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CAE-Link Corporation

**Building Design and
Engineering Services**

HVAC Designer 02-05

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AutoCAD 2000 - 2002, and 2005

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PRODUCTION, PRODUCTION, PRODUCTION

Congratulations. You have just installed (or about to install) the next generation in duct system design tools. CAE-Link Corporation has worked with duct design systems since 1987 and created the first commercially available automatic design system, T2A for Trane Corporation, in 1988. We are directed by registered Mechanical Engineers and know what is required for PRODUCTION of the designs and drawings you need.

We have studied and tested different methods. Some have had great success while most have just been hum. As you will see, this system provides the drawing methods that have been prevalent for years, as well as the method required to be PRODUCTIVE. HVAC Designer is a complete HVAC design package used to produce working drawings. It does NOT create 3D ductwork, it does NOT provide a material takeoff, it does NOT automatically create your HVAC drawings, and it does NOT have the bells and whistles found in many of the other HVAC systems.

HVAC Designer is a PRODUCTION tool used to create 2D HVAC drawings in the most efficient manner possible. Currently, it is a manual HVAC design system. We have found the most efficient method to create HVAC drawings is to follow the same basic steps that we have followed for years and years.

1. Calculate the building loads and air distribution requirements.
2. Select the air handling equipment.
3. Locate and tag all outlets on the drawing.
4. Create a schematic design (one-line layout) of the duct system.
5. Size all ductwork.
6. Draw, coordinate, and note the two-line duct system.

The above steps represent a very simplistic description, but are in fact the fundamental design method that has been employed by engineers and designers for years to create the final construction documents. As you may note, drawing the ductwork is a small part of the design process, but one of the most important. In many cases, the drawing of the system consumes more time than all other steps. Normally, this is because of the method employed to create the drawing. We typically perform steps 3 through 6 simultaneously. This is not the way to work productively. The most important steps are 3 through 5. Create a comprehensive schematic and the remainder is simple. As you will see in the tutorial, these steps work very effectively and efficiently to create final drawings, but do require up-front design and planning.

The intent of the final drawing is to convey information to the contractor. His job is to convert that information into a working HVAC system. As engineers and designers, we must be accurate, but we cannot model the system. We provide interference checks with the Architectural, Structural, Electrical, and all other trades in the course of normal design. We do not normally have the fees, which would provide the time to get into the intricate details of modeling the HVAC system in as 3 dimensional drawing.

HVAC Designer provides three methods of drawing ductwork:

1. Out in space
2. Extended from an existing connector, line, or polyline segment.
3. Centerline.

All three modes will be used in creating working drawings. As you will see in the tutorial, we will work primarily with the centerline method. This is the fastest method to employ for creating completed HVAC drawings. Simply locate the outlets, the air-handling unit, and the terminal units (if applicable). Next, connect the components with lines, forming a basic schematic design (or design development) drawing.

Plot the schematic design sketch and size all components. This is a good time to insure proper coordination with all disciplines to insure proper sizing and fit of the duct system. Once the schematic design is complete, the insertion of fittings and duct sections becomes a simple task to create the final working drawing.

To see how all this works, we recommend you proceed through the next couple of sections before attempting to dive in and use the system. This should take less than an hour, and will provide a powerful foundation for mastering the use of the system. Once you have completed the tutorial, you will quickly master any fittings not covered.

Thank you for purchasing the CAE-Link HVAC Designer. Should you have any problems with the system, or have need for additional features, be sure to let us know. If you experience bugs, please provide enough detail in your description for us to duplicate the problem. If we can duplicate it, we can fix it.

The fastest way to get our attention is email. Phone support has become a thing of the past. One exception is your license key. If you have a machine that requires a new key, call us. We will generate your new key while you are on the phone. We know how important it is to maintain production. We attempt to respond to all email inquires within 48 hours depending on the difficulty of the problem you have found. If we are having difficulty duplicating your problem or correcting it, we will email you and keep you up to date on our progress. All updates will be posted at our web site, so visit us on a regular basis to insure you have the latest version..

