1.0 SCOPE

This specification establishes the Documentation Requirements from Contractors.

All documents/data against the Tender / Contract shall be developed and submitted to EIL/Owner by the contractor for review / records, in line with this specification.

2.0 DEFINITIONS

2.1 Contractor

For the purpose of this specification, the word "CONTRACTOR" means the person(s), firm, company or organization who has entered into a contractwith EIL / Owner for delivery of some products and services.The word is considered synonymous to bidder, supplier or vendor.

2.2 Owner

Owner means the owner of the project for which services / products are being purchased and includes their representatives, successors and assignees.

3.0 REFERENCE DOCUMENTS

- Specification for Quality Management System Requirements from Bidders (Doc. No. 6-78-0001)

4.0 DOCUMENTATIONAND DATA REQUIREMENTS

4.1 Order Acknowledgement and Assigning Project Manager

After placement of order, Contractor shall acknowledge order through V-Portal within 7 days of receipt of FOA/PO. Contractor shall assign a Project Manager for that order though online portal and provide requisite details. Project Manager details shall include e-mail address, mailing address, mobile/telephone nos., fax nos. and name of Project Manager. All the system generated emails pertaining to that order shall be sent to the assigned Project Manager.

4.2 Documents/Data to be submitted by the Contractor

4.2.1 The contractor shall submit the documents and data against the Tender/Contract as per the list specified in respective Tender/Contract.

4.2.2 Review of the contractor drawings / Documents by EIL would be only to review the compatibility with basic designs and concepts and in no way absolve the contractor of his responsibility/contractual obligation to comply with Tender/Contract requirements, applicable codes, specifications and statutory rules/regulations. Any error/deficiency noticed during any stage of manufacturing/execution/ inspection / installation shall be promptly corrected by the contractor without any extra cost or time, whether or not comments on the same were received from EIL during the drawing review / inspection stage.

4.2.3 Unless otherwise specified, submission of documents for Review/Records shall commence as follows from the date of Fax of Intent /Letter of Intent/ Fax of Acceptance (FOA)/ Letter of Acceptance (LOA):

QMS	-	1week
Document Control Index	-	2weeks
Other Documents/Drawings	-	As per approved Document Control Index

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4.2.4 Documents as specified in Tender/Contract are minimum requirements.Contractor shall submit any other document/data required for completion of the job as per EIL/Owner instructions.

4.3 Style and Formatting

4.3.1 All Documents shall be in ENGLISH language and in M.K.S System of units.

4.3.2 Before submitting the drawings and documents, contractor shall obtain the title block from EIL and ensure that the following information are properly entered in each drawing:

- Tender Number
- Name of Equipment / Package
- Equipment / Package Tag No.
- Name of Project
- Owner
- Main Contractor (if work is sub-contracted)
- Drawing / Document Title
- Drawing / Document No.
- Drawing / Document Revision No. and Date

4.4 Review and Approval of Documents by Contractor

4.4.1 All the Drawing/Documents shall be reviewed, checked, approved and duly signed/stamped by contractor before submission.Revision number shall be changed during submission of the revised contractor documents and all revisions shall be highlighted by clouds. Whenever there is a requirement of any sub- contractor/DEC drawings to be reviewed by EIL, the same shall be submitted by the contractor duly reviewed, approved and stamped by the sub- contractor/DEC and the contractor.Direct submission of sub- contractor's drawings without contractor's approval shall not be entertained.

4.5 Transportation Plan

Transportation Plan for Over Dimensional Consignments (ODC), if any, shall be submitted within 2 weeks of receiving FOA / LOA, for approval. Unless otherwise mentioned, consignments with parameters greater than following shall be considered as over dimensional.

Dimensions : 4 meters width x 4 meters height x 20 meters length

Weight : 32 MT (Metric Ton)

Dimensions and weight provided above are inclusive of all nozzles, attachments, transportation saddles etc.

Physical Route survey for ODC movement shall be submitted to EIL within 8 weeks of receiving FOA / LOA.

4.6 Document Category

Following review codes shall be used for review of contractor Drawings/Documents:

Code 1 - No comments. Proceed withManufacture/ Fabrication/ Constructionas per the document.

Code 2 - Proceed with Manufacture/Fabrication/Constructionas per commented document.Revised document required.

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Code 3 - Document does not conform to basicrequirements as marked.Resubmitfor review.

Code R - Document is retained for Records. Proceed withManufacturing/ fabrication as per Tender/ ContractRequirement.

Code V - Void, Document is returned as invalid.

Document is marked as Void under following conditions:

a) Wrong item drawing uploaded.
b) Superseded or obsolete submission.
c) Duplicate submission.
d) Out of sequence submission.
e) Mismatch in document name and title under which document uploaded.
f) Document not legible.
g) For PMC projects, document not signed and stamped by contractor and DEC

4.7 Methodology for Submission of Documents to EIL/Owner

4.7.1 Document Control Index (DCI)

Contractor shall create and submit Document Control Index (DCI) for review based on PO/PR/MR along with schedule date of submission of each drawing/document on EIL Vendor Portal.The DCI shall be specific with regard to drawing/document no. and the exact title. Proper sequencing of the drawings/documents should be ensured in schedule date of submission.

4.7.2 Submission of Drawings/Documents / Data

Drawings/documents, data and DCI shall be uploaded on the EIL VendorPortal. The detail guidelines for uploading documents on EIL Vendor Portal are available on following URL:

http://edocx.eil.co.in/vportal

4.7.3 Statutory Approvals

Wherever approval by any statutory body is required to be taken by Contractor, the Contractor shall submit copy of approval by the authority to EIL.

4.7.4 Schedule and Progress Reporting

Contractor shall submit monthly progress report (MPR) and updated procurement, engineering and manufacturing status (schedule vs. actual) and highlight constraints, if any, along with action plan for mitigation, to the EIL / Owner by 1st week of every month. One month Look-ahead schedule including the mobilization plan shall be submitted within 2 weeks from FOA / LOA.In case of exigencies, EIL/Owner can ask for report submission as required on weekly/fortnightly/ad-hoc basis depending upon supply status and contractor shall furnish such reports promptly without any price implication.Format for progress report shall be submitted by the contractor during kick off meeting or within one week of receiving FOA/LOA, whichever is earlier.

Contractor shall submit progress reports including Daily Progress Reports (DPR) through planning portal. “EIL CP Contractor Daily Update System” available in following url: https://www6.eil.co.in/CDUS/

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4.7.5 Quality Assurance Plan/Inspection and Test Plan

Inspection and test plans attached if any, to the tender are generic and indicative only. Immediately after receipt of the order, contractor shall submit within one week of receiving FOA/LOA, job specific ITPs based on the indicative ITPs. Further, contractor shall also submit Quality Assurance Plan for project activities in the scope of contract, starting from manufacturing to handing over/ commissioning, these plans shall cover/identify the activities, relevant procedure, if any, code of conformance, resources for performance and checking/monitoring, approval requirements and authority, records to be generated and audit scope by EIL/Owner.

For EPCC/LSTK/Package contracts, the contractor shall prepare a list of items/ equipment and their inspection categorization plans for all items included in the scope of supply immediately after receipt of order and obtain approval for the same from EIL. The items shall be categorized into different categories depending upon their criticality for the scope of inspection of TPIA and/or EIL.

4.7.6 Inspection Release Note (IRN)/ Inspection Certificate (IC)

Contractor shall ensure that all documents viz. documents reviewed, manufacture's test certificate etc., mentioned in Inspection Release Note(IRN), issued by EIL/third party against the materials supplied by contractor, are sent to EIL along with the IRN.

IRN/ IC shall be issued by EIL Inspector/ third party inspection agency only after all the drawings/documents as per DCI are submitted and are accepted under review code-1& code R. Material/Equipment dispatch from contractor's/sub vendor's works shall not commence till above condition is met.

Note 1: Nonfulfilling above requirement shall result into appropriate penalty or with- holding of payment as per conditions of Tender/Contract.

Note 2: For items where IRN/IC is issued by TPIA, supplier to ensure that following as a minimum must be mentioned by TPIA in IRN/IC

a) Tender document number
b) List of drawings / documents with EIL approval code
c) Tests witnessed, documents reviewed
d) Compliance statement by TPIA that product meets the requirement as specified in EIL standard specifications, Inspection Test Plan / Quality Assurance Plan (QAP) and approved documents.

4.7.7 Pre-Commissioning& Commissioning Activities Management System (PCAMS)

Pre-Commissioning& Commissioning activities management system software shall be followed for Mechanical completion, check listing of loops, punch points, hydro test and issue of Formats during the Pre-Commissioning and Commissioning activities and the same can be accessed on following URL

https://pcams.eil.co.in/

4.8 Final Documentation

4.8.1 As built Drawings

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Minor Shop/Site changes made by contractor after approval of drawings under 'Code 1' by EIL and deviations granted through online system, if any, shall be marked in hard copies of drawings which shall then be stamped 'As-built' by the contractor.These 'As-built' drawings shall be reviewed and stamped by EIL Inspector/Site engineer/TPIA also, as the case may be. Format for completeness of final documents (Format No. 3-78-0004) is attached with this specification.Contractor shall prepare scanned images files of all marked – up 'As – built' drawings. Simultaneously contractor shall incorporate the shop/site changes in the native soft files of the drawings also.

4.8.2 As built Final Documents

As built final documents shall be submitted as listed in Tender/Contract

4.8.3 Packing/Presentation of Final Documents

Final Documents shall be legible photocopies in A4, A3 size only.Drawings will be inserted in plastic pockets (both sides transparent, sheet thickness minimum 0.1 mm) with an extra strip of 12 mm wide for punching so that drawings are well placed.

Final Documentation shall be bound in hard board plastic folder(s) of size 265 mm x 315 mm (10½-inch x 12½-inch) and shall not be more that 75 mm thick. It may be of several volumes and each volume shall have a volume number, index of volumes and index of contents of that particular volume.Where numbers of volumes are more, 90mm thickness can be used.Each volume shall have top Poly Vinyl Chloride (PVC) sheet of minimum 0.15 mm thick duly fixed and pressed on folder cover and will have 2 lever clips.In case of imported items documents, 4 lever clip shall also be accepted.All four corners of folders shall be properly metal clamped.Indexing of contents with page numbering must be incorporated by contractor.Spiral/Spico bound documents shall not be acceptable.As mentioned above, books should be in hard board plastic folders with sheets punched and having 2/4 lever clips arrangement.

Each volume shall contain on cover a title block indicating Tender No., name of project, name of customer, package equipment tag no. & name (if applicable).Each volume will have hard front cover and a reinforced spine to fit thickness of book.These spines will also have the title printed on them.Title shall include also volume number (say 11 of 15) etc.

4.8.4 Submission of Soft copies

Contractor shall submit to EIL, the scanned images files as well as the native files of drawings/documents, along with proper index.

In addition to hard copies, contractor shall submit soft copies of all the final drawings and documents in pen drive or any other specified medium with proper identification tag, all text documents prepared on computer, scanned images of all important documents (not available as soft files), all relevant catalogues, manuals available as soft files (editable copies of drawings/text documents, while for catalogues/manuals/proprietary information and data PDF files can be furnished). All soft files shall be appropriately named, systematically indexed, and duly bookmarked in PDF format to facilitate ease of reference and access.

All the above documents shall also be uploaded on the EILVendor Portal and if applicable on Client Server also.

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4.8.5 Completeness of Final Documentation

Contractor shall get the completeness of final documentation verified by EIL/TPIA and attach the Format for Completeness of Final Documentation (Format No. 3-78-0004) duly signed by EIL or TPIA as applicable to the final document folder.

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COMPLETENESS OF FINAL DOCUMENTATION

Name of Supplier/Contractor	:	
Customer	:	
Project	:	
EIL's Job No.	:	
Purchase Order No./ Contract No.	:	
Purchase Requisition No./ Tender No.	:	Rev. No.:
Name of the Work/ Equipment	:	
Tag. No.	:	
Supplier's/ Contractor's Works Order No.	:	

Certified that the Engineering Documents/ Manufacturing & Test Certificates submitted by the supplier (as per Index sheet mentioned in Annexure-1) are complete in accordance with the Vendor Data Requirements of Purchase Requisition / Tender.

Signature	: …….	Signature	: …….
Date	: …….	Date	: …….
Name	: ……..	Name	: ……..
Designation	: ……	Designation	: ……
Department	: ……	Department	: ……
	Supplier/Contractor		EIL/TPIA

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Annexure-1

Final Documentation Index Sheet			
PR/PO/Tender No.		Revision No.	
Serial No.	Document Title	Page/ Folder No.	No. of Pages

Signature	: ……	Signature	: ……
Date	: ……	Date	: ……
Name	: ……..	Name	: ……..
Designation	: ……	Designation	: ……
Department	: ……	Department	: ……

Supplier / Contractor

EIL / TPIA

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आपूर्तिकर्ताओं से प्रलेखन अपेक्षाओं हेतु विनिर्देश

SPECIFICATION FOR DOCUMENTATION REQUIREMENTS FROM SUPPLIERS

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convener	Standards Bureau Chairman
					Approved by	
3	29-09-2025	General Revision	QMS Standards Committee	QMS Standards Committee	AK	MN
2	01-06-2020	General Revision	QMS Standards Committee	QMS Standards Committee	SKB	SKS
1	12-03-2015	General Revision	QMS Standards Committee	QMS Standards Committee	MPJ	SC
0	04-06-2009	Issued as Standard Specification	QMS Standards Committee	QMS Standards Committee	SCT	ND

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Abbreviations:

DCI	Document Control Index
EIL	Engineers India Limited
EPS	Electronic Procurement System
FOA	Fax of Acceptance
IC	Inspection Certificate
IRN	Inspection Release Note
ITP	Inspection and Test Plan
LOA	Letter of Acceptance
LR	Lorry Receipt
MR	Material Requisition
ODC	Over Dimension Consignment
PO	Purchase Order
PR	Purchase Requisition
PVC	Polyvinyl Chloride
QAP	Quality Assurance Plan
QMS	Quality Management System
RPO	Regional Procurement Office
TPIA	Third Party Inspection Agency
URL	Universal Resource Locator
V-Portal	Vendor Portal

QMS Standards Committee

Convener: Mr. Anil Kumar

Members:
Mr. Himangshu Pal (SCM-Inspection)
Mr. Ravindra Kumar (Const.)
Mr. Vinod Kumar (CQA)
Mr. Swapnil Vaishnav (Projects)
Mr.Vijay Kumar Garg (SCM)
Mr.Raju Kumar Pandey (Equipment Division)

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Clause	Title	Page No.
1.0	SCOPE	4
2.0	DEFINITIONS	4
3.0	REFERENCE DOCUMENTS	4
4.0	DOCUMENTATION REQUIREMENTS	4

Annexures:

S. No.	Title	Doc. No.
1.	Format for completeness of Final Documentation	Format No. 3-78-0004

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1.0 SCOPE

This specification establishes the Documentation Requirements from Suppliers.

All documents/data against the PO / PR / MR shall be developed and submitted to EIL/Owner by the suppliers for review / records, in line with this specification.

2.0 DEFINITIONS

2.1 Supplier

For the purpose of this specification, the word "SUPPLIER" means the person(s), firm, company or organization who has entered into a contract with EIL / Owner for delivery of some products and/orservices.The word is considered synonymous to bidder, contractor or vendor.

2.2 Owner

Owner means the owner of the project for which services / products are being purchased and includes their representatives, successors and assignees.

3.0 REFERENCE DOCUMENTS

- Specification for Quality Management System Requirements from Bidders (Doc. No. 6-78-0001)

4.0 DOCUMENTATION REQUIREMENTS

4.1 Order Acknowledgement and Assigning Project Manager

After placement of order, Supplier shall acknowledge order through V-Portal within 7 days of receipt of FOA/PO. Supplier shall assign a Project Manager for that order though online portal and provide requisite details. Project Manager details shall include e-mail address, mailing address, mobile/telephone nos., fax nos. and name of Project Manager. All the system generated emails pertaining to that order shall be sent to the assigned Project Manager.

4.2 Documents/Data to be submitted by the Supplier

4.2.1 The Supplier shall submit the documents and data against the PO/PR/MR as per the list given in respectivePO/PR/MR.

4.2.2 Review of the supplier drawings/ documents by EIL would be only to review the compatibility with basic designs and concepts and in no way absolve the supplier of his responsibility/contractual obligation to comply with PR requirements, applicable codes, specifications and statutory rules/regulations.Any error/deficiency noticed during any stage of manufacturing/execution/inspection/ installation shall be promptly corrected by the supplier without any time and cost implications, irrespective ofcomments on the same were received from EIL during the drawing review stage or not.

4.2.3 Unless otherwise specified, submission of documents for Review/Records shall commence as follows from the date of Fax of Intent /Letter of Intent/ Fax of Acceptance (FOA)/ Letter of Acceptance (LOA):

QMS	-	1week
Document Control Index	-	2weeks
Other Documents/Drawings	-	As per approved Document Control Index

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4.2.4 Documents as specified in PO/PR/MR are minimum requirements.Supplier shall submit any other document/data required for completion of the job as per EIL/Owner instructions.

4.3 Style and Formatting

4.3.1 All Documents shall be in ENGLISH language and in M.K.S(Meter-Kilogram-Second) System of units.

4.3.2 Before forwarding the drawings and documents, contractor shallobtain the title block from EIL and ensure that the following information are properly mentioned in each drawing:

- Purchase Requisition Number
- Name of Equipment / Package
- Equipment / Package Tag No.
- Name of Project
- Client
- Drawing / Document Title
- Drawing / Document No.
- Drawing / Document Revision No. and Date

4.4 Review and Approval of Documents by Supplier

4.4.1 All, the Drawing/Documents shall be reviewed, checked, approved and duly signed/stamped by supplier before submission.Revision number shall be changed during submission of the revised supplier documents and all revisions shall be highlighted by clouds. Whenever the supplierrequires any sub-supplier drawings to be reviewed by EIL, the same shall be submitted by the supplier duly reviewed, approved and stamped by the supplier.Direct submission of sub-supplier's drawings without contractor's / suppliers' approval shall not be entertained.

4.5 Document Category

Following review codes shall be used for review of supplier Drawings/Documents:

Code 1 - No comments. Proceed with Manufacture / Fabrication / Construction as per the document.

Code 2 - Proceed with Manufacture / Fabrication / Construction as per commented document. Revised document required.

Code 3 - Document does not conform to basic requirements as marked.Resubmitfor review.

Code R - Document is retained for Records. Proceed with Manufacturing / fabrication as per Tender/ ContractRequirement.

Code V - Void, Document is returned as invalid.

Document is marked as Void under following conditions:

a) Wrong item drawing uploaded.
b) Superseded or obsolete submission.
c) Duplicate submission.
d) Out of sequence submission.
e) Mismatch in document name and title under which document uploaded.
f) Document not legible.
g) For PMC projects, document not signed and stamped by contractor and DEC

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4.6 Methodology for Submission of Documents to EIL/Owner

4.6.1 Document Control Index (DCI)

Supplier shall create and submit Document Control Index (DCI) forreview based on PO/PR/MR along with schedule date of submission of each drawing/document on EIL Vendor Portal.The DCI shall be specific with regard to drawing/document no. and the exact title. Proper sequencing of the drawings/documents should be ensured in schedule date of submission.

4.6.2 Submission of Drawings/Documents / Data

Drawings/documents, data and DCI shall be uploaded on the EIL Vendor Portal as per approved DCI. The detailed guidelines for uploading documents on EIL VendorPortal are available on URL:**http://edocx.eil.co.in/vportal**

4.6.3 Statutory Approvals

Wherever approval by any statutory body is required to be taken by Supplier, the Supplier shall submit copy of approval by the authority to EIL.

4.6.4 Manufacturing Schedule

Supplier shall prepare milestone based(milestones such as document submission, sub ordering, manufacturing, Inspection, dispatches, etc.) manufacturing schedule for the order, to meet delivery as per FOA/PO terms. Supplier shall submit manufacturing schedule to concerned Regional Procurement Office (RPO) of EIL, with a copy to Head office monitoring team/Owner for review within 7 days from date of FOA/PO.Same shall be uploaded in the EPS portal of EILi.e.,https://www6.eil.co.in/epsinspection/supp

4.6.5 Schedule and Progress Reporting

Supplier shall submit Monthly Progress Report(MPR) on or before the 9th of every monthindicating following milestone-based progress details as minimum:

- Drawing submission and approval status and schedule for submission of revised drawing / fresh Drawing requiring approval as per approved DCI
- Sub-ordering plan/details for all major items indicating item description, sub-order number, Date of sub-ordering, sub-vendor name, Location, contractual delivery data and expected delivery dates at main vendor's shop and other critical details requiring timely receipt of sub-ordered items at shop.
- Shop manufacturing progress indicating major milestone progress, in case of missing any milestone date, catch up plan for the same and expected dispatch date from shop and expected delivery date at site.
- Area requiring special attention/concern and proposed action plan to resolve the same.

First Monthly Progress Report (MPR) shall be submitted within2 weeks from FOA/LOA.In case of exigencies, EIL/Owner can ask for report submission as required on weekly/fortnightly/ad-hoc basis depending upon supply status and supplier shall furnish such reports promptly without any price implication.Format for progress report shall be submitted by the Supplier during kick off meeting or within 2 weeks of receiving FOA/LOA, whichever is earlier.

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4.7 Inspection and Testing

4.7.1 Quality Assurance Plan/Inspection and Test Plan

If Inspection and test plans (ITP)are attached with MR/PR same shall be followed along with additional tests requirement (if any) mentioned in MR/ PR. However for cases wherein EIL Standard ITPs not available/ have not been attached with MR/PR, Supplier shall submit within one week of receiving FOA/LOA, the Quality Assurance Plan for inspection & testing at various stages of production, quality control records for critical bought out items/ materials and site assembly & testing as may be applicable to the specific order and obtain approval from concerned Regional procurement Office of EIL/third party inspection agency, as applicable.

For Package equipment contracts, the supplier shall prepare a list of items/ equipment and their inspection categorization plan for all items included in the scope of supply immediately after receipt of order and obtains approval for the same from EIL. The items shall be categorized into different categories depending upon their criticality for the scope of inspection of TPIA and/or EIL.

4.7.2 Inspection Requirements:

Supplier shall perform internal inspection as per ITP/ approved QAP at their works based on approved documents/drawings. Upon satisfactory internal inspection, supplier shall raise inspection call through Inspection call Module of EPS (https://www6.eil.co.in/epsinspection) to concerned Regional Procurement Office (RPO) of EIL/ TPIA/ Owner with advance notice as per contractalong with Internal test reports. Where inspection is not in the scope of EIL and is carried out by nominated Third Party Inspection agency (TPIA), Inspection Release Note (IRN) issued by the nominated TPIA along with Manufacturer's Test Certificate (MTC) shall be uploaded in EIL EPS Portal (https://www6.eil.co.in/epsinspection).

All changes w.r.t. PR shall be recorded through agreed variations or Concessions & Deviations. Conflict, if any, between PR / Job specifications and approved drawings, shall be brought to the notice of EIL / owner bythe supplier/ contractor. Decision of EIL / owner will be binding on the supplier and to be complied without time and cost implications.

Identified bought out items/ raw material shall be procured under TPIA as per ITP.

4.7.3 Inspection Release Note (IRN)/ Inspection Certificate (IC)

IRN/ IC shall be issued by EIL Inspector/ third party inspection agency on successful inspection, review of test reports/ certificates as per specifications &ITP/ agreed quality plan (as applicable) and only after all the drawings/documents as per DCI are submitted and are accepted under review code-1or code R. Supplier shall ensure that necessary documents/manufacturing and test certificates are made available to EIL/TPIA as and when desired.

Note 1: Non fulfilling above requirement shall result into appropriate penalty or with- holding of payment as per conditions of PO/PR/MR.

Note 2: For items where IRN/IC is issued by TPIA, supplier to ensure that following as a minimum must be mentioned by TPIA in IRN/IC:

a) PR document number
b) List of drawings/documents with EIL approval code
c) Tests witnessed, documents reviewed

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d) Compliance statement by TPIA that product meets the requirement as specified in EIL PR, standard specifications, Inspection Test Plan/QAP and approved documents.

4.8 Transportation Plan

Transportation Plan for Over Dimensional Consignments (ODC), if any, shall be submitted within 2 weeks of receiving FOA/LOA, for approval. Unless otherwise specified, consignments with parameters greater than following shall be considered as over dimensional.

Dimensions : 4 meters width x 4 meters height x 20 meters length

Weight : 32 MT (Metric Ton)

Dimensions and weight provided above are inclusive of all nozzles, attachments, transportation saddles etc.

Physical Rout survey for ODC movement shall be submitted to EIL within 8 weeks of receiving FOA / LOA.

4.9 Dispatch Details

Upon receipt of IRN/IC from EIL inspector/TPIA, supplier shall dispatch items within 2 days. Item wise dispatch details shall be uploaded in EIL's EPS module within 24 hours of any item dispatched from shop, indicating PR item no, Quantity dispatched, Transporter's name, LR Number/ LR date.

4.10 Vendorshall ensure timely uploading of Manufacturing Schedule, Monthly Progress Report,Inspection Certificate (IRN)issued by the TPIA (as applicable for PO where Inspection is under nominated Third Party Inspection Agency)and updation ofitem wise dispatch details in EPS portal of EIL (https://www6.eil.co.in/epsinspection).

4.11 Final Documentation

4.11.1 Supplier shall prepare final documents in line with VDR(Vendor Document Requirements) attached with PR/Tender. A copy of final document along with filled in Format for Completeness of Final Documentation (Format No. 3-78-0004) to be submitted to EIL Inspector/TPIA for review & approval within 2 weeks from dispatch. Upon receipt of EIL/TPIA endorsement on Completeness of Final Documents, supplier shall submit soft/hard copies of Final documents to EIL/Owner in requisite quantity as per PO/PR details, along with covering letter. A copy of covering letter to be submitted to the concerned Regional Procurement Office (RPO) of EIL/Owner.

4.11.2 As Built Drawings

Minor Shop changes made by Supplier after approval of drawings under 'Code 1' by EIL and deviations granted through online system, if any, shall be marked in hard copies of drawings which shall then be stamped 'As-built' by the supplier.These 'As-built' drawings shall be reviewed and stamped by EIL Inspector/TPIA.Supplier shall prepare scanned images files of all marked – up 'As – built' drawings. Simultaneously Supplier shall incorporate the shop changes in the native soft files of the drawings also.

4.11.3 Packing/Presentation of Final Documents

Final Documents shall be legible photocopies in A4, A3 size only.Drawings will be inserted in plastic pockets (both sides transparent, sheet thickness minimum 0.1 mm) with an extra strip of 12 mm wide for punching so that drawings are well placed.

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Final Documentation shall be bound in Hard board Plastic folder(s) of size 265 mm x 315 mm (10½-inch x 12½-inch) and shall not be more that 75 mm thick. It may be of several volumes and each volume shall have a volume number, index of volumes and index of contents of that particular volume.Where number of volumes are more, 90mm thickness can be used.Each volume shall have top PVC sheet of minimum 0.15 mm thick duly fixed and pressed on folder cover and will have 2 lever clips.In case of imported items documents, 4 lever clip shall also be accepted.All four corners of folders shall be properly metal clamped.Indexing of contents with page numbering must be incorporated by supplier.Spiral/Spico bound documents shall not be acceptable.As mentioned above, books should be in hard board plastic folders with sheets punched and having 2/4 lever clips arrangement.

Each volume shall contain on cover a Title Block indicating package Equipment Tag No. & Name, PO/Purchase Requisition No., Name of Project and Name of Customer.Each volume will have hard front cover and a reinforced spine to fit thickness of book.These spines will also have the title printed on them.Title shall include also volume number (say 11 of 15) etc.

4.11.4 Submission of Soft Copies

Supplier shall submit to EIL, the scanned images files as well as the native files of drawings/documents, along with proper index.

In addition to hard copies, Supplier shall submit soft copies of all the final drawings and documents in pen drive or any other specified medium with proper identification tag, all text documents prepared on computer, scanned images of all important documents (not available as soft files), all relevant catalogues, manuals available as soft files (editable copies of drawings/text documents, while for catalogues/manuals/proprietary information and data, PDF files can be furnished). All soft files shall be appropriately named, systematically indexed, and duly bookmarked in PDF format to facilitate ease of reference and access.

All the above documents shall also be uploaded on the EILVendor Portal and if applicable on Client Server also.

4.11.5 Completeness of Final Documentation

Supplier shall get the completeness of final documentation verified by EIL/TPIA,as applicable, and attach the Format for Completeness of Final Documentation (Format No. 3-78-0004) duly signed by EIL Inspector or TPIA as applicable to the final document folder.

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COMPLETENESS OF FINAL DOCUMENTATION

Name of Supplier/Contractor	:	
Customer	:	
Project	:	
EIL's Job No.	:	
Purchase Order No./ Contract No.	:	
Purchase Requisition No./ Tender No.	:	Rev. No.:
Name of the Work/ Equipment	:	
Tag. No.	:	
Supplier's/ Contractor's Works Order No.	:	

Certified that the Engineering Documents/ Manufacturing & Test Certificates submitted by the supplier (as per Index sheet mentioned in Annexure-1) are complete in accordance with the Vendor Data Requirements of Purchase Requisition / Tender.

Signature	: ……	Signature	: ……
Date	: ……	Date	: ……
Name	: ……..	Name	: ……..
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Department	: ……	Department	: ……
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Annexure-1

Final Documentation Index Sheet			
PR/PO/Tender No.		Revision No.	
Serial No.	Document Title	Page/ Folder No.	No. of Pages

Signature	: ……	Signature	: ……
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वैसल्स, पाइपिंग तथा इक्वीपमैंट्स के ऊष्ण इन्स्यूलेशन हेतु मानक विनिर्देश

STANDARD SPECIFICATION FOR HOT INSULATION OF VESSELS, PIPING AND EQUIPMENT

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
0	24-11-2020	ISSUED AS STANDARD SPEC.	PP	BS	PS	SM

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Abbreviations:

ASTM	:	American Society for Testing and Materials
CG	:	Cellular Glass
CUI	:	Corrosion Under Insulation
DFT	:	Dry Film Thickness
ESCC	:	External Stress Corrosion Cracking
GI	:	Galvanized Iron
IE	:	Insulation for Electrically traced surfaces
IH	:	Insulation for heat conservation
IJ	:	Insulation for Steam jacketed surfaces
IS	:	Insulation for Personnel safety
IS	:	Indian Standard
IT	:	Insulation for Steam traced surfaces
ITP	:	Inspection Test Plan
max	:	shall indicate a maximum limit value
min	:	shall indicate a minimum limit value
PIR	:	Poly Isocyanurate Foam
PUF	:	Poly Urethane Foam
SS	:	Stainless Steel
SWG	:	Standard Wire Gauge

Definitions:

Ambient temperature:	Unless otherwise mentioned, ambient temperature referred in this specification shall mean 30^0C
Hot service:	Operating temperature from ambient to 760 deg C is considered as Hot service
Dual service:	Operating temperature ranging from minus (-) 200 to + 350 deg C is considered as dual service

Refractory & Insulation Standards Committee

Convenor : Mr Prasenjit Saha

Members :
Mr Biswarup Sarkar
Mr Prasenjit Pal
Mr Udayan Chakravarty (Piping)
Mr Prag Goel (Fired Heaters)
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1.0 SCOPE

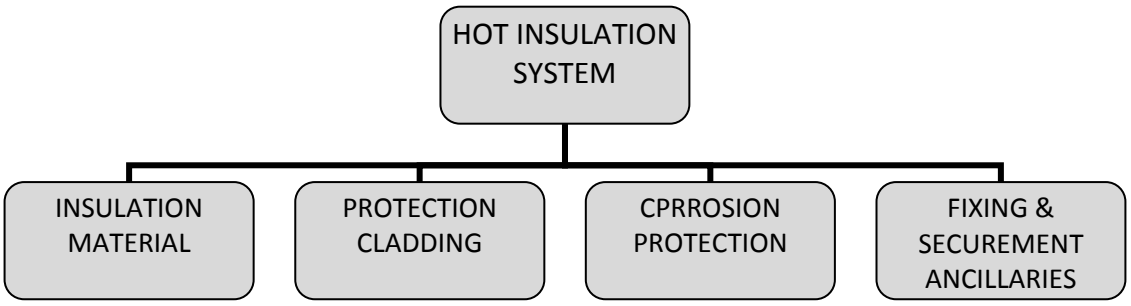
This specification covers the design and material aspects of external insulation of above ground piping, vessels and equipment having operating (process fluid) temperature from ambient to 760^{O}C for the purpose of heat conservation, process stabilization, temperature maintenance, personnel protection and fire protection.

Insulation material and thickness for a project shall be as per Process design basis, BEDB Part-B agreed with client. Insulation system, material properties and specific design requirements are provided in this specification.

Exclusion:
Unless otherwise specified, this specification shall not be binding for insulation of incinerators, boilers, economizers, air pre-heater / ducting of fired heaters etc. for which requirements may be covered in respective package specification. This specification shall not apply to licensed units, where licensor's standard/ specification is applicable.

2.0 GENERAL

Main constituents of a hot insulation system are insulation material and weather protection cladding. Insulation can lead to corrosion to the substrate (commonly known as CUI), especially at low operating temperatures (below 175^{0}C), hence some CUI prevention measures are adopted. Several other materials are used for fixing and securement ancillaries.



2.1 Insulation materials generally used in the industry for hot insulation are given below. Service temperature of each material is different and some may overlap. Material for an application temperature range is selected based on specific advantage of the materials in that range with respect to CUI and other relevant aspects. Insulation material for a project shall be specified in the Process design basis BEDB Part-B.

Insulation Material	General Classification	Temperature limit
Rock wool	ASTM C-547/592/612 / IS 8183	550^{0}C
Calcium silicate	ASTM C-533 / IS 9428	760ºC
Moulded Perlite	ASTM C-610	649^{0}C
Ceramic fiber	ASTM C-892	760^{0}C
Cellular glass	ASTM C-552	427^{0}C
PUF/ PIR	ASTM C-591	100/125^{0}C
Glass wool	ASTM C-553	350ºC
Aerogel	ASTM C-1728	649ºC
Insulating cement	ASTM C-195	760ºC

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2.2 Insulation shall be covered with a weather protection jacket, commonly known as cladding. Unless otherwise specified, aluminium is to be used as default cladding material. Stainless steel / aluminized steel cladding shall be used at higher temperature (>550°C) or where fire protection is an intended service requirement and / or fire safe is a criteria. Non-metallic cladding like UV cured GRP and HDPE can also be used for specific purposes.

2.3 Water ingress into insulation is a major concern, especially at low operating temperature, which may remain into the system and can cause corrosion to the substrate. The risk of corrosion is maximum at operating temperature ≤175°C (hereinafter referred as CUI risk zone).

2.4 Painting is used for general corrosion protection for all temperature range and for all types of insulation. Additional corrosion protection measure is necessary at CUI risk zone particularly when insulation material is fibrous in nature (like rock wool, glass wool, calcium silicate) and metal cladding is used for weather protection.

2.5 In order to prevent / minimize moisture ingress into insulation, a layer of moisture barrier / breather mastic shall be used in CUI risk zone where insulation is designed with fibrous material and metal cladding. All insulation system designed with fibrous material and metal cladding, falling in CUI risk zone, irrespective of the purpose i.e. whether it is for heat conservation, acoustic, fire protection or any other service, shall use this barrier layer. This layer is however not necessary when insulation is designed with a closed cellular material like PUF, PIR, Cellular glass or a water repellent material like aerogel or moulded perlite and / or non-metallic cladding like UV cured GRP or HDPE is used for weather protection.

2.6 Inspection window shall be provided at specific intervals to facilitate periodic inspection for CUI.

3.0 DESIGN BASIS

Insulation type and thickness for a project is finalized in Process design basis, BEDB Part-B. Wherever insulation is provided for heat conservation, thickness is decided on the basis of thermal conductivity of the insulation material, allowable heat loss, max allowable surface temperature/ maintenance temperature, emissivity of cladding material and wind velocity.

3.1 Insulation is required to meet any (or combination of) of the following objectives, generally indicated in P&IDs and line lists:

- Heat conservation
- Process stabilization to assist process control.
- Heat tracing (Steam or Electric)
- Hot water or solvent tracing (liquid)
- Hot Oil tracing
- Steam jacketing
- Hot water or liquid or Oil jacketing
- Fire protection
- Personnel protection

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3.2 Insulation type and thickness shall normally be specified in project specification/ SOR and any of the following documents:

- Piping and Instrument Diagrams (P&IDs) and Line Lists.
- Piping General Arrangement Drawings & Isometrics.
- Instrument Piping Details and Schedules.
- Vessel, Exchanger, Storage Tank and sphere documents and Insulation Schedules.
- Equipment suppliers General Arrangement Drawings for equipment items in Package plant.

3.3 Typical details of any vessel part not covered in this specification, but needs insulation as per good engineering practice shall be submitted by the contractor for approval of owner/ engineer in charge. The details shall include the following as minimum:

- Removable insulation housings
- Flashing details
- Additional Insulation supports
- Vessel head insulation supports
- Expansion joints
- Vessel insulation details
- Exchanger removable housings
- Machinery removable housings etc.

3.4 Codes & Standards

This specification shall be used along with relevant standards / code of practice wherever specified. However, specific technical requirement mentioned in this specification shall prevail over standards/ code and in the event of any difference or conflicting requirement between the code and this specification, stringent of the two shall apply.

Latest issue of the codes/standards prevailing on last submission date of the tender shall be applicable.

3.5 Extent of Insulation

Internally refractory lined piping and equipment and any other items for which heat loss is essential shall not be insulated.

Insulation is not desired for piping and equipment for which heat loss is desired - excepting for personnel protection or to avoid thermal stress problems. Instruments and associated piping (other than impulse piping/tubing) subject to operating flow and/or temperature conditions prevailing in the connected piping or equipment shall be insulated to the same requirements as that of piping or equipment.

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3.5.1 Extent of insulation on piping system

a) Items requiring insulation

- Insulated piping systems shall have straight pipe, bends, tees and pipe-fittings completely insulated.
- Unless otherwise specified, all valves and flanged joints shall be completely insulated only in steam, condensate service, hot oil lines and in lines which are trace heated or jacketed to maintain temperatures.
- For bucket and float type traps the inlet piping and trap shall be insulated.
- Insulation on inlet piping to thermostatic and thermodynamic steam traps shall terminate at approximately 500mm before the trap.
- Steam trap outlet piping other than closed condensate recovery system shall not be insulated except for personnel protection reasons.
- Heat traced instrumentation shall be insulated. The fluid containing sections of such instruments and the associated piping shall be completely insulated. Indication length shall remain visible. Instrumentation other than heat traced shall not be insulated unless otherwise required by Instrumentation department.

b) Items NOT requiring insulation

- Piping which becomes hot intermittently, such as relief valves, vents, steam-out and snuffing steam systems, flare and blow down systems.
- Steam condensate lines downstream of steam traps discharging to drainage system, unless otherwise mentioned.
- Supports for piping, excluding pipe hangers to the extent covered by insulation.
- Steam Traps (except as noted above).
- Valves, including control valves and flanges in process piping systems (except as noted above). However, personnel protection insulation for these items shall be applied, as required.
- Pipe Union fittings.
- Thermowell bosses, temperature and pressure tappings.
- Expansion joints, hinged joints and hose assemblies
- Sight flow indicators.
- Flange joints in Hydrogen service.

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3.5.2 Extent of insulation on equipments

a) Items requiring insulation

- Support skirts of insulated vertical vessel greater than 1200mm diameter shall be insulated both internally and externally for a minimum distance of 600mm below the bottom tangent line. The insulation shall terminate not less than 300mm above the anchor chair.
- Support skirts of insulated vertical vessels of 1200mm and less shall be insulated externally.
- Bottom heads of insulated vertical vessels enclosed by a support skirt shall be insulated without finishing material and shall be insulated only when the vessel outside diameter is greater than 1200mm.
- Turbines shall be insulated for heat conservation.
- Liquid ends of pumps shall be insulated when heat traced and jacketed.

b) Items NOT requiring insulation

- Pumps with operating temperature below 200°C unless pumped fluid has a pour point above minimum design ambient temperature.
- Fans, compressors and blowers and Liquid ends of pumps as noted above
- Internally insulated or refractory lined equipment unless specially designed for metal temperature control.
- Heads of vessels enclosed by support skirts with vessel diameters 1200mm and less.
- Internal surfaces of insulated vessel support skirts with vessel diameter 1200mm or less.
- Turbine casings to be insulated shall exclude shaft seal caps, shaft bearing housings, throttle valves, governors and supports.
- Exchanger channel and covers; shell and channel flanges & Exp. Joints.
- Nozzles flanges, manholes, handholes and flanges of equipment.
- Surfaces of coolers and condensers, Thermowell bosses, temperature and pressure tappings.
- Nameplates of all equipment items.

3.6 Safety Insulation (Personnel Protection)

Exposed surfaces of piping, equipment/ vessels above 60°C in normal or even for a short-term operation, where insulation is not a requirement from heat conservation or process point of view, but in approachable range of operating and maintenance personnel, shall be protected from accidental touch for human safety by appropriate personnel protection. Extent of personnel protection may be decided by the field construction personnel using the criteria that exposed surfaces within 600mm

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horizontally and / or 2100mm vertically of a normal access of walkways or adjacent to handrails, platforms travelled by personnel shall be protected as minimum.

3.6.1 Insulation at low temperature carries a risk of CUI. Hence, insulation to the extent possible should be avoided in CUI risk zone and appropriate personnel protection shall be selected based on the criteria given below.

a) Metal cage / guards may be used for personnel protection for 61 to 175°C

b) Insulation shall be used for personnel protection for 176°C and above

c) Equipment / piping having internal refractory / other lining, shall not be insulated unless specifically required in the design. Personnel protection wherever applicable shall be provided by means of metal cage / guards only.

3.6.2 Requirement and type of personnel protection to be adopted in a project shall be specified in Process design basis BEDB Part-B.

3.6.3 The metal cage / guards, wherever used for personnel protection shall typically be placed at a gap from the surface as given below:

Pipe / Equipment dimension	Gap to be maintained from hot surface (mm)
Pipe diameter up to 6 inches	50
Pipe diameter greater than 6 inch but less than 10 inch	75
Pipe diameter greater than 10 inch	100
Equipment / vessels	100

3.7 Hot insulation in Acoustic service

In specific cases, where a line is to be provided both hot insulation as well as acoustic insulation, following shall be adopted:

3.7.1 Wherever, the material for hot and acoustic insulation are same (e.g. materials like rock wool, glass wool or ceramic fibre), higher of the insulation thickness shall be adopted, cladding shall be as per acoustic requirement.

3.7.2 If the material for hot insulation is different (for example, calcium silicate, PIR, perlite, Cellular glass etc.), hot insulation except the metal cladding shall be first installed over the pipe and then the complete acoustic system installed over it with cladding as per acoustic requirement.

3.7.3 EIL standard specification 6-79-0022 shall be referred for Acoustic insulation.

3.8 Hot & Fire safe insulation

Insulation system in certain service may require serving the purpose of heat conservation and meeting the fire safe criteria. In such cases, insulation thickness needs to be designed for heat conservation during normal operation as well as to limit heat gain in a fire situation, when surrounding is at a higher temperature due to high heat flux released in a hydrocarbon fire.

Wherever insulation material selected for heat conservation is suitable for the fire safe range (for example rock wool, calcium silicate, ceramic fibre etc.), higher of the

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thickness required for heat conservation and fire safe requirement shall be adopted. Cladding shall be of stainless steel / aluminized steel.

Wherever material for hot insulation is not fully fire resistant (for example, PIR, PUF etc.), insulation for heat conservation except the metal cladding shall be first installed over the pipe/equipment and then a layer of fire resistant insulation like rock wool / ceramic fibre etc. of appropriate thickness as applicable for fire safe criteria shall be installed over it with stainless steel / aluminized steel cladding.

3.9 EHT (Electrical heat trace) insulation

Unless otherwise specified, insulation system for the electrically heat traced piping shall consist of pre formed pipe sections of rock wool (LRB is acceptable for higher pipe diameter, refer 4.1.2) with an outer layer of preformed PUF/ PIR, wrapped with a multiplex foil, followed by metal cladding as weather barrier.

Wherever EHT system uses a heat tube, the rock wool pipe section shall be one inch higher size of the pipe diameter. The PUF pipe section shall be of appropriate diameter so that same is snugly fit over the rock wool layer.

Unless otherwise specified, a heat containment shall be created by wrapping a layer of 0.1-0.15mm aluminium foil over the tracing (along with heat tube wherever used) prior to installation of insulation.

3.10 Steam traced insulation

Unless otherwise specified, insulation system for steam traced piping / equipments and instruments shall consist of pre formed pipe sections of rock wool (LRB is acceptable for higher pipe diameter, refer 4.1.3) with a multiplex foil underneath metal cladding as weather barrier. In general, rock wool pipe section shall be one inch higher size of the pipe diameter to accommodate tracer pipes.

A heat containment shall be created by wrapping the tracer pipe (heat tube) along with the parent pipe with a layer of 0.1-0.15mm aluminium foil (or stainless steel foil for >400 deg C) prior to installation of insulation.

Steam tracing expansion loops or couplings extending outside of insulated pipe surfaces shall be insulated for heat conservation.

3.11 Impulse lines

Unless otherwise specified, for impulse lines of austenitic stainless steel, insulation material shall be sodium silicate inhibited ceramic fiber rope (min density 250 Kg/m^3). Ceramic fiber ropes shall comprise of ceramic fibres laid parallel and reinforced with stainless steel wire.

3.12 Removable Insulation

Part of equipment and piping requiring periodic inspection may be provided with a removable and reusable type insulation. Pumps or turbines requiring insulation should have removable insulation cover.

3.12.1 Removable insulation may consist of a fibrous insulation stitched into a quilt of glass cloth fabric envelope and tied with wire around the valve or flange connections. Insulation thickness / number of wraps shall provide equivalent insulation as that of adjacent piping/ equipment.

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3.12.2 Wherever box insulation is used, removable insulation shall be of the same type and thickness as adjacent pipe or equipment insulation.

3.12.3 Removable insulation cover box shall be fabricated from 1mm cladding sheet with insulation installed inside the box. Removable covers box for valves shall cover the body, bonnet, and flanges as applicable.

3.12.4 Insulation covers box shall fit tightly over fittings and protrusions and shall be held in place with straps and stainless-steel toggles. Box shall have an integral metal flashing extending at least 50 mm on adjacent pipe insulation and must be designed to prevent air movement behind insulating covers.

4.0 INSULATION MATERIALS

Insulation material shall be selected primarily based on range of service temperature and other parameters like desired thermal performance, fire protection requirement etc. All materials shall be of high quality and good appearance. Insulation materials shall be of low chloride content, chemically inert, non-sulphurous , rot proof, vermin proof, non-injurious to health and non-corrosive to steel and aluminium (even if soaked in water at ambient temperatures for extended periods), shall not disintegrate, settle, change its form of composition, in a detrimental way during service conditions. Typical details/ minimum technical specification of the major insulation materials and accessories are given in this specification as a guideline.

- Insulation materials in general shall conform to respective ASTM standard/ grade. Equivalent IS grade are acceptable.
- ASBESTOS in any form is NOT permitted. Insulation or finishing materials shall contain no asbestos.
- No inflammable material shall be attached to the insulation.
- Special attention shall be paid for use over austenitic stainless steel surfaces for max permissible chloride level and additional testing for respective material.
- Unless otherwise mentioned, dimensions and tolerances for pipe sections, mattresses & slabs shall generally be as per respective codes. Lesser the number of segments is better. The installed insulation shall fit snugly and shall have a tight joint.

4.1 Rock wool

Rock wool is a fibrous insulation made from molten rock, bonded with resin or suitable binder. The term rock wool shall mean fibrous insulation wool made from natural rock and does not refer to products manufactured from slag or glass. For application over austenitic stainless steel, the material shall be zinc free and shall be inhibited with sodium silicate as per ASTM C-795.

4.1.1 The material may be used up to 550^0C, but shall meet the general classification of respective standards and service temperature requirements as mentioned below:

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Form of Fibrous Material	Quality standard	Max service temperature
Preformed pipe sections	ASTM C547 TYPE-II / IS 9842	760^{0}C
Insulation blanket with wire net facing (details as per 4.1.4, 4.1.5 & 4.1.6)	ASTM C592 CLASS-III/ IS 8183	649^{0}C
Resin bonded mattress (max 2% resin)	ASTM C612/ IS 8183	760^{0}C

4.1.2 Rock wool shall meet following minimum properties:

Properties		Values	Remarks
Density (kg/m^3) as per IS 8183 / IS 3144 / ASTM C-167	Pipe sections	140	Note-1
	Resin bonded mattress / Insulation blanket (density is measured without metal facing)	128	
Linear Shrinkage (%) at 550°C/ 24 hours as per ASTM-C-356, max		2	
Non fibrous shot (%) as per ASTM C-1335 / 3144, max		15	
Compressive strength at 10% deformation (kg/m^2), min		120	
Alkalinity, pH as per ASTM C- 871 / IS 8183		7-10	
Leachable Chloride as per ASTM C-871, ppm, max		10	Note-1, 2
Thermal conductivity (W/mK) as per IS 3346 / ASTM C-177 / ASTM C-518 at mean temperature, max	(+) 100°C	0.052	Note-3
	(+) 200°C	0.068	
	(+) 250°C	0.080	
	(+) 300°C	0.090	
Test of incombustibility OR fire resistivity	Incombustibility as per IS 8183 / IS 3144	Pass	
	OR flame spread index as per ASTM E84, max	25	
Note-1: Supplier shall provide test certificate for each production Batch *Note-2: Max 20ppm allowed for application over carbon steel and low alloy steel* *Note-3: Supplier shall provide Type test certificate no older than 2 years*			

4.1.3 Forms of rock wool insulation

Nominal pipe diameter	Form of Fibrous Material
Up to 6 inch	Preformed pipe section is mandatory
> 6 inch to 14 inch	Preformed pipe section is desirable
>14 inch & equipments	Insulation blanket with wire net facing OR resin bonded mattress

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4.1.4 For operating temperature up to 175°C for application over carbon steel and low alloy steel pipe, insulation blanket wherever used shall have GI metal facing on one side with hexagonal shaped (25mm) wire-woven netting (0.88 to 0.73mm dia.) stitched with tie wires (0.41mm dia.). Galvanization shall be minimum 30gsm.

4.1.5 For operating temperature 176°C and above, for application over carbon steel and low alloy steel pipe, insulation blanket wherever used shall have metal facing as per ASTM A167 type SS 304 with 25mm mesh and 0.8mm wire diameter, stitched with 0.41mm dia. tie wires.

4.1.6 For austenitic stainless steel and alloy 20 piping, irrespective of operating temperature, insulation blanket wherever used shall have metal facing as per ASTM A167 type SS 304 with 25mm mesh and 0.8mm wire diameter, stitched with 0.41mm dia. tie wires.

4.2 Moulded Expanded Perlite

Perlite block and pipe sections shall be made of expanded perlite and sodium silicate or appropriate binder, shall be suitable for continuous service up to 649°C.

4.2.1 Material shall conform to the general classification of ASTM C-610 and meet the following minimum properties:

Properties		Values	Remarks
Density (kg/m^3) as per ASTM C-302/303, max		240	Note-1
Compressive strength at 5% deformation (kPa), min as per ASTM C 165 (for block)		483	
Linear Shrinkage (%) max at 649°C for 24hrs,	Length and width	2	
	thickness	8	
Water absorption after heat aging at 315°C & 48 hr water immersion, weight gain %		50	
Alkalinity, pH as per ASTM C- 871		6-10.5	
Flexural Strength as per ASTM C203, Proc-D (kPa), min		310	
Leachable Chloride as per ASTM C871, ppm, max		10	Note-1 & 2
Thermal conductivity (W/mK) ASTM C-177 / ASTM C-518 / ASTM C-335, at mean temperature	(+) 93 deg C, max	0.079	Note-3
	(+) 149 deg C, max	0.086	
	(+) 204 deg C, max	0.095	
	(+) 260 deg C, max	0.106	
	(+) 371 deg C, max	0.126	

Note-1: Batch test - Supplier shall provide test certificate for each production Batch
Note-2: Max 20ppm allowed for application over carbon steel and low alloy steel
Note-3: Type test - Supplier shall provide Type test certificate no older than 2 years

4.2.2 For application over austenitic stainless steel, perlite block and pipe sections shall also meet the requirements of ASTM C-692.

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4.2.3 Forms of moulded perlite

Nominal pipe diameter	Form of Fibrous Material
Up to 14 inch	Preformed pipe section
>14 inch & equipments	Pipe sections / Wedge cut from block

4.3 Calcium silicate

Calcium silicate block or pipe sections shall conform to general classification of IS 9428 (950 grade) or ASTM equivalent C533 TYPE II, shall be suitable for continuous service up to 927°C.

4.3.1 Material shall conform to the general classifications of respective ASTM / IS code and meet the following minimum properties:

Properties		Values	Remarks
Density (kg/m^3) as per IS 5688 / ASTM C302/303, min		240	Note-1
Linear shrinkage as per IS 5688 / ASTM C-356 at 927^{0}C for 24hrs, (%) max.		2	
Moisture content , by weight, max, %		20	
Compressive strength (of dry sample) at 5% deformation, kPa	IS 5688 OR	415	
	ASTM C165	688	
Heat resistance after exposure to 927^{0}C for 24hrs, as per IS 5688	(%) loss in weight, max	15	
	Compressive strength at 10% deformation, kPa, max	345	
Leachable Chloride as per ASTM C871, ppm, max		50	
Thermal conductivity (W/mK) at mean temperature as per IS 9490 / AST C-177	(+) 200 ^{0}C, max	0.072	Note-2
	(+) 300 ^{0}C, max	0.078	
	(+) 400 ^{0}C, max	0.084	
	(+) 500 ^{0}C, max	0.088	
Note-1: Batch test - Supplier shall provide test certificate for each production Batch *Note-2: Type test - Supplier shall provide Type test certificate no older than 2 years*			

4.3.2 Forms of calcium silicate insulation

Nominal pipe diameter	Form of Fibrous Material
Up to 14 inch	Preformed pipe section
>14 inch & equipments	Pipe sections / Wedge cut from block

4.4 Ceramic Fiber

Ceramic fiber is a fibrous insulation made from molten alumino-silicate compositions, fibers are mechanically interlocked through a needling process into blanket form

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without use of chemical binder, shall conform to general classification of ASTM C892 Type III, Grade 8 (1260°C Grade) and meet the following minimum properties:

Properties		Values	Remarks
Density (kg/m^3) as per ASTM C-167, min		128	
Linear Shrinkage (%) at 1200°C for 24hrs as per ASTM C-356, max		3	Note-1
Chemical composition	Al_2O_3, min	43	
	SiO_2, max	57	
	Fe_2O_3, max	0.1	
	TiO_2, max	0.3	
Mean fibre diameter (microns), 3% standard deviation		2.5-3.5	
Non fibrous shot (%) as per ASTM C-1335, max		20	
Tensile strength as per BS 1902 Part-6, kg/cm^2, max	Longitudinal	0.6	
	Transverse	0.5	
Leachable Chloride as per ASTM C871, ppm, max		50	
Thermal conductivity (W/mK) ASTM C-177 / IS 3346 at 600°C mean temperature, max		0.13	Note-2
Note-1: Batch test - Supplier shall provide test certificate for each production Batch *Note-2: Type test - Supplier shall provide Type test certificate no older than 2 years*			

4.5 Cellular Glass

Cellular glass is a closed cellular structured rigid insulation made from glass, a preferred material for cyclic service in the temperature range of (-) 200 to (+) 427 ^{0}C. The material conform to general classification of ASTM C552 Type-II, Grade-6, cut into pipe sections or profile of the substrate as per ASTM C1639 and meet the following minimum properties:

Characteristics		Values	Remarks
Density(kg/m^3), min. (ASTM C303)		98	Note-1
Closed cell content		100	
Compressive Strength (kPa) (ASTM C165), min.		414	
Flexural strength (kPa), ASTM C203, min.		283	
Water absorption (Volume %), max., (ASTM C240)		0.5	
Water Vapour Permeability, ng/Pa.s.m (ASTM E96)		0.007	
Thermal conductivity , w/mK (ASTM C518/ASTM C177)	(+)10°C, max	0.046	
	(-) 18°C, max	0.042	
	(-) 73°C, max	0.033	
	(-)101°C, max	0.030	
Surface burning characteristics as per ASTM E84	Flame spread index, max	5	Note-2

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	Smoked developed index, max.	0	
Note-1: Batch test - Supplier shall provide test certificate for each production Batch *Note-2: Type test - Supplier shall provide Type test certificate no older than 2 years*			

4.6 PIR / PUF Rigid Foam Insulation

Rigid PIR (polyisocyanurate) / PUF (polyurethane) is closed cellular structured plastic foam insulation. PUF is generally suitable for use up to 100^{0}C, whereas PIR can be used to little higher, up to 125^{0}C. Wherever in the specification PUF / PIR or PUF is specified, any of the two can be used, but wherever PIR is only specified, PUF shall not be used.

4.6.1 PIR shall be performed into free rise rigid buns using HCFC free chemicals and cut into pipe sections or required profile using a CNC machine. The material shall be chemically inert, moisture free, rot and vermin proof, shall not disintegrate, settle, change its form or composition in a detrimental way while in service, shall conform to general classification of ASTM C591 Grade-2 Type-II, suitable for application up to 125^{0}C and meet the following minimum properties:

Characteristics		Value	Remarks
Bulk density (kg/m3) ASTM-C302/ ASTM -D1622/ IS-11239, min		40	Note-1
Closed Cell content (%) ASTM D-6226 Procedure-2/ IS-11239 Part-5, min		95	
Chloride content (ppm) ASTM C 871, Procedure 2, max		60	
pH (ASTM C 871)		6-7	
Water vapour transmission (ng/Pa-s-m) ASTM E-96 method-A at 23°C & 50% RH, max		5.1	
Compressive strength at 10% deformation (kPa), ASTM D 1621, min		240.	
Flame spread Index as per ASTM E84 OR Horizontal burning as per equivalent BIS method, max		25	Note-1
Thermal conductivity of 180 days aged sample at mean temp (W/mK) ASTM C-177	(+)10 °C, max	0.024	
	(+)24 °C, max	0.024	
Note-1: Batch test - Supplier shall provide test certificate for each production Batch *Note-2: Type test - Supplier shall provide Type test certificate no older than 2 years*			

4.6.2 PUF shall generally be supplied in performed pipe sections or required profile using HCFC free chemicals from vendor shop. The material will have equivalent physical properties as of PIR except temperature limit shall be 100^{0}C and may exhibit higher horizontal burning characteristics compared to PIR.

4.6.3 In-situ foaming of polyuretnane (PUR)

Certain applications like tank may specify use in-situ polyurethane foam (PUR), where the insulation foam can be formed by in-situ injection of the chemicals into an enclosed volume that after curing will be converted into PUF. The quality of in-situ foaming can

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vary and depends on substrate temperature, ambient temperature, humidity etc. Every time the in-situ foaming going to be adopted, it requires demonstration through mock up for achievement of optimum quality. This shall only be used where in-situ PUR is specified and NOT to be used as replacement for preformed rigid PIR / PUF.

4.7 Flexible Aerogel Insulation

Flexible aerogel insulation is a composite of an amorphous silica-based aerogel, a fibrous carrying media, or reinforcements, or a combination thereof, that allow the construct to be flexible. The material shall be in accordance with ASTM C1728 Type-III, Gr.1A. The material shall have following general properties:

Characteristics		Value	Remarks
Temperature range (°C)		24 to 649	
Density (kg/m^3) ASTM C303, min		160	
Compressive Strength (kPa), min, at 10% deformation (ASTM C165)		20.7	
Linear shrinkage at maximum exposure temperature for 24h , max, % (ASTM C356) in length & width		2	
Water absorption, max, % by weight		8	
Water vapour sorption, by weight, max %, (ASTM C1104/C1104M)		5	
Flame spread index (ASTM E84) , max Smoke developed index (ASTM E84) , max		5 10	
Thermal conductivity (W/mK) at mean temperature (°C) (ASTM C177)	(+) 24 °C, max	0.021	
	(+) 149 °C, max	0.025	
	(+) 204 °C, max	0.029	
	(+) 260 °C, max	0.032	
	(+) 371 °C, max	0.043	
Note-1: Batch test - Supplier shall provide test certificate for each production Batch *Note-2: Type test - Supplier shall provide Type test certificate no older than 2 years*			

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4.8 Glass Wool

Glass wool is a fibrous insulation made from molten glass into fibrous form bonded with organic or inorganic binder and suitable for application up to 350°C. Glass wool blanket shall meet the requirements specified in ASTM C553 Type-I and meet the following minimum properties:

Characteristics		Values	Remarks
Density (kg/m^3) as per ASTM C-167, max		64	Note-1
Water vapor sorption % by weight, max, (ASTM C1104/C1104M)		5	
Chlorides, ppm, (ASTM C 871, procedure 2)		10	
pH values, (ASTM C 871)		6-10	
Thermal conductivity, W/mK (ASTM C518)	(+) 24 ^{0}C, max	0.030	Note-2
	(+) 50 ^{0}C, max	0.033	
	(+) 100 ^{0}C, max	0.040	
Note-1: Batch test - Supplier shall provide test certificate for each production Batch *Note-2: Type test - Supplier shall provide Type test certificate no older than 2 years*			

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4.9 Insulating Cement

Insulating cement is primarily composed of chopped rock wool and heat resistant cement and may contain inorganic fillers / suitable heat resistant binder. The material shall conform to general classification of ASTM C195 and shall be suitable up to 1038^0C.

Properties		Values	Remarks
Linear Shrinkage (%) (at 871°C) for 24hrs, max, ASTM C356		5	Supplier shall provide test certificate for each production Batch
Volume change (shrinkage) upon drying, max, ASTM C166		35	
Thermal conductivity, at mean temperature, ASTMC177	(+) 93 deg C, max	0.101	
	(+) 260 deg C, max	0.123	
	(+) 482 deg C, max	0.173	

4.10 Materials / Components for Specific Insulation System

Primary insulation type / combination and thickness shall be specified in Process design basis BEDB Part-B. Based on the insulation type and temperature range, additional components like moisture barrier mastic, foil etc. needs to be as per below guideline:

4.10.1 There is always a risk of water ingress into the insulation through joints of metal cladding. Hence, except specific applications were non-metallic cladding like UV cured GRP or HDPE are used, the risk of CUI needs to be addressed by appropriate material selection and moisture barrier system.

4.10.2 The risk of CUI is highest in the operating zone 50-175°C. Materials like Perlite, Cellular glass, PIR (up to 125°C) and PUF (up to 100°C) are preferable in this zone.

4.10.3 When a fibrous material like rock wool / glass wool is used in CUI risk zone (<175°C), a moisture barrier layer of breather mastic must be used underneath metal cladding.

4.10.4 A combination system with inner aerogel (5-10mm) + outer rock wool can provide good CUI prevention in low operating temperature (<175°C) and shall not require this breather mastic moisture barrier.

4.10.5 The breather mastic need not be used in CUI risk zone (<175°C) wherever moulded perlite or a closed cellular material like PIR/ PUF/ Cellular glass is used as insulation material and / or where a layer of aerogel is used in the innermost layer. The joints of the block insulations shall be sealed with appropriate joint sealant and a multiplex foil (commonly known as mylar foil) shall be used over the outermost insulation layer underneath cladding.

4.10.6 In general, the breather mastic and / or multiplex foil is not necessary above 175°C. However, for HP steam lines longer than 2km which uses rock wool as insulation, a layer of multiplex foil shall be used underneath the metal cladding. The multiplex foil need not be used where insulation is designed with perlite or rock wool in combination with a closed cellular material like PIR or aerogel on the outermost layer.

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4.10.7 Cellular glass be shall be chosen where any one of the following is a requirement:

a) Service is dual temperature, the lower range extents below ambient and upper limit of the exposure exceeds (+) 125 ^{0}C
b) The insulation requires fireproofing over it (epoxy intumescent or vermiculite)

4.11 Insulation thickness

Insulation thickness and thickness for inner and outer insulation for combination lining shall be specified in schedule of rate / equipment datasheet.

Unless otherwise specified, layering of insulation as given below shall be followed:

Insulation thickness (mm)	Number of layers
≤ 75	Single layer
76-150	Two layers
>150	Three layers

4.12 Form of Insulation

All the preformed insulation (Cellular glass, PIR, Calcium silicate, Perlite, Pipe section made from Rock wool etc.) should match the contour of pipe /surface profile of the equipment. Half sections or radial sections shall have longitudinal and circumferential faces flat and smooth so as to match with the other half/ section. Ends of the preformed half sections shall be flat and perpendicular to the center line.

Cellular glass shall be fabricated as per ASTM C1639.

Preformed rigid insulation blocks of PIR shall be cut from buns using CNC machine.

Application	Sections
Pipes up to 12 inch NB	Two half sections
>12 inch up to 20 inch NB	Max 3 radial sections
>20 inch NB	Max 4 radial sections
Equipments, Vessel shells	Machine cut radial sections in required contour of the substrate/ underneath layer
Vessel heads	Manually cut slabs contoured to the profile of vessel heads is acceptable

5.0 ANCILLARY MATERIALS

Hot insulation system shall have the following ancillary components:

Primary components	Secondary components	Other ancillaries
• Multiplex foil • Weather protection Jacket • Protection guard	• Heat transfer cement • Painting • Expansion joint • Sealing tapes • Adhesive	• Band • Sealant for cladding • Screw • Clips • Rivets • Compression spring

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5.1 Weather Protection Jacket (Cladding)

5.1.1. Insulation shall be protected with cladding. Type of cladding shall be as below:

a) Unless otherwise mentioned, aluminium jacketing shall be used as weather protection cladding up to temperature 550 deg C. Aluminium cladding shall be as per ASTM C1729, Class-A having polysurlyn lamination on inside surface and shall meet the requirements of ASTM B209 alloy 3003 H14. Equivalent IS code shall be acceptable for the metal sheet.

b) For temperature above 550 deg C and/ or for fire safe insulation (for all temperature range) cladding shall be stainless steel or aluminized steel as per ASTM A167 / A240 type 304 or aluminized steel as per ASTM A463, type 2, coating designation T2-100, with polysurlyn lamination on inside surface. Equivalent IS code shall be acceptable for the metal sheet.

c) For grade piping in offsites jacket material shall be galvanized steel. Galvanized jacketing shall not be used over insulation on or near austenitic stainless steel and/or austenitic nickel steel Piping & Equipment. Galvanized steel shall be as per ASTM A526 with 275 gsm of coating of Zinc Layer on both the surfaces. Equivalent IS code shall be acceptable for the metal sheet.

5.1.2. Thickness of metal cladding shall be as follows:

Application	Thickness for Aluminium cladding	Thickness for Stainless steel /Aluminized steel cladding
For shells of vertical storage Tanks & Vessels	0.7lmm (22 SWG) Corrugated; The profile of corrugated sheet shall be 32mm x 5mm	0.56mm (24 SWG) Corrugated; The profile of corrugated sheet shall be 32mm x 5mm
For tank Roofs	1.22mm (18 SWG) Flat	0.91mm (20 SWG) Flat
For Horton Spheres & Horizontal vessel shell and heads; vertical vessel heads	0.7lmm (22 SWG) Flat	0.56mm (24 SWG) Flat
For removable covers	1.22mm (18 SWG) Flat	1.22mm (18 SWG) Flat
For all piping, other than grade piping in offsites	0.7lmm (22 SWG) Flat	0.56mm (24 SWG) Flat
For grade piping in Offsites	0.56mm (24 SWG) Galvanized steel (Refer note below)	

Note: For grade piping in offsites the cladding material shall be Galvanized steel.

5.2 Securement Bands / Wires

1 If material is Aluminium, then specification shall be ASTM B209 Alloy 3003 H16, If Stainless Steel, it shall be 18/8.

2 For securing fibrous insulation

A On Piping
Band, 24 SWG thick x 12mm (min) wide, Stainless Steel.

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B On Equipments
Band, 24 SWG thick x 20 mm wide, Stainless Steel.

C On Vertical Storage Tanks
Band, Stainless Steel, 25mm wide x 24 SWG thick.

D Horton Sphere
16 SWG SS Wire & Band, Stainless Steel, 25mm wide x 0.8mm thk.

3 For Securing Rigid Insulation

A On Piping upto 16" OD
Wire, stainless steel, 16 SWG.

B On Piping 18" OD & Larger, Vertical and Horizontal equipments
Band, stainless steel. 20 wide x 24 SWG thick.

4 For Securing Cladding on Insulation (all types)

A For Piping
Band, SS 12mm (min) wide x 24 SWG thick.

B On Equipment
Band, SS, 20mm wide x 24 SWG thick.

C On Vertical Storage Tanks & Spheres
Band, Stainless Steel, 25mm wide x 24 SWG thick.

5.3 Compression Spring

Compression spring (commonly known as MITY spring) shall be used on jacketing over tank, pressure vessels and equipment. The compression springs shall be of 100mm length made of SS 302 / SS 304 stainless steel, shall not be stretched more than 13mm during installation.

Requirement for springs on banding to secure metal jacketing shall be as follows:

Equip. OD	Equip. Circ.	Number of Jacket Expansion Springs					
		Steel Temperature					
(m)	(m)	93°C	204°C	315°C	427°C	538°C	649°C
1	2.9	0	0	0	1	1	1
2	5.7	0	1	1	1	2	2
3	9.6	0	1	2	2	2	2
4.6	14.3	1	1	2	3	3	4
6	19.1	1	2	3	3	4	4
7.6	23.9	1	2	3	4	5	6

5.4 Rivets

Rivets required for metal jacket securement shall be the expanding Aluminium "POP" blind eye type/ Stainless Steel, 9.5mm long x 5mm diameter.

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5.5 Screws

Screws required for metal jacket securement shall be Stainless Steel/cadmium plated steel self tapping type A No.8 dia. x 12mm long to BS 4176 complete with neoprene washers under the head.

5.6 'S.' and 'J' Clips

Formed from 25mm wide stainless steel banding.

5.7 Heat Transfer Cement

Maximum Exposure Temperature: 677^{o}C
Heat Transfer Coefficient to Equipment wall: 114-227 W/m^{2o}C
Bond Shear: 1.034 kPa
Electrical resistivity: 1.299 ohm/cm

5.8 Sealant for Cladding

Sealing materials which may either be in the form of a elastomeric sealing compound or fibre based bituminous felt strips.

The technical requirement and typical elastomeric material for joint sealant of metal cladding (aluminium and stainless steel) is specified below.

General Characteristics	Combustibility/ fire resistance	Water vapour permeance (max)
Average 52% volume solid as per ASTM C461	FSI (flame spread index) $\leq$ 20 as per ASTM E-84, tested on a 6.3mm inorganic reinforced cement board with DFT ~2mm	0.0092 metric perms (as per ASTM F-1249 with DFT 2.8mm)

5.9 Moisture Barrier (Breather Mastic)

When a fibrous material like rock wool / glass wool is used in CUI risk zone (<175°C), a moisture barrier layer of breather mastic must be used underneath metal cladding. The moisture barrier shall be a polymeric water based, breather type mastic (vapor under pressure will pass through it), fire resistive, flexible and be compatible with the type of insulation. Material shall be suitable for the range of temperature to which it is exposed.

Material shall be evaluated for fire resistance as per as per ASTM E-84 (flame spread index ~10) and water vapour permeability in accordance with ASTM E96, procedure-B >1perms for 1/16'' thickness. Average nonvolatile content: 60 to 64% by volume (64% by weight).

5.10 Multiplex Foil

Multiplex foil may be used as an alternative to mastic moisture barrier in specific applications (details shall be as per respective SOR). Multiplex foil shall consist of sandwiched sheets of aluminium and polyester be applied over the insulation prior to weather protection jacketing. It shall confirm to the following requirements:

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Foil composition:	12 µm polyester film
	25 µm aluminum foil
	12 µm polyester film
Tensile strength Yield strength Tear resistance	100 MPa 70 N / cm 400 g / mm
Temperature range	+120°C to -60°C
Volumetric mass	1.93 kg / dm³
Water vapour permeability in acc. with ASTM E 96, procedure E (37.8°C, 90% RH)	max. 10.10-6 g / (m².h.mmHg)

5.11 Sealing Tapes for Multiplex Foil

The sealing tape for joints in the multiplex foil shall meet the following requirements:

Foil composition	12 µm polyester film
	25 µm aluminium foil
	12 µm polyester film
	adhesive layer: polyacrylate
Total thickness exclusive of adhesive layer	50 µm
Temperature range	+120°C to -45°C
Volumetric mass	1.93 kg / dm³
Water vapour permeability in acc. with ASTM E 96, procedure E (37.8°C, 90% R.H.)	Max. 10.10-6 g / (m².h.mmHg)

5.12 Joint Sealant for Insulation Blocks

The joint sealant for joints between insulation blocks shall be compatible with the base insulation material and suitable for the temperature range to which it is exposed. Typical material and technical requirement for PUR/PIR insulation system is specified below. For cellular glass insulation, compatibility or specific products shall be recommended/ confirmed by the cellular glass supplier

General Characteristics	Combustibility/ fire resistance	Water vapour permeance (max)
Average 82% volume solid as per ASTM D2369	Flame spread ASTM E-84 and fuel contribution negligible when used as 3.2 mm wide sealant between joints of incombustible insulation blocks	Negligible when measured across 3.2 mm wide sealant between joints of impermeable insulation blocks

5.13 Protection Guard

Guards and their supports shall be manufactured from carbon steel, which may be galvanized or painted or with Stainless Steel (SS-304). (The mesh may be painted with yellow stripes, 50 mm wide, and shall include a hazard sign indicating 'Hot surface'.).

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The guard mesh shall be of 2mm thick and 12 mm square. Guard shall be designed with end cap of 0.7 to 1mm thk from galvanized Al-Zn coated or Al coated carbon steel with recommended spacing of 450mm to 600mm. Care to be taken that end caps are fitted in an orientation that will allow water drainage. If the metal surface requires greater protection, a fibre glass insulation tape can be fitted to area where end caps make contact to protect pipe work and reduce heat transfer. Mesh shall be rolled to shape as per normal cladding and shall be provided with 50 mm of overlap, sharp edges of cut mesh to be filed. In case of removable guard, the same can be made from toggle clips.

In case of protection guard for small bore piping, perforated metal sheet may be used. Sheet thickness shall be 1mm.Perforation hole shall be minimum 5mm, with minimum 40% free passage. Steel sheet shall be stainless steel in accordance with ASTM A167, type 304.

6.0 APPLICATION

6.1 General Requirements

6.1.1 The application methods, given in this specification are general in nature. The Contractor is responsible for applying an insulating system that will give a satisfactory operational performance and the requirements given herein shall be regarded as the acceptable minimum. The Contractor shall carryout the work in accordance with the best practices of insulation application with the minimum of waste and debris and the final job shall have a neat, efficient and workmanlike appearance.

6.1.2 The insulation shall be so designed/ applied such that ingress of water is prevented, leaked product can drain off and vapour can escape.

6.1.3 All hydrostatic tests on piping and equipment, including steam tracing systems, shall be carried out before insulating material is applied. The insulation Contractor shall only insulate those sections of the plant that have been specifically released for such work by the engineer-in-charge. If insulation must be installed before pressure test, then all welds and flanged joints in the pipe shall be left uncovered till successful completion of pressure test. Then insulation shall be completed.

6.1.4 Co-ordination with Other Agencies

Contractor shall work in close co-ordination with the erection Contractor. Wherever temporary supports are provided the contractor shall remove these and provide necessary support as per standard or as specified in the bid package/tender.

6.1.5 Surfaces to be insulated shall be thoroughly cleaned, dried and made free from loose scale, oil or grease. It shall be the Contractor's responsibility to remove loosely adhering scale and dirt before applying insulation.

6.1.6 Under Insulation Painting

Equipments and piping shall be protected from corrosion by providing appropriate painting under insulation, as per applicable painting specification for the project. Austenitic stainless steel especially 300 and 400 series are susceptible for external stress corrosion cracking (ESCC). For to avoid ESCC in stainless steel, 0.1mm thick aluminium foil up to 550^{o}C, above which stainless steel foil can be wrapped with an overlap of 50mm. Overlap joint shall be sealed with barium chromate sealer or self-

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adhesive (chloride free) aluminum tape at the edge of foil. Foil shall be secured in position either by pressure sensitive tape or aluminium band.

6.1.7 The insulation contractor shall not carry out any welding or drilling on plant equipment and piping.

6.1.8 Wet or Damaged Insulation shall not be used under any circumstances. Material awaiting its protective cover shall be adequately protected from damage, rain and contamination and shall be covered with cladding at a minimum loss of time.

6.1.9 Insulation shall be finished, bevelled and weatherproofed at all terminal points where it is required to remove bolts etc. without damage to the insulation.

6.1.10 Equipment nameplates shall remain visible after insulation has been applied by bevelling back the insulating material and carefully sealing the exposed edges to prevent ingress of moisture.

6.1.11 All projections, such as lifting lugs, trunnions and stiffeners on piping and equipment (i.e. vacuum rings) shall be insulated with the same thickness of insulation as specified for the equipment item or pipeline.

6.1.12 Thermowell bosses, pressure tappings and weephole nipples shall not be insulated in but left accessible.

6.1.13 A minimum clearance of 25mm between outside surface of any insulation finish and adjacent equipment, pipe or structural members shall be maintained.

6.1.14 Insulation supports shall not project out of the insulation outer surface and shall be given sufficient coverage of insulating material to avoid hot spots on the metallic cover at support positions.

6.1.15 Where insulated horizontal piping is supported on steel shoes, the height of the shoe shall be such that the underside of the insulation finishing material is clear of the supporting structure upon which the shoe rests by 25mm minimum.

6.1.16 Pieces of insulation with crushed and damaged ends shall not be used.

6.1.17 Packing and transport to site

Insulating materials should be packed in cartons, crates, bags or shrink film wrapping to minimize mechanical damage and to provide adequate weather-protection and to avoid contamination. Preferably, insulating materials should not be unpacked on site until required for immediate use.

All forms of packaging of insulating materials should be carefully marked. The marking should indicate the type of material and the size, thickness, quality, and quantity contained in each package.

6.1.18 Protection of Materials During Storage

Insulation materials must be protected against any damage, from delivery to finish cladding. Decking and covering with tarpaulins alone are not considered sufficient protection from weather for any length of time and shall not be permitted. Insulation material slabs, blankets and sections shall be stored on a flat surface in a horizontal

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position. Insulation material shall never be stacked directly on the ground. The contractor shall make own arrangement for covered storage for insulation materials as directed by the Engineer-in-Charge.

6.1.19 Protection of Partially Completed Jobs

Precautions must be taken to ensure that each day's work is adequately protected before being left over-night to prevent seepage of water. Unfinished / partially finished / ongoing insulation jobs shall be protected from water ingress by appropriate water shed / wrapping and other protective means.

6.2 Piping Applications

6.2.1 Horizontal Pipe

a) General

Insulation material shall be applied to fit snugly against the contours and shaped only where necessary to achieve this requirement

b) Pipe Section / Moulded Blocks / Segments

- End joints of adjacent blocks shall be staggered one half of the length of the block.

- Included angle between segments shall not be less than 30 deg. for both single and double layer insulation.

- Further, minimum arc length of segments should meet following staggering requirements.

When double layer is applied, both longitudinal and circumferential joints shall be staggered. The arc between the longitudinal seam lines of the inside and outside layers of insulation shall have an angle of over 15 deg. or the longitudinal joints staggered at least by one-layer thickness, whichever is more stringent. Circumferential seams of the inside and outside layers shall be at least 100mm apart.

c) Blankets (Fibrous insulation) shall be applied over the surface with joints tightly butted and laced together with stainless steel lacing wire.

d) Insulation Securement (All insulation materials)

Each layer of insulation shall be secured firmly in place with at least 3 loops of binding wire / band, one loop to be placed not more than 75 from each end and at least one loop to be equally spaced between end loops, for each section.
Binding wire shall be drawn about the insulation with ends tightly twisted together, bent under & pressed into the surface of insulation. Bands or wires in no case be spaced more than 200mm apart.

- For calcium silicate and moulded expanded perlite, all joints shall be sealed with insulating cement of same composition as the Moulded block.

- For Cellular glass, Polyurethane foam and polyisocyanurate, joints shall be sealed with suitable compatible material

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e) Frame work for supporting cladding fibrous insulation

This is not necessary for rigid materials. This is required only for horizontal pipe runs provided with fibrous insulation, in blanket forms; vertical piping provided with fibrous materials need not be provided with this. Piping provided with fibrous resin bonded pipe sections also need not be provided with this framework.

Spacer rings shall be fabricated out of 25x3 M.S. Flats. The outside diameter of these rings shall be equivalent to the outside diameter of the insulation. Spacer rings shall be riveted to 'Z' shaped stays fabricated from the same sized M.S. Flats. These rings shall be suitably painted for corrosion protection. Stays shall be provided at intervals of not more than 300 along the circumference of the insulation, subject to a minimum of 3 stays. Spacer rings shall be provided at every approx. 900. To minimize direct heat conduction through the stays, a packing of 2 sheets of 3 thick CF paper shall be provided at the joints of the stays and pipes. Joints between M.S. Spacer Ring and stays shall be riveted by 6 dia M.S. Rivets with 2 Sheets of 3 thick mill board interposed.

6.2.2 Vertical Pipe

Insulation on vertical or near vertical piping (i.e. greater than 45 deg. angle from horizontal) shall be supported by bolted on metal collars. Metal collars shall be of 6 thick M.S. or Alloy Steel bar (to suit piping material).

Outside diameter of collar shall be around 12 less than O.D. of insulation. Where multi-layer insulation is used, support collar shall be extended to provide for each layer.

Support positions shall be at no greater distance apart than the following:

Pipe operating Temp.(°C)	Support Spacing (mm)
Upto 400	4500
401 to 500	3500
501 to 550	2500
551 to 650	2000
651 to 760	1500

6.2.3 Expansion Joints (Both vertical and horizontal piping. Rigid insulation Materials)

Expansion joint shall be provided at regular intervals as below:

Temp.(°C)	Spacing (mm)
Upto 200	Not required
201 to 300	10
301 to 350	8
351 to 400	6
401 to 550	5
551 to 650	4
651 to 760	3

Expansion joint shall be formed by a 25mm space between the pipe insulation sections and the space shall be filled by compressed loose rock wool. Expansion joints in each layer shall be offset at least 150 from each other in case of multi-layer insulation.

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Expansion joint for first layer for vertical pipe shall preferably be just below insulation support collars.

6.2.4 Elbows and Bends (All insulation materials)

Insulation material shall be mitred and shall be same as that of pipe. Insulation securement bands/wire shall be same as that for equivalent dia pipe. Each mitred section shall be secured with minimum 2 wires/bands. For bends / elbows of nom. pipe size 6" & below, due to lack of space, for all insulation materials, insulation shall be secured by spirally wound 16 SWG SS wire for hard materials & 10 SWG SS wire for soft materials.

Insulation joint for calcium silicate shall be suitably sealed by insulating cement. Fittings below 50mm nom. dia, if insulated of calcium silicate shall be insulated with insulating cement build up in 6mm layers to the thickness of insulation of the adjacent piping. Each layer of insulation cement shall be reinforced with 25mm No. 20 SWG wire netting.

6.2.5 Tee (All Insulation Materials)

Preformed pipe sections or segments shall be carefully cut and shaped around "Tee,' junctions and the insulation material of the tangential pipe shall be carefully and neatly cut to mate upto the material applied to the parent pipe without the creation of voids or gaps, at the junction. Insulation shall be adequately secured by wire / bands of same specification as that of same size pipe.

6.2.6 Flanged Joints or Valves (all insulation materials)

Flanged Joints or Valves, if to be insulated, shall be insulated with removable type insulation.

6.2.7 Insulation Flashing (all insulation materials)

Insulation shall be stopped short of flanged joints and unions by a sufficient distance to permit easy removal of the flange nuts and bolts or breaking of the unions to take place without disturbance or damage to the insulating material. At these positions the insulation shall be beveled and sealed with a metal closure which in turn shall be sealed with waterproof sealing material.

6.2.8 Pipe Supports: (All insulation materials)

Insulation at solid welded or clamped supports shall be cut and shaped to fit around the support and banded securely to enable the insulation to be carried with the pipe movement. When the pipe hangers pass through insulation on piping outdoors, metal hoods packed with a waterproof sealing material shall be furnished and installed. Upper bolts of the hanger clamps are not to be covered with insulation.

6.2.9 Steam Traced Piping (All insulation materials)
Steam traced piping and fittings shall be installed with oversized sections to allow accommodation of both parent pipe and tracer without damage or deformation of the insulation. Traced instrument line and fittings shall be totally enclosed by the insulation in a similar manner and the designed warm air annulus maintained throughout the tracer pipe length. Insulation supports for vertical pipe shall have suitable clearance for tracer pipe. Composite box type insulation may be provided on the steam supply lead lines, in case they are routed together similarly this may be provided for the return lines to manifolds after the run of tracers.

