SPECIFICATION FOR STRUCTURAL STEEL WORKS

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B	08-11-2019	Issued for Design	SUR	KRK	JP/KC	JMC
A	16-10-2019	Issued for Design	SUR	KRK	JP/KC	JMC
REV.	**DATE**	**DESCRIPTION**	**PREPARED**	**CHECKED**	**APPROVED**	**AUTHORIZED**

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1. Introduction

INDIAN OIL CORPORATION LIMITED (IOCL) has awarded Fax of Acceptance (FOA) dated 29th August 2019 to M/s. Technip India Limited (TPIL) for Consultancy services (PMC/EPCM services) for overall project management, FEED Review / FEED, Detailed Engineering, Procurement & expediting services, Tendering & award, Construction Management & Supervision, Assistance in start-up, Commissioning & performance test runs for installation of a Standby SRU of 525 TPD capacity and execution of Additional tanks for Paradip Refinery, Odisha, India.

2. Definitions & Abbreviations

Abbreviation	Definition /Expanded form
IOCL/ CLIENT	Indian Oil Corporation Limited
PMC/ CONSULTANT	Technip India Limited
LICENSOR	Party selected by IOCL for process technology ownership for any UNIT
CONTRACTOR	Party whose services are obtained for performing the works specified as part of LSTK / packages.
EPCM	Engineering, Procurement & Construction Management Services.
LSTK	Lump Sum Turn Key portion of the work to be executed by CONTRACTOR
FEED	Front End Engineering Design
AUTHORISED REPRESENTATIVE	IOCL's/ CONSULTANT's representative authorized to act for and on behalf of them.
VENDOR	Any third party supplying the equipment/materials for setting up the Plant
PROJECT	Indicates Standby SRU and Additional tanks Project, Paradip Refinery
SITE	Indicates Paradip Refinery in Odisha, India
UNIT	Indicates any particular portion of the project to be built which can be Process related or Utilities/Offsites related
SRU	Sulphur Recovery Unit
BIS	Bureau of Indian Standards

3. General

Fabrication, erection and approval of steel structures shall be in compliance with:

1) These general specifications and IS 800:2007
2) Fabrication drawings shall be prepared by CONTRACTOR based on approved "Issued for Construction" design drawings and standard drawings.

The CONTRACTOR shall prepare the shop fabrication drawings and submit to OWNER/ENGINEER IN CHARGE for approval:

1) List of drawings that will be prepared by the CONTRACTOR.
2) Schedule of rates given in this document

This JSS covers typical General specification for some standard items only and the CONTRACTOR shall comply with the requirement as given in 080557C-000-JSD-1700-001/002 for specific cases and for any other items not mentioned/specified in this JSS. The requirement for various type of Buildings /Unit / Structures etc., as specified in the document 080557C-000-JSD-1700-001/002 shall be the governing one.

The CONTRACTOR shall submit the detailed specification for the items not covered in this specification for Approval by OWNER'S/ENGINEER IN CHARGE during execution.

3.1. Codes

The workmanship, fabrication and materials provided to this specification shall comply in construction and perform with the requirements of statutory authorities having jurisdiction over-all or part of the works, together with relevant requirements of the current issues of the following specifications and standards unless specified otherwise elsewhere within this specification.

- IS: 800 Code of Practice for General Construction in Steel.
- IS: 806 Code of Practice for use of Steel tubes in general building construction
- IS: 812 Glossary of Terms Relating to Welding and Cutting of Metal.
- IS: 813 Scheme of Symbol for Welding
- IS: 814 Covered Electrodes for Manual Metal Arc Welding of Carbon and Carbon Manganese Steel.
- IS: 816 Code of Practice for Use of Metal Arc Welding for General Construction in Mild steel.
- IS: 817 Code of Practice for Training and Testing of Metal Arc Welders.
- IS: 818 Code of Practice for safety and health requirements in electric and gas welding and cutting operations.
- IS: 822 Code of Practice for Inspection of Welds.
- IS: 1278 Filler Rods and Wires for Gas Welding.
- IS: 1363 Hexagonal Bolts, Screws and Nuts of Product Grade-C.

- IS: 1364 Hexagonal Bolts, Screws and Nuts of Product Grade A & B.
- IS: 1367 Technical Supply Conditions of Threaded Steel Fasteners.
- IS: 1393 Code of Practice for Training and Testing of Oxy-acetylene Welders.
- IS: 1477 Code of Practice for Painting of Ferrous Metals in Buildings.
- IS: 1852 Rolling and cutting tolerances for hot rolled steel products.
- IS: 2016 Plain Washers
- IS: 2629 Recommended practice for Hot Dip Galvanizing on Iron & steel.
- IS: 2062 Steel for General Structural Purposes.
- IS: 3502 Steel Chequered Plates.
- IS: 3640 Hexagon fit bolts.
- IS: 3757 High strength structural bolts.
- IS: 4000 High strength structural bolts in steel structures - Code of Practice.
- IS: 5369 General Requirements of Plain Washers and Lock Washers.
- IS: 6419 Welding Rods and Bare Electrodes for Gas Shielded Arc Welding of Structural Steel.
- IS: 7025 Safety Code for Erection of Structural Steel Works.
- IS: 7215 Tolerances for Fabrication of Steel Structures.
- IS: 7307 Approval Test for Welders Working to Welding to Approved Welding Procedures.
- IS: 6610 Heavy Washers for Steel Structures.
- IS: 6623 High Strength Structural Nuts.
- IS: 8172 Vertical Steel ladder.
- IS: 3138 Specification for hexagonal bolts and nuts (M42 to M150).

In case of conflict between the clauses mentioned here and the Indian Standards, those expressed in this specification shall govern. Any special provision as shown or noted on the design drawings shall govern over the provisions of this specification.

4. Scope

This specification covers the requirements for materials, storage, preparation of fabrication drawings, fabrication, assembly, tests/examination, transportation, erection and painting of all types of bolted and/or welded structural steel works for general construction works. Fabrication of structures shall also include fabricating,

1) Built-up sections/plate girders made from rolled sections and/or plate.
2) Compound sections made out of rolled sections.

5. Fabrication Drawings

Fabrication and erection drawings shall be prepared by the CONTRACTOR in AutoCAD/Any other software on the basis of latest "Approved for Construction" design drawings and standard drawings issued to CONTRACTOR.

Fabrication and erection drawings shall be thoroughly checked, stamped "Approved for Construction" and signed by the CONTRACTOR's own responsible engineer, to ensure the accuracy and correctness of the drawing. The CONTRACTOR shall proceed with the fabrication and erection work only after thoroughly satisfying himself in this regard.

All fabrication and erection drawings shall be Issued for Construction by the CONTRACTOR directly to his work-site. Six copies of such drawings shall be simultaneously submitted to OWNER/ENGINEER-IN-CHARGE who may review at his option some, all or none of such drawings at his sole discretion and offer his comments for incorporation in these drawings by CONTRACTOR.

However, the CONTRACTOR shall not proceed with the fabrication of such structures whose fabrication drawings are required to be reviewed before taking up the fabrication work as noted on "Approved for Construction" design drawings issued to CONTRACTOR or as conveyed by OWNER/ENGINEER-IN-CHARGE. The fabrication of such structures shall be done only as per the reviewed fabrication drawings.

Wherever such reviews are carried out the same shall be restricted to the following:

1) Structural layout, orientation and elevation of structures and members.
2) Size of members.
3) Critical connections and joints details.

In those cases where OWNER/ENGINEER-IN-CHARGE carries out either full or partial review, one copy of drawing submitted by the CONTRACTOR shall be returned to him and CONTRACTOR shall incorporate the amendments and submit further three copies of amended drawings for final review. In those cases where OWNER/ENGINEER-IN-CHARGE does not review the drawings, OWNER/ENGINEER-IN-CHARGE shall return one copy of drawings, stamped "Not reviewed, proceed at CONTRACTOR's responsibility" to the CONTRACTOR for further action.

Schedule for review of fabrication drawings to be worked out mutually.

Fabrication drawings shall be drawn to scale and shall include the following:

1) Reference to the Design Drawing No.
2) Structural layout, elevations and sections (with distinct erection marking of all members)
3) Framing plans, Sizes of structural members, orientation and elevations
4) Connections and joints marking
5) Design and detailing of structural joints for required strength and erection

6) Type and dimension of welds and bolts
7) Shapes and sizes of edge preparation for welding
8) Details of shop and field joints included in the assembly
9) Bill of materials along with total weight for each marked member on the drawing itself.
10) Quality of structural steel, welding electrodes, bolts, nuts and washers to be used.
11) Erection assemblies identifying all transportable parts and sub-assemblies associated with special erection instructions, if required.
12) Method of erection and special precautions to be taken during erection as required.
13) Fire proofing (dense / light weight)
14) Notes and Legends
15) Friction grip / Ordinary moment connections
16) Grating bearing bar directions
17) Floor drain and safety shower pan
18) Sheeting, cladding, louvers, turbo ventilators, rain water downspout, gutter and penetration details

The CONTRACTOR shall additionally ensure accuracy of the following and shall be solely responsible for the same.

1) Provision for erection and erection clearances
2) Marking of members
3) Cut length of members
4) Matching of holes and joints
5) Provision kept in the members for other interconnected members
6) BOM

Review by OWNER/ENGINEER-IN-CHARGE fully / partially or non-review of fabrication drawings submitted by CONTRACTOR shall not absolve the CONTRACTOR of his responsibility and he shall modify / rectify the structures at any stage of work when pointed out by OWNER/ENGINEER-IN-CHARGE that such work is not in conformity with specification and / or standard practice without any extra cost to OWNER.

Connections, splices etc. other details not specifically detailed in design drawings shall be suitably given on fabrication drawings considering normal detailing practices and developing full member strengths. Design calculations for such connections shall be submitted to OWNER/ENGINEER-IN-CHARGE for approval along with the fabrication drawings.

Any alternate design or change in section shall be allowed only when prior approval is obtained in writing from the OWNER/ENGINEER-IN-CHARGE. Fabrication and erection drawings shall be updated incorporating all such changes by CONTRACTOR at no extra cost to OWNER.

In case during execution of work, the OWNER/ENGINEER-IN-CHARGE on review of drawings considers any modifications/substitutions necessary to meet the design parameters / good engineering practice, these shall be brought to the notice of CONTRACTOR who shall incorporate the same in the drawings and works without any extra cost to OWNER. The CONTRACTOR will be totally responsible for the correctness of the detailed fabrication drawings and execution of work.

CONTRACTOR shall incorporate all the revisions made in the design drawings during the course of execution of work in his fabrication drawings and resubmit the drawings at no extra cost to OWNER. All fabrication shall be carried out only based on the latest AFC design drawings and corresponding fabrication drawings.

The CONTRACTOR shall supply two prints each of the final/ as-built drawings along with their transparencies to ENGINEER-IN-CHARGE for reference and records. The rate quoted shall include the same.

6. Materials

6.1. Rolled Sections, MS plates

All materials shall conform to their respective specification given in specification 080557C-000-JSS-1700-005.

6.2. Welding Material

Welding electrodes shall confirm to IS: 814.

Approval of welding procedures shall be as per IS: 823.

Welder's Performance Qualification Test shall be as per IS: 823.

6.3. Bolt, Nuts, Washers

Bolts and nuts shall be as per IS: 1367 and tested as per IS: 1608. It shall have a minimum tensile strength of 44 kg/mm2 and minimum elongation of 23% on a gauge length of 5.65x√A. Where A is the original cross sectional area of the gauge length. Bolts shall be threaded in accordance with IS 4218.Washers shall be as per IS: 2016. Only Bolts & nuts for equipment erection shall be hot dip galvanised.

6.4. Non-Standard Materials

All materials shall conform to their respective specifications. The use of equivalent or higher grade or alternate materials will be considered only in special cases subject to the approval of the TP in writing. Any defective material used, pointed out at any stage of work, shall be replaced by CONTRACTOR at his own expense, care shall be taken to prevent any damage to the other portion of work during removal.

Nuts, Bolts & Washers fixing equipment to structures, as well as those required for joints shall be deemed to be included in the rates of structural steel.

6.5. Receipt and Storing of Materials

Each section shall be marked for identification and each lot should be accompanied by manufacturer's quality certificate, conforming chemical analysis and mechanical characteristics.

All sections shall be checked, sorted out, straightened, and arranged by grades and qualities in stores. Any instruction given by ENGINEER-IN-CHARGE in this respect shall be strictly followed.

Structural steel with surface defects such as pitting, cracks, laminations etc. shall be rejected if the defects exceed the allowable tolerances specified in relevant standards. All such rejected material shall be immediately removed from store/site. The decision of ENGINEER-IN-CHARGE in this regard shall be final and binding.

Welding wire and electrodes shall be stored separately by quality (packed in their original cartons) and lots inside a dry and enclosed room in compliance with IS: 9595 and as per instructions given by ENGINEER-IN-CHARGE. Electrodes shall be kept perfectly dry to ensure satisfactory operation and weld metal soundness.

Checking of quality of bolts of any kind as well as storage of same shall be made conforming to relevant standards.

Manufacturer’s quality/test certificates shall accompany each lot of electrodes, bolts, nuts etc.

All bolts (including nuts and washer) shall be checked, sorted out and arranged diameter-wise by grade and quality in store.

6.6. Material Tests

CONTRACTOR shall submit manufacturer's quality certificate for the material supplied. Wherever quality certificates are missing or incomplete or when material quality differs from standard specifications, the CONTRACTOR shall conduct all appropriate tests as directed by ENGINEER-IN-CHARGE, at no extra cost, in approved test houses and submit to ENGINEER-IN-CHARGE for his approval.

Materials for which test certificates are not available or for which results do not tally with relevant standard specification, shall not be used and shall be removed from stores/site.

7. Fabrication of Steelworks

Fabrication shall be in accordance with IS 800:2007 Section 17. Fabrication shall be done as per “Approved for Construction” fabrication drawings adhering strictly to work points and work lines on the same. The connections shall be welded or bolted as per design drawings. Work shall also include fabricating built up sections.

Prior to commencement of structural fabrication, undulations in the fabrication yard, if any shall be removed

and area levelled and paved by CONTRACTOR.

Any defective materials used shall be replaced by CONTRACTOR at his own expense, care being taken to prevent any damage to the structure during removal.

Any faulty fabrication pointed out at any stage of work by the ENGINEER-IN-CHARGE, shall be made good or replaced by the CONTRACTOR at his own cost.

Tolerance for fabrication of steel structures shall be as per IS: 7215

7.1. Preparation Materials

All materials shall be straight and if necessary, before being worked shall be straightened and/or flattened and shall be free from twists.

Bending of rolled sections and plates shall be done by cold process to shape as shown on the drawings.

Warped members like plates and flats may be used as such only if wave like deformation does not exceed L/1000 but limited to 10mm (L = Length).

Surfaces of members that are to be joined by lap or fillet welding or bolting shall be even so that there is no gap between overlapping surfaces.

7.2. Marking

All members shall be properly marked showing the requisite cut length, width, connection provision, e.g. location and dimension of holes, weld, cleats etc. Marking for cutting shall be done judiciously so as to avoid wastages or unnecessary joints as far as practicable.

Marking of members shall be made on horizontal pads, or on appropriate racks or supports in order to ensure horizontal and straight placement of such members.

Each structural component shall refer to the relevant vendor drawing.

Marking accuracy shall be at least ± 1mm.

7.3. Cutting

Members shall be cut mechanically (by saw or shear) or by oxyacetylene flame.

All sharp, rough or broken edges and all edges of joints that are subjected to tensile or oscillating stresses shall be ground.

No electric metal arc cutting shall be allowed.

All edges cut by oxyacetylene process shall be cleaned of impurities and slag prior to assembly.

Cutting tolerances shall be as follows:

1) For members connected at both ends ± 1mm.
2) Elsewhere ± 3mm.

The edge preparation for welding of members more than 12mm thick shall be done by flame cutting and grinding. Cut faces shall not have cracks or be rough.

Edge preparation shall be as per IS: 823.

7.4. Drilling

Bolt holes shall be drilled.

Drilling shall be made to the diameter specified in drawings.

No enlarging of holes by filling, man drilling or oxyacetylene flame shall be allowed.

Allowable variations for holes (out of roundness, eccentricity, plumb-line deviation) shall be as per IS 800:2007.

1) Maximum deviation for spacing of two holes on the same axis shall be ± 1mm.
2) Two perpendicular diameters of any oval hole shall not differ by more than 1mm.

Drilling faults in holes may be rectified by reaming holes to the next upper diameter, provided that spacing of new hole centers and distance of hole centers to the edges of members are not less than allowed and that the increases of hole diameter does not impair the structural strength. Hole reaming shall be allowed if the numbers of faulty holes does not exceed 15% of the total number of holes for one joint.

7.5. Bending

Bending of plates, flats and sections shall be carried out on bending rolls or in presses.

Cold bending may be accepted when bending radius is equal or more than:

1) 25 times member thickness for plates and flats.
2) 25h or 25b for rolled steel beams and channels according to bending plate.
3) 45b for angle.

Where,

h = section height and

b = flange width.

When bending radius is less bending shall be done on hot metal by heating the member up to 850-900oC light red radiances. Cooling shall be done slowly as directed by OWNER/ENGINEER-IN-CHARGE.

Bending shall be discontinued when temperature drops below 500^{o}C.

Accuracy of bending operations shall be checked by means of templates. The clearance between member and template shall not be more than 1mm.

Bent members shall not have cracks or deep indentations from bending equipment.

7.6. Preparation of Members for Welding

Assembly of structural members shall be made with proper jigs fixtures to ensure correct positioning of members (angles, axes, nodes etc.)

Sharp edges, rust of cut edges, notches, irregularities and fissures due to faulty cutting shall be chipped or ground or field over the length of the affected area, deep enough to remove faults completely.

Edge preparation for welding shall be carefully and accurately made so as to facilitate a good joint.

Generally, no special edge preparation shall be required for members under 8mm thick.

Edge preparation (beveling) denotes cutting of the same so as to result in V, X, K or U seam shapes as per IS - 823.

The members to be assembled shall be clean and dry on the welding edges, under no circumstances shall wet, greasy rust or dirt covered parts be assembled. Joints shall be kept free from any foreign matter, likely to get into the gaps between members to be welded.

Before assembly, the edges to be welded as well as adjacent areas extending for at least 20mm shall be cleaned (until metallic polish is achieved).

When assembling members, proper care shall be taken of welding shrinkage and distortions, as per the drawings and dimensions cover finished dimensions of the structure.

The elements shall be got checked and approved by the OWNER/ENGINEER-IN-CHARGE of his authorized representative before assembly.

The permissible tolerances for assembly of members preparatory to welding shall be as per IS: 823.

After the assembly has been checked, temporary tack welding in position shall be done by electric welding, keeping in view finished dimensions of the structure.

Preheating of members to be joined to be carried out as per standards wherever necessary.

7.7. Welding Procedure

Welding shall be carried out only fully trained and experienced welders as tested and approved by the OWNER/ENGINEER-IN-CHARGE or his representative or the inspectors shall constitute a right by them for such tests and the cost involved there on shall be borne by the CONTRACTOR himself.

Qualification tests for welders as well as tests for approval of electrodes will be carried out as per IS: 823. The nature of test for performance qualification of welders shall commensurate with the quality of welding required on this work as judged by OWNER/ENGINEER-IN-CHARGE.

The steel structures shall be automatically, semi - automatically or manually welded.

Welding shall begin only after the checks shown under 5.6 have been carried out.

Welding procedures and tests for welders shall be conducted as per IS: 823 and approved by the

OWNER/ENGINEER-IN-CHARGE.

The welder shall mark with his identification mark on each element welded by him.

When welding is carried out in open air, steps shall be taken to protect the place of welding against wind or rain. The electrodes, wire and parts being welded shall be dry.

Before beginning the welding operation, each joint shall be checked to assure that the parts to be welded are clean and root gaps provided as per IS: 823.

For continuing the welding of seams discontinued due to some reason, the end of the discontinued seam shall be melted in order to obtain a good continuity. Before resuming the welding operation, the groove as well as the adjacent parts shall be well cleaned for a length of approximately 50mm.

For single butt welds (in V, 1/2V or U) and double butt welds (in K, double U, etc.) the re-welding of the root butt is mandatory but only after the metal deposition on the root has been cleaned by back gouging or chipping.

The welding seams shall be left to cool slowly. The CONTRACTOR shall not be allowed to cool the welds quickly by any method.

For multi-layer welding before welding the following layer, the formally welded layer shall be cleaned metal bright by light chipping and wire brushing. Backing strips shall not be allowed.

The order and method of welding shall be so that:

1) No unacceptable deformation appears in the welded parts.
2) Due margin is provided to compensate for contraction due to welding in order to avoid any high permanent stresses.

The defects in welds must be rectified according to IS: 823 and as per instruction of OWNER/ENGINEER-IN-CHARGE.

7.8. Weld Inspection

7.8.1. The weld seams shall satisfy the following:

1) Shall correspond to design shapes and dimensions.
2) Shall not have any defects such as cracks, incomplete penetration and fusion, under-cuts, rough surfaces, burns, blowholes and porosity etc. beyond permissible limits.

During the welding operation and approval of finished elements, inspections and tests shall be made.

The mechanical characteristics of the welded joints shall be as in IS: 823.

The following inspection methods shall be carried out,

1) Visual inspection
2) Mechanical test
3) Magnetic particle / dye penetration / ultrasonic examination
4) Radiographic examination

7.9. Preparation of Members for Bolting

The members shall be assembled for bolting with proper jigs and fixtures to sustain the assemblies without deformation and bending.

Before assembly all sharp edges, shaving, rust, dirt etc. shall be removed.

Before assembly, the contacting surfaces of the members shall be cleaned and given a coat of primer as per IS: 2074.

The member which is bolt assembled shall be set according to drawings and temporarily fastened with erection bolts (minimum 4 pieces) to check the co axiality of the holes.

The member shall be finally bolted after the deviations have been corrected, after which there shall not be gaps.

Before assembly, the member shall be checked and got approved by the OWNER/ENGINEER-IN-CHARGE.

The difference in thickness of the sections that are butt assembled shall not be more than 3% or maximum 0.8mm whichever is less. If the difference is large it shall be corrected by grinding or filing. Reaming of holes to final diameter or cleaning of these shall be done only after the parts have been check assembled.

As each hole is finished to final dimensions (reamed if necessary) it shall be set and bolted up. Erection bolts shall not be removed before other bolts are set.

7.10. Bolting Up

Final bolting of the members shall be done after the defects have been rectified and approval of joints obtained.

The bolts shall be tightened starting from the center of the joints towards the edge.

7.11. Planing of Ends

Planing of ends of members like column ends shall be done by grinding when so specified in the design. Planing of butt-welded members shall be done after these have been assembled and the sharp edges shall be removed with grinding machine or files.

The following tolerances shall be permitted on members that have been planned.

1) On the length of the member having ends planed, maximum ± 2mm with respect to design.
2) Level differences of planed surfaces, maximum 0.3mm.

3) Deviation between planed surface and member's axis, maximum 1/1500.

7.12. Holes of Field Joints

Holes for field joints shall be drilled in the shop to final diameters and tested in the shop, with trial assemblies. Gas cutting of holes shall not be permitted.

When three-dimensional assembly is not possible in the shop, the holes for field joints may be drilled in shop and reamed on site after erection, on approval by OWNER/ENGINEER-IN-CHARGE.

For bolted steel structures, trial assembly in shop is mandatory.

The tolerances for spacing of holes shall be ± 1mm.

7.13. Tolerance

All tolerances regarding dimensions, geometrical shapes and sections of steel structures, shall be as mentioned above and specified in the drawing.

7.14. Marking for Identification

All elements and members prior to dispatch for erection shall be shop marked.

The members shall be visibly marked with punch type marking. The size and thickness of the numbers shall be chosen as to facilitate the identification of members.

For the small members that are delivered in bundles or crates, the required marking shall be done on small metal tags securely tied to the bundle, while the crates shall be marked directly.

Each bundle of crate shall be packed with members for one and the same assembly in the same bundle or crate general utility members such as bolts, gussets etc. may be packed.

All bills of materials showing weight, quantity and dimension of contents shall be placed in the crates.

The members shall be marked with punch type in a visible location, preferably at one end of the member so that these may be easily checked during storage and erection.

The members shall be marked in the shop before inspection and acceptance and shall have reference to the relevant vendor drawing.

When the member is being painted the marking area shall not be painted but bordered with white paint.

The marking and job symbol shall be registered in all shop delivery documents (transportation, for erection etc.)

7.15. Shop Test Pre-assembly

For steel structures that have the same type of welding, the shop test pre-assembly shall be performed on one out of every 10 member’s minimum.

In case one member does not meet the limiting deviations specified in the general specification in pre-

assembly shop test, all members shall be shop tested.

For bolted steel structures, shop test pre-assembly is mandatory for all elements as well as for the entire structure in conformity with clause 7.2.

8. Shop Inspection and Approval

8.1. General

The OWNER/ENGINEER-IN-CHARGE or his representative shall have free access at all reasonable times to the CONTRACTOR's fabrication shop and shall be afforded all reasonable facilities for satisfying himself that the fabrication is being undertaken in accordance with drawings and specifications.

Technical approval of the steel structure in the shop by the OWNER/ENGINEER-IN-CHARGE is mandatory.

The CONTRACTOR shall not limit the number and kinds of tests, final as well as intermediate ones, or extra tests requested by the OWNER/ENGINEER-IN-CHARGE.

The CONTRACTOR shall furnish necessary tool gauges, instrument etc. and technical and non-technical personnel for shop tests by OWNER/ENGINEER-IN-CHARGE at free of cost and shall be borne by the CONTRACTOR.

8.2. Shop Acceptance

The following approval may be given in shop:

1) Intermediate approvals of work that cannot be inspected later.
2) Partial approvals.
3) Final approvals.

Intermediate approvals of work shall be given when:

1) A part of work is performed later
2) Inspection would be difficult to perform and results not be satisfactory.
3) Cannot be inspected later.

Partial approval in the shop is given on members and assemblies of steel structures before the primer coat is applied and includes.

1) Approval of material
2) Approval of field joints
3) Approval of part for correct application of surface preparation
4) Test erection
5) Approval of members based on dimensional conformity and visual aspect of the material used.

6) Approval of marking

7) Inspection and approvals of special features, like rollers, loading platform mechanism etc.

During the partial approval, intermediate approvals as well as former approvals shall be taken into consideration.

8.3. Final Approval in the Shop

The final approval refers to all elements and assemblies of the steel structures, with shop primer coat, ready for delivery from shop to be loaded for transportation or stored.

The final approval comprises of:

1) Partial approvals

2) Approval of shop primer coat

3) Approval of mode of loading and transport

4) Approval of storage (for material stored)

9. Packing, Transportation, Delivery

After final shop acceptance and marking, the item shall be packed and loaded for transportation.

Packing must be adequate to protect items against warping during loading and unloading.

Proper lifting devices shall be used for loading, in order to protect items against warping. Slender projecting parts shall be braced with additional steel bars before loading for protection against warping during transportation.

Loading and transportation shall be done in compliance with transportation rules.

If certain parts cannot be transported in the lengths stipulated in the design, the position and type of additional splice joints shall be approved by OWNER/ENGINEER-IN-CHARGE.

Items must be carefully loaded on platforms for transportation means to prevent warping, bending or falling, during transportation.

The small parts such as fin-plates, gussets etc. shall be securely tied with wire to their respective parts.

Bolts, nuts and washers shall be packed and transported in crates, marked in at least 2 places with water-resistant paint.

The parts shall be delivered in the order stipulated by the OWNER/ENGINEER-IN-CHARGE and shall be accompanied by documents showing:

1) Quality and quantity of structure of members.

2) Position of member in the structure.

3) Particulars of structures.

4) Identification number/job symbol.

10. Field Erection

The CONTRACTOR shall satisfy himself about the level, alignment etc. for the foundations well in advance, before starting the erection. Minor chipping etc. shall be carried out by the CONTRACTOR at his expense.

Any faulty erection done as under by the CONTRACTOR shall be made good at his cost.

1) Accuracy in alignment of structures

2) Erection according to drawings and specifications

3) Progress and workmanship

In case there are many deviations regarding positions of foundations, or anchor bolts, which would lead to erection deviations, the OWNER/ENGINEER-IN-CHARGE shall be informed immediately. Minor rectifications in foundations, orientation of bolt's holes etc. shall be carried out as a part of the work, at no extra cost.

The various parts of the steel structure shall be so erected as to ensure stability against inherent weight, wind and erection stresses.

The structure shall be anchored and final erection joints completed after plan and elevation positions of the structural members have been verified with corresponding drawings and approved by OWNER/ENGINEER-IN-CHARGE.

The bolted joints shall be tightened so that the entire surface of the bolt heads and nuts shall rest on the member. For parts with sloping surfaces, tapered washers shall be used.

CONTRACTOR shall prepare the field erection procedures and obtain approval from OWNER/ENGINEER-IN-CHARGE prior to the commencement of field erection.

11. Final Acceptance and Handing Over of Structure

At acceptance, the CONTRACTOR shall submit the following documents:

1) Shop and erection drawings - either in tracings or reproducible and compatible Auto CAD drawings in soft copy.

2) 6 copies of each of the following:

   a) Shop acceptance documents

   b) Quality certificates for structural members, plates etc. (electrodes, welding wire, bolts, nuts, washers etc.)

   c) List of certified welders who worked on erection of structure.

d) Acceptance and intermediate control procedure of erection operations.

12. Anchor Bolts

12.1. Material

1) Material for Anchor Bolts shall be as per IS: 2062 Grade A unless otherwise specified.
2) Nuts and lock nuts (hexagonal type) shall be of Grade C as per IS 1367 and conform to IS 1363.
3) Washers shall be of mild steel conforming to IS 2016.
4) Pipe sleeves shall be of mild steel tubes (medium duty) conforming to IS 1239.
5) Anchor plates and ribs shall conform to IS 2062.

12.2. Fabrication

Fabrication of anchor bolts and their complete assemblies shall be strictly in compliance with the specifications and drawings. Anchor bolts shall have coarse type threads conforming to IS 4218.

12.3. Placement

Anchor bolt assemblies shall be placed in position strictly as per drawings and securely held during pouring and vibrating of concrete with necessary templates and other dummy structures to prevent their dislocation.

12.4. Tolerances

Tolerances allowed for anchor bolts positioning shall be:

- For sleeved bolts, one tenth of the bolt nominal diameter.
- For bolts without sleeves, one twentieth of the bolt nominal diameter.

12.5. Protection

The exposed surfaces of bolts shall be properly covered (after greasing of bolts and packing of sleeves) with jute cloth so as to protect them from damage.

12.6. Special Anchors

“HILTI” anchor (or equivalent) either chemical or expansion type may be used to fasten minor steel items to concrete works.

The utilization of post installed anchor bolts shall be always submitted to ENGINEER-IN-CHARGE for approval.

13. M.S. Inserts/ Corner angles

13.1. Material

1) M.S. Inserts/ corner angles shall be of mild steel conforming to IS 2062.
2) Lugs shall be of mild steel conforming to IS 432 Grade – I.

13.2. Fabrication

M.S. Inserts/ corner angles shall be done strictly as per drawings and in compliance with the requirements given in specifications.

13.3. Placement

M.S. Inserts/ corner angles shall be correctly embedded as per their location shown in the drawings. Care shall be taken that these are securely held in position and do not get disturbed during concreting. Where necessary, these may be welded to the reinforcement bars. Suitable templates, spacers, dummy structures and temporary staging shall be provided. Necessary cutting in the form work and adjustment of reinforcement bars shall be affected for the placement of Inserts/ corner angles where required.

14. Chequered Plates

14.1. Material

The material shall conform to IS 2062.

14.2. Fabrication

Chequered plate shall be fabricated as per AFC fabrication drawings (prepared by the CONTRACTOR based on approved design and standard drawings). These shall be perfectly flat and without any dents/ deformations and shall be cut to the required size and shape. Holes/ notches/ openings of the required size shall be provided as per the drawings.

Nosing for staircase treads shall be made by cold bending of chequered plates. All edges shall be made smooth and even. All chequered plate units shall be given distinct erection marks in accordance with the marking drawings.

Drain holes shall be provided (1 number 12mm diameter hole per 1 Sq.m area)

15. Hand Railing

15.1. Material

1) Top rail shall be 32 mm dia. (NB) and Mid Rail shall be 32 mm dia (NB) mild steel medium grade conforming to IS 1239.

2) Toe plates shall be of mild steel conforming to IS 2062.

3) Upright post shall be 32 mm dia. (NB) mild steel medium grade conforming to IS 1239.

15.2. Fabrication

Hand-railing shall be fabricated strictly as per the AFC fabrication drawings prepared by the CONTRACTOR based on approved design drawings and standards. All tubes shall be straight and without any dents/ deformations. Tubes shall be cut and ands shall be prepared to a neat workman like finish. All elements shall be directly welded. Tubes shall be cold bent to shape and curvature in case of discontinuous ands of handrails. Lower ends of vertical posts shall be cut and splayed (for grouting in pockets provided in the concrete members). For removable type of hand railing, suitable base plates (with provision for bolting) shall be welded to the lower end of vertical posts. Chequered plates and gratings shall be suitably notched to accommodate vertical posts/ their base plates wherever required. All units shall be given distinct erection marks in accordance with the marking drawings.

15.3. Erection/ Fixing

Hand railing shall be fixed to the bearing members by welding/ bolting/ grouting as indicated in the drawings.

16. Mild Steel Rungs

16.1. Materials

Mild steel rounds for rungs shall be 20mm diameter conforming to IS 432 Grade-I.

16.2. Fabrication

Rungs shall be fabricated as per approved standards/ drawings. Mild steel bars shall be straightened if required, cut, bent to shape and given primer paint.

16.3. Fixing

Rungs shall be fixed in position as per approved detailed drawing and firmly tied/ welded with reinforcement to prevent their displacement during vibrating of concrete.

17. Payment (Applicable For Item Rate Tender)

Payment for steel work shall be made on the basis of admissible weight of the structure accepted, the weight being determined as described below.

The rate of fabrication and erection shall include cost of all handling and transport, delivery to store/site of work trimming, straightening, edge preparation, preparation and getting reviewed of fabrication drawings, providing scaffolding, temporary supports, tools and tackles, touching up primer coat and providing one coat of primer and two coats of approved final painting unless specified otherwise, and grouting etc. complete.

The weight for payment will be accessed from the approved fabrication drawings and to respective bill of materials prepared by the CONTRACTOR and approved by the OWNER/ENGINEER-IN-CHARGE. The weight of structural material/plate shall be calculated wherever necessary on the basis of IS Handbook. If sections are different from IS section, then manufacturer's Handbook shall be adopted. No allowance in weight shall be made for rolling tolerance.

