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ANALYSIS & OPTIMIZATION OF HEAVY SHELL TILTING FIXTURE BY USING FINITE ELEMENT METHOD

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ABSTRACT

Heavy Engineering is related to manufacturing of process plant equipment related to refinery and fertilizer, ship building etc.Manufacturing of reactor is related to heavy engineering industries. Reactor is made of two or more shell. Shell is an empty vessel which is manufactured by bending the plate. During welding of the vessels, vessels should be in a particular position for appropriate welding. For particular position of vessels, tilting is necessary. Tilting of vessel is an important part of heavy engineering industries. Tilting of vessel is done by use of two cranes, they have some limitation. Because of these reasons new mechanism required for tilting of heavy shell or vessel. Heavy shell tilting fixture is mainly used for tilting the shell from horizontal to vertical and vice versa. For certain types of application shell have to move vertical to horizontal at that time this fixture is used. During the time of assembly of Dished End and shell, both vessels should be in a horizontal position. At that time shell tilting will necessary. Second time during the heat treatment, vessel should be in a horizontal position for proper adjustment into furnace.

Design and analysis of heavy shell tilting fixture for weight capacity 120 MT will use in this work. The design includes design of fixture, design of support stool, design of saddle, selection of wire rope sling. Dimensions obtained from design, have been used for G.A (General Assembly) drawing, 2-D manufacturing drawings. Modeling of 3-D components and assembly of tilting fixture have been done with the help of CREO software and analysis of 3-D structure and analysis with ANSYS

KEYWORDS: Manufacturing, Bending, Tilting fixtures, Pressure vessel, Ansys.

I. INTRODUCTION

A fixture is a device for locating, holding and supporting a work piece. Fixtures are essential elements of production processes as they are required in most of the automated manufacturing, inspection, and assembly operations. Fixtures must correctly locate a work piece in a given orientation with respect to measuring device, or with respect to another component, as for instance in assembly or welding. Such location must be invariant in the sense that the devices must clamp and secure the work piece in that location for the particular processing operation. Heavy shell tilting fixture is mainly used for tilting the shell from horizontal to vertical and vice versa. For certain types of application shell have to move vertical to horizontal at that time this fixture is used.

II. METHODOLOGY

Material and Constructional detail of fixture
Structural steel - IS 2062 (Grade B)
E = 210 GPa
Density = 7033 Kg/m^3
Yield Strength = 240 MPa
Poisson's Ratio = 0.3
Factor of Safety = 2
Weight of fixture - 50.737 MT [18]
Structure - Box section
Bottom curvature plate - 30 mm thick

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Thick side plate - 30 mm thick
Inner plate - 12 mm thick
Upper (top) plate - 20 mm thick

