Colliers

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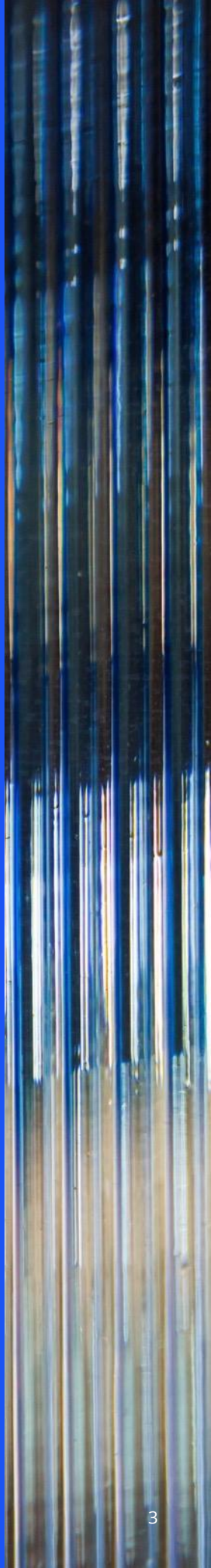
August 2025

Development of the necessary port and logistics infrastructure in Kundziņsala for the advancement of wind technology manufacturing

Contents

About project



General description

THE PROJECT`S TARGET

To strengthen the development of critically important offshore wind technology manufacturing within the European Union's supply chains by attracting producers of offshore and onshore wind technologies and their components. This will be achieved through the establishment of a green industrial zone on Kundziņsala area, enabling businesses to develop production facilities for wind energy technology components.

PLANNED DEVELOPMENT WITHIN THE PROJECT

According to the client, developing the port area as part of the project and leasing the constructed territory to companies manufacturing wind energy technology components is expected to facilitate approximately €160 million in exports, create around 650 jobs, and generate annual tax contributions of at least €7.8 million.

Scope of work

TASKS TO BE PERFORMED

Consultations and development of the territory and infrastructure plan, including:

- consultations on the necessary infrastructure and its layout to support offshore wind component manufacturing on Kundziņsala area, Riga;
- development of 2 alternatives for port infrastructure and territorial development planning to maximize the use of the project area and adapt it for businesses engaged in wind energy technology component manufacturing in the northern part of the Kundziņsala area;
- define technical requirements for each port infrastructure element, including size, area, load requirements, technical parameters, etc., based on best practices;
- development of best and highest-use scenarios for leasing/utilization of infrastructure by one or multiple (up to three) tenants.

Provision of consultations on the specifics and technical parameters of manufacturing equipment for offshore wind turbine blades, nacelles, and towers, including:

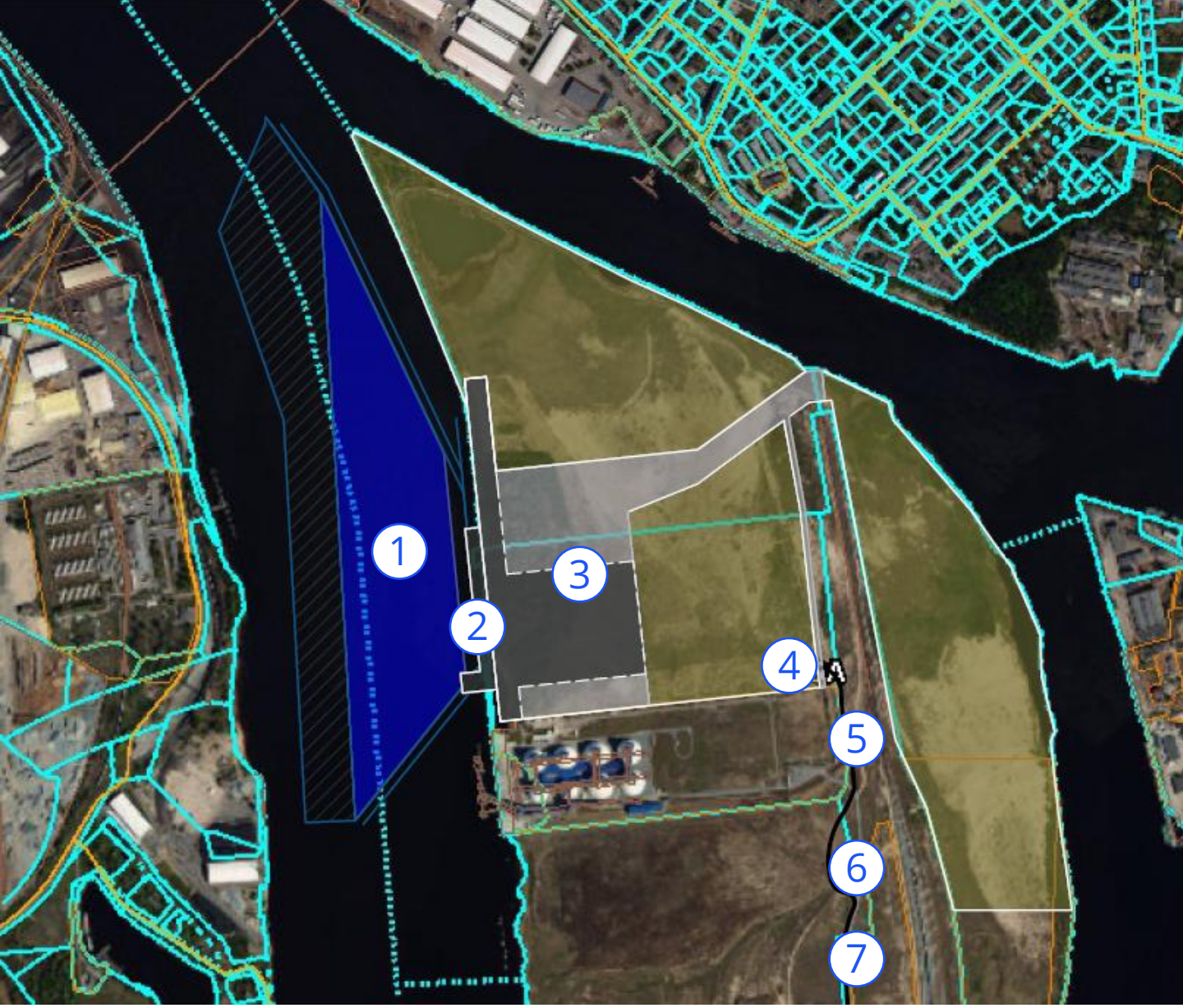
- consultations on the key technical parameters of various manufacturing facilities for each offshore wind turbine component;
- defining the main technical requirements for infrastructure (land plot, engineering communications, access, load capacity, height, etc.);
- defining the main parameters for the manufacturing process of each component (electricity consumption, waste, pollution levels, chemicals, environmental risks, etc.).

Development of visual materials, including

- development of a 2D master plan for the territory development scenario;
- development of isometric projections for the territory development scenario.

Technical description of the available land area, including:

- preparation of the technical description of land plots for lease to businesses/ manufacturers (provisional construction volumes and land-use planning document requirements), based on the selected development planning scenario;
- development of land plot layouts with approximate volumes.

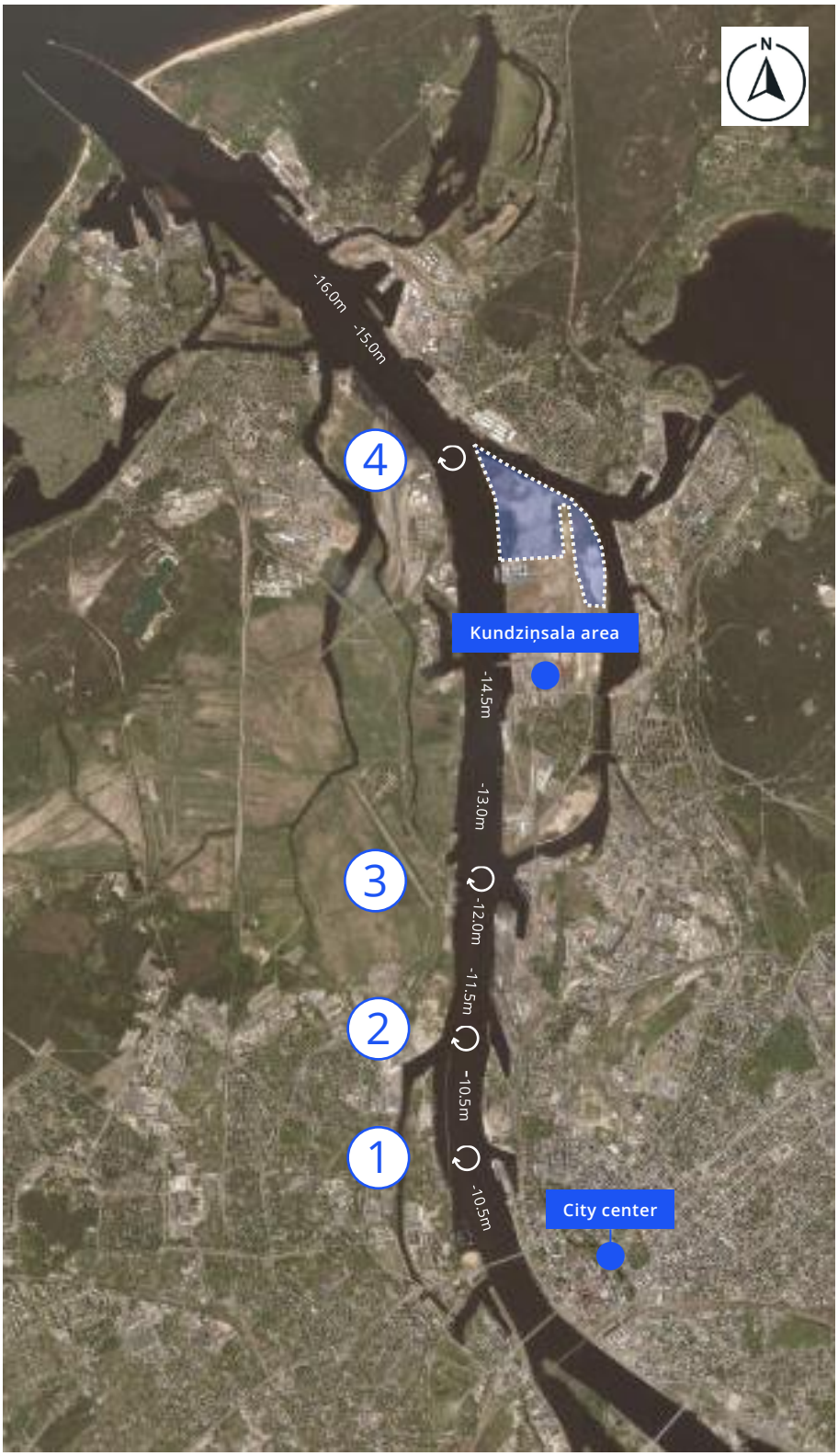


Upcoming infrastructure improvements in Kundziņsala area by Freeport of Riga

1. Dredging works near the planned quay (2) will cover an area of approximately 20 hectares, with a dredging volume of up to 437,000 cubic meters. The riverbed will be dredged to a depth of up to 13.5 meters in the area adjacent to the quay;
2. The quay infrastructure will feature enhanced load-bearing capacity, with a minimum length of 270 meters and a recommended extension to 290 meters. Quay infrastructure will also include a Ro-Ro ramp with minimum dimensions of 30 × 30 meters, with 40 × 40 meters recommended for optimal operational efficiency (*quay with Ro-Ro ramp schematic figure please see on page 62*);
3. Construction of new port logistics infrastructure or the reconstruction of existing facilities, including approximately 19,7 hectares of cargo logistics areas with high and medium load-bearing capacities (60 t/m² and 25 t/m²);
4. Construction of an access road approximately 2.3 kilometers long, connecting the Traffic Overpass to the quay, including the development of access roads and a railway level crossing within the port area;
5. Railway level crossing (construction of access roads and a railway crossing within the port area);
6. Railway level crossing (construction of access roads and a railway crossing within the port area);
7. Engineering networks, including water supply, sewerage, and other utilities, will also be constructed within the access road corridor.

** Freeport can provide up to 12 MW electrical power capacity. If a higher electrical power capacity is required, it should be discussed separately with the potential developer.*

