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The Material Failure by Von-Mise's Stress and Resonance Concept

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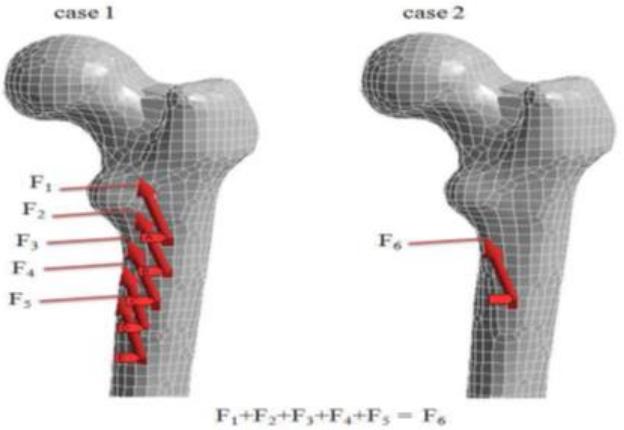
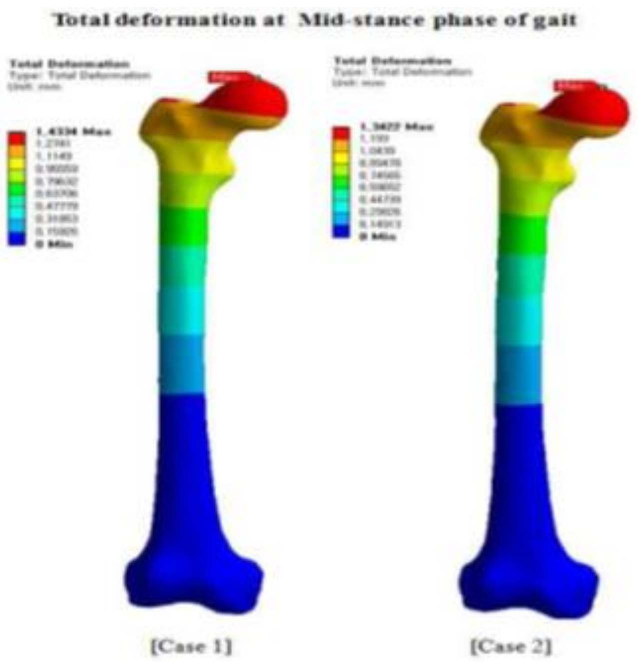
ABSTRACT
The failure of materials for living and non-living materials or organs is predicted by von mises criteria or distortion energy theory. It also aids in organ transplants or replacement depending on the level of stress considered. Usually specimen for living material is skeleton body parts of animal is considered. The software platform utilized is 3d cad,catia v5, fea, hypermesh& ls dyna used. The von mises is applied to metals, alloys, composite materials etc. when the $\sigma von \geq \sigma yield$ material will fail. The design is considered based on FOS or strain concept. Any material or living organ will fail after resonance, which is warning bell while in operation performing
Keywords : Musculoskeletal modeling, Finite element analysis, Fracture mechanics, Von-Mises stress, Deformation, Muscle attachment. Random vibration, Monte, F-scan, Insole Stress. Femur, Computed tomography, Deformation

I. INTRODUCTION

In static and dynamic loading it is very important for design engineer for stress distribution plots in order to prevent material failure. Bones are very vital organs in human body for strength and stability. Bones have a strong structure with hard cortical bone on the outside and soft cancellous bone on the inside. At birth, the human body has 270 bones and at adulthood, it has 206 bones. Stochastic loads are present in many mechanical and structural systems. Estimation of muscle forces, bone strength, and internal and external spinal loads are all important factors in the treatment of spinal fractures. The maximum shear stress is calculated using Mohr's circle. We can construct cameras out of any material by examining all classes of materials.. CT scan data of patient of femur of rigid organ provides strength and stability to perform task. The load varied from 1000N to 8000N to determine von mises stress. The non living this study investigates the failure of cylindrical pressure vessels.

