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# Design, Simulation of Loadcells for Commercial Vehicles

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**Abstract -** *The aim of this project is to fabricate the weight bridge on moving vehicle. The recent survey suggests that weighing at places makes unwanted time and travel. The project is used to measure the weight of vehicle in the loading and unloading conditions by using the sensors while on running condition. The work is carried out by using load cell based on the load. The load cell gives the value of the load that is carried, displayed through LED display to the driver. The load measured through load cell is proportional to the voltage displayed by the controller. This is mainly used in Lorries, trucks, and containers for measuring the weight before and after the load is applied on the vehicle. The project just works like a portable weight bridge. The dimensions of different parts of load cells and Truck chassis are calculated and used to make CAD models.*

## 1. INTRODUCTION

Road safety is one of the most significant issues in the world. Driving an overloaded vehicle causes various kinds of hazards such as mechanical failures and structural deformation of vehicles and roads, which lead to accidents, and it is an illegal and punishable offence in most countries. According to the South African National Road Traffic Regulations, driving an overloaded vehicle leads to prosecution for an offence under regulations in the National Road Traffic Act, 1996. According to the U.S. Department of Transportation, vehicle condition and road/environment conditions are the two factors which are collectively responsible for 5.2% of road accidents. Vehicles carrying more than the manufacturer's specified and permitted payload are considered overloaded. In other words, a vehicle is overloaded if the total weight of a vehicle when fully loaded is more than the maximum allowed Gross Vehicle Weight (GVW), where the GVW is the sum of kerb weight and payload. A relatively large number of infringements is related to weights of heavy goods vehicles. On average, one in three vehicles checked is overloaded. These excess loads often exceed the maximum authorized weight by 10 or even 20%. Overweight vehicles lead to all sorts of negative issues, e.g., related to road safety, driver's safety, road degradation, environment and competition. There is some discussion about making on-board weighing (OBW) systems mandatory for new trucks. However, information from other sources suggests this cost range is unrealistically high. Transport & Environment would like to have better founded cost estimates as well as a solid analysis of what is technically feasible.

### 1.1 Wim

Weighing the weight of a moving vehicle on the road is known as weigh-in-motion (WIM). Fred Moses and George Globe introduced Bridge WIM (B-WIM) in the USA in the early 1970s. The successful B-WIM application took place in Australia in the mid-1980s. WIM has been used in the transport industry for more than a decade and for many reasons. Earlier, it was only used to plan and build the roads and bridges. In recent years, the legislation has been changed, and the WIM data is also used by traffic enforcement departments for the enforcement of overloading.

### 1.2 Requirements on weight compliance

Different stakeholders have different perspectives and hence different requirements towards weight compliance,

• **Public authorities** must consider how to improve the overall goals they want to achieve, e.g., reduced maintenance costs for road infrastructure, reduced environmental impact from road transport, and improved road safety, more efficient use of the road transport system.

• **Transport companies** want to move goods in an efficient way, without being burdened by administration, paper work and frequent stops for compliance checks by authorities. In general, transport companies are also interested in fair competition, which includes that regulatory requirements are enforced and prosecuted equally for all market actors.

• **Vehicle manufacturers and suppliers** of (on-board) weighing systems want to make money by providing their customers with highly functional, productivity enhancing and distinctive products.

• **Professional drivers** want to conduct their profession under safe and comfort conditions in their cabin and on the road.

## 2. LITERATURE SURVEY

Using strain gauge as load cell sensor. It is used because the load cell has resistance to extraneous forces, and it is protected against dust, moisture, and adverse environmental conditions Using shear beam load cell as beam load cell type among various types. Shear beam load cell are relatively insensitive to the point of loading and offer a good resistance to side loads Using Ladder frame chassis for mounting of load cells. It is selected among various types of chassis because it has the adaptability to accommodate large variety of body shapes exhibiting good bending strength and stiffness.

### 3. PROBLEM IDENTIFICATION

The literature review yielded the following information about the load cells. Before the installation of load cells, the transportation companies faced huge problems

1. Excessive wear and tear of tyres, wheel disc cracks

2. More fuel consumption due to uneven loading

3. Rollover accidents while travelling through hairpin bends

4. Theft of loaded goods and commodities while the vehicle is stationary

5. Instability of the vehicle

### 4. SHEAR BEAM LOAD CELL

The (single ended) shear beam is designed for low profile scale and process applications. The shear beam capacities are from 100kg to 50t. One end of the shear beam contains the mounting holes while the opposite end is where the cell is loaded. The load cell should be mounted on a flat smooth surface with high strength hardened bolts. The larger shear beam cells have more than two mounting holes to accommodate extra bolts to keep the hardware from stretching under stress load.

