

Design of Fixture to Optimise Process Plan of Aerospace Component

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ABSTRACT

Missile shield is aero space component protects the missile by covering the entire body. Designing and process planning of aerospace component are studied in detail. Missile shield is aero space component it requires accurate machining and high finishing and it is typical to manufacture in 3-axis machines and it is highly impossible using 3-jaw chuck or machine vice for holding aerospace component rigidly. To manufacture aerospace component as per requirement with accurate dimension it demands a fixture to design considering the part holding points. It requires a designed fixture and clamping to hold the part rigidly. If part is fixed rigidly easily we can obtain smooth surfaces on part.

The main aim of this project is to optimize process plan and creating 3D model using Unigraphics software. Generating NC program of aerospace component using NX-CAM software which is exclusively CAM software used to generate part program by feeding the geometry of the component and defining the proper tool path and thus transferring the generated part program to the required CNC machine with the help of DNC lines. The operator thus executes the program with suitable requirements. The project deals with optimizing process plan by specifying appropriate tools, developing tools design if demanded.

INTRODUCTION

Designing a fixture for aerospace component:

The purpose of fixtures is to hold the work piece tightly or rigidly during manufacturing. Fixtures are developed to manufacture the critical and complex parts which are not held by chucks. by

fixturing or fixing the work piece by using fixtures, part can be obtained with required design specifications. Developing or designing of fixtures require little more cost. the design cost of fixture is reduced by implementing various computer-aided fixture design methods in market to support the fixture designer

Fixture layout design is a major concern in the development of automated fixture design systems. the task of fixture layout design is to layout a set of locating & clamping points on work piece surfaces such that the work piece is accurately located & completely restrained during manufacturing operations.

Fixture design concepts: (managing degree of freedom).

3:2:1 → (3 at least 3-point to define a plane) (2 at least 2-points to define location) (1 at least 1-point for clamping).

CAD:

CAD is computer aided designing or computer aided drafting. CAD is used for developing the 3d model from the 2d input. It is also used to drafting sheets which are used to inspection. CAD software has different modules. They are:

1. Modeling
2. Assembly
3. Drafting
4. Sheet metal
5. Piping
6. Shape studio
7. Welding

CAM:

CAM is computer aided manufacturing. In cam software, the processes from selection of raw material to NC program generation were done. Finally NC program was optimized using post builder and given to the machine. Generally, process involved in the CAM software.

1. Selection of raw material
2. Selection of machine
3. Selection of tools
4. Selection of process
5. Sequencing of the processes
6. Generation of the NC program
7. Optimization of the NC program

3D MODELING OF AEROSPACE COMPONENT

2d drawing:

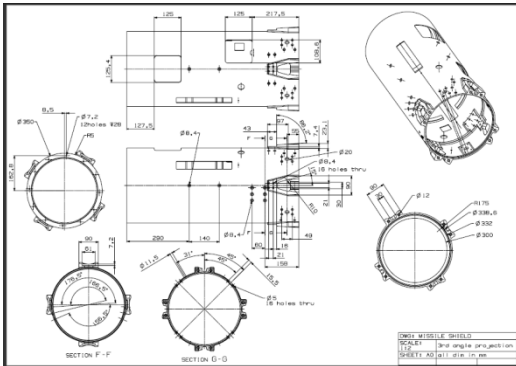


Fig shows drawing of aerospace component

3d modeling of aerospace component:

Below image shows sketch and extrude of shield

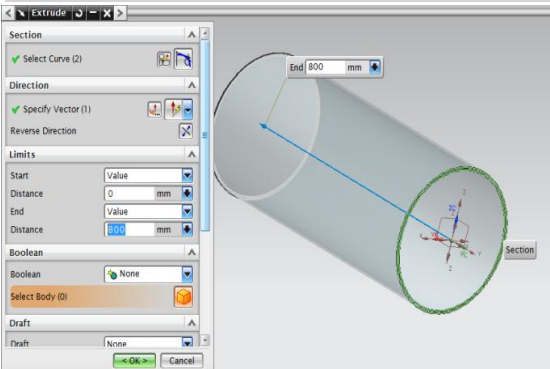
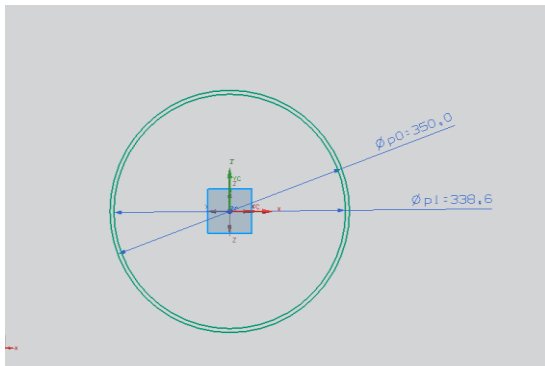


Fig shows Sketch and extrude of shield

Below image shows sketch and extrude of slots around shield

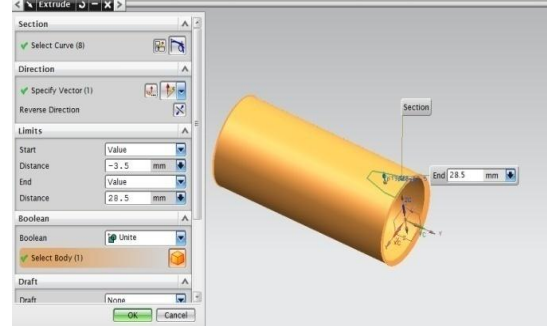
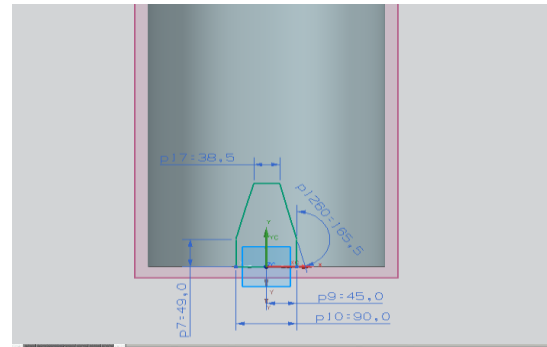


Fig shows Sketch and extrude of slots around shield
Below image shows sketch and extrude of slots around shield

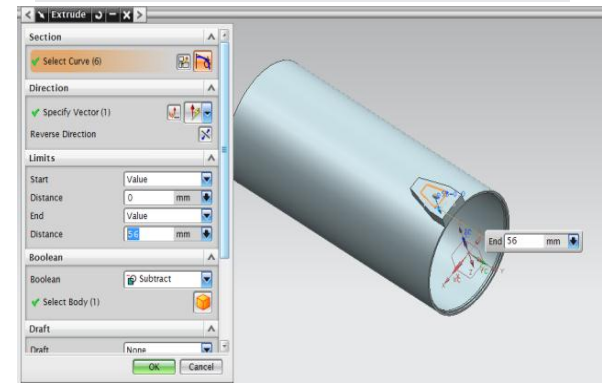
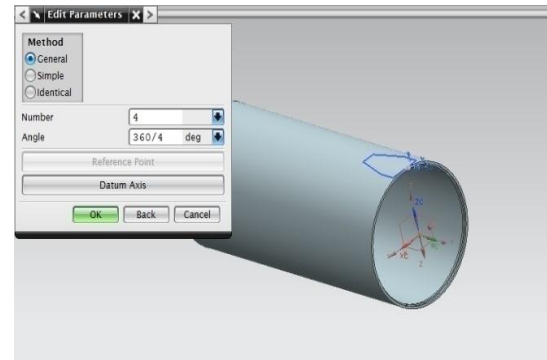


