JOURNAL OF CURRENT RESEARCH IN SCIENCE (ISSN 2322-5009)
CODEN (USA): JCRSDJ
2015, Vol. 3, No. 2, pp: 119-122
Available at www.jcrs010.com

ORIGINAL ARTICLE

Investigate the Parameters influencing on the Behavior of caisson wharf

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ABSTRACT: Iran, on its southern and northern frontiers, Have about three thousand kilometers of beach. Therefore In order to Marine connection, we need to build Wharf and ports which requires a significant budget. Safe design of these structures is very important, because in addition to construction costs, losses caused by the destruction of these structures are also very high. As a result, finding the most appropriate level size and characteristics of soils is of crucial importance. In this paper, in order to assess the influence of various parameters on the behavior of the wharf, Using finite element software ABAQUS, Kobe Port Caisson Wharf is modeled and under the force of the waves, the impact of changes in Concrete Hardness of the Wharf, The width of the wharf, Width and height of the toe and heel, Permeability and internal friction angle of the embankment behind the wharf And the amount of overhead is located on the wharf, on Vertical displacement occurred in structures is investigated. Finally Concludes that Change in the angle of internal friction and permeability of the embankment behind the wharf has not effect on Vertical displacement of the Wharf and Increases in parameters such as the width of the wharf, the width of toe and heel, concrete Hardness of the wharf And the amount of overhead based on it, Will Reduce Vertical displacement of the wharf.

Keywords: Caisson Wharf, Kobe Port, ABAQUS

INTRODUCTION

Nowadays, Caisson wharfs widely used for mooring ships in offshore work. This type of Wharfs

Consisting of prefabricated concrete caissons that after the build will Transport to the location and will be installed in their place. Depending on the type and conditions of the project and operating equipment that are available, Caissons can be designed and implemented in various forms In this regard; the most used are rectangular Caisson. Normally, Caissons built on the beach and then be transported to the desired Location and Installed By immersing in water on the level of prepared on the sea bed and in the respective position. Safe design of these structures is very important, because in addition to construction costs, losses caused by the destruction of these structures are also very high (Kabir Sadeghi, 2001). In order to reduce possible damage, various parameters affecting marine structures have been studied by researchers.

Omrachi and Kertenhaus in 1994 Implement Sensitivity analysis of parameters affecting the dynamic responses of Caisson breakwaters. Yun, Kim & Lee in 2009 implement design variables Sensitivity analysis for Caisson Quay. Khodabakhshi and Bazyar in 2010, Conducted Evaluation of parameters affecting Quay deformation, under earthquake loads.

To case study, the Caisson Wharf of Kobe Port considered and analyzed using the finite element software ABAQUS, under dynamic load of wave In different scenarios. The Force of wave is calculated Using conventional mini-Kane equation. In this study, investigated the Effect of geometric parameters and some of the behavioral parameters of the soil on Desired wharf Responses. And then the results of the change in particular parameter discussed in the charts. Also 3D analysis under the hit Force of the ship was done.

EXPLAINING PROBLEM

In this research considering and analysis of the result of all forces has been implemented on a model of a Caisson Wharf in Kobeh port in Japan. The process of construction included removing alluvial clay layer and replacing it with soil having proper loading capacity, constructing stone mass foundation, installing box and making stone back part (figure1). Considering Wharf has height of 16.5 m and width of 15.6m. Therefore modeling is done in flat strain mode. Whereas the length of Wharf was shorter, we could do 3D analysis. Quasi-static analysis of structure is done under the effect of wave force that was calculated through 3 methods and then a method that gives the most critical amount is considered in dynamic analysis of structure as implementing force. Dynamic analysis is done in two form: once equivalent forces enter separate structure and another time levee behind structure, the foundation and clay is modeled. In dynamic analysis of this research firstly we have general static step and then inexplicit dynamic step that al forces include side pressure of saturated and overhead soil, weight of overhead and. in static step and force of wave beating in inexplicit dynamic step.

