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Design and Analysis of Form Tool

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Abstract

A form tool is precision-ground into a pattern that resembles the part to be formed. The form tool can be used as a single operation and therefore eliminate many other operations from the slides (front, rear and/or vertical) and the turret, such as box tools. A form tool turns one or more diameters while feeding into the work. Before the use of form tools, diameters were turned by multiple slide and turret operations, and thus took more work to make the part.

In this Project we model a form tool using CATIA V5. The advantages of form tools are (a) cycle time, (b) it works as "POKA YOKA" (mistake proofing) (c) maintains relation between operation (d) cost optimization. This tool is designed based upon the component drawing supplied by the customer, spindle power and rpm of CNC machine on which this tool is proposed. This tool is modeled by using a 3D modeling software.

In this the design of form tool is carried out using CATIA modeling software, analyzed using FEA software ansys workbench.

Keywords— ***tool, single point cutting tool, designing , modeling , simulation, structural simulation, stress , strain, deformation***

INTRODUCTION

Forming a tool or die or designing a forming tool is one of vital factor of tool engineering, which must be known by every design engineer. Forming a tool means giving a particular and useful shape with required dimensions to the part. The part formed by forming operation is generally takes the shape of the dir or punch. In the forming operation, the metal flow is not uniform and localised to some extent, depending upon the shape of the work piece. Bending along a large radius in a straight line may also be referred to as a forming operation. It is difficult to distinguish between a bending and forming tools. Forming operation may be simple and extremely complicated.

A form tool is precision-ground into a pattern that resembles the part to be formed. The form tool can be used as a single operation and therefore eliminate many other operations from the slides (front, rear and/or vertical) and the turret, such as box tools. A form tool turns one or more diameters while feeding into the work. Before the use of form tools, diameters were turned by multiple slide and turret operations, and thus took more work to make the part. For example, a form tool can turn many diameters and in addition can also cut off the part in a single operation and eliminate the need to index the turret. For single-spindle machines, bypassing the need to index the turret can dramatically increase hourly part production rates.

Objectives

Know various types of forming tools, and understand design of forming tools

PURPOSE OF FORMING TOOLS

A form tool is defined as a cutting tool having one or more cutting edges with well defined profile or contour that is reproduced as the desired form on the workpiece surface. Form tools utilized for turning applications are classified according to type of cross section.

Design of Metal Shaping Tools

Flat or blocked tools are further classified according to the setting of tool with respect to the work piece, viz. radial-fed tools and tangential-fed tools. Further, form tools are also classified with respect to orientation of tools with respect to the work piece axis.

