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Stress Analysis and Design Optimization of a Pressure Vessel using Ansys

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Abstract **- Pressure vessel is used to carry liquids such as petrol, kerosene; aviation fuel etc and these fuel tanks are used to transport fuel. Finite element method is a mathematical technique used to design a fuel carrying vessel and performing the stress analysis. The main objective of this paper is to design and analysis of pressure vessel. The designing various parameters of Pressure Vessel checked and designed according to the principles specified in American Society of Mechanical Engineers (A.S.M.E).**

Keywords **- FEM, Presser vessel, Pressure, fuel, Boundary conditions.**

I. INTRODUCTION

Pressure vessel is used to carry liquids such as petrol, kerosene; aviation fuel etc and these fuel tanks are used to transport fuel. Finite element method is a mathematical technique used to design a fuel carrying vessel and performing the stress analysis. The main objective of this paper is to design and analysis of pressure vessel. The designing various parameters of Pressure Vessel checked and designed according to the principles specified in American Society of Mechanical Engineers (A.S.M.E).

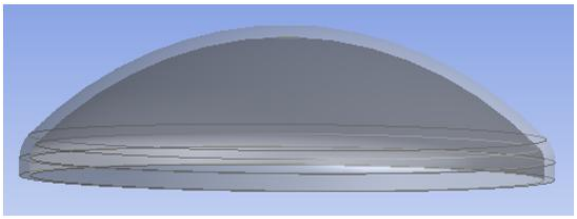
II. METHODOLOGY

1. Design of Pressure Vessels To Code Specification

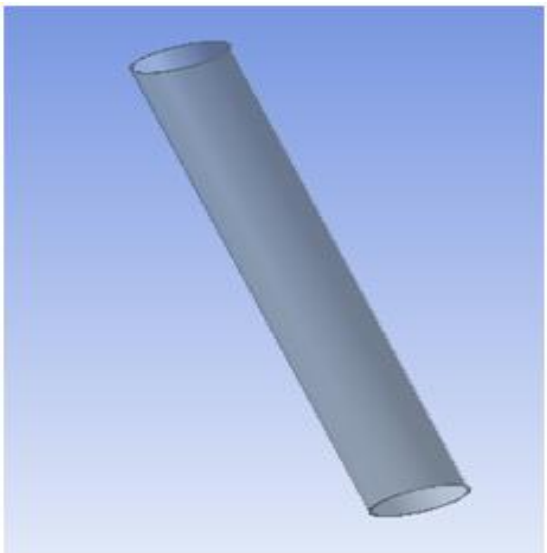
American, Indian, British, Japanese, German and many other codes are available for design of pressure vessels. However the internationally accepted for design of pressure vessel code is American Society of Mechanical Engineering (ASME). Various codes governing the procedures for the design, fabrication, inspection, testing and operation of pressure vessels have been developed; partly as safety measure. These procedures furnish standards by which, any state can be assured of the safety of pressure vessels installed within its boundaries. The code used for unfired pressure vessels is Section VIII of the ASME boiler and pressure vessel code. It is usually necessary that the pressure vessel equipment be designed to a specific code in order to obtain insurance on the plant in which the vessel is to be used. Regardless of the method of design, pressure vessels within the limits of the ASME code specification are usually checked against these specifications.

2. Input Data And Modeling In Ansys

1. Material: SA516 Gr60
2. Max Allowable Stress, S 118 MPa
3. Design Pressure, P =3.434 MPa
4. Design Temperature, T =343 K
5. Torispherical head is selected. [8] (According to UG 31 of ASME Section VIII Div. 1). As per ASME standard calculations the output dimensions of the pressure vessels are shown in following figures 1 to 2.3.5.



(a) Top head



(b) Top shell of pressure vessel

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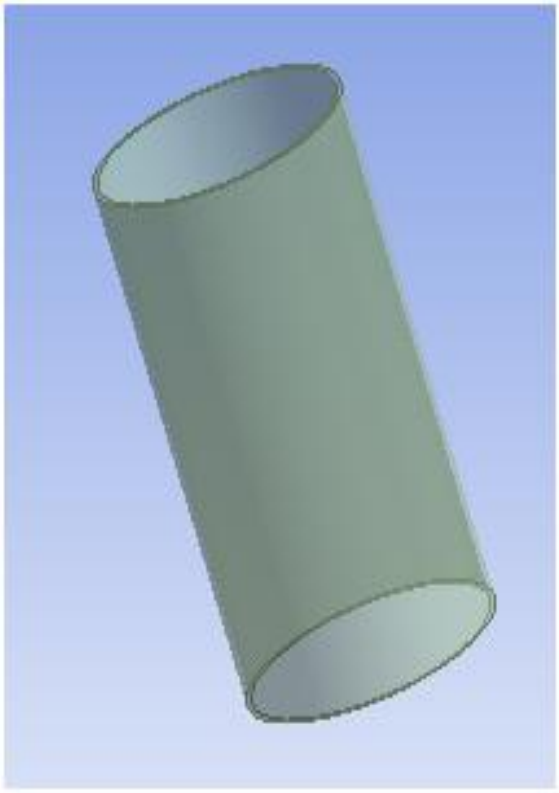
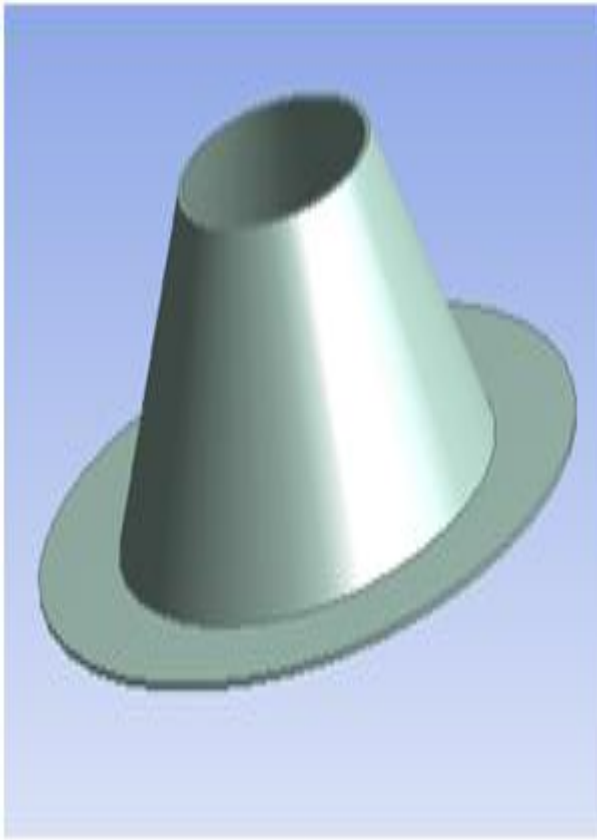
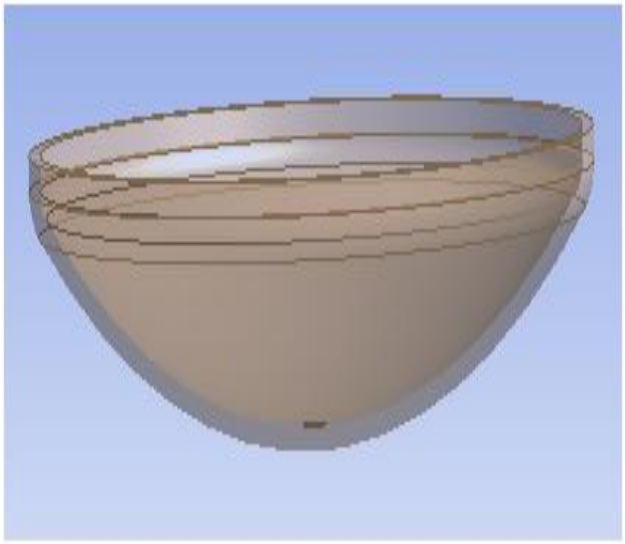