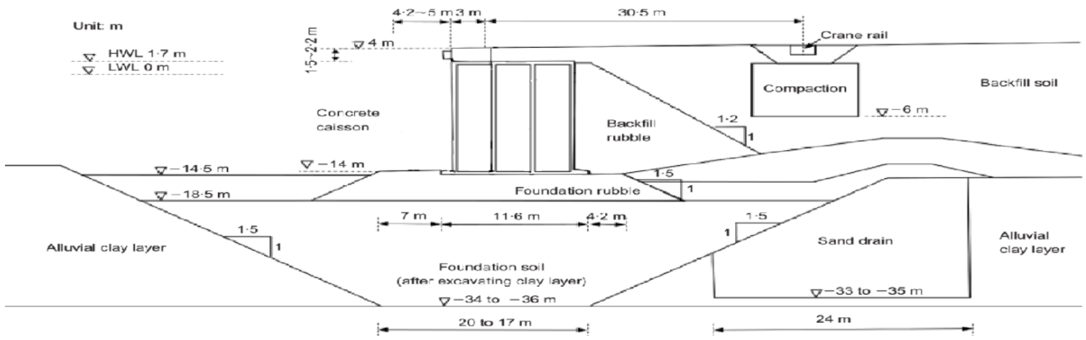

Figure 1. cross-section of Caisson Wharf of Island Rokko in Kobeh port

In quasi-static analysis in the state of putting force of waves we used elements CPE8R elements that is from the family of 4 angular, 8nodes and flat strain elements, and in quasi-static analysis in the mode of implementing force of ship's mooring we used element C3D4 that is from the family of 4 lines and 4 nodes elements that applied fender is rubber type in the form of V with dimension of 3.5m length, 1.3m height and 2.3m width that is installed in 16 meters height. In dynamic analysis of separate structure we used elements of CPE8R that is from the family of 4 angel, 8 nodes elements and flat strain. In dynamic analysis of general model we used element of the family Continuum, linear and 4 nodes hat is specifically called CEP$P. Any analysis in ABAQUS has its special element because here analysis is done in draining mode, the 4 angles elements of Pore Fluid/stress family is used.

Forces on Caisson Wharf include pressure of soil in fixed mode, hydrostatic force resulted from unmoving water, wind force, earthquake force, force of waves and the force of ship mooring. In calculation of force of unbreaker waves the Sen flo and in calculating breaker force two methods of Goda and Minikin have been used. In calculating force of ship mooring 3 methods of kinetic energy is used through experimental and statistical method that here kinetic energy method was used. Dynamic analysis of implementing beating force of wave is done for seconds. Function of wave beat has been considered in fig. Critical points of toe and hill have been shown in fig 3.

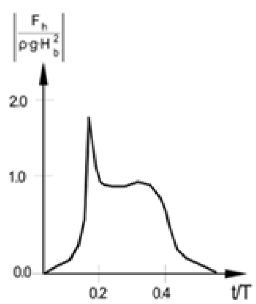

Figure 2. function of wave beat

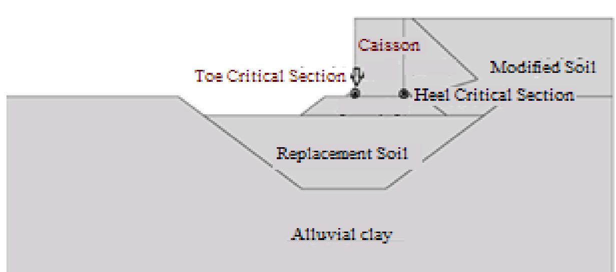

Figure 3. general model

CONCLUSION

From quasi-static dynamic analysis of separate and dynamic structure of general model this result is achieved:

Comparison between obtained responses of different methods of wave beating shows that replacement and tension created by Minikin are more so in dynamic analysis of Minikin method is used for certainty.

In mode that Caisson is modeled alone, replacement of nodes is much less than mode that soils around are modeled and it can be said that its reason is mostly due to location of the bottom of Separated Caisson is taken from land that causes lack of transference of placement to soil.

