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Research Paper

DESIGN AND ANALYSIS OF SCISSOR JACK

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Every engineering product involve cost effective manufacturing and its versatility in application maintaining its aesthetics as well as assign service life without failure keeping those parameters in mind we focused our intention on designing and analyzing the jack model for actual service loads for varying models of automobile L.M.V. sectors. Automobile sectors are very keen at their productivity and customer satisfaction. We also keen at reducing the weight of scissor jack at the same time maintaining its strength and service life. We made certain change in manufacturing process thereby made a new versatile jack that can be used for varying models of L.M.V automobile sector. Also the new design that made by Pro-e software can be tested by ANSYS software.

Keywords: L.M.V., Light motor vehicle, FEA, Finite element analysis, CAD, Pro-E

INTRODUCTION

Since traditional jack that available in market involve plenty of variety like screw jack. We had selected the traditional scissor jack for L.M.V. and focuses our intention to remove perm ant welds as that is the area where chances of failure is more. We replaced weld joints by rivets as well reduced materials by redesigning special brackets and employing special manufacturing processes for traditional.

As per the today's scenario of cost reduction, we need to find the cost effective solution for long term benefits. So in the production system it is necessary to redesign the various products for reducing the cost of the product over the same product. So we have chosen such exercise with the scissor jack. The main benefit of this paper is to reduce the unnecessary cost, reduce the over design, the design will be up to the mark. This paper will give new approach to product design. Such as in case of large volume, the cost reduction is more and it will increase the demand of product in market itself. In case of the manufacturing of the scissor jack we can reduce the material of the product by converting the manufacturing process, e.g., Casting into sheet metal, in which the strength

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of the product remain as it is and the cost of the material will be automatically reduces. Even part reduction by assembly process and no welding joints will give less deflection and the large accuracy.

OBJECTIVE

This paper includes the scissor jack of automobile L.M.V. vehicle. The objective of this exercise will be

1. To reduce the weight of the jack by changing the manufacturability.
2. To reduce the no. of parts for simplifying the assembly process.
3. Remove welding to avoid distortion.
4. Product should withstand the current strength requirements.

MATERIALS AND METHODS

Operation

A scissor jack is operated simply by turning a small crank that is inserted into one end of the scissor jack. This crank is usually "Z" shaped. The end fits into a ring hole mounted on the end of the screw, which is the object of force on the scissor jack. When this crank is turned, the screw turns, and this raises the jack. The screw acts like a gear mechanism. It has teeth (the screw thread), which turn and move the two arms, producing work. Just by turning this screw thread, the scissor jack can lift a vehicle that is several thousand pounds.

Construction

A scissor jack has four main pieces of metal and two base ends. The four metal pieces are all connected at the corners with a bolt that allows the corners to swivel. A screw thread runs across this assembly and through the corners. As the screw thread is turned, the jack arms travel across it and collapse or come together, forming a straight line when closed. Then, moving back the other way, they raise and come together. When opened, the four metal arms contract together, coming together at the middle, raising the jack. When closed, the arms spread back apart and the jack closes or flattens out again.

Design and Lift

A scissor jack uses a simple theory of gears to get its power. As the screw section is turned, two ends of the jack move closer together. Because the gears of the screw are pushing up the arms, the amount of force being applied is multiplied. It takes a very small amount of force to turn the crank handle, yet that action causes the brace arms to slide across and together. As this happens the arms extend upward. The car's gravitational weight is not enough to prevent the jack from opening or to stop the screw from turning, since it is not applying force directly to it. If you were to put pressure directly on the crank, or lean your weight against the crank, the person would not be able to turn it, even though your weight is a small percentage of the car's.

MODELLING

Design of scissor jack is done with Pro-E and model assembly is shown in Figures 1 to 3.

Design Details of Jack

- The total height of the screw jack = 276 mm.
- The deformation of the screw jack in *y* direction = 2.00 mm.
- Permanent set in *y* direction is = 0.37 mm.

