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EXPERIMENT OF BENDED HYDROFOIL-SUPPORTED OCEAN STRUCTURE PILLAR

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ABSTRACT

Ocean structure may be hit by strong waves or tsunami. One of some ways to reduce the horizontal force is as proposed here by fixing up side down tip bended hydrofoil. To observe the effect of the bended tip in reducing the force, an experiment has been performed at the flume tank of Ocean Engineering Study Program, Department of Naval Architecture, Faculty of Engineering, Hasanuddin University, Makassar, Indonesia. The specimen used here is circular cylinder pipe, representing the pillar of the ocean structure with down ward tip bent, upside down hydrofoil.Previously similar experiment was done without bending the hydrofoil tip, indicating only small effect of reducing horizontal force. The results have been compared with the previous results of the test. It is seen that the test results could improve the effect of reducing horizontal load on the pillar, based on the experimental oscillation.

Keywords: Flume tank, Ocean structure pillar, Tip bended hydrofoil

1. INTRODUCTION

Climate change affects many part of the world including ocean and beach. Coast or beach have been used for many functions, needed to fulfill the requirement of human being including recreational and sporting activities.

Indonesia as an island countries has very long coast line of about 80.000 km, second to Canada.

Beach and coastal structure most probably destroyed by strong or high amplitude waves. There are some ways to prevent them. One of the way, we proposed is using upside down hydrofoils.

The objective of this experimental study is to observe the effect of the position of the strips of hydrofoils on vertical cylinder motion..

Previous studies were performed by Mustakim [6], Hamzah [3], Nur Aenoon [1], and Juswan and M. A. Djabbar [5] relating the up side down hydrofoils without strip (no bending) to strengthen the pillar of the coastal structure.

2. HYDROFOILS

Since long time ago hydrofoils were being used for marine vehicle, the main function which is to lift the body of the vehicle by lifting the body (hull). So the resistance of the vehicle becomes smaller, which means that the speed increases. The theory is based on Bernoulli`s equation (Eq.1) as shown in Figure 1 [4].

$$p_1 + \rho g h_1 + \frac{1}{2}\rho v_1^2 = p_2 + \rho g h_2 + \frac{1}{2}\rho v_2^2 \quad (1)$$

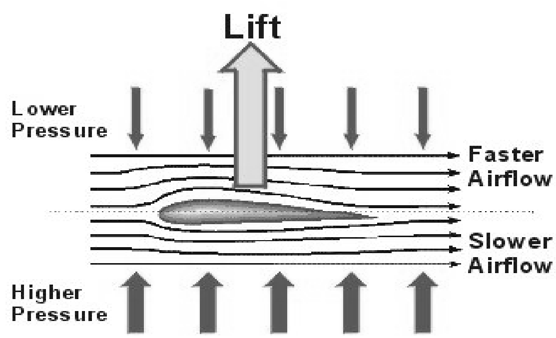

Figure 1. Lifting of the Foil (Wikipedia website 2009)

3. EXPERIMENT

The experiment was performed at the wave tank of Ocean Engineering Study Program, Department of Naval Architecture, Faculty of Engineering, Hasanuddin University. The tank (Figure 2), without specimen is 18.4 m long, 1.2 m wide, 1.0 m high. Water depth of 0.65 m was set for the experiment, Waves were generated by existing wave maker for regular wave, measuring about 6 cm high and 200 cm long. Figure 3 shows the wave tank with specimen hanging by spring (*pegas*)

Unlike previous experiment (regular and high amplitude waves), only regular waves was used with 5 configurations (Figure. 4) of the specimen making at least 15 runs were observed. Configuration of strip position 3 was enlarged for detailed size. One of the runs is shown in Figure. 5. The hydrofoil measuring 1.15 m uniform long, 0.095 m cord, NACA 2412 was located 0.6 m from the cylinder bottom. In the runs the readings were the water (wave crest and through) level on the mm scaled pipe, visually and plotted in oscillation versus strip position, shown in Figure. 7.

