. Tiles which are fixed in the floor adjoining the wall shall enter not less than 10 mm under the plaster, skirting or dado.

After tiles have been laid surplus cement slurry shall be cleaned off.

Pointing and Finishing

The joints shall be cleaned off the grey cement slurry with wire/coir brush or trowel to a depth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigment if required to match the colour of tiles. Where spacer lug tiles are provided, the half the depth of joint shall be filled with polysulphide or as specified on top with under filling with cement grout without the lugs remaining exposed. The floor shall then be kept wet for 7 days. After curing, the surface shall be washed and finished clean. The finished floor shall not sound hollow when tapped with a wooden mallet.

The vitrified tiles shall be of approved make and shall generally conform to IS 15622 (Tiles with water absorption E d" 0.08 per cent Group BIa) and the joint thickness in flooring shall not be more than 1mm. They shall be flat, and true to shape and free from blisters crazing, chips, welts, crawling or other imperfections detracting from their appearance.
The vitrified tiles shall be square or rectangular of nominal size. Thickness shall be specified by the manufacturer. The top surface of the tiles shall be double charged. Glaze shall be either glossy or matt as specified. The underside of the tiles shall not have glaze on more than 5% of the area in order that the tile may adhere properly to the base. The edges of the tiles shall be preferably free from glaze. However, any glaze if unavoidable, shall be permissible on only upto 50 per cent of the surface area of the edges.
Base concrete or the RCC slab on which the tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tile shall be with cement mortar 1:4 (1 cement : 4 coarse sand) or as specified. The average thickness of the bedding shall be 20 mm or as specified while the thickness under any portion of the tiles shall not be less than 10 mm. Mortar shall be spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer a fairly rigid cushion for the tiles to be set and to enable the mason to place wooden plank across and squat on it.
Over this mortar bedding neat grey cement slurry of honey like consistency shall be spread at the rate of 3.3 kg of cement per square metre over an area upto one square metre. Tiles shall be soaked in water washed clean and shall be fixed in this grout one after another, each tile gently being tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be kept as thin as possible and in straight lines or to suit the required pattern.
The surface of the flooring during laying shall be frequently checked with a straight edge about 2 m long, so as to obtain a true surface with the required slope. Where full size tiles cannot be fixed these shall be cut (sawn) to the required size, and their edge rubbed smooth to ensure straight and true joints. Tiles which are fixed in the floor adjoining the wall shall enter not less than 10 mm under the plaster, skirting or dado. After tiles have been laid surplus cement slurry shall be cleaned off.
The joints shall be cleaned off the grey cement slurry with wire/coir brush or trowel to a depth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigment if required to match the colour of tiles. Where spacer lug tiles are provided, the half the depth of joint shall be filled with polysulphide or as specified on top with under filling with cement grout without the lugs remaining exposed. The floor shall then be kept wet for 7 days. After curing, the surface shall be washed and finished clean. The finished floor shall not sound hollow when tapped with a wooden mallet.

FLAMED FINISH GRANITE STONE FLOORING

The process is often referred to as a "flamed" or "thermal" finish and can be best described as creating a textured look. To achieve the style, an intense flame is held at the stone's wet surface. While firing it, the surface becomes so hot it bursts and a layer flakes away to reveal a rough, even texture. It is especially used at a location of high importance to have a great finish for designs requiring a modern aesthetic.

Flamed Finish Granite Stone

Other granite details shall be as specified in sub head 8.0 . The flamed finish granite stone details shall be as specified in sub head 8.0. Other details such as dressing of slabs, laying ,polishing , finishing, measurement and rates shall be as specified in clause 11.19 with flamed finish granite stone in place of

Indian marble stone.

The granite stonework shall, in general, be carried out as per the CPWD Specifications and relevant specification for marble flooring, skirting, dado and tread/risers of steps under Flooring Sub Head of the CPWD Specifications shall prevail. Granite stone slabs shall be pre polished (mirror polished), eggshell polished, flame finished or given any other surface treatment as specified, as per the PMC/SBI/ PMC / Engineer in charge architectural drawings and as directed by the PMC/SBI/ PMC / Engineer in charge. Machine polishing and cutting to required size shall be done with water (as lubricant) only. Sawing shall also be done preferably with water as lubricant but as a special case, the PMC/SBI/ PMC / Engineer in charge may permit, at his discretion, oil or kerosene as lubricant subject to all kerosene or oil in the body and surface of tiles / slabs being thoroughly dried in ovens. Tiles / slabs with stains or patches due to the use of oil or otherwise, either before or after installation, shall be rejected and shall be replaced by the Contractor at his own cost. Nothing extra shall be payable on this account.

Before execution of the granite stone work, the Contractor shall submit for the approval of the PMC/SBI/ PMC / Engineer in charge, the samples with following details:

a) Three representative samples for each type of granite stone specified.

b) Details of physical characteristics such as dimensional tolerances (within the specified limits), water absorption, compressive strength, Mohs Hardness, Specific gravity with reference to IS or International standards.

c) Source of supply and confirmation of availability in full quantity and uniformity of colour, tone and textures.

d) Company profile of Suppliers.

The decision of the PMC/SBI/ PMC / Engineer in charge as regards the approval of the samples for the various types of the granite stones shall be final and binding on the Contractor.

The entire supply for each type of granite stone slab shall be procured from one location (in one quarry), and supplied preferably, in one lot to keep variations to the minimum. The Contractor shall also segregate and sort the slabs according to colour, shade, texture and size of grains etc. to keep variation(s) in stones used at any one floor to the minimum. Any slab with variation in the colour, shade, texture and size of grains etc., not acceptable to the PMC/SBI/ PMC / Engineer in charge, shall not be used in the work and shall be removed and replaced by the Contractor.

The stone work may be required to be carried out in patterns, design and / or in combination with granite stones of different colour and shade with or without borders and in combination of different stone slabs / ceramic tiles for which nothing extra shall be payable. The stones shall be provided in sizes and shapes as per the approved PMC/SBI/ PMC / Engineer in charge architectural drawings and wastages and incidental costs, if any, shall be deemed to be covered in the cost of the relevant items. Nothing extra shall be payable on this account.

The following tolerances shall be allowed in the dimension of granite stone slab:

Slabs:	**Tolerance**
a). Length	± 1mm
b). Width	± 1mm

c). Thickness - 1mm

d). Angularity at corners ± 0.25%

The stones slabs not meeting the above tolerance limits shall be rejected and not permitted to be used in the work. Nothing extra shall be payable on this account.

Stones slabs shall have uniform thicknesses with-in the tolerance limits and linear items like treads, sills and jambs, coping, risers, urinal partitions, kitchen / wash basin platforms, vanity counters, facias and other similar locations etc. shall have edge polished calibrated thickness i.e. exposed edges shall have edge polished uniform thickness throughout the length of the work.

For the steps (risers and treads) in the linear profile, the granite stone shall be provided in single pieces up to 2.0m, unless otherwise specifically permitted by the SBI/PMC in charge Wherever grooves are required to be provided the same is to be done, the joints shall be provided.

The granite slabs used for providing and fixing in the sills, soffits and jambs of doors, windows, ventilators and similar locations shall be in single piece unless otherwise directed by the PMC/SBI/ PMC / Engineer in charge.

The granite stone slab shall be fixed over low level storage cabinets using necessary adhesive as per the manufacturer's specification. The stone shall have uniform thickness and shall be provided in sizes as per architectural drawings. The stone slab shall have uniformly levelled surface after fixing. All the joints shall be finished smoothly in a workmanlike manner.

The granite work shall be adequately protected by a layer of Plaster of Paris, which shall be maintained throughout and removed just before handing over of the works.

ABRASION TEST FOR CONCRETE HARDENING COMPOUNDS

Preparation of Sample

25 mm cylinder shall be prepared in ratio 1:2 mix (1 cement: 2 grades stone aggregate 6 mm nominal size by weight) one each with and without the admixture of concrete hardening compound. The concrete hardening compound shall be used in the proportion by weight of cement as recommended by the firm. The cylinder shall be placed inside a damp box for 24 hours and then cured in water for 27 days. After that, they shall be subject to abrasion test on 'Dorry Type Avery Abrasion Testing Machine, using Emery powder No 80 as the abrasing medium under the condition given in para A-2 below:

A-2 Conditions of Test

(a) Area of rubbing surface shall be same in both the cylinders.
(b) Age of cylinder 28 days
(c) Duration of Test 60 minutes
(d) Total distance traverse During rubbing About 2.4 km
(e) Pressure on rubbing 0.04 kg/cm2surface

A -3 Results of Tests

The following observations shall be made in both the cases.
(a) Composition of the Test specimen
(b) Mean thickness rubbed away
(c) Percentage loss in weight

A -4 Remarks

Percentage loss in weight in the case of cylinders with concrete hardening compound, should not be m ore than 40% of the percentage loss in the case of cylinder without concrete hardening compound.

VACUUM DEWATERED CEMENT CONCRETE PAVEMENT

Cement concrete to be compacted by screed board vibrator of the type approved by Engineerin-Charge and by vaccum dewatering process complete as per directions of SBI/ PMC / Engineer in charge.

Measurements

It shall be measured in cubic meteres correct to two place of decimal.

GRANULAR SUB–BASE

Scope

This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross-sections shown on the drawings or as directed by the SBI/ PMC / Engineer in charge.

Materials

The material to be used for the work shall be natural sand, crushed gravel, crushed stone, crushed slag or combination thereof depending upon the grading required. Use of materials like brick metal, Kankar and crushed concrete shall be permitted in the lower sub-base. The material shall be free from organic or other deleterious constituents and shall conform to the grading given in Table 16.44 and physical requirement given in Table 16.45 Gradings III and IV shall preferably be used in lower sub-base. Grading V and VI shall be used as a sub-base-cum-drainage layer. The grading to be adopted for a project shall be as specified in the Contract. Where the sub-base is laid in two layers as upper sub-base and lower sub-base, the thickness of each layer shall not be less than 150 mm. If the water absorption of the aggregate determined as per IS : 2386 (Part 3); if this value is greater than 2 per cent, the aggregate shall be tested for Wet Aggregate Impact Value (AIV) (IS: 5640). Soft aggregates like Kankar, Brick ballast and laterite shall also be tested for Wet AIV (IS: 5640).

GRADING FOR GRANULAR SUB-BASE MATERIALS

Construction Operations

Preparation of Sub-Grade:

The surface of the sub grade to receive the Granular Sub-base shall be prepared to the specified lines and crossfall (Camber) as necessary and made free of dust and other extraneous materials. Any ruts or soft yielding places shall be corrected in an approved manner and rolled with 80 – 100 Kn smooth wheeled roller until firm surface is obtained if necessary by sprinkling water. Weak places shall be strengthened, corrugations removed and depressions and pot holes made good with suitable materials, before spreading the aggregate for GSB.

Where the existing surface over which the sub base of GSB is to be laid is black topped, to ensure effective internal drainage, furrows 50 mm x 50 mm (depth of furrows increased to reach bottom of bituminous layer where necessary) at one metre intervals shall be cut in the existing bituminous surface at 45 degrees to the central line of the carriageway at one metre intervals in the existing road before the GSB is laid.

Spreading and compacting:

The sub-base material of grading specified in the Contract and water shall be mixed mechanically by a suitable mixer equipped with provision for controlled addition of water and mechanical mixing. So as to ensure homogenous and uniform mix. The required water content shall be determined in accordance with IS:2720 (Part 8). The mix shall be spread on the prepared sub-grade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation, or other means as approved by the SBI/ PMC / Engineer in charge.

Moisture content of the mix shall be checked in accordance with IS:2720 (Part 2) and suitably adjusted so that, at the time of compaction, it is from 1 to 2 per cent below the optimum moisture

content (OMC).

IS Sieve Designation	Percent by Weight Passing the IS Sieve				
	Grading I	Grading II	Grading III	Grading IV	Grading V	Grading VI
75.0 mm	100	--	--	--	100	--
53.0 mm	80-100	100	100	100	80-100	100
26.5 mm	55-90	70-100	55-75	50-80	55-90	75-100
9.50 mm	35-65	50-80	--	--	35-65	55-75
4.75 mm	25-55	40-65	10-30	15-35	25-50	30-55
2.36 mm	20-40	30-50	--	--	10-20	10-25
0.85 mm	--	--	--	--	2-10	--
0.425 mm	10-15	10-15	--	--	0-5	0-8
0.075 mm	<5	<5	<5	<5	--	0-3

PHYSICAL REQUIREMENTS FOR MATERIALS FOR GRANULAR SUB-BASE

Aggregate Impact Value (AIV) IS:2386 (Part 4) or IS:5640	40 Maximum
Liquid Limit IS:2720 (Part 5)	Maximum 25
Plasticity Index IS:2720 (Part 5)	Maximum 6
CBR at 98% dry density (at IS:2720-Part 8) IS:2720 (Part 5)	Minimum 30 unless otherwise specified in the Contract

Immediately after spreading the mix, rolling shall be done by an approved roller. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer upto 200 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall or on super elevation. For carriageway having crossfall on both sides, rolling shall commence at the edges and progress towards the crown.

Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. During rolling, the grade and crossfall (camber) shall be checked and any high spots or depressions, which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour. Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material determined as per IS : 2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

Measurements

Granular sub-base shall be measured as finished work in position in cubic metres. The length and breadth shall be measured to the nearest centimetre. The depth of consolidated layer shall be computed to nearest half centimetre by taking average of depths at the centre and at 30 cm from the left and right edges at a cross section taken at 100 metre interval or less as decided by the SBI/ PMC / Engineer in charge by making small pits. The consolidated cubical contents shall be calculated in cubic metres correct to two places of decimal. The protection of edges of granular sub-base extended over the full formation as shown in the drawing shall be considered incidental to the work of providing granular sub-base and as such no extra payment shall be made for the same.

HEAT RESISTANCE TERRACE TILES

Terrace tiles

Heat resistance terrace tiles are basically ceramic floor tiles which reflects solar radiation. These tiles are used on the floor of the terrace to prevent building from getting heated. These are used on the roof of any building or balcony. These can be used on wall of a building which are directly exposed to sunlight.

Solar Refractive Index (SRI)
It is a measure of the constructed surface's ability to stay cool in the sun by reflecting solar radiation and emitting thermal radiation. SRI is calculated according to ASTM E1980.

Benefits of Heat Resistance Tiles:-
1. Reduce inside building temperature.
2. Save electricity.
3. Lower power demand.
4. Save burning fossil fuel by power plants.
5. Lower emission of green house.
6. Reduction of global warming.
7. Reduce conduction of heat into building.

Requirement for Heat Resistance Terrace Tiles

S. No.	Characteristics	Requirement
1	Size	300mm x 300mm x 20mm
2	Solar refractive index	Not less than 78
3	Solar reflection	Not less than 0.70
4	Initial emittance	Not less than 0.75

Tolerance
Tolerances on length and breadth shall be plus or minus one millimeter, and tolerance on thickness shall be plus 5 mm. The variation of dimensions in any one delivery of tiles shall not exceed 1 mm on length and breadth and in thickness not less than plus 3 mm.

Laying
Base concrete or RCC slab on which the tiles are to be laid shall be cleaned, wetted and mopped. Cement mortar 1:4 (1 Cement : 4 coarse sand) bedding shall be used. Average thickness of the bedding mortar shall be 20 mm and the thickness at any place shall not be less than 10 mm.

Cement mortar bedding shall be spread, tamped and corrected to proper levels. If cement mortar is laid in bedding the tiles, then tiles shall be set immediately after laying the mortar. Over this bedding neat grey cement slurry of honey like consistency shall be spread at the rate of 4.4 kg of cement per square metre over such an area as would accommodate about twenty tiles. Tiles shall be washed clean and shall be fixed in this grout one after another, each tile being gently tapped with a wooden mallet till it is properly bedded, and in level with the adjoining tiles. The joints shall be kept as thin as possible not exceeding 1 mm and in straight lines or to suit the required pattern. The joints shall be properly cleaned before filling with grout of mix of white cement and marble powder in the ratio of 1:1.

The surface of the flooring during laying shall be frequently checked with a straight edge of length at least 2 metre, so as to obtain a true surface with the required slope.

Where full tiles or half tiles can not be fixed, tiles shall be cut (sawn) from full tiles to the required size and their edges rubbed smooth to ensure a straight and true joint.

Tiles which are fixed in the floor adjoining the wall shall enter not less than 12 mm under the skirting which shall be fixed upto 150mm height along the parapet walls in the same manner.

After the tiles have been laid, surplus cement grout that may have come out of the joints shall be cleared off.

Curing, Polishing and Finishing
The day after the tiles are laid all joints shall be cleaned of the grey cement with a wire

brush or trowel to a depth of 5 mm and all dust and loose mortar removed and cleaned. Joints shall then be grouted with white cement mixed marble powder in the ratio of 1:1. The same cement slurry shall be applied to the entire surface of the tiles in a thin coat with a view to protect the surface from abrasive damage and fill the pin holes that may exist on the surface.

The floor shall then be kept wet for a minimum period of 7 days. The surface shall thereafter be grounded evenly with machine fitted with coarse grade grit block (No. 60). Water shall be used profusely during grinding. After grinding, the surface shall be thoroughly washed to remove
all grinding mud, cleaned and mopped. It shall then be covered with a thin coat of grey or white
cement, mixed with or without pigment to match the colour of the topping of the wearing surface in order to fill any pin hole that appear. The surface shall be again cured. The second grinding shall then be carried out with machine fitted with fine grade grit block (No. 120).

The final grinding with machine fitted with the finest grade grit blocks (No. 320) shall be carried out the day after the second grinding described in the preceding para or before handing over the floor, as ordered by the SBI/ PMC / Engineer in charge.

For small areas or where circumstances so require, hand grinding/polishing with hand grinder may be permitted in lieu of machine polishing after laying. For hand polishing the following carborundum stones, shall be used:
1st grinding — coarse grade stone (No. 60)
Second grinding — medium grade (No. 80)
Final grinding — fine grade (No. 120)
In all other respects, the process shall be similar as for machine polishing.
After the final polish, oxalic acid shall be dusted over the surface at the rate of 33 gm per square metre sprinkled with water and rubbed hard with a 'namdah' block (pad of woollen rags). The following day the floor shall be wiped with a moist rag and dried with a soft cloth and finished clean.
If any tile is disturbed or damaged, it shall be refitted or replaced, properly jointed and polished.
The finished floor shall not sound hollow when tapped with a wooden mallet.

Measurements
Heat resistance terrace tiles shall be measured as laid in square metre correct to two places of decimal. For length and breadth dimensions correct to a cm including skirting shall be taken. No deduction shall be made nor extra paid for voids not exceeding 0.20 sqm. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square metre. Nothing extra shall be paid for use of cut tiles nor for laying the floor at different levels in the same terrace.

CHEQUERRED PRECAST CEMENT CONCRETE TILES
Chequerred precast cement concrete tiles 22 mm thick in footpath & courtyard, jointed with neat cement slurry mixed with pigment to match the shade of tiles, including rubbing and cleaning etc. complete, on 20 mm thick bed of cement mortar 1:4 (1 cement: 4 coarse sand). Light shade pigment using white cement.

TACTILE TILE
Providing and laying tactile tile (for vision impaired persons as per standards) of size 300x300x9.8 mm having with water absorption less than 0.5% and conforming to IS:15622 of approved make in all colours and shades in for outdoor floors such as footpath, court yard, multi modals location etc., laid on 20 mm thick base of cement mortar 1:4 (1 cement : 4 coarse sand) in all shapes & patterns including grouting the joints with white cement mixed with matching pigments etc. complete as per direction of SBI/ PMC / Engineer in charge.

SPORTS FLOORING

(Area as specified in finishing schedule/ as per approval by the Architect/ Engineer- incharge)

Wooden flooring in 6.5 mm thickness with wear layer thick 0.80 mm in the size of 1.8 mtr X 15 mtr use area classification multiple indoor stadium weight 4.895 kg/m2 construction in multiple layer. It shall be ball bounce >97%, vertical deformation 2.8 mm ,shock absobation > 37%,sound insulation 23-25 db, pur coating with UV treatment . The flooring shall incorporated a specially (PUR) sports flooring , good resistant to scratch, slip ,fire ,chemical & does not favor in growth fungi & bacteria duly installed on smooth and hard surface on self levelling compound with company recommended adhesive & seamless protection (Design & Colour As Per SBI/ PMC / Engineer in charge) Above Cement concrete flooring 1 :2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate) finished with a floating coat of neat cement, including cement slurry, but excluding the cost of nosing of steps etc. complete. 40 mm thick with 20 mm nominal size stone aggregate.

LAMINATED WOODEN FLOORING

10 mm thick Laminated wooden flooring Classification of Use 23/32 (Heavy Domestic/General Commercial) with a Surface Abrasion Resistance of class AC4 (average 4500 cycles), Impact Resistance of IC2 (EN13329), Resistance to Cigarette Burn with a rating of 5 (EN 438-2:15), Swelling after 24 hrs in water of 15% (EN13329), Modulus of Rupture of 53.3 newton/mm2, Internal Bond 1.78 newton/mm2, Surface Soundness of 1.3 newton/mm2 (EN 13329:2000) with a 0.2mm thick wear layer on top of a High Density Fiber substrate core (density > 850 Kg/M3) of plank size 1291 mm X 135 mm having Uni fit locking arrangement (lock strength > 1000 lbs/ft) with an underlayment made of natural colour foam , with accessories like End profile, Transition profile, reducer, etc. complete. The rate includes cost of all materials, accessories, labour, HOM, etc., complete at all levels. (The Shade, pattern etc., to be approved by SBI/ PMC / Engineer in charge.

WOODEN DECKING FLOORING

Three-layer construction, wooden plank size 185—200 mm X 2000-2426 mm of 3 strip oak with a total thickness of 13.5- 14 mm and a wear layer thickness of 3.5mm should be re-sandable up to 2 to 3 times. Surface Treatment: Matt/ Ultra matt Lacquer, Core: Pine/ Spruce/ Alder. Joint: Woodloc 5S, fifth-generation locking system, Moisture Content as per EN 13183: 7%, Reaction to fire as per EN13501-2:1 Dfl- s1CARB 2 compliant, Biological Durability as per EN350-2 Class1 confirming to strict quality and environment norms. It should be certified by PEFC, FSC, Blue Angel, and Real Wood. Matching Accessories like skirting & profile with,. Installation should be done by a trained and authorized team on Zero level of the hard surface .

CARPET ROLL

High definition chromo-jet carpet , having 100% Type 6' Nylon cut pile or equivalent and 1/10 gauge, . The carpet should have a primary backing of PP woven cloth and secondary backing of action back to ensure high performance and comfort. The carpet should be of 3.66- 4M width to ensure lesser joints and minimum wastage. It should have a minimum total weight of 2000 gsm and minimum pile weight 1000 gsm , minimum number of tufts to be 185040 or more,pile height 7 mm and total height 9 mm The carpet should also qualify to the following minimum European standards performance specifications - (a) Fastness to rubbing, dry (ISO 105 X-12), minimum rating should be 4-5; (b) Fatness to rubbing, wet (ISO 105 X-12), minimum rating should be 5; (c) Water fastness, (ISO 105 E-01), minimum rating should be 4-5; (d) Fastness to light (ISO 105 B-2), minimum rating should be 5; (e) Thermal Resistance (ISO 8302), minimum rating should be 0,45 m² K/ W; ASTME 648-03(NEPA 253)-Class-1 (f) Impact sound insulation (ISO 140 - 8), (g) Green level-CRI+plus—GLP1350, (h) smoke density-ASTME662-03 (i) Fire classification-CE EN14041:2004. The carpet should be Microbial assay Test-110740,110740A,AATCC Method 174 part-2 for better stain resistance, and should have an approved fire rating of Class 1 under Bf1S1 and should be recommended for commercial usage under Class 23/32 classification." duly installed on smooth hard floor with support of 10 mm epe sheet & company recommended adhesive.

CARPET TILE

Supply & installation of 100% commercial grade nylon carpet tile of 500x500mm of solution dyed nylon 6.6 , Machine Gauge 1/10" or more, backing of glass fiber+ PVC and made of basic fabric of non oven polyster and yarn of solution dyed nylon and having properties of Super Soil Guard (SSG)or more, total height of 7 mm or more, smoke density(ASTM E 662) less than 450, anti staticless than 1.0kv (JIS-L4406 STROLL 23 C. degree 25%R.H.), electrostatic propensity –maximum average 0.5kv (AATCC 134) Color fastness to light- rating 5.0= No change (AATCC16) critical radiant flux –(ASTM E 648) Class 1 average CRF 0.48 / cm2 or higher certified It is absolutely mandatory that the manufacturer has valid certifications of CRI PLUS certified,GLP 8200, certified from Singapore Green Building Council , certified of Japanese industrial standard JIS mark.

11.4 ITALIAN MARBLE STONE FLOORING WITH DECORATIVE INLAY WORK.

Italian marbles Quarried and processed in Italy and these marble raw stones are imported from Italy to India. Italian marble is famous for rendering a high sheen and visual appeal to the ambiance in which it is installed. It is available all over world. Italian Marble gives the rich appearance to the house floor, walls, Kitchen, rooms and bathroom with its beautiful colour and special lusters. Because of its elegant visual it is commonly used for the decorative purpose in buildings.

Italian Marble Stone

The Italian marble details shall be as specified in sub head 8.0. Other details such as dressing of slabs, laying, polishing , finishing, measurements and rates shall be as specified in clause 11.19 with Italian marble stone in place of Indian marble stone.

The work shall comprise providing, supplying, cutting, dressing, laying, fixing, grinding, polishing and finishing approved quality Italian Marble Flooring of specified thickness, colour, texture and pattern, including decorative marble/stone/brass inlays complete in all respects as per architectural drawings, approved shop drawings, CPWD Specifications, relevant IS Codes and directions of the SBI/ PMC / Engineer in charge.
The item shall include all materials, labour, transportation, handling, lifting, cutting, matching, bedding mortar, adhesives, templates, machinery, tools, grinding, polishing, curing, protection and all incidental works necessary for completion of the work.

MATERIALS
Italian Marble
Italian marble shall be premium imported marble such as Botticino, Dyna, Statuario, Carrara, Travertine or approved equivalent conforming to CPWD Specifications. The marble shall be dense, sound, hard, uniform in colour and texture, free from cracks, cavities, stains, pinholes, seams, veins causing weakness and other defects.
The marble slabs shall be machine cut with true edges and square corners.
Thickness of marble shall be:
• 18 mm thick for flooring unless otherwise specified.
• 20 mm thick for heavy-duty areas where specified.
• Tolerance in thickness shall be as per CPWD Specifications.
The marble shall be selected and approved prior to procurement. The contractor shall arrange mock-up panels for approval of colour, shade, grain pattern and finish.

Decorative Inlay Material
Inlay work shall consist of approved marble, granite, semi-precious stones, mother-of-pearl, brass strips, stainless steel strips or combinations thereof as indicated in the drawings.
All inlay materials shall:
• Be of approved quality and colour.
• Be free from cracks and defects.

- Have uniform thickness.
- Be accurately cut to shape and dimensions.
- Match approved samples and design intent.

Cement shall be OPC/PPC conforming to relevant IS specifications and CPWD requirements.
Sand shall be clean coarse river sand conforming to IS 383 and free from silt, clay, organic matter and other impurities.

Adhesive and Epoxy
Approved polymer modified stone adhesive and epoxy resin adhesive shall be used wherever specified for fixing marble and inlay materials.

PREPARATION OF BASE
The RCC slab or sub-floor shall be cleaned thoroughly and made free from dust, dirt, grease, oil, laitance and loose particles.

Surface irregularities shall be rectified prior to commencement of flooring work.
The base shall be checked for line, level and slope as per drawings.
Necessary waterproofing treatment, where specified, shall be completed and approved before flooring work is started.

BEDDING LAYER
Marble flooring shall be laid over 20 mm thick average cement mortar bed of proportion 1:4 (1 cement : 4 coarse sand). The mortar shall be mixed mechanically and spread uniformly over the prepared surface.
The bedding shall be laid only to the extent that can be covered with marble before initial setting of mortar takes place.

LAYING OF ITALIAN MARBLE
Prior to laying, marble slabs shall be dry laid to determine pattern matching, grain orientation and colour consistency.

Adjacent slabs shall be selected to ensure continuity of veins and natural patterns.
The underside of marble slabs shall be cleaned and wetted before laying.
Each slab shall be laid over fresh mortar bed and pressed firmly using wooden mallets to achieve full bearing.
The flooring shall be laid true to line, level and slope.
Finished levels shall match adjoining flooring without unevenness.
The joints between slabs shall be as thin as possible and generally not exceed 1 mm width.
No hollow sound or debonding shall be permitted.

DECORATIVE INLAY WORK
The decorative inlay shall be executed strictly according to approved architectural drawings and shop drawings.
Templates shall be prepared and approved before commencement.
The inlay recesses shall be machine cut using CNC, water jet cutting or approved precision cutting equipment.
The cutting shall be clean and accurate without chipping or damaging adjacent marble.
Inlay pieces shall be fabricated separately and fixed into prepared recesses using approved epoxy adhesive.
The inlay pieces shall fit accurately without visible gaps.
The completed inlay shall be flush with surrounding marble flooring.

Decorative motifs, medallions, borders, floral patterns, geometric patterns and logos shall be executed with precise alignment and symmetry.
The Contractor shall ensure colour matching and consistency throughout the work.

JOINT FILLING
After laying and setting, all joints shall be filled with white cement slurry mixed with matching marble powder and approved pigments.
Joint filler shall completely fill the joints without shrinkage.
Excess slurry shall be cleaned immediately.
No visible joint lines shall remain after polishing.

GRINDING AND POLISHING
Grinding shall commence only after the mortar bedding and joint filling have adequately set.
The marble flooring shall be machine ground using progressively finer abrasives.
The grinding process shall include:
• First Grinding (Coarse Grinding)
• Second Grinding (Medium Grinding)
• Fine Grinding
• Final Mirror Polishing
All surface undulations, lippage and imperfections shall be removed during grinding.
Pinholes, cavities and minor defects revealed during grinding shall be filled with matching marble powder mixed with epoxy resin or white cement slurry.
Subsequent grinding shall continue until a smooth and uniform surface is achieved.
Final polishing shall produce a high-gloss mirror finish with minimum reflectivity of approved standards.
The finished surface shall be smooth, even and free from scratches, waviness or polishing marks.

CURING
The flooring shall be protected from traffic for a minimum period of seven days.
Proper curing shall be carried out to ensure complete setting of mortar and joint filling materials.

•Complete execution as per drawings and CPWD Specifications.
The work shall be complete in all respects and ready for use.

11.5 Flooring for SERVER/ Fire Control

False Flooring: False Flooring shall be provided in Server and sub-server Room. Height of false flooring shall be as per functional requirement to be approved PMC/SBI/ PMC / Engineer in charge and shall be done as per following specifications.

Providing and fixing removable raised/false access flooring with system and its components of approved make for different plenum height with possible height adjustment up 2to 50 mm, comprising of modular load bearing floor panels supported on G.I. rectangular stinger frame work and G.I. Pedestal etc. all complete, as per the architectural drawings, as specified and as directed by PMC/SBI/ PMC / Engineer in charge consisting of: (a) Providing at required spacing to form modular framework, pedestals made out of GI tube of thickness minimum 2 mm and 25 mm outer diameter, fully welded on to the G.I. Base plate of size 100mm x 100mm x 3mm at the bottom of the pedestal tube, G.I. pedestal head of size 75mmx75mmx3.5 mm welded with GI fully threaded stud 16mm outer diameter with two GI Check nuts screwed on

the stud for level adjustment up to 50mm, locking and stabilizing the pedestal head in position at the required level. The pedestals shall be fixed to the subfloor (base) through base plate using epoxy-based adhesive of approved make or the machine screw with rawl plug. (b) Stringers system in all steel construction hot dipped galvanized of rectangular size 570x20x30x0.80mm thick having holes at both ends for securing the stringers on to the pedestal head using fully threaded screws ensuring maximum lateral stability in all directions, the grid formed by the pedestal and stringer assembly shall receive the floor panel, this system shall provide adequate solid, rigid support for access floor panel, the system shall provide a minimum clear uninterrupted clearance between the bottom of the floor for electrical conduits and wiring etc. all complete as per the architectural drawings, as specified and as directed by the SBI/PMC in charge(c) Providing and fixing Access Floor panel of 600x600x32 mm medium grade Filled Steel anti static high pressure Lamination of 800H grade (FS800H). Access Floor panel shall be steel welded construction with an enclosed bottom pan with uniform pattern of 64 hemispherical cones. The top and bottom plates of Steel Gauges: top 0.6 mm and bottom 0.7mm

fused spot welded together (minimum 64 welds in each dome and 20 welds along each flange). The panel should be Corrosion resistant epoxy coated for lifetime rust protection and cavity formed by the top and bottom plate is filled with Pyro grip noncombustible Portland cementitious core mixed with lightweight foaming compound. The access floor shall be factory finished with Anti-static High Pressure laminate with Non Warp technology upto 1mm thickness for superior adhesion and Surface flatness within 0.75mm. The panel is to withstand a Concentrated Load of 363 kgs applied on area 25mm x 25mm without collapse in the Centre of the panel which is placed on four steel blocks. The panel will withstand and Uniformly Distributed Load (UDL) minimum 1250 kg/sqm and an impact load of 50kg all complete as per the approved manufacturers specification and as per the direction of PMC/SBI/ PMC / Engineer in charge. All specification must be printed on the side of the panel to ensure the quality of the product.

OTHER SPECIFICATIONS:

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

12 FALSE CEILING

a. General: -

Work shall in general be carried out as per the CPWD specification. Modular and acoustical false ceiling shall be provided and installed in all areas. All ceilings in the office areas, pantry and all service areas shall be openable, where provided in drawing and nothing extra shall be payable for provision for access panels.

The false ceiling material shall be of Gyp board, metal, acoustic modular tiles or calcium ***silicate*** mineral fibre ceiling tiles. The technical assistance and guidance is to be taken from the respective approved manufacturers and work shall be done strictly according to the manufacturers specifications and manuals. Material from original source shall only beused.

A sample of each finish shall be got approved before proceeding for bulk production. Galvanized Iron / Aluminium grid framing shall be erected as per recommendation of the manufacturer specification and approval of CPWD. No sagging, unleveled stretch of work or chipped tiles shall be accepted. Contractor shall take full responsibility for its firmness with the structure.

The false ceiling comprises of Gypsum board, Calcium Silicate and Metallic Tiles. The Gypsum board false ceiling is to be in different shapes. Such as Vaults, Coffers, cove's and Plain in unison with Acoustical Ceiling Tiles and Metallic Tiles Ceiling. The technical assistance and guidance is to be taken from manufacturers and work has to be done according to the manufacturer's specifications and manuals. A sample of each finish shall be got approved before proceeding for bulk production. GI framing shall be erected as per recommendation of the manufacturer specification and approval of the SBI/ PMC / Engineer in charge. The main contractor shall engage specialized agency and submit its credentials to SBI/ PMC / Engineer in charge for approval. The criteria for setting the terms and conditions shall be broadly in line with CPWD criteria for similar works. The work shall be taken up only when specialized agency is approved in writing by SBI/ PMC / Engineer in charge. False ceiling work shall be carried out in accordance with the actual site conditions at different
/split-levels. Any sagging, unleveled stretch of work shall be redone /replaced and made good, at no extra charge, to the satisfaction of SBI/ PMC / Engineer in charge. No compensation shall be paid on account of provision /coverage of openings for lighting fixtures, air-conditioning ducts and the likes as detailed in drawings and /or directed.

CEMENT CONCRETE GOLA

Cement Concrete

The specifications for concrete shall be the same as described in subhead 4.0 of concrete work.

Gola

A chase of 75 mm wide and 75 mm deep shall be cut in the parapet wall just above the junction of mud phuska or lime concrete with parapet wall and it shall be filled with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 stone aggregate 10 mm and down gauge) the external face finish with a slope of 1 : 0.75 and the exposed surface of the gola shall be plastered with cement mortar 1 : 3 (1 cement : 3 fine sand). Expansion joint at every 3.5 to 4.5 metres shall be provided and filled with bitumen filler. The bitumen filler shall be prepared by mixing bitumen, cement and coarse sand in the ratio of 80 : 1 : 0.25 (80 kg of hot bitumen : 1 kg of cement and 0.25 cum of coarse sand).

Curing

The finished surface shall be cured for at least 7 days.

KHURRAS

The khurras shall be constructed before the brick masonry work in parapet wall is taken up and it shall be of size 45 cm x 45 cm unless otherwise specified in the description of the item and shall be made of cement concrete 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) or other mix as stipulated in the description of the item.

Laying

A PVC sheet of size 1 m x 1 m x 400 micron (alternatively, aluminium foil of 32 SWG) shall be laid under the khurra and then cement concrete shall be laid over it to average thickness of 50 mm with its top surface lower than the level of adjoining roof surface by not less than 50 mm.

The concrete shall be laid to a size greater than the stipulated size of the khurra in such a way that the adjoining terracing shall overlap the concrete on its three edges by not less than 7.5 cm. The concrete will slope uniformly from the edges to the outlet, the slope being as much as possible and in no case less than 20 mm cement concrete at the outlet. The concrete shall be continued same slope through the width of the wall into the outlet opening to ensure

a water tight joint. The khurras and the sides of the outlet shall then be rendered with 12 mm coat of cement plaster 1:3 mix (1 cement : 3 coarse sand) or other mix as stipulated in the description of the item. This shall be done when the concrete is still green and shall be finished. The sides of the khurras and sides of the outlet opening shall be well rounded. The size of the finished outlet opening shall be 10 cm wide and by 20 cm high or as directed by the SBI/ PMC / Engineer in charge.

In cases where rain water is to be disposed off through rain water pipes, iron grating shall be provided at the outlet as a safeguard against choking, if so directed by the Engineer- in-Charge. Iron gratings, shall be of overall size 20 × 25 cm. with an outer frame of 15 × 3 mm M.S. flat to which 4 Nos M.S. bars of 10 mm dia shall be welded in a vertical direction keeping equal clear spacing of 2.5 cm. or as directed by the SBI/ PMC / Engineer in charge.

G.I. METAL TILES CEILING

Frame

The frame work shall consists of G.I spring tee of specified size fixed to main C carrier with the help of suspension Brackets. The frame work shall be executed in a manner so as to form a grid of 600 mm x 600 mm as specified in the item. The pre-painted steel 'C' wall angle of size 20x30x20 mm and 0.5mm thick shall be fixed along the periphery of the room with nylon sleeves and wooden screws at 300 mm center to center. The main 'C' carrier of size 10x38x10 mm made of G.I steel 0.7 mm thick shall be fixed with cleats of size 37x27x25x1.6 mm and rawl plugs of size 38x12 mm.

Ceiling tiles

Ceiling tiles shall be of G.I metal plain beveled of specified white color of size 600x600 mm and 0.5 mm thick with 25 mm height made of G.I. sheet having galvanizing of 100 gms/sqm and electro statically polyester powder coated of minimum 60 microns thickness including factory painted after bending with or without perforation.

Fixing of ceiling tiles

The ceiling tiles shall be placed over the G.I frame and clip-in with frame.

Tiled false ceiling of specified materials of size 595x595 mm in true horizontal level, suspended on inter locking metal grid of hot dipped galvanized steel sections (galvanized @ 120 grams/ sqm, both side inclusive) consisting of main 'T runner with suitably spaced joints to get required length and of size 24x38 mm made from 0.30 mm thick (minimum) sheet, spaced at 1200 mm center to center and cross·r of size 24x25 mm made of 0.30 mm thick (minimum) sheet, 1200 mm long spaced between main "T" at 600 mm center to center to form a grid of 1200x600 mm and secondary cross "T" of length 600 mm and size 24x25 mm made of 0.30 mm thick (minimum) sheet to be interlocked at middle of the 1200x600 mm panel to form grids of 600x600 mm and wall angle of size 24x24x0.3 mm and laying false ceiling tiles of approved texture in the grid including, required cutting/making, opening for services like diffusers, grills, light fittings, fixtures, smoke detectors etc. Main ~" runners to be suspended from ceiling using Gl slotted cleats of size 27 x 37 x 25 x1.6 mm fixed to ceiling with 12.5 mm dia and 50 mm long dash fasteners, 4 mm Gl adjustable rods with galvanised butterfly level clips of size 85 x 30 x 0.8 mm spaced at 1200 mm center to center along main T, bottom exposed width of 24 mm of all T-sections shall be pre-painted with polyester paint, all complete for all heights as per specifications, drawings and as directed by SBI/ PMC / Engineer in charge.

Gl Metal Ceiling Lay in plain Tegular edge Global white color tiles of size 595x595 mm, and 0.5 mm thick with 8 mm drop; made of G I sheet having galvanizing of 100 gms/sqm (both sides inclusive) and electro statically polyester powder coated of thickness 60 microns (minimum),

including factory
painted after bending.

Gl Metal Ceiling Lay in perforated Tegular edge global white color tiles of size 595x595 mm and 0.5 mm thick with 8 mm drop; made of Gl sheet having galvanizing of 100 gms/sqm (both sides inclusive) and 20% perforation area with 1.8 mm dia holes and having NRC (Noise Reduction Coefficient) of 0.5, electro statically polyester powder coated of thickness 60 microns (minimum), including factory painted after bending and perforation and backed with a black Glass fiber acoustical fleece.

12.5 mm thick fully Perforated Gypsum Board tile made from plasterboard having glass fibre conforming to IS: 2095 part I, of size 595x595 mm, having perforation of 9.7x9.7 mm at 19.4 mm clc with center borders of 48 mm and the side borders of 30 mm, backed with non woven tissue on the back side, having an NRC (Noise Reduction Coefficient) of 0.79, with 50 mm resin bonded glass wool backing.

CALCIUM SILICATE FALSE CEILING (TEGULAR EDGED- FIXED TO EXISTING T-FRAME)
Materials
Tiles
Eco friendly light weight calcium silicate tiles shall be made from Non-cementitious hydrated wet moulded calcium silicate slurry/mixture, reinforced with fibers and natural fillers. Free from
formaldehyde and other harmful materials. Does not contain any toxic ingredients. Shall have appropriate recycled material contents. The Ceiling Tiles shall be of appropriate class and of finished thickness as specified in the description of the item .Only selected tiles of uniform width shall be used. Unless otherwise specified in the description of the item or shown in the drawings, the width of tiles selected for use shall not be less than 595 x 595 mm in size and shall be 15 mm thick integral densified tegular edged type, light weight wet moulded calcium silicate. Where width of room/ corridor is in multiple of standard width of tiles, same pattern shall be maintained throughout the length. Where the width of rooms/ corridor is not in multiple of standard width of tiles, borders with appropriate width and material of boards shall be provided in design approved by the SBI/ PMC / Engineer in charge and maintained uniformly throughout of the length/ width of
room/ corridor. Calcium silicate tiles shall have the following properties:
(a) Surface: All tiles are prime coated on both sides. Standard finish in two coats white dispersion type, solvent free paint.
(b) Dimensions:
595mmx595mmx15mm thick tegular edged. Size referred to are always module sizes. The nominal panel size may differ depending on the suspension system used.
(c) Thickness: 10 mm thick in the center and 15mm thick all around on edge resting portion with integral densified edge.
(d) Density of material: 350 kg per cum in the central 10 mm thick portion and 450 kg cum on the edges, (Average 370 kg per cum as per ECBC Code 2007).
(e) Relative humidity: 100% RH resistant.
(f) Fire resistance: Non-combustible as per BS:476 Part-4. Fire performance: as per BS:476 (Part-6) for fire propagation and BS 476 (Part 7) for Surface spread of flame.
(g) Thermal conductivity: 0.048 W/m- K - 0.052 W/m- K as per ECBC Code 2007 and ASTM 518-1991.
(h) Recycled Content: Shall have 46-50% recycled content out of which 18-20% should be FLYASH.
(i) Acoustic control: Sound Attenuation 30-32dB
Noise reduction coefficient (NRC)
Plain & Designer tile: 0.10-0.15.

