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| ParadigmSteel Bridges – Structural Steelwork – SWS-PTender Specification |
| DECEMBER 2018  |



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|  |  |
| --- | --- |
|  | Special Work Specification |
|  | Special Work Specification (SWS) for Steel Bridges – Structural Steelwork, is an additional, special specification to: * General Work Specification (GWS) for Steel Bridges - Structural Steelwork
 |
| Please state any amendment sheet: | * ”…”
 |
|  | General |
| For composite structures, the following shall be added: | Eurocode 4, Design of Composite Steel and Concrete Structures - Parts 1-1, 1-2 and 2, Eurocode 2, Design of Concrete Structures and Eurocode 3, Design of Steel Structures, including national annexes and any amendment sheets. |
|  |  |
| Detailed specification of the scope of work by indicating which services are assumed to be designed, delivered, made or assembled. | The Work comprises:* Design of ”...”
* Supply of ”...”
* Production of ”...”
* Assembling of ”...”
 |
|  |  |
| Documentation requirements shall be related to the structural significance of the elements as specified in the General Note, e.g.: | Fatigue-affected structural elements comprise:* load-carrying bridge decks

Primary structural elements comprise:* structural steel girders
* bridge decks

Secondary structural elements comprise:* RHS profiles in parapets
* base plates in parapets
* inserts in bolting assemblies
 |
|  |  |
| If the Contractor shall carry out the design, e.g. in case of Design-Build Contracts for minor projects, it may be stated (time limit to be adapted to current contract form). For major projects, this will typically be described in SWS Management and Cooperation, see SWS-P Management and Cooperation: | The Contractor shall design structural elements as described below. For the individual structural elements, the basis of and extent of the Contractor's design is as follows:Structural elementBasis:Scope:The material shall be laid out in such a way that it can be directly – or with only insignificant editorial amendments – included in the material submitted to the authorities. Furthermore, the material shall, as a supplement to this work specification, contain the necessary supplementary specifications for manufacturing and assembling and maintenance of the structural elements.The above mentioned documentation material shall be submitted to the Employer 15 working days, at the latest, before commencement of production which must not commence prior to the acceptance of the material by the Employer.If comments etc. require amendments to the above documentation, a revised version shall be submitted.  |
|  |  |
| Indication of conditions for the Work, e.g. previously built structures on which construction shall continue. |  |
|  |  |
| Reference to drawings, tables. |  |
|  |  |
|  |  References |
| In case any new editions of codes of practice and stand­ards become available, these shall be specified. | Reference is made to SWS Structural Steelwork, Annex 1, in the present SWS with the following additions: |
|  |  |
|  | CE marking |
| The method of CE marking shall be specified. This will typically be methods 3a or 3b. | CE Marking of steel structures shall be carried out as per method 3a in compliance with table A.1 in DS/EN 1090-1. CE Marking and DoP shall be submitted to the Employer prior to handover procedure. |
|  |  |
| The contractor shall always specify any special perf­ormance properties. Please note that these properties only concern steel production, in other words there are no requi­rements for CE marking of assembly or application of paint - neither at the work­shop nor at the assembly site. The requirements known beforehand are specified for the guidance of the contractor. The requirements indicated in the table are a paradigm text and shall therefore be adapted to the project in question, including the actual CE marking method. | The applicable requirements for CE marking for the project, see table ZA.1: in DS/EN 1090-1: Execution of steel structures and aluminium structures - Part 1: Requirements for conformity assessment of structure components shall appear from the performance declaration. In the below table is specified the minimum requirements which have been determined on beforehand in compliance with the project. |

|  |  |
| --- | --- |
| Performance capacity | Requirement |
| Dimension and shape tolerances | With reference to GWS Steel Bridges - Structural Steelwork including SWS and the General Note |
| Weldability | DS/EN 10025-2 to 6 |
| Fracture toughness and impact value | 27 Joule at -20oC (steel quality S355J2+N, S275J2+N, DS/EN 10025-2) |
| Erection during fire | Class A1 |
| Migration of cadmium and cadmium connections | NPD |
| Emission of radio activity | NPD |
| Durability | Painted according to GWS Steel bridges - Surface protection including SWS corresponding to corrosion category C ”…”, ref. Coating specification ”…” |
| Constructional properties |
| Load-carrying capacity | According to the calculation documentation, elaborated from the design basis, Doc. No. ”…”(Or for method 3b: Reference to the design basis, Doc. No. ‘’...’’, prepared on the basis of the Design Guide for Load and Calculation rules for Bridges, Road Standards Committee – The Danish Road Directorate, or BN1-59 Load and calculation directions for bridges with railway tracks and earth structures. |
| Deformation in the mode of use |
| Fatigue resistance |
| Fire resistance | NPD |
|  |
| Production | With reference to GWS Steel Bridges - Structural Steelwork, including SWS and the General NoteExecution class EXC ”…” see DS/EN 1993-1-1 Annex C incl. DK NA and DS/EN 1090-2. |