Figure 2. Wave Tank

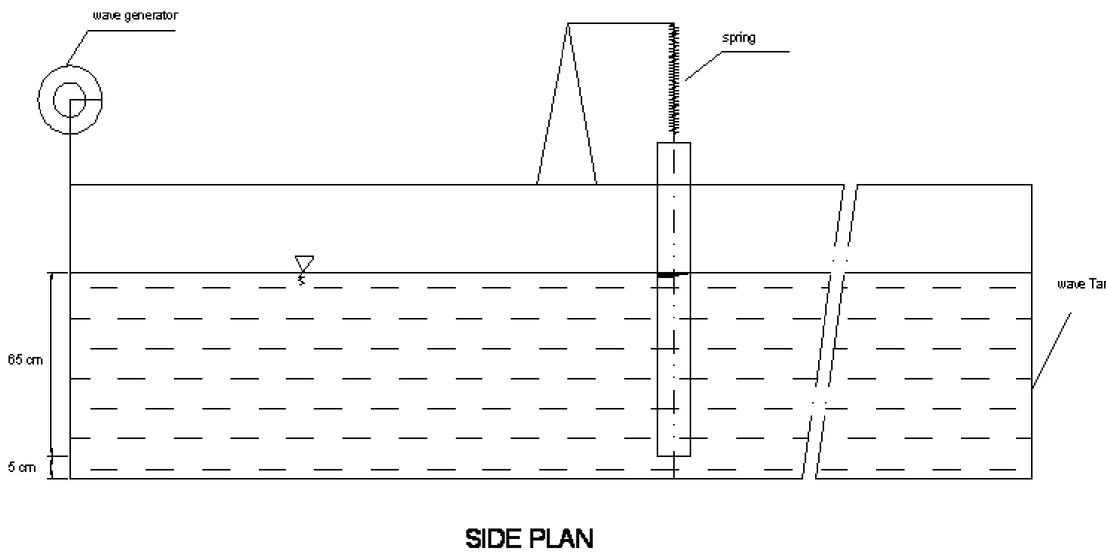

Figure 3. Tested material (side view)

4. RESULT AND DISCUSSION

Both Table 1 and Figure 7 show the experiment results. Configuration of strip position 4 produced shortest oscillation. Since we consider that the shorter the oscillation the higher the negative lift, the position 4 produced more down ward lift (force), however there was slightly unstable of turning. This was believed due to unsymmetrical moment. The most stable condition was configuration of strip position 2. Configuration of position 1 was the same as previous reading in Fig.6 [5] for regular waves therefore the present bended tip comparison with no tip bending produced higher negative lift (small oscillation) force as we expected.

Table 1 Specimen vertical motion

NUMBER	STRIP POSITION	OSCILLATION (cm)
1	no strip	6
2	Strip at tip	5
3	Strip 15 Cm from tip	4
4	Strip 20 cm From tip	3
5	Strip 30 cm from tip	4