Fig shows Sketch and extrude of slots around shield

Below image shows circular array of slots around shield

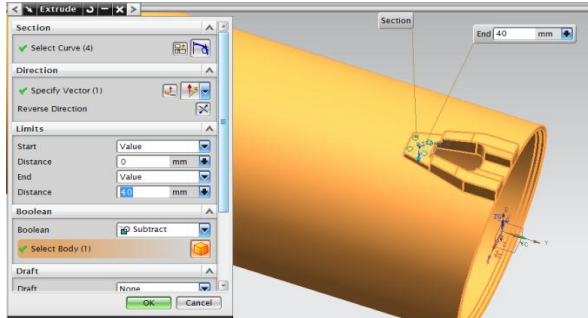


Fig shows Circular array of slots around shield

Below image shows countersunk holes

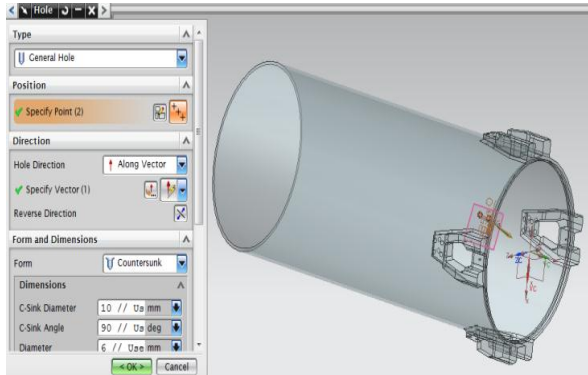


Fig shows countersunk holes

Below image shows sketch and extrude

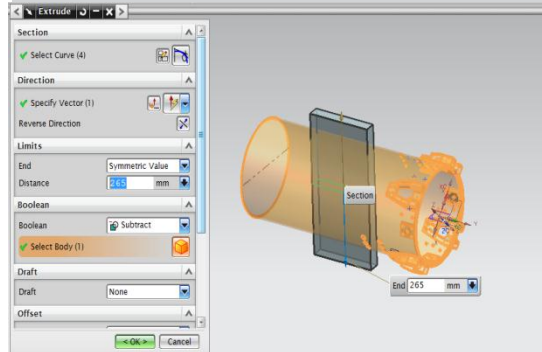
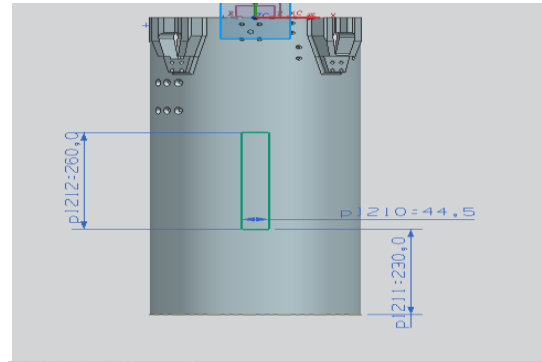
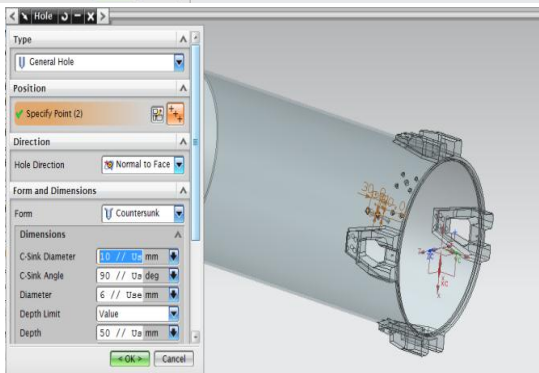


Fig shows Sketch and extrude

Below image shows sketch and extrude

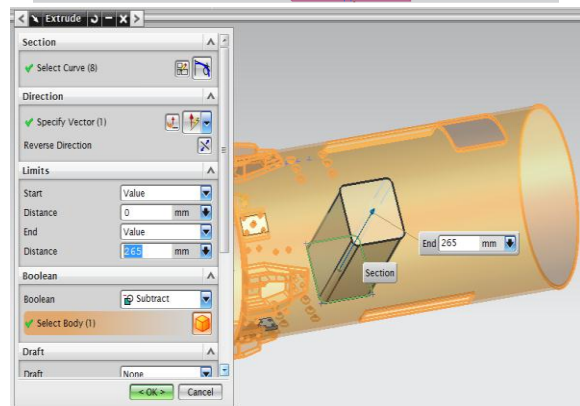
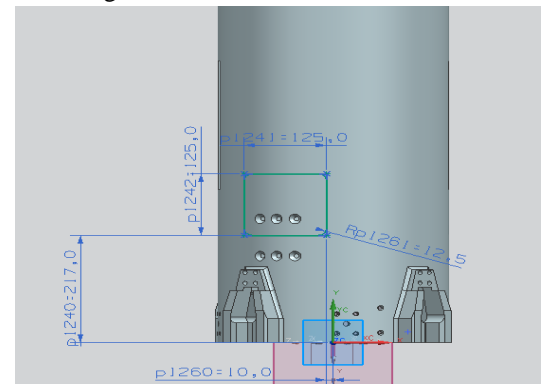


Fig shows Sketch and extrude

Below image shows 3d models of aerospace component

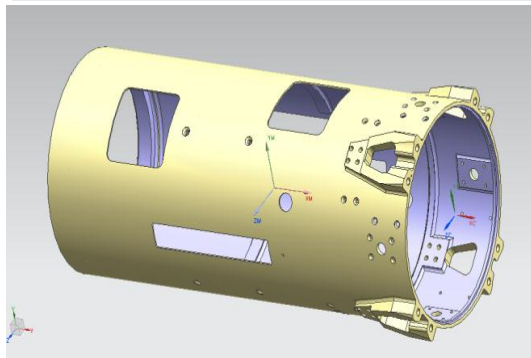
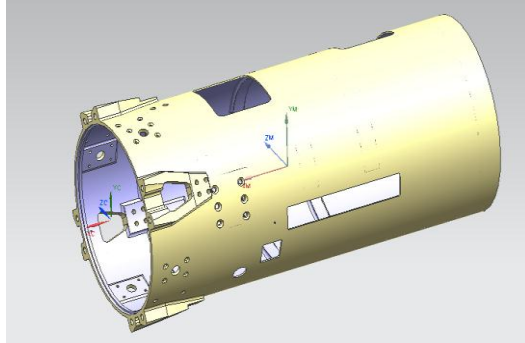


Fig shows 3dmodels of aerospace component

COMPUTER AIDED MANUFACTURING PROCESS

Methodology used in manufacturing of aerospace component is as mentioned below:

- Identifying suitable machine.
- Selecting suitable tools for manufacturing thin walled component.
- Designing fixture/mandrel to support aerospace component for external operations.
- Listing down the Sequence of operations performed on aerospace component.
- Generating tool path at specified cutting speed.
- Generating NC program using NX-CAM software.

Identify suitable machine.

