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Structural measures to restore Cua Tung beaches, Quang Tri province

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Abstract. This paper presents the calculations using LITPACK models, aiming to select the restoration solution for Cua Tung beach, severely eroded in recent years. The results are just the preliminary, but they are useful to direct the optimal measures to bring the beach back to its original state serving the social and economic development in Quang Tri province.

Keywords: MIKE, LITPACK, erosion, cross-sections, sediment, coastline.

1. Introduction

Cua Tung beach of Quang Tri province was one of the most beautiful ones, attracting many visitors (fig.1a). In recent years, Cua Tung beach is increasingly eroded shrinking its width due to erosion in both scale and intensity, which leads to the loss of tourism (fig.1b). Social Economic Development Strategy of Quang Tri province puts tourism as a effective way to bring the province out of poverty, and the restoring the Cua Tung beach is an urgent task. Despite the fact that there are several assumptions about the causes of erosion (direct and indirect, long term and short term), there is still not a detailed study which confirms the solid scientific basis and can help for the construction of the project. In 2009, the Department of Natural Resources and Environment of Quang Tri province in collaboration with Hanoi University of Science set the research project named "Investigation and assessment of beach erosion Cua Tung, Quang Tri Province" in order to establish the scientific basis to determine the causes of beach erosion, and then to find out the solutions to overcome Cua Tung beach erosion.

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Fig.1. Cua Tung beach before (a) and now (b).

2. Research methodology

At present many coastal areas of the Vietnam are changing, not only Cua Tung but also the coastal areas of high economic value of the provinces like Quang Ninh, Hai Phong, Nam Dinh, Quang Ngai , Binh Thuan, Vung Tau .. which are at risk of landslides, bank erosion. Several scientific researches [1-4] have found that the subject we consider about is not new, but not easy to solve, and is still in research status. At Cua Tung, the coincidence of events after building the groin, fish port and bridge (fig.2) may lead to the argument that the groin was the main reason leading to beach erosion. The analysis of mathematical modeling results show that the groin had retained a large amount of sand that can be not only a part of channel filling, but can be added to the north beaches.

Fig.2. Combination of groin (left), bridge (middle), and port (right).

Traditionally, the following methods can be used:

- Data collection: observed hydrometeorological data at Con Co station updated to 2008, wind and wave data available at Cua Tung, topographic data, geological samples, geomorphological characteristics obtained by TEDI, aerial images.

- Field surveys: two periods (8 / 2009 and 4 / 2010), field trips before and after the storm No. 9 in 2009. These data are particularly important to the application of mathematical models.

- Collecting and processing public information: opinions of local peoples, photos, records in site, guides of local authority.

- Application of physical models and mathematical models. In this study, the LITPACK models has been applied, the basis of the theory can be found in [5].

Before using LITPACK model, MIKE 21 model was used to simulate the hydrodynamic patterns in the domain. The basic conclusions are: wave induced flows are dominant in the study area in comparison with the river and tidal flows, the construction of structures: bridge, groin and fishing port has changing the hydrodynamic conditions of flow regime in the region, particularly the groin pushes flow away towards the sea, at the same time making sediment transport have no opportunity to reach the beach directly than before.

LITPACK model has five main modules, four modules of it are applied in this calculation: STP-calculates sediment transport, DRIF- drift currents, LINE (similar to GENESIS model) -shoreline change, and PROF (similar SBEACH model)- bottom change. Basic inputs for these models are wave characteristics (height, period and direction) according to the wave climate event from 7 years (1961-1967) at Cua Tung, instead of Con Co station which is 34km far from coastline (fig.3). Calculated shoreline extends about 3km to the north and 3 km to the south of Ben Hai river mouth with a resolution of 10 meters, accompanied by three representative cross-sections for the north shore and the south shore. Source from the river sediment is considered small and not included, bottom sediments are non-cohesive sand with median diameter d_{50} = 0.27mm, sorting parameter is of 1.4.

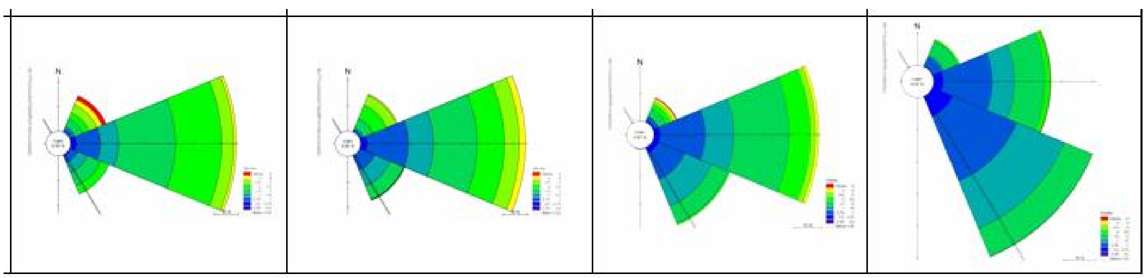

Fig.3a. Wave roses at Con Co in January, February, March and April.