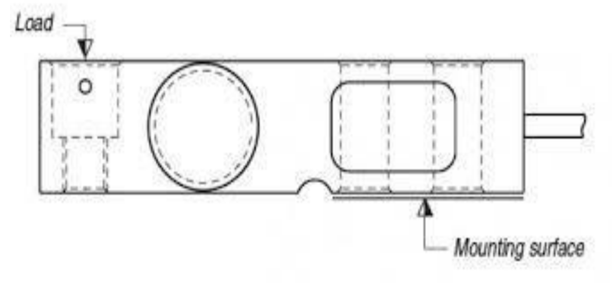


**Fig -1**: Shear beam load cell

## 5. CAD Model

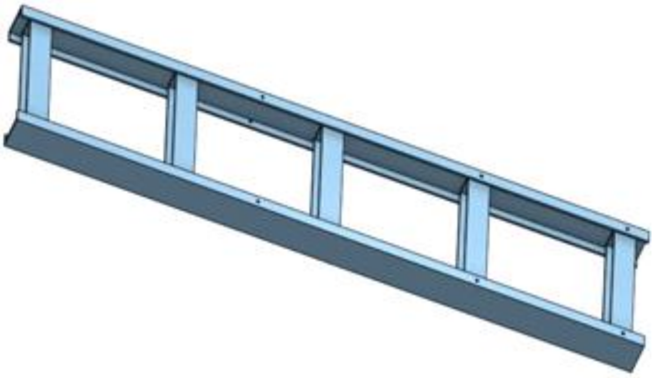

**Fig -2**: Ladder frame chassis

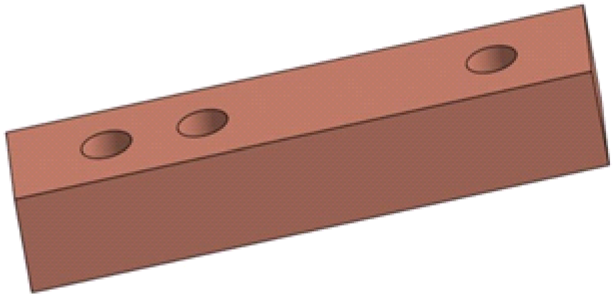

**Fig -3**: Shear beam load cell

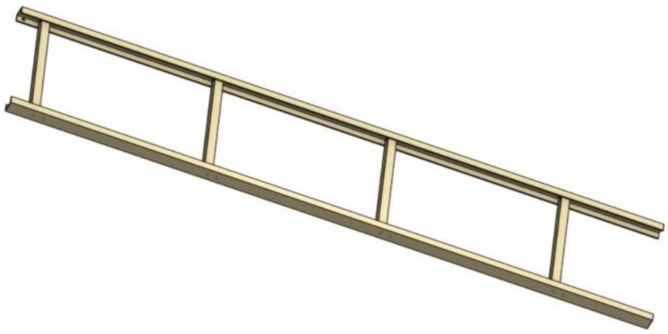

**Fig -4:** Steel channel

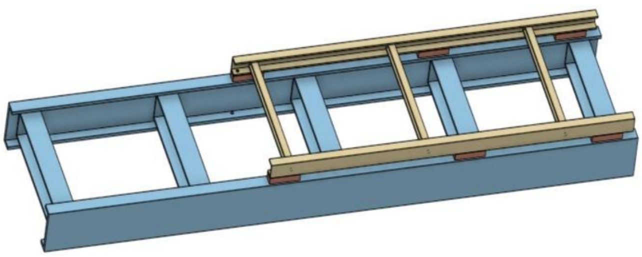

**Fig -5:** Final assembly of CAD model

**Table: 1** Specifications of model

| Specifications | Loadcell | Truck chassis | Steel channel |
|---|---|---|---|
| Type | Shear beam loadcell | Ladder frame chassis | C type steel channel |
| Material | Stainless steel | Alloy steel | Mild steel |
| Dimensions | L=252mm, W=50mm, H=65mm | L=7162mm, W=1100mm, H=300mm | L=5212mm, W=65mm, H=125mm |

## 6. STRUCTURAL ANALYSIS OF CAD MODEL

The load cell and steel channel design are analyzed in ANSYS Workbench 20.0 to find the maximum stress induced and deformation in when the model is subjected to shear loads. AISI 4130 steel alloy is assigned to the truck chassis, stainless steel is assigned to load cell and AISI 1018 mild steel is assigned to steel channel.

