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# OPTIMIZATION IN MANUFACTURING PROCESS OF ARTILLERY FUZE BY USING DESIGNED FIXTURE

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## ABSTRACT

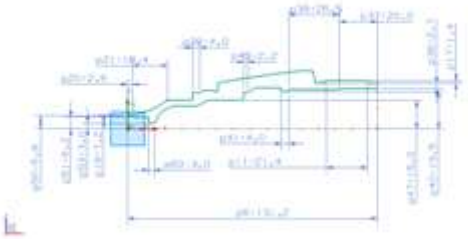
This paper deals with development of fixture. First there will be a trial machining using 3-jaw chuck as fixture and found more rejection rate, to reduce rejection rate a new fixture is developed for Manufacturing fuze shell. New fixture is validated using modal analysis, by comparing natural frequencies of fixture and part. After validation of fixture fuze shell is manufactured and found less rejection rate. Production is started using designed fixture, which reduced the machining cost of the component and at the same time reduced the labour work. NX-CAD software shall be used to design and optimize the fixture. Ansys software is used to validate the fixture. NX-CAM software shall be used to develop and optimize the manufacturing process plan.

## INTRODUCTION

An artillery fuze is the type of munition fuze used with artillery munitions. Typically they are projectiles fired by guns, howitzers and mortars. Artillery ammunition has had to fill different roles on the battlefield has led to many different designs and types of ammunition. There are four general types of artillery ammunition fixed, semi fixed, separated and separate loading ammunition. Fixed ammunition is issued and loaded as complete round, used in guns and recoilless rifles. Semi fixed rounds are issued with the catridge case and propellant separate from the projectile, used in howitzers and all mortars. Separated ammunition is issued as two separate components, a sealed catridge case and a projectile and they are used in large guns. Separate-loading ammunition are issues separately and unassembled.

## 3D MODELLING OF FUZE SHELL

Below image shows sketch and revolve of Fuze shell



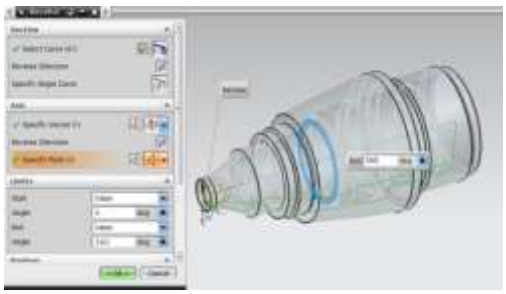


Fig shows sketch and revolve of Fuze shell

Below image shows sketch and Extrude of Fuze shell

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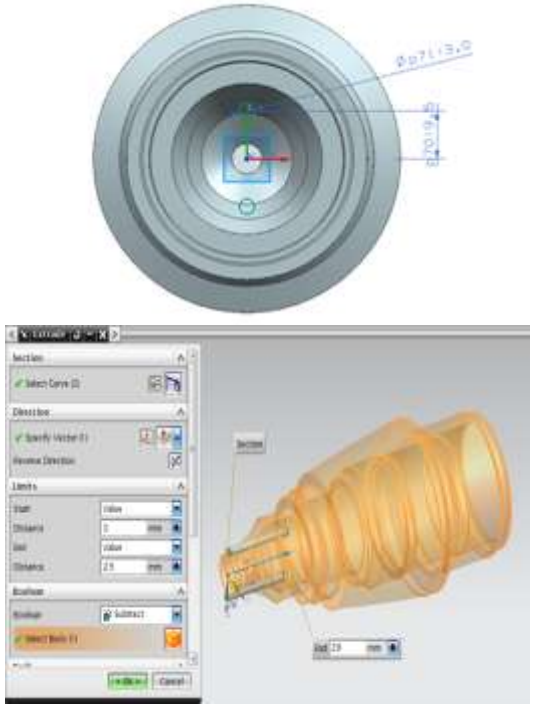

Fig shows sketch and Extrude of Fuze shell

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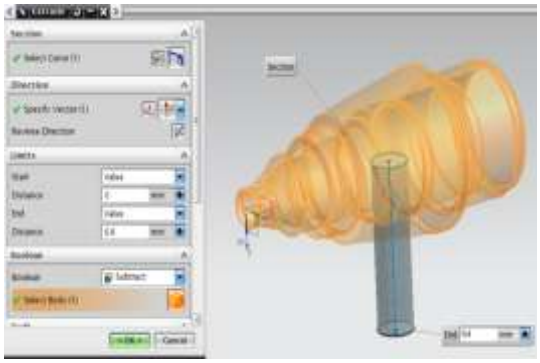