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6.2.10 Electrical Traced Piping

Electrical traced piping shall be provided with the same size insulation as would be provided if the piping were not electrically traced, unless otherwise specified.

6.3 Horizontal Equipments

6.3.1 Application in horizontal vessel

a) The vessel fabricator shall provide insulation cladding support /securement as per fabrication drawing / standard. Insulation contractor shall verify the same before commencing.

- For vessels of diameter 2000mm and above are provided insulation support at horizontal centre line as also vertically at tangent lines. Ring support at tangent lines are provided with 6mm diameter holes. These are to be used for insulation securement.

- At vessel heads above 600mm outside diameter are provided flats having 6mm dia holes. The flats are for insulation support and holes provided in them are to be used for insulation securement.
  Also provided on either head is a central ring made of 10 dia stainless steel rod.

- Boot of vessel, if any, is provided with circular support ring with holes, as indicated in sketch.

b) Blanket shall be applied over the surface with joints tightly butted and laced together with 1mm dia stainless steel lacing wire.

Other block insulation shall be applied with the longer dimension parallel to the axis of the vessel or equipment. When blocks are applied in multiple layers, all joints in successive layers shall be parallel to the long axis, shall be staggered and sealed with suitable sealant.

6.3.2 Insulation Securement

Each layer of insulation on shells of equipment shall be secured by bands at every 300 centres. Each band shall be machine stretched and tensioned to remove slack only. Each layer of insulation on vessel heads shall be secured as follows:

Band shall be in radial direction connecting the head central floating ring and shell girth ring. The radial bands shall be placed at not more than 150 centres for rigid and 300 for fibrous insulation, measured at the girth ring. These bands shall be machine stretched and sealed. Outermost layer of insulation shall also be supported by drawing and securing 16 SWG annealed wire through the 6 diameter holes provided in the shell girth ring as also the flats provided on heads. The wire shall be drawn through every hole and it shall be secured to the ring with a knot.

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6.4 Vertical Equipments

6.4.1 Application in vertical vessel

Application details on shell, top and bottom heads shall be similar to that of horizontal equipment. Insulation shall be laid on insulation support rings provided by the fabricator.

6.4.2 Insulation Securement (For all insulation materials)

Bottom and Top Head insulation shall be supported by 16 SWG SS wire drawn through holes in the insulation supports provided by the fabricator.

Top head insulation shall be secured by floating ring/bands provided by vessel fabricator similar to head of horizontal vessel.Shell insulation shall be supported by bands at every 300 centres on the cylindrical portion and the bands shall be kept horizontal.

Insulation Securement for Bottom head for vessel supported on legs shall be identical to that of Top head.

For insulation securement of bottom heads inside skirt no floating rings/bands need be provided; Firm securement should be ensured just by 16 SWG annealed SS wire drawn over insulation tightly and through the holes on support rings provided by the fabricator.

6.4.3 Expansion Joints (For rigid insulation)

Expansion joints shall be provided every 4000mm (max.). The expansion joint shall be provided at insulation support rings. It shall be a 25mm space between the top of the insulation and the bottom of the support ring. The space shall be filled up by compressed rockwool fibre.

6.5 Flange, Nozzle, Channel Cover, Manway & Handhole Flanged Cover (For All Insulation Materials)

Where insulation is required, these shall be insulated with lined removable prefabricated covers secured with bands or quick release toggle clips.

Otherwise, insulation shall be stopped short of uninsulated flanges and nozzles etc., a sufficient distance to permit withdrawal of bolts without disturbing the insulation. Insulation shall be weatherproofed and sealed at these locations.

6.6 Application over Irregular Surfaces Such as Pumps, Compressors, Turbines etc.

a) Rockwool: This shall be prefabricated removable covers, lined with pipe sections / lags / slabs / mattresses.

b) Calcium silicate/ Moulded expanded perlite: Insulation material shall be loose fill insulating cement/block insulation cut and fitted.

Insulation shall be applied in maximum 25mm thick layers until the scheduled thickness is obtained.

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Each layer shall be covered with a layer of 25mm hex. 20 SWG galvanised iron wire mesh for other than SS surfaces and with SS wire mesh for SS surfaces. The final layers shall be trovelled to a smooth finish with a 6mm thick finishing cement.

Insulation shall be beveled back at 45 deg. from all casing flanges, shaft seal caps and bearing boxes.

6.7 Vertical Storage Tanks (Carbon Steel)

a) Supporting rings / spikes (rods) for supporting insulation / cladding

- Shell

The extent of insulation/ cladding support/ securement details shall be as per the relevant tank fabrication standard/ drawings. Insulation contractor shall check for its presence before insulation application work.

Water Shed

At the junction of shell and roof, a watershed is provided to act as top covering for the shell insulation. The details of water shedding shall be as per the relevant tank fabrication standard/ drawings. Insulation contractor shall check for its presence prior to insulation application work.

Insulation Support

Insulation support will consist of 5mm dia steel rods provided at 400mm dia diamond pitch. Length of these lugs is 3mm less than insulation thickness.

Cladding Support

From tank top, horizontal rings shall be provided at every 1175mm on tank shell.

- Tank Roof

Shall be provided as per relevant tank fabrication standard.

b) Insulation laying and securement

- Shell (Application of fibrous insulation)

Insulation shall be applied between rings in horizontal mode. Mattresses insulation shall be applied with joints tightly butted and laced together with 1mm dia. Stainless steel lacing wire. Matts shall be impaled to the 5mm rod and speed washers fixed and pressed home for intimate contact of the insulation. In the case of multiple layers, speed washers are necessary only over the final layers, (upto and including 150mms). Rods and speed washers of spring steel should be selected to suit each other. While rods are provided by tank fabricator, speed washers shall be furnished by insulation contractor. Insulation shall be further secured by bands spaced centrally between insulation supports.

- Shell (Application of Polyisocyanurate / Polyurethane foam)

Shall be foamed cast in-situ as per vendor's procedure (approved by Client/Client's representative) and to the satisfaction of Site-in-Charge. The

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minimum requirement for thermal conductivity, density, compressive strength, fire properties and water vapour permeability shall be as specified herein this specification. Contractor shall ensure that cladding & band thicknesses are capable of withstanding foaming pressures which are developed at the time of injection of foam. Contractor can use foamed cast in-situ insulation only after getting the approval to material specification and application procedure.

- Roof (For all materials)

  Application fibrous insulation, Polyisocyanurate / Polyurethane foam shall be similar to that as for shell. Insulation support from 5mm dia M.S. lugs shall be exactly same as in shell.

6.8 Horton Spheres

c) Structural members provided by spheres fabricator for insulation/cladding securement. Insulation & Cladding supports shall be as per relevant sphere fabrication standard

d) Insulation laying and securement

Insulation shall be applied between rings. Insulation shall be applied with joints tightly butted and laced together with 1mm dia galvanized lacing wire.

Insulation shall be secured by drawing and securing tightly 16 SWG stainless steel wire through the 6 dia holes, provided every 200 centres, in the horizontal leg of the insulation support angle ring. The wire shall be rightly drawn over the insulation and the insulation firmly secured. The wire shall be drawn through every single individual hole and it shall be secured with angle with a knot at every fourth hole.

6.9 Inspection Windows

Removable plug type inspection window shall be provided on the outside thermal insulation metal jacketing to facilitate the maintenance inspection of substrate. The removable plug shall be made of silicon rubber and secured with small chain or lanyard made of stainless steel. Sealing flange shall be made of stainless (SS-304). An O-ring made of rubber shall be placed for any metal seal flange for proper retrofit.

Plug flange shall be fixed by screws and washers to outside metal jacketing and same shall be silicon sealed for a perfect watertight assembly sealing.

When inspection window installed on corrugated metal jacketing, a neoprene transition gasket shall be installed between cladding and flange

6.9.1 Piping

Plug type inspection windows of ellipsoidal shape shall be provided on all the insulated pipelines having diameter 2” and above. The locations of inspection plugs shall be as follows:

- Straight section:

  Two inspection window at 0-6 o’clock position shall be provided at a distance of every 12 meters.

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- Bends/Elbows:

  There must be three inspection window shall be installed near the bends. In case of no supports are welded at the centre of the elbows, one inspection window at the centre of the outer arc and another two at 100 mm away from the above and downstream of the plug. In case of supports are welded at the centre of the elbows, one on side of the elbows and another two at 100 mm away from the support upstream and downstream.

- Tee joints:

  Two no. inspection window shall be installed, one at the Tee bottom and another at the side of Tee.

6.9.2 Exchangers

All the heads shall be provided with one inspection window each. Minimum two inspection windows shall be provided on the shell side.

6.9.3 Columns & Vessels

Heads shall be provided with one inspection window each. One inspection window shall be provided at every platform. Minimum two inspection windows shall be provided on shell portion.

6.9.4 Tanks

One inspection window shall be provided at each course of the tank and also at the top.

6.9.5 Dimension of Inspection window

Application	Size
Pipe dia 2''	35mm minor diameter x 120mm major diameter
Pipe dia 3"	45mm minor diameter x 120mm major diameter
Pipe dia 4"	75mm minor diameter x 120mm major diameter
Pipe dia 6"	100mm minor diameter x 120mm major diameter
Pipe dia 8"	100mm minor diameter x 120mm major diameter
Pipe dia > 8"	120mm minor diameter x 120mm major diameter
Exchangers, Columns& Vessels and Tanks	120mm minor diameter x 120mm major diameter

6.10 Impulse Lines for Heat Traced Lines

Wrap the impulse lines with insulation (Sodium Silicate inhibited Ceramic rope) of required thickness after cleaning the impulse lines from dust, rust, grease etc. Ensure that the rope(s) have been tightly wrapped without leaving any gaps. Apply two layers of self adhesive Aluminium foil tape of minimum 0.1 mm thick spirally bound over the fibre rope surface with the joints in two layers staggered. Ceramic rope shall have minimum density of 250 Kg/m^3, other property like maximum use temperature, tensile strength, linerar shrinkage, non-fibrous content etc. shall meet the requirement specified as per ASTM C892, Type III. A suitable sealant shall be provided to stop the water ingress at the termination points of insulation.

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Note: Impulse line insulation details shall be as follows:

Size of Impulse line (inch)	Temperature (°C)	No. of layers	Thickness of each layer (inch)
1/2	150	2	1/2
3/4	150	2	1/2
1/2	250	2	3/4
3/4	250	2	3/4

6.11 Impulse Lines for Hot Insulated Lines

Wrap impulse lines with sodium silicate inhibited ceramic fiber rope (SS-wire braided) with thickness of layer as 3/4" irrespective of temperature, after cleaning the impulse lines from dust, rust, grease etc. The wrapping of the rope around impulse line shall cover it completely without leaving any gap. Apply two layers of self adhesive Aluminum foil tape of minimum 0.1 mm thick spirally bound over the fiber rope surface with the joints. Ceramic rope shall have minimum density of 250 Kg/m³, other property like maximum use temperature, tensile strength, linerar shrinkage, non-fibrous content etc. shall meet the requirement specified as per ASTM C892, Type III. A suitable sealant shall be provided to stop the water ingress at the termination points of insulation

6.12 INSULATION FINISH

6.12.1 Multiplex vapor barrier

In case of closed cell material (Cellular glass, perlite etc.) in CUI risk zone and on PIR in case of electrical tracing and multiplex vapour barrier shall be applied over the outer surface of Insulation. The joints of the vapor barrier foil shall be overlapped by 50mm. The joints shall be sealed with a tape confirming to the specification as mentioned herein in this specification.

6.12.2 Moisture Barrier

(Applicable for application on outer surface of the fibrous insulation in CUI risk zone)

The mastic shall be applied in two coats with glass cloth reinforcement such that total dry thickness is ~ 3mm.

Immediately after the insulation, a 3mm thick coating of the mastic shall be applied to the surface and a glass cloth shall be laid over the surface and embedded in the mastic. Care shall be taken to ensure that the glass cloth is laid smooth and free from wrinkles and that no pockets of air are trapped beneath the surface. The glass cloth shall have min 75mm overlap at joint. A second coat of 3mm shall be applied after approximately 12 hrs. During the drying time, the insulation shall be protected from the weather by "Alkathene" film type tarpaulin or similar materials approved by engineer-in-charge.

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6.12.3 Insulation Finish with metal jacketing

The insulation finish shall provide a weatherproofed and covering over the whole of the insulated areas and be applied and fitted in such a manner as to provide a close fitting assembly without gaps.

a) Piping

- Straight pipe shall have metal jacketing cut and machine rolled, (approx. 1metre long) wrapped around, with 50mm minimum overlaps on both longitudinal and circumferential overlaps. All laps shall be arranged to shed water.

- A single bead shall be made on all overlaps to ensure tight metal to metal water tight arrangement. Self-tapping screws, at every 150, shall be provided at all longitudinal overlaps for both horizontal & vertical piping.
- At all operating temperatures the seams at overlap positions shall be rendered watertight to ensure that insulation remains dry and unwetted, whether the possible water impingement is from rain, hose or fire sprinklers.

- The metal coverings shall be secured tightly around the insulated pipe and held in place with bands on a maximum of 300mm centres. One band shall be located on each circumferential lap and the distance between laps divided at equal band spacings. The band securing seals shall be kept neatly in line and positioned away from viewing angles as much as is possible.

- Vertical overlaps on vertical or near vertical piping shall be staggered to provide overlaps at 'North,' and 'South' positions in alternate sections of covering.

- Each sections of metal covering on vertical piping with insulation OD's larger than 250mm shall be supported from the next lower section with two ‘S' clips, fabricated from banding material. The ‘S' clip shall be of sufficient length to allow the minimum overlap of 50mm.

- On vertical piping with OD's of 600mm and larger, the securing bands shall be supported by ‘J’ clips, fabricated from banding material. The ‘J’ clip spacing shall be a minimum of two per band. All ‘J’ clips shall be screwed into position and secured.

- Insulated bends and elbows in piping 80mm and larger, shall be metalled with 'lobster back' segments using 10mm minimum ball swage to assist shaping. The metal bands shall be screwed with self tapping screws and metal sealants are to be provided to get a completely waterproofed arrangement.

- Insulated bends and elbows in piping smaller than 80 mm may use complete pressed and humped back flat metal elbows or fabricated 'stove pipe' elbows.

- The practice of locating all joints in the top portion of elevated horizontal pipes for the sake of good appearance when looking up from grade shall be strongly discouraged. The joints shall be located to shed water.

b) Equipments

- The metal jacket over vertical vessel shells shall be constructed of sheet metal panels with the weight of the panel taken on the equipment insulation support rings, via angle brackets bolted to the panel.

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- The panels shall be applied commencing at the bottom of the vessel. Each circumferential ring of panels shall be tensioned by means of tensioning bands until the final joint is screwed tight. 'S' clips shall be used as sheeting support at unscrewed circumferential overlaps.

- The panels shall be held tight over the vessel insulation by means of circumferential bands and sealed. The bands shall be positioned on all horizontal overlaps and at 300mm centres. Bands shall be held in their relative positions with 'J' clips fastened to the jackets with screw. Each band shall have J-clips on 1.8m maximum centre but not less than four J-clips per band. Each band shall have compression spring as specified in this specification.

- The panels shall have a minimum overlap of one corrugation on vertical joints and 80mm on horizontal joints. The overlaps shall be arranged to shed water at all times.

- The vertical and horizontal overlaps shall be secured with self tapping screws at 150mm pitch except the horizontal overlaps pre-selected to act as expansion joints, these shall be constructed with a 150mm overlap and shall remain unscrewed and left free to permit expansion. All overlaps shall be rendered watertight.

- All equipment projections such as nozzles, shall have the jacketing sealed using a metal flashing, cut to fit the projection and extending above the jacket at least 80mm. The seal between the flashing and jacket shall be made watertight by use of self-tapping screws and sealing mastic.

- Horizontal cylindrical equipment shall be furnished with flat metal jacket arranged in circumferential bands with the edge of the sheets, with the longer dimension applied around the circumference of the equipment insulation.

- The panels shall have a minimum of 80mm overlap of both longitudinal and circumferential edges, both overlaps being finished with a simple ball swage and rendered watertight.

- Horizontal overlaps shall be secured with No. 8x12mm long self-tapping screws set in the overlap at 150mm intervals and shall be so arranged that staggered bands of panelling encircle the equipment. Vertical overlaps shall not be screwed for horizontal equipment.

- The metal finish shall be banded and sealed at 450mm centres.

- The insulated heads of vertical and horizontal equipment shall be fabricated from flat metal, an "Orange peel" construction with all radial seams overlapping a minimum of 50mm and secured with self-tapping screws at 150mm centres. All overlaps shall be ball swaged and be rendered watertight.

- Projections from the heads shall be sealed using metal flashings, neatly cut to fit around the projections and extending above the jacket for a minimum of 80mm. The seal between flashing and jacket shall be weatherproofed with self-tapping screws and mastics.

- Insulation at bottom heads of fully skirted equipments does not require weatherproofing.

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- Heads of equipments 24" OD and smaller shall be finished and waterproofed with square ended fabricated covers.

c) Vertical Storage Tanks

Cladding Applications and Securement

➢ Shell

Cladding is applied over the system of horizontal rings as follows :

- Overlaps in the vertical joints will be one corrugation.
- Overlaps in the horizontal joints shall be 50mm (min.).
- Cladding to cladding fastening, at both horizontal and vertical overlaps shall be alternately by "POP" Rivets & selftapping screws at 150mm pitch.
- Cladding shall be secured to support ring by bolting. Bolts are provided by tank fabricator at 300mm centres on angles provided at every 1175 centres vertically. Felt washer, aluminium washer and nut shall be supplied by insulation contractor for all bolted connections at shell, roof and curb angle.
- Insulation shall be tucked into the skirt portion of the curb angle. Shell cladding and extended roof cladding shall be secured to curb angle by bolting as per relevant fabrication standard.
- Horizontal stainless steel bands over-cladding to be provided every 800mm and also to coincide at every horizontal cladding overlaps. Bands shall be tightened, locked and lock fastened featuring stainless steel fastening systems. In order to prevent sliding of the bands downwards, the bands shall be secured to the cladding using POP rivets at horizontal pitch not over 2 metres .

➢ Roof

- All cladding joints shall be sealed by elastomeric metal sealants.
- Min. 75mm overlap shall be ensured at all joints.
- At all joints, cladding-to-cladding securement shall be provided by self-tapping screws and pop rivets alternately, every 150 centres.
- Cladding shall be secured by bolting at every 300 provided by tank fabricator.

d) Horton Sphere

➢ Cladding Support

Insulation contractor shall provide 25mm x 0.8mm S.S. Bands over insulation and install them longitudinally from top to bottom of the sphere in such numbers so as to afford a maximum spacing of 1175mm at the equator. The

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S.S. Bands are spanned between four floating rings, the one at the top and bottom of the sphere are provided by the sphere fabricator. Generally the other two rings and SS bands are provided after insulation is applied prior to application of cladding. Floating rings will be constructed of 10mm diameter rods of S.S.. Diameter of ring at the top and bottom, to be provided by sphere fabricator would be around 1.2m. Cladding support bands shall be tightened using mechanical tighteners and fastened to MS / AS angles using two S.S.Rivets or four Nos. of Aluminium POP rivets, per angle cleat.

- Cladding Application

While applying cladding, following shall be ensured

-Minimum overlap both horizontal and vertical shall be 50mm.

- Cladding Securement and Scaling of Joints

All joints to be sealed using elastomeric metal sealant.

Cladding to cladding securement of both vertical and horizontal overlaps shall be alternately by POP rivets and self-tapping screws, at every 150mm spacing.

Cladding shall be secured to the insulation angle support by bolting the cladding on the bolts provided at every 300 pitch.

Further cladding shall be secured by 25mm x 0.5mm S.S. bands, applied identical to those for insulation securement. The bands shall be provided between two floating rings, one at the top and one at the bottom and arrangement & details shall be identical to that of insulation securement. Bands shall be secured to cladding every 2M by one SS or two aluminium POP rivets. While providing floating rings, for both insulation and cladding securement, following points shall be taken care of:

- Floating rings shall clear nozzles / manholes etc.
- Exercise extreme care while installing floating rings regarding cut outs in cladding around projections,
- Cladding at interface between leg and the body of the sphere to be provided with care and suitably sealed to prevent water ingress.

7.0 QUALITY CONTROL

7.1 Incoming Material Control

7.1.1 Insulation materials and accessories shall be inspected by appropriate authority according to inspection categorization of the materials as per project execution philosophy.

7.1.2 Irrespective of the inspection performed by TPI / PMC / Owner's representative, contractor shall submit QAP (quality assurance plan) of the materials and internal test reports for every production batch and type test wherever specified in this specification.

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The QAP shall include every stage of manufacturing process starting from raw material stage to final stage of manufacturing. The QAP shall also include reference of purchase order number and date, the types of checks, methods of tests followed, frequency of checks, lot size & acceptable criteria with permissible deviations.

7.1.3 Besides the inspection performed at supplier premises and / certificate of conformance provided by supplier, at the discretion of engineer-in charge, random inspection may be performed on the supplied materials. Parameters and extent of testing shall be advised by engineer-in charge.

On the advice of engineer-in charge, the contractor shall organize the testing on representative sample selected at random from an independent NABL approved laboratory. In the event of non-conformance in testing, repeat test may be performed. Failure in repeat test may call of rejection of the batch.

7.2 Installation Quality Control

7.2.1 Insulation shall be installed after hydrostatic testing and inspection. Insulation shall be protected from weather before and during installation.

7.2.2 Insulation system should be applied as per approved drawings/sketches, installation procedure and quality plan.

7.2.3 Contractor shall prepare an inspection test plan (ITP) for installation of insulation identifying inspection / witness points, frequency etc. and submit for approval of owner / engineer in charge at construction site.

7.2.4 The engineer in-charge may finalize the same with consultation of HO specialist. If so desired by engineer-in charge, HO specialist may assist inspection of insulation work at critical stages.

7.3 Qualification of Application Crews

Prior to start for installation work, contractor's credential shall be approved by engineer in-charge of insulation work. The application crew must be fully trained work force. At the beginning of every installation, the application shall be demonstrated and quality checks shall be carried out at site and shall be certified by Owner/Engineer in charge.

7.4 Documentation

Insulation contractor shall submit Insulation Application Procedure for review and approval. Such procedure shall contain minimum following information:

- Product data sheet, material safety data sheet and compliance certificate of all the insulation and ancillaries material.
- Insulation detail drawings showing insulation system, expansion/contraction joints, insulation supports, terminations etc.
- Method statement for insulation system application and repair.
- Quality Control Plan for Insulation application (QCP)

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7.5 Safety

The insulation contractor shall provide adequate protective appliances like hand gloves, masks, glasses etc. to the workmen carrying out the insulation work, to protect them from inhaling and touching insulation dust and fibers.

7.6 Specification Deviation / Concession Control

The insulation contractor shall notify Owner/Engineer in charge of any apparent conflict between this specification, product data sheets, the codes and standards, and any other specification or document noted herein. Resolution and/or interpretation precedence shall be obtained from the Owner/Engineer in charge in writing before proceeding with application of any insulation material.
Any technical deviation to the purchase order/contract and its attachment including, but not limited to, the data sheets and specification shall be sought by the insulation contractor only through the concession request format. Concession requests require the Owner's/Engineer in charge's review and approval, prior to the proposed technical changes being implemented. Technical changes implemented prior to Owner's approval are subject to rejection.

7.7 Guarantee for Supply and Installation Quality

Contractor shall ensure supplied materials conform to the technical requirements of this specification and relevant standards / codes applicable for the job. The insulation and ancillary materials shall be procured fresh for the project. Use of excess material from other site which does not have proper traceability shall not be allowed. It is the responsibility of insulation contractor to ensure adequate precautions are taken against damage and deterioration during sourcing, transportation and storage of insulation materials. For major insulation materials like rock wool, Perlite, Ceramic fiber PIR, cellular glass, aerogel etc. batch and type test certificates as applicable shall be submitted. For ancillary materials like multiplex foil, band, sealant etc. and metal cladding may be accepted based on supplier's compliance certificate.

Any deviations shall be clearly stated, and work shall proceed only after the deviations are approved by competent authority. The workmanship in execution of the insulation works shall be in accordance with sound engineering practice.

8.0 REFERENCE CODES & STANDARDS

ASTM Standards and Specifications

ASTM A167	Specification for stainless and heat-resisting chromium nickel steel plate, sheet and strip
ASTM A240	Specification for heat-resisting chromium and chromium-nickel stainless steel plate, sheet and strip for Pressure Vessels
ASTM A463	Specification for steel sheet, aluminum coated, by hot-dip process
ASTM A526	Specification of steel sheet, zinc coated (galvanized) by the hot-dip process, commercial quality
ASTM B209	Aluminum - Alloy sheet and plate
ASTM C165	Measuring Compressive properties of thermal insulations

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ASTM C177	Standard test method for Steady-state heat flux measurements & thermal transmission properties by means of the 'guarded-hot-plate' apparatus
ASTM C240	Standard test methods of testing Cellular glass insulation block
ASTM C302	Standard test method for Density and dimensions of preformed pipe-covering-type thermal insulation
ASTM C303	Standard test method for Density and dimensions of preformed block and board type thermal insulation
ASTM C335	Standard test method for Steady-state heat transfer properties of horizontal pipe insulation
ASTM C356	Standard test method for Linear shrinkage of preformed high-temperature thermal insulation subjected to soaking heat
ASTM C390	Standard criteria for Sampling and acceptance of preformed thermal insulation lots
ASTM C446	Standard test method for Breaking load and calculated modulus of rupture of preformed insulation of pipes
ASTM C518	Standard test method for Steady-state thermal transmission properties by means of the heat flow meter apparatus
ASTM C533	Standard specification for Calcium silicate block and pipe thermal insulation
ASTM C547	Standard specification for Mineral fiber pipe insulation
ASTM C552	Standard specification for Cellular glass thermal insulation
ASTM C591	Standard specification for Unfaced preformed rigid cellular polyisocyanurate thermal insulation
ASTM C592	Standard specification for Mineral fiber blanket insulation and blanket-type pipe insulation (metal-mesh covered) (industrial type)
ASTM C610	Standard specification for block and pipe thermal insulation
ASTM C612	Standard specification for Mineral fiber block and board thermal insulation
ASTM C795	Standard specification for thermal insulation for use in contact with austenitic stainless steel
ASTM C871	Standard test methods for Chemical analysis of thermal insulation materials for leachable chloride, fluoride, silicate and sodium ions
ASTM C892	Standard specification for High temperature fiber blanket thermal insulation
ASTM D1622	Test method for apparent density of rigid cellular plastics
ASTM E96	Standard test methods for Water vapor transmission of materials

EIL Standards and Specifications

7-13-0003	Hot insulation supports for storage tanks
7-13-0015	Hot insulation supports for spheres
7-12-0025	Fireproofing and insulation supports
7-13-0033	Hot insulation supports for horizontal vessels

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6-79-0022	Standard specification for acoustic insulation
6-79-0027	Standard specification for cold insulation of vessels, piping and equipment

IS Standards and Specifications

IS 8183	Bonded mineral wool - Specification
IS 9428	Calcium silicate insulation blocks and pipe-coverings
IS 11239	Method of test for rigid cellular thermal insulation materials

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9.0 INSULATION DIAGRAMS

The drawings/ sketches are general in nature. Specific insulation system/ requirement if any from insulation manufacturer, shall be submitted by contractor for approval by owner/ Engineer in charge.

The attached sketches describe general arrangement of insulation material, ancillaries and cladding. Difference if any on material type & quality between sketch and the description elsewhere in this specification/ SOR, later shall apply.

S.No.	Description	Drawing
1	Pipe insulation details (fibrous &rigid insulation)	DRAWING. No. 01
2	Pipe insulation method of staggering of sections rigid & fibrous insulation (preformed pipe sections only)	DRAWING. No. 02
3	Horizontal pipe : fibrous insulation; detail of spacer rings for cladding support	DRAWING. No. 03
4.	Detail of spacer ring fibrous insulation (mattress)	DRAWING. No. 04
5.	Bolted on insulation support for vertical pipe	DRAWING. No. 05
6.	Insulation details for bends / elbows	DRAWING. No. 06
7.	Insulation details : pipe bends & elbows	DRAWING. No. 07
8.	Insulation details: pipe branched & reducer	DRAWING. No. 08
9.	Example of removable flange box, horizontal	DRAWING. No. 09
10.	Removable flange box, vertical	DRAWING. No. 10
11.	Insulation details pipe supports	DRAWING. No. 11
12.	Insulation of traced piping	DRAWING. No. 12
13.	Horizontal equipment insulation	DRAWING. No. 13
14.	Horizontal equipment heads	DRAWING. No. 14
15.	Use of flexible insulation in combination with rigid insulation to compensate for vessel expansion	DRAWING. No. 15
16.	Insulation details : vertical vessel	DRAWING. No. 16
17.	Insulation details vertical vessel heads	DRAWING. No. 17
18.	Insulation details : vertical vessels	DRAWING. No. 18
19.	Insulation details : vertical storage tank	DRAWING. No. 19
20.	Insulation details : sphere	DRAWING. No. 20
21.	Non- insulated flanges, horizontal and vertical	DRAWING. No. 21
22.	Removable valve box, "T" connection, horizontal	DRAWING. No. 22
23.	Removable valve box, "T" connection, vertical	DRAWING. No. 23
24.	Hanger support	DRAWING. No. 24
25.	Personal protection	DRAWING. No. 25
26.	Details of lifting lugs	DRAWING. No. 26
27.	Removable box for pump	DRAWING. No. 27

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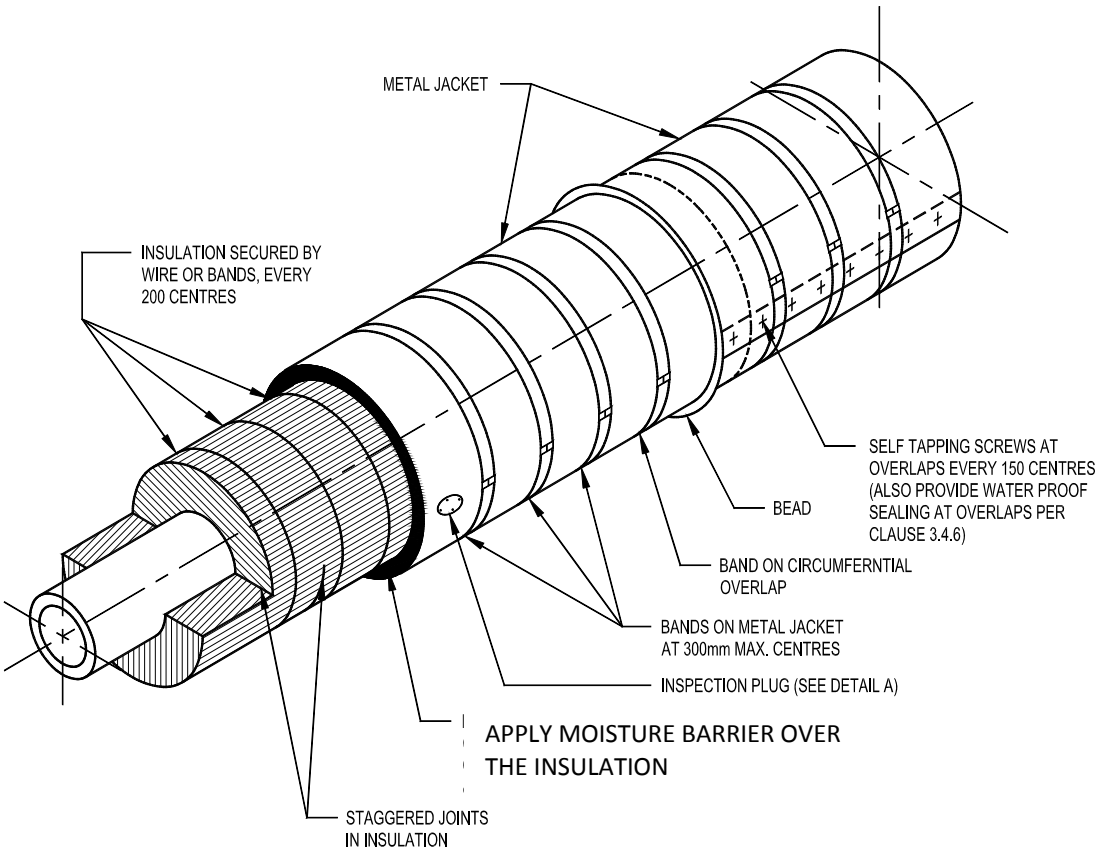

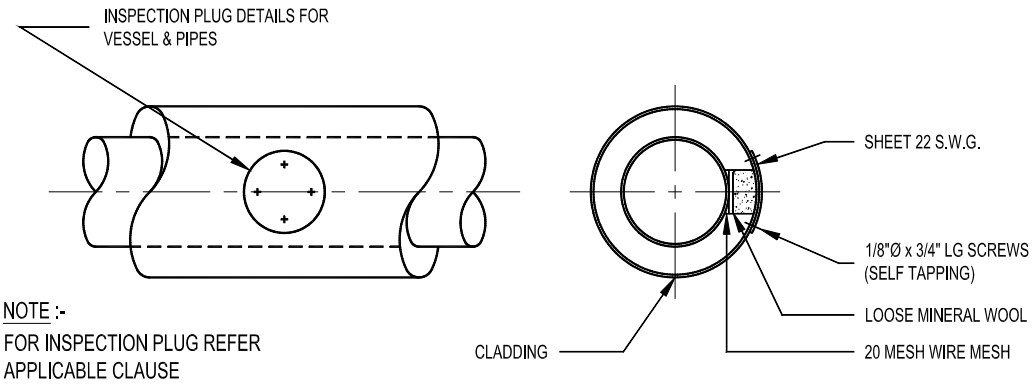

DETAIL 'A'

FIGURE – 01
PIPE INSULATION DETAILS
(FIBROUS &RIGID INSULATION)

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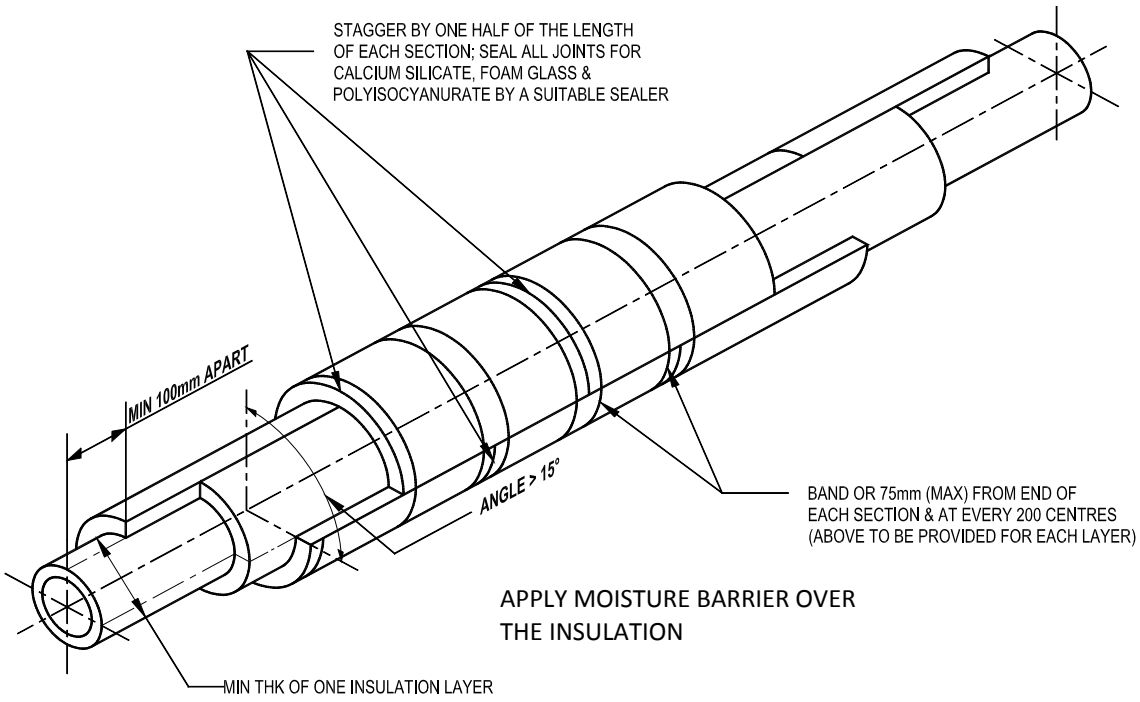

FIGURE – 02
PIPE INSULATION METHOD OF STAGGERING OF SECTIONS
RIGID & FIBROUS INSULATION (PREFORMED PIPE SECTIONS ONLY)

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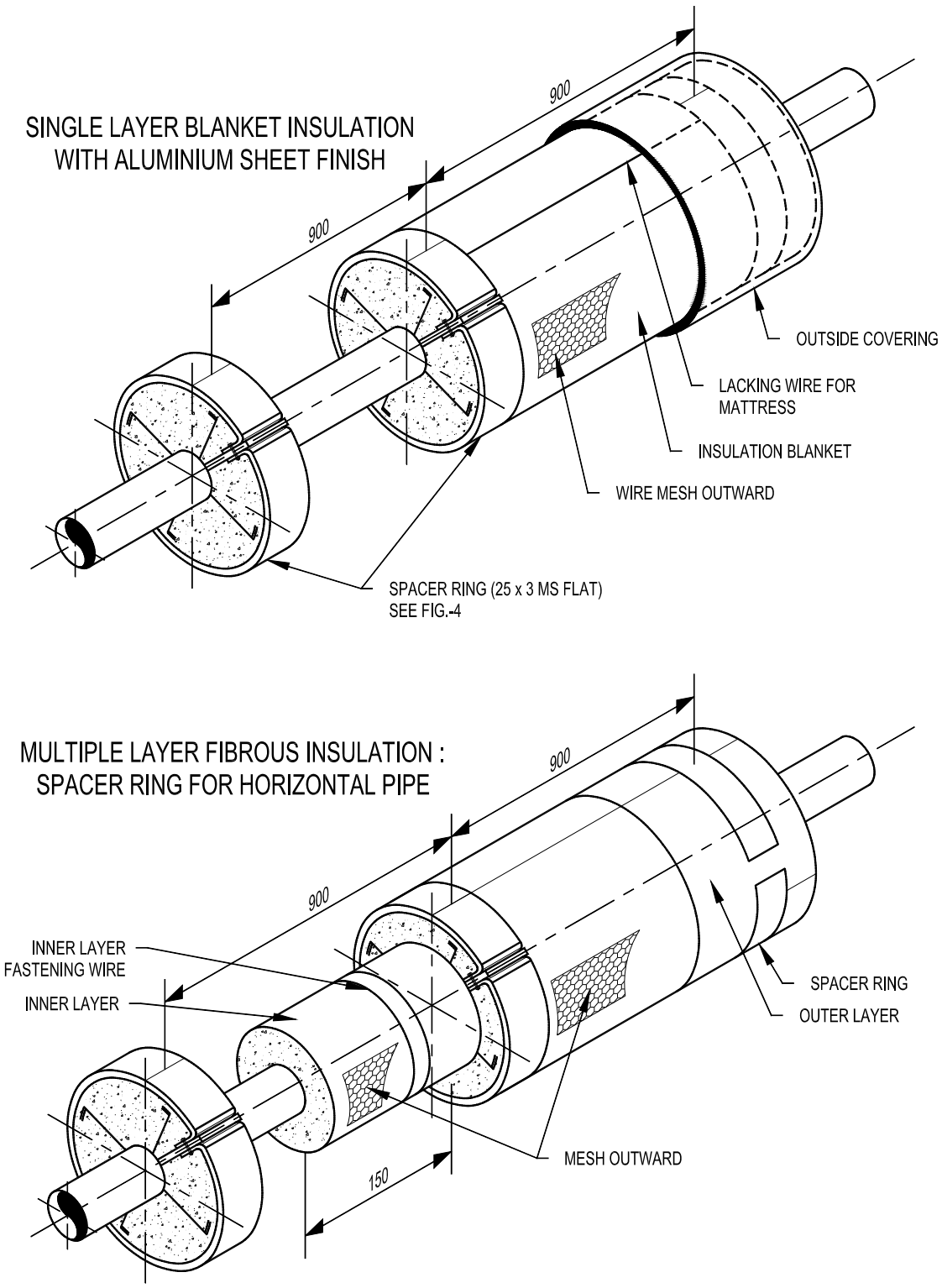

FIGURE – 03
HORIZONTAL PIPE : FIBROUS INSULATION; DETAIL OF SPACER RINGS FOR CLADDING SUPPORT

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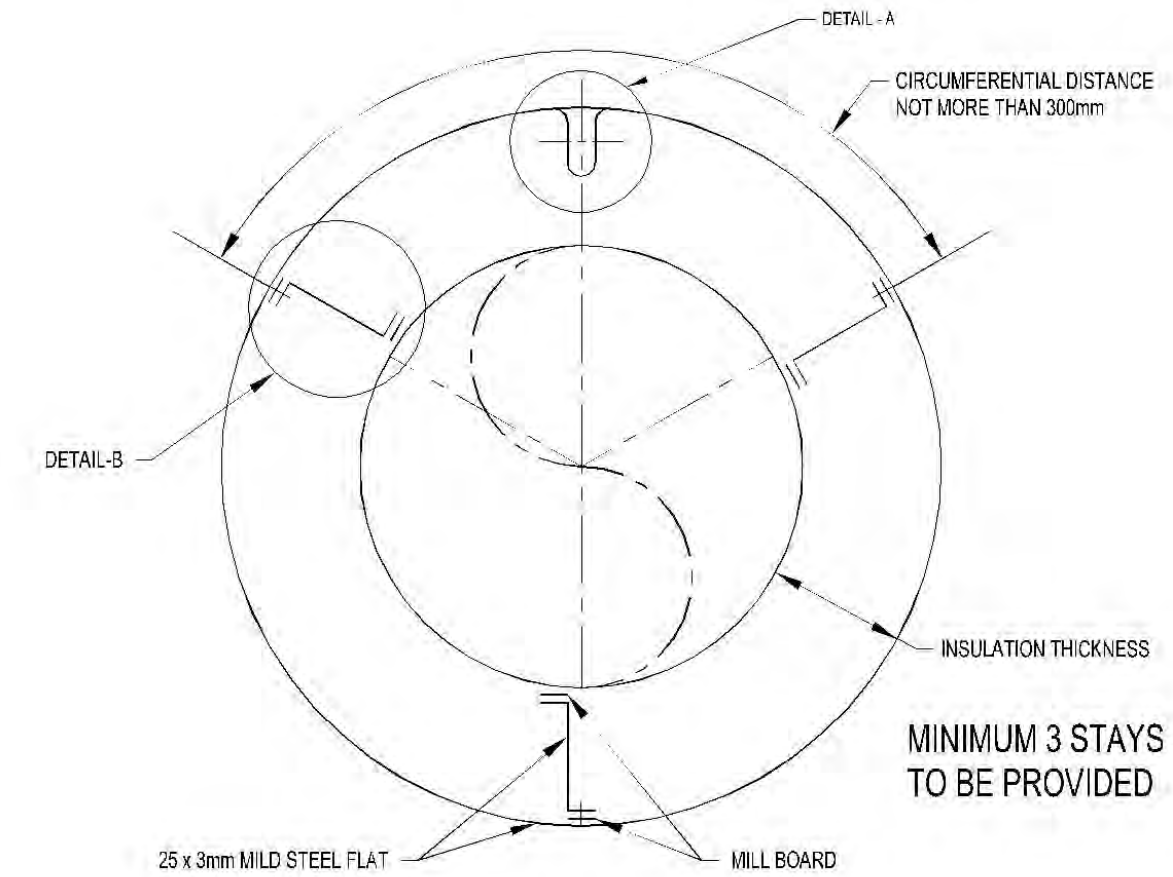

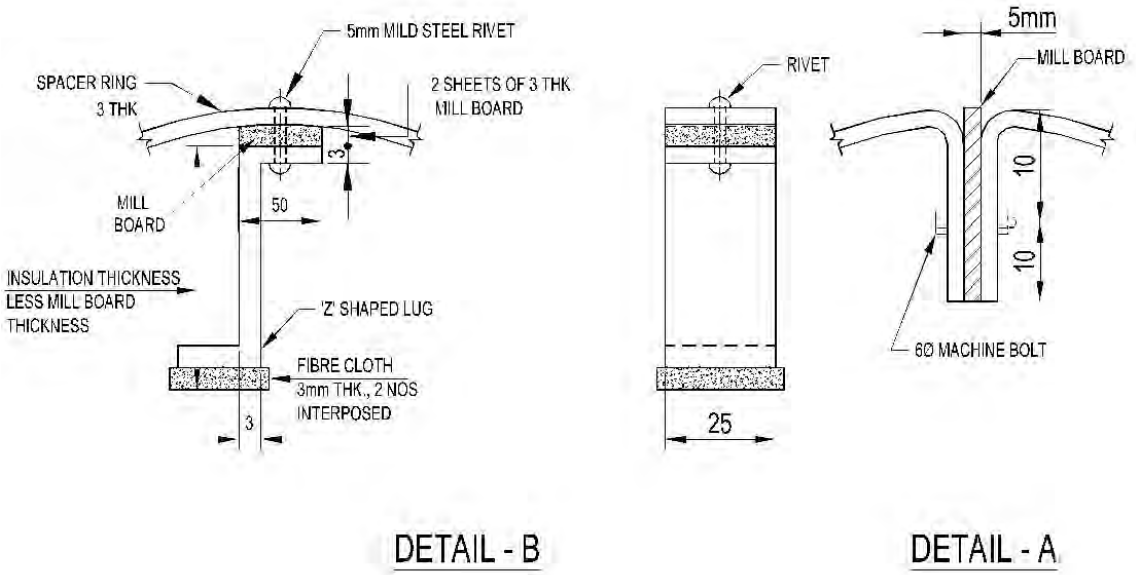

FIGURE – 04
DETAIL OF SPACER RING FIBROUS INSLUATION (MATTRESS)

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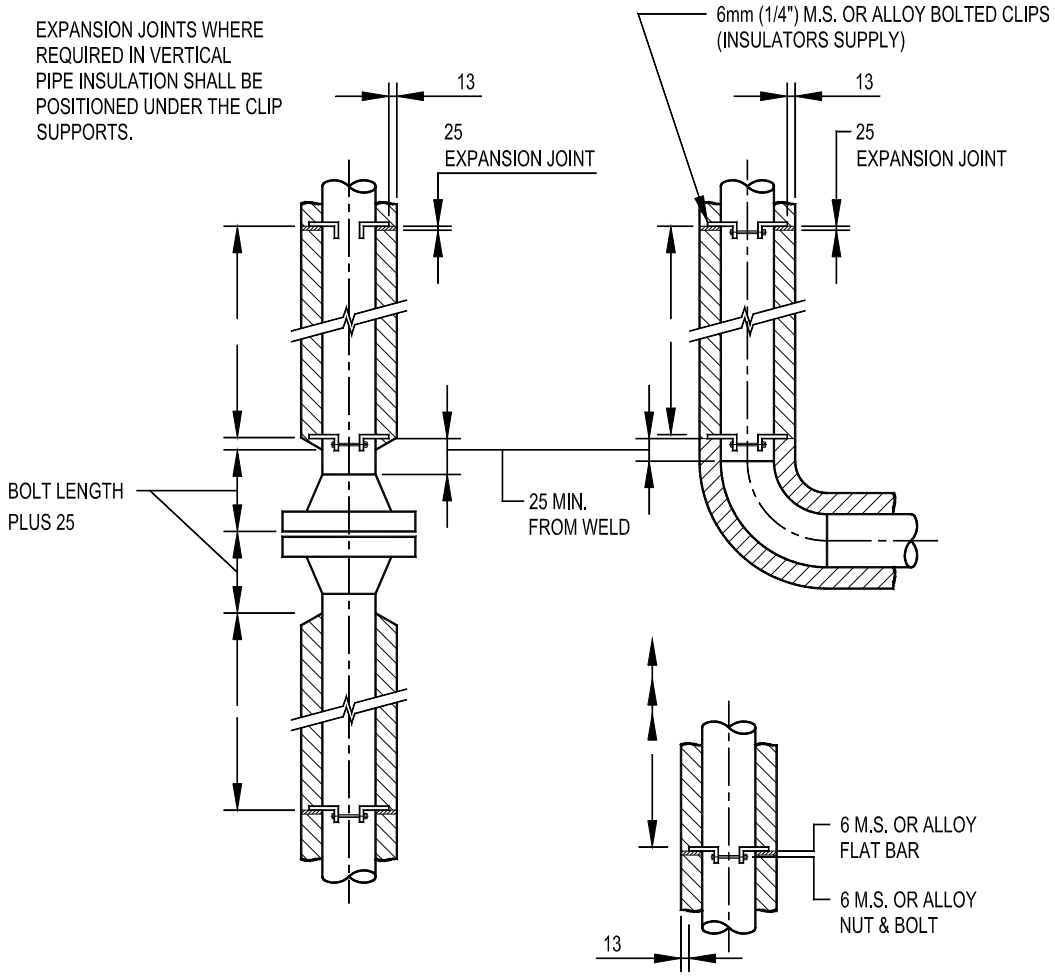

CLIP SPACING

PIPE TEMP. °C	MAX. SPACING 'D' MM
UPTO 400	4500
400 TO 500	3500
500 TO 550	2500

* CIRCUMFERENTIAL EXPANSION SHALL BE CONSIDERED AT THESE OPERATING TEMPERATURES.

FIGURE – 05
BOLTED ON INSULATION SUPPORT FOR VERTICAL PIPE

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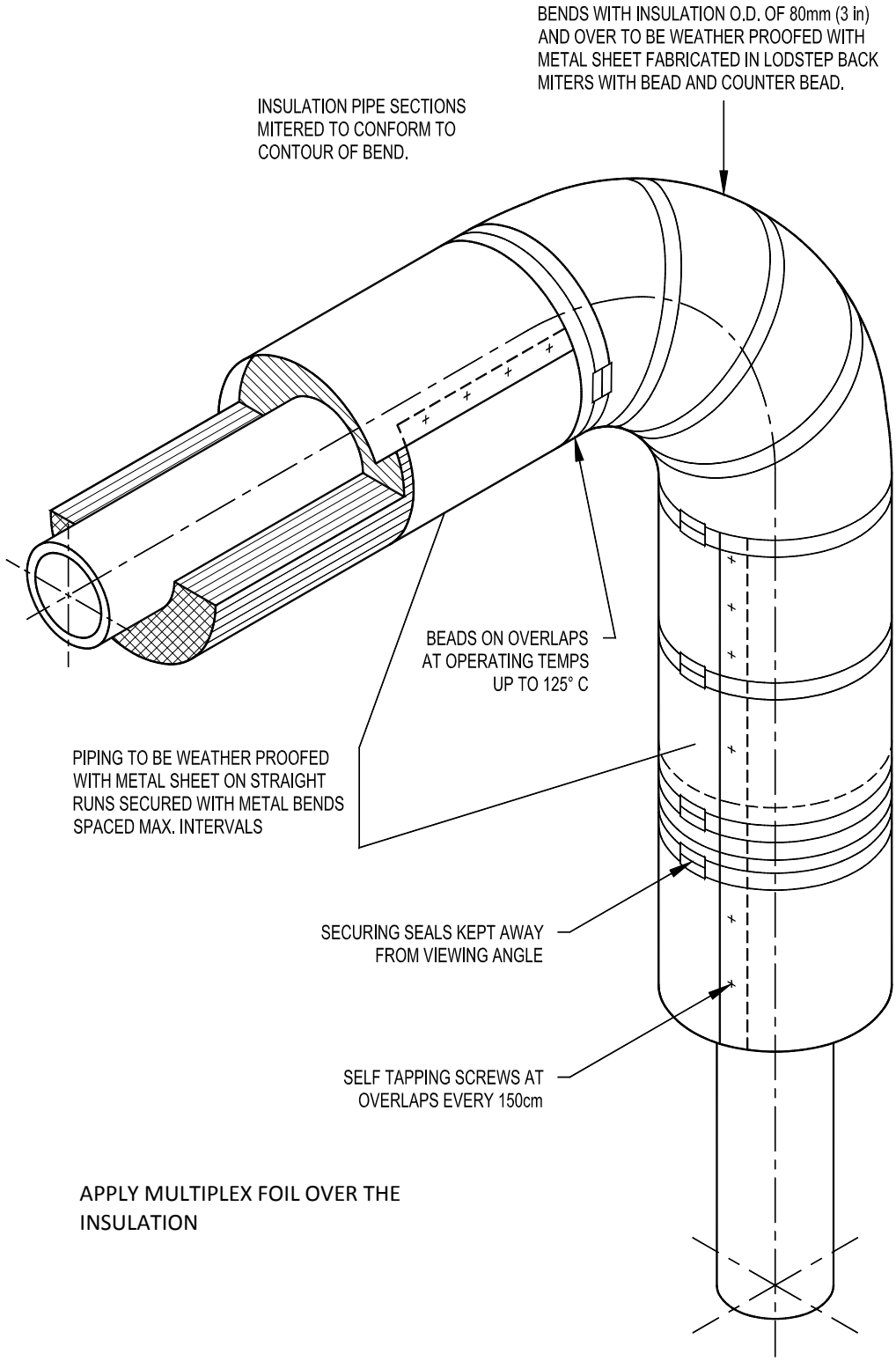

FIGURE – 06
INSULATION DETAILS FOR BENDS / ELBOWS

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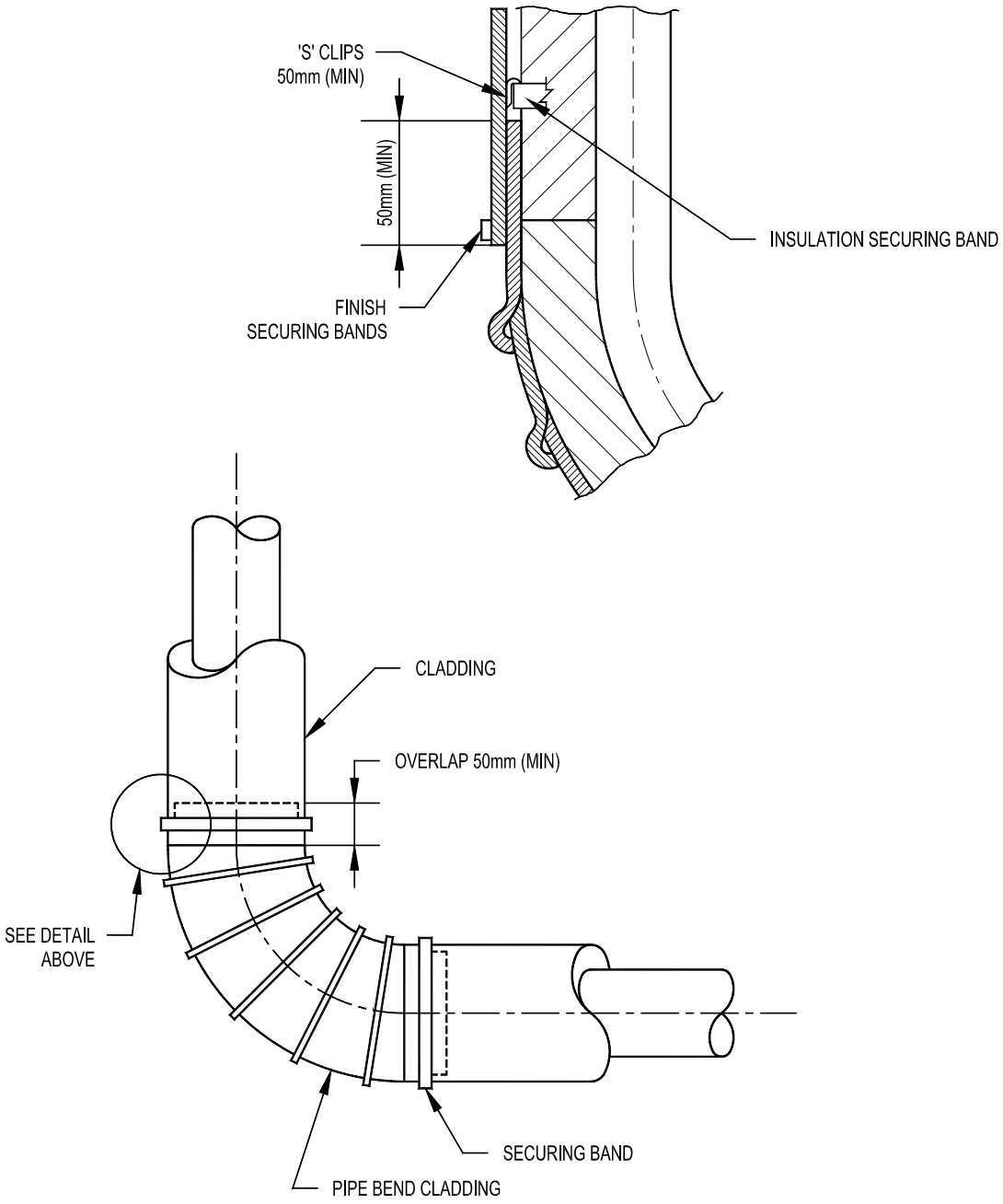

FIGURE – 07
INSULATION DETAILS : PIPE BENDS & ELBOWS

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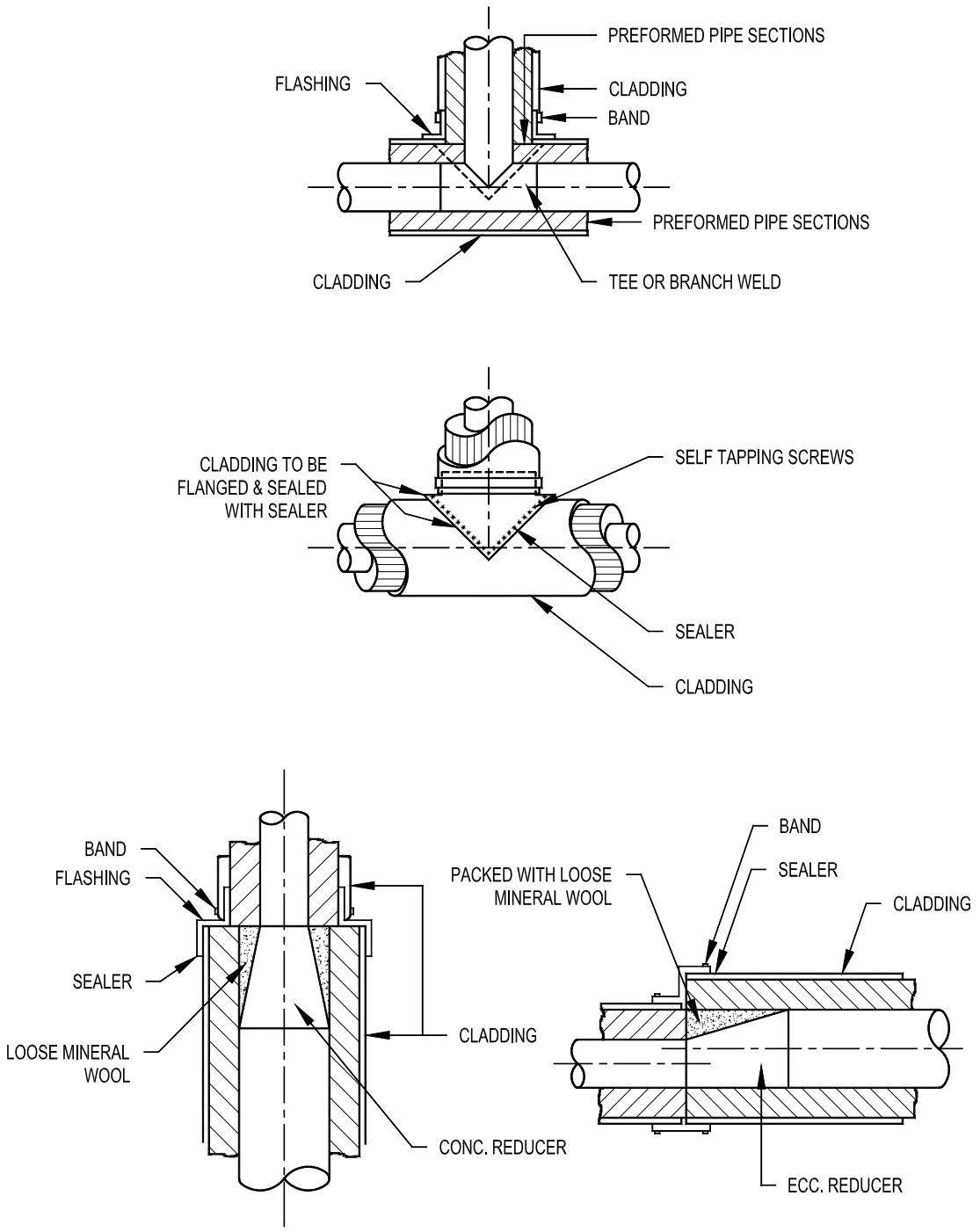

FIGURE – 08
INSULATION DETAILS: PIPE BRANCHED & REDUCER

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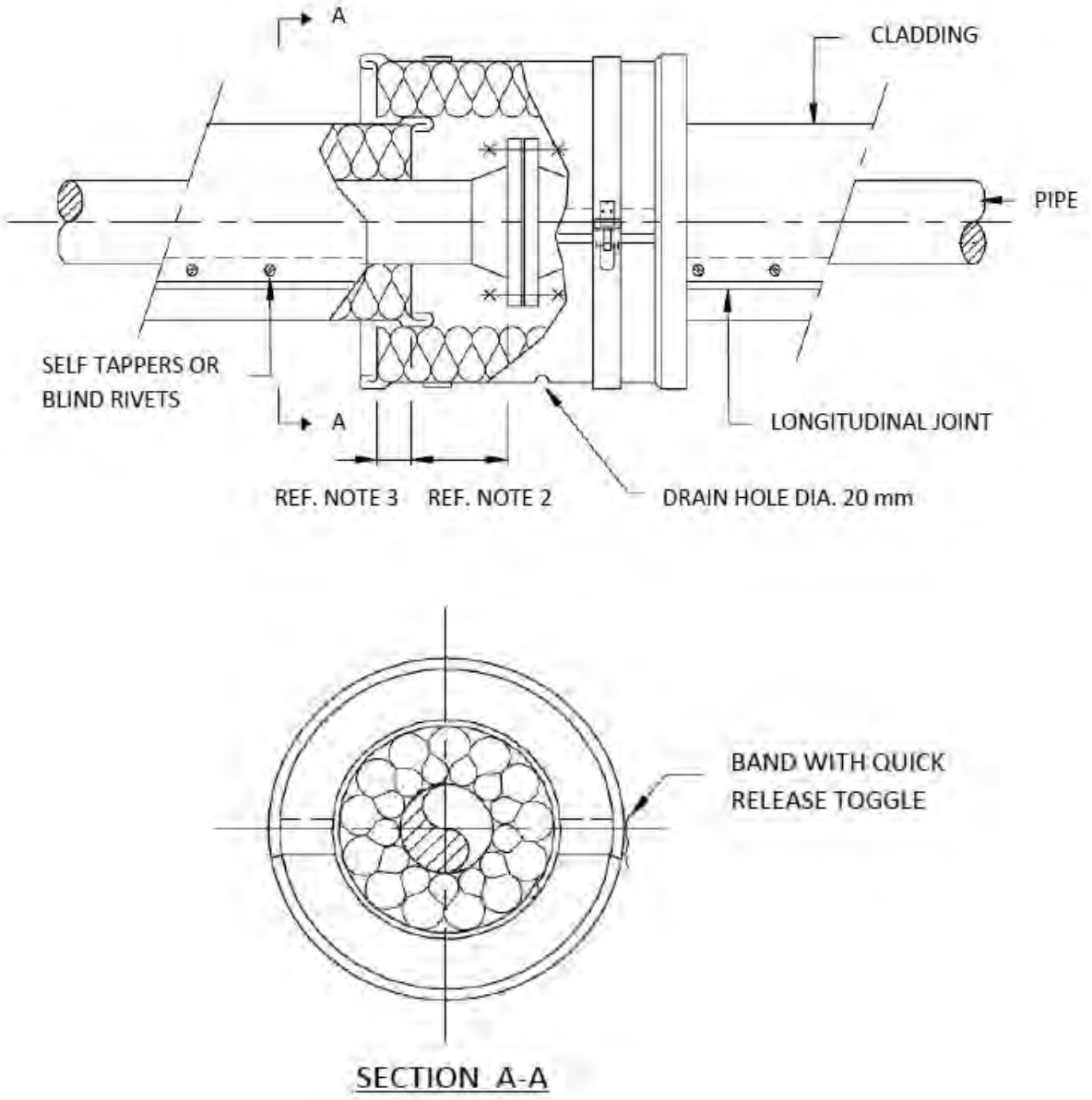

NOTE

1. MATERIAL AND FINSHING IN ACCORDANCE WITH INSTALLATION INSTRUCTIONS AND SPECIFICATION
2. DISTANCE BETWEEN INSULATION AND FLANGE TO BE BOLT LENGTH + 30 mm
3. INSULATION THICKNESS

FIGURE – 09
EXAMPLE OF REMOVABLE FLANGE BOX, HORIZONTAL

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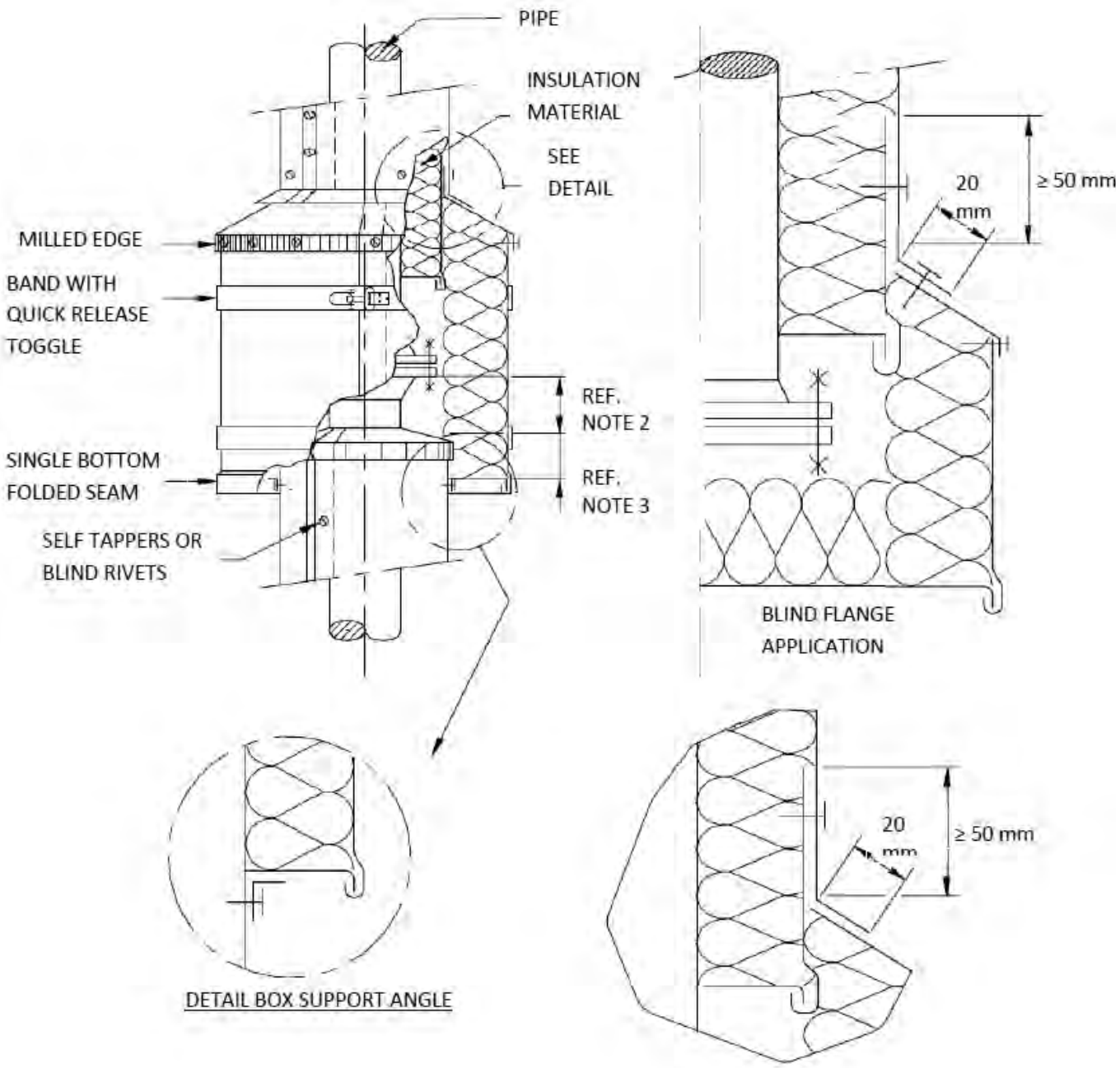

NOTE

1. MATERIAL AND FINSHING IN ACCORDANCE WITH INSTALLATION INSTRUCTIONS AND SPECIFICATION
2. DISTANCE BETWEEN INSULATION AND FLANGE TO BE BOLT LENGTH + 30 mm
3. INSULATION THICKNESS

FIGURE – 10
REMOVABLE FLANGE BOX, VERTICAL

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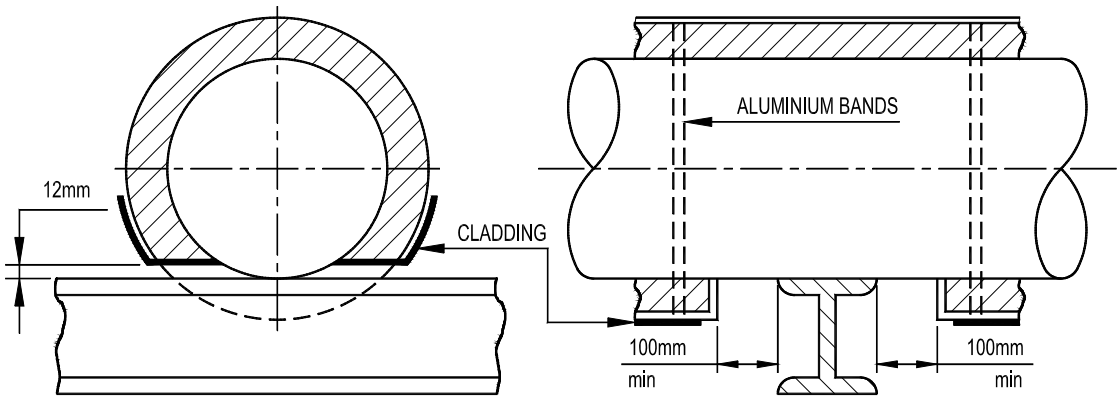
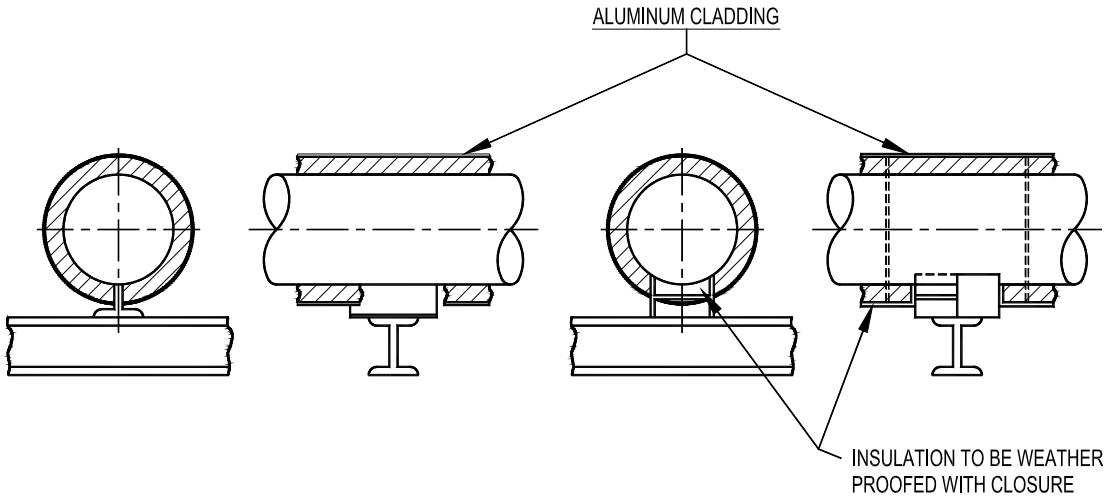


WHERE CLADDING IS TO BE CUT AWAY IT SHALL FIT CLOSELY TO THE PIPE AND TO BE COMPLETELY WEATHERPROOF

INSULATION DETAIL AT LINES WITHOUT SHOES
(THIS SHOULD ONLY BE REQUIRED IN EXCEPTIONAL CIRCUMSTANCES)



INSULATION OF LINE ON SHOES

FIGURE – 11
INSULATION DETAILS PIPE SUPPORTS

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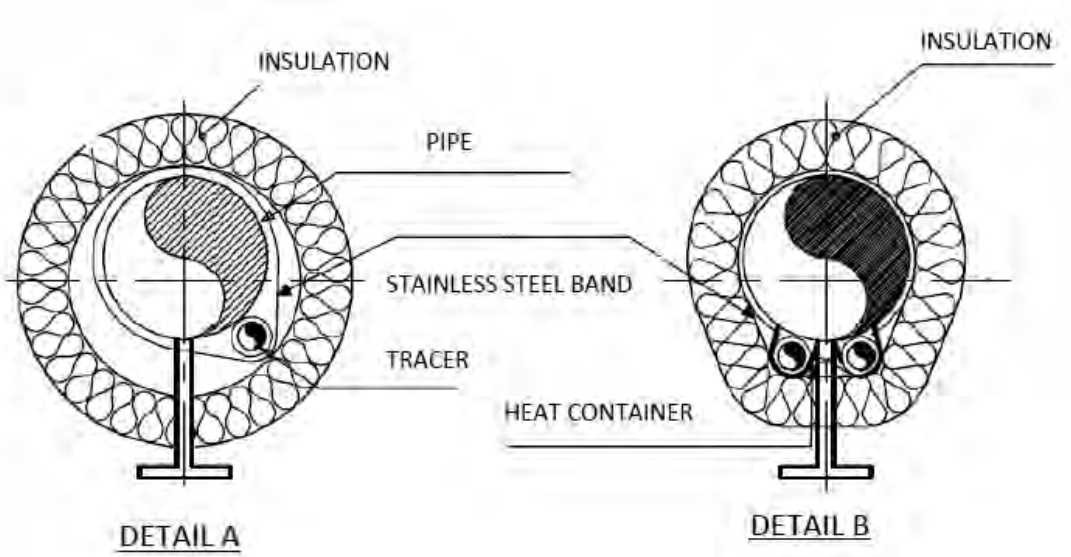

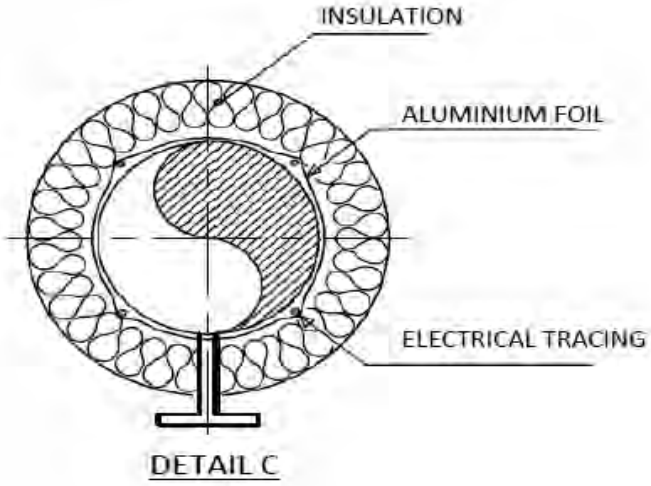

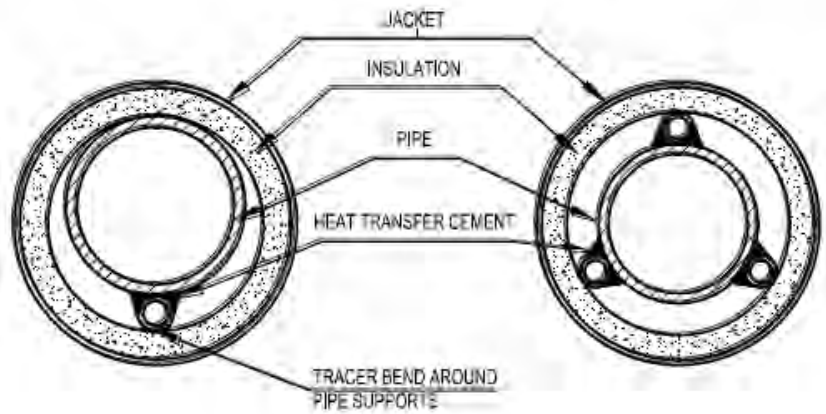

FIGURE – 12
INSULATION OF TRACED PIPING

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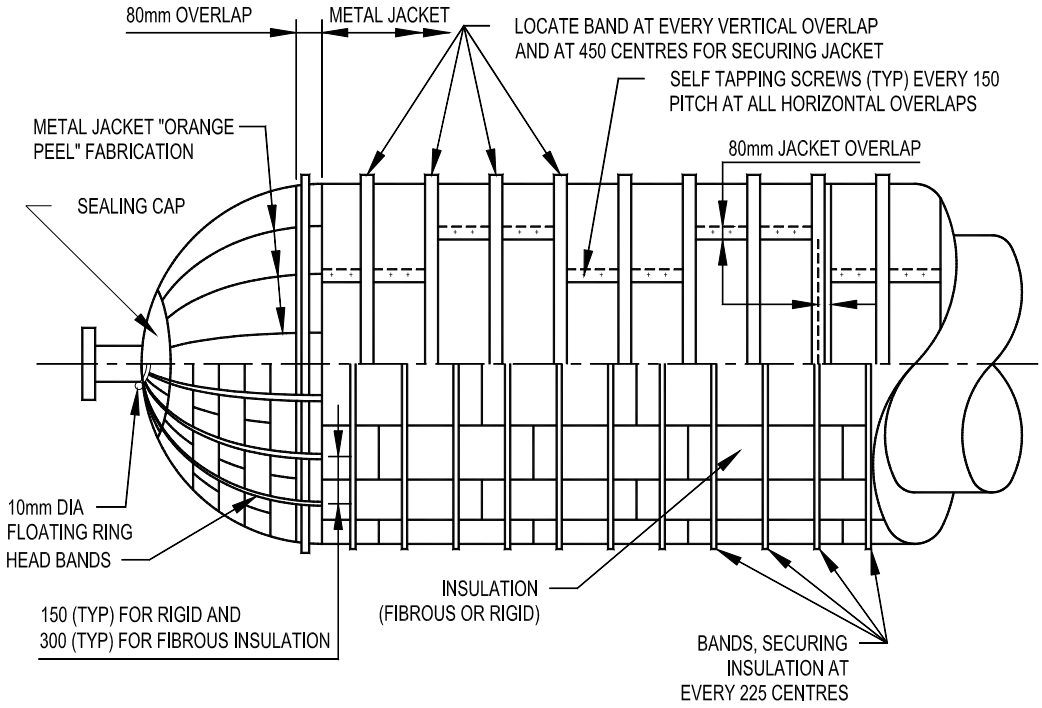

NOTES :-

1. SADDLE SUPPORTS FOR HORIZONTAL EQUIPMENT TOGETHER WITH SHOE AND ANCHOR SUPPORTS FOR HORIZONTAL PIPNG SHALL BE DESIGNED TO INCLUDE ELONGATED CUT-OUTS IN THE SUPPORT AT SUCH A DISTANCE FROM THE SUPPORTED EQUIPMENT AND PIPING TO ALLOW THE PASSAGE OF INSULATION SECURING BANDS AND TIES AROUND THE OUTSIDE FACE OF THE INSULATING AND FINISHING MATERIAL.

