

OCSC

O'CONNOR · SUTTON · CRONIN

MULTIDISCIPLINARY CONSULTING ENGINEERS

TECHNICAL SPECIFICATIONS DOCUMENT – STEELWORK SPECIFICATION

For

TIPPERARY COUNTY COUNCIL

12 March 2025

O'CONNOR SUTTON CRONIN

TECHNICAL SPECIFICATIONS MANUAL

CONTROLLED DOCUMENTATION

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STEELWORK SPECIFICATION

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DOCUMENT CONTROL & HISTORY

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1. General

1.1. Contents

1.1.1. THIS DOCUMENT

This specification includes

1) General issues
2) Quality assurance
3) Materials
4) Product handling
5) Workmanship generally
6) Dimensions
7) Preparations & protective coatings
8) Welding
9) Execution/erection
10) Repairs & defective work

1.2. Design Information & Related Documents

1.2.1. GENERAL

Drawings and general provisions of the contract, including general and supplementary conditions apply to this specification.

1.2.2. STANDARDS & CODES

All design and workmanship shall comply with the relevant Eurocodes or equivalent Irish standards. If no such Irish standards exist then compliance shall be with the relevant British Standards or good industry practice. In each case the standards which are most current and appropriate at the relevant obligation shall apply

1.2.3. CE MARKING OF STEEL PRODUCTS

All steel work products must comply with the CE marking requirements of the relevant harmonised product standard as specified in EN 1993-1-1.

1.2.4. CE MARKING OF FABRICATED PRODUCTS

All steel work fabricated products shall comply with the CE Marking requirements of the harmonised standard I.S. EN 1090.

1.2.5. EXECUTION CLASS

The Contractor will be responsible for requesting the Execution Class of the building from the Engineer. The Contractor may not rely on Clause 4.1.2 I.S. EN 1090 without written confirmation from the Engineer.

1.2.6.	FABRICATION	Steelwork should be fabricated and erected as per the information on the project drawings.
1.2.7.	SETTING OUT	Setting out of structural members shall be in compliance with the architectural drawings.

1.3. Definitions

1.3.1.	ACTION	a) Set of forces (loads) applied to the structure (direct action); b) Set of imposed deformations or accelerations caused for example, by temperature changes, moisture variation, uneven settlement or earthquakes (indirect action).
1.3.2.	ANCHOR SPECIFIER	The anchor specifier is a competent person or organisation who designs the connection and specifies the anchor.
1.3.3.	CONNECTION	Location at which two or more elements meet. For design purposes it is the assembly of the basic components required to represent the behaviour during the transfer of the relevant internal forces and moments at the connection. It therefore refers simply to the assembly which passes internal forces between members.
1.3.4.	CONSTRUCTION WORKS	Everything that is constructed or results from construction operations.
1.3.5.	EFFECT OF ACTION	Internal force (e.g. moment, stress, strain) on structural members or on the whole structure due to an action(s).
1.3.6.	ELEMENT	Shall apply as for "Member".
1.3.7.	ENGINEER	Defined as the individual or company responsible for the procedure or algorithm for determination of action effects in a structure. Notwithstanding any setting out or dimensional information given on architects drawings, the Engineer is the primary source of information transfer to the steelwork contractor. While another party may have qualified engineers in their organisation, this specification refers only to the individual/organisation described (i.e. OCSC).
1.3.8.	ETA	European Technical Approval (issued in accordance with a European Technical Approval Guidance document, ETAG).

1.3.9.	EXECUTION	Execution refers to all activities carried out for the physical completion of the work including procurement, the inspection and documentation thereof. It may refer to the overall project or to an individual construction activity within the project. It may also refer to work on site or the fabrication of components off site and their subsequent erection on site.
1.3.10.	FABRICATION	Fabrication refers to process of manufacture of steel structures or parts of steel structures by cutting, bending, and assembling.
1.3.11.	FABRICATOR	Fabricator may refer to the steelwork contractor, or a subcontractor to the main steelwork contractor, who is responsible for the fabrication and assembly of the structural steel frame or composite elements to be included in the overall assembly. The fabricator may also be the steelwork erector.
1.3.12.	FRAME	The whole or a portion of a structure, comprising an assembly of directly connected structural elements, designed to act together to resist actions; this term refers to both moment-resisting frames and triangulated frames; it covers both plane frames and three-dimensional frames.
1.3.13.	JOINT	Zone where two or more members are interconnected. For design purposes it is the assembly of all the basic components required to represent the behaviour during the transfer of the relevant internal forces and moments between the connected members. It therefore refers to the assembly which transfers forces through members and thus includes the members themselves.
1.3.14.	MAIN CONTRACTOR	The company responsible for the co-ordination of all construction activities on site.
1.3.15.	MEMBER	Is a physically distinguishable part of a structure (e.g. a column, a beam, a slab, a foundation pile)?
1.3.16.	PAINT	A protective system applied in liquid form to the structural steel. It may refer to a coating to prevent deterioration of the steel due to weathering, bimetallic corrosion or fire.

1.3.17.	SHEAR STUD	Mechanical fastener device used specifically to transfer shear stress between steel and concrete in composite construction, in which the fastener is connected by welding, or other approved method, to the steel member.
1.3.18.	STEEL	Unless otherwise specifically stated as cold-formed, references to steel in this specification should be taken as being to hot finished steel.
1.3.19.	STEELWORK CONTRACTOR	Steelwork contractor refers to the contractor responsible for the sourcing, production, design and assembly of the structural steelwork, including on-site erection. The steelwork contractor may also be the steelwork fabricator and/or Steelwork erector.
1.3.20.	STEELWORK ERECTOR	The company employed to perform on-site erection. This may be a separate company to the steelwork contractor.
1.3.21.	STRUCTURAL STEEL	Members made from steel material as defined in the appropriate codes (see Section 1.4.).
1.3.22.	STRUCTURE	The organized combination of connected parts designed to carry loads and provide adequate rigidity.