For Pin Hole/Texture pattern tiles: 0.20-0.30.
Pin hole/Texture fully perforated tile: 0.30-0.40.
For 5mm fully perforated 0.40-0.50.
For 5mm fully perforated with 50mm/48gsm glass wool 0.65-0.85.
(j) Light reflectance: >85%.
(k) Weight: 5 - 5.5Kg/m2.

Frame

Frame is already exists at site. The bottom surface of the frame shall be checked and corrected to true plans and slopes.

Fixing

The tiles shall be placed properly in the grids already exists at site, as per required pattern, texture and design/ drawing and as per directions of the SBI/ PMC / Engineer in charge/manufacturer guide line. If required. level of the false ceiling grid shall be checked after placing of calcium silicate tiles and necessary adjustment shall be made wherever required through level adjuster.

Finishing

Care should be taken while placing Light Weight calcium silicate tiles into the grid so that there will be no displacement to grid and stains/ dirty marks put by the workers. (worker should preferably wear clean soft cotton gloves while placing tile).
MTC: Manufacturers test certificate/ report of invoice to be submitted for every delivery challan by suppliers.

GLASS FIBRE REINFORCED GYPSUM (GRG) FALSE CEILING (SEMI PERFORATED MICRO TEGULAR EDGED)

Materials

Tiles

Glass fibre Reinforced Gypsum (GRG) false ceiling tiles shall be made of Gypsum plaster of 75 microns particle size mixed with short length glass fibre filament of 20 microns ± 5 microns diameter to give it high strength and shall be free from harmful or any toxic ingredients.
Tiles shall be appropriate class and of finished thickness as specified in the description of the item. Only selected tiles of uniform width shall be used. Unless otherwise specified in the description of the item or shown in the drawings, the width of tiles selected for use shall not be less than 595 x 595mm in size and of approved texture, design and patterns and patterns and shall be semi perforated 12mm thick micro tegular-edged type GRG tiles. Where width of room/ corridor is in multiple of standard width of tiles, same pattern shall be maintained throughout the length. Where the width of rooms/ corridor is not in multiple of standard width of tiles, borders with appropriate width and material of boards shall be provided in design approved by the SBI/ PMC / Engineer in charge and maintained uniformly throughout of the length/ width of room/ corridor. GRG tiles shall have the following properties:
(a) Surface: The GRG false ceiling tiles shall be painted with white dispersion type solvent free paint.
(b) Dimensions: 595mm x 595mm Semi perforated 12mm thick micro tegular-edged type GRG tiles. Size referred to are always module sizes. The nominal panel size may differ depending on the suspension system used.
(c) Density of material: 700 to 850 kg per Cum.
(d) Relative humidity:99% RH resistant.
(e) Fire resistance: Non-combustible as per BS:476, Part-4: 1970
(f) Moisture Content: < 2%
(g) Acoustic control: Noise reduction coefficient (NRC) = 0.50 to 0.75 as per IS: 8225-1981.
(h) Light reflectance:>85%
(i) Suspension system: Suspension system shall be made of interlocking metal T-grids of hot-dipped galvanized iron section.

Frame

Frame is made up of interlocking metal T-grids of hot dipped galvanized steel sections of 0.33mm thick(Galvanized @ 120 grams per sqm including both sides) comprising of main T runners of size 15 x 32mm of length 3000mm, cross T of size 15 x 32mm of length 1200mm and secondary intermediate cross T of size 15 x 32mm of length 600mm to form grid modules of size 600 x 600mm. This grid shall be suspended from ceiling using galvanized mild steel members (Galvanized @ 80 gms/m2 including all sides) i.e. 50mm long, 8mm outer diameter M-6 dash fasteners, 6mmdia fully threaded hanger rod upto 1000 mm length and L-shaped level adjuster of size 85 x 25 x 2mm. Frame also consist of galvanized iron perimeter wall angle of size 24 x 24 x 0.40mm of length 3000mm to be fixed on periphery wall/ partition with the help of plastic rawl plugs at 450mm centre to centre and 40mm long dry wall SS screws.

The bottom surface of the frame shall be checked and corrected to true plans and slopes.

Fixing

Outer wall angle shall be fixed accurately and truly at required height and level, parallel and close to the wall. Thereafter all the T members shall be placed and fixed carefully to form the grid. The grid comprises of main T-runners at 1200mm centres securely fixed to the structural soffit by approved and adjustable hanger rods at 1200mm maximum centres and not more than 150mm from spliced joints of main T-runners. The last hanger at the end of each runner should not be greater than 600mm from the adjacent wall. Similarly, cross T-runners of 1200mm length shall be placed at 600mm centre to centre. 600x600mm modules to be formed by fitting 600mm long flush fitting cross Tees (secondary cross T) centrally between 1200mm cross T-runners. The tiles shall then be placed properly in the grids as per

required pattern, texture and design/ drawing and as per directions of the SBI/ PMC / Engineer in charge. If required, level of the false ceiling grid shall be checked after placing of semi perforated GRG tiles and necessary adjustment shall be made wherever required through level adjuster.

Finishing

Care should be taken while placing semi perforated GRG tiles into the grid so that there will be no displacement to grid and stains/ dirty marks put by the workers.

Measurements

Length and breadth shall be measured correct to a cm. Areas shall be worked out to nearest 0.01sqm. The superficial area of the finished work ceiling shall be measured in square metres. No deduction in measurements shall be made for openings of areas upto0.36 Sqm. Nothing extra shall be payable either for any extra material or labour involved in forming such openings. For openings exceeding 0.36 sqm in area, deductions in measurements for the full opening in multiple of area of each tile (0.36 Sqm) will be made.

GLASS FIBRE REINFORCED GYPSUM (GRG) FALSE CEILING (FULLY PERFORATED MICRO TEGULAR EDGED)

Materials

Tiles

Glass fibre Reinforced Gypsum (GRG) false ceiling tiles shall be made of Gypsum plaster of 75 microns particle size mixed with short length glass fibre filament of 20 microns ± 5 microns diameter to give it high strength and shall be free from harmful or any toxic ingredients.

Tiles shall be appropriate class and of finished thickness as specified in the description of the item. Only selected tiles of uniform width shall be used. Unless otherwise specified in the description of the item or shown in the drawings, the width of tiles selected for use shall not be less than 595 x 595mm in size and of approved texture, design and patterns and patterns and shall be fully perforated 12mm thick micro tegular-edged type GRG tiles. Where width of room/ corridor is in multiple of standard width of tiles, same pattern shall be maintained throughout the length. Where the width of rooms/ corridor is not in multiple of standard width of tiles, borders with appropriate width and material of boards shall be provided in design approved by the SBI/ PMC / Engineer in charge and maintained uniformly throughout

of the length/ width of room/ corridor. GRG tiles shall have the following properties:
(a) Surface: The GRG false ceiling tiles shall be painted with white dispersion type solvent free paint. fully perforated GRG false ceiling tiles shall have a non-woven fabric of density minimum 30 grams per square meter pasted at the back.
(b) Dimensions: 595mm x 595mm Fully perforated 12mm thick micro tegular-edged type GRG tiles. Size referred to are always module sizes. The nominal panel size may differ depending on the suspension system used.
(c) Density of material: 700 to 850 kg per Cum.
(d) Relative humidity:99% RH resistant.
(e) Fire resistance: Non-combustible as per BS: 476, Part-4: 1970
(f) Moisture Content: < 2%
(g) Acoustic control: Noise reduction coefficient (NRC) = 0.50 to 0.75 as per IS: 8225-1981.
(h) Light reflectance:>85%
(i) Suspension system: Suspension system shall be made of interlocking metal T-grids of hot-dipped galvanized iron section.

Frame

Frame is made up of interlocking metal T-grids of hot dipped galvanized steel sections of 0.33mm thick (Galvanized @ 120 grams per sqm including both sides) comprising of main T runners of size 15 x 32mm of length 3000mm, cross T of size 15 x 32mm of length 1200mm and secondary intermediate cross T of size 15 x 32mm of length 600mm to form grid modules of size 600 x 600mm. This grid shall be suspended from ceiling using galvanized mild steel members (Galvanized @ 80 gms/m2 including all sides) i.e. 50mm long, 8mm outer diameter M-6 dash fasteners, 6mm dia fully threaded hanger rod upto 1000 mm length and L-shaped level adjuster of size 85 x 25 x 2mm. Frame also consist of galvanized iron perimeter wall angle of size 24 x 24 x 0.40mm of length 3000mm to be fixed on periphery wall/ partition with the help of plastic rawl plugs at 450mm centre to centre and 40mm long dry wall SS screws.
The bottom surface of the frame shall be checked and corrected to true plans and slopes.

Fixing

Outer wall angle shall be fixed accurately and truly at required height and level, parallel and close to the wall. Thereafter all the T members shall be placed and fixed carefully to form the grid. The grid comprises of main T-runners at 1200mm centres securely fixed to the structural soffit by approved and adjustable hanger rods at 1200mm maximum centres and not more than 150mm from spliced joints of main T-runners. The last hanger at the end of each runner should not be greater than 600mm from the adjacent wall. Similarly, cross T-runners of 1200mm length shall be placed at 600mm centre to centre. 600x600mm modules to be formed by fitting 600mm long flush fitting cross Tees (secondary cross T) centrally between 1200mm cross T-runners. The tiles shall then be placed properly in the grids as per required pattern, texture and design/ drawing and as per directions of the SBI/ PMC / Engineer in charge. If required, level of the false ceiling grid shall be checked after placing of semi perforated GRG tiles and necessary adjustment shall be made wherever required through level adjuster.

Finishing

Care should be taken while placing semi perforated GRG tiles into the grid so that there will be no displacement to grid and stains/ dirty marks put by the workers.

Measurements

Length and breadth shall be measured correct to a cm. Areas shall be worked out to nearest 0.01sqm. The superficial area of the finished work ceiling shall be measured in square metres. No deduction in measurements shall be made for openings of areas upto0.36 Sqm. Nothing extra shall be payable either for any extra material or labour involved in forming such openings. For openings exceeding 0.36 sqm in area, deductions in measurements for the full opening in multiple of area of each tile (0.36 Sqm) will be made.

MINERAL FIBRE FALSE CEILING (BEVELED TEGULAR MINERAL FIBRES)

Materials

Tiles

Mineral Fiber Ceiling Tiles shall be made of granulated high-density Mineral Wool as the main material and top production technique which gives it superior features of fire-proofing, sound absorption, heat insulation & sag resistance. They are cost effective and are mainly used for acoustics and decoration. Tiles shall be appropriate class and of finished thickness as specified in the description of the item. Only selected tiles of uniform width shall be used. Unless otherwise specified in the description of the item or shown in the drawings, the width of tiles selected for use shall not be less than 595 x 595mm in size and of approved texture, design and patterns and patterns and shall be of 16mm/ 20mm thick Beveled Tegular edge type.Where width of room/ corridor is in multiple of standard width of tiles, same pattern shall bemaintained throughout the length. Where the width of rooms/ corridor is not in multiple of standard width of tiles, borders with appropriate width and material of boards shall be provided in design approved by the SBI/ PMC / Engineer in charge and maintained uniformly throughout of the length/ width of room/ corridor. Mineral Fibre tiles shall have the following properties:

(a) Surface: Shall be of approved texture, design and pattern.

(b) Dimensions: 595mm x 595mm x 16mm (20mm) thick Beveled Tegular edge type. Size referred to are always module sizes. The nominal panel size may differ depending on the suspension system used.

(c) Relative humidity:99% RH resistant.

(d) Fire resistance: Fire performance as per BS:476 (Part-6 & 7)

(e) Thermal conductivity: 0.052 W/m–K – 0.057 W/m–K

(f) Acoustic control: Noise reduction coefficient (NRC) = 0.50 to 0.60

(g) Light reflectance:>85%.

(h) Weight: 3.10 Kg/m2 (for 16mm thick) & 5.29 Kg/m2 (for 20mm thick)

(i) Suspension system: Suspension system shall be made of interlocking metal T-grids of hot-dipped all round galvanized steel.

Frame

Frame is made up of interlocking metal T-grids of hot dipped all round galvanized steel sections of 0.33mm thick (Galvanized @ 120 grams per sqm including both sides) comprising of main T runners of size 15 x 32mm of length 3000mm, cross T of size 15 x 32mm of length 1200mm and secondary intermediate cross T of size 15 x 32mm of length 600mm to form grid modules of size 600 x 600mm. This grid shall be suspended from ceiling using galvanized mild steel members (Galvanized @ 80 gms/m2 including all sides) i.e. 50mm long, 8mm outer diameter M-6 dash fasteners, 6mmdia fully threaded hanger rod upto 1000 mm length and L-shaped level adjuster of size 85 x 25 x 2mm. Frame also consist of galvanized iron perimeter wall angle of size 24 x 24 x 0.40mm of length 3000mm to be fixed on periphery wall/ partition with the help of plastic rawl plugs at 450mm centre to centre and 40mm long dry wall SS screws. The bottom surface of the frame shall be checked and corrected to true plans and slopes.

Fixing

Outer wall angle shall be fixed accurately and truly at required height and level, parallel and close to the wall. Thereafter all the T members shall be placed and fixed carefully to form the grid. The grid comprises of main T-runners at 1200mm centres securely fixed to the structural soffit by approved and adjustable hanger rods at 1200mm maximum centres and not more than 150mm from spliced joints of main T-runners. The last hanger at the end of each runner should not be greater than 600mm from the adjacent wall. Similarly, cross T-runners of 1200mm length shall be placed at 600mm centre to centre. 600x600mm modules to be formed by fitting 600mm long flush fitting cross Tees (secondary cross T) centrally between 1200mm cross T-runners. The tiles shall then be placed properly in the grids as per required pattern, texture and design/ drawing and as per directions of the SBI/ PMC / Engineer in

charge. If required, level of the false ceiling grid shall be checked after placing of calcium silicate tiles and necessary adjustment shall be made wherever required through level adjuster.

Mineral fibre false ceiling tiles at all heights of size 595X595mm of approved texture, design and pattern. The tiles should have Humidity Resistance (RH) of 99%, Light Reflectance > 85%, Thermal Conductivity k = 0.052 - 0.057 w/m K, Fire Performance as per (BS 476 pt - 6 &7)in true horizontal level suspended on interlocking T-Grid of hot dipped all round galvanized iron section of 0.33 mm thick (galvanized @120 gsm) comprising of main T runners of 15x32 mm of length 3000 mm, cross T of size 15x32mm of length 1200 mm and secondary intermediate cross T of size 15x32 mm of length 600 mm to form grid module of size 600x600 mm suspended from ceiling using galvanized mild steel item (galvanised@80gsm) 50 mm long 8mm outer diameter M-6 dash fasteners, 6 mm diameter fully threaded hanger rod up to 1000 mm length and L-shape level adjuster of size 85x25x2 mm, spaced at 1200 mm centre to centre along main 'T'. The system should rest on periphery walls /partitions with the help of GI perimeter wall angle of size24x24X3000 mm made of 0.40 mm thick sheet, to be fixed to the wall with help of plastic rawl plug at 450 mm centre to centre & 40 mm long dry wall S.S. screws. The exposed bottom portion of all T-sections used in false ceiling support system shall be pre-painted with polyester baked paint, for all heights. The work shall be carried out as per specifications, drawings and as per directions of the engineer-incharge. With 20 mm thick beveled tegular mineral fibre false ceiling tile (NRC 0.7)

Finishing

Care should be taken while placing calcium silicate tiles into the grid so that there will be no displacement to grid and stains/ dirty marks put by the workers.

Measurements

Length and breadth shall be measured correct to a cm. Areas shall be worked out to nearest 0.01sqm. The superficial area of the finished work ceiling shall be measured in square metres. No deduction in measurements shall be made for openings of areas upto0.36 Sqm. Nothing extra shall be payable either for any extra material or labour involved in forming such openings. For openings exceeding 0.36 sqm in area, deductions in measurements for the full opening in multiple of area of each tile (0.36 Sqm) will be made.

MINERAL FIBRE FALSE CEILING (BEVELED TEGULAR MINERAL FIBRE ANTI-MICROBIAL)

Specification for the mineral fibre false ceiling using 16 mm Beveled Tegular Mineral Fibre Antimicrobial is same as 16 mm Beveled Tegular Mineral Fibres specified in above clause 26.22.

CHIPPING OF UNSOUND / WEAK CONCRETE:

Precaution, Preparation and procedure

The Chipping of unsound work / concrete / delaminated layer of gunniting etc. shall be done by

chipping(after properly supporting the member with false works) , in regular shape, with sides parallel or normal to the direction of the reinforcement. The chipping shall be done minimum 50 mm

beyond the perimeter of the spell. For a single spell, the repair area should have a minimum width of 100 mm in any direction. If a number of spells are closely located to each other, these should be

included in a single area marked for repair. The cut shall be made normal to the surface of member. The minimum depth of cut should be 12 mm. Adequate care is to be taken not to cut the reinforcement steel and a cover metre could be used to estimate the depth of cover, for which nothing extra shall be paid. Chipping should be done upto the required depth as decided by the Engineer-in- Charge to produce sound concrete surface to a near uniform depth for the repair areas. Removal of concrete should begin at the interior of the repair areas

and progress towards the boundaries. All edges and cavities shall be square shouldered.

Measurements

Dimensions of area chipped off for RCC slabs, beams, columns etc. shall be measured in centimeters after the chipping / dismantling operation is completed for different thicknesses as
specified in the item separately. The area of the chipped / exposed RCC surface shall be measured in sq. m correct to second place of decimal for different thicknesses as specified in the item separately
.

Providing and fixing mineral fibre false ceiling tiles at all heights of size 595X595 mm of approved texture, design and pattern. The tiles should have Humidity Resistance (RH) of 99%, Light Reflectance ≥ 85%, Thermal Conductivity k = 0.052 - 0.057 w/m K, Fire Performance as per (BS 476 pt - 6 &7)in true horizontal level suspended on interlocking T-Grid of hot dipped all round galvanized iron section of 0.33 mm thick (galvanized @120 gsm) comprising of main T runners of 15x32 mm of length 3000 mm, cross T of size 15x32 mm of length 1200 mm and secondary intermediate cross T of size 15x32 mm of length 600 mm to form grid module of size 600x600 mm suspended from ceiling using galvanized mild steel item (galvanised@80gsm) 50 mm long 8 mm outer diameter M-6 dash fasteners, 6 mm diameter fully threaded hanger rod up to 1000 mm length and L-shape level adjuster of size 85x25x2 mm, spaced at 1200 mm centre to centre along main 'T'. The system should rest on periphery walls /partitions with the help of GI perimeter wall angle of size24x24X3000 mm made of 0.40 mm thick sheet, to be fixed to the wall with help of plastic rawl plug at 450 mm centre to centre & 40 mm long dry wall S.S. screws. The exposed bottom portion of all T-sections used in false ceiling support system shall be pre-painted with polyester baked paint, for all heights. The work shall be carried out as per specifications, drawings and as per directions of the SBI/ PMC / Engineer in charge. With 20 mm thick beveled tegular mineral fibre false ceiling
tile (NRC 0.7)

Providing and fixing false ceiling at all heights including providing and fixing of frame work made of special sections, power pressed from M.S. sheets and galvanized with zinc coating of 120 gms/sqm (both side inclusive) as per IS : 277 and consisting of angle cleats of size 25 mm wide x 1.6 mm thick with flanges of 27 mm and 37mm, at 1200 mm centre to centre, one flange fiXed to the ceiling with dash fastener 12.5 mm dia x 50 mm long with 6 mm dia bolts, other flange of cleat fixed to the angle hangers of 25x1 Ox0.50 mm of required length with nuts & bolts of required size and other end of angle hanger fixed with intermediate G. I. channels 45x15x0.9 mm running at the spacing of 1200 mm centre to centre, to which the ceiling section 0.5 mm thick bottom wedge of 80 mm with tapered flanges of 26 mm each having lips of 10.5 mm, at 450 mm centre to centre, shall be fixed in a direction perpendicular to G.l. intermediate channel with connecting clips made out of 2.64 mm dia x 230 mm long G.I. wire at every junction, including fixing perimeter channels 0.5 mm thick 27 mm high having flanges of 20 mm and 30 mm long, the perimeter of ceiling fiXed to wall/partition with the help of rawl plugs at 450 mm centre, with 25 mm long dry wall screws@ 230 mm interval, including fixing of gypsum board to ceiling section and perimeter channel with the help of dry wall screws of size 3.5 x 25 mm at 230 mm c:Jc, including jointing and finishing to a flush finish of tapered and square edges of the board with recommended jointing compound , jointing tapes, finishing with jointing compound in 3 layers covering upto 150 mm on both sides of joint and two coats of primer suitable for board, all as per manufacturer's specification and also including the cost of making openings for light fittings, grills, diffusers, cutouts made with frame of perimeter channels suitably fixed, all complete as per drawings, specification and direction of the SBI/ PMC / Engineer in charge but excluding the cost of painting with : 12.5

mm thick tapered edge gypsum moisture resistant board

Mineral Fiber False Ceiling

Providing and fixing Wall angle of 19 mmx19mm x 0.40 mm shall be screw fixed to brick wall/partition with the help of approved screws at 600mm centers. Then suspending Main T grid of 15mm x 38 x 0.3 mm of length 3600mm is hung with adjustable level clips 80x30x0.6mm & 4mm diameter GI rod which are connected to Soffit Cleat 27x37x1.6mm with approved 8mm dia 40mm long dash Fasteners @1200mm centers or as approved from RCC Slab. The Cross T of 15mm x 38mm x 0.3 mm of 1200mm length shall be interlocked between main T Grid at 600mm centers to form 1200 x 600mm modules. 600 x 600mm modules to be formed by click fitting donn Cross T of 15mm x 38mm x 0.3 mm of 600mm length centrally between the 1200mm cross T's. Then 19mm thick Sonata Healthcare tile or equivalent made of Mineral Fiber tile substrate manufactured in wet felted technology and finished with painted fiber glass scrim of size 595 X 595 mm of FLB edge confirming to ISO 4 according to the norm ISO 14644-1 : 2015, ceiling panel shall be placed into the above grid of size 600x600mm. This ceiling panel confirms to ASTM E84 surface burning characteristics. (Class A, Flame Spread: 25 & Smoke developed: 70) Reaction to Fire: Euroclass A2-s1,d0 in accordance with EN-13501-1. The Ceiling panel provides NRC 0.70, CAC minimum: 37 Light Reflectance: 0.89, Recycled Content [up to 83%] and can withstand Relative Humidity up to RH 99%. Mold Prevention application as per ASTM D3273-1, Rate 10 as per D3274. Washability / Scrubbability exceeds 1000 Wash/Scrub Cycles without surface break or the extent of abrasion as per ASTM D4828 & D2486.

Gypsum Board False Ceiling

False ceiling at all height including providing and fixing of frame work made of special sections, power pressed from M.S. sheets and galvanized with zinc coating of 120 gms/sqm (both side inclusive) as per IS : 277 and consisting of angle cleats of size 25 mm wide x 1.6 mm thick with flanges of 27 mm and 37mm, at 1200 mm centre to centre, one flange fixed to the ceiling with dash fastener 12.5 mm dia x 50mm long with 6mm dia bolts, other flange of cleat fixed to the angle hangers of 25x10x0.50 mm of required length with nuts & bolts of required size and other end of angle hanger fixed with intermediate G.I. channels 45x15x0.9 mm running at the spacing of 1200 mm centre to centre, to which the ceiling section 0.5 mm thick bottom wedge of 80 mm with tapered flanges of 26 mm each having lips of 10.5 mm, at 450 mm centre to centre, shall be fixed in a direction perpendicular to G.I. intermediate channel with connecting clips made out of 2.64 mm dia x 230 mm long G.I. wire at every junction, including fixing perimeter channels 0.5 mm thick 27 mm high having flanges of 20 mm and 30 mm long, the perimeter of ceiling fixed to wall/partition with the help of rawl plugs at 450 mm centre, with

25mm long dry wall screws @ 230 mm interval, including fixing of gypsum board to ceiling section and perimeter channel with the help of dry wall screws of size 3.5 x 25 mm at 230 mm c/c, including jointing and finishing to a flush finish of tapered and square edges of the board with recommended jointing compound, jointing tapes, finishing with jointing compound in 3 layers covering upto 150 mm on both sides of joint and two coats of primer suitable for board, all as per manufacturer's specification and also including the cost of making openings for light fittings, grills, diffusers, cutouts made with frame of perimeter channels suitably fixed, all complete as per drawings, specification and direction of the SBI/ PMC / Engineer in charge but excluding the cost of painting with : 12.5 mm thick tapered edge gypsum plain board conforming to IS: 2095- (Part I) : 2011 (Board with BIS certification marks).

Gypsum Board Single Layer False Ceiling

Providing and fixing 12.5 mm thick tapered edge gypsum plain board conforming to IS: 2095 false ceiling at all height including providing and fixing of frame work made of special sections, power pressed from M.S. sheets and galvanized with zinc coating of 120 gms/sqm (both side inclusive) as per IS : 277 and consisting of angle cleats of size 25 mm wide x 1.6 mm thick with flanges of 27 mm and 37mm, at 1200 mm centre to centre, one flange fixed to the ceiling with dash fastener 12.5 mm dia x 50mm long with 6mm dia bolts, other flange of cleat fixed to the angle hangers of 25x10x0.50 mm of required length with nuts & bolts of required size and other end of angle hanger fixed with intermediate G.I. channels 45x15x0.9 mm running at the spacing of 1200 mm centre to centre, to which the ceiling section 0.5 mm thick bottom wedge of 80 mm with tapered flanges of 26 mm each having lips of 10.5 mm, at 450 mm centre to centre, shall be fixed in a direction perpendicular to G.I. intermediate channel with connecting clips made out of 2.64 mm dia x 230 mm long G.I. wire at every junction, including fixing perimeter channels

0.5 mm thick 27 mm high having flanges of 20 mm and 30 mm long, the perimeter of ceiling fixed to wall/partition with the help of rawl plugs at 450 mm centre, with 25mm long dry wall screws @ 230 mm interval, including fixing of gypsum board to ceiling section and perimeter channel with the help of dry wall screws of size 3.5 x 25 mm at 230 mm c/c, including jointing and finishing to a flush finish of tapered and square edges of the board with recommended jointing compound , jointing tapes , finishing with jointing compound in 3 layers covering upto

150 mm on both sides of joint and two coats of primer suitable for board, all as per manufacturer's specification and also including the cost of making openings for light fittings, grills, diffusers, cutouts made with frame of perimeter channels suitably fixed (if any additional members required at cutouts shall be provided free of cost) all complete as per drawings, specification and direction of the SBI/ PMC / Engineer in charge including final finishing and painting as per GFC drawing.

Gypsum Board Double Layer False Ceiling

a. Material : Gypsum board Plain 12.5 mm thick which have gray face paper and brown reverse side paper suitable for most applications where Normal fire, Structural and Acoustic levels are specified. Applicable standard of the boards should be IS 2095 (Part 1):2011 (BIS Certified) and should have thermal conductivity and thermal resistance of 0.16 and 0.078 (w/mºK).The boards should have Taper edge along length of board and Square edge along width of board. Flexural breaking load of Gypsum board as per IS 2095 (Part 1):2011 is 180 N in Transverse Direction and 500 N in Longitudinal Direction. Ceiling is in 2 layers with staggered joints.

b. Frame work : - Providing and fixing of frame work made of special/seratted sections, power pressed from M.S. sheets and galvanized with zinc coating of minimum120 gms/sqm (both side

inclusive) as per IS : 277 and consisting of angle cleats of size 25 mm wide x 1.6 mm thick with flanges of 27 mm and 37mm, at 900 mm centre to centre, one flange fixed to the ceiling with dash fastener 12.5 mm dia x 50mm long with 6mm dia bolts, other flange of cleat fixed to the angle hangers of 25x10x0.50 mm of required length with nuts & bolts of required size and other end of angle hanger fixed with intermediate G.I. channels 45x15x0.9 mm running at the spacing of 900 mm centre to centre to which the ceiling section 0.5 mm thick bottom wedge of 80 mm with tapered flanges of 26 mm each having lips of 10.5 mm, at 450 mm centre to centre, shall be fixed in a direction Perpendicular to G.I. intermediate channel with connecting clips made out of 2.64 mm dia x 230 mm long G.I. wire at every junction, including fixing perimeter channels

0.5 mm thick 27 mm high having flanges of 20 mm and 30 mm long, the perimeter of ceiling fixed to wall/partition with the help of rawl plugs at 450 mm centre, with 25mm long dry wall screws @ 230 mm interval, including fixing of double layer of 12.5mm tapered edge Gypsum board Plain (conforming to IS 2095-Part 1:2011, BIS Certified board) is then screw fixed to ceiling section with 25mm drywall screws for first layer and 35 mm drywall screws for second layer at 230mm centres on ceiling section & 150mm at periphery of ceiling including jointing and finishing to a flush finish of tapered and square edges of the board with recommended jointing compound , jointing tapes , with jointing compound in 3 layers covering upto 150 mm on both sides of joint and two coats of primer suitable for board, all as per manufacturer's specification and also including the cost of making openings for light fittings, grills, diffusers, cutouts made with frame of perimeter channels suitably fixed (if any additional members required at cutouts shall be provided free of cost) all complete as per drawings, specification and direction of the SBI/ PMC / Engineer in charge including painting as per GFC drawing.

PERFORATED GYPSUM BOARD CEILING

Perforated Gypsum Board Ceiling

Perforated GFR (glass fiber reinforced) gypsum panels backlined with acoustical fleece - Board should have 3x3mm square perforations @ 8.33mm pitch - 10.2 % open area, of size 1200x2400x12.5mm thick tapered edge along the length having base density 800Kgs/m3, weight 10 Kgs/m2 which is fixed by using concealed ceiling system. The core of gypsum should be of GFR & Fire Retardant Grade of A2-s1-d0 with NRC value of 0.75. Board should have climate RH-50, 70 & Termite Resistant with Light Reflectance of 75%. Board should possess Green Properties i.e. RC--25% & Low VOC of CLASS-1.

Ceiling System should be as follows:-The concealed ceiling framework system shall include GI Wall channel(WC22) having thickness 0.45mm, length 3600mm, unequal flanges of 20 & 30mm and web of 25mm should be fixed along the perimeters of the

wall with nylon sleeves and suitable fasteners at every 300mm centers. Then suspend Main channels(MC45) having thickness 0.8mm, length 3600mm, equal flanges of 15mm and web 45mm from the soffit at every 1200mm centers with Suspender angle(SA25) having thickness 0.45mm, unequal flanges of 25 & 10mm. GI Cross channel(CC25) having thickness 0.45mm, length 3600mm, knurled web 50mm, depth of 25mm and equal flanges 9.5mm is fastened to the Main channel in the direction perpendicular to the Main Channel at every 600mm centers. The tapered long edges of the gypsum board to be finished with Acoustical jointing compound(AJC) and jointing tape."

U-BAFFLE

"Torsion Spring U-Baffle (50mm x 150mm) False Ceiling System in 150mm module U Baffle open ceiling with fixed and demountable Torsion Spring.
Supply of torsion spring U-Baffle Ceiling System, comprising of baffle width of 50mm and height of 150mm manufactured out of 0.6mm thick Coil Coated Aluminium of alloy AA 3105 at a module of 150mm. The baffle shall be manufactured on high speed, high precision roll forming machine with Hi configuration roller levelling process to ensure the flatness and to avoid the failure of metal at corners which may occur normally on press brake machine. The coil is coated on a continuous paint line double baked and shall be stove enamelled in a continuous coil coating process of the approved colour on the exposed side and the reverse side with polyester primer. The U Baffle ceiling panels shall be mounted on coil coated customised Hat type Aluminium carrier of size 60mm * 30mm * 0.9mm thk. The customised carrier shall be suitable for both torsion spring based & standard fixed Baffle panels. The carrier shall be suspended with M6 Threaded rod hangers spaced at 1200mm c/c. Maximum upto 20% of the total ceiling area, based on client requirement, shall be demountable torsion spring-based panels. The length of the panel shall be upto 2400mm. Suspension System: As per manufacturer standard it is recommend to have minimum gap of 250mm between plenum and its baffle top surface height for easy engagement of spring. The baffle ceiling system should meet the required standards for Green Pro certification and should qualify as green product as per CII green products and services council. The manufacturer should be ISO 9001:2015 Quality Management System Certification compliant with in house testing facility and should have their own manufacturing plant in India.
Metal ceiling Tested for Seismic Zone V compliance as per IS 1893 part 1-2016”"

POLYCARBONATE SHEET

Polycarbonate Sheet Providing & Fixing Installation of Flux polycarbonate multi-layered, Multicell Connectible modular panel system for, a complete assembly of coextruded UV protected polycarbonate panels incorporated into a complete system. Standing seam polycarbonate panel system.of minimum 18 mm thick (Min.) Panels shall be with grip lock double tooth locking mechanism with interlocking connectible connectors running lengthwise at both sides of the panel. Panels shall be fixed on Purlins of MS structure (will be paid Separately) with 3 numbers of self-drilling screws to ensure a pull-out load of min. 7000 N (7KN) tested as per ISO 6892:1998 and IS 1608: 2005. Panels shall be solo opaque type in opaque and translucent clear combination with seven layers for required lux level along with all fixing accessories to ensure best performance for wind uplift, vibration, oil canning and visual appearance. Panels shall have transparent body and opaque layers in between to achieve angular daylighting effect to avaoid sunglight and heat. Panels with more layers will be preferred for better insulation and improved shading coefficient. Prices includes All acceosries including Aluminum profiles with EPDM Gaskets, at alernate edges with taper cutting to achieve the required profile,

aesthetics and performance cirterias. U value shall not be more than 1.9 Watt/m2K as per EN ISO 1077-2:2018 and respective third Party test certificate shall be produced before procurement. The width of the panels shall not be less than 1200 mm. Panels shall have an X cell strucutre also called truss bracing design to have more strenght and flexibility simulatneously.

Panels must satisfy Dart drop impact test as per IS 14443-97 shall show no sign of breakage on Polycarbonate sheets which have been exposed to UV for a min. of 500 Hours as per ASTM G 155.Panels shall not have Yellowness Index as per ASTM D 1925 of 15 units when tested on a sample exposed to UV for 500 Hours as per ASTM G 155. Panel shall be with additional End cap/Aluminium U/F profile/ Glazing Bar for ends as required. Panel shall be fixed over MS structural steel/MS purlin (paid separately) conforming to the detail technical specifications as per approved architectural drawings. Trained and factory authorized labour with supervision to complete the entire panel installation as per drawing and direction of the engineering in charge.

a. The polycarbonate sheet roofing shall be of approved make and shall confirm to manufacture's specifications. The material procured shall be free of any defects and damage to the edges, surface etc. The Contractor shall ensure that the material is procured and delivered at installation site without any damage.

b. Adequate care shall be taken for protection of the material before installation as well as afterwards till handing over the building for occupation. The Contractor shall ensure careful handling and storage and prevent any rough handling, to prevent any edge or surface damage. Any panel with edge damaged or damage to the finish etc. shall not be allowed to be used in the work and shall be replaced by the Contractor at his own cost. The Contractor shall procure the material including providing for wastages, damages etc. in one lot so as not have any color and shade variation. Atleast one sample of the polycarbonate sheets brought by the Contractor to the site of work shall be tested. The test shall be got done at reputed independent laboratory as approved by the PMC/SBI/ PMC / Engineer in charge. However, the Contractor shall obtain and submit to the Department the manufacturer's certificate for compliance of the polycarbonate sheets as per the manufacturer's specifications and also copy of the manufacturer's test report for the record.

c. The polycarbonate sheet shall be multi-wall (twin wall) section with thickness of the sheet not less than 16mm and the thickness of the walls on the two external faces not less than 0.8mm each. The sheet shall be extruded from polycarbonate material and shall have homogeneous composition of the material. The sheet shall have co- extruded UV protective layer. The sheet shall be fixed with the face treated for UV resistance, upward/exposed to sunlight. The weight of the sheets shall not be less than 2.7 Kg per sq.m. Light transmission shall be minimum 35% or as per manufacturers specifications. The sheets shall be obtained with closed edges. The sheet shall be bent (if required) to the require profile as per the architectural drawings but with radius not less than 175 times the thickness of the sheet. The sheet shall be fixed in a manner that the cells are parallel to the span of the shed.

d. The polycarbonate sheets shall be of colour and shade as approved by the SBI/PMC in-charge.

e. The physical and the chemical characteristics of the polycarbonate sheets shall be as per the manufacturer's specifications and shall confirm to the ASTM standards. The sheets shall confirm to BS 476 part 7 for the fire rating. The Contractor shall submit written guarantee to the PMC/SBI/ PMC / Engineer in charge for the polycarbonate sheets procured and provided by him against any defects like peeling, breakage, fading of color/ discoloration, cracking, leakage through the roofing loss of strength etc. for a period of ten years after the date of completion of the work. The Contractor shall obtain similar

back-to-back guarantee from the manufacturer.

f. The polycarbonate sheets shall be used in one piece along the span of the temporary sheds. The width of the sheet across the span of the shed shall not be more than 700mm. The polycarbonate sheets shall be bent to required profile (linear or curvilinear) as per the architectural drawings and fixed in position, to the structural steel framework, using self-driving self-tapping screws with EPDM washers etc. The sheets shall be secured to the structural steel framework so as to withstand all the design dead, live, wind, other accidental loads etc. and shall be fixed in a workmanlike manner. It shall not have any sag. Therefore, the fabrication work shall be got done through experienced & reputed fabricator, to be got approved from the PMC/SBI/ PMC / Engineer in charge. The Contractor shall submit to the PMC/SBI/ PMC / Engineer in charge the shop drawings giving fixing details for the polycarbonate sheets in roofing and also quality assurance and methodology statement for the item. The polycarbonate sheets shall be jointed along the length of the shed using aluminum top & bottom pressure plates having required profiles for fixing the EPDM gaskets, screws, washers etc. The aluminum pressure plates shall be color anodized or powder coated to the require shade. The joints in the sheet shall be provided only on the RHS steel sections of the framework and shall not be permitted elsewhere. The joint width of about 3-4 mm may be provided between the sheets at the junction for thermal expansion. The EPDM gaskets of the required profiles shall than be fixed in the grooves in the aluminum pressure plates on either side of the joint in the polycarbonate sheet. The bottom aluminum plate shall be fixed to the structural steel framework using self-driving self- tapping screws; washers etc. (one screw fixed to each sheet) and the screws fixed @300 mm center to center along the span of the shed.

g. The EPDM gaskets of the required profile shall be fixed in the grooves in the aluminum pressure plate on either side of the joint in the polycarbonate sheet. The top aluminum pressure plate shall than be fixed securely to the bottom

aluminum plate using countersunk self-driving self-tapping screws, EPDM washers etc. All the screws shall be concealed using structural silicone sealant DC 995 of Dow Corning or equivalent approved brand. Also, wherever required (especially at the joint in the EPDM gasket etc.) the junction of the polycarbonate sheet and the sides of the pressure plates on both sides shall be sealed using structural silicone sealant DC 995 of Dow Corning or equivalent brand as approved. The item includes cost of all the operations and all inputs of the materials including Polycarbonate sheet, EPDM gaskets, anodized aluminum capping, anodized aluminum edge capping to the sheet with U- shaped EPDM gasket, all structure silicone sealant, self-driving self-tapping screws with EPDM washers, nuts, bolts, washers etc. and the like, labor, T & P, all the incidental charges, wastages etc. involved in the work. The Contractor shall maintain the roofing scratch and damage free till the handling over the building for occupation, at his own cost. Tolerance shall be as per manufacturers specifications

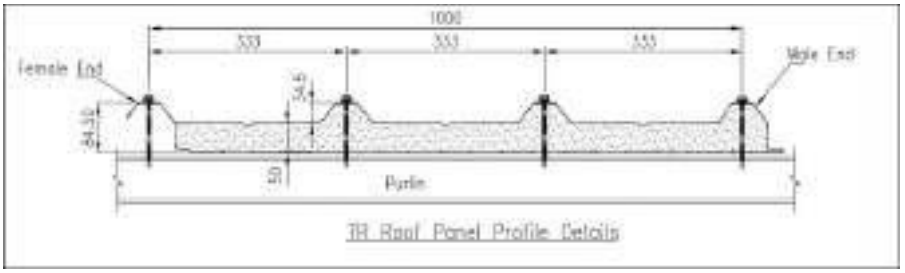
h. The polycarbonate sheets shall be obtained with protective films on both sides. Care shall be taken while fixing to fix the sheets with UV protected side exposed to outside. The sheet shall be stored in a manner not to expose to direct sunlight. The sheet shall be cut to the required size or drilled using the toothed blade/machine. After fixing the protective film shall be removed and the sheets cleaned using non-alkaline based detergent and abrasive equipments or solvents be avoided. The silicones, gaskets, tapes etc. shall be compatible with the polycarbonate sheet.

i. For joining the sheets, at least one complete channel width of each sheet shall be secured per sheet within the joining profile. Since thermal coefficient of expansion of the sheets is different from the RHS steel frames, suitable provision shall be made for accommodating differential expansions. Also any rigid jointing agent that may prevent thermal movements shall not be used. The required section aluminum profiles (upper central profile, lower central profile and top profile) for fixing the polycarbonate sheet to the structural framework as well as for joining the sheet shall be as per the manufacturer's specifications. The top capping profile shall be snap fit to the upper central profile, The EPDM gaskets and the screws shall be provided as per the manufacturer's specifications.

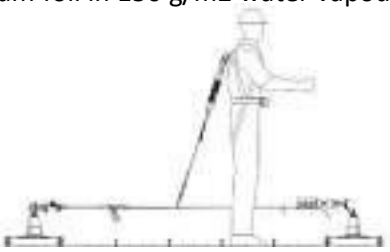
The Gaskets shall be extruded micro wave/ steam cured EPDM/ silicone of approved quality compatible with substrates, finishes and other components they are in contact with. All gaskets exposed directly on the exterior face shall be silicon gaskets, which are UV resistant. They shall not degenerate/discolor or/each on exposure to weather/ rain/pollutants etc.

Puff Insulated Roofing: -

Approved make Puff Insulated roofing sheet 40 mm thick with 38 mm High Rib, Double skin sandwiched between Pre painted Gallvalume (PPGL) sheet having outer skin 0.47mm thick Pre-coated GL Sky Blue or as approved colour Sheet with depth of crest- 30-40mm, pitch 195-200mm trapezoidal colour coated sheet & inner skin 0.47 mm thick Pre-coated GL White Sheet & minimum 40+30 mm thick layer of rigid CFC free polyurethane foam of density of 40±2 kg/m3 as insulation and PPGI sheet shall have minimum coating of 4-5 micron epoxy primer and 25 micron polyester top coat on the finish surface and 7- 8 micron primer alkyl base on reverse complete with Skirt Flashing, Corner Flashing and Rain Gutter 1.6 mm Thick G.I. Sheet.