The equivalent stress and deformation at the same time interval is analyzed for 120000N.

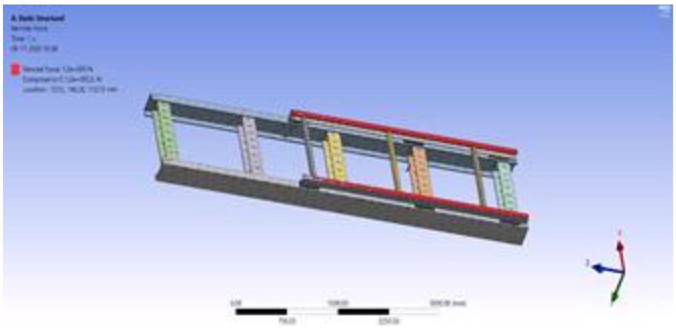

**Fig -6**: Boundary conditions of payload

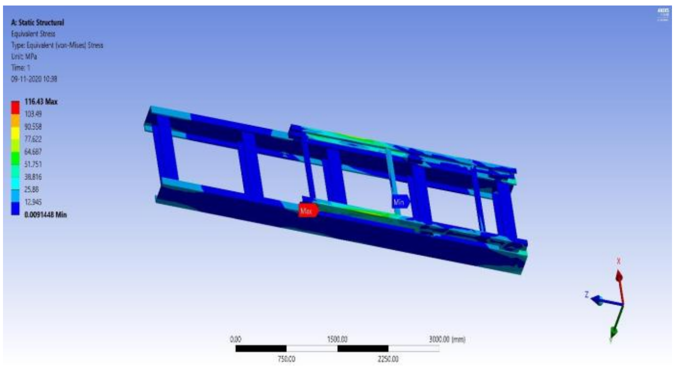

**Fig -7**: Von misses stress

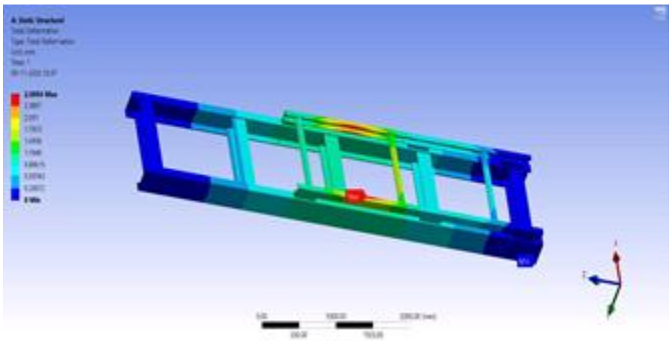

**Fig -8:** Total deformation

| Load applied | 120000N |
|---|---|
| Direction | -Y |
| Deformation | Maximum:2.68 mm |
| Stress | Maximum:116.43MPa |

**Table: 2** Payload observations

## 7. RESULTS AND DISCUSSIONS

The simulation was carried out for the steel channel which is been mounted on the load cell. The results that is the maximum stress and deformation for loading conditions are obtained from the ANSYS software and compared with the specified material properties. From simulation results following conclusions are made,

- The Von misses stress value obtained from the simulation is lesser when compared to the yield strength of the material
- The load applied on the steel channel distributes the force to the load cells
- The mounting ensures that stress values are within the elastic deformation.

## 8. CONCLUSION

The basic design of mounting the load cell and steel channel was made. The materials for the components were decided based on the requirement and application. The design was made in such that the system is cost effective, simple and reliable in construction making it accessible for manufactures. The design was made using ONSHAPE software and was analyzed with the help of ANSYS workbench where remote force is applied based on practical conditions where stress and deformation values are obtained. The simulation results are satisfactory, and the design is robust. It will be followed by fabrication and testing.

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