FIGURE – 13
HORIZONTAL EQUIPMENT INSULATION

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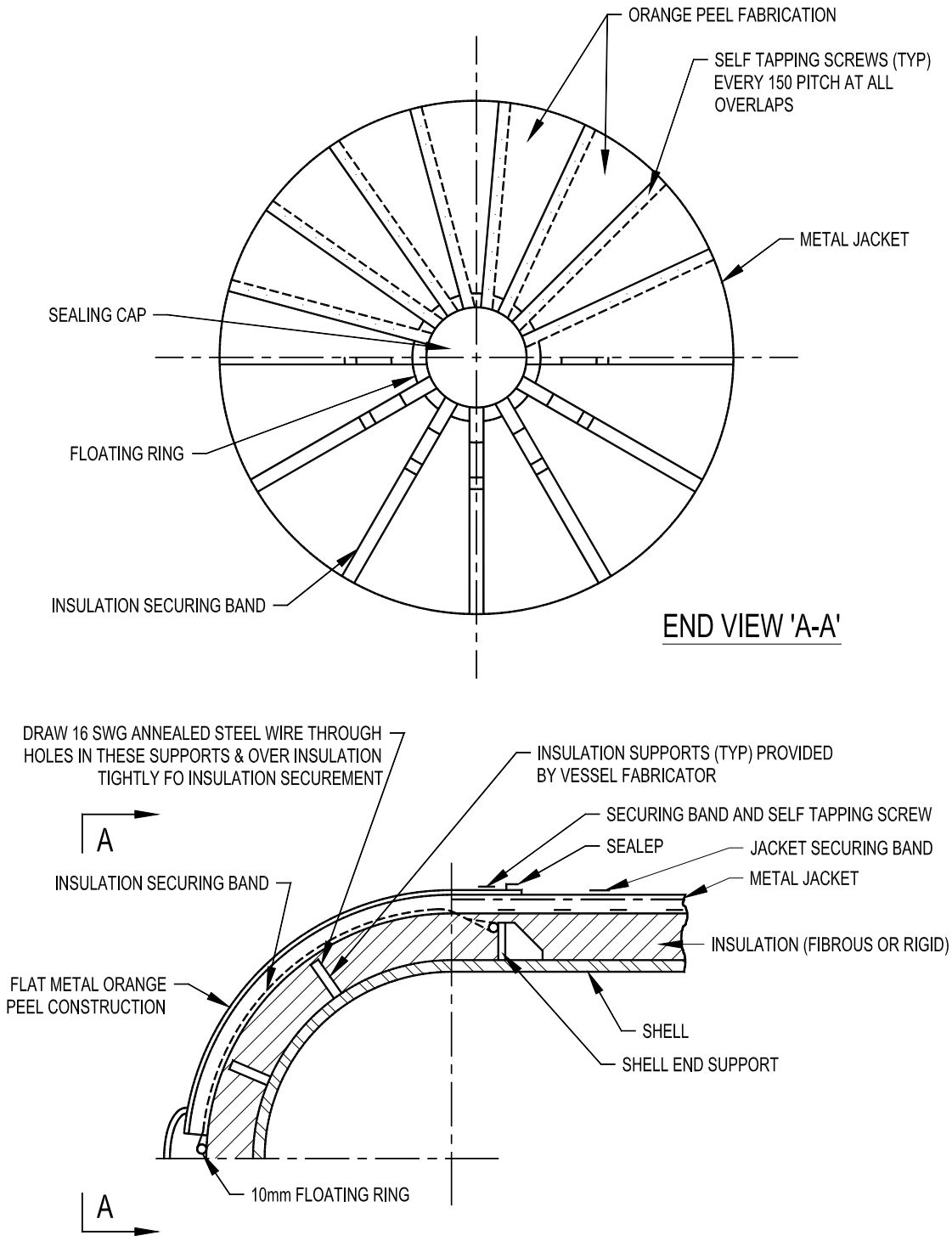

FIGURE – 14
HORIZONTAL EQUIPMENT HEADS

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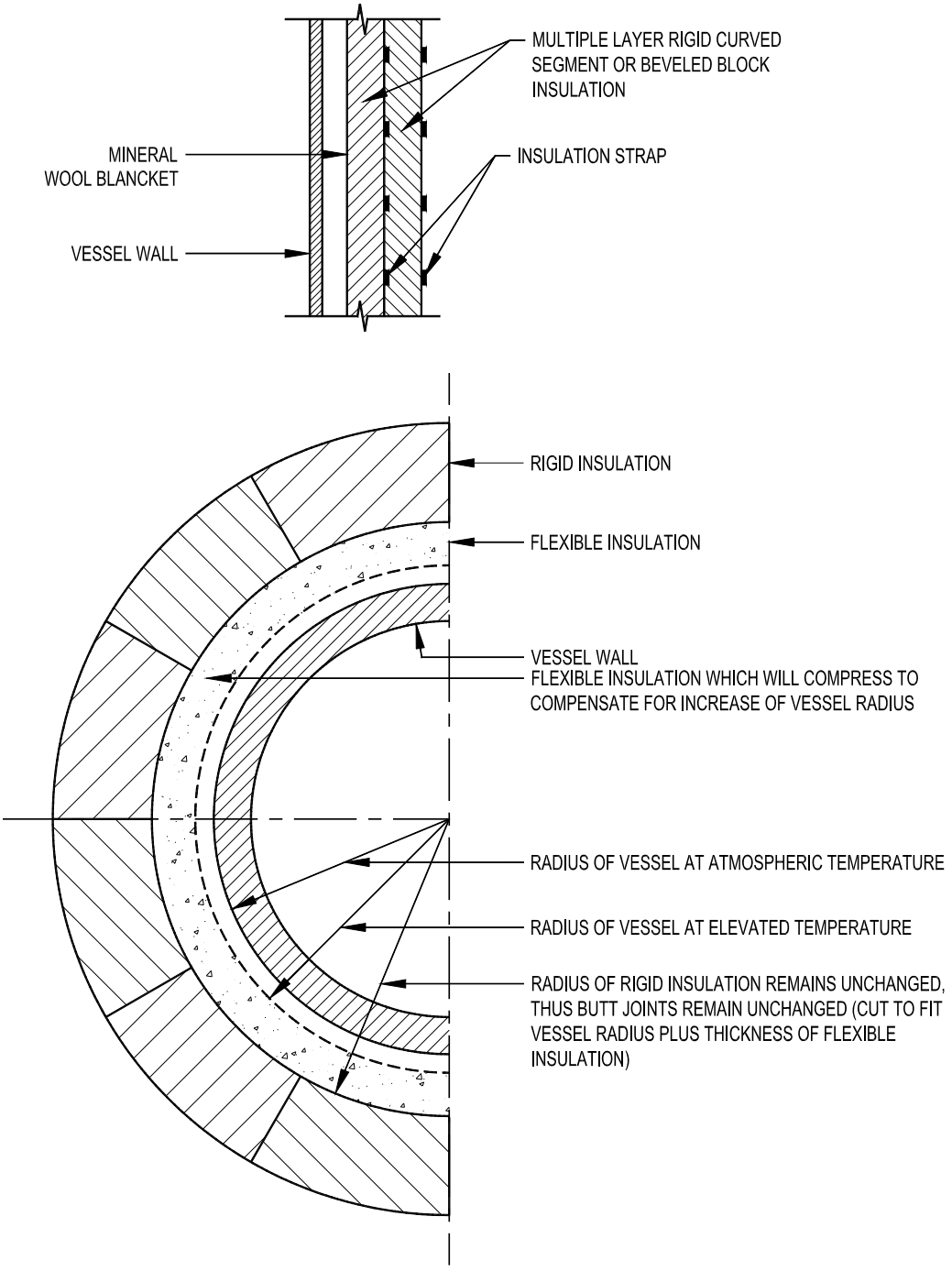

FIGURE – 15
USE OF FLEXIBLE INSULATION IN COMBINATION WITH RIGID INSULATION TO COMPENSATE FOR VESSEL EXPANSION

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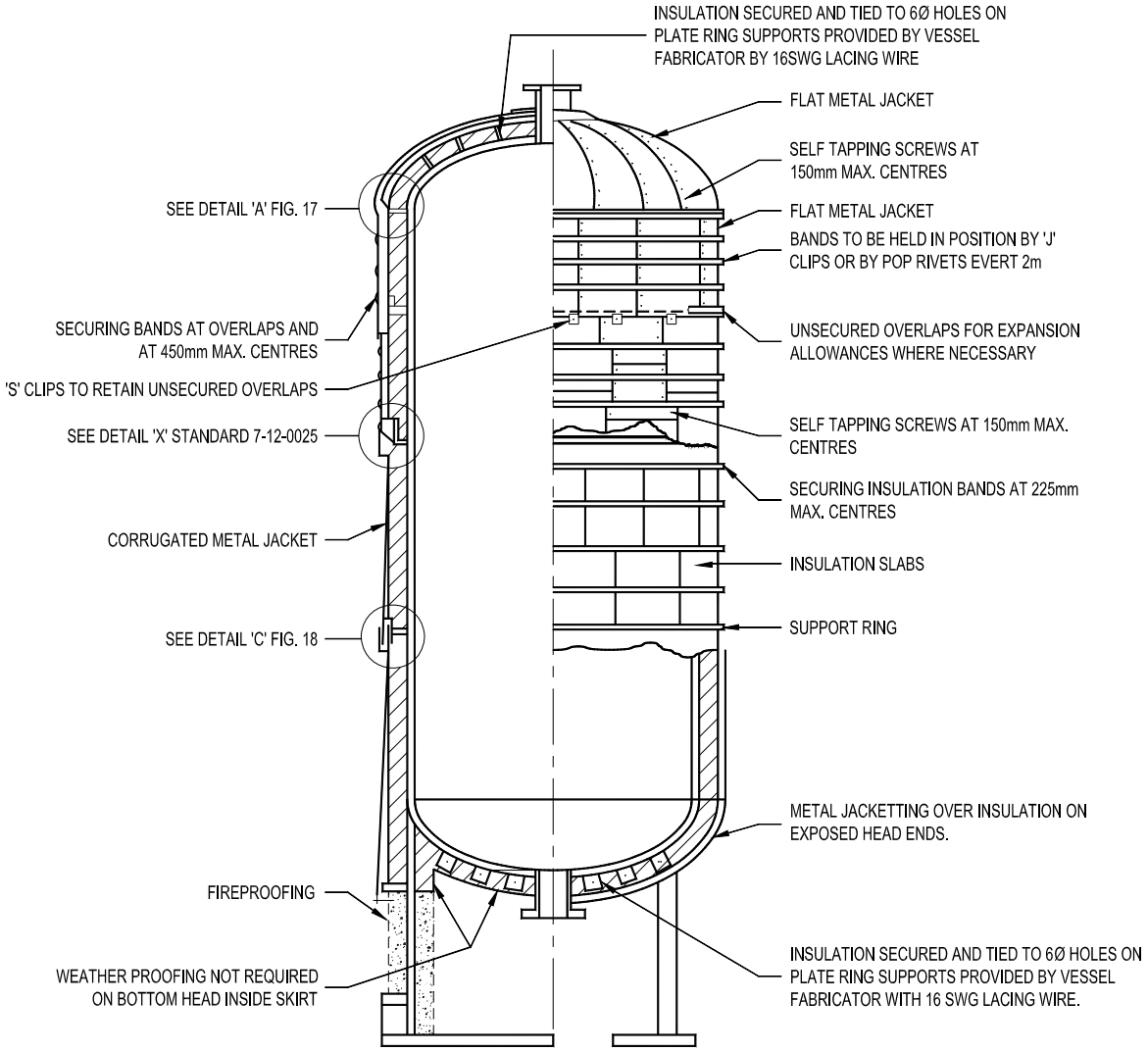

FIGURE – 16
INSULATION DETAILS : VERTICAL VESSEL

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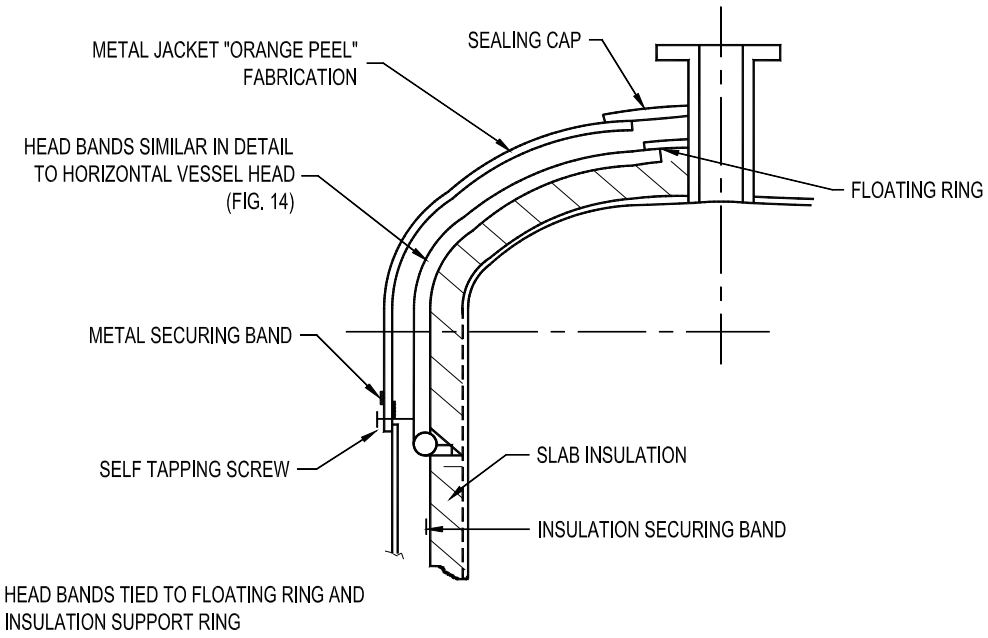

DETAIL 'A'

FIGURE – 17
INSULATION DETAILS VERTICAL VESSEL HEADS

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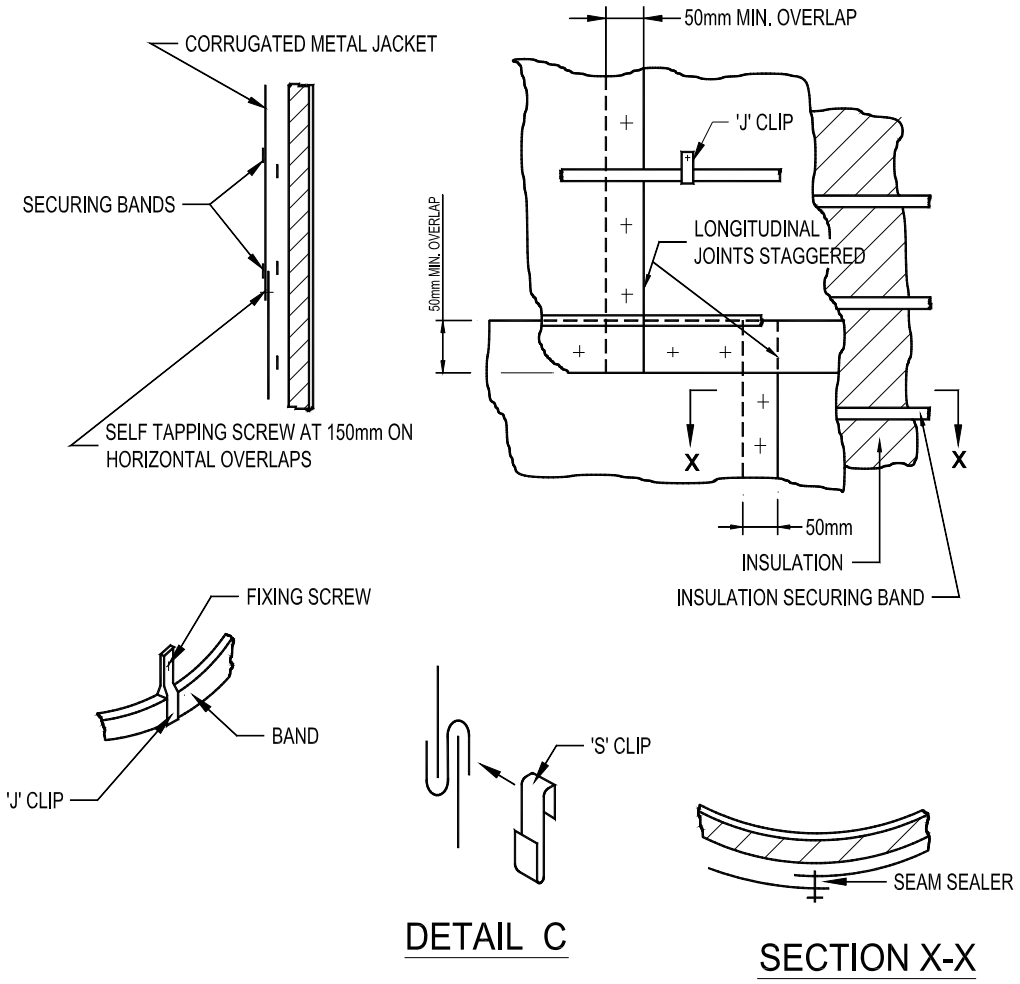

NOTE:

FINISHING SHEETING TO BE BANDED AND SCREWED. HORIZONTAL OVERLAPS LEFT UNSCREWED FOR EXPANSION PURPOSES SHALL BE SECURED AND SUPPORTED WITH 'S' CLIPS.

FIGURE – 18
INSULATION DETAILS : VERTICAL VESSELS

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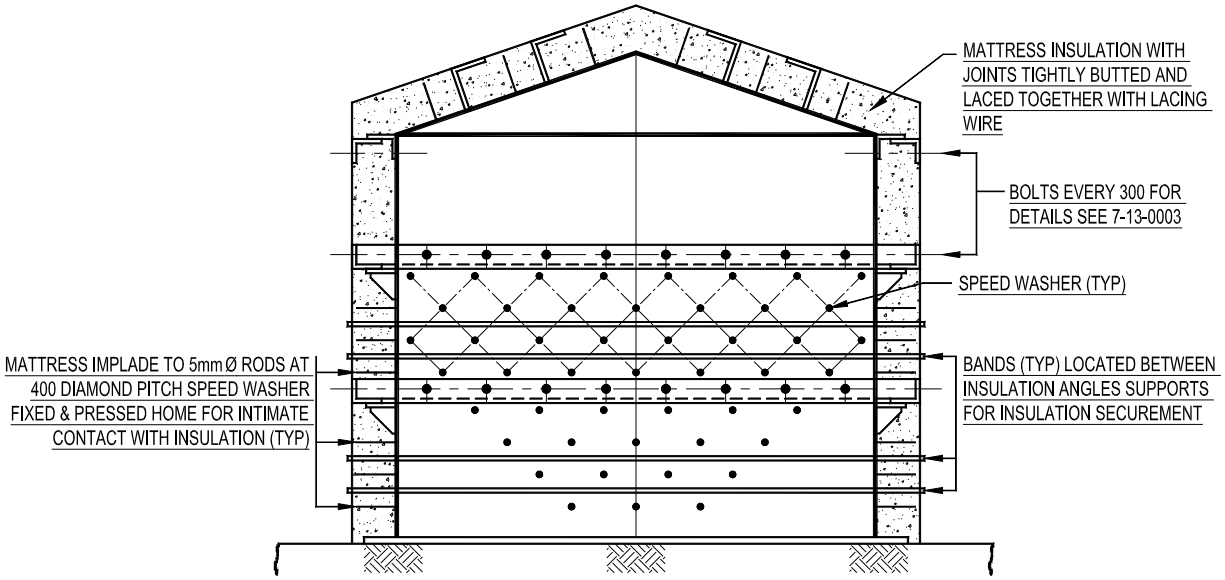
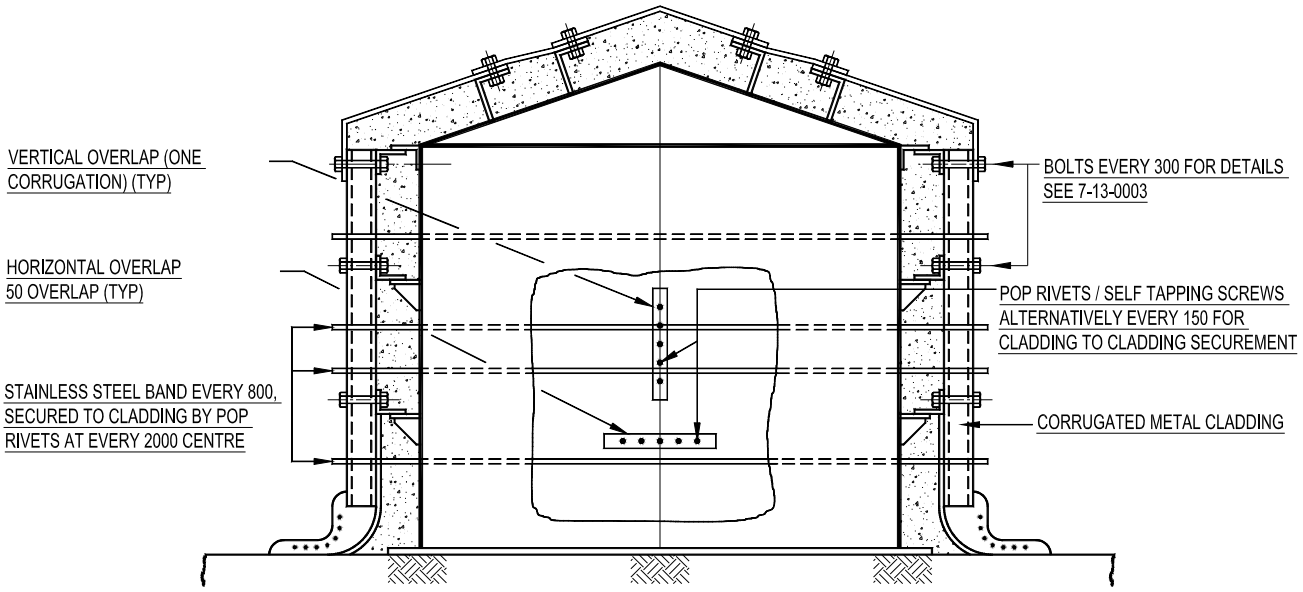


INSULATION SECUREMENT DETAIL



CLADDING SECUREMENT DETAIL

FIGURE – 19
INSULATION DETAILS : VERTICAL STORAGE TANK

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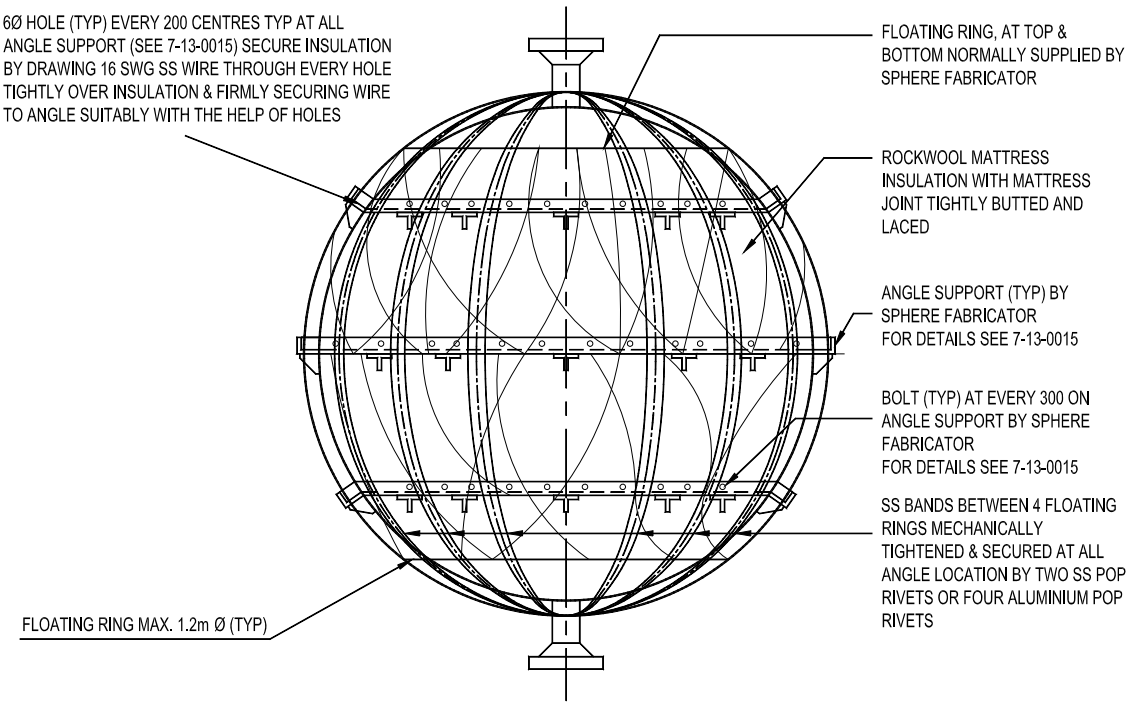
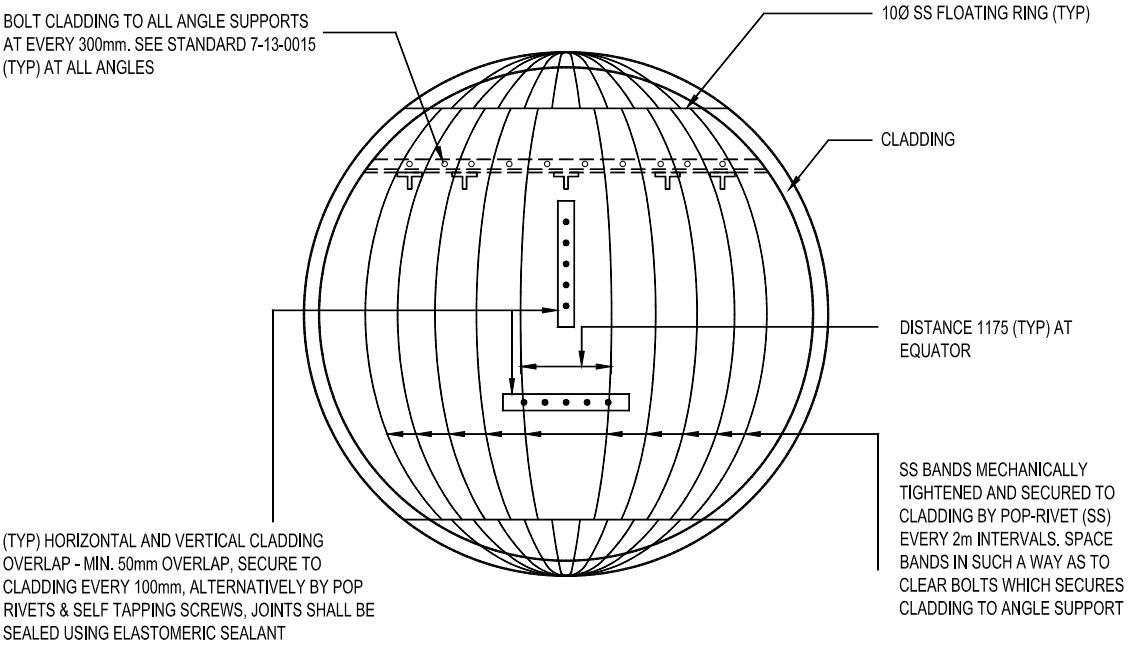


INSULATION SECUREMENT DETAILS



CLADDING SECUREMENT DETAILS

FIGURE – 20
INSULATION DETAILS : SPHERE

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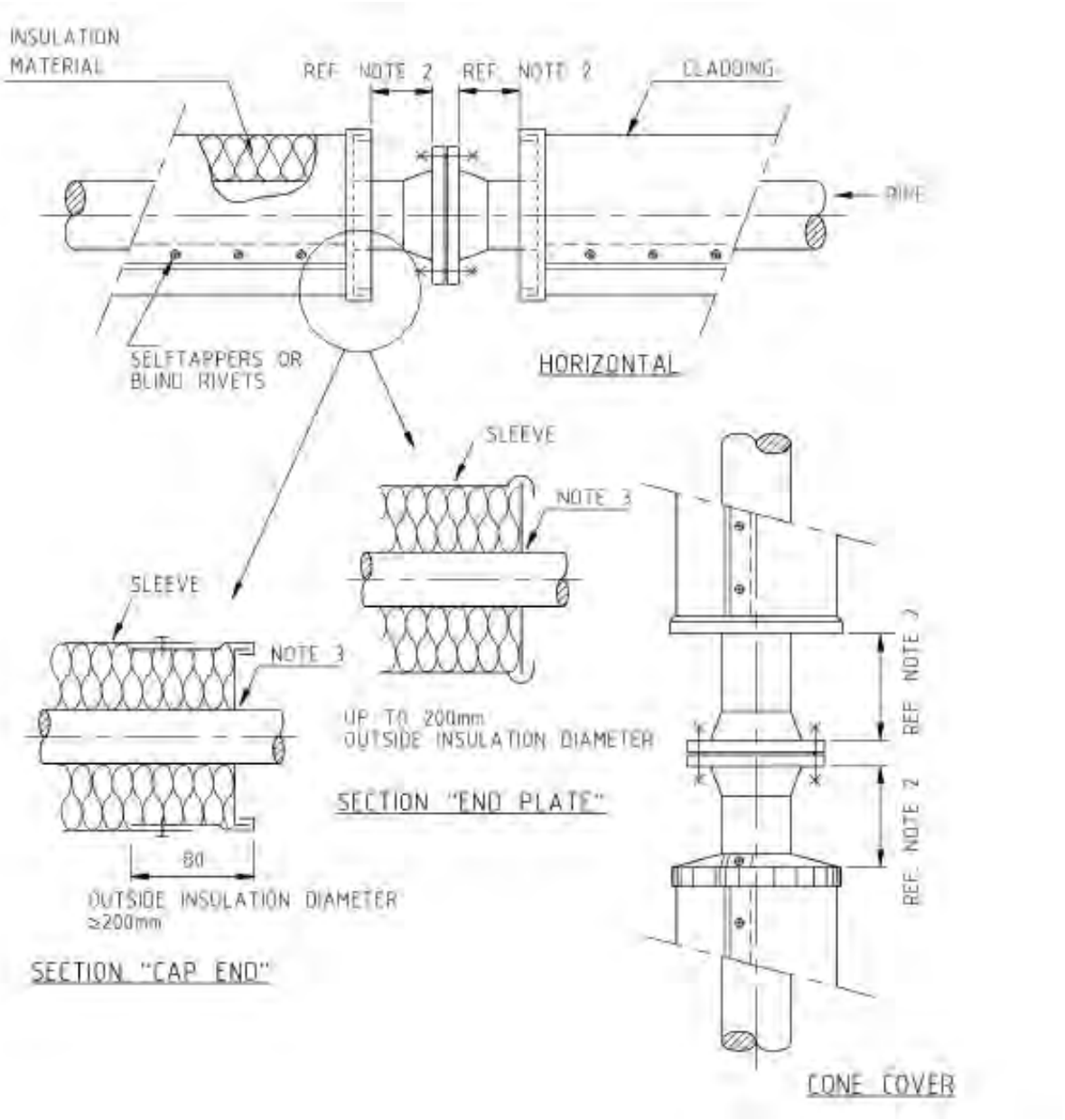

Note

1. Materials and finishing in accordance with installation instructions and specification.
2. Distance between insulation and flange to be bolt length+30mm
3. In case a end plate/cap end may damage the pipe, a heat resistant tape or gasket material to be installed between pipe and plate.

FIGURE – 21
NON- INSULATED FLANGES, HORIZONTAL AND VERTICAL

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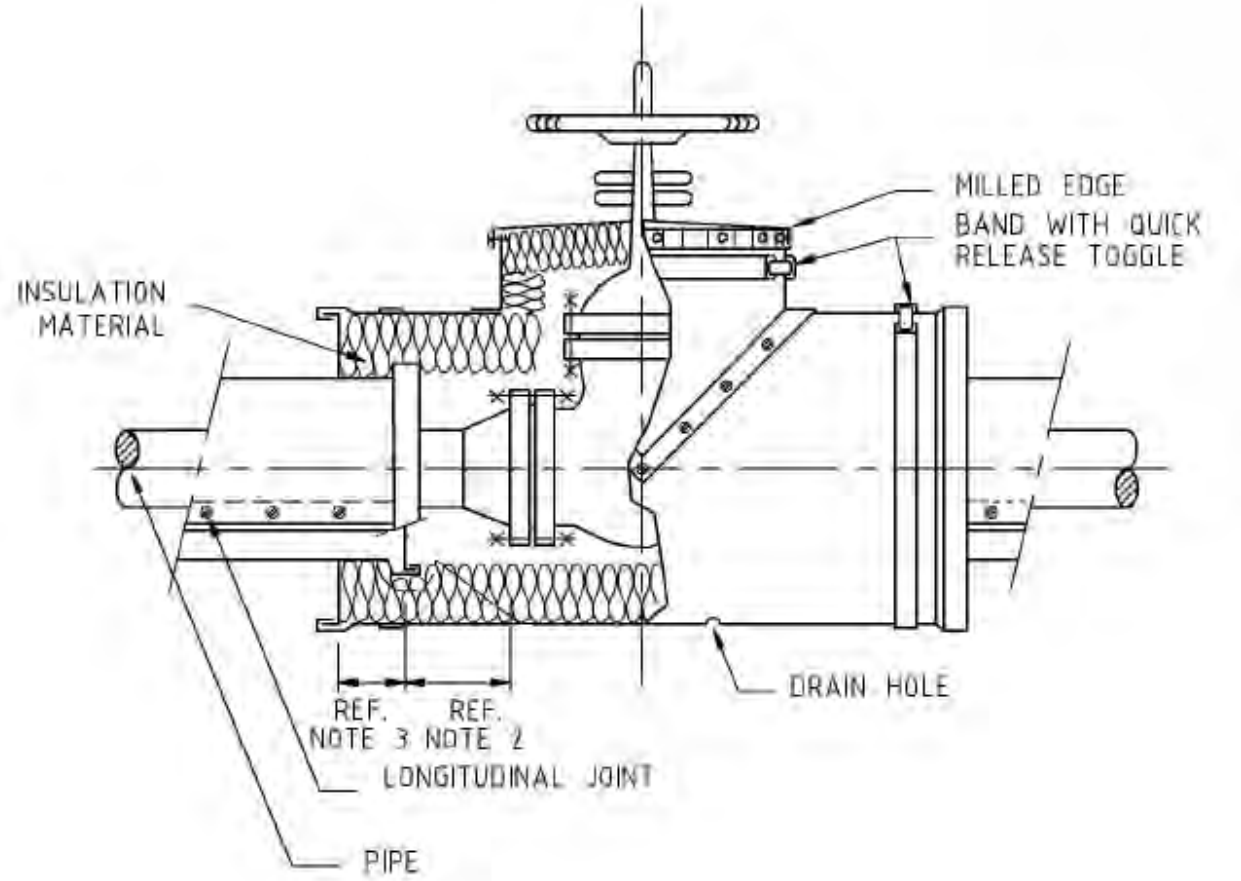

Note
1. Materials and Finishing in accordance with installation instructions and specification
2. Distance between insulation and flange to be bolt length + 30mm
3. Insulation Thickness

FIGURE – 22
REMOVABLE VALVE BOX, "T" CONNECTION, HORIZONTAL
Applicable only valves which needs to be insulated as per applicable specification

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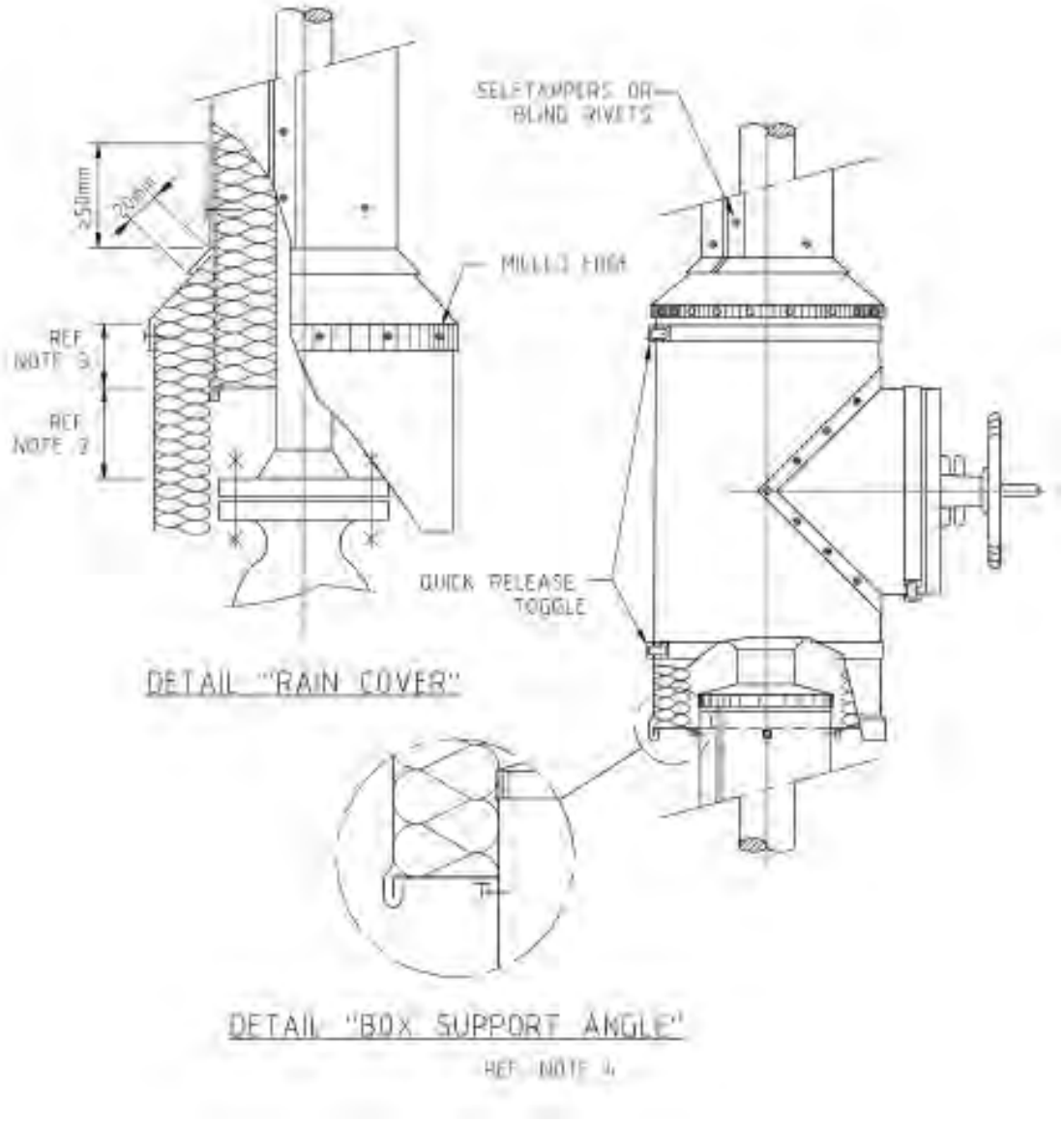

Note

1. Materials and Finishing in accordance with installation instructions and specification
2. Distance between insulation and flange to be bolt length + 30mm
3. Insulation Thickness
4. Per box minimal 4 support angles ≥ 30mm wide ≥ 0.8mm thick

FIGURE – 23
REMOVABLE VALVE BOX, "T" CONNECTION, VERTICAL
Applicable only valves which needs to be insulated as per applicable specification

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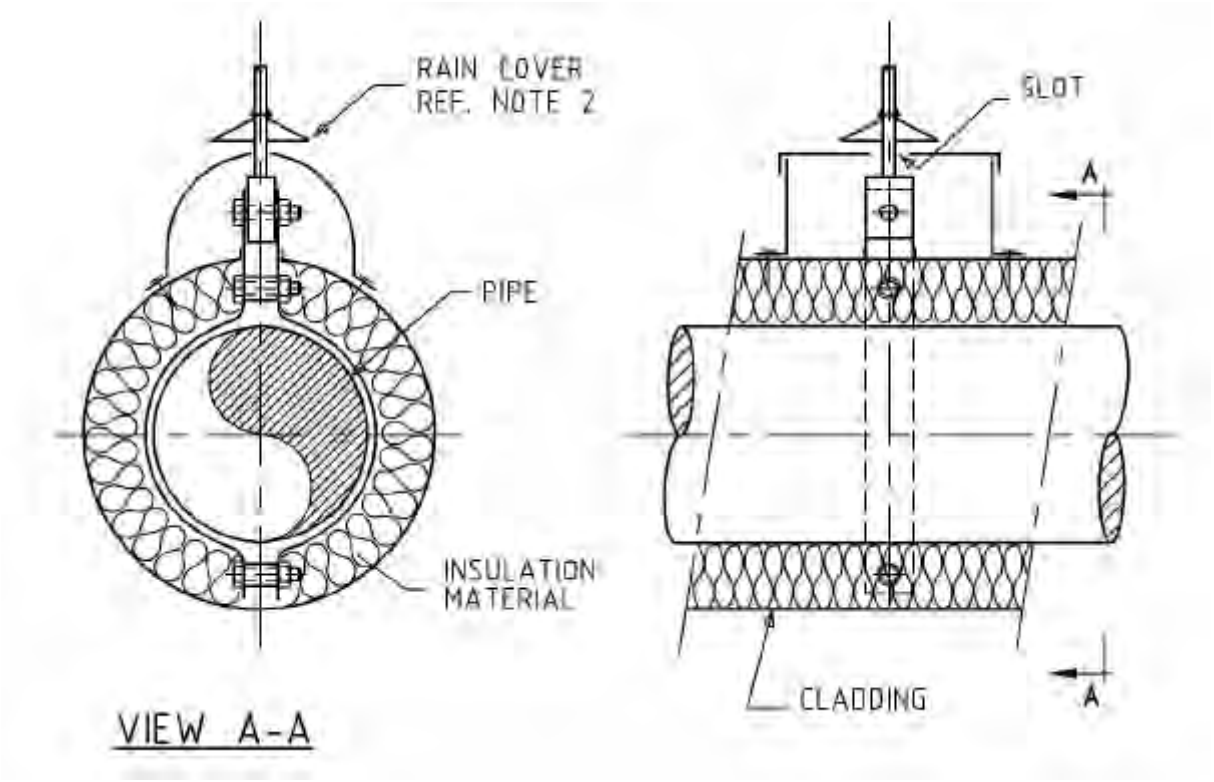

Note
1. Materials and finishing in accordance with installation instructions and specifications
2. Rain cover is a part of the bracket

FIGURE – 24
HANGER SUPPORT

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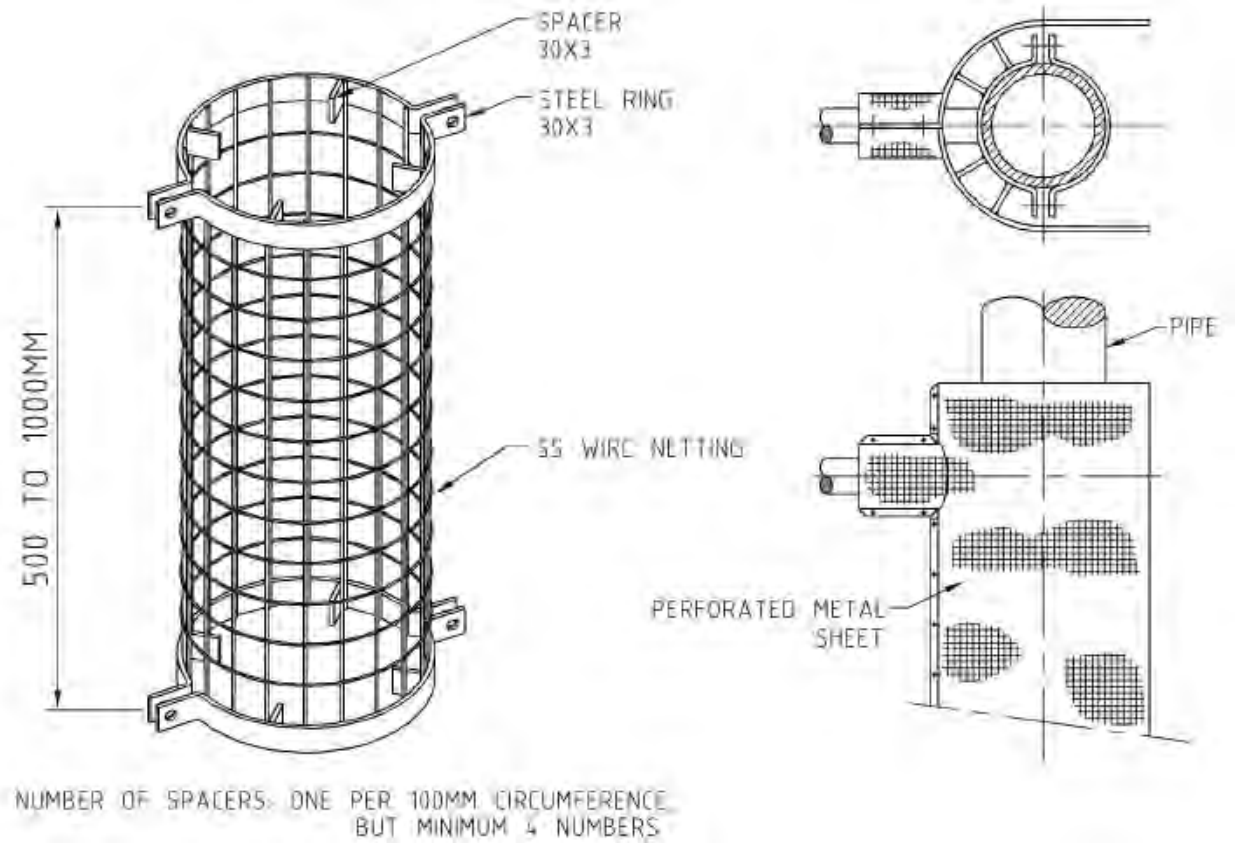

WIRE NETTING

PERFORATED METAL SHEET

Note

1. Materials and finishing in accordance with installation instructions and specifications

FIGURE – 25
PERSONAL PROTECTION

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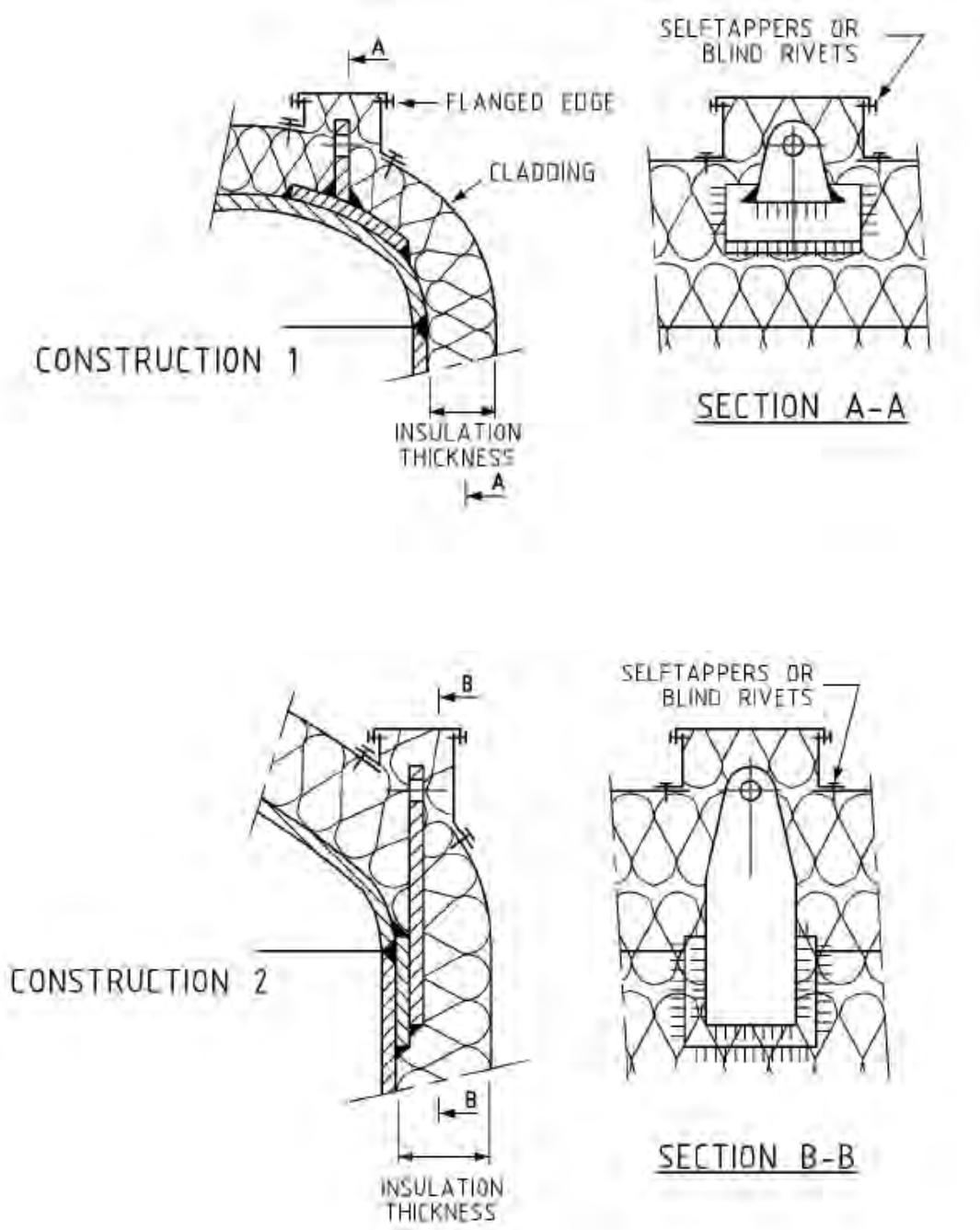

FIGURE – 26
DETAILS OF LIFTING LUGS

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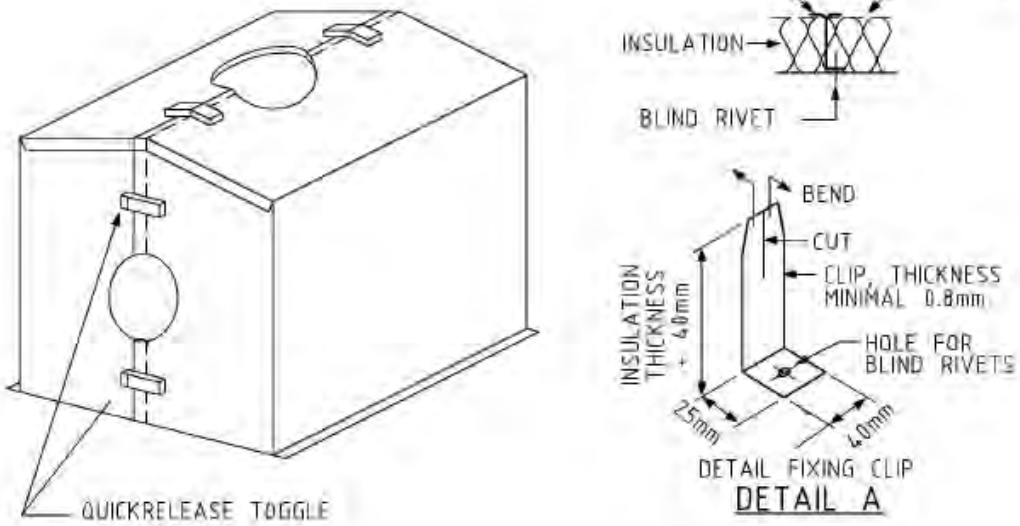

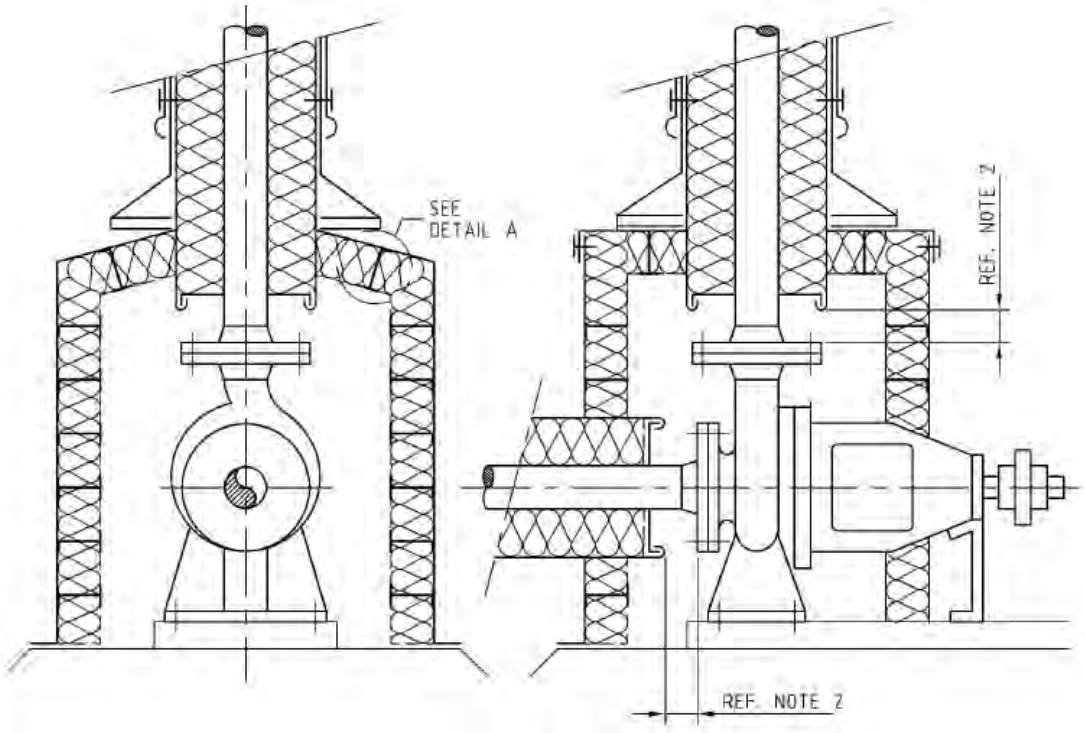

Note
1. Materials and Finishing in accordance with installation instructions and specification
2. Distance between insulation and flange to be bolt length + 30mm

FIGURE – 27
REMOVABLE BOX FOR PUMP

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अपकेंद्रीय क्षैतिज पम्प के लिए निरीक्षण और परीक्षण योजना

(सामान्य जल सेवा)

INSPECTION AND TEST PLAN FOR PUMP CENTRIFUGAL HORIZONTAL (GENERAL WATER SERVICE)

Rev. No.	Date	Purpose	Prepared by	Checked by	Convener Standards Committee	Chairman Standards Bureau
					Approved by	
5	23.05.20	REVISED AND RE-ISSUED	TV	RMR	RKS	SKS
4	20.03.14	REVISED AND RE-ISSUED	TKK	RKS	SCG	SC
3	19.08.13	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
2	15.07.11	REVISED AND RE-ISSUED	RMR	SCG	AKC	DM
1	21.01.08	REVISED AND RE-ISSUED	SMG	SS	MVKK	VC
0	23..07.02	ISSUED FOR IMPLEMENTATION	VKJ	TVD	AKB	GRR

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Abbreviations:

AS	:	Alloy Steel	NPSH	:	Net Positive Suction Head
COC	:	Certificate of Compliance	PESO	:	Petroleum and Explosives Safety Organization
DFT	:	Dry Film Thickness	PMI	:	Positive Material Identification
EIL	:	Engineers India Limited	PO	:	Purchase Order
EPC	:	Engineering Procurement Construction	PQR	:	Procedure Qualification Record
EN	:	European Norms	PR	:	Purchase Requisition
HT	:	Heat Treatment	QAP	:	Quality Assurance Plan
HV	:	High Voltage	RT	:	Radiography Testing
IC	:	Inspection Certificate	Specs.	:	Specifications
IRN	:	Inspection Release Note	SS	:	Stainless Steel
ITP	:	Inspection and Test Plan	Temp	:	Temperature
LCP	:	Local Control Panel	TPI or TPIA	:	Third Party Inspection Agency
MOM	:	Minutes of Meeting	UCP	:	Unit Control Panel
KW	:	Kilo Watt	UT	:	Ultrasonic Testing
MRT	:	Mechanical Run Test	VDR	:	Vendor Data Requirement
MTC	:	Material Test Certificate	VFD	:	Variable Frequency Drive
MV	:	Medium Voltage	WPS	:	Welding Procedure Specification
NDT	:	Non Destructive Testing	WPQ	:	Welders Performance Qualification

Inspection Standards Committee

Convener: Mr. R.K. Singh

Members:

Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. Chandrashekhar	Mr. Avdhesh Agrawal
Mr. Mahendra Mittal	Mr. R Muthuramalingam (RPO Representative)	Mr. Tarun Kumar / Mr. Mahesh Gupta, Eqpt Div	

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1.0 SCOPE:

This Inspection Test Plan covers the minimum testing requirements of Pump Centrifugal Horizontal (General Water Service).

2.0 REFERENCE DOCUMENTS:

PO/PR/ Standards referred there in/ Job specifications /Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures / Documents**						
1.1	Pressure test, MRT, Performance test, NPSH tests, NDT as applicable, Heat Treatment as applicable, Dynamic Balancing Test of Impeller, String Test as applicable and other procedure as applicable	Documented Procedures	100%	Procedures	-	H	R
1.2	WPS, PQR,WPQ - 1) Qualification for Overlay 2) Repair welding procedures	Welding procedure Qualification, Welder parameters	100%	WPS/PQR/ WPQ Records	-	H	W- New, R – Existing (Note-3)
1.3	Pre-Inspection meeting	Verification of technical requirements as per PR/contract	100%	MOM	-	H	W/R (For <160KW) H (For >160KW)

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.0	**Material Inspection**						
2.1	Incoming Material Casing, Stuffing Box, Impeller, Shaft Material, Wear rings & Bearing Housing (As applicable)	Visual & Dimensions, Chemical Properties / Physical Properties, Heat Treatment as per Specs, UT for Shaft & Other Forgings and (#)Wear ring differential hardness	100%	MTC, HT Chart, Inspection Report, COC for #	H	H	R (Note-4)
2.2	Accessories- Mechanical Seal, Coupling (As applicable)	Pressure Test of Mechanical Seal, Dynamic balancing of seal and coupling	100%	MTC/ Inspection & Test Record, Pressure test report and COC for Mechanical Seal	H	H	R (Note-4)
2.3	Piping & Hardware Items- Valves, Flanges, Pipes, Fittings, Gaskets, Fasteners etc (As applicable)	Visual & Other Requirement as per purchase specification / Approved Documents	100%	MTC & Inspection Report	H	H	R (Note-4)
2.4	Motor / VFD (As applicable) *(supplier/sub supplier to arrange TPIA certification)	1) Type test/ Routine test of Motor, VFD & Other test requirement as per purchase specification / Approved Documents 2) MTC review 3) PESO certificate review (As applicable)	100%	MTC & Inspection Report	H	H*	W / R (Note-7)
2.4.1	Combined testing of motor & VFD (As applicable) *(supplier/sub supplier to arrange TPIA certification)	1) Routine Test & Type Test 2) PESO requirement (As applicable)	100%	MTC & Inspection / Test Records	H	H*	W (Note-7)

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.5	Steam Turbine (As applicable)	MRT of Turbine & & Other checks as per approved QAP	100%	MTC & Inspection Report / Test Records	H	H	W (Note-6,9)
2.6	Diesel Engine with governor & accessories (As applicable)	MRT of Diesel Engine & Other checks as per approved QAP	100%	MTC & Inspection Report	H	H	R (Note-8,9)
2.7	Gear box (As applicable)	MRT of gear box & Other checks as per approved QAP	100%	MTC & Inspection Report	H	H	W (Note-6,9)
2.8	Lube Oil system (As applicable)	Functional test & Other checks as per approved QAP	100%	MTC & Inspection Report	H	H	W (Note-6,9)
2.9	LCP/UCP (As applicable)	Functional Test & Other checks as per approved QAP	100%	MTC & Inspection Report	H	H	W (Note-6,9)
3.0	**In Process Inspection**						
3.1	NDT (As applicable) for Casing, Impeller, Stuffing Box, Shaft Casing to Nozzle butt weld	Surface and Internal imperfections	100%	Test Reports, RT films & NDT report	-	H	R
3.2	Pressure test before Assembly of Pump casing (In un-painted condition) & stuffing box	Leak Tightness check	Each Set	Inspection and Test Records	-	H	R
3.3	Impeller / Rotor assembly	Dynamic Balancing	Each Impeller / Rotor assembly	Inspection and Test Records	-	H	W - 1 per Tag R - Spare (Note – 10)

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.0	**FINAL INSPECTION**						
4.1	Testing of Pumps	1) Performance test 2) NPSH (R) (As applicable) 3) MRT for 4 hours duration (To measure Vibration Limits, Noise level, Bearing Temp Rise)	Each Pump	Inspection and Test Records, Calibration records of Driver	-	H	H (Note-11)
4.2	Dismantle inspection of pump after performance test / MRT (4 Hours)	1) Visual insp. of casing inside surface 2) Wear ring area visual Check 3) Clearance measurement 4) Examination of Mechanical seal	Each Pump	Inspection and Test Records	-	H	W (Note-12)
4.3	Performance testing of pump after corro-coating (As applicable if specified in PR/pump datasheets)	Performance /Power consumption	One / Tag	Inspection and Test Records	-	H	W (One / Tag)
4.4	Unitization of Pump with job driver on a common job base Frame	Alignment of pump with driver and Check Direction of Rotation	Each Set	Inspection and Test Records	-	H	W
4.5	Complete Unit String Test along with all accessories (If applicable as per PR)	Mechanical Performance of the Train (Vibration Limits, bearing / Oil temperature, driver parameters and controls)	Each Set	Inspection and Test Records	-	H	H
4.6	Testing of auxiliary piping (As applicable)	Leak Tightness	Each Set	Inspection and Test Records	-	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.7	Job Instruments if applicable	Compliance to PR requirements	100%	MTC & Statutory certification (As applicable)	W	H	R
4.8	Testing and Measuring Instruments	Validity of calibration & accuracy	100%	Calibration Report	W	H	R
4.9	Final Pump skid Assembly & Spares verification	Visual, Nozzle dimensions including foundation dimensions of base frame, Battery Limits Check, Overall skid completeness check and PMI check of all SS & AS components and welds on skid	100%	Inspection Report	-	H	H
5.0	**Painting**						
5.1	Surface Preparation & Painting of all Carbon Steel Parts of Skid	Visual Inspection for workmanship, Panting Scheme, Paint Shade, Painting DFT Check	100%	Inspection Report	-	H	R
5.2	Pickling & Passivation for Stainless Steel Parts(As applicable)	Visual Inspection for workmanship	100%	Inspection Report	-	H	R
5.3	Packing & Preservation	Visual Inspection for workmanship	100%	Inspection Report	-	H	-
6.0	**Documentation & IC / IRN**						
6.1	Stamping and review of inspection documents, issue of IC	Review of documents for compliance as per PR.	100%	Inspection Certificate (IC)	-	-	H
6.2	Review of final documentation of supplier	Compilation of documents as per VDR attached with PR.	100%	Dossier / Completion certificate	-	H	H

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Legend: H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% (minimum 1 number of each size and type of Bulk item)), R-Review, W-Witness (Give due notice, work may proceed after scheduled date).

NOTES (As applicable):

1. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable.(Unless otherwise agreed upon)
2. Acceptance Norms for all the activities shall be as per PO/PR/Standards referred there in /Job Specification /Approved Documents.
3. WPS/PQR/WPQ Shall be qualified & certified by a reputed TPIA.
4. Certifications shall be as per EN 10204 Type 3.1 except for Mechanical seal & wear ring hardness.
5. Bought out items to be procured from EIL/Client approved suppliers.
6. Third Party Inspection Certifications shall be as per EN 10204 Type 3.2 and TPIA shall be arranged by supplier.
7. Inspection Test Requirements of Motors shall be as per EIL ITP 6-81-1064 (MV Motors), 6-81-1031 (HV Motors), 6-81-1038 (MV VFDs), 6-81-1050 (HV VFDs).
8. Inspection Test Requirements Diesel Engine Starting Battery shall be as per EIL ITP 6-81-1046 (For Lead Acid Battery Type).
9. Separate QAP/ITP of bought out items like Steam turbine, Diesel engine, Gear box, Lube Oil System & LCP/UCP shall be submitted for approval of TPIA/EIL.
10. Final balancing of impeller/shaft shall be done after corro-coating if applicable & specified in PR/datasheets.
11. For Pump up to 55KW, Performance test, Mechanical Run Test, NPSH tests (As applicable) and dismantling inspection shall be reviewed by EIL/TPIA. Pump above 55KW and up to 160KW, Performance test, Mechanical Run Test and NPSH test (As applicable) shall be witnessed by EIL/TPIA and shall be limited to one per PR Sr. No. excluding engine driven pump. Engine driven pump & Pump above 160KW, Performance test, Mechanical Run Test and NPSH test (As applicable) for each pump shall be witnessed by EIL/TPIA.
12. Dismantle inspection of pump after performance test shall be applicable only in case of abnormality in mechanical behavior (such as excessive noise & vibration, bearing temperature rise etc.) during performance test.
13. For EPC jobs, all inspection shall be carried out by TPIA, unless notified otherwise.

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वातानुकूलन पैकेज
के लिए
निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
AIR CONDITIONING PACKAGE

Rev. No.	Date	Purpose	Prepared by	Checked by	Convenor Standards Committee	Chairman Standards Bureau
					Approved by	
1	14.12.2020	REVISED AND RE-ISSUED	SK	CS	RKS	SM
0	02.07.2015	Issued for Implementation	PKS	RKS	RKM	SC

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Abbreviations:

AS/CS/SS	:	Alloy Steel/ Carbon Steel/ Stainless Steel	MOC	:	Material of Construction
AC	:	Air Conditioning	MPT/MT	:	Magnetic Particle Testing
ANSI	:	American National Standards Institute	MTC	:	Material Test Certificate
ASHRAE	:	American Society for Heating, Refrigeration & Air Conditioning Engineers	MRT	:	Mechanical Run Test
			NACE	:	National Association of Corrosion Engineers
ASTM	:	American Society for Testing & Materials	NDT	:	Non Destructive Testing
BIS	:	Bureau of Indian Standards	PESO	:	Petroleum Explosive Safety Organization
BOM	:	Bill of Materials	PLC	:	Programmable Logic Control
CEIL	:	Certification Engineers International Limited	PMI	:	Positive Material Identification
COC	:	Certificate of Compliance	PO	:	Purchase Order
DFT	:	Dry Film Thickness	PQR	:	Procedure Qualification Record
DPT	:	Dye Penetrant Testing	PR	:	Purchase Requisition
EIL	:	Engineers India Limited	RT	:	Radiography Testing
EN	:	European Standard	TC	:	Test Certificate
EPC	:	Engineering, Procurement & Construction	TPI or TPIA	:	Third Party Inspection Agency
HT	:	Heat Treatment	UL	:	Underwriters Laboratories
HV	:	High Voltage	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	WPS	:	Welding Procedure Specification
ITP	:	Inspection and Test Plan	WPQ	:	Welders Performance Qualification
IR	:	Insulation Resistance			

Inspection Standards Committee

Convenor : Mr. R.K. Singh

Members:

Mr. Rajesh Sinha
Mr. Chandrashekhar
Mr. Mahendra Mittal
Mr. Himangshu Pal
Mr. Avdhesh Agrawal
Mr. R. Muthuramalingam (RPO Representative)
Mr. Shishupal Chaudhary (Engg. Representative)

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of Air Conditioning Package (Comprising of Chilling Unit, Air Handling Unit, Control System & Ducts).

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/ Job specifications /Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
1.0	**Procedure**						
1.1	Functional/Performance test, Hydrostatic/Leak Test, Heat Treatment, NDT, Painting and other procedures, as applicable	Documented Procedures	100%	Procedure Documents	-	H	R
1.2	WPS/ PQR /WPQ for Equipments, piping & ducting	Documented Procedures	100%	Procedure documents	-	H	R-Existing W-New
1.3	Categorization Plan for bought out items	Documented Inspection Category	100%	Categorization Plan	-	H	H
2.0	**Inspection at manufacturer's works-Chilling unit**						
2.1	**Refrigeration System- Vapour Compression System (as applicable)-Material/Bought outs**						

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
2.1.1	Refrigerant Compressor & Motor (as applicable)	Compressor: Model/Type & Capacity/ rating, (MOC compliance, Dynamic Balancing, Leak Test, Performance characteristics (as applicable), Mechanical Run Test), Statutory certificate (as applicable) Motor: Type/rating/frame size-wise Type & Routine testing	100%	Manufacturer Test Certificate/ Inspection reports	H	As per Note - 1	As per Note - 1
2.1.2	Heat Exchangers like Refrigerant Condenser, Shell & Tube Economizer, Evaporator, Oil Cooler, High Pressure Absorber Chiller (as applicable)	Physical & Chemical properties for pressure parts, , Visual, Dimensions, Hydrostatic test	100%	Manufacturer Test Certificate/ Inspection reports	H	As per Note - 1	As per Note - 1
2.1.3	Vessels like Refrigerant Receiver, Compressor Knock-Out Drum, Oil Separator, Flash Vessel, Oil Recovery Vessel, Oil Reservoir / Sump, Oil Filters (as applicable)	Physical & Chemical properties for pressure parts, Visual, Dimensions, Hydrostatic test	100%	Manufacturer Test Certificate/ Inspection reports	H	As per Note - 1	As per Note - 1

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
2.1.4	Fan/Blower & drive motor for Condenser/Evaporator (as applicable)	Fan/Blower: Model/Type & Capacity/rating, MOC Compliance, Dynamic Balancing, Leak Test, Performance, Mechanical Run Test (as applicable) Motor: Type/rating/frame size-wise Type & Routine testing	100%	Manufacturer Test Certificate/ Inspection reports	H	As per Note - 1	As per Note - 1
2.1.5	Oil Pump Set Assembly (as applicable)	Pump: Model, MOC compliance, Dynamic balancing, Leak Test, Performance characteristic, Mechanical Run Test (as applicable) Motor: Type/rating/frame size-wise Type & Routine testing	100%	Manufacturer Test Certificate/Inspection reports	H	As per Note - 1	As per Note - 1
2.1.6	Piping items viz. Valves, Pressure Safety Valves, Strainers, Pipes, Flanges, Fittings, Fasteners & Gaskets (as applicable)	Physical & Chemical properties for parts, Hydrostatic test, Functional Test (as applicable)	100%	Manufacturer Test Certificate	H	As per Note - 1	As per Note - 1

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
2.1.7	Miscellaneous items viz. Compressor Couplings, Base Frame for Skid, V- Belt, Pulleys Insulation (Cold & Hot) & Structural Materials (as applicable)	Visual, Dimension, Dynamic Balancing of Coupling	100%	Manufacturer Test Certificate	H	As per Note - 1	As per Note - 1
2.2	**Refrigeration System- Vapour Absorption System (as applicable)- Materials/Bought Outs**						
2.2.1	Plates, Pipes/Tubes, Valves, Pump (Hydraulic/Vacuum),	Pump: Model/Type & Capacity/ rating, MOC compliance, Performance Characteristics, Mechanical Run Test (as applicable) Other items: Physical & Chemical properties, Hydrostatic test (as applicable)	100%	Manufacturer Test Certificate/Inspection reports	H	As per Note - 1	As per Note - 1
2.2.2	Expansion Tank, Cooling Tower (as applicable)	Tank: Physical & Chemical properties for parts, Visual, Dimensions, Hydrostatic test Cooling Tower: Performance characteristics for Fan, Type/Routine testing of Motor, Functional cum Mechanical Run Test, MOC compliance, Type test certificate for cooling capacity	100%	Manufacturer Test Certificate/Inspection reports	H	As per Note - 1	As per Note - 1

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
2.3	Instrumentation Items like Local Control Panel, PLC, Transmitters (Pressure, Differential Pressure, Temperature, Level), Pressure Gauges, Temperature Gauges, Level Gauges, Thermo Wells, Temperature Elements, Control Wiring & Junction Boxes, Control Valves, Solenoid Valves, Orifice Plates, Cable Trays, Instrument Tubing/ Fittings/Valves (as applicable)	Panel: HV/IR, Logic Check, BOM verification Other Instruments/items: Calibration & applicable statutory certificates, Leak testing, Functional test (as applicable)	100%	Manufacturer Test Certificate/Inspection reports	H	As per Note - 1	As per Note - 1
2.3.1	Package AC & Split/Window AC's	Manufacturer's certificate for Leak Test, Trial run, HV/IR, Logic check. Type test report for model/type w.r.t. refrigeration capacity.	100%	Manufacturer Test Certificate/Inspection reports/ COC	H	As per Note - 1	As per Note - 1
2.4	Pre-Fabricated Interconnecting Piping at shop	NDT (RT for Butt welded joint & MPT/DPT for Socket weld joint), Heat Treatment & Helium/Pneumatic/Hydrostatic Test	As per Spec.	Inspection Report	H	W	R

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
2.5	Final inspection of Complete Refrigeration Package	Visual, Dimensions, Completeness as per Piping & Instrument Drawing & Performance test (Type tests as per applicable standards, as applicable), Helium Spray/Shroud Test (For Vapor Absorption Chillers).	100%	Test Report	H	H	H
3.0	**Inspection at Works-Air Handling Unit**						
3.1	Plates, Filters (Fine/Chemical), Dampers etc.	- Compliance Certificate for Filtration capacity. - Compliance Certificate for removal of gases for Chemical Filter. - Functional test report, Material compliance, Statutory certificate UL555/UL555S for Dampers.	100%	Manufacturer's Test Certificate/Inspection Report/ COC	H	As per Note - 1	As per Note - 1
3.2	Heating Unit (Electric Heater)	Model/Type, Visual, Dimensions, Electrical Characteristics, Statutory approvals	100%	Manufacturer's Test Certificate/Inspection Report	H	As per Note - 1	As per Note - 1

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
3.3	Humidifier/De-humidifier Unit	Physical & Chemical properties for parts, Leak Testing, Compliance for Material/Insulation/Wiring - Statutory certificate for terminal box (as applicable).	100%	Manufacturer's Test Certificate/Inspection Report/ COC	H	As per Note - 1	As per Note - 1
3.4	Fan/Blower & Drive motor	Fan/Blower: Model/Type & Capacity/rating, MOC Compliance, Dynamic Balancing, Leak Test, Performance, Mechanical Run Test (as applicable) Motor: Type/rating/frame size-wise Type & Routine testing	100%	Manufacturer's Test Certificate/Inspection Report/COC	H	As per Note - 1	As per Note - 1
3.5	Complete Air Handling Unit	Visual, Dimensions, Completeness as per Piping & Instrument Drawing, Mechanical Run Test	As per PR/ Purchase Specification	Inspection report	-	H	H
4.0	**Inspection at manufacturer's works-Air Distribution Ducting/Diffuser/Grills**						
4.1	Sheets/Dampers/Louvers/ Insulation/Cladding	Physical & Chemical properties, Visual, Dimensions, Size, Quantity	100%	Manufacturer's Test Certificate/Inspection Report	H	R	R

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
4.2	Blower & Drive motor	Fan/Blower: Model/Type & Capacity/rating, MOC Compliance, Dynamic Balancing, Leak Test, Performance, Mechanical Run Test (as applicable) Motor: Type/rating/ frame size-wise Type & Routine testing	100%	Manufacturer's Test Certificate/Inspection Report	H	W	R
5.0	**Painting**						
5.1	Surface Preparation & Painting of all Carbon Steel Parts and Pickling & Passivation for Stainless Steel Parts	Visual Inspection for Workmanship / Paint Shade / Painting DFT/Adhesion/Holiday Check (as applicable)	100%	Inspection Report	-	H	W/R
6.0	**Documentation & IC**						
6.1	Submission of Certificates (as applicable)	• Certificate of Statutory testing agency for suitability of area classification • Certificate of Statutory approval authority like PESO (as applicable) • Valid BIS License (as applicable) • Degree of protection certificate (as applicable)	Each Model	Certificates from Statutory Bodies	R	R	R

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
6.2	Documentation & Inspection Certificate(IC)	Issue of IC	100%	Inspection Certificate	-	H	H
6.3	Final documents as per PR	Verification & compilation of inspection & test records for submission to customer	100%	Manufacturer data book		H	H
7.0	**Final inspection of package (AT SITE)**						
7.1	Inspection of welds & Pressure Testing	Fit up/NDT/Heat Treatments	As per specification	Inspection report	-	H	H
7.2	Installation of items/units	Installation of units as per lay out/location/Insulation	100%	Inspection report	-	H	H
7.3	Balancing of Air Distribution system	Verification of air quantities across various air terminals	100%	Inspection report	-	H	H
7.4	Inspection of Electrical circuits/installation	Verification of circuits & installations	100%	Inspection report	-	H	H
7.5	Performance Run test	Performance guarantee run test for 72 hours	100%	Inspection report	-	H	H
7.6	Spares (Mandatory, Commissioning, Operational), Special Tools & Tackles (as applicable)	Verification for quantity	100%	Inspection Reports	-	H	H

Legend: H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% (minimum.1 no. of each size and type of Bulk item)), R-Review, W-Witness (Give due notice, work may proceed after scheduled date).

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NOTES (As applicable):

1a. For Non NACE & Non Hydrogen service, following items shall be procured with EN 10204 type 2.2 certification.

Items	Dimensions	Material
Seamless Pipes	Size Upto 12"	Carbon Steel
Seamless Fittings	Size upto 14" and Socket welded fittings of all sizes	Carbon Steel
Flanges	Size Upto 24" 300 – ANSI Class & Socket Welded Flanges of all rating.	Carbon Steel
Valves	Size Upto 12" – 300 ANSI Class & All Forged Valves with socket welded ends upto 1500 ANSI Class (Other than Jacketed Valves)	Carbon Steel
Fasteners	All sizes	All material except Fasteners as per ASTM A453
Gaskets	All sizes	All material
Motor	Upto 55kiloWatt	For safe area
Catalogued Item	Electrical/ Mechanical Items	For safe area

1b. All other materials which are not covered in 1a and categorized as 'A' or 'B' shall be procured with EN10204 type 3.1 certification.

2. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable (unless otherwise agreed upon).
3. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.
4. Site activities covered under 7.0 shall be witnessed by EIL Construction Inspection or TPIA, as the case may be.
5. For EPC jobs, all inspection shall be carried out by TPIA, unless notified otherwise.

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सिविल, सरंचना एवं वास्तुकला कार्यों (ईपीसीसी/ एकमुश्त टर्नकी संविदाओं) के लिए निरीक्षण एवं परीक्षण योजना (आईटीपी)

INSPECTION & TEST PLAN (ITP) CIVIL, STRUCTURAL & ARCHITECTURAL WORKS (EPCC/LSTK CONTRACTS)

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by: StandardsCommitteeConvenor	Approved by: Standards Bureau Chairman
4	29.08.2023	REVISED AND REISSUED	DJ	DG	RKS	SM
3	27.07.2018	REVISED AND REISSUED	SKG	AP	AKK	RKT
2	19.02.2016	REVISED AND REISSUED	DJ	AKM	TKS	SC
1	04.07.2011	REVISED AND REISSUED	SM	SM	MKG	DM
0	17.10.2005	ISSUED AS STANDARD SPECIFICATION	MPJ	SPS	VNP	VJN

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Abbreviations:

AFC	:	Approved For Construction
BM	:	Bench Mark
CI	:	Cast Iron
CPT	:	Cone Penetration Test
GI	:	Galvanized Iron
IRC	:	Indian Road Congress
JB	:	Junction Box
MS	:	Mild Steel
MT	:	Magnetic Particle Testing
NDT	:	Non Destructive Testing
PCC	:	Plain Cement Concrete
PQR	:	Procedure Qualification Record
PT	:	Penetration Testing
PVC	:	Poly Vinyl Chloride
PWHT	:	Post Weld Heat Treatment
RCC	:	Reinforced Cement Concrete
RF	:	Reinforcement
SPT	:	Standard Penetration Test
U/G	:	Under Ground
WBM	:	Water Bound Macadam
WMM	:	Water Mix Macadam
WPS	:	Welding Procedure Specification

Construction Standards Committee

Convenor: Sh. Rupesh Kumar Singh , ED (Construction)

Members: Sh. Janak Kishore, ED (Projects),
Sh. Chinmoy Kapuria, CGM (SCM),
Sh. Udayan Chakravarty, Sr. GM (Piping),
Sh. Debasish Ghosal, GM (Construction),
Sh. Pankaj Kumar Rai, DGM (Construction),

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GENERAL NOTE

The enclosed ITPs shall be followed for the works to be performed by the contractor. The provisions indicated for stage wise inspection by EIL/Owner (For specific activities), may be modified in line with EIL scope of services as per the contract between EIL and Owner. Activities for which ITP's are not provided in this specification, contractor to develop and get the same approved by EIL/Owner before start of the work. In general, role of EIL has been specified in the document. The role of owner to be specified during preparation of site specific ITPs.

Contractor to submit job procedures for the jobs for which ITP's are attached & job specific reporting formats with the aid of enclosed sample reporting formats to EIL/Owner for approval, before commencement of the activity. If the contractor has to deviate from the given ITP for a valid reason, he shall obtain prior written approval of EIL/Owner. Contractor to carry out 100% examination of all activities.

LEGEND

HP : **Hold Point;**

A point which requires witnessing/inspection/verification and acceptance by Owner/EIL before any further processing is permitted.
The Contractor shall not process the activity/item beyond a Hold Point without written approval by Owner/EIL except where prior written permission for further processing is available.

W : **Witness Point;**

An activity which requires witnessing/inspection/verification by Owner/EIL when the activity is performed.
After proper notification has been provided (notification modalities and period shall be finalized before hand), the Contractor is not obliged to hold further processing if Owner/EIL is not available to witness the activity or does not provide comments before the date notified. In such cases, basis of acceptance shall be review of Contractor generated report/document as per relevant technical specification.

Rw : **Review** of Contractor's documentation.

S : **Surveillance** Inspection by Owner/ EIL.
Monitoring or making observations to verify whether or not material/items or services conform to specified requirements. Surveillance activities may include audit, inspections, witness of testing, Review of quality documentation & records.

WC : **100%** Supervision and Examination by Contractor.

Responsibility for execution of the inspection/testing is with the Contractor; Owner/EIL only verifies examination or testing done by the Contractor at important stages

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ITP NO. : 2701

LAND & TOPOGRAPHICAL SURVEY

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Boundary markings and submission of drgs./sketches	WC	Rw
2.	a) Availability of valid calibration certificates of instruments/ testing equipments	WC	Rw
	b) Field calibration, if any	WC	S
3.	Establishing permanent bench marks, temporary bench marks with ref. to Survey of India B.Ms. by check levels	WC	HP
4.	Block levels, contour plans and submission of relevant drgs. & records.	WC	S
5.	Protection of control points, permanent bench marks and regular rechecking	WC	S
6.	Submission of Master plan showing monuments, structures exposed rocks, weirs, water works, ponds, underground services if crossing that area, etc.	WC	Rw
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

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ITP NO. : 2702

SOIL INVESTIGATION

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Positioning of test location	WC	S
2.	a) Availability of valid calibration certificates of instruments/ testing equipments	WC	Rw
	b) Field calibration, if any	WC	S
3.	Boring & sampling	WC	S
4.	In-situ testing (SPT, CPT, Plate load test, Soil Resistivity, Block vibration test, etc.)	WC	S
5.	Lab testing (as applicable)	WC	S/Rw
6.	Monitoring of water level	WC	S
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

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ITP NO. : 2703

SITE GRADING

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
1.	Clearing and stripping of soil including disposal of unsuitable material	WC	S	-
2.	a) Availability of valid calibration certificates of instruments/ testing equipments	WC	Rw	Rw
	b) Field calibration, if any	WC	S	-
3.	Taking and plotting of initial levels at specified intervals for cutting as well as filling areas	WC	S*	S*
4.	Classification (Levels of strata) and testing of filling soil for suitability including preparation of Lead Charts to filling/disposal areas.	WC	S	-
5.	Proper warning of explosions, misfires and storage of explosive materials (As applicable).	WC	-	--
6.	Breaking up of clods, lumps, etc. at the time of filling and compaction.	WC	S	-
7.	Identification and suitability of borrow areas for filling soil/murrum including verification of payments for royalty, etc.	WC	Rw	-
8.	Compaction test for earth filling in specified layers including finished areas.	WC	Rw	-
9.	Verification of final finished grade levels.	WC	S*	S*
10.	Computation of Earth works.	WC	Rw*	Rw*
11.	Record of tree cuttings, stacking of blasted rocks and other quarry materials including handing over to Owner	WC	S	S
12.	Preparation of "As built drawings	WC	Rw	Rw
13.	Removal of Unserviceable Surplus earth/excavated material and leveling in disposal areas.	WC	S	-
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

CAT B: All fillings
CAT C: All cuttings.

* In case quantum of earthwork is required to be certified by EIL then W.

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ITP NO. : 2704

EXCAVATION

SL. NO.	ACTIVITY	CONTRACTOR	EIL		
			CAT A	CAT B	CAT C
1.	a) Availability of valid calibration certificates of instruments/ testing equipments	WC	Rw	Rw	Rw
	b) Field calibration, if any	WC	S	S	-
2.	Layout checking	WC	S	-	-
3.	Taking initial levels	WC	S	-	-
4.	Slopes of excavation, benching, overburden, shoring & strutting (in case of deep excavation)	WC	S	--	-
5.	Check for sub-soil water, dewatering requirements as per specifications.	WC	S	--	--
6.	Bottom level of excavation and compaction	WC	S	--	--
7.	Stacking of different type of soils separately	WC	S	-	-
8.	Making trial pits manually to check UG utilities before carrying out Mechanical excavation (if applicable).	WC	S	S	S
9.	List of obstacles encountered (cables, pipes, conduits, etc)	WC	S	S	-
10.	Barricading of excavated pits for safety & protection from rain	WC	S	S	S
	FOR HARD ROCK				
1	Obtaining license from district authorities for undertaking blasting operations	WC	Rw	Rw	Rw
2	Storing of explosive materials as per explosive rules	WC	--	--	--
3	Prominent display of red flags around the area to be blasted	WC	S	S	S
4	Check the dimensions of bore holes	WC	--	--	--
5	Stacking of hard rock for useable/non useable including handing over to owner	WC	S	S	S
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Rw

CAT A : Equipment foundations, Plant buildings, Technological structure, etc.
CAT B : Non Plant buildings, pipe racks, pipe culverts, bridges, etc.
CAT C : Boundary walls, wing walls, manholes, drains, isolated non-critical foundations etc.

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ITP NO. : 2705

BACK FILLING

SL. NO.	ACTIVITY	CONTRACTOR	EIL		
			CAT A	CAT B	CAT C
1.	Selection of materials/selected earth	WC	S	S	S
2.	Check for treatment of soil, if any	WC	S	S	-
3.	a) Availability of valid calibration certificates of instruments/ testing equipments	WC	Rw	Rw	Rw
	b) Field calibration, if any	WC	S	S	-
4.	Filling in specified layers, consolidating, watering.	WC	S	-	-
5.	Compaction tests for layers	WC	Rw	Rw	Rw
6.	Filling to required levels	WC	S	-	-
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Rw

CAT A: Equipment foundations, Plant buildings, Technological structure, etc.
CAT B: Non Plant buildings, pipe racks, pipe culverts, bridges, etc.
CAT C: Boundary walls, wing walls, manholes, drains, etc

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ITP NO. : 2706

UNDERGROUND PIPING (RCC/ CI/HDPE/UPVC/CPVC)

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
1.	Checking of material	WC	NOTE 1	NOTE 1
2.	Adequate slope, benching in excavation for safety purposes (if required)	WC	S	
3.	Layout, line & level	WC	S	-
4.	Laying & jointing, grouting at manholes/chambers	WC	S	-
5.	Check for supports/ firm bed/ sub soil water level	WC	S	-
6.	Testing for leakages by blocking pipe ends	WC	W	W
7.	Hydro-testing and other tests, Removal of blockages, Cleaning & flushing of system	WC	W	W
8.	Backfilling in layers	WC	Rw	Rw
9.	Check for MS rungs in proper position, inlet/outlet pipe levels in manholes	WC	S	--
10.	Preparation of "As-built drawings"	WC	Rw	Rw
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

CAT B: Main Plant Buildings, Utilities, Offsites etc.
CAT C: Non Plant Buildings, Technological Buildings, Admn. Buildings, Gate House, Security Rooms, etc.

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ITP NO. : 2707 A

WBM ROADS

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
1.	a) Availability of valid calibration certificates of instruments/ testing equipments	WC	Rw	Rw
	b) Field calibration, if any	WC	S	-
2.	Layout checking including Road crossings and taking initial levels	WC	S	S
3.	Approval of source & checking/testing of materials (wherever required)	WC	NOTE 1	NOTE 1
4.	Filling (if any), compaction, providing cambers in sub-base including levels	WC	S	S
5.	Spreading metal to required thickness, line & levels, dry rolling including spreading of screening material	WC	-	-
6.	Check for camber, superelevation and levels over metalling	WC	S	S
7.	Spreading murrum/ sand, watering and rolling	WC	S	-
8.	Checking thickness after each layer and rectification thereof (if any)	WC	S	S
9.	Checking quantity of aggregate by excavation of trial pits as per IRC Code	WC	S	S
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

CAT B: Roads subjected to heavy loading, connected to main highway, main plant roads
CAT C: Balance Roads

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ITP no: **2707 B**

WMM for Roads

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
1.	a.) Review of calibration certificates of instruments/testing equipment's.	WC	Rw	Rw
	b)Field calibration, if any.	WC	S	-
2.	Design Mix to fix the proportion of ingredients	WC	Rw/HP	Rw/HP
3.	Layout Checking including Road Crossing & taking initial levels.	WC	S	S
4.	Approval of source & checking /testing of materials (wherever required)	WC	Rw	Rw
5.	Filling (if any), compaction, providing chambers in sub-base including levels.	WC	S	-
6	Spreading metal to required thickness, line & levels, dry rolling including spreading of screening material.	WC	S	-
7	Check for camber, superelevation & levels.	WC	S	S
8	Spreading, watering & rolling.	WC	S	-
9	Checking thickness after each layer and rectification thereof (if any).	WC	S	S
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

CAT- A –Roads subjected to heavy loading connected to main High way, main plant roads etc.

