VRISHAL ENGINEERING PRIVATE LIMITED

PROCEDURE FOR STEEL-STRUCTURAL FABRICATION, ERECTION & ALIGNMENT

CLIENT: AARTI INDUSTRIES LTD, JHAGADIA, ZONE-4

PROJECT: CORAL-2

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1 SCOPE

This procedure covers execution of all structural steel related works such as Fabrication, Installation and Inspection at CORAL-2 Project, AIL JHAGADIA, ZONE-4.

2 PURPOSE

The purpose of this procedure is to provide guidelines and methods for fabrication, erection and alignment of structural steel work as per the relevant codes, standards and specific requirement of Aarti Industries Ltd as applicable at CORAL-2 Project, AIL JHAGADIA, ZONE-4.

3 DISTRIBUTION & INTENDED AUDIENCE

AIL: AARTI INDUSTRIES LTD, JHAGADIA, ZONE-4

AIL-TPI

VEPL: VRISHAL ENGINEERING PRIVATE LIMITED

4 RESPONSIBILITY

Site Manager: - Shall be responsible for construction management and responsible to provide all necessary resources to implement the procedure and complete the job without any delay by in safe & good quality manner.

Execution Engineer: - Shall be responsible for overall control on site activities to execute this procedure by following safe and quality practices.

QA/QC Engineer: - Shall be responsible for overall control of QC activities. The compliance of this procedure by performing inspections as mentioned in ITP and need to conduct periodical quality audits.

HSE Engineer: - Shall manage all safety requirements during construction. Need to ensure that the communication system is functioning properly and emergency vehicle / equipment are in place as required.

5 REFERENCE DOCUMENTS

SR. NO	DOCUMENT NAME	DOCUMENT NUMBER	LATEST REVISION

1	General Construction in Steel- Code of Practice	IS 800	--
2	Tolerance for Fabrication of Steel structures	IS 7215 & BS 5950-II	--
3	Tolerance for Erection of Steel structures	IS 12843	--
4	Specification for rolling and cutting tolerances for hot rolled products.	IS 1852	--
5	Hot rolled medium and high tensile structural steel specification	IS 2062	--
6	Dimensions for hot rolled steel Beam, Column, Channel and Angle sections.	IS 808	--
7	Hollow sections for Structural use - Specification	IS 4923	--
8	Steel tubes for structural purposes Specification	IS 1161	--
9	Welder Qualification, Welding	AWS D1.1	2020
10	Non-Detractive Testing	AWS D1.1	2020
11	Safety code for Erection of Structural Steel work	IS 7205	--

6 FABRICATION PROCEDURE

Materials: -

All steel structural materials used for permanent jobs shall be as mentioned as project specifications/AFC drawings.

- Rolled sections and plates confirming grade E250 quality B/BR as per IS2062. Dimensions and mass for hot rolled steels sections shall be confirm to IS808.
- To check if any discontinuities / lamination that may occur in plates equal to or greater than 25 mm in thickness should be ultrasonically tested.
- Pipes for handrails shall to confirm IS 1161 and Crane rails shall to confirm IS 3443 as per the approved specification by AIL.

- Hollow sections (square & rectangular) shall to confirm IS 4923 YST240 grade as per the approved specification by AIL.

- Carbon Steel Grating for Steel floors, walk ways, platforms, stairs etc. Including fixing with saddle clips for 30mm bearing bars including bolts & nuts as per manufacturers details, with hot deep galvanized coating mass of minimum 610 g/m2 total of zinc on both faces shall to confirm IS 4759 or as per the approved specification by AIL.

- Steel grating material Carbon steel as per IS 2062 minimum tensile strength Fy250 grating with main bars 25mm x 5mm@ 30/32mm c/c and cross bars 8mm dia mild round/square @ 100mm c/c or size as per item description.

- Unless otherwise mentioned in schedule of rates these shall can carry a uniformly distributed load of 5 kN/m2 or a concentrated load of 10 KN at mid span, whichever is governing. The maximum span for the above loading condition shall be 1200mm. The deflection shall not exceed span/200 or 6mm whichever is less.

