Base Load Power Hub (BLPH)

BLPH, TP and CF – Load In Manual

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1 INTRODUCTION

1.1 PROJECT OVERVIEW

Crosswind, a Shell and Eneco joint venture, was awarded the tender to develop the offshore Hollandse Kust Noord (HKN) wind farm, located 18.5km off the coast of Netherlands near the town of Egmond aan Zee. The consortium plans to have HKN operational in 2023 with an installed capacity of 759MW generating at least 3.3TWh per year. This is sufficient renewable power to supply more than 1 million Dutch households with green electricity.

Offshore wind farms produce intermittent electricity and balancing these dips and peaks and integrating this electricity into the national energy system requires new technologies. For this reason, the offshore wind farm will include several new technologies that could be implemented at full-scale in the future. The new technologies being explored include a floating solar park, a short-duration battery storage as well as long-term storage via green hydrogen produced by water electrolysis and subsequently consumed in a fuel cell. The combination of these individual measures, herein referred to as the Base Load Power Hub (BLPH) will ensure a continuous power supply regardless of the wind situation.

1.1.1 Project Location

The Hollandse Kust Noord (HKN) wind farm is located 18.5km off the coast of the Netherlands near the town of Egmond aan Zee.

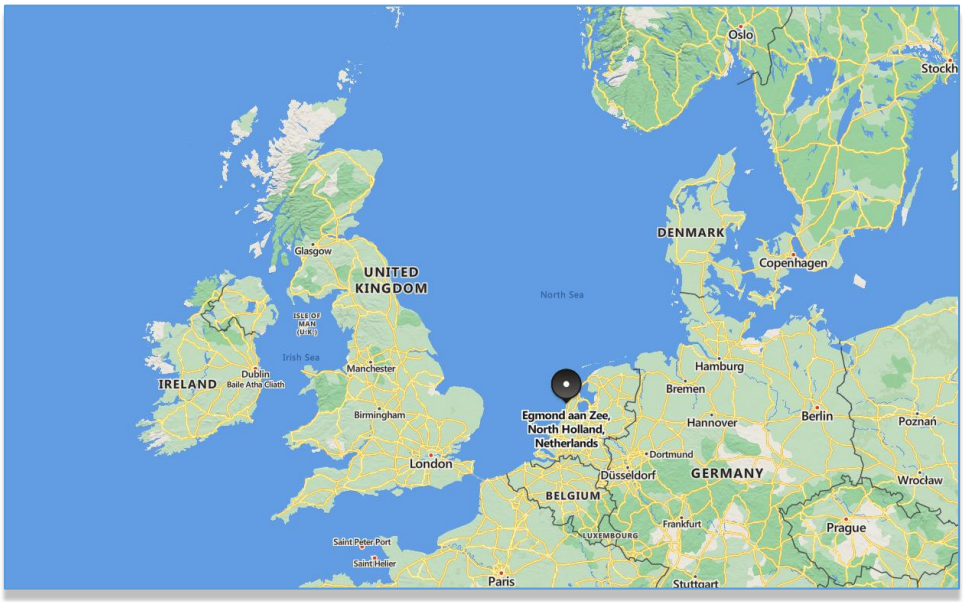


Figure 1.1 HOLLANDSE KUST NOORD WIND PARK Location Map

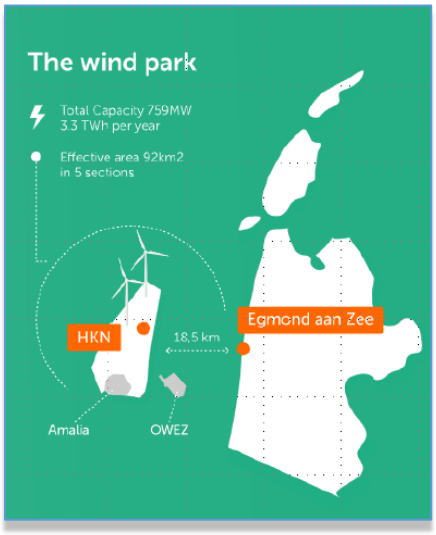


Figure 1.2 - Wind Park Details

The wind farm consist of No. 69 x 11.5MW wind turbine generators each to be installed on a dedicated monopile structure. A 70th monopile located on coordinates E 590719.1, N 5841602.3 is reserved for installing the platform accommodating the BLPH. The monopile structure was designed and installed by Van Oord Offshore Wind (VooW) and therefore not part of the BLPH scope.

1.1.2 Project Concept

All components included in the BLPH will be integrated onshore on a topsides and installed in an offshore location within the boundaries of the HKN wind farm. At its simplest, the BLPH will store energy during periods of high electricity generation from renewable sources (a wind turbine generator and the floating solar PV farm) and release it during periods of low generation. In practice. It is expected that the energy stored will supplement generation from renewable sources to ensure that at least 1.0MW of power is exported to the electrical grid regardless of wind/solar availability.

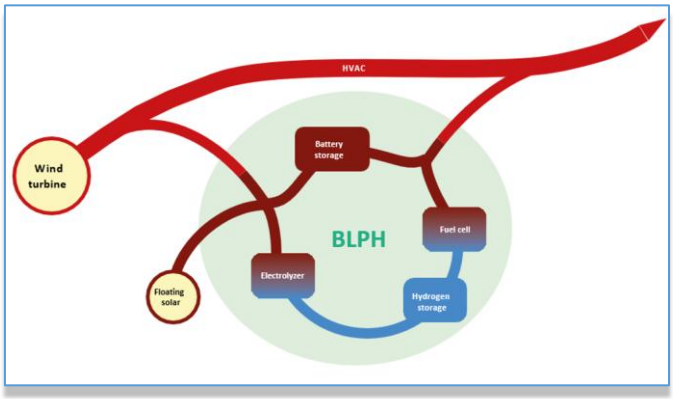


Figure 1.3 – BLPH Concept

Electricity in the BLPH will be stored in the form of electrons in a battery energy storage system (BESS) as well as converted into green hydrogen via water electrolysis. When the power output from the connecting wind turbine drops to below 1 MWe, the BLPH will return its stored energy to supplement the remaining power output. This will be by discharging the BESS, while stored hydrogen will be converted back into electricity using a fuel cell to extend the discharge duration.

The purpose of the BLPH s to function as a testbed for the integration of energy storage technologies with renewable generation. It is expected that equipment installed on the BLPH will operate as Normally Unmanned Installation for at least two (2) years with no or minimal maintenance and it will have its own independent control room with the ability to communicate with Crosswind's control room.

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2 SCOPE

2.1 PURPOSE

This document deals with the load-in procedure to be followed relevant to the CW BLPH topside, caisson frame and Transition piece.

The load-in operations have been scheduled for October 2025.

The document focuses on the main aspects of the activities: procedures, methods, responsibilities, safety criteria, site characteristics, mooring calculations and description of all the equipment's involved. A dedicated HIRA (Hazard Identification and Risk Assessment) has been held to ensure a correct evaluation of the risks together with all parties involved (Rosetti, CW, MWS, SARENS, BARGE owner).

This document, along with the associated documents, is intended to provide the procedure and guideline for the execution of the operations. The Load-in operation will be under the command of the Load-in Manager but, however, Load-in Manager may make amendments on site or exercise his best judgment, in consultation with the Marine Warranty Surveyor and Company representative, as the case may require, dealing with situations that may be encountered during the operation.

2.2 GENERAL

The site where the operation will take place is the Eemshaven Harbor located in north of Netherlands, quay Beatrixhaven.

BLPH Topside and TP, after seafastening removal, will be moved from the barge to the quay by means of suitable number of SPMTs positioned under the steel beams (BLPH) or upper grillage beams (TP); for details about Trailer configuration see Appendix "H".

Caisson frame (CF) instead will be lifted from cargo barge using a quay positioned mobile crane and moved to the final position by means of reach stacker, see Appendix "I".

Load-in of the TP will be performed moving the structure with 2 rows of SPMT positioned under the upper grillage beams from barge bow, for details about hydraulic configuration of SPMT and acting loads see Appendix "H". Load-in of the Topside will be performed moving the structure with 3 rows of SPMT positioned under the BLPH main beams from barge bow, for details about hydraulic configuration of SPMT and acting loads see Attachment "H".

During the movement of the structure from barge to the yard, the barge will be ballasted / deballasted to compensate for the weight and moment transferring to maintain the barge deck leveled with quay.

The whole operation shall be considered subdivided in several steps, corresponding to different positions of the SPMT compared to barge bow and tide level: for each step of the sequence the proper ballast plan shall be calculated so that the barge is maintained at same level of the quay, where the moving structure weight is considered as a set concentrated forces corresponding to the SPMT axle loads.

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3 REFERENCES

3.1 CODES AND STANDARDS

Doc. No.	Description
/1/ BS EN ISO 19900	General requirements for offshore structures - 2019
/2/ BS EN ISO 19901-1	Specific requirements for offshore structures - Part 1: Metocean design and operating considerations - 2015
/3/ BS EN ISO 19901-2	Seismic design procedures and criteria
/4/ BS EN ISO 19901-3	Specific requirements for offshore structures – Part 3: Topsides structure - 2014
/5/ BS EN ISO 19901-5	Specific requirements for offshore structures – Part 5: Weight Management - 2021
/6/ BS EN ISO 19901-6	Specific requirements for offshore structures – Part 6: Marine Operations – 2009
/7/ BS EN ISO 19902	Petroleum and natural gas industries - Fixed steel offshore structures – 2020
/8/ API RP 2A-WSD	Recommended practice for planning, designing and constructing fixed offshore platforms – Working stress design – 22nd edition – 2014
/9/ DNV-ST-N001	DNV - Marine operation and marine warranty - 2023
/10/ DNV-ST-0145	DNV, Offshore substations, 2021

3.2 COMPANY SPECIFICATIONS

Doc. No.	Description
/11/ DEP 37.19.00.12	Gen - Offshore Topsides Structures
/12/ DEP 37.19.00.30	Gen - Fixed Steel Offshore Structures (Adoption of IOGP S-631-11, Amendments / Supplements to ISO 19902:2020).
/13/ DEP 37.81.10.19	Gen - Marine Operations Requirements – Load-in, Transportation and Installation of Offshore Structures (Amendments / Supplements to ISO 19901-6)
/14/ DEP 37.91.10.11	Mobile Mooring Systems (Amendments / Supplements to API RP 2SK, API RP 2SM AND API RP 2I)

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3.3 PROJECT DOCUMENTS

Doc. No.	Description
/15/ 123A90-DDL-MD-RE-01006	Monthly Weight Report
/16/ 123A90-DDL-ST-SP-90017	Structural Design Basis
/17/ 123A90-DDL-ST-SP-90018	Structural Material Specification for Topside & TP
/18/ 123A90-DDL-ST-SP-90118	Structural Material Specification for Flange & Bolts
/19/ 123A90-DDL-ST-TN-90119	Evaluating ISO and DNV approaches
/20/ 123A90-DDL-TI-SP-99014	Specification for TP, Topside and Caissons Transportation and Installation
/21/ 123A90-DDL-ST-RE-90001	Topside loadout analysis
/22/ 123A90-DDL-TI-RE-99001	Topside Gr&SF report
/23/ 123A90-DDL-TI-DD-99021	Topside – Grillage Assembly
/24/ 123A90-DDL-TI-DD-99023	Topside – Grillage – Plan and Section
/25/ 123A90-DDL-TI-RE-99012	Topside – Yard Checklist
/26/ 123A90-PML-QHSE-PRO-00127	Topside – internal seafastening report
/27/ 123A90-DDL-ST-RE-90008	TP loadout analysis
/28/ 123A90-DDL-TI-RE-99003	Technical note – validation of TP grillage and SF design on barge Vervece
/29/ 123A90-DDL-TI-RE-99004	TP Gr&SF report
/30/ 123A90-DDL-TI-DD-99036	TP – Upper Grillage plan view
/31/ 123A90-DDL-TI-DD-99037	TP upper grillage sections
/32/ 123A90-DDL-TI-DD-99038	TP upper grillage section and details
/33/ 123A90-DDL-TI-DD-99039	TP – Lower Grillage Assembly
/34/ 123A90-DDL-TI-DD-99040	TP – Lower Grillage – Plan and Section
/35/ 123A90-DDL-TI-RE-99013	TP & CF – Yard Checklist
/36/ 123A90-DDL-ST-RE-90014	CF loadout analysis
/37/ 123A90-DDL-TI-RE-99007	CF Gr&SF report
/38/ 123A90-DDL-TI-DD-99047	CF – Grillage Assembly
/39/ 123A90-DDL-TI-DD-99048	CF – grillage and SF
/40/ Attachment E	Load-in mooring plan

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4 DEFINITIONS AND ABBREVIATIONS

COMPANY or Client (CPY)	Crosswind
CONTRACTOR (CTR)	ROSETTI MARINO S.p.A.
PROJECT	HOLLANDSE KUST NOORD WIND PARK Project
TRANSPORT CONTRACTOR	OCEAN
SPMT	SARENS
BESS	BATTERY ENERGY STORAGE SYSTEM
BG	Box Girder
BLPH	Base Load Power Hub
CF	Caisson Frame
CL	Concentrated Load
CoG	Centre of Gravity
CTV	Crew Transfer Vessel
CW	CrossWind
DAF	Dynamic Amplification Factor
DFF	Damage Fatigue Factors
DLB	Ductility Level Blast
DNV	Det Norske Veritas
DOP	Dropped Object Protection
El.	Elevation
EPCI	Engineering Procurement Construction and Installation
FEED	Front End Engineering Design
HAT	Highest Astronomical Tide
HKN	Hollandse Kust Noord
ICCP	Impressed Current Corrosion Protection
LAT	Lowest Astronomical Tide
LRFD	Load and Resistance Factor Design
MSL	Mean Sea Level
MOC	Management of Change
NTE	Not-to-Exceed

OD	Outside Diameter
PAU	Pre-Assembled Unit (H2 Vessels)
PBY	Piomboni Yard Ravenna
PG	Plate Girder
SCE	Safety Critical Equipment
SHL	Static Hook Load
T&I	Transport & Installation
ToS	Top of Steel
TP	Transition Piece
UC	Unity Check
UDL	Uniformly Distributed Load
VIV	Vortex Induced Vibration
VOOW	Van Oord Offshore Wind
WTG	Wind Turbine Generator
W2W	Walk to Work

Table 4.1 - Definitions and Abbreviations

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5 ITEMS DESCRIPTION

5.1 BLPH

The BLPH comprises of two main deck levels with overall deck plan dimensions of 40 m x 16 m, excluding external walkways, laydown areas and stairs, with an overall deck height of 7 m between decks. There are currently 6 hydrogen storage vessels which lie horizontally, aligned North - South, within the PAU structure located above the upper deck.

The Topsides layout is shown in Figure 5.1.

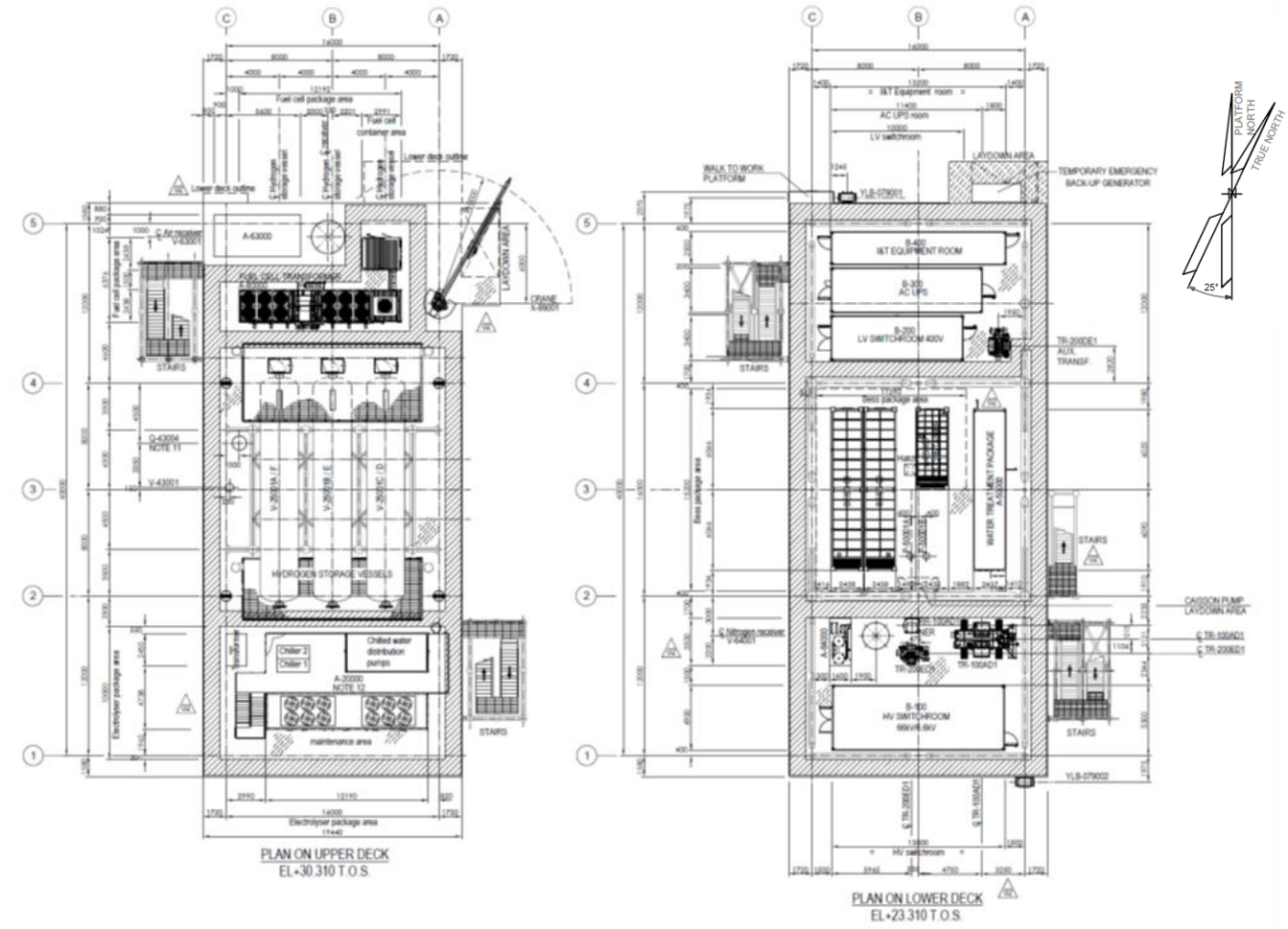


Figure 5.1 - Base Load Power Hub Plot Plan

5.1.1 COG position

According to the last issued physical weighing operation carried out at Rosetti Marino Yard, Topside has the following CoG and weight position (from A1 and LAT) relevant to load-in condition:

- Load-in Weight 1695 ton (excluding SPMT and spacer weight and including 3% cont.);
- X_G = 19.87 m;
- Y_G = 7.87m;

BLPH load-in scheme with CoG position is shown in the next figure. Refer to Appendix N for details about the load application.

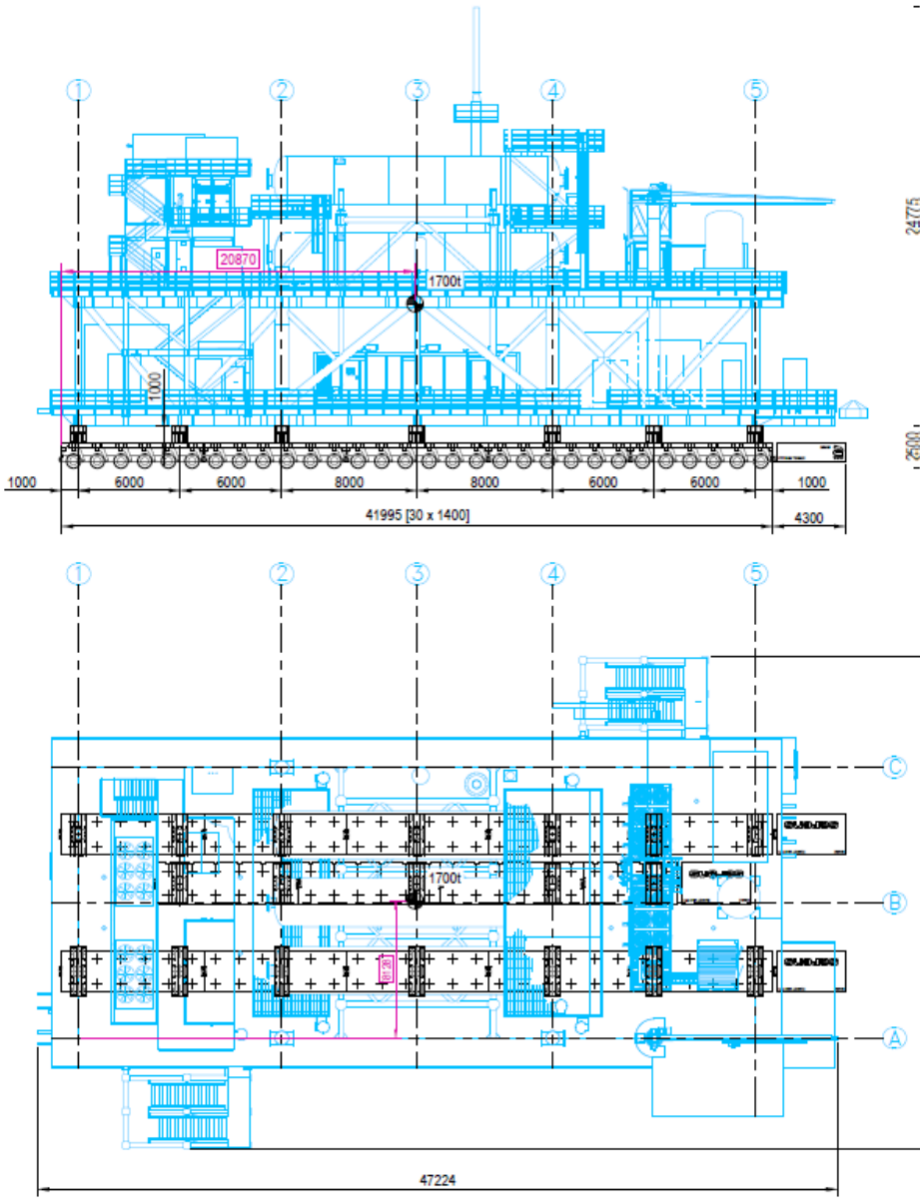


Figure 5.2 – BLPH SPMTs arrangement

5.2 TRANSITION PIECE

TP is composed by a central column with an outer diameter of 7m and Four (4) boxed girders with height ranging from 2.5 m to 1.4 m, oriented along the main diagonals of the TP.

TP main dimensions are 16m x 16m with height 7.9m.

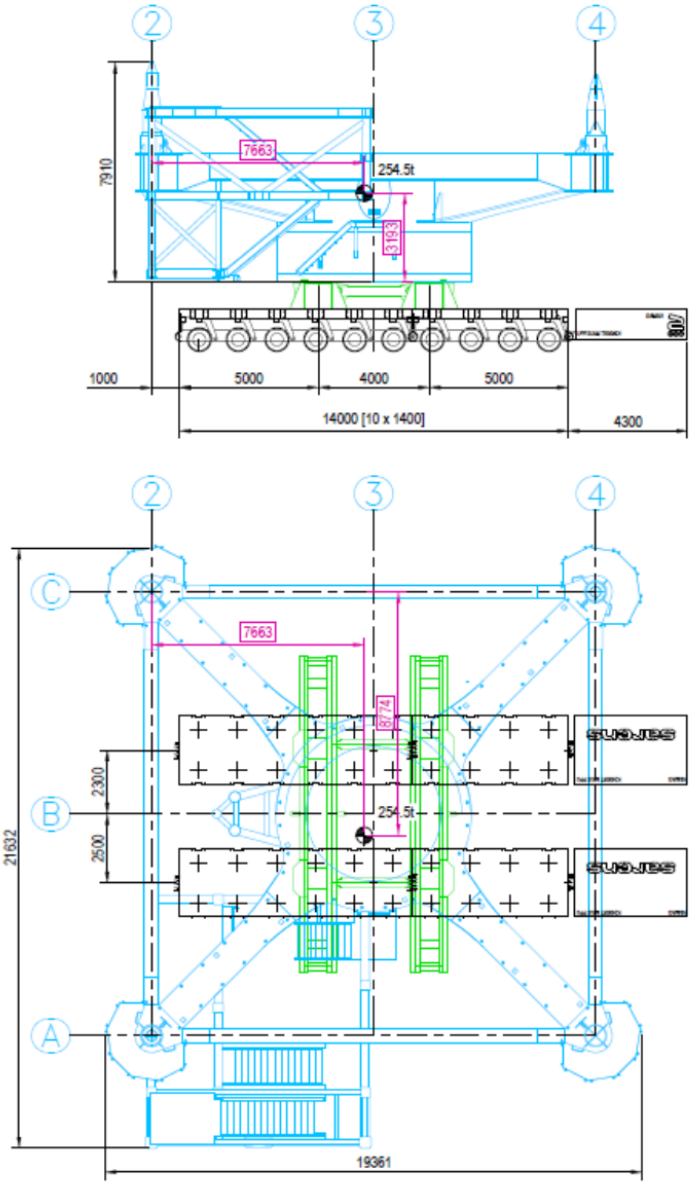


Figure 5.3 – Transition Piece – SPMTs arrangement

5.2.1 COG Position

According to the last issued physical weighing operation carried out at Rosetti Marino Yard, TP has the following CoG and weight position (from A1 and LAT) relevant to load-in condition:

- Load-in weight 254.4 ton (excluding SPMT weight and including 3% cont.);
- X_G = 19.663 m;
- Y_G = 8.774 m;

TP load-in scheme with CoG position is shown in the next figure.

5.3 CAISSON FRAME

The caisson frame is designed to structurally connect n.2 seawater lift caissons and n.1 brine discharge caisson to the Monopile CW70.

The support concept is that the CF form a structure similar to the boat landing frame, which has been successfully installed by Van Oord on monopile.

The brine caisson is "piggy-backed" off the CF. it is positioned on the outside of the CF and terminates 6m above the inlet to the seawater lift pump caissons. This to avoid, as far as possible, cross-contamination of waste brine water being dumped overboard with fresh seawater drawn for electrolysis.

The seawater lift caissons contain submersible pumps, so the caissons must be vertical.

5.3.1 COG Position

CoG position is taken from ref. /15/, and compared with TEKLA model:

- Loadout Expected Weight 32.5 ton (16% cont. included)

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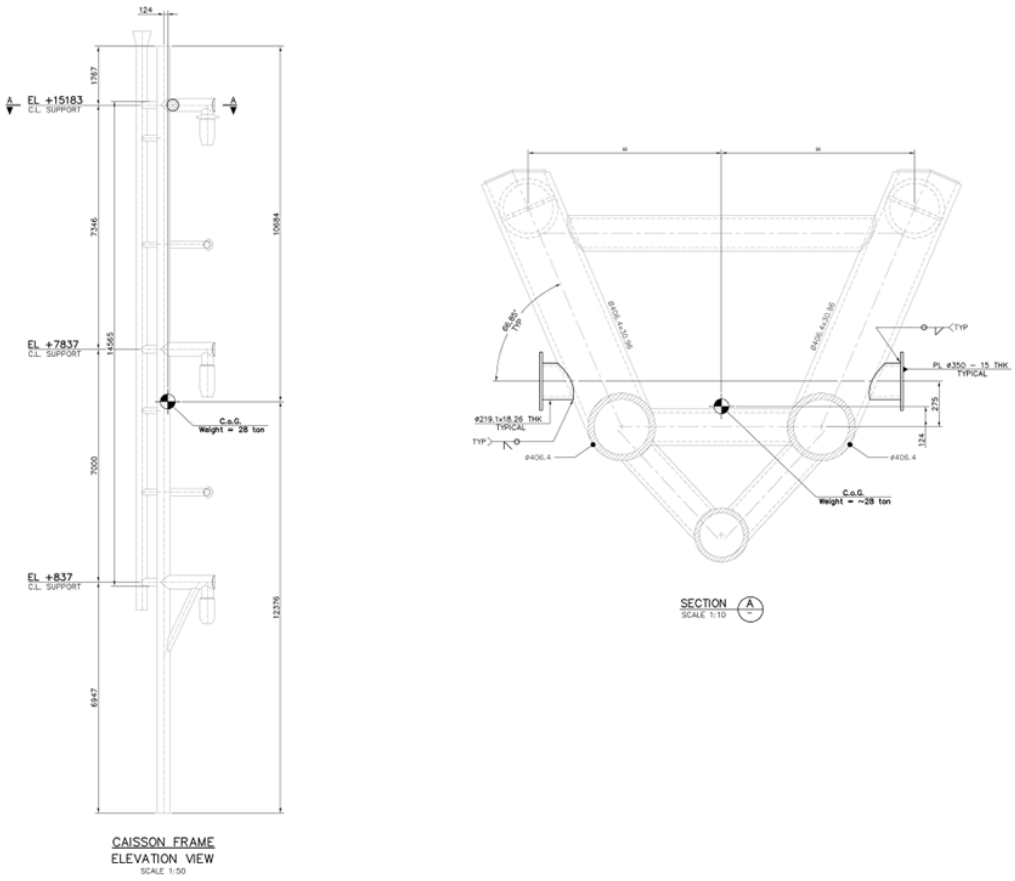


Figure 5.4 – CF COG position

6 SITE MAIN DATA

6.1 YARD GENERAL DATA

The area dedicated load-in activities is located in the North side of Eemshaven Harbour (Buss Terminal) and the waterfront overlooks an internal harbour area, the storage area is located.

The location is free from the influence of waves and currents and the main variations in terms of water level are only dependent on tide variation.

The elevation of quay capping beam above N.A.T. is 4,5 m, tide tables relevant to Harbor (see Appendix "M" for details) show that maximum water level excursion is less than +/- 1,6 m around N.A.T.

The following Picture shows the location:

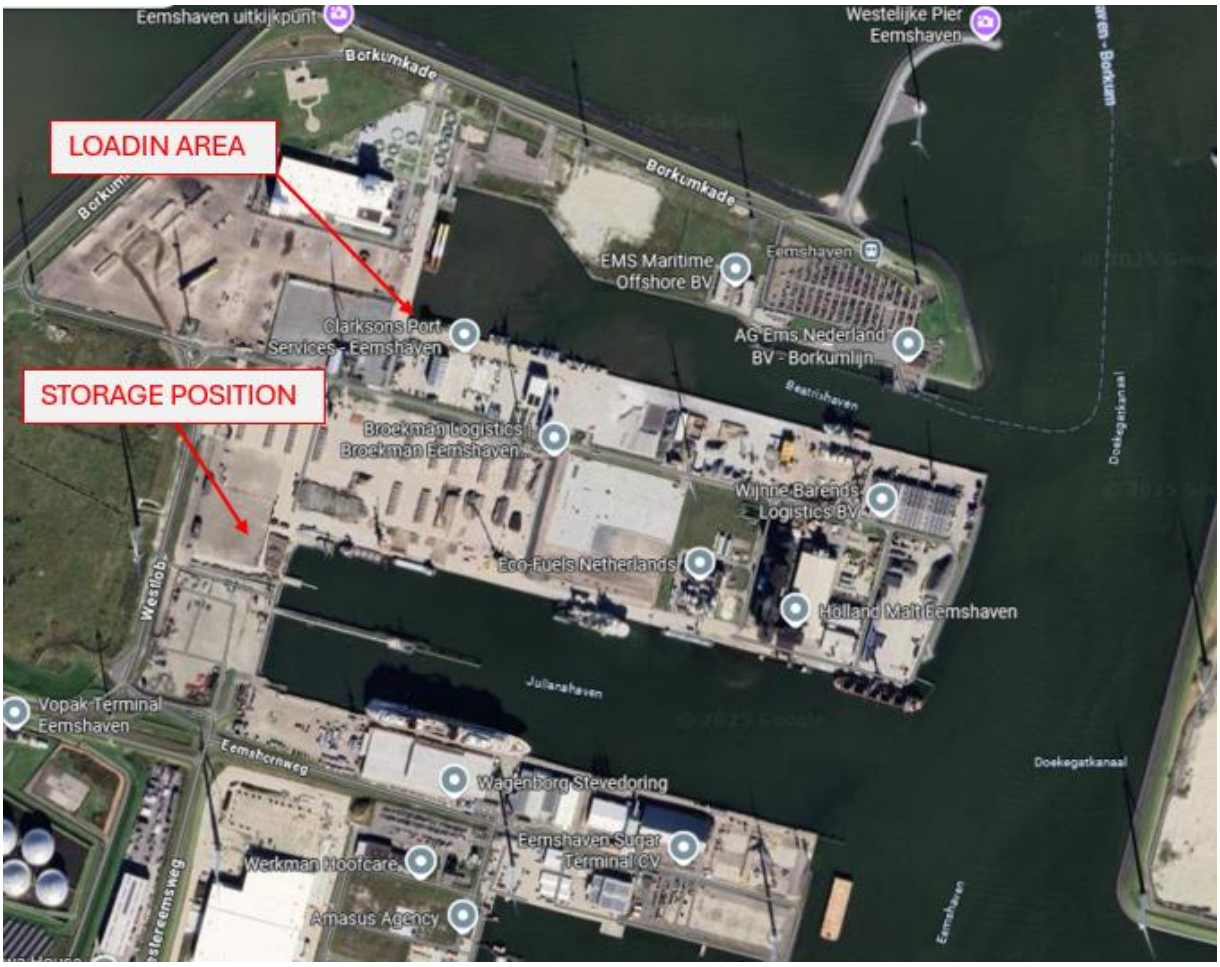


Figure 6.1 – Eemshaven port and BUSS Location

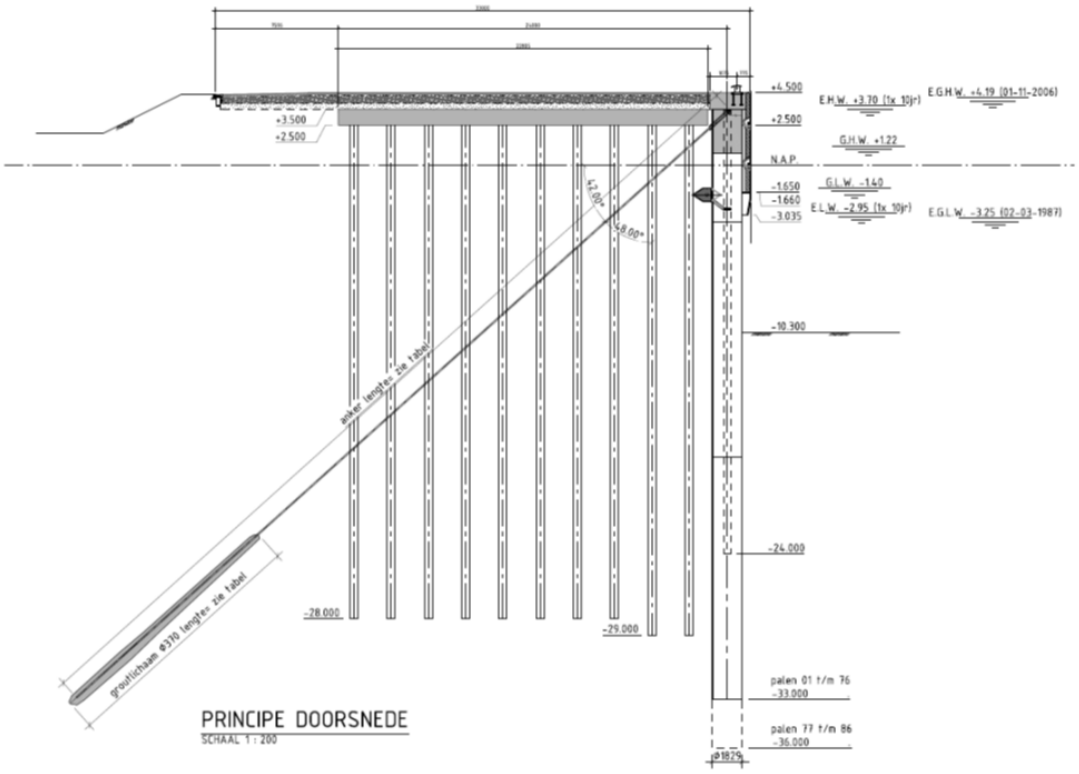


Figure 6.2 – Beatrixhaven quay section(See Appendix D)

6.2 YARD BOLLARDS LOCATION AND DETAILS

Bollards position along quayside is shown in Appendix "D", bollard capacity is 600 kN.

6.3 HYDROGRAPHICAL SURVEY AND TIDE DATA

The elevation of quay above N.A.T. is 4,5 m, tide tables relevant to Harbor (see Appendix "M" for details) show that maximum water level excursion is less than +/-1,6 m around N.A.T.

At the quay side the minimum water depth is 10 m (N.A.T. reference), see Appendix "D".

6.4 UNDER KEEL CLEARANCE

The maximum draft of barge will be 3,3 m (stern draft at barge arrival) therefore the minimum under keel clearance will be 10 – 3,3 – 1,6 = 5,1 m considering the low tide condition.

This under keel clearance is widely over 1 m that is the minimum required as per DNV rules.

6.5 WEATHER FORECASTING ARRANGMENT FOR THE YARD

Weather forecast for load out operation will be obtained from website www.windy.com and www.windfinder.com, during the week prior load-in operation weather forecast will be checked.

7 ENVIRONMENTAL LIMITS

7.1 TIDE

See section 6.3. max excursion +1,6 m/-1,6 m considered.

7.2 WAVE

Not present being in a closed basin. Marine traffic will be limited and wind wave negligible having limitation on max wind speed.

7.3 WIND

The load-in activities will be performed with good weather conditions and favorable weather forecast. The maximum wind speed should not exceed 12 m/s mean during load-in (15 m/s gust).

Prior to starting the load in the wind speed will be checked by means of an anemometer (hand anemometer available on roof of BUSS office).

The maximum wind speed assumed for mooring design is:

- 27 m/s (10 min. mean, 10m high) for long term mooring, this value is the reference wind for 50 years return period storm according to available site data; it is conservative approach since EN and DNV rules suggest 10 years return period storm.
- 18 m/s for mooring during load out (10 min at 10m high) with 15 m/s gust.

For the SPMT stability 15m/s is used.

For details relevant to Mooring Design see Chapter 8 and Attachment G for calculation.

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8 MOORING SYSTEM

The mooring system consists of the following items:

- Polypropylene Mooring Lines;
- Connection Devices (link plate, tackles, shackles …)
- Barge winches

The scope of mooring is to secure the Cargo Barge to Quay during load-in and long-term mooring for preparatory activities. The mooring analysis has been performed considering the barge moored by PS.

8.1 WINCHES MAIN FEATURES

N.3 winches will be placed on barge deck and be employed to stretch mooring wires. Each winch will be 40t capacity in pulling and 120t capacity in brake.

8.2 WIND EXPOSED AREAS

An analysis relevant to wind exposed areas is necessary in order to evaluate the acting loads on mooring lines due to wind pressure applied on barge, loaded out items and Grillage. Windage areas are calculated with coefficient 1 using the rectangular shape measured in AutoCAD.

8.2.1 Lateral View

The following picture shows the Lateral Exposed areas for the main items relevant to load-in condition and post load-in condition.

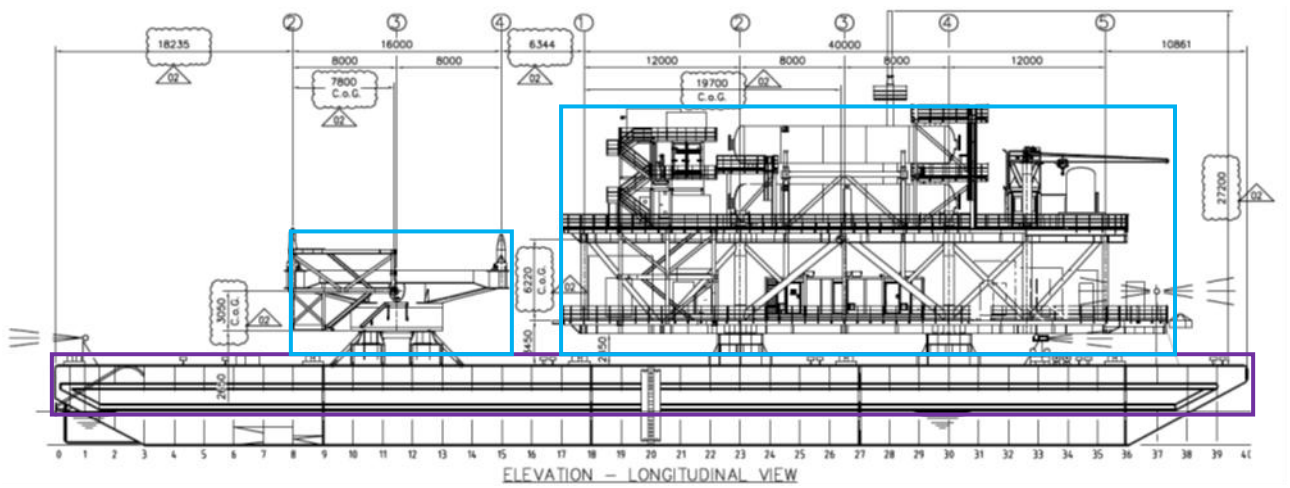


Figure 8.1 – Wind Lateral Exposed Area

The following list summarizes the main data relevant to Exposed Areas shown above:

- Cargo Barge (Violet): Exposed area equal to 190 m2 (considering min draft condition) with a Center of Exposed Area located at midship.
- TP, Topside & Grillages (Blue): BLPH Exposed Area equal to 650 m2 with a Center of Exposed Area located at 30.9 m from Barge bow, TP Exposed Area equal to 100 m2 with a Center of Exposed Area located at 66.4m from Barge bow, CF covered by the above numbers.

Total side windage area = 190+750 m2

8.2.2 Front View

The following picture shows the Exposed areas for the main items relevant to load-in condition and post load-in condition:

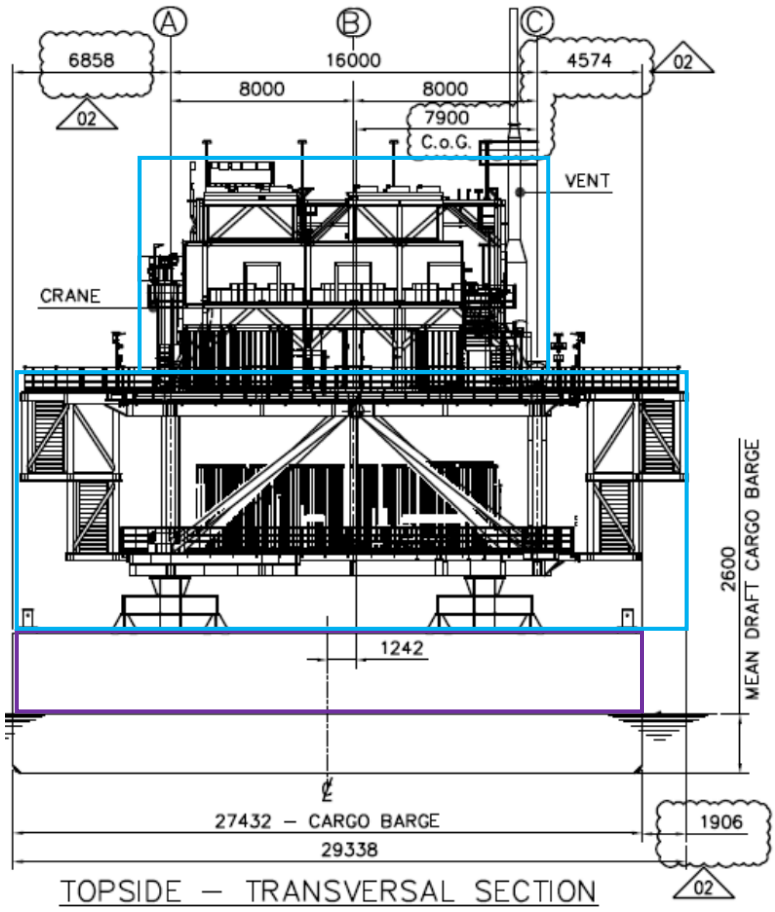


Figure 8.2 – Wind Front Exposed Area

The following list summarizes the main data relevant to Exposed Areas considered for this condition:

- Cargo barge (Violet): Exposed area equal to 80 m2 (considering min draft) with a Center of Exposed Area located on Barge Centre Line;
- Topside (Blue): Exposed Area equal to 400 m2 with a Center of Exposed Area located on Barge Centre Line;

Total front windage area = 80+400 m2.

See attachment G for mooring analysis.

9 LOAD-IN PROCEDURE

9.1 GENERAL

The basic principles of the operation consist of moving the items by means of SPMT until the edge of the ramp is reached, then, after a first set of proper alignment check and compliance of values of tide and water into the ballast tanks, the items will be moved on quay.

- Topside Row 5 will be the first to be transferred to the quay and the structure weight will be transferred to yard by SPMT tires. Three ramps (one for each SMPT line) will be provided to ensure the connection between yard capping beam and barge bow, for details and structural checks of these bridge plates see Appendix H.
- TP Row 2 will be the first to be transferred to the quay and the structure weight will be transferred to yard by SPMT tires. Two ramps (one for each SMPT line) will be provided to ensure the connection between yard capping beam and barge stern, for details and structural checks of these bridge plates see Appendix H.
- CF will be loaded in by crane, temporarily landed on quay and then moved to its final destination by reach stacker.

The transportation barge VERVECE will be ballasted / deballasted to compensate for the load transferred by the SPMT and during the progress of the load-in a monitoring system will be adopted to monitor the barge trim and roll.

During items load in, barge will be moored with bow at quay side; yard capping beam and barge deck will be kept at the same level during all load-in phases, however little vertical barge movements are allowed considering the arrangement of ramp system.

For ramp details see Appendix H.

During operations, a system of fenders will be arranged to keep unchanged the distance between barge and quay, their details are in Appendix E.

9.2 MAIN LOAD-IN TIMELINE

The following table summarizes the main steps necessary to carry out the items Load-in:

1.	Quay preparation (removal of access ladder/barricades)	Appendix E
2.	Crane LHM600 on quay for towing bridle pick-up and winches positioning	
3.	Barge moored by bow (fenders / winches / mooring lines)	Appendix E
4.	SPMT and ramp positioning for Topside load-in	Appendix H
5.	CF load-in by means of lifting by crane	Appendix I

6.	CF temporarily landed on quay to allow rigging modification	
7.	CF transferred to yard location by reach stacker	Appendix I
8.	Topside SF removal to allow load-in	Appendix Q
9.	Topside general inspection	
10.	Perform ballast plan as per phase 0 of Topside ballast plan	Appendix O
11.	Start Topside ballasting operation (after pumps positioning and test)	Appendix O
12.	Topside Complete load-in operation and movement to temporary parking area	Appendix B
13.	Removal of external sea fastening (simops)	
14.	SPMT positioning for TP load-in	Appendix H
15.	TP SF removal and Lower grillage to UG disconnection to allow load-in	Appendix Q
16.	Perform ballast plan as per phase 0 of TP ballast plan	Appendix O
17.	Start TP ballasting operation	Appendix O
18.	TP Complete load-in operation and movement to storage Area	Appendix B
19.	TP Lowering on yard supports	Appendix B
20.	Shimming and survey	Appendix R
21.	Restart Topside movement to final storage area	
22.	Lowering on yard supports	Appendix B
23.	Shimming and survey	Appendix R

9.3 ITEMS, QUAY AND BARGE PREPARATION

After the barge arrival, the items will be checked in terms of integrity and no loose items considered critical for load in operation will be properly secured.

9.3.1 TOPSIDE

All the activities listed below will be carried out prior to the load-in:

1. Removal of scaffolding and items not necessary for the load-in;
2. Check that no loose items will be on the item during the activity;
3. Removal of SF
4. Check that no clashes will occur between item and quay site facilities and no obstacles will be present along the route;

5. Check the SPMT arrangement;
6. Load-in operation shall not commence until MWS CoA has been issued.

9.3.2 TP

All the activities listed below will be carried out prior to the load-in:

1. Removal of scaffolding and items not necessary for the load-in;
2. Check that no loose items will be on the item during the activity;
3. Removal of 4-SF pipes and cutting of UG to LG connection
4. Check that no clashes will occur between item and quay site facilities and no obstacles will be present along the route;
5. Check the SPMT arrangement;
6. Load-ing operation shall not commence until MWS CoA has been issued.

9.3.3 CF

All the activities listed below will be carried out prior to the load-in:

7. Removal of scaffolding and items not necessary for the load-in;
8. Check that no loose items will be on the item during the activity;
9. Removal of SF (wooden stopper plates)
10. Check the Crane configuration;
11. Check the slings arrangement;
12. Load-ing operation shall not commence until MWS CoA has been issued.

9.3.4 Quay side

Activities required before the load-in listed as follows:

1. Clean off all material and equipment not strictly required for the load-in;
2. Check that no sharp objects will be present along SPMT route;
3. Check that no obstacles will be present between the fenders and the barge;
4. Perform safety inspection;
5. Cordon off the area involved for the operation;
6. Disposal of all the mooring equipment close to the designated bollards and check of compliance of the equipment itself;
7. Check and preparation of bollards and anchor points on-shore;

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8. Arrangement of all reference points necessary for the barge level monitoring during the load-in (an optical level and stadia system will be employed for the scope).

9.3.5 Barge Preparation

List of activities to be carried out before starting the load-in:

1. Check all barge appurtenances have been removed/installed (if any);
2. Check the ballast system arrangement and perform function test of ballast system prior to load in operation;
3. Check arrangement of ramps, welding of hinges on deck;
4. Check that no clashes will occur between topside/TP and barge appurtenances and / or grillages, if any remove;
5. Check if deck manholes are accessible for the using of ballasting portable pumps (ullage level will be monitored through open man holes);
6. Preparation of seafastening cutting tools.
7. Painting of the SPMTs path on the barge deck.

9.3.6 Personnel preparation

List of activities to be carried out before starting the load-in:

1. Tool box with all personnel involved into load-in operation (as per load-in organization chart) carried out;
2. Check radio communications (walkie-talkie and spare batteries tested);
3. Check first aids availability;
4. Check harbor authority has been informed of imminent start of load-in operation (Load-in Manager responsible for communication with Harbor Authority).

9.3.7 Fenders

During load-in operation the following fenders will be employed:

- Four Yokohama fenders on Portside

The fenders have a diameter equal to 2.5 m, see Appendix E for details.

9.3.8 Bridge Plates

During load-in operation the following ramps will be employed:

- Tot of 6 ramps for TP load-in. Each rump is 1m wide, hence 3 ramp for each SPMT will be employed
- Tot of 9 ramps for Topside load-in. Each rump is 1m wide, hence 3 ramp for each SPMT will be employed

The ramps are provided by Sarens and they are designed for SPMT , see Appendix H for details.

9.4 BALLAST SYSTEM

Ballasting sequence is included in Appendix "O".

The ballasting system consists of a set of submersible pumps provided by Sarens .

Load-in ballast sequence considers max 6 tanks contemporaneously manoeuvred at each of load-in phase.

Load in in considered Class 1 due to tidal restriction according to Table 10-1 of DNV-ST-N001 code. Barge cannot be maintained at the same elevation of the quay for the whole tidal cycle.

The load in will take place in falling tide with the speed of SPMTs driving off the barge (decreasing the weight on the barge and decreasing the draft of the barge). See Appendix O for ballast system calculation.

The details relevant to pumps characteristics and general layout has been included in Appendix "N".

According DNV-ST-N001.

Table 10-1 Load-out (operation) class

Tide range [1]	*Tide restricted?* [2]	*Weather restricted?* [3]	*Load-out Class*
Significant	Yes	No/Yes	1
Significant	No	Yes	2
Significant	No	No	3
Zero	No	Yes	4
Zero	No	No	5

Notes:

1) If ballasting is required in order to compensate for tide variation, then the tide range shall be defined as significant, see also [10.2.1.2] and [10.2.1.3].
2) If the ballast system cannot compensate for a complete tide cycle, then the load-out shall be defined as tide restricted.
3) If weather restrictions apply, then the load-out shall be categorized as weather restricted, see [2.6]. If there are **no** weather restrictions to the object movement/ballasting phase the load-out class may be selected accordingly.

10 LOAD-IN ORGANIZATION

10.1 ROLES AND RESPONSIBILITY

A description of the functions and responsibilities of the key personnel involved in the operation is given here below:

- *Load-in Manager* is responsible for the whole load-in operations. Client, Company and Marine Warranty surveyor representatives liaise only and directly with Load-in Manager. Load-in Manager is also responsible for external parties interface / communication (harbor tugs, port authority and emergency services).
- *Ballast Engineer* is responsible for the operations of the primary ballast system and eventually for the emergency systems, in accordance with the load-in procedure and the instructions of the load-in manager.
- *Mooring System Superintendent* is responsible for mooring the barge onto the quay and for adjusting the barge alignment throughout the load out operation.
- *Surveyors Superintendent* is responsible for the co-ordination of the surveyor teams who check the barge level and alignment during the operation.
- *Intervention Team Superintendent* is responsible for the intervention team equipped with cranes, welding machines, cutting gear etc. which will be ready to intervene throughout the operation.
- *HSE Manager* is responsible for all the aspects related to safety including control of access within the restricted area and the liaison with the first aid team.
- *SPMT Superintendent* is responsible for all the aspects related to correct preparation and execution of transport operation by means of self-propelled modular trailer.
- *CPY Representative* is responsible for interface with Rosetti project team, load-in manager and Marine Surveyor.
- *ABL Marine Surveyor* Issue Certificate of Approval to start the load-in. (A signed copy must be handed to CPY Site Rep prior to topside liftoff). Witness load-in operation. Interface with CPY and Rosetti as required.
- *Project Quality Manager* is responsible for providing all documentation and certification required by MWS and to ensure checklists are completed and signed off.
- *Construction Manager*, in collaboration with Load-in Manager is the responsible all barge / quay activities (bollard removal, double plate positioning, lower grillage cutting…) necessary to perform load-in.

- *Tide Surveyor* is responsible for checking the tide variations during load-in operation, he will inform Load-in Manager about tide behavior by radio.

10.1.1 Contact details of key personnel

Here are the following contact details of key personnel:

- *Massimiliano Brunelli – RM Project Manager;*
  mobile: +393346143049
  e-mail: massimiliano.brunelli@rosetti.it
- *Alessandro Balzarotti – RM Project Structural Engineer ;*
  mobile: *+393451449272*
  e-mail: alessandro.balzarotti@teconsrl.it
- *Daniele Ricci Picciloni –RM Project HSE Manager;*
  mobile: *+393351225148*
  e-mail: *daniele.riccipicciloni@rosetti.it*
- *Mart Van Hoorn –SARENS Project manager*
  mobile: *+31620132530*
  e-mail: *Mart.vanHoorn@sarens.com*
- *- SARENS Load-in Manager;*
  mobile:
  e-mail:
- *Hamish Forsythe - ABL Marine Warranty Surveyor;*
  phone: *+447827 186314*
  e-mail: *hamish.forsythe@abl-group.com*

10.2 COMMUNICATIONS

The Load-in Manager has overall responsibility and control of the operation. The Load-in Manager communicates with the Load-in team via walkie-talkie and is the only one entitled to give orders.

The Load-in Team is in constant communication with the Load-in Manager and follows his instructions. In case of any mismatch with expected data and conditions, each Load-in Team component must inform immediately the Load out Manager, who is the only entitled to decide relevant intervention.

In case of immediate danger to the Health and Safety of any operator each Load-in Team component must STOP the operation immediately and then inform the Load-in Manager.

In any case, the Load-in Manager is the only one entitled to restart the operation.

Communication among the load-out key personnel will be made via portable radio. Load-in Manager will be linked to the surveyor superintendent in charge of monitoring the barge draft, trim and heel. The tank sounding will be read in by measuring the ullage through the manholes.

Prior to starting the operations the correct functionality of the walkie-talkies (batteries, radio frequency...) will be checked. Each walkie-talkie will be provided with a spare battery ready in case of substitution. A dedicated RF Channel will be employed for load-in operation.

A toolbox talk will be carried out before the load in commences. All personnel involved in the load-in, as per the Operational Organizational Chart, should be present so that everybody understands the operation and is aware of their responsibilities.

All communications will be conducted in English.

In the event of the operation being stopped for unforeseen circumstances, as described in this section, the Load-in Manager will inform CPY and the MWS of the nature of the problem and the proposed corrective course of action.

10.3 HSE REQUIREMENTS

For general Safety Measures refer to Project HSE Plan applicable revision and Risk Assessment.

A dedicated HIRA has been held to ensure a correct risk assessment.

10.4 CONTINGENCY PROCEDURE

The following table summarizes the main risks and relative actions. See attachment H for details

RISK	INTERVENTION	TIME (min.)
Mooring line failure	- line reinstatement or substitution. Mooring analysis considers single line failure	10-20′
Primary ballasting system failure	- spare Portable Pumps	10-15′
SPMT failure	Spare PPU / spare SPMT.	
Clashes removing Requirement	Scaffold items and cutting/burning gear on standby at location on barge	

Table 10.1 –contingency plan

ATTACHMENT A – TP & BLPH GENERAL ARRANGEMENT ON VERVECE

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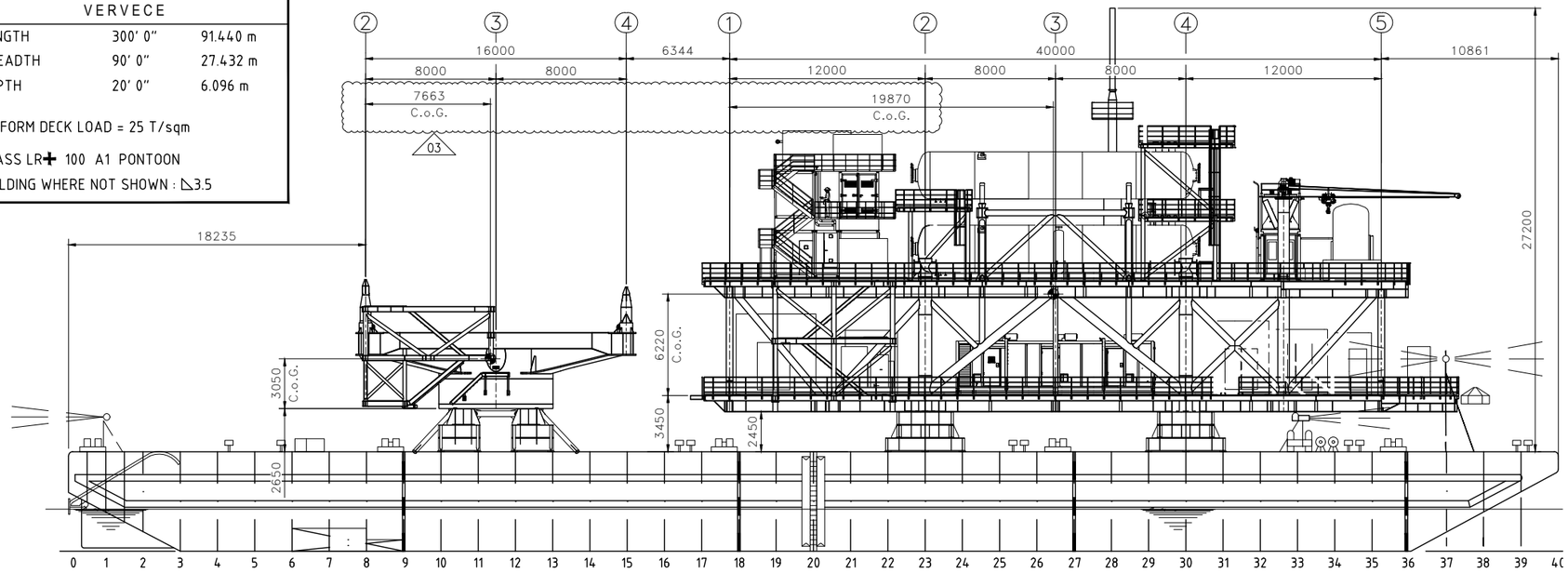
REV. 03

VERVECE		
LENGTH	300' 0"	91.440 m
BREADTH	90' 0"	27.432 m
DEPTH	20' 0"	6.096 m

UNIFORM DECK LOAD = 25 T/sqm

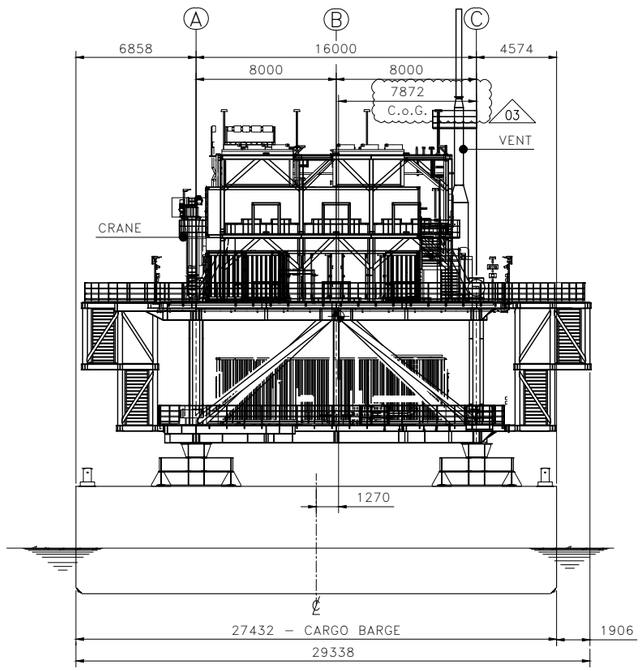
CLASS LR✚ 100 A1 PONTOON

WELDING WHERE NOT SHOWN : ◺3.5



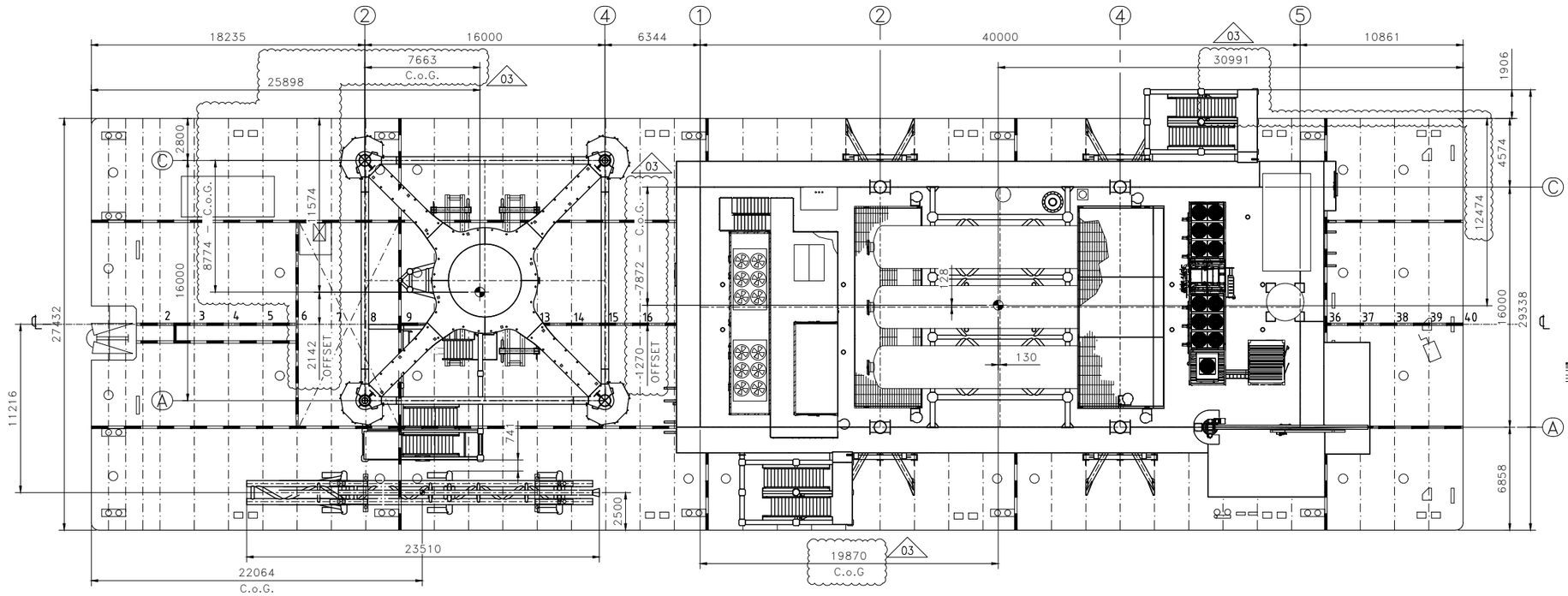
ELEVATION – LONGITUDINAL VIEW

SCALE 1:175



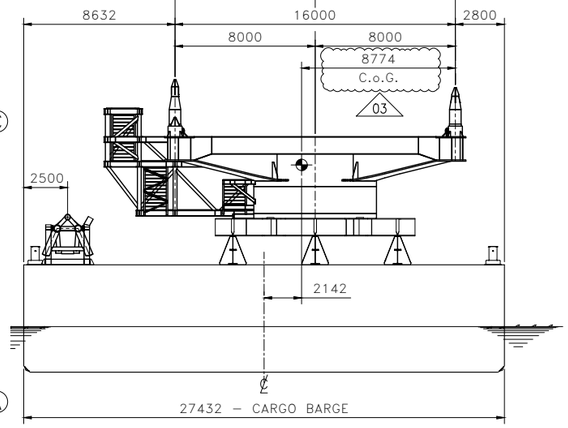
TOPSIDE – TRANSVERSAL SECTION

SCALE 1:175



BARGE LAYOUT – VERVECE

SCALE 1:175



TP – TRANSVERSAL SECTION

SCALE 1:175

NOTES
1 – ALL DIMENSIONS AND ELEVATIONS ARE IN MILLIMETERS U.N.O.
2 – ALL ELEVATIONS ARE REFERED TO C.D.

WEIGHT LIST		
TOPSIDE	= 1700 t	(3% CONTINGENCY INCLUDED)
TP	= 254.5 t	(3% CONTINGENCY INCLUDED)
TOPSIDE L.GRILLAGE & SF	= 75 t	
TP L.GRILLAGE & SF	= 45 t	
CAISSON FRAME	= 30 t	(10% CONTINGENCY INCLUDED)
CAISSON GRILLAGE & SF	= 0.5 t	

03

VERVECE - BALLAST PLAN for TOWING - Draft 2.50 bow - 3.30m stern - trim 0.50deg

STERN					BOW
	5PW	84% 4PW u=1.0m	3PW	2PW	1PW
	98% 5PC full	4PC	3PC	2PC	1PC
	5SC	4SC	3SC	2SC	1SC
	80.0% 5SW u=1.10m	4SW	3SW	61% 2SW u=2.40m	1SW

REV.	DATE	DRN	CHKD	APPD	DESCRIPTION
03	21/07/25	SGR	AB	DLS	ACCEPTED FOR CONSTRUCTION (AFC)
02	26/02/25	SGR	AB	DLS	ACCEPTED FOR CONSTRUCTION (AFC)
01	07/10/24	SGR	AB	DLS	ACCEPTED FOR CONSTRUCTION (AFC)
00	12/01/24	SGR	AB	DLS	ISSUE FOR REVIEW (IFR)

TECON

CROSSWIND

ROSETTI MARINO

TITLE : BASE LOAD POWER HUB (BLPH)
BARGE LAYOUT

CONTRACT NO./TITLE CW-I-WP4-2023-05/HOLLANDSE KUST NOORD WIND PARK			SCALE 1:175
DRAWN S.GRIFFINI	CHECKED A.BALZAROTTI	APPROVED D.LO STERZO	DATE 21/07/25
A1	DRAWING NO. 123A90-DDL-TI-DD-99015	SHEET 001	REV. 03

File Name : 123A90-DDL-TI-DD-99015_03.dwg

Client:	ROSETTI
Project:	CROSSWIND - Weighing and Load out TP & TOPSIDE
Job No.:	25HHL0045
Weighing Procedure ref.:	030-CRO-WP-02-001-0

WEIGHING DATA REPORT

Date [dd/mm/yyyy]:	19/06/2025
Location:	MARINA DI RAVENNA (RA)
Item:	TP

	Reading # 1	Reading # 2	Reading # 3	Reading # 4	Reading # 5
Time [hh:mm]	15:45	16:05	16:15		
Temperature °C	26	26	26		
Wind speed [m/s]	2,7	2,7	2,7		

Load cell ref.	Load cell serial nr.	LOAD CELLS LOCATION X [mm]	LOAD CELLS LOCATION Y [mm]	Reading # 1 [t]	Reading # 2 [t]	Reading # 3 [t]	Reading # 4 [t]	Reading # 5 [t]	Average [t]	Expected Load [t]
L.C.1	201309039	22000	2500	51,2	50,6	50,3			50,7	59,3
L.C.2	201407239	18000	2500	55,1	55,5	55,7			55,4	63,8
L.C.3	201308998	18000	13500	89,5	88,8	88,5			88,9	95,7
L.C.4	201309019	22000	13500	51,5	52,0	52,4			52,0	71,2

BY CLIENT		CALCULATED					
ITEM WEIGHT [t]	290,0	**TOTAL WEIGHT [t]**	247,3	246,9	247,0		
X_{COG} [mm]	19800	**X_{COG} [mm]**	19662	19663	19664		
Y_{COG} [mm]	8500	**Y_{COG} [mm]**	8770	8774	8777		
		Deviation %	0,11%	0,06%	0,04%		
		Consistent (Y/N)	YES	YES	YES		

AVERAGE	
TOTAL WEIGHT [t]	247,1
X_{COG} [mm]	19663
Y_{COG} [mm]	8774

ADDITIONAL EQUIPMENT WEIGHT [t]	0,0
ITEM NET WEIGHT [t]	247,1

DIFFERENTIAL	
TOTAL WEIGHT [t]	-42,9
X_{COG} [mm]	-137
Y_{COG} [mm]	274

Notes:

1. The effects of wind shall be calculated if weighing take place at wind speed above: 8 m/s (Class A); 11 m/s (Class B); 14 m/s (Class C)
2. Conversion Factor: 1kgf = 9,80665 N.
3.
4.
5.

Operated by:

	Name	Date	Signature
Site Manager:	David Perinan	19/06/2025	
Weighing Engineer:	Salvatore Rao	19/06/2025	
Weighing Operator:	Luigi Di Stefano	19/06/2025	

Attendees:

	Name	Date	Signature
Client:	Massimiliano Brunelli	23/06/2025	
MWS - witness: Alfredo Borobia		23/06/2025	

Client:	ROSETTI
Project:	CROSSWIND PROJECT
Job No.:	25HHL0045
Weighing Procedure ref.:	030-CRO-WP-01-001

WEIGHING DATA REPORT

Date [dd/mm/yyyy]:	15/07/2025
Location:	MARINA DI RAVENNA (RA)
Item:	TOPSIDE

	Reading # 1	Reading # 2	Reading # 3	Reading # 4	Reading # 5
Time [hh:mm]	16:50	17:15	17:35		
Temperature °C	28	28	28		
Wind speed [m/s]	3,6	3,6	3,6		

Load cell ref.	Load cell serial nr.	LOAD CELLS LOCATION X [mm]	LOAD CELLS LOCATION Y [mm]	Reading # 1 [t]	Reading # 2 [t]	Reading # 3 [t]	Reading # 4 [t]	Reading # 5 [t]	Average [t]	Expected Load [t]
L.C.1	201406598	0	16000	83,2	85,4	87,2			85,3	100,0
L.C.2	201406596	11150	16000	174,7	173,0	171,7			173,1	187,0
L.C.3	201406592	12850	16000	172,3	170,5	169,2			170,7	187,0
L.C.4	201406569	27150	16000	143,8	142,1	141,2			142,4	160,0
L.C.5	201406574	28850	16000	152,7	149,6	149,8			150,7	160,0
L.C.6	201406583	40000	16000	81,8	90,4	92,2			88,1	98,0
L.C.7	201406595	40000	0	97,9	97,9	97,8			97,9	93,0
L.C.8	201406599	28850	0	158,6	156,7	156,4			157,2	180,0
L.C.9	201406568	27150	0	166,2	164,8	165,0			165,3	180,0
L.C.10	201406581	12850	0	164,0	163,6	163,8			163,8	183,0
L.C.11	201406584	11150	0	162,6	163,1	163,2			163,0	183,0
L.C.12	201406586	0	0	87,2	90,2	90,7			89,3	95,0

BY CLIENT		CALCULATED	Reading # 1 [t]	Reading # 2 [t]	Reading # 3 [t]	Reading # 4 [t]	Reading # 5 [t]
ITEM WEIGHT [t]	1802,0	**TOTAL WEIGHT [t]**	1645,0	1647,3	1648,1		
X_{COG} [mm]	19700	**X_{COG} [mm]**	19859	19876	19876		
Y_{COG} [mm]	7900	**Y_{COG} [mm]**	7863	7876	7876		
		Deviation %	0,11%	0,03%	0,08%		
		Consistent (Y/N)	YES	YES	YES		

AVERAGE	
TOTAL WEIGHT [t]	1646,8
X_{COG} [mm]	19870
Y_{COG} [mm]	7872

ADDITIONAL EQUIPMENT WEIGHT [t]	0,0
ITEM NET WEIGHT [t]	1646,8

DIFFERENTIAL	
TOTAL WEIGHT [t]	-155,2
X_{COG} [mm]	170
Y_{COG} [mm]	-28

Notes:
1. The effects of wind shall be calculated if weighing take place at wind speed above: 8 m/s (Class A); 11 m/s (Class B); 14 m/s (Class C)
2. Conversion Factor: 1kgf = 9,80665 N.
3.
4.
5.