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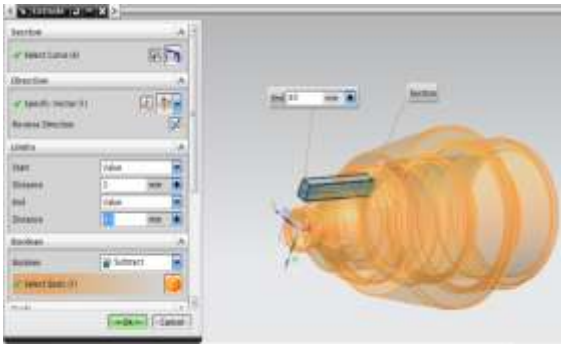

Fig shows sketch and Extrude of Fuze shell

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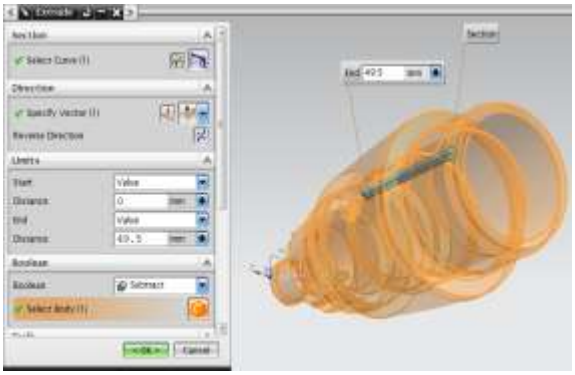

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Below image shows sketch and Extrude of Fuze shell

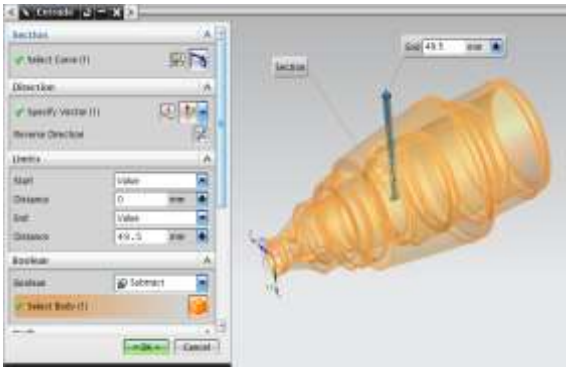

Fig shows sketch and Extrude of Fuze shell

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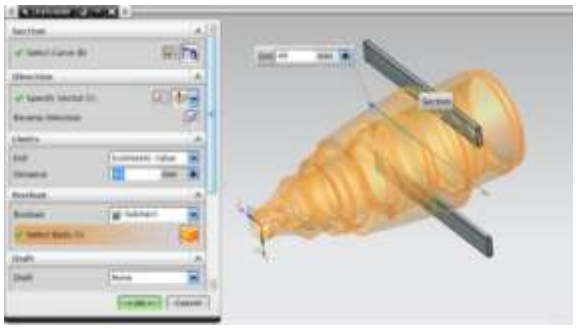

Fig shows sketch and Extrude of Fuze shell

Below image shows final 3D model of Fuze shell

Fig shows 3D model of Fuze shell

**COMPUTER AIDED MANUFACTURING**

Tool path creation and verification on Fuze shell:

Setup_1 operations:

Below image shows facing operation & verification

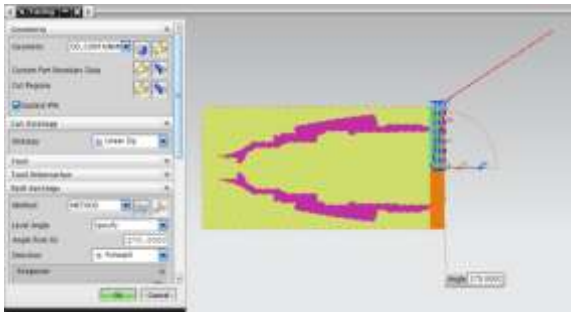

Fig shows Facing operation & verification

Below image shows Rough operation & verification

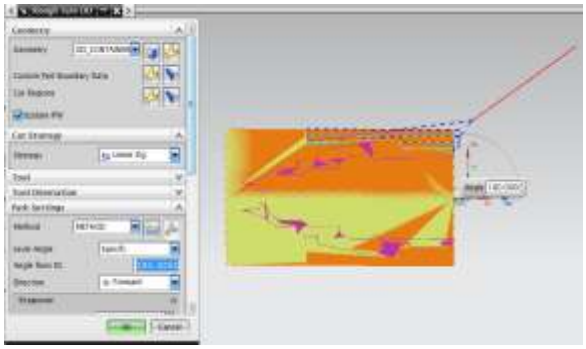

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Fig shows Rough operation & verification

