EXCOGITATION AND CONSTRUCTIVE OF UNIVERSAL FIXTURE FOR SUPER HEATER

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Abstract

As a result of research in the project of "Universal Fixture for Super Heater Products", is a device, which is used to weld the super heater products with the support of iron plates to reduce the wastage of material. Its main advantage is to securely locate and support the work ensuring that all the parts produced using the fixture will maintain conformity and interchangeability. However, at the same time the plates can be easily replaced by the gas welding.

This project presents some of the advantages by introducing Universal Fixture method. Such as to save space, time material and money by changing the iron plates, therefore total fixture beam will not be replaced often.

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Keywords: Gender, Depression, Life Events, Positive, Life events and Negative life events.

1. INTRODUCTION

The objective of this project is to use our knowledge acquired in Mechanical Engineering to weld the super heater products with the support of iron plates (Fig:1.1) to reduce the wastage of materials by using Universal Assembly fixture. Iron plate's main advantage is to securely locate and support the work ensuring that all the parts produced using the long beam fixture (Fig: 1.2) will maintain conformity and interchangeability. However, at the same time the plates can be easily replaced by the orbital welding

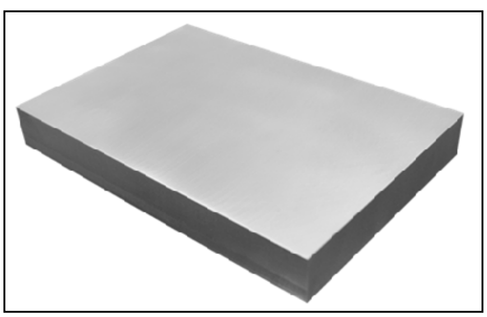


Fig:2.1 Iron Plate

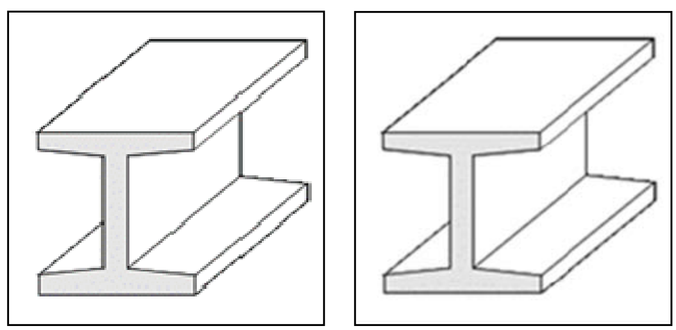


Fig: 2.2 Long beams Fixture

This project presents some of the advantages by introducing Universal Assembly Fixture method. Such as to save space, time material and money by changing the iron plates, therefore total fixture beam will not be replaced often.

1.1 PROBLEM IDENTIFICATION:

To evaluate these factors effectively, the following six goals were examined:

- Previously, the super heater a product was produced by using fixture, the super heater panel was welded by the process of Arc welding.
- After the welding work is completed that super heater panel has to be removed for another process by gas welding.
- So that, welded part of specified place will be affected or damaged in the fixture.

- The affected parts must be removed and replaced to the certain length of beam, eventually the beam has to be changed and wastage of material and cost of the products and time and labours are increased.
- Moreover, main disadvantage is that lot of storage space will be needed for producing different parts.
- Therefore above said types of fixtures will make huge loss for plant for producing super heater products.

1.2 MODIFICATION OF FIXTURE:

Considering the complexity of the fixture geometry, the fixtures were built in the Plant. The models were then designed. The use of space, cost, material, labor and time was limited to complete the fixture to the **Universal Fixture assembly**. The different attribute of the iron plates in the fixture was given by using existing welding processes.

Initial process is to place the fixture at the bottom of the base and the plates are fixed rigidly or welded in the top of the fixture at the required size and dimensions of the super heater products. Then, the panel has to be welded in the super heater. After the completion of product the super heater panel has to be removed by using gas welding.

Above this only a certain length of plates can be removed and it will make rework for producing another super heater product.

By fixing this temporary plates will improve the tolerances and easy to set the diagonal at each sides of the fixture beam. And easily different parts can be changed for producing super heater products.

Eventually, main advantage of this universal fixture for super heater products is that wastage of material and cost can be reduced for producing super heater products.

2. LITERATURE REVIEW

This chapter gives information regarding the literature searched and & referred for the project work. Following are literature searched from the various journal papers.

