



# Design and Analysis of Special Purpose Fixture for CNC Lathe Machine

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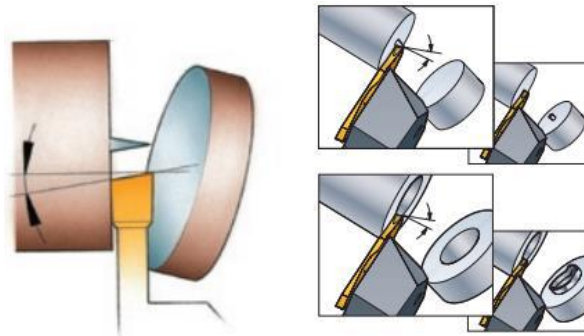
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**Abstract.** A lathe machine is a mechanical tool used to produce cylindrical shapes by rotating a workpiece against an appropriate cutting tool. Cutting a work piece from a piece of stock is known as parting in a CNC lathe. A tip that was left at the centre of the fastener after it had been parted on a CNC lathe machine had to be removed separately using a grinding wheel, which took time. This initiative is reliant on the issue the PRECISION TURN COMPONENT INDUSTRY is facing. We compile data from precision turn-components in this article. Then, using PTC CREO PARAMETRIC V5, we created a custom attachment fixture after doing manual calculations (PRO-E). We perform FE modeling and FE analysis after CAD.

**Keywords:** CNC, Lathe, Parting, Fixture

## 1. Introduction

**Parting Off:** Cutting a work piece after it has been machined to the desired size and shape is known as parting-off. In this method, the work piece is rotated on a different kind of chuck or at a speed that is half that of some operation, such as turning and feeding a narrow parting tool perpendicular to the lathe axis by manually moving the cross slide screw. Before the starting operation, the carriage is locked in position on the cutting tool and lathe bed is held rigidly on the tool post with the compound slide set parallel to the lathe axis. The tool should be fed very slowly to prevent chatter. The feed varies from 0.06 to 0.14 mm per revolution and the depth of cut



**FIGURE 1.** Formation of tip

**Problem Formulation:** Precision Turn comp Pvt. Ltd. produces about 2000 fasteners in a variety of sizes and types. These fasteners are separated from the stock at the conclusion of their machining cycle, and this separation leaves a tip on the fasteners' surface. This involves manually grinding each fastener, which takes a lot of time and extra labour to execute this straightforward activity. One of the main suppliers of Mahindra and Mahindra Pvt. Ltd. Nagpur is the firm. Therefore, the best quality is needed for the final output.

## 2. Research Methodology

This project is restricted to the design and FEA analysis of a tip removing machine (CNC Lathe) attachment. As part of the project, special purpose fixture (CNC Lathe) CAD models will be created, and FEA analysis will be done to determine the best design for Precision Turn Component Pvt. Ltd. To use CAD software to create a special purpose fixture that can cut a fastener during a parting operation without leaving a tip in the centre. To carry out a validation FEA study of a special purpose fixture. To perform hand calculation for loads and structure design of Special purpose fixture. To help the company in optimizing its manufacturing process by eliminating the manual grinding operation required to remove the tip. General Arrangement Drawing Of Special Purpose Fixture For Cnc Lathe Machine: This project is restricted to the design and FEA analysis of a tip removing machine (CNC Lathe) attachment. For Precision Turn Component Pvt. Ltd. Hingna, Nagpur, the project will entail creating the CAD models of special purpose fixtures (CNC Lathe) and completing FEA analysis for the

best design. Using CAD software, create a special-purpose device that can cut a fastener during a separating operation without leaving a tip at the centre. To do FEA analysis of a validation fixture for a certain purpose To manually calculate the loads and the construction needed for a special-purpose fixture. To assist the business in streamlining its manufacturing process by getting rid of the labor-intensive manual grinding procedure needed to remove the tip:

