Design and Analysis of Special purpose Fixture for CNC Lathe Machine

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Abstract— A lathe machine is the mechanical device in which work piece is rotated against a suitable cutting tool for producing cylindrical forms. Parting is the operation performed in CNC lathe to cuts a work piece from a piece of stock. During parting operation of fastener on CNC lathe machine, there was a tip remained at the center of the fastener and this tip is removed separately on the grinding wheel which was time consuming. This project is depends upon the problem faces by the PRECISION TURN COMPONENT INDUSTRY. In this article, we accumulate data from precision turn-component. Later on we did hand calculation and then designed special attachment fixture on PTC CREO PARAMETRIC V5 (PRO-E). After CAD we perform FE modeling and FE Analysis.

Key words: CNC Lathe, Parting

I. INTRODUCTION

A. *Parting Off*

Parting-off is the operation of cutting a work piece after it has been machined to the expected size and shape. The process involves rotating the work piece on a different type of the chuck or at half the speed to that of some operation i.e. turning and feeding by a narrow parting off tool perpendicular to the lathe axis by rotating the cross slide screw by hand. Before the starting operation, the carriage is locked in position on the cutting tool andlathe 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 is equal to the width of the tool. In parting off, a work of very large diameter, cuts are made in stages. The parting off tool is first fed through a desired depth, then withdrawn and two more cuts are made at the two sides of the central groove. The tool is next fed into the central groove until the work is cut off in two parts.

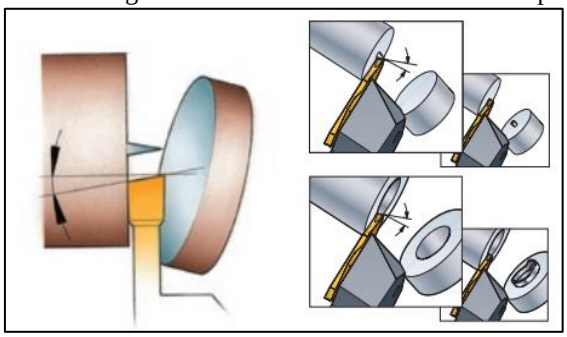

Fig. 1: Formation of tip

II. PROBLEM FORMULATION

Precision Turncomp Pvt. Ltd. Hingna, Nagpur manufactures about 2000 fasteners of different sizes and types. At the end of their machining cycle theses fasteners are parted from the stock, during this parting operation a tip is left behind on the surface of the fasteners. This requires manual grinding of individual fasteners which consumes lots of time and requires additional manpower to complete this simple task. The company is one of the major suppliers to Mahindra and Mahindra Pvt. Ltd. Nagpur. Hence the quality of the finished product is required to be the best.

III. RESEARCH METHODOLOGY

This project is limited to tip removing machine (CNC Lathe) attachment design and analysis using FEA. The project will involve building the CAD models of special purpose fixture (CNC Lathe) and performing FEA analysis for optimum design for Precision Turn component Pvt. Ltd. Hingna, Nagpur.

To perform design of Special purpose fixture using CAD software which is capable of cutting the fastener during parting operation without any tip remains at its center.

To perform FEA analysis of Special purpose fixture for validation

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.

IV. GENERAL ARRANGEMENT DRAWING OF SPECIAL PURPOSE FIXTURE FOR CNC LATHE MACHINE

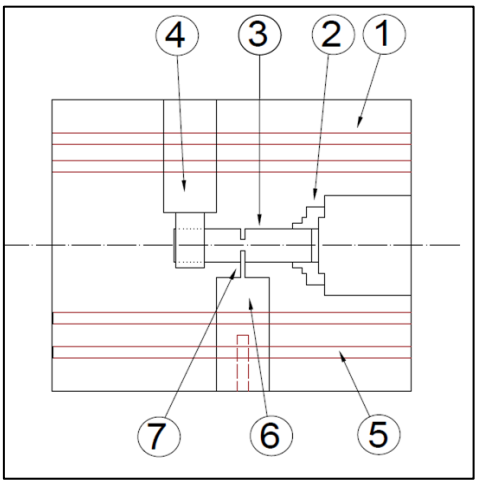

Fig. 2:

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

Table 1:

A. Data Accumulation

Data:
Material – EN8M (carbon steel)
Max. shear stress(τ) – 800N/mm^2
Hardness of material – 28 to 32HRC
Diameter – 110mm
Cutting speed (Vc) – 300m/mim
Feed (F) – 0.2mm/rev
Depth of cut – 0.5mm
Angles of single point cutting tool:
Friction angle(ʎ) - 31^0
Normal rake angle (α) - 11.6^0

V. HAND CALCULATION (REACTION FORCES DEVELOPED ON SPECIAL PURPOSE FIXTURE DURING PARTING OPERATION)

Angles of single point cutting tool:
Friction angle(ʎ) - 31^0
Normal rake angle (α) - 11.6^0
Shear plane angle (φ) = 45+11.6-31 = 25.6^0

Machining force as shown in fig.

$$\text{Cutting force (Fc)} = \frac{\tau \times F \times Dcut \times \cos(\varphi - \alpha)}{\sin(\varphi) X cos45^0}$$

$$= \frac{800 \times 0.2 \times 0.5 \times \cos(31 - 11.6)}{\sin(25.6)\, X cos45^0}$$

Machining force as shown in fig.

$$\text{Cutting force (Fc)} = \frac{\tau \times F \times Dcut \times \cos(\varphi - \alpha)}{\sin(\varphi) X cos45^0}$$

$$Fc = \frac{800 \times 0.2 \times 0.5 \times \cos(31 - 11.6)}{\sin(25.6) X cos45^0}$$

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

Fc = 251.5N

$$\text{Where, } Fr = Fc\ X \frac{\sin(ʎ - \alpha)}{\cos(ʎ - \alpha)}$$

$$Fr = 251.5\ X \frac{\sin(31 - 19.6)}{\cos(31 - 19.6)}$$

Fr = 88.02N

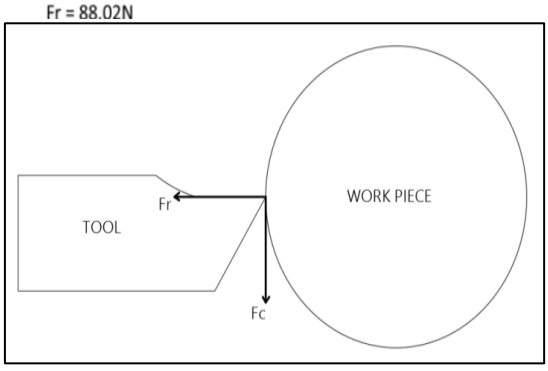

Fig. 3:

A. Cad model of CNC lathe machine equipped with special attachment fixture

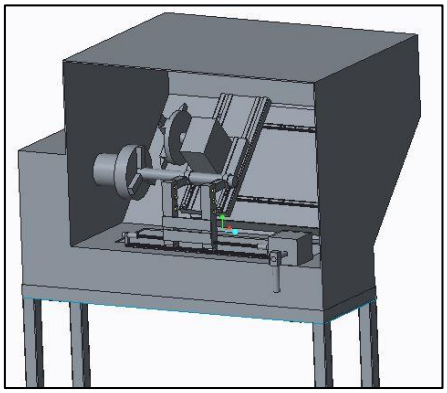

Fig. 4:

B. Cad model of special attachment fixture

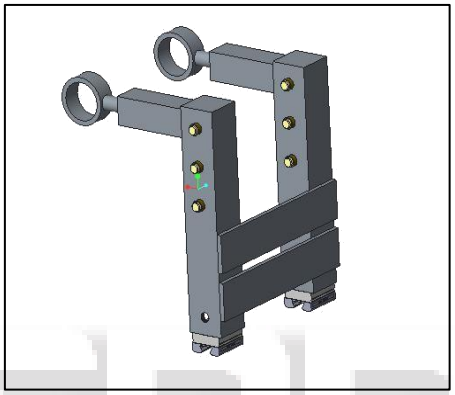

Fig. 5:

