Generating Cnc Part Program On Pru Side Wall For Dmg Machine

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Abstract

In the machining segment, a computer-numerical control machine cuts the part. This machine is usually a five-axis milling machine that can perform cuts with simultaneous motion in the X-, Y-, Z-, B-, C- axis with head tilting vertical machine control. The machine is connected to a controller at its input that funnels the incoming data to the main machine memory. These input instructions are in APT (Automated Programming of Tools) language. PRU side wall component is a part of an electronic package being used in AKASH missile. PRU side wall is assembled to PRU base plate. For any missile, identification of target is very important. In some missiles, it is wire guided, in some missiles it is image processing technology and in some it is laser guided. This particular electronic package in which PRU body is located will be used in image processing technology of target identification. The main aim of this project is to generate NC program for PRU side wall using NX_CAM software and validate on CNC 5-axis machine.

INTRODUCTION
UNIGRAPHICS INTRODUCTION:
About NX
- ✓ NX is one of the world's most advanced and tightly integrated CAD/CAM/CAE product development solutions.
- ✓ It simplifies complex product designs, thus speeding up the process of introducing products to the market.
- ✓ The NX software integrates knowledge-based principles, industrial design, geometric modeling, advanced analysis, graphic simulation, and concurrent engineering.
- ✓ The software has powerful hybrid modeling capabilities by integrating constraint-based feature modeling and explicit geometric modeling.
- ✓ In addition to modeling standard geometry parts, it allows the user to design complex free-form shapes such as airfoils and manifolds.

NX, also known as NX Unigraphics or usually just U-G, is an advanced CAD/CAM/CAE software package developed by Siemens PLM Software.

It is used, among other tasks, for:
- Design (parametric and direct solid/surface modeling)
- Engineering analysis (static, dynamic, electro-magnetic, thermal, using the Finite Element Method, and fluid using the finite volume method).
- Manufacturing finished design by using included machining modules

3D MODELING OF PRU SIDE WALL
COMPUTER-AIDED DESIGN

Computer-aided design (CAD) is the use of computer systems to assist in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing. CAD output is often in

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the form of electronic files for print, machining, or other manufacturing operations.

CAD software for mechanical design uses either vector-based graphics to depict the objects of traditional drafting, or may also produce raster graphics showing the overall appearance of designed objects. However, it involves more than just shapes. As in the manual drafting of technical and engineering drawings, the output of CAD must convey information, such as materials, processes, dimensions, and tolerances, according to application-specific conventions. CAD may be used to design curves and figures in two-dimensional (2D) space; or curves, surfaces, and solids in three-dimensional (3D) space.

CAD is an important industrial art extensively used in many applications, including automotive, shipbuilding, and aerospace industries, industrial and architectural design, prosthetics, and many more. CAD is also widely used to produce computer animation for special effects in movies, advertising and technical manuals, often called DCC Digital content creation.

GD&T SYMBOLS

GD & T is a symbolic language for researching and encoding the function of each feature of a part in design through decoding to guarantee assemblability and operability prior to drawing release, set reduce cost and set precise objectives for manufacturing and turn inspection and manufacturing process feedback into truly scientific processes.

COMMONLY USED BASIC GD&T SYMBOLS

SYMBOL	GEOMETRIC CHARACTERISTIC	TYPE OF TOLERANCE	PRIMARY CONTROL
▱	FLATNESS	Form No relation between features	Controls form (shape) of size and non-size features.
—	STRAIGHTNESS		Datum reference is not allowed
⌭	CYLINDRICITY		Controls form (shape) of size features
○	CIRCULARITY (ROUNDNESS)		Datum reference is not allowed
⊥	PERPENDICULARITY	Orientation No relation between features	Controls orientation (tilt) of surfaces, axes, or median planes for size and non-size features Datum reference required
//	PARALLELISM		
∠	ANGULARITY		*Optional: Angularity symbol may be used for all orientation controls*
⊕	POSITION	Location	Locates center points, axes and median planes for size features. Can also control orientation.
⌒	PROFILE OF A SURFACE		Locates surfaces Can also be used to control size, form, and orientation of surfaces based on datum reference
⌒	PROFILE OF A LINE		
⟋⟍	TOTAL RUNOUT	Runout	Controls surface coaxiality Can also control form and orienta-tion of surfaces.
⟋	CIRCULAR RUNOUT		
◎	CONCENTRICITY	Location of derived median points.	Locates derived median points of a feature
⩵	SYMMETRY		*Not common, consider position, runout, or profile.*

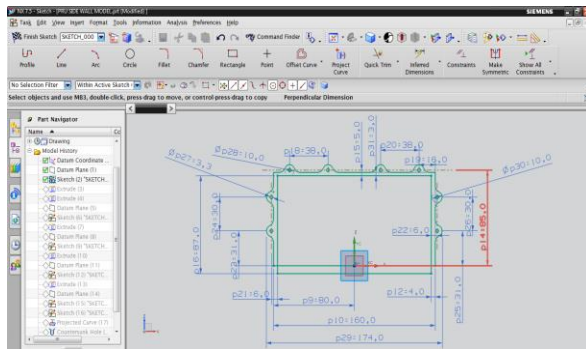## DEVELOPMENT OF 2D DRAWING:
PRU side wall **2D Drawing**
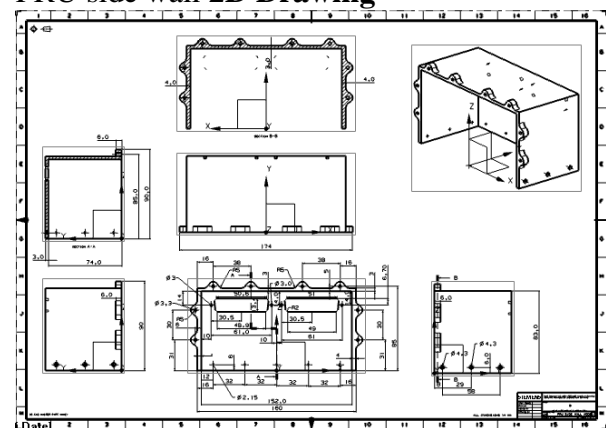
STEPS INVOLVED IN 3D MODELLIMG OF PRU SIDE WALL:
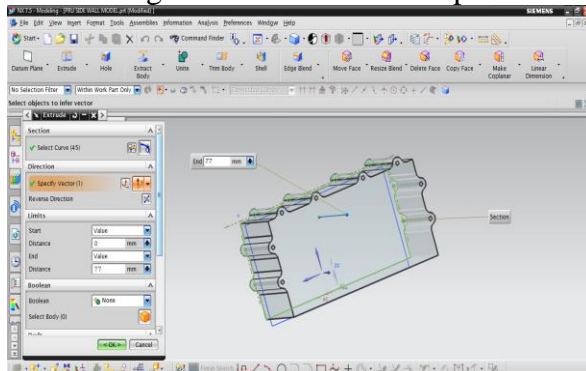3D model is designed by using NX cad software.

