

EFFECT OF TOOL STRESS RATE IN A SINGLE POINT DIAMOND TURNING OF ALUMINUM ALLOY BY VARYING ITS PARAMETERS

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ABSTRACT

While turning, a piece of comparatively rigid material (materials like wood, stone, plastic or metals) is replaced and a cutting tool is navigated along 1, 2, or 3 axis of motion to generate exact diameters & depths. Speeds and feeds for turning are selected on the basis of the cutting materials, work piece material, set up rigidity, machine tool rigidity and spindle power, coolant choice, and some other required factors.

According to this thesis, here the cutting tool is made of tungsten carbide. The analyses are conducted on 20 and 40mm diameter circular pieces. Theoretical calculations are done to determine cutting forces. Modeling is done in Catia and analysis is done by applying cutting forces to determine stresses in Ansys.

INTRODUCTION

TURNING

Turning is a machining process in which a cutting tool, generally a non-rotary tool bits, defines a helical tool track by stirring more or less linearly although the work piece revolutes. The tools axis strength will be accurately by showing as a straight line, else it may be along definite set of curves or angles, but it may be a linear (in nonmathematical reason). Often the term "turning" is the reticent for the generation of external surfaces by the cutting action; though this same critical cutting action when functional to internal planes (like holes, of one kind or other) is known as "boring". Thus, we can conclude that the "turning and boring" categorizes the bigger family of (basically similar) procedures.

TURNING OPERATIONS

Following are the basic turning operations

- a. Turning
- b. Facing
- c. paring
- d. Grooving
- e. Boring
- f. Drilling
- g. Reaming
- h. Knurling
- i. Threading
- j. Polygonal turning

CONFIGURATION OF CNC SYSTEM

Generally a CNC consists the following:-

1. CPU which is called a central processing unit
2. A servo control unit
3. Operator controlling unit
4. Machine controlling unit
5. Some peripheral devices

CUTTING FORCE CALCULATIONS

Speed – 2000rpm

Feed = 250mm/min, Depth of cut – 1mm

Cutting Force

$N_e = (\text{Depth} \times \text{Feed} \times \text{Cutting Speed} \times K_s) / (60 \times 10^3 \times \text{Coefficient of Efficiency})$

$N_e = 4.65\text{KW}$

$K_s = (N_e \times 60 \times 10^3 \times \text{Coefficient of Efficiency}) / (\text{Depth of cut} \times \text{Feed} \times \text{Cutting Speed})$