1.4. References

1.4.1.	CODES	EN 1993 Design of Steel Structures (all parts). EN 1090 Execution of steel structures – Technical requirements. EN 1461 Hot dip galvanized coatings on fabricated iron and steel articles – specifications and test Methods. EN ISO 2808 - Paints and varnishes. Determination of film thickness. EN ISO 5817 Arc-welded joints in steel - Guidance on quality levels for imperfections. BS EN ISO 8501 - Preparation of steel substrates before application of paints and related products. BS EN ISO 8503 - Preparation of steel substrates before application of paints and related products.

EN ISO 9013:2002 Thermal cutting - Classification of thermal cuts - Geometrical product specification and quality tolerances.

EN 10025-1:2004 Hot-rolled products of structural steels.

EN 10029:1991 Specification for tolerances on dimensions, shape and mass for hot rolled steel plates 3mm thick or above.

EN 10164:1993 Steel products with improved deformation properties perpendicular to the surface of the product.

EN 10210-1:1994 Hot finished structural hollow sections of non-alloy and fine grain structural steels.

EN 10219-1:1997 Cold formed hollow sections of structural steel.

EN 1090 Execution of steel structures and aluminium structure.

EN ISO 12944 Paints and varnishes – Corrosion protection of steel structures by protective paint systems.

ISO 19840 Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Measurement of, and acceptance criteria for, the thickness of dry films on rough surfaces.

All Irish National Annexes as appropriate to the above codes.

1.4.2. OTHER REFERENCES

National Structural Steelwork Specification 5th Edition (CE marking version) Referred to as the "Black Book" (NSSS).

Tata Steel Construction – The prevention of corrosion on structural steelwork.

2. Quality Assurance

2.1. General

2.1.1. CONTRACTOR

The work related to this specification shall be designed/detailed (as appropriate), fabricated, installed and erected by a company which has successfully completed projects of similar size and complexity, and has competent and experienced staff, including a chartered engineer and appropriate public and/or professional indemnity insurance cover.

The Steelwork Contractor shall submit satisfactory evidence of compliance with these requirements, including any additional information requested, such as, financial status, volume of work, fabrication capacity, and details on individuals and qualifications. The Steelwork Contractor shall provide a full time, senior, experienced and qualified representative to direct work on site.

2.1.2. RESPONSIBILITY

Comments, approval, and inspection by the Engineer shall not relieve the Main Steelwork Contractor of liability for rectifying any defects which may subsequently appear or be found after erection.

2.2. Testing

2.2.1. TESTING AUTHORITY

All tests will be carried out by a certified authority or a testing company approved by the Engineer.

2.2.2. TEST CERTIFICATES

Manufacturer's test certificates shall be provided to the Engineer.

2.2.3. TESTING FACILITIES

Facilities and attendances for specified tests in workshops and on site shall be provided by the Main Contractor. Facilities shall be approved by the Engineer prior to commencement of testing.

2.2.4. TEST MATERIALS

Any material tests specified shall be carried out in accordance with the appropriate product standards for technical delivery conditions and other relevant Standards.

2.2.5. NON-DESTRUCTIVE TESTING

The weld tests specified shall be carried out in accordance with the relevant Standards.

2.2.6.	DESTRUCTVE TESTING	Where necessary to prove the adequacy of a proposed method of welding or where otherwise required by the Engineer, testing shall be carried out in accordance with the requirements specified by the Engineer.
2.2.7.	REPORTING RESULTS	Results from all testing shall be furnished directly by the Main/Steelwork Contractor to the Engineer.

3. Materials

3.1. Sections and Plates

3.1.1.	FINISH	All structural sections to be hot finished unless otherwise specifically noted on OCSC project drawings.
3.1.2.	TEST CERTIFICATES	The steelwork provider will keep copies of 3.1 Inspection Certificates in Compliance with EN10204. The certificates shall be provided to the Engineer on request.
3.1.3.	CERTIFICATES	Material certificates describing mill strength tests and source/origin of all steelwork to be used in the works shall be provided to the Engineer for approval/comment.
3.1.4.	HOT ROLLED SECTIONS DIMENSIONS	The dimensions and tolerances of hot rolled steel sections, including hollow sections shall comply with BS EN 10029-(1-4):2006 as appropriate.
3.1.5.	SECTIONS AND PLATES MATERIAL	Hot rolled steel plates and sections, including hollow sections, shall comply with: • General sections – BS EN 10025-(1-6):2004; • Hollow sections – BS EN 10210-1:2006; • BS 7668:2004 – Hollow sections resistant to atmospheric corrosion.
3.1.6.	GRADE OF STEEL	Use the following minimum grades of steel unless indicated otherwise on the drawings: • Internal environments – S355 JR; • External environments – S355 J0.
3.1.7.	COLD FORMED STEEL SECTIONS	The dimensions and tolerances of cold formed structural steel sections shall comply with BS EN 10162:2003.

3.1.8.	COLD FORMED SECTIONS MATERIAL	The material for cold formed steel sections shall comply with BS EN 10219:2006, with a yield stress not less and 350 N/mm^2.
3.1.9.	EXPOSED STEEL	All steel shall be free from pitting and other surface flaws that are likely to impair the specified finish.
3.1.10.	CRANE RAILS	Crane rails shall comply with EN 1993-6:2007 or equivalent.
3.1.11.	GALVANISED STEEL	Galvanise structural steel specified for galvanising, in accordance with BS EN ISO 1461:2009.
3.1.12.	METAL FLOOR STAIR TREADS	Open type metal flooring and stair treads shall comply with BS 4592:2006.
3.1.13.	PROFILED STEEL SHEETING	Profiled steel sheets shall be manufactured from steel in accordance with EN 10025, cold formed steel sheet in accordance with EN 10149-2 or EN 10149-3 or galvanized steel sheet in accordance with EN 10147.
3.1.14.	PROFILED STEEL SHEETING THICKNESS	The minimum value for the nominal thickness *t* of steel sheets shall be 0.70mm.

