Analysis of Belt Conveyer System for Sugar Industry For Weight Reduction

[1] Prashant Kumkale Asst. Prof. Department of Mechanical Engineering,
[2] Jatin Sane, [3] Shubham Kute, [4] Chaitanya Dulange , [5] Shriram Saraf.
[2,3,4,5] UG Student Department of Mechanical Engineering,
JSPM's Imperial college of Engineering And Research Wagholi Pune 412207, Maharashtra, India.

Abstract : Conveyer System is the key piece of sugar industry. The primary function of the belt conveyer is to transportation of sugar bags to the storing section. In this technique the strong model of the segment is subdivided into littler components, imperatives and burdens are connected to the model. Geometrical show is made utilizing 3D demonstrating programming NX CAD 10.0. The static investigation of every parts are utilizing examination programming ANSYS WORKBENCH. The outcomes for greatest shear weight on the best, sustain, release rollers which are used in the conveyor are ascertained diagnostically and contrasted. Static examination of each of the rollers and conveyor structure are finished utilizing extraordinary materials for examining. It is observed that shear stress in Cast Iron is less than existing materials.

Keywords— Belt conveyor, Static analysis, Max. Shear stress theory, ANSYS Workbench

I. INTRODUCTION

A belt conveyor system consists of two or more pulleys (sometimes referred to as drums), with an endless loop of carrying medium the conveyor belt that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler pulley. There are two main industrial classes of belt conveyors; Those in general material handling such as those moving boxes along inside a factory and bulk material handling such as those used to transport large volumes of resources and agricultural materials, such as grain, salt, coal, ore, sand, overburden and more. The belt consists of one or more layers of material. It is common for belts to have three layers: a top cover, a carcass and a bottom cover. The purpose of the carcass is to provide linear strength and shape. The carcass is often a woven or metal fabric having a warp & weft.

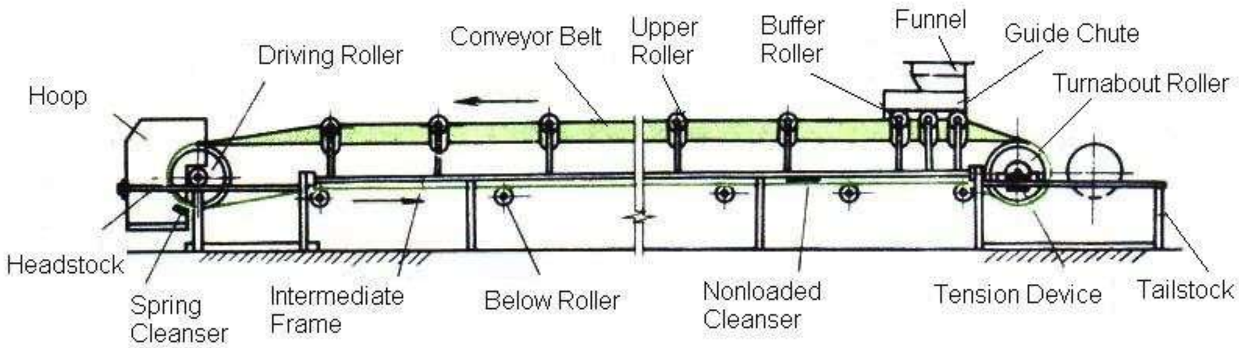

Fig.1 Drawing of Belt Conveyor

II. THEOROTICAL APPROACH

GIVEN DATA

Weight on conveyor = 450 kg
Length of Conveyor = 15150 mm

MATERIAL PROPERTIES

Material =**40c8**
ϱ=7850 kg/m^3
Sut=680 mpa
Syt=380 mpa

E=200000 mpa

Poisson ratio=0.3

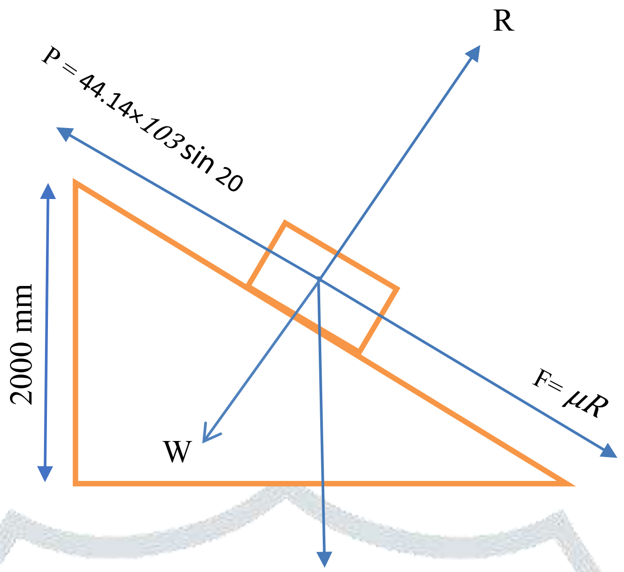

Fig 2 Tension Diagram for conveyor

Load = 450 × 9.81 N

= 44.14×10^3 N

μ = 0.25 (For Belt)….. from design manual

R= 44.18 $\times.10^3$ cos 20

$\sum$ Fx = 44.18×10^3 sin 20 +0.24 (44.18×10^3 cos 20) -F_T

Force Required to Lift the load (F_T) = 25.07×10^3 N

The force required to lift is 25.07×10^3 N

* Drive Pulley Shaft Design:

$\frac{T1}{T2}=e^{\mu\theta}$

Where,

T_1= Tension in tight side

T_2= Tension in slack side

μ = coefficient of Friction

θ = angle of contact

μ= For Flat belt = 0.20 (mannual)

θ= For Flat belt drive For 16600 mm distance

θ=180°=π rad

$\frac{T1}{T2}=e^{0.2\times\pi}$

T_1= 1.87×T_2

***Speed calculation**

The motor available in market is 1440 rpm

The speed of the conveyor belt,

we have to put 5 bags / min.