Vaibhav H. Bankar stated that present Universal fixtures can be created as needed during the intermediate process steps by referencing the gauge block towards the work piece. The milling forces are predicted from the work piece material properties, cutter parameters, tooth geometry, cutting condition and types of milling. Modeling has been applied to model a milling fixture-work piece system and to explore the influence of compliance of the milling fixture body on work piece deformation. In addition, the effects of vibration on the prediction of natural frequency are also examined.

Kulankara Krisnakumar, Shreys N.Melkote, states that the main functions or a machining fixture are to locate, constrain and adequately support the work piece during machining. These functions are achieved by strategically placing locator pins, clamps, and supports around the work piece and applying the appropriate clamping forces. A poor choice of the position of the fixture elements and clamping forces can lead to undesirable work piece deformation and low dimensional / form accuracy of the work piece. Consequently, an important consideration in fixture design is to optimize the fixture layout i.e. positions of locators and clamps, so that work piece deformation due to clamping and machining forces is minimized.

Sheldon Levine highlighted the importance of the rigidity of fixture. The paper of addresses the vibration response of the fixture, to get fixture as rigid as possible within the allowable weight limits and fixture should therefore have no resonances within the frequency range. That is, the first resonant frequency should be above the maximum specified tested frequencies.

Fiji Napata & Yuji Teacake, in his paper proposed that large vibration can occur in tools and work piece during machining. This vibration causes problems in machining accuracy, efficiency, tool life and safety. One of the causes for vibration is lack of sufficient dynamic rigidity to stabilize parts in a dynamic cutting force. In this case, parts are reinforced by a fixture to supplement inadequate rigidity. This report describes the development of vibration analysis technology for analysing of an entire system including jigs achieved through the utilization of recent 3D-CAD.

Neemettin Kaya, in his paper proposed that clamping is very important in the fixture design to get rigidity of the fixture.

Yi Zheng establishes the finite element model of fixture unit stiffness and develops the experimental approaches to identify contact stiffness. Based on this study, the database of fixture stiffness can be built up, and further used in CAFD.

J.E.Akin, proposed that feat is the most common tool for stress and structural analysis. Various fields of study are often related. Further he guided the steps involved in the finite element analysis. The basic concept behind the FEM is to replace any complex shape with the union (or summation) of a large number of very simple shapes (like triangles) that are combined to correctly model the original part. The smaller simpler shapes are called finite elements because each one occupies a small but finite sub-domain of the original part.

Xiumei Kang and Qingjin Peng, concludes with the research trend of computer aided fixture panning. Finite element analysis is a useful tool in modelling fixture work piece interactions for the deformation analysis. The model can be parametrically built to optimize a fixture layout and clamping forces at a minimized work piece deformation.

David Roy lance, purposes the Finite element analysis is now the basis of multibillion dollar per year industry. Numerical solutions to even very complicated stress problem can now obtained using Finite element analysis.

Hainan Deng proposed that fixture stability is an important concern in machining fixture design and refers to the ability of a fixture to fully restrain a work piece that is subjected to external forces generated by the machining operation. The majority of prior work on fixture stability analysis is static or quasi-static. Early efforts in this area focused on the study of form closure and force closure and present a systematic mathematical procedure for modelling and analysis of the fixture dynamic stability of an arbitrarily configured fixture work piece system in machining. The procedure consists of static model to calculate the work piece contact deformation due to clamping, a dynamic model to predict the work piece motion due to machining, a geometric model to capture the continuous change of system geometry and inertia due to the material removal effect, and a module to simulate the overall behaviour of the fixture work piece and detect instabilities at fixture-work piece interfaces.

3. MILD STEEL COMPOSITION:

The chemical composition of the mild steel is given below the table 2 in detail

Table 3.1 Chemical composition of mild steel SAE 1018

CHEMICAL COMPOSITION	
Carbon	0.15-0.20%
Silicon	0.10% max
Manganese	0.160-0.90%
Sulphur	0.040% Max
Phosphorus	0.040% Max

3.1 MATERIAL SELECTION FOR SUPER HEATER:

The low-temperature super heater material selection was straight forward. Due to the low temperature of both the steam and flue gas, and the service record of the existing super heater in this area, the selected material was identical to the existing super heater (SA 178). The process undertaken to finalize the material selection for the high-temperature, ted pass super heater included a general literature review of current practice and experience for super heaters in MSW, a companywide review of super heater experiences were carried out in 2000 covering 30 facilities, and some specific discussions with several key facilities. Two key factors that made for a difficult decision making process were that the expected flue gas temperature of 960°C (1,760°F) at the ted pass super heater inlet is higher than typically found in MSW units, and that the vast majority of super heater experience is with bare SA 213 T22 tubes only. The potential for high super heater corrosion rates was a major concern.