Vessel turning basin in the Daugava Waters



Development territory

Vessel turning basin

4 diameter - 460m
depth - 12.5m

3 diameter - 400m
depth - 12.5m

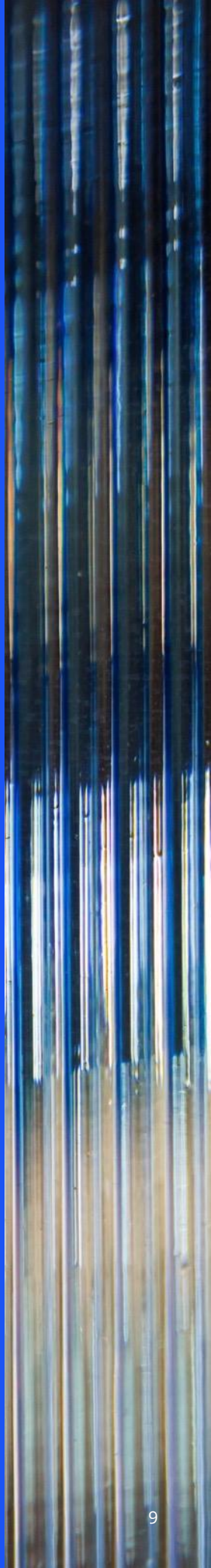
2 diameter - 300m
depth - 10.0m

1 diameter - 400m
depth - 10.5m

Laws, Cabinet of Ministers regulations, and municipal binding regulations

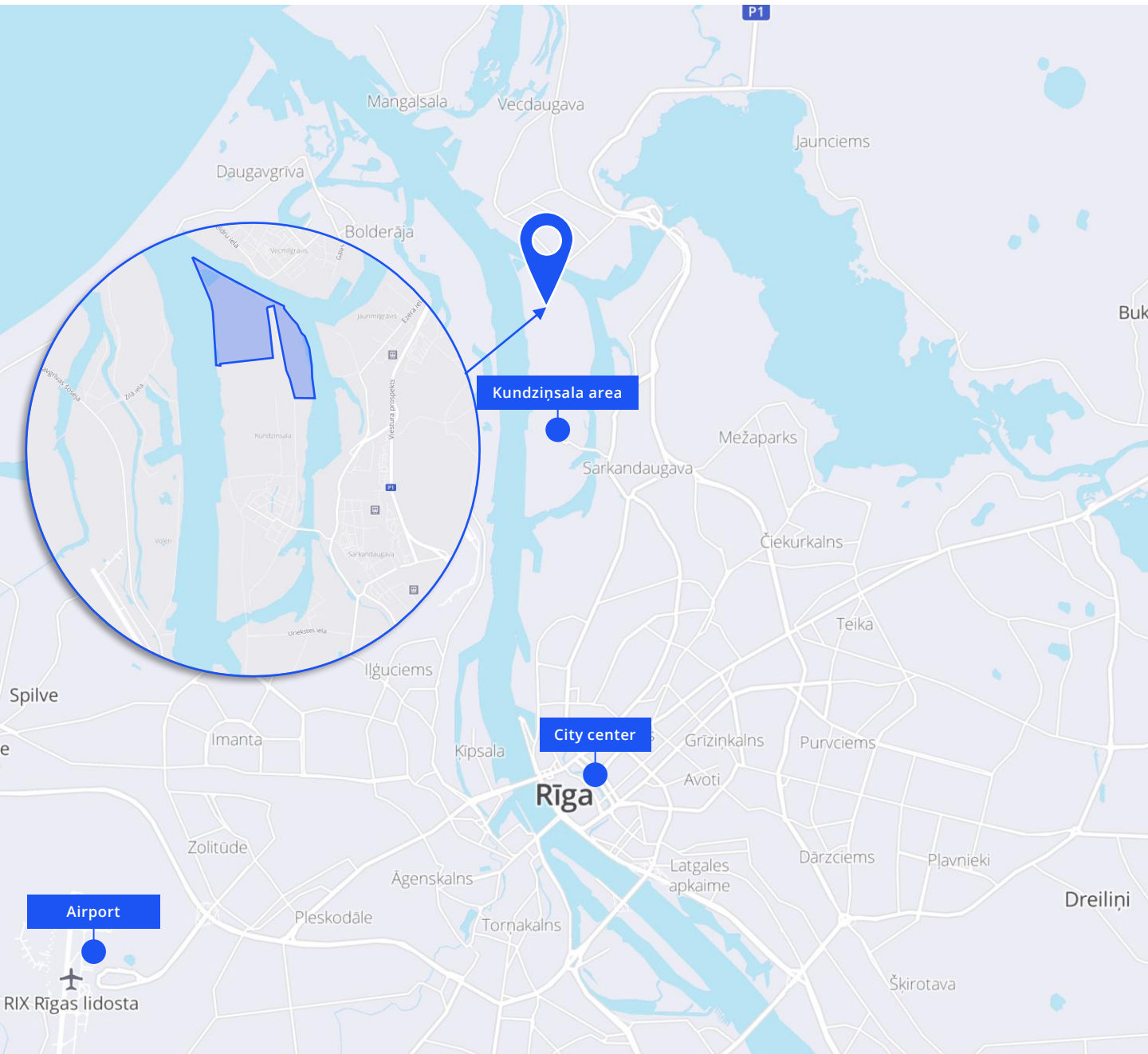
- Republic of Latvia Cabinet of Ministers Regulation No.240 of 30 April 2013 “General Regulations for the Planning, Use and Building of the Territory”;
- Binding Regulation No. 103 of the Riga City Council “Binding Regulations on the Land Use and Building in the Territory of Riga” dated 15 December 2021 and entered into force on 16 February 2023 , available: https://geolatvija.lv/geo/tapis#document_22161;
- Local plan as Binding Regulation No. 47 of the Riga City Council “Binding Regulations for the use and construction of the area between Kundziņsala and the territory between Sarkandaugava's backwater, Degvielas Street, Tvaika Street, and Uriekstes Street.” available: https://geolatvija.lv/geo/tapis#document_12143;
- Republic of Latvia Law of 9 March 2000 “The Free Port of Riga“;
- Republic of Latvia Cabinet of Ministers Regulation No.77 of 4 February 2020 “Freeport of Riga Regulations”;
- Republic of Latvia Law of 14 October 1998 “On Environmental Impact Assessment”;
- Republic of Latvia Cabinet of Ministers Regulation No.157 of 23 March 2004 “Procedures for Carrying Out a Strategic Environmental Impact Assessment”;
- Republic of Latvia Law of 5 February 1997 “Protection Zone Law“;
- Republic of Latvia Cabinet of Ministers Regulation No.563 of 19 September 2017 “Procedures for Identifying and Determining Objects of Increased Danger, as well as for the Planning and Implementation of Civil Protection and Disaster Management”;
- Republic of Latvia Law of 9 July 2013 ”Construction Law”;
- Republic of Latvia Cabinet of Ministers Regulation No.500 of 19 August 2014 “General Construction Regulations”;
- Republic of Latvia Cabinet of Ministers Regulation No.529 of 2 September 2014 “Building construction regulations”;
- Republic of Latvia Cabinet Regulation No.253 of 9 May 2017 “Construction regulations for certain engineering structures”;
- another State laws, regulations of the Cabinet of Ministers and the Riga City Council Binding Regulation attributable to the construction process.

Development analysis



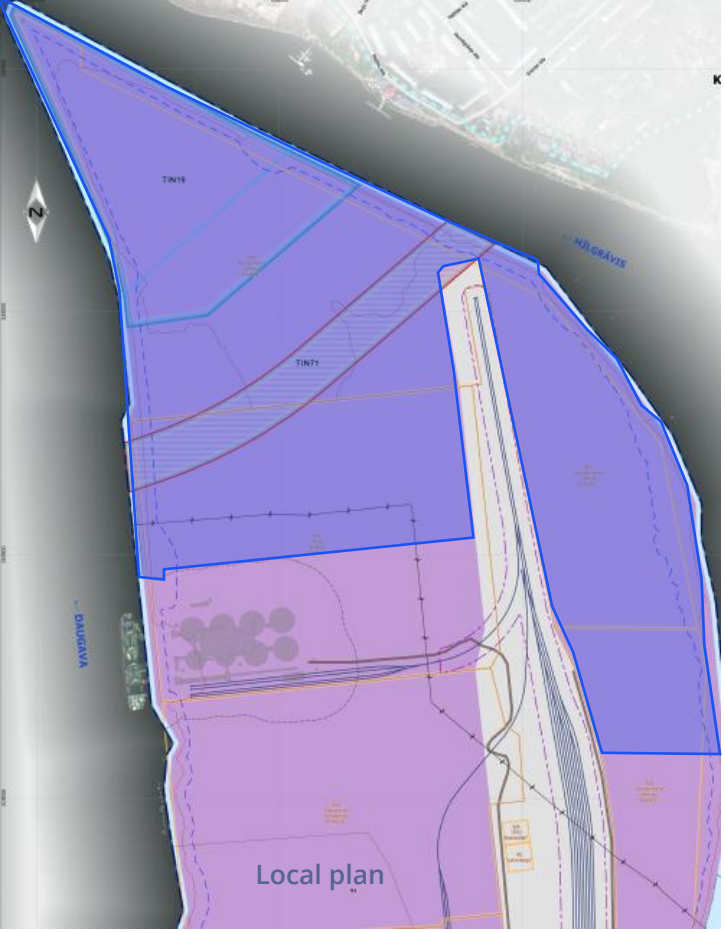
Location of the development territory

Kundziņsala area is located on the right bank of the Daugava River, slightly to the north of the central part of Riga, and is enclosed on all sides by bodies of water – the Daugava, Mīlgrāvis and Sarkandaugava. A development site is situated in the northern part of Kundziņsala area.



Available lease land

Approximately 90 hectares in total are designated for development, of which approximately 70 hectares of land are available for lease (1. 26,8 ha; 2. 15,9 ha; 3. 27,7 ha), offering significant potential for industrial and logistics development. Planned port infrastructure improvements (4. 19,7 ha) include the construction of a quay with a Ro-Ro ramp, as well as upgrades to internal transport and utility networks. The area is partially affected by encumbrances that may impact its potential development (see section «Encumbrances and restrictions»).



Analysis of local plan and territory planning requirements

Currently, the binding regulations No. 47 of the Riga City Council are into force, which specify individual land use and building regulations as well as the graphical part. Any matters not specifically regulated in the land use and building provisions of the local plan shall be governed by the applicable regulations of the Riga Territorial plan, ensuring continuity and compliance with the broader spatial planning framework.

In accordance with the local plan Land Use and Building Regulations, main design requirements for development territory:

- Industrial Building Territory (R4) is a functional sub-zone designated to ensure the operation of permitted industrial enterprises in the area and the necessary territories for their development;
- Permitted usage:
    - Building of light industry undertakings;
    - Building of waste management and recovery undertakings;
    - Engineering infrastructure;
    - Linear transport infrastructure;
    - Building of warehouses;
    - Building of airports and ports: Construction consisting of port terminals and related infrastructure, including hydraulic structures, quay infrastructure, navigation equipment and devices in the port, and river ship quay infrastructure;
    - Building of energy supply undertakings;
    - Building of heavy industry and primary processing undertakings;
    - Office buildings: Construction consisting of state administration institutions and other enterprises, organizations, and institutions;
    - Building of business and/or service objects.

Analysis of local plan and territory planning requirements

- Maximum building intensity – 280%;
- Maximum building density – not determined;
- Building height- up to 5 floors / 24m *;
- Minimum index of vacant green territory – 10%**.

** The height restriction does not apply to port cranes and other port equipment and structures that are not buildings, as well as structures for which it is not possible to comply with the height restriction due to the technologies and/or technical solutions used in production;*
*** The indicator of free green areas applies only to the permitted public development in the area.*

Engineering infrastructure preparation:
The preparation of engineering infrastructure within the local plan territory is permitted to be carried out in phases, to the extent necessary to ensure the implementation of the construction process for a specific development block or object.
In Industrial Building Territory (R4) it must be ensured that the ground surface elevations planned in the construction project are set above the maximum flood level with a 1% probability of occurrence.
In areas where a rainwater drainage system is not installed, outdoor (open-air) cargo storage yards in Industrial Development Zones (R4) and Technical Development Zones (TA4) are permitted to be constructed with gravel/crushed stone surfaces, ensuring the installation of an anti-infiltration layer in locations where pollution leakage is possible.

The following general minimal requirements for parking spaces:
The number of parking spaces for buildings or structures is determined at the building design stage, in accordance with the provisions of the Riga City Council Binding Regulation No. 34 of 20 December 2005, 'Regulations on the Use and Development of the Territory of Riga, as well as the requirements of other applicable regulatory enactments.

Building Type	Calculation unit	Parking spaces (Riga territorial plan)	Calculation unit	Parking spaces (Riga territorial plan (no longer in force))	Calculation unit	Parking spaces (Latvian National Standardization Institution)
Industrial buildings	100 m2	0,3	10 workplaces	1	50–70 m² of usable floor area or for 3 employees	1
Warehouses	100 m2	0,2	10 workplaces	1	80–100 m² of usable floor area or for 3 employees	1
Office buildings	100 m2	3	40 m2	1	30–40 m² of usable floor area	1

Analysis of local plan and territory planning requirements

Requirements for industrial accident risk objects in the local plan:
Safety distances around industrial accident risk objects and the restrictions on land use and construction within these distances are determined in a manner equivalent to the safety protection zones specified in the Law on Protected Zones, considering each object's industrial accident prevention program or safety report, as well as other relevant information.

The admissibility of constructing new industrial accident risk objects, reconstructing or renovating existing ones, and making significant changes to the operation of existing objects is assessed in the initial evaluation of the proposed activity's impact, in the environmental impact assessment report, in the industrial accident prevention program, or in the safety report of the industrial accident risk object.

High-risk and high fire hazard facilities may be constructed or reconstructed within a distance of up to 200 meters from an existing industrial accident risk facility, provided that such construction or reconstruction does not significantly increase the risk or consequences of industrial accidents at the existing facility. Exceptions apply if the new facility is necessary for the operation of the existing industrial accident risk facility and a decision or opinion has been obtained from the State Environmental Service.

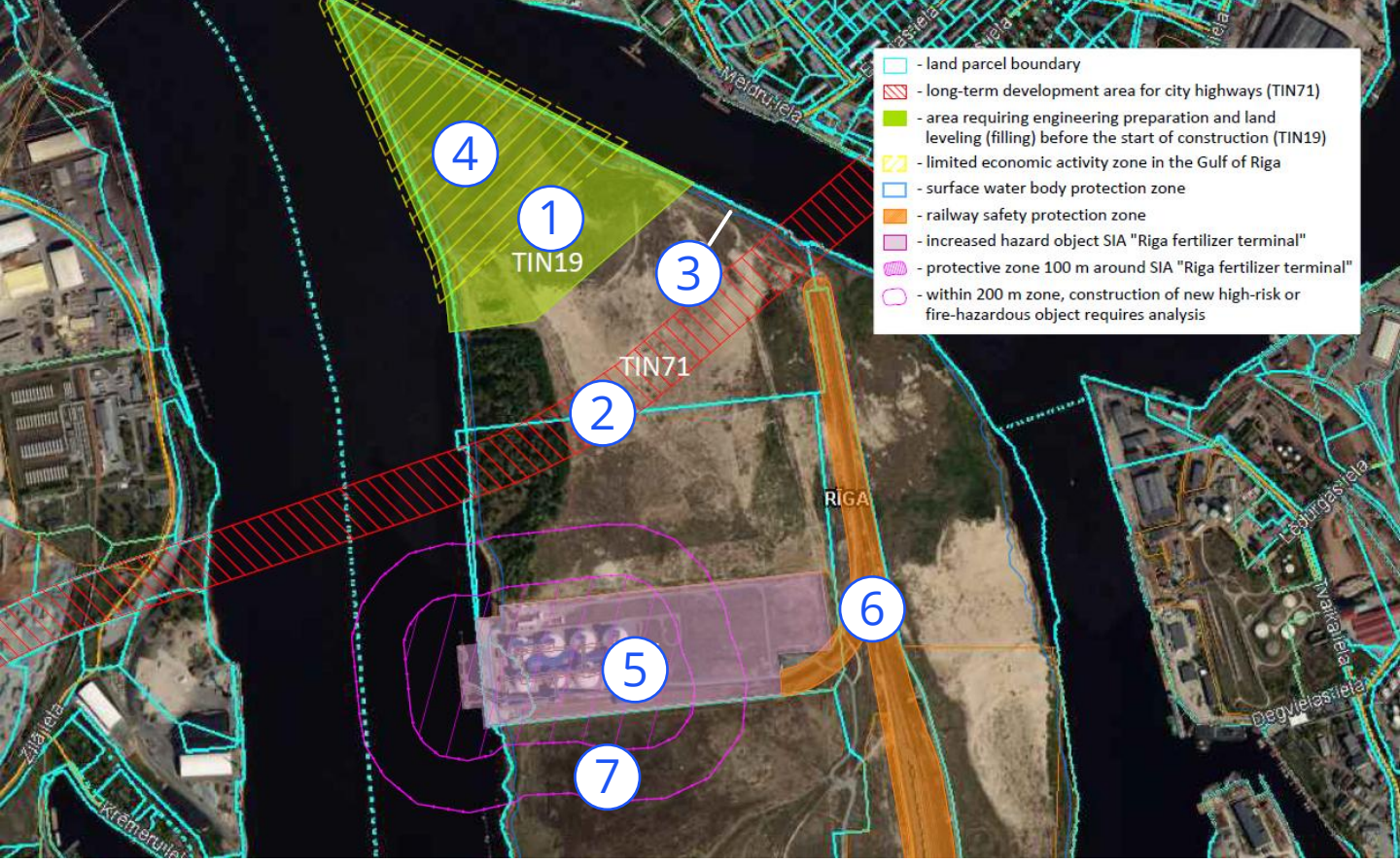
In accordance with the territorial plan:
A safety distance is established around an industrial accident risk object or technological equipment, which is equal to the distance of the harmful impact zone of a potential accident as indicated in the industrial accident prevention program or safety report of the object.

This distance is assessed using the criteria specified in these regulations and must not be less than the corresponding safety protection zone defined for the object or equipment in the Law on Protected Zones. If the calculated accident impact distance exceeds 500 meters, then the safety distance is set at 500 meters. If a risk assessment has been conducted and the analysis determines an acceptable risk level ($P_{let} \leq 1 \times 10^{-6}$), the safety distance may be reduced to the area with such a risk level, but it must not be less than the minimum safety protection zone specified in the Law on Protected Zones for the object or equipment.