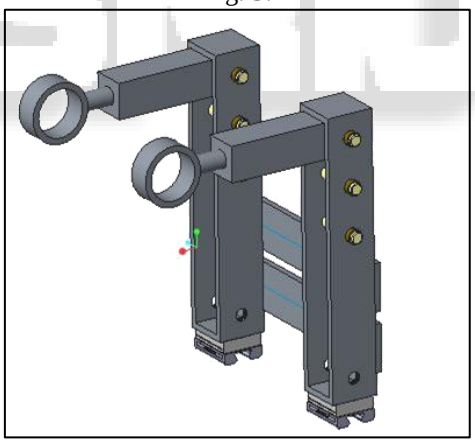

Fig. 6:

C. FE Model of Special Attachment Fixture

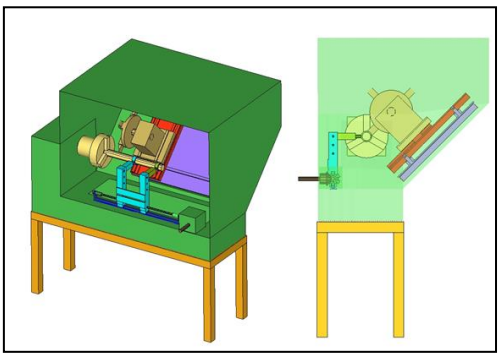

Fig. 7:

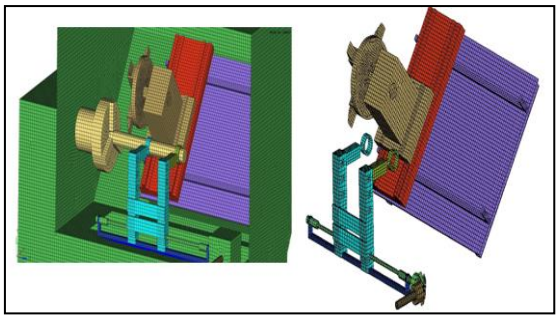

Fig. 8:

D. Forces

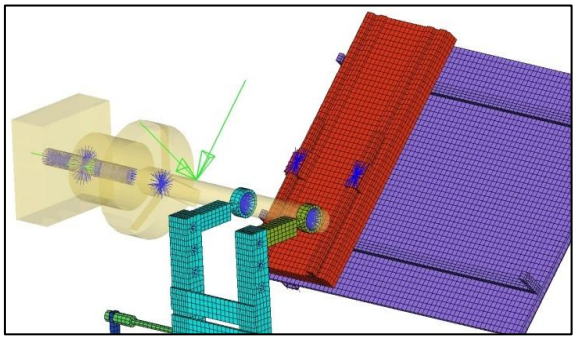

Fig. 9:

E. Fea Results (Static)

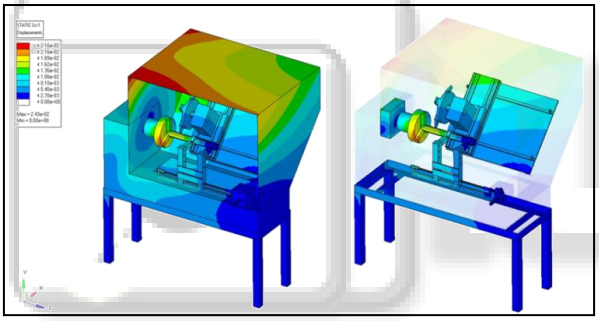

Fig. 10:

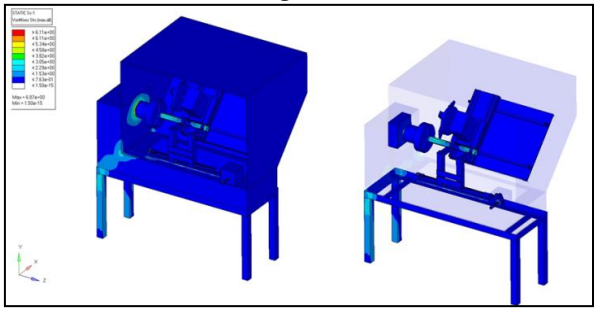

Fig. 11:

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

Table 1:

VI. CONCLUSIONS

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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