Figure 1.1 Performance capacities according to DS/EN 1090-1

|  |  |
| --- | --- |
|  |  |
| In case the Contract comp­rises both production and assembling, and in case the invitation to tender has the award criterion "most eco­nomically advantageous tender", and if it is import­ant for the assessment of the tender that assembling methods are stated, it should be specified what needs to be clarified: | Information concerning the planned actions in connection with transport of assembling sections and concerning special operations in connection with assembling in the form of a brief description, in addition with sketches, shall accompany the tender for the following structural elements and assembling operations: |
|  |  |
|  | Performance specification |
|  |  |
|  | General |
|  |  |
|  | Execution classes |
| Temporary supporting structures shall be attrib­uted to consequence class CC3, where failure during the construction phase can involve a considerable risk of personal injury. |  |
|  |  |
| Any clarification in relation to the General Note shall be specified. |  |
|  |  |
| If, in exceptional cases, in connection with the design of major steel bridges, a more rigorous control class is presupposed when des­igning constructions, all requirements for the meet­ing of this shall be specified. |  |
|  |  |
|  |  |
|  | Treatment qualities |
| Any clarification in relation to the General Note shall be specified. |  |
|  |  |
| Requirements for surface quality may be different­iated, but only if it does not appear from GN-P, e.g.: | The following surface quality requirements for steel plates shall be observed in accordance with DS/EN 10163:* Primary structures: Class B, sub-class 3
* Secondary structures: Class A, sub-class 3
 |
|  |  |
| The finish can be eased for structures that are corrosion protected below category C4. E.g. inside of a beam which is dehumidified. | The finish qualities mentioned in GWS are allowed to be eased to the following, for construction parts which are placed in a dehumidified environment in the final structure, in compliance with DS/EN ISO 8501-3:* Welds P2, however, P3 for 1.1
* Sheet and profile edges: P3
* Steel substrates: P2
 |
|  |  |
|  | Geometrical tolerances |
| For composite structures, the following shall be stated: | Measurements for composite steel and concrete structures apply at +10°C under the impact of dead weight and expected creep and shrinkage of the concrete. |
|  |  |
| Reference is made to the list in DS/EN 1090-2, annex A item 11. Supplementary or changed tolerance req­uirements for structural elements shall be specified. |  |
|  |  |
| If structures shall be carried out with a rise, this shall be stated on the drawings. Tolerances for superel­evation may be changed in GN, if there is a risk of the superelevation impacting on the visual impression or surface drainage. | The following structural elements shall be carried out as shown on the drawings with the specified height of arch to compensate for elastic deflection from dead weight of girder:* ”…”
 |
|  |  |
| In case of superelevation for composite steel and concrete structures, it shall be stated whether the superelevation applies before or after casting of the concrete slab.  | Requirements for superelevation in the steel structure of composite structures are stated after concreting slab. |
|  |  |
| In connection with composite structures, it shall be stated how any expected shrinkage shall be included, e.g.: | Steel girders shall be made with superelevation corresponding to the expected deflection from dead load including shrinkage of the concrete. The superelevation is determined during the detailed design phase and will be established as ”...” by the factory assembly in the girders at ”...”, cf. drawings. Deviations between the expected longitudinal section and a polygonal longitudinal section are accommodated by adjusting the height of the vaults. |
|  |  |
| Tolerances on the superelevation for the final structure and its location shall be stated by taking into account the visually appearance. | The deviation from the theoretical longitudinal section in the span centre shall not exceed ± l/3000 in the vertical orientation (l is span), but no less than ± 5mm. |
|  |  |
| The project shall specify which elements are subject, in the permanent structure, to tensile and pressure forces where the size of the tolerances depend on any pressure impact (see DS/EN 1090-2, Annex B, Table B.25 No. 1 and table B.4 No. 4 and table B.1 and table B.2). | The following components are exposed to pressure in the permanent state and shall comply with the tolerances specified in annex B: |
|  |  |
| If the general tolerance needs to be tightened for short piers, it shall be stated: | For the following elements, the deviation specified in DS/EN 1090-2, section 11.2.3.4 does not apply, since the calculation assumptions in general are L/1000:- ”...” |
|  |  |
|  | Constructor's documentation |
|  |  |
|  | Quality documentation |
|  |  |
|  | Quality plan |
| Any stricter or relaxed requirements for the contents of the control log shall be specified. The scope stated will usually cover the need for documentation. |  |
|  |  |
| If the Employer wish to monitor specific processes or works, these shall be specified – and in particular stop points where contin­uation of processes are subject to the Employer’s acceptance.Or in case the Employer wishes to carry out his own tests. | The following works shall be notified of checking for the Employer’s acceptance:* ”…”
* ”…”

