A STUDY OF EFFECT OF GROOVE ANGLE ON ANGULAR DISTORTION AND IMPACT STRENGTH IN BUTT WELDS

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Abstract Welding is an area in which technological developments out match the developments in its science base, which is primarily driven by the phenomenal industrial demand for welded structure. Reliability, Reproducibility and Viability requirements are forcing Technologists to look at weld defects such as distortion, hot cracking, in a systematic and logical approach than on adhoc basis. Distortion is an unwanted physical change from specifications in a fabricated structures is caused by non-uniform expansion and contraction of the weld metal during heating and cooling cycle of the welding process many factors viz., material properties, welding process and procedures adopted make accurate prediction of distortion difficult. Groove angle was taken to analyze angular distortion and impact strength in butt weld joints. In this paper detailed discussion is carried on in controlling the angular distortion by selecting proper angle in the shielded metal arc welded joints and by varying the same factor the impact strength of the joint was also evaluated.

1. INTRODUCTION

It was experimentally observed and theoretically studied that distortion[1] an unwanted physical change often reduces the usefulness of the finished structure for the purpose for which it was designed. Many factors effect distortion viz., more number of passes with small diameter electrodes, slow arc travel speed, groove angle, high residual stresses in plates to be welded, and welding sequence being improper. In present experiment much attention has now been on the groove angle were experimental results demonstrate that initially angular distortion increased with increased in groove angle and later decreased with the same and also impact strength of the joint was also evaluated by varying the same factor.

In the present experimental study it is found that angular shrinkage depends on the width and depth of the fusion zone relative to plate thickness, on the type of joint, weld pass sequence, thermo mechanical material properties and the characteristics parameters of the welding process. It is found that when two beveled plates are welded the plates are pulled out of line with each other since the opening of the weld metal is deposited there, and thus the drawing (or) pulling is greatest on that side of the joint.

Thermal expansion and contraction during welding cycle will result in distortion (or), if sufficient restraint is applied, in the developments of internal stresses, these stresses may result in plastic deformation if the yield stress is exceeded (or) even in the tearing of the material. In the former case, internal stresses up to yielded stress will remain and any subsequent thermal (or) mechanical treatment may lead to distortion, thus the material properties and the welding processes and properties affect the extent of distortion.

The present paper highlights the effect of groove angle on angular distortion and impact strength and these parameters were studied and evaluated by varying the groove angle.

2. MATERIALS

The materials used for experimental setup are (a) mild steel plates (b) electrodes. Mild steel plates of dimensions 250mm x 100mm x 10mm are used. Electrodes of 10 gauge (3.15mm dia) general-purpose mild steel electrodes of ADVANI OERLICON make (Over Cord)[2] are used. These electrodes are medium coated and are used in all properties for work of structural importance. These electrodes operate with a quiet arc and deposits smooth bead with fine ripples. They give medium penetration, least spatter and slag, which is easy to detach. These electrodes are versatile in nature i.e. they are easy to operate in all positions.

3. EDGE PREPARATION

Various types or edge preparation can be used and the choice of thee most suitable is influenced by a number

of factors some of these are, type of process, type of work, position of welding, distortion and shrinkage[3]. Considering the above-mentioned factors we have chosen 'v' edge preparation for our experiment, Milling machine is used to obtain various bevel angles of 'v' joints. The bevel angles produced using milling machine for experimental set up are given below.

Samples	Angle in degrees	Thickness in (mm)
W-1	30	10
W-2	45	10
W-3	60	10
W-4	75	10
W-5	90	10

4. WELDING PROCEDURE

The process adopted for our experiment is shielded metal arc welding (SMAW) [4] for its versatility as the joints in almost location can be welded because the power supply leads can be extended for relatively long distances and no hoses are required for shielded metal arc welding joints can controlled as joints welded by other manual methods that employ consumable electrodes. Shielded metal arc welding electrode materials are available for matching the properties of a joint can match those of the metals joined.

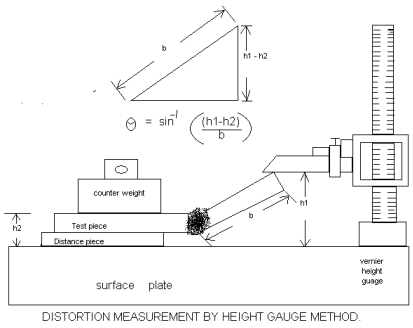
The work piece samples were welded using 10gauge (3.15 mm dia) general-purpose mild steel mild steel electrode of ADVANI OERLIKON make (Over Cord). After the establishment of arc by touching the electrode and to the work piece by momentarily touch, the arc length adjusted the electrode is inclined to an angle of approximately 20 degrees with the vertical. The machine used for welding process is INDARC 300.ST.

