

SECTION - 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS
& QUANTITIES

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SCOPE, SPECIFIC TECHNICAL REQUIREMENTS & QUANTITIES

1.1.0 SCOPE

1.1.1 The scope of work under this specification is engineering design, material supply, fabrication, shipment to job site, erection & commissioning of DC Hall Pre-engineered Buildings including associated works, required for +/-800kV NE-Agra HVDC Project at Agra in Uttar Pradesh, being executed by BHEL on turnkey basis. The Customer/Employer is Power Grid Corporation of India Ltd.

1.1.2 The works shall include, but not limited to, following:

1.1.2.1 Structural analysis and design of the main structure and auxiliary structural elements, submission of design reports and design drawings for approval to BHEL/Customer including as-built drawings.

1.1.2.2 Providing of loads on foundations at the base plate level.

1.1.2.3 Submission of detailed fabrication drawings.

1.1.2.4 Supply of fabricated structural steel main building frames and secondary framing including purlins and girts, cladding & roofing materials including insulation materials, gutters, downspouts, doors, windows, rolling shutters, louvers, anchor bolts, fasteners, sealants and any other accessories/materials required for the satisfactory performance of the buildings.

1.1.2.5 Erection & finishing of the entire structure, cladding and auxiliaries including providing of warranty certificate for above described system. This warranty certificate for life of all materials used should be for not less than that of the plant life **(40 years)**.

1.1.2.6 Providing structural stability certificate along with simulation studies at maximum wind condition.

1.1.2.7 Providing maintenance manuals for the various structural, cladding & roofing components.

1.1.2.8 Any other work required for the project.

1.1.3 The exclusions are as follows:

1.1.3.1 RCC grade floors and grade beams and inserts/equipment foundations coming thereon.

1.1.3.2 RCC foundations, pedestals, floor and roof slabs for ventilation rooms.

1.1.3.3 Masonry materials, plumbing, HVAC, electrical equipment and wiring.

1.1.3.4 Interior finishing to masonry or concrete elements.

1.2.0 SPECIFIC TECHNICAL REQUIREMENT

1.2.1 The specific technical requirements for the execution of this work shall be as per attached Technical Specification (Refer SECTION 3).

1.3.0 BILL OF QUANTITIES

1.3.1 The Bill of Quantity cum Price Schedule shall be as per page 1.2 & 1.3.

1.3.2 The quantities indicated in the 'Bill of Quantity cum Price Schedule' are indicative and can vary to any extent. Contractor shall not be entitled for any claim for any such variation in the quantities.

1.3.3 The provision of Bill of Quantity cum Price Schedule, specification and drawings shall be read in conjunction with each other and in case of conflict amongst them, the clarification shall be obtained from the Engineer-in-charge whose decision shall be final and binding.

SECTION - 3

ENCLOSURES TO THE SPECIFICATION
(i) Technical Specification

Technical Specification

Contents

	Page No.
1.0 General	4
1.1 Introduction	
2.0 References	4
2.1 Drawings	
2.2 Codes and Standards	
3.0 Site Conditions	
3.1 Environmental Conditions	6
3.2 Site Environmental Load Data	
4.0 System Description and Performance Requirements	6
4.1 General	
4.2 System Description	
4.3 Performance Requirements	
5.0 Design	7
5.1 Design Criteria	
5.2 Loads	
5.3 Load combinations	
5.4 Structural Framing Arrangement	
5.5 Structural Performance Requirements	
6.0 Documents / Drawings & other Submissions	9
6.1 Structural Framing	
6.2 Roof & Wall Panels	
6.3 Anchor Bolts	
6.4 Building Accessory Components	
6.5 Loads for foundation design	
6.6 Samples	
6.7 Certification	
6.8 As Built Drawings	
7.0 Delivery, Handling and Storage	11
7.1 Delivery	
7.2 Handling	
7.3 Storage	
8.0 Materials	12
8.1 General	
8.2 Structure Framing	
8.3 Roof & Wall Panels	
8.4 Doors	
8.5 Rolling Shutters	

8.6	Sheet Metal Accessories	
9.0	Fabrication	17
9.1	General	
9.2	Marking	
9.3	Structural Framing	
9.4	Shop Connections	
9.5	Field Connections	
9.6	Tagging	
10.0	Painting of Structural Steel Works	17
11.0	Erection of Structural Steel Works	17
11.1	Field Measurements	
11.2	Base Verification	
11.3	Inspections	
11.4	Framing	
11.5	Anchor Bolts	
11.6	Base Plates	
11.7	Stability during erection	
11.8	Field Modifications	
11.9	Touch up	
11.10	Purlins & side rails	
11.11.	Bracing	
11.12	Framed Openings	
12.0	Installation of Roof/Wall Panels, Accessories, Doors & Rolling Shutters	19
12.1	General	
12.2	Insulation	
12.3	Roof Panel System	
12.4	Wall Sheets	
12.5	Sheet Metal Accessories	
12.6	Doors & Frames	
12.7	Rolling Shutters	
13.0	Factory Tests	20
14.0	Changes in the Design	21
15.0	Method of Measurement	21
15.1	Structural Steelworks	
15.2	Outer & Inner Sheeting	
15.3	Mineral Wool Insulation	
15.4	Rolling Shutters	
15.5	Doors	
16.0	Structural Stability & Warranty Certificates	22

1.0 General

1.1 Introduction

The works to be performed under this specification is design, supply and erection of the Pre-Engineered Steel Structure with roofing & wall cladding and other accessories as described elsewhere in this document for DC halls that will house the DC filter equipments at Agra Converter Station. Two numbers of structures of identical size and shape are envisaged for housing the Pole 1&3 and Pole 2&4 DC equipments.

2.0 References

2.1 Tender Drawings

1. DC building Pole 4&2 - Main dimensions and layout – Drg.No. 5517-3-73-001
2. Over all GA layout Agra - Drg No. 1JNL100409-604-R2

2.2 Codes and Standards

Referenced codes and standards shall be the latest edition or revision, including amendments and supplements, in effect on the date of the purchase order, except as otherwise specified.

- | | | |
|-----|---------------|--|
| 1) | IS:277 | Galvanised steel sheet specification |
| 2) | IS:513 | Cold rolled low carbon steel sheets and strips |
| 3) | IS:800 (2007) | Code of Practice for general construction in steel |
| 4) | IS:801 | Code of Practice for use of Cold Formed Light Gauge Steel Structural Members in General Building Construction. |
| 5) | IS: 802 | Code of Practice for use of structural steel in overhead transmission line towers (All parts) |
| 6) | IS: 806 | Code of Practice for use of steel tubes in general building construction |
| 7) | IS: 808 | Dimensions for hot rolled steel beam, column channel and angle section |
| 8) | IS: 813 | Scheme of symbols for welding |
| 9) | IS:816 | Code of Practice for use of metal arc welding for general construction in mild steel |
| 10) | IS: 919 | Recommendations for limits and fits for engineering |
| 11) | IS: 1024 | Code of Practice for use of welding in bridges and structures subjected to Dynamic loading |
| 12) | IS: 1038 | Specification For Steel Doors, Windows And Ventilators. |
| 13) | IS: 1079 | Hot rolled carbon steel sheets and strips. |
| 14) | IS: 1161 | Specification for Steel tubes for structural purposes |

