

# Paper 72 - Waterways improvement of the Red River Delta (Vietnam): Design and construction of the Lach Giang River mouth

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**ABSTRACT:** A large program to renovate the waterways has been undertaken by the Vietnamese government. As part of this program, CNR and IMDC have designed and are in charge of the supervision of major works to protect the access channel and allow 3000T sea river units to enter in the Red River delta up to Ninh Phuc port.

## 1 INTRODUCTION

The Government of Vietnam has undertaken a large program of development and modernization of the Vietnamese waterways in the Red River Delta financed by the World Bank. Within this program, the PMU W is in charge of the waterway aspects of The Northern Delta Transport Development Project (NDTDP). The consortium CNR-Tractebel France and IMDC with a Vietnamese subconsultant VIPO has been selected to make the designs and supervise the work construction.

This project covers two of the three main waterway corridors in the Northern Delta Region:

Corridor 1:

Viet Tri – Hanoi - Pha Lai – Hai Phong – Quang Ninh;

Corridor 3:

Hanoi – Lach Giang Estuary.

More than 350 km of waterways are concerned by these modernizations.

The future waterways will be sized for 4X400T, 2X600T barges, 1000T sea-river vessels between Hanoi and Haiphong and for 3000T sea-river units between Ninh Phuc, the port of Ninh Binh city and the East Sea.



Figure 1: The different corridors of the Red River delta

The navigation at the mouth of the Ninh Co River, Lach Giang area, has been identified as a critical sector for navigation mainly due to the lack of minimum depth and due to the dynamic morphological changes happening in the area that require to adapt the navigation channel regularly.

The subject of this paper is to present the design phase and the construction under progress of a

structure which appears to be one of the major maritime structures in Vietnam.

## 2 DESIGN OF THE LACH GIANG BREAKWATER SYSTEM

### 2.1 Introduction

The starting point for the detailed design of the access channel at Lach Giang Mouth is the alternative proposed in the Feasibility Study (SMEC et al., 2008). The implemented alternative in the detailed design, performed by CNR and IMDC, comprises two breakwaters, three groins parallel to the breakwaters and a fourth long groin parallel to the Ninh Co River mouth. The aim is to allow navigation through an access channel lateral to the high morphological dynamic mouth of the Ninh Co River. The river outlet is constantly changing the shape of the sand bars and would make it difficult to predict their evolution.

### 2.2 Hydrodynamic and wave models

Metocean data assessment, hydrodynamics and wave modelling were performed to assess the average and extreme marine conditions for the design of the structures. Data collection and data analysis required special attention due to the fact that Lach Giang area is subjected to typhoons. The hydrodynamic conditions were assessed with assistance of a 2D finite element numerical model. For the analysis of the wave conditions, a wave numerical model with a three nesting approach was set-up. This wave model covers most of the Gulf of Tonkin and includes wind effect; it translates the offshore wave conditions in deep waters to nearshore conditions in shallow waters.

