FABRICATION METHOD STATEMENT

ATAK ENGINEERING CONSTRUCTION TRADE INC. CO.
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1.0 SCOPE OF WORK
The purpose of this procedure is to describe the fabrication methods, welding techniques, quality assurance and quality inspections to be carried out about welding, weld repair and weld inspections for ATAK Engineering Construction Industry Co. Inc.

2.0 PROGRAMME
Programme for Fabrication works refer to ATAK Structural Steel works Programme.

3.1 MATERIALS

3.2 Material Supply
The quality of materials should be according to Customer specifications and drawings. The Grade of structural steel shall conform to European Standard EN 10025 as noted on the drawings with minimum yield strength as specified below:

The steel shall be free from loose mill scale, surface defects, flaky rust, slag inclusions, laminations, pitting and be of full weight or thickness within tolerances specified in standard.
Approved Steel suppliers will be used. As a normal practice mill certificates will be made available for steel ordered. Substitution if any, on sizes or quality shall be implemented only after obtaining approval from the Owner / Engineer.

All steel supplied shall be stored in a safe condition with proper care taken during storage to ensure that no damage occurs, which renders the materials unserviceable.
All steel material shall be stored at the shop/yard above the ground on the platforms, skids or concrete blocks.

Materials for this project shall be marked differently from the other project material. The identifying and marking system shall be established. All steel material procured shall be properly documented to ensure conformity to specifications and it shall be the responsibility of the control foreman or staff to ensure conformity of steel to the specifications.
3.2. Material Identification and Traceability

After receipt of raw material warehouse responsible shall verify the material and forward the Raw material inspection report to quality acceptance. Project Engineer will inspect the raw material and verify the heat number correlation and material specification. On acceptance, Quality staff will give a Material Code number for punching as per Identification and Traceability Procedure. Refer Project Quality Plan.

The Fabrication Engineers / Foreman shall be responsible to arrange to mark the Item number and punch the material code number on each member.

4.1 METHOD & SEQUENCE OF THE WORK

4.2 Fabrication
The fabrication of steel works shall be carried out as per approved drawings and specification provided by ATAK. The method and sequence of fabrication is given in the following chapters.

4.3 Fabrication Process
4.3.1 Cutting Plans
The cutting plan shall be prepared for all material before commencement of fabrication work. Material mark number shall be provided for easy identification.

4.3.2 Marking
Marking shall be carried out as per approved cutting plan under the guide lines of fabrication foremen, and subsequently verified by the Fabrication engineer prior to cutting. Prior to marking the material shall be checked for its identification and the defects. Necessary items shall be carefully and accurately marked in accordance with approved shop drawings or templates.

4.3.3 Cutting
Material cutting shall be carried out either by shear, plasma, CNC Profile cutting and drilling machine, pug cutting machine. The edges of all plates shall be perfectly straight and uniform throughout. Cut edges shall be visually examined for laminations and inclusions. All corners shall be shaped so as to be notch free, sheared or cropped edges shall be dressed so that they are free from distortion and burrs. Edge preparations for field welding shall be done in the shop.

4.3.4 Cutting of Heavy Section:
The relevant standard rolled shapes or plate’s thickness exceeding 50 mm before cutting pre-heating (Min 66°C) shall be used. All cut edges shall be free of sharp notches and gauges.

4.2.4 Straightening
All steel material shall be straight and free from bends or twists. If the sections are distorted or twisted during transit, storage etc. they shall be straightened and/or flattened by straightening machine at ambient temperature, though minor bends may be corrected by limited heating under supervision.

4.2.5 Bending
The bending of plates and sections to specially required shapes shall be done on appropriate machine.

4.2.6 Holes
Punching and or drilling shall be done accurately as per the drawings and burrs removed effectively. Where several parts are to be connected to very close tolerances, such parts shall be first assembled, tightly clamped together and drilled through. All holes shall be minimum 1.5mm larger than the size of the bolt. The holes shall be drilled / reamed within the allowable limits specified in Project specs. Holes for bolts shall not be formed by a gas cutting process except in special case with specific permission of the customer.

4.2.7 Notches
The ends of all joints, beams and girders shall be cut truly square unless required otherwise and joist flanges shall be neatly cut away or notched where necessary, the notches being kept as small as possible.

4.2.8 Assembly
Structures shall be assembled in jigs or on suitable surfaces plates with proper layouts. The parts to be joined groove welds shall be brought into correct alignment. The members to be welded shall be held in the correct position by bolts, clamp and wedges where practicable. Any wedges used to space root gaps shall be removed from the root gaps immediately after tack welding and before making the root run. After completion of joint fit-up, ATAK controlor will check the fit-up and he will release the joint for welding.