- Before fabrication or procurement, the Contractor shall submit the drawings and manufacturer's literature and get the same approved from Client.

- The gratings for stair treads shall be provided with nosing of chequered plate of approved size and thickness.

- Stair treads shall be manufactured with a grit surface for slip resistance. For additional safety, and to meet OSHA requirements, stair treads shall be manufactured with a 1 1/2"wide nosing of contrasting color. Nosing shall be gritted with an angular quartz grit.

- Chequered plate shall to confirm IS3502.

- Plain washers shall be as per IS 5370, tapered washers as per IS 5372(for ISMC) & IS 5374 (for ISMB), IS 6610 (Heavy washer for steel structure) and IS 6649(hardened & Tapered washer for high strength structural bolt and nuts) as applicable or as per the approved specification by AIL.

- Bolts and nuts including lock nuts shall confirm to IS 1364, IS 1367, IS 3757 (High Strength Structural Bolts), IS 6623 (High Strength Structural Nuts) and IS 6639(Hexagon bolts for structure steel) as applicable or as per the approved specification by AIL.

- All connection bolts, nuts and washers shall be hot dip galvanized. Each lot of Fasteners shall be accompanied with MTC (manufacture’s test certificate).

- Bolts, Nuts and washers shall be stored out grade, type, diameter and manufactures. Quality and test certificate shall be maintained for record purpose.

- The use of alternate materials may be used in special case after written approve from concerned department of owner.

- All materials received at site shall only be used for work after IMIR clearance. Material should be stacked properly to avoid surface defects (pitting, cracks, dent or bend etc.). If any material found beyond acceptance tolerance shall be rejected. Each lot of materials shall be accompanied with MTC (manufacture’s test certificate).

- The bolts shall be from approved make or equal conforming to the above specifications.

- Welding electrodes and filler wires shall be stored separate properly as per manufacturer recommendation. Each lot of electrodes and fillers wires shall be accompanied with MTC (manufacture's test certificate).

- Bare wire electrodes for submerged are welding of structural steel shall conform to IS 7280. The combination of wire and flux shall comply with IS 3613. Filler rods and wires for gas welding shall conform to IS 1278. Filler rods and bare electrodes for gas shielded are welding of structural steel shall conform to IS 6419.

- Materials for which test certificate is not available or which test result do not conform to relevant standard specifications, shall not be used.

- Contractor required to provide manufacture's quality certificate for every item of material supplied by them. In case such certificates are not available, contractor carried out all such tests required by owner /consultant at an established test center at their cost and submit the results for approval. The approval of such material shall however be entirely at the discretion of the Owner/Consultant.

Fabrication: -

- Fabrication shall be done as per approved fabrication drawing accordance with AWSD1.1, IS800, IS 7215, IS 9595 and other relevant codes.

- Fabrication drawing prepared by contractor based on design drawing and take approval from AIL for proceedings.

- Fabrication works shall be carried in approved fabrication yard, if done outside the premises. Connections, splices and other details shall be suitably given in fabrication drawing.

- Any defective fabrication of material pointed out at any stage shall be replaced by the contractor free of cost.

- All material shall be straight and shall be free from warping, corrugation and twist. If necessary, rolled sections shall be straightened / flattened (unless required to be of curvilinear form) before use. Sections can be straightened by cold method by using Jim screw or hydraulic press arrangement.

- Wrapped members like plates and flats may be used as such, only if wave like dimensions does not exceed L/1000 but limited to10mm (L=Length)

- Surface of members that are to be joined by lap of fillet welding of bolting shall be even, so that temporary fastening alignment should not allow passage of a 0.2mm thick filler more than 20mm deep from member's edge.

- Marking shall be done as per approved fabrication drawing to avoid wastage or unnecessary joints. Marking accuracy shall be at least ±1mm.

