FINITE ELEMENT ANALYSIS OF EICHER 20.16 LADDER CHASSIS WITH OPTIMIZATION IN CHANNEL SECTION TO ENHANCE THE STRENGTH DURING STATIC LOAD

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Abstract

In the current work, the CAD model of chassis has been developed by using CREO 5.0. The model has been simulated using ANSYS software on static structural domain 15.0 workbench in order to observe various parameters affecting the structural performance of chassis. Six types of configurations of chassis including validation model have been used with different profile chassis with elliptical hole 3mm fillet radius, chassis with circular hole 3mm fillet radius, chassis with circular and elliptical hole, chassis fillet with 3mm radius. An optimized model of chassis with circular hole comprising 12mm thickness with 3mm of fillet radius has been developed. The simulation of the optimized model gives minimum value of stress and deformation at constant load of 83139.75N which has optimized and converged result compared to respected models of chassis, it has also been observed that stress and deformation was reduced at static load of 83139.75N in ladder chassis the material is reduced in present optimized model and also observed higher structural performance. The configuration of optimized model gives maximum convergence on all parameters amongst all the configurations used.

Keywords— *Chassis, Elliptical hole, Circular Hole, Stress, Deformation, Fillet radius, Pressure.*

I INTRODUCTION

A chassis is that the framework of a synthetic object, that supports the thing in its construction and use. an example of a chassis may be a vehicle frame, the body part of a automobile, on that the body is mounted; if the running gear like wheels and transmission, and generally even the driver's seat, area unit enclosed, then the assembly is delineated as a rolling chassis. Chassis is that the main support structure of the vehicle that is additionally called 'Frame'. It bears all the stresses on the vehicle in each static and dynamic condition. In a very vehicle, it's analogous to the skeleton in living organisms. The origin of the word Chassis lies within the French language. Each vehicle whether or not it's a two-wheeler or an automobile or a truck encompasses a chassis-frame. However, its kind clearly varies with the vehicle sort.

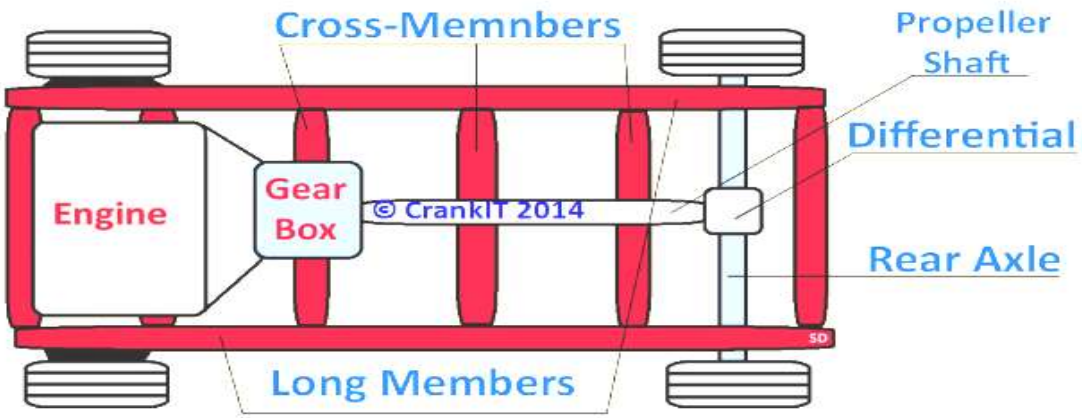


Fig 1.1 a ladder form chassis.

II FUNCTION OF CHASSIS

- Supports or bears the load of the vehicle body
- Provide the area and mounting location for numerous aggregates of auto
- Supports the load of varied systems of the vehicle like engine, transmission etc.
- Supports a load of passengers likewise because the baggage
- Withstands the stresses arising because of unhealthy road conditions
- Withstands stresses throughout braking and acceleration of the vehicle.

III USES OF CHASSIS

- In the case of vehicles, the term rolling chassis means that the frame and the "running gear" like engine, transmission, drive shaft, differential, and suspension.
- A below body that is sometimes not necessary for integrity of the structure, is made on the chassis to finish the vehicle.
- For industrial vehicles, a rolling chassis consists of associate degree assembly of all the essential elements of a truck to be prepared for operation on the road. Automotive chassis are going to be totally different from one for industrial vehicles thanks to the heavier masses and constant work use. Industrial vehicle makers sell "chassis only", "cowl and chassis", additionally as "chassis cab" versions which will be outfitted with specialised bodies. These embody motor homes, fireplace engines, ambulances, box trucks, etc.
- In particular applications, like college buses, a authority like National highway Traffic Safety Administration (NHTSA) within the U.S. defines the look standards of chassis and body conversions.
- An armoured fighting vehicles hull is the chassis and contains rock bottom a part of the AFV that features the tracks, engine, driver's seat, and crew compartment. This describes the lower hull, though common usage may embody the higher hull to mean the AFV while not the turret. The hull is a basis for platforms on tanks, armoured personnel carriers, combat engineering vehicles, etc