Sections built out of plates shall be paid on the actual weight incorporated except for gussets, which will be paid on the weight of the smallest rectangle enclosing the shape. No deduction shall be made for skew cuts in rolled steel section.

Welds, bolts, nuts, washers etc. shall not be measured. Rate for structural steel work shall be deemed to include the same.

No other payment either for temporary work connected with this contract or for any other item such as welds, shims, packing plates, etc. shall be made. Such items shall be deemed to have been allowed for in the rate quoted for steel work.

18. Grouting of Pockets / Baseplate

Grouting of pockets and under base plates will be done only after the steel work has been levelled and plumbed and the bases of stanchions are supported by steel shims. The space below the base plate and pocket shall be thoroughly cleaned.

Grouting shall be done with non-shrink grout having compressive strength not less than 40 N/mm2. Non-shrink grout shall be free flow premix type and of approved quality and make.

The grout mixture shall be poured continuously by grouting pump from one side of the base plate and spread uniformly with flexible steel strips and rammed with rods, till the space is filled solidly and the grout mixture carried to the other side of the base plate.

19. Tolerances Allowed in The Erection Of Plant Building

The maximum tolerances for line and level of the steel work shall be ± 3.0mm on any part of the structure. The structure shall not be out of plumb more than 5.0 mm on each 10M section of height and not more than 8.0 mm per 30M section height.

These tolerances shall apply to all parts of the structure unless the drawings issued for erection purposes state otherwise.

The CONTRACTOR shall follow the QA/QC requirements, as attached elsewhere.

SPECIFICATION
FOR
MS GRATINGS

REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED	AUTHORIZED
C	13-06-2020	Issued For Design	SUR	KRK	JP/KC	JMC
B	08-11-2019	Issued For Design	SUR	KRK	JP/KC	JMC
A	16-10-2019	Issued For Design	SUR	KRK	JP/KC	JMC

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1. INTRODUCTION

INDIAN OIL CORPORATION LIMITED (IOCL) has awarded Fax of Acceptance (FOA) dated 29th August 2019 to M/s. Technip India Limited (TPIL) for Consultancy services (PMC/EPCM services) for overall project management, FEED Review / FEED, Detailed Engineering, Procurement & expediting services, Tendering & award, Construction Management & Supervision, Assistance in start-up, Commissioning & performance test runs for installation of a Standby SRU of 525 TPD capacity and execution of Additional tanks for Paradip Refinery, Odisha, India.

2. DEFINITIONS & ABBREVIATIONS

Abbreviation	Definition /Expanded form
IOCL/ CLIENT	Indian Oil Corporation Limited
PMC/ CONSULTANT	Technip India Limited
LICENSOR	Party selected by IOCL for process technology ownership for any UNIT
CONTRACTOR	Party whose services are obtained for performing the works specified as part of LSTK / packages.
EPCM	Engineering, Procurement & Construction Management Services.
LSTK	Lump Sum Turn Key portion of the work to be executed by CONTRACTOR
FEED	Front End Engineering Design
AUTHORISED REPRESENTATIVE	IOCL's/ CONSULTANT's representative authorized to act for and on behalf of them.
VENDOR	Any third party supplying the equipment/materials for setting up the Plant
PROJECT	Indicates Standby SRU and Additional tanks Project, Paradip Refinery
SITE	Indicates Paradip Refinery in Odisha, India
UNIT	Indicates any particular portion of the project to be built which can be Process related or Utilities/Offsites related
SRU	Sulphur Recovery Unit
BIS	Bureau of Indian Standards

3. SCOPE

The purpose of this document is to lay down the specifications and requirements for Mild Steel Gratings, clamps and fasteners for use as flooring and stair tread in industrial structures and which are to be manufactured and supplied by the contractor as per approved drawings.

This JSS covers typical General specification for some standard items only and the CONTRACTOR shall comply with the requirement as given in 080557C-000-JSD-1700-001/002 for specific cases and for any other items not mentioned/specified in this JSS. The requirement for various type of Buildings /Unit / Structures etc., as specified in the document 080557C-000-JSD-1700-001/002 shall be the governing one.

The CONTRACTOR shall submit the detailed specification for the items not covered in this specification for Approval by OWNER'S/ENGINEER IN CHARGE during execution.

4. APPLICABLE CODES

The Indian Standard codes applicable to this section shall include but not limited to the following:

- IS 1364 : Hexagon Head Bolts, Screws and Nuts of Product Grades A and B
- IS 1367 : Technical Supply Conditions for Threaded Steel Fasteners
- IS 2062 : Steel for General Structural Purposes
- IS 2629 : Recommended Practice for Hot-Dip Galvanizing of Iron and Steel
- IS 2633 : Methods for testing uniformity of coating of zinc coated articles
- IS 6745 : Method for determination of mass of zinc coating on zinc coated iron and steel articles
- 080557C-000-LD-1890-001 : Construction standards for steel works.

5. MATERIALS

Floor gratings shall be fabricated from mild steel flats, and the component materials shall be of weldable quality rolled steel free from surface defects and conforming to the IS codes indicated below:

Flats and MS rounds : E250 A/BR/BO confirming to IS: 2062

Bolt/Nuts : E250 A/BR/BO confirming to IS: 2062

Bearing flats and End flat shall be as per IS:1730.

Flat for Clamps shall be as per IS:513

Bolts and nuts shall conform to the requirements of IS: 1364.

Bolts shall be ordinary strength conforming to IS: 1367, Property class 4.6.

6. SPECIFICATION

Gratings shall be minimum 25mm deep. Hot dip galvanized and Electro Forged/ Electric arc welded as per Standard (080557C-000-LD-1890-001).

These shall be of readymade bought out type and designed to carry specified loads with limitations on permissible deflections.

The specifications for the floor gratings to be fabricated shall be as follows:

Peripheral End Flats around panel : 25 x 6 mm

Transverse Main Flats : 25 x 6 mm @ 35mm c/c

Longitudinal Secondary Rounds : 8 mm sq. twisted bar @ 100 mm c/c

The specifications for the stair tread (gratings) to be fabricated shall be as follows:

End Carrier plate : 75 x 6 mm

Transverse Main Flats : 25 x 6 mm @ 35mm c/c

Longitudinal Secondary Rounds : 8mm sq. twisted bar at 75 mm c/c Nosing
: 6mm thick chequered plate

Commercial quality material shall be allowed only after ascertaining its weldability and strength.

All gratings shall be galvanized unless otherwise specified.

7. DESIGN LOADS AND PERMISSIBLE DEFLECTION

Unless otherwise mentioned, all floor gratings shall be capable of carrying a uniformly distributed load of 500 kg per square metre or 1000 kg(Area of application shall be as per handling requirement) at mid span, in handling area for maintenance, whichever is governing. The span for the above loading conditions shall be designed including deflection criteria. The deflection shall not exceed Span/200 or 6 mm whichever is less.

The design shall be done as per IS: 800, and it shall be mandatory for the Contractor to submit the design calculations, drawings and manufacturer's literature, when applicable, and get them approved from the Engineer-in-Charge prior to fabrication or procurement.

8. FABRICATION DRAWINGS AND DETAILS

Based on the arrangement of supporting beams on design drawings, the Contractor shall prepare shop fabrication drawings and get the same approved as per the procedure outlined for shop fabrication drawings for structural steel work. The Contractor shall ensure that the dimensions of gratings are as per specifications and in conformance to the design floor GA drawings.

Gratings for stair treads shall be provided with nosings of chequered plate of approved size and thickness, as per the standard (080557C-000-LD-1890-001).

Gratings shall be prepared by welding secondary members over the main members at junctions. All end flats of each grating panel shall have full contact with the supporting members at each end.

In case of grating panels with cut-outs/openings adequate strengthening shall be done using flats 25x6 around the periphery of openings up to 300 mm in diameter. For openings, greater than 300 mm in diameter relevant design drawings shall be referred to.

Galvanized U-clamps made out of 25x6 MS flats, with an 8 mm diameter hole at bottom for fixing M6 bolt to the 25x6 flat tack welded to the structural member, shall be used as fastenings over secondary members. The spacing between clamps shall not exceed 600 mm and a minimum of four such clamps shall be provided in a grating or stair-tread panel for fixing.

All unsupported edges of adjacent grating panels shall be connected by galvanized U-clamps.

9. GALVANISATION

All floor gratings shall be hot dip galvanized in accordance with IS:2629 and tested as per IS:2633 and IS:6745. The minimum thickness of galvanizing shall be 120 microns.

It shall be mandatory that a prototype of the grating fulfilling the following be demonstrated to the satisfaction of OWNER/Engineer-in-Charge prior to placement of bulk order. Particular attention shall be paid to the following requirements for approval/acceptance:

1. Conformance to all requirements defined above.
2. In the case of gratings manufactured using electro-forging/weld-forging process, the un-fused joints shall not be in excess of 5% of the total joints. If un-fused joints are found to be in excess of 5%, the prototype shall stand rejected. A fresh prototype shall then be prepared.
3. The projection of secondary member above the main member shall not be more than 1.5mm.
4. The un-fused 5% joints of (b) above shall be welded by SMAW/GMAW process.
5. The joints shall be able to sustain a minimum pull out load of 1.2 times the allowable shear capacity of the secondary member.

10. INSPECTION

Gratings made by electro-forge/weld-forge process shall be subjected to inspection as per Quality Control Plan for approval and subsequent acceptance.

11. SITE PREPARATION

Gratings shall be stacked and dispatched in a proper way so that distortion/damage of the panels are avoided.

All dispatched gratings shall carry material certification and release note by OWNER's inspection / Authorized Inspection Agency.

All gratings shall be identified as per Tag Numbers indicated in the fabrication drawings before dispatch of gratings to site.

12. GUARANTEE

The CONTRACTOR shall guarantee all materials supplied against any defect in respect of quality of material used, conformance to these Specification and dimensional tolerances against proper fitments.

13. PAYMENT (APPLICABLE FOR ITEM RATE TENDER)

Gratings shall be paid on the basis of the area of M.S. Gratings and frame actually laid. Full deduction shall be made for openings equivalent to 300 mm dia and above.

The rate shall include cost of preparation of fabrication drawings, supplying of readymade gratings and transporting to site, smoothing ends if necessary and fixing in positions by welding or clips as per the design drawings.

The rates shall also include all incidental costs and charges such as carriage, Octroi, loading, unloading, storing, safe custody, watch and ward, etc.

SPECIFICATION FOR FIRE PROOFING OF STEEL STRUCTURES

REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED	AUTHORIZED
			Written By: Umasankar Sundarajan 2019.11.08 12:25:14 +05'30'	Checked By: RamnKumar Kshanasundaram 2019.11.08 15:13:44 +05'30'	Approved By: Jayaprakash Jayaraman 2019.11.08 15:17:45 +05'30'	Authorized By: MariaChristopher Jesumarian 2019.11.09 11:54:03 +05'30'
A	08-11-2019	Issued for Design	SUR	KRK	JP / KC	JMC

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UNIT	Indicates any particular portion of the project to be built which can be Process related or Utilities/Offsites related
SRU	Sulphur Recovery Unit
BIS	Bureau of Indian Standards

3. SCOPE

This specification covers the general requirements of materials and the method of application for external protection of structural steel members, vessel/column skirts, saddles and supports against fire.

This JSS covers typical General specification for some standard items only and the CONTRACTOR shall comply with the requirement as given in 080557C-000-JSD-1700-001/002 for specific cases and for any other items not mentioned/specified in this JSS. The requirement for various type of building as specified in the document 080557C-000-JSD-1700-001/002 shall be the governing one. The CONTRACTOR shall submit the detailed specification for the other items not covered in this specification for Approval by OWNER'S/ENGINEER IN CHARGE during execution.

4. APPLICABLE CODES

The Indian Standard Codes applicable to this section shall include but not limited to the following:

IS 1566	: Hard drawn steel wire fabric for concrete reinforcement.
IS 6433	: Specification for guniting equipment.
UL 1709	: Rapid rise fire tests of protection of structural steel
OISD-164	: Fire Proofing in Oil & Gas Industry

5. PRIORITY OF REQUIREMENTS

In case of any variation and discrepancy in condition between the special conditions, this specification and codes, order of priority shall be as under: -

1) Special conditions
2) This specification
3) Codes

6. GENERAL

6.1. Purpose

Fire proofing is aimed at providing resistance to all the load bearing steel structures and equipment supports that would collapse under fire conditions and contribute to the intensity of the fire.

This fire resistance would allow the people to be evacuated and fire to be suppressed.

Therefore, the supports of all potential fire sources shall be fireproofed.

The support of non-potential fire hazards shall also be fireproofed, if their collapse is likely to endanger other hazardous equipment's.

6.2. Fire Resistance Rating

A minimum of 2 hours fire resistance under hydrocarbon fire condition as per UL1709 and as specified in OISD-164, shall be applied, unless specified otherwise.

7. CRITERIA FOR FIREPROOFING

7.1. Pipe Racks

7.1.1. Pipe rack main members such as columns, girder, beams and vertical bracings withstanding long term loads shall be fireproofed up to the first pipe support level, in the fire hazardous area, unless specified otherwise.

7.1.2. Pipe rack supports shall be fireproofed if they are within fire proofing zone or if they are in 20-30 feet distance from the open ditches/Drainage channels, likely to receive large accidental spills of hydrocarbons.

7.1.3. If a Pipe rack carries piping that has a diameter greater than 6 inches at levels above the first pipe support level or large hydrocarbon pumps are installed beneath the Pipe rack, fire proofing shall be considered up to and including the level that is nearest to 9.1 M elevation

7.1.4. Where equipment's such as Air Coolers are supported on top of the pipe rack, fire proofing shall be provided for all horizontal and vertical and vertical support members on all levels in Pipe rack including support members for Air Coolers regardless of its elevation, as per OISD-164.

7.1.5. The top flanges of beams supporting the pipes shall not be fire proofed.

7.1.6. Wind or earthquake bracings and non-load bearing stringer beams that run parallel to piping need not to be fireproofed.

7.1.7. Fire proofing shall be provided for knee and diagonal bracing that contributes to the support of vertical loads.

7.1.8. Pipe racks outside the fire hazardous area shall not be fire proofed.

7.2. Equipment Supporting Structures

7.2.1. Extent of fire proofing as per OISD-164.

7.2.2. Where structure supports the equipments classified to the potential fire hazard, columns shall be fire proofed from the base plates to the equipment support level.

The beams and bracings transmitting the equipment loads to the columns shall be fireproofed. Platforms, stairways and their supports shall not be fireproofed.

7.3. Where structure support non-fire potential Equipment within the fire proofing zone, fire proofing shall be considered for the vertical and horizontal members from Grade up to 9.1m level.

7.4. Fire proofing shall be considered for steel saddles that support horizontal heat exchangers, condensers and drums that have diameter greater than 760 mm.

7.5. For Common Chimneys or Stacks handling flue gas from several heaters, Structural support for ducts or Breeching between heaters and stacks shall be fireproofed, as per OISD-164.

7.6. Anchor bolts shall be completely fireproofed using a removable box construction which allows access to the anchor bolts and securing nuts.

8. FIREPROOFING THICKNESS

Fire-proofing of steel structures should be with vermiculite, wherever required as per OISD-STD-164, and should be done for 2 hours fire rating as per Specifications.

Fire resistance of a material is defined by fire rating, evaluated through a fire test based on applied thickness and time taken to reach the defined critical steel temperature. Fire rating adopted is based on UL-1709 rapid rise fire tests of protection materials for structural steel, conducted by Underwriters Laboratory, USA. In this test, fire resistance of a material is evaluated on a W10x49 steel column as per UL-1709 fire curve and fire rating is published in a UL design number under XR category for thickness and time. In addition to the fire rating, under this test, material for exterior use is also evaluated for accelerated ageing, high humidity, salt spray, wet-freeze-dry cycling, acid spray, solvent spray etc.

Thickness of fireproof coating to be applied shall be based on the following,

Type 1: In-situ cement concrete for application up to 1.8m from grade level for steel structures shall be applied with minimum 65mm thickness.

Type 2: Structural steel members such as column, beam etc. which shall be protected for 2 hours from reaching critical temperature 538°C, shall be applied with vermiculite based lightweight cementitious fireproof of thickness corresponding to 2 hours fire rating as per respective UL design number under UL-1709 (XR category) subject to a minimum of 30mm.

Type 3: For equipment skirts/ saddles/ supports (which shall be protected for 2 hours from reaching critical temperature 427°C), 2 hours fire rating as per UL design is not adequate as the UL-1709 test is based on 538°C critical temperature. Therefore, for the required fire protection from reaching 427°C, higher thickness shall be necessary. For this, fireproof thickness corresponding to 3 hours fire rating as per respective UL design number under UL-1709 (XR category) shall be adopted subject to a minimum of 30mm.

9. MATERIALS

All materials to be used shall conform to the requirements of UL-1709/ respective BIS codes/respective acceptance criteria (as applicable). Materials shall meet the minimum acceptance criteria given under this section. Samples, test results and approval certificates for all materials shall be submitted and got approved from the Engineer-in-Charge before execution of work.

1) Vermiculite based lightweight cementitious fireproofing system shall have following compatible components:

- Primer
- Reinforcing system
- Fireproof coating as per UL-1709

- Curing
- Water shed sealing at terminating edges/ metal joints
- Weather barrier finish coat

2) In-situ cement concrete fireproofing system shall have following compatible components:

- Primer
- Reinforcing system
- Cement concrete
- Curing
- Water shed sealing at terminating edges/ metal joints
- Weather barrier finish coat

9.1. Vermiculite Based Lightweight Cementitious Fireproofing Material

Vermiculite based lightweight cementitious fireproof material shall be UL certified for UL-1709 (Rapid rise fire test of protection materials for structural steels), UL classified under XR category and covered under UL follow up service (indicated by UL mark/ sticker on the packing). For list of UL certified materials. UL website (www.ul.com) shall be referred. The essential criteria for the material shall be:

1) Must be UL-1709 certified having UL design number under XR category
2) Listed on UL website under specified category
3) Bear UL-1709 mark/ sticker on packing bags/ container

The material shall be factory-blended, supplied in single component pre-mixed dry form, non-flaking and non-dusting suitable for spray-application, with added mold and fungi inhibitor. Material shall not contain asbestos & mineral wool and shall not contain more than 1% Sulphate (expressed in SO3). The material shall be free from toxicity release when subjected to heat.

In addition to the UL-1709 certificate, the contractor shall supply test certificate covering the information for the supplied batches of material.

Fire proofing materials shall be stored in well ventilated, dry place away from source of heat & direct sunlight. Special storage requirements such as temperature, humidity, stacking height, etc. as per manufacturer's specifications shall be ensured.

9.2. Reinforcement (for both Vermiculite based cementitious and In-situ concrete)

9.2.1. Expanded Metal Steel Sheet/ Lath

Expanded metal steel sheets shall conform to IS:412 and shall be of approved type. Size of the mesh shall be 10mm x 40mm with strands of 2.5mm width and 1.0mm thickness.

9.2.2. Wire Fabric

Welded wire fabric to be used as reinforcement, shall conform to IS:1566 and shall be of approved type. Mesh size shall be 50mm x 50mm and 3mm thickness.

9.2.3. Attachments

1) Mild Steel Tie Wire:

MS Tie wires shall be minimum 16 SWG and galvanized (having minimum zinc coating of 100 g/m2).

2) Mild Steel Nuts:

MS Nuts shall be of mild steel and conform to IS:1367 and IS:2585.

3) Cover plates:

Cover plates shall conform to IS:2062 Grade-BR.

4) Cover blocks:

Cover blocks shall be prepared in cement coarse sand mortar (1:3) with minimum 50mmx50mm size of thickness equal to half of the fireproofing thickness with MS Tie wire of sufficient length protruding from them for tying with the wire fabric.

5) Bitumen mastic flashing

Bitumen mastic flashing shall conform to IS:3037.

9.3. Curing Compounds (for both Vermiculite based cementitious and In-situ concrete)

Membrane curing may be used in lieu of moist curing with the permission of the Engineer-in-Charge. Such compounds shall be compatible and applied to all exposed surfaces by spraying or brushing as soon as possible after the material has set. Minimum film thickness of such curing compounds shall be as per the recommendation of the manufacturer so as to obtain an efficiency of 90% as specified by BS-8110. This film of curing compound shall be fully removed from the surface after the specified curing period.

9.4. Water Shed Sealing at Terminating Edges/ Metal Joints (for both Vermiculite based cementitious and In-situ concrete)

All termination of the fireproofing and steel junctions shall be sealed by non-bituminous polysulfide or silicon rubber mastic sealant. The sealing compound shall be compatible and approved by fireproofing material supplier.

9.5. Weather Barrier Finish Coat (for both Vermiculite based cementitious and In-situ concrete)

1) Sealer Coat

A sealer coat of epoxy polyamide shall be applied over the fireproofing surface as a base for the finish coat. The sealing compound shall be compatible and approved by fireproofing material supplier.

2) Finish Coat

The finish coat shall be pre-qualified for coating system No. 1 of NORSOK Standard M-501. Two coats of acrylic elastomeric or polyurethane coating shall be used as finish coat. The sealing compound shall be compatible and approved by fireproofing material supplier.

9.6. Water

Water shall conform to the requirements of IS:456.

9.7. Vermiculite Cementitious Coating

Branded product with base as Vermiculite and mixed with ordinary Portland cement shall have a maximum loose dry density of 400kg/m3; while in moulded condition, the density shall not exceed 800kg/m3.Sulphate content in the branded product shall not exceed 1% when sulphate content is expressed as Sulphur trioxide.

9.8. Materials for In-situ Concrete

9.8.1. Cement

Type of cement to be used shall be as per specification 080557C-000-JSS-1700-005.

Fireproofing of all structures in Sulphur handling units shall necessarily be by using Sulphate resisting Portland cement conforming to IS:12330.

9.8.2. Aggregates

1) Fine aggregates (Sand)

Fine aggregates shall conform to the requirements specified in specification 080557C-000-JSS-1700-005. Sand conforming to Zone IV shall not be used.

2) Coarse aggregates

Coarse aggregates shall conform to the requirements specified in specification 080557C-000-JSS-1700-005. Maximum size of aggregates shall be 10mm.

9.8.3. Admixture

Admixture shall conform to IS:9103. The admixture shall be mixed with concrete strictly as per manufacturer's recommendation and shall also meet the requirements of IS:456.

10. SURFACE PREPARATION

10.1. Surface Cleaning

All steel surfaces to be in contact with the fire proofing coating material, shall be cleaned of all oil, grease, loose rust, scales and dust by using wire brushing and washing using detergents.

10.2. Mesh Support System

10.2.1. Welding of Nuts and Application of Primer

Nuts of M16 bolts shall be welded with all the steel members to be fire proofed. Maximum spacing of nuts shall be 400mm center to center on a staggered diamond pitch. Nuts shall not be welded to the vessel supports/skirts (to be welded by vessel fabricator); unless directed by OWNER/ Engineer-in-Charge. Primer paint shall be applied to the MS nuts and affected surfaces of the members due to welding after proper cleaning. Primer paint shall be compatible with the primer already applied to the steel members.

10.3. Placement of Cover Blocks

Cover blocks shall be tied with the wire fabric at 300mm C/C along the span and at suitable locations along the periphery' of the member. The whole arrangement shall be placed over the Metal sheet/ lath and shall be held in position with the help of MS Tie wires wrapped at cover block locations. Cover blocks shall not be used over equipment skirts/legs, angles and box sections.

10.4. Fixing of Expanded Metal Steel Sheet

Expanded metal steel sheet shall only be used for built up sections, consisting of two members spaced apart. This shall be kept in position true to line and face, and shall be arranged firmly to structural steel member by tack welding or with the help of clips and 16 SWG tying wire at 300mm center to center. Minimum lap of 75mm shall be provided wherever required, however laps shall be avoided at bends. Stands of the expanded metal steel sheet shall slope inwards and downwards.

10.5. Placement of Wire fabric

Reinforcement shall be placed in the middle of coated material thickness. It shall be bent confirming with outlines of finished encasement and rigidly secured in place by tie wire with all the nuts. Minimum lap at ends and sides shall be 100mm and lapped wire fabric shall be tied firmly.

10.6. Cover Plate

Cover plates shall be welded to the top flange of the beams if top edges of fire proofing are not protected with bitumen mastic flashing.

11. APPLICATION

11.1. Application of fire proofing material coating shall be carried out by skilled and experienced operators.

11.2. Before start of application, pipes and equipment in the vicinity shall be covered with polythene/tarpaulin to protect them against damage. Open end of pipes shall be covered with wooden plugs or with other suitable shielding materials, to protect from splatter.

11.3. Steel sections up to and including 300mm depth, shall be coated by solid fill while sections more than 300mm shall be coated in the shape of profile of sections as shown in sketches. For vessel skirts, columns and saddles of horizontal vessels, the coating material shall be applied in horizontal bands working upwards from the bottom of the skirt or column / saddle base plate. All outside edges of the fire

proofing shall be chamfered by 20mm and corners shall be rounded.

11.4. Thickness of fireproof coating shall be established by providing ground wires both in vertical and horizontal directions. Ground wires shall be tight and true to line, and placed in such a manner that they can be further tightened if required.

11.5. The fireproofing material, after application, shall be cured by keeping it in moist condition for a period of at least 14 days (or as per vendor standard) or else the surface shall be coated with a membrane of approved curing compound. Brand name, name of manufacturer, test results and method of application shall be submitted to and got approved from the OWNER/ENGINEER-IN-CHARGE prior to procurement of curing compound.

12. APPROACH, WORKING PLATFORM, SCAFFOLDING & FORM WORK

12.1. The CONTRACTOR shall arrange all approaches, scaffolding, stairways, ladder, working platform etc., for carrying out the entire works safely. The working area shall be neatly maintained and all the facilities required by OWNER/ Engineer-in-Charge for proper supervision of the work shall be provided. In case, any special precaution is needed for the safety of the structure till the completion of application, the CONTRACTOR shall make and provide all such arrangement to the complete satisfaction of the OWNER/ Engineer-in-Charge and shall remove the same after completion of works.

12.2. Form work wherever required shall be of Plywood Sheeting. It shall be adequately supported and braced to protect against deformation on account of vibration during the application. Forms shall be oiled, dampened and cleaned before use.

13. SPECIFIC REQUIREMENT FOR FIREFROOFING

13.1. In-Situ Concrete

13.1.1 Concrete mixing and placing shall be done as per specification No. 080557C-000-JSS-1700-001.

13.1.2 Steel structures shall be fire proofed with concrete up to a minimum height of 1.8m from grade for protection against mechanical damage or as directed by the Engineer-in-Charge. A suitable slope of about 30° shall be provided at the junction of concrete and vermiculite based cementitious fireproofing material to avoid accumulation of water.

13.1.3 Concrete shall be poured into well made forms properly oiled and made to correct dimensions. Concrete shall be vibrated as necessary to ensure smooth surface, free from voids and irregularities. Any defects, honeycomb etc. shall be made good by contractor at his own cost.

13.2. Vermiculite Cementitious coating

13.2.1 Design requirement

a) Vermiculite cementitious coating shall restrict the temperature of a vessel/structure, below the maximum permissible temperature of 427°C for vessel supports & skirts and 550°C for structural

steel members respectively, for a minimum time period of 2 hours. The material shall not fail till the end of the specified period.

b) The coating shall be non-corrosive to the steel members & shall not be affected by environmental conditions, whether natural or from local leaks, spillage or pollution. It shall also be asbestos free.

c) The coating shall be able to withstand both thermal shock and impingement of water from fire hoses and/or monitors.

d) The coating material shall be durable and easily repairable.

e) Application procedure of the coating shall be easy; non-hazardous and also shall not interfere with the working of the adjoining areas.

f) The CONTRACTOR shall submit calculations of coating thickness for all structural steel sections to be fire proofed; for review/approval of the OWNER/ Engineer-in-Charge for the branded product but in no case thickness of coating shall be less than 30mm.

g) The CONTRACTOR shall submit the application procedure of fire proofing materials for review/approval of the OWNER/ Engineer-in-Charge for the branded product.

13.2.2 Application

a) Vermiculite cementitious coating shall be mixed with water on a clean platform or in a clean mixing box or in a suitable mixer as per manufacturer's specifications. Water cement ratio shall be adjusted so that vermiculite cementitious coating adheres properly to steel surface and does not sag or slide upon application.

b) Primer compatible with the vermiculite cement coating as recommended by the manufacturer's shall be applied over the steel surface after cleaning the shop primer if required as per the manufacturer's specifications.

c) Mixed vermiculite cementitious coating shall generally be applied, over the steel surface, with the help of spray gun except for small areas and inaccessible location, where application with conventional hand tools shall be permitted. Mixed vermiculite shall be used within the pot life specified by the manufacturer. Under no circumstances rebound material shall be used.

d) The full-specified thickness (Minimum 30 mm thick) shall be developed in three successive coats.

- Rending coat : Thickness as per manufacture's recommendation
- Floating coat : Thickness as per manufacture's recommendation
- Finishing coat : Thickness as per manufacture's recommendation

Each successive layer shall only be applied after the preceding layer has developed its initial set and is also properly scratched with steel brush to develop proper bond. If the application is interrupted and does not satisfy successive layers criteria, the coating shall be cut back to the steel surface/proceeding layer with a trowel at an inclined angle. Exposed surface of this coating shall

be thoroughly wetted before resuming the work.

e) Parameters like water quality, % water addition, wet density check at mixer discharge and spray head, slump test and other operating parameters like air pressure etc. shall be checked during application to ensure achievement of specified quality parameters.

f) Application of mixed vermiculite shall not be carried out if the air temperature or the temperature of the surface to be fire proofed is 4°C or less. Provision shall be made for adequate ventilation during and after application, until the coating is dry.

g) All patching of damaged fireproofing work shall be done by the contractor certified by the fireproofing material vendor.

14. FINISHING AND JOINT SEALING

14.1. Weather Barrier Finish Coat

In-situ concrete/ Vermiculite based cementitious fireproof coating shall be protected from weather damage by means of suitable coating. The weather barrier coat shall be applied after full curing (after a gap of min 28 days) and drying of the fire proofing coating. A sealer coat of epoxy polyamide @ 50-75 micron DFT shall be applied over the fireproofing surface as a base for the finish coat. The finish coat shall be UV resistant, suitable to withstand mechanical abrasion/ air erosion, shall be pre-qualified for coating system No.1 of NORSOK Standard M-501. Two coats of acrylic elastomeric or polyurethane coating shall be used as finish coat @ 100-125 µ DFT per coat. Number of coats shall be increased in case desired DFT not achieved. The coating system for finish coat shall be compatible and approved by fireproofing material vendor.

14.2. Water Shed Sealing at Terminating Edges/ Metal Joints

All termination of vermiculite based cementitious fireproofing and steel junctions shall be sloped to shed water and sealed by non-bituminous polysulfide or silicon rubber mastic sealant to prevent water ingress into the fireproofing from these joints. The sealing shall be applied by cutting a U-shaped groove approx.10mm deep and 10mm wide in to the fireproofing immediately adjacent to the junction. The sealing compound shall be approved by fireproofing material vendor.

15. INSPECTION AND TESTING

The finished application of the fireproofing shall conform to the approved samples submitted prior to the start of the work. Excessive abrasions or other damage to the applied fireproofing shall be replaced, if deemed necessary, and rejected work shall be corrected to the full satisfaction of the OWNER/ Engineer-in-Charge.

Thickness, strength and density of fireproofing shall conform to specifications. All records of approved test results shall be accessible immediately for inspection.

The CONTRACTOR shall submit the certificate of test results for the vermiculite cementitious coating over structural members, from a laboratory approved by the OWNER/ Engineer-in-Charge. Test shall be performed as per the requirements laid down in IS: 3809 /UL-1709.

After completion of the work, the surface of the fireproofing shall be inspected visually on plumpness, evenness, extent of cracks if any, and thickness of fireproofing.

All defects observed on the surface of the fireproofing shall be repaired / rectified by the approved method.

16. PAYMENT (Applicable For Item rate tender)

16.1. Payment shall be made on cubic meter (m^3/Mt) (as per relevant SOR) basis of actually finished work or as calculated from the construction drawings, whichever is less.

16.2. The rate quoted shall be inclusive of all labor, material, form work, plant & tools etc. required for the successful and satisfactory completion of work including curing, curing compound, all cleaning operations before and after the work, preparation of the surface as specified, applying the primer coat over MS nuts and effected surface of steel surfaces due to welding, finishing the surface smooth, painting the surface with sealer coat and weather barrier finish coats & sealing the joints with sealing compounds, providing required access, working platforms, props, scaffolding and other safety measures including their removal after completion.

16.3. The rate shall also be inclusive of supplying and fixing of reinforcement with nuts by using tying wire (including the cost of expanded metal steel sheets, cover plates) and other required accessories for satisfactory completion of the work as specified and directed.

16.4. The rates quoted shall be inclusive of the tests specified and directed to establish the quality and strength of materials.

17. FIRE PROOFING DETAILS

For Fire proofing details refer General Civil Standards doc.no. 080557C-000-LD-1790-001.

SPECIFICATION
FOR
ROOFING AND CLADDING

REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED	AUTHORIZED
			Written By: Umasankar Sundarajan 2019.11.08 12:33:10 +05'30'	Checked By: Rameshkumar Kalyanasundaram 2019.11.08 14:15:13 +05'30'	Approved By: Jayaprakash Jayaraman 2019.11.08 15:08:41 +05'30'	Authorized By: Morischristopher Jesumarian 2019.11.09 12:00:31 +05'30'
B	08-11-2019	Issued For Design	SUR	KRK	JP / KC	JMC
A	29-10-2019	Issued For Design	SUR	KRK	JP / KC	JMC

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2. DEFINITIONS & ABBREVIATIONS

Abbreviation	Definition /Expanded form
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PMC/ CONSULTANT	Technip India Limited
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CONTRACTOR	Party whose services are obtained for performing the works specified as part of LSTK / packages.
EPCM	Engineering, Procurement & Construction Management Services.
LSTK	Lump Sum Turn Key portion of the work to be executed by CONTRACTOR
FEED	Front End Engineering Design
AUTHORISED REPRESENTATIVE	IOCL's/ CONSULTANT's representative authorized to act for and on behalf of them.
VENDOR	Any third party supplying the equipment/materials for setting up the Plant
PROJECT	Indicates Standby SRU and Additional tanks Project, Paradip Refinery
SITE	Indicates Paradip Refinery in Odisha, India
UNIT	Indicates any particular portion of the project to be built which can be Process related or Utilities/Offsites related
SRU	Sulphur Recovery Unit
BIS	Bureau of Indian Standards

3. SCOPE

This specification covers the requirement of sheeting for roofing and siding including corner ridge pieces, eaves filler pieces etc. and all other accessories.