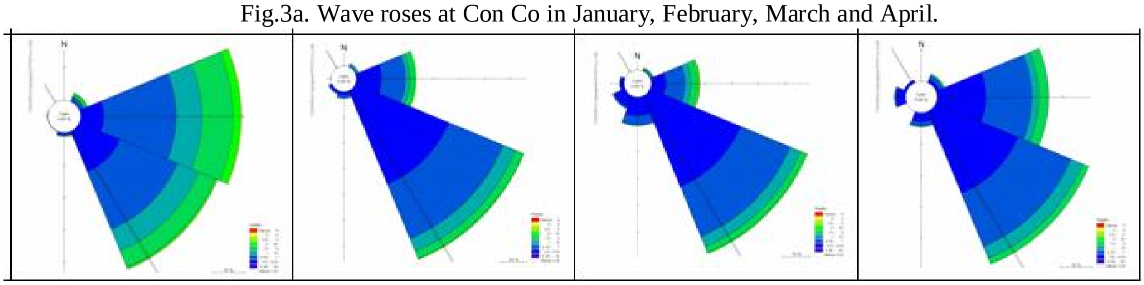

Fig.3b. Wave roses at Con Co in May, June, July and August.

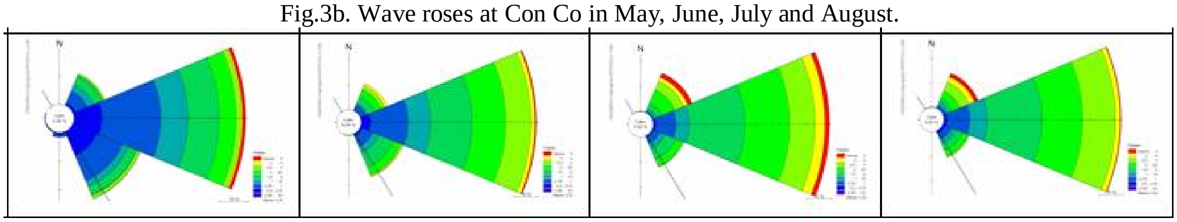

Fig.3c. Wave roses at Con Co in September, October, November and December.

3. Calculation results and proposal for the measures

With the orientation to restore the beach by adding sediment sources to the beach, one can do as follows:

a) to simulate the shoreline without groin. In this case one can find that sediments transported from the south fill up the estuary and navigation channel.

b) to simulate the shoreline in the present situation. It found that in the presence of the groin, sediment is gathered in the south side of groin, decreasing deposition in estuary and there is no sand source to be added to the north beach.

c) to shorten the groin to allow sediment to reach the north beaches faster (not given here)

d) to build new groin just north of the estuary to prevent sand slide down to navigation channel, and to accumulate sediment transported by NE waves, increasing the amount of sand to the beach (fig.4)

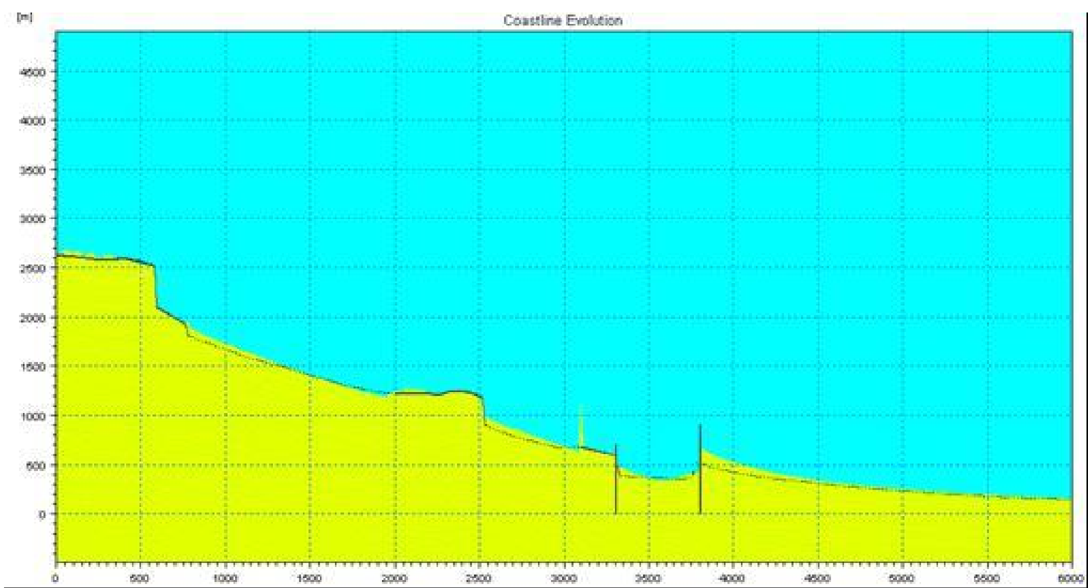

Fig.4. Shoreline behavior with 2 groins (after 1 year).