Operated by:

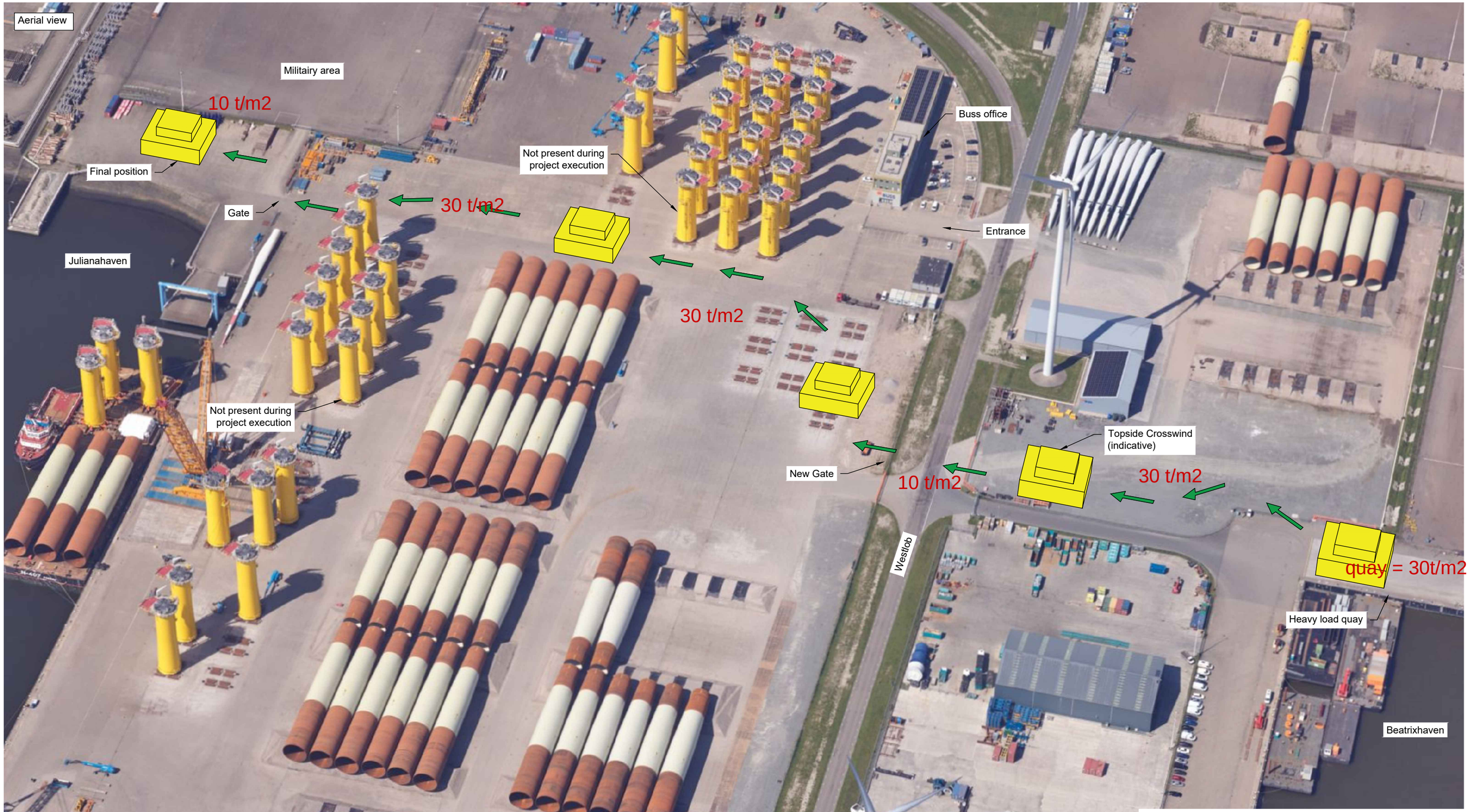
	Name	Date	Signature
Weighing Engineer:	Salvatore Rao	15/07/2025	Salvatore Rao
Weighing Operator:	Vincenzo Catania	15/07/2025	Vincenzo Catania

Attendees:

	Name	Date	Signature
Review			
Client:			

ATTACHMENT B – ITEMS LOCATION ON BUSS YARD

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0	First Issue	08-04-2025	FBR	KME

BUSS

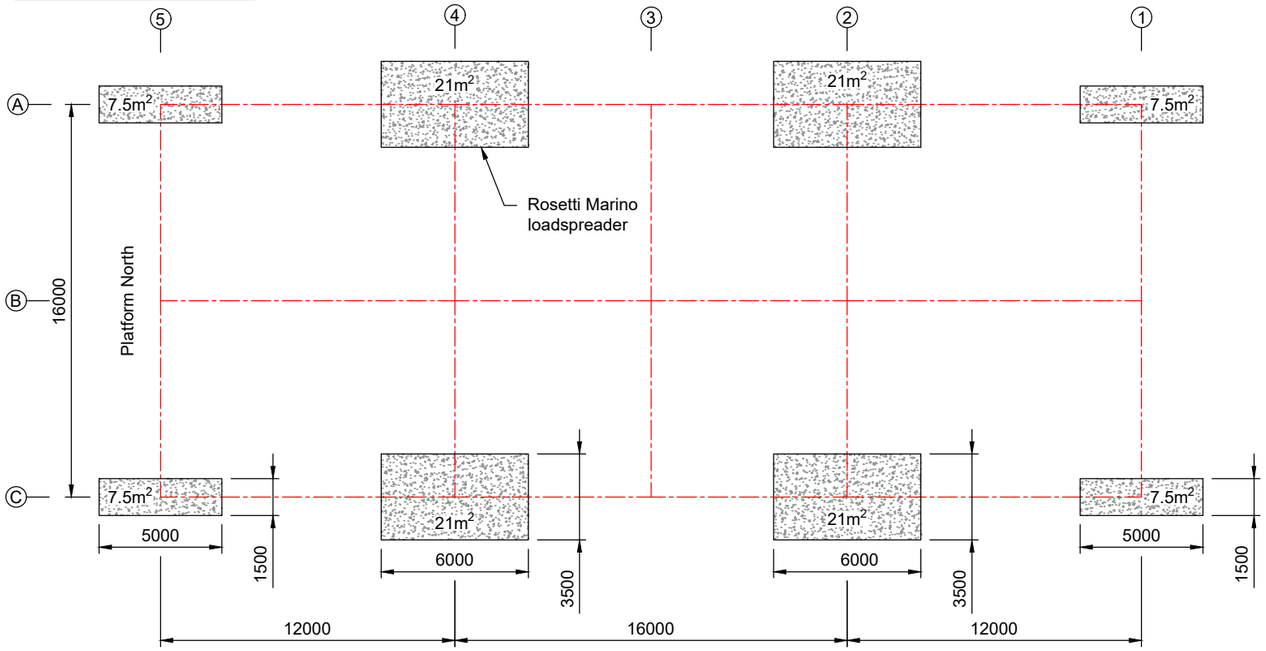
Buss Terminal Eemshaven
Westlob 10
9979 XJ Eemshaven, the Netherlands
+31 (0)596 516330

PROJECT: Crosswind Project

TITLE: Topside at BTE Terminal
Transport Route Proposal

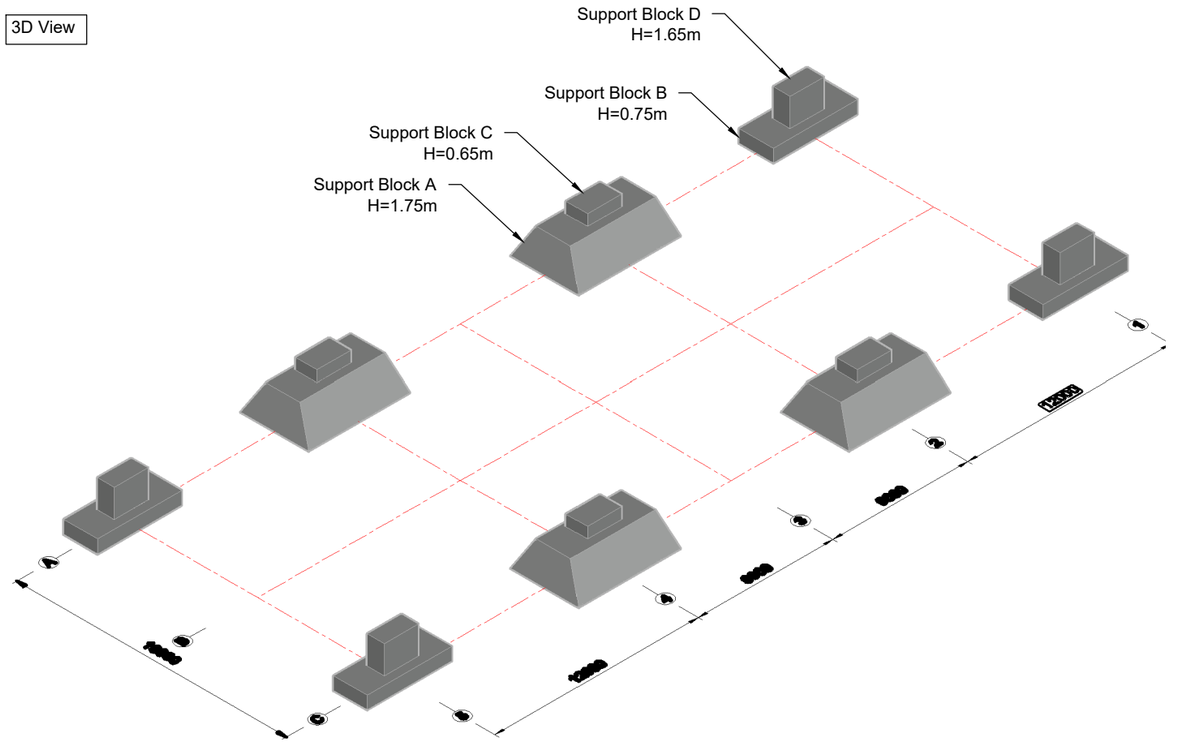
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DRAWING NUMBER: 000099-G - 003			REV: 0

Rosetti Marino Arrangement

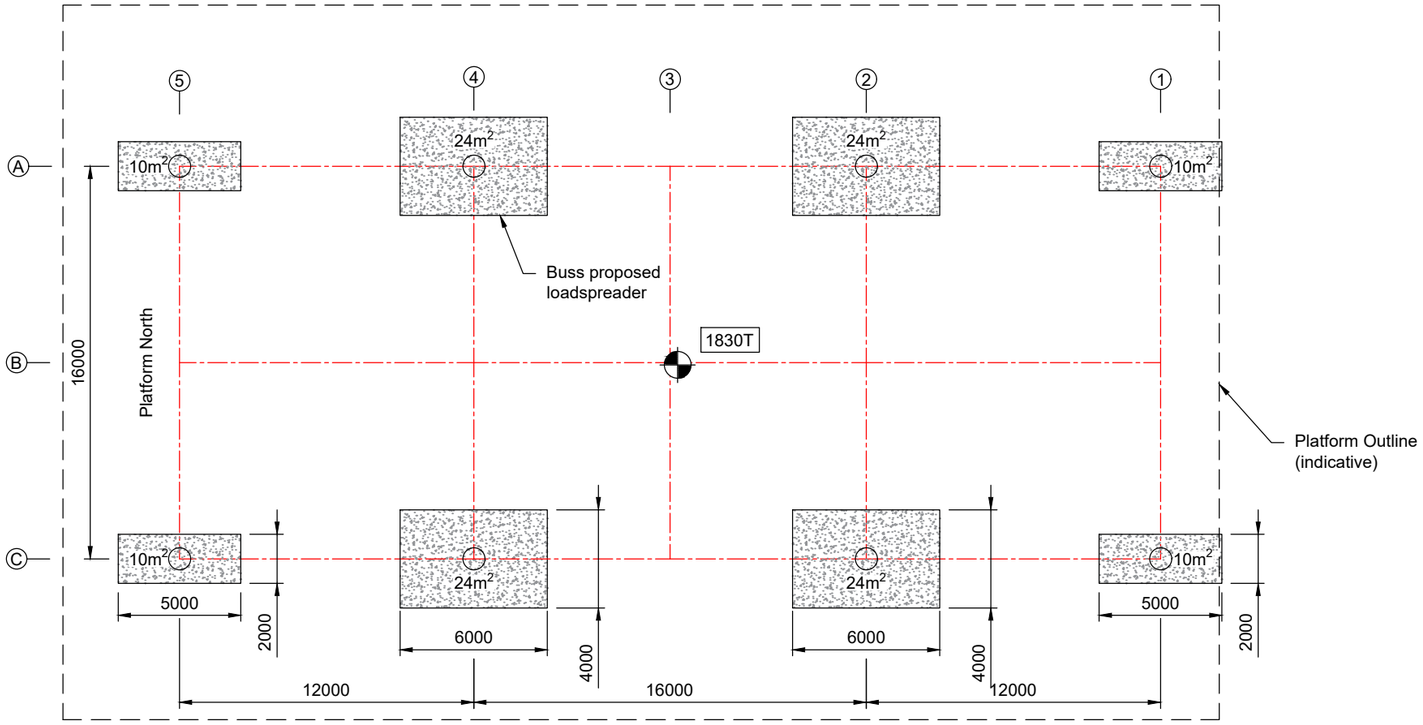


Total loadspreading area: 114m² Topside weight: 1830T
GBP: 1830T/114m² = 16.1T/m² (equally divided without selfweight of supports!)

3D View



Buss Terminal Eemshaven - Proposal



Total loadspreading area: 136m² Topside weight: 1830T
GBP: 1830T/136m² = 13.5T/m² (equally divided without selfweight of supports!)

Note: Client to provide load per support

REV.	DESCRIPTION	DATE	DRAWN	CHECKED
0	Preliminary	08-04-2025	FBR	KME

BUSS
Buss Terminal Eemshaven
Westlob 10
9979 XJ Eemshaven, the Netherlands
+31 (0)596 516330

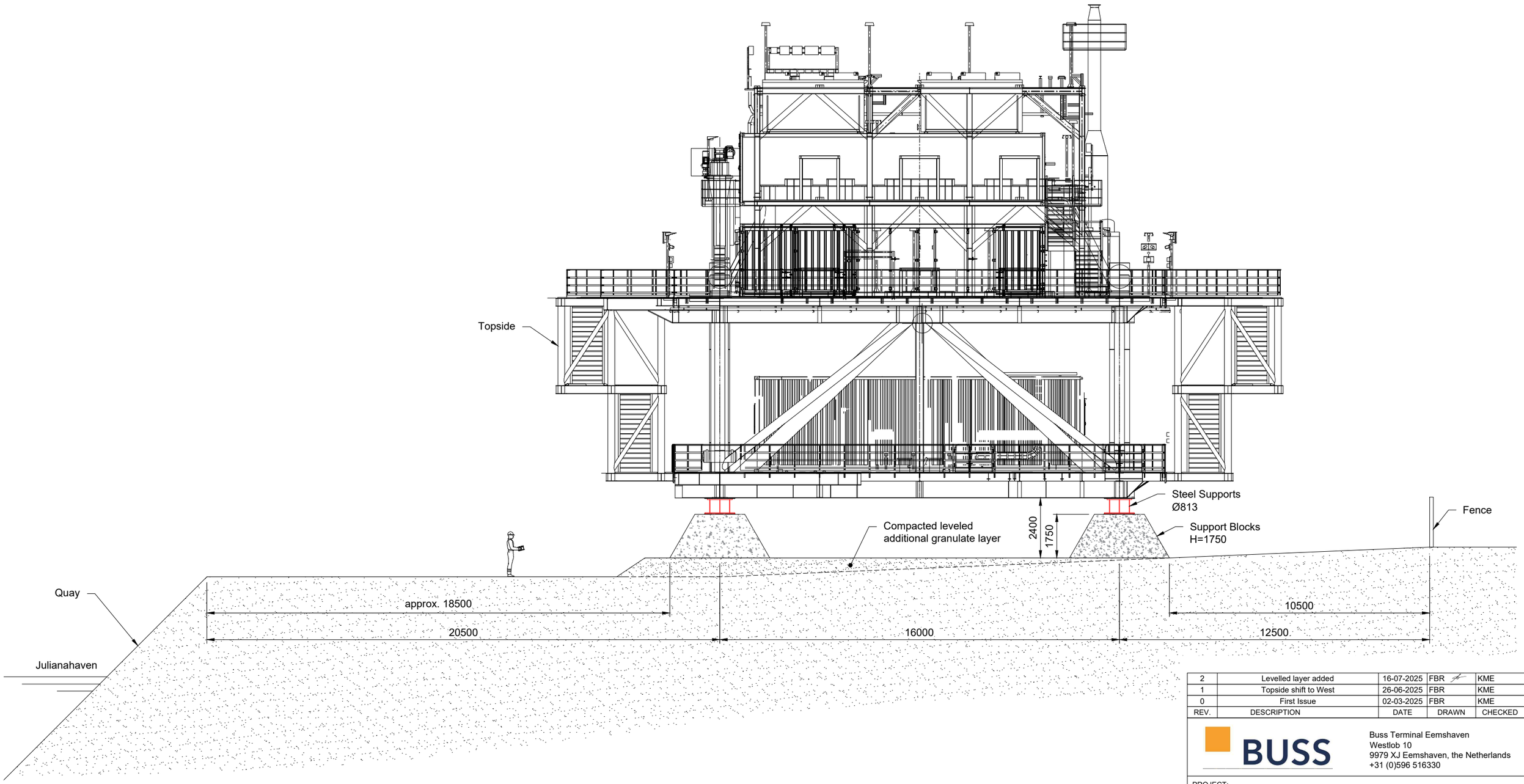
PROJECT: Crosswind Project

TITLE: Topside at BTE Terminal Support Arrangement

SCALE: DIV | Size: A3 | SHEET: 1/1

DRAWING NUMBER: 000099-G - 004 | REV: 0

Front View



REV.	DESCRIPTION	DATE	DRAWN	CHECKED
2	Levelled layer added	16-07-2025	FBR	KME
1	Topside shift to West	26-06-2025	FBR	KME
0	First Issue	02-03-2025	FBR	KME

BUSS

Buss Terminal Eemshaven
Westlob 10
9979 XJ Eemshaven, the Netherlands
+31 (0)596 516330

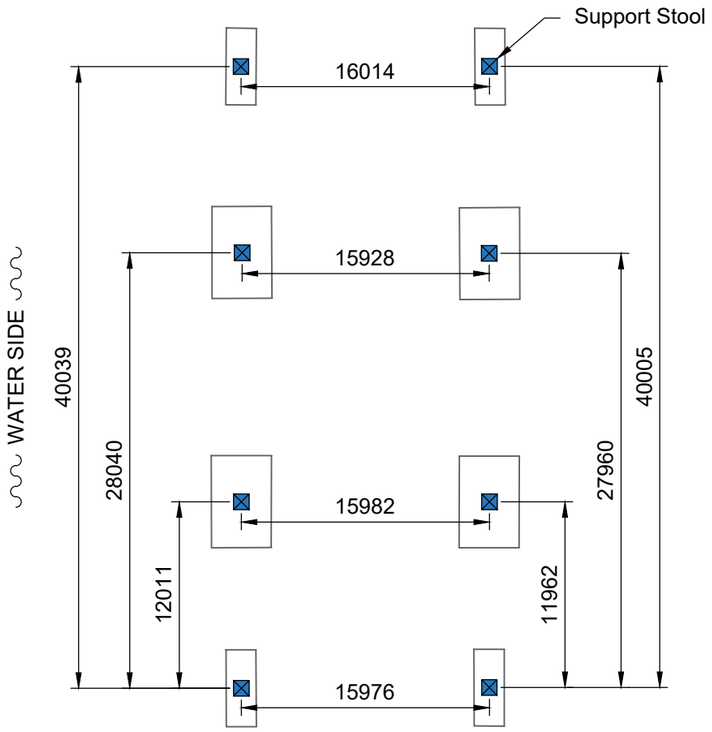
PROJECT: Crosswind Project

TITLE: Topside at BTE Terminal
Final Position Front View

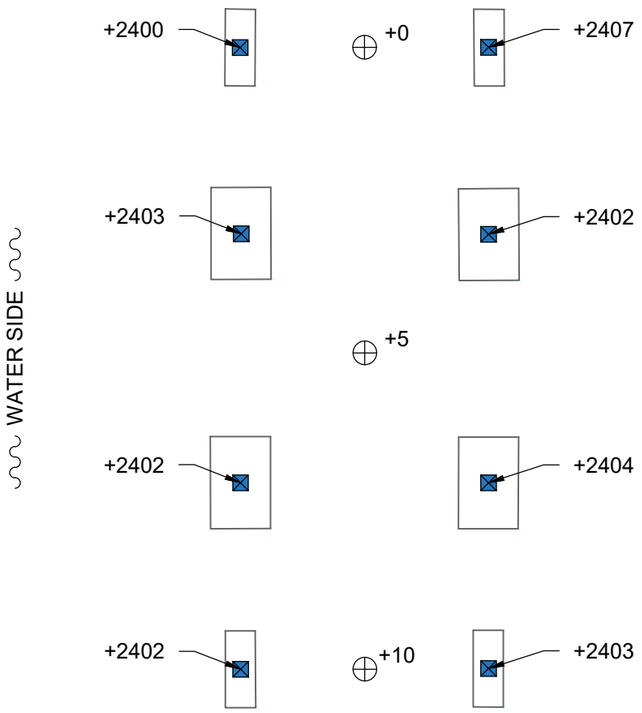
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DRAWING NUMBER: 000099-G - 005 | REV: 2

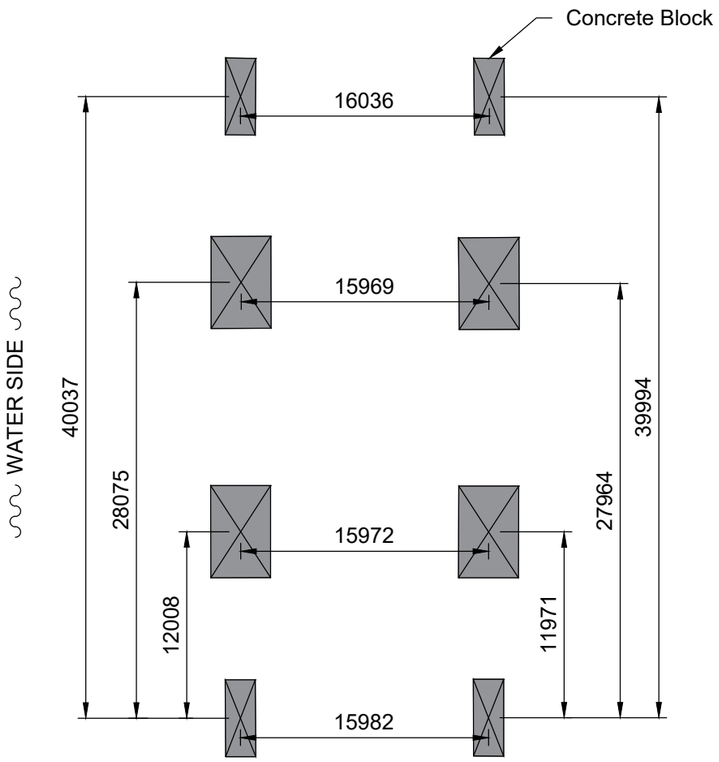
Survey 1: Position of Steel Support Stools X-Y
- Measuring point: center of steel support at top plate

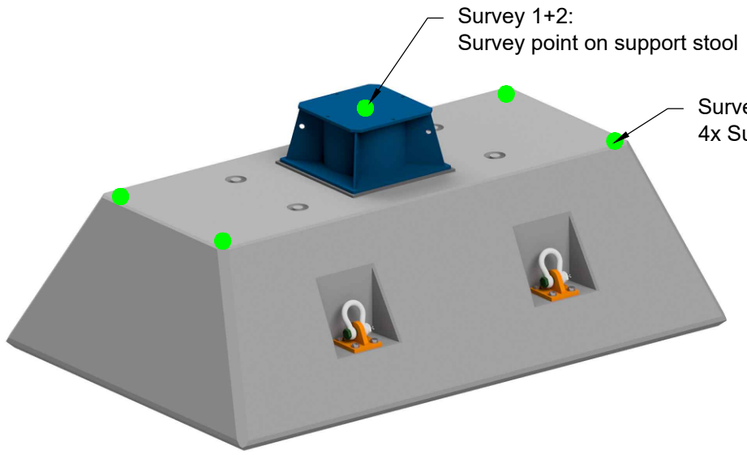


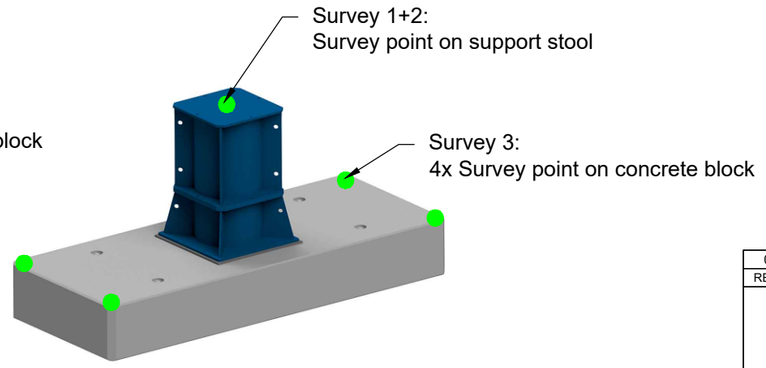
Survey 2: Level of support and ground
- Measuring point: center of steel support at top plate & ground level



Survey 3: Position of Concrete Blocks
- Measuring points: at 4 corners on top of block







Survey Date: 19-09-2025

All dimensions in millimeters

REV.	DESCRIPTION	DATE	DRAWN	CHECKED
0	Survey date: 19-09-2025	19-09-2025	FBR	KME

BUSS
Buss Terminal Eemshaven
Westlob 10
9979 XJ Eemshaven, the Netherlands
+31 (0)596 516330

PROJECT: Crosswind Project

TITLE: Topside at BTE Terminal
Survey of Supports

SCALE: DIV | Size: A3 | SHEET: 1/1

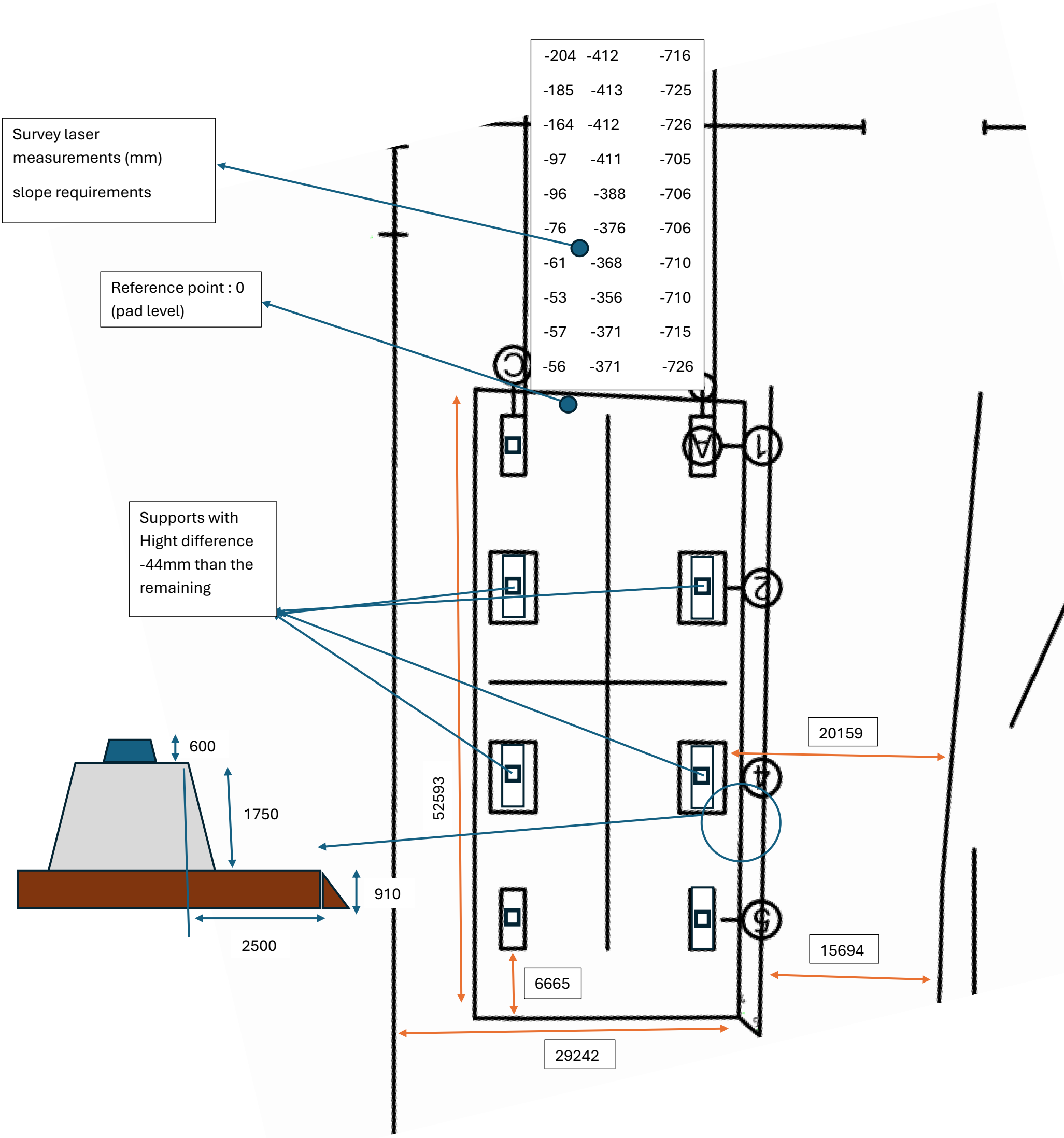
DRAWING NUMBER: 000099-G - 013 | REV: 1

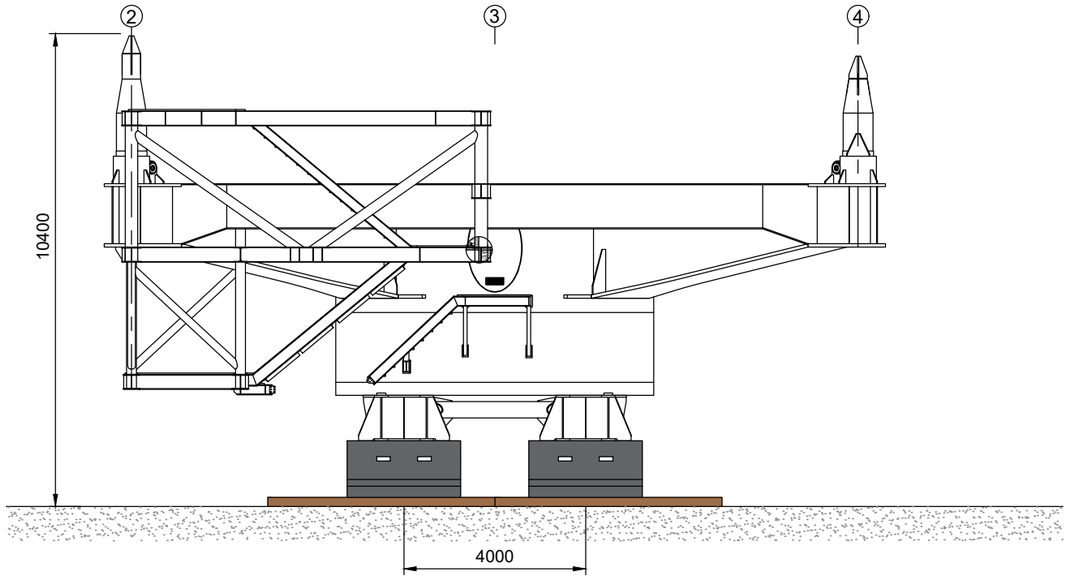
Project: Hydrogen BLPH platform / TP

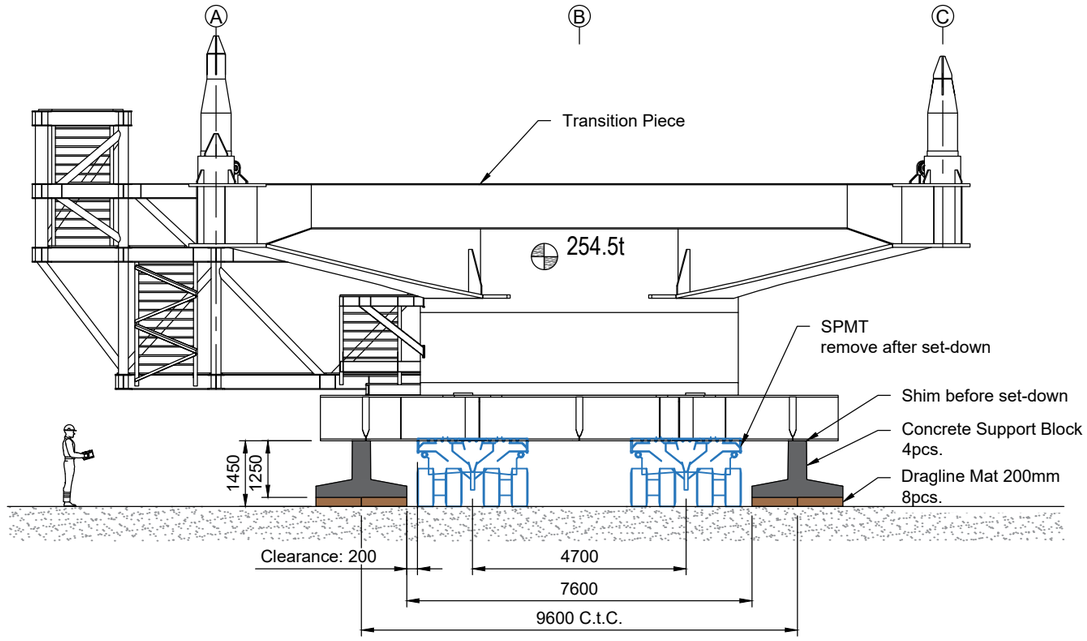
Date: 20-8-2025

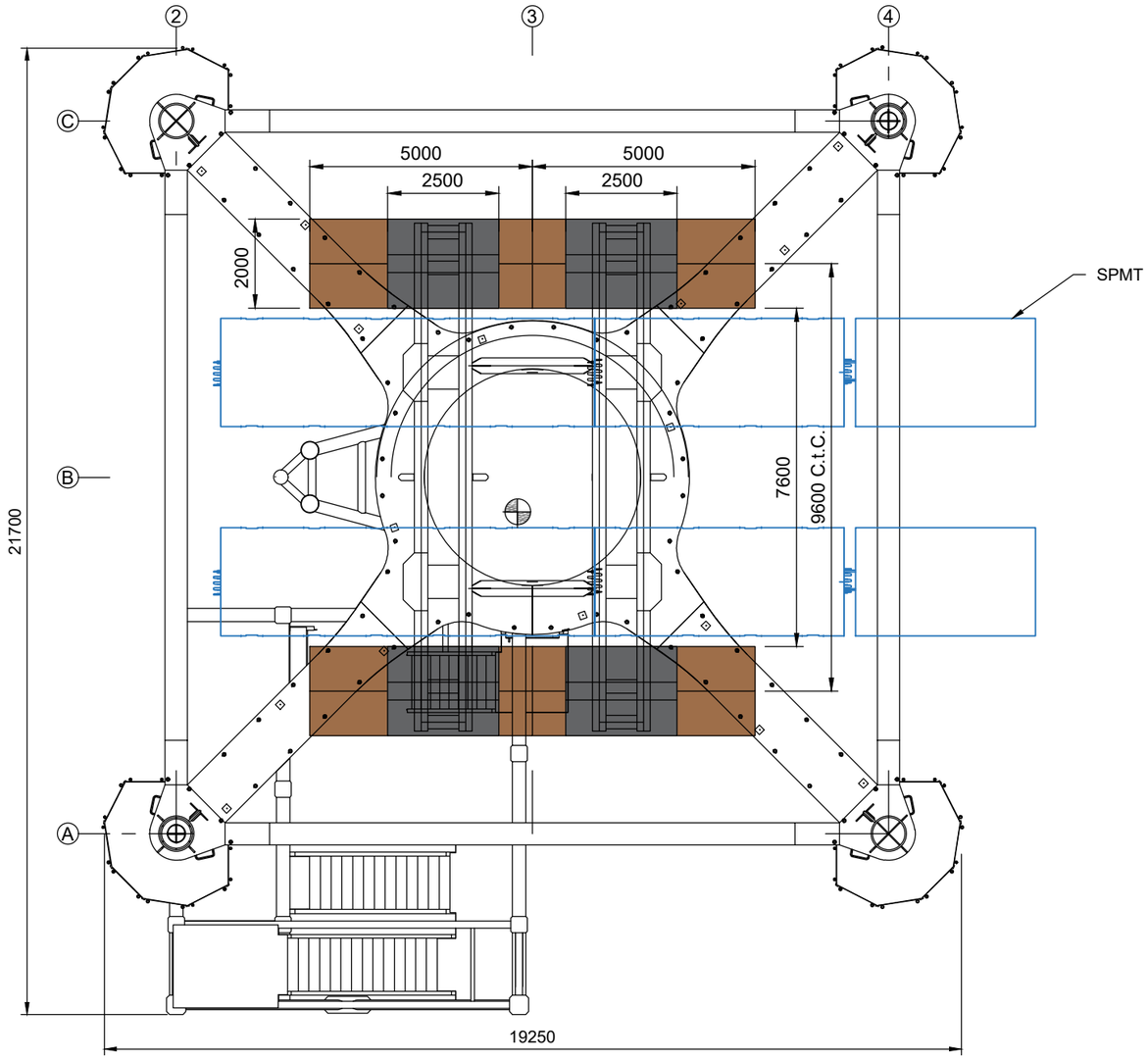
Report: Area surveying (GPS , Laser)

Reference: Eduardo Farias









REV.	DESCRIPTION	DATE	DRAWN	CHECKED
0	First Issue	28-08-2025	FBR	KME

BUSS
Buss Terminal Eemshaven
Westlob 10
9979 XJ Eemshaven, the Netherlands
+31 (0)596 516330

PROJECT: Crosswind Project

TITLE: Topside at BTE Terminal
Transition Piece Storage

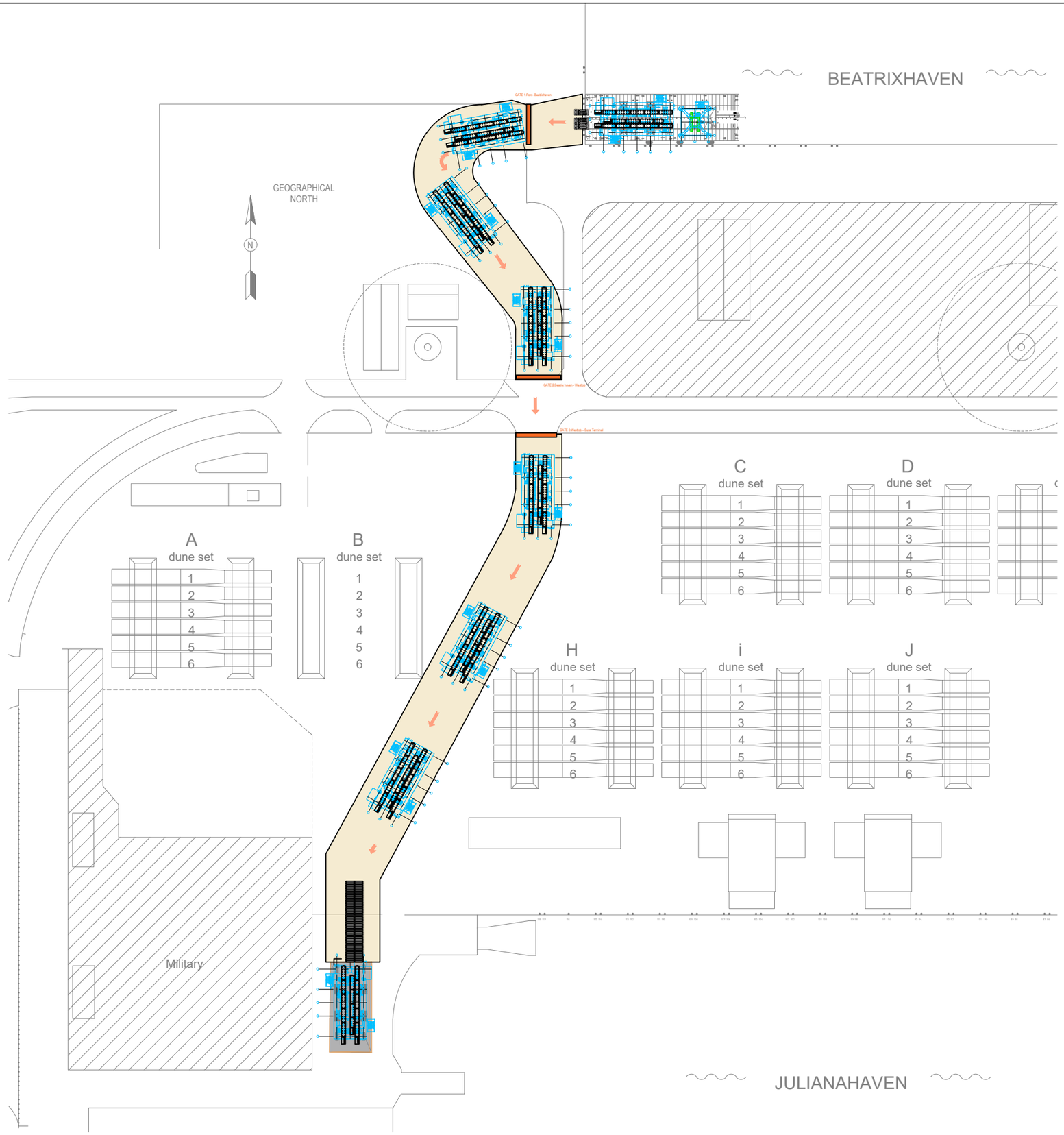
SCALE: 1:135	Size: A3		SHEET: 1/1
DRAWING NUMBER: 000099-G - 012			REV: 0


GATE 1
Roro - Beatrixhaven
2.60m
23.9m
Driving direction
Gate Width and heights
Doc nr: 00099-D001_rev0
Date: 22-08-2025
Ref: FBro


GATE 2
Beatrix haven - Westlob
BUSS
2.70m
26.5m
Driving direction
Gate Width and heights
Doc nr: 00099-D001_rev0
Date: 22-08-2025
Ref: FBro


GATE 3
Westlob – Buss Terminal
2.15m
24.3m
Driving direction
Gate Width and heights
Doc nr: 00099-D001_rev0
Date: 22-08-2025
Ref: FBro


GATE 4 (removed)
Julianhaven – Final position
2.50m
Fence removed,
so not critical
Driving direction
Doc: 0009
Gate Width and heights
Doc nr: 00099-D001_rev0
Date: 22-08-2025
Ref: FBro



rev.	date	description	designed	verified	approved
A	10/09/2025	Update	B.R.	B.R.	B.D.
-	01/09/2025	First Issue	I.R.	B.R.	M.v.H.

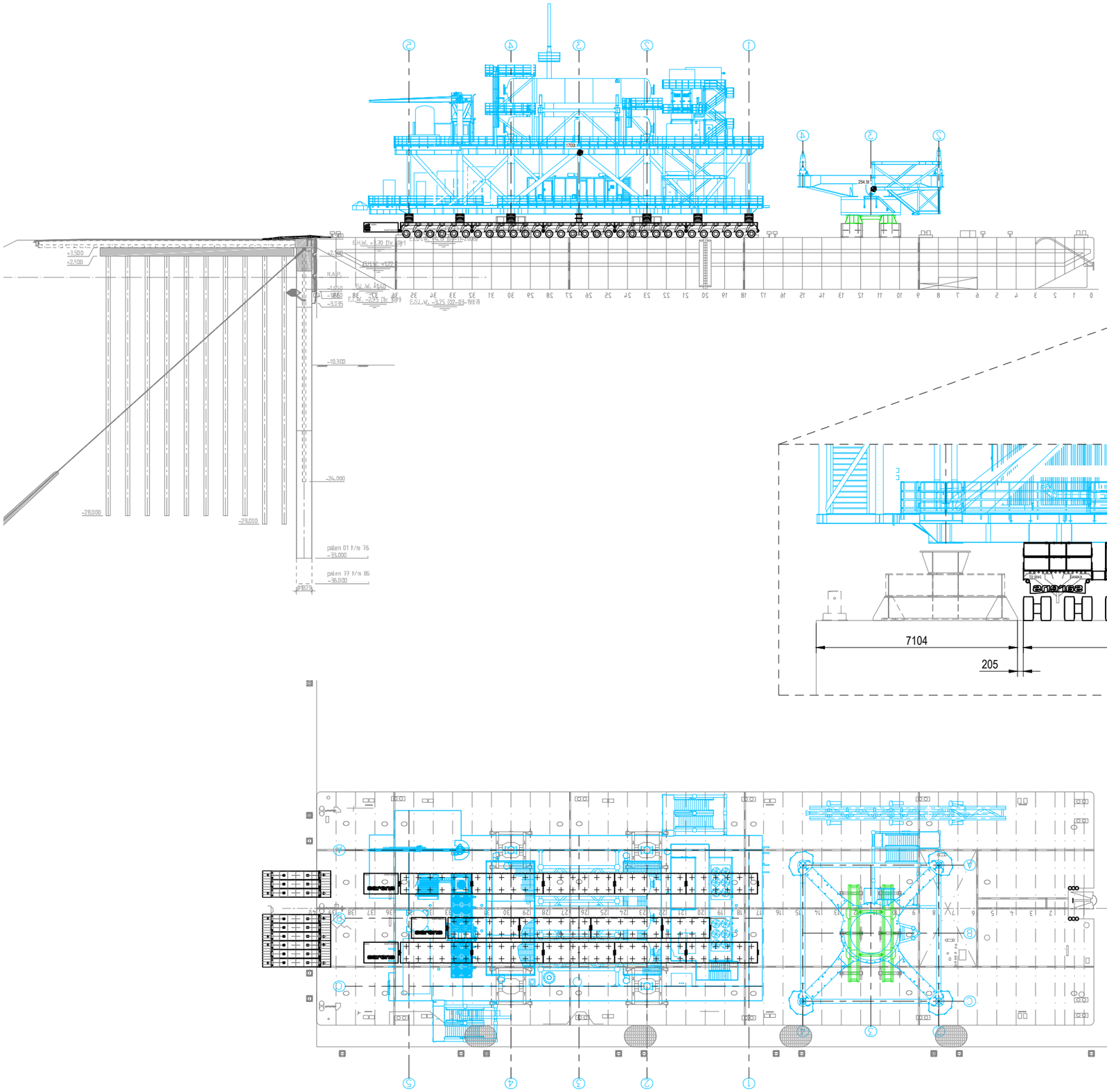
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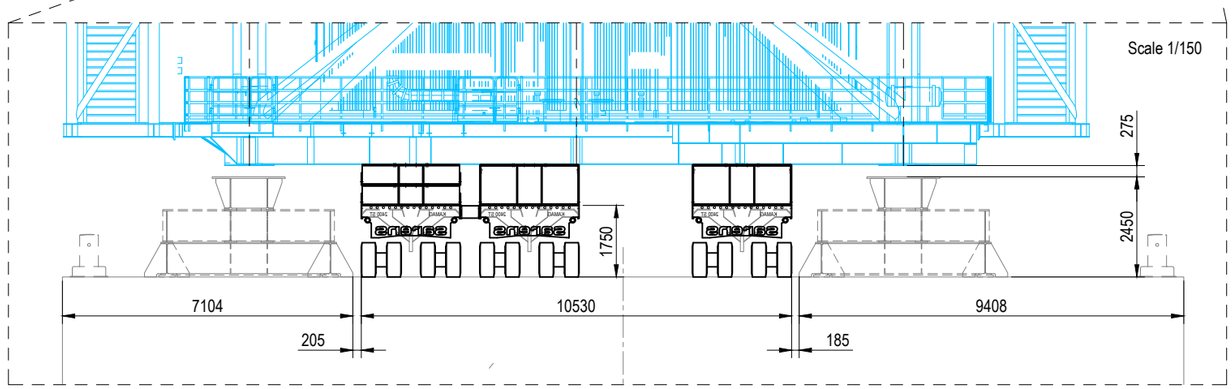
client: ROSETTI MARINO

equipment: 2x30AL + 1x22 K2400 ST

description: Site Move Sequence - Topside

site: Eemshaven, NL		proj.:	-
owner: SAR	drawing type: Route drawing	size:	A3
appr. state: For Approval	project: S-25-71129	scale:	1/750
doc No.: S-25-71129_DR2004_A		sheet:	1-5



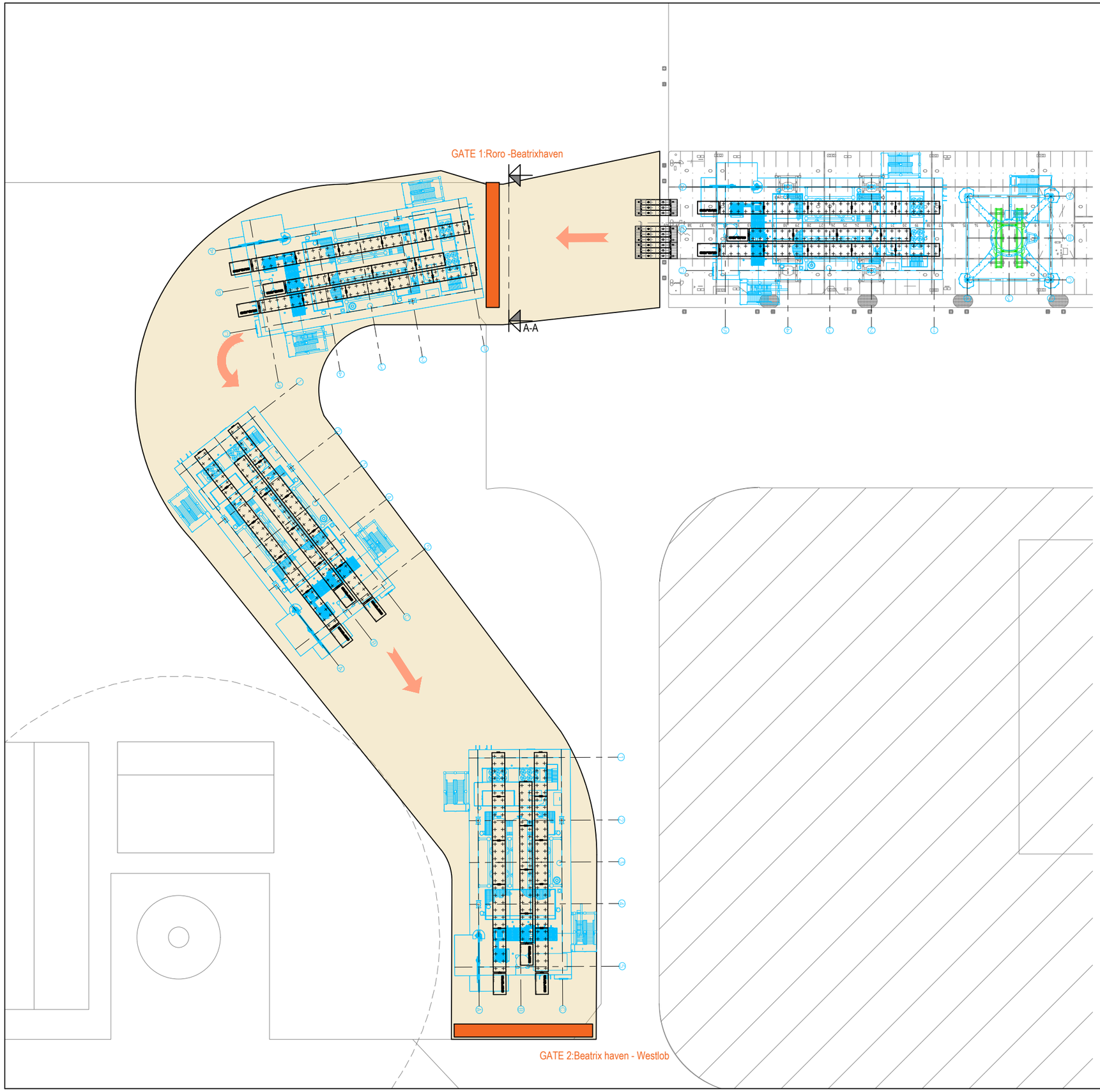


rev.	date	description	designed	verified	approved
A	10/09/2025	Update	B.R.	B.R.	B.D.
-	01/09/2025	First Issue	I.R.	B.R.	M.v.H.

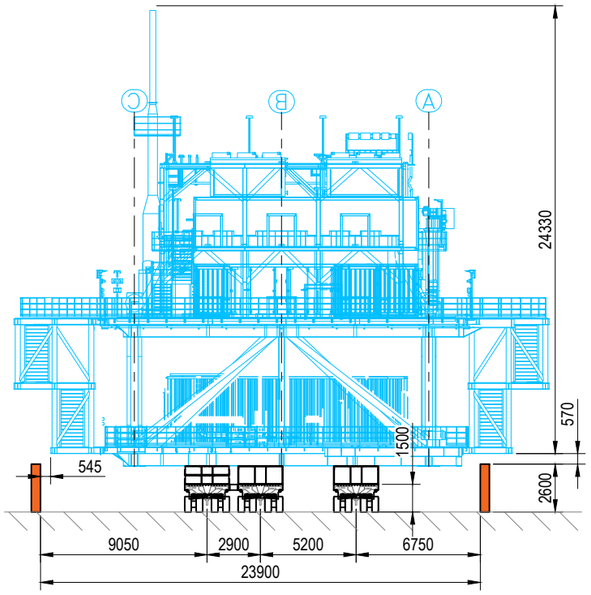
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client: ROSETTI MARINO

equipment:	2x30AL + 1x22 K2400 ST				
description:	Site Move Sequence - Topside				
site:	Eemshaven, NL			proj.:	.
owner:	SAR	drawing type:	Route drawing	size:	A3
appr. state:	For Approval	project:	S-25-71129	scale:	1/750
doc No.:	S-25-71129_DR2004_A			sheet:	2-5



Gate 1: Roro - Beatrixhaven
View A-A scale 1/333



rev.	date	description	designed	verified	approved
A	10/09/2025	Update	B.R.	B.R.	B.D.
-	01/09/2025	First Issue	I.R.	B.R.	M.v.H.

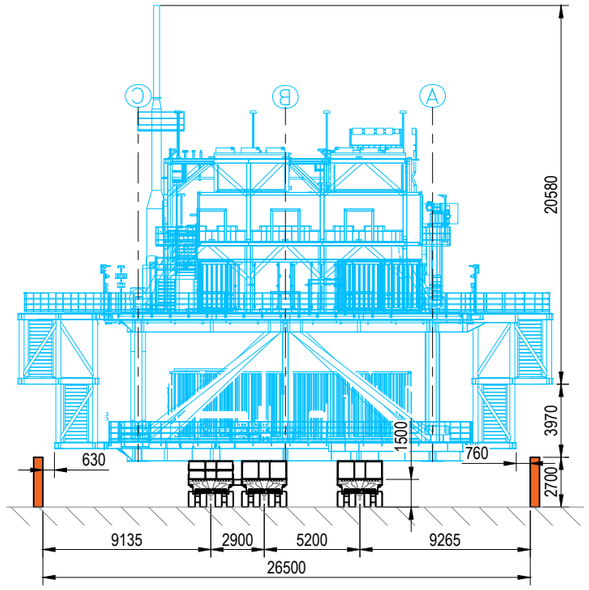
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client: ROSETTI MARINO

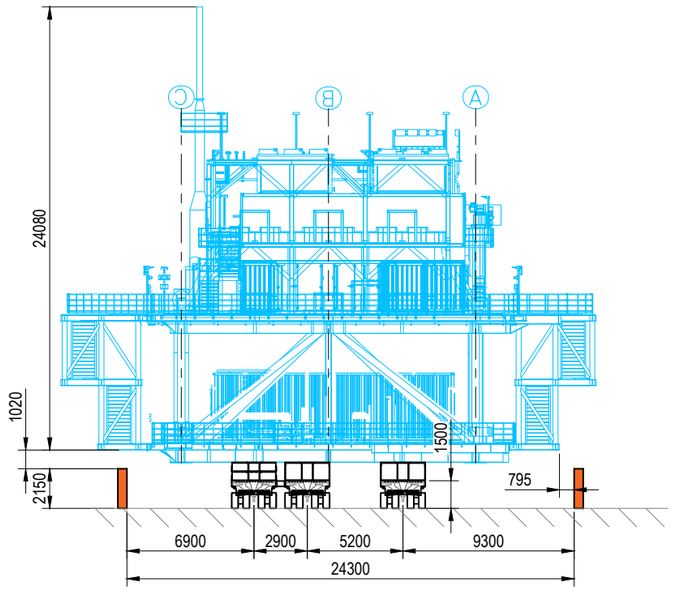
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description:	Site Move Sequence - Topside

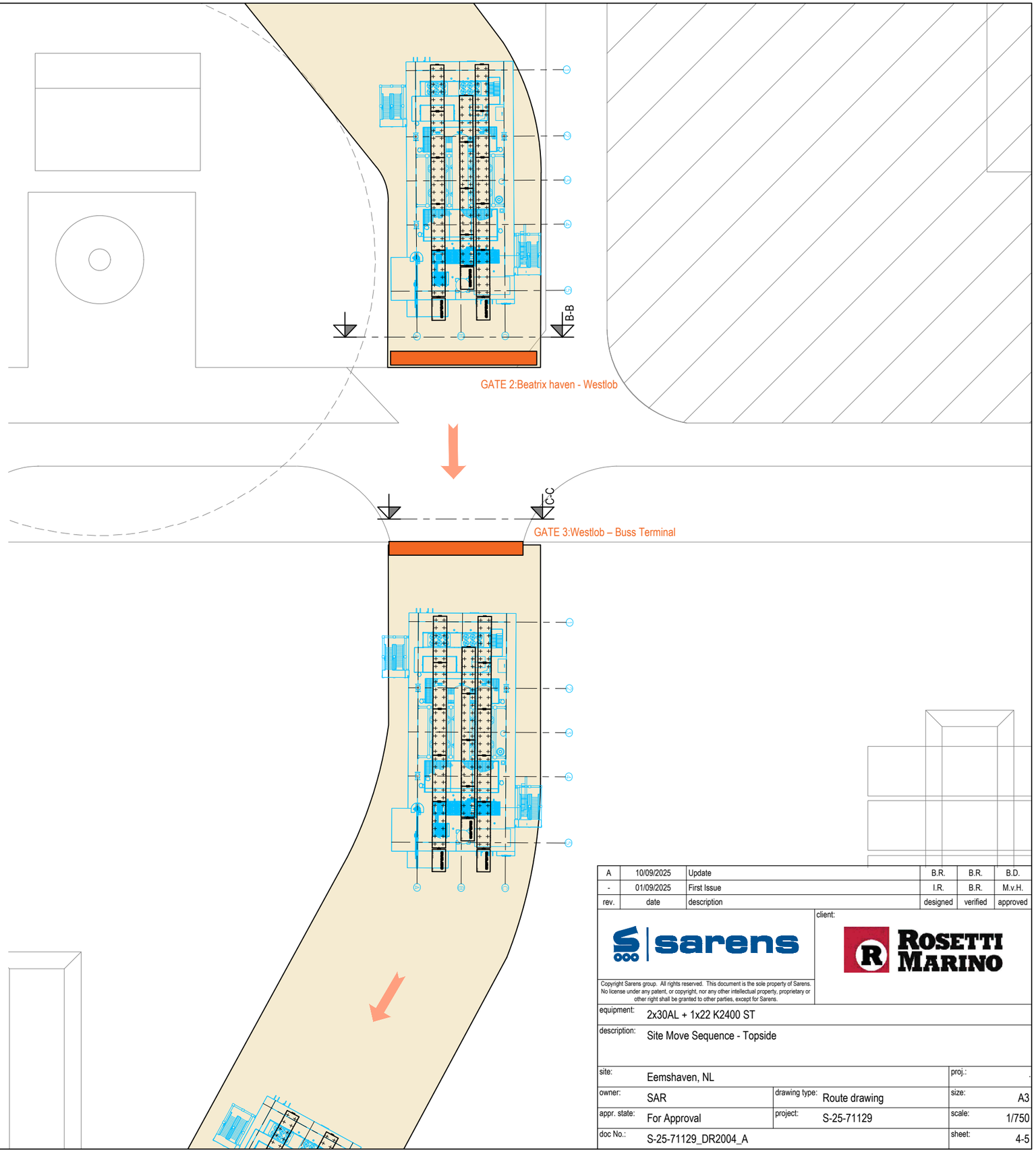
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owner:	SAR	drawing type: Route drawing	size: A3
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doc No.:	S-25-71129_DR2004_A		sheet: 3-5

Gate 2: Beatrix haven - Westlob
View B - B scale 1/333



Gate 3: Westlob – Buss Terminal
View C - C scale 1/333





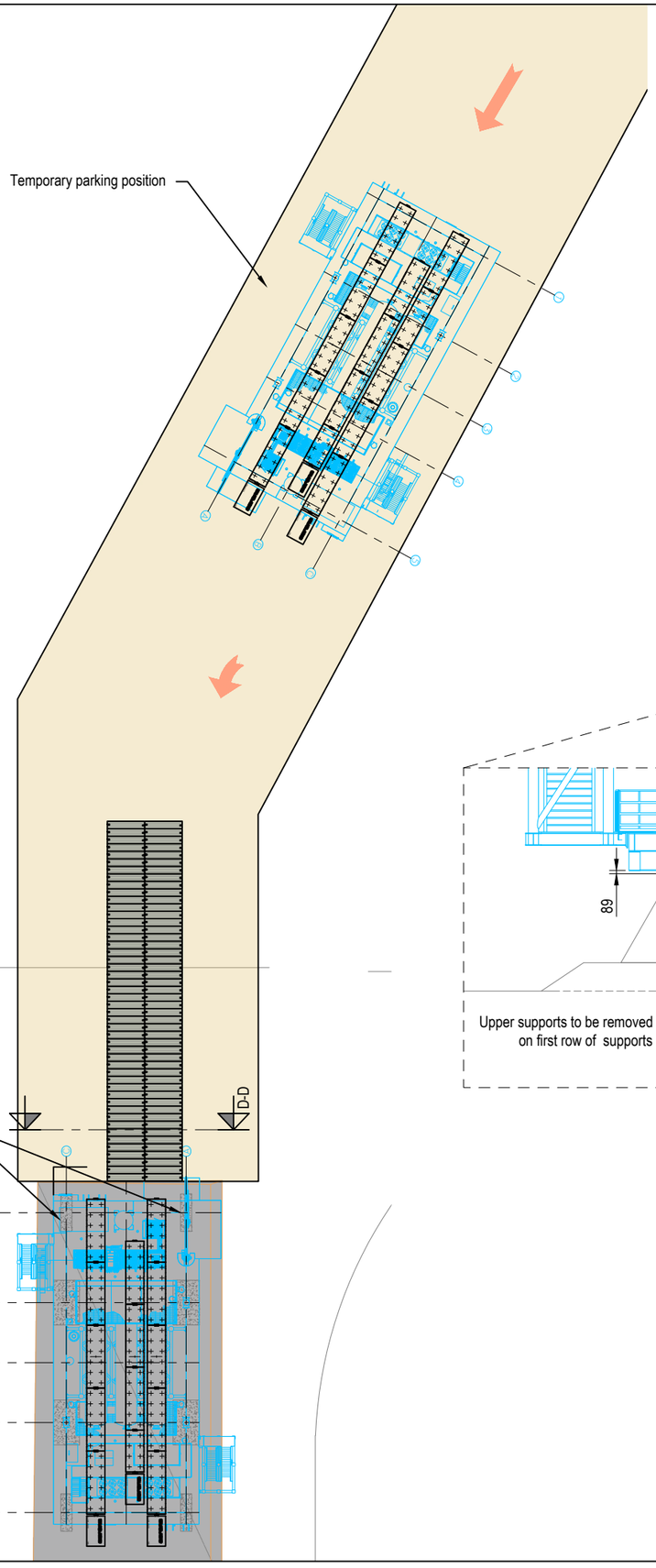
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A	10/09/2025	Update	B.R.	B.R.	B.D.
-	01/09/2025	First Issue	I.R.	B.R.	M.v.H.

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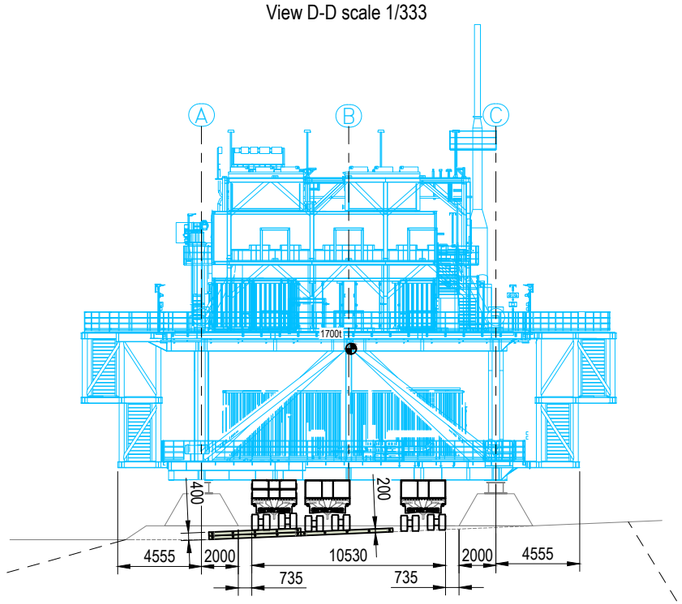
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client: ROSETTI MARINO

equipment:	2x30AL + 1x22 K2400 ST
description:	Site Move Sequence - Topside
site:	Eemshaven, NL
proj.:	.
owner:	SAR
drawing type:	Route drawing
size:	A3
appr. state:	For Approval
project:	S-25-71129
scale:	1/750
doc No.:	S-25-71129_DR2004_A
sheet:	4-5



View D-D scale 1/333



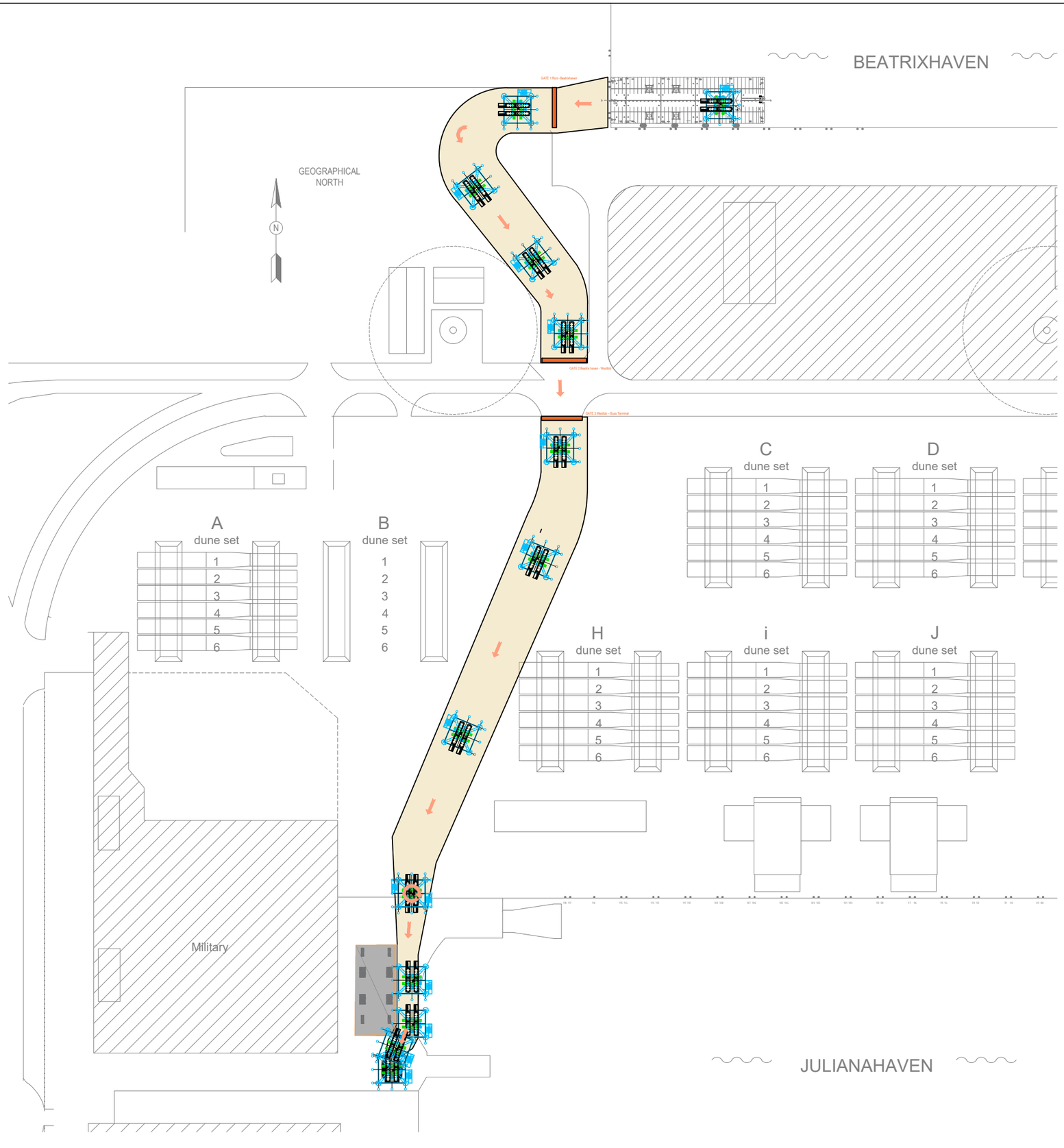
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rev.	date	description	designed	verified	approved
A	10/09/2025	Update	B.R.	B.R.	B.D.
-	01/09/2025	First Issue	I.R.	B.R.	M.v.H.

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client: ROSETTI MARINO

equipment:	2x30AL + 1x22 K2400 ST				
description:	Site Move Sequence - Topside				
site:	Eemshaven, NL			proj.:	
owner:	SAR	drawing type:	Route drawing	size:	A3
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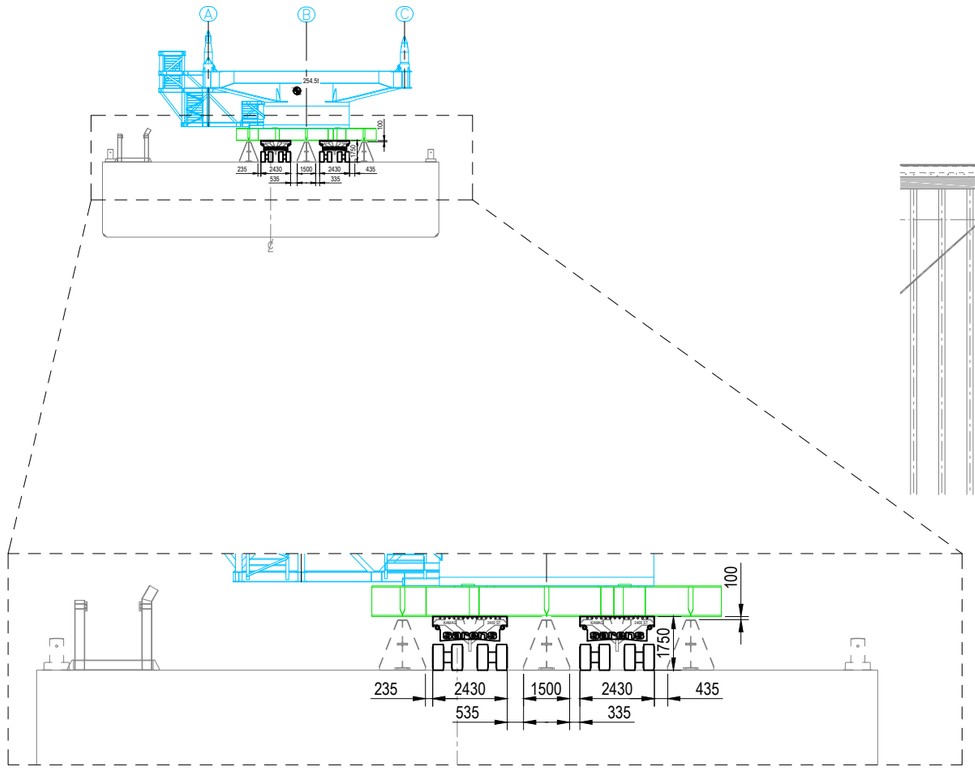


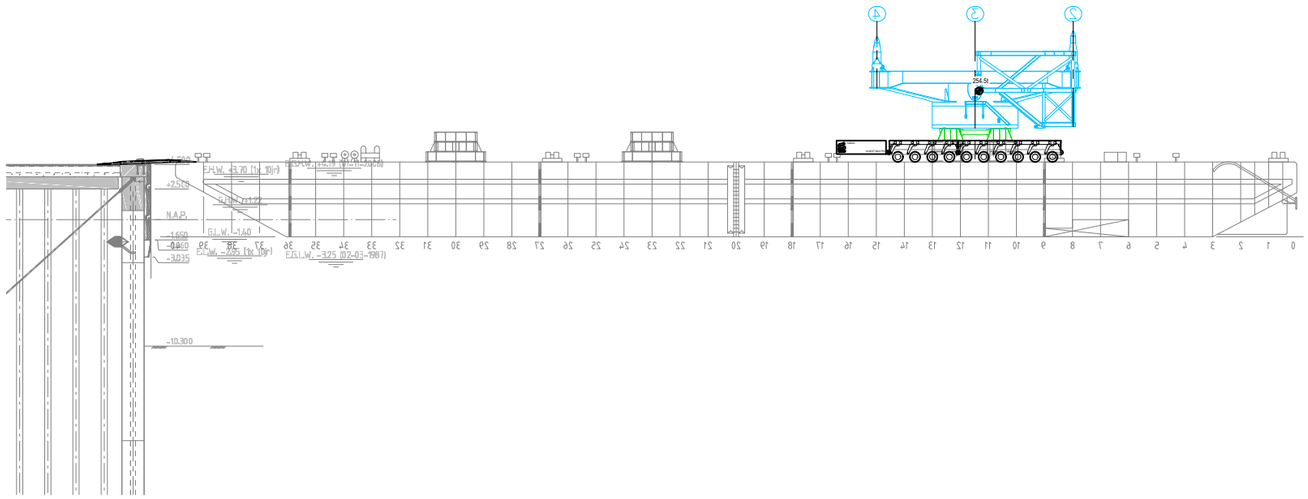
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-	01/09/2025	First Issue	I.R.	B.R.	M.v.H.

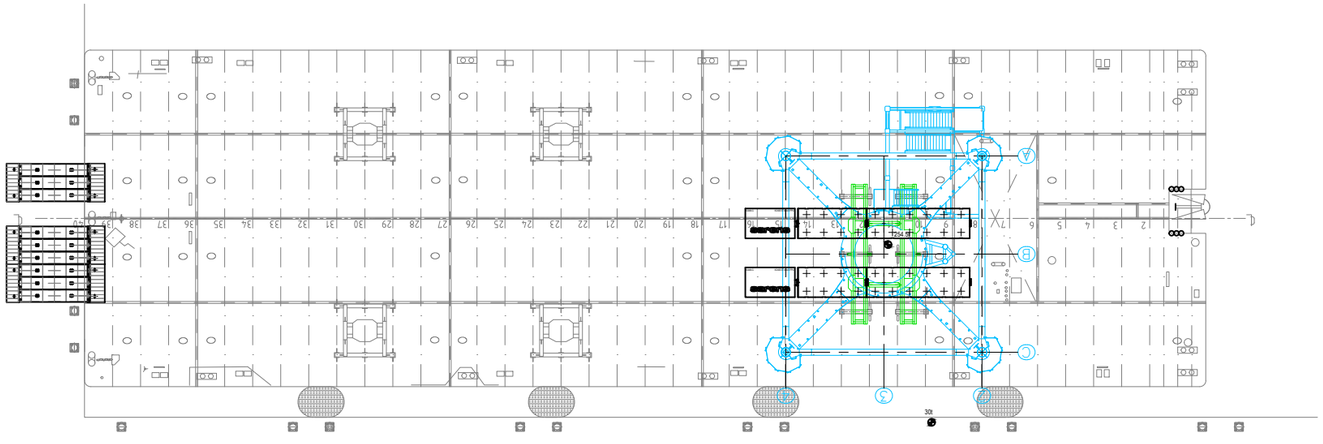
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client: ROSETTI MARINO

equipment:	2x10AL K2400 ST		
description:	Site Move Sequence - TP		
site:	Eemshaven, NL		proj.: -
owner:	SAR	drawing type: Route drawing	size: A3
appr. state:	For Approval	project: S-25-71129	scale: 1/500
doc No.:	S-25-71129_DR1004_A		sheet: 1-6







rev.	date	description	designed	verified	approved
A	10/09/2025	Update	B.R.	B.R.	B.D.
-	01/09/2025	First Issue	I.R.	B.R.	M.v.H.

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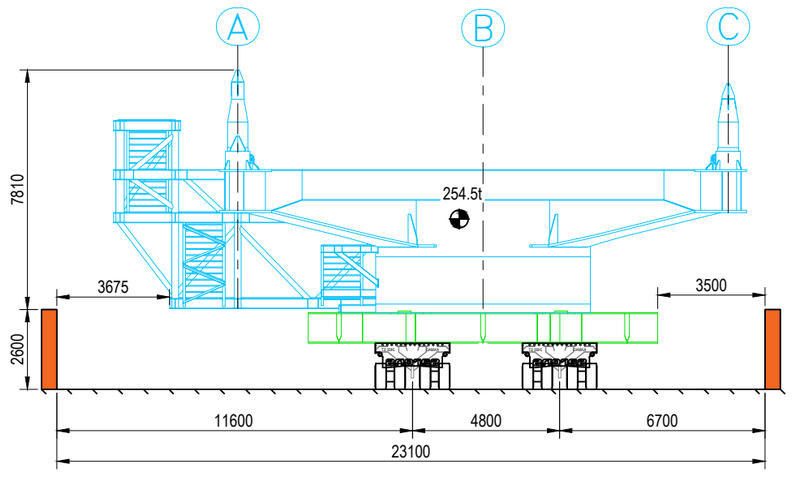
client: ROSETTI MARINO

equipment:	2x10AL K2400 ST		
description:	Site Move Sequence - TP		
site:	Eemshaven, NL		proj.: -
owner:	SAR	drawing type: Route drawing	size: A3
appr. state:	For Approval	project: S-25-71129	scale: 1/500
doc No.:	S-25-71129_DR1004_A		sheet: 2-6

GATE 1:Roro -Beatrixhaven

A-A

Gate 1: Roro - Beatrixhaven
View A-A scale 1/200



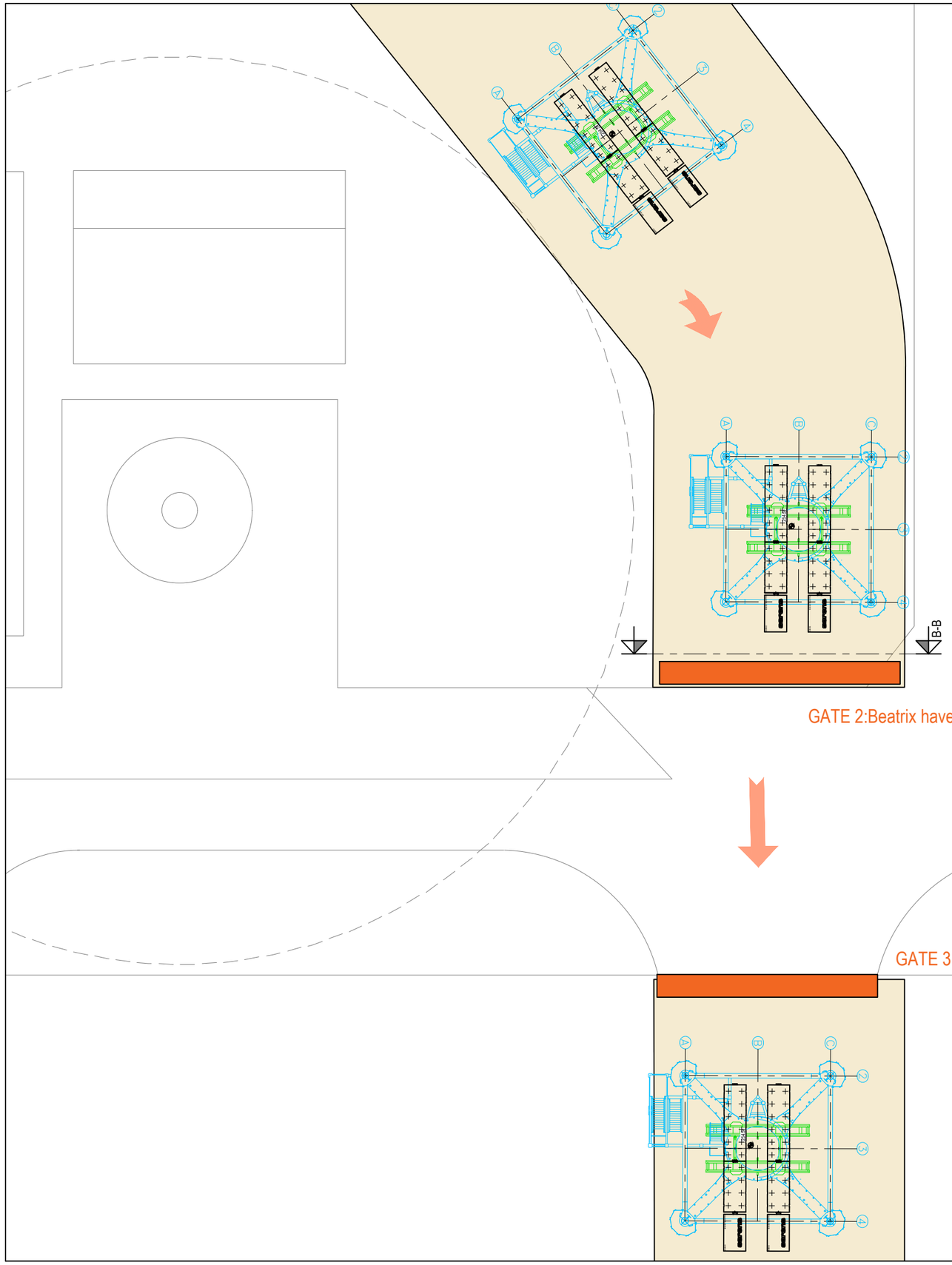
rev.	date	description	designed	verified	approved
A	10/09/2025	Update	B.R.	B.R.	B.D.
-	01/09/2025	First Issue	I.R.	B.R.	M.v.H.