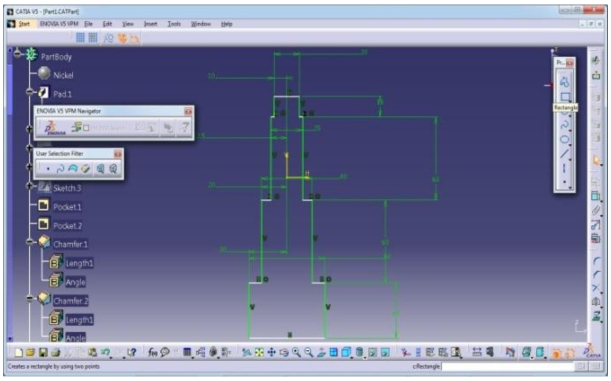
VARIOUS TYPES OF FORMING TOOLS

Flat Form Tool

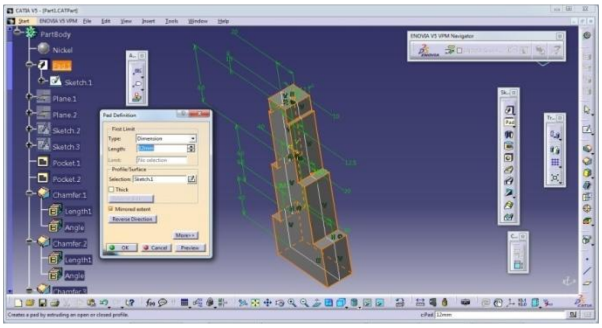
Straight and flat form tools have a square or rectangular cross-section with the form being along the side or end. These tools are similar in appearance to the turning tools. These are usually set centrally so that they will cut their contour which is identical to the desired contoured of the work piece. A typical example of V-notch tool is shown in Figure 7.2. This type of tool is suitable for making deep straight-sided form grooves. The cutting is restricted type due to the mixed chip flow. Because of the existence of the good surface finish, this type of tool must be operated at very low cutting speed.

CATIA

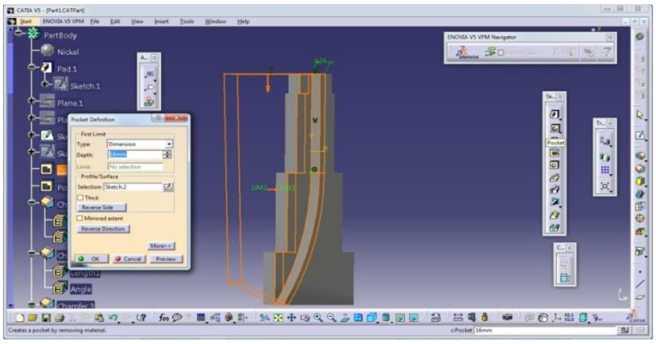
IMAGES OF FORM TOOL



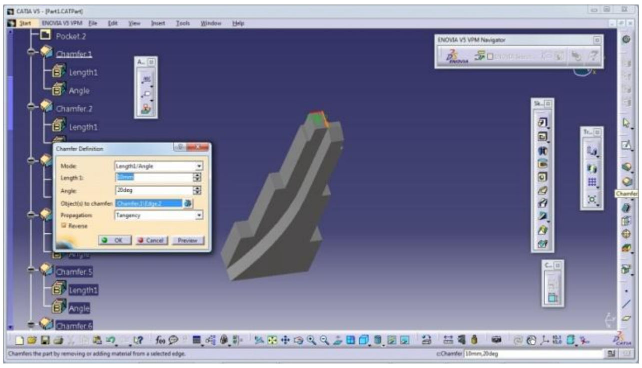
BASIC CROSS SECTIONAL PROFILE



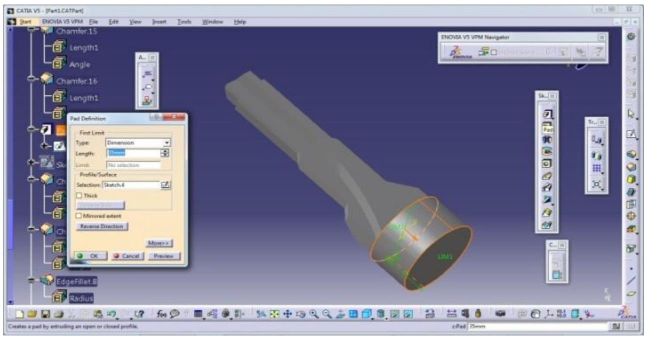
SOLID STRUCTURE OF PROFILE BY USING PAD TOOL



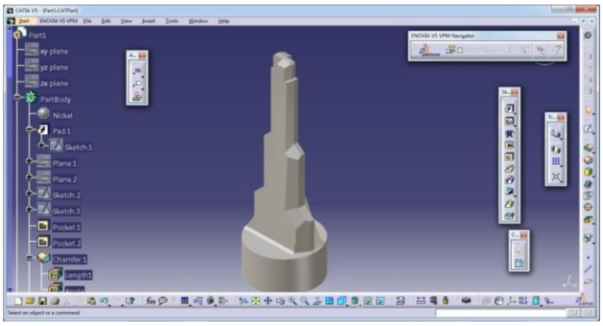
CREATING POCKET TO CREATE CONTOUR OF A TOOL



