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Stress Analysis Of Lpg Cylinder Using Ansys Software

Laxmikant D. Rangari[1]
Student M Tech.
K.D.K.C.E.,
NAGPUR,
440009

Mrs. P.M. Zode[2]
Assistant Professor,
K.D.K.C.E.,
NAGPUR,
440009

P.G. Mehar[3]
Assistant Professor,
K.D.K.C.E.,
NAGPUR,
440009

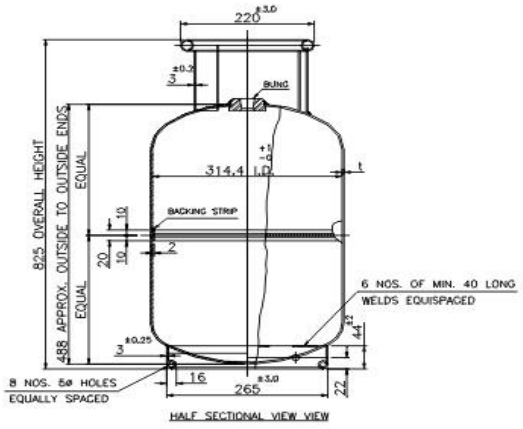
ABSTRACT:

Computer aided investigations are carried using ANSYS, to verify maximum stress and its location. To predict detailed stress 3D solid model has been chosen with the help of PROE software. Two different types of non-linear FE models, plane and shell, were developed using 2D axisymmetric finite plane and shell elements, respectively. To create these FE models and simulate the experimental burst, first, shell MPs and thickness variations of the LPG tanks due to spinning processes are investigated and input to the computer modeling processes. Additionally, after selecting the loading and boundary conditions and appropriate finite elements, the nonlinear axisymmetric 2D FE models were generated and simulated in non-uniform and non-homogeneous conditions. [2]

Keywords: LPG, Detailed stress, IS 3196, FEA modeling.

INTRODUCTION

The pressure cylinder models assumed a cylinder with both ends capped. To simplify modeling and hand calculations, both ends were treated as part of the cylinder. The hand calculations from Roark's Formulas for Strain table 28, condition 1c were used for comparison. **[4]**



[3]

FIG.NO.1 LPG gas cylinder IS3196

Stress analysis of LPG gas cylinder IS 3196 by using finite element method.

The cylinder is subjected to an internal pressure of 2.5 MPa .Type material used is low carbon steel .The material properties are :

Young's Modulus	2.e+005 MPa
Poisson's Ratio	0.3
Density	7.85e-006 kg/mm³
Tensile Yield Strength	240. MPa
Compressive Yield Strength	240. MPa
Tensile Ultimate Strength	420. MPa

ANSYS PROCEDURE FOR F.E. ANALYSIS

- Model
  - Geometry- Imported from PROE in ".iges" format
1. Solid- generated ansys geometry.
   - Mesh- tetrahedral element selection
- Static Structural

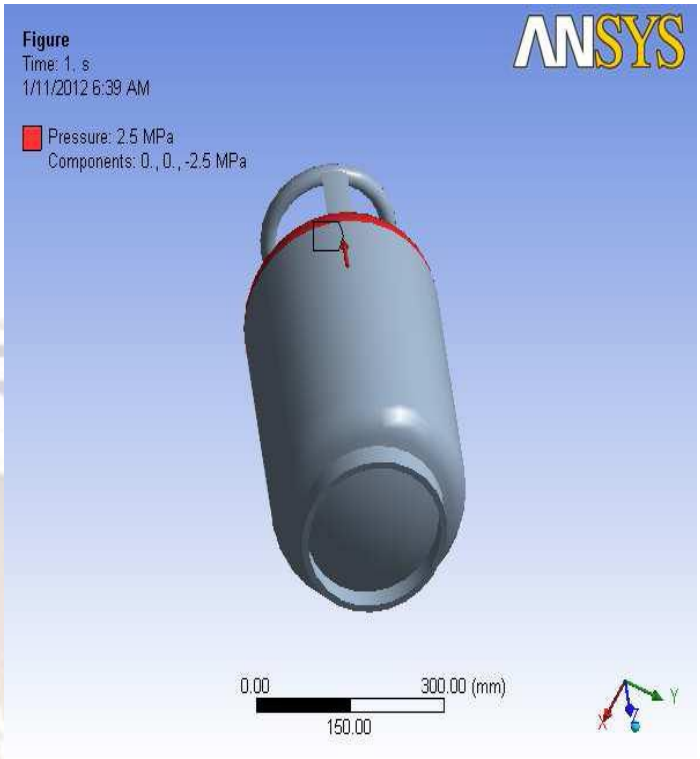
1. Analysis Settings- analysis settings are used for static structural, single step loading
2. Loads-

