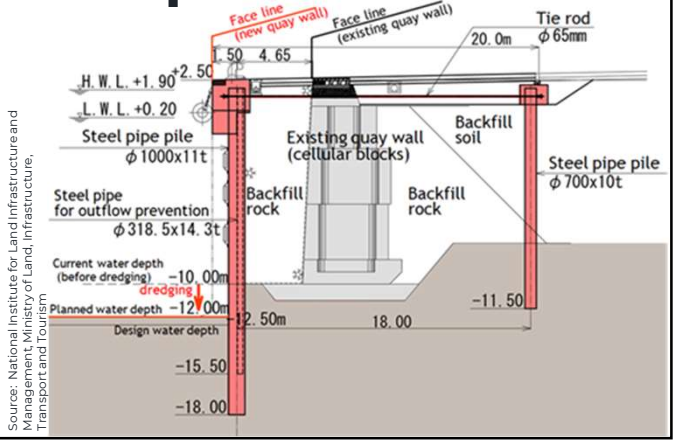
# MarCom WG 164 Update – Upgrade of Port Berths by Increasing Dredged Depth

**PIANC – APAC 2022**
**Date: 4-7 September, 2022**
**Subject: MarCom WG164 Update**
**Presenter: Michael Coull**




Source: National Institute for Land Infrastructure and Management, Ministry of Land, Infrastructure, Transport and Tourism

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## Introduction

This WG will be providing a guideline document that assists the port community with understanding the issues and approach to be taken for increasing the dredged depth at existing facilities.

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## Status

The Working Group was initially formed in 2016.

After a long interruption of the Working Group, the activities resumed in mid 2021.

Two coordination meetings (via videoconference) held.

## WG Makeup

The Working Group currently consists of 13 members covering very diverse skills (harbour engineering, structural, operations, geotechnics, dredging, etc) and scattered across the globe (Australia, Belgium, Germany, Japan, Portugal, the Netherlands, Spain and United Kingdom).

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## WG Members

Juan Ollero, Inros Lackner SE, Germany

Bauduin, Christophe, Besix, Belguim

Michael Coull, WSP, Australia

Gonzalo Aivar, Proes Consultores - Grupo Amper, Spain

Sandra Burg, WTM Engineers, Germany

Luiz Paulo Ferreira, Administração dos Portos de Sines e Algarve, Portugal

Masafumi Miyata, Ministry Infrastructure, Japan

Takaaki Mizutani, National Institute of Maritime, Port and Aviation Technology, Japan

Ian Lewis, Ramboll, UK

Martin Maloney, Anthony D Bates Partnership, UK

Alfred Roubos, Port of Rotterdam Authority, The Netherlands

Gert Schotanus, Delta Marine Consultants, The Netherlands

Annelies Van de Sijpe, Jan de Nul, Belgium

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## Introduction

The deepening of berth structures is very complex because each marine structure and the terminal facilities are unique.

The design of port facilities are to a high degree dependent on the existing subsoil conditions and the planned port operations. Additionally construction methods in the marine sector are very diverse.

Each project is unique.

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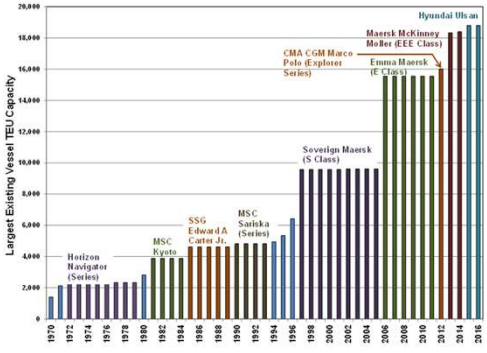
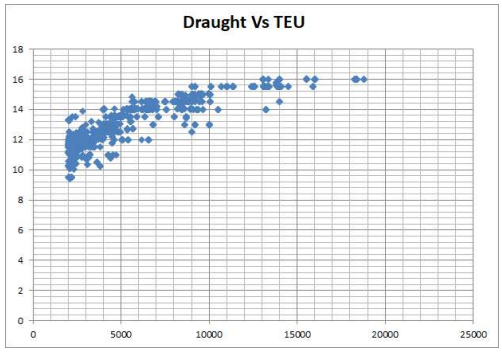
## The arrival of larger vessels is the driver for increasing berth depth