The Employer shall be notified and be given access for test of ‘’...’’ |
|  |  |
|  | Safety when mounting the constructions |
| Special safety conditions in relation to assembling work shall be specified. |  |
|  |  |
| It shall be specified how the Supervision Handbook on Falsework shall be used in connection with the current work, including specification of the skills requirements. Furthermore, requirem­ents for dimensions shall be stated for the temp­orary structures etc., cf. Design Basis for Falsework and, GWS and SWS-P for Scaffolding and Formwork. |  |
|  |  |
|  | Execution documentation |
| Special requirements for the degree of details of the fabrication drawings shall be stated. |  |
|  |  |
|  | Geometrical tolerances |
|  |  |
|  | Materials |
|  | General |
| Reference is made to the list in DS/EN 1090-2, Annex A item 5. Relevant items to be added. |  |
|  |  |
| If, during the design of e.g. major steel bridges, a stricter control class is assumed in exceptional cases, the inspection doc­ument for the material shall be changed to 3.2 in the General Note, and any req­uirements for the control body shall be specified here: | Where, the General Note requires inspection document 3.2, the document shall be issued by an accredited control body.In connection with inspection document type 3.2, verification shall be carried out by a person appointed by the buyer. In this context, the buyer means the Contractor. The Contractor shall appoint a person from an independent certification agency. In its quality plan, the Contractor shall describe the responsibilities of the certification agency. |
|  |  |
| The type of stainless steel shall be specified based on the requirements for mech­anical properties, weldab­ility, cutting capacity etc., and in case of special req­ui­rements for corrosion res­ist­ance. The general require­m­ent for corrosion resis­tance is fulfilled for austen­itic steel 1.4435, 1.4539 and duplex steel 1.4460, 1.4462, 1.4410 |  |
|  |  |
|  | Identification, inspection documents and traceability |
| To the extent that the section on the control deals with limited traceability, any requirements for the Contractor's document­ation shall be stated or agreed. |  |
|  |  |
| If hot dip galvanised bolts in quality 10.9 are used, these shall be supplied with a 3.1 certificate | Bolts and nuts in quality 10.9 shall be supplied with a 3.1 certificate in compliance with DS/EN 10204. |
|  |  |
|  | Products of structural steel |
|  |  |
|  | General |
| It shall be stated which materials that may be used as coils. |  |
|  |  |
| Relaxed requirements for documentation for small quantities may be stated. | Acid-resistant stainless steel may be delivered with inspection document type ... |
|  |  |
| In case requirements are made for special suitability for welding.  | For ”...”, steel with carbon equivalent < 0.xx shall be used |
|  |  |
| In case requirements are made for special suitability for cold deformation. (May also be specified in the GN). | For ”...”, steel suitable for cold deformation shall be used, according to DS/EN 1090-2, Table 3. |
|  |  |
| If cold deformation is req­ui­red for plate thicknesses >20mm, test method shall be described and requirem­ents for the test result shall be stated, which shall also include quality requirements (viscosity). |  |
|  |  |
| Where steel is to be hot dip galvanised for a layer thickness greater than the standard, cf. ISO 1461, and, especially, if the wall thickness is small, it may be necessary to purchase steel with a higher Si content. | The Contractor shall, in cooperation with the person responsible for the galvanisation, ensure that the steel can be hot-dip galvanised, according to the requirement for sheet thickness in SWS Steel Bridges – Surface Protection. The most important parameters of this is the chemical composition of the steel, surface roughness and dipping time and whether it is warm or cold ripped.Thus, it may be necessary to buy steel with a defined (higher) content of silicon. Accessibility and longer delivery times for these steels shall be included in the Contractor’s planning.Prior to production start-up, a test dip shall be carried out in order to verify that requirements of hot dip galvanising can be observed, unless the Contractor can present sufficient experience from recent projects with comparable requirements. |
|  |  |
|  | Thickness tolerances |
|  | Surface quality |
| Structural element shall be stated together with rust grade A or C. | The steel substrates on "..." must not show a rust grade that exceeds rust grade " ... ", according to DS/EN ISO 8501‑1. |
|  |  |
|  | Special properties |
| If special requirements are made for impact strength testing for some fatigue-affected sub elements, these shall be stated by steel type. Requirements should only be stated in GN. | For "...", "..." shall be used with a documented impact strength. |
| Special requirements for documented properties in the direction of thickness of the material for transv­ersely loaded structural elements may be stated. Requirements should only be stated in GN. | For "...", Z-steel grade "..." shall be used in accordance with DS/EN 10164. |
|  |  |
| Quality class Z15/Z25/Z35 shall be stated for the ind­ividual structural elements where Z-steel is required. |  |
|  |  |
| For welded joints, as indicated in DS/EN 1993-1-10, but where calculation shows that Z-steel is not required, grade S1 should be required, regardless of the load impact (for Z-steel, grade S1 is included) | For "...” quality class S1 under EN 10160 shall be used. |
|  |  |
|  | Steel castings |
| Steel castings are not comp­rised by Eurocode 3. For steel castings, requirements should be specified for:* Strength
* Surface structure
* Acceptance criteria for internal defects
* NDT control
* Repair procedure
* Marking