This JSS covers typical General specification for some standard items only and the CONTRACTOR shall comply with the requirement as given in 080557C-000-JSD-1700-001/002 for specific cases and for any other items not mentioned/specified in this JSS. The requirement for various type of Buildings /Unit / Structures etc., as specified in the document 080557C-000-JSD-1700-001/002 shall be the governing one.

The CONTRACTOR shall submit the detailed specification for the items not covered in this specification for Approval by OWNER'S/ENGINEER IN CHARGE during execution.

4. APPLICABLE CODES

The Indian Standard codes applicable to this section shall include but not limited to the following:

- IS 277 : Galvanized steel sheets (Plain and corrugated).
- IS 459 : Corrugated and semi corrugated asbestos cement sheets.
- IS 513 : Cold rolled low carbon steel sheets and strips.
- IS 730 : Hook bolts for corrugated sheet roofing.
- IS 1230 : Cast iron rain water pipes and fittings.
- IS 1626 : A.C. Building Pipes and Pipe fittings, Gutter and Gutter fittings and roofing fittings (Part I to Part III).
- IS 1728 : Specification for sheet metal rain water pipes upto 100mm Nominal size, gutters, fitting, accessories.
- IS 2629 : Recommended Practice for hot dip galvanizing on iron and steel.
- IS 2858 : Code of Practice for roofing with Mangalore tiles.
- IS 3007 (Part 1) : Code of Practice for laying A.C. Sheets - Corrugated sheets.
- IS 3007 (Part 2) : Code of Practice for laying A.C. Sheets - Semi-corrugated sheets.
- IS 3978 : Code of Practice for manufacture of burnt clay Mangalore pattern roofing tiles.
- IS 4021 : Timber door window and ventilator frames.
- IS 4671 : Expanded polystyrene for thermal insulation.
- IS 6745 : Methods for determination of mass of zinc coating on zinc coated iron and steel articles.
- IS 8183 : Bonded mineral Wool.
- IS 13229 : Zinc for galvanizing.
- IS 14164 : Industrial application & finishing of thermal insulation material at temperature above 80 degree & upto 700 degree (Superseding IS: 7240 & IS: 7413).

5. PRIORITY OF REQUIREMENTS

In case of any variation and discrepancy in condition between the special conditions, this specification and codes, order of priority shall be as under:-

(1) Special conditions

(2) This specification

(3) Codes

6. PRECOATED GALVALUME SHEET ROOFING AND CLADDING

6.1 Material

The base metal of the roofing shall be cold rolled steel sheet manufactured out of 0.50 mm thick, 550 MPa (Yield strength) steel with galvanized by hot-dip process of Zinc Aluminium alloy of AZ-150 conforming to AS 1397 or ASTM 792.

Zinc coating	:	150 gm/m^2 minimum on both side & 1.6% silicon coating
Primer coat	:	Epoxy primer 5 microns minimum
Top coat	:	Polyester coat
(Top exposed surface)		20 microns minimum of specified color
Back coat	:	Epoxy coating
(Bottom unexposed surface)		5-7 microns minimum epoxy grey paint over 5 micron primer
Overall sheet thickness	:	0.55 mm minimum

6.2 Properties

The Precoated galvalume sheets shall meet the following performance standards.

Pencil Hardness	:	Minimum HB
T-Bending Test	:	5T
Salt spray test	:	1000 hours (Exposed top side)
QUV Weatherometer Test	:	1000 hours
Humidity Test	:	1000 hours
Temperature Resistance	:	100° C for 24 hour
Impact Resistance	:	Min 10J
Fire Performance	:	Class-1

6.3 Profile

The profile shall have a depth of not less than 30mm and pitch of 190mm to 255mm.

6.4 Accessories

All roofing accessories like ridge, gutters, north light curves etc shall be fabricated out of the approved Pre-coated sheet as per drawing.

Metallic self-drilling, self-tapping Fasteners and Fixing accessories shall be corrosion proof Meeting performance standard as per AS:3566, class-III having neoprene washers. Sealants shall be neutral cure type and cold setting variety.

6.5 Laying and fixing of sheets

Laying and fixing of sheets shall be as per approved manufacturer's instructions.

6.6 Guarantee

CONTRACTOR shall give a guarantee of 15 years for the coating of sheet.

7. CORRUGATED GALVANISED IRON SHEETS

7.1 General

This specification covers supply and erection of galvanized iron corrugated sheets including flashings, fittings, valley gutters etc. for roofing and cladding of buildings.

7.2 Material

Material for Galvanized Iron sheets shall be in accordance with IS: 277. Thickness of sheet and depth pitch of corrugation should be properly chosen depending on the spacing of purlins and loading. This should be supported by certificate from the manufacturer and approved by OWNER'S/ENGINEER IN CHARGE.
Grade of zinc coating shall be as per clause 7.3 of IS: 277.

Minimum recommended thickness of Corrugated Galvanized Iron sheet for various use shall be as follows: -

1)	Roofing	:	20 gauge (1mm minimum thickness)
2)	Side cladding	:	22 gauge (0.8mm minimum thickness)
3)	Flashings	:	All necessary galvanized flashings, ridging, capping cable and corner trimmings shall be of 20 gauge. (1mm minimum thickness)
4)	Valley gutters	:	18 gauge (1.26mm minimum thickness)

The sheets shall be free from cracks, split edges, twists, surface flaws, etc. They shall be clean, bright and smooth. The galvanizing shall be uninjured and in perfect condition. The sheet shall show no signs of rust or white powdery deposits on the surface. The corrugation shall be uniform in depth and pitch and parallel with the sides.

7.3 Spacing of Purlins

One purlin each shall be provided at the ridge and the eaves. Spacing of purlins shall be as per manufacturer's recommendation for adopted sheet thickness and number of corrugations. Purlin shall coincide with the centre line of the end lap.

7.4 Painting for Purlins

The top surfaces of the purlins shall be painted before fixing the sheets and the embedded portion shall be applied with two coats of coal tar.

7.5 Laying of sheets

The sheets shall be laid and fixed in the manner described below unless otherwise shown in the working Drawings or as directed by OWNER'S/ENGINEER IN CHARGE.

Sheets shall be laid on the Purlins to a true plain with the lines of corrugations truly parallel or normal to the sides of the area to be covered, unless otherwise required as in special shaped roofs.

The sheets shall not generally be built into gables and parapets. They shall be bent up along their side edges close to the wall and the junction shall be protected by suitable flashing or by a projecting drip course, the latter to cover the junction by at least 75 mm.

7.6 Laps

All roofing sheets shall be provided with double corrugation side laps and 150mm end lap.

All side cladding sheets shall be provided with single corrugation side lap and 100mm end lap.

7.7 Cutting of sheets

Sheets shall be cut according to the dimensions and as per the drawings. Sheets shall be cut with a straight edge and chisel to give a straight finish.

7.8 Fixing of sheets

The sheets shall be fixed to the purlins and cladding runners with J or L polymer coated galvanized bolts, polymer cap, seal washer and thrust washer.

The bolts shall pass through the crown of the corrugations and shall be long enough to project at least 12mm above the top of their nuts.

The grip of J or L hook bolts on the side of purlins shall not be less than 25mm.

There shall be at least three hook bolts placed at ridges of corrugations in each sheet in every purlin and their spacing shall not exceed 300mm.

Sheets shall be joined together at side laps by polymer coated bolts and nuts. Each bolt shall be fixed with polymer cap, seal washer and polymer coated thrust washer.

Bolts shall be placed zigzag on overlapping corrugations. This spacing of the bolts shall not exceed 600mm in each of the staggered rows.

7.9 Holes

Holes for all bolts shall be drilled in the ridges of the corrugations from the underside before placing in position. The holes in the sheet shall be at least 50mm from the edge. The holes in the washers shall be of exact diameter of the hook bolts or the seam bolts. The nuts shall be tightened from above to give a leak proof roof. Sheets with holes drilled wrongly shall be rejected.

7.10 Ridges and Hips

The overlap for ridges and hips on either side of G.I. sheet and end legs shall be at least 225mm. Ridges and hips shall be fixed to the purlins with polymer coated hook bolts, thrust washer and polymer cap. At least one of the fixing bolts shall pass through the end laps of ridges and hips on either side. If it is not possible extra hook bolts shall be provided. Ridges and hips shall fit squarely on the sheets.

7.11 Valleys and Flashings

The edge, wherever the roof sheeting or valley gutter is turned up against a wall shall be made weather proof with flashing. Flashing shall be bent to shape and fixed as specified. Lap over the sheet shall be minimum 150mm. End laps between flashing sheets shall not be less than 225mm. Flashing shall be inserted into brick work or masonry joints to a depth of 50mm and shall be filled with cement mortar (1:3). When flashing has to be laid at a slope, it shall be stepped at each course of masonry. The steps shall be cut back at an angle of at least 30°.

Valleys shall be bent to shape and shall have at least 225mm end lap and projection on either side under GI sheet. Valleys shall be fixed to the roof members below with polymer coated GI bolts, polymer cap, seal washer and polymer coated thrust washer. At least one fixing bolt shall pass through end laps of the valley piece.

7.12 Gutters

The longitudinal edges shall be turned back by 12mm and beaten to form a rounded edge. The ends of the sheet at junctions of pieces shall be hooked into each other and beaten flush to avoid leakage.

Gutters shall be laid to minimum 1:120 slope. Gutters shall be true to line and slope and shall be supported by brackets as specified.

7.13 Wind Ties

Wind ties shall be of 40mm x 6mm flat section unless otherwise specified. These shall be fixed at the two eaves end of the sheet. Fixing shall be done with the same bolts which secure sheets to the purlins. Slot holes shall be cut in the wind ties to allow for temperature variations.

8. "S" TYPE A.C. LOUVERS

8.1 Material and general specification for "S" type louvers shall be the same as those for Galvalume sheets in roofing.

8.2 The Louvers shall be fixed to the M.S. angle or flat supports of ends by means of G.I. bolts and nuts with G.I. and Bitumen washers. The distance between the bolt centers shall be about 200 mm. The minimum lap of louvers shall be 100 mm.

9. TRANSLUCENT SHEETS

Translucent sheets shall be fiberglass reinforced polyester panels conforming to IS: 12866 or any other approved equivalent make, specified by OWNER'S/ENGINEER IN CHARGE. These sheets shall have a minimum thickness of 2 mm and shall be formed to match the profile of the metal sheeting panels. Translucent sheets shall have a light transmission factor of 55% to 80% and solar energy transmission of 25%.

10. PVC RAIN WATER PIPES

10.1 PVC Rain water pipes shall be of approved quality and make with pressure rating of 4kg/cm2 conforming to IS codes. The supply shall include all necessary accessories e.g. Rain water shoes, heads, clamps, connections, suitable bonding agent etc. complete.

10.2 All pipes shall be fixed to Structural Steel columns, Brick/ Concrete work accurately as shown in relevant drawings with M.S. Clips or as approved by OWNER'S/ ENGINEER IN CHARGE.

10.3 All holes in walls and floors shall be made good by Cement Concrete M20.

11. ROOF EXTRACTORS

Roof extractors shall be fixed in position as shown on drawings. The work shall include making required opening in the sheeting, fixing the extractors as per the manufacturer's instructions with necessary fasteners. Lead fillers, felts or any other specified flashing should be tucked into the sheeting. The lead flashings used shall be weighing not less than 30 kg/m2. No allowance in the rates for fixing of extractors on the roofs shall be made for wastage, cutting, extra bolts, nuts and washers, flashings, flat sheets etc.

12. WALL LOUVERS

Louvers shall be of units having minimum size of 1.0 m x 1.0 m with adjustable or nonadjustable blades. Paints and colour shall match sidewalls or as specified by Owner. Louvers shall include structural support members, necessary jamb trim, sealant and fasteners. Louver frames shall be fabricated from 1.2 mm thick sheets and louver blades shall be fabricated from minimum 0.91 mm thick sheets. In-adjustable louvers, blades shall be pivoted on 12 mm diameter rods. Louvers shall be equipped with an exterior mounted bird screen of Aluminium mesh that can be easily removed for cleaning. The louver design shall be such that water does not penetrate.

13. RIDGE VENTILATOR

Ridge Ventilator shall be of gravity type and shall be designed to accommodate the roof slope. Ventilators with or without dampers shall be fabricated from 0.63 mm thick pre-coated galvanised iron sheets with bird screen and end closures. Ventilator base shall be sealed at end connection. Edge of the skirt shall be sealed by a preformed rubber foam closure strip matching the roof panel configuration to close junction between ventilator base and roof panels. Dimensions and the location of ventilators shall be as shown on drawings.

14. INSTALLATION

The work shall be completed to the satisfaction of Contractor's representative as per the approved detail drawings and as per the instructions of the manufacturer wherever necessary. Minimum end lap shall be 150 mm for roof and 100 mm for side cladding, or as specified by the manufacturer. Side lap shall be minimum 75 mm. End laps shall be sealed with approved silicone sealants.

Roof sheeting shall be fixed by crest fixing only. Side cladding shall be fixed preferably by crest fixing but may be fixed by valley fixing also. In valley fixing fastener locations shall be as close as possible to the ribs. Side lap fasteners shall be fixed at intervals of 350-450 mm to hold the side laps of sheets firmly in place and maintain a weatherproof joint. Holes must always be drilled and not punched. Extreme care shall be taken to avoid over tightening of fasteners that will lead to deformation of sealing washers, sheet damage and sometimes damage of the fastener threads. Fixing of flashings in masonry / concrete wall shall be done by making groove of appropriate height and depth and embedding the same with mastic / cement mortar (1:2) and water proofing compound. Special precautions shall be taken while carrying out work at laps and expansion joints to ensure that there is no leakage.

15. HANDLING & STORAGE AT SITE

All materials shall be handled and stored in a proper manner so as to avoid damage. Any material damaged in transit, storage or during erection shall be rejected forthright and replaced at CONTRACTOR's cost. Sheets shall be stacked on firm and levelled ground on wooden battens as per instructions of the OWNER'S/ENGINEER IN CHARGE. Sheeting or panels shall preferably be stored with a slight inclination in longitudinal direction to allow water, which may get into the stack, to drip off. Sheets shall be stored under cover when they are required to be stacked for a long period.

SPECIFICATION

FOR

DEMOLITION & DISMANTLING WORKS

			Written By	Checked By	Approved By	Authorized By
			Umasankar Sundarajan 2019.11.08 12:57:49 +05'30'	Rameshkumar Kalyanasundaram 2019.11.08 14:14:28 +05'30'	Jayaprakash Jayaraman 2019.11.08 15:09:10 +05'30'	Morischristopher Jesumarian 2019.11.09 12:01:32 +05'30'
B	08-11-2019	Issued For Design	SUR	KRK	JP/KC	JMC
A	16-10-2019	Issued For Design	SUR	KRK	JP/KC	JMC
REV.	**DATE**	**DESCRIPTION**	**PREPARED**	**CHECKED**	**APPROVED**	**AUTHORIZED**

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UNIT	Indicates any particular portion of the project to be built which can be Process related or Utilities/Offsites related
SRU	Sulphur Recovery Unit
BIS	Bureau of Indian Standards

3. SCOPE

This specification covers the technical and precautionary requirements for the dismantling & demolition of Brick works, Concrete, RCC / steel works etc.

4. TERMINOLOGY

(a) Dismantling: The term 'Dismantling' implies carefully separating the parts without damage and removing. This may consist of dismantling one or more parts of the building as specified or shown on the drawings.

(b) Demolition: The term 'Demolition' implies breaking up. This shall consist of demolishing whole or part of work including all relevant items as specified or shown on the drawings.

5. PRECAUTIONS

(a) The demolition shall always be well planned before hand and shall generally be done in reverse order of the one in which the structure was constructed. The operations shall be got approved from the Engineer-in-Charge before starting the work.

(b) Due care shall be taken to maintain the safety measures prescribed in IS 4130.

(c) Necessary propping, shoring, Strutting and or under pinning shall be provided to ensure the safety of the adjoining work or property before dismantling and demolishing is taken up and the work shall be carried out in such a way that no damage is caused to the adjoining work or property. Wherever specified, temporary enclosures or partitions and necessary scaffolding with suitable double scaffolding and proper cloth covering shall also be provided, as directed by the Engineer-in- charge.

(d) Necessary precautions shall be taken to keep noise and dust nuisance to the minimum. All work needs to be done under the direction of Engineer-in-Charge. Helmets, goggle, safety belts etc. should be used whenever required and as directed by the Engineer-in-Charge. The demolition work shall be proceeded without causes the damage and nuisance to the adjoining building and the public.

(e) Dismantling shall be done in a systematic manner. All materials which are likely to be damaged by dropping from a height or by demolishing roofs, masonry etc. shall be carefully removed first. Chisels and cutters may be used carefully as directed. The dismantled articles shall be removed manually or otherwise, lowered to the ground (and not thrown) and then properly stacked as directed by the Engineer-in-Charge.

(f) Where existing fixing is done by nails, screws, bolts, rivets, etc., dismantling shall be done by taking out the fixing with proper tools and not by tearing or ripping off.

(g) Any serviceable material, obtained during dismantling or demolition, shall be separated out and stacked properly within the plant boundary or as directed by the Engineer-in-Charge. All unserviceable materials, rubbish etc. shall be disposed off as directed by the Engineer-in-Charge.

(h) The contractor shall maintain/disconnect existing services, whether temporary or permanent, where required by the Engineer-in-Charge. Suitable alternate arrangement shall be made to maintain the continuity and proper functioning of affected service lines with the approval of the Engineer-in-Charge.

(i) No demolition work should be carried out at night especially when the building or structure to be demolished is in an inhabited area.

(j) Screens shall be placed where necessary to prevent injuries due to falling pieces.

(k) Water may be used to reduce dust while tearing down plaster from brick work.

(l) Safety belts shall be used by laborers while working at higher level to prevent falling from the structure.

(m) First-aid equipment shall be got available at all demolition works of any magnitude.

6. RECOMMENDATIONS FOR DEMOLITION OF CERTAIN SPECIAL TYPES AND ELEMENTS OF STRUCTURES

(a) Roof Trusses: If a building has a pitched roof, the roof structure should be removed to wall plate level by hand method. Sufficient purlins and bracing should be retained to ensure stability of the remaining roof trusses while each individual truss is removed progressively.

(b) Temporary bracing should be added, wherever necessary to maintain stability. The end frame opposite to the end where dismantling is commenced, or a convenient intermediate frame should be independently and securely guyed in both directions before work starts.

(c) On no account should the bottom tie of roof trusses be cut until the principal rafters are prevented from making outward movement.

(d) Heavy Floor Beams

Heavy bulks of timber and steel beams should be supported before cutting at the extremities and should then be lowered to a safe working place.

(e) Brick Work

1) Expert advice should be obtained and at all stages of the demolition, the closes supervision should be given by persons fully experienced and conversant in the type of work to ensure that the structure is stable always.

2) Dead load as much as possible may be removed provided, it does not interfere with the stability of the main structure.

3) Where it is impossible to allow debris to fall to the ground below, centering designed to carry the load should be erected and the arch demolished progressively. The design of the centering should make appropriate allowance for impact.

4) Collapse of the structure can be effected in one action by the use of explosives. Charges should be inserted into boreholes drilled in brick work. This method is the most effective for demolition of tall viaducts.

5) Where explosives are used, it is preferable to ensure the collapse of the whole structure in one operation to obviate the chance of leaving unstable portions standing.

(f) Cantilevers (Not part of a Framed Structure)

A cantilever type of construction depends for its stability on the super imposed structure. Canopies, cornices, staircases and balconies should be demolished or supported before the tailing down load is removed.

(g) In-situ Reinforced Concrete

1) Before commencing demolition, the nature and condition of the concrete, the condition and position of reinforcement, and the possibility of lack of continuity of reinforcement should be ascertained.

2) Attention should be paid to the principles of the structural design to determine which parts of the structure depend on each other to maintain overall stability.

3) Demolition should be commenced by removing partitions and external non-load bearing cladding. It should be noted that in some buildings the frame may rely on the panel walls for stability.

(h) Where hard demolition methods are to be used, the following procedures shall be adopted.

1) Reinforced Concrete Beams

For beams, a supporting rope should be attached to the beam. Then the concrete should be removed from both ends by pneumatic drill and the reinforcement exposed. The reinforcement should then be cut in such a way as to allow the beam to be lowered under control to the floor.

2) Reinforced Concrete Columns

For columns, the reinforcement should be exposed at the base after restraining wire guy ropes have been placed round the member at the top. The reinforcement should then be cut in such a way as to allow the column to be pulled down to the floor under control.

3) Reinforced Concrete Walls

Reinforced concrete walls should be cut into strips and demolished as for columns.

CONSTRUCTION STANDARD
FOR
UNDERGROUND WORKS

			Written By	Checked By	Approved By	Authorized By
			N.Durai raj 2019.12.19 16:12:50 +05'30'	K.RAMESH KUMAR 2019.12.19 16:34:57 +05'30'	Jayaprakash Jayaraman 2019.12.19 18:16:12 +05'30'	Wilonschristopher Jesumarian 2019.12.20 19:50:34 +05'30'
C	19.11.2019	ISSUED FOR DESIGN	NDR	KRK	JP / KC	JMC
B	01.11.2019	ISSUED FOR DESIGN	NDR	KRK	JP / KC	JMC
A	16.10.2019	ISSUED FOR DESIGN	NDR	KRK	JP / KC	JMC
REV.	**DATE**	**DESCRIPTION**	**PREPARED**	**CHECKED**	**APPROVED**	**AUTHORIZED**

SL. NO.	DRAWING NO.	DESCRIPTION	REV	DATE	REMARKS
1	080557C-000-STC-1490-001	ABBREVIATIONS, LEGENDS AND SYMBOLS FOR GENERAL CIVIL WORKS	A	16.10.2019	1 SHEET
2	080557C-000-STC-1490-002	TYPICAL ROAD SECTION DETAILS	A	16.10.2019	1 SHEET
3	080557C-000-STC-1490-003	STANDARD R.C.C PAVEMENT DETAILS	A	16.10.2019	1 SHEET
4	080557C-000-STC-1490-004	STORM WATER SYSTEMS STANDARDS DITCHES	A	16.10.2019	1 SHEET
5	080557C-000-STC-1490-005	STORM WATER SYSTEMS DESANDER FOR STANDARD DITCH	A	16.10.2019	1 SHEET
6	080557C-000-STC-1490-006	MANHOLE WITH OR WITHOUT SUBMERGED CONNECTION OILY WATER AND CONTAMINATED RAIN WATER SYSTEM OWS AND CRWS -TYPE-1	A	16.10.2019	1 SHEET
7	080557C-000-STC-1490-007	MANHOLE WITH OR WITHOUT SUBMERGED CONNECTION OILY WATER AND CONTAMINATED RAIN WATER SYSTEM OWS AND CRWS -TYPE-2	A	16.10.2019	1 SHEET
8	080557C-000-STC-1490-008	SEALED MANHOLE DOUBLE CHAMBER	A	16.10.2019	1 SHEET
9	080557C-000-STC-1490-009	HYDRAULIC SEALS (SUBMERGED CONNECTION - STEEL SYSTEM)	A	16.10.2019	1 SHEET
10	080557C-000-STC-1490-010	SAND TRAP & VLAVE PIT DETAILS	B	01.11.2019	1 SHEET
11	080557C-000-STC-1490-011	CONTAMINATED RAIN WATER SYSTEM CATCH BASIN (OWS / CRWS)	A	16.10.2019	1 SHEET
12	080557C-000-STC-1490-012	CONDUITS UNDER PIPE WAYS	A	16.10.2019	1 SHEET
13	080557C-000-STC-1490-013	ROAD CROSSING DUCT BANK FOR CABLE TRENCHES	A	16.10.2019	1 SHEET
14	080557C-000-STC-1490-014	CONCRETE CABLE TRENCH (IN PAVED AREA))	A	16.10.2019	1 SHEET
15	080557C-000-STC-1490-015	PIPE SLEEVE DETAIL	A	16.10.2019	1 SHEET
16	080557C-000-STC-1490-016	STANDARD DETAILS OF CLEAN OUT TYPE-I	A	16.10.2019	1 SHEET
17	080557C-000-STC-1490-017	STANDARD DETAILS FOR CLEAN OUT TYPE-II	A	16.10.2019	1 SHEET
18	080557C-000-STC-1490-018	STANDARD DETAILS OF LAYING ABD & CBD NETWORKS	A	16.10.2019	1 SHEET
19	080557C-000-STC-1490-019	STANDARD DETAIL FOR DRAIN FUNNELS	B	19.12.2019	1 SHEET
20	080557C-000-STC-1490-020	GRAVITY AND PRESSURIZED SYSTEMS STANDARD VALVE PITS	A	16.10.2019	1 SHEET
21	080557C-000-STC-1490-021	STANDARD DETAIL OF BARBED WIRE FENCING (WITH ANGLE IRON POST)	A	16.10.2019	1 SHEET
22	080557C-000-STC-1490-022	FIRE SYSTEM HYDRANT-TYPICAL INSTALLATION	A	16.10.2019	1 SHEET
23	080557C-000-STC-1490-023	FIRE SYSTEM WATER CUM FOAM MONITOR -TYPICAL INSTALLATION	A	16.10.2019	1 SHEET
24	080557C-000-STC-1490-024	DETAILS FOR RUNGS	A	16.10.2019	1 SHEET
25	080557C-000-STC-1490-025	VENT FOR MANHOLES	A	16.10.2019	1 SHEET

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GENERAL NOTES - UNDERGROUND NETWORKS

UNLESS NOTED OTHERWISE :

1. THIS DOCUMENT COVERS THE GENERAL NOTES AND LEGENDS USED IN THE UNDERGROUND NETWORK DRAWINGS FOR STANDBY SRU & ADDITIONAL TANKS PROJECTS AT PARADIP REFINERY ODISHA OF IOCL. THIS DOCUMENT SHALL BE READ IN CONJUNCTION WITH ALL ISSUED FOR CONSTRUCTION DRAWINGS CONCERNING THE UNDERGROUND NETWORKS AND ASSOCIATED ACTIVITIES. IN CASE OF CONFLICT BETWEEN THIS DOCUMENT AND THE IFC DRAWINGS, THE LATER SHALL GOVERN.
2. ALL DIMENSIONS ARE IN MILLIMETERS, ELEVATIONS & CO-ORDINATES ARE IN METERS AND PIPE SIZES ARE IN INCHES.
3. ALL ELEVATIONS ARE WITH REFERENCE TO HPP LEVEL. HPP LEVEL +100.300M IS EQUAL TO 4.360M ABOVE I.M.S.L. (INDIAN MEAN SEA LEVEL).
4. DRAWINGS SHALL NOT BE SCALED, ONLY DIMENSIONS SHOWN ON THE DRAWINGS SHALL BE FOLLOWED.
5. PVC PIPES USED AS CONDUITS SHALL BE NOMINAL OUTSIDE DIA 110, 160 OR 210 AND SHALL BE AS PER THE LAYOUT DRAWINGS. THESE PIPES SHALL CONFIRM TO IS:4985 .
6. CABLE TRENCHES SHALL CLEAR THE ROAD SIDE DITCHES AND SHALL RUN BELOW THE DITCHES AT ROAD CROSSINGS.
7. BRICK / STONE PITCHING OF SURFACE DRAINS / ROADS SHALL BE DONE ONLY AFTER THE SIDES OF DRAIN ARE CUT , COMPACTED TO 95% OF MAX LABORATORY DRY DENSITY AND DRESSED TO THE REQUIRED SLOPE.
8. CONCRETE PAVEMENT SHALL BE LAID IN ALTERNATIVE CAST-IN-SITU PANELS OF 3.0M X 3.0M SIZE. PANELS SHALL BE SUITABLY MODIFIED TO MATCH EQUIPMENT LOCATION MAINTAINING THE SIZE LIMIT OF THE PANELS STATED ABOVE.
9. TOP ELEVATIONS OF DRAINS SHALL BE MATCHED WITH THE LOWEST POINT OF PAVING (LPP) FOR PROPER DRAINAGE OF SURFACE RUNOFF TO STORM WATER DRAINS.
10. TOP OF CONCRETE TRENCH SHALL BE FINISHED WITH TOP OF PAVING IN PAVED AREA.
11. COMPACTED EARTH BELOW TRENCH SHALL BE THOROUGHLY COMPACTED TO 95% LABORATORY DRY DENSITY AS PER IS:2720 PART VII.
12. WHENEVER TRENCHES ARE REQUIRED TO HAVE VERTICAL BENDS TO ACCOMODATE PIPE OR ANY OTHER FACILITY, THE VERTICAL ANGLE AT WHICH THE BOTTOM SLAB IS TO BE LOWERED SHALL BE AS FOLLOWS, UNLESS NOTED OTHERWISE :
    (A) FOR TRENCH CABLE = 30°
    (B) FOR TRENCH PIPE = 45°
13. WHEREVER IT IS UNAVOIDABLE, FW PIPES SHALL BE ROUTED BELOW CABLE TRENCH AT THEIR CROSSINGS.
14. WHEREVER UG PIPES CROSS THE ROADS THEY SHALL REST ON THE BOTTOM OF THE SLEEVES.
15. SLEEVE SHALL BE PLUGGED FROM BOTH END AFTER INSTALLATION OF PIPE WITH GUNNY BAG OR BRICKS WITH 1:4 MORTAR.
16. NP-3 RCC HUME PIPES AS PER IS-458 SHALL BE FOLLOWED OR USED FOR STORM WATER CULVERTS.
17. REFERENCE POINT ON AREA DRAWING SHALL BE FOLLOWED FOR LOCATING ANY UG SYSTEM / FACILITY / FOUNDATION.
18. VENT PIPE SCOPE FOR UG IN SEALED MANHOLE SHALL BE UPTO +0.300 FROM HPP / FGL AS APPLICABLE.
19. VENT PIPE FOR DOUBLE MANHOLE SHALL NOT BE MERGED.
20. FOR DEWATERING OF TRENCHES, DRAIN PIPE SHALL BE PROVIDED AT EVERY 6000mm c/c, UNLESS NOTED OTHERWISE.
21. EXTENDED STEM SHALL BE PROVIDED FOR VALVES INSIDE EVERY PIT UNLESS NOTED OTHERWISE.
22. MINIMUM COVER UNDER ROAD FOR UG PIPE SHALL BE 1000mm UNLESS NOTED OTHERWISE.
23. CONDUIT / SLEEVE FROM TRENCH TO ELECTRICAL / INSTRUMENTATION LOAD SHALL BE LAID BEFORE CONCRETING THE CABLE TRENCH WALLS IN CONSULTATION WITH ENGINEER - IN - CHARGE (ELECTRICAL).
24. UNLESS ANY FOUNDATION OR ANY UG NETWORK IS MENTIONED AS IFC IN THE REVISION NOTES ON AREA DRAWING, THE SAME SHALL NOT BE CONSTRUCTED AT SITE.
25. ELEVATION OF UG PIPES SHALL BE REFERRED FROM CORRESPONDING ISOMETRICS.
26. TOP OF MANHOLE IN PAVED AREA SHALL BE MATCHED WITH FINISHED PAVEMENT LEVEL.