Figure 1: 3D Model of Scissor Jack in Pro-E Software

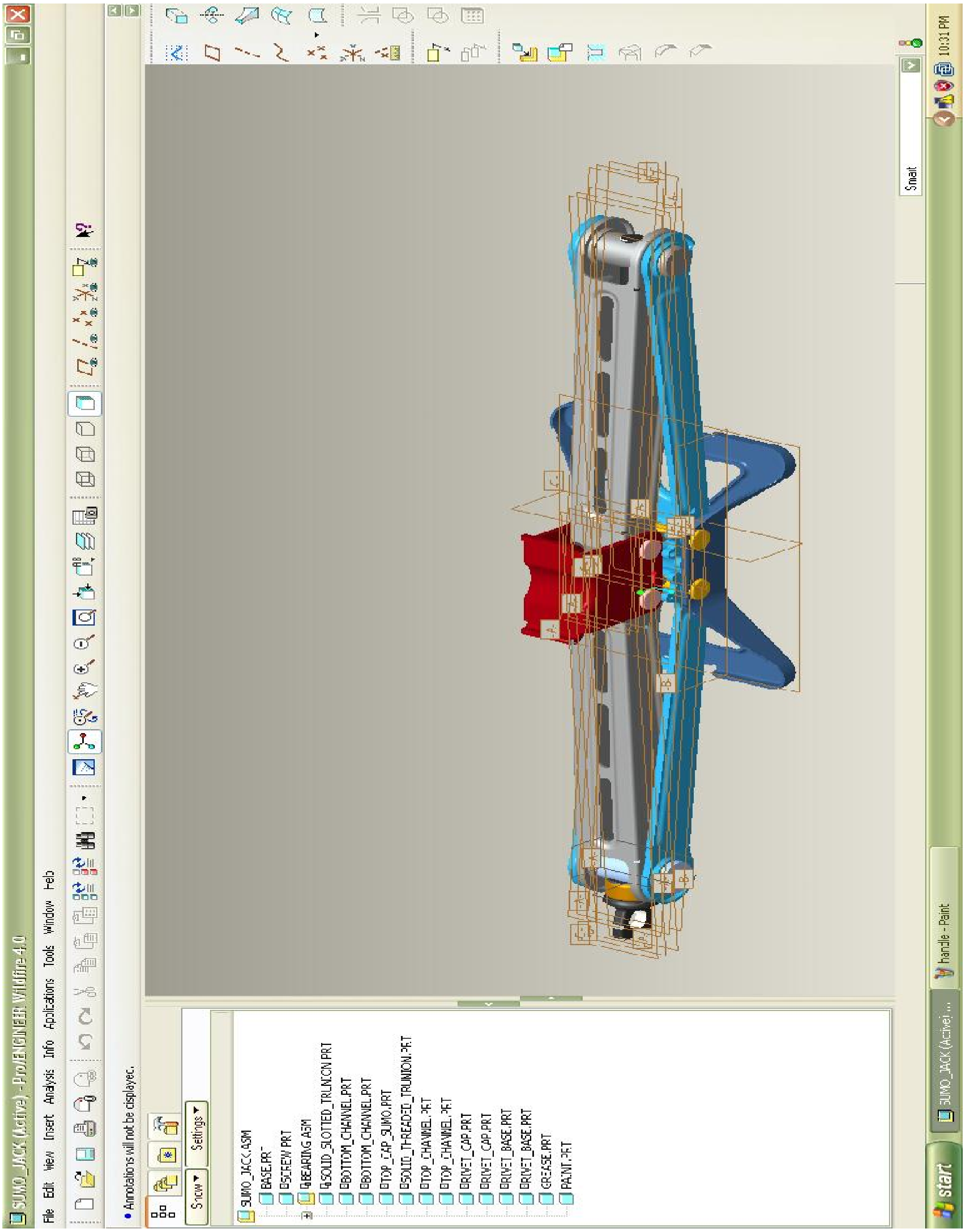

Figure 2: Displacement Contour of the Entire Jack at 23102 N Load

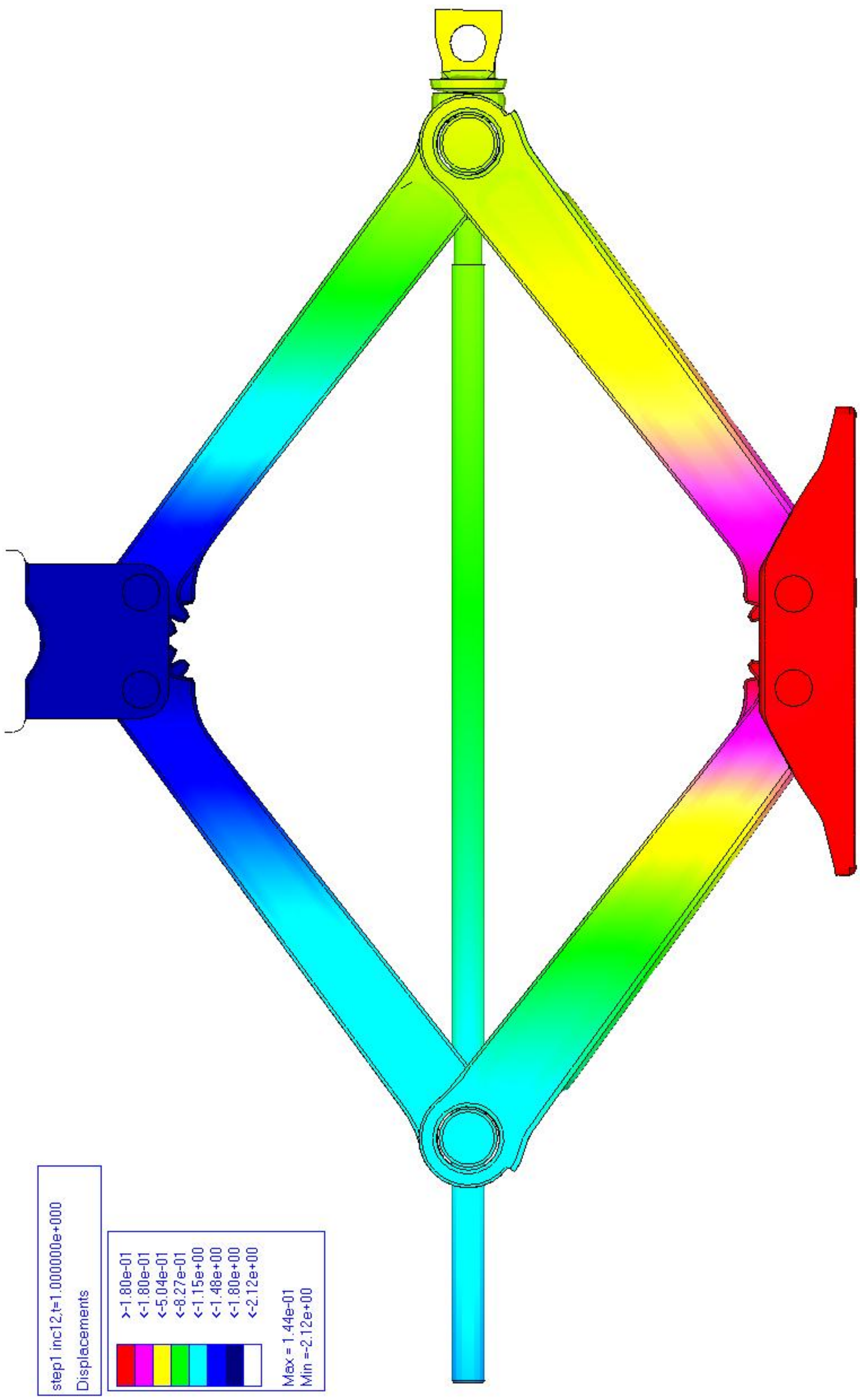

Figure 3: Von-Mises Stress Contour of the Entire Jack at 23102 N Load

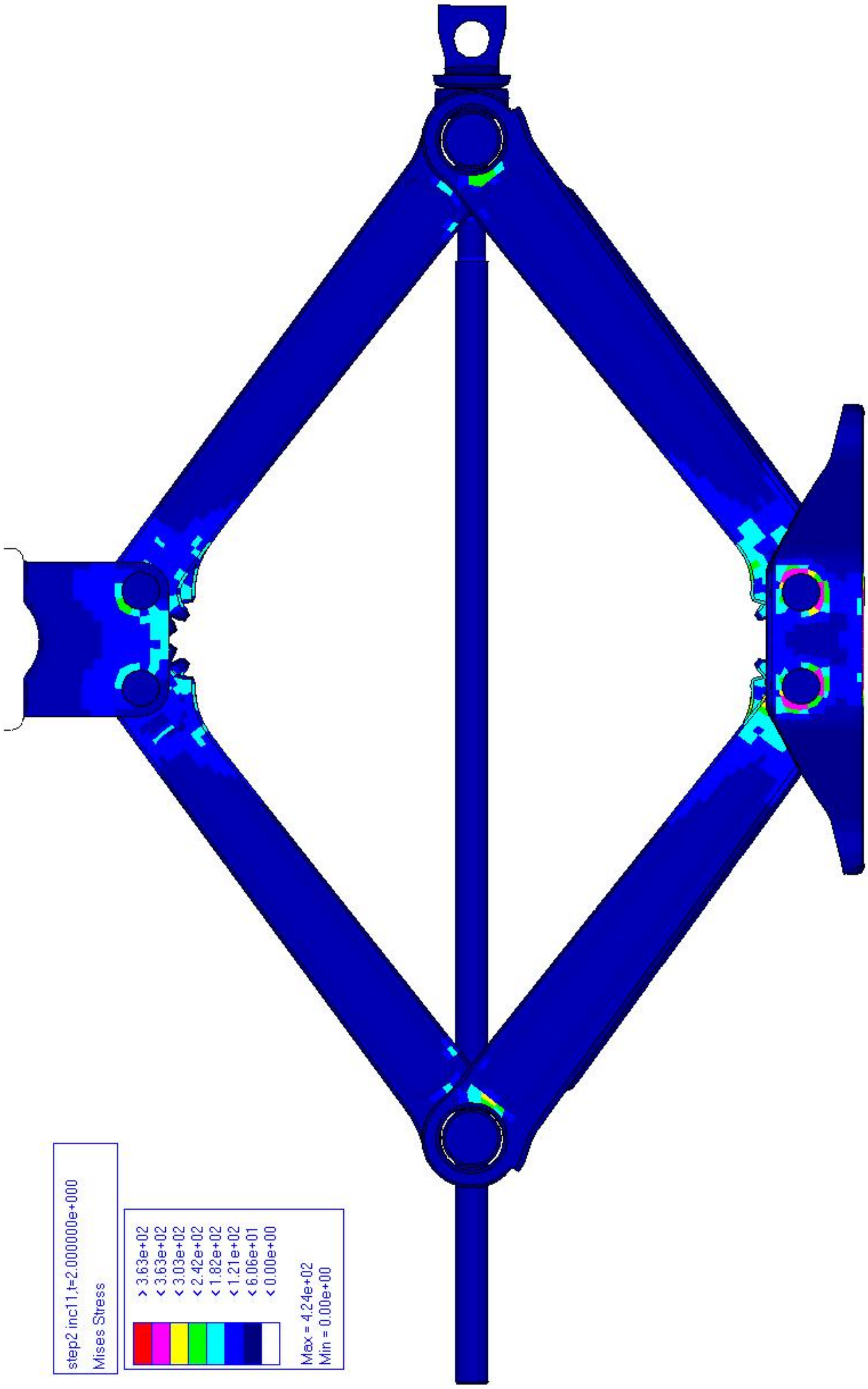

Figure 4: Cap-Von Mises Stress Contour

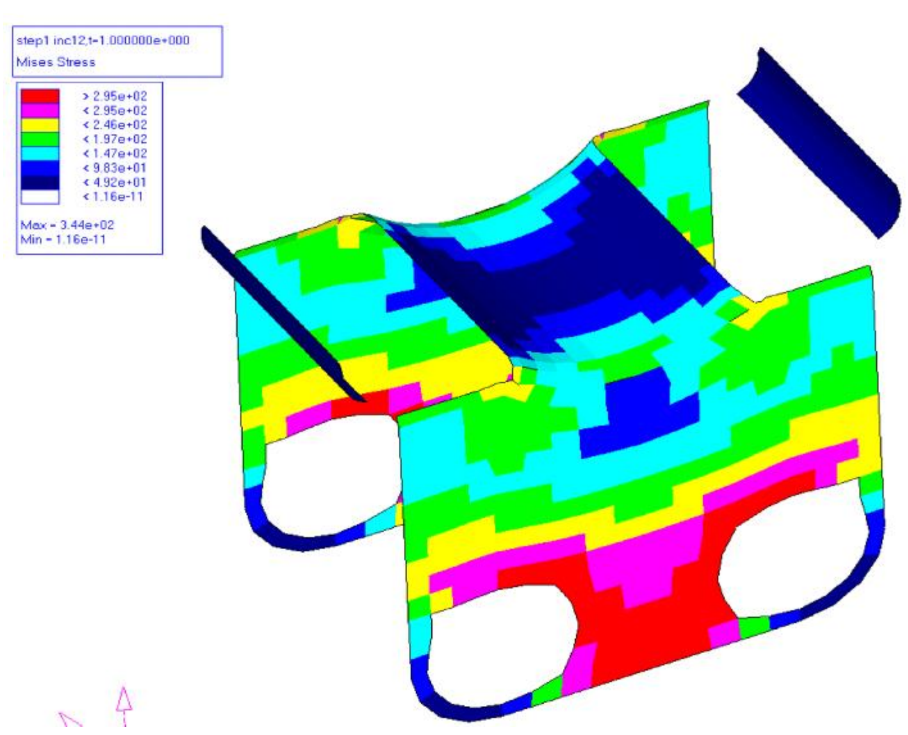

Figure 5: Base-Von Mises Stress Contour

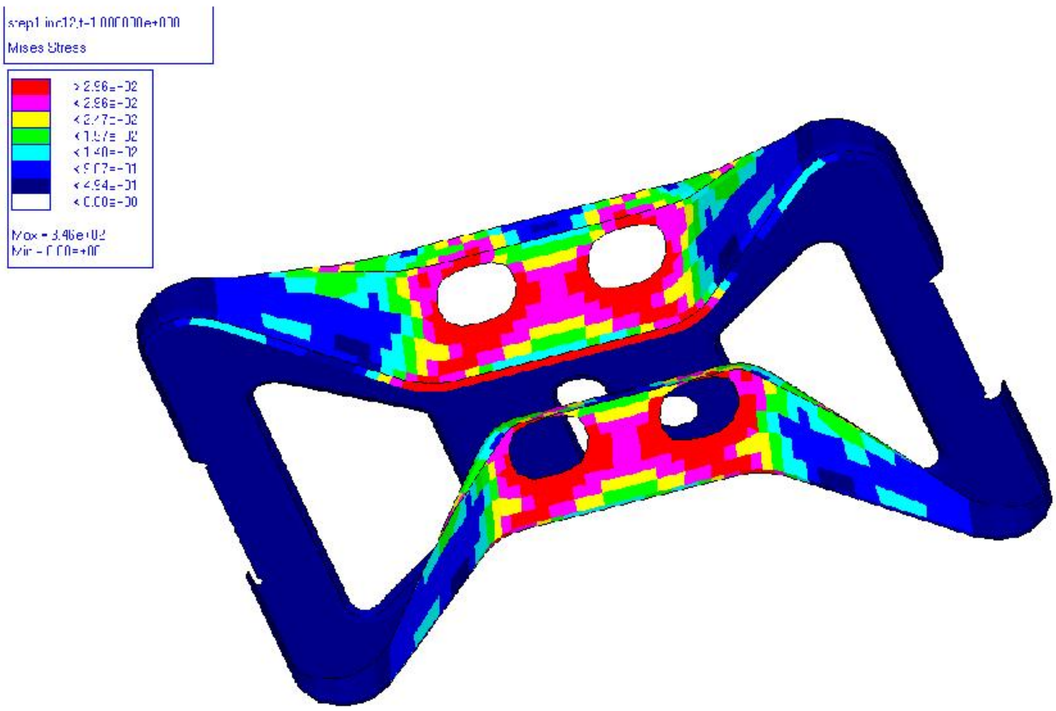

Figure 6: Base Rivet-Von Mises Stress Contour