3D model of tilting Fixture

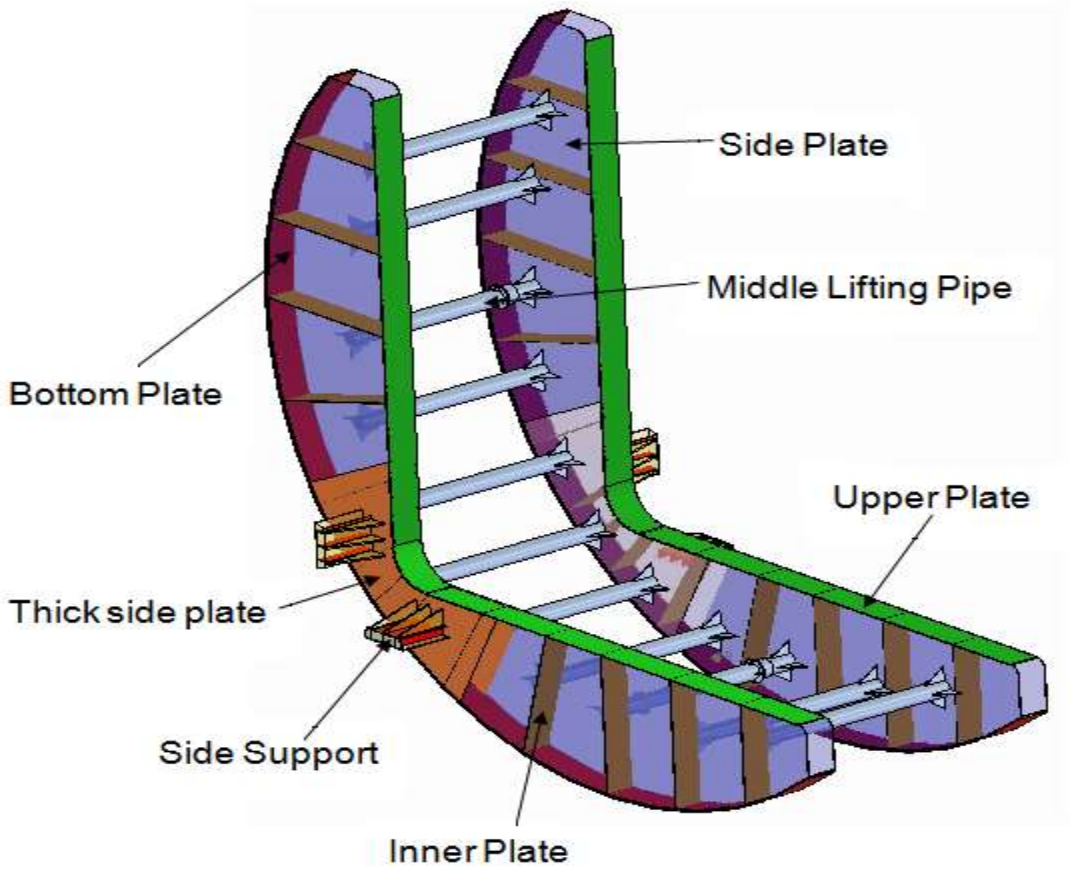

Figure 1 Tilting Fixture

Weight Optimization Of Tilting Fixture

Optimization is the act of obtaining best result under given circumstances. In weight optimization, weight is reducing at optimum level. There are different schemes are given for reduction (optimization) of weight of tilting fixture but here in this paper we shows the safe scheme.

Weight reduction scheme

Weight reduction : 4.85 MT
Structure : box section
Extra plates are cut from both sides
Upper plate - 20 mm
Side plates - 12 mm
Bottom curvature plate - 30 mm
Inner gusset plate -12 mm

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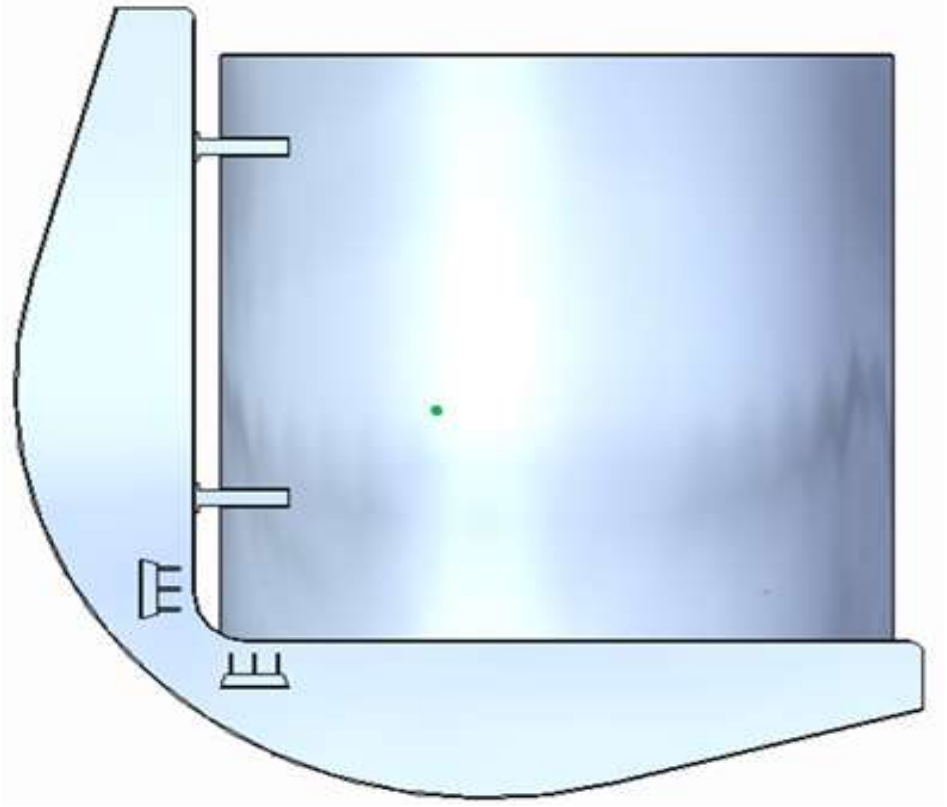

