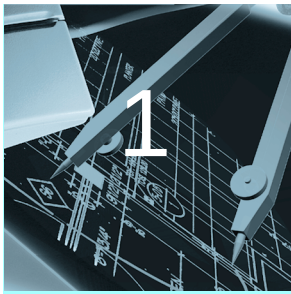
Learning VectorWorks



- **Drawing By Example**
- **Template Structure**

The most common question asked about any CAD or drawing program is "How do I draw something? Where do I start?". The first thing you should do is learn the features of the program. This is covered in the VectorWorks User's Manual. It is especially important to familiarize yourself the first three chapters, Introduction, Getting Started, and Organizing Your Drawing, as they contain summaries of the core VectorWorks concepts. Once you understand the basics of the application, you need to pool your knowledge and use all of those features together to accomplish the given task. What is the task? This question must be answered before you begin to draw. Understanding what you are going to draw will help you to pick a starting point and in VectorWorks that is a template. We have provided a series of templates that cover a broad base of tasks and can serve as a basis for most things that you will draw.

DRAWING BY EXAMPLE

The best way to describe how to draw is to show it through examples. Examples can be shown or created through exercises. Each exercise in this manual provides methodologies for a variety of tasks. It also brings a level of reality to the process. We certainly can not cover every possible need but can provide a broad spectrum of exercises which many people will find useful across many industries.

These exercises are written under the assumption that you have read the User's Manual and understand the operation of the features referred to. The procedures should be followed sequentially even through headers that break the numbering scheme.

Note: If at any time while performing the exercises in this manual you do not understand how to use a tool, refer to the VectorWorks User's Manual.

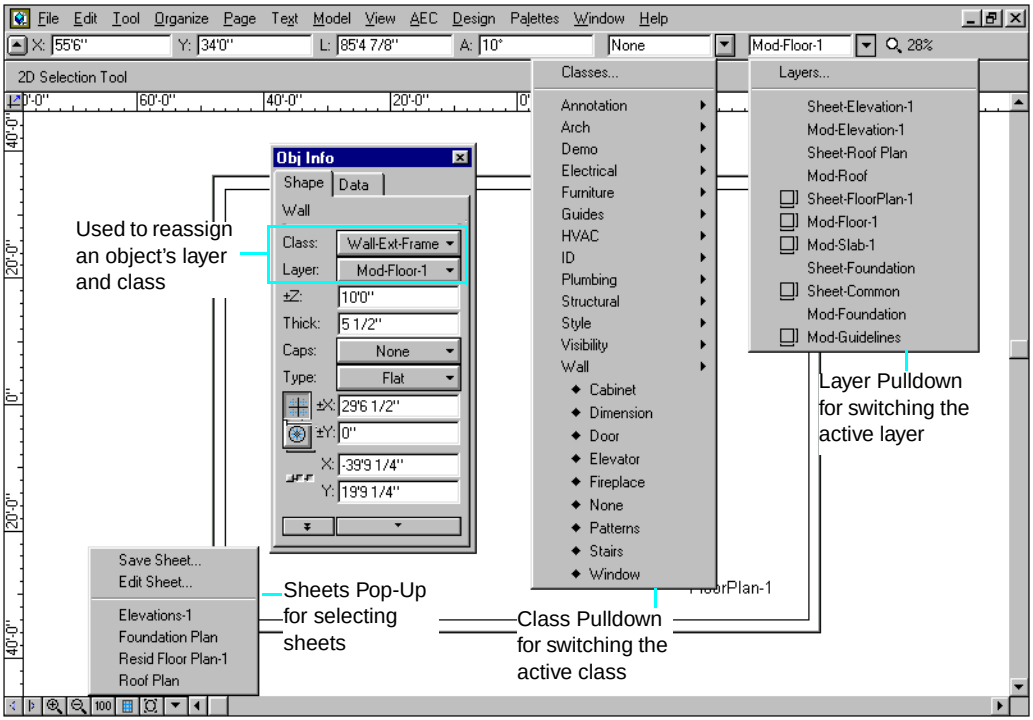
Each exercise has an accompanying sample file which is located in the Learning Exercises folder in your VectorWorks Toolkit folder. The sample file is the completed drawing that you will be creating. You can use this sample file as a point of reference to verify that you are executing the steps correctly. You can also use this file to import the resources needed for the exercise.

TEMPLATE STRUCTURE

VectorWorks's templates are designed to make drawing most efficient. As we provide layers, classes and sheets, we use a drawing methodology that is sheet based. Each of the exercises is based on the concept that switching between the provided sheets will hide and show the necessary layers and classes. Each sheet contains a title block that tells you the name of the sheet. Remember that a sheet is a combination of visible layers and classes and is what you desire as printed output.

Each exercise is structured similarly to make them easy to follow. They proceed in the order they are to be performed. In most cases, this is structured in a linear fashion in which the next procedure builds on the steps performed in the previous. The results of the steps are illustrated to help ensure you get the correct results for each step.

Note: If you add any layers or classes you will also need to add those layers and classes to the desired sheets. Otherwise they will not appear in the sheets.

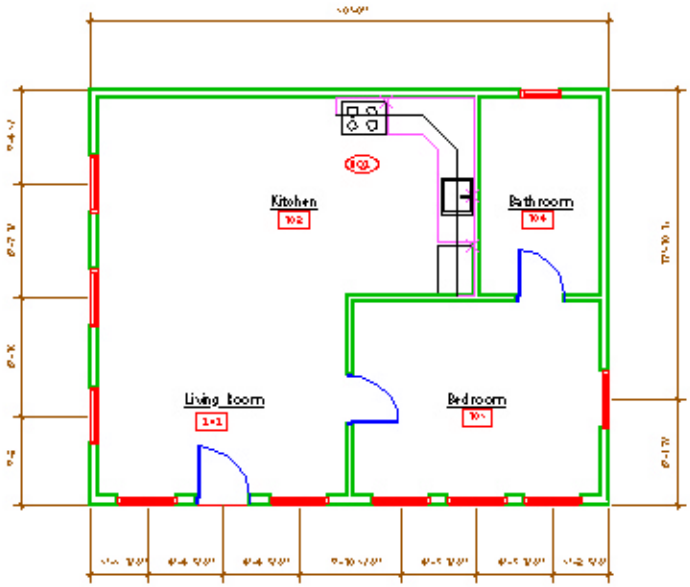


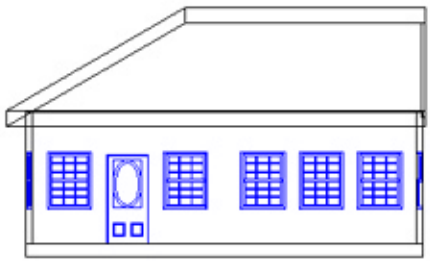
Level 1 Module - 2D House Exercises

This module combines many tools and techniques to create a small house in VectorWorks. Although this module is architectually based, it can be performed by any VectorWorks user. It shows concepts that apply to all disciplines and provides a concept that most users can relate to.

The structure of the exercises in the Level 1 Module is that all of the provided exercises are based on the 2D Drafting Plan which you will create. You must complete the 2D Drafting Plan exercise before moving on to other exersises in this module. Other exercises can then be completed in any order.

In this module you will design a simple 4 room house. You will then calculate the amount of concrete needed to pour the concrete slab, calculate the amount of paint needed to paint the interior walls, count the number of windows and doors and create detailed reports and schedules based on generated data. You will then transform your design into a high powered presentation.



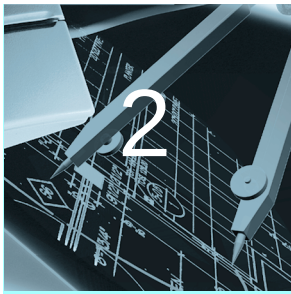


Floor Plan

ROOM FINISH SCHEDULE

Room ID	Name	Finish	Base Material	Walls North	East	South	West	Ceiling Material	Height	Remarks
101	Living Room	Wood	Wood	Gyp. Bd.	Gyp. Bd.	Gyp. Bd.	Gyp. Bd.	Gyp. Bd.	10'-0"	-
102	Kitchen	Tile	Wood	Wallpaper	Wallpaper	Wallpaper	Gyp. Bd.	Gyp. Bd.	10'-0"	-
103	Bedroom	Carpet	Wood	Gyp. Bd.	Gyp. Bd.	Gyp. Bd.	Gyp. Bd.	Gyp. Bd.	10'-0"	-
104	Bathroom	Tile	Tile	Tile / Gyp. Bd.	Tile / Gyp. Bd.	Tile / Gyp. Bd.	Tile / Gyp. Bd.	Gyp. Bd.	8'-0"	Use moisture resistant Gyp. Bd.

2D Drafting Plan



In this exercise we will build a simple house with four rooms over a crawl space. We will produce a Foundation Plan, a Floor Plan, a Roof Plan, and a Front Elevation. The completed file is located in Learning Exercises in your VectorWorks Toolkit folder and is entitled 2D_House_Sample.mcd. It may be used as a reference while drawing.

In this Exercise

- **AEC Setup Assistant**
- **Foundation Plan**
- **Floor Plan**
- **Roof Plan**
- **Front Elevation**
- **Annotations**
- **Dimensions**
- **Revising Your Drawing**

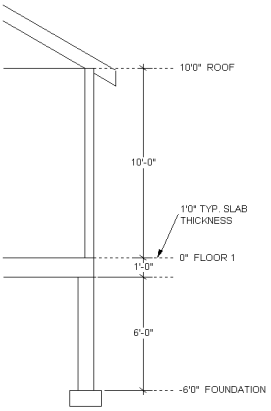
SET UP

It is important to set up your drawing before beginning to draw. The AEC Setup Assistant will create all the necessary layers and classes needed to follow the instructions in this exercise. Although we do not use all the layers and classes provided while performing this exercise, they are there for future use.

1. Select **New** from the File Menu.
2. Click the **Use Document Template** radio button.
3. Select the **AEC Setup Assistant.sta** template from the New dialog.
4. From the File menu, select **Workspaces** and then **AEC**.
5. Select **AEC Project Setup** from the AEC menu.

   The AEC Setup Assitant dialog appears.
6. Click **Yes**.

   By clicking Yes, you are given full instructions for each step as you proceed through the setup. Once familiar with the setup process, click the No button to skip these instructions during future sessions.
7. Enter the criteria as detailed below:



For Step 1, enter **1** for Number of Floors. Accept all other defaults.

Accept the defaults for Step 2.

For Step 3, change the printable area from US Arch D to **US Arch C**.

Accept the defaults for Step 4.

For Step 5, select **Foundation Plan**, **Resid Floor Plan**, and **Roof Plan**.

For Step 6, enter **10'0"** in the Roof field, **-6'0"** in the Foundation field, **1'0"** in the Typical Slab Thickness field, select the **Platform Framing** checkbox, and **10'0"** in the Clg Ht AFF field. Accept all other defaults.

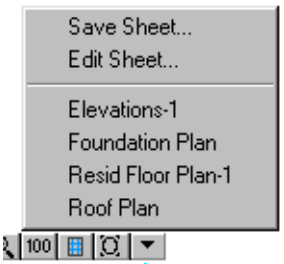
Accept the defaults for Step 7.

For Step 8, select **Elevations**. Enter **1** in the Qty field and **1/4** in the scale field.

For Step 9, select **Title block along the bottom**. Accept all other defaults.

In the Go Back dialog, click **OK**.

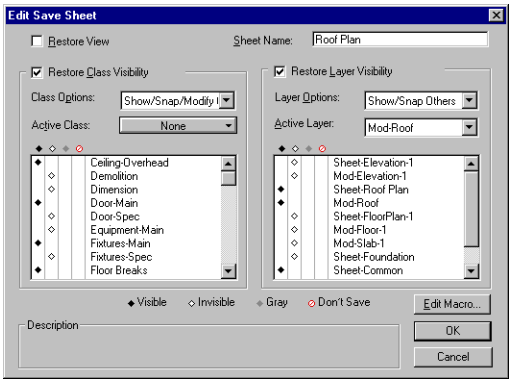
You end up with a drawing file that uses feet and inches as the unit and is in a 1/4 inch scale. It has also added a variety of layers, classes and sheets (Foundation Plan, Resid Floor Plan, and Roof Plan). You are now ready to draw.

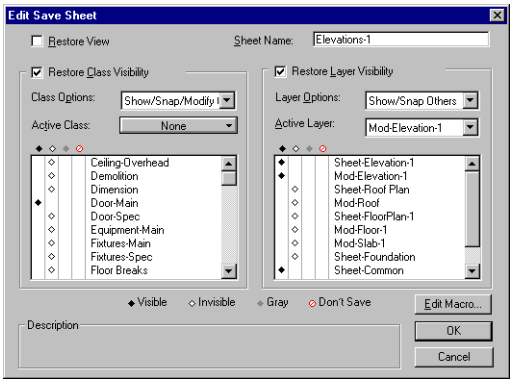


Sheets Menu

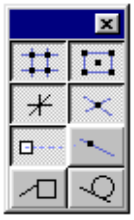
8. Browse the different sheets provided using the View bar.

You can look at the sheet's information using the Edit Sheet option. Notice that some of the visibility settings for the classes and layers are different.





9. Click **Fit to Window** on the View bar.
10. From the Palettes menu, select **Constraints**.



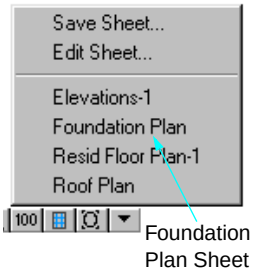
11. Click each of the following constraint buttons: **Snap to Objects**, **Snap to Grid**, **Constrain Angle**, **Snap to Intersection**, and **Smart Points** as shown.
12. From the Palettes menu, select **Resources**.
13. Using the file tree locate the file **2D_House_Sample.mcd** in the Learning Exercises folder in Toolkit. Select it and press the **Enter button** on the Resources palette.
14. From the **Show** pulldown, select **Symbols**.

Symbol Icon 

15. Select all of the listed symbols and click **Import**.
16. From the Palettes menu, open **Walls, Dimensioning, Editing, Object Info,** and **LE House Wall Styles**.

    If any of the palettes are already open, there is no need to open them again. You may move palettes by clicking on the title bar and moving them to the desired location.
17. Select **Save As** from the File menu and name the file **2Dhouse.mcd**.

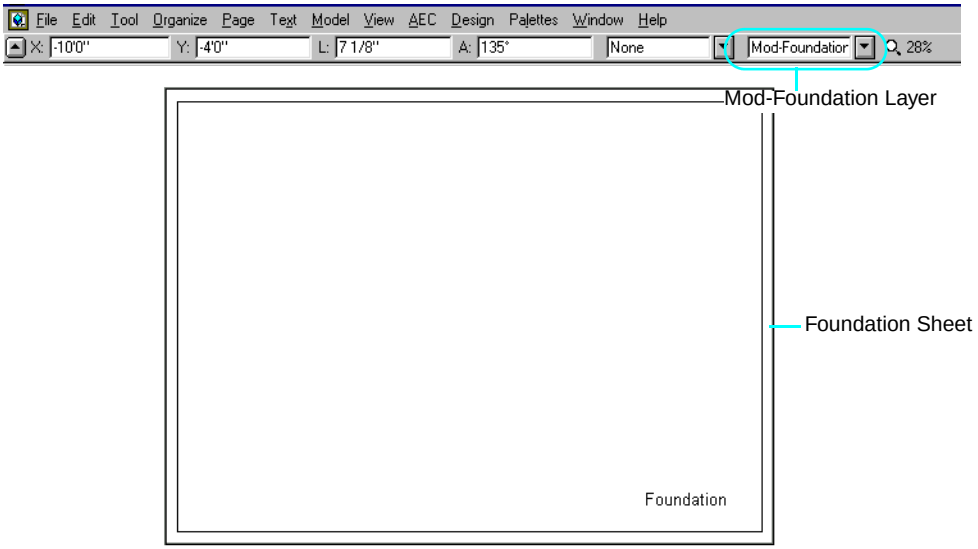
FOUNDATION PLAN



In the Foundation Plan you draw the necessary structural elements to support the house. You will also find out how to get the square footage of the slab.

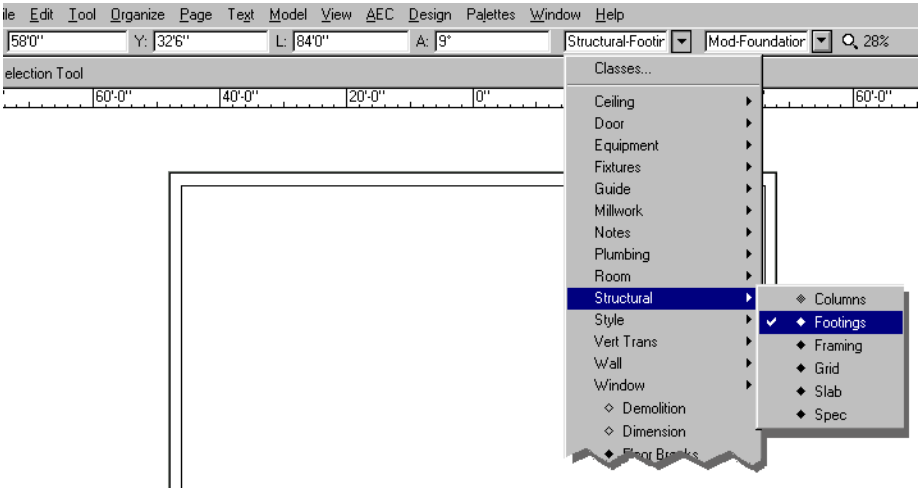
1. Select the sheet entitled **Foundation Plan**.

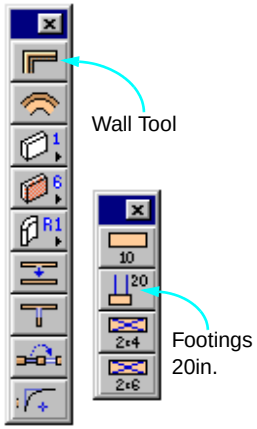
Notice that the sheet is displayed and its title block says Foundation Plan. You are also placed in the Mod-Foundation layer.



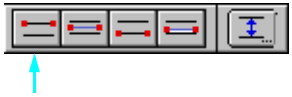
Draw the Footings

1. From the Classes pulldown, select **Structural-Footings**.





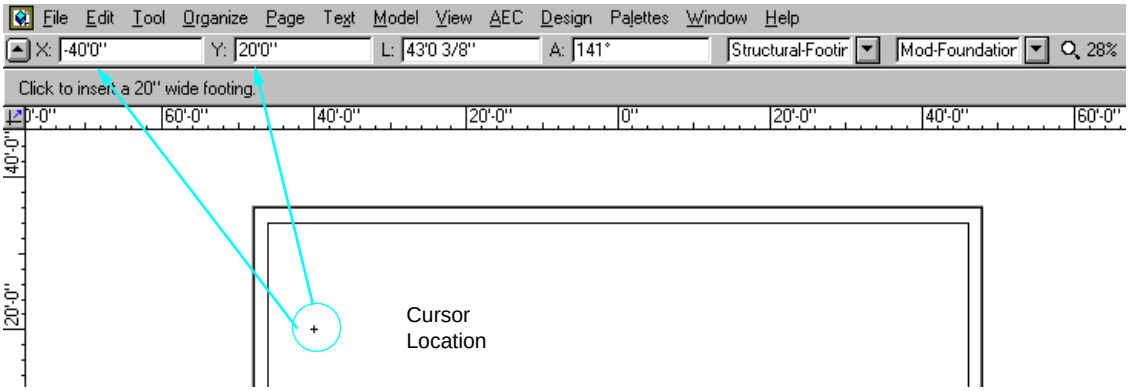
2. Click the **Wall tool**.
3. Click the **Top Control Line** mode button.



4. Click **Footings 20in.** from the LE House Wall Styles palette.

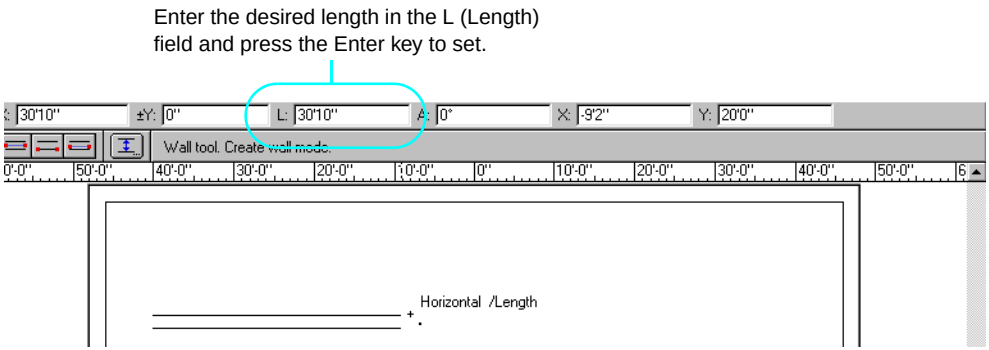
   This wall style draws a 20" wide footing.
5. Using the values on the rulers, click the mouse to start drawing your wall at **-40’0"** on the horizontal ruler and **20’0"** on the vertical ruler.

   -40’0" (X) and 20’0" (Y) will show in the Data Display Bar.



Tip: It is always a good idea to draw clockwise.

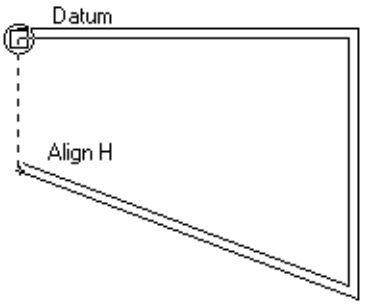
6. Press the Tab key until the L (length) field is highlighted. Enter **30’10"** into the field and press the Enter key. Move the cursor to the right until you see the cue Horizontal/ Length and click to set the wall.



7. Tab into the L field and enter **24’10"**. This time, after you press Enter, move the mouse downwards and click when the Vertical/Length cue appears.

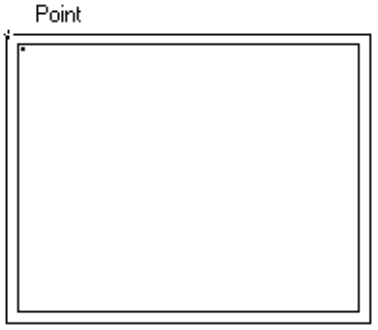
Click the Tab key until you highlight the L (length) field. Enter 24’10" and click the Enter key.

8. Drag the mouse up to the start point of the first footing. When the cue Point appears, move the mouse down so that a dashed line appears displaying the Align H cue. Move the mouse back down so that the footing is once again horizontal and you get the Horizontal/ Align H cue. Click once to set the footing.



9. Draw a vertical wall up toward the beginning of the top horizontal footing until the **Point** cue appears and click.

   The Point cue appears when you are over the exact point at which you started that line and tells you that the footings will be joined correctly. This completes your rectangle of foundation footings.



10. With all four walls still selected, enter **-10"** in the delta Z field of the Object Info. palette.

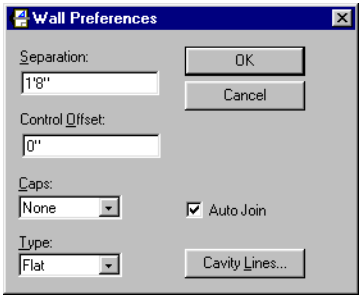
    This drops the walls 10" below the ground plane. Your drawing operation is now complete for foundation footings.

11. Click the **2D Selection tool** to deactivate the wall style tool.
12. Select **Save**.

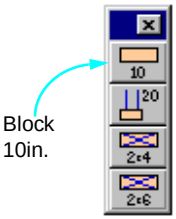
Walls

1. Select the **Wall-Ext-Masonry** class from the Classes pulldown in the Data Display bar.
2. Click the **Wall** tool.
3. Click the **Center Control Line** mode button which is the second mode button.
4. Click the **Wall Prerefences** button on the mode bar.

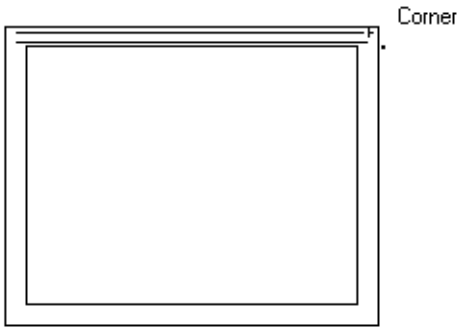
   The Wall Preferences dialog appears.



5. Uncheck **Auto Join**.
6. Click **OK**.
7. Click **Block 10in.** from the LE House Wall Styles palette.
8. Move the cursor to the upper left intersection of the foundation footings until you see the Corner cue and click.



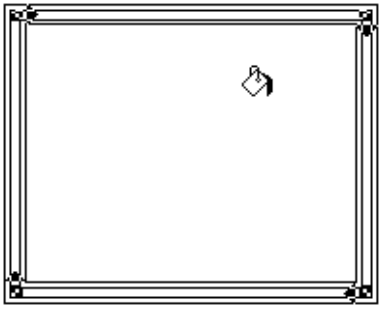
9. Click at each wall corner until you reach the original Corner cue to complete the foundation walls.



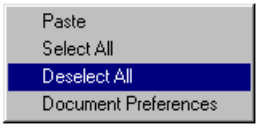
10. Click the **Wall** tool.
11. Click the **Wall Prerefences** button on the mode bar.
12. Check **Auto Join**.
13. Click **OK**.
14. Select the **2D Selection tool** to deactivate the Wall tool.
15. Select **Save**.

Create the Slab

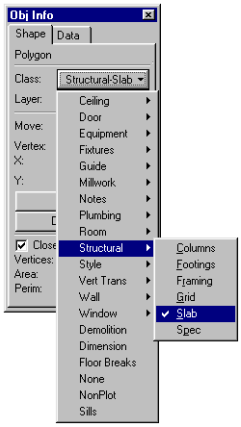
1. With the four walls just drawn still selected, select **Combine Into Surface** from the Tool menu.
2. Place the paint bucket cursor into the middle of the four walls and click.



A solid white polygon is created.



3. Right-click (Windows) or Control-click (Macintosh) anywhere in the drawing area to invoke the Edit menu and select **Deselect All**.

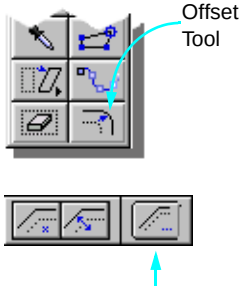


4. Click only on the just created polygon.
5. From the Object Info palette, select the Class pulldown then select **Structural-Slab**.

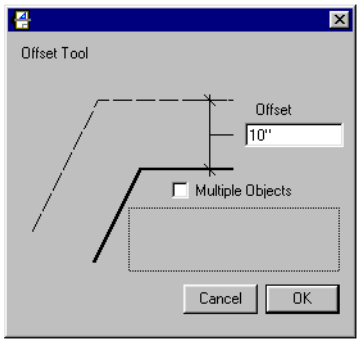
   This changes the class the polygon is in. Choosing a class or layer from the Object Info palette changes the layer or class an **Object is in**. Choosing a layer or class from the pulldowns on the Data Display bar changes the layers or class that you are **currently viewing and drawing in**. This polygon represents the slab.

FLOOR PLAN

In the floor plan you create all the information necessary to build a single floor of a building. We will now use the offset tool to create the first floor perimeter



1. With the polygon still selected, click the **Offset** tool from the Editing palette.
2. Click the **Offset Preference** button.
3. Enter **10"** in the Offset field then click **OK**.



4. Click anywhere outside of the polygon.

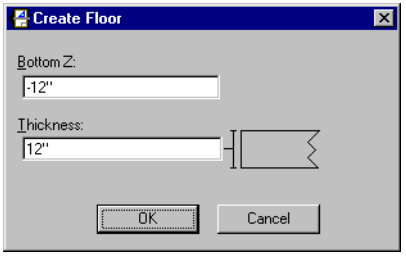
   A new polygon that is 10" wider is created.

5. With the polygon still selected, click the Class pulldown and select **None** in the Object Info. palette.
6. From the Edit menu, select **Cut**.

   This removes the polygon from the drawing and places it in the clipboard.
7. Select the **Resid FloorPlan-1** sheet.

   You are placed in the Mod-Floor-1 layer. The sheet is displayed and its title block shows FloorPlan-1.
8. Select the **Mod-Slab-1** layer from the Layers pulldown in the Data Display bar.
9. Select **Paste in Place** from the Edit menu.

   The polygon is pasted in exactly the same location on the Resid FloorPlan-1 Sheet as it was on the Foundation Plan sheet.
10. From the Model menu, select **Floor**.
11. Enter **-12"** for the bottom Z and **12"** for the thickness.

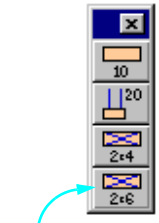


12. Click **OK**.

    A floor is created from the polygon according to your specifications.

Draw the walls

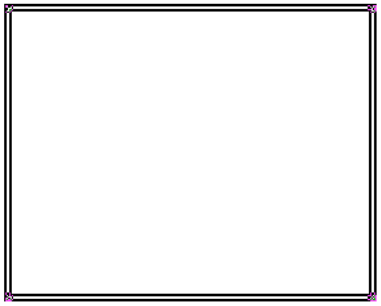
Exterior



Stud 2x6 Wood

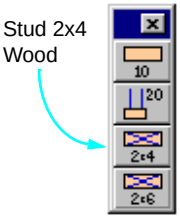
1. Select the **Mod-Floor-1** layer from the Layers pulldown in the Data Display bar.
2. Click the **Wall tool**.
3. Select the **Top Control Line** mode which is the first mode button.
4. Select the **Stud 2x6 Wood** wall style.

5. Trace the polygon by clicking at each corner where the **Point** cue appears.

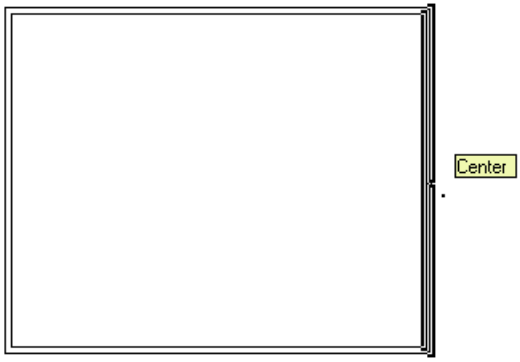


6. Click the **2D Selection** tool to deactivate the Wall Style tool.
7. Select **Save**.

Interior

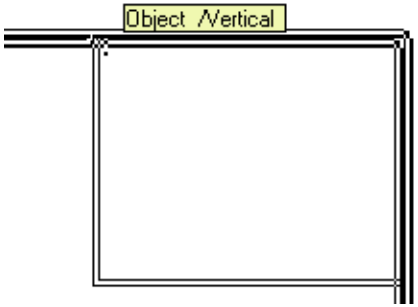


8. Click the **Wall** tool.
9. Click **Center Control Line** mode.
10. Select the **Stud 2x4 Wood** wall style.
11. Bring the cursor near the right hand vertical wall until the wall is highlighted. Use the SmartCursor to find the **Center** cue and thus the center of the wall and click.

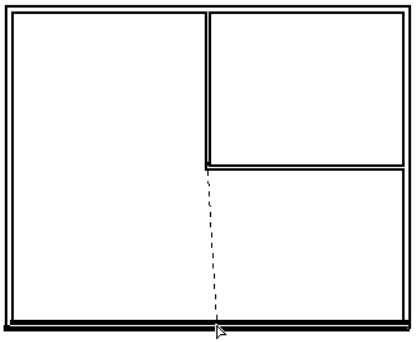


12. Using the L (length) data display bar field, draw a wall **14’6.5”** long from the wall into the house.
13. Draw a vertical wall upwards until the top horizontal wall is highlighted and click.

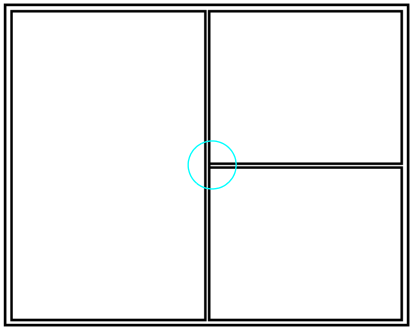
The highlight signifies that the walls will join correctly. Also note the Object/Vertical cue.



14. Click the **Wall Join Tool**. Make sure that the Standard Wall Join mode is on in the Mode bar. Click anywhere on the interior vertical wall and drag towards the bottom exterior wall until it is highlighted and click. Notice that a feedback segment is shown.



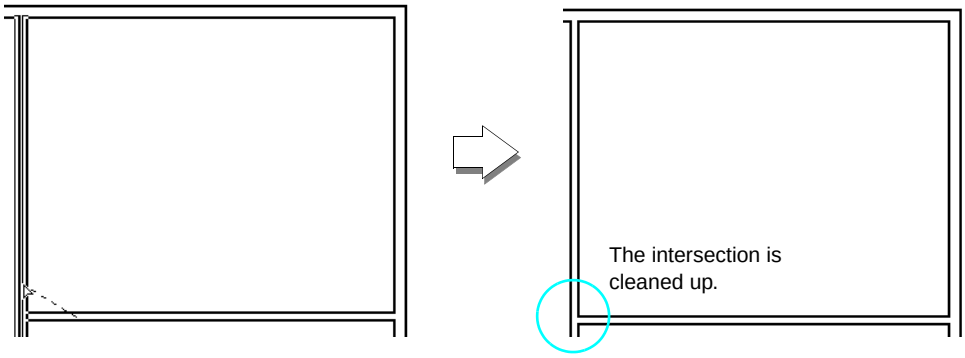
The short vertical wall is extended the full width of the house and is joined correctly at top and bottom. The interior connection has been changed and needs to be joined.