3.2. Protective Coatings

3.2.1.	GALVANISING	Galvanizing shall be carried out in accordance with the requirements of BS EN ISO 1461:2009.
3.2.2.	PRIMER FOR GALVANISING	Chemical primers shall be used for galvanising steel of type T-wash or Etch primer. Primer shall be sourced from the same manufacturer as the finished paint.
3.2.3.	NON-GALVANISING PRIMER	Primer for Non-Galvanized Steel: Epoxy Primer in compliance with EN ISO 12944-2. Primer shall be sourced from the same manufacturer as the finished paint.
3.2.4.	FINISH PAINT	Finish Painting shall be in compliance with the architects details and otherwise to the requirements of BS EN ISO 12944, and the guidance given in Tata Steel Construction – The prevention of corrosion on structural steelwork.

3.2.5.	PAINT SPECIFICATION	The minimum coatings to satisfy durability requirements shall be applied in accordance with CIRIA document 174 "New paint systems for the protection of construction steelwork".
3.2.6.	PROFILED STEEL SHEETING	A zinc coating, if specified, should conform to the requirements of EN 10147 or with relevant standards in force.
3.2.7.	STEEL SHEETING COATING THICKNESS	A zinc coating of total mass 275 g/m2 (including both sides) is sufficient for internal floors in a non-aggressive environment, but the specification may be varied depending on service conditions. For aggressive environments the thickness of coating shall be determined based on the environment class in accordance with code (See Section 3.2.1).

3.3. Welding Materials

3.3.1.	WELDING MATERIALS	Welding electrodes for manual metal arc welding shall comply with BS EN ISO 2560:2009.
3.3.2.	ELECTRODES, WIRES AND FLUXES	Electrodes, wires and fluxes for the submerged arc welding of carbon steel and medium-tensile steel and shall comply with BS EN ISO 14171:2010.
3.3.3.	FILLER RODS AND WIRES	Filler rods and wires for gas-shielded arc welding shall comply with BS EN 14341:2011, and for tungsten gas welding with BS EN ISO 636:2008.

3.4. Fasteners

3.4.1.	NON-PRELOADED BOLTS, SCREWS AND NUTS	Non-preloaded bolts, screws and nuts shall comply with BS 4190:2001. All bolts shall be fitted with lock nuts.
3.4.2.	BOLT TYPE	Unless indicated otherwise on the drawings use non-preloaded bolts, with minimum properties of: • 8.8 grade, high tensile; • 16mm diameter.
3.4.3.	NON-PRELOADED BOLTS, SCREWS & NUTS FINISH	All non-preloaded bolts, screws and nuts shall be sheradised in accordance with BS 4921:1988.

3.4.4.	COATINGS	Bolts which have been coated shall be manufactured with sufficient thread clearance to give a satisfactory fit in the finished bolt or nut.
3.4.5.	BIMETALLIC PROTECTION	Where there is a risk of occurrence of bimetallic corrosion, appropriate Nylon, neoprene or PTFE isolation washers and ferrules shall be used.
3.4.6.	PRECISION HEXAGON BOLTS, SCREWS AND NUTS	Precision hexagon bolts, screws and nuts shall comply with BS 3692:2001.
3.4.7.	TORQUE CONTROLLED EXPANSION ANCHORS AND BONDED ANCHORS IN CONCRETE	Unless otherwise specified expanding bolts are to be follow-up expansion type as approved by the Engineer. The specifier will ensure that all anchors selected shall have a current ETA.
3.4.8.	STEEL WASHERS	Steel washers shall comply with BS 4320:1968.
3.4.9.	STEEL WASHER FINISH	All steel washers shall be sheradised in accordance with BS 4921:1988.
3.4.10.	PRELOADED BOLTS	High strength friction grip bolts (HSFG) and associated nuts and washers shall comply with BS EN 14399:2005.
3.4.11.	CAVITY BOLTS	Cavity bolts to be manufactured from mild steel in grade 8.8 and is electro-zinc plated with the addition of a 1000-hour salt spray corrosion protection. Minimum size unless otherwise stated shall be 16mm with rubber collapse mechanism under collar.
3.4.12.	RAG BOLTS	Rag bolts and nuts shall comply with BS EN ISO 898:1999 and BS EN 20898-2:1994.

3.5. **Shear Studs**

3.5.1.	SHEAR STUDS	Unless otherwise stated on the drawings headed type studs shall be used with a minimum yield strength of 350MPa and a minimum ultimate tensile strength of 450MPa. Studs shall be of uniform diameter, with concentric heads normal to the shaft, have chamfered weld end and solid fluxed. Studs shall comply with BS EN ISO 13918. Testing shall be carried out on welded shear studs to determine suitability of welding procedure in accordance with BS EN ISO 14555.

4. Product Handling

4.1. General

4.1.1. DAMAGE

Handle and store steel materials in such a manner as to cause no damage to other materials, to existing buildings, to property or to the new structure.

4.1.2. DISTORTION

Handle steel members so as to avoid distortion and damage to protective coatings.

4.1.3. STORAGE GENERALLY

Store materials to permit easy access for inspection and identification. Structural steel products shall be kept off ground and spaced by using pallets, dunnage, or other supports and spacers. Structural steel products and packaged materials shall be protected from corrosion and deterioration.

Materials shall not be stored on the structure in a manner that might cause distortion, damage, or overload to members or supporting structures.

Damaged materials or structures shall be repaired or replaced as directed by the Engineer.

4.1.4. FASTENERS

Fasteners may be repackaged provided a system is implemented that inspects and observes repackaging and seals containers.

Clean and lubricate bolts and nuts that become dry or rusty before use.

Comply with manufacturers' written recommendations for cleaning and lubricating fasteners and for retesting fasteners after lubrication.

Fasteners shall be stored in a protected place in sealed containers with manufacturer's labels intact.