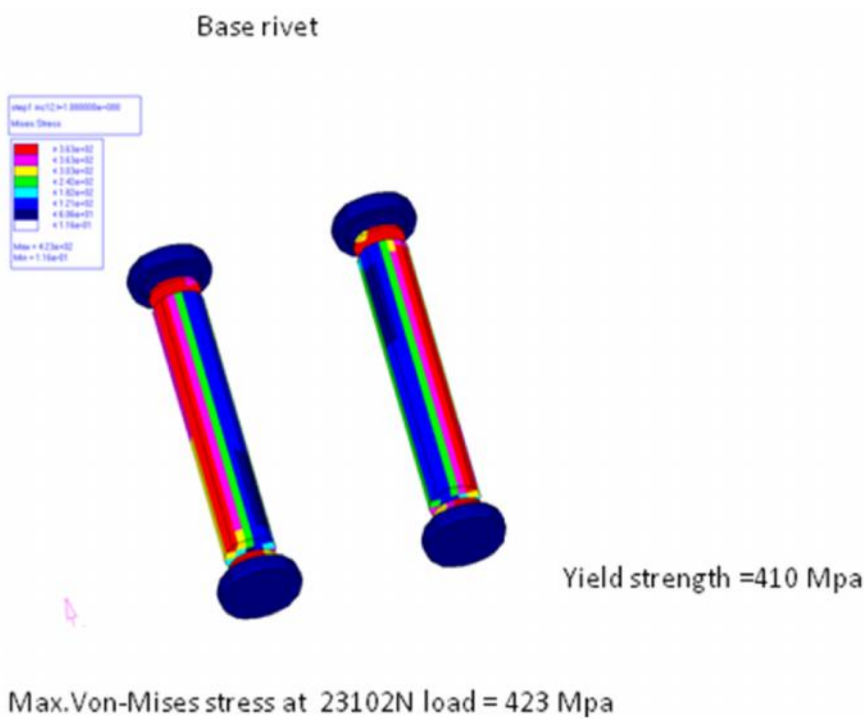

Figure 7: Lower Arm-Von Mises Stress Contour

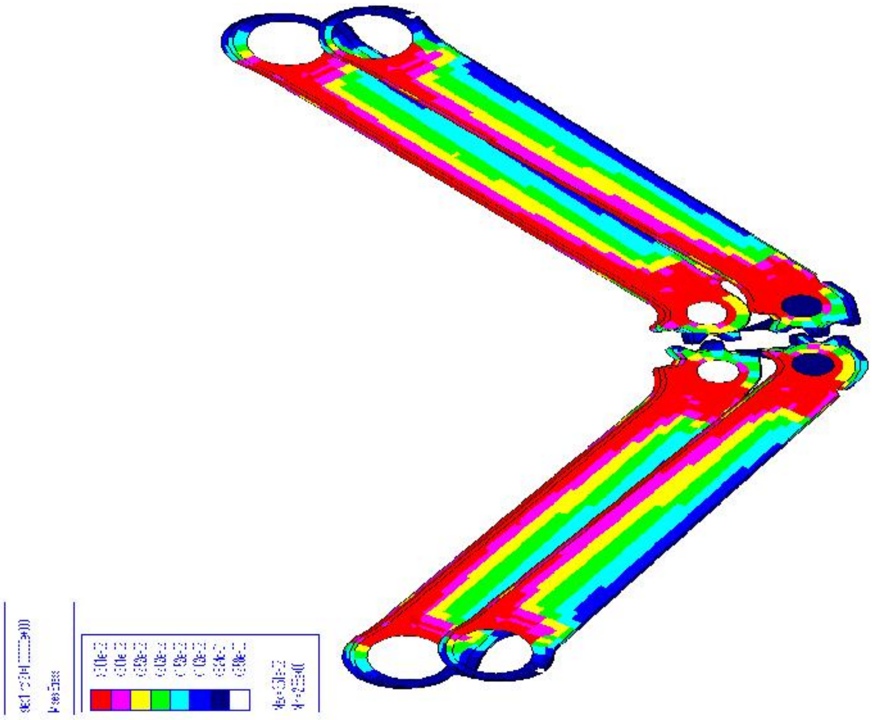

Table 1: Material Properties

Material	Tensile Yield Strength	Poisson's Ratio	Modulus of Elasticity
SAE J1392 050YLF	344 Mpa	0.3	200000 Mpa
SAE 1018	410 Mpa	0.3	200000 Mpa

Table-2: Data analysis of scissor jack

Part Names	Yield Stress (Mpa)	Failure Strain (%)	Load to Yield (Kgs)	Plastic Strain at 2355 Kg Load (%)
Cap	344	20%	2355	0.0174
Base	344	20%	1177	0.28
