Optimization of Assembly and Welding of Complex 3D Structures on the Base of Modeling with Use of Finite Elements Method

Authors : M. N. Zelenin, V. S. Mikhailov, R. P. Zhivotovsky

Abstract : It is known that residual welding deformations give negative effect to processability and operational quality of welded structures, complicating their assembly and reducing strength. Therefore, selection of optimal technology, ensuring minimum welding deformations, is one of the main goals in developing a technology for manufacturing of welded structures. Through years, JSC SSTC has been developing a theory for estimation of welding deformations and practical activities for reducing and compensating such deformations during welding process. During long time a methodology was used, based on analytic dependence. This methodology allowed defining volumetric changes of metal due to welding heating and subsequent cooling. However, dependences for definition of structures deformations, arising as a result of volumetric changes of metal in the weld area, allowed performing calculations only for simple structures, such as units, flat sections and sections with small curvature. In case of complex 3D structures, estimations on the base of analytic dependences gave significant errors. To eliminate this shortage, it was suggested to use finite elements method for resolving of deformation problem. Here, one shall first calculate volumes of longitudinal and transversal shortenings of welding joints using method of analytic dependences and further, with obtained shortenings, calculate forces, which action is equivalent to the action of active welding stresses. Further, a finite-elements model of the structure is developed and equivalent forces are added to this model. Having results of calculations, an optimal sequence of assembly and welding is selected and special measures to reduce and compensate welding deformations are developed and taken.

Keywords : residual welding deformations, longitudinal and transverse shortenings of welding joints, method of analytic dependences, finite elements method

Conference Title : ICMNE 2014 : International Conference on Marine and Naval Engineering

Conference Location : Istanbul, Türkiye

Conference Dates : September 29-30, 2014