Supply and fixing "SELF SUPPORTED" SECRET FIX STANDING ROOFING SYSTEM IN 0.9 mm THICK AA 3004 ALUMINIUM ALLOY. The general roof-construction shall comprise from bottom to top: Steel liner – 28-32/200-250 Galvalume steel liner sheet (GSM 150) 550 MPa, 0.5 mm TCT 1000 mm total cover width 35mm deep ribs spanning up to 1300 mm centres (multiple spans). The finish to the exposed surface of the liner will be polyester coating with film thickness of 23µm +/- 2 µm. (2) Second Layer - Single layer of scrim reinforced polyethylene or Aluminium foil in 150 g/m2 water vapour resistance.



The VCL shall be of 200 Microns thickness. (3) Third Layer - Insulation – One layer of Rockwool/ Glasswool insulation of 100 mm thickness each minimum 60 kg/m³ rockwool /24 Kg/m3 (glasswool) density with thermal conductivity of K=0.035 W/mk at 20 degrees Celsius when tested to ASTM C518.

(5) Fourth Layer - Aluminium Halters of suitable height with thermal barrier pads to be fixed to the purlins with SS 316 screws only.

(6) Fifth Layer – Aluminium Straight profile sheeting manufactured from aluminium self-supported standing seam roof system from aluminium alloy AA 3004 H44 (AlMn1Mg1) as specified in BS EN 1396: 2007 minimum material thickness of 0.9 mm and PVDF2 finish (standard colours) on the exposed surface. The profiled roof panel should have 3Nos of Mini ribs for extra strength Accessories, Fasteners. The material properties shall be as follows: Ultimate tensile strength: minimum 200 N/mm2, 0.2% Proof Stress: min 185 N/mm2, Modulus of elasticity: 70,000 N/mm2. Sheets are to be laid to meet the requirements of the building geometry and fixed on Aluminium Halters. Halters to be fixed to the top hat/purlins with SS 316 screws All installation is to be carried out by approved trained roofing installer. The roofing system provider should have both Factory Mutual & UL Certification. The Roofing system provider should have Thomas Bell Wright International Consultants certificate against the testing done for Water leakage (Static & Dynamic) and Air Infiltration test as per ASTM E 283-04, ASTM E330-02 (2010), ASTM E331-00, AAMA 501.1.05, AAMA 501.2-09. The system supplier is not eligible to take up the Roofing installation work as this being contractual work. The installation team shall be fully trained and approved by the supplier.

Aluminium Flashing 0.9 mm thick: Flashings manufactured from aluminium alloy as specified in BS EN 1396: 2007 minimum material thickness of 0.9 mm and Fluorocarbon PVDF finish on the exposed surface. The flashing shall be of same colour as of roof. Girth – 400mm to 570mm.

Gutter: Providing and fixing of 2 mm thick Aluminium gutter with double side vulcanised rubber Expansion joints at every 8m length. Necessary down take spout with diameter upto 150 mm at required intervals & other accessories like Cover plate, end caps and welding at joints. The Girth of gutter would be upto 1200mm.The gutter will be insulated with 100mmthk mineral wool of 60Kg/mt3 density and liner/ panel rib, Z-

girt, VCL at the bottom.

Supply &Fixing of **Fall Arrest System** as per EN 795 Class C: 2012. The system will be capable of taking load of minimum 4 users simultaneous. Systems Specifications: b. Systems Type & Length- FAS safety System- on 400 mm roof sheets. c. Systems Certification- EN 795 Class C Approved d. Testing has been done with 300 Kg weights to prove CFP's compliance for 4 simultaneous users. e. 1000 hours of corrosion testing in Salt spray test as per EN 795C. f. Material- SS 316, Steel Zinc Coated, stainless steel/Aluminium for Cast components and 5083/5084 treated aluminium alloys. g. Product marking complies to EN 795 h. CE certificate mark and EC declaration of confirmity i. The FAS system should have been tested for minimum 4 users with post spaced at minimum 11.00m.

Supply & Fixing of **Walkways System** with all required accessories. The system specification of Walkways is as mentioned below: i) FRP Gratings - FRP Pultruded Grating is made up of a mixture of Resin, Roving, woven matt, Pigment, surface veil etc. It consists of 'I' Section 38 mm Height with Bearing Bar C/c 40mm & Cross Bar of 12mm Dia Round Bar C/c 150mm. The FRP gratings fulfil the load and deflection conditions as p er EN-516. Width of Walkway- -- 500 mm Walkways System Accessories: ii) Seam Halters made of Aluminium Alloy Temper mill finished and will be as per BS EN 755-2 specifications iii) Aluminium L-Angle of thickness 4mm thick made of Aluminium Alloy 6063/T6 Temper mill finished and will be as per BS EN 755-2 specifications. iv) Fasteners used are of Stainless-Steel Grade 316.

Supplying & fixing of **STEP Walkway system** in which the complete system shall be planned, designed and fixed at site to cater all along the roof periphery like exhaust fan, louvers, skylights and gutters of the roof etc., complete all, as per the direction of SBI/PMC in charge. The specification of the system is as mentioned below: Steps the Adjustable steps are made in uncoated cast aluminum Brackets Aluminum alloy, with Nut & Bolts of Stainless Steel 316 of sufficient size. Size of Steps 460 x 250mm and thickness of aluminum tread is minimum 4mm. Minimum 3 steps per running meter. With Angle Adjustment 0 – 45 degrees and shall be of aluminum alloy.

Seam clamp for facilitating installation of solar panels:

Providing and fixing non penetrative aluminium seam clamps over the roof (solar panel framework is extra) for facilitating installation of solar panels.

Titanium Zinc Standing Seam Roofing System (Non-Insulated): General

Specifications:

Providing and fixing of 25/430 titanium zinc double lock standing seam roofing system (thickness: 0.7mm) with crest height of 25 mm thick consisting of fixing clips made of Stainless steel to connect the zinc panel to the hat section. Comprising of the following layers.

The roof system shall comprise of the following described from top to bottom:

Top Layer:
Zinc titanium standing seam profiled panels 25 /430 (25 mm seam height & 430 mm panel width) manufactured from zinc titanium alloy in pre-weathered equivalent finish in 0.80 mm BMT thickness. Pre-weathered zinc titanium with a matte subtle brushed surface in a natural medium-grey colour. The uniform medium-grey surface of Zinc originates after a chemical surface treatment following the rolling process. An organic temporary coating is applied to prevent fingerprints during installation and to optimize machine processing. An organic temporary coating shall be provided from the original sheeting manufacturer. No ermanent coating or lacquer layer should be applied as a top coat. The material properties shall be as follows: Ultimate tensile strength:

minimum 150 N/mm2,0.2% Proof Stress: min 110 N/mm2. Panels shall be fixed to the substructure using Stainless Steel clips fixing & sliding clips of suitable height. The zinc roofing sheets shall be as per EN 988 standards. The zinc roofing sheets shall have a protective coating at the underside of the sheet of minimum 12 microns. Zinc manufacturer must have supplied to public projects in India atleasst 6000sqmt.

Second Layer: Anti abrasive breathable membrane laid at the underside of zinc panels. Anti-Abrasive membrane to be laid underneath the roofing bullnose sheets. High Density polyethylene underlay membrane of 0.6 mm with Studs of 8.0 mm spaced at 19.5mm. Membrane shall have compression resistance of 200 kN/m². It shall have stud free lateral edge of 100 mm for overlap of membrane. It should be chemically and electrically neutral, resistant to mould and chemical aggressions.

Third Layer: 1.5 mm thick GI strips to place at distance of 430 mm for fixing of clips.

Fourth Layer: 0.47mm TCT steel sheets profile.
Item includes Designing, Supplying, installation and fixing of profiled zinc panels including stainless steel screws as required for the project.

Mechanical Properties of Titanium Zinc Cladding sheets:
(I) Density: 7.2kg/dm3
(2) Thermal expansion coefficient: 0.022 mm/m xºC
(3) Melting point: 420 ºC
(4) Re-crystallization point: 300 ºC
(5) Yield strength elasticity (Rp 0,2)- min. 110 N/mm2
(6) Tensile strength (Rm)- min. 150N/mm2

(7) Chemical composition

PRODUCT REQUIREMENT	TITANIUM ZINC
Zinc	Zn 99,995%
Copper	Cu 0,08 - 0,17%
Titanium	Ti 0,07 - 0,12%
Aluminum	Al < 0,015%

Size tolerances for standard products

PRODUCT REQUIREMENT	TITANIUM ZINC
Sheet and coil thickness	+- 0,025 mm
Sheet and coil width	+ 2/-0 mm
Sheet length	+ 2/-0 mm

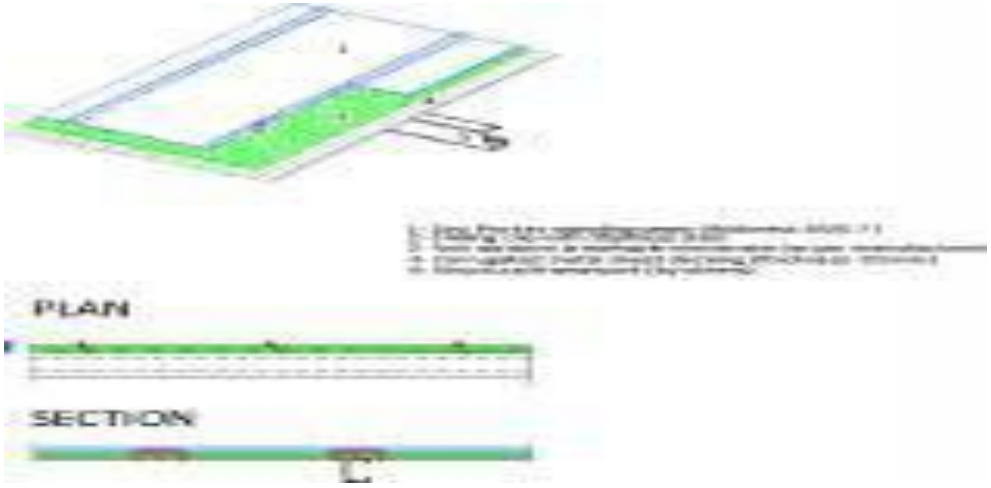
1-Ti-zinc standing seam system pane 430mm width and 25 mm seam height with .7mm thickness. Sliding and Fixed clips GI Strip

4 Anti Abrasive Membane

5. GI sheet .47 mm

6. Purlins by other or Main Civil Contractor with spacing 200mm.

Purlins to be provided at a spacing of 1000-1200 mm centre to centre maximum by main Contractor for fixing of titanium zinc roofing system.



Compatibility between materials Acceptable contact materials include:

(I) Lead

(II) Aluminum

(III) Galvanized Steel

(IV) Stainless Steel

(V) Timber such as pine, spruce, poplar and Scots pine

Unacceptable contact materials include:

(I) Copper

(II) Steel (Non-galvanized)

(III) Plywood or chipboard

(IV) Bituminous felt

(V) Concrete or reinforced concrete

(VI) Timber such as larch, Douglas fir, chestnut, oak, red cedar and white cedar.

ZINC SHEETING TOLERANCES (TO EN988)

Thickness	+/- 0.05 mm
Width	0 to +2 mm
Length	0 to +10 mm
Flatness of Sheeting	≤ 2 mm (Refer Omega rule)

Zinc Titanium Material Specifications:

Physical characteristics of pre-weathered ZINC Titanium roofing bullnose sheets:

(I) Density: 7.2kg/m3

(II) Thermal expansion coefficient: 0.022 mm/m x ºC

(III) Melting point: 420 ºC

(IV) Re-crystallization point: 300 ºC

(V) Heat conductivity: 110 W/ (m.K)

(VI) Electrical conductivity: 17Ms/m

Light Grey Pre- Weathered Titanium Zinc consists of rolled zinc alloyed with copper and titanium that complies with European standard EN 988 and the surface of which has a pre-weathering treatment upon which a transparent primer is applied, followed by a coating. This treatment consists of chemically converting the upper crystalline structure of the metal that transforms zinc into zinc phosphate. It gives rolled zinc a bright grey aspect, similar in color to the patina that forms on natural zinc after several months of exposure to the atmosphere. As an indication, the average characteristics of this conversion coating are as follows: **Compatibility between materials**

Acceptable contact materials include:

(I) Lead

(II) Aluminium

(III) Galvanized Steel

(IV) Stainless Steel

(V) Timber such as pine, spruce, poplar and Scots pine

Unacceptable contact materials include:

(I) Copper

(II) Steel (Non-galvanized)

(III) Plywood or chipboard

(IV) Bituminous felt

(V) Concrete or reinforced concrete

(VI) Timber such as larch, Douglas fir, chestnut, oak, red cedar and white cedar.

Transportation and storage

The zinc sheets shall be transported and stored in dry conditions and in a constant temperature. Item includes supplying, installation and fixing of profiled zinc sheeting including cost of system accessories insulation, Aluminum Foil vapor barrier, liner sheet, gutters, flashing, capping, trims, fasteners, gaskets, brackets, screws, rivets, sealants, , all machineries, etc complete. The above work is to be carried out by a specialized agency approved by the PMC/SBI/ PMC / Engineer in charge.

Standing seam panels

The zinc roofing bullnose sheets shall be installed with a - locked standing seam. The height of the standing seam shall be a minimum of 25mm in order to ensure perfect water tightness. The transversal junctions will depend on the slope. The minimum slope shall be ≥ 3º (or 5%).

Fixing clips for standing seam panels

The roof cladding system shall meet loading requirements in confirmity with minimum pullout strength of 50daN for each of the fixing clips (fixed and sliding), provided that the entire support transmits the cumulated load of all fixing clips to the structure. For this purpose, the support shall rest on at least 3 bearing elements.

The fixing of the roof sheets shall be done with fixed and sliding clips. These clips have a dual function of ensuring the mechanical resistance of the entire cladding and roofing bullnose area; and allowing free expansion of the cladding and roofing bullnose material. Fixed clips shall be stainless steel with a thickness of not less than 0.5mm. The clips shall be pre-punched with counter-sunk holes for attachment and designed to withstand negative load requirements.

The Sliding clips shall be stainless steel with a thickness of not less than 0.6mm for fixed base and not less than 0.4mm thick for the sliding part. The sliding clip base shall incorporate a 70mm long slot to allow permits movement. The clips shall be pre-punched with counter-sunk holes for attachment and designed to withstand negative load requirements.

The fixing to the support shall be done with stainless steel clips, with minimum pull-out strength of 50daN for each of the fixing clips (fixed and sliding).

Particular care shall be given to the calculations of the number of fixing clips per zinc panel with respect to weather and site conditions, and exposure of wind indifferent parts of the cladding and roofing bull nose area.

Particular care shall also be given to allow the bottom end of the zinc panels to dilate freely. Whenever necessary, the soldering works should be in accordance to the manufacturer's recommendations (either chemically with stripping products or mechanically.

Transversal junctions for standing seam panels

When the length of the roof slope exceeds the maximum recommended length, it is necessary to join the sheets using transverse junctions to suit the pitch of the roof. These include: Step (or drip): for pitches of 3° (5%) or more.

The step height will be a minimum of 8 cm for standing seam.

Double welt: for pitches of 11° (20%) or more

The double welt can be used for pitches of 11° and above. The minimum length of the overlap is 200 mm with a securing clip at the top. The dimensions can vary due to the projected expansion and/or contraction based on the conditions at the time of installation. Depending on climatic conditions such as wind and rain, the overlap should be increased. The fixed clip should be soldered onto the zinc sheet, not fastened to it.

Single welt: for pitches > 25° (47%) or more

The single welt or single lock cross-welt with an overlap of 50mm can be adopted for pitches greater than 25° (42%) in the standing seam technique.

Soldering

Soldering for Zinc: ASTM B 32, contains 60 percent lead and 40 percent tin with low antimony, as recommended by manufacturer.

Details at Flashing, Capping and Fascia

a. Flashing and Capping

Flashing and capping to the roof will be manufactured from the same quality grade and finish of material as the roofing bullnose elements.

Supply & fixing of 0.8 mm zinc flashing of Maximum Girth 250 mm in the same finish as the roof finish for eaves, gables, ridges, fascia, gutters, etc. as required for site detailing

- Supply & fixing of 0.8 mm zinc flashing of Maximum Girth 500 mm in the same finish as the roof finish for Skylight with soldering, silicone etc. as required for site detailing
- Supply and Fixing of 1.0 mm thick Galvanized Stiffeners maximum girth of 250 mm.

The Flashings for eaves / gutters to be profiled as per the Details Provided by Manufacturers. The flashing needs to be installed along with GI stiffener of 1 mm thick wherever recommended by the manufactures.

All Zinc Flashings and GI Stiffener for flashing shall be measured and invoiced on per Running Meter Basis. Pre-Qualification Criteria for Zinc Titanium roofing bullnose& cladding Item:

Specialized Agency for Zinc Titanium Installation:

The main Contractor shall submit the names of specialized successfully carried out similar nature:

The Specialized Agency must be trained by the Zinc Titanium Manufacturer for installation of zinc titanium roofing bullnose& façade works. Certificate of Training must be submitted by the specialized agency for zinc titanium roofing bullnose and façade. Specialized agency must have Order copy of past executed govt. jobs in titanium- zinc of similar quantity.

Zinc Titanium Supplier**:**

The principal material supplier must have necessary machines, tools, design team in India to profile the Zinc panels to support the Contractor.

Zinc Titanium Supplier:

The zinc titanium material supplier must have presence in India and must have supplied material to Public Buildings in India– Airport / Heliport / NBCC / PWD / CPWD etc. with tools and machinery for profiling of zinc.

MEASUREMENTS:

The area for roof sheeting shall be calculated by measuring actual length X breadth of roof sheeting o site up to two decimal places. Flashings for eaves, gables, ridges shall be charged extra on linear meter basis.

Protection of material

The zinc roofing sheets shall come with a proprietary protective film on the topside to protect it against damage and defect during transportation and storage. The protective film should be removed promptly after installation since the film is not UV resistant and residues of the adhesives may remain on the metal. The protective film

shall be removed no later than six weeks from the date of installation.

GLASS CANOPY

Glass canopy as per shop drawing. The glass should attack resistant laminated safety glass of thickness 15mm tested as per EN-356 of attack resistant. The glass should be vetrogard attack P6B 15 mm clear laminated safety glass with light transmission of 85%. The glass should be comliant to class 1B1 category of impact resistant as per EN-12600. The Glass should will be fixed on SS Structure of dimension 200x100x5 mm and base plates 20 mm thick 300x300 mm. The glass should be pasted with chemical sealant.

13 WATER PROOFING

The work shall be got executed as per CPWD Specifications and as per the manufacturer's specification through specialized agency as approved by the Engineer-in-Charge.

The contractor shall furnish the following particulars immediately after the issue of letter of acceptance by the SBI/ PMC.

i. The name of the specialized firm.

ii. The trade names of the product, which would be used.

iii. List of works where the treatment has been used.

iv. Quantity of chlorides and sulphides used in the product.

WATER PROOFING TREATMENT TO VERTICAL AND HORIZONTAL SURFACE OF DEPRESSED PORTION OF WC, KITCHEN AND THE LIKE

Before the water proofing treatment, the internal plaster of ceiling and walls of WC block leaving the portion for dado/skirting should be completed. Grooving / chasing for doing the concealed work of GI/CI pipes/Electrical conduits should be completed. Cleaning the depressed/sunken portion of WC of all debris, extra mortar sticking to the vertical and horizontal surface etc. Necessary holes for 'P' trap /Nhani trap/Water escape pipe etc should be completed.

Preparing Surface and Fixing Pipes and Fittings
Before the water proofing treatment work, proper key in the concrete surface should be provided. The depressed/sunken portion should be hacked by a hacking tool, after the concrete slab is cast and when this concrete is still green.

The vertical surfaces of the depressed /sunken portion should be hacked with a hacking tool just after the shuttering is removed.

In case of old work, the water proofing treatment on such surfaces shall be permitted after making

proper spatter dash key.

Fixing the 'P' trap in position and all other pipes work including the water escape pipe shall be fixed properly and the holes should be plugged carefully before taking up the water proofing work.

1st Course
Cement duly blended with water proofing compound as explained in clause 22.1 shall be used for preparing the cement slurry.

The consistency of the slurry should be such that 4.4 kg. of blended cement with water proofing compound is used per sq. metre area of surface to be treated. The slurry should be started from the vertical faces towards the bottom of the floor as shown in Fig. 22.4. Particular care should be taken to see that the slurry is applied to corners without leaving any gap.

2nd Course
Immediately on applying the blended cement slurry on the surface to be treated cement plaster 20 mm thick in CM 1:3 (1 blended cement: 3 coarse sand) shall be applied both on vertical and horizontal surfaces taking particular care to complete the entire depressed/ sunken portion of WC within a day so that the plaster can be done without any joint. Junctions shall be properly rounded. The surfaces of the plaster shall be left rough but finished in one plain and cured for a week.

On completion of the curing period both horizontal and vertical surfaces shall be cleaned properly and gently and allowed to dry.

3rd Course
Only after the surface is completely dried the blown or residual bitumen shall be applied @ 1.7 kg. of bitumen per sqm area.

4th Course
PVC sheet 400 micron thick shall be spread evenly without any kink immediately, so that the PVC sheet sticks to the surface firmly. PVC sheet shall be continued to be laid over the main slab upto 100 mm.
Overlapping of PVC sheet should be done with a minimum overlap of 100 mm, duly pasting the overlapped sheet with an application of bitumen @ 1.7 kg./ sqm. The projections of pipes and 'P' trap outlet etc. inside the depressed/sunken portion of WC shall also be cladded with water proofing treatment layer upto a height of 150 mm, using a coat of bitumen with PVC sheet complete.

The surfaces of depressed/sunken portion of WC shall not be left without covering with specified filling material and base concrete, otherwise the PVC sheet layer may be tampered by the labour working in the vicinity.

Fixing up of WC pan, filling specified material and the top base concrete should be done as early as possible and the top horizontal layer of water proofing may be taken up later i.e. just before laying the floor tiles.

WATER PROOFING TREATMENT IN SUNKEN PORTION OF WCs, BATHROOMS ETC.

Preliminaries to be Attended
The preliminaries shall be attended as described in clause 22.3.1.

Preparing Surface, Fixing Pipes and Fittings

In this case, unlike as described in clause 22.3.2, no hacking of surface need be made, but only extra mortar sticking to the surface should be removed and the surface should be cleaned thoroughly. Fixing 'P' trap etc. shall be done as described in Clause 22.3.2.

Providing and Laying of Slurry for First Layer
The consistency of the slurry should be such as to cover the desired area by using 0.488 kg of blended cement per sqm of area.

On deciding the correct quantity of water required per sqm. area the required quantity of slurry should be prepared which can be applied over the desired surface within half an hour of mixing with 0.488 kg. of grey cement + 0.253 kg. water proofing compound as per manufacturer specifications + x litres of water per sqm. area and the required quantity of slurry thus prepared should only be used for first application.

The first layer shall be applied with painting brushes over the specified and dampened area carefully including the corners, holes on the surfaces and joints of pipes in concrete etc. and the application should continue at least upto 150 mm height of fixtures of pipes from the surface. The surface on application shall be air cured for 4 hours.

Providing and Laying of Slurry for Second Layer
The quantity of slurry required for second application to be covered within an hour of mixing shall be prepared with 0.242 kg. cement + 0.126 kg. water proofing compound + y litres of water per sqm. area and the required quantity of slurry thus prepared should only be used for second application.

The application of 2nd layer of slurry is same as for first layer as detailed in clause 22.5.3.

The applied surface shall be allowed to air cure for 4 hours and thereafter water curing shall be done for full 48 hours.

In case no further work as described above is to be taken up immediately on completion of water proofing treatment due to any reason it is recommended to protect the treated portion with cement plaster 1:4 as a protective layer.

INTEGRAL CEMENT BASED WATER PROOFING TREATMENT WITH BRICK BAT COBA

Preparing the Surface
The surface of the slab should be roughened by scrapping when the slab concrete is still green, however, the surface need not be hacked. In case the slab is already cast and surface fairly finished, the same shall be cleaned neatly of all mortar droppings, loose materials etc with brooms/cloth.

Providing and Laying of Slurry under Base Coat
The quantity of water required to prepare the slurry with 2.75 kg. of blended cement to be painted over an area of 1 sqm. shall be calculated exactly as described in clause 22.5.3.

Depending upon the area of surface that has to be covered, the required quantity of slurry should be prepared using 2.75 kg. blended cement + water per sqm. area to be covered, taking particular care to see that only that much quantity of slurry shall be prepared which can be used within half an hour of preparation i.e. before the initial setting time of cement.

The prepared slurry shall be applied over the dampened surface with brushes very carefully, including

the joints between the floor slab and the parapet wall, holes on the surfaces, joints of pipes, masonry/concrete etc.

The application of the slurry should continue upto a height of 300 mm on the parapet wall and also the groove. The slurry should also be applied upto a height of 150 mm over pipe projections etc.

Laying Base Coat 20 mm thick

Immediately after the application of slurry and when the application is still green, 20 mm thick cement plaster as base coat with cement mortar 1:5 (1 blended cement : 5 coarse sand) shall be evenly applied over the concrete surface taking particular care to see that all the corners and joints are properly packed and the application of the base coat shall be continued upto a height of 300 mm over the parapet wall.

Laying Brick Bat Coba

Brick bat of size 25 mm to 115 mm out of well burnt bricks shall be used for the purpose of brick bat coba.

The brick bats shall be properly dampened for six hours before laying.

Brick bats shall be laid to required slope/gradient over the base coat of mortar leaving 15-25 mm gap between two bats. Cement mortar 1:5 (1 blended cement: 5 coarse sand) shall be poured over the brick bats and joints filled properly. Under no circumstances dry brick bats should be laid over the base coat.

The haunches/gola at the junction of parapet wall and the roof shall be formed only with brick bat coba.

In case the brick bat coba is laid on the base coat immediately on initial set there will be no necessity of applying cement slurry over the base coat before laying the brick bat coba. However, if the brick bat coba is to be laid on the subsequent day, cement slurry prepared as described in clause 22.7.3 shall be applied over the top surface of the base coat, then only the brick bat coba shall be laid.

Application of Slurry over Brick Bat Coba

After two days of curing of brick bat coba cement slurry prepared as per clause 22.7.3 shall be applied on the surface of brick bat coba The application of slurry shall be the same as described in clause 22.5.3 which should cover the haunches/gola, and the remaining small portion of parapet wall and also inside the groove as shown in the figure.

Laying Finishing Layer (Protective Coat)

Immediately on applying the cement slurry over the surface of the brick bat coba and when the slurry applied is still green, the fibre glass cloth as specified in clause 22.6.4 shall be spread evenly on the surface without any kink & pressed to see that no air spaces exist. The fibre glass cloth shall be taken up to a height of 300 mm on parapet walls & tucked in the groove specially prepared at that height. 20 mm thick layer of cement plaster, without leaving any joints shall be applied with cement mortar 1:4 (1 blended cement: 4 coarse sand) over the entire fibre glass cloth including the haunches/gola and the small portion on the parapet wall. The groove in the parapet wall over the haunches shall also be filled neatly packing the mortar firmly in the groove.

The surface of the finishing layer (protective coat) shall be neatly finished with cement slurry prepared as per clause 22.7.3. The finished surface shall be allowed to dry for a while and then pattern of 300 mm x 300 mm groove, 8 mm deep shall be made over the entire surface.

Curing and Testing the Treatment
The entire surface thus treated shall be flooded with water by making kiaries with weak cement mortar, for a minimum period of two weeks.

WATER PROOFING

STANDARDS

Indian and other International Standards are followed for this section. Any discrepancies or ambiguities seen shall be brought to the notice of the LDA and clarification / confirmation sought. SBI/ PMC / Engineer in charge's decision shall be final. However, as a general rule, more stringent specifications shall be followed.

WATERPROOFING SYSTEMS
Note: The waterproofing system for foundation, underground structures and basement (if any) to be finalized as per soil conditions, water table, basement level and foundation design. The waterproofing system shall be finalized from the below mentioned systems and approved by the Architect based on the mentioned criterias.

Raft & Rwtaining Wall Waterproofing: - Supplying and installing 1.5 mm composite thick fully bonded weldable HDPE membrane conforming to IS 16471:2017 requirements of UG waterproofing structures, requirements to provide Type A fully bonded protection of UG waterproofing structures. The membrane shall exhibit 25 years of service life tested and complied in accordance with EN 13251:2016 durability certification. The membrane should be minimum 2.4 m wide comprising of an HDPE layer and a pressure sensitive adhesive layer which is covered by a weatherproof protective layer with lap Joint Strength at overlaps >15000 N/m ASTM D 6392:2012. The membrane shall have minimum of 100 mm side and end laps which shall be thermofused with leister machines at all the joints for assuring watertightness and achieving monolithic membrane. End laps and side laps should be a minimum of 100 mm with double weld system, comprising of two parallel welds of 15 mm wide each with a 20 mm air channel gap in between the two weld lines.The size of the membrane should not be less than 2.4 Mtr. x 20 Mtr. to minimize the joints. This membrane shall be continued over the vertical surface but terminated minimum 100mm below the top edge of the raft slab/footings and fixed as per recommendation.
The HDPE membrane should have the below mentioned techncial properties-

1) Lap Joint(side and end lap) Strength at overlaps 15000 N/m ASTM D 1876
2) Resist hydrostatic pressure of 70 m head of water as per ASTM D5385
3) Puncture Resistance of 1000 N as per ASTM E154
4) Peel Adhesion to concrete of 1500 N/m as per ASTM D 903
5) Tensile strength (Bare HDPE membrane) of 25 N/mm2 as per ASTM D412
6) Elongation (Bare HDPE Membrane) of 500% as per ASTM D 412
7) Low temperature Flexibility -25deg C - Pass as per ASTM D 1970
8) UV Resistance: 45 days

Works will be executed as per approved methodology and drawing.

Providing & applying 2 components, solvent free, liquid applied elastomeric seamless hybrid Polyurea Polyurethane Membrane, using high pressure plural component spray equipment, to form a minimum system thickness of 1.5 mm in two or more passes with a total consumption of 1.5-1.6 kg / m2. The membrane shall have 100% Solids, VOC Free, Tensile strength > 15 Mpa as per ASTM D 412, Elongation > 450% as per ASTM D 412, Low temperature Crack bridging ability of 3.2mm as per ASTM C 1305, Shore A Hardness > 85 ASTM D 2240, Puncture Resistance > 1000 N as per ASTM E 154, Water

Head Resistance > 7 Bar as per ASTM D 5385.The coating should pass Dynamic Crack Bridging as per EN 1062-7, Method B for 20,000 cycles at -20 degree temperature. The membrane shall exhibit 25 years of service life tested and complied with EN 13251:2016 durability certification. Apply primer coat of epoxy primer by roller/ airless spray guideline and coverage 5-6 m2/ltr depends on porosity of concrete. Allow to cure for max 5-6 hours. Broadcast anti slip grains of 200-300 micron (dried sand) on wet primer at coverage of 0.8-1 kg/m2 and allow to come to touch dry condition before application of Membrane. Termination of Membrane at 300mm above G.L.-The waterproofing membrane shall be terminated on the vertical surface. The membrane shall be terminated either by creating a "U" shaped groove of approx. 10 mm x 10 mm size within the RCC retaining wall, tucking the membrane within the groove, followed by sealing the groove with polyurethane sealant/ epoxy mortar . Providing and fixing HDPE protection having dimple height of 6 to 8 mm, as a protection board, over the waterproofing membrane for vertical surface stuck to the membrane by spot bonding method, using synthetic adhesive with butt joints etc. complete.
Note-Necessary back filling to be done by the main civil contractor within 2-3 days' time progressively after installation of the membrane and protection board , taking care not to cause damage to the waterproofing treatment

Water Swellable Bar:-All Starter & Construction Joints of raft slab, retaining walls : Providing and applying water swellable bar at starter & all construction joints, of c/s size of minimum 20mm X 10mm, volumetric expansion of 300%, Shore A Hardness of 40± 5, hydrostatic head resistance of 60 m. It shall be fixed to the concrete using a hybrid adhesive or corrsion free nailing as recommended by manufacturer.

WATERPROOFING FOR WATER RETAINING STRUCTURES SUCH AS WATER TANKS/STP.

Cleaning the internal surface areas thoroughly so that they are free of all contaminants like dirt and laitance & to remove all the loose materials by various mechanical means. Removal of all surface imperfections, protrusions, loose concrete & filling of cracks using SBR latex modified Mortar in the ratio Cement: Sand (1:4) and 5% by weight of cement.
Providing & grouting at construction joints cementitious grout into each nozzles (1 mtr c/c) at regular intervals as per the requirements.
Applying 3 coats of 2 components, prepacked, polymer modified cementitious coating@ 3kg/sq.mtr all over the slab including the angular fillets and extendable over the vertical walls. Finally sprinkling sand over the third coat for better adhesion with plaster. The interval between each coat of coating application is 6-8 hrs.
Providing & laying a protection layer of 25 mm thick cement mortar admixed with integral waterproofing compound.
Technical Features of acrylic cementitious coating-

Product	**Test Standard**	**Results**
Tensile Strength	ASTM D 412	5 N/Sq.mm
Elongation at Break	ASTM D 412	120 % minimum
Crack Bridging	ASTM D 836	No cracking up to 2 mm
Adhesion Strength	ASTM D 4541	0.8 N/Sq.mm minimum

Food grade epoxy coating for potable water tanks
Providing & applying two coats antibacterial antifungal food grade coating with an interval of 6-8 hrs between each coat over the cured plastered surface as per manufacturer's instruction.
STP Tanks-Coal tar epoxy coating
Providing & laying Coal Tar Epoxy in two coats at a consumption of 3-4 sq.mtr/Kg complete as per

manufacturer's instruction

Method Statement

a. Ensure a properly clean, sound & leveled substrate, as they should be free from oil, grease, dust & debris. Ensure that the moisture content is less than 10%.
b. Make surface smooth, even & free from local depressions with sand –cement mortar modified with SBR latex and cure it for minimum 3 days.
c. The slurry to be grouted is prepared as per the mixing instructions with non-shrink compound for cementitious grout. Carry out injection grouting either by gravity or with grouting pump using the mixed material. Allow it to cure for at least 24 hrs.
d. Providing and laying gola of 75X75mm thickness all along the angular joints of wall and slab with cement mortar of mix 1:3 admixed with waterproofing compound
e. Clean the surface again thoroughly to make free from dirt, dust laitance etc. and saturate the cleaned concrete surface with ample amount of water.
f. Apply 1st coat of Acrylic coating on all the surfaces as per instructions & cure it for 6-8 Hrs.
g. Apply the second coat of Acrylic cementitious coating over the properly cured first coat and let the complete treatment air cure for 7 days and so on for the third coat.
h. Provide a protection layer over the waterproofing treatment with a 25 mm sand cement plaster admixed with integral waterproofing compound as per instructions & cure it for 7 days.

i. Mix the components of food grade coating as per the instructions given & apply two coats on all the plastered surfaces by brush with an interval of 6-8 hrs between each coats.

PROVIDING WATER STOPS

Water stops conforming to IS 12200 for construction/expansion joints should be fabrication from a plastic compound, the basic resin of which shall be polyvinyl chloride. The compound shall contain additional resin/ plasticizer inhibitors or other materials such that when the materials is compounded it shall meet the requirement given in IS 15058.

Type of Joints for which Water Bars are Provided

The water bars are provided only for the movement of joints in a water retaining structure. Different types of movement joints are as described below:

Complete Contraction Joint: This is a movement joint with deliberate discontinuity both in concrete as well as the reinforcement but no initial gap is maintained between the concrete on either side of the joint. This joint is intended to accommodate the contraction of the concrete.

Partial Contraction Joint: This is a movement joint with deliberate discontinuity in concrete but no water bar is provided and no discontinuity is provided in steel. No initial gap is maintained between the concrete on either side of joint.

Expansion Joint: This is also a movement joint with complete discontinuity in both reinforcement and concrete. It is intended to accommodate either expansion or contraction of the structure. In general such joint requires the provision of an initial gap between the adjoining parts of the structure which accommodates expansion or contraction of the structure.

Types and Performance of Water Bars

Water bars are performed strips of impermeable material which are embedded in the concrete during construction so as to span across the joints and provide a permanent water tight seal during the whole range of joint movement.

The most usual form of water bars are strip with a longitudinal corrugation

Another form of water bar of metallic type is Z shaped strip.
Water bars of copper, sheet lead, natural or synthetic rubber and plastic such as polyvinyl chloride (PVC) are also used. These bars comprise of central longitudinal hollow tube with thin walls and stiff wings of about 150 mm width. Out of the metals available copper is most suitable as regards ductility, resistance to corrosion in air, water and concrete. However, it may be attacked by some wastes. If sheet lead is used it should be insulated from concrete by a good coat of bituminous or suitable composition. Natural synthetic rubber and plastics have very considerable advantage in handling, splicing and in making intersections. Galvanized iron sheets may also be used with the specific permission of the SBI/ PMC / Engineer in charge
provided the liquid stored or the atmosphere around the liquid retaining structure is not excessively corrosive i.e. sewage. The strip water bars described as above, while placing in position has to be passed through the end shutter of the first placed concrete with the result the shuttering at this point should be perfectly water tight otherwise cement slurry may escape from the concrete being laid and will ultimately weaken the structure. Therefore to avoid the above problem one can prefer moulded type of water bar. The design of the moulded water bar with several projections need to be passed through the end shutter while placing the same in position. Another main advantage of this water bar is that since it occupies bigger proportion of the thickness of the joint it would lengthen the shortest alternative water path through the concrete.

It is important to ensure proper compaction of concrete around the water bar. Proper cover to all the reinforcement shall be maintained. Sometimes to increase the bond the holes are provided in the copper water bars but in the long run it proves to be disadvantageous as it shortens the path of water through concrete. Water bars should be placed at the centre of the wall or if it is to be provided away from the centre its distance from either face of the wall shall not be less than half of the width of water bar or as specified/directed by the SBI/ PMC / Engineer in charge.

Covers Plates for Joint
Sometimes joint cover plates have to be used for expansion joints mainly to avoid the risk of a fault in the water bar which is embedded. The plates to be used should be either copper or sheet lead. In case the copper plates are to be used, it should be clamped to the concrete face on each side of the joint. To ensure water tightness suitable gasket shall be used. Joint cover plates of sheet lead are also used and fixed on the joints. In this case the edges may return into grooves formed in the concrete and can be made completely water tight by lead caulking. Faces of the concrete to which sheet lead is to be fixed should be painted with bituminous or other suitable composition and the lead sheet should be similarly coated before fixing.

Spacing of Joints
In Reinforced Concrete floors movement joints should be spaced at not more than 7.5 m apart in two directions at right angles. The wall and floor joints should occur at the base of the wall in which case corresponding vertical joint is not important. In concrete walls, the vertical movement joints should normally be placed at a maximum spacing of 0.75 m in reinforced walls. The maximum length desirable between vertical movement joints will depend upon the tensile strength of the walls and may be increased by suitable reinforcements. Amongst the movement joints in floors and walls as mentioned above, expansion joint should be normally be provided at spacing of not more than 30 m between successive expansion joints or between the end of the structure and the next expansion joint, all other joints being of the contraction type. In case of expansion joints the filling of these with bitumen filler, bitumen felt or any such material etc. shall be paid for separately in running metre. The measurement shall be taken upto two places of decimal stating the depth and width of joint. In case joint cover plates either of copper or sheet lead with ancillaries are provided, these shall be measured and paid for separately.

GRADING ROOF WITH CEMENT CONCRETE 1:2:4

Materials

Cement, coarse sand and graded stone aggregate 20 mm nominal size, shall be used as specified in the item. The specifications for the materials and method of preparation of concrete shall conform in general to the specification described in sub-head 4.0 of CPWD Specifications.

Laying: Before laying cement concrete for grading, the level markings to the required slope/gradient shall be made only with cement concrete on the surface of the slab at suitable spacing with the help of string and steel tape (Measuring tape) so that the mason can lay the concrete to the required thickness, slope / gradient easily in between the two level markings.

On getting the level marking approved by the Site Engineer the surface should be sprinkled with thick cement slurry and the concrete should be laid carefully, without throwing from height, in predetermined strips. The concrete should be consolidated by specially made wooden tamping. After the tamping is done the surface should be finished to required slope/gradient with wooden trowels without leaving any spots of loose aggregates etc.

The mixed cement concrete must be laid in position, within half an hour of its mixing. In case any quantity of concrete remains unused for more than half an hour the same should be rejected and removed from the site.

Finishing: The slope of finished terrace shall not be more than 1 in 120 unless a steeper slope is desired by the SBI/ PMC / Engineer in charge. The minimum thickness of the concrete at its junction with Khurra or parapets shall be 5 cm. The concrete shall be rounded at the junction of roof slab and parapet. It is desirable to provide a haunch/ gola/filler at the junction of the parapet wall and the roof slab.

The finished concrete surface shall present a smooth surface with correct slopes and uniform rounding. The concrete should be free from cracks. Excess trowelling shall be avoided.

Thickness: Average thickness shall be as per clause 22.9.1.2 as shown in Fig. 22.8.

Curing: Curing shall be done either by spreading straw/Hessian cloth over the graded surface, keeping the same wet for full 10 days or flooding the graded area with water by making kiaries with weak cement mortar, for 10 days. Occasional curing by simply spraying water now and then shall not be permitted under any circumstances.

PODIUM/TERRACE GARDEN WATERPROOFING

Surface preparation-Wash the surface and remove all loose concrete, grease, oil using wire brush or by surface grinder. All critical areas such as joints, junctions, movement zones, penetrations drainage points and cracks are to be correctly sealed and detailed prior to waterproofing. All hairline cracks < 1mm should be cut and open up to 5mm width to fill with Polymer modified mortar. Providing and applying angle fillet of 50 mm X 50mm on the right angles of wall junction floor junctions and properly dressed by preparing polymer modified mortar admixed with URP 10 % by weight of cement in the ratio of 1:3 etc., complete Providing & applying 4500 PUH -2 components, solvent free, liquid applied elastomeric seamless hybrid Polyurea Polyurethane Membrane, using plural component airless spray equipment, to form a minimum system thickness of 1.5 mm in two alternative coats with a total consumption of 1.5-1.6 kg / m2. The membrane shall have 100% Solids, VOC Free, Tensile strength > 15 Mpa as per ASTM D 412, Elongation > 450% as per ASTM D 412, Static Crack bridging up to 2mm as per ASTM C 836, Shore A Hardness > 85 ASTM D 2240, Puncture Resistance > 1000 N as per ASTM E 154, Water Head Resistance > 7 Bar as per ASTM D 5385.The coating should pass Dynamic Crack Bridging as per EN 1062-7, Method B for 20,000 cycles at -20-degree temperature. Apply primer coat of epoxy primer by roller/ airless spray guideline and coverage @ 5-6 m2/ltr depends on porosity of concrete. Allow to cure for max 5-6 hours. Broadcast anti slip grains of 200-300 micron (dried sand) on wet primer at coverage of 0.8-1 kg/m2 and allow to come to touch dry condition before application of Membrane. Termination of Membrane at 300mm above G.L.-The waterproofing membrane shall be

terminated on the vertical surface. The membrane shall be terminated either by creating a "U" shaped groove of approx. 10 mm x 10 mm size within the RCC retaining wall, tucking the membrane within the groove, followed by sealing the groove with polyurethane sealant/ epoxy mortar . Supplying & laying 200 gsm Geotextile (non woven polyester)
over the entire membrane on horizontal area maintaining proper overlaps. Horizontal Slope & Protection:Laying minimum 75 mm THK at drainage point protective concrete screed of M20 grade of average 100 mm THK with slope 1:100 reinforced with Poly propylene fibre @ 0.9 kg / per Cu.m. After the application of screed, provide control joints by using a saw cutting machine attached with a 3 mm blade within 18-24 hrs. of application of screed. The panel size for providing joints should be up to max 15 sq.mt. Finishing. etc., Vertical Protection:Over the waterproofing membrane apply a coat of Epoxy bonding Agent conforming to Shear Bond strength as per ASTM C 881. Sprinkle fine sand over the primed surface at 2-3 Kg/sqm when the bonding agent is wet. Allow it to dry to form firm key for the plaster. Laying 15mm THK protective plaster of C:M – 1:4 admixed with integral waterproof compound conforming to IS 2645:2003 @ 220ml per bag of cement, over the waterproofing membrane forvertical protection including application of epoxy bonding agent conforming to ASTM C 881 and sprinkling of sand to create key for the plaster.