15)	IS: 1239	Specification for Mild steel tubes, tubular and other wrought steel fittings (all parts)
16)	IS: 1361	Steel windows for industrial buildings.
17)	IS: 1363	Black hexagonal bolts, nuts and locknuts (dia 6 to 39 mm) and black hexagon screws (dia 6 to 24 mm) [All parts]
18)	IS: 1364	Precision and semi-precision hexagon bolts, screws, nuts and locknuts (dia. range 6 to 39 mm). [all parts]
19)	IS: 1365	Slotted counter sunk head screws (dia range 1.6 to 20 mm)
20)	IS: 1730	Dimensions for steel plate, sheet and strip for structural and general engineering purpose
21)	IS: 2016	Plain Washers
22)	IS: 2062	Steel for General structural purposes (fusion welding quality)
23)	IS: 3502	Specification for steel chequered plates
24)	IS: 3589	Steel Pipes for Water and Sewage (168.3 to 2 540 mm Outside Diameter) - Specification
25)	IS: 3613	Acceptance tests for wire-flux combinations for submerged-arc welding of structural steels
26)	IS: 3757	High Strength Structural Bolts.
27)	IS: 4000	High strength bolts in steel structures – Code of Practice
28)	IS: 4351	Steel Door Frames
29)	IS: 4759	Hot dip zinc coatings on structural steel and other allied products
30)	IS: 4923	Hollow Steel sections for structural use
31)	IS: 6248	Metal Rolling Shutters and Rolling Grills
32)	IS: 6623	High Strength Structural Nuts.
33)	IS: 7215	Tolerances for fabrication of steel structures
34)	IS: 7280	Bare wire electrodes for submerged arc welding of structural steels
35)	IS: 8183	Bonded mineral wool.
36)	IS: 8500	Structural steel - micro alloyed (medium and high strength qualities)
37)	IS: 8640	Recommendations for dimensional parameters for industrial building
38)	IS:9595	Recommendation for Metal arc welding of carbon and carbon manganese steel
39)	IS: 12843	Tolerances for erection of steel structures
40)	ASTM A653	Standard Specification for Steel Sheet, Zinc Coated

- (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process
- 41) ASTM A792 Standard Specification for Steel Sheet, 55 % Aluminum Zinc Alloy Coated by the Hot Dip Process.

3.0 Site Conditions

3.1 Environmental Conditions

Site Altitude above MSL	100.5 m
Site Distance from Sea Port	1065 km from Agra (Kandla in Gujarat)
Road access	National Highway NH-2 connecting New Delhi and Kolkata runs through Agra. NH-3 & NH-11 also connects Agra to Mumbai & Jaipur respectively.
Nearest Railway Station	Agra Station which comes under Western Railways.
Terrain category	Flat
Rainfall	
1) Daily Max.	200 mm
2) Maximum hourly rainfall	30 mm / hour
Operating Atmosphere (Caustic, Chloride, etc.)	Later
DC equipment rated temperature	50°C

3.2 Site Environmental Data

Design Code	Wind Loading		Earthquake Loading	
IS: 800-2007	Maximum wind velocity	44 m/s	Seismic zone	III

The Sub-contractor shall take special precautions in the selection and protection of materials and equipment against deterioration due to the effects of humidity, temperature, dust, pollutants and atmosphere.

4.0 System Description and Performance Requirements

4.1 General

While certain proposals for the installation are made herein, this in no way relieves the contractor of the DC hall Steel Structure from complete responsibility for the design and construction.

The basic dimensions for the building, viz lengths, widths, heights and roof pitches are as indicated in the drawing 5517-3-73-001. Contractor's standard products may be used if structure, components and accessories conform to design indicated and specified requirements.

4.2 System Description

Pre-Engineered Steel Structure of DC hall will also house the ventilation room and cooling room as shown in the drawing 5517-3-73-001. The main DC hall will contain DC yard equipments connected to 800 kV HV pole bus such as smoothing reactors, high speed parallel/ de-parallel switch, line isolator, DCCT, voltage divider, DC filters and HV capacitors etc. The area between the DC yard for two adjacent pole halls house the ventilation room at EL(+) 6.00m. This room shall accommodate the ventilation equipment and the electrical equipment. Roof for the ventilation room shall be at EL (+) 12.00m and will be supporting the coolers.

The following input shall be provided by BHEL during contract stage.

1. Building plans and/or description.
2. Location of building.
3. Hoist (if required) capacities and service classifications.
4. Collateral Loads - The weight of additional permanent materials supported from the building frame such as mechanical systems, electrical systems, sprinklers, bushings, conductors, etc.
5. Painting colors for wall and roof panels and structural members in consultation with Customer.

4.3 Performance Requirements

4.3.1 Wall Panels

Field-assembled inner and outer sheeting with insulation of 20mm thickness and all fixing accessories as per specification.

4.3.2 Roof Panels

Roof panels with inner sheeting, insulation of 200mm thickness, outer sheeting and fixing accessories as per specification.

5.0 Design

The Pre-Engineered Steel Structure of DC hall shall be designed by the contractor as a complete system. Members and connections not indicated on the drawings shall be the responsibility of the contractor. All components of the system shall be supplied or specified by the same contractor.

5.1 Design Criteria

5.1.1 Applicable codes and standards

The proposed building shall conform to the referenced codes and standards as stated in Clause 2.2.

5.2 Loads

5.2.1 Dead Loads

The roof dead load is generally assumed to be distributed uniformly over the entire roof area and to act vertically upon the horizontal projection of the roof. However, the local effects of any large concentrated dead loads shall also be considered.

5.2.2 Live Loads

Sloped Roof for DC hall	:	0.75 kN/m ²
Flat Accessible Roof	:	1.5 kN/m ²
Ventilation Room at EL (+) 6.00m	:	10 kN/m ²
Electrical Room at EL (+) 6.00m	:	10 kN/m ²
Roof bays housing coolers	:	10 kN/m ²
Staircases	:	5 kN/m ²

Other area live loads and its design application shall be in accordance with the requirements of IS 875 (part2).

5.2.3 Snow Loads

Snow loads need not be considered.

5.2.4 Wind Loads

Wind loads shall be in accordance with IS: 875-Part 3.

1. Basic wind speed	V	=	44 m/s
2. Category of Terrain		=	Category 2
3. K ₂ varies with height		=	As per IS: 875-1987 (Part 3)
4. Risk Co-efficient K ₁		=	1.07
5. Topography factor		=	As per IS: 875-1987 (Part 3)

5.2.5 Seismic Loads

Earthquake loads shall be in accordance with IS: 1893 (Part 1 & 4).

1. Seismic Zone		=	III
2. Soil Condition		=	Medium
3. Importance Factor		=	1.5
4. Response Reduction Factor		=	As per Table 3 of IS: 1893 (Part 4)

5.2.6 Hoist Loads

Building shall be designed for forces induced by the operation or movement of the hoist as given hoist vendor drawings. All elements affected by hoist loads shall be designed to resist the loads specified. The vertical impact, lateral and longitudinal forces for hoists are to be calculated as per IS: 875. The hoist loads and locations, if required, shall be provided during detailed engineering.

5.2.7 Temperature Loads

The temperature variation shall be considered as 2/3 of the average maximum annual variation in temperature. The average maximum annual variation in temperature for this purpose shall be taken as the difference between the mean of the daily minimum temperature during the coldest month of the year and mean of daily maximum temperature during the hottest month of the year. The structure shall be designed to withstand thermal stresses due to 50% of the temperature variation.

The building shall be designed for thermal loads based on the variation in temperature as given below.

Highest monthly mean temperature	-	40 ⁰ C
Lowest monthly mean temperature	-	0 ⁰ C
Temperature Variation	-	26.66 ⁰ C

Hence structure shall be designed to with stand temperature variation of 13.33⁰ C.

5.2.8 Conductor loads

Loads from the conductors supported on the DC hall. The final loads with locations shall be furnished during contract stage.

5.2.9 Rainfall Intensity

All exterior gutters and downspouts shall be designed for a maximum rainfall intensity of 30mm per hour.

5.3 Load combinations

Load combinations shall be in accordance with IS: 875 – Part 5.

5.4 Structural Framing Arrangement

Structural framing arrangement shall follow the system proposed in the tender drawings which takes care of opening requirements, preferred location and arrangement of bracings.