Any other and/or supp­lementary requirements for the material than those specified in DS/EN 10340 shall be stated here. | Steel castings shall be delivered in strength and quality designation "...” according to DS/EN 10340. |
|  |  |
| Scope of allowable inhomogeneity shall be determined. |  |
|  |  |
| Repair procedure in case of material defects shall be determined. |  |
|  |  |
| Test scope to be specified:  |  |
|  |  |
|  | Filler materials |
|  |  |
|  | Mechanical fasteners |
| Where requirements are in place for special material requirements for bolts, e.g. tight-fitting bolts, hinge bolts, foundation bolts etc. they shall be stated here. Design and locking of hinge bolts shall be indicated on drawings or here. |  |
|  |  |
| Any special requirements for bolt design shall be stat­ed, e.g. as tight-fitting bolt or "load indication bolt". |  |
|  |  |
| If, in the design of disp­lacement connections, calculation includes displacement cross-sections corresponding to shank areas, please indicate: | Bolt lengths shall be selected so that the shear section of the joint passes through the unthreaded part of the shaft. |
|  |  |
| Where hot-dip galvanised bolts in quality 10.9 are pre­scribed, it shall be check­ed in connection with the design whether the bolts can be delivered with decl­arations as stated in GWS Steel Brid­ges - Structural Steelwork, section 2.6. Where bolts in quality 10.9 are not hot-dip galvanized, another surface protection shall be prescribed. | Hot dip galvanised bolts and nuts in quality 10.9 shall be delivered with a hardness under 340 HV. |
|  |  |
| If anchors are to be drilled and fixed in existing con­crete, these shall be spec­ified. This can perhaps be included in the SWS non-prestressed reinforcement, if the project concerns con­crete works. The text shall be coordinated with the text in GWS Concrete Bridge - Non-prestressed Rein­forcement, including SWS. | Anchors drilled into existing concrete, shall be made as adhesive anchorages in accordance with drawings. ETA approved adhesive mortar shall be used, in accordance with ETA guideline ETAG 001 option 1 for design subject to EOTA technical report TR029. Furthermore, the product shall be CE marked and without styrene.Requirements for load-carrying capacity: ”…”The product shall be approved for fractured concrete. |
|  |  |
|  | Dowels |
| For composite structures, the following shall be stated:(If stainless dowels are to be used, the text shall be adjusted) | Dowels shall be of the type "headed studs" in pursuance of DS/EN ISO 13918, Type SD1. The chemical composition of the material shall observe the requirements for S235J2+C470 or S355 in compliance with DS/EN 10025.  |
|  | Materials and assembling method shall be carried out in compliance with the current ETA of the dowel type in question. Performance capacity shall be available. |
|  | Reinforced steel welded to structural steel |
|  |  |
|  | Grouting materials |
| Additional or altered req­uirements for bedding or underfilling shall be stated, if relevant. (Please note that strength indicated in EN 1504 is not calculated as 5% fractile value of cylinder strength, and thus cannot be directly compared to fck in EN 1992-1-1). | * Suitability for use: horizontal/vertical/injection...
* Compressive strength: ”…”
* Sheet thickness ”…”
* Temperature: ”…”
* Shrinkage: ”…”
* Expansion: ”…”
* Fibre additives: ”…”
* ”…”
 |
|  |  |
|  | Construction joints for bridges  |
| Text shall be coordin­ated with the text in GWS Con­crete Bridge – Mechan­ical Joints, and associated SWS. |  |
|  |  |
|  | High-strength cables, rods and terminations |
|  |  |
|  | Bearings |
| Text shall be coordinated with the text in GWS Con­crete Bridge - Bearings, and associated SWS  |  |
|  | Execution |
|  | General |
|  |  |
|  | Manufacturing and joining |
|  |  |
|  | General |
| Reference is made to the list in DS/EN 1090-2, An­nex A, Table A.1 and 2, item 6. Relevant items to be added. |  |
|  |  |
| Requirements for the use of fixtures to secure specified geometries may be stated for tolerance-critical structural elements. |  |
|  |  |
|  | Identification |
|  | Marking out shall be carried out with a dot peen marker, of which the needle tip is round, or another method accepted by the Employer. |
|  |  |
|  | Handling and storage |
| Special requirements for trans­port in consideration of the surroundings or other Contractors may be specified: |  |
|  |  |
| Where sea transport may be relevant: | Areas, in which welding of fittings can be allowed for “sea-fastening”, are indicated on drawings. Design and calculation of fittings shall be approved by the Employer.The area is subject to ultrasonic and magnetic particle test, both before welding and after fittings have been removed. |
| It shall be specified if there is a requirement for certification of sea-fastening, lifting etc.Certification of sea-fastening (e.g. DNV) as well as review of marine surv­eyor should be submitted to the Employer. |  |
|  | Primer coating shall be applied to welded splices prior to sea transport. Requirements for maximum levels of rust apply to welded assembling joints during assembly – after sea transport. |
|  |  |
|  | Cutting |
| Requirements of hardness of edges after cutting shall be indicated for structures subject to fatigue, and for remaining free edges to be hot dip galvanised. |  |
|  |  |
|  | Shaping |
| If any plates are bent in excess of a plastic strain of 2%, functional requirements should be stated: |  |
|  |  |
|  | Holes |
| Where appropriate, a relaxation of bolt hole size should be prescribed, from normal holes to oversize holes, or short oblong holes in compliance with to DS/EN 1090-2 table 11: | Hole sizes in bolting assemblies are allowed to be made in larger sizes than normal holes, as specified in the General Note. |
|  |  |
| If oversized or slotted holes are used, oversized washers shall be placed over the holes. The size should be specified, as this is not indicated in DS/EN 1090-2 item 8.2.4. | Oversized washers shall be used over oversized or oblong holes as specified below:* for ”...” washers ”...” shall be used
 |
|  |  |
|  | Cut outs |
|  |  |
|  | Surfaces with contact pressure |
|  |  |
|  | Joints |
|  |  |
|  | Checking of joints |
| In case the requirement lapses for test joining in GWS Steel Bridges - Structural Steelwork, the following shall be stated: | Requirements for test joining lapses for the following structural elements:* ”...”
 |
|  |  |
| Requirements for scope of test joining shall be stated, e.g. superelevation at the test joint. |  |
|  |  |
|  | Welding |
|  |  |
|  | General |
| Reference is made to the list in DS/EN 1090-2, Annex A, Table A.1 and 2, item 7. Relevant items to be added. |  |
|  |  |
| Any special requirements for workshop equipment shall be stated, e.g. equipment for automated welding. |  |
|  |  |
| Any relaxed requirements for welding of secondary structures may also be stated: | For secondary structures, quality requirements for welding may be relaxed from DS/EN ISO 3834-2 to DS/EN ISO 3834-3. |
|  |  |
|  | Welding plan |
| Any requirements for completion times of shop works shall be stated and/or the following shall be included: |  |
|  |  |
| Weld seams to be verified in connection with the form of pre-production samples shall be stated. | The following weld seams shall be verified through pre-production samples: ”...” |
|  | Butts in bracings and welds between trough and cover plate shall be qualified by pre-production samples. The pre-production sample shall show that the planned panel (cover plate with trough bracings) can be produced with the intended geometry. |
|  | Pre-production samples shall represent actual conditions such as heat dissipation, degree of fixation, geometrical adjustment, accessibility, welding order, and preheating.In respect of buts in trough bracings, the usual WPS documentation shall be accompanied by special written instructions on the used machine type, settings, welding speed, and welding order. |
| The following shall be stated for automatic welding: | In respect of automatic welding, the usual WPS documentation shall be accompanied by special written instructions on the used machine type, settings, welding speed, and welding order. |
| Any relaxed or tightened requirements for verification of welding procedures shall be specified, but the requirements of ISO 3834-x shall be observed, see also 1090-2, 7.4.1. |  |
|  |  |
|  | Welding processes |
|  |  |
|  | Qualification of welding procedures and staff |
|  |  |
|  | Preparation for welding |
| Any additional requirements or permissions regarding procedures shall be stated (e.g. use of backing bar). |  |
|  |  |
| For composite structures, the following shall be stated: | Flash welding of dowels shall be verified by procedure testing. |
|  |  |
|  | Welding procedure specification and procedure testing report shall be submitted to the Employer for acceptance. |
|  |  |
|  | In connection with welding, the following tests shall be carried out in accordance with DS/EN ISO 14555. |
|  |  |
|  | * Normal work test. The test shall be made at the beginning of work and shall be repeated for every 5,000 welded dowels.
 |
|  |  |
|  | * A simple work test shall be carried out in connection with shifts and work being stopped for more than two hours.
 |
|  |  |
|  | Subject to the Employer's request, test results shall be submitted for acceptance. |
|  |  |
| Any requirements for heat treatment after welding (stress relieving annealing) of welded elements may also be stated: |  |
|  |  |
|  | Approval criteria |
| For welds subject to fatigue: | Any additional requirements of the quality level, for welding in structures subject to fatigue, are indicated on the drawings together with the welding symbols being one of the following* C63
* B90
* B125