Within the safety distance zone, it is prohibited to construct a new or convert an existing objects into a high-risk industrial accident object, to construct a new Category C high-risk object, or a object with increased fire hazard, unless such object has been assessed in accordance with the criteria set out in these regulations, a decision or opinion has been received from the State Environmental Service or the Energy and Environmental Agency allowing the operation of the object, and the operator of the existing high-risk industrial accident object, within whose safety distance the construction is planned, has provided written consent. Any restrictions resulting from construction, as defined in these regulations, must not significantly hinder or limit the development of other functional zoning areas in accordance with the land use specified in planning documents.

According to the State Environmental Service:
On 28 December 2024, the State Environmental Service issued the Initial Assessment of the Impact of the Proposed Activity (No. AP24SI0405), which establishes a 200-meter zone within which, prior to constructing any new high-risk or fire-hazardous facility, an analysis must be conducted to determine whether it could affect the safety of SIA "Riga Fertilizer Terminal".

**The classification of the planned activity as a Objects of Increased Danger (Category C) depends on factors such as the technological setup, the types and quantities of raw materials and hazardous substances involved, in accordance with the thresholds defined in national regulations.*



Encumbrances and restrictions

From the local plan:

1. TIN19 - a territory that requires engineering preparation and ground level elevation (landfill) before the start of the construction process;

2. TIN71 (the territory reserved for the development of the Coastal Highway) - the territory is allowed to continue its existing use, as well as to establish transport infrastructure facilities, including local roads, fuel stations, parking lots, warehouses (a manufacturing building is not permitted), cargo storage areas, and railway infrastructure;

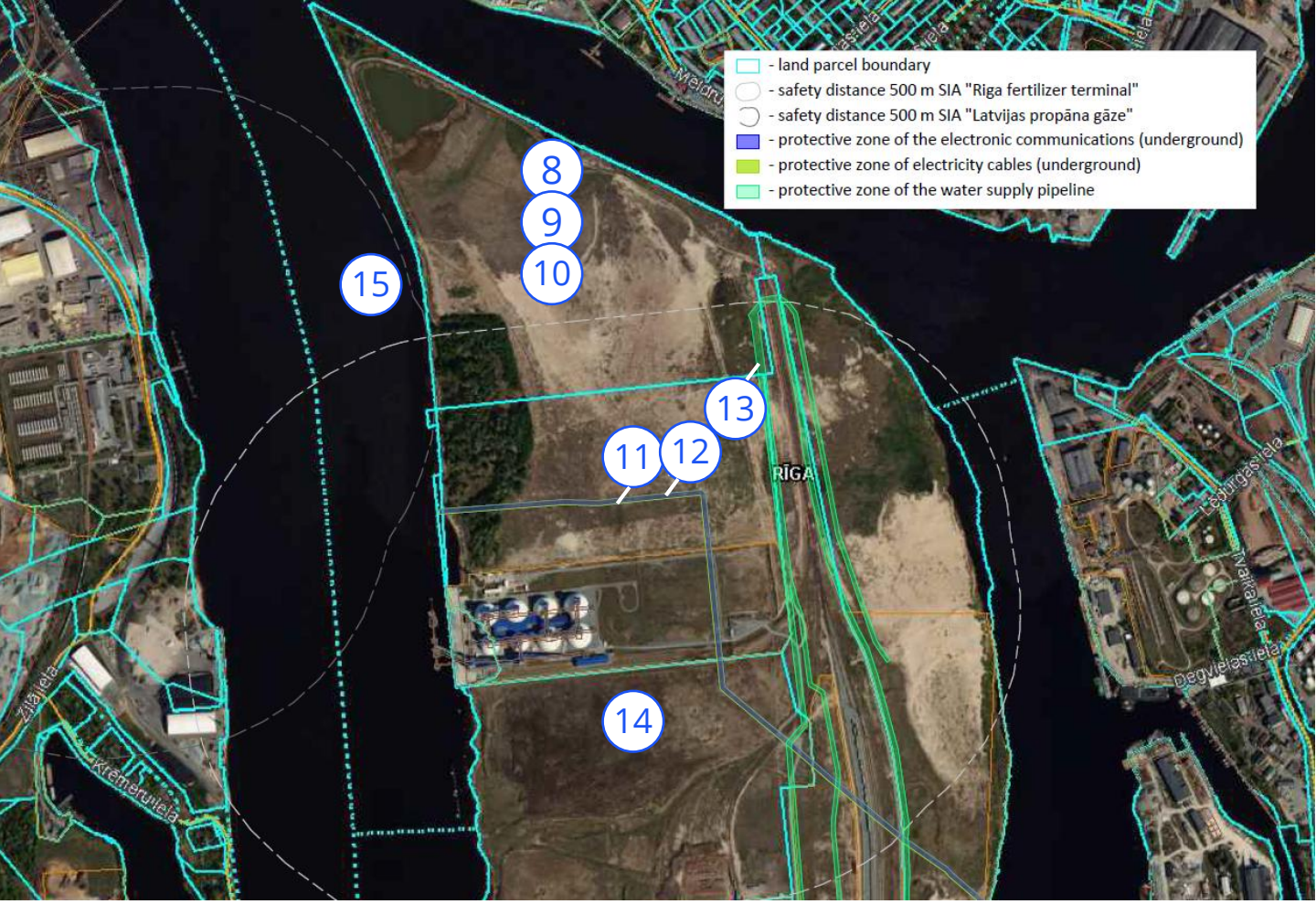
3. Protected zone of surface water bodies - Protection Zone Law, Section 37. (https://likumi.lv/ta/en/en/id/42348-protection-zone-law);

4. Restricted economic activity zone – The Gulf of Riga - Protection Zone Law, Section 6. (https://likumi.lv/ta/en/en/id/42348-protection-zone-law);

5. Protection zone around pumping and filling stations, tank parks, filling and discharge trestles, quaysides, and piers, heating points, warehouses, storage sites, processing and reloading establishments of oil and oil products, hazardous chemical substances and products - 100 m from object (High-risk object SIA "Riga fertilizer terminal"), Protection Zone Law, Section 30. (https://likumi.lv/ta/en/en/id/42348-protection-zone-law);

6. Railway safety protection zone;

7. Within a 200 m zone, construction of a new high-risk or fire-hazardous facility requires an analysis to determine whether it could impact the safety of SIA 'Riga Fertilizer Terminal'.



Encumbrances and restrictions

Based on the territorial plan and other applicable restrictions and protection zones:

8. Protection zone around technical aids to navigation for ensuring civil aviation aircraft flight safety – within the wider airport influence area from the aeronautical facilities;
9. 15 km zone around the reference points of the aerodrome "Rīga", "Spilve", "Ādaži", and "Ikšķile";
10. 5 km zone around the reference points of the aerodrome "Rīga", and "Spilve";
11. operational protection zone along the line of underground electronic communication networks and cable drainage;
12. operational protection zone along the cable line of electric networks;
13. operational protection zone around the water pipe, located up to 2 meters deep;
14. Safety distance for the high-risk object SIA "Riga fertilizer terminal" – 500 m from object (a high-risk object (Category C) cannot be located), Protection Zone Law, Section 30. (https://likumi.lv/ta/en/en/id/42348-protection-zone-law);
15. Safety distance for the high-risk object SIA "Latvijas propāna gāze" – 500 m from object (a high-risk object (Category C) cannot be located), Protection Zone Law, Section 30. (https://likumi.lv/ta/en/en/id/42348-protection-zone-law);

Encumbrances and restrictions

On the development territory registered Natural values in Natural data management system:

- Habitat: Alluvial forests (alluvial riverside and floodplain forests);
- Protected bird species (possible nesting site):
- Barred Warbler (*Sylvia nisoria*);
- Western Marsh Harrier (*Circus aeruginosu*);
- Tawny Pipit (*Anthus campenstris*);

On the development territory registered forests:

According to publicly available information, there are 8 forest parcels in the development territory, with a total area of 7.66 hectares.

Since the habitat is located within the planned development area, an opinion from the Department of Nature Conservation is required. This was received on 11 December 2024, under reference No. 3.15.1.3/1063/2024-N10, titled 'On the mitigation measures for the impact of economic development in Kundziņsala on habitats within the nature reserve “Krēmeri”'. In this opinion, the Department of Nature Conservation conceptually supports the construction of infrastructure objects within the project, including the destruction of the EU-protected habitat 91E0 Alluvial forests (alluvial riverside and floodplain forests), provided that mitigation measures are implemented. These measures include biotechnical management actions for species and habitat conservation within the “Krēmeri” nature reserve.

On 27 December 2024, a letter was received from the State Forest Service, reference No. CVM.7-1/2851, titled 'On Infrastructure Development in the Northern Part of Kundziņsala,' outlining the procedure that must be followed in order to deforest the existing forest areas.

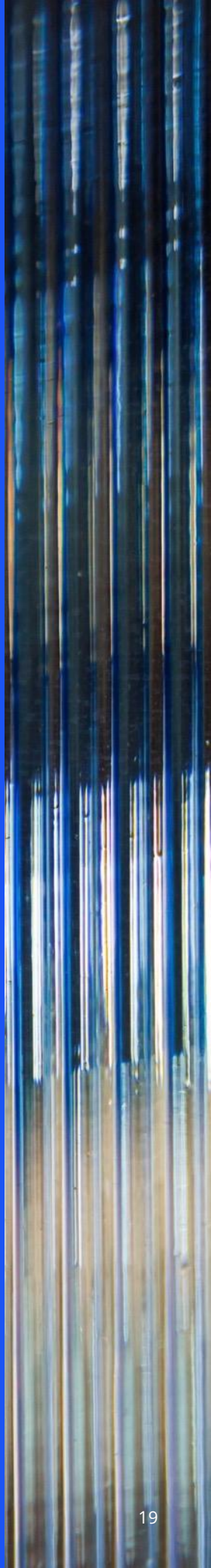
Encumbrances and restrictions

Development territory is not registered in the Register of potentially polluted sites

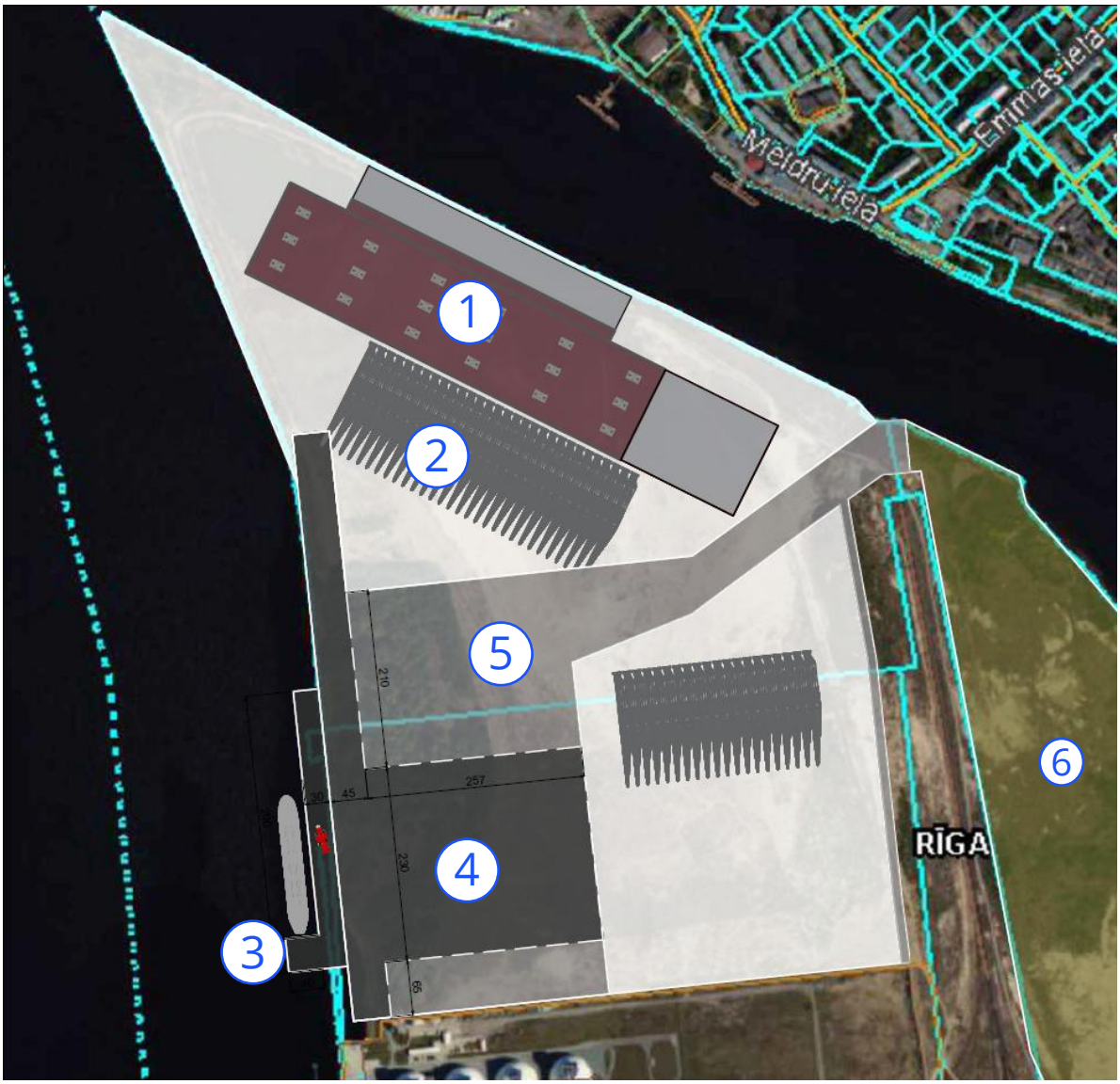
There is no construction documentation registered for the development territory in the Construction Information System (BIS)

Maximum permissible environmental noise levels (in the adjacent residential development area): 65 dBA during the day, 60 dBA in the evening, and 55 dBA at night.

Territory and port infrastructure development concept



Development Scenario for Wind Turbine Blades



1 – Wind Turbine Blades factory
(length – 500 m; width – 120 m; height – 25 m)

2 – Blades storage area

3 – Quay with Ro-Ro ramp

4 – Cargo logistics area with a load-bearing capacity of 60 t/m² is recommended, though not required, as other scenarios may also provide this capacity

5 – Cargo logistics area (25 t/m²)

6 – Potential development area

Development Scenario for Wind Turbine Blades

1 – Wind Turbine Blades factory
(length – 500 m; width – 120 m; height – 25 m)

2 – Blades storage area

3 – Quay with Ro-Ro ramp

4 – Cargo logistics area with a load-bearing capacity of 60 t/m² is recommended, though not required, as other scenarios may also provide this capacity

5 – Cargo logistics area (25 t/m²)

6 – Potential development area

In all scenarios, the same Freeport logistics area and infrastructure are assumed in order to avoid favoring any specific manufacturing process mentioned in the report. However, one alternative scenario involves the production of blades and towers components, where the cargo logistics infrastructure and quay is planned with lower load-bearing capacity (see page 54). This solution should be evaluated in due time, with the final decision made during the design stage.