The fabricated components shall be assembled in such a manner that they are neither twisted nor otherwise damaged. In order to minimize distortion in a member the components shall be positioned by using clamps, clips, jigs and other suitable manner and fasteners shall be placed in a balanced pattern.

If necessary items like roof trusses shall be trial assembled as per approved assembly drawing keeping in view the actual site conditions prior to dispatch to site for erection, so that, they can be conveniently preassembled before erection. Necessary match marks shall be made on these components before disassembly in the shop and dispatching.
4.2.9 Bolting
All bolt and nuts shall be used as per approved shop drawing and contract specification. Anchor bolt and nuts shall be as per specification.

4.2.10 Welding
Welding procedure qualifications and welders and welding operators’ performance qualification test shall be made in accordance with BS EN ISO or relevant ASTM standards.

4.2.10.1 Edge Preparation Inspection
The edges or surfaces of parts to be joined by welding shall be uniform, smooth and cleaned from all foreign materials such as moisture, slag, oil, grease, paint, scale or rust. Edge preparation shall be verified for proper groove angle and root face dimensions. Welding groove dimensions shall be inspected as per shop drawings under tack-welded condition prior to welding. The allowable misalignment of adjoining plates to be butt-welded shall be in accordance with AWS D1.1 or BS-EN-ISO.

4.2.10.2 Fit-up Assembly
The Members or Plates to be welded are fit-up, aligned and retained in position to welding operations. The location of integral parts / members to be assembled shall be checked dimensionally prior to full welding. Tack welds shall be use for secure alignment. Generally, the tack welds shall be subject to the same quality requirement as the final welds unless otherwise specified. Tack welds containing any cracks shall be removed thoroughly and replaced with sound tack welds. Size and location of tack welds based on Specification.

4.2.10.3 Backing Strip Inspection
Back-stripped surfaces shall be visually checked for root gap prior to start welding.

4.2.10.4 Welding Process
- The following practices shall be used for welding.
  - Run-on and run-off plates shall be welded at the ends of weld lines of crucial butt welds.
  - Prior to welding the surface to be welded and filler material to be used shall be checked.
  - Prior to welding root opening, groove angle and the crucial dimensions shall be checked and groove face shall be free from oil, water and dirt.
  - Prior to welding the welding current shall be measured the most appropriate welding condition (current & voltage) shall be maintained with ammeter and voltmeter through out welding work.
  - All welding is to be carried out in an approved environment and, if necessary, additional protection may be required. All joints are to be dried before welding in damp climatic condition.
During welding work, the most appropriate arc length, angle and welding speed shall be maintained so that welding defects shall be avoided and arc energy requirements are satisfied.

- Fillet weld terminating at the end of members shall be returned continuously around the corner for a distance of not less than twice the size of the weld.

- Surfaces of butt joints required to be flush shall be finished so as not to reduce the thickness of the inner base metal or weld metal than 1mm or 5% of the thickness whichever is the smaller not leave reinforcement that exceed 1mm. All reinforcement shall blend smoothly into the plate surfaces with transition areas free from undercut.

- Chipping and gouging shall be used, provided grinding follows them.

- In the case of multi layer welding, slags and spatters on each completed bead shall be removed prior to the start of welding for the following layer.

- All craters shall be filled to the full cross section of the welds.

### 4.2.10.4.1 Type of Welding Process

All Welding activities shall be carried out as per the approved Welding procedure specification. The following Welding Process used in Fabrication works:

- MIG & MAG Process
- SMAW Process
- FCAW Process
- SAW Process

### 4.2.10.4.2 Electrodes

The electrodes used for welding shall be of suitable type and size depending upon specifications of the parent materials, the method of welding, the position of welding and quality of welds desired. However, only low hydrogen electrodes (E 7018) shall be used for plates and sections.

All low hydrogen electrodes shall be baked and stored before use as per manufacturer’s recommendation. The electrodes shall be re-baked at 250 °C to 300° C for one hour and later on cooled in the same oven to 100°C. From baking oven the electrode shall be transferred to a holding oven maintained at 60° C–70° C. The electrodes shall be drawn from this oven for use. Where coated electrodes are used they shall meet the requirements of relevant BS-EN-ISO Standard, Bare Electrode and Granular flux conform to relevant BS-EN-ISO Standard. Where Charpy V – Notch values are required on the base metal, an electrode meeting the requirement of BS-EN-ISO or AWS and having a minimum average Charpy V- notch impact strength of 25 ft, lbs at –20°c.
4.2.10.4.3 Preheat and Inter-pass Temperature
Preheating of above 65 degree C shall be applied for over 38mm thick of S355JR, JO, J2 and K2 steel plate by means of oxy- acetylene flame or non-carbonizing like LPG. Uniform heating of the surface extending up to a distance of three times the thickness of the plate on either side of the plate shall be obtained. Preheating minimum 177 degree C shall be applied for relevant BS-EN-ISO Standard rolled shapes or plates equal or grater than 50mm in thickness joined by partial or full penetration welds in tension The specified preheat temperature and minimum inter-pass temperature shall be maintained during welding progress. Thermo-chalk or other approved methods shall be used for measuring the plate temperature.

