TWD

TEMPORARY WORKS DESIGN BV

YOUR PARTNER IN OFFSHORE DESIGN

Track Record Salvage.

www.twd.nl

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1 Company

TWD is a dynamic engineering firm specialized in the design of temporary works, structures which facilitate the construction of permanent works. Our thorough knowledge of structural and mechanical engineering, finite element methods, and design for offshore conditions, enables us to develop creative solutions to meet the wide variety of client demands.

Projects range from the design of a piling template used to drive foundation piles for offshore wind turbines, a motion study for an offshore lifting operation, to a parbuckle tool for a salvage project. Flexibility, practicality, and creativity are the driving forces behind each of our designs and our enterprising work ethic.

We offer cost-efficient solutions for the heavy civil, offshore, and salvage industries, specializing in the custom design of:

- Pile handling tools
- Lifting tools
- Seafastening
- Cable handling equipment
- Support structures
- Vessel motion analyses

We are able to assist in each stage of a project's execution, whether it be drafting, engineering, commissioning, or fabrication management. Our talented, international team of mechanical, civil, and maritime engineers is available for your requests.

For more information please visit our website: http://www.twd.nl

Decommissioning of topside and jacket of Camelot platform

2 Overview of salvage services

Whether the challenge is the recovery of a sunken vessel or the decommissioning of a retired platform, every salvage situation is unique. Temporary woks are especially important in assuring safety, for example, in assisting or eliminating the aid of divers. TWD has experience with a wide variety of salvage projects, including:

- Decommissioning tools
- Lifting tools
- Parbuckle tools
- Vessel motion analyses
- Mooring analyses
- Support frames
- Seafastening

In the following paragraphs, the abovementioned salvage projects are described in more detail. References can be provided upon request.