Below image shows Grooving operation & verification

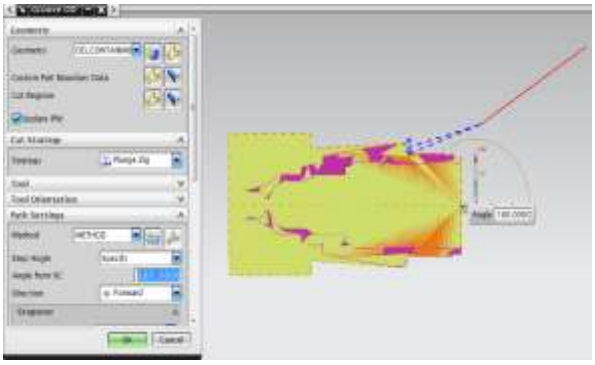

Fig shows Grooving operation & verification

Below image shows centre spot drilling operation & verification

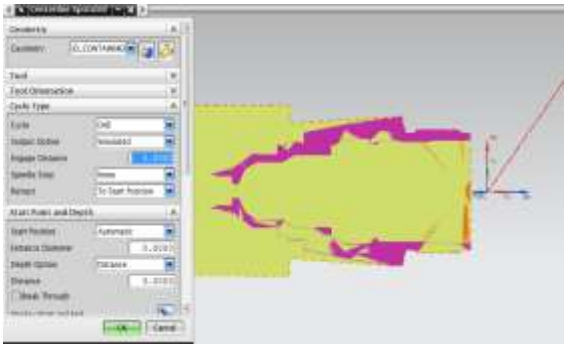

Fig shows Centre spot drilling operation & verification

Below image shows centre drilling operation & verification

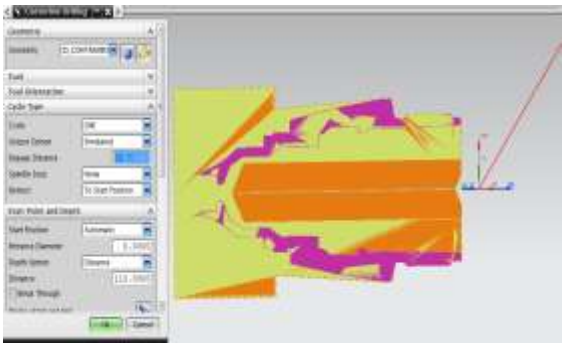

Fig shows Centre drilling operation & verification

Below image shows Rough bore operation & verification

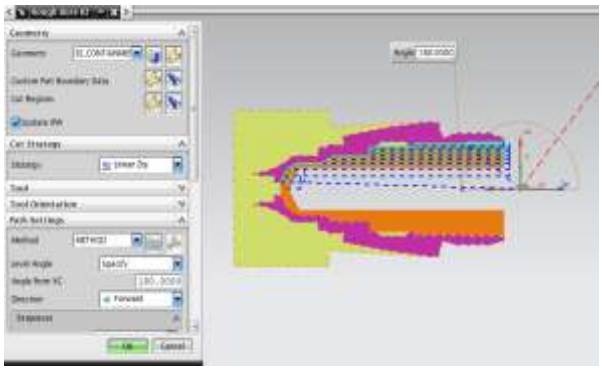

Fig shows Rough bore operation & verification

Below image shows Groove ID operation & verification

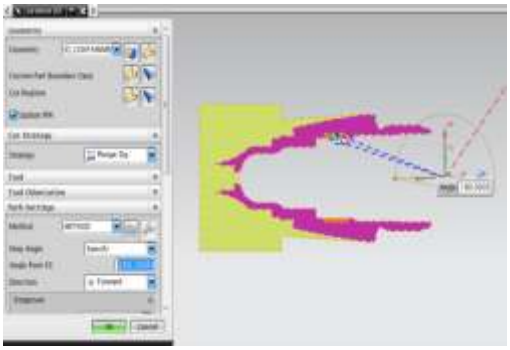

Fig shows Groove ID operation & verification

Setup_2 operations:

Below image shows semi finished part

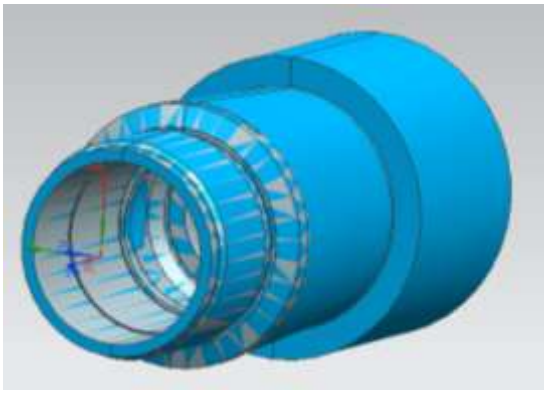

Fig shows Semi finished part

Below image shows facing operation and verification

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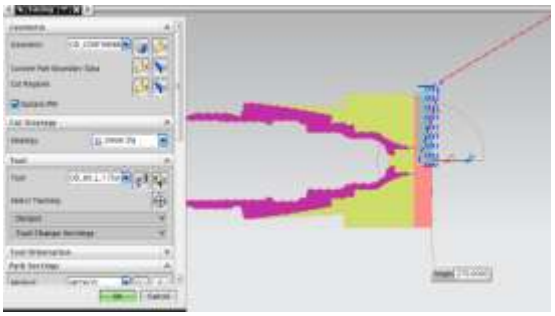