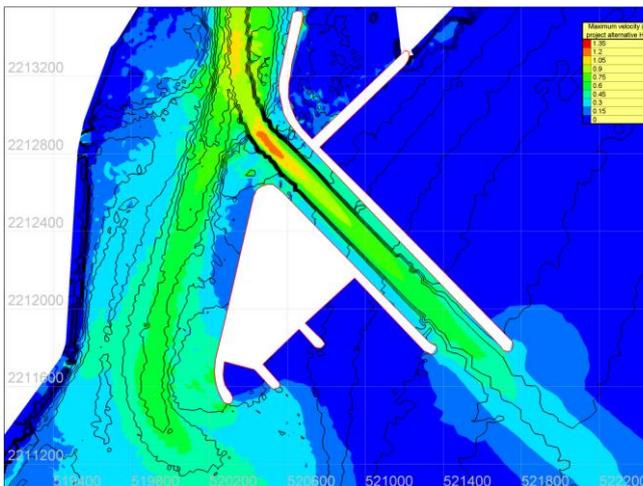


Figure 3: Maximum velocities for the Preferred Alternative

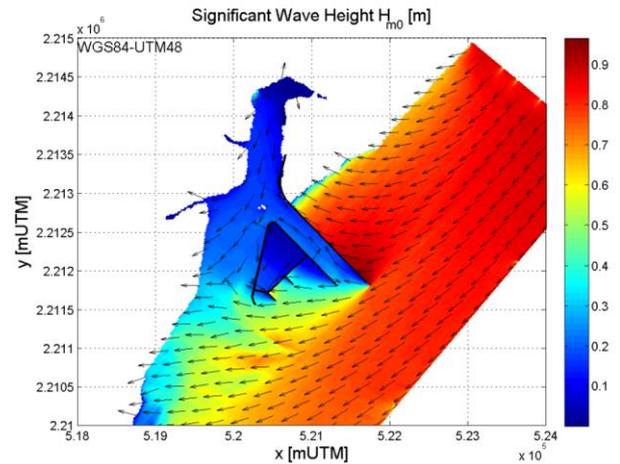


Figure 4: Significant wave height for winter monsoon

### 2.3 The design phase

The design of the breakwaters followed the Vietnamese and international standards. The final design of the structures was done with 2 layers of HARO units in the armour layer, based on an economical comparison with rock and other type of prefabricated concrete units. Furthermore, the orientation of the structures and their amount and length was optimized with the assistance of the numerical modelling.

During the detailed design phase of the project, the location of the structures proposed in the feasibility study has been moved 400m to the north, after learning from the new bathymetry survey (November 2011) that the area at the original location has been eroded and is deeper today than was originally thought. The new location of the structures is still through a sand pit which gives stability to the structures in such a morphodynamic area.

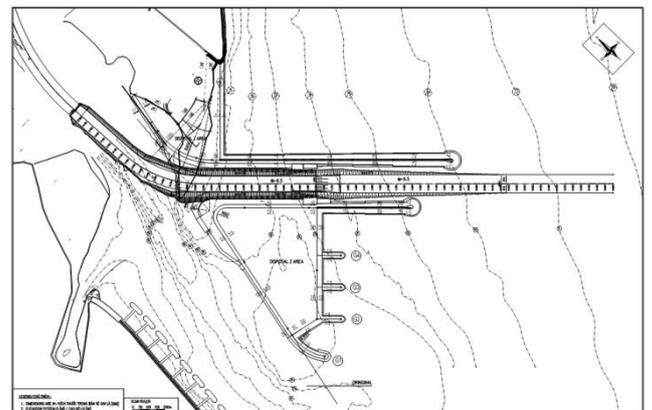


Figure 4: Final layout with 2 breakwaters and 4 groynes

### 3 CONSTRUCTION AND SUPERVISION PHASE

After the submission of the detail design reports and the bid documents for construction to the authorities, the client took in charge the tender procedure and decided about the packages distribution. A team of different contractors was selected and the different contracts were signed by the end of 2013 and beginning of 2014.

#### 3.1 Package distribution and organization

When the consultant started his supervision mission, he had to deal with 14 different Vietnamese contractors spread on 8 packages.