Pressure vessels must be able to function at temperatures ranging from 600°C to -20°C, with design pressures ranging from 0.1MPa to 15MPa. A combined inverse dynamics and finite element analysis study was conducted[1] . Von-Mises stress and deformation in Case 2 were underestimated by 8.42% and 6.29%, respectively, compared to Case 1[2]. different material and thickness by using Finite Element (FE), which using ANSYS Workbench V19.2 for analysis purpose[4]. The von Mises stress is used to predict yielding of materials under any loading condition from results of simple uni-axial tensile tests. 1.55MPa at 600°C applied to a tank model with a thickness of 2mm. Because the factor of safety is less than 3.5 (material's factor of safety) for the thickness range discussed in Table, 10mm thickness and lower will cause catastrophic failure if the LPG pressure tank is to run at 1.55MPa and 600C. Models of cylindrical LPG pressure tanks with thicknesses of 2mm, 5mm, 10mm, and 30mm are all subjected to the same internal pressure and temperature. LPG Temperature=200C 0.5MPa internal pressure Except for the temperature and LPG pressure, the tank characteristics for examination are the same as in cases 1 and 2.. By D'alembert principle external applied frequency is ω is noted. If $\omega = \omega_n$, then resonance is occurred. This will helpful for controlling vibration frequency ω for any matter.