Fig shows facing operation and verification

Below image shows roughing operation and verification

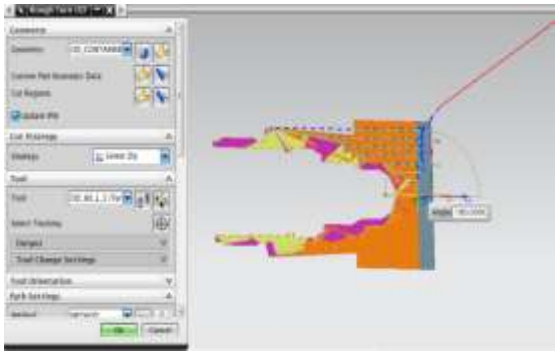


Fig shows roughing operation and verification

Below image shows Grooving operation and verification

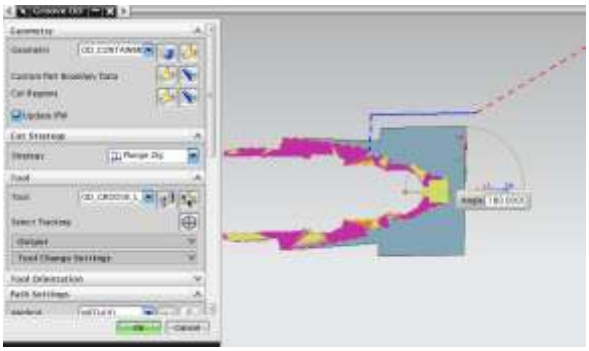


Fig shows Grooving operation and verification

Below image shows center line spot drill operation and verification

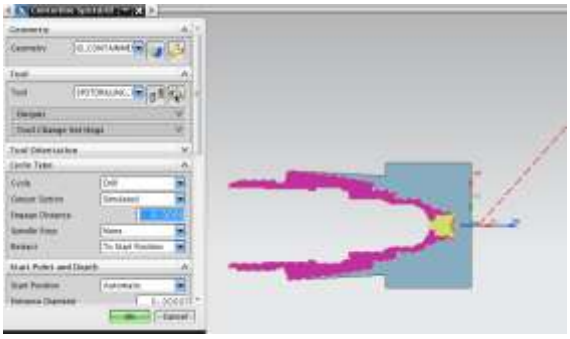


Fig shows center line spot drill operation and verification

Below image shows center line drilling operation and verification

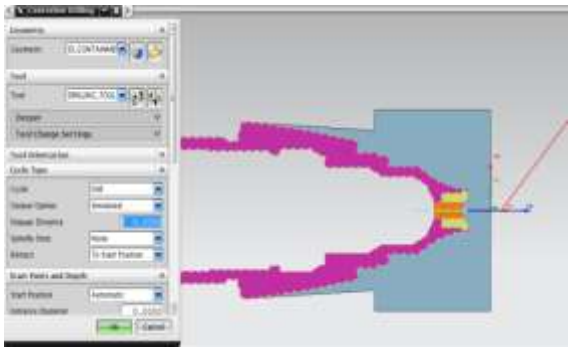


Fig shows center line drilling operation and verification

Below image shows groove operation and verification

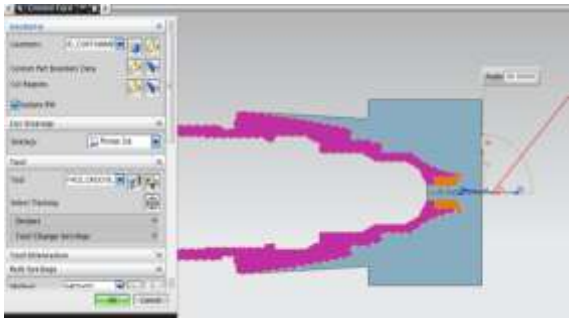
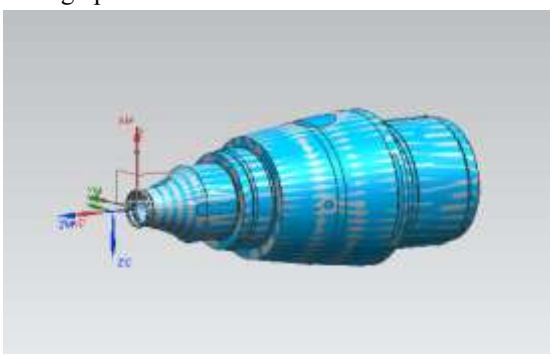