By decreasing concrete hardness for all existing moods, inductive placement is done for longer time. It was observed that by decreasing concrete elasticity modulus, response of separate structure in dynamic analysis toward response in a mode that full model is analyzed becomes closer, the reason of this action is that we lessened concrete hardness.

It is regarded that result of dynamic analysis in a mode that Caisson is seemed under equivalent forces, is significantly less than mode that Caisson is modeled by soil around. Its reason is that in mode that Caisson is modeled alone regarding that connection seems having boot omit is like concrete Caisson is located on the surface of rigid, so it will not have much placement but soil around are modeled, inductive placement in structure of lower foundation is transferred and so it will have much placement.

Comparing the result of quasi-static and dynamic analysis of structure under the effect of Minikin wave force shows that result of quasi-static analysis is twice of result of dynamic analysis result of separate structure and result of dynamic analysis of general model is multiple of result of quasi-static analysis result. High difference of the result of quasi-static and dynamic analysis and overtones of dynamic analysis shows the necessity of doing dynamic analysis of general model for Caisson structures against wave force and force of ship mooring.

Tension of Fon-Mis at the bottom of general model of Caisson is 30 times more than tension at the bottom of separate Caisson, horizontal placement in general model is 130 times more than horizontal placement of crown of Caisson in separate model and vertical placement of crown of Caisson in general model is 170 times more than horizontal placement of Caisson crown in separate model. Therefore although there are difficulties in Caisson modeling and soil around it than modeling separate structure, due to high placement and tension in general model, analysis of general model is more conservative.

After considering effect of different parameters like geometrical parameters of section, features of soil and overload situated on Wharf on placement created on Wharf crown that comparing to other nodes has the highest placement we conclude that:

By increase of width of toe and hill of wall amount of horizontal placement decreases, difference of placement for 2 and 4 width with 0 and 1 m width is a lot. However this difference between width 2 and 4m is low and it denotes that increase of width more than 2m doesn’t have much effect on decreasing placement.

Displacement of crown of wall decreases by increase of width of wall, the rate of decreasing placement decreases by increase of width and there isn’t meaningful difference between width of 11.6 and 13m.

As angel of internal friction of levee behind wall is less horizontal placement in height of Wharf will become more because we know that as friction coefficient between two levels is more, involvement between two levels becomes more and the degree of separation of two levels will become less.

It seems that it was better for decreasing height placement; Wharf should be made by height of toe and hill except 0.5m.

By increasing the degree of overload situated on the wall, degree of horizontal placement in height of Wharf becomes less. Because by increase of amount of overload, pressure behind Wharf becomes more and so wave beat in opposite direction will less be able to replace Wharf.

Regarding considerations it was observed that increase of penetration from 0.00004 to 0.5 doesn’t have much effect on placement of Wharf. Due to type of function of wave shape and its beating mode, system response to placement changes doesn’t change a lot and it seems in all cases soil doesn’t have permission in this short-term and acts as unique system in both cases.

It was observed that by decreasing concrete hardness, horizontal placement of crown becomes more.

Thus it is concluded that change of penetration and friction angel of levee behind Wharf doesn’t have much effect on horizontal placement of Wharf height. By increasing parameters like width of Wharf, amount of overload situated on it and width of toe and hill of horizontal placement of Wharf decreases. Another point is that by decreasing concrete hardness or if tools softer than concrete are used in construction of Wharf, amount of horizontal placement in height of Wharf increases. Since real width of Wharf is 11.6m and real width of toe and hill is 2m, favorability of width of Wharf and width of toe and hill of Kobeh Wharf is observed. Friction of internal angel of levee behind Wharf is in fact 40 degree that our result shows correctness of choosing tools of levee behind Wharf. By knowing amount of overload existing on Wharf is KN/M^2 20000 and as overload s higher height placement will be less it was better to use more overload above Wharf but since amount of maximum placement of crown is at the limit of centimeter and it is not tangible in dimension of wall that is some meters so this subject is not so important. Observing increase of height placement with decreasing hardness of concrete of Wharf proves such hardness in Wharf. It seems that considered parameters have been used by favorable amount in Caisson Wharf of Kobeh port.

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