MMP Mitra Murni Perkasa
BASIC ENGINEERING DESIGN

ORIGINAL

WIKA | FOR APPROVAL | DATE | 20 May 2022

PROJECT NAME : BED & DED JETTY MMP NICKEL SMELTER PROJECT

CLIENT : PT. MITRA MURNI PERKASA

CONTRACTOR : PT. WIJAYA KARYA (Persero) Tbk

PROJECT LOCATION : TELUK WARU, BALIKPAPAN – KALIMANTAN TIMUR

CONTRACT NO. : 065-1/LGL/MMP-WIKA/XII/2021

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C2	Approved with comments Work may proceed	
C3	Revise and resubmit Work may not proceed	
C4	Not Reviewed No review required / Information only	
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20/05	YO	

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1 INTRODUCTION

1.1 PROJECT DEFINITIONS

In this document, the following words and term shall have the meanings here by assigned to them, unless noted otherwise.

OWNER : PT MITRA MURNI PERKASA

CONTRACTOR : PT. WIJAYA KARYA (Persero), TBK

VENDOR : The supplier (Manufacture or Distributor) of equipment purchased by CONTRACTOR

OTHERS : The party which have been contracted by COMPANY to supply equipment, service, or material.

1.2 PROJECT LOCATION

Project location is at Kariangau, West of Balikpapan, about 27 km from Balikpapan City. The distance from Balikpapan City to site is about 28 km by road.

Figure 1-1 Project Location

Figure 1-2 Enlarged Project Location

1.3 PURPOSE OF THIS DOCUMENT

This document covers general requirements for the design of jetty facilities for Jetty MMP Nickel Smelter Project at Kariangau, Balikpapan, East Kalimantan, Indonesia. A specific design basis shall be developed and included in the calculations for designs of all major structures and foundations; and shall be approved by PT Mitra Murni Perkasa (MMP) prior to commencing detail design. This document shall be used for design and preparation of construction documents.

This document presents the basis of design for marine works captioned in this project. The scope that covered by this basis of design is as follow:

a. Causeway
b. Trestle (access road from shoreline to jetty area)
c. Control room platform
d. Main jetty (wharf, mooring dolphin, and catwalk)
e. LCT jetty (breasting dolphin, mooring dolphin, and catwalk)

1.4 REFERENCES

The following documents referred to throughout this design criteria document are to be followed.

- Laporan Soil Investigation – Rencana Pembangunan Nickel Smelter. December 2021. Prepared by PT Bumi Indonesia.
- Report Survey Bathymetri & Hidrografi PT MMP. 2020. Prepared by PT Bumi Indonesia.
- BED Basic Design Criteria. February 2022. Prepared by PT WIKA

2 SITE CONDITIONS

2.1 WATER LEVELS

Reference levels for marine facilities structure should refer to Lowest Water Spring (LWS) or called Chart Datum Level (CDL) ±0.00 m. According to Document Report Survey Bathymetri & Hidrografi PT MMP by PT Bumi Indonesia in 2020, the following are water levels in port area.

- Highest High Water Level (HHWL) : +3.49 mCDL
- Mean High Water Level (MHWL) : +2.82 mCDL
- Mean Sea Level (MSL) : +1.70 mCDL
- Mean Low Water Level (MLWL) : +0.56 mCDL
- Lowest Water Spring (LWS) : ±0.00 m
- Lowest Low Water Level (LLWL) : -0.21 mCDL

Based on tidal information available in similar projects in the surrounding area, these water level data are suitable and can be used for design.

2.2 TEMPERATURE, HUMIDITY, AND RAINFALL

Temperature, humidity, and rainfall are obtained from BMKG Sepinggan Balikpapan and summarized as follow:

a. Temperature

- Maximum = 35.2^{o} C
- Minimum = 22.3^{o} C
- Average = 27.7^{o} C

b. Relative Humidity

Average relative humidity is 83%

c. Rainfall

The maximum daily rainfall is 165.8 mm in July 2019.

2.3 BATHYMETRY

Bathymetry data is based on Document Report Survey Bathymetri & Hidrografi PT MMP by PT Bumi Indonesia in 2020. The map indicated that the contours of the water depth at the jetty location varies, with contours in the causeway and trestle is shallow

and sloping, while at the interface between trestle and jetty areas and up to the jetty faceline and the turning basin area have steep contours. The marine facilities are located at a depth of ±0.00 m to -17.0 mCDL. The faceline or berthing line of main jetty should be at -17.0 mCDL, this is to accommodate the maximum vessels that will operate in jetty.

Seabed elevation at jetty facilities are:

- Causeway : from shoreline to 130 m offshore = +3.0 mCDL to -2.0 mCDL
- Construction jetty : located 130 m from shoreline = -2.0 mCDL
  : with berthing line at -2.0 mCDL
- Building Platform : located approx. 320 m from shoreline = -6.0 mCDL to -9.0 mCDL
- Trestle : located from 130 m to 378 m from shoreline = -2.0 mCDL to -11.0 mCDL
- Main jetty wharf : located from 378 m to approx. 445 m from shoreline = -11.0 mCDL to -17.0 mCDL
  : with berthing line at -17.0 mCDL
- LCT Jetty (Ro-ro) : located approx. 355 m from shoreline = -4.0 mCDL to -9.0 mCDL
  : with berthing line at -6.5 mCDL tp -9.0 mCDL

The bathymetric map is shown in Figure 2-1.

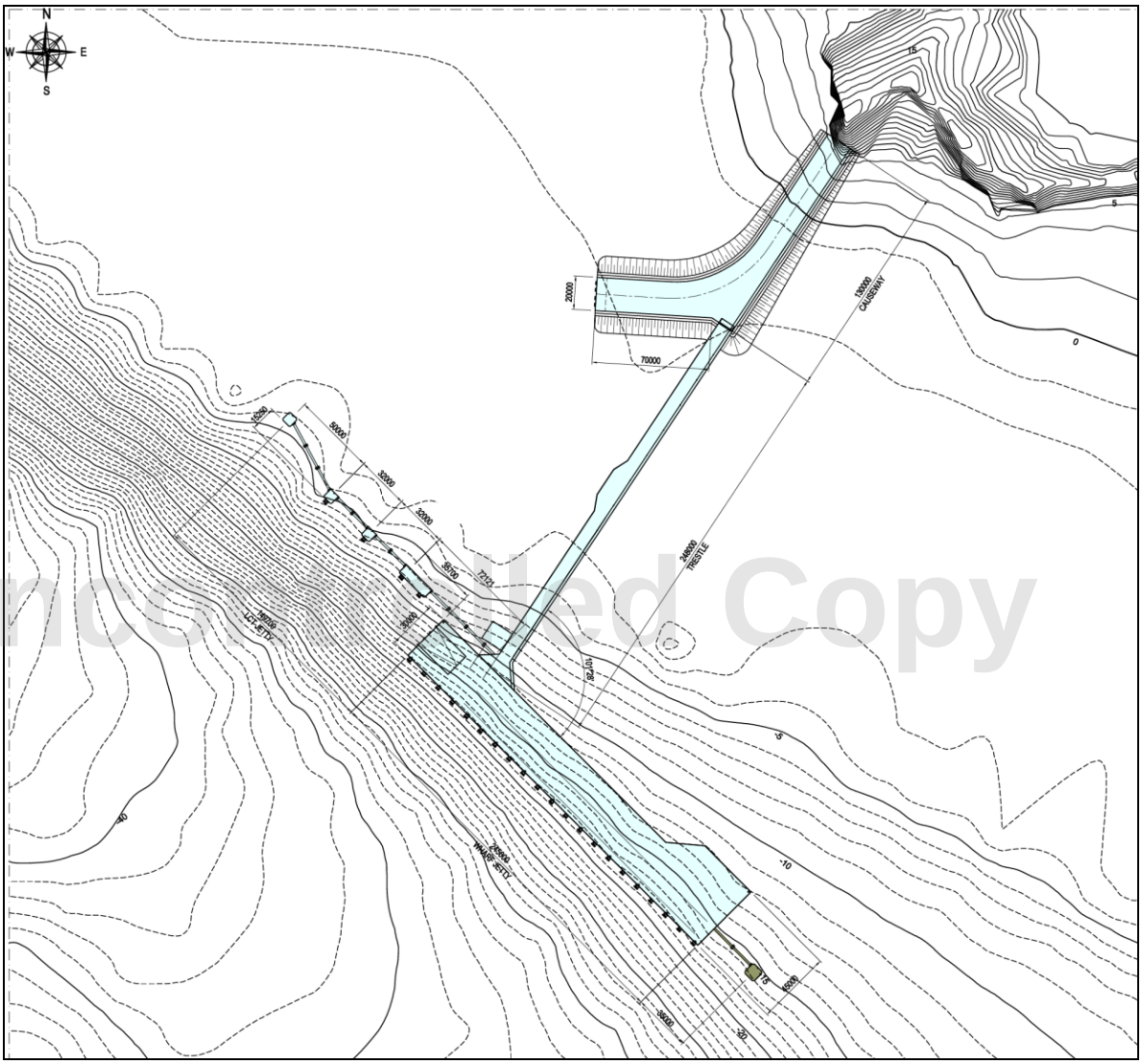

Figure 2-1 Bathymetry Map at Jetty Area

2.4 HYDROGRAPHYC CONDITIONS

2.4.1 Winds

Wind data at project area is taken from BMKG (Meteorological, Climatological, and Geophysical Agency) in BMKG Sultan Aji Muhammad Sulaiman Sepinggan.

