DESIGN OF A BASIC MODULE FOR EMERGENCY SITUATIONS:

Project Of A Fast Deployable Transitional Shelter Unit For Emergency Situations

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Call: February 2015
## 1 | Tender of Specifications

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1. **Scope of work**

This Tender of specification, which belong to the present document, has the objective of determine the execution and assembly of metallic structures and its related components, as well as defining the characteristics and quality of materials needed to guarantee the safety of people and structural security. This specification covers the requirements for material, storage, preparation of fabrication, drawings, fabrication, assembly, tests/examinations, transportation and erection of a steel frame structure with panel covering.

2. **Reference**

All the reference standards and rated specifications shall be the current issue or latest revision at the date of the tender advertisement.

- REAL DECRETO 314/2006, de 17 de Marzo por el Ministerio de la Vivienda por el que se aprueba el Código Técnico de la Edificación (CTE), según B.O.E.:28 de Marzo de 2006. (Documento Básico – Seguridad Estructural - Acero).

- CTE-DB-HS Código Técnico de la Edificación Documento Básico HS salubridad.


- EAE Instrucción de Acero Estructural

- Documento Básico SE-AE Acciones en la edificación. SE-AE.
3. Equipment and material requirements

- The Contractor shall submit manufacturers' quality certificates for all the materials supplied by him. In case, quality certificates are not available or are incomplete or when material quality differs from standard specifications, such materials shall not be used in the construction. However, the Contractor shall get all appropriate tests conducted in approved test houses for such materials as directed by the Engineer-in-Charge, at no extra cost, and submit the same to Engineer-in-Charge for his approval. The Engineer-in-Charge may approve the use of such materials entirely at his discretion.

- The Contractor shall ensure that all materials brought to site are duly approved by the Engineer-in-Charge. Rejected materials shall not be used and shall be removed from site forthwith. Any material of doubtful quality for which specific tests are to be carried out as per the instruction of the Engineer-in-Charge shall be separately stacked and properly identified and shall not be used. These shall be removed from site forthwith.

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

- All sections shall be checked, sorted out and arranged by grade and quality in the store. Any instruction given by the Engineer-in-Charge in this respect shall be strictly followed.

- All material shall be free from surface defects such as pitting, cracks, laminations, twists etc. Defective material shall not be used and all such rejected material shall be immediately removed from the store/site. The decision of the Engineer-in-Charge in this regard shall be final and binding.

- Welding wires and electrodes (packed in their original cartons) shall be stored separately by quality and lots inside a dry and enclosed room. Electrodes shall be kept perfectly dry to ensure satisfactory operation and weld metal soundness.

- Each lot of electrodes, bolts, nuts etc. shall be accompanied by manufacturer's quality/test certificates.

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

3.1 Structural Steel

- All structural steel shall be of tested quality. The material purchased has to meet the regulation standards. The conforming material selected S275JR is ensured to keep all the features of the structure.

- Other structural members such as hangers, louver frames, braced rods, snap fits, fasteners can be confirming to EAE Instrucción de Acero Estructural S275JR yield strength

- Wherever the material is procured by the contractor, the contractor shall submit the test certificates conforming to the relevant standards of all steel materials used for assembly and manufacturing.
- All structural steel shall be free from blisters, rust, scales, seams, lamination, cracks, fissures and other surface defects.

- Carbon steel pipes/tubes for structural purposes shall be mill formed steel sections conforming to EAE Instrucción de Acero Estructural S275JR.

3.2 Bolts and Nuts

- High strength bolts shall be hot dip galvanized and conforms EAE Instrucción de Acero Estructural S275JR.

- Class 8.8 Type 1 (or equivalent) used to connect primary members.

- Machine bolts are electro-galvanized with a yellow chromate color conversion coating and conform to DIN 933 Class 4.6 (or equivalent) which may be used to connect secondary members like purlins and girts.

- Anchor bolts shall be manufactured from rods conforming to EAE Instrucción de Acero Estructural S275JR.

- Anchor bolts shall be provided along with necessary templates during fixing of anchor bolts.

- Nuts shall be of at least the strength grade appropriate to the grade of bolts or other threaded elements with which they are used.

3.3 Welding

- Covered electrodes (for metal arc welding of structural steel) shall conform to EN ISO 5817.

- Filler rods & wires for gas welding shall conform to EN ISO 16834.

- Base wire electrodes (in submerged arc welding of structural steel) shall conform to EN ISO 18276.

- The combination of wire and flux shall comply with the requirements of EN ISO 14174.

- Filler rods & base electrodes (for gas shield arc welding of structural steel) shall conform to EN ISO 26304.

- Welding consumables & procedures shall be such that the mechanical properties of deposited weld metal are not less than the respective minimum values for the parent metal being welded. Conform to EN 13479, EN ISO 6848.
3.4 Fabrication Drawings

- Fabrication and erection drawings shall be prepared by the Contractor on the basis of "Approved for Construction (AFC)" design drawings, MMCI Standards issued to the Contractor. These drawings conforming to ISO standards shall be prepared by the Contractor or by an agency appointed by the Contractor and approved by the Engineer-in-Charge.