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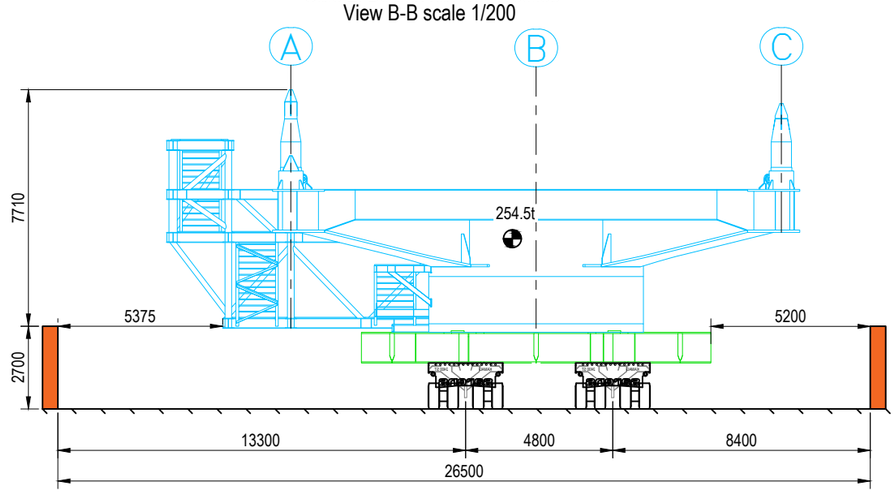
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client: ROSETTI MARINO

equipment:	2x10AL K2400 ST				
description:	Site Move Sequence - TP				
site:	Eemshaven, NL			proj.:	-
owner:	SAR	drawing type:	Route drawing	size:	A3
appr. state:	For Approval	project:	S-25-71129	scale:	1/500
doc No.:	S-25-71129_DR1004_A			sheet:	3-6



Gate 2: Beatrix haven - Westlob
View B-B scale 1/200

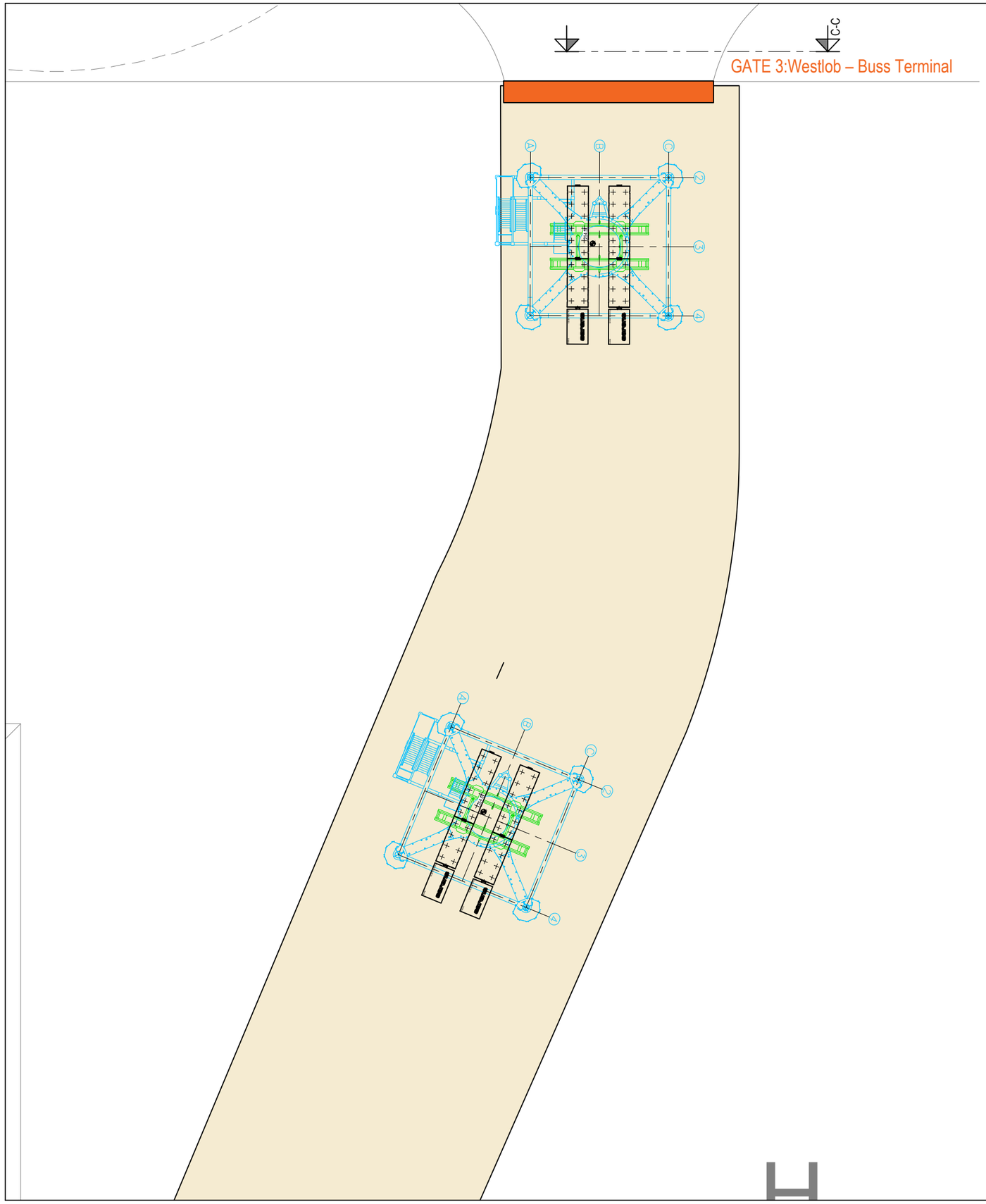


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A	10/09/2025	Update	B.R.	B.R.	B.D.
-	01/09/2025	First Issue	I.R.	B.R.	M.v.H.

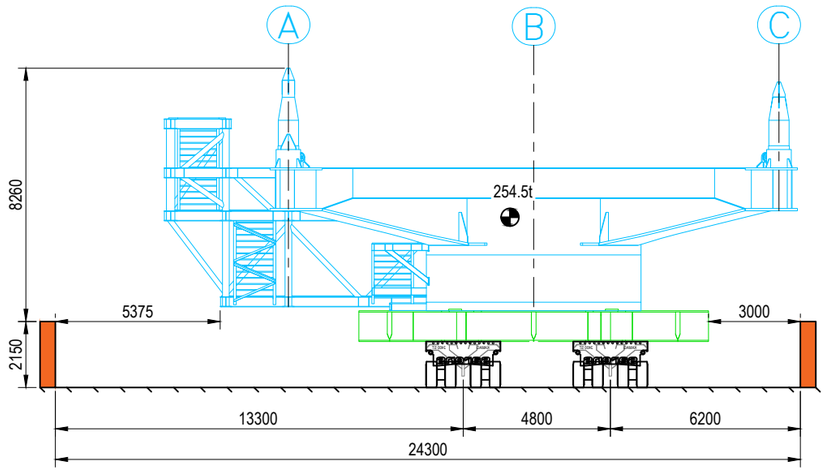
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client: ROSETTI MARINO

equipment:	2x10AL K2400 ST		
description:	Site Move Sequence - TP		
site:	Eemshaven, NL		proj.: .
owner:	SAR	drawing type: Route drawing	size: A3
appr. state:	For Approval	project: S-25-71129	scale: 1/500
doc No.:	S-25-71129_DR1004_A		sheet: 4-6



Gate 3: Westlob – Buss Terminal
View C-C scale 1/200



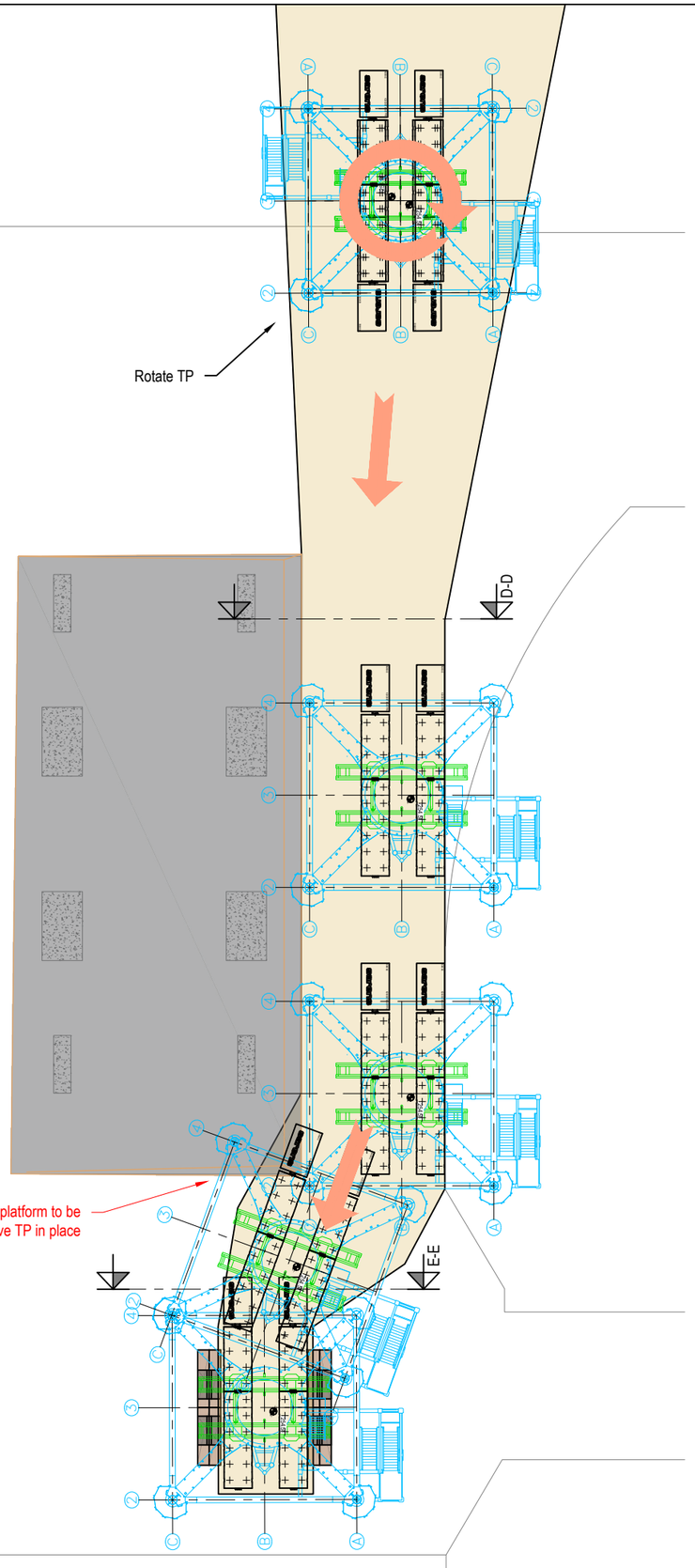
rev.	date	description	designed	verified	approved
A	10/09/2025	Update	B.R.	B.R.	B.D.
-	01/09/2025	First Issue	I.R.	B.R.	M.v.H.

sarens

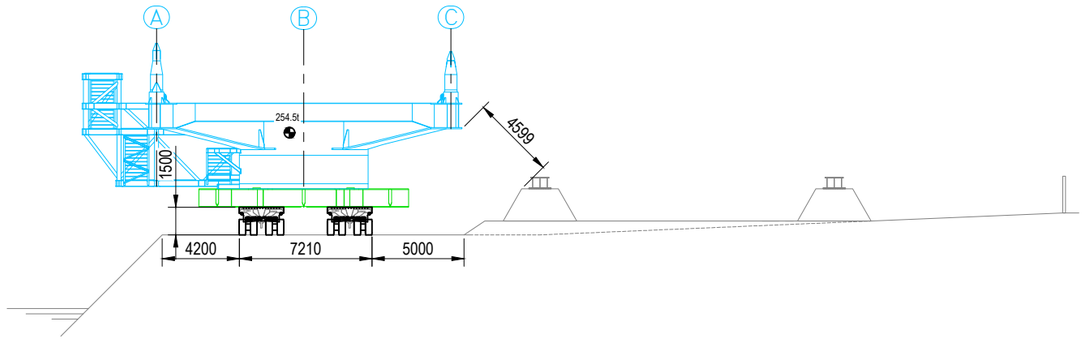
client: ROSETTI MARINO

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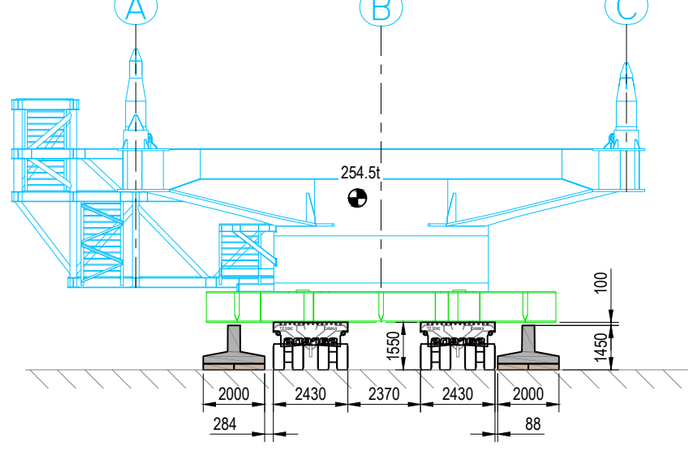
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description:	Site Move Sequence - TP				
site:	Eemshaven, NL			proj.:	.
owner:	SAR	drawing type:	Route drawing	size:	A3
appr. state:	For Approval	project:	S-25-71129	scale:	1/500
doc No.:	S-25-71129_DR1004_A			sheet:	5-6



View D-D scale 1/333



View E-E scale 1/200



rev.	date	description	designed	verified	approved
A	10/09/2025	Update	B.R.	B.R.	B.D.
-	01/09/2025	First Issue	I.R.	B.R.	M.v.H.

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client: ROSETTI MARINO

equipment:	2x10AL K2400 ST				
description:	Site Move Sequence - TP				
site:	Eemshaven, NL			proj.:	.
owner:	SAR	drawing type:	Route drawing	size:	A3
appr. state:	For Approval	project:	S-25-71129	scale:	1/500
doc No.:	S-25-71129_DR1004_A			sheet:	6-6

ATTACHMENT C – CARGO BARGE VERVECE - SPECIFICATIONS

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MARNAVI S.P.A.
TRASPORTI MARITTIMI



90 x 27m. 300 Feet - Flat deck cargo barge

"VERVECE"

• MAIN DESCRIPTION

Built	June 1996
Builder	SEVMASH – SMP Shipyard SEVERODVISNSK (Russia)
Owner	MARNAVI S.p.A. - Naples
Classification	**BV** - I ✠ Hull, Pontoon, No Propulsion, Unrestricted Navigation
Additional Class	**RINA** - C ✠ Pontoon, S, Unrestricted Navigation
IMO number	9088330
Port of Reg. / Flag	Naples / Italian
BV Number	20382G

• MAIN PARTICULARS

Loa	:	91,440 mt / 300 ft
Breath Moulded	:	27,432 mt / 90 ft
Depth Moulded	:	6,096 mt / 20 ft
Summer load line	:	4,842 mt
Deadweight	:	9700 tons (at Summer Draft)
Displacement	:	11573 tons
Light Weight	:	1850 tons
GRT	:	4066 tons
NET	:	1219 tons

• DECK CAPACITIES

Deck area	:	2508 m^2
Uniform Deck Load	:	25 tons / m^2
Point loads	:	200 – 160 – 100 tons
Bollards	:	For mooring 205 KN – For towing 540 KN
Hull and Structures	:	Raked bow and stern with skeg. Welding according to NS 6038
Material Protection	:	All steel shotblasted to Swedish standard SA 2,5 and primed according Jotum material protection. External and internal Cathodic protection. 5 years anode protect.

• BALLAST PUMP CAPACITIES

Tank Arrangement	:	20 ballast tank served from one pump room
Pump capacity	:	2 x 600m^3

• MACHINERY

Engine / Pumps	:	2 x Mitsubishi diesel driving 2 SPP centrifugal pumps
Submersible pump	:	1 portable electrical driven submersible pump for stripping etc.
Generator	:	One Busck 10 KW / 3 x 400 V / 50 Hz
Batteries	:	2 x 24 V / 115 AH

• DECK EQUIPMENT

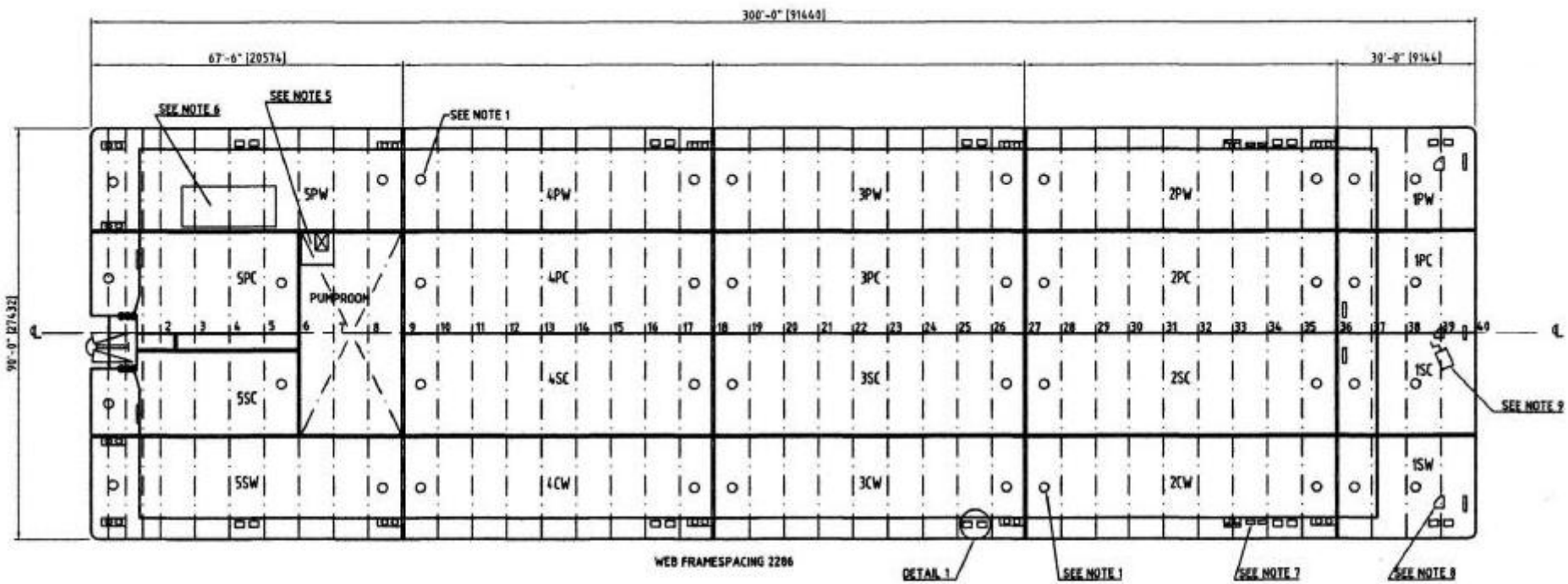
Navigation Light	:	Propane Gas lantern
Anchor	:	Type Stockless, weight 6300 Kg
Anchor Winch	:	Brattvaag / Hagglund hydraulic winch 18 tons pull 1000mt wire 32mm – BL 704 KN
Retriever winch	:	5 tons, manually operated
Towing arrangement	:	Smith's Brackets towing arrangement for main and emergency towing 100 tons SWL

and equipped with water treatment system (from 2023)

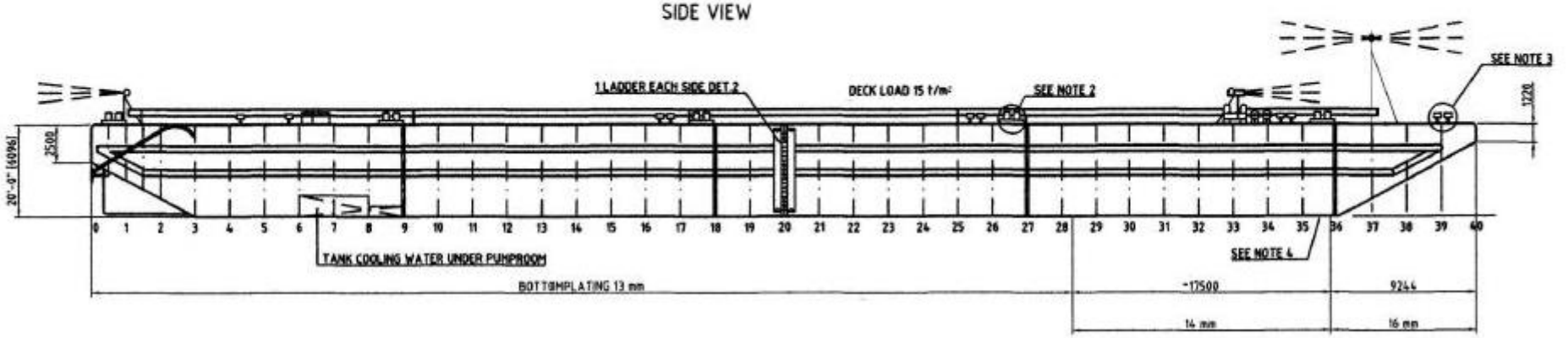
MARNAVI S.P.A. • Address: Via S. Brigida, 39 • 80133 NAPLES • ITALY • Phone: +39 081 251 33 00 • Fax: +39 081 251 33 57 • Email: offshore@marnavioffshore.it • Website: www.marnavi.it

C/B VERVECE – Flat deck cargo barge – 300 x 90 Feet / 90 x 27 m

DECK VIEW



SIDE VIEW



MARNAVI S.P.A.
TRASPORTI MARITTIMI

Whilst care has been taken in the preparation of this document, the data and/or information referred to herein are purely indicative and are not contractually binding . They must be checked with reference to the specific operations and are subject to change. No liability is accepted by the owners for any errors which may exist in this document.

ATTACHMENT D – QUAY

General Information | Buss Terminal Eemshaven

Technical Information & Infrastructure
Beatrixhaven Port Basin

Terminal Area

- Terminal area: 38.500m², planned extension from 01.01.2025 of additional 157.000m²
- Length of quay: 260 mtr (32 m priority, additional 100 m priority form 01.01.2025)
- Design load of 300 kN/sqm, higher point loads allowed

Port basin

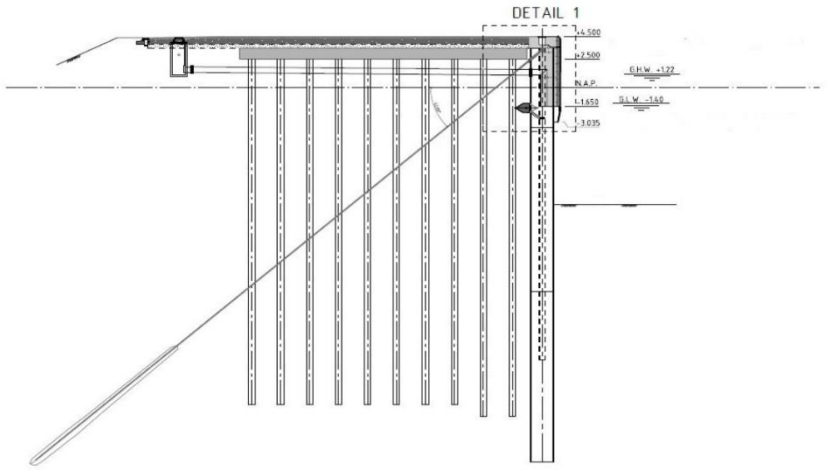
- Width of port basin: 260 mtr
- Width Beatrixhaven Passage: 110 mtr
- Water depth: 11 mtr
- Vessels with a width of > 26 mtr require a permission for berthing from GSP Port Authority

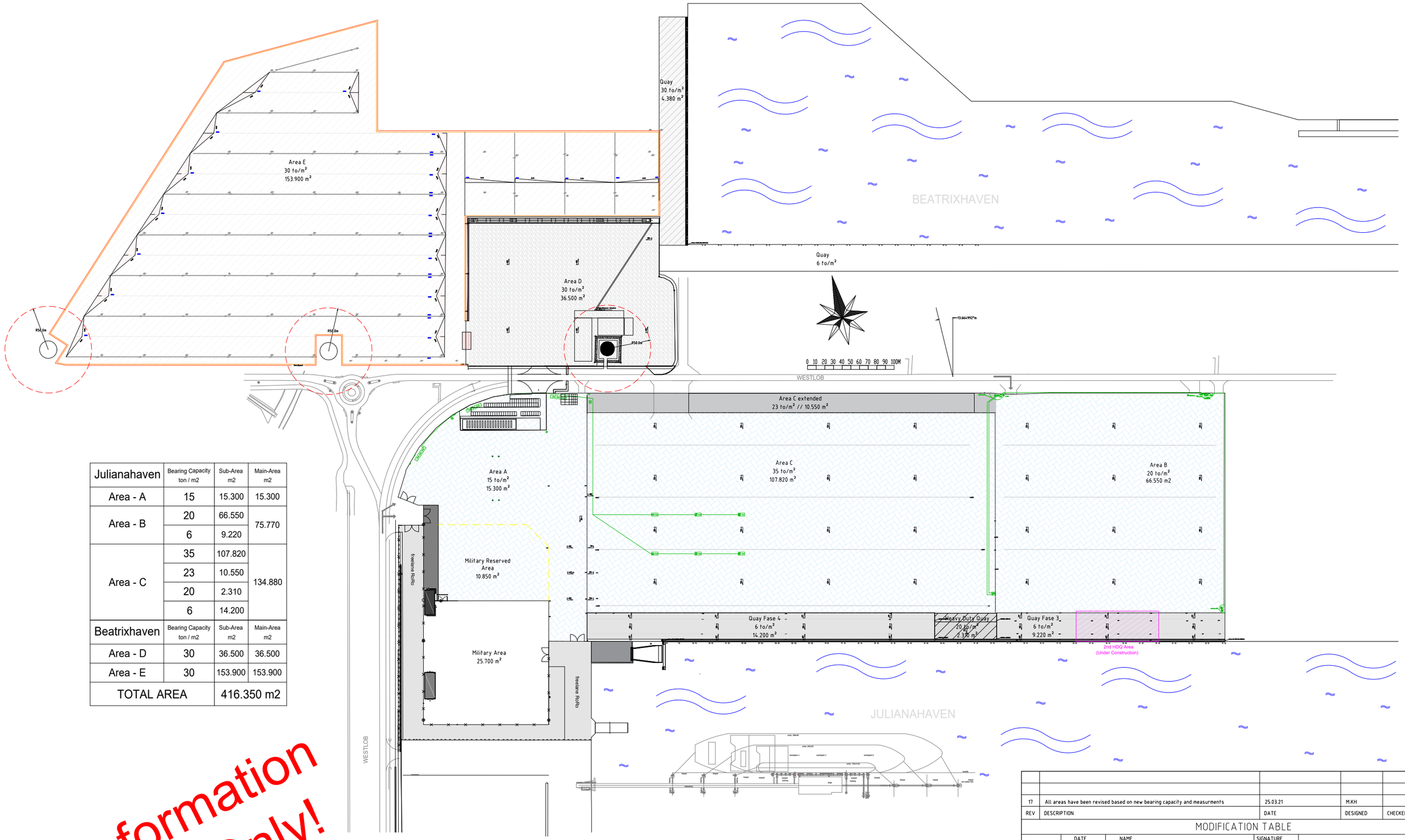
Port access

- Gate passage: unrestricted height
- Depth: 11 mtr at high water (NAP) incl. 10% UKC (UKC Under Keel Clearance)
- Density of water: 1,018 (brackish water)
- 2,5 kn flow velocity
- No locks

Quay infrastructure

- Height of quay above N.A.P.: 4,5 mtr
- Water depth at quay side: 10 mtr
- Tidal range 2 – 3 mtr
- Distance Jack-up Barge: min. 1 mtr from quayside for jacking up
- Uniform distributed design load of quay side 300 kN/sqm
- Bollard pull 600 Kilo Newton (two bollards every 20 mtr)





Julianahaven	Bearing Capacity ton / m2	Sub-Area m2	Main-Area m2
Area - A	15	15.300	15.300
Area - B	20	66.550	75.770
	6	9.220	
Area - C	35	107.820	134.880
	23	10.550	
	20	2.310	
	6	14.200	
Beatrixhaven	**Bearing Capacity ton / m2**	**Sub-Area m2**	**Main-Area m2**
Area - D	30	36.500	36.500
Area - E	30	153.900	153.900
TOTAL AREA		416.350 m2	

For Information Purpose Only!

REV	DESCRIPTION	DATE	DESIGNED	CHECKED	APPROVED
17	All areas have been revised based on new bearing capacity and measurments	25.03.21	M.KH		

MODIFICATION TABLE

	DATE	NAME	SIGNATURE
DESIGNED	25.03.21	Mohsen Kheirparast	M.KH
CHECKED			
APPROVED			

TITLE

Buss Terminal Eemshaven
Terminal Layout
(Internal)

Buss Terminal Eemshaven B.V.
Westlob 8,
NL-9979 XJ Eemshaven
www.buss-terminal-eemshaven.com

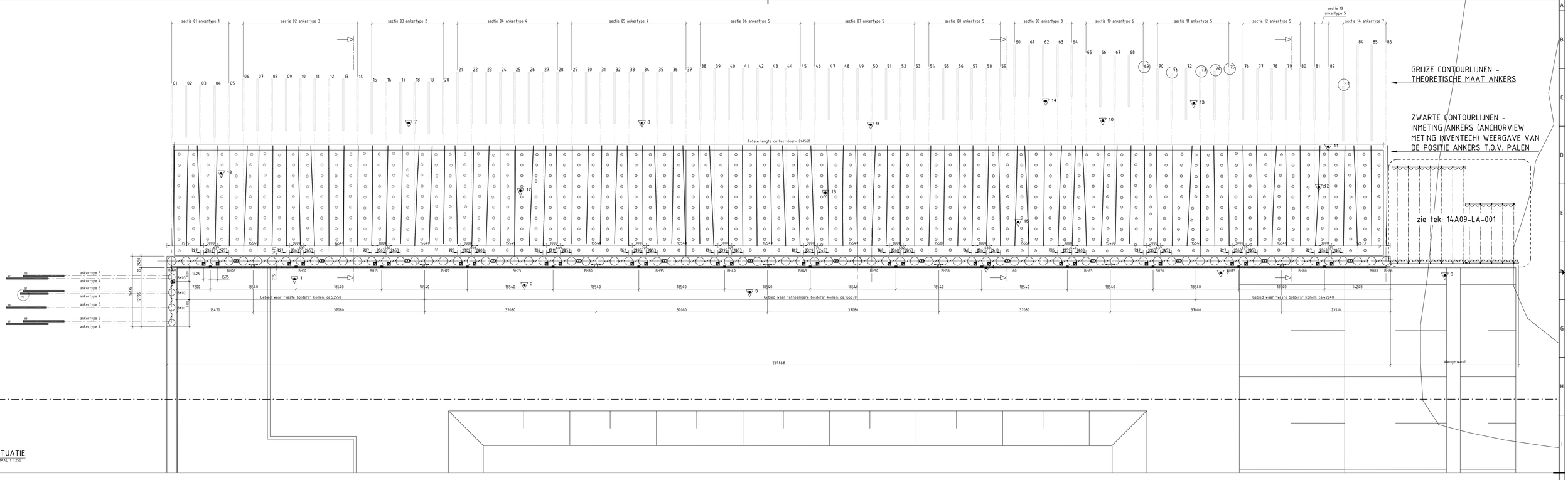
Customer

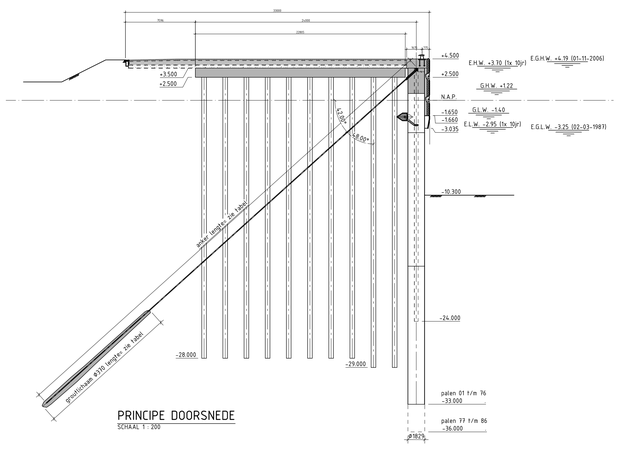
Scale	Size	Project	Drawing No.	Rev. No.	Sheet	Sheets
none	A3			17	1	1

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DocuSign Envelope ID: B46D582C-629B-4486-A3D1-FDF4F96F06CB

Annex 5 - Cross section Heavy Load Quay Beatrixhaven





Afwijking	
ankernr.	korter
69	4.0 m.
71	1.5 m.
73	1.0 m.
74	0.8 m.
75	0.4 m.
83	12.0 m.
90	4.0 m.

Tabel 25 Samenvatting ankerontwerp "Overgangskade Fase 3-5"

Type	Ankertype	Insteek-niveau	H.o.h. afstand	Helling anker t.o.v. de horizontaal	Totale lengte anker	Lengte grout-lichaam
	[°]	[m NAP]	[m]	[°]	[m]	[m]
3	103-6/2	+ 2,90	2,19	45	45,0	12,5
4 **	103-9/7	+ 2,90	2,19	41	47,0 **	12,0 **
5 **	103-6/7	+ 2,90	2,19	41	47,0 **	11,5 **

tabel is uit document: P14004 ontwerprapport verankering - rev A
GEOTECH foundation solutions B.V.

Tabel 26. Samenvatting ankerontwerp "Kademuur Fase 5"

Sectie	Ankertype	Insteek-niveau	H.o.h. afstand	Helling anker t.o.v. de horizontaal	Totale lengte anker	Lengte grout-lichaam
	[°]	[m NAP]	[m]	[°]	[m]	[m]
1 ①	117/64	+ 3,30	3,09	42	51,0	15,0
2 ①	117/64	+ 3,30	3,09	42	53,0	15,0
3 ①	117/64	+ 3,30	3,09	42	52,0	15,0
4 ①	117/64	+ 3,30	3,09	42	55,0	15,0
5 ①	117/64	+ 3,30	3,09	42	55,0	15,0
6 ①	117/64	+ 3,30	3,09	42	56,0	15,0
7 ①	117/64	+ 3,30	3,09	42	56,0	15,0
8 ①	117/64	+ 3,30	3,09	42	56,0	15,0
9 ①	117/64	+ 3,30	3,09	42	63,0	15,0
10 ①	117/64	+ 3,30	3,09	42	60,0	15,0
11 ①	117/64	+ 3,30	3,09	42	56,0	15,0
12 ①	117/64	+ 3,30	3,09	42	56,0	15,0
13 ①	117/64	+ 3,30	3,09	42	56,0	15,0
14 ①	117/64	+ 3,30	3,09	42	53,0 **	24,0 **

tabel is uit document: P14004 ontwerprapport verankering - rev C
GEOTECH foundation solutions B.V.
① = ankertype (gebaseerd op anker lengte).
** = aangepast

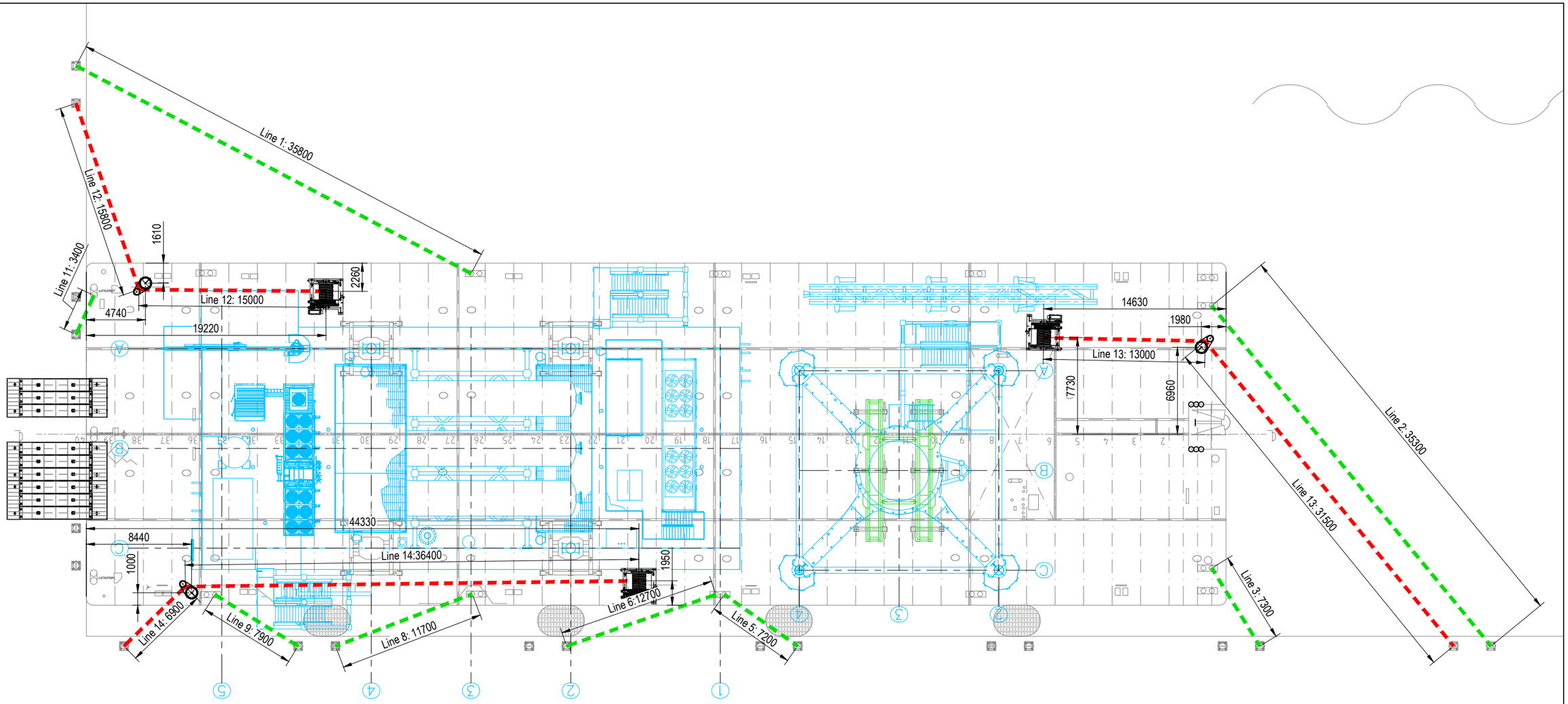
- Alle hoogtematen in meters tov NAP
- Alle maten in mm
- Coordinaten in het Rijksdriehoek-coordinatenstelsel
- Hoeken in "360-graden"
- Voor detailering "Vleugelwand" zie tekening: blad 16 van 68

GRONINGEN SEAPORTS	Location:	EEMSHAVEN	Dwg no. GIR: 13648_07
Port Authority Delfzijl/Eemshaven Handelskade Oost 1 - Box 20004 - 9930 PA Delfzijl Postbus 20004 - 9930 PA Delfzijl NL +31 (0) 596 64 34 00 - fax +31 (0) 596 63 04 44 info@groningenseaports.com website: www.groningenseaports.com	Discipline:	ALGEMEEN	
	Status:	AS BUILT	Revision: 0.0
	Title:	BEATRIXKADE FASE 3 BESTEK B00608/2012, BEATRIXHAVEN, WESTLOPER ANKERS	Reg. 3-4 Size A0+ Projection: 1250 Scale 1:200 1:250
	Blad 2 van 68		
	Drawn by De Klerk	Date 28-05-2014 Approved by	
Type Nr. Date By 0 13-01-2015 AS BUILT	Description		Dwn. by Chk.d. Appr. JWP

29-01-2015 G:\Projecten\14A09 - Kadeconstructie Beatrixhaven\Tekeningen\As built\13648-07.dwg

ATTACHMENT E – MOORING SCHEMES & FENDERS

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Material List Mooring Lines

Line	Material	Lenght [m]	MBL [t]	Safety factor	Capacity [t]	UC[%]
1	Polypropelene	35,800	30	3,25	9.2	4.3
2	Polypropelene	35,300	30	3,25	9.2	1.1
3*	Polypropelene	7,300	52	3,25	16.0	8.8
5*	Polypropelene	7,200	30	3,25	9.2	7.6
6*	Polypropelene	12,700	30	3,25	9.2	3.3
8*	Polypropelene	11,700	30	3,25	9.2	3.3
9*	Polypropelene	7,900	30	3,25	9.2	8.7
11*	Polypropelene	3,400	30	3,25	9.2	44.4
12	Steel wire	30,800	91	1,95	46.7	27.6
13	Steel wire	44,500	91	1,95	46.7	21.4
14	Steel wire	43,300	91	1,95	46.7	26.6

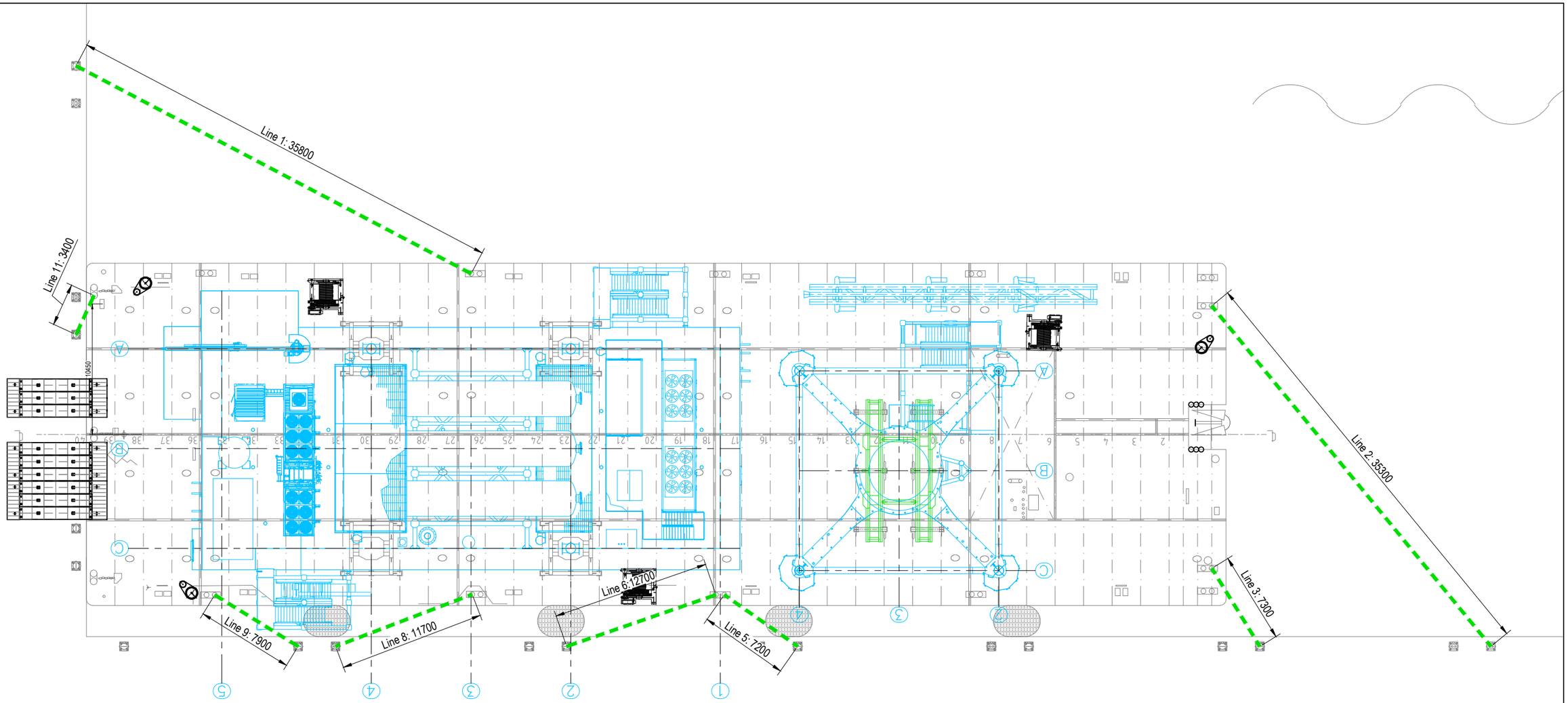
*Doubled, length to be doubled as well

rev.	date	description	designed	verified	approved
-	10/09/2025	First Issue	I.R	B.R.	B.D.

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client: ROSETTI MARINO

equipment:	Eemshaven, NL		
description:	Mooring for operational conditions		
site:	Eemshaven, NL		proj.: .
owner:	SAR	drawing type: Assembly Drawing	size: A3
appr. state:	For Approval	project: S-25-71129	scale: 1/333
doc No.:	S-25-71129_DR3001		sheet: 1-3



Material List Mooring Lines

Line	Material	Lenght [m]	MBL [t]	Safety factor	Capacity [t]	UC[%]
1	Polypropelene	35,800	30	3,25	9.2	8.7
2	Polypropelene	35,300	30	3,25	9.2	6.5
3*	Polypropelene	7,300	52	3,25	16.0	41.9
5*	Polypropelene	7,200	30	3,25	9.2	16.3
6*	Polypropelene	12,700	30	3,25	9.2	23.8
8*	Polypropelene	11,700	30	3,25	9.2	23.8
9*	Polypropelene	7,900	30	3,25	9.2	11.9
11*	Polypropelene	3,400	30	3,25	9.2	79.1

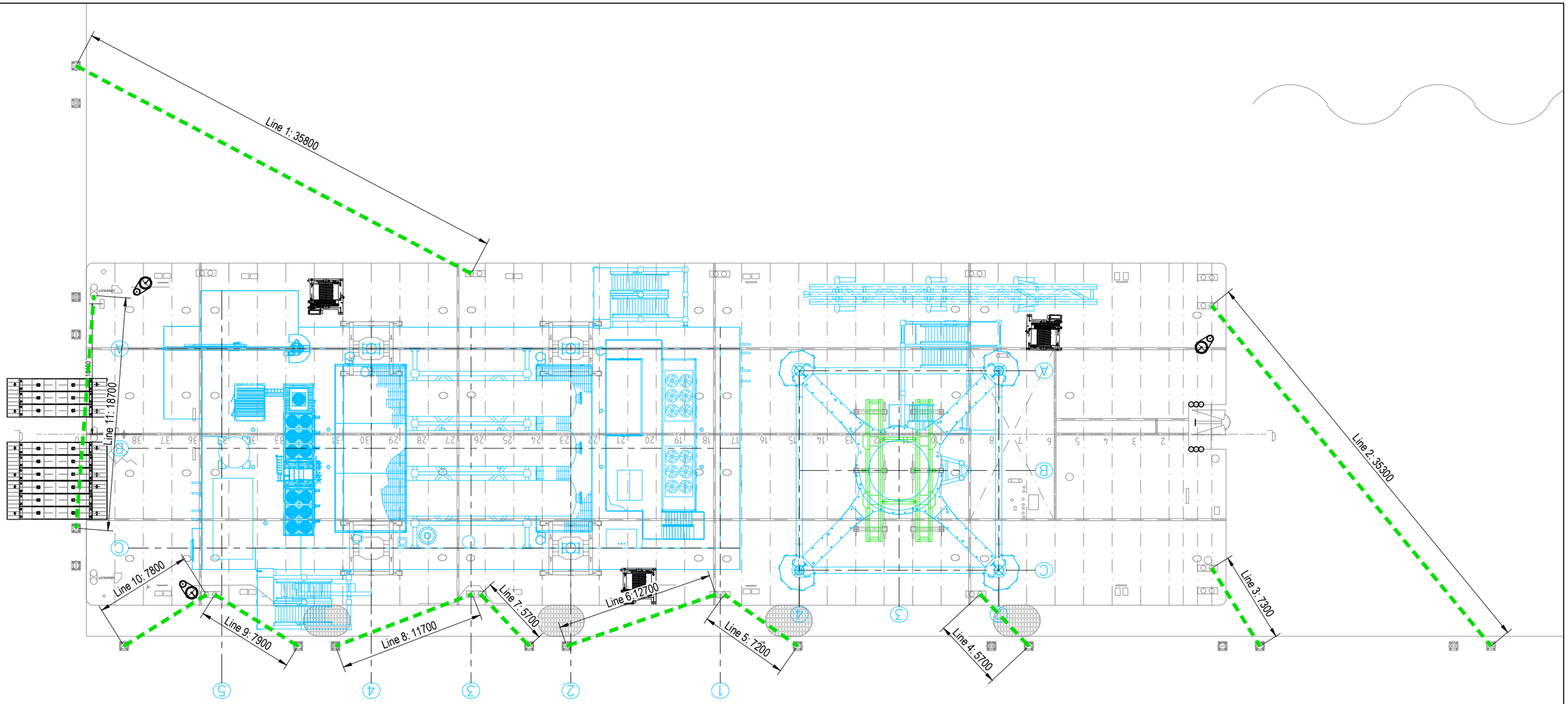
*Doubled, length to be doubled as well

rev.	date	description	designed	verified	approved
-	10/09/2025	First Issue	I.R	B.R.	B.D.

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client: ROSETTI MARINO

equipment:	Eemshaven, NL		
description:	Mooring for stand by up to 18m/s		
site:	Eemshaven, NL		proj.: .
owner:	SAR	drawing type: Assembly Drawing	size: A3
appr. state:	For Approval	project: S-25-71129	scale: 1/333
doc No.:	S-25-71129_DR3001		sheet: 2-3



Material List Mooring Lines

Line	Material	Lenght [m]	MBL [t]	Safety factor	Capacity [t]	UC[%]
1	Polypropelene	35,80	30	3,25	9.2	18.4
2	Polypropelene	35,30	30	3,25	9.2	8.7
3*	Polypropelene	7,30	52	3,25	16.0	63.1
4*	Polypropelene	5,70	52	3,25	16.0	62.5
5*	Polypropelene	7,20	30	3,25	9.2	29.3
6*	Polypropelene	12,70	30	3,25	9.2	49.8
7*	Polypropelene	5,70	52	3,25	9.2	71.3
8*	Polypropelene	11,70	30	3,25	9.2	39.0
9*	Polypropelene	7,90	30	3,25	9.2	36.8
10*	Polypropelene	7,80	170	3,25	52.3	46.1
11*	Polypropelene	18,70	30	3,25	9.2	33.6

*Doubled, length to be doubled as well

rev.	date	description	designed	verified	approved
-	10/09/2025	First Issue	I.R	B.R.	B.D.

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client: ROSETTI MARINO

equipment:	Eemshaven, NL		
description:	Mooring for stand by up to 33m/s		
site:	Eemshaven, NL		proj.: .
owner:	SAR	drawing type: Assembly Drawing	size: A3
appr. state:	For Approval	project: S-25-71129	scale: 1/333
doc No.:	S-25-71129_DR3001		sheet: 3-3

HIJSSPECIALIST.NL
Kaapweg 2
9982 EG Uithuizermeeden NL
T +31 595 413 080
I www.hijsspecialist.nl
E info@hijsspecialist.nl

KEURINGSRAPPORT HOISTING EQUIPMENT

REPORT OF EXAMINATION OF HOISTING EQUIPMENT

Ondergetekende verklaart namens zijn firma, dat onderstaande gegevens juist zijn en dat het omschreven reeds in gebruik zijnde bedrijfsmiddel is onderzocht door een bevoegd persoon onder zijn toezicht, volgens de EKH-Werkvoorschriften.

The undersigned certifies on behalf of his company, that below particulars are correct and that the described already used equipment was examinded by a competent person under his supervision, according to the EKH-Code of practice.

Documentnummer: *Documentnummer:*	24HU1355	**Eigenaar/gebruiker:** *Owner/User*	Bootlieden Vereniging Delfzijl - Eemshaven
Opdrachtnummer: *Order number:*	524124.1	**Referentie klant:** *Reference customer:*	Gangway 9
Naam: *Name:*	Gangway	**Registratie merk / nummer** *Distinguishing mark / number*	2018.23

Werklast (WLL) : **1000 Kg**
Working load limit (WLL)

Opmerkingen/veranderingen :
Remarks/changes

Aantal hijspunten	*Number of ifting points*	: 4
Serienummer	*Serial number*	: 2018.23
Maand/Jaar fabricage	*Month/Year of production*	: 2018
Tare		:
Payload		:
Max. gross weight		: 300 Kg eigen gewicht

Afmetingen *Dimensions*		: 12x0,6 mtr
Materiaal *Material*	**Warmtebehandeling** *Heat treatment*	: Niet Gloeien/Annealing not allowed
	Afwerking oppervlak *Surface finishing*	: Geverfd / Painted
Sterkte *Strength*	**Toegepaste proefbelasting** *Proofload applied*	: 1250 Kg
	Datum beproeving *Test date*	: 27-09-2024
	Gebruiksfactor *Coefficient of utilization*	:

Toepassing : Type AD 122-12-B Aluminium
Application

Hijsmiddel vervaardigd volgens norm : NEN-ISO 7061:2015
Equipmengt manufacured according standard

Datum inspectie : 27-09-2024
Date of inspection

Volgende inspectie aanbevolen voor : 27-09-2025
Next inspection suggested before

Volgende beproeving aanbevolen voor : 27-09-2028
Next test suggested before

Goedgekeurd / Approved

Leverdatum *Delivery date*	**Leverancier** *Supplier*	**Gegevens betreffende levering** *Note of delivery*	**Handtekening bevoegd persoon** *Signature authorized person*
	Hijsspecialist.nl Kaapweg 2 9982 EG Uithuizermeeden Nederland		Peter Straver CERT-EKHHH-20230321-10562

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FENDER cert.

质量管理体系认证证书

证书编号：71624Q1753R0S

兹证明

青岛航硕船舶用品有限公司

（组织机构代码/统一社会信用代码：91370282321437190 7）

注册地址：山东省青岛市即墨区灵山街道办事处工业园兴灵路 7 号
经营地址：山东省青岛市即墨区灵山街道办事处工业园兴灵路 7 号

质量管理体系符合标准

GB/T19001-2016/ISO9001:2015

认证范围：船用护舷(充气橡胶护舷)、船用下水橡胶气囊的生产

初次发证日期：2024 年 06 月 14 日
本次获证日期：2024 年 06 月 14 日
证书有效期至：2027 年 06 月 13 日

Shandong Saige Certification Technology Co., Ltd. 山东赛格认证技术有限公司 证书专用章 3701027664841

签发人：

CNCA-R-2020-716

本证书在国家规定的各行政许可、资质许可有效期内使用有效
获证组织必须定期接受监督审核并经审核合格后，方可保持证书有效性
国家认证认可监督管理委员会官方查询网站http://cx.cnca.cn
此认证证书的有效性以左下角二维码扫描结果为准

山东赛格认证技术有限公司

中国·山东·济南·融基大厦 22楼 2202室

CERTIFICATION ISO 9001 CERTIFICATION

ATTACHMENT F – MOORING WINCHES & LINES

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Alessandro Balzarotti

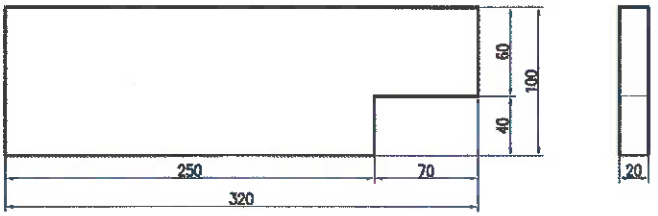
From: Ben Duym <ben.duym@sarens.com>
Sent: 19 September 2025 12:32
To: Alessandro Balzarotti
Cc: Mart van Hoorn; Massimiliano Brunelli; Jose Miguel Castro Escolar
Subject: RE: fixing of winches and fairleads
Attachments: RE: Meeting in Eemshaven - 19/20 August - Agenda

Follow Up Flag: Follow up
Flag Status: Flagged

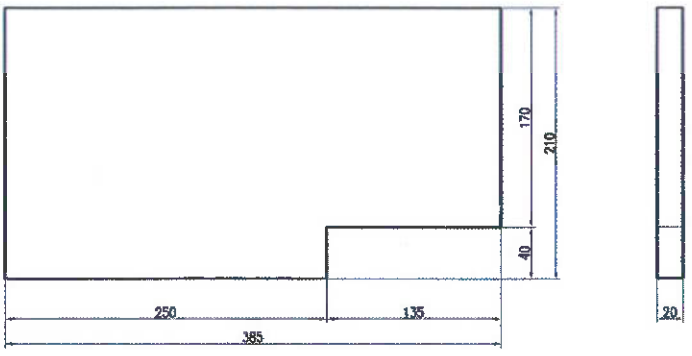
Dear,

Attached email was already some indication info requested by Broekman (in Dutch).

We supply the winches, means and fixations of them done by client/others
Especially if some sea fastening is removed, these plates can sometimes be cut from there.
Note that barge deck is never flat, so with some welds below the winch area, these plates sometimes need little extra cutting/grinding work to fit.



Forward bracket – Dimensions [mm]



Rear bracket – Dimensions [mm]

Each winch --) 2x front + 2x rear brackets

Welding on both sides with a6. (2000mm welding work per winch)

The fairleader to be welded on the deck without stoppers. Let's see as maybe in few cases we have possibility to guide the cable via a Panama chock or bollard. Will save welding, cutting/cleaning work. For welding --) each fairlead 4x L300mm a8

Kind regards
Ben

Ben Duym
Site Manager

T +32472182019

sarens

Sarens Project NV

REPORT

Commissioning

SARENS N.V.
Attention Carl Sarens
Autoweg 10
B – 1861 Wolvertem

Our reference:	A20240802-84183-KVA-1-COMMISSIONING HW40-5.doc	Date of inspection:	*02/08/2024*
WO-n°:	**325225-1.1**	Inspector:	*Kenji Van Hoof*
Report date:	*02/08/2024 KVA*	Location of inspection:	*Sarens Wolvertem Autoweg 10* Meise – Belgie

Report commissioning of hydraulic winch
(HW 40-5)

Characteristics of the winch:

Type	: Hydraulic Winch 40 ton
Serial number	: HW 40-5
Nominal load capacity	: 40 mT



Description of our inspection:

- Visual inspection of the winch
- Visual inspection of the cable (according internal procedure & ISO4309)
- Braking test

HW 40-5

- **Remarks:** None. Braking test successful.
- **Note:** Follow up wire break (2 at 6 x diameter).
  Knik, to follow up.





REPORT

Commissioning

SARENS N.V.
Attention Carl Sarens
Autoweg 10
B – 1861 Wolvertem

Our reference:	A20240802-84183-KVA-1-COMMISSIONING HW40-2.doc	Date of inspection:	*02/08/2024*
WO-n°:	**325225-1.1**	Inspector:	*Kenji Van Hoof*
Report date:	*02/08/2024 KVA*	Location of inspection:	*Sarens Wolvertem Autoweg 10* Meise – Belgie

Report commissioning of hydraulic winch
(HW 40-2)

Characteristics of the winch:

Type : Hydraulic Winch 40 ton

Serial number : HW 40-2

Nominal load capacity : 40 mT



Description of our inspection:

- Visual inspection of the winch
- Visual inspection of the cable (according internal procedure & ISO4309)
- Braking test

HW 40-2

- **Remarks:** None. Braking test successful.
- **Note:** None.

REPORT

Commissioning

SARENS N.V.
Attention Carl Sarens
Autoweg 10
B – 1861 Wolvertem

Our reference:	A20240806-84183-KVA-1-COMMISSIONING HW40-1.doc	Date of inspection:	*06/08/2024*
WO-n°:	**325225-1.1**	Inspector:	*Kenji Van Hoof*
Report date:	*06/08/2024 KVA*	Location of inspection:	*Sarens Wolvertem Autoweg 10* Meise – Belgie

Report commissioning of hydraulic winch
(HW 40-1)

Characteristics of the winch:

Type : Hydraulic Winch 40 ton

Serial number : HW 40-1

Nominal load capacity : 40 mT



Description of our inspection:

- Visual inspection of the winch
- Visual inspection of the cable (according internal procedure & ISO4309)
- Braking test

HW 40-1

- **Remarks:** None. Braking test successful.
- **Note:** None.

ATTACHMENT G – MOORING ANALYSIS

Clarification notes on the mooring analysis, as per points raised by PA:

- Calculation is based on mix of steel cables and polyprops
  - Only during the actual load-in the winch cables will be used for mooring, during the other time the barge is moored with only polyprops while the winch cables are slack
- How to control similar tension in polyprops
  - Line men team using small winch or forklift to apply similar tension in the ropes. RM already organised regularly check on the lines by them. If during such check it is noticed that one line is more tensioned than the rest, they need to give little slack on this line so that force is divided over the several lines. That lines are getting slack, is not a problem as long when they get tension again the tension is divided over several lines.
- Bollard checks to be done on the bollard of barge.
  - Barge bollards are checked for wind speed up to 27 m/s. Pushing with the tug alongside the barge might be needed when wind would exceed.
- How to ensure that polyprops will remain free between quay and barge.
  - Would assume that the the polyprops will touch the quay edge when the barge is lower than the quay. I see that the edge is rounded off, so with the frequent check of the lines by the line men team possible wear of the ropes would also be visible.

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ROSETTI MARINO S-25-71129

MOORING OF VERVECE BARGE
CALCULATION NOTE CN3001



A	18/09/2025	Client comments & wind speed update	ENG	J.C.	J.C.	B.D.
-	11/09/2025	First issue	ENG	B.R.	B.R.	B.D.
Rev.	Date	Description	Dept.	Edited	Verified	Approved

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1 INTRODUCTION

The purpose of this document is to provide the Client a confirmation of the methodology of the mooring for the load-in of the BLPH TP form Barge Vervece at the yard in Eemshaven, NL.

It provides documentation, verification & calculations for the client to review that the intended operation is feasible given the environment and parameters of the cargo.

1.1 General information

Self Propelled Modular Trailers (SPMT's) will be used to transport the TP. In the first part of the load-in, the SPMT's will be driven onto the barge, next the cargo will be picked up from its grillage position on the barge. Next, the cargo will be driving towards the quay. The operation will start as soon as the tide reaches the appropriate level. The gap between the barge and the quay will be covered using link spans.

The barge will be kept at a constant level relative to the quay during the load in operation. This will be achieved by ballasting the barge in strategic compartments.

In order to avoid an excessive movement of the barge respect to the position of the link span, (mostly sway), the barge will be moored by using hydraulic winches and mooring ropes.

The hydraulic winches will be used during the operation, and mooring ropes will be used during standby cases.

1.2 Reference documents

For this document the following references are used:

Design codes:
[A] EN 1990: Basis of structural design (2002)
[B] EN 1993-1-1: Design of steel structures - Part 1-1: General rules (2005)
[C] EN 1993-1-5: Design of steel structures - Part 1-5: Plated structural elements (2006)
[D] EN 1993-1-8: Design of steel structures - Part 1-8: Design of joints (2006)
[E] EN 10025: European structural steel standard
[F] DNV-ST-N001 Marine operations and marine warranty – December 2023

Client drawings & documents:
[1] Tidal chart - Eemshaven September-2025
[2] Appendix_5_-_att_3_Cross_section_Heavy_Load_Quay_Beatrixhaven (1)
[3] 123A90-DDL-TI-DD-99015_03: Barge layout, weight & COG
[4] VERVECE-Loading and stability book

Sarens drawings & documents:
[5] SNVD000000227: Bridge 5800x1000x200
[6] S-25-71129_DR1001: Transport arrangement

1.3 Abbreviations and designations

Abbreviations/ Designations	Definition
Cargo	BLPH TP
Barge	Vervece
Client	Rosetti Marino
CoG	Centre of Gravity
Site	Eemshaven, NL
SPMT	Self-Propelled Modular Trailer
t	(Metric) Tonne

2 EQUIPMENT

2.1 Barge – Vervece

2.1.1 General data

General data – Vervece			
	Length	91.44	m
	Breadth	27.432	m
	Depth	6.096	m
	Light Ship Weight	1833	ton

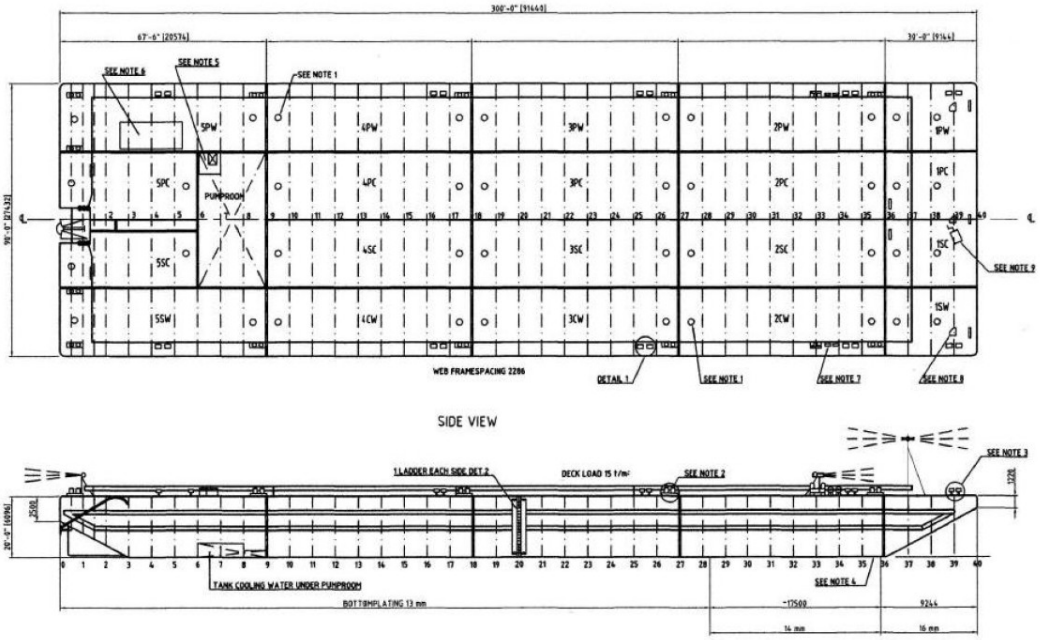


Figure 2-1: Barge Vervece General arrangement

For more details see Annex A: Vervece Barge.

2.1.2 Barge loading condition

A barge draft is approximately 2.90 m.

The software uses the barge area below water level to calculate the forces due to current and waves. The barge area above deck is used to calculated the forces due to wind.

2.1.3 Projected wind area above barge deck

An estimation of the transversal and longitudinal wind areas of the cargo is made using Autocad.

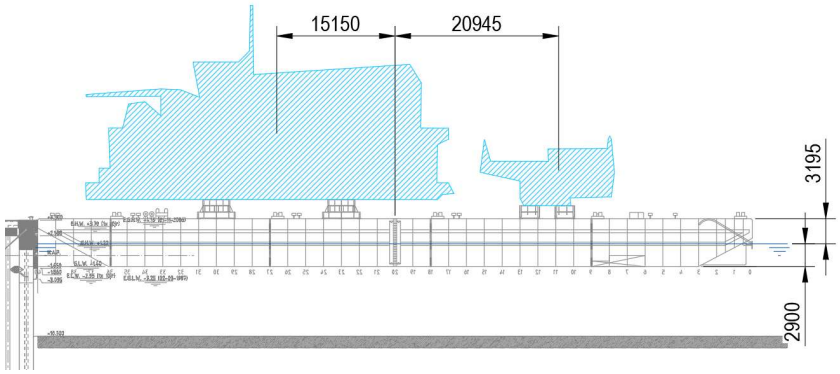


Figure 2-2: OSS - Wind area side

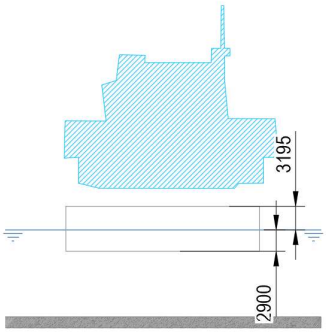


Figure 2-3:OSS - Wind area front

Wind area for mooring analysis is:

The combined application point for the transverse wind area is at 11m fwd from midship.

$A_{transversal}$	750 m²
$A_{longitudinal}$	400 m²

2.2 Mooring equipment

2.2.1 Hydraulic winch HW40

Brake capacity (WBC)	120t
Pulling capacity	40t
Wire	MBL of 91t (Ø36mm)

2.2.2 Vervece mooring equipment

The barge is equipped with bollards with a capacity of 21t.

2.2.3 Mooring lines

- Braided Polypropylene ropes	MBL of 30t (Ø48mm)
- Braided Polypropylene ropes	MBL of 52t (Ø56mm)
- Braided Polypropylene ropes	MBL of 170t (Ø104mm)

2.2.4 Onshore bollards

On the quay bollards are present. The bollards have a capacity of 60t

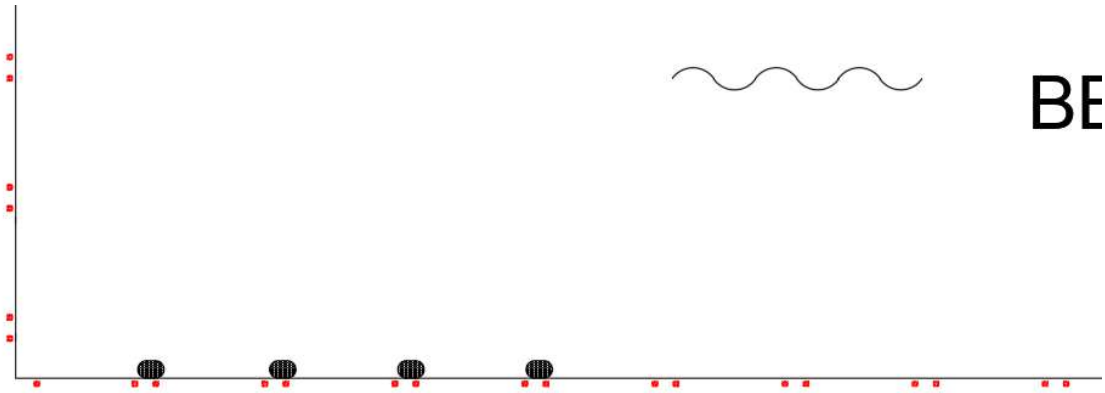


Figure 2-4: Bollard on quay

2.2.5 Fenders

4 Yokohama fenders of 2.5m diameter are present

2.2.6 Line pretension

Mooring lines to be pretensioned:

- Winches – 5 t;
- HMPE and polypropylene – manually / by telehandler

3 CARGO

The BLPH Topside, will be loaded in. The weight of the cargo is 1700t.

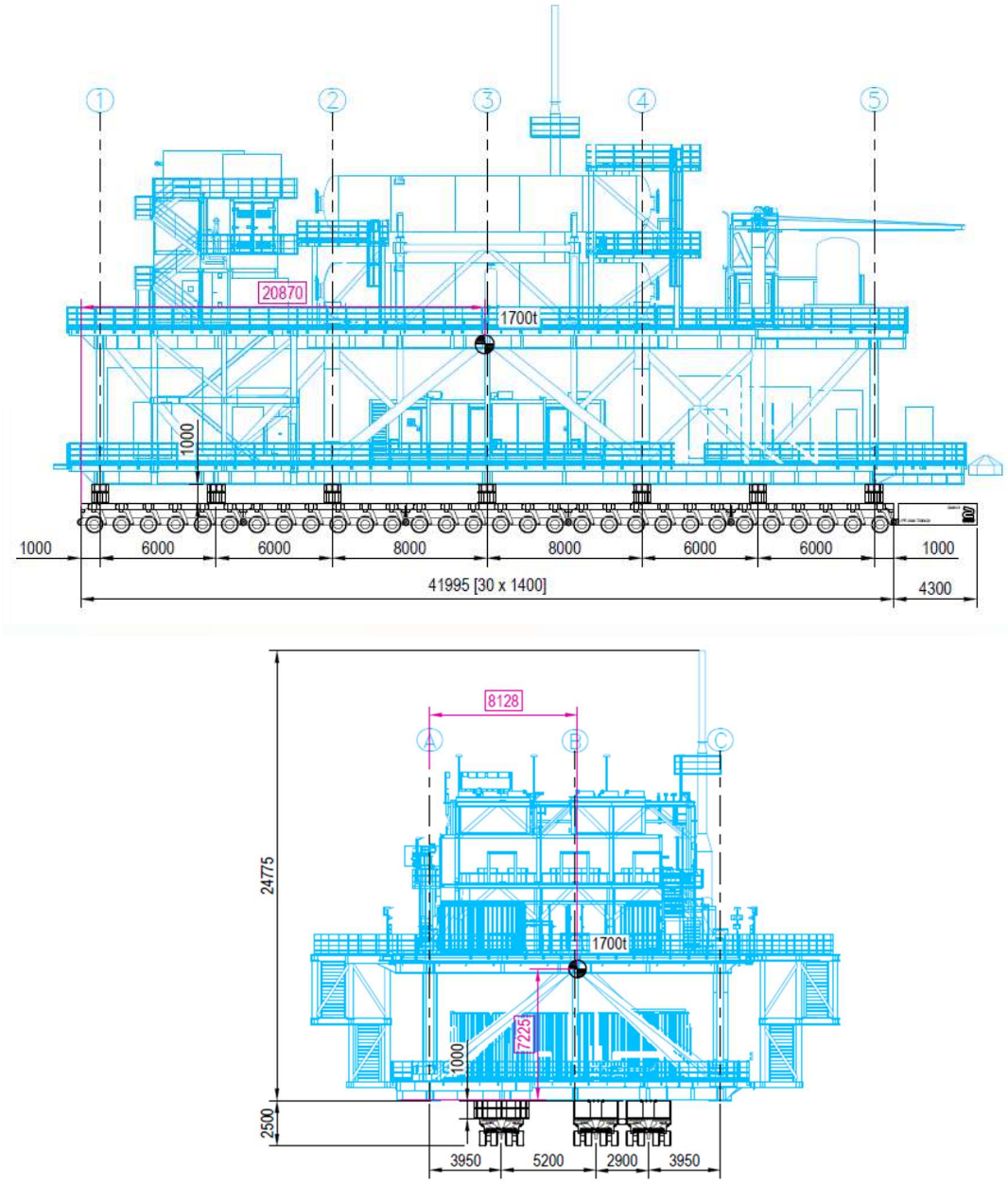


Figure 3-1: BLPH Topside

4 SITE AND ENVIRONMENTAL SPECIFICATIONS

In this section, the main specifications of the site and also the environmental conditions taken into account are listed.

