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“DESIGN POINT EXPLORATION & ANALYSIS OF 25 TON SINGLE GIRDER ELECTRIC OVERHEAD TRAVELLING (E.O.T.) CRANE”

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ABSTRACT

In this project design of girder of an EOT crane has been carried out. The dimensions of main component has been determined for a capacity of 25T with load factor 25%. Various cross-sections with dimensions of various shoes of stiffener-plate for crane girder have been found.

After the system was designed, the stress and deflection are calculated at critical points using ANSYS analysis software and optimized. And which cross-sections would be better, keeping some parameters constant for all the cases. This may done after analysis of various types of cross-sections in girder design..

KEYWORDS : EOT Crane, Stress, Deflection , Ansys.

I. INTRODUCTION

A crane is a mechanical lifting device equipped with a winder, wire ropes and sheaves that can be used both to lift and lower materials and to move them horizontally. It uses one or more simple machines to create mechanical advantage and thus move loads beyond the normal capability of a human. Cranes are commonly employed in the transport industry for the loading and unloading of freight; in the construction industry for the movement of materials; and in the manufacturing industry for the assembling of heavy equipment. The EOT Crane moves over the rails placed on the top of crane runway or Gantry Girders. The crane mainly comprise of bridge girder made from rolled sections such as I beams / U beams or fabricated box section. The bridge girder is supported on two end carriages, each housing a pair of wheels. The wheels are driven by motor gearbox units. A wire rope hoist is suspended below the bridge girder.

The single girder cranes find their application mainly for capacities up to 20 MT and Span up to 25 Meters. These are commonly used for light and medium workshop duty applications. However, in rare cases the single girder cranes are also used for hot metal ladle handling as well as with grab bucket.

In case of double girder crane, the trolley housing hoisting and cross traversing machinery move on the top of two bridge girders. The bridge girders are of box construction made from rolled plates. However for smaller capacities and spans, the bridge girders are also made from standard rolled sections.