LINE NAME OF PIPING (FLUID CODE)

CWS	COOLING WATER SUPPLY
CWR	COOLING WATER RETURN
DM	DEMINERALIZED WATER
WF	FIRE WATER
WR	RAW WATER
WDK	DRINKING WATER
WS	SERVICE WATER (FRESH WATER)
CRWS	CONTAMINATED RAIN WATER SEWER
OWS	OILY WATER SEWER
CS	CHEMICAL SEWER
ABD	AMINE BLOW DRAIN
CBD	CLOSED BLOW DRAIN
SS	STORM WATER
SWS	SOUR WATER SEWER

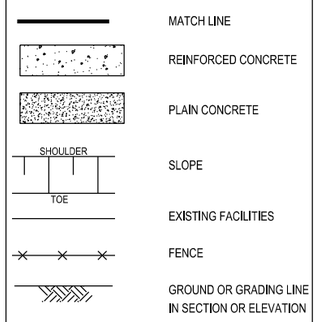
MANHOLE NUMBERING

UUU - FF - MM - NNN

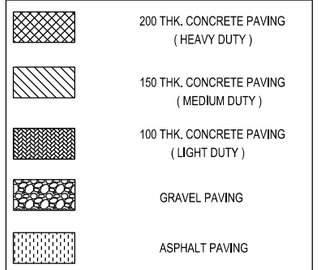
- NNN : SERAIL NUMBER
- MM : MANHOLE TYPE : MH : MANHOLE, CB : CATCHBASIN, VP : VALVE PIT, CO : CLEAN - OUT
- FF : FLUID CODE
- UUU : UNIT NUMBER

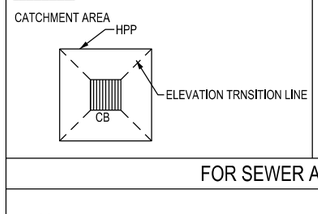
SYMBOLS

FOR GENERAL

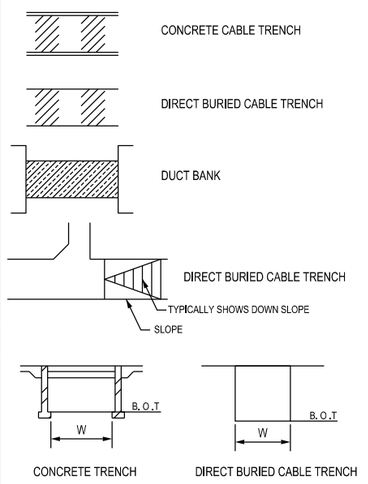


FOR ROAD AND PAVING

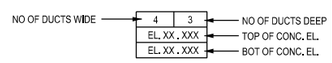




FOR TRENCH



TYPICAL DUCT BANK NOTATION



FOR SEWER AND DRAINAGE

ABBREVIATIONS

UNIT

M OR (m)	METERS
MM OR (mm)	MILLIMETERS
NOS.	NUMBERS

ABBREVIATIONS

A. BOLT	ANCHOR BOLT
ADD.	ADDITION
A / G	ABOVE GROUND
APPROX.	APPROXIMATELY
@	AT
AVE.	AVERAGE
B. F	BOTTOM FLAT
B / L	BATTERY LIMIT
BLDG	BUILDING
B. M	BENCH MARK
B . O . D	INVERT BOTTOM OF DITCH
B. O. DB	BOTTOM OF DUCT BANK
B. O . P	BOTTOM OF PIPE
B. O. T	BOTTOM OF TRENCH
C B	CATCH BASIN
C . J	CONSTRUCTION JOINT
℄	CENTER LINE
CON	CONCENTRIC
CONC.	CONCRETE
CON . JT	CONTRACTION JOINT
C . O	CLEAN OUT
C S	CARBON STEEL
DB	DUCT BANK
DET	DEATAIL
DIA . OR Ø	DIAMETER
D I	DUCTILE IRON
DWG	DRAWING
ECC	ECCENTRIC
ELEC.	ELECTRICAL
EXIST.	EXISTING FACILITIES
EXP . JT	EXPANSION JOINT
FDN.	FOUNDATION
F.G.L	FINISHED GROUND LEVEL / FINISHED GRADE LEVEL
FLG.	FLANGE
GEN.	GENERAL
H	HEIGHT
HORIZ.	HORIZONTAL
HPP	HIGH POINT OF PAVING
H . W . L	HIGH WATER LEVEL
I . D	INSIDE DIAMETER
IL	INVERT LEVEL
INCL.	INCLUDING
INST.	INTRUMENT
ISO . JT	ISOLATION JOINT
L	LENGTH
LPP	LOW POINT OF PAVING
L . W . L	LOW WATER LEVEL
MATL.	MATERIAL
MAX.	MAXIMUM
MH	MANHOLE
MIN.	MINIMUM
MISC.	MISCELLANEOUS
M / L	MATCH LINE
MSL	MEAN SEA LEVEL
NOM.	NOMINAL
NTS	NOT TO SCALE
O . D	OUTSIDE DIAMETER
P.C.C	PLAIN CEMENT CONCRETE
PS	PIPE SUPPORT
PVC	POLYVINYAL CHLORIDE
R	RADIUS
RE- BAR	REINFORCING BAR
REF	REFERENCE
REQD	REQUIRED
REV.	REVISION
RCC	REINFORCED CEMENT CONCRETE
RCP	REINFORCED CONCRETE PILE
SB	SUMP BOX
SCH.	SCHEDULE
SEC	SECTION
SPEC	SPECIFIACTION
SQ . OR □	SQUARE
S / S	SUBSTATION
STD	STANDARD
STR	STRUCTURE
t (OR) THK	THICKNESS
T . O . D	TOP OF DITCH
TOP	TOP OF PIPE
TYP	TYPICAL
U / G	UNDER GROUND
UON	UNLESS OTHERWISE NOTED
VP	VALVE PIT
VERT	VERTICAL
V	VENT PIPE
W	WIDTH
W / O	WITH OUT

▲ / H.P.P	HIGH POINT OF PAVING LEVEL
▼ / L.P.P	HIGH POINT OF PAVING LEVEL
△	TOP LEVEL OF WORKS
▽	BOTTOM LEVEL OF WORKS
(XXX)	INDICATES THICKNESS OF PAVING (IN MM)
XXXX | X	DETAIL ON DETAILS DWG (REF. TO DETAILS DWG N° AND DETAIL N°)

NOTES

1. THIS DRAWING SHALL BE APPLIED TO ALL DRAWINGS FOR PAVING AND UNDERGROUND FACILITIES PLAN UNLESS OTHERWISE NOTED.
2. REFER STRUCTURAL GENERAL NOTES 080557C-000-DW-1702-001

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
A	16-10-2019	IFD	NDR	KRK	JP / KC	JMC

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL	
☐ REVIEW	
☒ INFORMATION	

PROJECT

STANDBY SRU & ADDITIONAL TANKS

IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER

INDIAN OIL CORPORATION LTD.

PMC

TechnipFMC

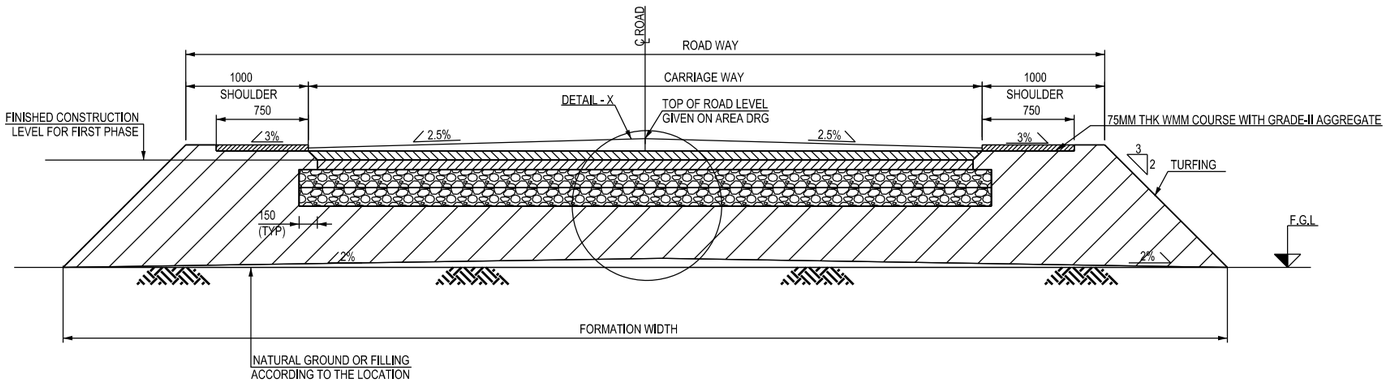
TITLE

ABBREVIATIONS , LEGENDS AND SYMBOLS FOR GENERAL CIVIL WORKS

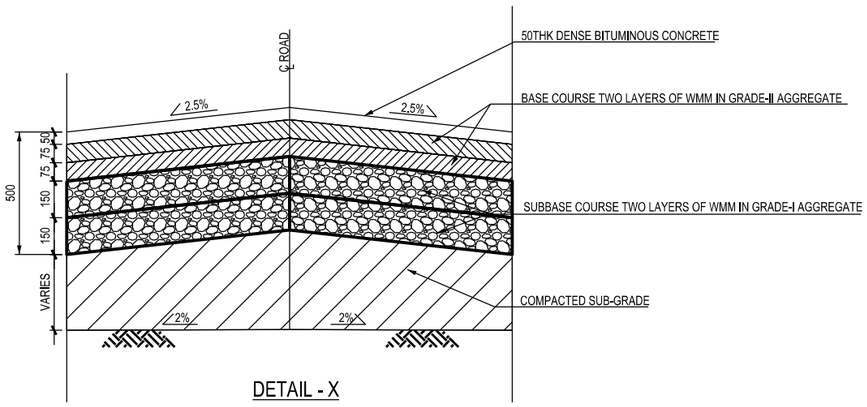
DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	001	1 OF 1	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1490-001_001_A.DGN

SHEET SIZE : A3



CROSS SECTION OF ROAD



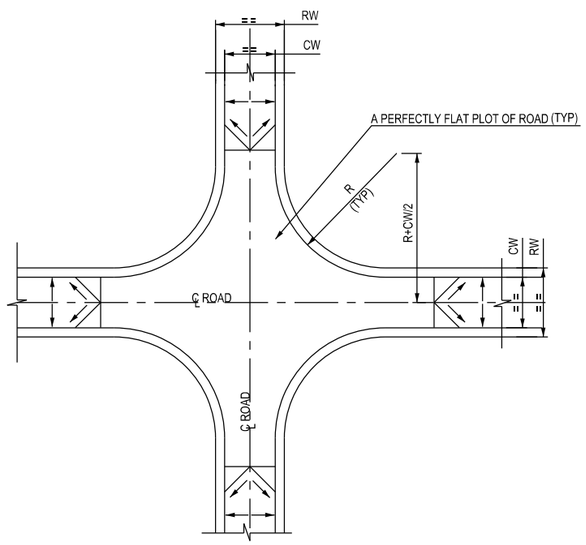
DETAIL - X

ROAD WIDTH

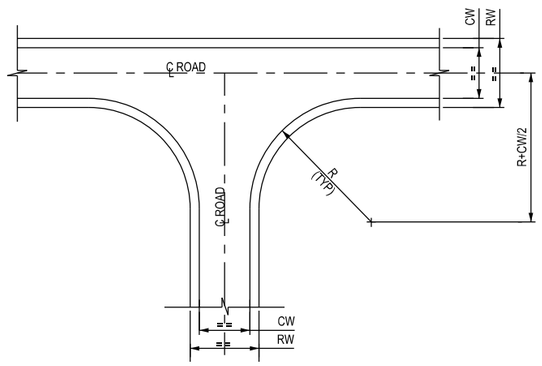
LOCATION	CARRIAGE WAY (CW)	ROAD WAY(RW)	RADIUS (R)
MAIN ROADS FOR PRODUCT PAVEMENT	14.0M	16.0M	15.0M
ROAD AROUND UNIT	10.5M /8.5M /7.0M	12.5M /10.5M /9.0M	12.0M
ROAD FOR HIGH LIFT CRANE	14.0M CONSIDERING 12M OUTER WIDTH OF CRAWLERS OF STANDARD 650MT CRANE CAPACITY OR AS PER THE REQUIREMENT	16.0M	15.0M
PLANT APPROACH ROAD	7.0M(TWO LANE)	9.0M	12.0M
ROADS AROUND TANKFARM	5.5M	7.5M	12.0M
PATROLLING ROADS ALONG BOUNDARY WALLS	4.0M	6.0M	8.0M
ACCESS TO BUILDING	3.75M	5.5M	8.0M
FOOTPATH	1.5M WALKWAY	1.5M	-

NOTES:

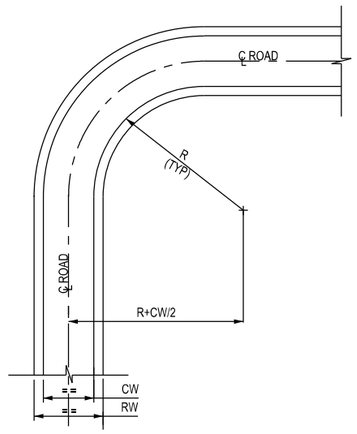
1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS.
2. ALL ELEVATIONS ARE WITH REFERENCE TO HPP LEVEL. HPP LEVEL +100.300M IS EQUAL TO 4.360M ABOVE I.M.S.L. (INDIAN MEAN SEA LEVEL).
3. RADIUS OF CURVES AND CROSSING WHEN DIFFERENT FROM THOSE GIVEN IN THIS STANDARD TO MEET IN THIS STANDARD TO MEET ANY SPECIAL REQUIREMENT SHALL BE MARKED IN THE AREA DRAWINGS.
4. ALL ROADS SHALL HAVE 1M WIDE SHOULDER ON EACH SIDE.
5. 50MM THK BITUMEN CARPET SHALL CONSIST OF:-
   FIRST LAYER OF 20mm THK
   SECOND LAYER OF 20mm THK
   SEAL COAT OF 10mm THK



CASE - 1



CASE - 2



CASE-3

TYPICAL DETAILS OF ROADS CURVES AND CROSSING

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
A	16-10-2019	IFD	NDR	KRK	JP / KC	JMC

DOCUMENT CATEGORY (USE " X " MARK)

- ☐ APPROVAL
- ☐ REVIEW
- ☒ INFORMATION

DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT

STANDBY SRU & ADDITIONAL TANKS

IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER

INDIAN OIL CORPORATION LTD.

PMC

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TITLE

TYPICAL ROAD SECTION DETAILS

DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	002	1 OF 1	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1490-002_001_A.DGN

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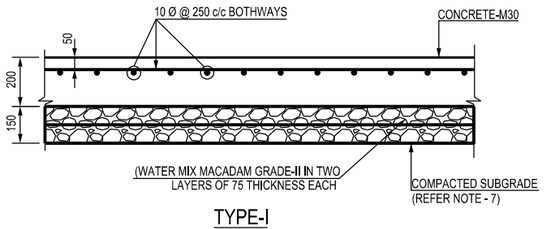
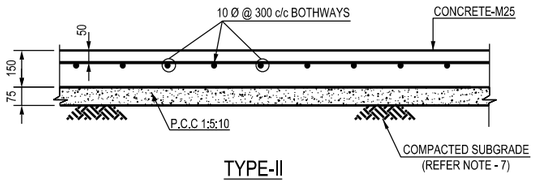
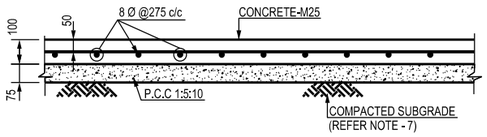


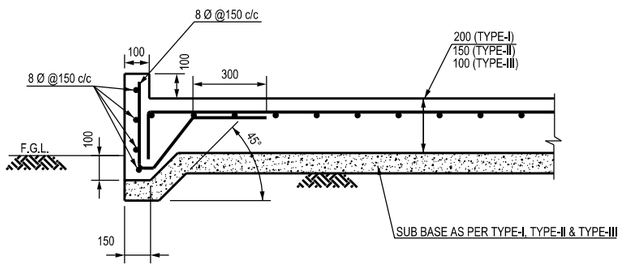
TYPE-I
(MAXIMUM PANEL SIZE 14M X 14M)
(HEAVY DUTY PAVEMENT)



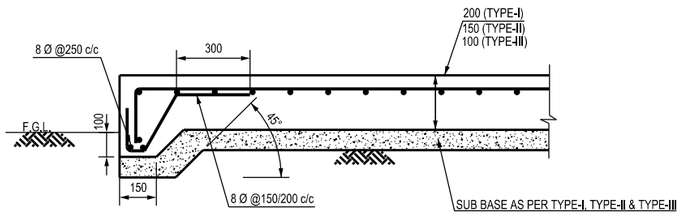
TYPE-II
(MAXIMUM PANEL SIZE 13M X 13M)
(MEDIUM DUTY PAVEMENT)



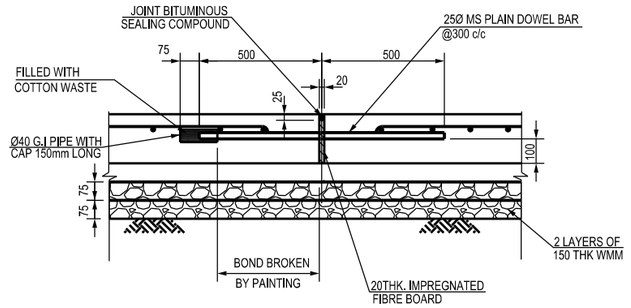
TYPE-III
(MAXIMUM PANEL SIZE 7.5M X 7.5M)
(LIGHT DUTY PAVEMENT)



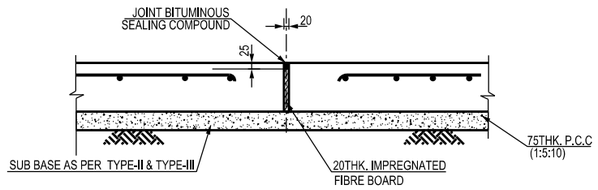
TYPICAL EDGE DETAIL
(WITH KERB WALL)



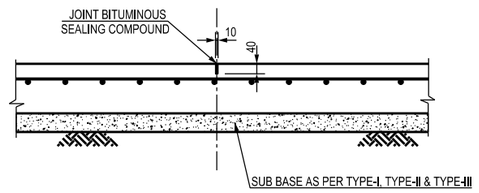
TYPICAL EDGE DETAIL
(WITHOUT KERB WALL)



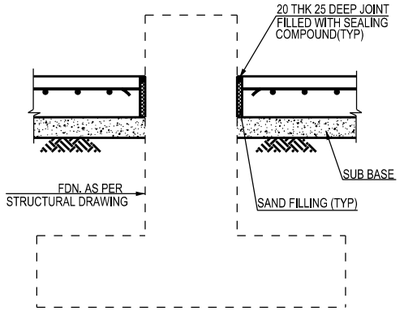
DETAIL OF EXPANSION JOINT
(FOR TYPE-I PAVEMENT)



DETAIL OF EXPANSION JOINT
(FOR TYPE-II & III PAVEMENT)



DETAIL OF CONSTRUCTION JOINT



TYP. DET. OF JOINT SEALING
AROUND FOUNDATION

200 THK. CONCRETE PAVING
(HEAVY DUTY)

150 THK CONCRETE PAVING
(MEDIUM DUTY)

100 THK. CONCRETE PAVING
(LIGHT DUTY)

REPRESENTATION ON AREA DWG.

NOTES:

1. ALL DIMENSION ARE IN MILLIMETERS UNLESS STATED OTHERWISE.
2. CONC. SHALL CONFORM TO IS:456.
3. REINFORCMENT SHALL BE HIGH YIELD DEFORMED BARS CONFORMING TO IS:1786.
4. JOINT SEALING COMPOUND IN PAVING AROUND FOUNDATIONS SHALL CONFORM TO IS:1834 TYPE-B.
5. EXPANSION JOINT SHALL BE FILLED WITH PRE-MOULDED FIBRE IMPREGNATED FELT BOARDS, CONFORMING TO IS:1838, PART-I WITH THE TOP 25mm FILLED WITH FLEXIBLE BITUMINOUS JOINT SEALING COMPOUND CONFORMING TO IS:1834, PART-B.
6. CONC. PAVING SHALL BE SLOPED STEEPEST TO 1:100 UNLESS OTHERWISE SHOWN IN DETAIL ENGINEERING DRGS. SLOPE OF THE SUB GRADE SHALL BE PREPARED TO MATCH WITH THE SLOPE OF PAVEMENT.
7. SUB GRADE SHALL BE THOROUGHLY COMPACTED TO 95% OF LAB DRY DENSITY AS PER IS:2720 PART VIII PROPER SLOPE & GRADE BEFORE LAYING WBM/PCC 1:4:8.
8. CONCRETE PAVEMENT SHALL BE LAID IN ALTERNATE PANELS OF 3.0Mx3.0M SIZE. PANEL SIZE SHALL BE SUITABLY MODIFIED TO MATCH EQUIPMENT FOUNDATION WITH IN THE SIZE LIMIT STATED ABOVE.
9. EXPANSIONS JOINTS SHALL BE SPACED AT 14.0m c/c. CONSTRUCTION JOINT MAY BE PROVIDED IN CASE OF PANEL SIZE IS LESS THAN THE REQUIREMENT OF EXPANSION JOINT TO SUIT SITE REQUIREMENT.
10. CONSTRUCTION JOINTS SHALL BE AT 7.5M MAXIMUM FOR TYPE-I & TYPE II PAVEMENTS. PROVIDED IN CASE OF PANEL SIZE IS LESS THAN THE REQUIREMENT
11. FOR GENERAL NOTES OF CONCRETE REFER STC NO.- 080557C-000-DW-1702-001.

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
A	16-10-2019	IFD	NDR	KRK	JP / KC	JMC

DOCUMENT CATEGORY (USE " X " MARK)
- ☐ APPROVAL
- ☐ REVIEW
- ☒ INFORMATION

DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT
STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER
INDIAN OIL CORPORATION LTD.

PMC
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TITLE
STANDARD R.C.C PAVEMENT DETAILS

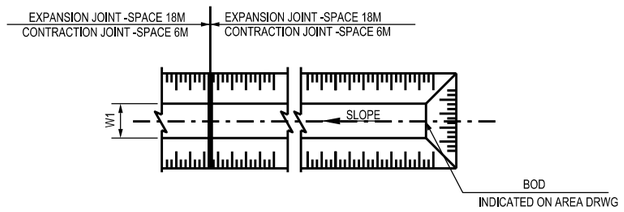
DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	003	1 OF 1	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1490-003_001_A.DGN

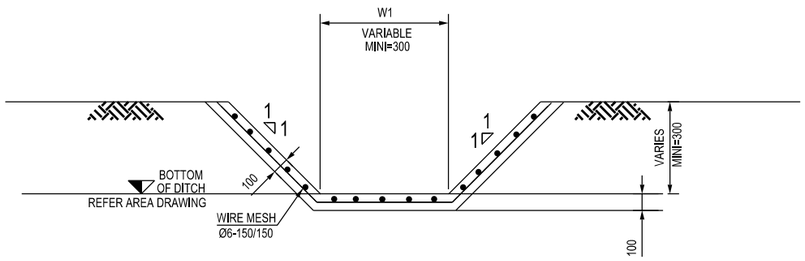
SHEET SIZE : A3

TYPE - 1

V.DITCH



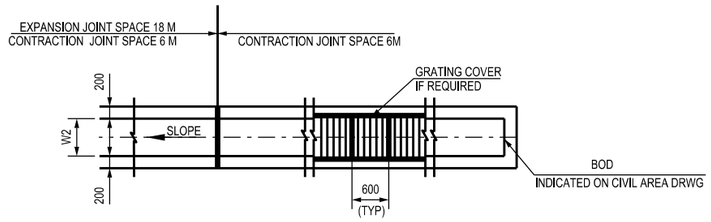
TYPICAL PLAN



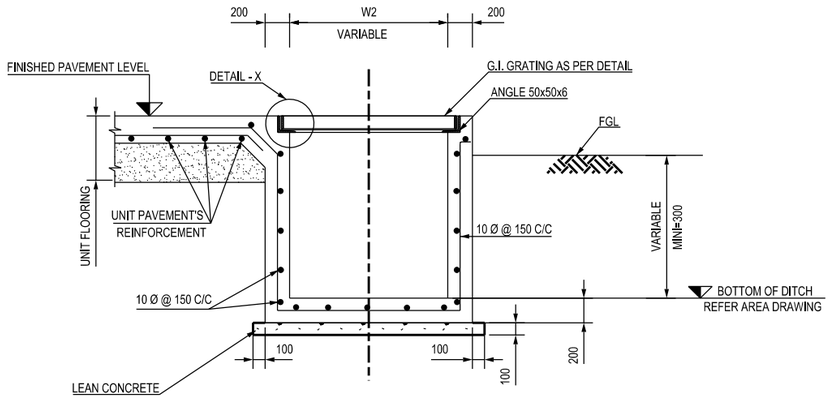
TYPICAL SECTION

TYPE - 2

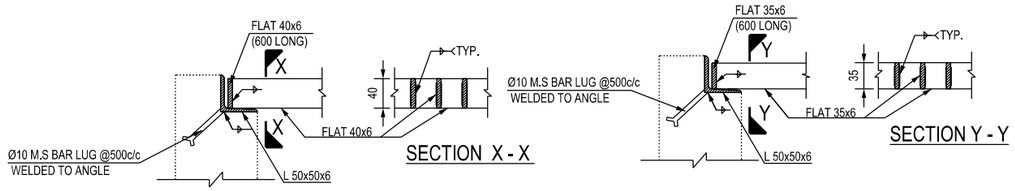
U.DITCH



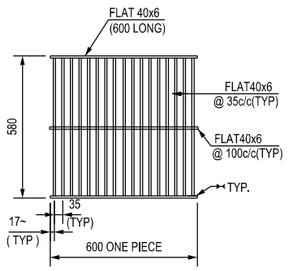
TYPICAL PLAN



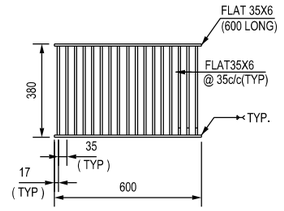
TYPICAL SECTION



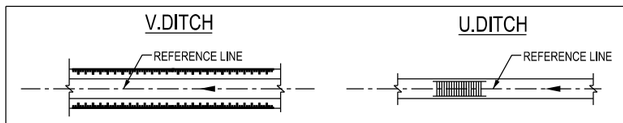
DETAIL X



DETAIL PLAN OF GRATING
(FOR 500mm WIDE DRAIN)



DETAIL PLAN OF GRATING
(FOR 300mm WIDE DRAIN)



REPRESENTATION ON AREA DRG.

NOTES :

1. ALL DIMENSIONS ARE IN MM.
2. REFER STRUCTURAL GENERAL NOTES 080557C-000-DW-1702-001 FOR REINFORCED CONCRETE STRUCTURES FOR FOLLOWING
   a) GRADE OF CONCRETE
   b) GRADE OF TYPE OF CEMENT
   c) GRADE OF REINFORCEMENT STEEL BARS
   d) CLEAR COVER IN RCC WORKS

MINIMUM WIDTH OF RECTANGULAR DRAINS SHALL BE AS FOLLOWS:

FOR DEPTH ≤ 500 mm : 300 mm

FOR DEPTH > 500 mm : 500 mm

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
A	16-10-2019	IFD	NDR	KRK	JP / KC	JMC

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT

STANDBY SRU & ADDITIONAL TANKS

IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER

INDIAN OIL CORPORATION LTD.

PMC

TechnipFMC

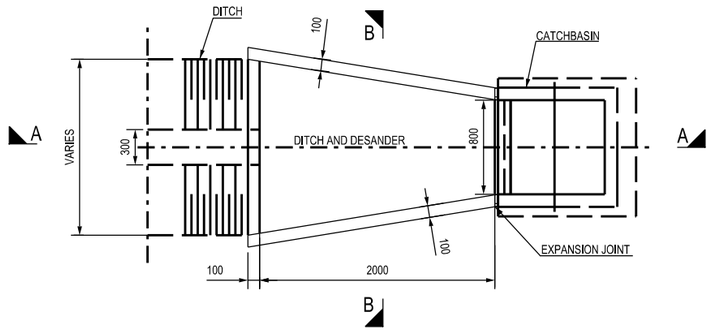
TITLE

STORM WATER SYSTEMS
STANDARDS DITCHES

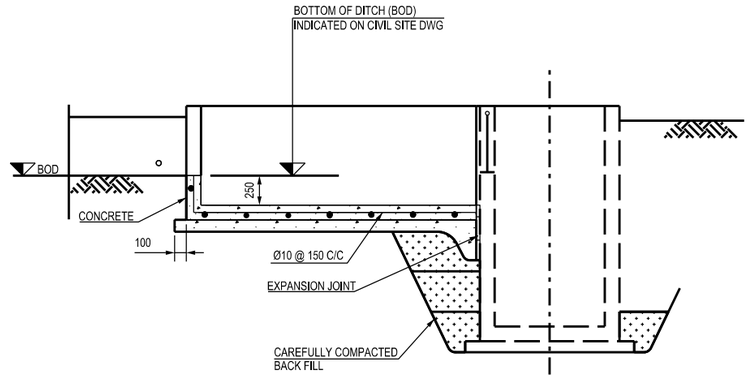
DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	004	1 OF 1	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1490-004_001_A.DGN

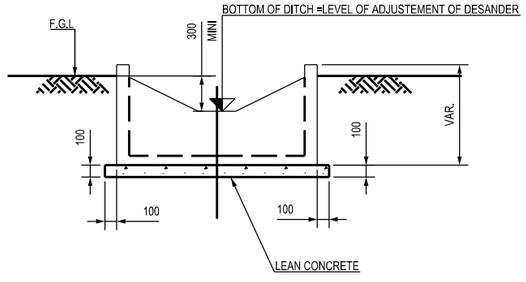
SHEET SIZE : A3



PLAN



SECTION A - A



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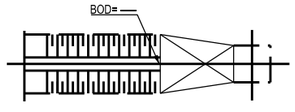


REPRESENTATION ON CIVIL AREA DWG

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. REFER STRUCTURAL GENERAL NOTES 080557C-000-DW-1702-001 FOR REINFORCED CONCRETE STRUCTURES FOR FOLLOWING
   a) GRADE OF CONCRETE
   b) GRADE OF TYPE OF CEMENT
   c) GRADE OF REINFORCEMENT STEEL BARS
   d) CLEAR COVER IN RCC WORKS

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
A	07-10-2019	IFD	NDR	KRK	JP / KC	JMC

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT

STANDBY SRU & ADDITIONAL TANKS

IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER

INDIAN OIL CORPORATION LTD.

PMC

TechnipFMC

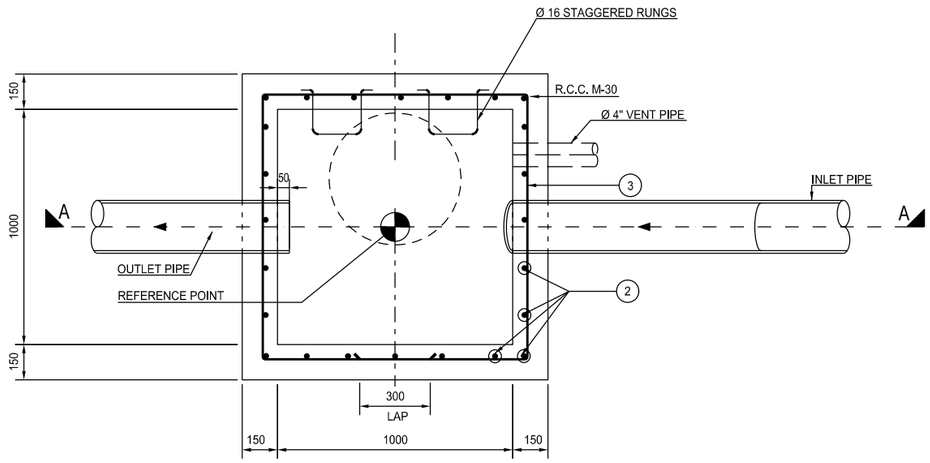
TITLE

STORM WATER SYSTEMS
DE SANDER FOR STANDARD DITCH

DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	005	1 OF 1	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1490-005_001_A.DGN

SHEET SIZE : A3



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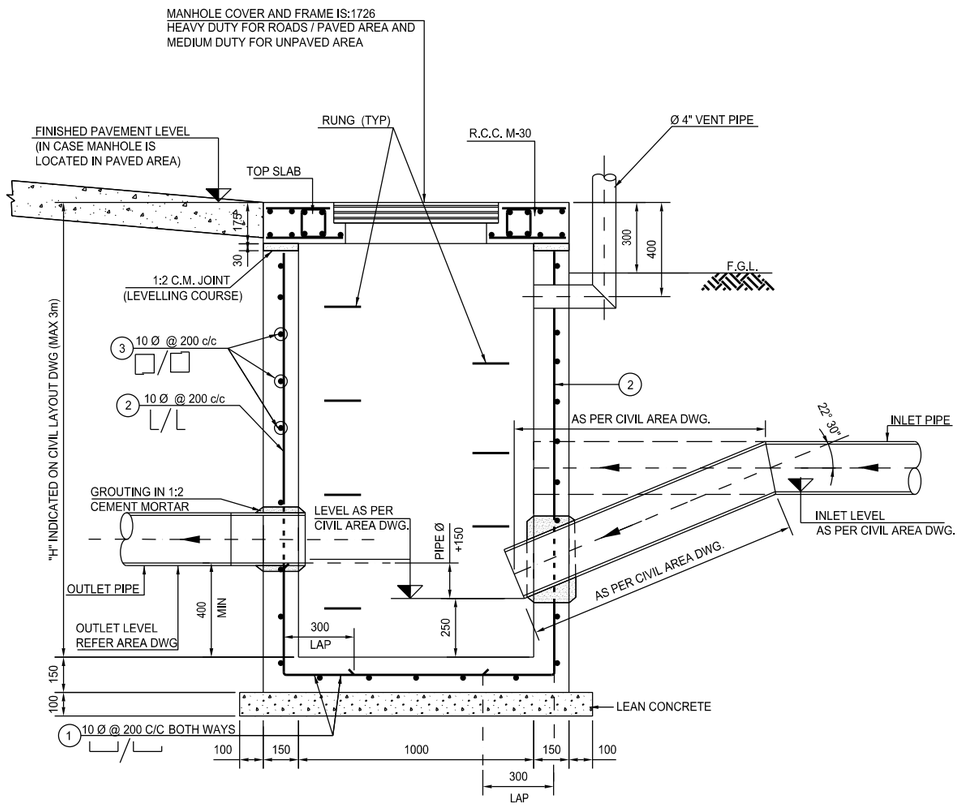
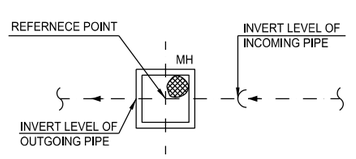


SECTION A-A



REPRESENTATION ON CIVIL AREA DWG.

NOTES:-

1. ALL DIEMENSIONS ARE IN MM.
2. REFER STRUCTURAL GENERAL NOTES 080557C - 000 - DW-1702 - 001 FOR REINFORCED CONCRETE STRUCTURES FOR FOLLOWING
   a) GRADE OF CONCRETE
   b) GRADE OF TYPE OF CEMENT
   c) GRADE OF REINFORCEMENT STEEL BARS
   d) CLEAR COVER IN RCC WORKS
3. FOR EXACT DIMENSION OF BEND REFER RESPECTIVE ISOMETRICS.
4. WATER PROOFING COMPOUND SHALL BE MIXED WITH CONCRETE FOR MANHOLES.
5. ALL MANHOLES FOR UNDERGROUND SEWWERS SHALL BE RCC CONSTRUCTION WITH ROUND SFRC (STEEL FIBRE REINFORCED CONCRETE) COVERS.

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
A	16-10-2019	IFD	NDR	KRK	JP / KC	JMC

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT

STANDBY SRU & ADDITIONAL TANKS

IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER

INDIAN OIL CORPORATION LTD.

