Strength Comparison of Cylinder Liner for different materials using Ansys

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Abstract: ***Many times it's troublesome to investigate the particular operating conditions and issues created might which can result in development of stresses and so may cause failure, conjointly it's troublesome to search out the stresses developed in every section of part so the, material needed to additional or subtracted not simply analyzed. Even material properties can't be thought-about solely by mathematical modeling while not virtual analysis Finite component Analysis is completed by victimization completely different software's like ANSYS and CATIA. This makes it straightforward to style a part for a lot of sturdiness with facilitate of virtual work by knowing its completely different shape in-actual operating. During this Case study mechanical (coupled filed) analysis on cylinder liner of 4-stroke diesel motor of Trucks Major R350 / 365 performed.***

Keywords:- ANSYS, CATIA V5, Thermo mechanical, Cylinder, Liner.

I. INTRODUCTION

FEA could be a numerical procedure which will be accustomed acquire answer to giant category of engineering issues involving stress analysis, heat transfer, electro magnetism and fluid flow. A finite part model could be a separate illustration of the continual, physical half that's being analyzed. This separate illustration is made exploitation nodes and components. Nodes ar connected along to create components. The nodes ar the separate points on the physical half wherever the analysis predicts the response of the half thanks to applied loading. This response is outlined in terms of nodal degrees of freedom (DOF). For stress analysis, up to 6 degrees of freedom arattainable at every node (three parts of translation and 3 parts of rotation).

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Betting on the part sort chosen (e.g.,beam, plate, 2-Dand 3D components,etc.), the
quantity of needed degrees of freedom at every node is set

Phases in Finite Element Analysis:

In general, there are three phases in any computer-aided engineering task:

1. Pre-processing: Defining the finite element model and environmental factors to be applied toit.
2. Analysis solver: Solution of finite elementmodel.
3. Post-processing of results using visualizationtools

Specifications:

Cylinder block-Iron

Cylinder Head-Aluminium

Cylinder Liner- Cast Iron, aluminium ,titanium

Performance: - Maximum Speed 160 Km/Hour 0-100kmph 16.9 seconds 1/4 Mile 20.6 seconds

Material for Liner-

For increasing some properties of cast iron some material is alloyed as shown in below

Table 1.Properties of material

Total Carbom	3.10-3.40%
Combined Carbon	0.75-0.90%
Manganese	0.55-0.75%
Phosphorous	0.20% max
Silicon	1.90-2.10%
Nickel	1.80-2.20%
Chromium	0.55-0.75%

Nickel-Chromium Iron - composition: The high nickel content of this alloy provides excellent resistance to chloride-ion stress corrosion cracking and imparts resistance to corrosion by a number of organic and inorganic compounds.

chromium gives this alloy its resistance to oxidation at temperatures up to 2150°f (1175°c).combines high strength with desirable workability. it has excellent mechanical properties from sub-zero to elevated temperatures.

Design and mesh model of liner

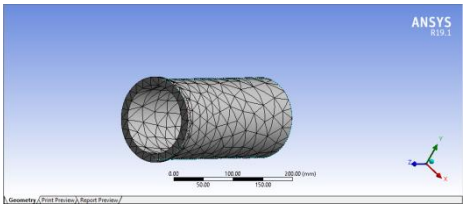


Fig 1: Mesh model

Boundary Conditions-

While taking part in out the examination the degrees of chance should be confined. Here all level of chance is proscribed for the auxiliary examination within the ANSYS the Surface burdens area unit often weights for basic part sorts, convections or heat motions for heat part sorts, and then forth. we tend to area unit brooding about the vi bar weight on within surface of chamber line