Several material selection options were considered for the high-temperature super heaters. These options included:

- Bare SA 213 T22 tubing

• SA 213 T22 tubing clad with refractory protection

• Income 625 spiral welded SA 213 T22

• Income 625 clad composite tubing

• Austenitic stainless steel tubing the material selected was Income 625 spiral welded SA 213 T22. The decision making process that arrived at this final selection involved a number of considerations including:

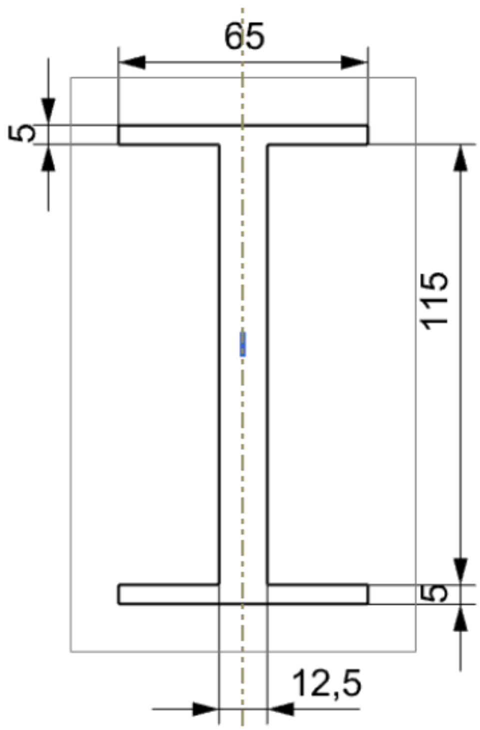
• The expectation that the life of bare SA 213 T22 would be very low (<2 years) at the required inlet flue gas temperature.

• The expectation that the service life would be significantly higher if Income 625 spiral weld overlay was applied to these same tubes

4. DESIGN AND MODEL CALCULATION
TO FIND:

1. I BEAM SHEAR STRESS,
2. C-CHANNEL SHEAR STRESS.

1. I-BEAM SHEAR STRESS:



All dimensions are in mm

I BEAM

Section – 1

Area$(a_1) = b \times h = 65 \times 5 = 325mm^2$

$$x_1 = {}^{b}/_{2} + h = 65mm$$

$$y_1 = \frac{\text{vertical distance of section}}{2} = {}^{h}/_{2} = {}^{5}/_{2} = 2.5mm$$

Where,

v = volume
L= length
h = height
w = width
t = thickness

Similarly:

For section 2 and 3

$a_2 = 1437.5mm^2$ $\quad$ $a_3 = 325mm^2$

$x_2 = 12.5mm$ $\quad$ $x_3 = 65mm$

$y_2 = 718.75\ mm$ $\quad$ $y_3 = 122.5mm$

To find volume:

$volume = L \times h \times w$

$$v_1 = 500 \times 125 \times 65 = 4.0625 \times 10^6 mm^3$$

Similarly

For volume 2 and 3

$v_2 = 718.75 \times 10^6 mm^3$ $\quad$ $v_3 = 4.0625 \times 10^6 mm^3$

$$\bar{X} = \frac{(v_1x_1) + (v_2x_2) + (v_3x_3)}{(v_1 + v_2 + v_3)}$$

$$= \frac{(4.0625 \times 10^6 \times 65) + (718.75 \times 10^3 \times 12.5) + (4.0625 \times 10^6 \times 65)}{(4.0625 \times 10^6) + (718.75 \times 10^3) + (4.0625 \times 10^6)}$$

$\bar{X} = 60.737mm$

$\bar{y} = \text{max. vertical distance}/_2 = h/_2 = 125/_2 = 62.5mm$

To find moment of inertia:

Formula used:

$I_{xx} = \sum(I_{self})_{xx} + \sum a(y - \bar{y})^2$ ⟶ 1

$I_{yy} = \sum(I_{self})_{yy} + \sum a(x - \bar{x})^2$ ⟶ 2

$(I_{self})_{xx} = \frac{bd^3}{12}$ $\quad$ $(I_{self})_{yy} = \frac{b^3d}{12}$

$I_{xx_1} = \frac{65 \times 5^3}{12} = 677.08mm^4$ $\quad$ $I_{yy_1} = \frac{12.5^3 \times 115}{12} = 18.717 \times 10^3 mm^4$