- Fabrication and erection drawings shall be thoroughly checked, stamped "Approved for Construction" and signed by the Contractor's own responsible Engineer irrespective of the fact that such drawings are prepared by the Contractor or his approved agency, to ensure accuracy and correctness of the drawings. Unchecked and unsigned drawings shall not be used for the purpose of proceeding with the work. 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 simultaneously be submitted to the Engineer-in-Charge who may check/review some or all such drawings at his sole discretion and offer his comments for incorporation in these drawings by the 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 (AFC)" design drawings issued to the Contractor or as conveyed by the Engineer-in-Charge. The fabrication of such structures shall be done only as per the reviewed fabrication drawings.

The review of such drawings by MMCI shall be restricted to the checking of the following only:

- Structural layout, orientation and elevation of structures members
- Sizes of members
- Critical joint details.

Fabrication drawings shall be drawn to scale and shall convey the information clearly and adequately. Following information shall be furnished on such drawings:

- Reference to design drawing number (along with revision number) based on which fabrication drawing has been prepared.
- Structural layout, elevations & sections (with distinct erection marking of all members).
- Framing plans, member sizes, orientation and elevations.
- Layout and detailing of rain water pipes and gutters showing all necessary levels, connections and provisions wherever required.
- Detailing of shop/field joints, connections, splices, for required strength and erection.
- Location, type, size and dimensions of Welds and Bolts.
- Shapes and sizes of edge preparation for welding.
- Details of shop and field joints/welds.
- Bill of materials/D.O.D. Lists.
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- Quality of structural steel, plates etc., welding electrodes, bolts, nuts and washers to be used.
- Erection assemblies identifying all transportable parts and sub-assemblies with special erection instructions, if required.
- Method of erection and special precautions to be taken during erection as required.
- The design of ladders, platforms, handrails, stairways & the like shall be as per standard drawings.

The Contractor shall additionally ensure accuracy of the following and shall be solely responsible for the same:
- Provision for erection and erection clearances.
- Marking of members
- Cut length of members
- Matching of joints and holes.
- Provision kept in the members for other interconnected members.
- Bill of materials/D.O.D. Lists.

- Connections, splices and other details were not shown on the design drawings shall be suitably designed and shown on the fabrication drawings based on good engineering practice developing full member strength. Design calculations for such connections/splices shall be submitted to the Engineer-in-Charge along with the fabrication drawings.

- Any substitution or change in section shall be allowed only when prior written approval of the Engineer-in-Charge has been obtained. Fabrication drawings shall be updated incorporating all such substitutions/changes by the Contractor at no extra cost to the Owner.

- In case during execution of the work, the 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 the Contractor who shall incorporate the same in the drawings and works without any extra cost to the owner. The Contactor will be totally responsible for the correctness of the detailed fabrication drawings and execution of the 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 the Owner. All fabrication shall be carried out only as per 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 in-Charge for reference and record. The rates quoted shall include for the same.

3.5 Canopy

Supplied Items shall be understood as clear span tents and canopies (no side walls and no high peaked roof) of certain sizes, areas and types as specified below (“Tents”). The Supplier shall obtain all licenses, certifications, approvals and permits as it may be required in relation to the supply of the Tents, including but not limited to structural calculations and fire resistance certifications. The Supplier is responsible to provide all
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engineering services and documentation necessary to obtain such licenses, certifications, approvals and permits. The following are the generic elements and services that all types of Tents must include and which cost shall be included in the Unit Prices of the Supplied:

- Tents shall be provided with floor when specified
- Floors shall have slip-resistant surface when required
- Floors shall be leveled on installation
- Tents and understructures must be provided with appropriate anchoring / ballast / footing system
- The Supplier shall confirm the application method for anchor/stake or ballast (optional item)
- Wall and roof shall be in compliance with Building Codes regarding Fire Rating
- Tents shall be entirely weatherproof and include appropriate drainage system with no leaks where required and shall be directed to drainage
- External single door: height = 2,100mm / width = 900mm
- External double door: height = 2,100mm / width = 2 x 800mm, except otherwise specified
- All doors shall have steel or metal frame, fiberglass, metal or wood panel and either glass or Plexiglas (solid) insert (or similar) on the upper part of the door
- All doors shall close properly
- All doors shall be new or like new finish.

3.6 Panels

Taking into account the stipulated implementation type, the test involves checking the existing substrate using simple methods customary in the trade (e.g. visual, measurement). To be checked in particular: Uniformity with regard to type and nature; longitudinal and cross gradient; Alignment and horizontals at the cornices and eave edges; existence and position of supply and exhaust air apertures. The contractor’s duty to check does not include in-depth technical or chemical inspections. The possible necessity of snow guards is pointed out.