Sketching:
Below is the sketch required to obtain the 3D model of the PRU side wall from the above 2D drawing.
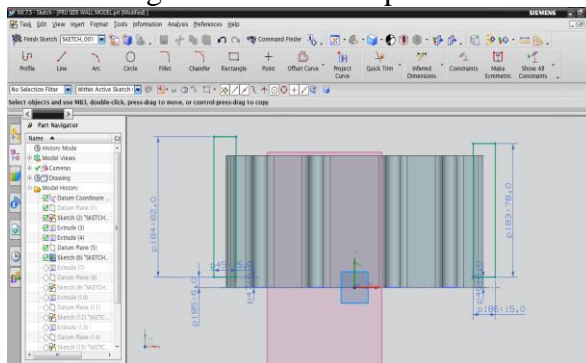
Below image shows the **SKETCH** of the PRU side wall.

Below image shows **EXTRUDE** option.
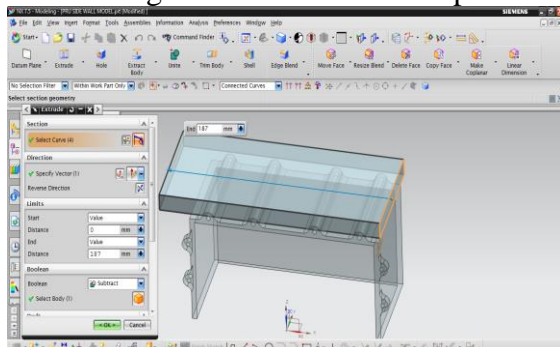

Below image shows s**ketch** option.
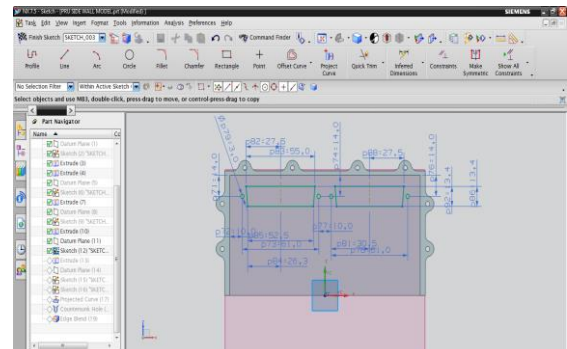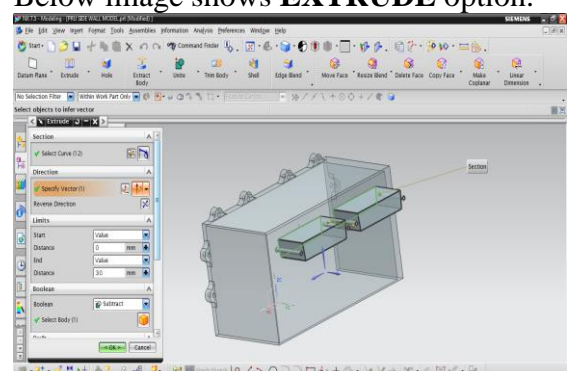

Below image shows **EXTRUDE** option.

Create cutting operations

≈ Planar mill.
≈ Profile Milling.
≈ Rough mill.
≈ Face mill area.
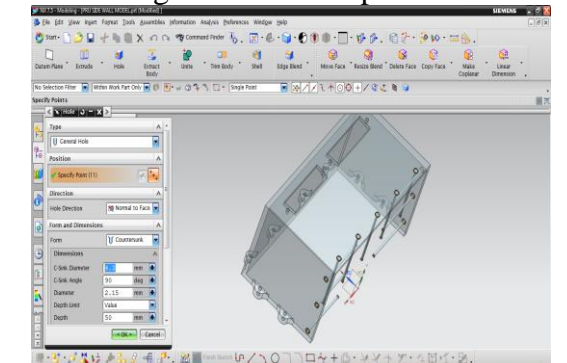
Below image shows **EXTRUDE** option.
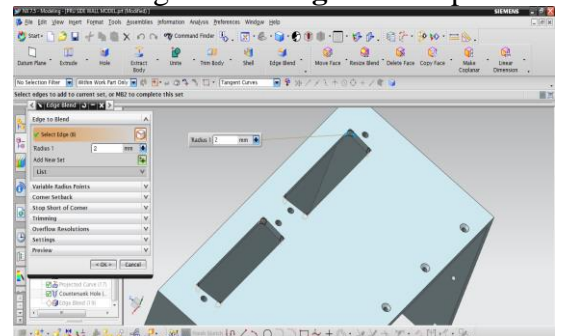

Below image shows s**ketch** option.
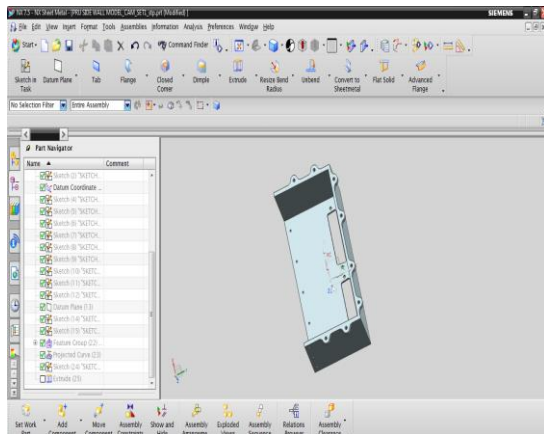

Below image shows **EXTRUDE** option.

Below image shows **hole** option.

Below image shows **edge blend** option.

Below image shows final model.

COMPUTER AIDED MANUFACTURING (CAM)

NC program will be generated from the 3D model of PRU side wall. The generated NC program is a generic machine program, this program is given to DMG 5axis machine according to that NC program only machine will manufactures the component.

The main objective of the project is to develop post processor for specified controller of machine Methodology of manufacturing PRU side wall

- Identify suitable machine.
- Selecting suitable tools for manufacturing PRU side wall component.
- Listing down the Sequence of operations performed on PRU side wall
- Generating general NC program using NX-CAM software.
- Developing post processor for DMG 5axis machine
- Generating NC program for HEIDENHAIN controller using NX-CAM software.
- Load generated NC program on CNC machine

IDENTIFY SUITABLE MACHINE
TYPES OF CNC MACHINE USED IN THIS PROJECT:
DMG 5-axis milling machine is used for manufacturing PRU side wall component. In DMG 5-axis milling machine X, Y, Z, B,

C are 5 vectors, X & Y are tool movement and Z is for table upwards movement, B for spindle movement, C for table rotation.

