



# **HOW TO INCREASE PRODUCTIVITY USING MANUFACTURING USER DEFINED FEATURES**

PTC Technical Support - Advanced Manufacturing Technique

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## Introduction

The intent of this document is to demonstrate and explain the use of “User Define Features” a.k.a. UDF in a Manufacturing Model. When used in a Manufacturing Model the UDF is properly referred to as a Manufacturing User Define Feature a.k.a. MUDF.

This technique utilizes the following functionalities:

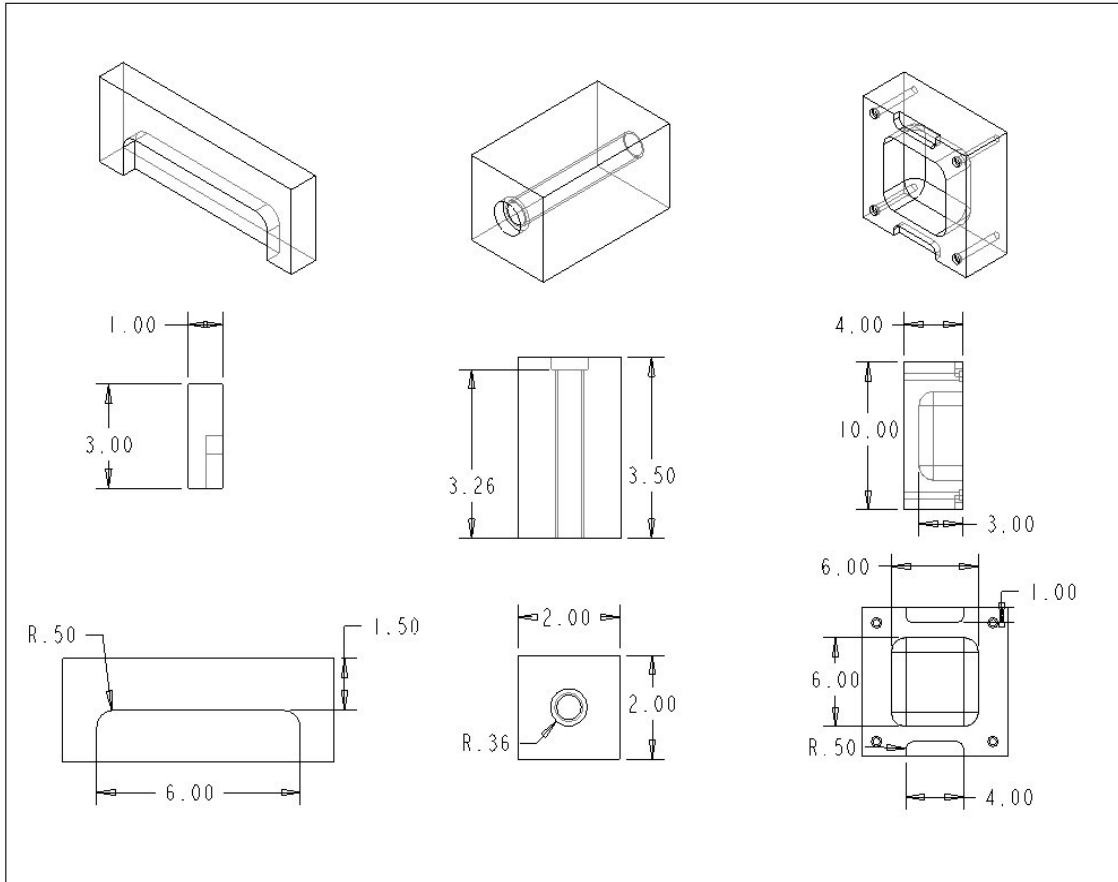
- Pro/NC Milling Sequence
- Pro/NC Holemaking Sequences
- User-Defined Features

The purpose of UDFs and MUDFs is to increase a user’s efficiency by removing repetitive actions and replacing it with a simple process of placing a completed feature with a minimal number of reference selections.