(c) Bottom shell of pressure vessel



(d) Skirt model of pressure vessel



(e) Bottomheadof pressure vessel

Fig.1. Actual pressure vessel individual parts modelling.

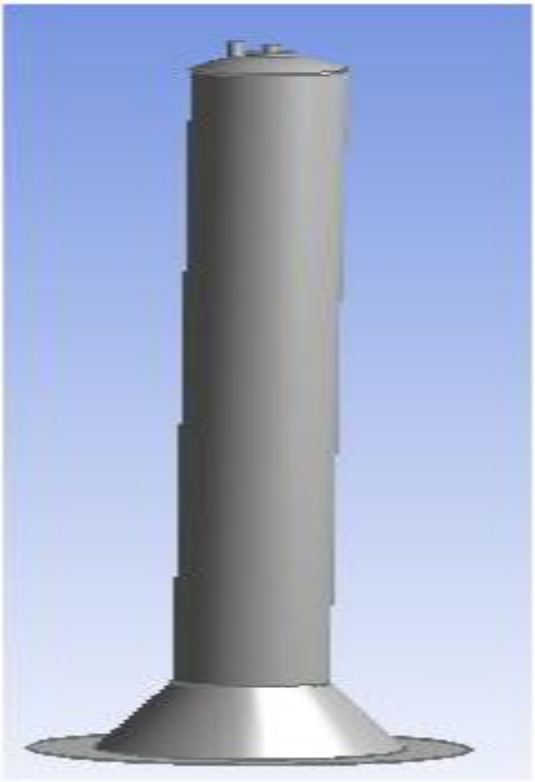


Fig.2.Reinforced pressure vessel assembly of various parts.

III.RESULT ANALYSIS

1. Top shell

The stress distribution in the top shell of the pressure is observed in the following figures.

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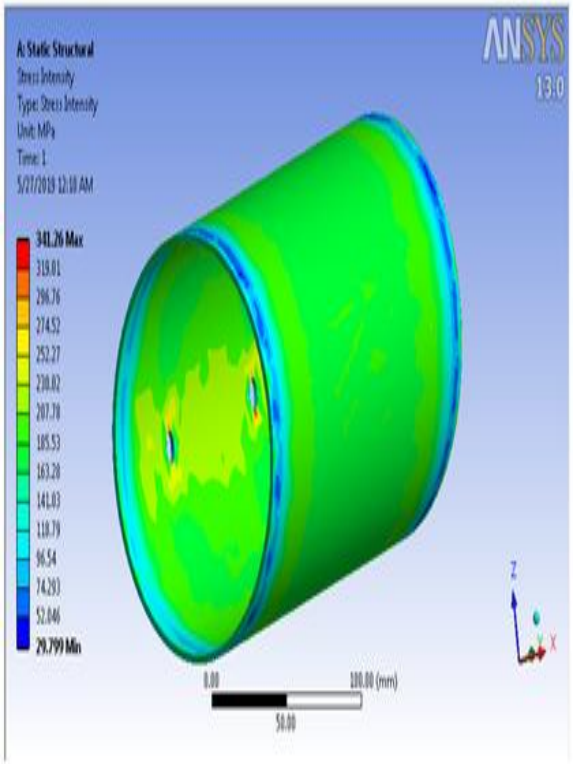

Fig.3. Actual model stress intensity of material: SA516GR60.