Coefficient of Efficiency = 0.8

$K_s = (4.65 \times 60 \times 10^3 \times 0.8) / (1 \times 250 \times 2000)$

$K_s = 446.4\text{N}$

Feed = 500mm/min, Depth of cut – 1mm

$K_s = (4.65 \times 60 \times 10^3 \times 0.8) / (1 \times 500 \times 2000)$

$K_s = 223.2\text{N}$

Feed = 750mm/min, Depth of cut – 1 mm

$K_s = (4.65 \times 60 \times 10^3 \times 0.8) / (1 \times 750 \times 2000)$

$K_s = 148.8\text{N}$

Feed = 250mm/min, Depth of cut – 1mm

$K_s = (4.65 \times 60 \times 10^3 \times 0.8) / (1 \times 250 \times 5500)$

$K_s = 162.33\text{N}$

Feed = 500mm/min, Depth of cut – 1mm

$K_s = (4.65 \times 60 \times 10^3 \times 0.8) / (1 \times 500 \times 5500)$

$K_s = 81.2\text{N}$

Feed = 750mm/min, Depth of cut – 1mm

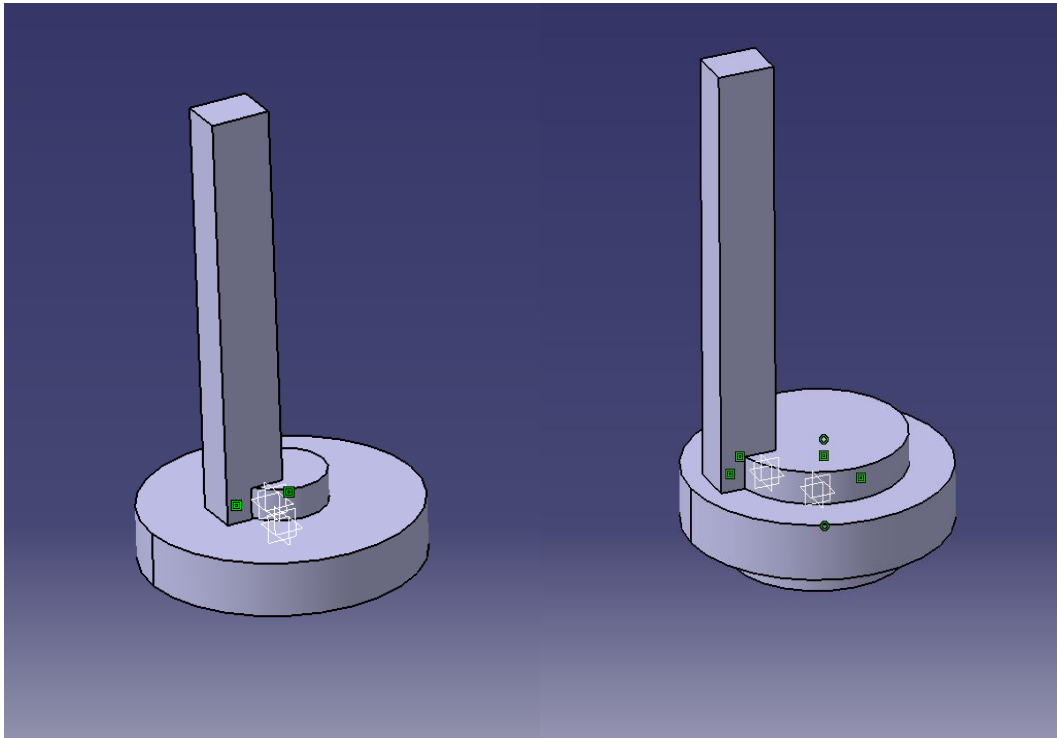
$K_s = (4.65 \times 60 \times 10^3 \times 0.8) / (1 \times 750 \times 5500)$

$K_s = 54.2\text{N}$

OBTAINED FORCE VALUES

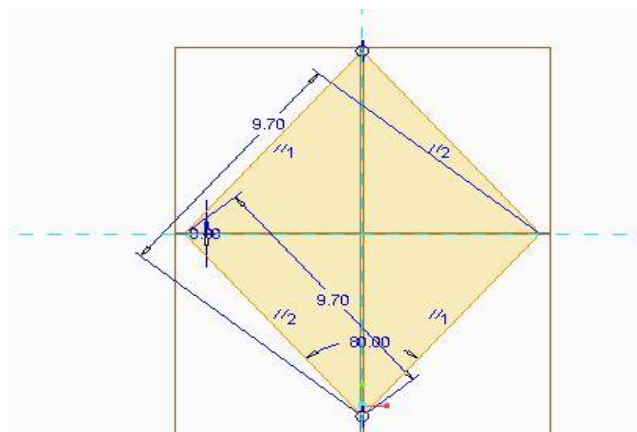
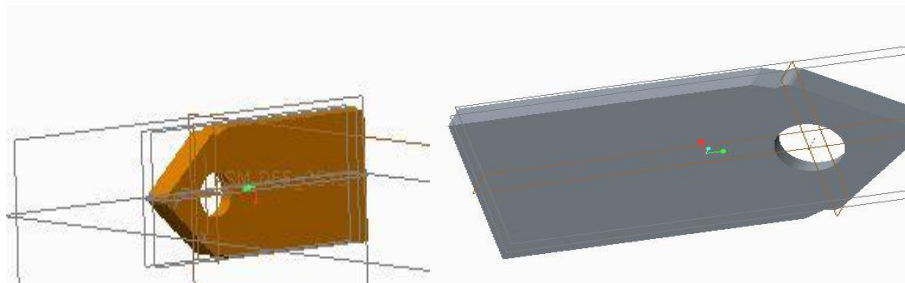
		FEED RATE		
RPM		250	500	750
	2000	446.4N	223.2N	148.8
	3000	297.6N	148.8N	99.2N
	5500	162.33N	81.2N	54.2N