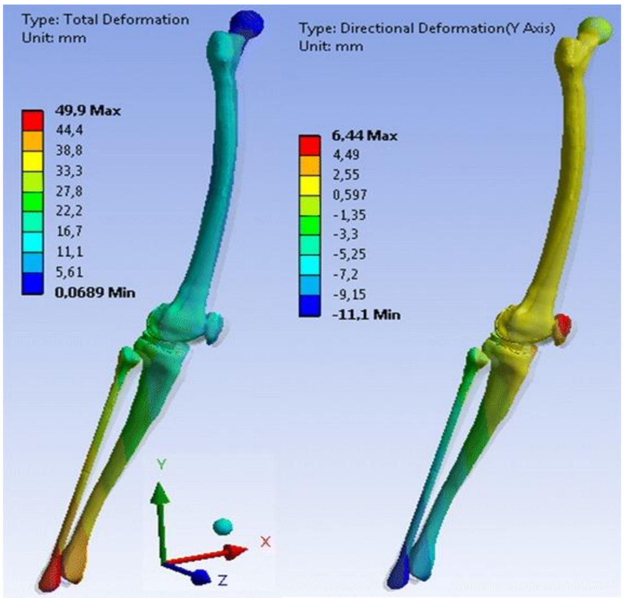


Fig. deformation of femur

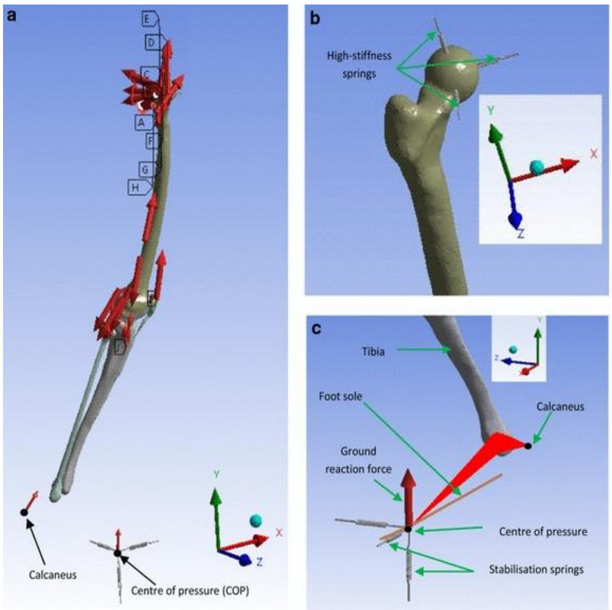


Fig. force application on femur

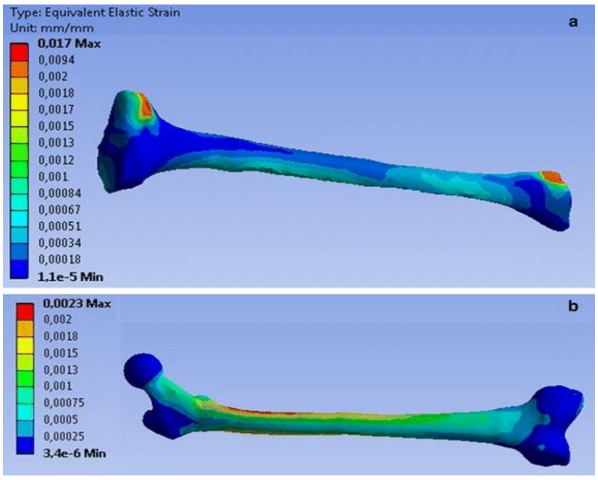


Fig. strain of femur

Indicating that the tall femur was capable of supporting more weight[6]. The Gluteus maximus, Gluteus medius, and Gluteus minimus, with respective muscle forces of 406, 840, and 516 N, showed substantial activity in the findings of the muscle force estimated using the musculos keletal model. Cases 1 and 2 had maximum Von-Mises stress values of 69.64 and 63.78 MPa, respectively, and maximum total transformation values of 1.43 and 1.34 mm, respectively, when the maximum Von-Mises stress acting on the femur was verified using 16 muscle forces as input values in the FEA. Figures 1 and 2 illustrate the figures and area that represent the level of activity.