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TITLE

MANHOLE WITH OR WITHOUT SUBMERGED CONNECTION
OILY WATER AND CONTAMINATED RAIN WATER SYSTEM
OWS AND CRWS (DIA ≤ 20")

DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	006	1 OF 1	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1490-006_001_A.DGN

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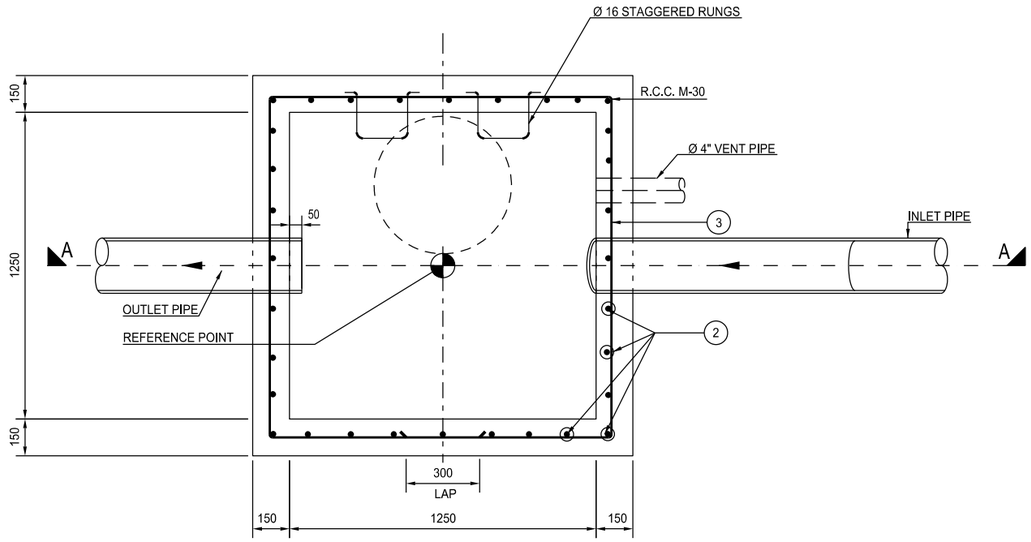

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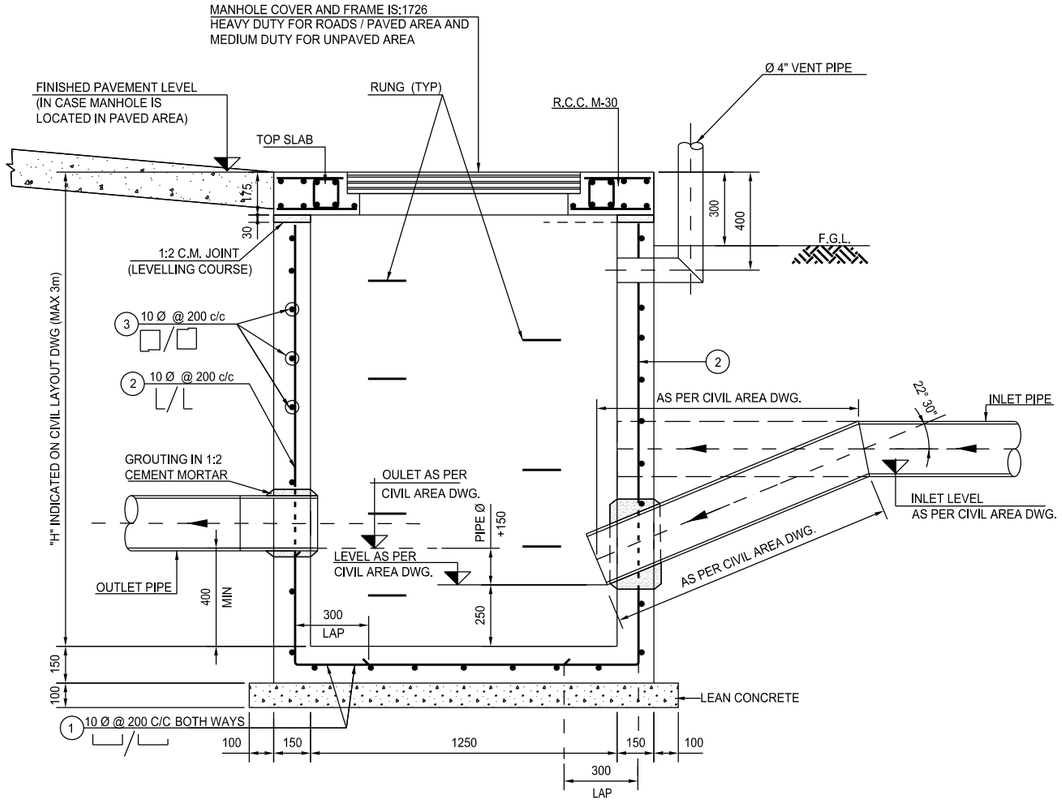

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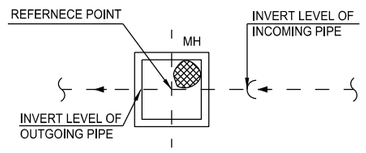

REPRESENTATION ON AREA DWG.

NOTES:-

1. ALL DIEMENSIONS ARE IN MM.
2. REFER STRUCTURAL GENERAL NOTES 080557C - 000 - DW-1702 - 001 FOR REINFORCED CONCRETE STRUCTURES FOR FOLLOWING
   a) GRADE OF CONCRETE
   b) GRADE OF TYPE OF CEMENT
   c) GRADE OF REINFORCEMENT STEEL BARS
   d) CLEAR COVER IN RCC WORKS
3. FOR EXACT DIMENSION OF BEND REFER RESPECTIVE ISOMETRICS.
4. WATER PROOFING COMPOUND SHALL BE MIXED WITH CONCRETE FOR MANHOLES.
5. ALL MANHOLES FOR UNDERGROUND SEWWERS SHALL BE RCC CONSTRUCTION WITH ROUND SFRC (STEEL FIBRE REINFORCED CONCRETE) COVERS.

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
A	16-10-2019	IFD	NDR	KRK	JP / KC	JMC

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT

STANDBY SRU & ADDITIONAL TANKS

IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER

INDIAN OIL CORPORATION LTD.

PMC

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TITLE

MANHOLE WITH OR WITHOUT SUBMERGED CONNECTION OILY WATER AND CONTAMINATED RAIN WATER SYSTEM OWS AND CRWS (DIA 20" TO 24")

DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	007	1 OF 1	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1490-007_001_A.DGN

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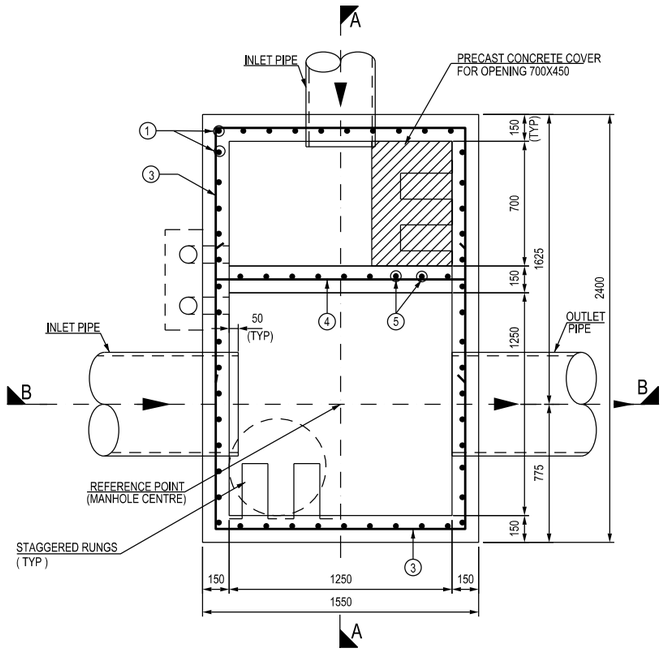
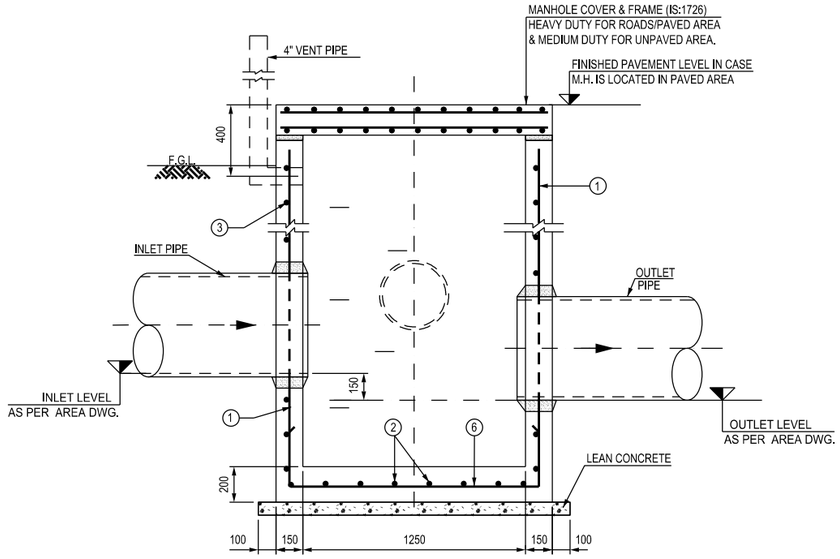


PLAN



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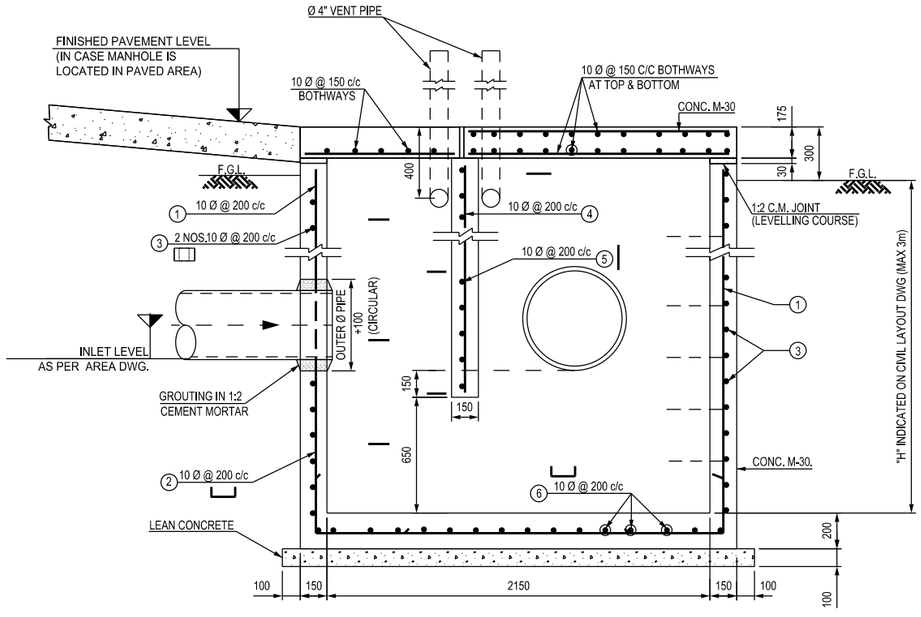
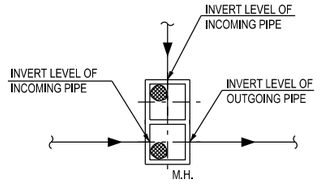


SECTION A-A



REPRESENTATION ON AREA DWG.

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. REFER STRUCTURAL GENERAL NOTES 080557C - 000 - DW-1702 - 001 FOR REINFORCED CONCRETE STRUCTURES FOR FOLLOWING
   a) GRADE OF CONCRETE
   b) GRADE OF TYPE OF CEMENT
   c) GRADE OF REINFORCEMENT STEEL BARS
   d) CLEAR COVER IN RCC WORKS

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
A	16-10-2019	IFD	NDR	KRK	JP / KC	JMC

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT

STANDBY SRU & ADDITIONAL TANKS

IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER

INDIAN OIL CORPORATION LTD.

IndianOil

PMC

TechnipFMC

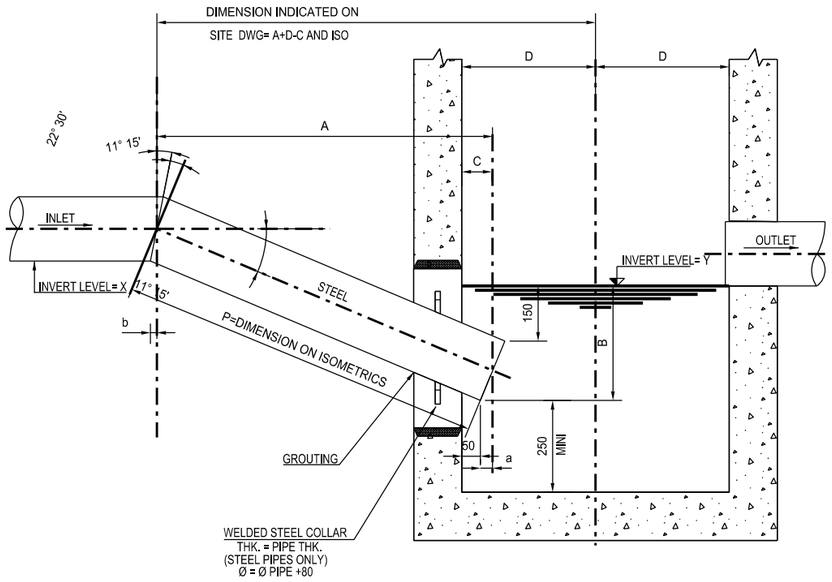
TITLE

SEALED MANHOLE
DOUBLE CHAMBER (TYPE-I)

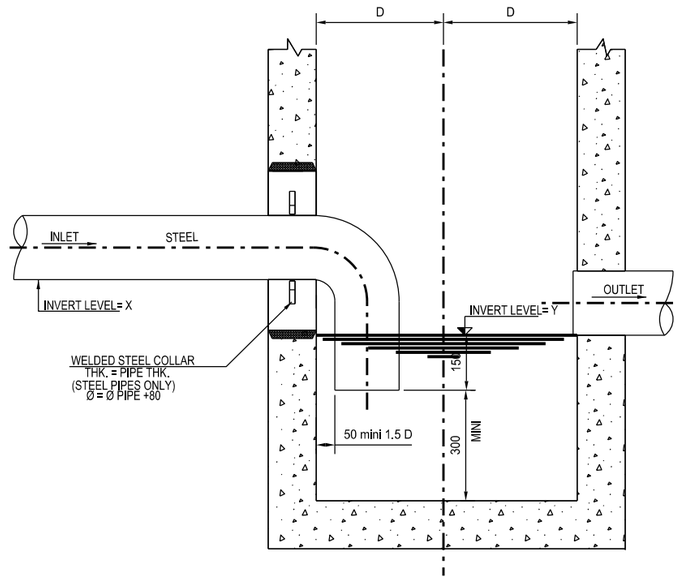
DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	008	1 OF 1	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1490-008_001_A.DGN

SHEET SIZE : A3



TYPE-I



TYPE-II

DETERMINATION OF DIMENSION .P. TO BE INDICATED ON ISOMETRICS

P=1.08 A

SUBMERGED INLET CONNECTION A= 2.414 [(NIV.X-NIV.Y)+B +(a-b)]

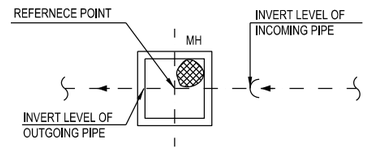
SUBMERGED OUTLET CONNECTION A=(2.414xB)+(a-b)

IMPORTANT:

WHEN SEVERAL INLET CONNECTIONS ARE SUBMERGED IN MANHOLE USE VALUE B OF THE LARGEST DIAMETER FOR CALCULATING DIMENSION "A" OF EACH PIPE

VALUE OF (a-b) B, AND C ACCORDING TO PIPE DIAMETER				
DIAMETER		(a-b)	B	C
STEEL	CAST IRON			
4"	100	10	250	70
6"	150	15	310	80
8"	200	20	360	90
10"	250	25	410	100
12"	300	30	460	110
14"	350	30	500	115
16"	400	35	550	125
18"	450	40	600	135
20"	500	45	650	145

ALL DIMENSIONS IN THIS TABLE ARE GIVEN AS ROUND NUMBERS FOR SIMPLIFICATION AND TO ALLOW FOR SIZE VARIATIONS IN STEEL AND CAST IRON PIPE DIAMETERS.



REPRESENTATION ON CIVIL AREA DWG.

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. REFER STRUCTURAL GENERAL NOTES 080557C - 000 - DW-1702 - 001 FOR REINFORCED CONCRETE STRUCTURES FOR FOLLOWING
   a) GRADE OF CONCRETE
   b) GRADE OF TYPE OF CEMENT
   c) GRADE OF REINFORCEMENT STEEL BARS
   d) CLEAR COVER IN RCC WORKS
3. THIS DRAWING APPLIES ONLY FOR PIPES Ø <=20". PIPES Ø >20" AND Ø<=28" USE DRAWING STC 14 90 24
4. FOR ALL PIPING DETAILS SEE ISOMETRICS

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
A	16-10-2019	IFD	NDR	KRK	JP / KC	JMC

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT

STANDBY SRU & ADDITIONAL TANKS

IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER

INDIAN OIL CORPORATION LTD.

PMC

TechnipFMC

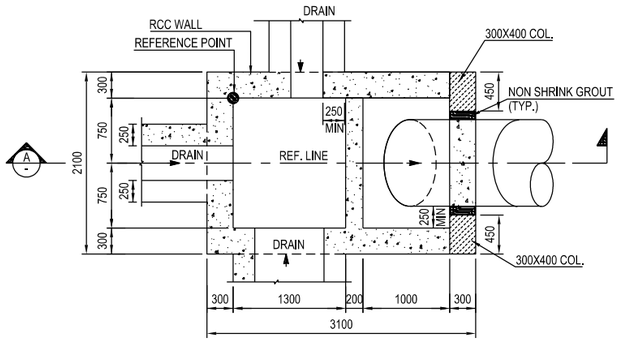
TITLE

HYDRAULIC SEALS
(SUBMERGED CONNECTION - STEEL SYSTEM)

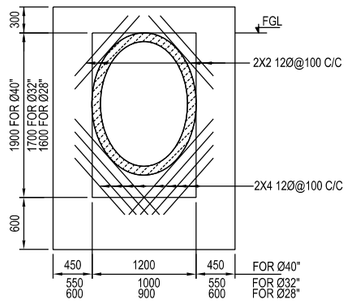
DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	009	1 OF 1	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1490-009_001_A.DGN

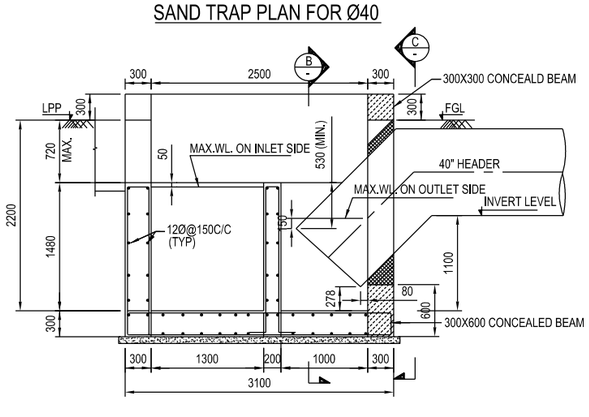
SHEET SIZE : A3



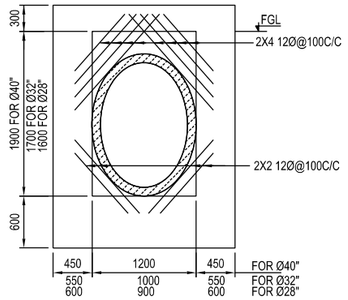
SAND TRAP PLAN FOR Ø40



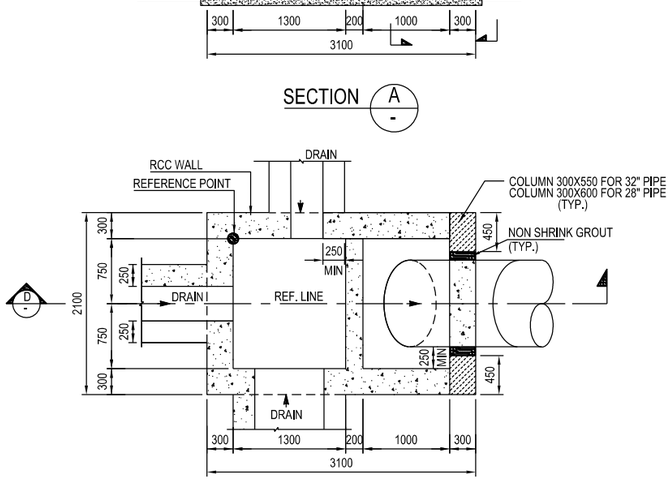
SECTION C



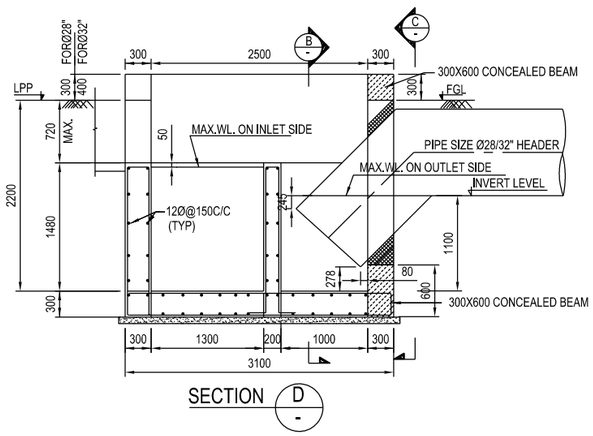
SECTION A



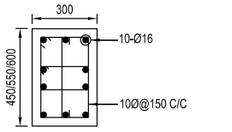
SECTION B



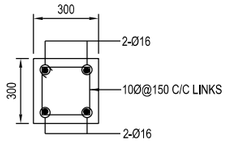
SAND TRAP PLAN FOR Ø32 & 28"



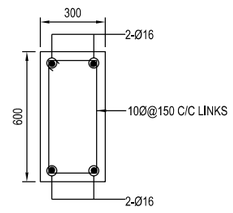
SECTION D



COLUMN 300X450 FOR 40" PIPE
COLUMN 300X450 FOR 32" PIPE
COLUMN 300X450 FOR 28" PIPE



BEAM 300X300



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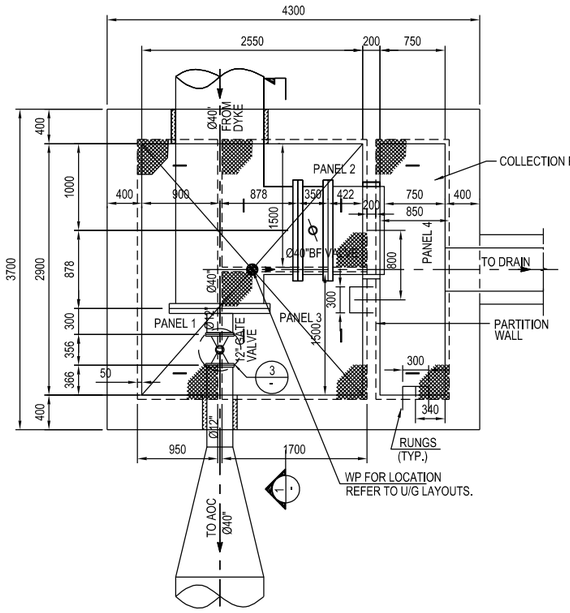
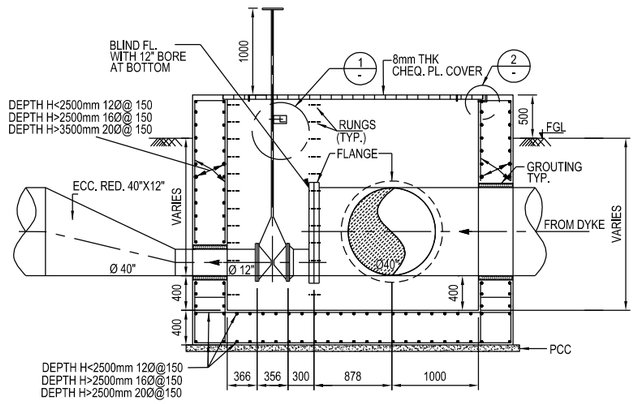
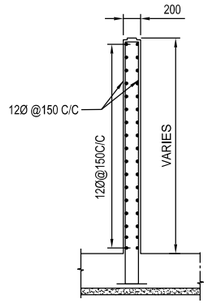


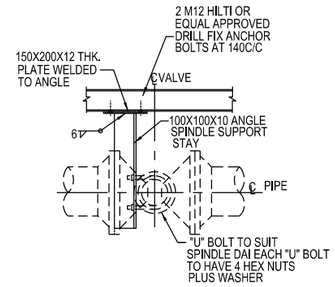
VALVE PIT DETAILS - AOC SYSTEM



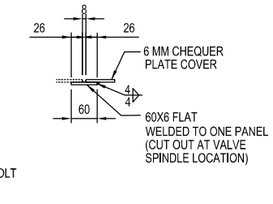
SECTION 1



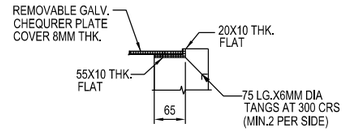
TYPICAL CROSS SECTION
DETAIL FOR PARTITION WALL



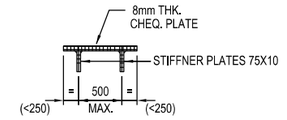
DETAIL 1



DETAIL 3



DETAIL 2



TYP. DETAIL OF CHEQ. PLATE COVER

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
B	01-11-2019	IFD	NDR	KRK	JP / KC	JMC
A	16-10-2019	IFD	NDR	KRK	JP / KC	JMC

DOCUMENT CATEGORY (USE " X " MARK)

- ☐ APPROVAL
- ☐ REVIEW
- ☒ INFORMATION

DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT

STANDBY SRU & ADDITIONAL TANKS

IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER

INDIAN OIL CORPORATION LTD.

PMC

TechnipFMC

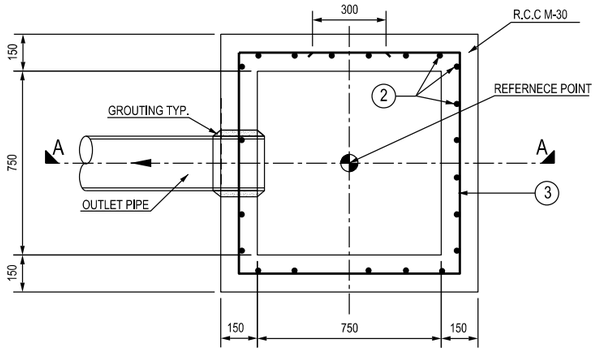
TITLE

STANDARD DETAIL OF SAND TRAP & VALVE PIT

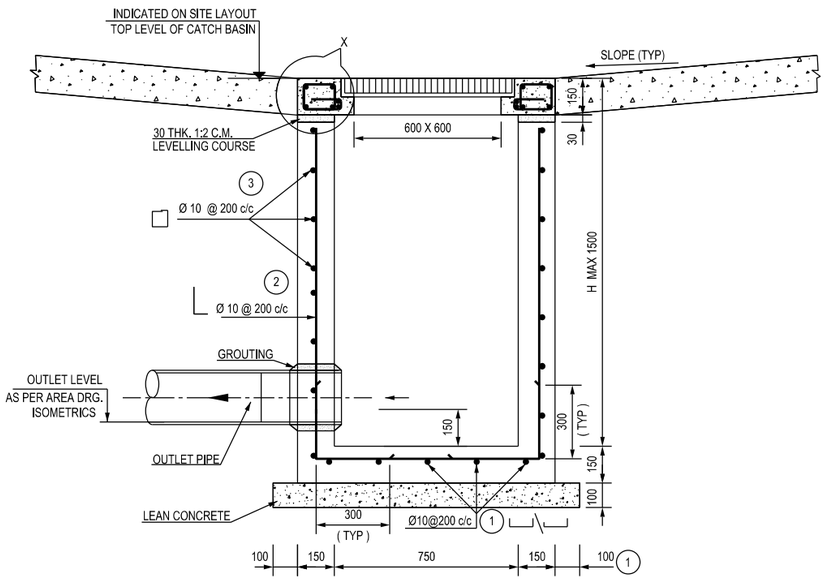
DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	010	1 OF 1	B
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1490-010_001_B.DXF

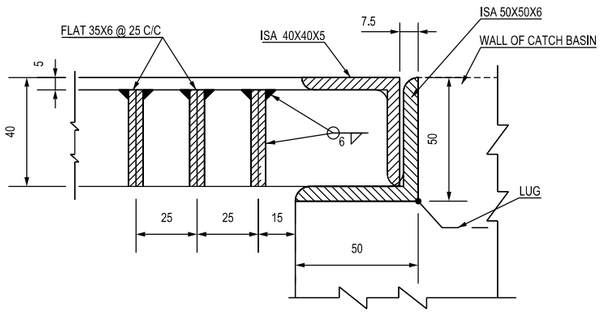
SHEET SIZE : A3



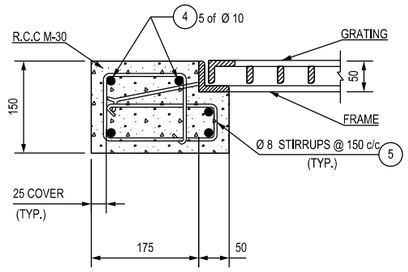
PLAN



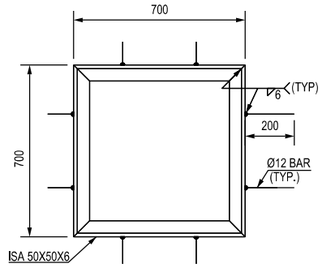
SECTION A-A



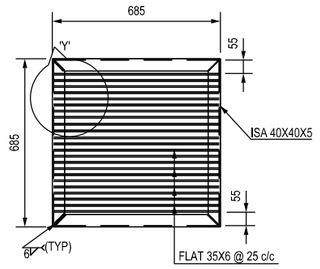
DETAIL 'Y'



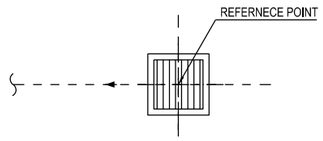
DETAIL X



DETAIL OF FRAME



DETAIL OF GRATING



REPRESENTATION ON UNIT AREA DRG.

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. REFER STRUCTURAL GENERAL NOTES 080557C-000-DW-1702-001 FOR REINFORCED CONCRETE STRUCTURES FOR FOLLOWING
   a) GRADE OF CONCRETE
   b) GRADE OF TYPE OF CEMENT
   c) GRADE OF REINFORCEMENT STEEL BARS
   d) CLEAR COVER IN RCC WORKS

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
A	16-10-2019	IFD	NDR	KRK	JP / KC	JMC

DOCUMENT CATEGORY (USE " X " MARK)
- ☐ APPROVAL
- ☐ REVIEW
- ☒ INFORMATION

DOCUMENT REVIEW STATUS (BY CLIENT)

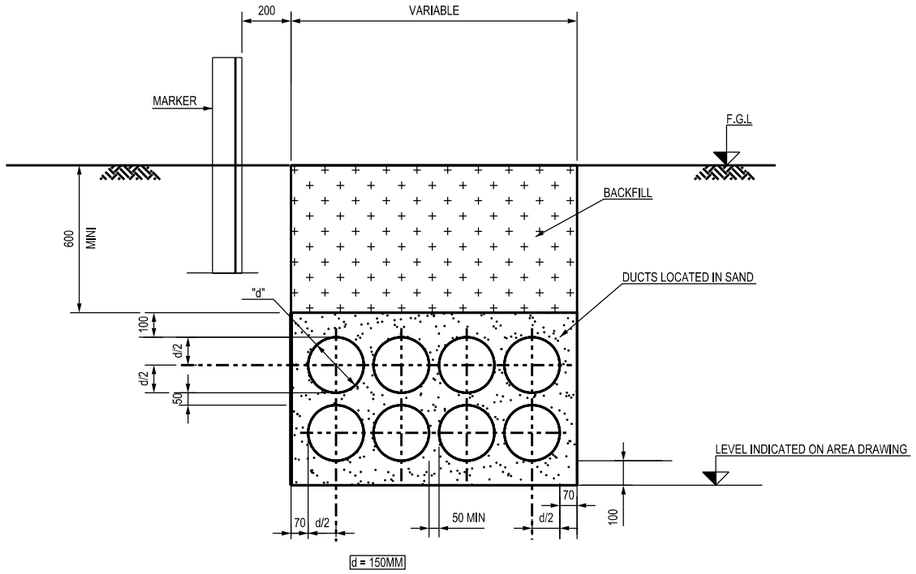
PROJECT
STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER
INDIAN OIL CORPORATION LTD.

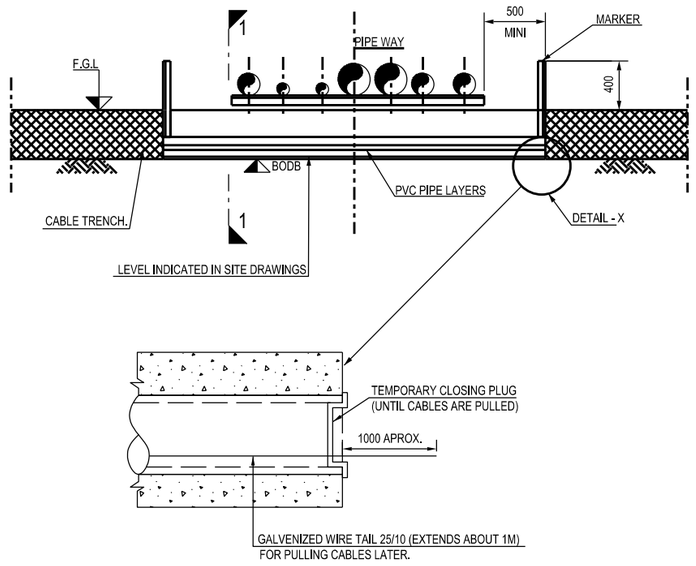
PMC
TechnipFMC

TITLE
CONSTRUCTION STANDARD
SITE ARRANGEMENT
CONTAMINATED RAIN WATER SYSTEM
CATCH BASIN (OWS / CRWS)

DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	011	1 OF 1	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		



SECTION 1-1



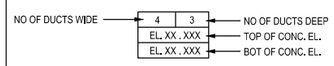
DETAIL - X

SLEEVE END PLUGGING DETAIL

NOTES:-

1. MATERIAL USED FOR CONDUITS PIPE :PVC

REPRESENTATION ON AREA DWG.



Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
A	16-10-2019	IFD	NDR	KRK	JP / KC	JMC

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT

STANDBY SRU & ADDITIONAL TANKS

IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER

INDIAN OIL CORPORATION LTD.