DESIGN FILES OF THE MODELS IN CATIA



Model 1 of 20mm diameter work piece Model 2 of 40mm diameter work piece

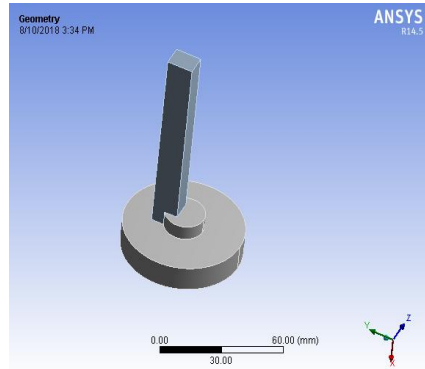
Tool design



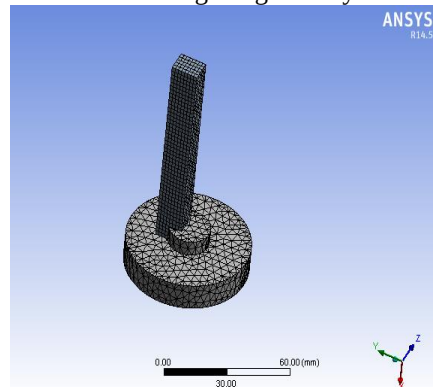
STRUCTURAL ANALYSIS

Work piece size 20mm

Force – 446.4N
Speed – 2000rpm, feed – 250mm/min

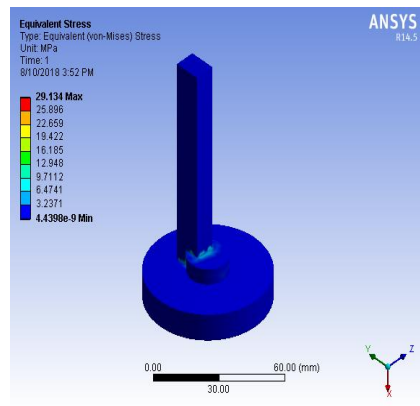


Imported model of original geometry file in ansys



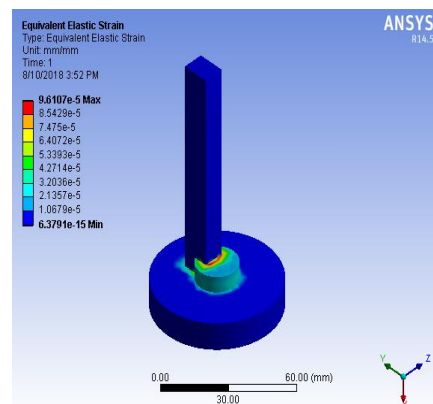
Meshed model of original geometry file in ansys

STRESS



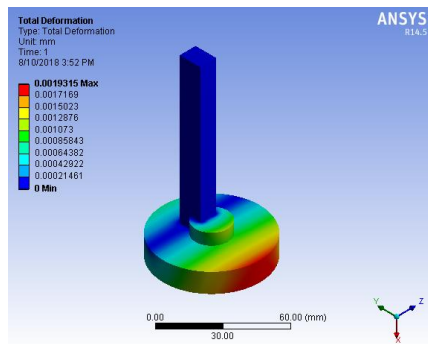
Resulted stress value of the original model

STRAIN



Resulted strain value of the original model

TOTAL DEFORMATION

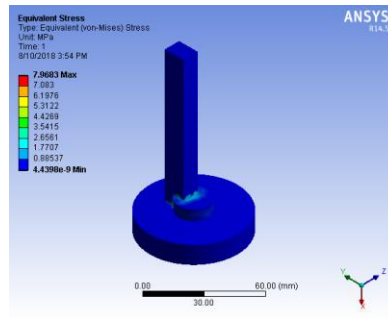


Resulted total deformation value of the original model

Force – 148.8 N

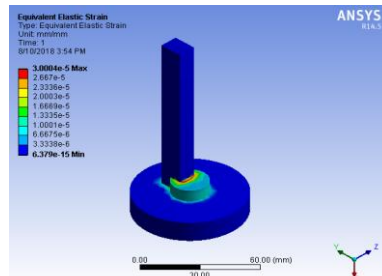
Speed – 2000rpm, feed – 750mm/min

STRESS



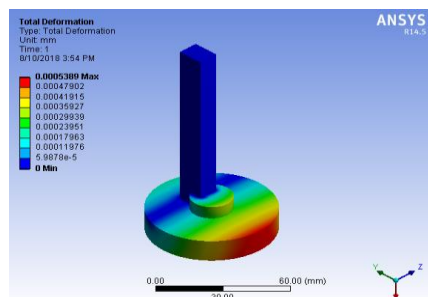
Resulted stress value of the original model

