Design and analysis of roller cutting machine in ginning industry

Project : IDP

Group no. ME014

GOALDONE SOLUTION , KADI

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INTRODUCTION OF COTTON GIN

- Cotton fibers must be separated from the seed before they can be used to manufacturing textile goods.
- The first machine of gin cotton was the “churka” gin.
- The “churka” gin was most efficient when handling naked seeds varieties with loosely attached fiber.
- Early American settlers found that the fuzzy seeded varieties that yielded best in the country were difficult to gin on a roller gin.

Why we select this project

- Once we visit in industry in which the roller cutting machine is operate manually . all the work is manually operated there and it was take so time and very time consuming and it need more labor work. so it is the major problem for company so we decide that we should design a roller cutting machine with some various change in parameters . our target is to make machine fully automated so it not need much manual work . so we analyze the machine in ansys software.

PROBLEM STATEMENT

- In ginning industries the most common problem is the roller, first of take away roller from gin machine and set on roller cutting machine , the motor is on base which is on sliding bearing so . when the motor is start with the help of high skilled labor the base is moving reciprocating so with this reciprocating moment the spiral cut is going on roller and it is totally manual work and machine is stopped until roller is spiral so it is taking so much time with this process. this process stop works until roller is not get spiral. Although it is long process but is not accurate also and it required high skilled labor the time waste is different.

Roller in ginning industries

Key Dimension = 30mm

Shaft Diameter = 40mm

Total length of roller = 1461.89mm

Shaft length with key = 1388.89mm

Spiral depth = 0.5inch

= 12.72mm

Spiral gap = 1.5inch

= 38.099mm

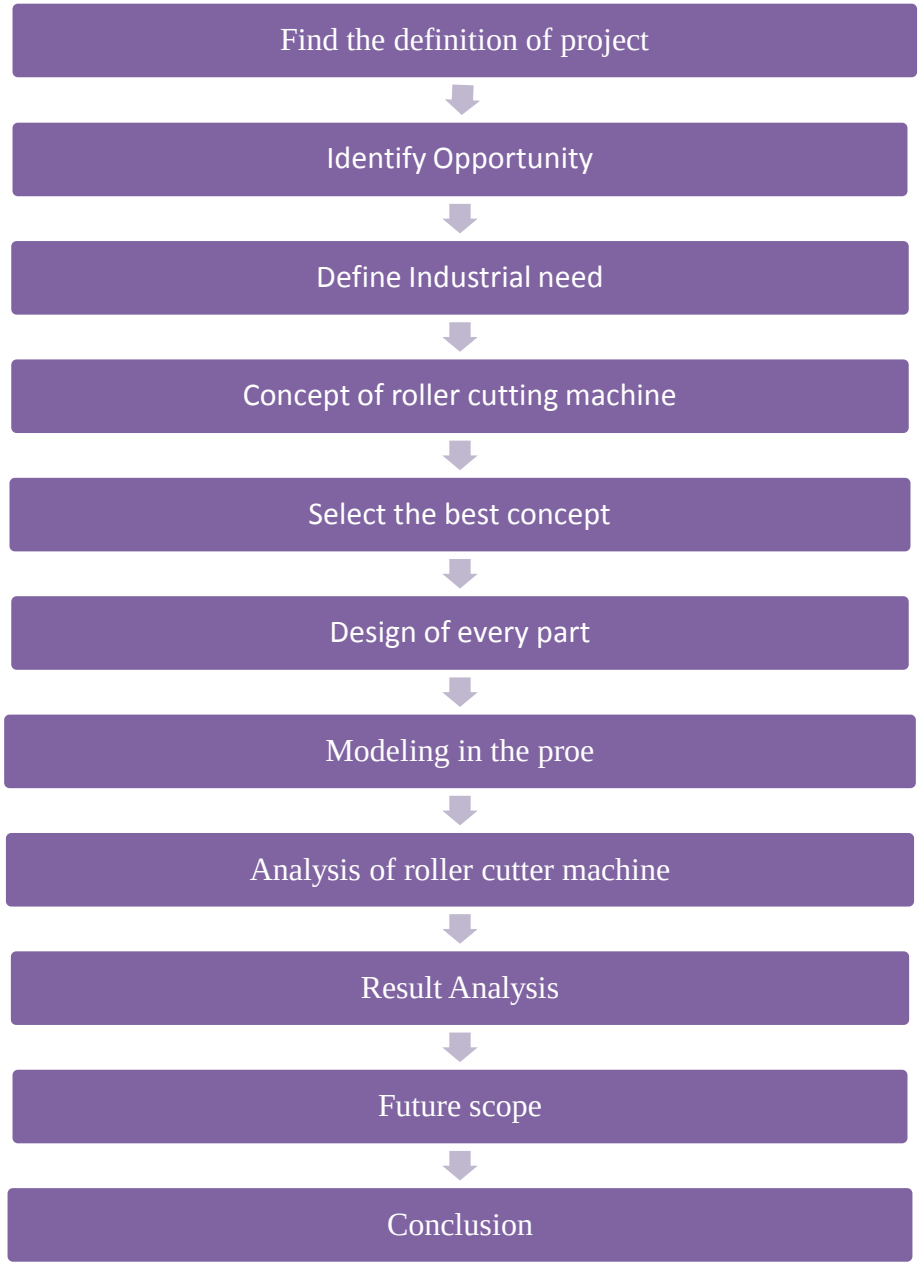
Objective Of Roller Cutting Machine

1. The Gap between two spiral has very accurate.
2. The Depth of cut is also perfect.
3. To familiar with operation procedure.
4. To increase the production rate.
5. To Reduce the preparing time work.
6. To make process more automatic.

Scope of Project

- In all ginning industries they have the need of roller cutter machine with automatic. so our scope of project is at all ginning industries, because they are very familiar with this project.

Methodology



Historical Background

- Before we go into the details of New Developments in Cotton Ginning, it would be appropriate to have a look on past developments in ginning technology.

- In this respect, Charles A. Bennett, former Principal Agricultural Engineer, Cotton Ginning Section, (A.E.R.D.) USDA stated that;

- “Neither history nor archaeology have established when mankind first began to use cotton fibers, but fabrics oh cotton are quite definitely known to have been in use as far back as 4000 years B.C. In India and probably served people long before then.”

- he further stated that; “Undoubtedly the first method of ginning cotton was with the human fingers, a method that has continued in use throughout the centuries.”

Type of Ginning Machines

A. Single Roller (SR) Gin

B. Double Roller (DR) Gin

C. Rotary Knife Gin (Rotobar)

1. Single Roller Gin

- It lies in picking and then moving the cotton fibres between the roller and fixed knife preventing the seeds to pass through. The seed cotton, when thrown into the hopper, passes through the machine. While the machine is working, at each elevation of the moving knife the grids lift the cotton to the level of the stationary knife-edge and of the exposed surface of the rollers. The free ends of the fibres are gripped, in the grooves of the rotating roller, and dragged forward till the seeds reach the edge of stationary knife.

2. Double Roller Gin

- In a double roller (DR) gin, two spirally grooved leather rollers, pressed against two stationary knives with the help of adjustable dead loads, are made to rotate in opposite directions at a definite speed. The three beater arms (two at end and one at the center of beater shaft) are inserted in the beater shaft and two knives (moving knives) are then fixed to the beater arms with proper alignment. This assembly is known as beater assembly, which oscillates by means of a crank or eccentric shaft, close to the leather roller. When the seed cotton is fed to the machine in action, fibres adhere to the rough surface of the roller and are carried in between the fixed knife and the roller such that the fibres are partially gripped between them.

- The oscillating knives (moving knives) beats drags the seeds from top to opposite direction causing separation of fibres from the seed end. This process is repeated a number of times till all spinnable fibres are separated from the seeds. The fibres so detached from seeds are carried forward on the roller and drop out of the machine. The ginned seeds drop down through the slots provided on seed grid and the gap between end of seed grid and rail.