5.5 Structural Performance Requirements

1. The metal building system shall be designed and fabricated to withstand loads from winds, gravity, equipment, structural movement including movement thermally induced and to resist in-service use conditions that the building will experience, including exposure to the weather, without failure, or excessive deformation. The contractor shall provide a structural guarantee of **40** years for the whole structure.
2. Each member shall be designed to withstand stresses resulting from combination of loads that produce the maximum allowable stresses in that member.
3. All loads shall be proportioned and applied in accordance with relevant IS codes.
4. Assembly shall permit movement of components without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to temperature ranges as specified in this specification.
5. Roof drainage system shall withstand the maximum rainfall intensity of rainfall.
6. Roof sheeting panels shall be free to move in response to the expansion and contraction forces resulting from a temperature variation.
7. Ends of the sheets shall be protected to prevent corrosion.
8. Anchor bolts shall be adequate to sustain all vertical tensile forces, anchor bolts shall not be assumed to take horizontal shear forces and shear key shall be provided to take the horizontal shear forces on one or two axes
9. The worst combination of loads shall apply.

6.0 Documents / Drawings & other Submissions

Design documents and drawings including shop drawings for metal building structural framing system, roof and wall panels and other metal building system components and accessories and as-built drawings shall be submitted for approval by BHEL/Customer

Drawings shall be clearly identified and coordinated with the schedule giving title and reference numbers. The title block and reference numbers shall be provided by BHEL as to achieve uniformity.

6.1 Structural Framing

1. Complete erection drawings with assembly dimensions shall be furnished.
2. Details showing fabrication and assembly of the metal building system shall be included..
3. Locations of structural members, connections, attachments, openings, cambers, etc shall be shown.
4. Wall and roof system dimensions, panel layout, general construction details, anchorages and method of anchorage, installation shall be indicated.
5. Anchor bolt settings, sizes, and locations from datum, etc shall be shown.
6. Field welded connections with AWS shall be indicated.
7. Transverse cross-sections shall be shown.
8. Structural calculations that have been initiated, checked and stamped by a professional engineer shall be submitted.
9. Certification of welder qualification for all operators performing welding of structural framing shall be submitted.
10. Steel Structural Weights

6.2 Roof and Wall Panels

Layouts of panels on walls and roofs, details of edge conditions, joints, corners, custom profiles, supports, anchorages, trim, flashings, closures and special details shall be provided.

6.3 Anchor bolts

Anchor bolt placement plan and column base forces and moments shall be provided.

6.4 Building Accessory Components

Details of metal building accessory components to clearly indicate methods of installation of following shall be provided:

1. Personnel doors
Elevations and details of each type of door and frame, including anchors and reinforcements, location and installation requirements for finish hardware, schedule of doors and frames including complete hardware schedule shall be provided.
2. Overhead rolling shutters.
Fully dimensioned details of construction, including 1:50 scale elevations of shutter units and not less than 1:20 scale details showing shutter sections, brackets, guides, hardware and method of operation shall be provided.

3. Sheet Metal Accessories

Details of openings, gutters, downspouts and other sheet metal accessories showing profiles, methods of joining, anchorage and flashings shall be provided.

6.5 Loads for foundation design

1. Loads for the design of foundations and pedestals shall be provided.
2. Soft copy of the super structure design file shall be provided.

6.6 Samples

Samples for initial selection purposes in the form of manufacturer's colour charts or chips showing colours, textures and pattern closest to those specified for metal roof and wall panels, louvers and windows with shop-applied finishes. Bought out items such as doors, rolling shutters etc shall be got approved by the contractor prior to delivery at site.

6.7 Certification

Professional engineer's certificate verifying that the structural framing and covering panels meet indicated loading requirements and codes of authorities having jurisdiction shall be provided.

6.8 As-Built drawings

On the conclusion of all the erection and finishing works, all As-Built drawings shall be submitted.

7.0 Delivery, Handling and Storage

7.1 Delivery

Prefabricated components, panels, accessories and other manufactured items shall be delivered in such a way that they are not damaged or deformed. Wall and roof panels and accessories shall be packaged for protection against transportation damage. A complete packing list shall accompany each shipment including components provided by sub contractors/suppliers.

7.2 Handling

Care shall be exercised in unloading, storing and handling wall and roof covering panels to prevent bending, warping, twisting and surface damage.

7.3 Storage

Materials shall be stacked on platforms or pallets, covered with tarpaulins or other suitable weather tight ventilated covering and arrangement shall be made to ensure that no water accumulates in the area. Panels shall not be stored in contact with other materials that might cause staining, denting or other surface damage.

8.0 Materials

8.1 General

All materials shall be new and free from defects. All the structural steel shapes shall comply with Indian Standards codes or equivalent American / Australian/ European standards.

8.1.1 Hot-rolled structural steel shapes

Hot-rolled structural steel shapes shall comply with IS: 808.

8.1.2 Steel tubing or pipe

Steel tubing or pipe shall comply with IS: 806 & IS 1161.

8.1.3 Steel Members Fabricated from Plate

Steel Members Fabricated from Plate as per IS:2062

8.1.4 Steel Members by Cold Forming

Steel Members by Cold Forming shall comply with IS:801 or as per manufacturer's standards.

8.1.5 Cold-Rolled Carbon Steel Sheet

Cold-Rolled Carbon Steel Sheet shall comply with requirements of IS:513 or as per manufacturer's standards.

8.1.6 Hot-Rolled Carbon Steel Sheet

Hot-Rolled Carbon Steel Sheet shall comply with requirements of IS:1079 or as per manufacturer's standards.

8.1.7 Structural Quality Zinc-Coated (Galvanised) Steel Sheet

Structural Quality Zinc-Coated (Galvanised) Steel Sheet shall comply with IS:277 or as per manufacturer's standards.

8.1.8 Zinc-Coated (Galvanised) Steel Sheet for Personnel Doors

Commercial Quality Zinc-Coated (Galvanised) Steel Sheet for Personnel Doors shall comply with IS:277 or as per manufacturer's standards.

8.1.9 Aluminium-Zinc-Alloy-Coated Steel Sheet

Aluminium-Zinc-Alloy-Coated Steel Sheet shall comply with ASTM A792 or as per manufacturer's standards.

8.1.10 Bolts for Structural Framing

Bolts for Structural Framing shall comply with IS1363, IS:1364, IS:3757, IS:4000 & IS:6623 as necessary for design loads and connection details.

8.1.11 Thermal Insulation

Glass fibre blanket insulation, complying with IS:8183, thickness as required for specified U-value, with UL flame spread classification of 25 or less and 50 mm wide continuous vapour-tight edge tabs.

8.1.12 Retainer Clips

26-gauge (0.45 mm) formed galvanised steel retainer clips to match the insulation facing.

8.1.13 Shop Primer Paint and Coating Materials

Shop primers shall be compatible with field-applied finish coatings. Shop Primer for Ferrous Metal Surfaces shall be fast-curing, lead-free, universal primer, selected by the contractor for resistance to severe atmospheric corrosion, compatibility with finish paint systems and capability to provide a sound foundation for field-applied top coats despite prolonged exposure.

8.1.14 Minimum Thickness

Materials, other than roof and wall covering and wall liner, shall be of thickness necessary to conform to design requirements, however the following table lists the minimum thickness which will be allowed:

ITEMS	MINIMUM THICKNESS UNCOATED
Light Gage Steel-Structural Members other than Wall and Roof Covering	1.2 mm Steel
Gable and Eave Trim, Fascia Closure Strips, Rake Flashing, Coping and Liner Panels	0.5 mm Steel
Gutter and Downspouts	0.5 mm Steel
Roof Ventilators	0.5 mm Steel

8.2 Structural Framing

8.2.1 General Requirements

Fabrication shall be done from hot-rolled structural steel shapes. All framing members shall be shop-welded (complete welding on both sides), & shop-primed. Frames shall be furnished with attachment plates, bearing plates and splice members. Shop drilling shall be done for field-bolted assembly.