Fig shows groove operation and verification

Milling operations

Below image shows raw material and part for milling operations



Below image shows planar mill operations and verification

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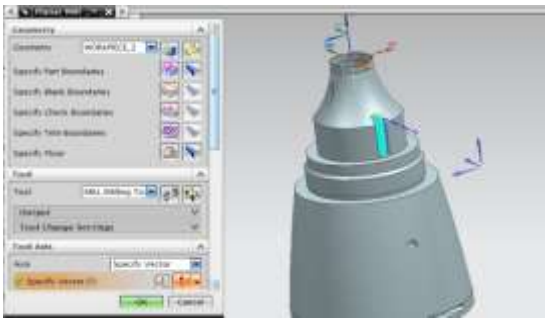

Fig shows planar mill operations and verification

Below image shows Drilling operations and verification

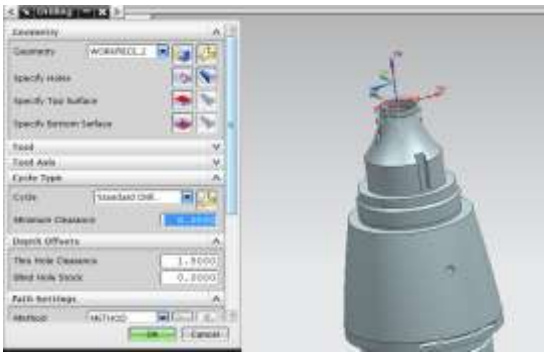

Fig shows Drilling operations and verification

Below image shows Drilling operations and verification

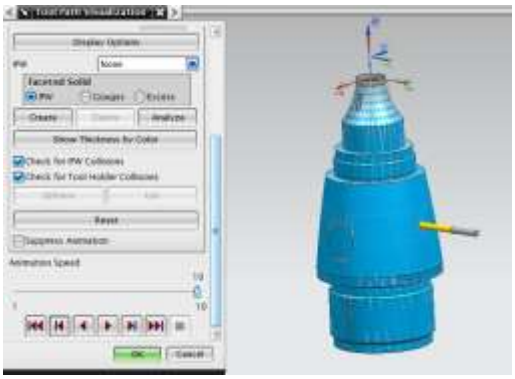

Fig shows Drilling operations and verification

Below image shows Drilling operations and verification

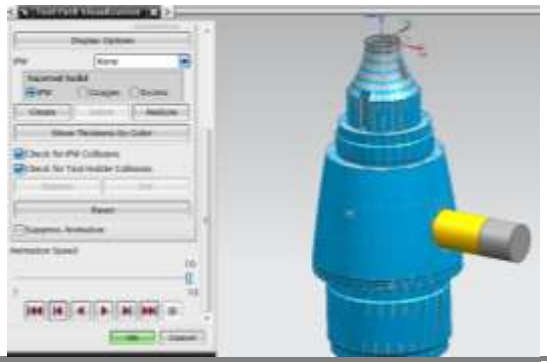

Fig shows Drilling operations and verification

Below image shows milling setup_2 raw material and part

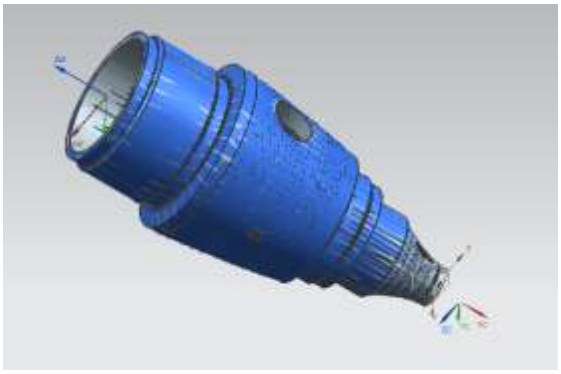

Fig shows setup_2 raw material and part

Below image shows planar mill operations and verification

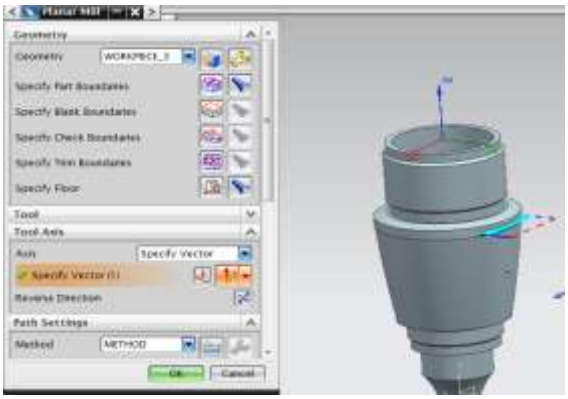

Fig shows planar mill operations and verification

Below image shows Drilling operations and verification

Fig shows Drilling operations and verification

**DEVELOPMENT OF FIXTURE**

Below image shows sketch and revolve of fixture

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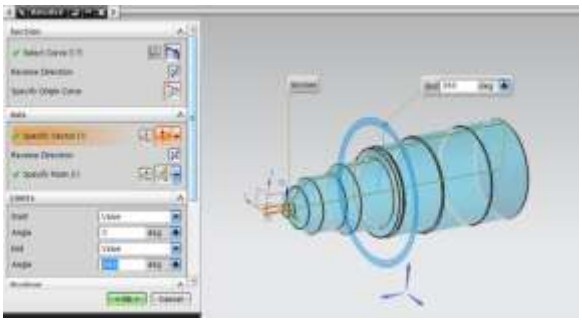