4.2.10.4.4 Sequence of Welding (Control of Distortion and Shrinkage)
- The sequence of welding shall be selected to ensure that the components assembled by welding are free from distortion and large residual stresses are not developed
- In assembling and joining parts of a structure or of built – up members and in welding reinforcing parts to members, the procedure and sequence shall be such as will minimize distortion and shrinkage.
- In so far as practicable, all welds shall be deposited in symmetrical sequence so that shrinkage on both sides of the structure will be equalized.
- Joints expected to have significant shrinkage shall be welded before joints expected to have lesser shrinkage and with as little restraint as possible.
- All shop splices in each component part of a cover plate beam or built – up members shall be made before such component part is welded to other components parts of the member.
- All welding shall be carried out continuously to completion or to a point that will ensure freedom from cracking before the joints is allowed to cool below the minimum specified preheat and inter- pass temperature.
- Butt weld in flange plates and / or web plates shall be completed before the flanges and webs are welded together.
- The ends of butt welds shall have full throat thickness. This shall be obtained on all main butt welds by the use of run off and run on pieces adequately secured on either side of main plates. Additional metal remaining after the removal of extension pieces shall be removed by grinding or by gas cutting.

4.2.10.4.5 Visual Examination of Welds
Each reinforcement height for butt welds and leg dimensions for fillet welds shall be checked in addition to bead contour appearance. Also, possible presence of such service defects, undercut, crack, surface porosity etc. shall be checked visually. The reinforcement on each side of butt-welded joints shall be checked in accordance with AWS D 1.1 or BS-EN-ISO
Temporary lugs, braces and clips shall be welded in connection with WPS and these shall be removed without damaging the base metal and the area ground flash and smooth.

4.2.11 PROCEDURE FOR BUILT UP GIRDERS / BEAMS

4.2.11.1 Preparation of Material

Marking of steel shall be done in accordance with the shop drawings and cutting plan. Material cutting shall be carried out by gas. Either by pug cutting or CNC machine to cut the plates to the required sizes. The dimensions and shape of the edges to be joined by welding shall be checked as per approved drawing / specification. Surfaces and edge preparation shall be free from loose scale, slag, grease, paint and other foreign matter. Edge preparation shall be verified for proper groove angle and root face dimensions. Joint surfaces shall be free from fins and tears.

4.2.11.2 Fit-up Assembly

Built up Girder Structure shall be assembled in jigs or on suitable surfaces plates with proper layouts as per the Drawing. Butt weld in flange plates and / or web plates shall be completed before the flanges with web fit-up Assembly. The Flange Plates shall be fit –up with web plate, for correct alignment and held in position by use suitable devices or by tack welds until welding is completed to assure the most suitable welding position and accurate assembly. After completion of Flanges and Web joint fit-up, ATAK Controlor shall be check the fit-up and release for welding.

4.2.11.3 Welding Process

Welding shall be carried out as per the approved Welding procedure specification (WPS) and welders. Run-on and run-off plates shall be welded at the ends of the Girder / beam. Before welding start, joints shall be preheated above 65°C by means of gas flame to bring to the specified preheat temperature in the full thickness of the base metal for a distance equal to the thickness of the part being welded. (Thickness t > 38 mm) specified preheat temperature and minimum inter-pass temperature shall be maintained during welding progress. The temperature shall be checked by thermal chalk. The approved electrodes shall be used for welding as per WPS. During welding most appropriate arc length, angle and welding speed shall be maintained so that welding defects shall be avoided.

In the case of multi layer welding, slags and spatters on each completed bead shall be removed prior to the start of welding for the following layer. After completion of welding all Temporary lugs, Run-on and run-off plates shall be removed without damaging the base metal and the area ground flash and smooth. All welding area shall be clean and inspect as per specification. After completion of inspection and test for girder release for further fabrication activities.