STRAIN



Resulted strain value of the original model

TOTAL DEFORMATION

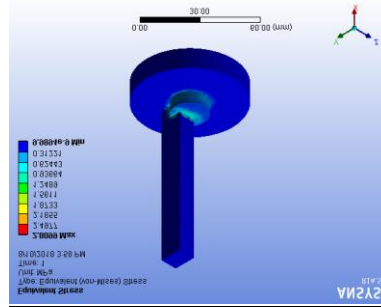


Resulted total deformation value of the original model

Force – 99.2N

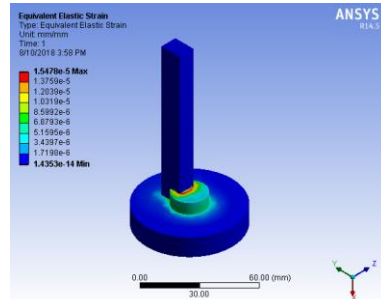
Speed – 3000rpm, feed – 750mm/min

STRESS



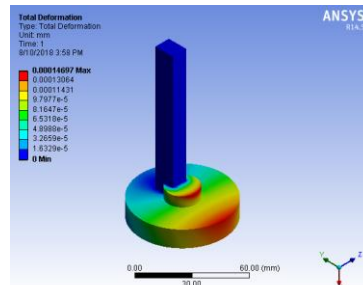
Resulted stress value of the original model

STRAIN



Resulted strain value of the original model

TOTAL DEFORMATION



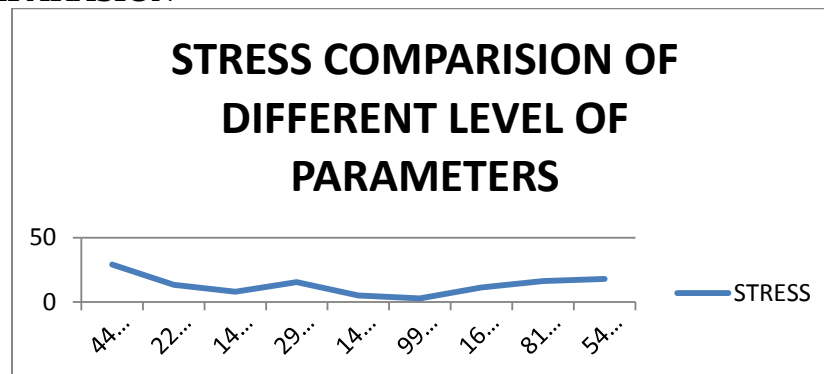
Resulted total deformation value of the original model

TABULAR COMPARASION OF THE 20MMDIA WORKPIECE WITH DIFFERENT RPM AND FEED RATE

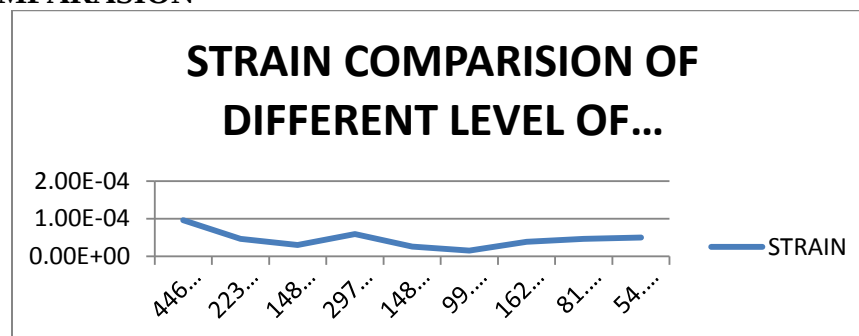
SPEED (RPM)	FEED (MM/MIN)	FORCE (N)	STRESS (MPa)	STRAIN	TOTAL DEFORMATION (mm)
2000 RPM	250	446.4N	29.134	9.6107E-5	0.0019315
	500	223.2N	13.248	4.6522E-5	0.00088685
	750	148.8N	7.9683	3.0004E-5	0.0005389
3000 RPM	250	297.6N	15.3	5.9255E-5	0.0010387
	500	148.8N	5.0135	2.6324E-5	0.00034687
	750	99.2N	2.8099	1.5478E-5	0.00014697
5500 RPM	250	162.33N	11.26	3.8856E-5	0.00049831
	500	81.2N	16.174	4.6735E-5	0.00085229
	750	54.2N	17.924	4.9761E-5	0.00097442