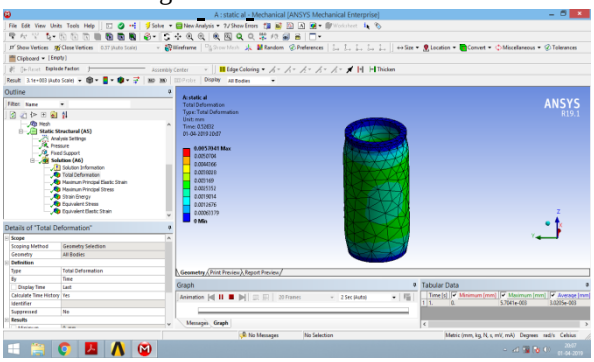


Fig 2:Deformation of liner due to high pressure

The pressure is uniform inside the liner. Therefore the maximum deformation is 5.7041e-003

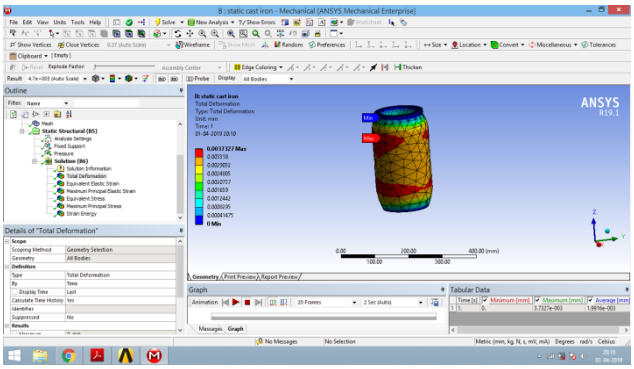


Fig 3:Deformation due to high pressure for cast iron

Due to temperature difference the deformation occur is 0.0037327mm

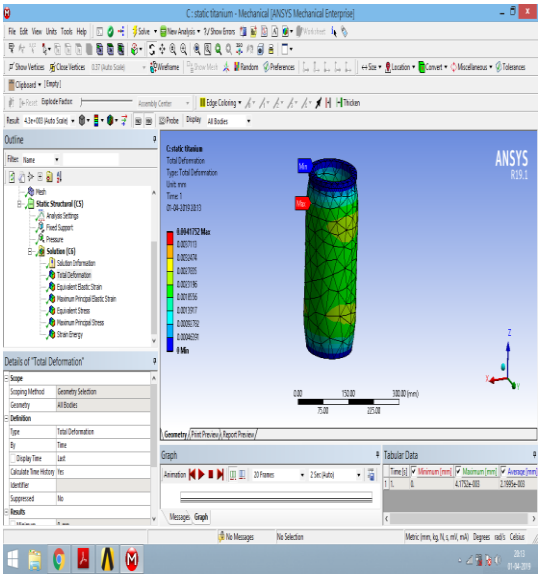


Fig 4: Deformation due to high pressure for Titanium

Due to temperature difference the deformation occurred is 0.0041752

OPTIMIZATION OF DESIGN:

Improvement deals with the examination of minimization or enlargement. Structure headway are in a general sense depending on number of parameters which are cost, measure, quality, weight, steady quality and execution. Everything considered if the engineer select burden as a streamlining standard, by then the general examination is performed to deal with the issue for weight minimization**.** The weight examination performed on that part gives suspected that if we clear certain proportion of structure of that portion. While playing out these weight examinations we manage when all is said in done factor of prosperity essential and weight following up on that fundamental part.

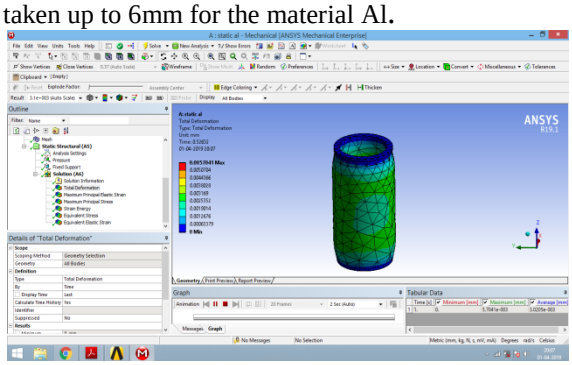
Optimization Statement and Constraints:

The basic and gas load is significant burden drawing close to the barrel liner thereupon the objective of the improvement was to weaken the mass of the pivoting shaft underneath the aftereffect of static burden including the stature weight load, such identical pressure adequacy square measure at interims the limits of passable pressure. The improved barrel liner must be exchangeable with existing one in current motor. everything about necessities or requirements, square measure right now to sum things up referenced.