4.2.12 NON-DESTRUCTIVE TESTING (NDT):
All non-destructive testing shall be performed as per approved agency as per the contract in accordance with the requirements of the applicable standards and project specifications. Non-destructive Testing shall be performed as follows:

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Description</th>
<th>Visual Inspection</th>
<th>NDT TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>UT</td>
</tr>
<tr>
<td>1</td>
<td>Raw material plate thickness 50 mm and above</td>
<td>100%</td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>Full penetration butt welds</td>
<td>100%</td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>Partial Penetration butt weld</td>
<td>100%</td>
<td>X</td>
</tr>
<tr>
<td>4</td>
<td>All fillet weld</td>
<td>100%</td>
<td>X</td>
</tr>
</tbody>
</table>

X : Project Specification

A third party Inspection agency shall be engaged as independent and approved testing and inspection agency to carry out the UT and MPT on Weldments. (If there is project specification)

4.2.12.1 General Requirement Of Visual Inspection

Weld Visual inspection shall be carried by Fabrication Engineers or certified Welding Inspector as per BS-EN-ISO standard for external defects like, surface porosity, under cut, excess penetration, over laps, lack of penetration or incomplete fusion and fillet sizes.

4.2.12.2 General Requirements Of Liquid Penetrant Testing (PT)

Liquid Penetrant Testing procedures shall be in accordance with ASTM E 165 or relevant BS-EN-ISO Standard. This test shall be carried during the welding process while back gouging. The evaluation of indications and the acceptance criteria shall be in accordance with Sec.VII Div.1 ASME code or relevant EN-ISO standards.

4.2.12.3 General requirements of Magnetic Particle Testing (MT)

Magnetic particle Testing procedures shall be in accordance with ASTM E 709, AWS D 1.1 or relevant BS-EN-ISO Standard. The evaluation of indications and the acceptance criteria shall be in accordance with ASTM E 709, AWS D 1.1 or relevant BS-EN-ISO Standard. Independent testing authority MPI reports shall be obtained for fillet welds.
4.2.12.4 General Requirements Of Ultrasonic Examination (UT):
The ultrasonic Testing of plates for lamination shall be in accordance with SA 435 and UT of Butt joint shall be in accordance with ASTM E 164, AWS D 1.1 or relevant BS-EN-ISO Standard. Independent testing authority UT reports shall be obtained for all butt joints.

5. DIMENSIONAL INSPECTION
The fabricated steel structure shall be inspected in accordance with respective approved fabrication drawings and specification. Over all length, orientation, diagonal measurement and all other dimensions shall be verified and recorded. If dimensions are not with required tolerance the member shall be corrected prior to further process. All dimensions shall be recorded in approved format. 100% visual inspection shall be carried out for external defects. ATAK Quality staffs shall conduct the final inspection and review all inspection reports and prepared as inspection and test plan (ITP).

6. PROTECTION

6.1 SHOT BLASTING (Surface Preparation)
Abrasives for blast cleaning shall be clean, dry and free of any constituent. Silica sand shall not be used. Surface preparation shall be in accordance with ISO 8501-01 and technical data sheet of specified paint. Abrasive shall be of steel grit and shot in the ratio of 70% - 30%. The surface grade finish shall be Sa 2 ½ or as recommended by manufacturer. Surface profile shall not be less than 15 microns and more than 150 microns, since too low height, prevents proper adhesion and too high profile may lead to profile peaks protruding the coating resulting in early pinpoint rusting. Paint shall be applied to dry, clean prepared surfaces under controlled favourable weather conditions and in accordance with manufacturer data sheet.

6.2 Painting Application
Painting shall be applied as per the project specification. Dry film thickness shall be checked prior to shipment to project site and painting inspection report shall be maintained. Preparation generally shall comply with requirements SSPC and printed instructions of the manufacturer. Check that all coating materials to be used are recommended by the manufacturers for the particular surface and condition of exposure. Painting shall be carried out with skilled workers. All coating materials shall be applied evenly in a continuous full coat free from over-spray, dry-spray, wrinkling, sagging, curtaining, holidays, thin spot, pinholes and other film defects.

7. PACKING AND DELIVERY
The painted structures after fabrication shall be protected from further damage during transportation. The materials will be loaded on to the trailers using timber supports and separators and secured properly to prevent any damage to the material while transportation to site. Fabricated items will be delivered loose. Minor fabricated items, which are not likely to be subject to permanent deformation during handling operations (i.e. bracing etc) maybe bundled or hoped. Small items (i.e. bolts, loose, cleats etc) will be packed in crates/drums or loaded on pallets.

8. INSPECTION AND TEST PLAN

Approved Inspection and test plan shall be implemented during each and every stage of fabrication, to ensure the work is carried out with full compliance drawings and specification. The Inspection and approving parties as per ITP shall ensure the quality of work at every level.