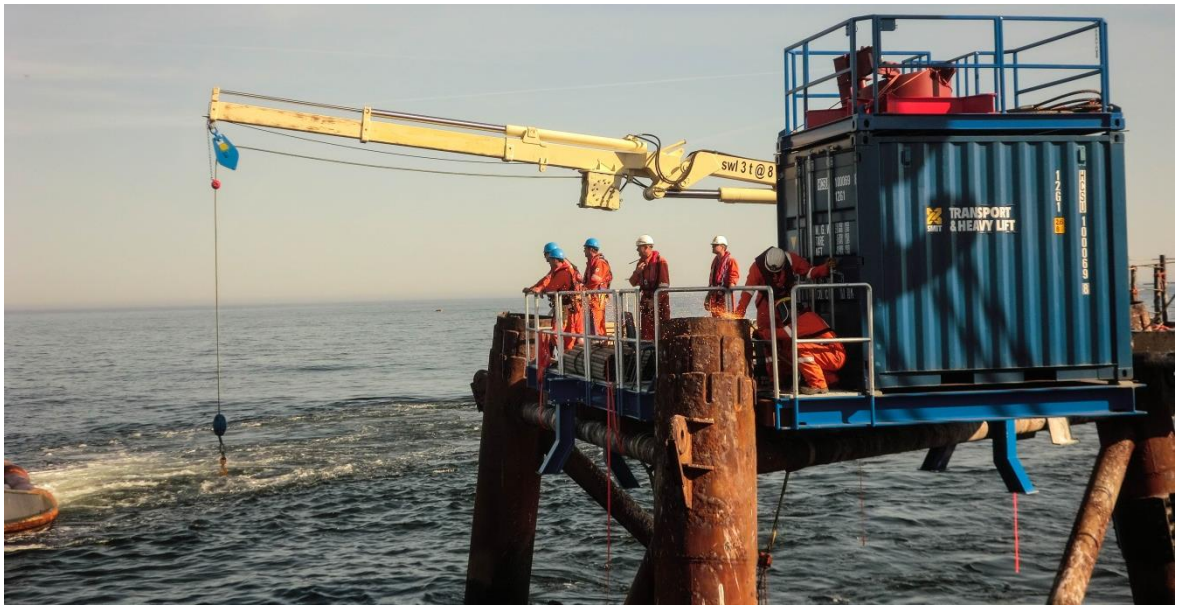
2.1 Lifting and parbuckle tools

To assist Boskalis with the salvage operation of a capsized JUB in Brazil, TWD designed two parbuckle and two lifting tools for the 2200T JUB. The parbuckle tools were inserted into two jack up legs to straighten the JUB. Subsequently, the lifting tools were attached around the jack up legs to facilitate the JUB lifting and re-floating process. TWD performed the detailed designs and structural analysis for these aiding tools.

Taklift 4 during salvage operation of JUB SEP Orion

2.2 Decommissioning of platform

SMIT Engineering requested TWD to design a working platform for the decommissioning of the Q8-A satellite platform. This included the foundation for a hydraulic crane, internal cutting tool, swiveling winch, and storage container. The working platform was lifted, transported to site, and installed on the jacket bracings of the Q8-A platform by the Taklift 7 crane. After works on the jacket were completed, the working platform was lifted by the Taklift and removed together with the attached jacket structure.



Decommissioning platform for the Q8-A satellite platform

2.3 Seafastening of damaged vessel

TWD designed the transverse seafastening for the transportation of the damaged vessel PC-22 Warao onboard the RollDock Sea vessel. With a length of 100m and a transport weight of 2274mT, the vessel had to be transported from Fortaleza, where it got damaged, to the port of Rio de Janeiro, to be scrapped. TWD designed a lately adaptable seafastening and grillage inside the hold of the RollDock Sea vessel.

The PC-22 Warao

2.4 Brace lifting tool

Heerema Marine Contractors requested TWD to develop a conceptual design for a “brace lifting tool.” This tool was required for the decommissioning of the North West Hutton platform jacket structure, located in the North Sea. The brace lifting tool was used to lift the jacket brace sections onto the heavy lift vessel Hermod in a safe and practical manner.