5. Workmanship Generally

5.1. Design and Construction

5.1.1.	CONTRACTOR	The fabrication and erection of the structural steel shall be carried out by an approved Fabricator and Steelwork Erector(s).
5.1.2.	DESIGN DETAILS	Any design and details including calculations shall be in accordance with EN 1993 and shall be submitted to the Engineer for review at least three weeks prior to commencement of fabrication.
5.1.3.	SPLICE LOCATIONS	Where splices are indicated on the Engineer's drawings, the location and number of splices shall not be altered without specific approval from the Engineer.
5.1.4.	SHOP DRAWINGS	Two copies of shop drawings shall be submitted to the Engineer for review at least three weeks before commencement of fabrication of the work shown on the drawings. Any necessary amendments in accordance with any comments by the Engineer or Architect shall be incorporated and re-submitted.
5.1.5.	SLIP FACTOR	For any HSFG bolted joints the slip factors shall be submitted to the Engineer for comment. Such comment will not constitute approval or remove responsibility from the Steelwork Contractor for their design.
5.1.6.	ERECTION METHOD	The Steelwork Contractor shall take necessary site dimensions unless otherwise agreed with the Main Contractor prior to commencement of fabrication.
5.1.7.	ERECTION PROGRAMME	Details of the erection programme shall be submitted at least three weeks before commencement of the work.
5.1.8.	TEMPORARY WORKS	The Main Contractor is responsible for all temporary works/support systems required to ensure adequate stability of the entire structure during erection.
5.1.9.	STEELWORK CONTRACTOR RESPONSIBILITY	Works associated with any instruction or requirement of the Engineer or Architect which the Steelwork Contractor considers to be a

variation to the contract shall be so stated in writing to the Engineer and such work shall not proceed until a confirmatory instruction is subsequently issued. Claims for extra cost of such work, if made after it has been carried out will not be allowed.

Notwithstanding the review of drawings or calculations by the Engineer, the Steelwork Contractor shall remain solely responsible for the accuracy and correctness of drawings and other details, for the design of connections, joints and for all dimensions shown on the drawings.

5.1.10. CONNECTIONS

The Engineer's drawings may show typical connection details which shall be adhered to unless otherwise approved. The Steelwork Contractor shall design the connection and complete the detailing. Connections shall be designed for loading where specified on the Engineer's drawings or for approved loadings calculated from first principles in accordance with the relevant Eurocodes for loadings on buildings, or as otherwise approved.

The connections forces to be designed for shall not be less than the minimum robustness requirements for disproportionate collapse covered in EN 1991-1-7 and Health and safety requirements to provide a safe erection sequence.

As an absolute minimum 2 No. Bolts shall be required in any connection.

5.1.11. COLD FORMED STEEL SECTIONS

Cold formed steel sections shall comply with the following:

a) Cold formed steel purlins, side rails etc. shall comply with EN 1993-1-3 and shall be obtained from an approved supplier.

b) At the time of tender, Steelwork Contractors shall state their proposed supplier, and main section sizes whether they are as shown on the drawings or alternatives.

c) Only those suppliers of cold formed sections who provide detailed recommendations and permissible load tables will be approved.

d) The Steelwork Contractor shall make provision for and indicate on shop drawings all anti-sag bars, sleeves, apex ties, eaves ties, rail struts plus diagonals and all other ancillary items. Joints to double span members shall be staggered.

e) Where connections are at the location of a fire boundary the connections will be slotted in the connecting cleat in order to relieve the thermal stress in the sheeting rails.

f) The Steelwork Contractor shall obtain for the Engineer from the supplier of the cold formed sections a letter which certifies that the supplier has examined the steel sub-contractor's shop drawings and all other relevant details and information and that the proposed section sizes and all ancillary items being provided are in accordance with the parent manufacturer's written recommendations and permissible load tables. This requirement applies whether or not the type and section sizes being used are as noted on the Engineer's drawings.

5.1.12. ANCHORAGE ITEMS

Installation of anchorage items to be embedded in or attached to other construction shall be coordinated to prevent delays to the Work. Setting-out diagrams, sheet metal templates, instructions, and directions shall be provided by the fabricator for installation.

The site supervisor for anchor installation must co-ordinate all work to ensure anchors are installed in accordance with the Code of Practice for the Design & Installation of Anchors and the manufacturer's installation requirements.

5.2. **Tolerances**

5.2.1. GENERAL

All tolerances are to be in accordance with the requirements of the National Structural Steelwork Specification 5th Edition (CE marking version), known as the "Black Book".

5.2.2. HORIZONTAL SURFACES

The overall height of a vertical member relative to its horizontal base level shall not deviate by more than +/- 10mm measured from the nearest reference level.

5.2.3.	VERTICAL SURFACES	For steel plate embedded in concrete on a vertical surface deviations Δx, Δy, Δz from the specified location and level shall not be greater than +/- 10mm measured from the nearest reference level.
5.2.4.	CROSS-SECTION DIMENSIONS	The permissible deviation of cross-sectional dimensions of built-up members from that shown on the drawings shall be +/-3mm or +/- 1:500 whichever is the smaller unless otherwise indicated on the drawings.
5.2.5.	PLUMBNESS	The maximum deviation of a column on plan from a vertical line through its centreline shall be 1:500.
5.2.6.	BOW	The permissible deviation in bow shall be 1/500 of the length of the members.
5.2.7.	CAMBER	The maximum deviation from the intended curve or camber at mid-length of curved position when measured with the web horizontal shall be the greater of span/1000, or 6mm.
5.2.8.	OVERALL DIMENSIONAL DEVIATIONS	The maximum permissible overall deviations for horizontal and vertical dimensions shall not exceed +/- 1:1000 or +/- 30mm whichever is the smaller.

5.3. **Fabrication**

5.3.1.	GENERAL	All structural steel shall be fabricated in accordance with EN 1993 and NSSS 5th Edition (CE marking) unless specified otherwise.
5.3.2.	INSPECTION	A minimum notice of three weeks shall be given to the Engineer prior to the commencement of steelwork Fabrication.
5.3.3.	COMPRESSION MEMBERS	Compression members at splices, caps or bases dependent on contact for transmission of compressive stress shall be machined so that the butting faces are in contact except for small areas, which shall not exceed 20% of the total area, where the clearances do not exceed 0.15mm, and the ends of each adjoining member shall not have a deviation from square greater than D/1000 (Where D is the depth of the member).
5.3.4.	BEARING STIFFNESS	Bearing stiffeners shall be cut and ground to ensure a tight fit along edges in contact flanges.