Estimated time to complete technique: 1 Hour

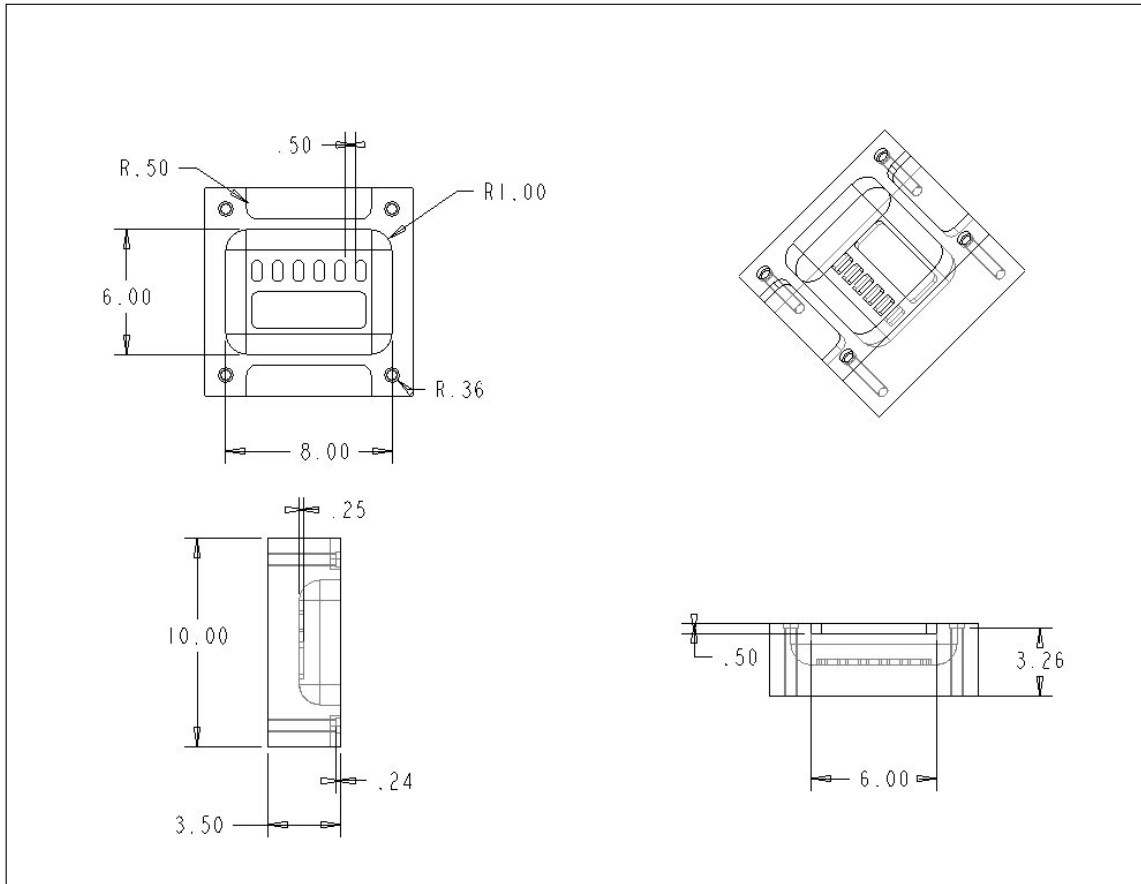
## Setup

For this technique, the three parts in figure 1 were used in separate manufacturing models in order to create different types of MUDF's. These MUDF's were then placed in the NC-Assembly Model shown in figure 2.



SCALE : 0.500 TYPE : PART NAME : HOLE\_TRIPLE SIZE : A

**Figure 1 – MUDF Models**



**Figure 2 – Manufacturing Model**

## Example Files

The example models used in this document can be downloaded at the following location:

[Example Part Files](#)

## Fundamentals

Manufacturing User-Defined Features (MUDF's) are used to simplify the creation of features, it's intended is to place similar features multiple times. Simply put, a MUDF combines NC Sequences into one feature providing a fast method for creating those sequences on another model.

This functionality enables you to create the NC sequences necessary to machine a group of features (geometry) only once. You can then group these NC sequences and place them in any other models that contain a similar group of references. By using a MUDF, you can ensure that similar features are machined using the same method for all instances.

There are many ways to use MUDF's in order to speed up the process of manufacturing. A library of manufacturing user-defined features can be set up to handle commonly used geometry. They can be used to duplicate sequences on simple features or to machine entire models.

The standard procedure for using a MUDF is to first create a Manufacturing Model with common geometry present and machine it with the desired sequence and strategy. From here the MUDF is created by selecting the sequences used to be machine the geometry and labeling the required references. The MUDF is than saved to disk and ready to be called out in a new model. A new model now requires machining and one simply creates a Manufacturing Model for it and defines the required Operation and Workcell. Next, simply select the MUDF, which was designed to machine the similar geometry and pick it's required references.

To help understand how and when to use a MUDF the following levels have been defined.

- Sequence MUDF - This is the simplest type of MUDF to create, it only contains a single sequence and it focuses on a particular type of geometry.
- Regional MUDF – This is used to machine a piece of geometry with several different sequences. An example of a Regional would be a chamfered hole which would require a center drill, deep and chamfering sequence to completely machine.
- Model MUDF – This is used for machining an entire model. In this case, a template is used to create the MUDF that will include all the sequences necessary to machine the entire part. The model template MUDF can then be applied to any parts that are derived from the original. This is an excellent to control the strategy for machining a part such as Face first, rough second, finish third and drill hole last.

