

PROJECT SHEET

SHAIKH KHALIFA BIN SALMAN CAUSEWAY PORT AND WATERWAY ENGINEERING, PROJECT DEVELOPMENT

INTRODUCTION

The Shaikh Khalifa Bin Salman Causeway is located in the State of Bahrain in an expanse of the inlet called the Khawr Al Qulayah. It connects the Hidd Drydock Highway to the Mina Sulman Port. This major infrastructure project is carried out in advance of the planned expansion of the Bahrain port activities. This New Port project is planned at the Hidd side and via the Shaikh Khalifa Bin Salman Causeway direct connected with the existing Mina Sulman port and Saudi Arabia.

The total length of the Shaikh Khalifa Bin Salman Causeway is approximately 6,500 m, including a bridge of 400 m, which was planned for construction in the year 2000. The project for the land reclamation and slope protection works was awarded as a lump sum Design and Construct Contract and executed under a full Quality Assurance system. The Client was represented by a team of his own staff, which had the task to control the Contractor's procedures as laid down in the Project Quality Plan and randomly attend the numerous testing procedures.

As a result there was no Engineer involved in this contract. During the preparation stage of the project Hydronamic has been involved in the review and optimisation of the design as laid down by the Client in order to advise Boskalis Westminster Middle East for taking over the design responsibility in the contract. Later on during the construction phase, Hydronamic assisted on site by the implementation of the quality system, the execution and interpretation of testing procedures, the reporting, planning and several design and engineering issues.

FEATURES

Client	Ministry of Works
Location	State of Bahrain
Period	1997 - 1998



A Location map

B TSHD Nautilus and Tug BKS 292

C Aerial view







THE DESIGN

During the development phase and negotiations, Boskalis Westminster Middle East, advised by Hydronamic, offered an alternative solution for the construction of the project. Because of the existence of a very soft toplayer, slope stability problems were encountered for the adopted 1:1.5 slope and also large settlements were calculated which resulted in a high percentage of losses of both rock and sand. In the alternative design a soil improvement was proposed in which the soft (unsuitable) material was excavated and replaced by sand and in addition the construction of a sand berm to a level of -3m Chart Datum to reduce the quantity of rock. A geotextile placed on top of the sand berm was designed to prevent erosion of the sand berm.

With the support of Hydronamic, Boskalis Westminster Middle East convinced the Client on the technical and economical feasibility of this solution, which resulted in the award of a design and construct contract.

QUALITY ASSURANCE

Because of the absence of an "Engineer", the contractor had to work according a fully implemented Quality Assurance system. All procedures and responsibilities were recorded in the Project Quality Plan. Hydronamic assisted in the set up and implementation of the testing procedures in the QA system. The testing methods and intervals were established based on the specific demands of this project, taking into account the practical implementation. The test program comprised materials testing (rock in the quarry and on site, geotextile, sand), in situ testing (density, compaction, silt content) and the survey of sand and rock levels.

During construction Hydronamic reviewed all test results and reported these to the Client for his record and approval. In case of a Non-Conformance the remedial measures and actions to prevent repetition were reported as well. Being part of the QA procedures, Hydronamic prepared the weekly update of the planning called the rolling program. Every week the actual progress was updated and an overview of the activities and planning for the next two weeks was presented to the Client.

INTERIM PAYMENT CERTIFICATE

For the IPC a calculation method was developed based on the planning. Each month the actual planning was compared with the target planning and the amount to be paid was valued based on the actual planning (progress) in such a way that the actual forecast always closed on the Lump Sum value. This approach saved a lot of (monthly) measurements and calculations of volumes and a quantity surveyor as well and gave at the same time a forecast for the project finish date and the Client's liquidity flow until the end of the project.

ENGINEERING TOPICS

During the construction of the project several engineering topics had to be solved. Amongst others Hydronamic advised on the following items, without the intention to be complete:

- the extent of the soil improvement, including the follow up of additional soil investigation;
- the soil stability during construction, including calculation of the minimum time required between two successive sandfill lavers:
- the lay-out of the access channel for the Trailer Suction Hopper Dredger(s) at the Hidd side;
- solutions for non-conformances;
- investigation of sand borrow areas, including sampling;
- design and implementation of a cable landing construction in the project;
- follow up of the drawings for construction, including revisions and the as-built drawings;
- preparation and optimisation of work methods especially for the placing of sand in the berm with a spreader pontoon and the placing of geotextile on the berm.



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