High rigidity with Integrated Spindle up to 12000rpm, Spindle is directly coupled with motor. Vertical Operations, Integrated rotary table of 1200mm X 700mm with rotary dia 700mm. Horizontal Operations, With head tilting at 90deg.Angular and 5-axes simultaneous machining, Capable of machining from +30 deg to -120deg head tilting. Machine accuracies, Positional Accuracy +/- 0.005mm, Repeatability +/- 0.003mm

FOR PRU side wall **5-axis milling machine is used**

Fig. DMG 5-axis machine

SELECTING SUITABLE TOOLS FOR MANUFACTURING PRU SIDE WALL COMPONENT
Selection of tools plays an important role in manufacturing any component. Proper tools must be selected otherwise in manufacturing process improper tools results in damage of work piece or damage to the tools, tool holders. Suitable tools for manufacturing PRU side wall are listed below

 SPOT_DRILLING
This operation subtype allows the tool to pause at the tool tip or shoulder depth of the tool by a specified number of seconds or revolutions.

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DRILLING

This operation subtype allows you to do basic point-to-point drilling

FACE_MILLING

FACE_MILLING is the main Face Milling operation subtype. A milling cutter that cuts metal with its face. Face milling creates large flat surfaces.

FACE_MILLING_AREA

Face Milling Area is a Face Milling operation subtype that is customized to recognize a cut area and wall selection.

END MILL

A milling cutter that performs a mix of peripheral and face milling. End milling engages the bottom and edges of the milling cutter. An end mill is a type of milling cutter, a cutting tool used in industrial milling applications. It is distinguished from the drill bit in its application, geometry, and manufacture. While a drill bit can only cut in the axial direction, a milling bit can generally cut in all directions, though some cannot cut axially

ROUGHING END MILL

Roughing end mills quickly remove large amounts of material. This kind of end mill utilizes a wavy tooth form cut on the periphery. These wavy teeth form many successive cutting edges producing many small chips, resulting in a relatively rough surface finish. During cutting, multiple teeth are in contact with the work piece reducing chatter and vibration.

DRILL BITS

Drill bits are cutting tools used to create cylindrical holes, almost always of circular cross-section. Bits are held in a tool called a drill, which rotates them and provides torque and axial force to create the hole. Specialized bits are also available for non-cylindrical-shaped holes.

The *shank* is the part of the drill bit grasped by the chuck of a drill. The cutting edges of the drill bit are at one end, and the shank is at the other. Drill bits come in standard sizes.

SEQUENCE OF OPERATIONS PERFORMED ON PRU SIDE WALL COMPONENT

Sequence of operations performed on PRU side wall in NX-CAM software are listed below

- Face mill area operation
- Planar mill operation for set up 1
- Planar mill operation for set up 2
- Drill operations
- Verification of operations

Step by step procedure of NC part program is shown below in flow chat

FLOW CHART FOR GENERATION OF NC PART PROGRAMS
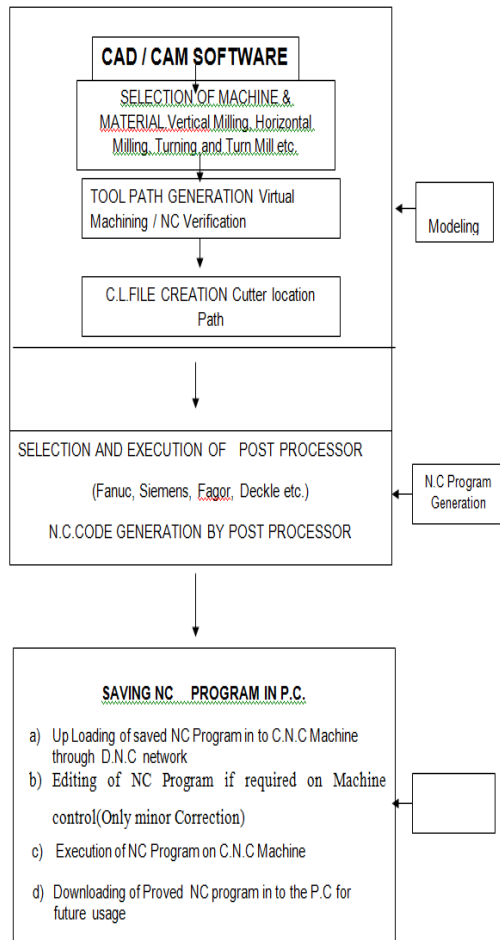
## CAM OPERATION IN NX-CAM

Basic cam setup

- In NX the NC machining environment is referred to as the setup.
- The set up for the machining jobs should be decided by looking at all the environmental information from four viewpoints: Program, Method, Geometry, and Tool.
- These four viewpoints were designed to mimic the thought process that can be used when planning the NC program.
- Each viewpoint organizes the information for the operation in a manner relevant to that particular viewpoint.

For example there are some standard setups available in NX-CAM are given below **CAM TOOL PATH GENERATION ON PRU SIDE WALL**

The series of movements made by the tip of a cutting tool. X and Z codes indicate a tool path within a part program. The path through space that the tip of a cutting tool follows on its way to producing the desired geometry of the workpiece.

Set_up_1 tool path generation

Below image shows blank and part of PRU side wall
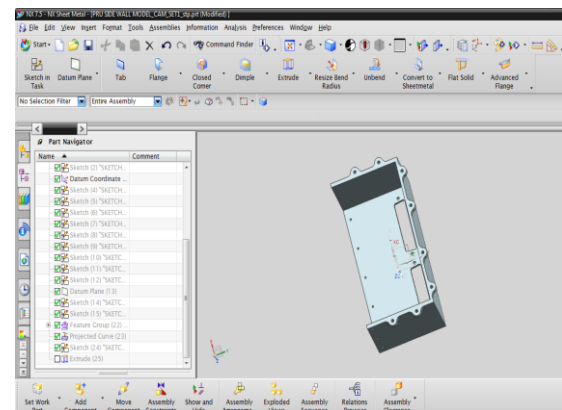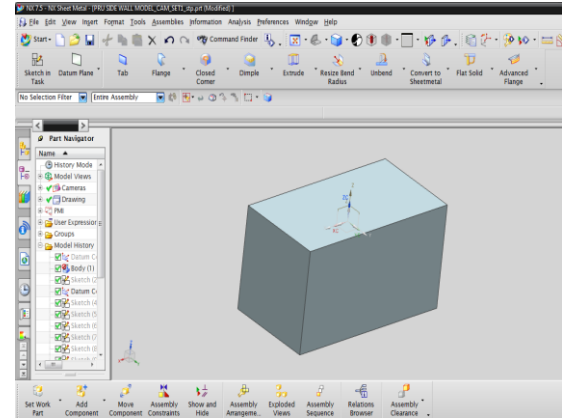
Below image shows face milling area operation
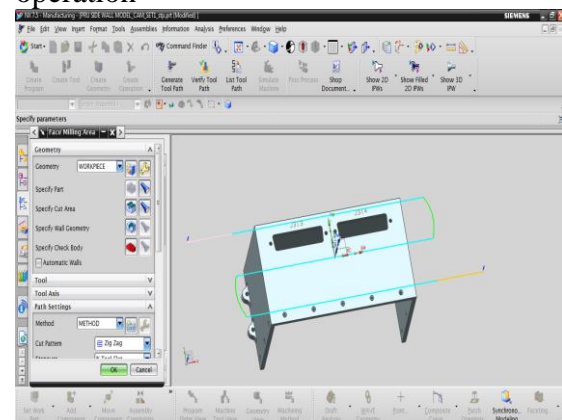
Below image shows face milling area verification