According to wind data from 2012 to 2021, wind distribution is shown in Figure 2-2.

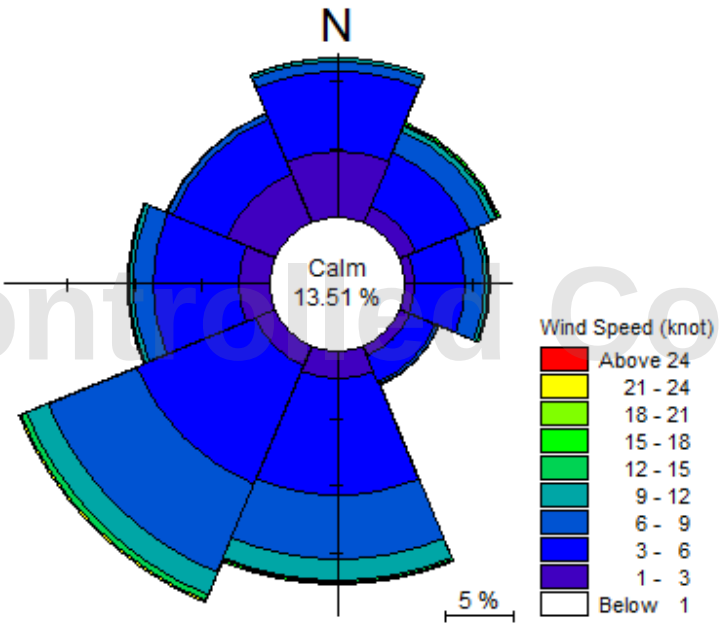

Figure 2-2 Wind Distribution (BMKG Sultan Aji Muhammad Sulaiman Sepinggan)

Wind condition is summarized below:

- Max. wind speed = 25 knots
- Dominant wind speed = 3-6 knots (46.0% per year)
- Dominant wind direction = South – Southwest (37.87% per year)

2.4.2 Waves

Waves condition at site is determined with modelling and hindcasting from wind data obtained from BMKG (Section 2.4.1). From the modelling, wave conditions at site are:

- Max. wave height (offshore) = 0.86 m
- Dominant wave height (offshore) = 0.00 – 0.20 m (46.91% per year)
- Dominant wave direction (offshore) = South – Southwest (37.87% per year)

- The results of refraction and diffraction modelling of waves with a return period of 50 years, the wave height (wave for design):
  - In front of jetty = 0.840 m
  - In front of causeway = 0.732 m

2.4.3 Currents

Current data is taken from Document Report Survey Bathymetri & Hidrografi PT MMP provided by PT Bumi Indonesia in 2020. From the report, it is concluded that the current condition in the project area based on observations on February 7, 2021 is quite calm, with average of current velocity of 1.30 km/hr and the maximum current velocity is at 2.60 km/hr.

However, data that is currently available cannot be used as a detail design reference. This is because:

a. The current measured data is on February 7, 2021, and the water conditions were neap tide at the time.
   Current measurements should be taken in both spring tide (high tidal range) and neap tide (low tidal range). In general, the current velocity is higher during spring tides.
b. Current measurements are only around 7 hours long
   However, to see the daily pattern of currents, observations should be done for 24 hours with one-hour observation intervals.

These data will be verified with observations and survey works in project area with the appropriate procedure. However, data from PT Bumi Indonesia can be used as reference for Basic Engineering Design stage and for Detailed Engineering stage will be updated based on New Survey Report.

Table 2-1 Results of Current Observations at MMP Area by PT Bumi Indonesia

LIST OF CURRENT OBSERVATIONS
BAHTYMETRY AND HYDROGRAPHY SURVEY
LOCATION AT JETTY PT. MMP
WEST BALIKPAPAN – EAST KALIMANTAN
DATE: 7 FEBRUARY 2021

No	Time	Depth			Average	Temp	Notes
		0.2d	0.6d	0.8d		(°C)	
1	10.30	1.1	2.6	1.7	1.8	28.8	d = 8 m
2	10 40	1.2	1.6	1.8	1.5	29.8	0.2d = 0 m
3	10.50	1.1	1.8	2.3	1.7	29.7	0.6d = 4 m
4	11.00	1.6	0.9	2.4	1.6	29.8	0.8d = 8 m
5	11.10	2.4	2.4	1.4	2.1	29.8	
6	11.20	1.4	1.1	2.4	1.6	29.7	Velocity unit (km/hr)
7	11.30	1.6	1.4	1.8	1.6	29.6	
8	11.40	1.0	0.8	0.4	0.7	30.0	
9	11.50	1.8	1.0	1.2	1.3	29.6	
10	12.00	1.0	0.7	1.0	0.9	29.9	
11	12.10	1.8	1.0	1.7	1.5	30.0	
12	12.20	1.2	1.5	1.8	1.5	29.8	
13	12.30	0.8	1.5	0.4	0.9	30.2	
14	12.40	1.0	0.6	1.5	1.0	30.2	
15	12.50	1.1	1.7	0.9	1.2	30.3	
16	13.00	1.5	0.9	1.4	1.3	30.3	
17	13.10	0.8	2.1	1.3	1.4	30.4	
18	13.20	2.0	1.2	0.8	1.3	30.3	
19	13.30	1.1	1.0	0.6	0.9	30.2	
20	13.40	0.7	1.2	0.9	0.9	30.4	
21	13.50	0.8	0.7	0.8	0.8	30.4	
22	14.00	0.5	1.1	1.2	0.9	30.4	
23	14.10	1.2	0.8	1.8	1.3	30.4	
24	14.20	1.2	0.6	1.1	1.0	30.3	
25	14.30	0.6	1.4	1.6	1.2	30.4	
Average		1.02	1.032	1.072	1.3		

Condition at highest tide level on that day

2.5 MARINE GROWTH

No survey data available for marine growth conditions in the project area. References/ other supporting documents that contain information about marine growth are also not available. Therefore, for the design and analysis. marine growth will be limited maximum at 150 mm. During the service life of the structure, it is necessary to control, inspect, and maintain the growth of marine organisms.

2.6 GEOTECHNICAL CONDITIONS

Geotechnical information at jetty facilities is available from the previous soil investigations work. There are 7 (seven) soil boring logs that available to assess design ground conditions offshore for basic engineering design works. Detail parameter of soil conditions is explained in the Document Report: Laporan Soil Investigation – Rencana Pembangunan Nickel Smelter by PT Bumi Indonesia – Dated December 2021. Location of soil investigation points are depicted in Figure 2-4 & 2-5.

Figure 2-3 Layout of Soil Investigation Points (Onshore & Offshore Area)