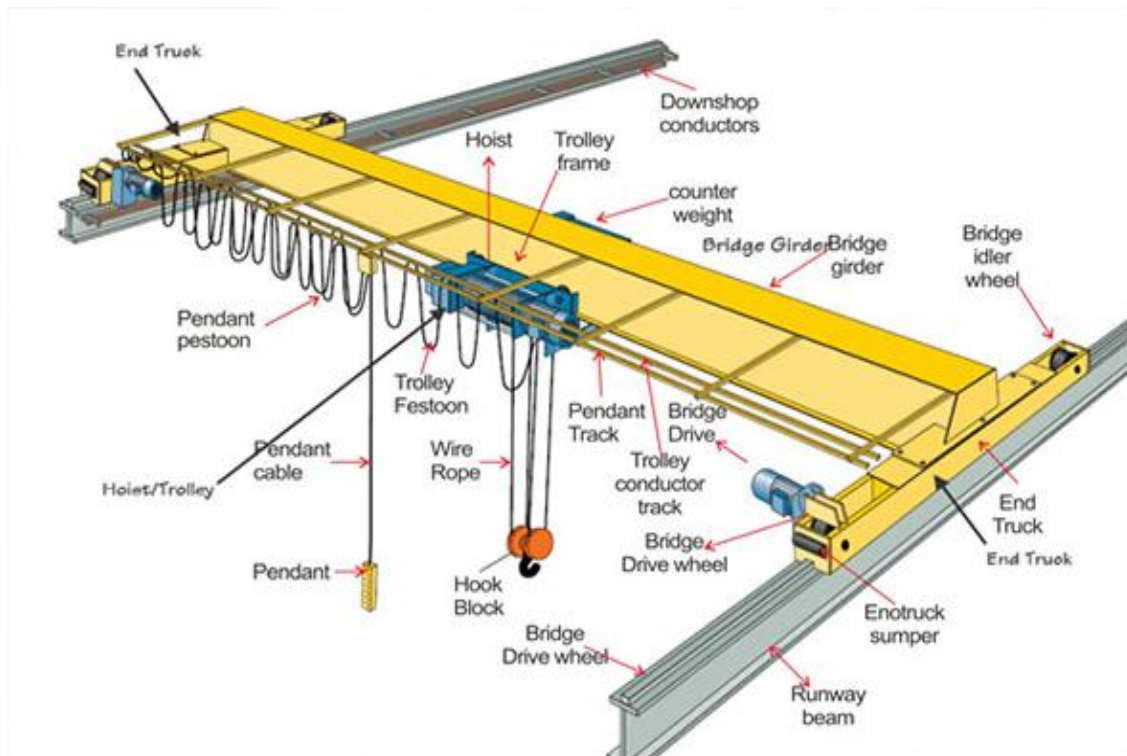


Fig.1 Single Girder EOT Crane

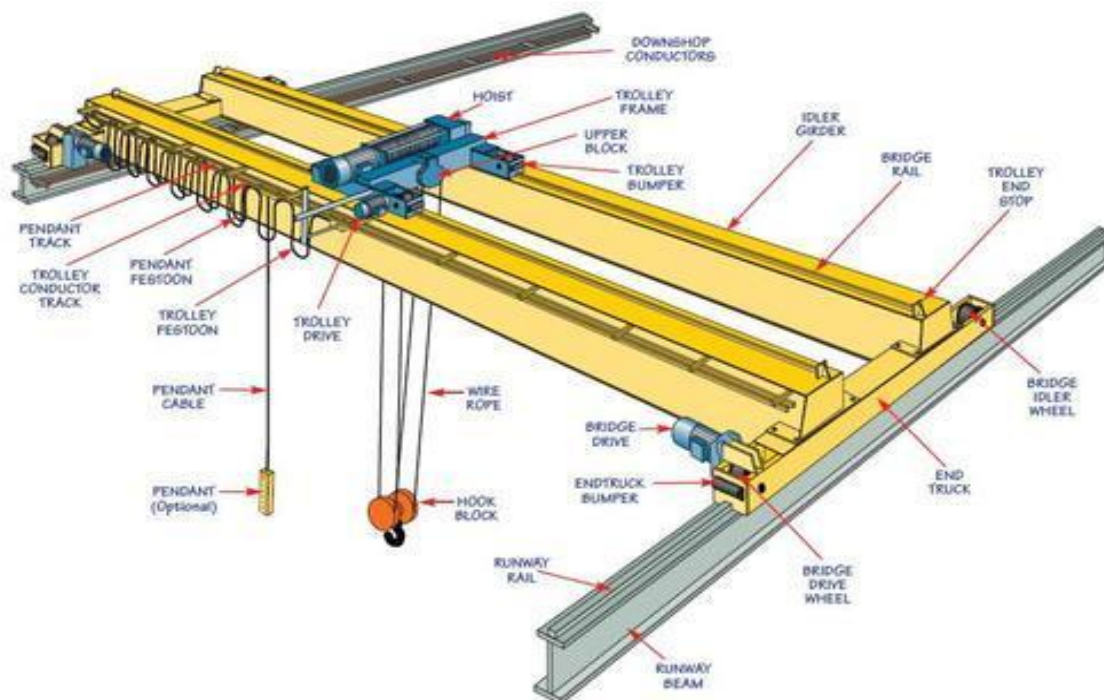


Fig.2 Double Girder EOT Crane

II. DESIGN OF GIRDER

2.1 3D Modelling of Girder in ANSYS

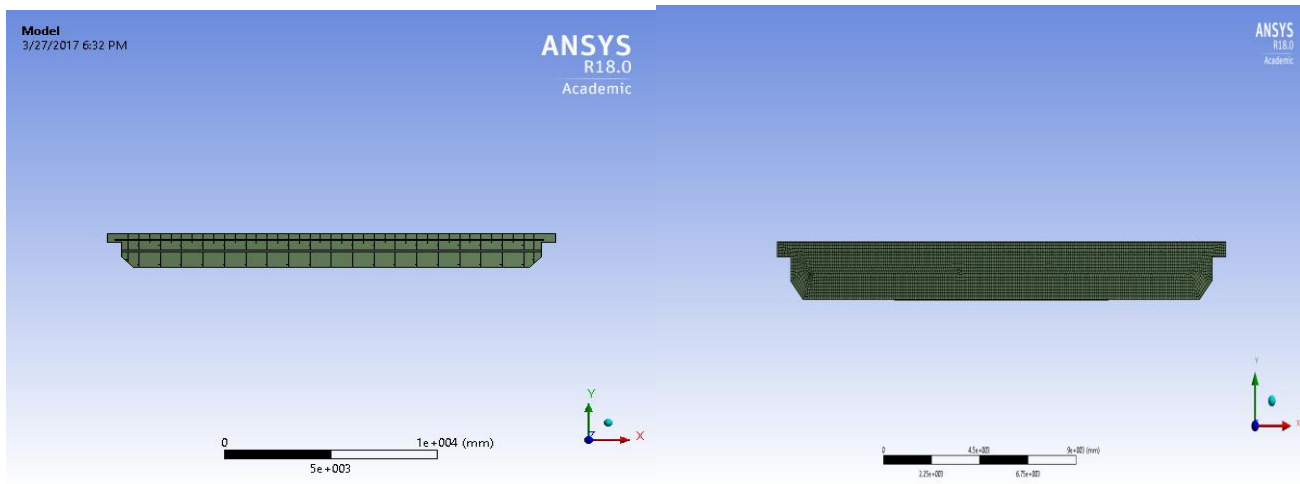


Fig.3. 3D Modelling of Girder

2.2 Overhead crane Load testing

The overhead crane should be positioned on a stanchion or column of the runway with the trolley or electric hoist placed adjacent to the end of truck at the beginning of the overhead crane load testing to measure the deflection of the crane main girders and the runway girders at center span.

Lift the rated load up to a sufficient height to make sure each and every tooth of the lifting gear train is subjected to the rated load.

Lower the load to a height of 4 to 8 inches above the ground.

Measure the deflection. Traverse the bridge to mid span of the runway girder and measure the deflection. Traverse the trolley with rated load to mid span of the bridge and measure the deflection. Comparing the data you get with the specifications given by the overhead crane manufacturer.

With the holding brake in the released position, start the load down slowly and then return the controller to the off position as the test load is lowering. The load controlling device should prevent the load from accelerating.

For overhead cranes with primary and secondary holding brakes and/ or eddy current or hoist eddy current or hoist dynamic load brakes visually observe that correct operation ensures control of the rated load.



Fig.4 Overhead crane Load testing

III. DESIGN CALCULATIONS

In all cases – W (load) = 32 tone

$$= 313812.800 \text{ N}$$

l (span of beam) = 21m = 21×10^3 mm

E (young's modulus) = $22 \times 10^5 \text{ N/mm}^2$

3.1 For old model

$$I, (\text{for whole body}) = 1.4279 \times 10^{10} \text{ mm}^4$$

$$\begin{aligned} \text{Deflection } (\Delta) &= \frac{Wl^3}{192EI} \\ &= \frac{313812.8 \times (21 \times 10^3)^3}{192 \times 2 \times 10^5 \times 1.0028 \times 10^{10}} \\ &= 7.5467 \text{ mm} \end{aligned}$$

Ansys result = 8.3688 mm

Company data = 8.75 mm

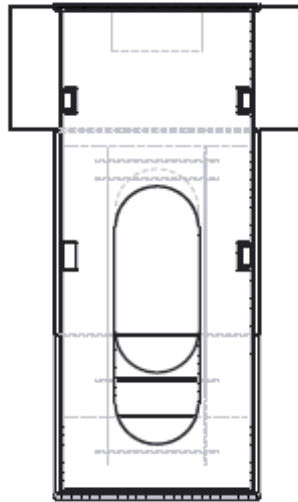


Fig.5 Old stiffener plate

3.2 For single I component,

$$I_2 = 1.601 \times 10^{10} \text{ mm}^4$$

$$\begin{aligned} \text{Deflection, } \Delta &= \frac{Wl^3}{192EI} \\ &= \frac{313812.8 \times (21 \times 10^3)^3}{192 \times 2 \times 10^5 \times 1.601 \times 10^{10}} \\ &= 4.17 \text{ mm} \end{aligned}$$

Ansys result = 4.4583 mm

Company data = 5.34 mm

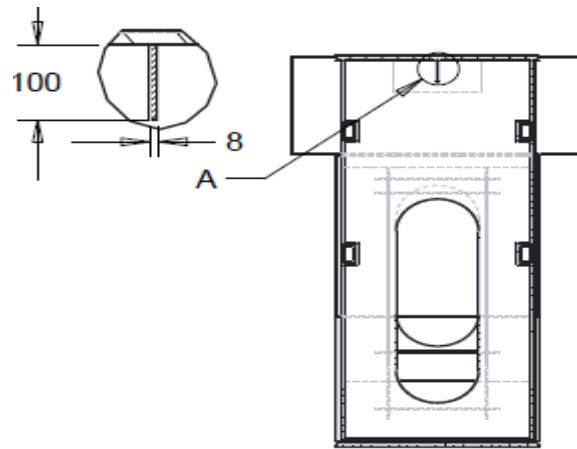


Fig.6 Single I stiffener plate

3.3 For double I component,

$$I_3 = 1.797 \times 10^{10} \text{ mm}^4$$

$$\begin{aligned} \text{Deflection, } \Delta &= \frac{Wl^3}{192EI} \\ &= \frac{313812.8 \times (21 \times 10^3)^3}{192 \times 2 \times 10^5 \times 1.797 \times 10^{10}} \\ &= 4.21 \text{ mm} \end{aligned}$$

