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DEFORMATIONS AND STRAIGHTENING OF WELDING STRUCTURES

The purpose of this paper is to analyze distortion in welding. The literature on welding stresses and deformation of welded structures is broad and the reader is referred to [1-27].

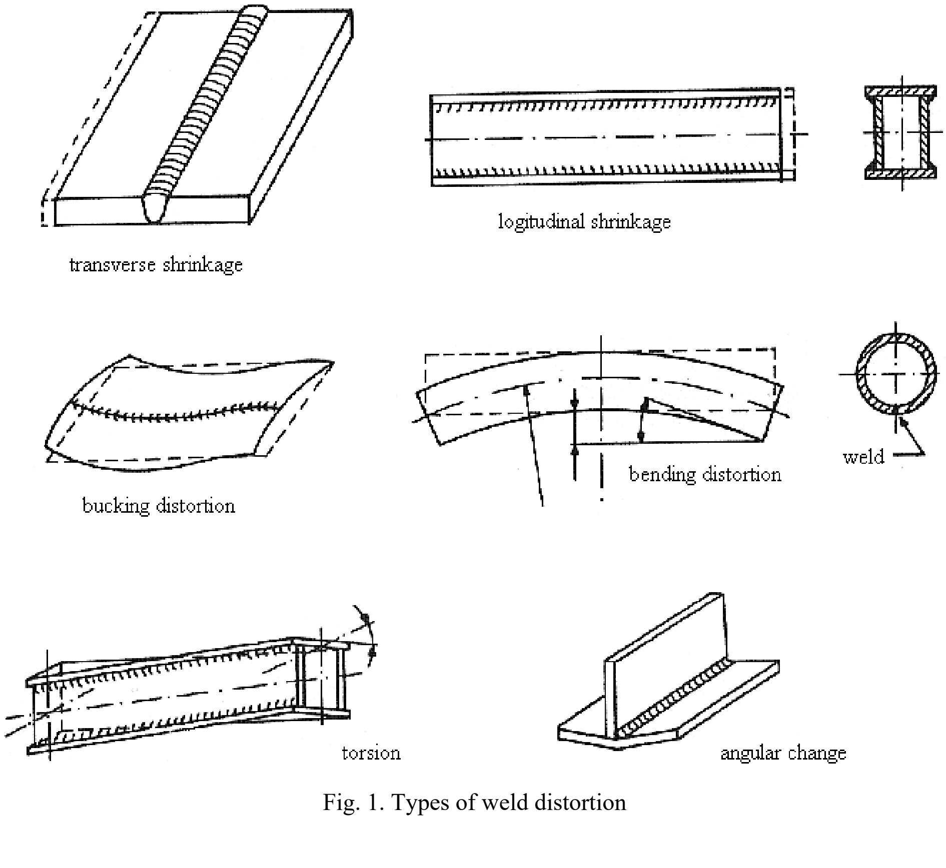

Fig. 1. Types of weld distortion

In the course of heating and cooling processes during welding thermal strains occur in the weld metal and base metal near the weld. The stresses resulting from thermomechanical loadings cause bending, buckling and rotation. These displacements are called distortion in weldments. In welding process three fundamental changes of the shape of welded structure are observed. These transverse shrinkage perpendicular to the weld line, longitudinal shrinkage parallel to the weld line and angular distortion (rotation around the weld line). These changes of welded structure are shown in Figure 1.

A typical structural component in ships, aerospace vehicles, and other structures is shown in Figure 2. It is a panel structure where a flat plate with longitudinal and transverse stiffness fillet is welded to the bottom. In the fabrication of panel structure distortion problem is caused by angular changes along the fillet welds.

The deflection of the panel changes in two directions as shown in Figure 2 when longitudinal and transverse stiffeners are fillet-welded.

The typical distortion in two types of simple fillet-welded structures is shown in Figure 3. In both cases, the plates are narrow in one direction and the distortion can be considered as two-dimensional.

If a fillet-joint is free from external constraint then the structure bends at each joint and forms a polygon. If the stiffeners are welded to a rigid beam the angular changes at the fillet welds will cause a wavy, or arc-form distortion of the bottom plate.

The above figures illustrates only the character of welding deformations. The amount of deformations should be calculated for each case of welding process and structure separately, because there not exist any simple formula for determination of welding deformations. The straightening of welding structures is based on heating of elements. The typical methods of straightening are presented in Figures 4-6.

