DYNAMIC ANALYSIS AND OPTIMIZATION OF HEAVY MOTOR VEHICLE CHASSIS FRAME

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ABSTRACT
The present study is focused towards the dynamic analysis of a truck chassis made of ladder type bolted cross members and side members having “c” channel reinforced with inner channel section. The chassis is given different boundary conditions with varying channel section thickness and the results are obtained.

The study is further focused on the transient analysis of the frame chassis after the preliminary modal analysis performed on the same. The data for the above chassis design are received from AMW workshop, near Sanand circle, Sanand highway, Ahmedabad.

Keywords: Modeling of chassis frame, static analysis, modal and transient analysis of truck chassis frame.

1. INTRODUCTION
The chassis is the truck’s backbone. If a construction truck is to last a long time, its chassis must withstand all the stresses and strains it’s subjected to every single day, both from the power it has to deliver while carrying a heavy load and from the difficult terrain in which it operates.

However, the chassis is only the base for the body. Wheelbases, chassis packaging, bogies and other features can be varied in a number of ways to suit each application.

The chassis of the truck is designed to withstand extreme conditions. World-class ground clearance means you can make your way everywhere. Together with a robust skid-plate to protect the engine, this prevents the risk of damage when driving in difficult terrain.

The frame is broad, torsionally rigid and made of high-strength steel. The side-members and cross-members are U-shaped, giving maximum strength combined with low weight. The bogie’s V-stay and reaction rod are dimensioned to handle considerable forces. This ensures stability and traction of absolute world class.

Chassis packaging is aided by the option of a wide range of tanks for fuel and AdBlue. Steel fuel tanks are available in volumes of large capacities. There’s also a wide range of power take-offs, both engine-mounted and gearbox-mounted, offering considerable scope for tailoring the truck to suit each application area.

Calculations for the chassis frame
Truck Company = AMW
Model No. = 2518 TP
Side bar of the chassis are made from “C” Channels with 256mm x 75 mm x 7 mm
Front Overhang (a) = 1350 mm
Rear Overhang l = 1435 mm
Wheel Base (l) = 4300 mm
Capacity of Truck = 25 ton
= 25000 kg
= 245250 N

Capacity of AMW with 1.25% = 245250 N
= 306562.5 N

Weight of the body and engine = 7.230 ton
= 7230 kg
= 70926.3 N

Total Load = Capacity of the Chassis + Weight of body and engine
= 306562.5 + 70926.3
= 377488.8 N

Chassis has two beams. So load acting on each beam is half of the Total load acting on the chassis.

Load acting on the single frame

\[
\frac{\text{Total load acting on the chassis}}{2} = \frac{377488.8}{2} = 188744.4 \text{ N/Beam}
\]

**Calculation for Reaction**

Chassis is simply clamp with Shock Absorber and Leaf Spring. So Chassis is a Simply Supported Beam with uniformly distributed load. Load acting on Entire span of the beam is 188744.4 N. Length of the Beam is 7085 mm.

Uniformly Distributed Load is \( \frac{188744.4}{7085} \) = 26.64 N/mm

**Calculation of the Deflection for Individual Side Bar**

Moment of Inertia around the X – X axis:-

\[
I_{xx} = \frac{bh^3 - b_1h_1^3}{12}
\]

\[
= 24546834.6 \text{ mm}^4
\]

Section of Modules around the X – X axis:-

\[
Z_{xx} = \frac{bh^3 - b_1h_1^3}{6h}
\]

\[
= 191772 \text{ mm}^3
\]
Basic Bending equation is as follow:

\[ \frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R} \]

**Material of the “C” channel**

**Material:** BSK 46 Steel

E = 2.10 x 10^5 N / mm^2

Poisson Ratio = 0.31

Radius of Gyration R = 203.20/2

= 101.60 mm

Maximum Bending Moment acting on the Beam: \( M_{max} = 35729503 \text{ N-mm} \)

\[ I = 24546834.6 \text{ mm}^4 \]

\[ y = 101.60 \text{ mm} \]

Stress produced on the Beam is as under:

\[ \sigma = \frac{M}{Z} = \frac{35729503}{191772} = 186.31 \text{ N/mm}^2 \]

**A 3D model of chassis & meshed model**

**Static Analysis**
Modal Analysis

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Optimization

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<th>Variable-2 $h$</th>
<th>Variable-3 $t_2$</th>
<th>Equivalent von-mises stress</th>
<th>Maximum shear</th>
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CONCLUSION

The vibration of the chassis can be controlled through structural modification like providing the stiffeners, damping.
By varying the thickness of the ladder ‘c’ section we can increase the load carrying capacity of the frame chassis. Further weight optimization could be carried out for getting the desired output.

REFERENCES


