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Design Optimization of Truck Body Floor for Heavy Loading

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ABSTRACT: *- Construction and mining segment in India has picked up pace in recent years. Due to this, equipments such as tippers, excavators and loaders are in great demand. Function of tipper trucks is to combine the two tasks of dumping and haulage. Truck Body Floor which is used for this purpose has been designed in a conventional way since its inception. Normal conventional method of floor construction is a sandwich floor with layers of steel floor on top and bottom and a layer of wood in between. Scope of this paper is to optimize the design of conventional truck body floor design considering heavy & impact loading in mines which damages the floor. Thus this demands the need of heavy duty impact resistance floor which replaces the normal conventional sandwich construction. Hence new concept of single layer heavy duty floor has been embarked upon with high strength material which will be able to resist severe impact loads and also results in weight reduction with various other advantages.*

Keywords: *- Impact, Sandwich, Single Layer Floor, Truck*

I. INTRODUCTION

Mining is the extraction of valuable minerals or other geological materials from the earth, from an ore body, vein or (coal) seam. The term also includes the removal of soil. The soil excavation results in huge amount of rocks/sand called overburden. This overburden needs to be moved to a dumping place in order to clear the area of mines. Tipper trucks are used here in order to move this overburden from mining area and dump it in a separate place. The type of body used for this application is Rock or Scoop body. The rock body is a rugged tipper truck body used typically for mine application. The loading of the material into the truck is done using a back-hoe loader. The back-hoe loader loads the overburden into the truck body from a height, this results in the boulders, rock etc striking the truck body floor with a very high impact. Hence, the truck body floor has to withstand severe loading patterns and needs to very rugged. In view of the severe loading on the truck body floor in mine application, floor damage is recurring problem in the trucks plying the market today. This reduces the life of the body considerably. Due to this very heavy sandwich floor is used, which increase the weight of body considerably. Thus a rugged, impact resistant floor with reduced weight is the need of the hour in mining trucks, which would increase the truck life and thereby result in higher up-time translating into profits for the customer

II. CONVENTIONAL DESIGN: THE SANDWICH FLOOR

The floor design currently used in majority of tipper trucks in the market is of a sandwich type. The sandwich floor is made up of 2 layers of steel floor on top and bottom, with a layer of wood between. The wood between the 2 metal plates acts as an impact absorber during the loading operation. This results in a heavy, rigid structure. These top and bottom layers of steel are made up of ST52 material, whose yield strength is around 335MPa.

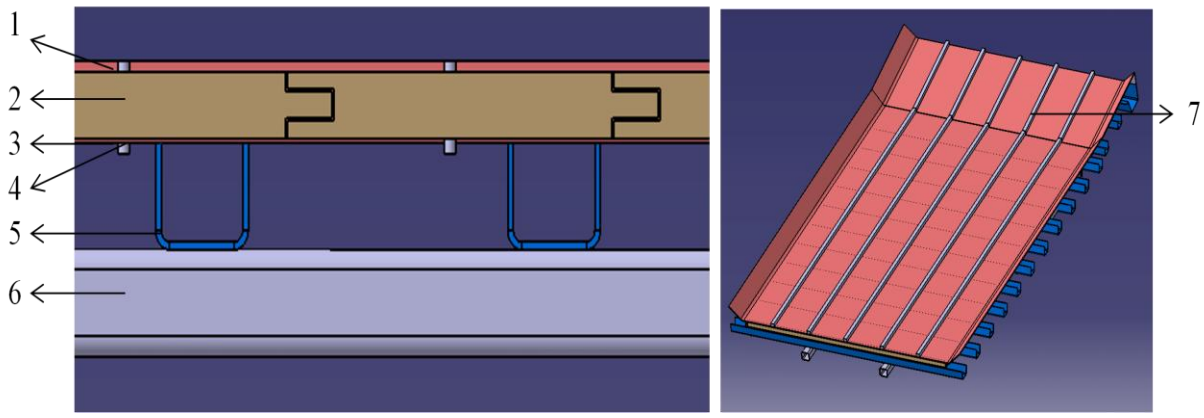

Figure 1: Cut Section & Assembly of Sandwiched Floor

Table 1: Sandwich Floor Parts & their description

1	Floor Top Sheet
2	Wood
3	Floor Bottom Sheet
4	Rod
5	Cross Member
6	Long Member
7	Rock Breaker

Cross Members are welded to the bottom sheet. On the top layer of the floor Solid Bars are welded. Apparently these bars are called "ROCK BREAKERS" The purpose of these bars is to break huge rocks. And save floor from direct impact loading. The main drawback in sandwich construction is too much welding is involved in assembly, and thus there is deterioration in properties of base metal. Assembly is too heavy and due to this customer can carry lesser payload and as too many parts need to be integrated results in higher takt time, hence production rate decreases.