15. Click the **Wall Join Tool** and drag from the interior vertical wall to the interior horizontal wall.

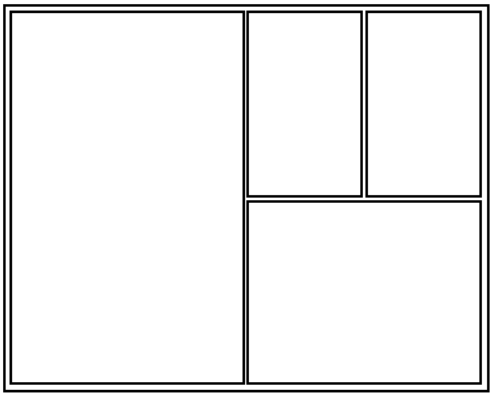
    The intersection that was broken is cleaned up.

With the Wall Join tool, click on the interior horizontal wall and then drag to the interior vertical wall.



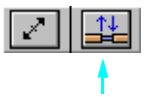
16. Click the **Stud 2x4 Wood** wall style.
17. Bring the cursor near the horizontal interior wall until the wall is highlighted. Use the SmartCursor to find the **Center** cue and thus the center of the wall and click

18. Using the Vertical cue, draw a vertical wall to the top exterior wall.



19. Click the **2D Selection tool** to deactivate the Wall Style tool.
20. Select **Save**.

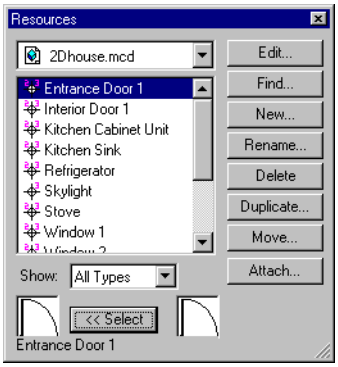
Add Doors And Windows

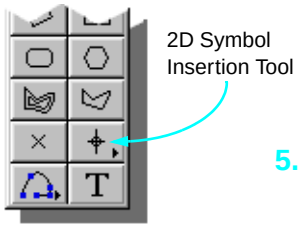


1. Click the 2D Selection tool and ensure that **Enable Wall Insertion** mode is on in the Data Display bar.
2. From the **Resource** palette, select the file **2Dhouse.mcd** (this file) from the bottom of the file tree list.
3. Click the **Entrance Door 1** symbol.

   The symbol appears in lower right window of the Resource palette.
4. Click the **Select** button.

Notice that a representation of the door is shown in the lower left window. This indicates that the symbol is now active and ready to be placed in your drawing.

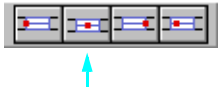




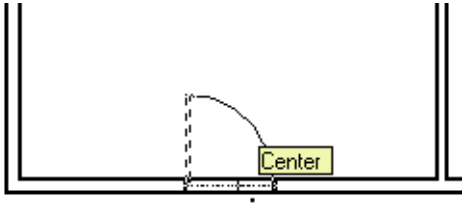
5. Click the **Symbol** tool.

   As you bring the cursor into the drawing area an outline of the selected symbol appears, becoming part of the cursor.

6. Change the insertion point to **Center**, the 2nd symbol insertion mode button.



7. Move the cursor along the bottom exterior wall of the room to the left. When the **Center** cue appears, click.



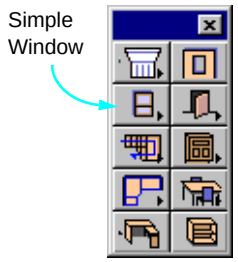
   The symbol is placed and can now be oriented.

8. Orient the symbol so that the arc faces the left ruler and click.

   This creates a left handed inward swinging door.

9. Move the cursor away from the wall to see the inserted symbol.

10. Choose the **Interior Door 1** symbol from the Resource Palette and make it active.



11. Place it at the **Center** of the horizontal interior wall of the room to the right as a left hand inward swinging door.
12. Using this same symbol place a door at the **Center** of the bottom vertical interior wall as a right hand inward swinging door.
13. Select the **Simple Window** Plug-In tool from the AEC palette.
14. Click on the **Simple Window Preferences** button in the mode bar.
15. Enter the parameters exactly as shown in the picture below.

    Config: Double Hung

    Width: 3'0"

    Height: 4'0"

    Elevation: 2'8"

    Offset: 0"

    Casing Face: 2"

    Casing Depth: 5"

    Use Wall Depth: leave unchecked

    Sash Thk: 2"

    Draw WallLines: leave unchecked

    Has Sill: leave unchecked

    Has Trim 1: leave unchecked

    Has Trim 2: leave unchecked

    Draw 3D Detail: leave checked

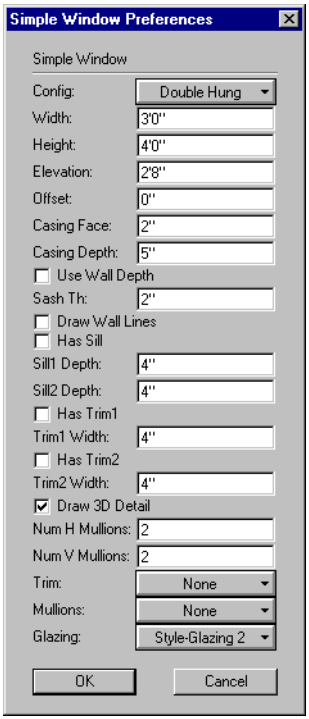
    Num H Mullions: 2

    Num V Mullions: 2

    Trim: None

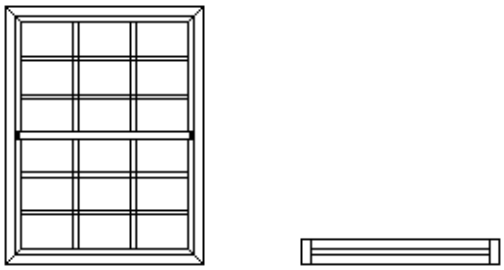
    Mullions: None

    Glazing: Style-Glazing 2



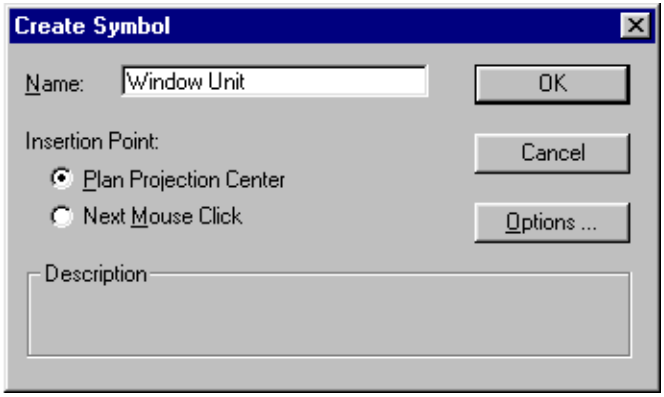
16. Click **OK**.

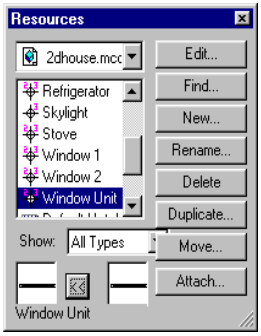
17. Place the window on screen by double clicking on a blank area in the drawing.



Front View Top View

18. With the newly created window selected, select **Create Symbol** from the Organize menu.
19. In the dialog that appears, name the symbol **Window Unit**. Use the defaults for the rest of the symbol creation options.



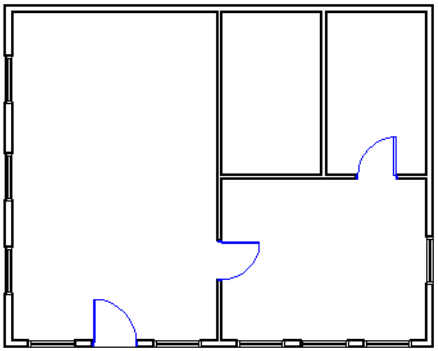


20. Click **OK**.
21. In the Resource palette select the new window symbol and make it active.
22. Click the **Symbol Insertion Tool**.
23. On the bottom exterior wall to the right of the door, locate the **Center** cue and click twice.

    The first click sets the location and the second the orientation.

Note: VectorWorks has redefined the center caused by the break in the wall where the door was placed.

24. Continue to place the windows, centered, for as many as shown in the illustration.



25. Select **Save**.

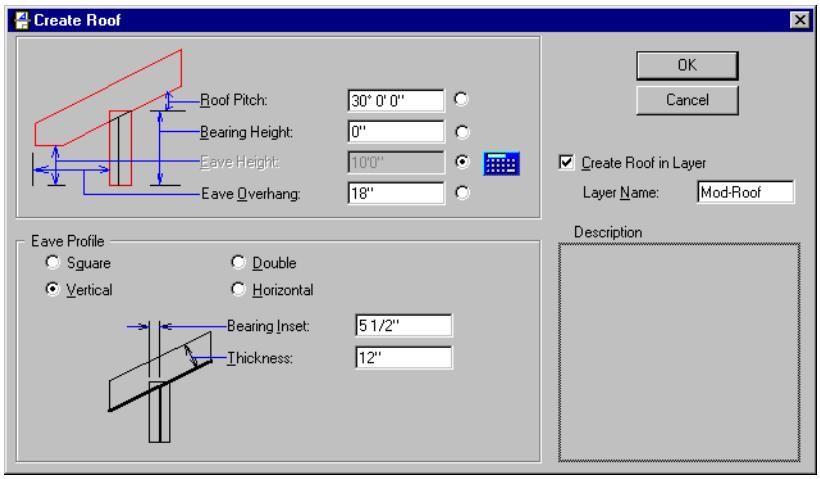
ROOF PLAN

There are many types of roofs and methods to place them. We will create a gable roof from the walls already in your drawing.

1. Use Marquee selection to select all the walls.
2. Select **Create Roof from Walls** from the AEC menu.

   The Create Roof dialog appears.
3. Enter **18"** in the **Eave Overhang** field. Enter **0"** in the **Bearing Height** field.
4. Click the **Vertical** radio button at the top of the Eave Profile section.
5. Enter 12" in the **Thickness** field

6. Enter **Mod-Roof** in the Layer Name field..

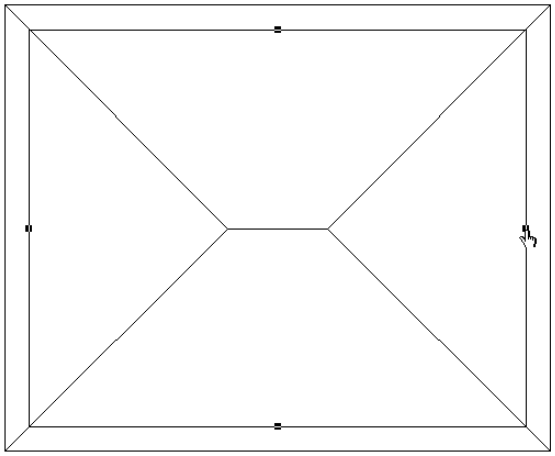


7. Click **OK**.

   The roof is placed in the Mod-Roof layer upon creation and this layer is now the active layer.

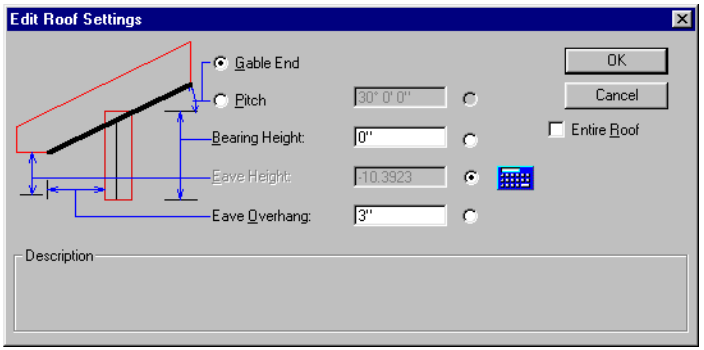
Note: In order for the roof to be created properly, all walls must be joined correctly.

8. Select the roof.
9. Place the cursor over the right selection handle until a hand cursor appears and click.



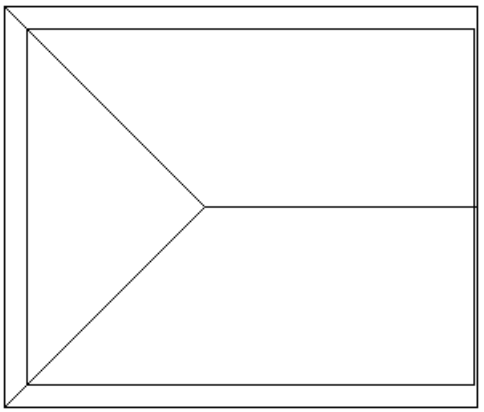
The Edit Roof dialog appears.

10. Click **Gable End** in the Edit Roof Settings dialog
11. Enter **3"** in the eave overhang field.



12. Click **OK**.

The hip roof section right is made into a gable with a 3" overhang.

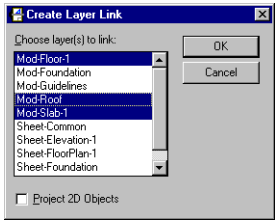


13. Select **Save**.

FRONT ELEVATION

Elevations are orthographic projections which show one side of your design. The design should be as complete as possible before you create elevations. We will create a Front Elevation, although elevations can be created from any view.

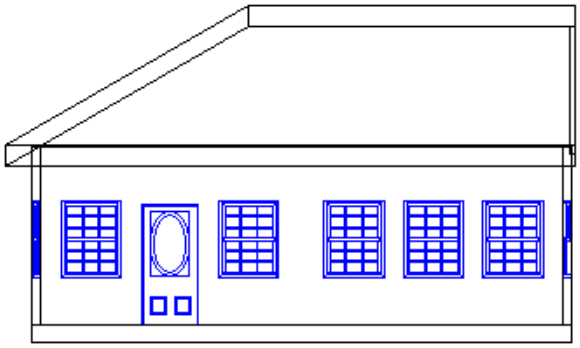
1. Select the **Elevations-1** sheet.



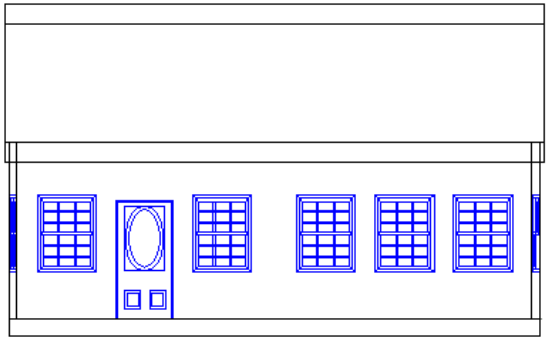
You are placed in the Mod-Elevation-1 layer. The title block shows Elevation-1.

2. Select **Create Layer Link** from the View menu and choose the Mod-Floor-1, Mod-Slab-1, and Mod-Roof layers.
3. Click **OK** on Windows/ **Link** on the Macintosh.
4. Select **Front** from Standard Views in the View menu.

   The elevation (in wireframe) is displayed.

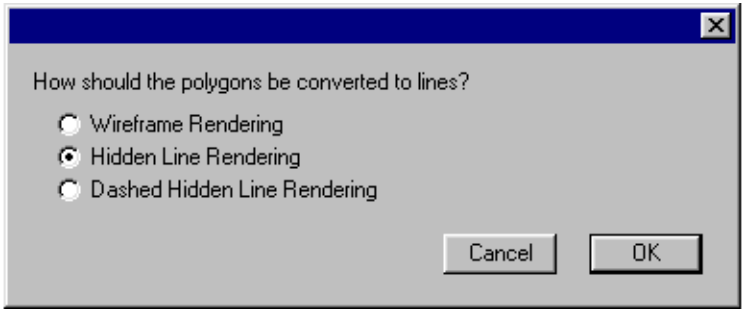


5. Select the **Roof Plan** sheet.
6. Switch to the **Mod-Roof** layer.
7. Place the cursor over the left selection handle on the roof until a hand cursor appears and click.
8. Click **Gable End** in the Edit Roof Settings dialog
9. Enter 3" in the eave overhang.
10. Click **OK**.
11. Switch to the **Elevations-1** sheet to view your change.



Editing the Elevation

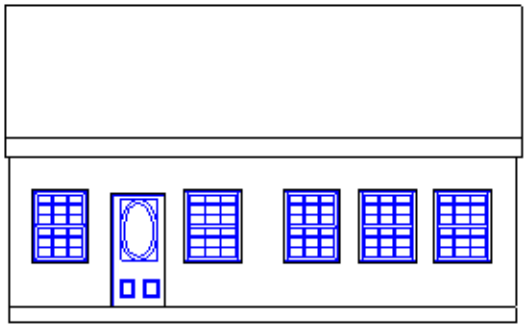
12. Marquee select everything on the Elevation sheet.
13. Select **Convert Copy to Lines** from the Tool menu.
14. Select **Hidden Line Rendering**.

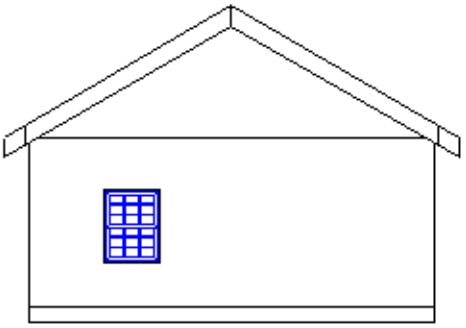


15. Click **OK**.
16. Select **Right** from Standard Views in the View menu.

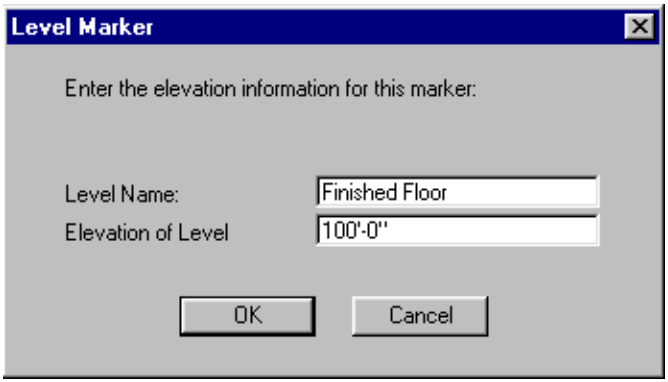
    Move the Front Elevation over to the left if necessary, to see both images clearly. To do this, click and drag the Elevation to one side.
17. Marquee select the Side Elevation view of the house.
18. Select **Unlock** from the Edit menu.
19. Select **Convert to Lines** from the Tool menu.
20. Select **Hidden Line Rendering**.
21. Click **OK**.

    The unlocked layer link will be converted into a grouped set of lines. They can be ungrouped and then manipulated as individual pieces.

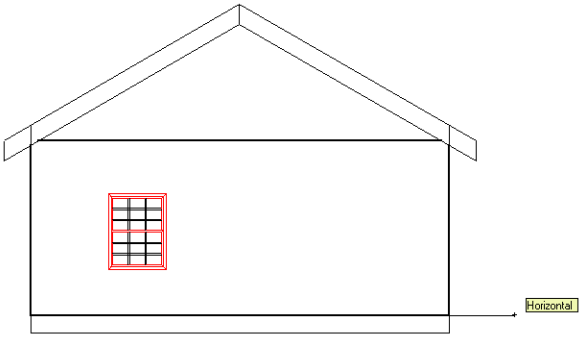




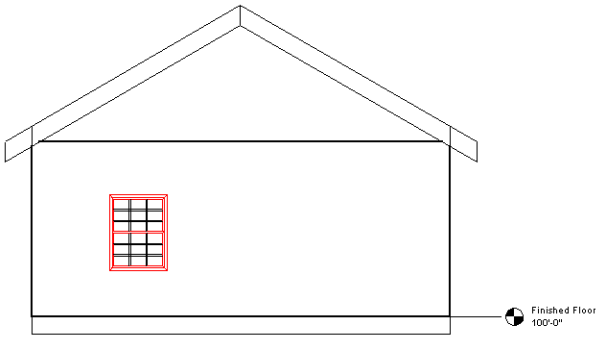
22. Select **Top/Plan** from Standard Views in the View menu.
23. Select **Sheet-Elevation-1** from the Layers menu.
24. Select **Level Marker** from Create Markers in the AEC menu.
25. Enter **Finished Floor** in the Level Name field and **100’-0"** in the Elevation field.



26. Place the Level Marker as shown.

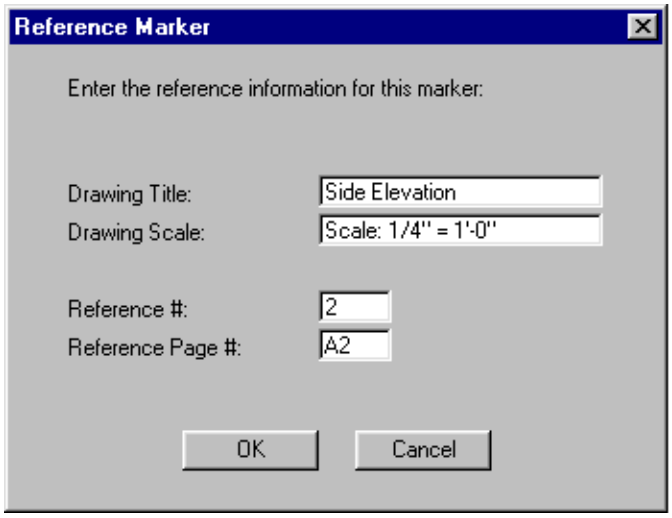


Click on the point you want to start the marker. Drag to and click on the point you want to end the marker.

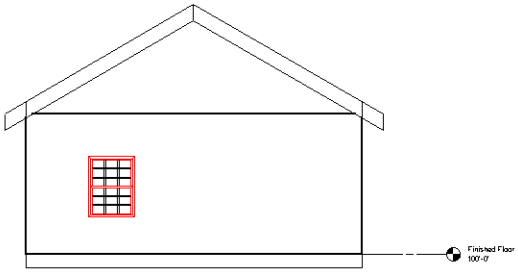


27. Select **Reference Marker** from Create Markers in the AEC menu.

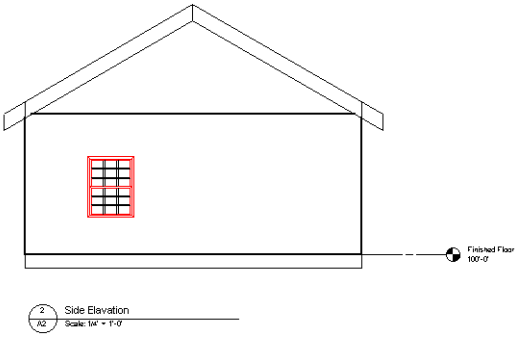
28. Enter **Side Elevation** in the Drawing Title field, **2** in the Reference # field, and **A2** in the Reference Page # field. The program automatically senses the Drawing Scale and enters it for you.



29. Place the Reference Marker as shown.



Click on the point where you want to place your marker.



30. Select **Save**.

ANNOTATIONS AND DIMENSIONS

For this exercise we place annotations, dimensions and finishes last. This ensures a clean process for creating the plans in this exercise.

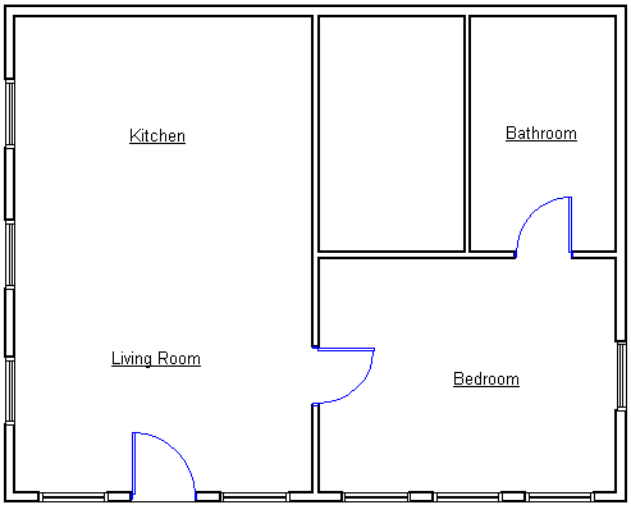
Annotations

1. Select the **Resid Floor Plan-1** sheet.
2. Select **Sheet-FloorPlan-1** from the Layers pulldown in the Data Display bar.
3. Select **Room Name** from Create Markers in the AEC menu.

   Use this command to create the names for each room.
4. Enter **Living Room** in the Room field.

5. Click **OK**.
6. With the bulls eye cursor, click in center of the Living Room to place the name.

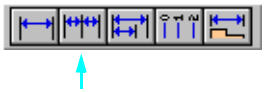
7. Finish naming each room using the Room Name command as shown below.



Note: General notes are added using the Text tool.

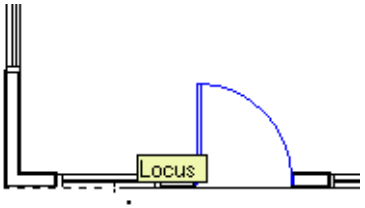
Dimensions

1. Open the **Dimensioning palette**.
2. Click the **Constrained Linear Dimensioning Tool.**
3. Click the **Constrained Chain Dimension** mode, which is the second mode button.

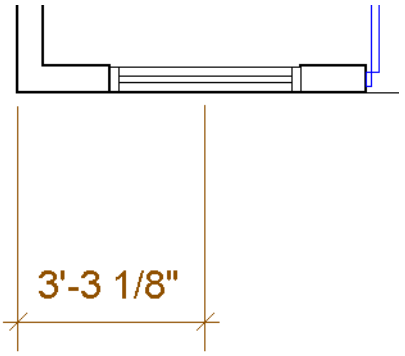


4. Move the cursor towards the lower left corner of the exterior walls and when the **Point** cue appears, click.

5. Trace the wall segment to the center of the first window where the **Locus** cue appears and click.



6. Move the cursor down and away from the wall until delta Y is about -4 feet and click.



7. Click on the **Locus** cue for the center of each window and door along that wall to dimension.
8. At the end of the wall double-click to end the chain dimension.

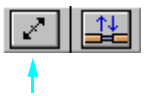
Repeat for the other walls, if desired.

Note: Dimensions are placed in the dimension class by the program.

REVISING YOUR DESIGN

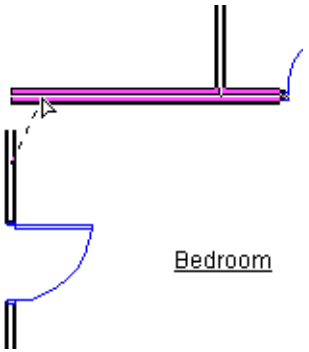
A design is rarely perfect the first try. It is important to know how to go back and modify what you've done. Here we will make some modifications to our interior walls, add some kitchen appliances and put in a skylight.

Move An Interior Wall



1. Switch to the **Mod-Floor-1** layer from the Layers pulldown in the Data Display bar.
2. Click the 2D Selection tool and ensure that **Enable Interactive Scaling** mode is on in the Data Display bar.
3. Click the vertical wall that separates the living room from the bedroom.
4. Click on the handle at the top of the wall and drag the wall down and just past the horizontal interior wall.
5. Click the Wall Join tool to join the interior vertical wall to the interior horizontal wall.

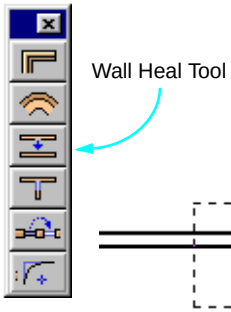
6. Click anywhere on the interior vertical wall and drag towards the interior horizontal wall until it's highlighted and click.

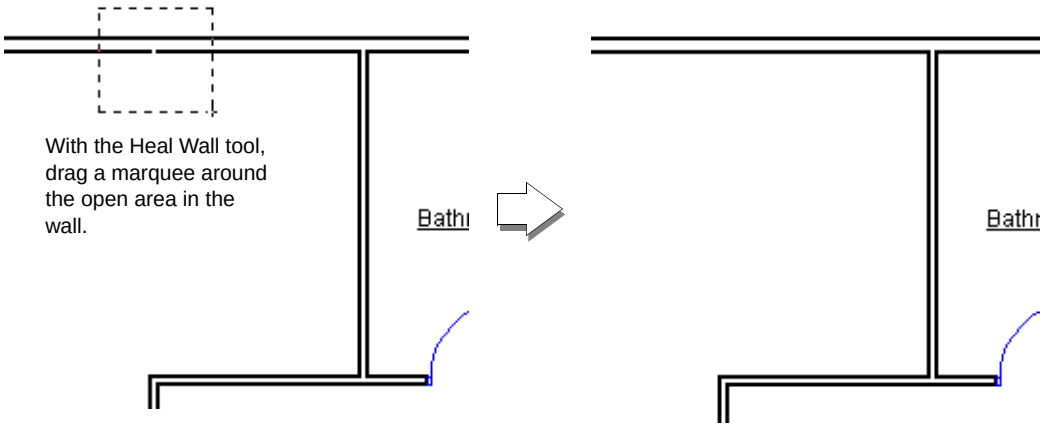


7. Select the **Wall Heal** tool.

   The Wall Heal tool cleans up old intersections and unjoins walls.

8. Drag a marquee around the open area along the top exterior horizontal wall.

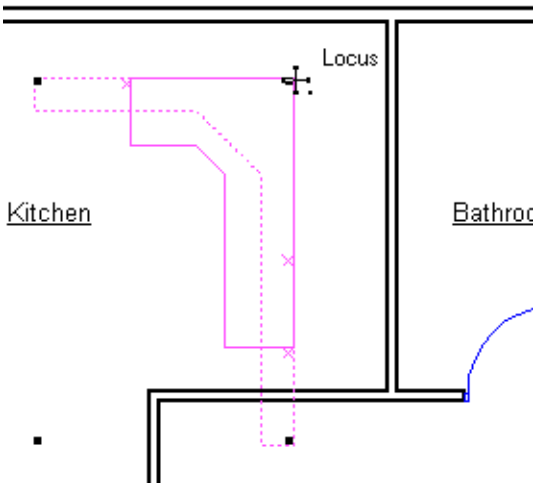


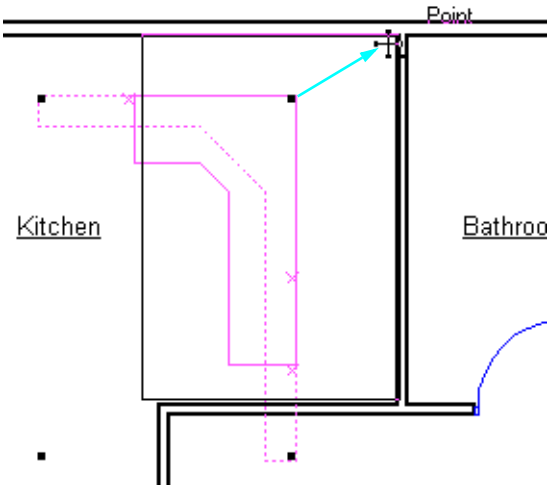


Adding Kitchen Symbols

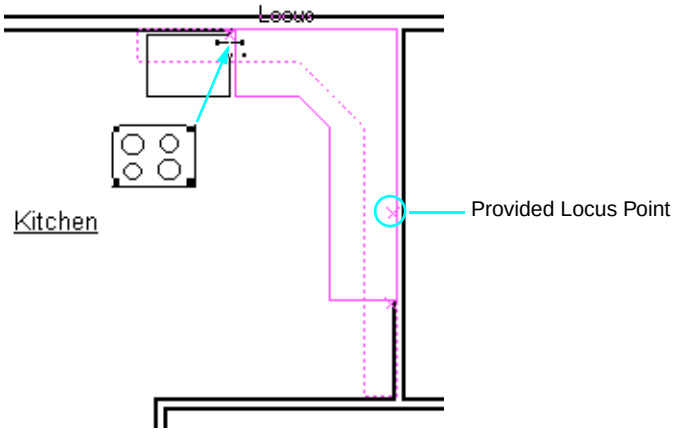
1. In the Resources palette, select the **Kitchen Cabinet Unit** symbol and make it active.
2. Click the **2D Symbol Insertion tool**.
3. Click on the drawing area near the corner of the Kitchen.
4. Click the **2D Selection tool**.
5. If on, deselect the **Enable Wall Insertion Mode**.
6. Click on the upper right corner of the Kitchen Cabinet Unit symbol and drag the symbol to the upper inside corner of the kitchen. Release when the **Point** cue appears.

Click and drag the symbol to the desired location. Uses the cues to help snap the symbol into place.

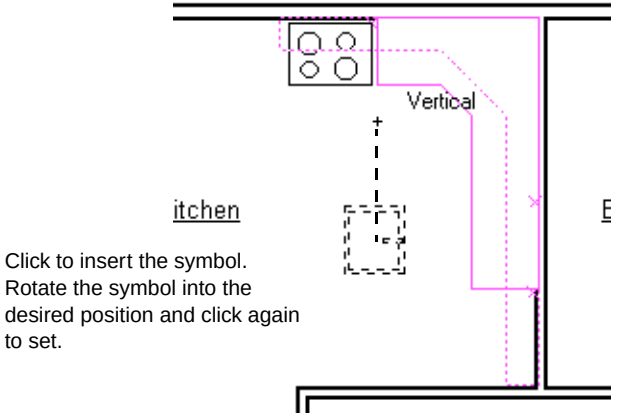




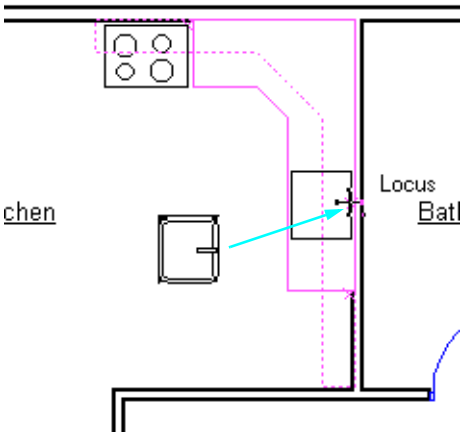
7. Select the **Stove** symbol from the Resource Palette and make it active.
8. Click the **2D Symbol Insertion tool**.
9. Double click on the drawing area near the Kitchen Cabinet Unit symbol.
   This places an instance of the symbol on screen
10. Click the **2D Selection tool**.
11. Drag the Stove symbol to the provided locus point.



