

## DISTORTION, CAUSES & CONTROL

### Distortion:

Distortion to some degree is present in all forms of welding. In many cases it is so small that it is barely noticeable, but in other cases allowance has to be made before welding commences for the distortion that will subsequently occur.

The study of distortion is very complex and the following is a brief outline of the subject.

A) The cause of distortion - when under load metals strain or move and change shape.

- ▲ Under light loading metals remain elastic (they return to their original shape or form after the load has been removed). This is known as the "elastic range".
- ▲ Under very high load, metals may be stressed to the point where they will not return to their original shape or form and this point is known as the "yield point". (YIELD STRESS)
- ▲ As metals are heated they expand and when cooled they contract. During welding, heating and cooling of metals occurs unevenly resulting in high stresses and the metal distorts.

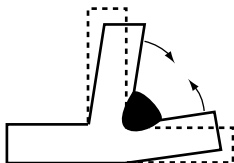
If these high stresses pass the elastic range and go over the yield point, some permanent distortion of the metals will occur. A metals yield stress is reduced at high temperatures.

\*Distortion is the result of uneven expansion and contraction of heated metals.

Distortion Types - the three main types of distortion are:-

- ▲ Angular
- ▲ Longitudinal
- ▲ Transverse

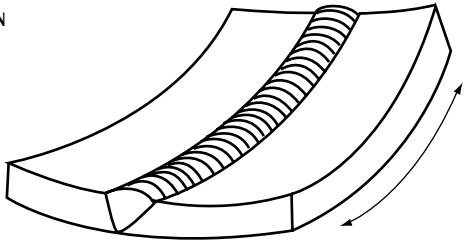
#### (i) ANGULAR DISTORTION



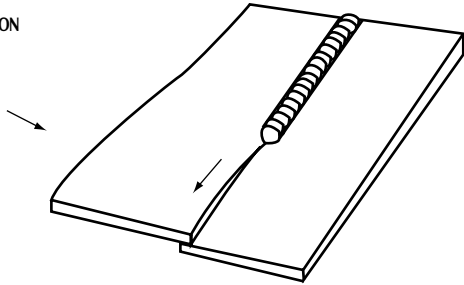
## DISTORTION, CAUSES & CONTROL

### Distortion:

#### (ii) LONGITUDINAL DISTORTION



#### (iii) TRANSVERSE DISTORTION

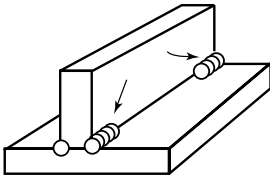


B) The **Control of distortion** can be broken up into three areas:-

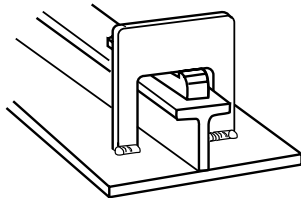
- (i) Before welding
- (ii) During welding
- (iii) After welding

(i) The control of distortion **before** welding can be facilitated by:

- ▲ Tack Welding
- ▲ Jigs, clamps and fixtures
- ▲ Uniform pre-heating
- ▲ Pre-setting



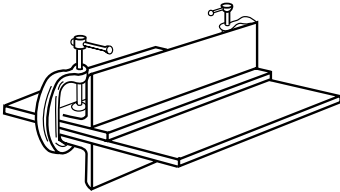
TACK WELDS



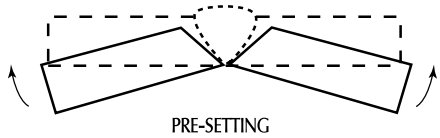
JIGS & FIXTURES

# DISTORTION, CAUSES & CONTROL cont.

## Distortion cont.:



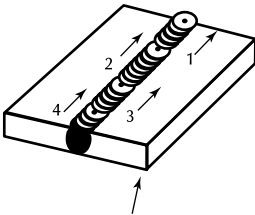
CLAMPS



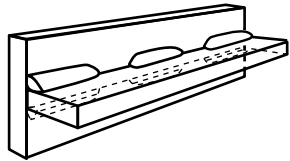
PRE-SETTING

(ii) The Control of distortion **during** welding can be facilitated by:

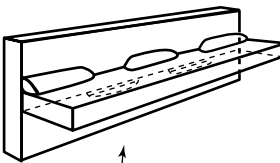
- ▲ Backstep welding
- ▲ Intermittent "Chain" welding
- ▲ Intermittent "Staggered" welding
- ▲ Balanced sequence welding
- ▲ A correct welding procedure to reduce the size of the weld beads



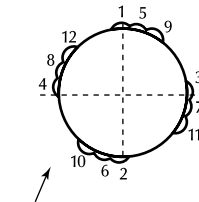
BACKSTEP WELDING



INTERMITTENT CHAIN WELDING



INTERMITTENT STAGGERED WELDING



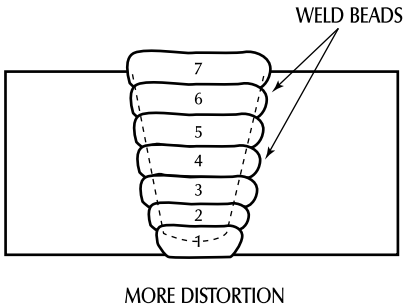
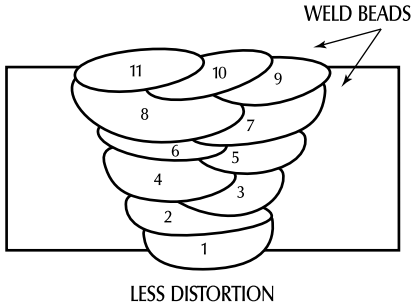
BALANCED SEQUENCE WELDING

## DISTORTION, CAUSES & CONTROL cont.

### Distortion cont.:

The correct welding procedure uses a greater number of weld runs positioned to refine the grain size of the weld metal in the previous layer.

A small number of heavy runs will cause more distortion due to the greater heat input, and the contraction stresses set up by the cooling of the larger deposit of weld metal.



(iii) The control of distortion **after** welding can be facilitated by:

- ▲ Slow Cooling
- ▲ Flame straightening (also known as contra-heating)
- ▲ Annealing
- ▲ Stress Relieving
- ▲ Normalising
- ▲ Mechanical straightening

## DISTORTION, CAUSES & CONTROL cont.

### Distortion cont.:

Annealing - is a heat treatment process designed to soften metals for cold working or machining purposes. The job or finished work is normally heated in a furnace so as the metal reaches its critical range (for .025% carbon steel @ 723-820°C) and then the work is very slowly cooled.

Stress Relieving - is the uniform heating of welded parts to a temperature below the critical range, followed by slow cooling. This process allows the yield point of the metal to be lowered allowing it to stretch or yield, so reducing the residual stresses in the work.

Normalising - is a process used to refine the grain structure of the metal so it improves its resistance to shock and fatigue.

In normalising the welded parts are heated just above the critical point (820°C for .025% carbon steel) for approximately 1 hour per 25mm thickness and then allowed to cool in **still** air.

Mechanical Straightening includes:

- Bend Pressing
- Hammering
- Rolling