Charts for increase in container vessel size and drafts

**A change of use in a berth may also be a driver for increasing depth.**

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## Report Contents

The guideline, following the Terms of References, deals with the following topics:

- survey and assessment of existing structures
- reliability and serviceability criteria for the geotechnical and structural aspects taking into consideration increased service life
- alternatives for geotechnical and/or structural improvement techniques according to structural type, ground conditions and dredging operations to be performed
- dredging techniques and constraints according to soil conditions and structural types
- consideration of extreme events i.e. earthquakes in design and setting safety and performance criteria
- geotechnical and structural design criteria for the adaptation of the facilities to a deeper harbour bottom
- tools for addressing the geotechnical and structural questions with focus on soil-structure-interaction
- different technologies for soil and structure improvement;
- dredging alternatives

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## Table of Contents



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## Details

The existing standards and recommendations regarding structural and geotechnical issues in the port engineering field and especially those concerning the upgrading of existing structures will be reviewed.

The engineering and construction process for the deepening of the harbour bottom in front of existing quay structures can be arranged in different steps as illustrated in the next slide

The diagram is very generic and might not reveal the whole complexity of the task to be dealt with, but it can be considered as the core of the guidelines.

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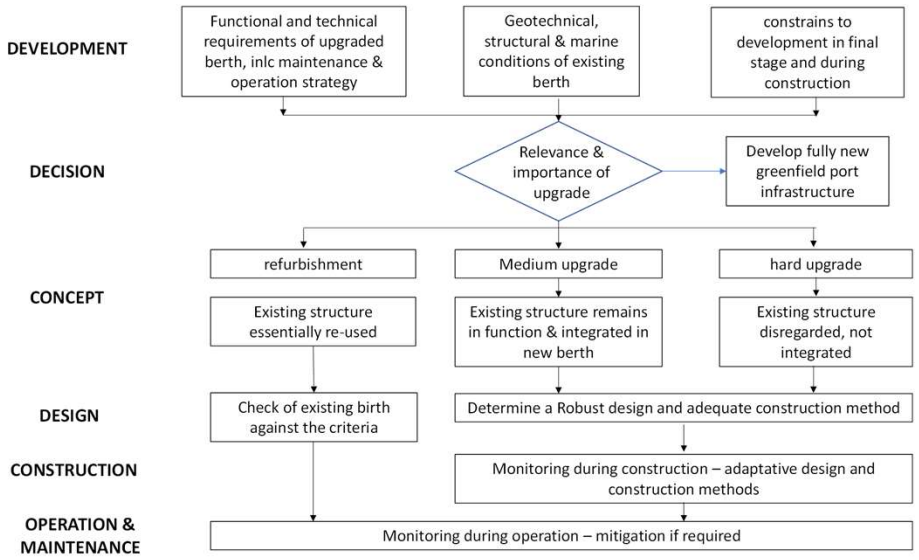
## Engineering and construction process for the deepening of the harbour bottom in front of existing quay structures




Source: Bauduin, C. , Mengeot, P., Ganne P. (2017) "Design and construction issues for deepening and strengthening of existing quay walls" Proc 19th International Conference on Soil Mechanics and Geotechnical Engineering, Seoul 2017

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## 1. Development

Inventory and assessment of existing conditions and boundary conditions, and setting of the functional and technical requirements to the design and construction method.

Existing conditions:

- geotechnical conditions,
- condition of the existing quay wall and scour protection and
- state and conditions of surroundings that might be affected by the deepening and (re)construction works.

OC1
OC2

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## 1. Development

The functional requirements and technical criteria set for deepening and to the quay wall.

- Dredging level and maintenance & intervention levels
- Ships expected at the quay and manoeuvres , - bollard and fender load, erosion potential
- Intended use of the quay wall and loads to be carried by the quay wall

The operational conditions during the deepening and upgrade works:

- accessibility of ships to nearby berths,
- limited interruption of the use of the basin or quay wall during the deepening and refurbishment works.