PMC

TechnipFMC

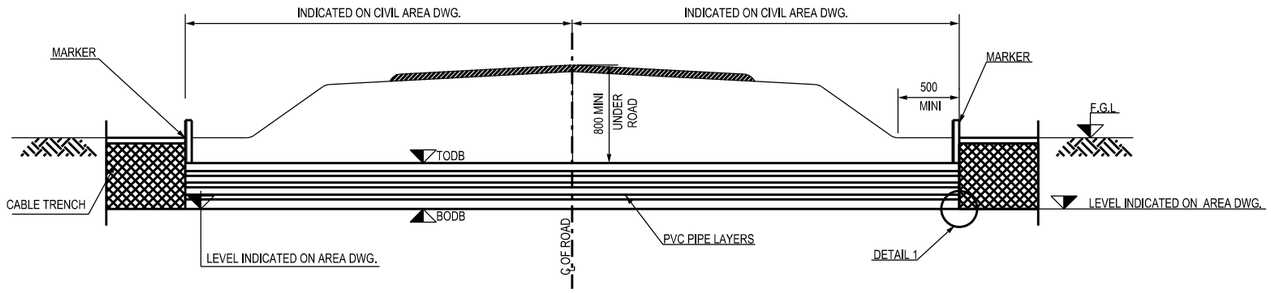
TITLE

CONDUITS UNDER PIPE WAYS

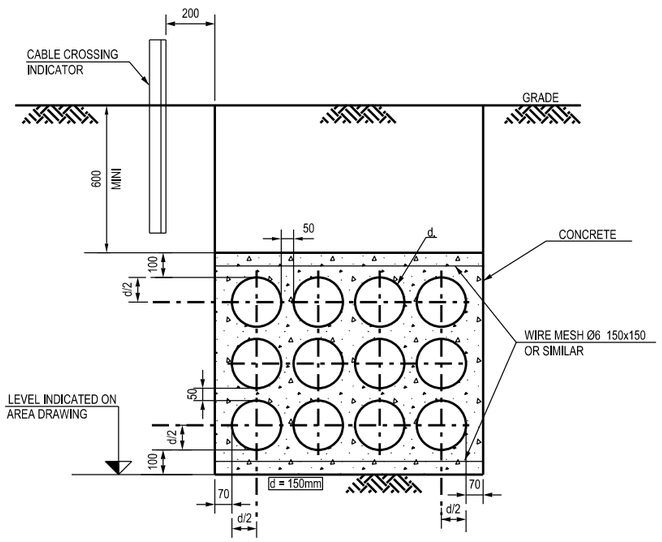
DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	012	1 OF 1	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1490-012_001_A.DGN

SHEET SIZE : A3

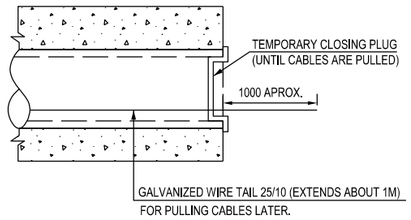


TRANSVERSAL SECTION ON ROAD



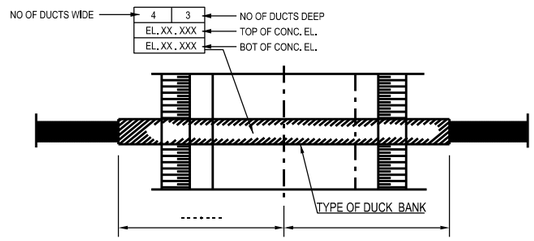
DUCT BANK

FOR UNITS ELECTRICAL CABLE ROUTING AND FOR
INSTRUMENTATION COPPER CABLE ROUTING



DETAIL 1

SLEEVE END PLUGGING DETAIL



REPRESENTATION ON CIVIL AREA DWG.

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. MATERIAL USED FOR CONDUITS : PVC

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
			NDR	KRK	JP / KC	JMC
A	16-10-2019	IFD				

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT

STANDBY SRU & ADDITIONAL TANKS

IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER

IndianOil — INDIAN OIL CORPORATION LTD.

PMC

TechnipFMC

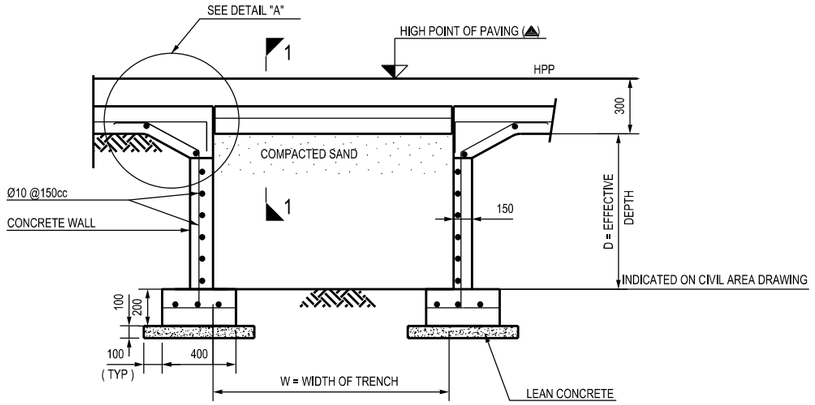
TITLE

ROAD CROSSING DUCT BANK FOR CABLE TRENCHES

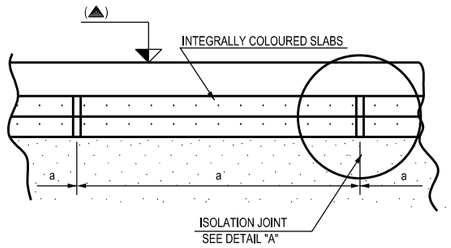
DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	013	1 OF 1	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1490-013_001_A.DGN

SHEET SIZE : A3



CONCRETE CABLE TRENCH (WITH CONCRETE WALL)
ECT/ICT



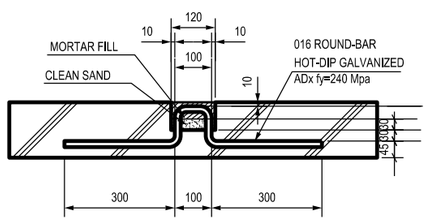
SECTION 1-1

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. FOR PRECAST CABLES TRENCH ONLY THE HEIGHT "D" CAN BE PRECAST. THE REMAINING PART WILL BE POURED IN PLACE DURING THE EXECUTION OF PAVING. POURED IN PLACE DURING THE EXECUTION OF PAVING. (ADJUSTMENT AS PER SLOPES OF PAVING)
3. TRENCH COVER TO BE CAST-IN-SITU TRENCH COVER SHALL BE FLUSHED WITH THE FINISHED LEVEL OF PAVING
4. FOR CONCRETE WALL TRENCH, EXPANSION JOINTS SHALL BE PROVIDED AT INTERVAL OF MAX.15 METERS
5. COATING: CONCRETE SURFACE PROTECTION AS PER SPECIFICATION
6. REFER STRUCTURAL GENERAL NOTES 080557C-000-DW-1702-001 FOR RENIFORCED CONCRETE STRUCTURES FOR FOLLOWING
   a) GRADE OF CONCRETE
   b) GRADE OF TYPE OF CEMENT
   c) GRADE OF REINFORCEMENT STEEL BARS
   d) CLEAR COVER IN RCC WORKS

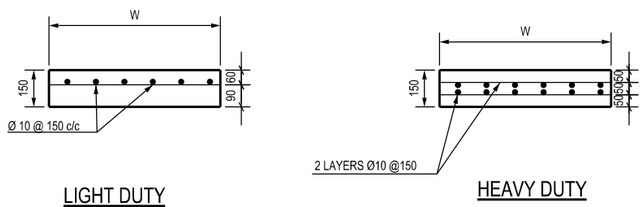
PLAN

LIFTING LUG ARRANGEMENT FOR PRECAST COVER



DETAIL OF LIFTING LUG

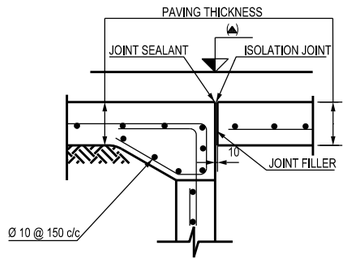
W : WIDTH OF TROUGH	a
W < 2000	3000
2000 < W < 4000	2500
4000 < W < 6000	2000



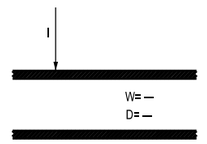
LIGHT DUTY

HEAVY DUTY

REINFORCEMENT FOR TRENCH C0VER



DETAIL "A"



REPRESENTATION ON CIVIL AREA DWG

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
A	16-10-2019	IFD	NDR	KRK	JP / KC	JMC

DOCUMENT CATEGORY (USE " X " MARK)

- ☐ APPROVAL
- ☐ REVIEW
- ☒ INFORMATION

DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT

STANDBY SRU & ADDITIONAL TANKS

IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER

INDIAN OIL CORPORATION LTD.

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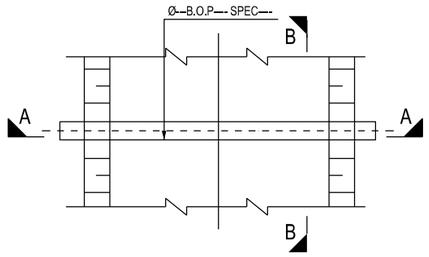
TITLE

CONCRETE CABLE TRENCH
(IN PAVED AREA)

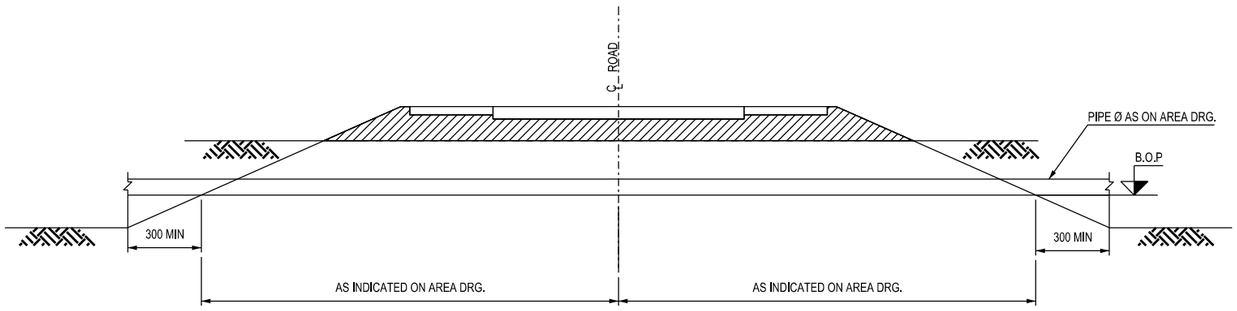
DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	014	1 OF 1	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1490-014_001_A.DGN

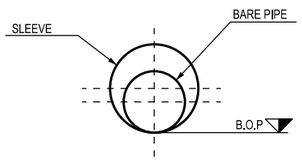
SHEET SIZE : A3



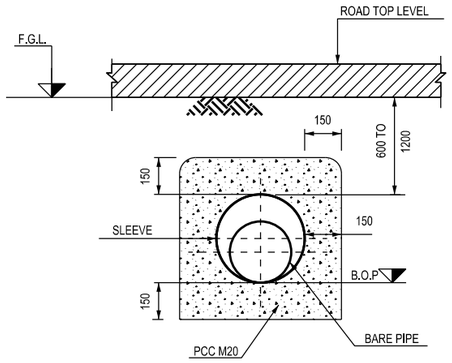
PLAN



SECTION - A A



SECTION B-B
(CASE I-FOR COVER > 1200)
(FOR OSBL ONLY)



SECTION B-B
(CASE II-FOR COVER 600 TO 1200)
(FOR OSBL ONLY)

TABLE OF SLEEVE

BARE PIPE SIZE OR OUTER Ø OF INSULATION IN CASE OF INSULATED PIPE	SLEEVE PIPE SIZE
1"	3"
2"	4"
3"	4"
4"	6"
6"	8"
8"	10"
10"	12"
12"	14"
14"	16"
16"	18"
18"	20"
20"	22"
22"	24"
24"	30"

NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. FOR GENERAL NOTES ON CONCRETE REFER STD. NO 080557C-000-DW-1702-001.

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
A	16-10-2019	IFD	NDR	KRK	JP / KC	JMC

DOCUMENT CATEGORY	DOCUMENT REVIEW STATUS (BY CLIENT)
(USE " X " MARK) ☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT

STANDBY SRU & ADDITIONAL TANKS

IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER

INDIAN OIL CORPORATION LTD.

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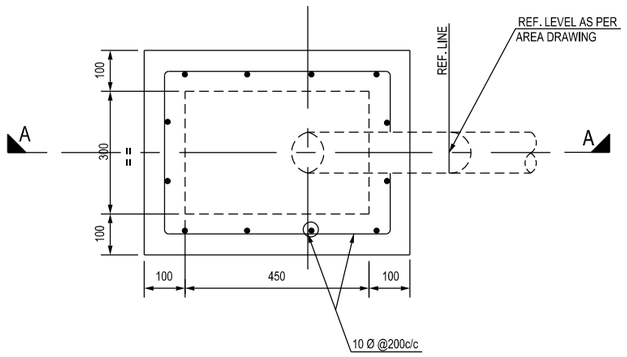
TITLE

PIPE SLEEVE DETAIL

DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	015	1 OF 1	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

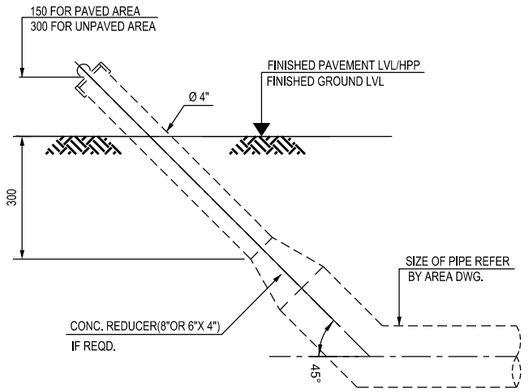
CAD FILE NAME : 080557C-000-STC-1490-015_001_A.DGN

SHEET SIZE : A3

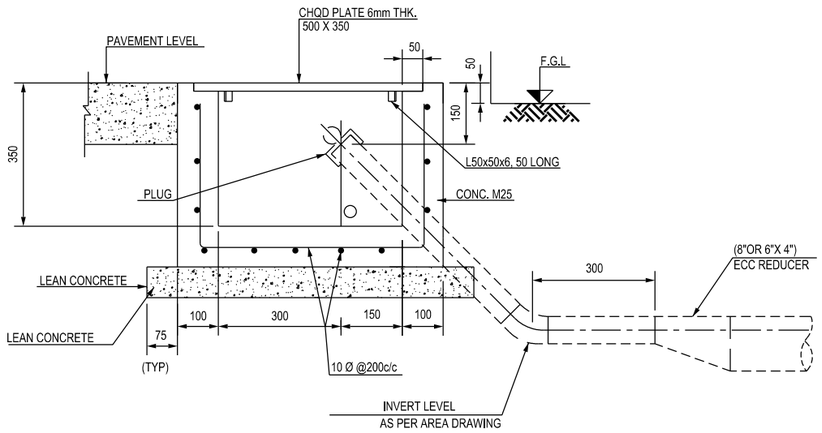


PLAN

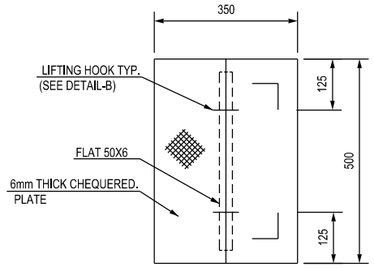
CLEAN OUT (TYPE-I)



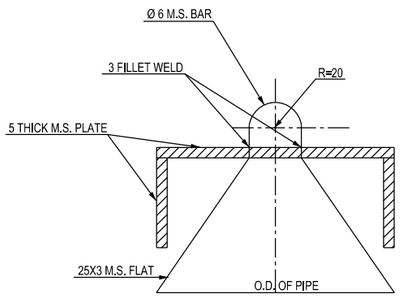
CLEAN OUT (TYPE-II)



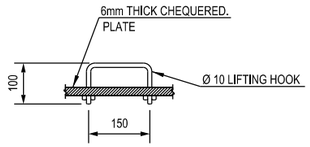
SECTION A-A



PLAN FOR CHEQUERED PLATE



DETAIL OF PLUG

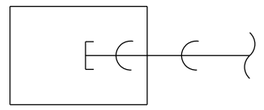


DETAIL-B

14

REPRESENTATION ON

LAYOUT/AREA DRG.



C01

NOTES :-

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. FOR GENERAL NOTES ON CONCRETE WORK REFER DRAWING NO 080557C-000-DW-1702-001.
3. WATER PROOFING COMPOUND SHALL BE MIXED WITH CONCRETE FOR CLEAN OUT.

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
A	16-10-2019	IFD	NDR	KRK	JP / KC	JMC

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT

STANDBY SRU & ADDITIONAL TANKS

IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER

INDIAN OIL CORPORATION LTD.

PMC

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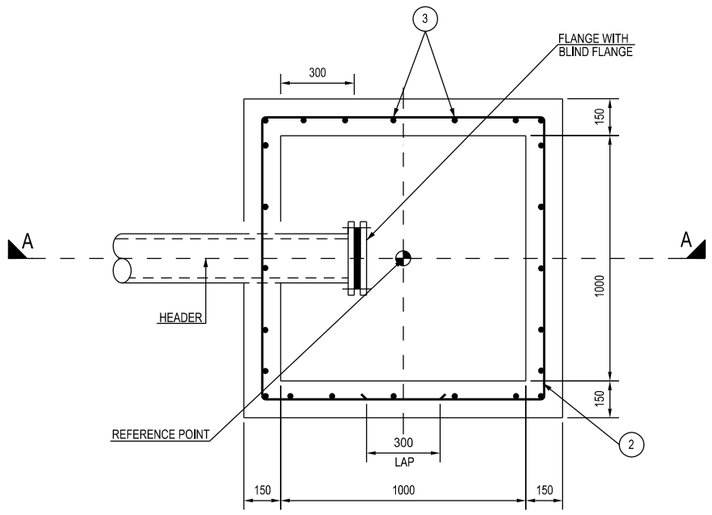
TITLE

STANDARD DETAILS OF CLEAN OUT TYPE-I

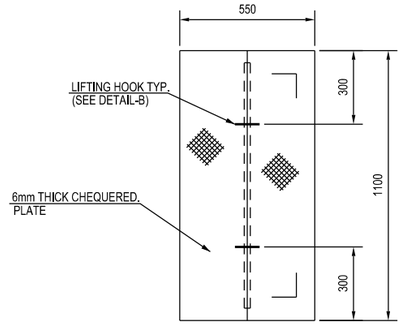
DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	016	1 OF 1	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1490-016_001_A.DGN

SHEET SIZE : A3

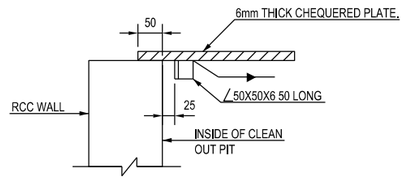


PLAN

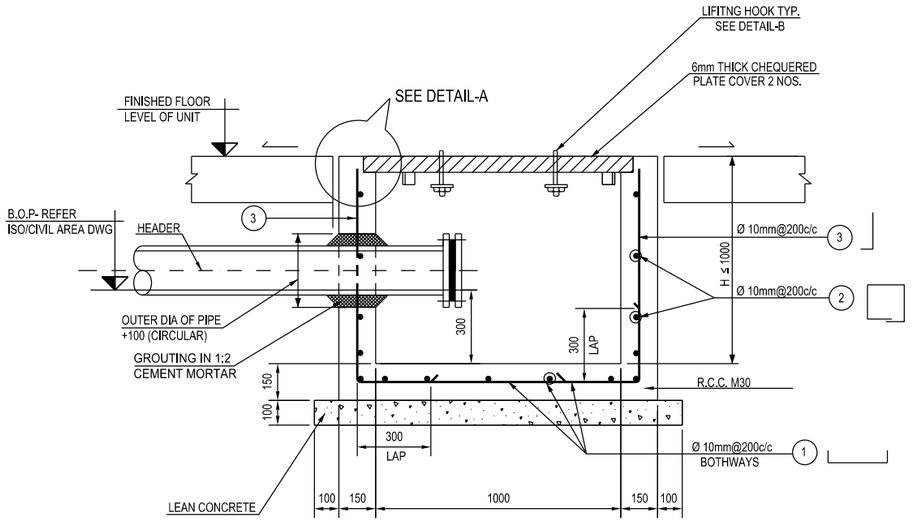


PLAN FOR CHEQUERED PLATE

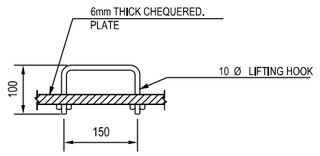
(2,NOS PER PIT)



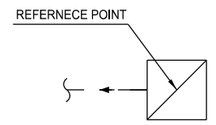
DETAIL - A



SECTION A-A



DETAIL - B



REPRESENTATION ON CIVIL AREA DWG.

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. REFER STRUCTURAL GENERAL NOTES FOR RENIFORCED CONCRETE STRUCTURES FOR FOLLOWING
   a) GRADE OF CONCRETE
   b) GRADE OF TYPE OF CEMENT
   c) GRADE OF REINFORCEMENT STEEL BARS
   d) CLEAR COVER IN RCC WORKS

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
A	16-10-2019	IFD	NDR	KRK	JP / KC	JMC

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT

STANDBY SRU & ADDITIONAL TANKS

IOCL PARADIP REFINERY, ODISHA, INDIA

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INDIAN OIL CORPORATION LTD.

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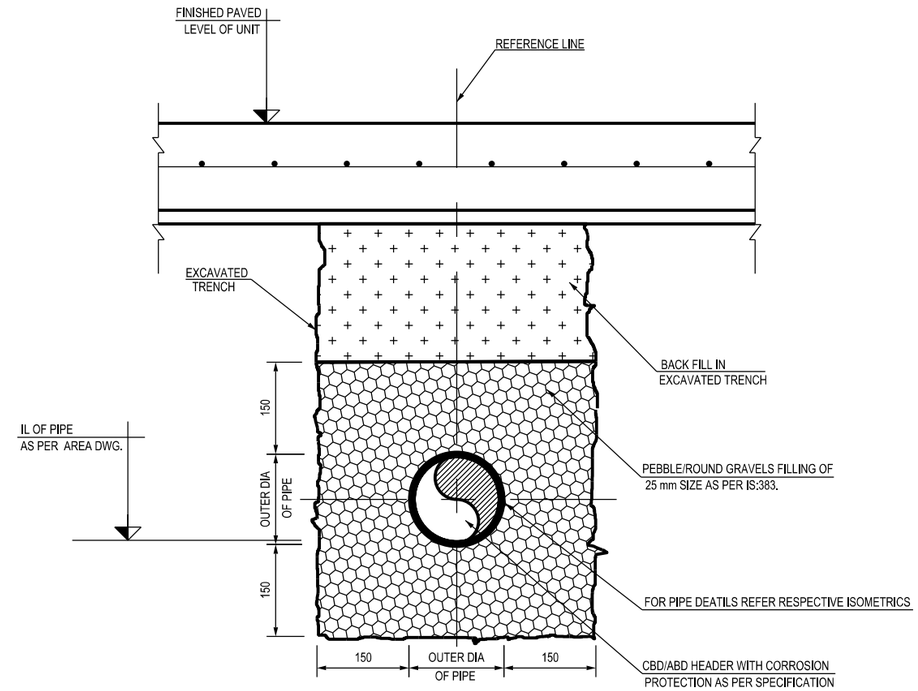
TITLE

STANDARD DETAILS FOR CLEAN OUT TYPE-II

DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	017	1 OF 1	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1490-017_001_A.DGN

SHEET SIZE : A3



CROSS SECTION OF PIPE LAYING DETAIL

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. PEBBLE/ROUND GRAVELS FILLING ALL ROUND THE CBD/ABD PIPE AFTER GIVING NECESSARY CORROSION PROTECTION AS PIPE AFTER GIVING NECESSARY CORROSION PROTECTION AS PER SPECIFICATIONS,SHALL BE ENSURED ON HORIZONTAL AS WELL AS VERTICAL BRANCH LINE/RISER POINTS UPTO AS WELL AS VERTICAL BRANCH LINE/RISER POINTS UPTO THE BOTTOM OF RCC PAVEMENT.
3. REFER STRUCTURAL GENERAL NOTES 080557C-000-DW-1702-001 FOR RENIFORCED CONCRETE STRUCTURES FOR FOLLOWING
a) GRADE OF CONCRETE
b) GRADE OF TYPE OF CEMENT
c) GRADE OF REINFORCEMENT STEEL BARS
d) CLEAR COVER IN RCC WORKS

Rev	Date DD-MM-YYYY	Description of Issue	Written By	Checked by	Approved by	Authorized by
A	16-10-2019	IFD	NDR	KRK	JP / KC	JMC

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT

STANDBY SRU & ADDITIONAL TANKS

IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER

IndianOil — INDIAN OIL CORPORATION LTD.

PMC

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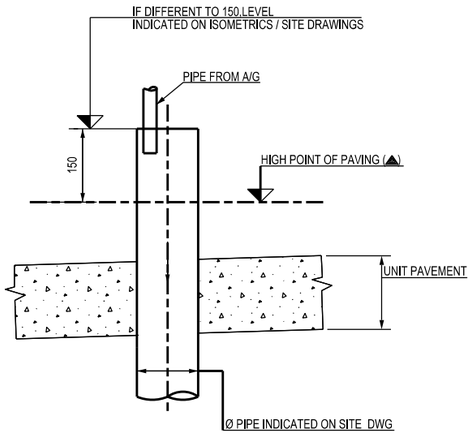
TITLE

STANDARD DETAILS OF LAYING ABD & CBD NETWORKS

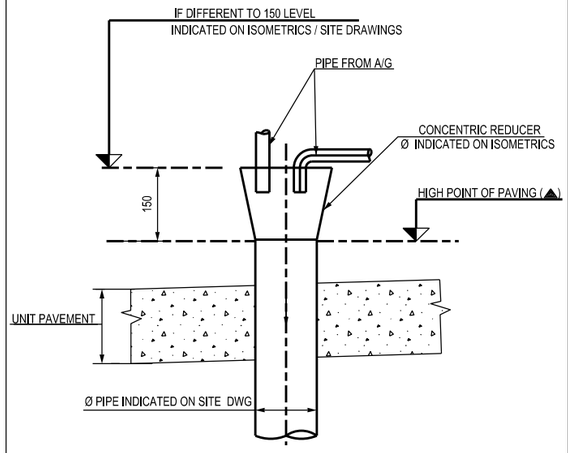
DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	018	1 OF 1	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1490-018_001_A.DGN

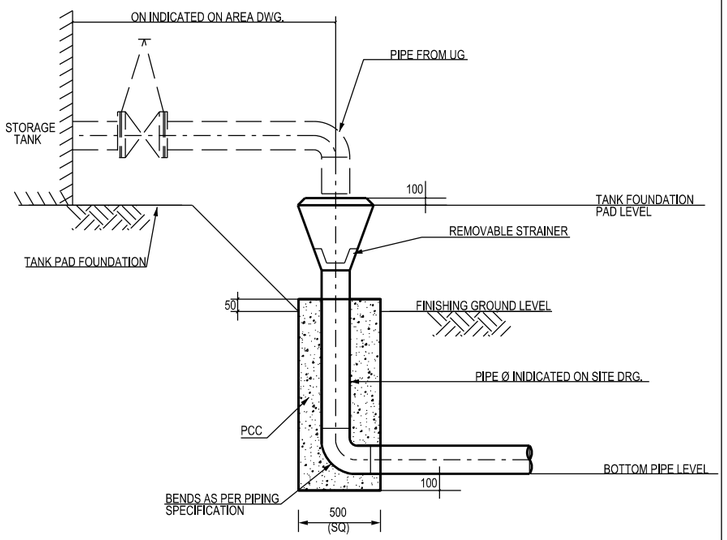
SHEET SIZE : A3



TYPE A



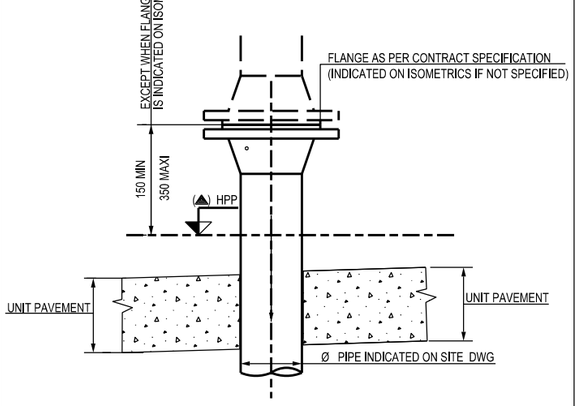
TYPE B



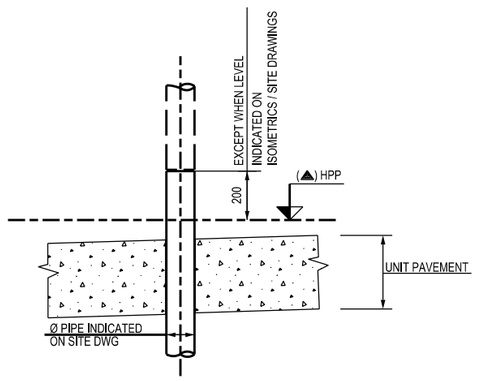
INSTALLATION DETAILS OF CLOSE TO STORAGE TANK

NOTES :

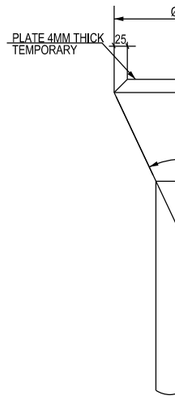
1. FOR ALL PIPING DETAILS REFER ISOMETRICS.
2. FOR PIPING CLASS REFER AREA DRAWING.



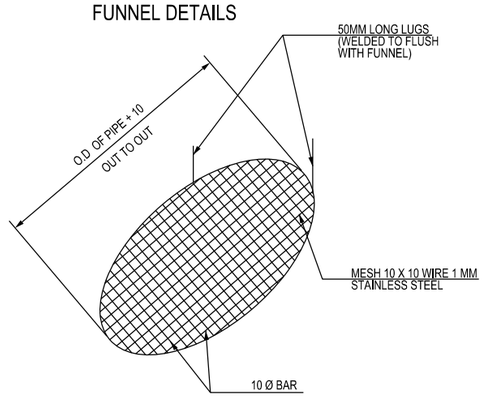
TYPE C



TYPE D

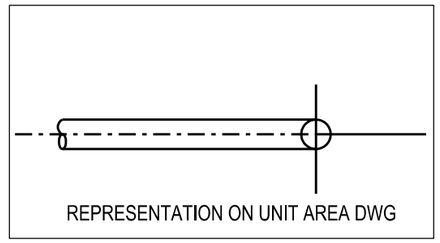


FUNNEL DETAILS



STRAINER

TYPE E



REPRESENTATION ON UNIT AREA DWG

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
B	19-12-2019	IFD	NDR	KRK	JP / KC	JMC
A	16-10-2019	IFD	NDR	KRK	JP / KC	JMC

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT

STANDBY SRU & ADDITIONAL TANKS

IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER

INDIAN OIL CORPORATION LTD.

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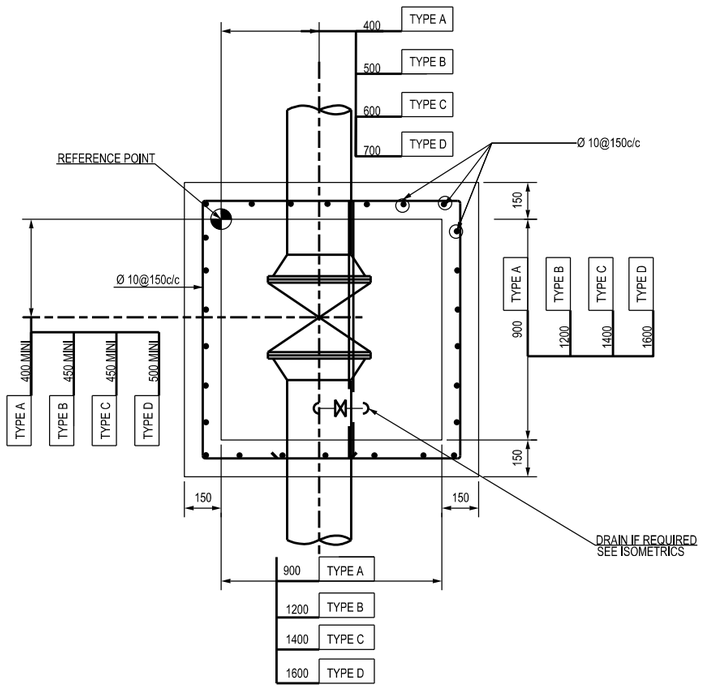
TITLE

STANDARD DETAIL FOR DRAIN FUNNELS

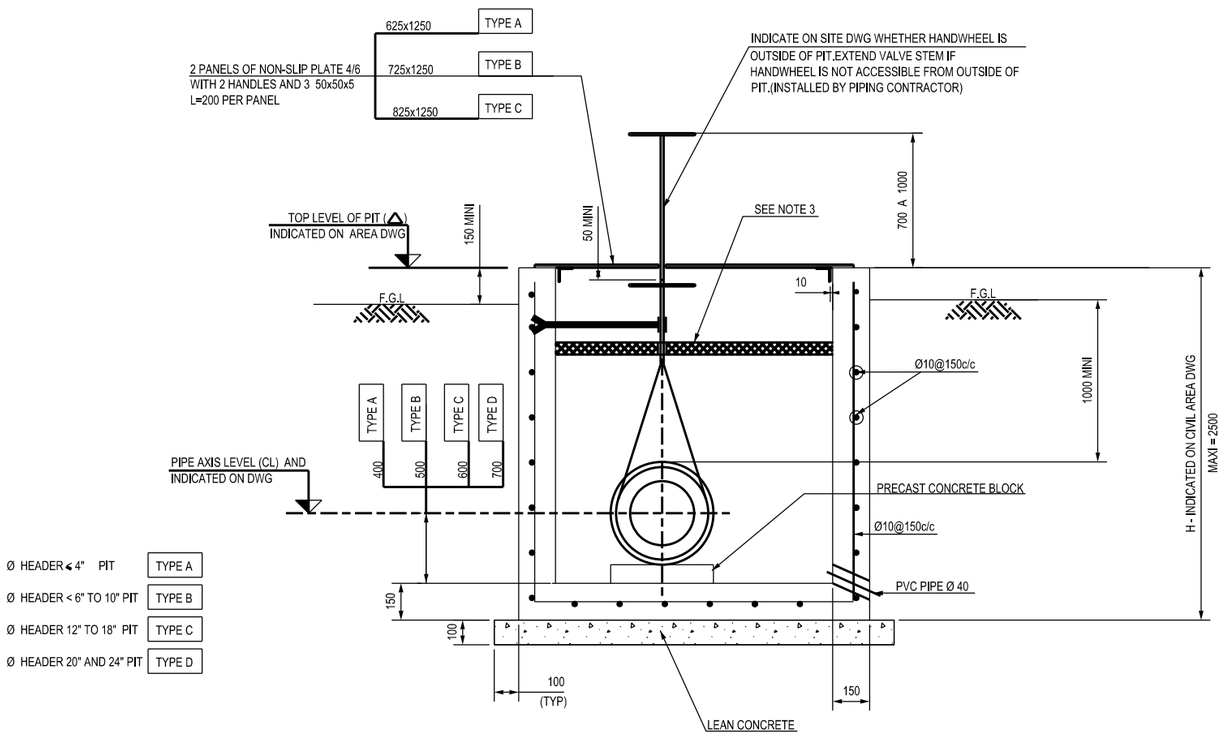
DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	019	1 OF 1	B
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1490-019_001_B.DGN

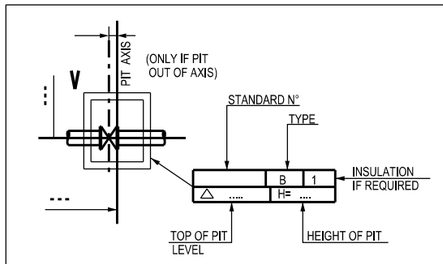
SHEET SIZE : A3



PLAN



SECTION



REPRESENTATION ON AREA DWG.