Fig. 1.2 Double roller ginning machine with auto feeder[1]

3. Rotobar gin

- The Rotobar gin is shown in Figure 1.3 It works on the same principle as the roller gin as shown in Figure 1.4. It has a rotating instead of oscillating beater bar, and is expected to give higher amount of lint per hour, per machine.

Fig.1.3 Rotobar gin[1]

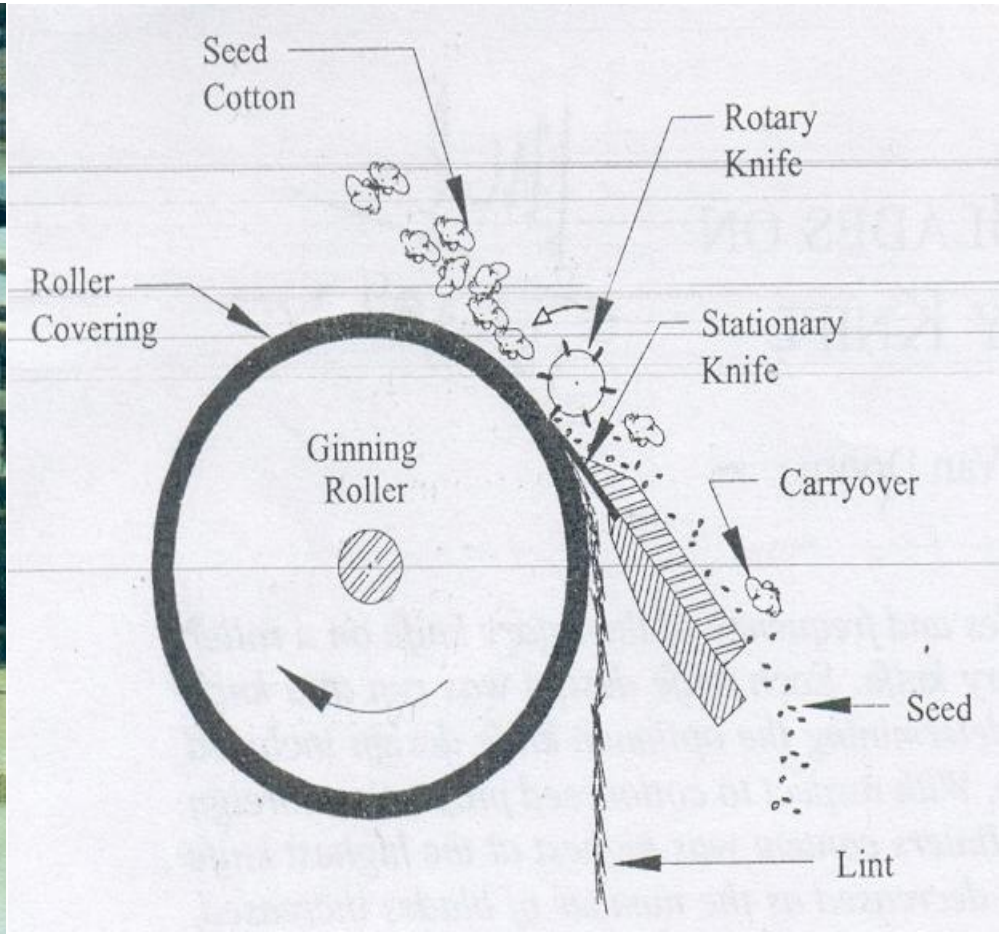


Fig. 1.4 Principal of Operation[1]

Literature Review

- Paper 1:

V. G. Arude et al.(2014)[1] conclude that Self-grooving rubber roller as substitute to chrome composite leather roller for use in ginning machine was developed. Self-grooving rubber roller was made out of rubber discs of hard and soft rubber compound prepared in a specially designed die by molding technique. Roller was made with nitrile rubber having radial layers of softer rubber compound to form grooves. Conclusion is that Self-grooving rubber roller was developed as substitute to chrome composite leather roller. Use of the rubber roller increased the productivity of the DR gin by 25 to 30%. Periodical grooving and drudgery involved in grooving operation was eliminated. It resulted in reduction in downtime up to 2 hours/day. 81 Energy consumption reduced by 15 to 18% and working like of the rubber roller was estimated to five times that of leather roller. Rubber roller is eco-friendly and there is no environmental pollution and health hazard to workers as there is no chromium contamination while ginning. It was observed that one time investment on the modification in DR gin can be paid back within a period of 76 working days of 20 hrs

PAPER 2

Mr. M. K. Sharma et al.(2012) Conclude that Ginning is the mechanical process for separating cotton into its constituents namely lint (Cotton Fibre) and Cotton Seed. The Seed Cotton that comes from the field has to be subjected to various treatments in the ginning factories depending upon its inherent characteristics such as trash contents, moisture contents, length of the fibre, variety of seed i.e. fuzzy or black, method of seed cotton transportation, storage practices, handling practices inside the ginning factories and finally subjected to ginning process for separation of fibre and seed before packing into bales etc. Conclusion is With the introduction of fully automatic plants for all the ginning technologies in the world man power requirement for all of them is more or less similar, hence the ginning technology which is most suitable for the type of cotton available for ginning should be selected i.e. for the black seed long and extra long staple cotton if it is clean McCarthy Single Roller or Double Roller should be selected but if it is machine picked / having higher trash then Rotobar should be used. For fuzzy seed cotton up to medium staple cotton if it is having higher trash Saw Gin set up should be used however if it is handpicked / clean Double Roller should be used to obtain best fibre parameters.

Calculation for design

1 Calculation of Lead Screw

(1) Calculate a Column theoretical strength (for linear motion)

d = 40mm

l = 1828mm

Fc = End fixing factor

$$Pcr = \frac{(14.03 * 10^6 * Fc * d^4)}{l\text{^}2}$$

where Fc = 4.0

Pcr = 42.99*10^6 N/mm^2

(2) Critical Speed (N)

$$N = \frac{4.76 * 10^6 * d * Fc}{l^2}$$

N = 127rpm

(3) Lead Angle

$$\tan\theta = \frac{l}{2\pi r}$$

$$\theta = \tan^{-1} 14.54$$

θ =89 degree

(4) Friction torque of the trust collar(Tc)

$$Tc = \frac{F * Fc * dc}{2}$$

Tc = 15.7064 kN

(5) Angular speed (w)

$$.5Iw^2 = F * d$$

w = 2.13

(6) Power required for lead screw(P)

$$P = T * w$$

$$P = F * d * w$$

$$P = 1.065\ kW$$

2.Calculation For Sliding Bearing

Rod1 = 25kN

Rod2 = 25kN

(1) Torque in Sliding Bearing(T)

Torque = Force*distance

T = 25*1828

T = 45720N-mm

(2) Power in required sliding bearing(P)

