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Process Optimization of Electronic Component by Using Nx-Cam Software

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ABSTRACT: *The paper presents the process plan techniques for the turn mill machine. The turn mill machine is the CNC machine which allows both milling and turning operations to process in the single setup of the component. Due to above aspects, both the machining cost and time taken for machining is reduces.*

This paper deals with turn mill operations of complex electronic component. The component has much number of operations to be performed.The component has both milling and turning operations to be performed. The component is being machined by 42 tools; it is very difficult to load 42 tools in 3 axes and 4 axes machines.Dimensions are also highly critical and complex.

This paper involves optimization of the turn mill processes or operations in order to good surface finish and to get less machining time. To optimize the turn mill process plan, CAD & CAM systems are used.

INTRODUCTION

Fuse body is a low type of resistance resistor. Fuse body that acts as a sacrificial device to provide over current protection, of either the load or source circuit. The fuse body has metal wire which is an essential component. The metal wire melts when high current flows and interrupts the circuit to which it is

Connected. The reasons for high flow of current are short circuit, overloading or device failure.

A fuse interrupts excessive current (blows) so that further damage by overheating or fire is prevented. Wiring regulations often define a maximum fuse current rating for particular circuits. Over current protection devices are essential in electrical systems to limit threats to human life and property damage. Fuses are selected to allow passage of normal current plus a marginal percentage and to allow excessive current only for short periods. Slow blow fuses are designed to allow harmless short term higher currents but still clear on a sustained overload. Fuses are manufactured in a wide range of current and voltage ratings and are widely used to protect wiring systems and electrical equipment. Self-resetting fuses automatically restore the circuit after the overload has cleared; these are useful, for example, in aerospace or nuclear applications where fuse replacement is impossible.

3D MODELING OF FUSE BODY

FUSE BODY 2D Drawing:

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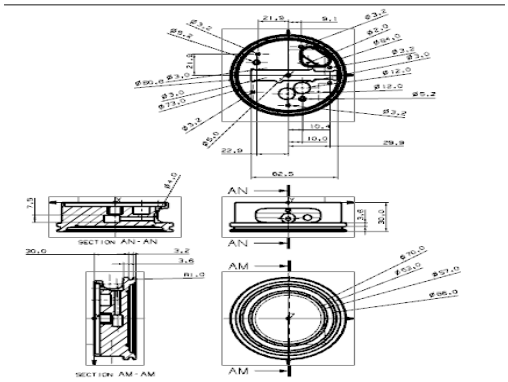

Fig shows 2D input of fuse body

3d Modeling:

Below image shows the sketch of the fuse body.

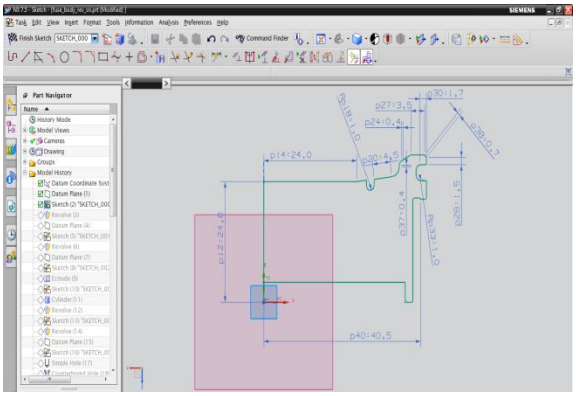

Fig shows sketch of fuse body

Below image shows revolve

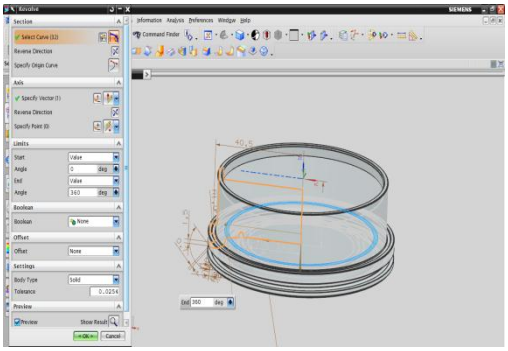

Fig shows revolve of fuse body

Below image shows sketch

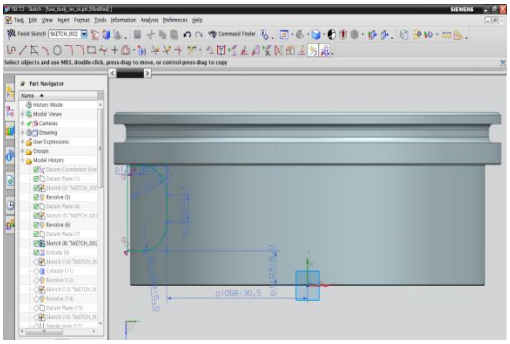

Fig shows sketch of fuse body

Below image shows extrude

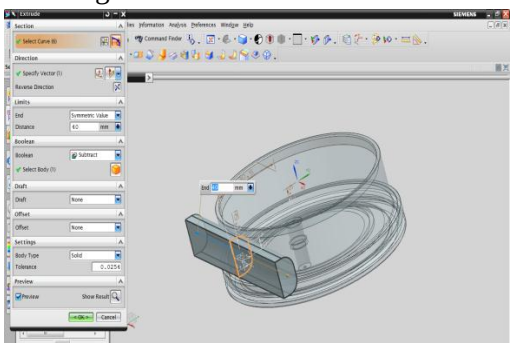

Fig shows extrude option

Below image shows sketch

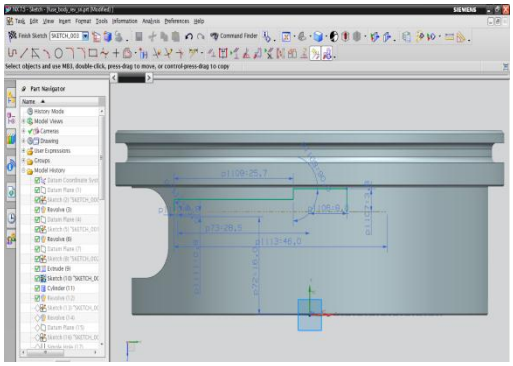

Fig shows sketch option

Below image shows revolve

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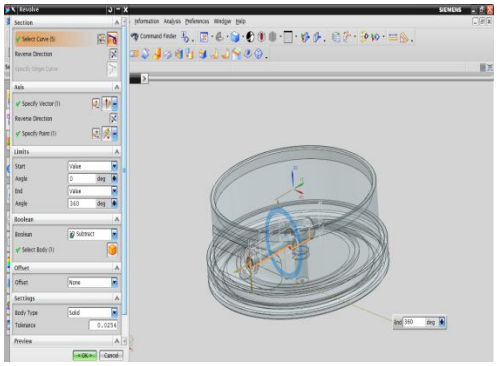