CHAMFERING THE TOOL



FORM TOOL CREATION



FORM TOOL

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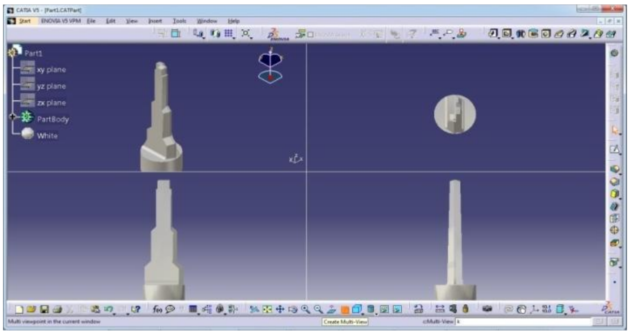
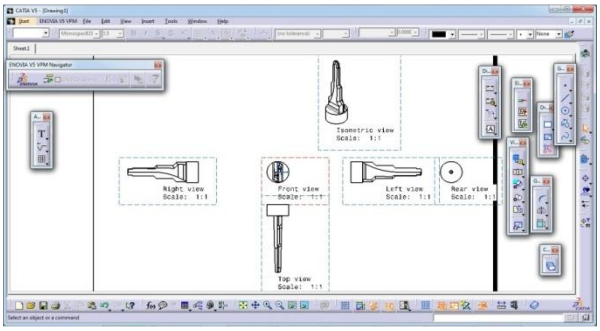
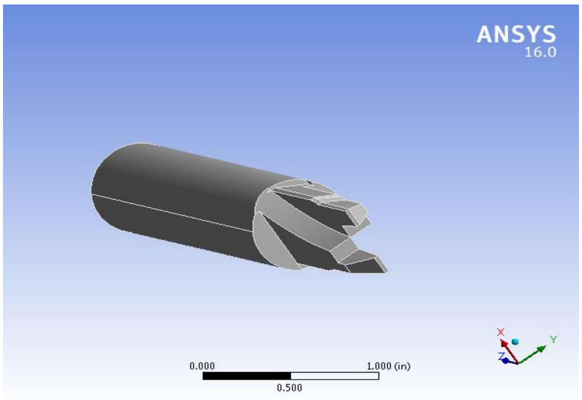