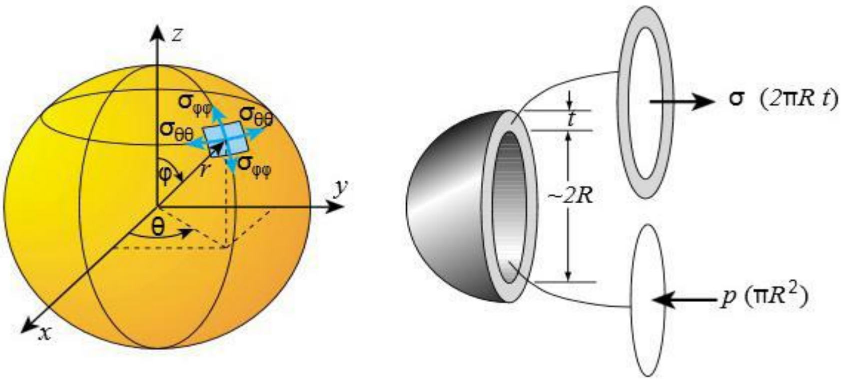


Fig. pressure tank

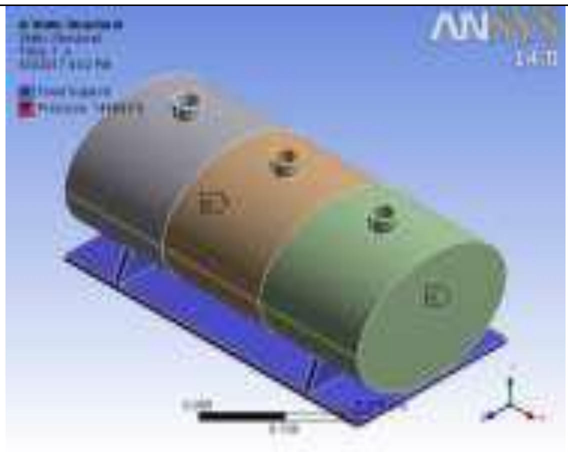


Fig. pressure tank load distribution

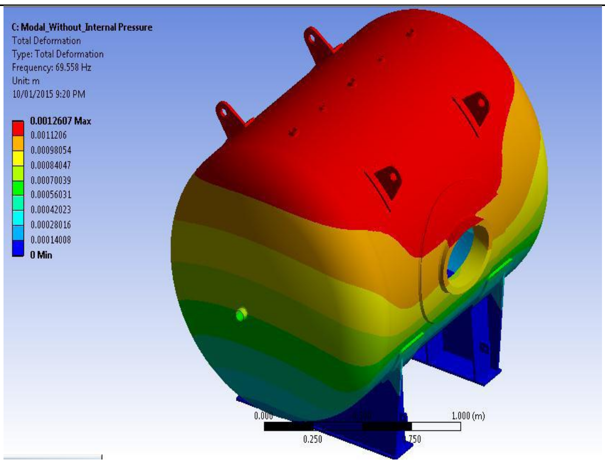


Fig deformation of vessel

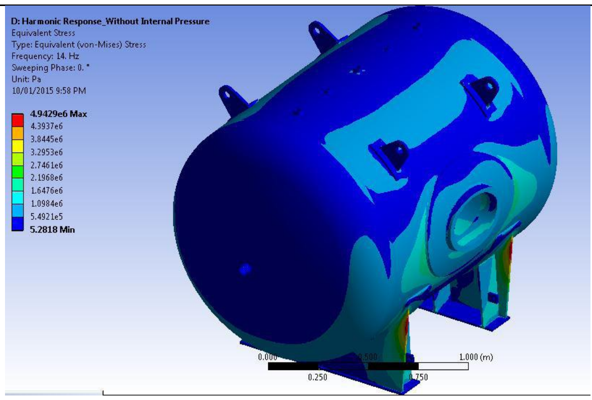


Fig. von mises stress

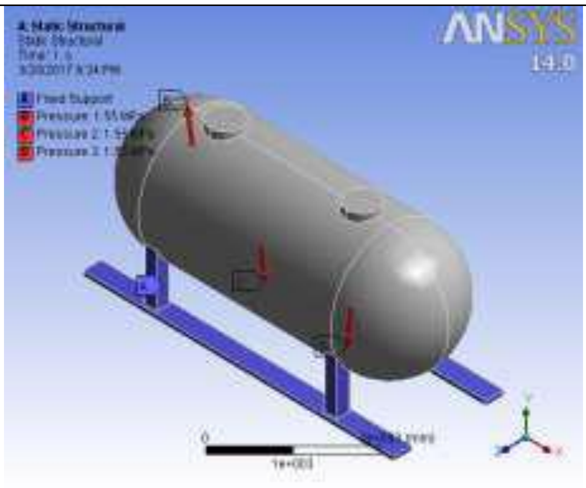


Fig. pressure tank

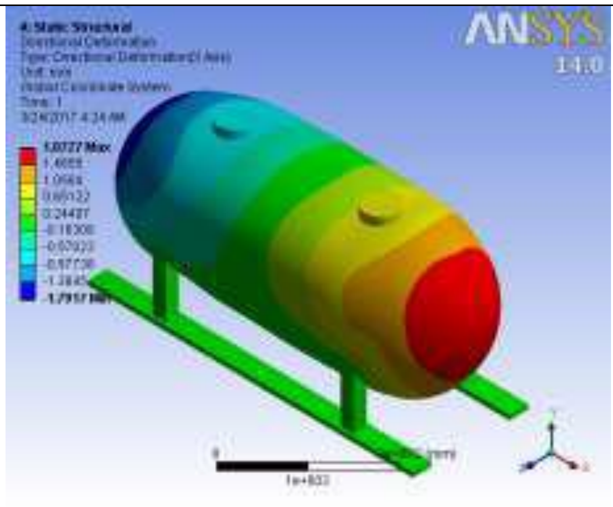


Fig. pressure tank load distribution

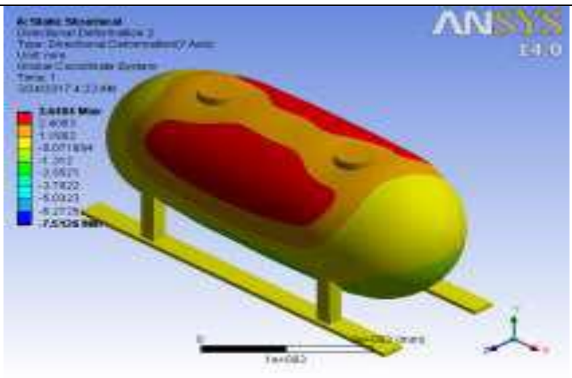


Fig. pressure tank stress distribution

