# Weight Optimization Of Girderbeam For 70t E.O.T Crane Through Fe Analysis

[1] **Apeksha. K. Patel,** [2] **Prof. V. K. Jani,**
[1]**M.E.[CAD/CAM] Student, Department Of Mechanical Engineering, C.U.Shah College Of Engineering and Technology, Wadhavan, Gujarat**
[2] **Professors,DepartmentOf Mechanical Engineering, C.U.Shah College Of Engineering and Technology, Wadhavan, Gujarat**

***ABSTRACT*****:** *Main Component of Overhead Crane is Girder Beam which transfers load to structural member. In Present Practice, industries overdesign girder beam which turns costly solution. So, our aim is to reduce weight of girder which has direct effect on cost of girder and also performance Optimization is done for fatigue (life) point of view. In this paper FE analysis of girder beam is carried out for the specific load condition. Here, we used ANSYS WORK BENCH V12.1.Software for the FE analysis of the girder beam. Through this analysis we get the result in terms of stresses and deformation and this result are within the allowable limits. We are optimize the weight of girder by use of TAGUCH I method.*

***Keywords—70T double girder electrical overhead crane, weight optimization.***

## 1. INTRODUCTION

Optimization is a mature field due to the extensive research that has been conducted over the last about 60 years. Many types of problems have been addressed and many different types of algorithms have been investigated. The methodology has been used in different practical applications and the range of applications is continuously growing.



Transcription of an optimization problem into a mathematical formulation is a critical step in the process of solving the problem. If the formulation of the problem as an optimization problem is improper, the solution for the problem is most likely going to be unacceptable. For example, if a critical constraint is not included in the formulation, then most likely, that constraint is going to be violated at the optimum point. Therefore special attention needs to be given to the formulation of the optimization problem.

Any optimization problem has three basic ingredients:

• Optimization variables, also called design variables denoted as vector x.

• Cost function, also called the objective function, denoted as f (x).

• Constraints expressed as equalities or inequalities denoted as gi(x)

The variables for the problem can be continuous or discrete. Depending on the types of variables and functions, we obtain continuous variable, discrete variable, differentiable and no differentiable problems. These models are described next; for more details and practical applications of the models, various references can be consulted. There are other optimization methods such as Shape Optimization and Topological Optimization, which change the appearance of the geometrical domain. The optimization approach in this study involved both size and shape optimizations. As discussed earlier, the optimization stages were considered not as a defined function of variables, but based on judgment using the results of the FEA and dynamic service load. The judgment was based on mass reduction, cost reduction, and improving fatigue performance using alternative materials and considering manufacturing aspects, as well as bending stiffness of the SteelGirder Beam.

## 1.2 Objective Function

Objective function is defined as the parameters that are attempted to be optimized. In this study the weight, manufacturing cost and fatigue performance of the component were the main objectives. Optimization attempt was to reduce the

weight and manufacturing cost, while improving the fatigue performance and maintaining the bending stiffness within permissible limits.
Manufacturing process and material alternatives are other design variables that were not considered in this study. Since automotive Girder Beams are mostly manufactured from micro alloyed steels, this was considered as the alternative material. Micro alloyed steels have the main advantage of eliminating the heat treatment step in the manufacturing process, which will reduce the cost of the final Girder Beam.
Other manufacturing aspects that are common in manufacturing of Girder Beams Including inducing compressive residual stress at the fillets were investigated to improve the fatigue performance of the component. This improvement would allow additional changes in the geometry in order to reduce the weight of the final optimized Girder Beam.

## 1.3 Outline of Optimization Process

The shape optimization of components in dynamic mechanical systems requires several quantities. These quantities are to be derived in every iteration of the optimization process. They result from various types of analyses and the optimization process is obtained by a combination of these analyses. Figure 1 outlines the stages with respect to the order in which they are carried out during the batch process. In the following section some basic aspects of each step of the process shown above are described in more detail in order to provide the reader with the necessary background for all analysis domains involved.