III LADDER FRAME CHASSIS

This term is wide used once it involves vehicles that are mounted on a separate frame. It's conjointly mentioned as a body-on-frame. It gets the ladder in its name from the manner it's. The frame consists of two long, serious beams of steel, control along by two shorter items. the rationale it tried thus well-liked, even to the present day in sure circles, is its simplicity. A ladder frame is simple to style, build and may be employed in multiple applications with negligible modification. Vehicles with a ladder frame are easier to assemble, which suggests a manufacturer will charge less for them. Ladder frames even have their draw back. Typically but, actually within the 4×4 community, these 'negatives' may be viewed as positive The construction is heavier, which may be viewed as each smart and unhealthy – smart for towing and sturdiness, unhealthy for fuel economy attributable to the additional weight. A ladder frame is hard a nice for carrying serious masses for an extended amount. A ladder frame vehicle sits higher off the bottom. This makes it at risk of torsional flexing, otherwise referred to as leaning through the corners. One will perceive why this could be a drag in a very sedan and why it doesn't very matter on a bakkie. But let's revisit to simplicity. The ladder frame is essentially used as a mounting purpose for the engine, body and suspension. From this we are able to surmise the advantages of getting a ladder frame on a correct. It sits higher off the bottom and wheel articulation is usually far better because of the manner the suspension is mounted. People who use their 4×4s for off-roading can appreciate the lower repair bills once the vehicle is broken. As a result of the chassis and body are two separate objects, they'll be mounted severally. In summary, ladder frames are powerful, additional suited to off-roaders because of major parts being mounted higher, and easier to mend after you get wise wrong..

V LITERATURE REVIEW

Swami K.I et al. [1] this paper connected with work performed towards the static structural analysis of the truck chassis. Structural systems just like the chassis may be simply analyzed victimisation the finite part techniques. Therefore a correct finite element model of the chassis is to be developed. The chassis is shapely in ANSYS. Analysis is finished victimisation the same software system.

Jagilam Kumar Chandra et al. [2] This paper describes design and analysis of heavy vehicle chassis as the prime objective of any automobile industries in today's fast changing world. in the present paper the pertinent information of an existing heavy vehicle chassis replacing materials of high specific weight with lower density materials without reducing rigidity and durability. Replacement of steel with aluminium, magnesium, composites are taken for modelling. Designing using computer aided design software catia and analysis by subjected to the identical load as that of a chassis. The numerical results are validated with analytical calculation considering the stress distribution and deformation using the ansys software.

Jayaprakash Vytla, Alok Kumar Rohit [3] The connecting rod is the intermediate member between the piston and the Connecting Rod. Its primary function is to transmit the push and pull from the piston pin to the crank pin and thus convert the reciprocating motion of the piston into rotary motion of the crank. The small end attaches to the piston pin, which is currently most often press fit into the connecting rod but can swivel in the piston, a "floating wrist pin" design. Presently connecting rod is manufacturing by using the material Carbon steel. In this project, connecting rod is designed using Aluminium alloys 7475 and 6061. The aim of this project is to design the connecting rod for 150cc engine motorbike by using Design formulas for the above materials. A2D drawing is drafted from the calculations. A parametric model of connecting rod is done in 3D modelling software Catia software. All the required data is collected from design data books, internet and journals..

K. Daniel et.al. [4] In this work, we've thought of ASTM A710C Steel because the material for the chassis. These material properties are applied on a ladder chassis and are analyzed under most load conditions. The ladder chassis is meant with I formed cross section for long members and C shaped cross section for cross members and additional material is far away from the cross members, thus on cut back the load. Chassis is modelled in SOLID WORKS with applicable dimensions. Static Structural analysis is completed in ANSYS work table. Results are compared with the present chassis model values.

Himanshu Hiraman Rathod et al. [5] In this paper, effect is been made to review few researches made in the earlier years. In general, the chassis is the base frame of a car, motorcycle, carriage or heavy vehicle. In this paper at attempt is made to view the research paper being published earlier on the analysis of chassis, the technique used to analyse it and also to analysis the material used for producing the chassis. A number of analytical and experimental technique are available used for the analysis of the chassis and the material which is used for manufacturing the chassis. In several chassis structure Steel forms are commonly used material for producing chassis but overtime aluminum has acquired its use. Hence, the chassis is considered as the most vital component of the any vehicle as it holds all the parts and components together. Further, meshing and analysis is done on HYPERMESH and ANSYS. There are many factors which are to be consider while designing any chassis like, material selection, strength, stiffness and weight.