Drainage board laying for Landscape Areas on Podium

Fixing of 10mm thick polypropylene geotextile laminated dimpled board, of compressive strength not less than 400kN/m2 before soil filling.

OTHER SPECIFICATIONS:

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

18 STRUCTURAL GLAZING ALUMINIUM COMPOSITE PANEL

Materials (General)

Materials and components used shall be of the first / superior quality and suitable for the purpose. All materials shall be free from any defects that may impair the strength, functioning/ performance or appearance of the curtain wall or adjacent construction.

Fasteners

The type, size, alloy, quantity and spacing of all anchor fasteners and/or anchorage devices shall be as required for the specified performance standards. Bolts, anchors and other fastening devices like screws, nuts, washers etc. shall be of approved types as required for the strength of the connections, shall be self-locking, unless otherwise specified. These shall be of austenitic stainless steel of specified grade and shall be torque tightened, wherever required, to achieve the maximum torque tension relationship in the fasteners. Washers, nuts and all accessory items shall be of the same material as fasteners. The rivets/ nuts, bolts and washers for fixing insulation layer to the shadow box or with fire-stops (barriers)-cum-smoke seal shall be stainless steel of approved grade.

Type of fasteners Grade of stainless steel

Anchor fasteners Stainless steel grade 316
Screws, Nuts, Bolts, Washers Stainless steel grade 304
Rivets, toggles and the like Stainless steel grade 304

The anchor fasteners shall not be provided using PVC sleeves. Only expandable type self locking fasteners shall be provided.

Aluminium extrusions

In general aluminium alloy for extrusions shall be 6063 T5 or T6 grade as per B.S.1474.
However, the grade and tempering specifications shall be as recommended by the supplier for each application. All extruded aluminium sections shall be anodized in approved colour to a minimum thickness of 20 microns or shall be PVDF coil / spray coated in approved colour and shade with metallic colours to a minimum thickness of 35 microns. The colour and the finish shall be uniform and free of streaks. The aluminium sections, before coating, shall be suitably cleaned, rinsed, buffed properly and sealed and protected after anodizing / PVDF coating, till the completion of the work. All surfaces of the aluminium sections designed to receive the sealants shall be finished
properly to match the finish of the parent section as used for initial testing of sealant and aluminium surface adhesion. Further, it shall be ensured that the entire aluminium surface has adequate sealant contact and adhesion. Sill sheets, plates and extrusions shall be visually flat under all lighting conditions. The members of aluminium extruded sections for mullions, transoms, members of sub frames & sash frames shall be in single piece and not be splice jointed in the panel length and height.

Aluminium flashing

All flashings shall be made from 1.0 mm thick solid aluminium sheet transparent anodized to a minimum thickness of 10 microns. It shall be fixed using stainless steel screws dipped in weather silicone sealant.

Aluminium composite panels

The soffits of the canopies / walkways / entrance canopies etc., required as per the architectural drawings, shall be covered with aluminium composite panel material. The top of the canopies / walkways / entrance canopies shall be covered with zincalume sheets. The aluminium composite panel and zincalume sheets shall be bent to the required profile and fixed as per the approved shop drawings prepared on the basis of architectural drawings.

Brackets

The brackets shall be fixed with high degree of accuracy to achieve the elevation as per the architectural drawing. The brackets shall have suitable lengths and sections to align curtain glazing in one face, as required as per the architectural drawings. Nothing extra shall be payable on this account. The brackets shall be fabricated from M.S rolled sections / plates to have the design strength. The quality of the weld shall also be ensured as per the standards. These shall be provided corrosion protection treatment by Hot Dipped Galvanizing. The mass of the zinc coating to be not less than 610 gm. per sqm of steel area to be galvanized. Slots of elliptical or circular shape in the brackets shall be pre-drilled / machine punched and not flame cut and it shall be done before galvanizing. The surface of the brackets shall be serrated for additional grip before galvanizing. Washers made of serrated plates of the corresponding material shall also be provided for additional grip. The directions of the serration and the slot shall be such that they allow movements as per the design requirement and at the same time prevent any movement in the other direction. Each bracket shall be fixed to the R.C.C using anchor fasteners of suitable capacities and in numbers as required as per the design requirements. The brackets shall be fixed to the structural steel members of the building using stainless steel bolts & nuts / fasteners of required capacity and in numbers as per the design requirement. The holes of the required sizes shall be pre- drilled in RCC/ structural steel for fixing anchor fasteners/
bolts etc. Nothing extra shall be payable on this account.

Fittings

All hardware and fittings such as patch fittings, handles, locks, stay-arms, floor springs, friction stays etc. for doors , windows and open able panels shall be heavy duty and of approved make as specified. Hinges for open able panels shall be heavy duty top hung stainless steel friction hinges selected for specified wind load and dead loads. All fittings and locks shall be as specified.
Each open able panel of the Curtain glazing shall be provided with the fittings as specified in item nomenclature.

SEALANTS & GASKETS

Selection of sealants

The compatibility and sequence of installation for all sealants must be carefully considered in all proposals in order to ensure the required curing and performance.
Sealants must not degrade and / or fail under any or all design conditions including wind, thermal and seismic movements, exposure to water and humidity, ultraviolet exposure and / or other adverse environmental conditions.

The designations of sealant types specified herein are intended for general design guidance only.
Final selection for the sealant types shall be based on their conformity with the Performance Requirements specified herein and as per the recommendations of the sealant manufacturer. It may use sealant of equivalent grade and characteristics, manufactured by the manufacturer other than those specified herein, based on recommendations of those sealant manufacturers for specified use but with the prior approval of the SBI/ PMC / Engineer in charge. The contractor shall submit the documentary evidence in this regard.
All precautions shall be taken during design of structural silicone bite and also during fabrication of the curtain glazing system to prevent failure of sealant during the guarantee period of 10 years after the date of completion of work and even beyond, upto the expected service life of the curtain wall.

Sealants and gaskets shall not leach, discolour, stain or dry.

Structural silicone sealant

The sealant manufacturer shall design the silicone bite for the design loads as specified and likely to come during the life of the curtain glazing system for arriving at bite size of the structural silicone sealant.
The structural silicone sealant bite as designed by the sealant manufacturer and as per the approved shop drawings shall be provided.
The Structural sealant shall be two part pump-filled Silicone sealant DC 983 of Dow Corning or equivalent recommended by manufacturer. The weather silicone sealant shall be one-part Silicone sealant DC 795 of Dow Corning or equivalent of other approved brand as per the list of approved materials.
The structural sealant to be used as specified for all exposed and concealed metal to metal (including tight or butt type metal to metal assembly prior to assembly) or glass to glass shall be 2-part silicone sealant, conforming to the manufacturer's recommendations for the specific uses and performance criteria. The sealant shall be applied using two-part pump for the same. All the sealing shall be done in a clean and controlled environment as specified by the silicone sealant manufacturer.

Weather silicone sealant

The grade of weather silicone sealants wherever required like for concealed metal to metal, metal to glass and metal to concrete/ masonry such as embedment and lapping of flashings etc. where elements are to be installed or embedded, the weather sealant shall be of grade 795 of Dow Corning or equivalent for the other approved brand, as per the recommendations of the sealant manufacturers. Also, the gap between the aluminum sections and the glass, if so required, shall be filled with weather sealant as specified above including providing and fixing backer rod wherever required as per the approved shop drawings. The weather silicone sealant shall be of approved colour and shade. The weather silicone sealant for fixing the butt jointed glass for the fixed partitions shall be transparent in colour DC 791 of Dow Corning or equivalent of other approved brands.

Compatibility

All sealants must be non-staining and compatible with adjoining sealants, backup materials, substrate materials and their respective finishes and/or applied colour coatings. Care shall be taken to ensure that two different types of sealant should not come in contact with each other unless compatibility is satisfied as per manufacturer's specifications.

Caulking compound
Dow Corning weather silicone sealant – 795 or equivalent as approved by the Engineer-in-Charge, (of approved colour and shade to match adjacent material wherever exposed and visible) for use around frame/ flashings or between frame/flashing and RCC/ masonry surface.

Gaskets
Gaskets and seals shall be of approved quality compatible with substrates, finishes and other components they are in contact with. All gaskets exposed directly on the exterior face shall be silicon gaskets, which are UV resistant. They shall not degenerate, discolour or leach on exposure to solar radiations/ rains/ pollutants etc.
Manufacturers' test Certificate shall be submitted as specified.

GLASS

General
All glass and glazing materials shall be as specified.
Vision and spandrel glass shall have characteristics as specified.

The performance characteristics of glass panels, have to be ensured within the constraints of aesthetic requirements like colour, shade, reflectivity etc. And performance requirements like light transmission, U value, shading coefficient, relative heat gain etc. as specified. Minor variations in the characteristics of glass on superior side may be allowed, but without any extra cost to the Department on this account.

Installation
Install glass panels and carry out glazing work as indicated on the drawings and as specified herein.
All glass panels shall be of accurate sizes as required.
All glass panels shall have clear undamaged edges and surfaces, which are not disfigured.
Any glass panel that does not fit in the curtain glazing system shall be rejected. Therefore, all care and precautions shall be taken while procuring the glass panels from the manufacturer / processors of the glass. No claims of any kind or any hindrance shall be entertained from the contractor on this account.
Glass panels shall not be in direct contact with the aluminum framework.

Identification
Permanent identification marking on glass shall be accomplished by a technique selected by the manufacturer. The location of the marking shall be proposed by the Manufacturer and approved by the Engineer – in - Charge. All glass shall be delivered to site with the manufacturer's / processor's label of identification attached.

Selection of Glass
Each type of glass shall be obtained from only one manufacturer and preferably in one lot.

Insulated Glazed Units (IGUs) in the vision panels

Insulated glazed units shall be obtained only from approved manufacturers/ processors as per the approved list.
Insulated units shall be factory assembled, with multiple panes, hermetically sealed, separated by and sealed to spacer tubes perforated on inner exposed face forming airtight dehydrated airspace inside the insulated units. The IGUs shall be assembled (prepared) by the manufacturer/ processor of the glass as per the approved list, in their dedicated workshops/ factory.

Laminating units

The glasses shall be laminated with interlayer of Polyvinyl butyral (PVB) sheet of specified thickness
The interlayer material (PVB) shall be clear or as specified with no tendency to bubble, discolour or lose physical and mechanical properties after laminating glasses.
The laminated panels shall be free of foreign substances, air or glass pockets and shall not delaminate at edges.

Precaution in storing and handling glasses

The glass manufacturer/ processor shall take necessary precautions as stated below besides any other precautions not specifically mentioned herein:
The reflective/ low E coating on the glass shall be protected against scratches, surface corrosion, staining and/ or any other abrasion.
The glasses shall not be stored without a clean inter-leaving material. Also they should not slide against each other.
The glass shall be protected from weld or grinding splatter.
The reflective/ low E coating shall be protected against contact with acids or strong alkalies.
The cleaners to be used for cleaning the surface shall be as per the manufacturer's recommendations.
The glass shall be protected against moisture from humidity, which can stain glass as well as coating.
Reflective/ low E coating shall also be protected against splashes from paints etc.

METAL COATINGS

Anodizing / PVDF coating

Aluminium extruded sections shall be satin finish colour anodized to minimum 20 microns thickness, as per the approved colour and shade or PVDF coil / spray coated to approved metallic colour and shade to minimum 35 microns thickness.

Galvanizing

The brackets for the curtain glazing system shall be hot dipped galvanized. The mass of the zinc coating to be not less than 610 gm. per sqm of steel area to be galvanized.

Samples

Three samples shall be prepared, which shall define the colour and gloss of anodizing and submit them for approval.

Matching of finish

Wherever the same colour finish is specified for extruded aluminium sections and composite aluminium sheets. It shall be ensured that the colour of both is matched as closely as possible.

STANDARDS

In general, it shall be followed either of the latest Indian/ International Standards as applicable for this sub head.

DESIGN

Architectural drawings and specifications only indicate the required basic dimensions, and performance criteria.
It shall be ensured that proper structural analysis and design for various load cases and their combination. This shall include designing and proper sizing of all sections meeting structural and architectural requirements. The anchor assemblies shall meet the performance and design requirements including installation of all inserts, fasteners, clips, bracing and framework as required for the proper anchorage to the structure, unless otherwise specified.
Design of the curtain glazing system shall comply with all Government codes and regulations.
The Contractor shall design the entire curtain glazing system for dead loads, wind loads, seismic loads, storm, air pollution, thermal stresses, building movements and consequent deflections without compromising the performance characteristic. Further, the individual members of the structural framing shall not deflect beyond permissible limits as specified. The design shall comply with the requirements of the relevant National Building Code and Indian Standard Code/ International Standards, unless specified

otherwise.
The curtain glazing system and its elements shall not sustain permanent deformation or failure under loading equivalent to 1.5 times the design wind pressure.
The specified deflections must be reduced if they are in any way detrimental to curtain glazing system and building.
It shall be ensured that the elevations are strictly as per the architectural drawings and that the intent of the architectural design is retained. Visual appearance shall be a key consideration for acceptance of work.

SHOP DRAWINGS

Submittals

The contractor shall prepare shop drawings based on approved design and submit the same to the Engineer –in-charge for approval.
The review of the shop drawings shall be limited to their conformity to the architectural and structural design concept & specifications.
No fabrication shall be taken up until the shop drawings and all other related submittals, documentation, certification, samples and the mock-up for that work have been reviewed and approved by the SBI/ PMC / Engineer in charge.

Scope of shop drawings

Shop drawings shall incorporate scaled and dimensioned plans, elevations, sections and complete size details for all the works.
The shop drawings shall indicate the required dimensional profiles and modules, function, design and performance standards and in general cover all dimensions and details required to fabricate and install the curtain glazing system.
The contractor shall verify and co-ordinate the shop drawings with all applicable and interrelated trades, drawings and specifications.
All dimensions / modules, etc., shall be field checked and the drawings shall be modified, if required, based on actual measurements at site.
Details shall show and specify all metal sections, types of finishes, areas to be sealed and sealant materials, gaskets, applicable construction materials including fasteners and welds, all anchorage assemblies and components, fabrication and erection tolerances for the work.
All details shall be subject to the approval of the SBI/ PMC / Engineer in charge, after incorporating all the modifications suggested by the SBI/ PMC / Engineer in charge.

Section profiles

Profile adjustments, if required as per the site conditions may be allowed by the Engineerin-Charge subject to meeting the architectural / performance requirements. However, this shall be carried out only with the written approval of the SBI/ PMC / Engineer in charge provided that the general design
and intent of the drawings and specifications are also maintained. Also, if any new / non-standard aluminium extruded section is required as per the site requirement and / or the architectural drawings for functional and / or aesthetic reasons, the contractor shall procure the same from the approved manufacturers for the aluminium sections, even if it entails preparing new die, etc. Nothing extra shall be payable on this account.

DOCUMENTATION AND CERTIFICATION

The manufacturer's certificate for compliance of the various components/ materials for the works (under this sub head) as per the manufacturer's specifications for the various characteristics.
A copy of the manufacturer's test report for each lot of material procured and supplied for the work shall also be obtained from the respective manufacturers and submitted to the SBI/ PMC / Engineer in charge
for the record.

Glass and glazing documentation

Before taking up the work, the glass manufacturer / processor shall submit written certification for the review of the SBI/ PMC / Engineer in charge and record, stating that all glass (properties

as
specified such as U value, shading coefficient, light transmission, solar factor, relative heat gain etc.) and glazing requirements (including heat strengthening/ toughening, reflective soft coating, low E coating, lamination, fabrication of IGUs including sealants) as per the shop drawings are recommended by them for use related to their specific applications and design parameters and that they are in conformity with the specifications.
Tests shall be carried out for glass, including properties after processing, for each lot supplied, by the glass manufacturer / processor in his factory /laboratory or any other accredited laboratory and the copies of the test results shall be obtained by the contractor and submitted to the SBI/ PMC / Engineer in charge for the record.

Sealant Documentation

All sealant applications must be clearly designated on shop drawings.

Quality control documentation

The methodology and quality assurance statement shall be submitted for quality control procedures for the review and approval of the SBI/ PMC / Engineer in charge before taking up the work to ensure the design integrity and performance of the curtain glazing, aluminium composite panel cladding and aluminium work (PVDF coated).
The SBI/ PMC / Engineer in charge or his authorized representatives may visit the plant / workshop / factory to inspect material, fabrication and quality assurance procedures.

25.9 SAMPLES AND MOCK-UP AT SITE

25.9.1 Submittals

The samples of the following materials together with detailed technical data / catalogues shall be submitted for review and approval of the SBI/ PMC / Engineer in charge along with the shop drawings..
Aluminium Composite Panel : Each type and thickness 600mmx600mm
Aluminium extrusions : Each section: 500mm long.
Glass : Each type 600 mm x 600 mm.
Gaskets, separators, glass setting blocks / spacer tape, etc : Each section or unit, backer rods, 300mm long or unit.
Bracket, fasteners and Connecting devices : Each type and size.
Finish samples : After approval of the final finish coating, the SBI/ PMC / Engineer in charge shall be provided with three (3) approved samples.
Ironmongery and accessories, as applicable.
Finished flashing samples
Finished samples of shadow boxes, fire stop (barrier)-cum smoke seals
Structural and weather silicone sealant

Mock-up at site

Before the fabrication and site installation is taken up and after the approval of shop drawings by the SBI/ PMC / Engineer in charge, a mock-up shall be prepared of his proposed curtain glazing system for a size of panel not exceeding 6 sqm. The mock-up shall be essentially put up at site for final approval of all materials and installation details by the SBI/ PMC / Engineer in charge. The mock up shall not form part of the work and shall not be paid for. It shall be dismantled and taken away by the contractor at his own cost, with the prior permission of the SBI/ PMC / Engineer in charge. Nothing extra shall be payable on this account.

STORAGE, PROTECTION AND PROGRAMME

A schedule of procedure shall be submitted for inspection during installation so as to control and assure quality on the job site.
A detailed method statement shall be submitted for the protection of the surface of the curtain glazing, aluminium composite panel cladding and aluminium work (PVDF coated), etc during delivery and erection, with description as to when the protection can be removed. The protection paper shall be kept for a period as recommended by SBI/ PMC / Engineer in charge and shall be replaced with the fresh protection paper, if so required. Further, it shall not have acid content, which in any manner may affect the substrate.

Delivery and Storage of Materials: All materials delivered to site shall be stored in allocated spaces where the stored materials shall not get exposed to rainwater, moisture or damage, and shall permit easy access to and handling of the materials. Materials shall be stored neatly and properly stacked.

Factory made glazing units and/or their components shall be transported, handled and stored in a manner to preclude damage of any nature.

Necessary materials, required for erection at the site shall be delivered in labeled containers by the manufacturer / supplier.

All units or components, which are cracked, bent, chipped, scratched or otherwise defective and unsuitable for installation shall be removed and replaced by the contractor. Nothing extra shall be payable on this account.

PERFORMANCE REQUIREMENTS

All components, assemblies and completed work shall conform to the various performance standards as applicable in respect of thermal movement of the curtain glazing, allowance for vertical and horizontal expansion and building movement and related building tolerance etc. The design and installation of the curtain glazing system shall accommodate all inherent building movements and deflections and the fabrication and installation tolerances of all related work not involved in this section without the loss of, or any detrimental effect to, the performance requirements herein specified. The contractor shall verify and coordinate all such movements and tolerances with the SBI/ PMC / Engineer in charge before designing the components of the curtain glazing system so that movements and deflections in the structure do not at any time affect the integrity and safety of curtain glazing system and vice versa.

Thermal property

All insulation materials, fire-stops (barriers)-cum-smoke seal shall comply with the current requirements of the Fire Officer, MIDC and other authorities.

Structural properties

The curtain glazing system shall be anchored to the R.C.C floor through serrated Hot Dipped Galvanized M.S brackets. As far as possible, the contractor shall take all precautions to avoid cutting through any reinforcement bars while fixing the brackets. The cost includes provision of sleeves/ leave slots at appropriate locations during casting of the concrete itself for making provision for fixing brackets for the curtain glazing system and to avoid chipping/ dismantling of concrete. The slot shall be filled up with concrete of the same grade in a workman like manner, after fixing the brackets. Any defect in alignment/ plumb in the building face shall be rectified by chipping/ dismantling of the concrete/ masonry and repairing the same as specified to achieve the required alignment of the curtain wall as specified. Any change in lengths of bracket/s required on this account and the consequent requirement of their sections and sizes shall be carried out. Nothing extra shall be payable on this account.

No holes shall be burned, filed or drilled in any structural steel/ RCC members unless expressly approved by the Engineer – in – Charge.

Member shapes and/or profiles if schematically shown on the Architectural drawings are not necessarily the exact shapes required or best suited for the particular conditions. Final shapes and locations shall be as designed by the contractor and are subject to the review and approval of the Engineer – in – Charge.

All framing members shall be shop fabricated and finished as specified.

Concrete tolerances

While fixing the brackets for curtain glazing system, the contractor shall take into account the variation in the concrete and the masonry faces to which the structural framework of the curtain glazing system is to be fixed and such variations shall be adjusted in the lengths of brackets to align them in perfect plumb. The bracket shall be designed accordingly. Nothing extra shall be payable on this account.

Fire stops (barriers)-cum-smoke seal and interface with building

25.11.4.1 Gaps between the building face and the curtain glazing system at soffit level between the successive floors shall be closed as specified with fire-stops (barriers)-cum-smoke seal. It shall have the required fire resistance to be approved by Fire Officer. Suitable gap for accommodating deflections

of the aluminium framing of curtain glazing system as per the approved shop drawings shall be maintained between the fire-stops (barriers)-cum-smoke seal and the curtain glazing system. This smoke seal shall however be provided using backer rod and weather silicone sealant as specified and as approved by the SBI/ PMC / Engineer in charge.
The fire-stops (barriers)-cum-smoke seal shall consist of 1 mm thick plain G.I. sheet tray with 100 mm thick layer of non inflammable heat insulating material, rock wool, having density of minimum 64 Kg. per Cum. of the make as approved by the SBI/ PMC / Engineer in charge. The rock wool layer shall be attached to G.I sheet using stainless steel rivets/ nuts, bolts and washers. The tray shall be fixed to the RCC / Masonry surface by using stainless steel screws dipped in weather silicone sealant as per the approved shop drawings. Screws with plastic sleeves shall not be allowed to be used for the above fixing.

An aluminium flashing of 1.0 mm thick shall be permitted transparent anodized (10 micron thickness) solid aluminium sheet of the approved design and profile at the window sill level and also fill the gap between the aluminum flashing and the curtain glazing using weather silicone sealant as specified and as approved by the SBI/ PMC / Engineer in charge. Also, the fasteners/ screws to be used for fixing flashing shall be dipped in weather silicone sealant before using.

Acoustics

Gaps between the mullions and the partitions of the cabins shall be suitably closed by double skin partition as directed by the SBI/ PMC / Engineer in charge including allowing for permissible deflections of mullions as per design requirements but without affecting the partitions and the curtain glazing system. The payment for this partition work shall be made under relevant item.

Provisions shall also be made to prevent metal to metal rubbing, any rattling, noise due to thermal changes and wind pressure by using Teflon separators and shims.

Visual appearance

It shall be ensured that the elevations are strictly as per the Architectural drawings and that the intent of the architectural design is retained. Visual appearance shall be a key consideration for acceptance of work.

CURTAIN GLAZING AND ALUMINIUM COMPOSITE PANEL CLADDING SYSTEMS

General

Movement of building components to which the curtain glazing system is attached including long term and short term movements due to thermal effect, structural effect, wind pressure, seismic forces, erection or dead loads, creep, column shortening, deflection, torsion and vibrations etc shall be free and noiseless. This shall be achieved without any strain or stress being transferred to the glass, without buckling of any components, without excessive stress to any members or assemblies and without compromising on any of the performance requirement of the curtain wall.

Waterproofing

Following precautions shall be taken by the contractor to ensure that the curtain glazing system is completely water tight during its guarantee period as well as expected service life besides any other precautions not specifically mentioned herein:
A drainage system must be incorporated into the curtain glazing system. The curtain glazing system shall have provision for air pressure equalization (all the internal spaces shall be vented by acceptable means to ensure air pressure equalization) so that water leakage and condensation, if any shall be drained or discharged to exterior face of the curtain glazing.
Care should be taken that the sections of the aluminum extrusions used for structural framing of curtain glazing provide for proper drainage of water that in-filters into the system by gravity and for this the section should have proper slope and weep holes as required. These shall be clearly indicated on the shop drawings.
Movement of water on exposed faces must be controlled to ensure that water is not retained and that elements will not be damaged or corroded by water and to minimize the potential for algae and fungal growth as a result of standing or trapped water.

EPDM gaskets of the quality as specified and of required size and thickness shall be provided at all required locations to prevent ingress of water or moisture. The same shall be indicated on the shop drawings also.

EPDM gaskets of the quality as specified and of required size and thickness shall be provided at all required locations to prevent ingress of water or moisture. The same shall be indicated on the shop drawings also.

Aluminium sheet flashing using 1.0mm thick transparent anodized (10 microns) aluminium sheet wherever required shall be provided including sealing the gap between the flashing and the other material like RCC, masonry, aluminium etc. by using weather silicone sealant as specified.

Mullions and transoms

The sections of mullions and transoms shall be designed to restrict deflection under dead loads, wind load, seismic loads etc. as specified and shall be rigid and stable enough to support and retain the in-fill panels in position under all conditions. The mullions and transoms shall also be designed for additional horizontal loads from the cleaning equipment and process besides horizontal live loads as specified.

Spandrel units

Spandrel shall be of glass having same colour matching with vision areas after using a shadow box as specified.

Structural spandrel wall, fins, slab or beam, aluminium frame work, anchor fasteners, brackets, shadow boxes, fire stop(barrier)-cum-smoke seals and other construction shall not be visible through the glass in the spandrel portion of the curtain glazing from the exterior and shall be fully concealed behind the shadow box.

A shadow box shall be provided at a distance of minimum 50 mm behind the spandrel glass panel to ensure that the insulation panel material does not come in contact with the soft coating of the spandrel glass to prevent any damage to the coating on account of any chemical reaction or otherwise. It shall consist of an approved black fibre glass non-woven tissue stuck on surface #1of 50 mm thick semi-rigid fibre glass wool insulation panel of minimum density of 48 kg per cum., and 1.5 mm thick transparent anodized (10 microns) solid aluminium sheet tray, on surface #2 by using suitable stainless steel rivets/ nuts, bolts and washers to hold the insulation panel in position. The periphery shall be properly sealed. Surface #1 shall be adequately protected against damage until spandrel glazing is done. Further, care shall be taken that the aluminium sheet backing of the shadow box does not heave or warp due to thermal stresses and/or its self-weight. Proper gaps at the edges of the tray shall be provided to accommodate movements on account of thermal stresses besides making elliptical slots if required to facilitate movements. The shadow box shall be fixed to the structural framing of the curtain glazing by using stainless steel screws. The fixing arrangement shall be as per the approved shop drawings.

Ventilators, open able windows and doors

Ventilators, openable windows and doors shall be provided at positions as shown on the architectural drawings. The openable panels when in closed position shall remain watertight under all weather conditions and pass the water tightness tests as specified. Besides, the openable panels shall appear similar to the fixed ones from outside.

All hardware and accessories shall be provided and fixed by the contractor and shall be as specified.

Coping and soffit trimmer

All coping and soffit panels shall have aluminium structural frame fixed rigidly to the structure.

Effective drainage system shall be provided to drain out the water that may penetrate through the joints, on to the exterior face of the curtain glazing.

Coping and soffits shall be visibly flat in all lighting conditions.

Aluminium extruded tubular and other aluminium sections as per the architectural drawings and approved

shop drawings , the aluminium quality as per grade 6063 T5 or T6 as per BS 1474,including super durable powder coating of 60-80 microns conforming to AAMA 2604 of required colour and shade as approved by the SBI/ PMC / Engineer in charge. (The item includes cost of material such as cleats, sleeves, screws etc. necessary for fabrication of extruded aluminium frame work. Nothing extra shall be paid on this account). The weight of aluminium extruded section shall be taken for purpose of payment.

Designing, fabricating, testing, protection, installing and fixing in position semi (grid) unitized system of structural glazing (with open joints) for linear as well as curvilinear portions of the building for all heights and all levels, including:
(a) Structural analysis & design and preparation of shop drawings for the specified design loads conforming to IS 875 part III (the system must passed the proof test at 1.5 times design wind pressure without any failure), including functional design of the aluminum sections for fixing glazing panels of various thicknesses, aluminium cleats, sleeves and splice plates etc. gaskets, screws, toggles, nuts, bolts, clamps etc., structural and weather silicone sealants, flashings, fire stop (barrier)-cum-smoke seals, microwave cured EPDM gaskets for water tightness, pressure equalisation & drainage and protection against fire hazard including:

(b) Fabricating and supplying serrated M.S. hot dip galvanised / Aluminium alloy of 6005 T5 brackets of required sizes, sections and profiles etc. to accommodate 3 Dimentional movement for achieving perfect verticality and fixing structural glazing system rigidly to the RCC/ masonry/structural steel framework of building structure using stainless steel anchor fasteners/ bolts, nylon seperator to prevent bimetallic contacts with nuts and washers etc. of stainless steel grade 316, of the required capacity and in required numbers.

(c) Providing and filling, two part pump filled, structural silicone sealant and one part weather silicone sealant compatible with the structural silicone sealant of required bite size in a clean and controlled factory / work shop environment, including double sided spacer tape, setting blocks and backer rod, all of approved grade, brand and manufacture, as per the approved sealant design, within and all around the perimeter for holding glass.

(d) Providing and fixing in position flashings of solid aluminium sheet 1 mm thick and of sizes, shapes and profiles, as required as per the site conditions, to seal the gap between the building structure and all its interfaces with curtain glazing to make it watertight.

(e) Making provision for drainage of moisture/ water that enters the curtain glazing system to make it watertight, by incorporating principles of pressure equalization, providing suitable gutter profiles at bottom (if required), making necessary holes of required sizes and of required numbers etc. complete. This item includes cost of all inputs of designing, labour for fabricating and installation of aluminium grid, installation of glazed units, T&P, scaffolding and other incidental charges including wastages etc., enabling temporary structures and services, cranes or cradles etc. as described above and as specified. The item includes the cost of getting all the structural and functional design including shop drawings checked by a structural designer, dully approved by SBI/ PMC / Engineer in charge. The item also includes the cost of all mock ups at site, cost of all samples of the individual components for testing in an approved laboratory, field tests on the assembled working structural glazing as specified, cleaning and protection till the handing over of the building for occupation. In the end, the Contractor shall provide a water tight structural glazing having all the performance characteristics etc. all complete, as per item description, as specified
Note:- 1. The cost of providing extruded aluminium frames, shadow boxes, extruded aluminium section capping for fixing in the grooves of the curtain glazing and vermin proof stainless steel wire mesh shall be paid for separately under relevant items under this subhead. However, for the purpose of payment, only the actual area of structural glazing (including width of grooves) on the external face shall be measured in sqm. up to two decimal places.

Note:-2. The following performance test are to be conducted on structural glazing system if area of structural glazing exceeds 2500 Sqm from the certified laboratories accreditated by NABL(National Accreditation Board for Testing and Calibration Laboratories), Department of Science & Technologies, India.. The NIT approving authority will decide the necessity of testing on the basis of cost of the work, cost of the test and importance of the work. Performance Testing of Structural glazing system Tests to be conducted in the **NABL accredited lab or by any other accreditation body which operates in accordance with ISO / IEC 17011 and accredits labs as per ISO/ IEC 17025.**

1. Performance Laboratory Test for Air Leakage Test (-50pa to - 300pa) & (+50pa to +300pa) as per ASTM E-283-04 testing method for a range of testing limit 1 to 200 mVhr
2. Static Water Penetration Test. (50pa to 1500p) as per ASTME- 331-09 testing method for a range up to 2000 ml.
3. Dynamic Water Penetration (50pa to 1500pa) as per AAMA 501.01- 05 testing method for a range upto 2000 ml
4. Structural Performance Deflection and deformation by static air pressure test (1.5 times design wind pressure without any failure) as per ASTME-330-10 testing method for a range upto 50 mm
5. Seismic Movement Test (upto 30 mm) as per AAMA 501.4- 09 testing method for Qualitative test, Tests to be conducted on site.
6. Onsite Test for Water Leakage for a pressure range 50 kpa to 240 kpa (35psi) upto 2000 ml

Providing, assembling and supplying vision glass panels (IGUs) comprising of hermetically-sealed 6-12- 6 mm insulated glass (double glazed) vision panel units of size and shape as required and specified, comprising of an outer heat strengthened float glass 6 mm thick, of approved colour and shade with reflective soft coating on surface # 2 of approved colour and shade, an inner Heat strengthned clear float glass 6 mm thick, spacer tube 12 mm wide, dessicants, including primary seal and secondary seal (structural silicone sealant) etc. all complete for the required performances, as per the Architectural drawings, as per the approved shop drawings, as specified and as directed by the Engineerin- Charge. The IGUs shall be assembled in the factory/ workshop of the glass processor (Payment for fixing of IGU Panels in the curtain glazing is included in cost
of item No.25.2) (i) Coloured tinted float glass 6 mm thick substrate with reflective soft coating on face # 2, + 12 mm Airgap + 6 mm Heat Strengthened clear Glass of approved make having properties as visible Light transmittance (VLT) of 25 to 35 %, Light reflection internal 10 to 15%, light reflection external 10 to 20 %, shading coefficient (0.25- 0.28) and U value of 3.0 to 3.3 W/m2 degree K etc. The properties of performance glass shall be decided by technical sanctioning authority as per the site requirement

Frameless Toughened Glass Door Shutter

Providing and fixing 12 mm thick frameless toughened glass door shutter of approved brand and manufacture, including providing and fixing top & bottom pivot & double acting hydraulic floor spring type fixing arrangement and making necessary holes etc. for fixing required door fittings, all complete as per direction of SBI/ PMC / Engineer in charge (Door handle, lock and stopper etc.to be paid separately).

Corner Patch Look

Providing and fixing Corner Patch Look with 6 levers without pair of handles of approved quality for aluminium door, with necessary screws etc complete as per direction of Engineer- in-charge.

Pull Handle H type

Providing and fixing , lSI Pull Handle H type 32 mm Dia 600 mm marked, anodised (anodic coating not less than grade AC 10 as per IS : 1868) transparent or dyed to required colour or shade, with necessary screws etc. complete :

19 BUMPER GUARD STRETCHER GUARD CRASH RAIL SYSTEM & WALL GUARD

The scope of work includes providing & fixing Bumper Guard / Stretcher Guard Crash Rail System of approved make consisting of continuous aluminum retainer, impact absorbing strip (B-ABS), adjustable end cap / corner joint, adjustable adaptor plate and high impact vinyl acrylic cover of desired shade to withstand impact and providing a cushioned surface with its integrated rubberized absorber complete as per manufacturer's specifications.

- The Bumper Guard / Stretcher Guard Crash Rail System shall be able to protect walls that are susceptible to trolley traffic, preventing unsightly scuffs and costly damage.
- This system shall be so designed to withstand impact and provides a cushioned surface with its integrated rubberized absorber, making it ideal for areas like high traffic corridors, loading bays and light cargo lifts.
- Bumper Guard shall be manufactured from specially developed vinyl acrylic materials and has the following qualities:
  a. Able to withstand high impact and abrasion
  b. Weather resistant and fire retardant
  c. Textured to provide an anti- slip surface
- Fittings and anchorages that can withstand corrosion when exposed to normal environmental conditions
- Easy to install and maintain

19.1 **Wall Crash Guard:** Corridors, Lobbies, Ramps of all the floors shall be provided with Wall Crash Guard as per approved drawings with following specifications.

Supply and fixing of CRUSH Rail of approved make having lead free vinyl snap on cover, PVC Holder and bumper of 2mm thickness each. Aluminum retainer of 2mm thickness that shall be fabricated from 6063-T5 aluminum having high impact resistance with size 157(+/-2) mm x 25(+/-2) mm with rail offset of 76mm along with continuous outside corner. The rigid vinyl profile shall resist an impact of minimum 30.4ft-Ibs/inch as per ASTM D-25690b. The finished surface shall not support any fungal or bacterial growth in accordance with ASTM G-21. The system shall also confirm to class A fire rating. ASTM D-543 rating for assurance of chemical and stain resistance. All fixing and fitting shall be done as per manufacturer's specifications. Color and design shall be approved by PMC/SBI/ PMC / Engineer in charge.

19.2 **Column & Wall Corners Guard:** All corners of walls and columns at corridors, lobbies and all inside area of all the floors shall be provided with Column & Wall Corner Guard up to a minimum height of 1.5m as per approved drawings with following specifications.

Supply and fixing of corner guard of approved make and model Corner Guard having lead free vinyl snap on cover with PVC End Capsandbumperof2mmthicknesseach.Aluminum retainer of 2mm thickness that shall be fabricated from 6063-T6 aluminum having high impact resistance with size 52mm x52 mm. The rigid vinyl profile shall resist an impact of minimum 30.4ft lbs/inch as per ASTM D-25690b and shall not support any fungal or bacterial growth in accordance with ASTM G-21. The system shall also confirm to class A fire rating. ASTMD-543 rating for assurance of chemical and stain resistance. All fixing and fitting shall be done as per manufacturer's specifications. Color and design shall be approved by PMC/SBI/ PMC / Engineer in charge.

20 ROAD/PARKING WORKS

The campus roads are to be constructed with filling of earth, preparation of sub-grade, sub-base WMM/GSB as specified and finished with minimum Grade M40 RCC 200mm thick and as per IRC code with Vacuum Dewatered concrete. All the main RCC roads are to be constructed as per road section drawings and as per IRC code and CPWD Specifications. –

(i) Vacum Dewatered RCC Road as shown in drawing.

(ii) For pedestrian movement and parking areas, paver blocks/ Grass-Crete blocks/Chequered CC tiles shall be used, as required.

(iii) Kerb stones: All roads edges shall be provided with kerb stones.

(iv) Adequate no. of hume pipes (RCC Pipes) of suitable dia. shall be laid across the roads/pathways etc. for crossing of cables, pipe etc. as per requirements.

ROAD WORKS

LIST OF MANDATORY TESTS

Material/ work	Clause / Para No.	Test	Field/ Laboratory	Test Procedure	Frequency of Testing
1) Coarse Aggregate	16.1.1 of CPWD specifications 2019 volume-2	Los Angeles Abrasion Value or Aggregate Impact Value	Laboratory	IS 2386 (Part 4)	Per 200 m3
		Specific gravity, Water absorption & Density	Laboratory	IS 2386 (Part 3)	

	16.1.1 Table 16.2 of CPWD specifications 2019 volume-2	Combined Flakiness and Elongation Indices	Laboratory		
			Field	IS 2386 (Part 1)	Per 100 m3
		Size and grading of aggregate	Field	IS 2386 (Part 1)	Per 100 m3
2) Fine Aggregate	16.1.2 of CPWD specifications 2019 volume-2	Deleterious materials	Field	IS 2386 (Part 2)	As required by the Engineer-in- Charge.
		Specific gravity, Water absorption & Density	Laboratory	IS 2386 (Part 3)	
		Size and grading of aggregate	Field	IS 2386 (Part 1)	
3) Bitumen	16.1.5 of CPWD specifications 2019 volume-2	As prescribed in IS 73 or IRC:SP:53, IS:15462	Laboratory	As prescribed in IS 73	As required by the Engineer-in- Charge.
4) Embankment under (O.M.C. conditions)	16.3.1 of CPWD specifications 2019 volume-2	Moisture content Density	Laboratory Field	IS 2720 (Part 2) IS 2720 (Part 28)	250 m3 250 m3
	16.3.4.4 of CPWD specifications 2019 volume-2	c) Control test on borrow pits.			
		(i) Gradation	Laboratory	IS 2720 (Part 4)	One to two tests per 8000 m3
		(ii) Plasticity	Laboratory	IS 2720 (Part 5)	-do-
		(iii) Proctor Test	Laboratory	IS 2720 (Part 8)	-do-

		(iv) Deleterious content	Laboratory	IS 2386 (Part 2)	As required by the Engineer-in- Charge
		(v) Moisture contents	Laboratory	IS 2720 (Part 2)	250 m3
5) Prime Coat / Tack Coat / Fog Spray		(i) Quality of Binder	Laboratory	IS:73	Number of samples per lot and tests as per IS:73, IS:217 and IS:8887 as applicable
		(ii) Binder temperature for application	Field		At regular close intervals
		(iii) Rate of spread of Binder	Field		Three tests per day
6) Seal Coat / Surface Dressing		(i) Quality of binder	Laboratory	IS:73	Same as mentioned under Serial No. 5
		(ii) Aggregate Impact Value or Los Angeles Abrasion Value	Laboratory	IS:2386 (Part 4)	One test per 200 cum of each source and whenever there is change in the quality of aggregate
		(iii) Combined Flakiness Index and Elongation Indices	Field	IS:2386 (Part 1)	One test per 100 cum of aggregate for each source and whenever there is change in the quality of aggregate
		(iv) Stripping value of aggregates (Immersion Tray Test)	Laboratory	IS:6241	One test of each source and whenever there is change in the quality of aggregate
		(v) Water absorption of aggregates	Laboratory	IS:2386 (Part 3)	-- do --
		(vi) Grading of aggregates	Field	IS:2386 (Part 1)	Two tests per day
		(vii) Soundness test (Magnesium and Sodium Sulphate)	Laboratory	IS:2386 (Part 5)	One test for each source and whenever there is change in the quality of aggregate
		(viii) Temperature of binder in boiler, aggregate in dryer and mix at the time of laying and	Field		At regular intervals

		compaction			
		(ix) Rate of spread of materials	Field		Same as mentioned under Serial No. 5
		(x) Percentage of fractured faces (When gravel is used)	Field		One test per 100 cum of aggregate
7) Bitumen Macadam	16.32 & 16.47 of CPWD specifications 2019 volume-2	(i) Quality of binder	Field	IS 73	Same as mentioned under Serial No. 5
		(ii) Aggregate Impact Value/ Los Angeles Abrasion Value	Laboratory	IS 2386 (Part 4)	Same as mentioned under Serial No. 6
		(iii) Combined Flakiness Index and Elongation Indices	Laboratory	IS 2386 (Part 1)	One test per 350 cum for each source
		(iv) Stripping value of aggregates	Laboratory	IS 6241	Same as mentioned under Serial No. 6
		(v) Water absorption of aggregates	Field or Laboratory	IS 2386 (Part 3)	Same as mentioned under Serial No. 6
		(vi) Deleterious material	Field	IS:2386 (Part 2)	Once in the month
		(vii) Grading of aggregates	Field	IS 2386 (Part 1)	Same as mentioned under Serial No. 6
		(viii) Soundness test (Magnesium and Sodium Sulphate)	Laboratory	IS:2386 (Part 5)	Same as mentioned under Serial No. 6
		(ix) Binder content	Laboratory		Two test per day per plant
		(x) Control of temperature of binder and aggregate for mix and of the mix at the time of laying and rolling	Field		Same as mentioned under Serial No. 6

		(xi) Density of Comp layer	Laboratory	IS 2386 (Part 3)	One test per 700 sqm area
8) Dense Bituminous Macadam / Bituminous Concrete		(i) Quality of binder	Laboratory	IS:73	Number of samples per lot and tests as per IS:73 or IRC:SP:53, IS:15462
		(ii) Aggregate Impact Value / Los Angeles Abrasion Value	Laboratory	IS:2386 (Part 4)	One test per 350 cum of aggregate for each sour and whenever there is change in the quality of aggregate
		(iii) Flakiness and Elongation Indices	Laboratory	IS:2386 (Part 1)	One test per 350 cum of aggregate for each source and whenever there is change in the quality of aggregate
		(iv) Soundness test (Sodium or Magnesium Sulphate test)	Laboratory	IS:2386 (Part 5)	One test for each source and whenever there is change in the quality of aggregate
		(v) Water absorption of aggregates	Laboratory	IS:2386 (Part 3)	One test for each source and whenever there is change in the quality of aggregate
		(vi) Plasticity Index	Laboratory	IS:2386 (Part 5)	One test for each source and whenever there is change in the quality of aggregate
		(vii) Mix grading	Laboratory		One set for individual constituent and mixed aggregate from dryer for each 400 tons of mix subject to minimum of two tests per day per plant
		(viii) Stability and voids analysis of mix including theoretical maximum specific of loose mix	Laboratory		Three tests for stability, flow value, density and void contents for each 400 tons of mix subject to minimum of two tests per day per plant.

