

GENERAL SPECIFICATION

STRUCTURAL

GS EP STR 100

Offshore steel structures - General

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1. Scope

This document defines the general procedures and Company requirements to be applied in the execution and reporting of the structural design, fabrication and installation of steel offshore platforms.

This specification is applicable for fixed substructures, their foundations, and their topsides; for subsea structures including mid-water structures associated with the support of flowlines; for floating structures, including their modules, superstructures, buildings and appurtenances; for anchor structures; and for coastal structures such as jetties. This specification also applies to the structural design of equipment packages.

Specific requirements and procedures to be applied for the structural design of particular sub-assemblies of an offshore platform are defined in the following specifications [GS EP COR 100](#), [GS EP COR 222](#), [GS EP COR 350](#), [GS EP EXP 201](#), [GS EP EXP 311](#), [GS EP GEO 702](#), [GS EP SAF 221](#), [GS EP STR 001](#), [GS EP STR 002](#), [GS EP STR 003](#), [GS EP STR 004](#), [GS EP STR 005](#), [GS EP STR 006](#), [GS EP STR 101](#), [GS EP STR 102](#), [GS EP STR 103](#), [GS EP STR 104](#), [GS EP STR 105](#), [GS EP STR 106](#), [GS EP STR 107](#), [GS EP STR 108](#), [GS EP STR 201](#), [GS EP STR 202](#), [GS EP STR 203](#), [GS EP STR 301](#), [GS EP STR 304](#), [GS EP STR 401](#), [GS EP STR 431](#), [GS EP STR 432](#), [GS EP STR 651](#), [GS EP STR 901](#) and [GS EP STR 902](#) listed in Section 2. In particular:

- Weight control and reporting is covered by specification [GS EP STR 001](#)
- Fixed substructures and subsea structures are covered by [GS EP STR 101](#)
- Topside structures are covered by [GS EP STR 102](#)
- General requirements for floating production installations are set out in [GS EP STR 651](#)
- Load out, transport and Installation are covered by specification [GS EP STR 401](#)
- Materials to be used are covered by specification [GS EP STR 201](#)
- Fabrication is covered by specification [GS EP STR 301](#)
- Requirements for monitoring systems which are to be installed onto the facilities for recording the oceanographic and metrological environment and forces needed for re-certification of the platform are covered by [GS EP EXP 201](#)
- Company's strategies for in-service inspection are described in [GS EP EXP 311](#).

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

The structural design of offshore platforms shall be conducted in accordance with the reference documents including codes and standards defined in specifications listed hereafter.

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External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
API RP 2A-WSD	Recommended practice for Planning, Designing and Constructing Fixed Offshore Platforms - Working Stress Design
ISO 19900	Petroleum and natural gas industries - General requirements for offshore structures
ISO 19901	Petroleum and natural gas industries - Specific requirements for offshore structures
ISO 19902	Petroleum and natural gas industries - Fixed steel offshore structures
NAFEMS	Management of Finite Element Analysis - Guidelines to Best Practice
NAFEMS QSS 001	Engineering Simulation - Quality Management Systems - Requirements

The Company recognizes [ISO 19900](#) and [ISO 19901](#) as a source of sound recommendations on good practice. However, in some cases the requirements of these International Standards do not comply with the requirements of the Company's General Specifications. Furthermore, there exists within these International Standards the requirement for the owner or operator to define certain parameters which may override suggested default values.

In general terms, the requirements of formally issued [ISO 19900](#), [ISO 19901](#) and [ISO 19902](#) standards when available shall be applicable in context to the design of new structures for Company and to the insurance that operations are performed within defined and recognized safety/confidence levels where these requirements are additional to or are more onerous than the requirements stated in the Company's General Specifications and Project Particular Specifications. In this context, the default values of parameters recommended by these International Standards shall apply, unless more onerous values are stipulated within the Contract documents.

Any other proposal based on the content of these International Standards shall be subject to Company approval.

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

The provisions of this document shall be applied in the light of the project documents supplied by Company, including:

- Country specificity appendices
- Particular project specification

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- Data sheets
- Articles and conditions; list of tasks
- Quality assurance provisions.

