Asociación Argentina
de Mecánica Computacional

Mecánica Computacional Vol XXIX, págs. 29-29 (resumen)
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Buenos Aires, Argentina, 15-18 Noviembre 2010

ULTIMATE STRENGTH OF SHIPS AND OFFSHORE STRUCTURES

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Abstract. The design of large ocean ships and new generation floating platforms is performed based on numerical simulation of the ultimate strength behavior. Buckling load and post-buckling behavior of the critical structural members of these structures allow the establishment of proper safety factors.

Ocean structures rely on the structural behavior of stiffened panels, which have their idealized shape modified by geometric imperfections generated during construction. Stiffened panels submitted to compressive loads up to and beyond the first buckling failure are influenced by the detrimental effect of distortions. Therefore, in addition to the large displacements and material plasticity, the numerical simulation incorporates the geometric imperfection distribution on the structure in order to obtain a realistic structural behavior.

Numerical-experimental correlation of the results obtained for small-scale models representative of typical stiffened panels are performed in order to confirm the ability of the numerical simulation to reproduce the physical buckling behavior. In addition, the type of the finite element as well as the mesh refinement are better established based on the experimental results.

Oil tanker ship and semisubmersible platform are considered for the ultimate strength analyses. In both cases the buckling failures are investigated in order to identify the most critical regions and also how these failures propagate in the post-buckling range.

The critical load acting on ship structures are due to the waves causing a bending configuration along the hull. Depending on the longitudinal bending configuration the stiffened panels above or below the neutral surface will be under compression, representing either sagging or hogging conditions, respectively. The focus of the analysis is to investigate the compressive regions and the propagation buckling behavior of both plates and stiffeners in the mid-ship section.

New generation of large semisubmersible platforms have been designed with square section columns composed of longitudinally stiffened flat plates. Columns are the main structural element in these large floating platforms, predominantly submitted to compressive axial loads due to the action of deck loads, balanced by the buoyancy of submerged structural members. The analysis is performed to evaluate the column axial load capacity and the propagation buckling under the influence of both mode and magnitude of realistic initial geometric imperfections.

Finally the effect of supply vessel collision on the ultimate strength of the semisubmersible platform column is assessed in order to evaluate the residual strength after such accident.