Finite Element Implementation of Multi-Pass Fillet Weld with Phase Changes

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First, in this paper, a brief review of theoretical aspects of weld simulation and residual stress modelling using the finite element method (FEM) is presented. Thermo-elastic-plastic formulations using a von Mises yield criterion with nonlinear isotropic hardening has been employed. Residual stresses obtained from the analysis have been shown. The commercial FEM code ANSYS and a user created code were used for uncoupled thermal-mechanical analysis. Second, the aim of this paper is to compare ANSYS capabilities extended by authors to model weld phenomena versus well known SYSWELD code. Element birth and death FEM technique was used to simulate the weld metal added to base metal due the welding process and to reset plastic history for molten portion of material. Goldak's double ellipsoid heat source was used to model welding heat source. The Leblond's model was used to simulate ferritic and bainitic phase transformations and Koistinen - Marburger model was used to simulate martensitic transformation.

Keywords: phase changes, metallurgical transformations, residual stresses, finite element method.

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