CAT B- Balance roads

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ITP NO. : 2708

BLACK TOPPING- PREMIX CARPETING - PC, BITUMINOUS CONCRETE (BC) & BITUMINOUS MACADAM (BM)/ DENSE BITUMINOUS MACADAM (DBM)

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Approval of source of materials	WC	Note 1
2.	a) Availability of valid calibration certificates of instruments/ testing equipments	WC	Rw
	b) Field calibration, if any	WC	S
3.	Surface preparation & check for camber/level	WC	S
4.	Checking/ testing of material wherever required	WC	S
5.	Tack coat application	WC	-
6.	Laying of Premix carpeting/ BC/BM/DBM including rolling	WC	S
7.	Application of Seal coat	WC	-
8.	Check for camber, superelevation and levels	WC	S
9.	Check for bitumen temperature and consumption	WC	S
10.	Thickness check of Premix carpet/ BC/BM/DBM	WC	S
11.	Removal of surplus earth	WC	-
12.	Berm preparation	WC	-
13.	Final Inspection	WC	S
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

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ITP NO. : 2709

TANK PADS

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT A	CAT B
1.	Approval of source of materials	WC	NOTE 1	NOTE 1
2.	Stripping the area	WC	-	-
3.	a) Availability of valid calibration certificates of instruments/ testing equipments	WC	Rw	RW
	b) Field calibration, if any	WC	S	S
4.	Layout and marking of ground level	WC	S	-
5.	Excavation to required level, compaction of sub-base	WC	S	S
6.	Checking/ testing of materials	WC	S	S
7.	Filling selected materials in specified layers, rolling, watering	WC	S	-
8.	Compaction tests	WC	Rw	Rw
9.	Gravel filling under annular ring with compaction and adding graded filler material (As applicable)	WC	S	S
10.	Anti-corrosive layer, consolidation	WC	S	-
11.	Premix carpeting on side slopes	WC	S	S
12.	Preparation of "As-built drawing" for erection	WC	Rw	Rw
13.	Check for settlement of pads during hydro testing of tanks	WC	W	S
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

CAT A: All Site fabricated steel storage tanks for process fluid/ Hydrocarbon, floating roof, tanks having capacity 600cum or 10m dia. and 8 m height.

CAT B: Site fabricated steel storage tanks for Raw water, Fire water, waste water, DM water, etc. and all tanks not covered under "CAT A".

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ITP NO. : 2710

MICRO GRADING

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	a) Availability of valid calibration certificates of instruments/ testing equipments	WC	RW
	b) Field calibration, if any	WC	-
2.	Taking initial levels	WC	S/Rw
3.	Clearing/ Removal of extra soil, debris, etc. from site by transportation	WC	-
4.	Taking final levels	WC	S
5.	Verification of gradient of ground	WC	S
6.	Finishing of ground surface by hand compactor/ Roller (As applicable)	WC	S
7.	Final inspection	WC	S
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

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ITP NO. : 2740

FOR UNDERGROUND PIPING (CARBON STEEL)

SL. NO	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
A.	**PRIOR TO FABRICATION**			
1	Incoming materials	WC	NOTE 1	NOTE 1
2.	Welding Filler Material Approval/Qualification			
	i) Review of Manufacturer's Test Certificates/ other documents	WC	RW	RW
	ii) Testing, if any	WC	Rw	Rw
3.	WPS/PQR			
	i) Review of proposed Procedure	WC	Rw	Rw
	ii) Welding of test coupon and subsequent Testing, if applicable	WC	W	W
	iii) Approval of Final WPS/PQR	WC	HP	HP
4	Certification & approval of welders	WC	Rw	Rw
5.	NDT Procedure Qualification			
	i) Review of proposed Procedure	WC	Rw	Rw
	ii) Testing	WC	Rw	Rw
	iii) Approval of NDT procedure	WC	HP	HP
6.	Preparation of sketches from General Arrangement drawings	WC	Rw	-
7.	Joint numbering	WC	Rw	-
8.	Approval of colour coding scheme	WC	Rw	-
9.	Monitoring of colour coding on pipes & fittings	WC	S	-
B.	**FABRICATION (SHOP & FIELD)**			
1.	Material as per piping class (check w.r.t. approved colour coding procedure)	WC	S	
	i) Fit-up check ii) Dimensional check	WC WC	S S	Rw Rw

NOTE : 1) For incoming material inspection please refer ITP no: -6-82-1010.

CAT B : All pressure lines, Fire Water line, Cooling Water line, etc.
CAT C : Balance Works

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ITP NO. : 2740

FOR UNDERGROUND PIPING (CARBON STEEL)

SL. NO	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
2.	Pre-heat (if any)	WC	S	-
3.	Check for purity of purging/shielding Gas (if any)	WC	S	-
4.	Purging (if any)	WC	S	-
5.	Shielding rate (if any)	WC	S	-
6.	Baking of Electrodes	WC	S	-
7.	Inter-pass cleaning & Temperature check.	WC	S	-
8.	Visual check of completed welds	WC	S	-
9.	PT/MT	WC	S	-
10.	Radiography marking (for Random Radiography)	WC	S	S
11.	Radiography Interpretation	WC	Rw	Rw
C.	**HYDROSTATIC/ PNEUMATIC TESTING**			
1.	Procedure Review	WC	Rw	Rw
2.	Correctness of Testing arrangements	WC	S	-
3.	Calibration of Pressure Gauges	WC	-	-
4.	R.F. Pad testing, if any	WC	S	-
5.	Scrutiny of test packs for Mechanical & NDT Clearance (Refer UG-01)	WC	HP	HP
6.	Air/Water Flushing (preliminary)	WC	S	S
6a.	Addition of corrosion inhibitors, if required – Approval of make & quality	WC	S	S

CAT B : All pressure lines, Fire Water line, Cooling Water line, etc.
CAT C : Balance Works

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ITP NO. : 2740

FOR UNDERGROUND PIPING (CARBON STEEL)

SL. NO	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
7.	Pneumatic/ Hydrostatic testing	WC	S	S
8.	Draining of water & Air drying	WC	S	S
D.	**LAYING**			
1.	Trench excavation and levels	WC	S	-
2.	Cleaning of pipe surface	WC	S	-
3	Approval of wrapping/coating material manufacturers	WC	Note 1	Note 1
4.	Approval of agency for wrapping & coating	WC	Rw	Rw
5.	Sample test of coating materials in approved laboratory	WC	Rw	Rw
6.	Application of primer	WC	S	S
7.	Coal tar temperature	WC	S	-
8.	Coating & wrapping	WC	S	S
9.	Approval of agency for epoxy coating/ cold tape joint/ hot jointing method	WC	Rw	Rw
10.	Check Thickness of coating (if applicable)	WC	S	-
11.	Calibration of Holiday tester	WC	Rw	Rw
12.	Holiday testing	WC	W	S
13.	Peel test	WC	S	S

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

CAT B : All pressure lines, Fire Water line, Cooling Water line, etc.
CAT C : Balance Works

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ITP NO. : 2740

FOR UNDERGROUND PIPING (CARBON STEEL)

SL. NO	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
14.	Lifting arrangement	WC	S	-
15.	Lowering (levels & orientation of branches)	WC	S	-
16.	Checking of wrapping & coating for damages during lowering, their repair, Holiday Testing, etc.	WC	S	S
17.	Back filling & compaction	WC	S	-
18.	Location, Brickwork, plaster of valve pit	WC	-	-
19.	Top cover & Finish of valve pit	WC	S	S
E.	**SYSTEM COMPLETION**			
1.	Tie in joints	WC	Refer 2740A	Refer 2740A
2.	Scrutiny of test packs for system testing	WC	Refer 2740B	Refer 2740B
3.	System testing	WC	W	Rw
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

CAT B : All pressure lines, Fire Water line, Cooling Water line, etc.
CAT C : Balance Works

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ITP NO. : 2740A

TIE IN JOINTS FOR UNDERGROUND PIPING (CARBON STEEL)

SL. NO.	ACTIVITY	CONTRACTOR	EIL
A.	Fit up	WC	S
B.	Root Run DP	WC	S
C.	Final Run DP	WC	S
D.	Radiograph Review	WC	Rw
E.	PWHT Hardness	WC	Rw
F.	RF Pad Testing	WC	W
G.	Cleaning & Priming	WC	S
H.	Coating, Wrapping	WC	S
I.	Peel Test	WC	S
J.	Holiday Testing	WC	W
K.	Checking For Any Damage In Wrapping & Coating After Lowering, Their Repair Holiday Testing, Etc.	WC	S
L	Back Filling	WC	S

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ITP NO. : 2740B

MECHANICAL COMPLETION RECORD FOR UNDERGROUND PIPING (CARBON STEEL)

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
1.	Clearance for flushing & testing	WC	Rw	Rw
1a.	Mechanical clearance			
	- Conformity with drawing	WC	Rw	Rw
	- Material as per Specification	WC	Rw	Rw
1b.	Welding & NDT clearance			
	- Material as per Specification	WC	Rw	Rw
	- Fit-up check record	WC	Rw	Rw
	- Visual check of completed welds	WC	Rw	-
	- PT/MT	WC	Rw	Rw
	- Radiography	WC	Rw	Rw
	- PWHT & hardness	WC	Rw	Rw
	- RF pad testing	WC	Rw	Rw
2.	Flushing & Pressure testing	WC	W	W
3.	Coating & wrapping			
	- Surface preparation	WC	Rw	-
	- Primer application	WC	Rw	Rw
	- Coating, wrapping & peel test	WC	Rw	-
	- Holiday check	WC	Rw	Rw
4.	Laying			
	- Trench leveling	WC	Rw	Rw
	- Lowering & checking for damages in wrapping & coating, their repair, Holiday testing, etc.	WC	Rw	Rw
	- Backfilling	WC	Rw	Rw

CAT B : All pressure lines, Fire Water line, Cooling Water line, etc.
CAT C : Balance works

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ITP NO : 2741

PLAIN CEMENT CONCRETE

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
1.	a) Availability of valid calibration certificates of instruments/ testing equipments	WC	RW	RW
	b) Field calibration, if any	WC	S	Rw
2.	Checking of layout and materials, compaction of sub –grade	WC	S	-
3.	Mix proportion	WC	S	-
4.	Check for shuttering, dewatering if any.	WC	-	-
5.	Concreting with proper compaction	WC	-	-
6.	Checking of top level of PCC	WC	Rw	-
7.	Curing	WC	-	-
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

CAT B : for filled-up area
CAT C : for cutting area

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ITP NO : 2742

REINFORCED CEMENT CONCRETE (SUBSTRUCTURE)

SL. NO.	ACTIVITY	CONTRACTOR	EIL		
			CAT A	CAT B	CAT C
1	Approval of source of materials	WC	HP	HP	Rw
2.	a) Availability of valid calibration certificates of instruments/ testing equipments	WC	Rw	Rw	Rw
	b) Field calibration, if any	WC	S	S	S
3.	Checking of layout & condition of PCC/ leveling course	WC	S	S	-
4.	Incoming material checking	WC	NOTE 1	NOTE 1	NOTE 1
5.	Design of mix &establishment of strength at site by trial mix	WC	HP	HP	HP
6.	Check for line & level of shuttering including its condition, quality and rigidity.	WC	S	--	-
7.	Check for sub-soil water & dewatering arrangement, if any	WC	S	--	-
8.	Reinforcement & covers to reinforcement	WC	S	S	--
9.	Inserts, Anchor bolts and pipe sleeves, pockets, dowels, etc.	WC	S	S	--
10.	Pour Card	WC	W	S	Rw
11.	Check for obstacles encountered (Electrical conduits, pipe lines, etc.)	WC	S	--	-
12.	Concreting, testing, compaction & finishing	WC	S	S	-
13.	Casting of cubes	WC	S	S	--
14.	Curing	WC	S	S	-
15.	Testing of cubes – 7 days	WC	S/Rw	S/Rw	S/Rw
16	Testing of cubes – 28 days	WC	W	S/Rw	S/Rw
17.	Removal of shuttering	WC	S	-	-
18.	Check for water tightness, rendering, if any	WC	S	S	S
19.	Preparation of As-built drawings	WC	Rw	Rw	Rw
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

CAT A: Critical foundations of equipments i.e. compressors, reactors, columns, stacks, foundations subjected to dynamic loading and any other foundation with RCC Quantity > 250 Cum in single pour ,etc.

CAT B: Unit Pipe racks, plant buildings and other equipment foundations not covered in category A, etc

CAT C: Non critical pipe racks (branch pipe, offsite pipe rack, etc.) non-plant buildings, pipe sleepers, manhole, catch pit and balance works.

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ITP NO : 2743

REINFORCED CEMENT CONCRETE (SUPER STRUCTURE)

SL. NO.	ACTIVITY	CONTRACTOR	EIL		
			CATA	CATB	CAT C
1	Approval of source of materials	WC	HP	HP	Rw
2.	a) Availability of valid calibration certificates of instruments/ testing equipment	WC	Rw	Rw	Rw
	b) Field calibration, if any	WC	S	S	S
3.	Checking of layout	WC	S	--	-
4.	Incoming material inspection	WC	Note 1	Note 1	Note 1
5.	Design of mix &establishment of strength at site by trial mix	WC	HP	HP	HP
6.	Check for line & level of shuttering and scaffolding/ vertical bracing including hoisting arrangements.	WC	S	S	-
7.	Reinforcement & covers to reinforcement	WC	S	S	--
8.	Inserts, bolts, pipe sleeves, MS rungs, concealed electrical conduits, fan hooks, dowels, etc. including welding if any	WC	S	S	-
9.	Pockets/ openings	WC	S	S	-
10.	Expansion joints, if any	WC	S	S	-
11.	Check for water stops, slopes, stoppers, if any	WC	S	S	-
12.	Pour Card	WC	W	S	Rw
13.	Concreting, testing, compaction & finishing	WC	S	S	S
14.	Casting of cubes	WC	S	S	S
15.	Curing	WC	S	S	-
16.	Testing of cubes – 7 days	WC	S/Rw	S/Rw	S/Rw
17	Testing of Cubes – 28 days	WC	W	Rw	S/Rw
18.	Removal of formwork/ staging	WC	S	-	-
19.	Verification of dimensions viz. AFC drawings and tolerances	WC	S	S	S
20.	Check for water tightness, rendering, if any	WC	S	S	-
21.	Preparation of As built drawings.	WC	Rw	Rw	Rw
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

CAT A: Super structure of foundations for Critical equipment's i.e. compressors, reactors, columns, stacks, foundations subjected to dynamic loading and super structure of any other foundation with RCC Quantity > 250 Cum. in single pour, Slabs of plant and non-plant buildings, etc.

CAT B: Unit Pipe racks, plant buildings and super structure of other equipment not covered in category A, etc

CAT C: Non critical pipe racks (branch pipe, offsite pipe rack, etc.) non-plant buildings, pipe sleepers, manhole, catch pit and balance works.

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ITP NO : 2745

RCC PAVEMENT/FLOORING

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Approval of source of materials	WC	Rw
2.	a) Availability of valid calibration certificates of instruments/ testing equipments	WC	Rw
	b) Field calibration, if any	WC	S
3.	Layout checking/ excavation of all new foundations	WC	-
4.	Incoming material inspection	WC	NOTE 1
5.	Design of mix &establishment of strength at site by trial mix	WC	HP
6.	Check for proper back filling/compaction/ completion of sub - Structure works	WC	S
7.	Check for edges of shuttering, alternate panels	WC	-
8.	Check for slopes, thickness of flooring	WC	S
9.	Shuttering, reinforcement (as applicable)	WC	-
10.	Check for expansion joints/ Construction joints	WC	S
11.	Check for concealed pipe embedment, earthing, if any	WC	-
12.	Check for dividing strips, as applicable	WC	S
13.	Concreting, finishing, etc	WC	S
14.	Checking for line, levels, slopes, joints, thickness of flooring viz. AFC drawings	WC	S
15.	Curing	WC	S
16.	Grinding & polishing, as applicable	WC	S
17.	Testing of concrete cubes -7 days (as applicable)	WC	S/Rw
18	Testing of concrete cubes -28 days (as applicable)	WC	W
19.	Preparation of "As Built Drawings"	WC	Rw
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

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ITP NO : 2746

BRICK MASONARY

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
1.	a) Availability of valid calibration certificates of instruments/ testing equipments	WC	RW	RW
	b) Field calibration, if any	WC	Rw	Rw
2.	Incoming material inspection	WC	Note 1	Note 1
3.	Cleaning of surface	WC	-	-
4.	Wetting/soaking of bricks	WC	S	S
5.	Cement mortar proportion	WC	S	S
6.	Staging & scaffolding	WC	-	-
7.	Hacking of adjacent concrete surface	WC	S	S
8.	Check for bond/closers, thickness of joints	WC	S	-
9.	Line, level & plumb	WC	S	S
10.	Raking out joints, keys in brick work, if any	WC	S	S
11.	Check for placement of Reinforcement bars in case of partition brick work	WC	S	S
12.	Embedment of fixtures	WC	S	S
13.	Curing	WC	-	-
14.	Preparation of 'As Built' Drawings	WC	Rw	Rw
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

CAT B : Load bearing walls
CAT C : Balance works

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ITP NO : 2747

STRUCTURAL STEEL WORKS

S. NO	ACTIVITY	CONTRA-CTOR	EIL		
			CAT A	CAT B	CAT C
A	**PRE – FABRICATION ACTIVITIES**				
1.	a) Availability of valid calibration certificates of instruments/ testing equipments	WC	Rw	Rw	Rw
	b) Field calibration, if any	WC	S	S	
2.	Incoming material inspection	WC	Note 1	Note 1	Note 1
3.	Welding Filler material approval/ qualification				
	a) Manufacturing test certificates/ documents	WC	Rw	Rw	Rw
	b) Testing, if any	WC	S	S	S
4.	Approval of WPS/ PQR	WC	HP	HP	HP
5.	Welders performance qualification	WC	Rw	Rw	Rw
6.	Layout checking	WC	S	-	-
7.	Welding equipment and accessories	WC	S	-	-
8.	Preparation and approval of Fabrication drawings	WC	Rw	Rw	-
B	**FABRICATION ACTIVITIES**				
1.	Materials as per design drawing	WC	Rw	Rw	Rw
2.	Check straightness and non-warping of members	WC	S	S	-
3.	Dimensional and fit-up checks including provision of slopes for deflection wherever required	WC	S	S	-
4.	Visual check for welding	WC	S	S	-
5.	Grinding including surface preparation for painting and application of primer	WC	S	S	-
6.	Checking paint as per specs, shelf-life, etc.	WC	S	S	-
7.	Application of specified paint, painting thickness, etc.	WC	S	S	-
C	**FIELD ERECTION ACTIVITIES**				
1.	Lifting arrangements including test certificates of lifting tackles	WC	S	S	Rw
2.	Correctness of location	WC	S	-	-
3.	Orientation of bracing, lugs, Anchor bolts	WC	S	-	-
4.	Alignment & levels	WC	S	-	-
5.	Field welding (if any)	WC	S	S	-
6.	Grouting	WC	S	S	-
7.	Finishing coat of paint, thickness of paint etc.	WC	S	S	S
8.	Preparation of As-built drawings	WC	Rw	Rw	Rw
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

CAT A: Steel structures pertaining to equipments i.e. compressors, reactors, columns, stacks, Technological structures.

CAT B: Steel structures pertaining to Unit Pipe racks, and other equipments not covered in category A, etc.

CAT C: Steel structures of Non critical pipe racks (branch pipe, offsite pipe rack, etc) plant buildings and non-plant buildings, pipe sleepers, manhole, catch pit, walkways, platforms at grade levels, etc.

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ITP NO : 2748

PILING WORKS

SL. NO.	ACTIVITY	CONTRACTOR	EIL		
			CAT A	CAT B	CAT C
1.	Approval of source of materials	WC	HP	HP	Rw
2.	Layout and ground level	WC	S	S	-
3.	Incoming material inspection	WC	Note 1	Note 1	Note 1
4.	Design of mix &establishment of strength at site by trial mix	WC	HP	HP	HP
5.	Driving of piles & check for set point	WC	S	S	-
6.	Check for depth of bore and lowering of cage measuring	WC	S	-	-
7.	Pour Card	WC	HP	S/Rw	Rw
8.	Concreting,	WC	W	S	S
9.	Casting of cubes/Testing – 7 days	WC	S/Rw	S/Rw	S/Rw
10.	Casting of cubes/Testing – 28 days	WC	W	S/Rw	S
11.	Check for cut off level of concreting & quantity of concrete poured	WC	S	-	-
12.	Lifting of casing pipe	WC	S	--	-
13.	Pile load tests (lateral/vertical/cyclic/pull out)	WC	W	Rw	Rw
14.	Submission of pile load test report	WC	Rw	Rw	Rw
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

CAT A: Critical foundations of equipments i.e. compressors, reactors, columns, stacks, foundations subjected to dynamic loading and any other foundation with RCC Quantity > 250 Cum in single pour ,Technological structures, etc.

CAT B: Unit Pipe racks, plant buildings and other equipment foundations not covered in category A, etc.

CAT C: Non critical pipe racks(branch pipe, offsite pipe rack, etc.) non-plant buildings ,pipe sleepers, manhole, catch pit, etc.

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ITP NO : 2771

ANTI-TERMITE TREATMENT

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Approval of applicator agency	WC	HP
2.	Incoming material inspection & spraying devices including personal protective equipments like facemask, gloves, shoes, etc.	WC	Note 1
3.	Preparation of surface for taking dosage of emulsion by ramming of each layer of soil by roding the earth at specified intervals	WC	-
4.	Backfilling and compaction in specified layers along with application of emulsifier along the sides of masonry & RCC structures	WC	S
5.	Compaction of top surface for taking dosage of emulsifier by roding the earth at specified intervals for the entire floor area before concreting	WC	-
6.	Check for consumption of emulsifier utilized	WC	S
7.	Shelf life of anti-termite chemical	WC	S
8.	Guarantee Certificate for performance	WC	Rw
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

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ITP NO : 2772

PLASTERING

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
1.	Check for completeness of all hidden jobs like piping, conduiting, etc.	WC	-	-
2..	Check for grading of sand, Mix proportion	WC	S	S
3.	Mortar Cube casting & its testing	WC	S	S
4.	Use of Chicken mesh of given gauge at junction of concrete & masonry.	WC	S	S
5.	Sample preparation for finish and its approval	WC	W	S
6.	Neeru application on plaster (as applicable)	WC	S	-
7.	Hacking and cleaning the surface, removing loose particles, wetting the surface	WC	S	S
8.	Leaving plaster rough where tiles are to be fixed	WC	-	-
9.	Checking of plaster thickness, plumb & even surface	WC	S	-
10.	Check for grooves, openings, rounding off the corners, hollowness in plaster	WC	S	S
11.	Checking for use of waterproofing compound , Mix proportion(as applicable)	WC	S	S
12.	Curing	WC	S	-
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	-

CAT B: Area requiring special finish (e.g. pebble dash finish etc.)
CAT C: Balance works.

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ITP NO. : 2773

DOORS, ROLLING SHUTTERS, WINDOWS AND VENTILATORS

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
1.	Incoming material inspection	WC	Note 1	Note 1
2.	Check for sections & dimensions	WC	S	-
3.	Line, level & plumb	WC	-	-
4.	Section joinery details	WC	Rw	-
5.	Check for orientation/ opening direction	WC	S	S
6.	Grouting with lugs/ dash fasteners	WC	-	
7.	Check for fixtures & fittings	WC	S	S
8	Check for thickness & type of glazing	WC	-	-
9.	Check for rubber gasket, anodizing (as applicable)	WC	-	-
10	Brand/ shade of paints, no. of coats including surface preparation (as applicable)	WC	S	Rw
11.	Check for fire rated certificate for fire doors/ windows/ partitions	WC	Rw	Rw
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

CAT B: Main plant buildings
CAT C: Balance works

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ITP NO. : 2774

PAINTING (BUILDING WORKS)

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
1.	Completion of surface preparation	WC	S	S
2.	Incoming material inspection	WC	Note 1	Note 1
3.	Confirmation of colour, shade & brand	WC	S	S
4.	Check for base surface preparation (Putty/ POP, Primer, rendering etc.)	WC	S	-
5.	Check for number of coats and thickness	WC	S	S
6.	Final check for touch up, repairs etc.	WC	S	-
7.	Curing, if any	WC	S	S
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

CAT B: Main plant buildings
CAT C: Balance works

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ITP NO. : 2775

SANITARY FITTINGS

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
1.	Incoming material inspection	WC	Note 1	Note 1
2.	Checking of sample (as applicable)	WC	S	-
3.	Check completeness of finishing works w.r.t. line, level & position	WC	S	-
4.	Check proper fixing of the sanitary fittings to give aesthetic appeal	WC	S	-
5.	Check for leakage/ testing at given pressure	WC	S	S
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

CAT B: Main plant buildings
CAT C: Balance works

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ITP NO. : 2776

WATER PROOFING (ROOF)

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Surface preparation for screeding/ water proof plastering	WC	S
2.	Mix proportion, thickness of screeding/ plastering & slope towards rain water pipes	WC	S
3.	Formation of groove at specified height on parapet wall/ pedestal/ columns etc.	WC	S
4.	Incoming material inspection, no. of coats, application procedure and consumption.	WC	S/Note 1
5.	Lapping (along the length & in transverse direction) of waterproofing membrane.	WC	S
6.	Termination of material in groove on vertical plane	WC	S
7.	Check for hollowness, bubbles in water proofing, if any	WC	S
8.	Conducting a sample of water proofing test by flooding the area for specified interval (as applicable)	WC	S
9.	Check for protective layer of PCC over waterproofing with chicken wire mesh, groove cutting, sealant filling.	WC	S
10.	Cleaning of surface	WC	-
11.	Submission of Guarantee in the requisite Performa	WC	Rw
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

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ITP NO : **2777**

FALSE FLOORING AND FALSE CEILING

SL. NO.	ACTIVITY	CONTRACTOR	EIL
	FALSE FLOORING		
1.	Manufacturers Test Certificate	WC	Rw
2.	Incoming material inspection	WC	Note 1
3.	Cleaning base floor	WC	S
4.	Painting base floor with Polyurethane based paint (as specified)	WC	S
5.	Check for cutouts in floor, anchor fasteners in floor, studs spacing etc.	WC	S
6.	Proper line, level & layout	WC	S
	FALSE CEILING		
1.	Manufacturers Test Certificate	WC	Rw
2.	Incoming material inspection	WC	Note 1
3.	Surface preparation of panel boards	WC	-
4.	Proper line, level & cut-outs	WC	S
5.	Finishing of panel boards	WC	S
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

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ITP NO. : 2778

UNDER DECK INSULATION

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Incoming material checking including density	WC	Note 1
2.	Checking of adhesive, fasteners for anchorage	WC	S
3.	Fixing of scaffolding, ladders, platforms	WC	S
4.	Fixing of under-deck insulation with adhesive	WC	S
5.	Use of chicken wire mesh while fixing the insulation sheet.	WC	S
6.	Fixing of dash fasteners at defined spacing	WC	-
7.	Finishing	WC	S
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

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ITP NO. : 2779

ROOFING ACCESSORIES

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
1.	Incoming material inspection	WC	HP/Note 1	HP/Note 1
2.	Check for mitring, overhang, laps, etc.	WC	S	-
3.	Slopes line, level of sheets, barge boards, ridges & gutters, overhang of sheets	WC	S	-
4.	Checking for profile, coating, shade of sheet.	WC	S	-
4.	Bolting by drilling only, length of bolts, nos., anodizing and type of washers	WC	S	-
5.	Check for slopes of rain gutters, down take pipes, north lighting curves/ supports for gutters	WC	S	-
6.	Check for wind ties installation of required dimensions	WC	S	-
7.	Check for leakage/ passing of light	WC	S	-
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

2) Fixing arrangement need to be reviewed with respect to contract specifications.

CAT B: Important structures (e.g. Compressor House, Warehouse and Pump House etc.)
CAT C: Balance works.

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ITP NO. : 2799

LIGHTING WORKS (NON PLANT BUILDINGS)

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Prepare detailed conduit layout diagram as per the approved electrical drawing	WC	Rw
2.	Provide /PVC/GI sleeves in columns/beams at identified locations to facilitate laying of conduit on later date.	WC	S
3.	Ensure conduit & accessories material is inspected at site before using	WC	Note-1
4.	Ensure that the conduit is laid in line with execution drawings & provide pull-wires as per requirement.	WC	S
5.	Check correctness of drop/JB locations	WC	S
6.	Check threaded joints are proper	WC	S
7.	Ensure all JB/Fan box are properly stuffed with jute	WC	S
8.	Ensure conduits are properly tied to reinforcement bars to prevent floating during concrete	WC	S
9.	Ensure proper supporting of conduit lengths wherever required	WC	S
10.	Ensure adequate chasing depth for conduit portion coming inside brick walls	WC	S
11.	Check workmanship towards joints and presence of any foreign material inside the conduits	WC	S
12.	Ensure wiring material is inspected at site before use & colour code is checked.	WC	Note-1
13.	Ensure correctness of lighting wire size and no. of wires as per the drawing in each conduit portion	WC	S
14.	Preparation of "As Built" drgs.	WC	Rw
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

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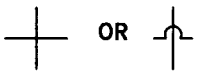
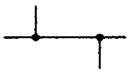
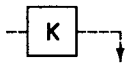
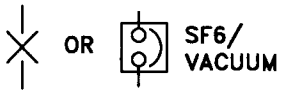
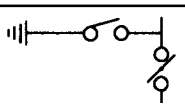
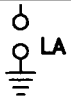
	BUS
	CROSSING OF CONDUCTORS–NOT CONNECTED
	CONNECTIONS OF CONDUCTORS
	KEY INTERLOCK, K–KEY, ARROW TERMINATES AT DEVICE
	SF6 / VACUUM CIRCUIT BREAKER
	AIR CIRCUIT BREAKER
	DRAWOUT FEATURE
	CABLE GLAND
	AIR BREAK ISOLATOR/DISCONNECT SWITCH
	OIL IMMERSED ISOLATOR/DISCONNECT SWITCH
	FUSE
	AIR CIRCUIT BREAKER WITH INHERENT RELEASES
	DOUBLE BREAK ISOLATOR
	ISOLATOR WITH EARTH SWITCH
	LIGHTNING ARRESTOR
	CONTACTOR

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	01.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	08.11.16	UPDATED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM

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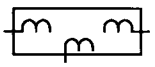
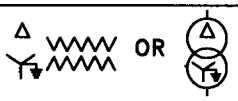
	CURRENT TRANSFORMER
	SUMMATION CT
	INTERPOSING CT
	CORE BALANCE CURRENT TRANSFORMER
	POTENTIAL TRANSFORMER
	POWER/DISTRIBUTION TRANSFORMER–DESCRIPTION AS NOTED (PRIMARY DELTA CONNECTED, SECONDARY STAR CONNECTED. STAR POINT SOLIDLY EARTHED)
	TRANSFORMER WITH OLTC
	INSTRUMENT, A– AMMETER, V– VOLTMETER, W– WATTMETER, KWH– KILOWATT HOUR METER, F– FREQUENCY METER, pf– POWER FACTOR METER, HM– HOUR RUN COUNTER MF – MULTI FUNCTION METER
	AS– AMMETER SELECTOR SWITCH, VS– VOLTMETER SELECTOR SWITCH
	FREQUENCY RECORDER
	VOLTAGE RECORDER
	TRI VECTOR METER
	INDICATING LIGHT R– RED, W– WHITE, B– BLUE, Y– YELLOW G– GREEN AND A– AMBER
	415V, 3 PHASE POWER/WELDING RECEPTACLE
	BUS DUCT
	BATTERY

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
6	01.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	08.11.16	UPDATED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM

Approved by

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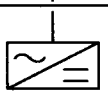
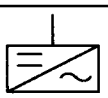
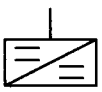
PMG	PERMANENT MAGNET GENERATOR
~ OR G	GENERATOR–DESCRIPTION AS INDICATED
M	INDUCTION MOTOR
M	SYNCHRONOUS MOTOR
	MINIATURE CIRCUIT BREAKER (MCB)
	MINIATURE CIRCUIT BREAKER WITH EARTH LEAKAGE CIRCUIT BREAKER (MCB + ELCB)
	MOULDED CASE CIRCUIT BREAKER (MCCB)
	RECTIFIER
	INVERTER
	DC – DC CONVERTER
SVR	STATIC VOLTAGE REGULATOR
AVR	AUTOMATIC VOLTAGE REGULATOR
	PUSH BUTTON STATION / LOCAL CONTROL STATION
	PUSH BUTTON STATION WITH AMMETER
	PUSH BUTTON STATION WITH INDICATING LAMP
	CAPACITOR, VARIABLE CAPACITOR

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	01.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	08.11.16	UPDATED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM

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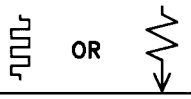
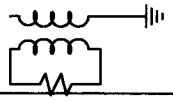
 OR	NEUTRAL GROUNDING RESISTOR
	NEUTRAL GROUNDING TRANSFORMER
	TWO WAY SELECTOR SWITCH
	THREE WAY SELECTOR SWITCH
(2)	TIME DELAY RELAY
(21)	DISTANCE PROTECTION RELAY
(25)	CHECK SYNCHRONISING RELAY
(27)	27 – UNDER VOLTAGE RELAY 27R – RESIDUAL VOLTAGE CHECK RELAY 27M – UNDER VOLTAGE RELAY (MOTOR PROTECTION) 27C – VOLTAGE HEALTHY CHECK RELAY
(32)	REVERSE POWER RELAY
(37)	LOW FORWARD POWER RELAY
(40)	LOSS OF EXCITATION RELAY
(46)	NEGATIVE PHASE SEQUENCE RELAY
(49)	THERMAL OVERLOAD RELAY
(50)	INSTANTANEOUS OVER CURRENT RELAY
(50N)	INSTANTANEOUS EARTH FAULT RELAY

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	01.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	08.11.16	UPDATED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM

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51	IDMTL OVER CURRENT RELAY
51G	STANDBY EARTH FAULT RELAY
51N	IDMTL EARTH FAULT RELAY
51V	VOLTAGE RESTRAINED IDMTL OVER CURRENT RELAY
59	OVER VOLTAGE RELAY
60	NEUTRAL DISPLACEMENT RELAY
63TX	AUX. RELAY FOR TRANSFORMER TROUBLE/TRIP
64F	ROTOR EARTH FAULT RELAY
64G 1,2	STATOR EARTH FAULT MAIN AND BACKUP RELAY
64R	RESTRICTED EARTH FAULT RELAY
67	DIRECTIONAL OVER CURRENT RELAY
67N	DIRECTIONAL EARTH FAULT RELAY
78	OUT OF STEP RELAY
80	CONTROL SUPPLY SUPERVISION RELAY
81	UNDER FREQUENCY / df/dt RELAY
86	LOCKOUT RELAY

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87CH	CHECK DIFFERENTIAL RELAY
87F	DIFFERENTIAL RELAY F– FEEDER, G– GENERATOR, T– TRANSFORMER, M– MOTOR, GT– GENERATOR+TRAFORMER COMBINED
95	TRIP CIRCUIT SUPERVISION RELAY
97	PT MONITORING RELAY
98	DEAD BUS RELAY
99	OVERFLUXING RELAY
MPR	MOTOR PROTECTION RELAY
ELR	EARTH LEAKAGE RELAY
	THERMAL OVERLOAD RELAY

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
6	01.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	08.11.16	UPDATED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM

Approved by

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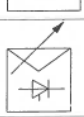
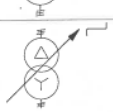
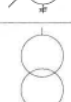
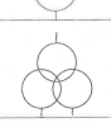
SYMBOL	DESCRIPTION	CODE/AGENCY
	A.C. MOTOR	IEC
	A.C. GENERATOR	IEC
	SYNCHRONOUS GENERATOR (GS)	IEC
	SYNCHRONOUS MOTOR (MS)	IEC
	MOTOR STARTER-GENERAL	IEC
	STARTER-NON REVERSING MOTOR	IEC
	STARTER-REVERSING MOTOR	IEC
	STAR-DELTA STARTER	IEC
	STARTER REGULATOR WITH THYRISTOR	IEC
	DIRECT ON-LINE CONTACTOR STARTER -REVERSING MOTOR	IEC
	STARTER OPERATING IN STEPS	IEC
	THREE PHASE DELTA-STAR TRANSFORMER	IEC
	THREE PHASE DELTA-STAR TRANSFORMER WITH OLTC	IEC
	TRANSFORMER WITH TWO WINDINGS	IEC
	TRANSFORMER WITH THREE WINDINGS	IEC
	VOLTAGE TRANSFORMER	IEC

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
2	05.05.2025	REAFFIRMED & ISSUED AS STANDARD	SKC	SKS	HK	MN
1	05.03.2019	REAFFIRMED & ISSUED AS STANDARD	VKS	HK	BRB	RKT
0	26.03.2014	ISSUED AS STANDARD	SL / AKH	HK / SA	BRB	SC

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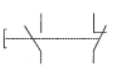
SYMBOL	DESCRIPTION	CODE/AGENCY
	CURRENT TRANSFORMER	IEC
	CURRENT TRANSFORMER, CORE BALANCE	IEC
	AUTO TRANSFORMER	IEC
	EMERGENCY STOP LOCKING TYPE	EIL
	EMERGENCY STOP NON-LOCKING TYPE	EIL
	THREE PHASE WINDING, STAR	IEC
	THREE PHASE WINDING, DELTA	IEC
	THREE PHASE WINDING, STAR WITH NEUTRAL BROUGHT OUT	IEC
	CIRCUIT BREAKER, GENERAL	IEC
	CIRCUIT BREAKER, 1 POLE	IEC
	CIRCUIT BREAKER, 3 POLE * =DENOTES TYPE ACB = AIR CIRCUIT BREAKER VCB = VACUUM CIRCUIT BREAKER MCCB = MOULDED CASE CKT. BREAKER MCB = MINIATURE CIRCUIT BREAKER SF6 = SULPHUR HEXAFLUORIDE CIRCUIT BREAKER	IEC
	DISCONNECTOR (ISOLATOR) 3 POLE	EIL
	SWITCH DISCONNECTOR, 3 POLE (ON-LOAD ISOLATING SWITCH)	EIL
	SWITCH DISCONNECTOR, 3 POLE NEUTRAL (ON-LOAD ISOLATING SWITCH)	EIL
	SWITCH DISCONNECTOR, 3 POLE NEUTRAL(FIXED) ON-LOAD ISOLATING SWITCH	EIL

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SYMBOL	DESCRIPTION	CODE/AGENCY
	FUSE, GENERAL	IEC
	MULTIPLE FUSE	EIL
	FUSE SHOWING POWER FLOW DIRECTION	IEC
	FUSE SWITCH 3 POLE	EIL
	CONTACTOR	IEC
	ARROWHEAD	EIL
	CONNECTION POINT	IEC
	TERMINAL	IEC
	CABLE TERMINATION	IEC
	PLUG AND SOCKET	IEC
	KEY INTERLOCK	IEC
	MECHANICAL INTERLOCK	EIL
	ELECTRICAL INTERLOCK	EIL
	REMOVABLE LINK	IEC
	INTEGRATING METER A1 = DENOTES TYPE Wh = WATT HOUR METER h = HOURS RUN METER Ah = AMPERE-HOUR METER	IEC

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SYMBOL	DESCRIPTION	CODE/AGENCY
	INDICATING INSTRUMENT A1 = DENOTES TYPE V = VOLTMETER A = AMMETER Hz = FREQUENCY METER cos Ø = POWER FACTOR METER Var = VAR METER Hz = FREQUENCY METER Ø = PHASE METER n = TACHOMETER	IEC
	RECORDING INSTRUMENT A1 = DENOTES TYPE W = WATT METER	IEC
	SYNCHROSCOPE	IEC
	1 PHASE/NEUTRAL/EARTH	EIL
	3 PHASE	EIL
	3 PHASE/NEUTRAL/EARTH	EIL
	DRAWOUT FEATURE	EIL
	BUSDUCT	EIL
	CENTRE BREAK DISCONNECT	EIL
	INTEGRAL EARTHING SWITCHGEAR	EIL
	ROTATING DISCONNECT CLOCKWISE EARTHING SWITCH	EIL
ASS	AMMETER SELECTOR SWITCH	EIL
VSS	VOLTMETER SELECTOR SWITCH	EIL

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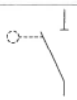
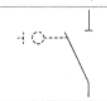
SYMBOL	DESCRIPTION	CODE/AGENCY
	OVERCURRENT PROTECTION	EIL
	THERMAL OVERCURRENT PROTECTION	EIL
	MAGNETIC OVERCURRENT PROTECTION	EIL
	UNDER VOLTAGE PROTECTION	EIL
	EARTH LEAKAGE PROTECTION BY CURRENT	EIL
	EARTH LEAKAGE PROTECTION BY VOLTAGE	EIL
	LOCKING DEVICE PADLOCK FACILITY	EIL
	MECHANICAL INTERLOCK BETWEEN TWO DEVICES	EIL
	AUTOMATIC RETURN	EIL
	OPERATED BY KEY	IEC
	OPERATED BY ELECTRIC MOTOR	IEC
	MOTOR-OPERATED VALVE	EIL
	REMOTE CONTROL UNIT WITH AMMETER CONTROLLED BY ROTARY STACK SWITCH	EIL
	REMOTE CONTROL UNIT WITHOUT AMMETER CONTROLLED BY ROTARY STACK SWITCH	EIL
	REMOTE CONTROL UNIT WITH AMMETER CONTROLLED BY PUSH BUTTON	EIL
	REMOTE CONTROL UNIT WITHOUT AMMETER CONTROLLED BY PUSH BUTTON	EIL

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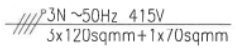
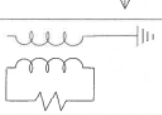
SYMBOL	DESCRIPTION	CODE/AGENCY
	CABLE SINGLE LINE REPRESENTATION	EIL
	EQUIPOTENTIALITY	EIL
	BUSBAR	EIL
	PROTECTIVE EARTH	IEC
	CHANGE-OVER CONTACT WITH CENTRE-OFF POSITION	IEC
	STATIC SWITCH PASSING CURRENT IN ONE DIRECTION	EIL
	T CONNECTION	IEC
	LIGHTENING ARRESTOR	IEC
	REACTOR	IEC
	BATTERY (PRIMARY OR SECONDARY CELLS)	IEC
	RECTIFIER	IEC
	INVERTER	IEC
	DC/DC CONVERTOR	IEC
	NEUTRAL GROUNDING RESISTOR	EIL
	NEUTRAL GROUNDING TRANSFORMER	EIL

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SYMBOL	DESCRIPTION	CODE/AGENCY
	START PUSH-BUTTON AND AUTOMATIC RETURN	IEC
	STOP PUSH-BUTTON	EIL
	MAKE CONTACT DELAYED WHEN CLOSING	IEC
	MAKE CONTACT DELAYED WHEN OPENING	IEC
	BREAK CONTACT DELAYED WHEN OPENING	IEC
	BREAK CONTACT DELAYED WHEN CLOSING	IEC
	MAKE CONTACT	IEC
	BREAK CONTACT	IEC
	CHANGE-OVER CONTACT BREAK BEFORE MAKE	IEC
	CHANGE-OVER CONTACT MAKE BEFORE BREAK	IEC
	CONTACT WITH TWO MAKES	IEC
	CONTACT WITH TWO BREAKS	IEC
	INDICATING LAMP * = DENOTES COLOUR GN = GREEN YE = YELLOW RD = RED BU = BLUE WH = WHITE	IEC
	FUSE SWITCH	IEC
	CIRCUIT BREAKER WITH AUTOMATIC RELEASE	EIL
	RELAY CONTACT MAKE WITH SPRING RETURN	EIL

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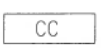
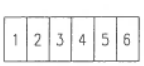
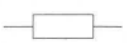
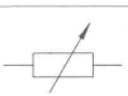
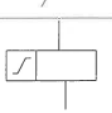
SYMBOL	DESCRIPTION	CODE/AGENCY
	DISCONNECTOR (ISOLATOR)	IEC
	SWITCH–DISCONNECTOR (ON–LOAD ISOLATING SWITCH)	IEC
	FUSE DISCONNECTOR (FUSE ISOLATOR)	IEC
	FUSE SWITCH DISCONNECTOR (ONLOAD ISOLATING FUSE SWITCH)	IEC
	ANTI–CONDENSATION HEATER	IEC
	CONTACTOR COIL	EIL
	EARTH (GROUND), GENERAL SYMBOL	IEC
	CHASSIS OR FRAME EARTH	IEC
	CLEAN EARTH (NOISELESS)	IEC
	THERMAL O/L RELAY–OPERATING DEVICE	IEC
	DIODE	IEC
	THYRISTOR	IEC
	TERMINAL STRIP	IEC
	RESISTOR, GENERAL	IEC
	ADJUSTABLE RESISTOR	IEC
	RELAY COIL OF PERMANENT RELAY	IEC

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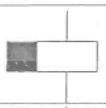
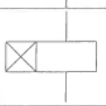
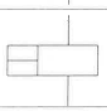
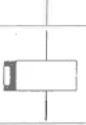
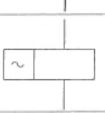
SYMBOL	DESCRIPTION	CODE/AGENCY
	RELAY COIL OF SLOW RELEASING RELAY	IEC
	RELAY COIL OF SLOW OPERATING RELAY	IEC
	RELAY COIL– SLOW OPERATING SLOW RELEASING RELAY	IEC
	RELAY COIL– HIGH SPEED RELAY (FAST OPERATING & RELEASING)	IEC
	RELAY COIL– POLARISED RELAY	IEC
	RELAY COIL OF ALTERNATING CURRENT RELAY	IEC
	CAPACITOR, GENERAL	IEC
	POLARISED CAPACITOR	IEC
	ADUSTABLE CAPACITOR	IEC
	INDUCTOR, COIL, WINDING CHOKE	IEC
	PHOTOVOLTIC CELL	IEC
	PHOTO DIODE (PHOTO CONDUCTIVE WITH ASYMMETRICAL CONDUCTIVITY)	IEC
	LIGHT DEPENDENT RESISTOR (PHOTO CONDUCTIVE DEVICE WITH SYMMETRICAL CONDUCTIVITY)	IEC
	2 POSITION SWITCH	IEC
	3 POSITION SWITCH	IEC
	4 POSITION SWITCH	IEC

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SYMBOL	DESCRIPTION	CODE/AGENCY
R1	RELAY COIL GENERAL	IEEE/NEMA
AVR	AUTOMATIC VOLTAGE REGULATOR RELAY	EIL
U=0	NO VOLTAGE RELAY	IEC
2	TIME DELAY RELAY	IEEE/NEMA
12	OVERSPEED RELAY	IEEE/NEMA
21	DISTANCE PROTECTION RELAY	IEEE/NEMA
25	CHECK SYNCHRONISING RELAY	IEEE/NEMA
27	27 – UNDER VOLTAGE RELAY 27R – RESIDUAL VOLTAGE CHECK RELAY 27M – UNDER VOLTAGE RELAY (MOTOR PROTECTION) 27H – VOLTAGE HEALTHY CHECK RELAY	IEEE/NEMA
32	REVERSE POWER / DIRECTIONAL POWER RELAY	IEEE/NEMA
37	LOW FORWARD POWER / UNDER CURRENT RELAY	IEEE/NEMA
40	LOSS OF EXCITATION RELAY	IEEE/NEMA
46	NEGATIVE PHASE SEQUENCE RELAY	IEEE/NEMA
49	THERMAL OVERLOAD RELAY	IEEE/NEMA
50	INSTANTANEOUS OVER CURRENT RELAY	IEEE/NEMA
50N	INSTANTANEOUS EARTH FAULT RELAY	IEEE/NEMA

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SYMBOL	DESCRIPTION	CODE/AGENCY
51	IDMTL OVER CURRENT RELAY	IEEE/NEMA
51G	STANDBY EARTH FAULT RELAY	IEEE/NEMA
51N	IDMTL EARTH FAULT RELAY	IEEE/NEMA
51V	VOLTAGE RESTRAINED IDMTL OVER CURRENT RELAY	IEEE/NEMA
59	OVER VOLTAGE RELAY	IEEE/NEMA
60	NEUTRAL DISPLACEMENT RELAY	IEEE/NEMA
63TX	AUX. RELAY FOR TRANSFORMER TROUBLE/TRIP	IEEE/NEMA
64F	ROTOR EARTH FAULT RELAY	IEEE/NEMA
64G 1,2	STATOR EARTH FAULT MAIN AND BACKUP RELAY	IEEE/NEMA
64R	RESTRICTED EARTH FAULT RELAY	IEEE/NEMA
67	DIRECTIONAL OVER CURRENT RELAY	IEEE/NEMA
67N	DIRECTIONAL EARTH FAULT RELAY	IEEE/NEMA
78	OUT OF STEP RELAY	IEEE/NEMA
80	CONTROL SUPPLY SUPERVISION RELAY	IEEE/NEMA
81	UNDER FREQUENCY / df/dt RELAY	IEEE/NEMA
86	LOCKOUT RELAY	IEEE/NEMA

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SYMBOL	DESCRIPTION	CODE/AGENCY
87CII	CHECK DIFFERENTIAL RELAY	IEEE/NEMA
87F	DIFFERENTIAL RELAY F–FEEDER, G–GENERATOR, T–TRANSFORMER, GT–GEN.+TRAFO.	IEEE/NEMA
95	TRIP CIRCUIT SUPERVISION RELAY	IEEE/NEMA
97	PT MONITORINC RELAY	IEEE/NEMA
98	DEAD BUS RELAY	IEEE/NEMA
99	OVERFLUXINC RELAY	IEEE/NEMA
MPR	MOTOR PROTECTION RELAY	EIL
ELR	EARTH LEAKAGE RELAY	EIL

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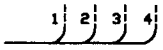
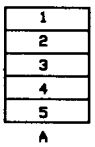
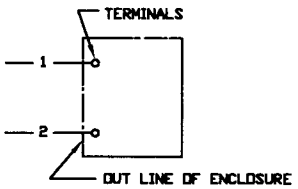
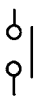
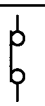
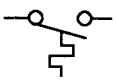
	GROUPING OF CONDUCTORS, LINE BEND INDICATES DIRECTION OF CONDUCTOR JOINING CABLE, NUMERAL INDICATES WIRE NUMBER
	TERMINAL BLOCK 'A', NUMERAL INDICATES TERMINAL NUMBER
	WIRES DESIGNATED 1 & 2 ARE CONNECTED TO TERMINALS OF AN APPARATUS
	HOOTER H – HORN S – SIREN LSP – LOUDSPEAKER
	RELAY COIL, 2 – INDICATES RELAY NUMBER
	BREAK CONTACT DELAYED BREAK
	MAKE CONTACT DELAYED MAKE
	BREAK CONTACT DELAYED MAKE
	MAKE CONTACT DELAYED BREAK
	OPEN CONTACT – THE POSITION OF THE CONTACT IN A RELAY IS SHOWN WITH COIL DE-ENERGISED
	CLOSED CONTACT – THE POSITION OF THE CONTACT IN A RELAY IS SHOWN WITH COIL DE-ENERGISED
	MOTOR, 3 PHASE
	NORMALLY OPEN
	NORMALLY CLOSED

TEMPERATURE ACTUATED SWITCH

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	01.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	08.11.16	UPDATED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM

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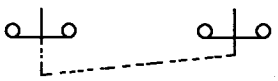
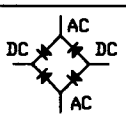
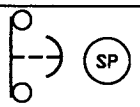
	HELD CLOSE	LIMIT SWITCH
	HELD OPEN	
	NORMALLY OPEN (OPEN ON LOW PRESSURE)	VACUUM/ PRESSURE SWITCH
	NORMALLY CLOSE (CLOSED ON LOW PRESSURE)	
	PUSH BUTTON – CLOSING, SINGLE CIRCUIT, MOMENTARY OR SPRING RETURN	
	PUSH BUTTON – OPENING, SINGLE CIRCUIT, MOMENTARY OR SPRING RETURN	
	PUSH BUTTON, TWO CIRCUIT, MOMENTARY OR SPRING RETURN	
	PUSH BUTTON, TWO CIRCUIT, MAINTAINED OR NON–SPRING RETURN	
	SEMICONDUCTOR DIODE	
	SILICON CONTROL RECTIFIER	
	FULL WAVE RECTIFIER	
	FUSE	
	EMERGENCY STOP (MUSHROOM HEAD)	
	STAY PUT EMERGENCY STOP (MUSHROOM HEAD) PUSH BUTTON WITH RESETTING FEATURE	
	EARTH CONNECTION	

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5	08.11.16	UPDATED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM

Approved by

Page 3833 of 4087 : B895-TENDER_DOC-B895-999-85-41-EP-T-9802 : Rev. A
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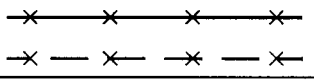
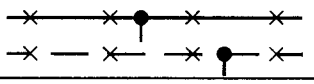
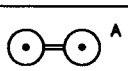
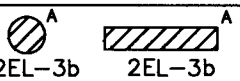
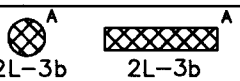
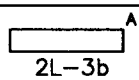
	EARTH CONDUCTOR–EXPOSED EARTH CONDUCTOR–BURIED SIZE AS SHOWN OR SPECIFIED ON PLANS
	EARTH STRIP / WIRE TAP, SIZE AS SHOWN OR SPECIFIED ON PLANS
	EARTH ELECTRODE IN TEST PIT
	DIRECTLY BURIED EARTH ELECTRODE
	EARTH PLATE
	LIGHTNING ARRESTOR
	POLE MOUNTED LIGHTING FIXTURE (IN ELEVATION)
	LIGHTING FIXTURE (IN ELEVATION)
A 2L–3b	CEILING MOUNTED LIGHTING FIXTURE
A 2L–3b	BRACKET MOUNTED LIGHTING FIXTURE
A 2L–3b	POLE MOUNTED LIGHTING FIXTURE
A 2L–3b	POLE MOUNTED STREET LIGHTING FIXTURE
A 2L–3b	POLE MOUNTED FLOOD LIGHTING FIXTURE
 A	DOUBLE OBSTRUCTION AVIATION LIGHTING FIXTURE
 A A 2EL–3b 2EL–3b	EMERGENCY LIGHTING FIXTURE
 A A 2L–3b 2L–3b	CRITICAL LIGHTING FIXTURE
 A 2L–3b	FLUORESCENT FIXTURE
	A – FIXTURE TYPE (AS PER DATASHEET FOR LIGHTING FIXTURE SCHEDULE) 2L – LIGHTING PANEL NO. 2, 3 – CIRCUIT NO., b – CONTROLLING SIWTCH
LP–2L 	LP – LIGHTING PANEL 2L – LIGHTING PANEL NO.
PP–2P 	PP – POWER PANEL 2P – POWER PANEL NO.
ELP–2L 	ELP – EMERGENCY LIGHTING PANEL 2EL – EMERGENCY LIGHTING PANEL NO.

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4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM

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MDB–501	MDB – MAIN DISTRIBUTION BOARD MDB–501 – MAIN DISTRIBUTION BOARD NO.
FLM–1	FLOOD LIGHT MAST–LATTICE STRUCTURE FLM–1 – FLOOD LIGHT MAST NO.
HM–1	HM – HIGH MAST HM–1 – HIGH MAST NO.
2e	5A, 240V SINGLE POLE SWITCH 2 – CIRCUIT NO., e – SWITCH NUMBER
	5A, 240V DOUBLE POLE SWITCH
	5A, 240V SINGLE POLE 2 WAY SWITCH
	15A, 240V SINGLE POLE SWITCH
	20A, DP MCB UNIT FOR WINDOW TYPE AC
	CEILING FAN
	AIR CIRCULATOR
	EXHAUST FAN
	5A, 240V, 3/5 PIN SOCKET/RECEPTACLE
	15/5A, 240V, 6 PIN SOCKET/RECEPTACLE
	10A, 240V, 3 PIN INDUSTRIAL TYPE SOCKET/RECEPTACLE
	20A, 240V, 3 PIN INDUSTRIAL TYPE SOCKET/RECEPTACLE
	5A, 24V, 3 PIN SOCKET/RECEPTALE
	15A, 240V, 3 PIN SOCKET /RECEPTACLE
	415V, 3 PHASE POWER/WELDING RECEPTACLE
	PUSH BUTTON STATION
	LIGHTING JUNCTION BOX (3WAY)
	LIGHTING JUNCTION BOX (4WAY)

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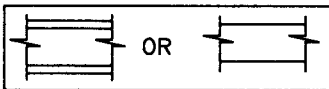
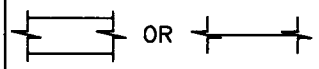
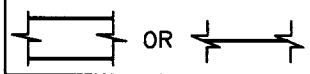
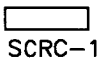
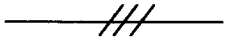
 OR	LINED (RCC) CABLE TRENCH
 OR	DIRECTLY BURIED CABLE TRENCH
 OR	CABLE TRAY
ERC–1	ERC – ELECTRICAL ROAD CROSSING ERC–1 – ELECTRICAL ROAD CROSSING NO.
 SCRC–1	SCRC – STREET LIGHTING AND COMMUNICATION/FIRE ALARM CABLES ROAD CROSSING SCRC–1 – STREET LIGHTING AND COMMUNICATION/FIRE ALARM CABLES ROAD CROSSING NO.
	CONDUIT / CABLE RUN EXPOSED
	CONDUIT / CABLE RUN CONCEALED OR EMBEDDED
	CONDUIT / CABLE BEND UP
	CONDUIT / CABLE BEND–DOWN
	CONDUIT RUN, NUMBER OF OBLIQUE LINES INDICATING NUMBER OF WIRES
	HOME RUN OF CIRCUIT TO PANEL/DISTRIBUTION BOX/JUNCTION BOX
LS	LIMIT SWITCH
VS	VIBRATION SWITCH
FC	MULTISENSOR FIRE ALARM DETECTOR FC – FALSE CEILING, TC – TRUE CEILING, FF – FALSE FLOORING
R	RESPONSE INDICATOR
BG	MANUAL BREAK GLASS UNIT
H	HOOTER H – HORN LSP – LOUDSPEAKER S – SIREN
FAJB	JUNCTION BOX FAJB – FIRE ALARM JUNCTION BOX TJB – TELEPHONE JUNCTION BOX PAJB – PLANT COMMUNICATION JUNCTION BOX
EXIT	EXIT SIGN
	END OF LINE RESISTANCE
	TELEPHONE

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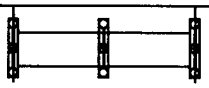
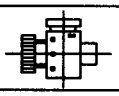
	2 PIN SOCKET FOR TELEPHONE
	CIRCUIT BREAKER (SWITCHYARD)
	ISOLATOR (SWITCHYARD)
	GANTRY (SWITCHYARD)
	TRANSFORMER (SWITCHYARD)
	POTENTIAL TRANSFORMER (SWITCHYARD)
	CURRENT TRANSFORMER (SWITCHYARD)
	LIGHTNING ARRESTOR (SWITCHYARD)

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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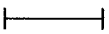
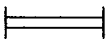
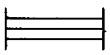
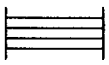
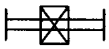
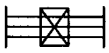
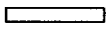
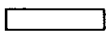
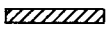
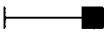
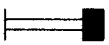
SYMBOL	DESCRIPTION	AUTHOR
	SURFACE MOUNTED 1x18/36W FLUORESCENT LIGHTING FIXTURE	IEC
	SURFACE MOUNTED 2x18/36W FLUORESCENT LIGHTING FIXTURE	IEC
	SURFACE MOUNTED 3x18/36W FLUORESCENT LIGHTING FIXTURE	IEC
	SURFACE MOUNTED 4x18/36W FLUORESCENT LIGHTING FIXTURE	IEC
	SURFACE MOUNTED 1x18/36W FLUORESCENT EMERGENCY LIGHTING FIXTURE	EIL
	SURFACE MOUNTED 2x18/36W FLUORESCENT EMERGENCY LIGHTING FIXTURE	EIL
	SURFACE MOUNTED 3x18/36W FLUORESCENT EMERGENCY LIGHTING FIXTURE	EIL
	SURFACE MOUNTED 4x18/36W FLUORESCENT EMERGENCY LIGHTING FIXTURE	EIL
	RECESS MOUNTED 1x18/36W FLUORESCENT LIGHTING FIXTURE	EIL
	RECESS MOUNTED 2x18/36W FLUORESCENT LIGHTING FIXTURE	EIL
	RECESS MOUNTED 3/4x18W FLUORESCENT LIGHTING FIXTURE	EIL
	RECESS MOUNTED 1x18/36W FLUORESCENT EMERGENCY LIGHTING FIXTURE	EIL
	RECESS MOUNTED 2x18/36W FLUORESCENT EMERGENCY LIGHTING FIXTURE	EIL
	RECESS MOUNTED 3/4x18W FLUORESCENT EMERGENCY LIGHTING FIXTURE	EIL
	SURFACE MOUNTED 1x18/36W FLUORESCENT EMERGENCY LIGHTING FIXTURE WITH BATTERY BACKUP	EIL
	SURFACE MOUNTED 2x18/36W FLUORESCENT EMERGENCY LIGHTING FIXTURE WITH BATTERY BACKUP	EIL

Rev No	Date	Purpose	Prepared by	Checked by	Stds Committee Convenor	Stds Bureau Chairman
					Approved by	
1	23 08 2019	REAFFIRMED & ISSUED AS STANDARD	BP	AR	SA	RKT
0	28 01 2015	ISSUED AS STANDARD	BP	FA / AK	BRB	SC

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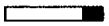
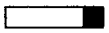
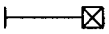
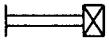
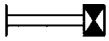
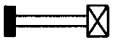
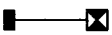
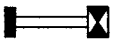
SYMBOL	DESCRIPTION	AUTHOR
	RECESS MOUNTED 1x18/36W FLUORESCENT EMERGENCY LIGHTING FIXTURE WITH BATTERY BACKUP	EIL
	RECESS MOUNTED 2x18/36W FLUORESCENT EMERGENCY LIGHTING FIXTURE WITH BATTERY BACKUP	EIL
	NON SPARKING 1x18/36W FLUORESCENT LIGHTING FIXTURE	EIL
	NON SPARKING 2x18/36W FLUORESCENT LIGHTING FIXTURE	EIL
	NON SPARKING 1x18/36W FLUORESCENT EMERGENCY LIGHTING FIXTURE	EIL
	NON SPARKING 2x18/36W FLUORESCENT EMERGENCY LIGHTING FIXTURE	EIL
	FLAME PROOF 1x18/36W FLUORESCENT LIGHTING FIXTURE	EIL
	FLAME PROOF 2x18/36W FLUORESCENT LIGHTING FIXTURE	EIL
	FLAME PROOF 1x18/36W FLUORESCENT EMERGENCY LIGHTING FIXTURE	EIL
	FLAME PROOF 2x18/36W FLUORESCENT EMERGENCY LIGHTING FIXTURE	EIL
	125W HPMV/150W METAL HALIDE LIGHTING FIXTURE SUITABLE FOR SAFE AREA	EIL
	250W HPMV/METAL HALIDE LIGHTING FIXTURE SUITABLE FOR SAFE AREA	EIL
	400W HPMV/METAL HALIDE LIGHTING FIXTURE SUITABLE FOR SAFE AREA	EIL
	125W HPMV/150W METAL HALIDE EMERGENCY LIGHTING FIXTURE SUITABLE FOR SAFE AREA	EIL
	250W HPMV/METAL HALIDE LAMP EMERGENCY LIGHTING FIXTURE SUITABLE FOR SAFE AREA	EIL
	400W HPMV/METAL HALIDE LAMP EMERGENCY LIGHTING FIXTURE SUITABLE FOR SAFE AREA	EIL

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SYMBOL	DESCRIPTION	AUTHOR
	NON SPARKING (Exn'R') TYPE 125W HPMV/150W METAL HALIDE LIGHTING FIXTURE	EIL
	NON SPARKING (Exn'R') TYPE 250W HPMV/METAL HALIDE LIGHTING FIXTURE	EIL
	NON SPARKING (Exn'R') TYPE 400W HPMV/METAL HALIDE LIGHTING FIXTURE	EIL
	NON SPARKING (Exn'R') TYPE 125W HPMV/150W METAL HALIDE EMERGENCY LIGHTING FIXTURE	EIL
	NON SPARKING (Exn'R') TYPE 250W HPMV/METAL HALIDE EMERGENCY LIGHTING FIXTURE	EIL
	NON SPARKING (Exn'R') TYPE 400W HPMV/METAL HALIDE EMERGENCY LIGHTING FIXTURE	EIL
	FLAME PROOF (Exd) TYPE 125W HPMV/150W METAL HALIDE LIGHTING FIXTURE SUITABLE FOR IIA/IIB AREA	EIL
	FLAME PROOF (Exd) TYPE 250W HPMV/METAL HALIDE LIGHTING FIXTURE SUITABLE FOR IIA/IIB AREA	EIL
	FLAME PROOF (Exd) TYPE 400W HPMV/METAL HALIDE LIGHTING FIXTURE SUITABLE FOR IIA/IIB AREA	EIL
	FLAME PROOF (Exd) TYPE 125W HPMV/150W METAL HALIDE EMERGENCY LIGHTING FIXTURE SUITABLE FOR IIA/IIB AREA	EIL
	FLAME PROOF (Exd) TYPE 250W HPMV/METAL HALIDE EMERGENCY LIGHTING FIXTURE SUITABLE FOR IIA/IIB AREA	EIL
	FLAME PROOF (Exd) TYPE 400W HPMV/METAL HALIDE EMERGENCY LIGHTING FIXTURE SUITABLE FOR IIA/IIB AREA	EIL
IIC	FLAME PROOF (Exd) TYPE 125W HPMV/150W METAL HALIDE LIGHTING FIXTURE SUITABLE FOR IIC AREA	EIL
IIC	FLAME PROOF (Exd) TYPE 250W HPMV/METAL HALIDE LIGHTING FIXTURE SUITABLE FOR IIC AREA	EIL
IIC	FLAME PROOF (Exd) TYPE 400W HPMV/METAL HALIDE LIGHTING FIXTURE SUITABLE FOR IIC AREA	EIL
IIC	FLAME PROOF (Exd) TYPE 125W HPMV/150W METAL HALIDE EMERGENCY LIGHTING FIXTURE SUITABLE FOR IIC AREA	EIL

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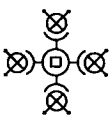
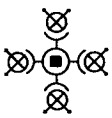
SYMBOL	DESCRIPTION	AUTHOR
IIC	FLAME PROOF (Exd) TYPE 250W HPMV/METAL HALIDE EMERGENCY LIGHTING FIXTURE SUITABLE FOR IIC AREA	EIL
IIC	FLAME PROOF (Exd) TYPE 400W HPMV/METAL HALIDE EMERGENCY LIGHTING FIXTURE SUITABLE FOR IIC AREA	EIL
	200W GLS LAMP EMERGENCY LIGHTING FIXTURE SUITABLE FOR SAFE AREA	EIL
	FLAME PROOF(Exd) TYPE 200W GLS LAMP EMERGENCY LIGHTING FIXTURE SUITABLE FOR IIA/IIB AREA	EIL
IIC	FLAME PROOF (Exd) TYPE 200W GLS LAMP EMERGENCY LIGHTING FIXTURE SUITABLE FOR IIC AREA	EIL
	BULKHEAD LIGHTING FIXTURE	EIL
	DECORATIVE LUMINAIRE	EIL
	NAVIGATION LIGHT	IEC
	20M HIGH MAST (NO. OF FLOOD LIGHTS AS PER LAYOUT)	EIL
	30M HIGH MAST (NO. OF FLOOD LIGHTS AS PER LAYOUT)	EIL
	PUSH BUTTON STATION (LOCAL CONTROL STATION)	EIL
	EMERGENCY STOP PUSH BUTTON STATION	EIL
	63A, 415V WELDING SOCKET	EIL
	63A, 415V FLAME PROOF WELDING SOCKET	EIL
	3 NOS., 5A SOCKET W1TH 1 NO. 15A SWITCH	EIL

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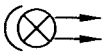
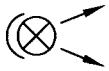
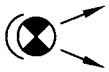
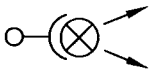
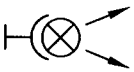
SYMBOL	DESCRIPTION	AUTHOR
	SPOT LIGHT	IEC
	FLOOD LIGHT FIXTURE	IEC
	FLOOD LIGHT FIXTURE SUITABLE FOR ZONE–1	EIL
	FLOOD LIGHT FIXTURE POLE MOUNTED	EIL
	FLOOD LIGHT FIXTURE WALL MOUNTED	EIL
	STREET LIGHTING FIXTURE POLE MOUNTED	EIL
	STREET LIGHTING FIXTURE WALL MOUNTED	EIL
	GROUND MOUNTED POLE LIGHTING FIXTURE	EIL
	LIGHTING FIXTURE IN ELEVATION	EIL
	POLE MOUNTED LIGHTING FIXTURE IN ELEVATION	EIL
	SURFACE MOUNTED CRITICAL LIGHTING FIXTURE	EIL
	RECESS MOUNTED CRITICAL LIGHTING FIXTURE	EIL
CFL–1	SURFACE MOUNTED CFL LIGHTING FIXTURE 1 – TYPE OF CFL LIGHTING FIXTURE	EIL
CFL–1	RECESS MOUNTED CFL LIGHTING FIXTURE 1 – TYPE OF CFL LIGHTING FIXTURE	EIL
LED–1	SURFACE MOUNTED LED LIGHTING FIXTURE 1 – TYPE OF LED LIGHTING FIXTURE	EIL
LED–1	RECESS MOUNTED LED LIGHTING FIXTURE 1 – TYPE OF LED LIGHTING FIXTURE	EIL

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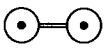
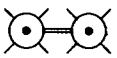
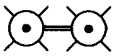
	DOUBLE OBSTRUCTION AVIATION LIGHTING FIXTURE SUITABLE FOR SAFE AREA	EIL
	DOUBLE OBSTRUCTION AVIATION LIGHTING FIXTURE SUITABLE FOR FLP IIA/IIB AREA	EIL
 IIC	DOUBLE OBSTRUCTION AVIATION LIGHTING FIXTURE SUITABLE FOR FLP IIC ARAE	EIL
	LIGHTING PANEL	EIL
	POWER PANEL	EIL
	EMERGENCY LIGHTING PANEL	EIL
MDB	MAIN DISTRIBUTION BOARD	EIL
FP	FEEDER PILLAR	EIL
	CEILING FAN	EIL
	AIR CIRCULATOR	EIL
	EXHAUST FAN	EIL
	5A SINGLE POLE SWITCH	IEC
	15A SINGLE POLE SWITCH	IEC
	5A TWO POLE SWITCH	IEC
	5A SINGLE POLE PULL CORD SWITCH	IEC
	5A TWO WAY SINGLE POLE SWITCH	IEC

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SYMBOL	DESCRIPTION	AUTHOR
	3 WAY JUNCTION BOX	EIL
	4 WAY JUNCTION BOX	EIL
	SOCKET OUTLET	IEC
	5A, 240V, 3 PIN SWITCHED SOCKET OUTLET / RECEPTACLE	EIL
	15A, 240V, 3 PIN SWITCHED SOCKET OUTLET / RECEPTACLE	EIL
	15/5A, 240V, 6 PIN SWITCHED SOCKET OUTLET / RECEPTACLE	EIL
	5A, 110V, 3PIN SWITCHED SOCKET OUTLET / RECEPTACLE	EIL
	15A, 24V, 3PIN SWITCHED SOCKET OUTLET / RECEPTACLE	EIL
	10A, 240V DP+E WITH MCB INDUSTRIAL TYPE FLAME PROOF SOCKET OUTLET / RECEPTACLE	EIL
	20A, 240V DP+E WITH MCB INDUSTRIAL TYPE FLAME PROOF SOCKET OUTLET / RECEPTACLE	EIL
	10A, 240V INDUSTRIAL TYPE SWITCHED SOCKET	EIL
	20A, 240V INDUSTRIAL TYPE SWITCHED SOCKET	EIL
	TV SOCKET OUTLET	EIL
	32A, DP MCB UNIT FOR WINDOW TYPE AC	EIL
	MOTOR OPERATED VALVE	EIL

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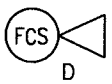
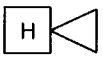
SYMBOL	DESCRIPTION	AUTHOR
	ADDRESSABLE DETECTOR TRUE CEILING (ABOVE FALSE CEILING) M – MULTI–SENSOR DETECTOR P – PHOTO ELECTRIC DETECTOR H – HEAT DETECTOR	EIL
	ADDRESSABLE DETECTOR BELOW FALSE CEILING M – MULTI–SENSOR DETECTOR P – PHOTO ELECTRIC DETECTOR H – HEAT DETECTOR	EIL
	ADDRESSABLE DETECTOR UNDER FALSE FLOORING M – MULTI–SENSOR DETECTOR P – PHOTO ELECTRIC DETECTOR H – HEAT DETECTOR	EIL
	MCS – MASTER CONTROL STATION (DESK TOP) OCS – OPERATOR CONTROL STATION (DESK TOP)	EIL
	FCS – FIELD CALL STATION WITH BUILT–IN MICROPHONE WITH EXTERNAL LOUD SPEAKER D – DESK TYPE W – WALL MOUNTED TYPE	EIL
	FIRE ALARM BREAK GLASS UNIT (MANUALLY OPERATED)	IEC
	FAJB – FIRE ALARM JUNCTION BOX	EIL
	CRM – CONTROL RELAY MODULE FIM – FAULT ISOLATOR MODULE	EIL
	EXIT SIGN W – WALL MOUNTED TYPE ONE FACED C – CEILING MOUNTED TYPE DOUBLE FACED	EIL
	H – ELECTRIC HOOTER	EIL
	HAB – HOOTER ACKNOWLEDGEMENT BOX	EIL
	R – RESPONSE INDICATOR	EIL

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SYMBOL	DESCRIPTION	AUTHOR
	HORN	IEC
	LOUD SPEAKER	IEC
	SIREN	IEC
	BELL	IEC
	BUZZER	IEC
	MASTER CLOCK	IEC
	CLOCK	IEC
	TELEPHONE SET GENERAL SYMBOL	IEC
	TELEPHONE SET WITH COMMON BATTERY	IEC
	TELEPHONE SET WITH LOUD SPEAKER	IEC
	TELEPHONE SET WITH PUSH BUTTON DIALING	IEC
PAJB	TJB – TELEPHONE JUNCTION BOX PAJB – PLANT COMMUNICATION JUNCTION BOX DCJB – DC JUNCTION BOX	EIL
LAN	LAN – LOCAL AREA NETWORK SOCKET TEL – TELEPHONE SOCKET Wi Fi – Wi Fi SOCKET	EIL
ES	ES – ETHERNET SWITCH	EIL
	TWO PIN SOCKET FOR TELEPHONE	EIL

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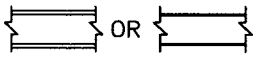
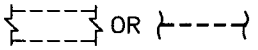
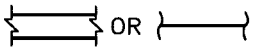
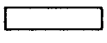
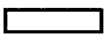
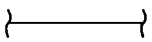
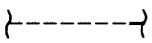
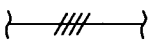
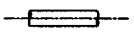
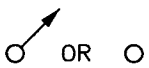
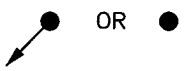
	LINED (RCC) CABLE TRENCH	EIL
	DIRECTLY BURIED CABLE TRENCH	EIL
	CABLE TREAY	EIL
	ELECTRICAL ROAD CROSSING	EIL
	STREET LIGHTING AND COMMUNICATION/FIRE ALARM CABLE ROAD CROSSING	EIL
	BOX CULVERT (ELECTRICAL ROAD CROSSING)	EIL
	CONDUIT / CABLE RUN EXPOSED	EIL
	CONDUIT RUN CONCEALED OR EMBEDDED	EIL
	CONDUIT RUN (EXPOSED OR CONCEALED) NO. OF OBLIQUE LINES INDICATES NUMBER OF WIRES	EIL
	HOME RUN OF CIRCUIT TO PANEL/DISTRIBUTION BOX/JUNCTION BOX	EIL
	PIPE SLEEVE	EIL
	CABLE RISES UP	EIL
	CABLE DROPS DOWN	EIL
	HEATER	EIL
	CONTACTOR	EIL
	ISOLATOR	EIL

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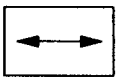
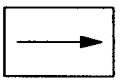
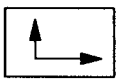
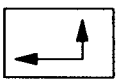
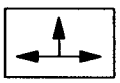
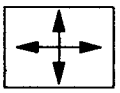
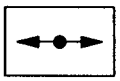
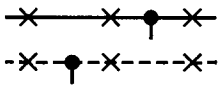
SYMBOL	DESCRIPTION	AUTHOR
	CABLE ROUTE MARKER BOTH WAYS	EIL
	CABLE ROUTE MARKER STRAIGHT	EIL
	CABLE ROUTE MARKER RIGHT ANGLE TYPE 'A'	EIL
	CABLE ROUTE MARKER RIGHT ANGLE TYPE 'B'	EIL
	CABLE ROUTE MARKER TEE	EIL
	CABLE ROUTE MARKER CROSS OVER	EIL
	CABLE JOINT MARKER	EIL
	EARTH STRIP / CONDUCTOR EXPOSED	EIL
	EARTH STRIP / CONDUCTOR BURIED	EIL
	EARTH STRIP / CONDUCTOR TAPPING	EIL
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	75x10 MM EARTH STRIP / CONDUCTOR BURIED	EIL
	EARTH ELECTRODE IN TEST PIT	EIL
	EARTH ELECTRODE WITHOUT TEST PIT	EIL
	EARTH PLATE	EIL

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1	23 08 2019	REAFFIRMED & ISSUED AS STANDARD	BP	AR	SA	RKT
0	28 01 2015	ISSUED AS STANDARD	BP	FA / AK	BRB	SC

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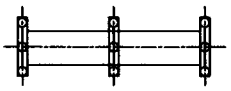
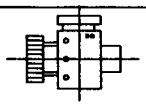
SYMBOL	DESCRIPTION	AUTHOR
	CIRCUIT BREAKER (SWITCH YARD)	EIL
	ISOLATOR (SWITCH YARD)	EIL
	GANTRY (SWITCH YARD)	EIL
	TRANSFORMER	EIL
	POTENTIAL TRANSFORMER (SWITCH YARD)	EIL
	CURRENT TRANSFORMER (SWITCH YARD)	EIL
	LIGHTNING ARRESTOR (SWITCH YARD)	EIL

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					Approved by	
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0	28 01 2015	ISSUED AS STANDARD	BP	FA / AK	BRB	SC

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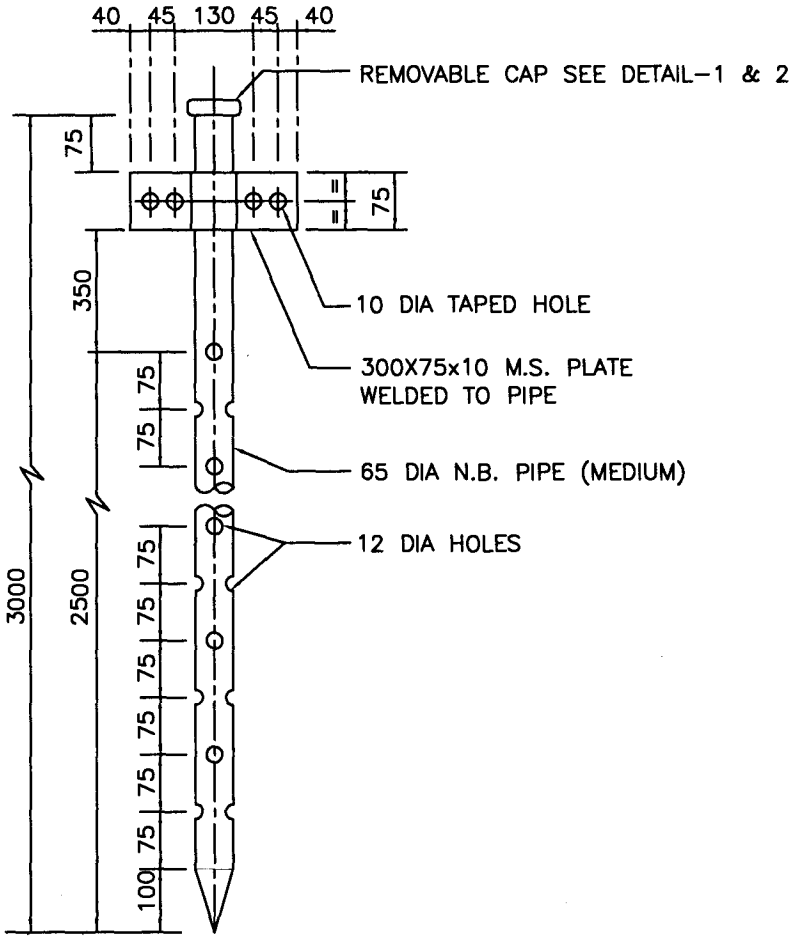
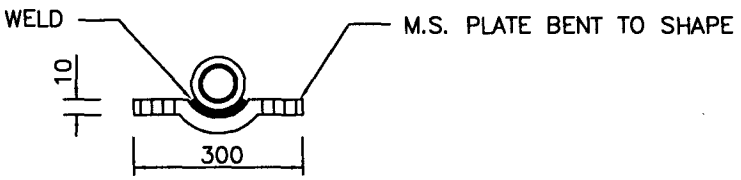
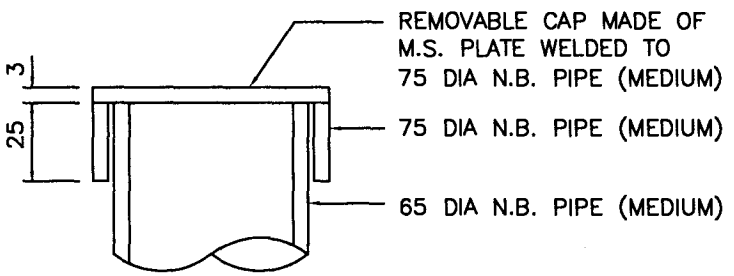
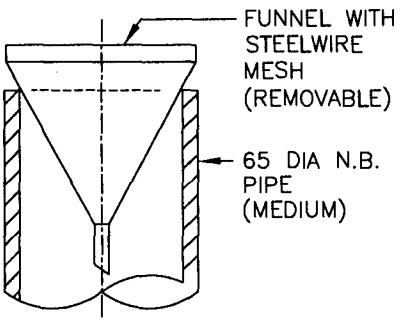






DETAIL-1



DETAIL-2

NOTE:-

1. THE PIPE ASSEMBLY SHALL BE HOT DIP GALVANISED AFTER FABRICATION. AMOUNT OF GALVANISING SHALL BE 150 MICRONS (MIN.) AS PER IS:3043.