1 Bag = 1 meter

Speed assumed as 5 meter / min.

Linear speed of belt = Vb= 0.083 m/s =83.33 mm/s.

***Roller Diameter**

The roller diameter calculated by shear force and Bending moment =100 mm.

Speed calculation For Pulley & motor,

$\frac{N1}{N2} = \frac{D1}{D2}$

$N1$=Speed of Motor

$N2$= Speed of the power roller

$D2$=Diameter of the power roller

$D1$=Diameter of the motor

We know that,

$V = \frac{\pi D\ N2}{60}$

$83.33 = \frac{\pi .1000.N2}{60}$

$N2$ = 159.1 rpm.

$N2$ = 160 rpm.

The speed reduction is to much. so we have to select smallest pulley for the motor which is available in market.

By referring the catalogue, the selected motor is of 37 kW/1500 rpm (Nominal power). The shaft diameter of the motor is 75mm.

$D1$= 75 mm.

There are various types of V belt which are recognized by A, B,C type.

According to the design manual for the speed load we select B type belt & pulley.

$\frac{N1}{N2} = \frac{D1}{D2}$

$\frac{N1}{160} = \frac{D2}{75}$

$D2$= 656.2mm.

***Power required**

We know that

$P = \frac{2\pi NT}{60}$

T = Tangent force × Radius

$= F_T \times R$

$= 25.07\times 10^3 \times 50$

$T = 2.25\times 10^3$ N.m

$P = \frac{2\pi\times 160\times 2.25\times 10^3}{60}$

P = 2091 Watt.

P = 2.8 HP.

So with respect to the calculations motor selected is P = 3.5 HP.

III. Structural Analysis

A) Three Dimensional CAD Model

A three dimensional model of belt conveyor is made by using modeling software NX CAD is the most powerful and widely used CAD software of its kind in the world.