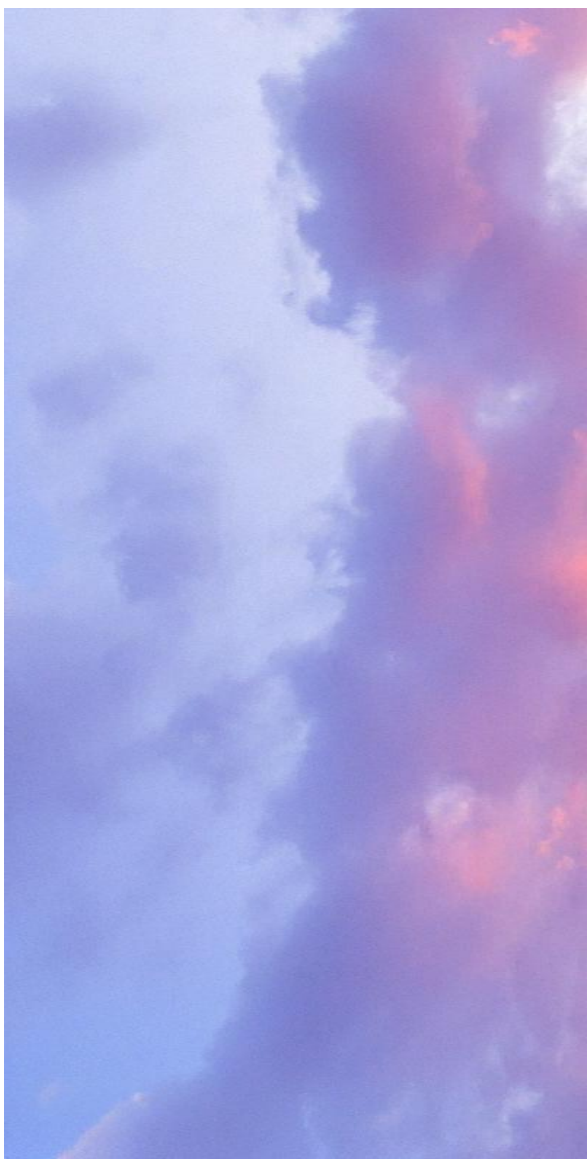
Development Scenario for Wind Turbine Blades

The purpose of this scenario is to provide a Site Developer with requirements in terms of load cases related to storage and transport of WTG Blades and ancillary components. It applies for the design of a greenfield Installation Harbour and/or Cargo logistic Areas.

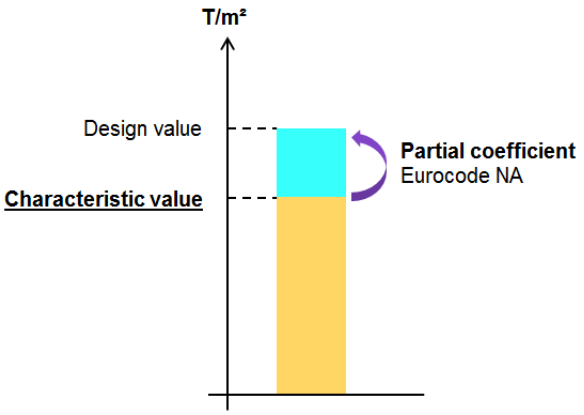
Load cases specified in this scenario are based on assumptions for current and future offshore WTG Blades.

This specification covers some typical large transport means except crawler cranes, which are project specific.

Values are minimum requirements and correspond to baseline. The Site Developer is free to assess and decide whether it is relevant to prepare the site and/or Infrastructure for higher bearing capacities.



Development Scenario for Wind Turbine Blades



Applicable References And Norms

Eurocode EN 1997-1 Geotechnical design

Part 1: General rules.

National Annex EN 1997-1 Table A.3.

In addition to the specifications and requirements expressed in this document, infrastructures, storage areas and installation harbour areas shall comply with all applicable local and European regulations, laws, codes, norms and standards.

Safety Factors

Unless otherwise stated, values provided in this document by are characteristic values and do not include any partial coefficient: neither for the self-weight limit states nor for the variable limit states (wind loads, transport load cases).

Based on its experience and knowledge, the Site Developer shall select applicable partial coefficients to design the Infrastructure according to the Eurocode.

Load Spreading Solutions

If some of the load requirements jeopardize the feasibility of the Installation Harbour and/or Cargo logistic Areas Infrastructure, solutions to improve the load spreading into the ground could be foreseen by the Site Developer.

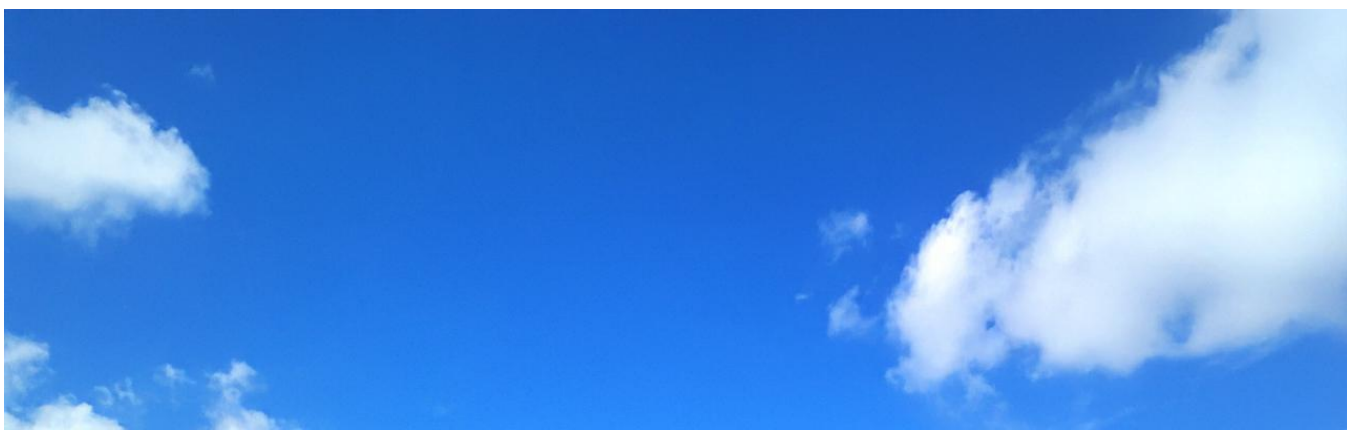
The efficiency of these spreading solutions is highly dependent on the type of ground it is placed on. They have a greater effect on compact grounds than on solid grounds.

These solutions shall be discussed and agreed to be compatible with operational constraints (such as: max. spreader dimensions and/or type of material).

The contractor shall cover the needs of load spreading in areas which have had no contracted work performed to it.

Existing solutions to improve the load spreading into the ground are for example:

- timber mats,
- steel plates,
- layer of gravel



Blades storage

Blades are stored on supports as shown below

- a support located at the root end
- a support located towards the tip end whose position depends on the blade length. Tip end supports for current blades, is typically between 50m and up to 75m measured from root end.

Blade storage supports evolve over time along WTG platform development.

The Infrastructure shall be compatible with the design load case provided in below table: blade supports configuration and the associated expected pressures related to the scales illustrated below.

Local pressure under blade storage supports (25t/m2 point load)

Pre-assembly and storage areas – Ground pressure (σ)

Area	Component	Weight (t)	Baseline ground pressure σ^{bas} (t/m²)	Spreading measure for baseline
Storage	Blade	83	25	steel plate

Blade transport

Blades are transported with a blade mover system made of:

- a remote-controlled mover driven by a load carrier at the root-end;
- a remote-controlled dolly vehicle underneath the tip end;
- both root and tip end remote controlled dollies connect to each other and act as a unit once underway.

The Blade mover design evolves over time along WTG platform development.

The Infrastructure shall be compatible with the design load case provided in below table.

Blade movers operate with max slope of 1% and with nothing higher than 0.5m across its length, anywhere on the site make up, due to belly and proximity to the ground.

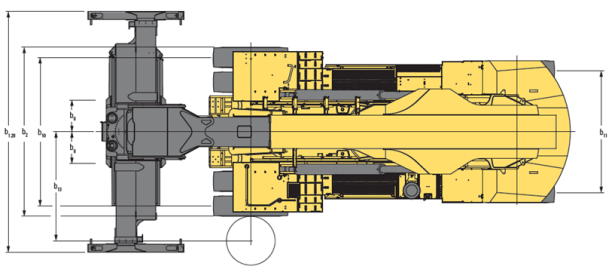
Description	Metric	Imperial
Service weight	35,000 kg	77,175 lbs
Payload	61,667 kg	135,976 lbs
Contact load	96,667 kg	213,151 lbs
Axle load frontal mode	48,334 kg	106,575 lbs
Per wheel assy	24,167 kg	53,288 lbs
Per wheel load	12,083 kg	26,644 lbs
Contact area	1,660 cm2	3,660 cm
Ground pressure	**7.28 kg/cm2**	**16.05 lb/cm2**
ROOT LOAD	61,667 kg	135,976 lbs
Axle loading	48,334 kg	106,575 lbs
Wheel loading	24,167 kg	53,288 lbs

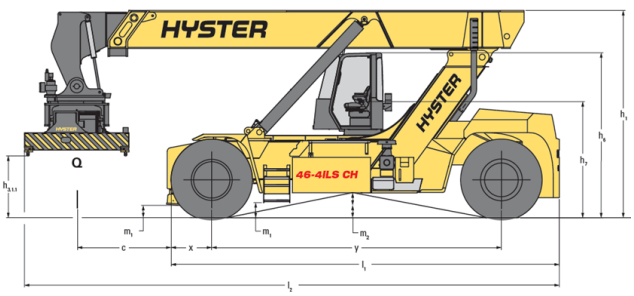
Other transport / logistic

Apart from the Blades components transportation means presented above, other moving equipment might be used on Cargo logistic Areas and Installation Harbour areas, such as but not limited to:

- Mobile and crawler cranes – project specific
- Reach stackers,
- Forklifts,
- Trucks,
- Telehandlers
- Cherry pickers,
- etc.

Reach stacker often used (model varies):

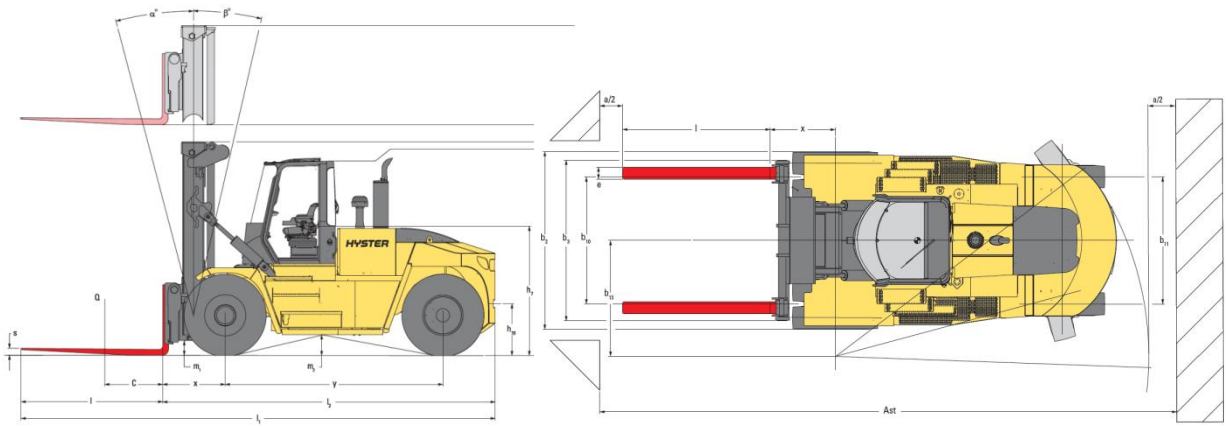




Manufacturer	HYSTER		
Model	RS 46-41S CH		
General	Load capacity at load centre distance c_1 (Q_1)	kg	46,000
	Load capacity at load centre distance c_2 (Q_2)	kg	41,000
	Load capacity at load centre distance c_3 (Q_3)	kg	28,000
	Load centre distance c_1	mm	1,865
	Load centre distance c_2	mm	3,815
	Load centre distance c_3	mm	6,315
Performance	Travel speed with / without load	km/h	21 / 23
Dimensions	Overall lenght (l_1)	mm	8,750
	Wheelbase (y)	mm	6,200
	Overall width across all of truck	mm	4,200
	Tread, front (b_{10})	mm	3,703
	Tread, rear (b_{11})	mm	3,060
Weight	Service weight	kg	83,600
	Axle loading with load, front/rear at c_1	kg	105,400 / 24,200
	Axle loading without load, front/rear at c1	kg	38,700 / 44,900
Wheels	No. Of wheels, front / rear	-	4 / 2
	Tyre size	-	18.00-33 36 PR
Source	www.hyster.com		

Other transport / logistic

Fork lift used currently (model varies)



Manufacturer	HYSTER		
Model	H20XM		
Rated capacity		kg	20 000
Dimensions	Load centre distance (c)	mm	900
	Wheelbase (y)	mm	3 750
	Tread (b10 / b11)	mm	2 100
Driving speed		km/h	0 - 25
Weight	Service weight	kg	29 284
	Axle loading, at rated load front/rear	kg	45 758 / 3 526
	Axle loading, unloaded front/rear	kg	15 000 / 14 285
Wheels	No. of wheels, front / rear	-	4 / 2
	Tyre size		14.00-24 24 PR
Source	www.hyster.com		

Main technical requirements for infrastructure

Requirements	Blade factory
Min. plot size (factory + storage)	40ha
Plant	60.000m2
Optimal outdoor Storage inbound	5ha
Optimal outdoor storage outbound	35ha
Min. plot length and width	L 800m/ W 400m
Plot shape (efficiency)	Rectangular (as much as possible)
Min. building height limitations	25m (manufactory part 1 floor; related auxiliary functions up to 3 floors)
Max. distance from factory to export quay	<0,3km (straight road or there need to be 150m turning radius)
Min. road width for transported goods	W 15m
Access	Unrestricted/ exclusive access to road
Min. load bearing capacity for roads	40t per axle
Min. length, width and depth for quay infrastructure	L 270m/ W 30m/ D 12m (LAT)
Min. baseline ground pressure	25t/m2
Min. availability of export quay	200 days per year
Min. buffering area size at quay side (first/last place of rest)	10.000m2 (200m x 50m)
Min. Lo-Lo quay requirements e.g. weight and load distance	600t/ 2 meter from quay side
Min. channel depth/ width	D 12/ W 55m
Min. ship length/ width allowance	L 210m/ W 33m
Optim. ship turning radius	250m
Max. Crawler crane height	120m

Development Scenario for Wind Turbine Nacelles

1 – Wind Turbine Nacelles factory
(length – 350 m; width – 160 m; height – 40 m)

2 – Nacelles storage area

3 – Quay with Ro-Ro ramp

4 – Cargo logistics area (60 t/m^2)

5 – Cargo logistics area (25 t/m^2)

6 – Potential development area

Development Scenario for Wind Turbine Nacelles

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Development Scenario for Wind Turbine Nacelles

The purpose of this scenario is to provide a Site Developer with requirements in terms of load cases related to storage and transport of WTG Nacelles and ancillary components. It applies for the design of a greenfield Installation Harbour and/or Cargo logistic Areas.

Load cases specified in this scenario are based on assumptions for current and future offshore WTG Nacelles.

This specification covers all the transport means except crawler cranes, which are project specific.

Values are minimum requirements and correspond to baseline. The Site Developer is free to assess and decide whether it is relevant to prepare the site and/or Infrastructure for higher bearing capacities.