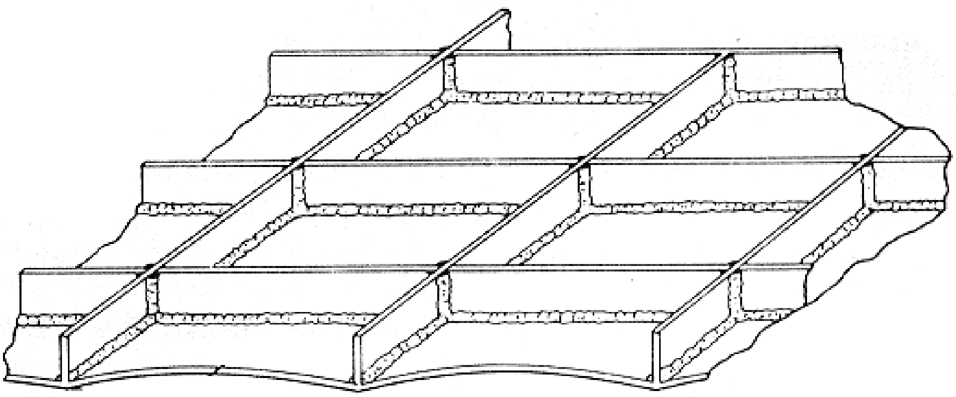

Fig. 2. Welded structure with stiffeners

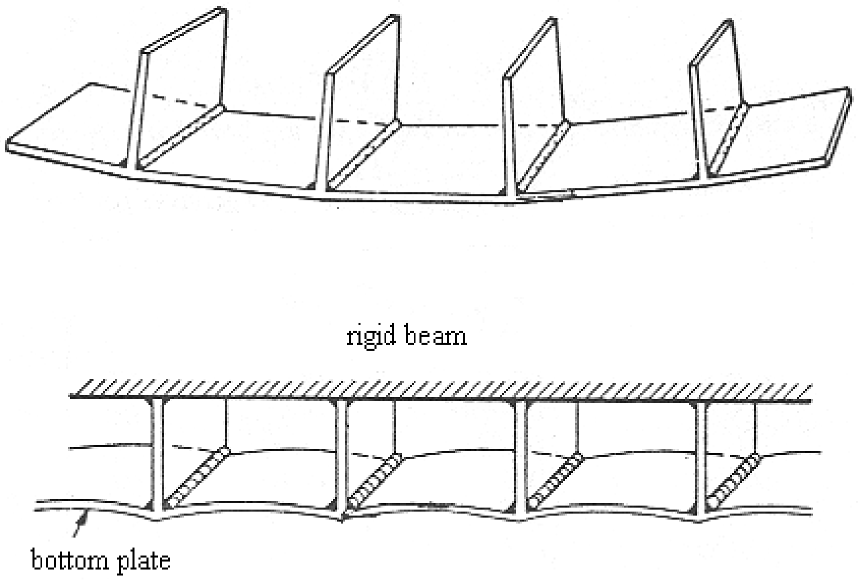

Fig. 3. Types of distortion in fillet-welded structure

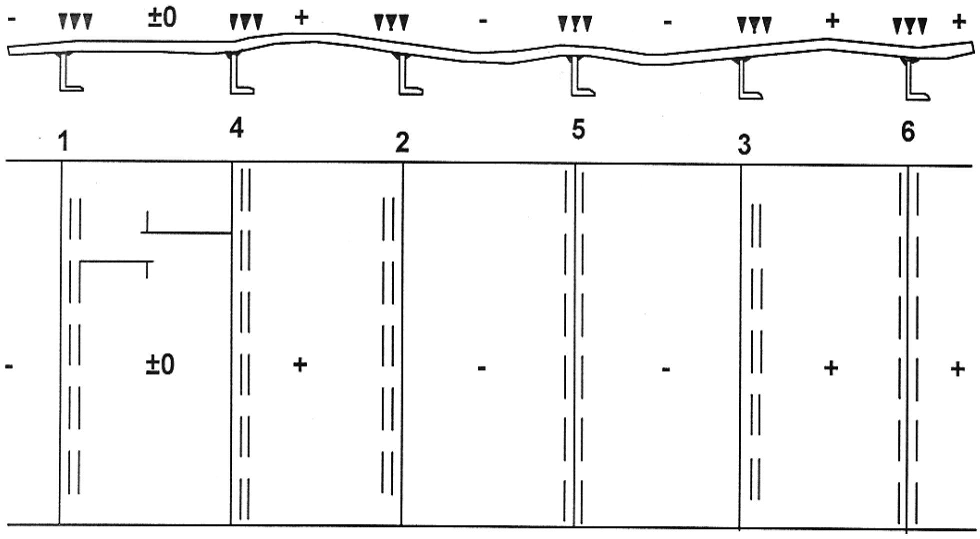

Fig. 4. Sheet straightening

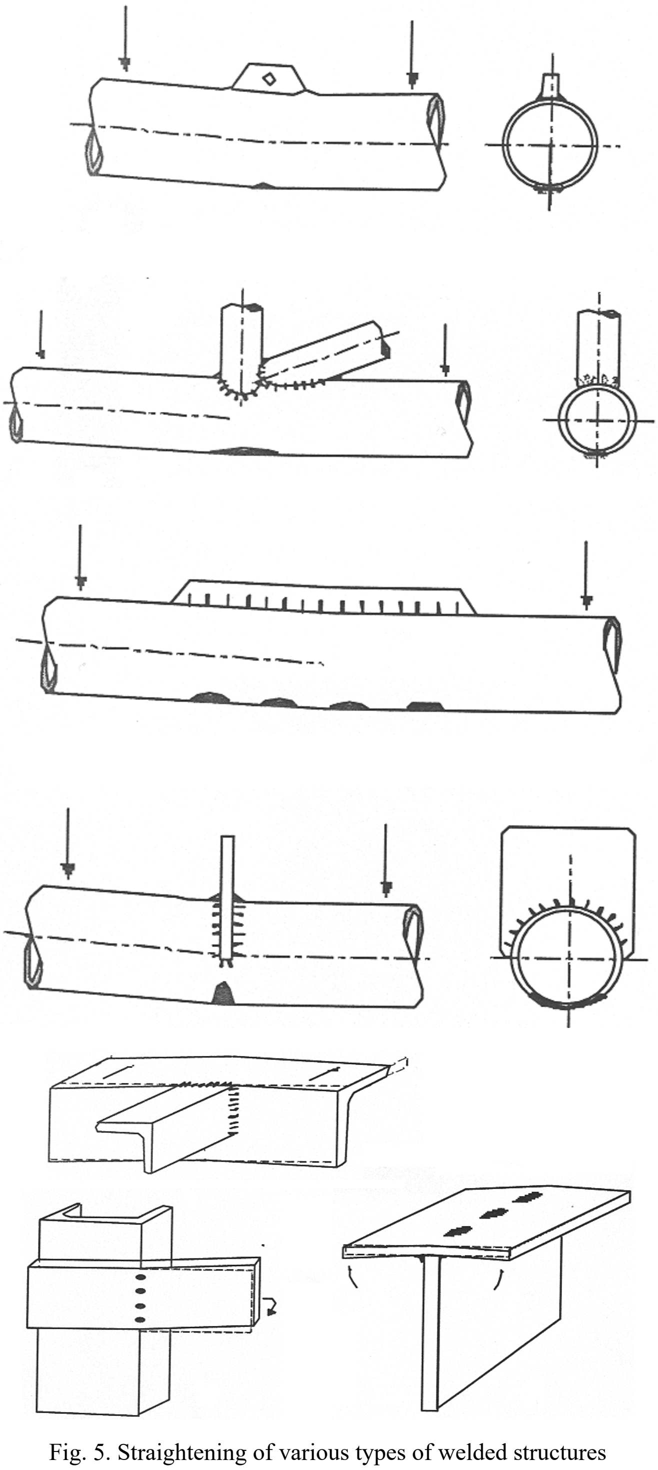

Fig. 5. Straightening of various types of welded structures

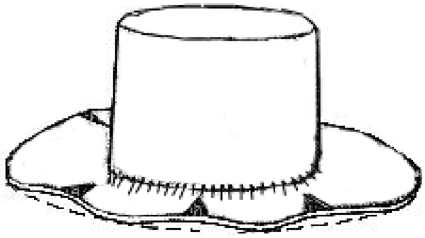

Fig. 6. Straightening of flange

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Abstract

The purpose of the paper is to analyze deformation problems in welded structures. The stresses resulting from thermomechanical loadings cause bending, buckling and rotation. The basic types of distortions in welding are analyzed. The paper has a review character.

Streszczenie

Naprężenia spawalnicze powodują skręcanie, zginanie i obrót elementów konstrukcji spawanych. W pracy przedstawiono główne typy deformacji konstrukcji spawanych. Praca ma charakter przeglądowy.