Installing HVAC Designer

Before installing HVAC Designer, log onto the CAE-Link web site and obtain a license code for the system. Without a license code, the system cannot be used. Be sure to fill in all information complete and double check to insure your email address and the volume serial number are correct. If your email address is wrong, we have no way of contacting you. Also, if your volume serial number is not correct, we cannot create a license code. All CAE-Link software is licensed and must have a valid license to operate.

The volume serial number is from your C: (or boot drive). The easiest way to get it is to open a dos window and go to c:\ (the root directory of C). Next, key in DIR/P and look at the top of the first page of the directory listing. DOS will report a Volume Serial Number. That is the number we need to generate you a license code to use our programs. If you have problems, please send us an email and let us know.

If we do not respond in a couple of days, something is wrong. Email us again to make sure we have the proper information. If once again we do not respond, call us. We have a toll free number for the US. Outside the US try a different e-mail address.

Installation

The following steps will install HVAC.

- 1 Insure ACAD is closed. Download HVAC_xx.EXE and place the file into a working directory (c:\temp), or open the file directly from the download and it will take care of the temporary files.
- 2 If saved, open Explorer and double click on the file name HVAC_xx.EXE. This will start the installation program. The files will automatically extract, the directories will be created, and the files will be placed in the proper location. The directory C:\Program Files\Caelink will be created. This will become the root for all CAE-Link software. Sub-directories will automatically be created and the files will be placed in the proper location. As the files are installed, respond to the questions as required.
- 3 Start AutoCAD and from the Tools menu, select Options... When the options dialog is displayed, select the Files tab. Next select the Support File Search Path option and make sure the path "c:\Program Files\Caelink" is present. The path should have been added during the installation. All other paths will be found by the system as required.
- 4 From the Tools menu, choose "Load Application..." When the dialog is displayed, check the Add to History box and select File of type "AutoLISP Files (*.lsp)". Next find the file
C:\Program Files\Caelink\hvac\load_hvac.lsp
Double click on the file name and it will be displayed in the History List and the display will indicate it successfully loaded. Next, select the Close button.
- 5 During the load process, the system will detect the absence of your license. A dialog will be displayed indicating the Security Failed. Select the License button and enter the license Code in the box provided. If the code is entered correctly, the system will complete the load process and will be ready for use. If not, everything will be unloaded.