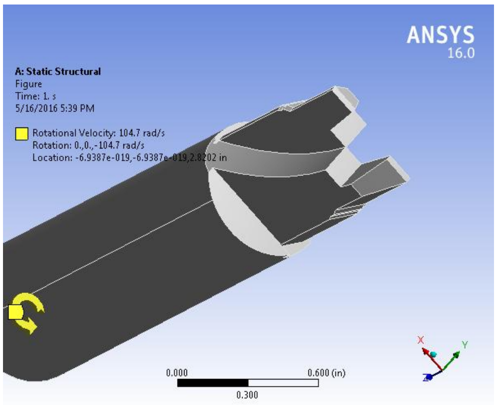
GEOMETRICAL VIEWS OF FORM TOOL

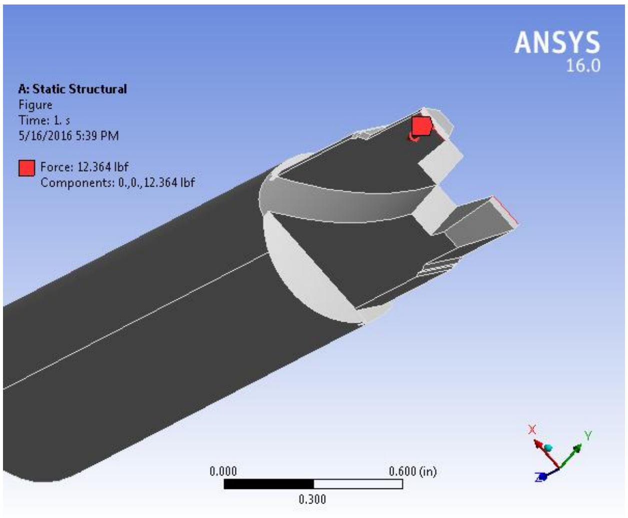


GENERATED DRAWING VIEWS

ANSYS







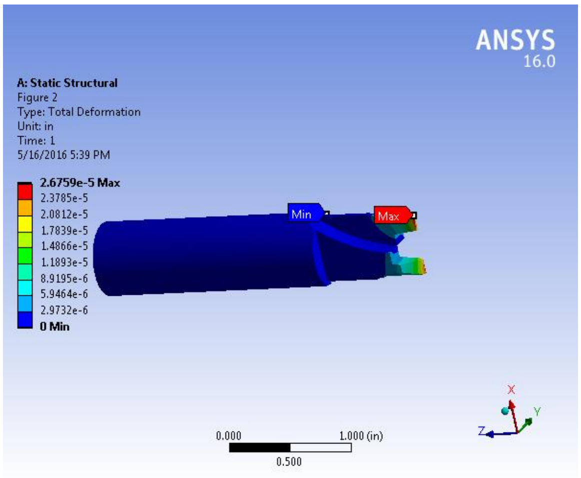


FIGURE 7

Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress

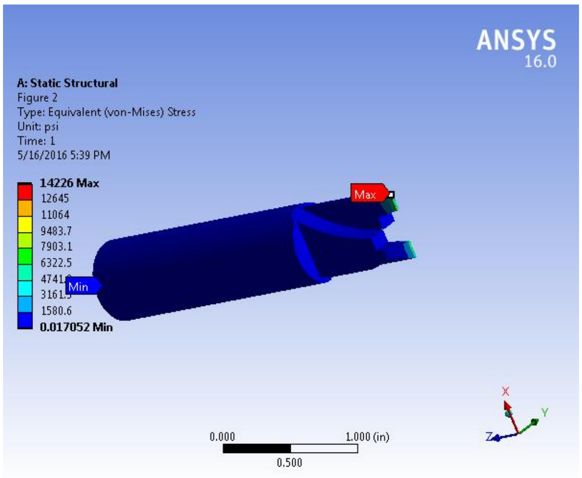


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FIGURE 9

Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain

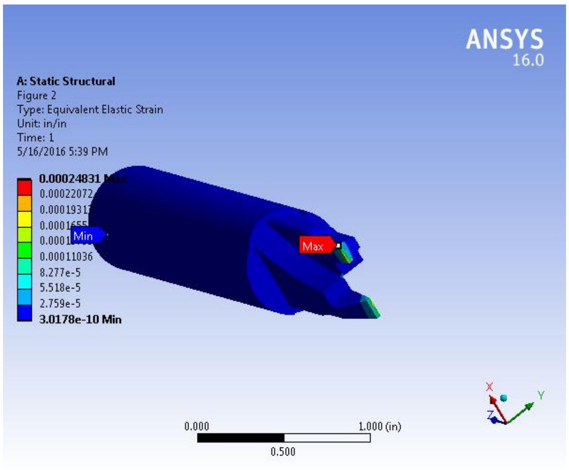

TABLE 11

Model (B4) > Modal (B5) > Solution (B6)