4.1 Design information of the quay

Depth at Quay :	- 10.3m
Quayside Elevation:	+ 4.50m
MHW:	1.22m
MLW:	-1.40m

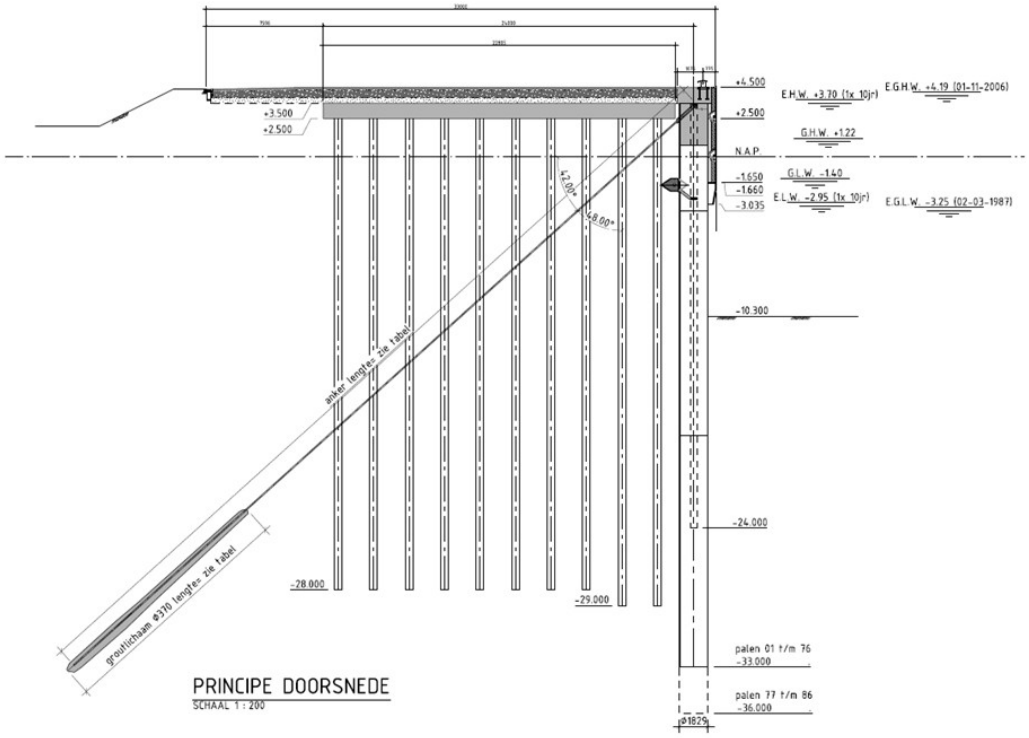


Figure 4-1: Cross-sections of quay

4.2 Environmental conditions

The following environmental conditions are used for this mooring arrangement

4.2.1 Current

No current has been considered, the barge is moored into a corner of a sheltered quay.

4.2.2 Waves

No waves have been considered, the barge is moored into a corner of a sheltered quay.

4.2.3 Water level

Average water level of 1.20m (ref. NAP) is taken into account.

4.2.4 Wind Velocity

The wind speed for the load in operation is limited to 18m/s (10min average at height 10m), corresponding to 35 knots.

- Wind direction: 360°

The wind speed for the standby during barge mob/demob 18m/s (10min average at height 10m), corresponding to 35 knots.

- Wind direction: 360°

The wind speed for the standby during barge mob/demob 27m/s (10min average at height 10m), corresponding to 52.5 knots.

- Wind direction: 360°

5 MODEL

5.1 General

Verification of the capacity / strength of the mooring system is based on a capacity check and provides the loads on the different elements (mooring lines, bollards, fenders…) of the mooring system.

Furthermore, it provides the necessary information for Client to verify the capacities of their facilities.
Depending on the port authorities and/or project requirements several conditions must / can be checked:

- Mooring forces with various wind directions
- Mooring line failures

The analysis of the mooring forces is made by using the 'Optimoor' mooring analysis software licensed to Sarens NV.

OPTIMOOR © mooring analysis software

This section is a standard that describes the modelling of the mooring arrangement and is not linked to the specific calculations of this project, but describes the way of calculating and modelling used for analyzing the mooring arrangement.

The OPTIMOOR© mooring analysis software takes input data from a particular vessel and a particular berth. It computes the mooring forces on fenders, bollards, anchors produced by defined parameters like;

- Wind
- Wave
- Current
- Other forces
- Changes in draft of vessel
- Tide

Different types and number of mooring types, environment conditions, draft and tide can be investigated.

The program defines and simulates the mooring based on the designated vessel and which mooring lines are connected to the berth mooring points or anchors.

The mooring line specifications, e.g. cable diameter, mooring tensions, distance from fairleader(s) to winch(es), etc. can be entered based on the vessel particulars resulting in a realistic simulation of the mooring conditions.

The software incorporates all governing parameters and boundary conditions of the mooring lines into its calculations, considering mechanical properties, material stiffness, tensile strength, diameter, length, and other defining characteristics.

6 GUIDELINES

6.1 General

Verification performed according to DNV-ST-N001, chapter 17.2.9.

For quayside / inshore moorings, a LRFD approach is adopted.
The guideline differentiates between intact conditions and redundancy conditions, with following loads:
- Permanent loads (G)
- Variable loads (Q)
- Deformation loads (D)
- Environmental loads (E)
- Accidental loads (A)

6.2 Intact conditions

17.2.9.2.5 Load factors in accordance with Table 5-10 shall be considered for the assessment of intact system. A common load factor can be used in lieu of partial load factors.

Table 5-10 Load factors for ULS

Load condition	*Load categories*				
	G	Q	D	E	A
ULS-a	1.3	1.3	1.0	0.7	n/a
ULS-b	1.0	1.0	1.0	1.3	n/a
1) Load categories G, Q, D, E and A are described in [5.5].					

17.2.9.2.6 The material factor for certified chain, wire rope and fibre rope shall be as per [5.9.8.5].

Material factors based on chapter 5.9.8.5 are:
- Steel rope γ_m 1.5
- Polyester γ_m 1.65
- HMPE and aramid γ_m 2.0
- Other γ_m 2.5 *(polyamide, polyethylene, polypropylene)*

6.3 Redundancy conditions

17.2.9.3.5 The failure cases should normally at least include conditions with any one line broken. Load factors for the load combinations shall be in accordance with ALS-D in Table 5-6.

Guidance note:
If the line utilization factors are maximum 0.7 in ULS, omitting verification of one line failure may be found acceptable in the following cases:

— Tug(s) is (are) standing by at the mooring site, and the system allows the tug(s) to provide sufficient thrust in the directions necessary to replace any one line within an acceptable time span.
— The mooring is for a weather restricted operation/period and the possibility of accidental damage to mooring lines is found neglectable. The mooring lines shall consist of certified ropes and equipment.

Table 5-6 LRFD load factors for ALS

Load condition	*Load categories*				
	G	Q	D	E	A
ALS-I	1.0	1.0	1.0	n/a	1.0
ALS-D	1.0	1.0	1.0	1.0	n/a
1) Load categories G, Q, D, E and A are described in [5.5.2].					

17.2.9.3.9 Material factor for redundancy conditions can be obtained by dividing the material factors given in [5.9.8.5] by 1.15.

According to the guideline above, this yields following material factors:

- Steel rope γ_m 1.3
- Polyester γ_m 1.43
- HMPE and aramid γ_m 1.74
- Other γ_m 2.17 *(polyamide, polyethylene, polypropylene)*

6.4 Bollards / Winches

17.2.9.9.3 The maximum characteristic mooring line load in intact condition in a specific direction shall be less than the working load limit (WLL) in that direction. When connected to multiple lines, the working load limit should be greater than 1.2 times the worst case combined loading from all the connected mooring lines. The mooring line loads from redundancy check shall be less than 1.5 times the WLL. Factors are not applicable for bollards designed with controlled failure mode.

Guidance note:
Care should be taken when comparing characteristic mooring line loads against WLL due to uncertainty in the mooring point's ultimate load capacity, see [Q.1.13] for guidance.

17.2.9.9.8 If the mooring load is to be held on a winch brake, then the winch brake capacity, with the outer wrap on the drum, should exceed the maximum mooring intact load multiplied by a minimum factor of 1.2, and be greater than the maximum line tension for redundancy check cases. Where winches are used, tension monitoring devices/meters shall be used.

6.5 Summary

The above information is summarized in the table below and the following design safety factors are applied for further verifications:

Item	Intact condition	Redundancy
Mooring line – Steel wire	MBL / 1.95	MBL / 1.3
Mooring line – Polyester	MBL / 2.15	MBL / 1.43
Mooring line – HMPE	MBL / 2.6	MBL / 1.74
Mooring line – Other*	MBL / 3.25	MBL / 2.17
Winch brake capacity	WBC / 1.2	WBC / 1
Bollard	WLL or WLL / 1.2**	1.5 x WLL
Fender	WLL	WLL

**Note: polyamide, polyethylene, polypropylene*
***Note: when multiple lines connected to one bollard*

7 RESULTS

7.1 Operational

7.1.1 Load cases

Load case	Single line failure?	Which line fails?	Wind Speed [knots]	Wind Direction [°]
1	no	None	35	All
2	yes	1	35	All
3	yes	2	35	All
4	yes	3	35	All
5	yes	5	35	All
6	yes	6	35	All
7	yes	8	35	All
8	yes	9	35	All
9	yes	11	35	All
10	yes	12	35	All
11	yes	13	35	All
12	yes	14	35	All

7.1.2 Intact condition

Below a summary of the maximum occurring loadings from the intact verification.

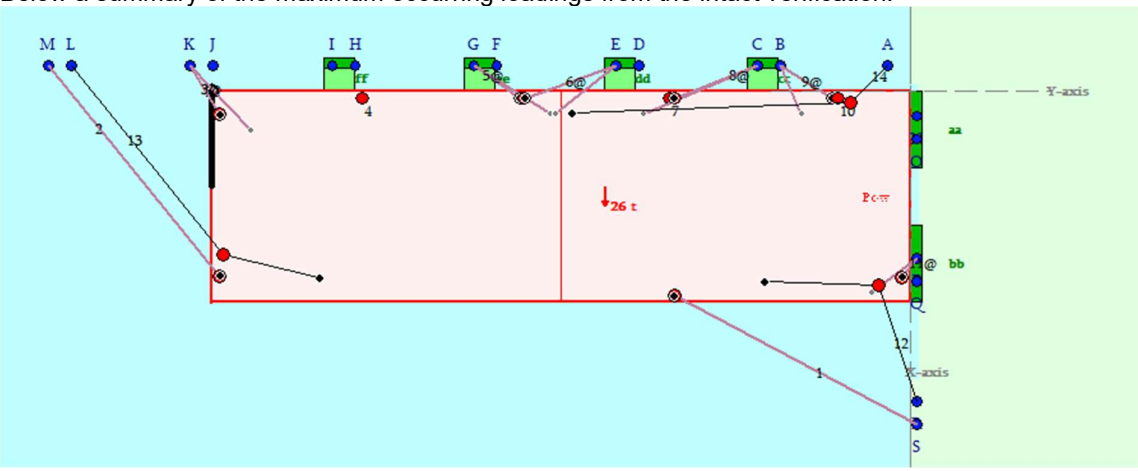


Figure 7-1: Intact condition – operational

Mooring lines forces:

	Load case	Mooring line													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
	1	0,4	0,1	1,4	Not used	0,7	0,3	Not used	0,3	0,8	Not used	4,1	12,9	10,0	12,4
	Maximum [t]	0,4	0,1	1,4	-	0,7	0,3	-	0,3	0,8	-	4,1	12,9	10,0	12,4
Winch	WBC [t]												120,0	120,0	120,0
	Safety factor	-	-	-	-	-	-		-	-	-	-	1,20	1,20	1,20
	Capacity [t]	-	-	-	-	-	-		-	-	-	-	100,0	100,0	100,0
	UC [%]	-	-	-	-	-	-		-	-	-	-	12,9%	10,0%	12,4%
Line	Line Type	Other	Other	Other	Other	Other	Other	Other	Other	Other	Other	Other	Steel wire	Steel wire	Steel wire
	MBL [t]	30,0	30,0	52,0	52,0	30,0	30,0	52,0	30,0	30,0	170,0	30,0	91,0	91,0	91,0
	Safety factor	3,25	3,25	3,25	3,25	3,25	3,25	3,25	3,25	3,25	3,25	3,25	1,95	1,95	1,95
	Capacity [t]	9,2	9,2	16,0	16,0	9,2	9,2	16,0	9,2	9,2	52,3	9,2	46,7	46,7	46,7
	UC [%]	4,3%	1,1%	8,8%	-	7,6%	3,3%	-	3,3%	8,7%	-	44,4%	27,6%	21,4%	26,6%

Fender forces:

Load case	Fenders					
	aa	bb	cc	dd	ee	ff
1	16	5	2	3	5	7
Maximum [t]	16	5	2	3	5	7

Bollard forces:

Load case	Bollards										
	A	B	C	E	G	K	L	M	P	R	S
1	12,4	1,6	0,6	0,5	1,4	2,8	10,0	0,1	8,2	12,9	0,4
Maximum [t]	12,4	1,6	0,6	0,5	1,4	2,8	10,0	0,1	8,2	12,9	0,4
WLL [t]	61	61	61	61	61	61	61	61	61	61	61
# Lines to Bollard	1	1	1	1	1	1	1	1	1	1	1
Safety factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Capacity [t]	61,0	61,0	61,0	61,0	61,0	61,0	61,0	61,0	61,0	61,0	61,0
UC [%]	20,3%	2,6%	1,0%	0,8%	2,3%	4,6%	16,4%	0,2%	13,4%	21,1%	0,7%

For Barge bollards capacity check see chapter 7.3.3. as worst case scenario.

7.1.3 Redundancy condition

Below a summary of the maximum occurring loadings from the redundancy verification (single line failure).

Mooring lines forces:

	Load case	Mooring line													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
	2	Failure	0,1	1,4	Not used	0,7	0,3	Not used	0,3	0,8	Not used	4,1	12,9	10,0	12,4
	3	0,4	Failure	1,4	Not used	0,7	0,3	Not used	0,3	0,8	Not used	4,1	12,9	10,1	12,4
	4	0,4	0,2	Failure	Not used	0,8	0,3	Not used	0,3	0,8	Not used	4,1	12,9	12,1	12,7
	5	0,4	0,2	1,5	Not used	Failure	0,3	Not used	0,3	0,8	Not used	4,2	12,9	10,3	12,6
	6	0,4	0,2	1,4	Not used	0,7	Failure	Not used	0,4	0,8	Not used	4,1	12,9	10,1	12,4
	7	0,4	0,2	1,4	Not used	0,7	0,3	Not used	Failure	0,8	Not used	4,2	12,9	10,1	12,4
	8	0,4	0,1	1,4	Not used	0,7	0,3	Not used	0,3	Failure	Not used	4,4	12,9	10,0	12,7
	9	0,4	0,1	1,3	Not used	1,2	0,3	Not used	0,5	1,9	Not used	Failure	12,9	9,1	21,2
	10	0,8	0,1	1,4	Not used	0,7	2,0	Not used	1,7	0,8	Not used	4,1	Failure	10,0	12,4
	11	0,4	0,5	4,9	Not used	1,1	0,7	Not used	0,7	0,8	Not used	3,7	12,9	Failure	14,4
	12	0,4	0,2	1,8	Not used	0,9	0,9	Not used	1,0	1,0	Not used	8,1	12,7	10,8	Failure
	Maximum [t]	0,8	0,5	4,9	-	1,2	2,0	-	1,7	1,9	-	8,1	12,9	12,1	21,2
Winch	WBC [t]												120,0	120,0	120,0
Winch	Safety factor	-	-	-	-	-	-	-	-	-	-	-	1,00	1,00	1,00
Winch	Capacity [t]	-	-	-	-	-	-	-	-	-	-	-	120,0	120,0	120,0
Winch	UC [%]	-	-	-	-	-	-	-	-	-	-	-	10,8%	10,1%	17,7%
Line	Line Type	Other	Other	Other	Other	Other	Other	Other	Other	Other	Other	Other	Steel wire	Steel wire	Steel wire
Line	MBL [t]	30,0	30,0	52,0	52,0	30,0	30,0	52,0	30,0	30,0	170,0	30,0	91,0	91,0	91,0
Line	Safety factor	2,17	2,17	2,17	2,17	2,17	2,17	2,17	2,17	2,17	2,17	2,17	1,30	1,30	1,30
Line	Capacity [t]	13,8	13,8	23,9	23,9	13,8	13,8	23,9	13,8	13,8	78,2	13,8	69,8	69,8	69,8
Line	UC [%]	5,8%	3,6%	20,5%	-	8,7%	14,5%	-	12,3%	13,8%	-	58,7%	18,5%	17,3%	30,4%

Fender forces:

Load case	Fender					
	aa	bb	cc	dd	ee	ff
2	16	5	2	3	5	7
3	16	5	2	3	5	7
4	16	8	2	3	5	7
5	16	5	2	3	5	7
6	16	5	2	3	5	7
7	16	5	2	3	5	7
8	16	5	2	3	5	7
9	15	2	2	3	5	7
10	12	6	11	8	6	6
11	16	16	2	3	5	7
12	13	0	2	3	5	6
Maximum [t]	16	16	11	8	6	7

Bollard forces:

Load case	Bollard										
	A	B	C	E	G	K	L	M	P	R	S
	12,4	1,6	0,6	0,5	1,4	2,8	10,0	0,1	8,2	12,9	0,0
	12,4	1,6	0,6	0,5	1,4	2,9	10,1	0,0	8,2	12,9	0,4
	12,7	1,6	0,6	0,5	1,6	0,0	12,1	0,2	8,2	12,9	0,4
	12,6	1,6	0,6	0,5	0,0	2,9	10,3	0,2	8,5	12,9	0,4
	12,4	1,6	0,7	0,0	1,4	2,8	10,1	0,2	8,3	12,9	0,4
	12,4	1,6	0,0	0,6	1,4	2,8	10,1	0,2	8,3	12,9	0,4
	12,7	0,0	0,6	0,5	1,4	2,8	10,0	0,1	8,8	12,9	0,4
	21,2	3,7	1,0	0,7	2,4	2,7	9,1	0,1	0,0	12,9	0,4
	12,4	1,6	3,3	4,0	1,4	2,8	10,0	0,1	8,2	0,0	0,8
	14,4	1,5	1,3	1,3	2,1	9,8	0,0	0,5	7,4	12,9	0,4
	0,0	2,0	2,0	1,8	1,7	3,6	10,8	0,2	16,2	12,7	0,4
[t]	21,2	3,7	3,3	4,0	2,4	9,8	12,1	0,5	16,2	12,9	0,8
	61	61	61	61	61	61	61	61	61	61	61
# Lines to Bollard	1	1	1	1	1	1	1	1	1	1	1
Safety factor	0,67	0,67	0,67	0,67	0,67	0,67	0,67	0,67	0,67	0,67	0,67
Capacity [t]	91,5	91,5	91,5	91,5	91,5	91,5	91,5	91,5	91,5	91,5	91,5
UC [%]	23,2%	4,0%	3,6%	4,4%	2,6%	10,7%	13,2%	0,5%	17,7%	14,1%	0,9%

For Barge bollards capacity check see chapter 7.3.3. as worst case scenario.

7.2 Stand by up to 18m/s

7.2.1 Load cases

Load case	Single line failure?	Which line fails?	Wind Speed [knots]	Wind Direction [°]
1	no	None	35	All
2	yes	1	35	All
3	yes	2	35	All
4	yes	3	35	All
5	yes	5	35	All
6	yes	6	35	All
7	yes	8	35	All
8	yes	9	35	All
9	yes	11	35	All

7.2.2 Intact condition

Below a summary of the maximum occurring loadings from the intact verification.

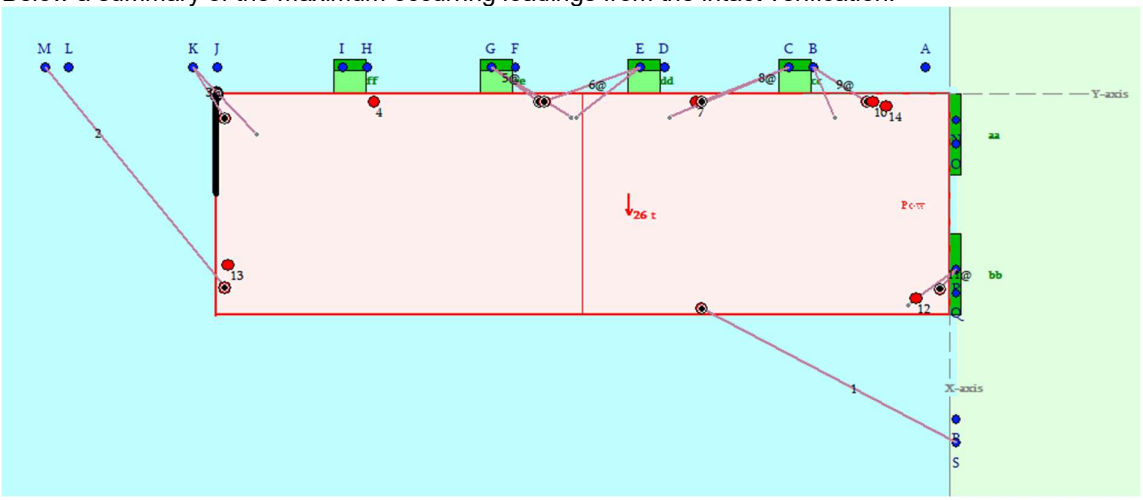


Figure 7-2: Intact condition – standby

Mooring lines forces:

	Load case	Mooring line													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
	1	0,8	0,6	6,7	Not used	1,5	2,2	Not used	2,2	1,1	Not used	7,3	Not used	Not used	Not used
	Maximum [t]	0,8	0,6	6,7	-	1,5	2,2	-	2,2	1,1	-	7,3	-	-	-
Winch	WBC [t]												120,0	120,0	120,0
	Safety factor	-	-	-	-	-	-		-	-	-	-	1,20	1,20	1,20
	Capacity [t]	-	-	-	-	-	-		-	-	-	-	100,0	100,0	100,0
	UC [%]	-	-	-	-	-	-		-	-	-	-	-	-	-
Line	Line Type	Other	Other	Other	Other	Other	Other	Other	Other	Other	Other	Other	Steel wire	Steel wire	Steel wire
	MBL [t]	30,0	30,0	52,0	52,0	30,0	30,0	52,0	30,0	30,0	170,0	30,0	91,0	91,0	91,0
	Safety factor	3,25	3,25	3,25	3,25	3,25	3,25	3,25	3,25	3,25	3,25	3,25	1,95	1,95	1,95
	Capacity [t]	9,2	9,2	16,0	16,0	9,2	9,2	16,0	9,2	9,2	52,3	9,2	46,7	46,7	46,7
	UC [%]	8,7%	6,5%	41,9%	-	16,3%	23,8%	-	23,8%	11,9%	-	79,1%	-	-	-

Fender forces:

Load case	Fenders					
	aa	bb	cc	dd	ee	ff
1	12	10	12	8	6	6
Maximum [t]	12	10	12	8	6	6

Bollard forces:

Load case	Bollards							
	B	C	E	G	K	M	P	S
1	2,2	4,5	4,5	3,1	13,3	0,6	14,6	0,8
Maximum [t]	2,2	4,5	4,5	3,1	13,3	0,6	14,6	0,8
WLL [t]	61	61	61	61	61	61	61	61
# Lines to Bollard	1	1	1	1	1	1	1	1
Safety factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Capacity [t]	61,0	61,0	61,0	61,0	61,0	61,0	61,0	61,0
UC [%]	3,6%	7,4%	7,4%	5,1%	21,8%	1,0%	23,9%	1,3%

For Barge bollards capacity check see chapter 7.3.3. as worst case scenario.

7.2.3 Redundancy condition

Below a summary of the maximum occurring loadings from the redundancy verification (single line failure).

Mooring lines forces:

	Load case	Mooring line													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
	2	Failure	0,6	6,7	Not used	1,5	2,4	Not used	2,4	1,1	Not used	7,3	Not used	Not used	Not used
	3	0,8	Failure	6,9	Not used	1,6	2,2	Not used	2,2	1,1	Not used	7,2	Not used	Not used	Not used
	4	0,8	3,3	Failure	Not used	4,9	5,1	Not used	4,7	0,2	Not used	7,2	Not used	Not used	Not used
	5	0,8	0,6	6,9	Not used	Failure	2,2	Not used	2,2	1,4	Not used	7,7	Not used	Not used	Not used
	6	1,1	0,6	6,9	Not used	1,4	Failure	Not used	4,1	0,8	Not used	7,6	Not used	Not used	Not used
	7	1,1	0,6	6,9	Not used	1,4	3,8	Not used	Failure	0,8	Not used	7,7	Not used	Not used	Not used
	8	0,8	0,6	6,5	Not used	1,8	2,2	Not used	2,2	Failure	Not used	7,9	Not used	Not used	Not used
	9	0,9	0,4	4,6	Not used	3,4	4,6	Not used	6,9	8,4	Not used	Failure	Not used	Not used	Not used
	Maximum [t]	1,1	3,3	6,9	-	4,9	5,1	-	6,9	8,4	-	7,9	-	-	-
Winch	WBC [t]												120,0	120,0	120,0
	Safety factor	-	-	-	-	-	-	-	-	-	-	-	1,00	1,00	1,00
	Capacity [t]	-	-	-	-	-	-	-	-	-	-	-	120,0	120,0	120,0
	UC [%]	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Line	Line Type	Other	Other	Other	Other	Other	Other	Other	Other	Other	Other	Other	Steel wire	Steel wire	Steel wire
	MBL [t]	30,0	30,0	52,0	52,0	30,0	30,0	52,0	30,0	30,0	170,0	30,0	91,0	91,0	91,0
	Safety factor	2,17	2,17	2,17	2,17	2,17	2,17	2,17	2,17	2,17	2,17	2,17	1,30	1,30	1,30
	Capacity [t]	13,8	13,8	23,9	23,9	13,8	13,8	23,9	13,8	13,8	78,2	13,8	69,8	69,8	69,8
	UC [%]	8,0%	23,9%	28,8%	-	35,5%	37,0%	-	50,0%	60,9%	-	57,2%	-	-	-

Fender forces:

Load case	Fender					
	aa	bb	cc	dd	ee	ff
2	16	10	12	8	6	6
3	11	10	12	8	6	6
4	10	19	12	8	6	6
5	11	11	12	8	6	6
6	15	10	12	8	6	6
7	12	10	12	8	6	6
8	11	10	12	8	6	6
9	10	5	12	8	6	6
aximum [t]	16	19	12	8	6	6

Bollard forces:

Load case	Bollard							
	B	C	E	G	K	M	P	S
2	2,2	4,7	4,7	3,1	13,3	0,6	14,6	0,0
3	2,2	4,5	4,5	3,1	13,8	0,0	14,5	0,8
4	0,4	9,3	10,2	9,9	0,0	3,3	14,3	0,8
5	2,7	4,5	4,5	0,0	13,8	0,6	15,3	0,8
6	1,6	8,1	0,0	2,7	13,9	0,6	15,1	1,1
7	1,6	0,0	7,6	2,7	13,8	0,6	15,4	1,1
8	0,0	4,5	4,5	3,5	13,1	0,6	15,7	0,8
9	16,7	13,9	9,3	6,8	9,2	0,4	0,0	0,9
Maximum [t]	16,7	13,9	10,2	9,9	13,9	3,3	15,7	1,1
WLL [t]	61	61	61	61	61	61	61	61
# Lines to Bollard	1	1	1	1	1	1	1	1
Safety factor	0,67	0,67	0,67	0,67	0,67	0,67	0,67	0,67
Capacity [t]	91,5	91,5	91,5	91,5	91,5	91,5	91,5	91,5
UC [%]	18,3%	15,2%	11,1%	10,8%	15,2%	3,6%	17,2%	1,2%

For Barge bollards capacity check see chapter 7.3.3. as worst case scenario.

7.3 Stand by up to 27m/s

To avoid overload in barge bollards, an external tug will be required for wind speeds higher than 44 knots. 20t pushing force has been considered for the calculation.

7.3.1 Load cases

Load case	Single line failure?	Which line fails?	Wind Speed [knots]	Wind Direction [°]
1	no	None	52,5	All
2	yes	1	53	All
3	yes	2	53	All
4	yes	3	53	All
5	yes	4	53	All
6	yes	5	53	All
7	yes	6	53	All
8	yes	7	53	All
9	yes	8	53	All
10	yes	9	53	All
11	yes	10	53	All
12	yes	11	53	All

7.3.2 Intact condition

Below a summary of the maximum occurring loadings from the intact verification.

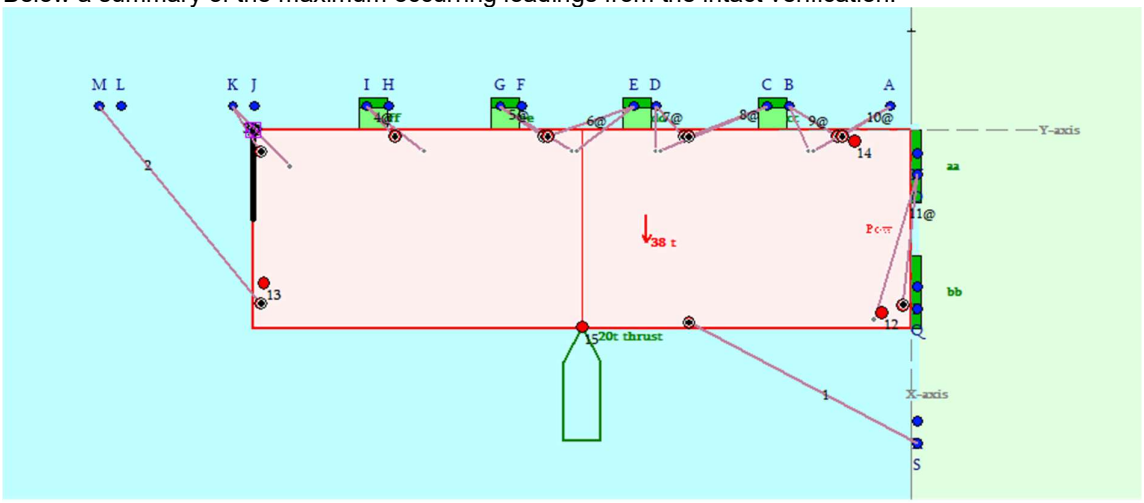


Figure 7-3: Intact condition – standby

Mooring lines forces:

	Load case	Mooring line													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
	1	1,8	0,5	4,6	4,6	1,4	3,5	6,2	2,8	2,3	12,2	2,0	Not used	Not used	Not used
	Maximum [t]	1,8	0,5	4,6	4,6	1,4	3,5	6,2	2,8	2,3	12,2	2,0	-	-	-
Winch	WBC [t]												120,0	120,0	120,0
	Safety factor	-	-	-	-	-	-		-	-	-	-	1,20	1,20	1,20
	Capacity [t]	-	-	-	-	-	-		-	-	-	-	100,0	100,0	100,0
	UC [%]	-	-	-	-	-	-		-	-	-	-	-	-	-
Line	Line Type	Other	Other	Other	Other	Other	Other	Other	Other	Other	Other	Other	Steel wire	Steel wire	Steel wire
	MBL [t]	30,0	30,0	52,0	52,0	30,0	30,0	52,0	30,0	30,0	170,0	30,0	91,0	91,0	91,0
	Safety factor	3,25	3,25	3,25	3,25	3,25	3,25	3,25	3,25	3,25	3,25	3,25	1,95	1,95	1,95
	Capacity [t]	9,2	9,2	16,0	16,0	9,2	9,2	16,0	9,2	9,2	52,3	9,2	46,7	46,7	46,7
	UC [%]	19,5%	5,4%	28,8%	28,8%	15,2%	37,9%	38,8%	30,3%	24,9%	23,3%	21,7%	-	-	-

Fender forces:

Load case	Fenders					
	aa	bb	cc	dd	ee	ff
1	32	23	33	22	18	18
Maximum [t]	32	23	33	22	18	18

Bollard forces:

Load case	Bollards										
	A	B	C	D	E	G	I	K	M	O	S
1	24,4	4,7	5,6	12,5	7,0	2,8	9,2	9,2	0,5	4,1	1,8
Maximum [t]	24,4	4,7	5,6	12,5	7,0	2,8	9,2	9,2	0,5	4,1	1,8
WLL [t]	61	61	61	61	61	61	61	61	61	61	61
# Lines to Bollard	1	1	1	1	1	1	1	1	1	1	1
Safety factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Capacity [t]	61,0	61,0	61,0	61,0	61,0	61,0	61,0	61,0	61,0	61,0	61,0
UC [%]	40,0%	7,7%	9,2%	20,5%	11,5%	4,6%	15,1%	15,1%	0,8%	6,7%	3,0%

For Barge bollards capacity check see chapter 7.3.3. as worst case scenario.

7.3.3 Redundancy condition

Below a summary of the maximum occurring loadings from the redundancy verification (single line failure).

Mooring lines forces:

	Load case	Mooring line													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
	2	Failure	0,5	4,7	4,7	1,4	3,7	6,4	2,9	2,4	12,5	2,1	Not used	Not used	Not used
	3	1,9	Failure	4,9	4,9	1,4	3,6	6,4	2,8	2,4	12,5	2,1	Not used	Not used	Not used
	4	1,9	1,0	Failure	9,0	1,8	3,6	6,4	2,8	2,4	12,6	2,1	Not used	Not used	Not used
	5	1,9	0,6	6,6	Failure	2,0	3,6	7,2	2,8	2,4	12,4	2,1	Not used	Not used	Not used
	6	1,9	0,5	4,8	5,0	Failure	3,6	6,9	2,8	2,5	12,3	2,1	Not used	Not used	Not used
	7	2,1	0,5	4,9	4,7	1,4	Failure	6,3	3,7	2,3	12,8	2,1	Not used	Not used	Not used
	8	1,9	0,4	4,8	5,7	2,1	3,6	Failure	2,8	3,3	15,8	2,6	Not used	Not used	Not used
	9	2,1	0,5	4,9	4,7	1,4	4,2	6,3	Failure	2,3	13,0	2,1	Not used	Not used	Not used
	10	1,9	0,5	4,5	4,9	1,7	3,6	7,3	2,8	Failure	13,5	2,4	Not used	Not used	Not used
	11	2,5	0,5	5,2	4,6	1,0	5,4	8,5	6,3	1,7	Failure	7,0	Not used	Not used	Not used
	12	1,9	0,5	4,6	4,7	1,6	3,6	7,6	2,8	3,2	14,7	Failure	Not used	Not used	Not used
	Maximum [t]	2,5	1,0	6,6	9,0	2,1	5,4	8,5	6,3	3,3	15,8	7,0	-	-	-
Winch	WBC [t]												120,0	120,0	120,0
Winch	Safety factor	-	-	-	-	-	-	-	-	-	-	-	1,00	1,00	1,00
Winch	Capacity [t]	-	-	-	-	-	-	-	-	-	-	-	120,0	120,0	120,0
Winch	UC [%]	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Line	Line Type	Other	Other	Other	Other	Other	Other	Other	Other	Other	Other	Other	Steel wire	Steel wire	Steel wire
Line	MBL [t]	30,0	30,0	52,0	52,0	30,0	30,0	52,0	30,0	30,0	170,0	30,0	91,0	91,0	91,0
Line	Safety factor	2,17	2,17	2,17	2,17	2,17	2,17	2,17	2,17	2,17	2,17	2,17	1,30	1,30	1,30
Line	Capacity [t]	13,8	13,8	23,9	23,9	13,8	13,8	23,9	13,8	13,8	78,2	13,8	69,8	69,8	69,8
Line	UC [%]	18,1%	7,2%	27,6%	37,6%	15,2%	39,1%	35,5%	45,7%	23,9%	20,2%	50,7%	-	-	-

Worst case for barge bollards corresponding to the lines 9+10.

Line 10 is distributed over both bollard posts, while Line 9 is assigned to a single post. The load calculation (15.8 + 2 × 3.3), resolved using vector analysis, results in 14.1 tons → OK

Fender forces:

Load case	Fender					
	aa	bb	cc	dd	ee	ff
2	23	24	33	22	18	18
3	24	24	33	22	18	18
4	36	26	33	22	18	18
5	31	24	33	22	18	18
6	35	24	33	22	18	18
7	31	24	33	22	18	18
8	27	25	33	22	18	18
9	26	25	33	22	18	18
10	35	25	33	22	18	18
11	24	24	33	22	18	18
12	24	25	33	22	18	18
Maximum [t]	36	26	33	22	18	18

Bollard forces:

Load case	Bollard										
	A	B	C	D	E	G	I	K	M	O	S
2	25,1	4,7	5,9	12,8	7,3	2,9	9,5	9,5	0,5	4,1	0,0
3	25,1	4,7	5,7	12,8	7,1	2,9	9,7	9,8	0,0	4,1	1,9
4	25,1	4,8	5,7	12,9	7,1	3,6	18,1	0,0	1,0	4,1	1,9
5	24,8	4,8	5,7	14,5	7,1	3,9	0,0	13,3	0,6	4,1	1,9
6	24,7	5,0	5,7	13,7	7,1	0,0	10,0	9,6	0,5	4,2	1,9
7	25,6	4,6	7,4	12,6	0,0	2,8	9,5	9,9	0,5	4,1	2,1
8	31,6	6,6	5,7	0,0	7,1	4,2	11,4	9,5	0,4	5,3	1,9
9	26,1	4,5	0,0	12,6	8,4	2,8	9,5	9,8	0,5	4,1	2,1
10	27,0	0,0	5,7	14,5	7,1	3,3	9,7	9,1	0,5	4,9	1,9
11	0,0	3,3	12,5	17,0	10,8	2,0	9,1	10,3	0,5	13,9	2,5
12	29,5	6,5	5,7	15,3	7,1	3,2	9,5	9,1	0,5	0,0	1,9
Maximum [t]	31,6	6,6	12,5	17,0	10,8	4,2	18,1	13,3	1,0	13,9	2,5
WLL [t]	61	61	61	61	61	61	61	61	61	61	61
# Lines to Bollard	1	1	1	1	1	1	1	1	1	1	1
Safety factor	0,67	0,67	0,67	0,67	0,67	0,67	0,67	0,67	0,67	0,67	0,67
Capacity [t]	91,5	91,5	91,5	91,5	91,5	91,5	91,5	91,5	91,5	91,5	91,5
UC [%]	34,5%	7,2%	13,7%	18,6%	11,8%	4,6%	19,8%	14,5%	1,1%	15,2%	2,7%

8 CONCLUSION

Based on the results of the mooring analysis for load-in configuration in Section 7, it has been found that:

- The winches have sufficient capacity
- The mooring lines have sufficient capacity
- The barge bollards have sufficient capacity
- The land side bollards have sufficient capacity

ANNEX A: VERVECE BARGE

MARNAVI S.P.A.
TRASPORTI MARITTIMI



90 x 27m. 300 Feet - Flat deck cargo barge

"VERVECE"

• MAIN DESCRIPTION

Built	June 1996
Builder	SEVMASH – SMP Shipyard SEVERODVISNSK (Russia)
Owner	MARNAVI S.p.A. - Naples
Classification	**BV** - I ✠ Hull, Pontoon, No Propulsion, Unrestricted Navigation
Additional Class	**RINA** - C ✠ Pontoon, S, Unrestricted Navigation
IMO number	9088330
Port of Reg. / Flag	Naples / Italian
BV Number	20382G

• MAIN PARTICULARS

Loa	:	91,440 mt / 300 ft
Breath Moulded	:	27,432 mt / 90 ft
Depth Moulded	:	6,096 mt / 20 ft
Summer load line	:	4,842 mt
Deadweight	:	9700 tons (at Summer Draft)
Displacement	:	11573 tons
Light Weight	:	1850 tons
GRT	:	4066 tons
NET	:	1219 tons

• DECK CAPACITIES

Deck area	:	2508 m^2
Uniform Deck Load	:	25 tons / m^2
Point loads	:	200 – 160 – 100 tons
Bollards	:	For mooring 205 KN – For towing 540 KN
Hull and Structures	:	Raked bow and stern with skeg. Welding according to NS 6038
Material Protection	:	All steel shotblasted to Swedish standard SA 2,5 and primed according Jotum material protection. External and internal Cathodic protection. 5 years anode protect.

• BALLAST PUMP CAPACITIES

Tank Arrangement	:	20 ballast tank served from one pump room
Pump capacity	:	2 x 600m^3

• MACHINERY

Engine / Pumps	:	2 x Mitsubishi diesel driving 2 SPP centrifugal pumps
Submersible pump	:	1 portable electrical driven submersible pump for stripping etc.
Generator	:	One Busck 10 KW / 3 x 400 V / 50 Hz
Batteries	:	2 x 24 V / 115 AH

• DECK EQUIPMENT

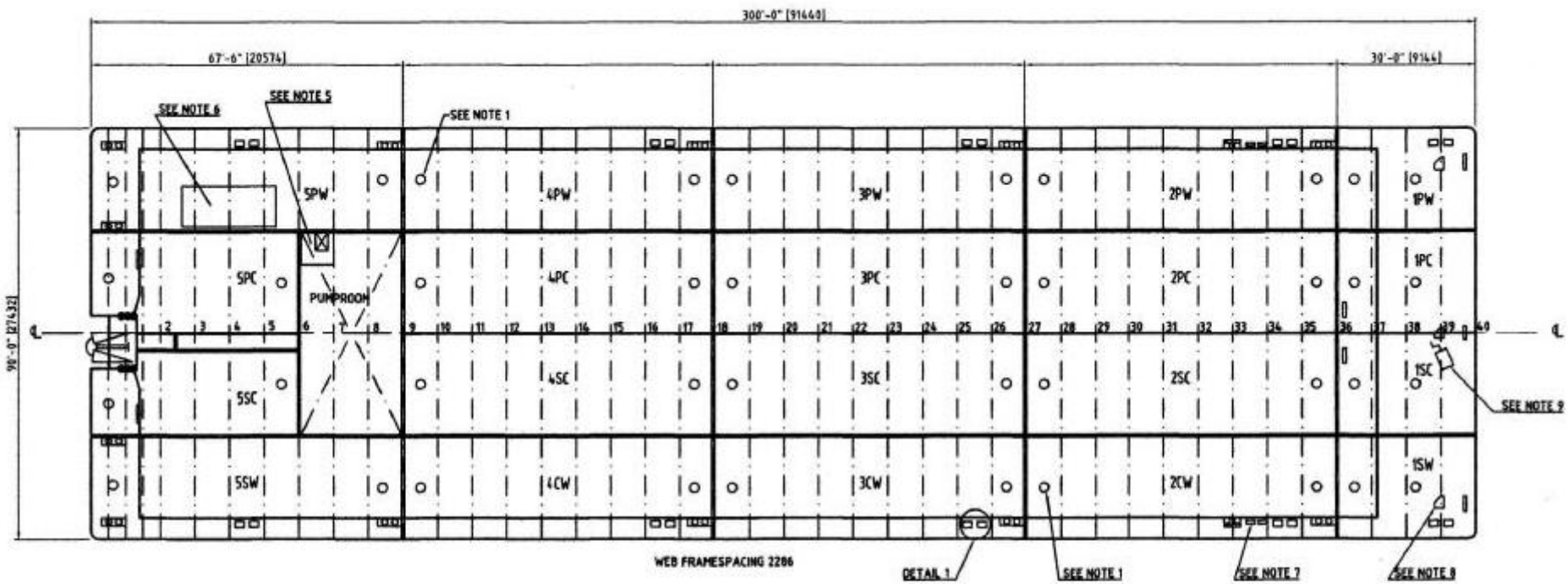
Navigation Light	:	Propane Gas lantern
Anchor	:	Type Stockless, weight 6300 Kg
Anchor Winch	:	Brattvaag / Hagglund hydraulic winch 18 tons pull 1000mt wire 32mm – BL 704 KN
Retriever winch	:	5 tons, manually operated
Towing arrangement	:	Smith's Brackets towing arrangement for main and emergency towing 100 tons SWL

and equipped with water treatment system (from 2023)

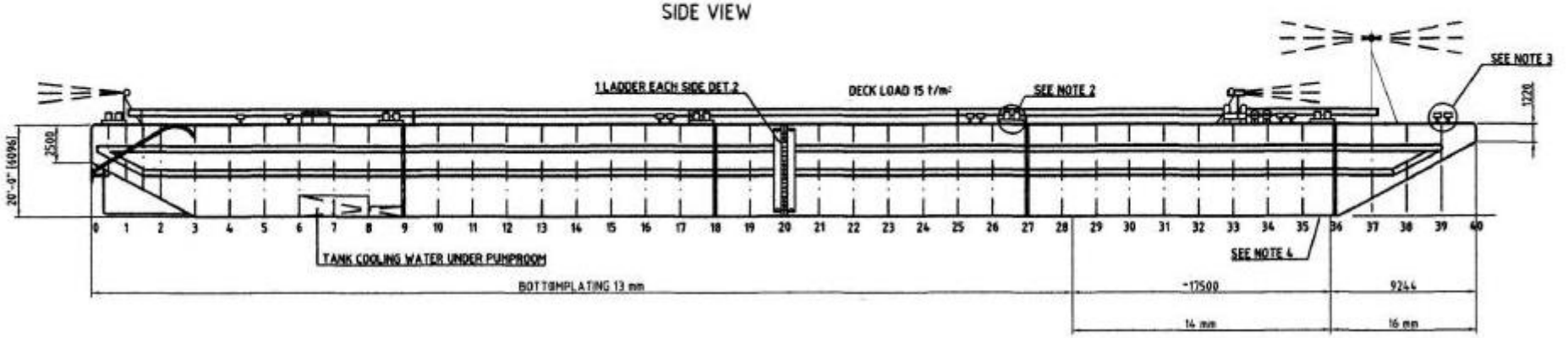
MARNAVI S.P.A. • Address: Via S. Brigida, 39 • 80133 NAPLES • ITALY • Phone: +39 081 251 33 00 • Fax: +39 081 251 33 57 • Email: offshore@marnavioffshore.it • Website: www.marnavi.it

C/B VERVECE – Flat deck cargo barge – 300 x 90 Feet / 90 x 27 m

DECK VIEW



SIDE VIEW



MARNAVI S.P.A.
TRASPORTI MARITTIMI

Whilst care has been taken in the preparation of this document, the data and/or information referred to herein are purely indicative and are not contractually binding . They must be checked with reference to the specific operations and are subject to change. No liability is accepted by the owners for any errors which may exist in this document.

ATTACHMENT H – SPMT METHOD STATEMENT FOR BLPH & TP

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

S-25-71129 – PL0003
Load In Manual – TP + Topside
Crosswind
Rosseti Marine



-	19.09.2025	First issue	TS	BD	JC	BD	39
Rev.	Date	Description	Dept.	Edited	Verified	Approved	Pg

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1 INTRODUCTION

The purpose of this document is to define and describe the Load In operation of the TP and BLPH Platform at the Buss terminal in Eemshaven – The Netherlands. Sarens will supply the transportation, ballasting and mooring equipment to perform the Load In and Transport operations.
The procedures and drawings mentioned in this document are to be followed for the successful and safe completion of the load-in.

The document provides information and documentation on the operation, equipment, actions, etc. for the load-out operation. It also shows that all reasonable measures have been taken with regards to minimizing any equipment malfunctions and risks to personnel and operations during the considered activities. The final version of this document after the approval of the Client be considered by the execution team as the main guide for the correct outcome of the operation.

1.1 General information

The procedures presented in the current document describes the load-in of both items from current position on the barge to the final position on the yard. The Load In will be performed using Self Propelled Modular Trailers (SPMT's). Using the hydraulic lifting capability of these trailers, the TP and Platform will be picked up from their grillage supports and driven off the barge. Once on the quay side, they will be moved towards the final parking position.

1.2 Reference documents

For this document the following references are used:

Design codes

[1] DNVGL-ST-0001: Marine Operations & Marine Warranty
[2] EN 1993-1-1: Eurocode 3 - Design of Steel Structures – Part 1-1 General Rules & Rules for Buildings
[3] EN 1993-1: Eurocode 3 - Design of Steel Structures – Part 1-8 Design of Joints

Sarens drawings

[4] S-25-71129_DR0100 - Deck Layout
[5] S-25-71129_DR1001 - SPMT Transport Configuration – TP
[6] S-25-71129_DR1002 - RoRo Ramp Layout – TP
[7] S-25-71129_DR1004 - Site Move Sequence – TP
[8] S-25-71129_DR2001 - SPMT Transport Configuration – Topside
[9] S-25-71129_DR2002 - RoRo Ramp Layout – Topside
[10] S-25-71129_DR2004 - Site Move Sequence – Topside
[11] S-25-71129_DR3001 - Mooring drawing

Sarens documents

[12] S-25-71129_PL0001 - Design Brief
[13] S-25-71129_PL0002 - SHEQ Plan
[14] S-25-71129_PL0004 - Load in Risk Analysis
[15] S-25-71129_CN0001 - RoRo Ramps Calculation
[16] S-25-71129_CN1001 - SPMT Capacity & Stability Calculation - TP
[17] S-25-71129_CN1002 - Barge Ballasting & Stability Calculation - TP
[18] S-25-71129_CN2001 - SPMT Capacity & Stability Calculation - Topside
[19] S-25-71129_CN2002 - Barge Ballasting & Stability Calculation - Topside

Client / Third party documents

[20] 123A90-DDL-TI-RE-99054 - BLPH – Load In Manual

1.3 Abbreviations and designations

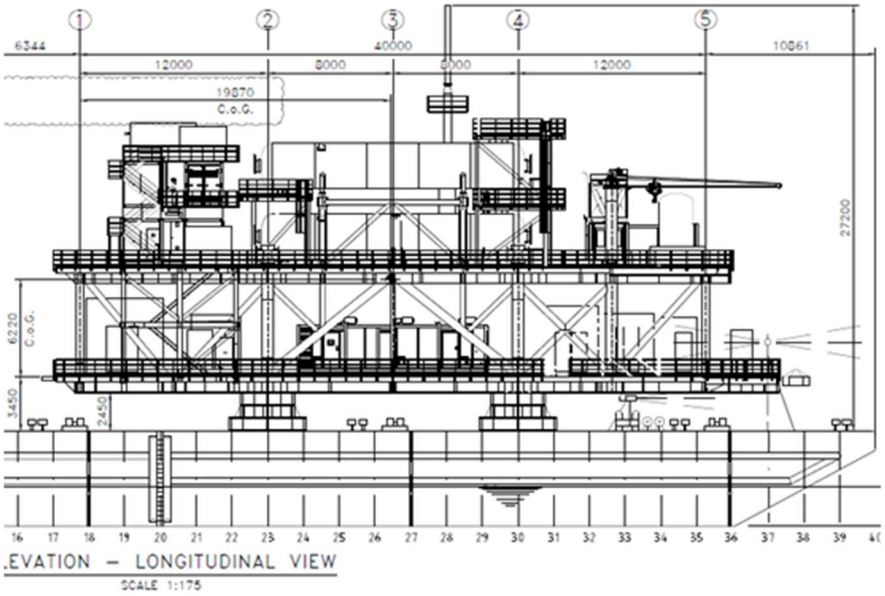
Item	TP / Platform
Client	Rosetti Marino
CoG	Centre of Gravity
Agent	Broekman
JSA	Job Safety Assessment
LCG	Longitudinal center of gravity
Load In	Movement of items from barge to quay
TP	Transition piece
Platform	BLPH platform
PPE	Personal Protection Equipment
Quay	Beatrix harbour – Eemshaven, NL
RA	Risk Assessment
Site / Yard	Buss Terminal Eemshaven, The Netherlands
SPMT	Self-Propelled Modular Trailer
SWL	Safe Working Load
T	(Metric) Tonne
TCG	Transversal center of gravity
UF	Utilization Factor
VCG	Vertical center of gravity
WLL	Working Load Limit

2 CARGO

The cargo to be transported are the TP and Platform

2.1 BLPH Platform

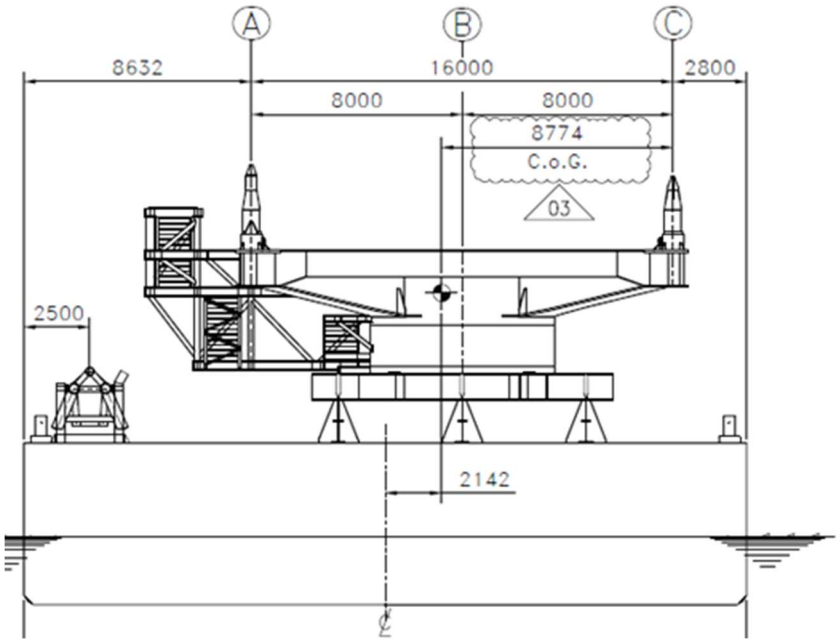
The Platform has the following characteristics:



Length	≈ 47.05 m
Width	≈ 29.11 m
Height	≈ 24.75 m
Net Weight	1700 t (incl 3% WCF)

2.2 TP

The TP has the following characteristics:



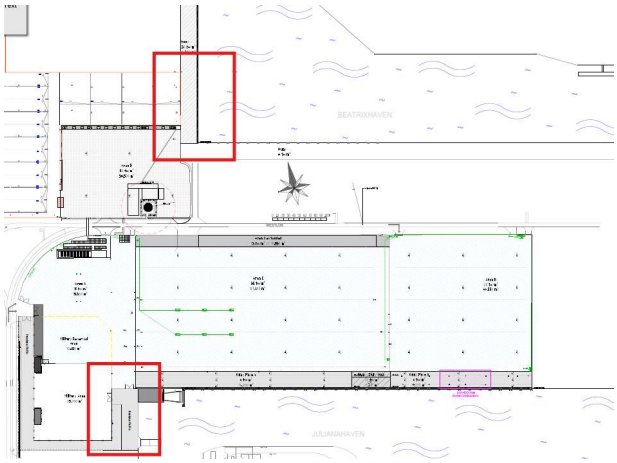
Length	≈ 19.40 m
Width	≈ 21.70 m
Height	≈ 7.90m
Net Weight	254.5 t (incl 3% WCF and upper grillage)

3 LOCATION OF THE WORK

3.1 Buss Terminal Eemshaven

The load-out operations will be conducted at the Buss Terminal, in Eemshaven – The Netherlands.





The used berth is the public Beatrix harbor, North of the main terminal area
Final set down location is at the south side of the main terminal area, close to the RoRo quay.

During Load In operations, limited traffic is allowed around the harbour basin.
Client to liaise with the Port authorities accordingly.

3.2 Quay

Quay infrastructure

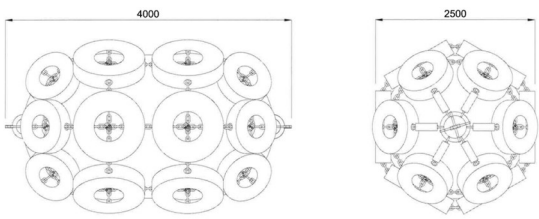
- Height of quay above N.A.P.: 4,5 mtr
- Water depth at quay side: 10 mtr
- Tidal range 2 – 3 mtr
- Distance Jack-up Barge: min. 1 mtr from quayside for jacking up
- Uniform distributed design load of quay side 300 kN/sqm
- Bollard pull 600 Kilo Newton (two bollards every 20 mtr)

3.3 Fendering

Four Yokohama fenders of 4.0x2.5 will be used in between the Barge Portside and Quay side to centre the barge between the bollard on the bow. Fenders will be supplied/installed by client.

The existing rubber fendering of the Beatrix quay will be used at the bow.

See mooring drawing for details.



3.4 Tides

Eemshaven official tide tables of 2025 will be used. Obtained from
https://waterinfo.rws.nl/publiek/astronomische-getij?parameters=&view=list

Eemshaven

Hoog- en laagwaterstanden en -tijdstippen

Oktober 2025

datum	uu:mm	HW cm NAP	LW cm NAP	datum	uu:mm	HW cm NAP	LW cm NAP	datum	uu:mm	HW cm NAP	LW cm NAP
1	*5:17*	101		**11**	*2:29*	131		**21**	*0:07*	124	
wo	*11:44*		-92	za	*9:08*		-154	di	*6:15*		-132
	18:04	79			*14:55*	141		*NM 14:25*	*12:05*	145	
					21:27		-133		*18:37*		-136
2	*0:06*		-80	**12**	*3:08*	131		**22**	*0:31*	125	
do	*6:37*	97		zo	*9:48*		-147	wo	*6:50*		-132
	13:00		-81		*15:43*	127			*12:32*	141	
	19:36	79			*22:05*		-120		*19:06*		-131
3	*1:29*		-70	**13**	*3:55*	127		**23**	*0:51*	128	
vr	*8:13*	105		ma	*10:31*		-135	do	*7:21*		-132
	14:47		-91	*LK 20:12*	*16:38*	112			*13:02*	138	
	21:08	91			*22:46*		-104		*19:33*		-129
4	*3:16*		-82	**14**	*4:54*	121		**24**	*1:18*	132	
za	*9:35*	122		di	*11:22*		-119	vr	*7:50*		-132
	16:04		-115		*17:45*	98			*13:34*	131	
	22:18	108			*23:39*		-87		*20:00*		-127
5	*4:27*		-104	**15**	*6:04*	117		**25**	*1:49*	131	
zo	*10:35*	139		wo	*12:32*		-106	za	*8:19*		-129
	17:04		-135		*19:00*	91			*14:04*	122	
	23:13	120							*20:27*		-122
6	*5:25*		-121	**16**	*0:58*		-76	**26**	*2:16*	128	
ma	*11:24*	150		do	*7:21*	118		zo	*7:47*		-124
	17:57		-147		*14:01*		-107		13:32	113	
					20:22	94			19:52		-117
7	*0:00*	127		**17**	*2:30*		-84	**27**	1:39	125	
di	*6:16*		-134	vr	*8:43*	127		ma	8:14		-118
VM 5:47	*12:08*	156			*15:20*		-122		14:00	104	
	18:45		-153		*21:41*	107			20:17		-113
8	*0:42*	129		**18**	*3:44*		-103	**28**	2:06	122	
wo	*7:02*		-145	za	*9:54*	140		di	8:44		-113
	12:50	157			*16:26*		-137		14:37	96	
	19:29		-155		*22:43*	118			20:51		-108
9	*1:20*	130		**19**	*4:45*		-120	**29**	2:49	117	
do	*7:46*		-152	zo	*10:49*	148		wo	9:25		-106
	13:30	155			*17:19*		-145	EK 17:20	15:33	87	
	20:10		-152		*23:31*	124			21:38		-98
10	*1:54*	131		**20**	*5:34*		-129	**30**	3:51	112	
vr	*8:28*		-155	ma	*11:32*	148		do	10:20		-97
	14:12	150			*18:01*		-143		16:42	80	
	20:50		-144						22:39		-85
								31	5:03	109	
								vr	11:35		-91
									18:02	81	
									23:57		-77

Referentievlak: NAP
LAT = NAP-192 cm

Nederlandse tijd
Cursief gedrukte tijdstippen zijn in ZOMERTIJD

4 EQUIPMENT

In this chapter the main equipment used for the operations is described.

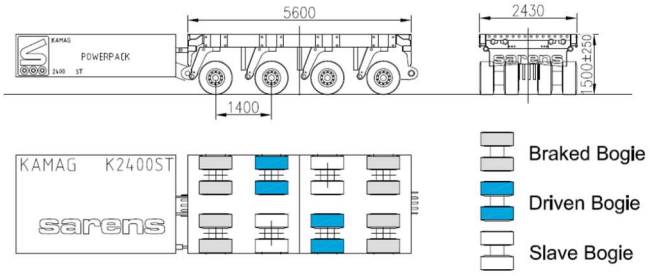
4.1 SPMT

The items will be transported using SPMT's of the type Kamag K24-ST. Both 4-axle, 5-axle and 6-axle modules can be used in the grouping.

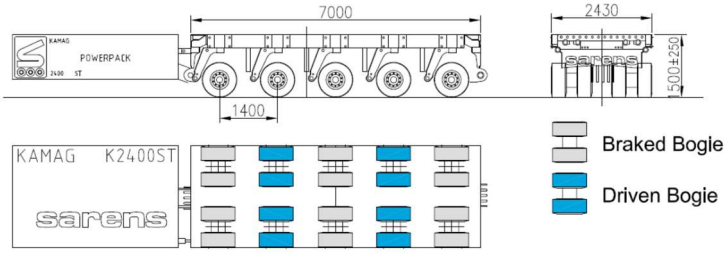
Platform configuration
2 rows of 30AL + MAXI PPU
1 row of 22AL + MAXI PPU

TP configuration
2 rows of 10AL + 2x MIDI PPU

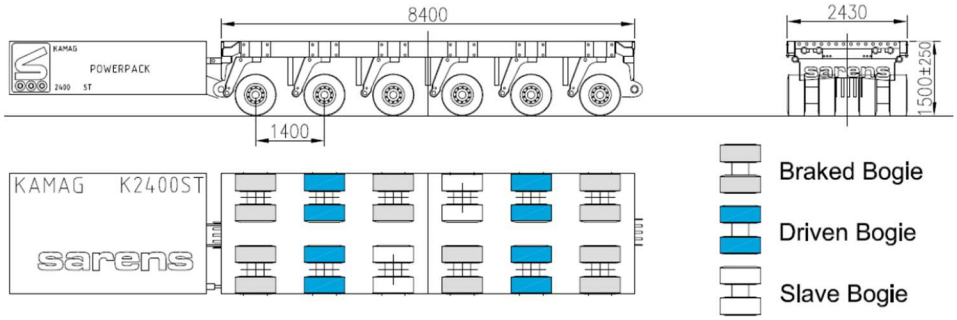
4 axle module:



5 axle module:



6 axle module:

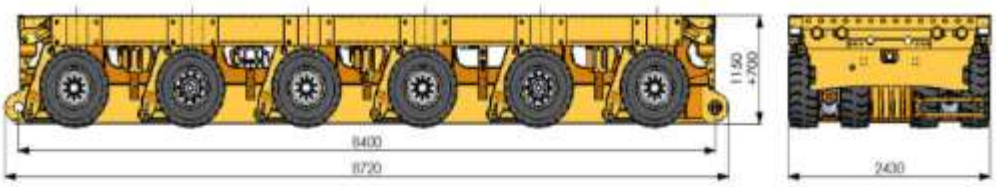


4.1.1 Kamag K24 details:

The below shown details are valid for a 6 axle module. The 4 axle module has similar characteristics but is shorter. Beside the amount of axles, driven axles etc, all other systems are similar

Modular Transporter K24 ST

Type K2406ST 4.6.PF24



Weights and Loads:		10 km/h	5 km/h	3 km/h	1 km/h
Dead weight		27.000 kg			
Payload [1]		160.200 kg	189.000 kg	213.000 kg	261.000 kg
Permissible total weight		187.200 kg	216.000 kg	240.000 kg	288.000 kg
Permissible axle load [2]	6x	31.200 kg	36.000 kg	40.000 kg	48.000 kg

Pendulum axles:	
Pendulum axles total	12
Pendulum axles driven	4
Pendulum axles braked	6
Standard tyres	355/65-15 Continental IC40
Tyre filling	polyfill

Drive system:	
Hydrostatic drive system	
Pulling force - total	240 kN
Permissible driving speed - unloaded [4]	12 km/h
Permissible driving speed with remote control	6 km/h
Electronic overspeed protection for wheel motors	
Emergency operation function	

Brake system:	
Hydraulic-mechanical service and parking brake	
Brake force - total [3]	240 kN
Emergency operation system	

Steering system:	
Electronic multi-directional steering with rack and pinon gear	
Steering angle	+/- 130°
10 steering programms, aligment system, emergency operation	

Lifting system:	
Hydraulic controlled axle load compensation	+/- 350 mm
Total lift	700 mm
Electro-hydraulically controlled equal lifting system	
1-circuit hose break safety system	
Emergency operation system: lifting and lowering	

Dimensions:	
Total length	8.720 mm
Coupling length	8.000 mm
Total width	2.430 mm
Platform height lowered (loaded)	1.150 mm
Platform height drive position (loaded)	1.500 mm
Axle base / Track	1.400 mm / 1.450 mm

Platform - Main beam:		
Bending moment	+ 9.250 kNm	/ - 9.250 kNm
Bending moment - stretched	-	-
Hydraulic locking cylinder (1 pc.)		

Electric / Electronic:	
Electric system	24 Volts
Electronic system via Industrial Ethernet / CAN-Bus system	
Emergency stop system w. performance level d (dual channel)	
1 emergency stop button on each side of the platform	
Side marker lights	

Painting:	
Painting in accordance with Kamag painting specification	
RAL-colour to customer's wishes (RAL 2000 standard)	
Anti-slip coating	optional

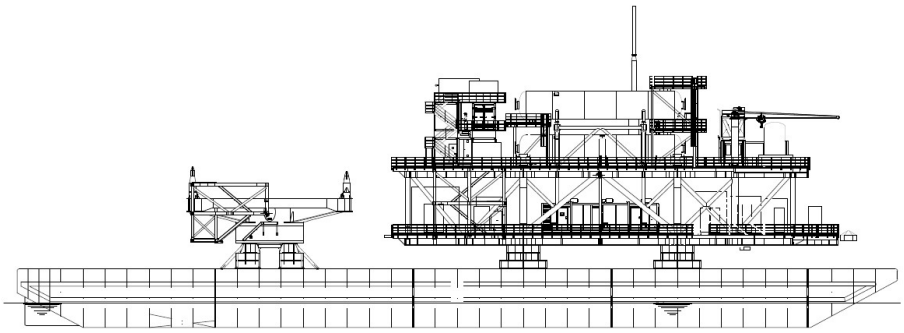
Standard accessories::
1 pc. LED working light
1 set of connections lines "end to end"
1 set of fixation part for longitudinal coupling
1 set of documentationincl. USB flash drive

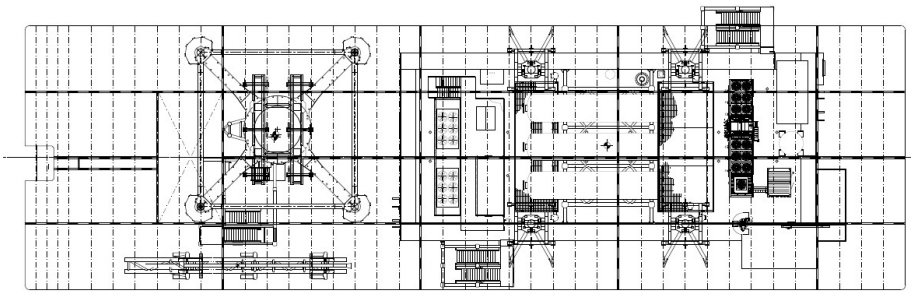
4.2 Barge

The Item will be offloaded from the barge Vervece which has the following specification

4.2.1 General data

General data – Vervece			
	Length	91.44	m
	Breadth	27.432	m
	Depth	6.096	m





4.3 RoRo Ramps

For the connection between the barge and the quay, RoRo Ramps with a length of 5.8mtr will be used. A general view of the RoRo Ramps is shown in the figure below.

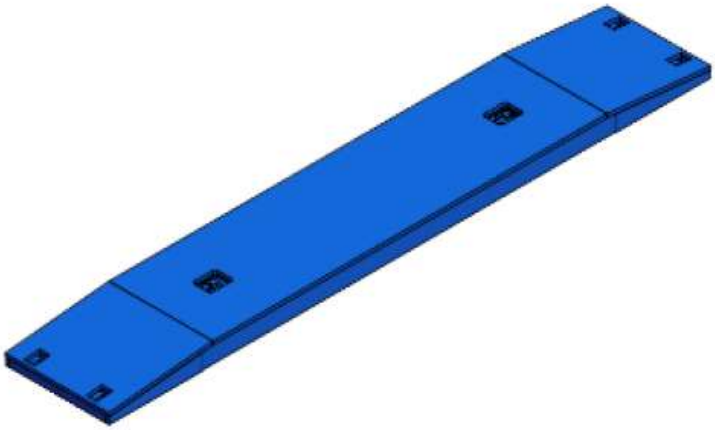


Figure 4-1 : RoRo Ramp 5.8m

The complete RoRo Ramp configuration consists of three main components:

- Wedges with cam
- Link span
- Wedges without cam

The wedges with cams are welded to the barge deck (3x 100 mm & a=4 mm per wedge). The ramps are to be positioned in such a way that the cams fit in the foreseen slots of the ramps. Below a typical wedge with cams (right) and without cams (left) is shown:

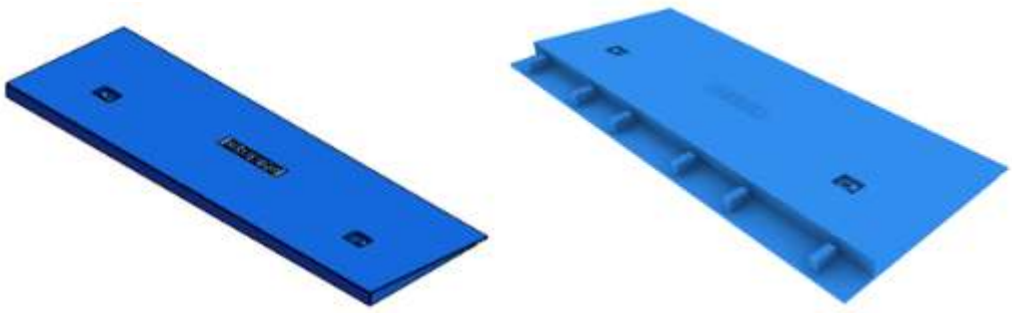


Figure 4-2 : RoRo Ramp Wedges

4.4 Ballasting equipment

During the Load In, continuous ballasting will be required for trim compensation. For the draft decrease due to the weight removal, the tidal variances will be utilized or additional water will be added to the tanks to keep the barge deck level with the quay

4.4.1 Ballasting equipment of barge

The internal ballasting system consists of 2 600m3/hr pumps with water treatment system. The internal system is not accounted for in the ballasting operations and will be used as a contingency.

4.4.2 External ballasting equipment

The external ballast pumps used are hydraulic driven submersible pumps. 16x semi-submersible pumps BE600 are used for ballasting the barge as per the Ballast Calculation.



Type	Hydraulic submersible ballast system
Brand	Ensival
Pump type	HC3VIM
Hydraulic motor	Rexroth A2FM 32
Max. Speed	1650 rpm
Max. pressure	400 bar
Max. return pressure	10 bar
Pump length	5250 mm
Pump diameter	390 mm
Pump weight	175 kg
Pump capacity @ 10m head	400 m³/h (@ 290bar)
Tube length	Variable extensions
Tube diameter	219,1 mm x 3 mm

These pumps are installed using a crane either hanging on the outside of the barge in the water, pumping into the barge tanks, or in the barge tanks to pump water out of the barge.

The pumps have 90° bend that can be extended with the pipes or flexible hoses, to reach tanks that are not directly near the edge of the barge.

4.5 Mooring equipment

The barge will moored by use of conventional polyprop mooring lines and winches. Details of both the operational mooring and the standby mooring can be found in mooring drawing

4.5.1 Polyprop lines

On the barge and tugs following lines would be available :

- Braided Polypropylene ropes MBL of 30t (Ø48mm)
- Braided Polypropylene ropes MBL of 52t (Ø56mm)
- Braided Polypropylene ropes MBL of 170t (Ø104mm)

4.5.2 Hydraulic winches HW40

For the winches, following equipment will be used:

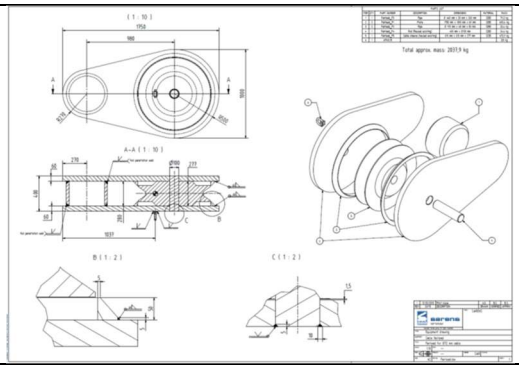
Dimentions:		
Length:	2970 mm	
Width:	2780 mm	
Height:	2075 mm	
Weight:	10000 kg (Without cable)	
Cable:	∅ 28 mm	
Standard hydraulic power pack:	2400 x 1100 x 1100 mm	
	1500 kg	
Drum specifications :		
Diameter of the drum :	1070 mm	
Diameter flanges :	2000 mm	
Width drum :	1270 mm	
Freewheel function:	NO	
Spooling system	NO	
Brake specifications :		
Manual-Mechanical blocking:	YES	
Brake type:	Drum Brake	
Brace capacity:	120 T	
Brake diameter:	1565 mm	
Brake Width:	240 mm	
Capacities :		
Motor info:	A2FM90/61-WVAB026	
Flow of motor:	90 cc	
Max. motor torque	572,97 Nm	$\Delta P = 400$
Reduction:	331	
Max. traction force first layer:	35,0 Ton	DP=400Bar
Max. traction force on average layer hieght:	24,6 Ton	DP=400Bar
Rope Speed (no-load) :		
Flow of Powerpack	90 cc	
Max rpm Powerpack	2000 RPM	
Max Drum revolutions:	6,0 RPM	
Max. speed agerage level:	29,1 m/min	



4.5.3 Fairleads

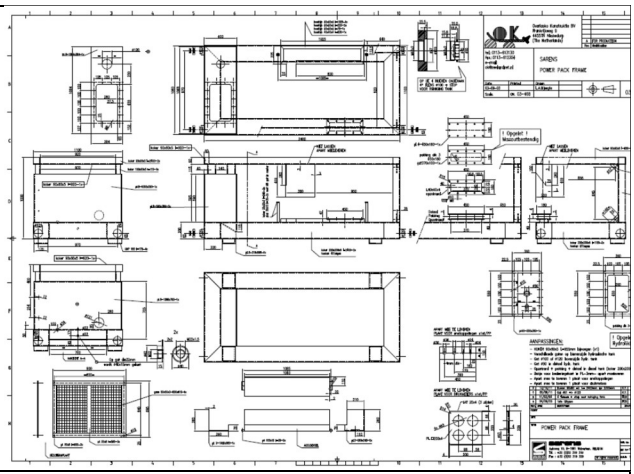
Fairleads are used to guide & orientate the mooring lines from the barge winch towards the mooring bollards/points on quay and/or to anchors.





4.5.4 Powerpack winches





DIMENSIONS & WEIGHTS		
	Length x Width x Height	2400 x 1100 x 1100 mm
	Weight	1850 kg
TECHNICAL SPECIFICATIONS		
	Pump type	REXROTH A4V90 (closed loop system)
	Diesel engine	DEUTZ / JOHN DEERE
	Fuel tank	200 liter
	Hydraulic oil tank	175 liter

5 SAFETY & GUIDELINES

A risk assessment for the different activities during the load-in work was made (see ref documents) :

- General risks
- General barge operations
- Working with SPMT
- Barge ballasting operations

5.1 General

- The overall safety procedures are based on the site procedures and the SHEQ plan. Further information is to be provided by the client during the site induction.
- All operations will be performed in such a way that applicable legal requirements are met.
- Access to the operation area shall be restricted to the parties involved in the operation. Only authorized personnel shall be present in the area. It is the responsibility of all parties involved to keep all personnel not directly involved out of the working area.
- The Sarens site supervisor will hold a daily start-work meeting. During this meeting all planned operations of that day will be explained, specific risks will be pointed out and the corresponding measures will be discussed.
- Required PPE:
    - Safety shoes
    - Safety helmet
    - Safety glasses
    - Work clothes
    - Gloves
    - Ear protection (when needed)
    - Life jacket, when at the quayside or the barge, 2m or less from the edge and no handrailing is present.

5.2 Specific Precautions

In order to minimize the risks and damage to personnel and equipment the following precautions should be taken into account:

- Life jackets should be worn on the barge or near the water edge, when 2m or less from the edge and when no handrailing is present.
- Client will provide gangway for access to/from the barge, always check visually if the gangway is properly fixed/supported.
- During the Load-in no-one except authorized personnel is to be present on the barge.
- During the Load-in the Sarens supervisor is in command of the operation. No site operations influencing the Load-in should be carried out without the explicit approval of the site supervisor.

5.3 Environmental Criteria & Weather

The environmental requirements are set to ensure safe operation and proper functioning of the Transport equipment.

5.3.1 Lighting

The Load-in activities will be carried out during daylight. If needed, lighting on/near the barge and quay should be foreseen by the client. These lights should be available at all times so that they can be switched on whenever deemed necessary.

5.3.2 Wind

Operationally the maximum allowable wind speed shall be limited to 12 m/s (10 min mean) with a maximum gust of 15 m/s. For installing and removal of the ramps/wedges, the max windspeed will be determined by the mobile crane.

The mooring verification has been made for a wind speed of 18 m/s. Should the actual wind be comparable to the maximum wind limits, the situation will be evaluated on site with all parties involved. The day prior to the Load-out a weather forecast will be provided by Sarens to ensure that all meteorological conditions are satisfied.

If the actual wind is comparable to the high wind limits, the situation shall be discussed with the yard and postponing of the load out considered.

If the weather forecast warns for strong gales and wind speeds exceeding 12 m/s, the weather situation shall be discussed with the MWS and Client and a decision will be taken to cancel or postpone the operation.

5.3.3 Temperature

No temperature constraints have been imposed on the Load-out.

5.3.4 Rain

The presence of rain does not pose any problem for the transport, thus no restrictions have been imposed concerning rain for the Load out itself.

However, as heavy rain can affect related load-in operations and activities (for example sea-fastening removal), this is a point of attention.

5.3.5 Hydrological

Hydrologically, following conditions have been assumed in the calculations. Should these be exceeded the calculation need to be revisited.