Base rivet	410	20%	1177	3.28
Cap rivet	410	20%	1577	3.05
Lower arms	344	20%	1177	1.89
Upper arms	344	20%	1577	0.595
Screw	410	20%	2355	0.599

- The maximum strain in the Base Rivet = 3.28%.
- The maximum strain in the Cap Rivet = 3.05%.
- Mass of the Jack in Kg = 1.824 Kg.

Project Backgroud

Model: Top channel, bottom channel, Base and Cap modeled with shell elements and bearing, Trunions, Base Rivet, Cap Rivet and Screw are modeled with Hexa and Penta elements.

Loading: The point load of 2,355 kgs applied on the top surface of the cap (23102 N applied on the top surface of cap by using rigid) after that unloading (for permanent set analysis) the point load to 1.47 N.

Boundary Conditions: Bottom face of the Base is constrained to all the DOF and mating parts are connected with rigid links.

RESULTS

Data analysis of scissor jack static loading conditions subjected to point load on upper cap of 2033 kgs is shown in Tables 1 and 2.

CONCLUSION

The paper will include a scissor jack of automobile L.M.V. vehicle and other same type of variants. This proposed design of scissor jack after its stress analysis concludes that:

This is a common jack for the variant (satisfying the product requirements).

The proposed jack has the reduced weight (by changing the manufacturability).

Designing this new jack reduces the no. of parts for simplifying the assembly process.

Only rivet joints are induced (Removal of welding to avoid distortion).

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