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Preliminary Results Of Hydrodynamic Responses To Ship Movements And Weather Conditions Along The Coastal Walls Of Shallow Areas

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Water-level variations in coastal areas and shallow channels take place under the influence of more complex factors, compared to those in deeper areas. Atmospheric pressure, wind, and wave interactions with bottom morphological characteristics are some important natural features while human-induced factors are usually maritime traffic and manoeuvres the ships. While weather conditions cause long-term changes in water level, water level interactions in near shore areas, can occur very quickly depending on the ship manoeuvres and squat characteristics, and these rapid changes can lead to unpredictable water level lowering. Such rapid changes may cause various dangerous incidents and ship accidents, particularly in areas where rapid water oscillations occur. Improper calculations of propulsion power or orientation of the ship body, especially in the areas where geological and morphological characteristics permit fast water movements, are the most important additional causes of accidents due to sudden water level decreases. For an example, even though a 200-m-long vessel can complete its 35° rotation in a circular area with radius of 250 m, if it is calm and sufficiently deep, this diameter increases 5 times at the shallow waters also depending on the hydrodynamic flow conditions. In 2005, “Gerardus Mercator” has bumped into the inside bottom wall of the channel with a low speed (4 knots) turn of when she had just made a 200° turn. Seven years later the cruise ship "Costa Concordia" struck a rock, before she drifted and grounded, in the calm seas of the coast of Isola del Giglio in Italy, due to a combined effects of waves generated by side waves of ship manoeuvres, atmospheric pressure and squat specifications as well.

The waves reflected from the seawalls complicate the navigation problems which should be examined in detail. Thus, three prototype models with various angular seawall features were prepared, simple in shape with perpendicular and sloped seawalls with flat bases. The spreading properties of water volumes together with the water level differences along the coastal walls were measured under the influence of a linear-turbine fan positioned above the model to simulate the dynamic wind pressure. The most severe water distributions and highest water-level losses have been observed on the model with +60° angular walls. Contrary, the model with reverse sloped (-60°) seawalls demonstrated the most oscillating level at the coast but has kept the water-level rather stable in the central part. This causes the waves to be reflected back to the wall as fast as it has been observed during the experiment. If compared to the other structures such a construction is quite costly to be made. However, the water depth in this model has been preserved at the shallow areas, since it is able to reflect the waves and its energy-absorbing feature is good with less “Ekman Condition” effect.

Keywords: Shallow channel, coastal waters, atmospheric pressure, Ekman Condition, squat