Ansys result = 4.4674

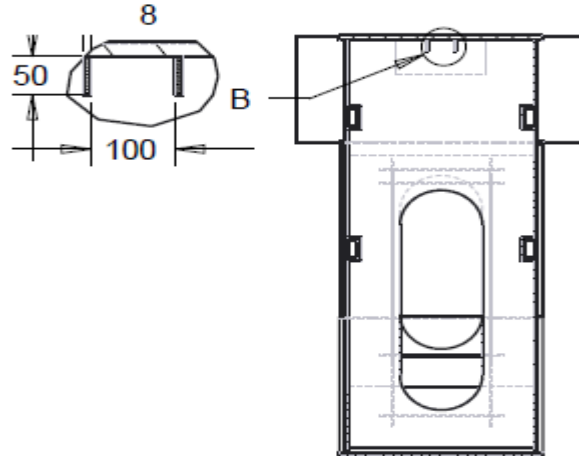


Fig.7 Double I stiffener plate

3.4 For square component

$$I_4 = 1.856 \times 10^{10} \text{ mm}^4$$

$$\begin{aligned} \text{Deflection, } \Delta &= \frac{Wl^3}{192EI} \\ &= \frac{313812.8 \times (21 \times 10^3)^3}{192 \times 2 \times 10^5 \times 1.856 \times 10^{10}} \end{aligned}$$

