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Optimization of Canopy Structure of a Dumper Body

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***Abstract*— This paper deals with optimization of canopy structure of a dumper truck without compromising the safety of driver cabin. The model was created by using cad tool and meshing is done by using FEA tool. The analysis is done for various stress and deformations. This paper is limited to only optimization of canopy structure by its mass. The stress obtained by this analysis is well within the safe limit.**

I. INTRODUCTION

In present condition trucks are the backbone of the in land transportation. Among them dumpers are heavy load carrying vehicles. They are mainly used in construction purpose, in mining's. "The dumper trucks have strong body made up of mainly HARDOX400 with hardness number 400HB. The HARDOX 400 is used because of its abrasion resistance and impact strength property".[1]Dumper trucks are used to carry the large quantity of materials, i.e. Sand, granites, crushed stone pallets, concrete. Etc. This paper deals with optimization of canopy structure of a dumper truck. We know that canopy is an additional part of the dumper body which protects the driver cabin. And this one is made up of same sheet that was used to make dumper body, with same gauge that leads to additional weight to dumper.

II. LITERATURE SURVEY

This paper analyses the static behavior of the body using Finite Element Modeling (FEM). The results obtained from FEM were studied and are compared with those of rigid body modeling. Conclusions were derived from the study and some suggestions are made to improve the performance of Vehicle. [2].Scope of this paper is to optimize the design of conventional truck body floor design considering heavy and impact loading in mines which damages the floor. [3].Physical interaction between the granular material and the tipper body is studied in three different cases. A validation of the load intensity pattern and the wear pattern of a real tipper body are done. The comparison shows a close .Agreement between the position and size of areas with highest load intensity and highest wear. [4]

III. METHODOLOGY

The canopy structure is modeled by using solid edge software and imported to hyper mesh and messing is carried out. The analysis is done by using Abacus software for different thickness i.e. 6, 5, 4mm. the mass is reduced as the thickness is reduced. Various stress i.e... Misses, maximum principal stress, minimum principal stress and deformations are obtained.

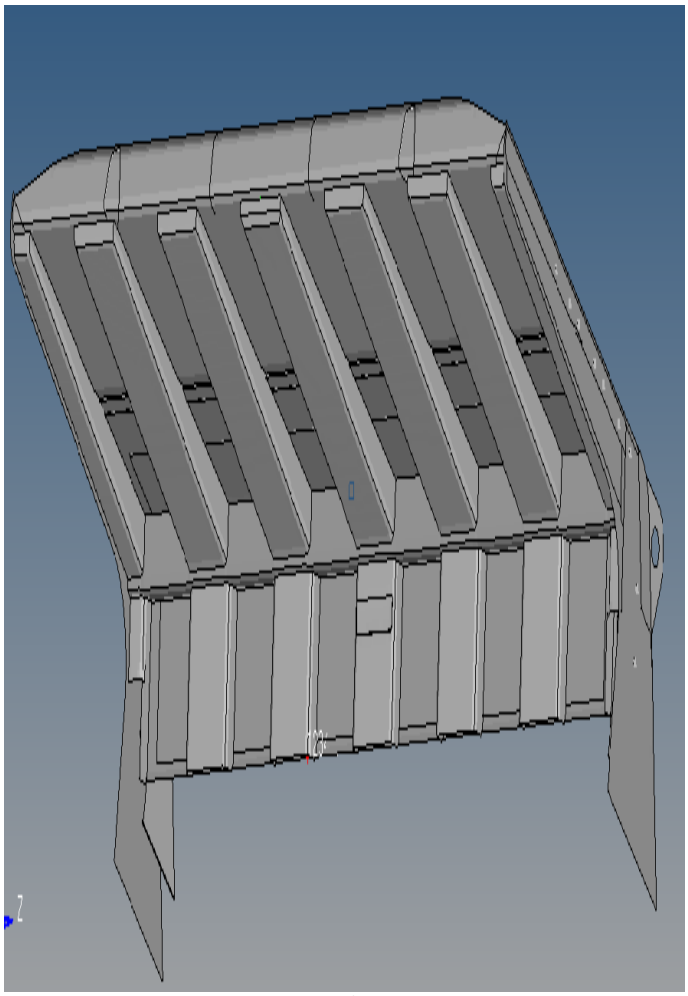

Fig. 1 CAD model of canopy structure.

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IV. LOAD CALCULATION

Considering the heap load on the canopy structure, taking the angle of repose of granite material as 35º. Calculating the volume of cone. Then using the density of the material the mass is calculated. The force is found by using formula F=M*a

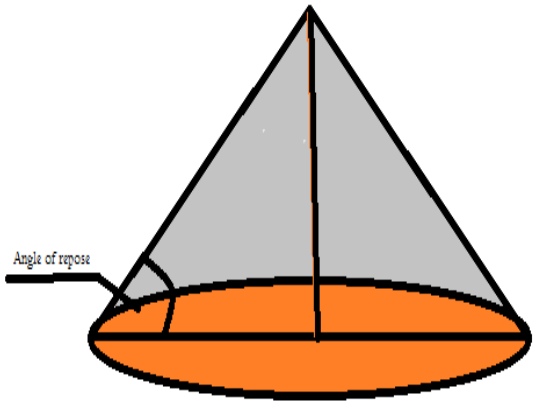

Fig. 2 drawing of heap with angle of repose

Considering the load acting on one third portion of the canopy i.e. total length is 5.013m and the load acting dia. 3.8m. and angle of repose for small pebbles of granite material is 35º using above parameters volume of cone is found as follows.

