COMPARISON ON 1037 CARBON, T-42 H.S.S, CHROME STEEL AND TUNGSTEN CARBIDE USED AS SINGLE POINT CUTTING TOOL RESEARCH METHODOLOGY

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ABSTRACT

Our main aim is the comparison of different material like 1037 Carbon, T-42 H.S.S, Chrome Steel and Tungsten Carbide which are used as single point cutting tool for different Depth of Cut. Modelling of single point cutting tool is done by using design software CATIA V5 R20. The model is then imported in ANSYS 14 software and meshing is done. Then at different depths of cut, the readings of stress were calculated and input to the software. The CATIA 14 software analysed the model by using finite element analysis and produced the stress readings for different depths of cut. The equivalent stresses developed at the tip of the tool, Maximum principal stress and also shear stresses are determined. Finite element analysis of single point cutting gave the result that a maximum stress is generated at the tip of the tool it is the one of the major cause of failure.

One of the best cutting tools is required to achieve maximum advantage in producing a good quality product. Our work is aimed at finding the best cutting tool among the most commonly used tools which are used in lathe machines for various operations. The various tools material that we have used is 1037 Carbon, T-42 H.S.S, Chrome Steel and Tungsten Carbide. Selection of suitable material for a cutting tool and its geometry is important for getting desirable MRR, rate of production, rigidity of the setup, machined surface, accuracy, surface finish etc. Although selection of a tool material doesn’t have a fixed rule but the economy, budget and demand of specific cutting tool property decides the type of material to be selected.

1. INTRODUCTION

The process of manufacturing work piece by removing undesirable material from a block of metal as chips is called Machining or Metal cutting. This method is most significant since the majority of the product get their final form and size by metal removal, either directly or indirectly [2]. Machining can be defined as the process of removing undesirable material from the work piece in the form of continuous and discontinuous chips. Turning operation is nothing but rotation of work piece against the tool in machine. Chip is formed due to the shear force acting on the cutting tool [4]. By direct application of force, a physical object or its portion can be separated into two parts. If a sharp object is supplied with a sufficiently larger force, it can cut a material provided it has hardness more than the object which is to be cut. Single point cutting tool as the name suggests removes the material using only one edge for cutting purpose and is used in various operation such as shaping, planning, turning and similar operations. Tools employed in Milling and Drilling operation uses multiple edges for cutting purpose and so they are called multipoint cutting tools. The factors which are most important during the cutting operation are various clearance angle of the cutting face, speed and feed at which the tool is run [1].

1.1 TYPES OF CUTTING TOOL

There are two types of cutting tool:

- Single point cutting tool
- Multi point cutting tool

1.1.1 Single Point Cutting Tool

Tools which have only single or one cutting edge is called single point cutting tool. A single point cutting tool consists of a sharpened part which is the actual cutting part and is called as its cutting point and the other part is called shank. The various operations for which these tools are used are turning, shaping, boring and planning operations. These single point cutting tool are used on lathe machines,planer,shaper, boring machines etc. [17].

1.1.1.1 Geometry of single point cutting tool

Tool geometry is defined as the basic tool angles, i.e. various relief and clearance angles given on single point cutting tool to make it highly efficient in cutting. A single point tool has been used most extensively in the industries and they have only one cutting edge. Single point cutting tool is designed with sharp edges to minimize rubbing contact between tool and work-piece. Factors like cutting tool life, surface finish of the work piece, force required to shear the work piece for formation of chip are substantially affected by variations in shape of cutting tool [17].

2 OBJECTIVE OF PRESENT WORK

Our main objective is the comparison of different tool material like 1037 Carbon, T-42 H.S.S, Chrome Steel and Tungsten Carbide used as single point cutting tool for different Depth of Cut. Following are the basic steps for the Analysis of Single point cutting tool.

- Modelling: Modelling of Single point cutting tool is done by CATIA V5 R21 as per the geometrical considerations.
- Meshing: Meshing is done by using ANSYS R15.0 workbench. It is necessary to understand how the structure is likely to behave and how elements are able to behave.
- Boundary conditions: Fixing the end face of the Single point cutting tool and applying force on the cutting edge.
- Analysis: Analysis is done by using ANSYS R14.0 workbench.
- Comparison of results.

3 MATERIAL SELECTION

The properties of various materials are collected and studied in detail with reference to the requirements of existing cutting tool materials. Below are few properties of materials that can substitute today's expensive tool material. Tool materials selected based on hardness, toughness and wear properties.