Fig shows sketch and revolve

Below image shows creating holes

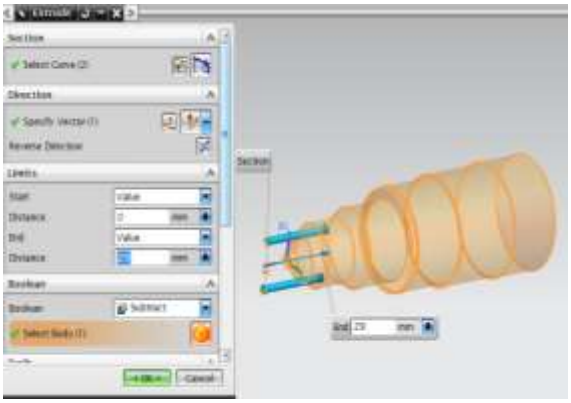

Fig shows creating holes

Below image shows creating holes

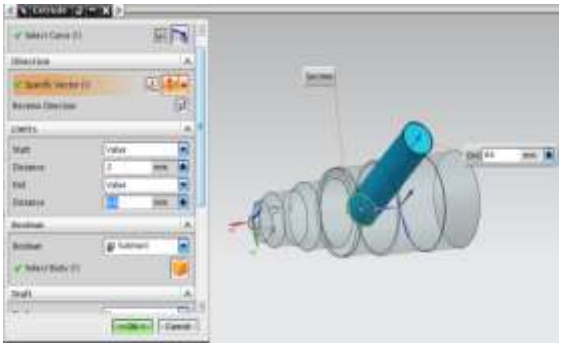

Fig shows creating holes

Below image shows creating holes

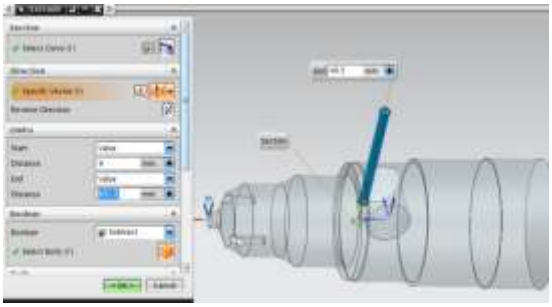

Fig shows creating holes

Below image shows sketch and extrude

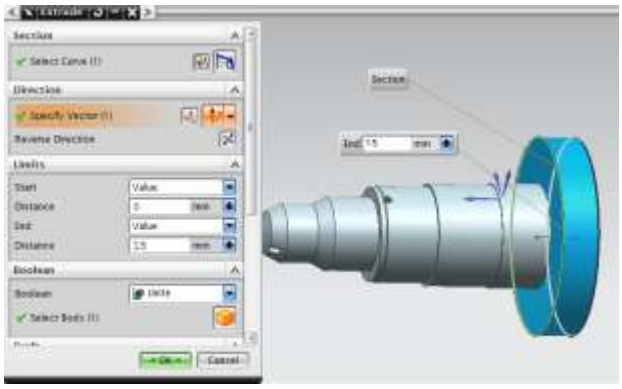

Fig shows sketch and extrude

Below image shows creating holes

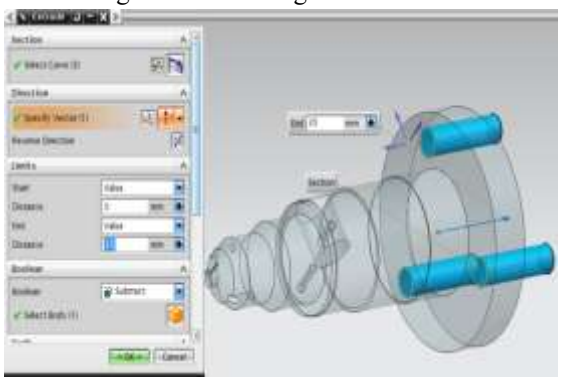

Fig shows creating holes

Below image shows 3D model of fixture

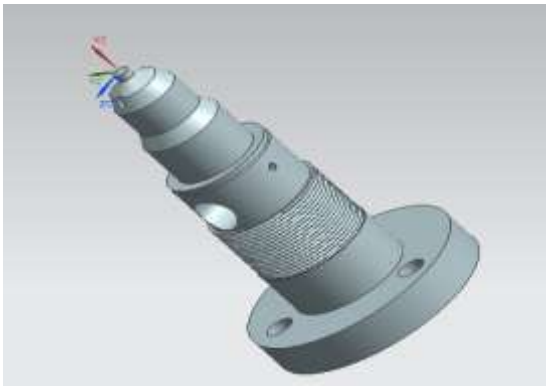

Fig shows 3D model of fixture

**TOOL PATH GENERATION FOR FIXTURE**

Below image shows spun generated in Turing operations in NX-CAM software

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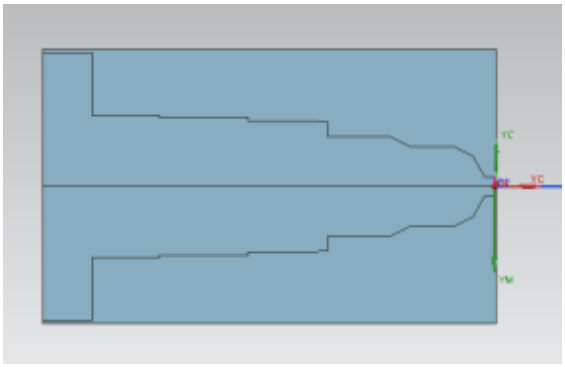