ANALYSIS ON LINER FOR OPTIMIZATION

For optimization three cases are taken as follows: -

Case 1: - In this case the thickness of cylinder liner is taken up to 6mm for the material Al.



Fig(5): Total deformation

In this case study I(a) the thickness of cylinder liner is taken as 6mm .the main objective of those case study I(a) was to investigate the assorted stresses performing on the cylinder liner. The variation of deformation, combined stress and impact of those stresses on cylinder liner pure mathematics area unit ascertained. The blue color indicates the utmost elastic strain impacting space. The Georgia home boy deformation that occurred is five.7041e-003.

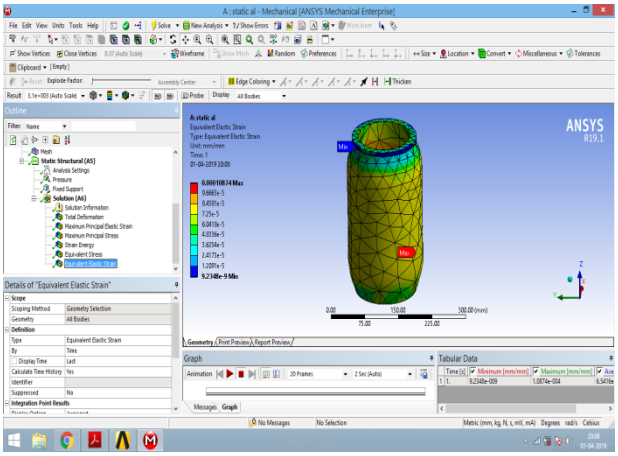


Fig (6): equivalent elastic strain

For this situation ponder I(b) the thickness of chamber liner is 6mm..The primary goal of these contextual investigation I(b) was to break down the different anxieties and strains following up on the barrel liner. The variety of consolidated pressure and impact of these weights on chamber liner geometry are watched. The yellow shading demonstrates the Max. Stress affecting region. So at last from this ANSYS result it is seen that for the given thickness the Max. stress following up on barrel liner expanded. For this situation the thickness, equal strain is 1.0735e-005.

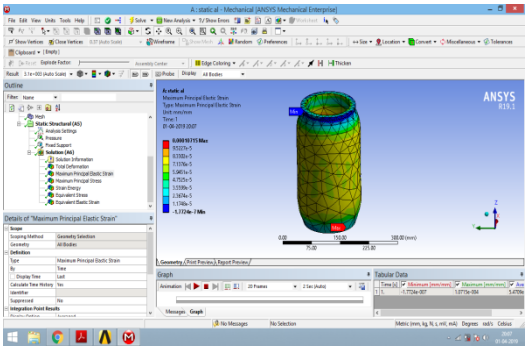
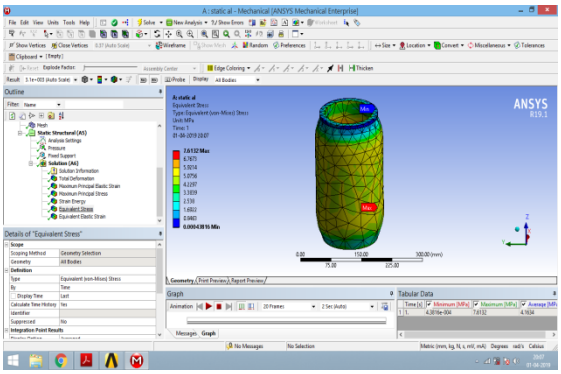