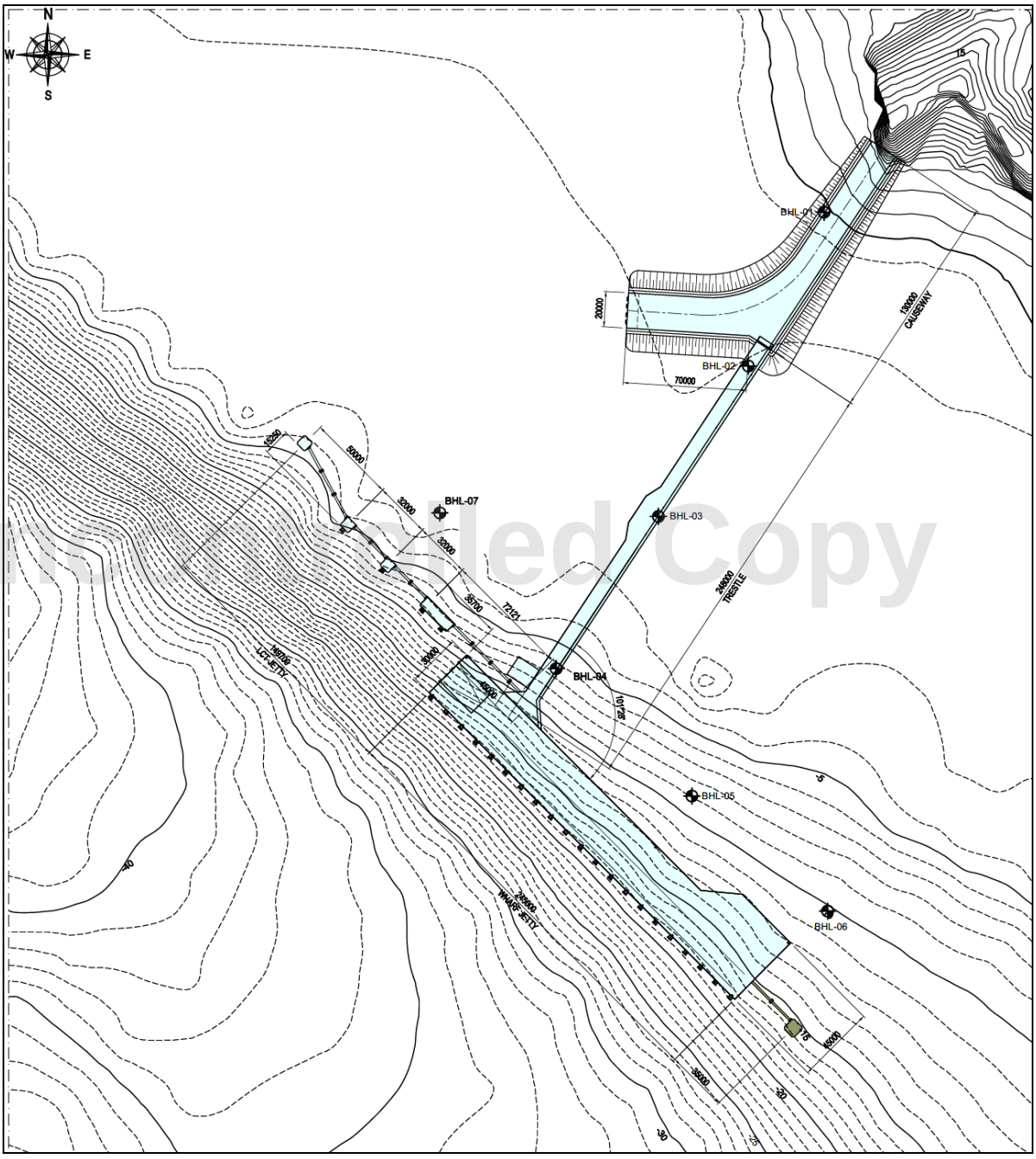

Figure 2-4 Layout of Soil Investigation Points (Offshore Area)

Soil data that can be considered as a reference in jetty facilities design are BH L-01, BH L-02, BH L-03, BH L-04, BH L-05, BH L-06, and BH L-07. The descriptions of the layer by layer of soil at each location of the boring points is described in Document Report: Laporan Soil Investigation – Rencana Pembangunan Nickel Smelter by PT Bumi Indonesia – Dated December 2021 (Appendix – A).

Furthermore, the additional soil investigations work had been completed at the time of completion this document. Additional soil investigations were done inside of the main jetty area. The new additional borehole is shown in Figure 2-5. The current progress is in the stage of testing work in the laboratory. The results of the additional three boreholes will be incorporated into this document for DED and the factual and interpretive reports attached as appendices (Appendix – B).

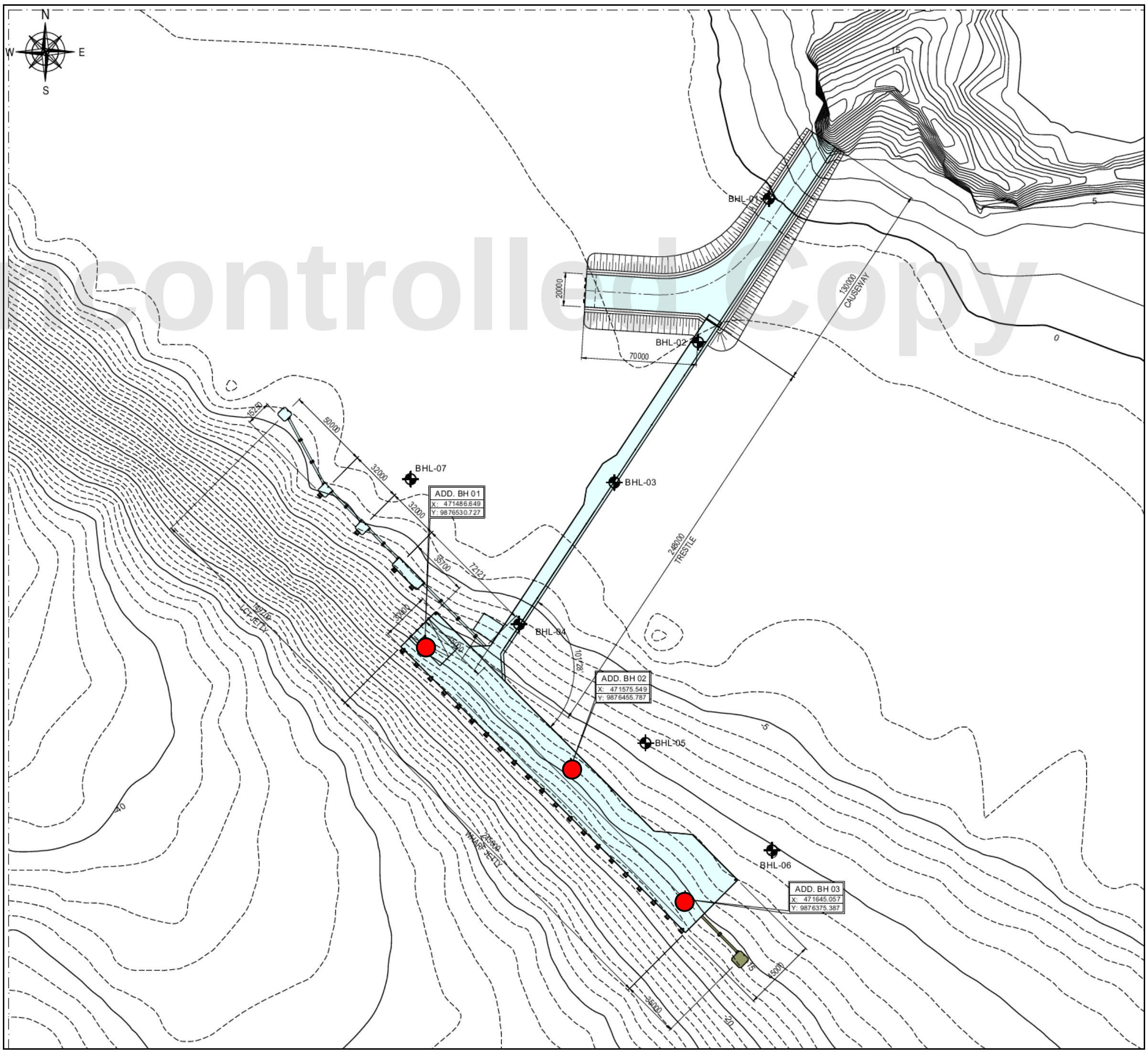

Figure 2-5 Layout of New Additional Borehole at Main Jetty (in Red Point)

3 LAYOUT DEVELOPMENT

Determination of layout of the jetty facilities should consider several aspects, such as, the function of jetty and the facilities, operational system, process system, vessel dimensions, water depth, environmental and site conditions, and vessel maneuverability. Jetty layout should be prepared to cater the various activities in the area.

The proposed marine facilities will consist of causeway, trestle, control room platform, main jetty wharf, mooring dolphins, breasting dolphins, platform for diesel supply, and catwalks. The jetty will be wharf type for main jetty and dolphin type for LCT jetty, and its orientation will be almost parallel to the shoreline. The location of each jetty should consider the required of water depth and minimum of water depth will depend on the size of the ships navigating the port area and the effect of wind and current.

The main jetty structure shall be designed to receive impact load and mooring load from vessels within the classes of Barges and Bulk Carrier/ Bulk Cement Cargo ranging from 8,000 DWT to 80,000 DWT. According to the maximum vessel, berthing line of main jetty should be minimum at -17.0 mCDL. The main jetty is sized approximately 30 m x 245 m as per preliminary design. The deck level is required at +5.50 mCDL. Jetty minimum shall accommodate loading/ unloading equipment, berthing and mooring system, access ladder, corner protection, corrosion protection system, and also should be provided with catwalk supports. Catwalk is used to connect the main jetty wharf and the mooring dolphin on southeast of main jetty.

At the northwest of the main jetty, the deck jetty structure is made as a ramp structure which is a part of the LCT jetty. The LCT jetty is designated as a loading and unloading area for 12,000 DWT LCT barge. This jetty comprises of breasting dolphins, mooring dolphin, platform for diesel supply, and catwalks structures to connect between dolphin structures. The water depth for this jetty should be minimum at -6.50 mCDL.

Access way from land to jetty area is required as an access from shore and it will accommodate the pipelines, utility line, and drainage structure. Total length of access ways from shoreline to jetty area to be approximately 378 m. The access way consists of causeway and trestle structure. The trestle structure should be designed to receive truck and other equipment loads. The width of trestle should consider two-way lanes of

roadway, pipelines, and drainage. For design basis, the trestle width should be minimum at least at 11.05 m and this should be examined thoroughly with considering piping system, drainage, utility, and other equipment.

The causeway should be designed as an access way from trestle and at the end of the causeway next to the trestle will be used for construction jetty. The causeway is required to accommodate the pipelines, drainage, truck, and large size equipment transport. For the width of the access road at causeway should be minimum at 15 m. This width is determined according to the SPMT arrangement plan. Total length of causeway from shoreline (El. ±0.00 mCDL) to the base point of trestle and construction jetty area to be approximately 130 m.