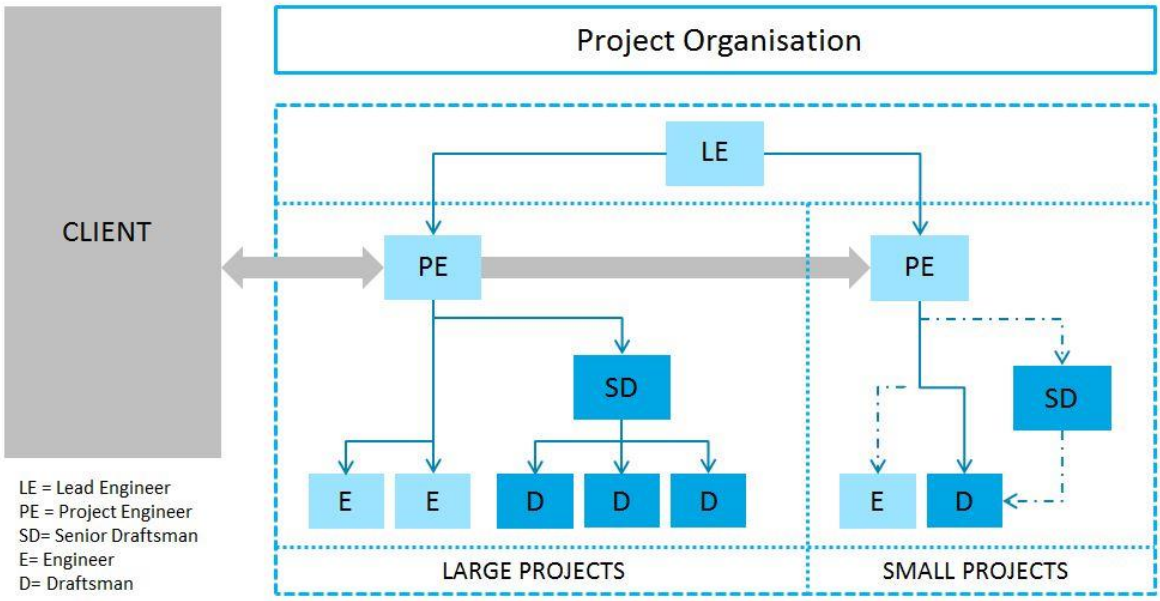
The brace lifting tool

2.5 Seafastening on crane boom design

TWD designed and assisted with the fabrication of the seafastening of the Conquest BM1 barge, which was used to recover the 114.000mT Costa Concordia cruise liner. In close cooperation with the client, the Marine Warranty Surveyor and the fabricator, a quick and efficient design was constructed within a demanding time frame.

Salvage of Costa Concordia

3 Organisation



TWD basic project organization diagram

3.1 Design team

The project engineer (PE) in the TWD project organisation plays the central role and is the primary point of contact for the client. The PE focuses on one single project and guides the complete process from kick-off to detailed design. In this role, the PE translates client wishes into practical, safe, and economical designs. The PE is responsible for budget and planning and supervises the design team of engineers and draftsmen.

The lead engineer (LE) supervises the project team and plays an active role in the design process. The LE oversees the design process, suggests concepts, and performs quality checks on every deliverable. (see chapter Quality system).

The senior draftsman (SD) is responsible for timely delivery of drawings, revision status, work distribution and planning of the draftsmen. The SD is in charge of the master model and analyzes the sub-assemblies provided by the draftsmen regarding overall function, clashes, and consistency.

3.2 Project documentation

The design team members work in close cooperation and constant communication with each other. For cases in which the basis of design report (BoD) is not sufficient or specific enough, a so called ‘mini-BoD’ will be created stating all requirements, functions, loads, and points of attention for a sub-design.

Decisions made throughout the design process are tracked by the design decision sheet, a to-the-point BoD, easy to update and maintain.

All deliverables (drawings, calculations, and reports) are listed in a document list, including revision and status, and will run through the quality system (see chapter Quality system).

The project planning is made in Microsoft Project, depicting an overview of deadlines, relations between processes, and capacity planning.

Project hours are electronically registered and can be split per project part. The weekly hour sheet will give a detailed overview of the hours spent per topic, providing a clear detailed overview of the budget status. The project parts to be monitored can be agreed upon.