Mode	Frequency [Hz]
1.	16248
2.	23061
3.	27381
4.	49553
5.	50721
6.	59384

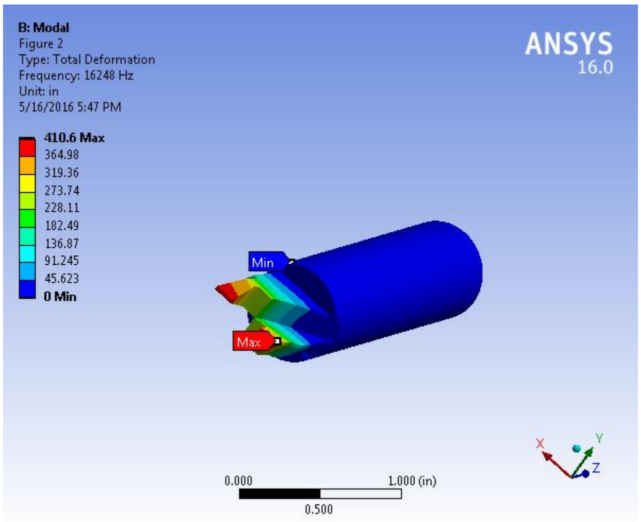

FIGURE 3

Model (B4) > Modal (B5) > Solution (B6) > Total Deformation 2 > Figure 2

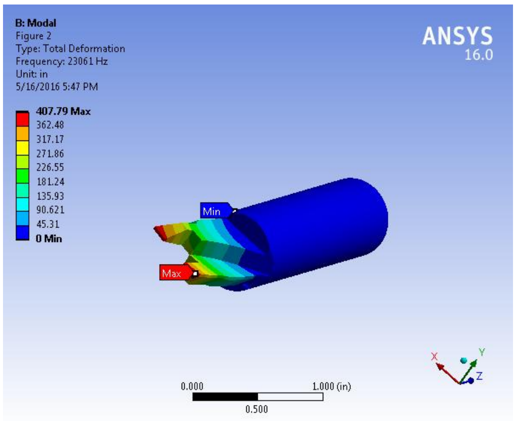

FIGURE 4

Model (B4) > Modal (B5) > Solution (B6) > Total Deformation 3 > Figure

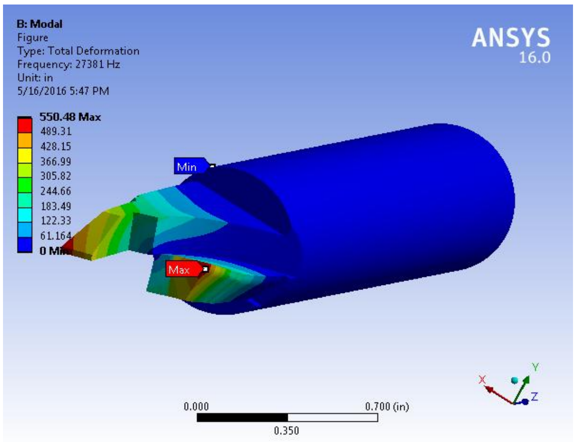

FIGURE 5

Model (B4) > Modal (B5) > Solution (B6) > Total Deformation 4 > Figure 2

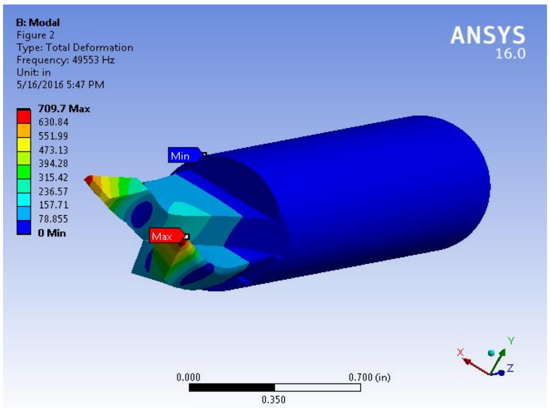

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FIGURE 6

Model (B4) > Modal (B5) > Solution (B6) > Total Deformation 5 > Figure 2

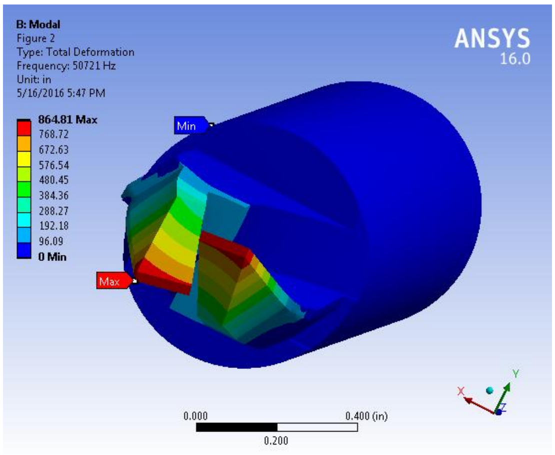
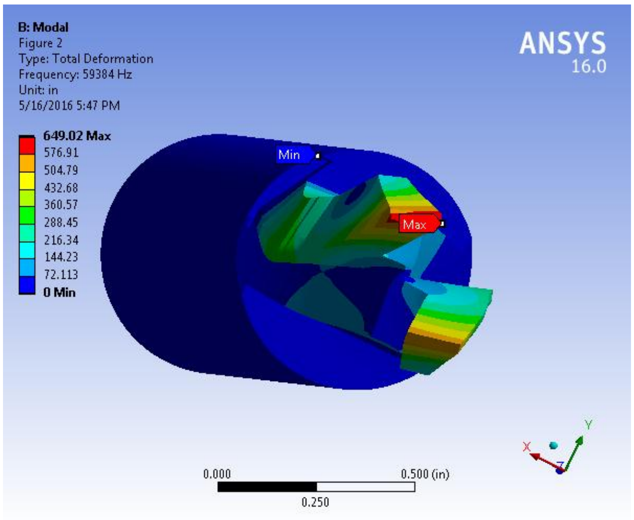


FIGURE 7

Model (B4) > Modal (B5) > Solution (B6) > Total Deformation 6 > Figure 2



Material Data

Structural Steel

TABLE 20

Structural Steel > Constants

Density	0.2836 lbm in^-3
Coefficient of Thermal Expansion	6.6667e-006 F^-1
Specific Heat	0.10366 BTU lbm^-1 F^-1
Thermal Conductivity	8.0917e-004 BTU s^-1 in^-1 F^-1
Resistivity	8.5235 ohm cmil in^-1

Results:

Static analysis

	HSS MATERIAL	SISIC MATERIAL
Deformation	0.00080489mm	0.00064053mm
Von mises stress	48.957MPA	68.986MPA
Strain	0.00020846mm/mm.	0.00017681mm/mm

Modal analysis

Mode shapes	HSS MATERIAL	SISIC MATERIAL
Mode 1	1090.1	979.74