A laying plan with bill of materials must be compiled prior to starting any work. In the course of this, item numbers are allocated which must be reflected in the plan, the bill of materials and on the packaging label, if possible. The technician compiling the documentation must furthermore include the laying direction of the panels. Before doing this, the technician must ask the customer about the main weather direction and have this verified. Using the laying plans, the site foreman attempts, as far as possible, to distribute the packages around the building in a practical way whilst the truck offloads. Never change the laying direction on the same façade. This will produce different appearances in oblique light. An example of such a laying plan is shown on the next page.
Bills of materials Draw up bills of materials which must correspond absolutely with the laying plans and show item numbers. This makes allocations easier and optimizes working processes. For reasons of time and cost, it would be wiser to order cut-outs for transverse joint overlaps and in the eaves area from us.

Be sure to specify the number and type of fasteners in the laying plans in order to make this information available to the fitters on site. Provide the verifiable static loading calculations on request of the builder.

Handling and storage of panel packages: Always store the panel packages sloping lengthwise to allow rainwater to flow off and away. Canvas covers must be used for long-term storage of panel packages in the open. Canvas covers allow fast ventilation of the packages. Avoid stagnant water between the panels at all cost. Even with surface treated sheet metal, this could cause lasting damage (stains, corrosion, white rust)! To avoid pressure marks, do not stack packages on top of one another. Secure opened packages against lifting during a storm (e.g. with straps or similar). For static loading reasons, intermediate storage on the roof structure must only be above the trusses; never stack in the centre of the purlin span! Coordinate your intentions with the builder of the structure or the site manager.

Use edge protection profiles under the hoisting straps of a crane. A crossbeam must be used for panel lengths > 8.00 m. Lift only one panel package at a time. If a forklift is used for offloading, the driver must operate with extreme care. Space the forks as far apart as possible. If necessary, use two forklifts when handling very long panels.

Repairing surface scratches A small (watercolor) brush can be used to repair minor damage to the surface coating, caused during transportation or installation. Ensure that you buy paint that can be applied to a galvanized substrate in a single layer and is of the same RAL colour as the panel. Repairs on metallic surfaces, such as RAL 9006 white aluminum for instance, are difficult. Micro-metal particles of aluminum dust incorporated in the resin reflect light at different angles, which creates this effect. This makes repairs very difficult of course.

Protective film In the course of continuous production, most panel manufacturers roll on a self-adhesive film to protect the sheet metal surfaces. Remove this protective film prior to or immediately after installation. If they are exposed to the UV light of the sun for a longer period, they can hardly be removed any longer!

Cutting to size Angle grinders may not be used for cutting panels to size. Mini grinders (1 mm discs) may be used for minor cut-outs in cases where other equipment cannot be used, but flying sparks must be controlled! But do not use angle grinders for cutting to size or cut-outs. They create hot sparks which burn into the coated surface of the sheet and are mostly permanent. The result: countless rust spots on the panel surface. Due to their high cutting speed, angle grinders distribute the abrasive dust across a large area. Use circular hand saws with tungsten carbide tipped saw blades or special chain saws. Remove the swarf from the surfaces immediately; it rusts with the slightest of moisture and causes the same damage as described above. Subsequent contractors must use suitable materials to protect the surfaces of the sandwich panels against
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damages and flying sparks. This often affects metalworking shops that produce chimney sweep catwalks or railings involving welding or grinding, or building services performing similar tasks, etc.

Drilling Metal chips produced by drilling and boring, using so-called self-tapping screws, form rust spots on the coated sheet metal surface unless suctioned away immediately.

The use of fastening and rivets cannot be avoided in the overall construction of roof and façade surfaces. Always use splash water-proof rivets on a roof, never conventional blind rivets. Use coated aluminum rivets. Buy rivets with a stainless steel mandrel. The coating on the aluminum rivet protects against corroding electrochemical potentials. This involves electrochemical breakdown of the base metal, bare aluminum in this case, by the noble metal, i.e. steel. Acid rain, as the corrosive medium, fully suffices to affect this. As a result, the rivets fall out of their holes after a few years. The coating on coated rivets acts as an insulator. The stainless steel mandrel is specified to prevent unsightly traces of rust, emanating from the rivets, on the façade surface. Coated multipurpose aluminum rivets with stainless steel mandrels are available on the market and should be used – they are also approved by building authorities.

Using permanently elastic sealing compounds Although often frowned upon on site, it is hardly possible to fashion coated sheeting joints without using permanently elastic sealants. You should, however, use modern hybrid sealing material with a high UV-light resistance. It is unreasonable to later burden the building owner with maintenance joints if this is avoidable using permanently elastic joints.

Roof panels Fasten the panels only through the crown and never in the water-bearing trough. Use only the original storm washers provided by the panel manufacturer or available from specialized dealers. This washer distributes the tensioned pressure of the screw over a wider area than the sealing washer is able to. The matching shape prevents lateral movement of the sheet in the crown area given proper tightening torque. Furthermore, due to its size, the neoprene seal inside the storm washer seals far better against water ingress than the 16 or 22 mm sealing washer on its own. Galvanized fasteners made of (carbon or case-hardened) steel, (hardened or tempered) may, however, only be used where fasteners are not expected to be subjected to moisture.