- Cutting shall be done preferably by power saw or shear. Cutting with oxygen-acetylene flame shall be done prior permission of respective Engineer. All cut edge shll be grind, clean, square and free from any distortion and burr. Electric metal arc cutting not allowed.

- All edges cut by oxygen-acetylene flame shall be cleaned off impurities and slag by grinding machine prior to assembly. Cutting tolerances as follows: -
  a) For members connected at both ends ±2mm
  b) Elsewhere ±3mm

- The edge preparation for welding of members equal and more than 12mm thick shall be flame cutting and grinding. Cut face shall not have cracks or be rough. No special edge preparation shall be required thickness less than 8mm.

- Finished holes for black bolts high strength friction grip bolts shall not have a diameter more than 2mm the diameter of the bolt passing through them or as specified in fabrication drawing.
  a) Maximum deviation for spacing of two holes on the same axis shall be±1mm
  b) Two perpendicular diameters of any oval hole shall not differ by more than 1mm.

- **Splicing In compound section**s, splicing of components shall be staggered with respect to each other by a minimum of 500mm. When the two parts of a component are not butt welded to each other, the opposing ends at a joint shall be ground flush for bearing and suitable flange and web splice plates shall be designed to cater for the full strength of the flange / web of the sections. In case full strength butt weld is used to connect opposing ends at a joint, additional flange and web splice plates shall be provided capable of carrying 20% strength of the flange and well.

- Holes for bolts shall not be formed by gas cutting.

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

- All assembly work shall be carried out on fabrication platform and proper jigs and fixtures shall be provided to avoid distortion during welding. Under no circumstances shall wet, greasy, rust or dirt parts be assembled. Joints shall be kept free from any foreign materials, likely to get into the gaps between members to be welded.

- Identification of each fabricated item shall be made by Welding with item no. / mark number to facilitate erection.

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

- Fabricated parts shall be handled and stacked in such a way that permanent damage is not caused to the components.

- **Tolerances for fabrication shall be as per IS: 7215.**

- All materials shall be set at least 150mm clear from ground on wooden or steel blocks for protection against direct contact with the ground and to permit drainage of water.

Welding: -

The contractor shall carry out weld procedure test as per IS: 7307/ASME section IX/AWS D1.1. The test weld shall be as per weld details required for the actual work and should simulate the worst conditions likely to be encountered in the actual work in terms or fit-up, electrode conditions, etc. The test weld shall be held at ambient temperature for a minimum period of 72 hours prior to testing to IS: 7307. The welding procedure once established shall be submitted in the standard format prescribed by IS: 99595 to the Owner for approval.

For welding of any particular type of joint, welders shall give evidence of having satisfactorily completed appropriate tests as described in any of IS 817-1966, IS1393-1961, IS 7307 (Part-I)-1974, IS 7310 (Part-I)-1974 and I.S. 7318 (Part-I)-1 974 as relevant.

Welds shall be made only by Operators who have been previously qualified by tests by the Owner / Consultant. A welder shall product satisfactory evidence of his ability to do a given type of work and shall prove his ability to product a connection of the strength required. Evidence of welder's qualification tests shall be produced if required by the Owner. Owner may reject any welder found not suitable during actual work.

Preparation of Fusion Faces: Fusion faces shall be cut by shearing machine or gas cutting and later dressed by filling or grinding so that they shall be free from irregularities such as would interfere with the deposition of the specified size of weld to cause the defects. Fusion faces and the surrounding surfaces shall be free from heavy slag, oil paint or any substance which might affect the quality of the weld or impede the progress of welding. The welding face shall be free of rust and shall have metal shine surfaces.

Preheating of members shall be necessary when the base metal temperature (based on ambient temperature) is less than the temperature required for that welding procedure. The preheating shall be done in such a manner that the part on which weld metal is to be deposited is above the specified temperature for a distance of 75mm on either wide of the weld line. The temperature shall be measured on the face opposite to the face being heated. In case access is limited to only the face being heated, the source of heat shall be removed, and sufficient time allowed elapsing for heat equalization prior to measurement. (1 minute per 25mm of plate thickness).