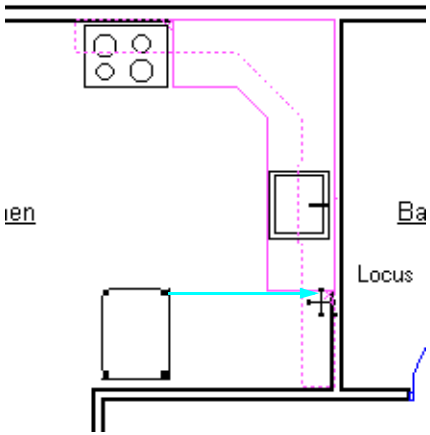
12. Select the **Kitchen Sink** symbol from the Resource Palette and make it active.
13. Click the **2D Symbol Insertion tool**.
14. Click on the drawing area near the Kitchen Cabinet Unit symbol.
15. Rotate the Kitchen Sink symbol until it faces left. Click to set the symbol's direction.



16. Click the **2D Selection tool**.
17. Drag the symbol as shown to the provided locus point.



18. Select the **Refrigerator** symbol in the Resource Palette and make it active.
19. Click the **2D Symbol Insertion tool**.
20. Double click on the drawing area near the Kitchen Cabinet Unit symbol to place.
21. Drag the symbol as shown to the provided locus point.



22. Select the **Kitchen Cabinet Unit** symbol in your drawing.
23. Select **Send to Back** from Send in the Tool menu.

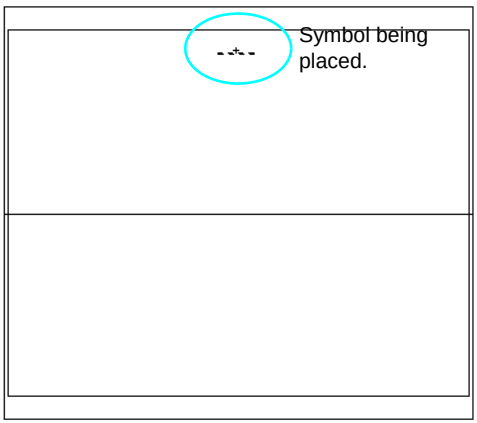
24. Select **Save**.

Adding a Skylight

1. Select the **Roof Plan** sheet.

   You are now in the Mod-Roof layer.

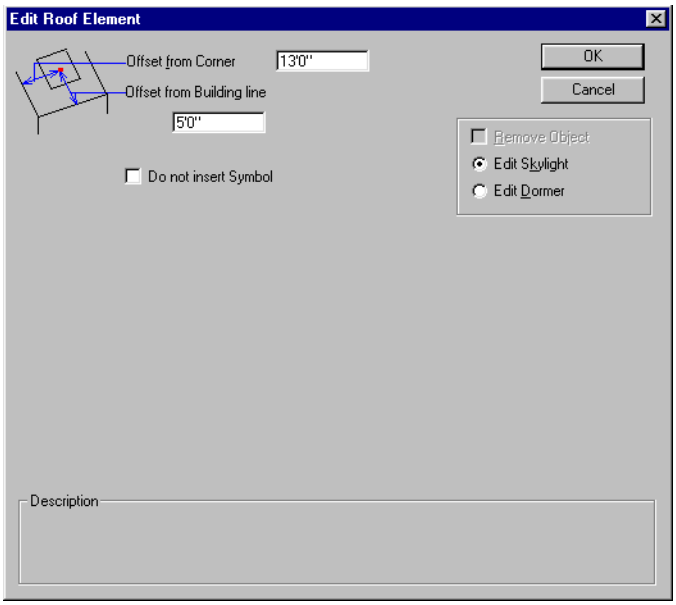
2. In the Resources palette, select the **Skylight** symbol.
3. Insert the skylight symbol on the rear of the building's roof (center toward the edge of the roof) as shown.



   The Edit Roof Element dialog appears.

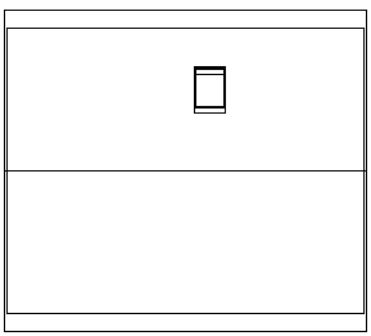
4. Click the **Edit Skylight** radio button.
5. Enter **13'0"** in the Offset from Corner field.

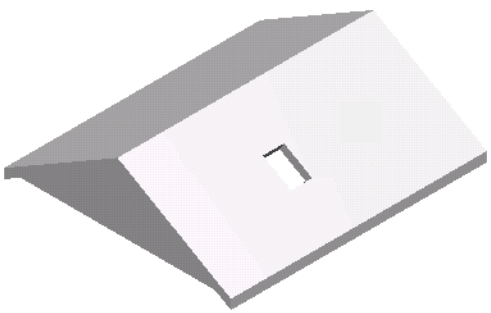
6. Enter **5'0"** in the Offset from Building Line field.



7. Click **OK**.

   The skylight opening is created in the roof.



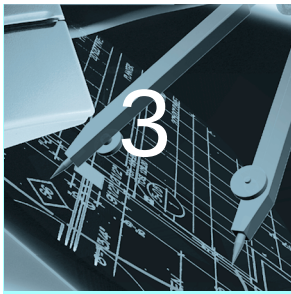


CONCLUSION

Congratulations! You have completed a 2D design in VectorWorks. Throughout this exercise you have used a combination of tools and techniques. Although this was an architecturally based exercise, you can use these same tools and techniques and apply them to any drawing task.

The remainder of this module contains exercises which will use and build upon the work you have done to complete this exercise.

Spreadsheets in VectorWorks



In this Exercise

- **Creating a Worksheet**
- **Estimating Cement Needed**
- **Estimating Paint Needed**
- **Estimating Totals**
- **Placing a Worksheet on the Drawing**

In this example we will create a worksheet which uses VectorWorks's spreadsheet capabilities. We will determine how many cubic yards of concrete are needed to pour the slab and how many gallons of paint are needed to paint the interior of the house. The completed file is located in Learning Exercises and is entitled Spreadsheet_Sample.mcd. It may be used as a reference while drawing.

SETUP

Since we are using the file created in the 2D Drafting exercise we do not need use the Setup Assistant. There are a few procedures we still need to do though.

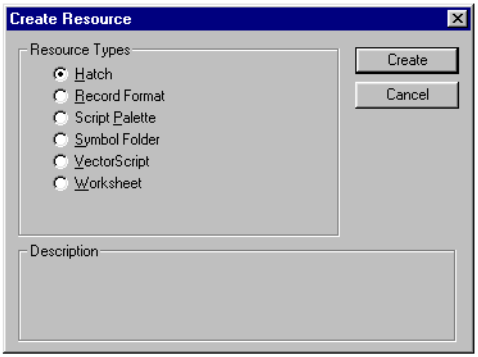
1. Open **2D_House_Sample.mcd** from the Learning Exercises folder in your VectorWorks Toolkit.
2. Select **Fit to Window**.
3. Select **Save As** and name the file **Spreadsheet.mcd**.
4. Select **Sheet-FloorPlan-1** from the Layer pulldown in the Data Display bar.

CREATE THE WORKSHEET

We will create a worksheet that can then be formatted to obtain the desired results.

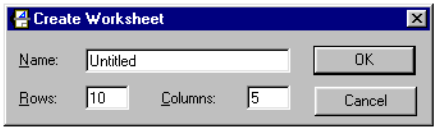
1. Select **Resources** from the Palettes menu.
2. Click the **New** button located on the right side of the palette.

The Create Resource dialog box appears.



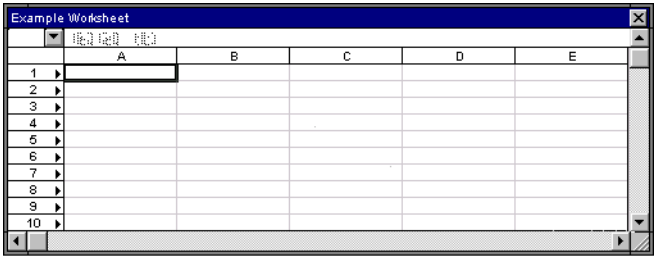
3. Click the **Worksheet** radio button.
4. Click **Create**.

   The Create Worksheet dialog box appears.



5. Enter **Example Worksheet** for the name of the worksheet. Accept the default settings for the number of Rows and Columns for the worksheet.
6. Click **OK**.

   Your new blank worksheet and the worksheet dialog box appears in the Drawing Area.



   You can now assign names and functions to your columns, as well as select whether you want individual rows to be spreadsheet or database rows.

7. Select **Save**.

FORMAT COLUMNS AND ROWS

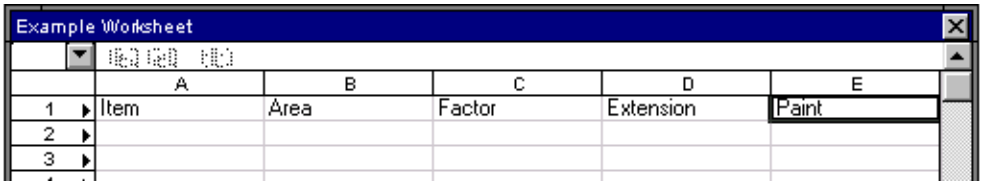
Tip: *If you make a mistake while entering data into the Worksheet Entry dialog box, click the X button to erase it.*

Once the worksheet is created you need to format the rows and columns that you have created. It is at this time that you make the worksheet look like you want, including adding headers to the columns and rows. VectorWorks worksheets are similar to Microsoft® Excel spreadsheets when considering formatting rows, columns and cells. The cell is selected by clicking, but data can only be entered in the Worksheet Entry dialog box.

1. Click Column A, Cell 1 (**A1**).
2. In the Worksheet Entry dialog box enter **Item**.

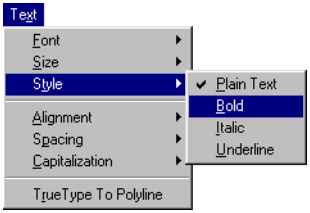
3. Click the **check mark** on the Worksheet Entry dialog box to confirm.
4. Click B1 and enter **Area**. Click the check mark.
5. Click C1 and enter **Factor**. Click the check mark.
6. Click D1 and enter **Extension**. Click the check mark.
7. Click E1 and enter **Paint**. Click the check mark.

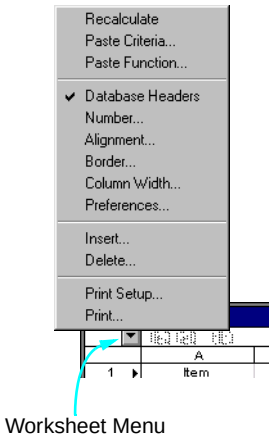
   All of your headers are now added.



8. Click **A1** and drag to **E1** to select all five cells.
9. Select **Style** then **Bold** from the Text menu.

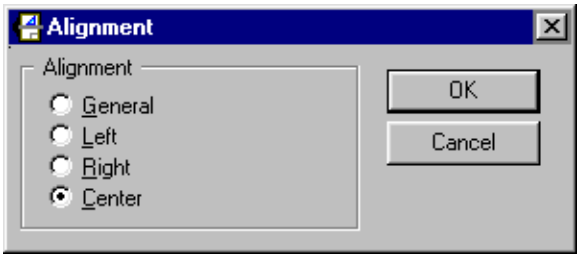
   This simultaneously formats all five cells to have a bold type face.



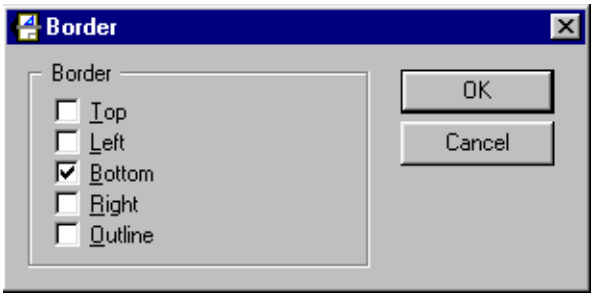


Worksheet Menu

10. With the cells still highlighted, click the down arrow button at the top left corner of the worksheet window. This brings up the Worksheet Menu. Select **Alignment**.
11. Click **Center**.



12. Click **OK**.
13. With the cells still highlighted, select **Border** from the Worksheet Menu.
14. Click **Bottom**.



15. Click **OK**.
16. Select **Save**.

ESTIMATING CONCRETE NEEDED

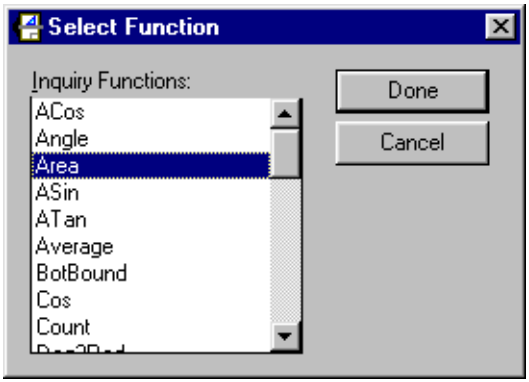
There are many ways to calculate data in VectorWorks worksheets. To calculate the amount of concrete needed to pour the slab of our four room house, you will use a combination of spreadsheet capabilities.

Note: All formulas must begin with the equals sign (=).

1. Click **A3** and enter **Basement Slab**. Click the check mark.
2. Click **B3** and enter = in the Worksheet Entry dialog box.

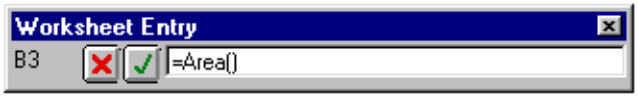
The equal sign indicates the beginning of a formula which VectorWorks will use to calculate the result instead of entered text.

3. Select **Paste Function** from the Worksheet Menu.
4. Select **Area**.

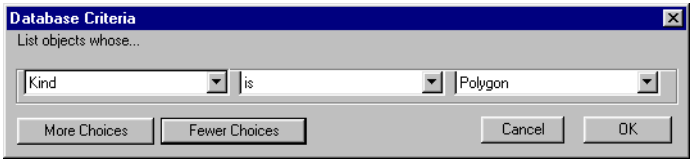


5. Click **Done**.

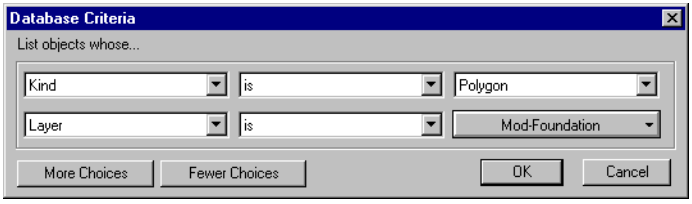
The Worksheet Entry dialog box is now updated to show the Area function.



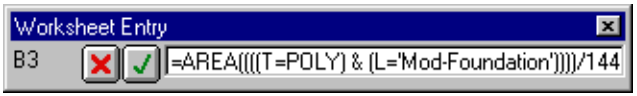
6. Select **Paste Criteria** from the Worksheet Menu.
7. Select **Kind /is /Polygon** from the 3 pulldown menus.



8. Click **More Choices**.
9. Select **Layer /is /Mod-Foundation**.



10. Click **OK**.
11. Click at the end of the formula in the Worksheet Entry dialog box and enter **/144**.

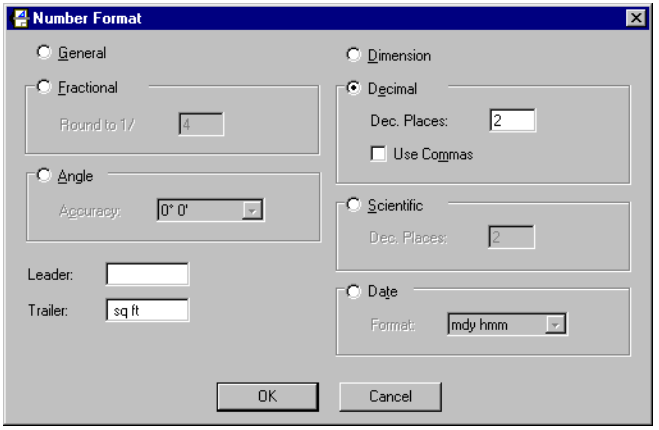


We divide by 144 to represent square feet instead of square inches.

12. Click the check mark.

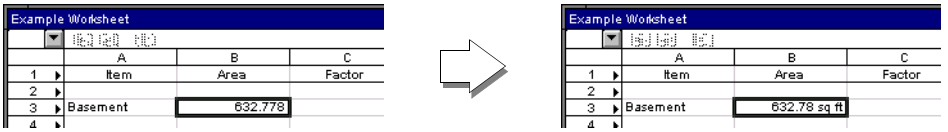
The Area function calculates the total area of all polygon objects in the Foundation layer and places it in the cell.

13. With the cell still selected, select **Number** from the Worksheet Menu.
14. Click **Decimal**.
15. Enter **2** in Dec. and **[space key]sq ft** in Trailer.



This does not change the value in the cell. It instead modifies the way the information in the cell is displayed.

16. Click **OK**.



17. Click **C3** and enter **4"**. Click the check mark.

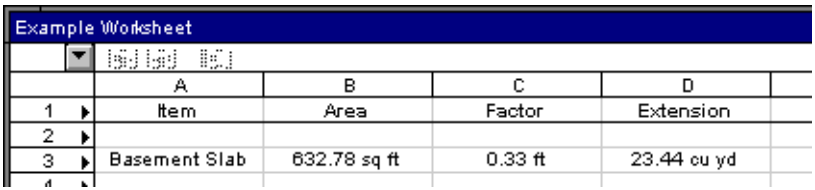
The quotation indicates inches. This is the thickness of your slab.

18. With the cell still selected, select **Number** from the Worksheet Menu.

19. Click **Decimal**.
20. Enter **2** in Dec. and **[space key]ft** in Trailer.
21. Click **OK**.
22. Click **D3** and enter **= B3*C3/9**.

    After typing in the equals sign (=), you can simply click in the cell that you want to add to the equation rather than typing in the dialog box.
23. Click the check mark.

    The value of cubic yards of concrete needed to pour the slab is placed in cell D3.
24. With the cell still highlighted, select **Number** from the Worksheet Menu.
25. Click **Decimal**.
26. Enter **2** in Dec. and **[space key]cu yd** in Trailer.
27. Click **OK**.



28. Select **Save**.

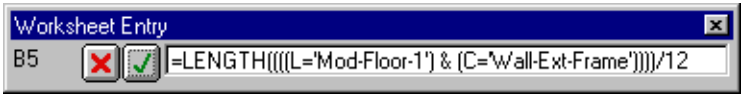
ESTIMATING PAINT NEEDED

We can estimate the amount of paint in gallons that is needed to paint all of the interior walls of our house using similar worksheet functions.

Estimating The Exterior Walls

1. Click **A5** and enter **Exterior Walls**. Click the check mark.
2. Click **B5** and enter **=** in the Worksheet Entry dialog box.
3. From the Worksheet Menu select **Paste Function**.
4. Select **Length**.
5. Click **Done**.
6. From the Worksheet Menu select **Paste Criteria** and select **Class is Wall-Ext-Frame**.

7. Click **More Choices**.
8. Select **Layer/ is/ Mod-Floor-1**.
9. Click **OK**.
10. Enter **/12** after the formula that appears. Click the check mark.



We divide by 12 to represent feet and inches instead of inches only.

11. With the cell still selected, select **Number** from the Worksheet Menu.
12. Click **Decimal**.
13. Enter **2** in Dec. and **[space key]lin ft** in Trailer.
14. Click **OK**.
15. Click **C5** and enter **10'**.Click the check mark.

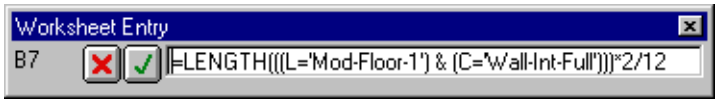
    This is the height of all exterior walls.
16. With the cell still selected, select **Number** from the Worksheet Menu.
17. Click **Decimal**.
18. Enter **2** in Dec. and **[space key]ft** in Trailer.
19. Click **OK**.
20. Click **D5** and enter **=B5*C5**. Click the check mark.

    This is the total linear length of all walls times the height which will yield the square footage.
21. With the cell still highlighted, select **Number** from the Worksheet Menu.
22. Click **Decimal**.
23. Enter **2** in Dec. and **[space key]sq ft** in Trailer.
24. Click **OK**.
25. Click **E5** and enter =**D5/250**. Click the check mark.

    250 is the estimated coverage in square feet of one gallon of paint. This formula divides your square footage referenced by cell D5 by the coverage.
26. With the cell still highlighted, select **Number** from the Worksheet Menu.
27. Click **Decimal**.
28. Enter **2** in Dec. and **[space key]gal** in Trailer.
29. Click **OK.**

Estimating the Interior Walls

1. Click **A7** and enter **Interior Walls**. Click the check mark.
2. Click **B7** and enter **=** in the Worksheet Entry dialog box.
3. From the Worksheet Menu select **Paste Function**.
4. Select **Length**.
5. From the Worksheet Menu select **Paste Criteria** and select **Class is Wall-Int-Full**.
6. Click **More Choices**.
7. Select **Layer/ is/ Mod-Floor-1**.
8. Click **OK**.
9. Click at the end of the formula and enter ***2/12** in the Worksheet Entry dialog box. Click the check mark.

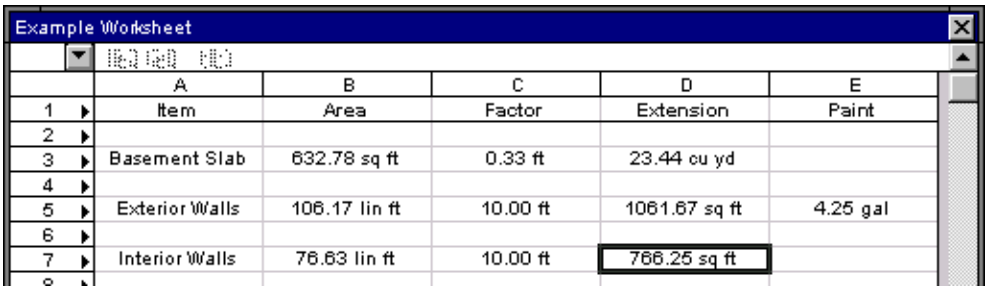


Each interior wall has two sides so the value of linear length is multiplied by 2. We divide by 12 to represent feet and inches instead of inches only.

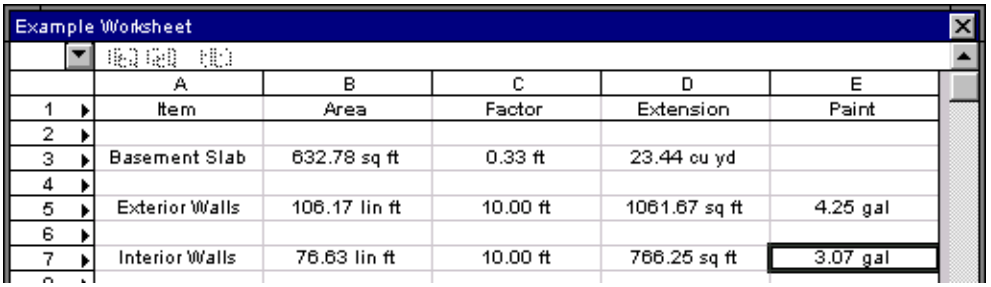
10. With the cell still selected, select **Number** from the Worksheet Menu.
11. Click **Decimal**.
12. Enter **2** in Dec. and **[space key]lin ft** in Trailer.
13. Click **OK**.
14. Click **C7** and enter **10'**. Click the check mark.

    This is the height of all the interior walls.
15. With the cell still selected, select **Number** from the Worksheet Menu.
16. Click **Decimal**.
17. Enter **2** in Dec. and **[space key]ft** in Trailer.
18. Click **OK**.
19. Click **D7** and enter **=B7*C7**. Click the check mark.
20. With the cell still highlighted, select **Number** from the Worksheet Menu.
21. Click **Decimal**.
22. Enter **2** in Dec. and **[space key]sq ft** in Trailer.

23. Click **OK**.



24. Click **E7** and enter =**D7/250**. Click the check mark.
25. With the cell still highlighted, select **Number** from the Worksheet Menu.
26. Click **Decimal**.
27. Enter **2** in Dec. and **[space key]gal** in Trailer.
28. Click **OK**.

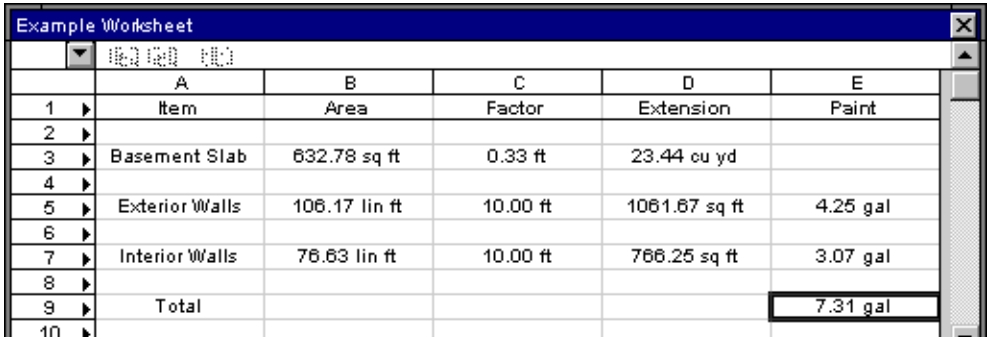


FINDING ESTIMATE TOTALS

Using the information gathered earlier, we can find the total estimated amount of painted need for our house.

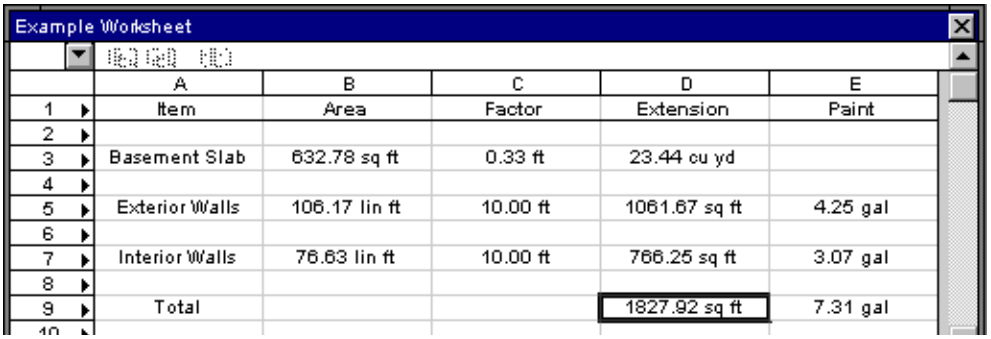
1. Click **A9** and enter **Total**. Click the check mark.
2. Click **E9** and enter **=E5+E7**. Click the check mark.
3. With the cell still highlighted, select **Number** from the Worksheet Menu.
4. Click **Decimal**.
5. Enter **2** in Dec. and **[space key]gal** in Trailer.

6. Click **OK**



7. Click **D9** and enter **=D5+D7**. Click the check mark.

8. With the cell still highlighted, select **Number** from the Worksheet Menu.
9. Click **Decimal**.
10. Enter **2** in Dec. and **[space key]sq ft** in Trailer.
11. Click **OK**.

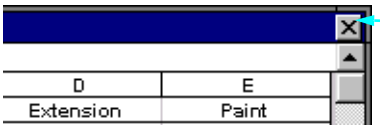


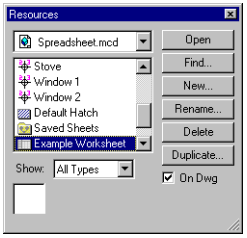
12. Select **Save**.

PLACING ON THE DRAWING

When your worksheet is complete you can place it on your drawing as an object. It can then be moved about just like any other object can be.

1. Close the Example Worksheet by clicking on the close box.



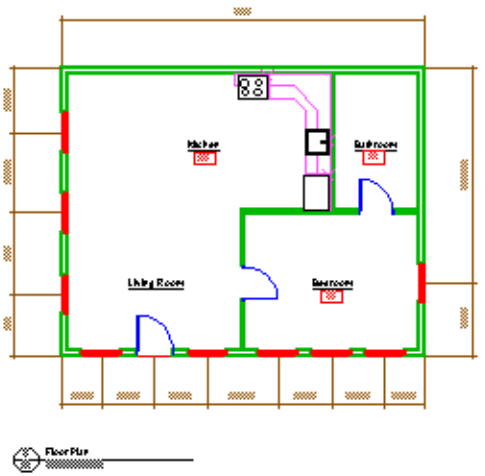


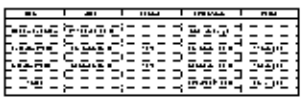
2. In the Resources Palette, click **Example Worksheet**.
3. Click the **On Drawing** checkbox.

   The worksheet is placed on the drawing as an object.

Item	Area	Factor	Extension	Paint
Basement Slab	632.78 sq ft	0.33 ft	23.44 cu yd	
Exterior Walls	106.17 lin ft	10.00 ft	1061.67 sq ft	4.25 gal
Interior Walls	76.63 lin ft	10.00 ft	766.25 sq ft	3.07 gal
Total			1827.92 sq ft	7.31 gal

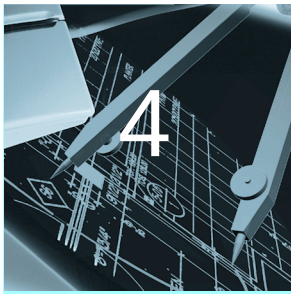
4. Click on the object and move it to the bottom right corner of the drawing area.





5. Select **Save**.

Reports and Schedules



In this Exercise

- **Creating List Reports**
- **Creating Schedule Reports**
- **Recalculating Database record information**

In this example we will create a worksheet which uses VectorWorks's database capabilities. We will create a list of symbols, attach database record information and create a schedule. The completed file is located in Learning Exercises and is entitled Database_Sample.mcd. It may be used as a reference while drawing.

SETUP

Since we are using the file created in the 2D Drafting exercise we do not need to run the Setup Assistant. There are a few procedures we still need to do though.

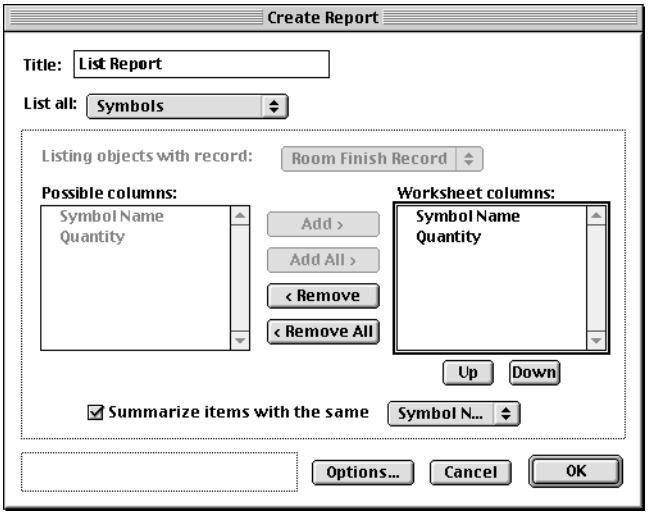
1. Open **2D_House_Sample.mcd** from the Learning Exercises folder in your VectorWorks Toolkit.
2. Select **Fit to Window**.
3. Select **Save As** and name the file **Database.mcd**.
4. From the Layers pulldown, select **Sheet-FloorPlan-1**.
5. From the Palettes menu, open **Object Info**, **Resources**, and **AEC 2D Tools**.

CREATE A LIST REPORT

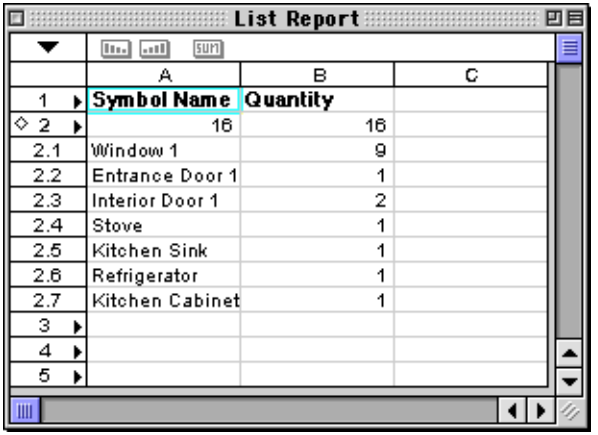
We will create a worksheet that can then be formatted to obtain the desired results.

1. Select **Create Report** from the Organize menu.
2. Enter **List Report** for the title.
3. Select **Symbols** in the List All pop-up.

4. Click **Summarize Items With the Same:.** The **Symbol Name** item in the pulldown list should already be selected.



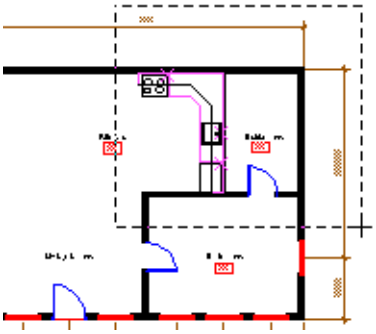
5. Click **OK**.

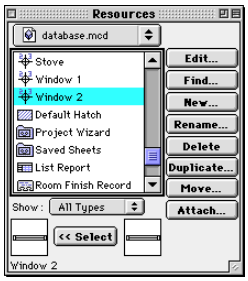


Your new worksheet appears in the Drawing Area. All the symbols are listed and the total quantity for each is displayed. The symbols are listed for the entire drawing not just the ones that you see in the Floor Plan sheet.

