Analysis and Performance Prediction of Monorail for Hoist Crane

Shyamali S. Shendekar[1], M. S. Bodkhe[2], A. A. Gangshettiwar[3]
[1] *M. E CAD/CAM, DBNCOET, Yavatmal, India*
[2] Prof., *I/C Principal, DBNCOET, Yavatmal, India*
[3]*HOD,* Prof., *Mechanical Engineering Department, DBNCOET, Yavatmal, India*

***Abstract*- The research aims at analysing the performance of monorail girder of hoist crane. Double box girder overhead hoist cranes are used for heavy duty applications in the Power Generation industries. A detailed design and Analysis of cross section of the main girder of box type is performed for a 145 ton capacity and 28.8 m span double box girder crane, in accordance with relevant design rules. Design is performed using principal calculations and finite element analysis is done with the help of ANSYS 12.0 Multiphysics. Then these values of manual calculation and analysis are compared to check the safety of monorail girder for various parameters like deflection, shear stresses, bending stresses, etc. As a result of analysis, it is observed that all these values are within permissible limit and the design of monorail girder is safe.**

***Index Terms*- Monorail, girder, crane, analysis, hoist.**

I. INTRODUCTION

Cranes are the best way of providing a heavy lifting facility covering virtually the whole area of a building. An overhead hoist crane is the most important materials handling system for heavy goods. The primary task of the overhead hoist crane is to handle and transfer heavy payloads from one position to another. Thus, they are used in areas such as power plants, automobile plants, shipyards and in many industrial applications. Their design features vary widely according to their major operational specifications, such as: type of motion of the crane structure, weight and type of the load, location of the crane, geometric features and environmental conditions. Since the crane design procedures are highly standardized with these components, most effort and time are spent on interpreting and implementing the avaliable design standards.

A overhead hoist crane is a type of crane with a hoist in a trolley which runs horizontally along rails, usually fitted underneath a beam spanning between uprights which have wheels so that the whole crane can perform cross travel and long travel. These cranes come in all sizes, and some can carry and move very heavy loads, particularly the extremely large examples are used in power plants, shipyards or industrial installations.

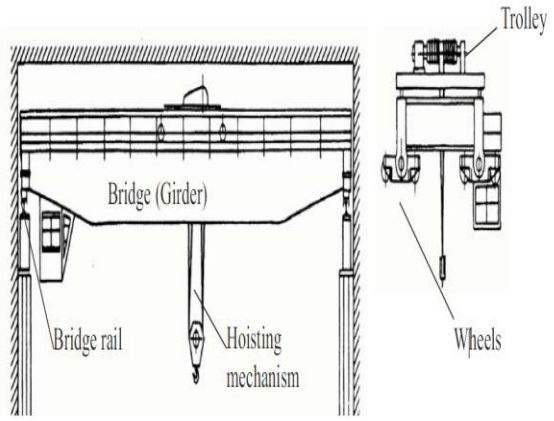

Fig.1 Overall view of an Overhead Hoist Crane

2. PROBLEM DEFINATION

Overhead hoist monorail cranes are primarily used to lift large or heavy loads and move them horizontally. During operation, the crane is subjected to various stresses like bending compressive, bending tensile, shear stress, tensile stress, deflection, etc. Due to these stresses, bending and buckling failure occurs in the monorail girder of the crane and the working of crane gets stopped suddenly causing danger to the workers also. Proper design and analysis of monorail girder may avoid this failure.

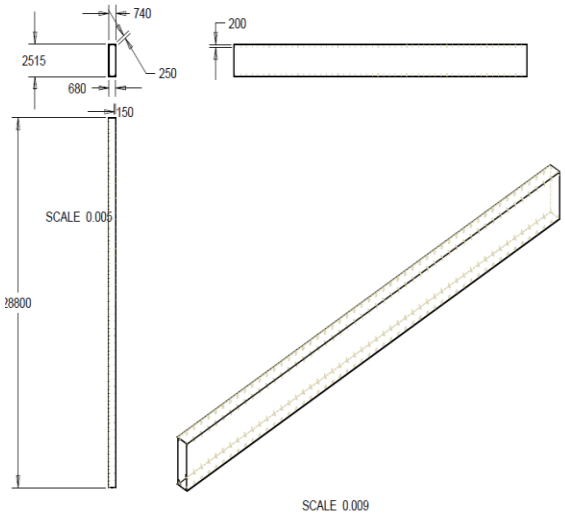

Fig.2 Detailed view of monorail girder

3. DESIGN OF MONORAIL GIRDER

Monorail girder calculations are given below:

a) Main Hoist Capacity - 115 T
b) Span - 28.8 M
c) Dead weight of each girder including rails & attachments - 22.00 T
d) Dead weight of trolley inclusive of top & bottom blocks - 31 T
e) Dead weight of non drives side platform - 1.30 T
f) Dead weight of panels, cables other electrical on drive side platform - 2 T
g) Dead weight of LT machinery including frame (each) - 2 T
h) Dead load on non drive side girders = g + I - 23.30 T
i) Minimum hook approach - 1.583 M
j) CT rail height - 150 mm

4. FINITE ELEMENT ANALYSIS OF GIRDER

The finite element analysis of a monorail girder of hoist crane is performed by using an ANSYS software. ANSYS is a general-purpose finite element modeling package for numerically solving a wide variety of mechanical problems. These problems include static/dynamic, structural analysis (both linear and nonlinear), heat transfer, and fluid problems, as well as acoustic and electromagnetic problems. The various findings of this analysis is shown in the following figures.

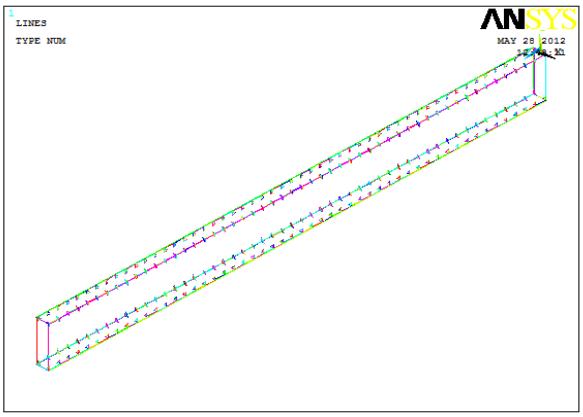

Fig.3 Wireframe model of Monorail Girder

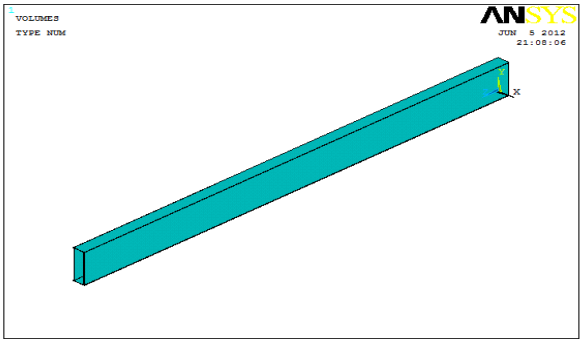

Fig.4 Extruded model of Monorail Girder

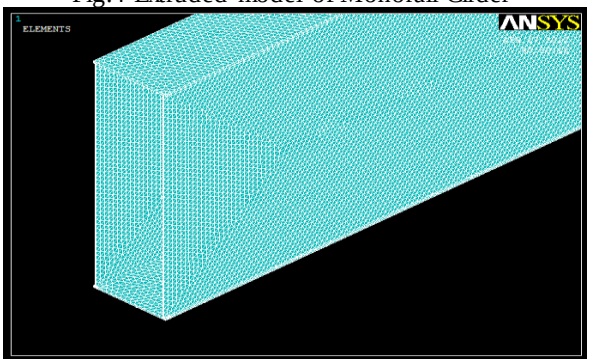

Fig.5 Meshed model of Monorail Girder

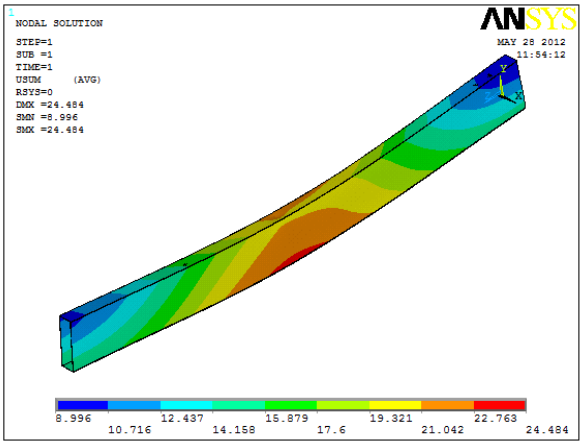

Fig.6 Deflection in Girder

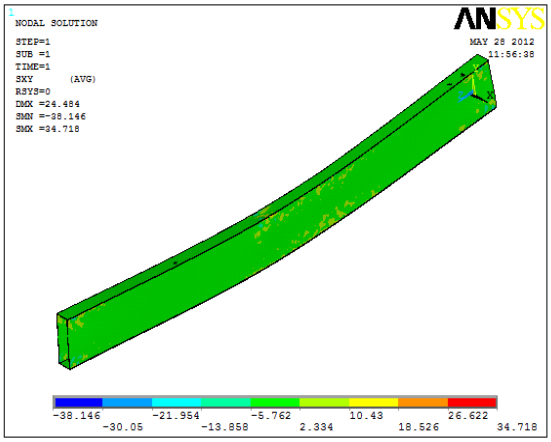