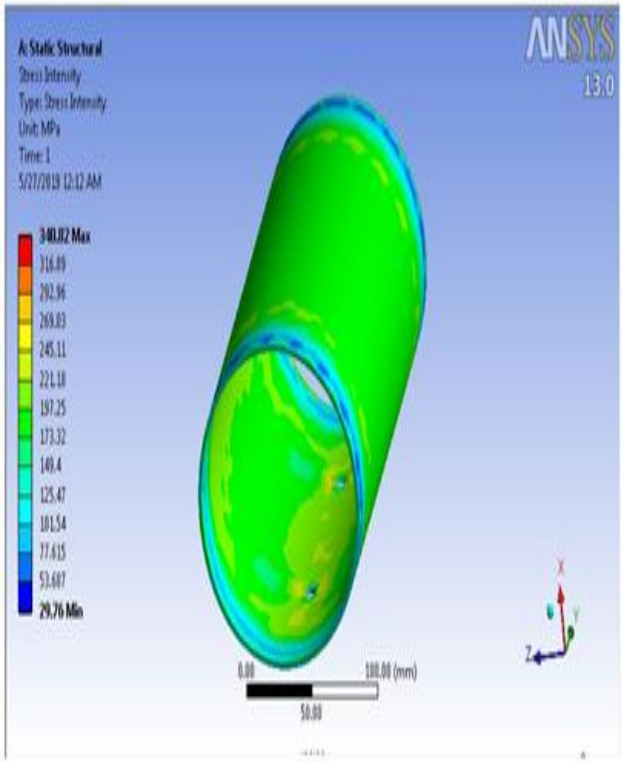

Fig.4.Reinforced model stress intensity of material: SA516GR60.

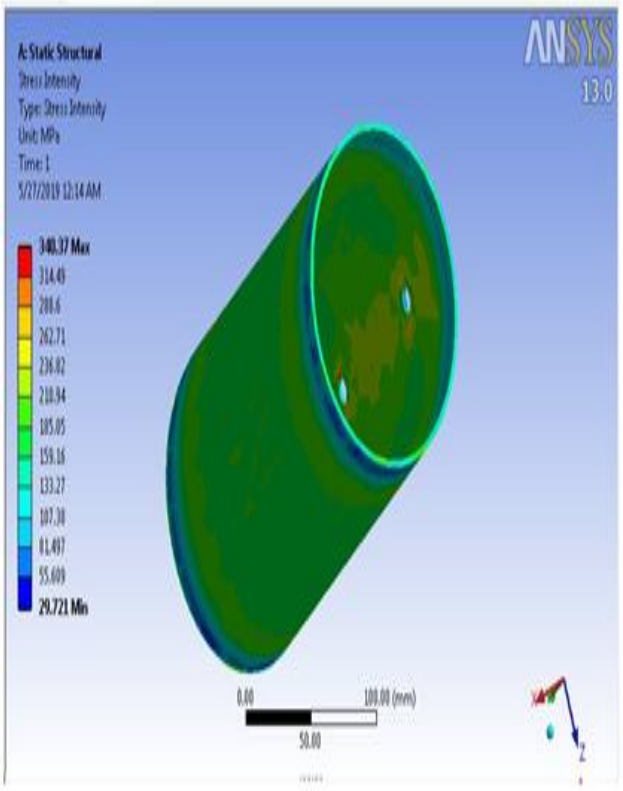

Fig.5. Actual model stress intensity of material: SA516GR70.

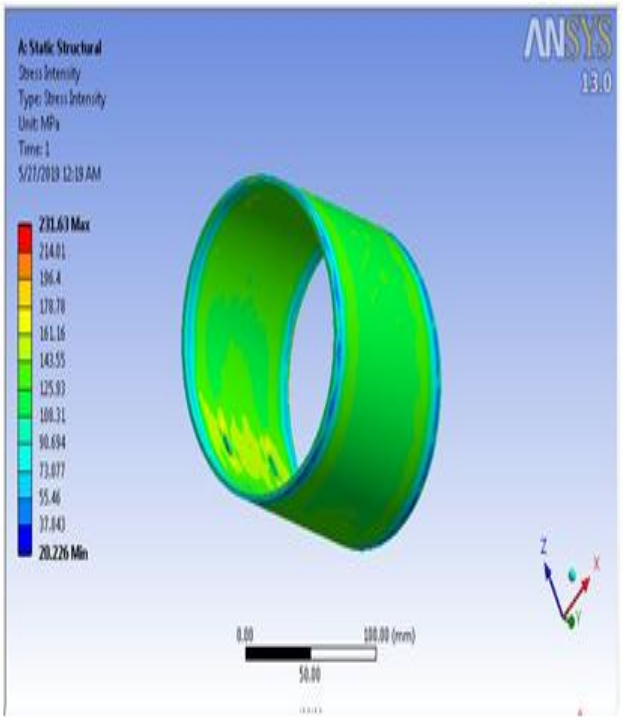

Fig.6. Reinforced model stress intensity of material: SA516GR70.

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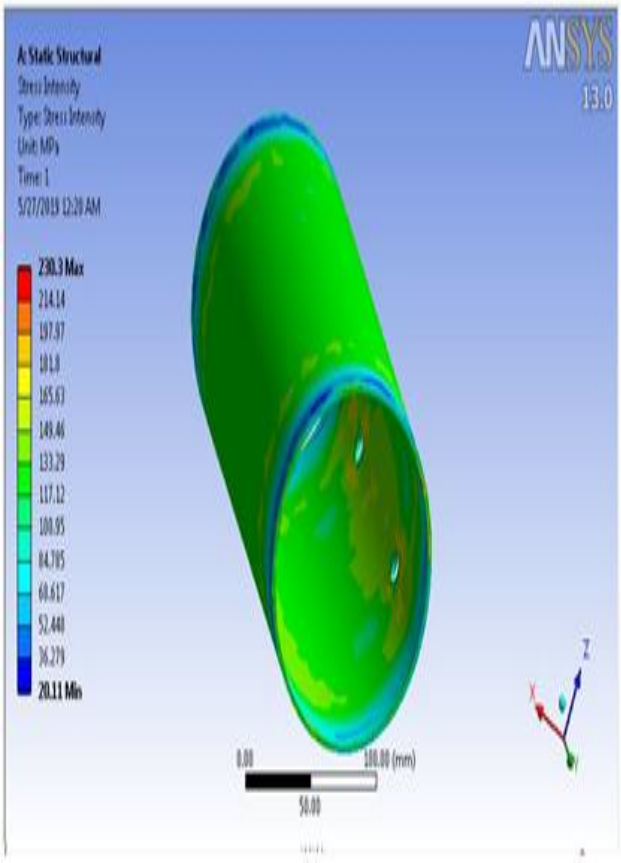

Fig.7. Actual model stress intensity of material: SA516GR65.