Fig.(7): Principal strain

For this situation ponder the thickness of barrel liner is 6mm.The fundamental goal of these contextual analysis I(c) was to examine the different burdens following up on the chamber liner. The variety of most extreme warm pressure and impact of these weights on barrel liner geometry are watched. The blue shading shows the Combined pressure affecting zone. So at long last from this ANSYS result it is seen that as the thickness of liner is same the Combined pressure following up on chamber liner diminished .For this situation the thickness of barrel liner isn't changed so Combined pressure diminished to 1.0715e-004N/mm2.For unaltered thickness of liner for various material and consolidated pressure gets decreased.



Fig(8) : Equivalent stress

In this case study the thickness of cylinder liner is taken as 6mm .the main objective of those case study I(d) was to investigate the varied stresses engaged on the cylinder liner. The variation of deformation, combined stress and impact of those stresses on cylinder liner pure mathematics square measure determined. The inexperienced color indicates the most stress and strain impacting space. thus finally from this ANSYS result it's determined that because the thickness of liner is 6mm, the most equivalent stress engaged on cylinder liner faded .In this case the strain is reduced to seven.6132N/ mm2.

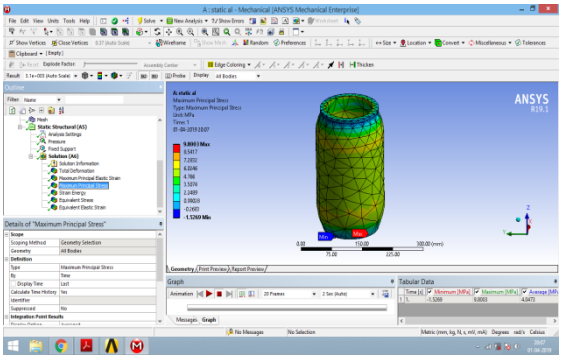


Fig (9): The max principal stress

For this situation think about the, principle goal of these contextual analysis I(e) was to break down the different burdens following up on the barrel liner. The variety of joined pressure and impact of these weights on barrel liner geometry are watched. The yellow shading demonstrates the greatest pressure affecting zone. So at last from this ANSYS result it is seen that as the thickness of liner is 6mm, the most extreme proportional pressure following up on barrel liner should diminished .For this situation the, greatest important pressure is 9.8003 N/mm2.

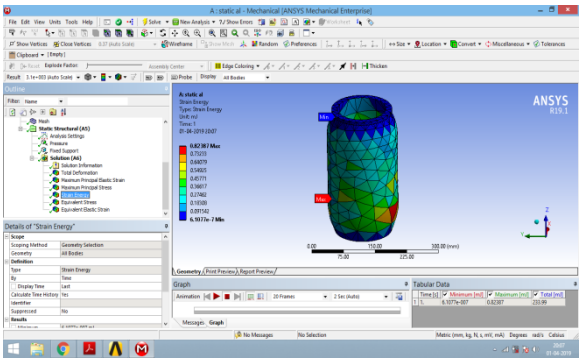


Fig (10) : strain Energy

For this situation think about the thickness of chamber liner is Similar. The principle target of these contextual investigation I(f) was to break down the different anxieties following up on the barrel liner. The variety of joined pressure and impact of these weights on chamber liner geometry are watched. The blue shading shows the greatest consolidated pressure affecting zone. So at long last from this ANSYS result it is seen that as the thickness of liner is 6mm, the joined pressure following up on chamber liner expanded .For this situation of barrel liner, so strain vitality is 0.82387 N/mm2.