5. MEASUREMENTS.

5.1 Measurement of Angular Distortion.

A method for measuring angular distortion is shown in the figure 1. In this method the test piece, the vernier height gauge[5] are placed as shown in the figure. Before welding i.e. at zero distortion the initial height (h2) at which the test piece is placed and is measured by vernier height gauge. After welding distortion is measured by placing a counter weight on one side joint so that

The other side rises to a certain height (h1). This height can be measured with vernier height gauge. After noting the heights h1 and h2 and width 'b' of the single test piece, the angular distortion is found by submitting the above values in the formula. The results were plotted on the graph shown below.



DISTORTION MEASUREMENT BY HEIGHT GAUGE METHOD.

Fig.1Indicates the effect of grove angle on the angular distortion.

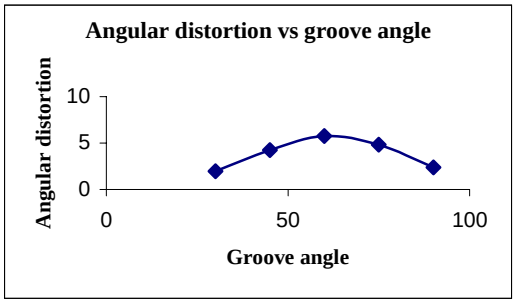


Fig.2 Effect of Groove Angle on Angular Distortion.

5.2 Measurement of impact strength

Welded joints in a structure are expected to possess certain service related capabilities, welded joints are generally required to carry loading of various types in which the weld is subjected to stress of either a simple (or) complex character. More over, a finished weld is not always as good or as bad as it may appear to be on its surface. It is there fore necessary to find out how satisfactory (or) how sound the weld is, for this purpose certain weld inspection and testing procedures have been discovered and standardized to estimate the expected performance of the welded structure. The testing and inspection of welds after fabricate can be grouped into two basic categories, namely

1. The Charpy (beam) test.
2. The Izod (cantilever test).

5.2.1 Preparation of izod test specimen

Izod test specimen has been taken from the welded joint of the size (10mm x 10mm x 75mm) from the weldments produced from the welding process. After cutting the specimen as per ASTM[6] specifications it is grinded on a smooth grinder in order to obtain good surface finish. Later a (v) notch is made on the grinded specimen. The same procedure is been followed for all the samples.

5.2.2 Izod test procedure

The swinging pendulum weight is raised to standard height depending upon the type of specimen to be tested. As the pendulum is released, its potential energy

is converted into kinetic energy until it strikes the specimen. The izod specimen is placed with the (v) notch facing the pendulum. The same procedure is followed for all the samples of the experiments and the obtained results are plotted on the graph shown in graph below.

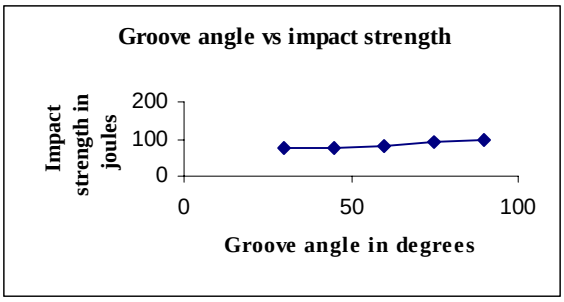


Fig.3 Effect of groove angle on impact strength

6. RESULTS

- It is observed from the graph between angular distortion versus groove angle that is initially angular distortion increased with increase in groove angle and later decreased.
- It is observed from the graph between impact strength versus groove angle that the impact strength is increased with increase in the groove angle.

7. CONCLUSIONS

- Distortion has been increased with the increase in the groove angle till 60 degrees.
- Groove angles like 45 degrees and 60 degrees requires multi passes.
- Very little angular distortion would result from the root pass weld.
- Multiple passes lead to distortion.
- Angular distortion decreases above 60 degrees due to fact that after the first pass the temperature of the base metal increases which result in heating of the base plates which lead to a decrease in temperature difference between base plate and welded area.
- The strength is increased with groove angle due to the increase in the amount of weld metal deposition.

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