The New Structural Solution for Sea Dike in Soft Soil Area

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***Abstract*—In Viet Nam, conventional types of coastal structures are earthen dikes, and later rubble-mound ones. Recently, Geotube structures and rubble-mound dikes in combination with L-shaped walls on pile foundation have been proposed to use. All the above-mentioned types of sea dikes' foundations behave as shallow or deep ones which is just suitable with hard soil areas. To limit that disadvantage, the paper'authors would like to propose a new structural solution that foundation behaviour is based on both shallow and deep ones. Therefore, it will be more adaptable to the soft soil in comparision to the already known types.**

***Index Terms*—sea dike, soft soil, shallow foundation, deep foundation**

I. Introduction

In construction investment, structural solution is one of three key factors that decide to construction investment effect (Fig. 1). Therefore, it is so important to investigate the new structural solution for sea-dike construction.

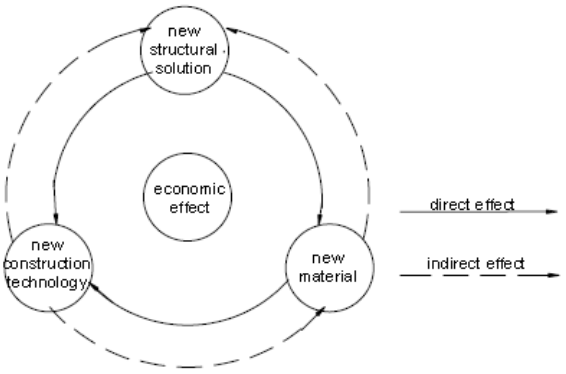

Figure 1. Factors impact to economic effect in construction investment.

II. Analysis of Working Mechanism of Some Known Breakwater Structures

Generally, the gravity and rubble-mound breakwaters are shallow foundation structure types. This means that the structure's stability is due to itself weight. In case of soft soil, the base is necessary to be treated leading to the effectless investment (Fig. 2). [1], [2]

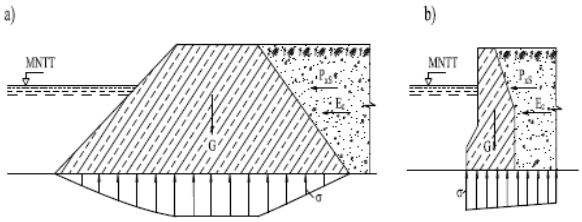

Figure 2. Diagram of loads on shallow foundation structures.

The L-shaped wall in combination with rubble mound breakwater can take the advantage of advantages and make good disadvantages of the 2 above structures. Therefore, it can bring an important technical - economic effect in case of the soft soil (Fig. 3). [3]

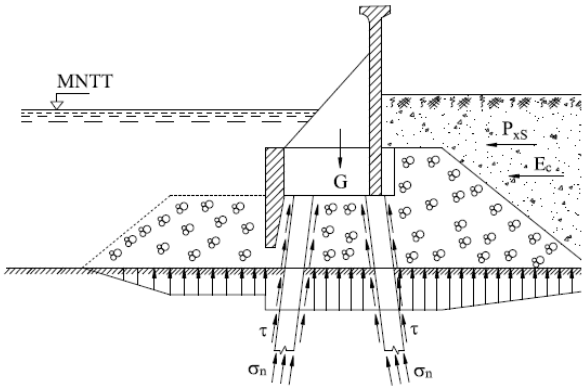

Figure 3. Diagram of loads on deep foundation structures in combination with shallow foundation.

III. Proposing the New Structural Solution

Newly-proposed structures are shown on Fig. 4. These hollow structures ' cross sections are circle, square, cubic and rectangles etc..., and their functioning mechanism is based on both shallow and deep foundation. [4]

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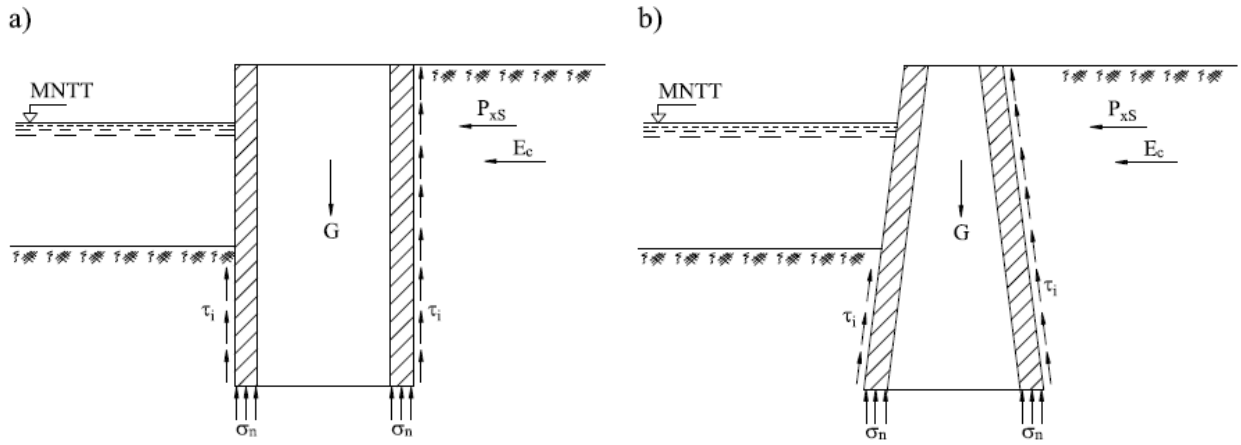

