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WELDING RESIDUAL STRESSES IN STEEL STRUCTURES

The purpose of the paper is to analyse the welding residual stresses in various welding structures. The literature on residual stresses is broad (see [1-26], for instance). In this paper the plug weld and circular path weld are discussed Plug welded element made of low carbon steel is shown in Figure 1. The distribution of residual stresses is shown in Figure 2.

In the weld and adjacent areas tensile stresses equal to the yield stress of the material are observed both in radial and tangential directions.

In areas away from the weld, radial stresses σ_r are tensile and tangential stresses σ_θ are compressive. Both stresses decreased as the distance from the weld increased.

Fig. 1. Plug welded element

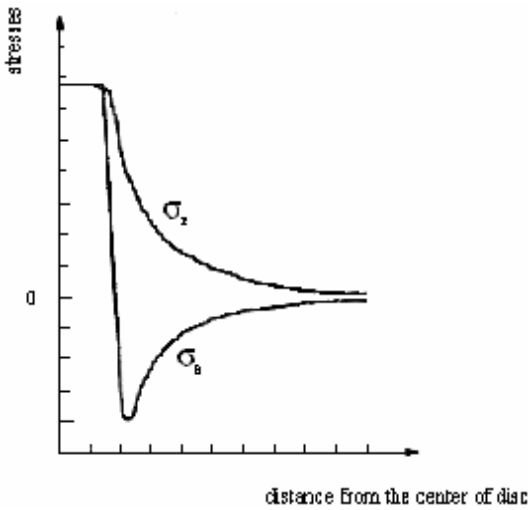

Fig. 2. Distribution of residual stresses in a plug weld

Patch weld which are used in repair jobs is shown in Figure 3. Consider a circular plate welded into a large plate with a circular hole. Since shrinkage of the inner plate is restrained by the surrounding outer plate, high residual stresses are produced. The typical distribution of residual stresses in circular patch welds is shown in Figure 3. The radial stresses σ_r and tangential stresses σ_θ are presented along the diameter. High tensile residual stresses exist in the weld area. The maximum of tangential stress is higher than the maximum radial stress. In the inner plate, radial and tangential stresses are tensile and approximately equal.

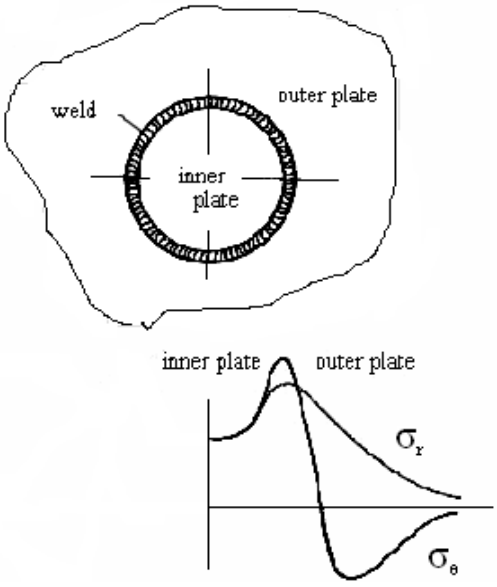

Fig. 3. Residual stresses in a circular patch weld

Residual stresses in a path weld are produced primarily by shrinkage of the weld metal in the direction parallel to the weld or in the circumferential direction and shrinkage of the weld metal in the direction perpendicular to the weld or in the radial direction.

Civil structures are often fabricated by welding. The typical distribution of residual stresses is shown in Figure 4.

First one shows residual stresses in a welded T-shape. High tensile residual stresses parallel to the axis are observed in areas near the weld in sections away from the end of the column. Stresses in the flange are tensile near the weld and compressive away from the weld. The tensile stresses near the upper edge of the weld are due to the longitudinal bending distortion caused by longitudinal shrinkage. Angular distortion is also observed.

The typical distribution of residual stress in an H-shape and a box shape are shown in Figure 4.