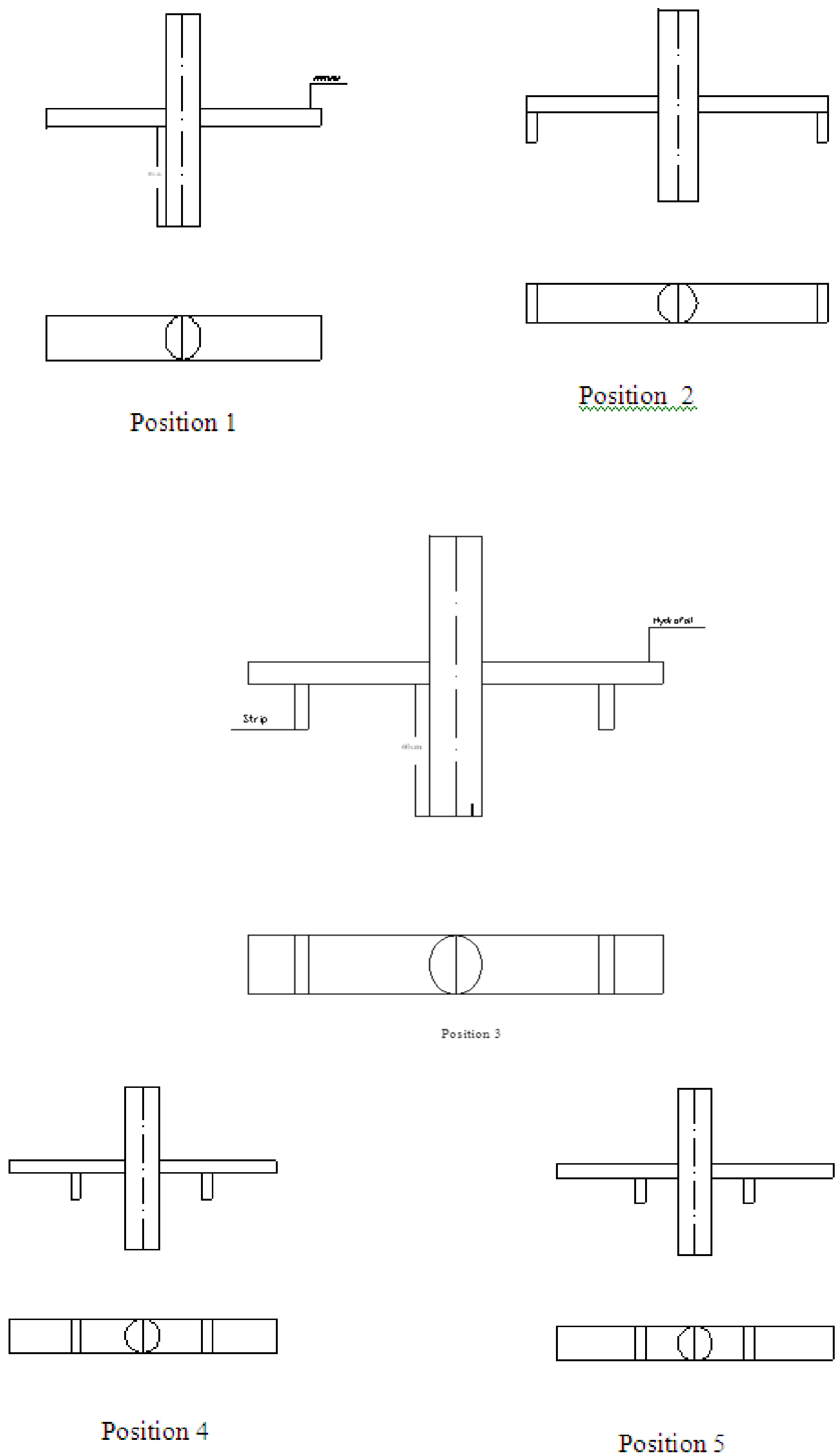

Figure 4   Configurations of the specimen.