Development Scenario for Wind Turbine Nacelles

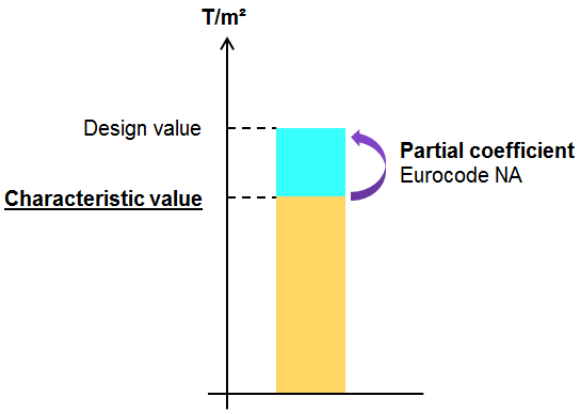
Applicable References And Norms

Eurocode EN 1997-1 Geotechnical design

Part 1: General rules.

National Annex EN 1997-1 Table A.3.

In addition to the specifications and requirements expressed in this document, infrastructures, storage areas and installation harbour areas shall comply with all applicable local and European regulations, laws, codes, norms and standards.



Safety Factors

Unless otherwise stated, values provided in this document by are characteristic values and do not include any partial coefficient: neither for the self-weight limit states nor for the variable limit states (wind loads, transport load cases).

Based on its experience and knowledge, the Site Developer shall select applicable partial coefficients to design the Infrastructure according to the Eurocode.

Load spreading solutions

If some of the load requirements jeopardize the feasibility of the Installation Harbour and/or Cargo logistic Areas Infrastructure, solutions to improve the load spreading into the ground could be foreseen by the Site Developer.

The efficiency of these spreading solutions is highly dependent on the type of ground it is placed on. They have a greater effect on compact grounds than on solid grounds.

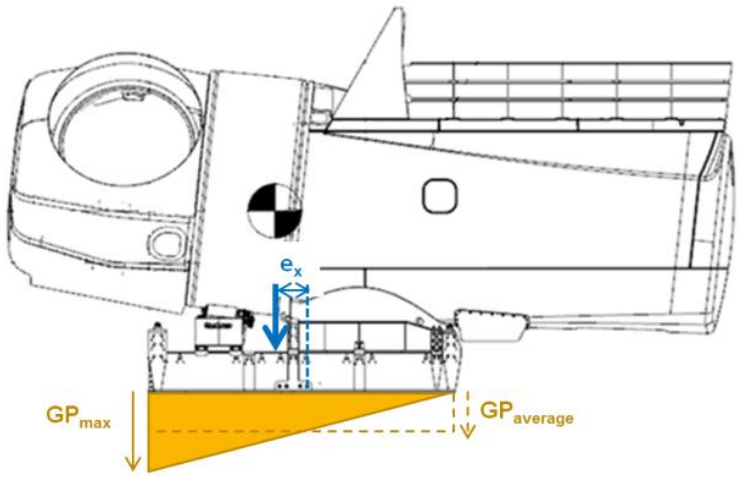
These solutions shall be discussed and agreed to be compatible with operational constraints (such as: max. spreader dimensions and/or type of material).

The contractor shall cover the needs of load spreading in areas which have had no contracted work performed to it.

Existing solutions to improve the load spreading into the ground are for example:

- timber mats,
- steel plates,
- layer of gravel.

Nacelles storage



Nacelles are typically stored on Transport Frames TF's. Below figure gives an overview of a typical TF shape.

The CoG (Center of Gravity) of the system "Nacelle + TF" does not always coincide with the geometric barycenter. As shown in picture the eccentricity of the load results in an overturning moment and the pressure under the TF beams is expected to be triangular.

	Load case	Value	Unit
TF dimensions	Length (L) - CIRCA	10	m
	Width (W) - CIRCA	5	m
	Beam width (b) - CIRCA	0,6	m
Ground pressure	Local scale - point load (GP_{max}) without large spreader blocks	60	t/m²
	Local scale - average ($GP_{average}$) with large spreader blocks	35	t/m²
	Medium scale (LxW)	8	t/m²
	Large scale *(indicative only)*	2.5	t/m²

Typical Nacelles ground pressure and maximum ground inclination

Pre-assembly and storage areas – Ground pressure (σ)

Area	Component	Weight (t)	Baseline ground pressure σ_{bas} (t/m²)	Spreading measure for baseline
Storage	Nacelle on transport Frame + load spread blocks + SPT	1400	60.0	Timber mats or Concrete block footprint
Axle Weight predicted:	1400t with 2 files of 17 axles with 34 axles total = 34t/axle line			
Max Inclination:	3 degrees ~ 5% (Preferred slope for pre-operations and drainage is 1.5% (+/- 0.5%))			

Setup quay infrastructure and storage areas

Minimum site Lighting.

Site (storage) electricity draw of 4000 kW.

Each Nacelle will require circa 150kW 690v supply 125amp + 9kW 400v supply 32amp.

100-200 electrical boards on pillars at the nacelle storage locations (recommend 4 boards per pillar location in storage).

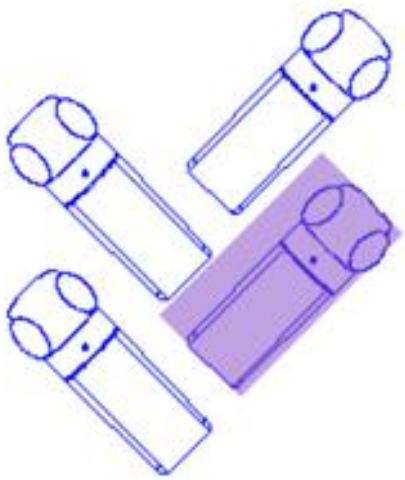
4 x Pillars with Electrical boards at the quay infrastructure.

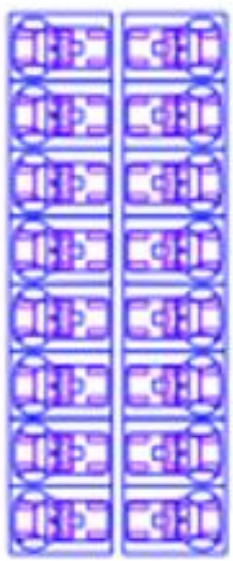
Lighting:

- Site should have a minimum of 5 lux around the storage areas.
- Site should have a minimum of 20 lux around quaysides.

Typical Nacelles storage pattern below:

The method used for positioning nacelles:





Nacelles transport

Nacelles are transported with a Self-Propelled Modular Transporter (SPMT) setup made of multiple SPMT sections:

- Nacelle movements with max slope of 1,5%,
- The infrastructure shall be compatible with the design load cases below:

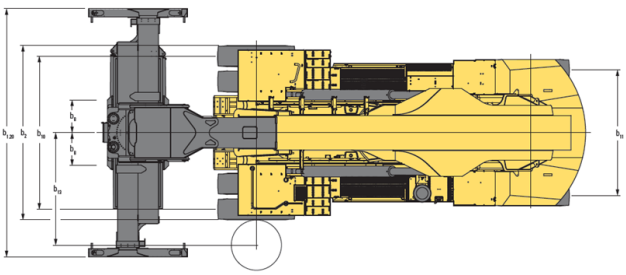
Parameter	Value	Unit
Module width	3	m
Distance between axle lines	1.5	m
Max. number of axle lines	34/36	n/a
Max. number of files	2	n/a
Max. load per axle line	60	t
Medium scale *(characteristic value)*	10	t/m²

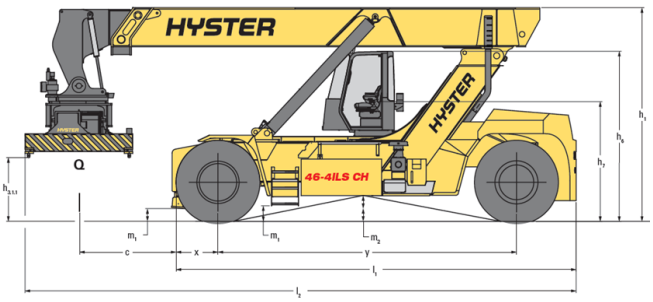
Other transport / logistic

Apart from the Nacelles components transportation means presented above, other moving equipment might be used on Cargo logistic Areas and Installation Harbour areas, such as but not limited to:

- Mobile and crawler cranes – project specific
- Reach stackers,
- Forklifts,
- Trucks,
- Telehandlers
- Cherry pickers,
- etc.

Reach stacker often used (model varies):

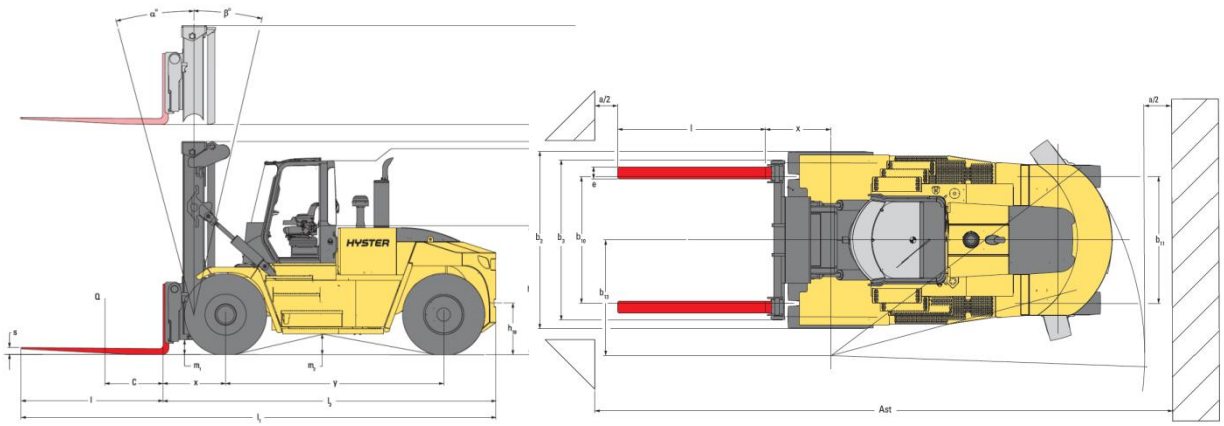




Manufacturer	HYSTER		
Model	RS 46-41S CH		
General	Load capacity at load centre distance c_1 (Q_1)	kg	46,000
	Load capacity at load centre distance c_2 (Q_2)	kg	41,000
	Load capacity at load centre distance c_3 (Q_3)	kg	28,000
	Load centre distance c_1	mm	1,865
	Load centre distance c_2	mm	3,815
	Load centre distance c_3	mm	6,315
Performance	Travel speed with / without load	km/h	21 / 23
Dimensions	Overall lenght (l_1)	mm	8,750
	Wheelbase (y)	mm	6,200
	Overall width across all of truck	mm	4,200
	Tread, front (b_{10})	mm	3,703
	Tread, rear (b_{11})	mm	3,060
Weight	Service weight	kg	83,600
	Axle loading with load, front/rear at c_1	kg	105,400 / 24,200
	Axle loading without load, front/rear at c1	kg	38,700 / 44,900
Wheels	No. Of wheels, front / rear	-	4 / 2
	Tyre size	-	18.00-33 36 PR
Source	www.hyster.com		

Other transport / logistics

Fork lift used currently (model varies)



Manufacturer	HYSTER		
Model	H20XM		
Rated capacity		kg	20 000
Dimensions	Load centre distance (c)	mm	900
	Wheelbase (y)	mm	3 750
	Tread (b10 / b11)	mm	2 100
Driving speed		km/h	0 - 25
Weight	Service weight	kg	29 284
	Axle loading, at rated load front/rear	kg	45 758 / 3 526
	Axle loading, unloaded front/rear	kg	15 000 / 14 285
Wheels	No. of wheels, front / rear	-	4 / 2
	Tyre size		14.00-24 24 PR
Source	www.hyster.com		

Main technical requirements for infrastructure

Requirements	Nacelles factory
Min. plot size (factory + storage)	15ha
Plant	45.000m2
Optimal outdoor Storage inbound	20ha (based on 4wks stock)
Optimal outdoor storage outbound	15ha (150 Nacelles) / 20ha for 200 Nacelles
Min. plot length and width	L 300m/ W 200m
Plot shape (efficiency)	Rectangular (as much as possible)
Min. building height limitations	40m (manufactory part 1 floor; related auxiliary functions up to 3 floors)
Max. distance from factory to export quay	<0,3km (straight road)
Min. road width for transported goods	W 15m
Access	Unrestricted/ exclusive access to road
Min. load bearing capacity for roads	40t per axle
Min. length, width and depth for quay infrastructure	L 270m/ W 30m/ D 12m (LAT)
Min. baseline ground pressure	60t/m2
Min. availability of export quay	100 days per year
Min. buffering area size at quay side (first/last place of rest)	5.000m2
Min. Lo-Lo quay requirements e.g. weight and load distance	750t/ 2 meters from quay side
Min. channel depth/ width	D 12/ W 55m
Min. ship length/ width allowance	L 210m/ W 33m
Optim. ship turning radius	250m
Max. Crawler crane height	120m

Development Scenario for Wind Turbine Towers

1 – Wind Turbine Towers factory
(length – 350 m; width – 120 m; height – 25 m)

2 – Towers storage area

3 – Quay with Ro-Ro ramp

4 – Cargo logistics area with a load-bearing capacity of 60 t/m² is recommended, though not required, as other scenarios may also provide this capacity

5 – Cargo logistics area (25 t/m²)

6 – Potential development area

Development Scenario for Wind Turbine Towers

1 – Wind Turbine Towers factory
(length – 350 m; width – 120 m; height – 25 m)

2 – Towers storage area

3 – Quay with Ro-Ro ramp

4 – Cargo logistics area with a load-bearing capacity of 60 t/m² is recommended, though not required, as other scenarios may also provide this capacity

5 – Cargo logistics area (25 t/m^2)

6 – Potential development area

In all scenarios, the same Freeport logistics area and infrastructure are assumed in order to avoid favoring any specific manufacturing process mentioned in the report. However, one alternative scenario involves the production of blades and towers components, where the cargo logistics infrastructure and quay is planned with lower load-bearing capacity (see page 54). This solution should be evaluated in due time, with the final decision made during the design stage.

Development Scenario for Wind Turbine Towers

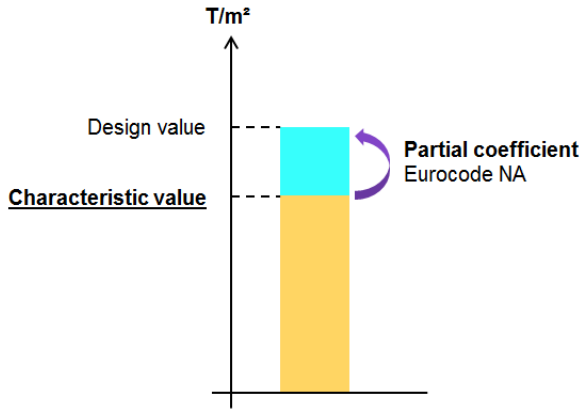
The purpose of this scenario is to provide a Site Developer with requirements in terms of load cases related to storage and transport of WTG Steel Towers and ancillary components. It applies for the design of a greenfield Installation Harbour and/or Cargo logistic Areas.

Load cases specified in this scenario are based on assumptions for current and future offshore WTG Steel Towers.

This specification covers all the transport means except crawler cranes, which are project specific.

Values are minimum requirements and correspond to baseline. The Site Developer is free to assess and decide whether it is relevant to prepare the site and/or Infrastructure for higher bearing capacities.

Development Scenario for Wind Turbine Towers



Applicable References And Norms

Eurocode EN 1997-1 Geotechnical design

Part 1: General rules.

National Annex EN 1997-1 Table A.3.

In addition to the specifications and requirements expressed in this document, infrastructures, storage areas and installation harbour areas shall comply with all applicable local and European regulations, laws, codes, norms and standards.

