ABSTRACT

This thesis deals with the finite element investigations to study the effect of geometrical parameters on the stress distributions in various types of fillet and butt welded joints subjected to external loading. The residual stresses due to shrinkage and thermal loading have not been considered. The fillet welded joints are subjected to either parallel loading or cantilever loading, and the butt joints are loaded with uniform tension. The joints are idealized to be in states of plane strain conditions. The material is assumed to be homogeneous and isotropic in the base metal (BM), heat affected zone (HAZ) and the weld metal (WM).

The various fillet profiles considered are triangular (flat), concave (circular and elliptical) and convex. In butt welded joints, the bead shapes considered are elliptical. Salient results include determination of stress values at key locations in the joints, presentation of the whole field stress contours, identification of localized peak stresses and the variation of stresses at danger sections etc. Comparison of stresses and relative standings of different types of fillet profiles have been provided with specific recommendations to use mostly elliptical profiles. Conclusions for butt welded joints are derived with respect to effect of reinforcement heights and widths on stress distribution for single V, equal double V and unequal double V-Butt joints. A series of theoretical results are obtained for butt welded joint with reinforcement with lack of penetration defects. These are presented in form of nomographs for ready use by the designers. The severe effects in form of introduction of high stress concentration have been highlighted.

Some experiments have been conducted employing two dimensional photoelastic principles to depict the whole field stress patterns in T-joints with various types of fillet profiles. Comparison among the fillet profiles are based on the isochromatic fringe patterns obtained from the experiments. The comparisons have well correlated with the conclusions derived from the finite element analyses. The theoretical results on butt joints with LOP defects have also been compared with the results obtained from photoelastic experiments.