where the quality requirements are found in DS/EN ISO 5817 Annex C. |
|  |  |
| Where relevant, this shall be stated about requirements in EN 1993-2 to be observed: | The requirements in DS/EN 1993-2, Table C.5, apply as an addition to the requirements stated in DS/EN ISO 5817.The following requirements in DS/EN 1993-2, Table C.4, apply:* ”…”
* ”…”
 |
|  |  |
| For EXC4, additional require­m­ents are stated for specific welding, as well as reference as to how they may be found in the drawing material |  |
|  |  |
|  | Welding of stainless steels |
|  |  |
|  | Mechanical fasteners |
|  |  |
|  | General |
| Reference is made to the list in DS/EN 1090-2, Annex A, Table A.1 and 2, item 8. Relevant items to be added. |  |
|  |  |
| Where there is a need for good adaptation, the req­uirement may be tightened to 1 or possibly 0mm. | The requirement of 2mm thickness difference in adjoining plate parts, stated in DS/EN 1090-2, item 8.1, is reduced to ”...” for the following components:* ”...”
 |
|  |  |
|  | Use of bolting assemblies |
| Shall be included, if relevant, when it does not appear from drawings: | Hinge bolts are used in the following places:* ”...”

Where a bolt is used as a hinge bolt, the nut shall not be tightened, but be protected against coming loose.  |
|  |  |
| Any requirements for use of locking agents shall be stated. In connection with structures affected by dyn­amic forces – including track-bearing bridges - locknuts (only in case of dis­placement), lock washers, jam nuts or locktite shall be used. The shorter the bolts - the greater the problem with loosening. |  |
|  |  |
| To avoid damages on the hot-dip galvanisation, it may be required: | Reduction of cross-section area is not allowed. |
|  |  |
|  | Tightening of non-distorted bolts |
|  | Tightening with torque in two steps shall be carried out at* Step 1: 75% of the torque/clamp force is indicated in the General Note
* Step 2: 100% of the torque/clamp force is indicated in the General Note
 |
|  |  |
| Where contra nuts are used: | Check nuts shall be tightened up to 50% of the torque/clamp force, indicated in the General Note. |
|  |  |
|  | Preparation of contact surfaces in slip-resistant connections |
| Location shall be described, and the class shall be described according to Table 17. | Slip-resistant connections are used as classified in DS/EN 1090-2, item 8.4, in the following locations:* ”...”