V MODELING AND ANALYSIS

5.1 Procedure for Solving the Problem

- Create the geometry.
- Meshing of the domain.
- Steady state thermal solver.
- Set the material properties and boundary conditions.
- Obtaining the solution.

5.1.2 Finite Element Analysis of Chassis model Profile

- Analysis type Static Structural domain

5.1.3 Type of Element

- Quadrahedral

5.2 Preparation of the CAD models

The dimensions of the structural domain of chassis model were based on the work done by Swami K.I. [1] author of base paper that was considered for present simulation of chassis model. After this process the constraints were applied and this way the model was created in modelling software CREO 5.0. The following table 5.1 show basic geometric parameters of Chassis.

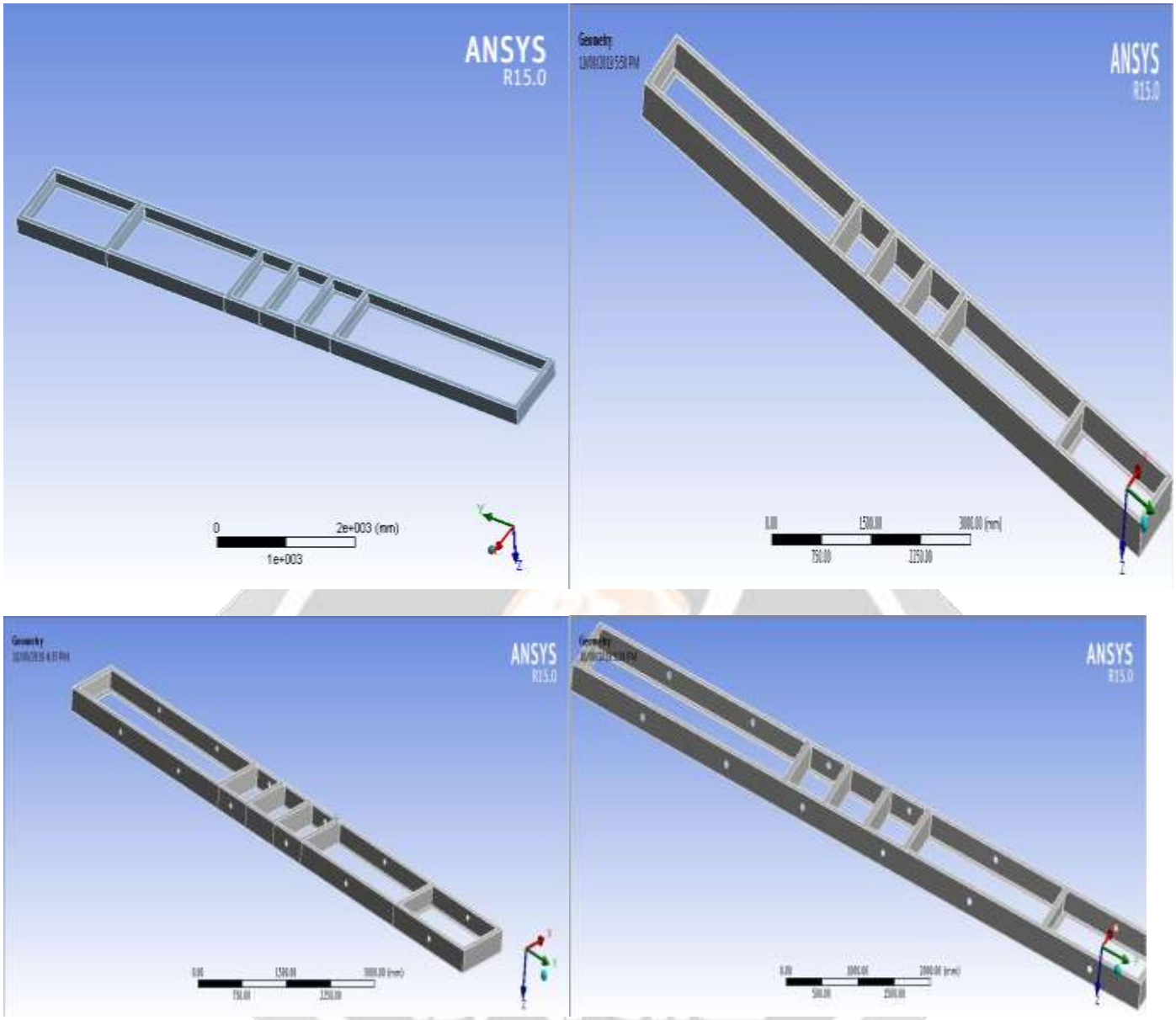


Figure 5.1: 3D Model of chassis.