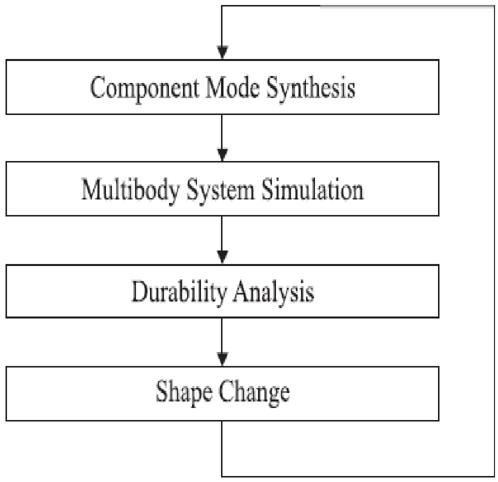


**Fig 1.1 Stages of Optimization Process**

products and which in turn is also aggravated by the noise and vibration produced.

## 1.4ThreeParameterforOptimization

Diaphragm to diaphragm distance
Thickness of web plate for girder beam
Height of Girder Beam

## 1.5 Optimization Array

| Diaphragm to diaphragm distance (mm) | Thickness of web plate of girder beam (mm) | Height of Girder Beam (mm) |
|---|---|---|
| 800 | 22 | 700 |
| 800 | 26 | 800 |
| 1000 | 22 | 800 |
| 1000 | 30 | 700 |
| 1200 | 22 | 900 |
| 1200 | 30 | 800 |

**Table 1.1 Optimization ArrayCase6**

Diaphragm to diaphragm distance: - 1200
Thickness of web plate of girder beam:-30
Height of Girder Beam:-800

