On the Hydrodynamic Parametric Comparisons of MOWC Wave Energy Caissons in Array

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Abstract: Experimental measurements of wave induced forces, air pressures and hydrodynamic efficiencies of an 1:50 scale model of an array of Multi-resonant Oscillating Water Column (MOWC) wave energy caissons have been compared. A range of hydrodynamic parameters with different degrees of damping of Oscillating Water Column (OWC) chamber and a range of center to center spacing (S) between the caissons in an array, for a constant OWC width (h) were tested. It is observed that the reduction of damping of the OWC air chamber reduces the force on the caisson array. For a particular input parameters of wave height and wave period, the wave forces and air pressures were found to increase with increasing S/h values. On the Contrary, the efficiency was found to increase up to the value of S/h=3, beyond which it decreased. A value of 60% efficiency can be achieved with S/h=3. Similarly, for identical input conditions, the wave forces and air pressures were found to decrease significantly from an a/A value of 0.0 to 0.81% (a/A; ratio of orifice opening area(turbine duct) to OWC plan area); beyond which the reduction is small. This shows that there exists a minimum force which is independent of a/A. On the Contrary, the hydrodynamic efficiency was found to increase significantly from an a/A value of 0.0 to 0.81%; beyond which it reduced significantly. An efficiency of 65% can be achieved with an a/A value of 0.81%. The comparative study of forces, pressures and efficiency shows that values of S/h =3 and a/A=0.81% are average optimum values to reduce forces and pressures, and increase the efficiency of this type of structural configuration. This paper discuss in detail on the comparison of certain hydrodynamic measurements on the physical model of MOWC caisson array which has been planned to be incorporated in rubble mound breakwater on the West Coast of India.


INTRODUCTION:
The Oscillating Water Column (OWC) is one of the promising device for extracting power from ocean water waves. It consists of a chamber exposed to wave action through a front opening. Under wave action, air inside the chamber is compressed and rarefied, and energy from this bi-directional air flow is absorbed using a pneumatic turbine. An OWC with two projecting side walls in front of device is found to be more effective in capturing wave energy from a wide range of wave frequencies (Ambli et al(1982), Koola(1990)). It is known as Multi-resonant OWC (MOWC). An 150kW MOWC prototype wave power plant has been installed off the South West Coast of India near Trivandum. (Fig.1)

Fig.1. Cross-sectional Elevation of Wave Energy Caisson.
(Vizhinjam, West Coast of India)

For India, a multi-functional wave energy caisson array is more suitable than isolated device, because the construction cost can be shared