GRAPHICAL COMPARISION OF PARAMETERS

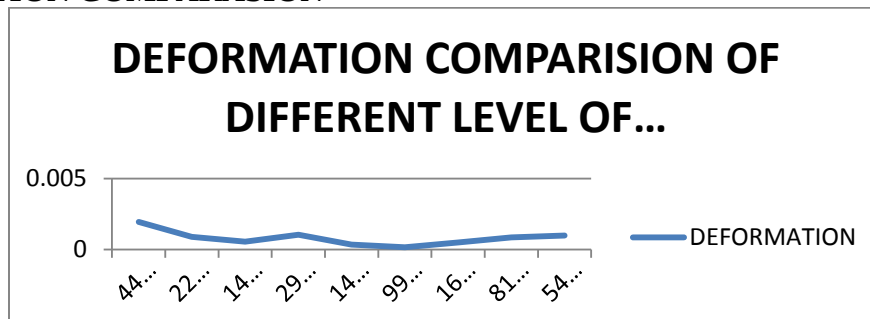
STRESS COMPARASION



STRAIN COMPARASION



DEFORMATION COMPARASION



As if we can observe the above comparison of stress, strain and deformation for the different level of parameters used for the 20mm Diameter work piece. As here we have considered 3 different types of RPM i.e., 2000rpm, 3000rpm, 5500rpm. And feed rate as 250mm/min, -500mm/min, 750mm/min. and the depth of cut is kept as constant as 1mm. all these required data is taken for the reference

STRESS

By observing he obtained results here the stress (2.8099MPa) is very less when compared with all the remaining obtained results, as here according to the stress we can use 3000rpm with 750mm/min feed rate.

STRAIN

By observing he obtained results here the strain (1.5478E-5) is very less when compared with all the remaining obtained results, as here according to the stress we can use 3000rpm with 750mm/min feed rate.

DEFORMATION

By observing he obtained results here the deformation (0.00014697mm) is very less when compared with all the remaining obtained results, as here according to the stress we can use 3000rpm with 750mm/min feed rate.

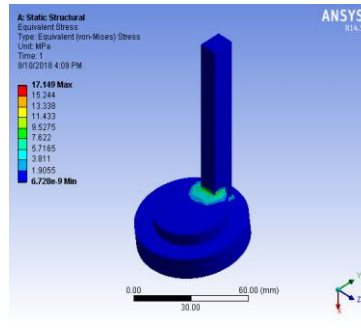
STRUCTURAL ANALYSIS

Work piece size 40mm

Force – 446.4N

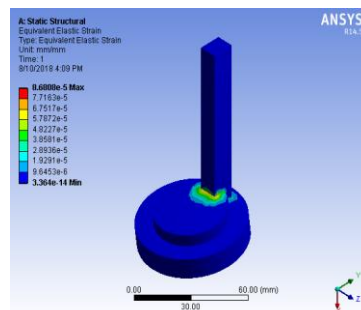
Speed – 2000rpm, feed – 250mm/min

STRESS



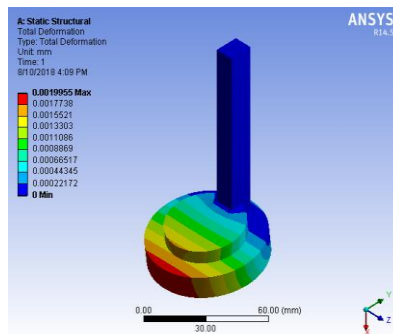
Resulted stress value of the original model