- Internal pressure of 2.5 Mpa is given on internal wall of cylinder
- The base of cylinder is kept fixed

3. Solution-

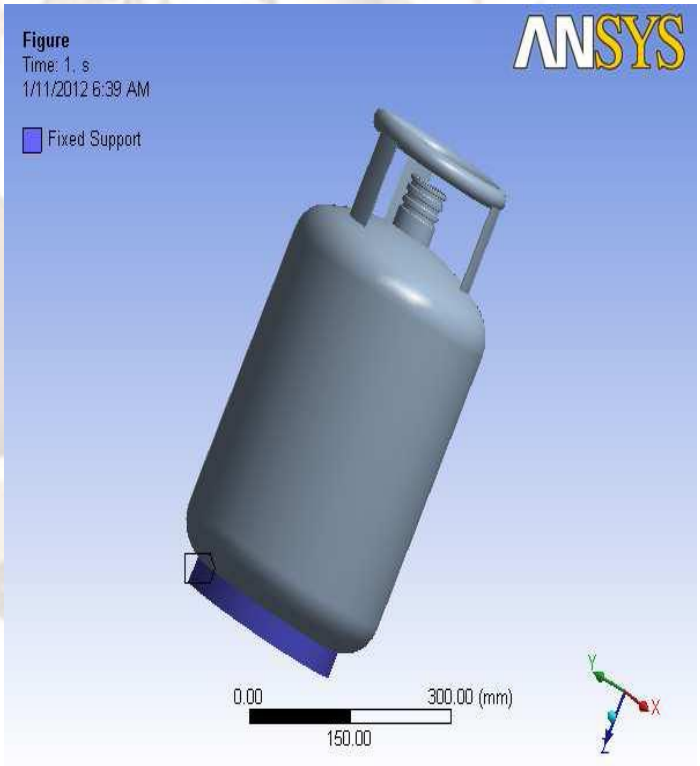
- Total Deformation
- Equivalent Stresses
- shear stress along xy plane
- Material Data
- low carbon steel

PROE model

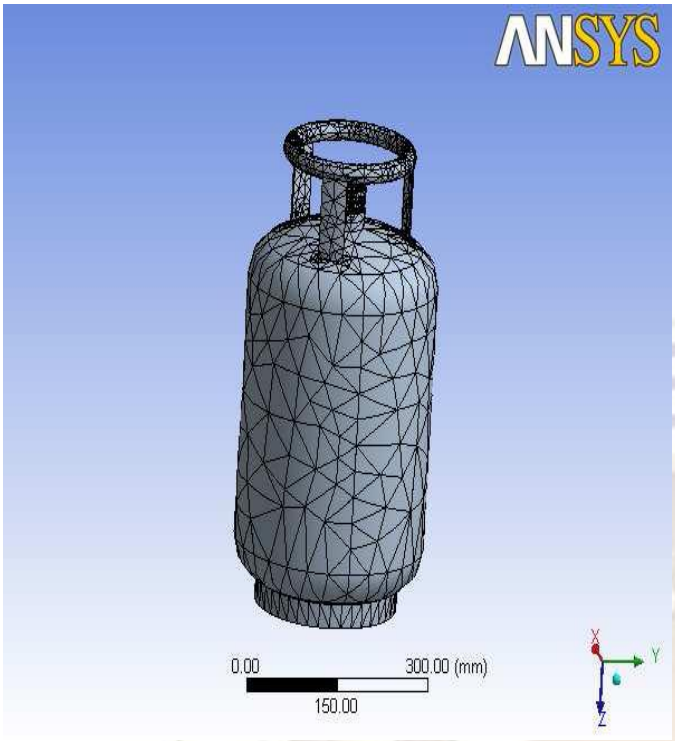


Pressure of 2.5 Mpa is given on the internal surface of the cylinder as shown in fig.