- **Current**
  Maximum current velocity in front of the quay is assumed (conservative) equal to 2.5 kts

- **Waves**
  No significant waves are expected. No waves have been considered in the mooring calculation. The barge is moored into a corner of a sheltered quay.

- **Tide**
  The Load In has been defined as a Class 1 operation as the barge cannot survive the tide during the Load Out window. Also certain water level is needed to start the load out, depending on the minimum draft of the barge.

- **Swell**
  Vertical barge movement due to swell shall be limited to less than 100 mm. Note that in such case 50mm extra ramp clearance is needed to prevent that the ramp can get in contact with quay.

5.3.6 Soil description and capacity

For the soil and quay, the following requirements should be satisfied:

- Resist to a tire pressure / footprint of 12 bar
- Maximum ground pressure of 30 t/m^2 on Load Out quay
- Maximum ground pressure of 15 t/m2 on Terminal
- Maximum ground pressure of 10 t/m2 on final storage position
- A maximum longitudinal and cross slope of 2 %

All foundations and soil preparations are to be completed by the client. On the transport route, only small differences in level due to the unevenness of the terrain are allowed.

5.3.7 Weather window

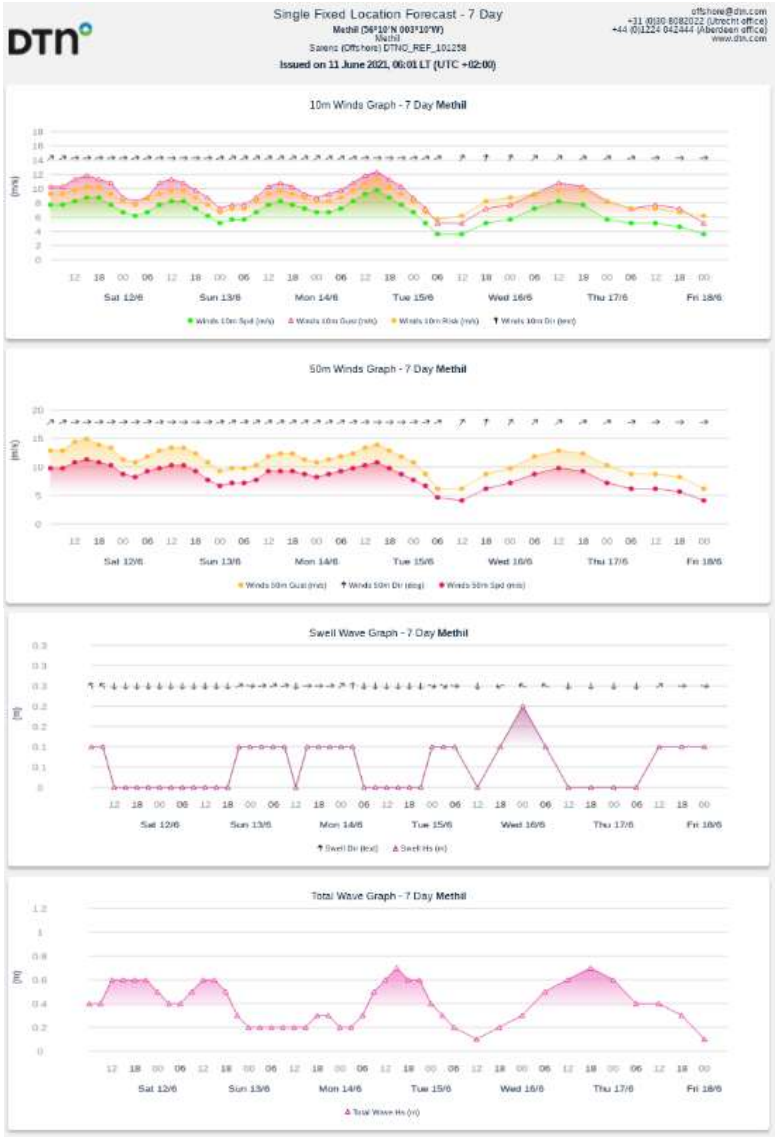
The weather window is defined as following:

- 4 hours of operations
- 2 hours of contingency
- Total Tpop of 6 hours window with max 12 m/s mean (10 min mean) and 15 m/s gust, counted from the time the link spans are positioned until the link spans are removed from the barge. Note that this value is typical and that

5.3.8 Weather forecast

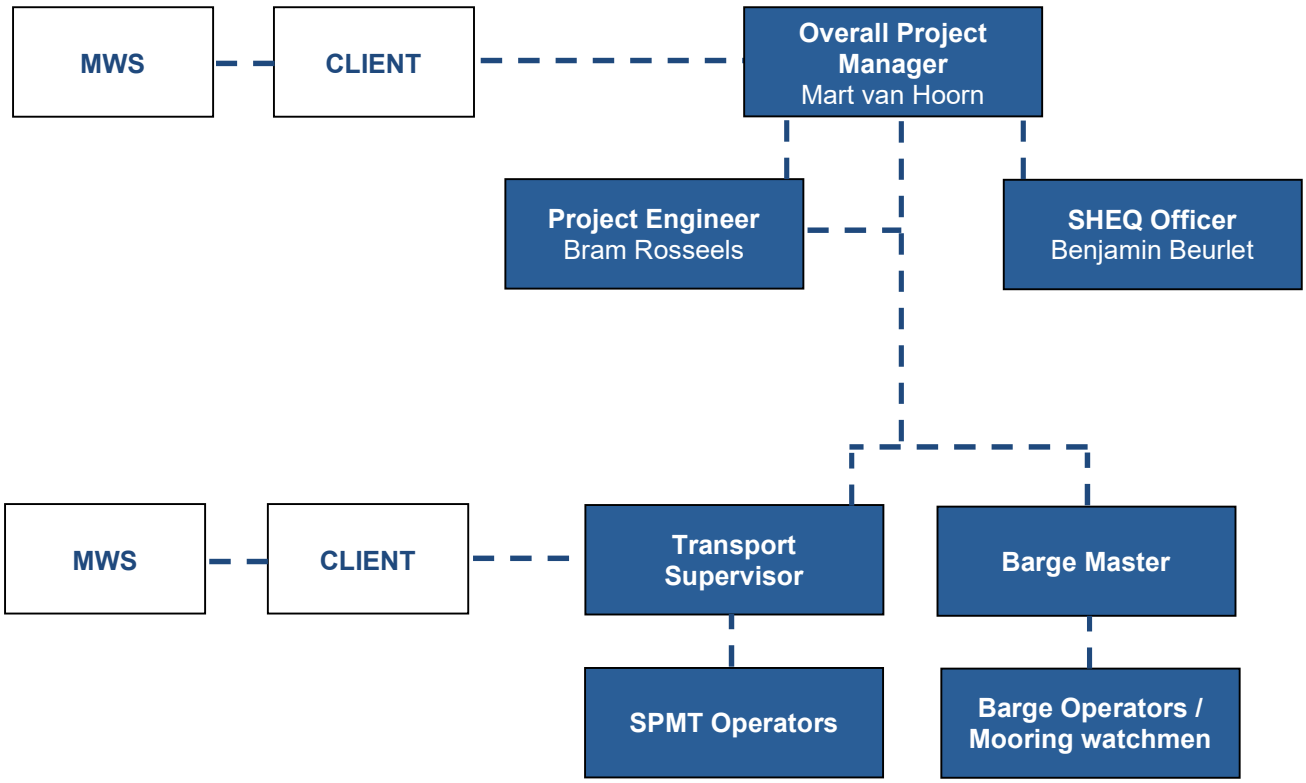
Starting 5 days before the load-in client will provide, a daily detailed 5-day weather forecast, to show the wind speed (mean & gust) and direction, wave height, swell height, visibility and temperature.

This forecast can be provided by a recognised service, such as DTN (www.dtn.com). Example of such a forecast included below



6 ORGANISATION & COMMUNICATION

6.1 Project Organisation Chart



Project Manager

The Project Manager is the senior Sarens representative and is responsible for the day to day as well as the commercial matters pertaining to this Project. With the assistance of the Project Engineer and the Site Supervisor, the Project Manager is responsible for the planning, quality and safety performance of the works in a timely and expeditious manner. The Project Manager will also establish and maintain close contact with the client's quality department, and supervise administration of the Project. He will also give senior management support to the implementation of the Project Safety Plan and the promotion of safety by encouraging and recognizing good attitudes. It is the responsibility of the Project Manager to ensure that the Site Supervisor is adequately briefed on the content of this Method Statement. The Project Manager will take necessary decisions in the event that a change to the procedure will be required during operations.

Project Engineer
The Project Engineer is responsible for the preparation of the necessary technical solutions and the related documentation performed for the operations. As such, he is responsible for preparation and collection of calculation notes, procedures, drawings and related documentation required for the intended operations.

SHEQ Officer
The SHEQ Officer (also referred to as Safety Officer) will coordinate and organize all safety activities and instruct the key personnel about the safety regulations. He shall take part in the preparatory meetings if required. The position of Safety Officer can be combined with function of Site Supervisor for the on-site activities. He will be responsible to specify and ensure that the necessary safety equipment is available in the designated areas during the load-out operations.

Barge Master
The barge master will have the on-site responsibility for the intended operations. He is directly in charge of the operators & the local assistance crew. He is also responsible for the correct operation of the different Load-in system and controls the movement of the cargo throughout the operation, in close collaboration with the Operators.

SPMT Operators
They are responsible for the correct operation of the SPMT's and control the movement of the cargo throughout the operation. They report to the Site Supervisor.

Client responsible
The Client operations responsible will have the responsibility for the overall schedule and all necessary site preparations to allow Sarens to execute the work. He will be the single point of contact for Sarens and is the person responsible for the coordination and organisation of all Client activities (site preparations, planning, time schedule, etc.). He will communicate with Sarens during the operation and is also involved in the meetings before and during the operations.

6.2 Communication

To ascertain correct lines of communication during the operation, direct orders will follow the organizational chart. All parties involved are in constant communication and will act on instructions from the Sarens Project Manager or Site Supervisor only. All communications will be done in English.

In particular, all communications between Sarens and the Client will be through the Project Manager or his representative during his absence.

6.2.1 Communications at the site

During the activities on site, all communications between Sarens and Client will pass by the Sarens responsible at site. This could be the project manager or the Site Supervisor.

During the transport and load-out operation all the instructions will be given by the site supervisor. He will be in charge of the operation. All parties involved are in constant radio communication. The communications on site will be done in English.

The Sarens Project manager will be the single point of contact for all parties outside of the Sarens organization. In absence of the Project manager, the supervisors will take the place as vocal point.

6.2.2 Meetings

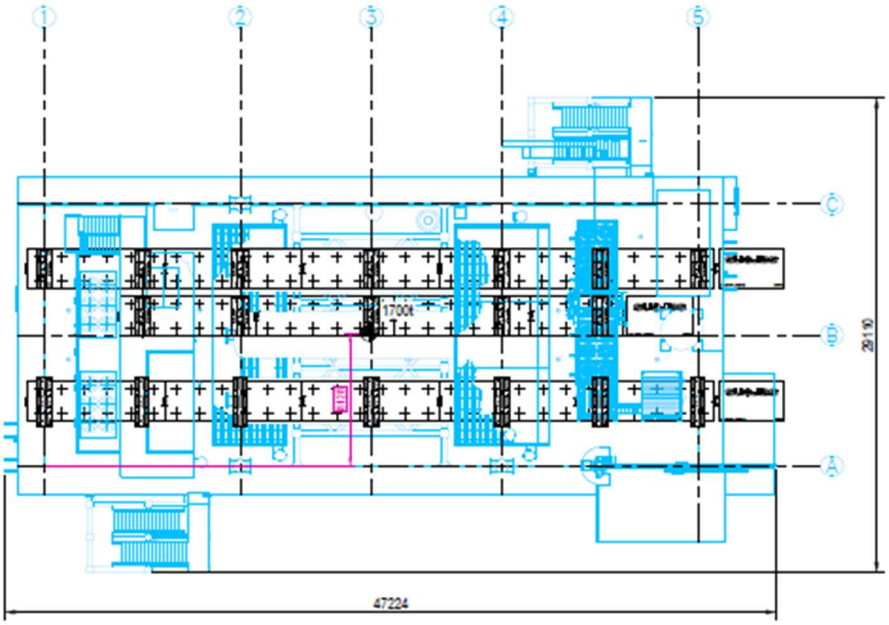
To ensure correct communication during the operation, meetings will be held at certain times.

- If required, status meetings throughout the preparation to ensure all parties are still on schedule.

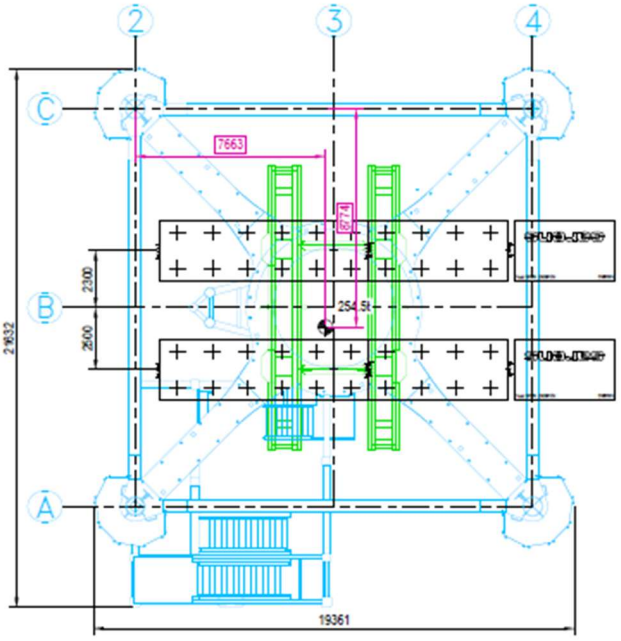
- Kick off meeting before start of the Load Out: a small meeting will be held between Sarens, Client and MWS. In this “kick-off” meeting, following items will be discussed:
  - Weather forecast: when the weather forecast looks unfavorable, the decision can be made to “hold” the procedure.
  - Particular specific requirements for each item can be discussed.
  - The “Kick-off” decision will be given.
  - A short toolbox will be included describing the operations which are to take place.
  - The “Kick-off” decision will be given. Go/NoGo

7 TRANSPORT ARRANGEMENT

The Load in of the topside will be performed using SPMTs Kamag K24-ST. For details refer to the transport drawings of both items



Transport arrangement for the TP :



8 OPERATIONAL PROCEDURES

In this chapter all phases of the operation are described. As some of the operations that are being carried out are a joint effort of various parties, it is advised to also consult the documentation prepared by those parties.

To avoid that this document becomes outdated when drawings are updated, no figures will be included. Instead the reader is referred to the relevant refence documents or drawings. Also the sequence of the activities might be different then descripted here. If certain work can be done in advance, this should be considered.

Independently of the description below, the actual scope division is determined in the contract, which will determine who is responsible for a certain activity.

8.1 General Safety Information/Preparations

DETAILED METHOD OF WORK	ACTION
• Safety conditions check, such as weather, site preparation, yard activities, …	All
• Required PPE: Working clothes Safety shoes Safety helmet Safety glasses Gloves (when needed) Ear protection (when needed) Safety harness (when working at heights) Life jacket (when working within two meter of edge of barge or quayside)	All
• Before the start of the intended activities, a kick-off meeting is organized to go through all planned activities, and where the specific risks are being pointed out and the corresponding measures are discussed in detail. Goal of the meeting is to ensure all involved know what their responsibilities and tasks are.	All
• Clearing work area during the full duration of work execution, setup of exclusion zone for non-authorized people.	Client
• Inspection of transport route and working areas (e.g. evenness/overall conditions/compaction strength, etc.). Areas to be cleared of obstacles by client.	All
• Inspection of Items	Client

8.2 Yard Preparations

DETAILED METHOD OF WORK	ACTION
• Clearing, filling and levelling working area and transport route	Client
• Permission of port authority for mooring the barge and crossing the public road between the 2x BUSS yards	Client
• Provide steel plates for below the ramps	Client

8.3 Mobilization & Preparations of Equipment

DETAILED METHOD OF WORK	ACTION
General	
• All equipment will be mobilized to site by road transport.	Sarens
• Before the work on site will start, a start work meeting will be held with the Sarens team.	Sarens
• Powerpacks of the ballast pumps and winches will be function tested on arrival, start/stop and see if pressure is given the outlet couplings. Fuel level to be checked and fueled if needed	Sarens
Offloading equipment	
• Use of telescopic cranes and/or telehandler for offloading of equipment	Sarens
• During unloading / assembling, no other activities in the indicated assembly area are permitted	Sarens
• Offloading and positioning of ramps and wedges close to the quayside at Load in position	Sarens
SPMT assembly	
• The trailers will be built up into the required configuration for the transport.	Sarens
• A crane is needed for assembling a Powerpack to a SPMT-unit. Once there is one SPMT-Powerpack combination, other SPMT modules can be assembled without the use of the crane. Separate trains will be connected through coupling blocks to each other for fixation	Sarens
• The SPMT trains will be independently function tested i.e. steering, hydraulic suspension, drive and braking while being positioned in the overall group.	Sarens
• Supports will be placed on top of the SPMTs according the drawing. Plywood or other friction material (rubber) will be used to prevent steel to steel surfaces	Sarens
Ballast pump assembly	
• The pumps are taken out the pump frames (using small crane or telehandler) and extended with pipes and a °90 bend near the barge location.	Sarens

• For the topside 12x pumps are needed, 2x pumps (for tank 2PS and 5PS) will be non-submersible pumps as the manhole openings are blocked by the items on the barge. (not possible to install with crane)	Sarens
Mooring set up	
• Once the barge is moored, the winches and fairleads can be lifted and installed in the correct position under supervision of Sarens supervisor	Client

8.4 Barge Arrival

DETAILED METHOD OF WORK	ACTION
• Upon barge arrival, it will be moored parallel to the quayside with polyprop lines, according the standby mooring drawing	Client
• Installation of a walkway between barge and quay	Client
• Inspection of the barge and items, and later also inspection for loose items that came loose and can fall down during transport	Client

8.5 Barge Preparations

DETAILED METHOD OF WORK	ACTION
Linkspans	
• Lifting, positioning and welding (client) of link span wedges / cams on barge bow	Sarens / Client
Winches	
• The mooring winches, hydraulic powerpacks and fairleads are installed on the barge	Client/Sarens
• The winches are fixed on the barge deck with stopper plates that are welded on the deck	Client
• The fairleads are welded directly on the barge deck	Client
• Once the powerpacks are connected onto the winches a function test is done to see if the winch is working (up/down).	Sarens
• While the winch operator pays out the winch cable, the end of the winch cable is pulled away from the winch towards the fairlead. The cable is guided via the fairlead. With a crane, the winch cable is lifted and brought and installed onto the correct bollard on the quay.	Sarens
• The cable will not be tensioned, this is only done during the load-in work when the SPMTs are driving on/from the barge.	Sarens

Ballast pumps	
• Opening the manholes and check if the clearance of the opening (600x400mm) in the tank is all the way down to the tank bottom. If staircase, walkways, platforms, or pipes in the tanks are in vertical line with the opening, they need to be removed	Client
• Lift and install the submersible pumps in the tanks, according the ballast plan. Once the pumps are installed the horizontal pipes/tubes will be installed to transfer the water from the tank to the side of the barge.	Sarens
• Both inboard and outboard pumps are installed, using a crane.	Sarens
• Lifting the powerpacks on the barge with the crane and connecting the ballast pumps onto the powerpacks.	Sarens
• Function test of the pumps to see if water is pumped IN/OUT of the tank. During this test we check for possible hydraulic leakages	Sarens
• Pre-ballasting of the barge for roll-on the empty trailers done for tanks with the Sarens pumps	Sarens
• Pre-ballasting of the barge for roll-on the empty trailers for the other tanks are done with the internal ballasting system of the barge	Client

8.6 Load-in of the Topside

DETAILED METHOD OF WORK	**ACTION**
• Once the barge is levelled with the quay, the mooring lines of the winches will be tensioned	Sarens
• The ramps and wedges on the quay will be installed using the crane	Sarens
• Below the ramp-end and wedges on the quay, client will install steel plates	Client
• Verification is done to see that there are no obstacles on the transport route.	Sarens
• Final verification of the SPMTs is done	Sarens
• **Go / No go meeting, to discuss if all parties are ready to proceed**	Client / MWS / Sarens
• The SPMT will be driven onto the barge instructed by the barge master	Sarens
• During roll-on, the ramp clearance is monitored. With removing water from the ballast tanks according the ballast plan, the barge is kept level with the quay	Sarens
• When ramp clearance is too small, the SPMT will slow down or stop driving until the barge is brought up by removing more ballast water.	Sarens
• When ramp clearance is too much the SPMT will speed up or the ballast pumps are stopped.	Sarens
• The SPMT trailers are maneuvered in position below the topside, some markings on the transport beams or from the grillage will be made for reference	Sarens

• Once in position, the trailer deck with the supports will be raised using the hydraulic system until contact with the transport beam	Sarens
• The trailer computers will be programmed and interconnecting data cables will be installed to create one trailer combination. Also hydraulic suspension will be set into a 3-point suspension as per drawing and the combination will then be function tested as a whole.	Sarens
• **Go / No go meeting, to discuss if all parties are ready to proceed**	Client / MWS / Sarens
• Certificate of Approval (COA) is provided	MWS
• Verification is done to see if all transport beams are properly supported by the SPMT and that all load is on the trailers. Hydraulic pressures are checked and compared with the expectations.	Sarens
• Depending of outcome lashing calculation the lashing is attached	Sarens
• With sufficient clearance between the transport beams and the grillage the topside is moved towards the bow of the barge. At the same time the ballasting is done according the ballast plan to keep the barge level with the quay. Communication between the SPMT supervisor and barge operators is done via the barge master.	Sarens
• The barge master will give instruction to the SPMT supervisor to start/stop driving, increase/decrease speed during the load-in operation. He is in charge of following up on the ballasting of the barge. He will be informed about the ramp clearance, the water level in the various tanks, as well as the level of the barge. Based on this information and the ballast calculation, he will provide feedback to the barge operators to ensure proper ballasting is done to control the trim and heel of the barge.	Sarens
• Check for level of the barge will be done by using spirit level, also the difference in ramp clearance between PS and SB, is used to determine transversal inclination of the barge.	Sarens
• The SPMT operator will keep advancing the transport configuration until the barge master gives the instruction to stop. The Load-in operation will be fully dependent on the speed of the ballasting and the tide. In principle the SPMT operator will keep advancing as long as there is an acceptable gap between the linkspans and the quayside (not using the full stroke of the SPMTs to keep transport horizontal)	Sarens
• Once the SPMT is one the quay side, the ramps are removed and the mooring winches will be operated to slack the lines.	Sarens

8.7 Site move and set down of the topside

DETAILED METHOD OF WORK	ACTION
• **Go / No go meeting to discuss if all parties are ready to proceed**. Special item to check is the approval for crossing the public road between the 2x yards	Client / MWS / Sarens
• Site move is done towards the setting down location	Sarens
• Once the topside is in correct position above the stools, the trailer will be lowered until just touching down	Sarens
• Approval for final position to be given	MWS / Client

• By decreasing in slow steps in the hydraulic pressure in the SPMT, the topside is set down onto the supports	Sarens
• In steps of 25% the load is set down, check to be done if all the transport beams are supported properly. This can be agreed on site with client and MWS.	MWS/Sarens /Client
• When shimming would be required, the item will be raised to get sufficient clearance.	MWS/Sarens /Client
• Once the load is set down, the data and hydraulic connecting between the SPMT trailers is removed	Sarens
• The separate SPMT trains are re-programmed, while also each trailer is set with a 3x point suspension	Sarens
• Trailers are removed from below the item	Sarens
• Supports are removed from the SPMTs	Sarens
• SPMT are ready to be split and prepared for transport, or ready to be changed for the next transport set up	Sarens

8.8 Load-in and site move of the TP

DETAILED METHOD OF WORK	ACTION
• Activities for the TP are quite similar	Sarens
• Ballast pumps and their powerpack might need to be repositioned to work according the ballast plan made for the TP	Sarens

8.9 Barge sail away

DETAILED METHOD OF WORK	ACTION
• Once the load out of the TP is done, the pumps on the outside from the barge will be removed and disassembled.	Sarens
• The wedges with cams that are welded on the barge bow can be removed and cleaned up.	Sarens / Client
• The winch cables will be released from the bollards using the crane and rolled up on the winch. Once the powerpacks are disconnected, the stoppers will be cut to lift the winch from the barge	Sarens / Client
• Before removal of the pumps from the tank, we can remove the water. Note that with these 600t/h pumps approx 40-50cm water remains in the tank.	Sarens
• Closing the manholes, restore railing and other works to prepare for sailaway	Client

8.10 Demobilization

DETAILED METHOD OF WORK	ACTION
• Disassembly of the SPMTs	Sarens
• Loading trailers and other equipment onto trucks using crane, forklift and telehandler	Sarens
• Departure of Sarens personnel from site	Sarens

9 CONTINGENCY PLANS

9.1 Introduction

This chapter sets out the necessary activities if deviations from the procedures are required. It also contains descriptions of procedures to follow if any part of the equipment should fail. The contingency procedures are those which, with foresight, appear to be the best actions in each situation. However, the Site Supervisor will always be responsible for taking whatever actions he considers will be the best protecting the safety of the personnel, units and equipment. He may therefore deviate from these contingency procedures if circumstances require him to do so.

9.2 Trailer failures

Hydraulic valves
All electrically operated valves are provided with a manually operated emergency exciter. By pulling a switch the valve can be operated manually.

Electric-electronic system
The electric-electronic system is built up in a modular way so that possible damage on electric-electronic cards can be easily located and that if necessary the card can be bridged or changed by spare ones available on site. Fuse boxes secure the electric wire system. The safety elements turn off the electric system when an electric wire is overloaded.

Steering system
All wheel bogies are secured by a security system integrated in the trailer's PLC and detect following deviations of the steering program.
If a wheel bogie deviates more than 6 degrees from the required direction a warning lamp lights up on all electrical systems and on the operator's control box.
If a wheel bogie deviates more than 8 degrees from the required direction a warning lamp lights up on all electrical systems and on the operator's control box and all steering and driving functions of the whole trailer combination stop.
If the trailer combination is switched in the steering program no driving or steering operation is possible until the axles have a deviation of less than 6 degrees of the theoretical value.
In case of failure of the control valve of an axle the valve can be replaced or manually operated by an external emergency control. It is also possible for the steering axle to electronically be bridged on the PLC controller cards in case of a steering error due to a defective potentiometer – servo valve.

Braking system
All brakes are spring actuated and released by hydraulic pressure at 40 bar obtained from the powerpack. In case of a pressure drop, each brake can be manually released.

Driving system
The trailer's driving power is obtained from the pumps in the powerpack, in case of a pump problem the driving system can be separated from the system by disconnecting the hose connections and switching off the relevant pumps in the electrical control system. As a system's redundancy each powerpack is equipped with two identical pumps for the driving system.

If the control system of the drive pumps fails, the drive system can be operated with a manual emergency control. Each trailer module is equipped with a limit speed regulator, which prevents extraordinary rotational speed of the hydro engines when one wheel is spinning.

Remark: The trailer driving system is developed in such a way that when a powerpack fails in one line, the hydraulic driving system can be put in a free rotating position. The other lines can take over the complete driving task.

Lift system
Each lift cylinder can be separated from the system by closing the relevant ball valve. To prevent overloading of the lift system safety valves are built in between the lift valves and lift cylinders and the system is also equipped with a hose rupture protection.
All elements in the lift system are also designed with a redundant capacity available.

Powerpack failure (general)
The SPMT's hydraulic power is obtained from the pumps in the powerpack (PPU). A General PPU failure of a SPMT is very uncommon and thus unlikely. A PPU failure consists of a malfunction of one (or more) of the components from which it is built up.

In case of any malfunctions the PPU can be replaced with a spare by disconnecting the hose connections & pin connections to the SPMT. In each SPMT a non-return valve is integrated which prevents loss of hydraulic pressure of the hydraulic cylinder(s)/drive system of the SPMT. In most situations this is a complicated and time consuming operation that can be avoided. (See next section: Failures which cannot be repaired by the operators).

More commonly a PPU failure can be fixed more easily and quicker. The common approach in case of any PPU malfunctions is that our SPMT operator(s)/supervisor assess the PPU malfunction and make the necessary repairs to the PPU. The most common components that can break down are available at the SPMT service container on site. Our SPMT operators/supervisor are trained to assess possible malfunctions and to make the necessary repairs to the system.

The following failures can happen:

- **Hydraulic pump**
  Use of the secondary back up pump available in PPU. In case both are not functional extra hydraulic hoses can be installed from another PPU connected to other SPMT-trains in the transport configuration (if applicable) to provide hydraulic power to the SPMT train with the failed PPU.

- **Electronic/electrical card**
  The electric/electronic system is built up in a modular way so that possible damage on electrical/electronic cards can easily be located and if necessary the card can be bridged or changed by spare ones available on site. In every case a card failure is investigated firstly before a replacement card should be installed. This is done to avoid repeating failures.

- **Hydraulic hose**
  Spare hoses are available should one become damaged.

- **Data cable**
  Spare data cables are available should one become damaged.

Tyre damage / blowouts
The tires used on the SPMT trailers are stiff tires which can endure severe loads. In the unlikely event a tire failure should occur, the decision can be taken to:

- Continue operation without changing the tire by taking the axle out of the suspension system.
- Changing the wheel on the trailers without using lift equipment. This can be changed under full load if required.

Failures which cannot be repaired by the operators
When a failure occurs which cannot be repaired by the operators due to the lack of spare parts / technical knowledge following procedure will be used:

- Operators will inform the Project Manager of the problems.
- The Site Supervisor or Project Manager will inform the Sarens chief technician who is available 24h / day. He is the warehouse responsible and responsible for the spare parts. He is also the most capable person regarding technical failures.
- In case of severe problems, The Site Supervisor or Project Manager can contact the Sarens intervention team (24h/24h) who can assist on site. All possible spare parts are available in the Sarens head office and can be flown in to resolve the issue.

Irreparable failures
In case of serious failures which cannot be repaired, SPMT's or PPU's should be replaced. A difference is made between PPU and SPMT failures:

PPU FAILURE
When a PPU failure occurs and it could not be repaired, there are two possibilities:

- Back-up system: This solution is the most preferred during time-critical actions: The broken PPU will be isolated and the SPMT's will be hydraulically bypassed to another PPU. This is the most efficient method when the failure occurs during a module transport. (All hoses needed for this operation are available in the spare parts container).
- Final solution: If time is not a critical parameter: the broken PPU has to be replaced. Therefore the chief technician will be informed and will load a spare PPU in the SARENS Head office (see: Failures which cannot be repaired by the operators). This PPU should be transported with a truck. For the replacement of a PPU a crane is needed.

SPMT FAILURE
When a serious SPMT-failure occurs and it could not be repaired, one of the SPMT-units should be replaced. This can only happen due to a major breakdown. Statistically seen and based on our experience of many years, this is highly unlikely. A SPMT-unit is built in such a way that all parts (except severe spine beam damages) can be replaced or repaired without replacing the whole unit. The cause of such extreme SPMT failures is always related to external or accidental factors.

- If the SPMT's are unloaded, the SPMT-unit can easily be separated from the train and replaced by another one. For the replacement of an SPMT a crane is needed.
- If the SPMT's are loaded, replacement of a SPMT-unit is not possible. The project engineer / manager should search for a solution together with Client to put the cargo on temporary stools / supports. In this case, decisions will be made during a special meeting with all involved parties

9.2.1 Summary for SPMT failure contingencies

The system contingencies are shown in table below:

MAIN SYSTEM	FAILURE MODE	BACKUP MEASURES
Electrically operated Hydraulic valve	Failure to operate	Operate manually with emergency exciter.
Electrical/electronic Steering system	Damaged.	Replace Fuse.
		Bridge Electric card(s)
		Replace electric card(s) with spare.
Steering system	Deviation on bogies of <6° from required direction	Electrical system gives warning light on PPU & Remote Control box.
	Deviation on bogies of <8° from required direction	Electrical system gives warning light on PPU & Remote Control box. & all steering/driving functions of trailer combination are stopped.
	Failure of control valve	Replace valve with spare
		Manually operate by external emergency control
	Potentiometer failure	Bridge servo valve on PLC controller cards.
Braking system	Pressure drop on brake release	Brake can be manually released
Driving system	Pump failure	Each PPU has 2 pumps, Hydraulically Separate pump and use one pump.
	Failure pump control system	Hand operate by external emergency control
	Uncontrolled speed	Each trailer has a limit speed regulator preventing extraordinary rotational speed of the hydro engines
Lift system	Breakdown of cylinder	Separate cylinder from combination
	Overload	Built in system safety valves
	Hose rupture	System is equipped with hose rupture protection
Powerpack failure (PPU)	Hydraulic Pump failure	Use secondary back up pump available in PPU
	Electronic/ electrical card	Replace Fuse.
		Bridge electrical card(s)
		Replace electrical card(s) with spare.

	Damage Hydraulic hose	Replace with spare
	Data cable	Replace with spare
	General failure	Spare PPU available and connected to each separate configuration
Remote control	Radio frequency blocked	Use data cable
	Data cable damages	Replace with spare
	General failure	Use spare remote control

9.3 Ballast Equipment

The ballast pumps are doubled in capacity during the operation. If a pump fails, the secondary pump can be used as contingency. This is described in the Ballast Calculation.

The Load Out is a Class 1 operation, i.e. the barge cannot be kept level with the quay throughout the entire tide cycle.

9.4 Mooring Failure

The mooring during the load out operation has been designed to allow for a single line failure. There is sufficient capacity for any of the mooring line to fail during the load-in without having to stop the operation. In case of a single line failure, the failed mooring line will be repaired on the spot and reinstalled as soon as possible. Depending on the phase of the operation (critical or non-critical part) the load-in will proceed or it will be stopped until the mooring line has been repaired.

At all times during the load-in a winch operator will be nearby the winches to correct the mooring in the event of a single line failure.

9.5 Failure handling procedure

In this chapter the conditions for abortion of the operation prior to and during the load-in have been defined.

9.5.1 Prior to Load Out commencing

Load-in operation will be postponed if one of the following conditions applies:

- If any significant item of the Load-out or mooring equipment becomes defective.
- If any data relating to the structure, the transporters or the barge is found to be significantly at variance with the Load-out drawings.
- If the weather conditions are found to be significantly worse than those expected.

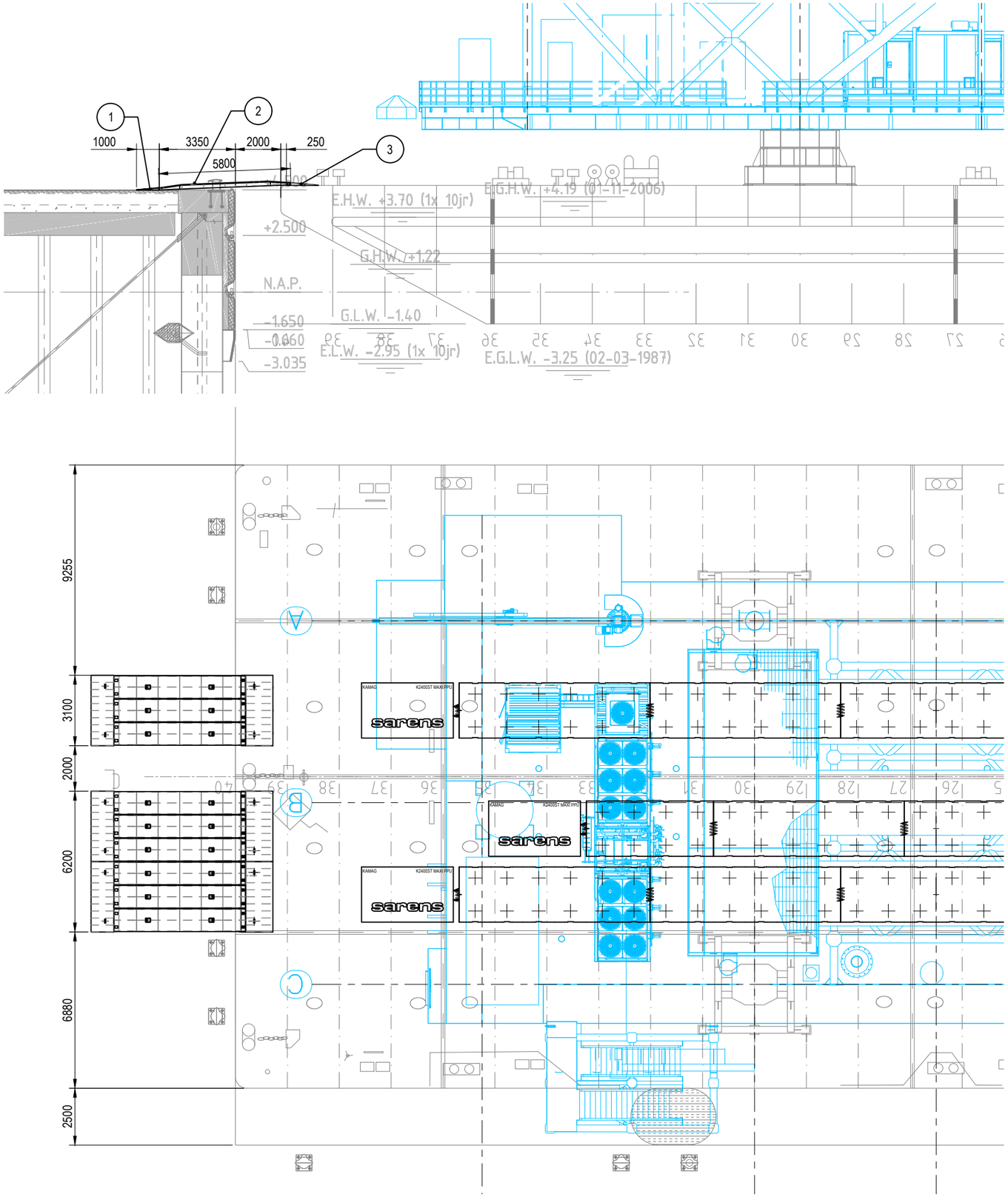
9.5.2 After the Load Out has commenced

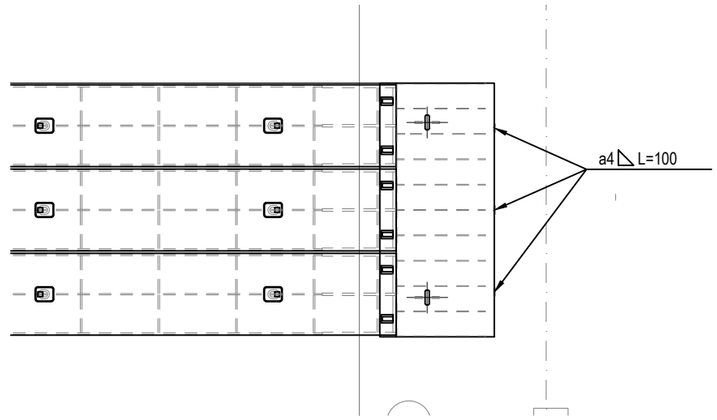
There can be no absolute rules for determining at what stage a Load-out would be “aborted“ or “continued “ with following technical problems arising once the load-in has commenced. In the event of a serious problem or delay occurring, a joint decision, whether to proceed or pull back, would be taken by CLIENT / SARENS, based on the following guidelines:

- If a serious problem with the stability or buoyancy of the barge occurs, the load-in would be aborted.

The abort/retrieval operation will follow a complete reversal of the load-in operation, as previously described in this document. The same checks will be performed.

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Notes	
1	All wedges to be welded to deck with 3x100m weld of size a=4mm

Material List

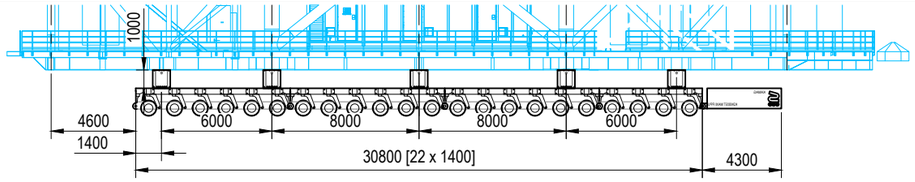
Item N°	Quantity	Description	Material	Weight/pce kg	Weight kg
1	3	Wedge 3100x100 without cams	Steel	530	1590
2	9	Bridge 5800x1000x200 Chamfer - Heavy	Steel	3400	30600
3	3	Wedge 3100x1400x120 cam	Steel	475	1425
			Total Weight		**33615**

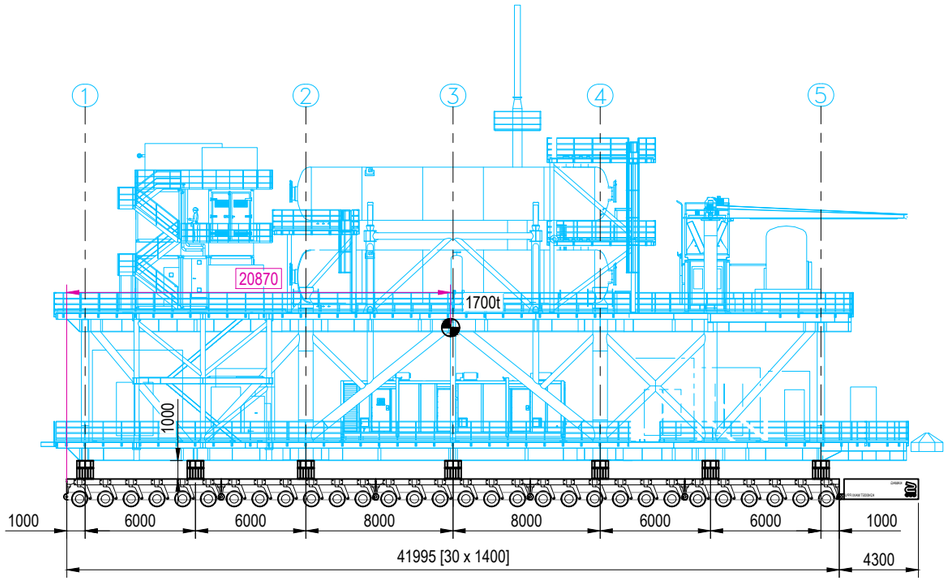
rev.	date	description	designed	verified	approved
A	29/08/2025	Removed fenders at Bow & side fenders 2.5m	B.R.	B.R.	M.v.H.
-	26/08/2025	First Issue	B.R.	B.R.	M.v.H.

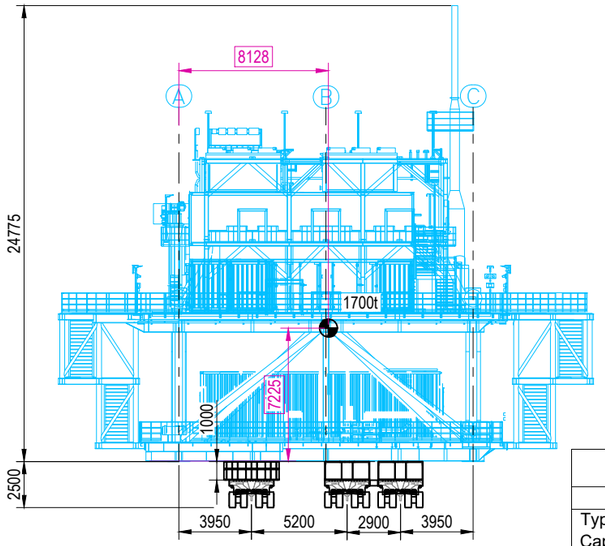
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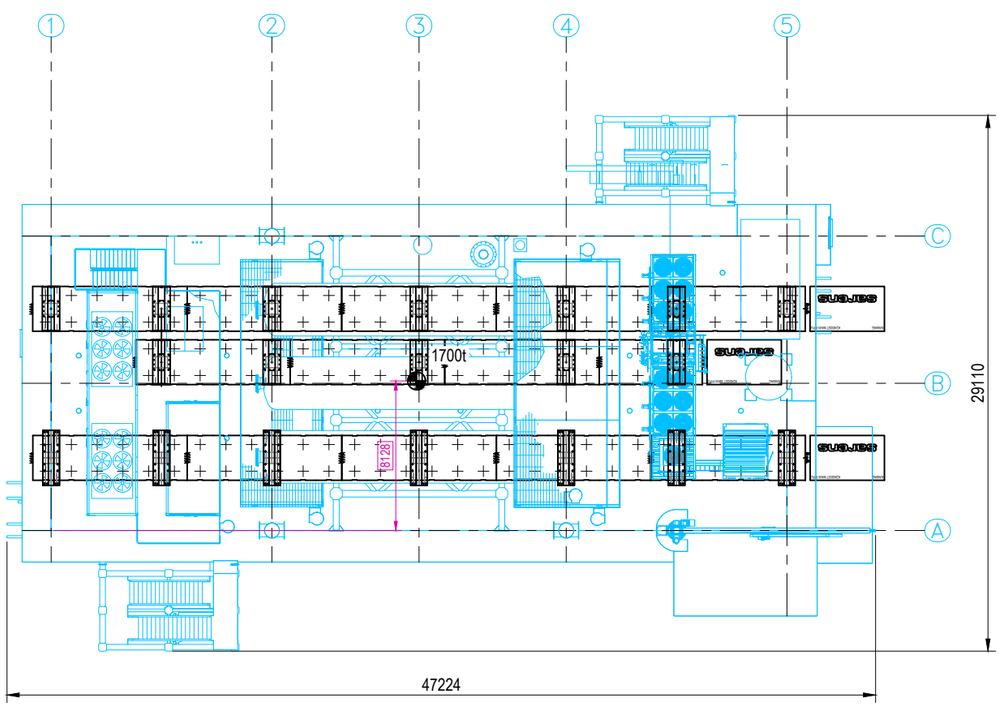
client: ROSETTI MARINO

equipment:	Bridge 5800x1000x200 Chamfer - Heavy
description:	RoRo Ramp Layout - Topside
site:	Eemshaven, NL
owner:	SAR
drawing type:	General Arrangement
appr. state:	For Approval
project:	S-25-71129
doc No.:	S-25-71129_DR2002_A
proj.:	.
size:	A3
scale:	1/200
sheet:	1-1









Indicative Hydraulic pressures

(Static loading on level ground, at average trailer height)

		Group 1	Group 2	Group 3
neutral	bar	152	134	138
A	bar	137	152	136
B	bar	137	132	157
C	bar	166	136	120
D	bar	166	115	140

COG offset

COG X	+/-	0,50	m
COG Y	+/-	0,30	m

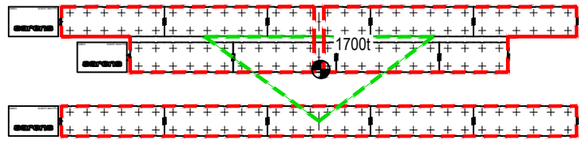
Gross static axle line loads
(Static loading on level ground, incl. COG offset)

		Group 1	Group 2	Group 3
neutral	t	27,8	24,8	25,5
A	t	25,3	27,9	25,2
B	t	25,3	24,4	28,7
C	t	30,3	25,1	22,3
D	t	30,3	21,6	25,8

STATIC LOADING AND CAPACITY OVERVIEW (on level ground)

			Group 1:	Group 2:	Group 3:
Type of Trailer			K2400 ST	K2400 ST	K2400 ST
Capacity per axle line	t		48,0	48,0	48,0
Capacity per bogie	t		24,0	24,0	24,0
Axle line self weight	t		4,5	4,5	4,5
Total no. of axle lines	#	82			
Total no. of bogies	#	164			
Total no. of active bogies	#	164	60	52	52
Total no. of powerpacks	#	3			
			Group loads from Neutral COG position		
Cargo weight	t	1700,0	666,6	528,6	504,8
Packing weight	t	52,2	25,5	13,4	13,4
Powerpack weight	t	18,6	6,6	-15,2	27,2
Deactivated axles weight	t	0,0	0,0	0,0	0,0
Total Net weight:	t	1770,8	698,7	526,7	545,4
Active axles deadweight	t	369,0	135,0	117,0	117,0
Total Gross weight:	t	2139,8	833,7	643,7	662,4
			Local Axle line loads		
			(N = at neutral COG / MAX E = maximum values for COG envelope)		
			N / MAX E	N / MAX E	N / MAX E
Net load per active AL	t	21,6	23,3 / 25,8	20,3 / 23,4	21,0 / 24,2
Gross load per AL	t	26,1	27,8 / 30,3	24,8 / 27,9	25,5 / 28,7
Gross load per bogie	t	13,0	13,9 / 15,1	12,4 / 14,0	12,7 / 14,3
Max. capacity utilisation	%	63%	58% / 63%	52% / 58%	53% / 60%
Ground Bearing Pressure	t/m²	7,7	8,9	8,2	8,4

Hydraulic Grouping



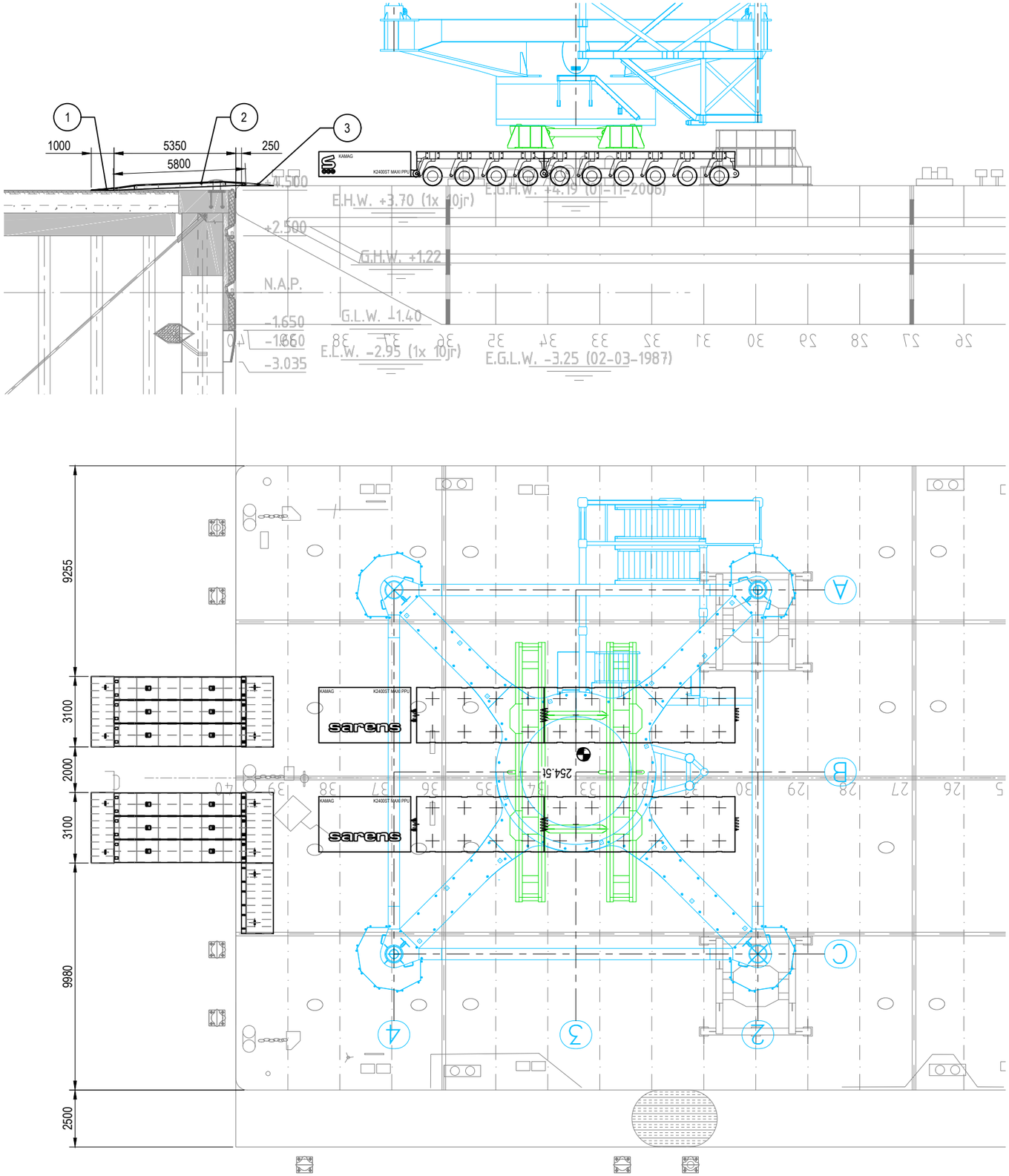
rev.	date	description	designed	verified	approved
-	26/08/2025	First Issue	I.R.	B.R.	M.v.H.

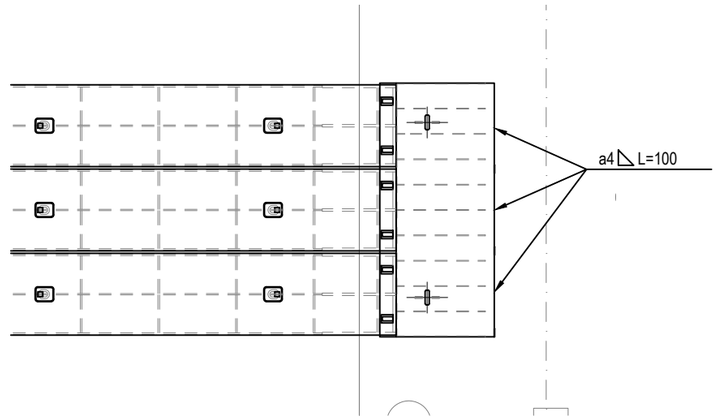
sarens

client: ROSETTI MARINO

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equipment:	2x30AL + 1x22 K2400ST		
description:	SPMT Transport Configuration - Topside		
site:	Eemshaven, NL		proj.:
owner:	SAR	drawing type: Transport Drawing	size: A3
appr. state:	For Approval	project: S-25-71129	scale: 1/200
doc No.:	S-25-71129_DR2001		sheet: 1-1





Notes

1	All wedges to be welded to deck with 3x100m weld of size a=4mm

Material List

Item N°	Quantity	Description	Material	Weight/pce kg	Weight kg
1	2	Wedge 3100x100 without cams	Steel	530	1060
2	6	Bridge 5800x1000x200 Chamfer - Heavy	Steel	3400	20400
3	3	Wedge 3100x1400x120 cam	Steel	475	1425
			Total Weight		**22885**

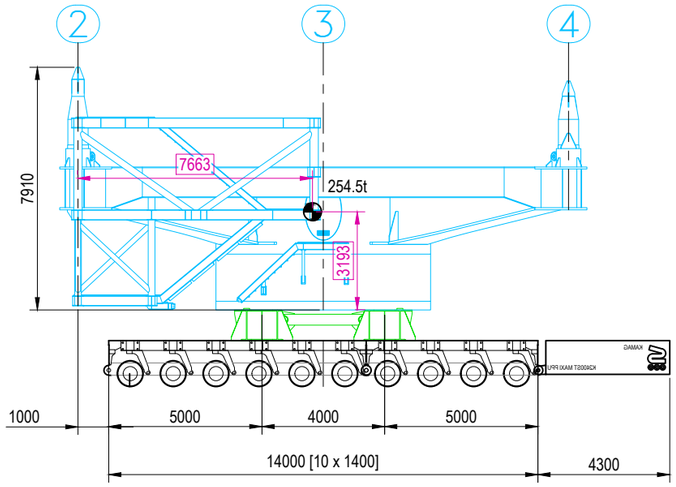
rev.	date	description	designed	verified	approved
A	28/08/2025	Removed fenders at Bow & side fenders 2.5m	B.R.	B.R.	M.v.H.
-	26/08/2025	First Issue	B.R.	B.R.	M.v.H.

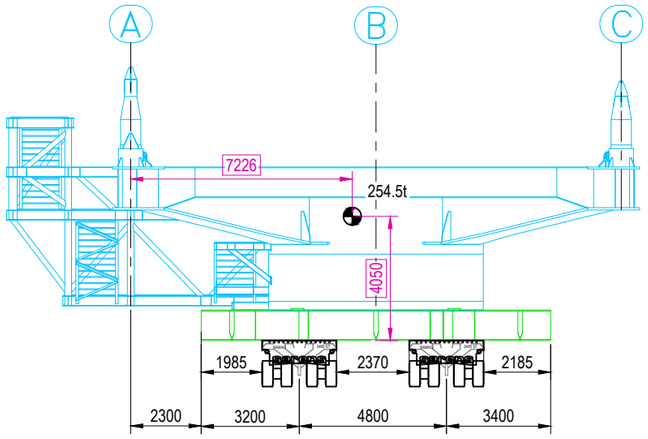
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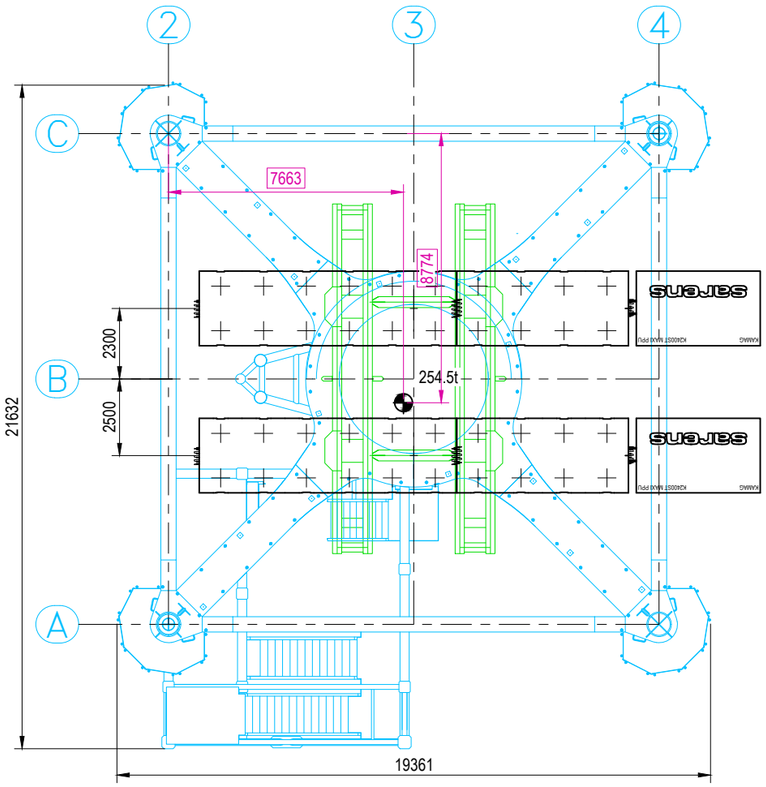
client: ROSETTI MARINO

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equipment:	Bridge 5800x1000x200 Chamfer - Heavy		
description:	RoRo Ramp Layout - TP		
site:	Eemshaven, NL		proj.:
owner:	SAR	drawing type: General Arrangement	size: A3
appr. state:	For Approval	project: S-25-71129	scale: 1/200
doc No.:	S-25-71129_DR1002_A		sheet: 1-1







STATIC LOADING AND CAPACITY OVERVIEW (on level ground)

			Group 1:	Group 2:	Group 3:
Type of Trailer			K2400 ST	K2400 ST	K2400 ST
Capacity per axle line	t		48,0	48,0	48,0
Capacity per bogie	t		24,0	24,0	24,0
Axle line self weight	t		4,5	4,5	4,5
Total no. of axle lines	#	20			
Total no. of bogies	#	40			
Total no. of active bogies	#	40	8	16	16
Total no. of powerpacks	#	2			
			Group loads from Neutral COG position		
Cargo weight	t	254,5	38,6	72,2	143,7
Packing weight	t	0,0	0,0	0,0	0,0
Powerpack weight	t	12,4	18,7	-3,1	-3,1
Deactivated axles weight	t	0,0	0,0	0,0	0,0
Total Net weight:	t	266,9	57,3	69,0	140,5
Active axles deadweight	t	90,0	18,0	36,0	36,0
Total Gross weight:	t	356,9	75,3	105,0	176,5
			Local Axle line loads		
			(N = at neutral COG / MAX E = maximum values for COG envelope)		
			N / MAX E	N / MAX E	N / MAX E
Net load per active AL	t	13,3	14,3 / 16,1	8,6 / 10,5	17,6 / 19,5
Gross load per AL	t	17,8	18,8 / 20,6	13,1 / 15,0	22,1 / 24,0
Gross load per bogie	t	8,9	9,4 / 10,3	6,6 / 7,5	11,0 / 12,0
Max. capacity utilisation	%	50%	39% / 43%	27% / 31%	46% / 50%
Ground Bearing Pressure	t/m²	5,2	6,1	4,4	7,0

COG offset

COG X	+/- 0,20	m
COG Y	+/- 0,22	m

Gross static axle line loads
(Static loading on level ground, incl. COG offset)

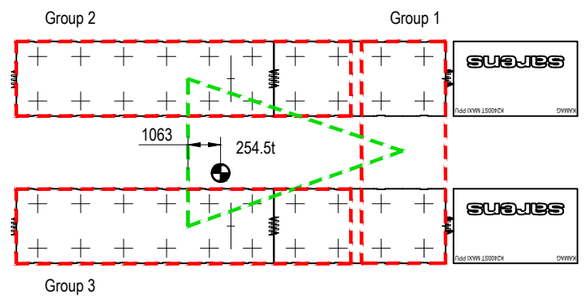
		Group 1	Group 2	Group 3
neutral	t	18,8	13,1	22,1
A	t	17,0	15,0	21,1
B	t	20,6	14,1	20,2
C	t	17,0	12,1	24,0
D	t	20,6	11,2	23,1

Indicative Hydraulic pressures

(Static loading on level ground, at average trailer height)

		Group 1	Group 2	Group 3
neutral	bar	99	66	118
A	bar	89	77	112
B	bar	110	72	107
C	bar	89	60	129
D	bar	110	55	124

Hydraulic Grouping



Reference Drawings

1	Item, Weight & COG	123A90-DDL-TI-DD-99015_03

rev.	date	description	designed	verified	approved
A	28/08/2025	Update trailer position	B.R.	B.R.	M.v.H.
-	26/08/2025	First Issue	I.R.	B.R.	M.v.H.

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client: ROSETTI MARINO

equipment:	2x10AL K2400ST		
description:	SPMT Transport Configuration - TP		
site:	Eemshaven, NL		proj.:
owner:	SAR	drawing type: Transport Drawing	size: A3
appr. state:	For Approval	project: S-25-71129	scale: 1/200
doc No.:	S-25-71129_DR1001_A		sheet: 1-1

REVISION	DATE	DESCRIPTION	BY	VER.	APPR.
-	26/08/2025	First issue	I.R.	B.R.	M.v.H.

1. INTRODUCTION

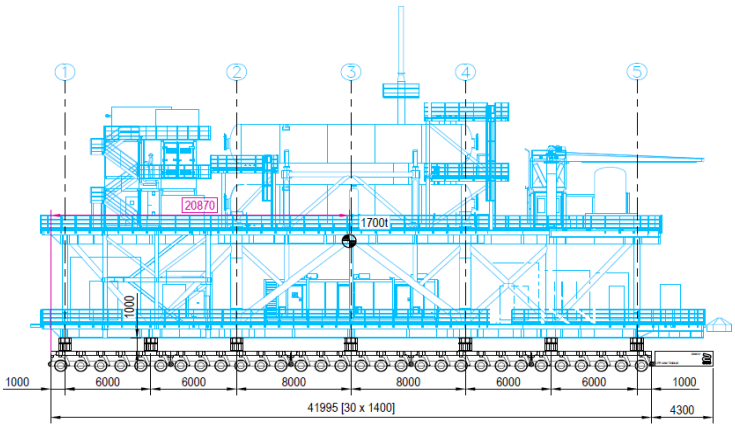
The below calculation wil demonstrate that the transport on the proposed trailer configuration is stable and within capacity based on Sarens' internal standards and verification level and the relevant DNV-ST-N001 criteria.

Level of Engineer reviewing the calculation	Second

Calculation sheet version 3.0.2 beta

2. CARGO NAME AND REFERENCES

Cargo:	**Topside**	Client Reference Drawing:	**123A90-DDL-TI-DD-99015_03**
Sarens Reference Drawing:	**S-25-71129_DR2001**	Weight and COG info:	**123A90-DDL-TI-DD-99015_03**

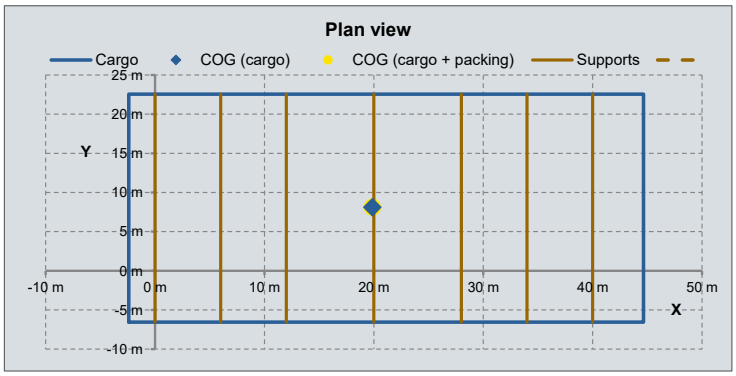


3. CARGO DEFINITION

Reference Point:	Crossing of Gridlines A-1

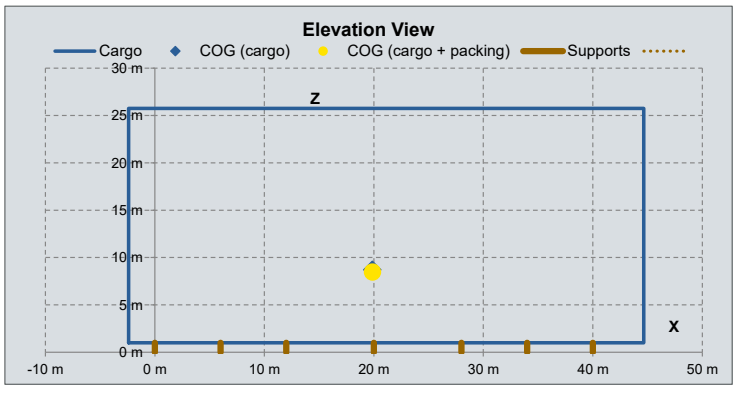
DIMENSIONS & POSITION			
Length	47,05m	along length of trailers	
Width	29,11m	in cross direction of trailers	
Extreme -X	-2,40m	coordinate of extreme point of cargo	
Extreme -Y	-6,56m	in left bottom corner (estimate)	
Height (1)	24,75m	from bottom of cargo transport beam	
Windarea Side	662m²	at height:	12,38m
Drag coeff. Side	1,2	(default: height/2)	
Windarea Front	382m²	at height:	12,38m
Drag coeff. Front	1,2	(default: height/2)	

WEIGHT			Envelope (+/-)	Advised values (2)
Cargo Mass	1700t			
COG X	19,87m	+/-	0,50m	2% of L
COG Y	8,13m	+/-	0,30m	2% W
COG Z (1) (3)	7,72m			



(1): Height (of COG) from bottom of cargo transport beam (or saddle)

(2): Advised values for typical cargo. Other values can be selected. Minimum envelope should be 0,1m for X and Y



PACKING/SUPPORTS/...	
Packing Mass	52t
Packing Height	1,00m
COG Packing X	20,00m
COG Packing Y	7,47m
COG Packing Z (3)	0,50m

CARGO + PACKING	
Net Mass	**1752t**
COG X	**19,87m**
COG Y	**8,11m**
COG Z (4)	**8,48m**

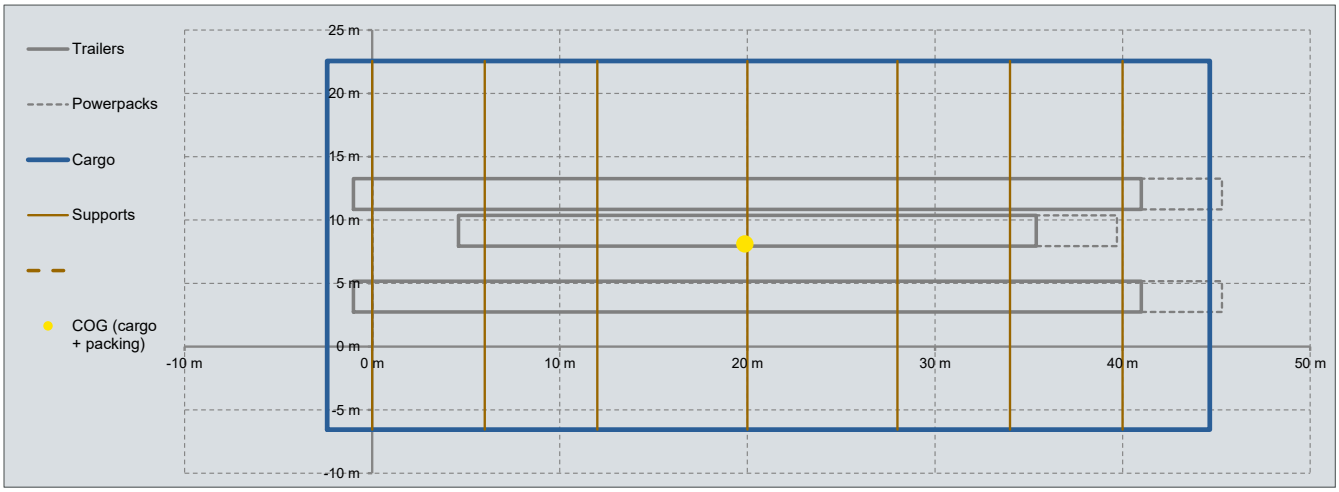
(4): height of cog from bottom of packing

	SUPPORTS	
	X position	Wt. (opt.)
1.	0,00m	*5,9t*
2.	6,00m	*8,1t*
3.	12,00m	*8,1t*
4.	20,00m	*8,1t*
5.	28,00m	*8,1t*
6.	34,00m	*8,1t*
7.	40,00m	*5,9t*
8.		
9.		
10.		
	Total X pos.	COG/Wt
	20,00m	52,2t

4. TRAILER DEFINITION

Trailer Deck Height	1,50m

	TYPE	# AXLE LINES	1-file?	X	Y	axle spacing	trailer length	trailer width	PPU Left?	PPU right?	PP left weight	PP right weight	axle line weight
1	**K2400 ST**	30	no	-1,00m	12,05m	1,40m	42,00m	2,43m	no	yes	0,0t	6,2t	4,5t
2	K2400 ST	22	no	4,60m	9,15m	1,40m	30,80m	2,43m	no	yes	0,0t	6,2t	4,5t
3	K2400 ST	30	no	-1,00m	3,95m	1,40m	42,00m	2,43m	no	yes	0,0t	6,2t	4,5t
4			no			#N/A	#N/A	#N/A			0,0t	0,0t	0,0t
5			no			#N/A	#N/A	#N/A			0,0t	0,0t	0,0t
6			no			#N/A	#N/A	#N/A			0,0t	0,0t	0,0t
7			no			#N/A	#N/A	#N/A			0,0t	0,0t	0,0t
8			no			#N/A	#N/A	#N/A			0,0t	0,0t	0,0t
9			no			#N/A	#N/A	#N/A			0,0t	0,0t	0,0t
10			no			#N/A	#N/A	#N/A			0,0t	0,0t	0,0t
11			no			#N/A	#N/A	#N/A			0,0t	0,0t	0,0t
12			no			#N/A	#N/A	#N/A			0,0t	0,0t	0,0t



WEIGHTS OVERVIEW	Wt	COG X	COG Y	COG Z (5)
COG net (excl ppu)	1752,2t	19,87m	8,11m	9,98m
Powerpacks (total)	18,6t	41,28m	8,38m	1,50m
COG net (incl powerpacks)	**1770,8t**	**20,10m**	**8,11m**	**9,89m**
Trailers (total)	369,0t	20,00m	8,31m	1,50m
COG all inclusive	**2139,8t**	**20,08m**	**8,15m**	**8,44m**

(5): COG from ground level up. Trailer COG taken at deck level.

5. HYDRAULIC GROUPING

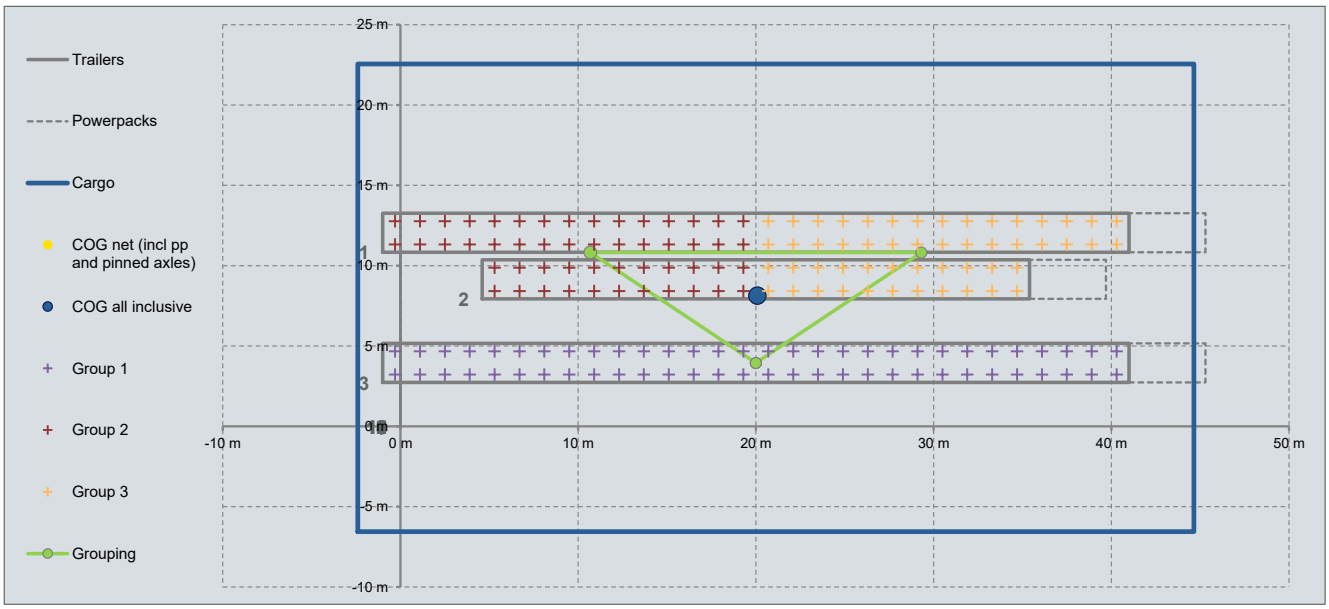
HYDRAULIC GROUPING			
Trailer	Hydraulic group of each corner of trailers		split after axle line no.:
1	2	3	15
	2	3	15
2	2	3	11
	2	3	11
3	1	1	15
	1	1	15
4			
5			
6			
7			
8			
9			
10			
11			
12			

PINNED (closed off) AXLE LINES								
Trailer	AXLE LINE NO.							
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

	Active axle lines	Active bogies	Net Static Group load (neutral)	Coordinates of groups X	Coordinates of groups Y
Group 1	30	60	698,7t	20,00m	3,95m
Group 2	26	52	526,7t	10,68m	10,82m
Group 3	26	52	545,4t	29,32m	10,82m

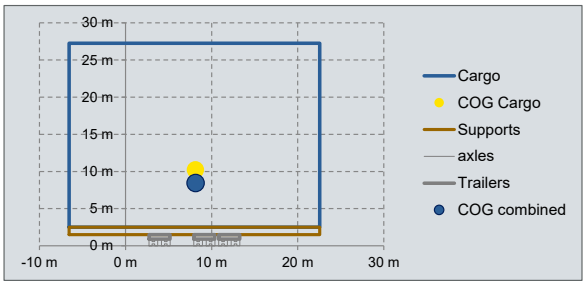
	Wt	COG X	COG Y	COG Z
COG net (incl pp)	1770,8t	20,10m	8,11m	9,89m
COG of pinned axle lines	0,0t	0,00m	0,00m	1,50m
COG net (incl pp and pinned axles)	**1770,8t**	**20,10m**	**8,11m**	**9,89m**

	Total Static Net Axle line loads					
	COG			Loads		
	COG X	COG Y	COG Z	Group 1	Group 2	Group 3
Neutral point = 0	20,10m	8,11m	9,89m	**23,3t**	**20,3t**	**21,0t**
A (X-offset, Y+offset)	19,62m	8,40m		20,8t	**23,4t**	20,7t
B (X+offset, Y+offset)	20,58m	8,40m		20,8t	19,9t	**24,2t**
C (X-offset, Y-offset)	19,62m	7,82m		**25,8t**	20,6t	17,8t
D (X+offset, Y-offset)	20,58m	7,82m		**25,8t**	17,1t	21,3t



6. STATIC CAPACITY AND STABILITY CHECK

1. Capacity and tipping angle checks, excluding slopes



STATIC CAPACITY CHECK on gross axle line capacity							
Trailer:	**Bogie capacity**	**Bogie Load**	**UC**	**Trailer:**	**Bogie capacity**	**Bogie Load**	**UC**
Trailer 1	24,0t	14,3t	60%	**Trailer 7**			
Trailer 2	24,0t	14,3t	60%	**Trailer 8**			
Trailer 3	24,0t	15,1t	**63%**	**Trailer 9**			
Trailer 4				**Trailer 10**			
Trailer 5				**Trailer 11**			
Trailer 6				**Trailer 12**			
CHECK 1: static capacity utilisation							
Max. UC:	**63%**	**<**	**Max. allowed UC for Second degree:**		**90%**	**OK**	

STATIC STABILITY ANGLES									
From cargo COG to ground					**From combined COG to ground**				
Cargo Weight:	**COG X**	**COG Y**	**COG Z**	**Tipping angle**	**Combined Weight:**	**COG X**	**COG Y**	**COG Z**	**Tipping angle**
	19,9m	8,1m	10,2m			20,1m	8,1m	8,4m	
1700,0t	**Horizontal distance to lines**				**2139,8t**	**Horizontal distance to lines**			
	Gr. 1 - 2	**Gr. 2 - 3**	**Gr. 3 - 1**			**Gr. 1 - 2**	**Gr. 2 - 3**	**Gr. 3 - 1**	
neutral point	3,28m	2,70m	3,44m	**14,8°**	neutral	3,42m	2,68m	3,33m	**17,6°**
A (X-offset, Y+offset)	3,23m	**2,40m**	3,98m	**13,2°**	A	3,38m	**2,44m**	3,75m	**16,1°**
B (X+offset, Y+offset)	3,82m	**2,40m**	3,38m	**13,2°**	B	3,85m	**2,44m**	3,28m	**16,1°**
C (X-offset, Y-offset)	2,75m	3,00m	3,49m	**15,0°**	C	3,00m	2,92m	3,37m	**19,1°**
D (X+offset, Y-offset)	3,34m	3,00m	2,90m	**15,8°**	D	3,47m	2,92m	2,90m	**19,0°**
CHECK 2: static tipping angle									
Smallest cargo tipping angle:		**13,2°**	**≥**	**Min. Required tipping angle for Second degree:**		**7,0°**	**OK**		
Smallest combined tipping angle:		**16,1°**	**≥**						

STATIC LOADING AND CAPACITY OVERVIEW (on level ground)						
	Total / Average:	**Group 1:**		**Group 2:**		**Group 3:**
Type of Trailer		K2400 ST		K2400 ST		K2400 ST
Capacity per axle line		48,0t		48,0t		48,0t
Capacity per bogie		24,0t		24,0t		24,0t
Axle line self weight		4,5t		4,5t		4,5t
Total no. of axle lines	82					
Total no. of bogies	164					
Total no. of active bogies	164	60		52		52
Total no. of powerpacks	3					
		Group loads from Neutral COG position				
Cargo weight	1700,0t	666,6t		528,6t		504,8t
Packing weight	52,2t	25,5t		13,4t		13,4t
Powerpack weight	18,6t	6,6t		-15,2t		27,2t
Deactivated axles weight	0,0t	0,0t		0,0t		0,0t
Total Net weight:	**1770,8t**	**698,7t**		**526,7t**		**545,4t**
Active axles deadweight	369,0t	135,0t		117,0t		117,0t
Total Gross weight:	**2139,8t**	**833,7t**		**643,7t**		**662,4t**
		Local Axle line loads (N = at neutral COG / MAX E = maximum values for COG envelope)				
		N	**MAX E**	**N**	**MAX E**	**N**	**MAX E**
Net load per active AL	21,6t	23,3t	25,8t	20,3t	23,4t	21,0t	24,2t
Gross load per AL	26,1t	27,8t	30,3t	24,8t	27,9t	25,5t	28,7t
Gross load per bogie	13,0t	13,9t	15,1t	12,4t	14,0t	12,7t	14,3t
Max. capacity utilisation	**63%**	**58%**	**63%**	**52%**	**58%**	**53%**	**60%**
Ground Bearing Pressure	7,7t/m²	8,9t/m²		8,2t/m²		8,4t/m²	

COG offset		
COG X	+/-	0,50m
COG Y	+/-	0,30m

Gross static axle line loads (Static loading on level ground, incl. COG offset)			
	Group 1	**Group 2**	**Group 3**
neutral	27,8t	24,8t	25,5t
A	25,3t	27,9t	25,2t
B	25,3t	24,4t	28,7t
C	30,3t	25,1t	22,3t
D	30,3t	21,6t	25,8t

Indicative Hydraulic pressures (Static loading on level ground, at average trailer height)			
	Group 1	**Group 2**	**Group 3**
neutral	152bar	134bar	138bar
A	137bar	152bar	136bar
B	137bar	132bar	157bar
C	166bar	136bar	120bar
D	166bar	115bar	140bar

2. Ground Bearing Pressure

The ground bearing pressure is evalutated based on static loads, including COG shift.
The calculation shows both average and local (per hydraulic group) ground bearing pressures.
The shadow area under the trailers is used as load spreading area.