$$P = T*W$$

$$P = 45720* \frac{2\pi N}{60}$$

P = 689.09184kW

3. Motor Power

N = 1440rpm

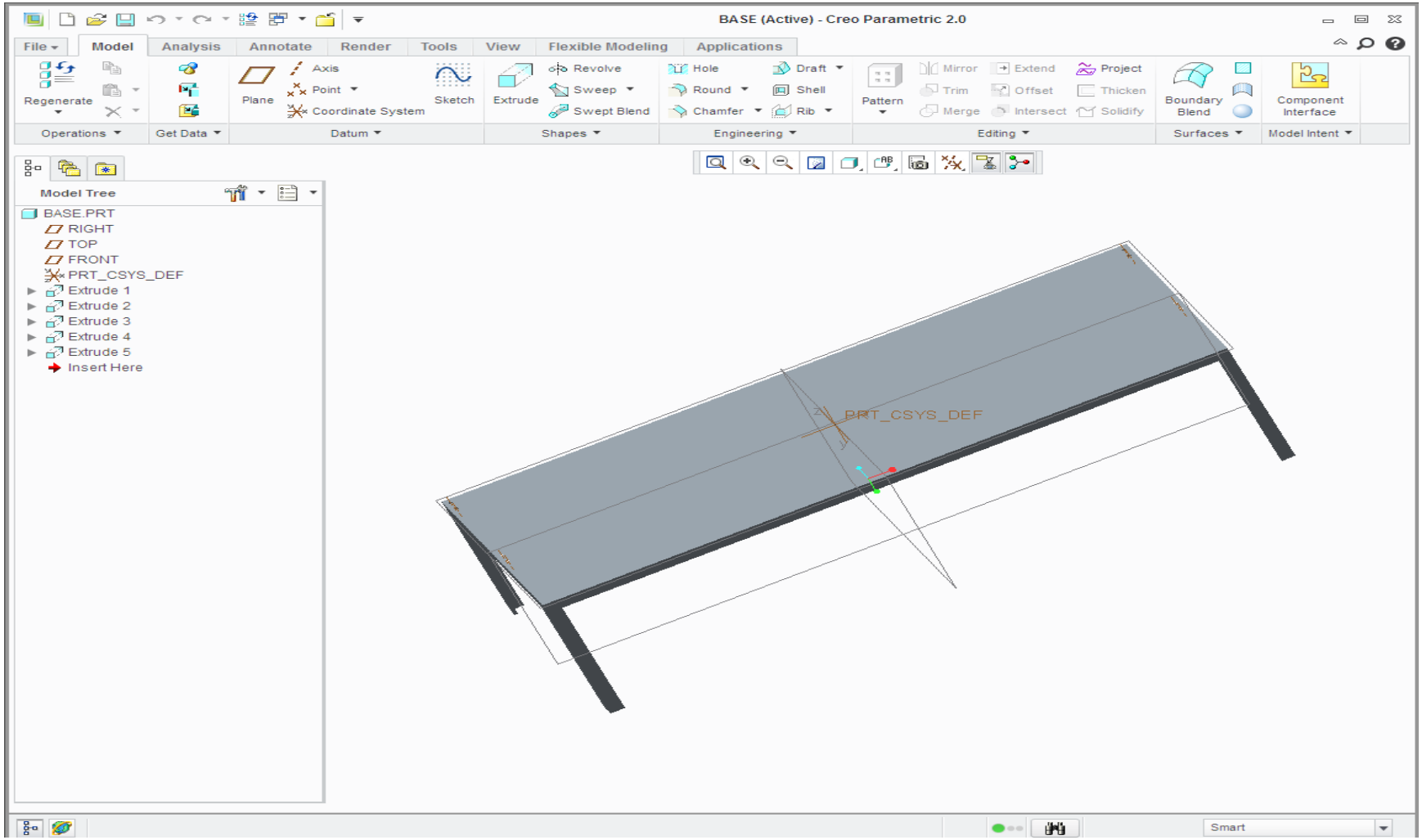
$$P = \frac{2\pi N}{60}$$

P = 150.72watt

Company Roller cutting Machine

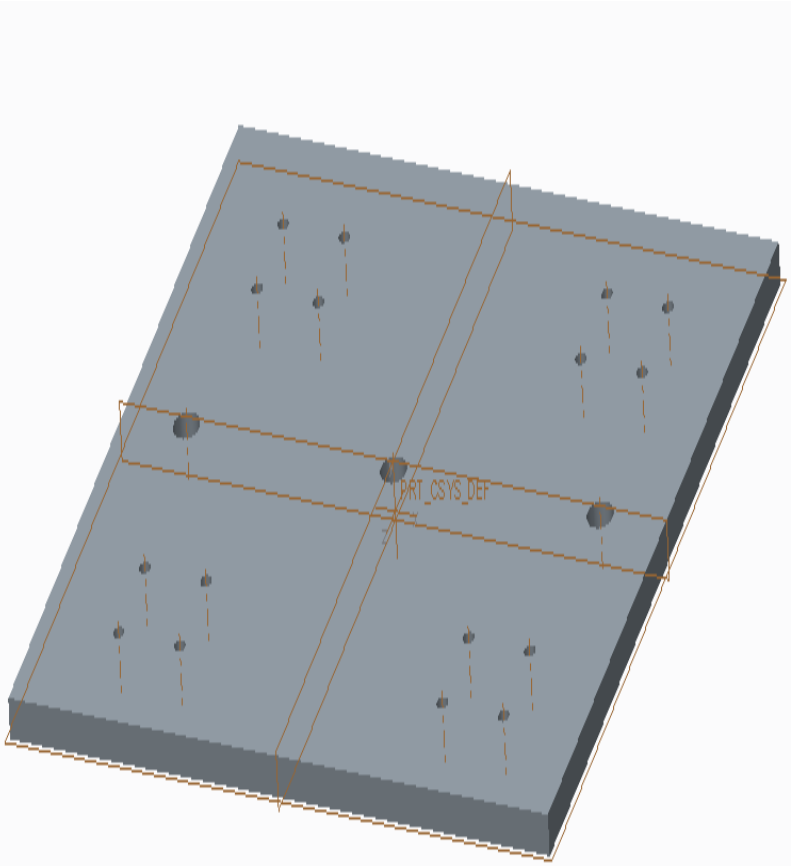
Modeling In ProE

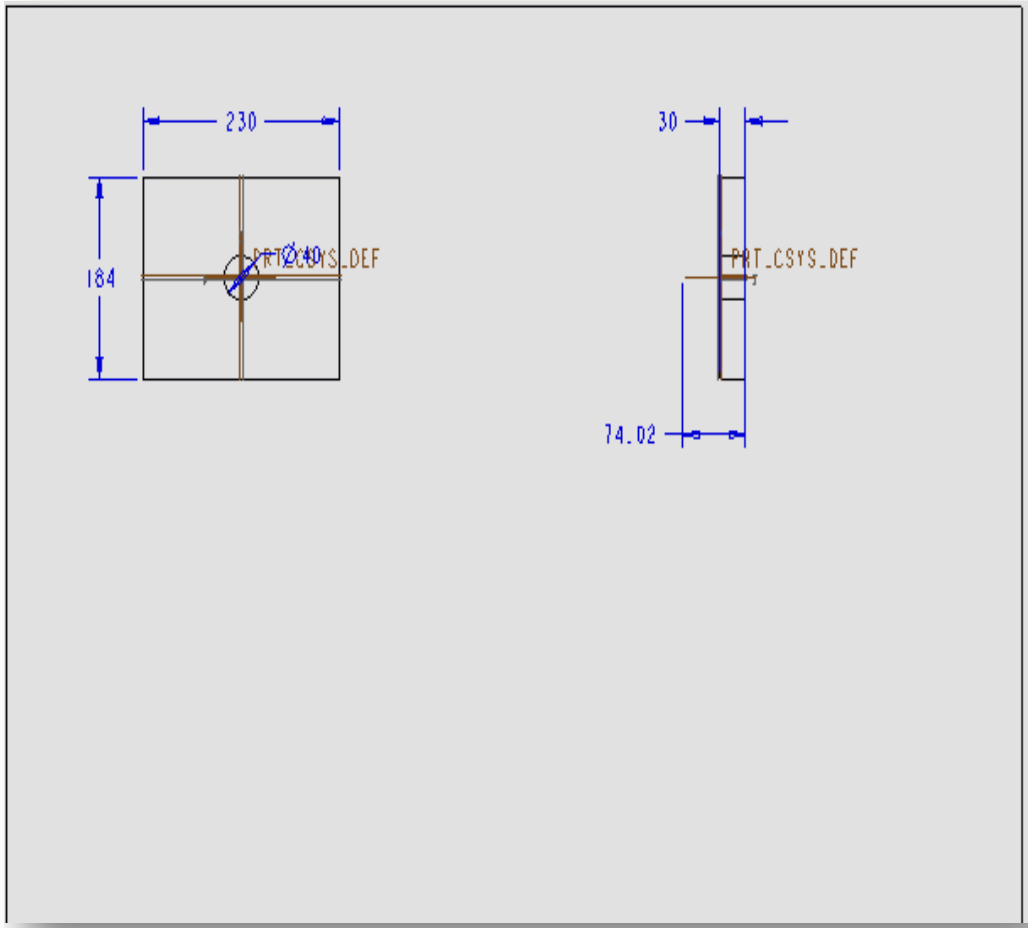
1. Base



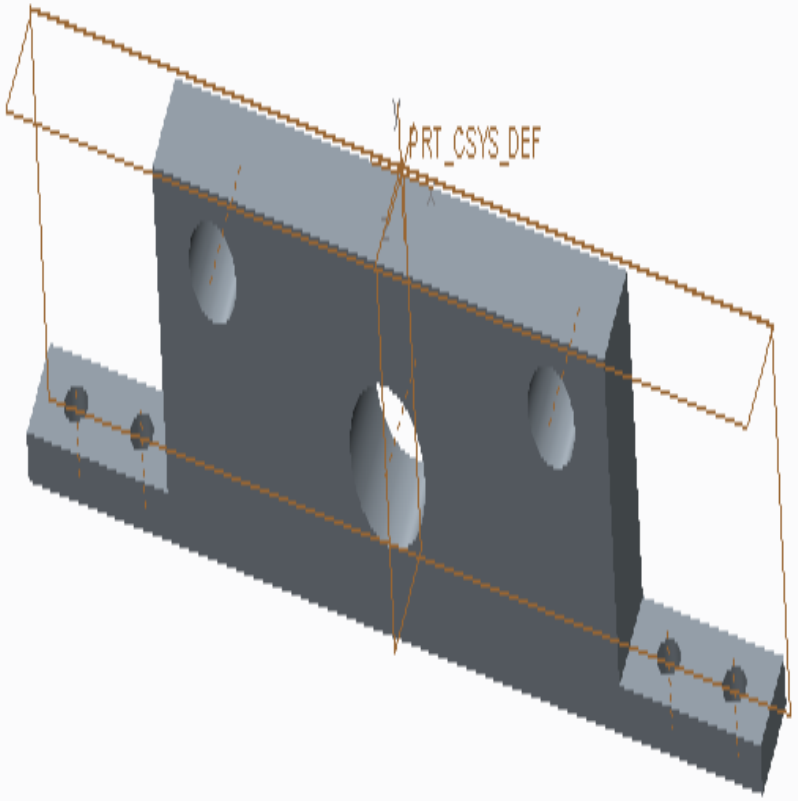
- 2. Rod

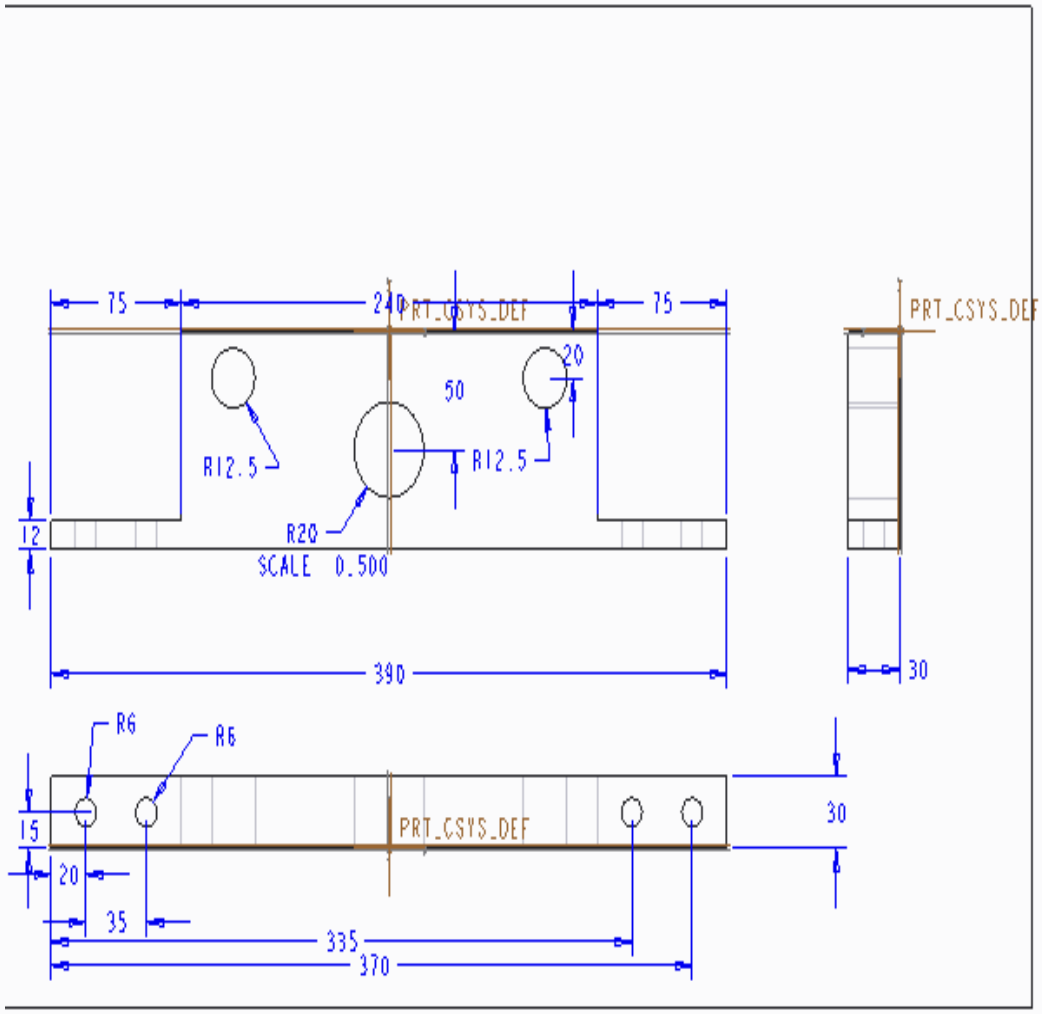
3. Base plate