		(ix) Moisture Susceptibility of mix (AASHTO T283)	Laboratory		One test for each mix type whenever there is change in the quality or source of coarse of fine aggregate
		(x) Temperature of binder in boiler, aggregate in dryer and mix at the time of laying and compaction	Field		At regular intervals
		(xii) Binder content	Laboratory		One set for each 400 tons of mix subject to minimum of two tests per day per plant
10) Mastic asphalt		(i) Quality of binder	Laboratory		Same as mentioned under serial No. 8
		(ii) Aggregate Impact Value or Los Angeles Abrasion Value	Laboratory	IS:2386 (Part 4)	Same as mentioned under serial No. 8
		(iii) Combined Flakiness and Elongation Indices	Field	IS:2386 (Part 1)	Same as mentioned under serial No. 8
		(iv) Stripping value	Laboratory	IS:6241	Same as mentioned under serial No. 6
		(v) Deleterious material	Field	IS:2386 (Part 2)	One in a month
		(vi) Grading of aggregates	Field	IS:2386 (Part 1)	Two tests per day per plant on the individual constituent and mixed aggregates from the dryer
		(vii) Water absorption of aggregates	Laboratory	IS:2386 (Part 3)	Same as mentioned under serial No. 8
		(viii) Soundness test (Magnesium Sulphate / Sodium Sulphate)	Laboratory	IS:2386 (Part 5)	Same as mentioned under serial No. 8
		(ix) Binder content	Laboratory		Two test per day per plant

		(x) Control of temperature of binder and aggregate for mixing and of the mix at the time of laying and rolling	Field		At regular close intervals
		(xi) Rate of Spread of Mixed Material	Field		Regular control through check of layer thickness
		(xii) Hardness number	Laboratory		Minimum two tests per day
11) Recycled Material		Grading of aggregate	Field	IS:2386 (Part 1)	Two tests per day
12) Cold Mixes			Laboratory		All tests as per S. No. 8
13) Quality of Modified Binder			Laboratory		Number of samples per lot and tests as per IS:15462
14) Geo textiles			Laboratory		The requirements of Section 700 of MORTH Specification shall apply
15) Granular Sub Base (GSB)		(i) Gradation	Field	IS:2386 (Part 1)	One test per 400 cum.
		(ii) Atterberg limits	Laboratory	IS:2720 (Part 5)	One test per 400 cum.
		(iii) Water absorption	Laboratory		One test per 400 cum.
		(iv) Density of compacted layer	Laboratory		One test per 1000 cum.
		(v) Deleterious constituents	Field	IS:2386 (Part 2)	As required
		(vi) Soundness test	Field	IS:2386 (Part 5)	Same as mentioned under serial No. 8
		(vii) CBR	Laboratory		As required
16) Lime / Cement Stabilised Soil Sub-base		(i) Quality of lime / Cement	Laboratory		One test for each consignment subject to a minimum of one test per 5 tons

		(ii) Lime / Cement content	Laboratory		Regularly, through procedural checks
		(iii) Degree of pulverization	Laboratory		Periodically as considered necessary
		(iv) CBR or Unconfined Compressive Strength Test on a set of 3 specimens	Laboratory		As required
		(v) Moisture content prior to compaction	Laboratory		One set of two tests per 500 sqm.
		(vi) Density of compacted layer	Laboratory		One set of two tests per 500 sqm.
		(vii) Deleterious constituents	Field		As required
17) Water Bound Macadam		(i) Aggregate Impact Value	Laboratory	IS:2386 (Part 4)	One tests per 1000 cum of aggregate
		(ii) Grading of aggregate	Field	IS:2386 (Part 1)	One test per 250 cum
		(iii) Combined Flakiness and Elongation Indices	Laboratory	IS:2386 (Part 1)	One tests per 500 cum of aggregate
		(iv) Atterberg limits of binding material	Laboratory	IS:2386 (Part 4)	One test per 50 cum of binding material
		(v) Atterberg limits of screenings	Laboratory	IS:2720 (Part 5)	One tests per 100 cum of aggregate
		(vi) Water absorption of aggregate	Laboratory	IS:2386 (Part 3)	Once in a month
		(vii) Deleterious material	Field	IS:2386 (Part 2)	As required, once in a month
18) Wet Mix Macadam		(i) Aggregate Impact Value or Los Angeles Abrasion value	Laboratory	IS:2386 (Part 4)	One tests per 1000 cum of aggregate
		(ii) Grading of aggregate	Field	IS:2386 (Part 1)	One tests per 200 cum of aggregate

		(iii) Combined Flakiness and Elongation Indices	Laboratory	IS:2386 (Part 1)	One tests per 500 cum of aggregate
		(iv) Atterberg limits of portion of aggregate passing 425 micron sieve	Laboratory	IS:2720 (Part 5)	One tests per 200 cum of aggregate
		(v) Density of compacted layer	Field		One set of three tests per 1000 sq.m.
		(vi) Water absorption of aggregate	Laboratory	IS:2386 (Part 3)	Once in a month
		(vii) Deleterious material	Field	IS:2386 (Part 2)	As required, once in a month
19) Cement concrete pavement under controlled conditions	16.37.19 of CPWD specifications 2019 volume-2	Coarse aggregate 1. Flakiness Index	Laboratory	IS 2386 (Part 1)	Before approval of the quarry and every sub- sequent change in the source of supply and one test per 100 cum.
		2. Impact Value	-do-	IS 2386 (Part 4)	-do-
		3. Loss Angles abrasion Value	-do-	-do-	-do-
		4. Deleterious material	-do-	IS 2386 (Part 2)	Before approval of the quarry and at every subsequent Change in the source of supply
		5. Moisture content	-do-	IS 2386 (Part 3)	Regularly as required subject to a minimum of one test per day
		Fine Aggregate			
		1. Silt content	Field	As per CPWD specification Vol. I.	One test per 15 cum.
		2. Gradation of sand	-do-	IS 2386 (Part 2)	-do-
		3. Deleterious material	-do-	IS 2386 (Part 2)	Before approval of the quarry and at every subsequent change in the source

					of supply
		4. Moisture content	-do-	IS 2386 (Part 3)	Regularly as required subject to a minimum of two tests per day
		5. Mix Aggregate	Field	IS 2386 (Part 1)	One test per 15 cum of concrete
		6. Flextural strength	Laboratory	IS 526	One test consisting of 8 specimen for 30 cum. of concrete

LIST OF BUREAU OF INDIAN STANDARDS CODES AND IRC STANDARDS

S. No.	BIS. No.	Subject
1.	IS 73	Specification for paving bitumen
2.	IS 164	Ready mixed paint for road marking
3.	IS 217	Specification for cut back bitumen
4.	IS 8112	Specification for 43 grade ordinary Portland Cement
5.	IS 278	Specification for galvanized steel barbed wire for fencing
6.	IS 334	Glossary of terms relating to bitumen and tar
7.	IS 383	Specification for coarse and fine aggregate from natural sources for concrete
8.	IS 460	Specification for test sieves
9.	IS 516	Method of test for strength of concrete
10.	IS 702	Specification for industrial bitumen
11.	IS 712	Specification for building limes
12.	IS 1195	Specification for bitumen mastic for flooring
13.	IS 1199	Methods of sampling and analysis of concrete
14.	IS 1203	Method of testing tar and bituminous material, determination of penetration
15.	IS 1205	Method of testing tar and bituminous material determination of softening paint
16.	IS 1208	Method of testing tar and bituminous material determination of ductility
17.	IS 1212	Method of testing tar and bituminous material determination of loss of heating
18.	IS 1216	Method of testing tar and bituminous material determination of solubility in carbon-di-sulphide, trichloroethylene
19.	IS 1834	Specification for hot applied sealing compound for joint in concrete

20.	IS 1838 (Pt. 1)	Specification for performed fillers for expansion joint in concrete pavements and structures (non extruding and resilient type/ bitumen impregnated fibre)
21.	IS 2386 (Pt. 1)	Method of test for aggregate for concrete particle size and shape
22.	IS 2386 (Pt. 2) 1963	Method of test for aggregate for concrete estimation of deleterious materials and organic impurities
23.	IS 2386 (Pt. 3)	Method of test for aggregate for concrete specific gravity, density, voids, absorption and bulking
24.	IS 2386 (Pt. 4)	Method of test for aggregate for concrete mechanical properties

25.	IS 2720 (Pt.V)	Method of test for soil: Determination of liquid and plastic limit.
26.	IS 2720 (Pt. VII)	Methods of test for soils: part VII determination of water content dry density relation using light compaction
27.	IS 2720 (Pt. XXVIII)	Method of test for soil: determination of dry density of soils in place, by sand replacement method
28.	IS 3812	Specification for fly ash for use as pozzolana and admixture
29.	IS 5317	Specification for bitumen mastic for bridges decking and roads
30.	IS 5640	Method of test for determining aggregate impact value of soft coarse aggregates
31.	IS 6241	Method of test for determination of stripping value of road aggregates

IRC STANDARDS:

1.	IRC 10	Recommended practice for borrow pits for road embankments constructed by manual operation
2.	IRC 29	Specification for bituminous concrete for road pavements
3.	IRC 36	Recommended practice for construction of earth embankments for road works
4.	IRC 60	Tentative guidelines for the use of lime flyash concrete as pavement base of sub base
5.	IRC 88	Recommended practice for lime flyash stabilized soil base/ sub base in pavement construction
6.	IRC 107	Tentative specification for bitumen mastic wearing courses

CEMENT CONCRETE PAVEMENT (UNDER ORDINARY CONDITIONS)

Specifications of item 16.37 of CPWD specifications 2019 volume-2 to be followed except that cement concrete of grade 1:2:4 or specified otherwise to be prepared and compacted.

CEMENT CONCRETE PAVEMENT UNDER CONTROLLED CONDITIONS

Materials

Cement
Cement used on work shall be as per sub head cement concrete of CPWD specifications- 2019 (Vol. – I).

Water : Water used on work shall conform to SH: cement concrete of CPWD, Specification 2019- Vol. I.

Coarse Aggregate : These shall be crushed or broken from hard stones obtained from approved quarry. These shall be clean strong, durable of fairly cubical shape and free from soft, friable, thin elongated and laminated disintegrated pieces. These shall also be free from dirt, organic deleterious and any other foreign matter and adherent coatings and shall satisfy the physical requirements laid down in para 16.37.19 of CPWD specifications 2019 volume-2 under quality control.

Fine Aggregate : This shall be coarse sand conforming to CPWD Specification 2019 Vol. I.

Grading of Mixed Aggregates : The grading of all aggregates (coarse and fine aggregates) to be used in the work shall be determined in the laboratory. The coarse and fine aggregates shall be mixed in suitable proportions so that the grading of the mixed aggregates shall be in the range indicated in Table 16.32 of CPWD specifications 2019 volume-2.

TABLE

I.S. Sieve Size (IS 460)	% age passing by weight
45 mm	100
22.4 mm	55 - 60
11.2 mm	45 - 50
5.6 mm	35 - 40
2.8 mm	30 - 35
1.4 mm	20 - 25
710 microns	15 - 20
355 microns	10 - 14
180 microns	2 - 5

Mix Design

The mix shall be approved by Engineer-in- Charge so as to obtain the following mean strength that exceeds the minimum specified flexural strength by 1.64 times the designed standard deviation.
Minimum works beam

flexural strength at 28 days	=	300 kg/sqm. for M-30 or specified in item
Designed standard deviation	=	60 kg/sqm. for M-30 or for specified grade(s)
Design flexural strength at 28 days	=	300+60x1.64
Water cement ratio by weight	=	398.4 kg/sqm. (f + 1.64 s) says 400 kg.
Water cement ratio by weight Minimum slump not more than 25 mm	=	0.5

For the purpose of tendering the contractor shall base his rate on the assumption that the quantity of cement used for one cum. of finished concrete shall be as per approved mixed design of M-30 grade.

Statistical Field Check

Samples of concrete shall be taken at the mixer and works beams, made, cured and tested in accordance with IS 1199 and IS 516.

When a mix is used for the first time, it is important to get a large number of results, as soon as possible, in order to establish the level of control and then suitability of the mix proportions. A sample of concrete shall be taken at random on eight separate occasions during each of the first five days of using that mix. From each sample two beams shall be made one for test at 7 days and the other for test at 28 days.

The work beam results shall be examined both individually and in consecutive (but not overlapping) sets of four, for which the average and the range of each set is calculated. The mix proportions shall be modified to increase the strength, if in the first ten consecutive (but not overlapping) sets any of the following conditions are not satisfied.
Each sample has a test strength not less than the minimum specified strength i.e. 30 kg/sq. cm. (or otherwise specified in item).
OR
(a) Not more than two individual results (Not more than one of first twenty) of the 40 beams tests shall fall below the minimum work beam strength but they shall not be less than 80% of the specified beam strength of 30 kg./sq. cm (or otherwise specified in item) or the minimum specified strength minus 1.35 times the standard deviation whichever is greater.

No value of the range in any set shall exceed 3 times the designed standard deviation.

The average for all samples (10 sets) shall not be less than the minimum specified strength i.e. 30 kg/sq. cm (or otherwise specified in item) plus 1.64 times the designed standard deviation 60 kg./sq.cm M-30.

If either of these conditions (16.37.3.3 I or 16.37.3.3 II) are not satisfied, the mix shall be modified and the procedure described above shall be repeated till results satisfying the above criterias are obtained.

Subsequently samples shall be taken at the rate of one for every 30 cubic metre of concrete laid. Eight beam specimen shall constitute one sample. A set of 4 specimen shall be tested after 7 days and another set of 4 specimen shall be tested after 28 days. These test results shall be checked individually and in sets of four as the work progresses. If at any stage it is found that either of conditions 16.43.4.3,I or 16.4.3,II are not satisfied, the overall average and the standard deviation of the previous consecutive 40 beam test results including the non-complying set shall be calculated.

If the overall average strength minus 1.64 times the standard deviation is more than the specified beam strength (30 kgm/sq.cm) (or otherwise specified in item) the concrete shall be accepted. But if it is less than the concrete work corresponding to these 40 beams tests shall be rejected and the mix proportion shall be modified forth with for further work. The rejected work shall be replaced by the contractor immediately at his own cost and expense.

The statistical field checks described in 16.37.3.1 to 16.37.3.2 are meant to control the quality of concrete. The standard of acceptance of concrete shall be governed by the provision of para 16.37.3.3 to 16.37.3.5.

Slump Test

The test shall be carried out as per IS 1199. A slump test shall be carried out at each mixer at least one in fifty batches mixed or more frequently if directed by the Engineer- in-Charge. Any batch from which slump test is being made shall not be transferred to the place of laying till the slump test has been completed. Not

only the batch which gives a slumps in excess of that specified shall be rejected but the concrete already laid immediately preceding the batch tested upto the nearest last transverse joint may be rejected by the SBI/ PMC / Engineer in charge or his subordinate, if he is satisfied that such preceding batches were substandard in this respect. The decision of the SBI/ PMC / Engineer in charge in this respect shall be final and binding on the contractor. Such rejected concrete shall be removed by the contractor immediately and replaced with proper slump concrete at his cost and expense.

Steel Forms

All side forms shall be of mild steel. The steel forms shall be of M.S. Channel sections and their depth shall be equal to the thickness of the pavement.

The side forms shall have a length of at least 3.0 metres except on curves of less than 4.5 metres radius where shorter lengths may be used. When set to grade and stacked in place the maximum deviation of the top surface of any section from a straight line shall not exceed 3 mm. The method of connection between sections shall be such that the joint formed shall be free from play or movement in any direction. The use of bent, twisted or worn out forms shall not be permitted. At least three stake pockets for bracing pins or stakes shall be provided for each 3.0 M length of forms. Bracing and supports must be ample to prevent the springing of forms under pressure of concrete or weight or thrust of the machinery (like screed vibrator) operating on the forms. Support to the forms shall be sufficiently rigid to hold them in position during the entire operation of laying and compacting and finishing and that they shall not at any time deviate more than 3 mm from straight edge 3 metres in length. Forms which show a variation from the required rigidity of the alignment and levels shown on the plans shall be reset or removed as directed. The length and number or pins or stakes shall be such as to maintain the forms at the correct line and grade.

The supply of forms shall be sufficient to permit their remaining in place for at least 12 hrs. after the concrete has been placed or longer, if in the opinion of the SBI/ PMC / Engineer in charge, it is necessary.

The top line of the forms is not to vary from the correct level or alignment and the levels and alignment of the forms are to be checked and corrected as necessary immediately prior to the placing of concrete. The top edges and faces of the forms are to be carefully cleaned and maintained in clean condition.

While removing the steel forms, care shall be taken to withdraw them gradually, any damage to the bull nosed edges shall be made good while the concrete is still green.

Setting of Forms

Setting of forms shall be according to the slab plan subject to the approval of Engineer-in- Charge and concreting shall not commence until the setting of forms is approved.
Forms shall be set for at least 50 metres in advance of the point where the concrete is being laid and shall not be removed until at least 12 hrs. of placing of the concrete or longer if in the opinion of SBI/ PMC / Engineer in charge is necessary.
After setting, the working faces shall be thoroughly oiled by using approved oil before concrete is placed against them.

The pavement joints of overlay layer would overlap with the joints of underlay cement concrete.

Batching and Mixing

As detailed in SH: 5 of reinforced cement concrete work of CPWD specifications 2019.

Placing of Concrete

As detailed in SH: 5 of reinforced cement concrete work of CPWD specifications 2019.

Compaction of Concrete

Compaction shall be carried out by electrically (or) diesel operated needle and screed vibrators as stipulated hereafter. Needle vibrator should be used all over the area for obtaining initial compaction of concrete. These should be of diameter not less than 4.5 cm. If the vibrator are pneumatic the pressure must not be below 4 kg/sq.cm. If electrically operated, they should have a minimum frequency of 3500 impulses per minute.

There should be at least three needle vibrators working in any bay. A vibrating screed consisting of a steel or timber section weighing not less than 15 kg. per metre with a tamping edge of not less than 7 cm width and having a vibrator mounted thereon shall follow needle vibrators to obtain full compaction. The face of the wooden tamping edge of the screed shall be lined with M.S. Plate rigidly fixed by means of counter sunk screw. Where screed vibrators are used for compaction, a standby unit shall always be maintained ready for use, should the other one go out of order. Where electrically driven vibrators are employed, a standby diesel pneumatic unit shall be kept ready for use in case of power failure. At the discretion of the SBI/ PMC / Engineer in charge, for compaction at edges and joints, vibrators may be supplemented by hand tamping and rodding for securing satisfactory results. Under no circumstances, honey combing of concrete at joints or elsewhere shall be permitted.

When using screed vibrator for compaction it should not be dragged over the concrete. During the initial passes it shall be lifted to the adjacent forward position in short steps, subsequently, it shall be slowly slided over the surface with its axis slightly tilted away from the direction of sliding and the operation repeated until a close, dense surface is obtained.

Concreting shall be carried out in one operation between the expansion joints and construction joints without any break at the dummy joints.

Concrete shall be deposited on the base as near the joints as possible without touching them. It shall then be shoveled against the sides, maintaining equal pressure and deposited approx. 50 mm higher than the depth of the joints, care being taken that it is worked well around the joints. The concrete shall not be dumped from the bucket directly upon or against the joints.

Workmen shall not be allowed to walk on freshly laid concrete and proper cat walk shall be provided with independent supports beyond concreting bays.

Finishing of Concrete

During compaction, any low or high spots shall be made up by adding or removing concrete. After longitudinal floating has been completed but while concrete is still plastic, the slab surface shall be tested for trueness with a 3 m straight edge. Any depressions or high spots showing departure from the true surface shall be immediately rectified. High spots shall be cut down and refinished. Depressions shall be enlarged to about 8-10 cm and filled up with fresh concrete, compacted and finished.

The straight edge testing the refloating is to continue until the entire surface:
is free from observable departure from the straight edge,
conforms to the required levels and across section, and
shall conform to the specified surface when the concrete has hardened.

The foregoing work is to be carried out while the concrete is still plastic and workable.

Belting

Just before concrete becomes non-plastic, the surface shall be belted with a two ply canvas belt not less than 20 cm wide and at least 1 metre longer than the width of the slab. Hand belts shall have suitable handles to permit controlled uniform manipulation. The belt shall be operated with short strokes transversed to the centre line of the pavement and with rapid advance parallel to the centre line.

Brooming

After belting and as soon as the surplus water, if any, has risen to the surface, the pavement shall be given a broom finish with an approved steel or fiber broom not less than 45 cm wide. The broom shall be pulled gently over the surface of the pavement from edge to edge. Adjacent strokes shall be slightly overlapped. Brooming shall be perpendicular to the centre line of the pavement and so executed that the corrugations formed shall be uniform in character and width and not more than 1.5 mm deep.
Brooming shall be completed before the concrete reaches such a stage that the surface is likely to be torn or unduly roughened by the operation. The broomed surface shall be free from porous or rough spots, irregularities, depressions, and small pockets such as may be caused by accidental disturbing of particles of coarse aggregates embodied near the surface. The brooming shall be of uniform pattern all through.

16. 37.11.3 Edging : After belting/brooming has been completed but before the initial setting of concrete, the edges of the slab shall be carefully finished with an edger of 6 mm radius, and the pavement edges shall be left smooth and true to line.

Honey Combing

The side forms shall not be removed until 12 hours or such longer period as the Engineer- in-Charge may decide after the laying of concrete.

As soon as the side forms are removed, any minor honey combed area shall be filled with mortar composed of one part of cement and two parts of fine aggregate. Major honey combing areas or segregated concrete or other defective work or areas damaged by removal of the forms or concrete damaged by rain or due to any other reason whatsoever shall be considered as defective work and shall be removed and replaced by the contractor at his own expense. The total area of honey combed surface shall not exceed 4 per cent of the area of the slab side. However, no individual honeycomb patch shall exceed 0.1 sqm. SBI/ PMC / Engineer in charge's decision as to whether the concrete is defective or not shall be final and binding.

Surface Accuracy

16. 37.13.1 After the concrete has sufficiently hardened after about 12 hours and not later than 24 hours, the surface shall be tested again for high spots. All high spots shall be marked and those exceeding 3 mm shall be ground down immediately. Care shall be taken to see that the grinding does not in any way damage the concrete surface.

The final surface finish is to be such that when tested with a profilograh/roughness indicator/or a 3 metre long straight edge or an equivalent mechanical unevenness indicator placed anywhere within the same or adjoining slab in any direction on the surface, there shall be no variation greater than 3 mm.

If the surface irregularity exceeding 3 mm still remains despite grinding as per para 16.37.13.2 the concrete shall be removed to its full depth. The area of concrete to be removed shall be complete slab between the nearest joints, where the defective slab is less than 4.5 metres from the expansion joint, the whole area upto the expansion joint shall be removed to the full depth. The concrete so

removed shall not be reused in the work. Fresh concrete shall be laid in the manner already de-scribed in above paras and shall again be subject to test for surface accuracy and other quality control measures. Nothing extra shall be paid on this account.

Every slab shall bear an impression not exceeding 3 mm in depth comprising the number allotted to the slab and the date on which it is laid. This impression shall be formed by the contractor when the concrete is green so as to leave permanent mark on setting.

Initial Curing

Immediately after completion of the finishing operations, the surface of the pavement shall be entirely covered with wetted burlap, cotton or jute mats. The mats used shall be of such length (or width) that as laid they shall extend at least 45 cm beyond the edges of the slab. The mats shall be placed so that the entire surface and both edges of the slab are completely covered. This covering shall be placed as soon as, in the judgment of the Engineer- in-Charge the concrete has set sufficiently to prevent damage to the surface prior to being placed, the mats shall be thoroughly saturated with water and shall be placed with the wettest side down. The mats shall be so placed and weighed down as to cause them to remain in intimate contact with the surface covered, and the covering shall be maintained full wetted and in position for 24 hours after the concrete has been placed or until the concrete is sufficiently hard to be walked on without suffering damage. Water shall be gently sprayed so as to avoid damage to the fresh concrete. If it becomes necessary to remove a mat for any reason, the concrete slab shall not be exposed for a period of more than half an hour.

Worn burlap or burlap with holes shall not be permitted. Burlap reclaimed from previous use other than curing concrete shall be thoroughly washed prior to use for curing purposes. If burlap is obtained in strips, shall be laid to overlap by at least 150 mm.

Burlap shall be placed from suitable bridges. Walking on freshly laid concrete to facilitate placing burlap shall not be permitted.

Final Curing

Upon the removal of the burlaps, the slab shall be thoroughly wetted and then cured as follows:-

All joints shall be filled with filler in order to prevent the edges of joints from getting damaged and entry of clay materials into the joints during final curing. Exposed edges of the slab shall be banked with a substantial berm of earth. Upon the slab shall then be laid a system of transverse and longitudinal dykes of clay about 50 mm high immediately covered with a blanket of sandy soil free from stones to prevent the drying up and cracking of clay. The rest of slab shall then be covered with sufficient sandy soil so as to produce a blanket of earth not less than 40 mm deep after wetting. The earth covering shall be thoroughly wetted while it is being placed on the surface and against the sides of the slab and kept thoroughly saturated with water for 21 days and thoroughly wetted down during the morning of the 22nd day and shall thereafter remain in place until the concrete has attained the required strength and permission is given by the SBI/ PMC / Engineer in charge. Thereafter the covering shall be removed and the pavement cleaned and swept. If the earth covering becomes displaced during the curing period, it shall be replaced to the original depth and resaturated.

Contractor shall appoint chowkidars at his expense to prevent workmen, cattle, etc., straying on the pavement concrete.

Concrete shall not be subjected to any load or weight of any plant until at least 28 days after laying.

16.37.16 Construction Joints
16.37.16.1 Construction joints shall be provided as shown in the drawing and also at places where concreting is stopped due to unforeseen circumstances. The joints shall be straight and vertical through the full thickness of the slab. While concrete in adjacent bay is still green, flats of suitable size shall be drawn along the edge and a groove of size 4 mm × 40 mm deep shall be neatly formed and finished. The edges of the groove shall be full nosed. After curing of concrete is complete, this groove shall be thoroughly cleaned of all sand dust and shall be perfectly dried and filled with poly sulphide/bitumastic sealant in the joints. Before filling with sealing compound the faces of concrete of the joint shall be coated with primer of approved brand to a depth of 25 mm at the rate of 2.6 liters per 10 square meters. Bitumen emulsion shall not be used as primer.

Dummy Joints
The joints shall be 10 mm wide and shall extend vertically from the surface of the slab to a depth equal to 1/3rd of the thickness of the slab but not less than 4 cm in any case. The joint may be formed by depressing into the soft but compacted concrete a high tensile M.S. or other approved Tee of flat bar of depth not less than required depth of the joint plus 25 mm. The bar used for forming the groove shall be coated with soft soap or other suitable lubricant to facilitate its removal when the steel Tee or flat is removed joints shall be neatly formed with proper tools and mortar/fine material from the slab itself. No additional cement mortar (rich or otherwise) shall be used.

Cutting or sawing by a saw mounted on a movable frame and driven mechanically shall also be permitted as a method for making the joint. In this case the width may be reduced to 6 mm. any other method for making joints can be followed with the prior approval of the SBI/ PMC / Engineer in charge.

In all cases, except where cutting is done with saw, the joint edges shall be bullnosed. Care should be taken to see that the edges of the grooves are not damaged.

The grooves shall be filled with hot poured sealing compound conforming to Grade B of IS:1834. Prior to filling with sealing compound, the joints shall be cleaned by compressed air and primed with Shalijet primer or equivalent at the rate specified in Para 16.37.16.1

All joints shall be sealed as soon as practicable after 28 days of casting of cc pavement. Joints shall be sealed flush with the adjacent pavement surface in summer and 3-4 mm below finished concrete surface in winter. The pavement shall be opened to traffic only after joint sealing over the entire pavement. To prevent tackiness or pickup under traffic, the exposed surfaces of the sealing compound shall be dusted with hydrated lime, if directed by SBI/ PMC / Engineer in charge, for which nothing extra shall be paid to the contractor.

In case of sudden rain or storm, the work can be concluded at the dummy joints but these will then be formed as construction joints.

Before sealing of joints, it may be ensured that the groove extends fully across the bay between consecutive longitudinal joints, in the case of transverse joints and is continuous in the case of longitudinal joints. Any concrete or other foreign matter must be removed from the groove.
Providing and Laying Cement Concrete (NP-3) Pipes 250 mm Dia at,across the Cement Concrete Road at Start , Intermediate & End part of Each Road Segment and if Length of Road Exceed 30 m than additional 1 intermediate Pipe at equidistance Including Brick Chamber at both Ends of Pipe as per requirement & Design approved by SBI/ PMC / Engineer in charge.
Note:- The quoted rate is all inclusive for laying the rigid pavement consisting of Compacted sub-grade, Sub base with GSB, Base layer with DLC and Surface layer with vacuum dewatered Cement concrete, CC Pipe,

Chamber etc complete and nothing extra shall be paid.(Details as per Annexure B-1)

Concreting during Rains

To prevent damage to freshly laid concrete during monsoon, or sudden rains, the contractor shall provide an adequate supply of tarpaulins or other water proof covering material. Any concrete damaged by rain shall be removed and replaced by the contractor at his own cost as directed by the SBI/ PMC / Engineer in charge.

Quality Control

The following quality control tests shall be carried out at frequencies specified against each as in Table as below.

TABLE

S.No	Test	Test Method	Frequency	Acceptance Criteria
1	2	3	4	5
(i)	COARSE AGGREGATE			
(a)	Flakiness index	IS 2386 (Pt.1)	Before approval of the quarry and at every subsequent change in the source of supply and one test per 100 cum of aggregates	Not more than 15%
(b)	Impact value	IS 2386 (Pt.4)	-do-	Not more than 30%
(c)	Los angles abrasion value	IS 2386 (Pt.4)	-do-	Not more than 40%
(d)	Deleterious materials.	IS 2386 (Pt.2)	Before approval of the quarry and at every subsequent change in the source of supply	As per table 1 of IS 383
(e)	Moisture content.	IS 2386 (Pt.3)	Regularly as required subject to a min. one test per day	-do-
(ii)	FINE AGGREGATES			
(a)	Silt content.	CPWD specifications 2019, Vol. I, SH: CC	One test per 15 cum	Not more than 8%
(b)	Gradation of sand	IS 2386 (Pt.1)	-do-	Fineness modulus
(c)	Deleteri us materials.	IS 2386 (Pt.2)	Before approval of the quarry and at every subsequent change in the source of supply	As per table 1 of IS 383
(d)	Moisture content.	IS 2386 (Pt.3)	Regularly as required subject to a min. 2 test/day	-do-

(iii)	MIXED AGGREGATES			
(a)	Grading	IS 2386 (Pt. 1)	1 test per 15 cum	As per para 16.37.1.5
(iv)	Slump test of concrete	IS 1199	At least once in 50 batches at each mixer or more frequently if directed by the SBI/ PMC / Engineer in charge	Not more than 25 mm
(v)	Flexural strength	IS 516	One test of sample consisting of eight specimen for every 30 cum of concrete	As per para 16.37.3.5.
(vi)	Surface accuracy	As prescribed	Regularly	As per para 16.37.13

Equipments

Equipments as per list at Appendix C shall be provided by the contractor in the field testing laboratory. Nothing extra shall be paid to him on this account. Records as required shall be maintained at site. All tests details in support of mix design shall be maintained as part of records of the contract and shall be signed both by the contractor and the SBI/ PMC / Engineer in charge. The contractor shall provide all labour, materials and equipment required for all tests to be carried out at his own cost.

The SBI/ PMC / Engineer in charge reserves the right to test any part of concrete laid regarding quality soundness, compactness, thickness, strength and finish of the concrete, at any time before the expiry of the "Defect liability period" not withstanding that necessary tests had been carried out and found satisfactory at the time of execution.

All defective unsound sub-standard work and concrete of sub-standard strength and quality etc. as established vide paras 16.37.3 shall be rejected and shall be replaced by the contractor at his own expense in the manner as detailed in para 16.37.3. Where due to operational or any other reason such replacement does not become possible (decision of SBI/ PMC / Engineer in charge in this respect being final and binding on the contractor), the cost of removal and replacement of such rejected work shall be recovered from the contractor whether such rejected work is subsequently replaced by the Government or not.

Defects Liability Period

This period shall be reckoned in the case of this work as one year from the date of completion of work and it shall be the liability of the contractor to repair, strengthen or reconstruct any portion of the work which has shown damage or any defect, arising out of any bad workmanship or defective material used in the work during this period. In the case of this rectification not being commenced by the contractor within 7 days from the date of notice from the SBI/ PMC / Engineer in charge and completed expeditiously the SBI/ PMC / Engineer in charge reserves the right to get the repair work executed at the risk and cost of the contractor.

The dimensions of each slab of pavement shall be measured as follows to the nearest 5 mm.
Length
Between the end of a pavement to the centre line of the expansion joints.

Between the centre lines of consecutive expansion joints.
Width
Between the edge of a pavement and the centre line of the construction joints.
Between the centre lines of construction joints and expansion joints.
Between the centre lines of consecutive construction joints.

Note : The quantity of concrete in the pavement slab shall be worked out by multiplying the area of the slab and its average thickness or specified thickness whichever is less. No deduction shall be made for any joints in the concrete slab.

Measurements of concrete slabs shall be recorded jointly by the SBI/ PMC / Engineer in charge or his authorised subordinate and the contractor or his authorised agent.

HARD CRETE

Hard crete of approved quality and brand to be used. It shall be mixed in ratio and method as recommended by manufacturer and approved by SBI/ PMC / Engineer in charge in cement concrete for laying in paramount. Quantity shall be measured in litre used in cement concrete. Hardcrete to be brought in sealed container and proper record of quantity be maintained. Empty containers of hardcrete shall not be removed from site with but prior permission of SBI/ PMC / Engineer in charge.

EXPANSION JOINT

Materials
Premoulded Joint Filler in Expansion Joint : It shall conform to IS 1838 (Pt. I). The thickness shall be as site requirement with tolerance 1.5 mm. and shall be of the maximum available standard length not less than one lane width. The filler board shall be positioned vertically with the prefabricated joint assemblies along the line of the joint within tolerance of + 10 mm from the intended line of the joint. The depth of board shall be 25 mm less than thickness of slab within a tolerance of ± 3mm so that the top of the board shall be below the surface or will not impead the passage of the finishing straight edge or oscillating beam of the paving machine.

Bitumine Hot Sealing Compound : The joint sealing compound shall be fuel and heat resistant type complying to grade B of IS 1834. It shall be capable of adhering to the concrete without cracking, spalling and disintegration.

CONSTRUCTION PROCEDURE

Expansion joints shall be provided as shown in the drawing and as per directions of Engineer- in-Charge. All joints shall be constructed true to line with their faces perpendicular to the surface of the pavement. The joint shall be 20 mm wide. The depth of the non-extruding filler pad shall be 25 mm less than the depth of the concrete slab.

Before the provision of expansion joint, the face of the already laid concrete slab shall be painted with primer at the rate of 2.6 liters per 10 square metres. The expansion pad shall be properly cut to shape and shall then be placed in position abutting the painted face of the already laid concrete slab. The adjacent slab shall then be concreted. The face of the pad against which the new concrete slab is to be laid shall also be painted with primer before laying the concrete, while concreting a neat groove of size 20 mm x 25 mm as per drawing shall be formed on top of the pad taking care that the edges are absolutely straight and that the groove so made does not get filled with any material like concrete, mortar and other rubbish.

Before the curing process is started, the top of expansion joint shall be filled with bitumen sand mixture in order to ensure that no foreign material used in curing enters into the joint. This filling shall be removed before filling the joints with sealing compound.

For sealing the joints following operations shall be carried out :—
The joints are cleared of any foreign matter to the full depth upto the top of expansion pad with steel spatula.
The joints are blown with compressed air.
Cleaning is done with Kerosene oil.
Priming is done with spray gun @ 2.6 liters per 10 sqm of the surface to be primed.
The primer is allowed to dry completely before pouring the sealing compound.
The sealing compound grade 'A' is heated to the required temperature ranging between 155 deg. C to 165 deg. C or to the temperature range specified by the manufacturer. Over heating shall be avoided. Pouring shall be done from vessel with spout in such a manner that the material will not get spilled on the exposed surface of the concrete, any excess filler on the surface of the pavement shall be removed immediately and the pavement surface cleaned.
The filling shall be worked into the joints with hot flats to ensure escape of trapped air.
The filling is then ironed with hot iron. It is recommended that while in summer the joints may be sealed flush with the adjacent pavement surface, in winter the sealing compound may be filled to a depth 3-4 mm below the surface.
The edges of the joints are then cut and trimmed to ensure neat and straight line finish.
To prevent tackiness or pick up under traffic, the exposed surfaces of the sealing compound shall be dusted with hydrated lime, if directed by SBI/ PMC / Engineer in charge (Nothing extra shall be paid for the same).

PAINTING ROAD/ RUNWAYS MARKINGS

Materials
Special Road marking paint of approved brand and manufacture shall be used. The paint shall conform to IS 164. Ready mixed paint as received from the manufacturer shall be used without adding any admixture.

During work, if the consistency of the paint gets thick and thinning becomes necessary it shall be done by use of thinner of the approved brand of paint recommended by the manufacturer and with the approval of the SBI/ PMC / Engineer in charge.

The paint shall be brought to the site of work by the contractor in original sealed containers. The material shall be brought in one lot in adequate quantity to suffice for the entire work. The material shall be kept in the joint custody of the contractor and the SBI/ PMC / Engineer in charge. The empty container shall not be removed from the site of work, till the work has been completed and permission obtained from the SBI/ PMC / Engineer in charge.

Preparation of Surface
The surface shall be thoroughly cleaned and free from dust. All the dirt, scales, oil and grease shall be thoroughly removed before painting is started. The prepared surface shall be inspected and approved by the SBI/ PMC / Engineer in charge before painting is commenced.
Application
Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its original container. The paint shall be continuously stirred in the smaller container while applying to runway surface so that its consistency is kept uniform.

The painting shall be applied evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternatively in opposite direction, two or three times and then finally brushing lightly in a direction at right angle to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.

Each coat shall be allowed to dry out thoroughly before the next coat is applied.

Earlier applied coat shall be cleaned off dust before the next coat is laid.

No left over paint shall be put back into the stock tins. When not in use, the containers shall be kept properly closed.

No hair marks from the brush or clogging of paint puddles shall be left on the work.

The surface shall ordinarily not be painted until it has dried up completely. Trial patches of paint shall be laid at intervals to check if drying is satisfactory.

The runway marking shall be done in accordance with the drawing unless otherwise instructed by the SBI/ PMC / Engineer in charge.

Brushes and Containers
After work, the brushes shall be completely cleaned of paint by rinsing with turpentine. A brush in which paint has dried up is spoiled and shall on no account be reused for painting work. On no account kerosene oil shall be used for washing the brush.

When the paint has been used, the containers shall be washed with turpentine and wiped dry with soft clean cloth so that they are clean, and can be used again.

PAINTING ROAD SURFACE (WITH READY MIXED ROAD MARKING PAINT)
Specifications of item no. 16.41 to be followed except that road surface to be painted with ready mixed road marking paint of approved brand instead of paint of superior make.
RETRO REFLECTIVE SIGN BOARD
General
The colour, configuration, size and location of all the traffic signs for highways other than Express ways shall be in accordance with the code of practice for road signs, IRC:67 or as shown on the drawings. For expressways, the size of the signage, letters and their placement shall be as specified in the contract drawings and relevant specifications or as directed by the SBI/ PMC / Engineer in charge.
Materials

Concrete
Concrete shall be of M-30,35,40 grade as per Structure Drawings.

Reinforcing steel
Reinforcing steel shall confirm to the requirement of IS 1786 unless otherwise specified.

Bolts Nuts and Washers
High strength bolts shall confirm to IS 1367 whereas precision bolts, nuts etc. shall confirm to IS 1364.

Plates and Supports
Plates and support sections for the sign posts shall confirm to IS 226 and IS 2062 or any other stated IS specification.

Substrata
The substrate shall be either aluminium sheeting or aluminium composite material (ACM) confirming to following sub-sections.

Aluminium
Aluminium sheets used for sign boards shall be of smooth, hard and corrosion resistant aluminium alloy confirming to IS 736 material designation 24345 or 1900.

Aluminium composite materials
The Aluminum Composite Material (ACM), used as the substrate for signage application shall have a thickness of at least 4.0mm (excluding coating thickness).
The ACM shall be composed of thermoplastic core of "Low Density Polyethylene' (LDPE) of 3.0mm thickness sandwiched between two thick sheets of aluminium, of 3003 grade and H- 18 temper and minimum thickness of 0.5mm each. The retro reflection sheeting must be applied on the top surface with aluminium surface with recommended surface preparation from sheeting manufactures.
A fluorocarbon coating may be applied over the exposed surface of aluminum to ensure corrosion resistance and weather proof and thus shall confirm to relevant ASTM.
The ACM shall have a high-surface energy coating on the top surface, over which the retro reflective sheeting shall be applied.
When measured after 24 hrs after application, the 90 peel-adhesion strength of the top surface of ACM with the retro reflective sheeting applied on it using a 2kg roller as per ASTM D3330 shall be at least 1.5 kg-f.

The front surface shall have no other coating other than the high-surface energy coating and shall be protected with a self-adhesive peel-off film. The retro refletive sheeting shall be applied only on the top surface with high-surface energy coating.
On the back surface, it shall have a polyester based service coating preferably grey in color to protect against possible corrosion and to avoid undesired glare from the rear side of the sign.
The mechanical properties of 4mm ACM and that of its aluminium skim shall confirm to the requirement given in table below. When tested accordance with the test methods mentioned against each of them.

