RESPONSE OF POSIDONIA OCEANICA PLANTS TO WAVE MOTION IN SHALLOW-WATERS - PRELIMINARY EXPERIMENTAL RESULTS

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Aquatic vegetation crucially affects in-shore currents, especially in shallow waters, where the vegetation has a length comparable to the water depth. At present, the effects of interaction between flow and vegetation are not clear and represent one of the elements of most uncertainty in the employment of both wave and circulation models. Among other species in the Mediterranean Sea, Posidonia Oceanica is often widespread in areas close to the shore, less than 40 m deep. Such specie usually settles on sandy bottoms forming meadows with the number of plants per square meter varying in the range 500 ÷ 1,000. Because of the peculiar characteristics of Posidonia Oceanica, it represents a significant roughness for the flow. The vegetation effects on the flow (velocity distribution, turbulence structure, energy dissipation, etc.) are yielded by the whole interference phenomena between oscillating water and vegetation. Hence, a roughness value, or better a friction factor value, has to be connected with the wave motion characteristics. The flow over and through flexible canopies was recently studied by Ghisalberti and Nepf (2006) and Ciraolo et al. (2006) in steady conditions. The interaction of rigid submerged canopies and a wave flow was also studied by Lowe et al (2005) while Augustin et al. (2009) studied the wave attenuation due to the presence of seagrass and showed that it can reduce the wave amplitude at a large extent.

In such a homework, the aim of the present work is to study the interaction between flexible canopies and wave, through laboratory experiments. The preliminary results here presented regard a study of the buoyancy of several artificial and real plants, in order to analyze the capability of artificial plants of reproducing at laboratory scale the movement and deformation of the real plants such a study has been carried out by means of image analysis. Experiment on the buoyancy of the artificial plants lead to the choice of an appropriate material which shows in fresh water the same buoyancy of the real plant in salt water. In order to outline flexible plants to be traced and projective geometric transformation to be inferred, specific image processing techniques were used, which made it possible more accurate measurements of plant movement to be obtained. Oscillations of real and artificial plants were analyzed and compared each others as wave motion characteristics varied. Then, response of both plants to wave motion was connected with wave characteristics. Preliminary studies on the hydrodynamic generated by wave in presence of a seagrass meadow were carried out in a wave flume by using an Acoustic Doppler Velocimeter and wave gauges. The results show that the near-bed velocity within a seagrass meadow is close to that predicted from the local the linear wave theory (Figure 1) and the wave height attenuation is function of both the product of the wave number and the depth and the ratio between incident wave height and water depth (Figure 2).

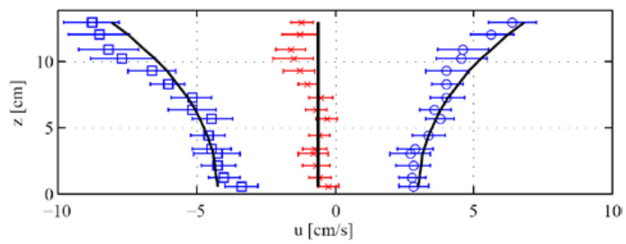

Figure 1 - Maxima (o), minima (□) and mean (×) horizontal velocities profile, in the middle of canopy, for the following incident wave characteristic on the meadow Hi = 3.2 cm and T = 0.62 s. Measurement confidence intervals and estimated velocity profiles as derived from linear theory are also plotted.

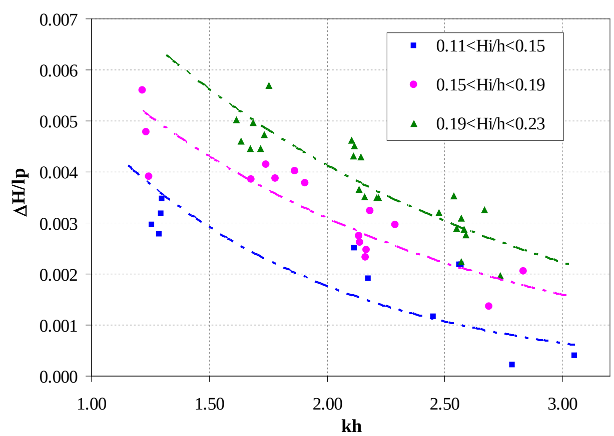

Figure 2 - Wave height attenuation (ΔH) for unit length of canopy (lp) versus wave number (k) times the local depth (h). The experimental results are collected for classes of incident wave height over local depth (Hi/h).

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