=4.077 mm

Ansys result = 4.20mm

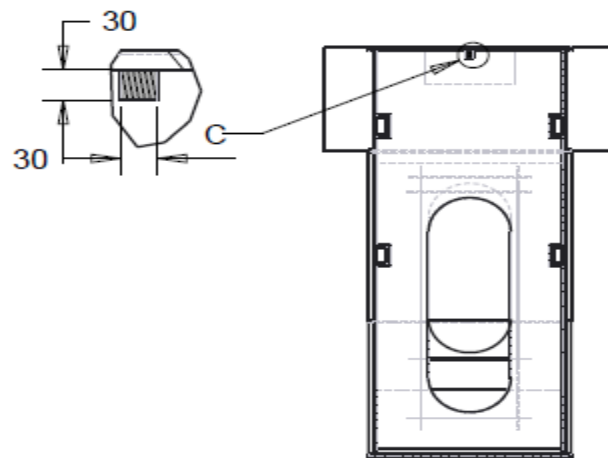


Fig.8 Square stiffener plate

IV. ANALYSIS

4.1 For old girder model

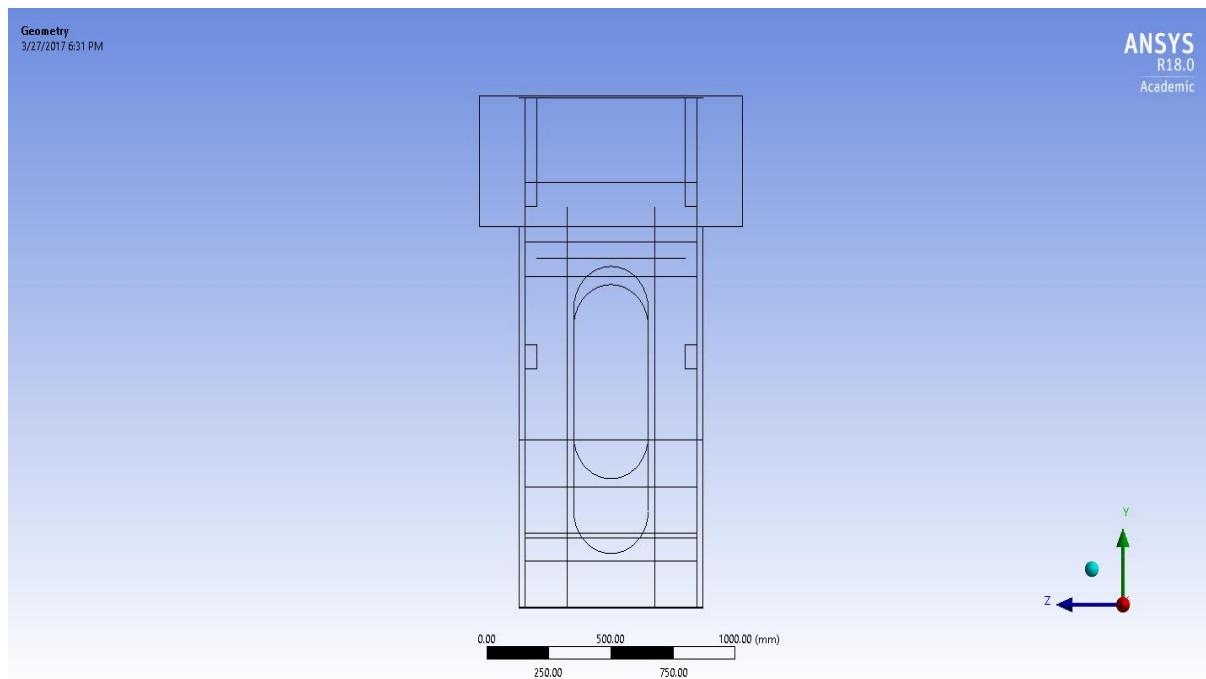


Fig.9 Old girder model cross-section

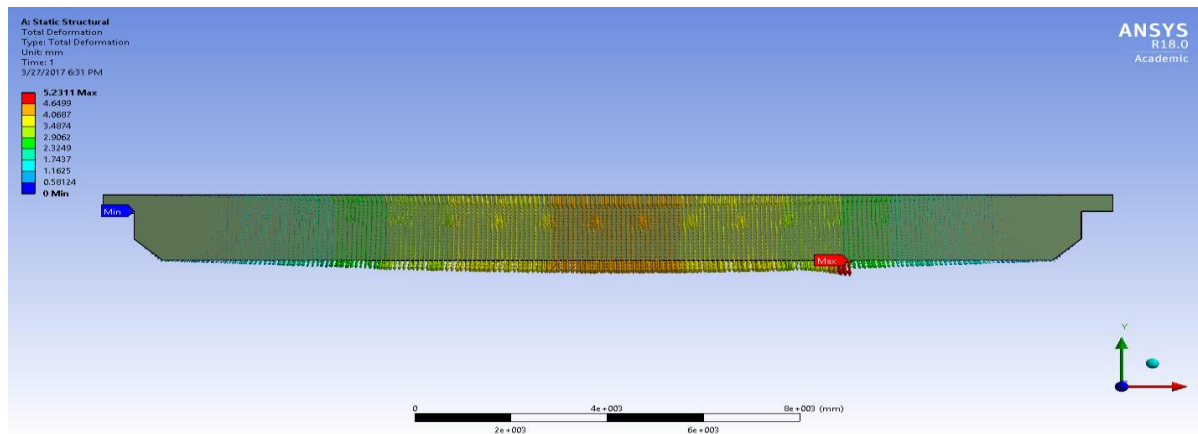


Fig.10 Old girder model analysis

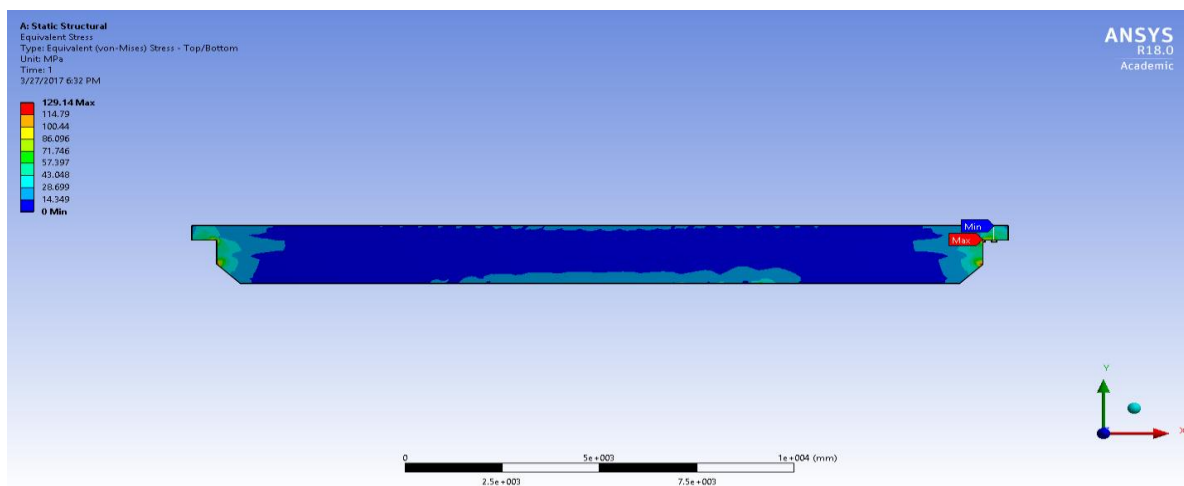


Fig.11 Single I girder component analysis

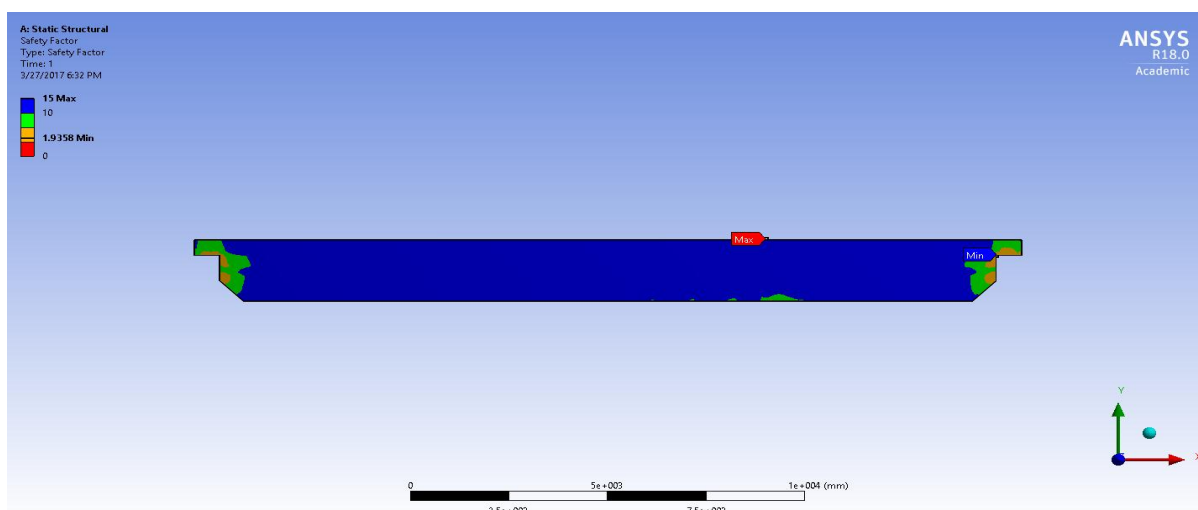