Load covered length=3.760m

Radius of cone R =1.880m

Density of granite material $p = 1650\ kg/m^3$

Height of cone H = R * tan (35) = 1.316m

Volume of cone=$0.33*\pi*R^2*H = 5m^3$

Total mass = p*V = 8250 kg

Force = mass*acceleration = 80.9KN

Above calculated force is assumed to be a uniformly distributed load action on the canopy, the analysis is carried out using abacus software.

V. RESULTS

Various stress and deformations are found as below for different thickness of materials.

1. RESULTS FOR 6MM GAUGE SHEET

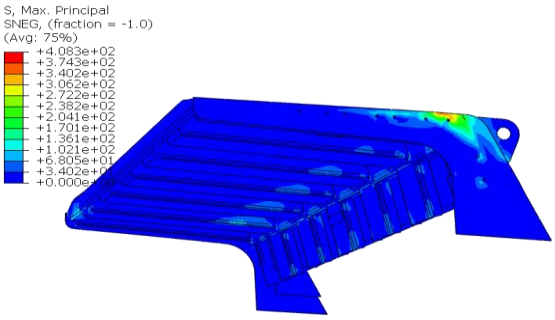

Fig. 3 max principal stress

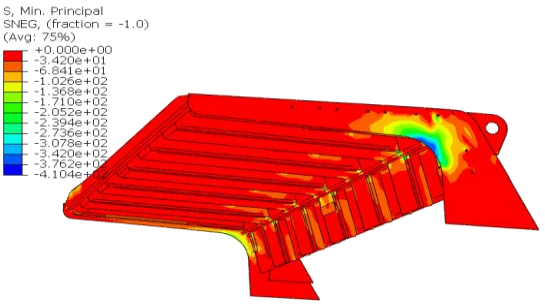

Fig.4 minimum principal stress

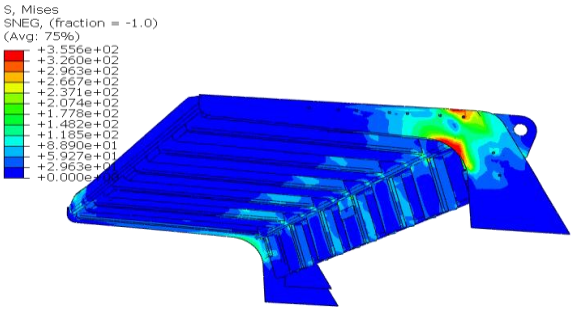

Fig.5 Von misses stress

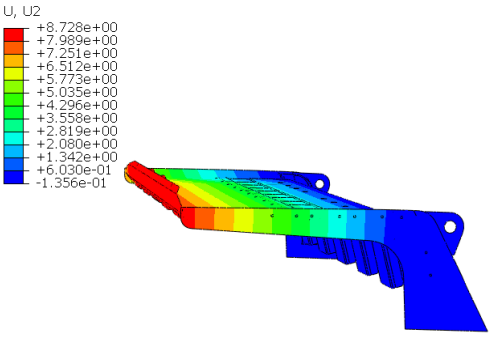

Fig.6 Deformation in Y direction

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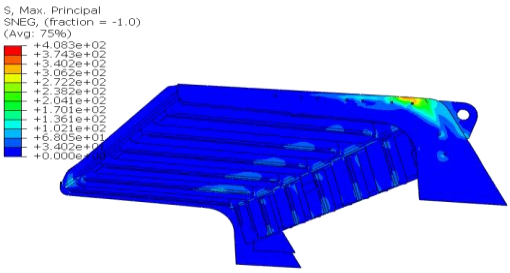
2. Results for 5mm gauge sheet