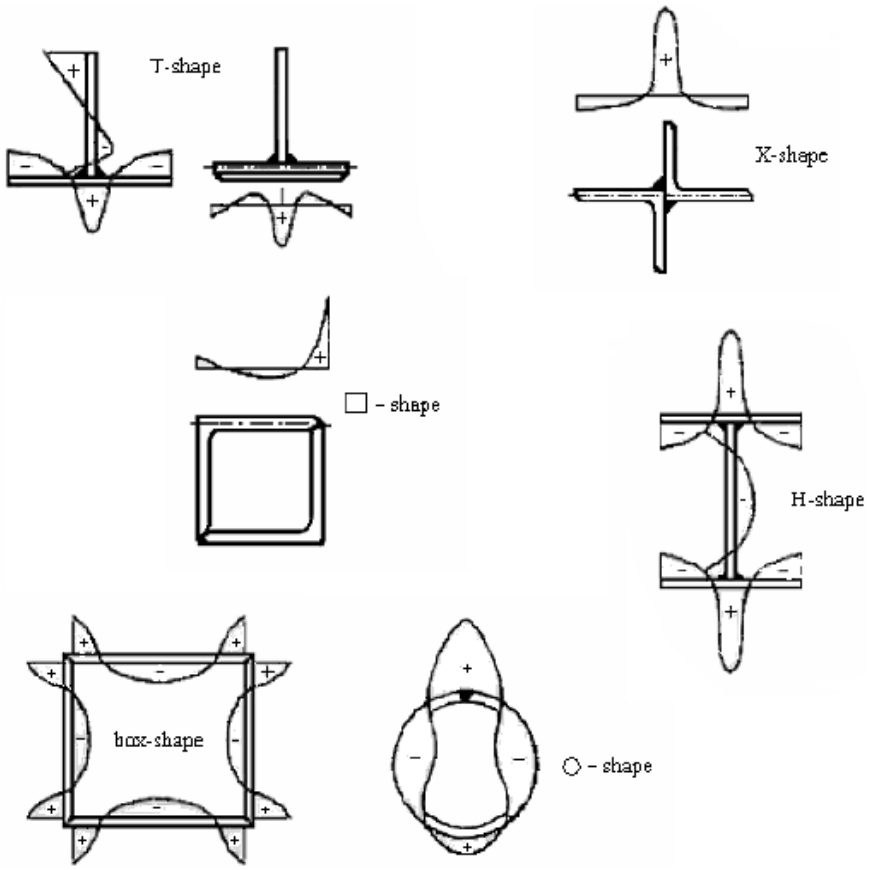

Fig. 4. Residual stresses in welded shapes

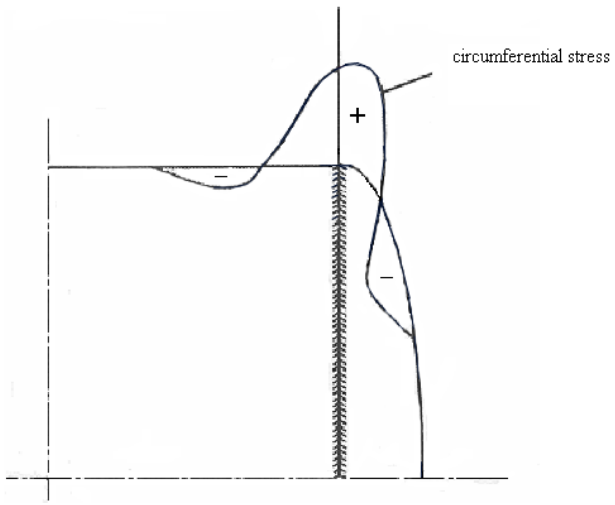

Fig. 5. Residual stresses in a cylindrical tank

The residual stresses shown are parallel to the axis. These are tensile in areas near the welds and compressive in areas away from the weld. In Figure 5 residual stresses in cylindrical tank are presented.

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Abstract

The purpose of the paper is to analyze the welding residual stresses in various kinds of welding structures. The paper has a review character.

Streszczenie

Celem pracy jest analiza naprężeń spawalniczych w różnego rodzaju konstrukcjach spawanych. Praca ma charakter przeglądowy.