Fig shows spun generated in Turing operations

Below image shows facing operation and verification

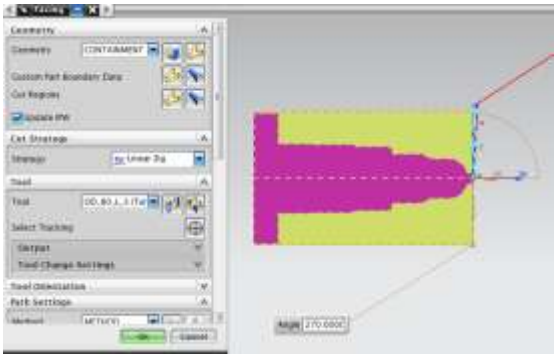

Fig shows facing operation and verification

Below image shows Roughing operation and verification

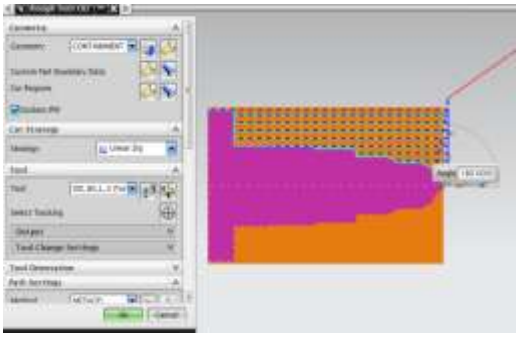

Fig shows Roughing operation and verification

Below image shows Drilling operations and verification

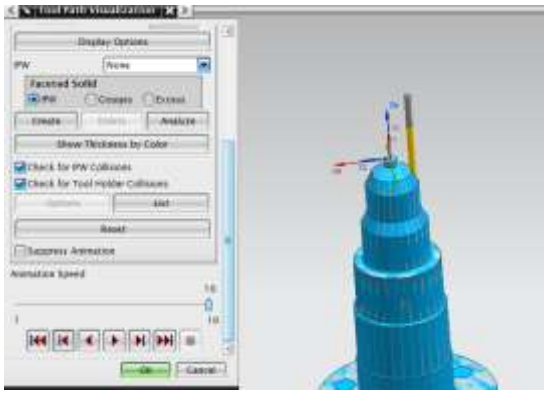

Fig shows Drilling operations and verification

Below image shows Drilling operations and verification

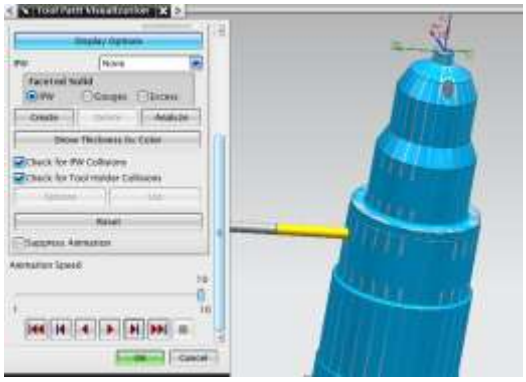

Fig shows Drilling operations and verification

Below image shows Drilling operations and verification

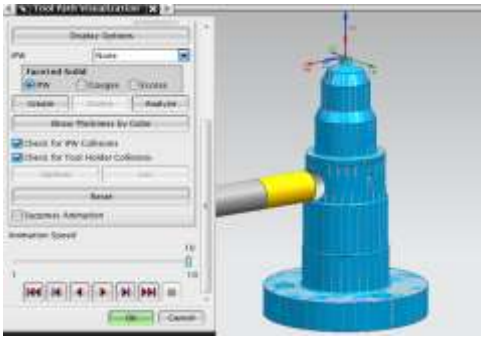

Fig shows Drilling operations and verification

Below image shows Drilling operations and verification

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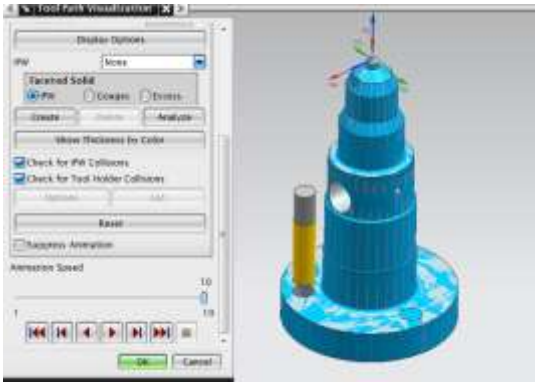


Fig shows Drilling operations and verification

## RESULTS

**Manufacturing of fuze shell with 3jaw chuck**

Time taken to manufacture a single component without fixture on CNC machine = 19 min 03 sec =19 min.

If the time in seconds is above 30 then it is taken as 1min, if it is below 30 then it is exception

Manufacturing cost of CNC machine per hour = 1200rs/hr

Manufacturing cost of single fuze shell = (1200/60)*19= 380rs

Direct Labour Cost = $T_m$ * Man Hour Rate Rs.

Man Hour Rate = Rs.96

$T_m$= machining time

$T_m$= (19/60) hrs= 0.316hrs

Direct Labour Cost = 0.316*96= 30Rs.

Total cost of part =raw material cost + labour cost +manufacturing cost =

300+30+380= Rs.710

