



## **Upgrade of Port Berths by increasing dredged depth**

### **Terms of reference**

#### 1. Historical background – Definition of the problem

Existing Port Infrastructure often needs to be adapted to new operational requirements owed to changes in use of terminals or improvements in ship size and capacity. Environmental and cost concerns require that upgrade of existing port structures needs to be considered as a preferred option when compared to Port extensions.

In this context, the need to increase depth in existing wharves at the toe of existing structures is nowadays a common challenge for Ports.

When dredging has to be performed near structures that need to be fully operational with the increased draft, a set of complex technical problems arises in addition to geotechnical considerations related to standard dredging projects due essentially to soil-structure interaction. Soil improvement and structural upgrading works often need to be performed. Additionally, increased depth at the toe of structures usually entail higher operation loads (mooring, berthing, cranes ...) and sometimes also storage loads on the structures due to the need to berth larger ships.

Main problems are: setting reliability criteria for design, inspection and assessment of existing structures, geotechnical stability, soil-structure interaction, structural design, comparison of alternatives for appropriate upgrading of structures and foundation, usually involving geotechnical and structural works, closely related to the typology of the berthing structure, definition of minimum impact dredging methodologies and finally additional problems such as scour protection.

Design of upgraded Port Berths needs to take into consideration extreme events such as earthquakes and other related loads. Also Port Berths improvements need to take into consideration the effect of climate change and related sea-level rise.

#### 2. Objective of the Working Group

The objective of the Working Group is to provide guidance to port and terminal owners, designers and dredging and contractor companies in order to address the problem of upgrading existing terminals when increased depth is needed at the toe of the structures. Guidelines and Recommendations issued by the Working Group have to be considered as additional to existing Standards related to geotechnical and structural aspects involved.

The Working Group will provide guidance on the following subjects:

- criteria for survey and assessment of existing structures;
- criteria for setting 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.

Real experiences will be studied in order to provide background on Case Studies.

### 3. Earlier reports to be reviewed

PIANC Working Groups on related issues that will be taken into consideration are:

- EnviCom WG 100 - *Dredging Management Practices for the Environment.-A Structured Selection Approach*;
- MarCom WG 103 – *Life Cycle Management of Port Structures. Recommended Practice for Implementation*;
- MarCom WG 144 (Ongoing) – *Classification of soils and rocks for the Maritime Dredging Process*;
- MarCom EG 160 (Ongoing) – *Overview of Design Codes and Guidelines for Harbour Structures*.

### 4. Matters to be investigated

Geotechnical and structural design criteria for modernization of existing infrastructures, tools for addressing geotechnical and structural problems with emphasis on soil-structure interaction, best available technologies for soil and structure improvement, dredging alternatives. Consideration of the effects of extreme events loads such as earthquakes in the design of upgraded structures.

Effects of sea-level rise induced by climate change needs to be considered in the design process.

### 5. Method of approach

Review existing standards and recommendations regarding structural and geotechnical design, focused on requirements for upgrading existing structures, bibliography, analysis of main geotechnical, structural and soil-structure interaction problems involved, effect of extreme events and sea-level rise, available technologies and analysis of case studies with special focus on design and construction criteria and final results achieved in several case studies.

### 5. Suggested final product

The final product of the Working Group will be a structured set of Guidelines and Recommendations for addressing the problem of increasing depth at the toe of structures by dredging, ranging from the understanding of the problem, definition of alternatives consistent with the structural type and soil conditions, conceptual and detailed design and , finally, implementation.

### 6. Desirable disciplines of the members of the Working Group

Disciplines that should be covered by the Working Group are: port or terminal owners, experts in engineering design (soil mechanics and structural design of port facilities), contractors, companies specialized in soil improvement techniques and dredging companies.

### 7. Relevance for countries in transition

The final product will help countries in transition by providing decision and engineering tools that will enable modernization of existing and sometimes obsolete port facilities