Figure 4. Diagram of loads of new structure-hollow structures

a) Hollow structure in shape of circle post, parallelepiped, cubic.

b) Hollow structure in shape of frustum of pyramid.

A. Advantages New Structures

The vertical load bearing capacity of structure is owing to the foundation reaction on its cross sectional area and lateral friction. Functioning mechanism is similar to the deep foundation's but it does not need to be driven to the hard soil layer.

The lateral load bearing capacity of structure is owing to itself weight. Functioning mechanism is similar to the shallow foundation's.

With the above proposed structure, base treatment is not required and without having to descend to the good soil layer, which will inevitably bring high economic - technical effect if it is applied in practice to replace conventional structural types.

IV. Application of Research Results in the Design for Tien Lang Dike

A. Boundary Conditions for the Design

The top elevation: + 4,75 m;

According to the National Standards TCVN (2013), the second work class is corresponding to the design frequency P_{tk} = 1% .

The designed length of 22,3 km [5].

At the seminar on the structure of Tien Lang Cofferdam [5], a soil dike structural solution was proposed, which was covered with geotextile bags (Fig. 5). [6]

B. The Hollow-Proposed Structure for Tienlang Dyke

Based on the hollow block structure analyzed and proposed together with many calculations, the author would like to propose the cross section of cofferdam, Tien lang, hai phong as shown in Fig. 6.[6]

C. Stability Calculation

1) According to Terxhagi method (Fig.7)

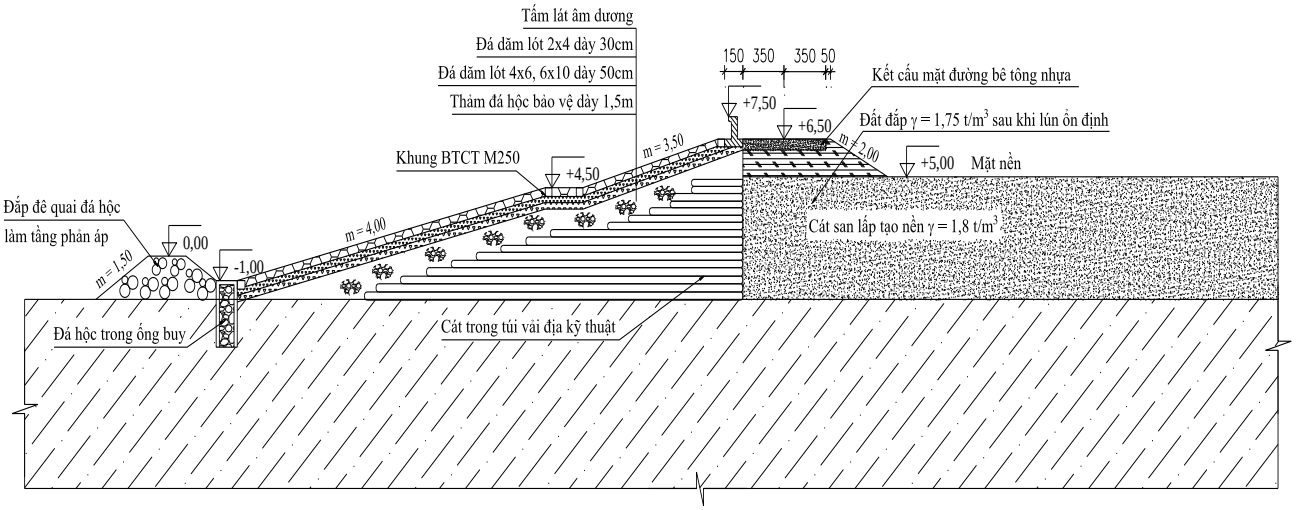

Figure 5. The first proposed structure for tienlang dyke.