Types of CNC machine used in this project are MORI SEIKI 4-AXIS CNC turning machine and DMG 5-axis milling machine



Fig shows 4-axis CNC MORI SIEKI turning machine



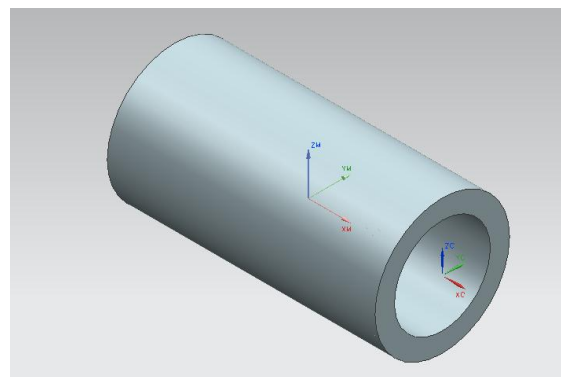
Fig shows DMG 5-axis machine

Selection of tools:

- OD_80_L facing
- OD_80_L rough
- OD_55_L finish
- ID_80_L rough
- ID_55_L finish

Generating tool path on aerospace component:

Below image shows Raw material and part of missile shield



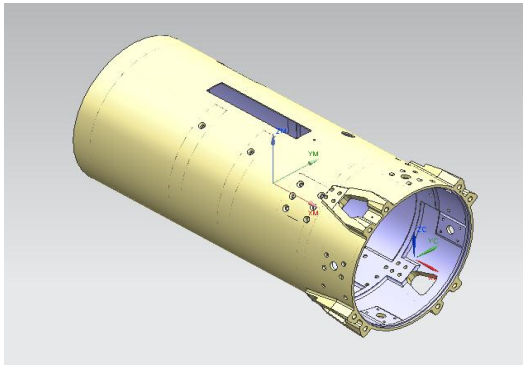


Fig shows Raw material and part of aerospace component

Spun generated in turning

Below image shows spun generated by part and raw material

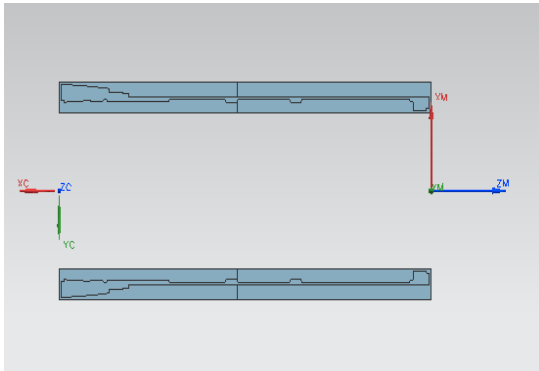


Fig shows spun generated by part and raw material

Set_up_1 tool path generation

Below image shows the creation of FACING operation on missile shield

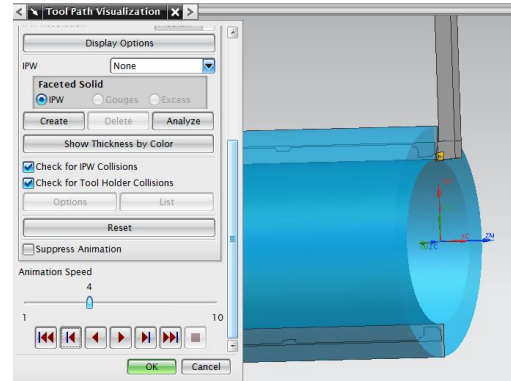
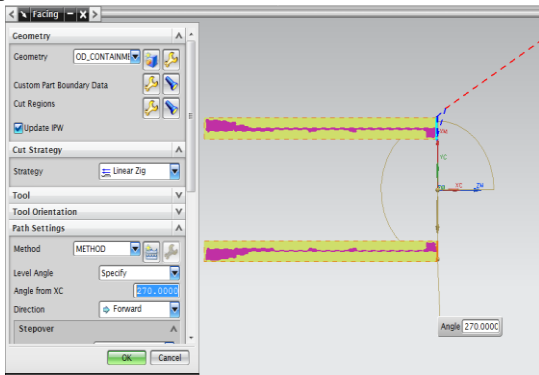


Fig shows FACING operation on aerospace component

Below image shows the creation of OD_Rough operation on aerospace component

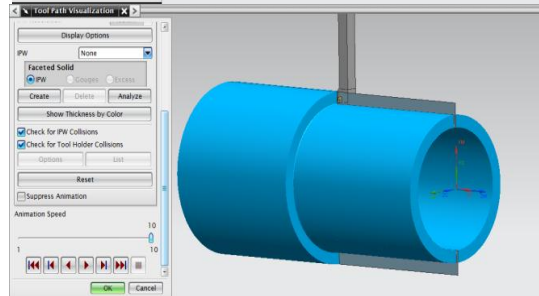
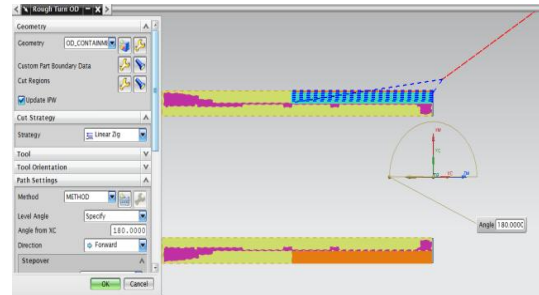
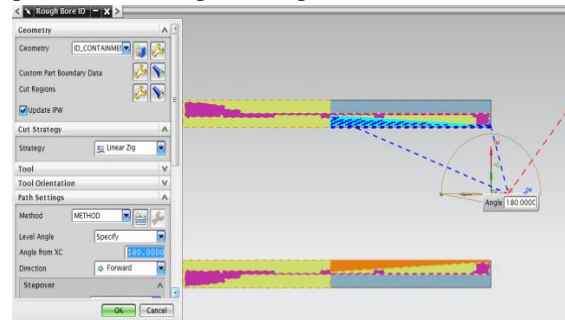


Fig shows OD_Rough operation on aerospace component

Below image shows the creation of ID_Rough operation on aerospace component



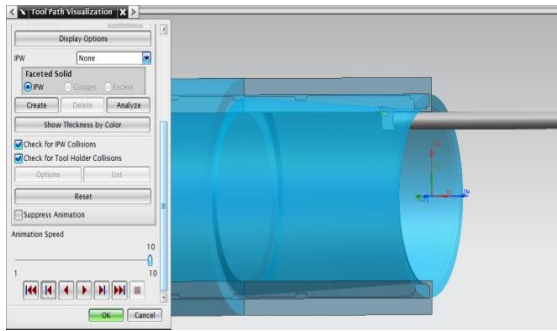


Fig shows ID_Rough operation on aerospace component

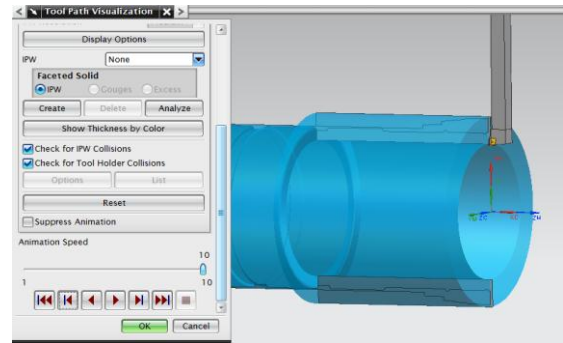
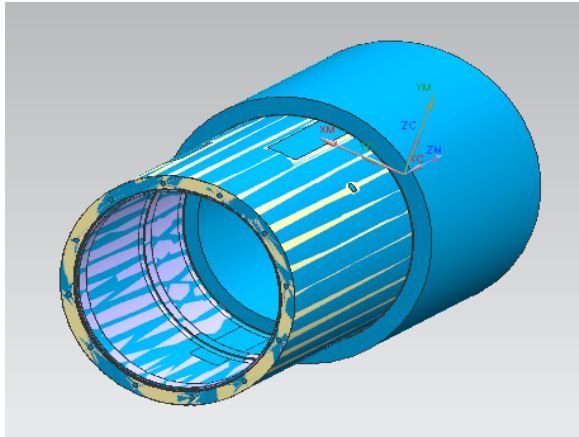