8.2.2 Bolts

Shop-primed bolts shall be provided except when structural framing components are in direct contact with roof and wall panels. Zinc-plated or cadmium-plated bolts shall be provided when structural framing components are in direct contact with roof and wall panels.

8.2.3 Shop Primer Painting

Surfaces to be primed shall be cleaned of loose mill scale, rust, dirt, oil grease and other matter detrimental to paint bond. Structural steel primary and secondary framing members shall be provided with specified rust-inhibitive primer, minimum 1 mil dry film thickness.

8.3 Roof and Wall Panels

8.3.1 Roofing

8.3.1.1 Outer Sheeting

The outer roof sheeting shall be as per contractor's standard roof design for mechanical attachment of panels to roof purlins using concealed clips. The sheeting shall be mild steel sheets of minimum 24 gauge (0.60 mm thick) or high tensile sheet of 0.5mm thick, factory coated both sides with aluminium zinc alloy. The coating shall have a minimum coated weight of 0.2 kg per square meter including both faces. The

exposed surface shall have PVF2 coating of 20 microns DFT over corrosion inhibitive primer. Interior surface shall have coating as per contractor's standard.

The sheeting shall be standing seam type sheets of lengths to minimize / eliminate end laps. The maximum purlin spacing shall be 1.5m. Closer spacing shall be adopted at local high pressure / suction areas of the roof and walls.

8.3.1.2 Inner Sheeting

The inner roof sheeting shall be as per contractor's standard design for mechanical attachment of panels to roof purlins using screws or other suitable device. The sheeting shall be mild steel sheets of minimum 24 gauge (0.60 mm thick) or high tensile sheet of 0.5mm thick, factory coated both sides with aluminium zinc alloy. The coating shall have a minimum coated weight of 0.15 kg per square meter including both faces. The exposed surface shall have PVF2 coating of 20 microns DFT over corrosion inhibitive primer. Interior surface shall have coating as per contractor's standard.

The roof shall be insulated. The thickness of the insulation shall be 200mm.

8.3.1.3 Clips

Minimum 16-gauge (1.52 mm) panel clips designed to allow thermal movement of panels shall be provided.

8.3.1.4 Cleats

Factory-caulked, mechanical seamed cleats formed from minimum 24-gage (0.61 mm), Grade C, zinc-coated steel sheets shall be provided.

8.3.2 Wall Cladding

8.3.2.1 Outer & Inner Sheeting

The outer & inner wall cladding sheeting shall be as per contractor's standard design for mechanical attachment of panels to wall runners using screws or other suitable device. The sheeting shall be mild steel sheets of minimum 24 gauge (0.60 mm thick) or high tensile sheet of 0.5mm thick, factory coated both sides with aluminium zinc alloy. The coating shall have a minimum coated weight of 0.15 kg per square meter including both faces. The exposed surface shall have PVF2 coating of 20 microns DFT over corrosion inhibitive primer. Interior surface shall have coating as per contractor's standard.

The wall shall be insulated. The thickness of the insulation shall be 25mm.

8.3.3 Accessories

Sheet metal accessories shop-formed of the same material and shop-applied finish as roof and wall panels, including flashings, closures, filters, ridge covers, fascials and similar items shall be provided.

8.3.4 Flexible Closure Strips

EPDM or closed-cell, expanded cellular rubber, self-extinguishing flexible closure strips shall be cut or premoulded to match configuration of roof and wall panels and

shall be provided wherever necessary to ensure weathertight construction. All roofing & wall cladding should be airtight to prevent ingress of dust and moisture.

8.3.5 Sealing Tape

Pressure-sensitive 100-percent-solids grey polyisobutylene compound sealing tape with release paper backing, elastic, non-sag, non-toxic, non-staining tape 12 mm wide and 3 mm thick shall be provided.

8.3.6 Joint Sealant

One-part elastomeric polyurethane, polysulfide, or silicone rubber sealant.

8.4 Doors

8.4.1 Shutter

Shutters shall comply with IS code with minimum 18-gauge galvanised steel faces.

8.4.2 Frames

Pressed steel frames 16 gauge minimum shall be used.

8.4.5 Fabrication

Units shall be fabricated in such a way that they are rigid, neat in appearance and free from defects, warp or buckles. Continuous welds shall be provided on exposed joints, ground, dressed and made smooth, flush & invisible.

8.5 Roller Shutter

8.5.1 General

Complete overhead coiling door assemblies including door curtain, guides, counterbalance, hardware, operators and installation accessories shall be provided.

8.5.2 Door Curtain

Interlocking steel slat door curtain with one-piece slats for the full length of door width and formed from minimum 20-gauge (0.91 mm), Grade A, structural quality, zinc coated steel sheets shall be provided. Shall be phosphate treated before fabrication.

8.5.3 Bottom Bar

Bottom bar on door curtain consisting of two 3 mm angles of the same metal as the door curtain slats shall be provided.

8.5.4 Curtain Jamb Guides

Curtain jamb guides, built up using steel rolled or pressed deep channel sections 75 mm and 25 mm wide fitted with necessary fitting and fixtures and galvanized after fabrication shall be provided.

8.5.5 Weather Seals

3 mm continuous rubber or neoprene sheet weather seals on metal pressure bars shall be secured to inside of curtain coil hood. At door jambs, 3 mm continuous strip shall be secured to exterior side of jamb guide.

8.5.6 Counterbalance

Adjustable steel helical torsion spring counterbalance, mounted around a steel shaft in a spring barrel and connected to door curtain with barrel rings shall be provided.

Grease-sealed bearings or self-lubricating graphite bearings for rotating members shall be used.

8.5.7 Brackets

Cast-iron or cold-rolled steel plate mounting brackets with bell-mouth guide groove for curtain shall be provided.

8.5.8 Hood

Form shall be provided to enclose the coiled curtain and operating mechanism entirely at the opening head and to act as a weather seal. It shall be contoured to suit end brackets to which attached. Top and bottom edges shall be rolled & reinforced for stiffness. Closed ends for surface-mounted hoods, and any portion of between-jamb mounting projecting beyond wall face shall be provided. Intermediate support brackets shall be provided to prevent-sag.

Hoods of minimum 20-guage, zinc-coated steel sheet, phosphate treated before fabrication shall be provided.

8.5.9 Shop Prime Painting

All exposed and concealed ferrous and galvanised metal surfaces except for tightly joined and lubricated surfaces shall be shop-cleaned and primed with the contractor's standard rust-inhibitive primer. Shop primer shall be compatible with field-applied finish coating.

8.5.10 Electrical Operation

All mechanical & electrical accessories suitable for operating the rolling shutter shall be provided.

8.6 Sheet Metal Accessories

8.6.1 General

Sheet metal accessories specified below to match material and finish of roof and wall panels to which they are attached shall be provided.

8.6.2 Gutters

These shall be formed in minimum 2.5 m-long sections, complete with end pieces, outlet tubes and other special pieces as required. Sections shall be joined with riveted and soldered or sealed joints. Expansion-type slip joint at centre of long runs shall be provided. Gutter supports of sufficient thickness spaced maximum 2 m on centre, constructed of same metal as gutters shall be furnished. Dissimilar materials shall not be used.

8.6.3 Downspouts

These shall be formed in minimum 3-m long sections, complete with elbows and offsets. Sections shall be joined with 35 mm telescoping joints. Fasteners designed to hold downspouts securely 25 mm away from walls shall be provided and shall be located at top and bottom and at approximately 1.5 m on centre in between.

8.6.4 Flashing for Wall Penetrations

Metal flashing and sealing materials for all types of wall penetrations, including piping, ducts, conduits, cable trays, bushings and other penetrations shall be provided. Flashing material and finish shall be same as specified for wall panels. Where possible, penetrations shall be centred between joints of wall panels.