### 1.5.1 Von Misses Stresses

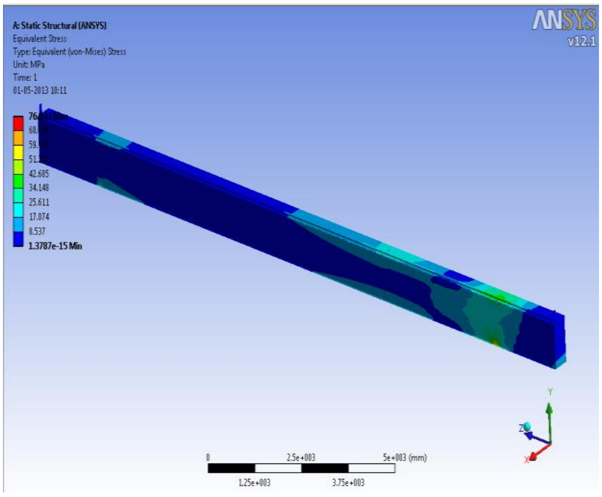


**Fig 1.2 Von Misses Stress of Case-9**

### 1.5.2Maximum Shear Stresses

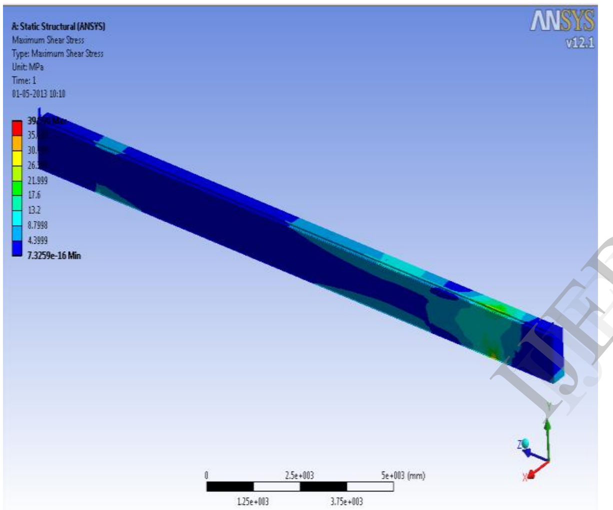


**Fig 1.3 Maximum Shear StresofCase-9**

### 1.5.3 Total Deformation

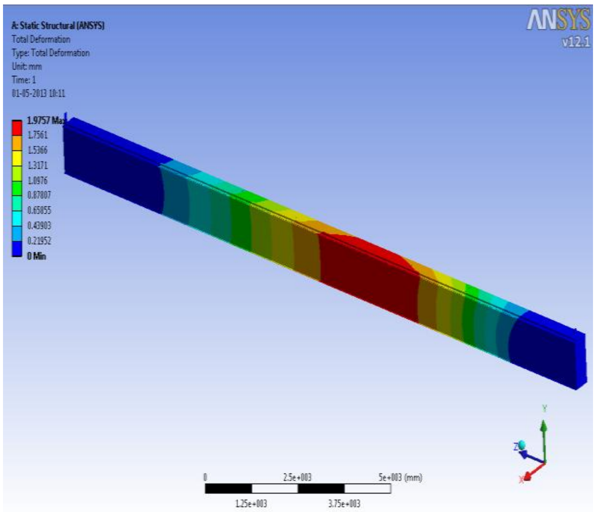


**Fig 1.4 Total Deformation of Case-9**

### Case 5

Pieces Length: -1200

Thickness of Girder Beam: - 22

Height of Girder Beam: - 900

### 1.5.4 Von misses stresses

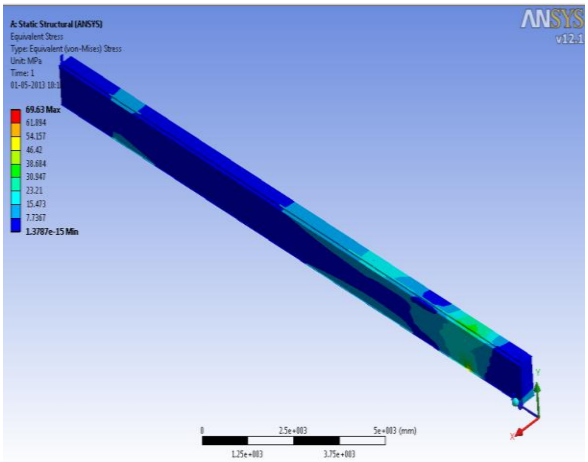


**Fig 1.5 Von Misses Stress of Case-7**

### 1.5.5 Maximum Shear Stresses

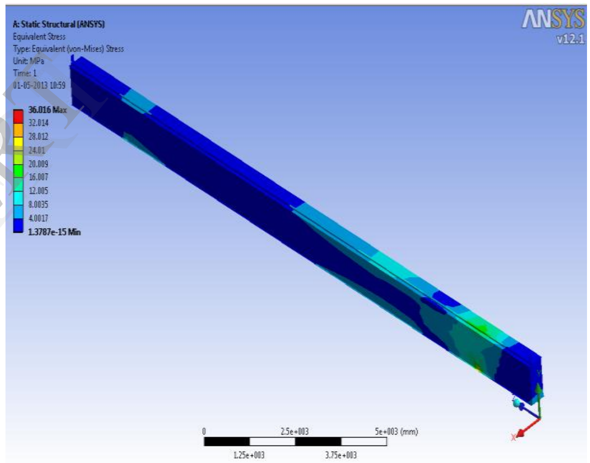