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. THESE VALVE PITS WILL USUALLY BE INSTALLED FOR FIRE WATER AND AROUND BUILDINGS FOR DRINKING WATER,SERVICE WATER,STEAM, ETC...SUPPLY
3. INSULATION IF REQUIRED (DUE TO CLIMATIC CONDITIONS) POLYURETHANE FOAM OR SIMILAR.
4. LARGE VALVE PITS OR PITS FITTED WITH RUNGS,OR A SPECIAL DESIGN, WILL BE DETAILED ON CONTRACT DWGS.
5. FOR EXTERNAL HANDWHEEL,COVER DETAILS FOR FLOOR-STAND PASSAGE AND FIXATION WILL ALSO BE DETAILED.
6. IF USING OF GRE MATERIAL , IT WILL BE PROVIDED A SLEEVE IN CONCRETE WALL FOR PIPE CROSSING AND SUPPORT UNDER VALVE OR ON CONCRETE WALL

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
A	16-10-2019	IFD	NDR	KRK	JP / KC	JMC

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT

STANDBY SRU & ADDITIONAL TANKS

IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER

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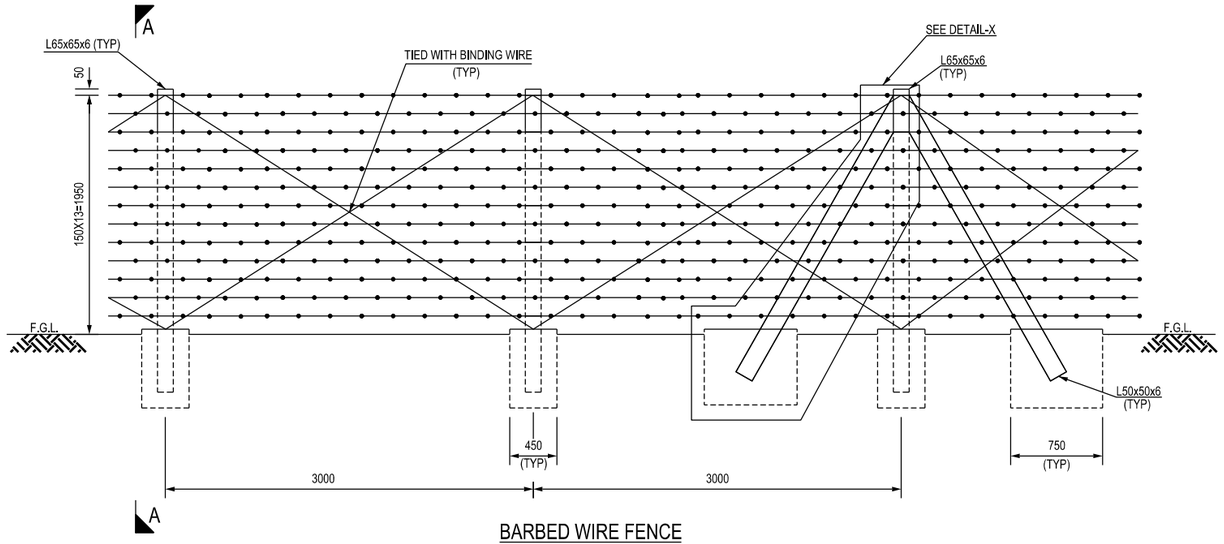
GRAVITY AND PRESSURIZED SYSTEMS STANDARD VALVE PITS

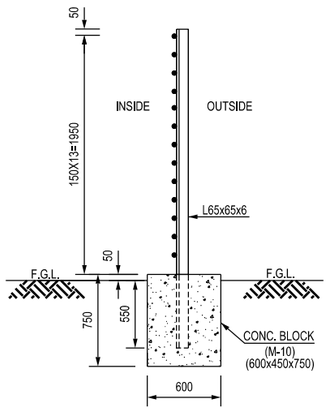
DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	020	1 OF 1	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1490-020_001_A.DGN

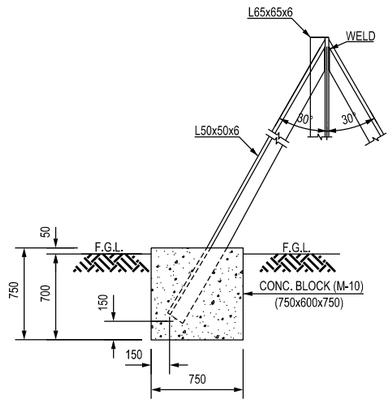
SHEET SIZE : A3



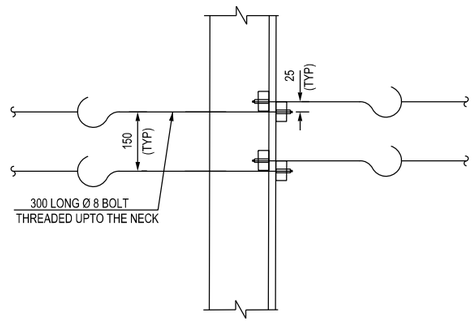
BARBED WIRE FENCE
(OUTSIDE)



SECTION ELEVATION-AA



DETAIL-X



FIXING DETAIL OF STRAINING
BOLT WITH POST

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. THE GALVANIZED STEEL BARBED WIRE DESIGNATED AS STEEL BARBED WIRE A-1 TO IS:278 SHALL HAVE LINE WIRE OF Ø 2.5MM, POINT WIRE OF Ø 20MM & MINIMUM WEIGHT OF COMPLETE BARBED WIRE SHALL BE 108gm/m WITH 75MM DISTANCE BETWEEN TWO BARBS.
3. LINE POST SHALL BE PLACED AT 3.0M C/C.
4. STRUT SHALL BE PROVIDED AT EVERY 15 th POST ON BOTH SIDE & END POST ON ONE SIDE.
5. STRAINING BOLTS SHALL BE PROVIDED AT THE END POST & AT PLACES AS DIRECTED BE ENGINEER INCHARGE.
6. EXPOSED FOUNDATION BLOCK AT GROUT LEVEL SHALL BE FINISHED SMOOTH IN CEMENT MORTAR 1:6.
7. GALVANIZED BARBED WIRE SHALL BE TIED TO THE ANGLE IRON POST EITHER WITH WELDED M.S. NIBS OR WITH G.I. WIRE THROUGH HOLES IN THE POST.

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
			Written By	Checked By	Approved By	
A	16-10-2019	IFD	NDR	KRK	JP / KC	JMC

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT

STANDBY SRU & ADDITIONAL TANKS

IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER

INDIAN OIL CORPORATION LTD.

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TITLE

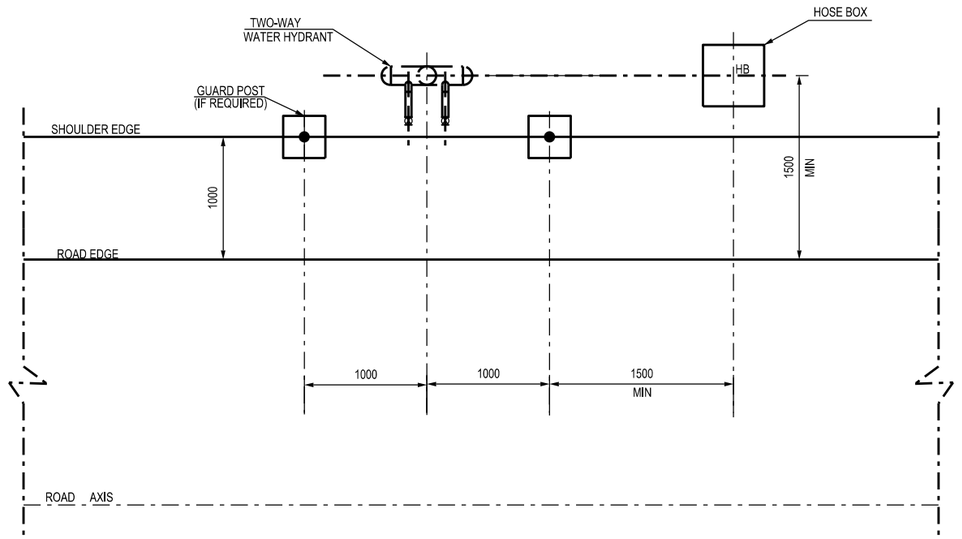
STANDARD DETAIL OF BARBED WIRE FENCING (WITH ANGLE IRON POST)

DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	021	1 OF 1	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

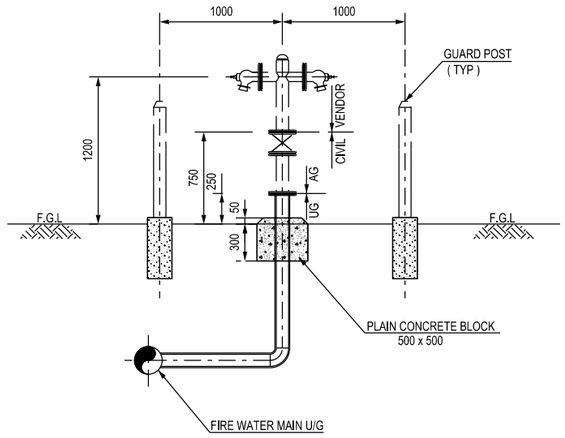
REPRESENTATION ON UNIT AREA DWG

CAD FILE NAME : 080557C-000-STC-1490-021_001_A.DGN

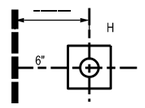
SHEET SIZE : A3



TYPICAL INSTALLATION OF TWO-WAY WITH HOSE BOX



TYPICAL ELEVATION OF TWO-WAY HYDRANT
(FOR UNDER GROUND PIPING)



REPRESENTATION ON CIVIL AREA DRAWING

NOTES

1. REFERENCE TO THIS STANDARD WILL NOT BE MADE ON AREA DRAWING FOR EACH HYDRANT. IT WILL BE INDICATED BY A GENERAL NOTE OR INDICATED ON REFERENCE DRAWINGS.
2. WHERE THE SOIL IS IMPERVIOUS PROVISION SHOULD BE MADE FOR PROMPT REMOVAL OF WATER ORIGINATING FROM LEAKS AND DRAINS AND RETAINED AROUND THE DRAIN VALVE DISCHARGE (TO THE OILY WATER SEWER FOR INSTANCE). THE SYSTEM SHALL BE DESIGNED ON THE BASIS OF THE SPECIFIC CONDITIONS OF THE SITE ESPECIALLY IN COLD COUNTRIES SO AS TO PREVENT FREEZING OF THE WHOLE FIRE SYSTEM.
3. FOR ALL PIPING DETAILS SEE ISOMETRICS

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
A	16-10-2019	IFD	NDR	KRK	JP / KC	JMC

DOCUMENT CATEGORY (USE " X " MARK)

- ☐ APPROVAL
- ☐ REVIEW
- ☒ INFORMATION

DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT

STANDBY SRU & ADDITIONAL TANKS

IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER

INDIAN OIL CORPORATION LTD.

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TITLE

FIRE SYSTEM
HYDRANT-TYPICAL INSTALLATION

DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	022	1 OF 1	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1490-022_001_A.DGN

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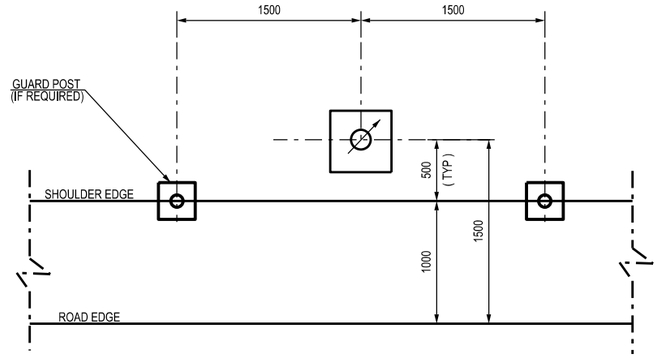
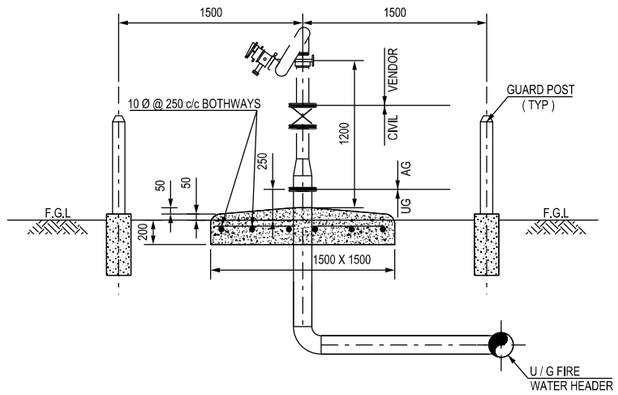
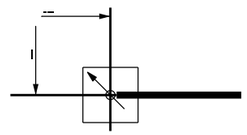




TYPICAL INSTALLATION OF WATER CUM FOAM MONITOR



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STANDBY SRU & ADDITIONAL TANKS

IOCL PARADIP REFINERY, ODISHA, INDIA

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TITLE

FIRE SYSTEM
WATER CUM FOAM MONITOR

DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	023	1 OF 1	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

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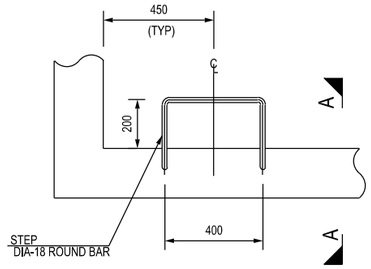

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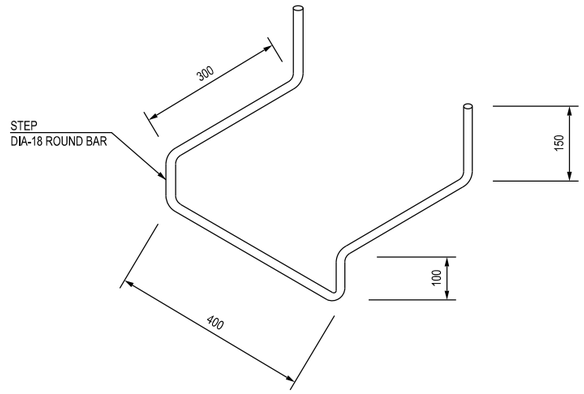

ISOMETRIC VIEW

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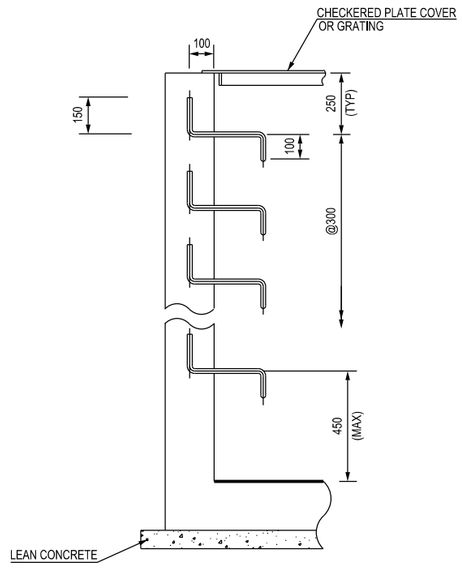
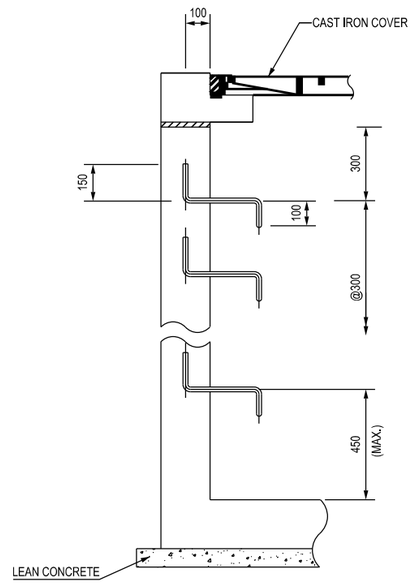


FOR CHECKERED PLATE COVER
OR GRATING COVER



FOR CAST IRON COVER

SECTION A-A

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
A	16-10-2019	IFD	NDR	KRK	JP / KC	JMC

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT

STANDBY SRU & ADDITIONAL TANKS

IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER

INDIAN OIL CORPORATION LTD.

PMC

TechnipFMC

TITLE

RUNGS FOR MANHOLE, CATCH BASIN AND VALVE PITS

DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	024	1 OF 1	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1490-024_001_A.DGN

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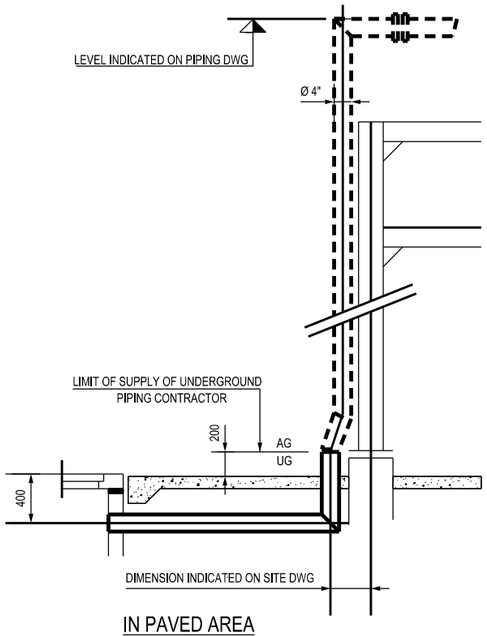

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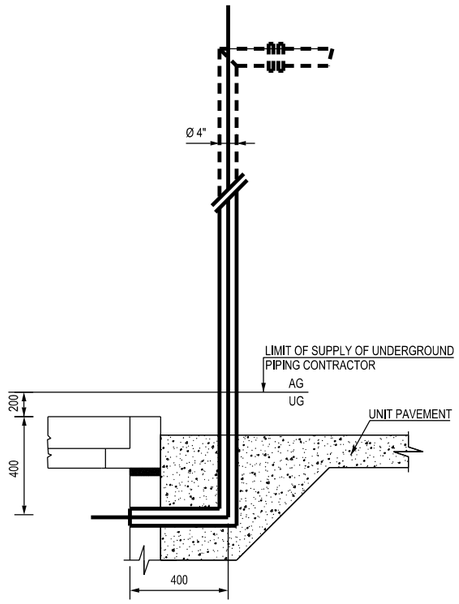

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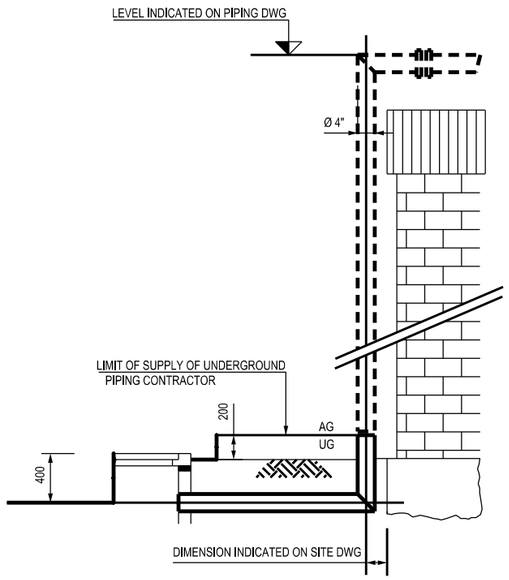

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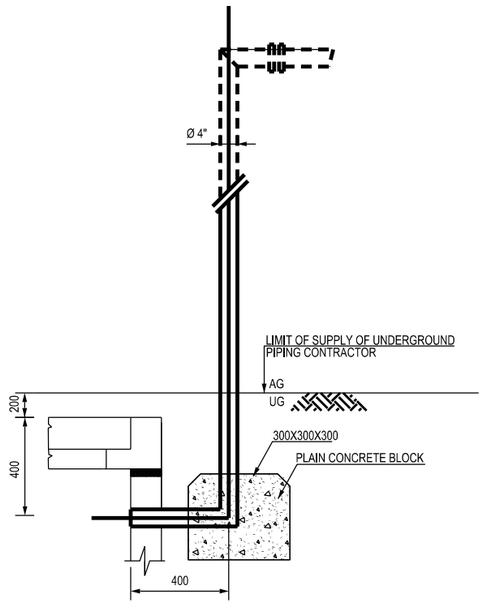
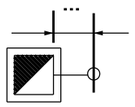
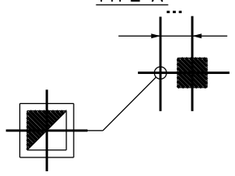


IN UNPAVED AREA
TYPE - B

VENTS IN OFFSITES AREA
ISOLATED MANHOLES TYPE "B"



VENTS IN ON-SITE AREAS
TYPE "A"



REPRESENTATION ON CIVIL AREA DWG

NOTES:

FOR ALL PIPING DETAILS SEE ISOMETRICS OR PIPING DRAWINGS.

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PROJECT

STANDBY SRU & ADDITIONAL TANKS

IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER

INDIAN OIL CORPORATION LTD.

IndianOil

PMC

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TITLE

VENTS FOR MANHOLES

DRAWING NO.						PAGE	REV.
SCALE	080557C	000	STC	1490	025	1 OF 1	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1490-025_001_A.DGN

SHEET SIZE : A3

SPECIFICATION
FOR
MASONRY WORKS

REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED	AUTHORIZED
			Written By: Umasankar Sundarajan 2019.11.08 11:26:11 +05'30'	Checked By: Rameshkumar Kalyanasundaram 2019.11.08 14:37:27 +05'30'	Approved By: Jayaprakash Jayaraman 2019.11.08 15:06:32 +05'30'	Authorized By: Morischristopher Jesumarian 2019.11.09 11:45:03 +05'30'
B	08-11-2019	Issued For Design	SUR	KRK	JP / KC	JMC
A	29-10-2019	Issued For Design	SUR	KRK	JP / KC	JMC

TABLE OF CONTENTS

1. INTRODUCTION

INDIAN OIL CORPORATION LIMITED (IOCL) has awarded Fax of Acceptance (FOA) dated 29th August 2019 to M/s. Technip India Limited (TPIL) for Consultancy services (PMC/EPCM services) for overall project management, FEED Review / FEED, Detailed Engineering, Procurement & expediting services, Tendering & award, Construction Management & Supervision, Assistance in start-up, Commissioning & performance test runs for installation of a Standby SRU of 525 TPD capacity and execution of Additional tanks for Paradip Refinery, Odisha, India.

2. DEFINITIONS & ABBREVIATIONS

Abbreviation	Definition /Expanded form
IOCL/ CLIENT	Indian Oil Corporation Limited
PMC/ CONSULTANT	Technip India Limited
LICENSOR	Party selected by IOCL for process technology ownership for any UNIT
CONTRACTOR	Party whose services are obtained for performing the works specified as part of LSTK / packages.
EPCM	Engineering, Procurement & Construction Management Services.
LSTK	Lump Sum Turn Key portion of the work to be executed by CONTRACTOR
FEED	Front End Engineering Design
AUTHORISED REPRESENTATIVE	IOCL's/ CONSULTANT's representative authorized to act for and on behalf of them.
VENDOR	Any third party supplying the equipment/materials for setting up the Plant
PROJECT	Indicates Standby SRU and Additional tanks Project, Paradip Refinery
SITE	Indicates Paradip Refinery in Odisha, India
UNIT	Indicates any particular portion of the project to be built which can be Process related or Utilities/Offsites related
SRU	Sulphur Recovery Unit
BIS	Bureau of Indian Standards

3. SCOPE

This specification covers the requirement for material, laying, jointing, curing, testing etc for brick masonry, stone masonry work, laterite block work, concrete block work and pitching.

This JSS covers typical General specification for some standard items only and the CONTRACTOR shall comply with the requirement as given in 080557C-000-JSD-1700-001/002 for specific cases and for any other items not mentioned/specified in this JSS. The requirement for various type of Buildings /Unit / Structures etc., as specified in the document 080557C-000-JSD-1700-001/002 shall be the governing one.

The CONTRACTOR shall submit the detailed specification for the items not covered in this specification for Approval by OWNER'S/ENGINEER IN CHARGE during execution.

4. APPLICABLE CODES

The Indian Standard codes applicable to this section shall include but not limited to the following:

- IS 1077 : Common burnt clay building bricks.
- IS 1121 (Part 1) : Methods of test for determination of strength properties of natural building stones – Compressive Strength.
- IS 1123 : Method of identification of natural building stones.
- IS 1124 : Method of test for determination of water absorption, apparent specific gravity and porosity of natural buildings stones.
- IS 1127 : Recommendations for dimensions and workmanship of Natural building stones for masonry work.
- IS 1129 : Recommendations for dressing of natural building stones.
- IS 1542 : Sand for Plaster.
- IS 1597 : Code of practice for construction of stone masonry.
  - Part-1 – Rubble Stone Masonry.
  - Part-2 – Ashlar Masonry.
- IS 1905 : Code of practice for structural use of un-reinforced masonry.
- IS 2116 : Sand for masonry mortars.
- IS 2180 : Heavy duty Burnt clay building bricks.
- IS 2212 : Code of practice for brickwork.
- IS 2250 : Code of practice for preparation and use of masonry mortars.
- IS 2386 : Methods of test for aggregates for concrete. (Part 1 to Part 8).

- ♦ IS 2430 : Methods of sampling of aggregates for concrete.
- ♦ IS 3495 : Method of test for burnt clay building bricks.
- ♦ IS 3620 : Specification for Laterite Stone Block for Masonry.
- ♦ IS 4082 : Recommendations Stacking and storage of construction materials and components at Site.
- ♦ IS 5454 : Methods of sampling of clay building bricks.

5. PRIORITY OF REQUIREMENTS

In case of any variation and discrepancy in condition between the special conditions, this specification and codes, order of priority shall be as under: -

1) Special conditions
2) This specification
3) Codes

6. MATERIALS

6.1 Cement

Cement used for all concrete works both above and below ground should be 43 grade or 53 grade Ordinary Portland cement conforming to IS: 8112 and /or Portland pozzolana cement (PPC, fly ash based) conforming to IS: 1489 Part-1 and/ or Portland Pozzolana Cement (PPC, Calcined clay based) conforming to IS: 1489 Part-2 and/ or Portland slag cement (PSC) conforming to IS: 455 and/ or Sulphate resisting Portland Cement (SRC) conforming to IS: 12330.

6.2 Sand

6.2.1 The sand shall consist of natural sand, crushed stone sand, crushed gravel sand or combination of any of these. The sand shall be hard, durable, clean, free from adherent coatings and organic matter and shall not contain the amount of clay, silt and fine dust more than specified in IS 2116.

6.2.2 The sand shall not contain any harmful impurities such as iron pyrites, alkalis, salts, coal or other organic impurities, mica, shale or similar laminated materials, soft, fragments, sea shells in such form or in such quantities as to affect adversely the hardening, strength or durability of the mortar.

6.2.3 The maximum quantities of clay, fine silt, fine dust and organic impurities in the sand, when tested in accordance with IS 2386, shall not be more than 5% by mass in natural sand, crushed gravel sand or crushed stone sand, unless specified otherwise. For organic impurities, when determined in accordance with IS 2386, colour of the liquid shall be lighter than that indicated by the standard solution specified in IS 2386.

6.2.4 Grading of Sand

Grading of sand for masonry works shall conform to "Specification for Materials - Civil & Structural Works", No. 080557C-000-JSS-1700-005.

6.2.5 Sampling and Testing

The method of sampling shall be in accordance with IS: 2430. The amount of material required for each test shall be as specified in relevant parts of IS: 2386. Any test which the OWNER'S / ENGINEER IN CHARGE may require in connection with this shall be carried out in accordance with the relevant parts of IS: 2386.

If further confirmation as to the satisfactory nature of the material is required, compressive test on cement mortar cubes (1:6) shall be made in accordance with IS: 2250 as instructed by the OWNER'S / ENGINEER IN CHARGE. These tests shall be performed, by using the supplied material in place of standard sand and the strength value so, obtained shall be compared with that of another mortar made with a sand of acceptable and comparable quality.

6.3 Water

Water for masonry works shall conform to "Specification for Materials - Civil & Structural Works", No. 080557C-000-JSS-1700-005.

6.4 Bricks

6.4.1 General

Bricks for masonry works shall conform to IS 1077 with minimum compressive strength of 70 kg/cm^2. If locally available bricks are used they shall not be less than 70 kg/cm^2 compressive strength. Specific requirement for any other class of bricks shall be as shown in drawings or as described in the contract for a particular type of work. Physical requirements, quality, dimensions, tolerances, etc of common burnt clay building bricks shall conform to the requirements of IS:1077.

Bricks shall be hand moulded or machine moulded and shall be made from suitable soils. The bricks shall have smooth rectangular faces with sharp corners and shall be well burnt, sound, hard, tough and uniform in colour. These shall be free from cracks, chips, flaws, stone or humps of any kind. Bricks shall give a clean ringing sound when struck. These shall have plane rectangular faces with parallel sides and sharp straight right angle edges.

6.4.2 Tests after delivery

The CONTRACTOR shall take samples of each type of brick as directed by the OWNER'S / ENGINEER IN CHARGE as per the requirements of IS: 5454 and tests shall be carried out as per IS:3495. The cost for carrying out any or all the tests shall be borne by the CONTRACTOR. The bricks, when tested, as per IS: 3495 shall have a minimum average compressive strength as given in the code for a particular class of brick. Water absorption shall not be more than 20% by its dry weight, when soaked in cold water for 24hours. Brick samples so approved, shall be deposited with the OWNER'S / ENGINEER IN CHARGE. All subsequent deliveries shall be upto the standards of the approved samples.

6.4.3 Stacking of Bricks

Bricks shall be stored at site as per the requirements given in IS: 4082 and shall not be dumped at site. They shall be unloaded from trucks to a place on a levelled surface near to the work site. They shall be stacked in regular tiers even as they are unloaded, to minimize breakages and defacement of bricks. Bricks of different class shall be stacked separately.

6.4.4 Local Bricks

Where shown on drawings, locally available bricks of non-modular size (230mmx115mmx75mm) in place of bricks of modular size (190mmx90mmx90mm) may be used in case the bricks satisfy the other requirements of IS: 1077.

6.5 Stones

6.5.1 General

All Stones used for masonry works shall conform to the requirements of IS: 1123, IS: 1127, IS:1129.

6.5.2 Quality of Stones

Stones shall be of approved quality, hard, dense, strong, sound, durable, clean and uniform in colour. They shall also be free from veins, adherent coatings, injurious amount of alkalis, vegetable matters and other deleterious substances such as iron pyrites, coal, lignite, mica, sea shells etc. Unless otherwise approved by OWNER'S / ENGINEER IN CHARGE, stones from one single quarry shall be used for any one work. The strength of stones adequate to carry the imposed load and shall meet all the requirements of IS 1905, taking into account the appropriate crushing strength of stone and type of the mortar used. The percentage of water absorption, when tested in accordance with IS: 1124, shall not exceed 5 percent.

6.5.3 Unloading/ Stacking

The stones shall be unloaded from the trucks to a site near to the place of work as defined in IS 4082 and shall be stacked on a firm ground having adequate slope for drainage.

7. CEMENT MORTAR

7.1 Cement mortar shall be prepared in accordance with IS: 2250.

7.2 Cement mortar shall be prepared by mixing cement, sand and water in specified proportions. The mortar shall be used as soon as possible after mixing and before it has begun to set and in any case within 30 minutes after the water is added to the dry mixtures. Mortar unused for more than 30 minutes shall be rejected and removed from the site of work.

7.2.1 Proportioning

The unit of measurement for cement shall be a bag of cement weighing 50kgs and this shall be taken as 0.035m3. Sand in specified proportion shall be measured in boxes of suitable size. It shall be measured on the basis of its dry volume. In case of damp sand its quantity shall be increased suitably to allow for bulkage.

Unless otherwise specified, the cement mortar proportion shall be as follows:

Sr.No.	Thickness of Masonry Work	Cement Sand Proportion
1.	115mm thick brickwork, hollow concrete block work	1:4
2.	230mm thick brickwork, solid concrete block work, stone masonry work.	1:6

7.2.2 Mixing

The mixing of mortar shall be done in mechanical mixer operated manually or by power. The OWNER'S / ENGINEER IN CHARGE may, however, relax this condition at his discretion, taking into account the nature and location of work, practicability of the use of these machines. For items, where the mixers are not to be used, the CONTRACTOR shall take the approval of the OWNER'S / ENGINEER IN CHARGE before the commencement of work.

1) Mixing in Mechanical Mixer

Cement and sand in specified proportions shall be mixed dry thoroughly in a mixer. Water shall then be added gradually and wet mixing continued for at least one minute. Care shall be taken not to add more water than that which shall bring the mortar to the consistency of a stiff paste. Only the quantity of mortar which can be used within 30 minutes of its mixing shall be prepared at a time.

Mixer shall be cleaned with water each time before suspending the work.

2) Hand Mixing

The measured quantity of sand shall be levelled on clean water tight platform, and cement bags emptied on top. The cement and sand shall be thoroughly mixed dry by being turned over and over, backward and forward, several times till the mixture is of a uniform colour. The quantity of dry mix which can be used within 30 minutes shall then be mixed with just sufficient quantity of water to bring the mortar to the consistency of a stiff paste.

8. CONSTRUCTION OF BRICK MASONRY

8.1 Soaking of bricks

Bricks shall be thoroughly soaked in clean water before use until air bubbles cease to come out. The soaked bricks shall be kept on suitable platform to avoid earth being smeared on them. The practice of dipping the bricks in water just before use shall not be allowed. All necessary water cisterns for this purpose shall be constructed or tubs brought by the contractor shall be to the satisfaction of the OWNER'S / ENGINEER IN CHARGE to ensure proper soaking of bricks.

8.2 Laying

1) All masonry work shall comply with the requirements of IS: 2212 and shall be laid in English bond unless otherwise specified.

2) No half or broken bricks shall be used, except as closures. No under burnt or overburnt bricks shall

be used.