Modify the List Report

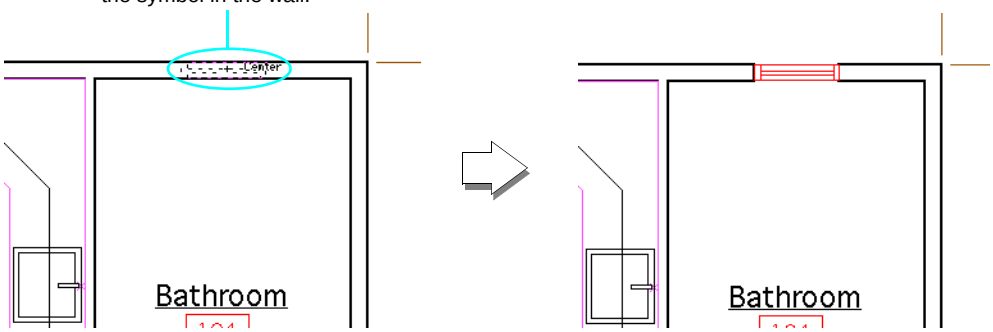
1. Click the **Zoom In Tool**.
2. Drag a marquee around the bathroom and kitchen area.

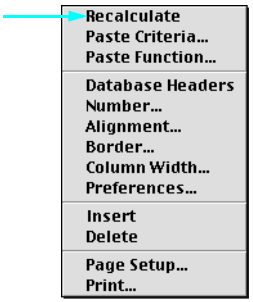




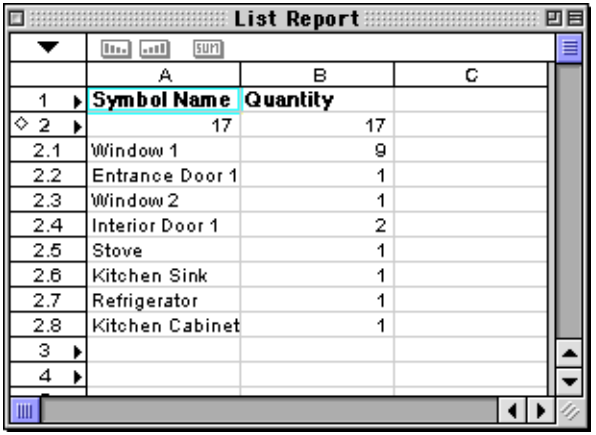
3. From the Resource palette, locate the file **Database.mcd** (this one) from the file tree.
4. Select the symbol **Window 2** and click the Select button to make it active.
5. Select **Mod-Floor-1** from the Layer pulldown in the Data Display bar.
6. Click the **2D Symbol Insertion Tool**.
7. Using the Center cue, place the symbol into the bathroom's top exterior wall.

Using the Center cue, place the symbol in the wall.



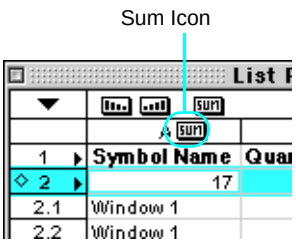


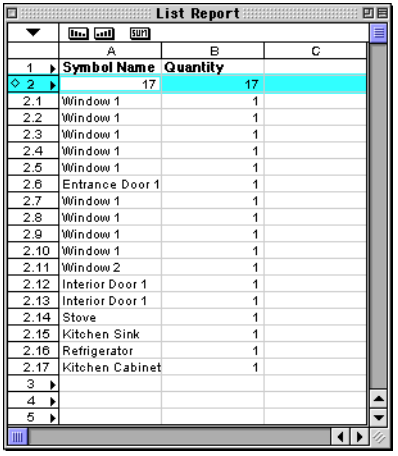
8. Select **Recalculate** from the Worksheet menu.



Window 2 is now added to the worksheet with the value 1.

Note: To get an itemized (not summarized) list, click in row 2 and then drag the **Sum** icon in cell A onto the bar where the other icons are. Move it back to cell A to summarize the list again.





9. Select **Save**.

CREATE A SCHEDULE

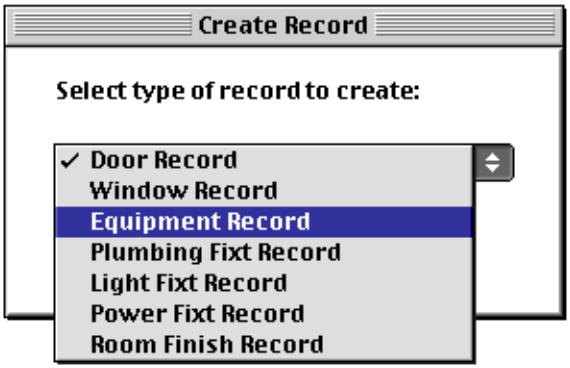
You can create a variety of schedules that use the objects you have already created. By attaching database data to objects you can keep an accurate and up to date record of them.

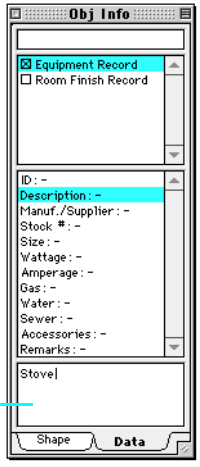
Create an Equipment Schedule

All schedules in the Create Schedule menu are created similarly (except the Room Schedule).

1. Close the List Report worksheet.
2. Select **Create Record** from the AEC Menu.

   The Create Record dialog appears.
3. Select **Equipment Record** from the pulldown list.





Data Entry Area

4. Click **OK**.

   An alert dialog appears informing you that the Equipment Record has been created. Click **OK** to continue.
5. Click the **2D Selection Tool**.
6. Click on the Stove symbol in the kitchen.
7. In the Object Info palette, click the **Data Tab**.
8. Click the checkbox next to **Equipment Record**.

   This automatically attaches that record to the stove symbol.
9. Click the item field called Description in the list and in the data entry area, enter **Stove**.

10. Continue filling out each field as listed below:

Manuf./Supplier: Acme

Stock #: 12345

Size: 22 7/8"D. X 30 1/8"W.

Wattage: -

Amperage: -

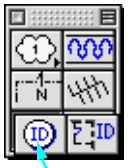
Gas: 1/2"

Water: -

Sewer: -

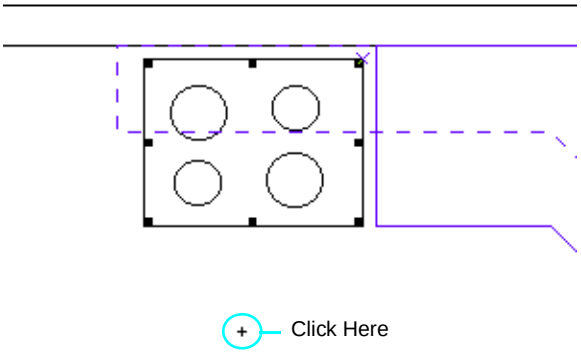
Accessories: -

Remarks: -

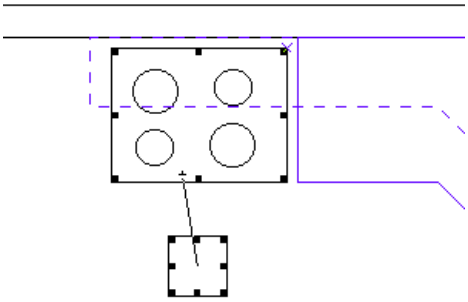


11. From the AEC 2D Tools palette, click the **ID tool.**

12. Click below the stove to place the marker.

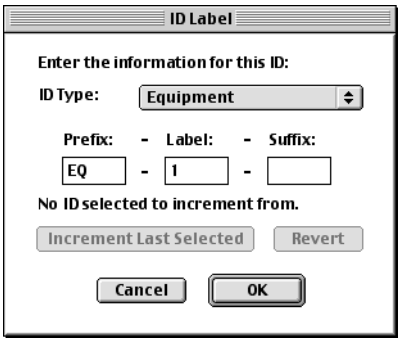


13. Click on the **Stove**.

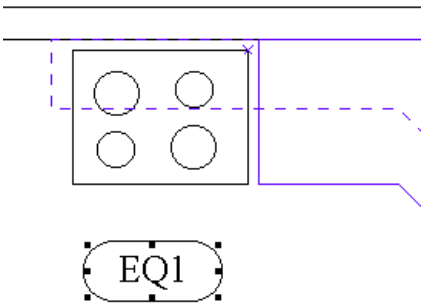


The ID Label dialog appears.

14. Select **Equipment** from the ID Type pulldown. Enter **EQ** in the Prefix field and **1** in the Label field. Leave the Suffix field empty.



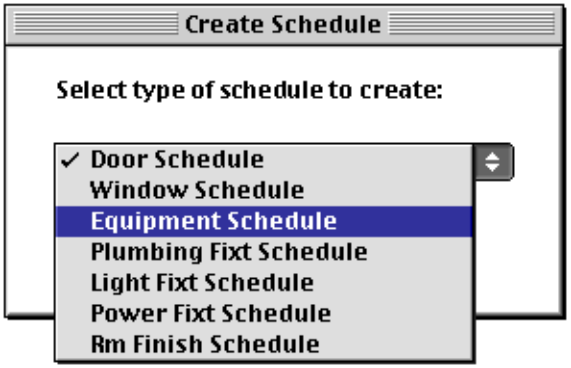
15. Click **OK**.



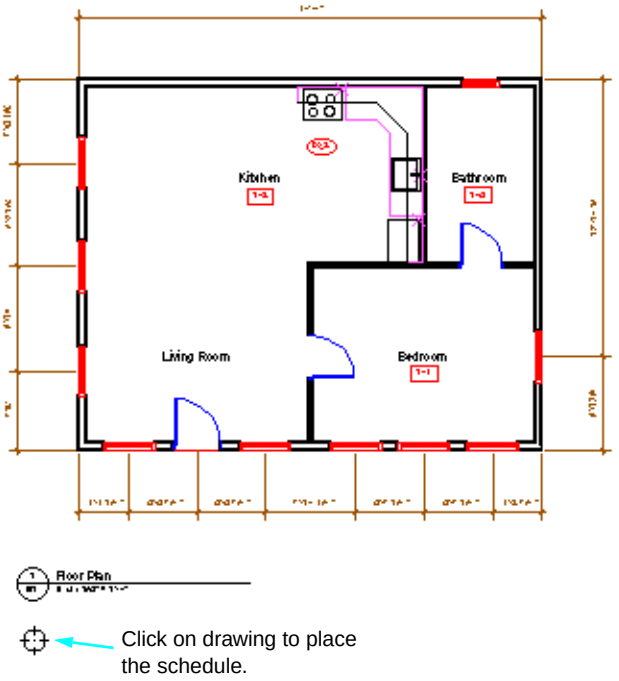
The ID Marker is updated.

16. Click **Fit to Window** on the View Bar.
17. Select **Create Schedule** from the AEC Menu.

    The Create Schedule dialog appears.
18. Select **Equipment Schedule** from the pulldown list.



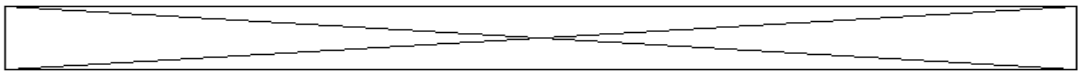
19. Click **OK**.
20. Click on the drawing (as indicated in graphic) to place the schedule on the drawing.



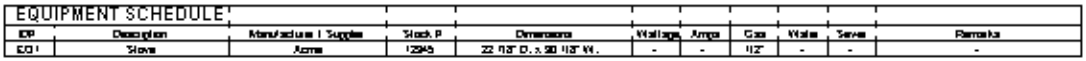
The location of your click represents the top left corner of the schedule placed on the drawing.

21. Close the floating worksheet.

    By closing the worksheet, the on drawing schedule will switch from showing a large X to showing the information from the worksheet.



Schedule on drawing with worksheet open.



Schedule on drawing with worksheet closed.

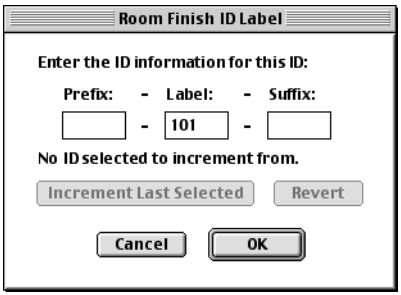
Creating a Room Schedule

Room ID Tool

This method for creating a Room schedule is slightly different than other schedules since it represents an area and not an object.

1. Click the **Room ID** tool.
2. Click below the Living Room text to place the marker.

   The Room Finish ID Label dialog appears.
3. Enter **101** in the Label field. Leave the other fields empty.



4. Click **OK**.
5. In the Object Info palette, click the **Data Tab**.

   The record **Room Finish Record** is already attached to the ID.
6. Click the Room Name field in the list and in the data entry area, enter **Living Room**.

Note: We have pre-filled the information for the other rooms in this file. This will give you an idea of how the entire schedule would typically look.

7. Continue filling out each field as shown.

Floor Finish: Carpet

Base Material: Wood

North Wall Finish: Gyp. Bd.

East Wall Finish: Gyp. Bd.

South Wall Finish: Gyp. Bd.

West Wall Finish: Gyp. Bd.

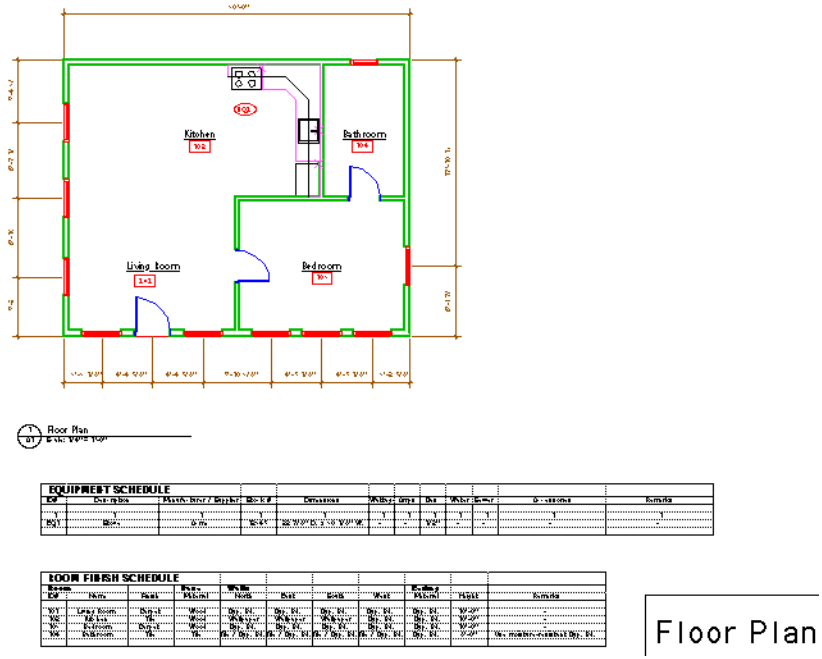
Ceiling Material: Gyp. Bd.

Ceiling Height: 10'-0"

Remarks: -

8. From the AEC Menu, select **Create Schedule**.
9. In the Create Schedules dialog box, select **Rm Finish Schedule** from the pulldown list.
10. Click **OK**.
11. Click under the Equipment Schedule to place.

12. Close the floating worksheet.



Modify Your Schedules

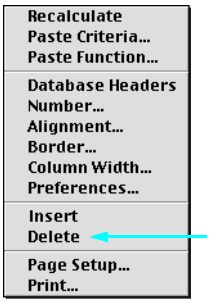
After you've created you schedules you may want to change objects in your drawing or the record data associated with them. Once recalculated, the worksheet will display the correct new information.

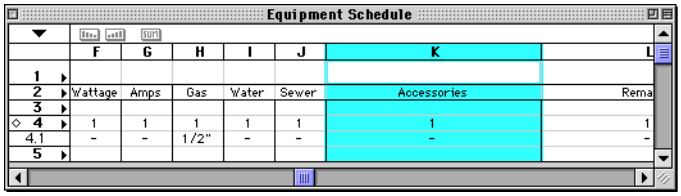
Removing A Database Record Field From Your Worksheet.

1. In the Resource palette, highlight the **Equipment Schedule**.
2. Click the **Open** button.
3. Scroll over to column K and click the **K** cell.

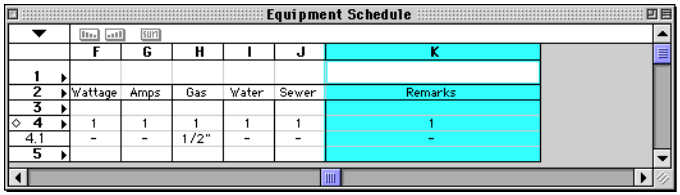
   The entire column is highlighted.

4. Click on the worksheet menu and select **Delete**.



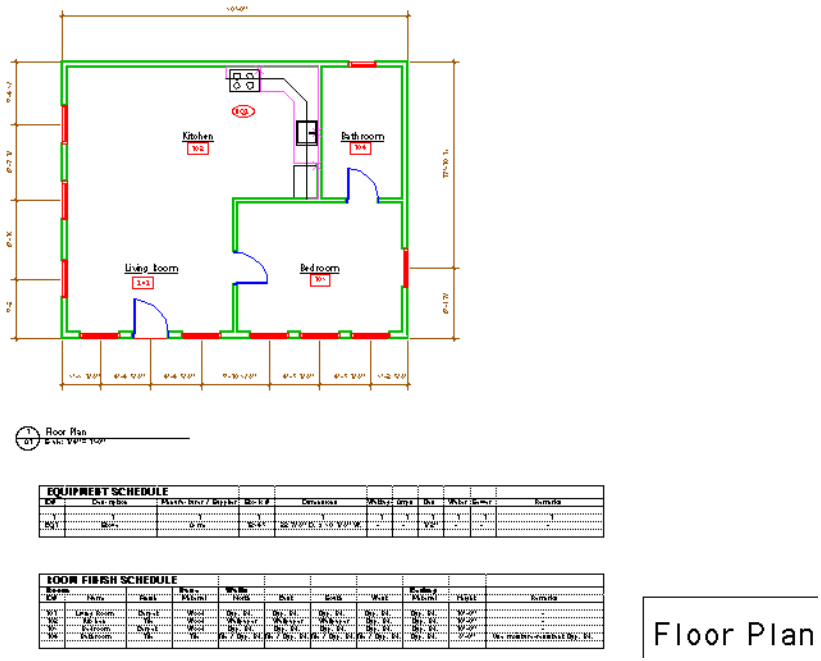


Click on the K in the column header.



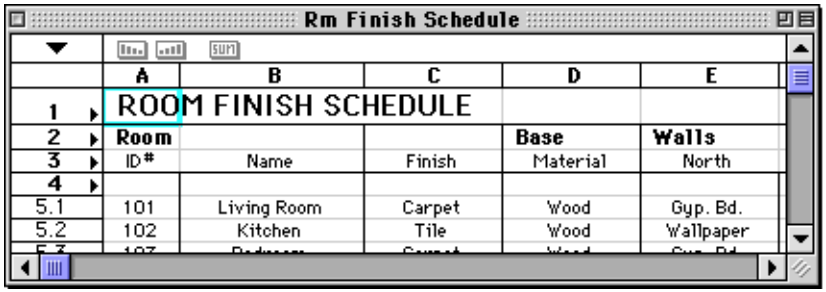
The original K column is deleted and the L column is moved into it's place.

5. Close the floating worksheet.

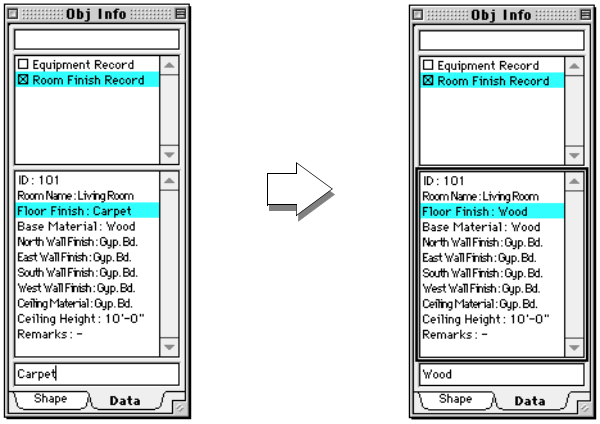


Updating Data In The Worksheet

1. From the Resource palette, highlight **Rm Finish Schedule**.
2. Click the **Open** button.

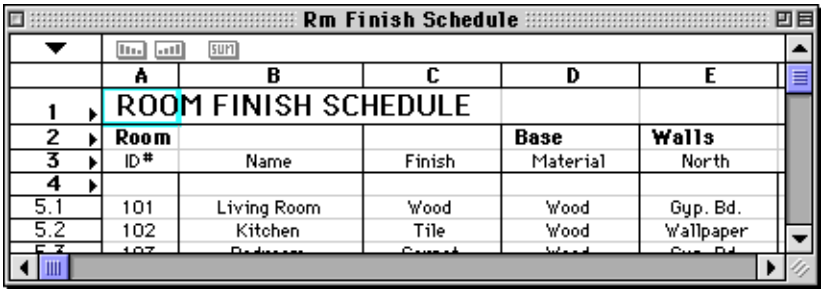


3. Click the **2D Selection Tool**.
4. Click the **Living Room ID** marker.
5. Click the **Data Tab** in the Object Info. palette.
6. Highlight the **Floor Finish** field.
7. Change the info. in the data entry field to **Wood**.



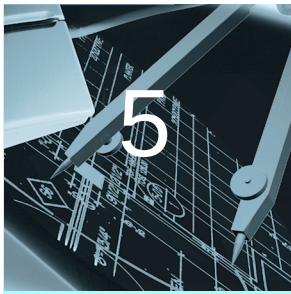
8. From the Worksheet menu, select **Recalculate**.

The worksheet is updated with the correct values.



9. Close the worksheet.

Presentations in VectorWorks



In this Exercise

- **Creating a Sheet**
- **Setting a 3D View**
- **Walkthough**
- **Adding Light**
- **Creating an Orbital Animation**
- **Create an Along Path Animation**

In this example we will perform the steps necessary to create a variety of ways to present your project to your client. We will create a sheet with a 3D view, render, and animate your drawing. The completed file is located in Learning Exercises and is entitled Presentation_Sample.mcd. It may be used as a reference while drawing.

SETUP

Since we are using the file created in the 2D Drafting exercise we do not need to run the Setup Assistant. There are a few procedures we still need to do though.

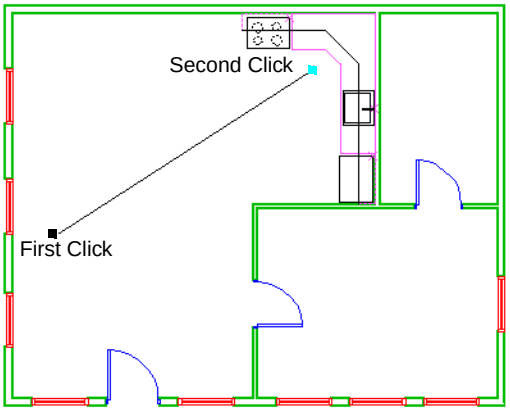
1. Open **2D_House_Sample.mcd** from the Learning_Exercises folder.
2. Select **Fit to Window**.
3. Select **Save As** and name the file **Presentation.mcd**.
4. From the Palettes menu, open **3D Tools** and the **Object Info.** palettes.

CREATE A SHEET

We will create a sheet that contains a rendered 3D view.

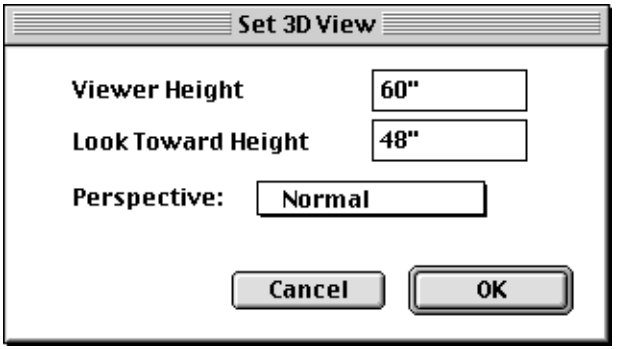
1. Select **Layer Options** then **Active Only** from the Organize menu.
2. From the View menu, select **Set 3D View**.
3. Click in the upper left corner area of the living room.

4. Click the upper right corner of the kitchen.



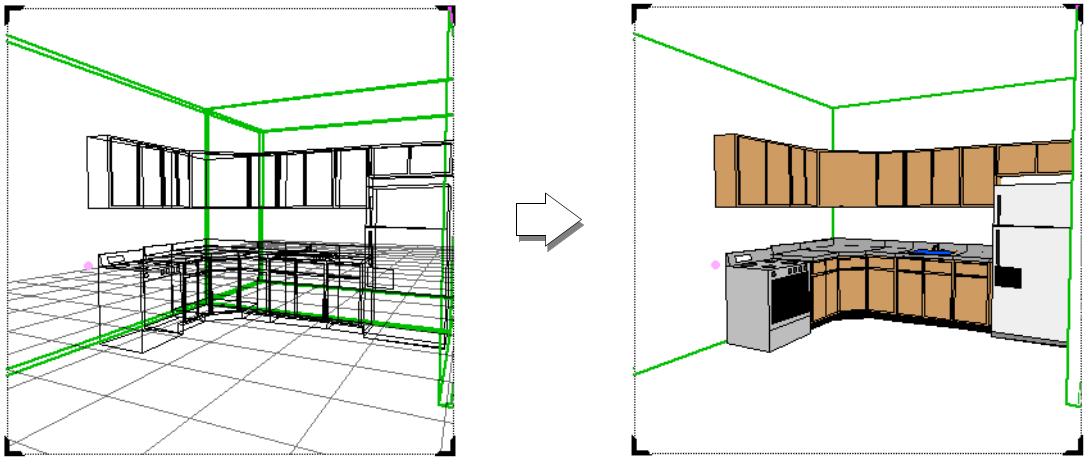
The Set 3D View dialog window appears.

5. Enter **60"** in **View Height** and **48"** in **Look Toward Height**. Select **Normal** from the Perspective pulldown.

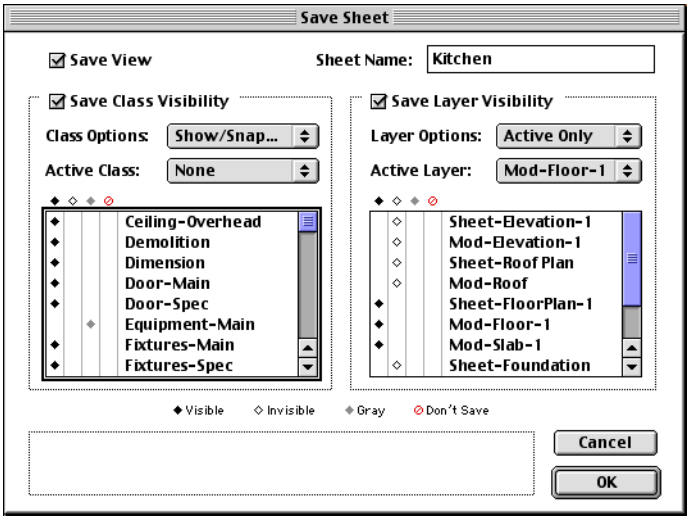


6. Click **OK**.

7. From the View menu, select **Rendering** then **Solid**.



8. From the View Bar, select **Save Sheet**.
9. Enter **Kitchen** for the Sheet Name.



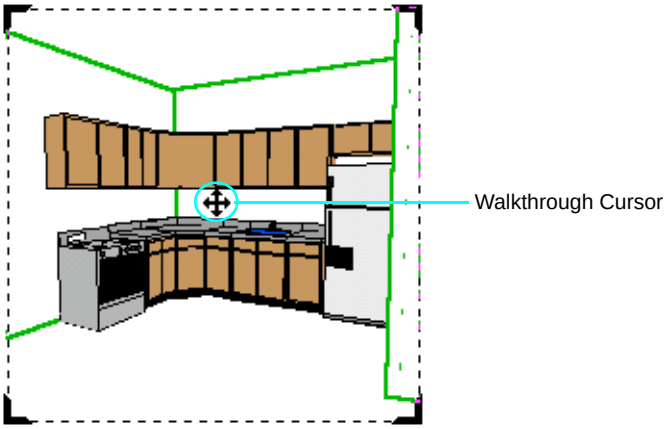
10. Click **OK**.

Walking Through The Model

1. Click the **Walkthrough Tool** from the 3D Tools palette.

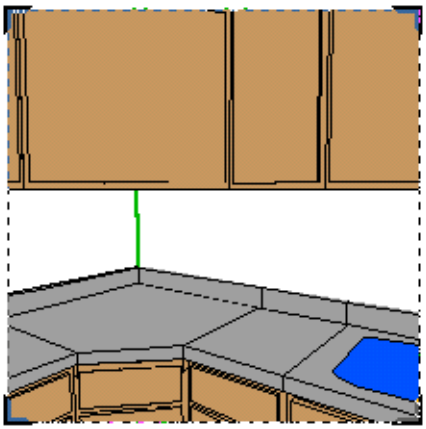
   With the walkthrough cursor, click on the screen and drag it in the direction you want to go. Left to go left, right to go right, up to go forward and down to go backwards. Holding the mouse in the center of the screen stops the motion.

2. With the **Walkthrough cursor**, right-click (Win) or click (Mac) and hold in the center of the screen.

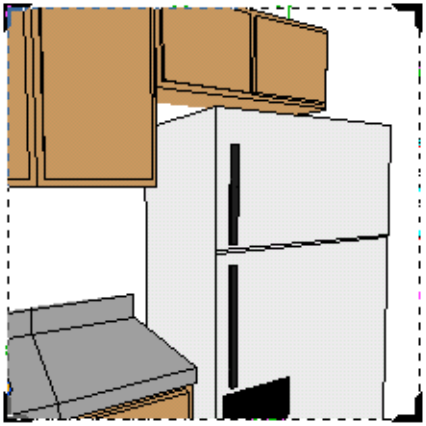


3. Slowly move the cursor upwards about 1" from the center to start moving forward in the model. You increase your velocity by moving the cursor farther from the center of the screen. Once the motion starts, stop moving the mouse upwards. Continue to hold down the mouse button down.
4. Release the mouse button when you get close to the sink.

The drawing will stop moving and the file will re-render.

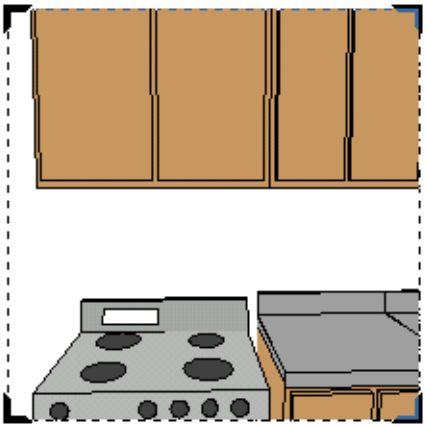


5. Click and hold the Walkthrough tool in the center of the screen and move the cursor to the right until motion begins.
6. Release the mouse button when the refrigerator comes in view.



7. Click and hold the Walkthrough tool in the center of the screen and move the cursor to the left until motion begins.

8. Release the mouse button when the stove reaches the center of the screen.

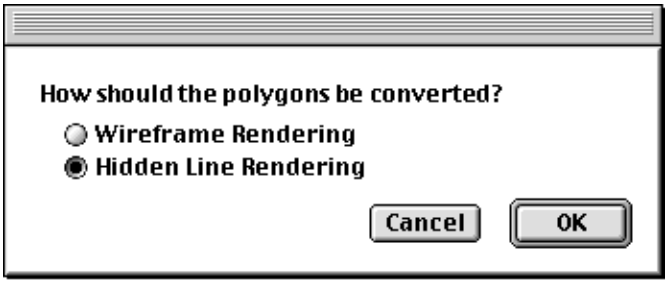


Note: If at any point you can't see anything, you may have traveled too far and through the other side of a wall.

9. Select **Kitchen** from the from the Saved Sheet list to restore the kitchen view created earlier.

Editing A Sheet

1. Right-Click (Win) or Control-Click (Mac) in the drawing area. This brings up the **Edit menu**.
2. Choose **Select All**.
3. From the Tool menu, select **Convert Copy to Polygons**.
4. In the dialog, accept the default setting (Hidden Line Rendering) and click **OK**.



5. With the copy still selected, select the Layer pulldown and then select **Sheet-FloorPlan-1** from the Object Info. palette.

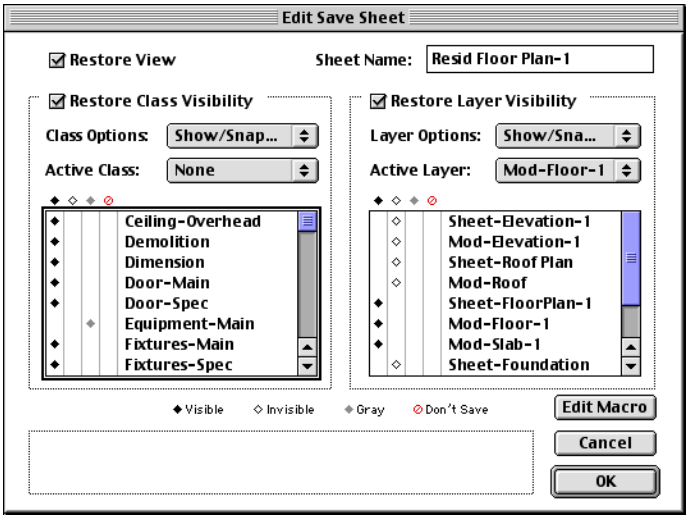
   The copy's type will be listed as Group in the Object Info. palette.

6. Select **Edit Sheet** from the View Bar.

7. In the Edit Sheet dialog, select **Resid Floor Plan-1** and click the Edit button.

   The Edit Save Sheet dialog appears.

8. Check the **Restore View** field.



9. Click **OK**.

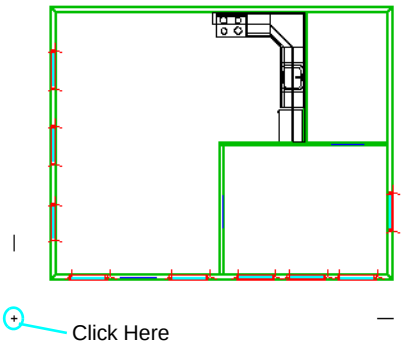
ADDING LIGHT

We will add a light source to the drawing to create shading when the model is rendering. This same lighting will also show as the model turns.

1. Select the **Resid Floor Plan-1** from the Sheet menu on the View Bar.
2. Select **Fit to Window**.
3. Select **Sheet-FloorPlan-1** from the Layers pulldown in the Data Display bar.
4. Drag the Perspective View copy to the right so that it does not obscure the floor plan.