Fig shows FACING operation on aerospace component

Set_up_2

Below image shows Raw material for setup_2 turning



In setup_2 raw material will be semi finished part which means the part left after setup_1 operations. Below image shows the creation of FACING operation on aerospace component

Below image shows the creation of OD_Rough operation on aerospace component

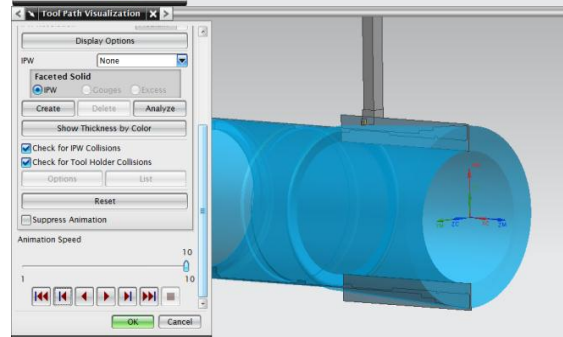
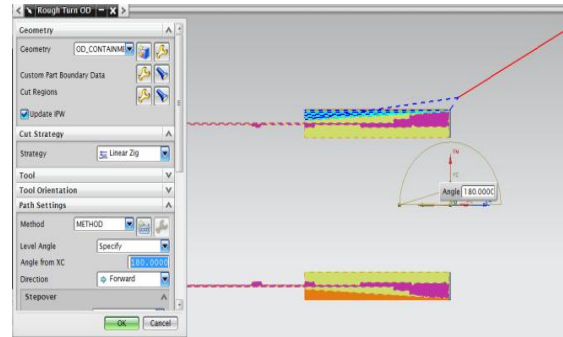
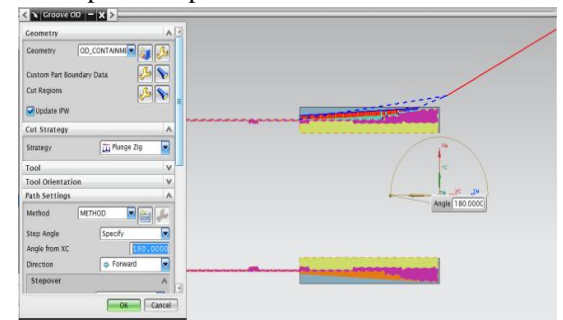
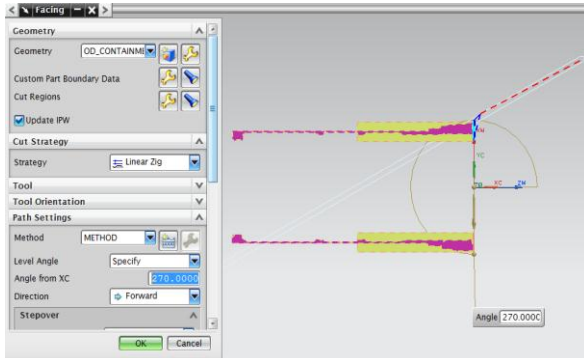


Fig shows OD_Rough operation on aerospace component

Below image shows the creation of Groove operation on aerospace component



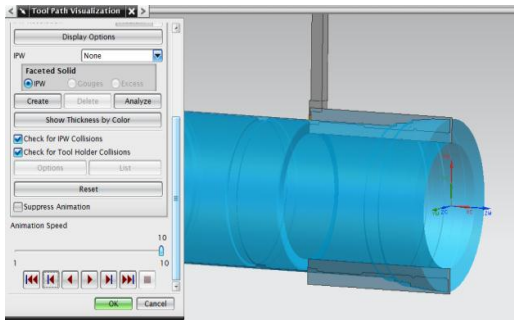


Fig shows Groove operation on aerospace component
Below image shows the creation of ID_Rough operation on aerospace component

