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Design and Manufacturing of Fixture Bed for Submerged Arc Welding

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Abstract: *Welding is fabrication or sculptural process that joins materials, usually metals or thermoplastics, by using high heat to melt the parts together and allowing them to cool causing fusion. In this current welding method used in "EMERGING BUILDCON" is manual welding which is time consuming and complicated. In current method of welding the beam is not properly supported and due to high temperature the heat distribution is uneven in beam, due to this the beam gets bent and it requires rework .Thus the accuracy of product gets affected. To reduce the cost of rework and to improve productivity they decided to accept the automation in welding processes. For further automation SAW machine is installed. In SAW the operating temperature is much higher than current welding method for that the proper welding bed fixture has to be design to avoid such problems. As we provide the proper support to welding method the bending can reduced majorly and it also reduce worker (welder) cost as well as it also reduce the material handling . Fixture bed having flexibility with change in length of work peace.*

Keywords: *SAW welding, Automation in welding processes, flexibility.*

I. Introduction

The weld quality is defined in terms of properties such as weld-bead geometry, mechanical properties, and distortion. Generally, all welding processes are used with the aim of obtaining a welded joint with the desired bead geometry and excellent mechanical properties with minimum distortion. Basically, distortion is a thermal problem. During welding, the weld zone is subjected to high localized heating. Due to uneven distribution of heat, temperature gradients cause the weld zone to deform plastically. This deformation happens to the fabricated I-beams in the form of bending distortion after submerged arc welding (SAW). Many structural steel elements are produced in form of I-beams. Many structural steel elements are produced in form of I-beams. Elements such as columns and rafters are joined together to build structures such as warehouses, hangars, and bridges. These elements should be structurally efficient and free of distortion so that a structure withstands loads. Therefore, bending distortion must be eliminated or minimized to an acceptable level. Flame straightening is the most common procedure used to get rid of distortion. However, this procedure is time-consuming and labor-intensive. The frequency of flame straightening could be reduced by selecting the proper values of input parameters of the SAW process. Several parameters and factors are affecting the SAW process. The type of the technology used, voltage, amperage, wire feed speed, wire diameter, flux type, fixture design, and thermal and mechanical properties of the weld material are some of these factors. Steel structures have high customization with very different specifications including length, cross section width, web width and thickness, and flange width and thickness. Therefore, there is no standard procedure to solicit the right values of SAW parameters. SAW machines' operators use their skills and trial and error to find the suitable values of parameters for a certain I-beam specification. The main challenge is to select the best values of these parameters that would create an excellent welded joint with the required weld-bead geometry and weld quality with minimal distortion within time and cost constraints.

The process requires a continuously fed consumable solid or tubular (metal cored) electrode. The molten weld and the arc zone are protected from atmospheric contamination by being "submerged" under a blanket of granular fusible flux consisting of lime, silica, manganese oxide, calcium fluoride, and other compounds. When molten, the flux becomes conductive, and provides a current path between the electrode and the work. This thick layer of flux completely covers the molten metal thus preventing spatter and sparks as well as suppressing the intense ultraviolet radiation and fumes that are a part of the shielded metal arc welding (SMAW) process. SAW is normally operated in the automatic or mechanized mode, however, semi-automatic (hand-held) SAW guns with pressurized or gravity flux feed delivery are available. The process is normally limited to the flat or horizontal-fillet welding positions (although horizontal groove position welds have been done with a special arrangement to support the flux). Deposition rates approaching 45 kg/h (100 lb/h) have been reported — this compares to ~5 kg/h (10 lb/h) (max) for shielded metal arc welding.

Although currents ranging from 300 to 2000 A are commonly utilized, currents of up to 5000 A have also been used (multiple arcs)

II. Problem Statement

In "**EMERGING BUILDCON"** Current welding method is manual type & it is time consuming. As we know the accuracy of the welding is depends on the worker skill. In current method the working temperature is near about 800˚C to 1000˚C. And beams have welding on both side due to which material get bend Due to improper support while welding beams and temperature. Thus beam required re-work for straitening. This process is time consuming and beam gets structurally affected. Due to lack of automation the Aesthetic view is poor and machine handling is more it also effect on production rate.
Thus company has to decide to move toward automation by in installing Submerged Arc Welding. For SAW there should be proper support for holding beam like fixture bed which is going to reduce bending of beam.