Below image shows planar mill operation

Below image shows planar mill operation

Below image shows planar mill operation
verification
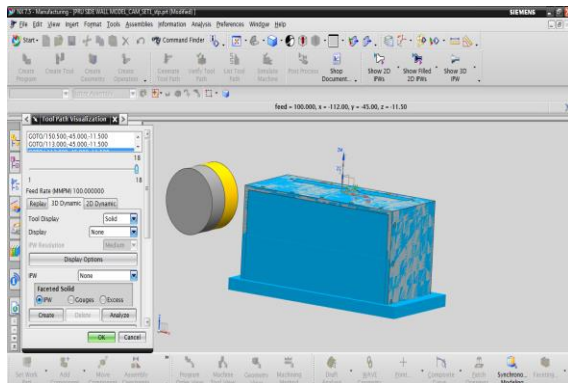

Below image shows planar mill operation
verification

Below image shows planar mill operation
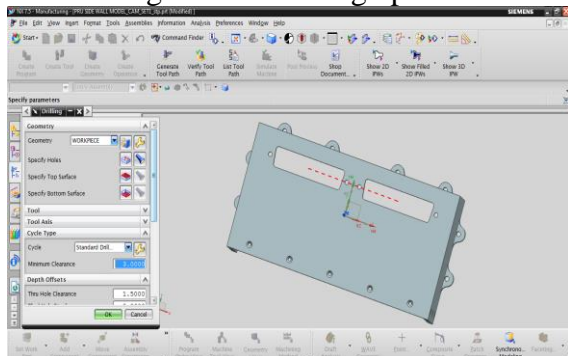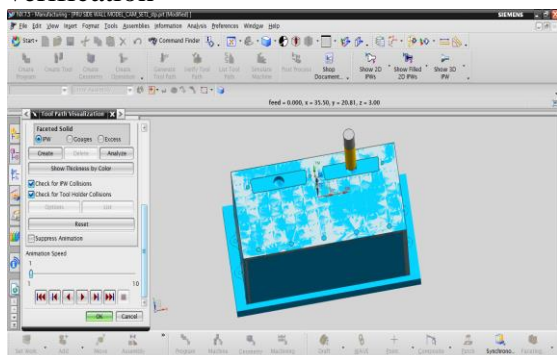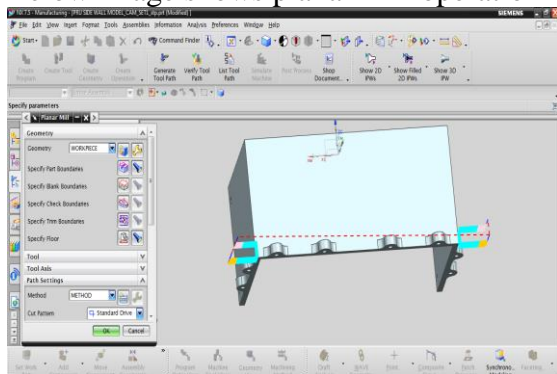

Below image shows planar mill operation

Below image shows planar mill operation
verification

Below image shows planar mill operation
verification
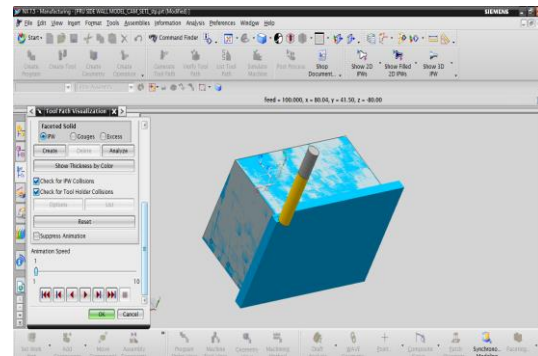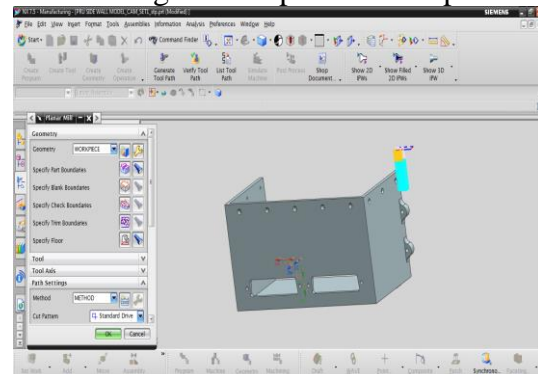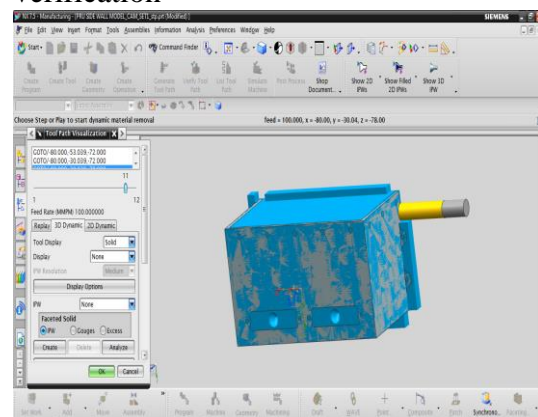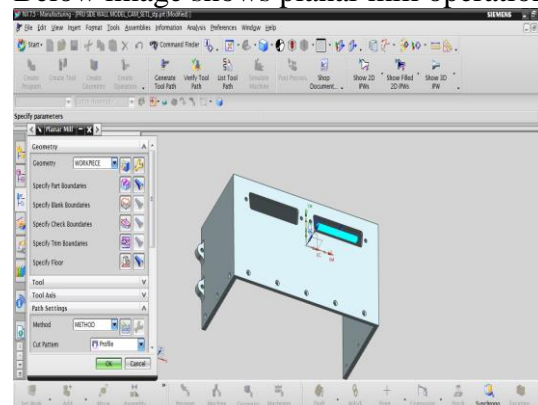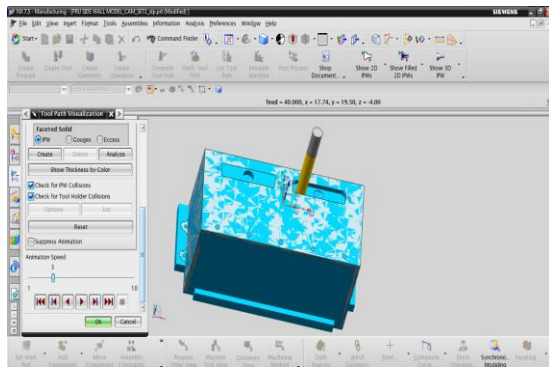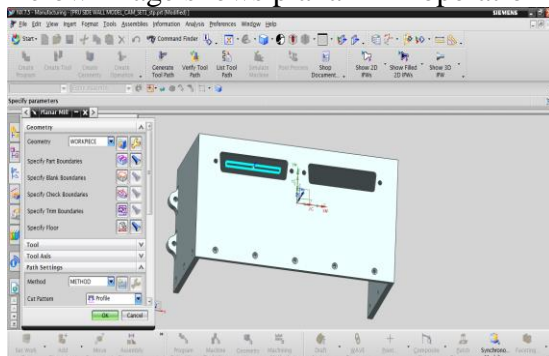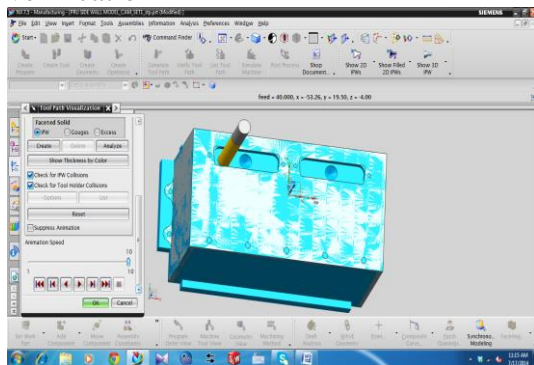
Below image shows drilling operation