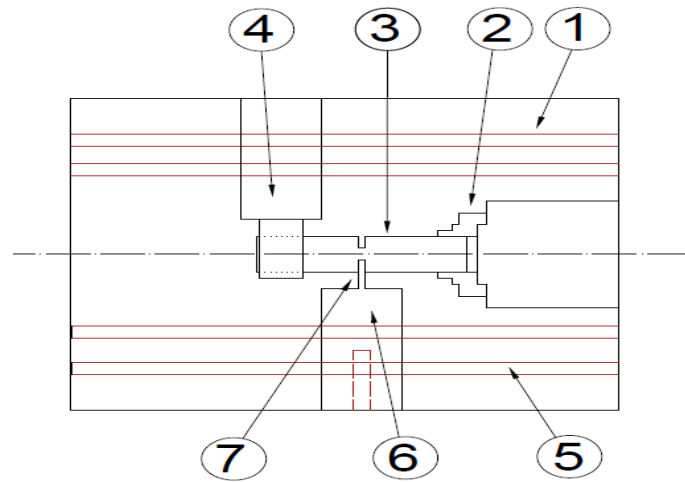


FIGURE 2. General Arrangement Drawing of Special Purpose Fixture for Cnc Lathe Machine

TABLE 1. General Arrangement Drawing of Special Purpose Fixture for Cnc Lathe Machine

Sr no	Parts Name
1	Guide Way for fixture
2	Chuck
3	Work piece
4	Special Purpose Fixture
5	Guide Way for Tool post
6	Tool Post
7	Tool

Data Accumulation

**Data:**

Materil-EN8M (Carbon Steel )  
 Max. shear stress ( $\tau$ ):- 800N/mm<sup>2</sup>  
 Hardness of Material:- 28 to 32 HRC  
 Diameter:- 110mm  
 Cutting speed ( $V_c$ ):- 300m/min  
 Feed (F):- 0.2mm/rev  
 Depth of cut:- 0.5mm  
 Angles of single point cutting tool:  
 Friction angle ( $\lambda$ ):- 31°  
 Normal rake angle ( $\alpha$ ):- 11.6°

FIGURE 3. Data Accumulation

Hand Calculation (Reaction Forces Developed On Special Purpose Fixture during Parting Operation):

Angles of single point cutting tool:

Friction angle ( $\lambda$ );  $31^\circ$

Normal rake angle ( $\alpha$ );  $11.6^\circ$

Shear plane angle ( $\phi$ ) =  $45 + 11.6 - 31 = 25.6^\circ$

Machining force as Shown in fig.

$$\text{Cutting force (F}_c\text{)} = \frac{\tau \times F \times D_{cut} \times \cos(\phi - \alpha)}{\sin(\phi) \times \cos(45)}$$

$$F_c = \frac{800 \times 0.2 \times 0.5 \times \cos(31 - 11.6)}{\sin(25.6) \times \cos(45)}$$