Figure 2: Weight reduction scheme

III. ANALYSIS CONDITION: NEUTRAL POSITION

Element : 4 noded rectangular
Meshing : shell mesh
Material : structural steel
Load applied by gravity
Constraint : at ground level
12 mm side plates
30 mm plates for more strength in critical zone

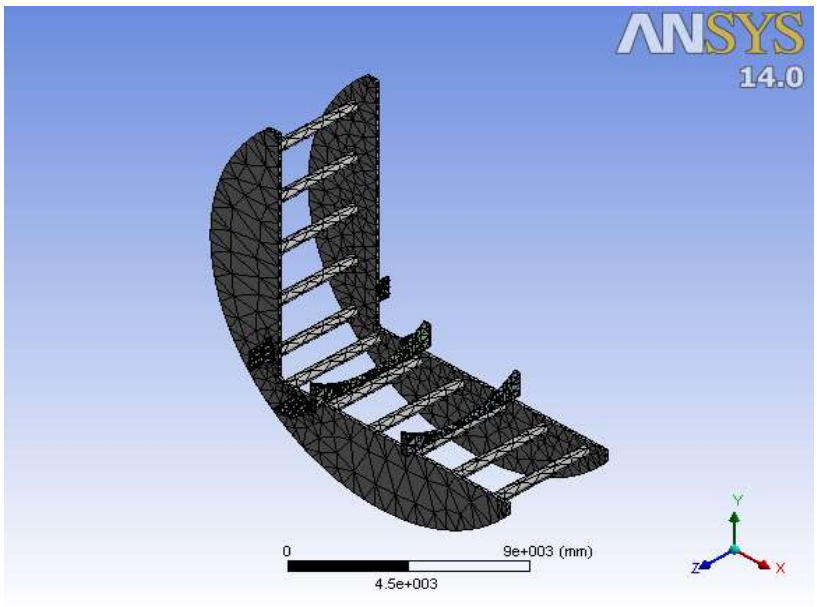

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Figure 3: Mesh model

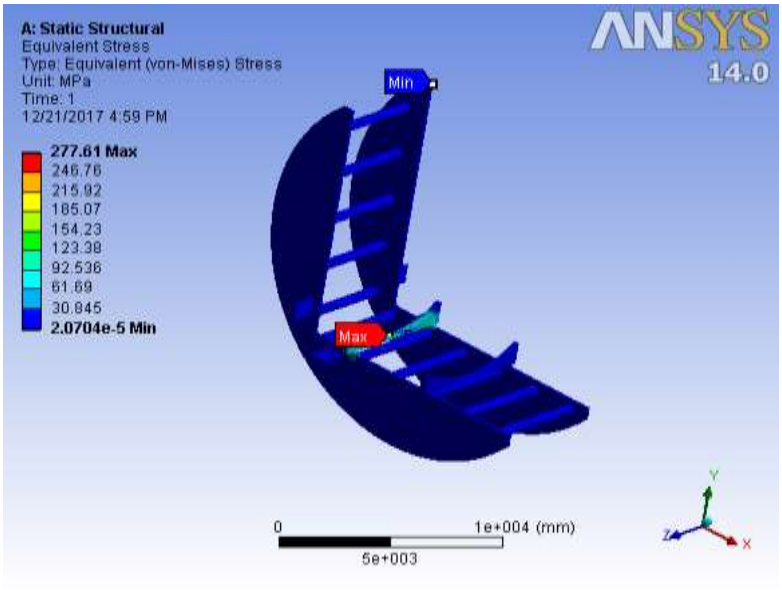

Figure 4: Stress generated in tilting fixture

Deformation produced in tilting fixture

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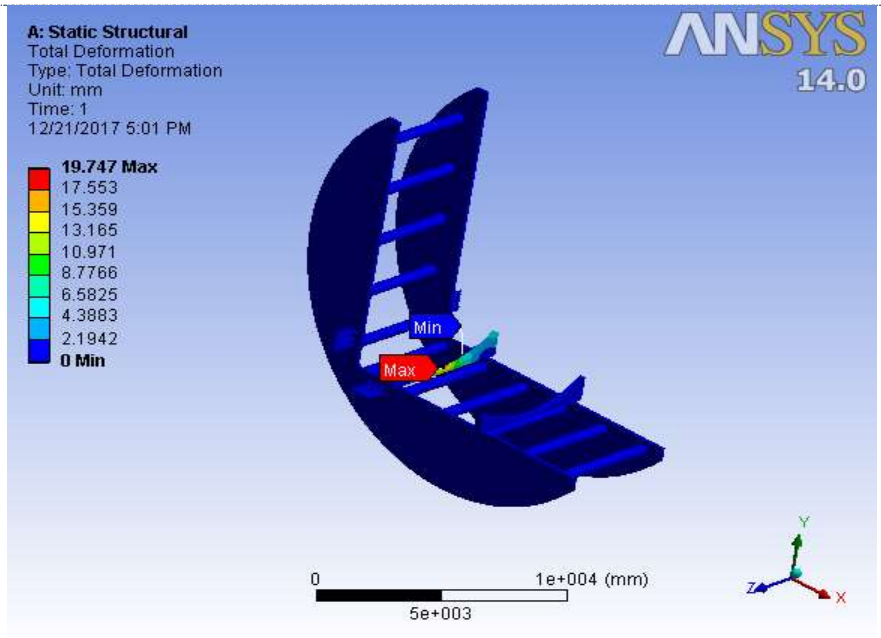