The calculation of the anticipated loading for wall panels is similar to that of roof panels. The number and appropriate types of screws must be determined in consideration of the three mechanical parameters discussed above. So-called load distribution plates for fastening of façade panels are available from various panel manufacturers. They significantly increase the width of the area over which the panel loading is distributed. By increasing the area and given proper installation, later unattractive dents on the façades are avoided. The use of these plates does not change the suction forces; pull-out is merely improved by distribution over a wider area. Fewer screws will be required due to the increased pull-over value.
Installation rules on steel structures:

- Screws are screwed in
- Fully for component II thicknesses up to 6 mm
- At least 6 mm for greater thicknesses of component II with their cylindrical threaded region.
- Impact wrenches may not be used.
- Already stressed screws in planned force transmitting connections may only be replaced by self-tapping screws with a larger diameter, whereby the hole for the thicker screw must be appropriately drilled.

3.7 Storing Materials

- Each section shall be marked for identification and each lot shall be accompanied by manufacturer's test/quality certificate, chemical analysis and mechanical characteristics.
- All sections shall be checked, sorted out and arranged by grade and quality in the store. Any instruction given by the Engineer-in-Charge in this respect shall be strictly followed.
- All material shall be free from surface defects such as pitting, cracks, laminations, twists. Defective material shall not be used and all such rejected material shall be immediately removed from the store/site. The decision of the Engineer-in-Charge in this regard shall be final and binding.
- Welding wires and electrodes (packed in their original cartons) shall be stored separately by quality and lots inside a dry and enclosed room and the instructions given by the Engineer-in-Charge. Electrodes shall be kept perfectly dry to ensure satisfactory operation and weld metal soundness.
- Each lot of electrodes, bolts, nuts etc. shall be accompanied by manufacturer's quality/test certificates.
- All bolts (including nuts & washers) shall be checked, sorted out and arranged diameter-wise by grade and quality in the store.

4. Fabrication

4.1 General

Fabrication of structures shall be done strictly as per "Approved for Construction" fabrication drawings (prepared by the Contractor based on the latest design drawings. Prior to commencement of structural fabrication, undulations in the fabrication yard, if any, shall be removed and area leveled and paved by the Contractor. Any defective material used in the work shall be replaced by the Contractor at his own expense. Necessary care and precautions shall be taken so as not to cause any damage to the structure during any such removal and replacement. 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. Tolerances for fabrication of steel structures for this project are not essential. No accurate parts need to be assembled.
4.2 Cutting
- Marking for cutting shall be done judiciously so as to avoid wastages or unnecessary joints as far as practicable. Marking shall be done by placing the members on horizontal supports/pads in order to ensure accuracy. Marking accuracy shall be limited to +1 mm.

- Cutting may be affected by shearing, cropping or sawing. Gas cutting by mechanically controlled torch shall be permitted for mild steel. Hand flame cutting may be permitted subject to the approval of the Engineer-in-Charge.

- Except where the material is subsequently joined by welding, no loads shall be transmitted into metal through a gas cut surface.

- Shearing, cropping and gas cutting shall be clean, square, free from any distortion & burrs, and should the Engineer-in-Charge find it necessary, the edges shall be ground afterwards, to make the same straight and uniform at no extra cost to the Owner.

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

- Holes through more than one thickness of material of members such as compound stanchions and girder flanges shall, where possible, be drilled after the members are assembled and tightly clamped/bolted together. Punching may be permitted before assembly, provided the thickness of metal is less than 16 mm and the holes are punched 3 mm less in diameter than the required size and reamed, after assembly, to the full diameter. Punching shall not be adopted for dynamically loaded structures.

- Holes may be drilled in one operation through two or more separable parts and burrs removed from each part after drilling.

- Holes in connecting angles and plates, other than splices, also in roof members and light framing, may be punched full size through material not over 12 mm thick, except where required for close tolerance bolts or barrel bolts.

- All matching holes for black bolts shall register with each other so that a gauge of 2 mm less in diameter than the diameter of hole shall pass freely through the assembled members in the direction at right angle to such members. Finished holes shall be not more than 2 mm in diameter larger than the diameter of the black bolt passing through them, unless otherwise specified by the Engineer-in-Charge.

- Holes for turned and fitted bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to H8 tolerance specified in IS: 919. Parts to be connected with close tolerance or barrel bolts shall be firmly held together by tacking bolts or clamps and the holes drilled through all the thicknesses in one operation and subsequently reamed to size. Holes not drilled through all the thicknesses in one operation shall be drilled to a smaller size and reamed out after assembly. Where this is not possible, the parts shall be drilled and reamed separately.

- To facilitate grouting, holes shall be provided in column bases or seating plates exceeding 300mm in width for the escape of air.
To avoid accumulation of water in gusseted column bases of laced, battened or box type stanchions, suitable reverse U-type holes shall be provided at the junction of base plate and column section in the vertical gussets for draining out of any water.

4.4 Straightening & Bending

- All materials shall be straight and if necessary, before being worked shall be straightened and/or
- Bending of rolled sections and plates shall be done by cold process.