$$F_c = \frac{75.45}{0.3}$$

$$\mathbf{F_c = 251.5 \text{ N}}$$

Where,

$$F_r = F_c \times \frac{\sin(\lambda - \alpha)}{\cos(\lambda - \alpha)}$$

$$F_r = 251.5 \times \frac{\sin(31 - 19.6)}{\cos(31 - 19.6)}$$

$$\mathbf{F_r = 88.02 \text{ N}}$$

FIGURE 4. Hand Calculation

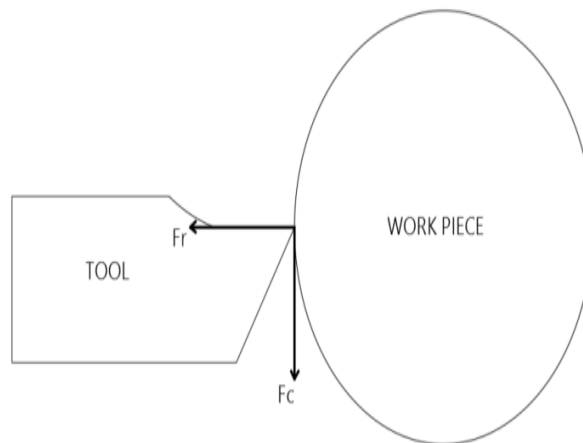


FIGURE 5. Hand Calculation

Cad model of CNC lathe machine equipped with special attachment fixture

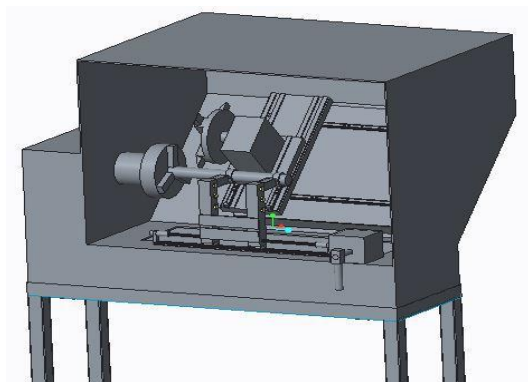
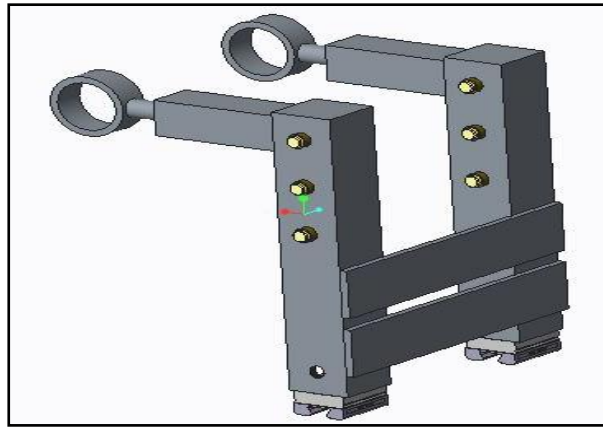
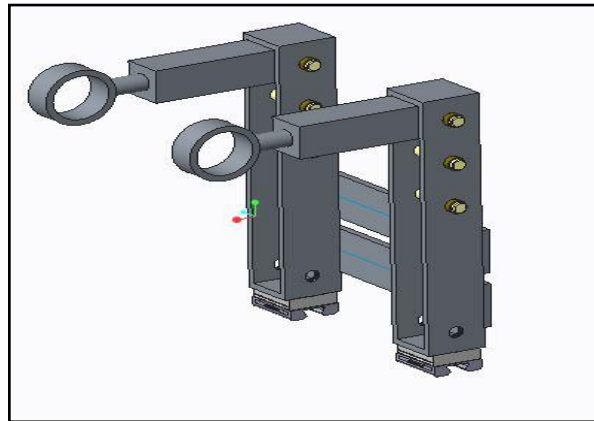