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4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM

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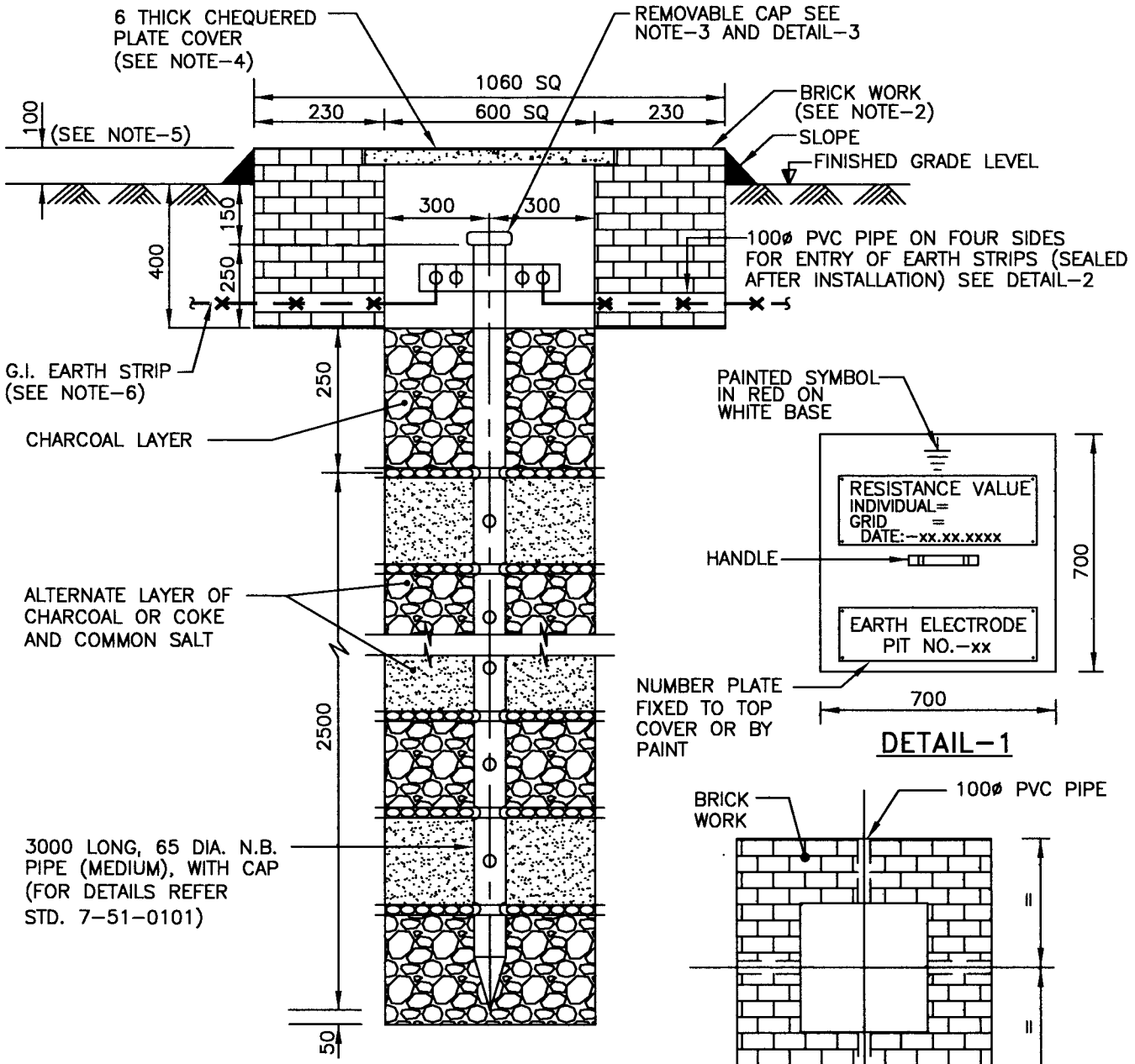
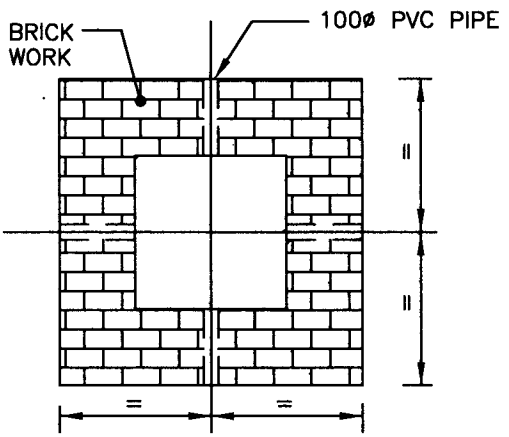
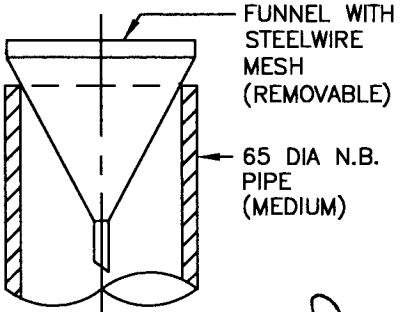


DETAIL-1



DETAIL-2



DETAIL-3

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. BRICK WORK SHALL BE DONE AFTER COMPACTING THE SOIL IN UNPAVED AREA.
3. AFTER REMOVAL OF CAP, OWNER SHALL BE ABLE TO POUR WATER THROUGH HIS OWN FUNNEL WITH STEEL WIRE MESH.
4. COLOUR CODING & PAINTING OF COVERS SHALL BE AS PER PAINTING SPEC. NO. 6-79-0020.
5. IN CASE OF PAVED AREAS, TOP OF PIT SHALL BE FLUSHED WITH FFL, WHEREAS IN UNPAVED AREAS, TOP OF PIT SHALL BE PROJECTED 100MM ABOVE FGL.
6. CONNECTIONS OF G.I. EARTH STRIP TO THE PLATE SHALL BE IN LINE WITH STD. 7-51-0103.

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6	08.11.16	UPDATED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN

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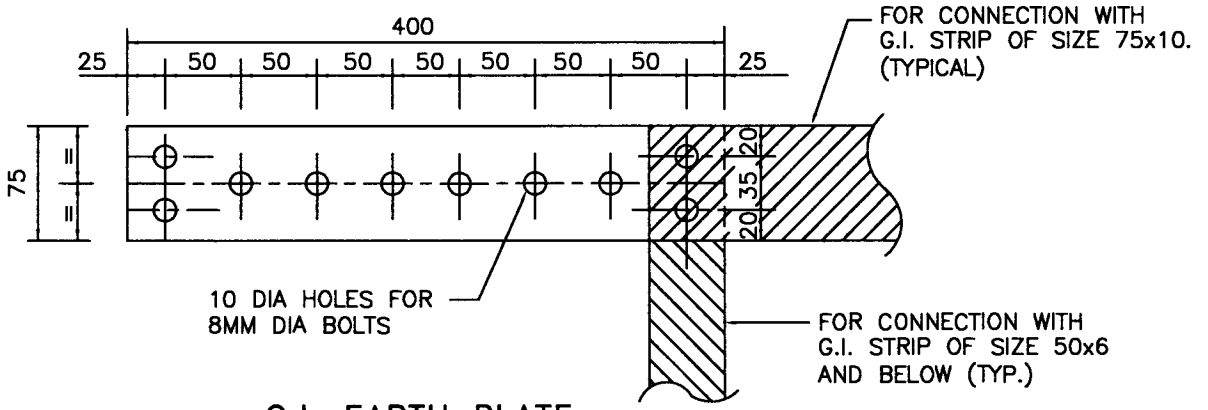
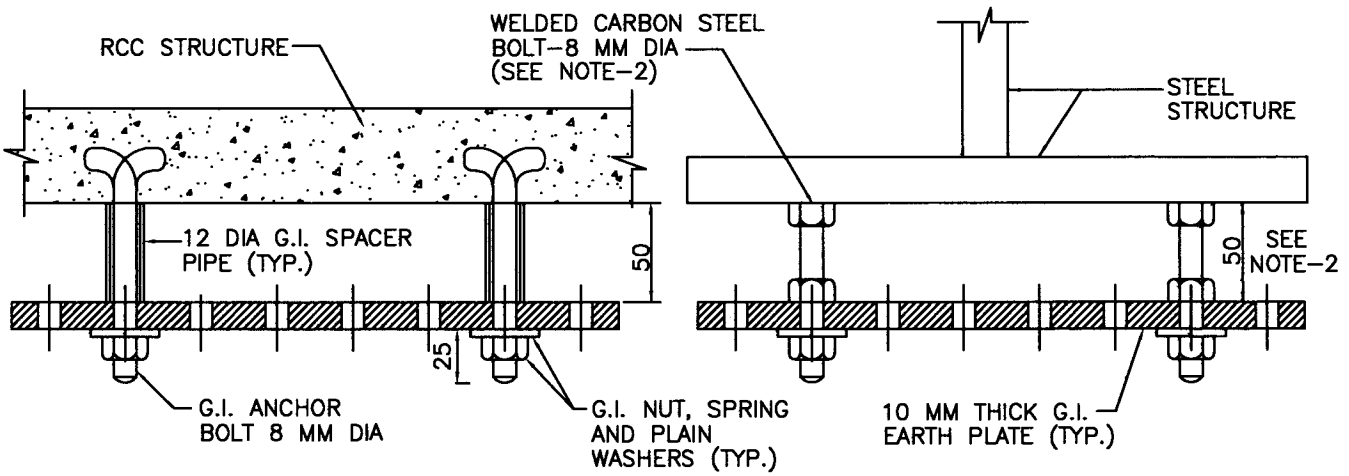
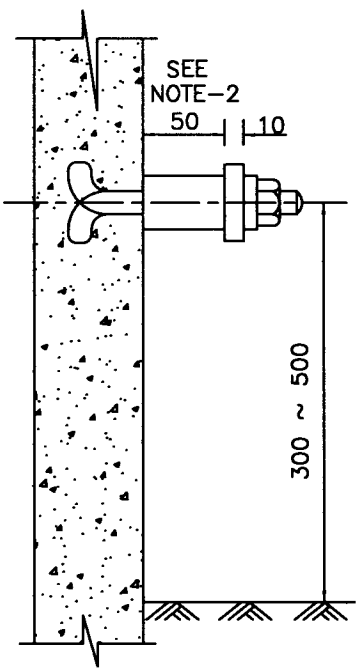
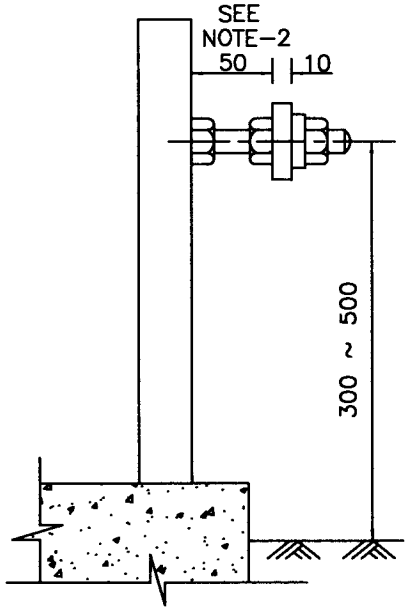


G.I. EARTH PLATE

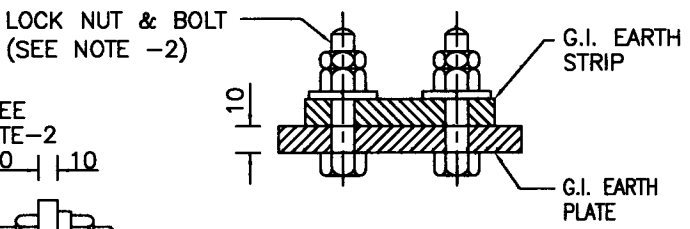




TYPICAL INSTALLATION OF EARTH PLATE ON R.C.C. STRUCTURES



TYPICAL INSTALLATION OF EARTH PLATE ON STEEL STRUCTURES



TYPICAL FIXING DETAIL OF G.I. EARTH STRIP TO EARTH PLATE

NOTES:–

1. ALL DIMENSIONS ARE IN MM.
2. WHERE FIRE PROOFING OF STEEL STRUCTURES ARE ENCOUNTERED LENGTH OF CARBON STEEL BOLTS SHALL BE SUITABLY INCREASED FOR FIXING OF EARTH PLATE.
3. ALL CONNECTIONS WITH EARTH PLATE SHALL BE MADE WITH 8MM DIA. G.I. BOLT, NUT, SPRING AND PLAIN WASHERS.
4. CRIMP TYPE CABLE LUGS SHALL BE USED FOR CONNECTION WITH G.I. WIRE ROPE/CU/AL CABLES.

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7	01.11.21	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
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5	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM

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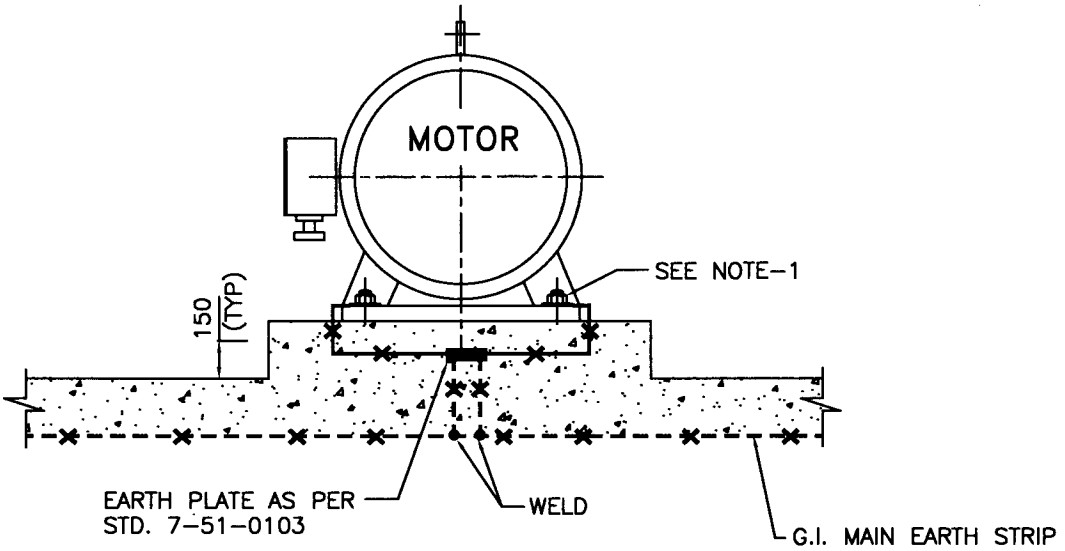
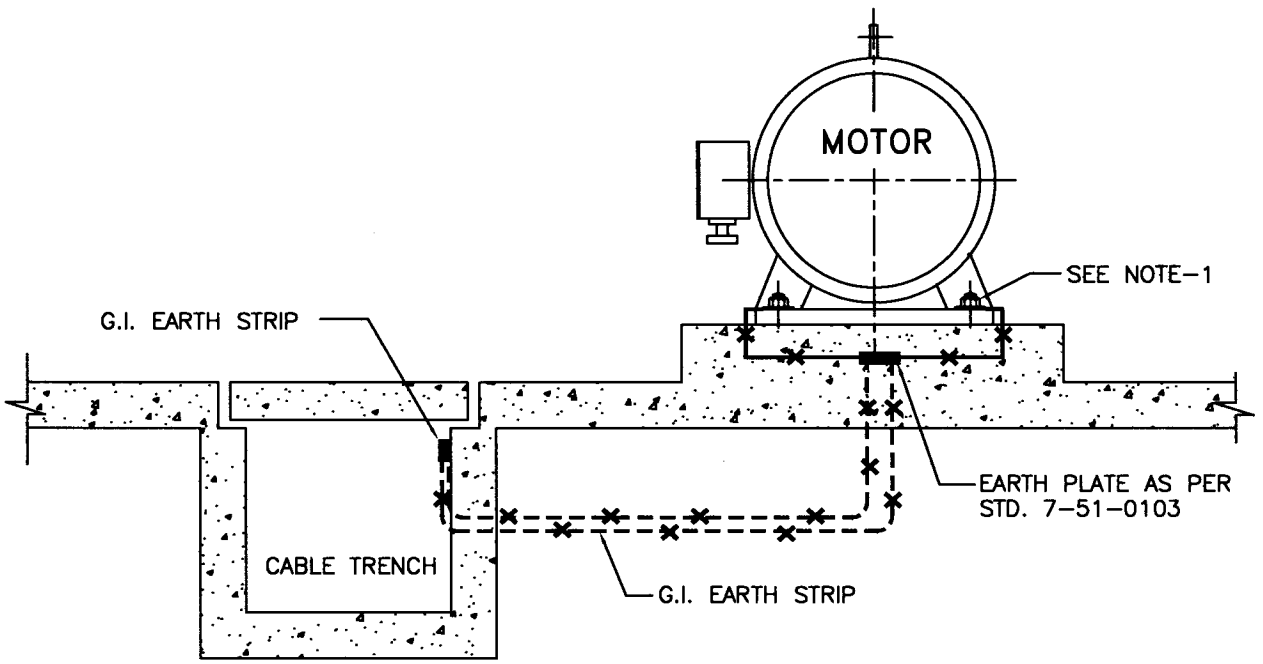


DETAIL-1
CONNECTION WITH BURIED EARTH GRID



DETAIL-2
CONNECTION WITH EARTH GRID IN RCC TRENCH

NOTE:-

1. MOTOR FOUNDATION BOLT SHALL NOT BE USED FOR EARTHING.
2. EARTHING OF P.B. STN. INSTALLED NEAR MOTOR FOUNDATION SHALL BE DONE BY TAPPING 8 SWG G.I. WIRE FROM EARTH PLATE.

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6	01.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
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4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM

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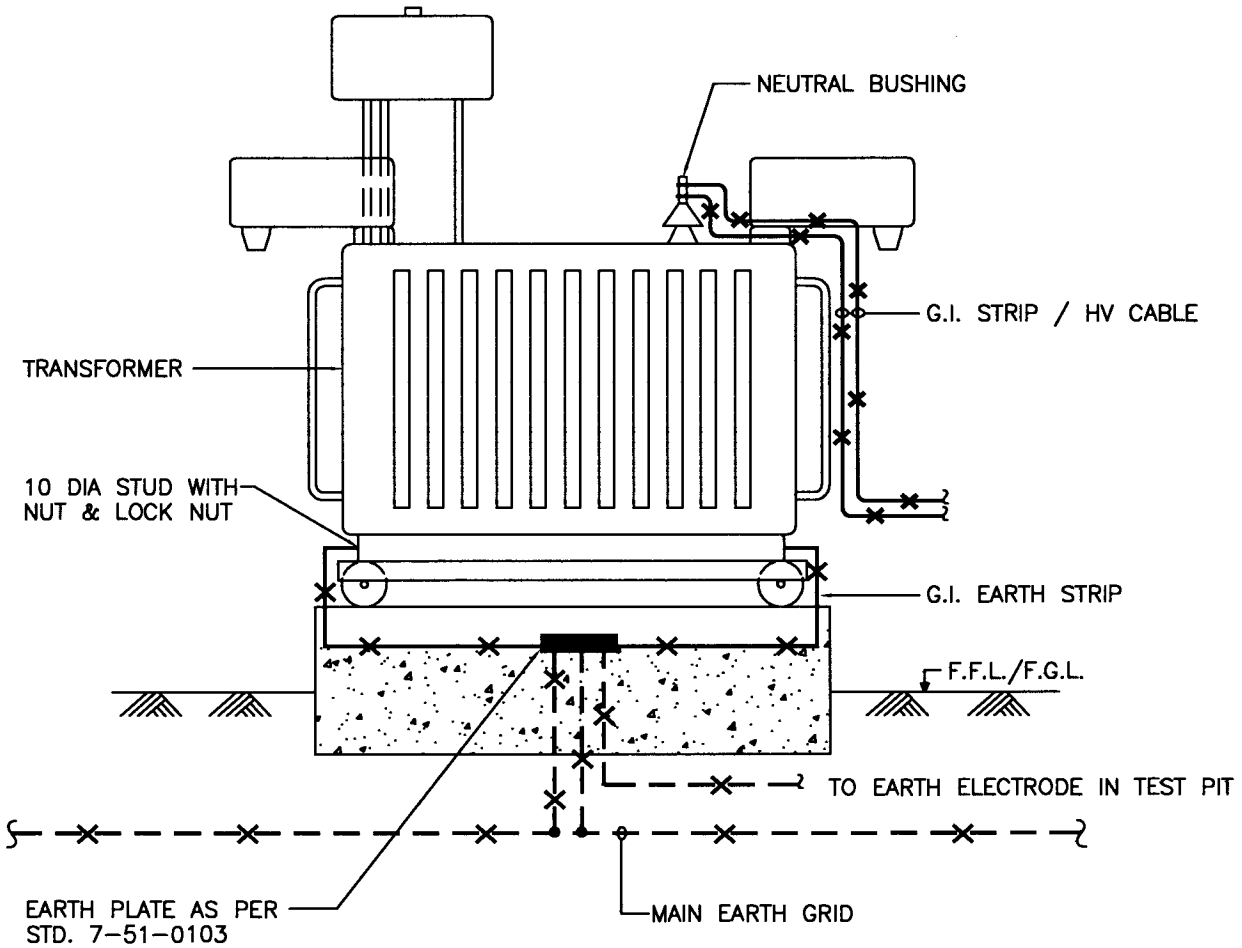
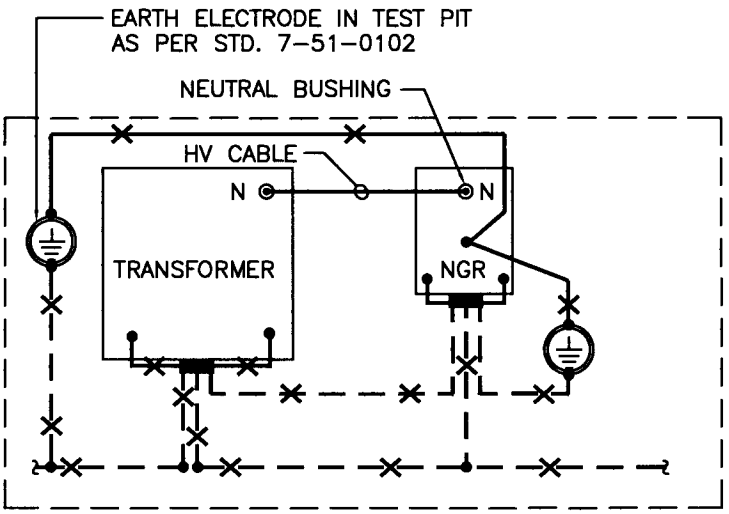
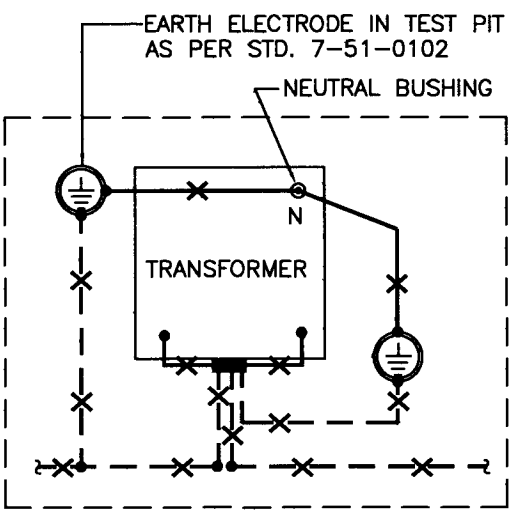




LINE DIAGRAM
NEUTRAL EARTHING THROUGH NGR



LINE DIAGRAM
SOLID NEUTRAL EARTHING

NOTES:-

1. EARTH ELECTRODE IN TEST PITS SHALL BE SO LOCATED THAT DISTANCE BETWEEN TWO PITS SHALL BE MINIMUM 6 METER.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
7	01.11.21	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
6	08.11.16	REAFFIRMED & ISSUED	BP	FA/HK	BRB	RN
5	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM

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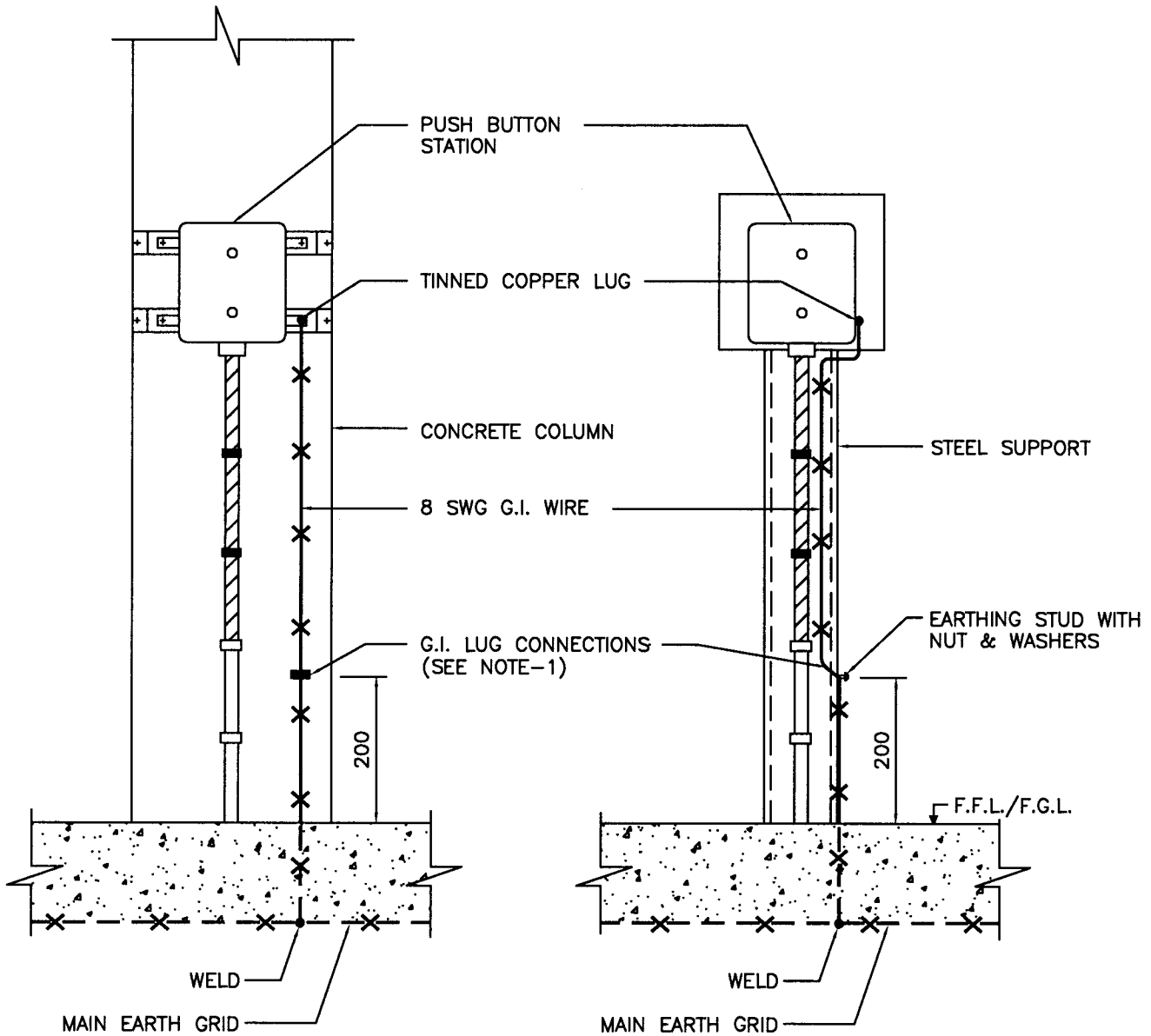

NOTES:-

1. ALTERNATIVELY, CONNECTION SHALL BE TAKEN FROM THE NEAREST AVAILABLE EARTH PLATE.

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6	29.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
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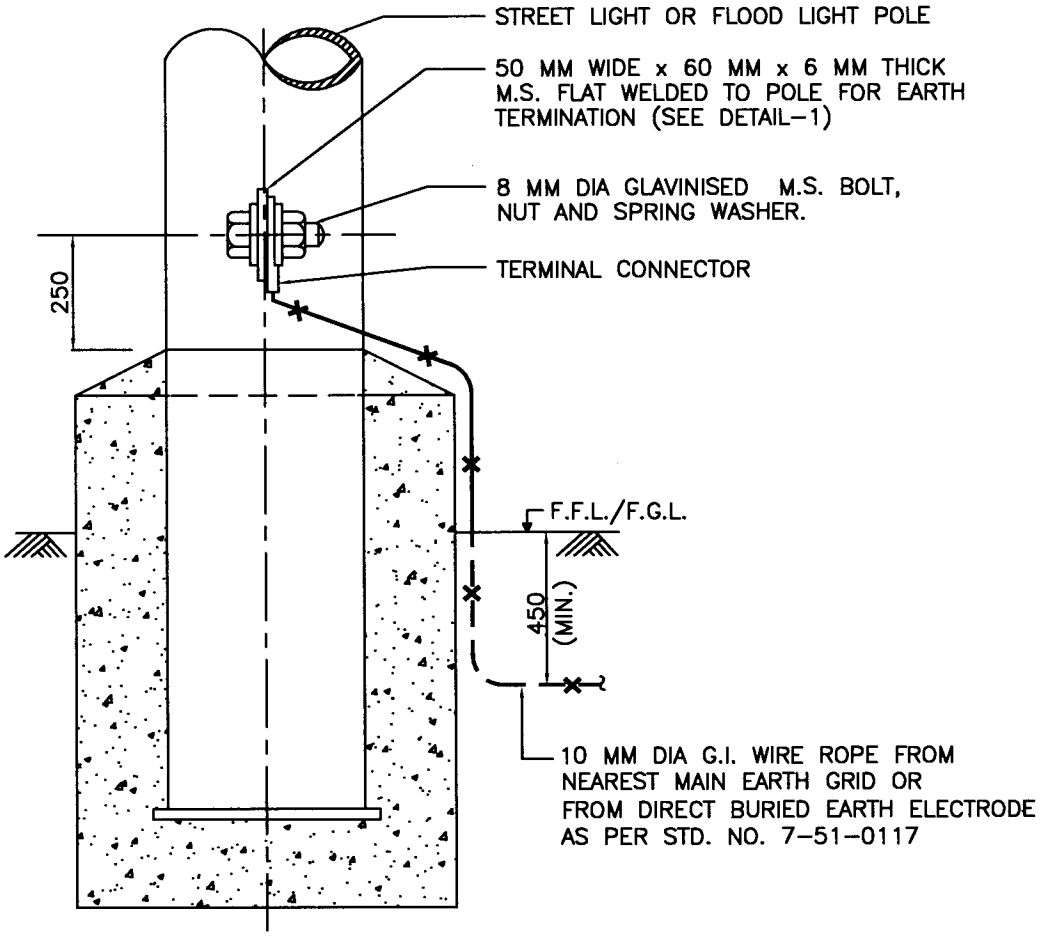

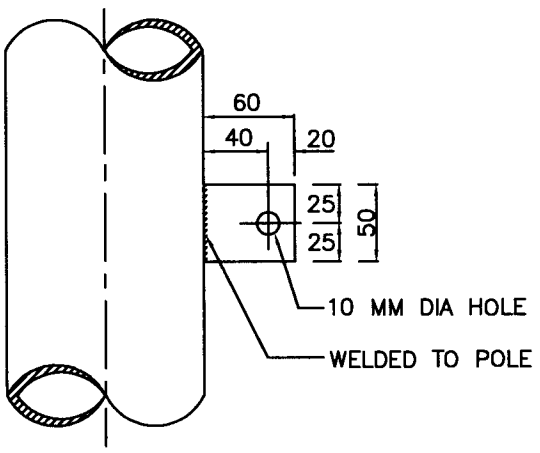

DETAIL–1

NOTES:–

1. USE TWO WIRES ROPES IF VOLTAGE IN THE POLE JUNCTION BOX IS 415 VOLTS.

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6	01.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
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4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM

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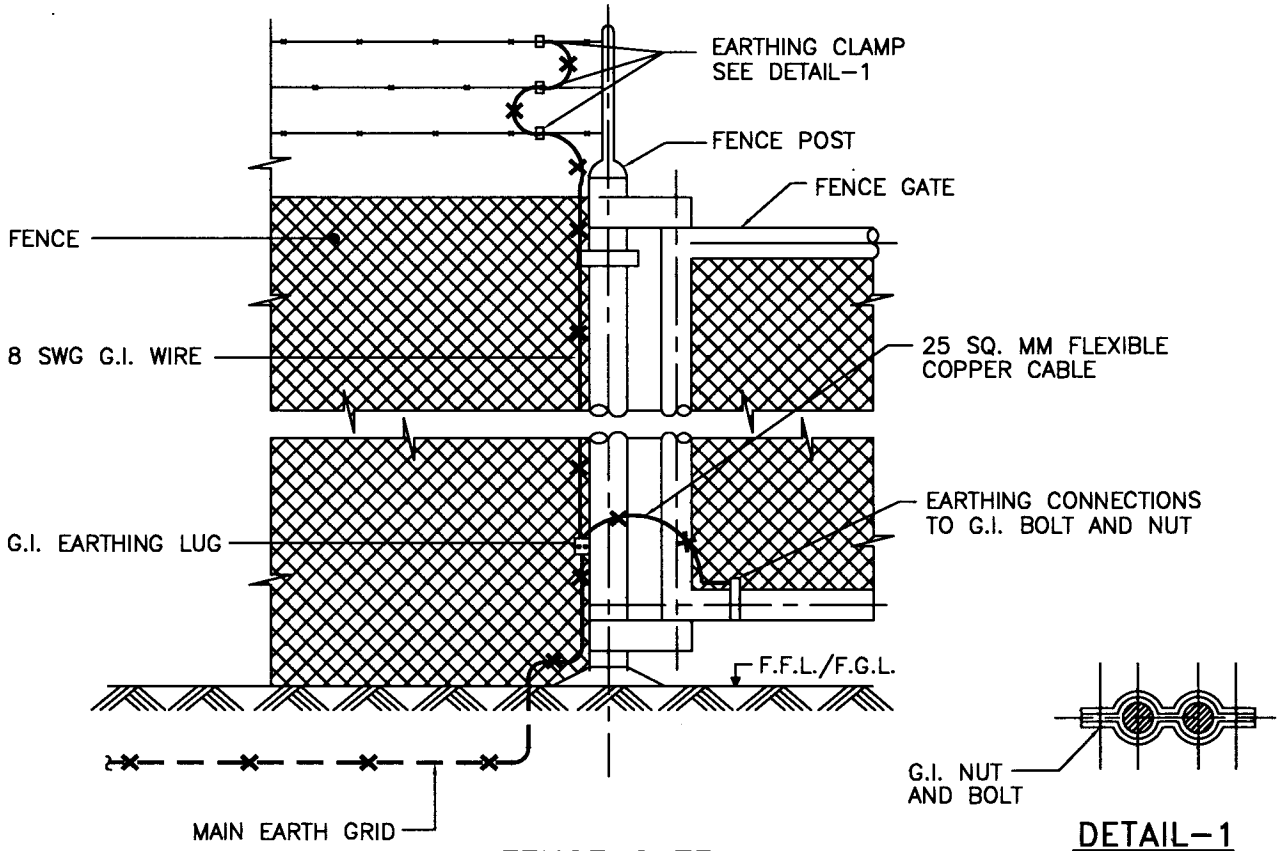
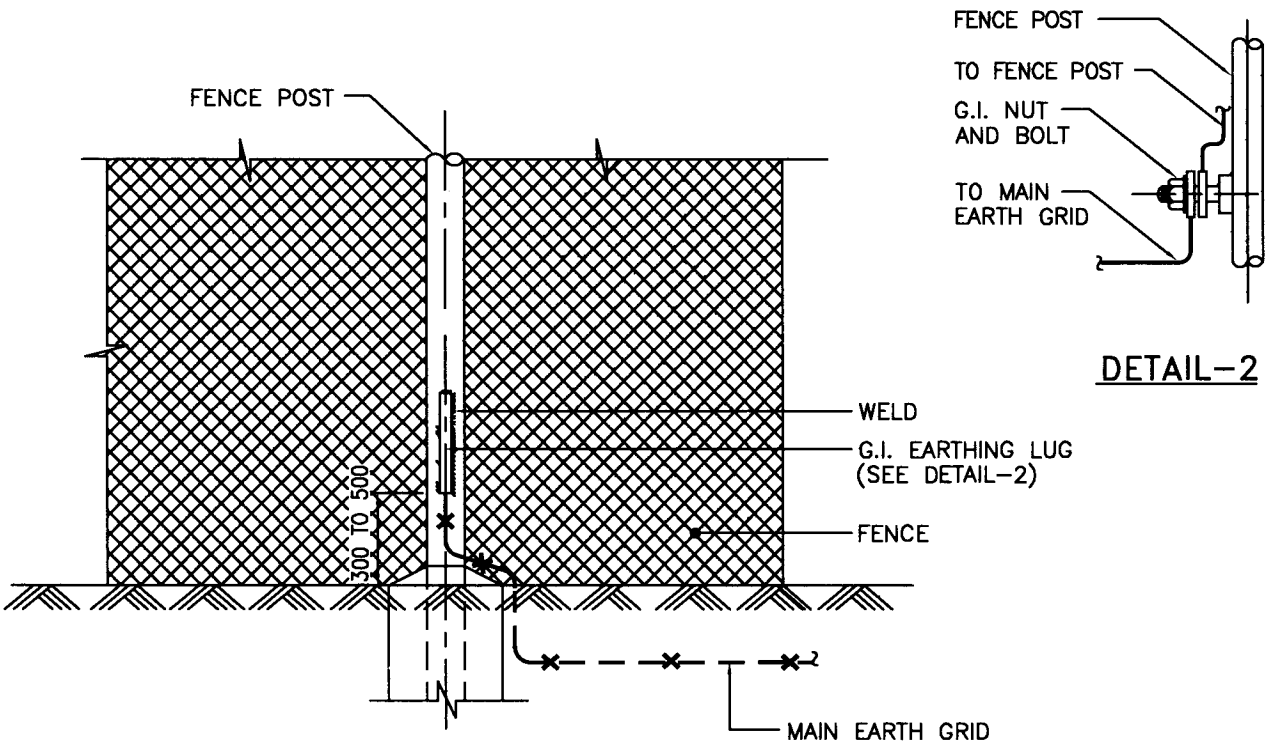


DETAIL–1

FENCE GATE



DETAIL–2

FENCE POST

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6	01.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
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TYPE OF EQUIPMENT	EARTH CONDUCTOR SIZE (SEE NOTE-1)
LV MOTORS UPTO 3.7KW	8 SWG SOLID G.I. WIRE
LV MOTORS FROM 5.5KW TO 30KW & WELDING RECEPTACLES	10 MM (3/8") DIA G.I. WIRE ROPE
LV MOTORS ABOVE 30KW INCLUDING MV MOTORS	16 MM (5/8") DIA G.I. WIRE ROPE/ 40x5 MM G.I. STRIP
BUILDING COLUMNS	40 x 5 G.I. STRIP
STORAGE TANKS (VERTICAL & HORIZONTAL)	40 x 5 G.I. STRIP
LOADING RACKS	40 x 5 G.I. STRIP
VESSELS & HEAT EXCHANGERS	40 x 5 G.I. STRIP
SMALL EQUIPMENT & INSTRUMENTS	8 SWG SOLID G.I. WIRE
LIGHTING, POWER & INSTRUMENT PANELS	10 MM (3/8") DIA G.I. WIRE ROPE
MAIN EARTH BUS / LV, MV, HV & EHV SWITCH GEAR INTERCONNECTIONS/ POWER TRANSFORMER	AS SPECIFIED
EHV, HV & MV SUB-STATIONS	AS SPECIFIED
PUSH BUTTON STATIONS	8 SWG SOLID G.I. WIRE
STREET LIGHT POLES	10 MM (3/8") DIA G.I. WIRE ROPE
LIGHTING TRANSFORMER	16 MM (5/8") DIA G.I. WIRE ROPE
PIPE RACK	40 X 5 G.I. STRIP
BONDING OF PIPE	25 SQ. MM INSULATED FLEXIBLE CU. CABLE
LIGHTNING PROTECTION	25 X 3 MM G.I. EARTH STRIP
CABLE TRAYS	40 X 5 G.I. STRIP

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TYPE OF EQUIPMENT	ALUMINUM CABLE (SEE NOTE-1&2)	COPPER CABLE (SEE NOTE-1&2)
LV MOTORS UPTO 3.7KW	16 SQ MM	10 SQ MM
LV MOTORS FROM 5.5KW TO 30KW	16 SQ MM	10 SQ MM
LV MOTORS ABOVE 30KW TO 55KW	25 SQ MM	16 SQ MM
LV MOTORS ABOVE 55KW TO 160KW	70 SQ MM	50 SQ MM
MV MOTORS	120 SQ MM	95 SQ MM
STORAGE TANKS (VERTICAL & HORIZONTAL)	70 SQ MM	50 SQ MM
VESSELS & HEAT EXCHANGERS	25 SQ MM	16 SQ MM
LIGHTING, POWER & INSTRUMENT PANELS	10 SQ MM	10 SQ MM
PUSH BUTTON STATIONS	10 SQ MM	10 SQ MM
STREET LIGHT POLES & FLOOD LIGHT MAST	16 SQ MM	10 SQ MM
PIPE RACK	25 SQ MM	16 SQ MM
WELDING RECEPTACLES	25 SQ MM	16 SQ MM

NOTE:-

1. TYPE OF EARTH CONNECTIONS TO INDIVIDUAL EQUIPMENT (I.E. WIRE ROPE / STRIP OR CABLE) FROM NEAREST EARTH PLATE / GRID SHALL BE SELECTED AS SPECIFIED ELSEWHERE. CABLE/WIRE ROPE CONNECTIONS SHALL BE MADE USING CRIMP TYPE OF LUGS.

2. EARTHING CABLE SHALL BE SINGLE CORE PVC INSULATED GREEN COLOR/GREEN WITH YELLOW COLOR STRIPE OUTER SHEATH.

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8	01.11.21	UPDATED AND ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
7	08.11.16	REVISED AND ISSUED AS STANDARD	BP	FA/HK	BRB	RN

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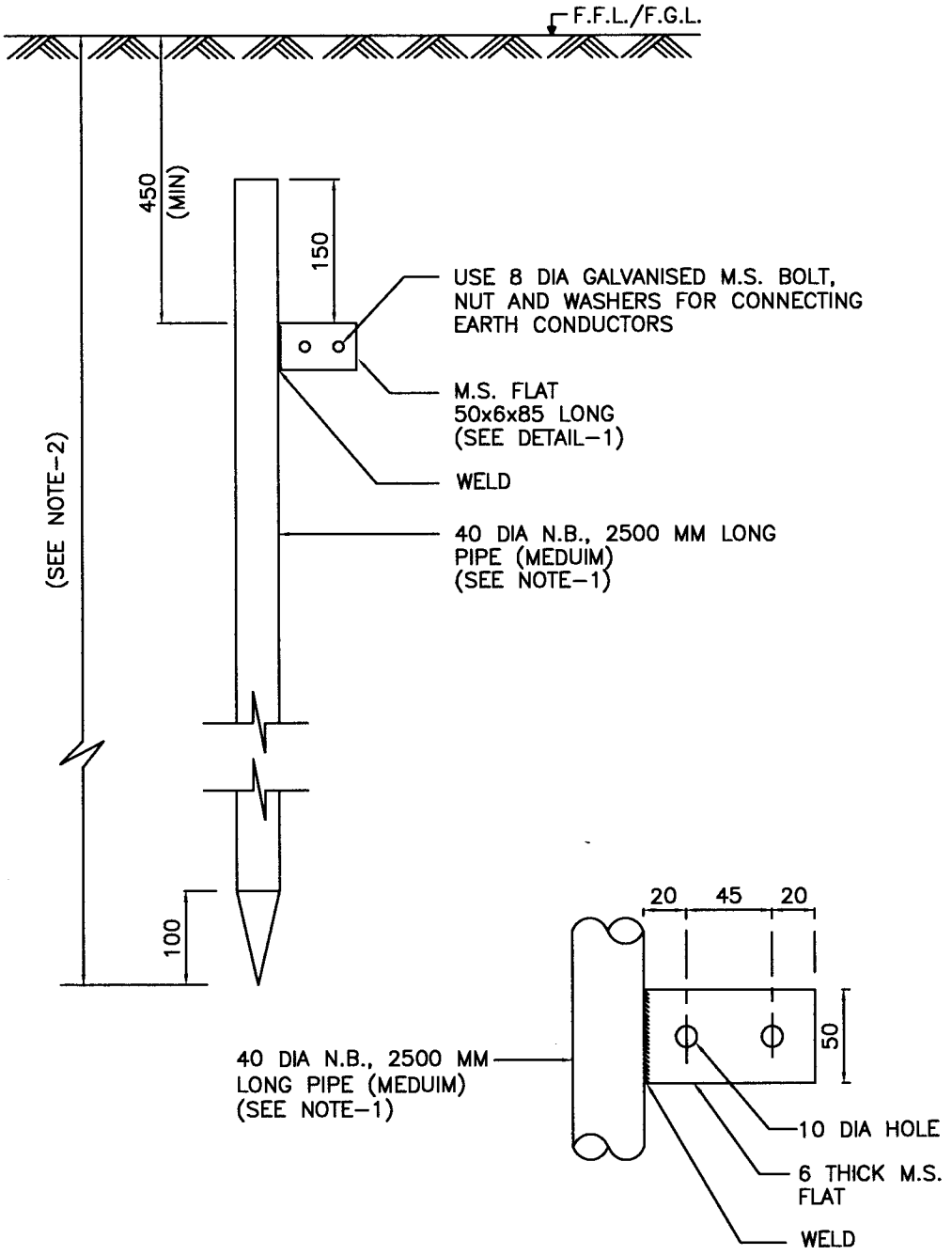

DETAIL-1

NOTES:-

1. PIPE ASSEMBLY SHALL BE HOT DIP GALVANISED AFTER FABRICATION.
2. THE ELECTRODE SHALL BE DRIVEN TO A DEPTH TO REACH PERMANENT MOIST SOIL.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
6	01.11.21	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	08.11.16	REAFFIRMED & ISSUED	BP	FA/HK	BRB	RN
4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM

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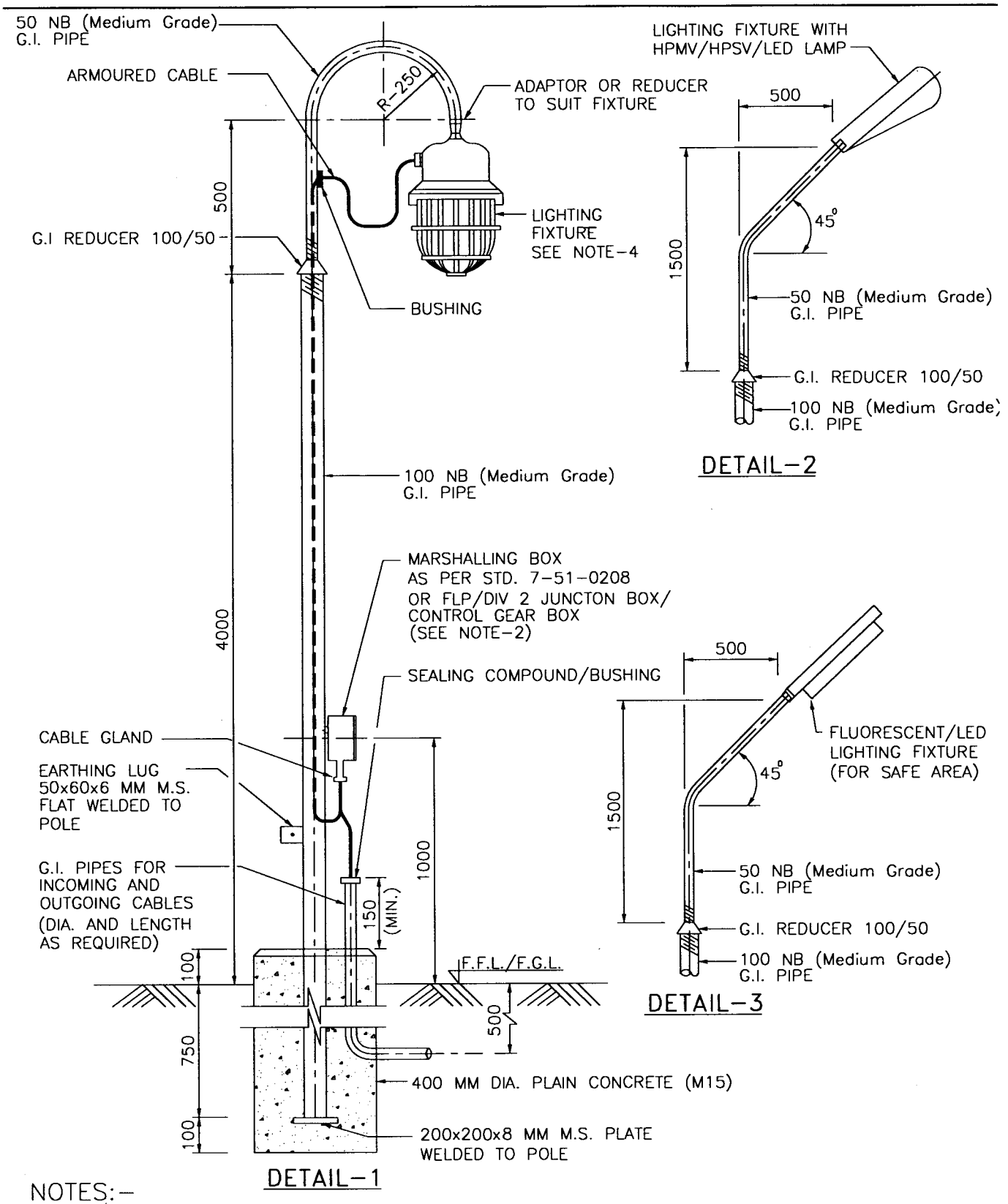

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. MARSHALLING BOX/JUNCTION BOX AND G.I. PIPES FOR CABLES SHALL BE LOCATED FACING CABLE TRENCH SIDE.
3. ALL G.I. PIPES SHALL BE MEDIUM GRADE.
4. LIGHTING FIXTURE CAN BE WELL GLASS/DOME GLASS/FLAT GLASS TYPE BASED ON TYPE OF LAMP.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	29.09.20	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	SA	SM
5	10.07.17	UPDATED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN

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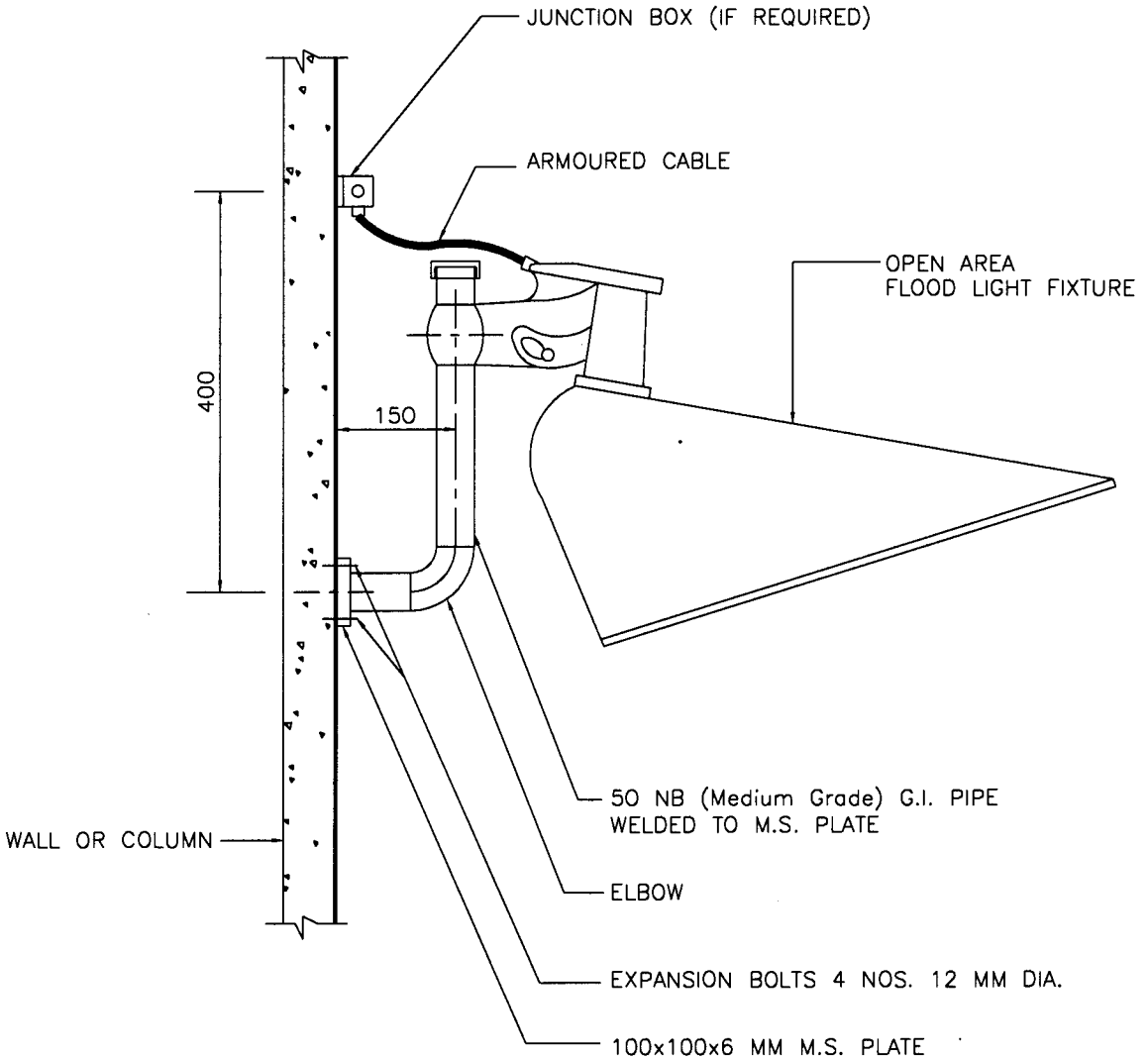

NOTES:–

1. ALL DIMENSIONS ARE IN MM.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
			JSK	VKS/HK	Approved by SA	SM
6	29.09.20	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	SA	SM
5	10.07.17	REAFFIRMED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN

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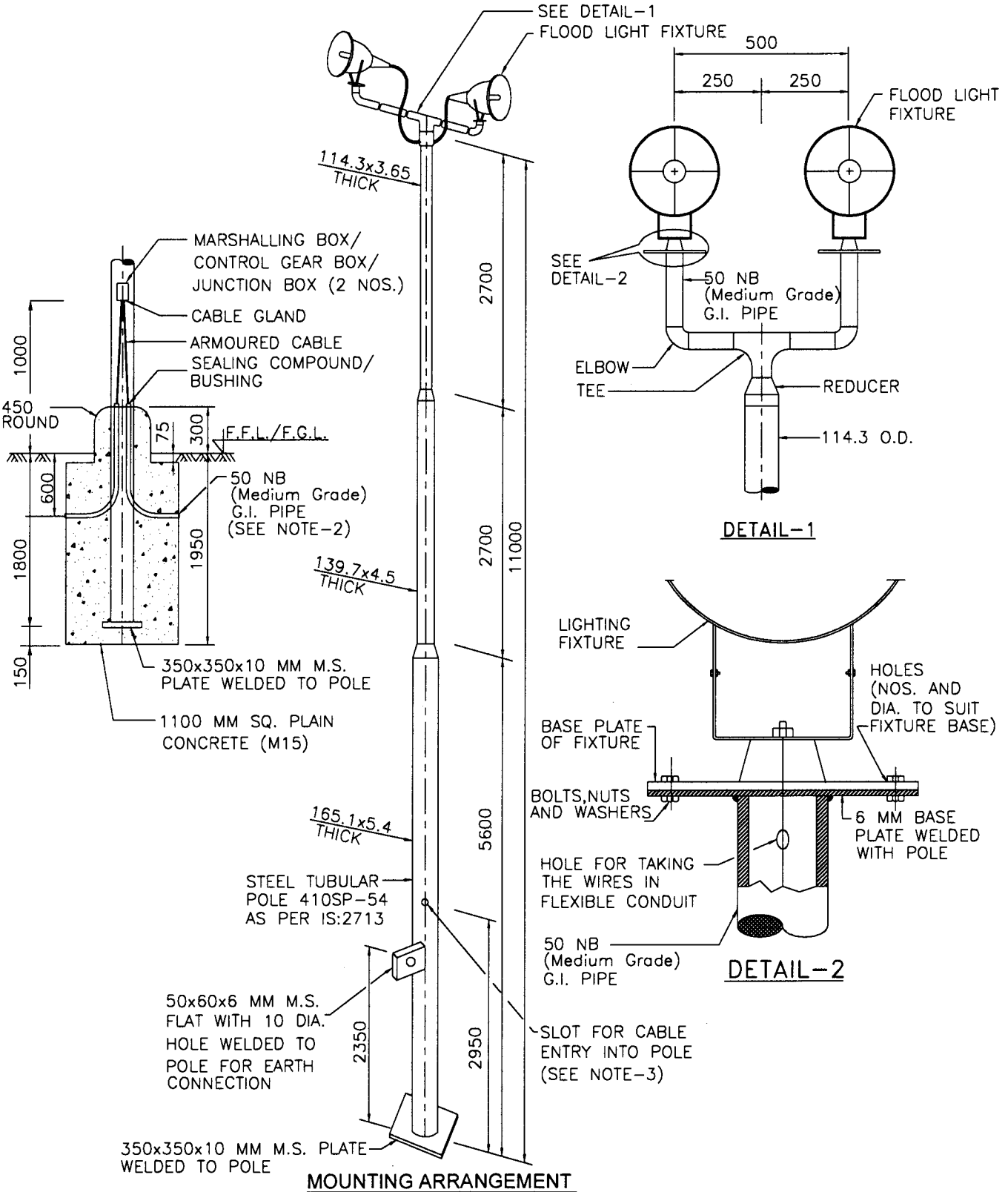

MOUNTING ARRANGEMENT FOR SAFE AREA FIXTURES

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. MINIMUM TWO AND MAXIMUM THREE NUMBERS OF SLEEVES SHALL BE PROVIDED AS PER PLAN DRAWING.
3. 2 NOS. 25 DIA. HOLES SHALL BE POVIDED ON OPPOSITE ENDS FOR FIXING OF MARSHALLING BOX ON ONE END AND CONTROL GEAR BOX/JUNCTION BOX ON OTHER END.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	29.09.20	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	SA	SM
5	10.07.17	UPDATED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN

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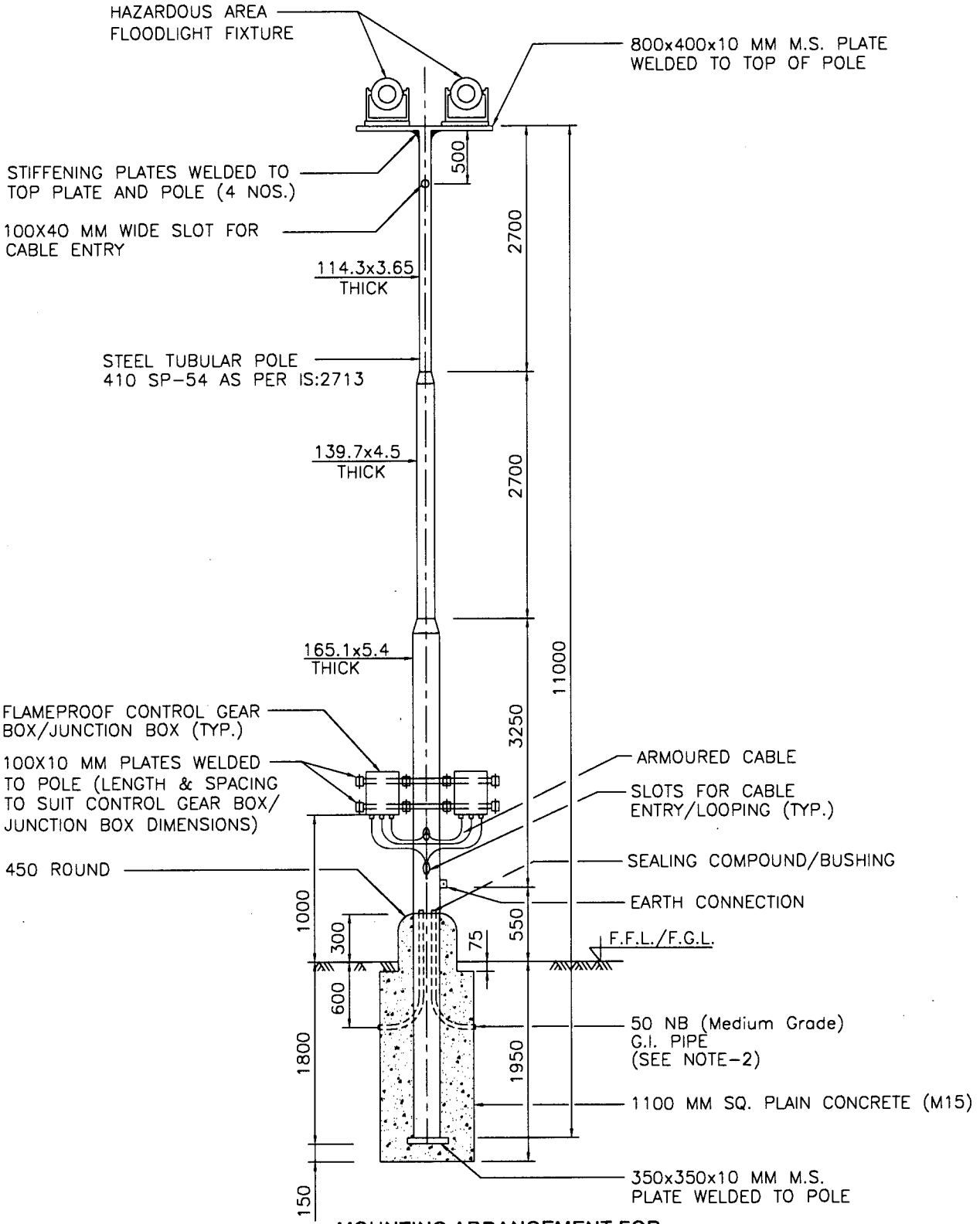

MOUNTING ARRANGEMENT FOR HAZARDOUS AREA FIXTURES

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. MINIMUM TWO AND MAXIMUM THREE NUMBERS OF SLEEVES SHALL BE PROVIDED AS PER PLAN DRAWING.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	29.09.20	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	SA	SM
5	10.07.17	UPDATED & ISSUED AS STANDARD	BP	FA/HK	BRB	DM

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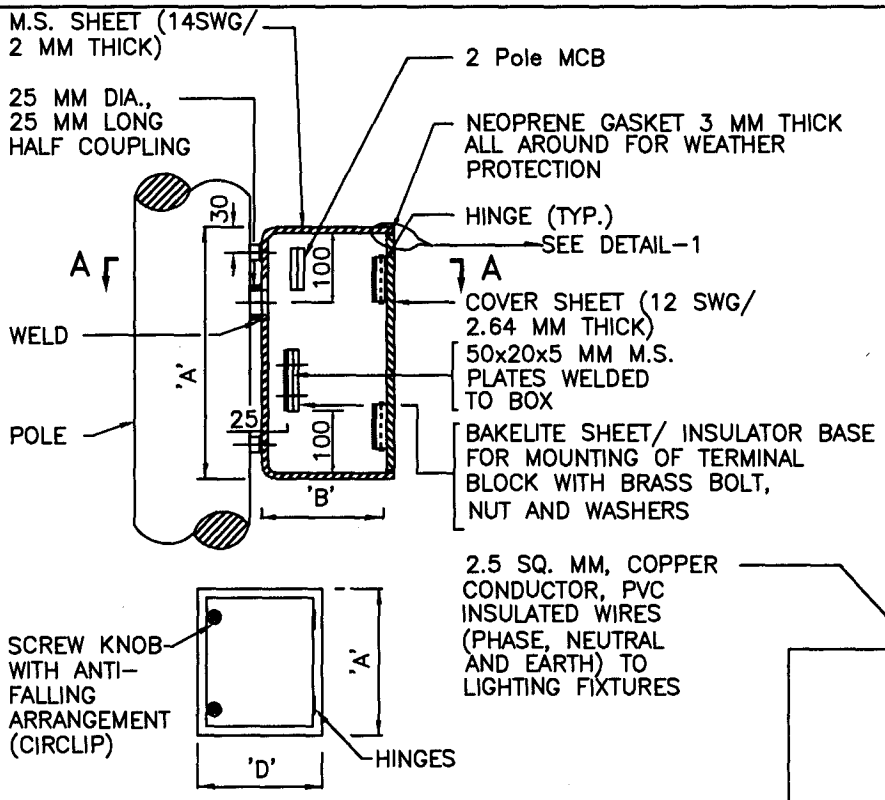
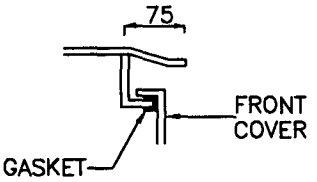
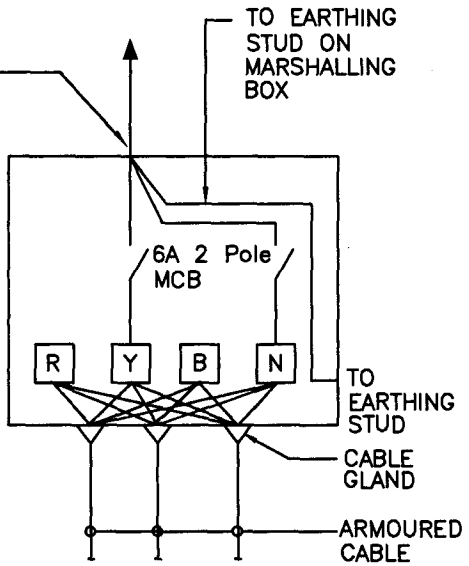


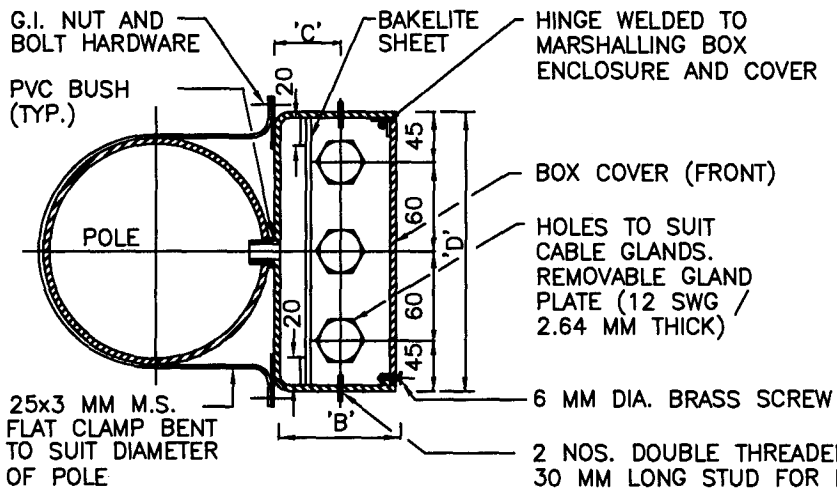


DETAIL-1

BOX COVER



WIRING DIAGRAM OF MARSHALLING BOX



SECTION-AA

MARSHALLING BOX DIMENSIONS

CABLE SIZE (IN SQ. MM)	CABLE ENTRIES	DIMENSIONS IN MM				
		'A'	'B'	'C'	'D'	Terminal Bolt Size
UPTO 4 X 16	2	250	100	45	210	5
ABOVE 4 X 16 AND UPTO 3.5 X 50	3	300	150	75	210	10

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. MARSHALLING BOX SHALL HAVE WEATHER PROOF (IP55) ENCLOSURE PROTECTION, WITH DOUBLE COMPRESSION CABLE GLANDS WITH CHECK NUTS & LUGS.
3. THE BOX WITH ALL WELDED ATTACHMENTS, SHALL BE THOROUGHLY CLEANED AFTER FABRICATION AND SHALL BE PAINTED WITH EPOXY PAINT.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
7	12.10.20	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	SA	SM
6	10.07.17	UPDATED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN

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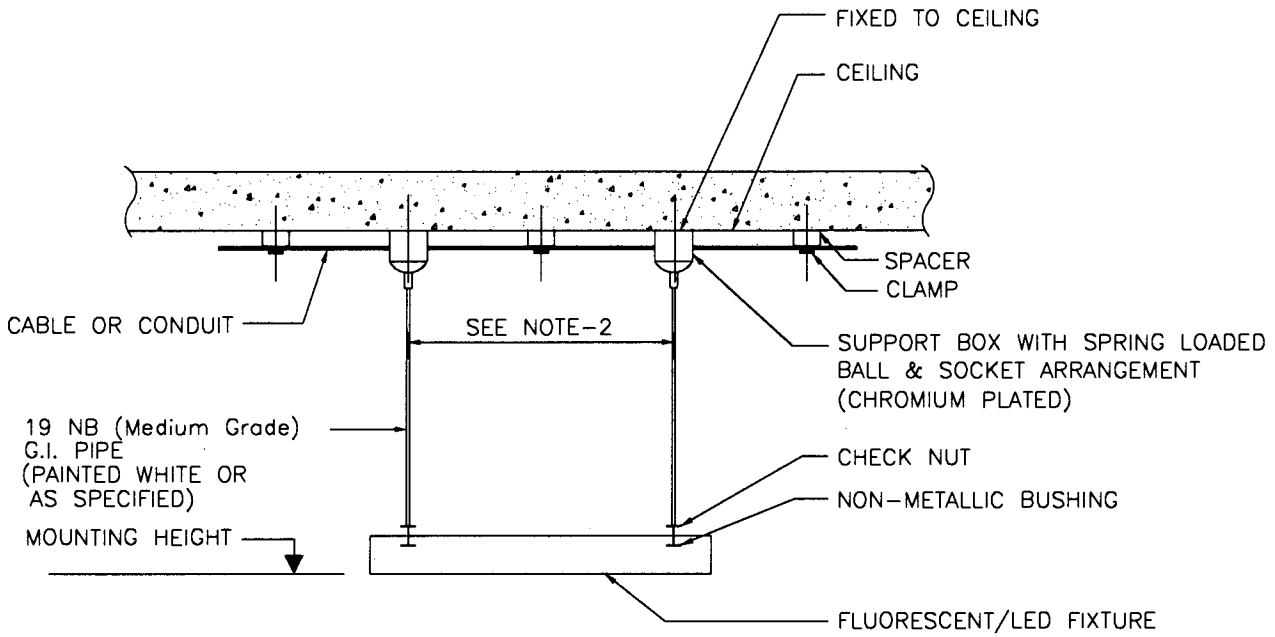
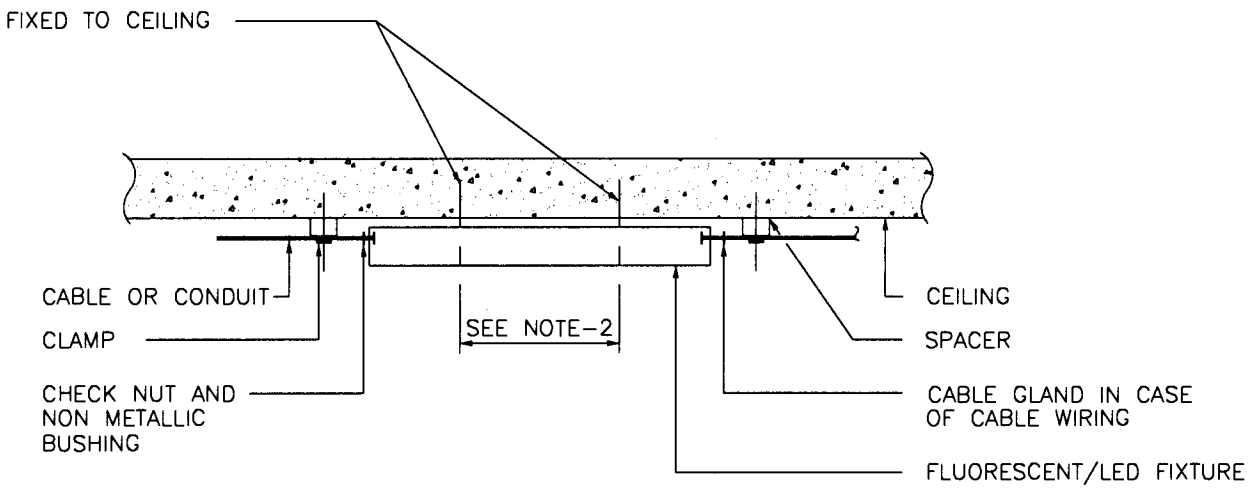


DETAIL-1
SUSPENSION MOUNTING



DETAIL-2
CEILING MOUNTING

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. SUSPENSION/FIXING CENTRES SHALL BE AS PER FIXTURE MANUFACTURER'S DETAILS.
3. IN CASE OF CABLE WIRING ONE NO. JUNCTION BOX COMPLETE WITH CABLE GLANDS SHALL BE PROVIDED NEAR EACH FIXTURE.

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6	29.09.20	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	SA	SM
5	10.07.17	UPDATED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN

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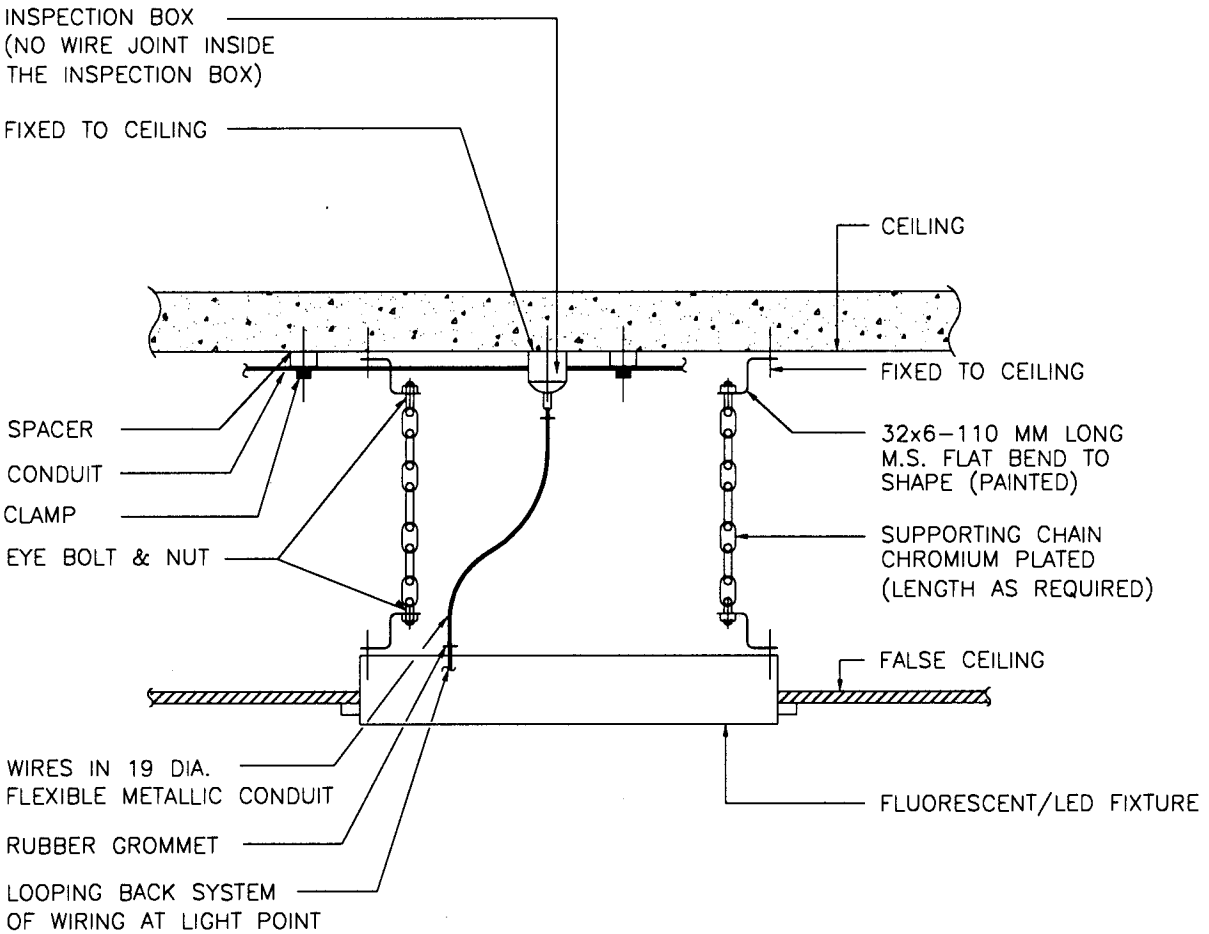

MOUNTING ARRANGEMENT WITH CHAIN SUPPORT

NOTES:–

1. ALL DIMENSIONS ARE IN MM.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	29.09.20	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	SA	SM
5	10.07.17	UPDATED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN

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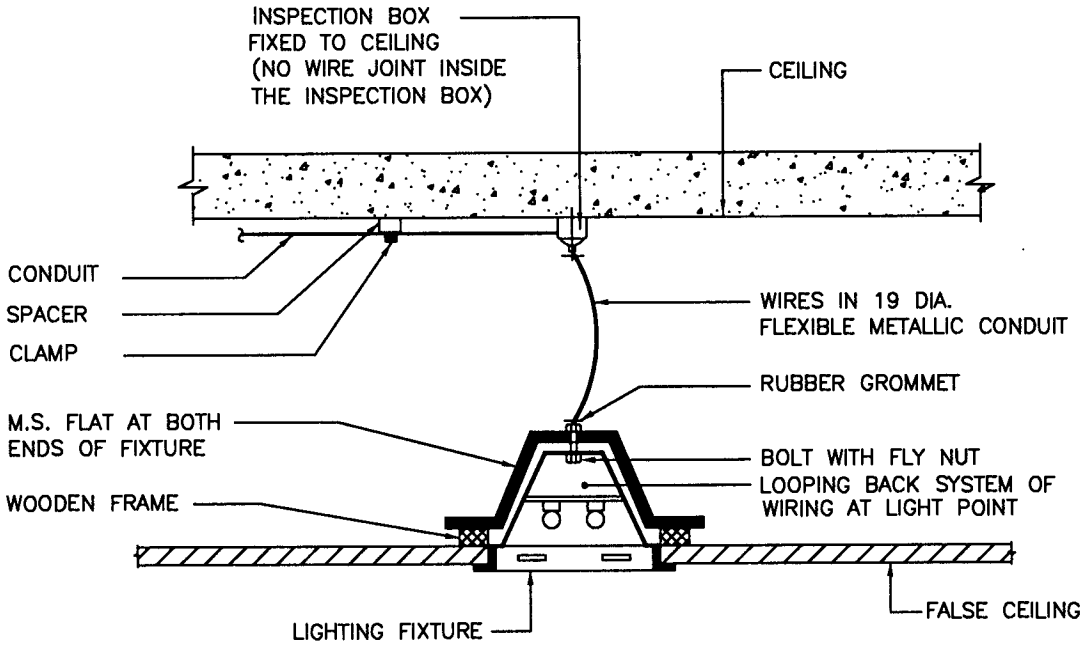
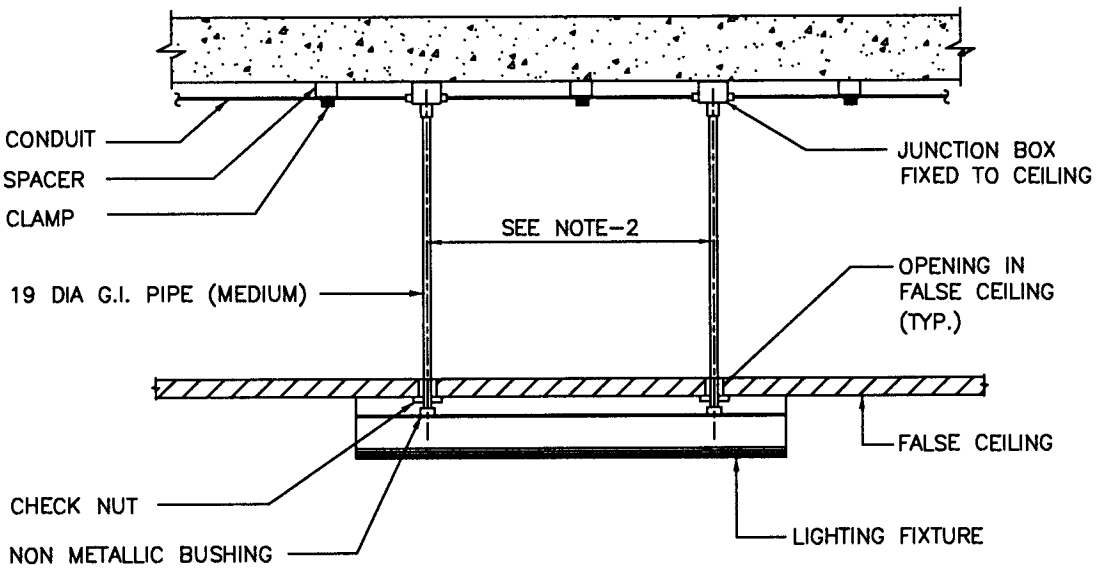


DETAIL–1
RECESS MOUNTED FIXTURE SUPPORTED ON WOODEN FRAME



DETAIL–2
FIXTURE MOUNTING BELOW FALSE CEILING

NOTES:–

1. ALL DIMENSIONS ARE IN MM.
2. SUSPENSION/FIXING CENTRES SHALL BE AS PER FIXTURE MANUFACTURER'S DETAILS.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	29.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	21.10.16	REVISED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
4	17.07.13	REAFFIRMED & ISSUED AS STANDARD	BP	FA/SA	UAP/JMS	DM

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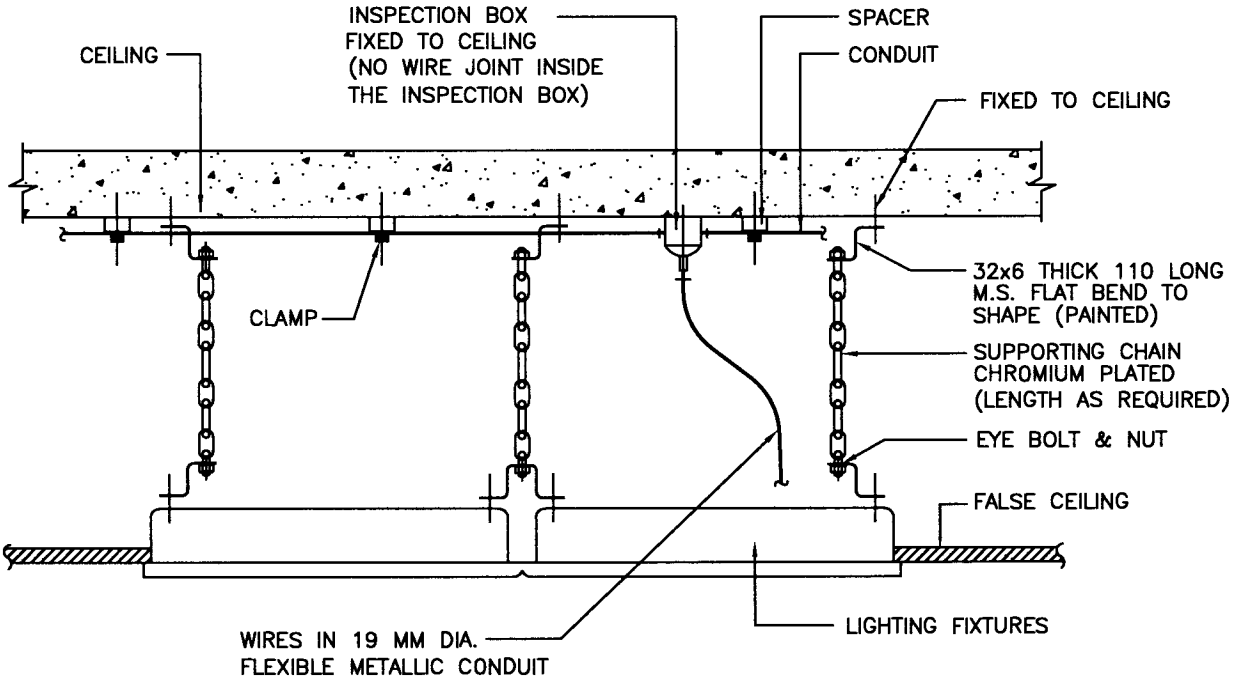

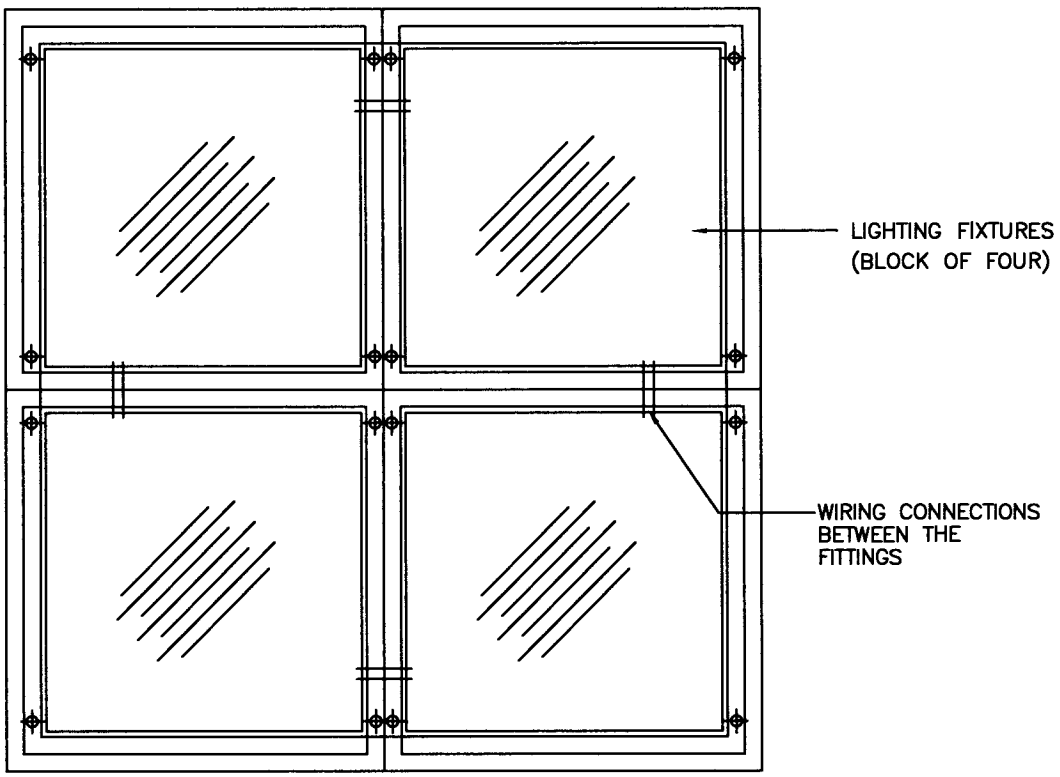

NOTES:–

1. ALL DIMENSIONS ARE IN MM.
2. SUSPENSION/FIXING CENTRES SHALL BE AS PER FIXTURE MANUFACTURER'S DETAILS.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
6	01.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	21.10.16	REVISED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
4	17.07.13	REAFFIRMED & ISSUED AS STANDARD	BP	FA/SA	UAP/JMS	DM