AVERAGE GROUND BEARING PRESSURE	
Total Load	2139,8t
Total area (exclucing pinned axlelines)	279,0m²
Average Ground Bearing Pressure	**7,7t/m²**

MAX LOCAL GROUND BEARING PRESSURES(incl. COG shift)			
	Group 1	**Group 2**	**Group 3**
Static Gross axle line load	30,3t	27,9t	28,7t
Individual trailer width	2,43m	2,43m	2,43m
Individual axle line length	1,40m	1,40m	1,40m
Ground Bearing Pressure	**8,9t/m²**	**8,2t/m²**	**8,4t/m²**

3. Static capacity and tipping angle checks, including slopes

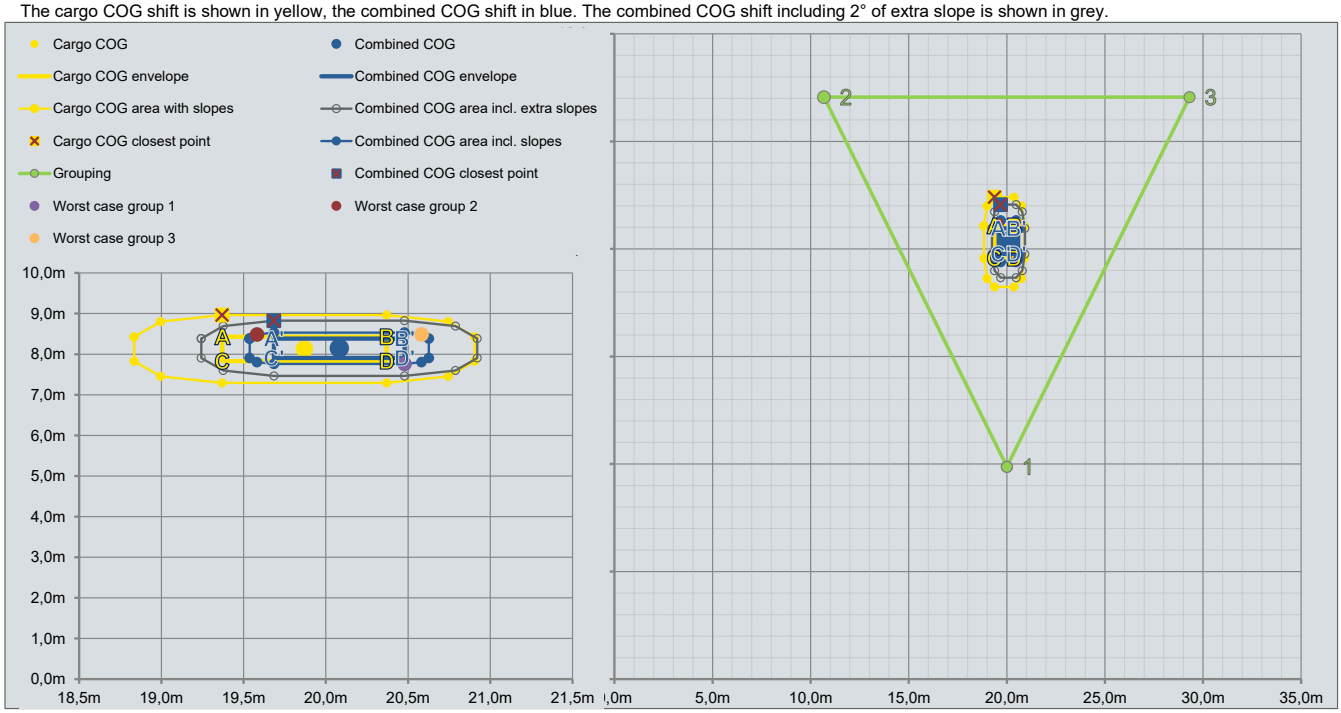
The static stability on slopes is analysed by moving the COG over a horizontal distance, equivalent to the tangent of the given slope angles. The 4 extremities of the COG envelope are each shifted in 3 directions: X, Y and a combination of both, including a combination factor (typically 0,7) and this for both Cargo and Combined COG.

STATIC ENVIRONMENT PROPERTIES								info
	slopes on route	Remaining slopes after compensation	extra slope	Total (degrees)	slopes after comp.	extra slope	**TOTAL (%)**	max slope compensable by trailer stroke (1 direction only)
Longitudinal Slope	2,0°	1,0°	2,0°	3,00°	1,7%	3,5%	5,2%	0,7°
Cross Slope	1,0°	1,0°	2,0°	3,00°	1,7%	3,5%	5,2%	3,0°
Combination Factor	0,70							

CHECK 3: Remaining stability angles, including slopes, at closest points:					
Smallest cargo tipping angle:	**10,3°**	**≥**	**Min. Required tipping angle for Second degree:**	**5,0°**	**OK**
Smallest combined tipping angle:	**13,3°**	**≥**			

AXLE LINE LOADS AND UTILISATIONS INCLUDING SLOPE EFFECT							
	Extreme COG positions		Max Group load (gross)	Total max Axle Line load	Extra load due to slopes	Relative load due to slopes	**UC to trailer capacity**
	X	Y					
Worst case group 1	20,48m	7,76m	953,8t	31,8t	1,5t	4,8%	**66%**
Worst case group 2	19,58m	8,49m	754,3t	29,0t	1,1t	3,7%	**60%**
Worst case group 3	20,58m	8,49m	773,1t	29,7t	1,1t	3,6%	**62%**
CHECK 4: static capacity utilisation, incldng slopes							
Max. UC:	**66%**	**<**	**Max. allowed UC for Second degree:**			**90%**	**OK**

The chart below shows the COG shift due to slopes from the 4 corners of the COG envelope.
The cargo COG shift is shown in yellow, the combined COG shift in blue. The combined COG shift including 2° of extra slope is shown in grey.



7. DYNAMIC CAPACITY AND STABILITY CHECK

Dynamic effects are evaluated in the same manner as slopes. Dynamic stability and capacity checks are performed for combined COG only.
Every transverse load results in an equivalent horizontal virtual shift of the COG, found by dividing the tipping moment created by the horizontal load (= Load x Height to ground) by the combined mass of the transporter, packing and cargo. The load effect table shows the generated horizontal load (on the cargo) by the given dynamic effect, the consequent loadmoment to the trailer deck for the cargo mass and the loadmoment to ground for the combined mass.
The COG is virtually shifted from the four corners of the basic envelope in X and Y direction and in a combination of both in diagonal direction. In the latter case, the effect of slopes is used with a combination factor as defined in the section above, the other side loads are combined with a factor of 0,7.

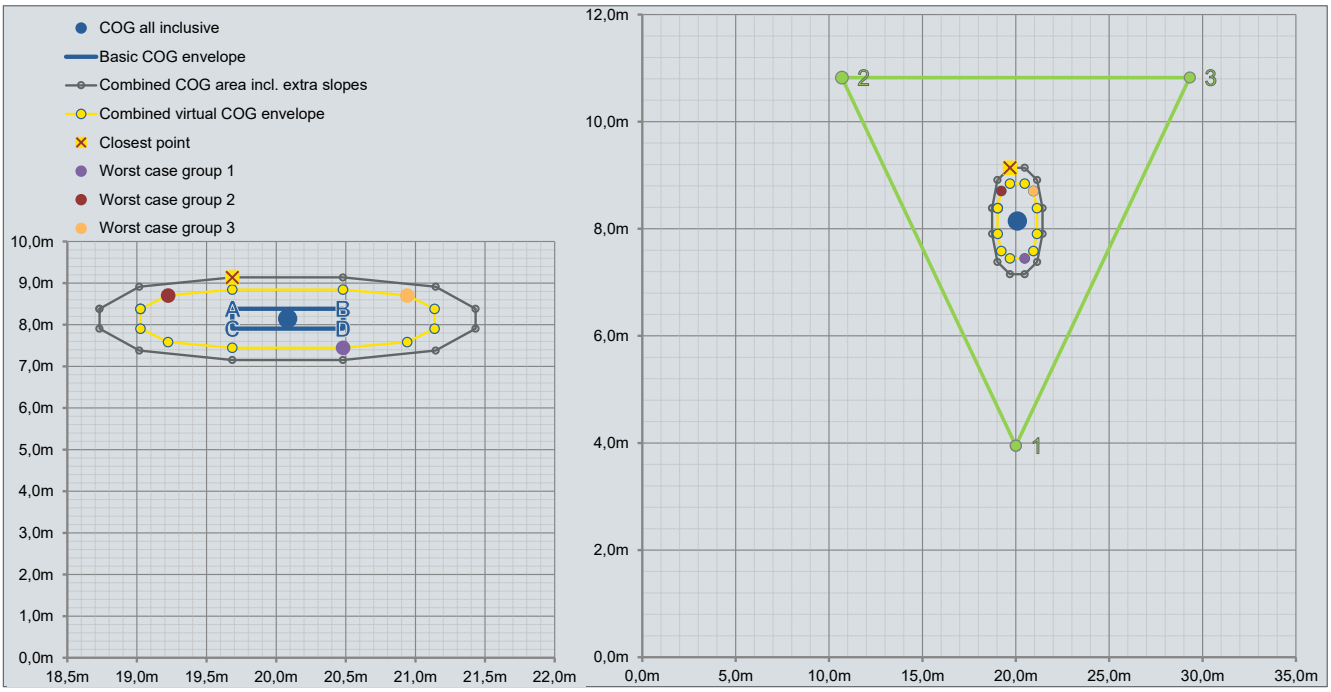
DYNAMIC ENVIRONMENT PROPERTIES	
Design 1min averaged wind speed	20m/s
Longitudinal Acceleration	0,5m/s²
Cross Acceleration	0,2m/s²

DYNAMIC LOAD EFFECTS:

	Fx on cargo	My to deck (by cargo)	My to ground (by total mass)	Fy on cargo	Mx to deck (by cargo)	Mx to ground (by total mass)
Slope effect	291,1 kN	2467kNm	3092kNm	291,1 kN	2467kNm	3092kNm
wind force	114,6 kN	1533kNm	1705kNm	198,6 kN	2656kNm	2954kNm
acceleration	850,0 kN	7412kNm	9030kNm	340,0 kN	2965kNm	3612kNm

CHECK 5: Remaining stability angle considering the vertiual COG shift due to dynamic effects:					
Smallest tipping angle:	**11,3°**	**≥**	**Min. Required tipping angle for Second degree:**	**5,0°**	**OK**

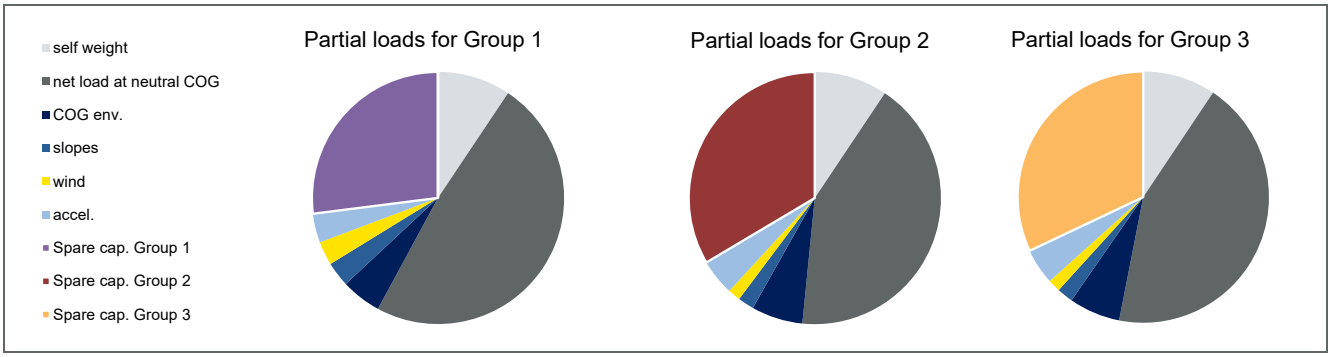
The chart below shows the total virtual combined COG shift due to all dynamic effects in yellow. The virtual COG shift including 2° of extra slope is shown in grey.



Maximum axle line loads and utilisations incl. dynamic effects

	Extreme virtual COG positions		Max Group load (gross)	Total max Axle Line load	Partial loads from : self weight	net load at neutral COG	COG env.	slopes	wind	accel.	UC to trailer capacity
	X	Y									
Worst case group 1	20,48m	7,45m	1051,1t	35,0t	4,5t	23,3t	2,5t	1,5t	1,5t	1,8t	**73%**
Worst case group 2	19,22m	8,71m	829,5t	31,9t	4,5t	20,3t	3,2t	1,0t	0,8t	2,2t	**66%**
Worst case group 3	20,94m	8,71m	848,3t	32,6t	4,5t	21,0t	3,2t	1,0t	0,8t	2,2t	**68%**

CHECK 6: Max utilisation including dynamic effects:					
Max. UC:	**73%**	**≤**	**Max. allowed UC for Second degree:**	**100%**	**OK**



Minimum group loads incl. dynamic effects (ESTA GD23018-EN / DNV-ST-N001 10.5.3.22 verification)

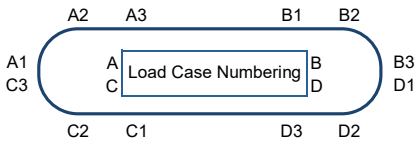
	Extreme virtual COG positions		Min dynamic group load	Static gross group load	Dynamic to static load ratio
Worst case group 1	19,68m	8,84m	616,2t	833,7t	**74%**
Worst case group 2	20,94m	7,58m	457,8t	643,7t	**71%**
Worst case group 3	19,22m	7,58m	476,6t	662,4t	**72%**

CHECK 7: Minium dynamic load over static load ratio:					
Minimum ratio:	**71%**	**≥**	**Min. allowed ratio**	**60%**	**OK**

8. SPINEBEAM CALCULATION

Number of analysed Trailer	1
Load case (Static loading, with or without slopes)	Neutral
Mesh Size	0,023m

(cannot be used for 1-file trailer unit)

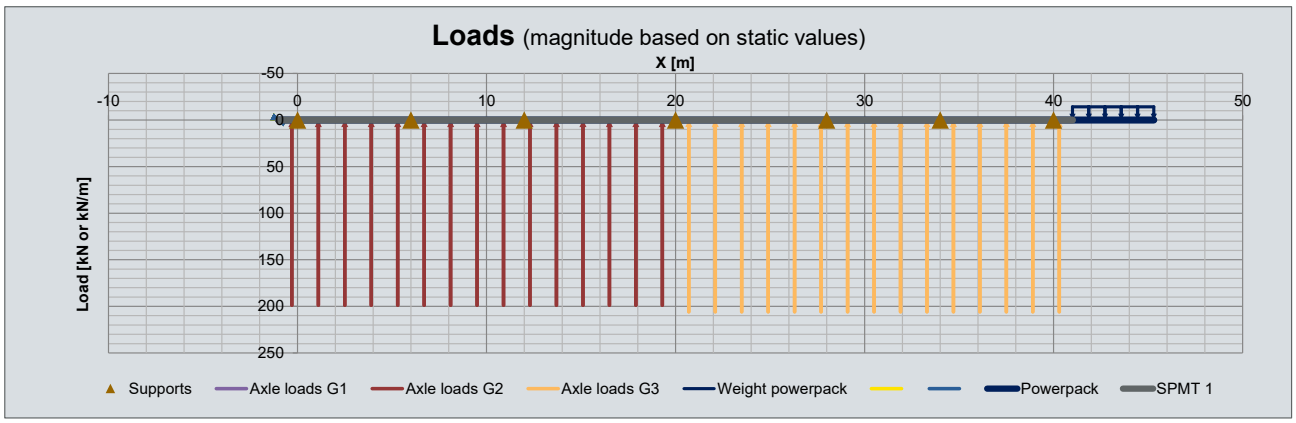


LOOSE PACKING (POWERPACK, WEIGHTS,...) ON TRAILER 1			
Type	Mass	Start X	End X

Loose packing is any packing **on the specific trailer under investigation** which is not sitting in between and the trailer deck and the cargo itself and not making part of the cargo. For example: loose powerpacks or counterweight slabs to relieve the trailer's spine beam loading.
Note: the weight of this packing is already been included in the packing declared in the section "Cargo definition".
Start and End are defined in absolute coordinates (not relative to trailer!).

SUPPORT SPREADING AND OVERRIDING					
Support	X position	Width of support	Allowed?	R_{static}	Active?
1.	0,000 m		yes	498 kN	yes
2.	6,000 m		yes	907 kN	yes
3.	12,000 m		yes	972 kN	yes
4.	20,000 m		yes	1226 kN	yes
5.	28,000 m		yes	1002 kN	yes
6.	34,000 m		yes	987 kN	yes
7.	40,000 m		yes	414 kN	yes
8.					yes
9.					yes
10.					yes

Note:
A support should be deactivated (by setting the 'Active?' value to 'no') in the following cases:
- the support is not present on the current trailer
- the Rstatic load is negative but no tension load is to be taken by the support.



SPINEBEAM UTILISATION SUMMARY						
Based on static loading	Min	Min All.	Util.	Max	Max All.	Util.
Shear force	-622kN	-2000kN	**31%**	613kN	2000kN	**31%**
Bending moment	-515kNm	-9250kNm	**6%**	876kNm	9250kNm	**9%**
	Downwards deformation:			Upwards deformation		
Deformation	**-0,4 mm**	@ X pos.:	41,0 m	**0,7 mm**	@ X pos.:	24,2 m
CHECK 8: Spine beam utilisation of Trailer no. 1						
Max. UC:	**31%**	**<**	**Max. allowed UC for Second degree:**		**85%**	**OK**

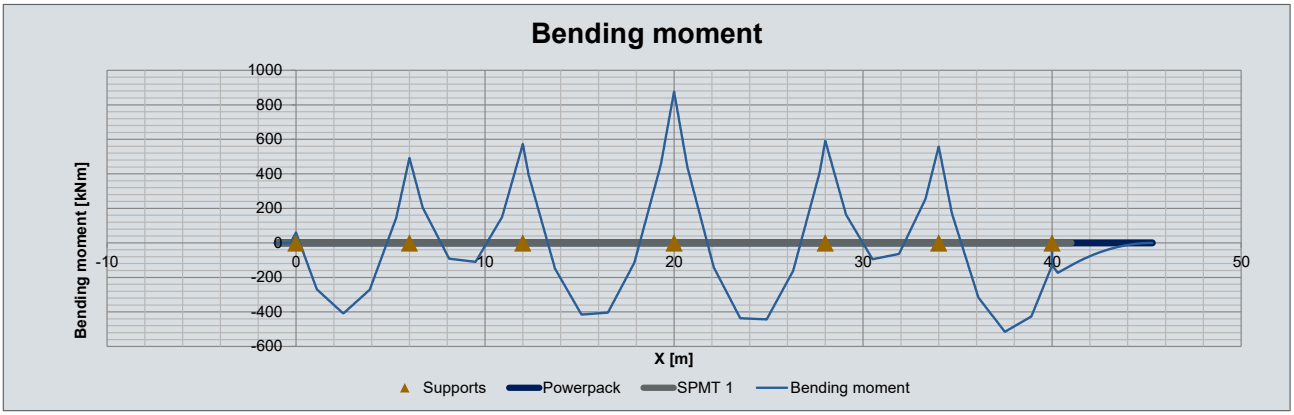
9. SUMMARY AND CONCLUSION

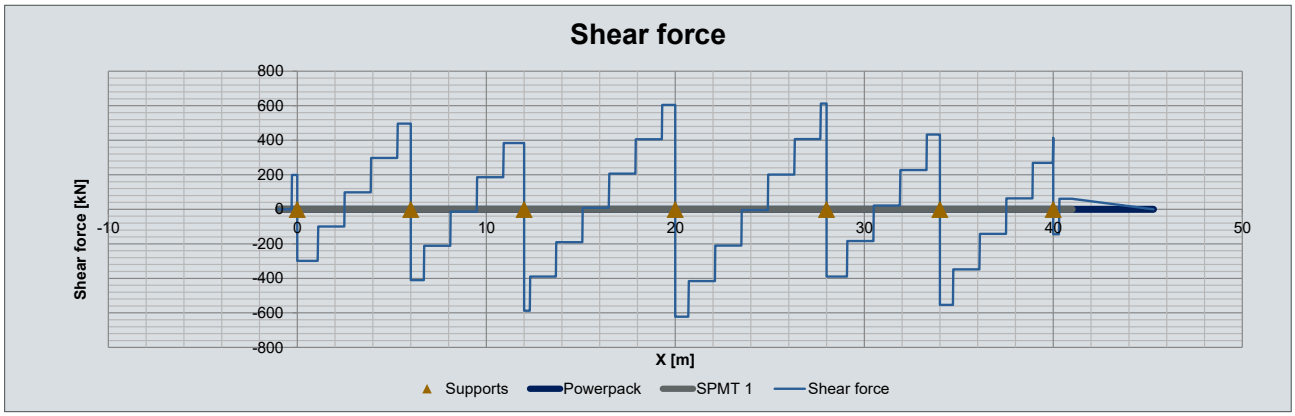
Trailers:	Type: K2400 ST	**Cargo:**	Topside (47,05m x 29,11m x 24,75m)	**Mass:**	1700,0t
Number of trailers:	3	**Load parameters:**		**X**	**Y**
N° of axle lines in longest trailer	30	COG envelope considered		+/-0,50m	+/-0,30m
Total amount of axle lines:	82	Slopes (after compensation)		1,0°	1,0°
Total number of powerpacks:	3	Windspeed and area	20m/s	1,2 x 382m²	1,2 x 662m²
Gross axle line capacity:	48,0t	Accelerations		0,5m/s²	0,2m/s²

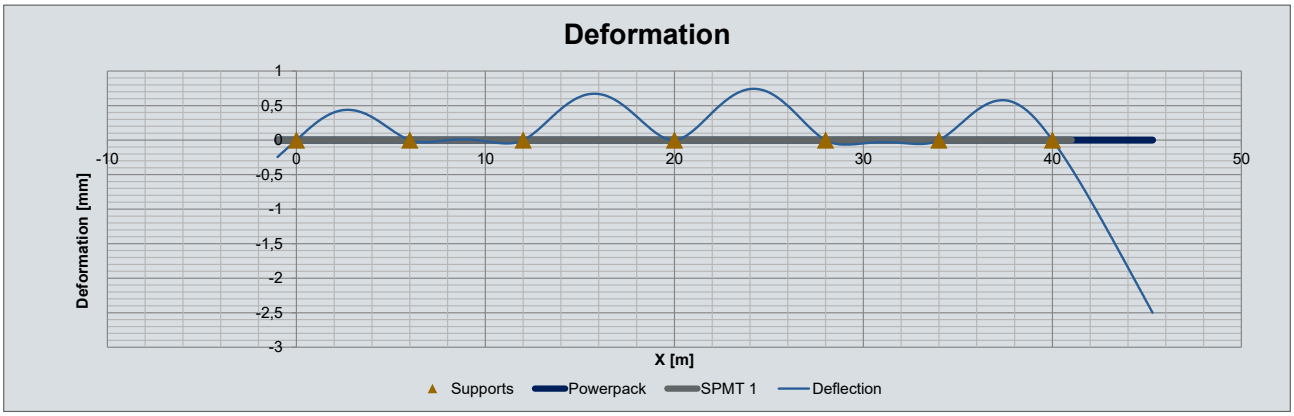
Axle load summary	Gross static axle load	Gross static axle load incl envelope	Gross dynamic axle load
Group 1	27,8t	30,3t	35,0t
Group 2	24,8t	27,9t	31,9t
Group 3	25,5t	28,7t	32,6t

Degree of engineering for calculation verification:			**Second**		
Capacity checks			**Stability checks**		
Basic Static Utilisation	**63%**	**OK**	Basic Static Tipping Angle	**16,1°**	**OK**
Static Utilisation Including Slopes	**66%**	**OK**	Static Tipping Angle incl. Slopes	**13,3°**	**OK**
Dynamic Utilisation	**73%**	**OK**	Dynamic Tipping Angle	**11,3°**	**OK**
Spine Beam Utilisation of trailer no. 1	**31%**	**OK**	Minimum dynamic load to static load ratio	**71%**	**OK**
Notes:					
1. The transport complies with the capacity and stability requirements of DNV-ST-N001 10.5.3.22 and ESTA GD23018					
2. The transport complies with the capacity and stability requirements of DNV-ST-N001 10.5.3.16 and 10.5.3.17					

Annex: BENDING DIAGRAMS FOR STATIC LOADING in trailer no. 1







REVISION	DATE	DESCRIPTION	BY	VER.	APPR.
-	26/08/2025	First issue	I.R.	B.R.	M.v.H.

1. INTRODUCTION

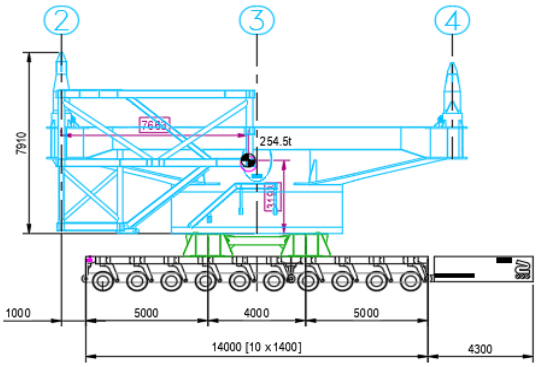
The below calculation wil demonstrate that the transport on the proposed trailer configuration is stable and within capacity based on Sarens' internal standards and verification level and the relevant DNV-ST-N001 criteria.

Level of Engineer reviewing the calculation	Second

Calculation sheet version 3.0.2 beta

2. CARGO NAME AND REFERENCES

Cargo:	TP	Client Reference Drawing:	123A90-DDL-TI-DD-99015_03
Sarens Reference Drawing:	S-25-71129_DR1001	Weight and COG info:	123A90-DDL-TI-DD-99015_03

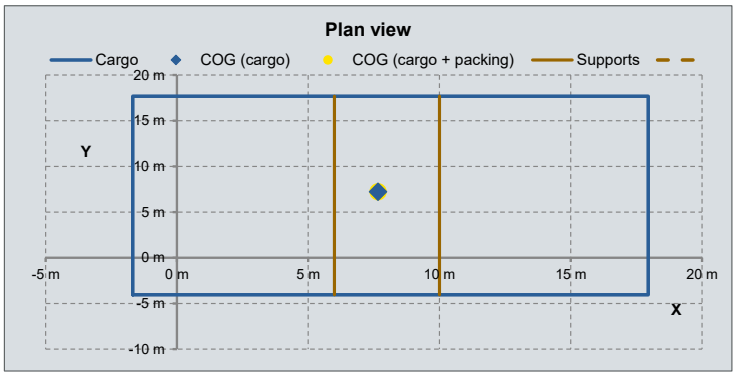


3. CARGO DEFINITION

Reference Point:	Crossing of Gridlines A-2

DIMENSIONS & POSITION			
Length	19,63m	along length of trailers	
Width	21,74m	in cross direction of trailers	
Extreme -X	-1,68m	coordinate of extreme point of cargo	
Extreme -Y	-4,06m	in left bottom corner (estimate)	
Height (1)	7,91m	from bottom of cargo transport beam	
Windarea Side	85m²	at height:	3,96m
Drag coeff. Side	1,2	(default: height/2)	
Windarea Front	10m²	at height:	3,96m
Drag coeff. Front	1,2	(default: height/2)	

WEIGHT			Envelope (+/-)	Advised values (2)
Cargo Mass	255t			
COG X	7,66m	+/-	0,20m	2% of L
COG Y	7,23m	+/-	0,22m	2% W
COG Z (1) (3)	3,05m			



(1): Height (of COG) from bottom of cargo transport beam (or saddle)

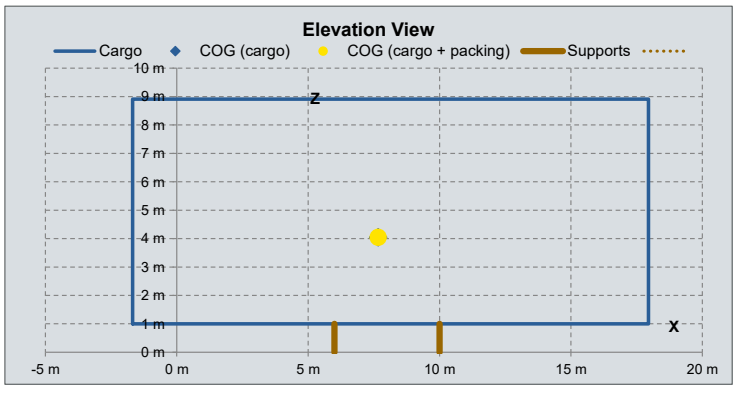
(2): Advised values for typical cargo. Other values can be selected. Minimum envelope should be 0,1m for X and Y

PACKING/SUPPORTS/...	
Packing Mass	0t
Packing Height	1,00m
COG Packing X	7,66m
COG Packing Y	7,23m
COG Packing Z (3)	0,50m

CARGO + PACKING	
Net Mass	**255t**
COG X	**7,66m**
COG Y	**7,23m**
COG Z (4)	**4,05m**

(4): height of cog from bottom of packing

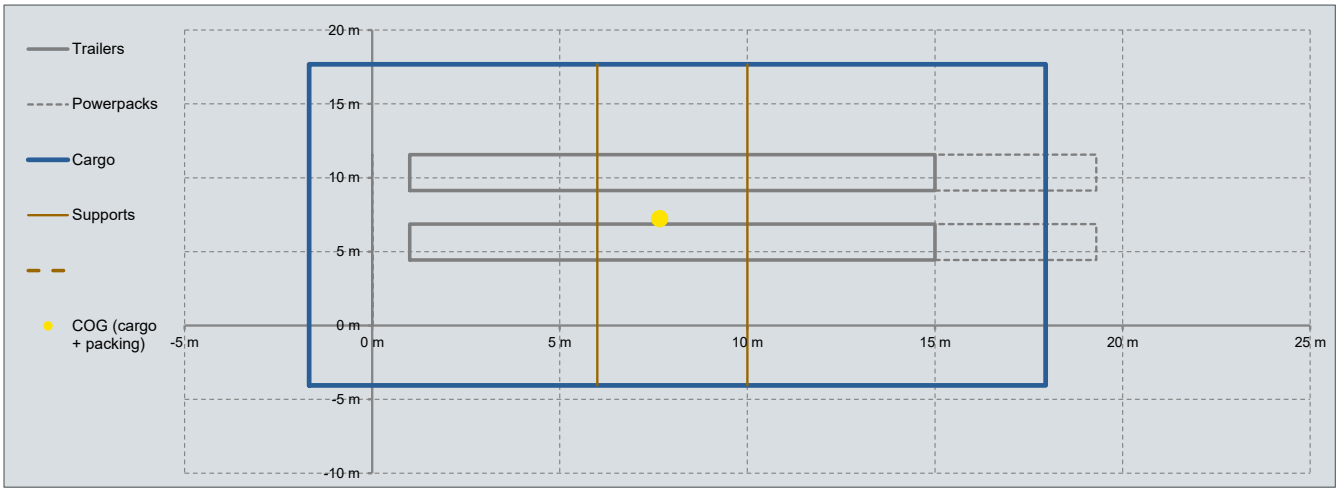
	SUPPORTS	
	X position	Wt. (opt.)
1.	6,00m	*0,0t*
2.	10,00m	*0,0t*
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
	Total X pos. COG/Wt	
	#DIV/0!	0,0t



4. TRAILER DEFINITION

Trailer Deck Height	1,50m

	TYPE	# AXLE LINES	1-file?	X	Y	axle spacing	trailer length	trailer width	PPU Left?	PPU right?	PP left weight	PP right weight	axle line weight
1	**K2400 ST**	10	no	1,00m	10,35m	1,40m	14,00m	2,43m	no	yes	0,0t	6,2t	4,5t
2	K2400 ST	10	no	1,00m	5,65m	1,40m	14,00m	2,43m	no	yes	0,0t	6,2t	4,5t
3			no			#N/A	#N/A	#N/A			0,0t	0,0t	0,0t
4			no			#N/A	#N/A	#N/A			0,0t	0,0t	0,0t
5			no			#N/A	#N/A	#N/A			0,0t	0,0t	0,0t
6			no			#N/A	#N/A	#N/A			0,0t	0,0t	0,0t
7			no			#N/A	#N/A	#N/A			0,0t	0,0t	0,0t
8			no			#N/A	#N/A	#N/A			0,0t	0,0t	0,0t
9			no			#N/A	#N/A	#N/A			0,0t	0,0t	0,0t
10			no			#N/A	#N/A	#N/A			0,0t	0,0t	0,0t
11			no			#N/A	#N/A	#N/A			0,0t	0,0t	0,0t
12			no			#N/A	#N/A	#N/A			0,0t	0,0t	0,0t



WEIGHTS OVERVIEW	Wt	COG X	COG Y	COG Z (5)
COG net (excl ppu)	254,5t	7,66m	7,23m	5,55m
Powerpacks (total)	12,4t	17,15m	8,00m	1,50m
COG net (incl powerpacks)	**266,9t**	**8,10m**	**7,26m**	**5,36m**
Trailers (total)	90,0t	8,00m	8,00m	1,50m
COG all inclusive	**356,9t**	**8,08m**	**7,45m**	**4,39m**

(5): COG from ground level up. Trailer COG taken at deck level.

5. HYDRAULIC GROUPING

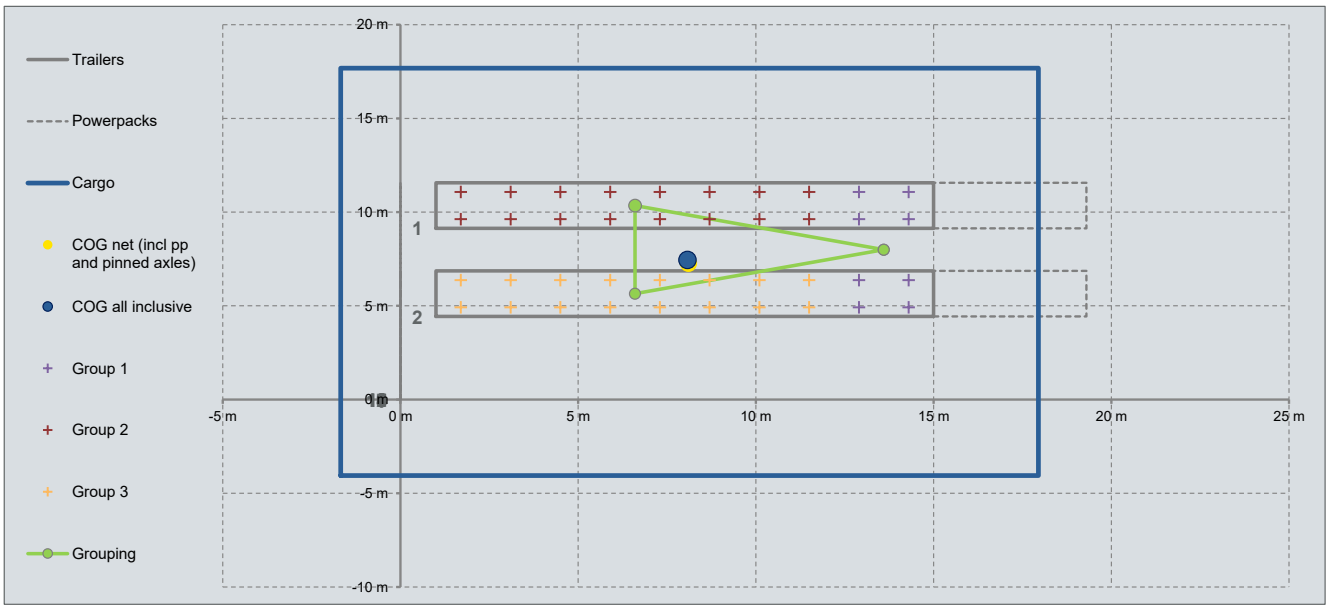
Trailer	HYDRAULIC GROUPING Hydraulic group of each corner of trailers		split after axle line no.:
1	2	1	8
	2	1	8
2	3	1	8
	3	1	8
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

PINNED (closed off) AXLE LINES								
Trailer	AXLE LINE NO.							
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

	Active axle lines	Active bogies	Net Static Group load (neutral)	Coordinates of groups X	Coordinates of groups Y
Group 1	4	8	57,3t	13,60m	8,00m
Group 2	8	16	62,9t	6,60m	10,35m
Group 3	8	16	146,7t	6,60m	5,65m

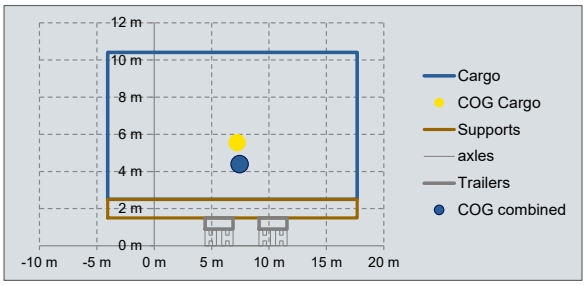
	Wt	COG X	COG Y	COG Z
COG net (incl pp)	266,9t	8,10m	7,26m	5,36m
COG of pinned axle lines	0,0t	0,00m	0,00m	1,50m
COG net (incl pp and pinned axles)	**266,9t**	**8,10m**	**7,26m**	**5,36m**

	Total Static Net Axle line loads					
	COG			Loads		
	COG X	COG Y	COG Z	Group 1	Group 2	Group 3
Neutral point = 0	8,10m	7,26m	5,36m	**14,3t**	**7,9t**	**18,3t**
A (X-offset, Y+offset)	7,92m	7,47m		12,5t	**9,8t**	17,3t
B (X+offset, Y+offset)	8,29m	7,47m		**16,1t**	8,9t	16,4t
C (X-offset, Y-offset)	7,92m	7,05m		12,5t	6,8t	**20,3t**
D (X+offset, Y-offset)	8,29m	7,05m		**16,1t**	5,9t	19,4t



6. STATIC CAPACITY AND STABILITY CHECK

1. Capacity and tipping angle checks, excluding slopes



STATIC CAPACITY CHECK on gross axle line capacity							
Trailer:	**Bogie capacity**	**Bogie Load**	**UC**	**Trailer:**	**Bogie capacity**	**Bogie Load**	**UC**
Trailer 1	24,0t	10,3t	43%	**Trailer 7**			
Trailer 2	24,0t	12,4t	**52%**	**Trailer 8**			
Trailer 3				**Trailer 9**			
Trailer 4				**Trailer 10**			
Trailer 5				**Trailer 11**			
Trailer 6				**Trailer 12**			
CHECK 1: static capacity utilisation							
Max. UC:	**52%**	**<**	**Max. allowed UC for Second degree:**		**90%**	**OK**	

STATIC STABILITY ANGLES										
From cargo COG to ground					**From combined COG to ground**					
Cargo Weight:	**COG X**	**COG Y**	**COG Z**	**Tipping angle**	**Combined Weight:**	**COG X**	**COG Y**	**COG Z**	**Tipping angle**
	7,7m	7,2m	5,6m			8,1m	7,4m	4,4m	
254,5t	**Horizontal distance to lines**				**356,9t**	**Horizontal distance to lines**			
	Gr. 1 - 2	**Gr. 2 - 3**	**Gr. 3 - 1**			**Gr. 1 - 2**	**Gr. 2 - 3**	**Gr. 3 - 1**	
neutral point	2,62m	1,06m	1,16m	**10,8°**	neutral	2,28m	1,48m	1,23m	**15,7°**
A (X-offset, Y+offset)	2,48m	**0,87m**	1,42m	**8,9°**	A	2,18m	1,34m	1,43m	**17,0°**
B (X+offset, Y+offset)	2,35m	1,26m	1,30m	**12,8°**	B	2,09m	1,62m	1,34m	**16,9°**
C (X-offset, Y-offset)	2,89m	**0,87m**	1,01m	**8,9°**	C	2,47m	1,34m	1,13m	**14,5°**
D (X+offset, Y-offset)	2,77m	1,26m	0,89m	**9,1°**	D	2,38m	1,62m	**1,04m**	**13,4°**
CHECK 2: static tipping angle									
Smallest cargo tipping angle:		**8,9°**	**≥**	**Min. Required tipping angle for Second degree:**		**7,0°**	**OK**		
Smallest combined tipping angle:		**13,4°**	**≥**						

STATIC LOADING AND CAPACITY OVERVIEW (on level ground)						
	Total / Average:	**Group 1:**	**Group 2:**	**Group 3:**		
Type of Trailer		K2400 ST	K2400 ST	K2400 ST		
Capacity per axle line		48,0t	48,0t	48,0t		
Capacity per bogie		24,0t	24,0t	24,0t		
Axle line self weight		4,5t	4,5t	4,5t		
Total no. of axle lines	20					
Total no. of bogies	40					
Total no. of active bogies	40	8	16	16		
Total no. of powerpacks	2					
		Group loads from Neutral COG position				
Cargo weight	254,5t	38,6t	66,0t	149,8t		
Packing weight	0,0t	0,0t	0,0t	0,0t		
Powerpack weight	12,4t	18,7t	-3,1t	-3,1t		
Deactivated axles weight	0,0t	0,0t	0,0t	0,0t		
Total Net weight:	**266,9t**	**57,3t**	**62,9t**	**146,7t**		
Active axles deadweight	90,0t	18,0t	36,0t	36,0t		
Total Gross weight:	**356,9t**	**75,3t**	**98,9t**	**182,7t**		
		Local Axle line loads				
		(N = at neutral COG / MAX E = maximum values for COG envelope)				
		N	**MAX E**	**N**	**MAX E**	**N**	**MAX E**
Net load per active AL	13,3t	14,3t	16,1t	7,9t	9,8t	18,3t	20,3t
Gross load per AL	17,8t	18,8t	20,6t	12,4t	14,3t	22,8t	24,8t
Gross load per bogie	8,9t	9,4t	10,3t	6,2t	7,1t	11,4t	12,4t
Max. capacity utilisation	**52%**	**39%**	**43%**	**26%**	**30%**	**48%**	**52%**
Ground Bearing Pressure	5,2t/m²	6,1t/m²		4,2t/m²		7,3t/m²	

COG offset		
COG X	+/-	0,20m
COG Y	+/-	0,22m

Gross static axle line loads (Static loading on level ground, incl. COG offset)			
	Group 1	**Group 2**	**Group 3**
neutral	18,8t	12,4t	22,8t
A	17,0t	14,3t	21,8t
B	20,6t	13,4t	20,9t
C	17,0t	11,3t	24,8t
D	20,6t	10,4t	23,9t

Indicative Hydraulic pressures (Static loading on level ground, at average trailer height)			
	Group 1	**Group 2**	**Group 3**
neutral	99bar	62bar	123bar
A	89bar	73bar	117bar
B	110bar	68bar	112bar
C	89bar	56bar	134bar
D	110bar	51bar	129bar

2. Ground Bearing Pressure

The ground bearing pressure is evalutated based on static loads, including COG shift.
The calculation shows both average and local (per hydraulic group) ground bearing pressures.
The shadow area under the trailers is used as load spreading area.

AVERAGE GROUND BEARING PRESSURE	
Total Load	356,9t
Total area (exclucing pinned axlelines)	68,0m²
Average Ground Bearing Pressure	**5,2t/m²**

MAX LOCAL GROUND BEARING PRESSURES(incl. COG shift)			
	Group 1	**Group 2**	**Group 3**
Static Gross axle line load	20,6t	14,3t	24,8t
Individual trailer width	2,43m	2,43m	2,43m
Individual axle line length	1,40m	1,40m	1,40m
Ground Bearing Pressure	**6,1t/m²**	**4,2t/m²**	**7,3t/m²**

3. Static capacity and tipping angle checks, including slopes

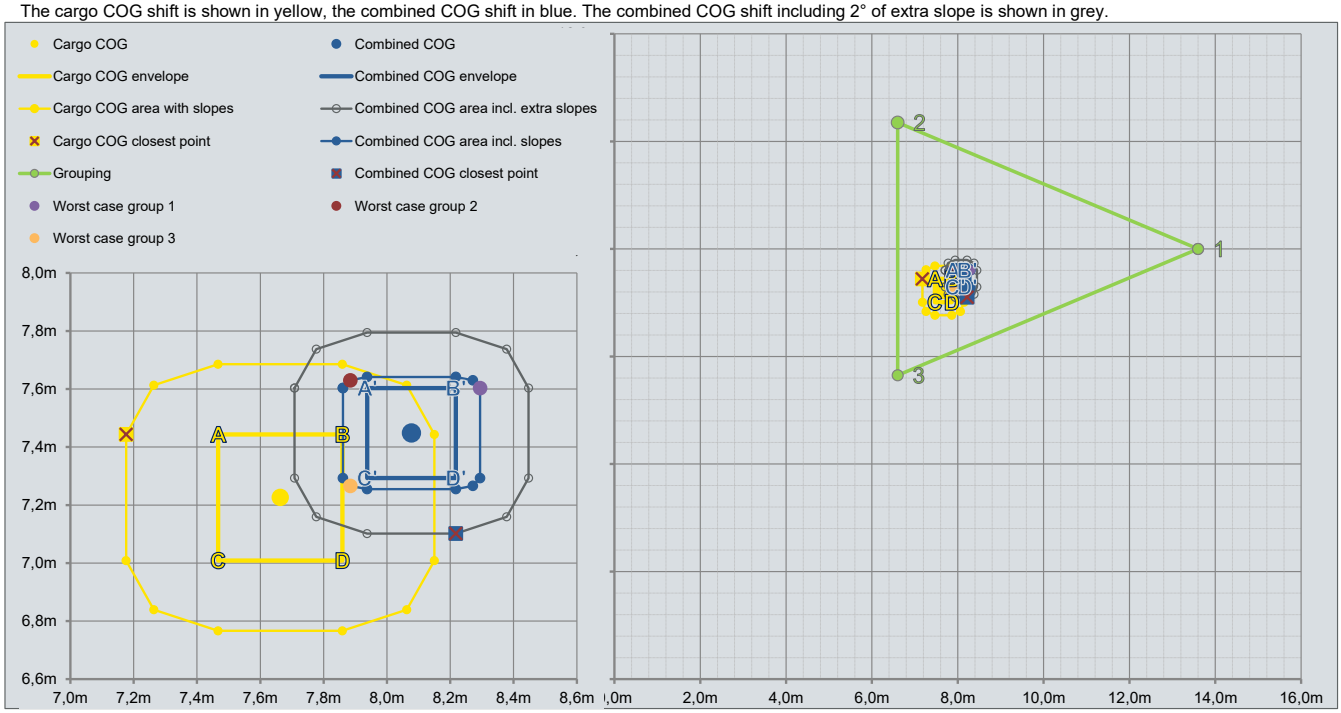
The static stability on slopes is analysed by moving the COG over a horizontal distance, equivalent to the tangent of the given slope angles. The 4 extremities of the COG envelope are each shifted in 3 directions: X, Y and a combination of both, including a combination factor (typically 0,7) and this for both Cargo and Combined COG.

STATIC ENVIRONMENT PROPERTIES								info
	slopes on route	Remaining slopes after compensation	extra slope	Total (degrees)	slopes after comp.	extra slope	**TOTAL (%)**	max slope compensable by trailer stroke (1 direction only)
Longitudinal Slope	1,0°	1,0°	2,0°	3,00°	1,7%	3,5%	5,2%	2,3°
Cross Slope	0,5°	0,5°	2,0°	2,50°	0,9%	3,5%	4,4%	4,6°
Combination Factor	0,70							

CHECK 3: Remaining stability angles, including slopes, at closest points:					
Smallest cargo tipping angle:	**5,9°**	**≥**	**Min. Required tipping angle for Second degree:**	**5,0°**	**OK**
Smallest combined tipping angle:	**11,1°**	**≥**			

AXLE LINE LOADS AND UTILISATIONS INCLUDING SLOPE EFFECT							
	Extreme COG positions		Max Group load (gross)	Total max Axle Line load	Extra load due to slopes	Relative load due to slopes	**UC to trailer capacity**
	X	Y					
Worst case group 1	8,29m	7,60m	86,4t	21,6t	1,0t	4,5%	**45%**
Worst case group 2	7,88m	7,63m	117,6t	14,7t	0,4t	2,9%	**31%**
Worst case group 3	7,88m	7,27m	201,4t	25,2t	0,4t	1,7%	**52%**
CHECK 4: static capacity utilisation, inclding slopes							
Max. UC:	**52%**	**<**	**Max. allowed UC for Second degree:**		**90%**		**OK**

The chart below shows the COG shift due to slopes from the 4 corners of the COG envelope.
The cargo COG shift is shown in yellow, the combined COG shift in blue. The combined COG shift including 2° of extra slope is shown in grey.



7. DYNAMIC CAPACITY AND STABILITY CHECK

Dynamic effects are evaluated in the same manner as slopes. Dynamic stability and capacity checks are performed for combined COG only.
Every transverse load results in an equivalent horizontal virtual shift of the COG, found by dividing the tipping moment created by the horizontal load (= Load x Height to ground) by the combined mass of the transporter, packing and cargo. The load effect table shows the generated horizontal load (on the cargo) by the given dynamic effect, the consequent loadmoment to the trailer deck for the cargo mass and the loadmoment to ground for the combined mass.
The COG is virtually shifted from the four corners of the basic envelope in X and Y direction and in a combination of both in diagonal direction. In the latter case, the effect of slopes is used with a combination factor as defined in the section above, the other side loads are combined with a factor of 0,7.

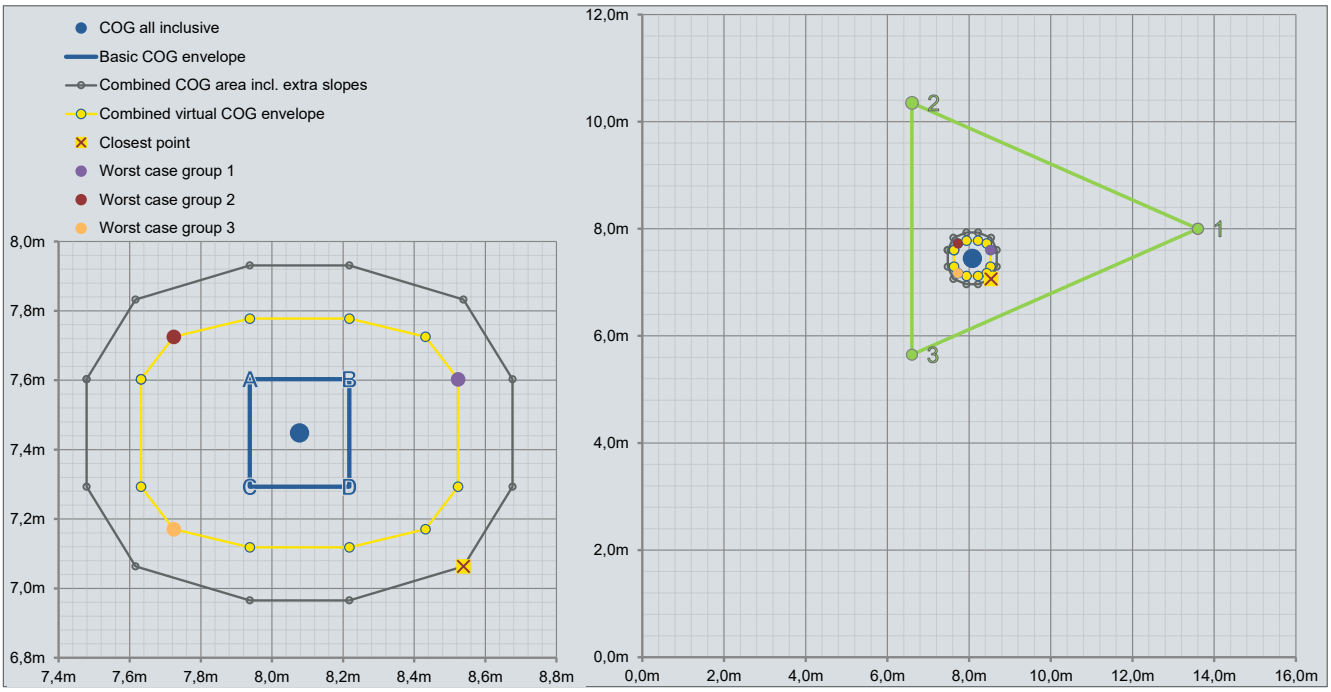
DYNAMIC ENVIRONMENT PROPERTIES	
Design 1min averaged wind speed	20m/s
Longitudinal Acceleration	0,5m/s²
Cross Acceleration	0,2m/s²

DYNAMIC LOAD EFFECTS:

	Fx on cargo	My to deck (by cargo)	My to ground (by total mass)	Fy on cargo	Mx to deck (by cargo)	Mx to ground (by total mass)
Slope effect	43,6 kN	176kNm	268kNm	21,8 kN	88kNm	134kNm
wind force	3,0 kN	15kNm	19kNm	25,5 kN	126kNm	165kNm
acceleration	127,3 kN	515kNm	783kNm	50,9 kN	206kNm	313kNm

CHECK 5: Remaining stability angle considering the vertiual COG shift due to dynamic effects:					
Smallest tipping angle:	**9,4°**	**≥**	**Min. Required tipping angle for Second degree:**	**5,0°**	**OK**

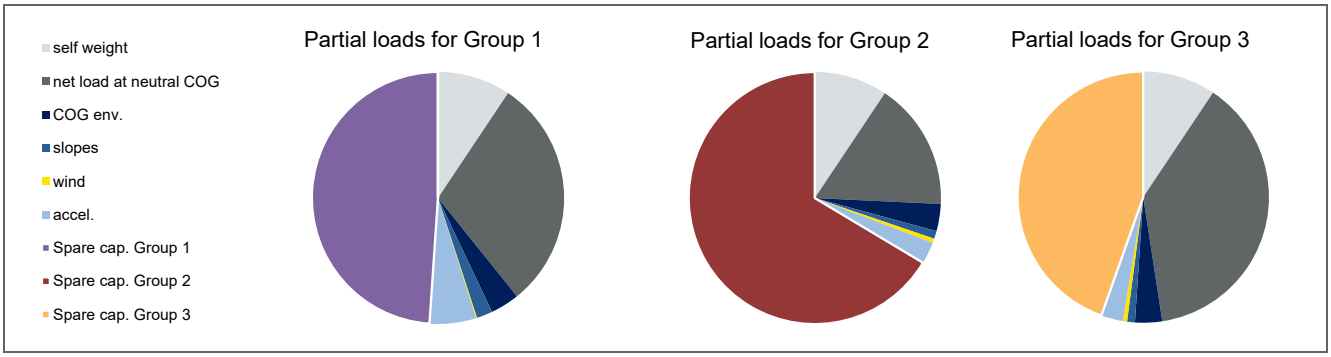
The chart below shows the total virtual combined COG shift due to all dynamic effects in yellow. The virtual COG shift including 2° of extra slope is shown in grey.



Maximum axle line loads and utilisations incl. dynamic effects

	Extreme virtual COG positions		Max Group load (gross)	Total max Axle Line load	Partial loads from : self weight	net load at neutral COG	COG env.	slopes	wind	accel.	UC to trailer capacity
	X	Y									
Worst case group 1	8,52m	7,60m	98,1t	24,5t	4,5t	14,3t	1,8t	1,0t	0,1t	2,9t	**51%**
Worst case group 2	7,72m	7,73m	129,0t	16,1t	4,5t	7,9t	1,7t	0,5t	0,3t	1,3t	**34%**
Worst case group 3	7,72m	7,17m	212,8t	26,6t	4,5t	18,3t	1,7t	0,5t	0,3t	1,3t	**55%**

CHECK 6: Max utilisation including dynamic effects:					
Max. UC:	**55%**	**≤**	**Max. allowed UC for Second degree:**	**100%**	**OK**



Minimum group loads incl. dynamic effects (ESTA GD23018-EN / DNV-ST-N001 10.5.3.22 verification)

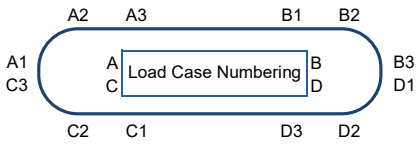
	Extreme virtual COG positions		Min dynamic group load	Static gross group load	Dynamic to static load ratio
Worst case group 1	7,63m	7,60m	52,6t	75,3t	**70%**
Worst case group 2	8,43m	7,17m	68,8t	98,9t	**70%**
Worst case group 3	8,43m	7,73m	152,6t	182,7t	**84%**

CHECK 7: Minium dynamic load over static load ratio:					
Minimum ratio:	**70%**	**≥**	**Min. allowed ratio**	**60%**	**OK**

8. SPINEBEAM CALCULATION

Number of analysed Trailer	1
Load case (Static loading, with or without slopes)	Neutral
Mesh Size	0,023m

(cannot be used for 1-file trailer unit)

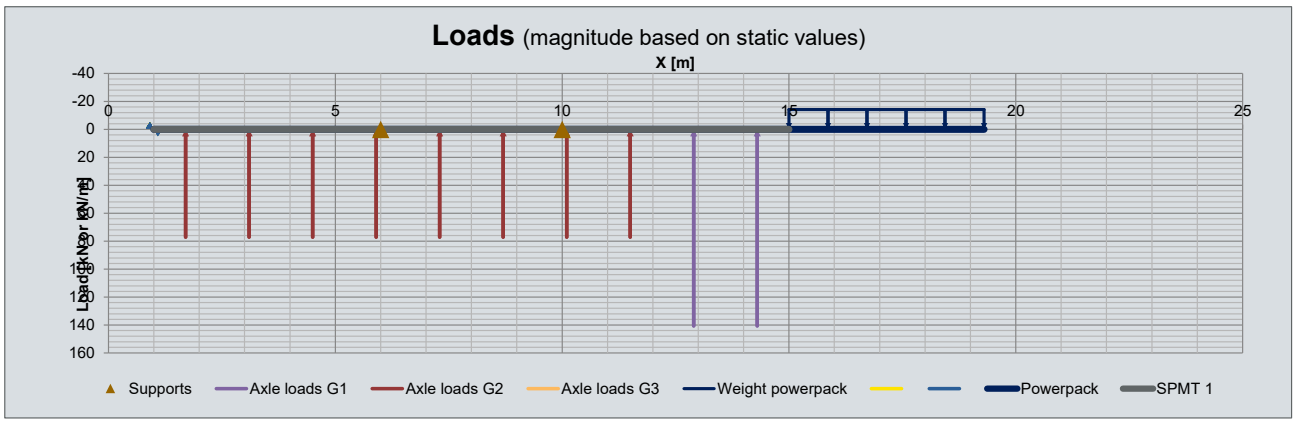


LOOSE PACKING (POWERPACK, WEIGHTS,...) ON TRAILER 1			
Type	Mass	Start X	End X

Loose packing is any packing **on the specific trailer under investigation** which is not sitting in between and the trailer deck and the cargo itself and not making part of the cargo. For example: loose powerpacks or counterweight slabs to relieve the trailer's spine beam loading.
Note: the weight of this packing is already been included in the packing declared in the section "Cargo definition".
Start and End are defined in absolute coordinates (not relative to trailer!).

SUPPORT SPREADING AND OVERRIDING					
Support	X position	Width of support	Allowed?	R_{static}	Active?
1.	6,000 m		yes	380 kN	yes
2.	10,000 m		yes	457 kN	yes
3.					yes
4.					yes
5.					yes
6.					yes
7.					yes
8.					yes
9.					yes
10.					yes

Note:
A support should be deactivated (by setting the 'Active?' value to 'no') in the following cases:
- the support is not present on the current trailer
- the Rstatic load is negative but no tension load is to be taken by the support.



SPINEBEAM UTILISATION SUMMARY						
Based on static loading	Min	Min All.	Util.	Max	Max All.	Util.
Shear force	-375kN	-2000kN	**19%**	308kN	2000kN	**15%**
Bending moment	-173kNm	-9250kNm	**2%**	701kNm	9250kNm	**8%**
	Downwards deformation:			Upwards deformation		
Deformation	**-0,4 mm**	@ X pos.:	8,0 m	**3,8 mm**	@ X pos.:	1,0 m
CHECK 8: Spine beam utilisation of Trailer no. 1						
Max. UC:	**19%**	**<**	**Max. allowed UC for Second degree:**		**85%**	**OK**

9. SUMMARY AND CONCLUSION

Trailers: Type: K2400 ST
Number of trailers: 2
N° of axle lines in longest trailer: 10
Total amount of axle lines: 20
Total number of powerpacks: 2
Gross axle line capacity: 48,0t

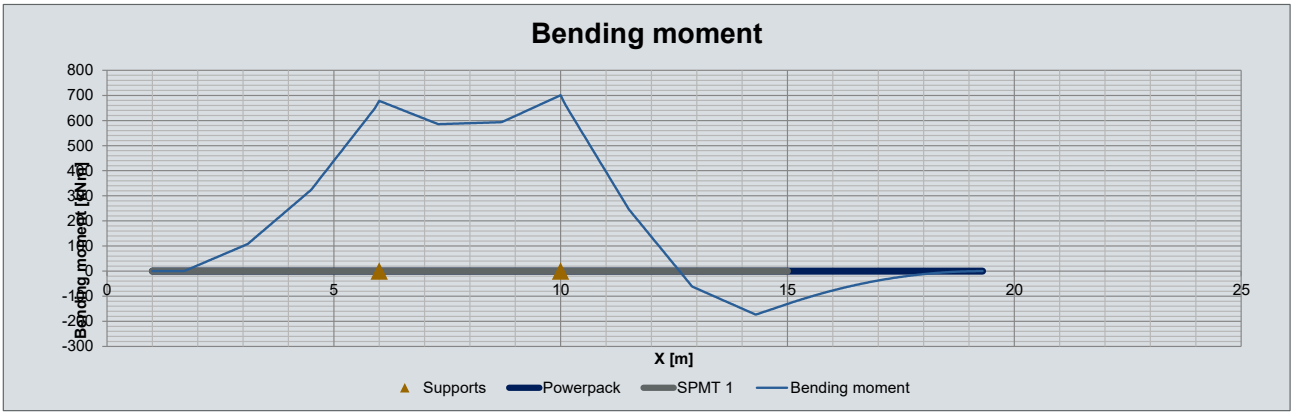
Cargo: TP (19,631m x 21,736m x 7,91m)
Mass: 254,5t

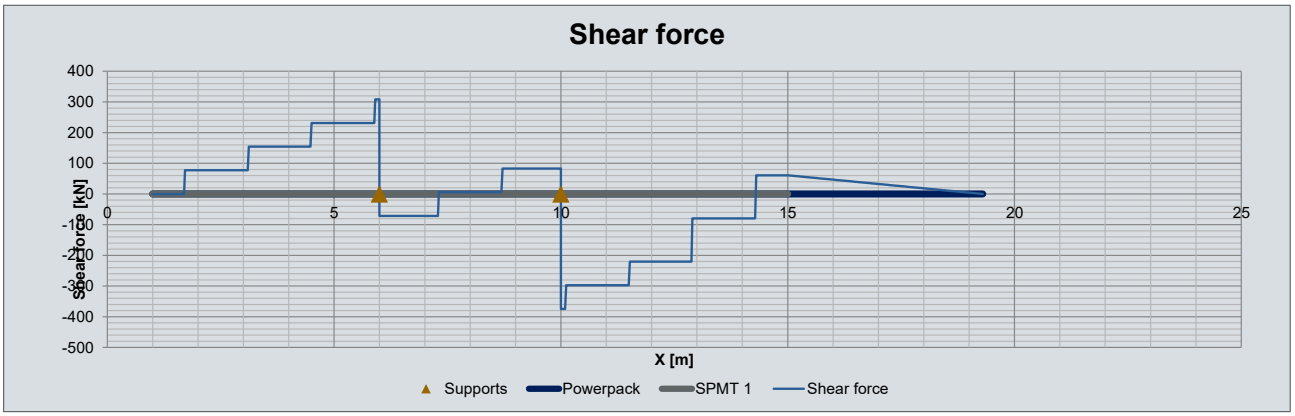
Load parameters:		**X**	**Y**
COG envelope considered		+/-0,20m	+/-0,22m
Slopes (after compensation)		1,0°	0,5°
Windspeed and area	20m/s	1,2 x 10m²	1,2 x 85m²
Accelerations		0,5m/s²	0,2m/s²

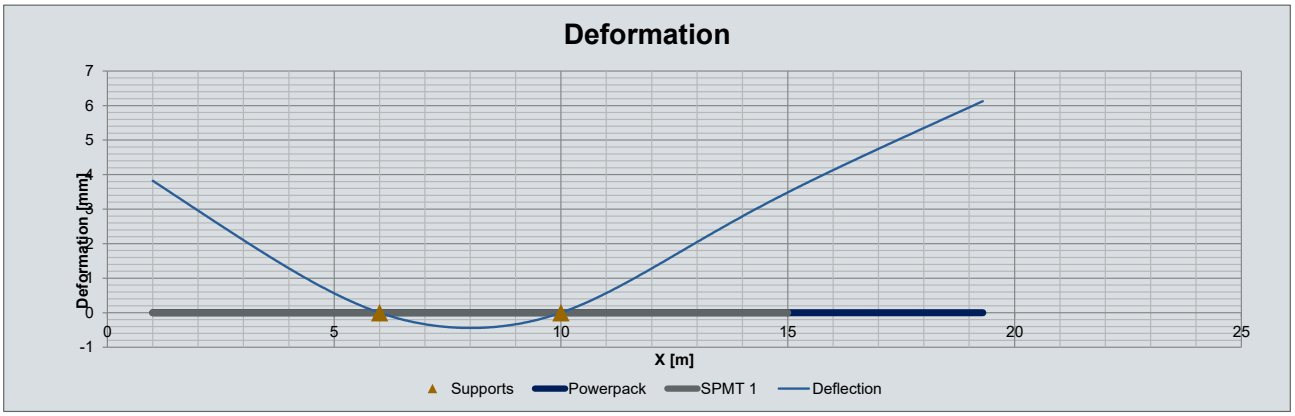
Axle load summary	Gross static axle load	Gross static axle load incl envelope	Gross dynamic axle load
Group 1	18,8t	20,6t	24,5t
Group 2	12,4t	14,3t	16,1t
Group 3	22,8t	24,8t	26,6t

Degree of engineering for calculation verification:			**Second**			
Capacity checks				**Stability checks**		
Basic Static Utilisation	**52%**	**OK**		Basic Static Tipping Angle	**13,4°**	**OK**
Static Utilisation Including Slopes	**52%**	**OK**		Static Tipping Angle incl. Slopes	**11,1°**	**OK**
Dynamic Utilisation	**55%**	**OK**		Dynamic Tipping Angle	**9,4°**	**OK**
Spine Beam Utilisation of trailer no. 1	**19%**	**OK**		Minimum dynamic load to static load ratio	**70%**	**OK**
Notes:						
1. The transport complies with the capacity and stability requirements of DNV-ST-N001 10.5.3.22 and ESTA GD23018						
2. The transport complies with the capacity and stability requirements of DNV-ST-N001 10.5.3.16 and 10.5.3.17						

Annex: BENDING DIAGRAMS FOR STATIC LOADING in trailer no. 1







Bridge 5800x1000x200 heavy Chamfer

CALCULATION NOTE



-	16/01/2020	First issue	RDTS	S.W.	K.D.	L.R.	35
Rev.	Date	Description	Dept.	Edited	Verified	Approved	Pg

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1 INTRODUCTION

1.1 General information

The purpose of this document is to provide the design calculation note of the bridge 5800x1000x200 heavy chamfer. It provides the loads taken into account and verification that all components of the structure are calculated, verified and that they meet the required capacity.

This calculation note is a controlled document about the bridge 5800x1000x200 heavy chamfer. The valid version can be found on Sarplan.

The purpose of this calculation note is to check the strength of bridge 5800x1000x200-2 under the load of SPMT Kamag 2400 ST (max gross capacity: 48t/axle line).





1.2 Reference documents

Standards:
EN 1990: Basis of structural design (2002)
EN 1993-1-1: Design of steel structures - Part 1-1: General rules (2005)
EN 1993-1-5: Design of steel structures - Part 1-5: Plated structural elements (2006)
EN 1993-1-8: Design of steel structures - Part 1-8: Design of joints (2006)
EN 10025: European structural steel standard

Sarens drawings:
SNVE000048537 (Recent drawing according to new drawing standards)
BR 5800x1000x200 FA.idw (construction drawing used in 2013) (BR5800-2 CH 001-024)
SNVE000001737 (construction drawing used in 2015) (BR5800-2 CH 025-047)

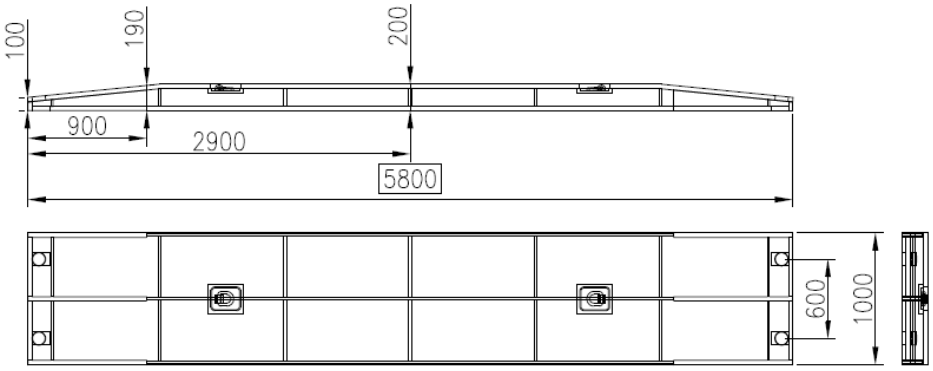
2 MATERIAL

The plates are steel grade S460. (EN 1993-1-1, EN 10025-2)

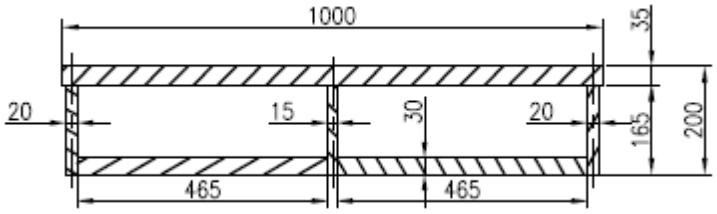
Steel grade	Nominal thickness of the element t [mm]			
	t ≤ 50 mm		50 mm < t ≤ 100 mm	
	f_y [N/mm²]	f_u [N/mm²]	f_y [N/mm²]	f_u [N/mm²]
S 460	460	550	440	550

3 DIMENSIONS AND PROPERTIES

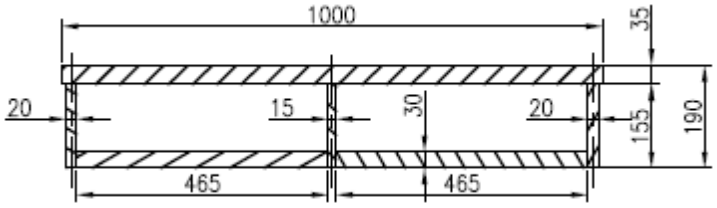
3.1 Geometry



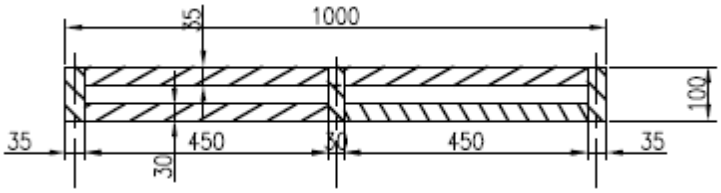
Cross section H=200 (x=2900)



Cross section H=190 (x=900)



Cross section H=100 (x=0)

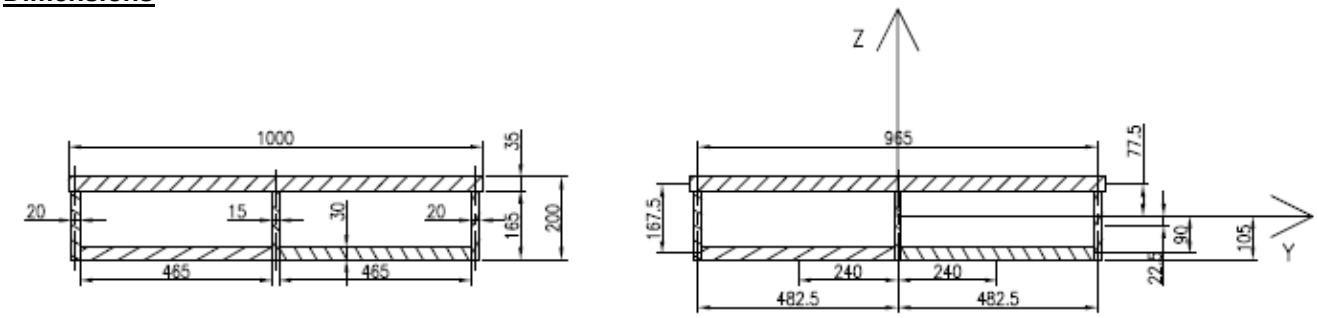


3.2 Cross section properties

The design resistance of the cross sections is calculated based on EN 1993-1-1.