The construction jetty is intended as a place for unloading area for large equipment and other material that also used for berthing facility. The unloading area shall be designed to receive impact load and mooring load from vessels within the classes of LCT vessels ranging from 500 DWT to 1,200 DWT. The berthing line of jetty should be located at -2.0 mCDL of depth.

Platform for control room building will be located at the end of the trestle adjacent to the main jetty. This platform is area for control room building. Dimension of this platform is 14.5 m width and 19.2 m length.

Turning basin should usually be in the central area of the harbour basin. The minimum diameter where the ship has tugboat assistance, the turning diameter could be 2 times of the maximum length of the ship. Under very good conditions the diameter might be reduced to 1.6 times the length as a lower limit. In this project, turning basin diameters is taken 2 times of the longest vessel (L max = 229 m), then the diameter of turning basin is 460 m.

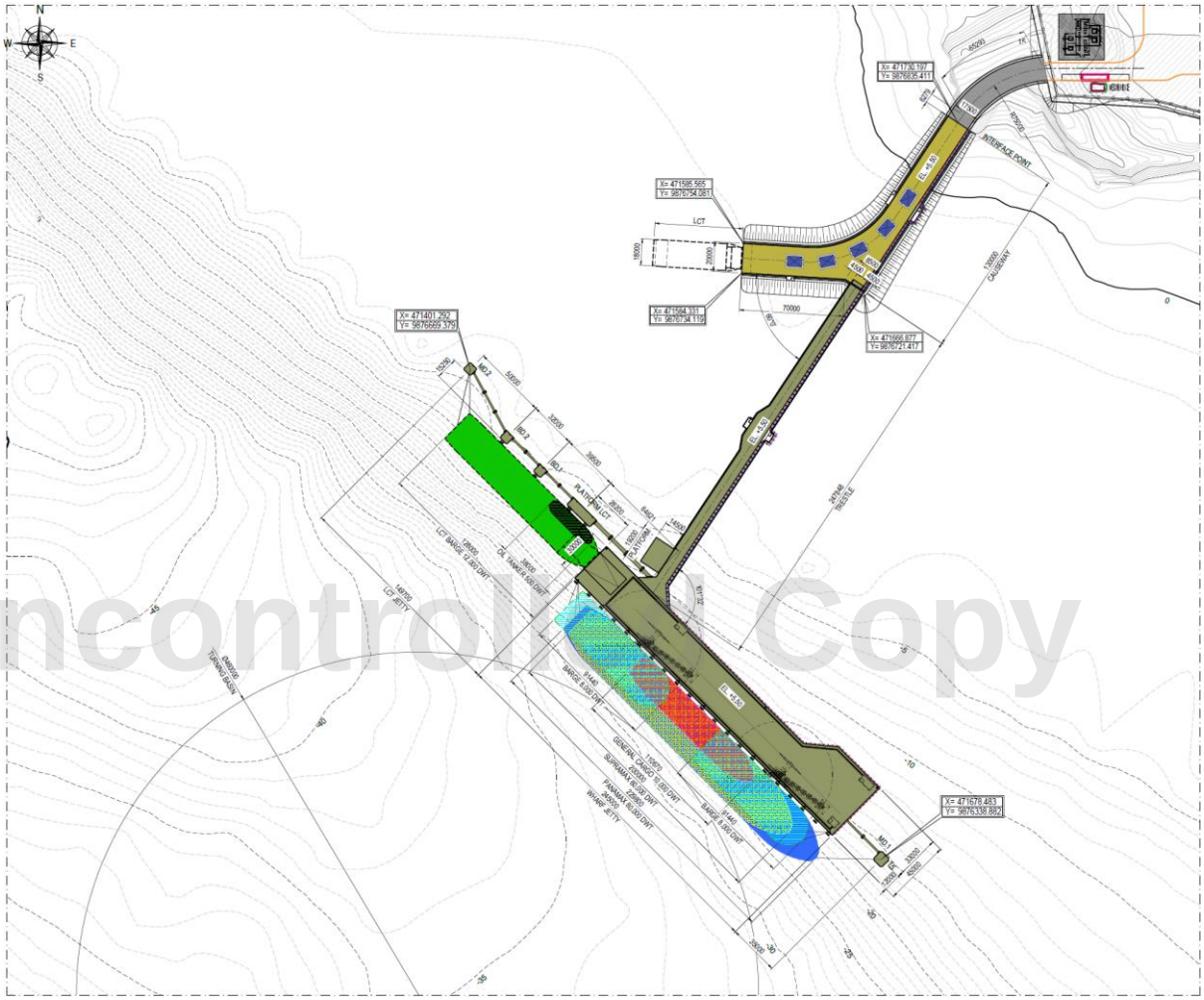

Figure 3-1 General Layout of Jetty Facilities

4 GENERAL DESIGN CRITERIA

4.1 DESIGN PHILOSOPHY

The design shall be in accordance with good engineering practices and in compliance with the latest editions and revisions (unless noted otherwise) of the Codes, Standards, and Guidelines. The design shall take into consideration all the applicable loads and transfer them into realistic load combinations. Appropriate use of load factors and material factors is required.

Design shall be done with appropriate software and shall include 3D modelling. Individual items may be designed as separate unit with the provision that interaction between the elements is properly addressed. Deflections shall be in line with the requirements from the applicable Codes and Standards as minimum and suitable to accommodate the intended topside pipe work and equipment. The design shall consider the Serviceability Limit State (SLS) and Ultimate Limit State (ULS) condition.

The Serviceability limit states is a condition that is in accordance with conditions outside the specified service conditions of a structure or structural component that are no longer met. They generally include problems such as deformation, cracking, and vibration that damage the structure or nonstructural elements, cause discomfort to the occupants of buildings, and adversely affects appearance, durability, or water resistance. Serviceability limit state governs the rigidity of the structure and the details of the reinforcement within it. The ultimate limit state (ULS) is a condition related to failure or collapse, and generally regulates the strength of a structure or member because it is in accordance with the maximum load resistance of the member. ULS also includes loss of balance or overall structural stability.

4.2 CODES AND STANDARDS

Currently there is no Indonesian code and standard for marine structural design, therefore jetty facilities structure or marine structure should be designed according to international standards. However, in some aspects, the Indonesian standard will be considered as a complement and reference.

The marine facilities design shall be based on the following codes and standards.

Indonesian codes and standards

SNI 1726:2019	Tata cara perencanaan ketahanan gempa untuk struktur bangunan gedung dan nongedung (Code for seismic design for buiding and non-building)
SNI 1727:2020	Beban desain minimum dan kriteria terkait untuk bangunan gedung dan struktur lain (Code for minimum design loads for building and other structure)
SNI 1729:2020	Spesifikasi untuk bangunan gedung baja struktural (Design standard steel structure for building)
SNI 2847:2019	Persyaratan beton struktural untuk bangunan gedung dan penjelasan (Code for concrete structure design for building)
PBI 1983	Peraturan Pembebanan Indonesia (Code for Design Loads)

International codes, standards, and guidelines

ACI 318	Building Code Requirements for Structural Concrete and Commentary
AISC	American Institute of Steel Construction
ASCE	American Society of Civil Engineers
BS 5950	Structural Use of Steelwork in Building
BS 6349	Code of Practice for Maritime Structures
BS 8004	Code of Practice for Foundation
OCDI	Technical Standards for Port and Harbour Facilities in Japan, by the Overseas Coastal Area Development Institute of Japan
PIANC	Guidelines for the Design of Fenders Systems

Order of precedence applicable for this project as per below hierarchy:

1. Indonesian Laws and Regulations
2. Local and International Standards
3. Project Technical Specifications

4.3 DESIGN LIFE

The design life service of the marine structures shall be 20 years. Appropriate periodic maintenance and precaution step should be done to increase the lifetime of short-time elements such as fenders, ladder, berth light, and others.

4.4 DESIGN VESSELS

The jetty facilities shall be suitable for receiving and handling vessels of the following ranges and types:

- Main jetty : 8,000 DWT barge up to 80,000 DWT bulk carrier
- LCT jetty : 500 DWT Oil Barge/ Oil Tanker and 12,000 DWT LCT barge
- Construction jetty at causeway : 1,200 DWT LCT

Ship details are shown in Table 4-1.

Table 4-1 Ships and Barges Detail

Type	Dead Weight Tonnage (DWT)	length Overall (LOA)	Beam (B)	Maximum Draft (D)	Berth Location
	(ton)	(m)	(m)	(m)	
Bulk Carrier	80,000	229.8	32.26	14.35	Main Jetty
Bulk Carrier	60,000	200	32.25	12.92	Main Jetty
General Cargo	10,000	110.67	19.2	8.47	Main Jetty
Barge	8,000	91.44	27.43	4.29	Main Jetty
LCT Barge	12,000	128	25	5.6	LCT Jetty
Oil Barge	500	45.5	11	2.5	LCT Jetty
Tanker	500	38	9	3.5	LCT Jetty
LCT	1,200	66	18	2.5	Construction Jetty

Note: Maximum draft of vessel is draft at maximum DWT

4.5 ELEVATIONS DESIGN

The deck elevation of the jetty structure shall be determined with taking consideration of the water levels, the sea level rise, the highest top of wave crest; and elevation of terminal/ land behind the berth. The wave overtopping should also be avoided, this may result damage to topside facilities. With these requirements, the berth slab should be located above the working water level. To reduce uplift forces and damage to the berth structure, the deck elevation should be designed with sufficient air gap to avoid wave contact at the underside of the deck.