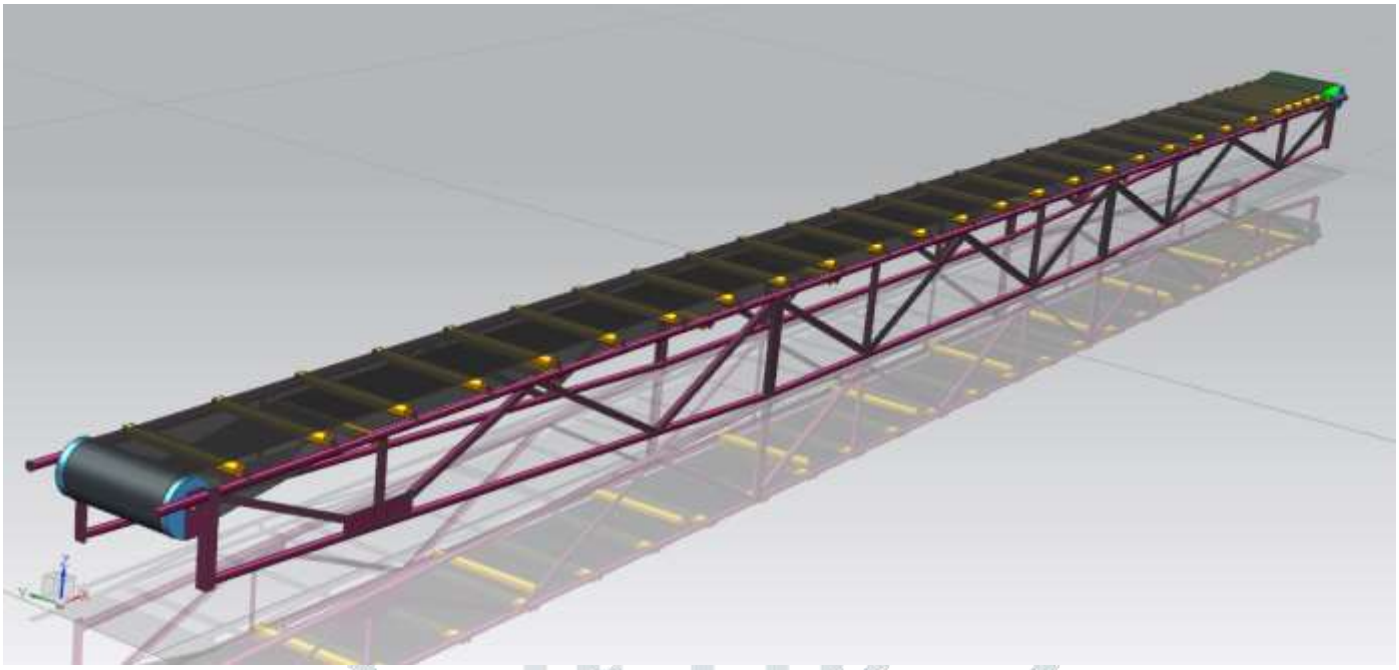

Fig.3.NX CAD 10.0 3D model of conveyor belt

B) STATIC ANALYSIS OF TOP ROLLER

*1) **Mesh Generation in roller***

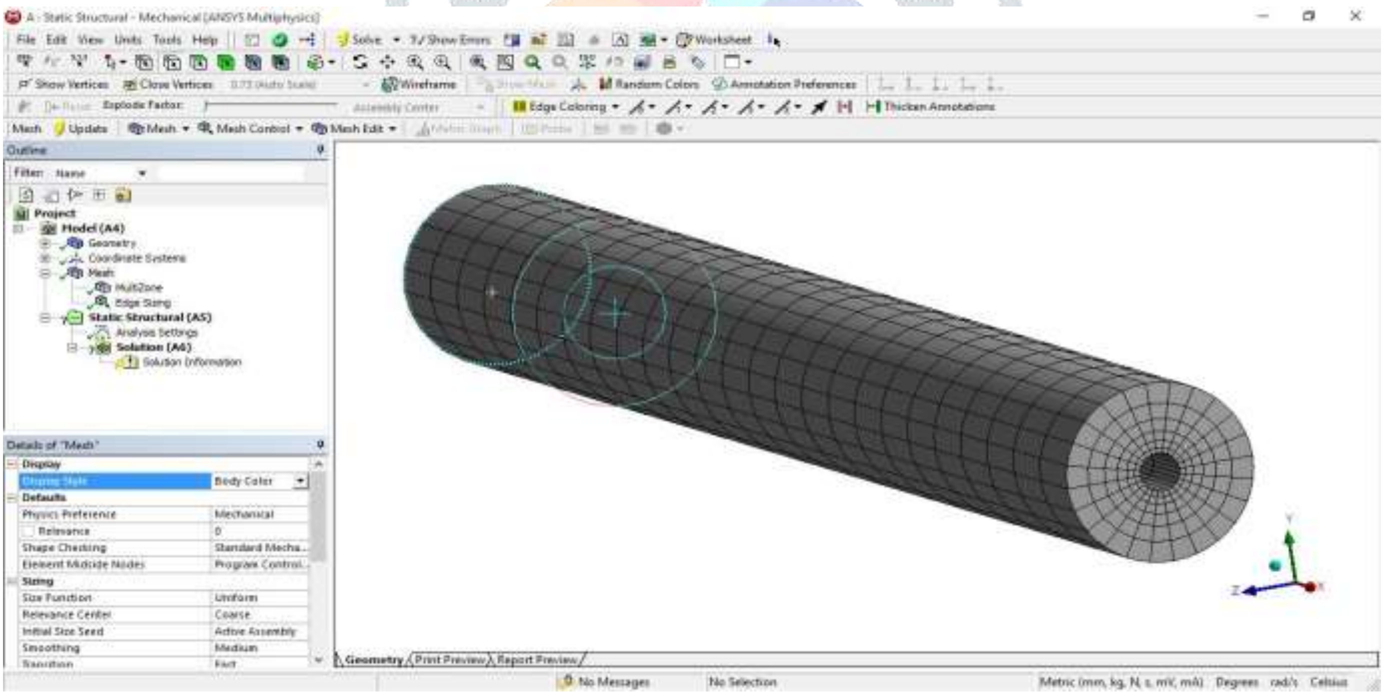

Fig.4. Meshing of end roller

2) Results of Static Analysis of End Roller With Different Materials

2.1 Cast Iron

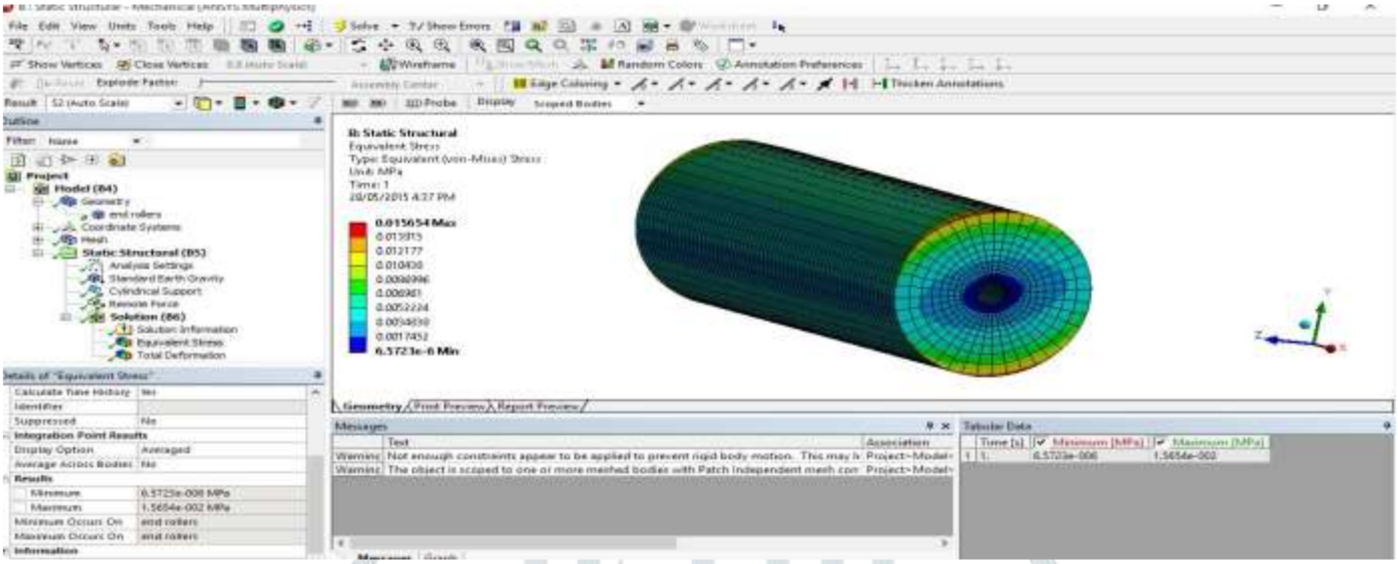

Fig.5.Shear stress on end roller

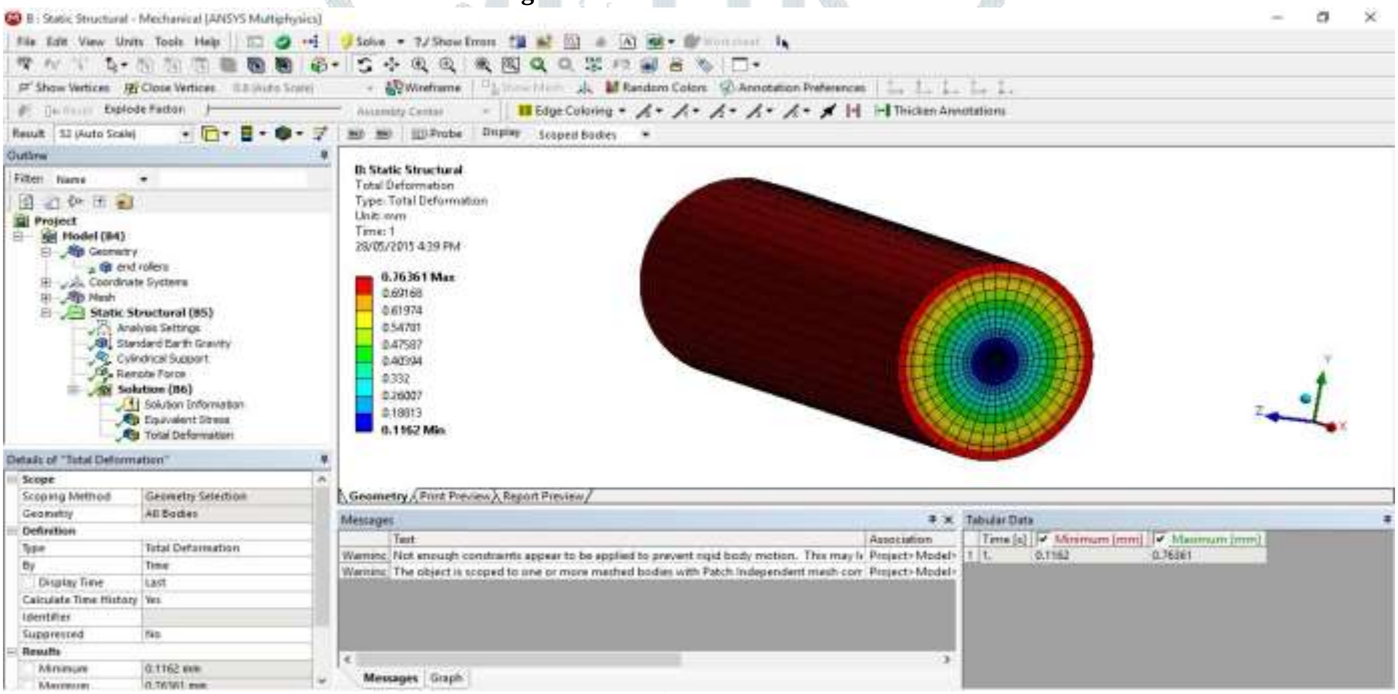

Fig.6.Deformation in end roller roller

2.2 STRUCTURAL STEEL

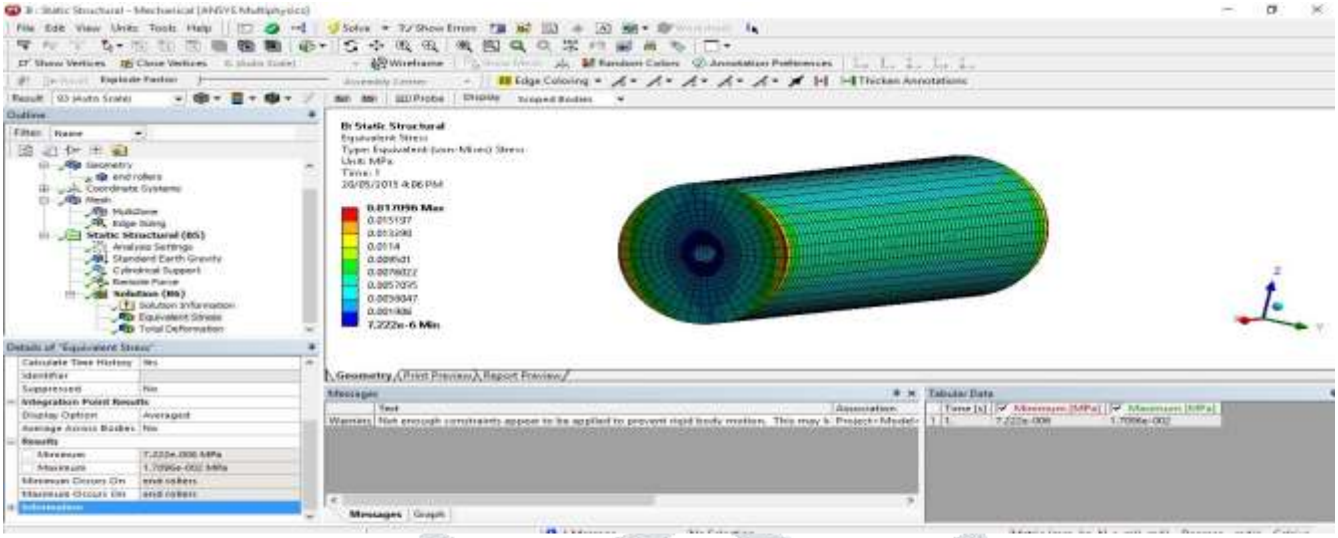