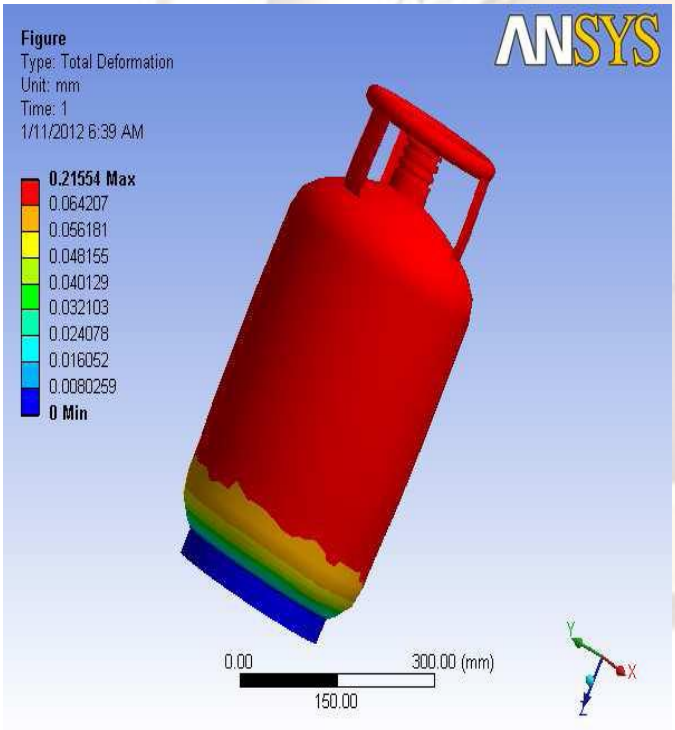
ANSYS11 .iges from PROE



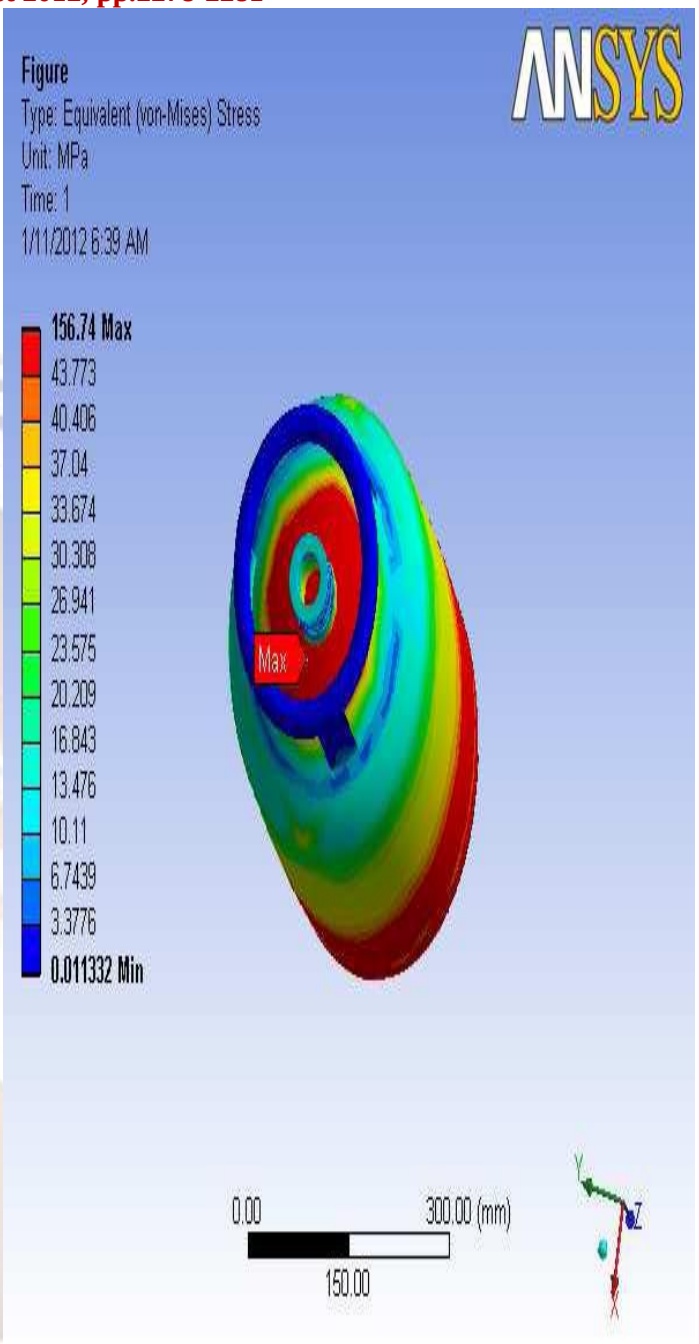
The fixed support is given on the bottom of the cylinder.