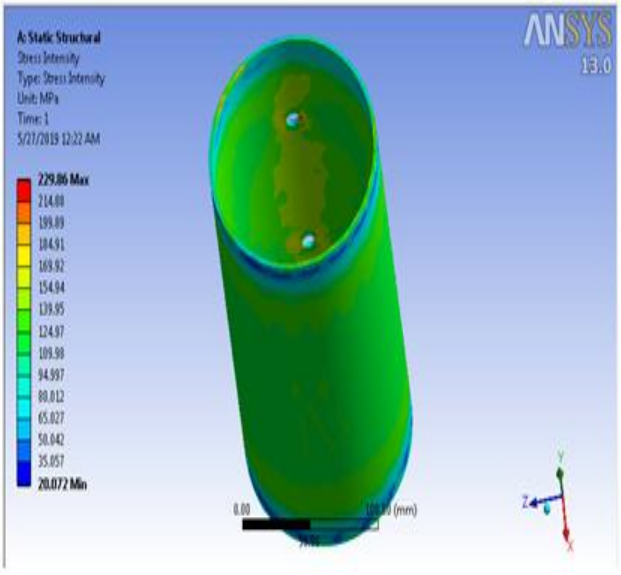

Fig.8. Reinforced model stress intensity of material: SA516GR65.

2. Top head

The stress distribution in the top head of the pressure are observed in the following.

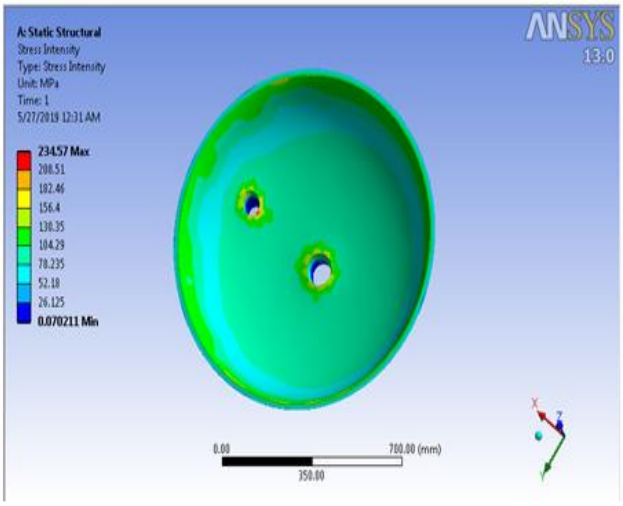

Fig.9. Actual model stress intensity of material: SA516GR60.

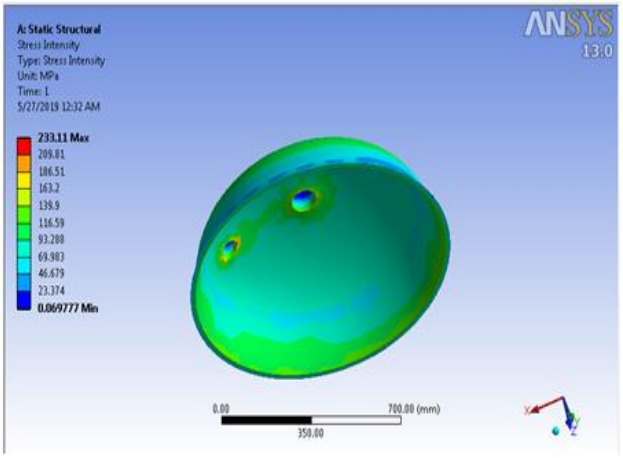

Fig.10.Reinforced model stress intensity of material: SA516GR60.

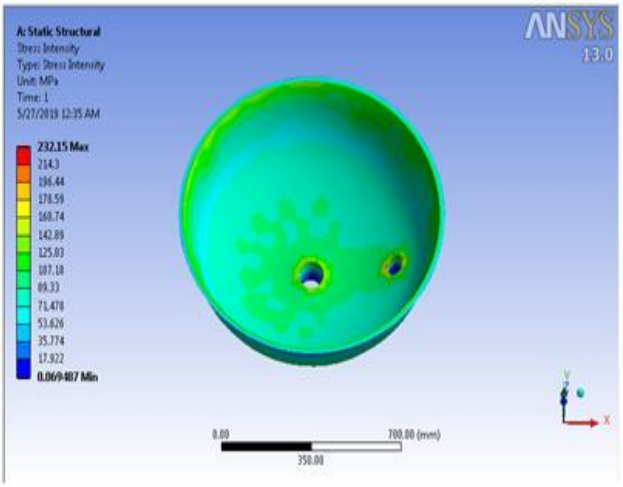

Fig.11. Actual model stress intensity of material: SA516GR70.

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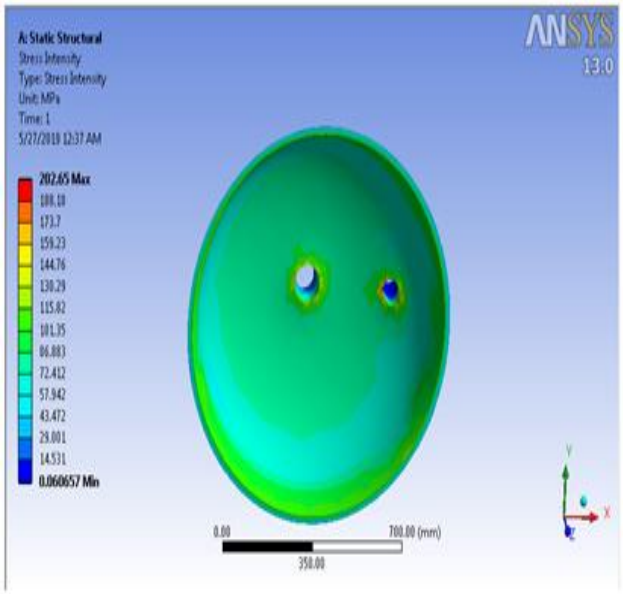

Fig.12.Reinforced model stress intensity of material: SA516GR70.