Below image shows planar mill operation

Below image shows drilling operation verification

Below image shows drilling operation verification

Below image shows planar mill operation

Below image shows planar mill operation

Below image shows drilling operation verification

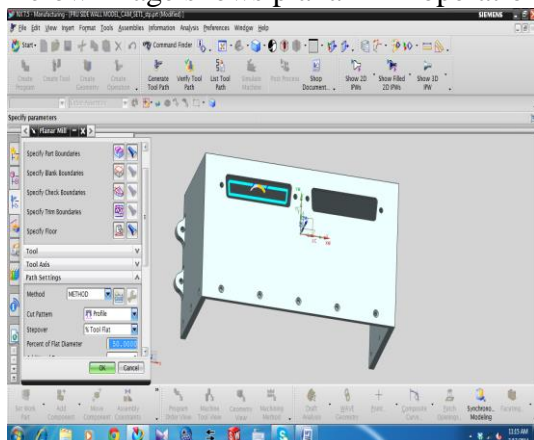Below image shows drilling operation verification

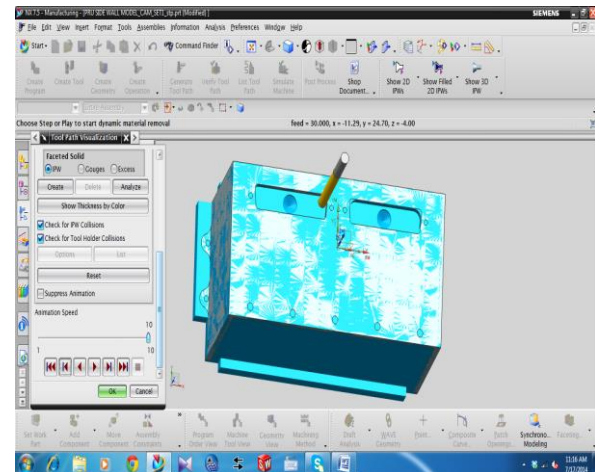Below image shows planar mill operation

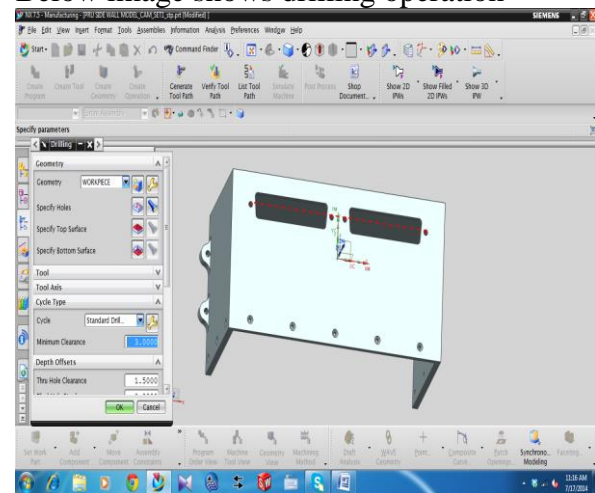Below image shows drilling operation
verification

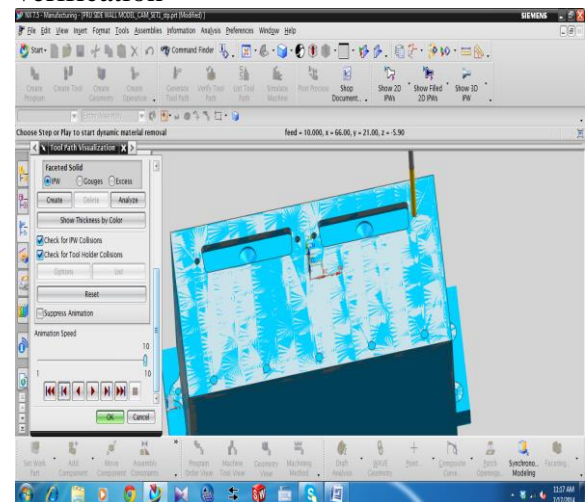Below image shows planar mill operation

Below image shows planar mill operation
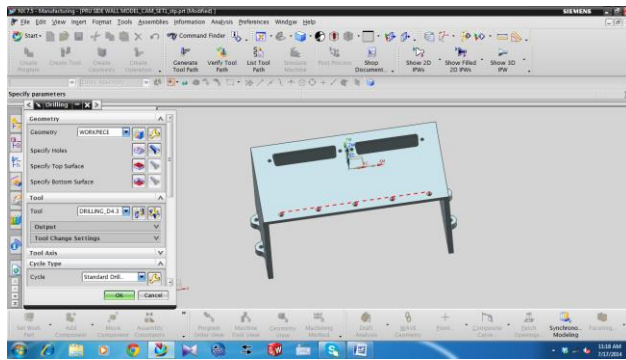verification