Case 2: Taking thickness equal to 6mm for the material "Cast Iron" the results obtained are as follows

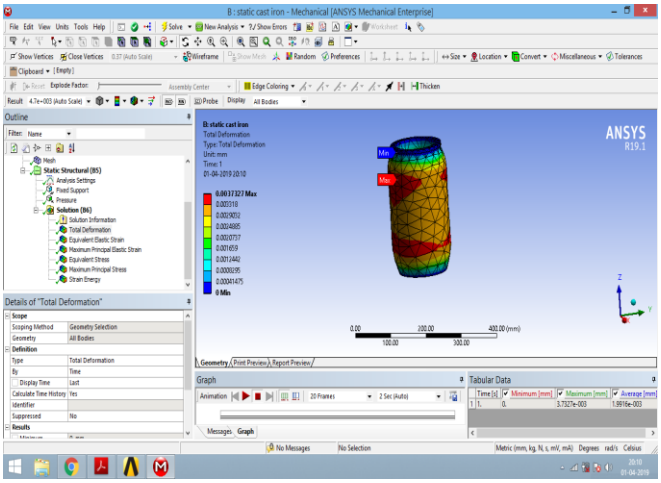
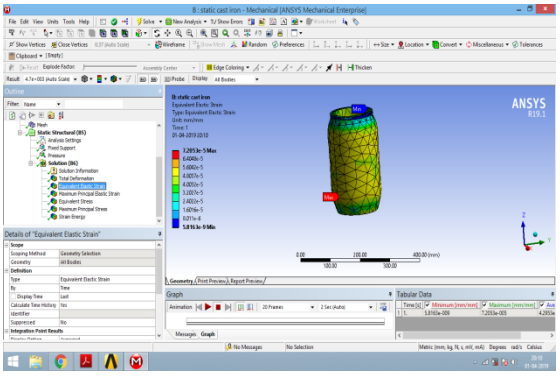


Fig (11) :Max. Deformation for 6mm

For this situation think about II(a) the thickness of chamber liner is taken as 6mm .the primary goal of these contextual investigation II(a) was to break down the different anxieties following up on the barrel liner. The variety of twisting, consolidated pressure and impact of these weights on chamber liner geometry are watched. The blue shading demonstrates the most extreme versatile strain affecting territory. The maximum misshapening that happened is 3.7327e-003.



Fig(12): Equivalent strain

For this situation consider II(b) the thickness of chamber liner is 6mm.The primary target of these contextual investigation II(b) was to dissect the different anxieties and strains following up on the barrel liner. The variety of consolidated pressure and impact of these weights on chamber liner geometry are watched. The yellow shading demonstrates the Max. stress affecting territory. So at long last from this ANSYS result it is seen that for the given thickness the Max. stress following up on chamber liner expanded. For this situation the thickness, identical strain expanded to 7.2053e-005/mm2.

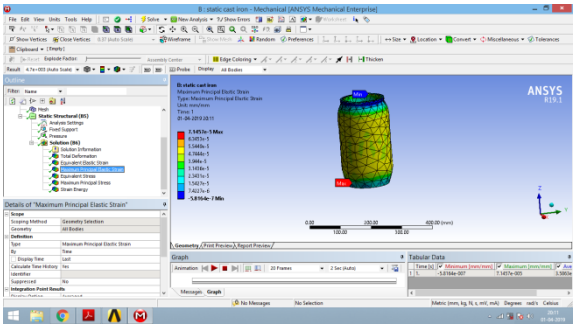


Fig (13) :principal strain

For this situation think about the thickness of barrel liner is 6mm.The fundamental target of these casestudy II(c) was to examine the different burdens following up on the chamber liner. The variety of joined pressure and impact of these weights on barrel liner geometry are watched. The blue shading demonstrates the Combined pressure affecting region. So at long last from this ANSYS result it is seen that as the thickness of liner is same the Combined pressure following up on chamber liner diminished .For this situation the thickness of barrel liner isn't changed so Combined pressure diminished to 7.1457e-005N/mm2.For unaltered thickness of liner for various material Maximum pressure, and joined pressure gets decreased.