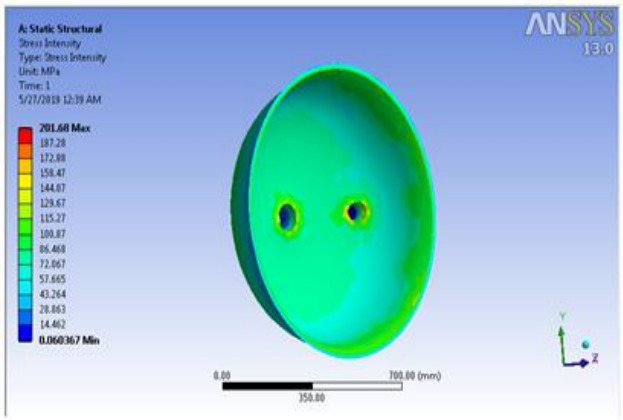

Fig.13. Actual model stress intensity of material: SA516GR65.

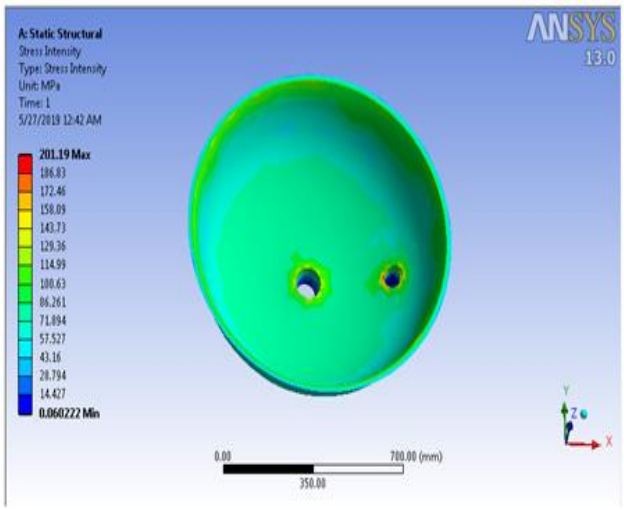

Fig.14.Reinforced model stress intensity of material: SA516GR65.

3. Bottom shell

The stress distribution in the bottom shell of the pressure are observed in the following figures.

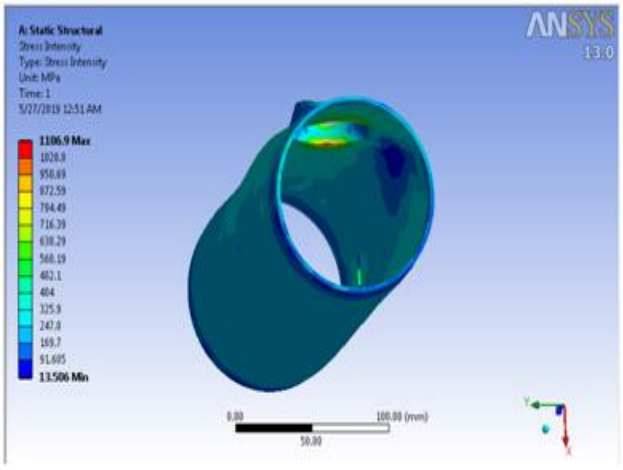

Fig.15. Actual model stress intensity of Material: SA516GR60.

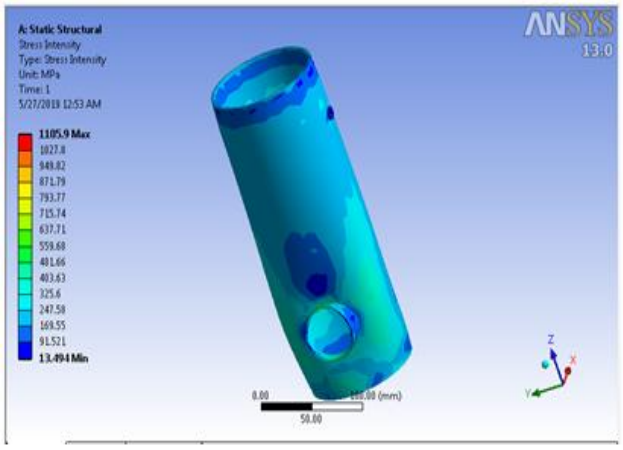

Fig.16. Reinforced model stress intensity of Material: SA516GR60.

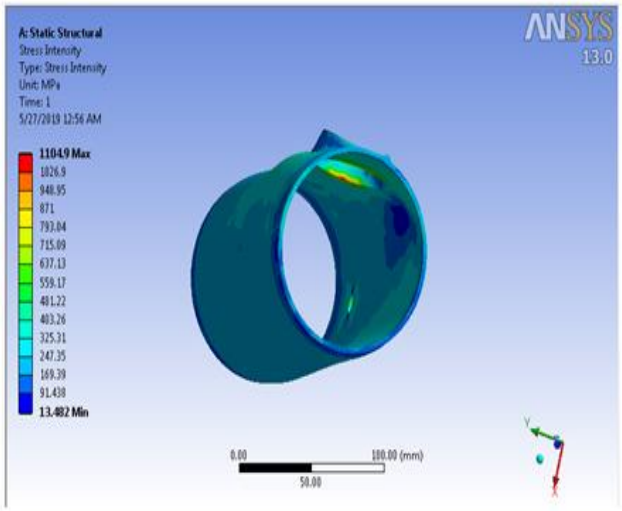

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Fig.17. Actual model stress intensity of Material: SA516GR70.