e) beach nourishment (an additional amount of sand for beach, sand can be bypassed from the southern groin). Hereby one finds that with the beach length of about 1000m, by raising sand beach about 100 000 m^3, it can basically maintain the beach for recreational purposes. The change of cross-section (formation of sand bars) occurs only 200m from the shore.

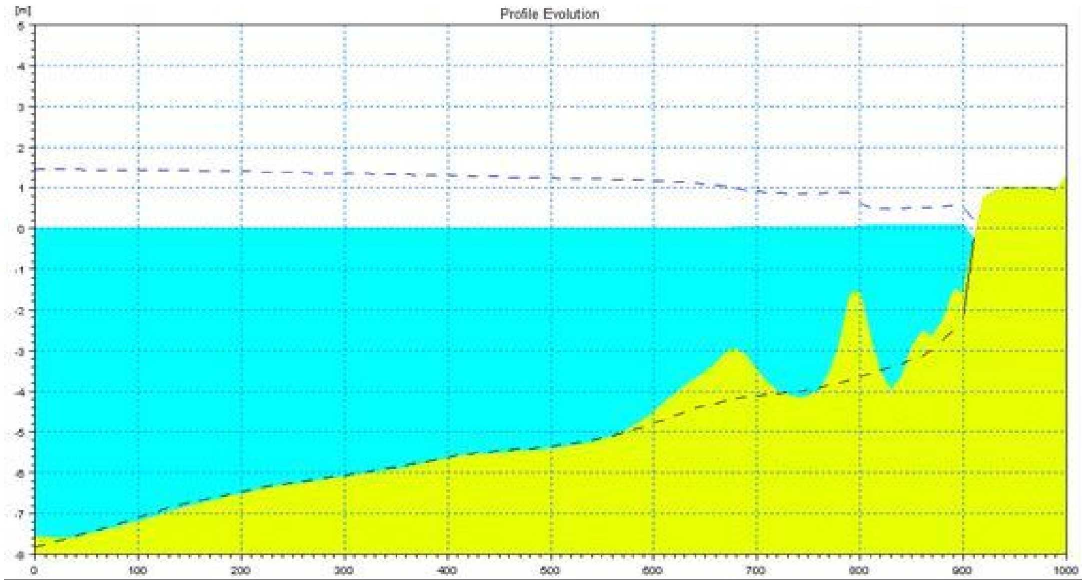

Fig.5. Beach cross-sections using beach nourishment: $100m^3$/1m of beach length (after 1 year).

f) to build a offshore breakwater gradually expanding beach (not mentioned here). These scenarios can be calculated in more details and more accurately in near future, but at the present they show quite prominent situations which can occur. The detail calculation can be compared and the best solution can be chosen from it.

Conclusions

LITPACK model has its limitations, it is good for regular straight shoreline but not so effective to irregular shoreline with complicated morphology. But anyway this tool has to meet the basic assessment for structural measures.

What about the system of structures built in Cua Tung? The bridge is clearly giving a significant benefit for transportation; fishing ports can be developed into a regional logistics as initial goals; groin has retained sand transport which may lead to channel filling (helpful), but at the same time it not allows the sand to be added to the north beach (malicious). To not disrupt the structures and beach rehabilitation, it's better to do beach nourishment in the eroded beach by sand bypassing from the south.

References

[1] National scientific research program KT-03-14: "*Current status and the reasons of erosion in Vietnam coastline. Scientific and technical proposed measures to protect and exploit the coastal areas*". Hanoi, 1995.

[2] National scientific research program 5B: "*Research, forecast, and preventing shore erosion in central coast of Vietnam (from Thanh Hoa to Binh Thuan)*". Hanoi, 2001.

[3] Seminar on "*Vietnam coast erosion-prevention measures*", Haiphong, 2008.

[4] National scientific research program KC-08-07/06-10: "*Researching and proposing the solutions to stabilize the central coast estuaries*". Hanoi, 2010.

[5] DHI. "LITPACK. User's Manual. 2007.