The following aspects should be considered in determining of the top deck elevation:

a. Water level:

Water levels are determined from Chart Datum Level (CDL) at LWS ±0.00 m.

- Highest high water level (HHWL) at +3.49 m from CDL
- Mean sea level (MSL) at +1.70 m from CDL
- Lowest Water Spring (LWS) at ±0.00 m
- Lowest low water level (LLWL) at -0.21 m from CDL

b. Maximum wave height (H)

Maximum wave height used in the design is taken 0.84 m. This height is a result of refraction and diffraction modelling of waves with a return period of 50 years (See Section 2.4.3)

c. Sea level rise is projected to be 0.24 m in 20 years.

This number is taken form ICCSR (Indonesia Climate Change Sectoral Roadmap) year 2010.

d. Maximum Water Elevation

Maximum water elevation is defined by adding up the HHWL elevation with sea level rise and 0.5 of the wave height. Maximum elevation in this area predicted at 3.49 m + 0.24 m + (0.5*0.84 m) = +4.15 mCDL. This elevation will be used to check the air gap under the deck.

e. The bottom elevation of deck slab should be kept at least 0.50 m above maximum water elevation (Air gap). In this project, the air gap is 0.95 m from the bottom of concrete deck slab and the thickness of deck slab is 0.40 m.

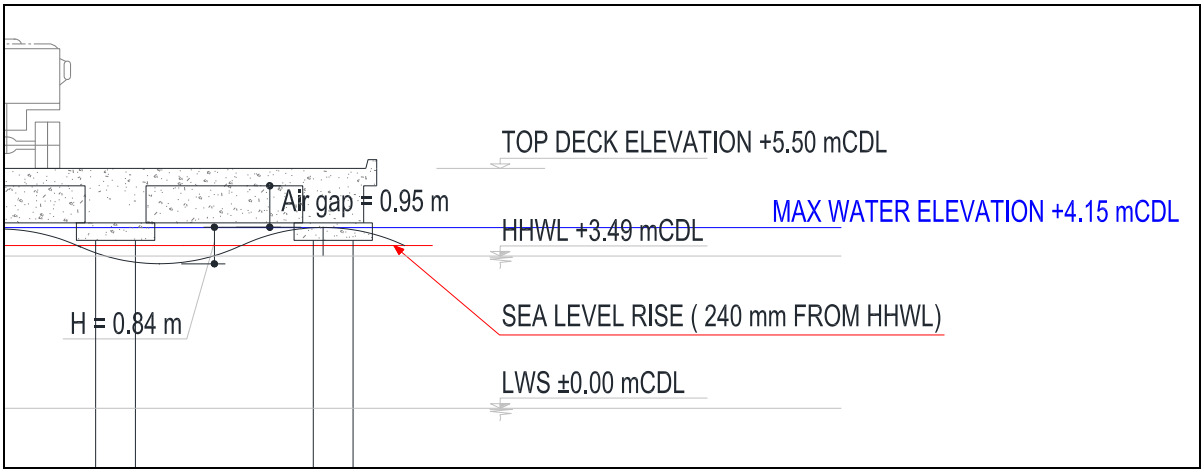

Figure 4-1 Simulation of Deck Elevation

All deck elevations of marine structure will be at +5.50 mCDL.

Water depth in front of the jetty structure shall be sufficient for the maximum draft of the vessel, including 10% - 20% additional underkeel clearance at LWS. Seabed elevation at berthing line of jetty varies from -6.5 mCDL to -18.0 mCDL.

- Construction jetty : berthing line minimum at -2.0 mCDL
- LCT Jetty (Ro-ro) : berthing line minimum at -6.5 mCDL
- Main jetty wharf : berthing line minimum at -17.0 mCDL

4.6 MATERIALS

4.6.1 Concrete

Minimum concrete grade for marine structure shall be minimum at f'c = 35 MPa (cylinder compressive strength) at 28 days.

4.6.2 Reinforcement Bar

Steel reinforcement in this project will have the following characteristic.

- Plain rebar fy = 280 MPa
- Deformed bar fy = 420 MPa
- Young modulus Es = 200,000 MPa

4.6.3 Structural Steel

The steel profile will be in accordance with JIS G3101 or ASTM A36 with minimum yield strength of 2400 kg/cm2 (fy = 235 MPa).

4.6.4 Steel Pipe Piles for Foundation

Steel pipe piles shall comply with ASTM A252 Grade 2 or Grade 3 with yield strength (fy) is 240 MPa and 310 MPa respectively, with modulus of elasticity (Es) is 200,000 MPa.

4.6.5 Prestressed Concrete Spun Piles for Foundation

The design and materials specification for concrete spun pile shall comply with SNI 2847:2019 and other relevant codes. Minimum concrete grade for concrete pile is 52 MPa (cylinder compressive strength) at 28 days.

4.7 DESIGN LOADS

4.7.1 Dead Loads

Dead loads are the weight of the structural members considering specific gravity of the material, except for bollard loads, fender, light pole, infill concrete, and other will be considered as superimposed dead load. The weight of material structure is according to ACI Standards and SNI Standards. For other additional element/ equipment such as bollard, fender, etc will be based on actual weight from vendor/ catalog.

4.7.2 Live Loads

Live load shall be uniformly distributed over the specified areas and shall be in accordance with the following lists unless otherwise specified.

- Causeway = 5.00 ton/m^2 (or 50 kN/m^2)
  This load is according to the calculation of distributed load under the SPMT carrying heavy equipment
- Trestle = 1.50 ton/m2 (or 15 kN/m^2)
  Basic load is according to SNI 1725:2016 (Design Load for Bridge), distributed load for bridge with traffic of 50 ton truck is 9.0 kPa. With considering the different type of truck and another vehicle or mobile crane that will driving occasionally along the trestle and refer to typical project the distributed load on trestle is taken 1.5 ton/m2 (15 kN/m^2)
- Main jetty = 3.00 ton/m^2 (or 30 kN/m^2)
  This distributed live load is taken according to ASCE, for general cargo facility using portal crane and truck for material handling, the uniform live load can be taken 500-1000 psf. In addition, the distributed live load commonly used on the deck of industrial jetty (general cargo) with reference to typical projects with similar material handling is 2-3 ton/m^2.
- Mooring dolphin = 0.25 ton/m^2 (or 2.5 kN/m^2)
  Refer to SNI 1727:2020
- Breasting dolphin = 0.25 ton/m^2 (or 2.5 kN/m^2)
  Refer to SNI 1727:2020
- Catwalk = 0.25 ton/m^2 (or 2.5 kN/m^2)
  Refer to SNI 1727:2020

- Control Room Platform = 1.50 ton/m^2 (or 15 kN/m^2)

  Loads of building and equipment above the platform are still in the preliminary design, then to cover building and equipment loads 15 kN/m^2 of uniform load is taken. However, this value will be verified if the actual loads above the platform are defined.

4.7.3 Crane Load

Portal crane is one of the live loads that operate on the jetty. In the load combination, this load is included as L (Live Load). Crane on main jetty is used as a loading/ unloading equipment. To meet the loading and unloading time target, in the jetty head area, 2 units of portal cranes are required with a capacity of 750 tons/hour per crane.

The following portal crane specifications will be considered in the design structure:

- Number of cranes = 2 cranes
- Self-weight = 590 ton/ unit
- Payload capacity = 36.4 ton
- Capacity = 750 ton/hr per crane
- Rail span = 10.5 m
- Number of wheels = 8 wheels
- Wheel spacing = 1.0 m (assumed)
- Wheel load = 40 ton/wheel