3. fig . 7 max principal stress

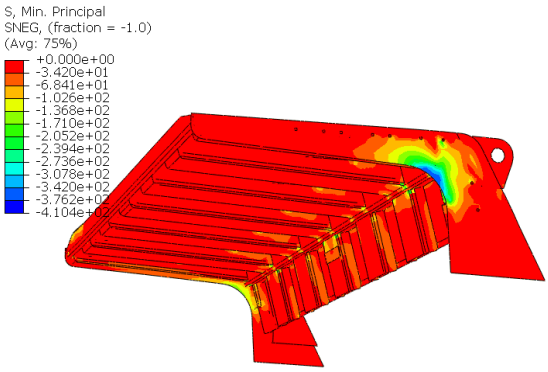


Fig.8 minimum principal stress

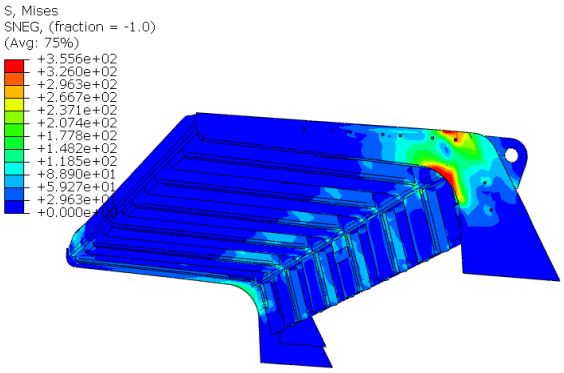


Fig.9 Von misses stress

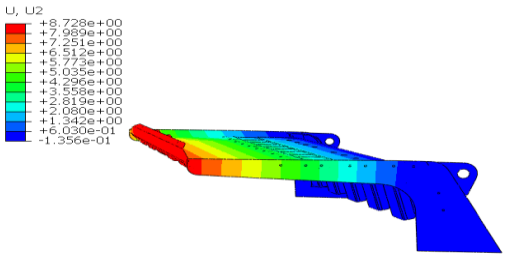


Fig.10 Deformation in Y direction

3. Results for 4mm gauge sheet

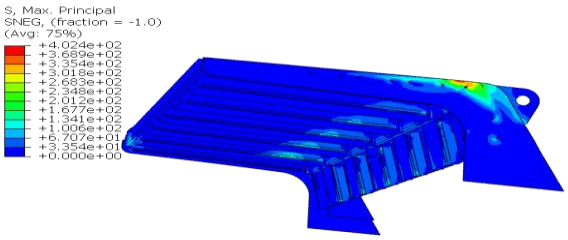


fig. 11 max principal stress

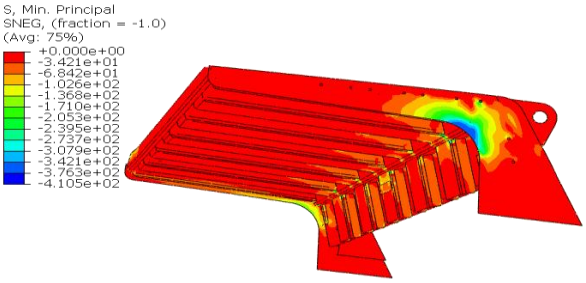


Fig.12 minimum principal stress

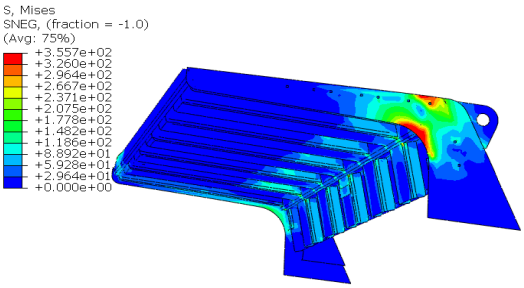


Fig.13 Von misses stress

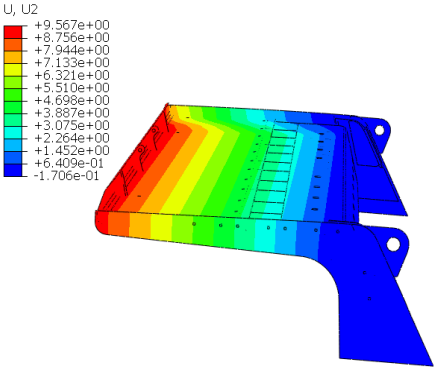


Fig.14 Deformation in Y direction

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SL.NO	Thickness of sheet in “mm”	stress			yield strength of HARDOX 400	Remarks
		Misses	Max Principal	Min principal		
1	6	355.6 Mpa	408.3 Mpa	0 Mpa	1000 Mpa	Safe
2	5	355.6 Mpa	408.3 Mpa	0 Mpa		Safe
3	4	355.7 Mpa	402.4 Mpa	0 Mpa		Safe

Table.1 comparison of stress after reducing the thickness

SL.NO	Thickness of sheet In “mm”	Weight of canopy in “kg”	Weight of stiffeners in “kg”	Percentage of reduction	Weight reduced in “kg”
1	6	1267	282	-	-
2	5	1220	236	4%	47
3	4	1173	188	7.50%	94

Table.2 comparison of weight after reducing the thickness

VI. CONCLUSION

By using the HYPERMESH and ABACUS software the analysis was carried out, the stress obtained by this analysis are found well within the safe limit. Hence the design of the structure is safe.

VII. REFERENCES

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[3] D. FORSSTROM, P. JONSEN, “load intensity calculations on tipper body using deem Fem coupling”, Department of Engineering Science and Mathematics Lulea Tenaska universities 971 87 Lulea Sweden.

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