Working procedures for achieving the above class shall be presented to the Employer before commencement of the work. The Employer shall be notified and be given the opportunity to monitor the Work. |
|  |  |
|  | Tightening of distorted bolts |
| To ensure that the specified minimum distortion is achieved, method shall be stated. | Calibration by using DS/EN 1090-2, Annex H, is allowed. |
|  |  |
| Any requirements may be stated for re-tightening of structures affected by dynamic forces. | Bolts ”...” shall be re-tightened at ”...” intervals ”...” times after fitting. |
|   |  |
| Requirements for bolt type and distortion of any tension bolts shall he specified as these are not tightened to 0.7fub As. | At the following joints, exposed to tensile forces, bolts with a large width across flats are used, which are distorted to ‘’...’’  |
|  |  |
|  | Fit bolts |
|  |  |
|  | Hot riveting |
|  |  |
|  | Use of special fasteners and fastening methods |
|  |  |
|  | Galling and seizure of stainless steels |
|  | On stainless threads, lubricant with ‘anti-seize’ properties, appropriate for stainless threads, shall be used. Lubricants shall be submitted to the Employer for approval. |
|  |  |
|  | Assembling |
|  |  |
|  | General |
| Reference is made to the list in DS/EN 1090-2, Annex A, Table A.1 and 2, item 9. Relevant items to be added. |  |
|  |  |
| Special requirements for assembling and joining while considering the surround­ings or collaboration with other Contractors may be stated. |  |
|  |  |
|  | Construction site conditions |
| Any special requirements for protection shall be stated, including weather precautions. |  |
|  |  |
|  | Assembling method |
| Special requirements shall be stated for temporary supporting structures and for load of existing structures. |  |
|  |  |
| It shall be stated how the principles in the “Super­vision Handbook on Falsework” shall be used for the project in question.The text shall be coordin­ated with the text in section 1.4.3 in this SWS.Including a specification of, in what way important pro­cedures in the supervision handbook are adapted to the specific project. It shall also be stated to what extent and in what way, the individual tables in the supervision handbook should be used for the specific project. | This section specifies how the principles of "Supervision Handbook for Falsework” shall be used in the planning, design and construction phase of the assembling project. |
|  |  |
| Where requirements are made for weighing and indication of centre of gra­vity, their scope and accu­racy shall be stated here. |  |
|  |  |
| If appropriate, please include: | Regarding requirements for checking in connection with welding and removal of assembling fittings and similar, reference is made to item 4.4. |
| For composite structures, the following shall be stated: | For composite bridges, the provisions in GWS – Falsework and Formwork apply for the concrete deck, since the steel part shall be considered as part of the falsework structure. Deflections shall be verified during execution and be compared with the design values, cf. Annex ”...”Measuring program and acceptance criteria shall be presented to the Employer for acceptance, together with the assembling project. |
| For composite bridges it shall be stated, if execution phases and casting order have not been determined in advance. | The Contractor shall prepare calculation documentation, showing that safety is present in all execution phases, as well as additional tensioning and additional deformation do not exceed established limits, as a consequence of the selected rate of execution and casting, together with the maximum/minimum tensions and deformations from the permanent situation. If the limits are exceeded, amendments shall be made in the project at the Contractor's initiative. |
|  |  |
|  | Surveying and measuring |
|  |  |
|  | Supports, anchors and bearings |
| Requirements shall be stated for detailed setting out of bearings on existing concrete structures. |  |
|  |  |
| Tolerances of horizontal and vertical location in relation to existing structures (e.g. support or bearings) shall be stated, if they do not appear from/ are not included in DS/EN 1090-2. |  |
|  |  |
| Where the Contractor shall supply embedded items for fixings, the following may also be stated: | The Contractor shall provide templates for use in setting-out the anchor bolts for the following bolt groups:”...” |
|  |  |
| Where grouting is to be performed: | Grouting shall be carried out in compliance with DS/EN 1504-4, Principle 4, Method 4.4. |
|  | Grouting should obtain a strength of minimum ”…” before impacting. |
|  |  |
| Any tightened requirements shall be stated for the sur­face style of welds in excess of the requirements in GWS Struct­ural Steelwork, section 3.3.5.  | Special requirements for the grinding of welds are shown on drawing ”…” |
|  |  |
| Special requirements for checking measurement shall be stated | As part of the Contractor's normal checking measurements of the completed structure, checking measurements shall be carried out and documentation of the following dimensions shall be stated:”...” |
|  |  |
| Tolerances for bearings shall be stated separately (Please note: small, too large, spherical or pot bearings)  |  |
| Special requirements for contact surfaces in bolting assemblies shall be stated here or in drawings: | Contact surfaces for contact surfaces in bolting assemblies shall be plane. The deviation shall be less than 0.2% [2‰] of the short side of the surface. The deviation is defined as the total distance between two parallel, limiting planes. |
|  |  |
| Where anchors are drilled into the concrete: | On stainless anchors, threads shall have applied lubrication as well as be tightened to the maximum torque specified by the Supplier and secured with check nuts. Thus, torque forces indicated in the General Note do not apply to adhesive anchorages. |
|  |  |
|  | Assembling and work at the construction site |
|  |  |
|  | Surface protection |
|  |  |
|  | Checking |
|  | General |
| Reference is made to the list in DS/EN 1090-2, Annex A, Table A.1 and A.2, item 12, as well as Annex C. Relevant items to be included. |  |
|  |  |
| The list shall be adapted to the current project: | Besides items from GWS Steel Bridges - Structural Steelwork, requirements for documentation shall, as a minimum, be met for the following: * All participant manufacturers should be certified for the required execution class
* Equipment
* Identity control of materials and components
* Checking for visible defects in material
* Checking of shaping
* Contact surfaces in slip-resistant connections
* Cross plates in cross plate assemblies
* Inspection of joints made
* Welding plan
* Division into sections of weld seams
* Checking of welding
* Bolt quality, dimensions, surface protection, bolt holes
* Checking of tightening
* Tightening of anchor bolts
* Locking of anchor bolts
* Strength and quality of anchor bolts
* Geometrical tolerances
* Dimensions and shape tolerances
* Height of arches
* Plan for control of corrosion protection
* Inspection of pre-treatment and application of coating
* Measurement report for zinc and coating thicknesses.
* Report of climatic conditions during execution
* Controls on receipt of elements, also for surface protection
* Setting-out control
* Blocking and grouting
* Bearing function
* Temporary bracing
 |
|  |  |
| Requirements for identif­ication, of who has made the weld seams and pre­loaded bolting assemblies, shall be stated for structures in Consequence Class CC3. Requirements and order for labelling shall be stated. | Traceability shall be documented and be included in the control log. |
|  |  |
| If not all steel materials are subject to the same trace­ability, it shall be defined which materials that are primary and which are sec­ondary. Where required, the following shall be included: | Limited traceability entails that the production process until handover shall allow submission or reconstruction of the relevant documentation for each produced item. |
| The following table shall be included to the necessary extent; any additions or divisions shall be added: | Results of checking, tests and inspections shall be recorded in such a way that the below traceability requirements are met. |
|  |  |

| **Subject** | **Traceability** | **Cf. GWS / SWS item** |
| --- | --- | --- |
| **Limited** | **Complete** |
| Inspection technology |  | + | 4.1 |
| Primary steel materials |  | + | 4.2 |
| Secondary steel materials | + |  | 4.2 |
| Checking lamination |  | + | 4.4 2.3.4  |
| Checking shaping | + |  | 4.3 |
| Placement of unforeseen butts |  | + | 3.3.1 |
| Checking of the execution of welded joints | + |  | 4.4 |
| Checking of the execution of non-distorted bolting assemblies | + |  | 4.5 |
| Identification of who made the weld seams | + |  | 4.1 |
| Identification of who distorted the bolting assemblies |  | + | 4.1 |
| NDT of weld seams |  | + | 4.4 |
| Serious welding defects – cracks |  | + | 4.4 |
| Checking of finished weld seams in general | + |  | 4.4 |
| Tightness testing of voids |  | + | 4.4 |
| Process checking of heat treatments |  | + | 4.1 |
| Surface checking at removed fittings |  | + | 4.4 |
| Checking of distortion of bolting assemblies | + |  | 4.5 |
| Checking of geometrical imperfections | + |  | 4.3 |
| Checking of main dimensions and built-in geometry  |  | + | 4.34.73.5.63.5.5 |

