

Galvafacts

Avoiding distortion during hot dip galvanizing

OCCURRENCE

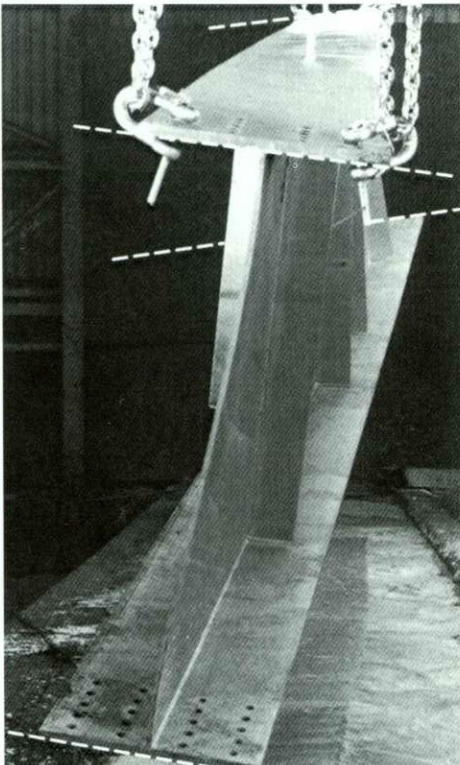
Galvanizing will not generally cause distortion provided that design and fabrication principles are correct. When steel fabrications do distort during galvanizing, the reasons have usually been "built-in" at an earlier stage. Distortion almost always arises from the relief of stresses as the steel is heated to galvanizing temperature (usually 445 °C - 465 °C). Although such stresses may be inherent in the steel and may vary from batch to batch, they are more commonly caused during fabrication. Distortion may also occur if steels of significantly different thicknesses are joined together in a fabrication. Only very rarely is it caused by handling in the galvanizing plant.

Basic design points and other means of minimising distortion are outlined in this leaflet. Symmetrical sections (I-beams, tubes) have less inherent tendency to distort than asymmetrical ones (channels). Similarly, cylindrical vessels are less liable to distort than rectangular or elliptical ones. Other things being equal, the lighter the gauge of steel, the greater the risk of distortion.

Designer, fabricator and galvanizer should liaise at an early stage to get best results.

INHERENT STRESSES IN STEEL

Steel invariably contains internal stresses: hot dip galvanizing can release or vary the amount of stress, making distortion possible.



Above: The effect of distortion upon a beam with asymmetric design features.

FABRICATION STRESSES

Stresses can be introduced by welding, forming or by punching holes.

Minimising introduction of stresses during welding.

Welding results in extreme differences in temperature within small areas of an assembly and hence in significant residual stresses. In general:

1. Thick sections should be continuously welded: thin sections and sheet fabrications may benefit from intermittent welding, depending on whether or not heat is conducted rapidly away from the weld, although more stress may arise at the starting point of the weld.
2. Components of an assembly should be preformed accurately so that they need not be forced, sprung or restrained during welding.
3. As far as possible, welded assemblies should be aligned so that the stresses are balanced rather than all pulling in the same direction.

Other design features to avoid or minimise distortion.

Steel sections should vary as little as possible. Thick and thin sections absorb and lose heat at different rates and so can expand and contract unevenly. Large unsupported flat sheets may tend to buckle (see illustration), so stiffeners should be included in the design. Frames around flat panels - whether of solid steel or open material such as welded mesh - should be galvanized separately as the frame would offer a constraint and so tend to cause buckling rather than reduce it.

Where there is an inherent tendency to distort e.g. in asymmetrically shaped fabrications (including fabricated girders or lattice beams with top and bottom chords of different sections), the effect can be minimised or possibly eliminated if the fabrication is of such a size and design that it can be rapidly immersed in a single dip. Whether or not this can be done will depend on both the size of the sections in relationship to the galvanizer's dipping facilities, and also on the extent to which hollow sections are involved. The galvanizer should be consulted to decide on the maximum advisable lengths. There is little or no distortion in standard symmetrical components whether they are single or double dipped.

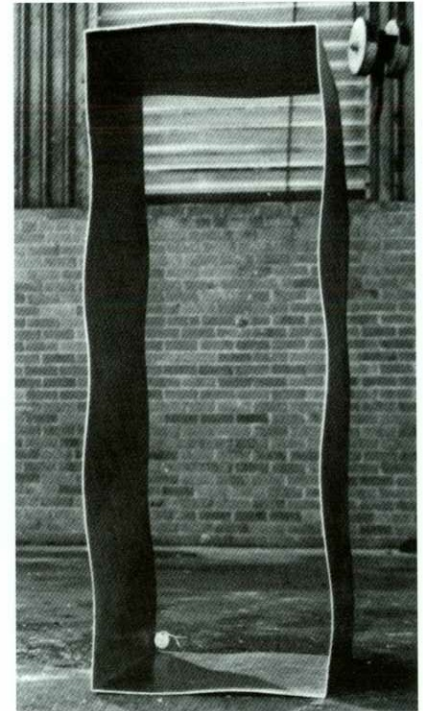
The size and position of filling and drainage holes in tubular structures can have a major effect on distortion as can the size and position of lifting holes or lugs particularly on any hollow structures.

Cases of distortion are relatively few and the benefits of having a hot dip galvanized coating protecting the fabrication will in all but the most extreme cases far outweigh the risks of distortion.

STRESS RELIEF

Fabrication stresses can sometimes be eliminated by stress relief before galvanizing.

Early consultation between galvanizer, fabricator and designer is the key to success in avoiding distortion, through the incorporation of good design and fabrication features.



Top: A fabrication using unsupported flat sheets shows considerable distortion which could have been avoided by including stiffeners as illustrated below.