4.5 Assembly

The component parts shall be assembled and aligned in such a manner that they are neither twisted nor otherwise damaged, and shall be so prepared that the required camber, if any, is provided. Proper clamps, clips, jigs and other fasteners (bolts and welds) shall be placed in a balanced pattern to avoid any distortion in the members and to ensure their correct positioning (i.e. angles, axes, nodes etc.). Any force fitting, pulling/stretching of members to join them shall be avoided. Proper care shall be taken for welding shrinkage & distortion so as to attain the finished dimensions of the structure shown on the drawings.

4.6 Welding

All joints shall be welded unless noted otherwise on the design drawings. The Contractor shall make necessary arrangement for providing sufficient number of welding sets of the required capacity, all consumables, cutting and grinding equipment with requisite accessories/ auxiliaries, equipment & materials required for carrying out various tests such as dye penetration, magnetic particle, ultrasonic etc.

Adequate protection against rain, dust, snow & strong winds shall be provided to the welding personnel and the structural members during welding operation. In the absence of such a protection no welding shall be carried out. It shall be the responsibility of the Contractor to ensure that all welding is carried out in accordance with the terms of this specification and relevant BIS codes. The Contractor shall provide all the supervision to fulfill this requirement.

Edge Preparation

Edge preparation/beveling of fusion faces for welding shall be done strictly as is mended. In case, the same are not indicated, edges shall be prepared (depending on the type of weld indicated in the drawing). Beveling of fusion faces shall be got checked and approved by the Engineering-Charge.

Cleaning

Welding edges and the adjacent areas of the members (extending up to 20mm) shall be thoroughly cleaned of all oil, grease, scale and rust and made completely dry. Gaps between the members to be welded shall be kept free from all foreign matter.
Preheating
Preheating of members shall be carried out when the base metal temperature is below the requisite temperature for the welding process being used.
Preheating shall be done in such a manner that the parts, on which the weld metal is being deposited, are above the specified minimum temperature for a distance of not less than 75mm on each side of the weld line. The temperature shall be measured on the face opposite to that being heated. However, when there is access to only one face, the heat source shall be removed to allow for temperature equalization (1 minute for each 25mm of plate thickness) before measuring the temperature.

Grinding
Column splices & butt joints of struts and compression members (depending on contact for load transmission) shall be accurately ground and close-butted over the whole section with a tolerance not exceeding 0.2mm locally at any place. In column caps & bases the ends of shafts together with the attached gussets, angles, channels shall be accurately ground so that the parts connected butt over minimum 90% surface of contact. In case of connecting angles or channels, care shall be taken so that these are fixed with such accuracy that they are not reduced in thickness by grinding by more than 2 mm.
Ends of all bearing stiffeners shall be ground to fit tightly at both top and bottom. Similarly bottom of the knife edge supports along with the top surface of column brackets shall be accurately ground to provide effective bearing with a tolerance not exceeding 0.2 mm locally at any place.
Slab bases and caps shall be accurately ground over the bearing surfaces and shall have effective contact with the ends of stanchions. Bearing faces which are to be grouted direct to foundations need not be ground if such faces are true & parallel to the upper faces.

Welding Processes
Welding of various materials under this specification shall be carried out using one or more of the following processes.

- Manual Metal Arc Welding Process (MMAW)
- Submerge Arc Welding Process (SAW)
- Gas Metal Arc Welding Process (GMAW)
- Flux Cored Arc Welding Process (FCAW)

The welding procedure adopted and consumables used shall be specifically approved by the Engineer-in-Charge. A combination of different welding processes or a combination of electrodes of different classes/makes may be employed for a particular joint only after qualifying the welding procedures to be adopted and obtaining the written approval of the Engineer-in-Charge. Welding procedure shall cover the following:
- Type and size of electrodes
- Position of welding
- Current and arc voltage
- Length of run per electrode or (for automatic welding) speed of travel of electrode
- Number of run in multipass welds and arrangement
- Preparation of the parts
- Welding sequence
- Pre or post heating
Approval & Testing of Welders

The Contractor shall satisfy the Engineer-in-Charge that the welders are suitable for the work upon which they will be employed. For this purpose the welders shall have satisfied the relevant requirements EN ISO standards. Adequate means of identification shall be provided to enable each weld to be traced to the welder by whom it was made. The Contractor shall intimate the Engineer-in-Charge sufficiently in advance, the commencement of tests, to enable him to be present to witness the same.

Approval & Testing of Welding Procedures

The Contractor shall carry out procedure tests in accordance with EN ISO standards to demonstrate by means of a specimen weld of adequate length on steel representative of that to be used, that he can make welds with the welding procedure to be used for the work to the complete satisfaction of the Engineer-in-Charge. The test weld shall include weld details from the actual construction and it shall be welded in a manner simulating the most unfavorable instances of fit-up, electrode condition etc., which are anticipated to occur on the particular fabrication. Where material analysis is available, the welding procedure shall be carried out on material with the highest carbon equivalent values.

After welding, but before the relevant tests given in EN ISO standards are carried out, the test weld shall be held as long as possible at room temperature, but in any case not less than 72 hours, and shall then be examined for cracking. The examination procedure shall be sufficiently rigorous to be capable of revealing significant defects in both parent metal and weld metal.

After establishing the welding method, the Contractor shall finally submit to the Engineer-in-Charge for his approval the welding procedure specification before starting the fabrication.