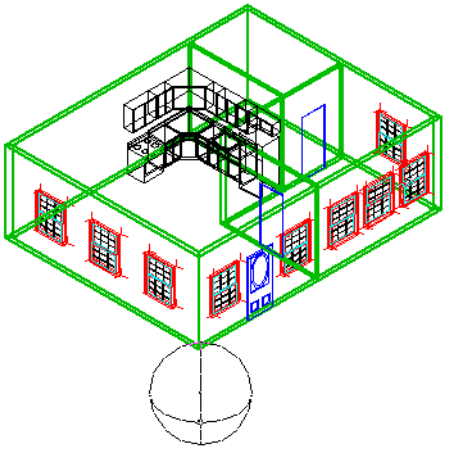
5. Select the layer entitled **Mod-Floor-1** from the Layers pulldown in the Data Display bar.
6. Select **Layer Options** then **Active Only** from the Organize menu.
7. Select the **Light Tool** from the 3D Tool palette.

   Because you have selected a 3D tool while in a 2D mode, you will be asked if you want to switch the drawing into the 3D mode to use the tool. Click **Yes Always**.
8. Click near the lower left corner of the house.



The Light Preferences dialog appears.

9. Accept the defaults in the Light Preferences dialog by clicking **OK**.
10. From the View menu, select **Standard Views** then **Left Isometric**.



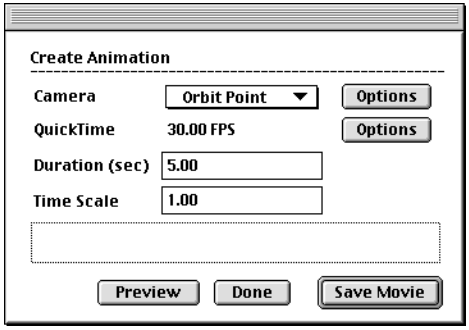
11. Select **Save**.

CREATE THE ORBIT ANIMATION

We will create an orbital animation of your drawing which rotates about a given point. You will be able to view your drawing on all sides and even see through the windows. Since you added light you will also see the effect of the light as the model turns.

1. From the View menu, select **Rendering** then **Shaded Solid**.
2. From the Model menu, select **Create Animation**.

   When the Create Animation dialog appears, accept all defaults.



3. Click **Preview**.

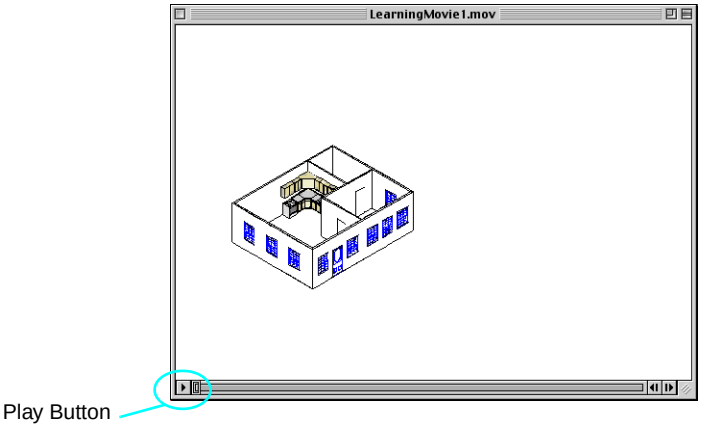
   This will show you a preview of the animation in wireframe mode.
4. When the animation has stopped, click **Save Movie.**
5. Enter **LearningMovie1.mov** for the name.
6. Click **Save**.

   A dialog appears displaying how long the generation will take. Upon completion you are returned to your drawing.
7. Hide VectorWorks.

8. Locate the file **LearningMovie1.mov** on your system and open it using your QuickTime Movie Player.

   You house is shown in the movie window.

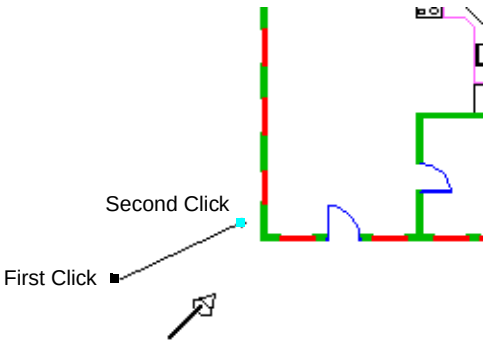
9. Click the **Play** button to start the movie.



The house rotates about the ground plane. Notice the way the light is seen as the house moves.

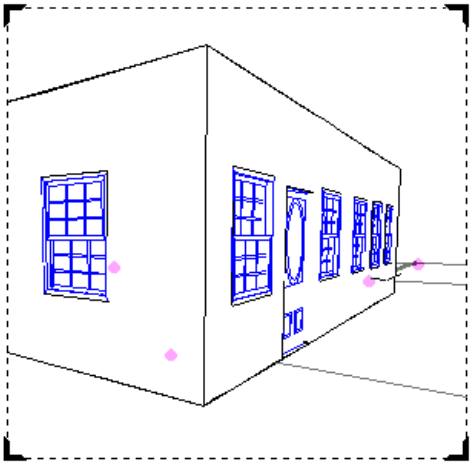
CREATE AN ALONG PATH ANIMATION

1. From the View menu, select **Standard Views** then **Top/Plan**.
2. From the View menu, select **Set 3D View**.
3. Click on the lower left side of the screen.
4. Drag and click closer to the left exterior wall.

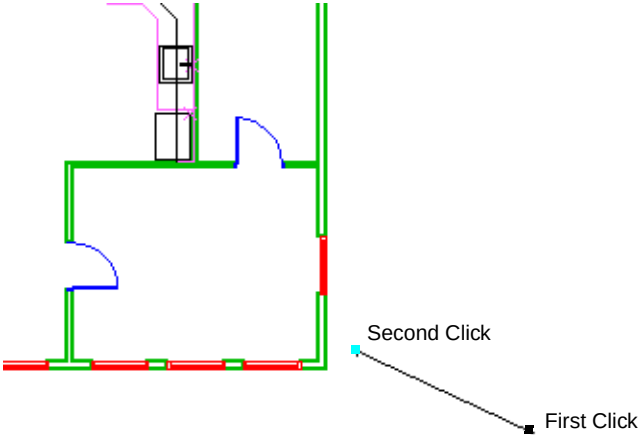


5. Enter **60"** in **View Height** and **48"** in **Look Toward Height**. Select **Normal** from the Perspective pulldown.

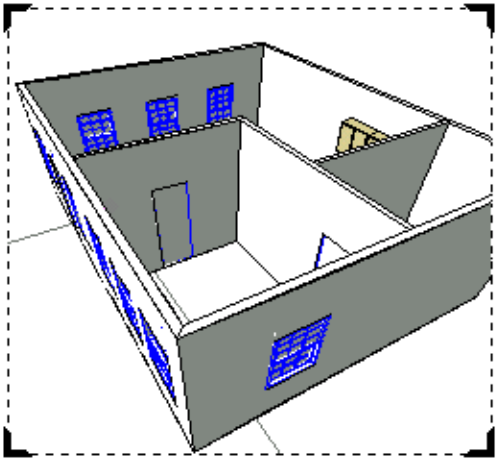
6. Click **OK**.
7. From the View menu, select Rendering then **Shaded Solid**.



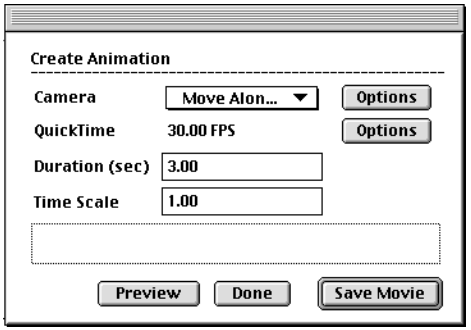
8. From the View bar, select **Save Sheet**.
9. Name this sheet **View1**.
10. Click **OK**.
11. From the View menu, select **Standard Views** and then **Top/Plan**.
12. From the View menu, select **Set 3D View**.
13. Click on the lower right side of the screen.
14. Drag and click closer to the right exterior wall.



15. Enter **20’0"** in **View Height** and **12’0"** in **Look Toward Height**. Select **Normal** from the Perspective pulldown.
16. Click **OK**.
17. From the View menu, select **Rendering** then **Shaded Solid**.

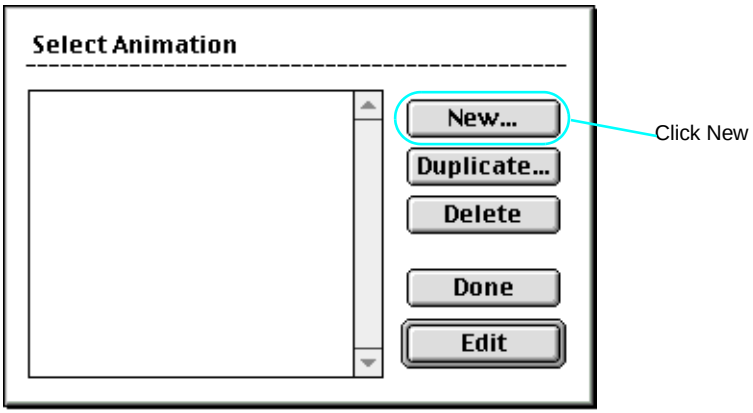


18. From the View bar, select **Save Sheet**.
19. Name this sheet **View2**.
20. Click **OK**.
21. From the Model menu, select **Create Animation**.
22. From the Camera pulldown, select **Move Along Path**.
23. Enter **3** in the Duration field.

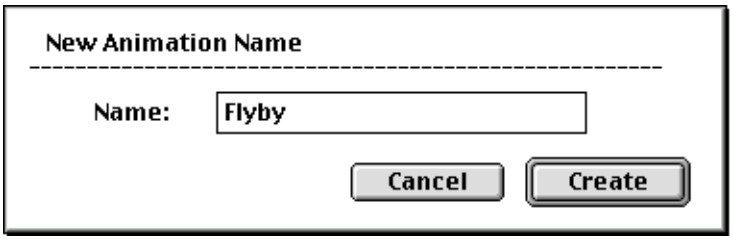


24. Click the **Options** button next to the Camera pulldown.

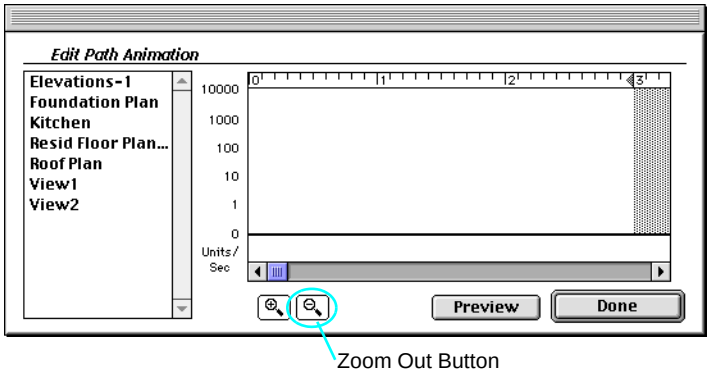
25. Click **New** in the Select Animation dialog.



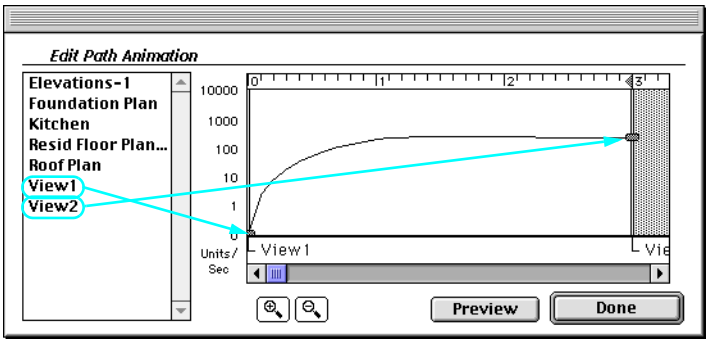
26. In the New Animation Name dialog, enter **Flyby**.



27. Click **Create**.
28. Click **Edit** in the Select Animation dialog.
29. Click the **Zoom Out** button to show the entire 3 sec duration on screen.



30. From the list of sheets on the left, drag **View1** into the Edit window.
31. Drag **View2** to the end of the Edit window.



32. Click the **Preview** button.
33. Once the preview is finished being presented, click **Done**.
34. Click **Save Movie** in the Create Animation dialog.
35. Enter **LearningMovie2.mov** for the name.
36. Click **Save**.

    Upon completion you are returned to your drawing.
37. Hide VectorWorks.
38. Locate the file **LearningMovie2.mov** on your system and open it using your QuickTime Movie Player

    Your house is shown in the movie window.
39. Click the **Play** button to start the movie.

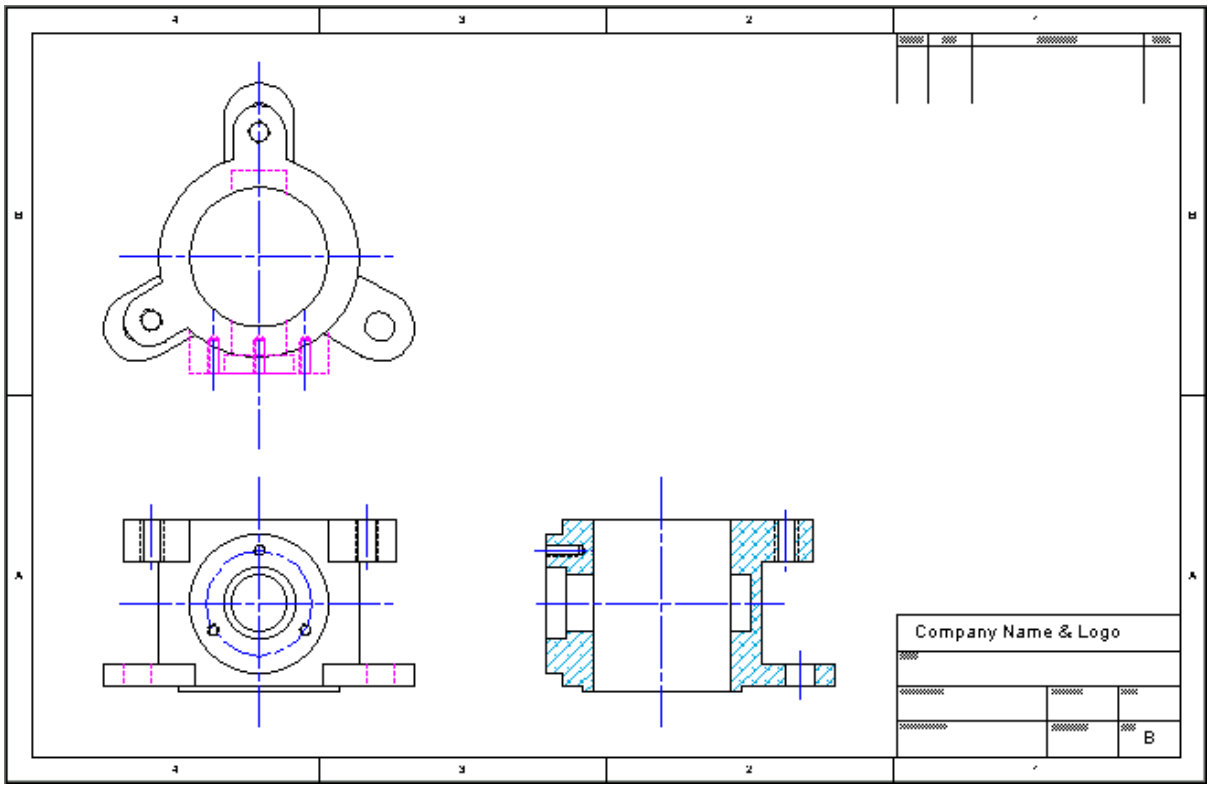
Level 1 Module - Mechanical Exercises

This module combines many tools and techniques to create a mechanical part in VectorWorks. Although this module is mechanically based, it can be performed by any VectorWorks user. It shows concepts that apply to all disciplines and provides a concept that most users can relate to.

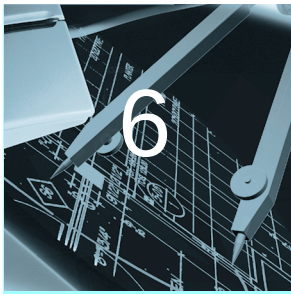
The structure of the exercises in this Level 1 Module is that all of the provided exercises are based on the 2D Mechanical Draft which you will create. You must complete this exercise before moving on to other exersises in this module. Other exercises can then be completed in any order.

In this module you will design a butterfly valve. You will create a draft which shows a top, front and side view. You will then dimension the drawing and make a 3D model of it.

As of this printing only the 2D drafting exrecise is provided.



Mechanical 2D Drafting



In this example we will create a butterfly valve used in combustion engines using VectorWorks' 2D capabilities. We will create guides, use cues, and use standard and plug-in tools. This exercise focuses on traditional drafting techniques in 2D. This exercise is not optimized for conversion into 3D. In order to simplify this exercise, we have provided certain numeric values for you. In the real world, you may have to calculate these values on your own.

The completed file is located in your Learning Exercises folder and is entitled Mechanical2D_Sample.mcd. It may be used as a reference while drawing.

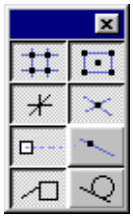
In this Exercise

- **Creating the Top View**
- **Creating The Front View**
- **Creating The Side View**

SETUP

It is important to set up your drawing before beginning to draw. In this exercise we will be using a template with most of your options pre-set. Although we do not use all the classes provided while performing this exercise, they are there for future use.

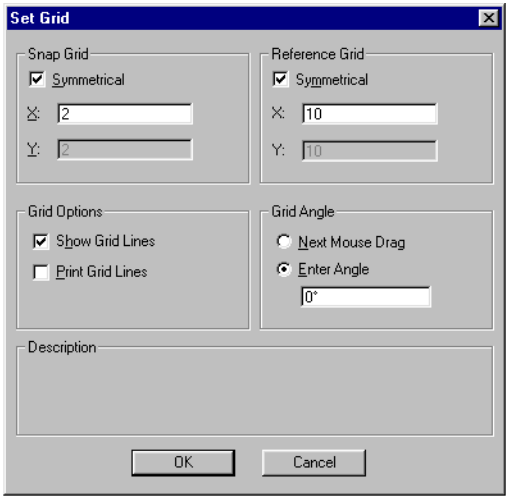
1. Select **New** from the File Menu.
2. Click the **Use Document Template** radio button. From the template pulldown, select **ME_Detail-A3.sta**.
3. In the View bar, click **Fit to Window**.
4. From the File menu, select **Workspaces** and then **Mechanical Eng**.
5. From the Palettes menu, open **2D Tools**, **Object Info**, **Editing**, **Constraints**, and **Attributes**.



Snap to 

6. Click each of the following buttons on the Constraints palette: **Snap to Grid**, **Snap to Objects**, **Constrain Angle**, **Snap to Intersection**, **Smart Points** and **Smart Edge** as shown.
7. On the Constraints palette, double click **Snap to Grid**.

   The Set Grid dialog appears.

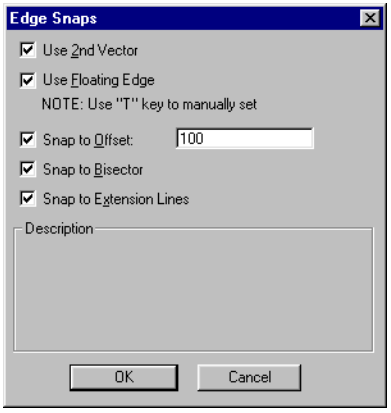


8. Change the Snap Grid X value to **1**. Uncheck **Show Grid Lines**.
9. Click **OK**.

Smart 

10. On the Constraints palette, double click **Smart Edge**.

    The Edge Snaps dialog appears.

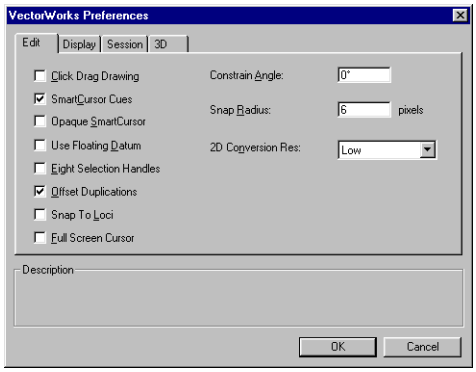


11. Uncheck **Use 2nd Vector**, **Use Floating Edge** and, **Snap to Bisector**.

In this particular exercise you will use the "T" key on the keyboard to manually set Edges.

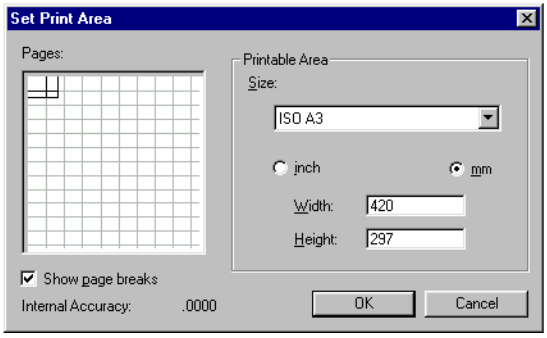
12. Click **OK**.
13. From the File menu, select **Preferences** and then **VectorWorks Preferences**.

    The VectorWorks Preferences dialog appears.



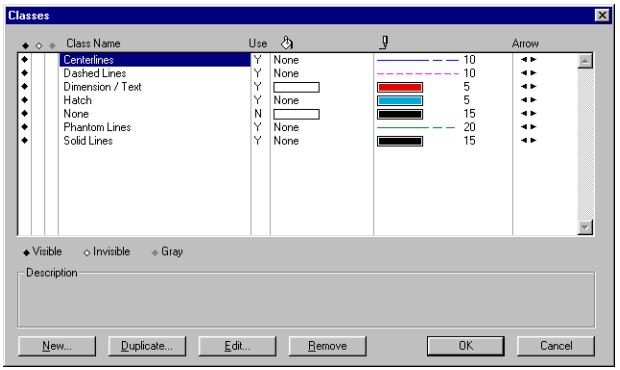
14. Check **Eight Selection Handles**.
15. Click **OK**.
16. From the Page menu, select **Set Print Area**.

    The Print Area dialog appears.

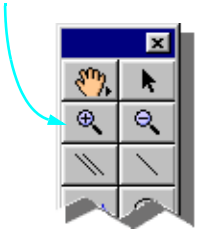


17. Uncheck **Show Page Breaks**.
18. Click **OK**.
19. From the Data Display Bar, click the **Classes** pulldown then select **Classes**.

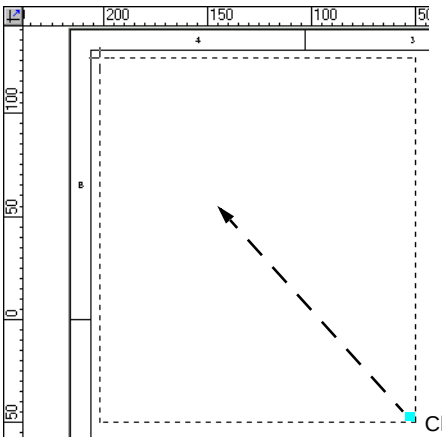
This brings up a dialog. Notice that there are a number of classes already created in this file. Each class has its own color, line style, and line weight.



Zoom In Tool



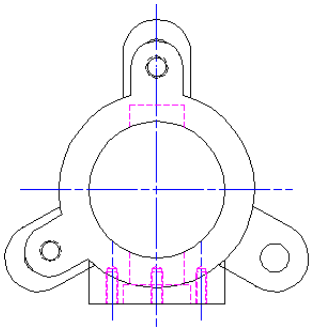
20. Click **Cancel**.
21. Click the **Zoom In** tool.
22. Using the rulers, move the cursor to an X of **-50** and a Y of **-50** then click. Drag the mouse diagonally and marquee the upper left portion of the drawing area.



Note: There will be times throughout this exercise where you may find the need to zoom in or out to better see and snap to objects.

23. From the File menu, select **Save As** and name the file **Mechanical.mcd**.

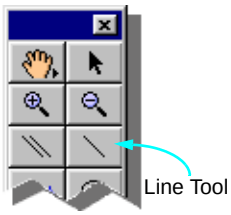
CREATE THE TOP VIEW



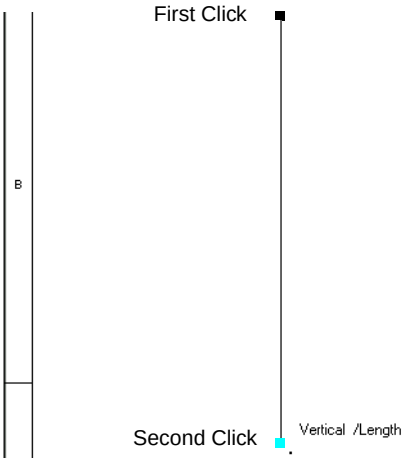
We will start by creating the Top View of this object. We will later use this view to help create the Front View.

Creating The Centerlines

Centerlines are used to visually divide objects in half. Centerlines can be any shape (lines, circles, etc...). Centerlines differ from Guidelines in that they are specifically for bisecting objects and remain on screen as part of the final drawing. Guidelines on the other hand, are working lines used to aid in drawing but are not part of the final drawing. Guidelines are typically hidden or deleted from view. Guidelines can also be any shape.



1. Click the **Line tool**.
2. Utilizing the Data Display Bar, move the cursor until X is **-125** and Y is **120** then click.
3. Drag downwards a little bit then press the **Tab key** until the L (length) field is highlighted. Enter **140** then press the **Enter key**. With the line now drawn (notice the Vertical/ Length cue) click on the screen to end.



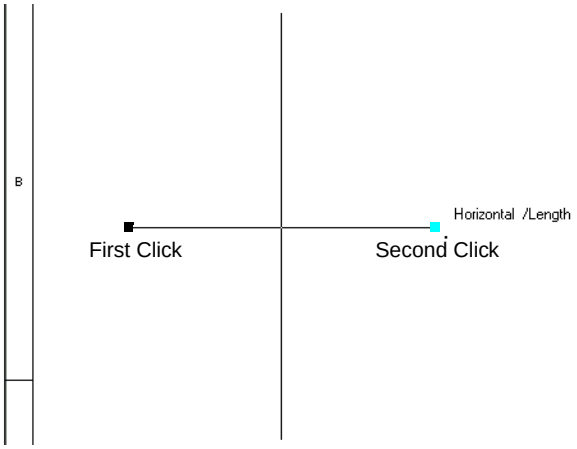
Tip: *To keep lines constrained while drawing, hold the Shift key down*

4. With the line selected, select the **Class** pulldown and then select **Centerlines** from the Object Info. palette.

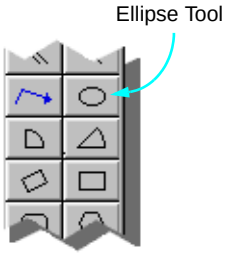
Note: At this point (or later in the exercise) a dialog will appear asking if you want the attribute change to take place, click **Yes Always**.

Selecting *Yes Always* allows any object made in one class to take on the attributes of another. The program will not ask again about such changes in that session. Clicking *Yes* will only allow that particular change to take place. The dialog will appear for each attempt to change attributes after that. *No Always* disallows any attempt to change the pre-assigned class attributes for that session. *No* disallows the change to take place for that instance.

5. Click the **Line tool**.
6. Move to an X of **-175** and a Y of **50** and click.
7. Drag to the right a little bit then press the Tab key until the L (length) field is highlighted. Enter **100** then press the Enter key. With the line now drawn (notice the Horizontal/ Length cue) click on the screen to end.



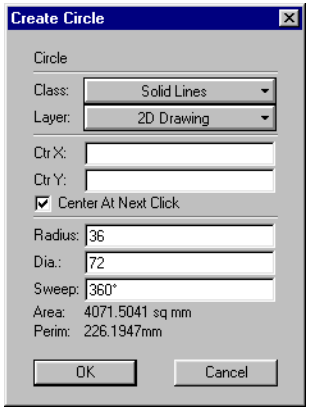
8. With this line selected, select the **Class** pulldown and select **Centerlines** from the Object Info. palette.
9. From the File menu, select **Save**.



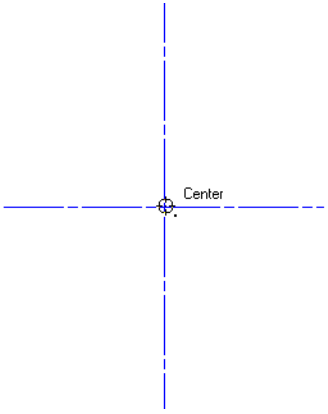
Creating The Body

1. Double click the **Ellipse tool**.

2. Enter in a diameter of **72**.

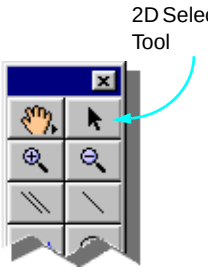


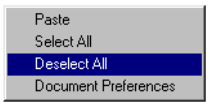
3. Click **OK**.
4. Move the mouse to the intersection of the two Centerlines. When the Center cue appears, click.



5. Double click the **Ellipse tool**.
6. Enter in a diameter of **50**.
7. Click **OK**.
8. Move the mouse to the intersection of the two Centerlines. When the Center cue appears, click.
9. Click the **2D Selection tool**.
10. Hold down the Shift key and click on the first (larger) circle.

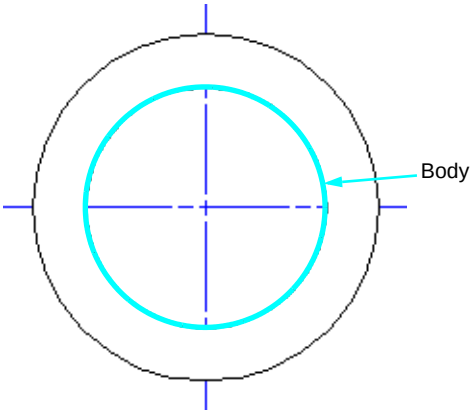
    Both circles are now selected.





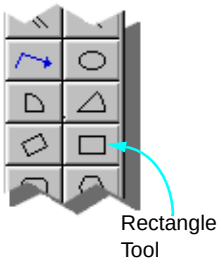
11. From the Attribute palette, select the **Fill Style** pulldown then select **Solid**.
12. With the two circles still selected, select **Clip Surface** from the Tool menu.
13. Right Click (Win)/ Control Click (Mac) on the screen and select **Deselect All** from the Edit menu.
14. Click on the inner circle then press the **Delete key** to remove it.

This area is the body



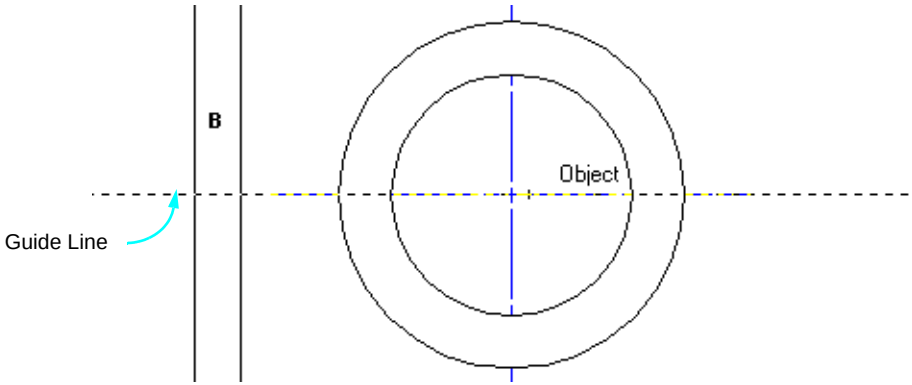
15. Select **Save** from the File menu.

Creating The Front Boss

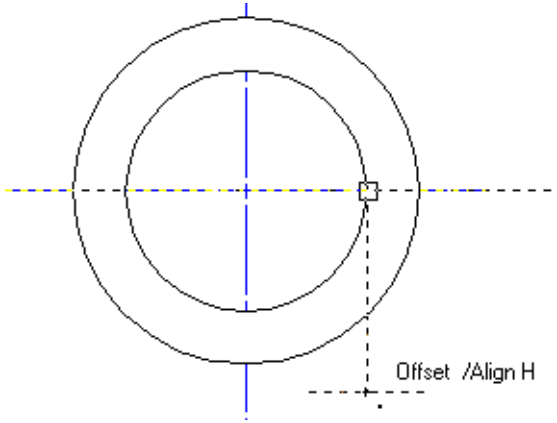


1. Double click the **Smart Edge** constraint.
2. Enter **42** in the Snap Offset field.
3. Click **OK**.
4. Click the **Rectangle tool**.
5. Move to the horizontal centerline and press the **T key**.

A guide line appears along its length.

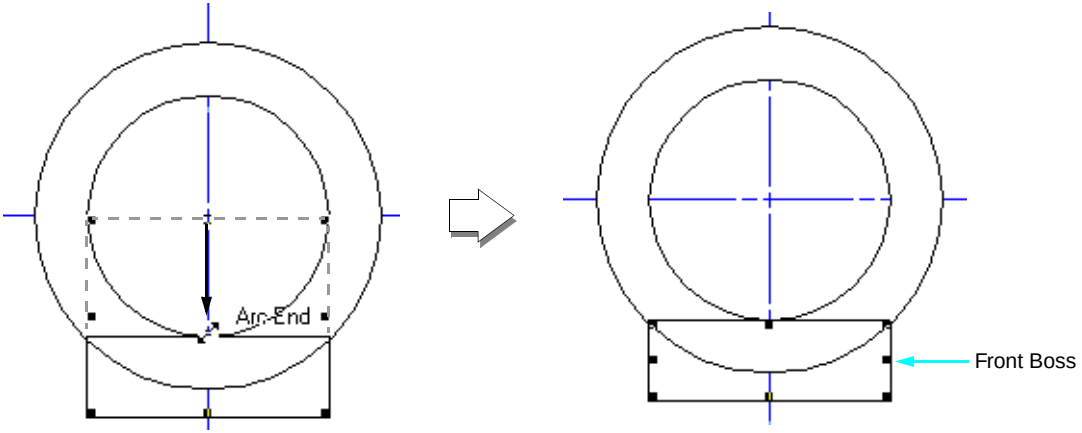


6. Move to the intersection of the horizontal centerline and the right center of the body (Arc End cue) then downwards without clicking. When the **Offset/ Align H** cue appears click.