9.0 Fabrication

9.1 General

All prefabricated components and necessary field connections required for erection to permit easy assembly and disassembly shall be designed.

Components shall be fabricated in such a manner that once assembled, they may be disassembled, repackaged, and reassembled with a minimum amount of labour.

9.2 Marking

Each piece and part of the assembly shall be clearly and legibly marked to correspond with previously prepared erection drawings, diagrams and instruction manuals.

9.3 Structural Framing

Framing components shall be shop-fabricated to required size and section with base plates, bearing plates and other plates necessary for erection. Holes shall be provided for anchoring or connections shop-drilled or punched to template dimensions.

9.4 Shop Connections

Bolted or welded (full on both sides) shop connections shall be provided.

9.5 Field Connections

Bolted field connections shall be provided. Pretensioned HSFG bolted connections shall be preferred.

9.6 Tagging

All steel work members shall be clearly tag marked for easy identification.

10.0 Painting of Structural Steel Works

All shop fabricated & primed structural steel members supplied at site shall be given 2 or more coats of synthetic enamel paint of colour, shade & brand as approved by BHEL/Customer.

11.0 Erection of Structural Steel Works

11.1 Field Measurements

Contractor shall verify that field measurements are as indicated in contract drawings.

11.2 Base Verification

Contractor shall verify that foundation, floor slab, mechanical and electrical utilities, and placed anchors are in correct position and properly squared.

11.3 Inspections

Contractor shall provide access to the work as scheduled for provided inspections. The cost of any required inspections is the responsibility of Customer/BHEL. Work shall not proceed until unsatisfactory conditions have been corrected.

11.4 Framing

Erection of framing shall be in accordance with relevant IS codes. Building frames shall be erected true to line, level, plumb and shall be rigid and secure with vertical members plumb and bracing properly installed. Structural stability of frame during erection shall be ensured.

11.5 Anchor Bolts

Templates shall be used for accurate setting of anchor bolts. All previously placed anchorages shall be checked.

11.6 Base Plates

Base plates shall be levelled to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Non-shrinking grout shall be used to obtain uniform bearing and to maintain a level base line elevation. Grout shall be moist cured for not less than 7 days after placement.

11.7 Stability during Erection

The Contractor shall furnish temporary guys and bracing where needed for squaring, plumbing, and securing the structural framing against loads, such as wind loads acting on the exposed framing and seismic forces, as well as loads due to erection and erection operation, but not including loads resulting from the performance of work by others. Bracing furnished by the contractor for the metal building system cannot be assumed to be adequate during erection and are not to be used to pull frames into plumb condition.

The temporary guys, braces, falseworks and cribbing shall be removed immediately upon completion of erection.

11.8 Field Modifications

No modification or field cutting of structural members shall be done without approval of BHEL/Customer.

11.9 Purlins and Side Rails

Rake or gable purlins shall be provided with tight-fitting closure channels and fascials. Wall side rails shall be located and spaced to suit wall opening arrangements and heights, including doors, windows, louvers, openings and penetrations. Purlins and side rails shall be secured to structural framing and shall be held rigidly to a straight line by sag rods.

11.10 Bracing

Diagonal rod, angle or tubular bracing shall be provided in roof and side walls.

11.11 Framed Openings

Shapes of proper design and size shall be provided to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. These should be securely attached to building structural frame.

11.12 Touch up & Final Coat of Paint

After erection, Contractor shall prime welds, abrasions, and surfaces not shop primed or needing touch-up. A final coat of paint shall be given before handing over.

12.0 Installation of Roof/Wall Panels, Accessories, Doors & Rolling Shutters

12.1 General

1. Sidelap joints shall be arranged so that prevailing winds blow over, not into, lapped joints.
2. Ribbed or fluted sheets shall be lapped one full rib corrugation.
3. Panels and associated items shall be fixed to get a true to line weathertight enclosure.
4. Shop finishes shall be protected from damage.
5. Field cutting of panels by torch is not permitted.
6. Weatherseal shall be provided under ridge cap. Flash and seal roof panels at eaves shall be flashed and sealed and raked with rubber, neoprene or other closures to provide a weathertight, dust-tight and moisture tight enclosure.
7. Corner panels shall be supplied pre-formed by the contractor.
8. Sheeting system shall be fastened to structural supports, using proper fasteners aligned, level and plumb.

12.2 Insulation

12.2.1 Roof Insulation

Thermal insulation shall be installed concurrently with installation of roof panels in accordance with contractor's directions. Blankets shall be installed straight and true in one-piece lengths with both sets of tabs sealed to provide a complete vapour barrier. Insulation shall be located above the inner roof sheets, extending across the bottom flange of purlins members and held taut and snug to roof panels with retainer clips and galvanized wire mesh 75x75x1.6mm thick. Insulation shall be placed with facing exposed to interior of building unless otherwise indicated. Retainer strips shall be installed at each longitudinal joint, straight and taut, nesting with roof rib to hold insulation in place. Retaining material shall be used to prevent sagging. The thickness of the insulation shall be 200mm .

12.2.2 Wall Insulation

Same as roof insulation. The thickness of the insulation shall be 20mm.

12.3 Roof Panel System

1. Roof panels shall be fastened to purlins with concealed clips in accordance with the contractor's instructions for outer sheet.
2. Clips shall be installed over thermal insulation pad at each support with self-drilling fasteners or bolts.
3. At end laps of panels, tape caulk shall be installed between panels.
4. Shop-caulked cleats shall be installed at standing-seam joints. Cleats shall be machine-seamed to the panels to provide a weather tight joint.
5. The inner sheet shall be connected to the purlins using self tapping screws.

12.4 Wall Sheets

1. Elastomeric sealant shall be applied continuously between metal base channel (sill angle) and block work walls and elsewhere as necessary for waterproofing. Apply sealant and backup in accordance with the sealant manufacturer's recommendations.
2. The wall cladding shall be fixed as explained for roof sheeting. Door frames shall be fastened with machine screws or bolts. When building height requires two rows of panels at gable ends, lap of gable panels over wall panels shall be aligned at eaves height.
3. Screw fasteners shall be installed with power tools having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or panels. Screws shall be installed in pre-drilled holes.
4. Weatherproof escutcheons and flashings shall be provided for pipe, conduit and other wall penetrations.

12.5 Sheet Metal Accessories

Gutters, downspouts, louvers, roof jacks, pipe flashings and other sheet metal accessories shall be installed in accordance with contractor's recommendations for positive anchorage to building and weather tight mounting.

12.6 Doors and Frames

Doors and frames shall be installed straight, plumb and level. Frames shall be securely anchored to building structure. The units shall be set with 3 mm maximum clearance between door and frame at jambs and head and 20 mm between door and floor. Hardware shall be adjusted for proper operation.

12.7 Rolling Shutters

Rolling shutter and operating equipment shall be set complete with necessary hardware, jamb and head mould stops, anchors, inserts, hangers and equipment supports in accordance with contractor's instructions to ensure smooth & proper functioning. Hardware shall be adjusted for proper operation.

13.0 Factory Tests

Quality assurance plan and procedures shall be furnished to BHEL and got approved prior to commencement of fabrication. All materials shall be tested at contractor's

expense and shall be in accordance with the relevant standards indicated. Certified copies of all factory tests shall be submitted to BHEL/Customer in six (6) copies.

14.0 Changes in the Design

BHEL/Customer reserves the right to get any changes in the design, that may be necessary to make the building conform to the requirements of the specification, done by the Contractor, without any additional cost.

15.0 Method of Measurement

15.1 Structural Steelworks

The structural steel shall be measured in kgs.

For standard steel sections unit weight shall conform to IS 808 with tolerance in sizes as per IS 1852.

For built up sections unit weight shall be worked out considering theoretical dimensions & density of steel as 7850kg/cum.