Below image shows drilling operation

Below image shows drilling operation
verification

Below image shows drilling operation

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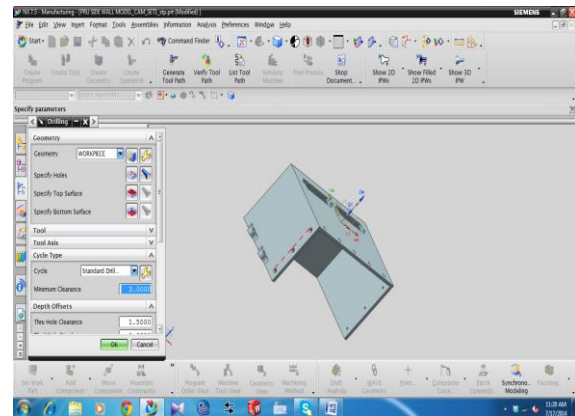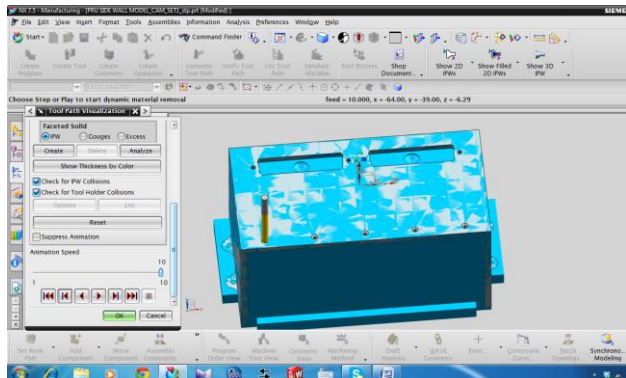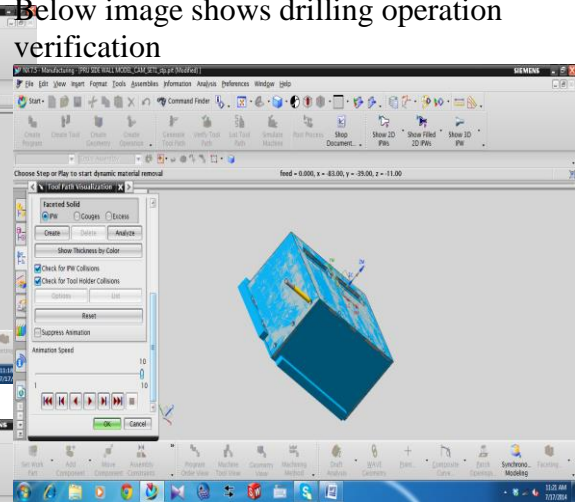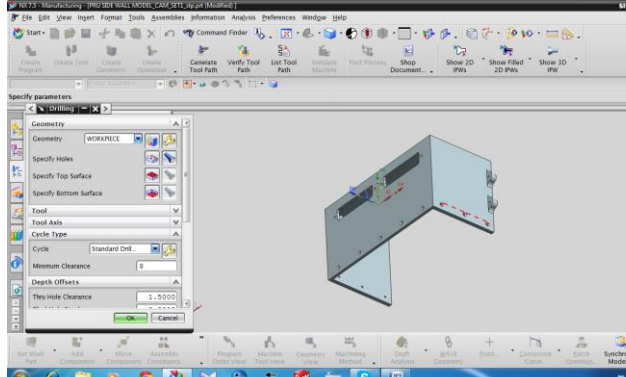
Below image shows drilling operation verification

Below image shows drilling operation verification

Below image shows drilling operation

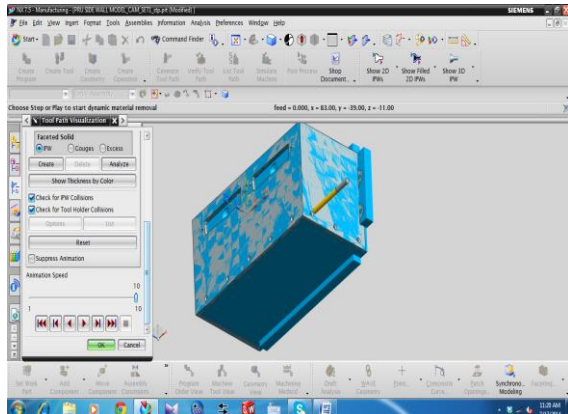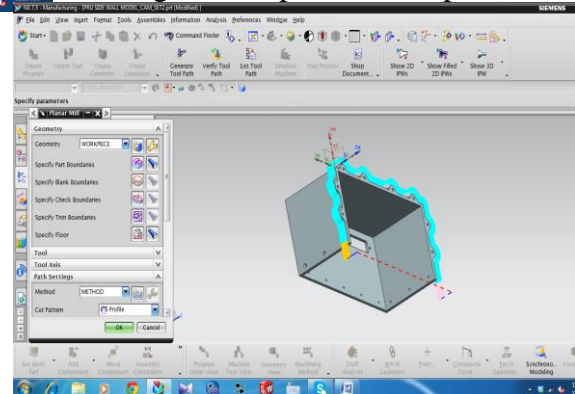Below image shows drilling operation verification

Set_up_2 tool path generation

After completion of set_up_1 operations on top side PRU side wall, part is placed reversely in the fixture for bottom side machining of the part which is semi finished.
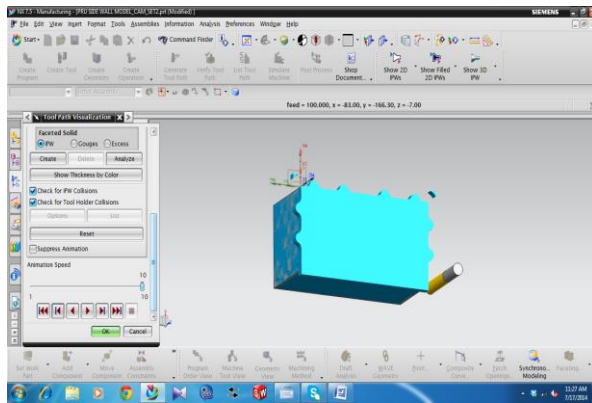
Below image shows planar mill operation