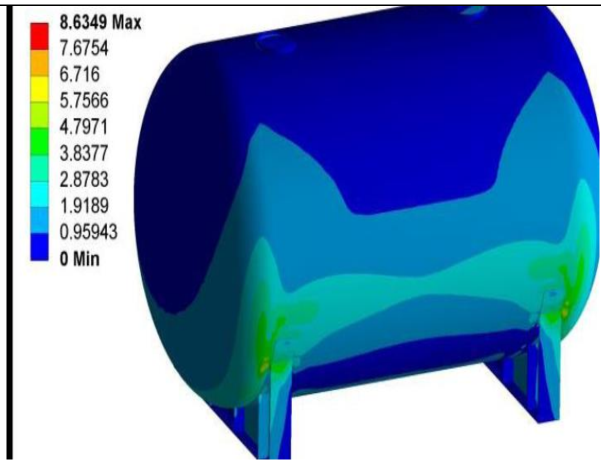


Fig. von mises stress

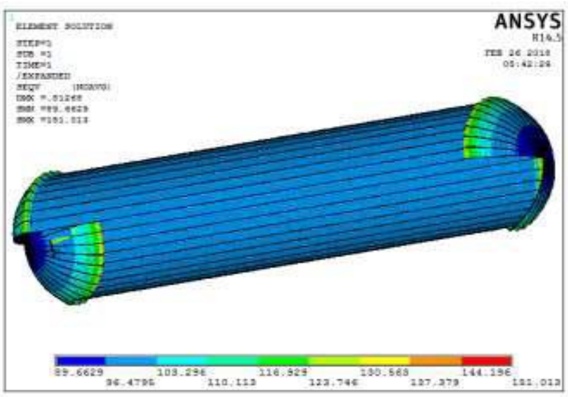


Fig. von mises stress

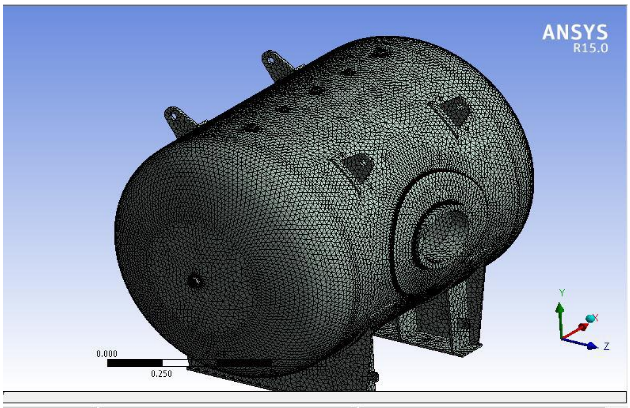


Fig. meshing

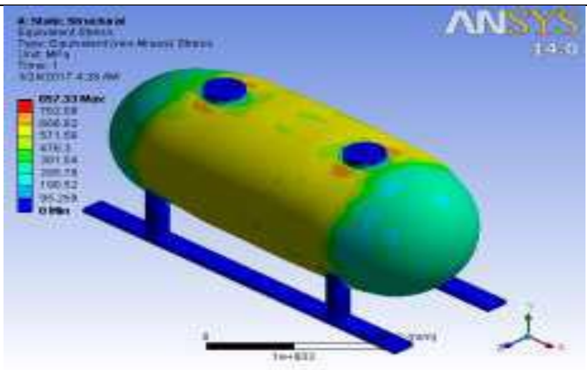


fig. pressure tank von mises stress distribution

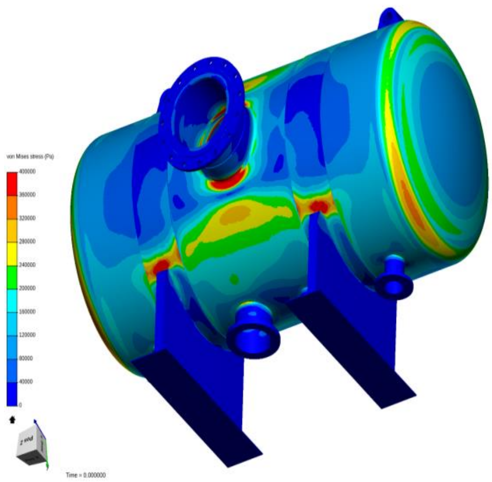


fig. von mises stress distribution

Sl no.	D diameter in mm	P internal pressure in N/mm^2	S allowable stress in N/mm^2	T shell in mm	T head in mm
1	2000	0.5	138	3.6	1.8
2	2000	1	138	7.3	3.6