5.3.5.	DE-BURRING	All burrs and sharp arises shall be removed.
5.3.6.	SPLICING	Splices shall be indicated on fabrication drawings. Splices not indicated on the drawings will not be allowed unless specifically approved by the Engineer. Where splices are indicated on the Engineer's drawings, the location and number of splices shall not be altered without specific approval from the Engineer.
5.3.7.	MARKING GENERALLY	All steelwork shall be marked in accordance with an assembly drawing before delivery on site.
5.3.8.	MARKING PAINTING	Contrasting and compatible paint shall be used to mark steel which is given anti-corrosion treatment before delivery to site.
5.3.9.	MARKING STEEL	Steel shall be marked by hard stamping or by another approved method as shown on the drawings. An adequate depth of stamping shall be employed to prevent obliteration.
5.3.10.	HOLLOW SECTIONS	All hollow sections shall be effectively sealed at ends and at Penetrations. Where a hollow section is to be galvanised the galvanising coating shall be applied prior to the end sealing. To prevent internal pressure build up an air release hole may be drilled in the end plate. This will be sealed and protected as appropriate after fabrication.

5.4. **Fabrication Bolting**

5.4.1.	BOLTED CONNECTIONS	Bolted connections shall be designed in accordance with EN 1993-1-8 unless otherwise specified by the fabricator. Minimum forces shall be applied in accordance with 5.1.9 of this specification. As an absolute minimum 2 No. Bolts shall be required in any connection.
5.4.2.	HOLES	Holes, where required, shall be drilled. Punching and burning to form holes shall not be accepted

unless written approval is sought from, and provided by, the Engineer.

5.4.3. ALIGNMENT OF HOLES

Drifts in holes which are 2mm diameter or more off centre shall not be used.

5.4.4. FRICTION GRIP BOLTS

HSFG bolts shall be used in accordance with EN 1993-1-8.

5.4.5. PROPRIETARY

Proprietary bolts and accessories shall be used in accordance with the manufacturers written instructions.

5.4.6. SITE SUPERVISOR FOR ANCHOR INSTALLATION

The contractor will appoint a site supervisor for anchor installation to ensure the correct installation of anchors to the code of practice (see 3.4.7) and manufacture's installation requirements.

5.4.7. TORQUE CONTROLLED EXPANSION ANCHORS AND BONDED ANCHORS IN CONCRETE

Anchors where required by the Engineer are to be installed as per the information provided by the specifier. The anchor specifier is to carry out the design of the anchor in accordance with the Health & Safety Authority Code of Practice for the design and installation of anchors.

The anchor specifier is to certify that all the Engineer's drawings and specifications have been read and understood. The specifier will comply with the FM-01 form prepared by the Engineer. The specifier will ensure that all anchors selected shall have a current ETA.

Installation to comply with the anchor manufacturer's requirements and Form FM-02 prepared by the specifier.

In the event that an anchor hole clashes with reinforcement or other changes arise, the supervisor should give clear instructions to the anchor installer for the correct installation of the anchor. In this instance the anchor specifier must make the Engineer aware of proposed changes prior to the anchors being installed on site. ETAG 001, Annex C: Design methods for anchorages, gives guidance on the effects of reinforcement on the anchor design.

Changes in the specification of the proprietary anchors should only be made where the proposed alternative satisfies all the original design

parameters and has been approved by the anchor specifier and the Engineer notified. Proprietary anchors should never be adapted or altered.

5.4.8. WASHERS — Washers shall be placed under bolts and under heads and nuts of all bolts connecting metal coated steel.

6. Dimensions

6.1. Correctness

6.1.1. CHECKING — The Steelwork Contractor shall be responsible for checking all site dimensions and dimensions on drawings.

6.1.2. CORRECTNESS OF DIMENSIONS — The dimensions should be confirmed from architects drawings and other stated requirements.

7. Preparations & Protective Coatings

7.1. General

7.1.1. COORDINATION — Selection of shop primers with topcoats to be applied over them shall be coordinated. Paint and coating manufacturers' recommendations shall be complied with to ensure that shop primers and topcoats are compatible with one another.

7.2. Preparations

7.2.1. GENERAL — The guidance provided in BS EN ISO 12944 shall be complied with; the paint system used shall be compatible with the environment category defined in the code.

7.2.2. FILM THICKNESS — The method and procedure for checking the thicknesses of dry films on rough surfaces shall be in accordance with ISO 19840, and for smooth and galvanized surfaces in accordance with EN ISO 2808, unless otherwise agreed. "DFT" means dry film thickness. "WFT" means wet film thickness.

7.2.3. STANDARDS — Surface preparation standards shall be in accordance with BS EN ISO 8501-1.

7.2.4.	CLEANING & PROFILE	Oil, grease, dirt, rust and mill scale shall be removed by an approved chemical process. Cleaning chemicals shall be completely rinsed off. Cleanliness of surfaces shall be in accordance with BS EN ISO 8501-1. The surface profile shall be compatible with the coating to be applied in accordance with BS EN ISO 8503-2. Unless otherwise agreed or specified, all steel other than cold formed sections and pre-primed hollow sections shall be blast cleaned and protected with blast primer, in compliance with BS 12944 to standard AP2A or better.
7.2.5.	PAINT	All paints are to come from the one approved manufacturer. Paint is to be applied strictly in accordance with the recommendations of the manufacturer. Alternative protective systems may be proposed and used if approved by the Engineer.
7.2.6.	HSFG BOLTS	The mating surfaces of HSFG bolted joints shall not have paint applied to them.
7.2.7.	ENCASED SURFACES	Surfaces to be encased in concrete shall not have paint applied to them. For top flanges of beams which are in contact with a metal deck, or precast slab, to form a composite section the entire top surface will be left unpainted except for a strip of maximum dimension 25 mm width on the outside edges of the flange running along the length of the member.
7.2.8.	PAINTING RESTRICTIONS	Coatings shall not be applied: 1) To surfaces affected by condensation, damp or frost. 2) When heat is likely to cause blistering or wrinkling. 3) When ambient temperatures are below 4 degrees Celsius. 4) Before previous coats have hardened sufficiently.
7.2.9.	PRECAUTIONS	Adequate precautions shall be taken to minimise damage to coatings, both at works and on site. Any paint coating which gets damaged or does not meet the specification shall be suitably prepared and spot-patched or otherwise treated as instructed, before the next coat is applied. The

main contractor shall ensure that the steel fabricator has applied the primer as specified before continuing with the protective system.