Fig.12 Single I girder component analysis

4.2 For single I girder component

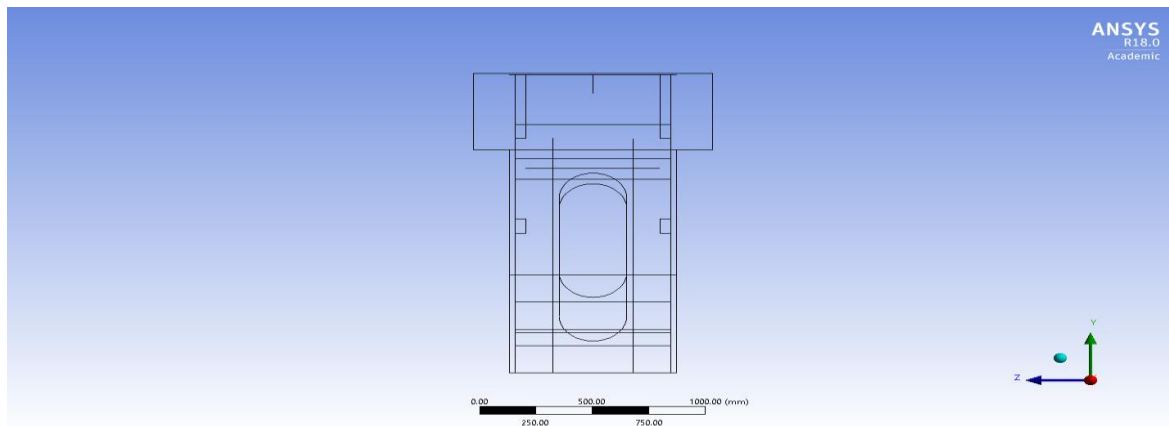


Fig.13 Single I girder component cross-section

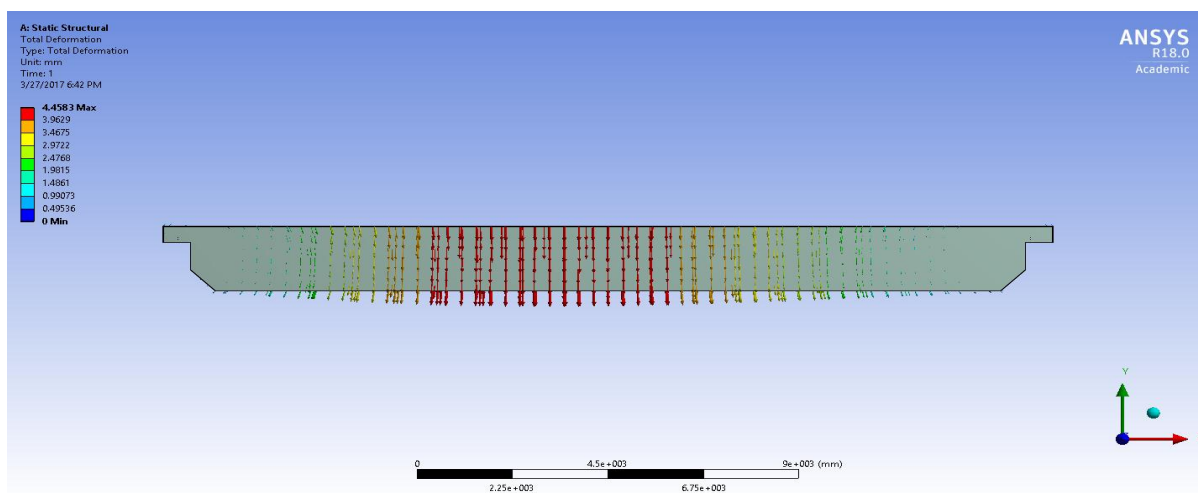


Fig.14 Single I girder component analysis

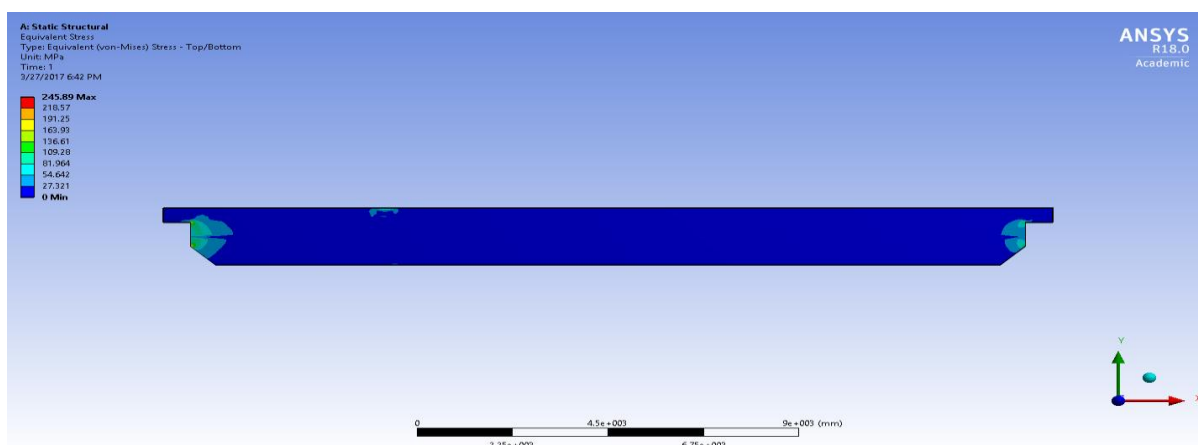


Fig.15 Single I girder component analysis

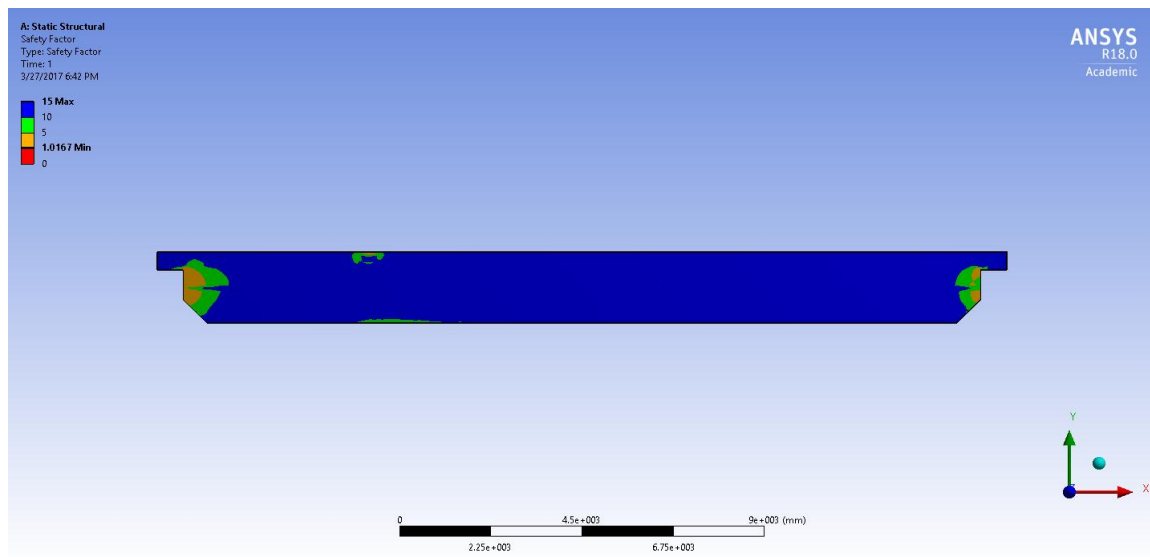


Fig.16 Single I girder component analysis

4.3 For double I girder component