3) Bricks shall be laid with frog upwards. While laying, bricks shall be thoroughly bedded and flushed in mortar. They shall be tapped into position with a mallet and the superfluous mortar removed.

4) Each brick shall be adjusted to its final position in the wall, while the mortar is still soft and plastic. Any unit which is disturbed after mortar has stiffed, shall be removed and re-laid with fresh mortar.

5) All courses shall be laid truly horizontal and all vertical joints shall be truly vertical.

6) The levels and verticality of the brick work in walls shall be checked up at every 1m interval. Masonry work shall be raised in a uniform manner, so that no one portion is being raised more than 1m above another portion, at one time.

7) At the junction of any two walls, the brick shall, at each alternate course, be carried into each of the respective walls so as to thoroughly unite the work.

8) Masonry work, if unfinished shall be stepped back for joining with new work. Toothing may be resorted to only if specifically approved. Before the new work is started, all loose mortar shall be removed and the exposed joints thoroughly cleaned, before the laying of new work.

9) Spaces around metal door frames and other built up items shall be solidly filled with mortar. Anchors, wall plugs, accessories, flashings and other items required to be built in with masonry shall be provided in the walls, as the work progresses. Iron holdfasts shall be given a coating of Bitumen to avoid rusting.

8.3 Jointing

1) All horizontal bed joints shall be 10mm thick and the vertical joints 6mm wide.

2) The vertical joints in alternate courses shall come directly one above the other and shall be truly vertical.

3) Care shall be taken that all joints are fully mortared, well flushed up and in case where no pointing is to be done, neatly struck as the work proceeds.

4) The joints in faces which are to be plastered or pointed shall be squarely raked out, to a depth of 12mm, while the mortar is still green.

5) All raked out joints shall be well brushed to remove loose particles. After the work, the faces of the brick work shall be cleaned with wire brush and all mortar droppings removed.

8.4 Half Brick Walls

These walls shall be provided a horizontal reinforced concrete band (M15). The band shall be provided at every fourth course and shall consist of 2 nos. of 8mm tor steel bars with 3mm binders spaced at 150mm centers. Such bands shall also be provided at the free edge of all masonry work including window sills and top of free standing walls.

The walls shall be provided with reinforced concrete posts (M15), of size 230mmx115mm at every 3m and at corners. These posts shall have 4nos. of 8mm vertical tor steel bars with 8mm rings spaced at 150mm centers.

The partition walls shall be constructed in two stages. In the first stage, the brick work with horizontal bands shall be constructed, leaving the gaps for vertical posts, which shall be concreted in the second stage.

8.5 Curing:

Green work shall be protected from rain by suitable covering. Masonry work as it progresses shall be kept thoroughly well-watered on all faces for at least 7 days. Curing shall start commencing 24 hours after laying.

8.6 Tolerances:

The permissible tolerance in brickwork as per IS 1905 shall be as follows:

Sr. No.	Item	Tolerance (Not more than)
1	Deviation from position shown on plan of any brick work.	12.5mm
2	Deviation from vertical within a storey.	6mm per 3m height
3	Deviation from vertical in total height of building.	12.5mm
4	Relative displacement between load bearing walls in adjacent storeys and intended to be in vertical alignment.	6mm
5	Deviation from line in plan upto 12m.	6mm
6	Deviation from line in plan over 12m.	10mm (total)
7	Deviation of bed joint from horizontal	
	In any length upto 12m	6mm
	In any length over 12m	12mm (total)

9. CONSTRUCTION OF STONE MASONRY

9.1 Stone

1) Stone masonry, wherever required shall conform to the requirements of IS: 1597 and shall be composed generally of large stones.
2) The stones shall be roughly dressed and uniform in colour and of equal in size on the face. The face stone shall be flat beaded, shall tail back and bound well into body of the wall and shall not be of height greater than either the breadth on face or length of the tail.
3) Face stones shall be hammer and chissel dressed on all beds and joints so as to give them approximately rectangular shape. These shall be square on all joints and bed faces. The bed joints faces shall be chisel drafted for at least 80mm back from the face and for the side joint faces for at least 40mm. No portion of the dressed surface shall show a gap more than 6mm from straight edge placed on it. The remaining unexposed portion of the stone shall not project

beyond the surface of bed and side joints.

4) Through stones covering the whole width of walls or 600mm long, where the walls are thicker Than 600mm, shall be inserted at every 800mm measured horizontally and vertically.

5) If the wall is more than 600mm thick, a line of headers, shall be laid from face to back, which shall overlap each other, by at least 150mm.

6) The stones shall be clean bedded, properly selected for their places and carefully laid with a suitable proportion of smaller stones and chips, to fill up the interstices. The mortar including the constituents shall conform to the requirements of IS: 2250.

7) The whole masonry shall be hand set, solidly bedded and surrounded with mortar on every side except the face.

8) There shall be no hollows or dry portions in work or pinning on the face.

9) Joints shall not exceed 25mm in thickness.

10) The masonry work as far as possible shall be carried up, at one uniform level throughout. Where breaks are unavailable, the joint shall be made in long steps, so as to prevent cracks arising between the new and old work.

11) The stones shall be arranged to break joints as far as possible. Long vertical lines shall be avoided in the face work.

12) All fixtures, plugs, frames shall be placed securely as the work proceeds and not after **c**ompletion of the masonry. Iron holdfasts shall be given a coating of Bitumen to avoid rusting.

9.2 Laterite Blocks

1) Laterite blocks used in construction shall conform to IS 3620. The stone blocks shall be without any soft veins, cracks, cavities, flaws and similar imperfections.

2) The blocks shall be exposed at least for the period of three months before being used in the construction of masonry to ensure adequate stabilization. Exposure to rain shall be avoided.

3) Blocks shall have specific gravity not less than 2.5 and shall absorb water not more than 12% by mass, when tested in accordance with IS:1124. Compressive strength of blocks when tested in accordance with IS: 1121 (Part I) shall not be less than 3.5N/mm2. The compressive strength is for saturated dry samples.

4) Block sizes shall be generally in accordance with IS: 3620. If CONTRACTOR intends to use other sizes manufactured locally, the same shall be submitted for approval to OWNER'S / ENGINEER IN CHARGE. Tolerance of ±5 mm shall be allowed on dimension.

5) In any consignments, all the blocks from the same quarry shall be grouped together to constitute a lot. Sample blocks shall be selected by OWNER'S/CONSULTANT'S REPRESENTATIVE and tested separately for each lot for determining its conformity to the requirements of the specification. The number of blocks to be selected for the sample shall depend on the size of the lot and shall be

generally in accordance with Table-1.

6) All the blocks selected as given in Column 2 of Table-1 shall be examined for general requirements, dimensions and workmanship. Any block failing in any one or more of the above requirements shall be considered defective. A lot shall be considered as conforming to these requirements, if number of defective blocks is not more than the permissible number given in Column 3 of Table 1.

7) The lot shall be further tested for physical properties for which a sub-sample as given in Column 4 of Table-1, shall be selected at random. These blocks shall be first tested for compressive strength and then for water absorption and specific gravity. A lot shall be considered satisfactory, if none of the blocks tested fails in any of these tests.

TABLE – 1

No. of Blocks	No. of Blocks in Sample	Permissible No. of Defectives	Sub-Sample Nos.
Upto 100	5	0	3
100 to 300	8	0	3
301 to 500	13	0	6
501 and above	20	1	6

8) All materials rejected by OWNER'S / ENGINEER IN CHARGE, due to non-conformity to specifications shall be promptly removed and replaced by new material for OWNER'S / ENGINEER IN CHARGE approval at CONTRACTOR's own cost.

10. CONCRETE BLOCK WORK

10.1 Constituents of Concrete Block

10.1.1 Aggregates

For reason of economy, strength and density it is desirable to use coarse aggregate which is retained on a 4.75mm sieve and well graded sand. The maximum size of aggregate should not exceed 12.50mm. A Fineness Modulus (FM) of the combined aggregate of 3.6 to 4.20 is recommended.

10.1.2 Admixtures

Admixtures like air-entraining agents, colouring pigments, substance to control or adjust the set and hardening of the mix, substance to improve workability of the mix can be mixed as per manufacturer's specifications with the approval of OWNER'S / ENGINEER IN CHARGE.

10.1.3 Mix of Concrete

The mix shall be 1 part of cement and 6 parts of combined aggregates by weight.

10.1.4 Quantity of mixing water

In block manufacturing, a mix much drier than that of ordinary field concrete is used, since the block is removed from the mould as soon as it is compressed.

10.1.5 Mixing

Concrete shall be mixed in a mechanical mixer till uniform distribution of material in uniform colour is obtained.

10.1.6 Curing

Blocks should not be removed from the place of casting for curing until they are sufficiently strong. From casting platform, the blocks are removed to a curing yard where they are frequently sprinkled with water and kept continuously moist for at least 10 days. Curing blocks by immersing in a water tank shall not be allowed.

10.2 Physical Requirements

At the time of delivery to the work site, concrete blocks shall conform to the physical requirements as given in table below. Water absorption shall not be more than 20% by its dry weight, when soaked in cold water for 24 hours.

TABLE – 2 Physical Requirements

masonry unit	Average of 3 units	Individual Unit
Hollow blocks	50	40
Solid blocks	85	70

10.2.1 Dimensions

The nominal sizes of concrete block are: -

Length : 400mm, 500mm, 600mm

Height : 200mm, 100mm

Width : 100mm, 150mm, 250mm and 300mm

In addition, blocks may also be manufactured in half lengths of 200mm, 250mm and 300mm to correspond to the full lengths.

10.2.2 Tolerances

The maximum variation in the overall dimensions of the units (length, height and width) should not be

more than +3mm.

10.3 Construction

Construction of block masonry shall be same as that of brick masonry explained earlier.

10.4 Joints

Same as in brick masonry. The joints are classified as horizontal and vertical joints. The thickness of the joints should be restricted to 10mm.

10.5 Curing

Green work shall be protected from rain by suitable covering. The blockwork shall be kept wet for a period of at least 7 days commencing from 24 hours after laying.

11. SCAFFOLDING

Scaffolding shall be properly planned and designed by the CONTRACTOR. It shall be approved by OWNER'S / ENGINEER IN CHARGE before commencement of work. Double scaffolding, sufficiently strong so as to withstand all loads likely to come upon it and having two sets of vertical supports, shall be provided. Where two sets of supports are not possible, the inner end of the horizontal scaffolding member shall rest in a hole provided in the header course only. Only one header for each member shall be left out. Such holes shall be filled up immediately after removal of scaffolding.

The following measures shall be considered while designing and erecting of scaffolding

1) Sufficient sills or under pinnings in addition to base plates shall be provided. Particularly where scaffoldings are erected on soft grounds.
2) Adjustable bases to compensate for uneven ground shall be used.
3) Proper anchoring of the scaffolding/ staging at reasonable intervals shall be provided in each case with the main structure, wherever available.
4) Horizontal braces shall be provided to prevent the scaffolding from rocking.
5) Diagonal braces shall be provided continuously from bottom to top between two adjacent rows of uprights.
6) The scaffolding shall be checked at every stage for plumb line.
7) All nuts and bolts shall be properly tightened.
8) Wherever steel tubes are used care shall be taken that all the clamps/ couplings are firmly tightened so as to avoid any slippage.

12. PITCHING

12.1 Materials

12.1.1 Stone

Stone shall be of best quality and approved by OWNER'S / ENGINEER IN CHARGE. It shall be hard, sound and free from delay, weathering and fissures. Stone with round surface shall not be used. The size of stone shall be 150 to 300mm thick.

12.1.2 Sand

Sand shall conform to IS 2116 and IS 1542, and as approved by OWNER'S / ENGINEER IN CHARGE.

12.2 Dressing of stones

Stones shall be hammer/chisel dressed on the face and side. The projections shall not be more than 40mm on exposed face and 15mm on the face to be plastered.

12.3 Thickness of Pitching and size of stones

The thickness of pitching shall be 300mm, unless specified otherwise. The size of stones shall be 150 to 300mm thick, unless specified otherwise.

12.4 Mortar

Cement mortar 1:6 shall be used for jointing and 1:4 for pointing.

12.5 Preparation of Sub Grade

1) The sub grade shall be prepared, dressed and rolled true to level and according to required levels and cross sections to form a firm compacted bed for the pitching.
2) If at any point, material of prepared subgrade has been excavated beyond the required levels of pitching; the excess excavation shall be filled with material compatible with subgrade material and thoroughly compacted.
3) The sub grade shall then be uniformly soaked with water, without making it slushy to ensure that water penetrates to a depth to about 300mm in sandy soil and about 150mm in other soils.

12.6 Laying

The surface to be stone pitched shall be properly dressed and rammed prior to commencement of the work and the approval of the OWNER'S / ENGINEER IN CHARGE shall be obtained. Stones used shall be wetted before use. The surface shall be properly watered before placing the stone. The stones shall be carefully laid and hammered down with a mallet to positions. The bond shall be obtained by fitting in closely the adjacent stones and properly applying the cement mortar to the joint. The slopes as shown in the drawing shall be maintained.

12.7 Joints

Stones shall be so laid that all joints are full of mortar. Face joints shall not be more than 25mm thick; joints shall be struck flush and finished at the time of laying. Joints shall be raked to a depth of 20mm during construction in case of plastering or pointing.

12.8 Flush Pointing

The joints shall be brushed clean of dust with a wire brush and wetted thoroughly for 6 hours before pointing is commenced. The raked joints shall be filled with cement mortar of specified grade and shall be well pressed on the face and rubbed smooth. After pressing the mortar to the joints, a neat cement wash shall be given to the mortar area only and finished smooth. The finished work shall give a clean, well worked look without blotches or runs or mortar on stone surface.

12.9 Curing

Green work shall be protected from rain by suitable covering. Pitching work shall be kept constantly moist for a minimum period of 10 days.

13. PAYMENT (APPLICABLE FOR ITEM RATE TENDER)

Payment for brick works shall be made on cubic metre (M^3) basis on the volume of actual work done, the thickness of wall being calculated on the basis of nominal brick length or breadth, as the case may be, for brickwork of one or more brick thickness. Payment for wall less than one brick thickness shall be made on square metre (M^2) basis on the net area of brickwork.

Deduction for voids shall be as per IS: 1200. The rate of brick work shall include scaffolding and all items mentioned above and no extra payment shall be made for cutting bricks if required either for openings or for rounding or for insertions or for recesses at the time of brick wall construction. In case of bricks not conforming to 35A and 35B classification are accepted for use, a rebate of 0.25% of the quoted rate for brick work shall be applicable for every 1 % or part thereof reduction in strength of bricks below 5 N/mm2. All other terms of payment shall be as above.

SPECIFICATION

FOR

DISTEMPERING, PAINTING AND POLISHING

REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED	AUTHORIZED
C	11-06-2020	Issued For Design	SUR	KRK	JP / KC	JMC
B	08-11-2019	Issued For Design	SUR	KRK	JP / KC	JMC
A	29-10-2019	Issued For Design	SUR	KRK	JP / KC	JMC

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1. INTRODUCTION

INDIAN OIL CORPORATION LIMITED (IOCL) has awarded Fax of Acceptance (FOA) dated 29th August 2019 to M/s. Technip India Limited (TPIL) for Consultancy services (PMC/EPCM services) for overall project management, FEED Review / FEED, Detailed Engineering, Procurement & expediting services, Tendering & award, Construction Management & Supervision, Assistance in start-up, Commissioning & performance test runs for installation of a Standby SRU of 525 TPD capacity and execution of Additional tanks for Paradip Refinery, Odisha, India.

2. DEFINITIONS & ABBREVIATIONS

Abbreviation	Definition /Expanded form
IOCL/ CLIENT	Indian Oil Corporation Limited
PMC/ CONSULTANT	Technip India Limited
LICENSOR	Party selected by IOCL for process technology ownership for any UNIT
CONTRACTOR	Party whose services are obtained for performing the works specified as part of LSTK / packages.
EPCM	Engineering, Procurement & Construction Management Services.
LSTK	Lump Sum Turn Key portion of the work to be executed by CONTRACTOR
FEED	Front End Engineering Design
AUTHORISED REPRESENTATIVE	IOCL's/ CONSULTANT's representative authorized to act for and on behalf of them.
VENDOR	Any third party supplying the equipment/materials for setting up the Plant
PROJECT	Indicates Standby SRU and Additional tanks Project, Paradip Refinery
SITE	Indicates Paradip Refinery in Odisha, India
UNIT	Indicates any particular portion of the project to be built which can be Process related or Utilities/Offsites related
SRU	Sulphur Recovery Unit
BIS	Bureau of Indian Standards

3. SCOPE

This specification covers the general requirement for executing white/colour washing, distempering and painting of surfaces.

This JSS covers typical General specification for some standard items only and the CONTRACTOR shall comply with the requirement as given in 080557C-000-JSD-1700-001/002 for specific cases and for any other items not mentioned/specified in this JSS. The requirement for various type of Buildings /Unit / Structures etc., as specified in the document 080557C-000-JSD-1700-001/002 shall be the governing one.

The CONTRACTOR shall submit the detailed specification for the items not covered in this specification for Approval by OWNER'S/ENGINEER IN CHARGE during execution.

4. MATERIALS & CODES

The Indian Standard codes applicable to this section shall include but not limited to the following:

- IS 6278 : Code of practice for white washing and colour washing.
- IS 2395 : Code of practice for painting concrete, masonry and plaster surfaces.
- IS 712 : Specification for building limes.
- IS 55 : Specification for Ultramarine blue for paints.
- IS 63 : Specification for whiting for paint and putty.
- IS: 5411 : Specification for plastic Emulsion paint for interior use.
- IS: 2338 : Code of practice for finishing of wood, and wood based materials.
- IS: 5410 : Cement paint, colour as required.
- IS: 384 : Brushes, paints and varnishes, flat.
- IS: 486 : Brushes, sash, tool, for paints and varnishes.
- IS: 110 : Ready mixed paint, brushing, grey filler enamels for use over primers.
- IS: 426 : Paste filler for colour coats.
- IS: 345 : Wood filler, transparent liquid.
- IS: 3585 : Ready mixed paint, alum brushing priming water resistant for woodwork.
- IS: 426 : Paste filler for colour coats.
- IS: 106 : Ready mixed paint, brushing, priming for enamels, for use on metals.
- IS 2395 Part-1: Painting of Concrete, Masonry and Plaster Surfaces - Code of Practice, Part 1: Operations and Workmanship.
- IS 2395 Part-2: Code of practice for painting concrete, masonry and plaster surfaces, Part 2: Schedules.

All materials required for the execution of painting work shall be obtained direct from approved manufacturers and shall be brought to the site in makers drums, bags etc with seals unbroken. In case of ready mixed paints, thinning if necessary, the brand of thinner shall be as per recommendations of the manufacturer.

Paint shall be applied by brushing or spraying. Spray machine used may be of high-pressure type or low pressure depending on the nature and location of work. The paint containers, when not used shall be kept close and free from air. After finishing of the work, the adjacent surfaces not intended to be washed/distempered/painted/polished shall be thoroughly cleaned of all paint patches and finished in accordance with finishing of such surfaces.

5. OIL BOUND DISTEMPERING

Oil bound distempering work shall be done in the following steps.

Preparation of surface

The surface shall be thoroughly brushed free from dust, dirt, grease, mortar droppings etc and made smooth by sand papering. In case of distempering over existing distempered surface, the existing distempering shall be scrapped by steel scrappers leaving a clean surface. All nails shall be removed. Pitting in plaster shall be made good with Plaster of Paris mixed with distemper of colour to be used. The surface then shall be rubbed down again with a fine grade sand paper and made smooth. A coat of distemper shall be applied over the patches. The surface shall be allowed to dry thoroughly. Surfaces affected by moss, fungus, algae, efflorescence shall be treated in accordance with IS: 2395.

Any unevenness shall be made good by applying putty made of approved quality Plaster of Paris mixed with water and then sand papering the same after it is dry. Scaffolding, wherever required, shall be erected in such a way that no part of the scaffolding rest against the surface to be painted.

Primer coat

The primer coat shall be alkali resistant primer or distemper primer and shall be of the same manufacture as oil bound distemper.

Base preparation

After the primer coat, the base preparation shall include applying two or more coatings of oil based putty in paste form made from chalk powder mixed with linseed oil, white zinc, varnish etc. as per manufacturers recommendations. After each coat of putty, sandpapering of the surfaces shall be done.

Application of Distemper

After the base preparation coats have dried, the surface shall be lightly sand papered and dusted off so that rubbing off of the primer coat is avoided. The distemper shall conform to IS: 428 and shall be diluted with water or any other prescribed thinner recommended by the manufacturer. Minimum two coats of distemper shall be applied with brushes in horizontal strokes, followed immediately by vertical strokes, which together shall constitute one coat. The subsequent coats shall be applied after at least 24 hours between consecutive coats to permit proper drying of the preceding coat. The finished surface shall be even and uniform without patches, brush marks drops etc.

Application of a coat in each room shall be finished in one operation. 140 mm double bristled distemper brushes shall be used. After each day's work brushes shall be thoroughly washed in hot water with soap solution and hung down to dry. Surfaces of doors, windows, floors etc. shall be protected from being splashed upon. Such surfaces shall be cleaned of distemper splashes.

6. PLASTIC EMULSION PAINT

Plastic Emulsion paintwork shall be executed as follows.

Preparation of surface

The surface shall be thoroughly brushed free from dust, dirt, grease, mortar droppings etc and made smooth by sand papering. Surfaces affected by moss, fungus, algae, efflorescence shall be treated in accordance with IS: 2395.

Any unevenness shall be made good by applying putty made of approved quality Plaster of Paris mixed with water over roughened plastered surfaces and then sand papering the same after it is dry. Plaster of Paris paste shall be in sufficient thickness to give absolutely smooth, plumb and straight surfaces. The surface then shall be rubbed down again with a fine grade sand paper and made smooth. Scaffolding, wherever required, shall be erected in such a way that no part of the scaffolding rest against the surface to be painted.

In case of plastic emulsion paintwork over an existing distempered/emulsion surface, the existing distempering/ emulsion shall be scrapped clean using steel scrappers. All nails shall be removed. Pitting in plaster shall be made good with Plaster of Paris mixed with the plastic emulsion to be used. A coat of plastic emulsion shall be applied over the patches and the entire surface allowed to dry thoroughly.

Primer coat

The primer coat shall be alkali resistant primer or emulsion primer and shall be of the same manufacturer as plastic emulsion paint.

Base preparation

After the Primer coat, the base preparation shall include applying two or more coatings of oil based putty in paste form made from chalk powder mixed with linseed oil, white zinc, varnish etc. as per manufacturers recommendations. After each coat of putty, sandpapering of the surfaces shall be done.

Application of Plastic Emulsion Paint

After the base preparation coats have dried, the surface shall be lightly sand papered and dusted off avoiding rubbing off of the primer coat. The plastic emulsion paint shall conform to IS: 5411 (Part- I) and shall be diluted prescribed thinner recommended by the manufacturer. Minimum two coats of plastic emulsion paint shall be applied with brushes in horizontal strokes followed by immediate vertical strokes, which together shall constitute one coat. The subsequent coats shall be applied after at least 24 hours between consecutive coats to permit proper drying of the preceding coat. The finished surface shall be even and uniform without patches, brush marks drops etc. Application of a coat in each room shall be finished in one operation. 140 mm double bristled distemper brushes shall be used. After each day's

work brushes shall be thoroughly washed in hot water with soap solution and hung down to dry. Surfaces of doors, windows, floors etc. shall be protected from being splashed upon. Such surfaces shall be cleaned of splashes.

7. PAINTING OF WOOD SURFACES (SYNTHETIC ENAMEL PAINT)

Preparation of wood surface shall conform to IS: 2338 (Part-1) in general. All woodwork shall be dry and free from any foreign matter. Nails shall be punched well below the surface. The surface shall be smoothened off with abrasive paper used across the grain prior to painting, but with the grain prior to the staining. Knots and resinous or bluish sapwood, cutting out of which is not justified, shall be covered with red lead conforming to IS: 103. Plywood and block board shall be treated in the same manner as for woodwork. Particleboard surface shall be filled with a thin brushable filler and finished as for solid wood. Painting of wood surfaces shall consist of the following steps.

Priming

Priming shall be in accordance with IS: 2338 (Part I and II). Dirt or any other extraneous material on the surface shall be removed and the priming shall be applied by brushing. Priming shall be done on all exposed and unexposed surfaces. Unless specified otherwise all joinery work intended to be painted shall receive at least 2 coats of primer. Type of primer shall be in accordance with Table-1 and Table-2 of IS: 2338 (Part-II).

Stopping and Filling

Stopping and filling shall be done after priming. Stopping shall be made to the consistency of stiff paste and shall be used to fill holes and cracks. Filler shall be used to level up slight irregularities of the surface. Filler shall be applied with a putty knife and subsequently rubbed down to a level surface with abrasive paper. The filler coat shall be allowed to fully flatten and harden before subsequent coat is applied.

Application of Undercoat

Under coat shall be applied after the surface has been primed, stopped and filled, and rubbed down to a smooth surface. Under coat may be brushed or sprayed. After drying the coat shall be carefully rubbed down and wiped clean before the next coat is applied. The type of undercoat shall be depending upon the finishing and in accordance with Table 1 and Table-2 of IS: 2338 (Part II).

Finishing

The finishing paint shall be two or more coats of synthetic enamel paint and shall be applied either by the brush or by spraying to give a uniform, smooth and glossy finish. Reference shall be made to the Table-1 and Table-2 of IS: 2338 (Part-II).

8. WATERPROOF CEMENT PAINT

The surface shall be thoroughly cleaned of all dirt, dust, mortar dropping and other foreign matter before paint is to be applied. Surfaces already white/colour washed shall be broomed down to remove all dust, dirt and loose scales of lime wash, or other foreign matters. Preparation of surface & scaffolding shall be same as white wash.

The surface so prepared shall be thoroughly wetted with clean water before the paint is applied. Waterproof cement paint of approved make shall be mixed with water and stirred to obtain a thick paste, which shall then be diluted to brushable consistency. The proportion of mixture shall be as per manufacturer's recommendations. The paint shall be mixed in quantities that can be used up within an hour of mixing to avoid setting and thickening of the paint. The surface shall be treated with minimum two coats of waterproof cement paint. No less than 24 hours shall be allowed between the successive coats, and only after the preceding coat has become hard to resist marking by subsequent brushing. The finished surface shall be even and uniform in shade without patches, brush marks, paint drops etc. Cement paints shall be applied with a brush with relatively short stiff hog or fiber bristles.

Curing shall be started after the paint has hardened. Curing shall be done by sprinkling with water two or three times a day. This shall be done between coats and for at least two days following the final coat. Surfaces of doors, windows, floors etc. shall be protected from being splashed upon. Such surfaces shall be cleaned of paint splashes.

9. ACRYLIC COPOLYMER AGGREGATE FINISH

Material

Material shall be acrylic based textured wall coating consisting of quartz and silica aggregate, inorganic pigment and other additives to form a crack-free, flexible, tough and waterproof coating.

Preparation of Surface

The surface to be coated shall be cleaned of all dirt, dust, grease and loose particles. Old textured surfaces shall be scrapped with a removing agent of approved quality.

Application

Bonding agent and water shall be mixed first and then flakes/ granules added and the entire mixture kneaded thoroughly until no lumps are present. The bonding agent, flakes/ granules and water shall be mixed in ratios specified by manufacturer, depending on the type of finish required. The dough shall be left for 20-30 minutes before starting application. The first application shall be using steel trowels and subsequently smoothened, if the specified finish requires, with plastic trowels.

10. PAINTING OF STEEL AND OTHER METAL SURFACES

The painting of steel structure shall be as per painting specification 080557C-000-JSD-2300-001.

11. PAYMENT (APPLICABLE FOR ITEM RATE TENDER)

Payments for white/colour washing, distempering & every other type of painting shall be based on unit rate per square meter of surface covered, and the rate quoted shall be inclusive of all labor, materials, scaffolding, tools etc. required for the successful and satisfactory completion of work as per specifications including cleaning operations before and after the work, leaving the worksite free of all used materials/containers & other encumbrances, and any other safety measures required to be undertaken as directed by the OWNER'S/ENGINEER IN CHARGE.

SPECIFICATION

FOR

ACID PROOF BRICK LINING

			Written By: Umasankar Sundarajan 2020.06.13 16:00:04 +05'30'	Checked By: RameshKumar Kalyanasundaram 2020.06.13 16:28:18 +05'30'	Approved By: Jayaprakash Jayaraman 2020.06.13 16:33:08 +05'30'	Authorized By: Morischristopher Jesumarian 2020.06.13 23:37:48 +05'30'
B	13-06-2020	Issued For Design	SUR	KRK	JP / KC	JMC
A	20-05-2020	Issued For Design	SUR	KRK	JP / KC	JMC
REV.	**DATE**	**DESCRIPTION**	**PREPARED**	**CHECKED**	**APPROVED**	**AUTHORIZED**

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1. SCOPE

This specification covers the requirement of materials and laying of Acid proof brick lining.

This JSS covers typical General specification for some standard items only and the CONTRACTOR shall comply with the requirement as given in 080557C-088-JSD-1700-001 for specific cases and for any other items not mentioned/specified in this JSS. The requirement for various type of building as specified in the document 080557C-088-JSD-1700-001 shall be the governing one. The CONTRACTOR shall submit the detailed specification for the other items not covered in this specification for Approval by OWNER'S/ENGINEER IN CHARGE during execution.

2. REFERENCES

2.1 APPLICABLE CODES

The Indian Standard codes applicable to this section shall include but not limited to the following:

- IS 4832(Part-I) : Chemical resistance mortar – silicate
- IS 4832(Part-II) : Chemical resistance mortar – resin type
- IS 4457 : Acid and/or alkali Resistant tiles.
- IS 4860 : Acid resistant bricks.
- IS 9510 : Specification for Bitumen Mastic, Acid resistant grade.
- IS 10570 : Methods of testing Refractory castables

2.2 APPLICABLE SPECIFICATIONS

- ASTM D41-94 : Standard Specification for Asphalt Primer Used in Roofing, Damp proofing, and waterproofing

3. PRIORITY OF REQUIREMENTS

In case of any variation and discrepancy in condition between the special conditions, this specification and codes, order of priority shall be as under: -

(1) Special conditions.

(2) This specification.

(3) Codes.

4. MATERIALS

Acid Proof Bricks / Tiles

The Bricks shall conform to IS: 4860 - Class I quality. All bricks shall be dense, homogeneous and manufactured out of special raw material which shall have low lime, flint, sand and iron contents. These shall be specially fired and vitrified at high temperature to have qualities of low absorption. The size of the bricks shall normally be 230mm x 114mm x 64 mm or as per IS: 4860. The size of Acid proof tile shall be as per IS: 4457.

Acid Proof Mortar

Silicate mortar

It shall consist of selected potassium silicate solution and inert filter powder. Both mixed well to enable to set at ambient temperature. The mortar shall conform to IS: 4832 (Part — I). The mixing proportion and other instructions for use shall be as specified standard manufacturers. Silicate mortar from standard manufacturers only shall be used. Contractor shall obtain approval from Engineer - in - charge prior to order and supply of the material. This type of Mortar is resistant to most acids except hydro-fluoric acid and concentrated ortho-phosphoric acid; they are not resistant to alkalies of any concentration or to boiling water or stream.

Resin Mortar

The furane and phenolic mortar for jointing consist of inert powder synthetic resin syrup. No water shall be used during mixing. This mortar shall conform to IS: 4832 (Part — II). The mixing proportion and other instructions shall be as specified by standard manufacturers. Resin mortar from standard manufacturers only shall be used. Contractor shall obtain approval from Engineer — in — charge prior to order and supply of the material. This type of Mortar has a good resistance to non-oxidising mineral acids, and poor resistance to oxidising mineral acids. They are fairly resistant to inorganic alkalies and water.

Bitumen Primer

A bitumen primer is an asphalt based material thinned with petroleum solvent (conforming to ASTM D-41) should be applied over the surface. Primers from standard manufacturers only shall be used.

Bitumen Mastic

The bitumen mastic shall consist of a mixture of asphalt cement mineral filler, and mineral aggregate, which are acid alkali proof. The composition, preparation and properties of the bitumen mastic shall be as per IS: 9510 for resisting acid. The bitumen mastic shall be insoluble in Benzol and the matter soluble in diluted hydrochloric acid should not be more than five percent. "Prodorphalte" by Coromandal Prodorite or equivalent may be used.

5. LAYING

Surface preparation

The concrete surface shall be thoroughly cleaned with all loose/damaged areas chipped out, patched or replaced. Proper slope for good drainage shall be ensured by laying a fresh bedding in cement mortar, if necessary, and avoiding all low spots. The concrete shall be dry, clean and well cured before installation of the membrane is taken up.

a) All damaged or questionable areas should be chipped out and replaced.
b) Adequate floor slope for good drainage is important.
c) Low spot should be avoided because finished floor will follow contour or sub floor.
d) Concrete should be dry, clean and well cured before application of membrane is started.

Primer application

A bitumen primer should be applied over the prepared surface. It should be allowed to dry before applying the membrane material.

Membrane application

Bitumen mastic is used to build up the membrane. It is heated to 120-205° C and applied to the primed surfaces. Multiple coat application should be made to thickness requirements. The thickness of the mastic layer shall be to suit the acid concentration and expected load or as specified by the Engineer-in-charge. Each coat should be inspected for blisters and pinholes. If present, they should be broken and before Applying subsequent coats. Bitumen mastic should not be used as the membrane material where solvents are involved.

Reinforcement application

Bitumen coated glass cloth can be used for membrane reinforcements at the corners, edges, walls, etc. depending on the requirements.

Application of mortar and bricks

A thin layer of about 6mm potassium silicate type mortar is spread on the back of the acid proof brick and the bricks are pressed down on the bed. Proper joint thickness of about 20mm should be maintained and filled up with suitable resin type mortar.

In this case, joints with silicate mortar should be acid cured with 20 to 25 percent hydrochloric acid or with 30 to 40 percent sulphuric acid before applying the resin type mortar. After acid curing, the free acid in the joints shall be cleaned with water and sufficient time should be allowed should be allowed for thorough drying. After curing resin mortar is used for filling up the joints.

6. GUARANTEE

The vendor shall give material and performance guarantee for a minimum period of one year from the date of commissioning of the plant.

7. PAYMENT (APPLICABLE FOR ITEM RATE TENDER)

Payment shall be on basis of actual area covered measured in square metres, and shall include supply and cost of all materials, tools, labour, installation as per specifications and manufacturer's recommendations all complete and as directed.