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STRUCTURAL BEHAVIOR OF FLOATING BREAKWATERS WITH DIFFERENT MOORING LINES. APPLICATION TO MARINA CORUÑA

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INTRODUCTION

The structural behavior of floating breakwaters has been studied thoroughly during the past decades. Prototype tests have been carried out and there have also been efforts to formulate the forces that appear between pontoons, both analytically and numerically, resulting in specific design programs for these marine structures (eg, [1], [2], [3]). However, physical modelization of breakwaters in current use and rare.

The present study offers a description of the physical modelization of the Marina Coruña floating breakwater (Galicia, Spain) and the dynamic results obtained with different mooring systems.

PHYSICAL MODEL

Working on a 1:25 scale, the Marina Coruña Port breakwater was modelized as 13 pontoons of stainless steel of 48x16x7.6cm^3 each connected between them with neoprene joints and anchored to the bottom of a wave basin with twenty-eight 4.7m long chains of steel, arranged in three different ways: all 28 in the shape of a catenary (with and without clump weights of 140g each) and half of the chains loosened completely, simulating the real situation in the port.

The breakwater was placed in a 33x12m^2 wave basin where high and low tides were reproduced. A wave generator propagated waves in a direction perpendicular to the breakwater simulating heights from 0.3 to 1.1m and periods from 2 to 6 seconds. Incident and transmitted wave heights were recorded using level sensors and two transducers measured the force (F) at the connection of two mooring lines with the anchor. A third transducer was placed in between two pontoons to detect forces in between the two modules such as heave shear (Vy), sway shear (Vx), yaw moment (My) and pitch moment (Mx).

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Fig. 1) Physical model of the Marina Coruña floating breakwater

RESULTS

As far as transmission is concerned, these experiments have validated two facts: the transmission coefficient (Ct) increases with corresponding increasing wave periods (T), and the period for which Ct=0.5 (indicated as Tc in figure 2) also increases with corresponding increasing tide. Moreover, the values obtained do not depend on the state of the mooring system, whether the chains are tight or half-loosened. Figure 2 shows these results when all the chains are in the shape of a catenary.

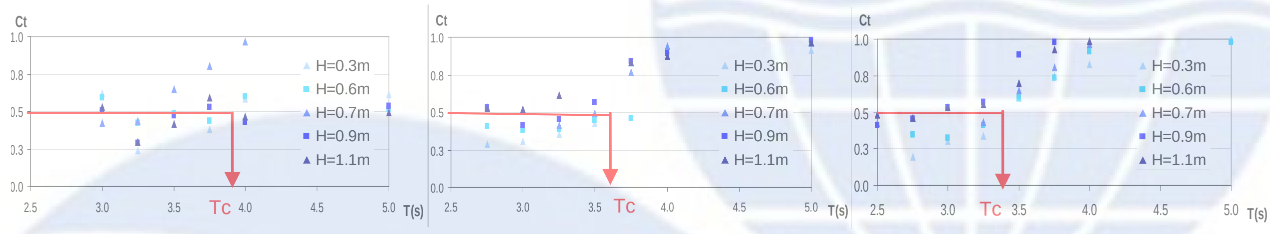

Fig. 3) Transmission coefficients in high (left), medium (center) and low (right) tide

Regarding the forces measured in the structure, both the sway shear (Vx) and pitch moment (Mx) are found to be neglectable due to the relative position of the breakwater to the incident wave front. When half of the chains are loosened, the force F at the connection of the tight mooring lines with the anchor increases in about 50% as seen in figure 3.

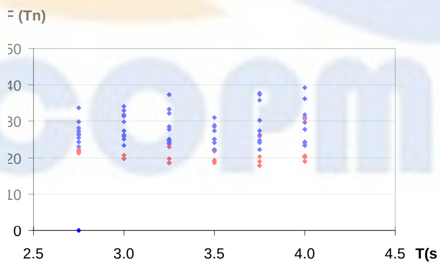

Fig. 3) Load F in mooring lines when all are tense (red) and half are loosened (blue)

When using clump weights, even though the force F in the chains increases, it is distributed in a more evenly matter throughout the chains. Also, the heave shear (Vy) in the pontoons decreases. Thus, we can conclude that mooring lines with clump weights behave similarly to flexible mooring lines and therefore improve overall performance of the breakwater.

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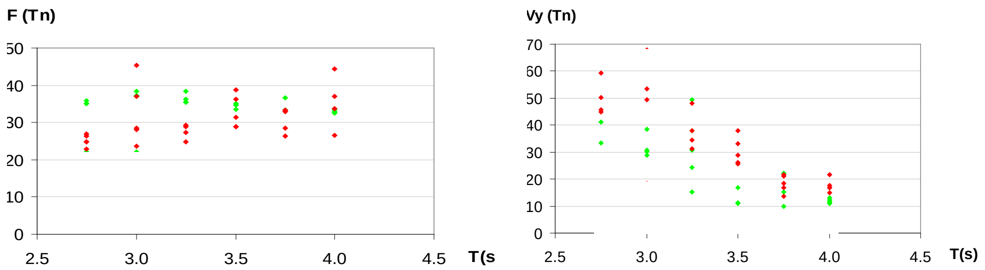

Fig. 4) Load F and heave shear (Vy) for chains without clump weights (red) and with them (green)

REFERENCES

[1] Van Tol, P.T.G., (2008), Floating breakwaters. A theoretical study and preliminary design of a dynamic wave attenuation system.

[2] Report of working Group No. 13 of the Permanent Technical Committee II (1994). Floating breakwaters. A Practical guide for design and construction. *PIANC Bull*, No. 85

[3] Blumberg; G; Cox, RJ. (1988), Floating Breakwater Physical Model Testing for Marina Applications, *PIANC Bull*, No. 63.

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