## Procedure

### 1.1 Creating a Library to Contain all MUDFs

A library of commonly used MUDFs can be created containing frequently used features. Once the MUDFs (.gph files) are created, they can be placed in a separate directory. The config.pro option "pro\_group\_dir" should be set to the complete path of this directory. When attempting to place a MUDF using the menu picks **Machining, Utilities, Group**, Pro/ENGINEER will automatically access the directory containing the previously defined MUDFs.

### 1.2 Defining and Placing a Manufacturing User Defined Feature of a Sequence

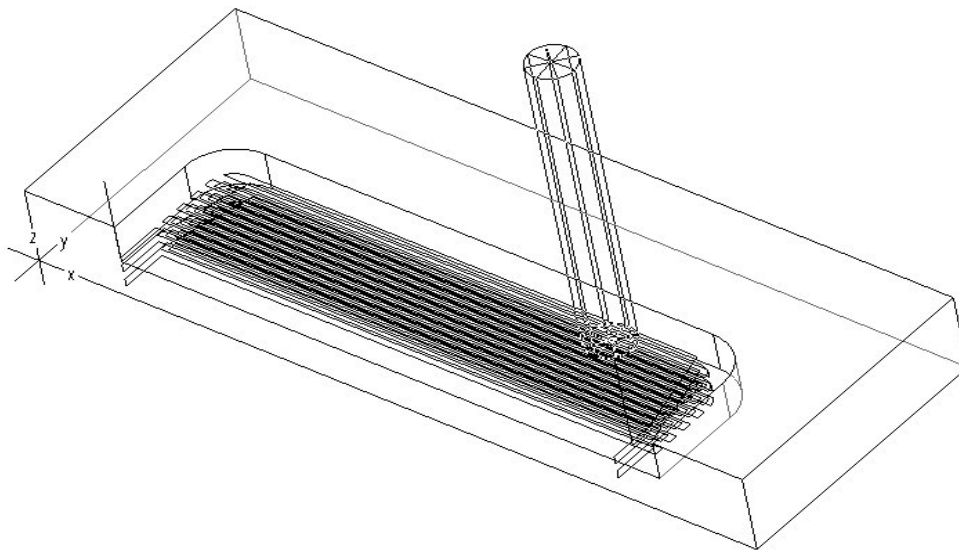


Figure 3 – Single Sequence MUDF

#### 1.2.1 Defining a MUDF

The simplest form of a MUDF is one where a single sequence is involved as seen in figure 3. These MUDF's can be placed in a manufacturing model in order to machine simple features quickly.

The first step is to define a MUDF referencing the NC Sequence. From the Manufacturing Menu, select **Machining, Utilities, UDF Library, Create**.

At this point you will be prompted to enter a name for this MUDF. For this example, enter **Volume** for the name. Once a name has been entered you will be prompted to select **Standalone**, or **Subordinate**. A Standalone MUDF copies all the original model information into the MUDF file. A subordinate MUDF gets its values directly from the original model at run time, so the latter must be present for the subordinate MUDF to function. If you make any changes to the dimension values in the original model, they are automatically reflected in the MUDF. In this example Standalone was selected. After selecting Standalone, select **NC Sequence** as the feature to add to the MUDF, and select the NC Sequences from the list. You will be prompted “Do you want to include VOLUME in group definition?” “VOLUME” being the name of the volume that was created for the sequence in this model. If a mill window or a mill surface had been used in the sequence, then those items would have been prompted. Accept the default Yes if you wish to include the volume in the MUDF, otherwise select No. Select **Done Sel**, **Done**, and **Done/Return** to begin defining the MUDF prompts.

### 1.2.2 Selecting References

At this point all references that went into creating the NC Sequence will be called upon for the user to assign a title so that the references can be picked upon placing this MUDF in another model. Select from the PROMPTS MENU **Single** so that the prompt will only be asked once for all NC Sequences. The first prompt is for the coordinate system. Whatever is entered at this prompt will be used again upon placing that MUDF. Enter the word **Coord\_Sys**. In this example, the nc coordinate system and the machining coordinate system are the same. If they were different you would be prompted for both.