5.3 Meshing of the Domain

The total number of elements of 18544 & nods of 213699 were employed to assess the grid independence in the IC engine fin case. The total number of elements higher than above mesh was employed in the IC engine fin (Perforated Convex Shaped) case. It is clear that the present results have good agreement with the available data in the literature. The results of the grid refinement study showed that the simulation based on the IC engine fin case and IC engine fin (Perforated Convex Shaped) case mesh provide satisfactory numerICal accuracy, and are the essentially grid independent in these cases.

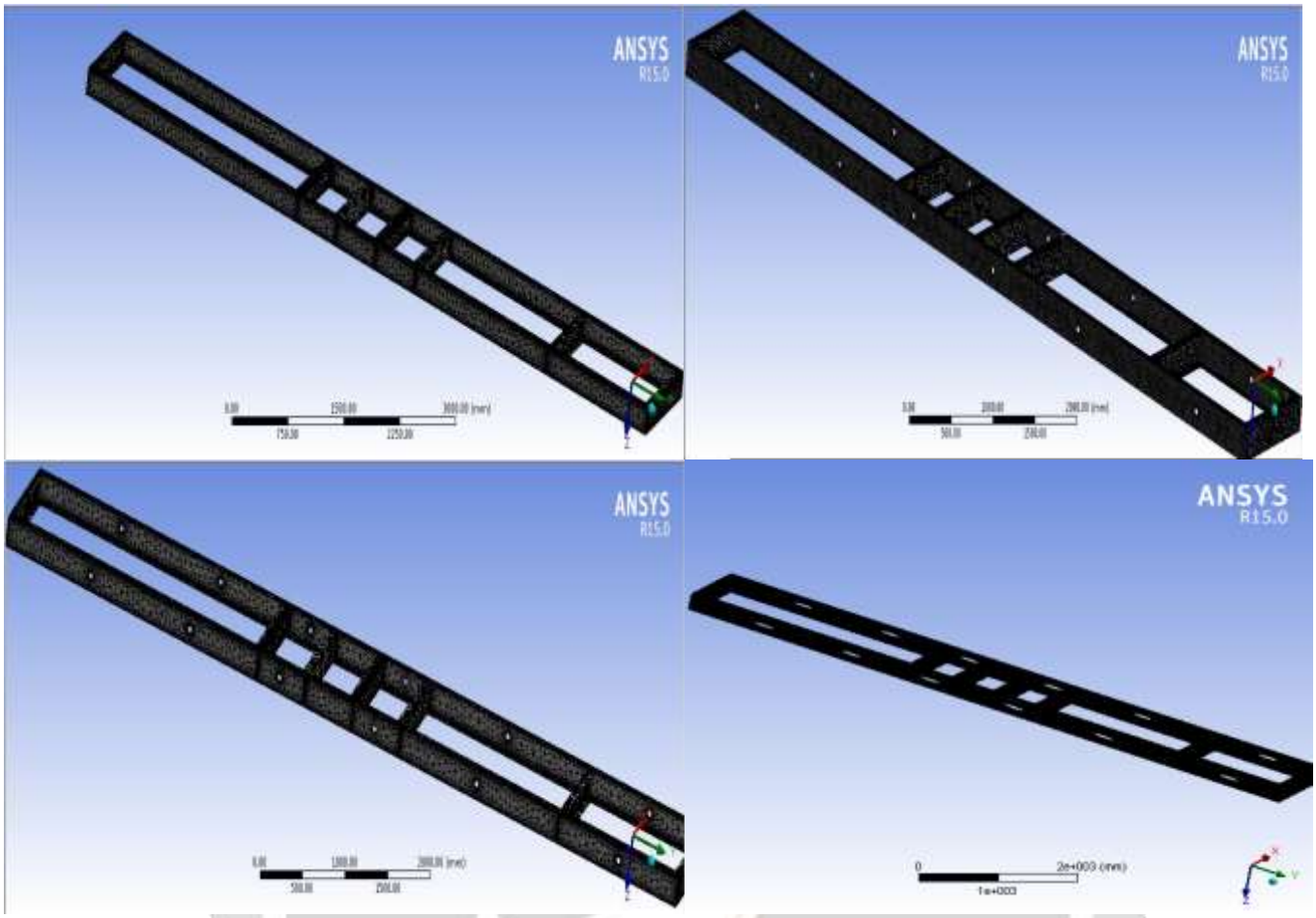


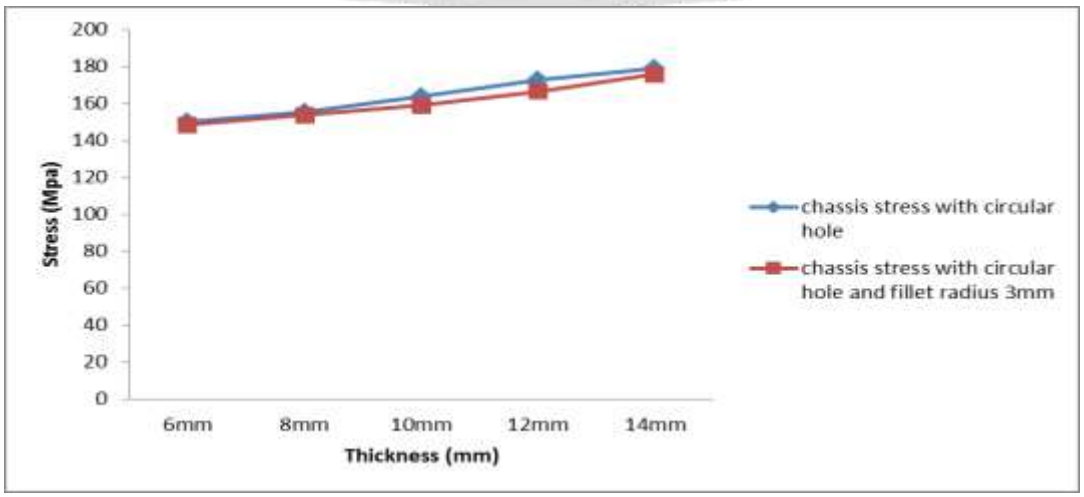
Figure 5.5: Mesh of Chassis

Table 5.1: Materials Properties

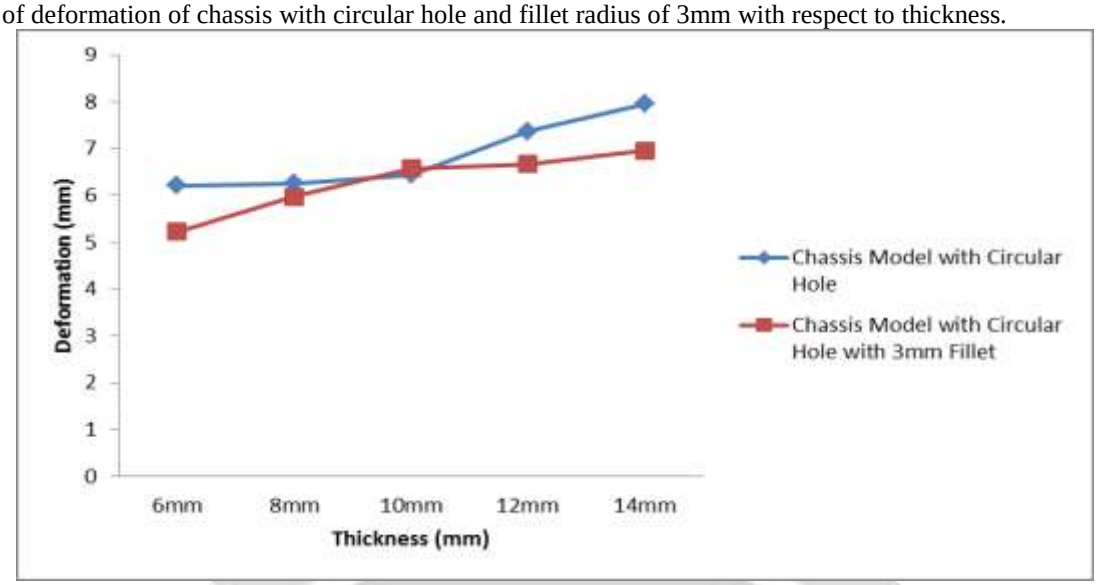
Properties	St 52 (Structural Steel)
Young' s Modulus (E)	2.10×10^5 N/mm^2
Poission's Ratio	0.31