7.2.10. NOTIFICATION

The Engineer and inspecting authority shall be notified of projected date(s) for start of surface preparation and coating a minimum of one week in advance of commencement.

7.3. Pre-Erection Protective Coating

7.3.1. GENERAL

Cold form steel sections (e.g. purlins, sheeting rails etc) and their cleats, sleeves, anti-sag bars and all other ancillary items including fixing nuts and bolts shall be galvanized.

All external steelwork shall be hot-dipped galvanised unless an alternative agreement is received in writing from the Engineer.

Where the fabricator can show that Hollow sections which come adequately primed from the manufacturer they need not be blast-cleaned. Where a single pack primer has been applied it.

Will not be considered suitable for over coating with a two pack system.

7.3.2. PAINT SPECIFICATION

The primary source of protective coating specification shall be the Engineer's drawings. The information contained in this specification is to be incorporated as supplementary to the primary source.

Where conflicts between the Engineer's drawings and this specification occur it shall be brought to the Engineer's attention for decision.

7.3.3. CLEANING

Following fabrication of the steelwork all weld and spatter, rough edges, etc. shall be removed by careful scraping, chipping and grinding to a smooth surface. Any unsound or scorched primer around welded areas is to be removed along with dust, dirt, grease, etc.

Blast cleaning shall be to preparation grade Sa 2 ½ or in accordance with BS EN ISO 8501. All traces of loose rust, grit and other debris shall be removed by compressed air hose or by careful clean dry brushing. Laminations shall be removed by careful grinding, to produce a smooth surface.

Unless otherwise agreed, within two hours of shot blasting the surface shall be dusted off and the specified blast primer shall be applied. The time between completion of blasting and placement of primer shall never be allowed to be greater than 24 hours.

One coat of primer in compliance with BS 5493 shall be applied to all steelwork except for encased or galvanised sections. Areas to be site welded shall be masked.

7.3.4. CLEANING CONTACT SURFACES

Loose scale, loose rust and grease shall be removed from contact surfaces and surfaces inaccessible after assembly prior to applying primer which shall be as specified for adjacent surfaces. Two coats of primer shall be applied to surfaces inaccessible after shop assembly. The surfaces shall be brought together while the paint is still wet.

7.3.5. PAINT SET UP

Paint shall be allowed to dry hard before dispatch to site (5 days minimum).

7.3.6. JOINTS TO BE WELDED

Each coat shall be stepped back 30 mm from the previous coat adjacent to joints which are to be welded after completion of painting.

7.4. Post-Erection Protective Coating

7.4.1. PREPARATION

Unless otherwise specified, following erection the main contractor shall clean off all dust, dirt, grease, and other debris.

7.4.2. FILM THICKNESS

DFT specified is the nominal DFT and shall comply with the relevant British Standards or other relevant standards. The average of DFT readings shall equal or exceed the nominal DFT and no reading shall be less than 80% of nominal DFT.

7.4.3. PAINT

To each item to be painted the following should be applied:

1) Undercoat FUIB (DFT 40um) (MIO/modified phenolic);
2) Finish FFIB (DFT 40um) (MIO/modified phenolic).

All finishes should be compatible with the Architect's required finish.

7.4.4.	WIRE BRUSHING	Preparation by wire brushing etc., shall not be employed unless specifically approved by the Engineer. Where wire brushing is approved the protective system must also be approved by the Engineer and/or Architect prior to commencement of application.
7.4.5.	JOINTS TO BE WELDED	Each coat shall be stepped back 30mm from the previous coat adjacent to joints which are to be welded after completion of painting.
7.4.6.	STEELWORK IN CAVITIES	For steelwork to be placed within cavity walls or external solid walls the steelwork should be galvanised. Alternative forms of protection shall not be applied without specific approval from the Engineer. The protection is to be suitable for a Grade 2 environment, with a minimum design life of 60 years unless indicated elsewhere.
7.4.7.	STEELWORK BELOW GROUND	For steelwork located below ground provide minimum 100 mm concrete surround with a minimum of D98 mesh reinforcement. The concrete shall a minimum structural grade.

7.5. Galvanising Coatings

7.5.1.	GENERAL	Galvanising shall be carried out in accordance with BS EN ISO 1461.
7.5.2.	MINIMUM THICKNESS	A minimum average coating thickness 85 microns shall be applied.
7.5.3.	WEIGHT	A minimum mean coating weight of 610 g/m^2 shall be applied to all steelwork > 6mm thickness. For steel work less than this thickness the guidance in BS EN ISO 1461 shall be followed.
7.5.4.	POST-GALVININSING	All post-galvanising inspection and processes shall be in accordance with the National Structural Steelwork Specification 5th (CE marking).

7.6. Fire Protection

7.6.1.	GENERAL	Fire protection periods and requirements shall be in accordance with the Architect's and/or Fire Consultants' specification.
7.6.2.	INTUMESCENT COATINGS	Intumescent coatings shall satisfy the performance requirements of the project building fire rating and be in accordance with ASFP

Technical Guidance Documents 11 and 16. Intumescent coatings shall be compatible with the paint coatings underneath. All shop and site applied intumescent coating systems and touch-ups shall be applied in accordance with Technical Guidance Note: ASFP TGN 007:2001 – 'On Site Guidance Note for the Specification and Use of Site Applied Intumescent Coating Systems'.