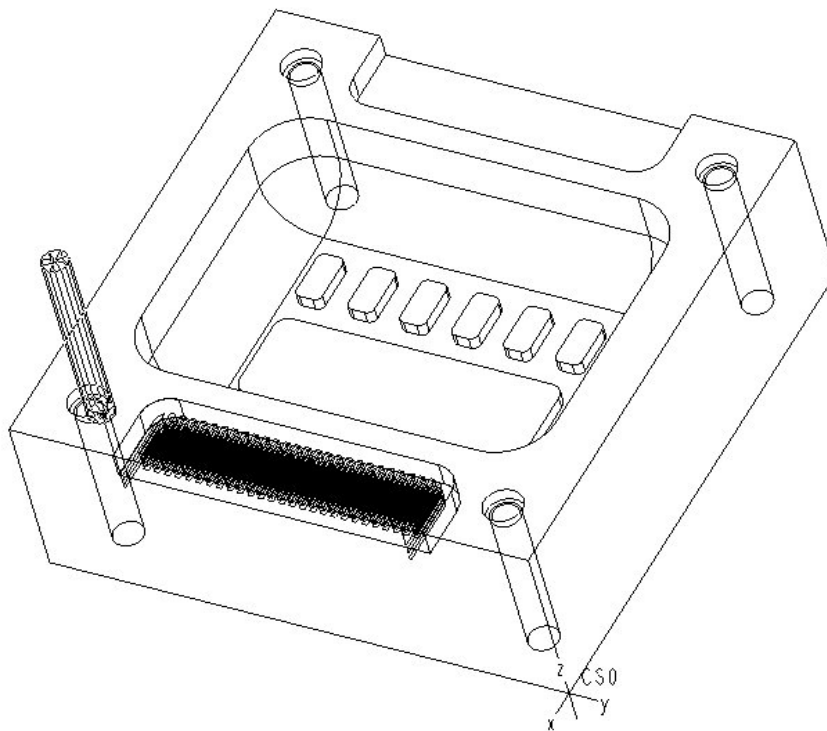
The next prompt is for the operation. Enter the word **Operation**. Next, the reference to be highlighted will be the Retract Plane, enter **Retract Plane** for its title. The next required references are for the placement of the volume. Enter corresponding description (i.e. **Front Ref Surface**, **Top Ref Surface**, **Right Vol Surface**, etc...). Once all references have been prompted for, the user will then be placed in the MOD PRMPT menu where modifications can be made to the titles entered at each prompt. If none have to be made, select **Done/Return** and select **OK** from the MUDF dialog box. The creation of the Drilling MUDF has been completed and will be saved as **Volume.gph** in the current working directory. Note that MUDF's are given **.gph** extensions. The next step is to now place the MUDF in another manufacturing model.

### 1.2.3 Placing the MUDF

The first step in placing the MUDF is to select **Machining**, **NC Sequence**, **New Sequence**, **User Defined**, **Done**. At this point the Open Dialog Box will appear with a listing of all MUDF's in the current working directory. Select the appropriate MUDF and then select **OPEN**. From the PLACE

OPTS menu, select **Independent** or **UDF Driven**. In addition, there will also be a selection box for **Use CurOper** that has a check mark in it by default. When checked, the MUDF being placed will be created in the currently active operation. Select **Done** to go on to the next step.

The first prompt is for the coordinate system, and note the prompt states "Select Coord Sys". The words "Coord Sys" were entered as the prompt in Step 1.2. Select the coordinate system on the manufacturing model that the MUDF is to be placed. If the **Use CurOper** was left checked, the Retract Plane will not be prompted for if it has been defined in the currently active operation. Once all references have been defined, a menu will come up to allow the modification of the newly created NC Sequences; i.e. if a different tool is to be used or a parameter has to be changed, it can be done here. If no modifications have to be done, select **Done/Return** from the SEL MENU and the message window will state "**Group created successfully. Select Done to accept.**" Select **Done** from the GRP PLACE menu to finalize the creation of the MUDF.



**Figure 4 – Placed Single Sequence MUDF Placed on Manufacturing Model**



### 1.3 Defining and Placing a Manufacturing User Defined Feature of a Region

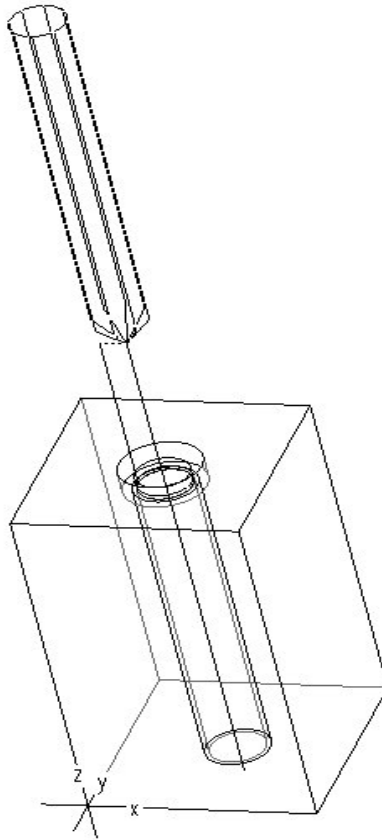


Figure 5 – Feature/Region MUDF

#### 1.3.1 Defining a MUDF

When machining a specific area, it is sometimes required that multiple sequences be used in order to complete the job. A MUDF can be created to encompass many sequences that target a specific region. In figure 5, a counter-bore hole is being machined. Four different sequences (center drill, deep drill, counter-bore, tap) are being used in order to completely machine the hole. The first step is to define a MUDF referencing the NC Sequences. From the Manufacturing Menu, select **Machining, Utilities, UDF Library, Create**. At this point you will be prompted to enter a name for this MUDF. For this example, enter **Drilling** for the name. Once a name has been entered you will be prompted to select **Standalone**, or **Subordinate**. A Standalone MUDF copies all the original model information into the MUDF file. A subordinate MUDF gets its values directly from the original model at run time, so the latter must be present