Fig shows extrude option

Below image shows sketch

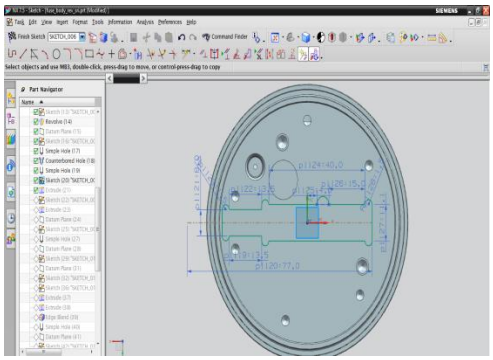

Fig shows sketch option

Below image shows extrude

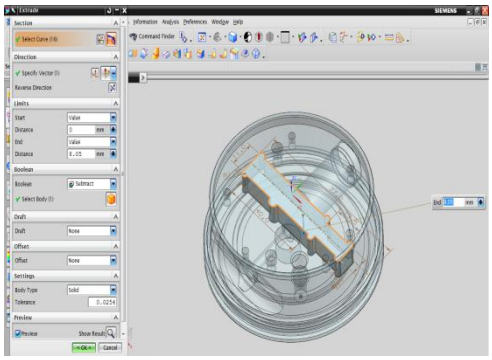

Fig.3.2.8. extrude option

Below image shows hole option

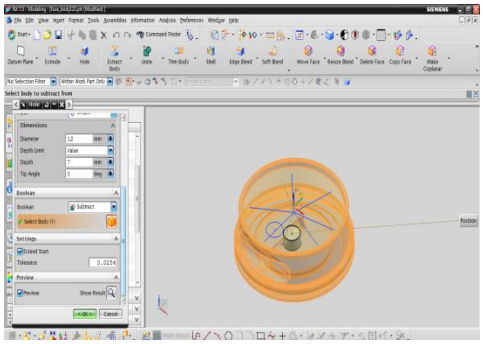

Fig shows option of hole

Below image shows option of hole

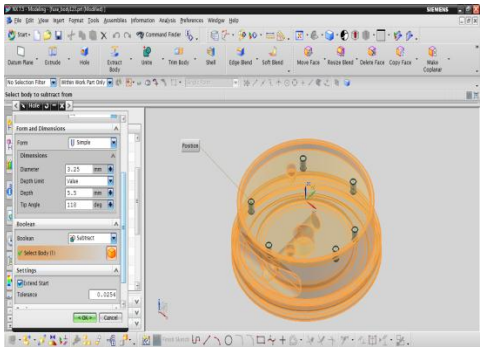

Fig shows option of hole

Below image shows sketch

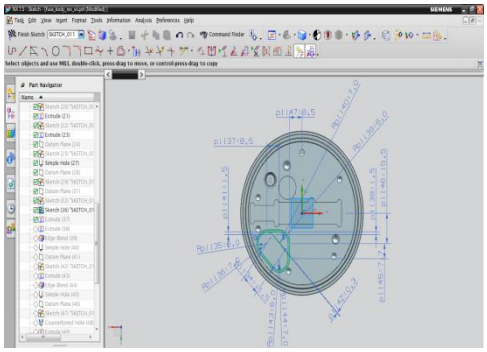

Fig shows sketch option

Below image shows extrude

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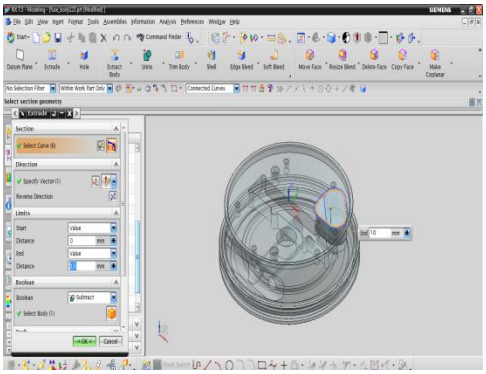

Fig shows extrude option

Below image shows 3D model of fuse body

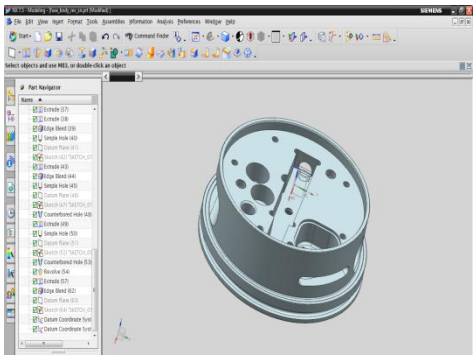

Fig shows final 3D model

COMPUTER AIDED MANUFACTURING (CAM)

The main objective of the project is to obtain high surface finish and less machining time.

Methodology of manufacturing fuse body

- Identify suitable machine.
- Selecting suitable tools for manufacturing fuse body component.
- Selection of fixture.
- Listing down the Sequence of operation performed on fuse body component.
- Generating NC program using NX-CAM software.
- Designing tools for reducing machining time.

Identification of suitable machine:

Fuse body is manufactured on both turning and milling machine. Facing od_roughing

Types of CNC machine used in this project:

DMG 5-axis milling machine and MORI SEIKI 4-axis CNC turning machine is used for manufacturing fuse body component.

Fig shows DMG 5-axis milling machine

Fig shows4-axis CNC MORI SIEKI turning machine

Selection of tools:

 Spot drilling.

 Drilling

 Tapping

 Face milling

 Face_milling_area

COMPUTER AIDED MANUFACTURING

Below image shows Blank of the fuse body

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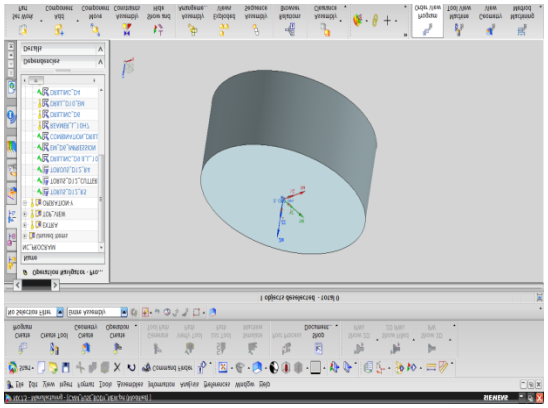

Fig shows Blank of the fuse body

Below image shows part of fuse body

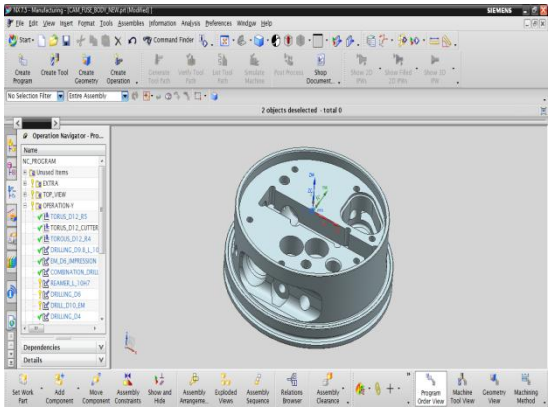

Fig shows part of fuse body

Turing operations on fuse body:

Below image shows facing operation

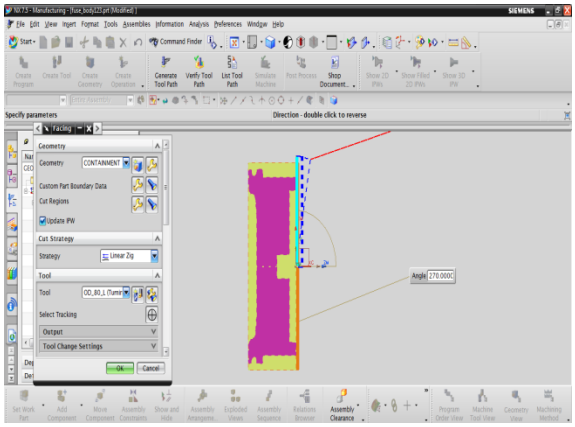

Fig shows facing operations of fuse body

Below image shows verification of facing operation

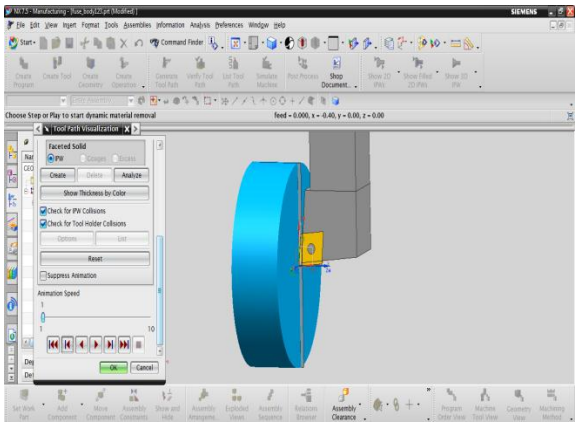

Fig shows verification of facing operation

Below image shows ROUGH TURN_OD operation of fuse body with 1300rpm speed and 0.24mmpr feed

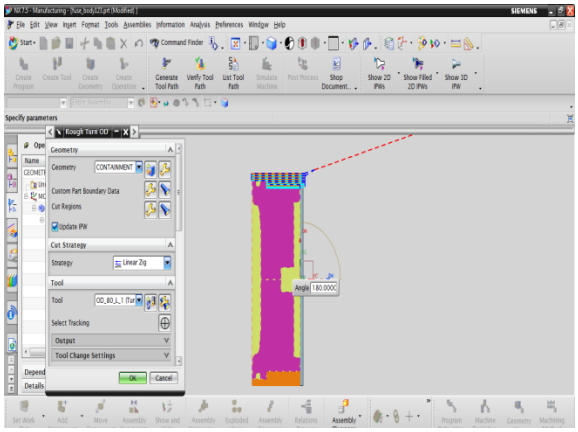

Fig shows ROUGH TURN_ODoperation

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Below image shows verification of ROUGH TURN_OD operation

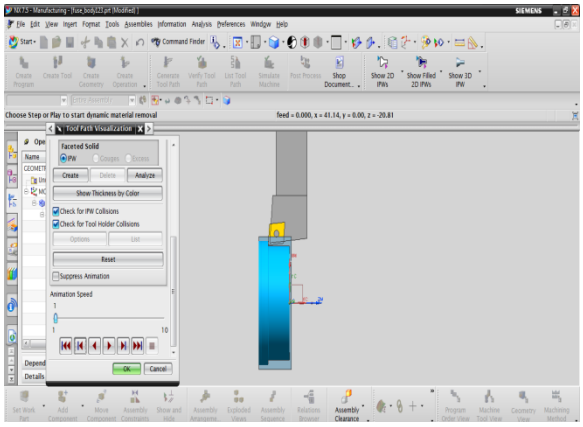

Fig shows verification of ROUGH TURN_ODoperation

Below image shows GROOVE_OD operation of fuse body with 1300rpm speed and o.24mmpr feed

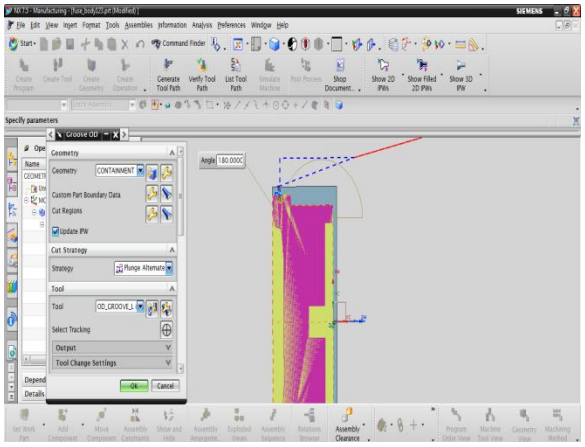

Fig shows GROOVE _ODoperation

Below image shows verification of GROOVE_OD operation

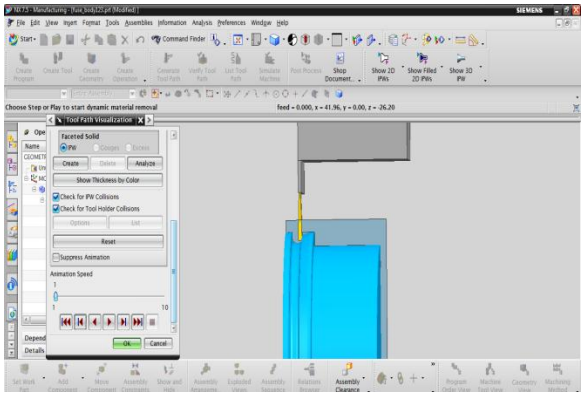

Fig shows verification of GROOVE _ODoperation

Below image shows ROUGH BORE_ID operation of fuse body with 1300rpm speed and o.24mmpr feed

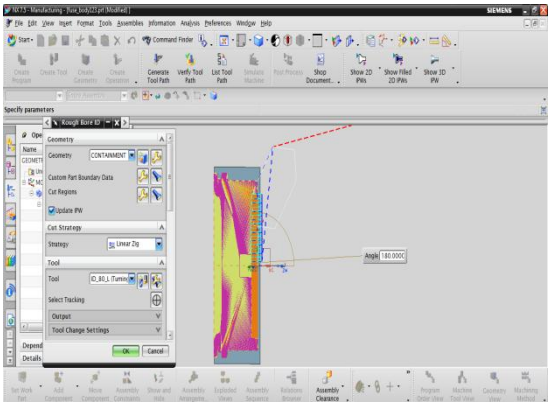

Fig shows ROUGH BORE_IDoperation

Below image shows verification of ROUGH BORE_ID operation

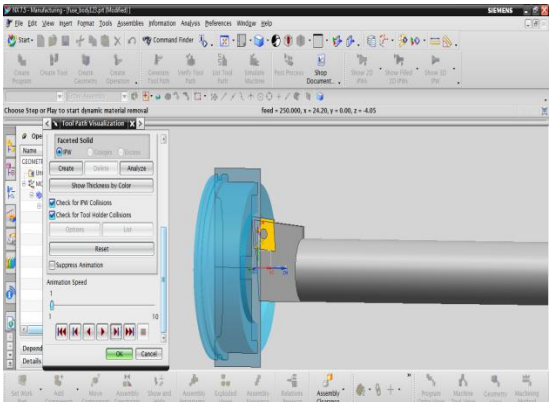

Fig shows verification of ROUGH BORE_IDoperation

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Milling operations on fuse body:

Below image shows planar mill operation of fuse body with 1400rpm speed and 230mmpm feed

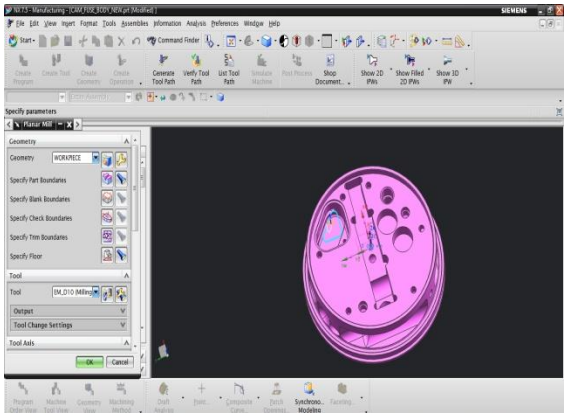

Fig shows planar mill operation

Below image shows verification of planar mill operation

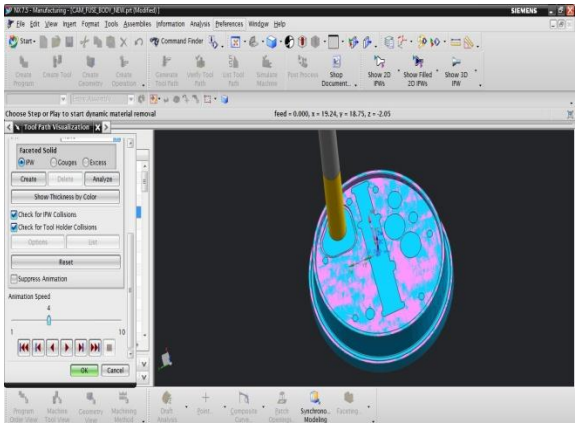

Fig shows verification of planar mill operation

Below image shows planar mill operation of fuse body with 1400rpm speed and 230mmpm feed

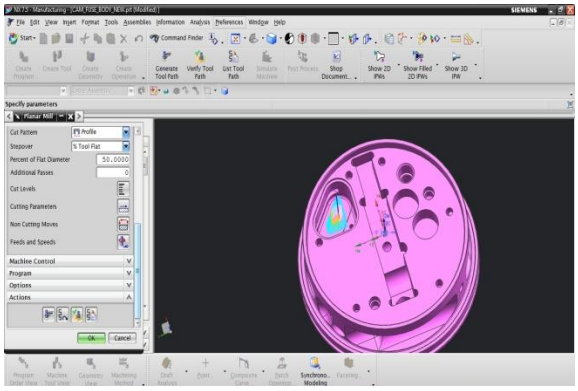

Fig shows planar mill operation

Below image shows verification of planar mill operation

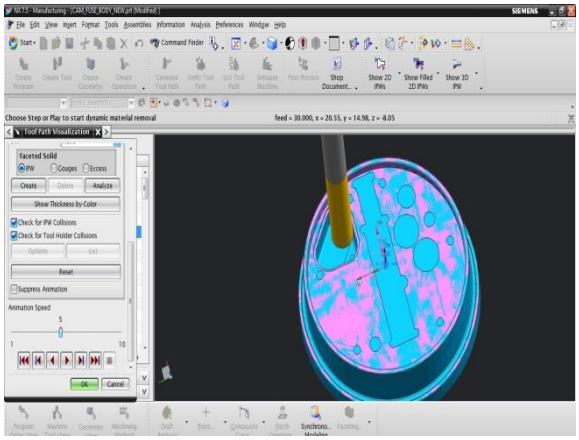

Fig shows verification of planar mill operation

Below image shows planar mill operation of fuse body with 1400rpm speed and 230mmpm feed

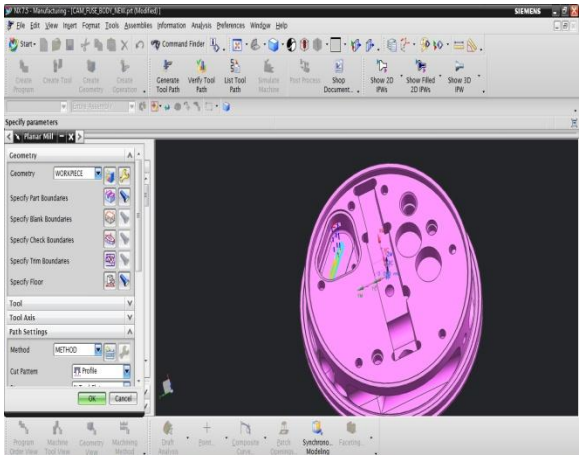

Fig shows planar mill operation

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Below image shows verification of **planar mill operation**

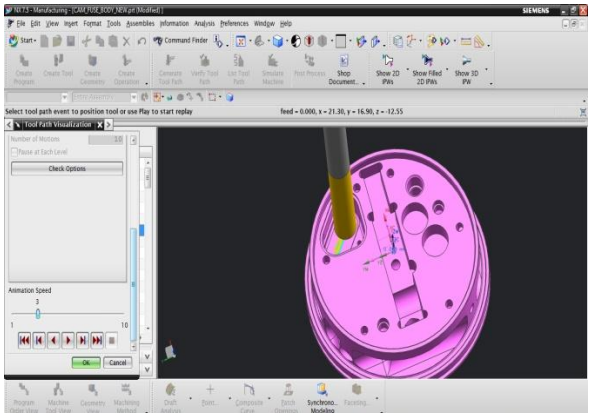

Fig shows verification of planar mill operation

Below image shows planar mill operation of fuse body with 1400rpm speed and 230mmpm feed

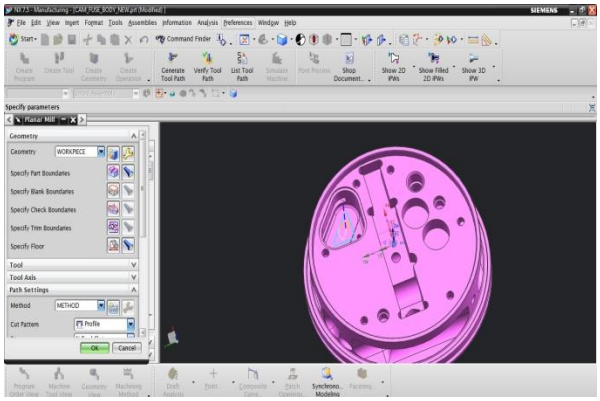

Fig shows planar mill operation

Below image shows planar mill operation of fuse body with 1400rpm speed and 230mmpm feed