Figure 5: Deformation produced in tilting fixture

IV. ANALYSIS CONDITION: STATIC POSITION

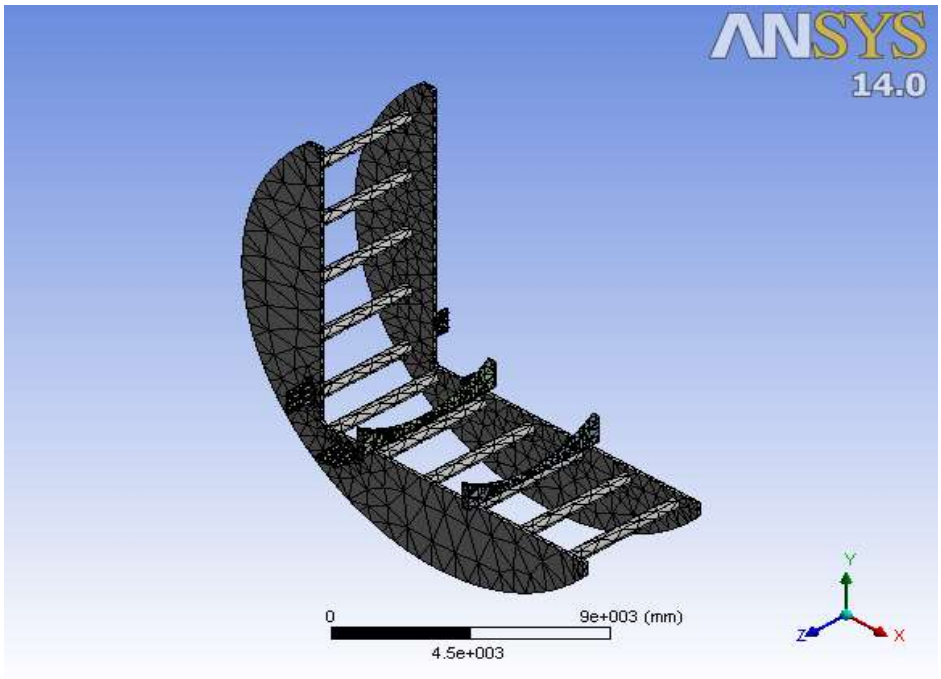

Figure 6: Mesh model

Stress generated in tilting fixture

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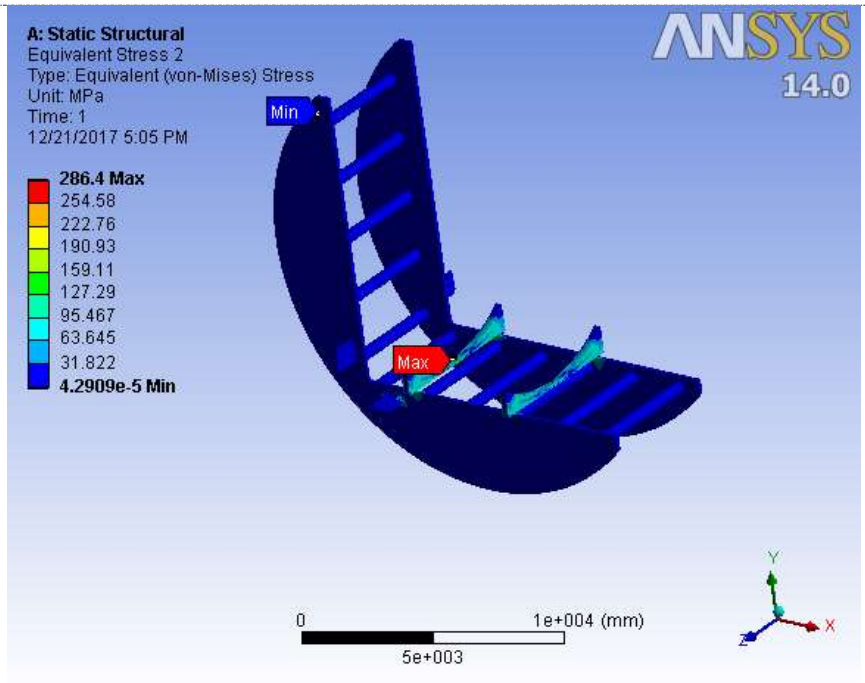

Figure 7: Stress generated in tilting fixture

Deformation produced in tilting fixture

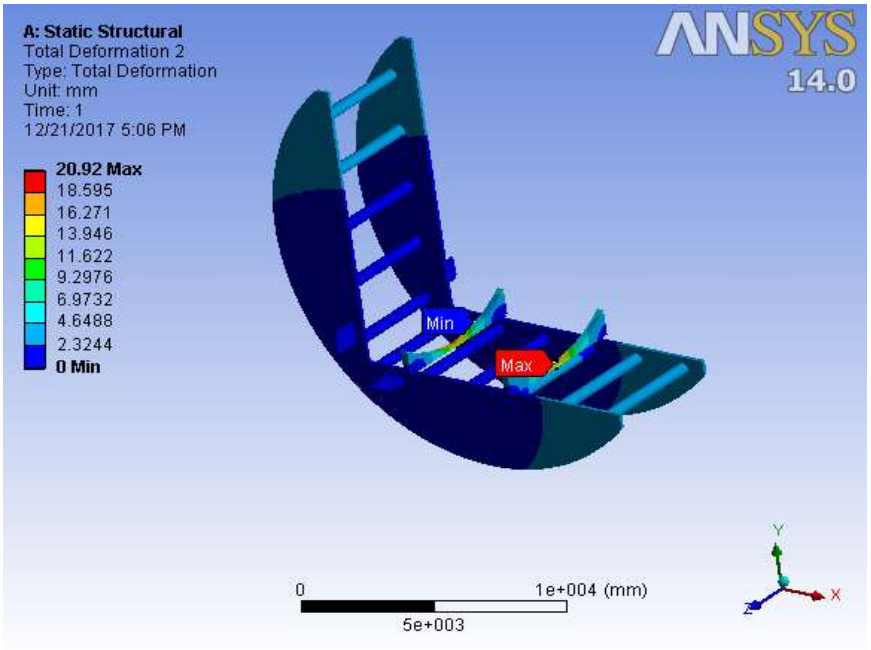

Figure 8: Deformation produced in tilting fixture

Analysis condition: Neutral position
Maximum stress is 277.61 MPa which is in local area.
Deflection of fixture is 1-3 mm
Result of analysis is within limit, so for particular loading condition in neutral position fixture is safe.
Analysis condition: Static position
Maximum stress is 288..64 MPa which is in local area.

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Deflection of fixture is 1-3 mm.
Result of analysis is within limit, so for particular loading condition in static position fixture is safe.

V. CONCLUSION

As define in problem, design and analysis of tilting fixture has been done for weight capacity of 125 MT. After comparing the results of original and modified tilting fixture, some observations were made. These observations are as below:

In weight reduction scheme,Results of structural analysis for neutral position and static position were safe.

1. The weight reduction of fixture was 4.85 MT.
2. The maximum stress produced in fixture was 146 MPa.
3. The displacement of fixture was 1-3 mm.
4. In critical region of fixture, stresses were inacceptable level.

VI. FUTURE SCOPE

1. Automation of tilting fixture
2. Design of tilting mechanism for automation
3. Chain drive through reduction gearbox and idler rollers
4. Loading / Unloading : By crane
1. Operation : By gearbox and motor

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