7. Moving up and to the left, click at the left center (Arc End cue) of the body.
8. Click the **2D Selection tool**.
9. With the rectangle still selected, move the mouse to its Top Center (Top Center cue). When the Reshape cursor appears, click.

10. Drag the rectangle's top down until it reaches the bottom of the body (Arc End cue) then click.



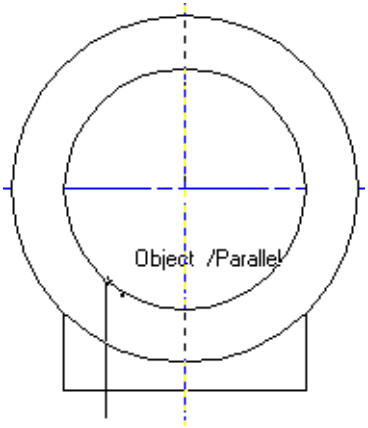
This rectangle is the Front Boss.

11. From the Tool menu, select **Send** and then **Send to Back**.
12. From the File menu, select **Save**.

Creating the Tapped Holes

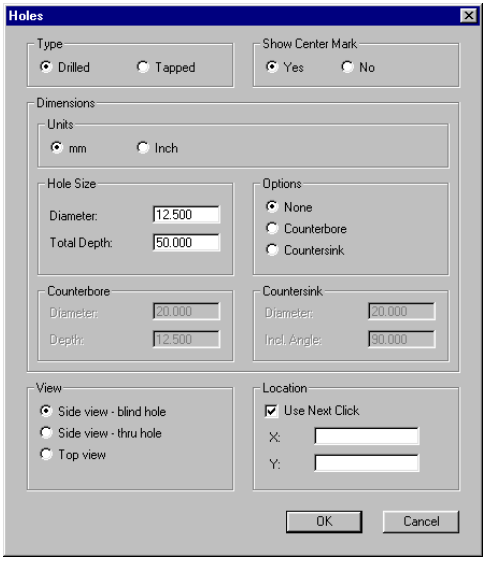
1. Double click the **Smart Edge constraint**.
2. Enter **16.45** in the Snap Offset field.
3. Click **OK**.
4. Click the **Line tool**.
5. Move the cursor over the vertical centerline. Press the **T key**.

6. Move the cursor to the left until the Offset cue appears. Click and draw a vertical line starting just below the bottom of the rectangle. Drag up to the bottom of the body (Object /Parallel or Object /Vertical cue) and click to end.



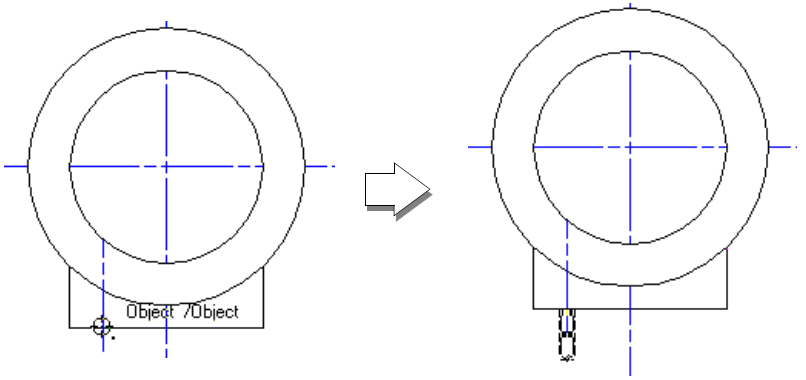
7. With the line still selected, select the **Class** pulldown then select **Centerlines** from the Object Info. palette.
8. From the Design menu, select Drafting Aids and then **Holes**.

   The Holes dialog appears.

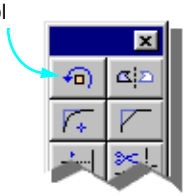


9. Click the **Tapped** radio button for Type and the **No** radio button for Show Center Mark. Enter **4** in the Diameter field and **12** in the Total Depth field.

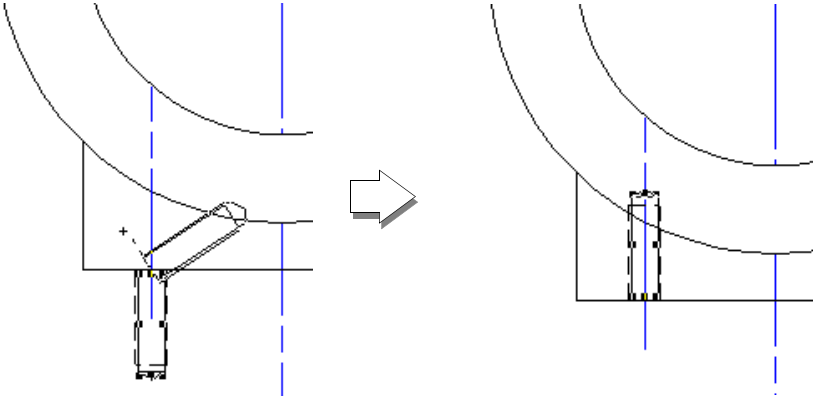
10. Click **OK**.
11. Click at the intersection of the vertical line you just drew and the bottom of the Front Boss (Object/ Object cue).



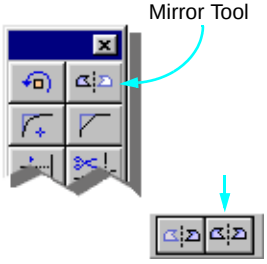
2D Rotate Tool



12. From the Editing palette, click the **2D Rotate tool**.
13. Click at the intersection of the tap hole and the bottom of the Front Boss (Top Center cue).
14. Drag horizontally to the right of the tap hole and click.
15. Drag left until you see the tap hole mirror in the upward direction then click to set.

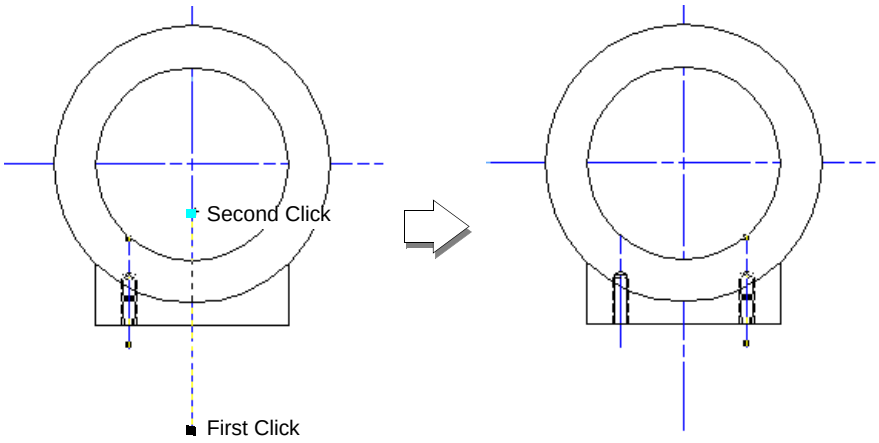


Mirror Tool



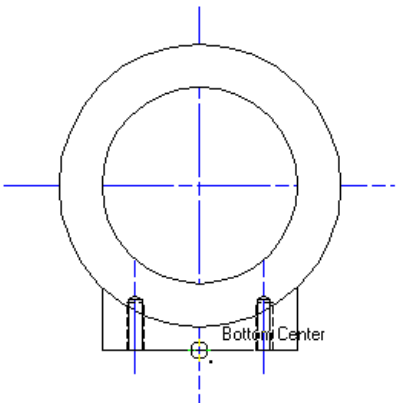
16. Select the **2D Selection tool**.
17. Hold down the **Shift Key** and click on the small vertical centerline.
18. From the Editing palette, click the **Mirror tool**. Click the **Mirror and Duplicate mode** in the Mode Bar.
19. Move the cursor to the bottom of the large vertical centerline and click.

20. Move vertically then click to set the mirror axis.



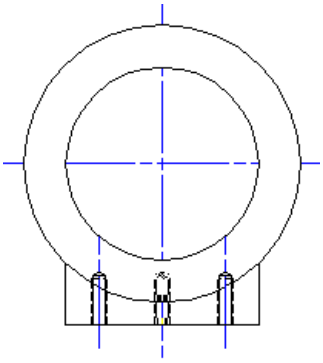
This creates a mirror image of the tap hole to the right of the centerline.

21. From the Design menu, select **Drafting Aids** and then **Holes**.
22. Click the **Tapped** radio button for Type and the **No** radio button for Show Center Mark. Enter **4** in the Diameter field and **12** in the Total Depth field.
23. Click **OK**.
24. Click at the intersection of the large vertical centerline and the bottom of the Front Boss (Bottom Center cue).



25. Click the **2D Rotate tool** from the Editing palette.
26. Click at the intersection of the tap hole and the bottom of the Front Boss (Top Center cue).
27. Drag horizontally to the right of the tap hole and click.

28. Drag horizontally left until you see the tap hole mirror in the upwards direction then click to set.

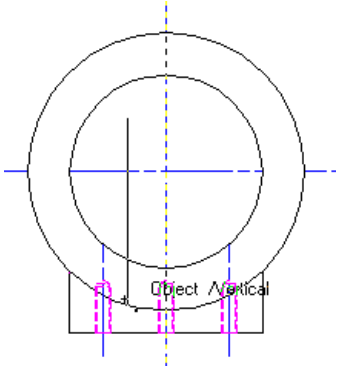


29. Click the **2D Selection tool**.
30. Hold down the **Shift key** and click on the left and right tap holes.
31. From the Object Info. palette, select the **Class** pulldown then select **Dashed Lines**.
32. From the File menu, select **Save**.

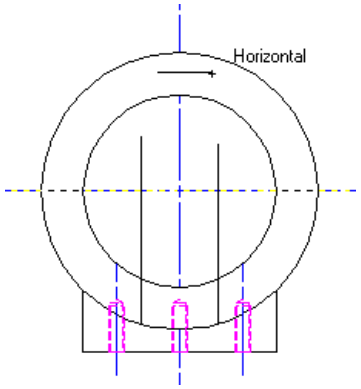
Creating The Drilled Hole

1. Double click the **Smart Edge** constraint.
2. Enter **10** in the Snap Offset field.
3. Click **OK**.
4. Click the **Line tool**.
5. Move the cursor over the large vertical centerline. Press the **T key**.

6. Move the cursor to the left until the Offset cue appears. Click and draw a vertical line starting inside of the body and extending down to the outer edge of the circle (Object/ Vertical cue or Object/ Parallel). Click to end.



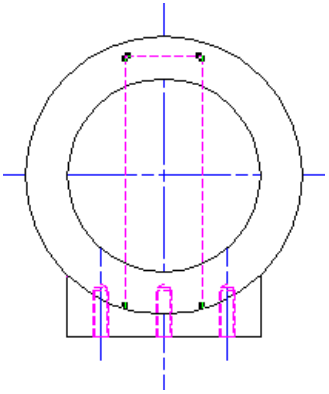
7. Move the cursor over the large vertical centerline. Press the **T key**.
8. Move the cursor to the right until the Offset cue appears. Click and draw a vertical line starting inside of the body and extending down to the outer edge of the circle (Object/ Vertical cue or Object/ Parallel). Click to end.
9. Double click the **Smart Edge** constraint.
10. Enter **31** in the Snap Offset field.
11. Click **OK**.
12. Click the **Line tool**.
13. Move the cursor over the horizontal centerline and click the **T key**.
14. Move the cursor upward until the Offset cue appears. Click and draw a horizontal line the approximate width between the two vertical lines. Click to end.



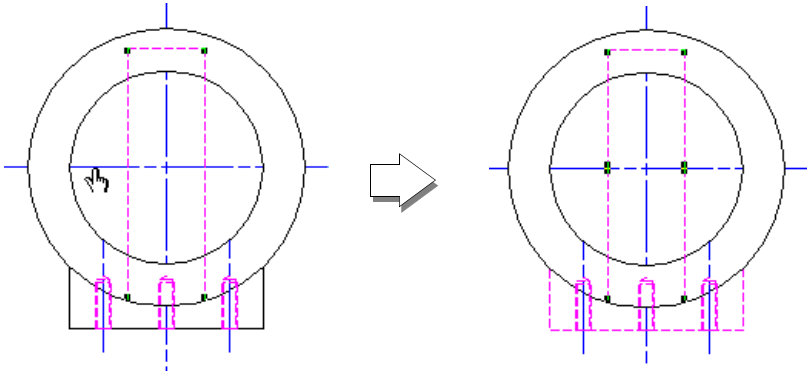
Look for the Horizontal or Perpendicular cue.

15. Click the **2D Selection tool**.

16. Hold the **Shift key** down and click on the left vertical line.
17. From the Tool menu, select **Join**.
18. Click on the right vertical line. Hold the **Shift key** down and click on the horizontal line.
19. From the Tool menu, select **Join**.
20. Hold the **Shift key** down and click on the left vertical line.
21. From the Object Info. palette, select the **Class** pulldown and select **Dashed Lines**.

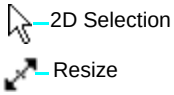


22. Click on the horizontal centerline. Hold down the Shift key and click on the two vertical lines.
23. From the Tool menu, select **Trim**.
24. Click on the horizontal centerline.

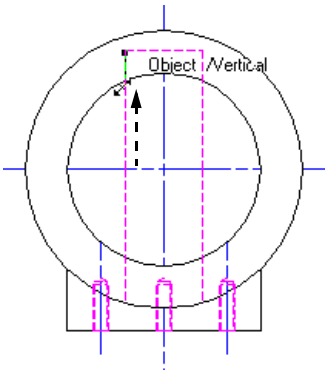


The two vertical lines are now split where they intersect the horizontal centerline.

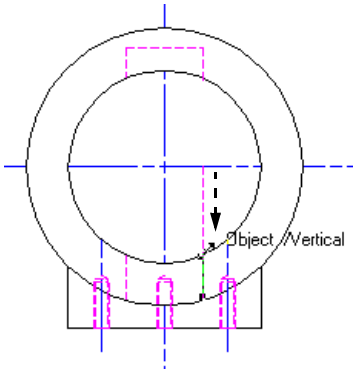
25. Right Click (Win)/ Control-Click (Mac) in the drawing area to bring up the Edit dialog. Select **Deselect All.**
26. Click on the top left vertical line.



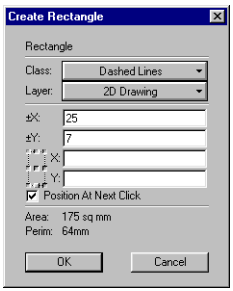
27. Move the cursor over the bottom handle of this vertical line. When the Arrow cursor changes into the Resize cursor, click and drag vertically upwards to the edge of the inner circle. Click when the Object/ Vertical cue appears.



28. Repeat procedure for right upper vertical line.
29. Click on the bottom left vertical line.
30. Move the cursor over the top handle of this vertical line. When the Arrow cursor changes into the Resize cursor, click and drag vertically downwards to the edge of the inner circle. Click when the Object/ Vertical cue appears.
31. Repeat procedure for right lower vertical line.

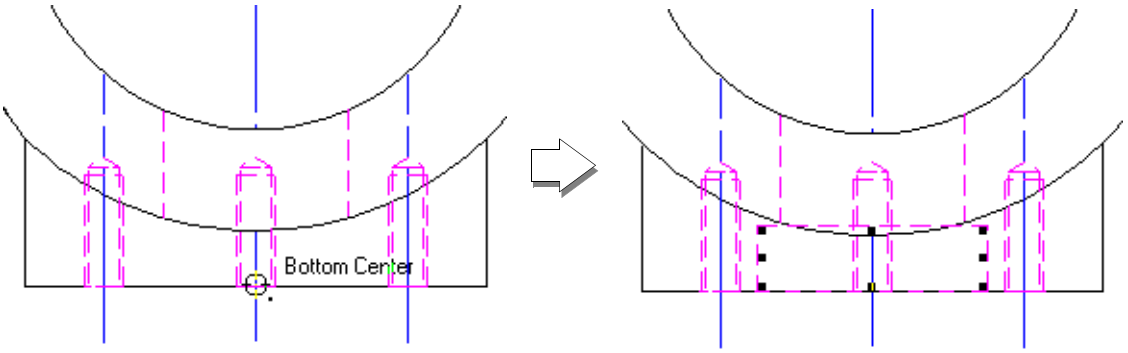


32. From the File menu, select **Save**.



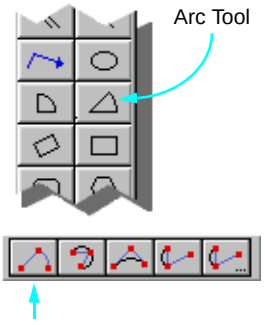
Creating The Counter Bore

1. Double click the **Rectangle** tool.
2. Enter **25.5** for delta X and **7** for delta Y. Click the **Bottom Center** alignment radio button. Select the Class pulldown and select **Dashed Lines**.
3. Click **OK**.
4. Move to the bottom of the rectangle under the outer circle until the Bottom Center cue appears then click.



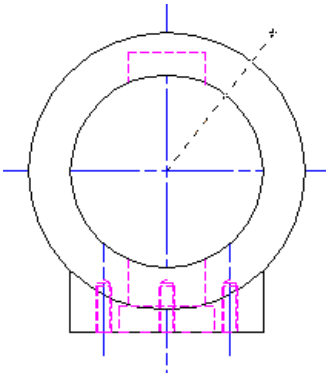
5. From the File menu, select **Save**.

Creating The Upper Ears



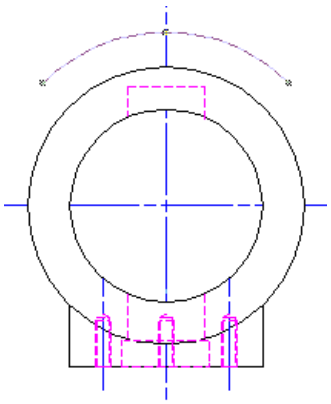
1. Click the **Arc tool**.
2. Move the cursor to the intersection of the two main centerlines. When the Center cue appears, click.

3. Drag the cursor up and to the right past the circle.



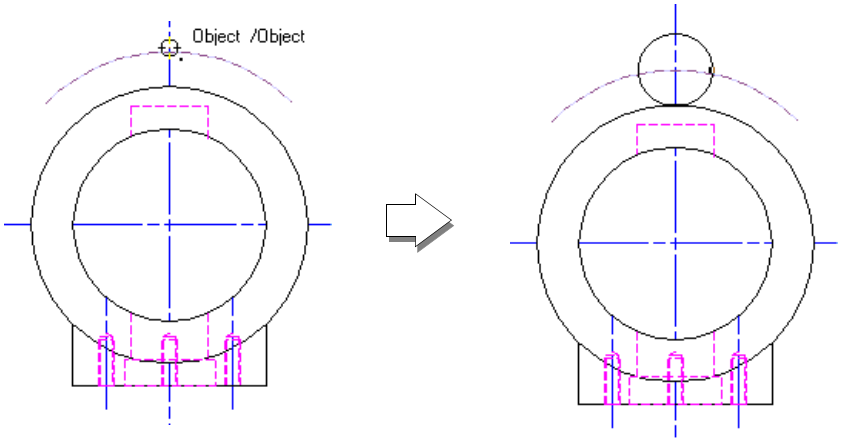
4. Press the **Tab key** until the L (length) field is highlighted. Enter **45**. Press the **Enter key** on the Numeric keypad to set.
5. The A (Angle) field is now highlighted. Enter **45**. Press the **Enter key** on the Alpha-Numeric keypad to set. Click on the screen to set the beginning of the arc, then drag left a little bit.

6. Click the **Tab key** to activate the **Sweep** field in the Data Display bar.
7. Enter **90** and press the **Enter key**. Click in the drawing to set the arc.
8. With the arc selected, select **Guides** then **Make Guide** from the Edit menu.

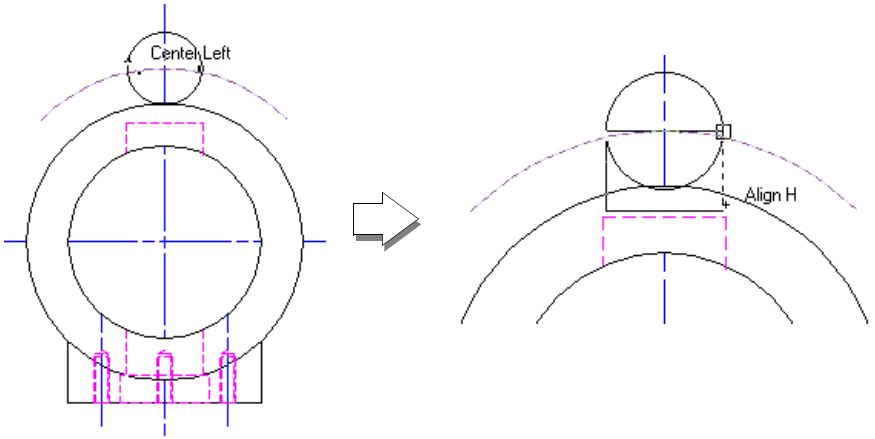


9. Double click the **Ellipse tool**.
10. Enter a radius of **9.5**.

11. Click **OK**.
12. Move the cursor to the intersection of the vertical centerline and the guide arc. Click when the Object/Object cue appears.



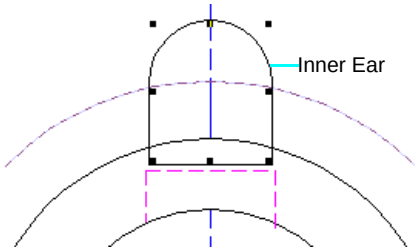
13. Click the **Rectangle tool**.
14. Move to the left side of the small circle just drawn. When the Center Left cue appears, click. Drag to the opposite side until the Center Right cue appears. Drag down, using the Align H cue to keep you aligned with the Right Center of the circle, until the rectangle is just between the inner and outer circle then click.



15. Select the **2D Selection tool**.
16. Hold down the **Shift key** and click on the small circle.

Note that circles have a center and single side handle which may not be obvious during this part of the exercise.

17. From the Tool menu, select **Add Surface**.

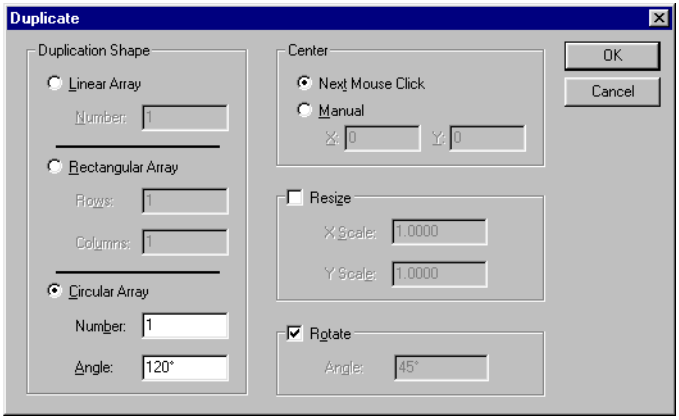


This is now one of the upper ears.

18. With the inner ear still selected, select **Duplicate Array** from the Edit menu.

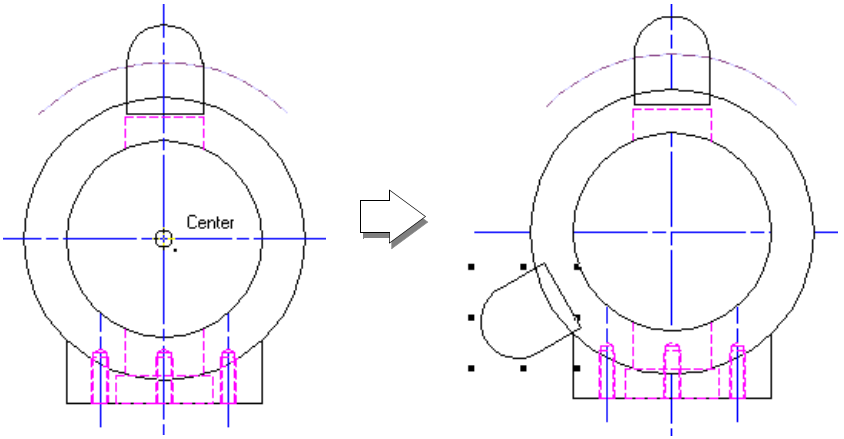
The Duplicate dialog appears.

19. Click the **Circular Array** radio button. Enter **120** in the Angle field. Click the **Next Mouse Click** radio button.

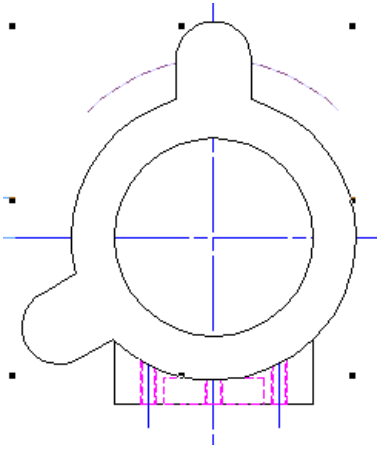


20. Click **OK**.

21. Move the cursor to the intersection of the centerlines (Center cue) and click.

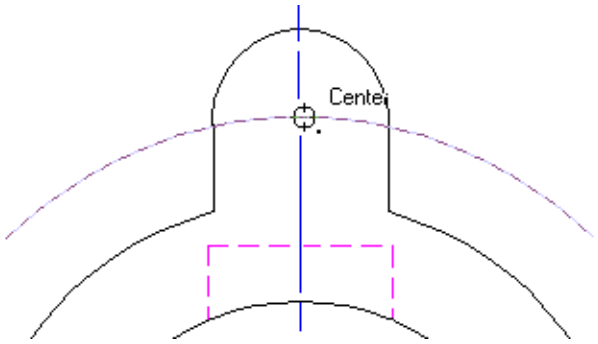


22. Click the **2D Selection tool**.
23. Click the top upper ear. Hold down the **Shift key** and click on the body.
24. From the Tool menu, select **Add Surface**.
25. Hold down the **Shift key** and click on the left ear.
26. Select **Add Surface** from the Tool menu.

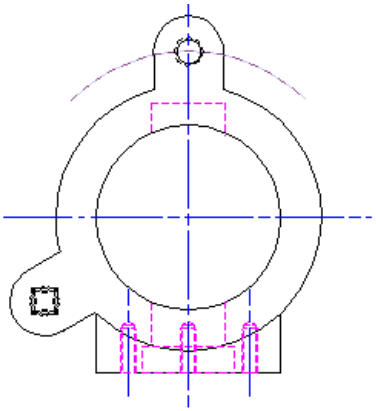


27. With the polyline still selected, select **Send** and then **Send to Back** from the Tool menu.
28. Click on the rectangle (Front Boss). Select **Send** and then **Send to Back** from the Tool menu.

29. From the Design menu, select **Drafting Aids** and then **Holes** from the pulldown.
30. Click the **Tapped** radio button for Type, the **No** radio button for Show Center Mark. Enter **8** in the Diameter field. Click the **Top view** radio button for View.
31. Click **OK**.
32. Click at the center of the arc guide (Center cue).



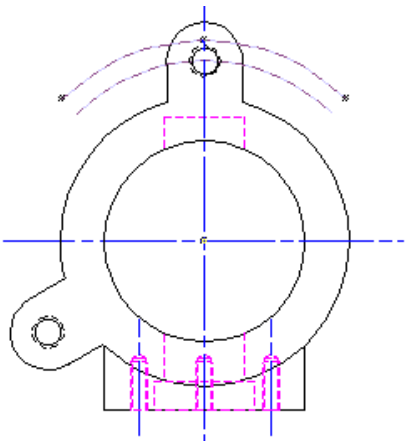
33. With the tapped hole still selected, select **Duplicate Array** from the Edit menu. All settings should be the same as you used previously, so there is no need to change anything.
34. Click **OK**.
35. Move to the intersection of the centerlines (Center cue) and click.



36. From the File menu, select **Save**.

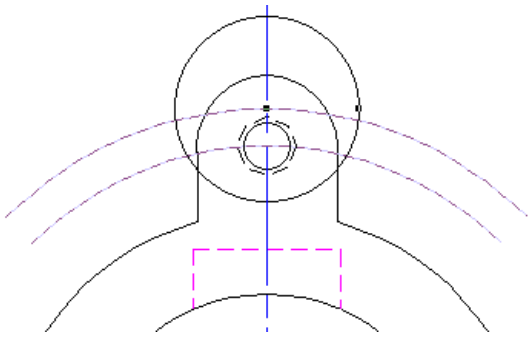
Creating The Lower Ears

1. Click the **Arc tool**.
2. Move the cursor to the intersection of the centerlines (Center cue) and click.
3. Drag the cursor up and to the right of the polyline. Press the **Tab key** until the L field is highlighted. Enter **50**. Press the **Enter key** on the Numeric keypad to set.
4. The A (Angle) field is now highlighted. Enter **45**. Press the **Enter key** on the Alpha-Numeric keypad to set. Click on the screen to set the beginning of the arc, then drag left a little bit.
5. Press the **Tab key** to highlight the **Sweep** field in the Data Display bar. Enter **90** and press the **Enter key** on the Alpha-Numeric keypad. Click on the drawing to end the arc.
6. With the arc selected, select **Guides** then **Make Guides** from the Edit menu.

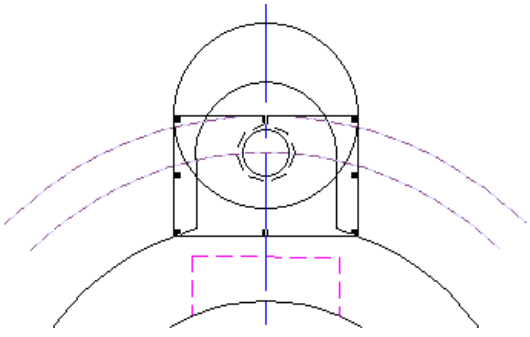


7. Double click the **Ellipse tool**.
8. Enter a radius of **12.5**.
9. Click **OK**.

10. Move to the intersection of the vertical Centerline and the new guide arc. When the Object/Object cue appears, click.

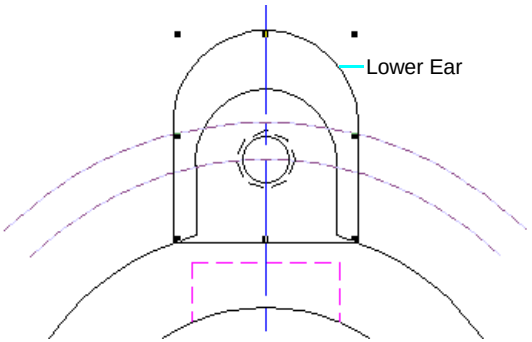


11. Click the **Rectangle tool**.
12. Move to the left side of the new circle. When the Center Left cue appears, click on the drawing. Drag to the opposite side of the circle until the Center Right cue appears. Drag down, using the Align H cue to keep you aligned with the right center of the circle, until the rectangle intersects the outer circle (Object/ Align H cue) then click.



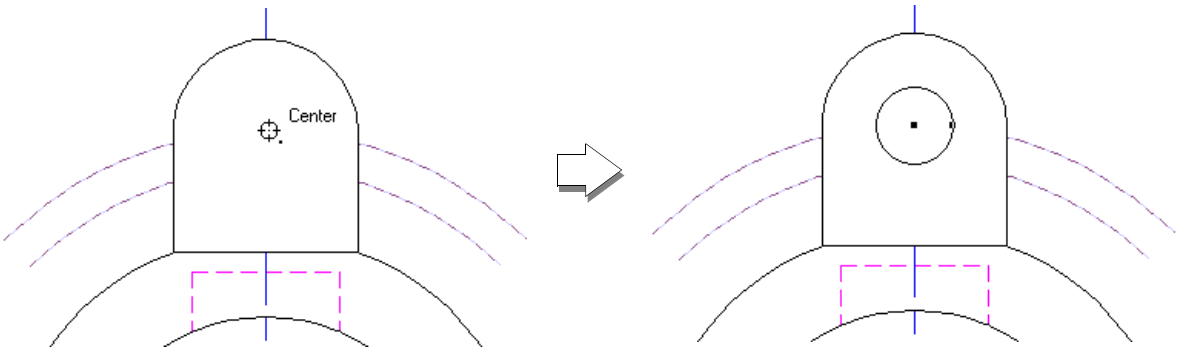
13. Click the **2D Selection tool**.
14. Hold down the **Shift key** and click on the circle.

15. Select **Add Surface** from the Tool menu.



This is one of the lower ears.

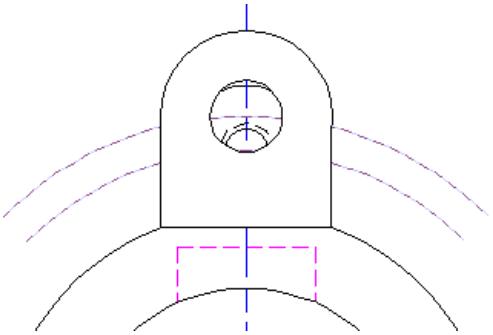
16. While the ear is still selected, select the Fill pulldown then select **Solid** from the Attributes palette.
17. Double click the **Ellipse tool**.
18. Enter a diameter of **10.5**.
19. Click **OK**.
20. Click at the center of the second arc guide.



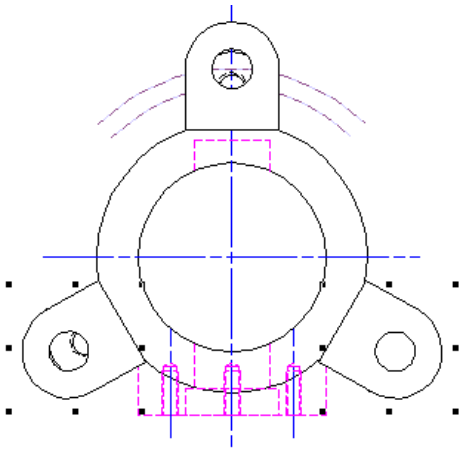
21. Click the **2D Selection tool**.
22. Hold down the **Shift key** and click on the ear.
23. From the Tool menu, select **Clip Surface**.
24. Hold down the **Shift key** and click on the ear.