4 Quality system

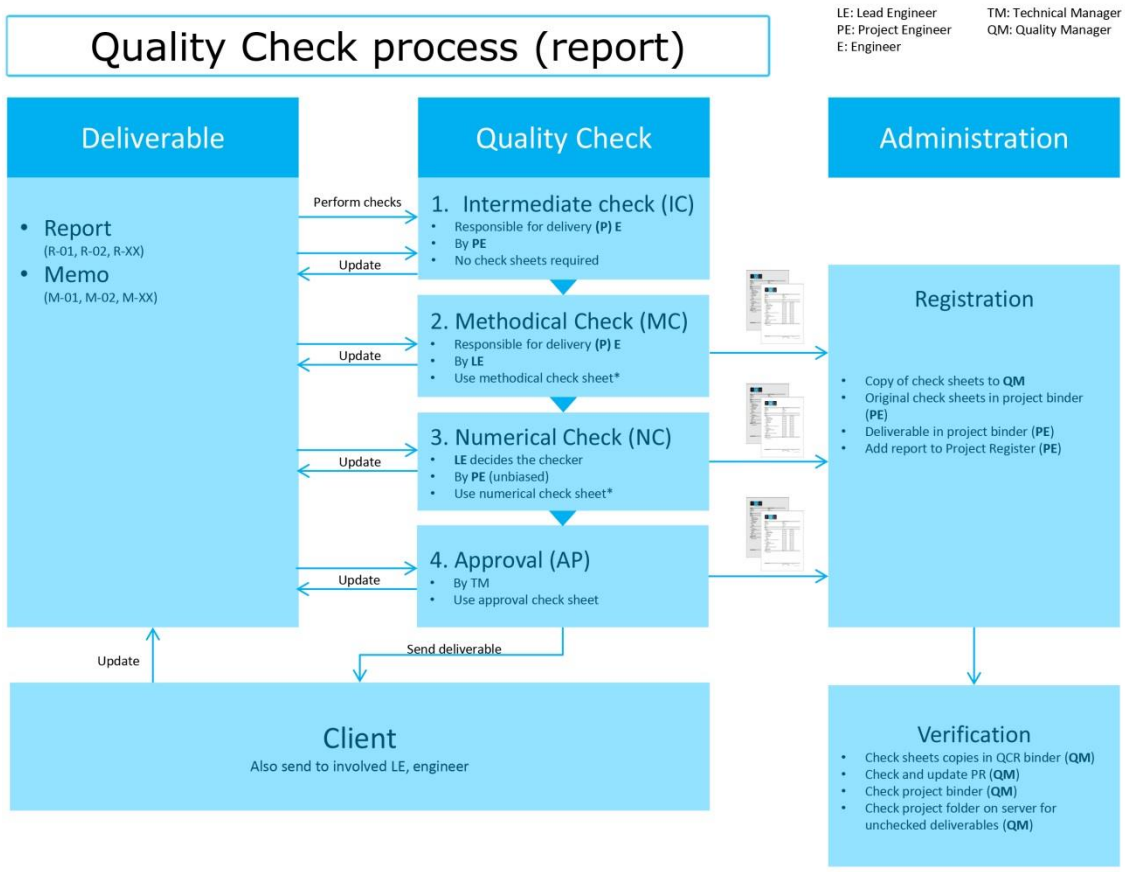
TWD is dedicated to achieve client satisfaction by delivering high quality designs that are practical, safe, and economical. We do this by using a quality management system that provides a framework for our complete design and engineering process.

4.1 Document control and quality checks

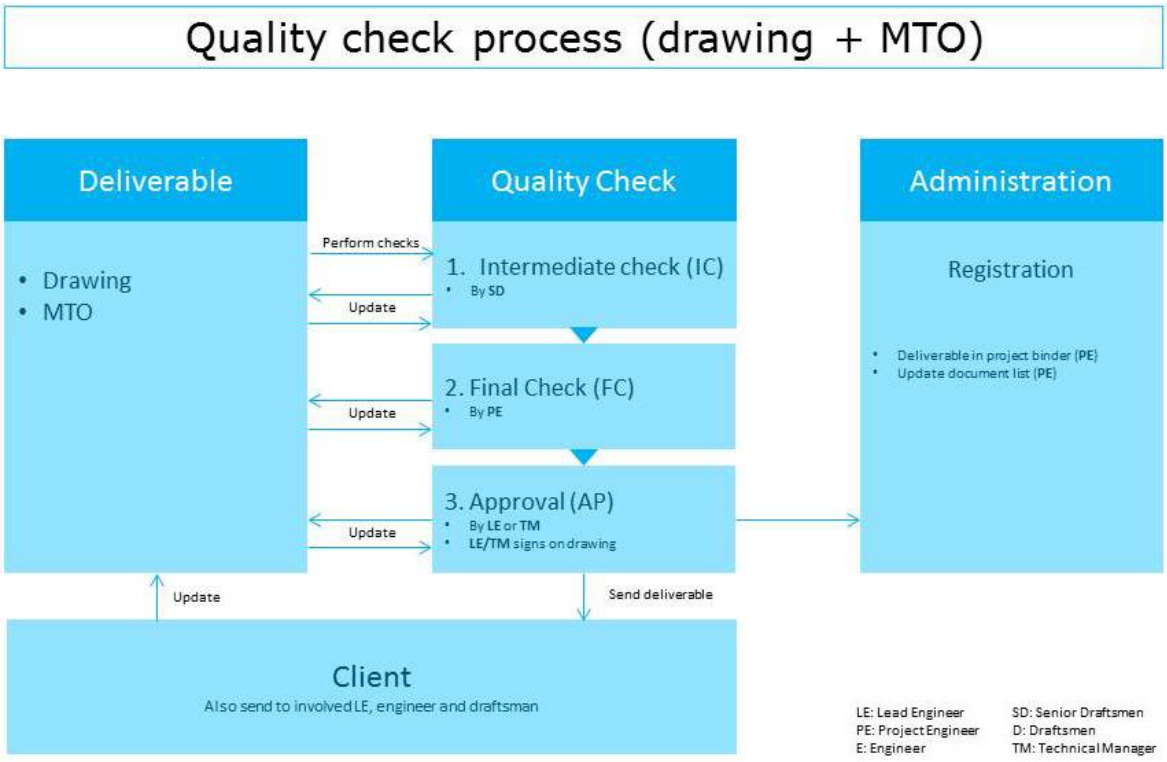
Most of TWD's clients are involved in projects where delay and/or failure is very expensive. Consequently, TWD has developed and implemented thorough quality control systems for calculations, reports, and drawings. Clear file and revision names are used and registered in document lists to avoid errors. Check sheets are used to register the checks performed for every revision of a document. An example flow diagram of the report quality check process used by TWD is shown on page 9.