III. PROPOSED DESIGN: SINGLE LAYER FLOOR FOR IMPACT

The floor design proposed is with a Single Layer floor. Cross Member spacing increased to allow the sheet to flex and absorb the impact of boulders. In this design wood, Rock Breaker & bottom sheet of steel is removed. Three layers of conventional floor is replaced with single layer floor, floor panel is made up of high strength steel. Severe impact loading done in this segment requires material property of high yield strength, better wear resistance, weld ability, formability and high hardness. High strength steel such as Hardox 450 posses all the above properties, Hardox 450 is an abrasion resistant plate with a hardness of 450 BHN, and high yield strength of around 1200 MPa, intended for applications where demands are imposed on abrasion resistance in combination with good cold bending properties. Hardox 450 offers very good weld ability. Hardox 450 has obtained its mechanical properties by quenching and when necessary by means of subsequent tempering. Due to higher wear resistance of this material life of floor increases.

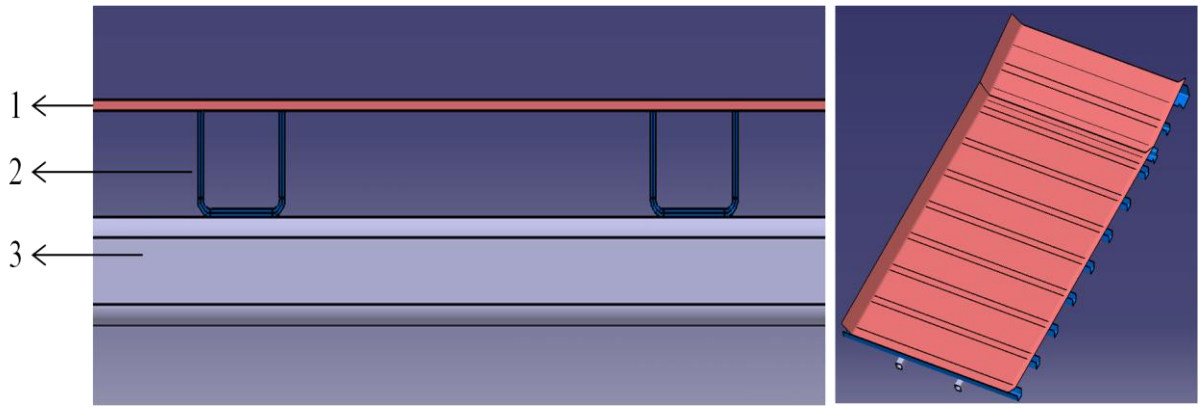

Figure 2: Cut Section & Assembly of Single layer Floor

Table2: Single Layer Floor Parts & their description

1	Floor Top Sheet
2	Cross Member
3	Long Member

As in this design wood, Rock Breaker & bottom sheet of steel is removed, which results in reduction of floor weight by approx 500kg in comparison to sandwiched floor, and reduction in no. of parts while assembly reduces the takt time and hence production rate increases. Welding in the proposed design of single layer floor is reduced considerably. Due to less welding, material properties of base metal are not deteriorated. Also as wood is removed in single layer floor proposed design is environment friendly.

IV. ANALYSIS

The Purpose of finite Element Analysis is to verify whether the single layer floor is designed for having enough static strength to withstand the loads under critical (heavy load conditions). For this Analysis is done for various conditions

Case I: Uniform Distributed load of 50T applied on Floor

Case II: Impact Analysis: Stone of 2T is dropped from the height of 2.5m with velocity of 7.003m/sec

