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Analysis of Tool Geometry of Single Point Miranda Tool with Pointed Tip

To find and compare the cutting forces of a single point Miranda tool with pointed tip for a solid cylindrical job with materials wood and MS.

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***Abstract*— In this paper, we find the cutting tool force and other parameters of a single point Miranda tool with a pointed tip. We analyse the heat generated and stresses produced in the Miranda tool for both cases of the job (wood and MS)**

***Keywords*—Miranda tool; tool geometry; cutting force; semi circular tip; pointed tip**

I. INTRODUCTION

We have a simple tool room production lathe, with parallel cone pulley drive and back gears, which has parallel jaw bench vice and a lever clamp on the tool carriage with a compound rest (fixture) tool post. We take a simple turning operation where the MS/ wooden cylindrical job is mounted on the headstock using a 3 piece chuck and a chalk method is used for centering the job using the tailstock dead center and analyse and compare the parameters produced analytically.

II. ASSUMPTIONS

1. Chip area is either rectangular or triangular for simplicity purposes and is assumed to be equal to area of contact.
2. Assuming countershaft speed is the same as motor speed which is 1500 rpm.
3. Depth of cut is assumed 1 mm and chip thickness is assumed 0.2mm/rev.

III. PROBLEM STATEMENT

Lathe - Simple tool room electric motor driven cone pulley belt drive and countershaft lathe with tool carriage along bed of length 135 - 180 cm using a manual wheel, with a cross slide lever handle for motion across the bed, where tool post (which can swivel the whole tool diagonally using a tool post slide) is mounted on the carriage with a simple bench vice double plate lever clamp.

Operation - Turning

Motion of Job - Rotary

Material of Job - MS or wood

Dimensions of Job - Cylindrical solid with 50mm diameter and 60 mm height

Motion of cutting tool - Orthogonal forward translation

Type of cutting tool - 1. Miranda single point MS

Dimensions of cutting tool - 13 cm x 1 cm x 1 cm

Manual Feed f= 1.04 mm/rev

Feed rate F = f*N = 300 × 1.04 mm/min = 5.2 mm/s

Motor speed - 1500 rpm (standard)

Rake angle a - (single point) arctan[(D1 - D2)/(2×60)] = 27.5 degrees

Cutting speed - pi*50*N/1000 = 47 m/min = 0.78 m/s

Spindle speed N - 300 rpm
Countershaft speed - 1500 rpm
Pulleys Diameters 75 mm and 15 mm (open belt)
Pulley speed (big) = 15/75 * 1500 = 300 rpm
Depth of cut d - 1mm

`Volume of cut in 1 pass of job length (rectangular cross section chip area) = 9236.28 mm^3

Volume of cut in 1 pass of job length (triangular cross section chip area) = 4618.14 mm^3

Area of chip (rectangular) = t*d = 1*0.2 = 0.2 mm^2

Area of chip (tringular) = t*d = 1*0.2*0.5 = 0.1 mm^2

Cutting chip thickness t = 0.2 mm/rev

Feed = sq.root(0.2^2 + 1^2) = 1.04 mm (approx)

Cutting force Fc = Kc. Achip(rectangular)
= 2000*0.2 (MS)
= 400 N

Cutting force Fc = Kc. Achip(triangular)
= 2000*0.1 (MS)
= 200 N

Cutting force Fc = Kc. Achip(rectangular)
= 500*0.2(wood)
= 100 N

Cutting force Fc = Kc. Achip(triangular)
= 500*0.1 (wood)
= 50 N

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Shear Force Sc = Fc/2

= 200 N (rectangular MS)

= 100 N (triangular MS)

= 50 N (rectangular wood)

= 25 N (triangular wood)

Heat Generated Q = Sc. Vc - 0.3*Sc.Vc

=0.7*Sc*Vc

= 200 N * 0.78 * 0.7(rectangular MS) = 109.2 W

= 100 N* 0.78 * 0.7 (triangular MS) = 54.6 W

= 50 N * 0.78 * 0.7(rectangular wood) = 27.3 W

= 25 N * 0.78 * 0.7(triangular wood) = 13.65 W

IV. TABLES

Heat Generated (W)	Chip Area Triangle	Chip Area Rectangle
Job Material (wood)	13.65	27.3
Job Material (MS)	54.6	109.2

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Parameter	Value
Feed Rate	5.2 mm/s
Rake Angle	27.5 degrees
Spindle Speed	300 r.p.m
Cutting Speed	0.78 m/s

Shear Force (N)	Chip Area Triangle	Chip Area Rectangle
Job Material (wood)	25	50
Job Material (MS)	100	200

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VI. REFERENCES

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