

PROJECT SHEET

NORTH MANAMA CAUSEWAY
SUSTAINABLE BEACH CONSTRUCTION AND LAND RECLAMATION
KINGDOM OF BAHRAIN

INTRODUCTION

The contract for the North Manama Causeway project, situated in the Diplomatic area north of the capital Manama in the Kingdom of Bahrain, was secured by Boskalis Westminster Middle East through an open public tender process. A variation to the original contract scope required the design optimization and construction of a land mass which included a reclamation, revetments, five breakwaters, a dredged navigation channel and storm water outfalls. The purpose of the project was to provide additional land to accommodate a section of a proposed new highway system to service the area and to relieve congestion on the corniche road. Boskalis appointed Hydronamic (the in-house engineering department of Boskalis) to provide detailed design and on site assistance with supervision of the sub-contractor for the rock works.

The integration of Hydronamic engineers into the Project Team brought together the technical insight and knowledge of the design team and the practical knowledge and experience of the Contractor. The project team developed innovative ideas to optimize rock protection design, leading to a successful and efficient construction with significant cost savings to the project.

A Overview of project, September 2009



FEATURES

Client	Ministry of Works & Housing
Location	Kingdom of Bahrain
Period	2005 - 2009



B Location map

OPTIMIZATION DURING DESIGN AND PREPARATION PHASE

The contract variation was awarded on a lump sum basis and called for the design and construction of the land reclamation and associated rock and auxiliary works. Engineering department Hydronamic were engaged to execute the conceptual, preliminary, and detailed final design of the breakwaters and rock protection.

The Environmental Impact Assessment (EIA) was prepared by Hyder Consulting. Hydronamic developed an Environmental Management Plan to meet the requirements set out in the EIA, and the Project Team implemented the plan during construction.

INNOVATIVE SAND BERM SOLUTION

Taking into consideration the abundance of sand in the area and the relative scarcity and cost of suitable armour rock, Hydronamic designed a sand berm solution for the deeper sections, using rock protection for the shallower sections only. The rock protection was made up of rock armour with a 0.3-1 ton grading, quarry run with a 1-300 kg grading and an under layer with a 5-40 kg grading. As a direct consequence of this design the original total rock requirement for the project was reduced by approximately 50 per cent.

INTRODUCTION PUBLIC BEACHES IN BAHRAIN

The northern part of the land reclamation (see figure A and C), was originally designed with rock revetment. In August 2007 Boskalis proposed an alternative to this original design by introducing two beaches, one to the west and the other to the north (see figure B). The beach slope of 1:12 performed according to design requirements. Four breakwaters (see figure C) were necessary to maintain a stable beach profile. Hydronamic was engaged to produce the detailed design of the revetment and the breakwaters. The design was optimized by using a rock revetment with a sand slope of 1:1.5. The beach and rock revetment solution resulted in a successful and efficient construction with significant cost savings to the project.

An additional benefit of the introduction of beaches was the improved aesthetic appeal to the public as there was a distinct lack of public beaches in Bahrain.

CONSTRUCTION

The sand material used for the reclamation works was sourced from approved marine borrow areas. The reclamation work was performed using the Trailer Suction Hopper Dredger Coastway, the spreader pontoon Liftnix as well as auxiliary equipment.

The navigation channel (see figure C) was excavated with land based equipment, this was made possible by making successive bunds and dewatering the area. This work method was also the most environmentally friendly way of performing the work, as it reduced the amount of fines in the water.

During construction Hydronamic was responsible for the Engineering Management and for ensuring the Quality Assurance of the reclamation and shore protection works. The rock protection works were sublet to local contractors under the supervision of Boskalis.



C Overview of the North Manama Causeway contract scope and variation orders

ENVIRONMENTAL MONITORING

Environmental Monitoring was performed by a specific project Quality Assurance team during construction. The threshold limits were very strict. Due to the close cooperation between the reclamation construction and the quality assurance teams the performance with regard to minimizing environmental impact was excellent during the work. The good sand quality delivered to the site with low fines percentage (<4%) contributed to Total Suspended Solids levels in the water that were on average well below the threshold limits.

ENGINEERING TOPICS

During the preparation and construction of the project several engineering issues were addressed by Hydronamic. These included the following:

- Feasibility of the sand berm solution to a level of -3m CD
- Detailed design reporting including drawing up of specifications
- Site supervision work ensuring adherence to design and specification during construction
- Establishing practical guidelines during construction
- Comparisons of theory versus practice
- Design evaluations and optimizations during construction
- Feasibility studies of alternative beaches and breakwaters
- Implementation of practical Risk Management during construction
- Review of rock armour quality supplied by Bahrain quarry Askar
- Lessons learnt with rock quality control
- Successful implementation of sustainability goals (reduce paper, reduce waste, reduce gasoline)

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