Weight of cleats, brackets, packing pieces, bolts nuts, washers, pieces, separators diaphragm, gussets, etc. shall be added to the weight of structural item. No deduction shall be made for bolt holes. Weight of welding material, paint, etc., shall not be added in the weight of members for payment and nothing extra shall be paid for making and filling holes for temporary fastening of members during erection before welding.

15.2 Outer & Inner Sheets

The outer & inner sheets shall be measured in sqm.

For roofing & wall cladding, area shall be worked out considering outer to outer dimensions of sheeting.

No separate payment shall be made for laps & corrugations/profiles, flashings, closure strips, sealing tapes, sealants, etc.

No deductions in measurements shall be made for openings upto 0.4 sqm.

15.3 Mineral Wool Insulation

The mineral wool insulation shall be measured in sqm.

Area shall be worked out considering outer to outer dimensions of mineral wool insulation laid.

No deductions in measurements shall be made for opening upto 0.4 sqm.

15.4 Rolling Shutters

The rolling shutters shall be measured in sqm.

Area shall be worked out considering clear width & clear height of the opening.

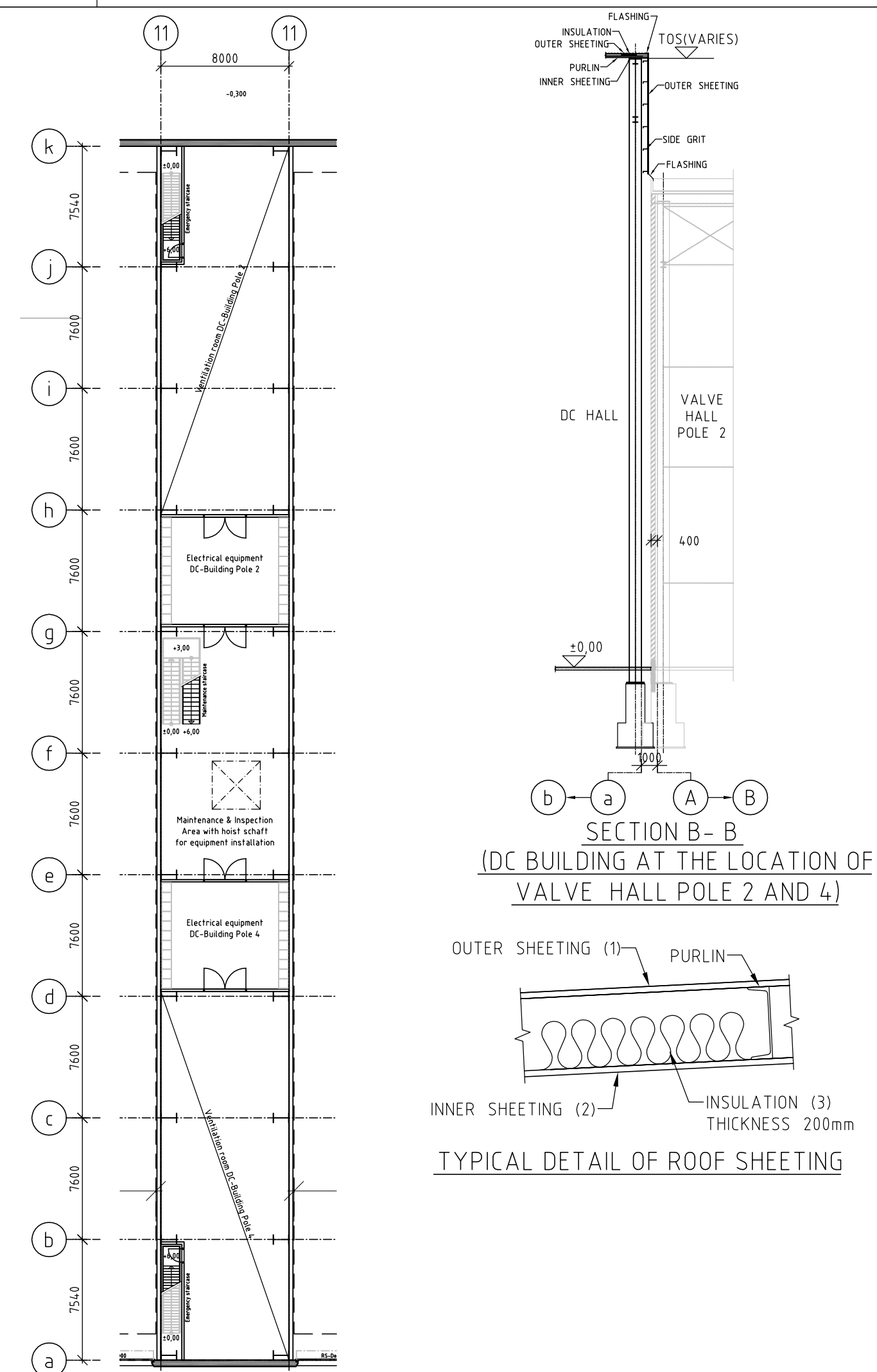
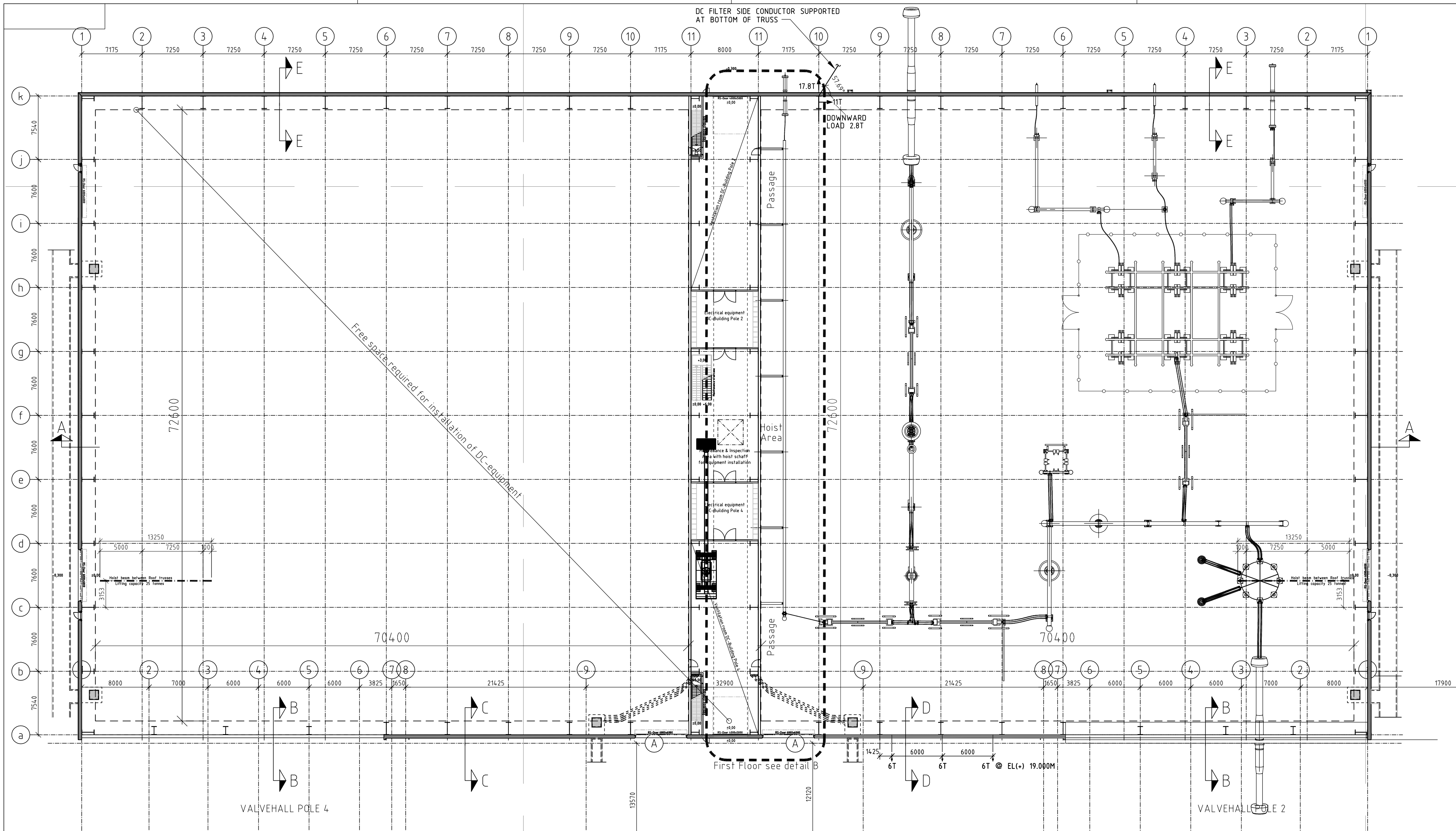
15.5 Doors

The doors including frames shall be measured in sqm.