Case I: Uniform Distributed load of 50T applied on Floor

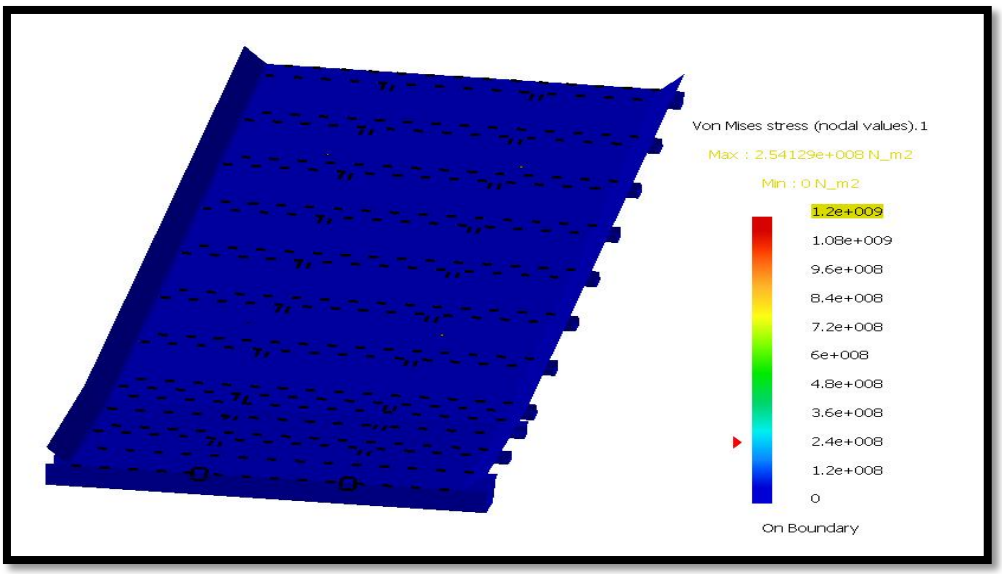

Figure 3: Von Mises Stress Plot at 50T UDL applied on floor,

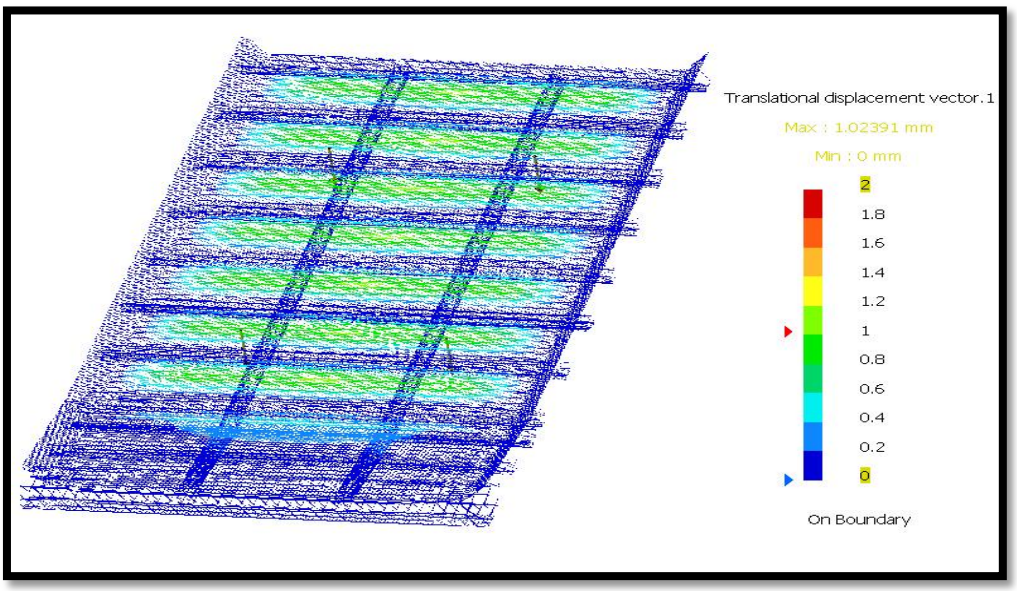

Fig 4: Displacement Plot at 50T UDL

Case II: Impact Analysis: Stone of 2T is dropped from the height of 2.5m with velocity of 7.003 m/sec

In this case a spherical shape stone of density 2500kg/cum is dropped from height of 2.5m