Mesh- mesh with automatic mesh settings is generated.

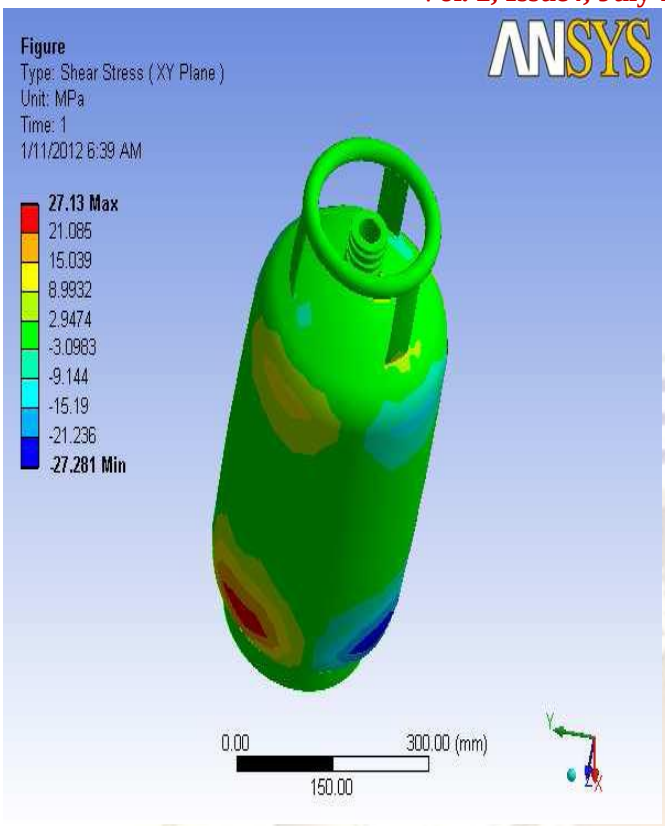


Observing the following results, the total deformation in the cylinder for the internal stresses of 2.5 MPa is found to be maximum at the top i.e. highlighted in red, and the minimum is found at the fixed position i.e shown in blue colour.



The maximum equivalent stresses are found ranging from 0 to 156 MPa. As shown in figure, the contour plot of von mises stresses shows the distribution of the stresses are concentrated along the valve area of the cylinder and the bottom portion.

The shearing effect is negligible as compared to equivalent stresses. i.e 27 MPa. That can be found concentrated at the bottom of the cylinder.



CALCULATIONS

LPG Gas Cylinder IS3196

Let

P - Internal or burst pressure of cylinder = 2.5 Mpa

t - Thickness of wall cylinder = 2.5 mm.

d - Inner dia. of cylinder = 314.44 mm.

Circumferential stress (σ)

$\sigma_1 = Pd/2t = 150$ *Mpa*

Longitudinal stress

$\sigma_2 = Pd/4t = 75$ *Mpa*

Maximum shear (τ_{max})

$\tau_{max} = Pd/8t = 37.5$ Mpa

Equivalent Shear Stress

$= \sqrt{[\sigma_1^2 - \sigma_1 \sigma_2 . \sigma_2^2]} = 75$ *Mpa*

[1]

CONCLUSION

Name	P= 2.5 Mpa		Hand Calculation
	Max. Mpa	Min. Mpa	Mpa
Equivalent stress	153.79	0.0019614	75
Shear stress	86.08	0.0010221	37.5
Deformation	0.12906	0.00	0.060

The burst pressure of LPG gas cylinder has been determined by use of finite element analysis max. and min. equivalent stress, maximum shear stress and deformation at critical area has been calculated . The result of FEA analysis by using ANSYS software are verified with hand calculation. For comparison with ANSYS Software result hand calculation has been done.

CONCLUSION:

The finite element simulation employed to estimate the stresses of LPG gas cylinder via ANSYS 11 software. The critical location of burst pressure can be investigated by using ANSYS software which is difficult by analytical method. Maximum shear stress location also found by using ANSYS Software.

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