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**Slide 11**

**OC1** Suggest to use for hyperlink: https://www.portvancouver.com/projects/habitat-restoration/
Olson, Charlotte, 29/08/2022

**OC2** Minor edits in red for consideration :)
Olson, Charlotte, 29/08/2022

## 1. Development

The different questions to be asked during the development and design process

| Design Questions | Criteria |
|---|---|
| Which area is available for upgrading? | General layout |
| | Type of upgrade/new structure |
| | Quay wall type |
| How long does the structure need to be operational? | Design life |
| | Repair and maintenance |
| Which capacity is required for the renewed port? | Dredging depth and width of access channel |
| Which design vessels are taken into account? | Dredging depth at berth |
| | Erosion risks/Scour protection |
| | Quay infrastructure: bollards, cranes, handling and storage area, ... |
| Which design code/standard should be applied? | Design approach/Safety level |
| Which physical/environmental conditions have to be taken into account? | Metocean data (wind, water levels, waves and currents) |
| | Geotechnical conditions |
| | Extreme events: vessel impact, sea level rise, earthquake, tsunami, ice loads, ... |
| | Physical and environmental issues |

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## 1. Development – operational requirements

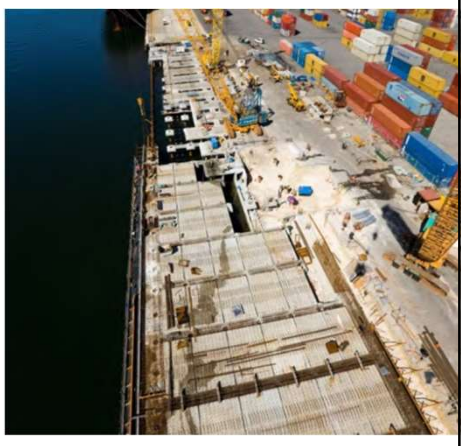
Operational requirements are key factors in the planning, design, and the selection of construction methods

Execution of works on the quay or in the docks will affect the Port operations by:

- disturbing or temporarily interrupting land or vessel traffic,
- affecting waterborne traffic at the berth(s) and waterway access routes
- affecting logistic capacities on the quay and the inlands facilities

Execution of works increase safety risk due to:

- non-usual conditions for Port personnel, for contractors personnel
- interference of construction activities with Port activities



Source: Freemantle Ports

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## 1. Development - Operational requirements

The operational conditions may need:

- the construction of temporary facilities, such as temporary dolphins,
- staging of works to allow at least part of the quay or dock to be used
- flexibility to interrupt works

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## 2. Decision - assessment of type of upgrade

Depending on the existing design and future water depth and loading conditions, the geotechnical and structural assessment of the existing structure and the boundary conditions, three main types of upgrade exist:

- Refurbishment
- Medium upgrade
- Hard upgrade

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## 2. Decision - assessment of type of upgrade

Refurbishment

- In a refurbishment, the existing quay wall is essentially re-used without far going repair or strengthening works.
- This option is restricted to situations of limited deepening and existing structures in adequate conditions, or
- to deepening in front of structures of which the design anticipated already some future deepening.

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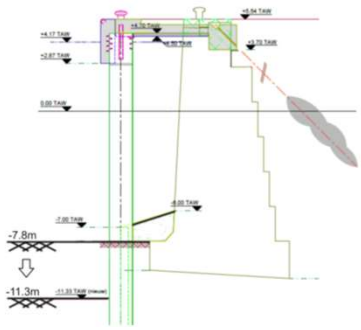
## 2. Decision - assessment of type of upgrade

Medium Upgrade

- the existing structure is partly or entirely integrated in the new design, still having an important retaining or load bearing function.
- Strengthening works or significant repair of the existing structure can be needed to ensure it functions with required level of safety and durability.
- Usually the cope line of the upgraded structure is the same or displaced up to a few meters compared to the cope line of the original quay




Source: Besix, Belgium

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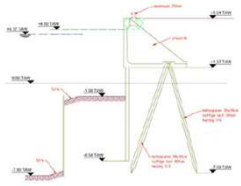
## 2. Decision - assessment of type of upgrade