Safety Factors

Unless otherwise stated, values provided in this document by are characteristic values and do not include any partial coefficient: neither for the self-weight limit states nor for the variable limit states (wind loads, transport load cases).

Based on its experience and knowledge, the Site Developer shall select applicable partial coefficients to design the Infrastructure according to the Eurocode.

Load spreading solutions

If some of the load requirements jeopardize the feasibility of the Installation Harbour and/or Cargo logistic Areas Infrastructure, solutions to improve the load spreading into the ground could be foreseen by the Site Developer.

The efficiency of these spreading solutions is highly dependent on the type of ground it is placed on. They have a greater effect on compact grounds than on solid grounds.

These solutions shall be discussed and agreed to be compatible with operational constraints (such as: max. spreader dimensions and/or type of material).

The contractor shall cover the needs of load spreading in areas which have had no contracted work performed to it.

Existing solutions to improve the load spreading into the ground are for example:

- timber mats,
- steel plates,
- layer of gravel.

Towers storage

Towers are stored on supports as shown below supports located at each root end.

The Infrastructure shall be compatible with the design load case provided below:

towers supports configuration and the associated expected pressures related to the scales illustrated below.

Local pressure under towers storage supports (25t/m2 point load).

Towers storage areas – Ground pressure (σ)

Area	Component	Weight (t)	Baseline ground pressure σ_{bas} (t/m²)	Spreading measure for baseline
Storage	Towers	100	25	Timber mats or Concrete block footprint
Max Inclination:	Preferred slope for operations and drainage is 1.5% (+/- 0.5%)			

Towers transport

Towers are transported with a different systems made of:

- a remote controlled mover driven by a load carrier at each end.
- a SPMT.

The Infrastructure shall be compatible with the design load case provided in below table.

Towers movers operate with max slope of 1,5% and with nothing higher than 0.5m across its length, anywhere on the site make up, due to belly and proximity to the ground.

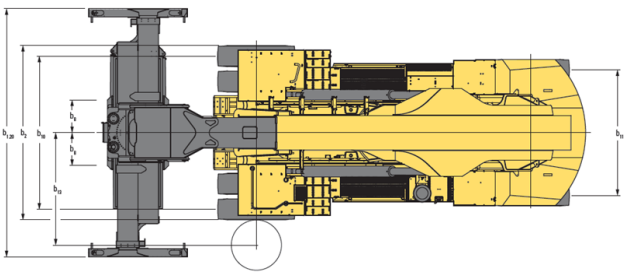
Description	Metric	Imperial
Service weight	35,000 kg	77,175 lbs
Payload	61,667 kg	135,976 lbs
Contact load	96,667 kg	213,151 lbs
Axle load frontal mode	48,334 kg	106,575 lbs
Per wheel assy	24,167 kg	53,288 lbs
Per wheel load	12,083 kg	26,644 lbs
Contact area	1,660 cm2	3,660 cm
Ground pressure	**7.28 kg/cm2**	**16.05 lb/cm2**
ROOT LOAD	61,667 kg	135,976 lbs
Axle loading	48,334 kg	106,575 lbs
Wheel loading	24,167 kg	53,288 lbs

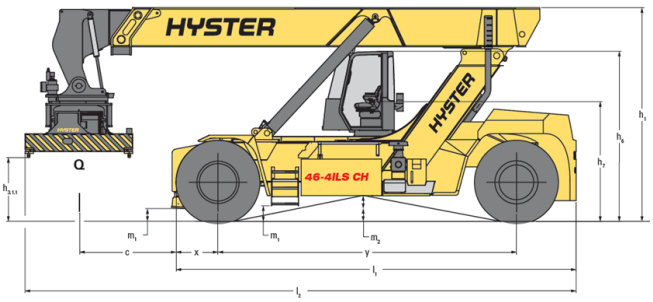
Other transport / logistics

Apart from the Towers components transportation means presented above, other moving equipment might be used on Cargo logistic Areas and Installation Harbour areas, such as but not limited to:

- Mobile and crawler cranes – project specific
- Reach stackers,
- Forklifts,
- Trucks,
- Telehandlers
- Cherry pickers,
- etc.

Reach stacker often used (model varies):

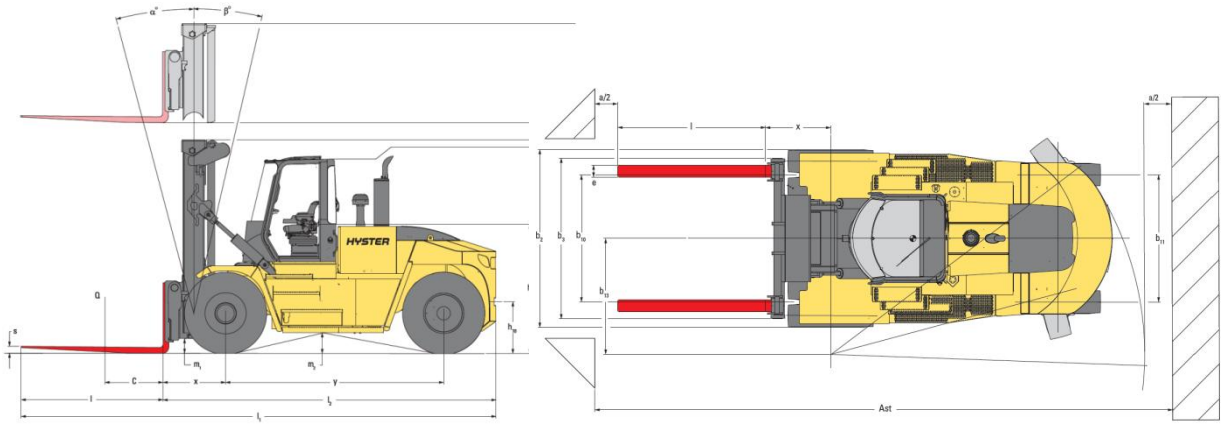




Manufacturer	HYSTER		
Model	RS 46-41S CH		
General	Load capacity at load centre distance c_1 (Q_1)	kg	46,000
	Load capacity at load centre distance c_2 (Q_2)	kg	41,000
	Load capacity at load centre distance c_3 (Q_3)	kg	28,000
	Load centre distance c_1	mm	1,865
	Load centre distance c_2	mm	3,815
	Load centre distance c_3	mm	6,315
Performance	Travel speed with / without load	km/h	21 / 23
Dimensions	Overall lenght (l_1)	mm	8,750
	Wheelbase (y)	mm	6,200
	Overall width across all of truck	mm	4,200
	Tread, front (b_{10})	mm	3,703
	Tread, rear (b_{11})	mm	3,060
Weight	Service weight	kg	83,600
	Axle loading with load, front/rear at c_1	kg	105,400 / 24,200
	Axle loading without load, front/rear at c1	kg	38,700 / 44,900
Wheels	No. Of wheels, front / rear	-	4 / 2
	Tyre size	-	18.00-33 36 PR
Source	www.hyster.com		

Other transport / logistics

Fork lift used currently (model varies)



Manufacturer	HYSTER		
Model	H20XM		
Rated capacity		kg	20 000
Dimensions	Load centre distance (c)	mm	900
	Wheelbase (y)	mm	3 750
	Tread (b10 / b11)	mm	2 100
Driving speed		km/h	0 - 25
Weight	Service weight	kg	29 284
	Axle loading, at rated load front/rear	kg	45 758 / 3 526
	Axle loading, unloaded front/rear	kg	15 000 / 14 285
Wheels	No. of wheels, front / rear	-	4 / 2
	Tyre size		14.00-24 24 PR
Source	www.hyster.com		

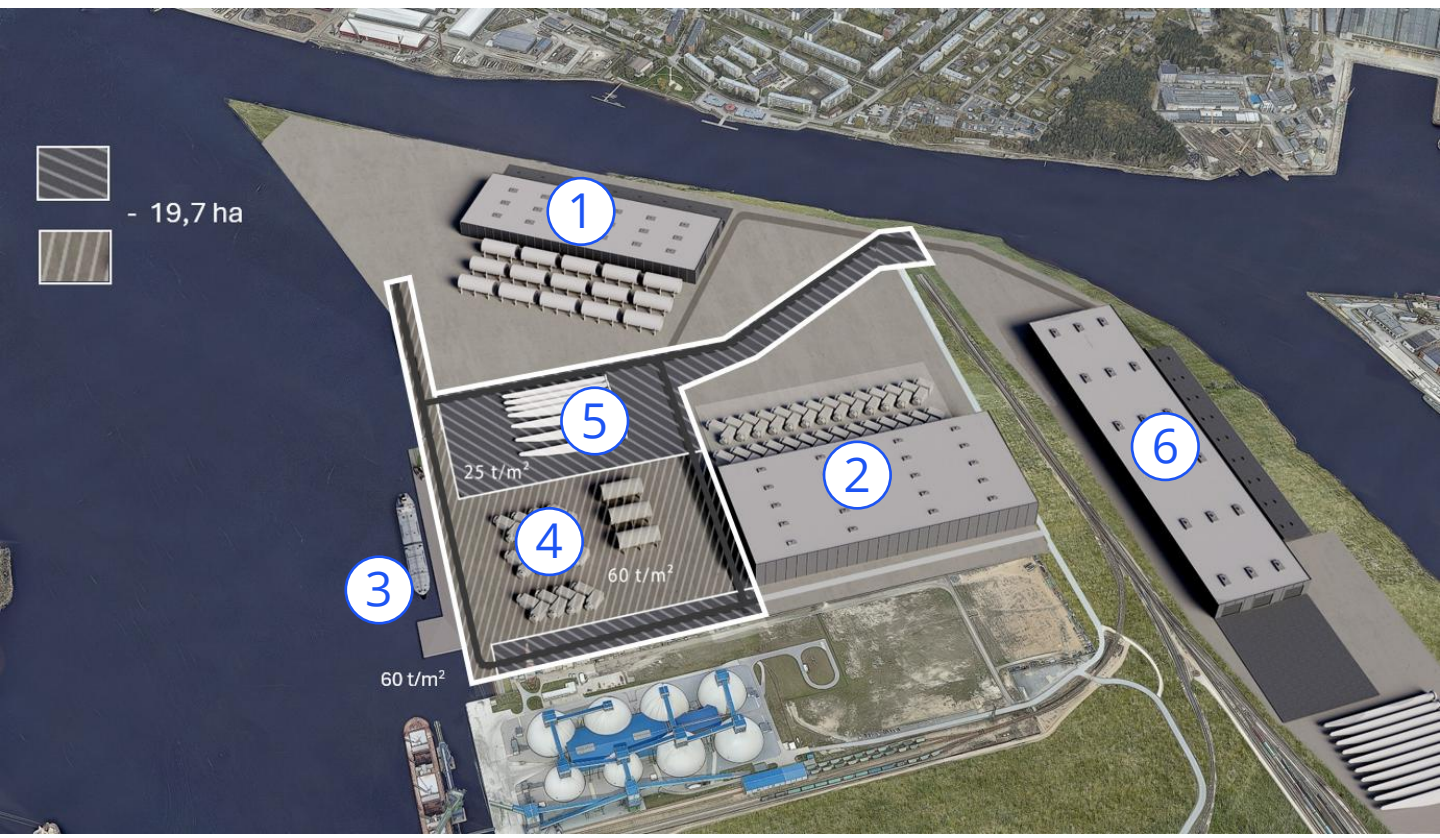
Main technical requirements for infrastructure

Requirements	Tower factory
Min. plot size (factory + storage)	15ha
Plant	35.000m2
Optimal outdoor storage inbound	15ha (based on 4wks stock)
Optimal outdoor storage outbound	15ha (150 Towers) – 20ha for 200 Towers
Min. plot length and width	L 300m/ W 200m
Plot shape (efficiency)	Rectangular (as much as possible)
Min. building height limitations	25m (manufactory part 1 floor; related auxiliary functions up to 3 floors)
Max. distance from factory to export quay	<0,3km (straight road)
Min. road width for transported goods	W 15m
Access	Unrestricted/ exclusive access to road
Min. load bearing capacity for roads	40t per axle
Min. length, width and depth for quay infrastructure	L 270m/ W 30m/ D 12m (LAT)
Min. baseline ground pressure	25t/m2
Min. availability of export quay	100 days per year
Min. buffering area size at quay side (first/last place of rest)	5.000m2
Min. Lo-Lo quay requirements e.g. weight and load distance	750t/ 2 meters from quay side
Min. channel depth/ width	D 12/ W 55m
Min. ship length/ width allowance	L 210m/ W 33m
Optim. ship turning radius	250m
Max. Crawler crane height	300m

Main infrastructure requirements for all scenarios

Requirements	Towers factory	Nacelle factory	Blade factory
Min. plot size (factory + storage)	15ha	15ha	40ha
Plant	35.000m2	45.000m2	60.000m2
Optimal outdoor Storage inbound	15ha (based on 4wks stock)	20ha (based on 4wks stock)	5ha
Optimal outdoor storage outbound	15ha (150 Towers) – 20ha for 200 Towers	15ha (150 Nacelles) – 20ha for 200 Nacelles	35ha
Min. plot length and width	L 300m/ W 200m	L 300m/ W 200m	L 800m/ W 400m
Plot shape (efficiency)	Rectangular (as much as possible)	Rectangular (as much as possible)	Rectangular (as much as possible)
Min. building height limitations	25m (manufactory part 1 floor; related auxiliary functions up to 3 floors)	40m (manufactory part 1 floor; related auxiliary functions up to 3 floors)	25m (manufactory part 1 floor; related auxiliary functions up to 3 floors)
Max. distance from factory to export quay	<0,3km (straight road)	<0,3km (straight road)	<0,3km (straight road or there need to be 150m turning radius)
Min. road width for transported goods	W 15m	W 15m	W 15m
Access	Unrestricted/ exclusive access to road	Unrestricted/ exclusive access to road	Unrestricted/ exclusive access to road
Min. load bearing capacity for roads	40t per axle	40t per axle	40t per axle
Min. length, width and depth for quay infrastructure	L 270m/ W 30m/ D 12m (LAT)	L 270m/ W 30m/ D 12m (LAT)	L 270m/ W 30m/ D 12m (LAT)
Min. baseline ground pressure	25t/m2	60t/m2	25t/m2
Min. availability of export quay	100 days per year	100 days per year	200 days per year
Min. buffering area size at quay side (first/last place of rest)	5.000m2	5.000m2	10.000m2 (200m x 50m)
Min. Lo-Lo quay requirements e.g. weight and load distance	750t/ 2 meters from quay side	750t/ 2 meters from quay side	600t/ 2 meter from quay side
Min. channel depth/ width	D 12/ W 55m	D 12/ W 55m	D 12/ W 55m
Min. ship length/ width allowance	L 210m/ W 33m	L 210m/ W 33m	L 210m/ W 33m
Optim. ship turning radius	250m	250m	250m
Max. Crawler crane height	300m	120m	120m

Development Scenario for Combined Manufacturing Processes



1 – Wind Turbine Towers factory
(length – 350 m; width – 120 m; height – 25 m)

2 – Wind Turbine Nacelles factory
(length – 350 m; width – 160 m; height – 40 m)