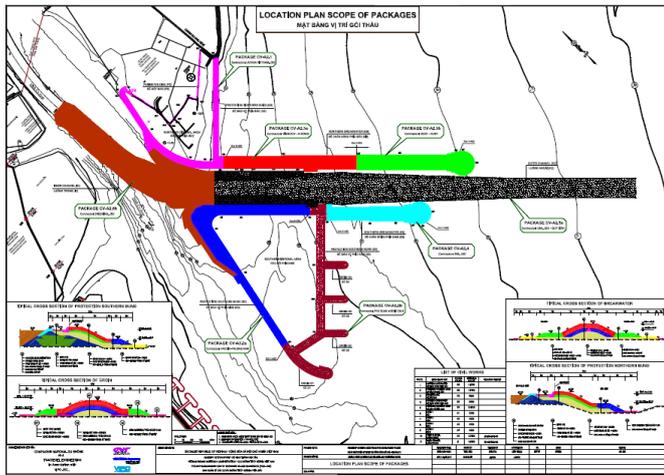


Figure 5: packages distribution

#### 3.2 Soil conditions

The structure will be located on soft clayey silt fifteen meter thick covered along the sea side by a sandy formation which disappears further. Deeper silts become less soft (but not compact anyway). The instantaneous expected settlements are of the order of forty centimeter on the stroke rating and increase progressively offshore as 60 to 85 cm depending on the sector and the relevant structures. A pilot sector has been installed to monitor the long term settlement.

#### 3.3 Main difficulties

Despite the fact that the contract, loaned by the World Bank was supposed to be in English, very few workers were fluent in English, generating the need that all the meetings and decisions had to be translated or transmitted through the Vietnamese subconsultant’s engineers.

The first 6 month of construction were devoted to site installation, execution drawings preparation and start of the concrete precast work. The real start of the construction operation really occur after 6 month and it appeared that none of the contractors, except

one, had a maritime experience. Their equipment was river equipment not suitable to maritime works.

The first role of the consultant has been to specify and to require the appropriate equipment which took 3 more months.

The other constraint for the works is a meteorological constraint, since the site is located in a region where severe typhoons occur between August and October.

The major challenge was to coordinate the 14 contractors who signed their contracts on the same time and had to face to the same construction delay.

According to the importance of the structure, the consultant decided to nominate a permanent expatriate on site. His principal role has been to detail step by step with each contractor the construction procedure and to follow with supervision engineers all the construction progress.

The construction of the armour structure designed with Haro blocks needed a special attention to assure its protection role coupled with wave energy breaker. The particularity of the Haro protection compared to tetrapodes or acropodes, is that the setting up of the units cannot be random. The core of the breakwater made of crush stone and rock fill should be adjusted such as the final layer of Haro respect the design constraint which are the crest height and width of the breakwater.



Figure 6 : Part of the north breakwater.

By June 2015, the work progress represents more than 65% and the goal is to complete the structure by the end of year 2015.

#### 3.4 Environment, safety, training and social impacts

The organization of such a large structure concentrating more than 200 hundred workers in a small city requires to take into consideration other aspects which are less technical:



- Safety.

Specific information and control had to be undertaken concerning safety equipment and procedures for workers who have few experience of maritime works.

- Environment and site cleanliness.

The consultant monitors the environment impacts off the works on water quality. The cleanliness of the site is a priority considering that a dirty site produce low quality work.

The consultant proposed mangrove restoration and forest plantation. A total of 200.000 trees are grown (2015) in 3 trees nurseries and will be planted on the 2 disposal areas under consultant supervision. It will allow to create 40 ha of coastal forest, to increase the local biodiversity and to offer sustainable resources of wood for local people.

- Workers training

To compensate the lack of experience of contractors, the consultant and the client had to reinforce their presence and to organize on site training sessions to insure the quality of the final work. Good results have been obtained thanks to a daily presence which allowed a good reactivity especially during the most critical phases.

- Human and social impacts

Since the beginning of the supervision phase in 2012, according to the World Bank recommendations, the consultant has supported, with the collaboration of a NGO, a medical program. This program consists in meetings organization during which workers representatives and local people were taught about the risk of sexual diseases and Aids. Concerning Lach Giang site, these meetings were coordinated with the local clinic staff.

#### 4 CONCLUSION

The Lach Giang maritime structure will be the first stage to open the waterways to 3000T sea river units and allow them to sail to the Ninh Phuc Port which has been renovated within the NDTDP project. The second step, which will connect the Ninh Co River and the Day River through a lock and a 1km canal, is still waiting for a final approbation.

The construction of the Lach Giang breakwaters designed with an armour layer of Haro blocks has been challenging, due to the implementation of the Haro units and the coordination of the numerous local contractors.

The human, environment aspects have also been considered on a site where more than 200 workers have to be integrated in the life of a small city.