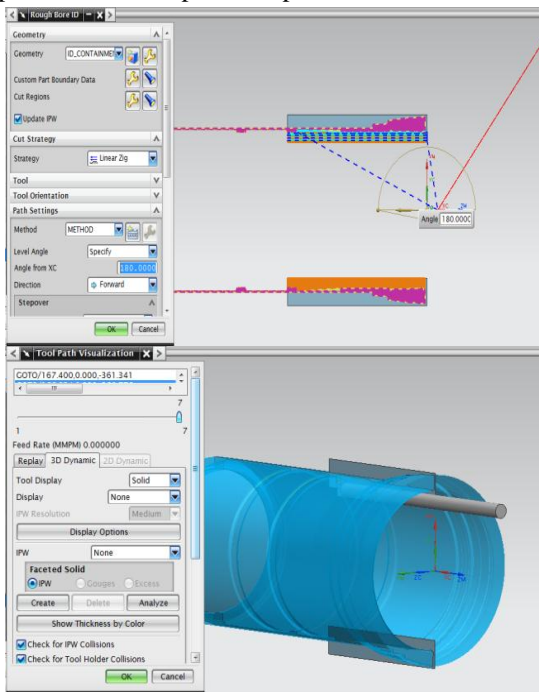


Fig shows ID_Rough operation on aerospace component

Milling operations

Below image shows Raw material for milling

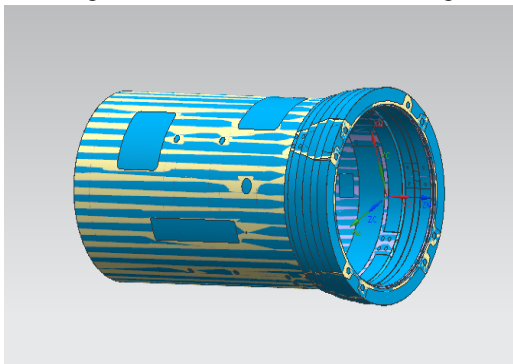


Fig shows Raw material for milling
Below image shows planar mill operations

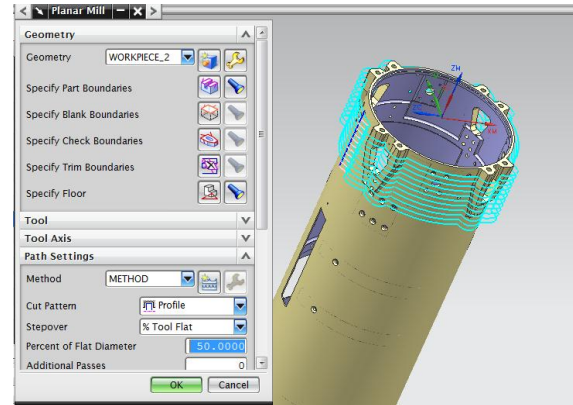


Fig. planar mill operations
Below image shows face mill area operations

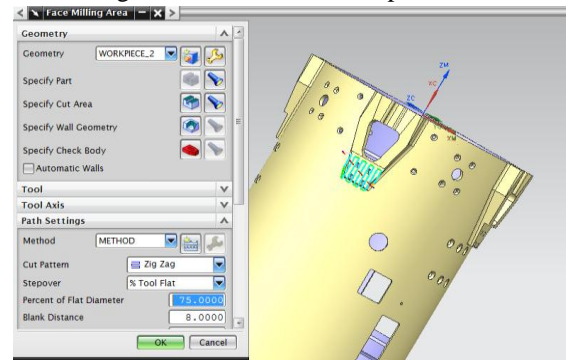


Fig shows face mill area operations
Below image shows planar mill operations

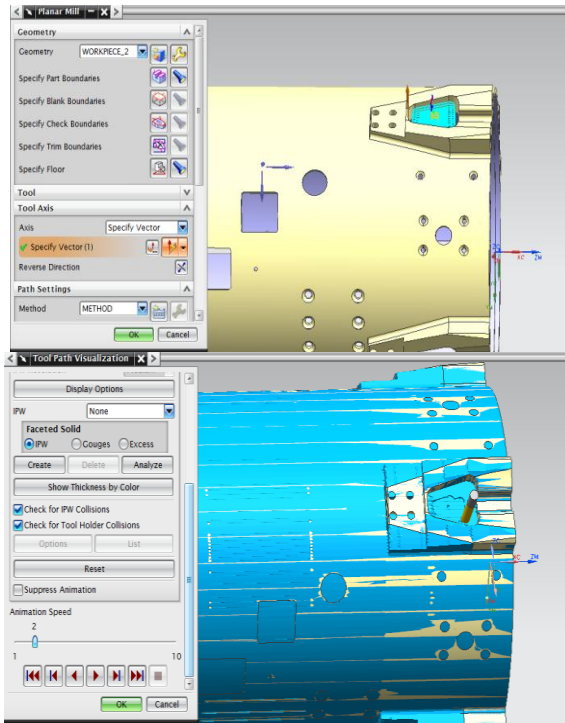


Fig shows planar mill operations
Below image shows planar mill operations

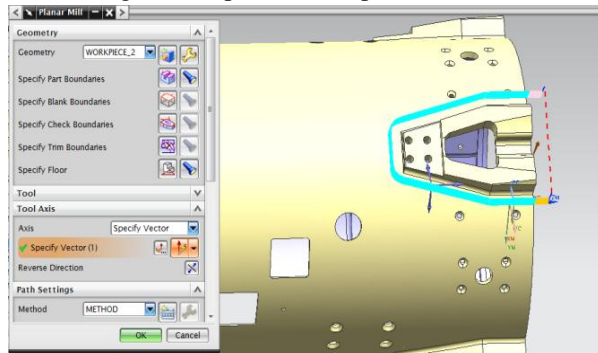


Fig shows planar mill operations
Below image shows planar mill operations

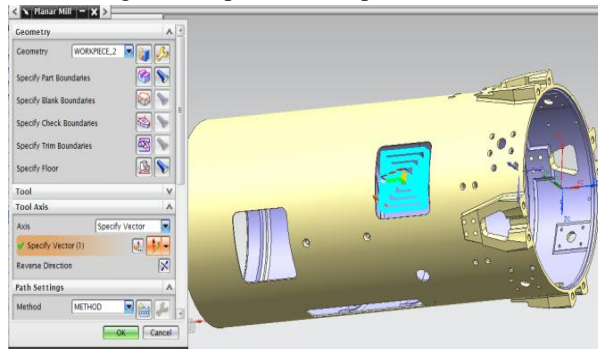


Fig. planar mill operations
Below image shows planar mill operations

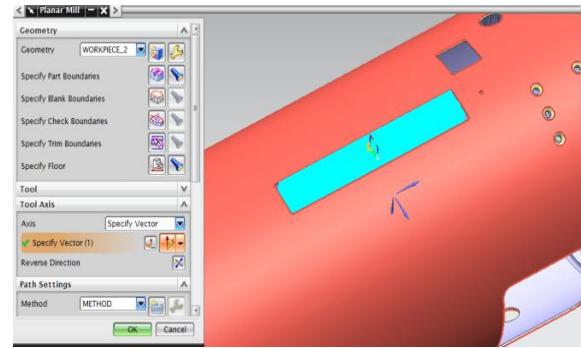


Fig. planar mill operations
Below image shows planar mill operations

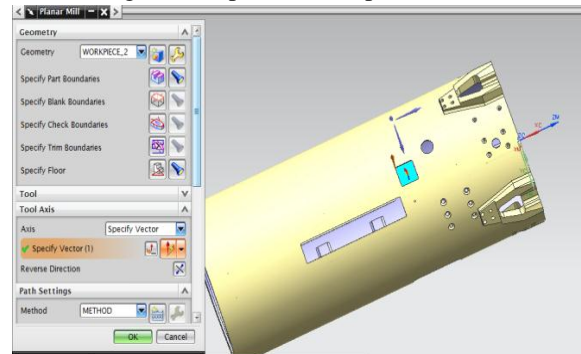


Fig. planar mill operations
Below image shows drilling operations

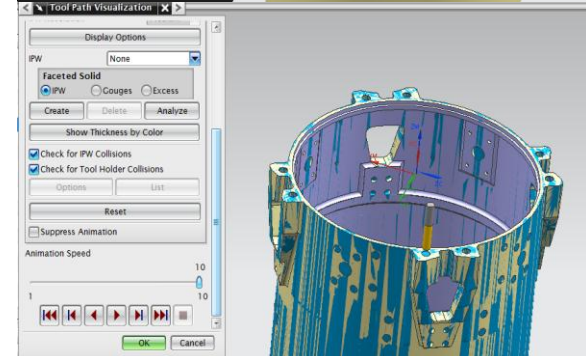
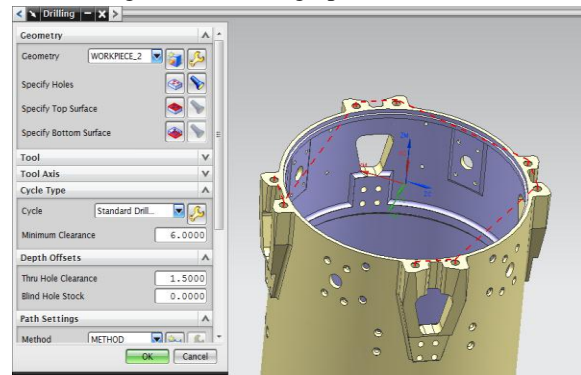


