World Academy of Science, Engineering and Technology
International Journal of Marine and Environmental Sciences
Vol:13, No:01, 2019

Coastal Modelling Studies for Jumeirah First Beach Stabilization

Authors : Zongyan Yang, Gagan K. Jena, Sankar B. Karanam, Noora M. A. Hokal

Abstract : Jumeirah First beach, a segment of coastline of length 1.5 km, is one of the popular public beaches in Dubai, UAE. The stability of the beach has been affected by several coastal developmental projects, including The World, Island 2 and La Mer. A comprehensive stabilization scheme comprising of two composite groynes (of lengths 90 m and 125m), modification to the northern breakwater of Jumeirah Fishing Harbour and beach re-nourishment was implemented by Dubai Municipality in 2012. However, the performance of the implemented stabilization scheme has been compromised by La Mer project (built in 2016), which modified the wave climate at the Jumeirah First beach. The objective of the coastal modelling studies is to establish design basis for further beach stabilization scheme(s). Comprehensive coastal modelling studies had been conducted to establish the nearshore wave climate, equilibrium beach orientations and stable beach plan forms. Based on the outcomes of the modeling studies, recommendation had been made to extend the composite groynes to stabilize the Jumeirah First beach. Wave transformation was performed following an interpolation approach with wave transformation matrixes derived from simulations of a possible range of wave conditions in the region. The Dubai coastal wave model is developed with MIKE21 SW. The offshore wave conditions were determined from PERGOS wave data at 4 offshore locations with consideration of the spatial variation. The lateral boundary conditions corresponding to the offshore conditions, at Dubai/Abu Dhabi and Dubai Sharjah borders, were derived with application of LitDrift 1D wave transformation module. The Dubai coastal wave model was calibrated with wave records at monitoring stations operated by Dubai Municipality. The wave transformation matrix approach was validated with nearshore wave measurement at a Dubai Municipality monitoring station in the vicinity of the Jumeirah First beach. One typical year wave time series was transformed to 7 locations in front of the beach to count for the variation of wave conditions which are affected by adjacent and offshore developments. Equilibrium beach orientations were estimated with application of LitDrift by finding the beach orientations with null annual littoral transport at the 7 selected locations. The littoral transport calculation results were compared with beach erosion/accretion quantities estimated from the beach monitoring program (twice a year including bathymetric and topographical surveys). An innovative integral method was developed to outline the stable beach plan forms from the estimated equilibrium beach orientations, with predetermined minimum beach width. The optimal lengths for the composite groyne extensions were recommended based on the stable beach plan forms.

Keywords : composite groyne, equilibrium beach orientation, stable beach plan form, wave transformation matrix
Conference Title : ICCEM 2019 : International Conference on Coastal Engineering and Modelling
Conference Location : Dubai, United Arab Emirates
Conference Dates : January 30-31, 2019