for the subordinate MUDF to function. If you make any changes to the dimension values in the original model, they are automatically reflected in the MUDF. In this example Standalone was selected. After selecting Standalone, you will then be prompted with the question "Do you want to include the mill surface?" Accept the default Yes if you wish to include the mill surface in the MUDF, otherwise select No. Select **NC Sequence** as the feature to add to the MUDF, and select the all the NC Sequences from the list. You will then be prompted "'Do you want to include MILL\_SURFACE in group definition?" "MILL\_SURFACE" being the name of the mill surface that was created for one of the sequences in this model. If a mill window or a mill volume had been used in any of the sequences, then those items would have been prompted as well. Select **Done Sel**, **Done**, and **Done/Return** to begin defining the MUDF prompts.

### 1.3.2 Selecting References

At this point all references that went into creating the NC Sequence will be called upon for the user to assign a title so that the references can be picked upon placing this MUDF in another model. Select from the PROMPTS MENU **Single** so that the prompt will only be asked once for all NC Sequences. The first prompt is for the Operation. Whatever is entered at this prompt will be used again upon placing that MUDF. Enter the word **Operation**. The next prompt is for the coordinate system. In this example, the nc coordinate system and the machining coordinate system are the same. If they were different you would be prompted for both.

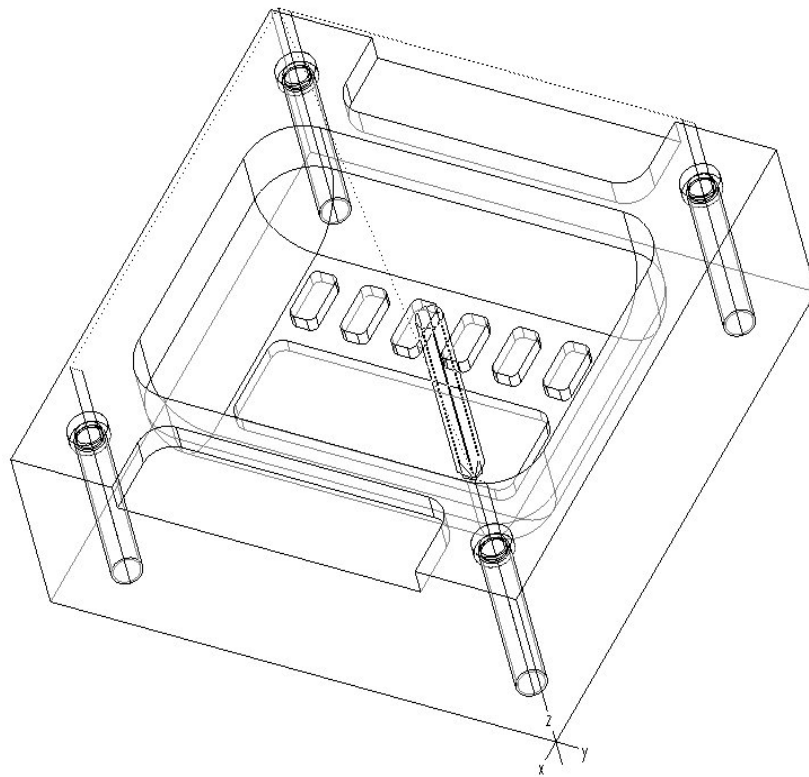
Enter **Coord\_Sys**. Next, the reference to be highlighted will be the Retract Plane, enter **Retract Plane** for its title. The next required references are for placement purposes. Enter corresponding descriptions (i.e. **Front Ref Surface**, **Top Ref Surface**, **Right Ref Surface**, etc...) for easy placement at a later time. Once all references have been prompted for and defined, you will then be placed in the MOD PRMPT menu where modifications can be made to the titles entered at each prompt. If none have to be made, select **Done/Return** and select **OK** from the MUDF dialog box. The creation of the Drilling MUDF has been completed and will be saved as **Drilling.gph** in the current working directory. Note that MUDF's are given **.gph** extensions. The next step is to now place the MUDF in another manufacturing model.