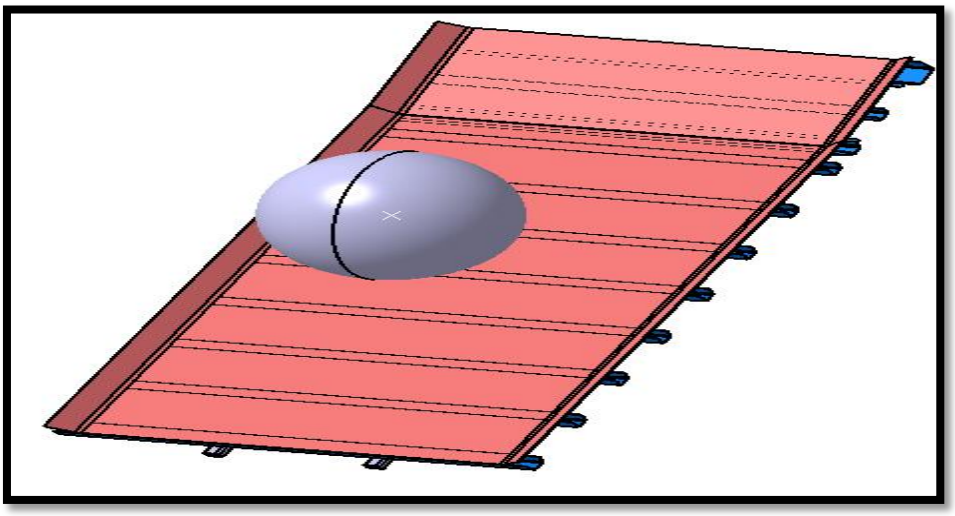

Figure 5: Impact loading of spherical stone on floor

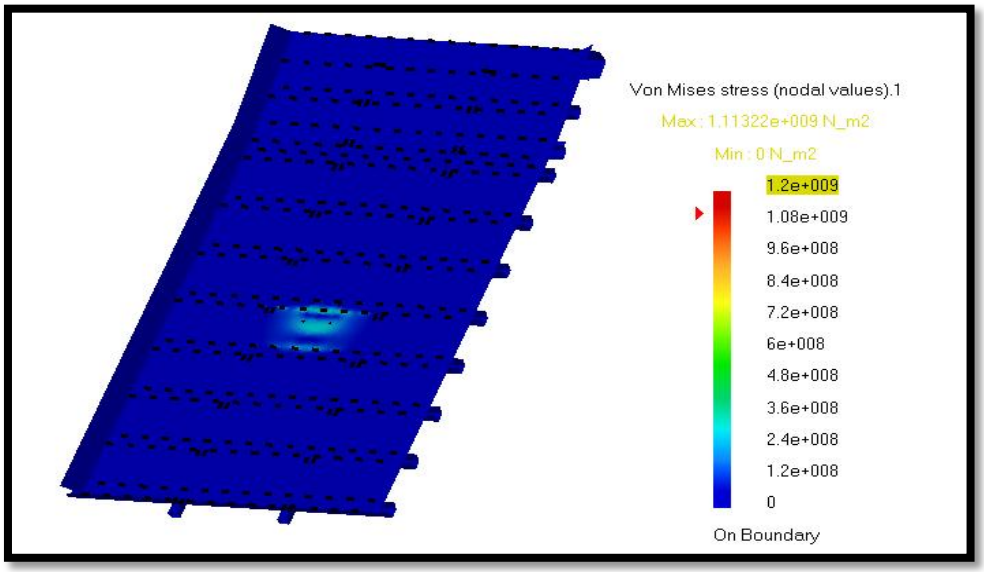

Fig 6: Von Mises Stress Plot on floor when Stone of 2T Dropped from height of 2.5m with velocity of 7.003m/sec

