Optimization of I-section of a Flat Bed Trailer

Ashwini Bhoi[1], L P Koushik[2], Narendra Yadav[3], Manas Patnaik[4]
[1]M.Tech Scholar, Christian College of Engineering and Technology, Bhilai, Chattisgarh India
[2]Asst. Prof., Christian College of Engineering and Technology, Bhilai, Chattisgarh India
[3]Asst. Prof., Rungta Engineering College, Raipur, Chattisgarh India
[4]Asst. Prof., Rungta College of Engineering & Technology, Raipur, Chattisgarh India

Abstract

Flat Bed trailers are employed in heavy automobiles to carry tonnes of loads safely. These trailers have a big role to play as far as the safety of the cargo loaded is concerned. With more and more industrialization the rate at which these trailers are fabricated are increasing. This work has been carried out on one of the major I-Beams carrying a larger load comparatively. The CAD model of the I beam is initially prepared with the help of existing drawings. It is then followed by implementation of Finite element method in the static structural analysis workbench of CATIA V5. FEM results led us to the determination of stress and deflections in the existing model. In order to reach the most optimum dimensions several models in the form of different dimensions of flange, web and width were tested and the most optimum dimension was selected. The selection was based on the satisfaction of several factors in the form of load carrying capacity, stress induced and deflection.

KEYWORDS: FEM(Finite Element Method), Computer Aided Design(CAD), CAE(Computer Aided Engineering)

I. INTRODUCTION

Development of a I Beam is a long process which requires number of tests to validate the design and manufacturing variables. We have used CAE to shorten this development thereby reducing the tests. A systematic procedure is obtained where CAE and tests are used together. CAE tools are widely used in the automotive industries. In fact, their use has enabled the automakers to reduce product development cost and time while improving the safety, comfort, and durability of the vehicles they produce. In this paper work is carried out on flat bed trailer of an heavy automobile. The objective of this work is to carry out computer aided design and analysis of an I Beam in a Flat Bed Trailer. The material of the I Beam is Structural Steel. The CAD modelling and finite element analysis is done in CATIA V5R20.

II. MATERIAL ASSIGNMENT

Many industries manufacture I-beams by structural steel material. These materials are widely used for production of I beams and beams of different cross sections. Other than the load carrying capacity of I beams, it must also be able to absorb the vertical vibrations, shocks and bumps loads (induced due to road irregularities). Ability to store and absorb more amount of strain energy ensures the safety of cargo. The mechanical properties of structural steel has been shown in Table 2.1 below

Table 2.1 Mechanical Properties of Structural Steel

PARAMETER	VALUE
Material selected	Structural steel
Young's Modulus (E)	2x10^11 N/m^2
Poission's Ratio	0.266
Tensile Strength Yield	2.5e+008 N/m^2
Density	7850 kg/m^3
Thermal Expansion	1.17x10^{-5} / ^{o}C

III. CAD MODELLING

CAD Modelling is the base of any project. Finite Element software will consider shapes, whatever is made in CAD model. The model of the Flat bed trailer and I beam is prepared by using CATIA V5 R20 software. The 3D model of the flat bed trailer and I beam is shown in fig. 3.1 and fig. 3.2 respectively.

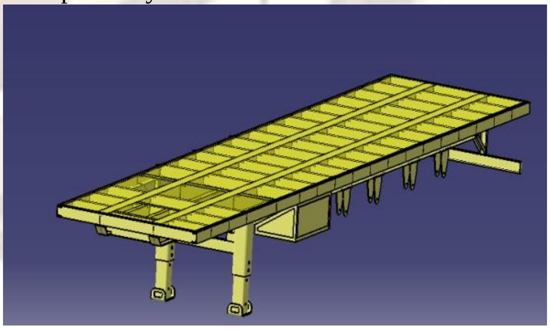

Fig. 3.1 Flat Bed Trailer

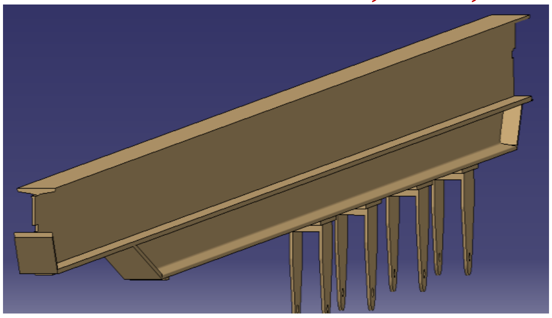

Fig. 3.2 I Beam

IV. FINITE ELEMENT ANALYSIS

The Finite Element Method (FEM) has developed into a key, indispensable technology in the modelling and simulation of advanced engineering systems in various fields like housing, transportation, communications, and so on. In building such advanced engineering systems, engineers and designers go through a sophisticated process of modelling, simulation, visualization, analysis, designing, prototyping, testing, and lastly, fabrication. Note that much work is involved before the fabrication of the final product or system. The Flat bed trailer taken into consideration is having a load carrying capacity of 40 Tonnes.

This particular trailer is having two I-Beams on either side which carry a load of 20 Tonnes each. The application of load and restraining of component is shown in Fig. 4.1 below. The I beam has been fixed at those areas where provisions for leaf springs have been provided. The front portion of the I beam which is a part of assembly in the form of a flat bed trailer is connected to the truck.

