

Abstract #445

Design of Fillet and Partial Penetration Groove Welds using Finite Element Analysis (FEA)

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The recommended welding criteria for radioactive material transportation packages for Type B contents are found NUREG/CR-3019 (ref 1). Generally speaking, for Category I contents, the ASME Boiler and Pressure Vessel Code, Section III, Subsection NB is the recommended standard, with the requirement of full penetration, full fusion butt welds. For other applications involving Category II or III contents, partial penetration groove welds and fillet welds are allowed, as described in other recommended ASME Code Sections and commercial codes, such as the AWS Structural Welding Codes. The guidelines presented in the latter are based more on empirical rather than analytical considerations. The methodology presented in this paper allows the characterization of partial penetration and fillet welds for the weld's function and the mechanical properties required for the service application.

Welded fabrication can have a significant impact on the structural integrity and mechanical performance of a design. Overload failures may result from the reduction of strength of weldments. Stress concentrations may result from the geometrical design and weld discontinuities, such as incomplete penetration or fusion, and/or sharp transitions. The use of FEA with shell elements for predicting stresses and deflection of loaded structures has the following advantages:

- accurate determination of weld loads including distribution along the weld joint
- Weld loading resulting from displacement mismatch of components welded together due to Poisson effects, restraint, stiffness differences, etc.
- Stress risers due to "end effects" on skip welds and lack of penetration/fusion
- Size requirements for partial penetration welds