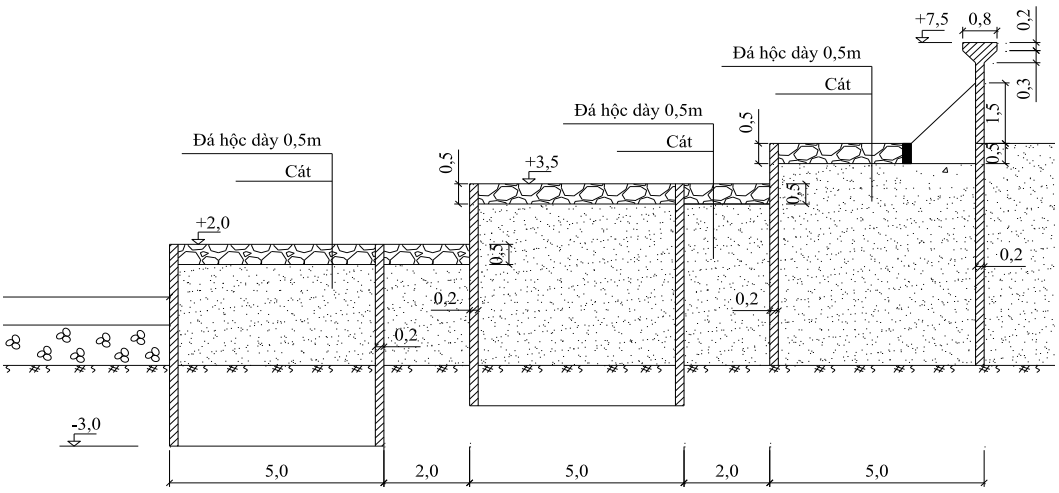

Figure 6. The newly - proposed structure for tienlang dyke.