Below image shows drilling operation

Below image shows face mill area operation

Below image shows face mill area operation verification

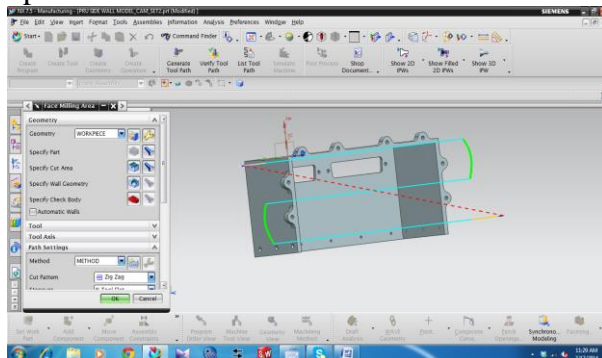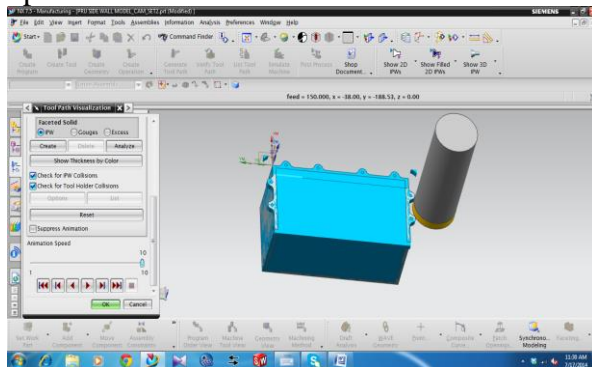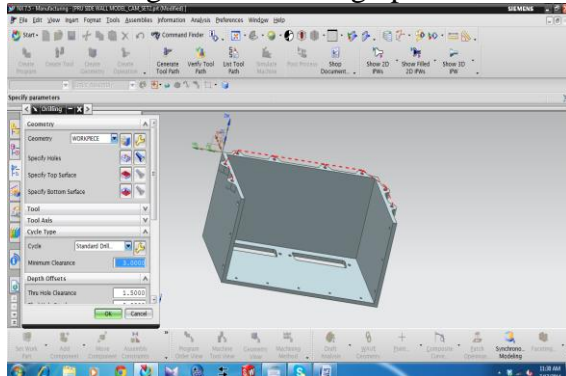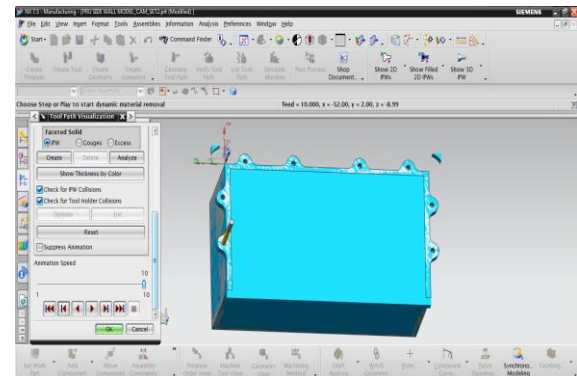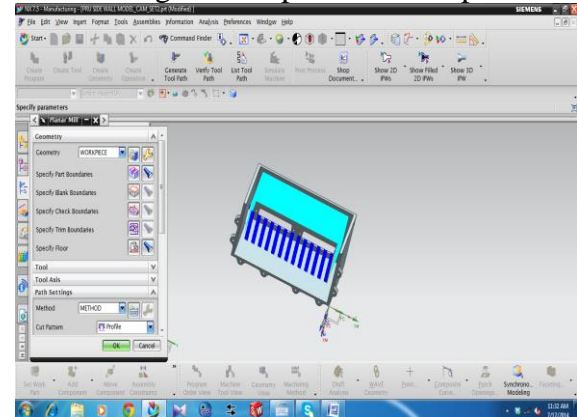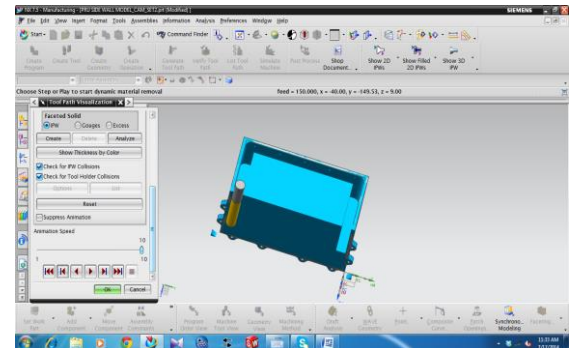Below image shows drilling operation

Below image shows drilling operation verification

Below image shows planner mill operation

Below image shows planner mill operation verification

Below image shows planner mill operation

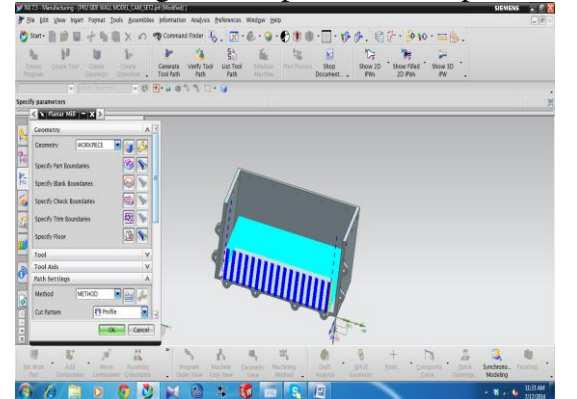Below image shows planner mill operation verification

Below image shows planner mill operation
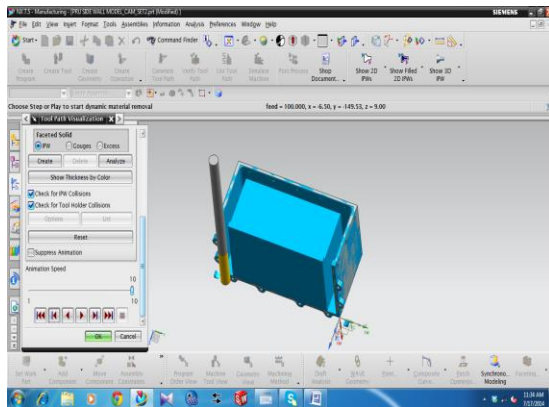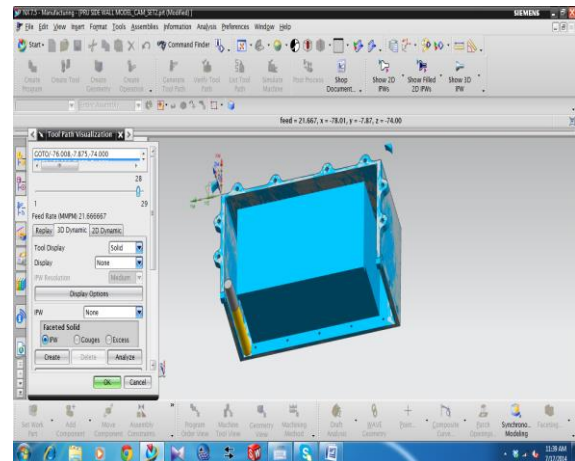