Reference	Title
GS EP COR 100	Design of cathodic protection of offshore structures
GS EP COR 222	Fusion Bonded Epoxy (FBE) external coating for pipelines
GS EP COR 350	External protection of offshore and coastal structures and equipment by painting
GS EP EXP 201	Operations preparation during project - Maintainability & Inspectability criteria
GS EP EXP 311	Plant integrity - Minimum inspection requirements
GS EP GEO 702	Requirements for design and installation of skirted foundations and suction anchors
GS EP SAF 221	Safety rules for buildings
GS EP STR 001	Weight monitoring and weighing offshore units
GS EP STR 002	Crane for fixed offshore installations
GS EP STR 003	Crane for floating offshore installations
GS EP STR 004	Riser / Umbilical Pulling Rig, Pulling and Mooring Winches
GS EP STR 005	Lifting Appliances other than cranes and winches
GS EP STR 006	Requirements for the design, fabrication and testing of Overhead Travelling Cranes
GS EP STR 101	Design of offshore jacket and subsea structures
GS EP STR 102	Design of offshore topside structure
GS EP STR 103	Design and fabrication of skids and equipment supporting structures
GS EP STR 104	Design and fabrication of technical cubicles for offshore oil installations
GS EP STR 105	Boat landings and bumpers
GS EP STR 106	Assessment of existing fixed offshore steel platforms
GS EP STR 107	Offshore structures decommissioning
GS EP STR 108	Requirements for evaluation of finite elements analysis and results
GS EP STR 201	Materials for offshore steel structures
GS EP STR 202	Cast materials for steel structures
GS EP STR 203	Forged materials for steel structures

Reference	Title
GS EP STR 301	Fabrication of offshore steel structures
GS EP STR 304	Fabrication of Welded Plate Girders (W.P.G.) and Box Girders (B.G.)
GS EP STR 401	Loadout, seafastening, transportation and installation of offshore structures
GS EP STR 431	Installation of piles for offshore steel structures. Driven piles
GS EP STR 432	Installation of piles for offshore steel structures. Drilled and grouted piles
GS EP STR 651	General principles for a F(P)SO design
GS EP STR 901	Design rules and construction standards for ancillary structures of offshore installations
GS EP STR 902	Pultruded fire resistant fibre reinforced plastic floor grating

3. Definitions

Throughout this specification, the following definitions shall apply:

Purchaser: Means the Company or Supplier (as applicable) which have placed the Purchase Order to the Manufacturer.

Inspector: Means Company's representative(s) or member(s) from an Inspection Agency duly appointed by Company or Supplier (as applicable) to act as its representative(s) for the purpose of the Contract.

Third Party: Means the Company in charge of independent design appraisal or independent analysis or independent inspection in accordance with the rules defined in the contractual reference documents. Third Party can be an independent Company, the Certifying Authority, the MWS, or the Classification Authority, as defined in the contractual reference documents.

Certifying authority: Means the Company in charge of the certification of the platform (or part thereof) and of issuing of the relevant certificates in accordance with the rules defined in the contractual reference documents.

MWS: Means the Marine Warranty Surveyor.

Classification authority: Means the Company in charge of issuing the various certificates pertaining to the class of a ship, in accordance with its own rules.

4. Design quality control

4.1 Contractor Quality Management Plan

At the beginning of the design phase, Contractor shall submit a detailed Quality Management Plan for the structural discipline to Company for review/approval. This may form part of a general project Quality Management Plan provided that the provisions here are included. All applicable corporate general procedures and project-specific procedures shall be supplied to

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Company, and no structural design shall be initiated before the approval of the Quality Plan by Company.

The Quality Plan shall, from the beginning of the Work, cover the full duration of the Work and all parties involved in it. If the Work is divided between a Contractor and a number of Subcontractors, then there shall be clear single responsibility for the structural engineering over the full period. Procedures shall be issued to show team reporting structure, working methods for management of internal and external interfaces, and Vendors; procedures for criticality assessment; planning and change control; procedures pertaining to use of software; procedures relating to the execution and checking of the different types of analysis that will be undertaken; procedures relating to the management of 3D plant models and checking of drawings; procedures relating to engineering queries, production site queries, deviation requests, non-conformance and other communications; and weight control. A list is required to be maintained of names, signatures, and responsibilities of all signatories to engineering documents. The quality plan shall include job descriptions for all of the contributors to the structural engineering, and shall define the minimum qualifications and experience needed in each case.

Referenced documents from the National Agency for Finite Element Methods and Standards (NAFEMS) provide additional guidance on quality management of engineering analysis and simulation which shall be addressed in Contractor's Quality Plan.

Each and every document issued by Contractor shall be verified and checked by its QA/QC system. Document verification by Contractor shall be performed at several levels:

- Structural discipline checks by component design engineer and discipline lead
- Inter-discipline checks
- Project engineer checks and engineering management approval.

Each level of verification shall be signified by a box in the document title block. This box shall be signed by the lead engineer in charge of the discipline or the project manager. Document signing protocols shall ensure devolution of responsibility to originating engineers, with ultimate responsibility for review by the lead structural engineer. A project management signature shall indicate confirmation of compliance with the procedures and fulfilment of the Contractual requirements.