STRAIN



Resulted strain value of the original model

TOTAL DEFORMATION

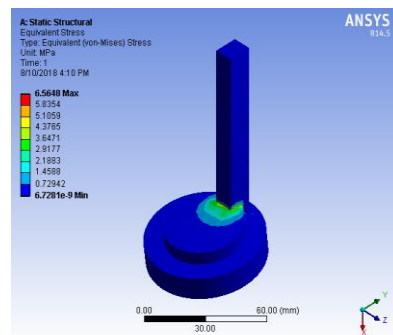


Resulted total deformation value of the original model

Force – 223.2 N

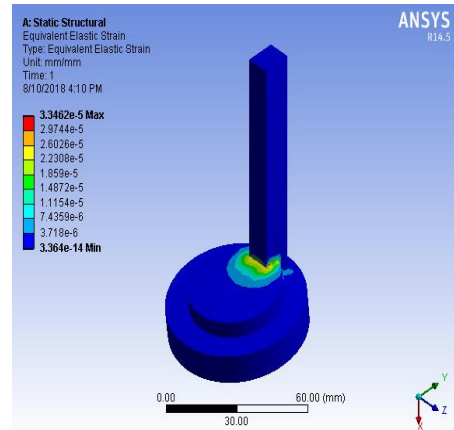
Speed – 2000rpm, feed – 500mm/min

STRESS



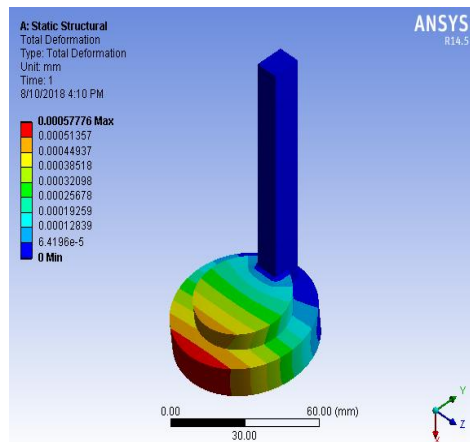
Resulted stress value of the original model

STRAIN



Resulted strain value of the original model

TOTAL DEFORMATION



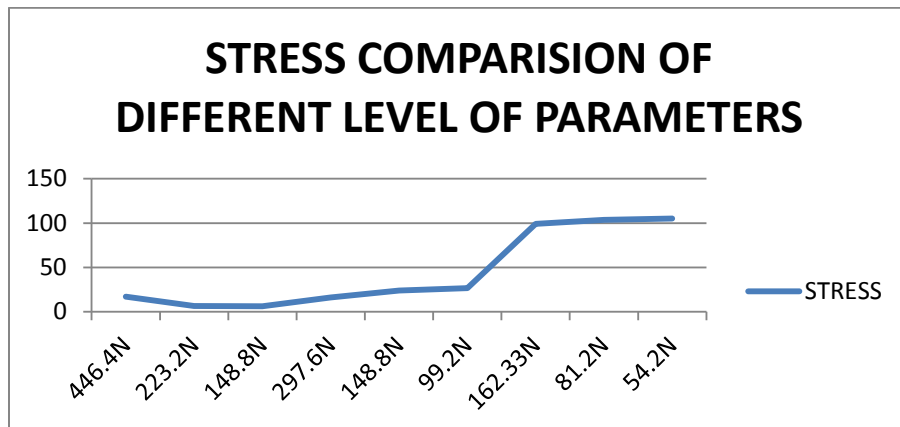
Resulted total deformation value of the original model

TABULAR COMPARASION OF THE 20MMDIA WORKPIECE WITH DIFFERENT RPM AND FEED RATE

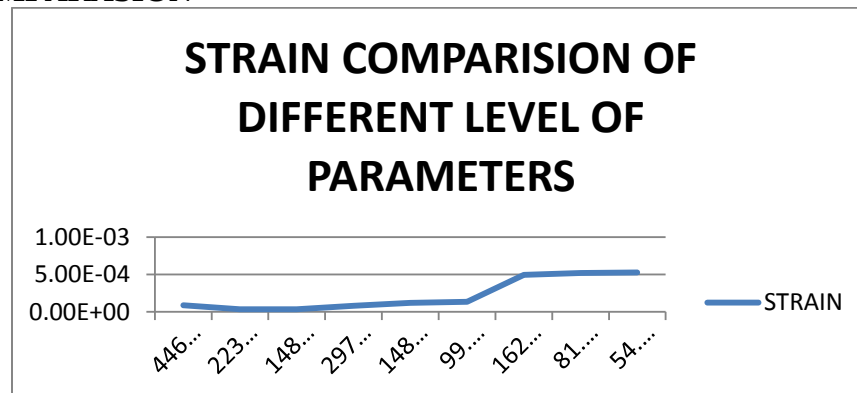
SPEED (RPM)	FEED (MM/MIN)	FORCE (N)	STRESS (MPa)	STRAIN	TOTAL DEFORMATION (mm)
2000 RPM	250	446.4N	17.149	8.6808e-5	0.0019955
	500	223.2N	6.5648	3.3462e-5	0.00057776
	750	148.8N	6.3275	3.1637e-5	0.00015843
3000 RPM	250	297.6N	16.107	8.0537e-5	0.00026204
	500	148.8N	23.977	0.00011989	0.0010344
	750	99.2N	26.674	0.0001337	0.0013447
5500 RPM	250	162.33N	99.026	0.00049513	0.0056003
	500	81.2N	103.49	0.00051745	0.0061147
	750	54.2N	104.98	0.00052489	0.0062861