|  |  |
| --- | --- |
|  |  |
|  | Materials and components |
|  |  |
|  | Geometrical control (Manufacturing: geometrical dimensions of manufactured components) |
|  |  |
|  | Welding |
| Where the requirements for welding control are relaxed, cf. item 1.3.5, the following shall be stated | Control shall be carried out in accordance with DS/EN ISO 3834-3 and not DS/EN ISO 3834-2, as specified in GWS. |
|  |  |
| In case the scope of non-destructive control deviates from the requirements of the standard, it shall be stated here. |  |
|  |  |
| For EXC4, the scope of pre-production testing shall be indicated, as well as NDT after welding. |  |
|  |  |
| In case the Employer, in ex­ceptional cases, is in charge of checking weld seams, this shall be stated: | Checking of weld seams is carried out in a control body appointed by the Employer, which is “...” |
|  |  |
|  | In case the Employer is responsible for checking NDT, periods of notice shall be stated in the checking plan. |
|  |  |
| If the Employer is respons­ible for the checking, it shall be stated: | The Contractor shall always notify the inspection company in good time about the extent of the checking and its scheduled time. Any delay, due to waiting time for checking as a result of late notification, is of no concern to the Employer. |
|  |  |
|  | The Contractor shall provide construction drawings etc. in two copies to the inspection company, specifying the areas to be checked. |
|  |  |
|  | Likewise, revised drawings shall be provided in two copies to the inspection company as soon as they have been presented to the Employer. |
|  |  |
| Supplementary control in relation to DS/EN 1090-2 may be stated, e.g.: | In case a visual inspection of studs and shear connector welds reveals irregularities, in the form of lack of fusion or irregular protrusion of weld, which does not reach all the way round, all such stud and shear connector welds shall be tested by bend tests, cf. item 3.3.5. |
|  |  |
|  | Supplementary acoustic testing by striking with a hammer may be carried out to delimit defective welds. |
|  |  |
|  | In each inspection lot, at least six random dowels are chosen for testing. |
|  |  |
|  | If defective welds are found at this test, testing shall immediately be exten­ded to comprise another six dowels in the vicinity of the one initially tested. |
|  |  |
|  | If further defective welds are found among these six dowels, the entire inspection lot shall be discarded. |
|  |  |
|  | Bent dowels, which have passed the test, are included in the permanent structure. |
|  |  |
| In case requirements are made in respect of the tight­ness of closed voids in the structure, the method for and the scope of the tight­ness check­ing shall be stated here.If relevant, DS/EN 1593 may be used. | The tightness checking is carried out with a positive pressure of 0.3 bar, where all weld seams are brushed with soapy water, alternatively as a vacuum test. Any holes for establishment of a positive pressure shall be closed by welding. All repairs of leaks shall be subject to renewed checking. |
|  |  |
|  | Testing shall include ”...” % of weld seams, respectively. |
|  |  |
|  | Mechanical fasteners |
|  |  |
|  | Surface protection |
|  |  |
|  | Geometrical control assembling |
| The scope of the geom­etr­ical control shall be stated. It shall be indicated which horizontal and vertical main and detail measurem­ents, as well as which pre-deflect­ions that shall be checked and entered into the log. |  |
|  |  |

# SWS STRUCTURAL STEELWORK, ANNEX 1

Overview of European (EN), Danish (DS) and foreign standards, codes of practice, recommen­dations and procedures and proposals for these same, to which references are made in GWS and SWS.

|  |  |
| --- | --- |
| The list shows the standards referred to in GWS. Standards marked with 1) are only mentioned in SWS-P, the Guidance or the Gene­ral Note, and should there­fore be deleted if they are not used. |  |
|  |  |
| To the relevant extent, the list shall be updated accor­ding to the actual project.Furthermore, DK NA shall also be stated for Eurocodes. | The specified references are applicable in the most recent editions, including any amendment sheets and annexes, as well as national annexes, if any. |
|  |  |

