



ADVANCED DESIGN OF PORT AND MARINE STRUCTURES

DESIGN SERVICES FOR THE EMPLOYER OR CONTRACTOR

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RAMBOLL

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RAMBOLL HAS VAST EXPERIENCE WITH THE DESIGN OF ADVANCED PORT AND MARINE STRUCTURES FROM PROJECTS WORLDWIDE.

Ramboll has through a various number of projects around the world gained wide experience with the design of advanced marine structures. Ramboll offers a design which is optimized with regard to material use, fabrication and installation cost, as well as operation and maintenance cost. Furthermore, limiting the environmental impact is an integrated part of the design process.

Port and Marine structures

Ramboll has experience with design of all types of marine structures:

Sheet Pile Quay Wall

Steel sheet pile wall with a concrete capping beam on top, with one or more anchor levels consisting of stretch, anchors and anchor heads.

Diaphragm Quay Wall

Reinforced concrete wall cast in a deep ditch with a capping beam on top, anchored with a tie rod to a structure of piles, a barette wall or a dead man.

Block Quay Wall

Precast concrete blocks stacked on top of each other and thereby forming a wall which is stable by its deadweight.

Concrete Caisson Quay Wall

Precast concrete caissons placed in a line, forming a quay wall. The caissons are typically cast in a dry dock, on a barge or similar, floated to the site and filled with ballast. The caissons can if necessary be anchored by a tie rod and a dead man.

Gravity based foundations for offshore wind turbine generators

Concrete structures casted on land, transported to sea and lifted in place, where it is filled with ballast material.

Gravity based foundations for offshore transformer stations

Precast concrete caisson, floated to the site and filled with ballast. On top of the concrete caisson a steel transition piece which carries the topsite structure will be placed. The foundation additionally consists of secondary structures such as boat landing, fenders, J-tubes etc.

Design process

Marine structures are often highly complex, and the design requires a wide range of competences. Ramboll has the expertise to cover the entire spectrum of disciplines required for the design of marine structures. The most important aspects of the design are:

Geostatic analysis

The geostatic analysis contains soil bearing capacity, stability, settlement analysis etc.

Structural design of steel and concrete structures

The structural design of steel and concrete structures are carried out by numerical modelling. The design comprises of ULS, SLS, FLS, ALS as well as seismic analysis.

Floating stability

For floating structures, the depth of immersion as well as the stability is analyzed.

Software

Besides various kind of specialized in-house developed software programs, Ramboll uses the following commercial programs for analyzing advanced marine structures:

Plaxis 3D

PLAXIS 3D is a finite element package intended for three-dimensional analysis of deformation and stability in geotechnical engineering. It is equipped with features to deal with various aspects of complex geotechnical structures and construction processes using robust and theoretically sound computational procedures.

LUSAS

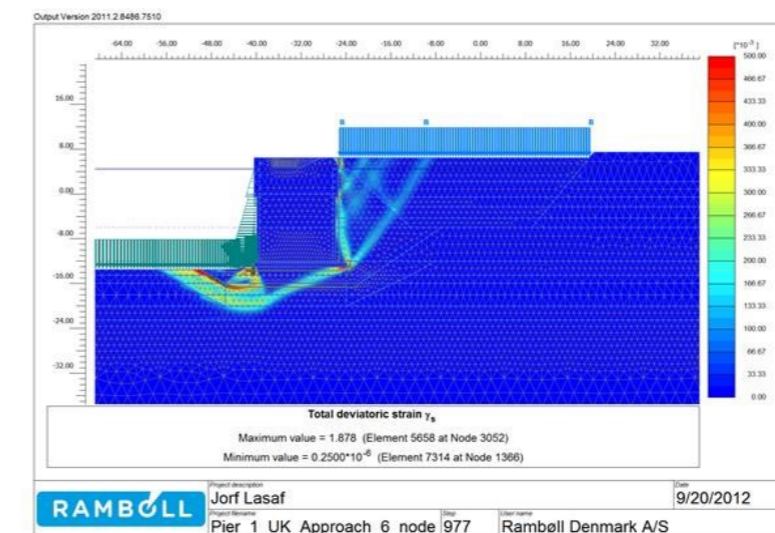
LUSAS is a world-leading finite element analysis software application for the analysis, design and assessment of all types of structures.

D-sheet

D-sheet is a tool used to design sheet pile retaining walls. D-sheet automatically calculates the optimized length for a retaining structure. D-Sheet Piling verifies the safety of the sheet pile wall for selected construction stages. The stability of the anchor wall is checked according to the Kranz theory. A Bishop slip-circle analysis is used to check the overall stability of the wall and soil.

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Port of Jorf Lasfar (Morocco)

Frontpage and upper photo

Ramboll has carried out detailed design for remedial and extension works at the Port of Jorf Lasfar in Morocco. The work includes rehabilitation and increasing the draft of 6 existing quays and construction of seven additional quays.

Ramboll has carried out all detailed design work for the site including: Remedial works and durability design, Quay wall design, Concrete caisson design, 2D & 3D Plaxis Modelling, Revetment & scour, Design of M&E works, Drainage design, Design of crane rails, Planning of Dredging works.

Ramboll has been working for the EPC Contractor.

Port of Beirut (Lebanon)

Lower photo

Ramboll has been responsible for all design works related to the expansion of the new Quay 12-14 - including the construction of a new 500 m long deep water block quay wall, dredging works in front of the new quay wall, reclamation of the old harbour basin to make space for an additional 20 hectares container terminal, as well as new fenders, bollards, crane rails, pavements.

Ramboll has prepared detailed design for the Contractor and participated in the Approval process with Port of Beirut.