Numerical prediction of slamming loads - DTU Orbit (19/08/2019)

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It is important to include the contribution of the slamming-induced response in the structural design of large vessels with a significant bow flare. At the same time it is a challenge to develop rational tools to determine the slamming-induced loads and the prediction of their occurrence. Today it is normal practice to apply a standard sea-keeping procedure to determine the relative velocity distribution between the water surface and the hull and then to estimate the bottom slamming loads and the bow-flare slamming loads based on two-dimensional formulations similarly to water-entry problems. The pressure distribution as well as the total force is then determined by integration over a pseudo-three-dimensional presentation of the hull geometry. In this paper the evaluation of the slamming load is taken one step further by performing direct three-dimensional, fully non-linear numerical calculations in a realistic wave environment. Both the global and the local slamming loads are assessed numerically using a finite-volume formulation with the free surface captured by a volume-of-fluid technique. This numerical procedure is justified by comprehensive validation studies where numerically evaluated slamming pressures are compared with experimentally measured results. To obtain an insight into the three-dimensional flow effects the next step is to apply the validated numerical procedure to evaluate and compare the accuracy and performance of the traditionally used two-dimensional formulations by a comparison with three-dimensional numerical formulations for a fine-form Panamax container ship bow hitting a flat water surface at a constant trim angle. Finally, the slamming evaluation is carried out on the basis of a three-dimensional case study of the same container ship sailing in a head sea at half the service speed in a critical wave episode which is defined conditional on a given extreme response level of the hull girder bending moment.

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