Sequence of Welding

- As far as practicable, all welds shall be made in a sequence that will balance the applied heat of welding while the welding progresses.
- The direction of the general progression in welding on a member shall be from points where the parts are relatively fixed in position with respect to each other towards points where they have a greater relative freedom of movement.
- All splices in each component part of a cover-plated beam or built up member shall be made before the component part is welded to other component parts of the member.
- Joints expected to have significant shrinkage shall be welded before joints expected to have lesser shrinkage.
- Welding shall be carried continuously to completion with correct number of runs.
- The Contractor shall choose the welding sequence after carefully studying each case such as to minimize distortion and shrinkage & submit the same to the Engineer-in-Charge for comments and approval.
- The welding seams shall be left to cool slowly. The CONTRACTOR shall not be allowed to cool the welds quickly by any other method.
- For multipass welding, before welding the following layer the formerly welded layer shall be cleaned metal bright by light and wire brushing.
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Welding Technique

After the fusion faces are carefully aligned and set with proper gaps, the root pass of butt joints shall be executed properly so as to achieve full penetration with complete fusion of the root edges.

On completion of each run all slag and spatters shall be removed and the weld and the adjacent base metal shall be cleaned by wire brushing and light chipping. Visible defects such as cracks, cavities and other deposition faults, if any, shall be removed to sound metal before depositing subsequent run of weld.

All full penetration butt welds shall be completed by chipping/gouging to sound metal and then depositing a sealing run of weld metal on the back of the joints. Where butt welding is practicable from one side only, suitable backing steel strip shall be used and joint shall be arranged in such a way as to ensure that complete fusion of all the parts is readily obtained.

While welding is in progress care shall be taken to avoid any kind of movement of the components, shocks, vibrations to prevent occurrence of weld cracks.

Any deviation desired from the recommended welding technique and electrodes shall be adopted only after obtaining written approval of the Engineer-in-Charge.

Inspection & Testing of Welds

The method of inspection shall be according to EN ISO standards and extent of inspection and testing shall be in accordance with the relevant applicable standard or, in the absence of such a standard, as specified by the Engineer-in-Charge. Welds shall not be painted or otherwise obscured until they have been inspected, approved and accepted.

The Engineer-in-Charge or his representative shall have access to the Contractor's work at all reasonable times and the Contractor shall provide him with all facilities necessary for inspection during all stages of fabrication and erection with, but not limited to, the following objectives.

- To check the conformity with the relevant standards and suitability of various welding equipments and their performance.
- To witness/approve the welding procedure qualification.
- To witness/approve the welders performance qualification.
- To check whether shop/field welding being executed is in conformity with the relevant specifications and codes of practice.

Inspection and testing of all fabricated structures shall be carried out by the Contractor by any, or, a combination of all the following methods as directed by the Engineer-in-Charge and no separate payment shall be made, unless otherwise mentioned, for inspection and testing of welds/fabricated structures:

Visual Inspection

- All finished welds (i.e. 100 percent) shall be visually inspected for identification of the following types of weld defects & faults.

- Weld defects occurring at the surface such as blow holes, exposed porosity, unfused welds etc.

- Surface cracks in the weld metal or in the parent metal adjacent to it.

- Damages to the parent metal such as undercuts, burning, overheating etc.
Tender of Specifications

- Profile defects such as excessive convexity or concavity, overlapping, unequal leg lengths, excessive reinforcement, incompletely filled grooves, excessive penetration beads, root grooves etc.

- Distortion due to welding i.e., local shrinkage, camber, bowing, twisting, rotation, wariness etc.

- Linear eccentric, angular and rotational misalignment of parts.

- Dimensional errors.

4.7 Painting & Coating

Surface preparation by grit blasting

The grit blasting of the surface shall be carried out by compressed air and blasting gun. Clean screened grit of uniform size shall be used for blasting purpose. For grit blasting, the surface shall be made free from mill scale, rust, grease, oil or other foreign material and shall appear to have foreign white base metal roughened texture to form good adhesion of the primer coating, conforming to Swedish Standards "Sa 2 ½". Compressed air should be free from moisture and oil. The grit blasted surface shall be applied with primer coat within 3 to 4 hours or before any trace of oxidation appears on the cleaned surface.

Primer Application

All components and members of steel work shall be given one coat of Inorganic Zinc Silicate Epoxy primer. Primer coat shall be applied immediately after the surfaces have been properly prepared by grit blasting as explained above and cleaned. The primer coat shall be applied over completely dry surfaces (using brushes of good quality) in a manner so as to ensure a continuous and uniform film without "holidaying". Special care shall be taken to cover all the crevices, corners, edges etc. However, in areas which are difficult to reach by brushing, daubers/mops shall be used by dipping the same in paint and then pulling/pushing them through the narrow spaces. The primer coat shall be air dried and shall have a minimum film thickness of 75 microns or (tolerance + 10%) after drying, as applicable.