**Fig 1.6 Maximum Shear Stress of Case-7**

### 1.5.6 Total Deformation

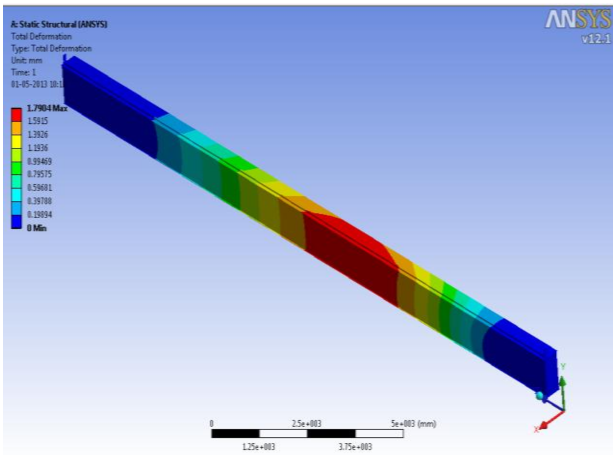


**Fig 1.7 Total Deformation of Case-7**

## Case 4

Pieces Length: -1000
Thickness of Girder Beam:-30
Height of Girder Beam: - 700

### 1.5.7 Von Misses Stresses

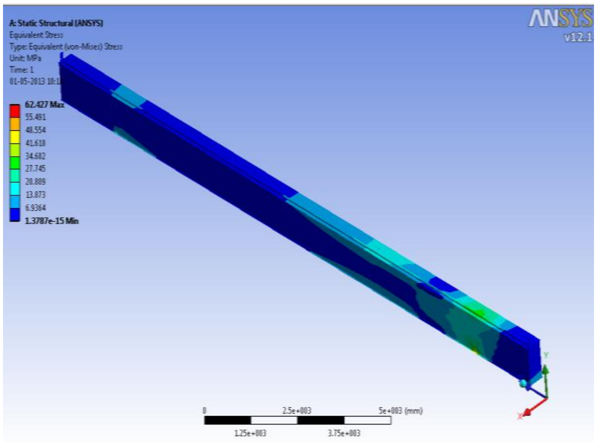


**Fig 1.8 Von Misses Stress of Case-6**

### 1.5.8 Maximum Shear Stresses

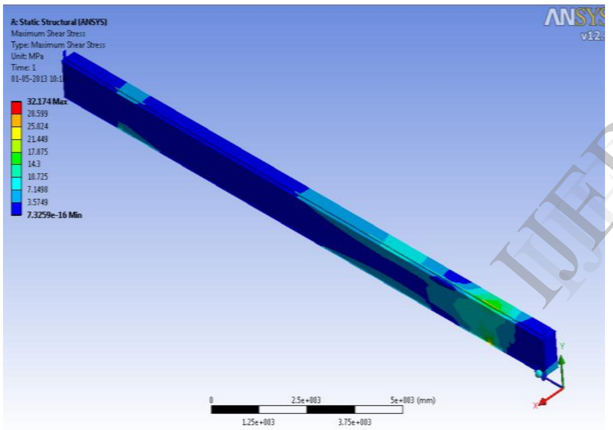


**Fig 1.9 Maximum Shear Stress of Case-6**

### 1.5.9 Total Deformation

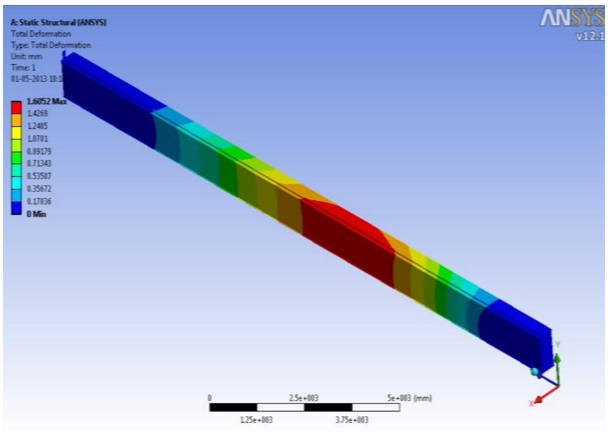