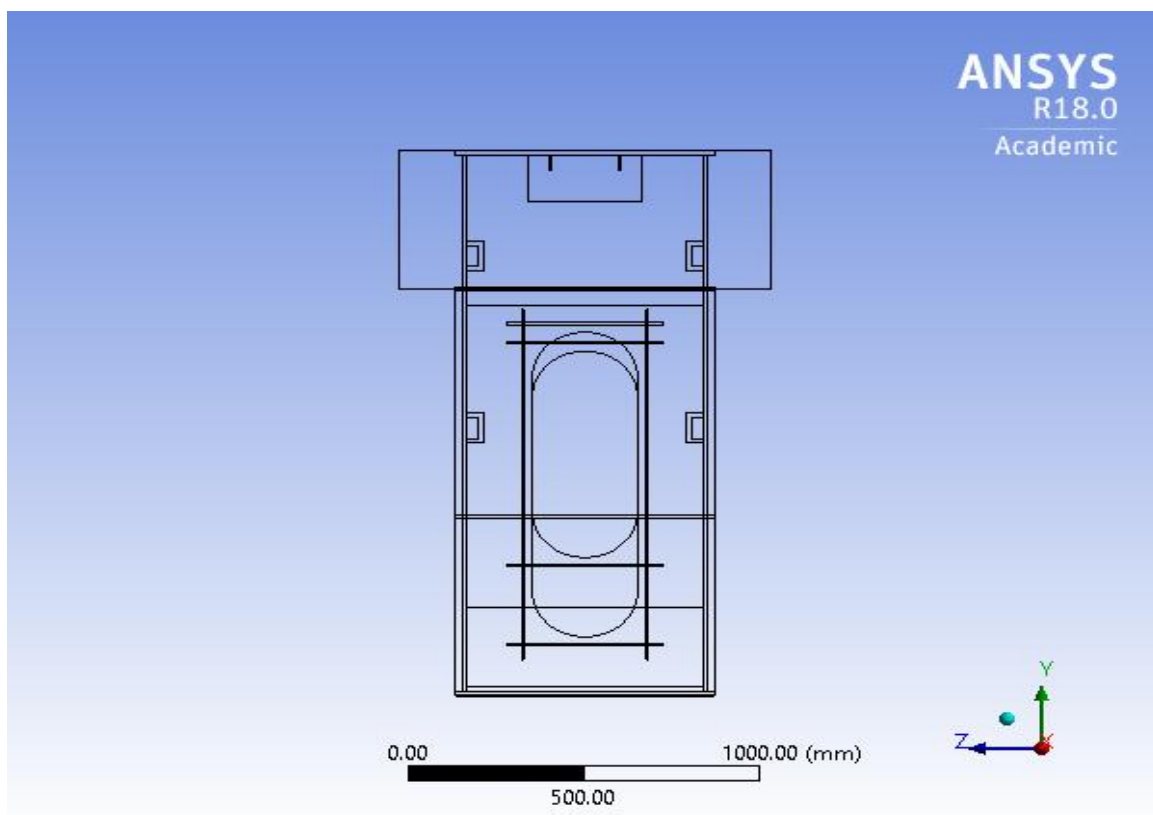


Fig.17 Double I girder component cross-section

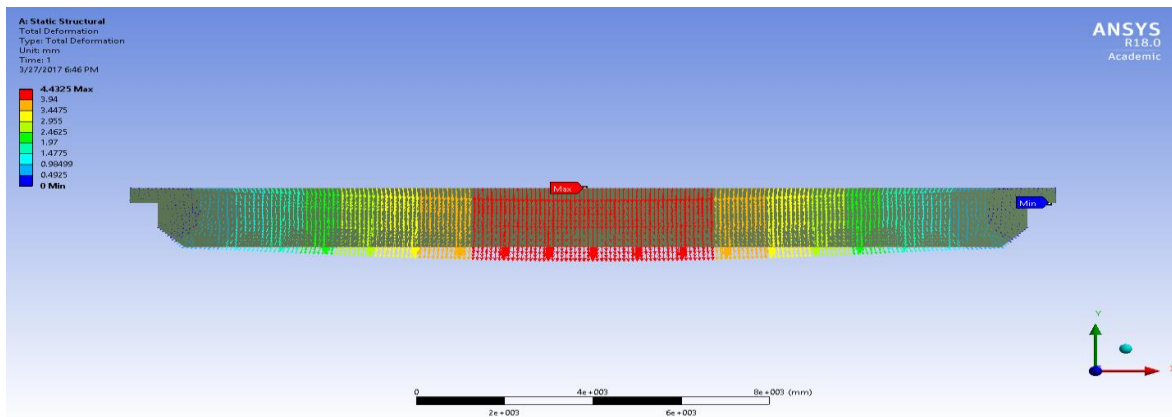


Fig.18 Double I girder component analysis

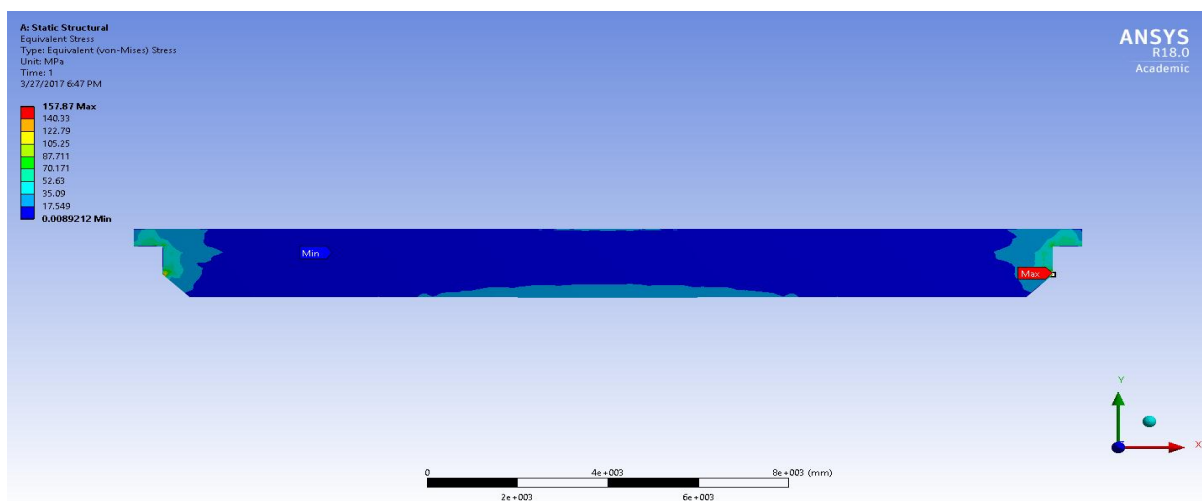


Fig.19 Double I girder component analysis

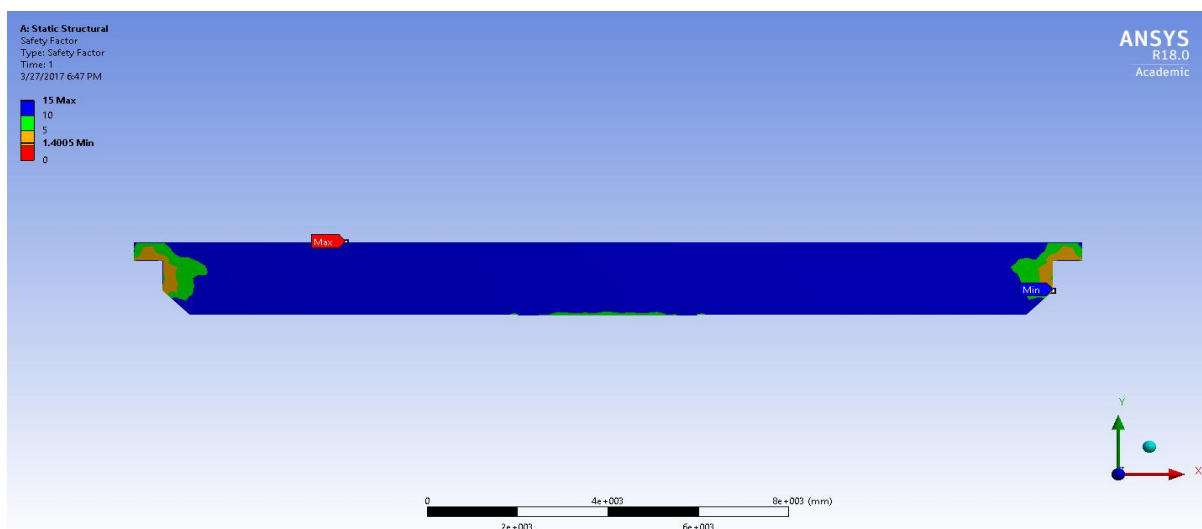


Fig.20 Double I girder component analysis

4.4 For square girder component

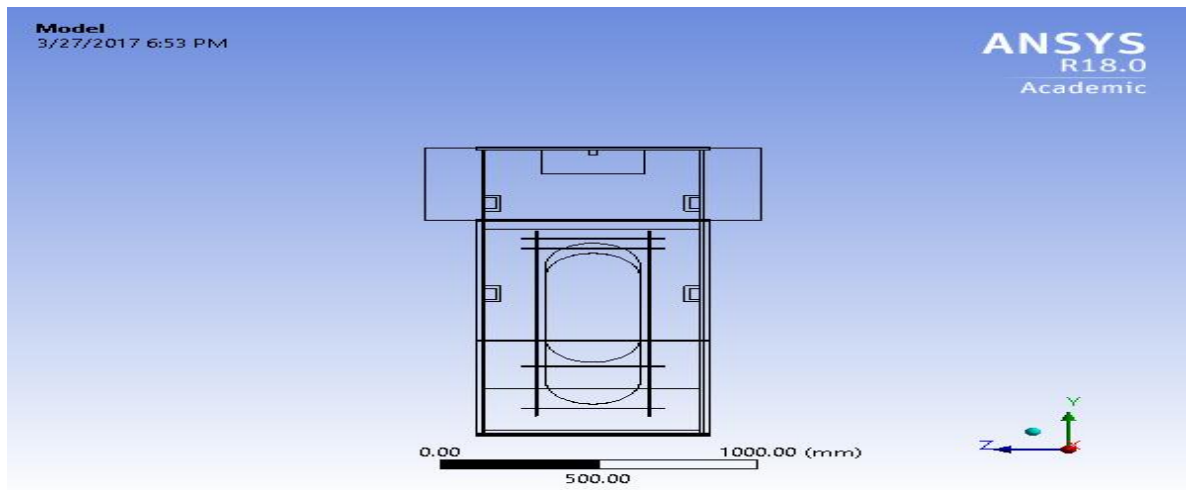