Fig.7. Shear stress in structural steel

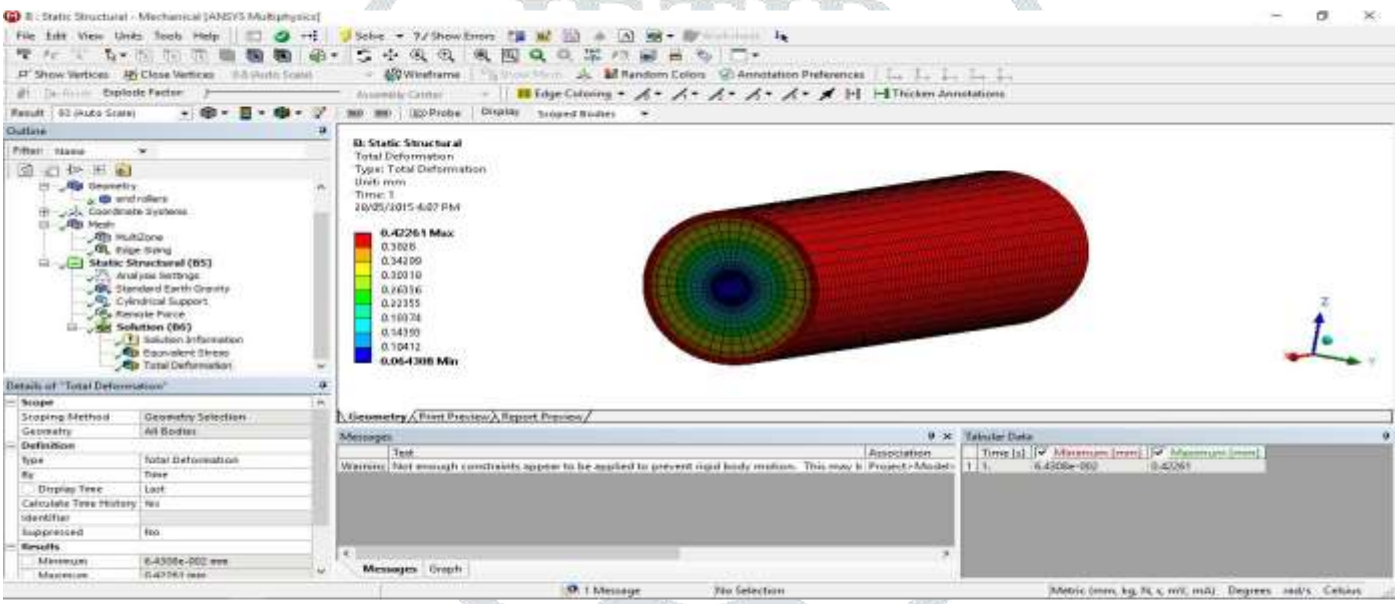

Fig.8. Deformation in structural steel

3) Results of Static Analysis of Start Roller With Different Materials

3.1 Cast Iron :

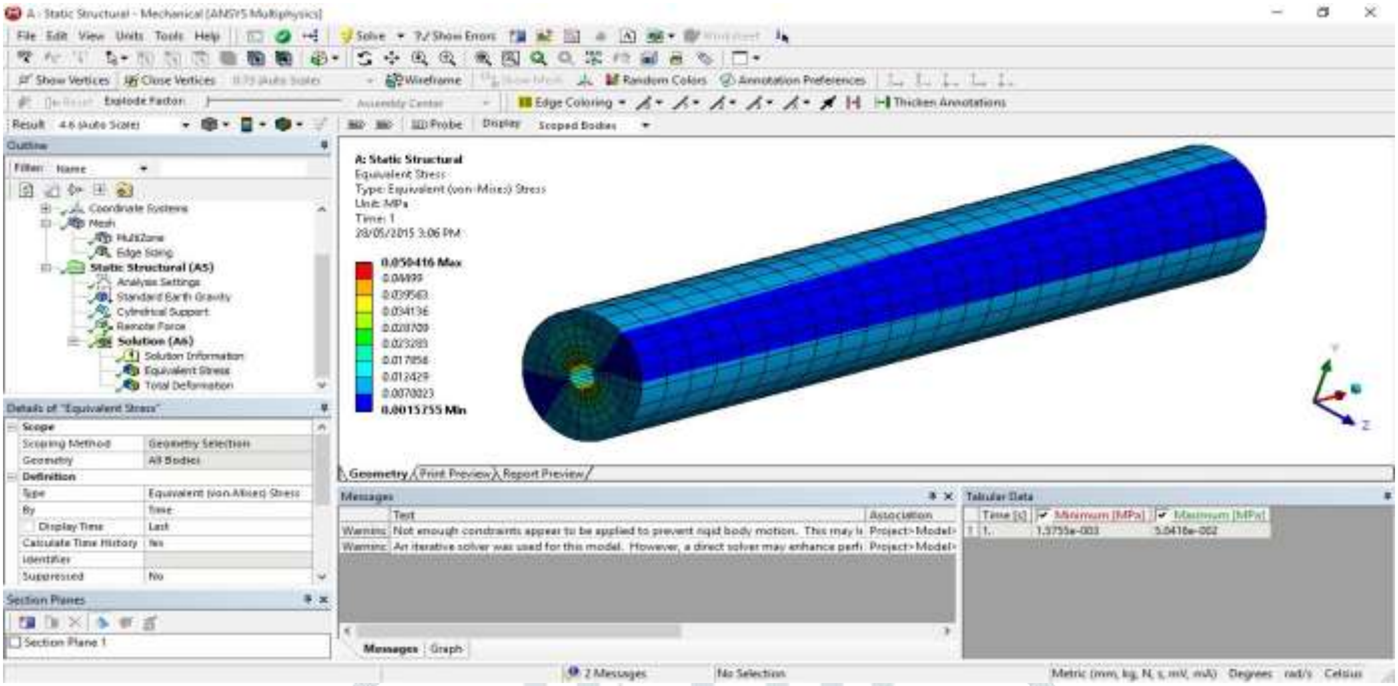

Fig.9. Shear stress in cast iron

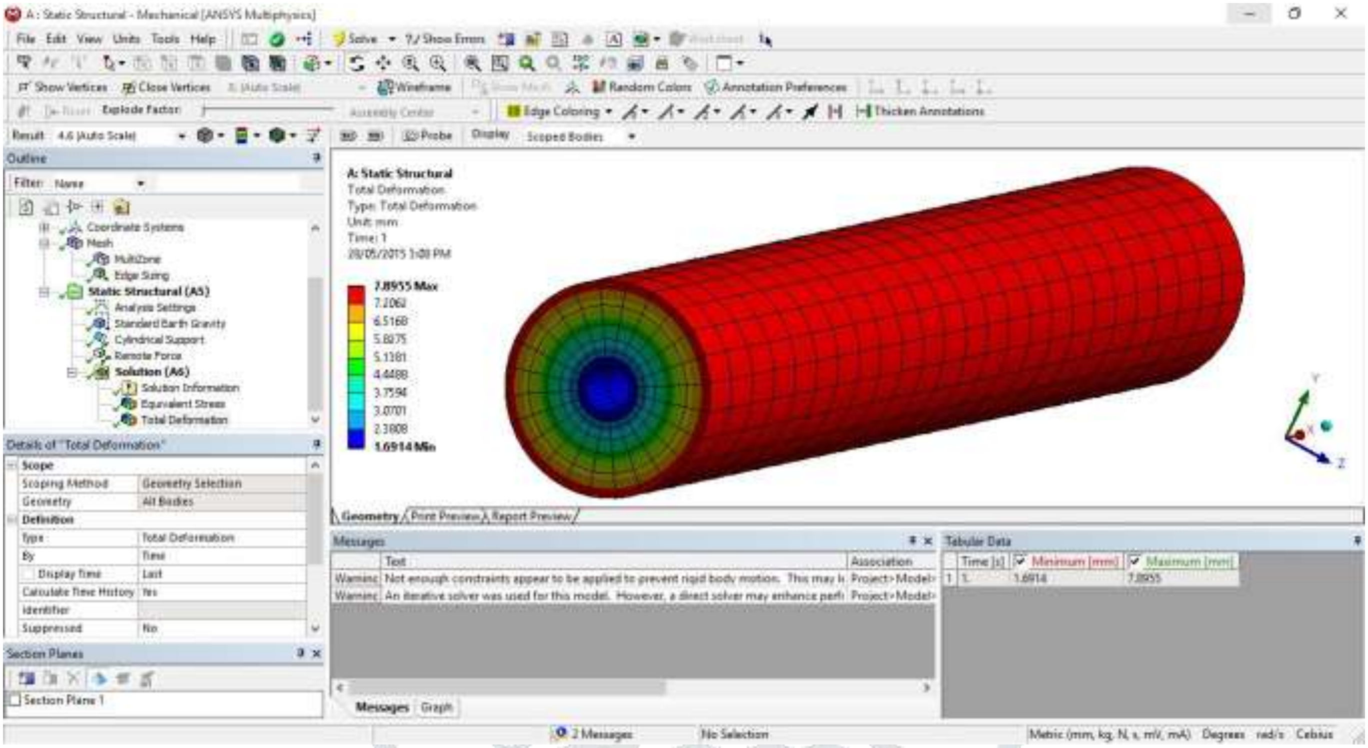

Fig.10. Deformation in cast iron

3.2 Structural Steel

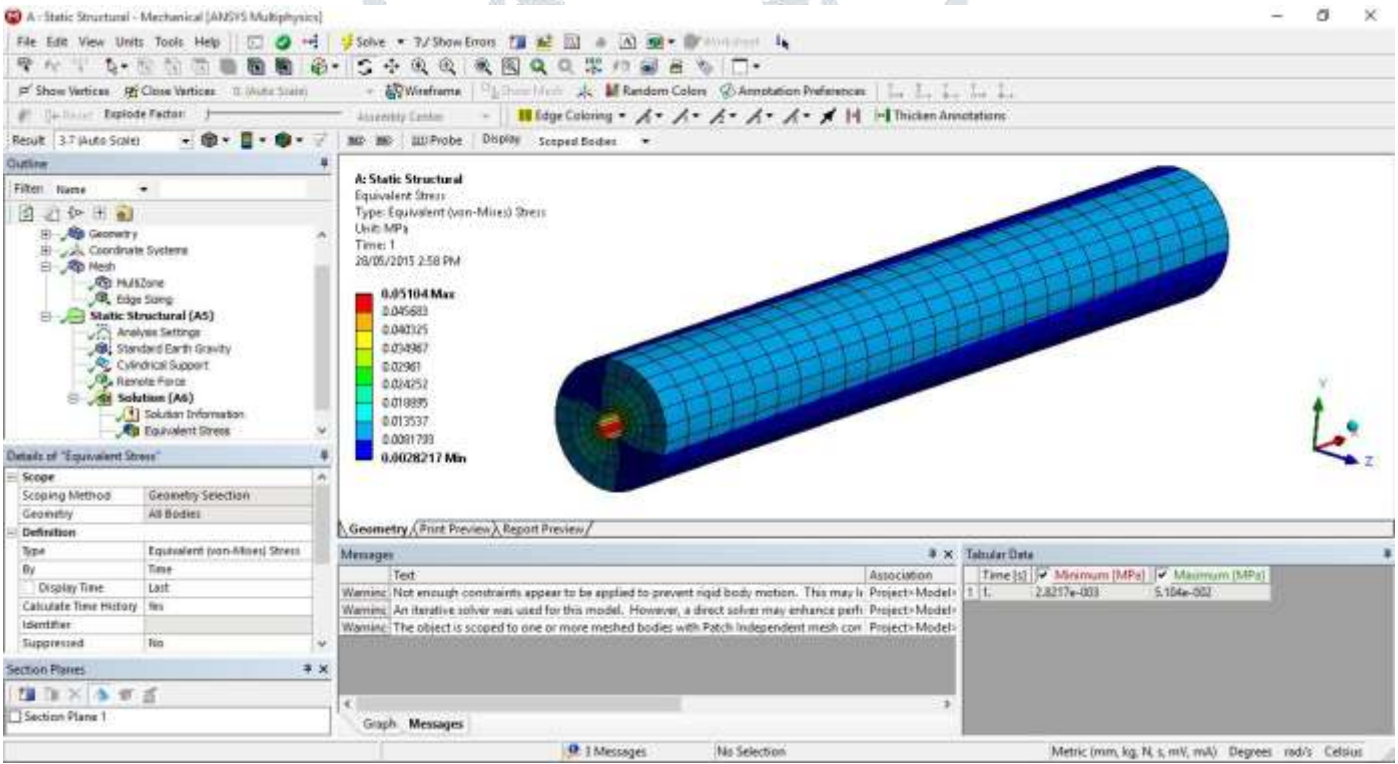

Fig.11. Shear Stresses in Structural steel

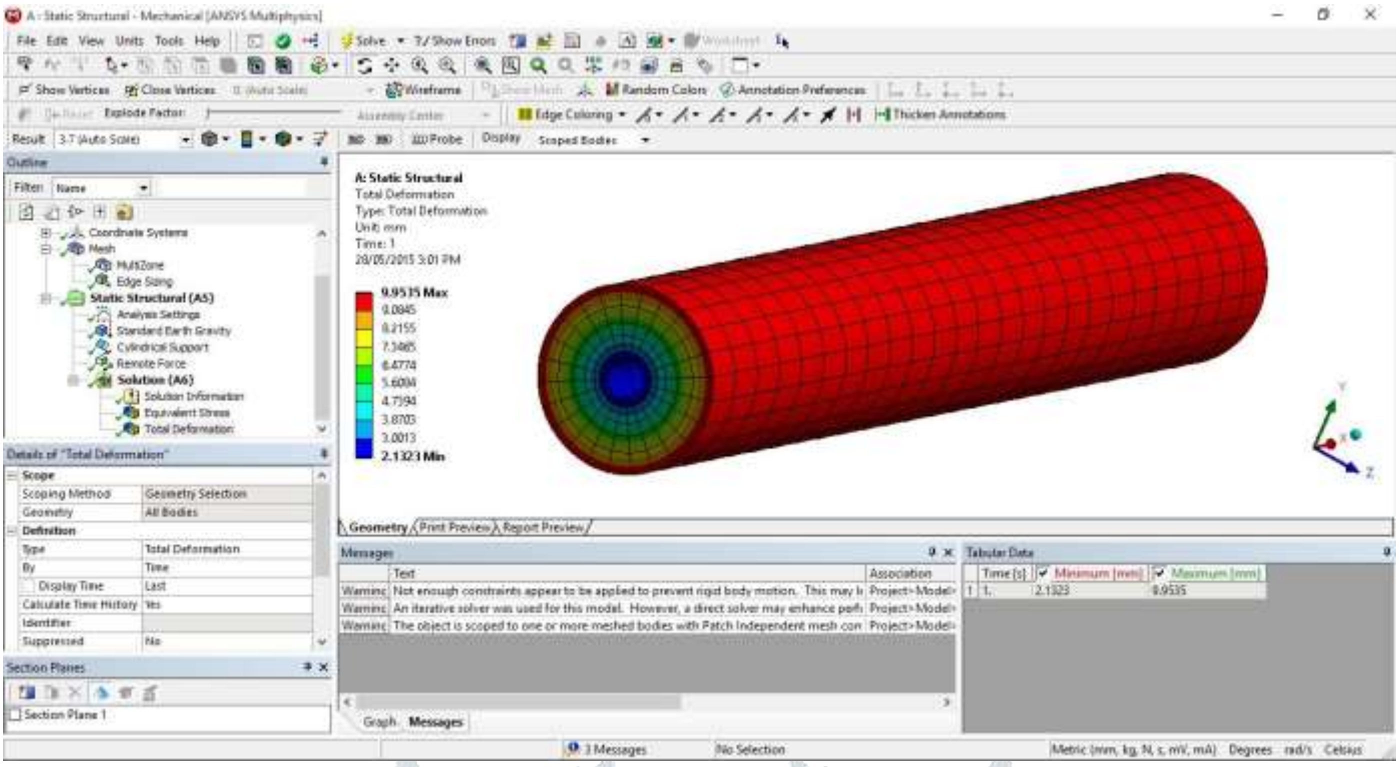

Fig.12 Deformation in Structural Steel