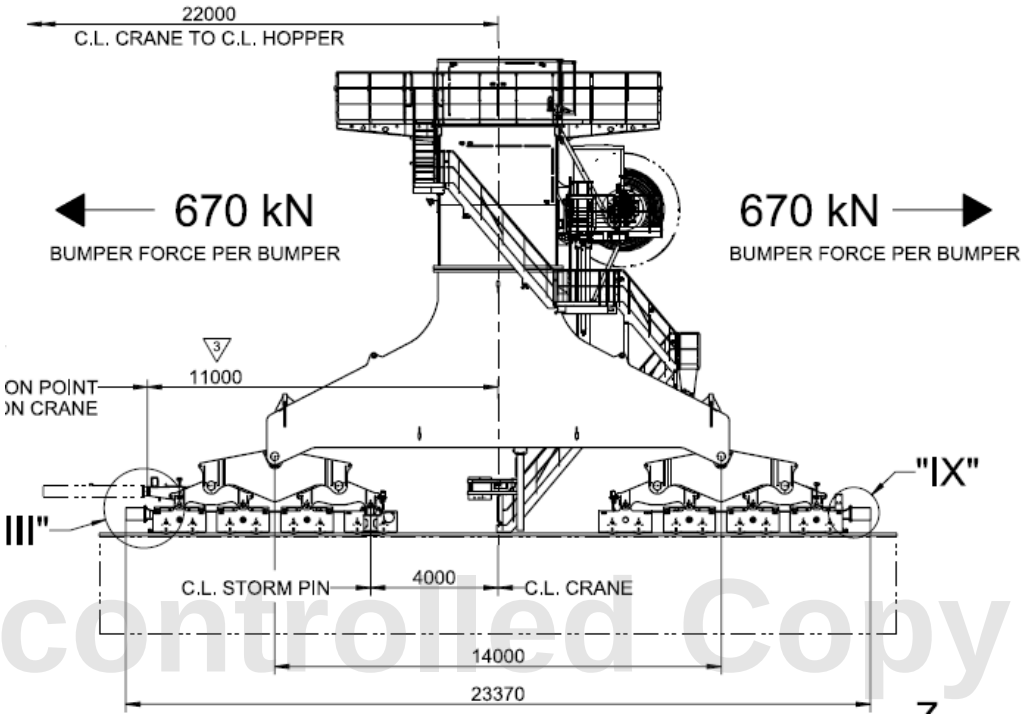

Figure 4-2 Wheel Configuration of Portal Crane (View from Seaside or Landside)

Figure 4-3 Portal Crane Above the Main Jetty Wharf

4.7.4 Major Handling Equipment Loads

The following major handling equipment will operate at jetty facilities and shall be considered in the design structure. The loading data of all equipment to be verified during Detailed Engineering Design phase.

4.7.4.1 Mobile Hopper

Mobile hoppers that will be used as a part of unloading process have 9.44 ton of self-weight, with 97.3 m^3 of capacity. In the jetty head, 2 (two) mobile hoppers will operate.

4.7.4.2 Flatbed Truck

Flatbed truck with 40 ton capacity will operate at main jetty, trestle, and causeway with full load capacity. Specification and loading data of flatbed truck will be informed after it is decided which type will be used in operations.

4.7.4.3 Dump Truck

Dump truck with 40 ton capacity (30 m^3) will operate at main jetty, trestle, and causeway with full load capacity. Specification and loading data of dump truck will be informed after it is decided which type will be used in operations.

For design and analysis at Basic Design stage, this load has been covered by distributed live load.

4.7.4.4 Single Bucket Loader

Single bucket loader with 5 m^3 capacity will driving with empty load on the main jetty, trestle, and causeway. Specification and loading data of single bucket loader will be informed after it is decided which type will be used in operations.

Since this equipment/ heavy vehicle only passes through the structure occasionally and does not queue, then for design and analysis of structure at Basic Design stage, this load has been covered by distributed live load.

4.7.4.5 Truck Crane

Truck crane (40 ton) with lifting weight of 16 ton will operate at jetty head and will driving with empty load along the trestle and causeway. Specification and loading data of truck crane will be informed after it is decided which type will be used in operations.

Since this equipment/ heavy vehicle only operating occasionally, then for design and analysis of structure at Basic Design stage, this load has been covered by distributed live load.

4.7.4.6 Crawler Excavator

Crawler excavator with 30 ton capacity will driving with empty load on the main jetty deck, trestle, and causeway, this crane is planned to operate on a barge at the LCT jetty. Specification and loading data of crawler excavator will be informed after it is decided which type will be used in operations.

Since this equipment/ heavy vehicle only passes through the structure occasionally and does not queue, then for design and analysis of structure at Basic Design stage, this load has been covered by distributed live load.

4.7.4.7 Mobile Crane

Mobile crane with 150 ton capacity will operate at main jetty and will driving with empty load along the trestle and causeway. Specification and loading data of mobile crane will be informed after it is decided which type will be used in operations.

Since this equipment/ heavy vehicle only operating occasionally, then for design and analysis of structure at Basic Design stage, this load has been covered by distributed live load.

4.7.5 Pipe Loads

Pipeline at jetty head will be placed inside the trench which located on the deck of jetty along the outer side of the structure. At trestle and causeway, pipeline is located at one side of along the trestle and causeway. These pipes should be considered as an additional load. For basic design and analysis, pipe loads on structure have been covered by distributed live load.

The details of pipe loads will be provided in Detailed Engineering Design phase.

4.7.6 Electrical and Instrument Loads

Electrical and instrument system at jetty head will be placed inside the trench which located on the deck of jetty along the outer side of the structure. At trestle and causeway, this utility is located at one side of along the trestle and causeway. This

utility should be considered as an additional load. For basic design and analysis, electrical and instrument loads on structure have been covered by distributed live load.

The details of electrical and instrument loads will be provided in Detailed Engineering Design phase.

4.7.7 Berthing Loads

The berth facilities shall be designed to absorb the berthing loads. The berthing energy is determined by the size of the vessel and the berthing characteristic. The berthing energy shall be calculated using BS 6349-4. The berthing structures including the rubber fenders shall be capable of absorbing an abnormal berthing energy. The ship should not berth at high waves condition.

Fender system shall be designed to cover all dimension of ships that will operate in the jetty area. Berthing speed is a very important factor in determining the berthing energy. The approach velocity of the vessels based on Figure 9 of BS 6349-4:2014 for the navigation condition “difficult berthing, sheltered”.

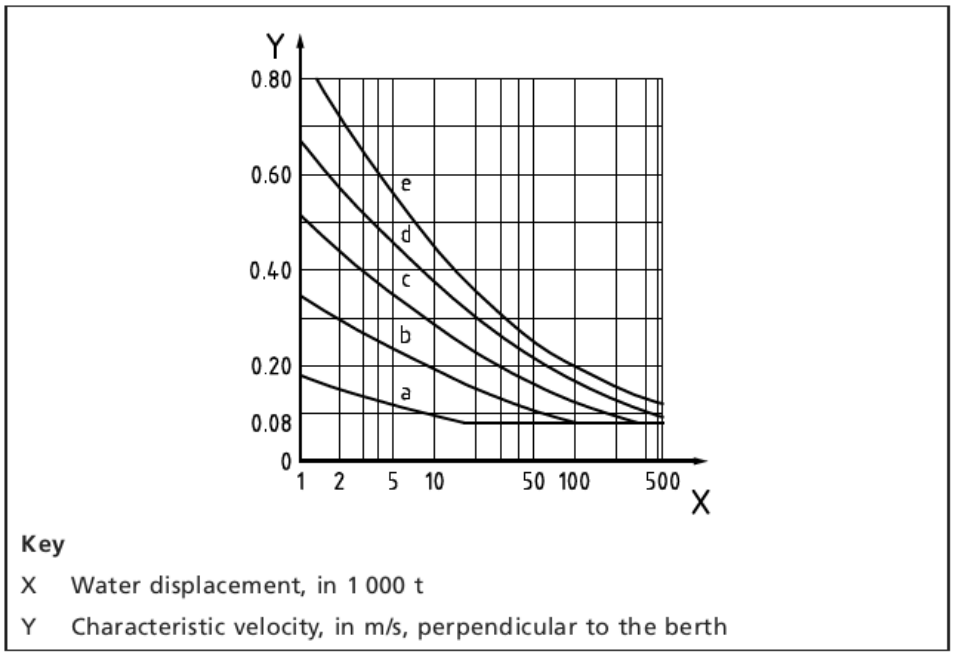

Figure 4-4 Design Berthing Velocity (Ref.: BS 6349-4:2014)

Berthing parameter should be used in the basic design is:

- Vessel = at main jetty 8,000 DWT Barge up to 80,000 DWT
  = at LCT jetty 500 DWT and 12,000 DWT Barge
  = at construction jetty 1,200 DWT LCT Barge
- Navigation cond. = 'b' Difficult berthing, sheltered
  This navigation condition is taken according to BS 6349-4:2014 and with considering the location and site condition at jetty area. sheltered is defined as an area that is not exposed to waves and/or currents.
- Berthing angle = 6^o – 10^o

4.7.8 Mooring Loads

Mooring point load will be taken from the bollard capacity. The capacity of bollard depends on the maximum tonnage of vessel and will be based on BS 6349-4 and OCDI.

Table 4-2 Mooring Point Load (Ref.: BS 6349-4)

Vessel displacement t	Mooring point load t
20 000 up to and including 50 000	80
Above 50 000 up to and including 100 000	100
Above 100 000 up to and including 200 000	150
Above 200 000	≥200

NOTE Storm bollards may be used in the mooring pattern. These are typically >250 t in capacity.