| References in GWS and SWS |  |  |  |
| --- | --- | --- | --- |
| Basis of calculation: |  |  |  |
|  |  |  |  |
|  |  |  |  |
| Eurocodes: |  |  |  |
| DS/EN 1990 |  | Eurocode 0: Design basis of structural bearings |  |
| DS/EN 1990/A1  | 1 | Annex A2 |  |
|  |  |  |  |
| DS/EN 1991(the individual parts should be noted) | 1 | Eurocode 1: Actions on structures |  |
|  |  |  |  |
| DS/EN 1992 | 1 | Eurocode 2: Concrete structures |  |
|  |  |  |  |
| DS/EN 1993-1-1/AC | 1 | Eurocode 3: Steel Structures - Part 1-1: General rules and rules for buildings |  |
| DS/EN 08/01/1993/AC | 1 | Eurocode 3: Steel Structures - Part 1-8: Joints |  |
| DS/EN 1993-1-10 |  |  |  |
| DS/EN 1993-2 | 1 | Eurocode 3 - Design of steel structures - Part 2: Bridges  |  |
| (the individual steel elements should be stated (just as for the composite below) |  |  |  |
| DS/EN 1994 | 1 | Eurocode 4: Design of composite steel and concrete structures |  |
| DS/EN 01/01/1994 | 1 | Part 1-1: Genral rules and rules for buiding structures |  |
| DS/EN 01/01/1994/AC |  |  |  |
| DS/EN 1994-1-2 | 1 | Part 1-2: General rules - Structural fire design |  |
| DS/EN 02/01/1994/AC |  |  |  |
| DS/EN 1994-1-2 A1 |  |  |  |
| DS/EN 1994-2 | 1 | Part 2: General rules and rules for composite bridges |  |
| DS/EN 1994-2/AC | 1 |  |  |
|  |  |  |  |
| DS/EN 1997: | 1 | Eurocode 7: Soil Engineering |  |
|  |  |  |  |
| Steel |  |  |  |
| DS/EN 1090: |  | Execution of steel and aluminium structures |  |
| DS/EN 1090-1 |  | Part 1: Requirements for conformity assessment of structures components  |  |
| DS/EN 1090-2 |  | Part 2: Technical requirements for steel structures. |  |
| DS/EN 1090-4 |  | PART 4: Technical requirements for hot-rolled thin steel plates and cold-rolled structures in steel for roofs, ceilings, floors and walls |  |
|  |  |  |  |
| DS/EN 10025 |  | Hot rolled products of structural steels  |  |
| DS/EN 10025-1 |  | Part 1: General technical delivery conditions |  |
| DS/EN 10025-2 | 1 | Part 2: Technical delivery conditions for unalloyed structural steels |  |
| DS/EN 10025-3 |  | Part 3: Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels |  |
| DS/EN 10025-4 |  | Part 4: Technical delivery conditions for thermomechanical rolled weldable fine grain structural steels |  |
| DS/EN 10025-5 |  | Part 5: Technical delivery conditions for structural steels with improved atmospheric corrosion resistance ”…” |  |
| DS/EN 10025-6 |  | Part 6: Technical delivery conditions for flat products of high yield strength structural steels in the quenched and tempered condition |  |
|  |  |  |  |
| DS/EN 10088 |  | Stainless steels |  |
|  |  |  |  |
| DS/EN 10160 |  | Ultrasonic testing of steel flat products of thickness ≥ 6 mm |  |
|  |  |  |  |
| DS/EN 10163 |  | Delivery requirements for surface condition of hot-rolled steel plates, wide flats and profiles  |  |
|  |  |  |  |
| DS/EN 10164 |  | Steel products with improved deformation properties perpendicular to the surface of the product (Z-steel) - ”…” |  |
|  |  |  |  |
| DS/EN 10204 |  | Metallic products - Types of inspection documents. |  |
|  |  |  |  |
| DS/EN 10306: |  | Iron and steel - Ultrasonic testing of H beams with parallel flanges and IPE beams |  |
| DS/EN 10340 | 1 | Steel castings for structural uses |  |
|  |  |  |  |
| Welding |  |  |  |
| DS/EN ISO 3834 |  | Quality requirements for fusion welding of metallic materials |  |
| DS/EN ISO 3834-1 | 1 | Part 1: Criteria for the selection of the appropriate level of quality requirements |  |
| DS/EN ISO 3834-2 | 1 | Part 2: Comprehensive quality requirements |  |
| DS/EN ISO 3834-3 | 1 | Part 3: Standard quality requirements |  |
| DS/EN ISO 3834-4 | 1 | Part 4: Elementary quality requirements |  |
| DS/EN ISO 3834-5 | 1 | Part 5: Documents to be observed |  |
|  |  |  |  |
| DS/EN ISO 5817 |  | Welding - Fusion welded joints in steel ”…” - quality levels for welding faults |  |
|  |  |  |  |
| DS/EN ISO 14555 |  | Welding - Stud welding (stud welding) of metallic materials |  |
| Mechanical fasteners |  |  |  |
| DS/EN 14399 | 1 | High-strength structural bolting assemblies for preloading |  |
| DS/EN 14399-1 | 1 | Part 1: General requirements |  |
| DS/EN 14399-3 | 1  | Part 3: System HR – Hexagon bolt and nut assemblies |  |
|  |  |  |  |
| DS/EN 15048 | 1 | Non-preloaded structural bolting assemblies  |  |
| DS/EN 15048-1 | 1 | Part 1: General requirements |  |
|  |  |  |  |
| DS/EN ISO 3506 |  | Mechanical properties of corrosion-resistant stainless steel fasteners |  |
| DS/EN ISO 3506-1 |  | Part 1: Bolts, screws and studs |  |
| DS/EN ISO 3506-2 |  | Part 2: Nuts |  |
|  |  |  |  |
| DS/EN ISO 4014 | 1 | Hex head bolts - Product grades A and B |  |
|  |  |   |  |
| DS/EN ISO 4032 | 1 | Hexagon regular nuts (style 1) – Product grades A and B |  |
|  |  |  |  |
| DS/EN ISO 7089 | 1 | Plain washers – Normal series – Product grade A |  |
|  |  |  |  |
| DS/EN ISO 10684 | 1 | Fasteners - Hot dip galvanised coatings |  |
|  |  |  |  |
| DIN 976 | 1 |  Gewindebolzen |  |
|  |  |  |  |
|  |  |  |  |
| Surface protection |  |  |  |
| DS/EN ISO 1461 | 1 | Hot-dip galvanised coatings on fabricated iron and steel articles - Specifications ”…” |  |
|  |  |  |  |
| DS/EN ISO 8501 |  | Preparation of steel substrates before application of paints ”...” - Visual assessment of surface cleanliness |  |
| DS/EN ISO 8501-1 |  | Part 1: Rust grades and preparation grades of uncoated steel substrates ”…” |  |
| DS/EN ISO 8501-3 |  | Part 3: Preparation grades of welds, edges and other areas with surface imperfections ”…” |  |
|  |  |  |  |
| DS/EN ISO 8502 |  | Preparation of steel substrates before application of paints ”...” - Tests for the assessment of surface cleanliness  |  |
| DS/EN ISO 8502-2 |  | Part 2: Laboratory determination of chloride on cleaned surfaces |  |
| DS/EN ISO 8502-3 |  | Part 3: Assessment of dust on steel surfaces prepared for painting (pressure-sensitive tape method)  |  |
| Miscellaneous: |  |  |  |
| DS/EN 1504 |  | Products and systems for the protection and repair of concrete structures. |  |
| DS/EN 1504-3 |  | Part 3: Structural and non-structural repairs |  |
| DS/EN 1504-4 | 1 | Part 4: Structural bonding |  |
|  |  |  |  |
| DS/EN 1593 | 1 | Non-destructive testing – Leak testing – Bubble emission techniques |  |
|  |  |  |  |
| DS/EN 2553 | 1 | Welding and allied processes – Symbolic representation on drawings – Welded joints |  |
|  |  |  |  |
| DS/EN ISO 13918 |  | Welding - Studs and ceramic ferrules for arc stud welding |  |
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| Havnegade 27P.O Box 90181058 Copenhagen KTelephone +45 7244 3333vd@vd.dkvejdirektoratet.dkvejregler@vd.dkvejregler.dk |