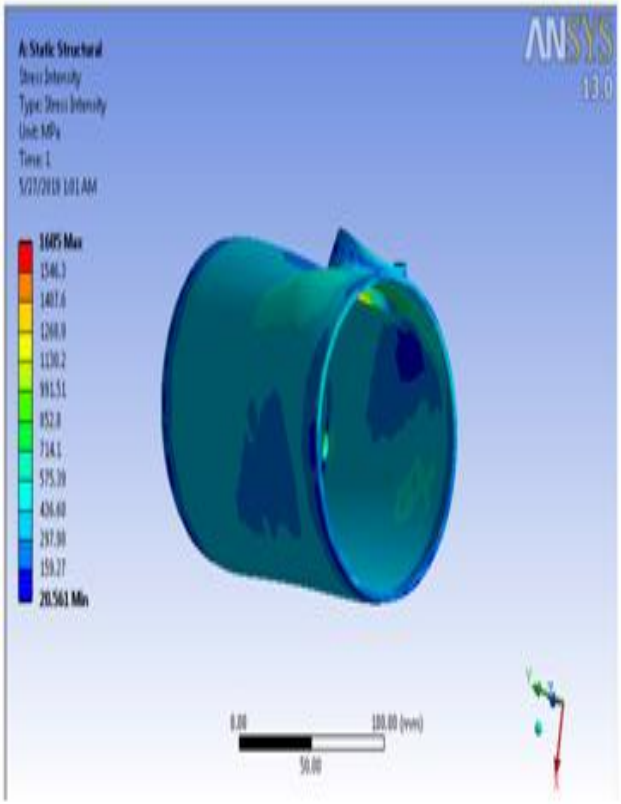

Fig.18. Reinforced model stress intensity of Material: SA516GR70.

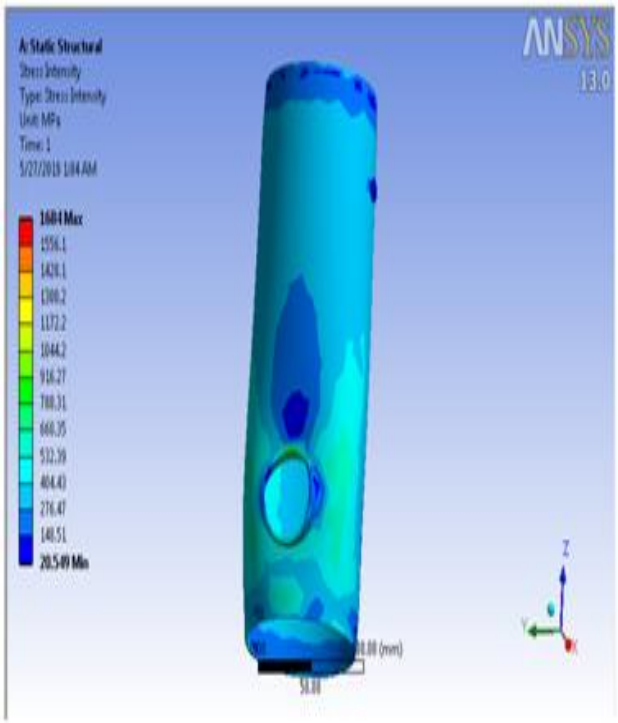

Fig.19. Actual model stress intensity of Material: SA516GR65.

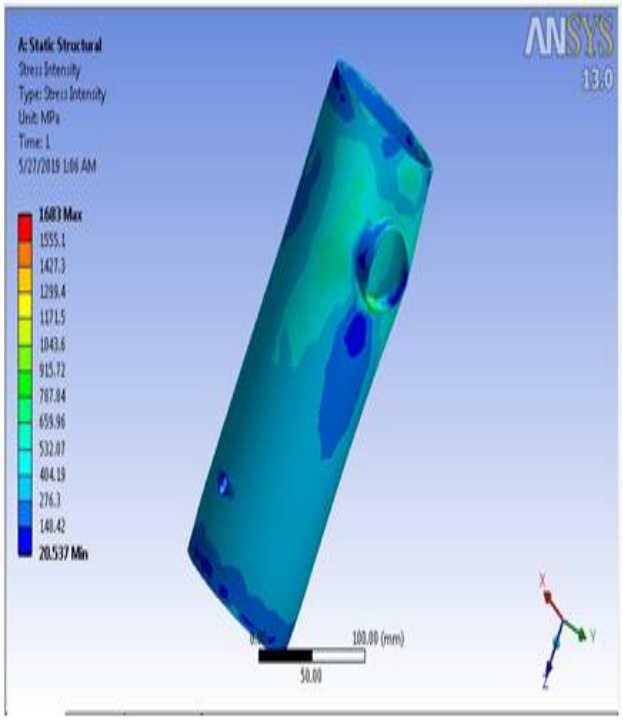

Fig.20. Reinforced model stress intensity of Material: SA516GR65.

Bottom head

The stress distribution in the bottom head of the pressure are observed in the following figures

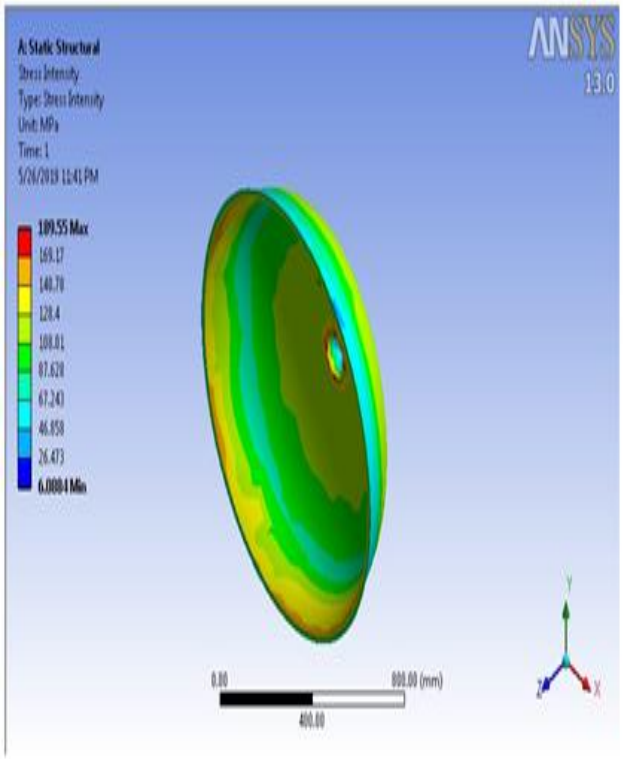

Fig.21. Actual model stress intensity of Material: SA516GR60.