### 1.3.3 Placing the MUDF

The first step in placing the MUDF is to select **Machining, NC Sequence, New Sequence, User Defined, Done**. At this point the Open Dialog Box will appear with a listing of all MUDF's in the current working directory. Select the appropriate MUDF and then select **OPEN**. From the PLACE OPTS menu, select **Independent** or **UDF Driven**. In addition, there will also be a selection box for **Use CurOper** that has a check mark in it by default. When checked, the MUDF being placed will be created in the currently active operation. Select **Done** to go on to the next step.

Select the appropriate references as being described by the prompts. Notice that the references being prompted are the ones that were input in step 2.2. Once all references have been defined, a menu will come up to allow the modification of the newly created NC Sequences; i.e. if a different tool is to be used or a parameter has to be changed, it can be done here. If no modifications have to be done, select **Done/Return** from the SEL MENU and the message window will state "**Group created successfully. Select Done to accept.**" Select **Done** from the GRP PLACE menu to finalize the creation of the MUDF.

You will now notice that the hole on which the axis was selected has four NC Sequences assigned to it. In this example, since there are many additional holes that have been patterned on the design model, the group can also be patterned to include all of the holes. Simply select **Machining, Utilities, Group, Pattern, NC Sequence**, select one of the sequences from the list and then select **Ref Pattern**. All four sequences in the group will be patterned.



**Figure 6 – Feature/Region MUDF Placed on Manufacturing Model**

## 1.4 Defining and Placing a Manufacturing User Defined Feature of a Model Template

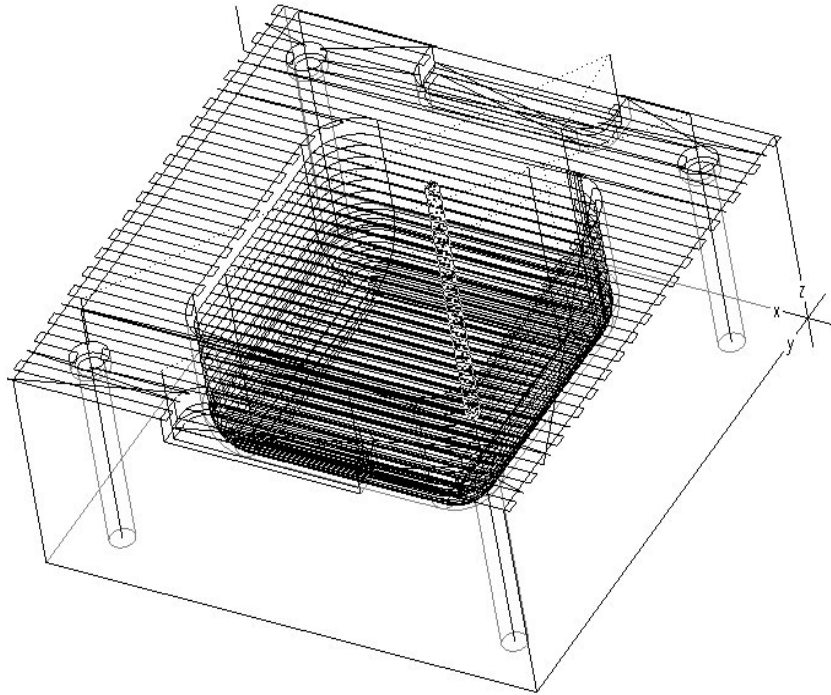


Figure 7 - Model Template MUDF

### 1.4.1 Defining a MUDF

In many cases, a model template is used from which various designs are created. A MUDF can be created from the template, which will contain most, if not all, the sequences required to machine the entire model, depending upon the modifications done to the template. This MUDF can then be applied to the subsequent incarnations of the original template. Figure 7 is a model template. Figure 8 is the resulting model that contains additional features and numerous dimensional modifications to the existing ones. The first step is to define a MUDF referencing the NC Sequences. From the Manufacturing Menu, select **Machining, Utilities, UDF Library, Create**. At this point you will be prompted to enter a name for this MUDF. For this example, enter **Template** for the name. Once a name has been entered you will be prompted to select **Standalone**, or **Subordinate**. A Standalone MUDF copies all the original model information into the MUDF file. A subordinate MUDF gets its values directly from the original model at run time, so the latter must be present

for the subordinate MUDF to function. If you make any changes to the dimension values in the original model, they are automatically reflected in the MUDF. In this example Standalone was selected. After selecting Standalone, you will then be prompted with the question "Do you want to include WINDOW in group definition?" "WINDOW" being the name of the mill window that was created for one of the sequences in this model. If a mill surface or a mill volume had been used in any of the sequences, then those items would have been prompted as well. Select **Done Sel, Done,** and **Done/Return** to begin defining the MUDF prompts.