3.2.1 H = 200mm

Dimensions



Classification

Compression: $\frac{482.5}{35} = 14 < 33 * \varepsilon = 33 * 0.71 = 23.4$ (Class 1)

Bending: $\frac{165}{15} = 11 < 72 * \varepsilon = 72 * 0.71 = 51$ (Class 1)

For safety reasons the design calculation is based on the elastic capacity of the cross section.

Properties

Length y [mm]	Height z [mm]	Area A_i [mm²]	Distance d_{zi} center-cog z [mm]	I_{yi} [mm⁴]	$A_i d_{zi}^2$ [mm⁴]	Distance d_{yi} center-cog y [mm]	I_{zi} [mm⁴]	$A_i d_{yi}^2$ [mm⁴]
1000	35	35000	77,5	3,57E+06	2,10E+08	0	2,92E+09	0
465	30	13950	-90,0	1,05E+06	1,13E+08	240	2,51E+08	8,04E+08
465	30	13950	-90,0	1,05E+06	1,13E+08	240	2,51E+08	8,04E+08
20	165	3300	-22,5	7,49E+06	1,67E+06	482,5	1,10E+05	7,68E+08
15	165	2475	-22,5	5,62E+06	1,25E+06	0	4,64E+04	0
20	165	3300	-22,5	7,49E+06	1,67E+06	482,5	1,10E+05	7,68E+08
		71975	**105,0**					

I_{yy} [mm⁴]	4,67E+08
f_y [N/mm²]	460
W_y [mm³]	4449746,1
$M_{y,Rd,el}$ [kNm]	2046,9

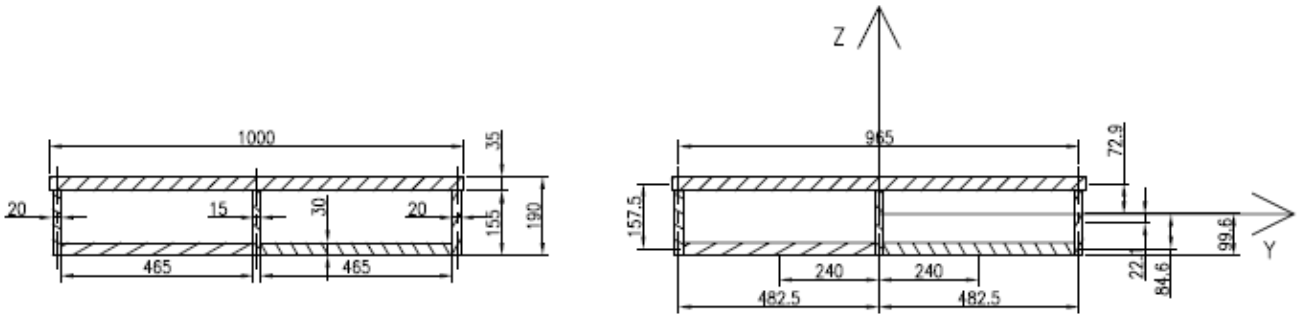
I_{zz} [mm⁴]	6,56E+09
f_y [N/mm²]	460
W_z [mm³]	13126434,9
$M_{z,Rd,el}$ [kNm]	6038,2

K_ϕ	1,37E+09

A_{Vz} [mm³]	9075,0
f_y [N/mm²]	460
$V_{z,Rd}$ [kN]	2410,1

3.2.2 H = 190mm

Dimensions



Classification

Compression: $\frac{482.5}{35} = 14 < 33 * \varepsilon = 33 * 0.71 = 23.4$ (Class 1)

Bending: $\frac{155}{15} = 10 < 72 * \varepsilon = 72 * 0.71 = 51$ (Class 1)

For safety reasons the design calculation is based on the elastic capacity of the cross section.

Properties

Length y [mm]	Height z [mm]	Area A_i [mm²]	Distance d_{zi} center-cog z [mm]	I_{yi} [mm⁴]	$A_i d_{zi}^2$ [mm⁴]	Distance d_{yi} center-cog y [mm]	I_{zi} [mm⁴]	$A_i d_{yi}^2$ [mm⁴]
1000	35	35000	72,9	3572917	1,86E+08	0	2,92E+09	0
465	30	13950	-84,6	1046250	9,99E+07	240	2,51E+08	8,04E+08
465	30	13950	-84,6	1046250	9,99E+07	240	2,51E+08	8,04E+08
20	155	3100	-22,1	6206458	1,52E+06	482,5	1,03E+05	7,22E+08
15	155	2325	-22,1	4654844	1,14E+06	0	4,36E+04	0
20	155	3100	-22,1	6206458	1,52E+06	482,5	1,03E+05	7,22E+08
		71425	**99,6**					

I_{yy} [mm⁴]	4,13E+08
f_y [N/mm²]	460
W_y [mm³]	4140823,4
$M_{y,Rd,el}$ [kNm]	1904,8

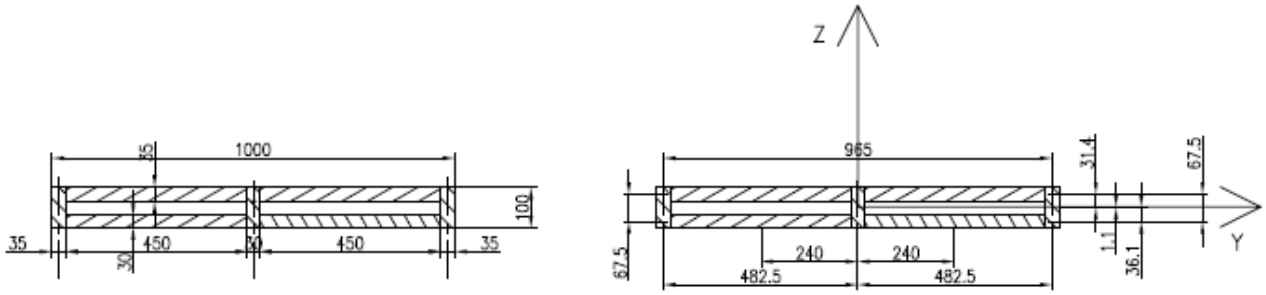
I_{zz} [mm⁴]	6,47E+09
f_y [N/mm²]	460
W_z [mm³]	12940157,6
$M_{z,Rd,el}$ [kNm]	5952,5

K_ϕ	1,22E+09

A_{Vz} [mm³]	8525,0
f_y [N/mm²]	460
$V_{z,Rd}$ [kN]	2264,1

3.2.3 H = 100mm

Dimensions



Classification

Compression: $\frac{482.5}{35} = 14 < 33 * \varepsilon = 33 * 0.71 = 23.4$ (Class 1)
Bending: $\frac{100}{35} = 3 < 72 * \varepsilon = 72 * 0.71 = 51$ (Class 1)

For safety reasons the design calculation is based on the elastic capacity of the cross section.

Properties

Length y [mm]	Height z [mm]	Area A_i [mm²]	Distance d_{zi} center-cog z [mm]	I_{yi} [mm⁴]	$A_i d_{zi}^2$ [mm⁴]	Distance d_{yi} center-cog y [mm]	I_{zi} [mm⁴]	$A_i d_{yi}^2$ [mm⁴]
450	35	15750	31,4	1,61E+06	1,55E+07	240	2,66E+08	9,07E+08
450	35	15750	31,4	1,61E+06	1,55E+07	240	2,66E+08	9,07E+08
450	30	13500	-36,1	1,01E+06	1,76E+07	240	2,28E+08	7,78E+08
450	30	13500	-36,1	1,01E+06	1,76E+07	240	2,28E+08	7,78E+08
35	100	3500	-1,1	2,92E+06	4,63E+03	482,5	3,57E+05	8,15E+08
30	100	3000	-1,1	2,50E+06	3,96E+03	0	2,25E+05	0
35	100	3500	-1,1	2,92E+06	4,63E+03	482,5	3,57E+05	8,15E+08
		68500	**51,1**					

I_{yy} [mm⁴]	7,98E+07
f_y [N/mm²]	460
W_y [mm³]	1560720,8
$M_{y,Rd,el}$ [kNm]	717,9

I_{zz} [mm⁴]	5,99E+09
f_y [N/mm²]	460
W_z [mm³]	11974741,7
$M_{z,Rd,el}$ [kNm]	5508,4

K_ϕ	2,67E+08

A_{Vz} [mm³]	10000,0
f_y [N/mm²]	460
$V_{z,Rd}$ [kN]	2655,8

4 LOADINGS

The loads are divided in groups

- Permanent load
- Variable load
  - Environmental load
  - Operational load

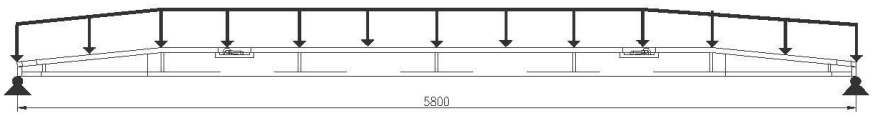
4.1 Permanent load

4.1.1 Dead load

The weight of the bridge is considered as a uniform load over the length of the bridge.

G =34.2 kN

$$g = \frac{G}{5.8} = 5.9 \frac{kN}{m}$$



4.2 Variable loads

4.2.1 Axle load

The maximum allowed axle load is 48 ton. 1 axle line consists in 4 wheels.
The self-weight of the SPMT is included in the axle load.
Depending on the load case, the position and amount of wheels on the bridge, can be determined in the worst case scenario.

P = 480kN/ axle line
P = 120kN/ wheel

4.2.2 Horizontal load

A horizontal load of 5% of the total vertical load (dead load + axle load) is considered, in order to account for side effects (e.g. wind, imperfection).

$$H = 0.05 \times (nP + g)$$

5 COMBINATIONS

5.1 Load factors

Partial safety factor of loads

Combination factor of permanent loadings with unfavorable effect γ = 1,35
Combination factor of permanent loadings with favorable effect γ = 0,90
Combination factor of variable loadings with unfavorable effect γ = 1,50
Combination factor of variable loadings with favorable effect γ = 0

5.2 Load combinations

SLS

$$1.0 * Dead\ load + 1.0 * Axle\ load + 1.0 * Horizontal\ load$$

ULS

$$1.35 * Dead\ load + 1.35 * Axle\ load + 1.5 * Horizontal\ load$$

5.3 Material and connection factors

Resistance of cross-sections γ_{M0} = 1,00
Resistance of members to instability assessed by member checks γ_{M1} = 1,00
Resistance of cross-sections in tension to fracture γ_{M2} = 1,25

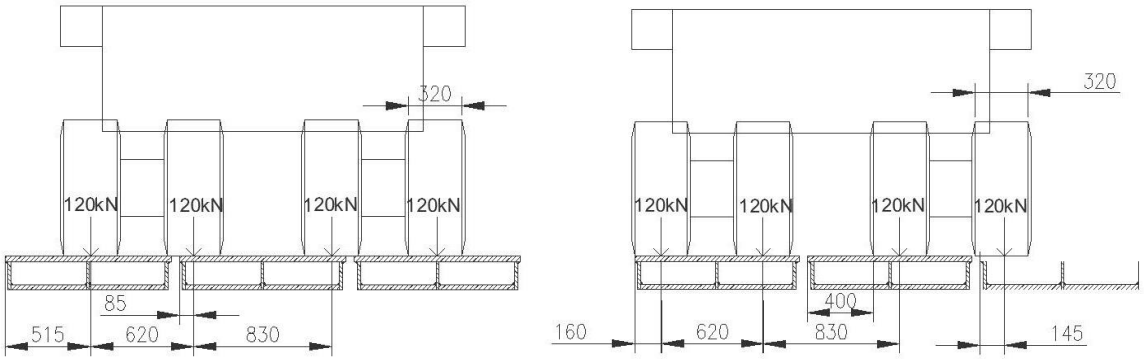
Partial safety factor of joints

Bolt resistance γ_{M2} = 1,25
Weld resistance γ_{M2} = 1,25
Pin resistance γ_{M2} = 1,25

6 LOAD INTRODUCTION POINTS

6.1 Lateral position of the SPMT

In lateral direction, two positions of the SPMT on the bridge can be defined: centered or at the extreme side, as shown in the following figure.

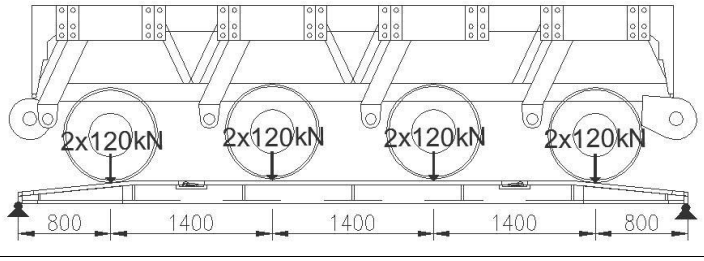


In both cases, the most loaded bridge section supports 2 wheels (2x120kN).

6.2 Longitudinal position of the SPMT

The position of the SPMT in longitudinal direction is not fixed, because the SPMT is driving on the bridge. Thus the worst case position needs to be verified. Three load cases in longitudinal direction will be analyzed and maximum internal forces can be compared.

6.2.1 Case (a): 4 point load

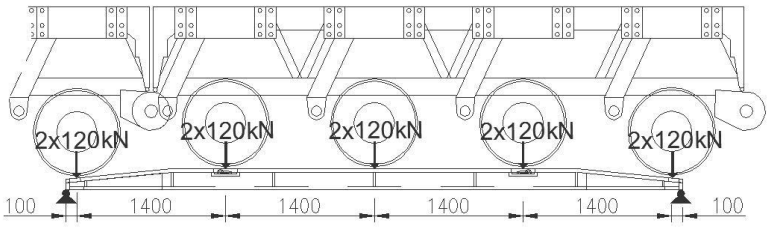


Maximum internal forces

$$V_{max} = R_L = R_R = \frac{4 * 2 * 120kN}{2} = 480kN$$

$$M_{max}\left(x = \frac{L}{2}\right) = 480kN * 2900mm - 240kN * 2100mm - 240kN * 700mm = 720kNm$$

6.2.2 Case (b): 5 point load



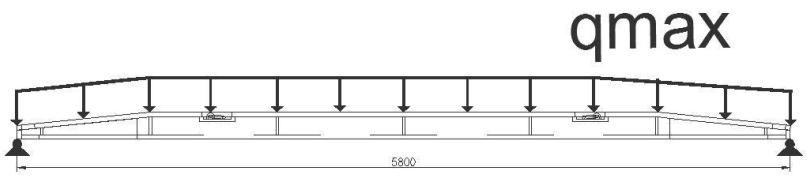
Maximum internal forces

$$V_{max} = R_L = R_R = \frac{5 * 2 * 120kN}{2} = 600kN$$

$$M_{max}\left(x = \frac{L}{2}\right) = 600kN * 2900mm - 240kN * 2800mm - 240kN * 1400mm = 732kNm$$

6.2.3 Case (c): uniform load

In this load case, the load of 5 axles (with each 2 wheels/bridge) is considered as a uniform load over the length of the bridge.



$$q_{max} = \frac{5 * 2 * 120kN}{5800mm} = 206.9\frac{kN}{m}$$

Maximum internal forces

$$V_{max} = R_L = R_R = q_{max} * \frac{L}{2} = 206.9\frac{kN}{m} * \frac{5800mm}{2} = 600kN$$

$$M(x) = R_L * x - q * x * \frac{x}{2}$$

$$M_{max}\left(x = \frac{L}{2}\right) = R_L * \frac{L}{2} - q_{max} * \frac{L^2}{8} = 600kN * \frac{5800mm}{2} - 206.9\frac{kN}{m} * \frac{(5800mm)^2}{8} = 870kNm$$

6.3 Determination of worst case scenario

In lateral direction: 2 wheels on 1 bridge section.
In longitudinal direction: uniform load distribution of 5 axles (with each 2 wheels/bridge)

7 ANALYSIS

Based on the determination of the worst case scenario, the following combinations can be used:

SLS

$$1.0 * (g + q) + 1.0 * H$$

ULS

$$1.35 * (g + q) + 1.5 * H$$

Total vertical uniform load

$$q_{max} + g = 206.9 \frac{kN}{m} + 5.9 \frac{kN}{m} = 213 \frac{kN}{m}$$

Maximum internal forces (SLS)

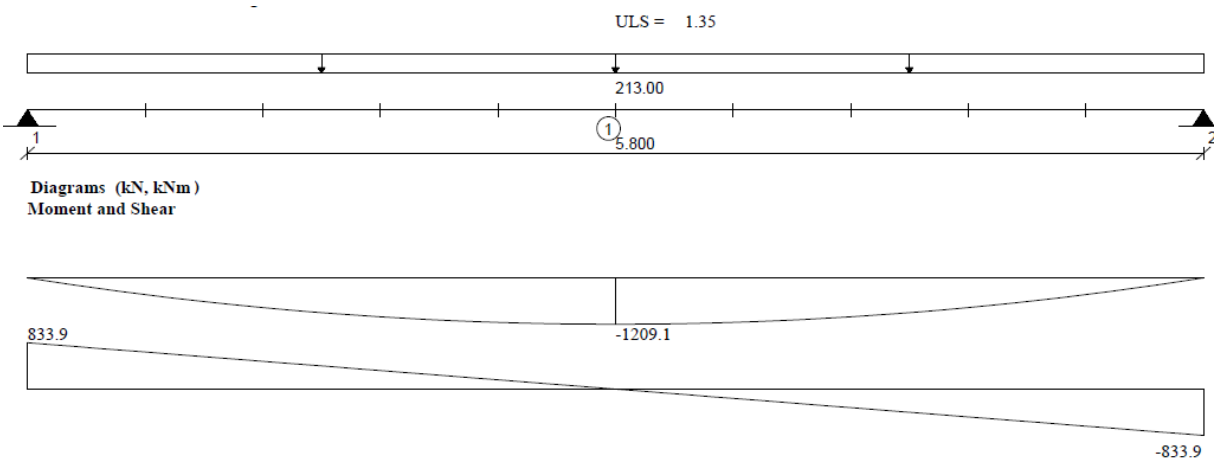
$$V_{max} = R_L = R_R = q_{max} * \frac{L}{2} = 213 \frac{kN}{m} * \frac{5800mm}{2} = 618kN$$

$$M_{max}\left(x = \frac{L}{2}\right) = R_L * \frac{L}{2} - q_{max} * \frac{L^2}{8} = 618kN * \frac{5800mm}{2} - 213 \frac{kN}{m} * \frac{(5800mm)^2}{8} = 897kNm$$

7.1 Global check

The bridges are verified at 3 sections assuming a uniform load distribution, centered in the lateral direction.

$M_{y,Ed}$ and $V_{z,Ed}$ is given below:



Max. forces (kN, kNm)

Forces and Moments

Span no.	xl (m)	Shear force		Moment	
		Max.	Min.	Max.	Min.
1	0.00	833.90	0.00	0.00	0.00
	0.58	667.12			-435.29
	1.16	500.34			-773.85
	1.74	333.56			-1015.68
	2.32	166.78			-1160.78
	2.90		0.00		-1209.15
	3.48		-166.78		-1160.78
	4.06		-333.56		-1015.68
	4.64		-500.34		-773.85
	5.22		-667.12		-435.29
	5.80	0.00	-833.90	0.00	0.00

Support Reactions

Support no.	Force		Moment	
	Max.	Min.	Max.	Min.
1	833.90	0.00	0.00	0.00
2	833.90	0.00	0.00	0.00

5% of the vertical load is taken as the horizontal load. And it is considered as a variable load. Hence the moment in the Z axis is obtained as :

$$M_{Z,Ed} = \frac{0.05 \cdot M_{Y,Ed}}{1.35} \cdot 1.5$$

Shear check:

$$U.C = \frac{V_{Z,Ed}}{V_{Z,Rd}}$$

Combined bending moment check:

$$U.C = \frac{M_{Y,Ed}}{M_{Y,Rd}} + \frac{M_{Z,Ed}}{M_{Z,Rd}}$$

7.1.1 Verification in section x = 2900mm

$V_{z,Ed}$ [kN]	0,0
$V_{z,Rd}$ [kN]	2410,1
U.C.	0,00
Check	OK

$M_{y,Ed}$ [kNm]	1209,1	$M_{z,Ed}$ [kNm]	67,2
$M_{y,Rd,el}$ [kNm]	2046,9	$M_{z,Rd,el}$ [kNm]	6038,2
	U.C. Combined bending		0,60
		Check	OK

7.1.2 Verification in section x = 900mm

$V_{z,Ed}$ [kN]	575,1
$V_{z,Rd}$ [kN]	2264,1
U.C.	0,25
Check	OK

$M_{y,Ed}$ [kNm]	634,0	$M_{z,Ed}$ [kNm]	35,2
$M_{y,Rd,el}$ [kNm]	1904,8	$M_{z,Rd,el}$ [kNm]	5952,5
	U.C. Combined bending		0,34
		Check	OK

7.1.3 Verification in section x = 0mm

$V_{z,Ed}$ [kN]	833,9
$V_{z,Rd}$ [kN]	2655,8
U.C.	0,31
Check	OK

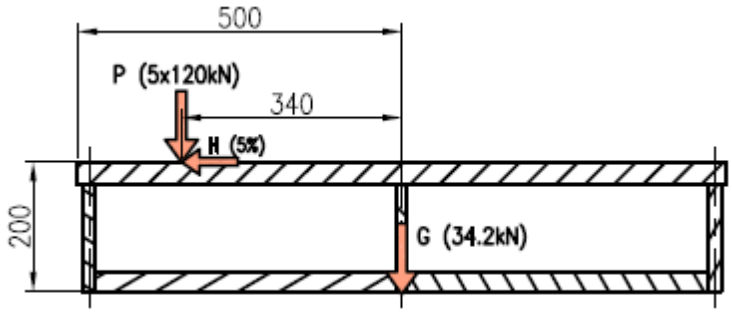
$M_{y,Ed}$ [kNm]	0,0	$M_{z,Ed}$ [kNm]	0,0
$M_{y,Rd,el}$ [kNm]	717,9	$M_{z,Rd,el}$ [kNm]	5508,4
	U.C. Combined bending		0,00
		Check	OK

7.1.4 Conclusion

Global check of the bridge in different cross sections is verified and OK.

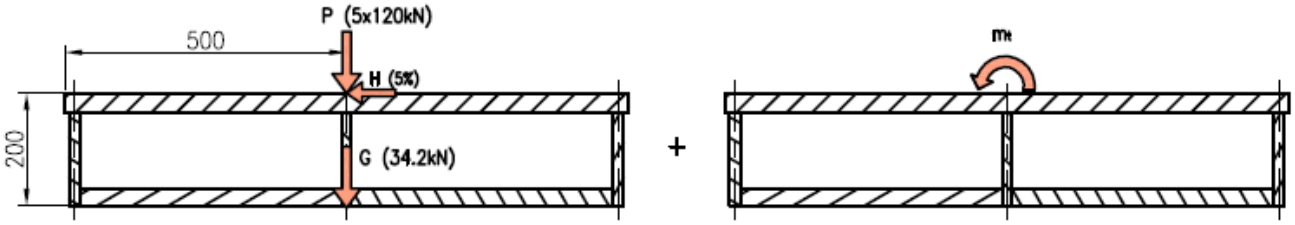
7.2 Torsional check

The bridges are verified assuming that the load is not centered in the lateral direction, but at the extreme position. In this case only 1 wheel of the axle line can be taken into account.

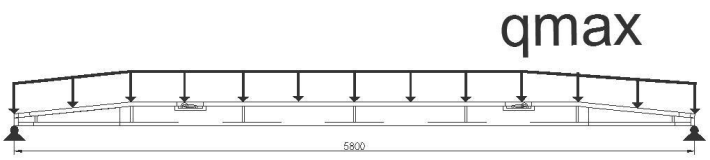


7.2.1 Loading

This load case is modeled by combination of a uniform load centered on the bridge and a torsional moment.

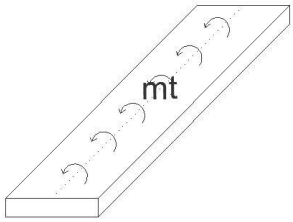


Uniform load



$$q_{total} = \frac{5 * 120\text{kN} + 34.2\text{kN}}{5800\text{mm}} = 110\frac{\text{kN}}{\text{m}}$$

Torsional moment



$$\text{m}_\text{t} = \frac{5 * 120\text{kN}}{5800\text{mm}} * 340\text{mm} + 5\% * \frac{5 * 120\text{kN}}{5800\text{mm}} * 200\text{mm} = 36.2\frac{\text{kNm}}{\text{m}}$$

7.2.2 Analysis

Maximum internal forces

- By uniform load

$$\text{V}_{\text{max}} = \text{R}_\text{A} = \text{R}_\text{B} = \frac{110\frac{\text{kN}}{\text{m}} * 5800\text{mm}}{2} = 319\text{kN}$$

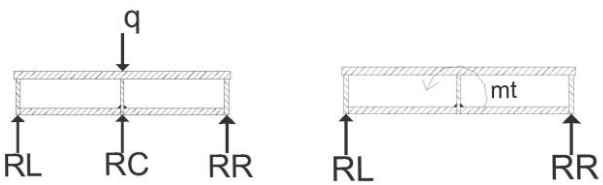
$$\text{M}_{\text{max}(\frac{L}{2})} = 319\text{kN} * 2900\text{mm} - 110\frac{\text{kN}}{\text{m}} * \frac{(2900\text{mm})^2}{2} = 463\text{kNm}$$

- By torsional moment

$$\text{m}_{\text{t,max,(A,B)}} = 36.2\frac{\text{kNm}}{\text{m}} * \frac{5800\text{mm}}{2} = 105\text{kNm}$$

Reaction forces

- First iteration



  - By uniform load

$$R_{L,A} = R_{C,A} = R_{R,A} = \frac{319kN}{3} = 106.3kN$$

- By torsional moment

$$R_{L,A} = -R_{R,A} = \frac{105kNm}{0.965m} = 108.8kN$$

$$R_{C,A} = 0\text{kN}$$

- Total

$$R_{L,A} = \frac{319kN}{3} + \frac{105kNm}{0.965m} = 215.1kN$$

$$R_{C,A} = \frac{319kN}{3} + 0 = 106.3kN$$

$$R_{R,A} = \frac{319kN}{3} - \frac{105kNm}{0.965m} = -2.5kN \approx 0$$

→ verification of maximum force taken by 1 web

$$V_{Ed} = 215.1\text{kN} * 1.35 = 488\text{kN}$$

$$V_{Rd} = \frac{35 * 100 * 460}{1.0 * \sqrt{3}} = 929.5\text{kN}$$

$V_{z,Ed}$ [kN]	290.4
$V_{z,Rd}$ [kN]	929,5
U.C.	0,31
Check	OK

7.2.3 Conclusion

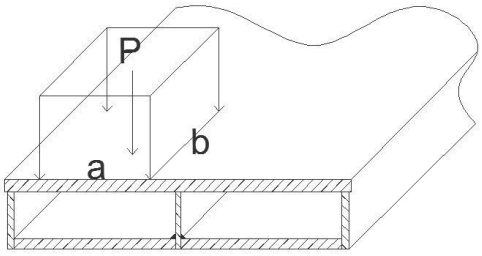
If the wheel of the SPMT is at the most extreme side of the bridge, the outside web can still take the load.

7.3 Local bending

The top flange of the bridge is locally verified, taken into the width of the wheel.

7.3.1 Loading

Based on the tire pressure and the width of the wheel, the contact surface can be calculated.



Width of the wheel: $a = 320\text{mm}$

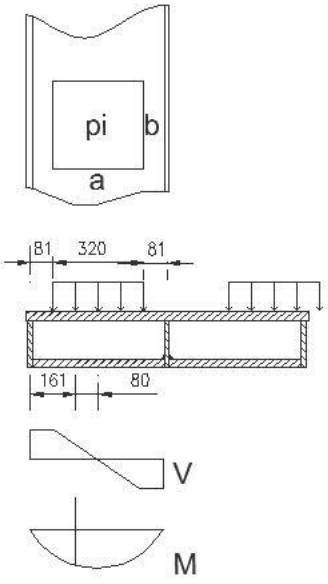
Pressure in the wheel: $p_i = 12\text{bar} = 1.2\frac{\text{N}}{\text{mm}^2}$

Max load on the wheel: $P = 120\text{kN}$

Contact area of the wheel: $A = \frac{P}{p_i} = \frac{120\text{kN}}{1.2\frac{\text{N}}{\text{mm}^2}} = 100\,000\text{mm}$

$$b = \frac{100000\text{mm}^2}{320\text{mm}} = 312.5\text{mm}$$

7.3.2 Analysis



Maximum internal forces

$$V = \frac{320mm}{2} * 1.2\frac{N}{mm^2} = 192\frac{N}{mm}$$

$$V_{Ed} = 1.35 * 0.192\frac{kN}{mm} = 0.259\frac{kN}{mm}$$

$$M = V * 161mm = 192\frac{N}{mm} * 161mm = 30\,960\frac{Nmm}{mm}$$

$$M_{Ed} = 30960\frac{Nmm}{mm} * 1.35 = 0.042\frac{kNm}{mm}$$

Design resistance of top flange

$$A_V = 1mm * 35mm = 35mm^2$$

$$V_{Rd} = A_V * \frac{f_y}{\sqrt{3}} = V_{Rd} = 35mm^2 * \frac{460\frac{N}{mm^2}}{\sqrt{3}} = 9.3kN$$

$$W_{el(1x35)} = \frac{\frac{1mm * (35mm)^3}{12}}{\frac{35mm}{2}} = 204\frac{mm^3}{mm}$$

$$M_{el,Rd} = 204\frac{mm^3}{mm} * 460\frac{N}{mm^2} = 0.094\frac{kNm}{mm}$$

Verification

$$\eta_3 = \frac{V_{Ed}}{V_{Rd}} = \frac{0.259kN}{9.3kN} = 0.03<0.5 \text{ (No interaction between } M - V)$$

$$\eta_{1,A,transverse} = \frac{M_{Ed}}{M_{el,Rd}} = \frac{0.042\frac{kNm}{mm}}{0.094\frac{kNm}{mm}} = 0.45<1.00$$

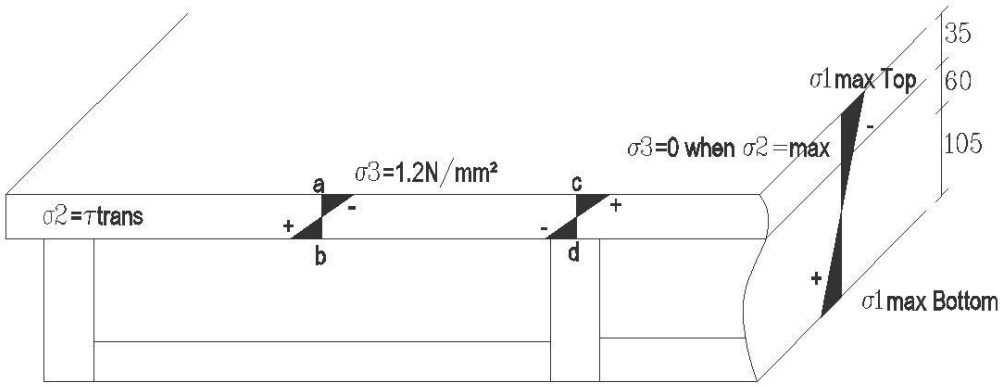
7.3.3 Conclusion

Local bending of the top flange caused by the contact pressure of 1 wheel is verified.
The minimum distance between the centers of the 2 wheels is 620 mm, the second wheel will not create higher bending moment.

7.4 Von Mises stress

Combining the different load cases, the maximum stress is verified. This verification is done in SLS. Afterwards the total safety factor of the combined stress can be analyzed.

$$\sigma_{VM} = \frac{1}{\sqrt{2}} * \sqrt{(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2}$$



The maximum stress is determined in the cross section of H = 200 mm. The COG of this cross section is positioned at 105 mm from the bottom.

$$\sigma_{1,max,top} = \frac{95mm}{105mm} * \sigma_{1,max,bottom} = 0.9 * \sigma_{1,max,bottom}$$

7.4.1 Verification in node a

$$\sigma_{1,\max,\text{top}} = -\frac{95}{105} * \left(\frac{1209.1\text{kNm}/1.35}{2046.9\text{kNm}} * 460 \frac{\text{N}}{\text{mm}^2} \right) = -194 \frac{\text{N}}{\text{mm}^2}$$

$$\sigma_{2,\max,\text{top}} = -\frac{0.042 \frac{\text{kNm}}{\text{mm}} / 1.35}{0.094 \frac{\text{kNm}}{\text{mm}}} * 460 \frac{\text{N}}{\text{mm}^2} = -152.2 \frac{\text{N}}{\text{mm}^2}$$

$$\sigma_3 = 1.2 \frac{\text{N}}{\text{mm}^2} \approx 0 \frac{\text{N}}{\text{mm}^2}$$

$$\sigma_{\text{C,a}} = \frac{1}{\sqrt{2}} * \sqrt{\left(-194 \frac{\text{N}}{\text{mm}^2} + 152.2 \frac{\text{N}}{\text{mm}^2}\right)^2 + \left(-152.2 \frac{\text{N}}{\text{mm}^2} - 0\right)^2 + \left(0 + 194 \frac{\text{N}}{\text{mm}^2}\right)^2} = 176.8 \frac{\text{N}}{\text{mm}^2}$$

7.4.2 Verification in node b

$$\sigma_{1,\max} = \frac{60}{95} * \left(-194 \frac{\text{N}}{\text{mm}^2}\right) = -122.5 \frac{\text{N}}{\text{mm}^2}$$

$$\sigma_{2,\max} = 152.2 \frac{\text{N}}{\text{mm}^2}$$

$$\sigma_{C,b} = \frac{1}{\sqrt{2}} * \sqrt{\left(-122.5\frac{N}{mm^2} - 152.2\frac{N}{mm^2}\right)^2 + \left(152.2\frac{N}{mm^2} - 0\right)^2 + \left(0 + 122.5\frac{N}{mm^2}\right)^2} = 238.4\frac{N}{mm^2}$$

7.4.3 Verification in node c

$$\sigma_{1,max} = -194\frac{N}{mm^2}$$

$$\sigma_{2,max} = \frac{3}{4} * \frac{0.042\frac{kNm}{mm} \Big/ 1.35}{0.094\frac{kNm}{mm}} * 460\frac{N}{mm^2} = 114.15\frac{N}{mm^2}$$

$$\sigma_{C,c} = \frac{1}{\sqrt{2}} * \sqrt{\left(-194\frac{N}{mm^2} - 114.15\frac{N}{mm^2}\right)^2 + \left(114.15\frac{N}{mm^2} - 0\right)^2 + \left(0 + 194\frac{N}{mm^2}\right)^2} = 269.8\frac{N}{mm^2}$$

7.4.4 Verification in node d

$$\sigma_{1,max} = -122.5\frac{N}{mm^2}$$

$$\sigma_{2,max} = -114.15\frac{N}{mm^2}$$

$$\sigma_{C,d} = \frac{1}{\sqrt{2}} * \sqrt{\left(-122.5\frac{N}{mm^2} + 114.15\frac{N}{mm^2}\right)^2 + \left(-114.15\frac{N}{mm^2} - 0\right)^2 + \left(0 + 122.5\frac{N}{mm^2}\right)^2} = 118.5\frac{N}{mm^2}$$

7.4.5 Conclusion

The combined stress is verified. The maximum design stress is occurring in node c, and is lower than the yield strength.

$$\text{U. C.} = \frac{\sigma_{C,c}}{f_y} = \frac{269.8}{460} = 0.59$$

$$\text{Safety factor} = \frac{f_y}{\sigma_{C,c}} = \frac{460}{269.8} = 1.70$$

7.5 Welds

Weld verification is performed based on the welds shown below:

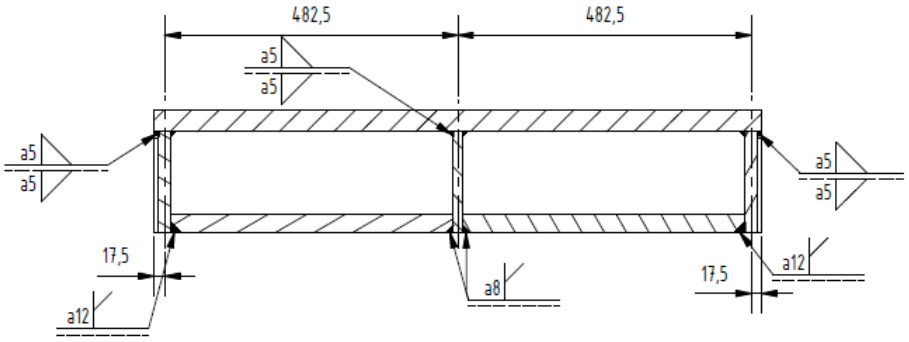


Figure 7-1: Cross section 1: 900<x<4900

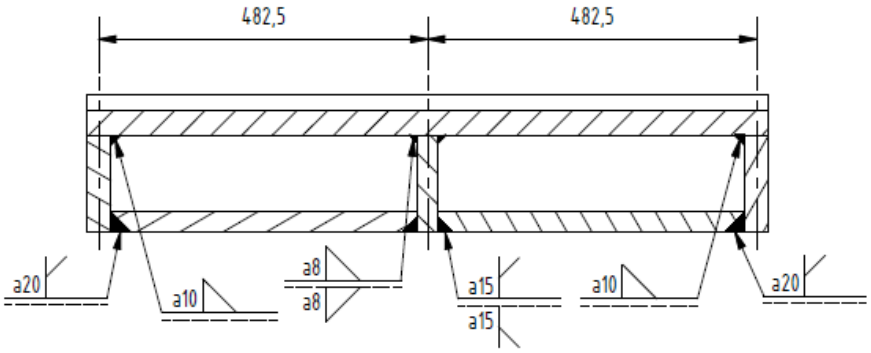
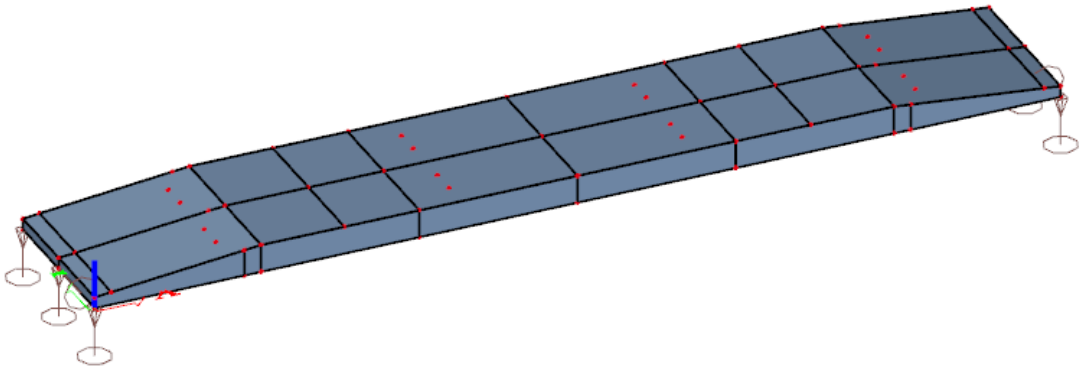


Figure 7-2: cross-section 2: x<900 and x>4900

Allowable shear stress in welds:

$$\tau_{v,w,Rd} = \frac{460\frac{N}{mm^2}}{\sqrt{3}} = 266\frac{N}{mm^2}$$

Welds are verified using a SCIA engineer model.





Load cases are:

Load case ID	Description
1	5x12t left
2	5x12t centre
3	5x12t right
4	4x12t centre left
5	4x12t centre right

6	3x12t left-right diagonal
7	5xH=1.2t left and right
8	G – self weight

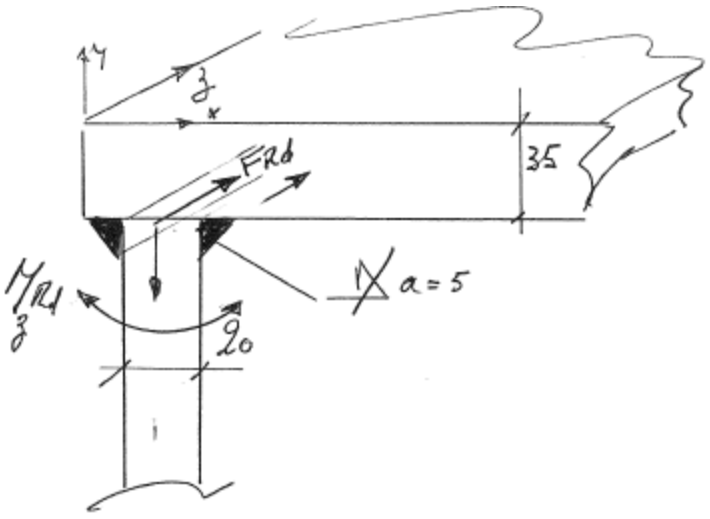
With the following (non-linear*) combinations:

Combination ID	Description	Load cases
1	5x12t left	1
2	5x12t centre	2
3	5x12t right	3
4	4x12t centre left	4
5	4x12t centre right	5
6	3x12t left-right diagonal	6
7	5xH=1.2t left and right	7
8	G – self weight	8
9	SLS 2x5x12t edge (L/R)	1 – 3 – 7 - 8
10	SLS 2x5x12t centre (L/R)	4 – 5 – 7 – 8
11	SLS 2x5x12t edge (L) and centre (R)	3 – 4 – 7 – 8
12	SLS torsion 5x12t edge (R)	3 – 7 (x0.5) – 8
13	SLS torsion 2x3x12t diagonal	6 – 7 (x0.6) – 8
14	SLS 2x5x12t local bending	4 – 5 – 7 – 8

*Non-linear combinations are used since supports are compression only.

Model is meshed based on 50mm elements., based on plate thickness. Material non-linearity is ignored. Outlier values are, conservatively, taken into account as values for weld calculation.

7.5.1 External webs / top / t_w = 20mm / 900 < x < 4900



Allowable strengths of weld:

$$F_{Rd,w,long} = 2 \cdot 5 \cdot 1000 \cdot \left(266 \frac{N}{mm^2}\right) \cdot 10^{-3} = 2660 \frac{kN}{m}$$

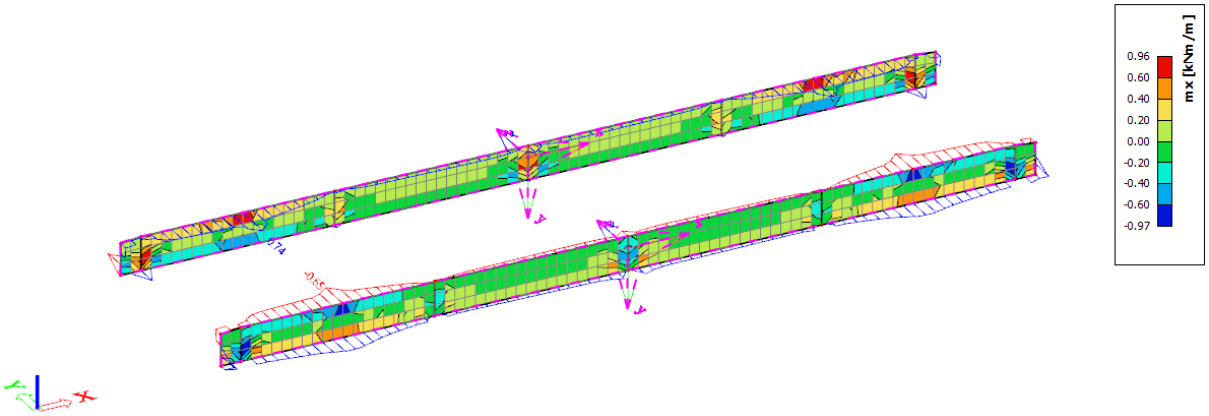
$$M_{z,Rd,w} = \frac{2660}{2} \cdot (0.02m) = 26.6\ kN \cdot m/m$$

Moment

Load combination	$M_{z,SLS,max}$ (kNm/m)
9	0.74
10	**0.81**
11	0.76
12	0.79
13	0.78
14	**0.81**

$$M_{z,Ed,Maxmax} = 1.5 \cdot 0.81 = 1.22\ kNm/m$$

Example NC9:

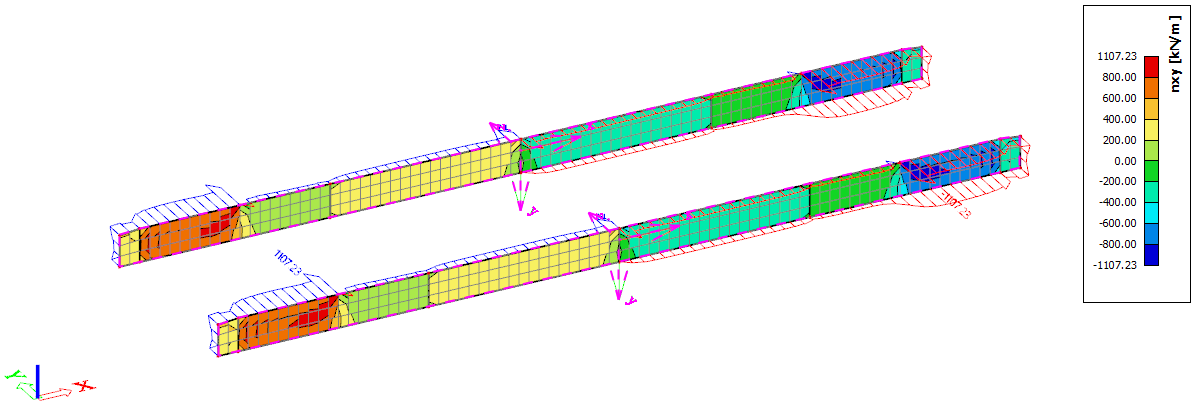


Web in-plane shear:

Load combination	Shear n_{yz} (kN/m) [SLS]
9	1107
10	498
11	**1165**
12	1030
13	964
14	462

$$n_{yz,Ed,Maxmax} = 1.5 \cdot\ 1165\ \ = 1748\ \ kN/m$$

Example NC9:



Interaction:

$$\left(\frac{1.22}{26.6}\right)^2 + \left(\frac{1748}{2660}\right)^2 = 0.05^2 + 0.66^2 = 0.44 < 1.0$$

Web width correction:

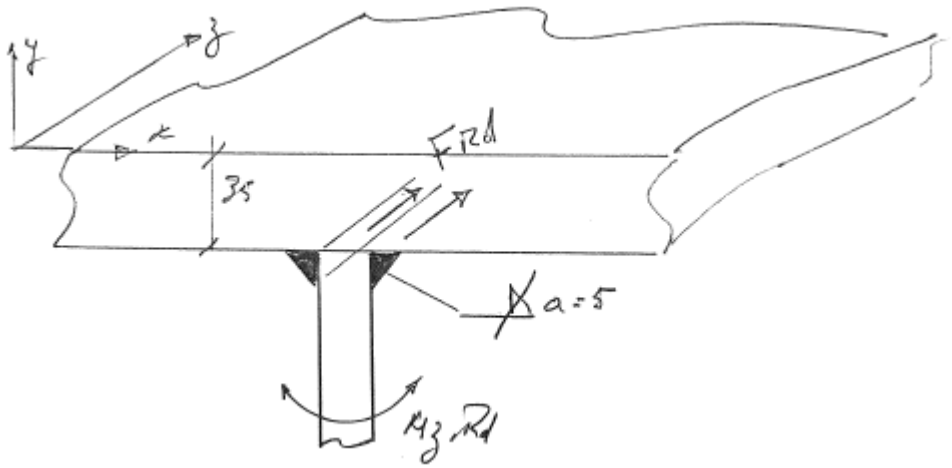
$$t_{w,model} = 16\ mm$$
$$t_{w,real} = 20\ mm$$

$$\frac{\frac{35^3}{482.5} + \frac{20^3}{167.5}}{\frac{35^3}{482.5} + \frac{16^3}{167.5}} = 1.21$$

So interaction becomes:

$$0.44 \cdot 1.21 = 0.53 < 1.0$$

7.5.2 Internal web / top / t_w = 15mm / 900 < x < 4900



Allowable strengths of weld:

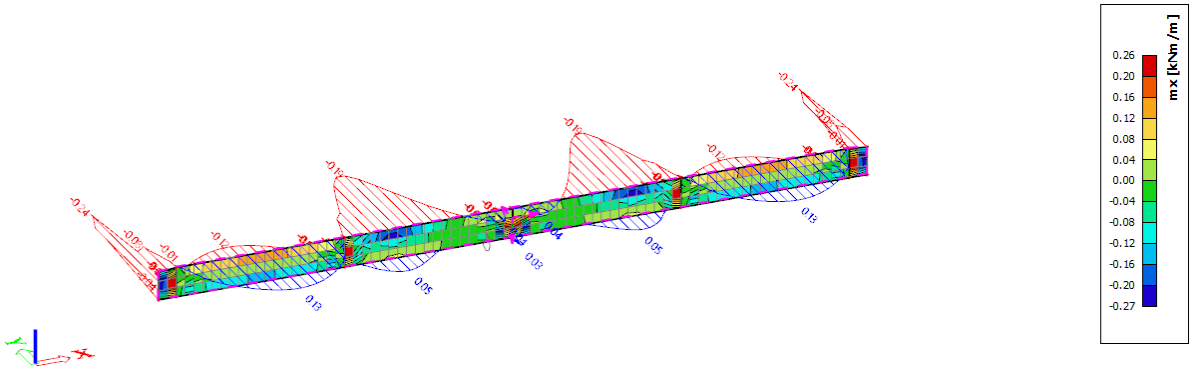
$$F_{Rd,w,long} = 2 \cdot 5 \cdot 1000 \cdot \left(266 \frac{N}{mm^2}\right) \cdot 10^{-3} = 2660 \frac{kN}{m}$$
$$M_{z,Rd,w} = \frac{2660}{2} \cdot (0.015m) = 20.0\ kN \cdot m/m$$

Moment

Load combination	$M_{z,SLS,max}$ (kNm/m)
9	0.02
10	0.02
11	**0.19**
12	0.17
13	0.15
14	0.02

$$M_{z,Ed,Maxmax} = 1.5 \cdot 0.19 = 0.29\ kNm/m$$

Example NC11:

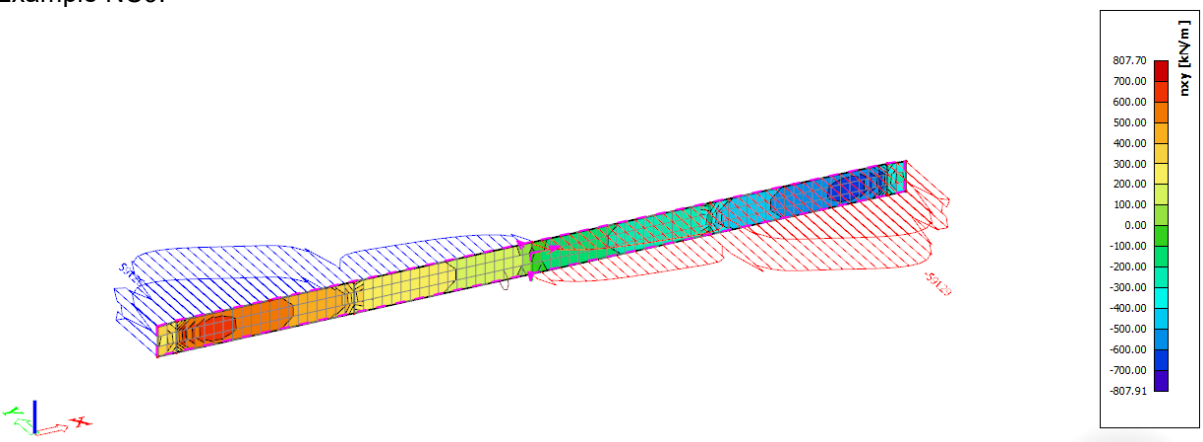


Web in-plane shear:

Load combination	Shear n_{yz} (kN/m) [SLS]
9	**591**
10	540
11	546
12	299
13	417
14	540

$$_{yz,Ed,Maxmax} = 1.5 \cdot 591 \quad = 887\ kN/m$$

Example NC9:



Interaction:

$$\left(\frac{0.29}{20.0}\right)^2 + \left(\frac{887}{2660}\right)^2 = 0.01^2 + 0.33^2 = 0.11 < 1.0$$

Web width correction:

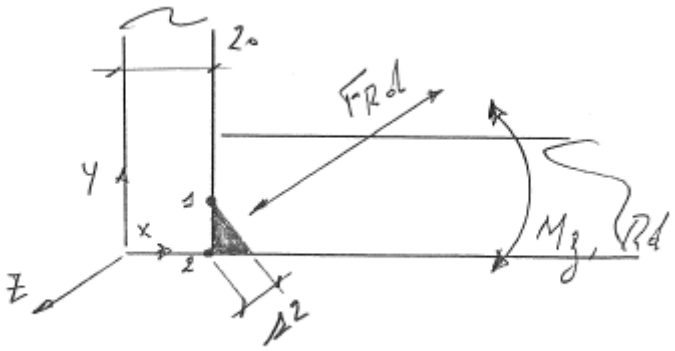
$$t_{w,model} = 12\ mm$$
$$t_{w,real} = 15\ mm$$

$$\frac{\frac{35^3}{482.5} + \frac{15^3}{167.5}}{\frac{35^3}{482.5} + \frac{12^3}{167.5}} = 1.10$$

So interaction becomes:

$$0.11 \cdot 1.10 = 0.12 < 1.0$$

7.5.3 External webs / bottom / t_w = 20mm / 900 < x < 4900



Allowable strengths of weld:

$$F_{Rd,w,long} = 12 \cdot \sqrt{2} \cdot 1000 \cdot \left(266 \frac{N}{mm^2}\right) \cdot 10^{-3} = 4514 \frac{kN}{m}$$

$$M_{z,Rd,w} = \frac{\left(12 \cdot \sqrt{2}\right)^2}{6} \cdot 1000 \cdot 460 \cdot 10^{-6} = 22.1\ kN \cdot m/m$$

Moment

Load combination	$M_{z,SLS,max}$ (kNm/m)
9	0.48
10	0.29
11	0.47
12	**0.55**
13	0.53
14	0.29

$$M_{z,Ed,Maxmax} = 1.5 \cdot 0.55 = 0.83\ kNm/m$$

Web in-plane shear:

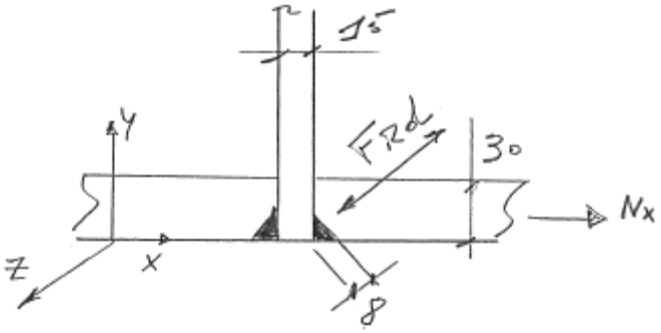
Load combination	Shear n_{yz} (kN/m) [SLS]
9	735
10	444
11	**812**
12	678
13	599
14	444

$$n_{yz,Ed,Maxmax} = 1.5 \cdot 812 = 1218\ kN/m$$

Interaction:

$$\left(\frac{0.83}{22.1}\right)^2 + \left(\frac{1218}{4514}\right)^2 = 0.04^2 + 0.27^2 = 0.075 < 1.0$$

7.5.4 Internal web / bottom / t_w = 15mm / 900 < x < 4900



Allowable strengths of weld:

$$F_{Rd} = 8 \cdot \sqrt{2} \cdot 1000 \cdot \left(266 \frac{N}{mm^2}\right) \cdot 10^{-3} = 3009 \frac{kN}{m}$$

$$M_{z,Rd,w} = \frac{\left(8 \cdot \sqrt{2}\right)^2}{6} \cdot 1000 \cdot 460 \cdot 10^{-6} = 9.8\ kN \cdot m/m$$

$$N_{x,Rd} = 8 \cdot \sqrt{2} \cdot 1000 \cdot \left(460 \frac{N}{mm^2}\right) \cdot 10^{-3} = 5204 \frac{kN}{m}$$

Moment

Load combination	$M_{z,SLS,max}$ (kNm/m)
9	0.01
10	0.01
11	0.12
12	**0.17**
13	0.15
14	0.01

$$M_{z,Ed,Maxmax} = 1.5 \cdot 0.17 = 0.26\ kNm/m$$

Web in-plane shear:

Load combination	Shear n_{yz} (kN/m) [SLS]
9	**591**
10	540
11	546
12	299
13	420
14	540

$$n_{yz,Ed,Maxmax} = 1.5 \cdot 591 = 887\ kN/m$$

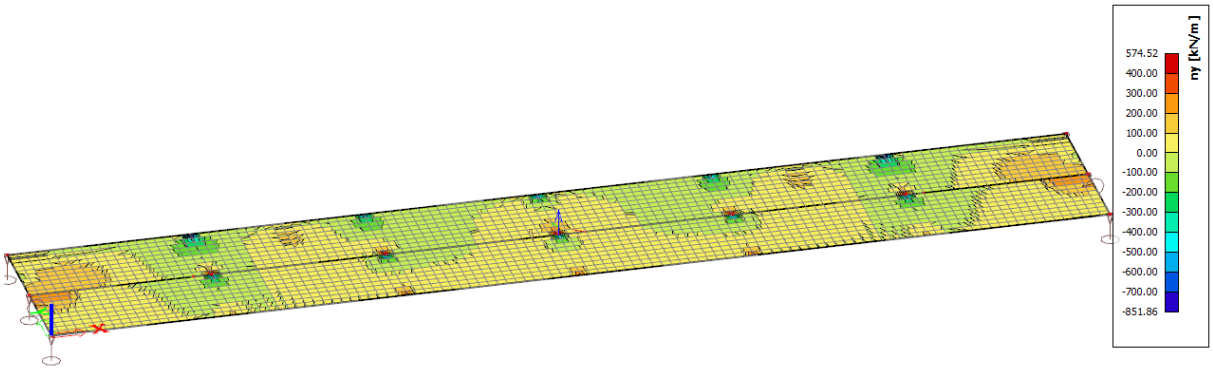
Bottom flange normal force:

Load combination	Normal force n_x (kN/m) [SLS]

9	185
10	147
11	379
12	**574**
13	364
14	147

$$N_{x,Ed,Maxmax} = 1.5 \cdot 574 = 861\ kN/m$$

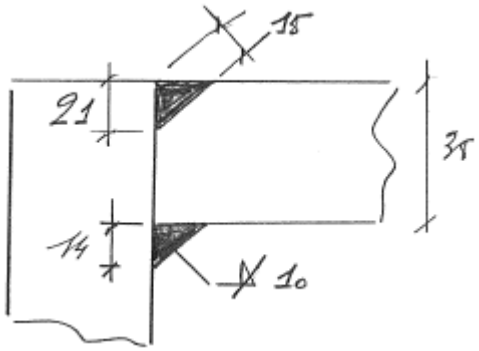
Example NC12:



Interaction:

$$\left(\frac{0.26}{9.8}+\frac{861}{5204}\right)^2+\left(\frac{887}{3009}\right)^2 = 0.19^2+0.29^2 = 0.12 < 1.0$$

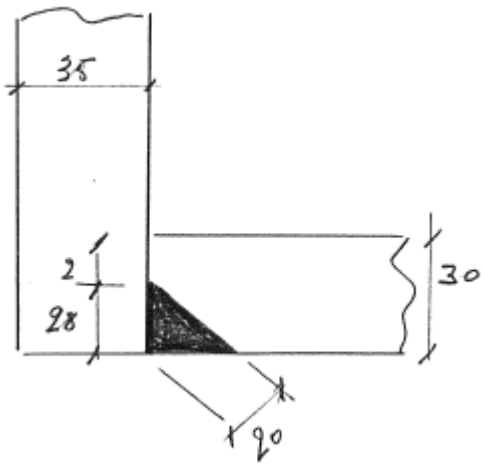
7.5.5 External webs / top / t_w = 35mm / x < 900 & x > 900



$$21 + 14 = 35 = t_w = t_f$$

➔ OK without calculation

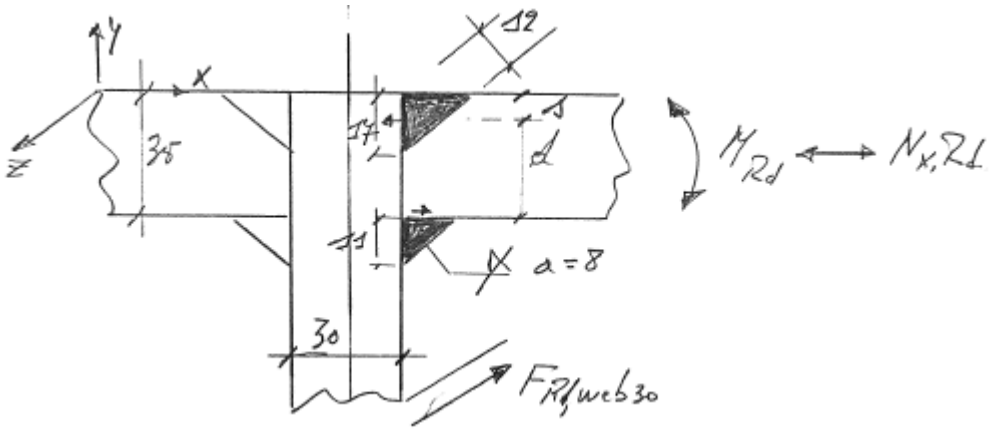
7.5.6 External webs / bottom / t_w = 35mm / x < 900 & x > 900



$$\frac{28}{30} = 0.93$$
$$2 < 3$$

➔ OK without calculation (butt weld)

7.5.7 Internal web / top / t_w = 30mm / x < 900 & x > 900



$$11 + 17 = 28 < t_f = 35$$

➔ Further calculation required

Web in-plane shear:

$$F_{Rd,web30} = 30 \cdot 1000 \cdot \frac{460}{\sqrt{3}} \cdot 10^{-3} = 7967kN$$
$$F_{Rd,w,long} = (11 + 17) \cdot 1000 \cdot \left(266 \frac{N}{mm^2}\right) \cdot 10^{-3}$$
$$= 7448 \frac{kN}{m} > \frac{7967}{2} \ (OK)$$

Moment

$$M_{z,Rd,f} = \frac{35^2 \cdot 1000}{6} \cdot 460 \cdot 10^{-6} = 93.9 \ kN \cdot m/m$$

$$M_{z,Rd,w} = 11 \cdot 266 \cdot d = 2926 \cdot d$$
$$M_{z,Rd,w} = 2926 \cdot 32 = 93.6kN \cdot m/m$$

$$\frac{93.6}{93.9} = 0.99 > \frac{1.5\sigma_{VMmax}}{460} = \frac{1.5 \cdot 213}{460} = 0.70$$

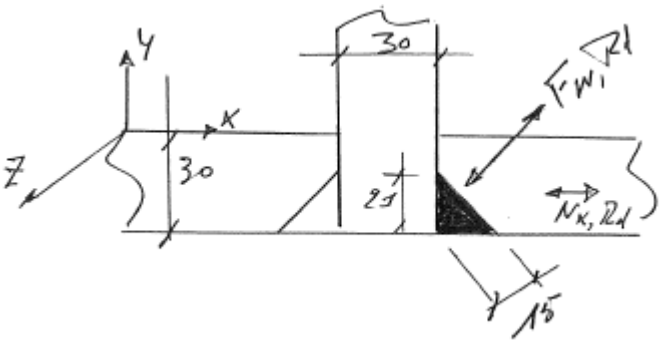
Normal force top flange

$$N_{x,Rd,w} = 17 \cdot 460 + 11 \cdot 266 = 7820 + 2926 = 10746\ kN$$

Load combination	Normal force n_x (kN/m) [SLS]
9	342
10	**446**
11	390
12	543
13	210
14	**446**

$$N_{yz,Ed,Maxmax} = 1.5 \cdot\ 446\ = 669\frac{kN}{m} < N_{x,Rd,w}$$

7.5.8 Internal web / bottom / t_w = 30mm / x < 900 & x > 900



$$F_{Rd,w,long} = 21 \cdot 1000 \cdot \left(266\frac{N}{mm^2}\right) \cdot 10^{-3} = 5586\ kN/m$$
$$M_{z,Rd,w} = \frac{(21)^2}{6} \cdot 1000 \cdot 460 \cdot 10^{-6} = 33.8\ kN \cdot m/m$$
$$N_{x,Rd} = 21 \cdot 1000 \cdot \left(460\frac{N}{mm^2}\right) \cdot 10^{-3} = 9660\frac{kN}{m}$$

Moment

Load combination	$M_{z,SLS,max}$ (kNm/m)
9	0.43
10	0.43
11	0.46
12	**0.71**
13	0.32
14	0.43

$$M_{z,Ed,Maxmax} = 1.5 \cdot 0.71\ =\ 1.07\ kNm/m$$

Web in-plane shear:

Load combination	Shear n_{yz} (kN/m) [SLS]
9	1222
10	**1511**
11	1367
12	477
13	750
14	**1511**

$$n_{yz,Ed,Maxmax} = 1.5 \cdot 1511 \quad = 2267\ kN/m$$

Bottom flange normal force:

Load combination	Normal force n_x (kN/m) [SLS]
9	70
10	99
11	150
12	**450**
13	26
14	99

$$N_{x,Ed,Maxmax} = 1.5 \cdot \ 450 \ = 675\ kN/m$$

Interaction:

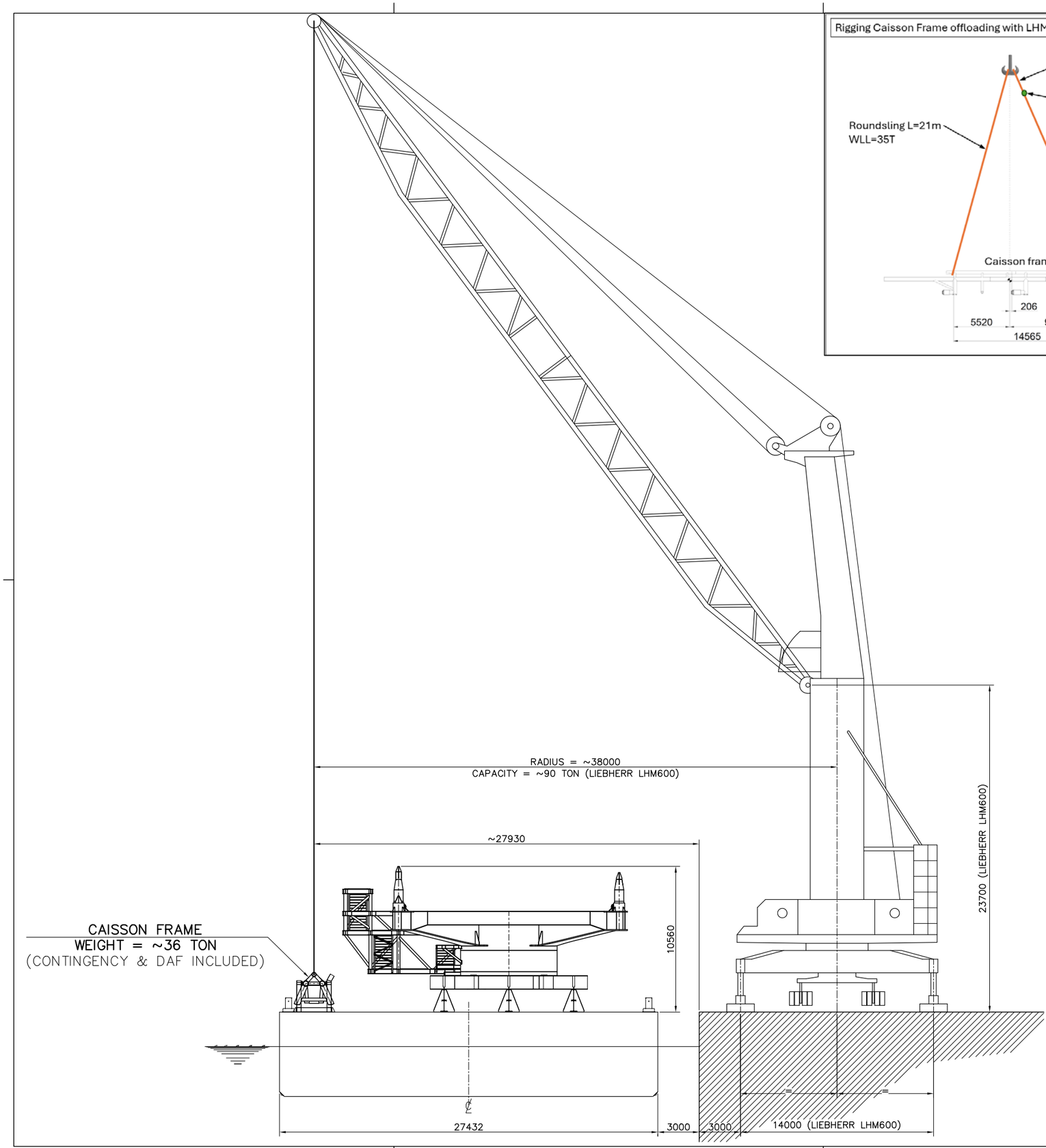
$$\left(\frac{1.07}{33.8} + \frac{675}{9660}\right)^2 + \left(\frac{2267}{5586}\right)^2 = 0.10^2 + 0.41^2 = 0.18 < 1.0$$

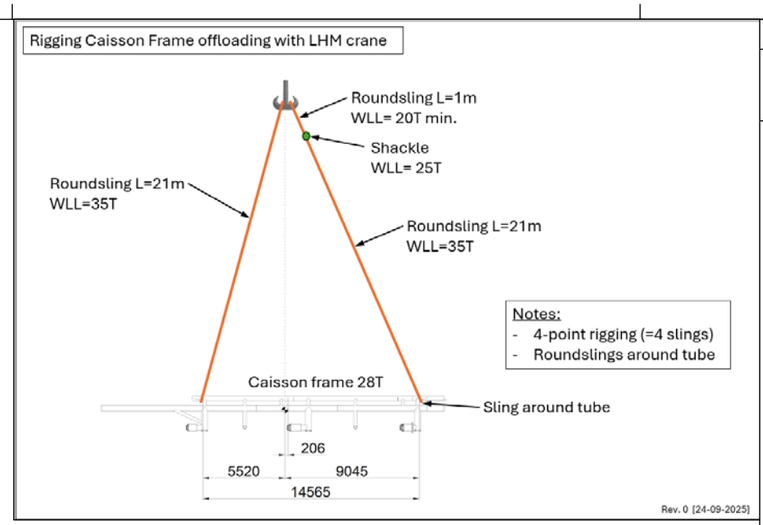
8 CONCLUSION

The bridge 5800x1000x200 heavy Chamfer is verified and is suitable for the operation.

ATTACHMENT I – LIFTING AND TRANSPORT SCHEME FOR CAISSON FRAME

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NOTES

1 – ALL DIMENSIONS AND ELEVATIONS ARE IN MILLIMETERS U.N.O.
2 – ALL ELEVATIONS ARE REFERED TO C.D.
3 – MOORING SCHEME TO BE DEFINED
4 – FENDER DIAMETER AND POSITION TO BE DEFINED

CRANE LHM600

BOOM RADIUS= 38 m
CAPACITY= 88.6t (heavy lift)
LOAD=36t (CONT. INCL.)
RIGGING= 2t

TOTAL LOAD= 38t
U.F. = 0.43

REFERENCE DRAWINGS

DWG No.	DESCRIPTION

TECON

REV.	DATE	DRN	CHKD	APPD	DESCRIPTION
02	24/09/25	NM	FC	CA	
01	26/08/25	NM	FC	CA	
00	21/08/25	NM	FC	CA	

CROSSWIND

ROSETTI MARINO

TITLE :
LOADIN CROSSWIND
CF LOADIN VIEW

CONTRACT NO./TITLE CW-I-WP4-2023-05/HOLLANDSE KUST NOORD WIND PARK .			SCALE
DRAWN N.MARIANI	CHECKED F.CERONI	APPROVED C.ANTONELLINI	DATE 24/09/25

A1	DRAWING NO. 123A90-FDL-MT-DD-00804	SHEET 001	REV. 02

LHM 600

www.liebherr.com

LIEBHERR

Mobile harbour crane

EN



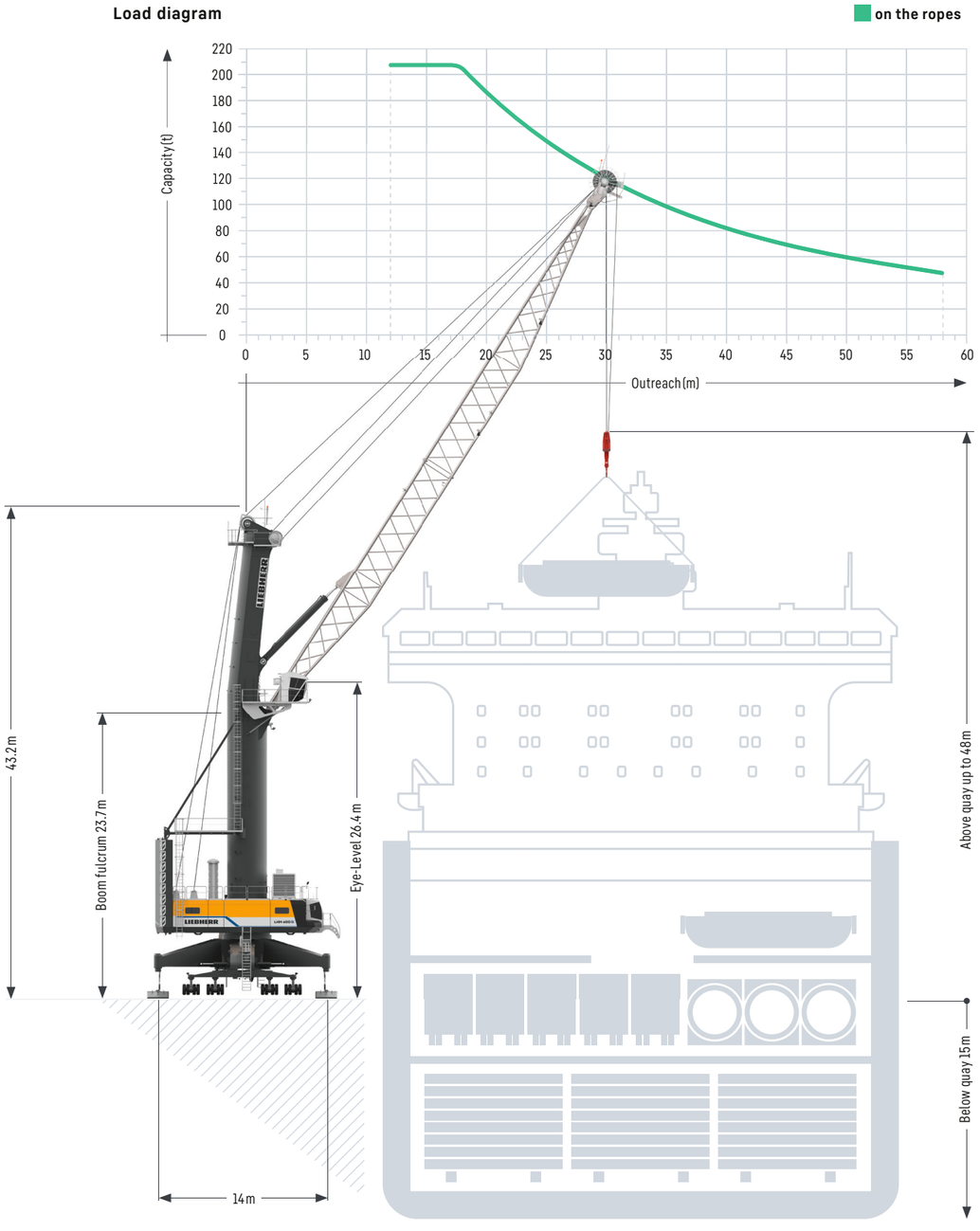
Maximum lifting capacity
208 t

Maximum outreach
58 m

Ship size
New Panamax, Very Large Bulk Carrier, Ultra Large Container Ship

Main dimensions

Heavy lift operation



Lifting capacities

Heavy lift operation

Lifting capacity 208 t

	Hook operation on the ropes
Outreach	Heavy lift
(m)	(t)
12	208.0
17	208.0
18	203.9
20	185.4
22	168.4
24	153.2
26	141.2
28	130.4
30	120.0
32	110.5
34	102.0
36	94.8
38	88.6
40	82.7
42	77.3
44	72.2
46	67.6
48	63.5
50	59.6
52	56.1
53	54.5
56	50.2
58	47.8

Weight rotator 5.5 t

Project cargo & heavy lift up to 208 tonnes

Safety and precision are the most important criteria when lifting heavy goods.

Technical Data

Heavy lift operation

Capacity and Classification

	Capacity	Classification
Heavy lift operation	≤ 73t	A8
Heavy lift operation	≤ 208t	A3

Main Dimensions

Min. to max. outreach	12 – 58m
Height of boom fulcrum	23.7m
Tower cabin height (eye level)	26.4m
Overall height (top of tower)	43.2m
Overall length of undercarriage	21.5m
Overall width of undercarriage	10.3m
Number of axle sets (standard)	26
Number of axle sets (optional)	32

Working Speeds

Hoisting / lowering	0 – 90m/min
Slewing	0 – 1.6rpm
Luffing (average horizontal speed)	58m/min
Travelling	0 – 5km/h

Propping Arrangements

Standard supporting base	14.0m x 14.0m
Standard pad dimension	4.0 x 5.5m x 1.8m
Standard supporting area of pads	9.9m²

Optional size of supporting pads and bases on request

Quay Load Arrangements

Uniformly distributed load	3.1t/m²
Max. load per tyre	5.8t

Due to a unique undercarriage design the quay loads specified above can even be reduced. Pad sizes, supporting base and the number of axle sets can easily be adapted to comply with the most stringent quay load restrictions.