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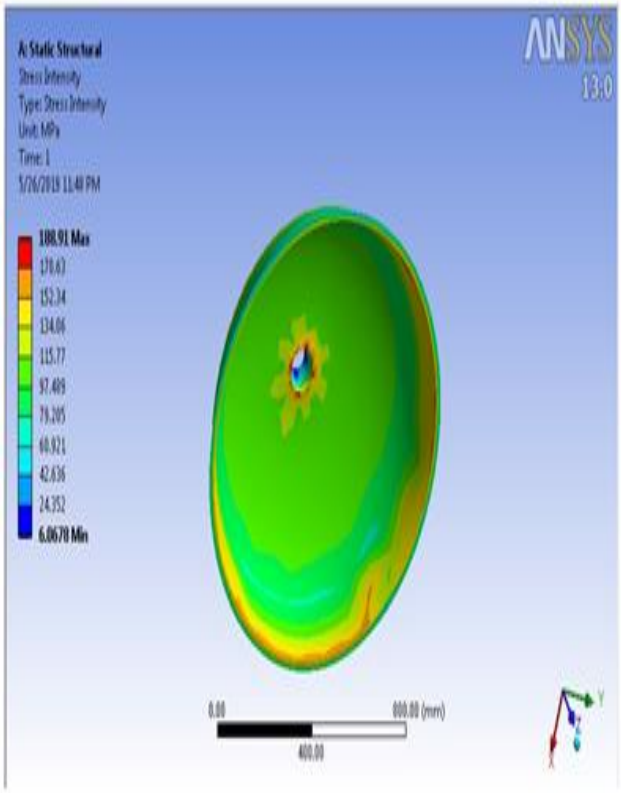

Fig.22. Reinforced model stress intensity of Material: SA516GR60.

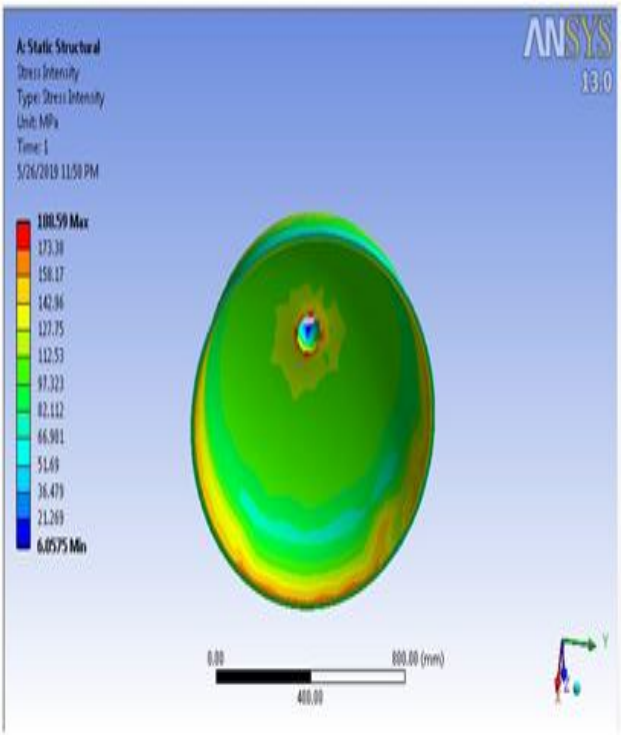

Fig.23. Actual model stress intensity of Material: SA516GR70.

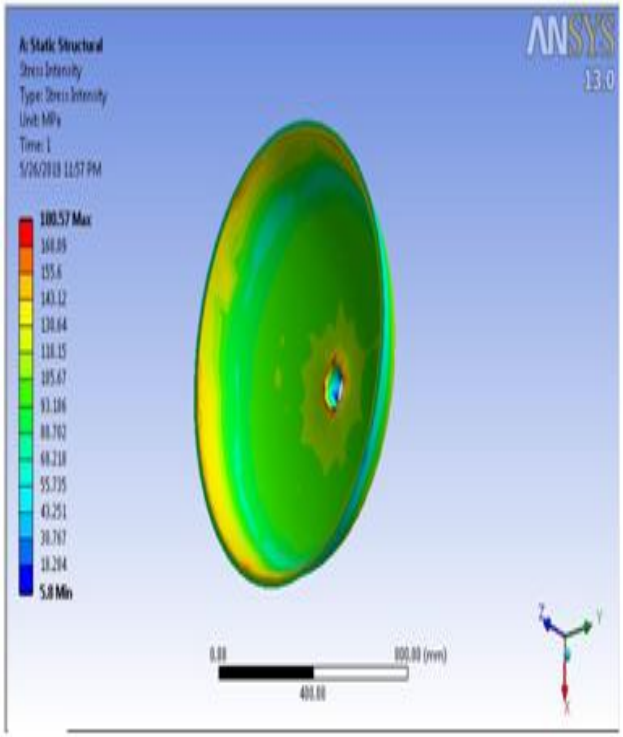

Fig.24. Reinforced model stress intensity of Material: SA516GR70.