4.2 Quality accreditation

TWD's designs are routinely reviewed, approved and certified by certifiers including DNV-GL, London Offshore Consultants (LOC), Lloyds Register, Bureau Veritas and ABS.



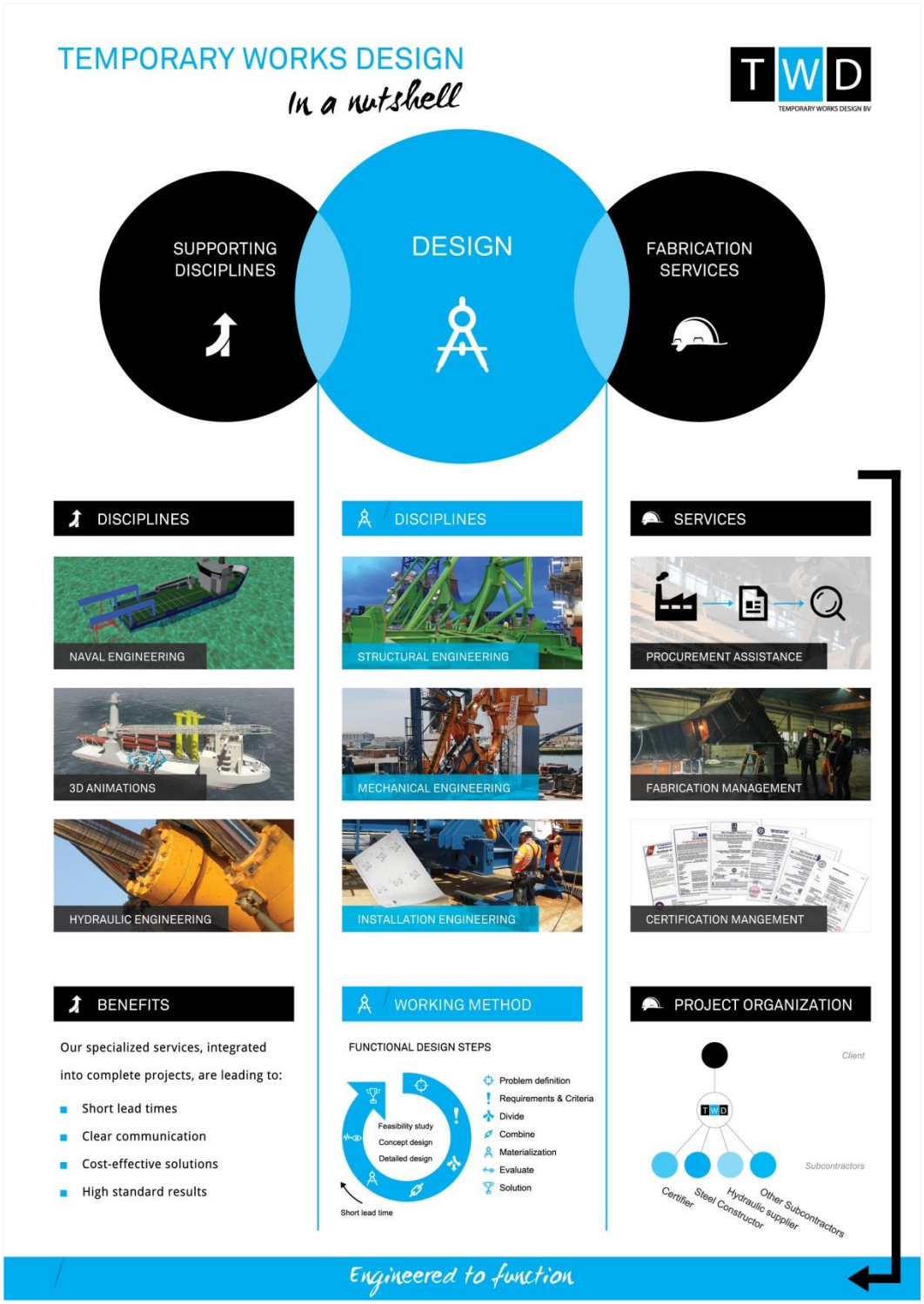
TWD quality check process diagram



TWD quality check process diagram

5 Services overview

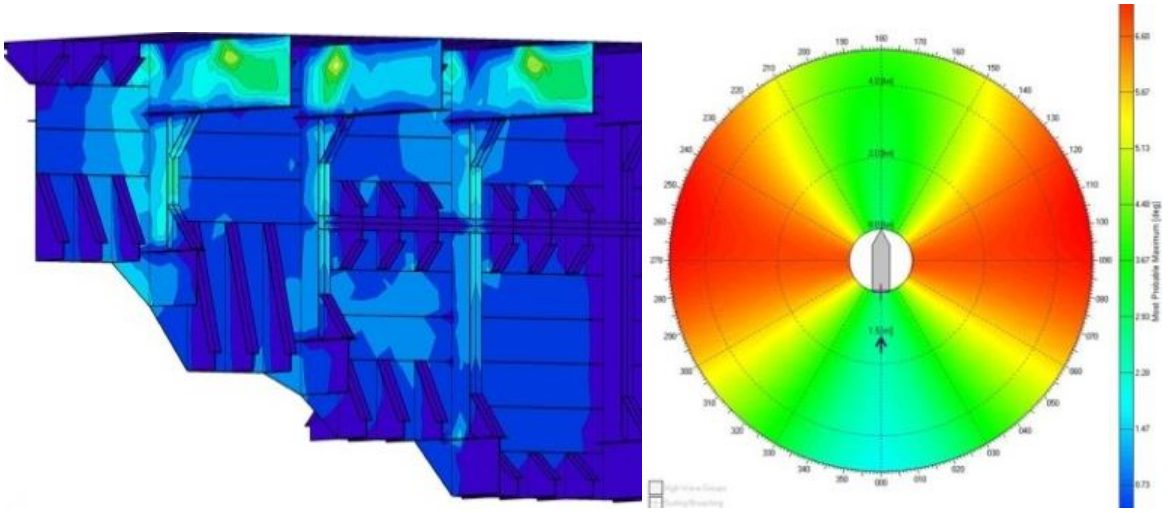
The overview below shows the different services that are offered by TWD. Allowing TWD to manage the entire design process, from supporting disciplines to fabrication services, will result in short communication lines, a solid project overview, and savings in time and costs.



