Dynamics of wave-induced loads and their effects on coastal structures

Abstract

When waves impact a seawall, vertical breakwater, exposed jetty, pier or a coastal bridge, they abruptly transfer their momentum into the structure. This energy transfer can be very violent and its duration exceptionally short.

Over the last 15 years improved awareness of wave impact induced failures has focused attention on the need to account for the dynamic response of maritime structures to wave impact loads. Previous forensic studies have documented the relative importance of impulsive loads on caisson breakwaters and deck suspended structure, demonstrating the need to assess the effect of wave impacts on both the stability and the integrity of structural members since the early stages of the design. This requires the estimation of the dynamic characteristics of the loading pattern, and in particular the wave impulse and corresponding impact maxima and rise time.

Experimental work has recently focused on recording and analysing violent wave impacts on coastal structures. These new data are however of little relevance unless a complete methodology is available to evaluate the dynamic response of maritime structures to such short-duration loads. Based on the conservation of momentum, functional relationships between these parameters have been identified since pioneering work dating back to the late ’30s of 20th century. The complexity of the loading process however results in a significantly large variability of wave impact maxima and rise time even under similar conditions, suggesting the need for a probabilistic approach to the definition of the relationship between these two variables, to be used when estimating the dynamic properties of wave-induced loads to be considered in structural analysis of coastal structures.

After an introductory note, the seminar will present findings of recent research and consultancy projects in Europe, USA and Japan, together with recently developed methods relating to performance design of costal structures.

Giovanni Cuomo - Short Bio

Dr. Giovanni Cuomo, is Principal Coastal Engineer at Hydraulic Applied Research and Engineering Consulting (HAREC) s.r.l. (Italy), Senior Engineer at the Coastal Structures Group of HR Wallingford Ltd. (United Kingdom) and Researcher at the Hydraulic Structures and Probabilistic Design section of the Hydraulic Engineering department of TU Delft (the Netherlands).

Giovanni holds a PhD in Science of Civil Engineering at the University of Rome TRE, and in particular in risk assessment and dynamics of coastal structures. In the past 8 years, he has been research scientist at HR Wallingford (UK), Universidad Politecnica de Cataluna (UPC), Barcelona (Spain), the Johns Hopkins University, Baltimore (USA), the SCRIPPS Institution of Oceanography, San Diego (USA), the Port and Airport Research Institute (PARI) in Japan.

Specialised in the dynamics of currents-waves-structures interaction, Dr Cuomo has experience in physical model testing and development and application of advanced computational fluid dynamics models to coastal circulation, harbour agitation and three-dimensional two-phase compressible flows. He has been involved in several international joint research projects including the development of design guidelines and methodologies for risk assessment in flood, earthquake and tsunami-prone areas. Co-author of more than 40 scientific publications he is reviewer for a series of international journals and conferences and consultant for the design of coastal and hydraulic structures in Europe, USA, Africa, Central America, the Middle East and Japan.