Final Paint Application

After the primer is hard dry, the surfaces shall be lightly sand the primer surface with emery paper no.320 and clean the dust with dry cloth. Apply two coats of compatible Phinolic based epoxy paint coats at an interval of 16 – 20 hours. Paint shall be applied by brushing/spraying so that a film free from "holidaying" is obtained. The colour & shade of first coat of paint shall be slightly lighter than the second coat in order to identify the application of each coat. The second coat of paint shall be applied after the first coat is hard dry. The minimum thickness of each film shall be 75 microns (+ 10% tolerance) after drying. The Contractor shall carry out the painting work in all respects with the best quality of approved materials and workmanship in accordance with the best indicating the
suitability for the required service conditions. The paint manufacturer's instructions supplemented by Engineer-in-Charge's direction if any shall be followed at all times. Particular attention shall be paid to the following:

- Proper storage to avoid exposure & extremes of temperature,

- Surface preparation prior to painting.

- Mixing & thinning.

- Application of paint and the recommended limit on time intervals between consecutive coats.

Painting shall not be done in frost or foggy weather, or when humidity is such as to cause condensation on the surfaces to be painted. Primers & finish coat paints shall be from the same manufacturer in order to ensure compatibility. Painting colour code shall be as per Annexure-'B'. Surfaces which are inaccessible after shop assembly, shall receive the full specified protective treatment before assembly (this shall not apply to the interior of sealed hollow sections). Steel surfaces shall not be painted within a suitable distance of any edges to be welded if the paint specified would be harmful to welders or impair the quality of the welds. Welds and adjacent parent metal shall not be painted prior to deslagging, inspection and approval by the Engineer-in-Charge. Parts to be encased in concrete shall have only one coat of primer and shall not be painted after erection.

5. Packing

- All items shall be suitably packed in case these are to be dispatched from the fabrication shop to the actual site of erection so as to protect them from any damage/distortion or falling during transit. Where necessary, slender projecting parts shall be temporarily braced to avoid warping during transportation.
- Small parts such as gussets, cleats etc., shall be securely wired on to their respective main members.
- Bolts, nuts washers etc. shall be packed in crates.

6. Transportation

Loading and transportation shall be done in compliance with transportation rules. In case, certain parts cannot be transported in the lengths stipulated on the drawings, the position details of such additional splice joints shall be got approved by the Engineer-in-Charge. The use of standard ISO containers is required for international acceptance and method to control the goods. Small goods must be carefully packed and identified.
7. Site Erection

Plant & Equipment

The suitability and capacity of all plant and equipment used shall be to the complete satisfaction of the Engineer-in-Charge. The packed equipment shipped has to be checked on the delivery place. All steel work shall be stored and handled at site so that the members are not subjected to excessive stresses and any damage.

Setting Out

One set of reference axes and one benchmark level shall be furnished to the Contractor. These shall be used for setting out of structures. The Contractor shall assume complete responsibility for correct setting out of all steel work, erecting it correctly as per alignment / levels shown in the drawings and plumb (verticality) of vertical members.

6.1 First erection

The Contractor shall furnish the detailed scheme and sequence of erection to match with the project schedule and get the same approved by the Engineer-in-Charge. All necessary coordination and synchronization shall be done with the civil contractor where civil works are not included in the scope of structural contractor at no extra cost so as to match with the project schedule. The step by step configuration is showed below:

- Open the container and identify all the goods inside
- Check the delivery form and compare to the shipment form.
- Parts are perfectly packed on a single pellet.
- The unit parts are either wrapped on protecting film or in cardboard boxes.
- Identify each box and set a layout of boxes on the exact site where the unit is going to be assembled.
- Open the box that has the base beams
- Place them simulating the shape of the base
- Remember to place the longer beams across the base linking both long sides of the structure

- Link the beams with the joints
- When the beam is fixed with the joint pass the pin through
- Fasten the pin with the bolt
- The corner joints on the corner.
- The 3 axial joints in the long side of the base
- The flat joints on the short side of the base
- The base is assembled
- Start linking the vertical beams

- Now the roof beams need to be linked by sections
- Elevate those sections
Now a tent or a panel covering can be arranged

**Tent option:**

- Identify the canopy package
- Take the canopy out of the package
- Unroll it over the base of the frame structure
- Make sure the right side of the canopy is face up
- Identify the lockers (metal part on the corners)
- Secure them on the base
- Do the same on the roof securing

- Take the shade poles out of its package
- Fit them on each protuberance on the roof corners
- Identify the shade package
- Unroll it
- Reach the end of the pole and fix it
Panel option:

- Identify the panels
- Face the panels with the holes up
- Be careful with the roof panel while applying load on the ground. The vent outlet could break
- Identify the snap fit package
- For the wall panels (with windows) secure the 63mm ones on the thicker side.
- Make sure the arrow on the snap fit points the sky direction when it is erected
- For the wall panels secure the 57mm ones on the thicker side.
- Make sure the arrow on the snap fit points the sky direction when it is erected
- For roof panels use the 100mm ones and for floor panels use the 120mm ones.
- Make sure the arrows point the opposite direction towards the beams
- To secure floor panels face the ground with the fasteners
- To secure each panel on the frame structure face the center of the unit and apply pressure until a snap noise is heard.
6.2 First disassembly

