

Design and Construction of Breakwaters on Soft Seabeds – MarCom WG205 Update

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Summary

PIANC's MarCom WG 205 has been preparing a technical report titled "Design and Construction of Breakwaters on Soft Seabeds". This technical report is now progressing to a draft stage with assistance of contributing authors from across the globe. This author is contributing to the report as the lead for Chapter 2 and as a representative for the PIANC Australia and New Zealand. This presentation will consider the terms of reference for the working group, provide an overview of the report contents, review progress towards publishing and discuss how you can contribute.

Keywords: breakwater, soft soils, data collection, geotechnical design, risk management

Background

Soft seabed layers are frequently observed in coastal areas because of the active deposition phenomenon. These deposits include unconsolidated muddy, soft silt and/or clay, loose sand, and multilayered ground. Design and construction of breakwaters on seabeds are associated with many problems like sinking of rock into the seabed, general instability, large settlements, and complex behaviour under seismic loads.

There are some strategies for dealing with the aforementioned problems: pouring rock without any special action (gravity replacement), dredging and replacement of soft soil, basal reinforcement by sand mattresses and/or geosynthetics, preloading, ground improvement (e.g. sand compaction, rock or grout piles, deep mixing and jet grouting), and staged construction (to allow consolidation of soft foundation layers).

Improvement of soft clayey seabeds is challenging and expensive. Therefore, the method dealing with soft seabeds must be carefully chosen. Although codes, standards and literature have general recommendations in this regard, there is a lack of technical guidelines for selecting effective and optimum approach(es) for different circumstances.

Introduction

PIANC Maritime Commission (MarCom) has established a Working Group (WG 205) to prepare a technical report addressing the design and construction of breakwaters on soft seabeds. This working group is now progressing towards a draft version of the report. This presentation provides an overview of the working group, the scope of the report, progress made to date, some key findings and how you can contribute.

Working Group Membership

The working group includes members from the PIANC members across the globe with backgrounds in:

- Marine consultants and contractors;
- Port managers and operators
- Maritime authorities and regulatory bodies
- Professional organisations.

The countries represented include Argentina, Australia, Belgium, Denmark, France, Iran, Japan, Netherlands, Spain, United Kingdom and United States of America.

As with all international working groups the inclusion of a diverse range of experiences is valuable to ensure the report has a comprehensive approach and the findings have wide application. However, it is challenging for the organisers to manage the contributions. With this in mind, it is worth noting three key members of the working group are:

- Chair – Prof. Yoichi Watabe of Hokkaido University;
- Mentor – Yoshiaki Higuchi of Oriental Consultants Co. Ltd.; and
- Secretary – Dr. Hidenori Takahashi of Port and Airport Research Institute (PARI)

Scope of Report

The Working Group has been investigating the geotechnical issues relating to breakwaters on soft seabeds such as unconsolidated muddy, soft silt and/or clay, loose sand, and multilayered grounds. The working group has included assessment of replacement and base reinforcement approaches like gravity replacement, sand mattresses and geosynthetics, and ground improvement. In this regard, the settlement of rock into seabeds and its reduction by application of sand mattresses and/or

geosynthetics will be of concern. Static and dynamic stability of breakwaters with and without basal reinforcement and anticipated consolidation settlement of breakwaters will be studied.

A quick overview for each chapter in the report is provided below. The contentment's of the chapters will be discussed in more detail during the presentation.

1. General Aspects

This is an overview chapter setting out scope of the report and contents. It also acknowledges the contributing authors and make-up of the working group.

2. Geotechnical Characterisation of Site

This chapter addresses the different settings where soft sediments exist and the collection of data required to characterise sediments. Finally, it sets out the laboratory analysis that should be used to identify various key design inputs.

3. Design considerations on breakwater types

Issues with soft sediments and resulting failure modes for breakwaters constructed on soft seabeds are examined. From this an assessment of how different types of breakwater design respond to the failure modes is discussed. The chapter also looks at the various loads impacting breakwaters and tools available that can be used to assist in the assessment of breakwater performance.

4. Construction considerations on breakwater types

The transition from design to construction is discussed with an overview of how soft sediments impact the works with risks and issues impacting decisions. Materials and equipment plus the logistics of constructing over soft sediments are addressed

5. Existing codes, standards, and guidelines

In this chapter relevant codes, standards or guidelines in use around the world are identified. This is intended to guide readers towards text that will provide appropriate practice guidance in various jurisdictions.

6. Stability and settlement analysis

Analysis of the response of soft sediments to the loading of the breakwater are discussed in this chapter. This includes theories for assessment and modes of analysing the responses

7. Ground conditions improvement and reinforcement

A major feature of breakwaters constructed on soft sediments is how will ground improvement be realised. This chapter examines various techniques

utilised to improve foundations and approaches to selecting the most appropriate one.

8. Monitoring

Due to the response of the foundations breakwaters on soft sediments often undergo ongoing changes and movement. In this section the ways of monitoring the movements and impacts over time are discussed.

9. Conclusion

The conclusion provides a wrap up summary and draws together the findings of the technical report.

Progress

At the timing of preparing this abstract it is anticipated the draft of the report will be ready for submission to PIANC by the end of 2022.

How Can You Contribute

As drafting of the report draws to an end a key area where we could use input from the broader industry is in the provision of Case Studies. For this we are looking for projects where soft soil issues have been encountered and how these were assessed and treated, and what was the outcome. If you have a suitable project please contact the author.

Acknowledgements

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