GRAPHICAL COMPARISON OF PARAMETERS

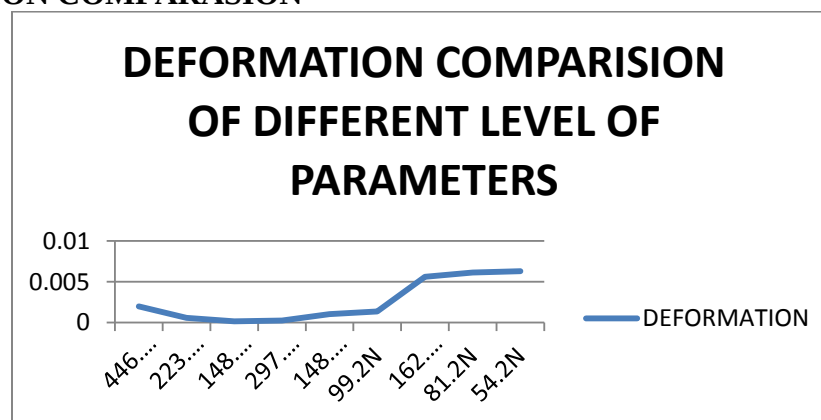
STRESS COMPARASION



STRAIN COMPARASION



DEFORMATION COMPARASION



As if we can observe the above comparison of stress, strain and deformation for the different level of parameters used for the 40mm Diameter work piece. As here we have considered 3 different types of RPM i.e., 2000rpm, 3000rpm, 5500rpm. And feed rate as 250mm/min, -500mm/min, 750mm/min. and the depth of cut is kept as constant as 1mm. all these required data is taken for the reference

STRESS

By observing he obtained results here the stress (6.3275MPa) is very less when compared with all the remaining obtained results, as here according to the stress we can use 2000rpm with 750mm/min feed rate.

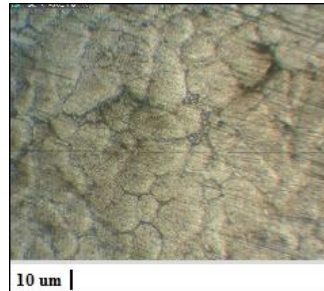
STRAIN

By observing he obtained results here the strain (3.1637×10^{-5}) is very less when compared with all the remaining obtained results, as here according to the stress we can use 2000rpm with 750mm/min feed rate.

DEFORMATION

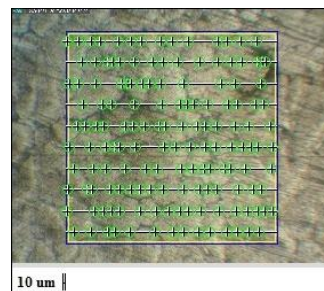
By observing he obtained results here the deformation (0.00015843mm) is very less when compared with all the remaining obtained results, as here according to the stress we can use 2000rpm with 750mm/min feed rate.

Micro structure for 2000RPM with 250mm/min Feed Rate



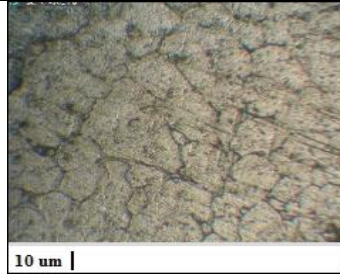
<u>GRAIN SIZE RESULTS SUMMARY</u>	<u>GRAIN SIZE</u>
ASTM Grain size #	6.
Intercepts	181
Mean Int. length (μm)	39.1
Fields measured	1
Analysed Area	0.5009 sq mm
Standards Used	ASTME 112

Micro structure for 2000RPM with 500mm/min Feed Rate



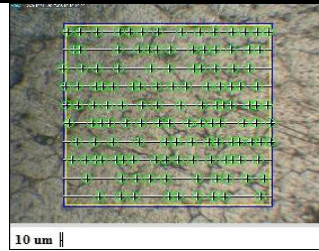
<u>GRAIN SIZE RESULTS SUMMARY</u>	<u>GRAIN SIZE</u>
ASTM Grain size #	4.5
Intercepts	149
Mean Int. length (μm)	69.1
Fields measured	1
Analysed Area	0.5009 sq mm
Standards Used	ASTME 112