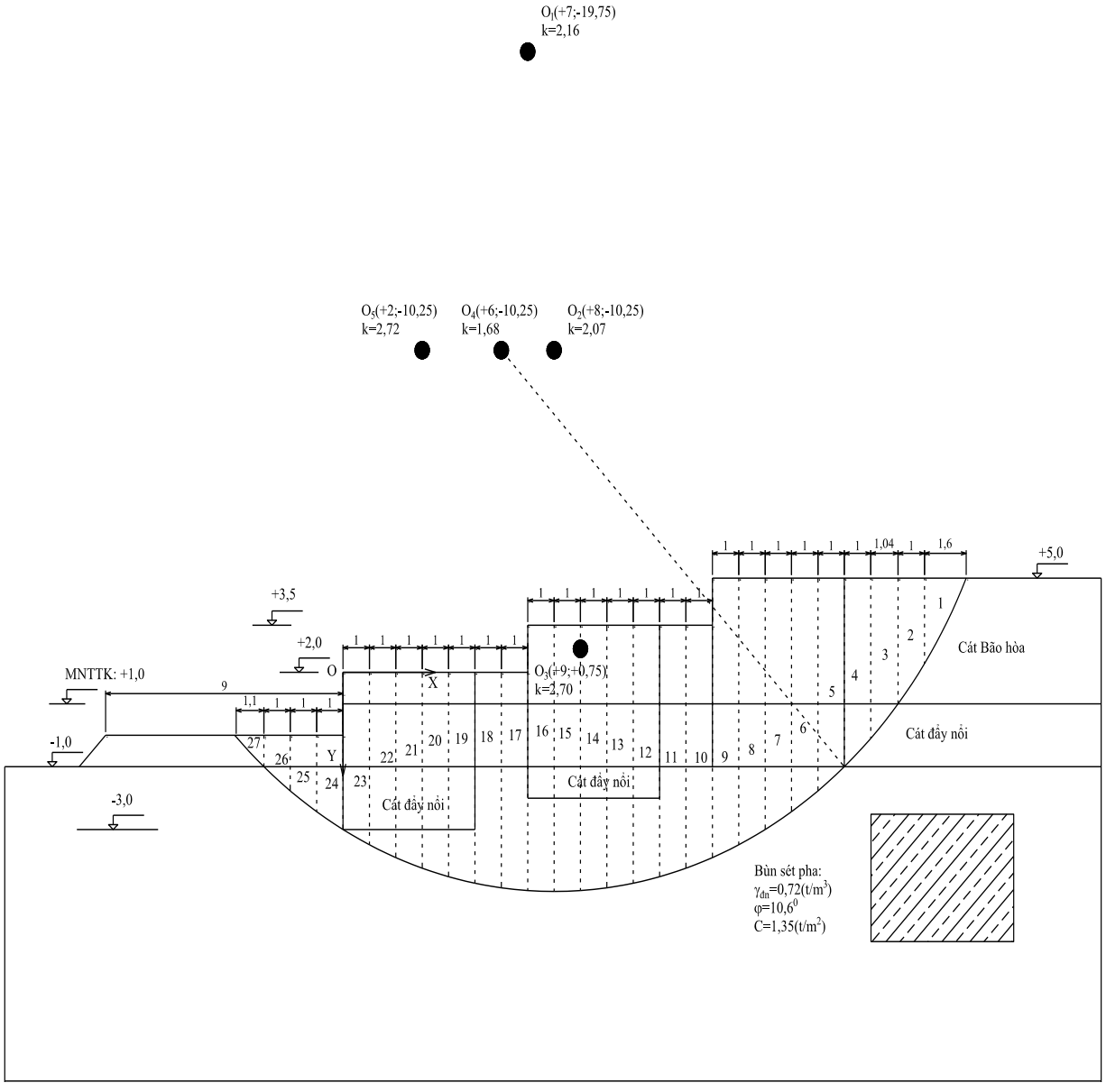

Figure 7. Diagram of circular shearing test.

2) According to geoslope method(Fig. 8)

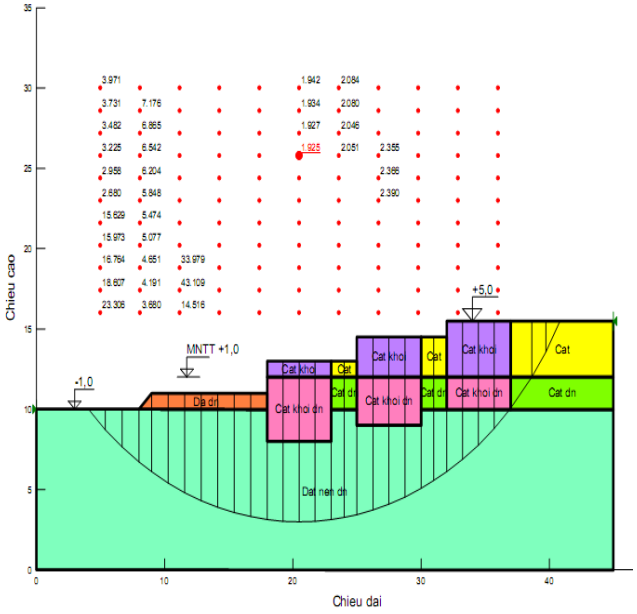

Figure 8. Diagram of stability test according to Geoslope.

Calculated results show that the construction is in a stable condition [7].

V. Some Technical Issues in Using Hollow Block Structure

A. Construction Methods for Driving Works

- Based on the weight of the hollow block to select the floating means and the suitable installation equipment;
- Calculating of weight counter in order to drive the block to the designed altitude;
- Locating the block by cross positioning method;
- Placing the block in the designed position;
- Using the weight counter to drive the required altitude.

Note: During block construction, the block settlement must be tracked within the limit. If it exceeds the limit, it is necessary to stop to adjust accordingly.

B. Settlement Calculation

Settlement problem: Assuming that the hollow blocks and backfill soil are the settlement loads. In this paper, the authors using current settlement calculation methods to design ensuring the allowable settlement.

VI. Preliminarily Estimated Cost for Construction

TABLE I. The Comparision Result of Preliminarily Estimated Cost for Constructing for 1M Long of Dyke According to the First Proposed Alternative [7] and the Newly-Proposed One

No.	Items	Result (USD)	
		Earth dyke	*Hollow structure*
I	Direct cost		
1	Material cost	3.900,30	2.086,82
2	Labour cost	*2.274,00*	1.743,43
3	Cost of construction machines	*534,84*	*226,63*
4	Other direct expenses	*134,18*	81,14
5	Total direct cost	***6.843,32***	**4.138,02**
II	Overhead cost	**342,17**	**206,90**
III	Pre-determined taxable income	395,20	238,97
IV	Estimated construction cost before tax	7.580,69	4.583,89
V	Construction cost of on-site temporary accommodation during construction	83,39	50,42
VI	Output Value added tax	758,07	458,39
VII	Estimated construction cost after tax	8.338,76	5.042,28
	Round up	8.422,14	5.092,70

Preliminarily economic comparison with the conventional earth dyke, the newly- proposed structure bring back higher economic benefit to state (Table. I).

VII. Conclusion

The newly-proposed structure - the hollow block's functioning mechanism is based on both shallow and deep foundation's, so it is suitable to be applied for construction of sea dykes built in weak soil area with high economic-technical efficiency. In addition, this structure can be applied to a number of different types of works in strong soil areas.

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