Two options can be assembled, so two ways of tearing them apart are considered:

Tent option:

- First untie the shade from the poles end
- Fold the shade on a roll and pack it in the package
- Take the poles out of the fitting and place them together
- Wrap them with the ropes
- Make sure no one is inside the tent
- Pull the tent lockers on the upper corner.
- Do the same with the lower corner ones
- Make sure the canopy is flat on the base of the structure and each edge has its lower and upper side together.
- Fold it in a roll and tight it with the ropes.
- Start unpinning the junctions where the beams on the roof meet the vertical beams.
- Take down the roof frame and put it on the ground.
- Start grouping the beams by size and length and put them on the boxes
- Take down the vertical beams and do the same as before
- Take apart the base and gather all the parts as before
- The unit is taken apart and all the elements are sorted
- Wait until the transporting people takes care of the pallet

Tent option:
- First untie the shade from the poles end
- Fold the shade on a roll and pack it in the package
- Take the poles out of the fitting and place them together
- Wrap them with the ropes
- Make sure no one is inside the unit
- Push the snap fit outline towards the middle of the panel to make it easy to push out and unsecure it.
- Do the same with the all the remaining snap fits
- Unsecure the roof first
- Continue with side walls
- Unscrew the snap fits from the panels and group them
- Stack the panels by size
- Leave the floor panels
- Start unpinning the junctions where the beams on the roof meet the vertical beams.
- Take down the roof frame and put it on the ground.
- Start grouping the beams by size and length and put them on the boxes
- Take down the vertical beams and do the same as before
- Flip the base and gently lay it on the ground
- Take apart the base and gather all the parts as before
- Push the snap fit outline towards the middle of the panel to make it easy to push out and unsecure it.
- Unscrew the snap fits from the panels and group them
- Stack the panels by size
- The unit is taken apart and all the elements are sorted
- Wait until the transporting people takes care of the pallet

7.3 Maintenance

From time to time some checking has to be done.

- Make sure the electric outputs are secured and none of the holes are obstructed or foreigner bodies lay on it.

- The battery of the solar panel must be checked due to the acid and characteristics must be controlled.

- The solar panel may gather dust or other particles on the sun screen and after storms or unusual events check fixations and connections.

- Take in to account over loads that can be applied on panels and beams and check displacements and bending from standard units.

- Check junctions for rust or any signal of stress.

- Control the looseness of the junctions.
- Tent canopy has the most stress on the locking. Hence a look on shred or scrapes must be done.

- After long periods of medium loads applied either on the panels or the canopy check for marks that could lead to leaking or breaking.

7.4 Cleaning
Cleaning panels with polyester coating: Clean soiled areas on panel surfaces with a lot of water and a soft brush. A high pressure cleaner may also be used, but with no more than 50 bar pressure and with cold water.

A diluted, PH-neutral cleaning agent may be used to remove very stubborn dirt. Very hard to remove stains may in individual cases be very carefully removed with ethanol. Rinse such areas with water immediately thereafter, though. Acidic and alkaline cleaning agents are not suited for polyester coated panel surfaces.

Roof panels need to be wiped from time to time to avoid stains and lost of properties due to laying and stuck elements.

The canopy tent can be simply washed by hand as the water proof coating allows wet element to touts the surface. Inside cover can and should be washed as a regular dwelling floor.

Beam parts and corners must be checked once the structure is erected and once is dismantled. Throughout its use the structure parts need to be checked from time to time to notice rust or any other unusual defect but no further consideration need to be taken.

Solar panels must be wiped every time to time to avoid bad performance due to low sun radiation collection.

Sockets and batteries need to be clean to avoid rust on connectors and bugs or animal in cavities.

7. Safety
The contractor shall comply for necessary safety and adhere to safe erection practices and guard against hazardous as well as unsafe working conditions during all stages of erection.

During erection, the steel work shall be securely bolted or otherwise fastened and when necessary, temporarily braced/guyed to provide for all loads to be carried by the structure during erection till the completion, including those due to the wind, erection equipment & its operation etc.

No extra cost to the owner. For the purpose of guying, the Contractor shall not use other structure in the vicinity without prior written permission of the Engineer-in-Charge. No permanent bolting or welding shall be done until proper alignment has been achieved.

Proper access and safety arrangement shall be provided for working and inspection, (at no extra cost to the owner) whenever required.
8. End of life
The majority of the products are ensured to be eco-friendly and recyclable.

If the reason of its disassemble is due to relocation or end of operation, and the life expectancy of the unit is not reached, it can be stored and ready for use again.

If the unit has reached its life expectancy limit or a major cause has occurred and evaluation dictates that the unit needs to be disassembled the following considerations can be taken

Steel beams and components made out of steel can be recycled, so once the unit is packed they can be sent to melt and maybe reuse it for new units.

The panels are made out of PVC foam which can be recycled.

Methacrylate cannot be recycled so no further uses could be carried out with that element.

The tent canopy and the shade are made out of PVC and can be recycled in many ways.

Regarding electric devices or components such as solar panels and batteries must be treated carefully and brought to the treatment plant where they recycle them.