Specification for Aluminium Composite Material (ACM)

S. No.	Description	Specification for 4mm	
		Standard Test	Acceptable Value/Results
A	Physical Tests for ACM		
1	Over all thickness of ACM	Measurement	4mm (Tolerance + 0.2mm)
2	Aluminium Skin thickness (each side)	Measurement	0.5mm (Tolerance +/- 0.03mm)
	Panel weight (ACM)	Measurement	5.5 Kg/m2 (+ 5%)
B	Mechanical Properties of ACM		
1	Peel off strength with retro reflective sheeting. (Drum Peel Test)	ASTM D903	Min. 4 N/mm
2	Tensile strength	ASTM E638	Min. 40 N/mm2
3	0.2% Proof Stress	ASTM E638	Min. 34 N/mm2
4	Elongation	ASTM E638	Min. 6%
5	Flexural strength	ASTM C393	Min. 130 N/mm2
5	Shear strength with punch shear test	ASSTM D732	Min. 18 N/mm2
C	Properties of Aluminium skin		

1	Tensile strength (Rm)	ASTM E8	Min. 150 N/mm2
2	Modules of elasticity	ASTM E8	Min 70000 N/mm2
3	Elongation	ASTM E8	Min. 2%
4	0.2% proof stress	ASTM E8	Min. 110 N/mm2
D	Properties of High surface energy coating		
1	(90deg) Peel adhesion strength of Retroreflective sheeting on ACM surface with high-surface energy coating	ASTM D330	Min. of 1.5 kgf i.e. Equal to or more than that with surface prepared aluminium

Performance Certificate
Requisite performance certificate from the manufacturer of the ACM stating compliance with ACM technical specification as per above Table shall be submitted by the contractor to the Engineer- in-Charge.

Retro- Reflective Sheeting (Type-XI Prismatic Grade sheeting):
(AS per IRC 67-2012 Clause 6.7)
The retro reflective sheeting used on the signs shall consist of white or coloured sheeting having a smooth outer surface which has the property of retro reflection over its entire surface. It shall be weather resistant and exhibit colour fastness. It shall be new and unused and show no evidence of cracking, scaling, and pitting, blistering, edge lifting or curling and shall have negligible shrinkage or expansion. A certificate of having the sheeting tested for coefficient of retro reflection, daytime colour
and luminance, shrinkage, flexibility, liner removal, adhesion, impact resistance, specular gloss and fungus resistance, 3 years outdoor weathering and its having passed these tests shall be obtained from International / Government Laboratory / Institute by the manufacturer of the sheeting and in case the certificate is obtained from international agency, it should also be obtained from Indian agency within 3 years of launching of product by the manufacture in abroad. Alternatively, a certificate conforming to ASTM Specification (D 4956-09) on artificial accelerated weathering requirements from a reputed laboratory in India can be accepted provisionally. In such a situation, the Employer/ Client, if so desires, could seek for a performance guarantee which would be released after receipt of certificate meeting the requirement of three years outdoor weathering of the sheeting.

Retro-reflective sheeting is typically manufactured as a cube corner. The reflective sheeting shall be retro-reflective sheeting made of micro prismatic retro-reflective material. The retro-reflecting surface after cleaning with soap and water and in dry condition shall have minimum co-efficient of retro reflection (determined in accordance with ASTM D4956-09) confirming to IRC:67 Table 6.9.

When totally wet, the sheeting shall not show less than 90 per cent of the values of retro-reflection. At the end of 10 years the sheeting shall return at least 80 per cent of its original retro-reflectance.

Adhesives : The sheeting shall have a pressure-sensitive adhesive of the aggressive- tack type requiring no heat, solvent or other preparation for adhesion to a smooth clean surface, in a manner recommended by the sheeting manufacturer and approved by SBI/ PMC / Engineer in charge. The adhesive shall be protected by an easily removable liner (removable by peeling without soaking in water or other solvent) and shall be suitable for the type of material of the base plate used for the sign. The Adhesive shall form a durable bond to smooth, corrosion and weather resistant surface of the base plate such that it shall not be possible to remove the sheeting from the sign base in one piece by use of sharp instrument. The sheeting shall be applied in accordance with the manufacturers specifications.

Installation

Surface to be reflectorised shall be effectively prepared to receive the retro- reflective sheeting. The Aluminium / ACP sheeting shall be de-greased either by acid or hot alkaline etching and all scale/dust removed to obtain a smooth plain surface before the application of retro-reflective sheeting. Complete sheet of the material shall be used on the signs except where it is unavoidable. Sheeting with heat-activated adhesives may be spliced with an overlap not less than 5 mm or butted with a gap not exceeding 0.75 mm. The material shall cover the sign surface evenly and shall be free from twists, cracks and folds.

Sign posts, their foundations and sign mountings shall be so constructed as to hold these in a proper and permanent position against the normal storm wind load or displacement by vandalism. Normally, sign with an area upto 0.9 sq.m shall be mounted on a single post and for greater area two or more supports shall be provided. Sign supports shall be as specified in item or as per directions of SBI/ PMC / Engineer in charge. The work of foundation shall conform to relevant specification as specified.

Backside of aluminium sheet portion shall be painted with two coats of epoxy paint. Any part and support frame with two or more coats of synthetic enamel paint.

Performance Certificate
Requisite performance certificate from the manufacturer of the ACM stating compliance with ACM technical specification as per Table 16.44 above shall be submitted by the contractor to the Engineer- in-Charge.

Warranty and Durability
The Contractor shall obtain from the manufacturer a ten year warranty as per IRC:67 for satisfactory performance including stipulated retro-reflectance of the retro-reflective sheeting, the screen printed areas and cut out sheeting and cut out durable transparent overlay film and submit the same to the SBI/ PMC / Engineer in charge.

Processed and applied in accordance with recommended procedures, the reflective material shall be weather resistant and following cleaning, shall show no appreciable discoloration, cracking, blistering or dimensional change and shall not have less than 50 percent of the specified minimum reflective intensity values when subjected to accelerated weathering of 1000 hours, using type E or EH Weather meter (AASHTO Designation M 268).

RETRO REFLECTIVE OVERHEAD SIGNAGE

General
Overhead signs may be used in lieu of, or as an adjunct to, ground signs where the situation so warrants for proper information and guidance of the road user.

The support system should be properly designed based on sound engineering principles, to safety sustain the dead load, live load and wind load on the completed sign system. For this purpose, the overhead signs shall be designed to withstand a wind loading of 150 kg/m2 normal to the face of the sign and 30 kg/m2 transverse to the face of the sign. In addition to the dead load of the structure, walkway loading of 250kg concentrated live load shall also be considered for the design of the overhead sign structure.

Height
Overhead signs shall provide a vertical clearance of not less than 5.5 m over the entire width of the pavement and shoulders except where a lesser vertical clearance is used for the design of other structures. The vertical clearance to overhead sign structures or supports need not to be greater than 300 mm in excess of the minimum design clearance of other structures.

Lateral Clearance

16. 50.2.1 The minimum clearance outside the usable roadway shoulder for expressway sign mounted at the road side or for overhead sign supports either to the right or left side of the roadways shall be 1.80 m. This minimum clearance of 1.80 m shall also apply outside of an unmountable kerb. Where practicable, a sign should not be less than 3 m from the edge of the nearest traffic lane.

16.50.2.2 Where a median is 3.6 m or less in width, consideration should be given to spanning over both roadways without a central support. Where overhead sign supports cannot be placed at a safe distance away from the line of traffic or in an otherwise protected site, they should either be so designed as to minimize the impact forces or protect motorists adequately by a physical barrier or guard rail of suitable design.

Number of Signs at an Overhead Installation
In no case should there be more than three signs displayed at any one location, including regulatory or warning signs, either on the overhead structure or on its support.

Materials for Overhead Sign and Support Structures

Aluminium alloy or galvanized steel to be used as truss design supports shall conform to relevant IS. These shall be of sections and type as per structural design requirements as shown on the plans.

Plates and support sections for sign posts shall conform to IS 226 and IS 2062.

The overhead signs shall be reflectorised with high intensity retro-reflective sheeting of encapsulated lens type.

16.50.5 Size, Locations, etc of Signs
16.50.5.1 The size of the signs, letter and their placement shall be as specified in the Contract drawings and specifications as per direction of SBI/ PMC / Engineer in charge.

Installation
The supporting structure and signs shall be fabricated and erected as per details given in the plans.

Sign posts, their foundations and sign mountings shall be so constructed as to hold sign in a proper and permanent position to adequately resist swaying in the wind or displacement by vandalism.

The work of construction of foundation for sign supports including excavation and backfill, forms, steel reinforcement, concrete and its placement shall conform to the relevant specifications given in this specification.

The structures shall be erected with the specified camber and in such a manner as to prevent excessive stresses, injury and defacement.

Brackets shall be provided for mounting signs of the type to be supported by the structure. For better visibility, they shall be adjustable to permit mounting the sign faces at any angle between a truly vertical position and three degree from vertical. This angle shall be obtained by rotating the front lower edge of the sign forward. All brackets shall be of a length equal to the heights of the signs being supported.

Before erecting support structures, the bottom of each base plate shall be protected with an approved

material which will adequately prevent any harmful reaction between the plate and the concrete.

The end supports shall be plumbed by the use of levelling nuts and the space between the foundation and base plate shall be completely filled with an anti-shrink grout.

Anchor bolts for sign supports shall be set to proper locations and elevation with templates and carefully checked after construction of the sign foundation and before the concrete has set.

All nuts on aluminium trusses, except those used on the flanges, shall be tightened only until they are snug. This includes the nuts on the anchor bolts. A thread lubricant shall be used with each aluminium nut.

All nuts on galvanized steel trusses, with the exception of high strength bolt connections, shall be tightened only to a snug condition.

Field welding shall not be permitted.

After installation of signs is completed; the sign shall be inspected by the Engineer. If specular reflection is apparent on any sign, its positioning shall be adjusted by the Contractor to eliminate or minimize this condition.

ROAD MARKINGS STRIPS

The colour width and layout of road makings shall be in accordance with the Code of Practice for Road Markings with paints, IRC : 35, and as specified in the drawings or as directed by the Engineer- in-Charge.

Materials

Road markings shall be of ordinary road marking paint (retro-reflective), hot applied thermoplastic compound as specified in the item.

Hot Applied Thermoplastic Road Marking

General

The thermoplastic material shall be homogenously composed of aggregate, pigment, resins and glass reflectorizing beads.

The thermoplastic compound shall be screeded/extruded on to the pavement surface in a molten state by suitable machine capable of controlled preparation and laying with surface application of glass beads at a specific rate. Upon cooling to ambient pavement temperature, it shall produce an adherent pavement marking of specified thickness and width and capable of resisting deformation by traffic.

The thermoplastic material shall conform to ASTM D36/BS-3262-(Part I).

The material shall meet the requirements of these specifications for a period of one year. The thermoplastic material must also melt uniformly with no evidence of skins or unmelted particles for the one year storage period. Any material not meeting the above requirements shall be replaced by the manufacturer/supplier/Contractor.

Marking : Each container of the thermoplastic material shall be clearly and indelibly marked with the following information:

The name, trade mark or other means of identification of manufacturer.

Batch number

Date of manufacture

Colour (White or yellow)

Maximum application temperature and maximum safe heating temperature.

Sampling and Testing : The thermoplastic material shall be sampled and tested in accordance with the appropriate ASTM/BS method. The Contractor shall furnish to the SBI/ PMC / Engineer in charge a copy of certified test reports from the manufacturers of the thermoplastic material showing results of all tests specified herein and shall certify that the material meets all requirements of this Specification.

Preparation

The material shall be melted in accordance with the manufacturer's instructions in a heater fitted with a mechanical stirrer to give a smooth consistency to the thermoplastic material to avoid local overheating. The temperature of the mass shall be within the range specified by the manufacturer, and shall on no account be allowed to exceed the maximum temperature stated by the manufacturer. The molten material should be used as expeditiously as possible and for thermoplastic material which has natural binders or is otherwise sensitive to prolonged healing, the material shall not be maintained in a molten condition for more than 4 hours.

After transfer to the laying equipment, the material shall be maintained within the temperature range specified by the manufacturer for achieving the desired consistency for laying.

Properties of Finished Road Marking

The stripe shall not be slippery when wet.

The marking shall not lift from the pavement in freezing weather.

After application and proper drying, the stripe shall show no appreciable deformation or discolouration under traffic and under road temperatures upto 60oC.

The marking shall not deteriorate by contact with sodium chloride, calcium chloride or oil drippings from traffic.The stripe or marking shall maintain its original dimensions and position. Cold ductility of the material shall be such as to permit normal movment with the road surface without chopping or cracking.

The colour of yellow marking shall conform to IS Colour No. 356 as given in IS 164.

Application

Marking shall be done by fully /semi automatic paint applicator machine fitted with profile shoe, glass beads dispenser, propane tank heater and profile shoe heater, driven by experienced operator as specified in item. For locations where painting cannot be done by machine, approved manual methods shall be used with prior approval of the SBI/ PMC / Engineer in charge. The Contractor shall maintain control over traffic while painting operations are in progress so as to cause minimum inconvenience to traffic compatible with protecting the workmen.

The thermoplastic material shall be applied hot either by screeding or extrusion process. After transfer to the laying apparatus, the material shall be laid at a temperature within the range specified by the manufacturer or otherwise directed by the SBI/ PMC / Engineer in charge for the particular method of laying being used. The paint shall be applied using a screed or extrusion machine.

The pavement temperature shall not be less than 10oC during application. All surfaces to be marked shall be thoroughly cleaned of all dust, dirt, grease, oil and all other foreign matter before application of the paint.

Thermoplastic paint shall be applied in intermittent or continuous lines of uniform thickness of at least 2.5 mm unless specified otherwise. Where arrows or letters are to be provided, thermoplastic compound may be hand-sprayed.

The minimum thickness specified is exclusive of surface applied glass beads.

The finished lines shall be free from ruggedness on sides and ends and be parallel to the general alignment of the carriageway. The upper surface of the lines shall be level, uniform and free from streaks.

KERB CHANNEL OF CEMENT CONCRETE

Base : The base of the channel to be of the 75 mm compacted thick dry brick ballast 40 mm nominal size well rammed and consolidated and grouted with fine sand.

Kerb channel shall be provided in cement concrete of specified grade. These shall be cast in-situ of specified size as given in the item. Top surface of channel to be finished smooth.

COMPACTED BED OF DRY BRICK BALLAST

Collection of Material

Before the start of work brick aggregate 40 mm nominal size unless specified otherwise, shall be stacked for the entire work and record measurements done as per para 16.4.

Preparation of Sub Grade

The formation for a width equal to that of the area shall be cut to the depth below the proposed finish level, equal to the thickness of the course of brick aggregate (due allowance being made for consolidation) and dress off in level to the finished profile. In case of made up soil, copious water shall be poured so that earth settles down as much as possible and the same rolled up with 3 tonnes or light power roller, as directed by the SBI/ PMC / Engineer in charge.

Laying and Packing Brick Aggregate

Brick aggregate shall be racked off the stack with the racks so as to leave behind mud and dust. It shall be spread evenly over the prepared surface to the required depth with a finishing material to avoid segregation. Brick aggregate shall be carefully laid and packed, bigger size being placed at the bottom to 7.5 cm. depth unless specified otherwise. After that the area shall be grouted with fine sand.

Consolidation

The bricks aggregate shall be consolidated by dry rolling with 3 tonne or light weight power roller as directed by the SBI/ PMC / Engineer in charge.

POST DELINEATORS

The role of delineators is to provide visual assistance to drivers about alignment of the road ahead, especially at night. Delineators are particularly effective in the case of complex locations involving changes in horizontal / vertical geometry and doing severe weather condition such as heavy rain, fog or snow. Normally reflectors are used on the delineators for better night time visibility. Road delineators may have a circular, rectangular or triangular cross-section, however the side facing the traffic should not be less than 10 cm wide.

In board sense, Delineators stands for any device or treatment whose aim is to outline the road way.

Material :

The design, materials to be used and the location of the road delineators shall conform to recommended practice for road delineators, IRC:79, and to relevant drawings and as directed by the SBI/ PMC / Engineer in charge.

The delineators are to be made of Acrylonitrite Butadiene Styrene (ABS) body fitted with 2 No. 100 mm dia of highly reflective reflectors are mounted on M.S. pipe of 65 mm dia or of size specified otherwise, duly powder coated of minimum 40 microns thickness anti-rust and anti-theft, installed as per direction of SBI/ PMC / Engineer in charge. Road delineators may have a circular, rectangular or triangular cross-section, however the side facing the traffic should not be less than 10 cm wide.

Dimensions :

Height of the delineator should be not less than 800 mm above ground. Width not less than 100 mm. Not more than 300 mm below the ground while being installed.

Placement and spacing :

As a general rule, delineators posts should be erected at the edge of the usable shoulders, and in the case of kerbed sections at a distance of 0.6 to 1.5 m from the kerb face. On hill roads they may be placed either on the parapet or at the edge of the shoulders.

The delineator should be so positioned that the reflectorised face is perpendicular to the direction of travel.

Warranty :
The contractor shall obtain a two years warranty for satisfactory performance including stipulated retro-reflectance of the retro-reflective sheeting and submit the same to the SBI/ PMC / Engineer in charge.

EXCAVATING HOLES UPTO 0.10 CUM
The specifications of sub head earth work of CPWD specifications 2019 Vol-I to be followed for this item.

FACTORY MADE RCC PAVEMENT SLAB
Precast RCC slab casted with the cement concrete of M-30 or specified otherwise grade of size specified in item made of approved brand and manufacturer to be used.

Specification of cement concrete base, bed cement mortar and RCC to be of the sub head cement concrete, mortar and RCC of the CPWD specification- 2019 Vol- I to be followed.

FACTORY MADE CEMENT CONCRETE INTERLOCKING PAVER BLOCK
Base
Interlocking paver block to be fixed on the bed 50 mm or specified otherwise thick of coarse sand of approved specification and filling the joints with the sand of approved type and quality or as specified and as directed by SBI/ PMC / Engineer in charge.

Interlocking Paver Block
Factory made 80mm thick reflectiveprecast paver block of M-30 or otherwise specified grade to be used. Paver blocks to be of approved brand and manufacturer and of approved quality. Minimum strength as prescribed by manufacturer and as per direction of SBI/ PMC / Engineer in charge for the grade specified to be tested as per method mentioned in specification of subhead cement concrete of CPWD Specification 2019 Vol. I.

Measurement & Rates
Area provided with paver block to be measured in sqm. correct upto two places of decimal. The rate include the cost of the material, labour, tools etc. required in all the operations described above.

KERB STONE (PRECAST)

Laying

Trenches shall first be made along the edge of the wearing course of the road to receive the kerb stones of cement concrete of specified grade. The bed of the trenches shall be compacted manually with steel rammers to a firm and even surface and then the stones shall be set in cement mortar of specified proportion.

The kerb stones of M-25, with top 15 cm. wide shall be laid with their length running parallel to the road edge, true in line and gradient at a distance of 30 cm. from the road edge to allow for the channel and shall project about 12.5 cm. above the latter. The channel stones with top 30 cm. wide shall be laid in position in chamber with finished road surface and with sufficient slope towards the road gully chamber. The joints of kerb and channel stones shall be staggered and shall be not more than 10 mm. Wherever specified all joints shall be filled with mortar 1:3 (1 cement : 3 coarse sand) and pointed with mortar 1:2 (1 cement: 2 fine sand) which shall be cured for 7 days.

The necessary drainage openings of specified sizes shall be made through the kerb as per drawings or as

directed by the SBI/ PMC / Engineer in charge for connecting to storm water drains.

Finishing

Berms and road edges shall be restored and all surplus earth including rubbish etc. disposed off as directed by the SBI/ PMC / Engineer in charge. Nothing extra shall be paid for this.

VACUUM DEWATERED CEMENT CONCRETE PAVEMENT

Cement concrete to be compacted by screed board vibrator of the type approved by Engineer- in-Charge and by vaccum dewatering process complete as per directions of SBI/ PMC / Engineer in charge.

GRANULAR SUB–BASE

Scope

This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross-sections shown on the drawings or as directed by the SBI/ PMC / Engineer in charge.

Materials

The material to be used for the work shall be natural sand, crushed gravel, crushed stone, crushed slag or combination thereof depending upon the grading required. Use of materials like brick metal, Kankar and crushed concrete shall be permitted in the lower sub-base. The material shall be free from organic or other deleterious constituents and shall conform to the grading given in Table 16.44 and physical requirement given in Table 16.45 Gradings III and IV shall preferably be used in lower sub-base. Grading V and VI shall be used as a sub-base-cum-drainage layer. The grading to be adopted for a project shall be as specified in the Contract. Where the sub-base is laid in two layers as upper sub-base and lower sub-base, the thickness of each layer shall not be less than 150 mm.

16.62.2.2 If the water absorption of the aggregate determined as per IS : 2386 (Part 3); if this value is greater than 2 per cent, the aggregate shall be tested for Wet Aggregate Impact Value (AIV) (IS: 5640). Soft aggregates like Kankar, Brick ballast and laterite shall also be tested for Wet AIV (IS: 5640).

TABLE No. 16.44
GRADING FOR GRANULAR SUB-BASE MATERIALS

IS Sieve Designation	Percent by Weight Passing the IS Sieve					
	Grading I	Grading II	Grading III	Grading IV	Grading V	Grading VI
75.0 mm	100	--	--	--	100	--
53.0 mm	80-100	100	100	100	80-100	100
26.5 mm	55-90	70-100	55-75	50-80	55-90	75-100
9.50 mm	35-65	50-80	--	--	35-65	55-75
4.75 mm	25-55	40-65	10-30	15-35	25-50	30-55
2.36 mm	20-40	30-50	--	--	10-20	10-25
0.85 mm	--	--	--	--	2-10	--
0.425 mm	10-15	10-15	--	--	0-5	0-8
0.075 mm	<5	<5	<5	<5	--	0-3

TABLE No. 16.45
PHYSICAL REQUIREMENTS FOR MATERIALS FOR GRANULAR SUB-BASE

Aggregate Impact Value (AIV)	IS:2386 (Part 4) or IS:5640	40 Maximum
Liquid Limit	IS:2720 (Part 5)	Maximum 25

Plasticity Index	IS:2720 (Part 5)	Maximum 6
CBR at 98% dry density (at IS:2720-Part 8)	IS:2720 (Part 5)	Minimum 30 unless otherwise specified in the Contract

Construction Operations

Preparation of Sub-Grade:

The surface of the sub grade to receive the Granular Sub-base shall be prepared to the specified lines and crossfall (Camber) as necessary and made free of dust and other extraneous materials. Any ruts or soft yielding places shall be corrected in an approved manner and rolled with 80 – 100 kN smooth wheeled roller until firm surface is obtained if necessary by sprinkling water. Weak places shall be strengthened, corrugations removed and depressions and pot holes made good with suitable materials, before spreading the aggregate for GSB.

Where the existing surface over which the sub base of GSB is to be laid is black topped, to ensure effective internal drainage, furrows 50 mm x 50 mm (depth of furrows increased to reach bottom of bituminous layer where necessary) at one metre intervals shall be cut in the existing bituminous surface at 45 degrees to the central line of the carriageway at one metre intervals in the existing road before the GSB is laid.

16.62.3.2 **Spreading and compacting:**

The sub-base material of grading specified in the Contract and water shall be mixed mechanically by a suitable mixer equipped with provision for controlled addition of water and mechanical mixing. So as to ensure homogenous and uniform mix. The required water content shall be determined in accordance with IS:2720 (Part 8). The mix shall be spread on the prepared sub-grade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation, or other means as approved by the SBI/ PMC / Engineer in charge.

Moisture content of the mix shall be checked in accordance with IS:2720 (Part 2) and suitably adjusted so that, at the time of compaction, it is from 1 to 2 per cent below the optimum moisture content (OMC).

Immediately after spreading the mix, rolling shall be done by an approved roller. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer upto 200 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall or on super elevation. For carriageway having crossfall on both sides, rolling shall commence at the edges and progress towards the crown.

Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. During rolling, the grade and crossfall (camber) shall be checked and any high spots or depressions, which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour.

Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material determined as per IS : 2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

REFLECTIVE PAVEMENT MARKERS (RPM) OR ROAD STUDS

Scope

The work shall cover the providing and fixing of reflective pavement marker (RPM) or road stud, a device which is bonded to or anchored within the road surface, for lane marking and delineation for night-time

visibility, as specified in the Contract.

Material

Plastic body of RPM/road stud shall be moulded from ASA (Acrylic Styrene Acrylonitrite) or HIPS (Hi-impact Polystyrene) or Acrylonitrite Butadiene Styrene (ABS) or any other suitable material approved by the Engineer. The markers shall support a load of 13.635 kg tested in accordance with ASTM D 4280.

Reflective panels shall consist of number of lenses containing single or dual prismatic cubes capable of providing total internal reflection of the light entering the lens face. Lenses shall be moulded of merthyl methecrylate conforming to ASTM D 786 or equivalent.

Design

The slope or retro-reflecting surface shall preferably be 35 ± 5º to base and the area of each retro-reflecting surface shall not be less than 13.0 sq.cm.

Optical Performance
16.64.4.1 Unidirectional and Bi-directional Studs.

Each reflector or combination of reflectors on each face of the stud shall have a Coefficient of Luminous Intensity (C.I.L.), as specified.
TABLE NO
Minimum C.I.L. values for Road Studs

Entrance Angle	Observation Angle	C.I.L. in mcd/lx		
		White	Amber	Red
0º U 5º L&R	0.3º	220	110	44
0º U 5º L&R	0.5º	120	60	24

Tests
Co-efficient of luminance intensity can be measured by procedure described in ASTM E 809 “Practice for Measuring Photometric Characteristics” or as recommended in BS:873-Part 4 : 1973.
Fixing of Reflective Markers or Road Studs or Cats Eyes.
Requirements
The enveloping profile of the head of the stud shall be smooth and the studs shall not present any sharp edges to traffic. The reflecting portions of the studs shall be free from crevices or ledges where dirt might accumulate. Marker height shall not be less than 10 mm and shall not exceed 20 mm, and its width shall not exceed 130 mm. The base of the marker shall be flat within 1.3 mm. If the bottom of the marker is configured, the outermost faces of the configurations shall not deviate more than 1.3 mm from a flat surface. All road studs shall be legibly marked with the name, trade mark or other means of identification of the manufacturer.

Placement
The reflective marker shall be fixed to the road surface using the adhesives and the procedure recommended by the manufacturer. No nails shall be used to affix the marker so that they do not pose safety hazard on the roads. Regardless of the type of adhesive used, the markers shall not be fixed if the pavement is not surface dry and on new asphalt concrete surfacing until the surfacing has been opened to traffic for a period of not less than 14 hours. The portions of the highway surface, to which the marker is to be bonded by the adhesive, shall be free of dirt, curing compound, grease, oils, moisture, loose or unsound layers, paint and any other material which would adversely affect the bond of the adhesive.
The adhesive shall be placed uniformly on the cleaned pavement surface or on the bottom of the of the

marker in a quantity sufficient to result in complete coverage of the area of contract of the marker with no voids present and with a slight excess after the marker has been lightly pressed in place. For epoxy installations, excess adhesive around the edge of the marker, excess adhesive on the pavement and adhesive on the exposed surfaces of the markers shall be immediately removed.

Warranty and Durability

The contractor shall submit a two year warranty for satisfactory field performance including stipulated retro-reflectance of the reflecting panel, to the SBI/ PMC / Engineer in charge. In addition, a two year warranty for satisfactory infield performance of the finished road marker shall also be given by the contractor who carries out the work of fixing of reflective road markers. In case the markers are displaced, damaged, get worn out or lose their reflectivity compared to stipulated standards, the contractor would be required to replace all such markers within 15 days of the intimation from the SBI/ PMC / Engineer in charge, at his own cost.

APPENDIX C
LIST OF MINIMUM EQUIPMENT TO BE PROVIDED IN THE FIELD TESTING LABORATORY BY THE CONTRACTOR AT HIS OWN COST.

Concrete Section
Sieve Analysis of stone ballast
Sets of I.S. Sieves of sizes 63 mm, 45 mm, 22.4 mm, 11.2 mm, 5.60 mm. etc.
Sieve analysis of sand
Sets of I.S. sieves of sizes 2.36 mm, 1.18 mm, 600 micron, 355 micron and 180 micron.

Silt content of sand
Graduated glass cylinders 500 C.C. capacity.

Bulkage of sand
Graduated glass cylinders 500 C.C. capacity.

Slump test.
Slump cones.
Slump rods 3/8" dia. 24" long bullet pointed.
Steel plates 24” x 24”
Steel scales.

For making beam specimens for flexural strength.
Beam moulds.
Tamping rods.

Testing flexural strength of concrete:-
100 ton capacity compressive strength testing i/c hand operated in two numbers with flexure test attachment.

Other miscellaneous items.
Physical balance with set of weights.
Pan balances.
Spring balances.
Glass measuring jar.
Beakers.
Towels, glass plates etc.

APPENDIX D

GENERAL GUIDELINES ISSUED BY NDMC

I. Roads/Foot Paths/and Storm Water Drains.

RESIDENTIAL

S.No	Specifications applicable prior to 26.9.79	Specifications applicable after 27.9.79 (Modified)	Remarks
(1)	(2)	(3)	(4)
1.	15 ft wide right of way service lanes: Metal width not less than 8'-0" 4-1/2" soling 4-1/2" metal two coats of bitumen painting	4.577tres (15ft) right of way service lane: Metalled width not less than 2.44 metres (8 ft.) 0.1143 metres (4-1/2") thick stone aggregate sub-base course of W.B.M. as per IRC specifications. 0.1143 metre (4-1/2") thick stone aggregate base-course W.B.M. as per IRC specifications. 2 cm (3/4") thick pre-mix carpet with seal coat of premixed stone dust. 0.2286 metre (9") wide brick-on- edge edging on either side. CC (M-150) channel 8 cm thick and 30 cm wide with gola of 8 cm radius laid over a bed layer of 8 cm thick 1:5:10 c.c. top surface finished with a floating coat of neat cement. The space between brick edging and c.c. channel on both sides shall have brick on-edge flooring.	
2.	20 ft. wide right of way service lanes: Metalled width 10 ft. plus 9" brick-on-edge on either side. 4-1/2" soling 4- 1/2" metal ¾" bitumen carpet.	6.098 metres (20 ft.) right of way service lane: Metalled width 3.48 metres (10 ft.) 0.1143 metre (4-1/2") thick stone aggregate sub-base course of W.B.M. as per IRC specifications. 0.1143 metre (4-1/2") thick stone aggregate base-course of W.B.M. as per IRC specifications. 2 cm (3/4") thick pre-mix carpet with seal coat of premixed stone. 0.2286 metre (9") wide brick on edge edging on either side.C C (M-150) channel 8cm thick and 30 cm wide with gola of 8 cm radius laid over a bed layer of 8 cm thick 1:5:10 cement concrete top surface finished with a floating coat of neat cement. The space between brick edging & CC channel on both side brick on edge flooring.	
3.	Roads with right of way	9.14 metre (30 ft.) right way roads:	

	30 feet: 12 ft. Metalled width plus 9" thick edging on either side. 6" soling 6" metal (water bound 3" thick each layer) 3/4" carpet	(i) metres (12 ft.) mettalled width with 0.2286 metre (9") wide brickon- edge-edging on either side 0.1016 metre (4") thick stone aggregate base-course of W.B.M. as per IRC specifications. 0.2032 metre (8") thick stone aggregate base-course of W.B.M. as per IRC specifications (to be laid in two layers).2 cm (3/4") thick pre mix carpet with seal coat of premixed stone dust.	
4.	Service roads with right of way 40 ft. 18 ft. metalled width plus 9" thick edging on either side. 6" soling 7-1/2" metal (water bound 4-1/2" & 3" thick separately) 1" carpet.	12.19 mtrs. (40 ft.) and less than 13.71 mtrs. (45 ft.) right of way roads: 7.32 m. (24 ft.) metalled width with 0.2286 m (9") wide brick-on-edge edging on either side. 0.1524 m (6") stone aggregate sub- base course of W.B.M. as per IRC specifications. 0.2032 m (7-1/2") stone aggregate base-course of W.B.M. as per IRC specifications (to be laid in two layers) 2.5 cm (1") thick pre-mix carpet with seal coat of premixed stone dust.	The change in metalled width is to adopt two lane width since 18 ft. width is not standard width.
5.	Service roads with right of way 60 ft. 22 ft. metalled width plus 9" brickon-edge on both sides. 6" soling. 7-1/2" metal. 1-1/2" thick asphaltic concrete.	13.71 mtrs. (45 ft.) and less than 18.29 mtrs.(60 ft.) right of way road: 7.32 mtrs. (24 ft.) metalled with 0.2284 m (9") wide brick-on-edge on either side. 0.1524 m (6") thick stone aggregate sub-base course of W.B.M. as per IRC specifications. 0.2032 m (71/2”) thick stone aggregate base-course of W.B.M. as per IRC specifications (to be laid in two layers). 5 cm (2”) thick Bituminous Macadam (B.M.) with seal coat of premixed stone dust.	The change in metalled width from 22 ft. to 24 ft. is to adopt standard two lane width.
6.	Roads with right of way above 60 ft. and upto 79 ft. 22 ft. metalled width 9" brick-on- edge on either side. 9" soling 7-1/2" metal (W.B.M. 4-1/2" & 3" thick separately). 1-1/2" thick asphaltic concrete	18.29 mtrs. (60 ft.) and less than 24.38 mtrs. (80 ft.) right of way road 7.32 mtrs. (24 ft.) metalled with 0.2286 mtrs. (9”) wide brick-on-edge edging. 0.1524 m (6”) thick stone aggregate sub-base of W.B.M. as per IRC specifications. 0.2667 m (10-1/2”) thick stone aggregate base-course of W.B.M. as per IRC specifications (to be laid in three layers). 5 cm (2”) thick Bituminous Macadam (BM) with seal coat of premixed stone dust.	The change in metalled width from 22 ft. to 24 ft. is to adopt standard two lane width.
7.	Roads with right of way 80 ft. and above 9" soling. Metalled width 24 ft. soling 9"	24.38 mtrs. (80 ft.) and above right of way road. (i) 14.64 mtrs. (48 ft.) metalled width.	The change in metal width is to adopt standard X

	7- 1/2" metal. 1" carpet.	0.1524 m (6”) thick stone aggregate sub-base course of W.B.M. as per IRC specifications. 0.2667 m (10-1/2”) thick stone aggregate base-course of W.B.M. as per IRC specifications (to be laid in three layers). 5 cms. (2”) thick Bituminous Macadam (BM) with seal coat of premixed stone dust. 3.048 mtrs. (10 ft.) wide raised foot path on both sides of the carriageway as per specifications given hereinafter.	section for 80 ft. wide roads. Such roads normally carry heavy amount of traffic which needs a metalled width of 48 ft. for easy flow of traffic.
8.	Service lanes/ walkways having right of way less than 15 ft. Nil	Service lanes/walkways having right of way less than 4.57 mtrs.(15 ft.) 0.1143 mtrs. (4-1/2”) thick cement concrete (M-150) over 0.1143 (4-1/2”) dry brick ballast in complete width with c.c. (M-150) channel 8 cms. thick and 30 cm wide with gola of 8 cm radius laid over a bed layer of 8 cms. Thick 1:5:10 cement concrete top surface finished with floating coat of neat cement.	

Notes :
Roads with right of way 80 ft. and above passing through residential colony should have raised foot paths on either sides.
Where raised footpaths are not provided, berms shall be properly dressed to slope towards the side drains.

PROVISION FOR LATERAL CONFINEMENT OF AGGREGATES
Sub Head : Road Work Clause: 16.7.5

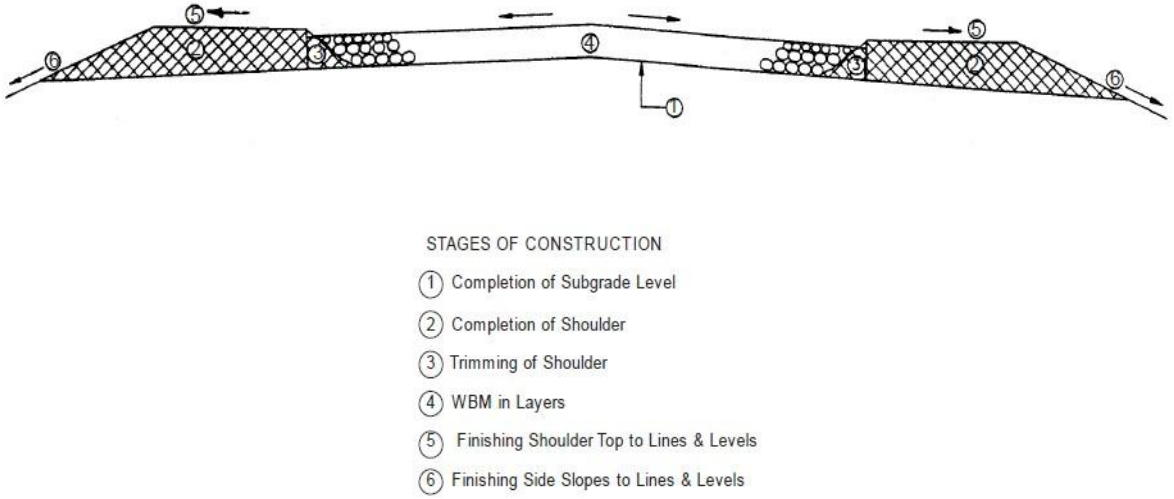
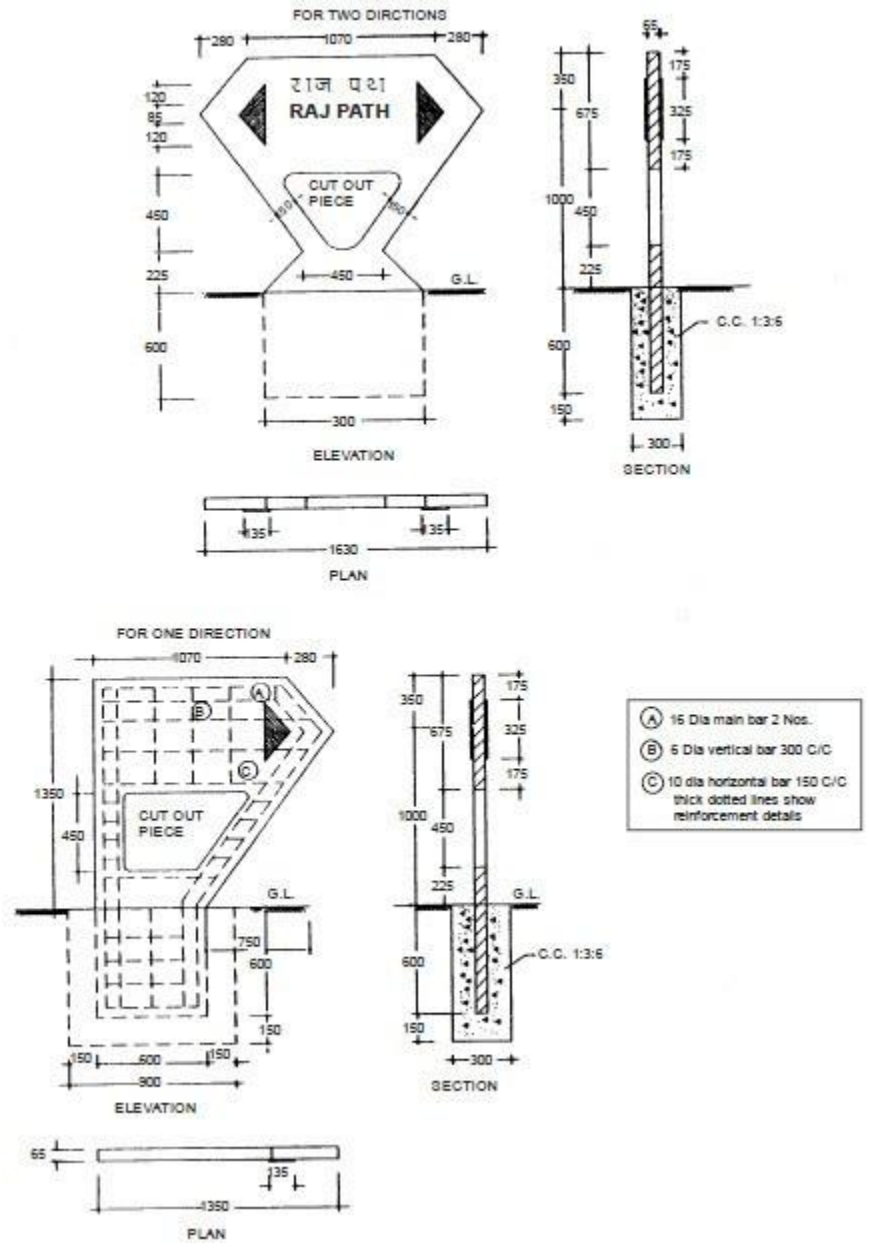