Welding should be done with the structural steel in flat position in a down hand manner wherever possible. Adequate steps shall be taken to maintain the correct arc length, rate of travel, current and polarity for the type of electrode and nature of work. Welding plant capacity shall be adequate to carry out the welding procedure laid down. Adequate means of measuring the current shall be available either as a part of the welding plant or by the provision of a portable ammeter. In checking the welding current, a tolerance of 10% or 30 amperes from the specified value whichever is less shall be permitted.

- Edge preparation for welding shall be carefully and accurately made so as to facilitate a good joint. Edge preparation (beveling) denotes cutting of the same so as to result in V,Y,K of U shapes & tolerance as per IS 9595.

- 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).

- After assembly is done and checked, temporary tack welding shall be done by electric welding and to be cross verify for finished dimensions of the structure.

- All welding works shall be carried out by tested and qualified welders in accordance to the approved welding procedures using approved welding consumables. Surface to be welded, shall not be painted prior to welding.

- Welding shall be carried as per approved drawing, technical specification. Each joint shall be checked to assure that the parts to be welded are clean and root gaps provided as per IS:9595.

- When welding is carried 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. Welding seams should not be left in middle. If for any reason welding seam discontinued, for continuing the same the end of the seam shall be cleaned properly and melted to obtain a good continuity.

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

- 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 code. For single butt welds and double butt welds the re-welding of the root is mandatory but only after the metal deposit on the root has been cleaned by back gouging or chipping. Due margin is provided to compensate for contraction due to welding to avoid any high permanent stresses for continuing the welding of seams discontinued due to some reasons, adjacent area of 50 mm shall be cleaned & the end of the discontinued welding shall be melted.

- For multi-layer welding the former welded layer shall be cleaned metal bright by chipping &brushing the welding seam shall be left to cool slowly. Contractor shall not be allowed to cool the welds quickly by any method. Backing strips shall not be allowed.

- 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 larger, it shall be corrected by grinding or filling.

- The direction of welding shall be from points relatively fixed with respect to each other towards points having more flexibility.

- Welding shall be carried out continuously to completion with the required number of runs.

- For compound section splices, each component part shall be spliced prior to welding with other component parts.

- Welds shall progress in a sequence that will balance the applied heat so as to reduce distortion.

- Joints having more shrinkage shall be welded prior to joints having less shrinkage.

- The sequence causing minimum distortion of shrinkage shall be chosen

- **Repair of Welds: -** Welds not meeting the requirements of the specification and IS codes shall be removed and replaced. Repairs to defective welds shall be carried out only after the repair procedure submitted is approved by the Owner.

7 INSPECTION

All welds shall be visually inspected after completion and it shall be made in accordance with the guidance given in IS:822.

The contractor shall extend to Owner all facility required to inspect all stages if fabrication and erection including welding procedure qualification and welder's procedure qualification. No painting of welds shall be undertaken prior to inspection and approval.

- 100% welds shall be visually inspected to ascertain absence of the following defects:
- Surface cracks in weld or parent metal, or undercut, burning, overheating of parent metal.
- Blow holes, exposed porosity in the weld or unused welds.
- Defects in the profile such as excessive convexity of concavity, unequal leg lengths incompletely filled grooves, excessive penetration beds, root grooves, etc.
- Distortion due to welding and misalignment.
- Mechanical Tests Tensile load tests, bend tests, impact tests, etc. shall be carried out as per the standard.

Radio-graphic Testing: - Such testing shall be carried out only in very special cases when so directed by the Owner. The tests shall be carried out as per IS: 822. The contractor shall full fill all necessary statutory safety requirements while handling X-ray and game ray equipment and provide the Owner viewing facilities.

Magnetic Particle / Dye Penetration / Ultrasonic Tests: - Such tests shall be carried out only when directed by Owner / Consultant. These shall be carried out to the procedure specified in IS: 822.