Clicking on an object already selected, deselects it.

25. With only the smaller circle now selected, press the **Delete key** to remove it.

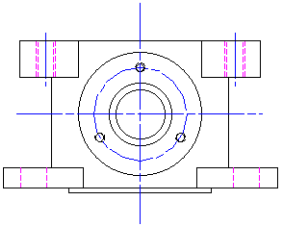


26. Click on the ear.
27. From the Edit menu, select **Duplicate Array**.
28. In the **Circular Array** section, enter **2** in the Number field.
29. Click **OK**.
30. Move the cursor to the intersection of the two main centerlines (Center cue) and click.



31. Click the **2D Selection tool**.
32. Hold down the Shift key and click on the top ear.
33. From the Tool menu, select **Send** and then **Send to Back**.
34. From the File menu, select **Save**.

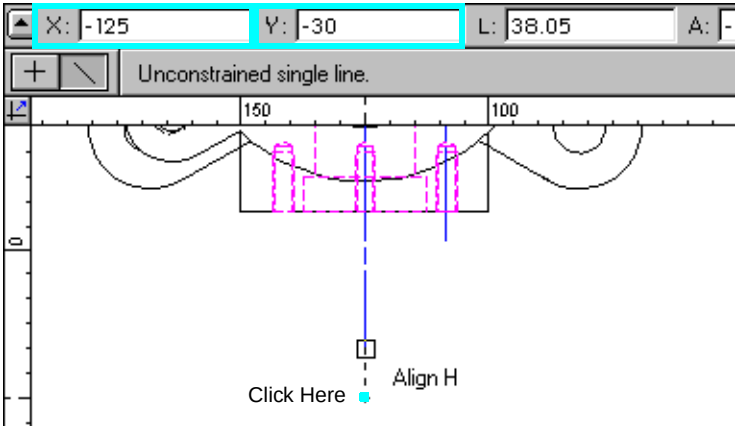
CREATE THE FRONT VIEW



Using the Top view as a guide, we will now create the Front View.

Creating the Centerlines

1. Click the **Line tool**.
2. Move to the bottom of the vertical centerline. When the Point cue appears, move downwards, keeping the Align H cue on.
3. Using the Data Display Bar, move the cursor down until X is **-125** and Y is **-30** then click.

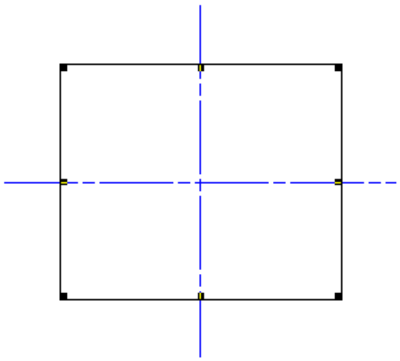


Depending on your zoom factor, you may need to scroll the screen down or zoom out at this point.

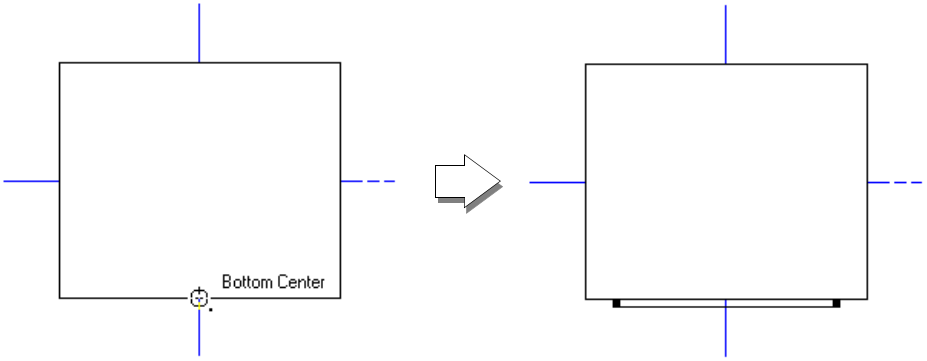
4. Drag down a little bit then press the **Tab key** until the L (length) field is highlighted. Enter **90** then press the **Enter key**. Click to finish the line.
5. With the line still selected, click the **Class** pulldown from the Object Info. palette then select **Centerline**.
6. Using the Data Display Bar, move the cursor until X is **-175** and Y is **-75** then click.
7. Drag to the right a little bit then press the **Tab key** until the L (length) field is highlighted. Enter **100** then press the **Enter key**. Click to finish the line.
8. With the line still selected, click the **Class** pulldown from the Object Info. palette then select **Centerline**.
9. From the File menu, select **Save**.

Creating the Body

1. Double click the **Rectangle tool**.
2. Enter **72** for delta X and **60** for delta Y. Select the **Center** alignment button.
3. Click **OK**.
4. Using the Center cue, click at the intersection of the centerlines.



5. With the rectangle selected, select the **Fill** pulldown then select **Solid** from the Attribute palette.
6. Double click the **Rectangle tool**.
7. Enter in **58** for delta X and **2** for delta Y. Click the **Top Center** alignment radio button.
8. Click **OK**.
9. Move to the bottom center (Bottom Center cue) of the rectangle and click.

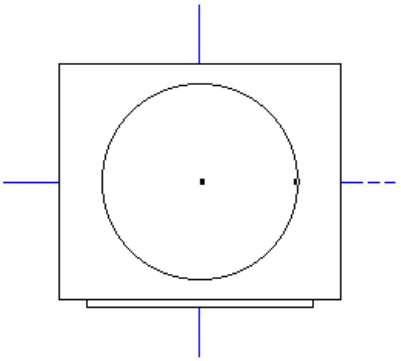


10. With this rectangle selected, click the **Fill** pulldown then select **Solid** from the Attribute palette.

11. Select **Save** from the File menu.

Creating The Front Boss

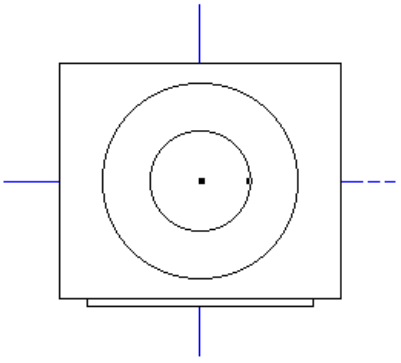
1. Double click the **Ellipse tool**.
2. Enter **50** in the diameter field.
3. Click **OK**.
4. Using the Center cue, click in the middle of the first rectangle.



5. From the File menu, select **Save**.

Creating The Counter Bore

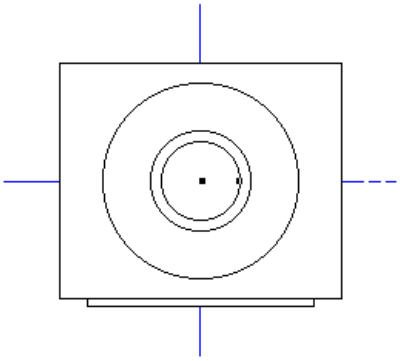
1. Double click the **Ellipse tool**.
2. Enter **25.5** in the diameter field.
3. Click **OK**.
4. Using the Center cue, click in the middle of the first rectangle.



5. From the File menu, select **Save**.

Creating The Drilled Hole

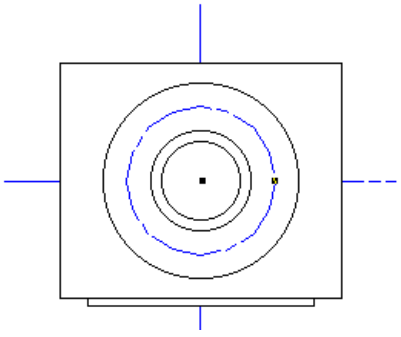
1. Double click the **Ellipse tool**.
2. Enter **20** in the diameter field.
3. Click **OK**.
4. Using the Center cue, click in the middle of the first rectangle.



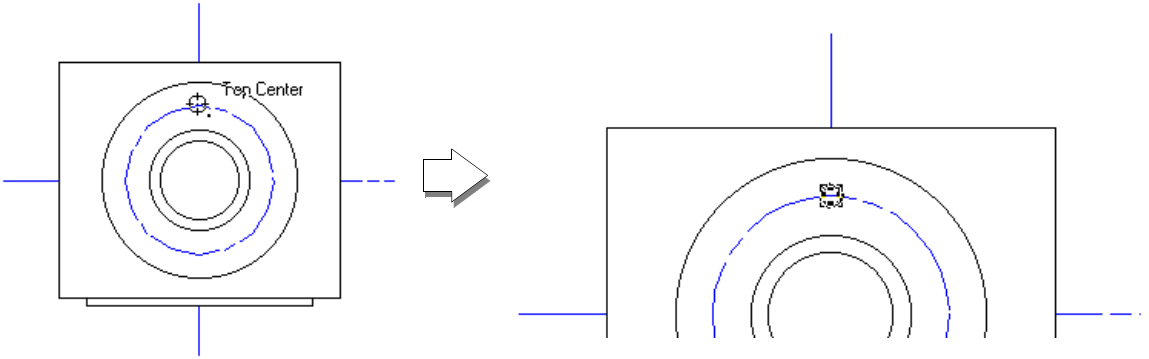
5. From the File menu, select **Save**.

Creating The Bolt Circle

1. Double click the **Ellipse tool**.
2. Enter **38** in the diameter field. Select the Class pulldown then select **Centerlines**.
3. Click **OK**.
4. Using the Center cue, click in the middle of the first rectangle.

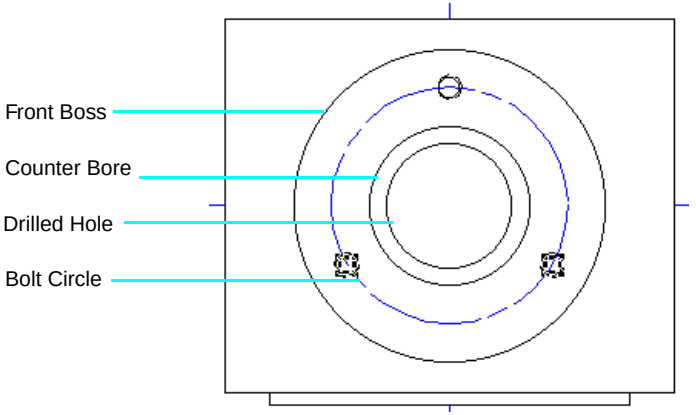


5. From the Design menu, select Drafting Aids then **Holes**.
6. Click the **Tapped** radio button for Type and the **No** radio button for Show Center Mark. Enter **4** in the Diameter field. Select the **Top View** radio button for View.
7. Click **OK**.
8. Click at the top center of the Bolt Circle (Top Center cue).



9. With the tapped hole still selected, select **Duplicate Array** from the Edit menu.

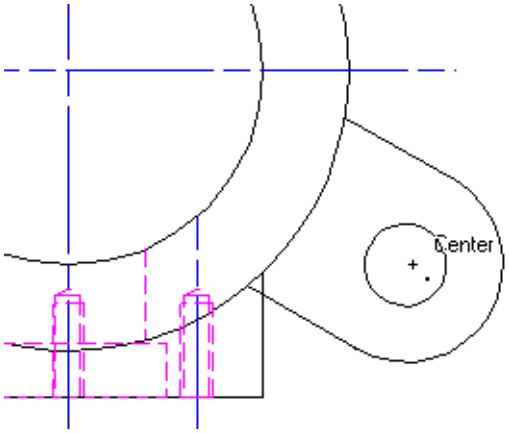
   All settings should be the same as you used previously so there is no need to change anything.
10. Click **OK**.
11. Move to the center (Center cue) of the first rectangle and click.



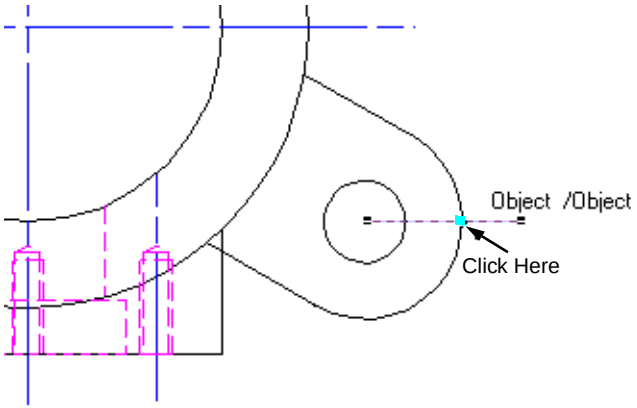
12. From the File menu, select **Save**.

Creating the Front View of the Ears

1. Click the **Line tool**.
2. In the Top View drawing, move the cursor to center of the hole in the right lower ear. When the Center cue appears, click.

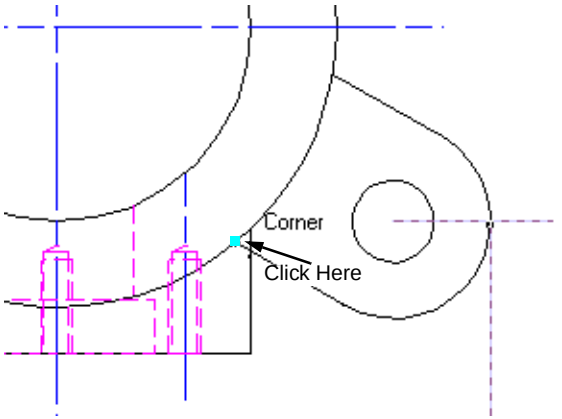


3. Draw a horizontal line to the right of the outer ear approximately **25mm** long. Click to end.
4. With the line selected, select **Guides** then **Make Guide** from the Edit menu.
5. Find the intersection of the lower ear and this guideline (Object/ Object cue). Click and draw a vertical line down to the bottom of the Front View drawing (about where the vertical centerline ends). Click to end.

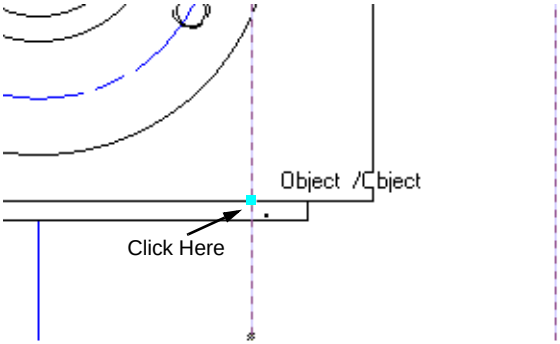


6. With the line selected, select **Guides** then **Make Guide** from the Edit menu.

7. Returning to the Top View drawing, use the Corner cue to find the intersection of the right lower ear and the outer circle of the body. Click and draw a vertical line down to the bottom of the Front View drawing. Click to end.

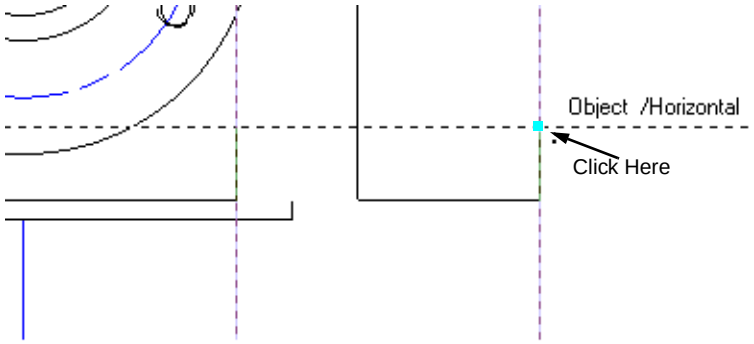


8. With the line selected, select **Guides** then **Make Guide** from the Edit menu.
9. Click the **Rectangle tool**.
10. In the Front View drawing, find the intersection of the left guideline and the bottom of the first rectangle (Object/Object cue). At the intersection click to start the rectangle.

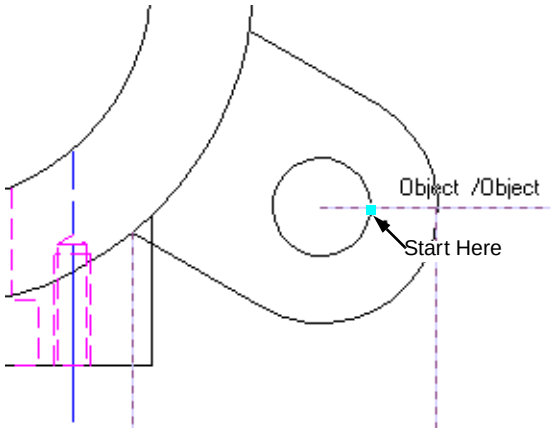


11. Move upwards then press the Tab key until the delta Y field is highlighted. Enter **8** and press the **Enter key**.

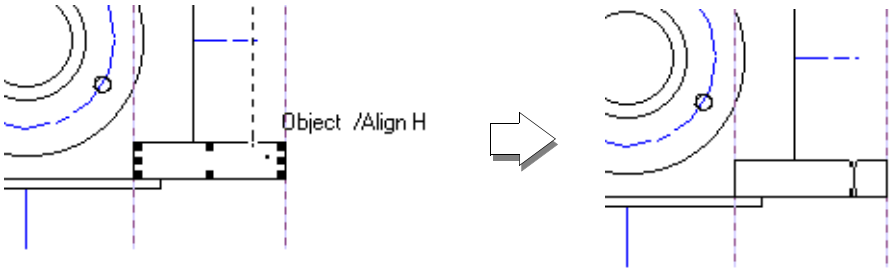
12. Move over to the right guideline until the Object/ Horizontal cue appears (you may have to move upwards a bit). Click to set the rectangle.



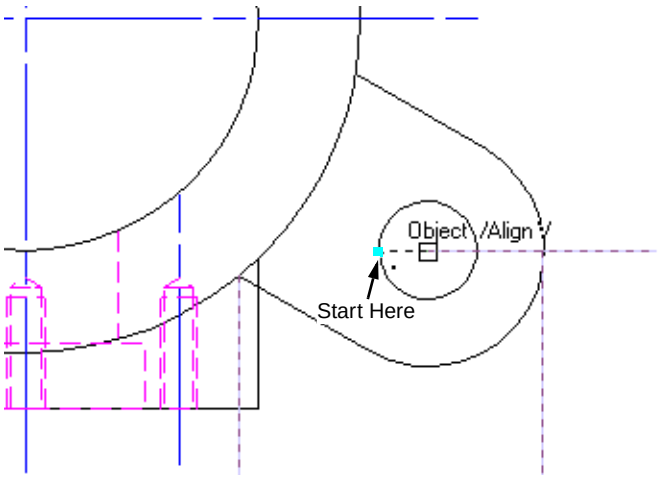
13. With this rectangle selected, select the **Fill** pulldown then select **Solid** from the Attribute palette.
14. Select the **Line tool**.
15. In the Top View drawing, locate the intersection of the guideline and the circle in the right lower ear. When the Object/ Object cue appears move downwards.



16. With the Align H cue active, move down until you reach the top of the rectangle just drawn in the Front View (Object/ Align H cue) and click. Draw a vertical line extending to the bottom of the rectangle (Object/ Vertical cue). Click to end.

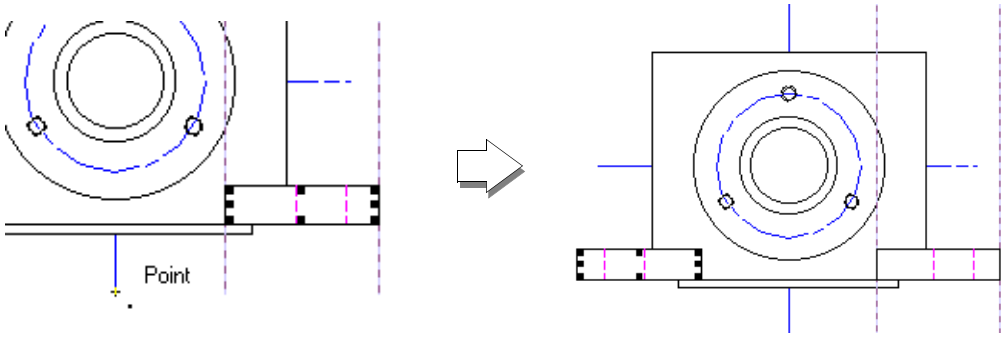


17. In the Top View drawing, use the Center cue to find the left end of the guideline in the right lower ear. Move to the left until the Object/ Align V cue appears then move downwards.



18. With the Align H cue active, move down until you reach the top of the rectangle just drawn in the Front View (Object/ Align H cue) and click. Draw a vertical line extending to the bottom of the rectangle (Object/ Vertical cue). Click to end.
19. Click the **2D Selection tool**.
20. Hold down the **Shift key** and click on the right vertical line inside the rectangle.
21. From the Object Info. palette, select the **Class** pulldown then select **Dashed Lines**.

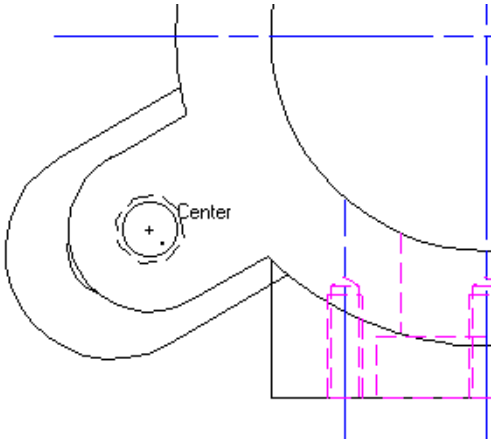
22. Hold down the **Shift key** and click the rectangle.
23. From the Organize menu, select **Group**.
24. With this new group still selected, click the **Mirror tool** from the Editing palette. Click the **Mirror and Duplicate mode** in the Mode Bar.
25. Move to the center of the body rectangle (Center cue) and click.
26. Keeping the drag line vertical, click at the bottom of the Front View vertical centerline (Point cue).



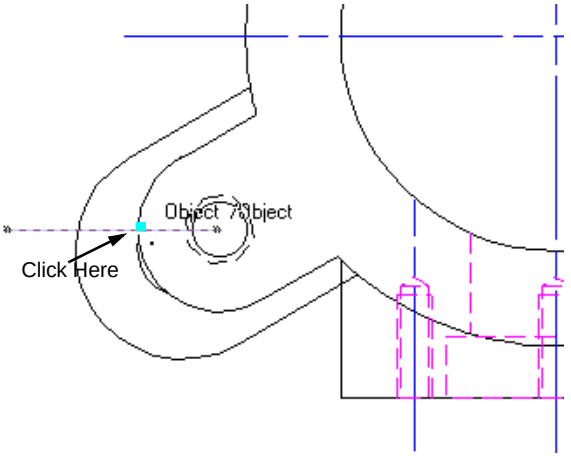
27. From the **File** menu, select **Save**.

Creating the Upper Ears

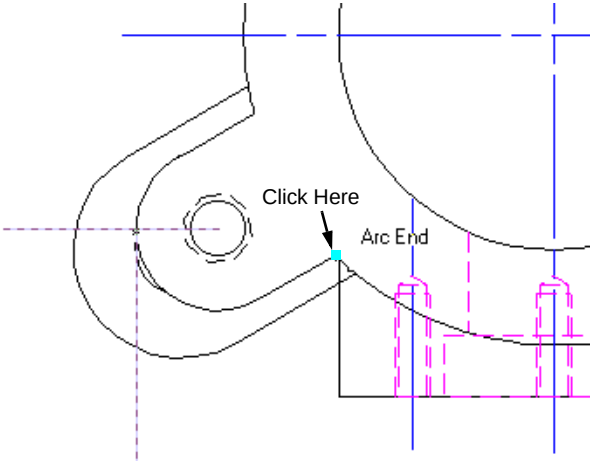
1. Click the **Line tool**.
2. In the Top View drawing, move the cursor to center of the hole in the left inner ear. When the Center cue appears, click.



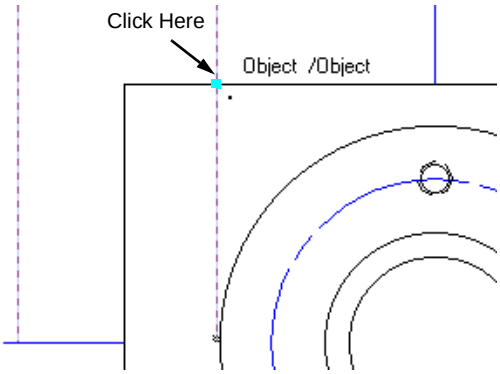
3. Draw a horizontal line to the left of the inner ear approximately **25mm** long. Click to end.
4. With the line selected, select **Guides** then **Make Guide** from the Edit menu.
5. Find the intersection of the inner ear and this guideline (Object/ Object cue). Click and draw a vertical line down to the middle of the Front View drawing (about where the horizontal centerline is). Click to end.



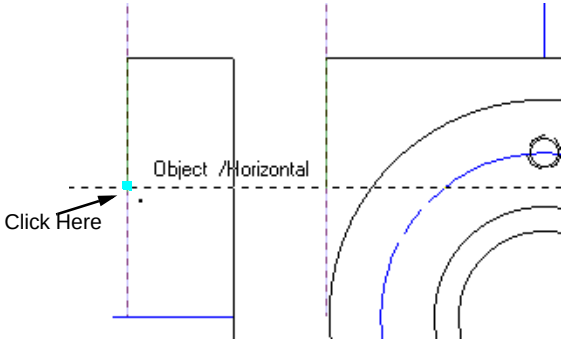
6. With the line selected, select **Guides** then **Make Guide** from the Edit menu.
7. Returning to the Top View drawing, use the Corner cue to find the intersection of the left inner ear and the outer circle of the body. Click and draw a vertical line down to the middle of the Front View drawing. Click to end.



8. With the line selected, select **Guides** then **Make Guide** from the Edit menu.
9. Click the **Rectangle tool**.
10. In the Front View drawing, find the intersection of the right guideline and the top of the first rectangle (Object/Object cue). At the intersection click to start the rectangle.

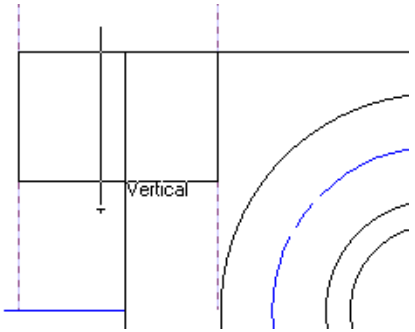


11. Move downwards then press the Tab key until the delta Y field is highlighted. Enter **-15** and press the **Enter key**.
12. Move over to the left guideline until the Object/ Horizontal cue appears (you may have to move downwards a bit). Click to set the rectangle.

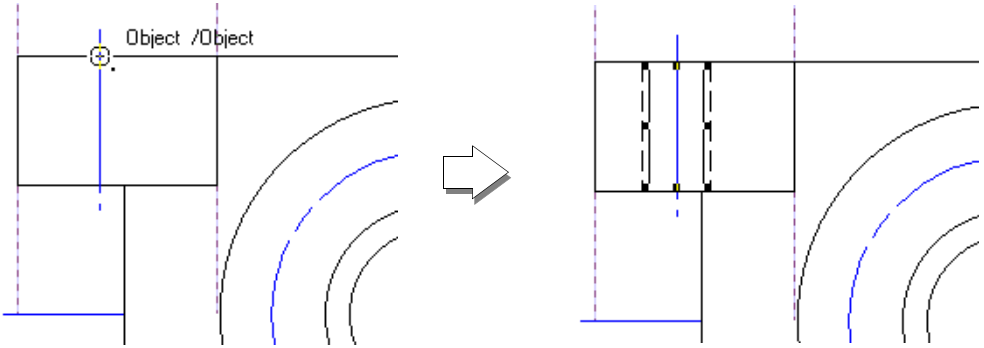


13. With this rectangle selected, select the **Fill** pulldown then select **Solid** from the Attribute palette.
14. Click the **Line tool**.
15. In the Top View drawing, move the cursor to center of the hole in the left inner ear. When the Center cue appears, move the mouse downwards without clicking.

16. In the Front View drawing, click just above the rectangle and draw a vertical line that goes through the rectangle and ends just below it. Click to end.

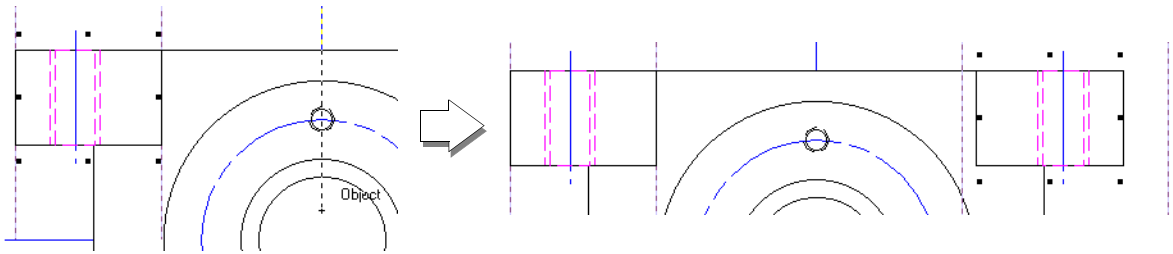


17. With the line still selected, select the **Class** pulldown then select **Centerlines** from the Object Info. palette.
18. From the Design menu, select **Drafting Aids** and then **Holes** from the pop-out.
19. Click the **Tapped** radio button for Type and the **No** radio button for Show Center Mark. Enter **8** in the Diameter field and **15** in the Total Depth field. Click the **Side view - thru hole** radio button.
20. Click **OK**.
21. Move to the intersection of the top of the rectangle just drawn and the small vertical centerline (Object/ Object cue) and click.



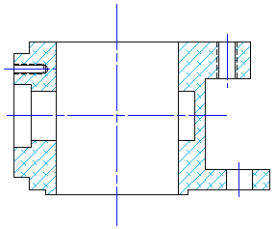
22. With the Tapped Hole still selected, select the **Class** pulldown then select **Dashed Lines** from the Object Info. palette
23. Click the **2D Selection tool**.

24. Hold down the **Shift key** and click on the small vertical centerline and on the rectangle.
25. From the Organize menu, select **Group**.
26. With this new group still selected, click the **Mirror tool** from the Editing palette.
27. Move to the top of the vertical centerline (Point cue) and click.
28. Keeping the drag line vertical, drag downwards and click near the middle of the body rectangle.



29. Click the **2D Selection tool**.
30. Click on the main vertical centerline. Hold down the **Shift key** and click the main horizontal centerline.
31. From the Tool menu, select **Send** then **Send to Front**.
32. From the File menu, select **Save**.

CREATE THE SECTION VIEW

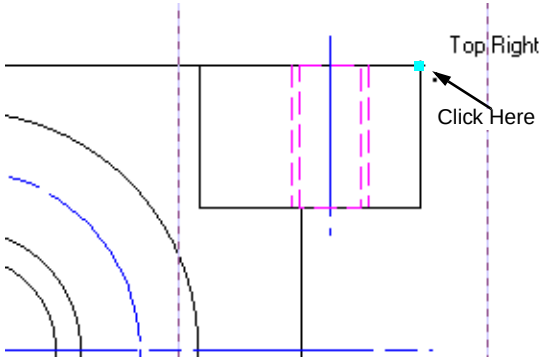


Using the Front view as a guide, we will now create the Section View.

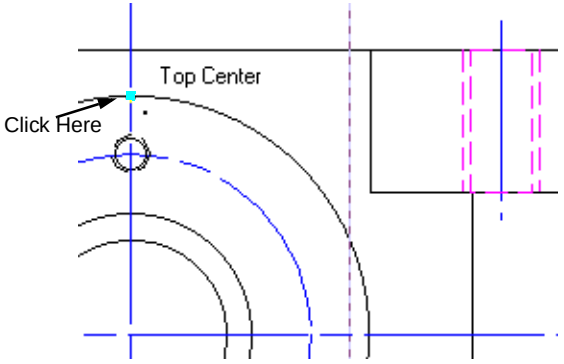
Creating The Horizontal Guides

1. Click the **Line tool**.

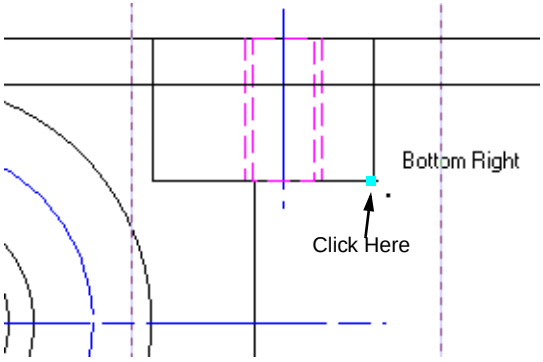
2. Using the Corner cue, find the top right corner of the upper right ear and click. Draw a horizontal line approximately **170mm**. Click to end.



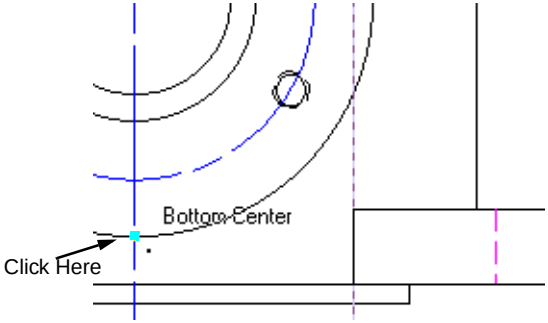
3. Find the top center of the Front Boss (Top Center cue) and click. Draw a horizontal line that ends around the same distance as the previous line then click.



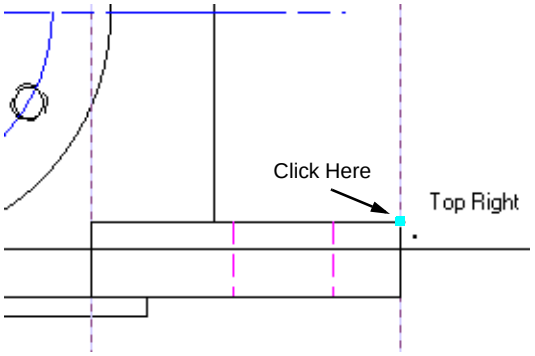
4. Find the bottom right of the upper right ear (Bottom Right cue) and click. Draw a horizontal line that ends around the same distance as the previous line then click.