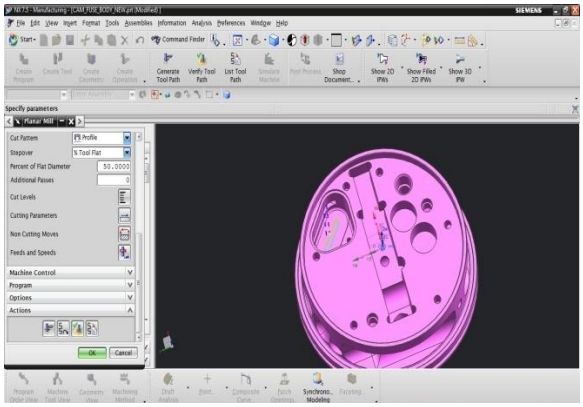

Fig shows planar mill operation

Below image shows verification of planar mill operation

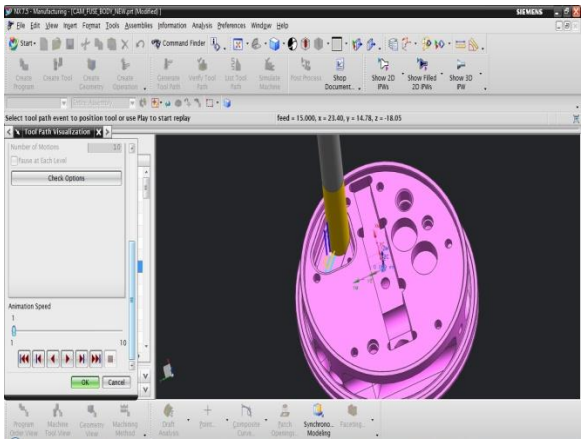

Fig shows verification of planar mill operation

Below image shows drilling operation of fuse body with 1250rpm speed and 230mmpm feed

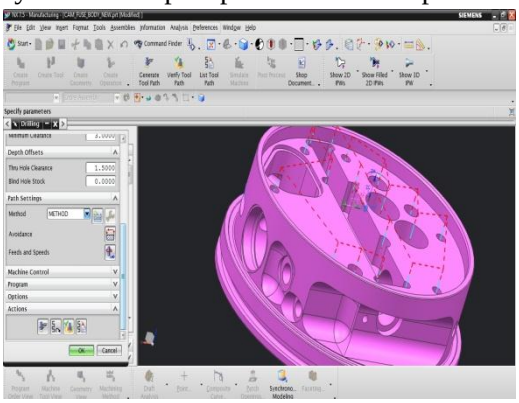

Fig shows drilling operation

Below image shows verification of drilling operation

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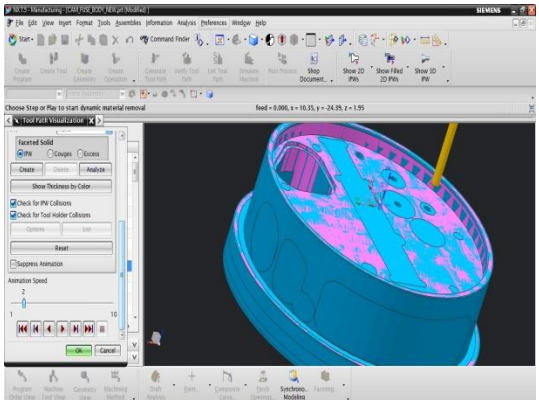

Fig shows verification of drilling operation

Below image shows drilling operation of fuse body with 1250rpm speed and 230mmpm feed

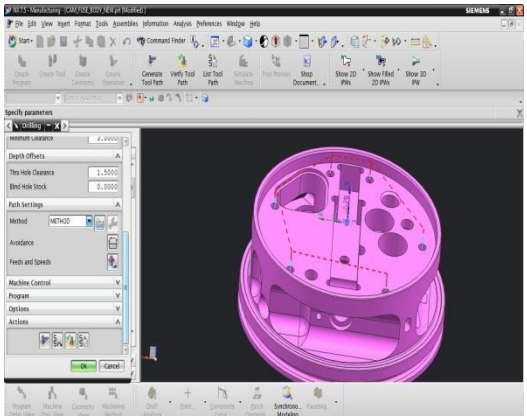

Fig shows drilling operation

Below image shows drilling operation of fuse body with 1250rpm speed and 230mmpm feed

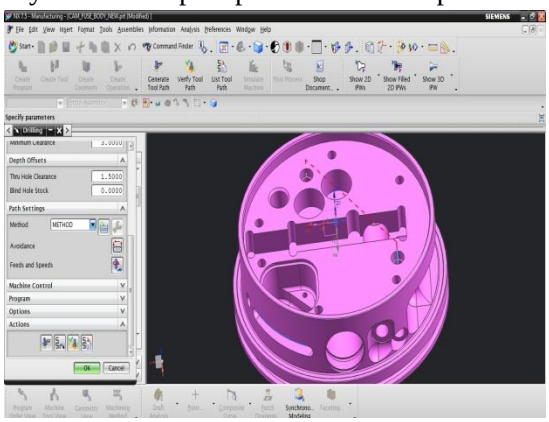

Fig shows drilling operation

Below image shows verification of drilling operation

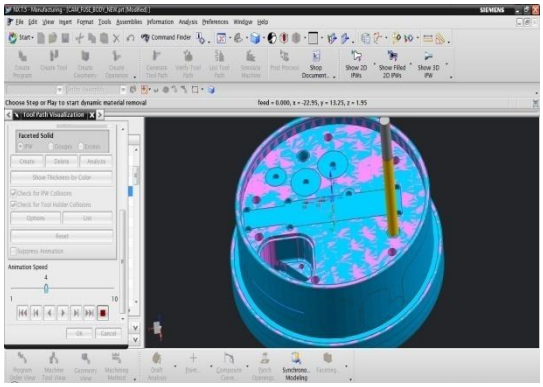

Fig shows verification of drilling operation

Below image shows drilling operation of fuse body with 1250rpm speed and 230mmpm feed

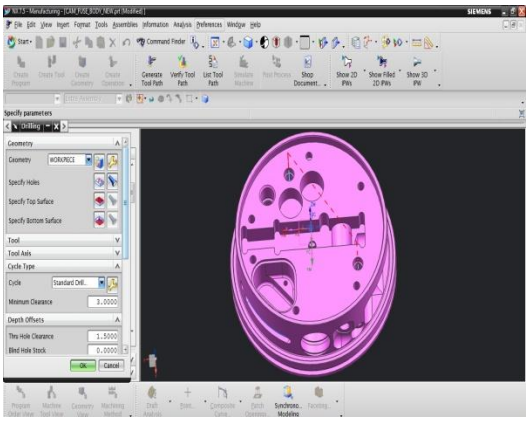

Fig shows drilling operation

Below image shows verification of drilling operation

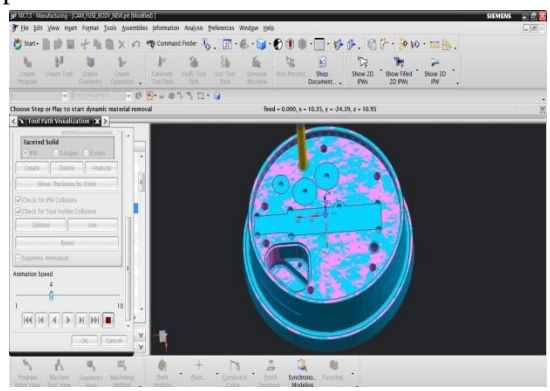

Fig shows verification of drilling operation

Below image shows drilling operation of fuse body with 1250rpm speed and 230mmpm feed