6 Software

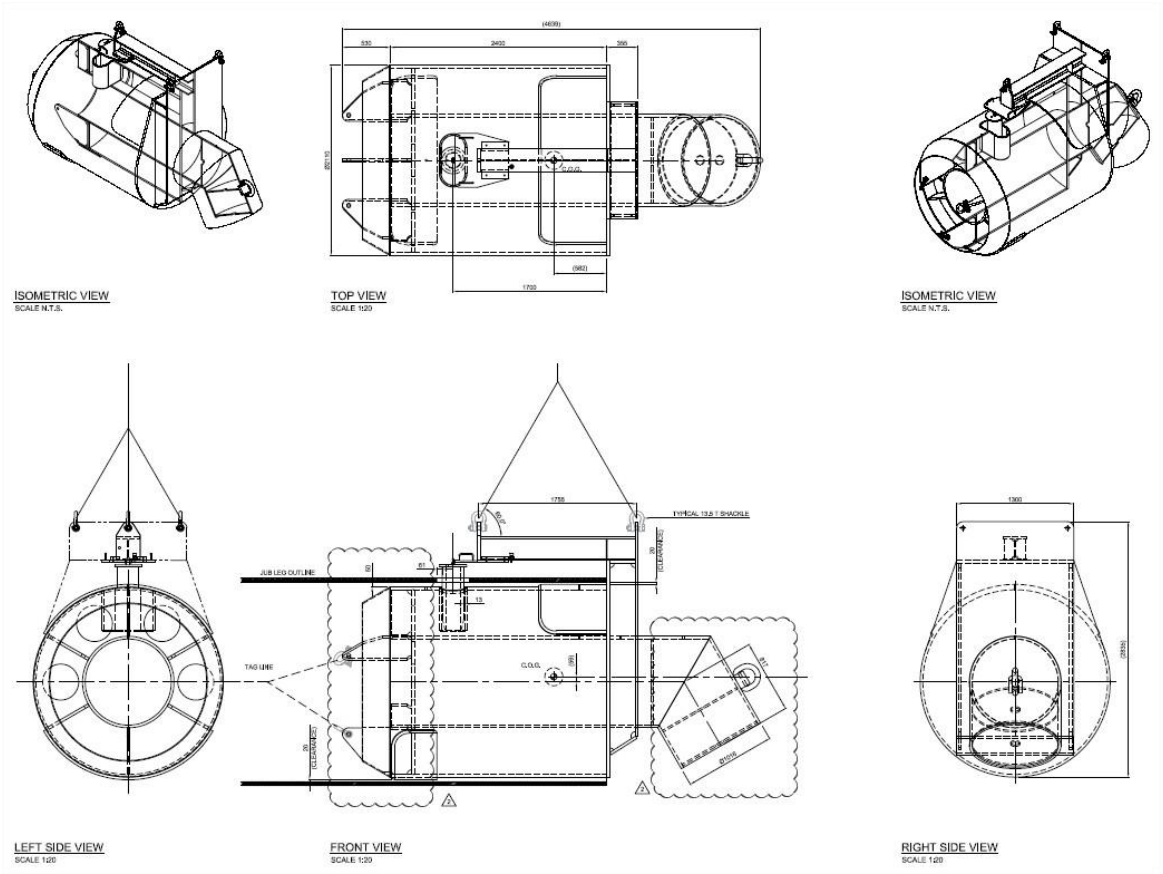
TWD has developed several calculation tools for reliable and efficient calculation of pad- and lashing eyes, kicker plates, current and wave loading, loading capacity of deck constructions, and forces acting on cargo due to vessel motion. Furthermore, the following several widely recognized software packages are used:

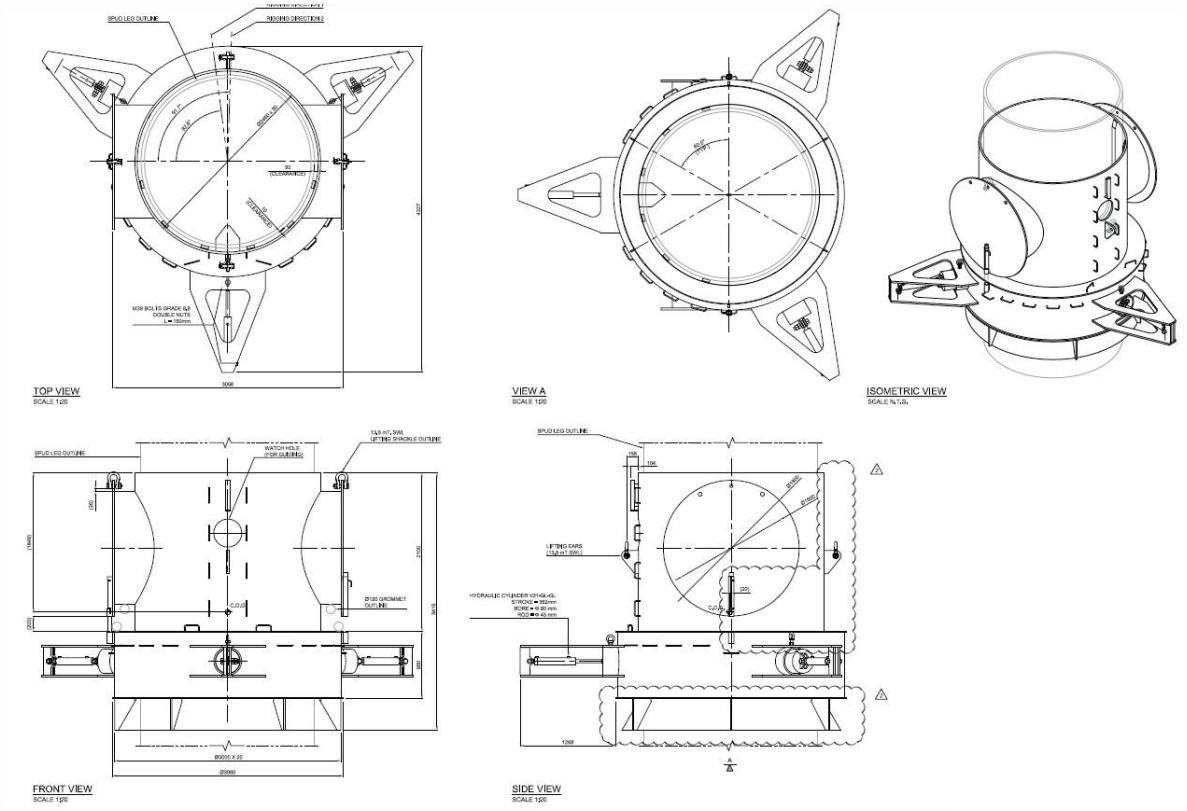
- **Amarcon Octopus**
  Accurately determining vessel motions based on strip theory. By calculating vessel and cargo motions, the resulting seafastening loads can be accurately determined.
- **Autodesk AutoCAD**
  Industry standard 2D- and 3D drafting software
- **Autodesk Inventor**
  Intelligent digital prototyping software developed for mechanical engineering design
- **Delftship**
  Software which allows for fast and accurate hull modelling and hydrostatic analysis
- **Dlubal Rfem**
  Finite element method structural analysis software with 1D, 2D, and 3D analysis capabilities
- **Global Maritime GMOOR**
  Analyses the performance of mooring systems by simulating the station keeping behavior and line tensions for catenary moored vessels
- **Mathworks MatLab**
  Mathematics / programming software with numerous tools for analysis of complex problems and processing of large amounts of data
- **Nemetschek SCIA Engineer**
  Finite element method structural analysis software for 1D and 2D elements. Capabilities include buckling and non-linear calculations. The extensive profile library ensures rapid calculation
- **OrcaFlex**
  Marine multibody dynamics program for static and dynamic analysis of a wide range of offshore systems, including all types of marine risers (rigid and flexible), moorings, offshore installations and towed systems



Example of 2D FEM analysis of barge construction (left) and of detailed motion analysis (right)

7 Example of general arrangements lifting and parbuckle tool





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