Hard Upgrade

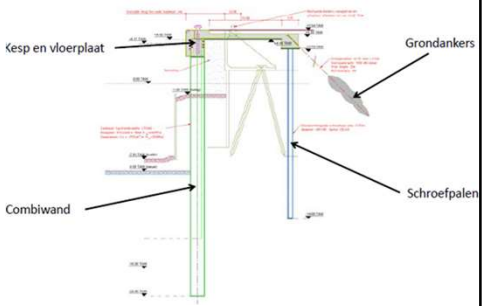
- existing structure remains (partly) in place, but does not have a structural role.
- new structure is realized “around” the existing one. Usually the cope line of the quay is moved seawards several metres



Source: Besix, Belgium

Completely new structures:

- located several tens of meters ahead or behind the existing structure
- may require demolition of the existing structure




Source: Besix, Belgium

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## 4. Design of the solution - refurbishment

- The emphasis of design depends on the selected type of refurbishment, the deepening (dredging) technique and scour protection:
- Emphasis on verification of the existing structures to the ultimate and serviceability limit states for the modified situation.
- includes geotechnical checks (eg bearing capacity), structural verifications and durability assessments.
- The design results in specification for the execution and repair works if needed, and to new quay wall equipment where relevant

- **Requires a reliable assessment of the state of the existing structure**
- **Requires a sufficient structural state of the existing structure**

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## 4. Design of the solution - medium upgrade

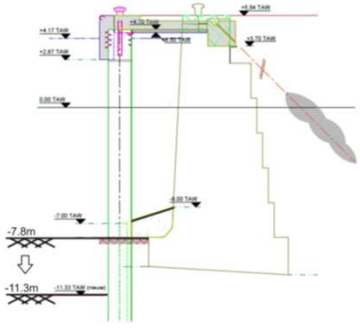
Is usually complex, as it includes assessment of the existing structure and the design of integrated existing and new structure elements.

The design output consists of:

- design of new elements,
- of strengthening to the existing structure and
- specification on the integral execution of the works.

Constructability to be evaluated continuously during the design development.

The design should include an amount of robustness depending on the reliability of the available geotechnical and structural information to encompass unexpected or deviating conditions that may appear during construction.




Source: Besix, Belgium

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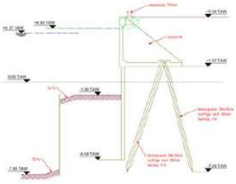
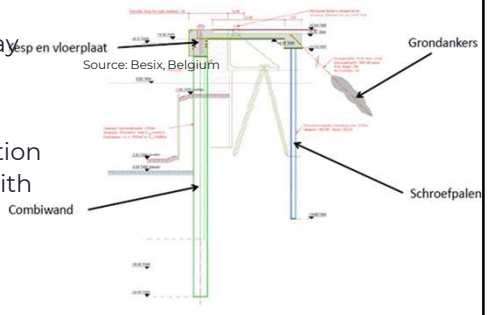
## 4. Design of the solution – hard upgrade

- the existing structure is not integrated but has to be passed over and around by the new one,
- may include some difficulties but is not hampered by the uncertainties concerning the existing structure.
- attention required to the constructability of the new structure, and
- the effects of construction techniques as they may damage but not lead to failure of the existing structure
- design of the deepening works, the scour protection and the selected dredging techniques interact with the design of the quay.



Source: Besix, Belgium




Source: Besix, Belgium

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## 5. Monitoring during construction period

Monitoring during the construction stage is an important measure to reduce risk and to validate design and construction assumptions, especially for medium upgrade projects. The monitoring program, including observational methods, should already be included in the design stage.


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## Case Studies

- The report will be rounded off with interesting case studies.
- These demonstrate the various possibilities that have already been successfully implemented in many different countries and considering different boundary conditions.
- Additional case studies will be included as the report gets finalised.