**Fig 1.10 Total Deformation of Case-6**

## Case 3

Pieces Length: -1000
Thickness of Girder Beam:-Height of Girder Beam: - 800

### 1.5.10 Von Misses Stresses

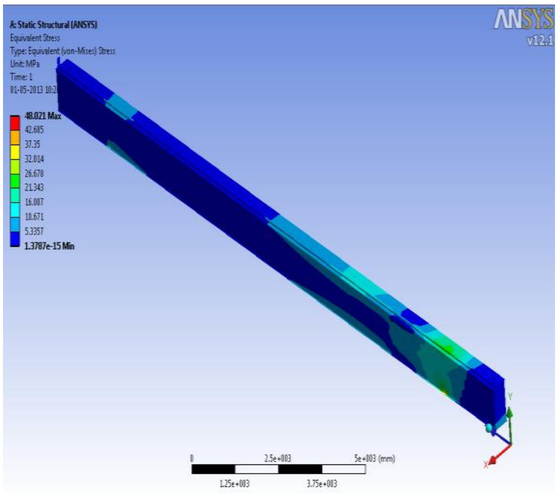


**Figure 1.11 Von Misses Stress of Case-4**

### 1.5.11 Maximum Shear Stress

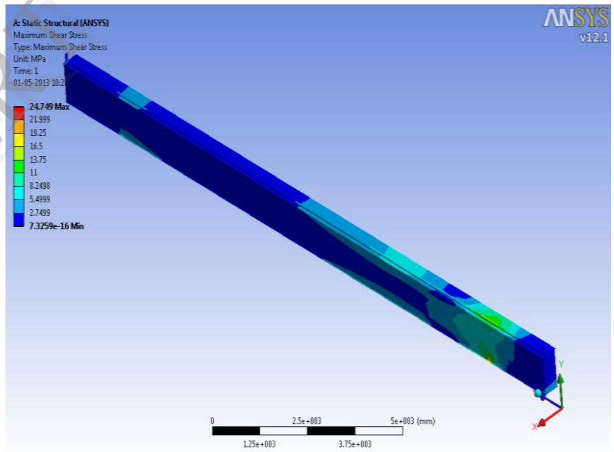


**Fig 1.12 Maximum Shear Stress of Case-4**

### 1.5.12 Total Deformation

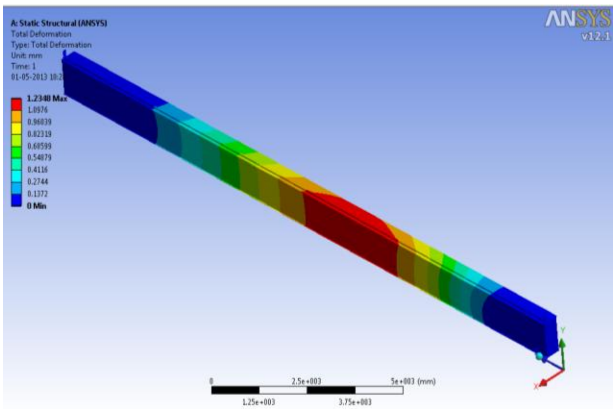


**Fig 1.13 Total Deformation of Case-4**

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**Case 2**
Pieces Length: -800
Thickness of Girder Beam:-26
Height of Girder Beam: - 800