Fig.21 Square girder component cross-section

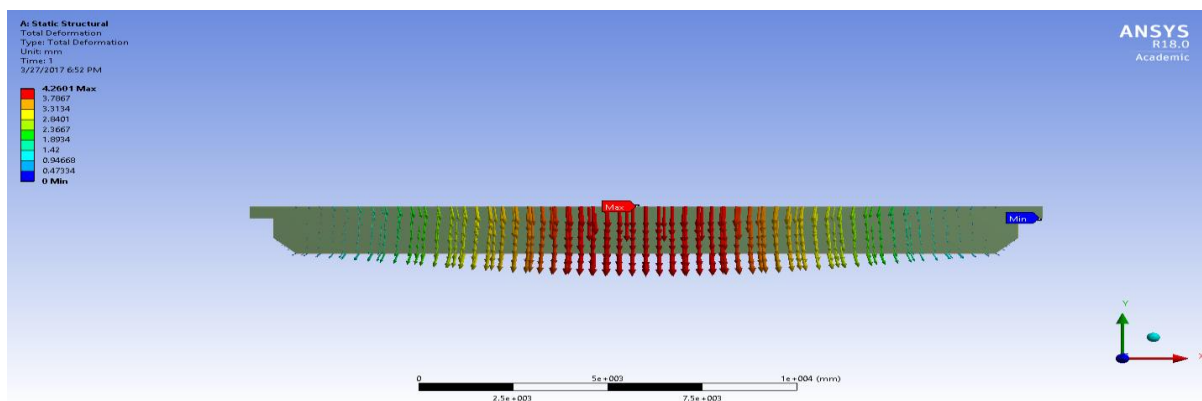


Fig.22 Square I girder component analysis

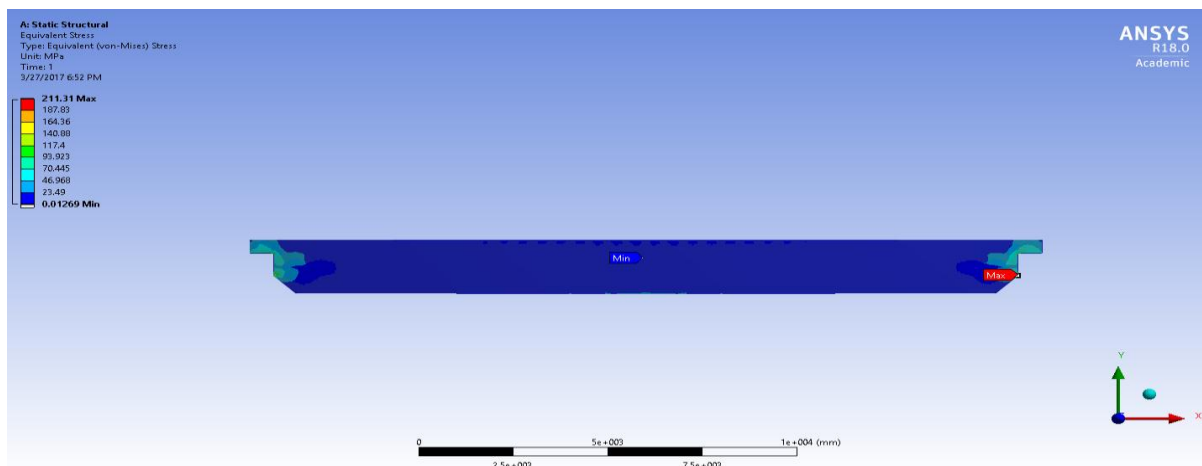


Fig.23 Square I girder component analysis

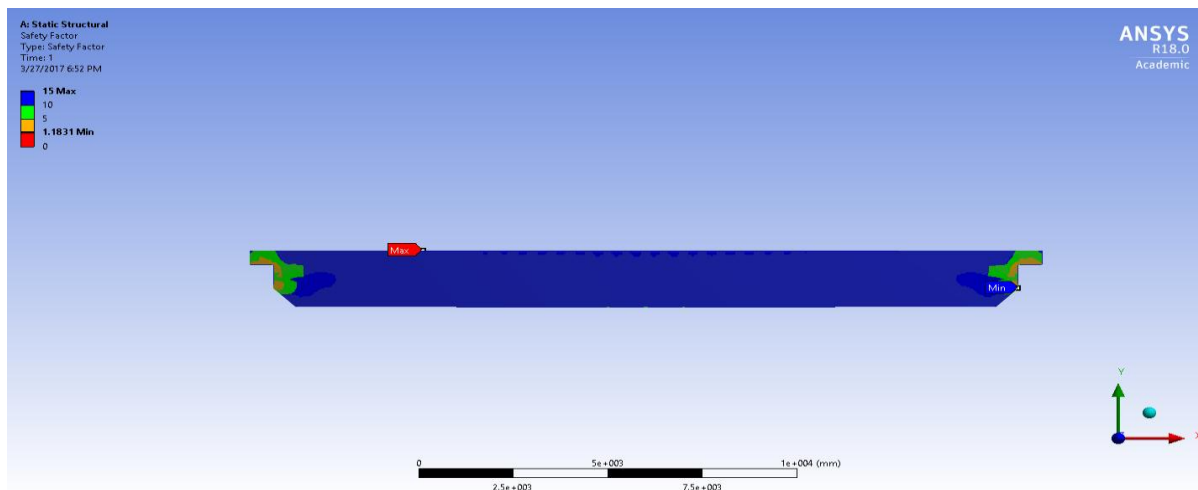


Fig.24 Square I girder component analysis

V. CONCLUSION

As Shown from analysis that maximum deflection is decreased by adding stiffener plate of support element and the maximum