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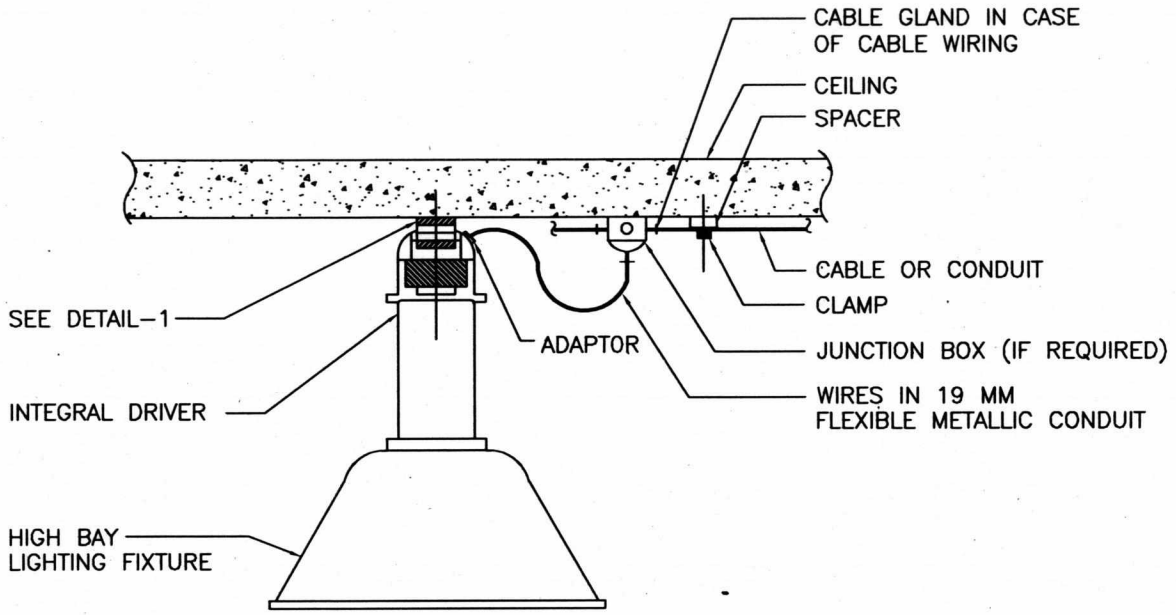

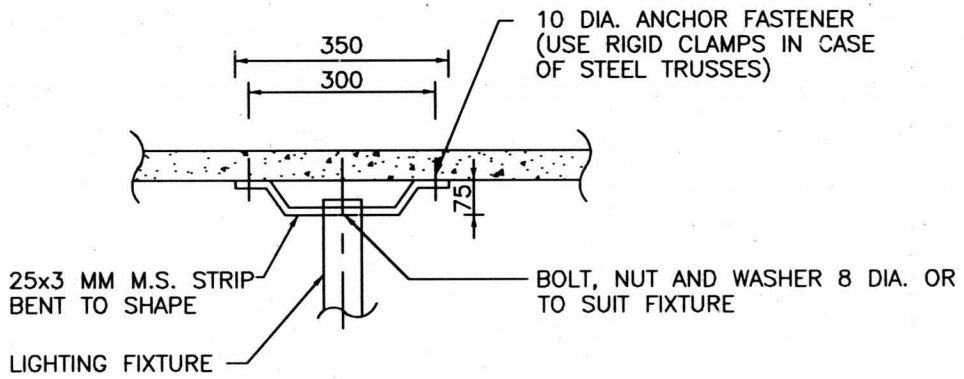

DETAIL–1

NOTES:–

1. ALL DIMENSIONS ARE IN MM.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	15.09.22	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	MKS	SM
5	22.02.18	UPDATED & ISSUED AS STANDARD	BP	VKS/HK	BRB	RN
4	17.07.13	REAFFIRMED & ISSUED AS STANDARD	BP	FA/SA	UAP/JMS	DM

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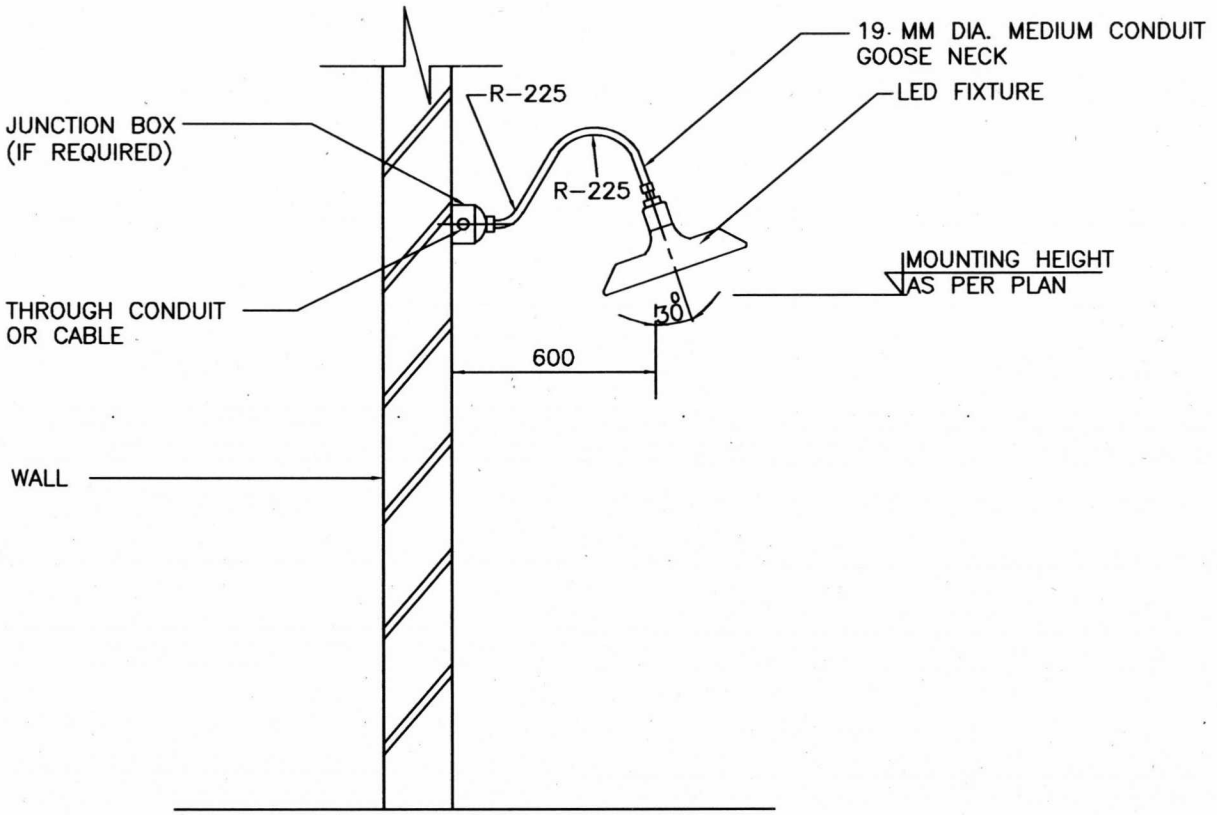
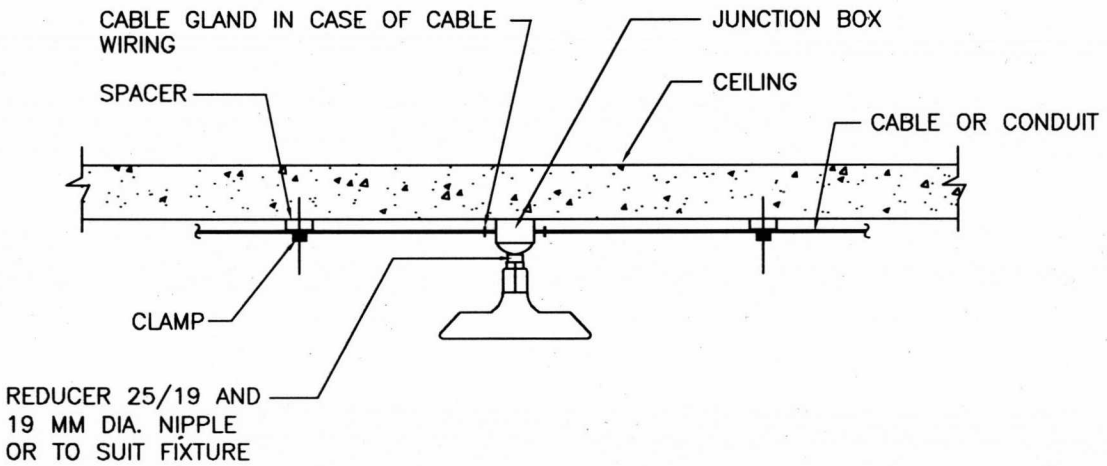


WALL-MOUNTED



CEILING-MOUNTED

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. APPLICABLE FOR SAFE AREAS.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	15.09.22	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	MKS	SM
5	22.02.18	UPDATED & ISSUED AS STANDARD	BP	VKS/HK	BRB	RN
4	17.07.13	REAFFIRMED & ISSUED AS STANDARD	BP	FA/SA	UAP/JMS	DM

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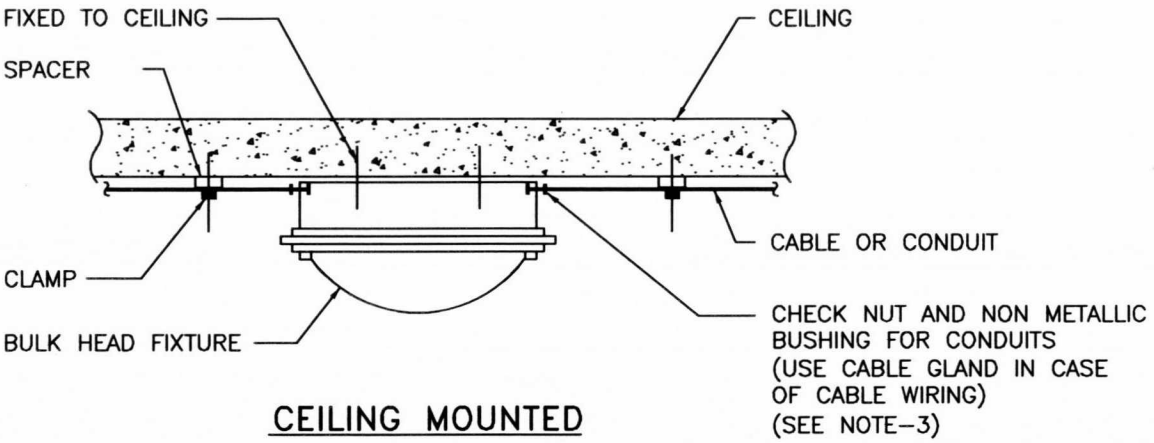

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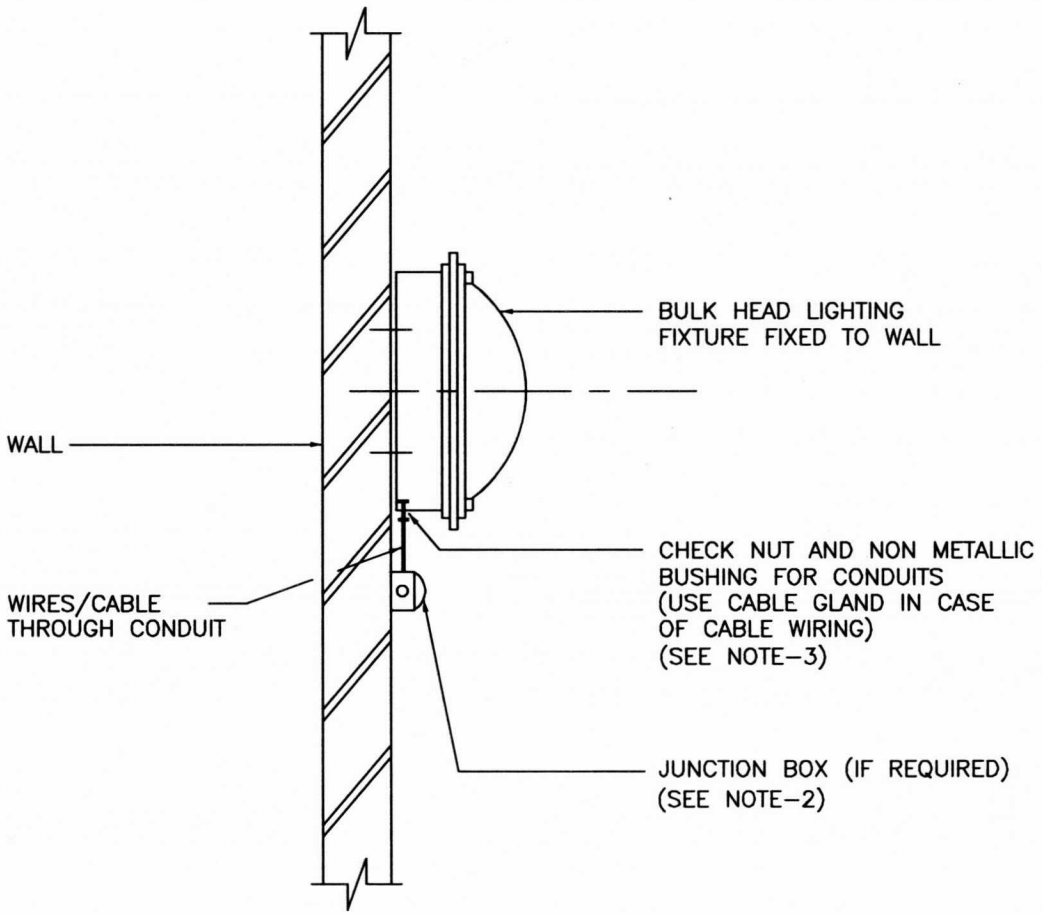

WALL MOUNTED

NOTES:–

1. ALL DIMENSIONS ARE IN MM.
2. FOR INSTALLATION IN OUT DOOR FIXTURES, FIXTURES & JUNCTION BOX SHALL BE IP–55 (WEATHER PROTECTED).
3. PROPER SEALING SHALL BE ENSURED WHEREVER REQUIRED TO PREVENT INGRESS OF WATER.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	15.09.22	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	MKS	SM
5	22.02.18	UPDATED & ISSUED AS STANDARD	BP	VKS/HK	BRB	RN
4	17.07.13	REAFFIRMED & ISSUED AS STANDARD	BP	FA/SA	UAP/JMS	DM

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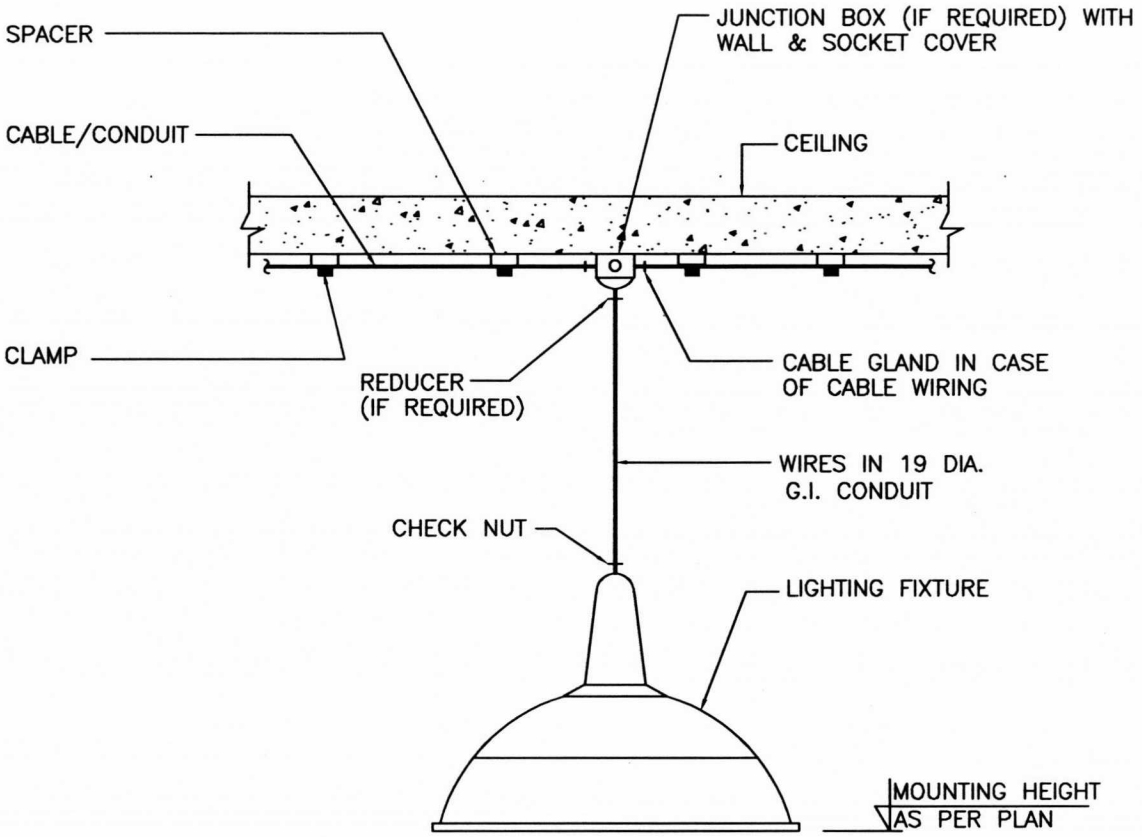

NOTES:–

1. ALL DIMENSIONS ARE IN MM.

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					Approved by	
6	15.09.22	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	MKS	SM
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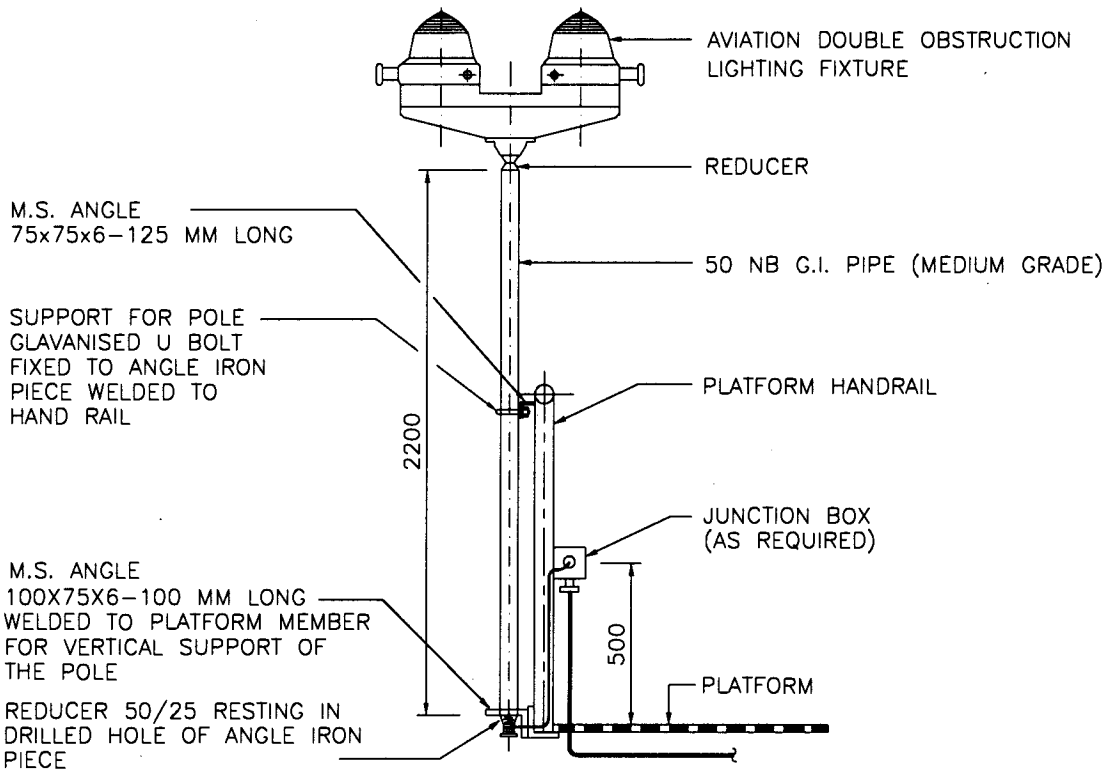
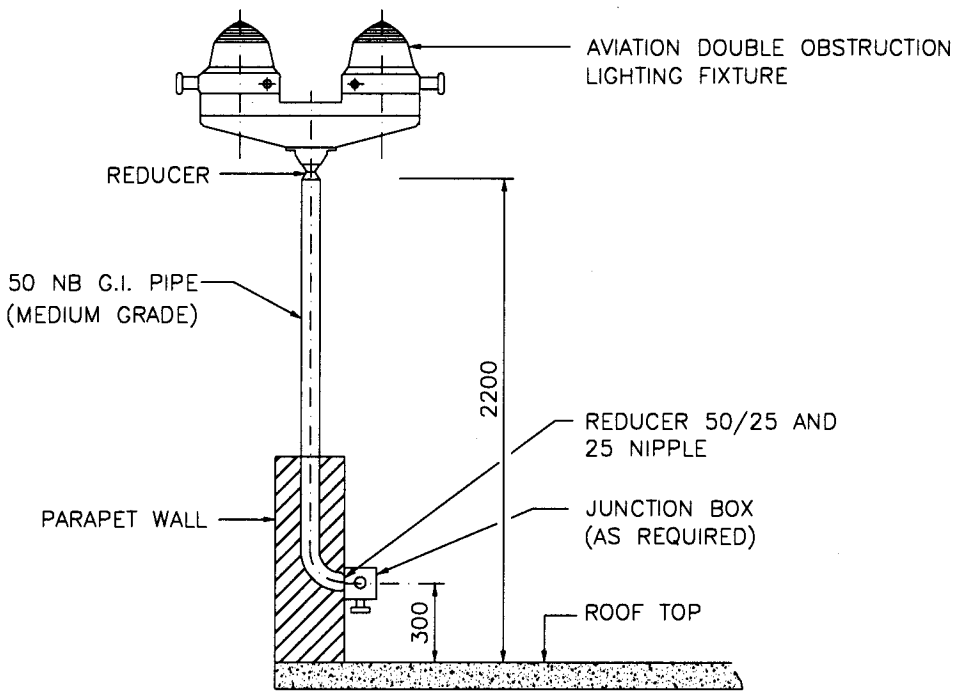


MOUNTED ON TOP OF STRUCTURE PLATFORM

DETAIL–1



MOUNTED ON TOP OF BUILDING PARAPET WALL

DETAIL–2

NOTES:–

1. ALL DIMENSIONS ARE IN MM.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
			JSK	VKS/HK	SA	SM
6	29.09.20	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	SA	SM
5	22.02.18	REAFFIRMED & ISSUED AS STANDARD	BP	VKS/HK	BRB	RN

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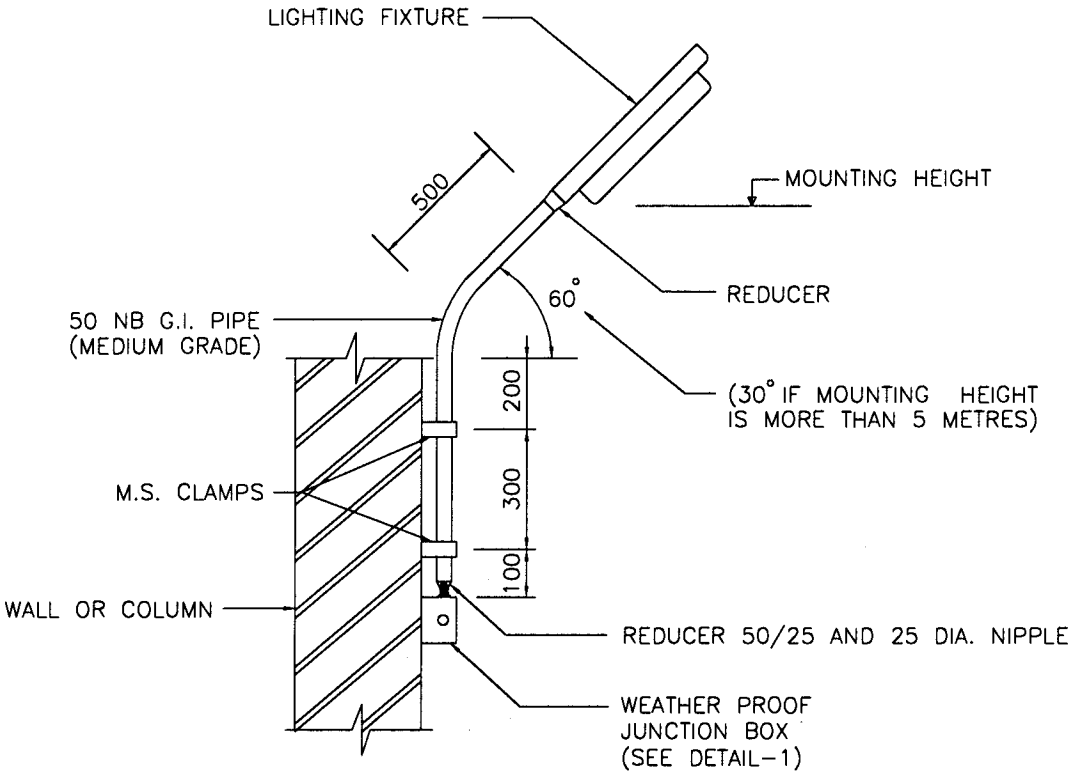
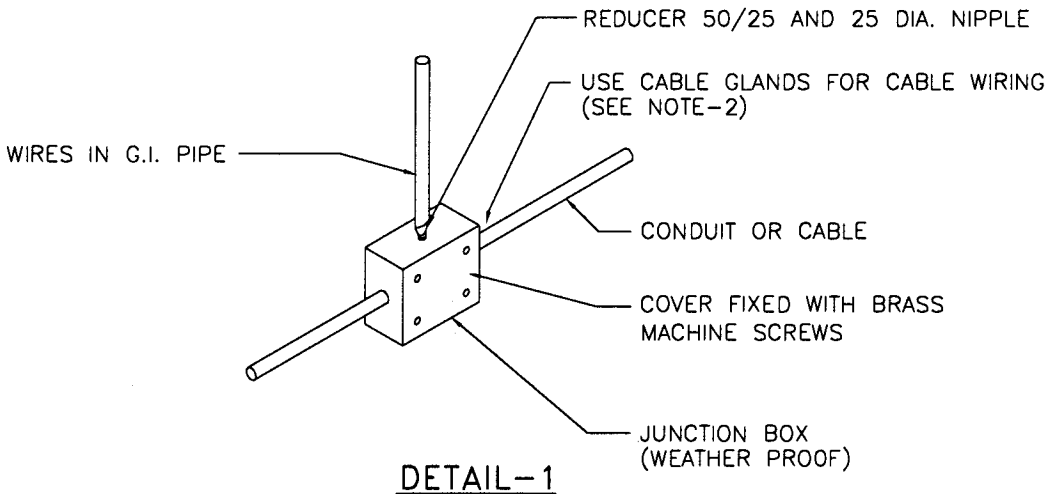


MOUNTED ON WALLS OR COLUMNS



DETAIL-1

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. PROPER SEALING SHALL BE ENSURED TO PREVENT INGRESS OF WATER.
3. WHERE FIRE PROOFING COLUMNS / STRUCTURES ARE ENCOUNTERED FIXTURE/ JUNCTION BOX AND CABLE/CONDUIT SHALL BE INSTALLED ON A SUITABLE DEEP LEGGED ANGLE IRON FRAME / DISTANCE BRACKET.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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6	29.09.20	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	SA	SM
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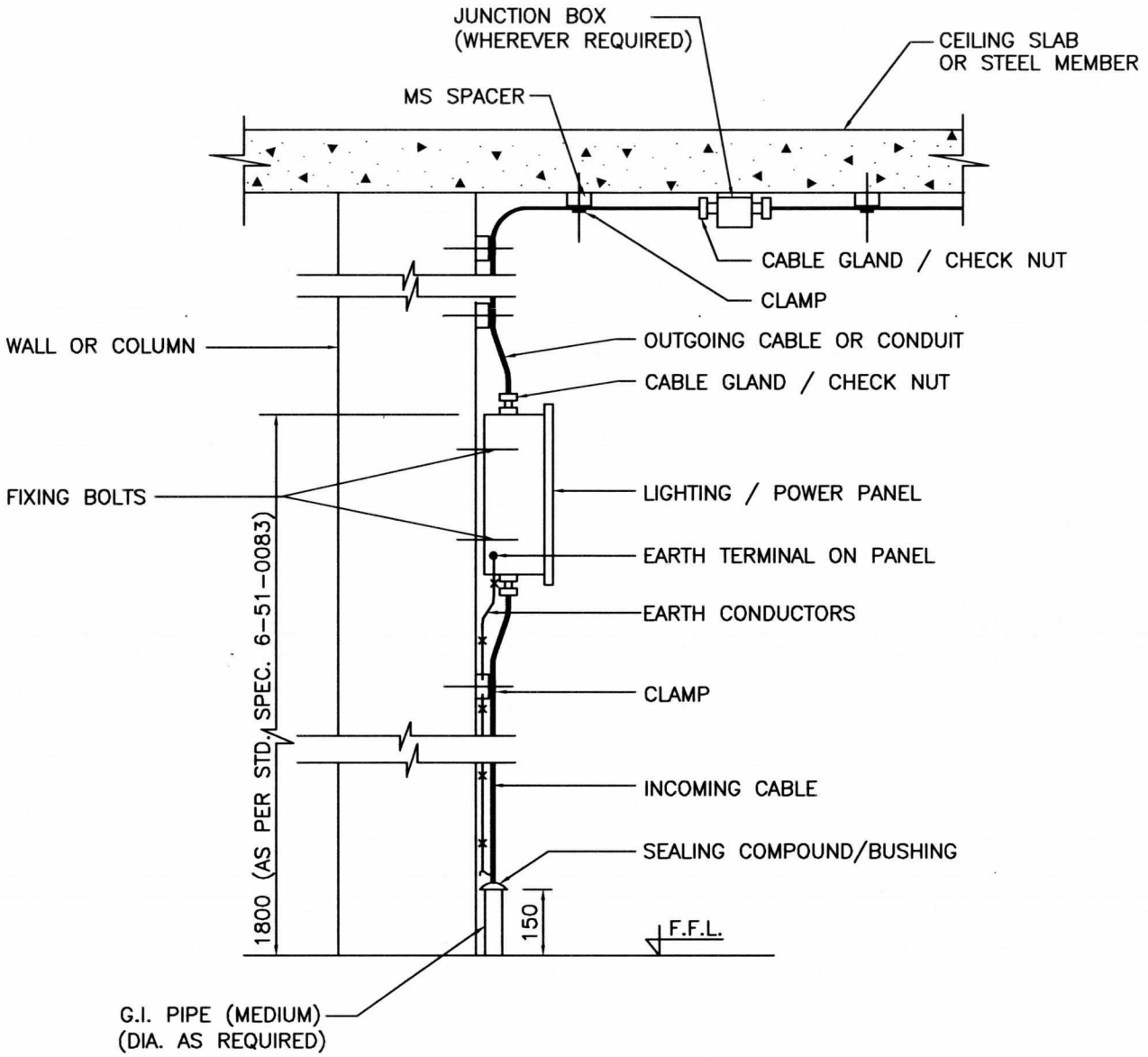

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. WHERE FIRE PROOFING COLUMNS / STRUCTURES ARE ENCOUNTERED FIXTURE/ PANEL/ JUNCTION BOX AND CABLE/CONDUIT SHALL BE INSTALLED ON A SUITABLE DEEP LEGGED ANGLE IRON FRAME / DISTANCE BRACKET.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
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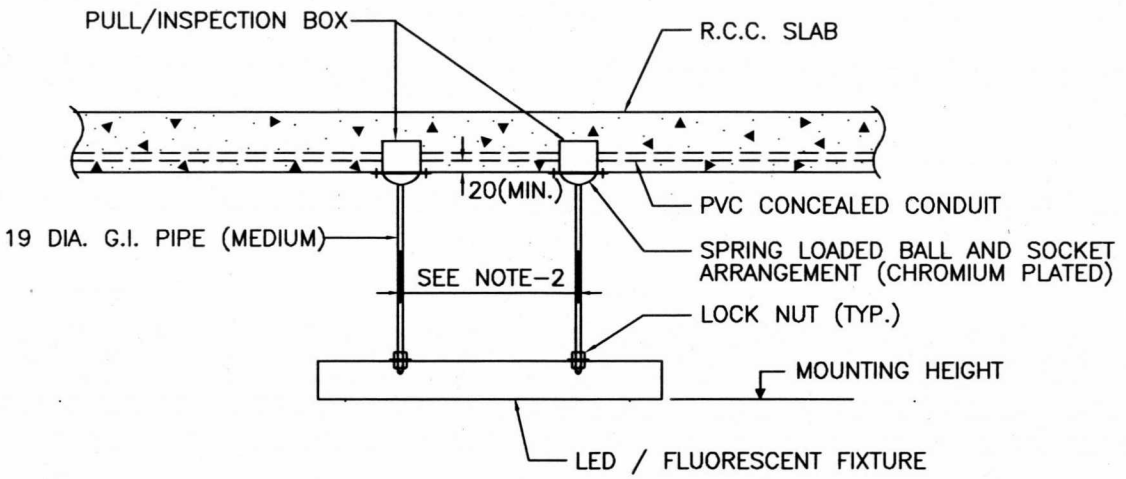
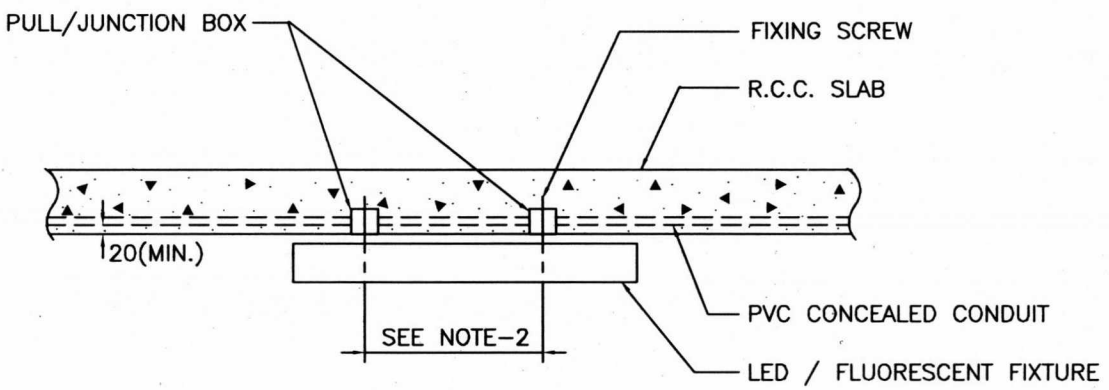


SUSPENSION MOUNTING



CEILING MOUNTING

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. SUSPENSION/FIXING CENTERS SHALL BE AS PER FIXTURE MANUFACTURER'S DETAILS.

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6	15.09.22	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	MKS	SM
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4	17.07.13	REAFFIRMED & ISSUED AS STANDARD	BP	FA/SA	UAP/JMS	DM

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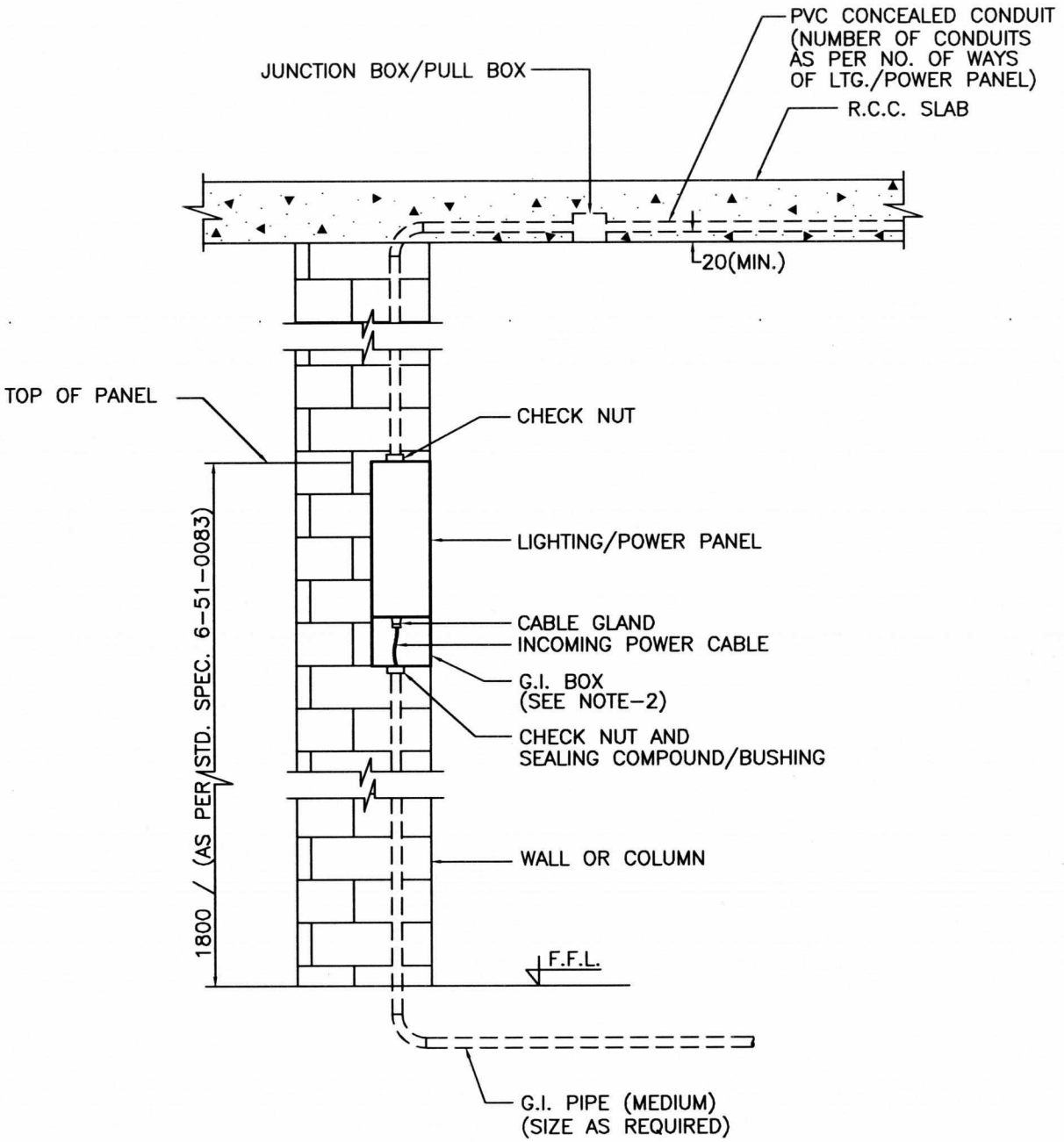

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. G.I. ADAPTOR BOX OF SUITABLE SIZE WITH REMOVABLE COVER SHALL BE PROVIDED BELOW THE PANEL TO FACILITATE CABLE TERMINATION.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	15.09.22	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	MKS	SM
5	09.03.18	UPDATED & ISSUED AS STANDARD	RSD	VKS/HK	BRB	RN
4	17.07.13	REAFFIRMED & ISSUED AS STANDARD	BP	FA/SA	UAP/JMS	DM

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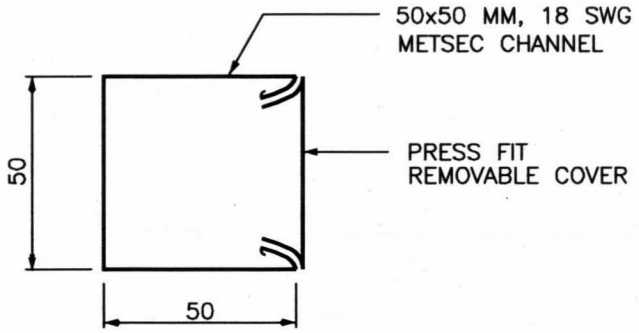
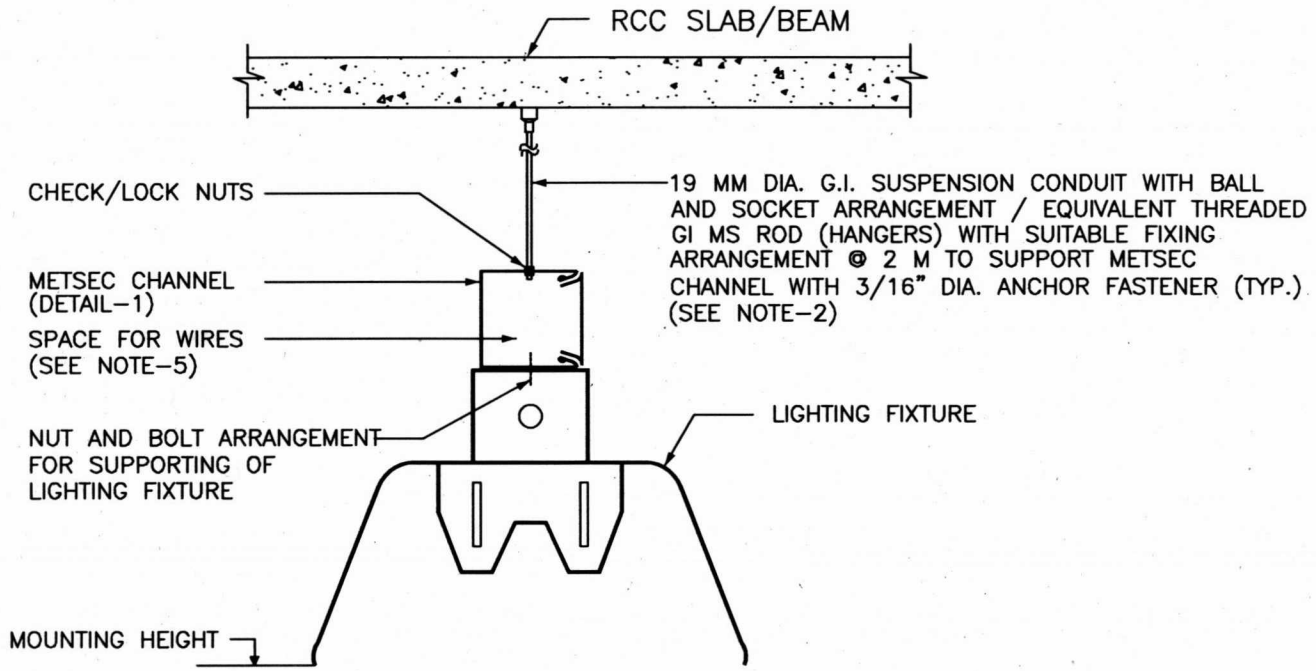


DETAIL–1
METSEC CHANNEL



INSTALLATION OF LIGHTING FIXTURE BELOW METSEC CHANNEL

NOTES:–

1. ALL DIMENSIONS ARE IN MM.
2. LENGTH OF SUSPENSION CONDUITS / MS ROD SHALL BE ADJUSTED AS PER MOUNTING HEIGHT OF LIGHTING FIXTURES.
3. IN CASE, METSEC CHANNEL IS NOT TO BE SUSPENDED, IT SHALL BE DIRECTLY FIXED TO THE CEILING BY 3/16" DIA. ANCHOR FASTENERS @ 2 M INTERVALS.
4. METSEC CHANNEL SHALL BE SPRAY PAINTED AFTER INSTALLATION.
5. WIRES FOR EACH TYPE OF CIRCUIT (LIGHTING/POWER/DC LIGHTING) SHALL BE NEATLY BUNCHED IN METSEC CHANNEL.

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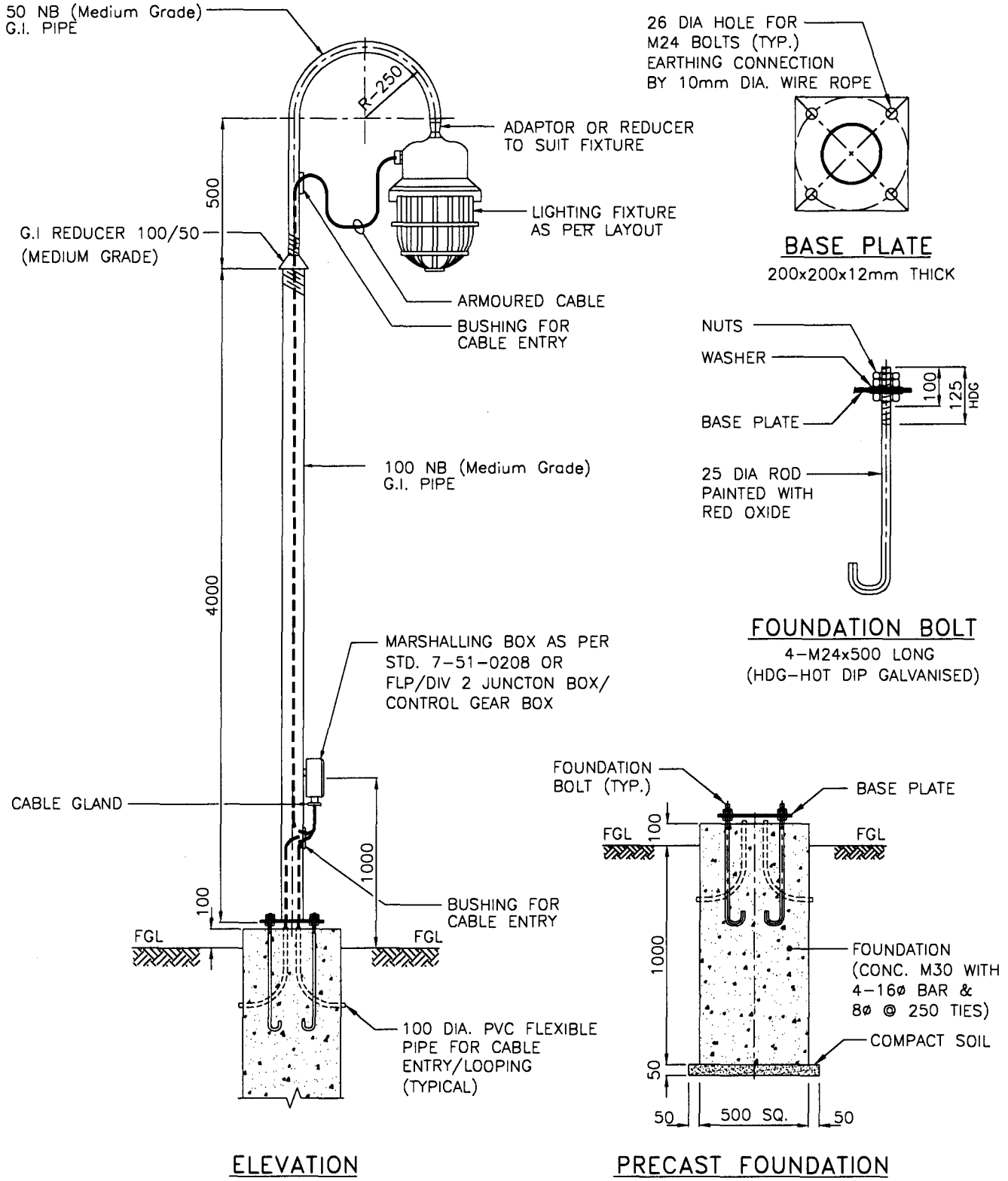

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. THE LIGHTING POLE AND ACCESSORIES DETAILS SHOWN HERE ARE INDICATIVE ONLY. ACTUAL DESIGN & ARRANGEMENT SHALL BE AS PER MANUFACTURER'S DETAILS.

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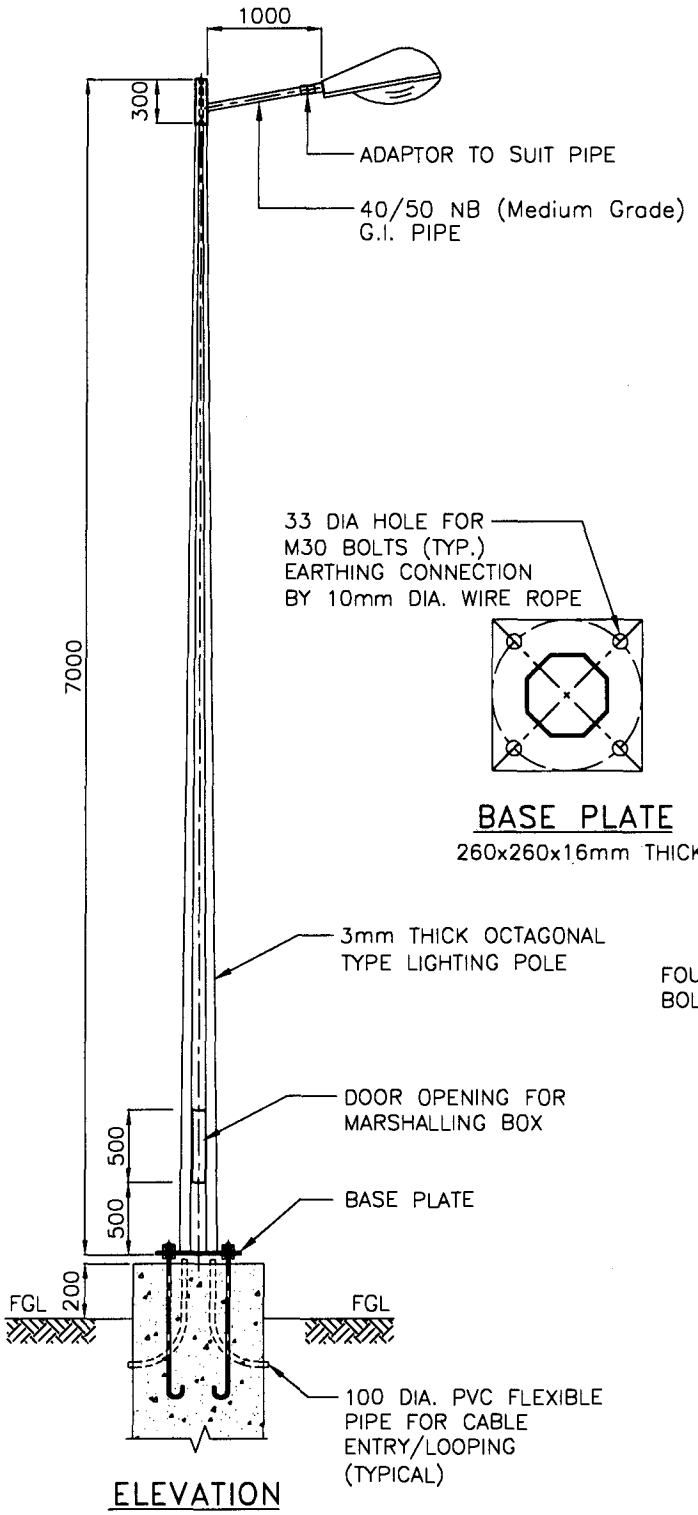
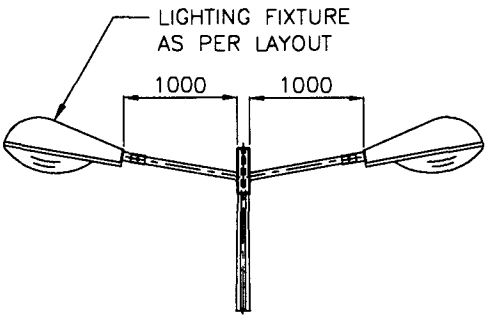


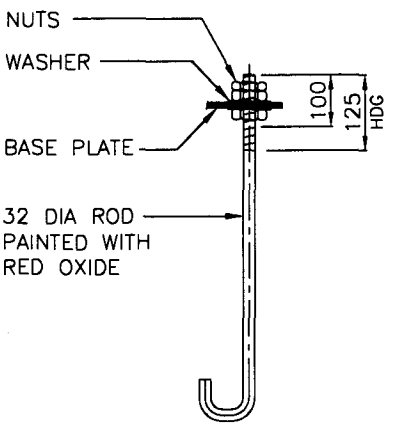
ELEVATION



ARRANGEMENT FOR TWO FIXTURES

BASE PLATE

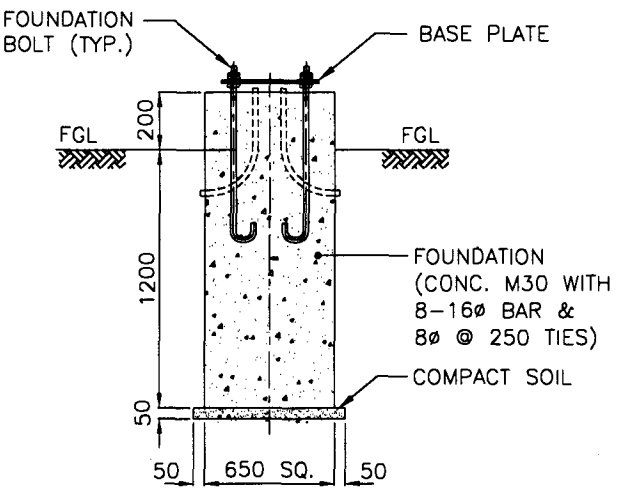
260x260x16mm THICK



FOUNDATION BOLT

4–M30x750 LONG

(HDG–HOT DIP GALVANISED)



PRECAST FOUNDATION

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. THE LIGHTING POLE AND ACCESSORIES DETAILS SHOWN HERE ARE INDICATIVE ONLY. ACTUAL DESIGN & ARRANGEMENT SHALL BE AS PER MANUFACTURER'S DETAILS.

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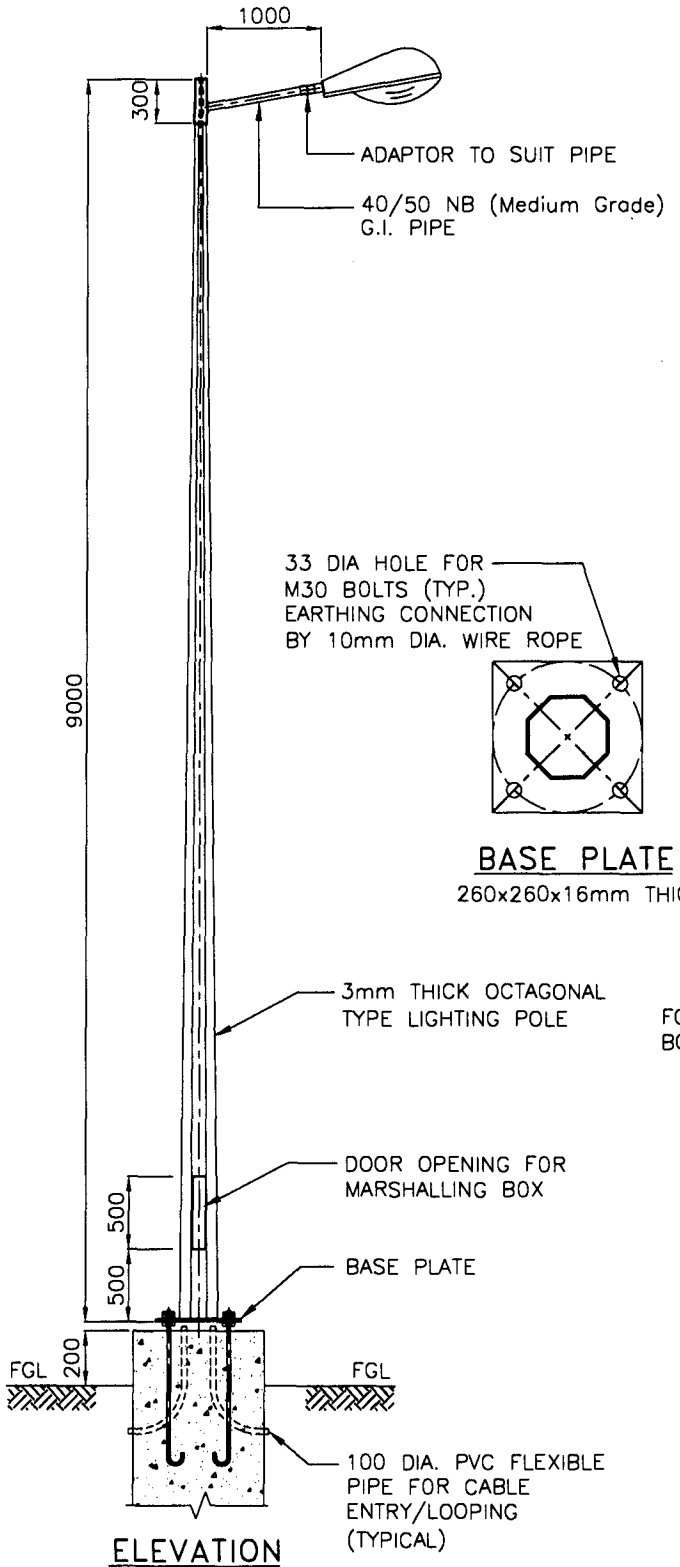
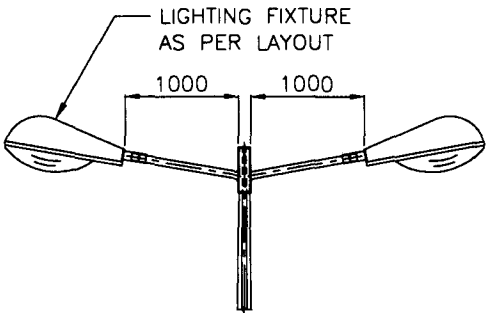


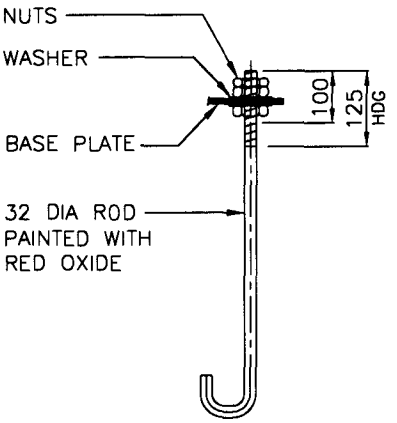
ELEVATION



ARRANGEMENT FOR TWO FIXTURES

BASE PLATE

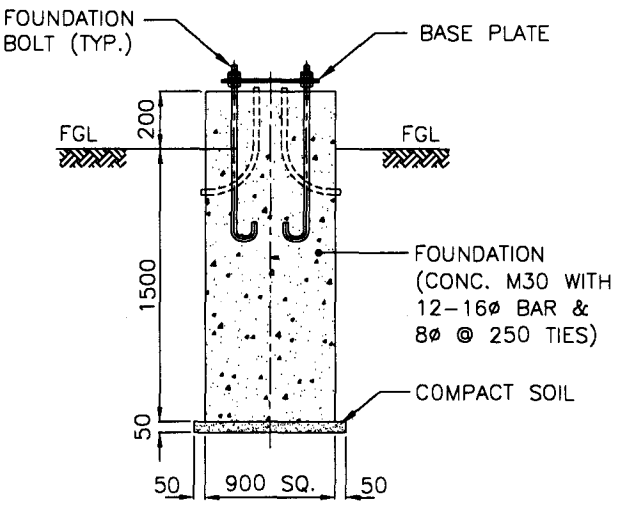
260x260x16mm THICK



FOUNDATION BOLT

4–M30x750 LONG

(HDG–HOT DIP GALVANISED)



PRECAST FOUNDATION

NOTES :

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2. THE LIGHTING POLE AND ACCESSORIES DETAILS SHOWN HERE ARE INDICATIVE ONLY. ACTUAL DESIGN & ARRANGEMENT SHALL BE AS PER MANUFACTURER'S DETAILS.

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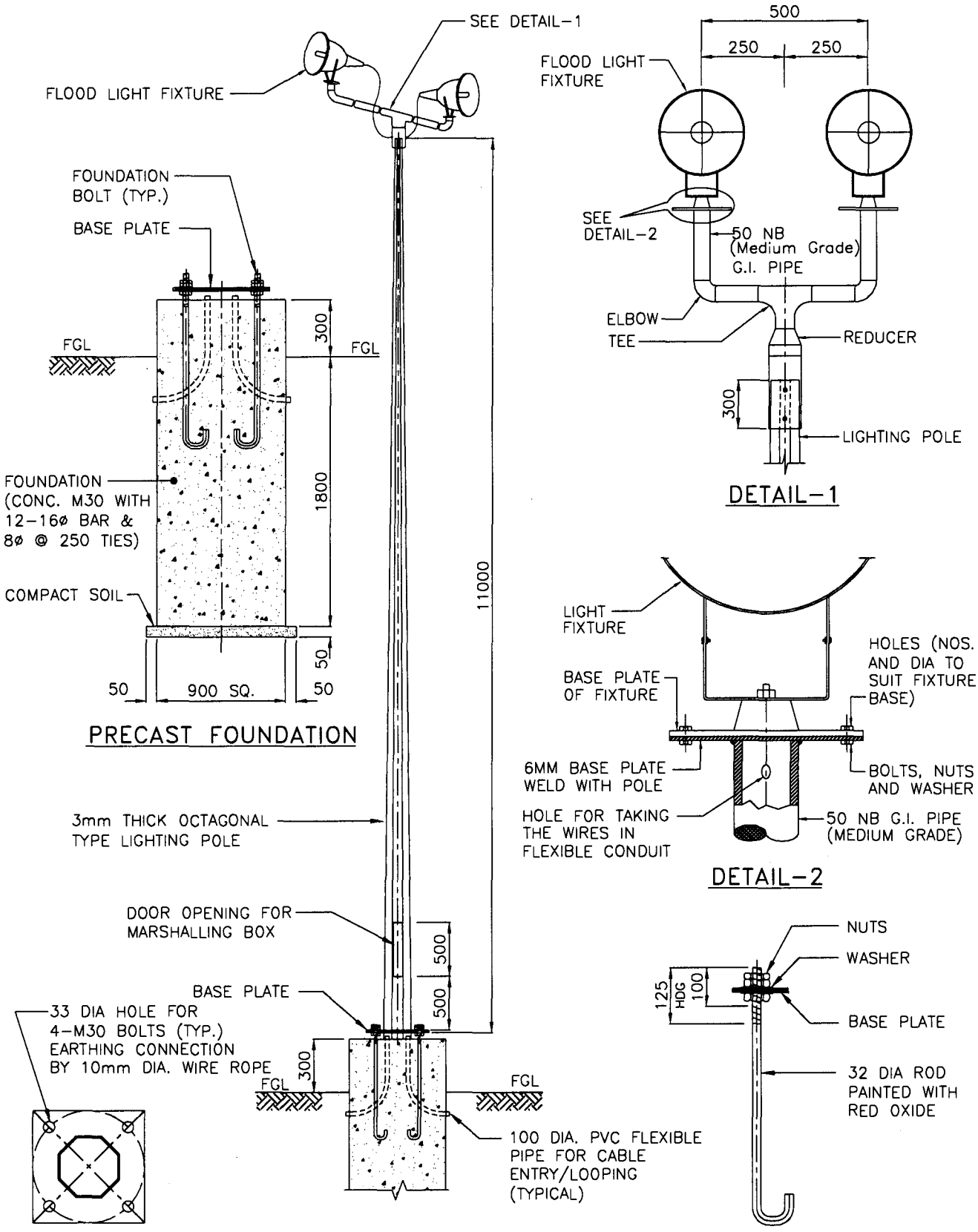

PRECAST FOUNDATION

DETAIL-1

DETAIL-2

BASE PLATE
350x350x16mm THICK

MOUNTING ARRANGEMENT FOR SAFE AREA LIGHTING FIXTURE

FOUNDATION BOLT
4-M30x900 LONG
(HDG-HOT DIP GALVANISED)

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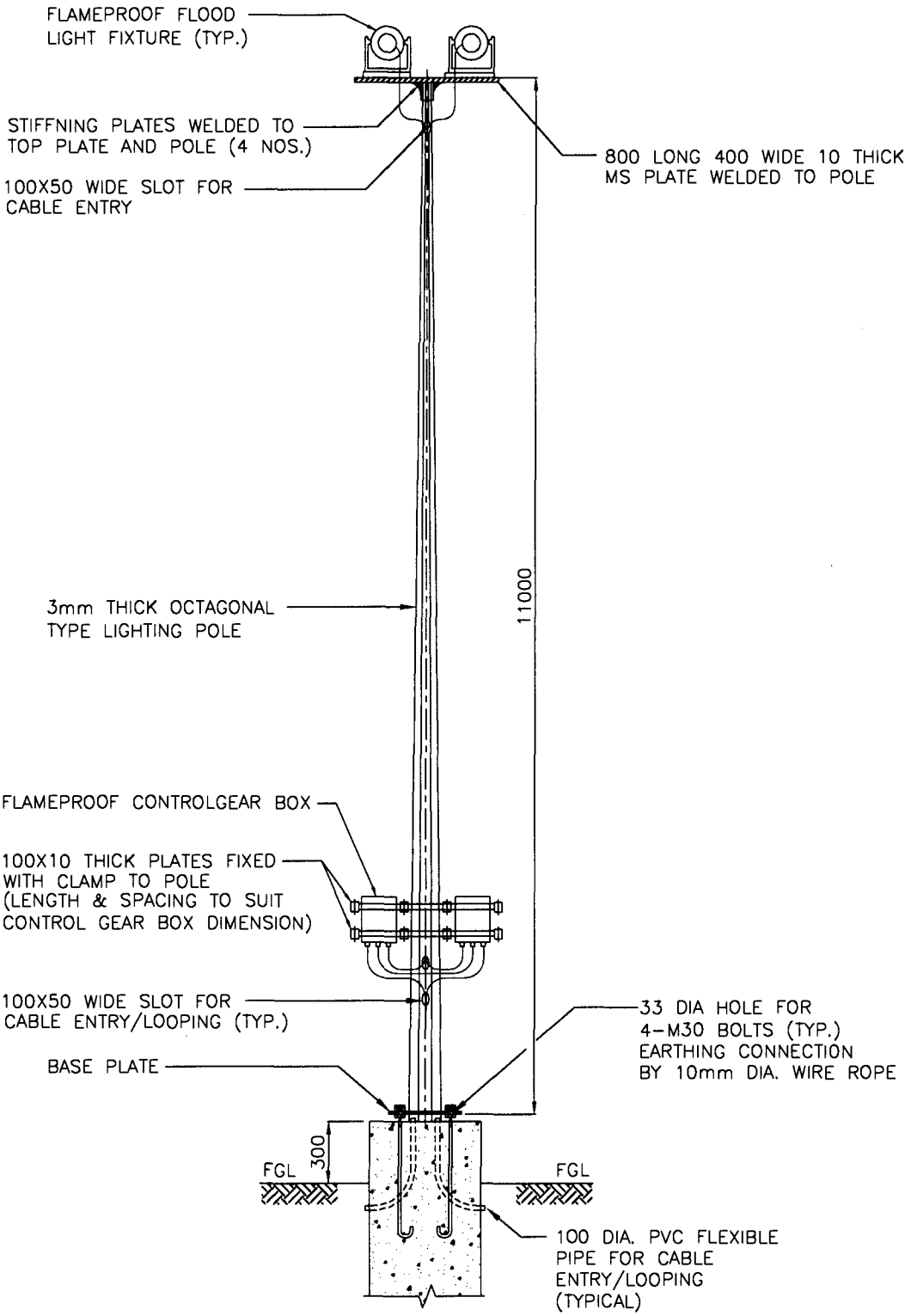

MOUNTING ARRANGEMENT FOR HAZARDOUS AREA LIGHTING FIXTURE

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. THE LIGHTING POLE AND ACCESSORIES DETAILS SHOWN HERE ARE INDICATIVE ONLY. ACTUAL DESIGN & ARRANGEMENT SHALL BE AS PER MANUFACTURER'S DETAILS.
3. 2 NOS. 25 DIA. HOLES SHALL BE PROVIDED ON OPPOSITE SIDE FOR FIXING OF MARSHALLING BOX ON ONE END AND CONTROL GEAR BOX ON OTHER END.

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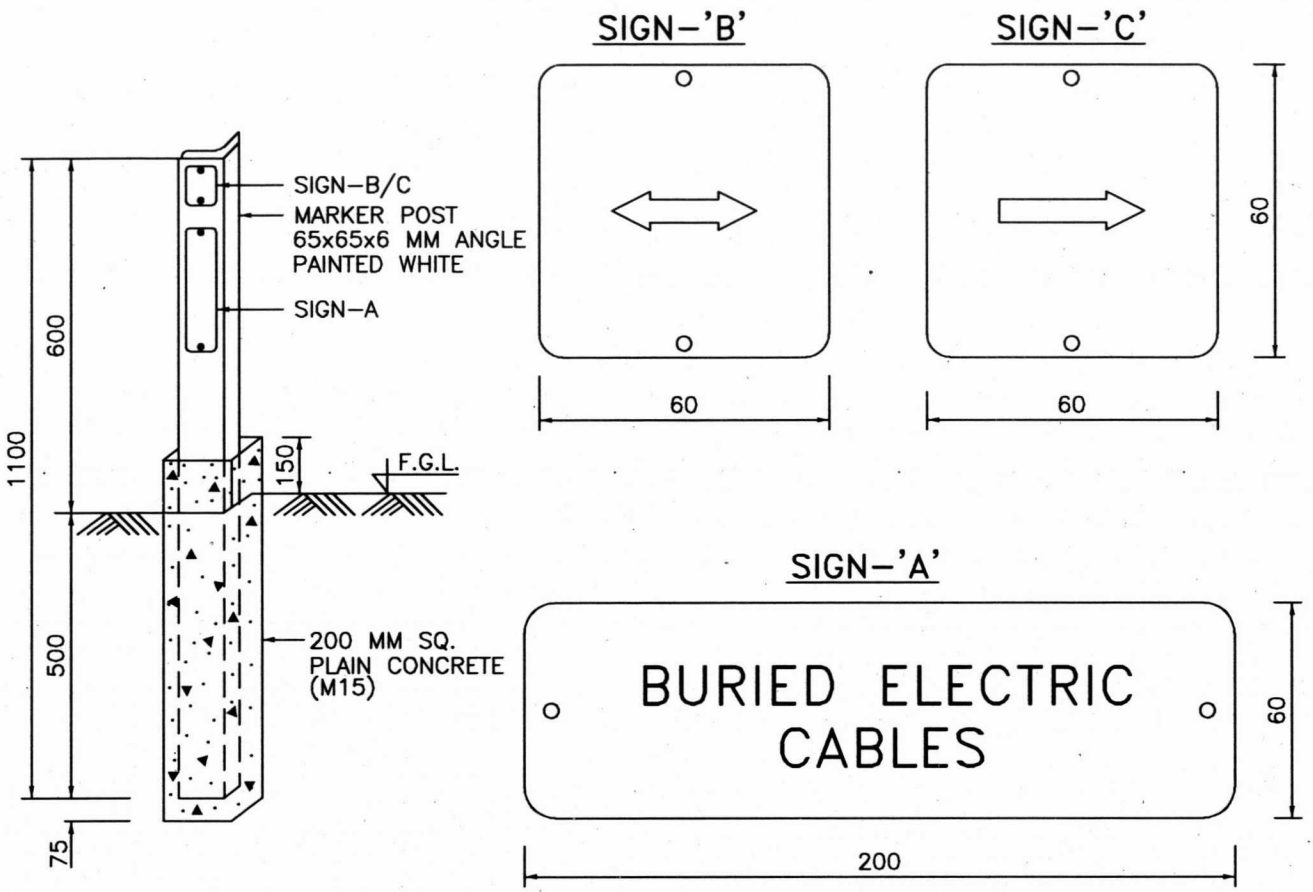
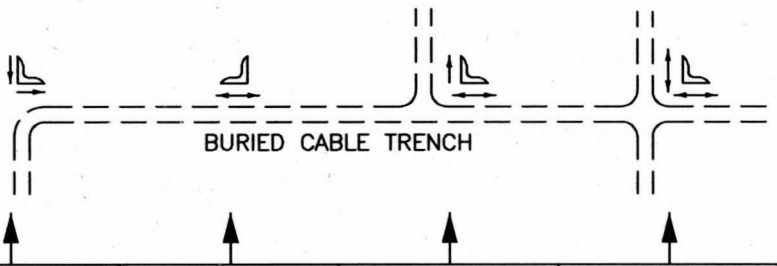


TYPICAL ARRANGEMENT OF MARKER

(SEE NOTE–2)



	ANGLE 65x65x6 1100 MM LONG	ANGLE 65x65x6 1100 MM LONG	ANGLE 65x65x6 1100 MM LONG	ANGLE 65x65x6 1100 MM LONG
ASSEMBLY CONSISTING OF	SIGN.–A–1 NO. SIGN.–C–2 NOS.	SIGN.–A–1NO. SIGN.–B–1NO.	SIGN.–A–1NO. SIGN.–B–1NO. SIGN.–C–1NO.	SIGN.–A–1NO. SIGN.–B–2NOS.

NOTES:–

1. ALL DIMENSIONS ARE IN MM.
2. TRENCHES SHALL BE MARKED AT ALL DIRECTION CHANGES, INTERSECTIONS AND STRAIGHT RUNS.
3. SIGN BOARDS SHALL BE MADE OF 14 GAUGE ENAMELLED STEEL PLATE. WHITE LETTERING SHALL BE ON JADE GREEN BACKGROUND.

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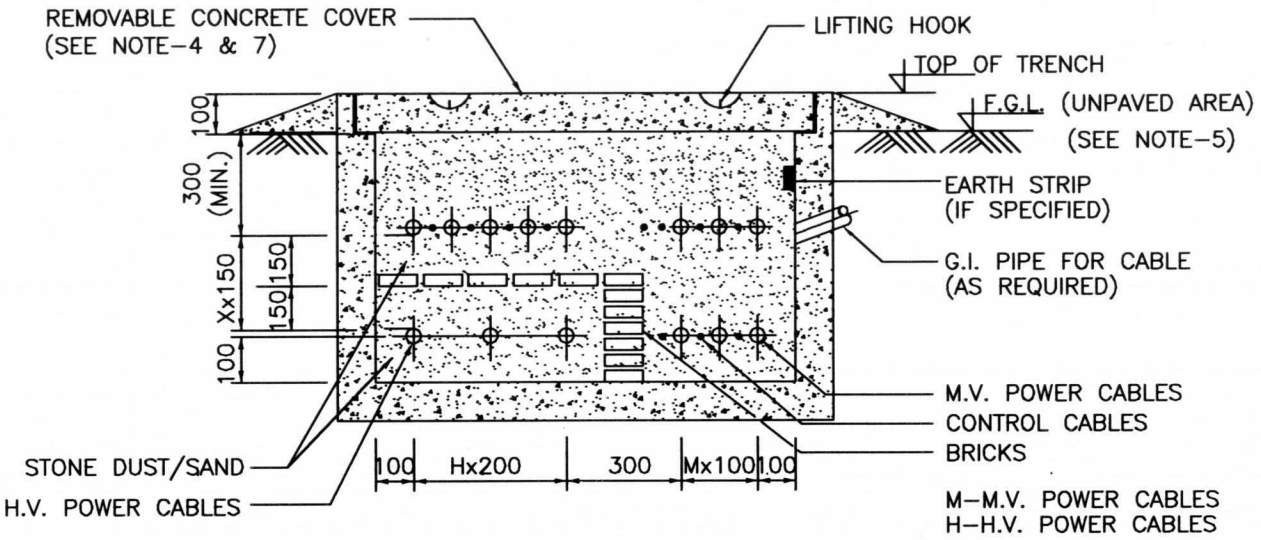
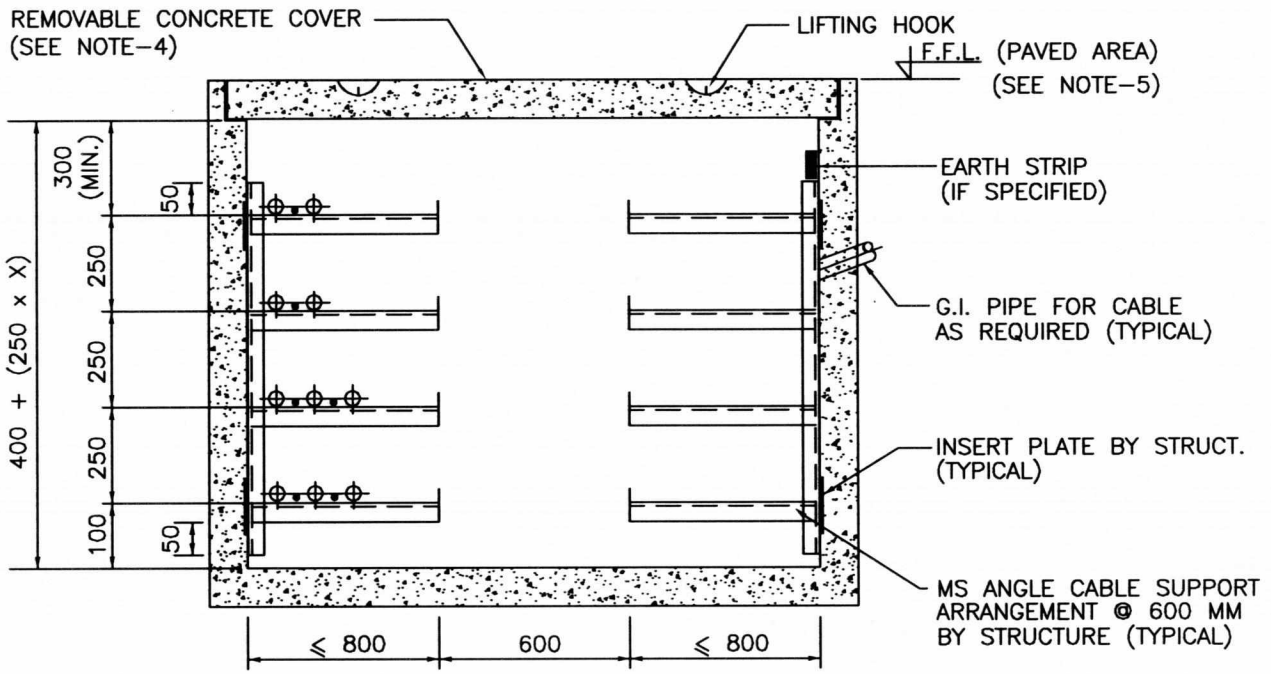
TYPICAL SECTION OF RCC CABLE TRENCH



TYPICAL SECTION OF RCC CABLE TRENCH WITHOUT RACKS



TYPICAL SECTION OF RCC CABLE TRENCH WITH RACKS

NOTES:–

1. ALL DIMENSIONS ARE IN MM.
2. WIDTH OF RACKS ON ONE SIDE OR BOTH SIDES SHALL BE DECIDED AS PER JOB REQUIREMENT.
3. THE EXACT HEIGHT OF OPENING IN TRENCH WALL FOR G.I. PIPE FOR TAKING CABLE SHALL BE SUITABLY DECIDED AT SITE.
4. THE REMOVABLE CONCRETE COVERS SHALL BE SEALED WITH MASTIC ASPHALT FILLER / BITUMEN TO PREVENT INGRESS OF WATER / HYDROCARBONS IN CABLE TRENCH.
5. TOP OF THE TRENCH SHALL BE 100 MM ABOVE FINISHED GRADE LEVEL (F.G.L.) IN CASE OF UNPAVED AREAS AND SHALL BE FLUSHED WITH FINISHED FLOOR LEVEL (F.F.L.) IN CASE OF PAVED AREAS.
6. MINIMUM GAP OF 250MM SHALL BE PROVIDED BETWEEN FA / COMMUNICATION / TELEPHONE CABLES AND ALL OTHER POWER / CONTROL CABLES.
7. INSTEAD OF REMOVABLE CONCRETE COVER, PCC/LEAN CONCRETE SHALL BE PROVIDED IF SPECIFIED IN JOB SPECIFICATION. THE THICKNESS OF PCC SHALL BE MININUM 100mm OR AS SPECIFIED IN STRUCTURAL SPECIFICATION.