Fig. 16.1 : Provision for Lateral Confinement of Aggregates

Drawing not to Scale
All dimensions are in mm

R.C.C. NAME BOARD WITHOUT POST

Sub Head : Road Work



Drawing not to Scale

All dimensions are in mm

Fig. 16.2 : R.C.C. Name Board without Post

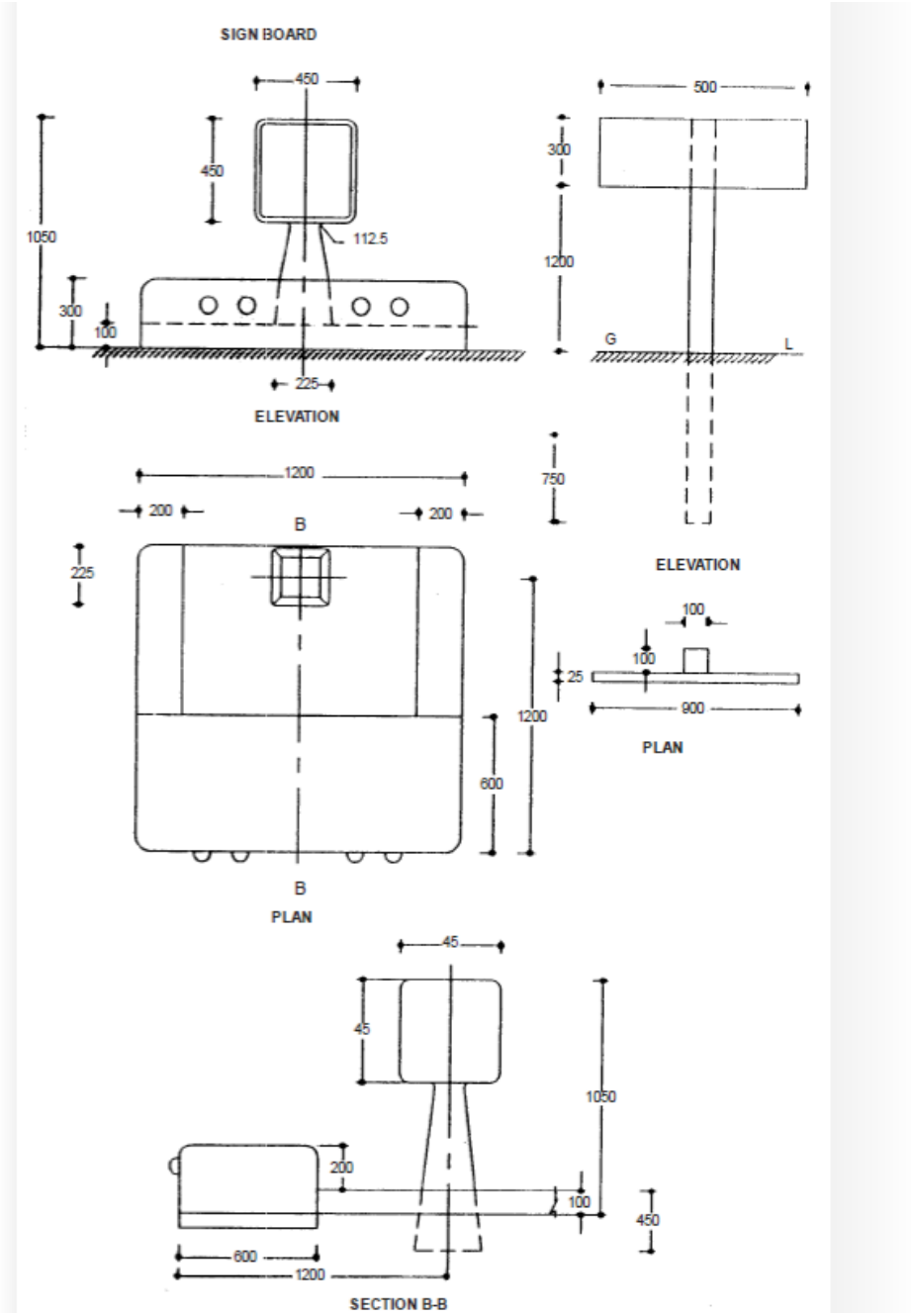
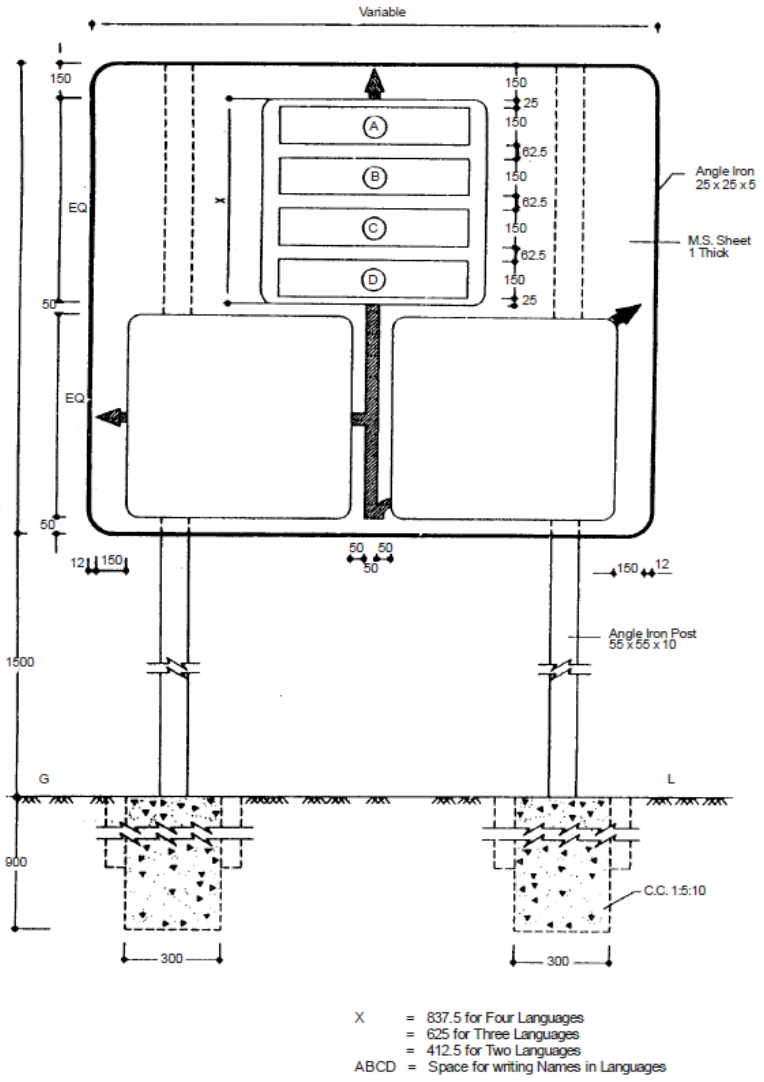


Fig. 16.3 : Sign/Name Board

INFORMATORY SIGN BOARD
Sub Head : Road Work
Clause : 16.49



Drawing not to Scale
All dimensions are in mm

Fig. 16.8 : Informatory Sign Board

LOCATION OF INFORMATORY SIGN BOARDS

Sub Head : Road Work
Clause : 16.49

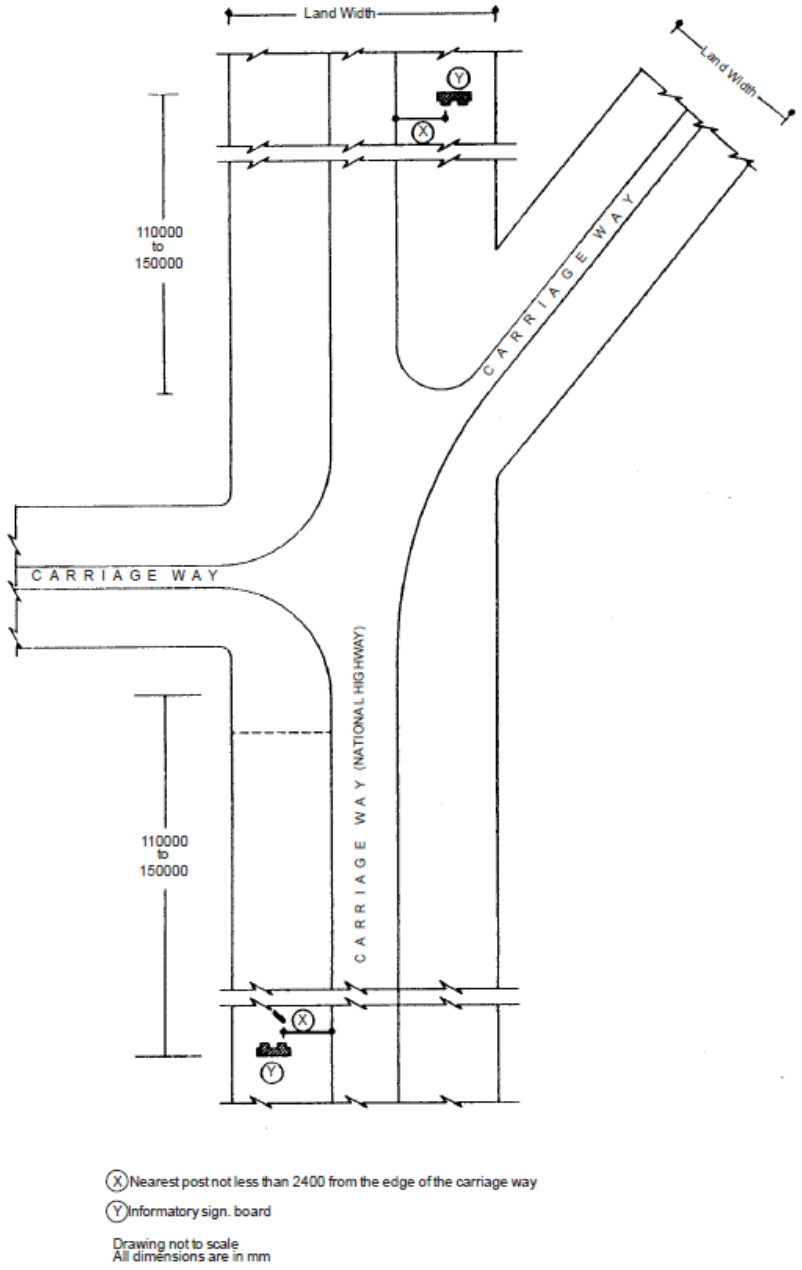
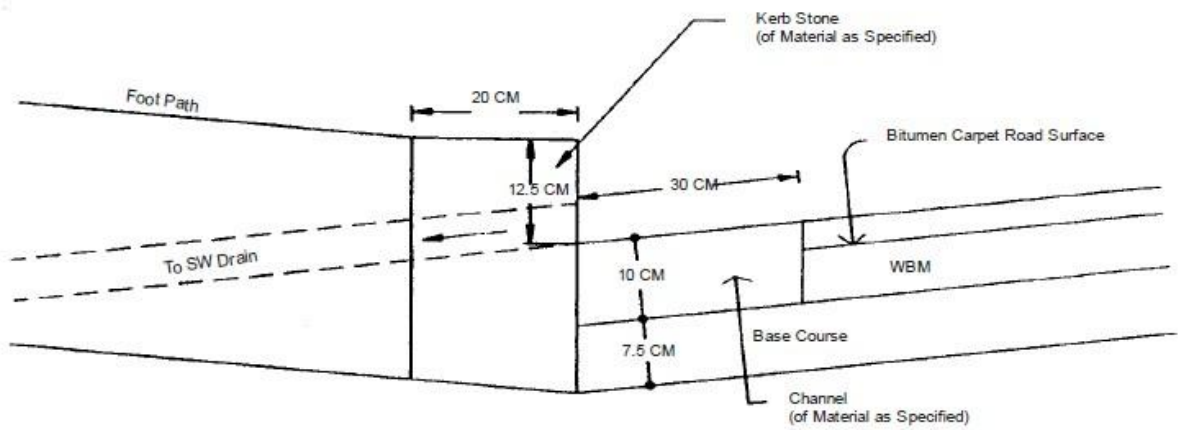


Fig. 16.11 : Location of Informatory Sign Boards

KERB & CHANNEL STONES

Sub Head : Road Work
Clause : 16.1.20



Drawing not to Scale
All dimensions are in mm

21 DRY STONE PITCHING

Stones: These shall be clean, hard stones, free from decay and weathering. They shall be in block and hammer dressed on all sides. The size of the pitching stones shall be approximately 22.5 cm.in depth and not less than 15 cm. in any other direction.

Preparation of surface: The sides and bottom of earth work to be pitched, shall be brought to the required slope and gradient and shall be compacted to a firm and even surface.

Pitching: Pitching shall be of 22.5 depth unless specified otherwise. Profiles shall be put up by means of pegs and strings or by placing stones, at intervals of not more than 15 cm. Stones shall then be laid closely in position in between the profile and firmly embedded with joints staggered and with exposed faces true to line, gradient and in uniform slope throughout.

Cross bands of approximately 22.5 cm. width through bond stones equal to the full depth of pitching shall be provided at an interval of approximately 3 metres centre to centre both longitudinally and transversely.

The interestices between adjacent stones shall be filled in with stones of proper size, well driven in with crow bars to ensure tight packing and complete filling of all interstices. Such filling shall be carried on simultaneously with the placing in position of the large stones and shall in no case be permitted to fall behind. Final wedging shall be done with the largest sized chip practicable, each chip being well driven home with a hammer so that no chip is possible of being picked up or removed by hand.

22 G.I. BARBED WIRE FENCING WITH ANGLE IRON POSTS

Materials: G.I. Barbed wire shall be as per IS 278 and angle iron shall be as per CPWD Specification Vol. The angle shall be of size 40 × 40 × 6 mm or as specified in the tender drawings.

Spacing of Posts and Struts: The spacing of posts shall be 3.00 m centre to centre, unless otherwise specified or as directed by the PMC/ SBI/ PMC / Engineer in charge to suit the dimensions of the area to be fenced. Every 15th, last but one end posts and corner post shall be strutted on both sides and end post on one side only.

Fixing of Posts and Struts Pits 45 x 45 cm and 75 cm deep or as directed shall first be excavated true to line and level to receive the posts. In the case of struts, pits 70 x 45 x 75 cm deep or as directed shall be excavated to suit the inclination of the strut so that it is surrounded by concrete by not less than 15 cm at any point.

The pits shall be filled with a layer of 15 cm thick cement concrete 1:2:4 (1 cement: 2 fine sand: 4 graded stone aggregate 20 nominal size). The posts and struts shall then be placed in the pits, the posts projecting as per specified height above ground, true to line and position. The cement concrete

1:2:4 shall be filled in upto 15 cm for posts and 25 cm for struts below ground level at the base of the concrete so that the posts are embedded in the cement concrete block of size 45 x 45 x 60 cm and strut in block of size 70 x 45 x 50 cm. The concrete in foundations shall be watered for at least 7 days to ensure proper curing. The remaining portions of pits shall be filled up with excavated earth and the surplus earth disposed off as directed by the PMC/SBI/ PMC / Engineer in charge and site cleared.

The angle iron post at bottom shall be split and banded at right angle in opposite direction for 10 cm length to get proper grip.

Fixing G.I. Barbed Wire: The barbed wire shall be stretched and fixed in specified number of rows and two diagonals. The bottom row should be 14 cm above ground and the rest at specified spacing. The diagonal shall be stretched between adjacent posts from the top wire of one post to the bottom wire of 2nd post. The diagonal wire will be interring woven with horizontal wires by fixing the odd

rows of wires first, then the diagonal cross wires and lastly even rows of wires. The barbed wire shall be held by tearing the

holes of 10 mm dia in the post and tied with G.I. wire, turn buckles and straining bolts shall be used at the end post. The Barbed Wire shall be Weighing 9.38 kg /100 m (minimum).

23 SIGNAGE & ASSOCIATED WORKS

a. The scope of the work includes preparation of the Architectural Drawings/ shop drawings based on details given in the tender drawings and as directed by SBI/PMC in charge. Fabrication, supply, installation and protection of the Signages shall be carried based on approved shop drawings.

b. The item of work for the respective signage shall be confirming to Specifications/ tender drawings and shall cover all operations, fabrications and their installations and materials required for finished product.

c. The signage work shall be got executed through specialized fabricator having experience of similar works. The EPC Contractor shall submit the credentials of such fabricator for the approval of the PMC/SBI/ PMC / Engineer in charge.

d. The EPC Contractor shall submit the Design, Size and installation procedure along with samples to PMC/SBI/ PMC / Engineer in charge for approval. Approved samples will be kept at site till the whole work is completed. PMC/SBI/ PMC / Engineer in charge has right to modify the design of the approved samples and Contractor is bound to follow these written instructions / changes in design/ size etc. from PMC/SBI/ PMC / Engineer in charge.

e. The typical patterns shown in the drawings are only indicative. The Contractor shall submit shop drawings, for approval of the PMC/SBI/ PMC / Engineer in charge, for fabricating signage with detailing of frame work, if any, along with the fixing details. The details of the signage including location, etc. shall be shown in the shop drawings.

f. The Contractor shall submit to the PMC/SBI/ PMC / Engineer in charge, samples of various materials for the signage work, for approval. After approval of samples of materials, the Contractor shall prepare sample(s) for approval of PMC/SBI/ PMC / Engineer in charge. The material shall be procured and the mass work taken up only after the approval of the mock up by the PMC/SBI/ PMC / Engineer in charge. The mock-up shall be dismantled and removed by the Contractor as per the directions of the PMC/SBI/ PMC / Engineer in charge. Nothing extra shall be payable on this account.

g. The finished surface shall be free of any defects like dents, waviness, scratches, stains etc. and shall have uniform finish. Any defective work shall be rejected and redone by the Contractor at his own cost. The finished surface shall therefore be protected using protective tape which

shall be removed at the time of completion of the work. The surface shall then be suitably cleaned using nonabrasive approved cleaner for the material. Nothing extra shall be payable on this account.

h. The signages shall be fixed with stainless steel anchor fasteners or other suitable arrangement for fixing the signage.

i. The entire work shall be carried out to the satisfaction of PMC/SBI/ PMC / Engineer in charge. The Pictures shown for Internal Signages are for reference. The shape & Size of the Signages shall be as per the reference pictures. All the Internal Signages should Bilingual (English/Hindi). The colour of the print to be finalized after having a careful study of the Building Interior which shall be constant in all the buildings. The content of the Signages will be as per Architectural Plans.

j. The fabricator will keep a liberty to choose any one of the items between "IF, IG, IV, IX and IY", wherever they are mentioned/marked without hanging The text height which shall be constant. For Example, if at any particular location "IG" is marked, but the content gets fitted in "IY", the fabricator shall use "IY"in that location instead of using "IG". Similarly, if at any particular location "IX" is marked, but the content doesn't get fitted in "IX" with the standard font size used everywhere, but gets fitted in "IV", the fabricator shall use "IV" in that location instead of using "IX

k. Way finding & Fire Exit signages suspended from Ceiling on corridors and other locations shall have content on both the two sides of the Signage for giving directions as per site requirement.

l. General Specifications of various types of Signages are given below: -

24 SAMPLES OF MATERIALS:

a. Sample of all materials/ fittings and fixture to be used in the work such as doors, windows, tiles, sanitary, water supply, drainage fittings and fixtures shall be submitted well in advance by the Contractor for approval from the SBI/PMC in charge of work in writing before placing orders for the entire quantity required for completion of work. Samples approved by the EIC shall be kept in Sample Room under the charge of PMC/SBI/ PMC / Engineer in charge and shall retain till completion of work.

b. Finished items in respect of typical portion of works of repetitive nature such as typical room, toilet, railing, door, window or any other work desired by the SBI/PMC in charge shall be prepared by the Contractor to the satisfaction of SBI/PMC in charge and got approved from him in writing before the commencement of these items for the entire work.

c. The requirements for preparation of samples shall be observed and fulfilled by the Contractor well in advance to avoid any detriment to the general progress of work. In other words, this will not be allowed to have any effects on the general progress of work or on any of the terms and conditions of the contract. No claims of any kind whatsoever including the claims of extension of time will be entertained due to the incorporation of this requirement.

PLAYING COURT

Scope of Work

The work shall comprise preparation of subgrade, construction of granular sub-base, base course, reinforced cement concrete or asphalt surface (as specified), application of synthetic/acrylic sports flooring system, court markings, drainage arrangements, and all allied works complete in accordance with relevant IS Codes, CPWD Specifications, approved drawings, and directions of the Engineer-in-Charge.

Site Preparation and Earthwork

The site shall be cleared of all vegetation, debris, loose soil, and other unsuitable materials. Excavation shall be carried out to the required depth and profile. The subgrade shall be dressed, watered, and compacted to not less than 95% of the maximum dry density as determined by IS:2720. Any soft pockets encountered

shall be removed and replaced with approved filling material compacted to the specified density.

Granular Sub-Base

Granular Sub-Base (GSB) shall consist of approved graded crushed stone aggregates conforming to MoRTH Specifications. The material shall be spread in layers not exceeding 150 mm compacted thickness, watered, and compacted using suitable vibratory rollers to achieve the specified density. The finished surface shall be true to line, level, and grade.

Base Course

The base course shall consist of Wet Mix Macadam (WMM) or Dry Lean Concrete (DLC) as specified in the drawings. The material shall be laid, watered, and compacted to the required thickness and density. The finished base shall provide a smooth and stable foundation for the court surface with permissible tolerances as per relevant specifications.

Concrete Court Surface (Where Specified)

The court surface shall consist of M30 grade reinforced cement concrete of minimum thickness 100 mm or as specified in the drawings. Concrete shall be machine mixed, placed, compacted using mechanical vibrators, and finished to a smooth and even surface. Reinforcement shall consist of welded wire mesh or TMT steel reinforcement as detailed in the drawings. Expansion joints, contraction joints, and construction joints shall be provided at locations approved by the Engineer-in-Charge and sealed with approved joint sealing compound.

Synthetic/Acrylic Sports Surface

The prepared concrete or asphalt base shall be thoroughly cleaned and free from dust, grease, moisture, and other contaminants. A synthetic acrylic sports coating system shall be applied comprising primer coat, resurfacer coats, cushion coats (where specified), and coloured finish coats. The coating system shall be UV-resistant, anti-skid, weather-resistant, and suitable for outdoor sports applications. The finished surface shall provide uniform colour, texture, elasticity, and slip resistance in accordance with international sports standards.

Court Markings

Court markings shall be carried out using approved acrylic or polyurethane sports paint of approved colour and width conforming to the requirements of the respective sporting authority. The dimensions and layout of the courts shall conform to the latest standards of the concerned sports federation. Marking lines shall be straight, sharp, durable, and resistant to wear and weathering.

Drainage

The court shall be provided with adequate longitudinal and transverse slopes, generally ranging between 0.8% and 1.0%, to facilitate proper surface drainage. Peripheral drains, catch pits, and drainage channels shall be constructed as shown in the drawings to ensure that no water stagnation occurs on the playing surface.

Fencing and Accessories

Where specified, the court shall be enclosed with chain-link fencing of approved height fixed to galvanized steel posts embedded in concrete foundations. Gates, net posts, basketball poles, volleyball posts, tennis posts, and other accessories shall be provided as per approved drawings and relevant sports standards.

Quality Control

All materials shall conform to relevant IS specifications and shall be subject to inspection and testing. Surface regularity, levels, compaction, concrete strength, coating thickness, adhesion, and finish shall be checked and approved before acceptance. Any defective work shall be rectified by the contractor at no additional cost.

Mode of Measurement

The playing court shall be measured in square metres of finished court area complete with sub-base, base, surface finishing, synthetic coating, line marking, and all incidental works necessary for satisfactory completion of the work.

Rate

The rate shall include cost of all materials, labour, machinery, tools and plants, transportation, loading, unloading, royalty, testing, wastage, curing, surface preparation, synthetic coating system, court marking,

drainage provisions, scaffolding, safety measures, and all other operations required to complete the work in all respects as per specifications, drawings, and directions of the Engineer-in-Charge

25 IGBC PLATINIUM REQUIREMENTS:

The Contractor shall procure materials considering their recycled content to ensure compliance with IGBC requirements, as specified in the Special Conditions of Contract (SCC) and other relevant documents.

26 **VARIATION IN CONSUMPTION OF MATERIALS**:

The variation in consumption of material shall be governed as per CPWD specification and clauses of the contract to the extent applicable.

27 MISCELLANCEOUS:

Materials manufacture by reputed firms and approved by Engineer – in charge shall only be used. Only articles classified as "First Quality" by the manufactures shall be used unless otherwise specified. Preference shall be given to those articles which bear ISI certification marks. In case articles bearing ISI certification marks are not available the quality of sample brought by the Contractor shall be judged by the standards laid down in the latest CPWD specifications. For items not covered by the latest CPWD specification, relevant ISI standards shall apply.

28 TESTS:

Materials brought at site of work shall not be used in the work before getting satisfactory test results for Mandatory tests as per relevant provisions in Latest CPWD Specifications for works. These tests shall be got done from laboratories approved by SBI/PMC in charge. or the laboratory set up by the Contractor at site as per directions of SBI/PMC in charge.

HUMEPIPE WORKS

A:- Earth work in excavation by mechanical means (Hydraulic excavator) I manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, for all lift, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.

B:- Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and for all lift.

C:- Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work upto plinth level. 1:5:10 (1 Cement : 5 coarse sand (zone-III): 10 graded stone aggregate 40 mm nominal size)

D:- Providing and laying non-pressure NP2 /NP-3class (light duty) R.C.C. pipes with collars jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 cement : 2 fine sand) including testing of joints etc. complete : 1000 mm dia. R.C.C. pipe or above as per SBI/ PMC / Engineer in charge

NON PRESSURE NP-3 CLASS (MEDIUM DUTY)/ NP-4 CLASS (HEAVY DUTY) R.C.C. PIPES

19.19.1 The pipes shall be with reinforcement as required and shall be of class not lesser than NP2. These shall conform to IS 458 and shall be capable of withstanding a test pressure of 0.07 MPa (7 m head). The

reinforced cement concrete pipes shall be manufactured by centrifugal (or spun) process or vibrated casting process. All pipes shall be true to shape, straight, perfectly sound and free from cracks and flaws. The external and internal surface of the pipes shall be smooth and hard. The pipes shall be free from defects resulting from imperfect grading of the aggregate mixing or moulding. Concrete used for the manufacture of reinforced concrete pipes and collars shall be as per design mix. The concrete quality (concrete mix, maximum water-cement ratio, minimum cement content. etc) shall be as per IS 456 for at least very severe environment exposure condition with minimum cement content 260 kg/m^3. The maximum size of aggregate should not exceed one third of the thickness of the pipe or 20 mm whichever is smaller for pipes above 250 mm internal diameter. But for pipes of internal diameter 80 to 250 mm, the maximum size of aggregate should be 10mm. The reinforcement in the reinforced concrete pipes shall extend throughout the length of the pipe. The circumferential and longitudinal reinforcements shall be adequate to withstand the specified hydrostatic pressure and further bending stresses due to the weight of water when running full across a span equal to the length of pipe plus three times its own weight

Laying and Jointing Cement Concrete Pipes and Specials

19.19.2.1 Trenches:

(i) Trenches shall be as described in 18.4.4. Where the pipes are to be bedded directly on soil, the bed shall be suitably rounded to fit the lower part of the pipe, the cost for this operation being included in the rate for laying the pipe itself.

(ii) Loading, transporting and unloading of concrete pipes shall be done with care. Handling shall be such as to avoid impact. Gradual unloading by inclined plane or by chain pulley block is recommended. All pipe sections and connections shall be inspected carefully before being laid. Broken or defective pipes or connections shall not be used. Pipes shall be lowered into the trenches carefully. Mechanical appliances may be used.

Pipes shall be laid true to line and grade as specified. Laying of pipes shall proceed
upgrade of a slope

.

(iii) If the pipes have spigot and socket joints, the socket ends shall face upstream. In the case of pipes with joints to be made with loose collars, the collars shall be slipped on before the next pipe is laid. Adequate and proper expansion joints shall be provided where directed.

(iv) In case where foundation conditions are unusual such as in the proximity of trees or holes, under existing or proposed tracks manholes etc. the pipe shall be encased allaround in 15 cm thick cement concrete 1:5:10 (1 cement : 5 fine sand : 10 graded stone aggregate 40 mm nominal size) or compacted sand or gravel.

(v) In cases where the natural foundation is inadequate the pipes shall be laid either in concrete cradle supported on proper foundations or on any other suitably designed structure. If a concrete cradle bedding is used the depth of concrete below the bottom of the pipe shall be at least 1/4th of the internal dia of the pipe subject to the min. of 10 cm and a maximum of 30 cm. The concrete shall extend up the sides of the pipe at least to a distance of 1/4th of the outside diameter of pipes 300 mm and over in dia. The pipe shall be laid in this concrete bedding before the concrete has set. Pipes laid in trenches in earth shall be bedded evenly and firmly and as far up the haunches of the pipe as to safely transmit the load expected from the backfill through the pipe to the bed. This shall be done either by excavating the bottom of the trench to fit the curve of the pipe or by compacting the earth under around the curve of the pipe to form an even bed. Necessary provision shall be made for joints wherever required.

(vi) When the pipe is laid in a trench in rock hard clay, shale or other hard material the space below the pipe shall be excavated and replaced with an equalising bed of concrete, sand or compacted earth. In no place shall pipe be laid directly on such hard material.

(viii) When the pipes are laid completely above the ground the foundations shall be made even and

sufficiently compacted to support the pipe line without any material settlement. Alternatively the pipe line shall be supported on rigid foundations at intervals. Suitable arrangements shall be made to retain the pipe line in the proper alignment, such as by shaping the top of the supports to fit the lower part of the pipe. The distance between the supports shall in no case exceed the length of the pipe. The pipe shall be supported as far as possible close to the joints. In no case shall the joints come in the centre of the span. Care shall be taken to see that super imposed loads greater than the total load equivalent to the weight of the pipe when running full shall not be permitted. Suitably designed anchor blocks at change of direction and grades for pressure lines shall be provided where required.

19.19.2.2 Jointing:

Joints are generally of rigid type. Where specified flexible type joints may also be provided.

(a) Rigid Spigot and Socket Joint (Fig. 19.10): The spigot of each pipe shall be slipped home well into the socket of the pipe previously laid and adjusted in the correct position. The opening of the joint shall be filled with stiff mixture of cement mortar in the proportion of 1:2 (1 cement: 2 fine sand) which shall be rammed with caulking tool. After a day's work any extraneous material shall be
removed from the inside of the pipe and the newly made joint shall be cured.

(b) Rigid Collar Joint (Fig. 19.10): The two adjoining pipes shall be butted against each other and adjusted in correct position. The collar shall then be slipped over the joint, covering equally both the pipes. The annular space shall be filled with stiff mixture of cement mortar 1:2 (1 cement: 2 fine sand) which shall be rammed with caulking fool. After a day's work any extraneous materials shall be removed from the inside of the pipe and the newly made joint shall be cured.

(c) Semi Flexible Spigot and Socket Joint (Fig. 19.10): The joint is composed of specially shaped spigot and socket ends on the concrete pipes. A rubber ring shal be placed on the spigot which shall be forced into the socket of the pipe previously laid. This compresses the rubber ring as it rolls Into the annular space formed between the two surfaces of the spigot and the socket, stiff mixture
of cement mortar 1:2 (1 cement: 2 fine sand) shall then be filled into the remaining annular space and rammed with a caulking tool. After day's work any extraneous materials shall be removed from the inside of the pipe and the newly made joint shall be cured.

(d) Semi Flexible Collar Joint: This is made up of a loose collar which covers two specially shaped pipe ends as shown in the Fig. 19.10. Each end shall be fitted with a rubber ring which when compressed between the spigot and the collar, seal the joint. Stiff mixture of cement mortar 1:2 (1 cement: 2 fine sand), shall then be filled into the remaining annular space and rammed with a caulking tool. After day's work, any extraneous material shall be removed from the inside of the pip and the newly made joint shall be cured.

(e) Internal Flush Joint (Fig. 19.10): This joint is generally used for culvert pipe of 60 cm dia and over. The ends of the pipe are specially shaped to form a self centering joint with an internal jointing space 1.3 cm wide the finished joint is flush with both inside and outside with the pipe wall .The jointing space is filled with cement mortar 1:2 (1 cement: 2 fine sand) mixed sufficiently dry to remain in position when forced with a trowel or rammer. After day's work, any extraneous material shall be removed from the inside of the pipe and the newly made join shall be cured.

(f) External Flush Joint : This joint is suitable for pipes which are too small for jointing from inside. This joint is composed of specially shaped pipe ends. Each end shall be butted against each other and adjusted in correct position. The jointing space shall the be filled with cement mortar 1:2 (1 cement: 2 fine sand) sufficiently dry and finished off flush. Great care shall be taken to ensure that the projecting ends are not damaged as no repairs can be readily affected from inside the pipe.

In all pressure pipe lines the recess at the end of the pipe line shall be filled with jute braiding dipped in hot bitumen or other suitable approved compound. Pipe shall be so jointed that the bitumen ring of one pipe shall set into the recess of the next pipe. The ring shall be thoroughly compressed by jacking or by any other suitable method. The number of pipes that shall be jacked together at a time shall depend on the diameter of the pipes and the bearing capacity of the soil, for small pipes up to 25 cm diameter, six pipes can be jacked together at a time.

The quantity of jute and bitumen in the ring shall be just sufficient to fill the recess in the pipe when pressed hard by jacking or by any other suitable method. Before and during jacking care shall be taken to see that

there is no offset at the joint.

Testing: For pressure pipes, the completed pipeline shall be tested for pressure (Known as site test pressure) which shall not be less than the maximum pipeline operating pressure plus the calculated surge pressure, but in no case shall it exceed the hydrostatic test pressure. For non pressure pipes the joints shall be tested as per procedure laid down under Para 19.2.1.2 (iv).

19.19.2.5 Refilling of Trenches:

The specification described in 19.2.1.2 (v) shall apply. In case where pipes are not bedded on concrete special care shall be taken in refilling, trenches to prevent the displacement and subsequent settlement at the surface resulting in uneven street surfaces and dangers to foundations etc. The backfilling materials shall be packed by hand under and around the pipe and rammed with a shovel and light tamper. This method of filling will be continued up to the top of pipe. The refilling shall rise evenly on both sides of the pipe and continued up to 60 cm above the top of pipe so as not to disturb the pipe. No tamping shall be done within 15 cm of the top o pipe. The tamping shall become progressively heavier as the depth of the backfill increases.

D:- **Haunching Of Pipes**

Providing and laying cement concrete 1:5:10 (1 cement : 5 coarse sand : 10 graded stone aggregate 40 mm nominal size) up to haunches of NP-2 pipes including bed concrete as per standard design : Concrete bedding with additional concrete at the sides of the pipe.

CHAPTER B

TECHNICAL SPECIFICATIONS - HORTICULTURE WORKS:

1. Scope of work

The work shall in general confirm to the Latest CPWD Specifications for works. Work under this Contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the plumbing and other specialized services as described in DBR, Tender Drawings.

2. **Excavation**

The top excavated soil shall be collected, stacked, preserved for use in landscaping / horticulture works. Surplus top excavated soil may be given to the nurseries or put to use in other Horticulture works.

3. **GRASSING**

a. **Preparation**

i. During period prior to planting the ground shall be maintained free from weeds.

ii. Grading and final leveling of the lawn shall be completed at least three weeks prior to the actual sowing. Clods of excavated earth shall then be broken upto the size not more than 75mm in any direction. The area shall then be flooded with water and after 10 days and within 15 days of flooding, weeds that re-germinate shall be uprooted carefully. The rubbish arising from this operation shall be removed and disposed of in a manner directed by Engineer. Regular watering shall be continued until sowing by dividing the lawn area into portion or approx 5 mts. Square by constructing small bunds to retain water. These 'bunds' shall be level just prior to sowing of grass plants. At the time of actual planting of grass, it shall be ensured that he soil has completely settled.

iii. Slight unevenness, ups and downs and shallow depressions resulting from the settlement of the flooded ground, in drying and from the subsequent weeding operations, shall be removed by fine dressing the surface to the final levels by adding suitable quantities of good earth brought from outside, if necessary as directed by the Engineer. In fine dressing, the soil at the surface and for 40mm depth below shall be broken down to particles of size not exceeding 6mm in any direction.

b. **SOIL**: The soil itself shall be ensured to satisfaction of Engineer to be a good, fibrous loam, rich in humus.

c. **SOWING THE GRASS ROOTS:**

i. Grass roots (Cynodon dectylon or a local approved by the Engineer) shall be obtained from a grass patch, seen and approved beforehand.

ii. The grass roots stock received at site shall be manually cleaned of all weeds and water sprayed over the same after keeping the stock in a place protected from sun and dry winds.

iii. Grass stock received at site may be stored for a maximum of three days. In case grassing for some areas is scheduled for a later date fresh stock of grass roots shall be ordered and obtained.

d. EXECUTION:

i. Small roots shall be debbled about 15 cms apart into the prepared grounds. Dead grass and weeds shall not be planted.

ii. Grass areas will only be accepted as reaching practical completion when germination has proved satisfactory and all weeds have been removed.

iii. All planting is to be done in moderately dry to moist (not wet) soil and at times when wind does not exceed a velocity of 8 kilometer per hours.

e. MAINTENANCE OF LAWN

i. As soon as the grass is approximately an inch high it shall be rolled with a light wooder, roller in fine, dry weather and when it has grown to 2 to 3 inches above the ground, weeds must be removed and regular cutting with the scythe and rolling must be begun. A top dressing of announce of guano to the square yard on well decomposed well broken sludge manure will help on the young grass. The scythe must continue to be used for several months until the grass is sufficiently secure in the ground to bear the mowing machine. It should be possible to use the inch above the normal level of the first two or three cuttings. That is to day the grass should be cut so that it is from 1 to 2 inches in length, instead of the ½ to ¾ of an inch necessary for mature grass.

ii. In absence of rain the lawn shall be watered every ten days heavily, soaking the soil through to a depth of at least 25 cms.

iii. Damage failure or dying back of grass due to neglect of watering especially for seeding out of normal season shall be the responsibility of the Contractor.

iv. Any shrinkage below the specified levels during the contract or defects liability period shall be rectified at the Contractor's expense.

v. The Contractor is to exercise care in the use of rotary cultivator and mowing machines to reduce to a minimum the hazards of flying stones and brickbats. All rotary mowing machines are to be fitted with safety guards.

f. **ROLING**: A light roller shall be used periodically, taking care that the lawn is not too wet and sodden. Rolling should not be resorted to, to correct the levels in case certain depressions are formed due to watering

g. **EDGING**: The Contractor shall establish a neat edge where planting areas meet grass areas with spade or edging tool immediately after all planting, including lawn planting, is completed. Particular care shall be exercised in edging to establish good flowing curves as shown on the plans or as directed by the Engineer. Edging must be cut regularly and shall be maintained by the Contractor.

h. FERTILIZING: The lawn shall be fed once a month with liquid manure prepared by dissolving 45 grams of ammonia sulphate in 5 litres of water.

i. WATERING: Water shall be applied daily during dry weather. Watering whenever done should be thorough and should wet the soil at least upto a depth of 20 cms to eliminate air pockets and settle the soil.

j. WEEDING: Prior to regular mowing the Contractor shall carefully remove rank and unsightly weeds.

4. **MAINTENANCE:** The Contractor shall maintain all planted area within the landscape contract

boundaries until the period of one year after the completion of project. Maintenance shall include replacement of dead plants. Watering, weeding, cultivating, control of insects, fungicide and other disease by means of spraying with an approved insecticide or fungicide, pruning and other horticulture operations necessary for the proper growth of the plants and for keeping the landscape area neat in appearance.

5. **PRUNING & REPAIRS: U**pon completion of planting work on the landscape all trees should be pruned and all injuries repaired where necessary. The amount of pruning shall be limited to the minimum necessary to remove dead or injured twigs and branches and to compensate for the loss of roots and the results of transplanting operations. Pruning shall be done in such a manner as not to change the natural habit or special shape of the trees. In general, one third to one fourth branching structure of the plants to be removed to compensate the loss of roots during transplantation by thinning or shortening branches but no leaders shall be cut. All pruning shall be done with sharp tools in accordance with instructions of the SBI. Pruning cuts shall be painted with recommended paints.

6. DIGGING HOLES FOR PLANTING TREES

In ordinary soil, refilling earth after mixing with manure and Watering.

Holes of circular shape in ordinary soil shall be excavated and excavated soil broken to clods of size not exceeding 75 mm in any direction, shall be stacked outside the hole, stones, brick bats, unsuitable earth and other rubbish, all roots and other undesirable growth met with during excavation shall be separated out and unserviceable material removed from the site as directed. Useful material, if any, shall be stacked properly and separately. Good earth in quantities as required to replace such discarded stuff shall be brought and stacked at site by the Contractor. The tree holes shall be manured with powdered Neam/castor oil cake at the specified rate along with farm yard manure over sludge shall be uniformly mixed with the excavated soil after the manure has been broken down to powder, (size of particle not be exceeded 6 mm in any direction) in the specified proportion, the mixture shall be filled in to the hole up to the level of adjoining ground and then profusely watered and enable the soil to subside the refilled soil shall then be dressed evenly with its surface about 50 to 75 mm below the adjoining ground level or as directed by the SBI/PMC in - charge.

7. FLOODING THE GROUND WITH WATER AND MAKING KIARIES

The water for flooding shall be of soft water and free from chemical and good for growing the trees and shrubs etc. Before flooding the kiaries shall be made in required size and shape as per directions of Officer-in-charge. After uprooting weeds from the trenched area and uprooting vegetation, kiaries shall be dismantled.

8. SPECIFICATIONS OF PLANTS

The plants should be as per following specification.

i. The plants should be full of fresh and healthy foliage.

ii. The plants should be free from insect, pest and disease.

iii. Plant should be healthy and vigorous growth

iv. The height of the plants will be measured from top of the pots.

v. The plants should be well settled and should not be newly shifted.

vi. The plants should be true to the variety and named Variety should be tagged.

vii. Moss stick used should be made on plastic pipe.

viii. Moss stick should be straight and properly fixed in the pot.

ix. The rejected plants materials should be removed from the site immediately.

x. Moss stick should be covered with the plants in case of plants supplied with moss stick.

xi. The Plant should be well established and good spread.

xii. Good earth and manure used for filling the pot/poly bag free from any inert material and mixed to proper ratio.

xiii. Pot/ Poly bag used for filling the plants should be proper size good quality not damaged.

xiv. There should be proper drainage in pots for plants.

xv. The flowering plants should also have proper flowering and should be true to the variety.

xvi. All plant should have the tendency of growth and should not be stunted type.

xvii. There should be no stagnation of water in the pots.

9. **NURSERY STOCK:** Planting should be carried out as soon possible after reaching site. Where planting must, of necessity, be delayed, care should be taken to protect the plants from pilfering or damage from people or animals. Plants with bare roots should be healed in as soon as received or otherwise protected from dying out, and others set closely together and protected from the wind. If planting should be unpacked, the bundles opened up and each group of plants heeled in separately and clearly abeled. If for any reason the surface of the roots becomes dry the roots should be thoroughly soaked before planting.

10. **PROTECTIVE FENCING**: According to local environment shrubs may have to be protected adequately from vandalism until established.

11. **COMPLETION:** On completion the ground should be formed over and left tidy.

GENERAL SPECIFICATIONS FOR HORTICULTURE WORKS

1.0 HORTICULTURE WORK

Horticultural operations shall be started on ground previously levelled and dressed to required formation levels and slopes. In case where unsuitable soil is met with, it shall be either removed or, replaced or it shall be covered over to a thickness decided by the SBI/ PMC / Engineer in charge with good earth. In the course of excavation or trenching during horticultural operations, any walls, foundations, etc. met with shall not be dismantled without pre-measurement and prior to the written permission of the SBI/ PMC / Engineer in charge.

1.1 **TRENCHING IN ORDINARY SOIL**

1.1.0 Trenching is done in order to loosen the soil, turn over the top layer containing weeds etc. and to bring up the lower layer of good earth to form a proper medium for grassing, regrassing, hedging and shrubbery. Trenching shall be done to the depth ordered by the Engineer-incharge. The depth is generally 30 cm for grassing and 60 cm for regrassing in good soil.

1.1.1 The trenched ground shall, after rough dress, be flooded with water by making small kiaries to enable the soil to settle down. Any local depression unevenness etc. shall be made good by dressing and/or filling with good soil.

1.1.2 Weeds or other vegetation which appear on the ground are then uprooted and removed and disposed off and paid.

1.1.3 Trenching

Trenching shall consist of the following operations:

1. The whole plot shall be divided into narrow rectangular strips of about 1.5 m width or as directed by the SBI/ PMC / Engineer in charge.

2. These strips shall be sub-divided lengthwise into about 1 m long sections. Such sections shall be excavated serially and excavated soil deposited in the adjacent section preceding it.

3. In excavating and depositing care shall be taken that the top soil with all previous plant growth including roots, get buried in the bottom layer of trenched area, the dead plants so buried incidentally being formed into humus.
4. The excavated soil shall be straight away dumped into the adjoining sections so that double handling otherwise involved in dumping the excavated stuff outside and in back filling in the trenches with leads is practically eliminated.