Parts undergoing welding process

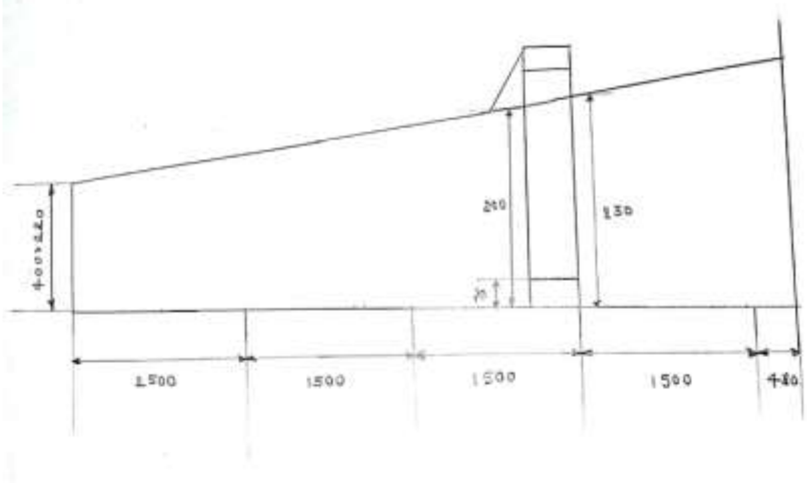

Fig.1. Non Uniform column

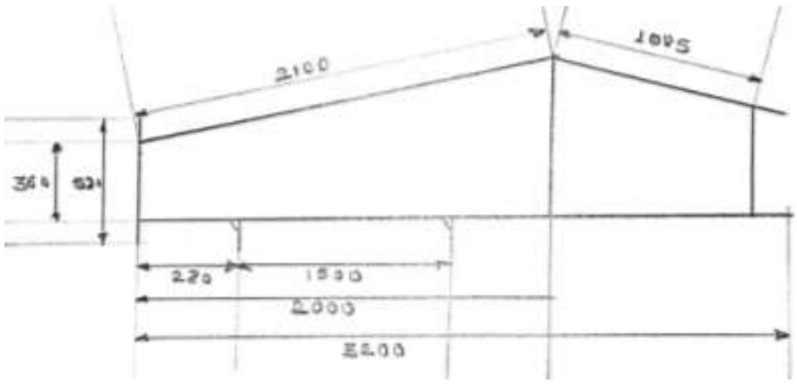

Fig.2.Rafter

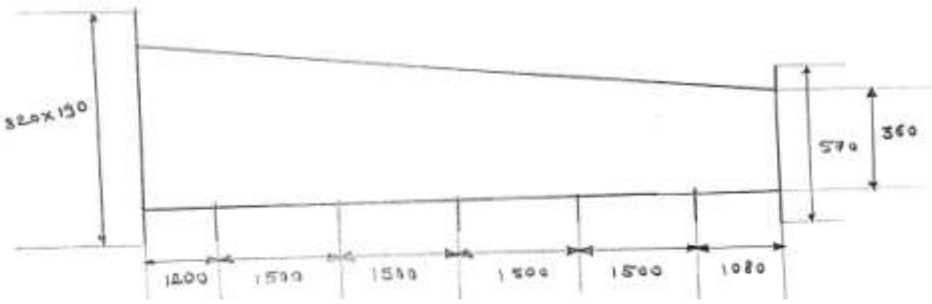

Fig.3.Canopy

Fig.4-uniform column

Fig 1,2,3 & 4 are the part's fabricated by SAW welding processes. In SAW temperature during welding is near about 800 ˚C to 1000 ˚C , and part's length is about 9m. Due to high temprature and long length there is possibility of bending of part's hence to avoid this phenomenon part's should properly supported.

III. Design And Fabrication of Fixture Bed

i. Load calculation

Maximum load on fixture bed support.
Generally all parts are in **" I "** section
Cross-sectional area – [2(area of web) + (area of flange)]
= 2(700*36) + (1200*12)
=$64.8 * 10^3 mm^2$

Volume of beam = area* length
=($64.8 * 10^3 mm^2$) * 12000
= $777.6 * 10^6 mm^3$
=0.7776 m^3

Density of beam material
Beam material = MS E250
Mini. Yield strength=250 Mpa
Max. carbon % = 0.42

Density = 7850 kg/m^3

Therefore
Total mass of beam = load acting on bed = Density*Volume
= 7850*0.776
= 6104.16kg = 6.1 tonne approx.

Hence the bed shold be designed to sustain more than this load for safety purpose.
Hence we are considering Factor of Safety =1.5
Therefore ,
= 6104.16*1.5
= 9156.24kg
= 9.156 tonne
Hence the bed should have strenth to handle 9 to 10 tonne

ii. Fixture Design

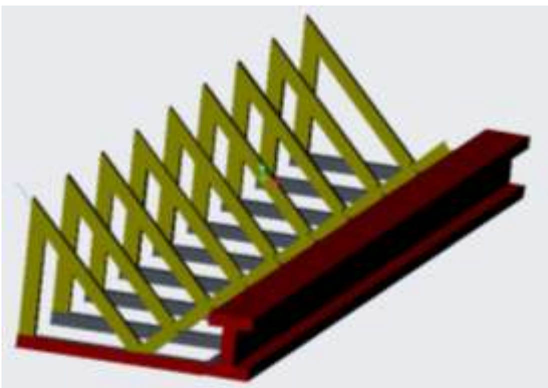

Fig 5: Fixture Design

Fig. no 5 is design of fixtue bed created on CREO Parametric 4.0 . Red colour represent the moving path of SAW machine. & yellow colour represent the support on which the part is going to rest .Initially we are going to provide 9-10 support channels & can be added according to size variation. Due to number of supports the load gets distributed equally on each support.

IV. Conclusion

1. In EMERGING BUILDCON the major work is welding & current welding method is manual. Due to which the skilled & unskilled worker required.
2. In Manual method following problem are observed

I. Material handling is more
II. Distortion in beam is more due in proper support
III. Less accuracy
IV. Time consuming
V. Strength of welded joint is affected

3. To overcome the above mentioned problems the automated welding with proper support is required
4. EMERGING BUILDCON going to install the automated SAW machine. Due to automated SAW the platform with fixture bed is required.

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