Similarly:

For I_{xx_2} & I_{xx_3} $\quad$ For I_{yy_2} & I_{yy_3}

$I_{xx_2} = 633.69 \times 10^3 mm^4$ $\quad$ $I_{yy_2} = 813.8\ mm^4$

$I_{xx_3} = 677.08mm^4$ $\quad$ $I_{yy_3} = 18.717 \times 10^3 mm^4$

$\sum I_{xx} = 635.04 \times 10^3 mm^4$ $\quad$ $\sum I_{xx} = 38.247 \times 10^3 mm^4$

Put all values in equation 1&2

$\sum a(y - \bar{y})^2 = 620.24 \times 10^6 mm^4$

$\sum a(x - \bar{x})^2 = 3.355 \times 10^6 mm^4$

Similarly:

For I_{xx} & I_{yy}

$I_{xx} = 620.87 \times 10^6 mm^4$

$I_{yy} = 3.393 \times 10^6 mm^4$

POLAR MOMENT OF INERTIA:

$I_{zz}(or)\ I = I_{xx} + I_{yy}$ ⟶ 3

$I_{zz}(or)\ I = 624.26 \times 10^6 mm^4$

To find shear stress;
Formula used

$$\tau = \frac{F \times A \times \bar{y}}{I \times b}$$

Load F - 200×10^{3} N

Similarly:

For $\tau_1, \tau_2 \& \tau_3$

$$\tau_1 = 31.373 \times 10^{6}\, {N}/{mm^2}$$

$$\tau_2 = 19.678 \times 10^{6}\, {N}/{mm^2}$$

$$\tau_3 = 31.373 \times 10^{6}\, {N}/{mm^2}$$

To find τ_{max}

$$\tau_{max} = \tau_1 + \tau_2 + \tau_3$$

$$\tau_{max} = 81.424 \times 10^{6}\, {N}/{mm^2}$$

Maximum shear stress for one I Beam $= 81.424 \times 10^{6}\, {N}/{mm^2}$

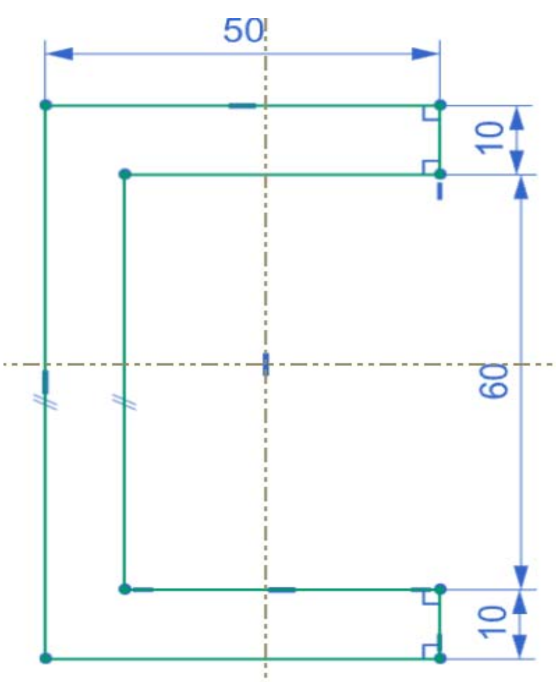
Therefore,

Two parallel I Beams

$= 81.424 \times 10^{6} \times 2$

$= 162.848 \times 10^{6}\, {N}/{mm^2}$

1. C-CHANNEL SHEAR STRESS:



Section – 1

Area$(a_1) = b \times h = 50 \times 10 = 500mm^2$

$$x_1 = {b}/{2} + \quad x_1 = 55mm$$

$$y_1 = \frac{\text{vertical distance of section}}{2} = {h}/{2} = {10}/{2} = 5mm$$

$$volume = L \times h \times w = v1 = 10 \times 50 \times 40 = 2000mm^3$$

Where,

v = volume
L= length
h = height
w = width
t = thickness

Similarly:

For section 2 and 3

$a_2 = 700mm^2$ $\quad$ $a_3 = 500mm^2$

$x_2 = 35mm$ $\quad$ $x_3 = 28mm$

$y_2 = 45mm$ $\quad$ $y_3 = 75mm$

$v_2 = 1.5 \times 10^6 mm^3$ $\quad$ $v_2 = 2000mm^3$

$$\bar{X} = \frac{(v_1x_1) + (v_2x_2) + (v_3x_3)}{(v_1 + v_2 + v_3)}$$

$$\bar{y} = \text{max. vertical distance}/{2} = {h}/{2}$$

Similarly

$$\bar{X} = 7.087 \times 10^6 mm$$

$\bar{y} = 40mm$

To find moment of inertia:

Formula used:

$$I_{xx} = \sum (I_{self})_{xx} + \sum a(y - \bar{y})^2 \quad \rightarrow 1$$

$$I_{yy} = \sum (I_{self})_{yy} + \sum a(x - \bar{x})^2 \quad \rightarrow 2$$

$(I_{self})_{xx} = \frac{bd^3}{12}$ $\quad$ $(I_{self})_{yy} = \frac{b^3 d}{12}$

Similarly:

For I_{xx_1} I_{xx_2} &I_{xx_3} $\quad$ For I_{yy_1}, I_{yy_2} &I_{yy_3}

$I_{xx_1} = 4.16 \times 10^3 mm^4$ $\quad$ $I_{yy_1} = 104.16 \times 10^3 mm^4$

$I_{xx_2} = 285.83 \times 10^3 mm^4$ $\quad$ $I_{yy_2} = 5.83 \times 10^3 \ mm^4$

$I_{xx_3} = 4.16 \times 10^3 mm^4$ $\quad$ $I_{yy_3} = 104.16 \times 10^3 mm^4$

$\sum I_{xx} = 294.15 \times 10^3 mm^4$ $\quad$ $\sum I_{xx} = 214.15 \times 10^3 mm^4$

Put all values in equation 1&2

$$\sum a(y - \bar{y})^2 = 942.5 \times 10^3 mm^4$$

$$\sum a(x - \bar{x})^2 = 8.534 \times 10^4 mm^4$$

Similarly:

For $I_{xx} \& I_{yy}$

$I_{xx} = 1.236 \times 10^6 mm^4$

I_{yy} =8.748$\times 10^6 mm^4$

POLAR MOMENT OF INERTIA:

$$I_{zz} (or)\, I = I_{xx} + I_{yy} \longrightarrow 3$$

$I_{zz} (or)\, I =$ 9.984$\times 10^6 mm^4$

To find shear stress;
Formula used

$$\tau = \frac{F \times A \times \bar{y}}{I \times b}$$

Load F - 200$\times 10^3$

A-1700mm^4

Similarly:

For τ_1, τ_2

$\tau_1 = 39.243 \times 10^6 \, N/_{mm^2}$

$\tau_2 = 26.486 \times 10^6 \, N/_{mm^2}$

To find τ_{max}

$\tau_{max} = \tau_1 + \tau_2$

$\tau_{max} = 65.729 \times 10^6 \, N/_{mm^2}$

Maximum shear stress for one ‘c’-channel=$65.729 \times 10^6 \, N/_{mm^2}$

Therefore,

Maximum shear stress obtained for three c-channel is equally sustributed.

$\tau_{max} = 65.729 \times 10^6 \times 3$

$\tau_{max} = 197.187 \times 10^6 \, N/_{mm^2}$

Total shear stress:

Finally add two parallel I Beam & c – channel

$= 2\ 'I' - \text{Beam} + 3\ 'C' - \text{Channel}$

$= (162.848 \times 10^6) + (197.18710^6)$

$= 360.035 \times 10^6 \, N/_{mm^2}$

i. The ultimate tensile strong for fixture is 440Mpa.
ii. Yield strength is 370Mpa.

So, that shear stress for total fixture is **360.035**$10^6 \, N/_{mm^2}$ **or** <u>**360.035Mpa** </u>within the limit of

yield strength.

We have chosen medium carbon steel <u>SAE-1018 material is best suitable for making universal fixture for super heaters.</u>

5. CONCLUSION

This report provides a brief synopsis of the work, universal fixture for super heater product was studied and an analysis was done to determine the possibility for making panel for different part numbers. The process of making the universal fixture will achieve a greatest target time and to increase the production rate of super heater products. This model over the course of Arc welding and Gas welding by iron plates manually showing the basic principles and components of fixtures. It is established to set up Universal Assembly Fixture method, to save space, time, material and money by changing the iron plates, therefore total fixture beam will not be replaced often. So that such a model will be useful to engineers and technicians who are in-charge of fixture.

6. REFERENCES

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