Fig shows Drilling operations
Below image shows drilling operations

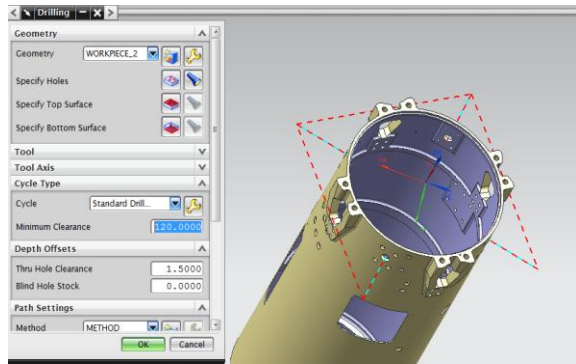


Fig shows Drilling operations
Below image shows drilling operations

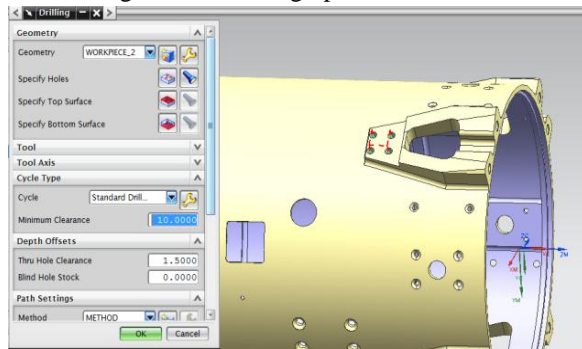


Fig shows Drilling operations
Below image shows Final part after operations

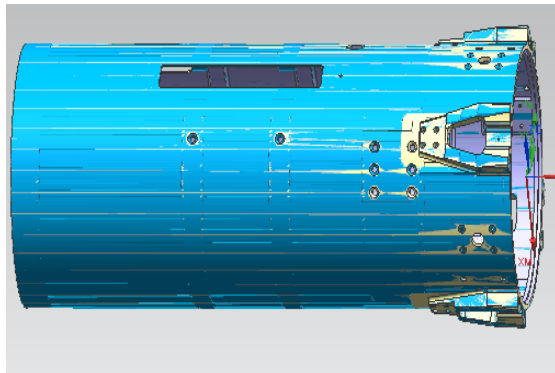


Fig. Final part after operations

Name	To...	P...	Tool	Time	Feed	Speed
NC_PROGRAM				13:41:34		
PROGRAM				13:41:34		
FACING		✓	OD_80_L	00:00:10	8 mmpr	3000 rpm
ROUGH_TURN_OD		✓	OD_80_L	00:03:01	5 mmpr	2600 rpm
GROOVE_ID		✓	ID_80_L	00:02:16	4.5 mmpr	2560 rpm
ROUGH_TURN_OD_1		✓	ID_GROOVE_L	00:01:36	4 mmpr	2600 rpm
FINISH_TURN_OD		✓	OD_80_L_1	00:00:08	9 mmpr	2900 rpm
GROOVE_OD		✓	OD_80_L_1	00:00:59	7 mmpr	2700 rpm
ROUGH_BORE_ID_1		✓	OD_55_L	00:00:05	4 mmpr	2650 rpm
GROOVE_ID_1		✓	OD_GROOVE_L	00:01:15	4 mmpr	2540 rpm
GROOVE_ID_2		✓	ID_80_L_1	00:01:36	5 mmpr	2540 rpm
GROOVE_ID_3		✓	ID_GROOVE_L_1	00:00:08	5 mmpr	2800 rpm
PLANAR_MILL		✓	ID_GROOVE_L_2	00:00:08	4 mmpr	2400 rpm
FACE_MILLING_AREA		✓	ID_GROOVE_L_1	00:00:15	5.5 mmpr	2600 rpm
PLANAR_MILL_1		✓	MILL	01:02:15	260 mmpr	3500 rpm
FACE_MILLING_AREA		✓	MILL_1	01:00:39	260 mmpr	3500 rpm
PLANAR_MILL_2		✓	MILL_2	00:03:30	250 mmpr	2350 rpm
FACE_MILLING_AREA		✓	MILL_3	00:20:36	240 mmpr	2150 rpm
PLANAR_MILL_3		✓	MILL_4	00:13:00	261 mmpr	2347 rpm
FACE_MILLING_AREA		✓	MILL_2	00:03:30	250 mmpr	2350 rpm
FACE_MILLING_AREA		✓	MILL_2	00:03:30	250 mmpr	2350 rpm
FACE_MILLING_AREA		✓	MILL_2	00:03:30	250 mmpr	2350 rpm
FACE_MILLING_AREA		✓	MILL_2	00:03:30	250 mmpr	2350 rpm
PLANAR_MILL_2_IN...		✓	MILL_3	00:20:36	240 mmpr	2150 rpm
PLANAR_MILL_2_IN...		✓	MILL_3	00:20:36	240 mmpr	2150 rpm
PLANAR_MILL_2_IN...		✓	MILL_3	00:20:36	240 mmpr	2150 rpm
PLANAR_MILL_2_IN...		✓	MILL_3	00:20:36	240 mmpr	2150 rpm
PLANAR_MILL_3_IN...		✓	MILL_4	00:13:00	261 mmpr	2347 rpm
PLANAR_MILL_3_IN...		✓	MILL_4	00:13:00	261 mmpr	2347 rpm
PLANAR_MILL_3_IN...		✓	MILL_4	00:13:00	261 mmpr	2347 rpm
PLANAR_MILL_4		✓	MILL_5	00:36:26	270 mmpr	2620 rpm
PLANAR_MILL_5		✓	MILL_6	02:11:11	268 mmpr	3100 rpm
PLANAR_MILL_6		✓	MILL_7	00:12:19	260 mmpr	2800 rpm
PLANAR_MILL_5_IN...		✓	MILL_6	02:11:11	268 mmpr	3100 rpm
PLANAR_MILL_7		✓	MILL_8	00:49:15	267 mmpr	3150 rpm
PLANAR_MILL_8		✓	T_CUTTER	00:11:23	250 mmpr	2900 rpm
PLANAR_MILL_8_IN...		✓	T_CUTTER	00:11:23	250 mmpr	2900 rpm
PLANAR_MILL_8_IN...		✓	T_CUTTER	00:11:23	250 mmpr	2900 rpm
PLANAR_MILL_8_IN...		✓	T_CUTTER	00:11:23	250 mmpr	2900 rpm
PLANAR_MILL_9		✓	T_CUTTER	00:07:34	250 mmpr	2900 rpm
PLANAR_MILL_10		✓	T_CUTTER	00:05:14	250 mmpr	2900 rpm
PLANAR_MILL_11		✓	T_CUTTER	00:03:16	250 mmpr	2900 rpm
PLANAR_MILL_12		✓	T_CUTTER	00:04:43	250 mmpr	2900 rpm
PLANAR_MILL_13		✓	T_CUTTER	00:14:15	250 mmpr	2900 rpm
PLANAR_MILL_14		✓	T_CUTTER	00:19:06	250 mmpr	2900 rpm
DRILLING		✓	DRILLING_TOOL	00:01:24	240 mmpr	2640 rpm
DRILLING_1		✓	DRILLING_TOOL	00:02:27	240 mmpr	2640 rpm
DRILLING_2		✓	DRILLING_TOOL	00:00:29	240 mmpr	2640 rpm
DRILLING_2_INSTA...		✓	DRILLING_TOOL	00:00:29	240 mmpr	2640 rpm
DRILLING_2_INSTA...		✓	DRILLING_TOOL	00:00:29	240 mmpr	2640 rpm
DRILLING_2_INSTA...		✓	DRILLING_TOOL	00:00:29	240 mmpr	2640 rpm
DRILLING_2_INSTA...		✓	DRILLING_TOOL	00:00:29	240 mmpr	2640 rpm
DRILLING_3		✓	DRILLING_TOOL	00:08:14	240 mmpr	2640 rpm
COUNTERSINKING		✓	COUNTERSINKI...	00:01:02	230 mmpr	2600 rpm
COUNTERSINKING_1		✓	COUNTERSINKI...	00:01:02	230 mmpr	2600 rpm
COUNTERSINKING_2		✓	COUNTERSINKI...	00:01:02	230 mmpr	2600 rpm
DRILLING_4		✓	DRILLING_TOOL	00:00:48	240 mmpr	2640 rpm
DRILLING_5		✓	DRILLING_TOOL	00:00:32	240 mmpr	2640 rpm
DRILLING_6		✓	DRILLING_TOOL	00:00:32	240 mmpr	2640 rpm
COUNTERSINKING_3		✓	COUNTERSINKI...	00:00:18	230 mmpr	2600 rpm
COUNTERSINKING_4		✓	COUNTERSINKI...	00:00:18	230 mmpr	2600 rpm
DRILLING_7		✓	DRILLING_TOOL	00:00:04	240 mmpr	2640 rpm
DRILLING_8		✓	DRILLING_TOOL	00:00:04	240 mmpr	2640 rpm
DRILLING_9		✓	DRILLING_TOOL	00:00:12	240 mmpr	2640 rpm
DRILLING_10		✓	DRILLING_TOOL	00:00:12	240 mmpr	2640 rpm
COUNTERSINKING_5		✓	COUNTERSINKI...	00:00:07	230 mmpr	2600 rpm
COUNTERSINKING_6		✓	COUNTERSINKI...	00:00:07	230 mmpr	2600 rpm
DRILLING_11		✓	DRILLING_TOOL	00:02:06	240 mmpr	2640 rpm