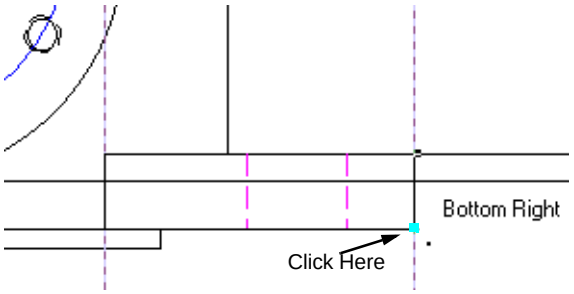
5. Find the bottom center of the Front Boss (Bottom Center cue) and click. Draw a horizontal line that ends around the same distance as the previous line then click.



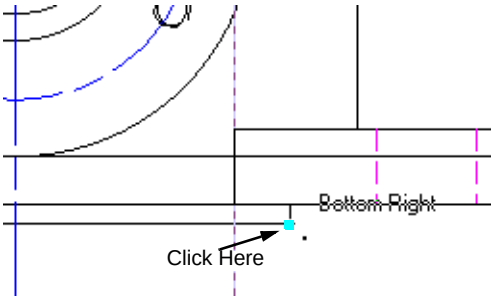
6. Find the top right of the lower right ear (Top Right cue) and click. Draw a horizontal line that ends around the same distance as the previous line then click.



7. Find the bottom right of the lower right ear (Bottom Right cue) and click. Draw a horizontal line that ends around the same distance as the previous line then click.



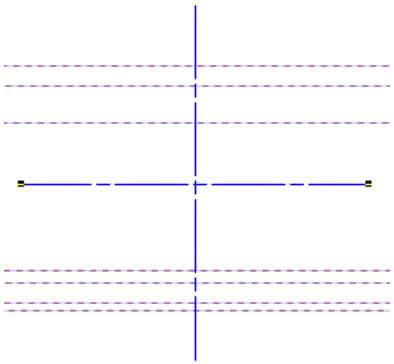
8. Find the bottom right of the lower most rectangle (Bottom Right cue) and click. Draw a horizontal line that ends around the same distance as the previous line then click.



9. Click the **2D Selection tool**.
10. With the bottom-most horizontal line still selected, hold down the **Shift key** and click on the other 6 horizontal lines.
11. From the Edit menu, select **Guides** and then **Make Guide**.
12. From the File menu, select **Save**.

Creating The Centerlines

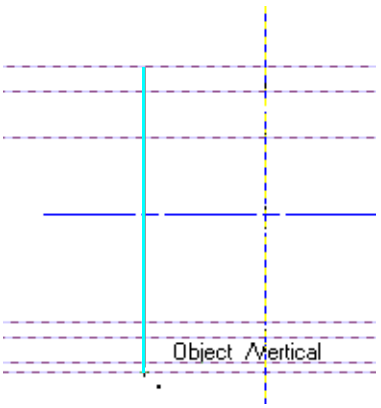
1. Click the **Line tool**.
2. Utilizing the Data Display Bar, move the cursor until X reads **20** and Y reads **-30** then click.
3. Drag vertically downwards then press the **Tab key** until you highlight the L field.
4. Enter **90** then press the **Enter key**. Click to end.
5. With this line selected, select the **Class** pulldown then select **Centerlines** from the Object Info. palette.
6. Move to the left of the vertical centerline. When X reads **-25** and Y reads **-75** click.
7. Drag horizontally a little bit to the right then press the **Tab key** until you highlight the L field.
8. Enter **90** then press the **Enter key**. Click to end.
9. With this line selected, select the **Class** pulldown then select **Centerlines** from the Object Info. palette.



10. From the File menu, select **Save**.

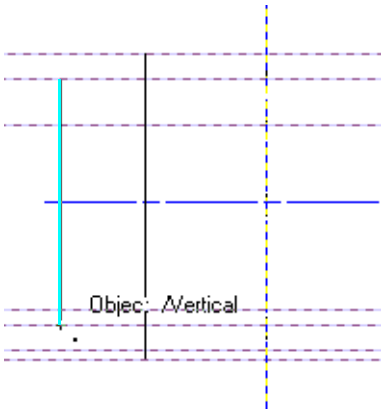
Creating The Left Side Guides

1. Double click the **Smart Edge constraint**.
2. Enter **25** in the Snap Offset field.
3. Click **OK**.
4. Click the **Line tool**.
5. Move the cursor over the vertical centerline and press the **T key**.
6. Move to the left of the centerline until the Offset cue appears. Starting at the top horizontal guideline (Object/ Offset cue), click and draw a vertical line that ends at the bottom horizontal guideline (Object/ Vertical cue). Click to end.

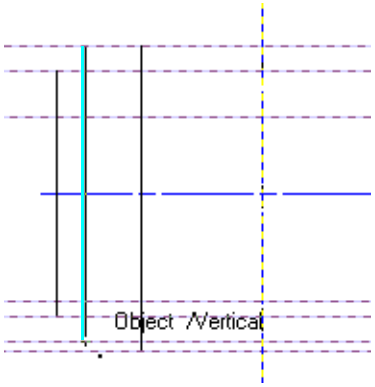


7. Double click the **Smart Edge constraint**.
8. Enter **42** in the Snap Offset field.
9. Click **OK**.
10. Move the cursor over the vertical centerline and press the **T key**.

11. Move to the left of the centerline until the Offset cue appears. Click at the top Boss guideline (Object/ Offset cue). Drawing vertically, click to end at the bottom Boss guideline (Object/ Vertical cue).

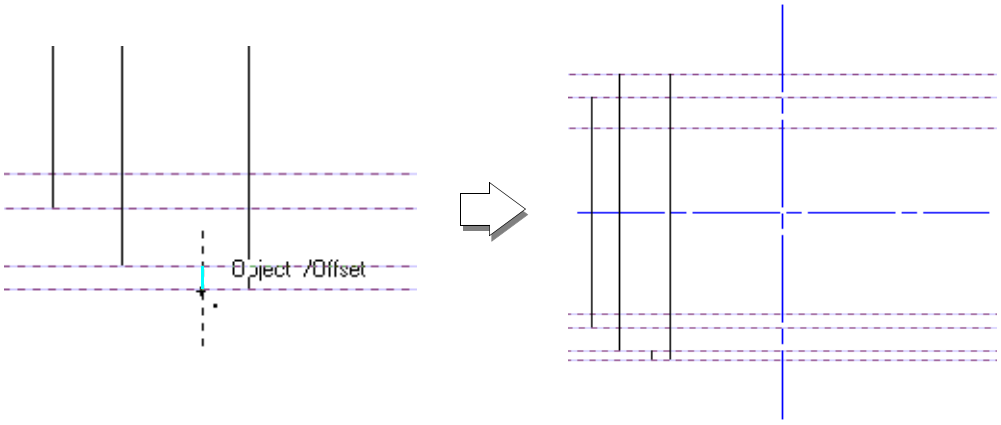


12. Double click the **Smart Edge constraint**.
13. Enter **36** in the Snap Offset field.
14. Click **OK**.
15. Move the cursor over the vertical centerline and press the **T key**.
16. Move to the left of the centerline until the Offset cue appears. Click and draw a vertical line starting at the top horizontal guideline (Object/ Offset cue). Click to end at the bottom guideline of the lower ear (Object/ Vertical cue).

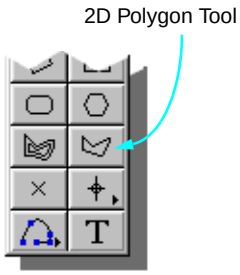


17. Double click the **Smart Edge constraint**.
18. Enter **29** in the Snap Offset field.
19. Click **OK**.

20. Move the cursor over the vertical centerline and press the **T key**.
21. Move to the left of the centerline until the Offset cue appears. Click and draw a vertical line starting at the bottom guideline of the lower right ear (Object/Offset cue). Click to end at the bottom horizontal guideline (Object/ Offset cue).



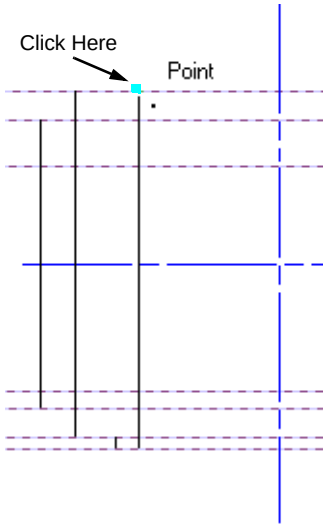
22. From the File menu, select **Save**.



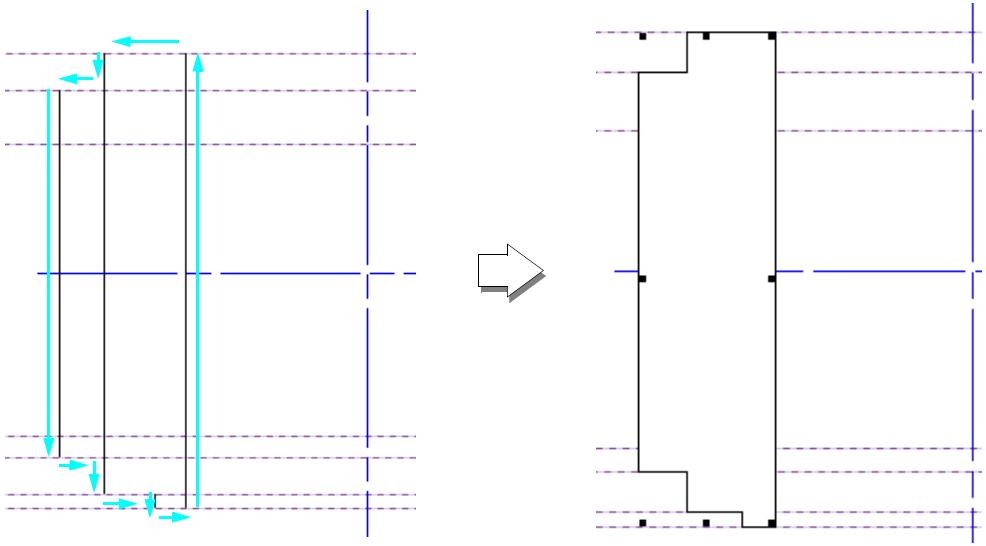
Creating The Left Side of the Body

1. Click the **2D Polygon tool**.

2. Move to the intersection of the top body guideline and the vertical line closest to the vertical centerline (Object/ Object cue) then click.

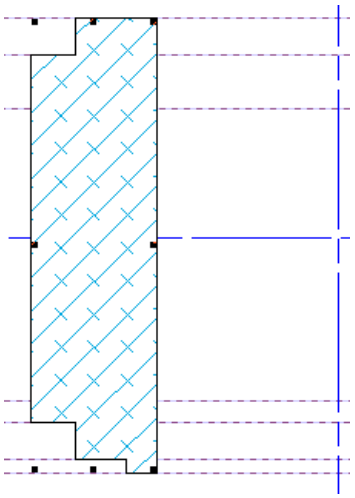


3. Moving in the left direction, trace the outline of the four vertical lines as shown.



At the last click location, the polygon is closed indicating that the operation is finished.

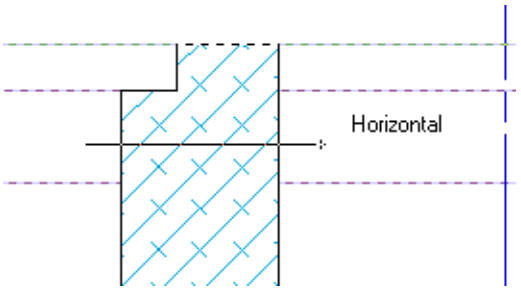
4. With the polygon still selected, select the **Fill** pulldown then select **Hatch** from the Attributes palette. Select the **Hatch** Pattern pulldown then select **Aluminum-3 x 45**.



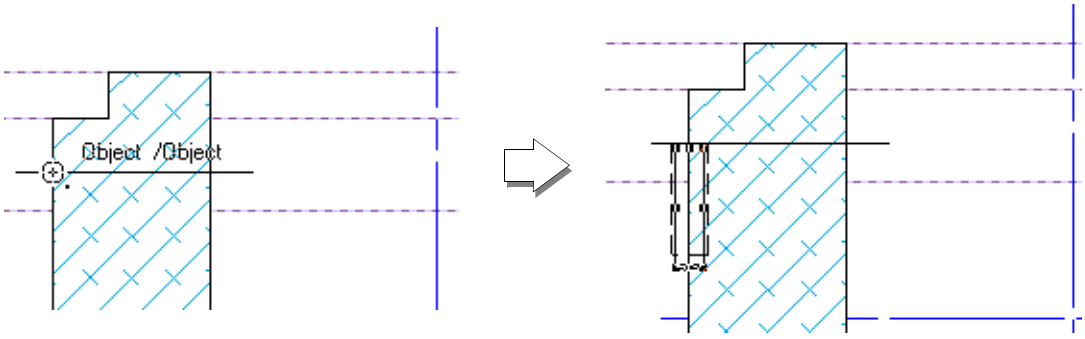
5. From the File menu, select **Save**.

Create the Tapped Hole

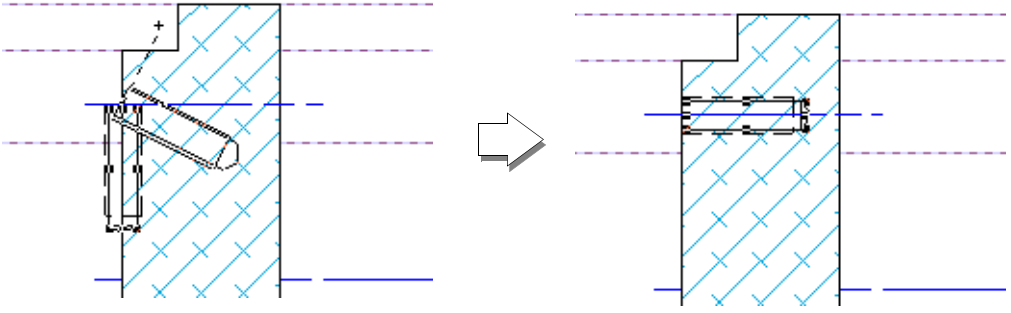
6. Double click the **Smart Edge constraint**.
7. Enter **11** in the Snap Offset field.
8. Click **OK**.
9. Click the **Line tool**.
10. Move the cursor over the top horizontal guideline and press the **T key**.
11. Move downwards until the Offset cue appears. Click and draw a line that starts to the left and goes through the polygon as shown. Click again to end.



12. With this line selected, select the **Class** pulldown from the Object Info. palette then select **Centerlines**.
13. From the Design menu, select **Drafting Aids** and then **Holes** from the pop-out.
14. Click the **Tapped** radio button for Type and the **No** radio button for Show Center Mark. Enter **4** in the Diameter field and **12** in the Total Depth field.
15. Click **OK**.
16. Click at the intersection of the new horizontal centerline and the left side of the polygon (Object/Object cue).



17. From the Editing palette, click the **2D Rotate tool**.
18. Click at the intersection of the tap hole and the left side of the polygon (Top Center cue).
19. Drag to the right of the tap hole and click.
20. Rotate the line upwards until the tap hole is facing into the polygon then click to set.

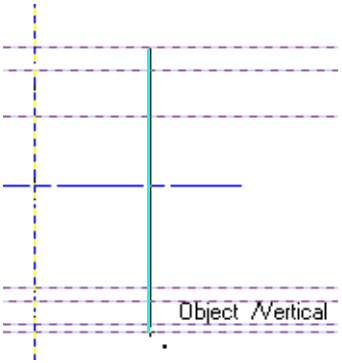


21. With the tap hole still selected, select the Fill pulldown and select **Solid** from the Attribute palette.

22. Select the **2D Selection tool**.
23. Click on the centerline of the tap hole just drawn.
24. From the Tool menu, select **Send** then **Send to Front**.
25. From the File menu, select **Save**.

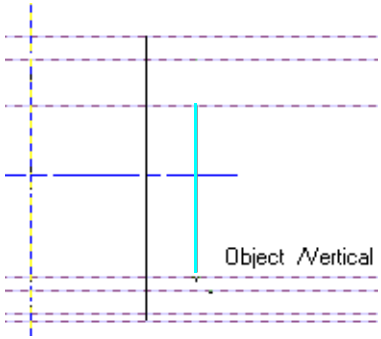
Creating The Right Side Guidelines

1. Double click the **Smart Edge constraint**.
2. Enter **25** in the Snap Offset field.
3. Click **OK**.
4. Click the **Line tool**.
5. Move the cursor over the vertical centerline and press the **T key**.
6. Move to the right of the centerline until the Offset cue appears. Click on the top horizontal guideline (Object/ Offset cue. Click to end at the bottom horizontal guideline (Object/ Vertical cue).

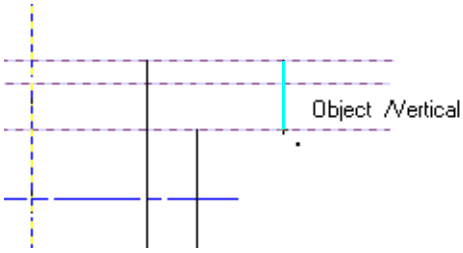


7. Double click the **Smart Edge constraint**.
8. Enter **36** in the Snap Offset field.
9. Click **OK**.
10. Move the cursor over the vertical centerline and press the **T key**.

11. Move to the right of the centerline until the Offset cue appears. Click on the bottom guideline of the upper ear (Object/ Offset cue). Click to end at the top guideline of the lower ear (Object/ Vertical cue).



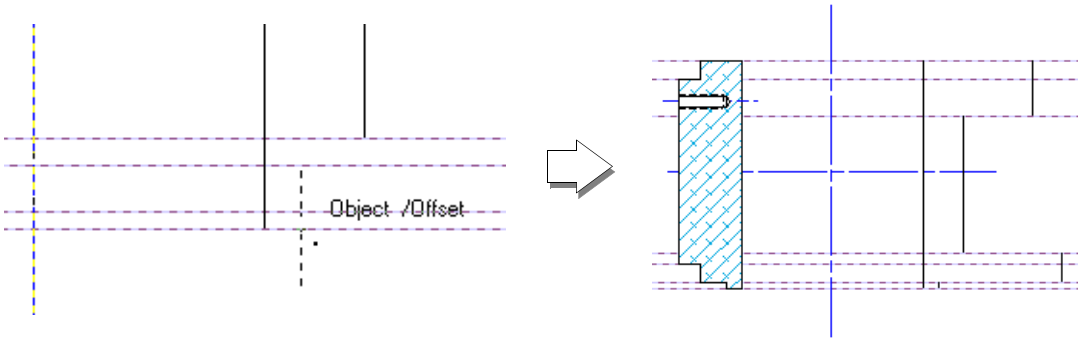
12. Double click the **Edge Snap constraint**.
13. Enter **54.5** in the Snap Offset field.
14. Click **OK**.
15. Move the cursor over the vertical centerline and press the **T key**.
16. Move to the right of the centerline until the Offset cue appears. Click on the top horizontal guide line. Click to end at the bottom guideline of the upper ear.



17. Double click the **Smart Edge constraint**.
18. Enter **62.5** in the Snap Offset field.
19. Click **OK**.
20. Move the cursor over the vertical centerline and press the **T key**.

21. Move to the right until the Offset cue appears. Click on the top guideline of the lower ear (Object/ Offset cue). Click to end at the bottom guideline of the lower ear (Object/ Vertical cue).

22. Double click the **Smart Edge constraint**.
23. Enter **29** in the Offset field.
24. Click **OK**.
25. Move the cursor over the vertical centerline and press the **T key**.
26. Move to the right of the centerline until the Offset cue appears. Click on the bottom guideline of the lower ear (Object/Offset cue). Click to end at the bottom body guideline (Object/ Offset cue).

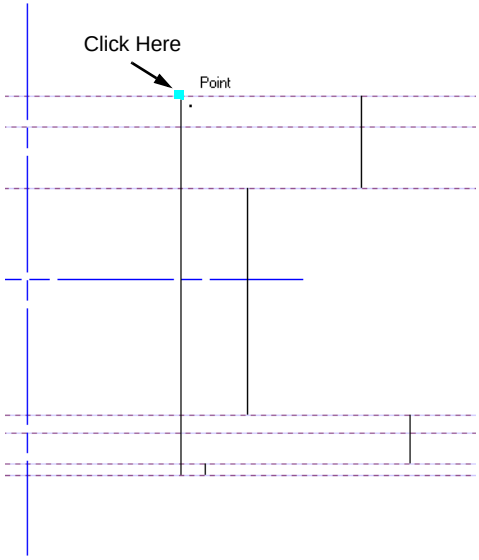


27. From the File menu, select **Save**.

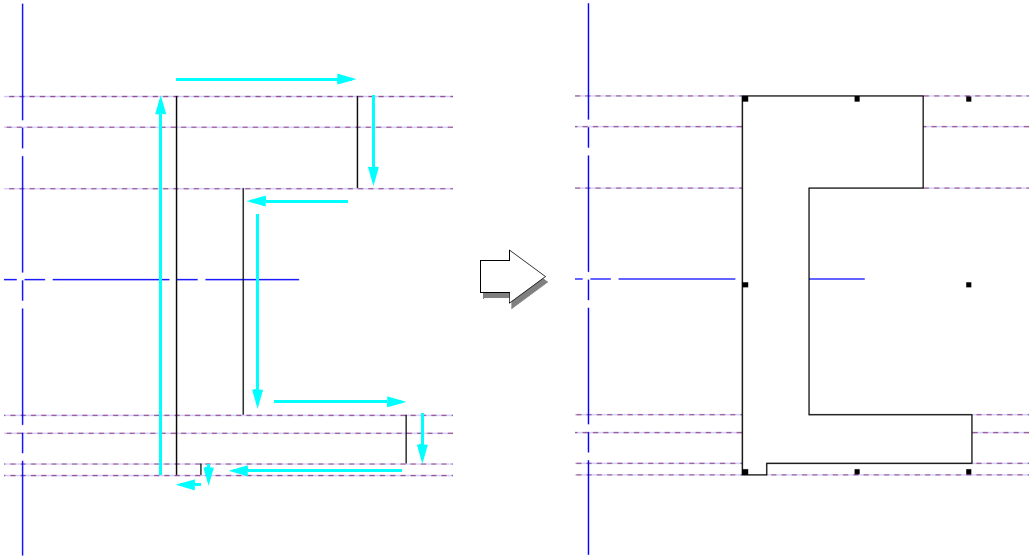
Creating the Right Side of the Body

1. Click the **2D Polygon tool**.

2. Move to the intersection of the top body guideline and the vertical line closest to the vertical centerline (Object/ Object cue) then click.

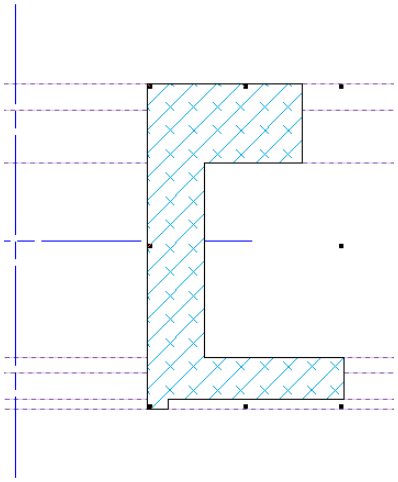


3. Moving in the right direction, trace the outline of the five vertical lines as shown.



At the last click location, the polygon is closed indicating that the operation is finished.

4. With the polygon still selected, select the **Fill** pulldown then select **Hatch** from the Attributes palette. Select the **Hatch** Pattern pulldown and select **Aluminum-3 x 45**.

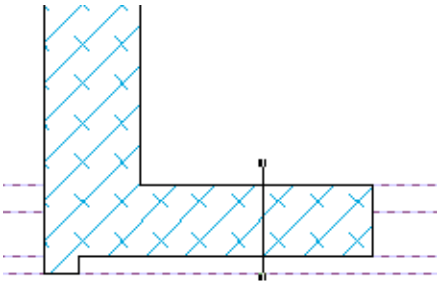


5. From the File menu, select **Save**.

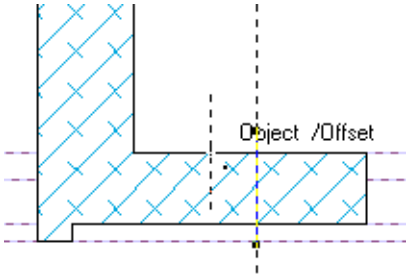
Creating the Drilled Hole

1. Double click the **Smart Edge constraint**.
2. Enter **50** in the Snap Offset field.
3. Click **OK**.
4. Click the **Line tool**.
5. Move the cursor over the vertical centerline and press the **T key**.

6. Move to the right until the Offset cue appears. Click and draw a line that starts above and goes through the lower ear of the polygon as shown. Click again to end.

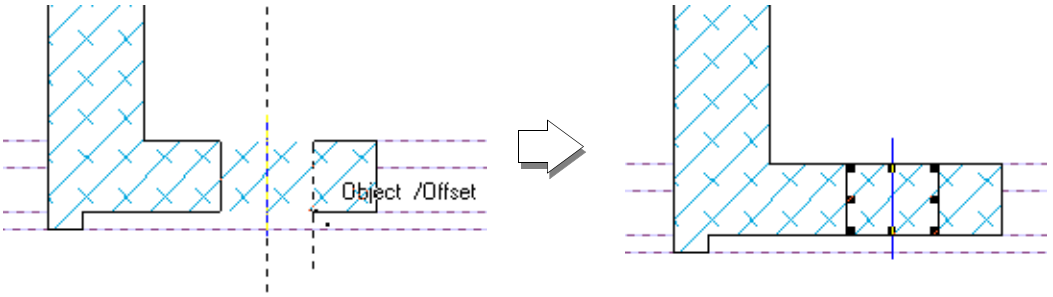


7. With this line still selected, select the Class pulldown then select **Centerline** from the Object Info. palette.
8. Double click the **Smart Edge constraint**.
9. Enter **5.25** in the Snap Offset field.
10. Click **OK**.
11. Click the **Rectangle tool**.
12. Move the cursor over the vertical centerline just created and press the **T key**.
13. Move to the left until the Offset cue appears. Move to the intersection of the top of the lower ear and the offset line (Object Offset cue) then click.



14. Move downwards to the bottom of the ear (Object/ Vertical cue).

15. Moving right along the bottom of the ear, click to end when the Object/ Offset cue appears.

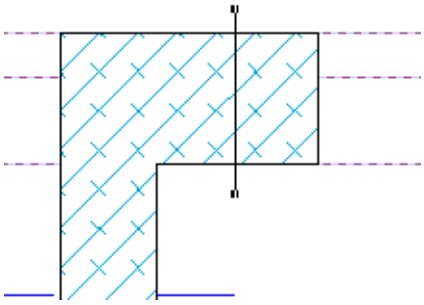


16. With the rectangle still selected, select the Fill pulldown then select **Solid** from the Attributes palette.
17. Select the **2D Selection tool**.
18. Click on the centerline of the rectangle just drawn.
19. From the Tool menu, select **Send** then **Send to Front**.
20. From the File menu, select **Save**.

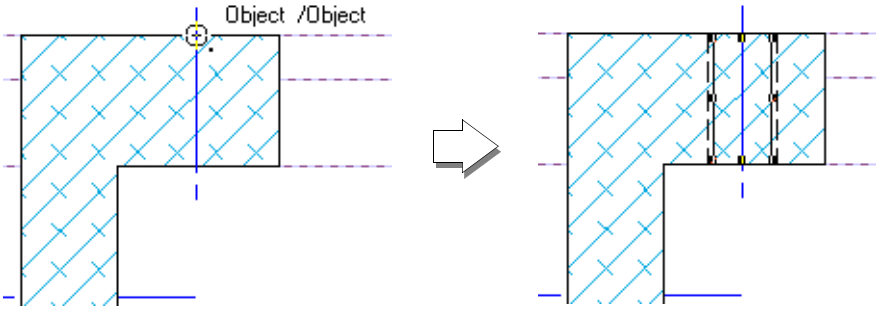
Creating the Tapped Hole

1. Double click the **Edge Snap constraint**.
2. Enter **45** in the Snap Offset field.
3. Click **OK**.
4. Click the **Line tool**.
5. Move the cursor over the main vertical centerline and press the **T key**.

6. Move to the right until the Offset cue appears. Click and draw a line that starts above the upper ear and goes through it as shown. Click again to end.



7. With the line still selected, select the Class pulldown then select **Centerline** from the Object Info. palette.
8. From the Design menu, select **Drafting Aids** and then **Holes**.
9. Click the **Tapped** radio button for Type and the **No** radio button for Show Center Mark. Enter **8** in the Diameter field and **15** in the Total Depth field. Select the **Side View - thru hole** radio button for View.
10. Click **OK**.
11. Click at the intersection of the vertical line just drawn and the top of the polygon (Object/ Object cue).



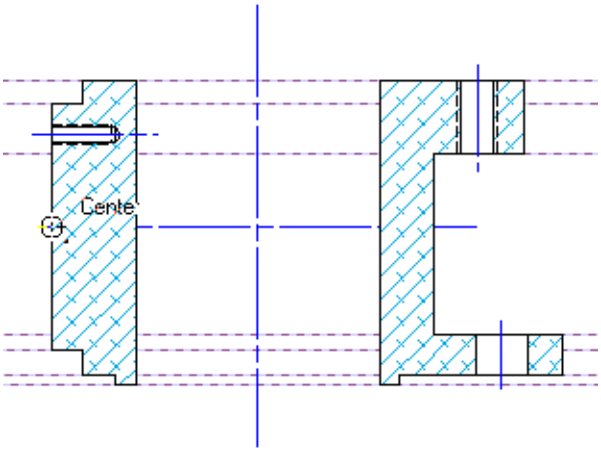
12. With the tap hole still selected, select the **Fill** pulldown then select **Solid** from the Attributes palette.
13. Select the **2D Selection tool**.
14. Click on the centerline of the tap hole just drawn.
15. From the Tool menu, select **Send** then **Send to Front**.

16. From the File menu, select **Save**.

Finishing the The Section View

Create the Counter Bore

1. Double click the **Rectangle tool**.
2. Enter **7** for delta X and **25.5** for delta Y. Click the **Left Center** alignment radio button.
3. Click **OK**.
4. Move to the intersection of left side of the left polygon and the horizontal centerline (Center cue) then click.

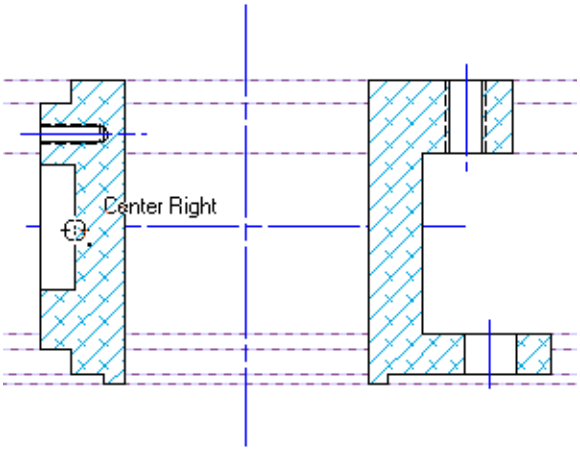


5. With this rectangle still selected, select the **Fill** pulldown then select **Solid** from the Attribute palette.
6. From the File menu, select **Save**.

Create the Drilled Hole

1. Double click the **Rectangle tool**.
2. Enter **67** for delta X and **20** for delta Y.
3. Click **OK**.

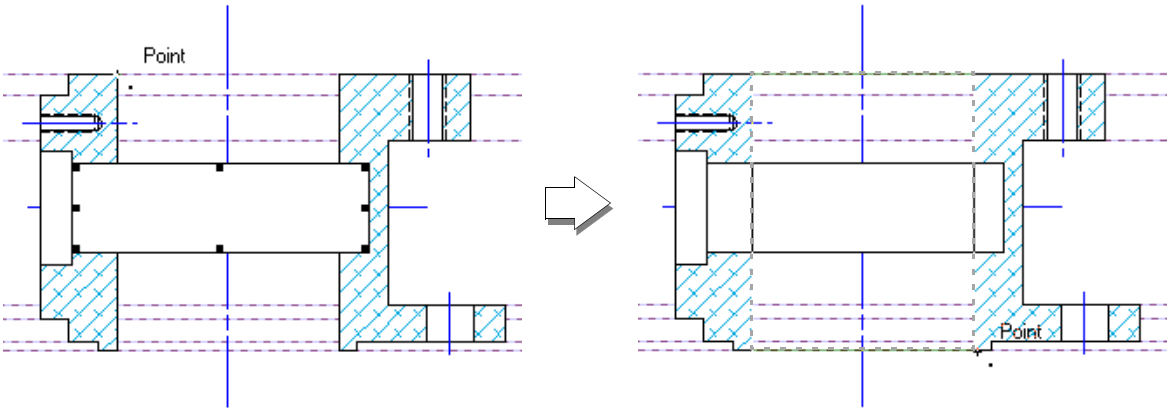
4. Click at the center right of the rectangle just created (Center Right cue).



5. With the rectangle still selected, select the **Fill** pulldown then select **Solid** from the Attribute palette.
6. From the File menu, select **Save**.

Creating the Bored Hole

1. Select the **Rectangle tool**.
2. Click at the top right of the left polygon (Point cue). Drag diagonally to the bottom left on the right polygon then click (Point cue).



3. With the rectangle still selected, select the **Fill** pulldown then select **Solid** from the Attribute palette.
4. Click the **2D Selection tool**.
5. Click on the main vertical centerline. Hold down the **Shift key** and click the main horizontal centerline.
6. From the Tool menu, select **Send** then **Send to Front**.
7. From the Edit menu, select **Guides** and then **Hide Guides**.
8. From the File menu, select **Save**.