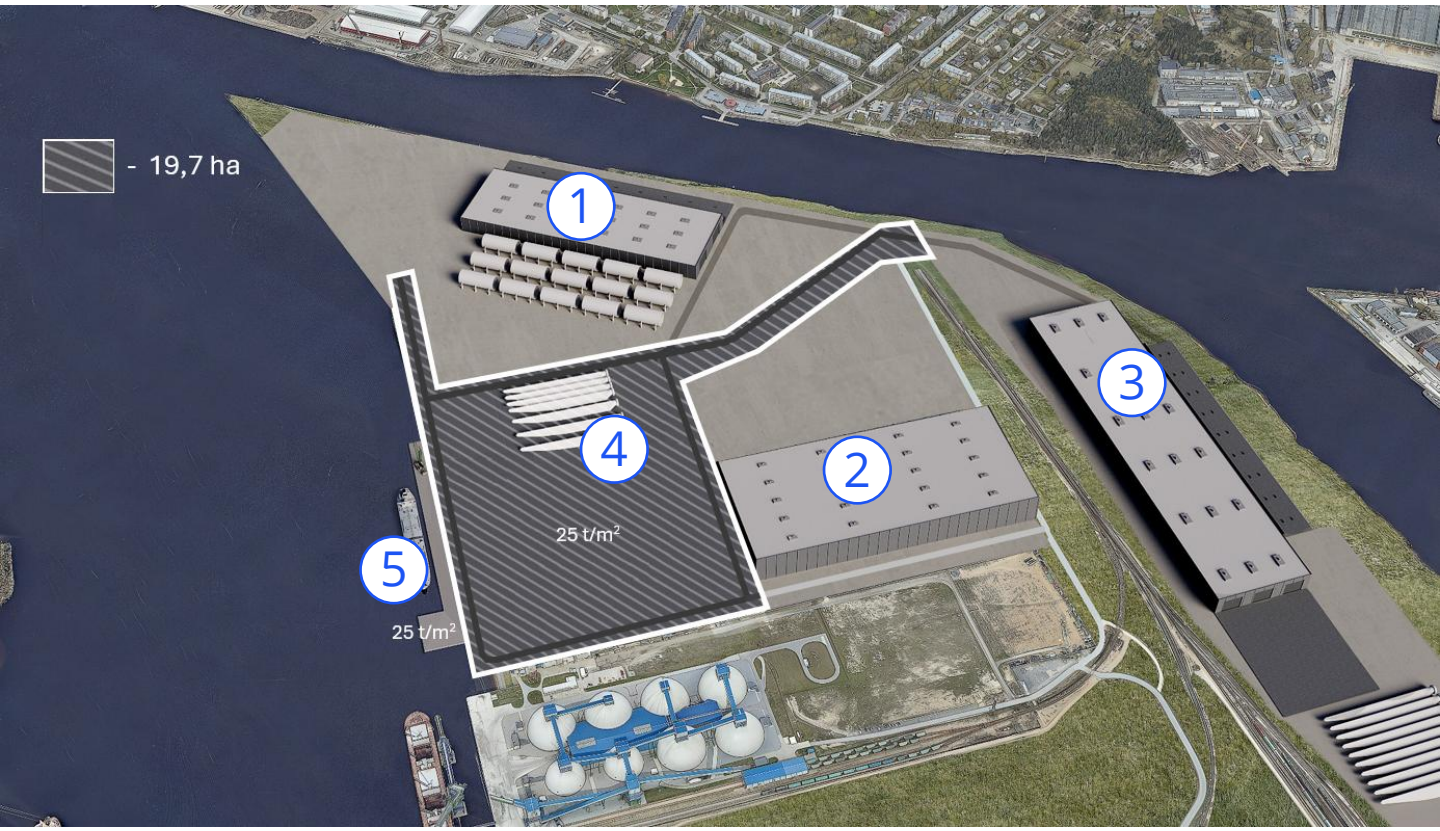
3 – Quay with Ro-Ro ramp

4 – Cargo logistics area with a load-bearing capacity of 60 t/m²

5 – Cargo logistics area (25 t/m²)

6 – Wind Turbine Blades factory
(length – 500 m; width – 120 m; height – 25 m)

Development Scenario of two Manufacturing Processes (Blades and Towers)



1, 2, 3 – Available lease land (approximately 90 hectares in total are designated for development, of which approximately 70 hectares of land are available for lease (1. - 26,8 ha; 2. - 15,9 ha; 3. – 27,7 ha)

4 – Cargo logistic area (25 t/m²)*

5 – Quay with Ro-Ro ramp (25 t/m²)*

** Theoretical load-bearing capacities for blades and towers manufacturing scenarios (excluding the possibility of nacelles production) have been set at a minimum of 25 t/m² for the cargo logistics zone and quay. This solution should be evaluated in due time, with the final decision made during the design stage.*

Quay for Lo-Lo

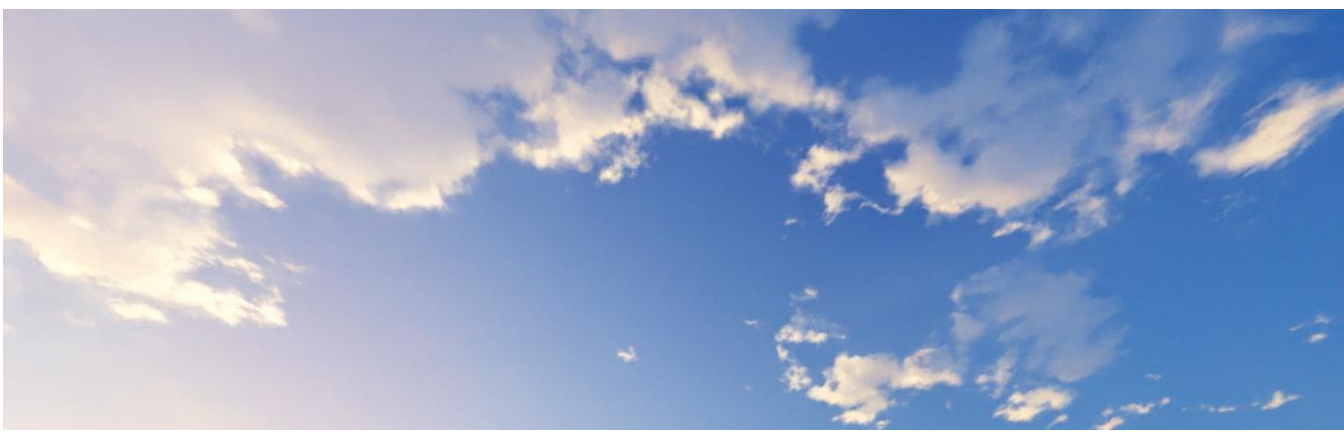
The purpose of this section is to provide a Site Developer with the minimum requirements for a Lo-Lo (Lift on – Lift Off) quay, to facilitate the loading and offloading operations of Lo-Lo vessels.

Requirements specified in this section are based on generic assumptions for Lo-Lo vessels suitable for transportation of current offshore wind turbines and on our best assumptions regarding future wind turbine generations.

This specification covers general requirements for Lo-Lo transportation activities conducted by wind turbine component handling

A Lo-Lo Facility is an infrastructure where load-in and load out activities take place to fulfil multiple logistic operations, including but not limited to:

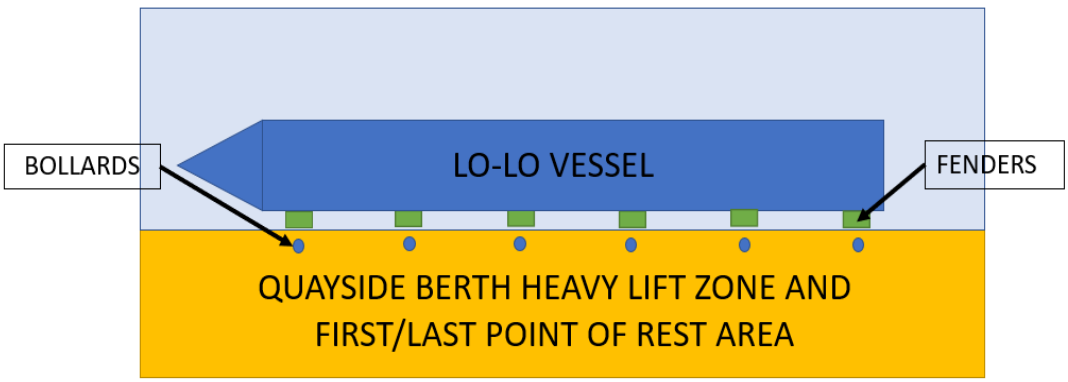
- Import and export WTG components: nacelles, blades, tower sections, etc.
- Import inbound material and goods: bed frames, raw hubs, etc.
- Import and export transportation frames, spare parts, tools and equipment, etc.



Quay for Lo-Lo

A Lo-Lo Facility and the associated environment can be split into different entities as presented below:

- A quay (the "**Lo-Lo quay**", in orange) where Lo-Lo vessels are moored and serviced. This quay will also be used for storage of components awaiting Lo-Lo operations;
- A temporary cargo logistic area (the "**First / Last Place of Rest**") where components are stored on the short-term (typically over a day, during vessel loading operations). This area is used to streamline loading activities: mount and dismount lashing equipment, quality inspection, guarantee short driving distances to vessel logistic teams, accelerate loading operations, etc.;
- A long-term cargo logistic area (the "**Cargo logistic Area**") where components are stored on the long-term, for instance prior to shipment or part of production. This area shall be located in the vicinity of the Lo-Lo quay infrastructure;
- Fenders and Bollards will be positioned as required long the face of the quay infrastructure as shown and at intervals.



Quay for Lo-Lo

Infrastructure bearing capacity

The Site Developer shall ensure the ground bearing capacity is compatible anywhere on each area, with all load cases applicable as per Table below

No.	Load Cases	LoLo Quay	First Place of Rest	Cargo logistic area
Storage				
1	Nacelle	X(*)	X	X
2	Blades	X(*)	X	X
3	Generators	X(*)	X	X
4	Nacelle Components	X(*)	X	X
Transport				
5	Nacelle on SPT	X	X	X
6	Blade on Blade Mover	X	X	X
7	Components on SPT	X	X	X
8	Components on Mafi Trailers	X	X	X
Others				
9	Forklift 12t	X	X	X
10	Forklift 20t	X	X	X
11	Reach Stacker 70t	X	X	X

** Long term storage of WTG components is not planned on the Lo-Lo quay itself. However, this infrastructure shall be dimensioned to bear the weight of these components over a short period (presentation to vessel crane or removal to storage).*

Quay for Lo-Lo

The Site Developer shall ensure the Lo-Lo quay infrastructure shall comply with following requirements:

Lo-Lo quay infrastructure characteristics

- Complete quay Dimension – from 270m, recommended 290m.
- Heavy Lift Zone 250m x 40m.
- Minimum water depth at 13,5m along quayside.
- Heavy lift area will be required to support a point load of 60t/m2 or greater.
- A minimum of 4 Nacelles should be able to be supported at any one time at the quayside 1 meter from the quay wall.
- Fresh Water – 200m3 per day acceptable.
- Fire Hydrants (Minimum European standard for supply) – 2 x Hydrants along quay.
- Under Keel Clearance (UKC): min.1m.
- Water depth: min. 13,5 m/LAT.
- Tidal range acceptable for vessel ballast system: max. 3,5 m.
- Relative movements between vessel and quay: max. ±50mm.
- Material: concrete or steel.
- Settlement of no more than 10cm per year for 2 years. Cranes must be considered in the settlement criteria.
- The Heavy lift zone must be as near as possible to being flat and even for the cranes to operate.
- Maximum slope during driving to the quayside: +/-1°.
- Site Developers must pay particular attention to the quay wall surcharge capabilities.

Quay for Lo-Lo

The Site Developer shall ensure the Lo-Lo quay infrastructure shall comply with following requirements:

Furniture

The Lo-Lo Quay shall be equipped with:

- 150 tons mooring bollards every 25m along Lo-Lo Quay;
- Energy absorbing fitted fenders every 25m. Allowable hull pressure: maximum 100t/m²;
- 4 x Electrical hock up Pillars will be located centrally at the quay infrastructure to power the waiting Nacelles;
- Each Nacelle will require 150kW 400v or 690v supply 125amp + 9kW 400v supply 32amp;
- Cold ironing infrastructure is not foreseen.

Quay for Lo-Lo

The Site Developer shall ensure the Lo-Lo quay infrastructure shall comply with following requirements:

First place of rest

To optimize loading and unloading operations, the Site Developer shall make available an area of minimum 250mx40m. adjacent quay (the "First Place of Rest").

The Site Developer shall ensure the ground bearing capacity is compatible with all load cases listed in Table.

Cargo logistic areas

Near the Shore Ramp and First Place of Rest, the Site Developer shall make available larger cargo logistic areas (the "Cargo logistic Areas").

For storage capacity as first approach, below table provides an estimate of the surface required per type of component to store around 6 WTGs, as stated 250m x 40m will be made available where positioning the Nacelles and component pieces as required for the receipt or load out of the vessels.

Components	Surface area required for storage (m^2)
6 nacelles	3000
40 Containers	4000

Road access and egress

The Lo-Lo Facility shall be accessible and available for use 24/7.

Cargo logistic Areas shall be accessible directly from the First Place of Rest.

Road access to and from the quay infrastructure shall be suitable for heavy load transports, in particular:

- Clear width: minimum 12m.
- Clear height: no restriction below 15m.
- Bearing capacity sufficient for minimum axle loads of 40t/axle (SPMT for WTG transport).

Lighting

The Site Developer shall ensure lighting system complies with below requirements:

- Local standards and regulations for all areas, with proper illumination level to operate safely.
- Minimum 20 lux over the Lo-Lo quay infrastructure.

Visibility

The Lo-Lo facility shall be located in an open area with good access and visibility, swept paths for turning shall be easy to use and free from obstructions.

Quay with Ro-Ro ramp

The purpose of the section is to provide a Site Developer with the minimum requirements for a Ro-Ro (Roll on – Roll Off) quay, to facilitate the loading and offloading operations of Ro-Ro vessels.

Requirements specified in this section are based on generic assumptions for Ro-Ro vessels suitable for transportation of current offshore wind turbines and on our best assumptions regarding future wind turbine generations.

This specification covers general requirements for Ro-Ro transportation activities conducted by wind turbine component handling

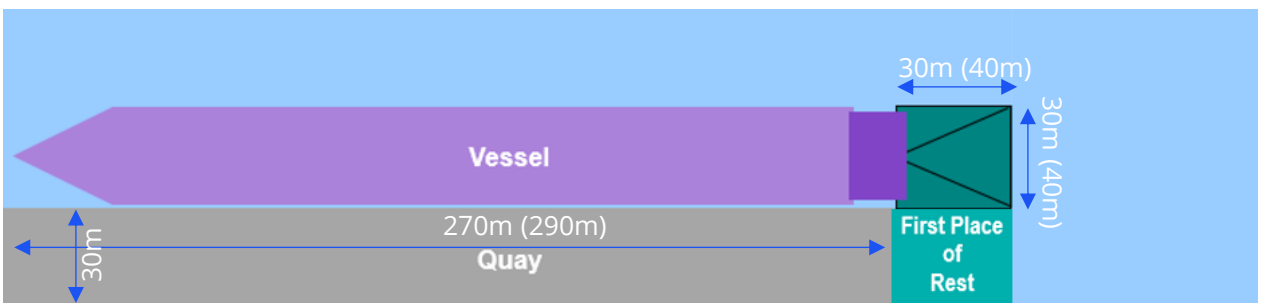
A Ro-Ro Facility is an infrastructure operated where load-in and load out activities take place to fulfill multiple logistic operations, including but not limited to:

- Import and export WTG components: nacelles, generators, tower sections, blades, etc.
- Import inbound material and goods: bed frames, raw hubs, etc.
- Import and export transportation frames, spare parts, tools and equipment, etc.