3D MODELLING OF FIXTURE

Below image shows 2D drawing of fixture part1
Below images shows sketch and extrude of fixture part1

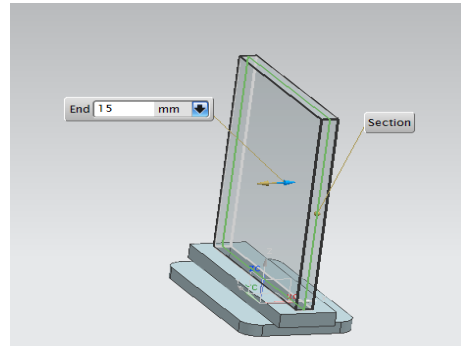
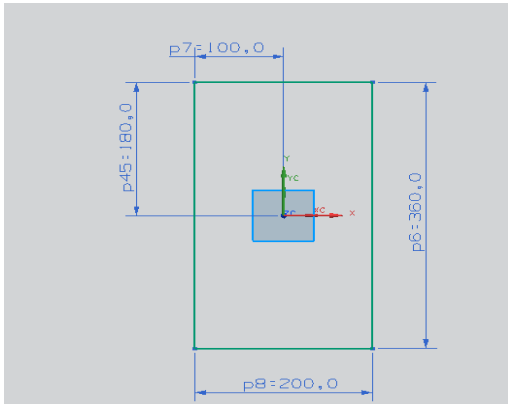


Fig. sketch and extrude of fixture part1
 Below image sketch and extrude of fixture part1

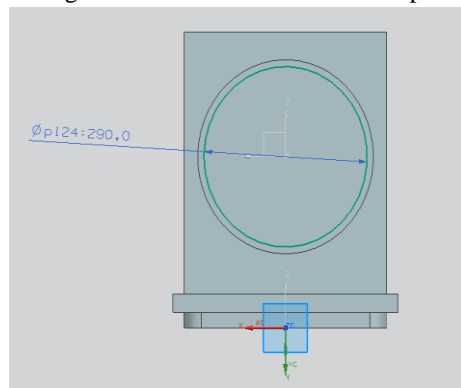
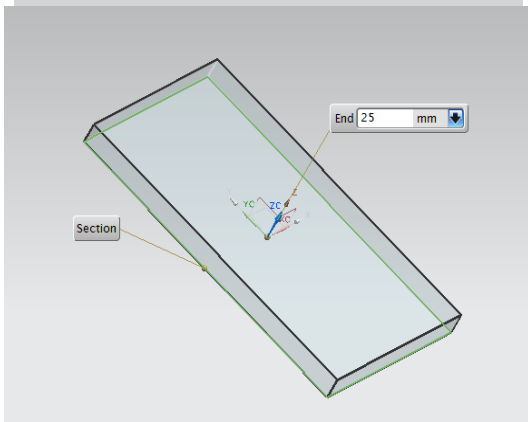


Fig. sketch and extrude of fixture part1
 Below images shows sketch and extrude of fixture part1

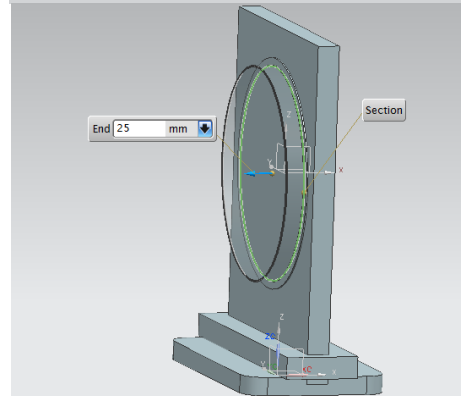
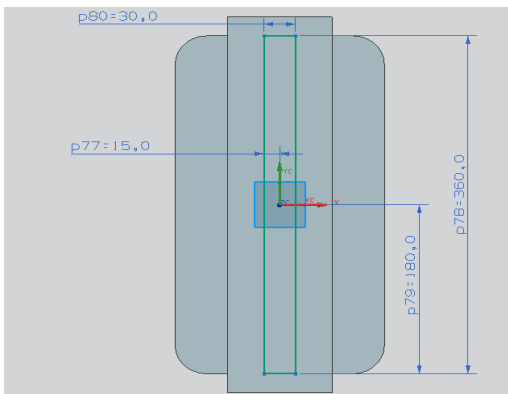


Fig. sketch and extrude of fixture part1
 Below image shows 3D model of fixture part1

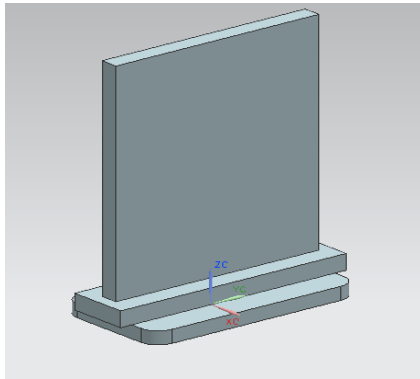


Fig. 3D model of fixture part1

Below image shows 2D drawing of fixture part2

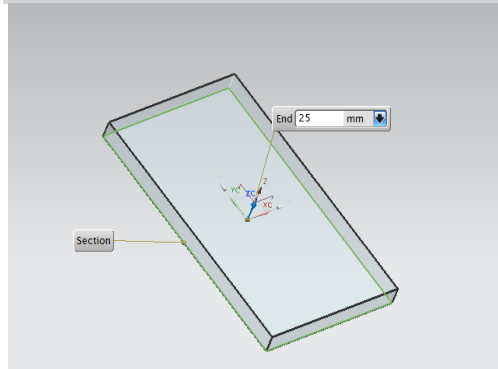
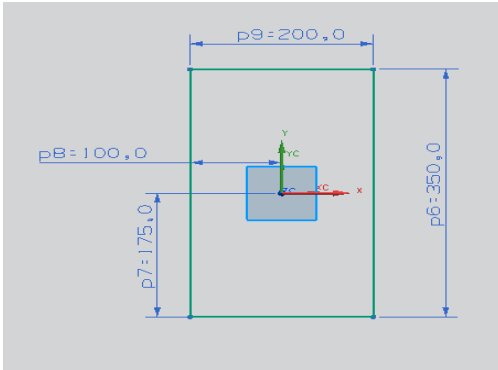