Table 2.1 Properties Of Various Materials Used In Single Point Cutting Tool

MTERIALS	DENSITY	YOUNG'S MODULUS	POISSON'S RATIO
	gcm^3	MPa	
1037C	7.79	190000	0.29
Chromium Steel	7.7	285000	0.24
Tungsten Carbide	15	664200	0.23
T-42 H.S.S	8	217000	0.28

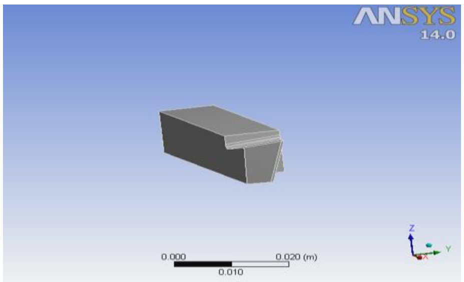

Fig 3.4 3D Model of Single Point Cutting Tool

4 Results and Discussion

4.1 Results for Equivalent Stress, Maximum Principal Stress and Shear Stress Of Single Point Cutting Tool At 0.2 Mm Depth Cut For 1037 Carbon Material, Chromium Steel, Tungsten Carbide And T-42 H.S.S. For 0.2 mm depth of cut we found that tungsten carbide have lowest value in shear stress, Equivalent stress and maximum principal stress among all four material which shows best suitable tool material for .2 mm depth of cut.

0.2mm Depth of cut			
MATERIAL	Shear stress 0.2mm Depth cut(pa)	Equivalent stress 0.2mm Depth cut(pa)	Maximum principal stress 0.2 mm Depth Cut(pa)
1037 Carbon	5.70E+07	5.95E+08	2.21E+08
Chromium Steel	5.51E+07	5.93E+08	2.18E+08
Tungsten Carbide	5.50E+07	5.92E+08	2.16E+08
HSS	5.50E+07	5.93E+08	2.17E+08

4.2 Results for Equivalent Stress, Maximum Principal Stress and Shear Stress Of Single Point Cutting Tool At 0.5 Mm Depth Cut For 1037 Carbon Material, Chromium Steel, Tungsten Carbide And T-42 H.S.S For .5 mm depth of cut we found that Tungsten carbide have lowest value in shear stress, Equivalent stress and maximum principal stress among all four material which shows best suitable tool material for .5 mm depth of cut.

0.5 Depth of Cut			
MATERIAL	Shear stress 0.5 mm Depth Cut(pa)	Equivalent stress 0.5 mm Depth cut(pa)	Maximum principal stress 0.5 Depth Cut(Mpa)
1037 Carbon	1.40E+08	1.49E+09	5.45E+08
Chromium Steel	1.40E+08	1.48E+09	5.45E+08
Tungsten Carbide	1.39E+08	1.48E+09	5.45E+08
HSS	1.40E+08	1.49E+09	5.47E+08

4.3 Results for Equivalent Stress, Maximum Principal Stress and Shear Stress Of Single Point Cutting Tool At 1 mm Depth Cut For 1037 Carbon Material, Chromium Steel, Tungsten Carbide And T-42 H.S.S. For 1 mm depth of cut we found that Tungsten carbide have lowest value in shear stress, Equivalent stress and maximum principal stress among all four material which shows best suitable tool material for .1 mm depth of cut.

1 mm Depth of Cut			
MATERIAL	Shear stress1mm Depth Cut(pa)	Equivalent stress 1mm Depth cut(pa)	Maximum principal stress 1 Depth Cut(pa)
1037 Carbon	2.79E+08	2.98E+09	1.09E+09
Chromium Steel	2.78E+08	2.98E+09	1.09E+09
Tungsten Carbide	2.68E+08	2.97E+09	1.09E+09
HSS	2.74E+08	2.98E+09	1.09E+09

7. Conclusions

In the present work results for Equivalent Stress, Maximum Principal Stress and Shear Stress Of Single Point Cutting Tool At .2mm, .5mm and 1 mm Depth Cut For all four material (1037 Carbon Material, Chromium Steel, Tungsten Carbide And T-42 H.S.S) shows that Tungsten carbide have lowest value in share stress,Equivalent stress and maximum principal stress by which it is best suitable tool material for single point cutting tool.

This work highlights that as the depth of cut increases, the stresses developed in the tool increases. It is the main reason for tool failure. The deformation also noted as higher side with every interval of rise in depth of cut. It is also one of the reasons for tool failure. As the depth of cut is increased further from .2 mm to 1.00 mm stresses are set up in the tool, due to which the geometry of the tool gets affected and the tool becomes unusable.

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