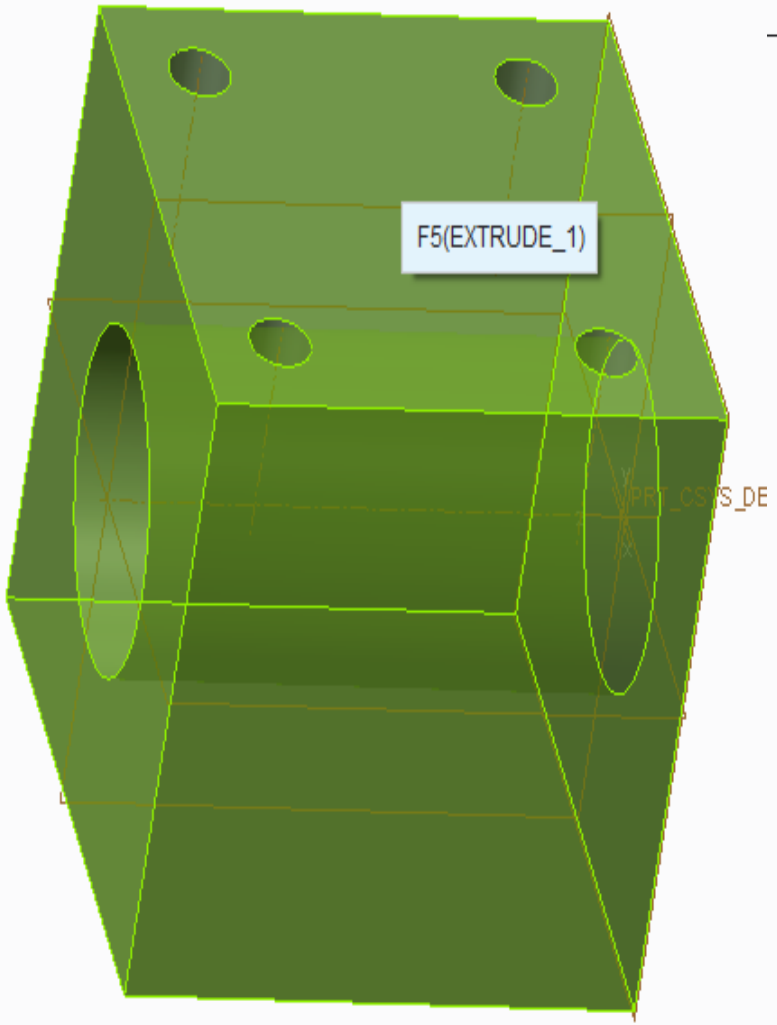


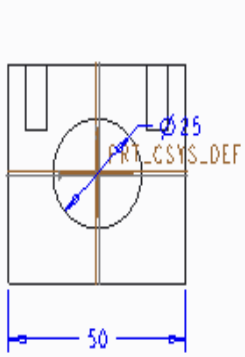
4. Support plate

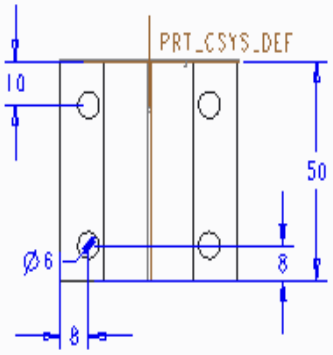




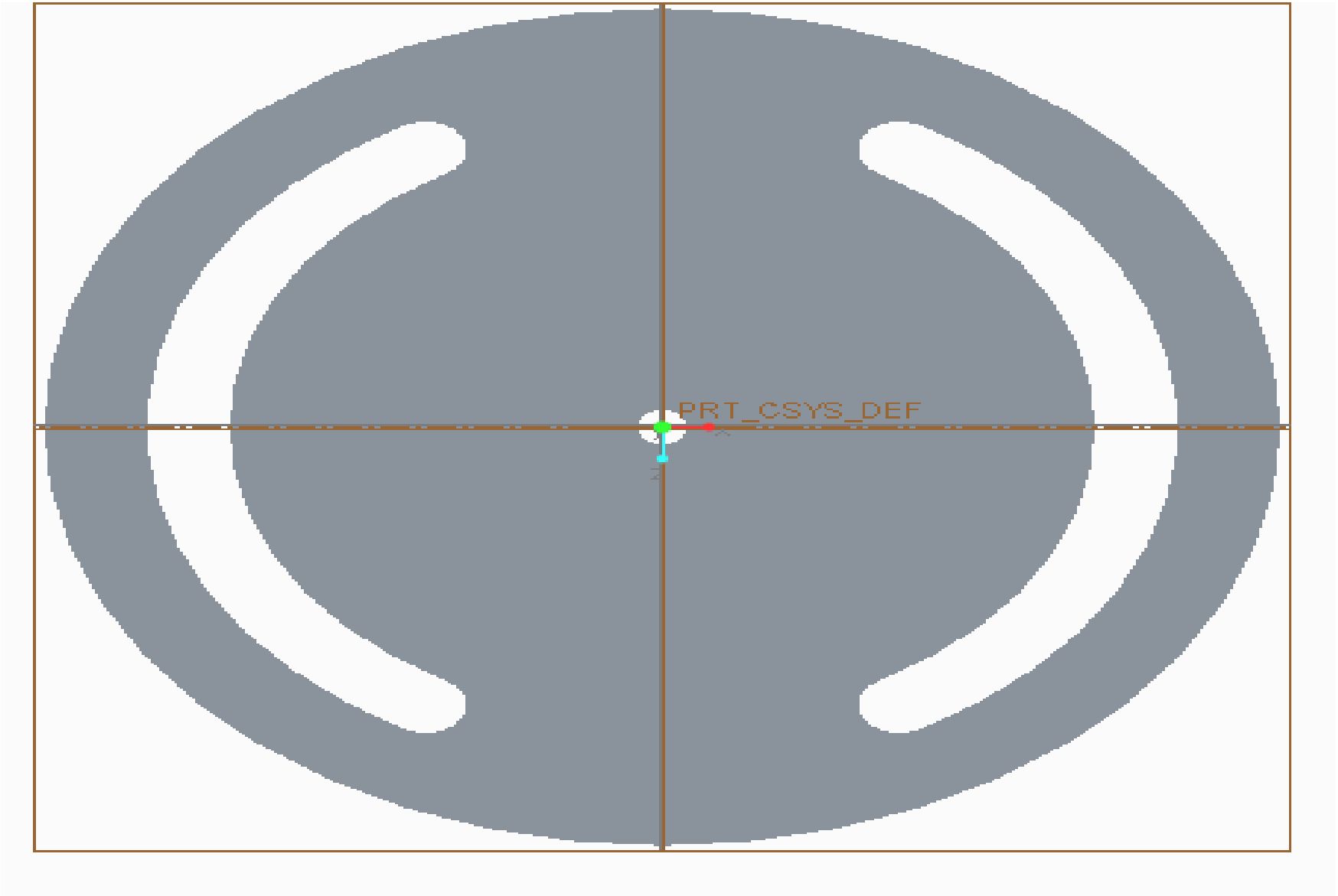
5. Sliding Bearing



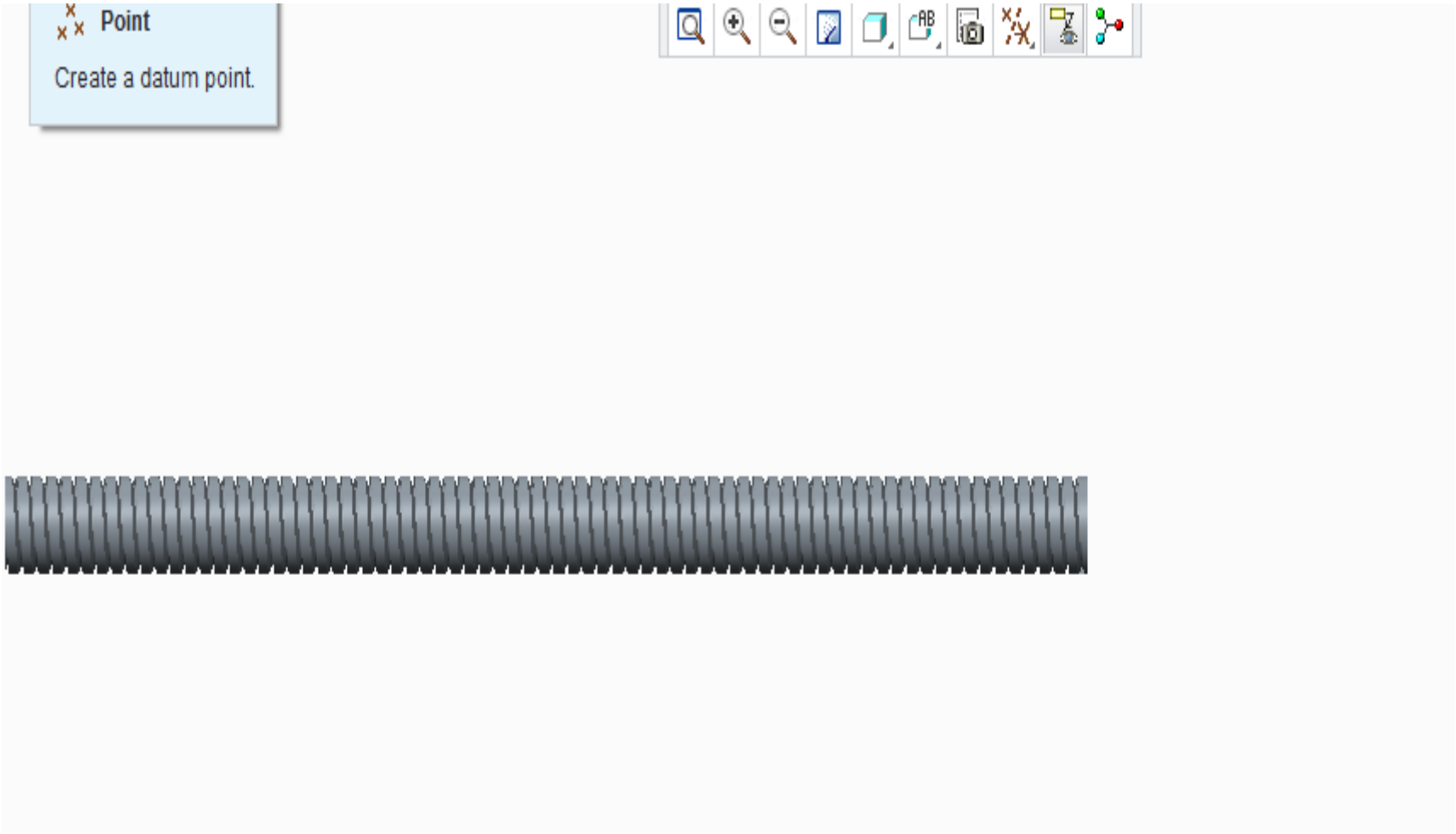




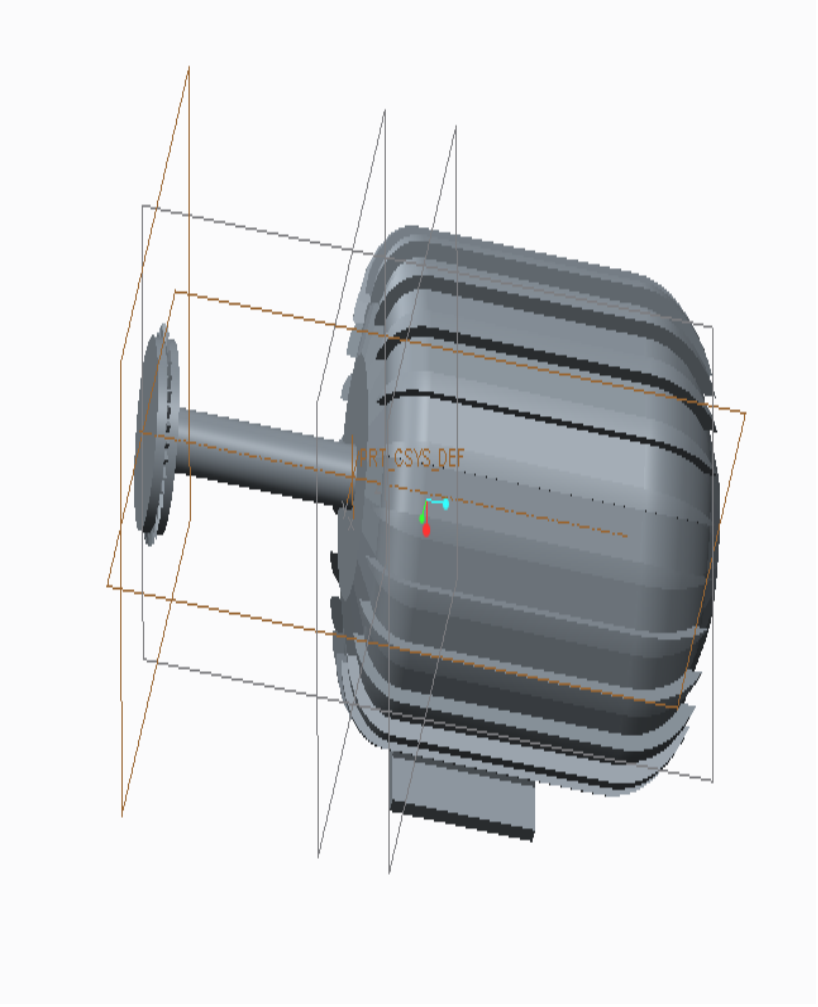
6. Motor Base Plate

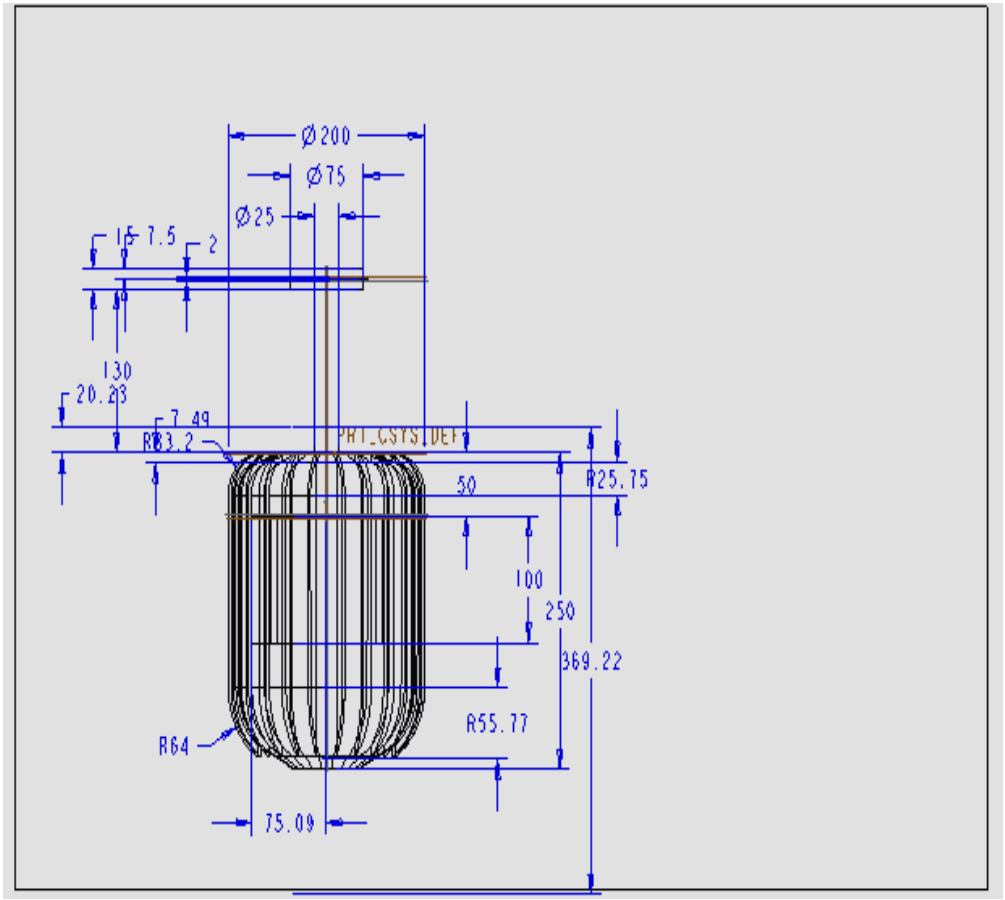


7. Lead screw

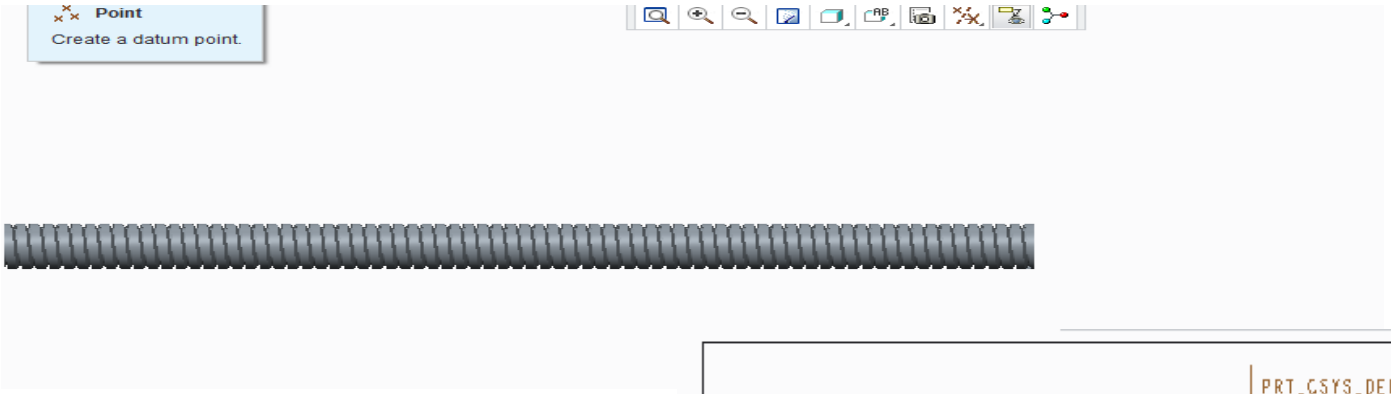


