Simulación de oleaje para el estudio de vulnerabilidad de obras marítimas

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Abstract

Ultimately a change of tendency in the focus of maritime works verifications is being experienced, taking more importance the vulnerability calculation. In fact R. O. M. 0.0 adapts from the PIANC a verification methods classification were the highest step, necessary for works with the most repercussion, are the Type III methods. These methods are base on the calculation of the works vulnerability without doing any assumption, neither in the adopted probability distributions nor in the events acceptance regions. Inside the context provided by these methods emphasize those based on Monte Carlo's method.

The tesina is included inside the methods of Monte Carlo's for the vulnerability calculation, and more concretely inside the generation of the actions to consider. To sum up, the objective is to develop a method able to generate random storms from a global descriptor. The descriptor used is the maximum significant wave height. From this descriptor and from incomplete data storms described by the individual wave should be generated. The sea waves are described by eight parameters, which are not independent among themselves, they are: the wave height, the wave period, the maximum wave elevation over the mean level, the minimum wave elevation over the mean level, the time elapsed among the up-crossing zero and the down-crossing zero, the instant wave direction, the instant position of the sea level and the time when the wave is produced. To generate the storm's waves an autoregressive model is used. That process is considered to be independent from the direction. From these hypothesis a methodology capable of generating random storms has been developed. At the same time a program that adapted to the proposed methodology is also developed. The program is capable of generating random storms from fixed parameters. The plan and the program are divided into three parts, conceptually very differentiated .

In the first part the storm is characterized. Both the storm duration and its peak period are simulated. Sea spectrum is generated using storm's peak period. The spectrum will mark the the periods distribution in relation to the wave height, but not the final height distribution since a re-scaling is used. Once the spectrum is built, Fourier analysis is applied in order to obtain the autoregressive coefficients, and with them the white noise variance and the process initial conditions.

In the second one, a base storm that later will be adapted to imposed conditions is generated. The parameters obtained previously are used in an autoregressive process where free surface positions are generated while the storms lasts. Later, using interpolation, up-crossing zero and the down-crossing zero are evaluated. As a result of it the wave period is obtained as the time elapsed between two down-crossing zero. The time elapsed between a down-crossing zero and an up-crossing zero is also measured as a wave asymmetry. From each wave maximum and minimum free surface elevation are obtained. The difference of both, is the initial wave height. Once all wave heights are obtained, significant wave height is calculated. All wave heights, and maximum and minimum free surface elevation , are divided among the significant wave height. This way a base storm whose significant wave height is 1 is generated.

In the third one, for each individual wave the instant where it is produced is calculated. The instant is used to calculate the significant wave height, the average instant direction and the sea level (due to atmospheric conditions and due to astronomical tides). The significant wave height is used to re-scale wave height, so that the storm follows the storm evolution marked. As final step it is calculated a random perturbation which is added to the direction.

The greater difficulties we can find when applying the methodology are that is not well know the significant wave height-storm duration probability joint distribution, neither the interaction between the significant wave height with the sea level elevation due to atmospheric conditions. Even for the known distributions, a complex statistical study must be done in order to estimate the parameters value.