4.1.1 Company review

Each calculation note or drawing is to be submitted to Company for review/comment. The calculation notes shall be issued together with the fabrication drawings. No drawing shall be issued for tender, for construction or for material order without Company review. The Company expects to review engineering drawings during the course of their development and will not accept to review any fabrication drawings without first having reviewed the design calculations. Company review/comment approval does not release Contractor from his responsibility concerning the subject design. No document may be issued which in any way deviates from the Contract requirements without prior Approval by Company in writing.

4.1.2 Computer software packages reliability

All software packages, programs and sub-programs used shall have been previously tested and known to give reliable results. Software packages used for global 3D structural analyses shall

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be validated by a recognised Third Party approved by Company, and validation reports shall be issued to Company.

4.1.3 External quality check

In addition to its review, Company reserves the right to have the calculation notes, the drawings and the various documents checked or verified by:

- A Third Party, as defined in Section 3 above
- A Certifying Authority, as defined in Section 3 above
- MWS.

In such case, Contractor shall supply each and every documents requested by the Third Party or Certifying Authority or Inspection Agency.

5. Structural Design plan

Contractor shall submit a detailed structural design plan and document register to show a task breakdown, activity durations and planned completion dates, plus planned date of issue for all documents at their various issues including the status of issue (“for comments”, “for approval”, “for call for tender”, “for construction”, “as-built drawings”, etc.) and the schedule of design. The planning is required to show the main cycles of reanalysis, and to indicate dependencies for key information from others, including data supplied by other disciplines within the Contractor’s organization. The planning shall show the design and review logic required to complete calculations and gain approval before the issue of drawings used for construction.

An overall manning histogramme shall be supplied for the discipline, with separate identification of supervision, engineering, particular specialists, and draughting/modelling.

Contractor shall provide reporting of progress against the plan at regular discipline coordination meetings with Company’s specialists.

6. Documentation of Design Development

6.1 Phasing of Design Development

The type and content of engineering documentation that is required will depend on the stage reached in the development of a project. A typical project will move from feasibility and other early studies into a period of Basic Engineering, and then into Detailed Design. Engineering documentation is required throughout the construction and installation phases, and a continuing record is required of further works during the operating life. The particular phase and context of any Work must be defined in the Contract, and it is the responsibility of the Contractor to request clarification in respect to any ambiguities in this respect.

6.2 Feasibility studies

Generally, the purpose of structural feasibility studies is to determine:

- If the solution is technically achievable with due account taken of all the potential variations, such as shifts in CoG and weight growth consistent with the uncertainty parameters of the studies in hand. Such studies shall establish all of the potential failure

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modes, and document an evaluation of foundations, strength and stability under intact and damage conditions, during construction, installation and service, and establish methodologies and equipment for installation.

- An estimate of the costs and the project time schedule.

The following documents shall be supplied:

- Design report(s) which set the work in context, and define the main input assumptions. These shall describe the structural calculations performed, and clearly state the main conclusions and any recommendations for further evaluation. Structural calculations at this stage should be as simple as possible to evaluate the dominant behaviour and the configuration of the main or special components and items of equipment. Other common or standard secondary components should be simply defined or listed with reference to other similar projects.
- A quantitative weight estimate (with a 30% margin of error).
- The supply, fabrication and installation approximate schedules.
- The conceptual drawings describing the structure and its installation.

6.3 Pre-project and preliminary studies

Various pre-project studies may be performed between the Feasibility Study and the Basic Engineering Study. These are often intended to refine the concept and reduce uncertainties to provide the basic set of design assumptions with which to commence the Basic Engineering. Studies at this level do not allow steel to be ordered.

Documents for such studies shall consist of:

- Design report(s) which set the Work in context, and define the main input assumptions. These shall describe the structural calculations performed; and clearly state the main conclusions and any recommendations for further evaluation. Structural analyses and calculations at this stage should remain as simple as possible to evaluate the dominant behaviour and the configuration of the main or special components and items of equipment. Dominant loadings used in analysis should be logically developed and shall account for shift in CoG within the uncertainty pattern, and for weight increase or decrease. Company's weight reserve for future growth shall be included. Other common or standard secondary components should be simply defined or listed with reference to other similar projects.

Depending on the purpose of the study, reporting at this stage shall generally address:

- Foundation capacity or strength capacity of underlying substructure
- In-service strength and stability of the primary structure for intact and damage conditions
- A review of the installation methods, strength and stability of the primary structure for installation, and identification of requirements, limitations and availability of important items of equipment and facilities needed for installation (jacking system, barge strength, quay foundation, etc.).
- A weight estimate, broken down over the main components (within 20%).