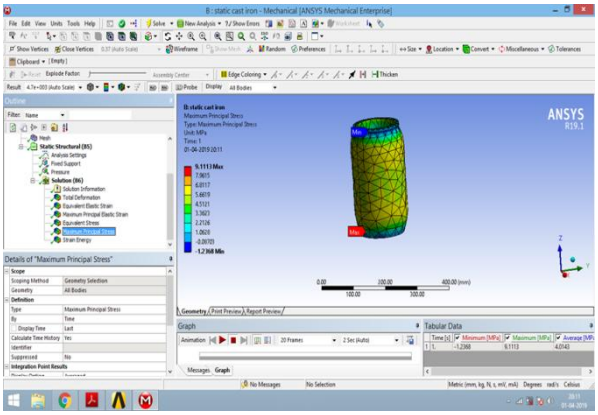
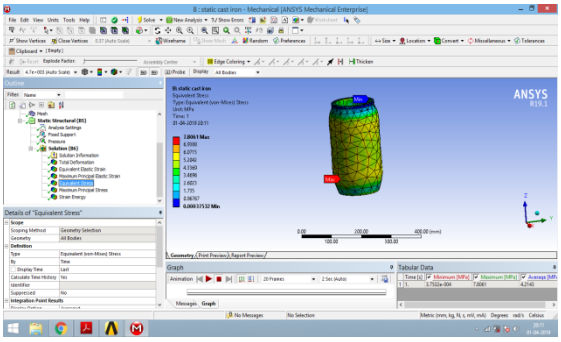


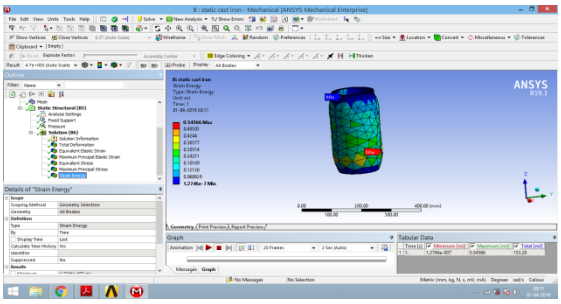
Fig (14): The max principal stress

For this situation think about the, principle goal of these contextual investigation II(d) was to break down the different anxieties following up on the barrel liner. The variety of joined pressure and impact of these weights on chamber liner geometry are watched. The yellow shading demonstrates the greatest pressure affecting zone. So at long last from this ANSYS result it is seen that as the thickness of liner is 6mm, the most extreme pressure following up on barrel liner ought to be diminished .For this situation the, greatest primary pressure is 9.1113 N/mm2.



Fig(15):Max equivalent stress

For this situation consider the thickness of chamber liner is taken as 6mm .the primary target of these contextual analysis II(e) was to break down the different burdens following up on the barrel liner. The variety of distortion, joined pressure and impact of these weights on chamber liner geometry are watched. The green shading demonstrates the greatest anxiety affecting region.So at last from this ANSYS result it is seen that as the thickness of liner is 6mm, the most extreme equal pressure following up on barrel liner diminished .For this situation the pressure is decreased to 7.8061 N/mm2.



Fig(16): Strain energy

For this situation consider the thickness of barrel liner is Similar. the primary goal of these contextual investigation II(f) was to break down the different burdens following up on the chamber liner. The variety of joined pressure and impact of these weights on chamber liner geometry are watched. The blue shading shows the most extreme joined pressure affecting zone. So at long last from this ANSYS result it is seen that as the thickness of liner is 6mm, the consolidated pressure following up on chamber liner expanded .For this situation of barrel liner, so strain vitality is 0.54566 N/mm2

Case 3: Taking thickness equal to 6mm for the material "Titanium" the results obtained are as follows