Table No-1.Result of static analysis of End roller

Material	Shear stress (Mpa)	Total deformation (mm)	Mass (Kg)
Structural Steel	17.046	4.76	5.5896
Cast iron	15.285	2.589	4.9428

Table No-2.Result of static analysis of Start roller

Material	Shear stress (Mpa)	Total deformation (mm)	Mass (Kg)
Structural Steel	51.042	9.954	4.7848
Cast iron	50.275	7.1425	3.9856

IV. Conclusion

3-D modeling and analysis has been done for roller the driver roller and driven roller from static analysis for different material results is observed. From the results it is conclude that-

1) Maximum shear stress value for roller is less than yield strength in shear of material so,the shaft is safe.
2) As the value of max. Shear stress is very less than yield strength in shear of material, so there is scope for weight optimization.
3) Maximum shear stress values by analytical calculations and by software are nearly same, so results are validated.
4) Based on the total deformation and mass of material,Cast Iron is the best among given materials.
5) As material is a changed value of max. Shear stress is nearly same.
6) The shear stress in Cast iron is less than strucutal steel , so strength also be increases.

V. ACKNOWLEDGMENT

It gives us great pleasure to express our deep gratitude to our project guide Asst. Prof. Prashant Kumkale for his support and help from time to time during this work. It is our pleasure to acknowledge deep sense of gratitude to Mr. Nagesh Bhujbal chief Engineer Shrinath Mhaskoba Sakhar Karkhana Ltd. for their great support and encouragement in project work.

REFERENCES

[1] Nikhil V. Bhende, Aniket C. Wasule, Pratik R. Patil, V-type merged conveyor system IJSRD Vol-3, Issue 01,2015 ISSN(online) 2321-0613

[2] Konakala Naga Sri Ananth, Vaitla Rakesh, Design and Analysis of Conveyor Assembly E-ISSN 0976-3945

[3] Deepak Gupta, Dheeraj Dave, Study and performance of belt conveyor system with different type parameter, IJIRSR Vol-2,issue 06, November 15 ISSN(Online) 2349-6010

[4] V.B. Bhandari (2010), Design of machine element,Tata McGraw Hill publications .

[5] ANSYS workbench help.

[6] A text book of machine design by R.S. Khurmi.