Materials and workmanship at all times shall be subject to inspection by the Owner/ Consultant. All inspection as far as possible shall be made at the place of fabrication and the contractor shall cooperate with the Owner / Consultant's inspector and permit access for inspection to all places where work is being done. The contractor shall supply free to the Owner / Consultant all necessary gauges and templates necessary for inspection. However, such inspection shall not relieve the contractor of his responsibility to furnish satisfactory work. Materials of workmanship, not conforming to provisions of the specifications, may be rejected at any time when defects are found during the progress of work. The contractor shall obtain approval from the Owner / Consultant of all fabricated items prior to commencement of their erection. However, any such approval shall not absolve the Contractor from his responsibility of correctness and workmanship of the entire work.

8 PAINTING

Contractor will submit Grit blasting and painting procedure separately and strictly follow AIL design code of surface preparation and coating operations.

All steel work shall be provided one coat of appropriate primer (depending upon the type of final painting). Surfaces which are inaccessible after erection shall be provided the full number of coats prior to assembly.

The steel work shall be cleared of all rust, scale and grease prior to the application of the primer. When specifically called for the structural steel shall be cleaned by Grit blasting to SA2 as per SIS-5900. All care shall be taken to cover all crevices, comers, edges, etc.

Application of primer shall not be done near edges which are to be welded thereafter. Similarly, welds which are yet to be approved by Owner / Consultant shall not receive the primer coat. Parts which are to be encased in concrete shall not be painted. Machine finished surfaces shall be protected against corrosion by a rust inhibiting coating that can be removed prior to erection.

9 ERECTION PROCEDURE

The contractor shall submit to the Owner the planned mobilization of plant and equipment for approval.

Loading and transportation shall be done in accordance with transport rules prevailing at that location Items shall be packed to protect them from damage/distortion. Small parts shall be securely wired to their main members.

Loose items such as Bolts, nuts and washers shall be packed in crates.

Contractor is responsible to follow all safety guide lines by AIL and **IS 7205** during each and every stage of steel structure construction.

Unwanted material not be stacked at work location, materials need to be shifted as per readiness and clear work front for erection.

- Erection work shall be permitted only after the foundation or other structure handover which the steel work is to be erected, is accepted and is ready for erection.

- Before erection, respective foundation shall be handed over to structure team with signed applicable formats.

- Leveling pads must be grouted (by non-shrink grouting material) on the top of foundation in order to support the column and allow for shimming below columns base for proper alignment.

- Structure shall be installed after minimum 24 hours of curing of the level pads.

- Foundation preparation and checking shall be done to check elevation, orientation, bolt details, cleaning of bolt sleeves/ pockets, chipping of foundation surface and placement of packing plates etc. In case noticed any deviation regarding position of anchor bolts or foundation, it will inform to the engineer concerned immediately.

- Equipment’s used for erection, shall have suitable capacity to facilitate safe erection. All statutory requirements for lifting tools & tackles shall be complied.

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

- Tolerances for erection of steel structure shall be as per mentioned below. Verticality shall be checked by theodolite for all structures more than 3m height. Less than 3m to be inspected by magnetic spirit level/ plump.

- No permanent bolting or welding shall be done until proper alignment is achieved. Holes for all erection bolt shall be plugged after removal of bolts after final erection. Alternatively, erection bolts may be left and secured.

- Proper sequence of erection shall be followed to allow erection of member without fouling with fouling with other members and avoid rework.

- The bolting shall be done is such a fashion that the threaded portion of each bolt shall project through the nut at least one thread.

- The bolted joints shall be tightened so that entire surface of the bolt beads and nuts shall rest on the member.

- The members which are bolt assembled shall be set according to drawings and temporarily fastened with erection bolts (minimum 4 nos.) to check the co-axially of the holes.

- All members shall be finally bolted after the deviations have been corrected, after which there shall not be gaps through which 0.02 mm filler gauge may pass for depth more than 20 mm.