All paint products and applications shall be compliant with any aesthetic finish specified by the Architect.

7.6.3. SIET DAMAGE

Where on site activities reduce or remove fire protection in localised areas, the intumescent paint coating shall be touched up by the contractor to restore the required level of protection.

7.6.4. DFT MEASUREMENTS

Dry film thickness (DFT) of intumescent coatings should be verified on site through dry film thickness measurements. All measurement tools shall be calibrated based on industry standard methods. Proof of calibration along with the DFT site measurement results shall be issued to the ER/Engineer, Architect and Contractor.

Primer DFT shall be carried out prior to application of intumescent coatings.

The proportion of elements or coated area for testing is to be agreed with the ER, Contractor and the Fire Consultant.

Tests shall be carried out in accordance with following:

- UB, T and PFC sections:
  - Web: 2 No. readings per metre length on each face of the web.
  - Flanges: 2 No. readings per metre length on the outer face of each flange.
    1 No. reading per metre length on the inner faces of each flange.
- SHS and RSH sections:
  - 2 No. readings per metre length on each face.

- CHS sections:
  - 8 No. readings per metre length evenly spread around the section.

- For members less than 2m long, 3 No. sets of readings shall be taken as follows:
  - 1 No. near to each end of the member
  - 1 No. at the centre of the member
- Flat plates:
  - 5 No. readings per square metre.

If defects are identified, a more detailed survey area shall be agreed with the ER, Contractor and Fire Consultant.

7.6.5. COATING ACCEPTANCE CRITERIA

Intumescent coating dry film thickness (DFT) acceptance criteria:

- Average DFT applied to each element shall not be less than the specified nominal value.
- Average DFT measured on any face of any member shall not be less than 80% of the specified nominal value.
- Where measured DFT is less than 80% of the nominal value, 3 No. readings shall be carried out within 150 – 300mm of the affected area. If one or more of the readings is less than 80% of the specified value, the extent of the area with under thickness shall be determined through further readings. This area shall then be made good or calculated with the rest of the element to determine overall fire resistance.
- All dry film thickness shall be at least 50% of the nominal value.
- Mean intumescent DFT shall not exceed maximum fire tested thickness +10%.

8. Flame Cutting & Welding

8.1. Flame Cutting

8.1.1. APPROVAL

Flame cutting shall only be employed where approval has been requested and provided by the Engineer in advance of the commencement of such activities.

8.1.2. FLAME CUT METHOD

Flame cutting shall be carried out by machine.

8.1.3. CONDITION OF FLAME CUT EDGES

Flame cut edges which will be subjected to substantial stress or which are to have weld metal deposited on them shall be reasonably free from gouges. Occasional notches or gouges not more

than 3mm deep shall be permitted. Gorge marks greater than 3mm that remain from cutting shall be removed by grinding. Shape all re-entrant corners to a radius of at least 15mm.

8.1.4. WELDING FLAME CUT EDGES

The forming of flame cutting of edges to be welded shall not be permitted without approval. Grades of steel other than S275 and S355 shall not be approved for flame cutting.

8.2. Welding Generally

8.2.1. TACK WELDS

The steelwork contractor's system for management of welding shall meet the standard quality requirements described in BS EN ISO 3843-3.

The length of tack welds which shall be incorporated in the finished work shall not be less than four times the thickness of the thicker plate or 50mm whichever is the smaller.

8.2.2. SITE WELDING PRECAUTIONS

The following precautions shall be taken when site welding. The surface to be welded shall be dry and BS 9692-1:2003 shall be complied with. **Approval must be obtained from the Engineer in writing for site welding.**

8.2.3. QUALIFICATIONS

All welders should hold a current proficiency certificate of approved qualification appropriate to the class or work on which they are to be engaged.

A copy of all proficiency certificates shall be submitted to the Engineer on request. Welders shall be tested to meet the requirements of BS EN 287-1.

8.2.4. COMPETENCE OF WELDERS

Where welders do not hold approved current proficiency certificates, submit for approval evidence in accordance with BS EN 287-1 of the proficiency of welders for the class of work to be carried out.

8.2.5. FILLET WELDS

Fillet welds shall be of minimum 6mm full-penetration unless otherwise specified. Welding details shall be submitted to the Engineer for review.

8.2.6. ANGLES

Angles shall be welded all round at connections.

8.2.7.	BUTT WELDS	Butt welds shall be complete penetration welds between prepared fusion faces unless otherwise specified. Prepared run on and run off plates shall be used. **Approval must be obtained from the Engineer in writing for butt welding on site**.
8.2.8.	PLACING WELDS	Do not place any welds, even tack welds, except those shown on the drawings, without approval.
8.2.9.	WELDING PROCEDURES	Written welding procedure specifications (WPSs) shall be made available in accordance with BS EN 15609-1 and tested in accordance with BS EN ISO 15614-1 by the steelwork contractor. The procedures shall comply with the guidance of BS EN 1011-2, Annex C, Method A. Welding procedure specifications shall be submitted to the Engineer for comment at least three weeks prior to commencement of the activity.
8.2.10.	HIGHLY VISUAL/AESTHETIC WELDED JOINTS	Grind down as appropriate to achieve specified visual finish. The work shall need to be approved/agreed by the Engineer and the Architect.

8.3. Inspection and Testing

8.3.1.	VISUAL EXAMINATION OF WELDS	100% of all welds and adjacent surfaces shall be examined visually to ensure they have been completed satisfactorily and with the absence of the following defects: 1) Cracks in the weld or adjacent surfaces. 2) Slag inclusions. 3) Porosity. 4) Lack of fusion at the edge of weld. 5) Undercut. 6) Concave weld profile. 7) Excessively convex weld bead. 8) Poor transition between weld and members welded. 9) Lack of alignment between components of joint. 10) Lack of penetration at the roof of the weld. 11) Excessive penetration bead.
8.3.2.	WELD TEST SPECIMENS	Test specimens of welded joints shall be prepared as required. The delivery of samples to the testing authority shall be the responsibility of the contractor.