Quay with Ro-Ro ramp

A Ro-Ro Facility and the associated environment can be split into different entities as presented below:

- A quay (the "Ro-Ro Quay", in grey) where Ro-Ro vessels are moored and serviced. This quay might also be used for storage of components and Lo-Lo operations in case the vessel offers combined loading solutions.
- A land based ramp (the "Ro-Ro Shore Ramp", in dark green on below figure where hatches of Ro-Ro vessels are laid down to get access to the vessel cargo with wheel based transport systems.
- The optimal size of the Quay is 270 meters, while the recommended size is 290 meters.
- A temporary cargo logistic area (the "First Place of Rest") where components are stored on the short-term (typically over a day, during vessel loading operations). This area is used to streamline loading activities: mount and dismount lashing equipment, quality inspection, guarantee short driving distances to vessel logistic teams, accelerate loading operations, etc. This area shall be adjacent to the Ro-Ro Shore Ramp.
- A long term cargo logistic area (the "Cargo logistic Area") where components are stored on the long-term, for instance prior to pre-assembly activities and installation at sea. This area shall be located in the vicinity of the Ro-Ro Shore Ramp.
- The optimal size of the Ro-Ro ramp is 30 × 30 meters, while the recommended size is 40 × 40 meters.



Quay with Ro-Ro ramp

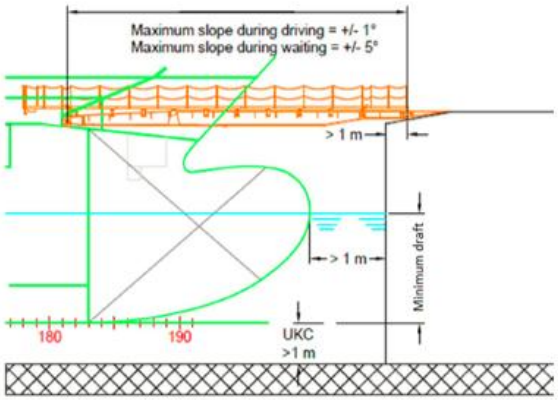
Infrastructure bearing capacity

The Site Developer shall ensure the ground bearing capacity is compatible anywhere on each area, with all load cases applicable as per Table below

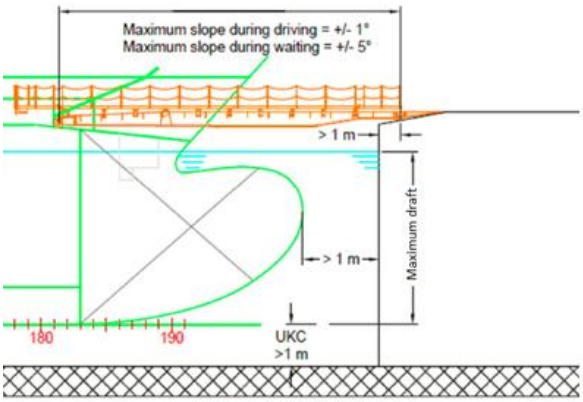
No.	Load Cases	Ro-Ro Shore Ramp	Quay	First Place of Rest	Cargo logistic Area
Storage					
1	Nacelle	X(*)	X	X	X
2	Tower section	X(*)	X	X	X
3	Blade		X	X	X
4	Generator	X(*)	X	X	X
Transport					
5	Nacelle on SPMT	X	X	X	X
6	Tower section on SPMT	X	X	X	X
7	Blade transport with Blade Mover	X	X	X	X
Others					
8	Forklift 5t	X	X	X	X
9	Forklift 20t		X	X	X
10	Reach Stacker 46t		X	X	X

** Long term storage of WTG components in not planned on the Ro-Ro Shore Ramp itself. However, this infrastructure shall be dimensioned to bear the weight of these components over a short period. This might happen exceptionally, for instance if the transport system (e.g. SPMT) breaks down and has to be changed.*

Quay with Ro-Ro ramp



View at low tide



View at high tide

Ro-Ro QUAY INFRASTRUCTURE AND RAMP

The Site Developer shall ensure the Ro-Ro Quay infrastructure and Shore Ramp comply with following requirements:

Ro-Ro Quay infrastructure characteristics

- Under Keel Clearance (UKC): min.1m.
- Water depth: min. 12 m/LAT.
- Tidal range acceptable for vessel ballast system: max. 3,5 m.
- Relative movements between vessel and quay: max. ±50mm.
- Distance between shore ramp wall and vessel ramp touch points: min. 1m.
- Distance from vessel stern/bow to shore ramp wall: min. 1m.

Shore Ramp characteristics

- Minimum width: 30m
- Shore ramp height:
  - minimum 1,5m above high spring tide
  - maximum 4,7m above low spring tide
- Axle load bearing capacity: min. 40t/m
- The longitudinal profile and slope of the ramp shall be determined in coordination with the Site Developer, taking into account local regulations and the specific characteristics of the vessels.
- Material: concrete or steel.

Others

- Maximum slope during driving: +/-1°
- Maximum slope during waiting: +1,5°/-2,5°
- Trim tolerance during operations (mm): +/-300
- Heel tolerance during operations (mm): +/-35

Quay with Ro-Ro ramp

The Site Developer shall ensure the Ro-Ro Quay infrastructure shall comply with following requirements:

Furniture

The Ro-Ro Quay and Shore Ramp shall be equipped with:

- 150 tons mooring bollards every 25m along Ro-Ro Quay
- 150 tons mooring bollards on each side of the Shore Ramp.
- Energy absorbing fitted fenders every 25m. Allowable hull pressure: maximum 100t/m^2.

The bollards and fenders shall not be coincident. The fenders will be designed to accommodate the tidal range.

Quay with Ro-Ro ramp

The Site Developer shall ensure the Ro-Ro Quay infrastructure shall comply with following requirements:

First place of rest

To optimize loading and unloading operations, the Site Developer shall make available an area of minimum 250mx40m adjacent quay (the “First Place of Rest”).

The Site Developer shall ensure the ground bearing capacity is compatible with all load cases listed in Table.

In the Quay zone, First Place of Rest load bearing capacity have not been lower than it is set to Quay and Ro-Ro ramp.

Components	Surface area required for storage (m²)
6 nacelles	3000
40 Containers	4000

Cargo logistic areas

Near the Shore Ramp and First Place of Rest, the Site Developer shall make available larger storage areas (the “Cargo logistic Areas”).

For storage capacity as first approach, upper table provides an estimate of the surface required per type of component to store around 6 WTGs, as stated 250m x 40m will be made available where positioning the Nacelles and component pieces as required for the receipt or load out of the vessels.

Quay with Ro-Ro ramp

Road access and egress

The Ro-Ro Facility shall be accessible and available for use 24/7.

Cargo logistic Areas shall be accessible directly from the First Place of Rest.

Road access to and from the quay infrastructure shall be suitable for heavy load transports, in particular:

- Clear width: minimum 12m.
- Clear height: no restriction below 15m.
- Bearing capacity sufficient for minimum axle loads of 40t/axle (SPMT for WTG transport).

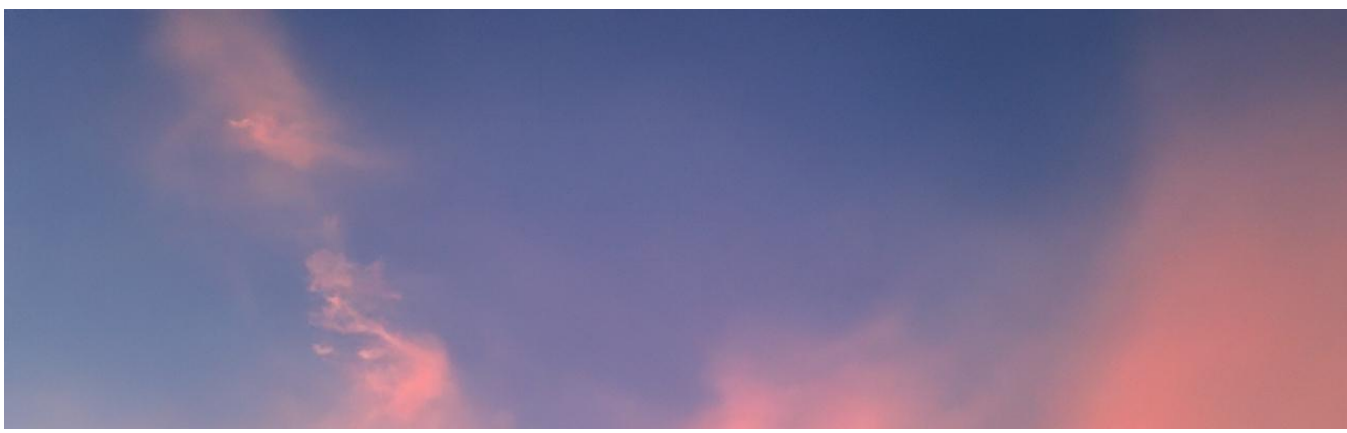
Lighting

The Site Developer shall ensure lighting system complies with below requirements:

- Local standards and regulations for all areas, with proper illumination level to operate safely.
- Minimum 20 lux over the Ro-Ro quay infrastructure.

Visibility

The Ro-Ro facility shall be located in an open area with good access and visibility, swept paths for turning shall be easy to use and free from obstructions.



Main technical parameters for the production process

Environmental information

Blades

- Resin consumption per day circa 10.000L. Resin storage at any point in time circa 80.000L;
- Hardner consumption per day circa 3.000L. Hardner storage at any point in time circa 20.000L;
- Paint consumption per day circa 600L. Paint storage at any point in time circa 12.000L;
- Solvent consumption per day circa 100L. Solvent storage at any point in time circa 3.000L;
- Fiberglass storage at any point in time circa 1000 t;
- VOC emissions during paint operation < 5h per day;
- Noise levels (outdoor) < 85dBA measured 10m from any operation (production, storage, logistic);
- Light levels up to 50 LUX outside (standard 20 LUX at most times);

Nacelles

- Hydraulic oils consumption per day circa 1.200L. Hydraulic oils storage at any point in time circa 30.000L;
- Paint consumption per day circa 600L. Paint storage at any point in time circa 12.000L;
- Solvent consumption per day circa 100L. Solvent storage at any point in time circa 3.000L;
- VOC emissions during paint operation < 3h per day;
- Noise levels (outdoor) < 80dBA measured 10m from any operation (production, storage, logistic);
- Light levels up to 50 LUX outside (standard 20 LUX at most times).

Towers

- Paint consumption per day circa 600L. Paint storage at any point in time circa 12.000L;
- Solvent consumption per day circa 100L. Solvent storage at any point in time circa 3.000L;
- VOC emissions during paint operation < 6h per day;
- Noise levels (outdoor) < 85dBA measured 10m from any operation (production, storage, logistic);
- Light levels up to 50 LUX outside (standard 20 LUX at most times).

All information is based on the current main principles of industry operations, which depend on the manufacturer and the technologies used. The choice of raw materials and VOC emissions is determined by the potential developer.

** The raw materials data sheets and VOC emissions are included in the report annex.*

Main technical parameters for the production process

Required Engineering Infrastructure Capacities

Electricity

	Production process	Number of transformers	Total MW required
Electricity	Blades	4	12
	Towers	2	25
	Nacelles	3-4	20

Water

	Production Process	Number of Employees	Peak Flow Rate (L/min)	Annual Consumption (m³)
Water*	Blades	1200	2000	100000
	Towers	500	800	40000
	Nacelles	300	500	30000

** Excluding the required water capacity for fire safety hydrants*

Sewage

Normal sewage designed on the domestic water consumption stated above

Main technical parameters for the production process

Rainwater sewage

	Production Process	l/s
Rainwater sewage	Blades	3300
	Nacelles	2100
	Towers	2300

Low voltage networks

	Production Process	Voltage Level
Low voltage networks	Blades	400V
	Towers	400V
	Nacelles	400V + 690V (only for test)

Another necessary utilities

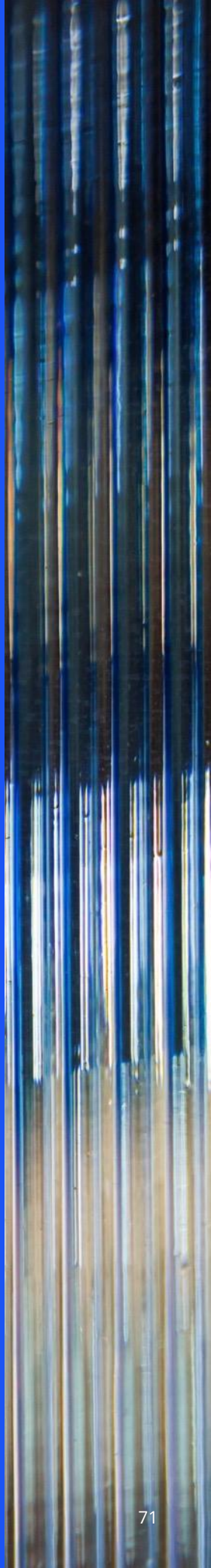
DATA connections high speed

Material delivery and export of products

Raw material delivery methods are distributed as follows: towers components are transported 90% by sea (50% Lo-Lo operations with crawler cranes, 50% Ro-Ro ramp) and 10% by road; nacelles components are delivered 50% by sea (100% Ro-Ro ramp) and 50% by road; blades components are transported 100% by road.

The loading process outgoing - towers and blades 100% Lo-Lo operations with crawler cranes, nacelles 50% Lo-Lo operations with crawler cranes, 50% Ro-Ro ramp.

Summary



Summary

- The total planned development area is approximately 90 hectares;
- The analysis is based on wind technology manufacturing, specifically for offshore applications;
- The development area is located in the Industrial Building Territory (R4), where manufacturing is permitted;
- The development of the area must be carried out in accordance with the applicable legal regulations;
- In all scenarios, the same Freeport logistics area and infrastructure are assumed in order to avoid favoring any specific manufacturing process mentioned in the report;
- The height restriction does not apply to port cranes, other port equipment and structures that are not buildings, as well as to building heights for which it is not possible to comply with the height restriction due to manufacturing requirements. However, one alternative scenario has been considered, which foresees the production of blade and tower components (excluding nacelle manufacturing), with logistics infrastructure and the quay planned for a lower load-bearing capacity. This solution should be evaluated in due time, with the final decision made during the design stage.;
- The production process runs continuously, 24 hours a day, 7 days a week;
- Even though it's technically possible to carry out all three planned scenarios at the same time with the available land, it's not recommended. It would be optimal to locate two of three production processes. The placement of three different production processes within the area is affected by the irregular shape of the land plot, the movement of raw materials and produced elements, as well as the limited possibility to adjust the size of individual leasable land parcels.
- If it is necessary to change the building development parameters specified in the planning documents, amendments to the local plan must be prepared;
- To ensure long-term operational efficiency and competitiveness, it is essential to conduct a comprehensive review of the infrastructure, logistics and technological systems every five years. This periodic reassessment allows for timely upgrades, alignment with industry standards and the integration of next-generation technologies, thereby supporting continuous improvement and resilience in manufacturing operations.

Development of the necessary port and logistics infrastructure in Kundziņsala for the advancement of wind technology manufacturing

Contact us:

Ēriks Bergmans
Partner
+371 2643 0099
Eriks.Bergmans@colliers.lv

Jesper Simonsen
Expert

colliers.com

Colliers
OrigoOne Business center
Satekles str. 2B - 512
Riga | Latvia