- Packing / shim plates of suitable profile will be used to get frictional grip and to maintain true level and verticality wherever required.

- During all stage of installation safe erection practice shall be followed. Proper access, platforms and safety arrangements shall be provided for working and inspection whenever required.

- To resist wind or seismic forces acting upon components of the finished structure installed temporary bracing and guys shall be arranged. Temporary arrangements shall be removed after completion of plumbing, leveling, aligning and grouting of the erected steel structure unless otherwise agreed arrangements are made.

- Tower cranes are not permitted for steel structure erection.

Tolerance: -

Structural steel work shall be fabricated, and erected within the tolerances specified in **IS:7215**(fabrication) and **IS:12843**(Erection) with the exception of those items specified below.

Maximum Permissible Tolerances in Erected Steel Columns as Per IS 12843

1	**Deviation of column axis at foundation top level with respect to true axis:**	
	In longitudinal direction	**±5mm**
	In lateral direction	**±5mm**
2	**Deviation in the level of bearing surface of columns at foundation top with respect to true level**	**±5mm**
3a	**Out of plumpness(verticality) of column axis from true vertical axis, as measured at column top:**	
	For columns without any special requirements:	
	Up to & including 30m height	**±H/1000 or ±25mm whichever is less**
	Above 30m height	**±H/1200 or ±35mm whichever is less**
3b	**For columns with special requirements like cranes such similar**	
	Up to & including 30m height	**±H/1000 or ±20mm whichever is less**
	Above 30m height	**±H/1500 or ±25mm whichever is less**
4	Deviation in straightness in longitudinal and transverse planes of column at any point along the height	±H/1500 or ±10mm whichever is less
5	Difference in the erected positionsof adjacent pairs of columns along length or across width of building prior to connecting trusses;beams with respect to true distance	±5mm
6	Deviation in difference in bearing levels of a member on adjacent pair of columns both across and along the building	±5mm

NOTE:-
1. Tolerance specified under 3(a) and3(b) should be read in conjunction with 4 and 5.
2. 2 'H' is the column height in mm.

Maximum Permissible Tolerances in Erected Steel Trusses & Beams

1	Shift, at the centre of span of top chord member with respect to the vertical plane passing through the centre of bottom chord	±1/250 of height of tress in mm at centre of span or ±15mm whichever is less.
2	Lateral shift of top chord of truss at the centre of span from the vertical plane passing through the centre of supports of the truss	±1/1500 of span of tress in mm or ±10mm whichever is less.
3	Lateral shift in location of truss from its true axis in plan	±10 mm
4	Lateral shift in location of purlin from true position	±15 mm
5	Deviation in difference of bearing levels of trusses from the true difference	±1/1200 of span of truss in mm or ±20mm whichever is less.

Maximum Permissible Tolerances in Erected Steel Crane Girders & Rails

1	Shift in the centre line of crane rail with respect to centre line of web crane girder	± web thickness in mm /2 +2
2	Shift in plan of alignment of crane rail with respect to true axis of crane rail at any point	±5mm
3	Deviation in crane track gauge with respect to true gauge	
	a)For track gauge up to and including 15 mm	±5 mm
	b)For track gauge more than 15 m	±[5 + 0.25 (S- 15)] mm subject to a maximum of ± 10 mm, where Sin meters is true track gauge
4	Difference in levels between crane track rails at:	
	a) supports of crane girders	15mm
	b) mid span of crane girders	20mm
5	Relative shift of crane rail surface at a joint in plan and elevation	2 mm subject to grinding of surfaces for smooth transition

10 ALIGNMENT

Before raise RFI to AIL, contractor need to complete alignment and tightening of entire structure and inspect to ensure all activities are done as per the IS 12843 guidelines mentioned above accordance with project specification and AIL SOP.

If noticed any discrepancy during AIL inspection, contractor fully responsible to rectify the occurred issue without any cost and time impact to the owner.