**1.5.13 Von Misses Stresses**

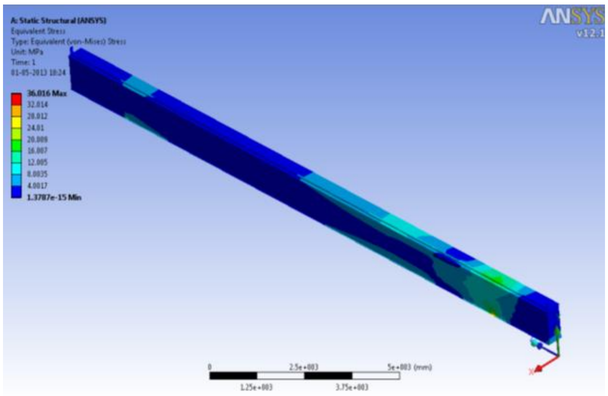

**Fig 1.14 Von Misses Stress of Case-2**

**1.5.14 Maximum Shear Stresses**

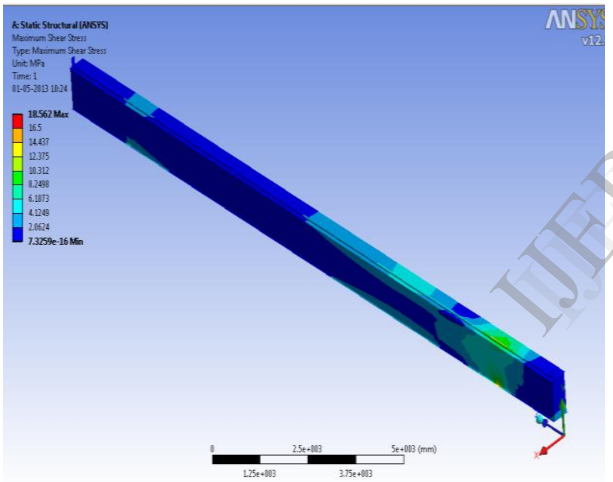

**Fig 1.15 Maximum Shear Stress of Case-2**

**1.5.15 Total Deformation**

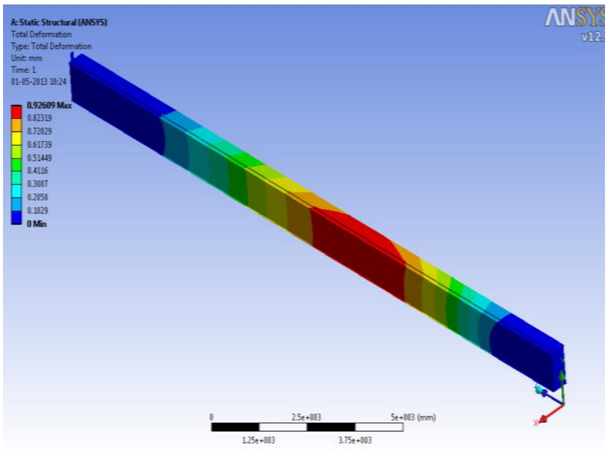

**Figure 1.16 Total Deformation of Case-2**

**Case 1**
Pieces Length: -800
Thickness of Girder Beam:-22
Height of Girder Beam: - 800

**1.5.16 Von Misses Stresses**

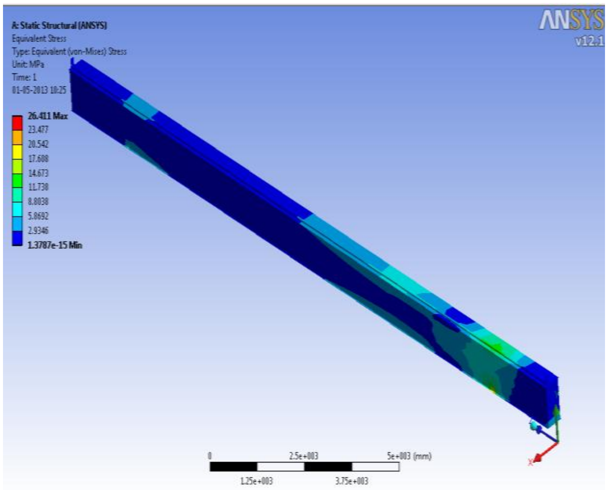

**Figure 1.17 Von Misses Stress of Case-1**

**1.5.17 Maximum Shear Stresses**

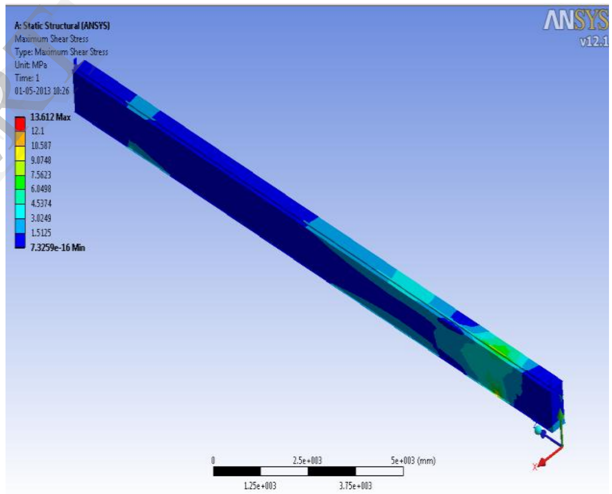

**Fig 1.18 Maximum shear stress of Case-1**

**1.5.18 Total Deformation**

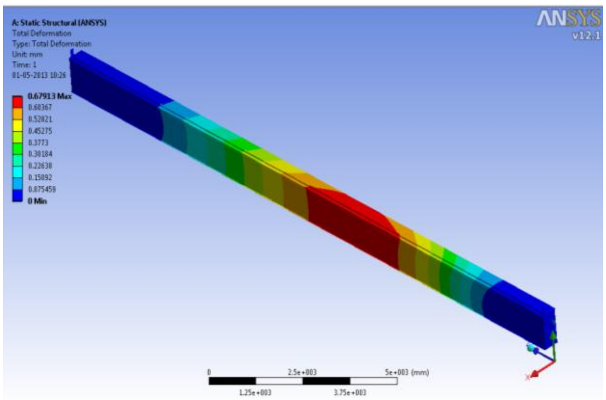

**Fig 1.19 Von Misses Stress of Case-1**

### 1.5.19 Main Effect plot for Means

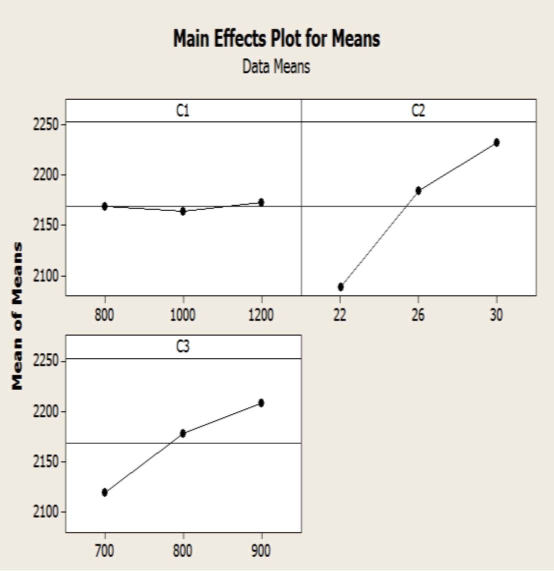


**Figure 1.20 Main Effect plot for Means**

### 1.5.20 Main Effect plot for SN ratio

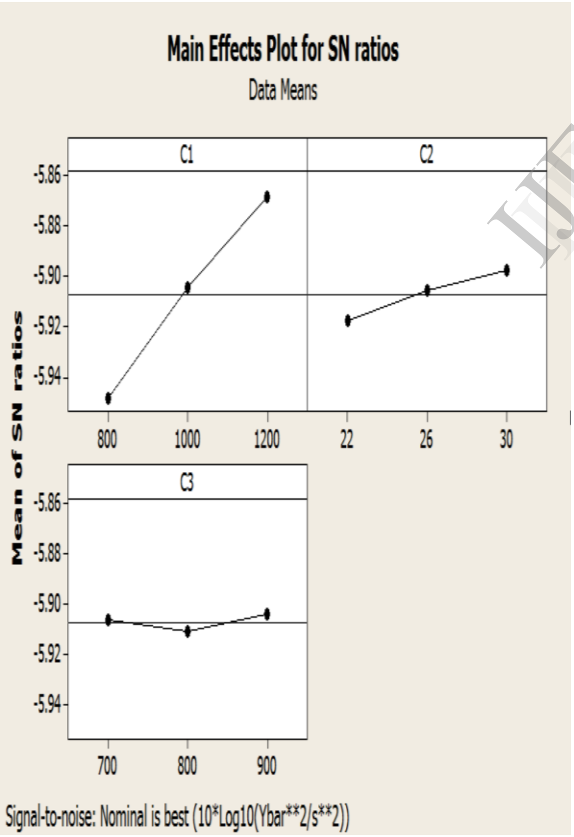