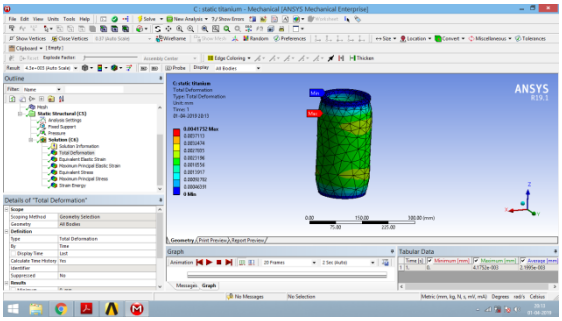


Fig (17): Max deformation

For this situation ponder III(a) the thickness of barrel liner is taken as 6mm .the fundamental goal of these contextual investigation III(a) was to examine the different anxieties following up on the chamber liner. The variety of twisting, consolidated pressure and impact of these weights on chamber liner geometry are watched. The blue shading demonstrates the most extreme flexible strain affecting territory. The maximum disfigurement that happened is 4.1752e-003.

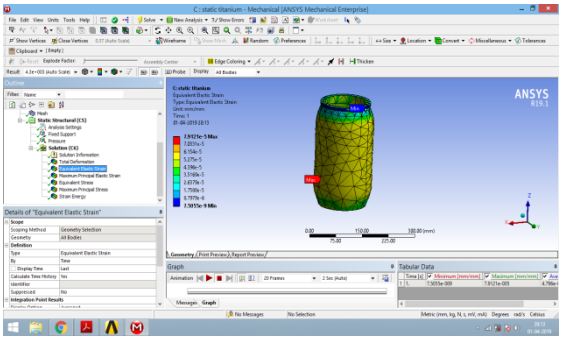
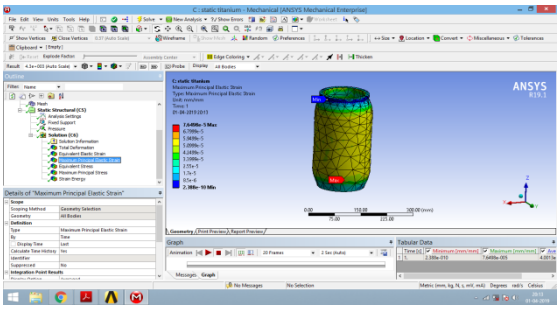


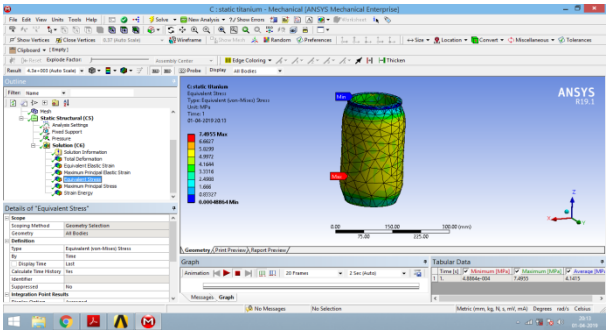
Fig (18): equivalent elastic strain

For this situation ponder III(a) the thickness of barrel liner is taken as 6mm .the fundamental goal of these contextual investigation III(a) was to examine the different anxieties following up on the chamber liner. The variety of twisting, consolidated pressure and impact of these weights on chamber liner geometry are watched. The blue shading demonstrates the most extreme flexible strain affecting territory. The maximum disfigurement that happened is 4.1752e-003.