### 1.4.2 Selecting References

At this point all references that went into creating the NC Sequence will be called upon for the user to assign a title so that the references can be picked upon placing this MUDF in another model. Select from the PROMPTS MENU **Single** so that the prompt will only be asked once for all NC Sequences. The first prompt is for the Operation. Whatever is entered at this prompt will be used again upon placing that MUDF. Enter the word **Operation**. The next prompt is for the coordinate system. In this example, the nc coordinate system and the machining coordinate system are the same. If they were different you would be prompted for both.

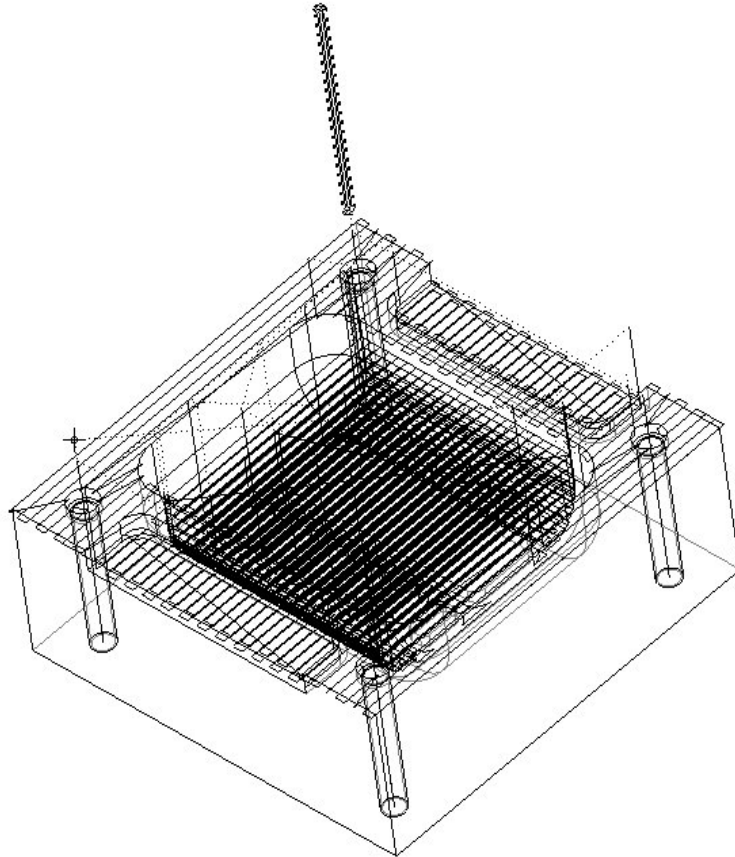
Enter **Coord\_Sys**. Next, the reference to be highlighted will be the Retract Plane, enter **Retract Plane** for its title. The next required references are for placement purposes. Enter corresponding descriptions (i.e. **Front Ref Surface, Top Ref Surface, Right Ref Surface,** etc...) for easy placement at a later time. Once all references have been prompted for, the user will then be placed in the MOD PRMPT menu where modifications can be made to the titles entered at each prompt. If none have to be made, select **Done/Return** and select **OK** from the MUDF dialog box. The creation of the Template MUDF has been completed and will be saved as **Template.gph** in the current working directory. Note that MUDF's are given **.gph** extensions. The next step is to now place the MUDF in another manufacturing model.

### 1.4.3 Placing the MUDF

The first step in placing the MUDF is to select **Machining, NC Sequence, New Sequence, User Defined, Done**. At this point the Open Dialog Box will appear with a listing of all MUDF's in the current working directory. Select the appropriate MUDF and then select **OPEN**. From the PLACE OPTS menu, select **Independent** or **UDF Driven**. In addition, there will also be a selection box for **Use CurOper** that has a check mark in it by default. When checked, the MUDF being placed will be created in the currently active operation. Select **Done** to go on to the next step.

Select the appropriate references as being described by the prompts. Notice that the references being prompted are the ones that were input in step 3.2. Once all references have been defined, a menu will come up to

allow the modification of the newly created NC Sequences; i.e. if a different tool is to be used or a parameter has to be changed, it can be done here. If no modifications have to be done, select **Done/Return** from the SEL MENU and the message window will state "**Group created successfully. Select Done to accept.**" Select **Done** from the GRP PLACE menu to finalize the creation of the MUDF.



**Figure 8 – Model Template MUDF Placed on Manufacturing Model**

## Review

This document has touched on the basic functionality in Pro/NC for defining and placing a Manufacturing UDF. In addition, it has looked at several different ways they can be implemented in a manufacturing environment.