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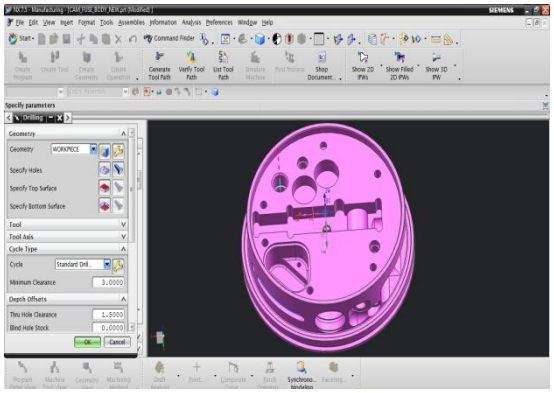

Fig shows drilling operation

Below image shows verification of drilling operation

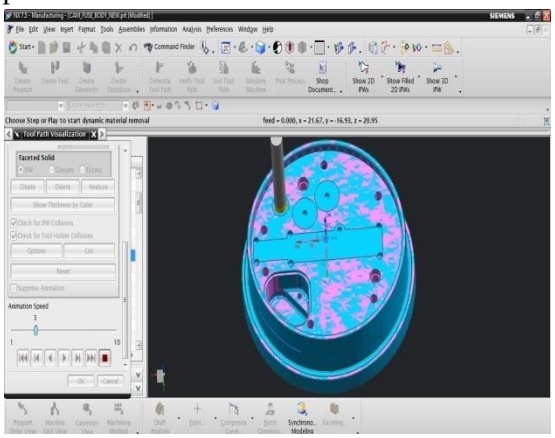

Fig shows verification of drilling operation

Below image shows drilling operations of fuse body with 1250rpm speed and 230mmpm feed

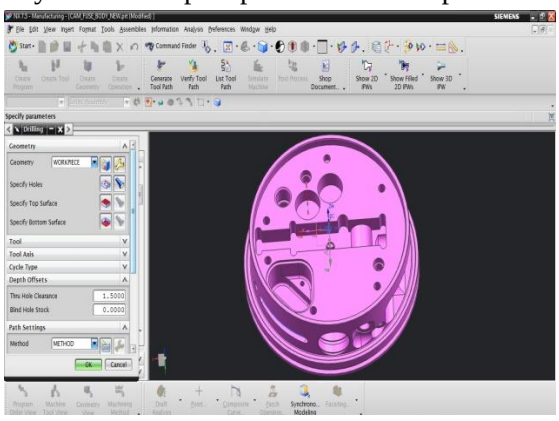

Fig shows drilling operation

Below image shows verification of drilling operation

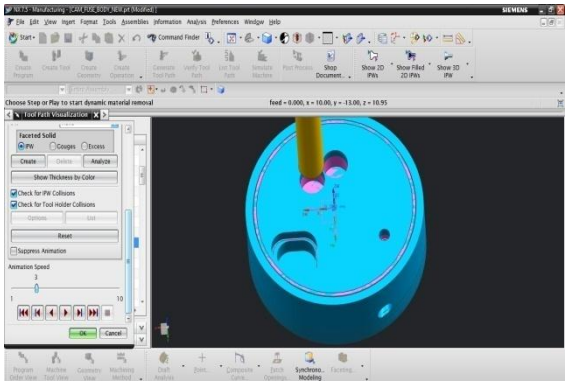

Fig shows verification of drilling operation

Below image shows planar mill operation of fuse body with 1400rpm speed and 230mmpm feed

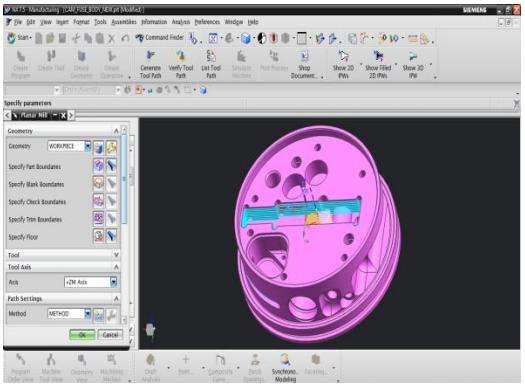

Fig shows planar mill operation

Below image shows verification of planar mill operation

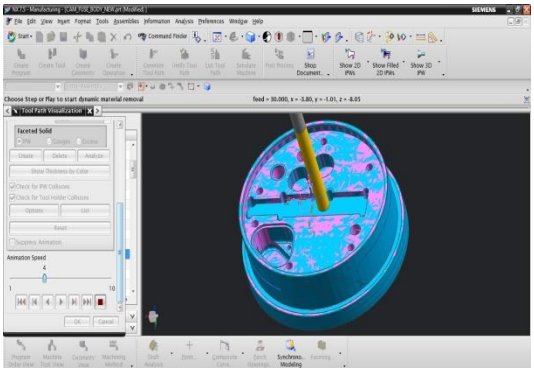

Fig shows verification of planar mill operation

Below image shows planar mill operation of fuse body with 1400rpm speed and 230mmpm feed

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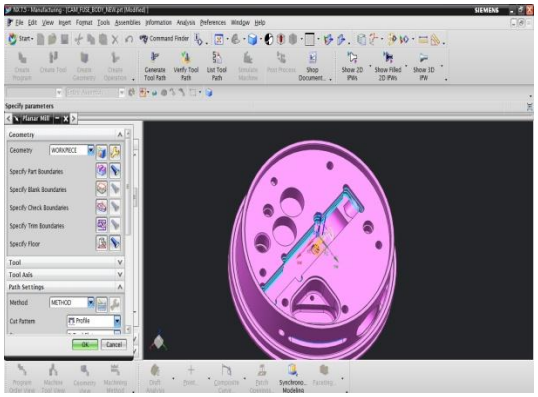


Fig shows planar mill operation

Below image shows verification of planar mill operation

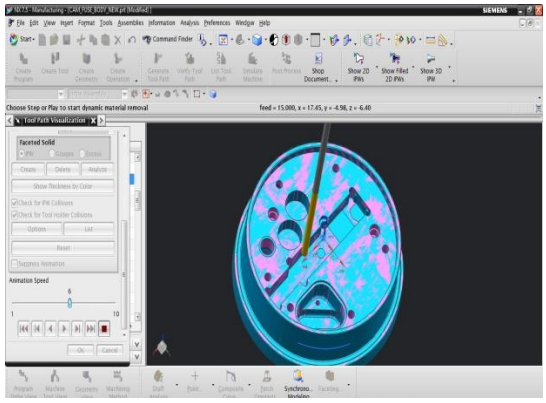
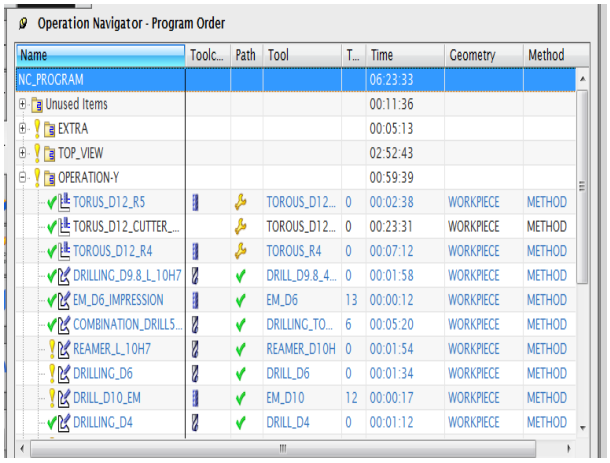


Fig shows verification of planar mill operation

The manufacturing process of fuse body on CNC machine:

Raw material is placed on the machine, and degree of freedom is arrested using fixtures. 3-jaw chuck is used for arresting degree of freedom of the fuse body.