Fig(19):Principal elastic strain

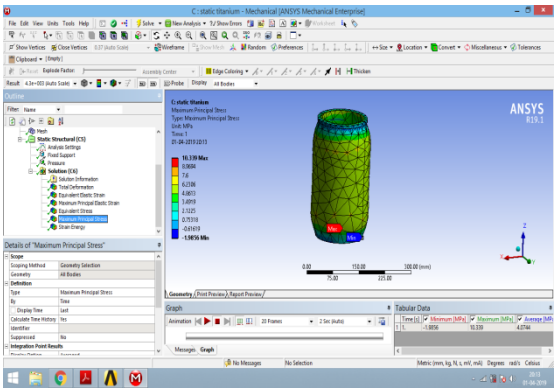
For this situation think about the thickness of barrel is 6mm.The fundamental target of these contextual investigation III(c) was to break down the different burdens following up on the chamber liner. The variety of joined pressure and impact of these weights on barrel liner geometry are watched. The blue shading demonstrates the Combined pressure affecting region. So at long last from this ANSYS result it is seen that as the thickness of liner is same the Combined pressure following up on chamber liner diminished .For this situation the thickness of barrel liner isn't changed so Combined pressure diminished to 7.6498e-005N/mm2.For unaltered thickness of liner for various material Maximum pressure, and consolidated pressure gets decreased.



Fig(20): Equivalent stress

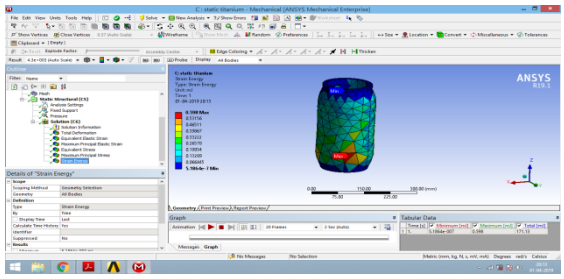
For this situation contemplate the thickness of chamber liner is taken as 6mm .the primary target of these contextual investigation III(d) was to break down the different burdens following up on the barrel liner. The variety of twisting, consolidated pressure and impact of these weights on chamber liner geometry are watched. The green shading demonstrates the most extreme anxiety affecting zone.

So at long last from this ANSYS result it is seen that as the thickness of liner is 6mm, the most extreme comparable pressure following up on chamber liner diminished .For this situation the pressure is decreased to 7.4955 N/mm2.



For this situation consider the, principle goal of these contextual investigation III(e) was to break down the different anxieties following up on the barrel liner. The variety of consolidated pressure and impact of these weights on barrel liner geometry are watched. The

yellow shading shows the most extreme pressure affecting territory. So at long last from this ANSYS result it is seen that as the thickness of liner is 6mm, the greatest identical pressure following up on barrel liner should diminished .For this situation the, most extreme important pressureis10.339N/mm2.



Fig(22): Strain energy

For this situation think about the thickness of barrel liner is Similar. the fundamental goal of these contextual investigation III(f) was to break down the different burdens following up on the chamber liner. The variety of joined pressure and impact of these weights on chamber liner geometry are watched. The blue shading demonstrates the greatest consolidated pressure affecting zone. So at last from this ANSYS result it is seen that as the thickness of liner is 6mm, the joined pressure following up on chamber liner expanded .For this situation of barrel liner, so strain vitality is 0.598 N/mm2

Tabular Results:

Tabular Results:

	Total Deformation	Equivalent strain	Principal strain	Equivalent stress	Principal stress	Strain energy
Aluminum	0.0057041	0.00010874	0.00010715	7.6132	9.8003	0.82387
Cast iron	0.00037327	0.000072053	0.000071457	7.8061	9.1113	0.54566
Titanium	0.0041752	0.000079121	0.000076498	7.4955	10.339	0.598

CONCLUSION:

- The structural analysis of cylinder liner component is done byusing:
- Solid 45brickelement → structural analysis
- Solid 70brickelement → thermal analysis
- The outer surface of cylinder liner is under maximum stress
- From case study I it is concluded that By checking the thickness of cylinder liner component max reformation, and combined stress(stress and strain) increase for the given different materials.
- From case study II it is concluded that For given thickness of cylinder liner, Max deformation and combined stress gets reduced increase for the given different material.
- From Case study III it is concluded that

For given thickness of cylinder liner, Max deformation and combined stresses get reduced increased for given material.

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