Fig. sketch and extrude of fixture part2

Below images shows sketch and extrude of fixture part2

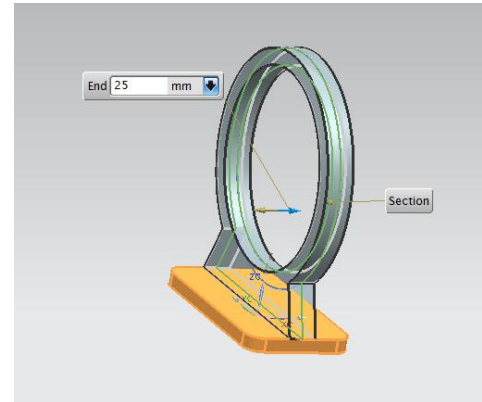
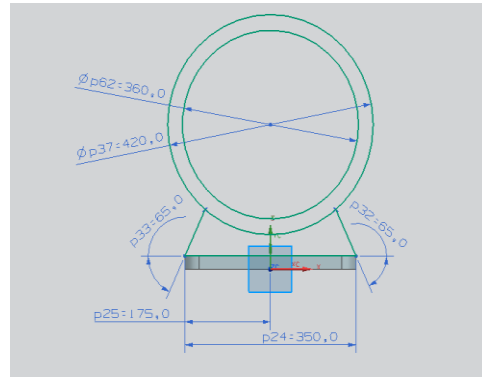


Fig. sketch and extrude of fixture part2

Below images shows sketch and extrude of fixture part2

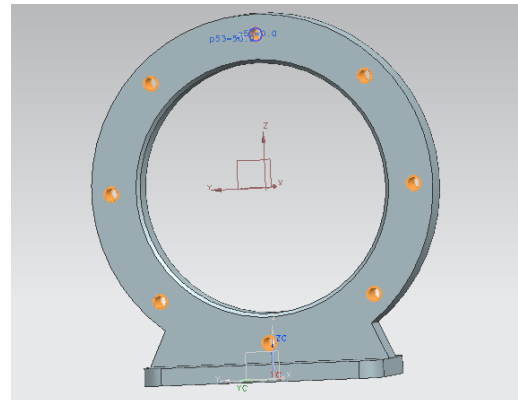


Fig. sketch and extrude of fixture part2

Below image shows 3D model of fixture part2

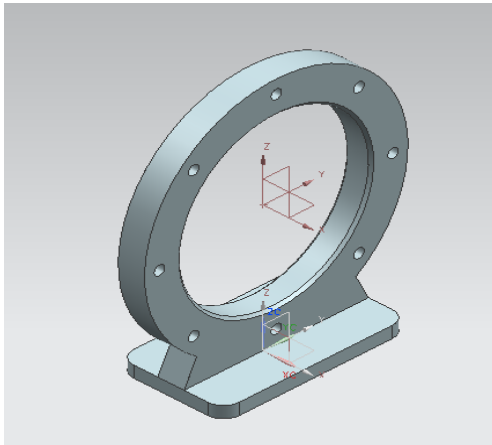


Fig. 3D model of fixture part2

Below image shows sketch and extrude of clamp stud

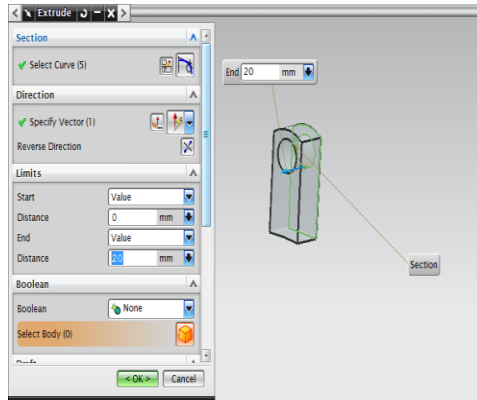


Fig. sketch and extrude of clamp stud

Below image shows sketch and extrude of clamp stud

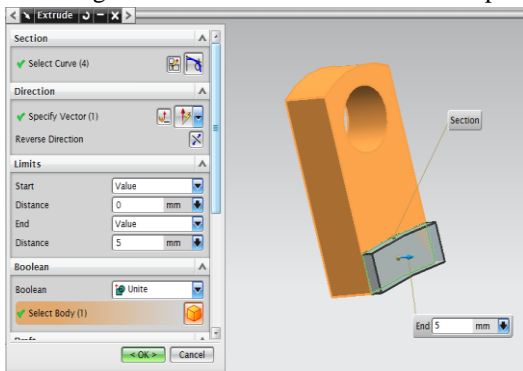


Fig. sketch and extrude of clamp stud

Below image shows sketch and extrude of clamp stud

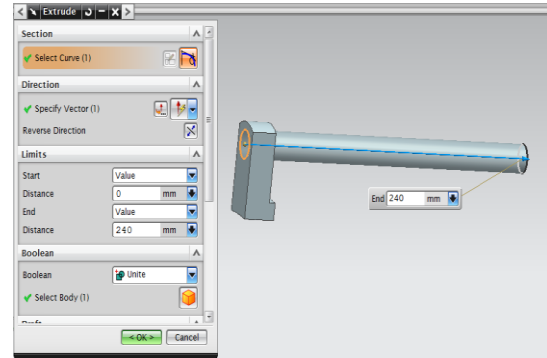


Fig. sketch and extrude of clamp stud
Below image shows 3D model of clamp stud

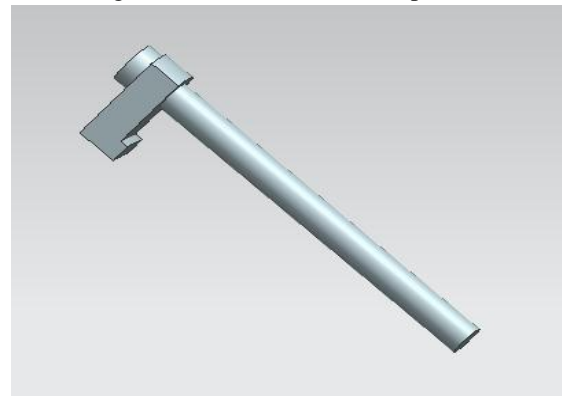
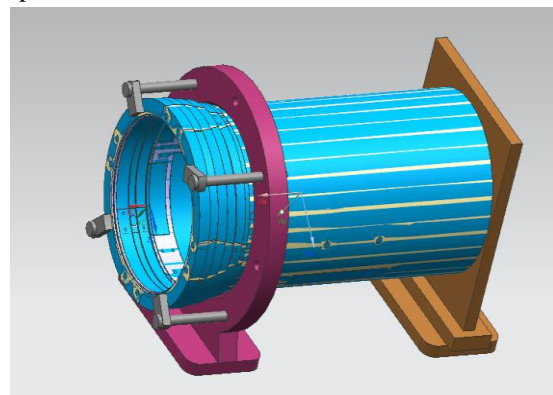


Fig. 3D model of clamp stud

Fixture assembly

Assembly of fixture after completing turning operations





Manufacturing time, labour cost, manufacturing cost where reduced Using designed fixture.

Inspection charts are shown in report

Graphical representation of reduction of time and cost are in and shown in results.

There is a drastic reduction of reworks and rejection rate using designed fixture.

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