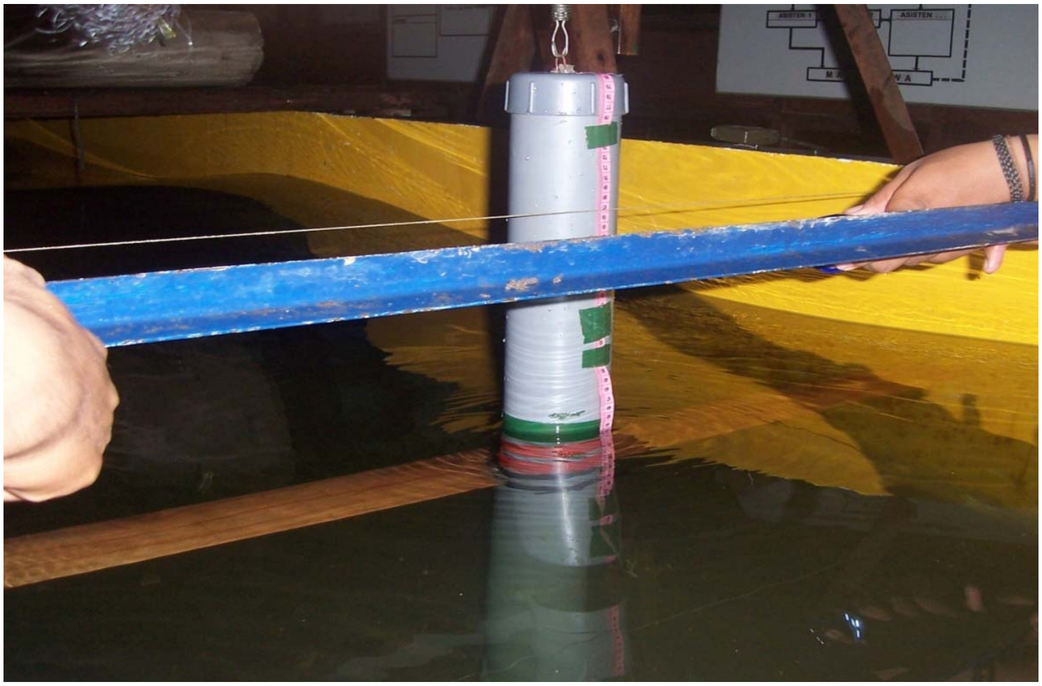

Figure 5 Running experiment

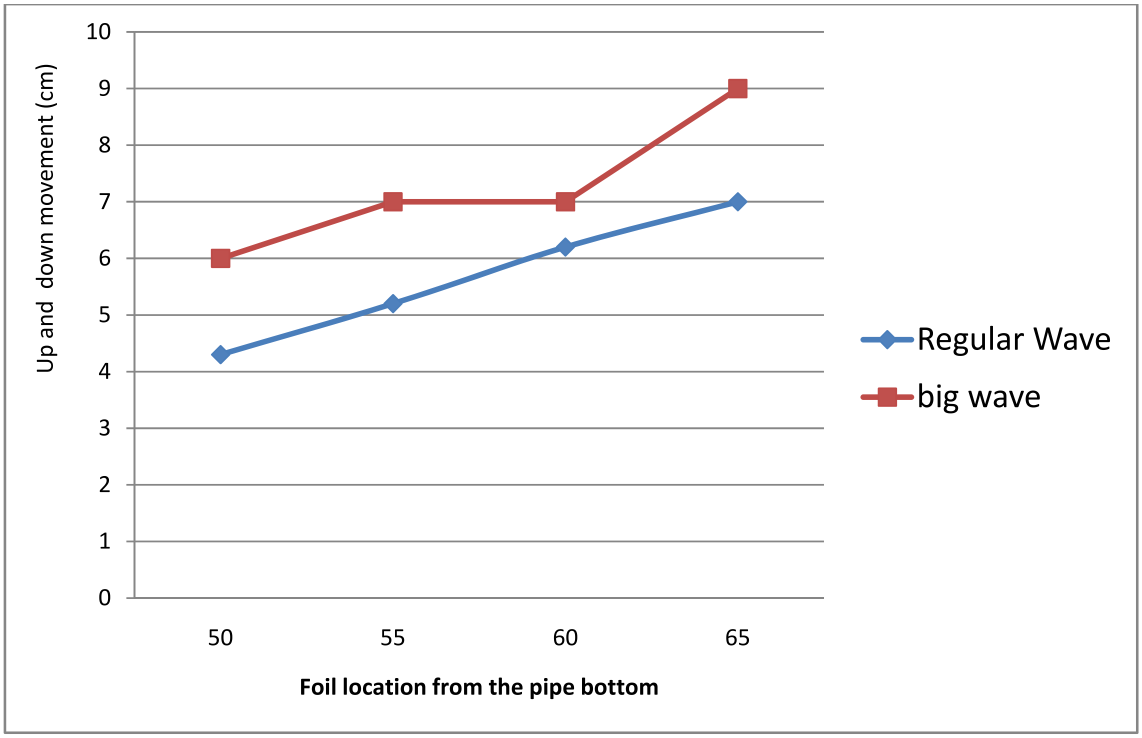

Figure 6 Experimental results (motion forces location)

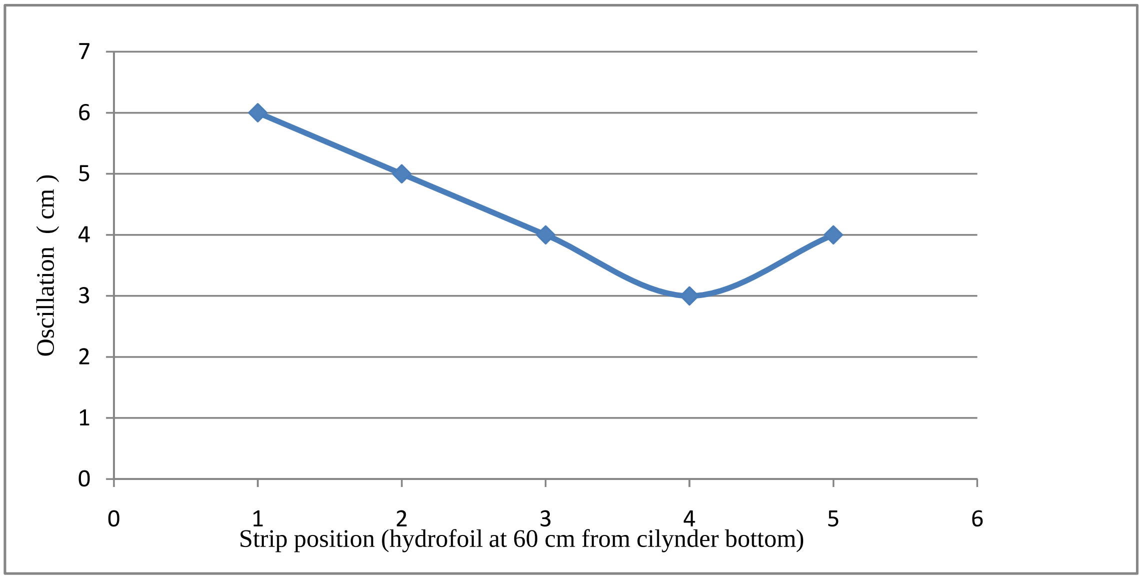

Figure 7 Specimen motion

5. CONCLUSION

♦ There is a possibility, based on smaller oscillation of using hydrofoil on the coastal structure, fixing on its pillar (circular cylinder) to reduce the horizontal wave forces with strip (bended foil).

♦ The experiment used only regular waves and compared the oscillation of the specimen between with and without tip bending.

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