1.2 **GOOD EARTH**
1.2.1 The earth shall be stacked at site in stacks not less than 50 cm high and of volume not less than 3.0 cum.
1.2.2 Measurements: Length, breadth and height of stacks shall be measured correct to a cm. The volume of the stacks shall be reduced by 20% for voids before payment, unless otherwise described.
1.2.3 Rate: The rate shall include the cost of excavating the earth from areas lying at distance not exceeding one km. from the site, transporting the same at site breaking of clods and stacking at places indicated. The rate shall also include royalty if payable.
OIL CAKE
Neem/Castor: The cake shall be free from grit and any other foreign matter. It should be undecorticated and pulverized. The material shall be packed in old serviceable gunny bags of 50 kgs capacity approximately. The weight of gunny bag shall be deducted @1 kg per bag and payment shall be made for net quantity. The quality of cake should be got approved by the SBI/ PMC / Engineer in charge before supply.
Measurements
The arrangement for weighing shall be made at site of work by the department. The gunny bags shall be the property of the government.
Rate: The rate shall include the cost of labour and material involved in all operations described above, including carriage up to site of work with all lead and lifts, weighing etc.
1.3 SUPPLY AND STACKING OF SLUDGE
1.3.1 It shall be transported to the site in lorries with efficient arrangement to prevent spilling enroute. It shall be stacked at site. Each stack shall not be less than 50 cm height and volume not less than 3 cum.

1.4 ROUGH DRESSING OF THE TRENCHED GROUND

1.4.0 Rough dressing of the area shall include making kiaries for flooding.
1.4.1 The trenched ground shall be levelled and rough dressed and if there are any hollows and depressions resulting from subsidence which cannot be so levelled, these shall be filled properly with earth brought from outside to bring the depressed surface to the level of the adjoining land and to remove discontinuity of slope and then rough dressed again. In rough dressing, the soil at the surface and for 75 mm depth below shall be broken down to particle size not more than 10 mm in any direction.

1.5 UPROOTING WEEDS FROM TRENCHED AREAS

1.5.1 After 10 days and within 15 days of flooding the rough dressed trenched ground with water, the weeds appearing on the ground shall be rooted out carefully and the rubbish disposed off as directed by the SBI/ PMC / Engineer in charge.
1.6 FINE DRESSING THE GROUND
1.6.1 Slight unevenness, ups, and downs and shallow depressions resulting from the settlement of the flooded ground, in drying and from the subsequent weeding operations, shall be removed by fine dressing the surface to the formation levels of the adjoining land as directed by the SBI/ PMC / Engineer in charge, and by adding suitable quantities of good earth brought from outside, if necessary.

1.7 SPREADING GOOD EARTH
1.7.1 Good earth shall be removed from stacks by head load and spread evenly over the surface to the thickness

ordered by the SBI/ PMC / Engineer in charge. It shall be spread with a twisting motion to avoid segregation and to ensure that spreading is uniform over the entire area.
1.7.2 Measurements: The quantity of good earth spread shall be determined by the difference in the volume of good earth in stacks before and after spreading duly reduced for looseness in stacking by 20% of good earth.
1.7.3 Rate: The rate shall include of all the labour and material involved in all the operations described above, but does not include the cost of the good.

1.7.A SPREADING SLUDGE/MANURE
1.7.A.1 Good earth shall be thoroughly mixed with sludge or manure in specified proportion as described in the item or as directed by the SBI/ PMC / Engineer in charge. The mixing shall be spread as described in 1.8.1 to the thickness ordered by the SBI/ PMC / Engineer in charge.
1.7.A.2 Measurements
The quantity of good earth and sludge or manure mixed shall be determined by the difference in the volume of good earth and sludge or manure in stack, before and after spreading duly accounted for voids and looseness in stack.
1.7.A.3 Rate
The rate shall include of all the labour and material involved in all the operations described above.
1.8 MIXING OF GOOD EARTH AND SLUDGE/MANURE
1.8.1 The stacked earth shall, before mixing be broken down top particle of sizes not exceeding 6 mm in any direction. Good earth shall be thoroughly mixed with sludge or manure in specified proportion as described in the item or as directed by the SBI/ PMC / Engineer in charge.

1.**9 GRASSING WITH SELECT GRASS NO. 1**
1.9.0 The area from where the grass roots are to be obtained shall be specified by the Engineerin- Charge at the time of execution of the work and no royalty shall be charged on this account from the contractor. Grass is to be arranged by contractor.
The soil shall be suitably moistened and then the operation of planting grass shall be commenced. The grass shall be dibbled at 10 cm, 7.5 cm, 5 cm apart in any direction or other spacing as described in the item. Dead grass and weeded shall not be planted. The contractor shall be responsible for watering and maintenance of levels and the lawn for 30 days or till the grass forms a thick lawn free from weeded and fit for moving whichever is later. Generally planting in other direction at 15 cm, 10 cm, spacing is done in the case of large open spaces, at 7.5 cm spacing in residential lawn and at 5cm spacing for Tennis Court and sports ground lawn. Rates are including cost of labour.
During the maintenance period, any irregularities arising in ground levels due to watering or due to trampling by labour, or due to cattle straying thereon, shall be constantly made up to the proper levels with earth as available or brought from outside as necessary, Constant watch shall be maintained to ensure that dead patches are replanted and weeds are removed.

1.10 RENOVATION OF LAWNS
1.10.1 The area shall be first weeded out of all undesirable growth. The entire grass shall be scrapped (cheeled) without damaging roots and level of the grounds. Slight irregularities in surface shall be levelled off and the area shall then be forked so as to aerate the roots of the grass without, however uprooting them.
Specified quantity of sludge or manure shall than be spread uniformly with wooden straight edge (phatti) as directed by the SBI/ PMC / Engineer in charge. The area shall then be slightly sprinkled with water so as to facilitate proper integration of the manure or sludge with the soil and later flooded. The contractor shall be responsible for watering, proper maintenance and tending of the lawn for 30 days or till the grass forms a lawn fit for mowing, whichever is later. During the above operations, all undesirable growths shall be constantly weeded out and all rubbish removed and disposed off as directed by the SBI/ PMC / Engineer in charge.
1.11 UPROOTING RANK VEGETATION AND WEEDS AND PREPARING THE GROUND FOR PLANTING 'SELECT GRASS NO. 1'

1.11.1 Initially the area shall be dug up to a depth of 30 cm. and weeds and rank vegetarian with roots removed thereon by repeated forking. The whole area then shall be retrenched to a depth of 60 cm in the same manner as described in 2.1. Clods of excavated earth shall then be broken upto the size not more than 75 mm in any direction. The area shall then be flooded with water and after 10 days and within 15 days of flooding, weeds shall be uprooted carefully. The rubbish arising from the above operations shall be removed and disposed off in a manner directed by the SBI/ PMC / Engineer in charge, away from the site. The earth shall then be rough dressed and fine dressed as described in 2.6 & 2.8.

1.12 **EXCAVATION AND TRENCHING FOR PREPARATION OF BEDS FOR HEDGE AND SHRUBBERY**

1.12.1 Beds for hedges and shrubbery are generally prepared to width of 60 cm. to 125 cm. and 2 to 4 meters respectively.

1.12.2 Beds for hedges and shrubbery shall be prepared in the following manner. The beds shall first be excavated to a depth of 60 cm. and the excavated soil shall be stacked on the sides of the beds. The surface of the excavated bed shall then be trenched to a further depth of 30 cm, in order to loosen the soil, in the manner described in 2.1. No flooding will be done at this stage but the top surface shall be rough dressed and levelled. The excavated soil from the top 60 cm depth of the bed stacked at the site shall then be thoroughly mixed with sludge over manner in the proportion 8:1 by ratio or other proportion described in the item. The mixed earth and manure shall be refilled over the trenched bed, levelled neatly and profusely flooded so that the water reaches even the bottom most layers of the trenched depth of the bed. The surface after full subsidence shall again be refilled with the earth and manure mixture, watered and allowed to settle and finally fine dressed to the level of 50 mm to 75 mm below the adjoining ground or as directed by the SBI/ PMC / Engineer in charge. Surplus earth if any, shall be disposed off as directed by the SBI/ PMC / Engineer in charge. Any surplus earth if removed beyond initially lead. Stones, bricks bats and other foreign matter if met with during excavation or trenching shall be removed and stacked within initially lead & lift, such material as is declared unserviceable by the SBI/ PMC / Engineer in charge shall be disposed by spreading and levelling at places ordered by him. If disposed outside the initial lead & lift, then the transport for the extra leads. If a large proportion of material unsuitable for the hedging and shrubbery operations is met with and earth from outsides is required to be brought in for mixing with manure and filling, the supply and stacking of such earth.

1.13 **DIGGING HOLES FOR PLANTING TREES**

1.13.1 In ordinary soil, including refilling earth after mixing with oil cake, manure and watering.

1.13.1.1 Holes of circular shape in ordinary soil shall be excavated to the dimensions described in the items and excavate soil broken to clods of size not exceeding 75 mm in any direction, shall be stacked outside the hole, stones, brick bats, unsuitable earth and other rubbish, all roots and other undesirable growth met with during excavation shall be separated out and unserviceable material removed from the size as directed. Useful material, if any, shall be stacked properly and separately. Good earth in quantities as required to replace such discarded stuff shall be brought and stacked at site by the contractor. The tree holes shall be manured with powdered Neam/castor oil cake at the specified rate along with farm yard manure over sludge shall be uniformly mixed with the excavated soil after the manure has been broken down to powder, (size of particle not be exceeded 6 mm in any direction) in the specified proportion, the mixture shall be filled in to the hole up to the level of adjoining ground and then profusely watered and enable the soil to subside the refilled soil shall then be dressed evenly with its surface about 50 to 75 mm below the adjoining ground level or as directed by the SBI/ PMC / Engineer in charge.

1.13.2 In Soil other than Ordinary Soil

1.13.2.1 Where holes are dug in (a) Hard soil (b) Ordinary rock or (c) Hard rock, the above soils occurring independently over in conjunction with each other and /or ordinary soil in any hole, the different excavated soil shall be stacked separately. Excavation in hard rock shall be carried out by chiseling only.

1.13.2.2 The stack measurement of ordinary rock and hard rock shall be reduced by 50% and of soil by 20% to arrive at the excavated volume. This excavation shall bfor holes dug in ordinary soil above, at rate appropriate to particular soil concerned.

1.13.2.3 Sufficient quantity of good soil to replace the solid volume of stones, brick bats, unsuitable earth and other rubbish, all roots and other undesirable growth, ordinary and hard stacks shall be brought and stacked at site.

1.13.2.4 The useless excavated stuff shall be disposed off by spreading at places as ordered by the SBI/ PMC / Engineer in charge. If such places are outside initially leads, carriaged.
1.13.2.5 The ordinary soil excavated from the hole and the earth brought from outside shall then be mixed with manure screened through sieve of IS designation 16 mm in the proportion specified in the description of the item and filled with the pit and the same watered and finally dressed.

(a) cost of manure over sludge
(b) cost of supplying and stacking of good earth for replacement and
(c) the cost of carriage beyond initial lead for disposing off useless materials. The excavation other than that of ordinary soil.

1.14 **M.S. FLAT IRON TREE GUARD**

1.14.1 M.S. Iron Riveted Tree Guard
1.14.1.1 The tree guard shall be 600 mm in diameter and 2 meter high above ground level and 25 cm in below ground level.
1.14.1.2 The tree guard shall be framed of 4 nos. 25 x 6 m M.S. flat 2 meter long excluding displayed outward at lower and upto an extent 10 cm and 8 nos. 25 x 3 mm vertical M.S. Flat Rivetted to 3 Nos. 25 x 6 mm Flat iron rings in two halves, bolted together 8 mm dia and 30 mm long M.S. bolts and nuts. The entire tree guard shall be given two coats of synthetic enamel paint of approved brand and manufacturer of required shade over a priming coat of ready mixed steel primer of approved brand and manufacturer. The design of tree guards shall be shown in the drawing.
1.14.2 M.S. Flat Iron Welded Tree Guard
1.14.2.1 The tree guard shall be 600 mm in diameter and 2 meter high above ground level and 25 cm in below ground level.
1.14.2.2 The tree guard shall be framed of 4 nos. 25 x 6 mm MS. Flat 2 metres long excluding displayed outward at lower and upto an extent 10 cm and 8 Nos. 25 x 3 mm vertical M.S. Flat Riveted to 3 nos. 25 x 6 mm flat iron rings in two halves, bolted together 8 mm dia and 30 mm long M.S. Bolts & nuts. The entire tree guard shall be given two coats of synthetic enamel paint of approved brand and manufacturer of required shade brand and manufacturer of required shade over a priming coat of ready mixed steel primer of approved brand and manufacturer. The design of tree guards shall be shown in the drawing.
1.15 FILLING MIXTURE OF EARTH & SLUDGE OVER MANURE
1.15.0 The separately specified earth and sludge shall be broken down to particles of size not exceeding 6 mm in any directions before mixing. Good earth shall be thoroughly mixed with sludge over manure in specified proportions as directed by Officer-in-Charge. During the process of preparing the mixture as above, trenches shall be flooded with water and levelled.

1.16 **EXCAVATION OF DUMPED STONE OR MALBA**

1.16.1 Excavation operations shall include excavation and getting out water if required. During the excavation

stone, brick bats and other foreign material if met shall be removed and stacked within 50meter leads and lifts. Such material as is declared unserviceable by the Engineer -in- Charge be disposed within 50 m. The excavated surface shall be neatly dressed and levelled.

1.17 EXCAVATION IN BAJRI PATH
1.17.1 All excavated operations shall include excavation and stacking of serviceable and unserviceable material. Excavated surface of Bajri path shall be removed and stacked upto 50 meter lead and disposed material neatly dressed.
1.18 EXCAVATION OF WATER BOUND MACADAM
1.18.1 All excavated operations shall include excavation, stacking of serviceable and unserviceable material. Excavation shall be straight and uniform in width. Soling stone and aggregate obtained from excavation of W.B.M. shall be stacked separately and unserviceable material disposed off with lead upto 50 meter and lift upto 1.50 meter and neatly dressed.

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1.19 **FLOODING THE GROUND WITH WATER AND MAKING KIARIES**
1.19.1 The water for flooding shall be of soft water and free from chemical and good for growing the trees and shrubs etc. Before flooding the kiaries shall be made in required size and shape as per directions of Officer-in-charge. After uprooting weeds from the trenched area and uprooting vegetation, kiaries shall be dismantled.
1.20 CLEANING AND SWEEPING OF LAWN
The Cleaning of Garden shall cover to proper sweeping work including removing litter, debries, picking of leaves, papers, plastic bottles etc. & disposal of collected waste in dustbin/designated place as decided by officer in charge.

1.21 REMOVAL OF GARDEN WASTE
Removal of garden waste by TATA 407 or equivalent including loading/unloading and carriage up to 1 km lead, complete disposal at designated place decided by officer in charge.

1.21.1 Measurements
Measurement shall be made per Trip.

1.21.2 RATE
The rate shall be for per Trip basic and include the cost of all the labour and material & TATA 407 or Equivalent involved in all the operations described above.

1.22 PRUNING, TRIMMING, SHAPING OF TREES
Pruning, trimming, shaping of trees/shrubs (ht 15 feet and above) i/c removal of cut materials up to 50mt. lead and as per direction of officer in charge.(i/c necessary T&P shall be arranged by the contractor. Pruning, trimming, shaping of trees/ shrubs shall be done as per direction of officer incharge.

SPECIFICATIONS OF PLANTS
The plants included under Sub Head 3 to 10 should be as per following specification.
1. The plants should be full of fresh and healthy foliage.
2. The plants should be free from insect, pest and diseases.
3. Plant should be well developed and healthy.
4. The height of the plants will be measured from top of the pots.
5. The plants should be well settled and should not be newly shifted/Transplanted.
6. The plants should be true to the variety and Variety name should be tagged.
7. Moss stick used should be made on plastic pipe.

8. Moss stick should be straight and properly fixed in the pot.
9. The rejected plants materials should be removed from the site immediately.
10. Moss stick should be covered with the plants in case of plants supplied with moss stick.
11. The Plant should be well stablished and should have good foliage.
12. Good earth and manure used for filling the pot/poly bag should be free from any inert materialand mixed to proper ratio.
13. Pot/ Poly bag used for filling the plants should be of proper size.
14. There should be proper drainage in pots for plants.
15. The flowering plants should also have proper flowering and should be true to the variety.
16. All plant should have the tendency of growth and should not be stunted or deshaped.
17. There should be no stagnation of water in the pots.
18. Plant should not have any physiological disorder.
19. Tips of the Plants should have intact, there should not be any damages etc.
20. In case of flowering pots flower should be on bud stage/semi bloom stage.
21. In case of potted plant pots should have uniformity/same size and quality.
22. Plants of bigger height should be properly supported/stacked by bamboo stick.
23. Pots/Polybags soil should not be infectious and plant should have free from all kind of diseases.
24. Bulbs, seeds, seedling, suckers should properly treated with fungicides before supply.

All Horticulture works including materials shall be done in accordance with the provisions of CPWD/NBC of relevant codes.

Pre-construction measures of prevention of soil erosion, management of storm water, preservation of existing vegetation, top soil removal and preservation of utilizing its rich organic content by stripping the top soil to a depth of 200 mm from area proposed to be occupied by buildings roads, pavement etc. shall be taken.

In the case the soil is unsuitable for horticulture the same shall be substituted or covered over to the required level with suitable soil.

LIST OF APPROVED MAKES LIST OF APPROVED MAKES OF CIVIL WORKS

SN	Material Description	Brand	Preferred Material/ Make
1	Anti-termite treatment contractor	PECOPP, HI-CARE, Pest Control India Ltd., Godrej Pest Control, Bayer India Ltd.	
2	Ordinary Portland (43 grade) and Portland Pozzolana	ACC	ACC Ltd
		UltraTech	UltraTech Cement Ltd.

	Cement	Birla	Birla Corporation Ltd.
		J. K. Cement	J.K. Cement Pvt. Ltd.
		Lafarge	Lafarge India Pvt. Ltd
3	Damp Proof material	MAPEI	MAPEI Construction Products India
		Duraseal	Apurva India Pvt. Ltd.
		Dr. Fixit	Pidilite Industries
		Fosroc	Fosroc Chemicals India Pvt. Ltd.
		Nerolac Perma	Kansai Nerolac Paints Ltd.
		CICO	CICO Industries
		Technonicol	Technonicol
		SIKA	Sika India Pvt. Ltd
		MYK	MYK Arments range of products
		PIDILITE	Pidilite Industries Ltd.
4	TMT bars Fe-500D	SAIL	Steel Authority of India Ltd.
		TISCO	TATA STEEL Ltd
		RINL	Rastriya Ispat Nigam Ltd.
		JSW	JSW Steel Ltd
5	Plasticiser & Super Plasticiser	Contrament, Power flow	MC Bauchemie (India) Pvt. Ltd
		MYK Schomburg	MYK Arments range of products
		Plastiment, Sikament	Sika Inida Pvt Ltd.,
		Conplast SP430	FOSROC India
		Chryso-HP / Delta/ Optima	Chryso India Pvt. Ltd.,
		BASF	BASF India Ltd
		Technonicol	Technonicol
		Nerolac Perma	Kansai Nerolac Paints Ltd.
		CICO	CICO Industries
		Asian Smart care	Asian Paints Ltd
6	Post tensioning System	VSL	VSL India Pvt Ltd.
		Ultracon	Ultracon Structural Systems Pvt Ltd
		Tech9	Tech9 Engineering pvt ltd.
7	PT Strands	DP wires	D.P Wires Ltd.
		TATA wires	TATA Steel Ltd.,
8	Adhesive	Usha Martin	Usha Martin Ltd
		Dunlop	India Tyre & Rubber Co (India) Ltd.
		Sika	Sika India Pvt. Ltd
		Fevicol	Pidilite Industries
		CICO	CICO Industries
		VURA	Vura Bau- Chemie LLP
		MYK	MYK Arments range of products
		Mapei	Mapei Construction Products Pvt Ltd
		Proofex of adhesive	FOSROC India Ltd
		Ardex	Ardex Endura Adhesive India Pvt.Ltd
		Ferrous Crete	Ferrous Crete (India) Pvt. Ltd.
		LATA POXY	MYK LATICRETE India Pvt. Ltd
		Nerolac Perma	Kansai Nerolac PaintsLtd.
		Fosroc GP2	Fosroc India Ltd.
		MYK	MYK Arments range of products

9	Grout	VURA	Vura Bau- Chemie LLP
		Dr. Fixit	Pidilite Industries
		Weber	Saint-Gobin India Pvt. Ltd
		Mapei	Mapei Construction Products Pvt Ltd
		AsianSmartcare	Asian Paints Ltd
10	Ready Mix Concrete	Ultra Tech	Ultra Tech Concrete Ltd
		Lafarge	Lafarge India Pvt. Ltd
		Ferrous Crete	Ferrous Crete (India) Pvt. Ltd.

11	AAC Blocks	Xtralite	ULTRATECH Cement Ltd
		Max blocks	Max Blocks Industries Ltd.
		Siporex	SIPOREX
		Ferrous Crete	Ferrous Crete (India) Pvt. Ltd.
		Ecolite	JVS Comats co Industries Pvt. Ltd.
		Biltech	Biltech Building Elements Ltd
12	Wooden Flush door shutters (ISI Mark Only)	Green lam	Green lam Ply Industries Ltd.
		Durian	Durian Industries Ltd.
		Merino	Merino laminates
		Duro	Duroply Industries Ltd.
		Century	Century
13	Commercial ply, Fire retardant ply and Block boards, Waterproof Plywood	Green Ply	Green ply Industires Ltd.
		Durian	Durian Industries Ltd.
		Merino	Merino laminates
		Century ply	Century Flush Doors
		Samrat	Samrat
14	Laminate	Merino	Merinolaminates
		Century ply	Century Flush Doors
		Greenlam Laminates	GreenlamIndustries
		Durian	Durian Industries Ltd.
15	High Density (HDF) Pre laminated board	Pergo	Red Floor India
		GreenPly	Green Ply Industries Ltd.
		Century ply	Century Flush Doors
17	Gypsum Board	Gyproc Saint Gobain	Saint Gobain Gyprock India Ltd.,
		Knauf	Knauf India (P) Ltd.
		Armstrong	Armstrong wold Industries
18	Glass door hardware	Dorma	Dorma India Pvt. Ltd
		Hafele	Hafele India Pvt. Ltd
		Hettich	Hettich India Pvt. Ltd
		Geze	Geze GMbH
		Ozone	Ozone
19	Hydraulic door closers/	Dorma	Dorma India Pvt. Ltd
		Hafele	Hafele India Pvt. Ltd
		Hettich	Hettich India Pvt. Ltd

	Floor springs	Geze	Geze GMbH
		Ozone	Ozone
20	Locks & Latches	Dorma	Dormakaba India Pvt Ltd
		Hafele	Hafele India Pvt. Ltd
		Geze	Geze GMbH
		Hettich	Hettich India Pvt.Ltd
21	Metal Fire Rated Doors	Vetrotech	Saint Gobain India Pvt. Ltd.
		Navair	Navair International Pvt. Ltd
		Acodor	Koleshwari Pvt Ltd
22	Fire Smoke Seal	Hormann	Shakthi Hormann Pvt Ltd,
		Dorma	Dorma India Pvt. Ltd
		Athmer	Athmer
		Raven	Raven Global
23	Fire rated hardware	Dorma	Dorma India Pvt. Ltd
		Becker	Becker
		Geze	Geze GMbH
		ASSA ABLOY	ASSA ABLOYIndia Pvt. Ltd
		ASES	ASES Industries
24	Panic Bar	Dorma	Dorma India Pvt. Ltd
		Becker	Becker
		Geze	Geze GMbH
25	Nonmetallic Fire Door	Tata Pravesh	Tata Steel Ltd
		Promat	Promat fire& Insulation (P) Ltd.
		Godrej	Godrej Security solutions
		Sukri	Sukri Multipurpose Doors
26	Butt Hinges openable window shutters	Hafele	Hafele India Pvt. Ltd
		Assa Abloy	ASSA ABLOY India (P) Ltd.
		Dorma	Dormakaba India Pvt. Ltd
		Ozone	Ozone
		Williams	Williams Architectural
27	Multipurpose Metal Doors	Sukri	Sukri Multipurpose Doors
		Tata Pravesh	Tata Pvt Ltd,
		Signum	Signum Fire Protection
		Synergy	Synergy Thrislington Product Ltd.
28	Lead Line doors	Sukri	Sukri Multipurpose Doors
		Dorma	Dormakab India Pvt Ltd
		Navair	NavairInternationalPvt. Ltd
		Geze	Geze GMbH
29	Stainless Steel Butt hinges	Williams	Williams Architectural
		Geze	Geze GMbH
		Ozone	Ozone
		Dorma	Dormakaba India Pvt Ltd
30	Concealed tower bolt	Dorma	Dormakaba India Pvt Ltd
		Ingersolrand	Ingersolrand (India) Ltd,
		Assa Abloy	ASSA ABLOY India (P) Ltd.
		Williams	Williams Architectural
		Ozone	Ozone
		Alu Alpha	Alu Alpha India
		Dorma	Dormakaba India Pvt Ltd
		Williams	Williams Architectural

31	Hardware	Ozone	Ozone
		Geze	Geze GMbH
		Assa Abloy	ASSA ABLOY India (P) Ltd.
		Hettich	HettichIndiaPvt.Ltd
32	UPVC doors/window and Frames	Fenesta	Fenesta Building Systems
		Kommerling	Kommerling
		Veka	NCL Building Systems
		Winkcraft	RM PPL.
		Encraft	Encraft India Pvt. Ltd.
33	Float Glass	Saint Gobain,	Saint Gobain India Pvt .Ltd. ,
		AIS Asahi	Asahi India glass. Ltd.
		Pilkinton	Pilkinton India Pvt .Ltd.
		Modi guard	Gujarat Guardian Ltd.
34	Reflective Glass/ Smart Glass	Saint Gobain,	Saint Gobain India Pvt .Ltd. ,
		Asahi	Asahi India glass .Ltd.
		Pilkinton	Pilkinton India
		Modifloat Guardian	Gujarat Guardian Ltd.
35	Tempered reflective/clear glass	Saint Gobain,	Saint GobainIndiaPvt .Ltd.
		Asahi	Asahi India glass Ltd,
		Modiguard	Gujarat Guardian Ltd.
36	Fire rated Glass	Asahi	Asahi India Ltd.
		Pyro gaurd	Pyro gaurd
		Schott	Schott glass India Pvt .Ltd.
		Saint Gobain	Saint Gobain India Pvt .Ltd.
37	Dash Fasteners	Hilti	Hilti India Pvt .Ltd.
		Fischer	Fischer India
		Klimas	KlimasPvt .Ltd.
		Rawplug	Rawplug India
		Helfen	HelfenGmbh
38	Structural Steel	SAIL	SAIL
		TISCO	TATA STEEL
		JSW	JSW
39	MS Pipe, Tubes	SAIL	SAIL
		TISCO	TATA STEEL
		JINDAL	Jindal Pipes Limited
40	Stainless steel railing	Dorma	Dormakaba India Pvt Ltd
		Koncept	Konceptsteel Pvt. Ltd.
		Kich	Kich Architectural Products Pvt. Ltd.
		Williams	Williams Architectural
41	Vitrified Tiles/Anti-skid mat finish tiles (Double charged)	Johnson	JohnsonIndia Ltd
		NITCO	NITCO Ltd
		Kajaria	Kajaria Ceramic Ltd

42	Glazed Vitrified tiles (also wall tiles)	Johnson	Johnson India Ltd
		NITCO	NITCO Ltd
		Kajaria	Kajaria Ceramic Ltd
43	Floor spring (for non DSR Items)	Assa Abloy	ASSA ABLOY India (P) Ltd.
		Dorma	Dormakaba India Pvt Ltd
		Ozone	Ozone
		Geze	Geze
		Williams	Williams Architectural
44	Synthetic Carpet Tiles	Armstrong	Armstrong world Industries India Ltd.
		Modulyss	Beaulieu International Group
		Floor Master	Consolidated Carpet Industries Ltd.
		NLF	NLF Industries
		JCC	Japan Carpet Company
45	Vitrified paving tiles	PAVIT	PAVIT ceramics Pvt Ltd. or Equivalent
		Kajaria	Kajaria Ceramic Ltd
		Nitco	NITCO Ltd
46	Glass mosaic tiles	Italia	Tile Italia mosaics Pvt Ltd.
		Coral	Coral tiles
		Palladio	Palladio Mosaics
		Bisazza	Bisazza Italy
		Sicis	Sicis
		JK White	JK Cement ltd.
		PAVIT (Eco Tile)	PAVIT Ceramics Pvt Ltd.
47	Thermal Insulation treatment	Pidilite	Pidilite industries
		Asian	Asian Paints Ltd
		Texsa	Texsa India Ltd
		Nerolac Perma	Kansai Nerolac PaintsLtd.
		Elastospray	BASF
		Knauf	Knauf India (P) Ltd.
48	Acoustic Insulation	Saint Gobain Gyproc	Saint Gobain Gyproc India
		Armstrong	Armstrong world Industries India Ltd.
		NLF	NLF Industries
		Himalaya	Himalaya Acoustics Ltd.
		TRANQUIL	Tranquil Pvt Ltd
		Texsa	Texsa India Ltd
		Anutone	Anutone Pvt Ltd
49	UPVC Pipes and fittings (Rain water pipes)	Supreme	Superme Industries Ltd.
		Prince	Prince
		Astral	Astral polytechnik Ltd.
50	Self-supported standing seam Non-Insulated Roofing System	Kingzip	Kingspan Jindal Pvt Ltd
		NLF	NLF Solution Pvt Ltd
		Sanko	SANKO METAL INDUSTRIAL
51	Polycarbonate Sheet	DPI (FLUX)	DPI Daylighting Pvt Ltd
		Polygal	PlazitPolygal
		Bayer	Bayer Macrolon
		Danpalon	Danpal Pvt Ltd

		Coxwell	Coxwell Pvt Ltd
		Tuflite	Tuflite Polymers Ltd
52	False Ceilings (Mineral Fibre Board)	Aerolite	Andhra Polimers Pvt. Ltd.
		Anutone	AnutoneAccoustics Ltd.
		Knauf Ceiling	Knauf Ceiling solution.
		Hunter Dougals	Hunter Dougals
		Armstrong	Armstrong
		Saint Gobain Gyproc	Saint Gobain Gyproc India
53	Synthetic Enamel Paint and Primers	Premium gloss enamel	Asian paint Ltd
		Dulux	ICI Dulux Ltd
		Nerolac	Nerolac Paints Ltd
		Asian Paints	Asian Paints
		Berger	Berger Paints India Ltd.
54	Acrylic Distemper	Tractor Aqalock	Asian Paints
		Dulux (Maxilite)	Dulux
		mGPolyplast	Nerolac
		Berger (Bisom)	Berger paints India Ltd.
55	Acrylic Emulsion	Premium emulsion	Asian Paint
		Dulux (Super Cover)	ICI Dulux
		Nerolac (Beauty Gold)	Nerolac
		Berger (BISM)	Berger paints India Ltd.
56	Textured Elastomeric Exterior Paint	Dulux	ICI Dulux
		Apex	Asian Paints
		Nerolac	Nerolac
		Ultratech	Ultratech paints India Ltd.
57	Premium Acrylic smooth exterior paint with silicon additives	ULTIMA	Asian paint
		Dulux	ICI dulux
		Nerolac	Nerolac
		Berger	Berger paints India Ltd.
58	Cement based wall putty	J.K.wall putty	J.K. Cement Ltd.
		Birla wall care	Birla Cements Ltd.,
		Knauf	Knauf India (P) Ltd.
		Asian paints	Asian paints Ltd
		Western	Western Infrabuild Products LLP.
59	Multiwet Synthetic Plaster	Spectrum paints	Spectrum paints Ltd.
		Ferrous crete	Ferrouscrete
		Heritage	Heritage Rajkamal Group
		Asian paints	Asian paints
60	Gypsum Plaster	Gyproc Plasters	Saint Gobain Gyproc India
		Ultra tech	Ultra tech Cement Ltd.
		Knauf	Knauf India (P) Ltd.
		Ferrous Crete	Ferrouscrete
		Western	Western Infrabuild Products LLP.
		Lafarge	Lafarge Holcim
61	Melamine Polish, Piu, Wood Coatings	Asian paints	Asian paints
		Melamine Gold wudfin	Pidilite industries
		Premium coatings	Premium Coatings & Chemicals Pvt
		Ital Coats	Ital Coats
		Sirca	SirColor Wood Coatings Pvt Ltd
		Kupsa	Kupsa Coatings Pvt Ltd
		Nerolac	Kansai NerolacPaintsLtd.

62	Fire Retardant Paint	Hilti	Hilti India
		Akzonobel	DuluxAkzonobel Paints
		Nerolac	Kansai NerolacPaintsLtd.
		Asian Paints	Asian Paints
63	Epoxy Tile Joint Grouts	BASF	BASF India Ltd.
		Fosroc	Fosroc India
		Laticrete	MYK Laticrete India
		Ardex Endura	Ardex Endura India Pvt. Ltd
		VURA	Vura Bau- Chemie LLP
64	Silicon coating	Dow corning	Dow corning India
		BASF	BASF India Ltd.
		GE	GE Silicones
		Wacker	Wacker silicones.
65	Interlocking Concrete Paver Blocks	Ultra	Ultra tiles Pvt Ltd.
		Hitech	Hitech Concrete Products
		NITCO (ROCKARD)	NITCO
		Dalal	Dalal Tiles
66	Solar studs/Median markers	3M	3M Science
		Avery Dennison	Avery Dennison India Pvt Ltd.
		Nikkalite	Nippon carbideIndustires (USA)
67	Polycarbonate Convex Mirrors, Rubberised road hump	Unique safety solutions or Equivalent	Unique safety solutions or Equivalent
68	Mirror	Modi Guard	Gujarat Guardian Ltd.
		Saint Gobain	Saint Gobain Glass India Ltd.,
		AIS mirror	Asahi India glass Ltd,
		Atul	Atul glass Industries Ltd.,
69	Plastic Encapsulated Footrest	KK	KK Manhole and gratings Co Pvt Ltd.
		KGM	KGM Exports.
		Accurate Buildcon	Accurate Buildcon company.
70	Spun cast iron covers & gratings	Neco	JayaswalNeco Ltd
		Jagannath	Sri Jagannath Iron Foundry Pvt.Ltd.
		Kapilansh Centrifugal	Kapilansh Dhatu Udyog(P)Ltd.
		SKF brand	SINGHALIRON FOUNDARY Pvt.Ltd.
71.	Aluminium doors/windows sections	Hindalco	Hindalco Industries Ltd.,
		Jindal	Jindal Aluminium Ltd.,
		Indalco	Cotmac Industrial Trading Pvt Ltd
72.	Factory Made Aluminium doors/windows	Fenesta	Fenesta India Pvt. Ltd.,
		Technal	Technal
		Scheuco	Schueco India Pvt. Ltd.,
		Aluk	Aluk India Pvt. Ltd.,
73.	Aluminium systems/ Anodisedaluminiumfittin gs for doors/windows	Fenesta	Fenesta India Pvt. Ltd.,
		Schuco	Schuco India Pvt. Ltd.,
		Bhayva Aluwin	WAW
		Tostem	Tostem India
		RMPPL	Winkraft
		Aluk	Aluk India Pvt. Ltd.,
	EPDM Gaskets	Anand	Anand NVH products (P) Ltd.,
		Hanu	Hanu Industries

74.		Lescuyer	ALP Group
75.	Masking Tapes	3M	3M
		Sun	Sun
		Wonder polymer	Wonder Tape Industries
		Roop	Roop Polymers Ltd.,
76.	Membrane Water proofing system	STP Ltd	Shalimar Tar Products
		Asian Smart Care	Asian Paints Ltd
		Dr. Fixit	Pidilite Industries
77.	Chemical waterproofing system	Asian Smart Care	Asian Paints Ltd
		STP Ltd	Shalimar Tar Products
		VURA	Vura Bau- Chemie LLP
		Dr. Fixit	Pidilite Industries
78.	Water Stops	Asian Smart Care	Asian Paints Ltd
		BASF	BASF India Ltd.,
		Dr. Fixit	Pidilite Industries
		VURA	Vura Bau- Chemie LLP
		STP Ltd	Shalimar Tar Products
79.	Aluminum composite panels	Alucobond	3A Composites India Pvt.Ltd.
		Reynobond Alcoa	Reynobond
		Aludecor	Aludecor metal ind. Pvt Ltd.
		Alstone	Alstone India
		VIVA	Viva Composite Panel Pvt Ltd
		Eurobond	Eurobond
80.	Structural Sealant	Dow corning	Dow corning India
		Wacker	Wacker Silicones.
		GE	GE Silicones
		STP Ltd.	Shalimar Tar Products
		Fosroc	Fosroc India
		BASF	BASF India Ltd.,
		Asian Paints –Smart Care	Asian Pants (Bath Division)
81.	Bitumen Impregnated Board	Shalitex or equivalent make	Shalimar Tar Products or equivalent make
82.	Polyethylene backer rod	Supreme or equivalent make	Supreme Industries or equivalent make
83.	Epoxy	Fosroc	Fosroc India
		Shalibons	Shalimar Tar Products
		Tikidan	Tiki Tar Danosa Pvt Ltd
		Asian paints	Asian Paints
		VURA	Vura Bau- Chemie LLP
		Ardex	ArdexEndura (India) Pvt. Ltd,.
84.	Weather Silicon make and grade	Dow corning	Dow corning India
		Momentive (GE)	GE Silicones
85.	GRC Jali	Unistone	Unistone Products Pvt Ltd
		Sanderson	Sanderson Products Pvt Ltd
		Dalal GRC	Dalal Tile Industry
		Avon Ston	Avon Ston Pvt Ltd
		kanbuilt	kanbuilt
86.	Steel Windows/Pressed	JSW	JSW

	Steel Frames	TATA Steel	TATA Steel
		RINL	RINL
87.	Anti-Static/ESD Vinyl Flooring	Armstrong	Armstrong world Industries India Ltd.
		Mannington	Mannington
		DLW	DLW Flooring Gmbh
88.	Grass Paver	Unistone	Unistone
		Pavit	Pavit
		Hitech	Hitech Industries Pvt Ltd
89.	Non-Metallic Floor Surface Hardeners	Ironite	Ironite
		Hardonite,	Hardonite
		VURA	Vura Bau- Chemie LLP
		SIKA	SIKa India
		BASF	BASF India Ltd.,
		CICO,	CICO Technologies Ltd.,
		Pidilite	PidiliteIndustries Ltd,
90.	PU Enamel Metallic Paints on MS Structure & Epoxy paints (Premium Quality)	Berger,	Berger paints India Ltd.
		Akzonobel	Akzonobel
		Asian	Asian Paints
91.	Structural Glazing	Modi Guardian	Modi Guard
		Saint Gobain	Saint Gobain Glass India Ltd.,
		Asahi,	Asahi India glass Ltd,
92.	Float Valve (Ball Valve)	Prayag,	Prayag Polymers (P) Ltd
		Leader,	Leader valves Ltd.
		Zoloto,	Zolota Industries
		IBP	IBP Industries
		Arco	Arco valves Pvt. Ltd.,
93.	Spider Patch Fittings for Structural Glazing	Dorma	Dormakaba
		Williams	Williams Architectural
94.	AAC Block Adhesive	Ultratech	Ultratech cements Ltd.
		Ardex Endura	Ardex Endura
		FerrousCrete	Ferrouscrete
95.	Aluminium Form work	MFE(MIVAN)	MIVAN
		S-Form	S-Form
		MFS	MFS
96.	Polyurea – PU Hybrid water proofing membrane	Smart Care	Asian Paints
		SIKA	SIKa India
		VURA	Vura Bau- Chemie LLP
		Pidilite	PidiliteIndustires
97.	GP Grout	Smart Care	Asian Paints
		BASF	BASF
		Pidilite	Pidilite Industries Ltd.
		VURA	Vura Bau- Chemie LLP
		FOSROC	FOSROC Chemical India Pvt Ltd.
		SIKA	SIKa India
98.	Galvalume sheet for roofing, cladding, Sandwich Panel	Tata Blue Scope	Tata Bluescope
		JSW	JSW
		Essar	Essar Group

99.	Mechanical Coupler for Reinforcement	Dextra	Dextra India Pvt. Ltd.
		Sanfield	Sanfield India Ltd.
		Alstone	Alstone
100.	Wood Polymer composite material for door frames and shutters, plain/pre laminated boards for wall linings etc	Alstone	Alstone Industries Pvt Ltd,
		Ecoste	Ecoste wood polymer composite, Delhi
		Greenply	Greenply Industries
101.	Terracotta tile	Hunter Douglas	Hunter Douglas
		CCIL	Consolidated Carpet Industries LTD.
		NLF	NLF Solutions Pvt Ltd
		AgrobButchal	AgrobButchalGmbh
		Clayton	New Era Industries
		Unistone	Unistone
102.	Acoustic Fabric Paneling	Armstrong	Armstrong world Industries India Ltd.
		Anutone	Anutoneacoustics Ltd
		NLF	NLF Solutions Pvt Ltdsd
		Hunter Douglas	Hunter Douglas
103.	Acoustic Wooden Paneling	Armstrong	Armstrong world Industries India Ltd.
		Anutone	Anutoneacoustics Ltd
		NLF	NLF Solutions Pvt Ltd
		Hunter Douglas	Hunter Douglas
104.	Acoustic Doors	Tata Parvesh	TATA Steel Ltd.
		Shakti Hormann	Shakthi Hormann Pvt Ltd,
105.	Furniture	Godrej	Godrej Interior
		Geeken	Geeken Seating Collection (P) Ltd.
		NLF	NLF India Ltd
		Steelcase	Steelcase
		Herman Miller	Herman Miller
		Durian	Durian Furniture Pvt. Ltd.
106.	Artwork	Design Artist / Muralist	As per approved by PMC/SBI
107.	Solid Mineral Surface (Quartz) for all countertops except Toilets and Labs	Caesarstone	Hafele Pvt Ltd
		Zodiac	Dupont International
		Silestone	Hettich Pvt Ltd
109.	Metal Suncreen System	Hunter Douglas	
		Colt	
		Kawneer	
110.	Toilet Cubical	Greenlam	
		Century	
		Merino	
111.	EXPANSION JOINT	Construction specialties	
		Emseal	
		Latham	

		Migua	
112.	Engineered Wooden Flooring	Armstrong	Armstrong world Industries India Ltd.
		Euro	NLF Solution Pvt Ltd
		FloorMaster	Consolidated Carpet Industries Ltd.
113.	Sports and Rubber flooring	Armstrong	Armstrong world Industries India Ltd.
		Egger	Egger
		FloorMaster	Consolidated Carpet Industries Ltd.
114.	Signages	247 Sign	Ergomax Solution India Pvt Ltd
		Prolite	ProliteAutoglo Ltd
		Ozone	Ozone Overseas Ltd
		Cosign	Cosign India Ltd
		Williams	Williams Architectural

115.	Auomated Car Parking Systems	Pari	Precision Auomation and Robotics India Ltd
		Honesty	Honesty Automation Pvt Ltd
		Jarvis	Jarvis Automate
116.	Automatic Gates, Boom Barriers, Turnstiles	Pari	Precision Auomation and Robotics India Ltd
		Honesty	Honesty Automation Pvt Ltd
		Jarvis	Jarvis Automate
		Selve	Selve India Pvt Ltd
117.	Tensile Structures / Fabric	Serge Ferrari	Serge Ferrari – Altos India
		Mehler	Mehler Technologies
119.	Exposed / Exterior Brick Tile Cladding	Prayag	Prayag Clay Products Ltd
		Greyscale Mega Concrete	Mega Concrete
		JJB	Jay Jalaram Brick Works
		Pioneer	Pioneer Bricks
		Tunch	Tunch Bricks
120.	Landscaping Elements (Benches, Bollards, etc)	Greyscale Mega Concrete	Mega Concrete
		Hitech Concrete Products	Hitech Concrete Products