FIGURE 6. Cad model

Cad model of special attachment fixture

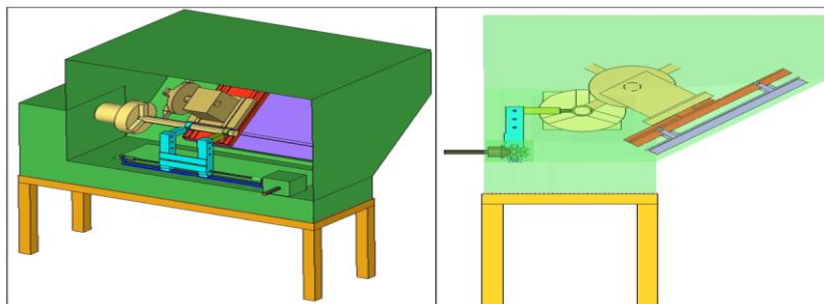


**FIGURE 7.** Cad model of special attachment fixture

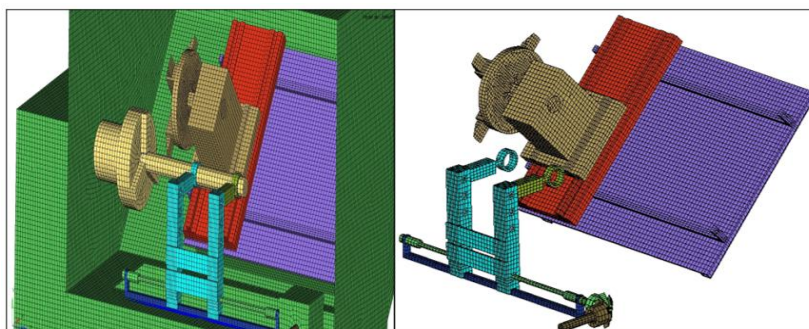


**FIGURE 8.** Cad model of special attachment fixture

C. FE Model of Special Attachment Fixture



**FIGURE 9.** FE Model of Special Attachment Fixture



**FIGURE 10.** FE Model of Special Attachment Fixture

D. Forces

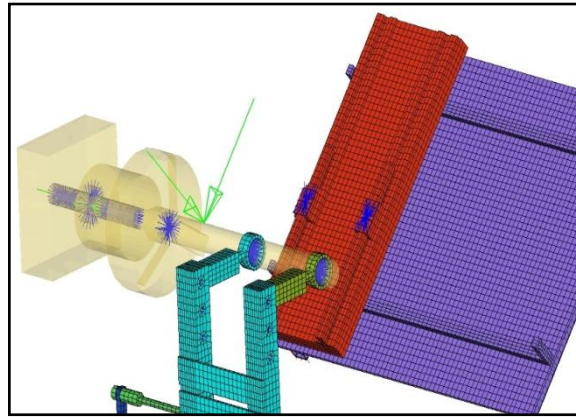


FIGURE 11. Forces

E. Fea Results (Static)

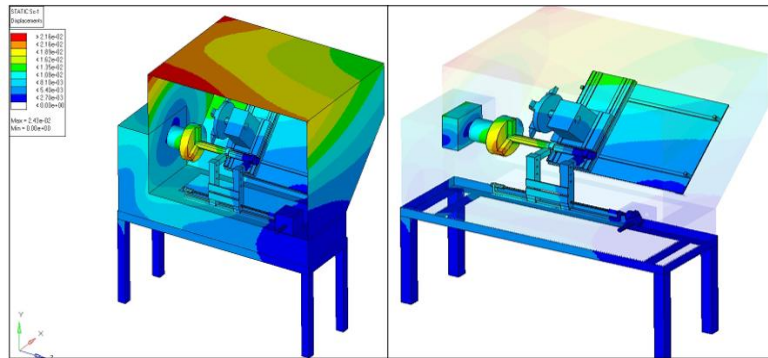


FIGURE 12. Fea Results (Static)

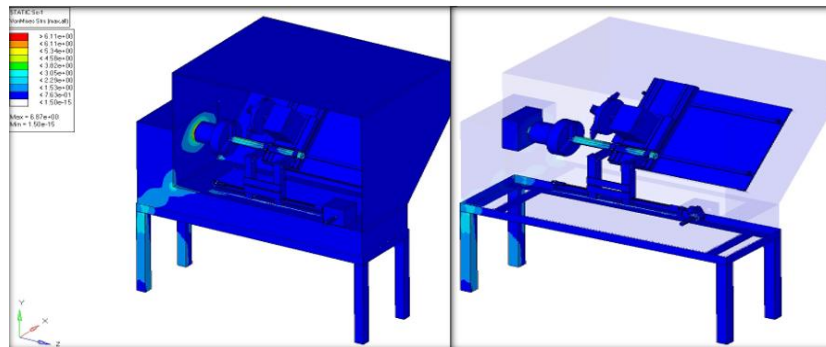


FIGURE 13. Fea Results (Static)

TABLE 1. Fea Results (Static)

1.	Displacement = 0.0243 mm
2.	Stresses = 6.87 MPa

3. Conclusion

This fixture holds the tool and prevents formation of peep. In this article we performed analysis of the fixture. The results of the analysis are safe. So, this fixture will save the labor, time, and quality of the product also increased by eliminating the formation of peep.

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