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7	15.09.22	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	MKS	SM
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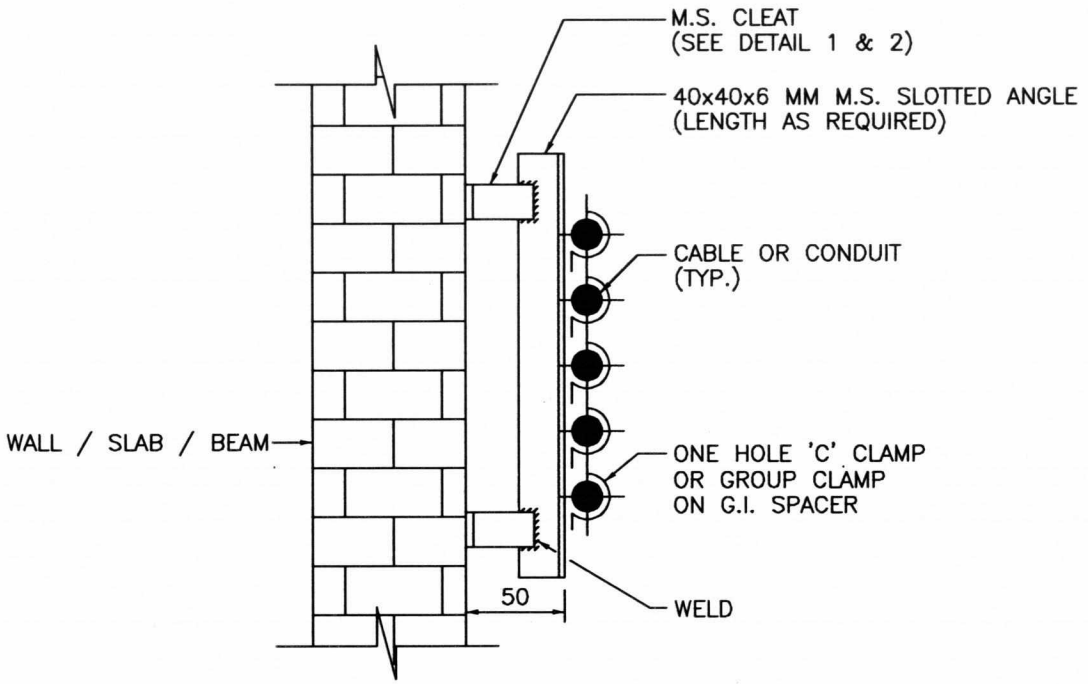
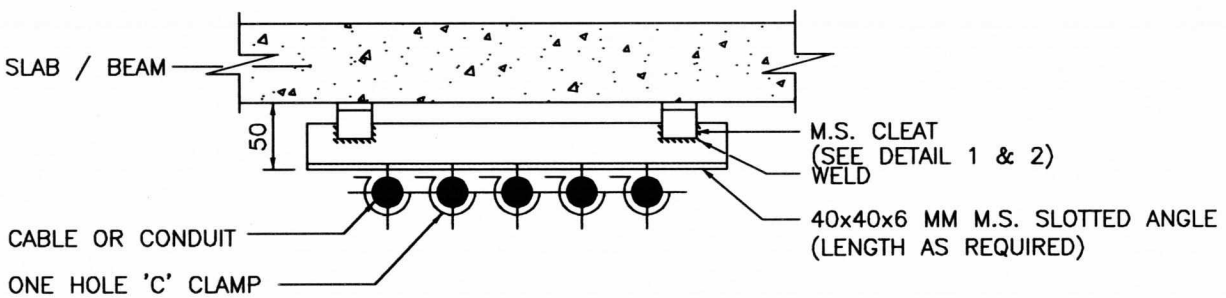
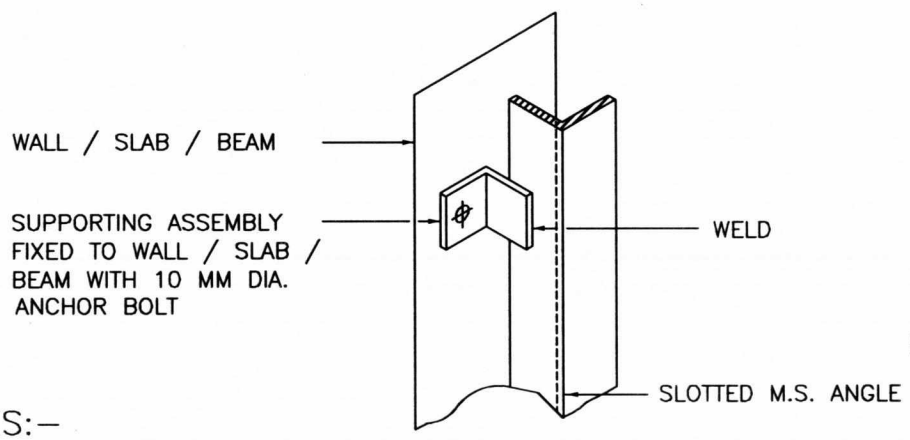


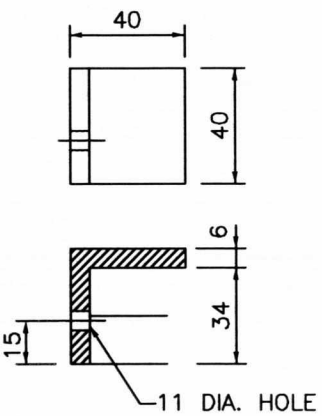
SUPPORT ON WALL



SUPPORT ON SLAB / BEAM



DETAIL–1



DETAIL–2
M.S. CLEAT

NOTES:–

1. ALL DIMENSIONS ARE IN MM.

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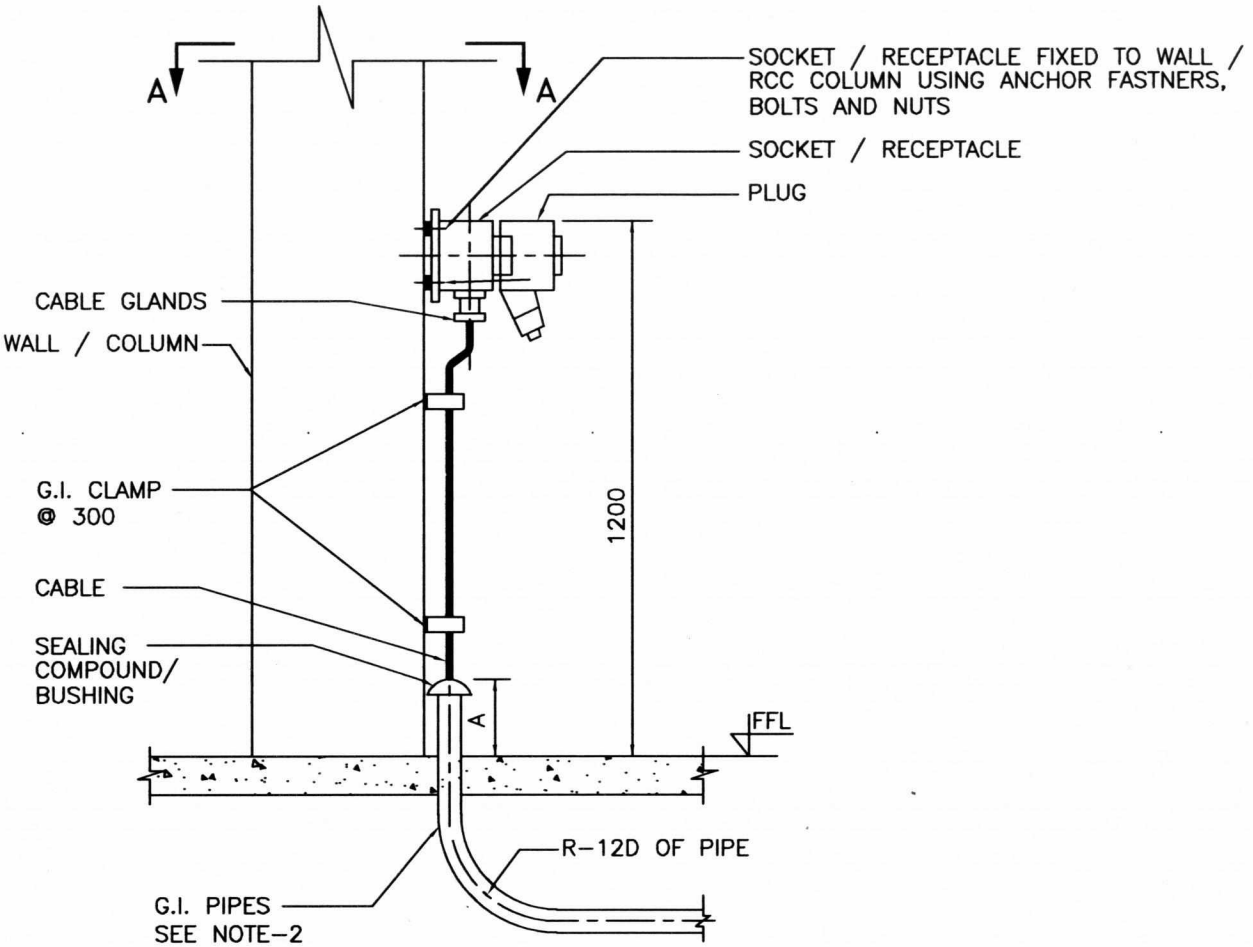
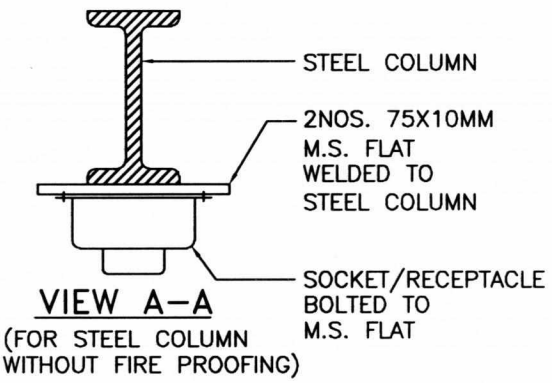
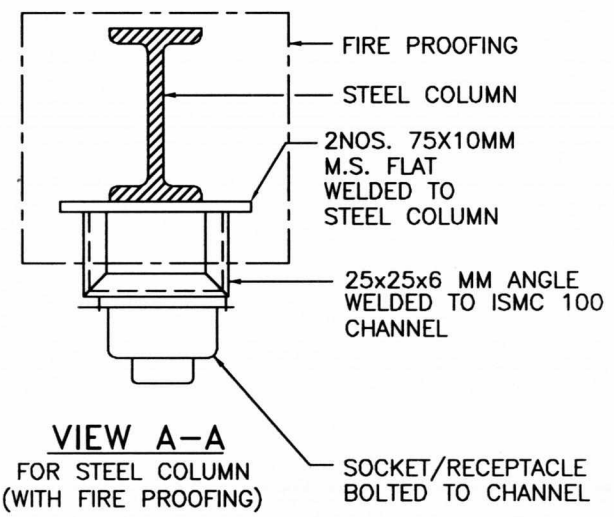




VIEW A-A
(FOR STEEL COLUMN WITHOUT FIRE PROOFING)

A = 150 MM (MIN.) FOR INDOOR LOCATIONS.
300 MM (MIN.) FOR OUTDOOR LOCATIONS.



VIEW A-A
FOR STEEL COLUMN (WITH FIRE PROOFING)

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. QUANTITY AND SIZE OF PIPE SLEEVES SHALL BE AS PER LAYOUT DRAWINGS.
3. WHERE STEEL STRUCTURES ARE ENCOUNTERED, SOCKET / RECEPTACLE SHALL BE MOUNTED ON SUITABLE ANGLE IRON FRAME WELDED TO STEEL STRUCTURE.
4. WHERE FIRE PROOFING COLUMNS / STRUCTURES ARE ENCOUNTERED SOCKET / RECEPTACLE AND CABLE SHALL BE INSTALLED ON A SUITABLE DEEP LEGGED ANGLE IRON FRAME / DISTANCE BRACKET.

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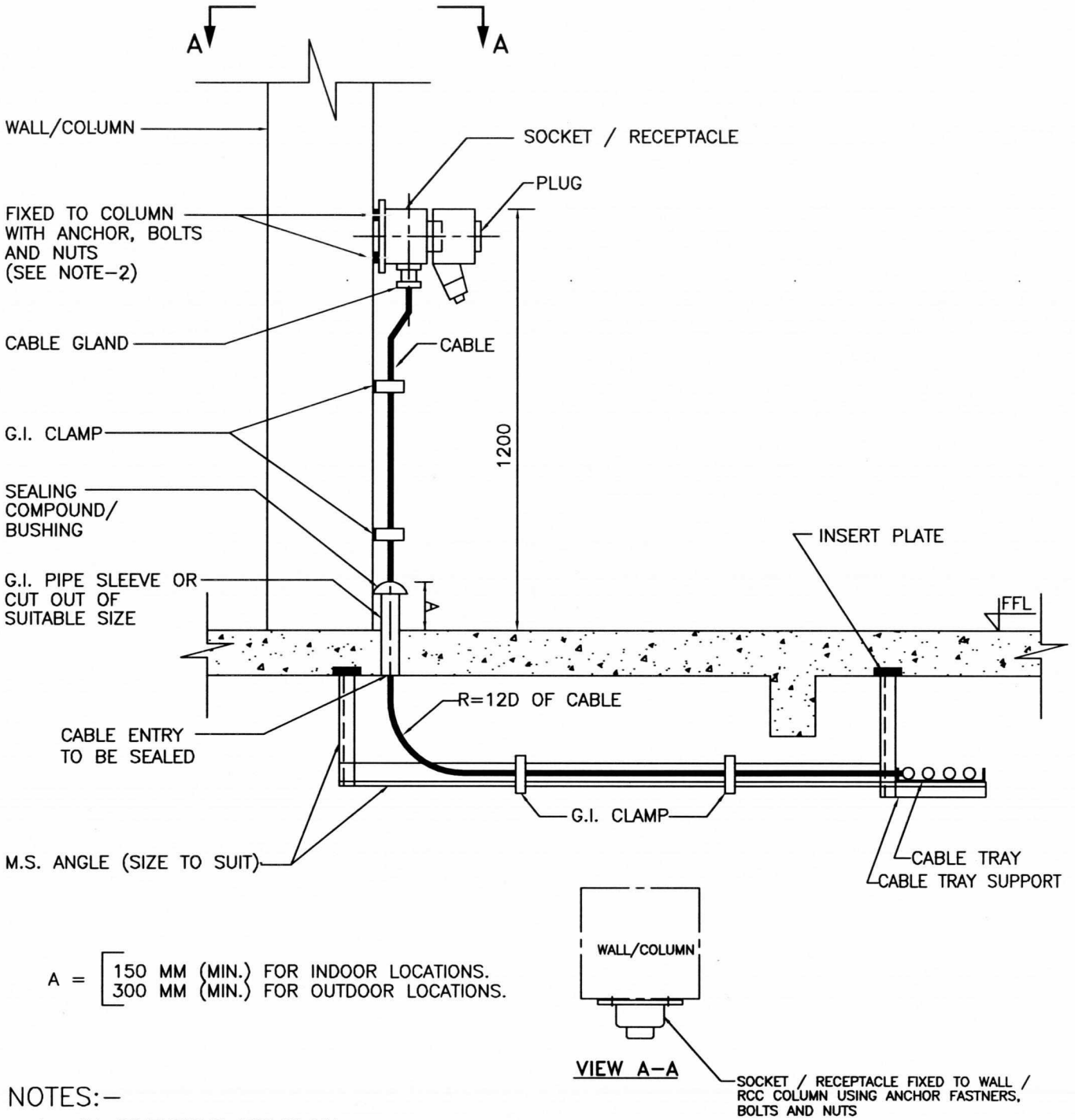

A = 150 MM (MIN.) FOR INDOOR LOCATIONS.
300 MM (MIN.) FOR OUTDOOR LOCATIONS.

VIEW A-A

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. WHERE STEEL STRUCTURES ARE ENCOUNTERED, SOCKET / RECEPTACLE SHALL BE MOUNTED ON SUITABLE ANGLE IRON FRAME WELDED TO STEEL STRUCTURE.
3. WHERE FIRE PROOFING COLUMNS / STRUCTURES ARE ENCOUNTERED SOCKET / RECEPTACLE AND CABLE SHALL BE INSTALLED ON A SUITABLE DEEP LEGGED ANGLE IRON FRAME / DISTANCE BRACKET.
4. QUANTITY AND SIZE OF PIPE SLEEVES SHALL BE AS PER LAYOUT DRAWINGS.

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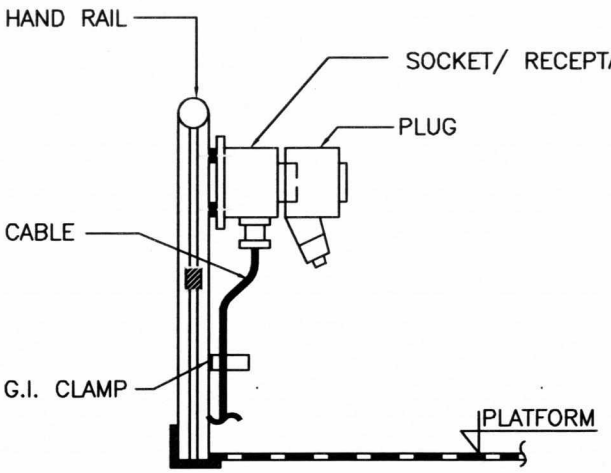

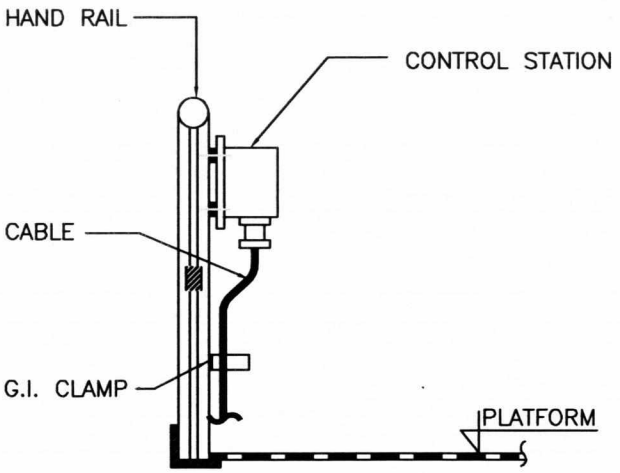

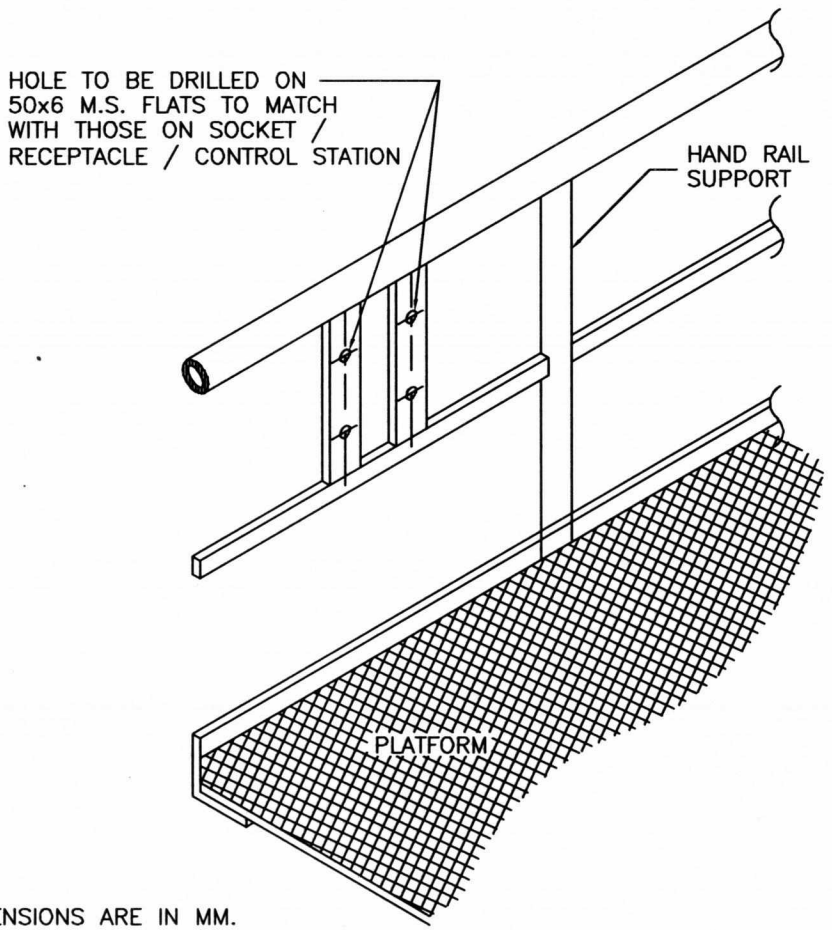

NOTES:–

1. ALL DIMENSIONS ARE IN MM.
2. CABLE SHALL NOT BE ROUTED ALONG HAND RAIL.

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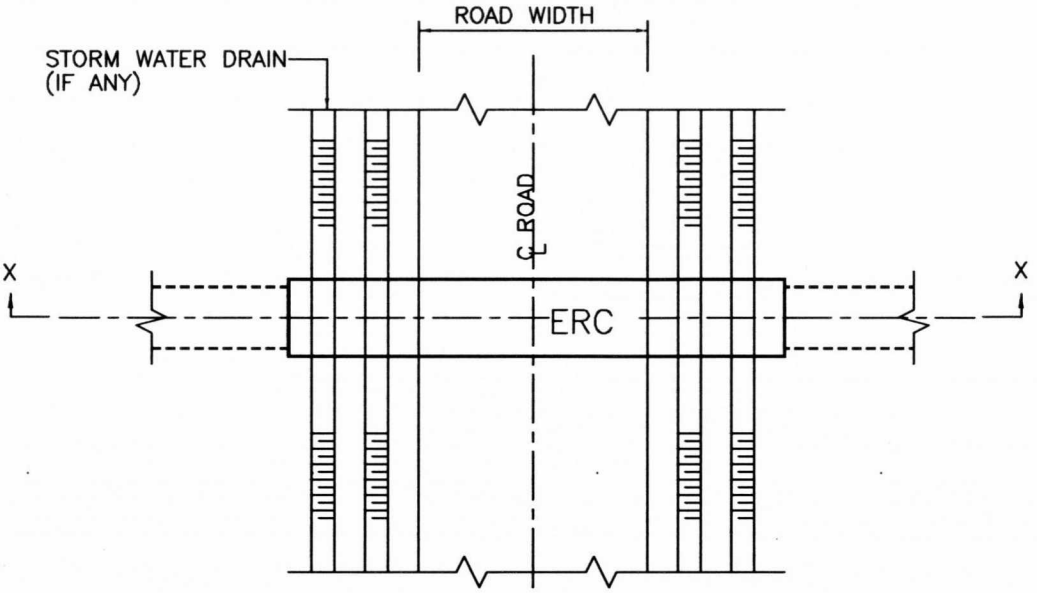
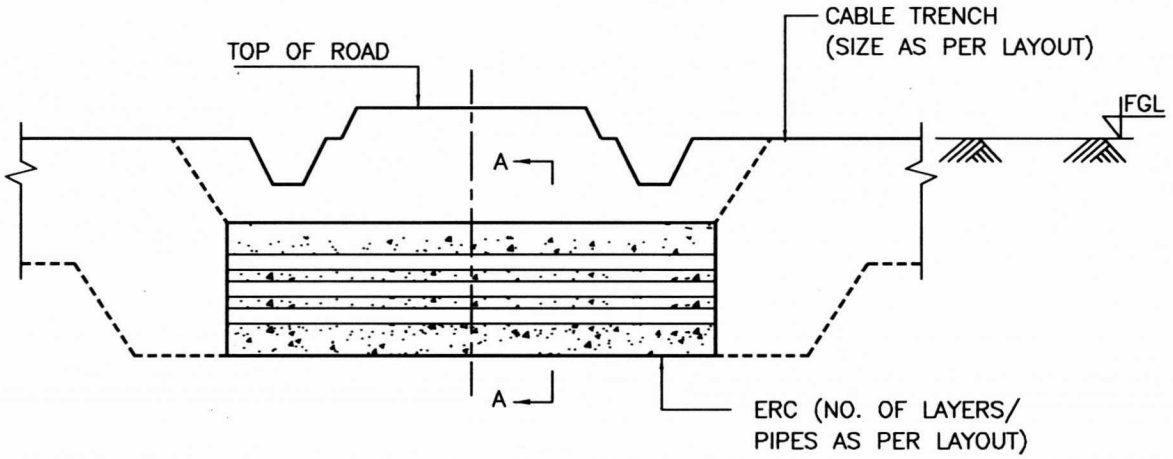
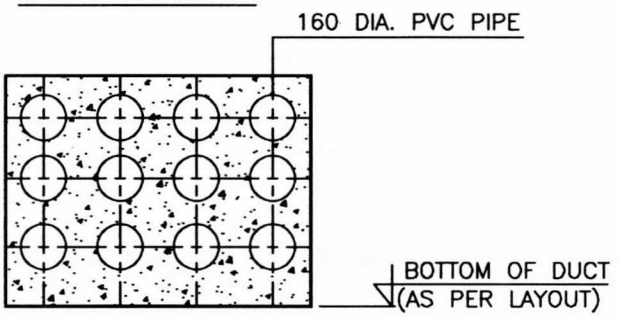


PLAN



SECTION X–X



SECTION A–A (ERC)

(AS PER STRUCTURAL STD.)

NOTES:–

1. ALL DIMENSIONS ARE IN MM.

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					Approved by	
5	15.09.22	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	MKS	SM
4	14.03.18	UPDATED & ISSUED AS STANDARD	RSD	VKS/HK	BRB	RN
3	21.11.13	REVISED & REISSUED AS STANDARD	BP	FA/SA	UAP/JMS	SC

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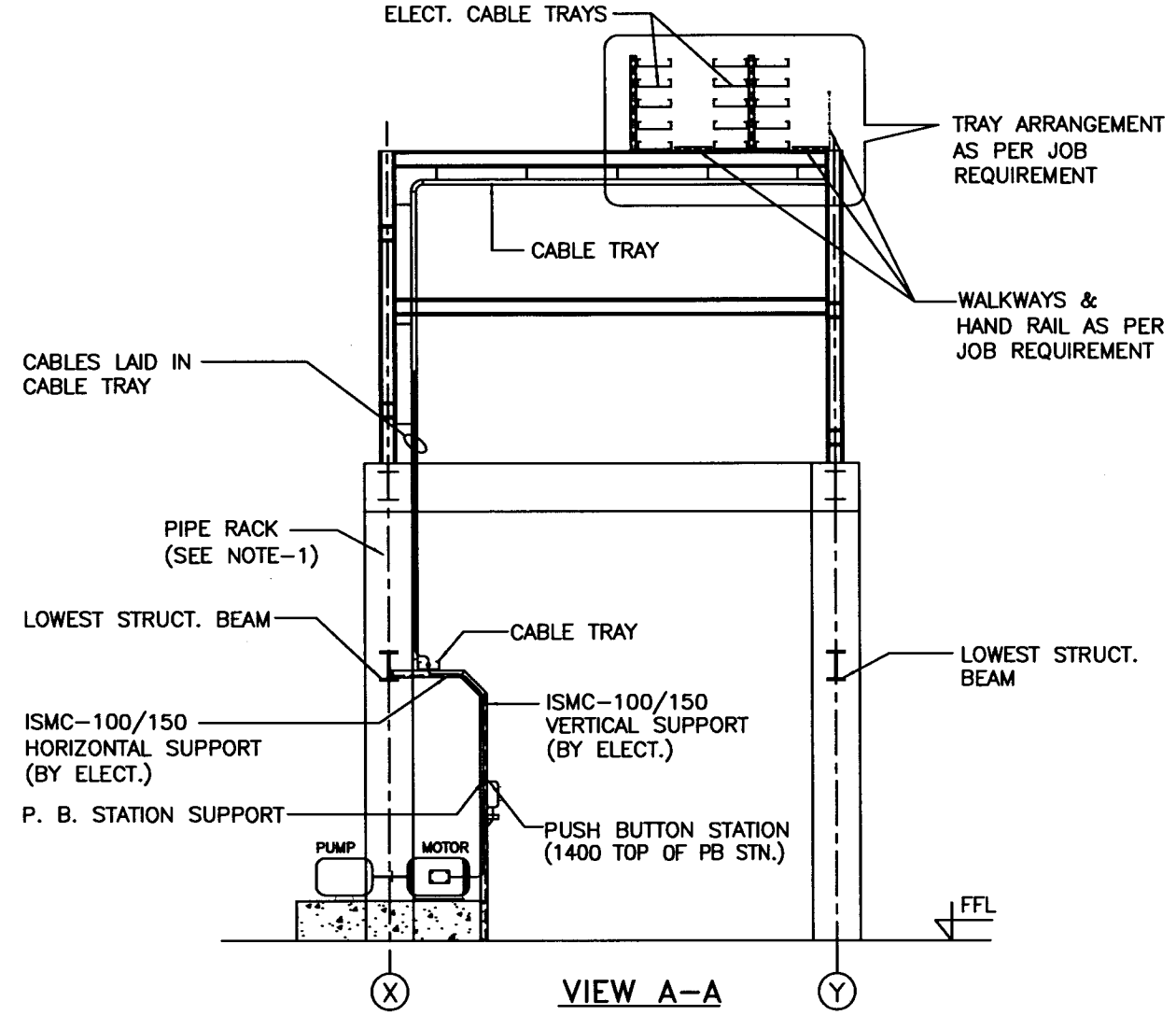
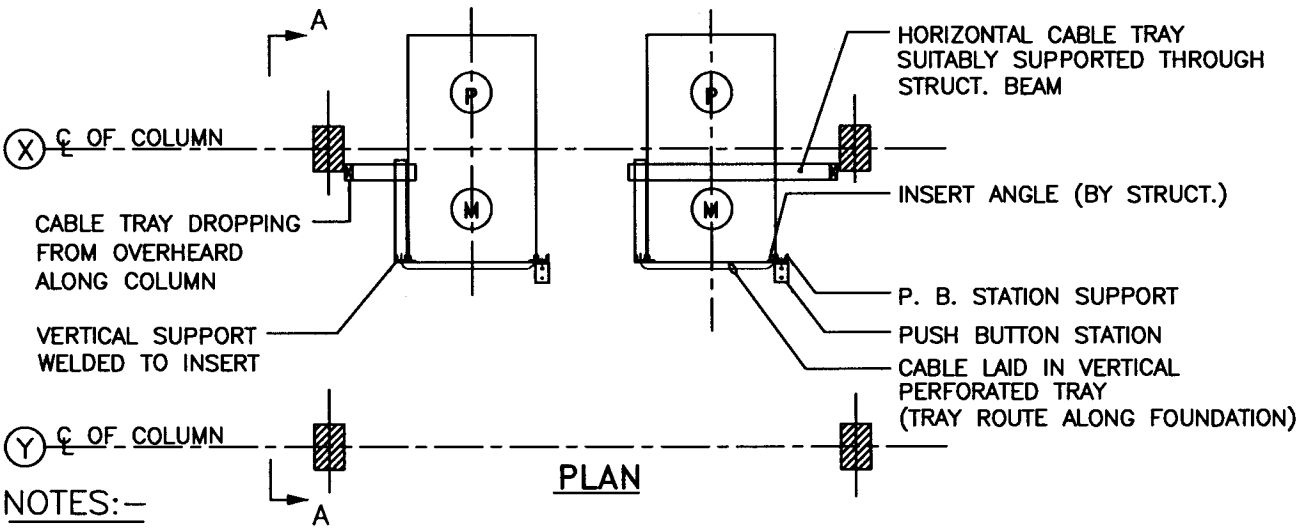


VIEW A-A



PLAN

NOTES:-

1. IN CASE OF COMPLETE STEEL PIPE RACK, SUITABLE CLEATS FOR CABLE TRAY SUPPORTS SHALL BE PROVIDED AT SUITABLE INTERVALS BEFORE FIRE PROOFING.

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5	16.06.21	REVISED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
4	04.04.16	REVISED & ISSUED AS STANDARD	BP	FA/SA	BRB	RN
3	21.11.13	REVIED & REISSUED AS STANDARD	BP	FA/SA	UAP/JMS	SC

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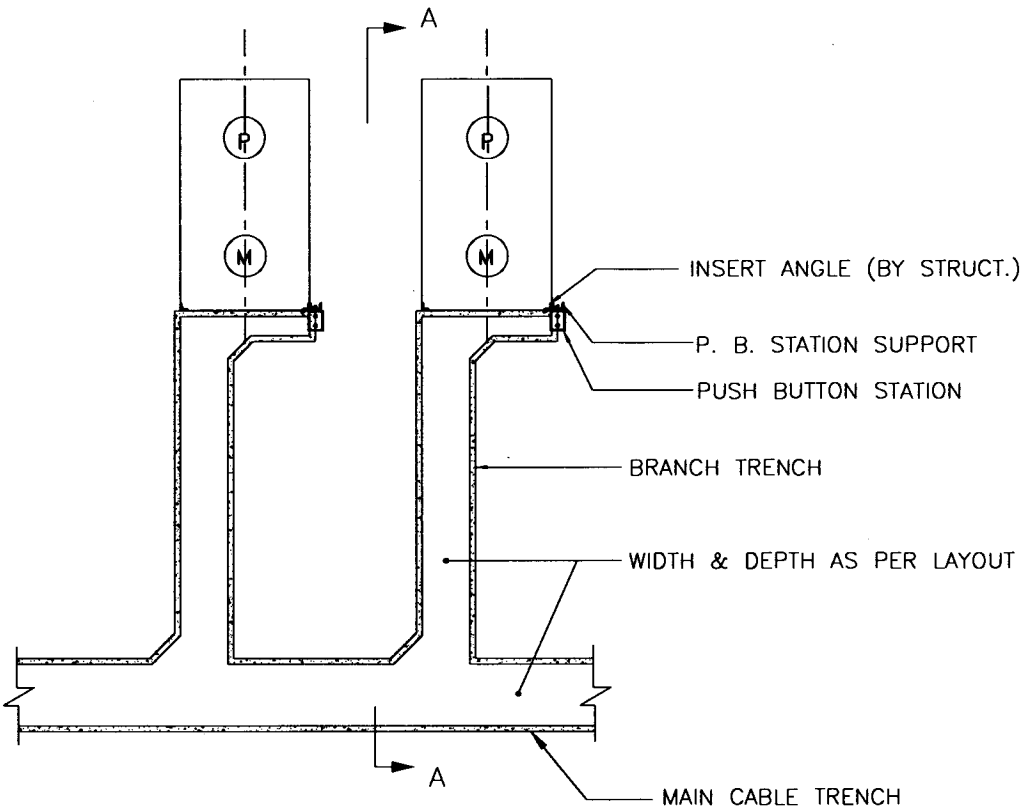

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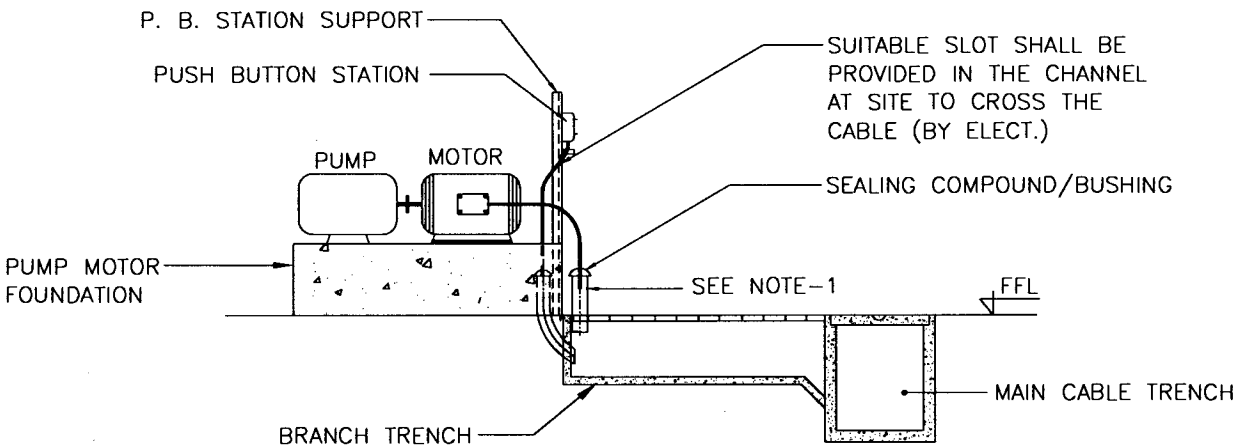

SECTION A-A

NOTES:-

1. CABLE SHALL BE LAID IN SUITABLE SIZE OF G.I. PIPES .
2. CABLE TRENCH SHALL BE FILLED WITH SAND AFTER LAYING OF CABLES IN HAZARDOUS AREA (BY THE ELECTRICAL CONTRACTOR).

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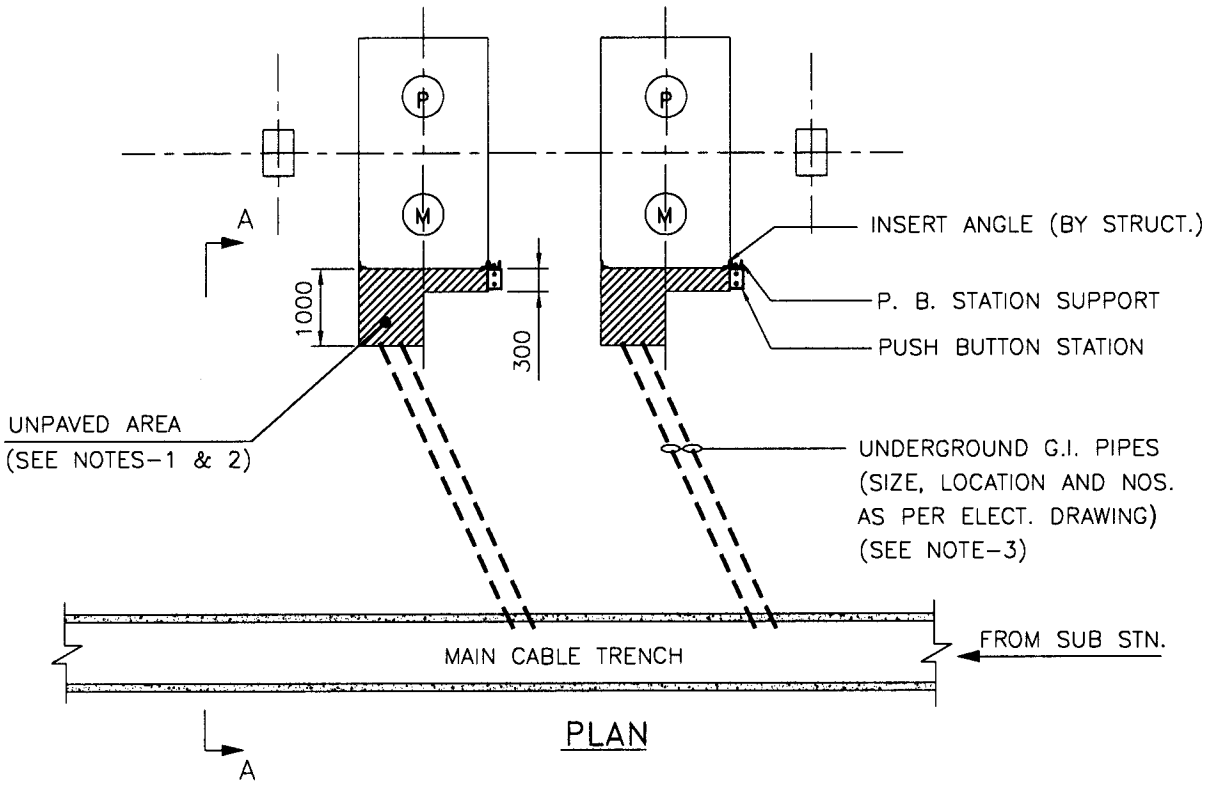

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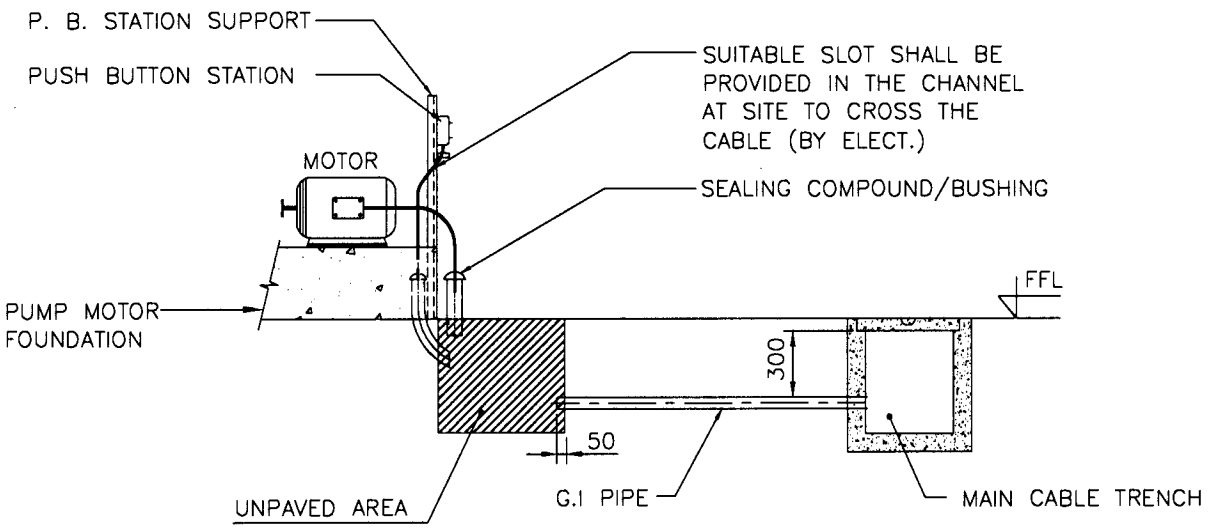

SECTION A-A

NOTES:-

1. AREA SHOWN AS HATCHED NEAR EACH PUMP MOTOR FOUNDATION SHALL BE LEFT UNPAVED BY PAVEMENT CONTRACTOR.
2. CABLES LAYING & SAND / LEAN CONCRETE FILLING IN THIS UNPAVED AREA SHALL BE DONE BY ELECTRICAL CONTRACTOR.
3. CIVIL CONTRACTOR SHALL PROVIDE G.I PIPES AND PLUG BOTH ENDS OF THE PIPES WITH PVC BUSHINGS.

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ELECTRICAL POWER IS THE MAINSTAY OF ANY CONSTRUCTION ACTIVITY. AT THE SAME TIME IT REQUIRES UTMOST CARE IN IT'S UTILISATION TO AVOID ACCIDENTS DUE TO ELECTRICAL SHOCK, FIRE INCIDENTS OR ELECTRIC SHORT CIRCUITS. EXPOSURE OF ELECTRICAL INSTALLATION TO ADVERSE ENVIRONMENTAL CONDITIONS INCREASE THE RISK OF SUCH ACCIDENTS. HENCE IT IS NECESSARY TO TAKE EXTRA PRECAUTIONS FOR SUCH INSTALLATIONS TO ENSURE SAFETY OF PERSONNEL AND EQUIPMENT. THIS STANDARD ADDRESSES THE SAFETY MEASURES REQUIRED TO BE ADOPTED FOR THE ELECTRICAL INSTALLATIONS BY ALL CONTRACTORS DURING CONSTRUCTION PHASE.

1. ALL ELECTRICAL CONNECTIONS/WORK FOR ELECTRICAL INSTALLATIONS SHALL BE CARRIED OUT AS PER PROVISIONS OF THE LATEST REVISION OF THE FOLLOWING CODES AND STANDARDS IN ADDITION TO THE REQUIREMENTS OF STATUTORY AUTHORITIES AND CEA REGULATIONS–2010.
   OISD–STD–173 : FIRE PREVENTION AND PROTECTION SYSTEM FOR ELECTRICAL INSTALLATIONS.
   OISD–STD–192 : SAFETY PRACTICE DURING CONSTRUCTION.
   SP–30 (BIS) : NATIONAL ELECTRIC CODE.
   THE INSTALLATION SHALL HAVE APPROVAL FROM CONCERNED STATUTORY AUTHORITIES.
2. ALL ELECTRICAL CONNECTIONS SHALL BE DONE BY AN ELECTRICIAN WITH VALID LICENCE AND TO THE SATISFACTION OF ENGINEER–IN–CHARGE.
3. ONE COMPETENT LICENCED ELECTRICIAN SHALL BE MADE AVAILABLE BY CONTRACTOR AT SITE ROUND THE CLOCK TO ATTEND TO THE NORMAL/EMERGENCY JOBS.
4. ALL SWITCH BOARDS/WELDING MACHINES SHALL BE KEPT IN WELL VENTILATED & COVERED SHED. THE SHED SHALL BE ELEVATED TO AVOID WATER LOGGING. NO FLAMMABLE MATERIALS SHALL BE USED FOR CONSTRUCTING THE SHED. ALSO FLAMMABLE MATERIALS SHALL NOT BE STORED IN AND AROUND ELECTRICAL EQUIPMENT/SWITCHBOARD. ADEQUATE CLEARANCES AND OPERATIONAL SPACE SHALL BE PROVIDED AROUND THE EQUIPMENT.
5. FIRE EXTINGUISHERS AND INSULATING MATS SHALL BE PROVIDED IN ALL POWER DISTRIBUTION CENTERS.
6. TEMPORARY ELECTRICAL EQUIPMENT SHALL NOT BE EMPLOYED IN HAZARDOUS AREAS WITHOUT OBTAINING SAFETY PERMIT.
7. PROPER HOUSE KEEPING SHALL BE DONE AROUND THE ELECTRICAL INSTALLATIONS.
8. ALL TEMPORARY INSTALLATIONS SHALL BE TESTED BEFORE ENERGISING, TO ENSURE PROPER EARTHING, BONDING, SUITABILITY OF PROTECTION SYSTEM, ADEQUACY OF FEEDERS/CABLES ETC.
9. ALL WELDERS SHALL USE HAND GLOVES IRRESPECTIVE OF HOLDER VOLTAGE.
10. MULTILINGUAL (ENGLISH, HINDI AND LOCAL LANGUAGE) CAUTION BOARDS, SHOCK TREATMENT CHARTS AND INSTRUCTION PLATE CONTAINING LOCATION OF ISOLATION POINT FOR INCOMING SUPPLY, NAME & TELEPHONE NO. OF CONTACT PERSON IN EMERGENCY SHALL BE PROVIDED IN SUBSTATIONS AND NEAR ALL DISTRIBUTION BOARDS/LOCAL PANELS.
11. OPERATION OF EARTH LEAKAGE DEVICE SHALL BE CHECKED REGULARLY BY PORTABLE ELCB/RCCB TESTER.
12. THE FOLLOWING DESIGN FEATURES SHALL BE ENSURED FOR ALL ELECTRICAL INSTALLATIONS DURING CONSTRUCTION PHASE.

12.1 EACH INSTALLATION SHALL HAVE A MAIN SWITCH WITH A PROTECTIVE DEVICE, INSTALLED IN AN ENCLOSURE ADJACENT TO THE METERING POINT. THE OPERATING HEIGHT OF THE MAIN SWITCH SHALL NOT EXCEED 1.5 M. THE MAIN SWITCH SHALL BE CONNECTED TO THE POINT OF SUPPLY BY MEANS OF ARMOURED CABLE.

12.2 THE OUTGOING FEEDERS SHALL BE DOUBLE OR TRIPLE POLE SWITCHES WITH FUSES/MCBs. LOADS IN A THREE PHASE CIRCUIT SHALL BE BALANCED AS FAR AS POSSIBLE AND LOAD ON NEUTRAL SHOULD NOT EXCEED 20% OF LOAD IN THE PHASE.

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2	02.03.12	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP/JMS	DM

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12.3 THE INSTALLATION SHALL BE ADEQUATELY PROTECTED AGAINST OVERLOAD, SHORT CIRCUIT AND EARTH LEAKAGE BY THE USE OF SUITABLE PROTECTIVE DEVICES. FUSES WHEREVER USED SHALL BE HRC TYPE. USE OF REWIRABLE FUSES SHALL BE STRICTLY PROHIBITED. THE EARTH LEAKAGE DEVICE SHALL HAVE AN OPERATING CURRENT NOT EXCEEDING 30 mA.

12.4 ALL CONNECTIONS TO THE HANDTOOLS/WELDING RECEPTACLES SHALL BE TAKEN THROUGH PROPER SWITCHES, SOCKETS AND PLUGS.

12.5 ALL SINGLE PHASE SOCKETS SHALL BE MINIMUM 3 PIN TYPE ONLY. ALL UNUSED SOCKETS SHALL BE PROVIDED WITH SOCKET CAPS.

12.6 ONLY 3 CORE (P+N+E) OVERALL SHEATHED FLEXIBLE CABLES WITH MINIMUM CONDUCTOR SIZE OF 1.5 MM^2 COPPER SHALL BE USED FOR ALL HAND TOOLS.

12.7 ONLY METALLIC DISTRIBUTION BOXES WITH DOUBLE EARTHING SHALL BE USED AT SITE. NO WOODEN BOXES SHALL BE USED.

12.8 ALL POWER CABLES SHALL BE TERMINATED WITH COMPRESSION TYPE NICKEL PLATED BRASS CABLE GLANDS. LUGS OF COPPER/ALUMINIUM/BIMETALLIC MATERIAL, AS APPLICABLE SHALL BE USED FOR MULTISTRAND WIRES/CABLES HAVING MUTISTRAND/SOLID CONDUCTOR.

12.9 CABLES SHALL BE FREE FROM ANY INSULATION DAMAGE.

12.10 CABLES SHALL BE LAID IN UNDERGROUND AT A MINIMUM DEPTH OF 750 MM, FOR LV & CONTROLS AND 900MM FOR HV CABLES COVERED WITH SAND, BRICK AND SOIL FOR ENSURING MECHANICAL PROTECTION. CABLES SHALL NOT BE LAID IN WATER LOGGED AREA AS FAR AS PRACTICABLE. CABLE ROUTE MARKERS SHALL BE PROVIDED AT EVERY 25 M OF BURIED TRENCH ROUTE. WHEN LAID ABOVE GROUND, CABLES SHALL BE PROPERLY CLEATED OR SUPPORTED ON RIGID POLES OF ATLEAST 2.1 M HIGH. MINIMUM HEAD CLEARANCE OF 6 METERS SHALL BE PROVIDED AT ROAD CROSSING.

12.11 UNDER GROUND CABLES SHALL NOT BE ALLOWED TO CROSS THE ROADS WITHOUT PIPE SLEEVE.

12.12 ALL CABLE JOINTS SHALL BE DONE WITH PROPER JOINTING KIT. NO TAPED/TEMPORARY JOINTS SHALL BE USED.

12.13 AN INDEPENDENT EARTHING FACILITY SHOULD PREFERABLY BE ESTABLISHED WITHIN THE TEMPORARY INSTALLATION PREMISES. ALL APPLIANCES AND EQUIPMENT SHALL BE ADEQUATELY EARTHED. IN CASE ARMOURED CABLES ARE USED, THE ARMOUR SHALL BE BONDED TO THE EARTHING SYSTEM.

12.14 ALL CABLES AND WIRE ROPE USED FOR EARTH CONNECTIONS SHALL BE TERMINATED THROUGH LUGS OF TINNED COPPER/ALUMINIUM/ BIMETALLIC MATERIAL, AS APPLICABLE.

12.15 IN CASE OF LOCAL EARTHING, EARTH ELECTRODES SHALL BE BURIED NEAR THE SUPPLY POINT AND EARTH CONTINUITY WIRE SHALL BE CONNECTED TO LOCAL EARTH PLATE FOR FURTHER DISTRIBUTION TO VARIOUS APPLIANCES. ALL INSULATED WIRES FOR EARTH CONNECTION SHALL HAVE INSULATION OF GREEN COLOUR.

12.16 SEPARATE CORE SHALL BE PROVIDED FOR NEUTRAL. EARTH/STRUCTURES SHALL NOT BE USED AS A NEUTRAL IN ANY CASE.

12.17 ON/OFF POSITION OF ALL SWITCHES SHALL BE CLEARLY DESIGNATED/PAINTED FOR EASY ISOLATION IN EMERGENCY.

13. ALL INSULATIONS AND ELECTRICAL INSTALLATIONS SHALL BE INSPECTED BY ENGINEER-IN-CHARGE ATLEAST ONCE IN A MONTH.

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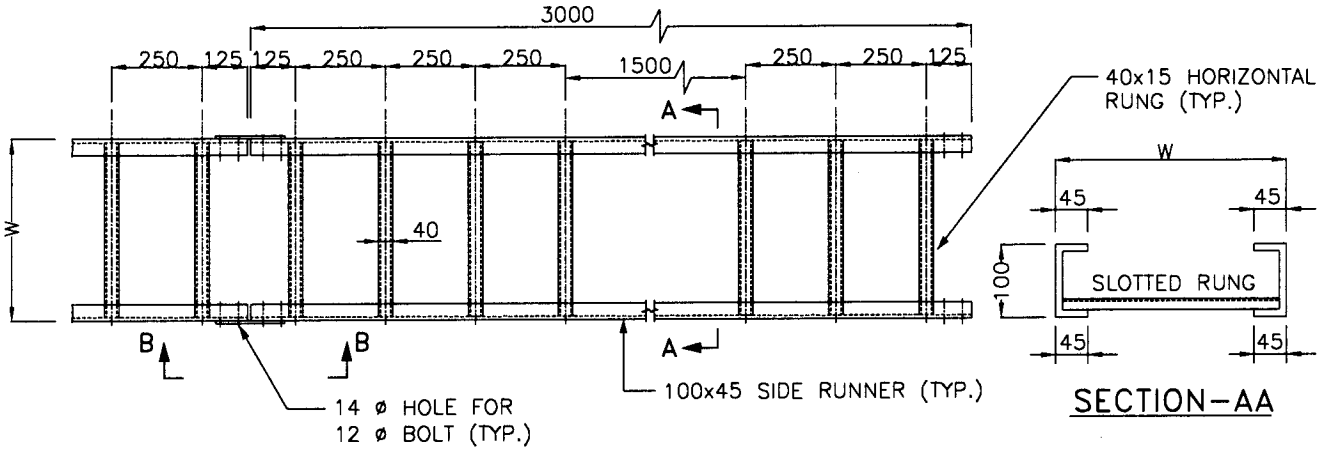
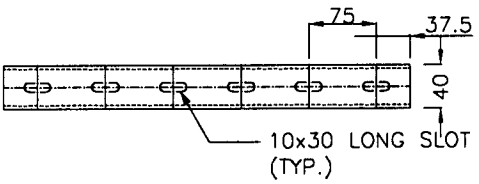
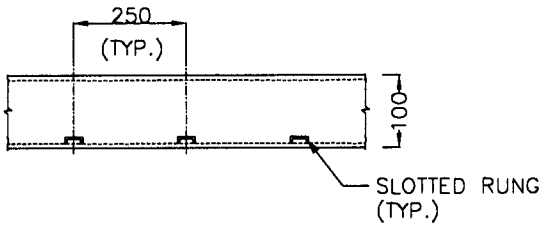


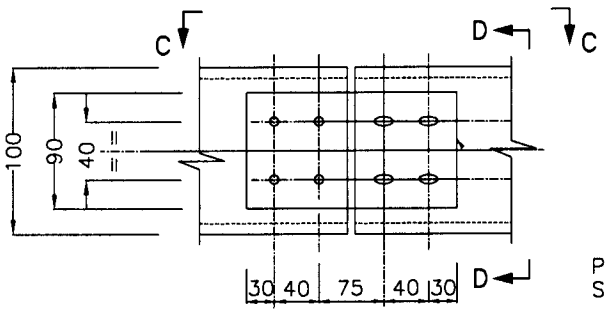
LADDER TYPE CABLE TRAY
(W=300/450/600/750/1000)



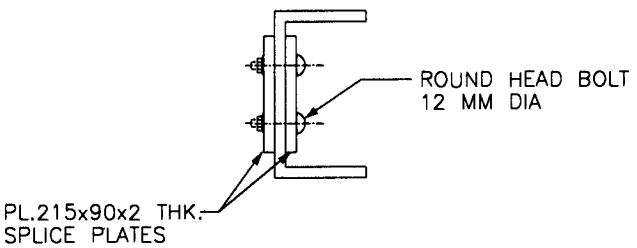
SLOTTED RUNG



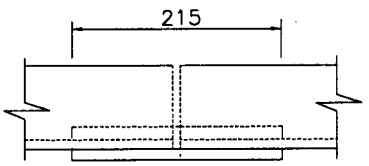
SIDE RUNNER



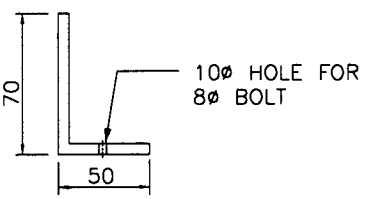
VIEW B–B



SECTION D–D



VIEW C–C



BARRIER PLATE
(100 MM LONG)

NOTES:–

1. 12 DIA ROUND HEAD BOLT WITH WASHERS & NUTS CONFORMING TO IS 1367 SHALL BE USED FOR FIXING OF SPLICE PLATE.

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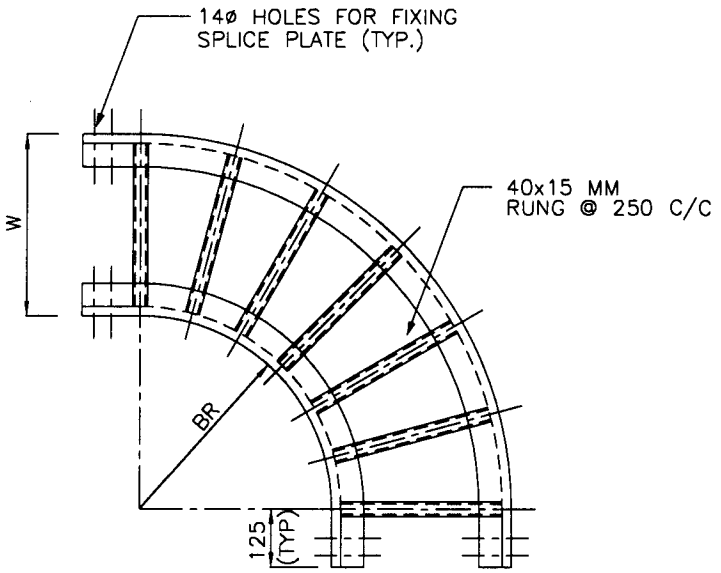
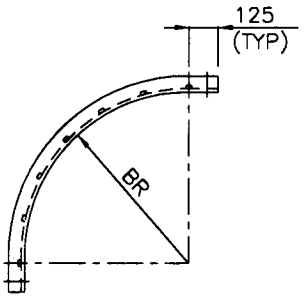
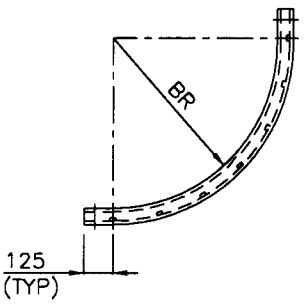


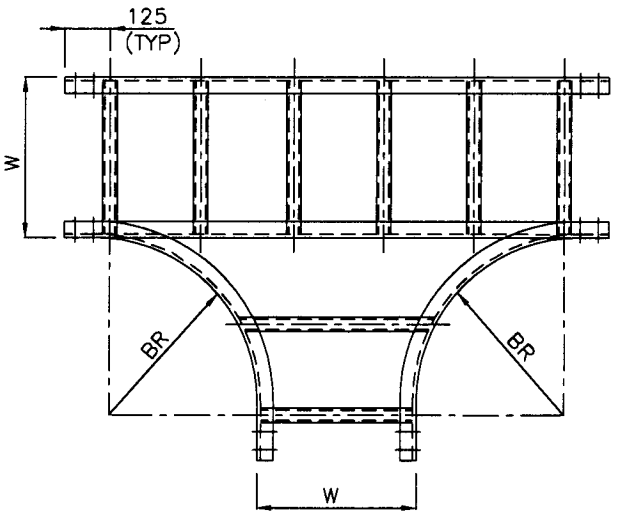
HORIZONTAL BEND



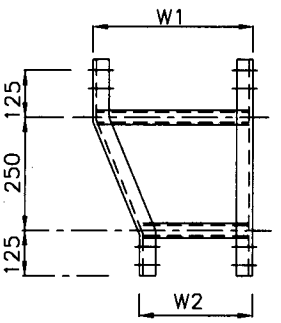
VERTICAL OUTSIDE BEND



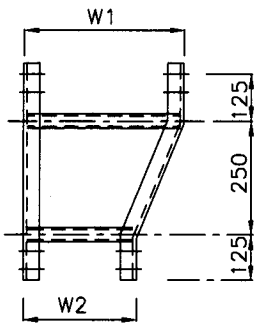
VERTICAL INSIDE BEND



'T' JOINT



LEFT HAND REDUCER



RIGHT HAND REDUCER

W – WIDTH OF CABLE TRAY (300/450/600/750/1000 MM)
W1 – WIDTH OF CABLE TRAY ON ONE SIDE
W2 – WIDTH OF CABLE TRAY ON OTHER SIDE
BR – BENDING RADIUS (750/1000/1250/1600/2000 MM)

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GENERAL NOTES:-

1. THE CABLE TRAYS AND ACCESSORIES SHALL COMPLY WITH LATEST EDITION OF INDIAN STANDARDS IS: 1367(PART-13), IS:2629, IS:5986.
2. THE CABLE TRAYS SHALL BE LADDER TYPE PREFABRICATED, HOT DIP GALVANIZED. THE LADDER TYPE TRAYS SHALL CONSIST OF SIDE RUNNERS & HORIZONTAL RUNGS AS PER DETAILS SHOWN IN PAGE 1 & 2.
3. THE LADDER TYPE TRAYS AND ACCESSORIES SHALL HAVE RIGID WELDED CONSTRUCTION AND SHALL BE FABRICATED OUT OF 2 mm THICK HOT ROLLED SHEET STEEL. THE RUNGS SHALL BE WELDED TO THE SIDE RUNNERS.
4. SIDE RUNNERS SHALL BE 100 x 45 mm CHANNEL INCLUDING FOR HOIZONTAL & VERTICAL BENDS WITH THE FLANGES FACING INSIDE. RUNGS SHALL BE 40 x 15 mm SLOTTED CHANNEL TYPE.
5. CABLE TRAYS SHALL BE SUITABLE FOR A CABLE WEIGHT OF 75 kg PER METRE OF RUNNING LENGTH OF TRAY AND SHALL BE SUPPORTED AT 3 m INTERVALS. IN ADDITION, TRAYS SHALL BE SUITABLE FOR A POINT LOAD OF 70 kg (EQUIVALENT WEIGHT OF A MAN WORKING ON THE CABLE TRAY).
6. EACH SIDE RUNNER CHANNELS SHALL BE CONNECTED AT ENDS USING 2 SPLICE PLATES ONE ON EACH SIDE AS SHOWN IN PAGE 1.
7. THE SIDE RUNNER WILL ALSO HAVE SUITABLE HOLES AT EVERY METRE FOR CLEATING EARTHING STRIP. SUITABLE THREADED HOLES SHALL BE PROVIDED ON THE RUNNER TOP AND BOTTOM FOR SUPPORTING AND FIXING TRAY COVERS WITH SCREWS AT EVERY METRE.
8. HOT DIP GALVANIZING SHALL BE DONE AFTER FABRICATION AS PER THE RELEVANT INDIAN STANDARD SPECIFICATIONS. THE AMOUNT OF GALVANIZING SHALL BE MINIMUM 610 g/m^2.
9. THE TYPE OF CONSTRUCTION SHALL BE SUCH AS TO FACILITATE EASY HANDLING, ASSEMBLY AND INSTALLATION AT SITE. FOR THE CONSTRUCTION OF CABLE TRAYS THE STANDARD STRAIGHT LENGTH OF CABLE TRAY SHALL BE 3 METERS UNLESS OTHERWISE SPECIFIED.
10. SPLICE PLATE OF CABLE TRAYS SHALL BE PLACED NOT MORE THAN 750 MM FROM SUPPORT ANGLE.
11. THE WORKMANSHIP SHALL BE SUCH AS TO ENSURE EASY LAYING OF CABLES WITHOUT CAUSING DAMAGE TO CABLES. ALL SURFACES SHALL BE FREE FROM DEFECTS SUCH AS BURRS, SHARP EDGES ETC.
12. THE HARDWARE SHALL CONFORM TO THE RELEVANT INDIAN STANDARD SPECIFICATIONS AND SHALL BE ABLE TO WITHSTAND THE MAXIMUM LOADING CONDITIONS AS REQUIRED. ALL HARDWARE AND FITTINGS SHALL BE STAINLESS STEEL SS-304. HARDWARE SHALL INCLUDE BOLTS, NUTS, WASHERS ETC.
13. THE BENDS, TEES, REDUCERS AND DROPPERS SHALL HAVE A BENDING RADIUS AS DESCRIBED IN THE SCHEDULE OF RATES.
14. THE FOLLOWING TESTS FOR THE AMOUNT OF ZINC COATING SHALL BE CARRIED OUT:
    - THICKNESS OF GALVANIZED COATING BY ELCOMETER.
    - MASS OF GALVANIZED COATING BY STRIPPING TEST.
    - DETERMINATION OF UNIFORMITY OF GALVANIZED COATING.

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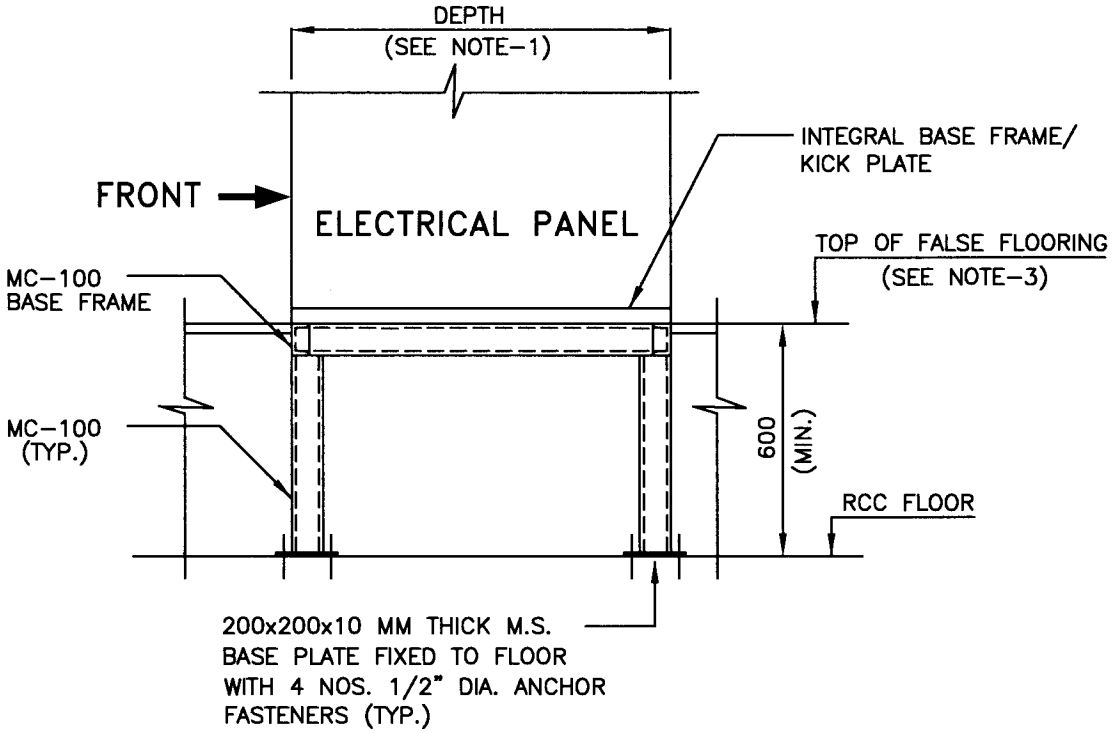
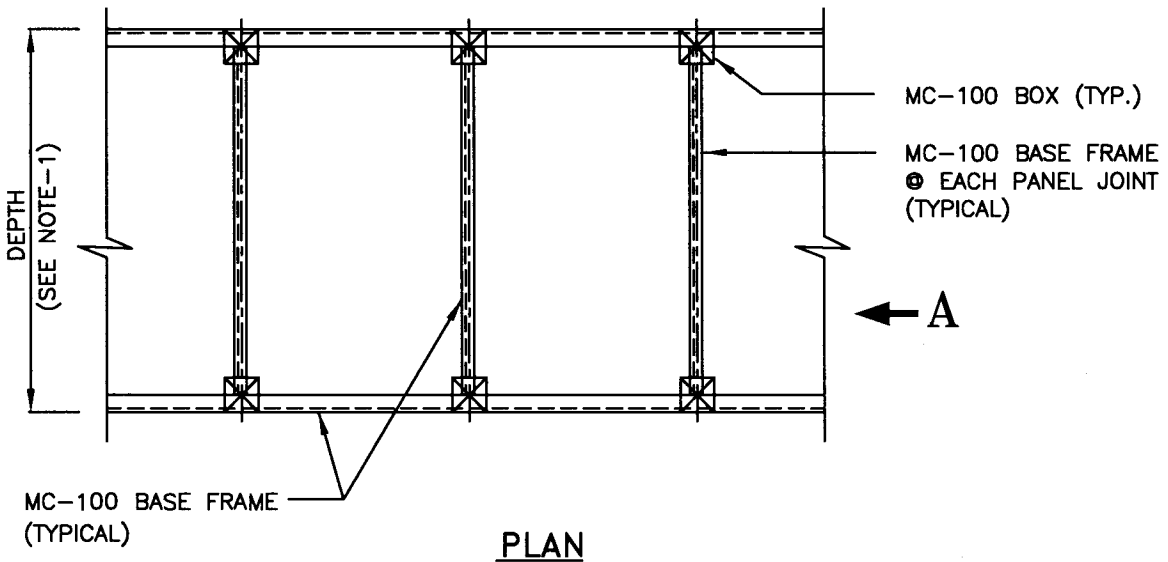


ELEVATION
(VIEW-A)



PLAN

NOTES:-

1. FOR PANELS DEPTH UPTO 800 MM SUPPORTING ARRANGEMENT AS SHOWN SHALL BE FOLLWED. FOR PANELS DEPTH MORE THAN 800 MM ADDITIONAL SUPPORTS AS PER VENDOR'S FDN. PLAN SHALL BE PROVIDED.
2. ALL PANELS SHALL BE TACK WELDED WITH BASE FRAME OF SWITCHBOARD.
3. SUPPORTING ARRANGEMENT FOR FALSE FLOORING SHALL BE AS PER ARCHITECTURAL DRAWINGS.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
4	01.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
3	08.11.16	REAFFIRMED & ISSUED	BP	FA/HK	BRB	RN
2	02.03.12	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP/JMS	DM

Approved by

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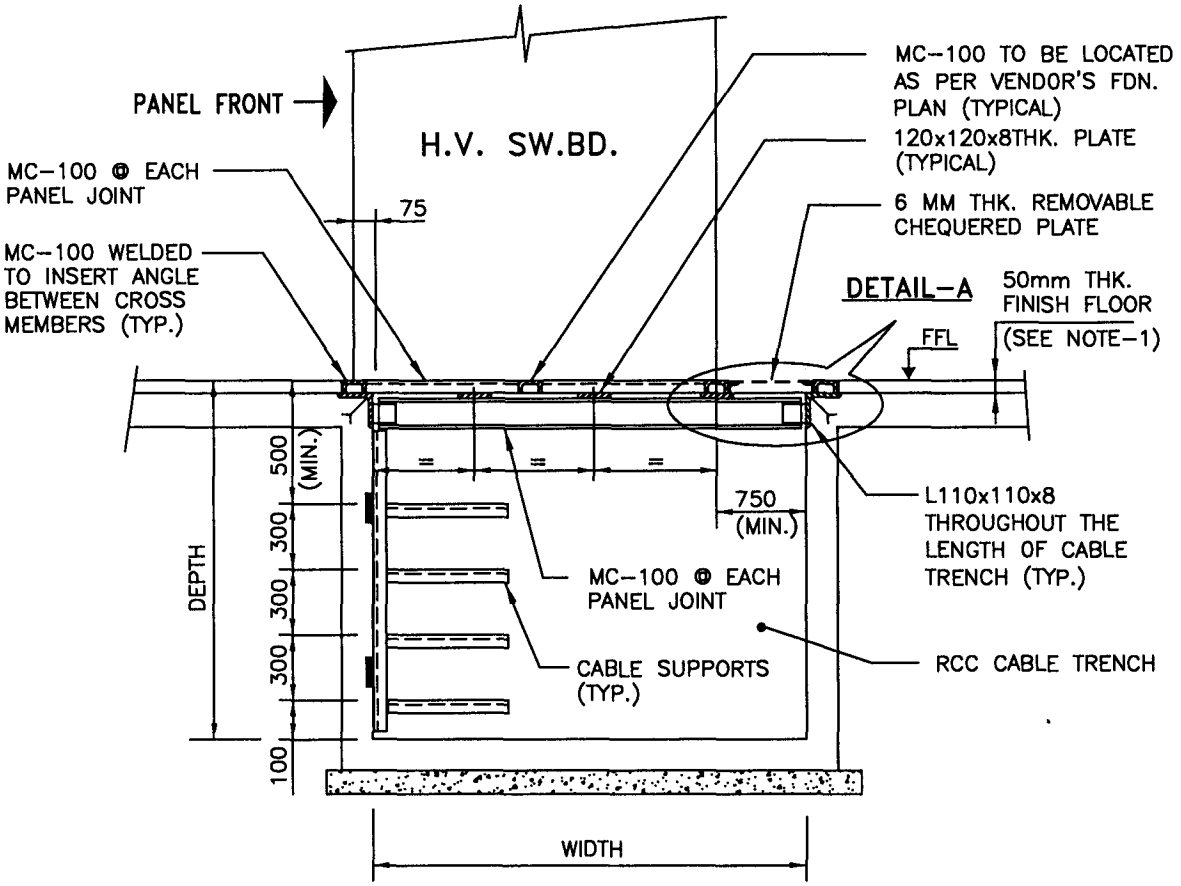
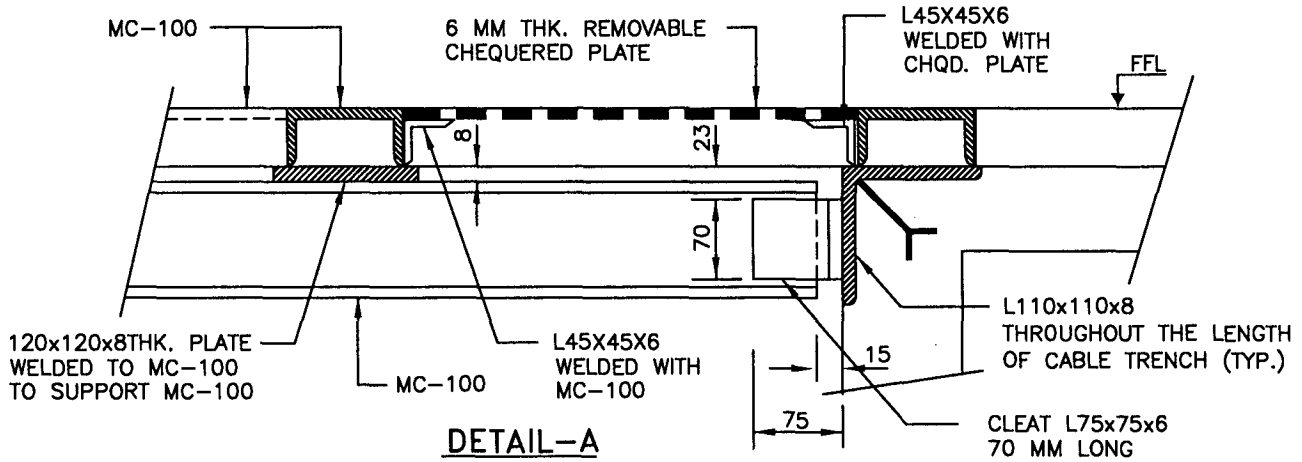


TYPICAL INSTALLATION DETAIL OF H.V. SWITCHBOARD (FOR REMOTE LOCATION SUB STATION)

(UPTO 11KV AND FOR MAXIMUM 3 CABLES PER PHASE)



NOTES:-

1. 50 THICK FINISH FLOORING SHALL BE DONE ONLY AFTER INSTALLATION OF BASE FRAME
2. ALL PANELS SHALL BE TACK WELDED WITH BASE FRAME OF SWITCHBOARD.
3. UNUSED PORTION OF CUTOUTS SHALL BE COVERED WITH 6 MM THICK CHEQUERED PLATES.
4. WIDTH OF TRENCH TO SUIT THE DIMENSIONS OF SWITCHBOARD SHALL BE AS PER AFC DRAWING OF THE PROJECT.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
4	29.11.21	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
3	08.11.16	REVISED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
2	02.03.12	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP/JMS	DM

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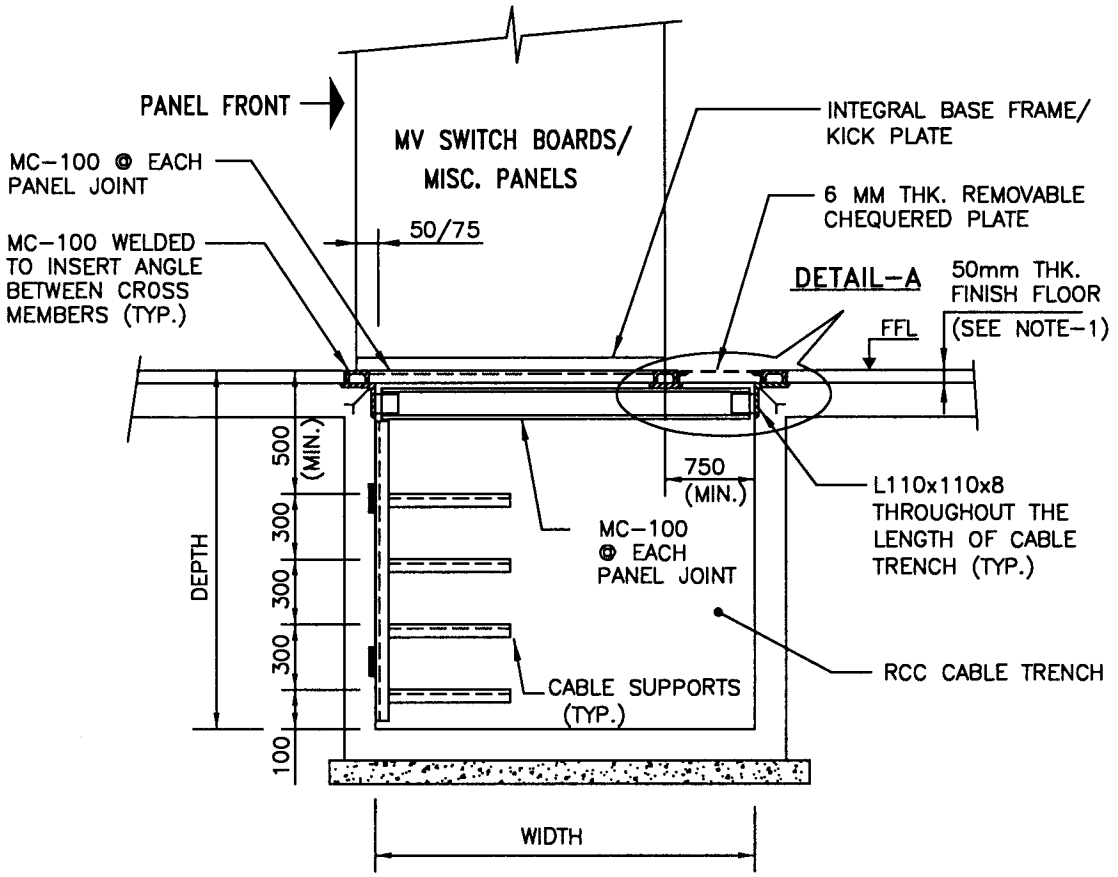
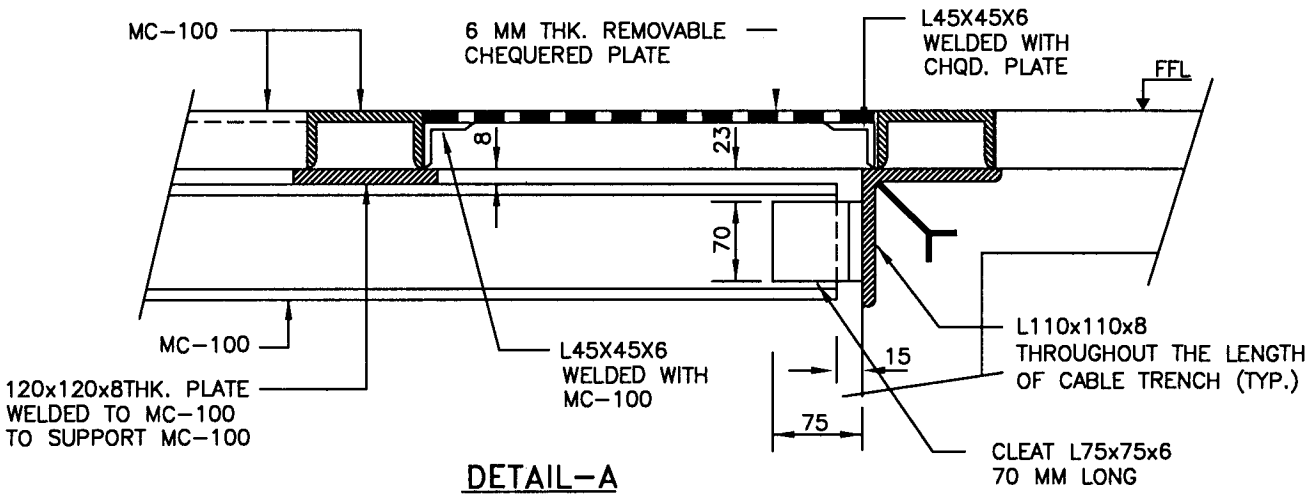


TYPICAL INSTALLATION DETAIL OF M.V. PANELS ON CABLE TRENCH



DETAIL–A

NOTES:–

1. 50 THICK FINISH FLOORING SHALL BE DONE ONLY AFTER INSTALLATION OF BASE FRAME
2. ALL PANELS SHALL BE TACK WELDED WITH BASE FRAME OF SWITCHBOARD.
3. UNUSED PORTION OF CUTOUTS SHALL BE COVERED WITH 6 MM THICK CHEQUERED PLATES.
4. WIDTH OF TRENCH TO SUIT THE DIMENSIONS OF SWITCHBOARD SHALL BE AS PER AFC DRAWING OF THE PROJECT.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
4	29.11.21	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
3	08.11.16	REVISED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
2	02.03.12	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP/JMS	DM

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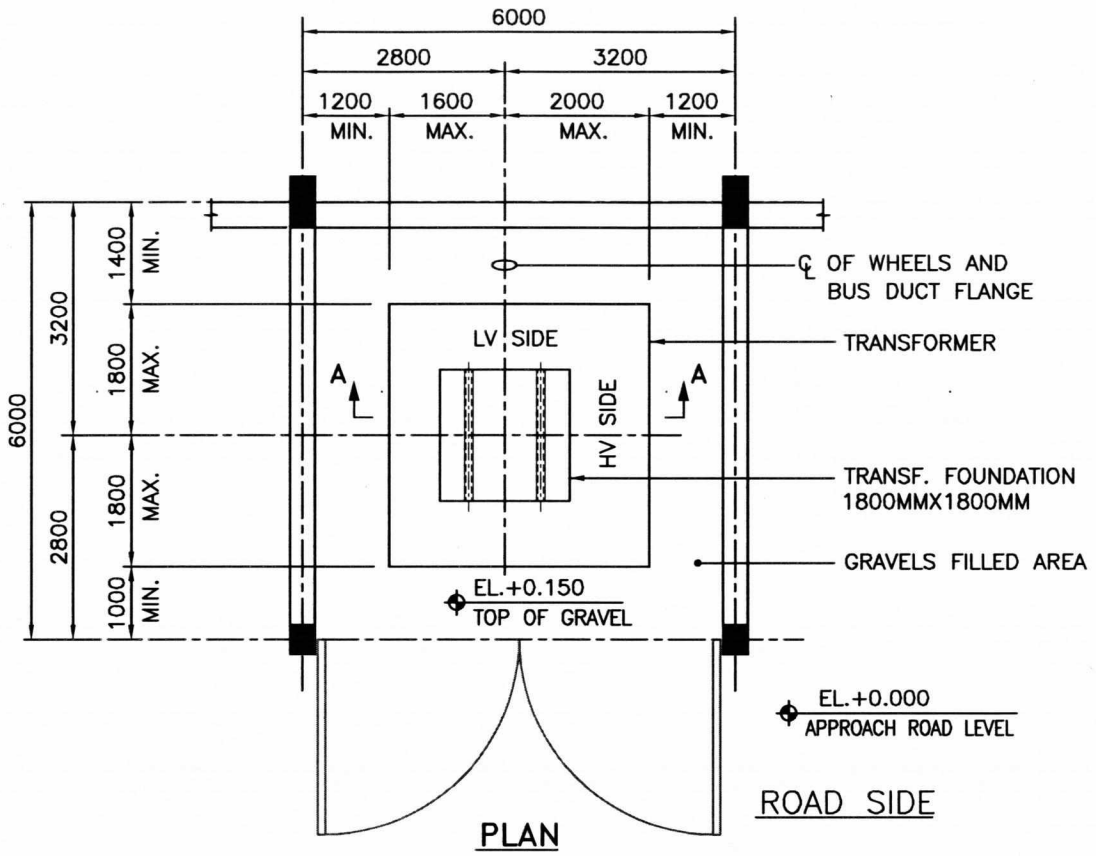
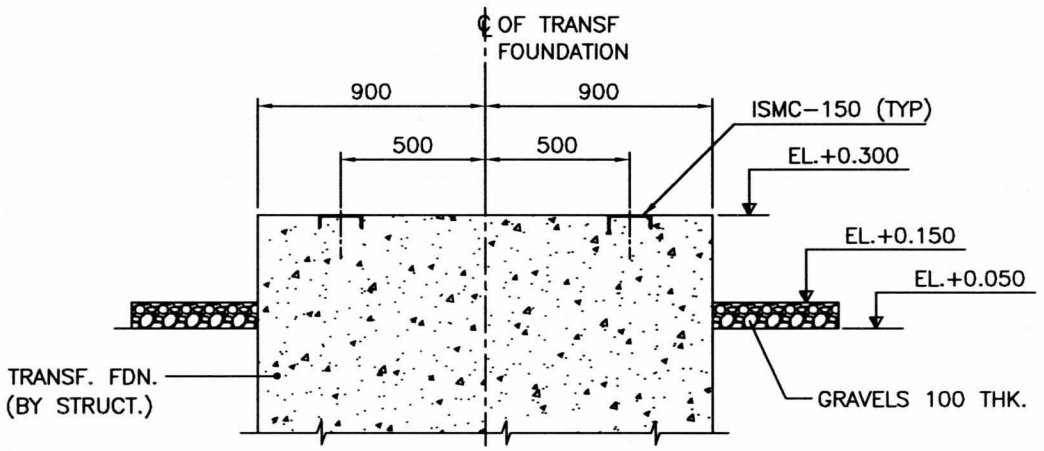
SUB STATION/SW. GR. ROOM SIDE





SECTION A–A
(TRANSFORMER FOUNDATION DETAIL)

NOTES:–

1. ALL DIMENSIONS ARE IN MM.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
2	15.09.22	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	MKS	SM
1	10.07.17	REVISED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
0	01.05.13	ISSUED AS STANDARD	BP	FA/SA	UAP/JMS	DM