Table 4-3 Tractive Force on Bollard (Ref.: OCDI)

GT of ship (ton)				Tractive force acting on a bollard (kN)	Tractive force acting on a mooring post (kN)
Over	200	and not more than	500	150	150
Over	500	and not more than	1,000	250	250
Over	1,000	and not more than	2,000	250	350
Over	2,000	and not more than	3,000	350	350
Over	3,000	and not more than	5,000	350	500
Over	5,000	and not more than	10,000	500	700
Over	10,000	and not more than	20,000	700	1,000
Over	20,000	and not more than	50,000	1,000	1,500
Over	50,000	and not more than	100,000	1,000	2,000

Over 100,000 and not more than 120,000	1,500	2,000
Over 120,000 and not more than 150,000	1,500	2,000
Over 150,000 and not more than 170,000	2,000	2,000
Over 170,000 and not more than 200,000	2,000	2,000

4.7.9 Current Loads

The current induced drag loads on piles shall be determined according to BS 6349. Current load will consider marine growth.

Current data is taken from Document Report Survey Bathymetri & Hidrografi PT MMP provided by PT Bumi Indonesia in 2020. The current condition in the project area based on observations at February 7, 2021 is quite calm, with average of current velocity of 1.30 km/hr and the maximum current velocity is at 2.60 km/hr.

This data will be verified with observations and survey works in project area. However, data from PT Bumi Indonesia can be used as reference for Basic Engineering Design stage. For Detailed Engineering stage the current velocity will be updated based on New Survey result.

For structural analysis, current velocities are taken:

- Normal condition = 1.30 km/hr (or 0.361 m/s)
- Extreme condition = 2.60 km/hr (or 0.722 m/s)

Marine growth of 150 mm of thickness will be considered in the design of current force on piles.

4.7.10 Wind Loads

Wind force acting on the surface of structure shall be calculated according to BS 5400.

Wind data at project area is taken from BMKG (Meteorological, Climatological, and Geophysical Agency) in BMKG Sultan Aji Muhammad Sulaiman Sepinggan. Wind conditions at site are summarized below:

- Max. wind speed = 25 knots
- Dominant wind speed = 3-6 knots (46.0% per year)
- Dominant wind direction = South – Southwest (37.87% per year)

The wind speed data above is considered relatively small and according to Peraturan Pembebanan Indonesia (1983), the wind pressure at sea must be taken to a minimum of 40 kg/m^2 or equivalent with 91 km/hr. However, for structural analysis the wind

speeds are taken based on experience with considering the maximum wind speed that occurred in several area in Indonesia:

- Normal condition = 40 km/hr
- Extreme condition = 120 km/hr

4.7.11 Wave Loads

Waves condition at site is determined with modelling and hindcasting from wind data obtained from BMKG. From the modelling, wave conditions at site are:

- Max. wave height (offshore) = 0.86 m
- Dominant wave height (offshore) = 0.00 – 0.20 m (46.91% per year)
- Dominant wave direction (offshore) = South – Southwest (37.87% per year)

The results of refraction and diffraction modelling of waves with a return period of 50 years, the wave height (wave for design):

- In front of jetty = 0.840 m
- In front of causeway = 0.732 m

For structural analysis, wave height is taken 0.840 m. Wave induced drag loads on piles is calculated by the following formula based on API WSD – 2000.

4.7.12 Temperature Loads

Temperature is obtained from BMKG Sepinggan Balikpapan and summarized as follow:

- Maximum = 35.2^{o} C
- Minimum = 22.3^{o} C
- Average = 27.7^{o} C

4.7.13 Seismic Loads

Seismic load shall be in accordance with SNI 1726:2019, with return period of 2,500 years. Parameters and site coefficients to create response spectrum curve in project location shall be determined from seismic maps which are provided by the Indonesia Seismic Code. The value that can be obtained from these maps are PGA (Peak Ground Acceleration), SS (response spectral acceleration parameter MCER for T=0.2 sec), and S1 (response spectral acceleration parameter MCER for T=1.0 sec). An amplification factors are needed for determine response spectrum in the ground surface. The amplification values depend on the soil type.

SNI 1726:2019

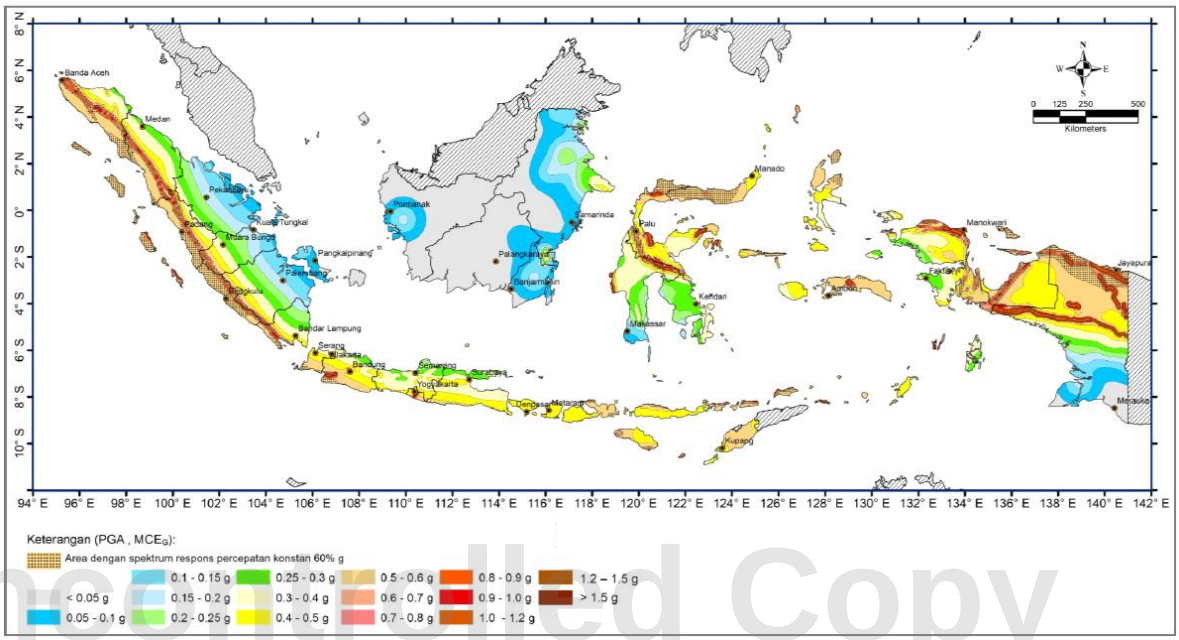

Figure 4-5 PGA. Max considered earthquake geometric mean peak ground acceleration (MCEG)

SNI 1726:2019

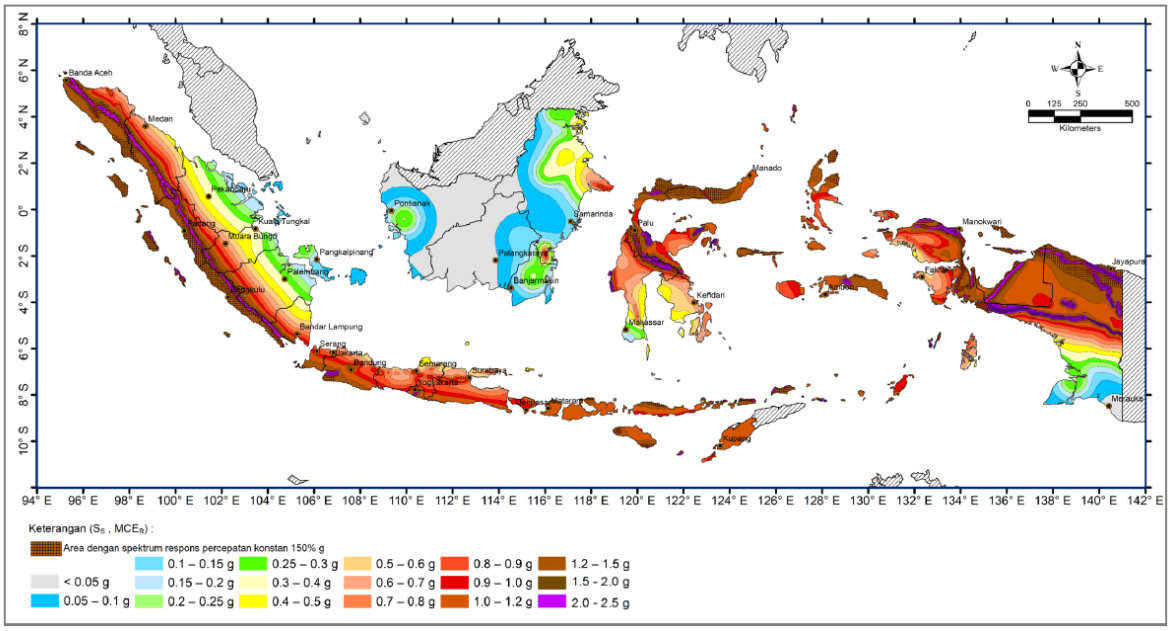

Figure 4-6 Ground Motion Parameter SS, Risk-Targeted Max Considered Earthquake (MCER), for 0.2 s Spectral Response Acceleration (5% of Critical Damping)