Fig.7 Shear stress developed in Girder

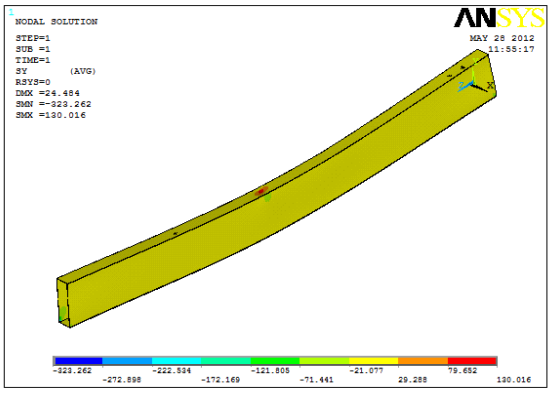

Fig.8 Bending compressive stress developed in Girder

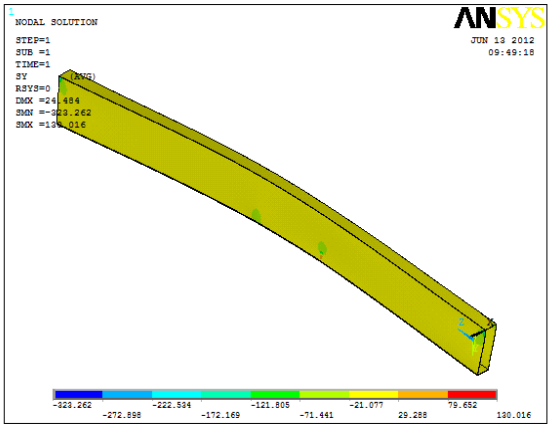

Fig.9 Tensile stress developed in Girder

5. RESULT AND COMPARISON

After analyzing the monorail girder of overhead hoist crane by using finite element method, the results obtained from manual calculations and ANSYS software are given in the table 1 below.

Table.1 Comparison of values of result

Paramete-rs	Calcu-lated Value	Value in ANS-YS	Rema-rk
Deflectio-n	22.3 mm	24.48 mm	Safe
Tensile Stress	143.54 N/mm^2	133.99 N/mm^2	Safe
Bending Compres-sive	115.14 N/mm^2	111.11 N/mm^2	Safe
Shear Stress	40.28 N/mm^2	38.06 N/mm^2	Safe

After comparing the results of analysis of monorail girder by manual calculations and by using ANSYS software, it is found that the difference between both results is close and acceptable. So the design is valid and safe.

6. CONCLUSION

Finite Element Analysis is successfully implemented for the analysis of monorail girder. From the analysis, it is found that the design of monorail girder is safe under various stresses such as bending compressive stress, tensile stress, shear stress and the deflection occuring in monorail girder of overhead hoist crane is within permissible limit.

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