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ABBREVIATIONS

ABD	AMINE BLOW DOWN
A/G	ABOVE GROUND
API	AMERICAN PETROLEUM INSTITUTE
ANSI	AMERICAN NATIONAL STANDARD INSTITUTE
AWWA	AMERICAN WATER WORKS ASSOCIATION
BC	BOX CULVERT
BCR	BEARING COOLING RETURN
BE	BEVEL END
BF	BLIND FLANGE
BL	BED LEVEL
BOP	BOTTOM OF PIPE
BOTT.EL	BOTTOM ELEVATION(CABLE DUCT ETC)
CBD	CLOSE BLOW DOWN
CI	CAST IRON
C/C	CENTRE TO CENTRE
℄	CENTRE LINE
CONC.RED	CONCENTRIC REDUCER
CONC	CONCRETE
CPLG	COUPLING
CS	CARBON STEEL
CONN	CONNECTION
CONT	CONTINUATION
CRWS	CONTAMINATED RAIN WATER SEWER
CW	CONSTRUCTION WATER/CARRIAGE WAY
CWPH	COOLING WATER PUMP HOUSE
CWS	CAUSTIC WASTE SEWER
COL	COLUMN
DIA	DIAMETER
DWG	DRAWING
DISCH.	DISCHARGE
ETP	EFFLUENT TREATMENT PLANT
ECC	ECCENTRIC
EL	ELEVATION
ERC	ELECTRIC CABLE ROAD CROSSING
EWSS	EYE WASH & SAFETY SHOWER
FCR	FOR CONTINUATION REFER
FF	FLAT FACE
FGL	FINISHED GROUND LEVEL
F TO F	FACE TO FACE
FFL	FINISHED FLOOR LEVEL
FLGD.	FLANGED
FDN	FOUNDATION
GLV	GALVANISED
GT	GALVANISED BLACK STEEL TUBE
GR	GROUND/GRADE
HC	HOSE COUPLING
HP	HORSE POWER
HS	HOSE STATION
HPP	HIGH POINT OF PAVEMENT
ID	INSIDE DIAMETER
INST	INSTRUMENT
INV	INVERT
IRC	INSTRUMENT CABLE ROAD CROSSING
MDS	MECHANICAL DATA SHEET
MK	MARK
MR	MATERIAL REQUISITION
MTO	MATERIAL TAKE OFF
MS	MILD STEEL
MH	MANHOLE
NGL	NATURAL GROUND LEVEL
OD	OUTSIDE DIAMETER
OHT	OVERHEAD TANK
OWS	OILY WATER SEWER
PC	PIPE CULVERT
PDS	PROCESS DATA SHEET
PE	PLAIN END
PR	PURCHASE REQUISITION
PWS	PROCESS WASTE SEWER
PWB	PIPE WAY BRIDGE
RCC	REINFORCED CEMENT CONCRETE
R	RADIUS
RF	RAISED FACE
REF	REFERENCE
RW	ROAD WAY
SO	SLIP ON
SOR	SCHEDULE OF RATES
SS	STORM SEWER
STD	STANDARD
SCRC	STREET CABLE ROAD CROSSING
STN	STATION
SWS	SANITARY WASTE SEWER
TEMP	TEMPERATURE
TOS	TOP OF SLEEPER
TYP	TYPICAL
TWDK	TEMPORARY DRINKING WATER
U/G	UNDER GROUND
WCS	COOLING WATER SUPPLY
WCR	COOLING WATER RETURN
WDK	DRINKING WATER
WF	FIRE WATER
WR	RAW WATER
WH	HORTICULTURE WATER
WT	TREATED WATER
WF	FILTERED WATER
WWS	WASTE WATER SYSTEM

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
5	14.03.2024	REVISED & ISSUED AS STANDARD	MK	AK	SKN	MN

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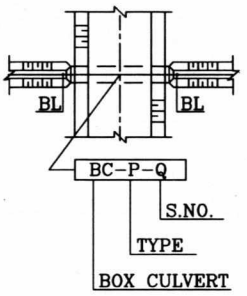
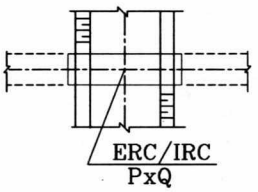
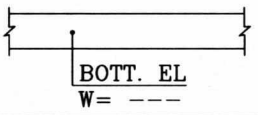
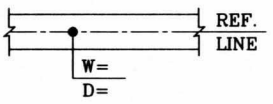
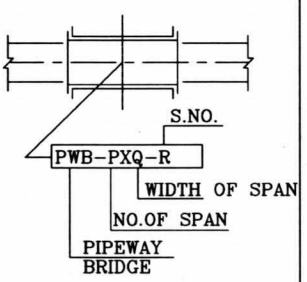
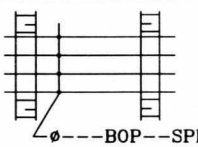
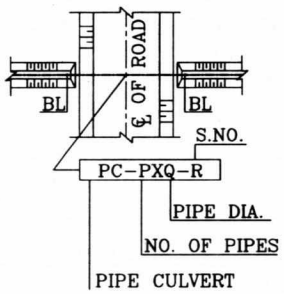
LEGENDS

○	NATURAL GROUND LEVEL		BOX CULVERT REPRESENTATION ON AREA DRAWING
●	FINISHED GROUND LEVEL		
⊖	ROAD TOP LEVEL/ PAVEMENT TOP LEVEL		
⊕	FINISHED FLOOR LEVEL OF BUILDING		
—·—·—	CENTRE LINE		
— — —	LAND ACQUISTION LIMIT		ERC–ELELCTRIC CABLE PxQ ROAD CROSSING NO.OF PIPE IN EACH LAYER NO. OF LAYERS
▬▬▬	COMPOUND WALL		
———	BATTERY LIMIT		
—·—·—	MATCHING LINE		R.C.C. CABLE TRENCH
ROAD–A	ROAD–A REPRESENTATION ON LAYOUTS (A=COORDINATE OF ROAD ℄)		
ROAD–A	ROAD–A REPRESENTATION IN AREA DRAWINGS (A=COORDINATE OF ROAD ℄)		BURIED CABLE TRENCH D=DEPTH W=WIDTH
HIGHER EDGE LOWER EDGE	SIDE SLOPE		PIPEWAY BRIDGE
BL	TRAPEZOIDAL DITCH REPRESENTATION ON AREA DRAWING		
BL TYPE---	RECTANGULAR DITCH REPRESENTATION ON AREA DRAWING		
BL	TRAPEZOIDAL DITCH REPRESENTATION ON LAYOUT DRAWING		
BL TYPE---	RECTANGULAR DITCH REPRESENTATION ON LAYOUT DRG.		PIPE SLEEVES
BL BL PC/BC---	PIPE CULVERT BOX CULVERT REPRESENTATION ON LAYOUT DRG.		
	PIPE CULVERT REPRESENTATION ON AREA DRAWING	ø--- -CW-PIPE CLASS---	CONSTRUCTION WATER PIPE LINE
		ø--- -WT-PIPE CLASS---	TREATED WATER PIPE LINE
		ø--- -TWDK-PIPE CLASS---	TEMPORARY DRINKING WATER PIPE LINE
		ø--- -WDK-PIPE CLASS---	DRINKING WATER PIPE LINE

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
5	14.03.2024	REVISED & ISSUED AS STANDARD	MK	AK	SKN	MN

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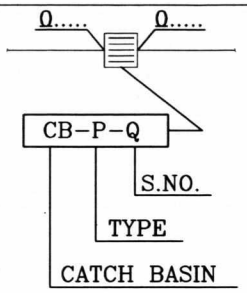
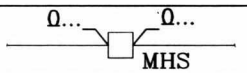
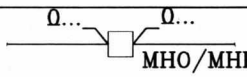
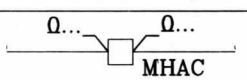
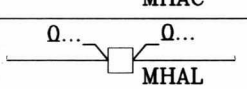
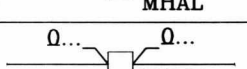
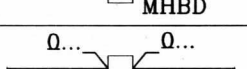
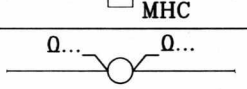
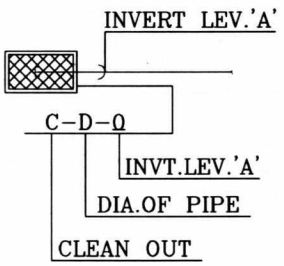
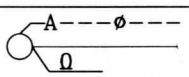
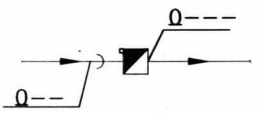
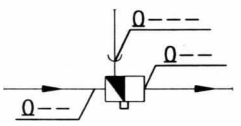
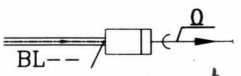
ø--- -WCS-PIPE CLASS---	COOLING WATER SUPPLY PIPE		45° BEND (TURNED DOWN)
ø--- -WCR-PIPE CLASS---	COOLING WATER RETURN PIPE		CATCH BASIN
ø--- -WF-PIPE CLASS---	FIRE WATER PIPE LINE		
ø--- -WH-PIPE CLASS---	HORTICULTURE WATER PIPE LINE		
ø--- -WS-PIPE CLASS---	SERVICE WATER PIPE LINE		
ø--- -SS-PIPE CLASS---	STORM SEWER		PIPE INVERT LEVEL
ø--- -DS-PIPE CLASS---	SANITARY WATER SEWER		SANITARY SEWER MANHOLE
ø---OWS/PWS-PIPE CLASS--	OILY WASTE SEWER/ PROCESS WASTE SEWER		OILY/PROCESS SEWER MANHOLE
ø--- -CTBD-PIPE CLASS--	COOLING TOWER BLOW DOWN		ACIDIC SEWER MANHOLE
ø--- -ACID-PIPE CLASS--	ACIDIC SEWER		ALKALI SEWER MANHOLE
ø---ALKALI-PIPE CLASS--	ALKALI SEWER		CTBD SEWER MANHOLE
ø---SANITARY PUMPING-PIPE CLASS---	SANITARY PUMPING MAIN		CHEMICAL SEWER MANHOLE
	GATE VALVE		CIRCULAR MANHOLE
	GLOBE VALVE		CLEAN OUT
	BUTTERFLY VALVE		
	CHECK VALVE		
	FLOAT VALVE		
	PIPE WITH FLANGED END		FUNNEL FOR STORAGE TANK DRAIN
	BLIND FLANGED END		RECTANGULAR SEALED MANHOLE (SINGLE COMPARTMENT)
TYPE	VALVE PIT IN PIPE LINE		
	90° BEND (TURNED UP)		RECTANGULAR SEALED MANHOLE (DOUBLE COMPARTMENT)
	90° BEND (TURNED DOWN)		
	45° BEND (TURNED UP)		SAND TRAP

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
5	14.03.2024	REVISED & ISSUED AS STANDARD	MK	AK	SKN	MN

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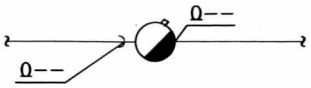
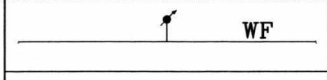
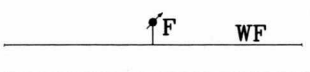
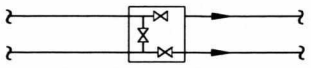
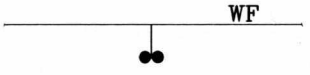
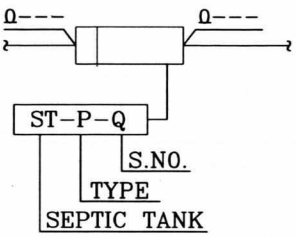
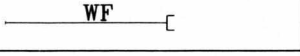
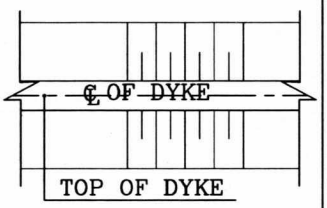
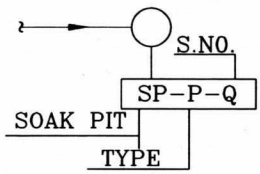
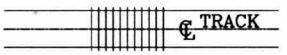
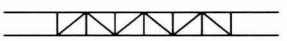
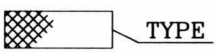
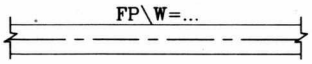
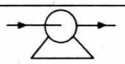
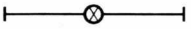
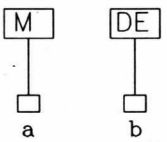
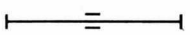
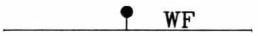
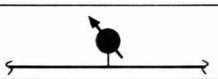
	SEALED MANHOLE (CIRCULAR)		WATER MONITOR FOR FOR FIRE WATER SYST.
			FOAM MONITOR FOR FOR FIRE WATER SYST.
	THREE WAY VALVE PIT (VALVE PITS OUTSIDE TANKFARM AREA FOR DRAINAGE)		DOUBLE HEADED FIRE HYDRANT AWAY FROM HEADER
	SEPTIC TANK		FIRE HOSE COUPLING
			EARTHEN DYKE
	SOAK PIT		RAILWAY TRACK REPRESENTATION ON LAYOUT
			RAILWAY TRACK REPRESENTATION ON AREA DWG.
	GULLY TRAP		PIPE RACK
	GATE		PIPE WAY
	BARBED WIRE FENCING	EQPT. SYMBOLS	
	CHAIN LINK FENCING		HOSE CABINET
	R.C.C. PAVEMENT		HOSE REEL
	FOOTPATH W=WIDTH OF FOOTPATH		DELUGE VALVE ASSEMBLY
	SLIDING SLEEPER		PUMP (HORIZONTAL)
	ANCHOR SLEEPER		PUMP VERTICAL a) ELECT. DRIVE b) DEISEL DRIVE
	GUIDE SLEEPER		
	JUMP OVER SLEEPER		
	FIRE HYDRANT SINGLE HEADED		WATER CUM FOAM MONITOR
	FIRE HYDRANT DOUBLE HEADED		

Rev. No	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
5	14.03.2024	REVISED & ISSUED AS STANDARD	MK	AK	SKN	MN

Approved by

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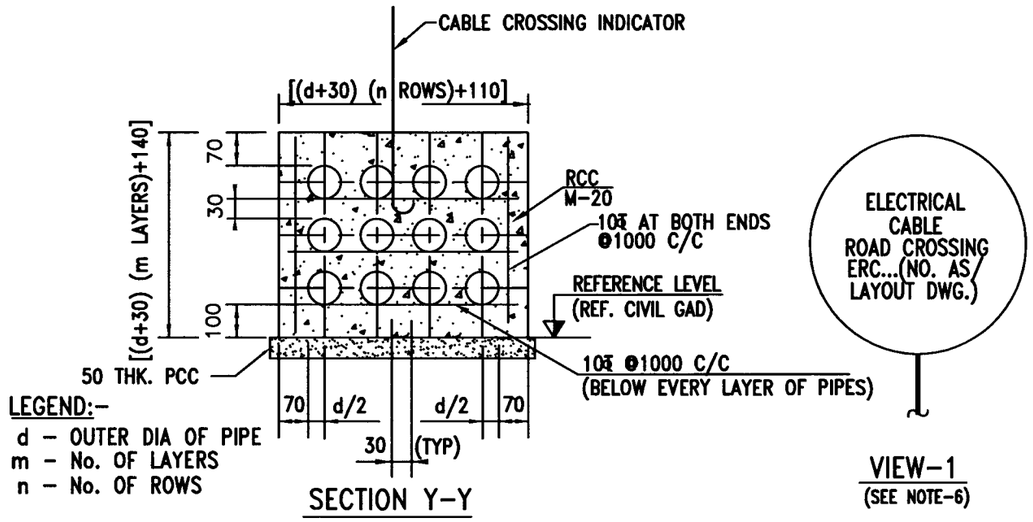
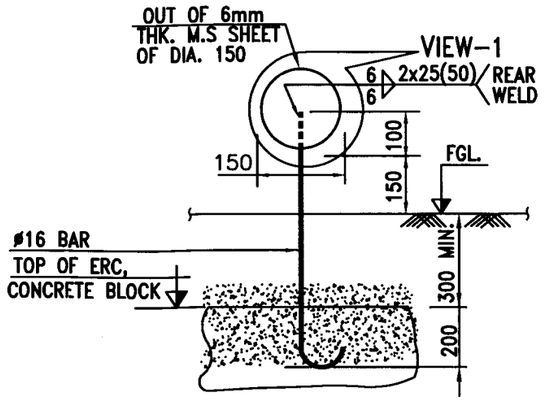


SECTION Y–Y

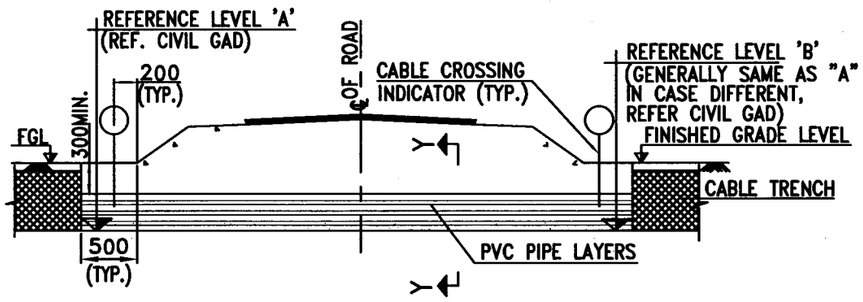
VIEW–1
(SEE NOTE–6)



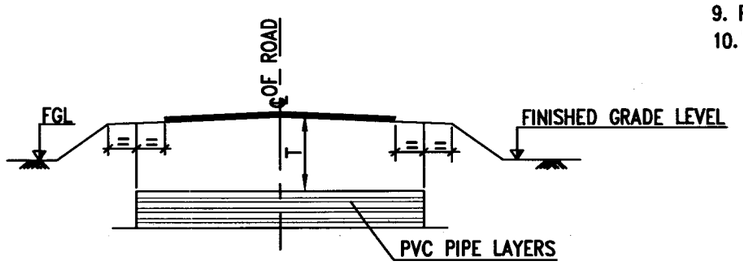
DETAILS OF
CABLE CROSSING INDICATOR

NOTES:–

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
2. CONDUIT MATERIAL P.V.C. PIPES OF NOM. OUT SIDE PIPE DIA. ϕ110, ϕ160 OR ϕ210 AS PER LAYOUT PLAN.
3. PIPES SHALL CONFIRM TO IS:4985 CLASS–I AND EMBEDDED IN RCC M–20.
4. BACK FILLING OVER ERC/ IRC/ SCRC SHALL BE DONE IN CONFORMATION TO SUB GRADE REQUIREMENT FOR ROADS AS PER 7–65–0011/JOB DRAWING FOR ROAD CROSS SECTION.
5. IN CASE CABLE CROSSING IS REQUIRED TO CROSS THE OPEN DITCHES ON EITHER SIDE, AS SHOWN IN STD.NO.7–51–0322, THE LENGTH AND THE LEVEL OF CABLE CROSSING SHALL BE DECIDED CLEARING THE SERVICES ALONG ROAD SIDE.
6. CABLE CROSSING INDICATOR MADE OF 6mm THICK MILD STEEL PLATE AS PER IS: 2062, ENAMEL PAINTED IN TRAFFIC GREEN (RAL 6024) BACKGROUND ON BOTH SIDES WITH WHITE LETTERING.
7. THE SHAPE OF PVC REMOVABLE TYPE CAP AS SHOWN IS INDICATIVE.
8. PVC PIPES WILL BE TIED WITH SUPPORTING 10 BARS AND 16 SWG BINDING WIRE AT @ 1000C/C.
9. REINFORCEMENT SHALL BE OF GRADE Fe500 TMT BAR CONFIRMING TO IS: 1786.
10. 'T' IS THE THICKNESS OF ROAD CRUST.



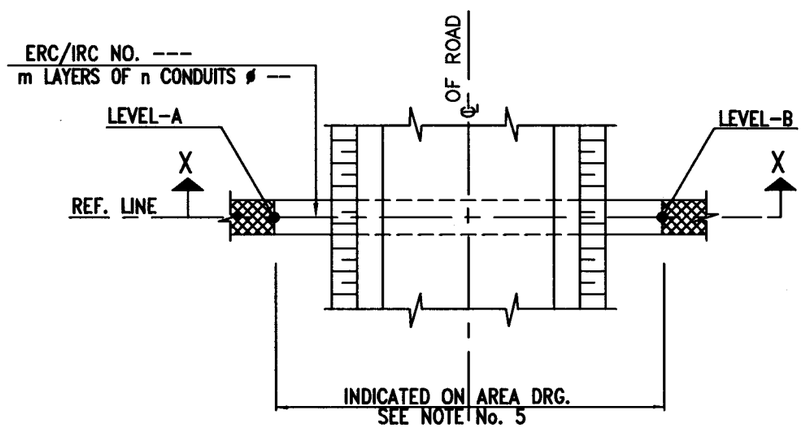
SECTION X–X
(APPLICABLE FOR ERC & IRC)



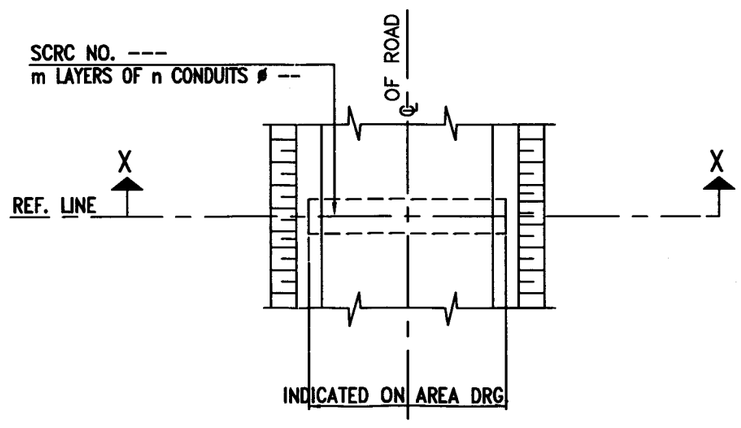
SECTION X–X
(APPLICABLE FOR SCRC)
(REFER SECTION Y–Y FOR CROSS SECTION DETAILS OF SCRC)

LEGENDS:

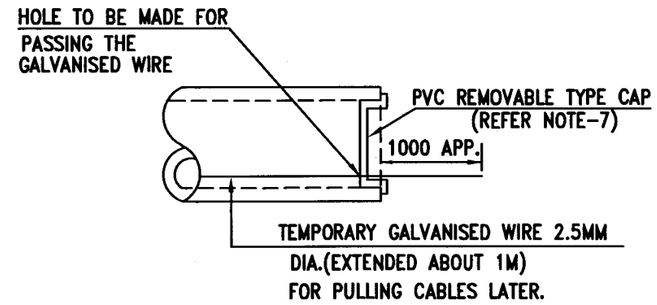
SCRC	STREET CABLE ROAD CROSSING
ERC	ELECTRICAL ROAD CROSSING
IRC	INSTRUMENTATION ROAD CROSSING



PLAN
(REPRESENTATION ON AREA DRG.)



PLAN
(REPRESENTATION ON AREA DRG.)



SLEEVE END PLUGGING DETAIL

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
5	21.12.20	REVISED AND ISSUED AS STANDARD	ADP	AK	A.SINHA	SM
4	25.07.14	REAFFIRMED AND ISSUED AS STANDARD	HV	RKS	RBB	SC

इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

CABLE CROSSING UNDER ROAD (P.V.C. PIPES)

STANDARD No.
7–65–0006 Rev. 5

Format No. 8-00-0001-F5 Rev. 0
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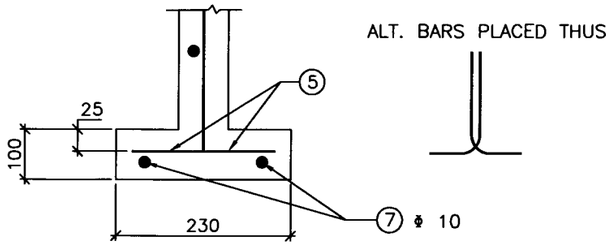
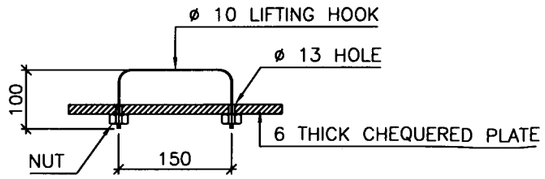
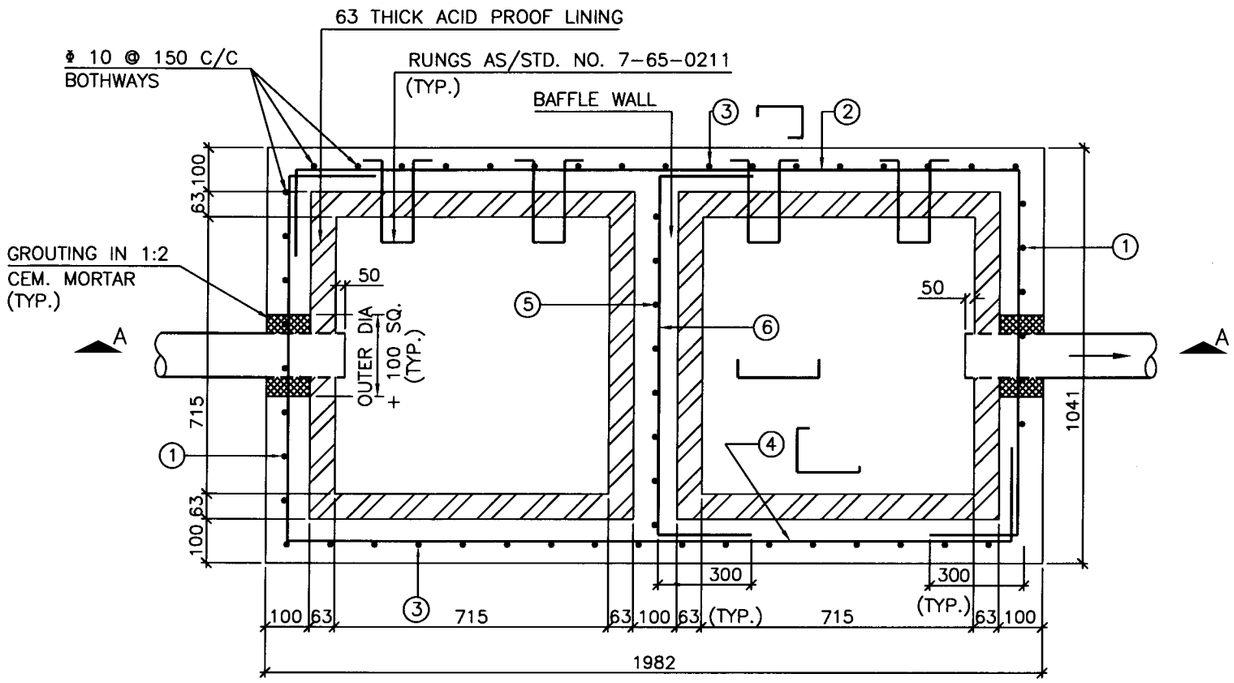


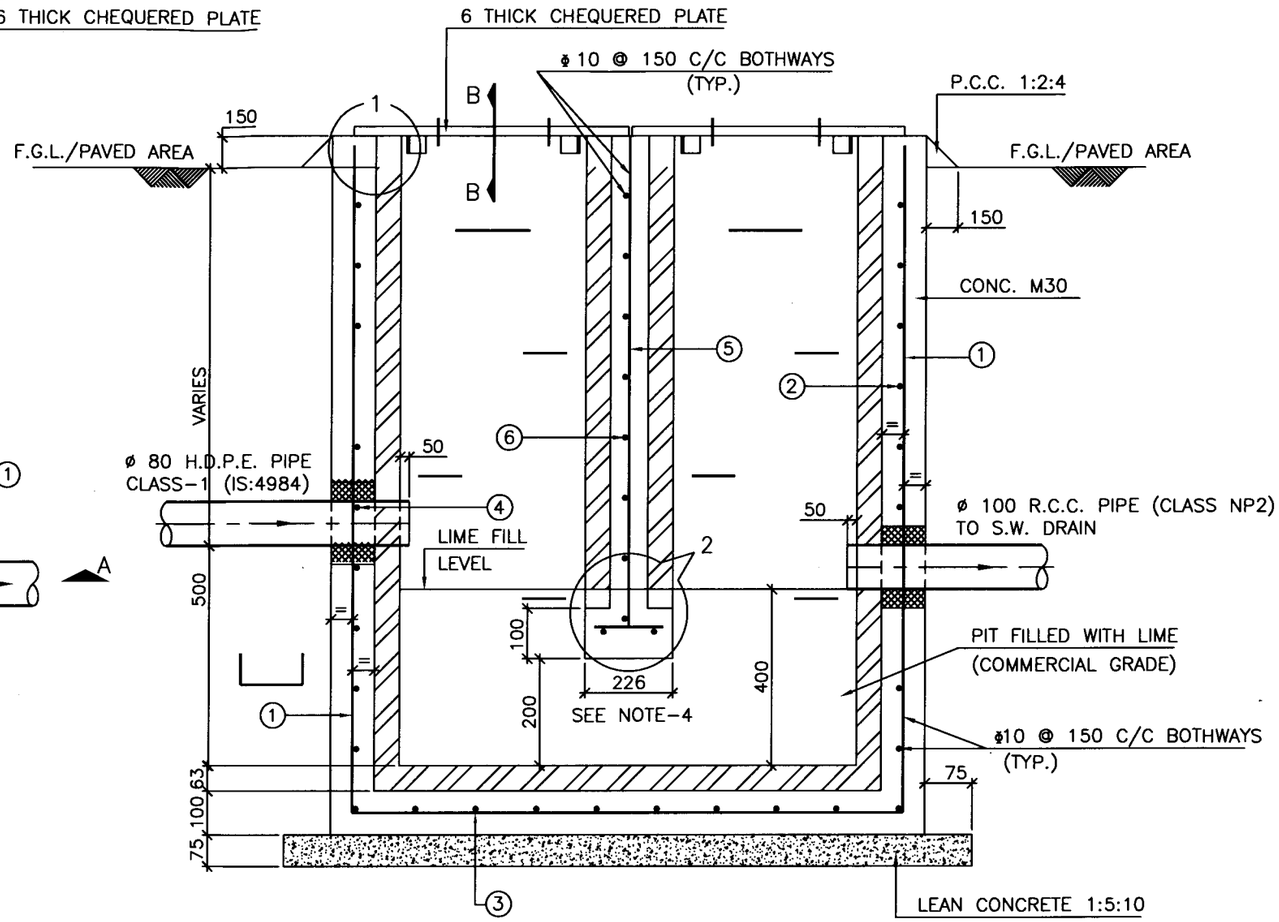
DETAIL–2



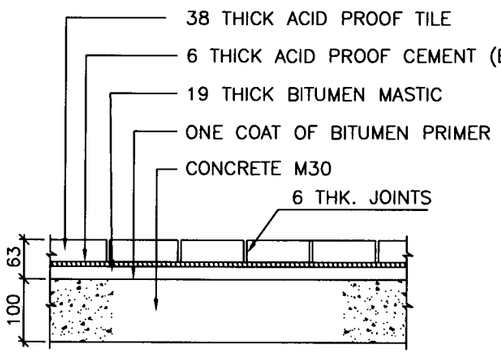
SECTION B–B



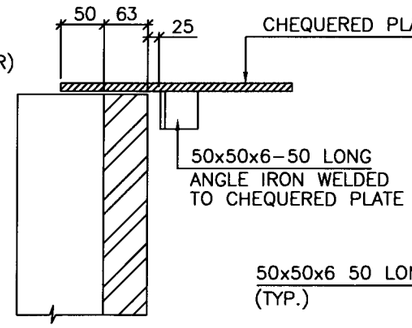
PLAN



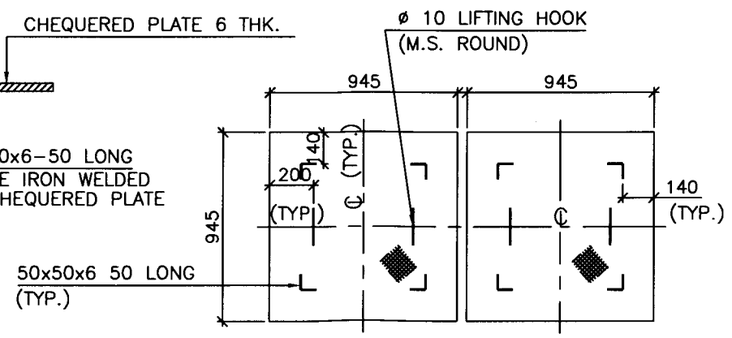
SECTION–AA



ACID PROOF LINING DETAIL



DETAIL–1



PLAN
CHEQUERED PLATE

NOTES: –

1. ALL DIEMNSIONS ARE IN MILLIMETERS
2. HYD. BARS SHALL CONFORM TO IS:1786 (FE 500)
3. UNDER SIDE OF THE CHEQUERED PLATE COVER, ANGLE IRON AND RUNGS SHALL BE PAINTED WITH AMBIENT TEMPERATURE CURING TYPE TWO COMPONENT EPOXY PHENOLIC COATING CURED WITH AMINE ADDUCT HARDENER IN THREE COATS OF 100 MICRON DFT / COAT AFTER SURFACE PREPARATION BY GRIT BLASTING.
4. EXPOSED BOTTOM AND SIDES OF THE BAFFLE WALL (CONCRETE SURFACE) SHALL BE PROVIDED WITH ONE COAT OF BITUMEN PRIMER 25 MICRON AND TWO COATS OF EPOXY PAINT 100 MICRON EACH.

4	28.06.18	REAFFIRMED & ISSUED AS STD.	RP	DCB	RS	RK TRIVEDI
3	03.02.10	REVISED & ISSUED AS STD.	SKP	RKS	RBB	ND
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	

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DETAIL OF NEUTRALISATION PIT

STANDARD No.
7-65-0310 Rev. 4
Page 1 of 1

Format No. 8-00-0001-F5 Rev. 0

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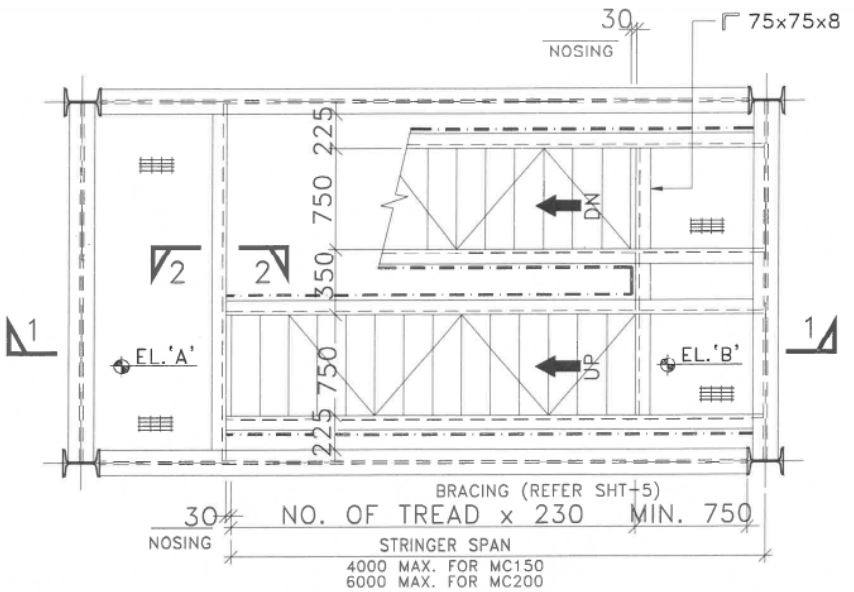
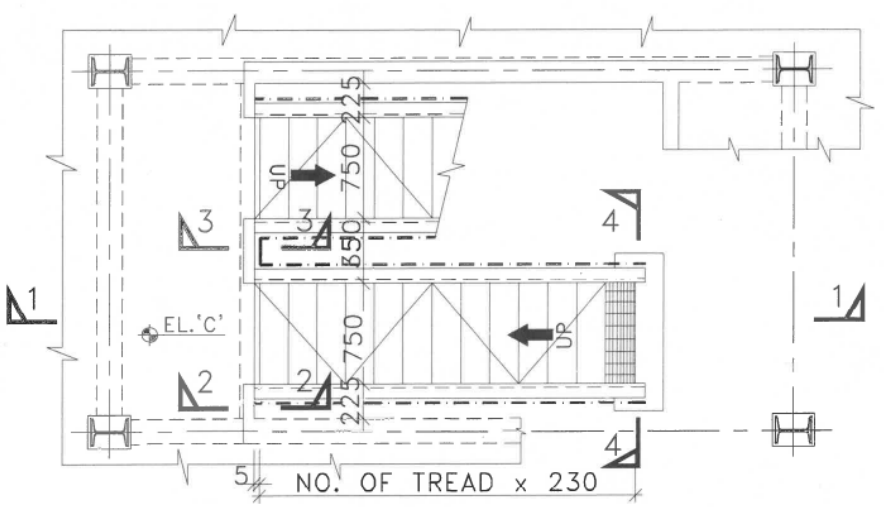
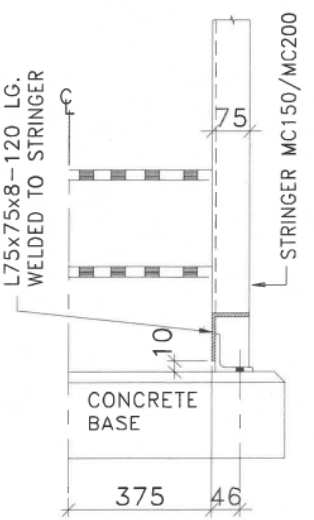


PLAN AT EL. 'A'



PLAN AT EL. 'C'



SECTION 4-4

NOTES :-

1. FOR STAIRWAY/TREAD USE ELECTROFORGED GRATING TYPE-II AS PER EIL STD NO 7-68-0697.
2. FOR CONNECTION DETAILS REFER SHEETS 3, 4, 5 AND 6.
3. STRINGER SHALL BE SUITABLY DESIGNED FOR OFFICE BUILDING, WARE HOUSES AND WORKSHOP.
4. FOR DETAIL OF INSERT PLATE 'R1a' REFER EIL STD. NO. 7-68-0056.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
8	03.04.25	REAFFIRMED AND ISSUED AS STANDARD	SHUBHAM	SUDIP PAUL	ANURAG SINHA	MAINAK NANDI
7	01.08.19	REAFFIRMED AND ISSUED AS STANDARD	JS	AVM	RAJANJI SRIVASTAVA	R.K. TRIVEDI

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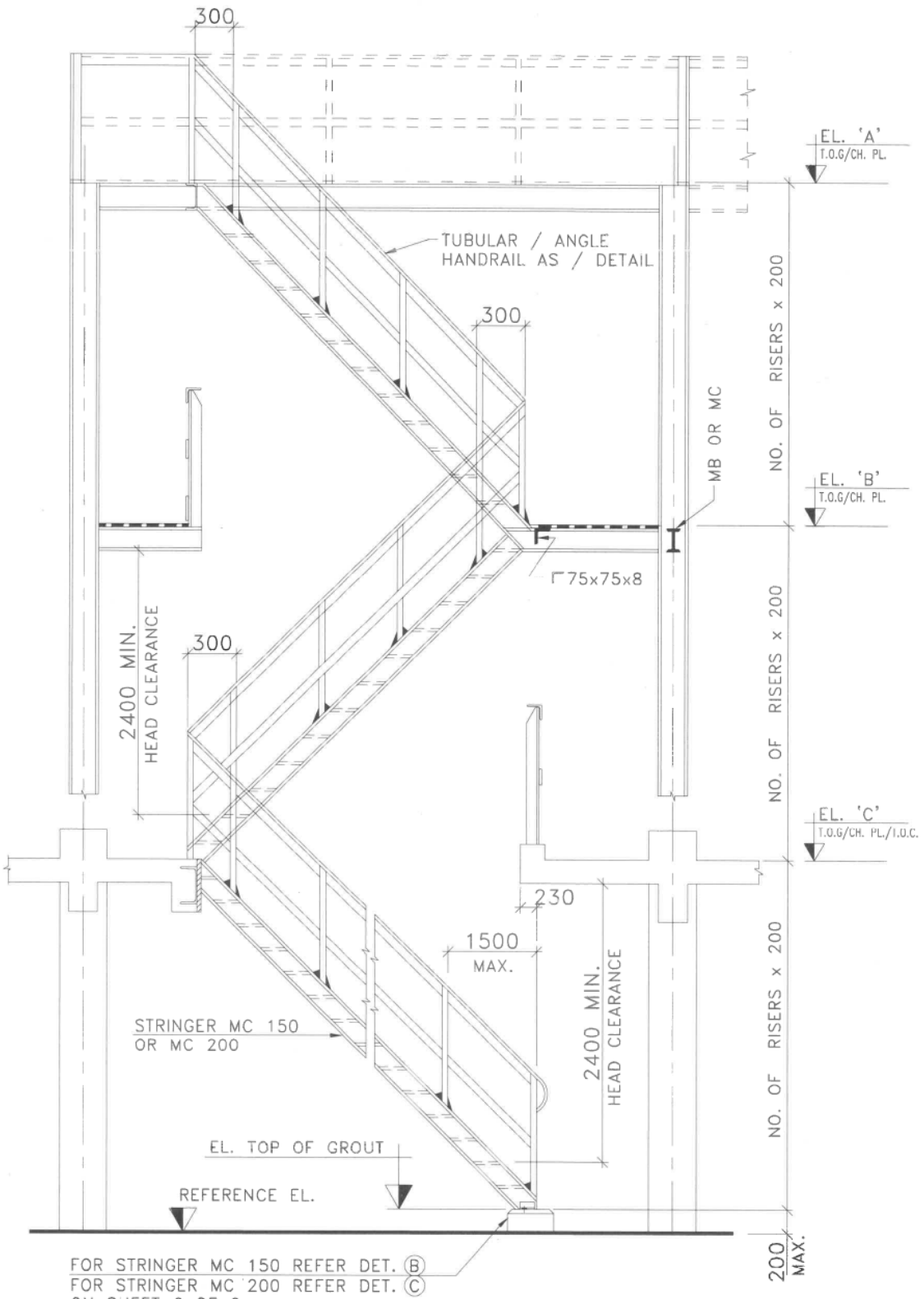

SECTION 1–1

MAXIMUM RISER IS 200 HOWEVER IT MAY BE REDUCED AND ADJUSTED AS REQUIRED.

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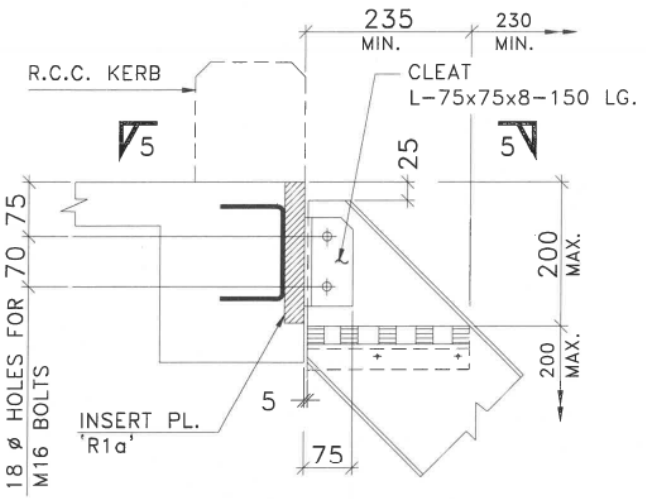
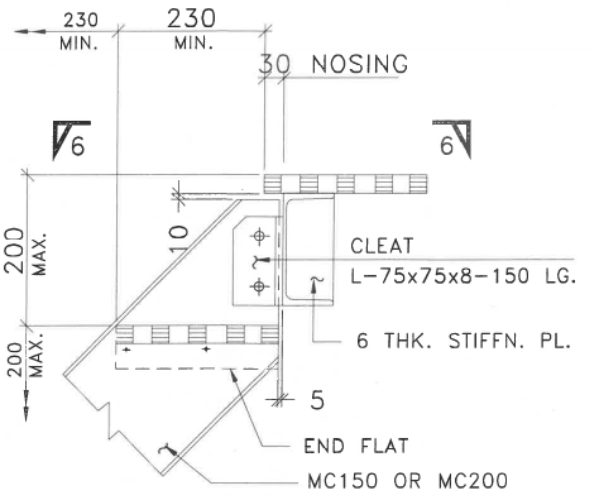


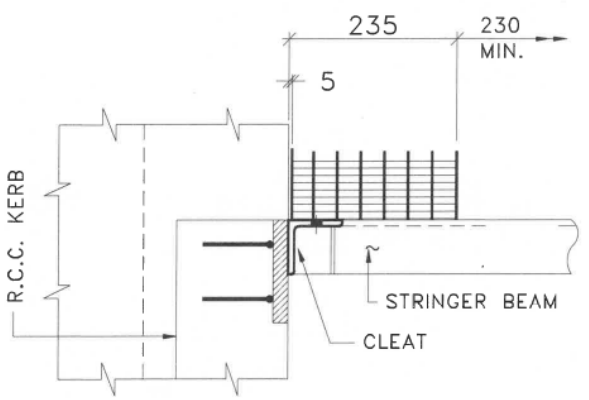
SECTION 2-2

(CONNECTION WITH CONCRETE BEAM)

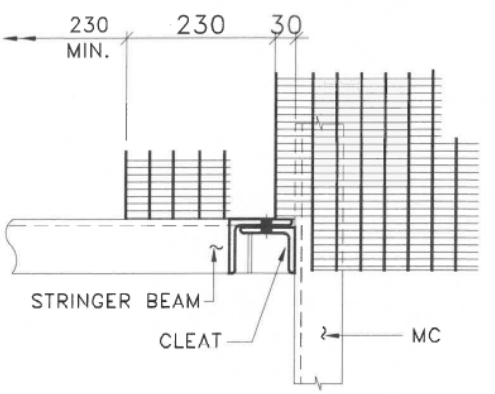


SECTION 2-2

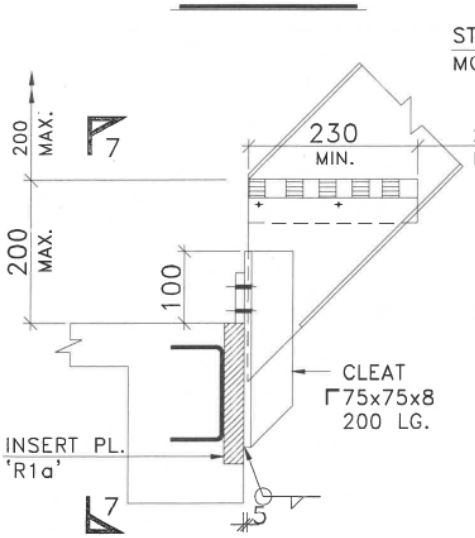
(CONNECTION WITH STEEL BEAM MC)



VIEW 5-5

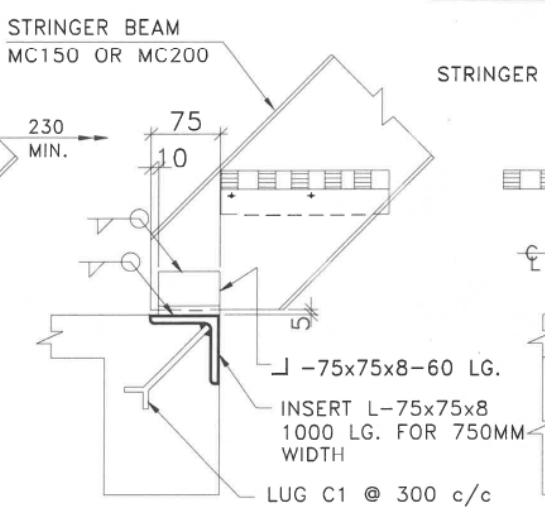


VIEW 6-6



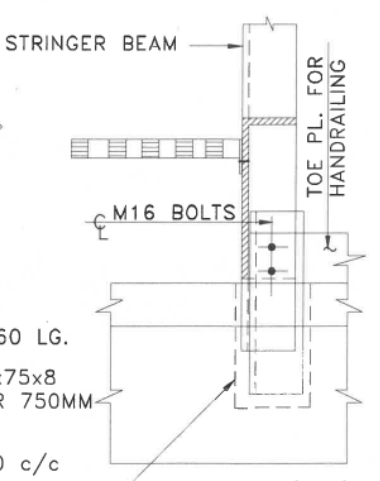
SECTION 3-3

(CONNECTION WITH CONCRETE BEAM)
(R.C.C. KERB NOT SHOWN FOR CLARITY)



SECTION 3-3 (ALT.)

(CONNECTION WITH CONCRETE BEAM)
(R.C.C. KERB NOT SHOWN FOR CLARITY)



VIEW 7-7

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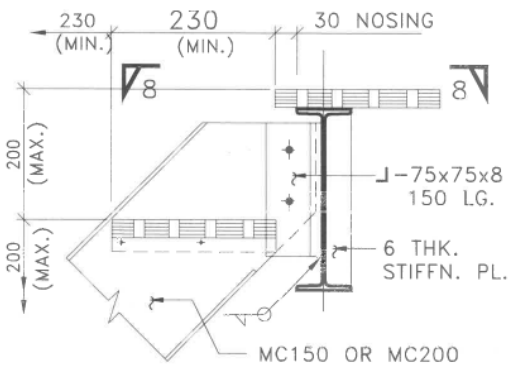
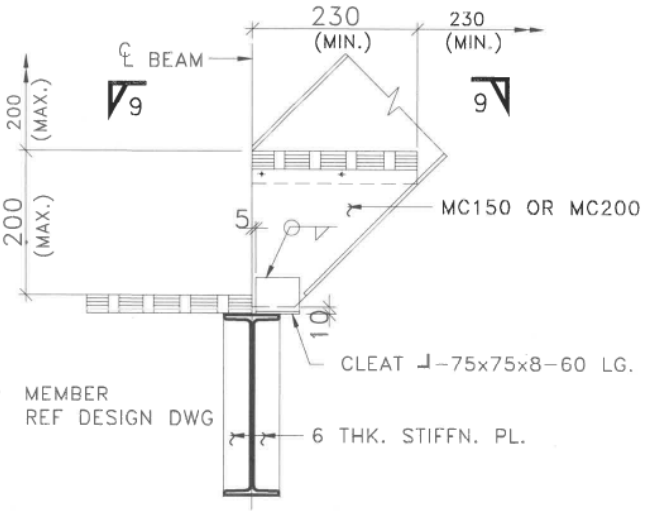


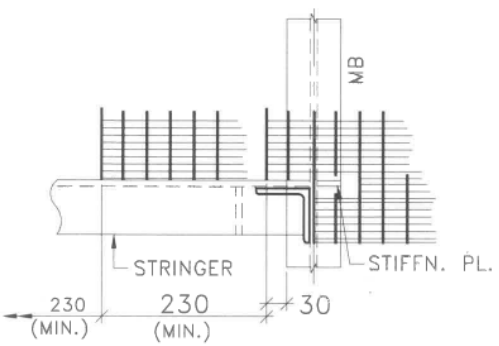
SECTION 2-2

(CONNECTION WITH STEEL BEAM ISMB)

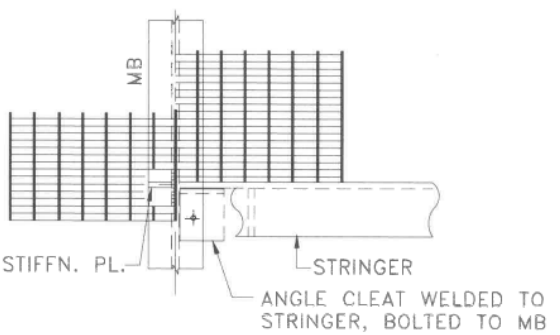


SECTION 3-3

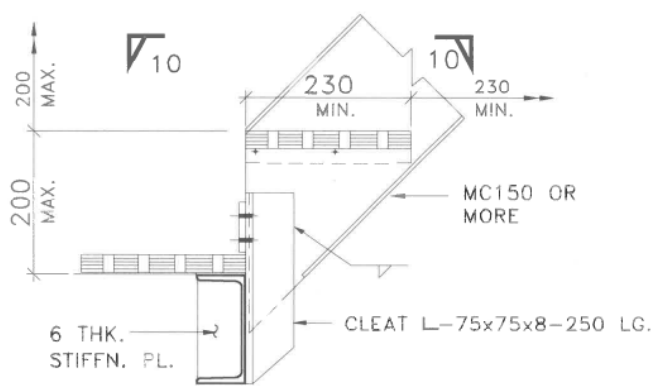
(CONNECTION WITH STEEL BEAM ISMB)



VIEW 8-8

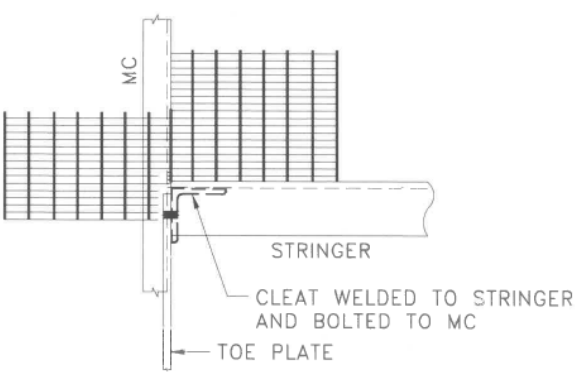


VIEW 9-9



SECTION 3-3

(CONNECTION WITH STEEL BEAM ISMC)



VIEW 10-10

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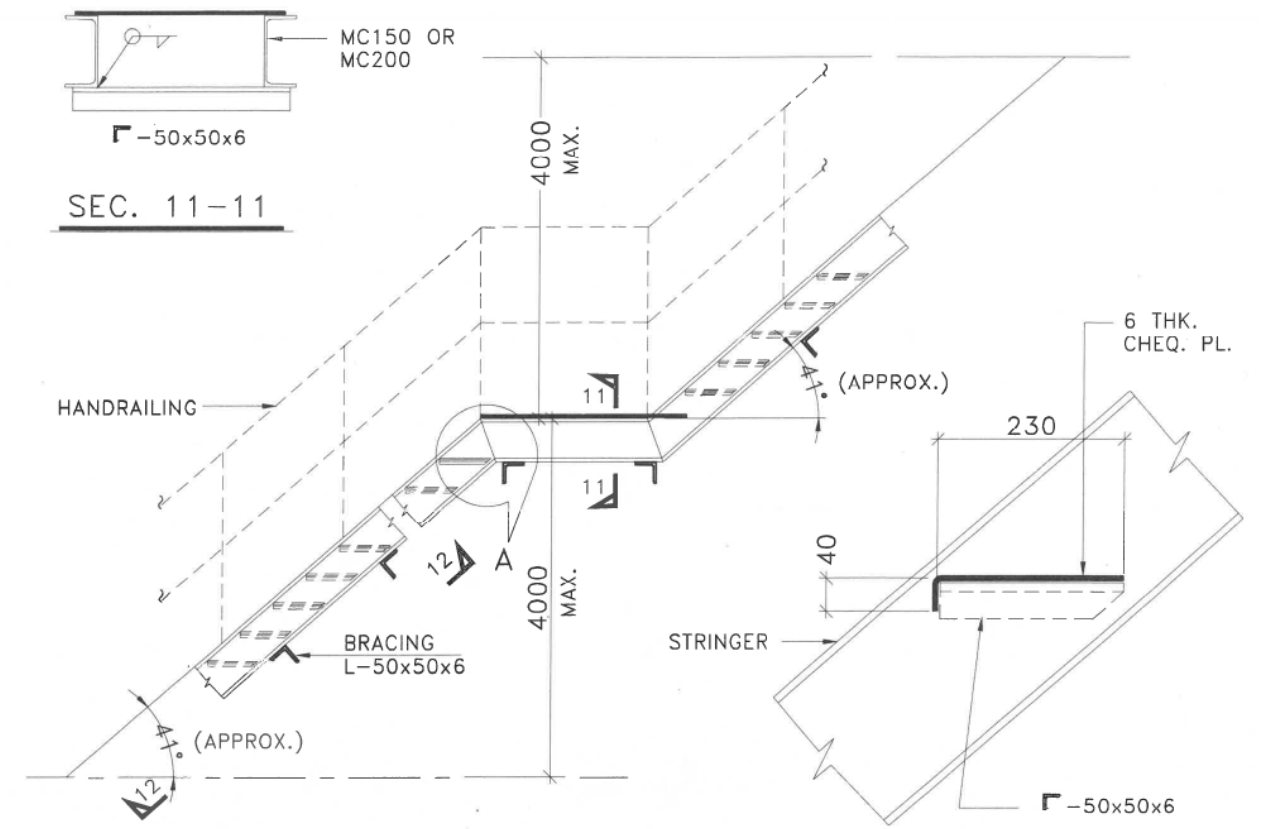
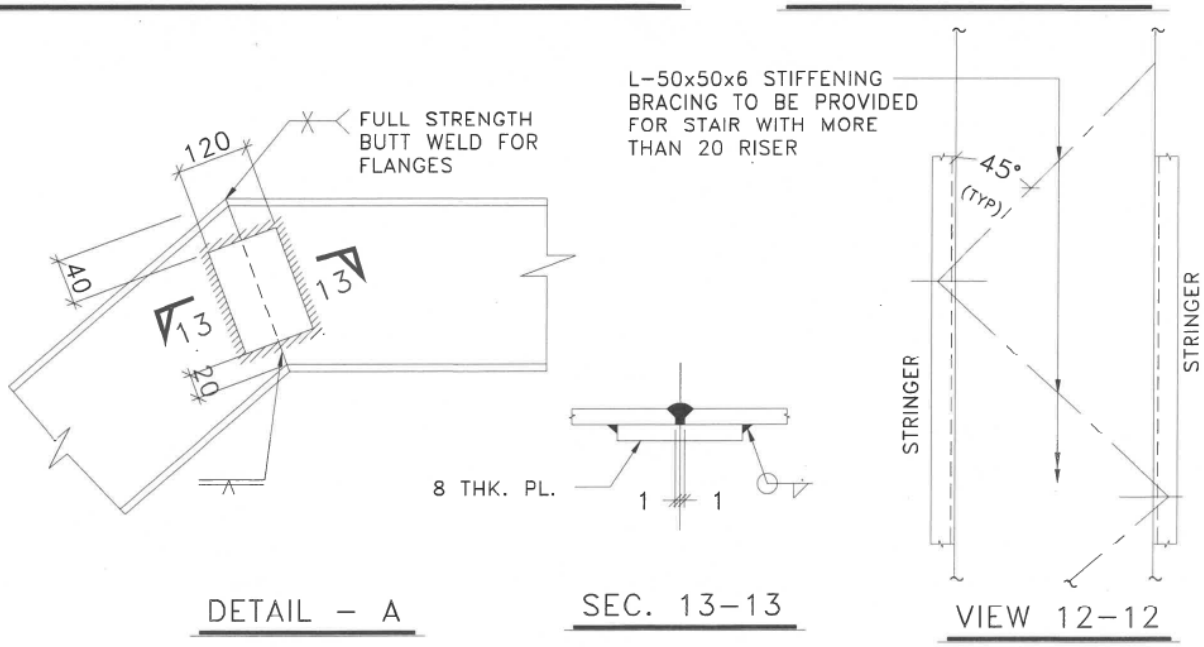


ELEVATION SHOWING STRINGER BRACINGS

TYP. DET. OF CHEQ. PL. STEP



DETAIL − A

SEC. 13−13

VIEW 12−12

STAIR DETS WITH CHEQURED PLATE STEPS

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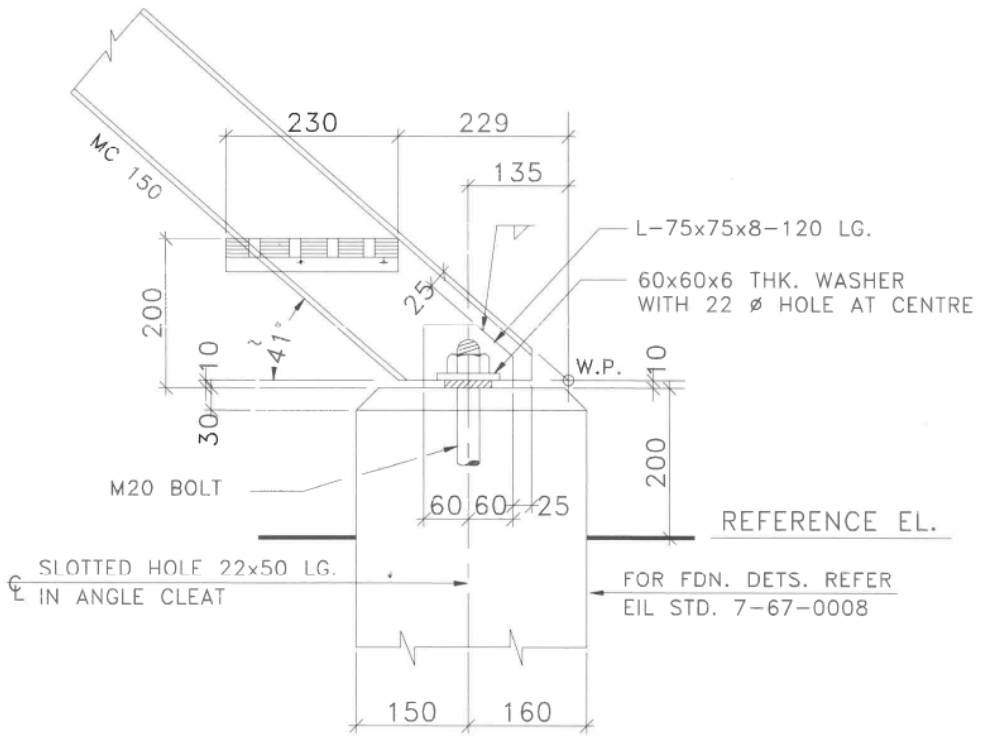
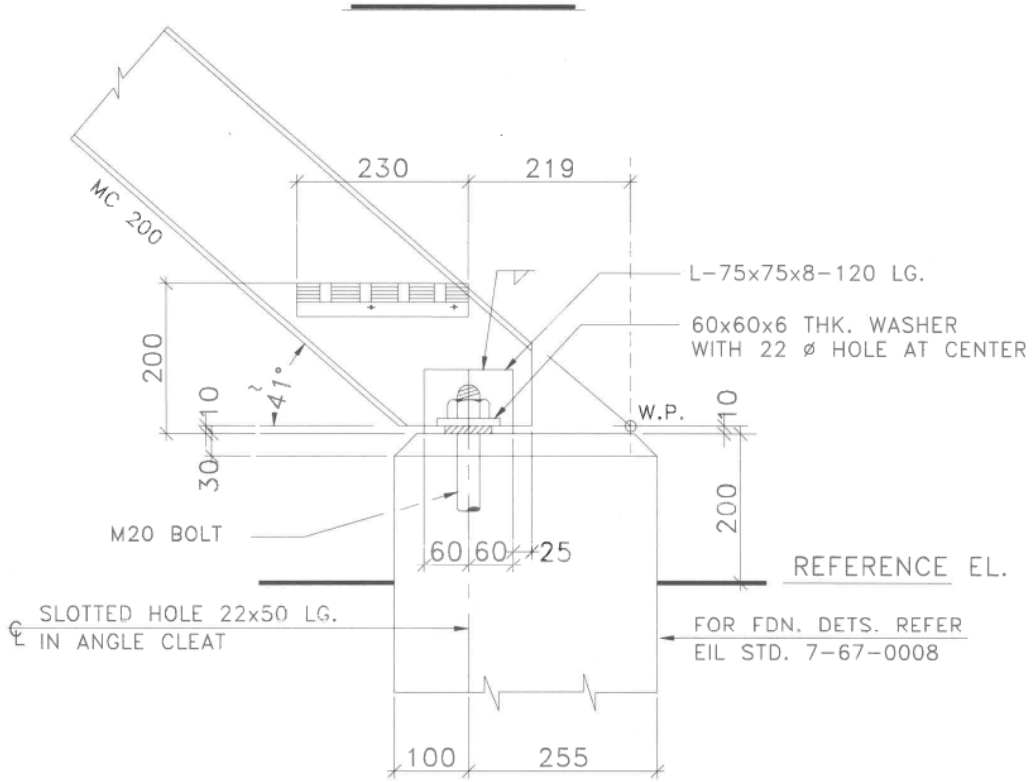


DETAIL – B



DETAIL – C

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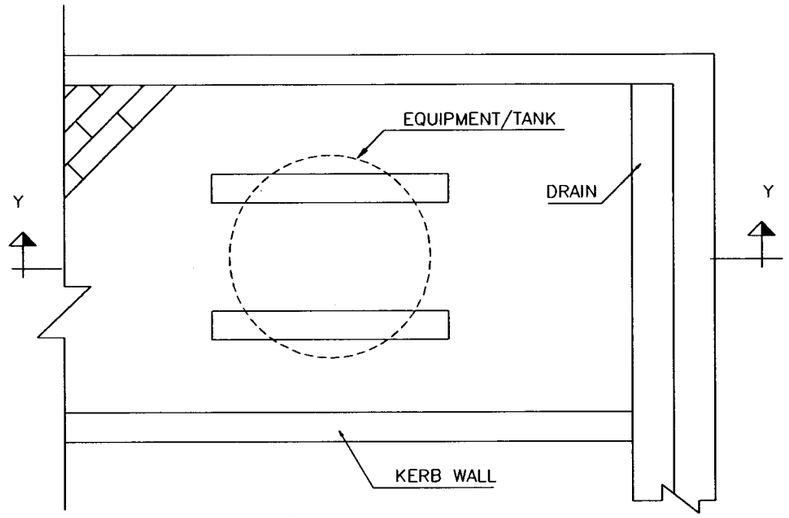
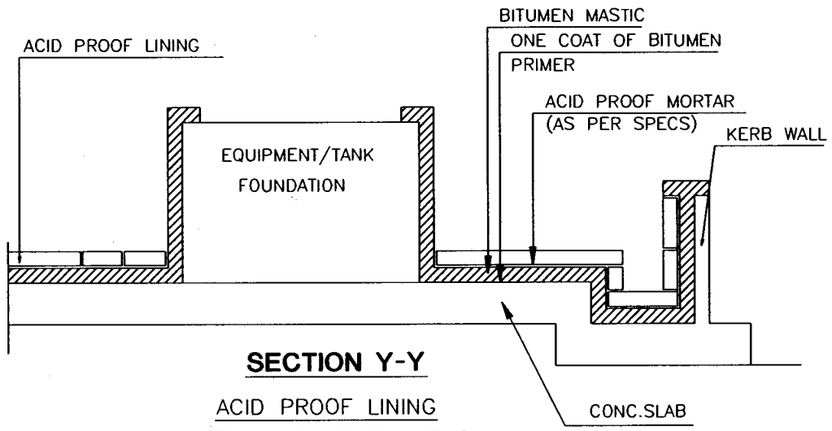
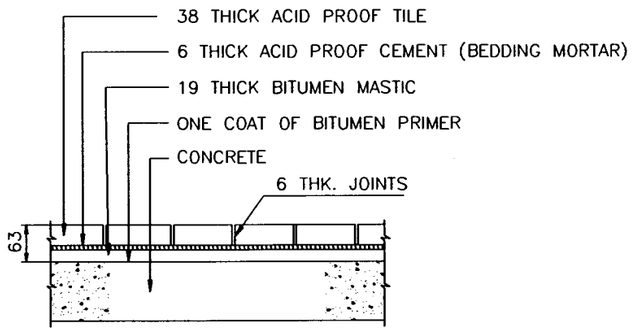


PLAN

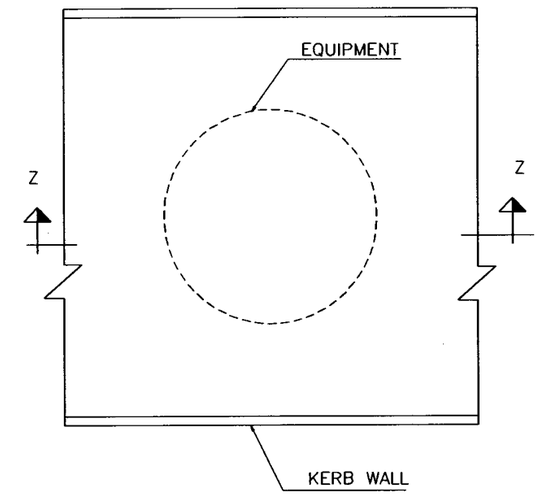


SECTION Y-Y

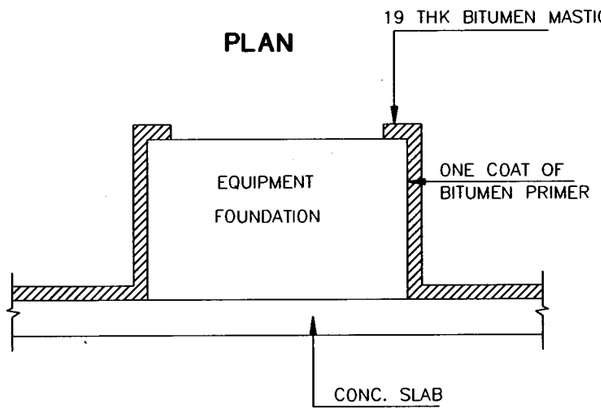
ACID PROOF LINING
(FOR H_2SO_4 STORAGE AREA)
(REFERENCE SPEC. NO 6-65-0062)



ACID PROOF LINING DETAIL



PLAN



SECTION Z-Z

ACID/ALKALI PROOF LINING WITH BITUMEN MASTIC
(REFERENCE SPEC.NO. 6-65-0061)

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
4	28.09.20	REAFFIRMED & ISSUED AS STD.	SK	RKS	AS	SM
3	25.07.14	REAFFIRMED & ISSUED AS STD.	KC	RKS	RBB	SC

ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

TYP. DETAIL OF ACID / ALKALI PROOF LINING

STANDARD No.
7-65-0412 Rev. 4
Page 1 of 1

Format No. 8-00-0001-F5 Rev. 0

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GENERAL NOTES :-

1. ALL LUGS SHALL BE OF HIGH STRENGTH DEFORMED BARS OF GRADE Fe500/Fe500D CONFORMING TO IS 1786 (WITH GUARANTEED WELDABILITY) AND SHALL BE CONNECTED TO METAL INSERT PLATES BY 6 mm FILLET WELDS AS SHOWN IN SKETCHES.
2. METAL INSERT PLATES SHALL BE OF GRADE E250, CONFORMING TO IS 2062 (GR-A/BR/BO).
3. METAL INSERT PLATES MARKED ON DRAWING REFER AS UNDER

   IP-(A) @ (C)

   IP = INSERT PLATE

   A = TYPE OF INSERT PLATE

   C = ELEVATION OF INSERT PLATE (TOP EDGE)

   e.g IP-R9a @ EL.110.300 MEANS INSERT PLATE TYPE R9a AT EL.110.300.
4. METAL INSERT PLATES SHALL BE KEPT FLUSH WITH CONCRETE SURFACE.
5. THE LONGER SIDE OF METAL INSERT PLATE SHALL BE KEPT VERTICAL UNLESS SHOWN OTHERWISE.
6. METAL INSERT PLATE ON COLUMN OR BEAM SHALL BE KEPT SYMMETRICAL ABOUT ℄ OF COLUMN OR BEAM, UNLESS SHOWN OTHERWISE.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
8	14.03.24	REVISED AND ISSUED AS STANDARD	EMMANUEL	SUDIP PAUL	ANURAG SINHA	MAINAK NANDI
7	06.06.18	REAFFIRMED AND ISSUED AS STANDARD	CS	AVM	R SRIVASTAVA	RK TRIVEDI

Approved by

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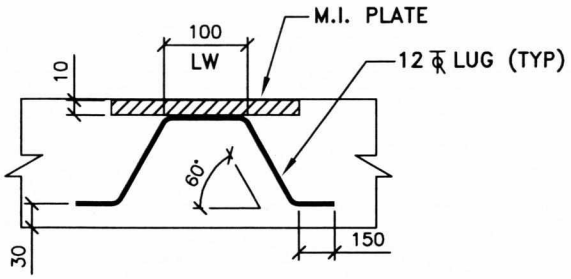
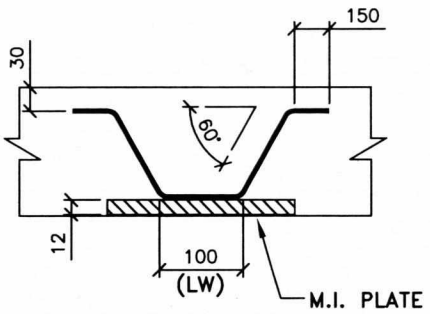
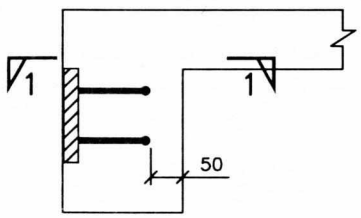
LUG BENDING DETAILS



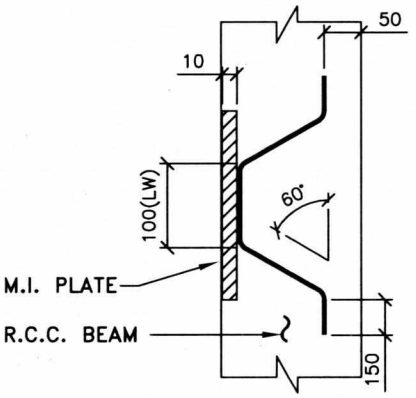
METAL INSERT DETAIL
ON TOP OF SLAB



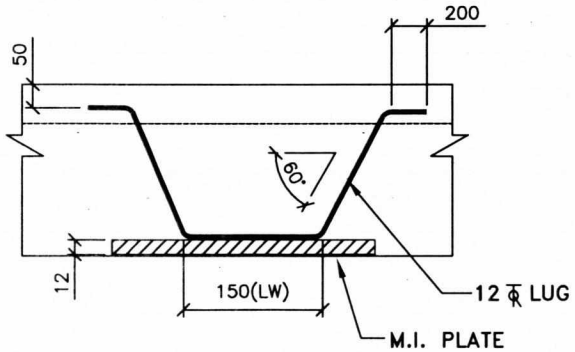
METAL INSERT DETAIL
ON BOTTOM OF SLAB



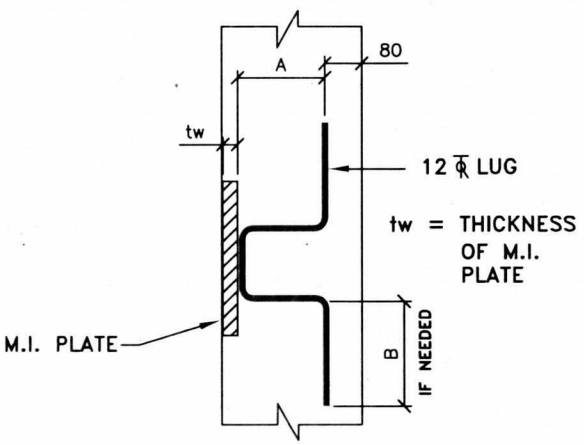
METAL INSERT DETAIL
ON SIDE OF BEAM



VIEW 1–1



METAL INSERT DETAIL
ON BOTTOM OF BEAM
(FOR ALTERNATE DETAIL REF. SHT. 7 OF 7)



METAL INSERT DETAIL
ON COLUMNS

A+B = LUG EMBEDMENT REQUIRED AS PER SHT. 4,5,6 OF 7

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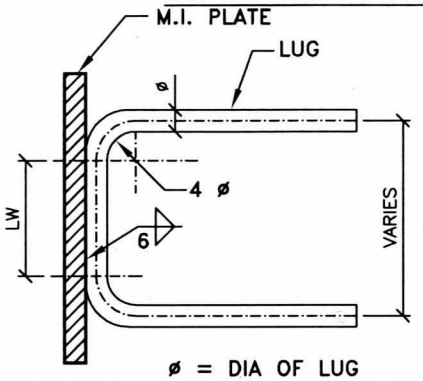
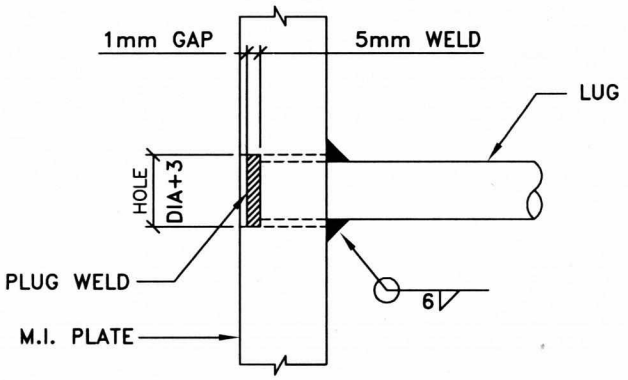
LUG BENDING DETAILS



ø = DIA OF LUG
LW = WELD LENGTH AVAILABLE

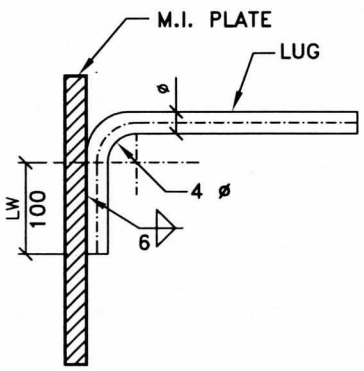
BENDING DIMENSIONS FOR 12ϕ & 16ϕ LUGS

(FOR SPACING OF LUGS ⩾ 190)
(NOT APPLICABLE FOR S1, S2, R1 & PS1)



WELD DETAIL OF 12ϕ & 16ϕ LUGS WITH M.I. PLATE

(FOR SPACING OF LUGS < 190)
(VALID FOR S1, S2 R1 & PS1)



BENDING DIMENSIONS FOR 12ϕ & 16ϕ LUGS

(VALID FOR R9, R10, R12, R13, R14, PS11, & PS12)

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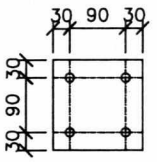
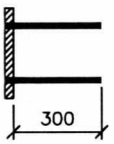
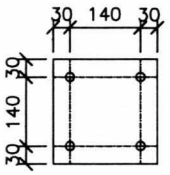
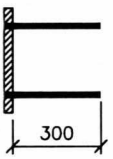
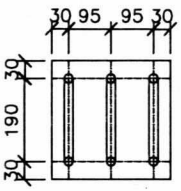
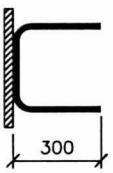
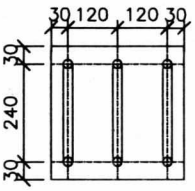
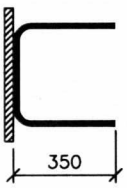
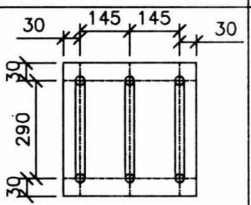
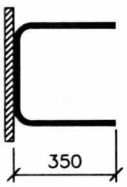
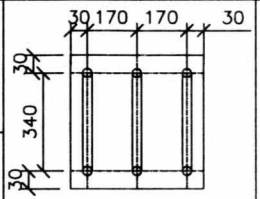
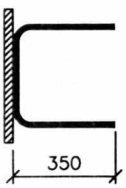
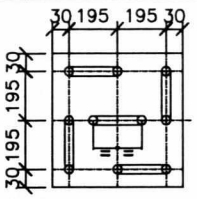
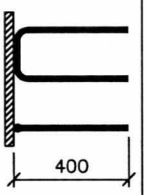
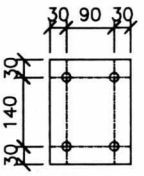
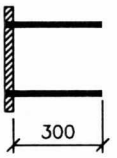
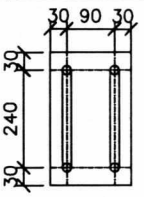
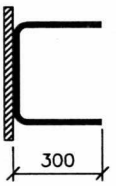
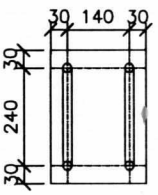
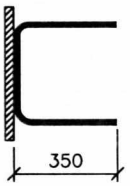
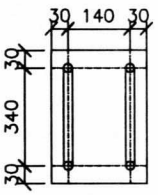
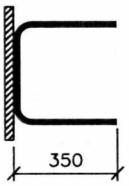
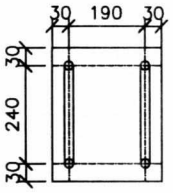
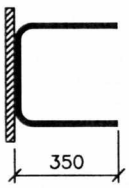
S/R DESIGNATES

S. NO.	TYPE OF INSERT	DIA OF LUGS	THK. OF INSERT	DETAILS OF INSERT PLATE	
				PLAN	CROSS SECTION
1.	S1a	12	12	 SIZE 150x150	
	S1b	16	16		
2.	S2a	12	12	 SIZE 200x200	
	S2b	16	16		
3.	S3a	12	12	 SIZE 250x250	
	S3b	16	16		
4.	S4a	12	12	 SIZE 300x300	
	S4b	16	16		
5.	S5a	12	12	 SIZE 350x350	
	S5b	16	16		
6.	S6a	12	12	 SIZE 400x400	
	S6b	16	16		

S. NO.	TYPE OF INSERT	DIA OF LUGS	THK. OF INSERT	DETAILS OF INSERT PLATE	
				PLAN	CROSS SECTION
7.	S7a	12	12	 SIZE 450x450	
	S7b	16	16		
8.	R1a	12	12	 SIZE 150x200	
	R1b	16	16		
9.	R2a	12	12	 SIZE 150x300	
	R2b	16	16		
10.	R3a	12	12	 SIZE 200x300	
	R3b	16	16		
11.	R4a	12	12	 SIZE 200x400	
	R4b	16	16		
12.	R5a	12	12	 SIZE 250x300	
	R5b	16	16		

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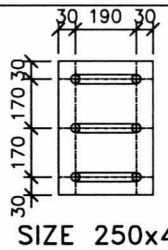
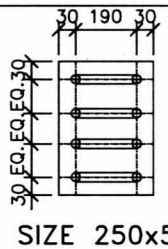
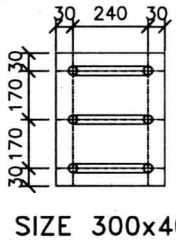
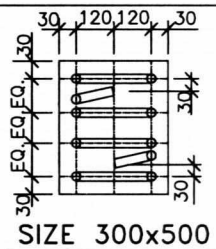
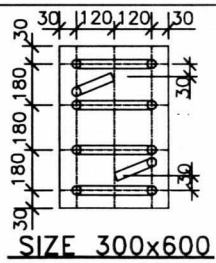
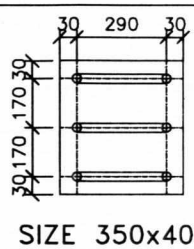
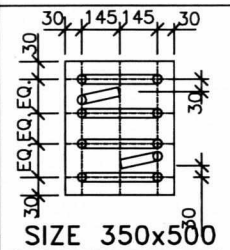
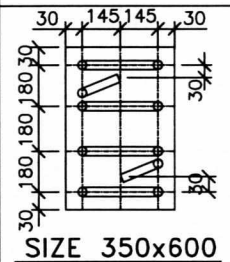
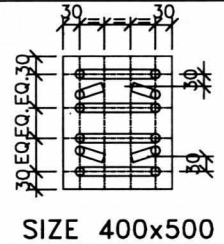
R DESIGNATES

S. NO.	TYPE OF INSERT	DIA OF LUGS	THK. OF INSERT	DETAILS OF INSERT PLATE	
				PLAN	CROSS SECTION
13.	R6a	12	12	 SIZE 250x400	
	R6b	16	16		
14.	R7a	12	12	 SIZE 250x500	
	R7b	16	16		
15.	R8a	12	12	 SIZE 300x400	
	R8b	16	16		
16.	R9a	12	12	 SIZE 300x500	
	R9b	16	16		
17.	R10a	12	12	 SIZE 300x600	
	R10b	16	16		
18.	R11a	12	12	 SIZE 350x400	
	R11b	16	16		

S. NO.	TYPE OF INSERT	DIA OF LUGS	THK. OF INSERT	DETAILS OF INSERT PLATE	
				PLAN	CROSS SECTION
19.	R12a	12	12	 SIZE 350x500	
	R12b	16	16		
20.	R13a	12	12	 SIZE 350x600	
	R13b	16	16		
21.	R14a	12	12	 SIZE 400x500	
	R14b	16	16		

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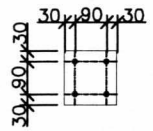
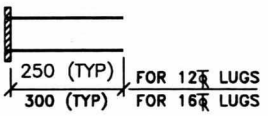
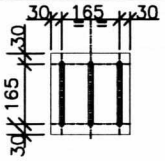
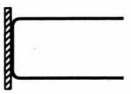
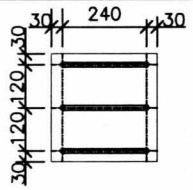
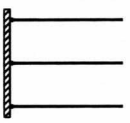
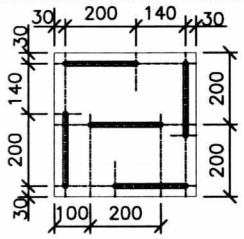
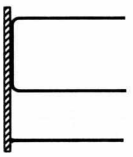
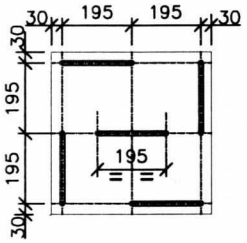
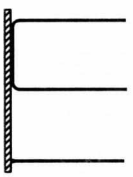
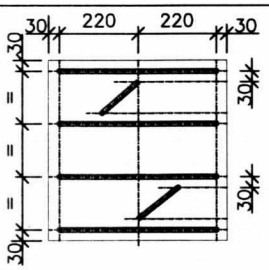
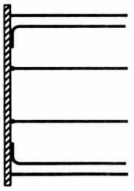
PS DESIGNATES

S.NO.	TYPE OF INSERT	DIA OF LUGS	THK. OF INSERT	DETAILS OF INSERT PLATE	
				PLAN	CROSS SECTION
1.	PS1	12	12	 SIZE 150x150	
	PS2	16	16		
2.	PS3	12	12	 SIZE 225x225	
	PS4	16	16		
3.	PS5	12	12	 SIZE 300x300	
	PS6	16	16		
4.	PS7	12	12	 SIZE 400x400	
	PS8	16	16		
5.	PS9	12	12	 SIZE 450x450	
	PS10	16	16		
6.	PS11	12	12	 SIZE 500x500	
	PS12	16	16		

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Location: eProcure-EPROC
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