**Manufacturing of Fuze shell with designed fixture**

Time taken to manufacture a single component with fixture on CNC machine = 12min 06sec=12min.

If the time in seconds is above 30 then it is taken as 1min, if it is below 30 then it is exception.

Manufacturing cost of CNC machine per hour = Rs. 1200

Machining cost per piece (machining cost per min x machining time in min) = (1200/60)*12=240rs

Manufacturing cost of single Fuze shell= Rs. 240

Direct Labour Cost = $T_m$ * Man Hour Rate Rs.

Man Hour Rate = 96Rs.

$T_m$= machining time

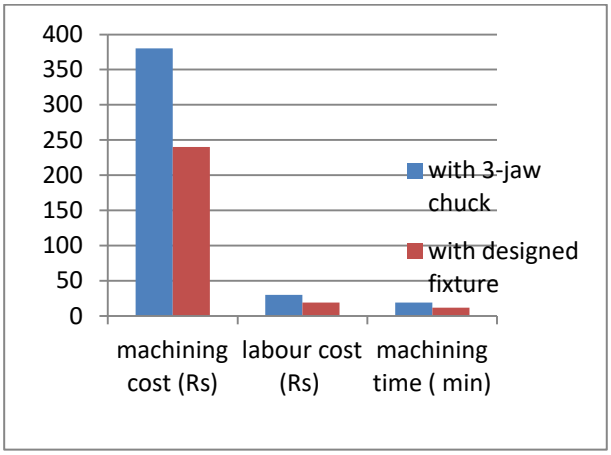
$T_m$= (12/60) hrs= 0.2hrs

Direct Labour Cost = 0.2*96= Rs. 19.

Total cost of part =raw material cost + labour cost +manufacturing cost =

300+19+240= Rs.559

Graphical representation of machining cost, labour cost and machining time.




Graphs represents there is reduction in machining cost, labour cost, machining time by using designed fixture compared to 3jaw chuck.

## CONCLUSION

1. It is difficult to manufacture Fuze shell with 3-jaw chuck because it cannot hold the part rigidly for machining Outer diameter of Fuze shell and creates dimensional errors. More number of parts was rejected. Due to this reason new fixture is developed to support internally while outer diameter operations are done.
2. Dynamic analysis done on the fixture to validate and mode shapes are plotted in report.
3. Manufacturing time, labour cost, manufacturing cost where reduced Using designed fixture.
4. Inspection charts are shown in report.
5. Graphical representation of reduction of time and cost are shown in results.
6. There is a drastic reduction of reworks and rejection rate using designed fixture.

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