VI RESULT AND DISCUSSION

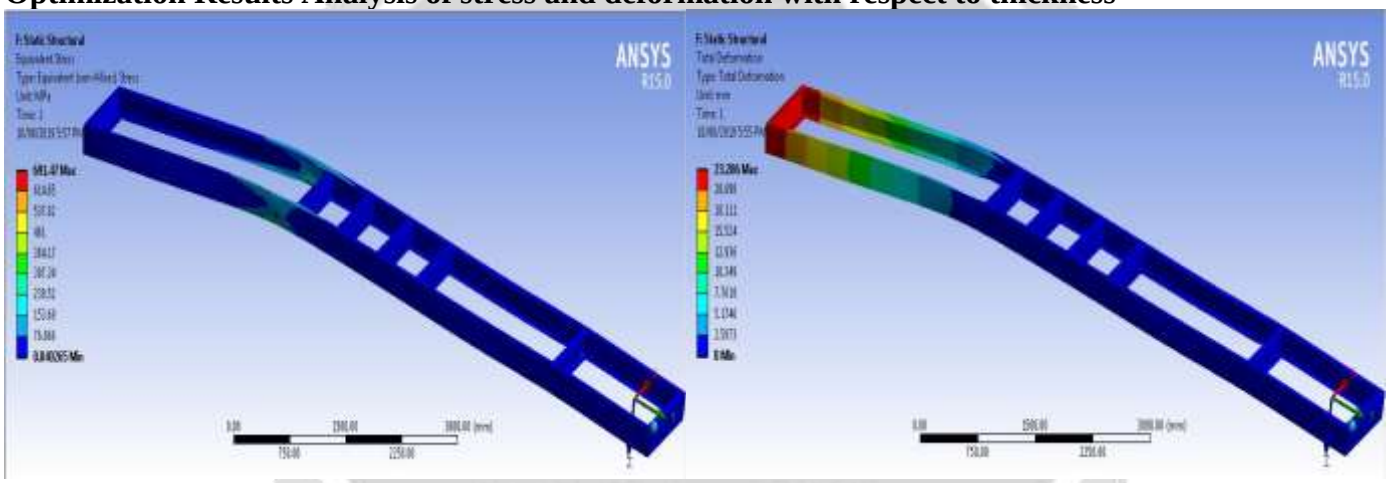
Comparison of stress of chassis with circular hole and fillet radius of 3mm with respect to thickness..



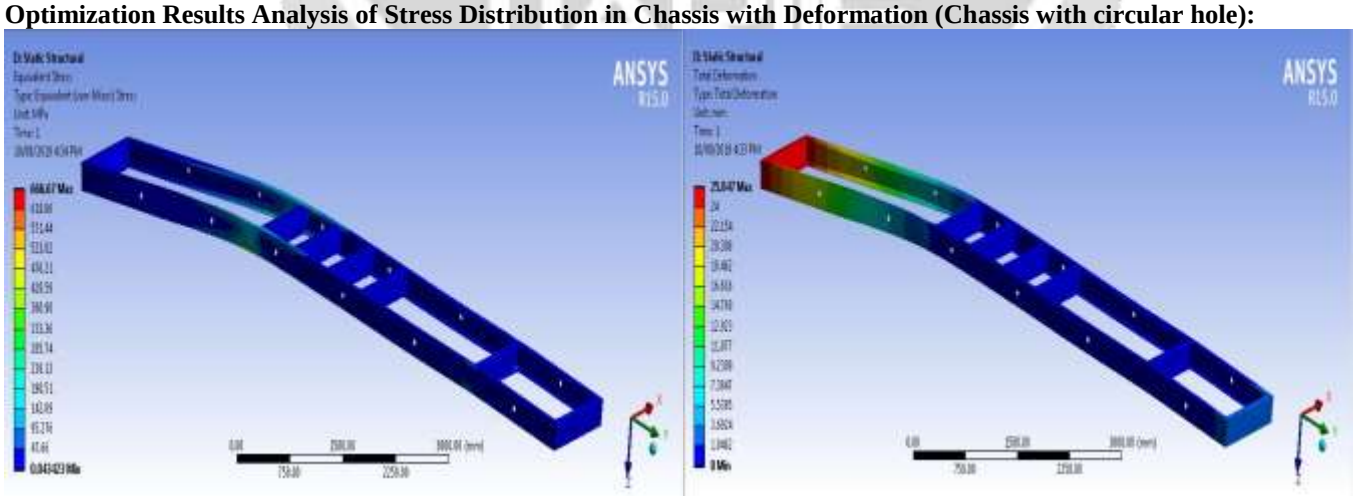
Comparison of deformation of chassis with circular hole and fillet radius of 3mm with respect to thickness.