8.3.3. WELDING TEST SPECIMENS

Weld specimens shall be tested in accordance with the following standards:

- Transverse tensile test – BS EN ISO 4136:2011;
- Longitudinal test – BS EN ISO 5178 :2011;
- Hardness test – BS EN ISO 9015-1:2011;
- Bend test – BS EN 5173:2010;
- Fracture Test – BS EN 1320:1997;
- Tensile (cruciform joints) – BS EN ISO 9018:2003.

8.3.4. NON-DESTRUCTIVE WELD TESTING

Non-destructive weld testing shall comply with the following standards:

- BS EN ISO 17640:2010, Non-destructive examination of welded joints - Ultrasonic examination of welded joints;
- BS EN 1435:1997, Non-destructive testing of welds - Radiographic testing of welded joints;
- BS EN 571-1 1997 Non-destructive testing. Penetrant testing. General principles;
- BS EN ISO 17638:2009 Non-destructive testing of welds: Magnetic particle testing.

8.3.5. DESTRUCTIVE WELD TESTING

Destructive testing of welds shall comply with the requirements of BS ISO 22826:2005. Shear stud welding shall comply with the requirements of the NSSS.

9. Execution/Erection

9.1. Examination and Preparation

9.1.1. EXAMINATION

It shall be verified before delivery of structural steel that work of other sections on which work of this section is dependant is correctly installed and located.

9.1.2. PREPARATION

Anchor bolts, base and bearing plates and other members shall be placed during work in advance of the main steelwork frame erection. The Steelwork Contractor shall co-ordinate with installers of this work and provide instructions for its setting-out.

9.2. Erection

9.2.1. GENERALLY

Erect all structural steel in accordance with EN 1993 and the National Structural Steelwork Specification 5th Edition (CE marking version). All

erection should comply with legal Health and safety requirements.

9.2.2. STABILITY

The Steelwork Contractor shall be fully responsible for all programming/scheduling of works, bracing, temporary works, and ensuring stability of the frame during the erection process.

9.2.3. CAST-IN FIXING BOLTS TO CONCRETE OR MASONRY

All steel to concrete fixing bolts are to be supplied by the steelwork fabricator and set out and fitted by the main contractor. Steel fabricator shall check line, level, and protruding length before erection and report any defects to the main contractor and the Engineer.

The site supervisor for anchor installation must co-ordinate all work to ensure bolts are installed correctly.

9.2.4. HOLDING DOWN BOLTS

All holding-down bolts shall be supplied by the steelwork fabricator complete with approved, loose fitting anchorage washers.

Set out and fixing in place shall be the responsibility of the main contractor unless otherwise agreed with the Engineer.

Holding-down bolts shall be cast within cardboard wax cones. The bolt cone shall be a nominally 75mm shorter than the required bolt length with an absolute minimum of 50mm shorter.

The wax former shall be placed over the inverted bolt, fitting flush with the plate washer or anchorage. The formers shall be left insitu until the concrete has set. The former may be rotated to break the bond with the concrete.

After erection and after inspection and approval by the Engineer of holding down bolts the former shall be removed prior to grouting of the void.

9.2.5. ERECTION STRESSES

Stresses shall not exceed those compliant with the rules given for structural design in EN 1993.

9.2.6. GROUTING

The responsibility for grouting under all steelwork bearing plates and baseplates shall be co-ordinated between the Main Contractor and the Steelwork Contractor. This work shall normally be carried out under the main contract by the main contractor unless noted or agreed otherwise.

The grout shall be non-shrink and have a minimum cylinder strength of 50 N/mm^2 unless otherwise stated by the Engineer.

Grout shall extend on plan around the baseplate on all sides to a minimum distance equal to the depth of grout placed under the base plate.

9.2.7. HOLES

Any holes through steel members required by other trades shall be the responsibility of the Steelwork Contractor. The location and extent should be approved by the Engineer. All holes are to be reinforced by the steelwork contractor where necessary so that the full strength of the steel member section is maintained.

9.2.8. STEEL PACKS

Steel packs under base plates shall not be less than 50mm wide and each pack shall comprise not more than four separate plates.

Steel packs shall be located symmetrically on plan.

9.2.9. TEMPORARY CLEATS

All temporary cleats used for erection shall be removed after erection and any surface coatings impaired by their removal shall be made good to the satisfaction of the Engineer and the Architect.

9.3. Existing Structures

9.3.1. SITE CONNECTIONS TO EXISTING STRUCTURE

The Steelwork Contractor shall be responsible for the design of all connections between new and existing structure after carrying out a site inspection and dimensioned survey of the existing structure.

9.3.2. SITE DIMENSIONS

The Steelwork Contractor shall be responsible for checking on site dimensions to both existing structures and new build structures.

9.3.3. TEMPORARY WORKS TO EXISTING STRUCTURE

Where existing steelwork members are to be removed or replaced the Steelwork Contractor shall submit details of his proposed temporary works and sequence of operations.

9.3.4. COMPATIBILITY

The sizes of some new members are subject to change in order that the new structure ties in with the existing structure. This applies particularly to the sheeting rails and purlins. The Main Contractor will be responsible for supplying

accurate survey information to determine compatibility.

10. Repairs and Defective Work

10.1. General

10.1.1. DEFINITION — Variations in excess of specified tolerances, and failure of materials or workmanship to meet requirements of this specification, and which cannot be repaired by approved methods, will be considered defective work performed for the purpose of this specification.

10.1.2. RECOURSE — Defective work shall be replaced or corrected as directed by Engineer at the expense of the Main Steelwork Contractor.

10.1.3. RESPONSIBILITY — The Main Contractor/ Steelwork Contractor shall pay for additional inspection and testing and related expenses if work has proven to be deficient.

10.1.4. CORRECTIVE ACTIONS — In the event of any member or connection being found unsatisfactory before or after erection or due to errors arising in fabrication, the Steelwork Contractor shall submit to the Engineer his proposals as to the method to be adopted in making good. The Steelwork Contractor shall abide by the Engineer's decision and, in the event of remediation or replacements being required, for all costs involved.