stress is under limit and also prove that design of girder so better reliability, life span & high strength of crane is to be achieved.

Result: Graph of Deflection

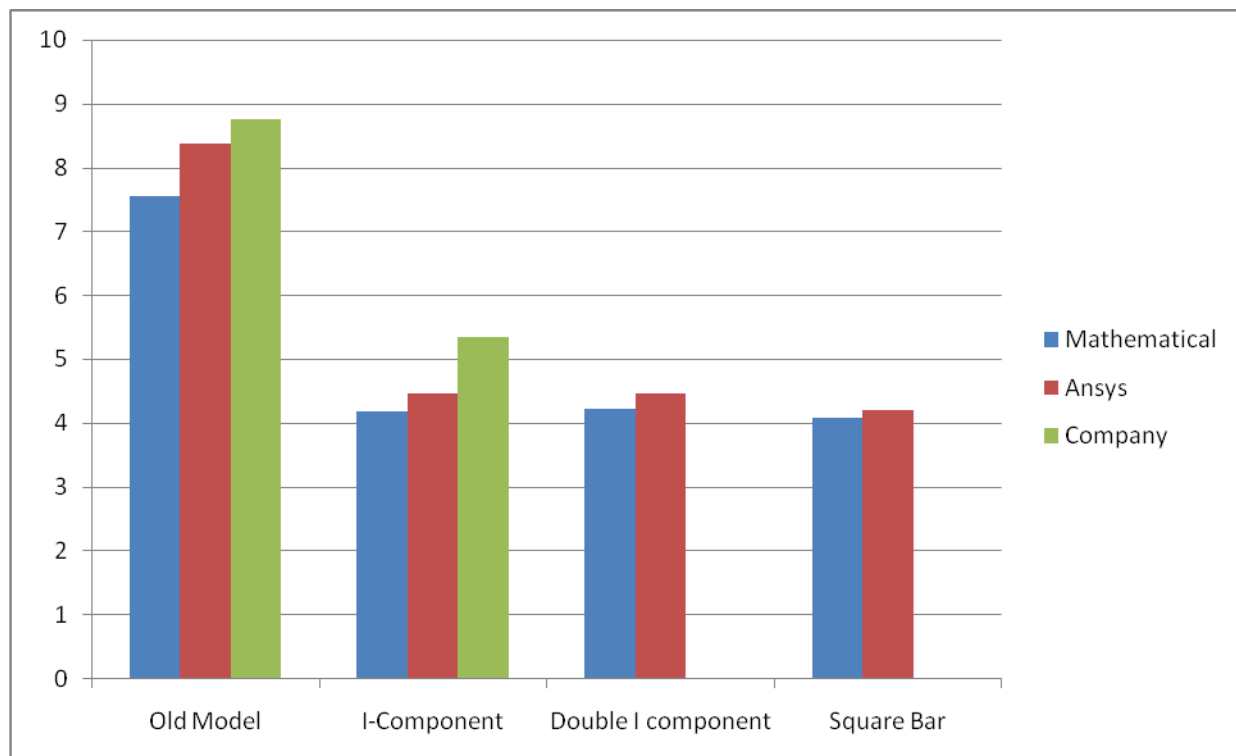


Table-1 Deflection Data Analysis

Model	Mathematical	Ansys	Company
Old Model	7.5467	8.3688	8.75
I-Component	4.17	4.4583	5.34
Double I component	4.21	4.4674	-
Square Bar	4.077	4.2	-

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