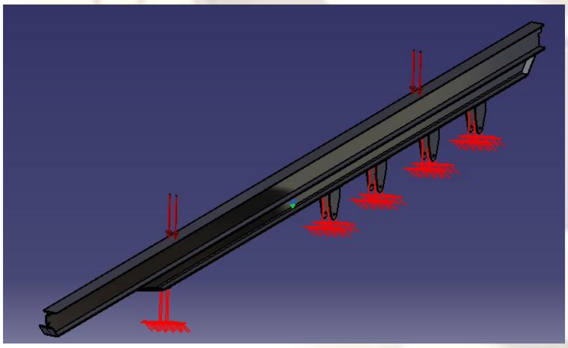

Fig. 4.1 Boundary conditions and application of load

FEA on existing model ISMB 500:

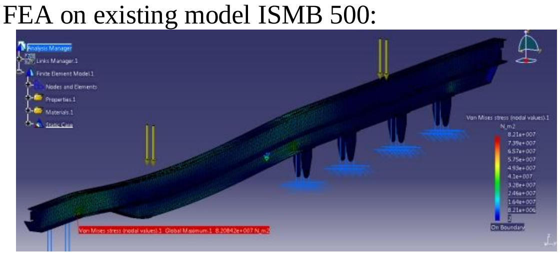

Fig. 4.2 Stress Plot for ISMB 500

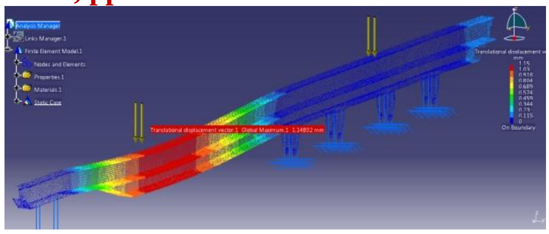

Fig. 4.3 Deflection Plot for ISMB 500

FEA on an alternative model ISMB 450:

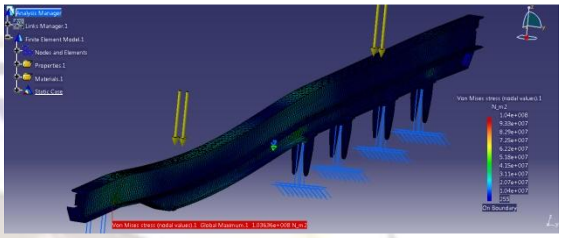

Fig. 4.4 Stress Plot for ISMB 450

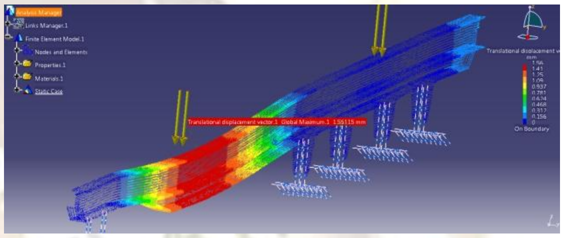

Fig. 4.5 Deflection Plot for ISMB 450

FEA on an alternative model ISMB 400:

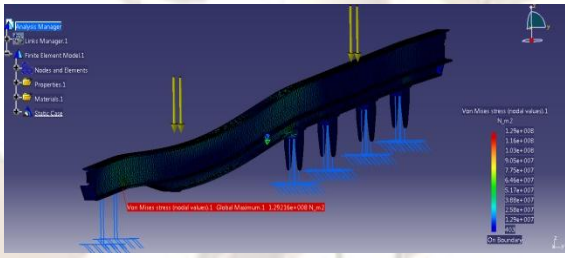

Fig. 4.6 Stress Plot for ISMB 400

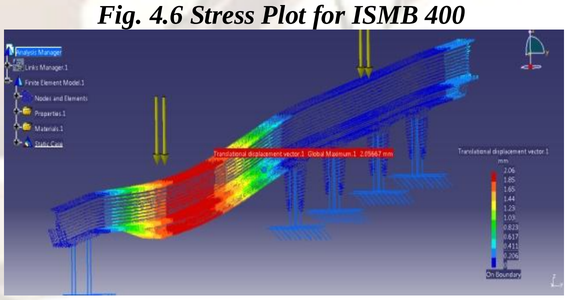

Fig. 4.7 Deflection Plot for ISMB 400

V. RESULTS & CONCLUSIONS

On the basis on mass, deflection and stress values obtained from FEM Table 5.1 has been constructed. The factor of safety recommended by ISO, Govt. of India is 1.26. The best value of FOS (1.94) corresponding to which mass is minimum is ISMB 400.

Table 5.1 Comparative Analysis for all beams

Beam Type	**ISMB 500**	**ISMB 450**	**ISMB 400**
Mass(Kg)	1373.19	1213.95	1125.98
Deflection(mm)	1.15	1.56	2.06
Stress Induced(N/m^2)	8.21E+07	1.04E+08	1.29E+08
S_{yt} (Yield Strength)	2.50E+08		
S(Factor of safety)	3.05	2.40	1.94

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