Micro structure for 2000RPM with 750mm/min Feed Rate



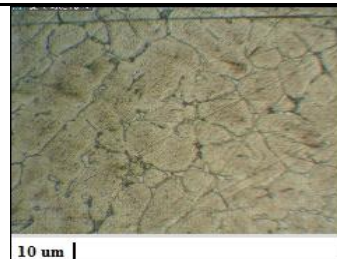
<u>GRAIN SIZE RESULTS SUMMARY</u>	<u>GRAIN SIZE</u>
ASTM Grain size #	3.5
Intercepts	124
Mean Int. length (μm)	82.3
Fields measured	1
Analysed Area	0.5009 sq mm
Standards Used	ASTME 112

Micro structure for 3000RPM with 250mm/min Feed Rate



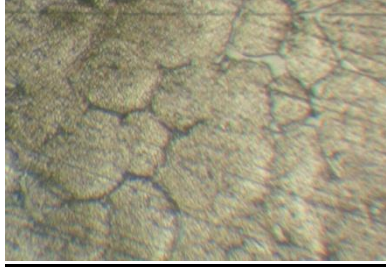
<u>GRAIN SIZE RESULTS SUMMARY</u>	<u>GRAIN SIZE</u>
ASTM Grain size #	6.5
Intercepts	192
Mean Int. length (μm)	33.5
Fields measured	1
Analysed Area	0.5009 sq mm
Standards Used	ASTME 112

Micro structure for 3000RPM with 500mm/min Feed Rate



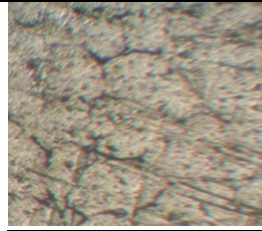
<u>GRAIN SIZE RESULTS SUMMARY</u>	<u>GRAIN SIZE</u>
ASTM Grain size #	5.0
Intercepts	132
Mean Int. length (μm)	53.6
Fields measured	1
Analysed Area	0.5009 sq mm
Standards Used	ASTME 112

Micro structure for 3000RPM with 750mm/min Feed Rate



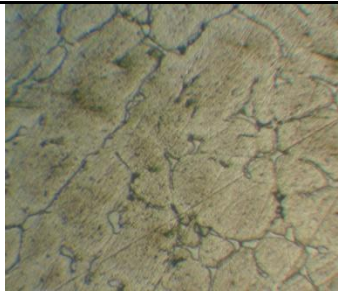
<u>GRAIN SIZE RESULTS SUMMARY</u>	<u>GRAIN SIZE</u>
ASTM Grain size #	4.5
Intercepts	149
Mean Int. length (μm)	47.5
Fields measured	1
Analysed Area	0.5009 sq mm
Standards Used	ASTME 112

Micro structure for 5000RPM with 250mm/min Feed Rate



<u>GRAIN SIZE RESULTS SUMMARY</u>	<u>GRAIN SIZE</u>
ASTM Grain size #	5.5
Intercepts	151
Mean Int. length (μm)	46.0
Fields measured	1
Analysed Area	0.5009 sq mm
Standards Used	ASTME 112

Micro structure for 5000RPM with 500mm/min Feed Rate



<u>GRAIN SIZE RESULTS SUMMARY</u>	<u>GRAIN SIZE</u>
ASTM Grain size #	6.5
Intercepts	192
Mean Int. length (μm)	33.5
Fields measured	1
Analysed Area	0.5009 sq mm
Standards Used	ASTME 112

Micro structure for 5000RPM with 750mm/min Feed Rate



<u>GRAIN SIZE RESULTS SUMMARY</u>	<u>GRAIN SIZE</u>
ASTM Grain size #	6.
Intercepts	182
Mean Int. length (μm)	39.0
Fields measured	1
Analysed Area	0.5009 sq mm
Standards Used	ASTME 112

CONCLUSION

In this thesis our aim is to find the better speed and feed for the material Al 5083 in turning process with tungsten carbide tool. As here if we verify we have considered a 20mm diameter block cutting and even 40mm diameter block. So here we are going to analyze as if the block size differs what sort level of parameters are required for turning operation for Aluminum blocks.

As here we have considered three different RPM i.e., 2000, 3000, 5500 Rpm and feed as 250mm/min, 500mm/min and 750mm/min, which is taken from the reference of a journal. Here the depth of cut is kept constant.

As after all the tabular and graphical conservations, we have observed that as the material size of diameter is being increased the RPM has to be decreased for the better quality of the product, as there is a dramatically change in the stress and deformation values. As the speed is decreasing the change of stress and deformation has been decreased.

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