Weight

Total weight of crane in heavy lift version (206t winch, 58m boom, Pactronic®)	approx. 603t

Hoisting Heights

Above quay at minimum radius	48m
Above quay at maximum radius	41m
Below quay level (approx.)	15.0m

Bulk Operation

Capacity and Classification

	Capacity	Classification
Four rope grab operation	≤ 63t	A8
Motor grab	≤ 63t	A8

Main Dimensions

Min. to max. outreach	12 – 50m
Height of boom fulcrum	23.7m
Tower cabin height (eye level)	26.4m
Overall height (top of tower)	40.4m
Overall length of undercarriage	21.5m
Overall width of undercarriage	10.3m
Number of axle sets (standard)	26
Number of axle sets (optional)	32

Working Speeds

Hoisting / lowering	0 – 120m/min
Slewing	0 – 1.6rpm
Luffing (average horizontal speed)	0 – 53m/min
Travelling	0 – 5km/h

Propping Arrangements

Standard supporting base	14.0m x 14.0m
Standard pad dimension	4.0 x 5.5m x 1.8m
Standard supporting area of pads	9.9m²

Optional size of supporting pads and bases on request

Quay Load Arrangements

Uniformly distributed load	2.3t/m²
Max. load per tyre	5.2t

Due to a unique undercarriage design the quay loads specified above can even be reduced. Pad sizes, supporting base and the number of axle sets can easily be adapted to comply with the most stringent quay load restrictions.

Weight

Total weight of crane in bulk version (144t winch, 50m boom, Pactronic®)	approx. 536t

Hoisting Heights

Above quay at minimum radius	48m
Above quay at maximum radius	38m
Below quay level (approx.)	15.0m

Container operation

Capacity and Classification

	Capacity	Classification
Container operation	≤ 73t	A8
Heavy lift operation	≤ 104t	A6

Main Dimensions

Min. to max. outreach	12 – 58m
Height of boom fulcrum	23.7m
Tower cabin height (eye level)	26.4m
Overall height (top of tower)	43.2m
Overall length of undercarriage	21.5m
Overall width of undercarriage	10.3m
Number of axle sets (standard)	26
Number of axle sets (optional)	32

Working Speeds

Hoisting / lowering	0 – 120m/min
Slewing	0 – 1.6rpm
Luffing (average horizontal speed)	58m/min
Travelling	0 – 5km/h

Propping Arrangements

Standard supporting base	14.0m x 14.0m
Standard pad dimension	5.5m x 1.8m
Standard supporting area of pads	9.9m²

Optional size of supporting pads and bases on request

Quay Load Arrangements

Uniformly distributed load	2.6t/m²
Max. load per tyre	5.7t/m²

Due to a unique undercarriage design the quay loads specified above can even be reduced. Pad sizes, supporting base and the number of axle sets can easily be adapted to comply with the most stringent quay load restrictions.

Weight

Total weight of crane in container version (154t winch, 58m boom, Pactronic®)	approx. 590t

Hoisting Heights

Above quay at minimum radius	48m
Above quay at maximum radius	41m
Below quay level (approx.)	15.0m

Noise emissions and vibrations

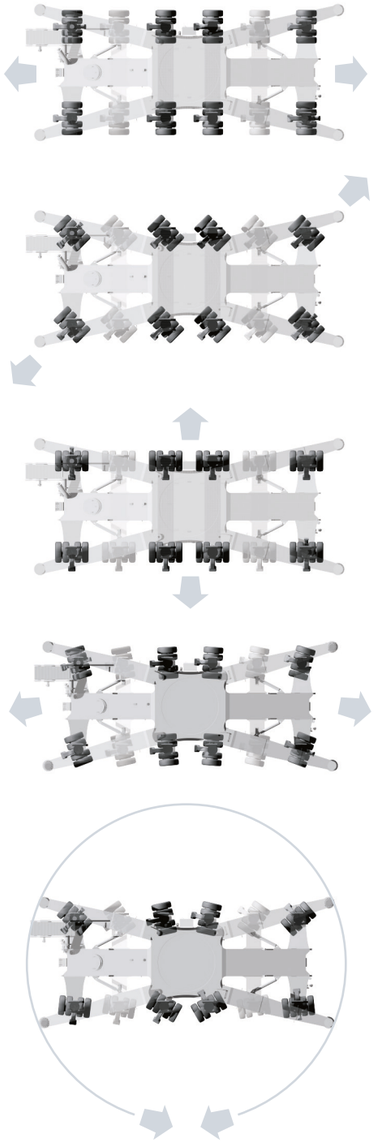
Emission sound pressure level LPA in the cabin	63.9db(A)
Guaranteed sound power level LWA oft he machine	108db(A)
Vibrations on upper limbs of the machine operator	< 2.5m/s²
Vibrations on the entire body of machine operator	< 0.5m/s²

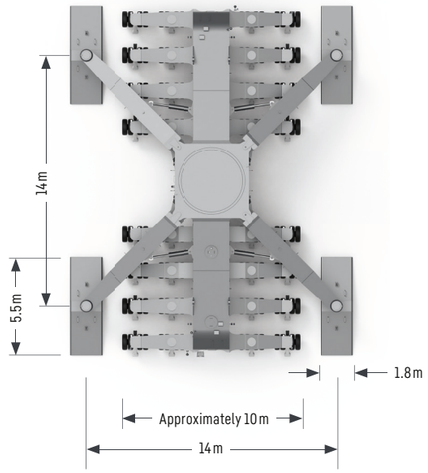
Undercarriage

Mobility
- Outstanding mobility and manoeuvrability
- Curves at any possible radii and even slewing on the spot

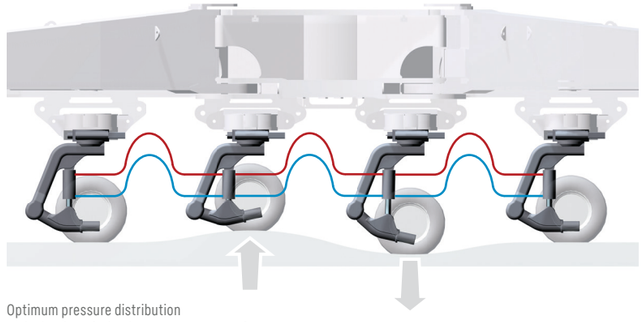
Modular propping system
- Minimised stress and strain of undercarriage due to cruciform support base which directs the load path from boom tip to quay
- Modular system allows further reduction of quay loads by installing additional axle sets
- Easy adaptation to various sizes of support pads and bases

Schematic diagram





Hydraulic load distribution
- Hydraulic suspension avoids overloading of individual wheel sets
- Standard trailer tyres making requisition of spares economical and time-saving
- Increased lifetime of tyres due to individually steerable wheel sets

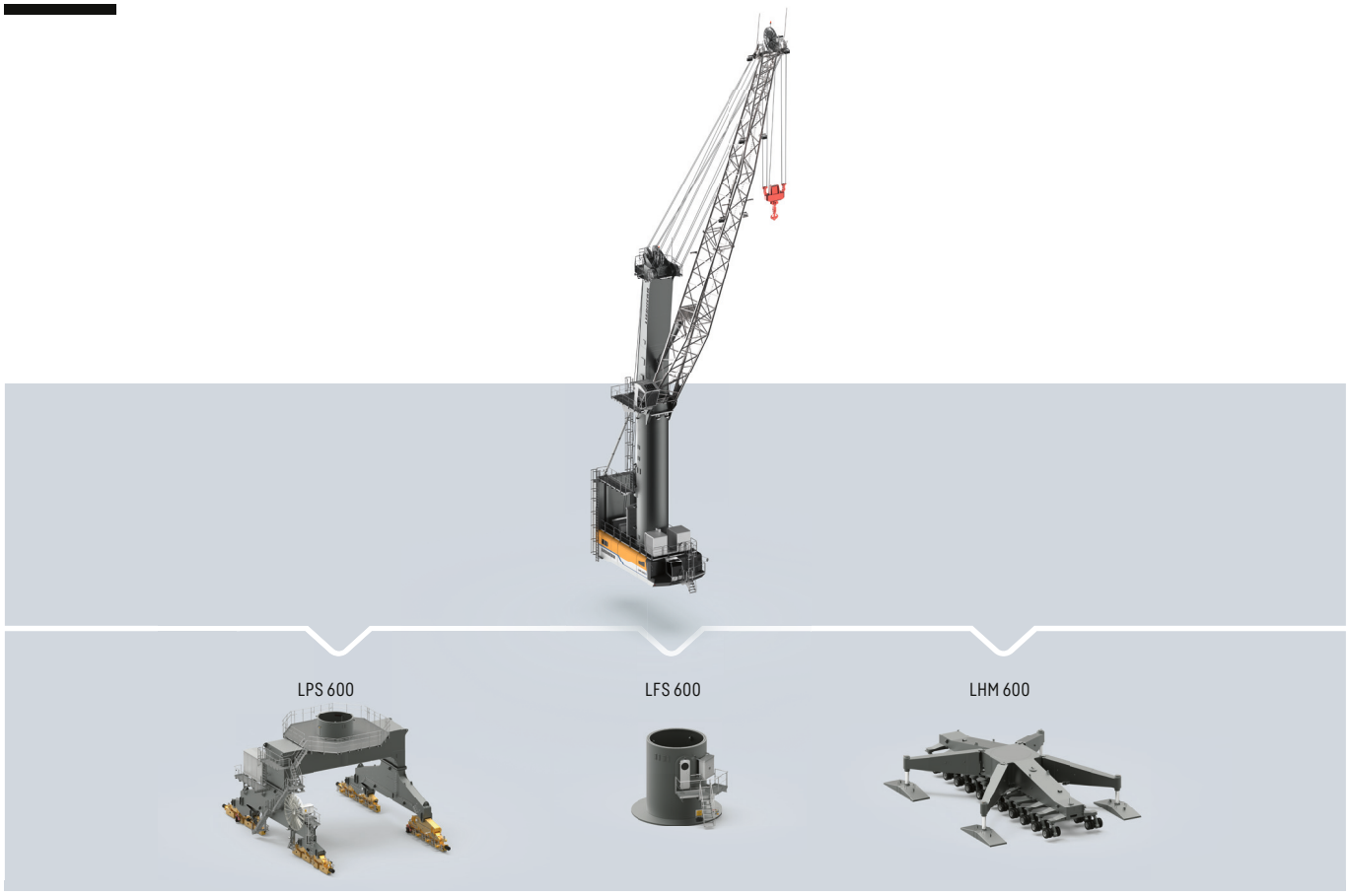


Optimum pressure distribution
and adaption of wheel sets on uneven surfaces

Optional equipment

Additional products and services
- Electric drive with high or low voltage connection
- Fully biodegradable hydraulic fluids
- HVO 100 certified drives
- Pactronic® – power by accumulator and electronics
- SmartGrip – intelligent grabbing
- Anti-sway system
- Teach-In – semi-automatic point to point system
- Sycratronic® – synchronizing crane control system
- Vertical Line Finder – diagonal pull preventing system
- Collision alert system
- LiDAT® – smartApp
- Economy software – for optimised fuel consumption
- Video monitoring system
- Radio remote control
- Autopropping undercarriage
- Cyclone air-intake system for the engine
- Low temperature package
- Customer-specific painting & logo
- Additional (driven) axle sets
- Axle sets equipped with foamed tyres
- Different supporting bases and pad sizes
- Tower extension 9.6 m
- And many more as per customers' requirements

Practical solutions



Liebherr develops and produces special designs and solutions to meet customer-specific requirements

The Liebherr Portal Crane (LPS) is an efficient combination of a space-saving portal (mounted on rails) and the proven mobile harbour crane concept. Particularly on narrow quays, individual portal solutions permit (railway) trains and (road) trucks to travel below the portal.

Liebherr Fixed Slewing Cranes (LFS) are an efficient combination of a mobile harbour crane upper carriage and a fixed pedestal. LFS cranes provide an economical and space-saving solution for the installation on quaysides and jetties, especially where room for manoeuvring is limited and low ground pressure is essential. Additionally LFS solutions are also ideally suited for the installation on crane barges.

Liebherr-MCCtec Rostock GmbH • Liebherrstraße 1 • 18147 Rostock, Germany • Phone +49 381 6006-5020 • Fax +49 381 6006-3999
mobile.harbour.crane@liebherr.com • www.liebherr.com • www.linkedin.com/company/liebherr-maritime-cranes

HM 3508.03.04 MCR-10098942-04.24_en
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ATTACHMENT L – HYDROGRAPHICAL SURVEY

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General Information | Buss Terminal Eemshaven

Technical Information & Infrastructure
Beatrixhaven Port Basin

Terminal Area

- Terminal area: 38.500m², planned extension from 01.01.2025 of additional 157.000m²
- Length of quay: 260 mtr (32 m priority, additional 100 m priority form 01.01.2025)
- Design load of 300 kN/sqm, higher point loads allowed

Port basin

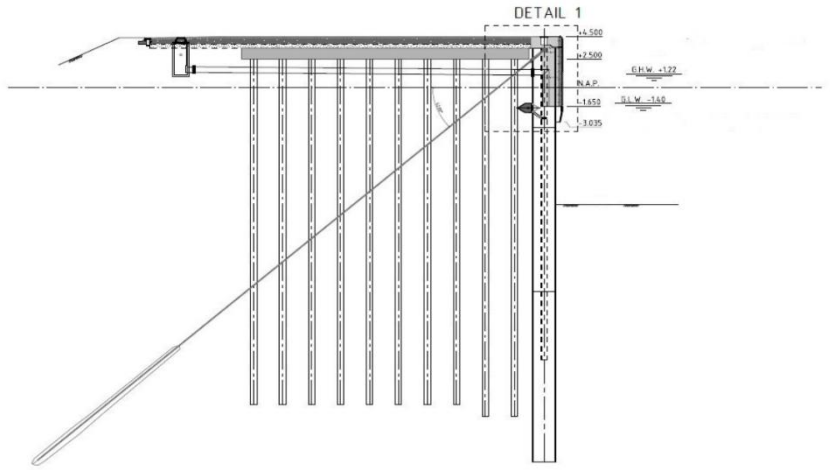
- Width of port basin: 260 mtr
- Width Beatrixhaven Passage: 110 mtr
- Water depth: 11 mtr
- Vessels with a width of > 26 mtr require a permission for berthing from GSP Port Authority

Port access

- Gate passage: unrestricted height
- Depth: 11 mtr at high water (NAP) incl. 10% UKC (UKC Under Keel Clearance)
- Density of water: 1,018 (brackish water)
- 2,5 kn flow velocity
- No locks

Quay infrastructure

- Height of quay above N.A.P.: 4,5 mtr
- Water depth at quay side: 10 mtr
- Tidal range 2 – 3 mtr
- Distance Jack-up Barge: min. 1 mtr from quayside for jacking up
- Uniform distributed design load of quay side 300 kN/sqm
- Bollard pull 600 Kilo Newton (two bollards every 20 mtr)



ATTACHMENT M – TIDE TABLE

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Eemshaven

Hoog- en laagwaterstanden en -tijdstippen

Oktober 2025

datum	uu:mm	HW cm	LW NAP
1	*5:17*	101	
wo	*11:44*		-92
	18:04	79	
2	*0:06*		-80
do	*6:37*	97	
	13:00		-81
	19:36	79	
3	*1:29*		-70
vr	*8:13*	105	
	14:47		-91
	21:08	91	
4	*3:16*		-82
za	*9:35*	122	
	16:04		-115
	22:18	108	
5	*4:27*		-104
zo	*10:35*	139	
	17:04		-135
	23:13	120	
6	*5:25*		-121
ma	*11:24*	150	
	17:57		-147
7	*0:00*	127	
di	*6:16*		-134
VM 5:47	*12:08*	156	
	18:45		-153
8	*0:42*	129	
wo	*7:02*		-145
	12:50	157	
	19:29		-155
9	*1:20*	130	
do	*7:46*		-152
	13:30	155	
	20:10		-152
10	*1:54*	131	
vr	*8:28*		-155
	14:12	150	
	20:50		-144

datum	uu:mm	HW cm	LW NAP
11	*2:29*	131	
za	*9:08*		-154
	14:55	141	
	21:27		-133
12	*3:08*	131	
zo	*9:48*		-147
	15:43	127	
	22:05		-120
13	*3:55*	127	
ma	*10:31*		-135
LK 20:12	*16:38*	112	
	22:46		-104
14	*4:54*	121	
di	*11:22*		-119
	17:45	98	
	23:39		-87
15	*6:04*	117	
wo	*12:32*		-106
	19:00	91	
16	*0:58*		-76
do	*7:21*	118	
	14:01		-107
	20:22	94	
17	*2:30*		-84
vr	*8:43*	127	
	15:20		-122
	21:41	107	
18	*3:44*		-103
za	*9:54*	140	
	16:26		-137
	22:43	118	
19	*4:45*		-120
zo	*10:49*	148	
	17:19		-145
	23:31	124	
20	*5:34*		-129
ma	*11:32*	148	
	18:01		-143

datum	uu:mm	HW cm	LW NAP
21	*0:07*	124	
di	*6:15*		-132
NM 14:25	*12:05*	145	
	18:37		-136
22	*0:31*	125	
wo	*6:50*		-132
	12:32	141	
	19:06		-131
23	*0:51*	128	
do	*7:21*		-132
	13:02	138	
	19:33		-129
24	*1:18*	132	
vr	*7:50*		-132
	13:34	131	
	20:00		-127
25	*1:49*	131	
za	*8:19*		-129
	14:04	122	
	20:27		-122
26	*2:16*	128	
zo	7:47		-124
	13:32	113	
	19:52		-117
27	1:39	125	
ma	8:14		-118
	14:00	104	
	20:17		-113
28	2:06	122	
di	8:44		-113
	14:37	96	
	20:51		-108
29	2:49	117	
wo	9:25		-106
EK 17:20	15:33	87	
	21:38		-98
30	3:51	112	
do	10:20		-97
	16:42	80	
	22:39		-85
31	5:03	109	
vr	11:35		-91
	18:02	81	
	23:57		-77

Referentievlak: NAP
LAT = NAP-192 cm

Nederlandse tijd
Cursief gedrukte tijdstippen zijn in ZOMERTIJD

ATTACHMENT N – PORTABLE BALLASTING PUMPS & GENERAL ARRANGEMENT ON BARGE

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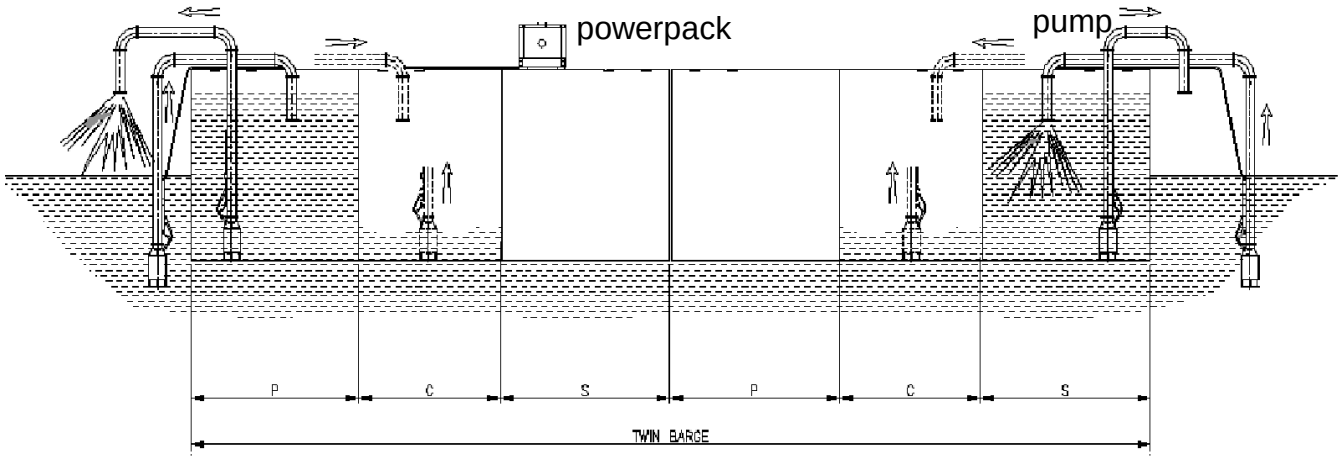
BALLASTING EQUIPMENT – 600T CAPACITY

2	08-03-13	Modification (HSP)	D.V.M.	W. Charita	C.sarens	11
1	09-02-12	Modification (Frames)	W.Charita	C. Sarens	B.Sarens	
0	28-01-08	FIRST ISSUE	W.Charita	C. Sarens	B.Sarens	
REV	DATE	ADAPTION	author	Audited	approved	Pg

1 Ballasting System

1.1 General

The design of this system is the result of many years of experience and through the years, Sarens adopted the principle of “simplicity equals reliability” : “Two pumps - one powerpack - two hoses”. This means that every pump can be individually checked and the flow from each pipe can be individually seen when starting, because the powerpack can only drive 2 pumps and is located (if possible) near the pump. As every discharge is visible, it is easy to confirm which pumps are operating and which are not.
This setup and configuration allows also an easy backup because there is no equipment involved which is necessary and common for all the installed pumps.
This equipment also allows a quick and reliable installation of the ballasting system without disrupting the customer’s main objective of loading with as less as possible influence on the customer’s work like sea



fastenings. The vertical submersible pumps are hydraulically driven by a diesel engine. The diesel engine is equipped with an hydraulic pump, dimensioned in such a way that 2 water pumps can be operated by one power pack. The hydraulic pump is linked with the hydraulic motor inside the pump housing by hydraulic hoses. Inside the power pack, the pump is equipped with a load sensing system. In total there are 48 pumps of 600 T/h (10 m water height) capacity available at Sarens

1.2 Power pack

The power pack is designed to supply two submersible pumps and is equipped with the following parts.

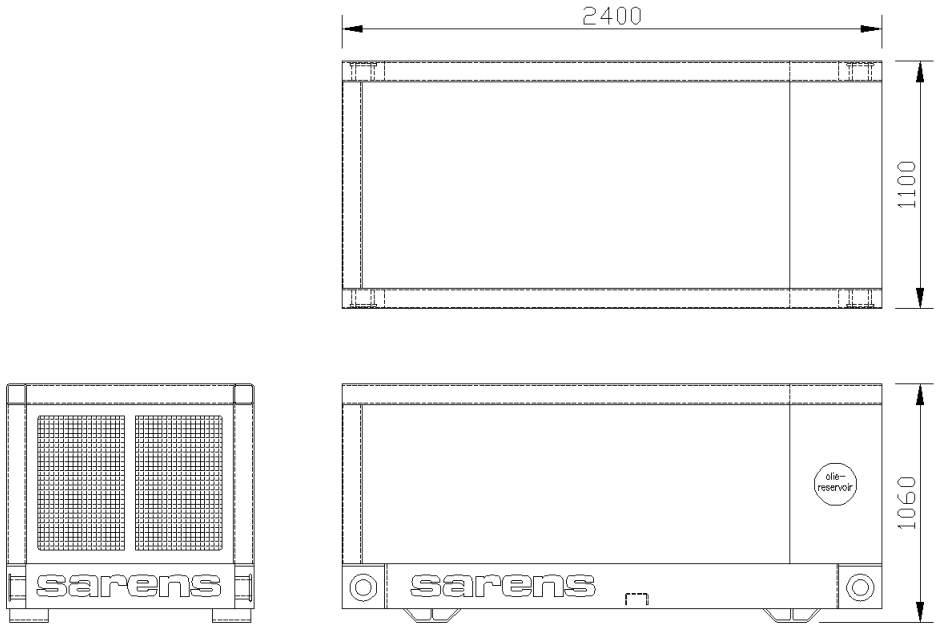
Diesel engine

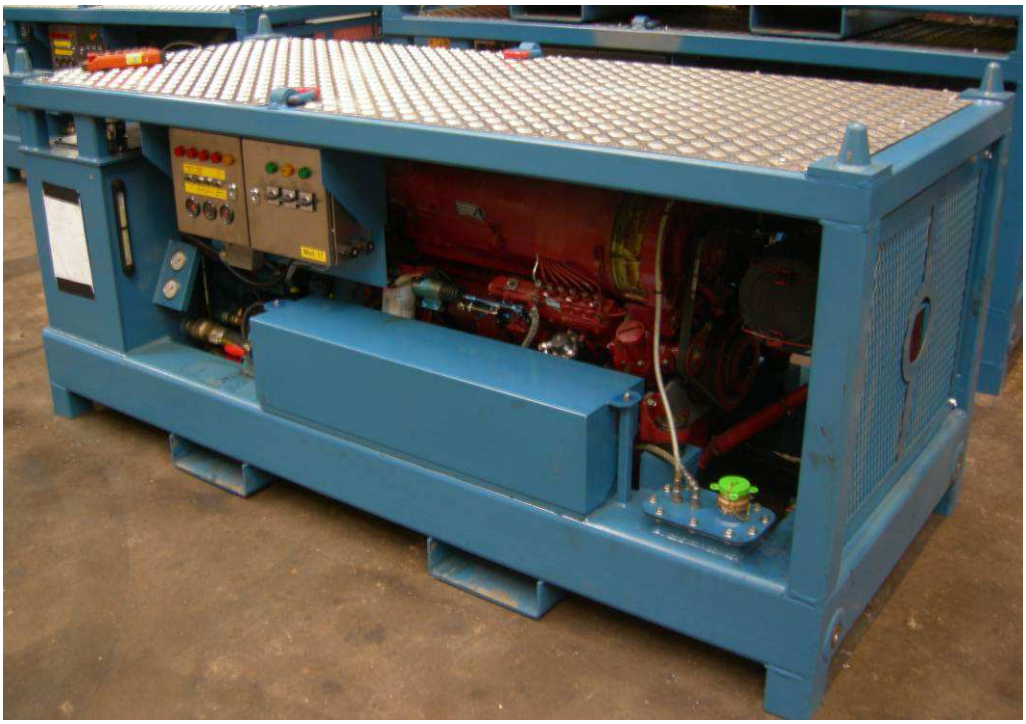
Make	KHD Deutz
Identification number	F6L913
Type	6 cil. in line, air cooled
Speed	1500 - 2000 rpm
Capacity	70 kW
integral fuel tank	200 L diesel (10 hours operation)
Options	Oil cooler
	V-belt tension switch
	lubricating oil pressure

Hydraulic pump :

Make	Rexroth
Identification number	A4VSO 71
Type	axial piston pump with variable displacement
Speed	1500 - 2000 rpm
max. pressure	400 bar
Capacity	58 cm^3/r

The power pack is assembled in such way that handling and positioning on a load out barge is possible in a way that it doesn't matter the trailerpath. Therefore the power packs are only 2400 x 1100 x 1060 (L x W x H) and can be handled by truck or crane.





1.3 Pumps

The water pump is installed together with the hydraulic motor inside the pump house to have some protection during installing and assembling of the ballasting system. The connection between the pump house and the hydraulic pump in the power pack is realised by 3 hydraulic hoses whose length can easily be changed depending on the distance between power pack and water pump.

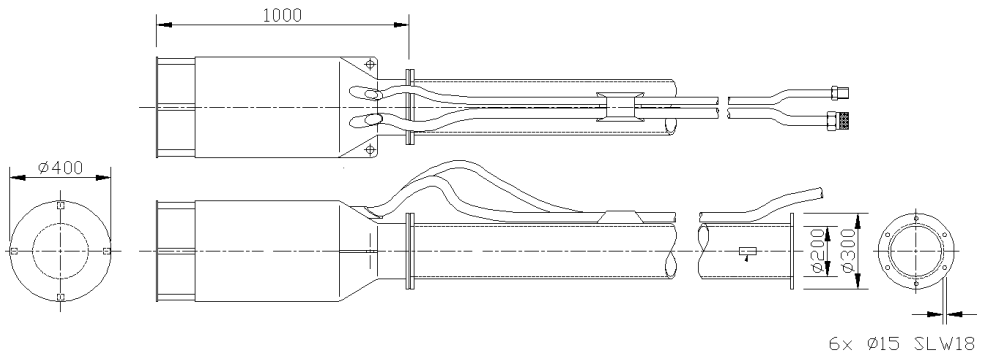
1.3.1 Ensival Pump

Water pump:

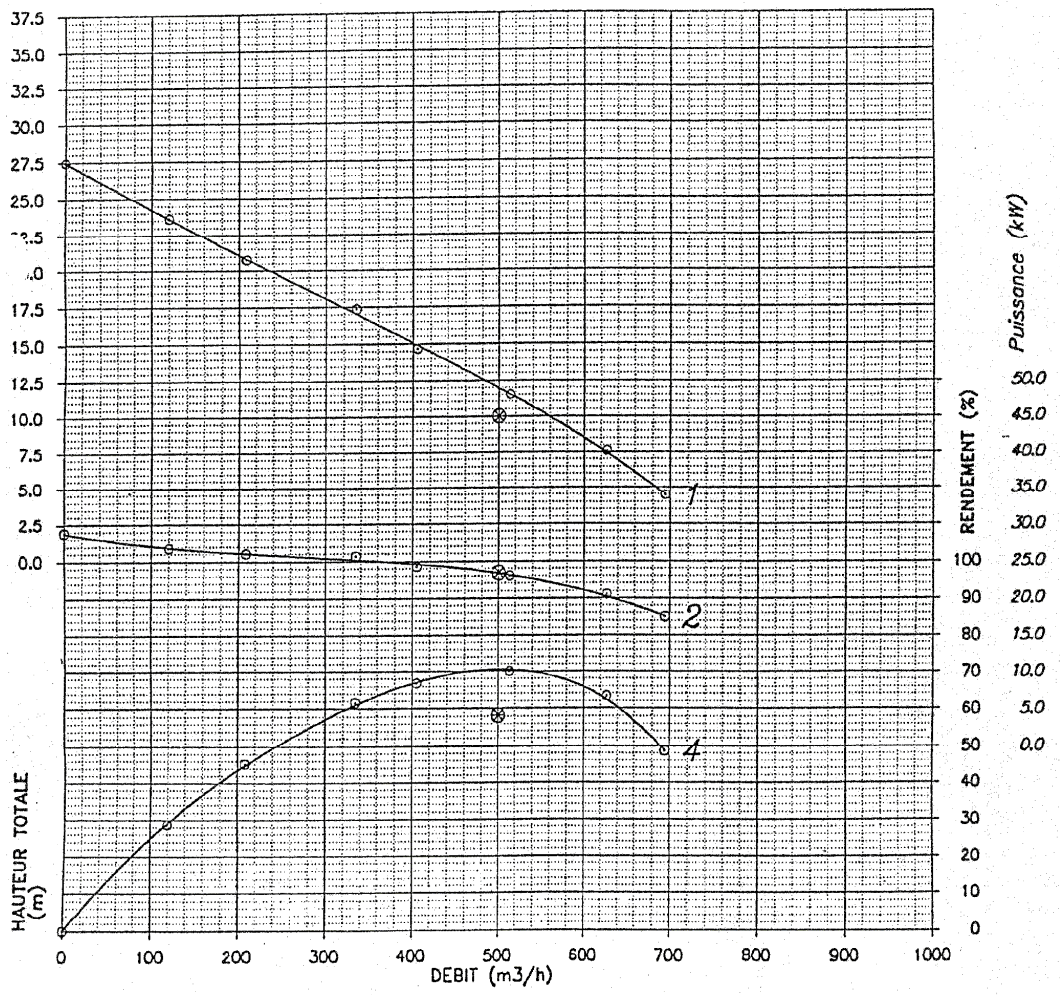
Make	Ensival
Type	HC3VIM submersible pump
Sarens id	Be 600 pump EN1-001-034
rotation speed	1500 - 1700 rpm

Hydraulic motor:

Make	Rexroth
Identification number	A2FM 32
Type	axial piston pump with fixed displacement
Speed	1650 rpm
max. pressure	400 bar
Capacity	28 cm^3 / tr



Capacity chart



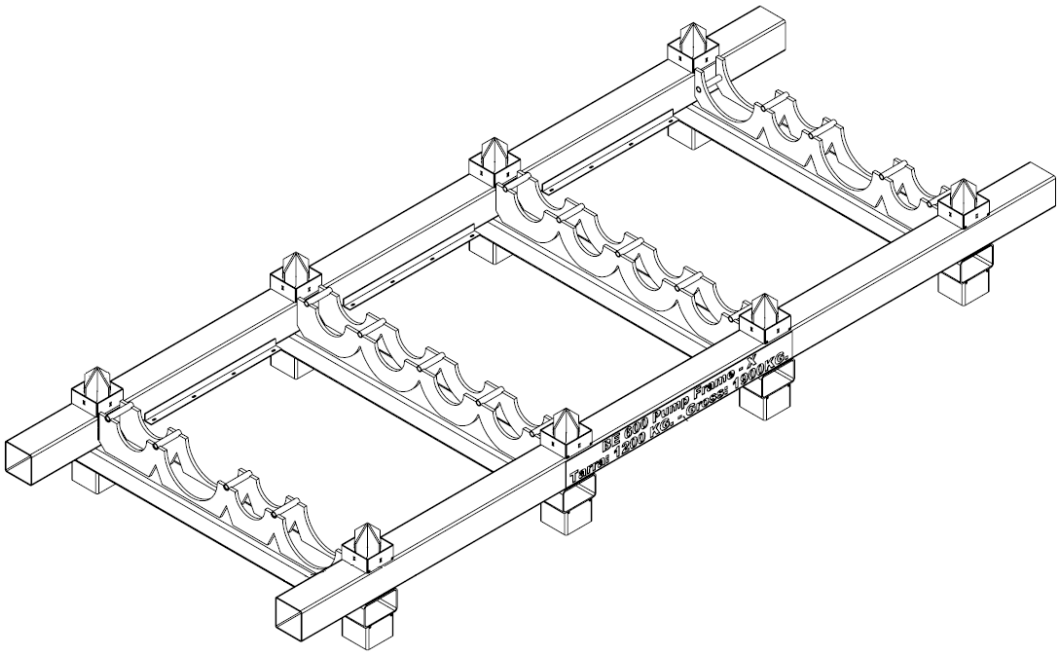
1: head -capacity

2: power

4: Efficiency

Storage frame ensival

The storage frame is made for 4 pumps and fits inside a 20 ft Container. 16 pumps per container. With a weight of 2 tons per frame.



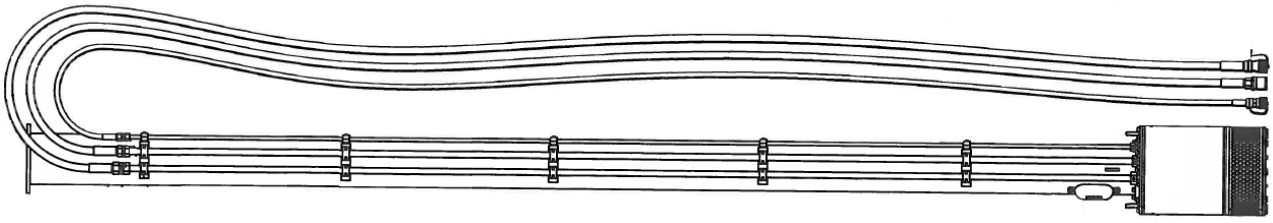
1.3.2 Holland special Pump

Water pump:

Make	Holland special pumps
Type	HSP-10A submersible pump
Sarens Id	BE600 pump HSP1-001-024
Dimensions	Ø390 x 5500 mm
Weight	250kg

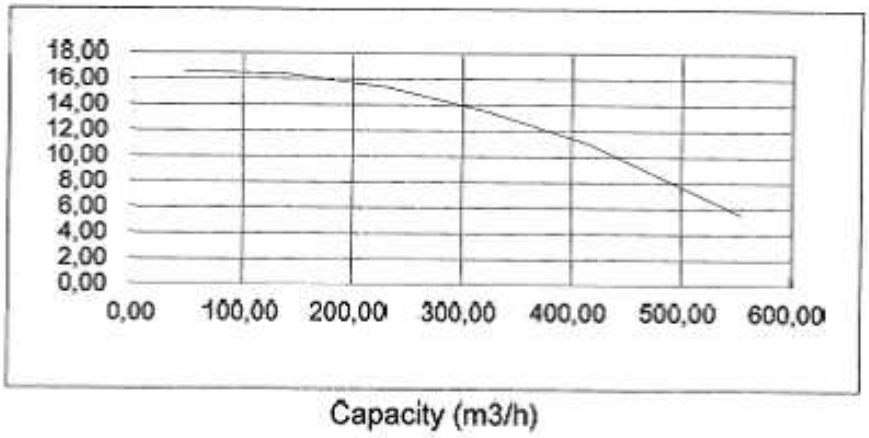
Hydraulic motor :

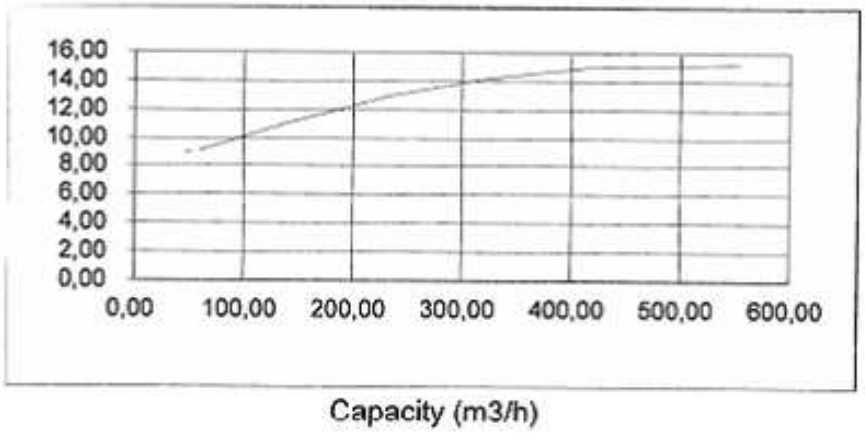
Make	Parker-Volvo
Type	F12-030-iso-Mod
Max. Speed	1840 rpm
Max. pressure	350 bar
Max. return pressure	10 bar

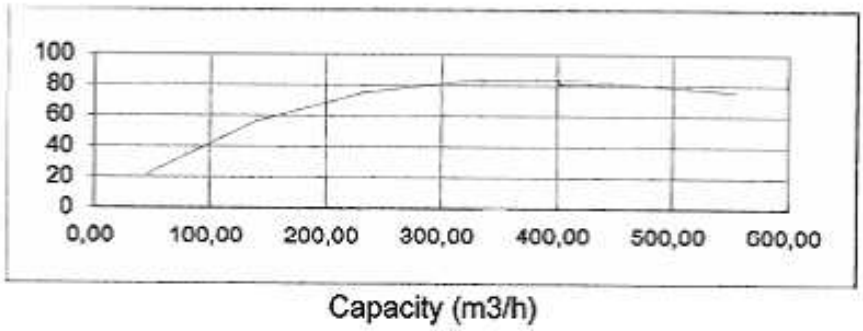


Capacity chart:

RPM : 1350





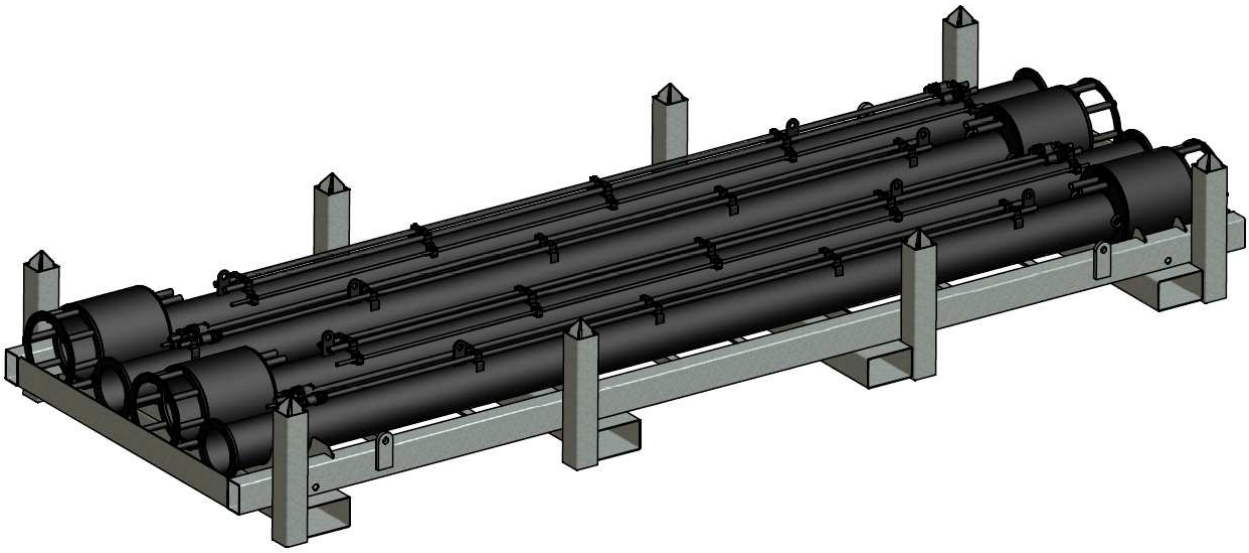


Storage frame Holland special pump

The storage frame is made for 4 pumps.

Dimensions 5600mm x 2140mm x 721mm

Weight with 4 pumps 2 T



1.4 Accesoires

A total set of tubes and hoses (can all be handled by hand) is available to make connections between tanks, pumps and bridging seafastenings, trailerpaths and mooringlines. All this tubes and hoses are connected with bolts and seals to make the connection watertide. Each pump has as a standard configuration a 4 m tube and a 90° bow and is fitted with 15m of hydraulic hoses. List of extra ballasting material : (for information only)

Tubes 4 m / 3 m / 2 m / 1 m / 0,5 m
Bows 45 ° & 90°
Flexibel hoses 6 m
Extra sets hydraulic hoses 15 m
Valves & T – connections



ATTACHMENT O – BALLAST SEQUENCES

HOLD

ATTACHMENT P – SAFETY CHECKLIST

ROSETTI MARINO SPA

Crosswind
BLPH

SAFETY CHECK LIST

Date: _____

LOAD IN OPERATION

Location: Eemshaven

N°	TOPIC	CHECKED
	MOORING ARRANGEMENT	
1	Check winch engines and trial start	
2	Check winch fuel and lubricant levels	
3	Inspect and grease-up wire ropes and block sheaves	
4	Control positions and elevations of quay fenders	
	BARGE BALLASTING	
5	Instruct ballast superintendent to perform all checks on ballast pumps	
6	Ballast the barge according to the pattern defined for the initial phase	
7	Check and report ballast tank levels by manual sounding	
	BARGE TRIM AND ALIGNMENT	
8	Check position of all targets on barge	
9	Check position and readings of survey instrument	
10	Check and report the barge trim and alignment	

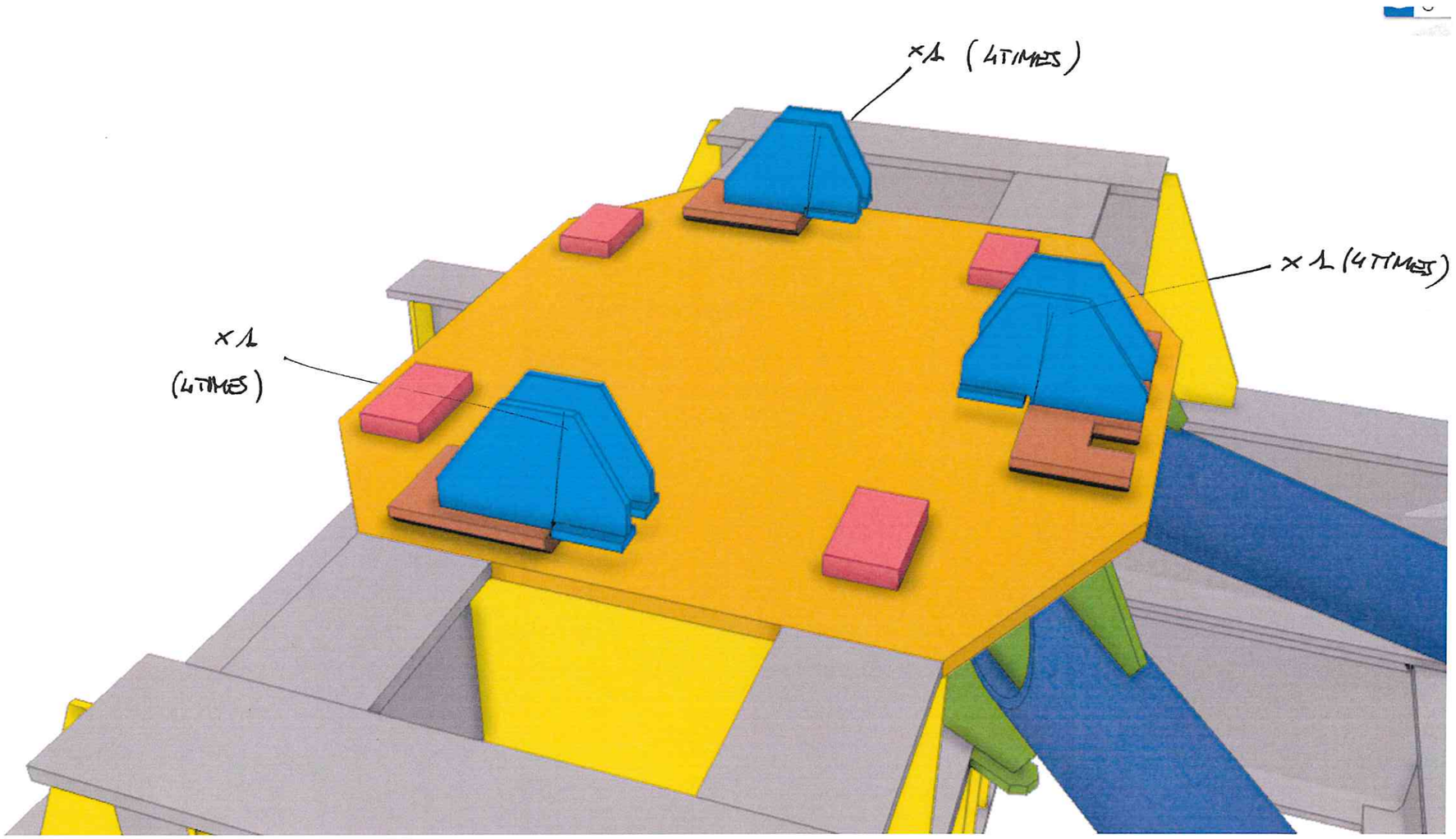
	SPMT Trailers	
11	No loose or not secured material	
12	Correct configuration of SPMT trailers as per attached drawings	
13	Functioning of every SPMT trailer	
14	Functioning of radio communications between SPMT trailer operator and lifting supervisor	
15	Briefing with personnel involved in the operation	
16	Area to be used cordoned off and access forbidden to unauthorized personnel	
	TIDE READINGS	
17	Check that the tide reading instrument is in place and perfectly working	
	WEATHER FORECAST	
18	In the week before load-out require every day official weather forecast and report to load-out manager	
	COMMUNICATION EQUIPMENTS	
19	Available communication equipments and spare units and batteries	
	CONTINGENCY	
20	Cutting equipment	
21	Shims in accordance with loadin manual and App.”R” .	

	APPROVAL	
22	Check warranty surveyor approval before going from barge to quay.	

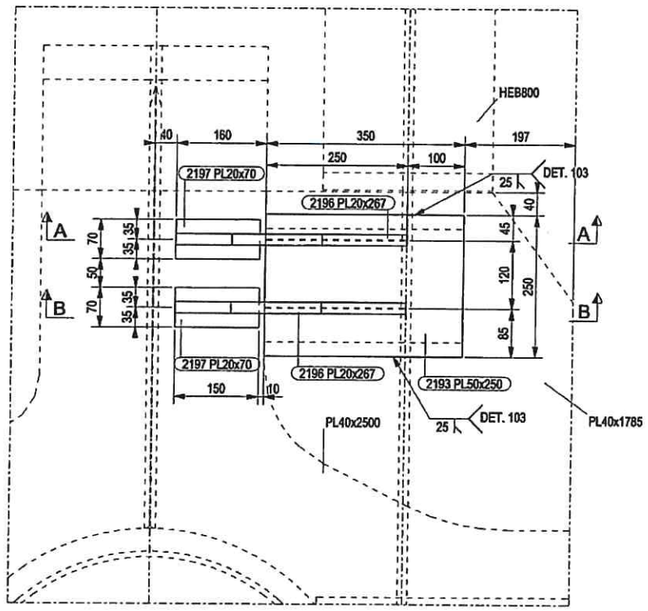
ATTACHMENT Q – SF DISCONNECTION

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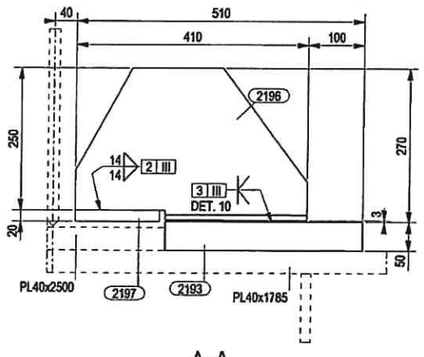
STRENGTHENING BUFF "CUT LINES"



MARK	POS.	Q.TY	DENOMINATION	LENGTH (mm)	MATERIAL GRADE	STR. CAT.	WEIGHT (Kg)	P. SURF. (m^2)	NOTES
CWGS017	2193	1	PL50x250	350	S355MLO	3	32.6	0.22	
CWGS017	2196	2	PL20x267	410	S355MLO	3	25.7	0.37	
CWGS017	2197	2	PL20x70	150	S355MLO	3	3.3	0.06	
CWGS018	2193	1	PL50x250	350	S355MLO	3	32.6	0.22	
CWGS018	2196	2	PL20x267	410	S355MLO	3	25.7	0.37	
CWGS018	2197	2	PL20x70	150	S355MLO	3	3.3	0.06	
CWGS023	2193	1	PL50x250	350	S355MLO	3	32.6	0.22	
CWGS023	2196	2	PL20x267	410	S355MLO	3	25.7	0.37	
CWGS023	2197	2	PL20x70	150	S355MLO	3	3.3	0.06	
CWGS024	2193	1	PL50x250	350	S355MLO	3	32.6	0.22	
CWGS024	2196	2	PL20x267	410	S355MLO	3	25.7	0.37	
CWGS024	2197	2	PL20x70	150	S355MLO	3	3.3	0.06	
						TOTALE	246.4	2.62	



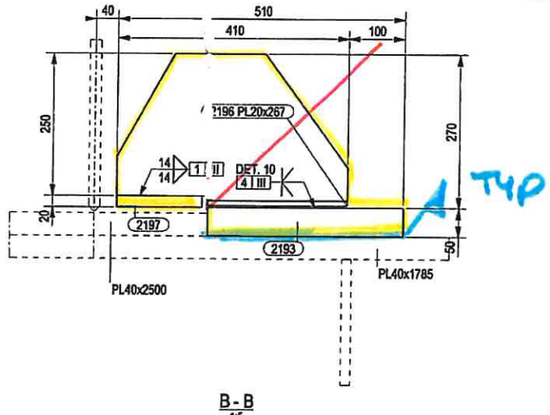
CWGS017 CWGS018
CWGS023 CWGS024



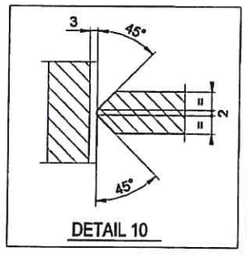
A - A
1:5

CUTLINES 3 TIMES × EACH NODES (4)

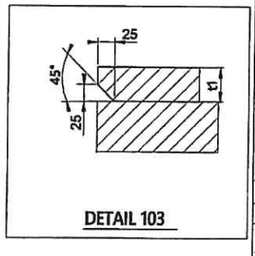
TOTAL => 12 TIMES



B - B
1:5



DETAIL 10

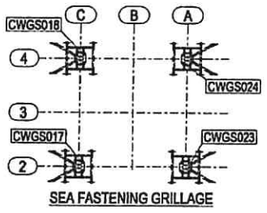


DETAIL 103

NOTES

1 – ALL DIMENSIONS AND ELEVATIONS ARE IN MILLIMETERS U.N.O.
2 – ALL ELEVATIONS ARE REFERED TO C.D.

KEY PLAN



SEA FASTENING GRILLAGE

HOLDS

REFERENCE DRAWINGS

DWG No.	DESCRIPTION
123A90-DDL-TI-DD-99024	TOPSIDE SEAFASTENING - ASSEMBLY
123A90-DDL-TI-DD-99025-002	TOPSIDE SEAFASTENING - DETAILS

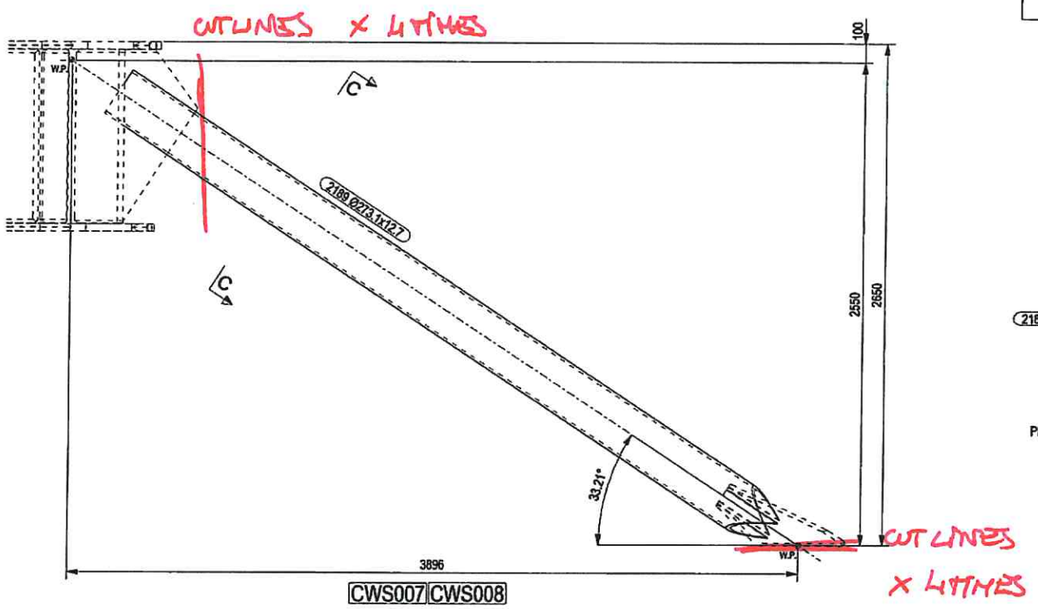
REV.	DATE	DRN	CHKD	APPD	DESCRIPTION
0	06/03/2025	CM-TS	MR	DC	ISSUED FOR CONSTRUCTION

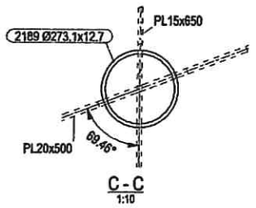
CROSSWIND | ROSETTI MARINO

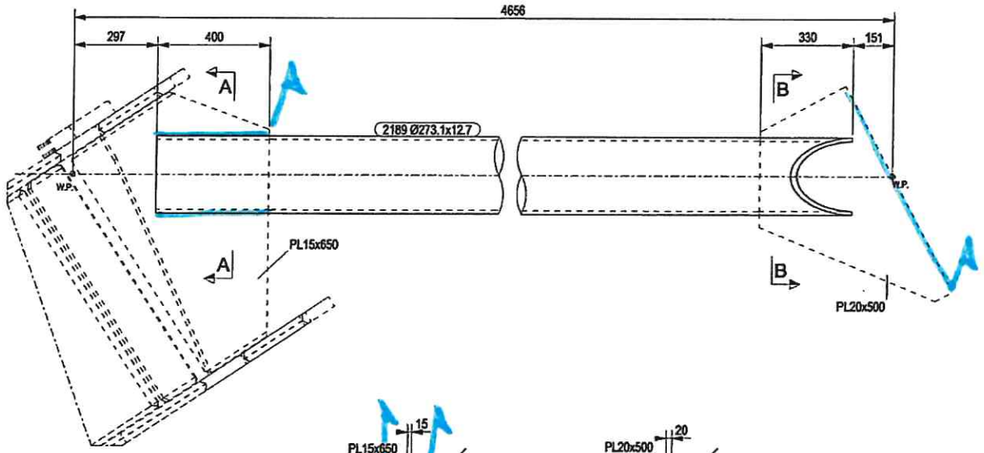
TITLE :
BASE LOAD POWER HUB (BLPH)
TOPSIDE SEA FASTENING GRILLAGE
MARK CWGS017 – CWGS018 – CWGS023 – CWGS024

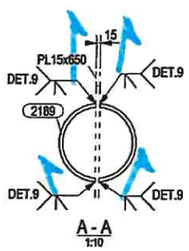
CONTRACT NO./TITLE CW-I-WP4-2023-05/HOLLANDSE KUST NOORD WIND PARK			SCALE 1:5
DRAWN CM-TS	CHECKED M.ROSSI	APPROVED D.CASADIO	DATE 06/03/2025
A1	DRAWING NO. 123A90-FDL-ST-DD-90830	SHEET 001	REV. 0

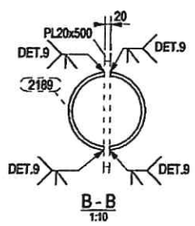
MARK	POS.	Q.TY	DENOMINATION	LENGTH (mm)	MATERIAL GRADE	STR. CAT.	WEIGHT (Kg)	P. SURF. (m^2)	NOTES
CWS007	2189	1	Ø273.1x12.7	4203	API5LX52	3	328.6	3.50	
CWS008	2189	1	Ø273.1x12.7	4203	API5LX52	3	328.6	3.50	
						TOTALE	657.2	7.01	

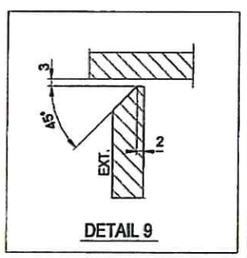










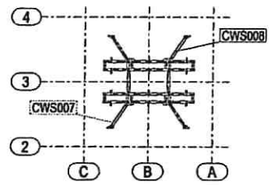


DETAIL 9

NOTES

1 – ALL DIMENSIONS AND ELEVATIONS ARE IN MILLIMETERS U.N.O.
2 – ALL ELEVATIONS ARE REFERED TO C.D.

KEY PLAN



UPPER GRILLAGE

HOLDS

REFERENCE DRAWINGS

DWG No.	DESCRIPTION
123A90-DDL-TI-DD-99041-001/002	TP - SEAFASTENING - ASSEMBLY AND DETAILS

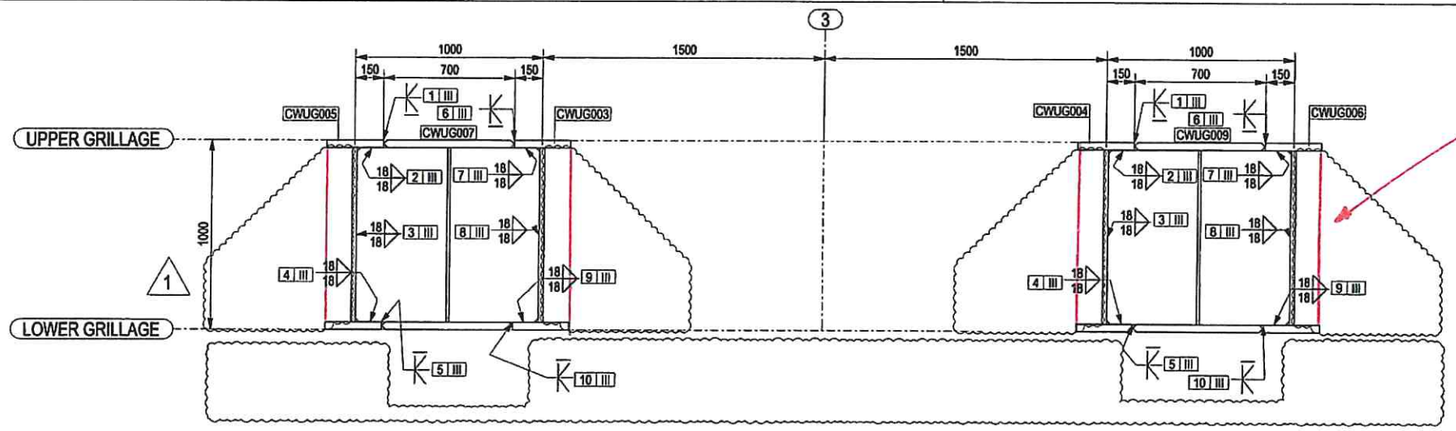
REV.	DATE	DRN	CHKD	APPD	DESCRIPTION
0	21/02/2025	CM-TS	MR	DC	ISSUED FOR CONSTRUCTION

CROSSWIND

ROSETTI MARINO

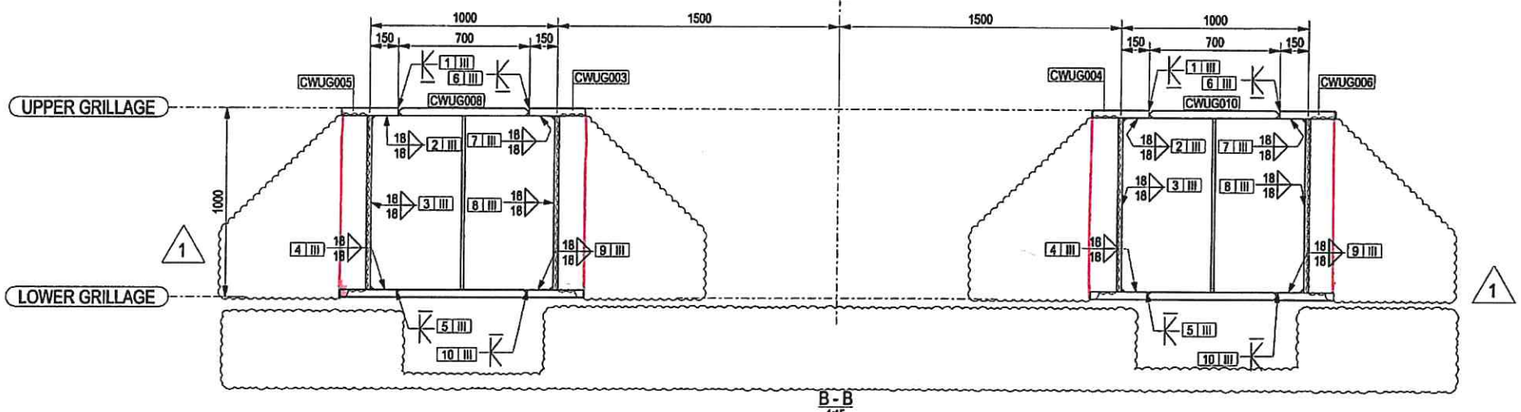
TITLE :
BASE LOAD POWER HUB (BLPH)
TP SEAFASTENING
MARK CWS007 – CWS008

CONTRACT NO./TITLE CW-I-WP4-2023-05/HOLLANDSE KUST NOORD WIND PARK			SCALE 1:15
DRAWN CM-TS	CHECKED M.ROSSI	APPROVED D.CASADIO	DATE 21/02/2025
A1	DRAWING NO. 123A90–FDL–ST–DD–90791	SHEET 001	REV. 0

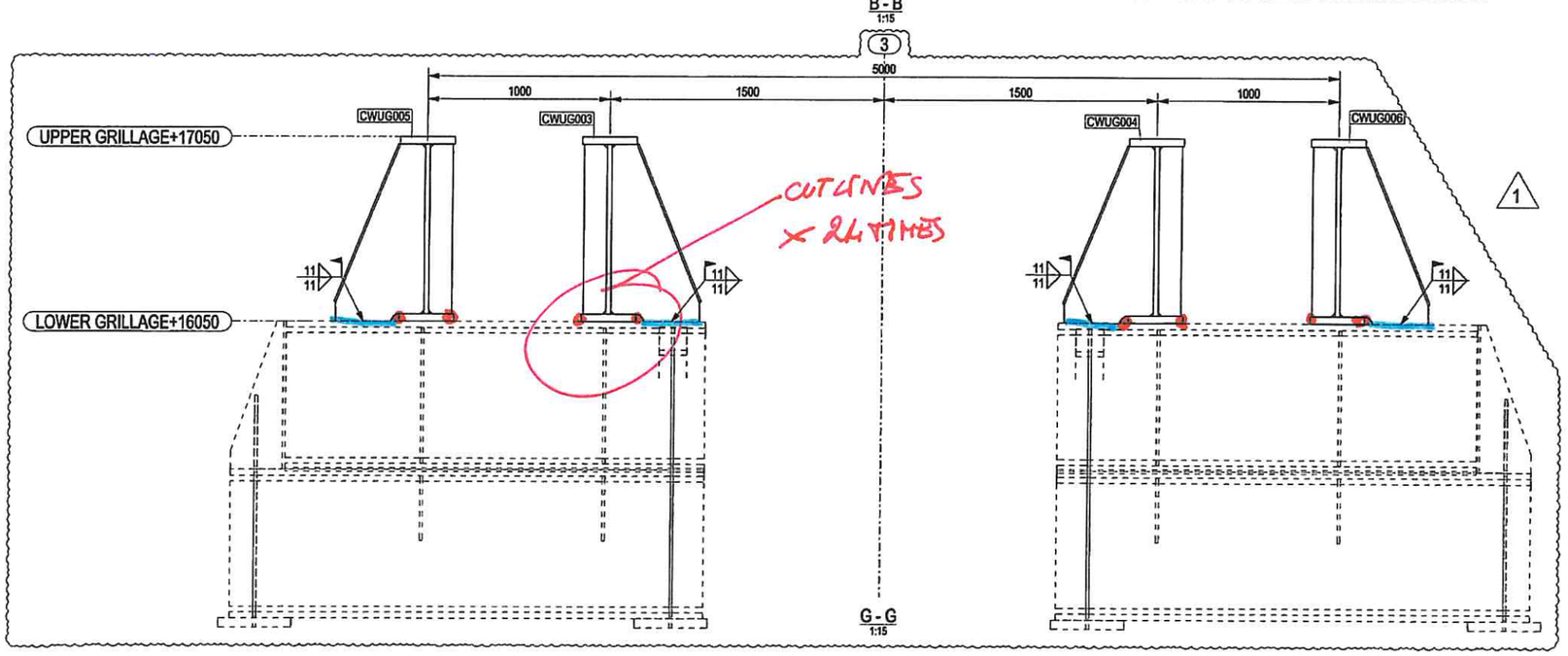


Typ. taglio vecchi spuntoni a filo

A - A
1:15



B - B
1:15

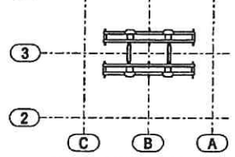


G - G
1:15

NOTES

1 – ALL DIMENSIONS AND ELEVATIONS ARE IN MILLIMETERS U.N.O.
2 – ALL ELEVATIONS ARE REFERED TO C.D.
3 – FOR PLAN VIEW E DRAWINGS LIST SEE DWG 123A90-FDL-ST-DD-90603

KEY PLAN



UPPER GRILLAGE

HOLDS

REFERENCE DRAWINGS

DWG No.	DESCRIPTION
123A90-DDL-TI-DD-99036	TP-UPPER GRILLAGE - PLAN VIEW
123A90-DDL-TI-DD-99037	TP-UPPER GRILLAGE - SECTIONS
123A90-DDL-TI-DD-99038	TP-UPPER GRILLAGE - SECTION AND DETAILS

REV.	DATE	DRN	CHKD	APPD	DESCRIPTION
1	25/02/2025	CM-TS	MR	DC	REVISED WHERE INDICATED
0	09/05/2024	CM-TS	MR	DC	ISSUED FOR CONSTRUCTION

CROSSWIND

ROSETTI MARINO

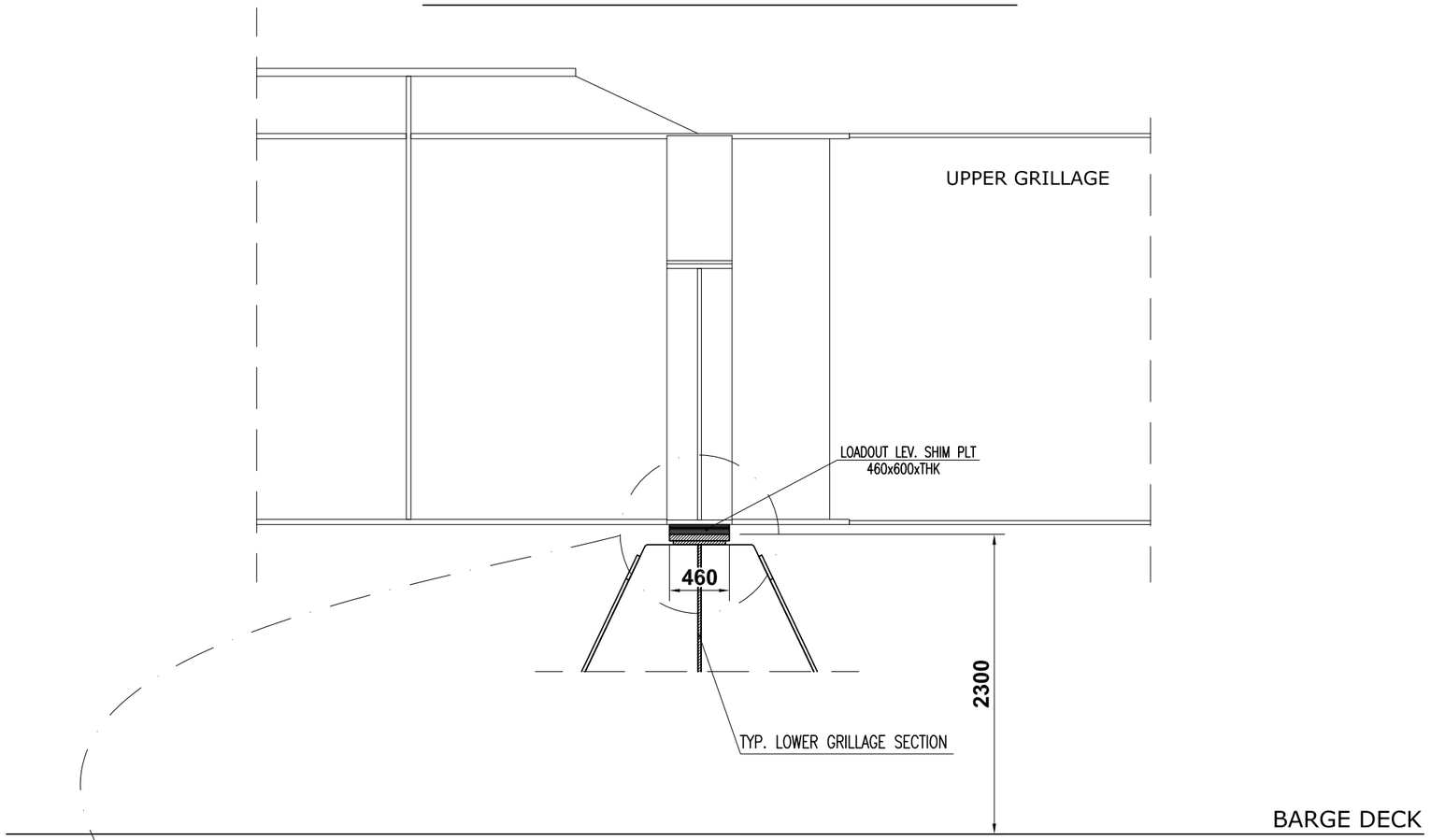
TITLE :
BASE LOAD POWER HUB (BLPH)
TP – UPPER GRILLAGE
ASSEMBLY

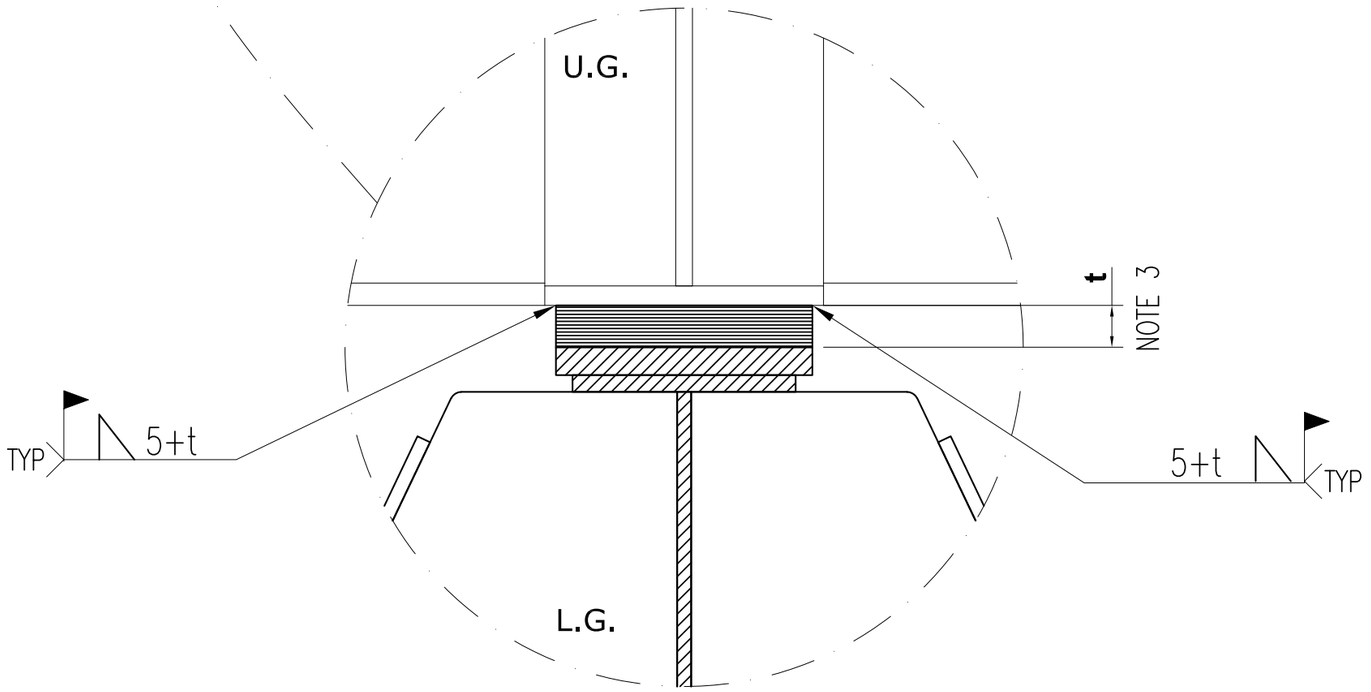
CONTRACT NO./TITLE CW-I-WP4-2023-05/HOLLANDSE KUST NOORD WIND PARK			SCALE 1:50
DRAWN CM-TS	CHECKED M.ROSSI	APPROVED D.CASADIO	DATE 25/02/2025
A1	DRAWING NO. 123A90–FDL–ST–DD–90604	SHEET 001	REV. 1

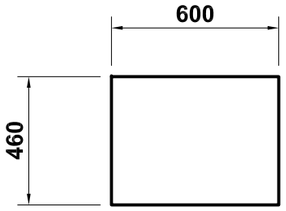
ATTACHMENT R – SHIMMING PLATES FOR FINAL SET DOWN

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TYPICAL GRILLAGE ARRANGEMENT







SUITABLE NUMBER OF LOADOUT LEV. SHIM PLT. TO BE FABRICATED (t 1, 2, 3 mm)

NOTES:

1 - ALL DIMENSIONS ARE IN MILLIMETERS IF NOT SPECIFIED OTHERWISE
2 - ALL PLATES TO BE EN-10025 S355 JR OR EQUIVALENT
3 - LOADOUT LEV. SHIM PLATES IF ANY

REFERENCES:

00	05/03/2021	FC	FCR	CA	Issue for review

TOPSIDE - TYP SHIMMING SCHEME

ATTACHMENT S – MOC

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CROSSWIND

ROSETTI MARINO

MANAGEMENT OF CHANGE

Hollandse Kust Noord

No. TQ :	123A90-PML-PM-MOC-00002	**Rev:**	0

Originating Party	Rosetti Marino – STR dept.					
Subject	Loadin Operation					
Author	A.Balzarotti	TQ Aconex unique number:				
Interface TQ - from		TQ interface source Aconex unique number:				
Type	Query		x	Interface		
	Deviation			Derogation (SHALL[PS])		
	Note: No deviations nor derogations which have an adverse effect on HSSE will be granted					
Workpackage						
Area(s) of application	Design & Eng.		Procurement		Construction	
	Commissioning		Operations	x	Other	
Issue date	19/09/2025		Urgent reply 5 days	x	Routine reply 10 days	
Close-out date						
Closed-out by			MOC status:		Open	

1. Description

Reference documents / Aconex unique numbers:

2. Response

Reference documents / Aconex unique numbers

This communication is issued for the recipient's information and to facilitate the obligations of the Parties under the Contract. This communication has no authority to amend or vary the Contract nor relieve either Party of any duties, obligations or responsibilities.