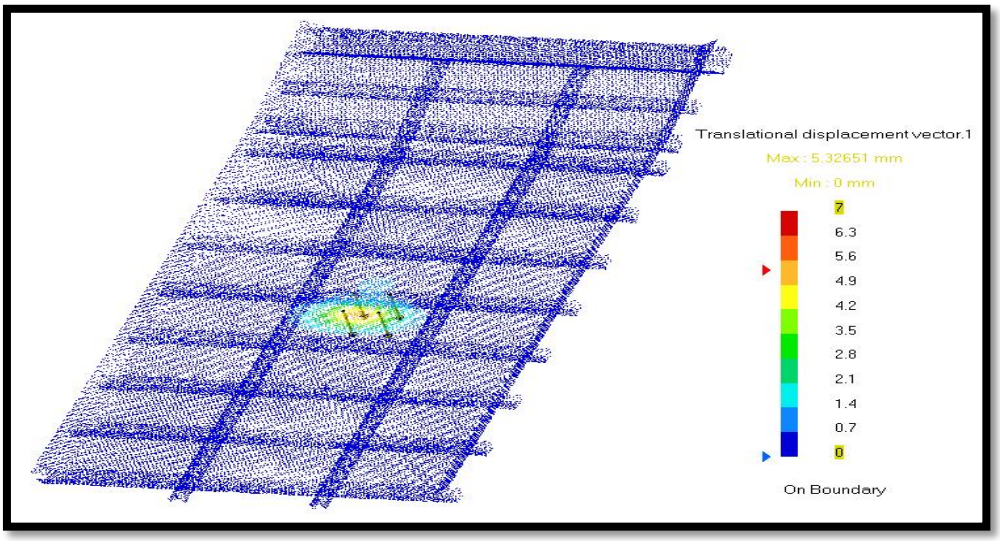

Fig 7: Displacement Plot on floor when Stone of 2T Dropped from height of 2.5m with velocity of 7.003m/sec

V. RESULTS:

Loading Condition	Maximum Von Mises Stress (MPa)	Maximum Displacement (mm)
Uniform Distributed load of 50T applied on Floor	254	1.02
Impact Analysis: Stone of 2T is dropped from the height of 2.5m with velocity of 7.003m/sec:	1113	5.32

Thus the analysis results shows in both the cases stresses observed are less than 1200MPa yield strength of material. Thus stresses on proposed design of single layer floor are under permissible limit and thus it will able to sustain impact as well as Heavy loads

VI. CONCLUSION:

Thus it is observed from FEA Analysis that Single Layer floor is able to sustain impact loads and all the stress values are under permissible limit. Also it is observed that single layer floor is much lighter than sandwich floor, which imparts a benefit to customer as he can takes more payload and will get better fuel efficiency when the vehicle is running in unladen condition.

Welding in single layer floor reduces considerably as there is only one layer of floor. Property of base material doesn't deteriorate in single layer floor in comparison to sandwich floor. As there are less no. of parts to be integrated in Single layer floor, Takt time of single layer floor is less than sandwiched floor, which increase the production rate. Reduction in thickness of floor in single layer floor decreases the CG height of the body, which in turns improve the stability of the vehicle. Single layer floor is environment friendly too as there is no use of wood in comparison to sandwich floor.

With various other advantages it can be concluded that a single layer floor can be a replacement of sandwiched floor and can be used in complete range of truck segment where impact loading is done. Especially for mining segment, where severe overloading is done, single layer floor can increase the life of tipper truck body.

VII. SCOPE OF FUTURE WORK:

Single Layer floor has various advantages over sandwiched floor. This new proposed design concept can be implemented in full range of truck segment where impact loading is done. Especially for mining segment implementation of single layer floor will be great benefit to customer in terms of extra payload and durability. Further use of High strength material can be evaluated to be used in side structures and front structures

REFERENCES

[1] Bo Lindstrom, "Dumper Body", *United States Patent US 2011/0227366, 22nd Sep 2011*.
[2] Dr Eng. Frydman S., Dr Eng. Pękalski G "Modern Low-Alloy Wear- Resistant Steels Structure And Impact Strength", *Institute Of Materials Science And Applied Mechanics, Faculty of Mechanical Engineering, Wrocław University Of Technology*.
[3] William, G., "Innovative Design Concepts for Lightweight Floors in Heavy Trailers," *SAE Technical Paper 2010-01-2033, 5th Oct 2010*.
[4] John A, D Amico, "Light Weight Body for a Dump Truck" *United States Patent 6022068, 8th Feb 2000*.
[5] Hardox 450 Data Sheet, *SSAB, 2nd Jan 2010*.
[6] IRTE (Institute Of Road Transport Engineers), Guide to Tipper Stability, *Second Edition, March 2004*.
[7] M. Adamiak, J.Gorka, T Kik, "Comparison of Abrasion Resistance of Selected Constructional Materials", *Journal of Achievements in Material & Manufacturing Engg, Volume 37, Issue 02, Dec 2009*.
[8] Robert L. Reinhardt, "Dump Vehicle", *United States Patent 3695709, 3rd Oct, 1972*.
[9] AIS093, Code of Practice for Construction and Approval of Truck Cabs, Truck Bodies & Trailers.
[10] SSAB Drives a Hardox Bargain, *Engineering & Mining Journal, Oct 2010, Page no.94-97*.
[11] Nitin S Gokhale, Sanjeev Badekar,"Practical Finite Element Analysis", *January 2008*.