Area shall be worked out considering clear width & clear height of the opening.

16.0 Structural Stability & Warranty Certificates

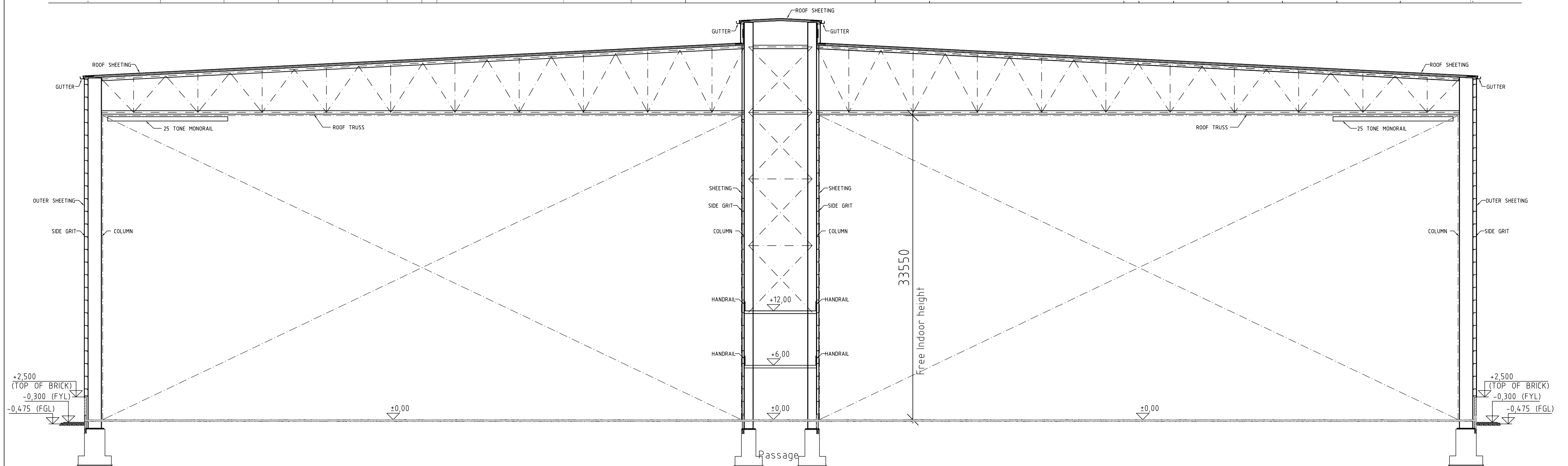
- 16.1** Structural stability certificate along with simulation studies at maximum wind condition shall be submitted.
- 16.2** Warranty certificate for life of all materials used (which should be for not less than that of the plant life i.e. 40 years) shall be submitted.



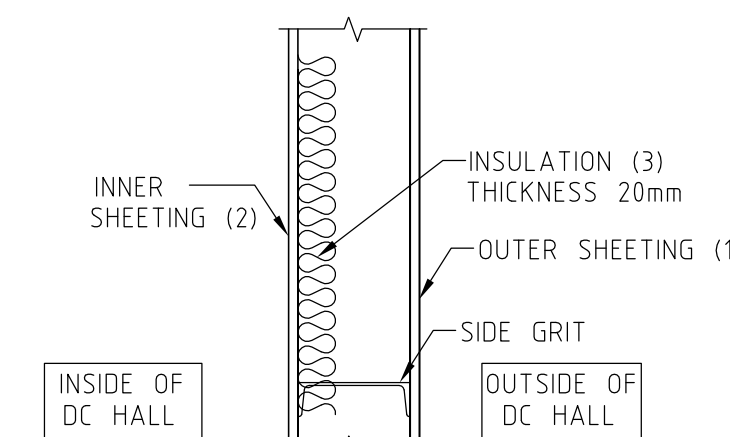
DETAIL B, DC-BUILDING FIRST FLOOR

LEGEND

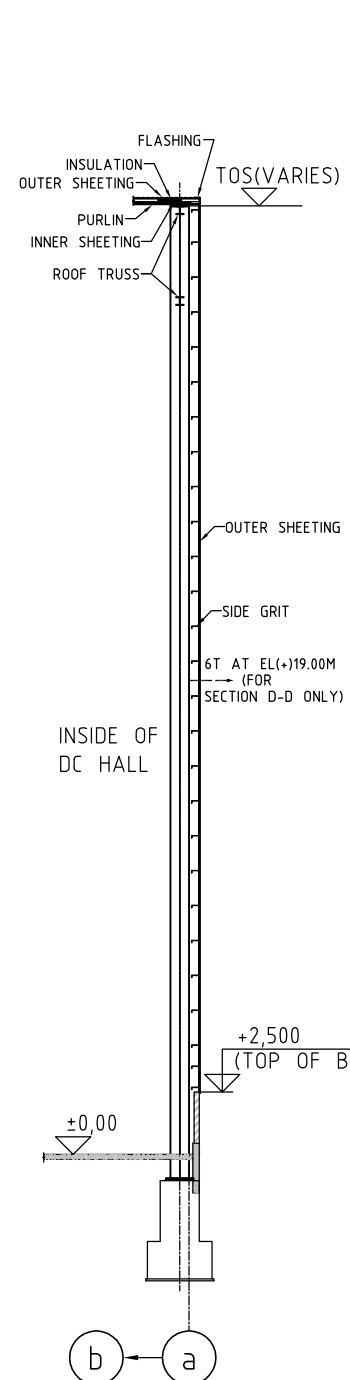
1. OUTER SHEETING : MS SHEET HAVING TROUGHED ZINC ALUMINIUM ALLOY HOT DIP COATED (BOTH SIDES TOGETHER 200GM/SQ.M) HAVING 0.6MM MINIMUM THICKNESS (OR HIGH TENSILE STEEL SHEET OF 0.5MM MINIMUM THICKNESS) EXPOSED SURFACE WITH PVF2 COATING (20 MICRONS DFT) OVER CORROSION INHIBITIVE PRIMER; THE INTERIOR SURFACE SHALL BE COATED AS PER MANUFACTURER'S STANDARD. PAINTS SHALL BE FACTORY APPLIED AND OVEN BAKED. STANDING SEAM SHEET FIXED WITH CLIP LOCK SYSTEM SHALL BE USED.
2. INNER SHEETING : MS SHEET HAVING TROUGHED ZINC ALUMINIUM ALLOY HOT DIP COATED (BOTH SIDES TOGETHER 150GM/SQ.M) HAVING 0.6MM MINIMUM THICKNESS (OR HIGH TENSILE STEEL SHEET OF 0.5MM MINIMUM THICKNESS) EXPOSED SURFACE WITH PVF2 COATING (20 MICRONS DFT) OVER CORROSION INHIBITIVE PRIMER; THE INTERIOR SURFACE SHALL BE COATED AS PER MANUFACTURER'S STANDARD. PAINTS SHALL BE FACTORY APPLIED AND OVEN BAKED.
3. INSULATION : MINERAL WOOL INSULATION CONFORMING TO IS:8183 HAVING A DENSITY OF 32KG/CUM FOR GLASS WOOL OR 48KG/CUM ROCK WOOL OF THICKNESS AS PER DETAIL.