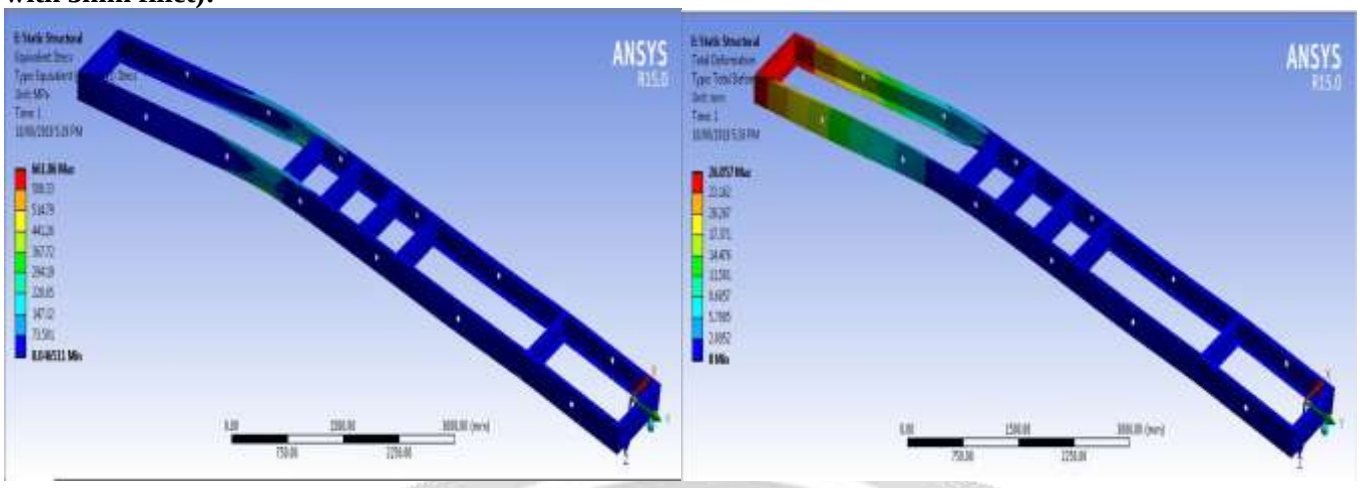
Optimization Results Analysis of stress and deformation with respect to thickness



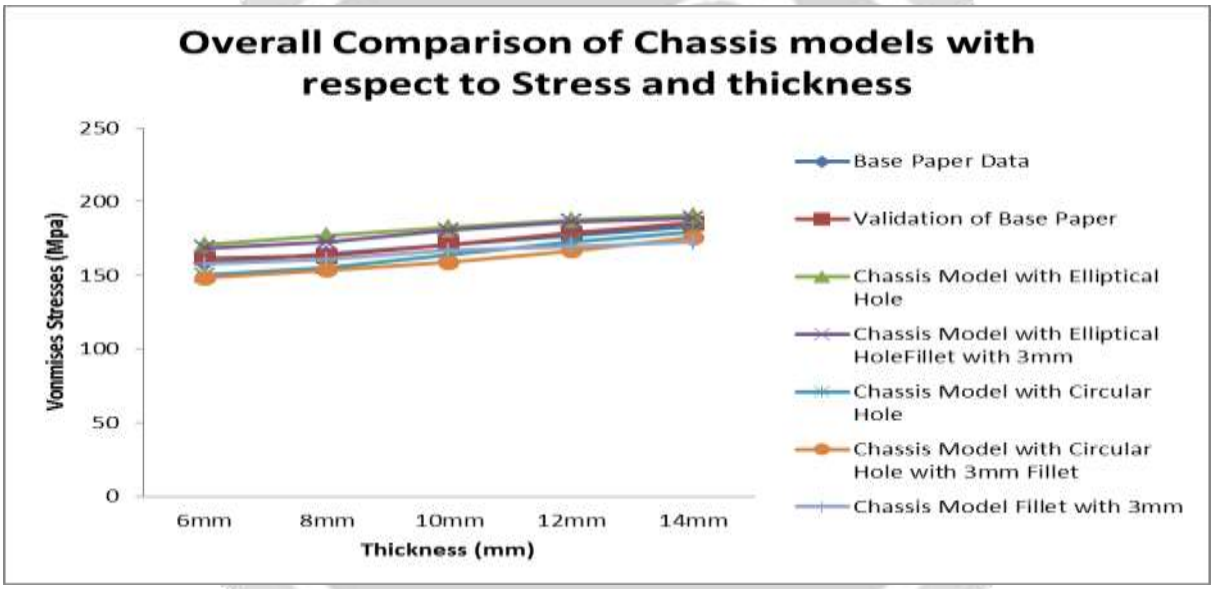
Optimization Results Analysis of Stress Distribution in Chassis with Deformation (Chassis with circular hole):