Below image shows time taken for manufacturing fuse body.



Name	Toolc...	Path	Tool	T...	Time	Geometry	Method
NC_PROGRAM					06:23:33		
Unused Items					00:11:36		
EXTRA					00:05:13		
TOP_VIEW					02:52:43		
OPERATION-Y					00:59:39		
TORUS_D12_R5			TOROUS_D12...	0	00:02:38	WORKPIECE	METHOD
TORUS_D12_CUTTER_...			TOROUS_D12...	0	00:23:31	WORKPIECE	METHOD
TOROUS_D12_R4			TOROUS_R4	0	00:07:12	WORKPIECE	METHOD
DRILLING_D9.8_L_10H7			DRILL_D9.8_4...	0	00:01:58	WORKPIECE	METHOD
EM_D6_IMPRESSION			EM_D6	13	00:00:12	WORKPIECE	METHOD
COMBINATION_DRILL5...			DRILLING_TO...	6	00:05:20	WORKPIECE	METHOD
REAMER_L_10H7			REAMER_D10H	0	00:01:54	WORKPIECE	METHOD
DRILLING_D6			DRILL_D6	0	00:01:34	WORKPIECE	METHOD
DRILL_D10_EM			EM_D10	12	00:00:17	WORKPIECE	METHOD
DRILLING_D4			DRILL_D4	0	00:01:12	WORKPIECE	METHOD

Fig shows Time Taken for Manufacturing Fuse Body

DESIGN OF TOOLS

Tools are designed for typical operations to reduce manufacturing time and cost and to get high surface finish. These tools reduce number of operations using designed tools we can go for high cutting speed and feeds. The machining time will be reduced at high speed cutting as well as component cost is reduced.

Tool 1:

Below image shows sketch of designed tool

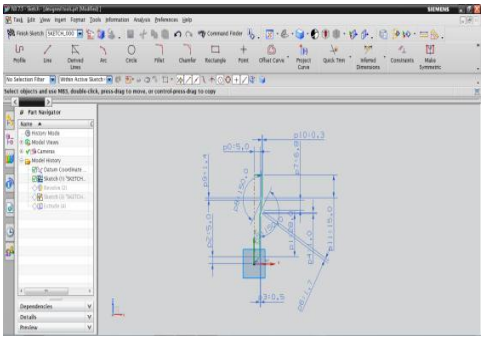


Fig shows sketch option of tool-1

Below image shows revolve of designed tool

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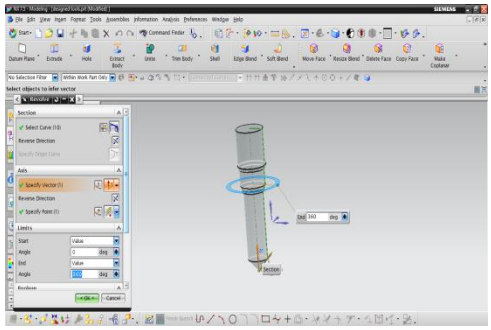