SNI 1726:2019

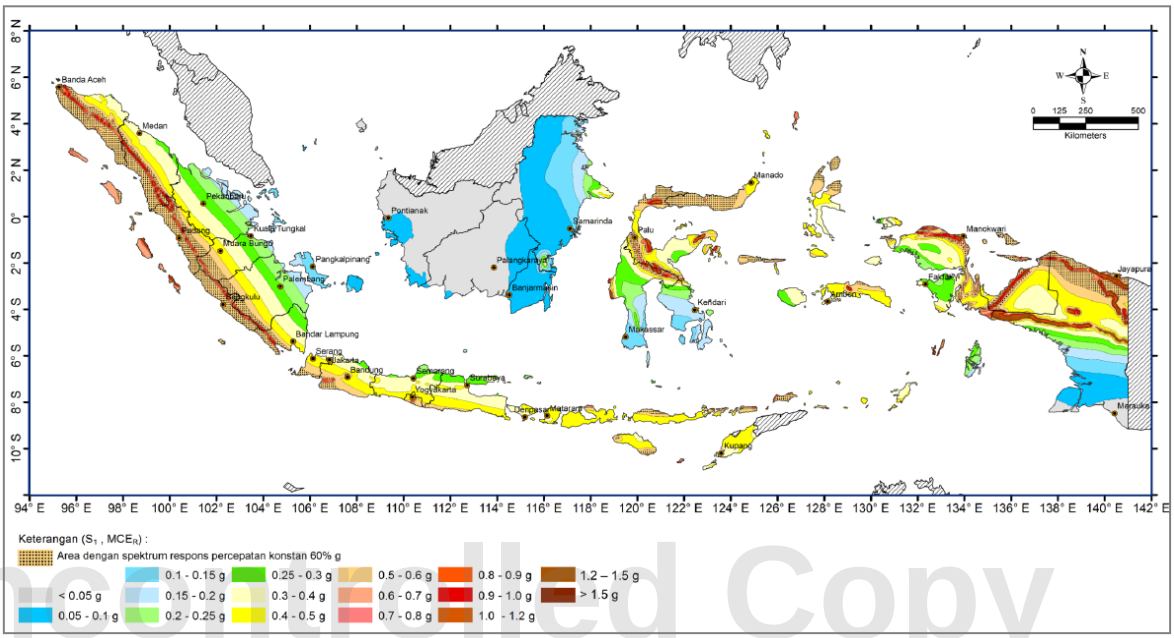

Figure 4-7 Ground Motion Parameter S1, Risk-Targeted Max Considered Earthquake (MCER), for 1.0 s Spectral Response Acceleration (5% of Critical Damping)

The seismic design for structures and facilities in this project will be based on Indonesia Seismic Code SNI 1726:2019. Dynamic response spectrum analysis shall be used in the seismic design, with the following parameters:

- Site Class : Soft Soil (SE)
- PGA : 0.056g
- S_S : 0.109g
- S_1 : 0.080g
- Important factor, I : 1.0
- 10% of distributed live load will be considered during earthquake

According to the soil data obtained from investigation works at trestle and jetty area, there are differences in soil stratigraphy and the depth of the hard soil layer calculated from the seabed elevation. According to the soil data, in the trestle area the soil condition is included in the site class 'SD – Medium Soil', while in the jetty area it is included in the site class 'SE – Soft Soil'. Therefore, at the basic design stage, the site class for the jetty facilities will use the SE type as a conservative value. However, for

the detail design stage, a more detailed study will be conducted to determine the class of this site.

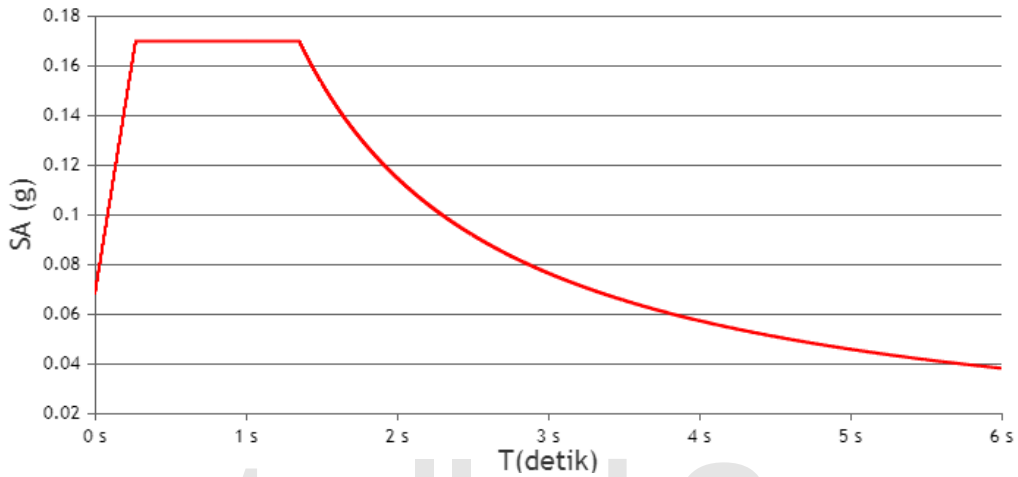

Figure 4-8 Response Spectrum Design at Jetty Location (Site Class: SE)

For seismic loading condition, the following directions shall be combined to produce the largest demand on the structure

- ±100% EQx ±30% EQy
- ±30% EQx ±100% EQy

4.7.14 Load Combinations

Load combination shall be designed to ensure application of the worst load combination for sizing of, and determination of maximum stress levels in the individual members of the structure. Where applied wind, wave, or current loads cause lower stress levels than without their exposure, their effects shall be eliminated from the relevant load combination. The upper structure should be designed to resist all combination of loads which may realistically be assumed to act on the structure simultaneously. Loads may act directly on the upper structure or indirect via the piles. Basis of load combinations shall be based on American Standard which are described in the POLB WDC (Port of Long Beach) and for earthquake loads shall be calculated based on SNI 1726:2019.

Basic load combinations for Operational Condition (Basis Ref.: American Standard/ POLB):

Table 4-4 Basic Load Combinations

Service Design Load (SLD)/ Allowable Stress Design (ASD)							
Load Combination	**D**	**L**	**W**	**BE**	**MO**	**T**	**C**
Comb 1	1.00	-	0.60	-	-	1.00	1.00
Comb 2	1.00	1.00	0.60	-	-	1.00	1.00
Comb 3	1.00	0.75	0.45	1.00	-	-	1.00
Comb 4	1.00	1.00	0.60	-	1.00	-	1.00

Load and Resistance Factor Design (LRFD)							
Load Combination	**D**	**L**	**W**	**BE**	**MO**	**T**	**C**
Comb 1	0.90	-	1.00	-	-	1.20	1.20
Comb 2	1.40	-	1.00	-	-	-	1.40
Comb 3	1.20	1.60	1.00	-	-	1.20	1.20
Comb 4	1.20	1.00	1.00	1.60	-	-	1.20
Comb 5	1.20	1.60	1.00	-	1.60	-	1.20

Where:

D = Dead Loads (include Superimposed Dead Load)

L = Live Loads

W = Wind Loads

BE = Berthing Load

MO = Mooring Load

T = Temperature Load

C = Current Load on Structures

Basic load combination for Seismic Loads (Ref.: SNI 1726:2019):

Service Design

1. Comb 1 : $1.0D + 0.7E_v + 0.7E_h$
2. Comb 2 : $1.0D + 0.525E_v + 0.525E_h + 0.75L$
3. Comb 3 : $0.6D – 0.7E_v + 0.7E_h$

Ultimate Design

Comb 1 : $1.2D + E_v + E_h + L$

Comb 2 : $0.9D – E_v + E_h$

Where:

D = Dead Loads (include Superimposed Dead Load)

L = Live Loads

E_h = Horizontal Seismic Load

E_v = Vertical Seismic Load

4.8 GEOTECHNICAL AND PILE FOUNDATION DESIGN

4.8.1 Pile Foundation

The bearing capacity/ foundation design of driven steel piles shall be carried out in accordance with the recommendations presented in SNI 8460:2017 and OCDI Code Standard. The following table presents an overview of the applicable safety factors for the considered load cases.

Table 4-5 Minimum Factor of Safety for Axially Loaded Piles

Condition	Bearing	FS Piles in Compression	FS Piles in Tension	Reference
Service Load	Friction bearing	2.5	2.5	SNI 8460 : 2017
	End bearing	2.5	2.5	SNI 8460 : 2017
Seismic Load	Friction bearing	2.0	2.0	OCDI Code Standard
	End bearing	1.5	1.5	OCDI Code Standard

4.8.2 Slope and Retaining Structure

According to SNI 8460:2017, safety factor minimum (slope stability) is allowed depends on the following points.

Service and Static condition FOS = 1.50

Temporary condition FOS = 1.25

Seismic Condition FOS = 1.10

APPENDIX - A SOIL INVESTIGATION REPORT BY PT BUMI INDONESIA

Doc.: Laporan Soil Investigation – Rencana Pembangunan Nickel Smelter. December 2021. Prepared by PT Bumi Indonesia

APPENDIX - B FACTUAL AND INTERPRETIVE REPORT

Doc.: MMP-DBS-100-C-0003 Rev.1

Factual Report – Geotechnical Report (Soil Reports) 3 Additional Boreholes