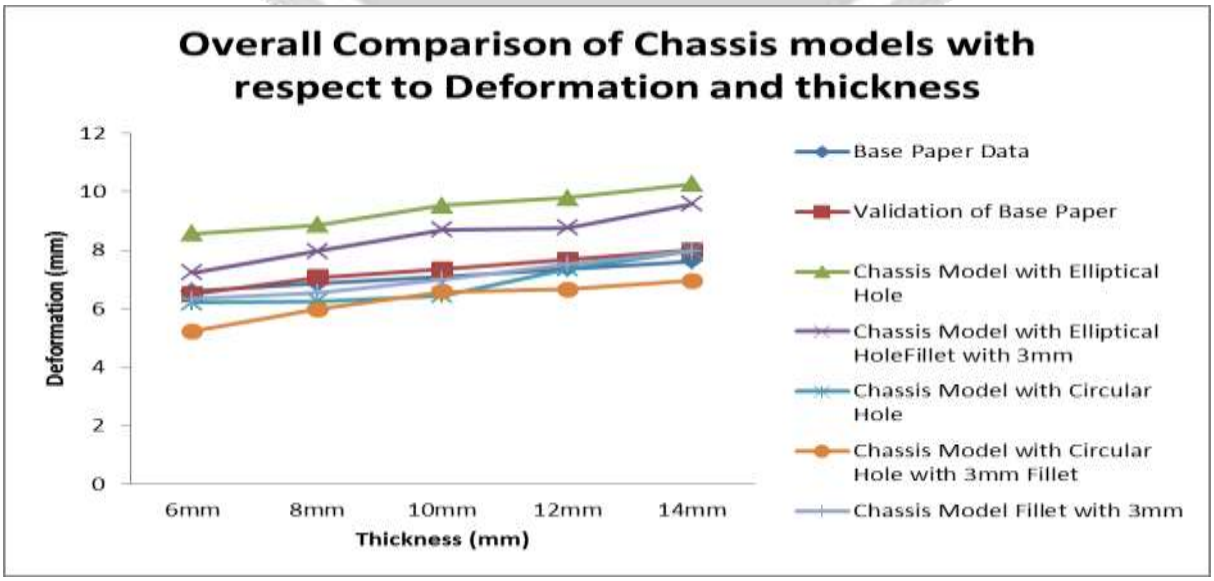


Optimization Results Analysis of Stress Distribution in Chassis with Deformation (Chassis with circular hole with 3mm fillet):



Comparative Results Analysis of Different chassis profiles with respect to thickness.





VII CONCLUSION

- In this research, detailed analysis of the influences of stress distribution, deformation effect of chassis with different profiles has been conducted by simulations using the ANSYS software on static structural domain 15.0. Work bench. The following conclusions are withdrawn.

- The different chassis model was developed on CREO 5.0 and analysis was done using the ANSYS software (Static Structural domain) 15.0.

- The stress distribution is the fundamental parameter in the performance of different chassis profiles. The load is constant i.e.83139.75N.

- In the study chassis with elliptical hole 3mm fillet radius, chassis with circular hole 3mm fillet radius, chassis with circular and elliptical hole, chassis fillet with 3mm radius are the key geometric parameter on the performance of chassis under constant loading with an implementation of chassis with circular holes comprising 12mm thickness with 3mm fillet, the developed stresses and deformation effect is improved.

- Results have least in chassis of different configuration, it concludes that at constant load, chassis of circular holes with 3mm fillet comprising 12 mm of thickness configuration having minimum stresses with a minimum deformation.

- The simulations of ANSYS models of chassis with different configurations show a good relation with base paper results presented in the literature.

- It is also observed that chassis with circular holes comprising 12mm thickness with 3mm fillet includes less material compared to other chassis configurations

Properties	**12 mm Thickness chassis model with circular Hole with 3mm Fillet**	**Base paper**
Young's Modulus	2.10×10^5 N/mm^2	2.10×10^5 N/mm^2
Bulk Modulus	1.667	1.667
Density	7850 kg/m^3	7850 kg/m^3
Total Load Applied	83139.75N	83139.75N
Length	230 mm	230
Width	76 mm	76
Thickness	12 mm	6 MM
Total Weight of Channal Section Bar	136.634 kg	148.566 KG
Volume of Channel Section Removed Materials	0.00014236m^3	
Mass Removed	1.1175	
Weight Removed	10.962 kg	
Stress	166.585	164.438
Deformation	6.666	6.849

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