Vessel Length, L = 10000 mm

1. Design of Pressure, Pd = 1.05 × maximum working pressure.

2. Hydrostat pressure = 1.365 × maximum working pressure.

Design temp.:-75° C.

-65° C is the operating temperature.

Material SA 516 Gr. 70

Total volume of the pressure vessel is 2.293 m^3

mass 1499.4 kg respectively.

Sl no.	Frequency (Hz)
1	70
2	115

The maximum stress values of the shell side of the pressure vessel are 117.313 N/mm2 and 103.296 N/mm2, respectively. It is important to note that the shell side of the vessel is secure, based on the results of all 20 cases. The maximum displacement for cases 1 and 2 in the weld zone is shown in Fig.

RESONANCE OF MATTER

Natural frequency of some materials in Hertz frequency of some planets

Natural Frequency of Planets	
Name of Material	ω_n in Hz
Sun	126 Hz
Moon	210 Hz
Mars	144 Hz
Mercury	432 Hz
Jupiter	183 Hz
Venus	221 Hz
Saturn	147 Hz
Universe	432 Hz
Earth	7.83 Hz

Natural Frequency of Human Body Parts	
Name of Material	ω_n in Hz
Heart	13-120 Hz
Whole Body	3-17Hz
Kidney	45-76 Hz
Brain	12 Hz
Skin	140 – 185 Hz
eye	19Hz
Head	8-12 Hz
body torso	7.5Hz
thoracic cavity	4-6 Hz

Natural frequency of some colours	
Name of Material	ω_n in Hz
white	405-790THz
red	429THz
black	0
blue	620-670THz
green	530-600THz
yellow	521-512THz
orange	500THz

Natural frequency of some particular	
Name of Material	ω_n in Hz
MS	1306-3829 Hz
CI	890-5539 Hz
Copper	63-18.46MHz
Carbon	118-1167 GHz
H_2	1420,405,752 Hz
O_2	60GHz
water	120,180 GHz
plastic	9225 Hz
glass	200-500 Hz
Air at 22^0 c temp	128Hz

II. RESULTS AND DISCUSSION

The 3d model can be draft from any drafting software like auto cad, solid edge , catia ,pro-E and discretization , mesh can be made by taking suitable nodes , as nodes carries loads .while importing 3d model in ansys or hypermesh software workbench. Then analyzed results will be plotted as deformation, stress strain, von-mises stress, nodal solution, reactions etc. By taking these results we conclude that peak stress or maximum stress which can withstand the material. So from tabular results or plots we analyze failure path, crack initiation, modal behavior, and natural frequency of particular living or non-living material.

III. CONCLUSION

The various graphs of analysis curves will be plotted from living & non-living materials. The living organs like skeleton body of animal will be taken as specimen from that we conclude analyze the various plots. E.g. von-mises stress can be estimated from specimen & pressure vessel or container can be estimated from specimen. Failure of material at what level of stress will be predicted. It helps in transplantation of organs or replacement of organs at what stress levels will be considered. Bio mechanical stress strain relationship will be noted down. The equation of curve fit for the distortion energy or von-mises stress criteria is $U=\sigma\epsilon/2$. The material will fail at condition $\sigma_{von} \geq \sigma_{yield}$ .the living human beings bones material Ca is utilized as part for that analysis is FEA done like von-mises stress is calculated, computed for several graphs loading will comes. Von-mises stress is applied to metals, alloys, composite materials etc. This helps for controlling vibration frequency ω for any matter, earthquake etc.

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