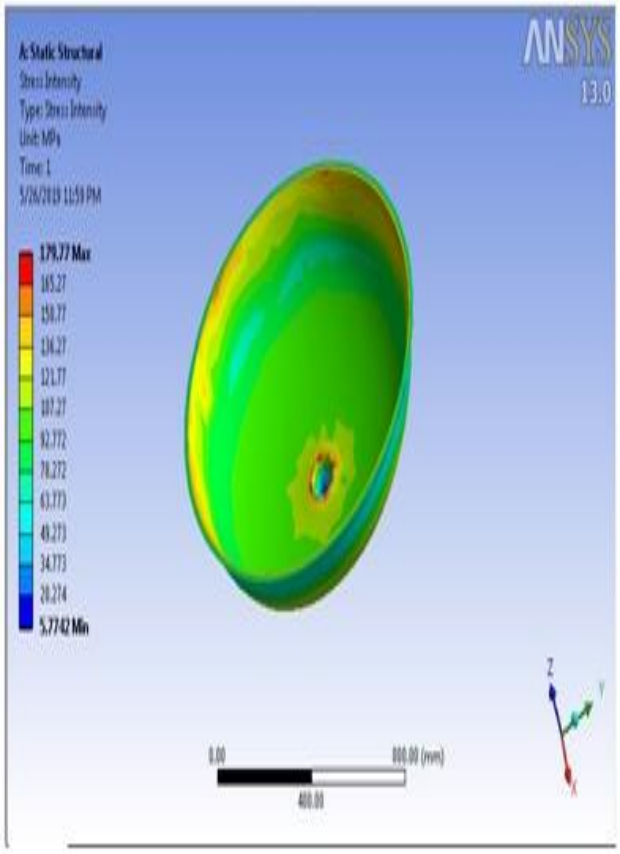

Fig.25.Actual model stress intensity of Material: SA516GR65.

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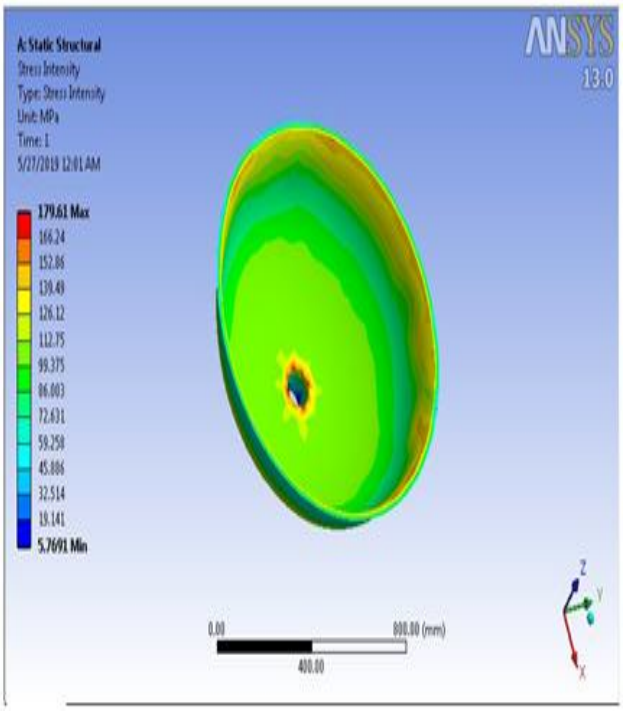
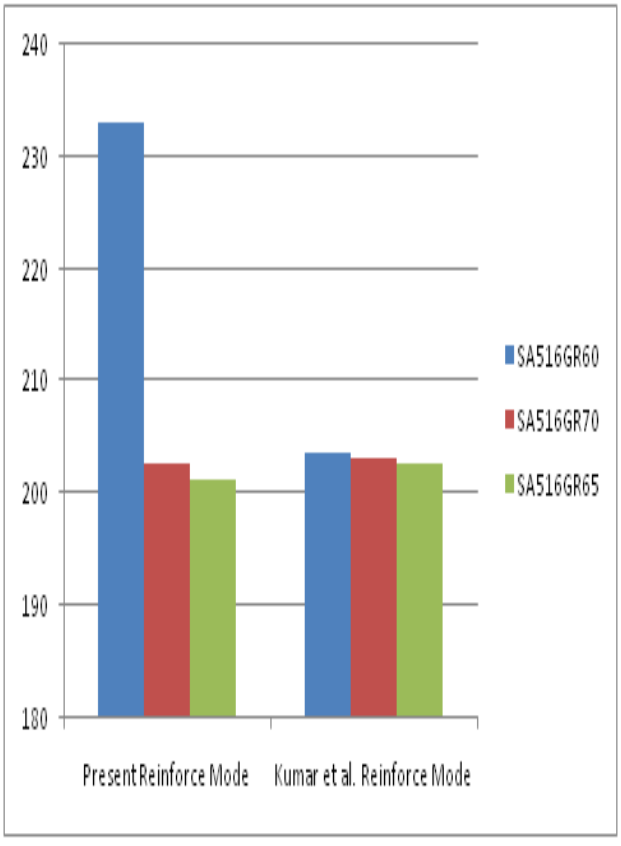


Fig.26. reinforced model stress intensity of material: SA516GR65.



Graph 1: Comparison of actual mode of present and previous result.

III. CONCLUSION

Designing the parts of the vessel as per the ASME is successful. The analysis is performed on the both model parts and results are compared. The finite element analysis is more accurate than any other mathematical techniques. The pressure vessel is subjected to hoop stresses and longitudinal stress the variation of stresses can be analyzed by the ANSYS results hence the design is safe under the operating conditions. By the results we observed that the stress and deformed values of the modified model is better than the actual model because of the reduction of the stress values the life time of the vessel mayincrease.In the result analysis part we used three materials as per the regulations of ASME in observation of resultsSA516GR65 has the stress values less compared to all other materials by this we conclude that the for pressure vessel design SA516GR65 may be used and with the small modifications in design the life time of the pressure vessel may increases.

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