Following the steps listed in the procedure and implementing Sequence, Feature and Model Level MUDF can provide a significant increase in productivity for programmers who find themselves creating the same type of sequences and toolpath. The keys to properly implementing MUDFs at your site is to:

- Identify similar toolpath that are constantly being created.
- Development a library of sample models that contain similar geometry to models that are being machined
- Develop a naming convention for common geometry such as Mill Volumes, Mill Windows, Mill Surface, Machine Csys, Retract Planes, Turn Profiles and Drill Groups.
- Develop a naming convention for identifying references that will assist in placement of MUDFs
- Create a library folder and store all templates and their MUDF files (.gph) there.

Family tables and Pro/PROGRAM can be used in conjunction with MUDF's in order to better automate the process. You can create a MUDF Family Table at the time you create or modify the MUDF through the definition dialog box.

In the end, MUDF's can be used to maintain machining standards and to save time throughout the creation of toolpaths.

## **Additional Information**

### **Basic Pro/HELP Information on MUDFs**

Creating an NC Sequence

[http://www.ptc.com/cs/help/2001/html/usascii/proe/nc/to\\_crea3.htm](http://www.ptc.com/cs/help/2001/html/usascii/proe/nc/to_crea3.htm)

Creating a Volume Milling NC Sequence

[http://www.ptc.com/cs/help/2001/html/usascii/proe/nc/to\\_crea7.htm](http://www.ptc.com/cs/help/2001/html/usascii/proe/nc/to_crea7.htm)

Creating a Holemaking NC Sequence

[http://www.ptc.com/cs/help/2001/html/usascii/proe/nc/to\\_cre41.htm](http://www.ptc.com/cs/help/2001/html/usascii/proe/nc/to_cre41.htm)

Defining a Manufacturing UDF

[http://www.ptc.com/cs/help/2001/html/usascii/proe/ncsheet/how\\_to24.htm](http://www.ptc.com/cs/help/2001/html/usascii/proe/ncsheet/how_to24.htm)

Placing a Previously Defined Group in Another Manufacturing Model

[http://www.ptc.com/cs/help/2001/html/usascii/proe/nc/to\\_plac1.htm](http://www.ptc.com/cs/help/2001/html/usascii/proe/nc/to_plac1.htm)

### **Advance Pro/HELP Information on MUDFs**

Including Operations, Workcells, and Reference Superfeatures in a Manufacturing UDF

<http://www.ptc.com/cs/help/2001/html/usascii/proe/nc/includin.htm>

### **Basic Pro/HELP Information on UDFs**

About User-Defined Features

[http://www.ptc.com/cs/help/2001/html/usascii/proe/part/about\\_us.htm](http://www.ptc.com/cs/help/2001/html/usascii/proe/part/about_us.htm)

To Create a UDF (basic)

[http://www.ptc.com/cs/help/2001/html/usascii/proe/part/to\\_cre79.htm](http://www.ptc.com/cs/help/2001/html/usascii/proe/part/to_cre79.htm)

To Place a UDF (basic)

[http://www.ptc.com/cs/help/2001/html/usascii/proe/part/to\\_plac0.htm](http://www.ptc.com/cs/help/2001/html/usascii/proe/part/to_plac0.htm)

To Create a UDF Library



[http://www.ptc.com/cs/help/2001/html/usascii/proe/part/to\\_cre80.htm](http://www.ptc.com/cs/help/2001/html/usascii/proe/part/to_cre80.htm)

## **Advance Pro/HELP Information on UDFs**

About User-Defined Feature Family Tables

[http://www.ptc.com/cs/help/2001/html/usascii/proe/core/about\\_u0.htm](http://www.ptc.com/cs/help/2001/html/usascii/proe/core/about_u0.htm)

To Create a UDF Family Table

[http://www.ptc.com/cs/help/2001/html/usascii/proe/core/to\\_cre15.htm](http://www.ptc.com/cs/help/2001/html/usascii/proe/core/to_cre15.htm)

About Adding Features to Family Tables

[http://www.ptc.com/cs/help/2001/html/usascii/proe/core/about\\_a2.htm](http://www.ptc.com/cs/help/2001/html/usascii/proe/core/about_a2.htm)

To Modify a UDF Family Table

[http://www.ptc.com/cs/help/2001/html/usascii/proe/core/to\\_modi5.htm](http://www.ptc.com/cs/help/2001/html/usascii/proe/core/to_modi5.htm)

To Activate Pro/PROGRAM in the UDF

[http://www.ptc.com/cs/help/2001/html/usascii/proe/part/to\\_activ.htm](http://www.ptc.com/cs/help/2001/html/usascii/proe/part/to_activ.htm)

To Define Variable Elements in the UDF

[http://www.ptc.com/cs/help/2001/html/usascii/proe/part/to\\_defi4.htm](http://www.ptc.com/cs/help/2001/html/usascii/proe/part/to_defi4.htm)