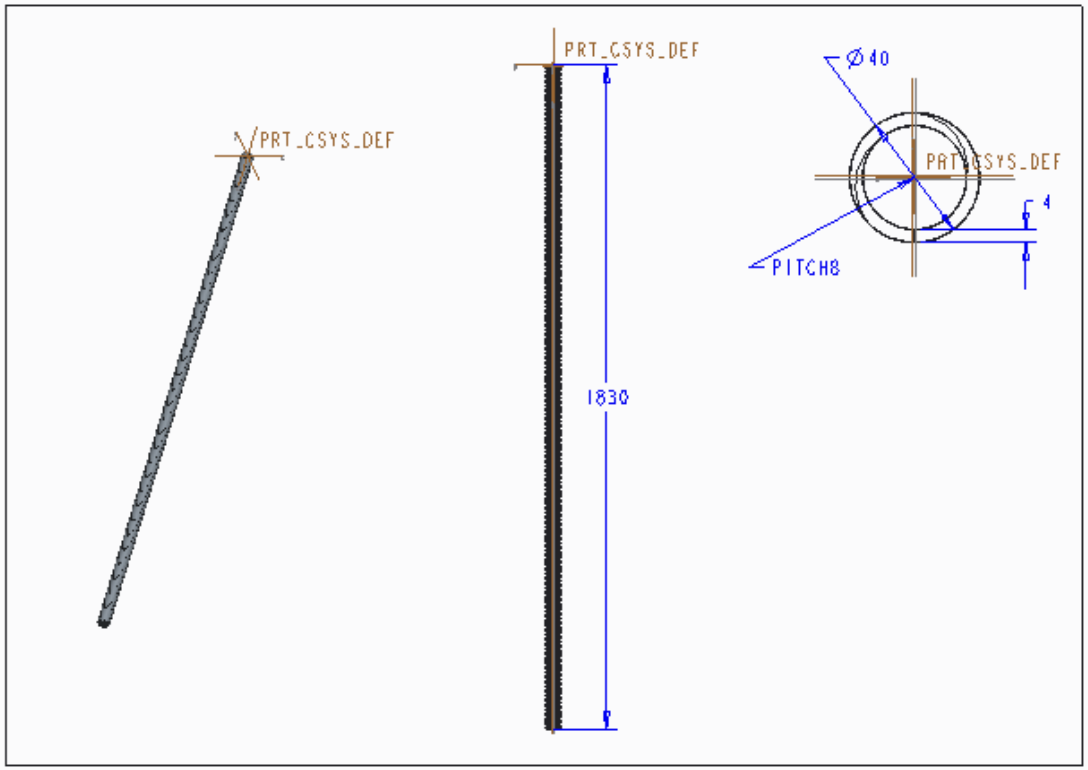
8. Motor


PRT_CSYS_DEF

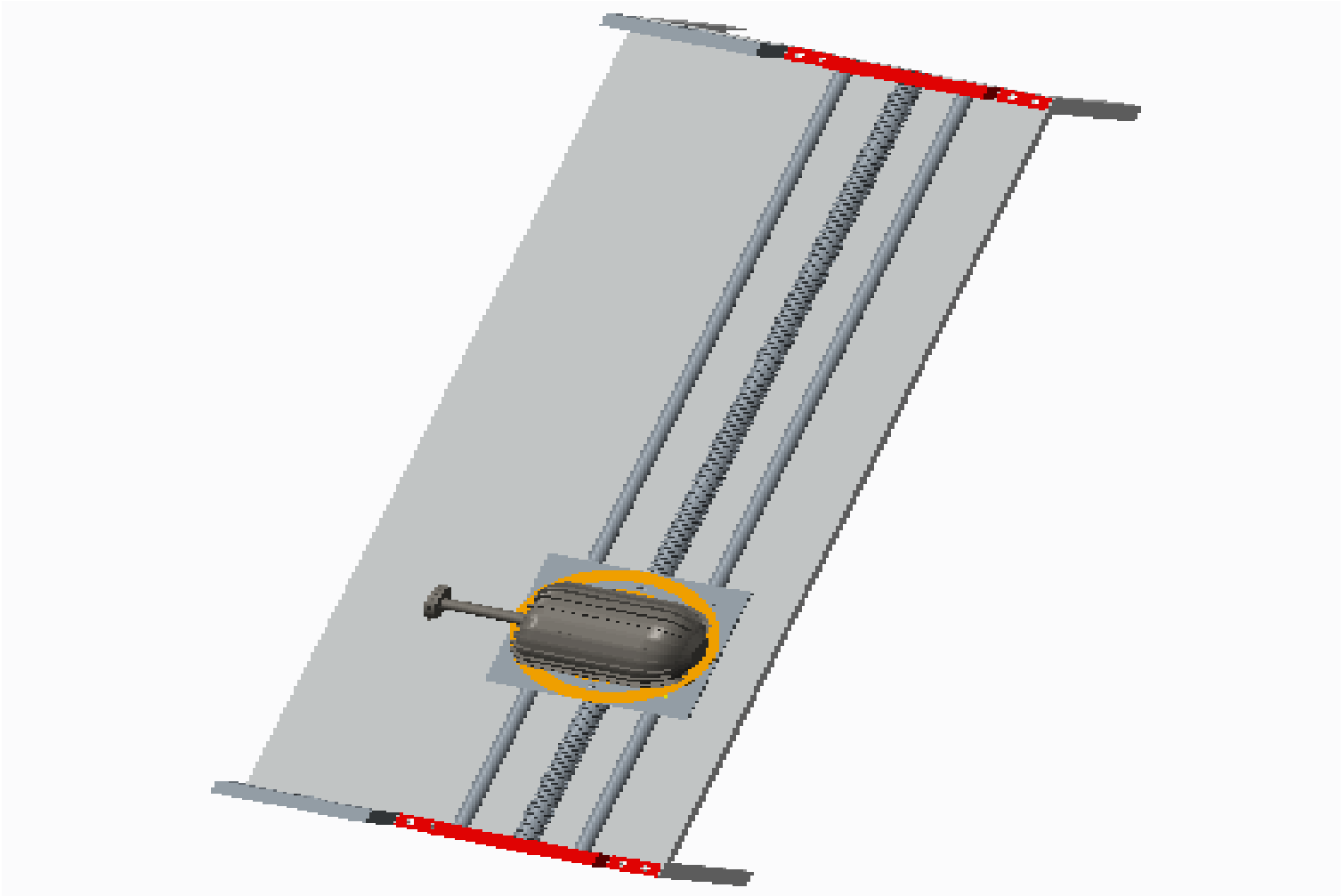

Ø200
Ø75
Ø25
7.5
2
130
20.23
7.49
R3.2
PRT_CSYS_DEF
50
R25.75
100
250
369.22
R55.77
R64
75.09

Design of lead screw

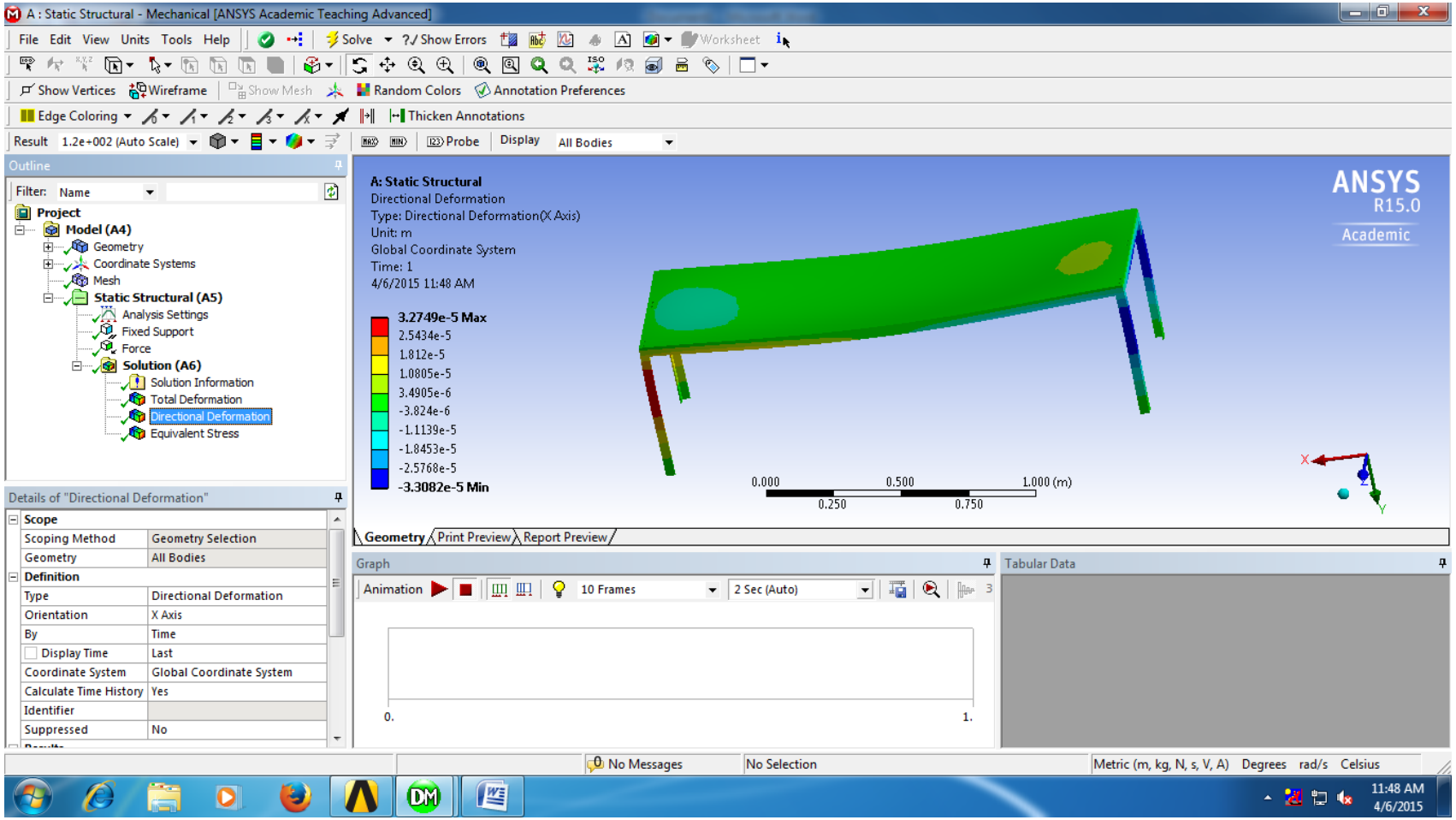




9. Assembly

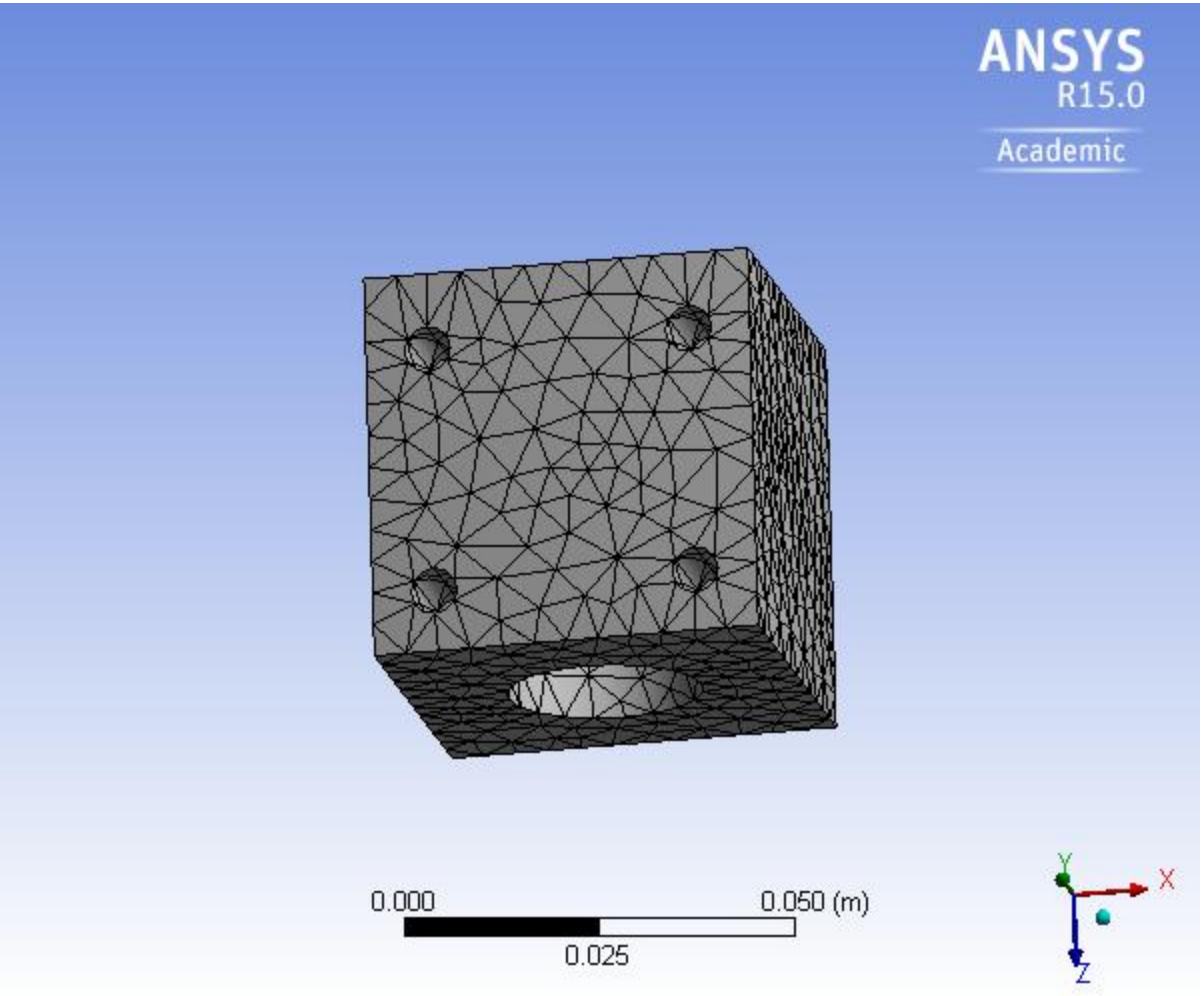


Analysis of Base plate in directional deformation



Results				
Minimum	0. MPa	0. mm	-4.3021e-003 mm	0. mm/mm