**Figure 1.21 Main Effect plot for SN ratio**

## Conclusion

### 1.6 Optimization result.

| Pieces length (mm) | Thickness (mm) | Height (mm) | Von Misses Stresses (Mpa) | Maximum Shear Stresses (Mpa) | Total Deformation (mm) | Weight (Kg.) |
|---|---|---|---|---|---|---|
| 800 | 22 | 700 | 26.411 | 13.612 | 0.67913 | 8125 |
| 800 | 26 | 800 | 36.016 | 18.562 | 0.92609 | 8614 |
| 800 | 30 | 900 | 43.219 | 22.274 | 1.1113 | 9125 |
| 1000 | 22 | 800 | 48.021 | 24.749 | 1.2348 | 8400 |
| 1000 | 26 | 900 | 57.625 | 29.699 | 1.4817 | 8800 |
| 1000 | 30 | 700 | 62.427 | 32.174 | 1.6052 | 8514 |
| 1200 | 22 | 900 | 69.63 | 36.016 | 1.7904 | 8314 |
| 1200 | 26 | 700 | 74.432 | 38.362 | 1.9139 | 8547 |
| 1200 | 30 | 800 | 76.833 | 39.599 | 1.9757 | 8874 |

Here from above table and graphs conclude that case 6 is optimum solution.



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