Inspection: -

All inspection shall be performed in accordance to the approved Inspection Test Plan (ITP):

Pre-Erection Checks

- Physical inspection of structure to ensure free from any damage during transpiration
- Paint touch-up on damaged areas
- Availability of foundation release note & ensure Hacking completed on civil foundation surface to facilitate grouting.
- Availability of inspection reports/IRN of fabricated structures.
- Correctness of location, fasteners materials size, grade and quantity.
- Orientation of bracing, columns, grid beams, floor beams etc…
- Check and ensure the position and mark number the members
- Installation of bolts, washers, nuts, check nuts and tightness of pre- assembled structure.
- Modification requirement prior or after installation if any.

Post-Erection Checks

- Ensure all members are installed as per drawing. (GB,TB,FM,SC,CL,CT,VB,HB,KB,MR,platforms,handrail, stairways, ladders, ladder barriers ,chequered plate, grating, grating hold down clamps)
- Ensure all members are secured by bolting or welding as per the drawing.
- Tightening of bolts as per specification/IS 4000, Torquing on high tensile bolt 8.8 grade.
- Alignment of all structure members.
- Verticality of columns, stub columns, cable tray supports, cage and cat ladders.
- Field welding completion (splice joints of columns, welding with insert plates, nuts for fire proofing) where ever applicable.
- Grouting of foundation
- Painting touch-up Inspection
- Final inspection of structure and acceptance
- Hand over to further activities. (Like piping, equipment erection, electrical, instrumentation and fire proofing)

11 GROUTING

Before grouting all packing plates need to be tack welded which is placed under the base plate of columns.

If set-nuts are provided under the base plates, nuts to be hand tightened and touched to base plate bottom.

All bolt sleeves and foundation surface need to clean and ensure proper socking before grouting.

After completion alignment all columns need to grouted (wherever is applicable) with non-shrink grouting material as per the project specification.

Ensure 7days proper curing after grouting of columns without any fail.

12 HEALTH SAFETY & ENVIRONMENT

The contractor shall take necessary safety measures to comply with IS: 7205 and shall ensure that hazardous or unsafe working conditions do not exist during any stage of erection During erection, the contractor shall ensure that all loads due to wind, erection equipment etc. is catered for either by introducing temporary bracing or guy wires. The guy wires shall not be anchored from other adjoining permanent structures.

AIL will not provide any extra cost to the contractor, to arrange proper access, platforms, scaffolding, cherry picker and other safety arrangements at work site.

Contractor shall responsible to protect the environment during the period of construction, need to take more care during grit blasting, painting and avoid spillage of oil, diesel, petrol and paint, concrete, grouting materials and additives which are using at site.

- All necessary HSE requirements shall be followed:
- TBT will be mandatory before commencement of any job.

- Responsible to follow communication protocol without any fail.
- Contractor is responsible to avail proper work permit from AIL before commence any activity at site. And responsible to complete the work as per the work procedure with the compliance of all necessary safety and quality standards.
- Confined space awareness training needs to attend before such type of works and avail confined space permit separately.
- Vertigo test need to conducted for height work peoples. (where ever is applicable as per AIL safety standard)
- Emergency and response plan shall be followed in case of any emergency.
- Site security procedure shall be followed.
- Hazard identification and risk assessment and mandatory PPE shall be followed.
- First aid arrangements shall be followed as per procedure.
- Competent personal inspection certificated must for operating lifting equipment like Fharana, fork lift, boom loader, cherry picker, and all lifting tools and tackles.
- Competent personal inspection certificated must for compressor, hopper and air purifier.
- In absence of permanent platform or floor, proper scaffolding platform or cherry picker need to use during working at height.
- Tower cranes are not permitted for structure erection works.
- Man, basket's load calculation and competent personal inspection certificate was must at for its use.
- Ensure all peoples are wearing appropriate PPEs at work site.
- Rope ladders are not permitted at site.
- Ensure Fall arrester and three-point contact of personal be while using ladders.
- Full body harness and life lines are mandatory during height work.
- Flag man compulsory during movement of construction equipment.