Mode 2	1075.6	961.49
Mode 3	1399.1	1316.2
Mode 4	1607.6	1643.3
Mode 5	2164.9	2093.6
Mode 6	1546.5	1478.9

CONCLUSION:

In this project we modeled a form tool according to customer drawing/ requirement using CATIA V5. The form tool reduces the waste as errors due to operator fatigue, interruptions and production planning. The form tool mainly used to reduce the machining time and analyzed and stresses are using FINITE ELEMENT ANALYSIS with SISIC material as compared to High Speed Steel material

The following conclusions are drawn from the present work

- The Von mises stresses of HIGH SPEED STEEL are obtained in static analysis is 48.957MPA Mpa and Von mises stresses of SISIC is 68.986MPA
- The deformation in HIGH SPEED STEEL is0.00080489mm in static analysis and deformation in SiSiC is 0.00064053mm.
- The Stain Distribution in HIGH SPEED STEEL is 0.00020846mm/mm and strain distribution in SiSiC is 0.00017681mm/mm
- The Eigen values (natural frequencies) of HIGH SPEED STEEL are 1546.5mm and Eigen values of SiSiC is 1478.9mm

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From above stress, strain, total deformation we can observe that both HSS and SiSiC materials gave accurate results for form tool but according to cost HSS material is best.

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