- Approximate schedules for fabrication and installation.
- Drawings detailing all of the key points of the design.
- A Design Basis definition of the requirements to be met by the Contractor in charge of the Basic Engineering Studies.

6.4 Basic engineering

Basic Engineering studies shall define the main structure, and addresses the principles for the completion of secondary and tertiary structures to a degree that is sufficient for the purposes of awarding the Contract that will include detailed engineering and other parts of the Work. Development of the structural design shall give priority to the safety of personnel during construction, installation and in service. Engineering methods shall also aim by a process of optimization to achieve structurally efficient structures, light in weight and economical to fabricate and maintain.

Required structural documents shall include:

- A design brief summarising the design methods and criteria to be used for Basic Engineering shall be issued and approved by Company before any basic design is started. It is to be specifically identified where methods used in Basic Engineering include simplifications and assumptions that are not applicable for Detailed design.
- A project-specific structural Design Basis defining all criteria and necessary design data to be used for the execution of Detailed Design Engineering and other components of the Work to be undertaken in the phases following Basic Engineering.
- Additional project-specific structural specifications as required to supplement the General Specifications. These may include specifications for components such as bearings, castings, handling devices, or for specific materials.
- Calculation note(s) for the whole of the main structure including the main connections and stiffeners, the lifting pad eyes, the foundations, the cathodic protection. These shall document assessment of all the phases of the platform life (i.e. load out, transport, installation, in-place, seismic, fatigue analyses, boat impact, dropped object, natural frequencies and vibration response, blast and fire, drivability analysis and pile fatigue, etc.) For some classes of structure, such as for a modular topside on an FPSO, it may be acceptable (as defined in the Contract Scope of Work) to undertake these assessments on a limited number of representative modules chosen to encompass the most complex and demanding performance over the whole installation (flare towers, the heaviest process, support of large machines, multiple deck levels, large buildings, etc), the full range of potential support conditions, and all options for fabrication and installation.

Structural calculations shall be supplied where required to provide deflection and other data needed for multi-disciplinary or interface demonstration of the feasibility of particular aspects of the equipment and piping layout (e.g. for studies to establish preferred structural support arrangements, and global distributions of structural and equipment deflection, or local interface stiffness in piping assessments of particular equipment nozzle loads).

- Study reports to define requirements or feasibility of particular project-specific features, especially where these have multi-disciplinary inputs. Such studies may demonstrate, for

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example, facilities for flare-tip handling, or proposed use of a FLOTEL, or interaction between a jack-up and a well-head platform, or facilities for riser installation on a floating structure, or requirements for future-installed modules, etc.

- Main structure design drawings (complying with requirements of [API RP 2A-WSD](#) for design drawings), showing the geometry and detail of the main structure, including connections and details such as lift points, support points, piling, auxiliary buoyancy and other primary installation aids. Standard details with individual detail drawings must define geometry, weld symbols, material grades and qualities for all components, and specific tolerance requirements. Each drawing shall indicate the weight of the components which are shown.
- Interface drawings, specifications, and data-sheets identifying all primary interfaces, giving functional requirements and battery limits. Expected not-to-exceed loadings on support structures shall be defined with allowance for centre-of-gravity shift, deck live loading, and Company's management reserve.
- Secondary structure generally does not need to be defined in detail, but the principles for detailing shall be defined. This generally requires a definition on drawings of overall deck layouts, the type of flooring, and overall live loading in different areas of each level. General arrangement and typical support concept drawings are required for appurtenance structures, such as conductors, risers, caissons, J-tubes, fenders, access structures, mooring attachments, helidecks, buildings, fire barriers, main pipe-racks, and to show the extent of special coatings and passive fire protection. Standard details and expected welding shall be specified for the most common types of connection.
- A weight report covering main and secondary and tertiary structures estimate broken down over the main components. Items should be cross referenced to the defining structural drawings, and indicate the level of detail in the design and give the reason for the reserve.
- Structural material take-off and requisitions as required by the Basic Engineering Contract providing itemised lists by drawing, and overall consolidation by grade, thickness, etc. This document shall enable steel orders or reservations to be placed and priced for the main structure.
- Main structural steel requisition if required.

6.5 Detailed engineering

The object of detail engineering is to completely define the structure for the purpose of verification, procurement, fabrication and installation, and to supply documents required by interfacing parties to define inputs for their detailed engineering. Detailed design development of the structural design shall maintain priority for the safety of personnel during construction, installation and in service, and shall continue processes of optimization to achieve structurally efficient structures which are light in weight and economical to fabricate and maintain.

Required structural documents shall include:

- A maintained up-to-date Design Basis defining all criteria and necessary design data to be used for the execution of Detailed Design Engineering.