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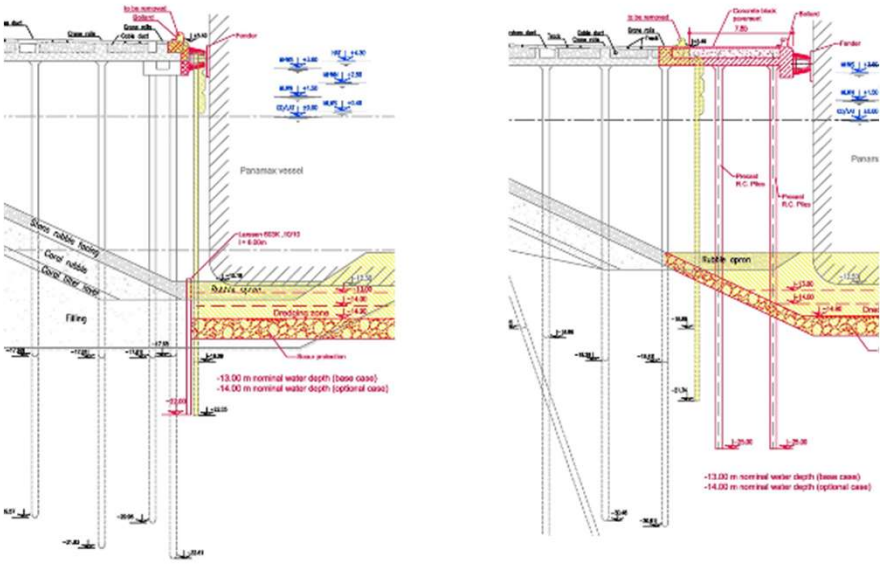
## Case study – deepening of a deck on piles



Source: Inros Lackner SE, Germany

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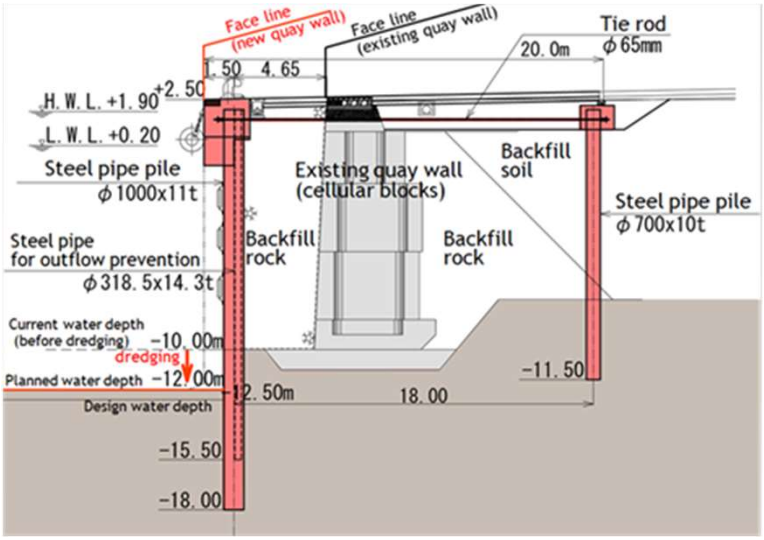
## Case study – deepening in front of a blockwork wall




Source: National Institute for Land Infrastructure and Management, Ministry of Land, Infrastructure, Transport and Tourism

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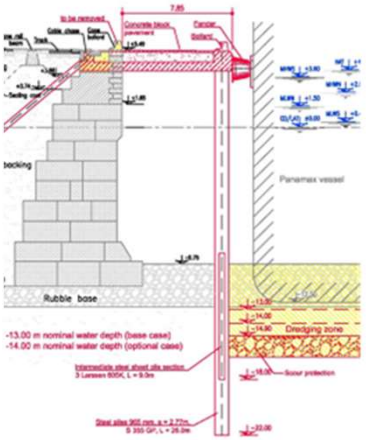
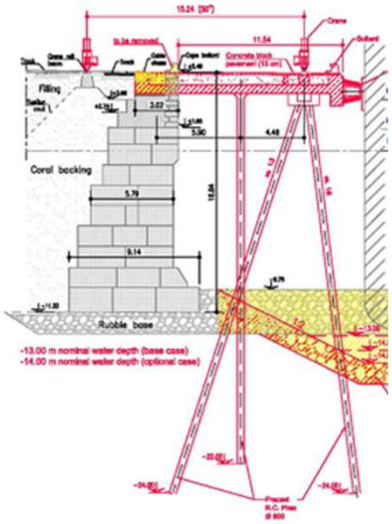
## Case study – deepening in front of a blockwork wall




Source: Inros Lackner SE, Germany

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## Conclusion

It is anticipated that the draft Guideline will be completed in 2023

The Guideline will assist port owners, port engineers and designers when considering and implementing deepening of berths at existing facilities

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