SECTION A-A, DC-BUILDING



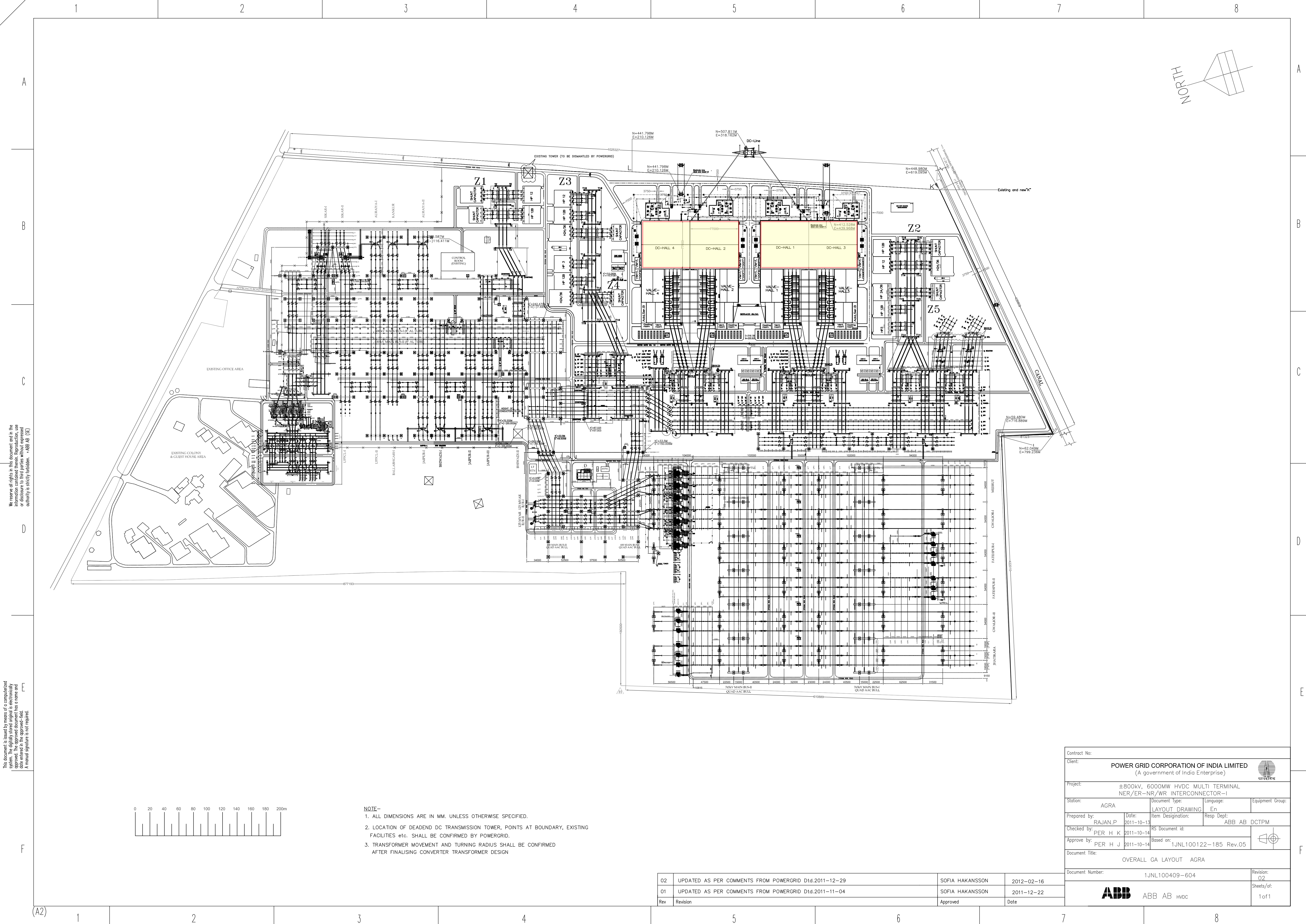
TYPICAL DETAIL OF WALL SECTION



SECTION C - C (AS DRAWN)
SECTION D - D (AS DRAWN AND NOTED)
SECTION E - E (OPP. HAND)

THIS MEASUREMENT IS 100 mm ON ORIGINAL DRAWING
IF NOT 100 mm ON THIS COPY, ADJUST SCALES ACCORDINGLY.

FOR TENDER PURPOSE POWER GRID CORPORATION OF INDIA LIMITED (A government of India Enterprise)	
±800 kV 6000 MW HVDC Multi Terminal NER/ER - NR/WR Interconnector-I	
ABHARAT HEAVY ELECTRICALS LTD. TRANSMISSION PROJECTS DIVISION	
Civil and Building Works incl EL and Mech. Services.	
ABB'S CONSULTANT FICHTNER Consulting Engineers (India) Private Limited Chennai.	AGRA CONVERTER STATION DC BUILDING POLE 4 AND 2 MAIN DIMENSIONS AND LAYOUT
Date: 2012-06-12 Drawn by: NAR Checked by: RMB Scale (A1-Print): 1:1 Drawing No: 5517- 3-73-001 Rev: R0	F:\Civil_Engg\ABB-HVDC - 11114\DWG\Agra\2D 3D Dwg files\3-73-001 REV R0-20120612.dwg

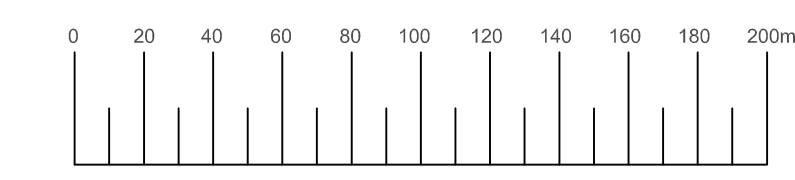


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F

(A2)



- NOTE-**
1. ALL DIMENSIONS ARE IN MM. UNLESS OTHERWISE SPECIFIED.
 2. LOCATION OF DEADEND DC TRANSMISSION TOWER, POINTS AT BOUNDARY, EXISTING FACILITIES etc. SHALL BE CONFIRMED BY POWERGRID.
 3. TRANSFORMER MOVEMENT AND TURNING RADIUS SHALL BE CONFIRMED AFTER FINALISING CONVERTER TRANSFORMER DESIGN

02	UPDATED AS PER COMMENTS FROM POWERGRID Dtd.2011-12-29	SOFIA HAKANSSON	2012-02-16
01	UPDATED AS PER COMMENTS FROM POWERGRID Dtd.2011-11-04	SOFIA HAKANSSON	2011-12-22
Rev	Revision	Approved	Date

Contract No:			
Client:		POWER GRID CORPORATION OF INDIA LIMITED (A government of India Enterprise)	
Project:		±800kV, 6000MW HVDC MULTI TERMINAL NER/ER-NR/WR INTERCONNECTOR-I	
Station:		AGRA	
Document Type:		LAYOUT DRAWING	
Language:		En	
Equipment Group:			
Prepared by:		RAJAN.P	
Date:		2011-10-13	
Item Designation:		ABB AB OCTPM	
Checked by:		PER H K	
RS Document id:		1JNL100122-185 Rev.05	
Approve by:		PER H J	
Based on:		1JNL100122-185 Rev.05	
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Document Number:		1JNL100409-604	
Revision:		02	
Sheets/of:		1 of 1	
ABB		ABB AB HVDC	