Maximum	24.789 MPa	0.79668 mm	4.9424e-002 mm	1.2859e-004 mm/mm
Minimum Value Over Time				
Minimum	0. MPa	0. mm	-4.3021e-003 mm	0. mm/mm
Maximum	0. MPa	0. mm	-4.3021e-003 mm	0. mm/mm
Maximum Value Over Time				
Minimum	24.789 MPa	0.79668 mm	4.9424e-002 mm	1.2859e-004 mm/mm
Maximum	24.789 MPa	0.79668 mm	4.9424e-002 mm	1.2859e-004 mm/mm

Analysis of sliding bearing



Results		
Minimum	33.438 m	-1.2174e-007 m
Maximum	33.501 m	1.3264e-007 m
Minimum Value Over Time		
Minimum		-1.2174e-007 m
Maximum		-1.2174e-007 m
Maximum Value Over Time		
Minimum		1.3264e-007 m
Maximum		1.3264e-007 m

Conclusion

- As per our design and analysis we come to conclude that the best suitable material is Mild steel as compared to other. So our conclusion is the or design is safe against force and stress. So with this help the productivity of roller cutter machine in ginning industries increase with high rate. The preparing time of roller cutting machine in ginning industries is also reduce and machining time is reduce. With the previous machine it requires high skill labor but with our calculation it is not need high skill labor. Accuracy is also main concern and it will increase. The preparing time is decrease just due to an automatic principal.

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