Below image shows planner mill operation verification

Below image shows planner mill operation

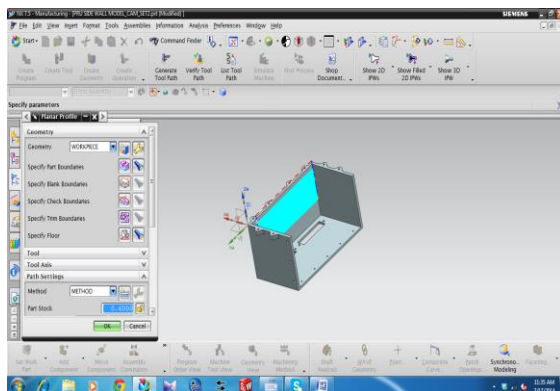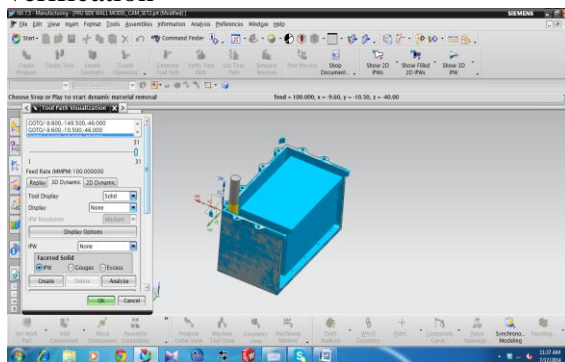Below image shows planner mill operation verification

OPERATION LIST BY PROGRAM
PROGRAM NAME : SET_UP1

| OPERATION NAME	OPERATION DESCRIPTION	TOOL NAME
1_FACE_D50	mill_planar/FACE_MILLING_AREA	FACE_D50
2_FACE_D50_RS	mill_planar/PLANAR_MILL	FACE_D50
2_FACE_D50_LS	mill_planar/PLANAR_MILL	FACE_D50
2_FACE_D50_BACK	mill_planar/PLANAR_MILL	FACE_D50
2_FACE_D50_FRONT	mill_planar/PLANAR_MILL	FACE_D50
3_EM_D10_RS	mill_planar/PLANAR_MILL	EM_D10
3_EM_D10_LS	mill_planar/PLANAR_MILL	EM_D10
3_EM_D10_BACK	mill_planar/PLANAR_MILL	EM_D10
4_DRILLING_D12.7	drill/DRILLING	DRILLING_12.7
5_EM_D10_STKP2	mill_planar/PLANAR_MILL	EM_D10
5A_EM_D10_STKP2	mill_planar/PLANAR_MILL	EM_D10
6_EM_D6	mill_planar/PLANAR_MILL	EM_D6
6A_EM_D6	mill_planar/PLANAR_MILL	EM_D6
7_EM_D4	mill_planar/PLANAR_MILL	EM_D4
7A_EM_D4	mill_planar/PLANAR_MILL	EM_D4
8_DRILLING_D3	drill/DRILLING	DRILLING_D3
9_DRILLING_D4.3	drill/DRILLING	DRILLING_D4.3
9_DRILLING_D4.3_COPY	drill/DRILLING	DRILLING_D4.3
9_DRILLING_D4.3_COPY_COPY	drill/DRILLING	DRILLING_D4.3

OPERATION NAME	OPERATION DESCRIPTION	TOOL NAME
1_EM_D12_STKP3	mill_planar/PLANAR_MILL	EM_D12
2_EM_D6_STKP1_FIN	mill_planar/PLANAR_MILL	EM_D6
3_FACE_D50_SET2	mill_planar/FACE_MILLING_AREA	FACE_D50
4_DRILLING_D3.3_FOR_M4	drill/DRILLING	DRILLING_D3.3_FOR_M4
5_REM_D12_STKP6	mill_planar/PLANAR_MILL	EM_D12
5A_REM_D12_STKP6	mill_planar/PLANAR_MILL	EM_D12_LONG
6_REM_D12_STKP6	mill_planar/PLANAR_PROFILE	EM_D12
6A_REM_D12_STKP6	mill_planar/PLANAR_PROFILE	EM_D12
7_EM_D8_FIN	mill_planar/PLANAR_MILL	EM_D8
7A_EM_D9.4_FIN	mill_planar/PLANAR_MILL	EM_D9.4
7B_FACE_D50_STK1	mill_planar/PLANAR_MILL	FACE_D50
7C_FACE_D50_STK1	mill_planar/PLANAR_MILL	FACE_D50
8_EM_D9.4_HORI_FIN	mill_planar/PLANAR_MILL	EM_D9.4
CSK_D6	mill_planar/PLANAR_MILL	CSK_D6_90DEG
CSK_D6_STKP5	mill_planar/PLANAR_MILL	CSK_D6_90DEG
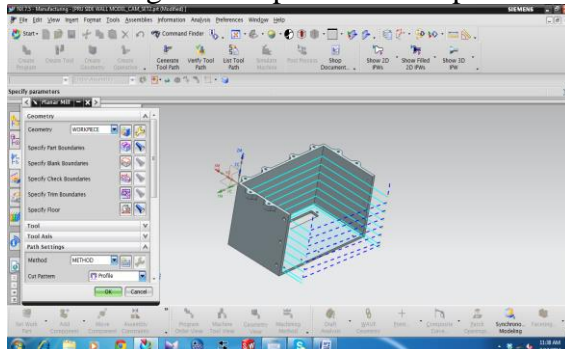
PROGRAM NAME : SET_UP2

Convert to NC Code

Using the post processor we have to convert CL file data into machine specified NC part programme

1. In the Project Manager, select the first operation on the Operations page, then hold down the Shift key and select the last operation. All the cutting operations are selected.
2. Press the right mouse button and select NC Code from the menu.
3. Select a Machine Format file from the pull down list (3-Axis/5-Axis).
4. Select Apply.

VALIDATING THE NC PROGRAM GENERATED BY THE CUSTOMIZED POST PROCESSOR:

the program is studied thoroughly considering each operation and tool change and then it is loaded on the machine, a test run is done on the machine, minor changes(feed and speed setting) in the program is done and finally the component is manufactured.

Blank of PRU SIDE WALL
Setup_1 operations completed

Setup_1 operations completed Extra material from inside is removed
Total manufacturing time of the component = 3hrs 53min
Manufacturing cost on milling machine per hour= 1200rs
Total manufacturing cost of the component = 1200/60*233min= 4660rs

CONCLUSION:

Pru side wall is modeled using NX-cad software and NC program is generated by created tool path on component using NX-cam software. Manufacturing time and cost are calculated in results.

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