Fig shows revolve option of tool-1

Below image shows extrude of designed tool

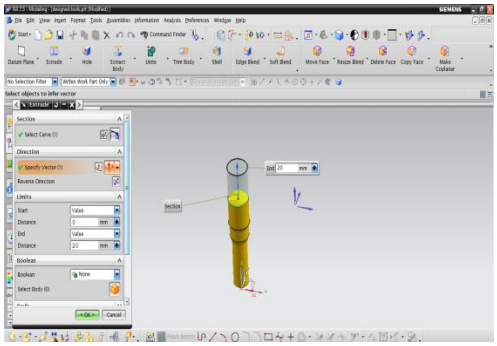

Fig shows extrude option

Below image shows final part of designed tool

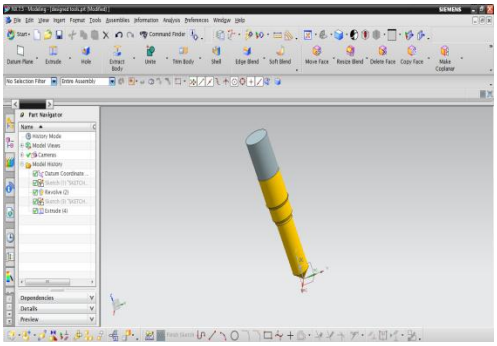

Fig shows final part of designed tool-1

Tool 2

Below image shows sketch of designed tool

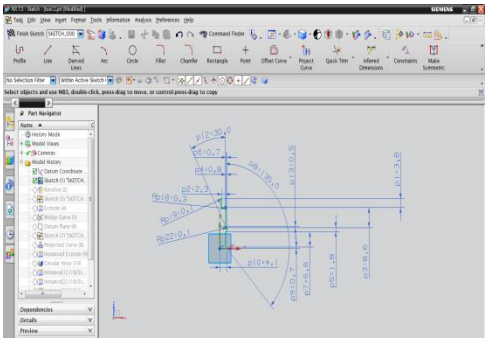

Fig shows sketch option of tool-2

Below image shows revolve of designed tool

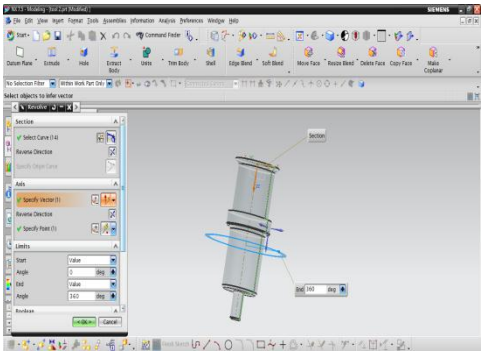

Fig shows revolve option

Below image shows bridge curve option

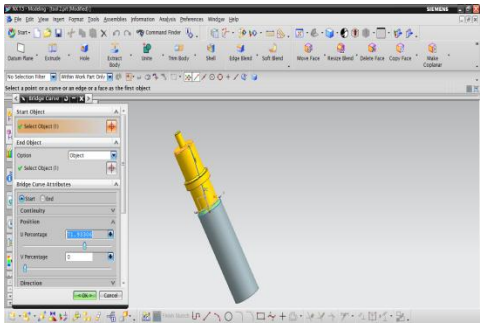

Fig shows bridge curve option

Below image shows sketch of designed tool

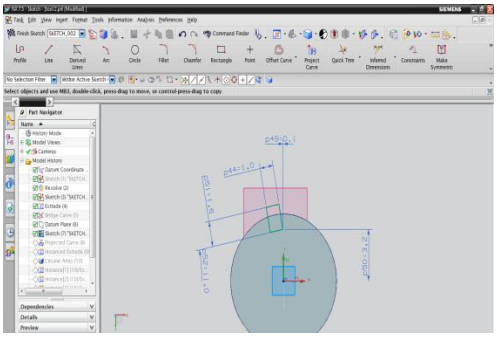

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Fig shows sketch option

Below image shows extrude of designed tool

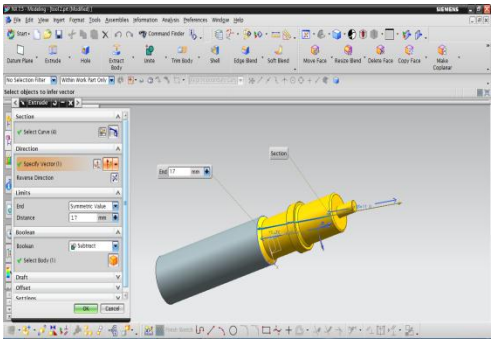

Fig shows extrude option

Below image shows array of designed tool

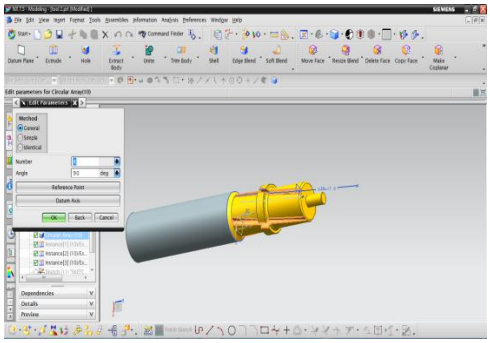

Fig shows array of designed tool

Below image shows final part of designed tool

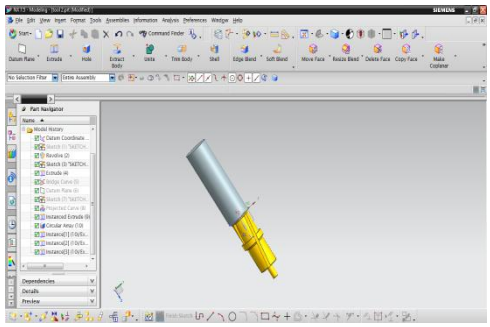

Fig shows final part of designed tool-2

The manufacturing process of fuse body on CNC machine with designed tools.

Manufacturing process will be same for machining fuse body but designed tools were used to reduce machining time and cost of the part. The time taken for manufacturing fuse body is shown below

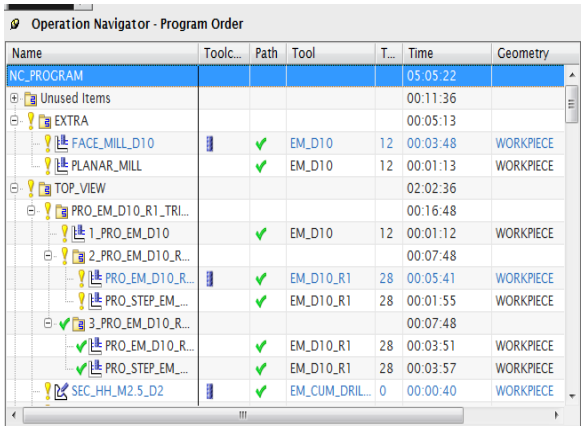

Fig shows Time Taken for Manufacturing Fuse Body using designed tools.

Below image shows Final component after manufacturing

RESULTS & DISCUSSION

Product cost reduction, Reduction machining time

Time and cost calculation for manufacturing fuse body as shown below

Manufacturing time taken by single component= 6hrs 24mins

Machining cost per hour for milling operations = 1200rs

Machining cost per hour for drilling operations = 800rs

Machining cost per piece for turn- mill operations (machining cost per min x machining time in min) = 1200/60*198min= 3960rs

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Machining cost per piece for drilling operations (machining cost per min x machining time in min) = 800/60*186min= 2480rs

Total machining cost per piece= turn-mill + drilling= 3960+2480 = 6440rs

Table1: Table of machining time& cost using default tools for manufacturing

SET UP operations	TIME REQUIRED IN MINS.	MACHINING COST PER HOUR	MACHINING COST/PIECE
Turn-Mill	198	RS.1200/HR	RS.3960
Drilling	186	RS.800/HR	RS.2480
TOTAL	384		RS.6440

Manufacturing component on CNC machine using Designed tools

Manufacturing time taken by single component= 5hrs 6min

Machining cost per hour for turn-mill operations = 1200rs

Machining cost per hour for drilling operations = 800rs

Machining cost per piece for turn-mill operations (machining cost per min x machining time in min) = 1200/60*198min= 3960rs

Machining cost per piece for drilling operations (machining cost per min x machining time in min) = 800/60*108min= 1440rs

Total machining cost per piece= turn-mill+drilling= 3960+1440 = 5400rs

Table of machining time& cost using designed tools for manufacturing

SET UP operations	TIME REQUIRED IN MINS.	MACHINING COST	MACHINING COST/PIECE
Turn-Mill	198	RS.1200/HR	RS.3960
Drilling	108	RS.800/HR	RS.1440
g		R	
TOTAL	306		RS.5400

Graph:

Graphical representation of manufacturing time and cost of the component

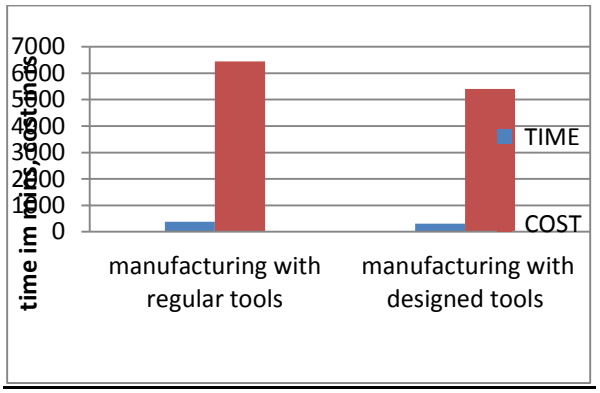

Fig shows Graph of machining time & cost

CONCLUSION

Modeling of fuse body is done using Unigraphics software.Proper tools are specified which will support for machining typical components like fuse body.Manufacturing process sequence of fuse body is shown in the document.Manufacturing time is noted when part is manufactured with regular tools, to reduce time and cost tools are designed as per the operations.New tools are designed to do 4 operations at a time and reduce manufacturing cost and timeGraphical representation of Product cost reduction, Reduction of manufacturing times is shown in results. Graphical representation of Product cost reduction rate of fuse body shows reduction of time as well as cost of component when manufactured by using designed tools which will reduce manufacturing time and cost of the component.Optimization of manufacturing process by using designed tools to reduce manufacturing cost and time

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