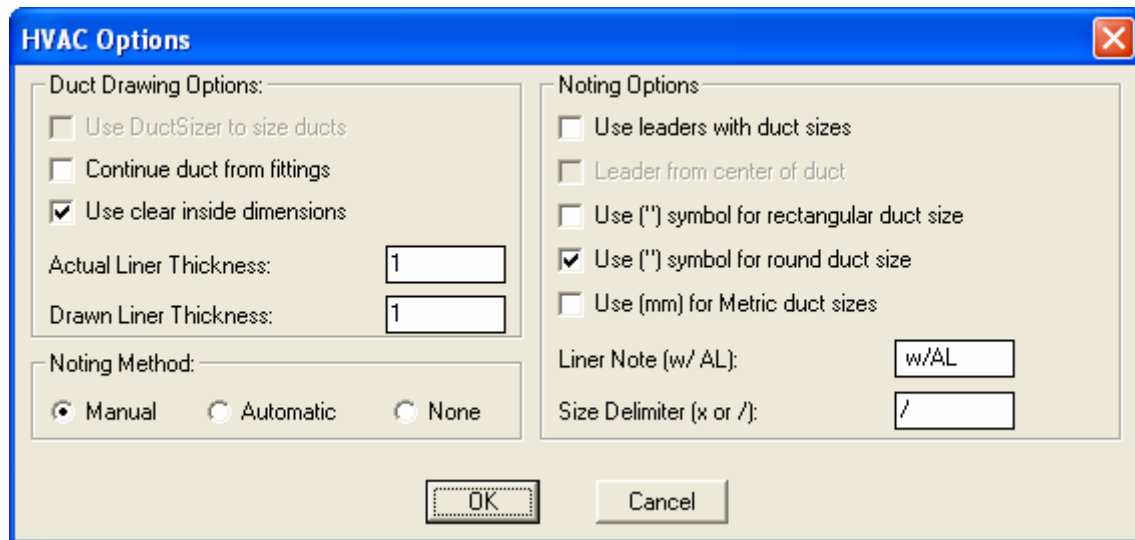
Congratulations

You have successfully installed HVAC Designer. To uninstall the software, from the HVAC menu, select Utilities then Unload HVAC Menu. When the menu is unloaded, open Windows Explorer and delete the directory you no longer want. In this case, you would delete HVAC. If you want to delete all CAE-Link software, delete the directory C:\Program Files\Caelink.

There is no need to keep a backup copy of the install file hvac_xx.exe, but you may if you wish. If you need to install the software again, simply download another copy from our web site at caelink.com. We intend to provide updates and enhancements on a regular basis, so if you download a new file, you will be downloading the most up-to-date files that are available.

HVAC Options

The HVAC Options provide a means of setting the Duct Drawing Options, Noting Method, and the Noting Options. When HVAC Options is selected from the Options menu, the following dialog is displayed.



Drawing Options

The drawing options allow you to determine how to continue the ductwork, how to size the duct, and how to handle duct liner for your final presentation.

Use DuctSizer to size ductwork:

This option is not implemented in this release.

Continue duct from fittings:

Selecting this option will cause the system to continue drawing a duct from the currently drawn fitting unless the fitting is drawn based on the center point. This option only applies to fittings that will have a duct extending from the discharge of the fitting. In cases where more than one connection is available such as tees, you will be asked to select the connector to continue from. If this box is not selected, the fitting will be drawn and the function will be complete.

Use clear inside dimensions:

Selecting this option will cause the duct sizes to be noted on the drawing as clear inside dimensions. This only applies when the ductwork is lined. If this option is not selected, all duct sizes will be sheet metal sizes. For example, if a 12"x12" duct is lined and the option is selected, the duct size noted on the drawing will be 10/10 w/1" AL (depending on the noting option settings).

Actual Liner Thickness:

Input the actual liner thickness. This is used to calculate the clear inside dimensions. This is not used to draw the liner in the duct. See drawn liner thickness.

Drawn Liner Thickness:

Input the liner thickness to be drawn. Normally, at 1/8" scale, if the liner were indicated at the actual thickness, it would bleed into the duct line when plotted and would not be seen. We have found 2" for the liner typically works well for all scales. Experiment and input the thickness that works best for you.

Noting Method

The noting method determines whether duct sizes will be placed in the drawing and how to place them. When noting is placed in the drawing, it will use the same settings and layers that are defined within the Noting System. The duct size will be placed in the drawing using the same text size and on the layer defined in noting for "Noting Text". The leader will be placed on the layer defined in noting for "Noting Leader".

Manual:

The manual method requires you to place the note in the appropriate position. This requires an additional selection of points during the processing of a duct section. It provides the means of placing the note in the drawing in a location that will not interfere with other entities in the drawing.

Automatic:

The automatic method automatically places the leader and note in the drawing.

None:

This option will shut off noting altogether. No duct sizes will be placed in the drawing.

Noting Options

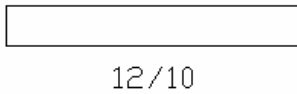
The noting options provide the means of defining the noting to match your drawing requirements. In the automatic and manual mode with leaders, the leader arrow is always located in the center of the duct section and extended in the direction directed by you. If automatic noting is selected, the leader will always be drawn to the top or left side of the duct section. In all noting modes, if the duct size can be located inside the duct section, it will be automatically placed inside the duct. This will only occur if the duct section has the proper width and length.

Use leaders with duct sizes:

Use leaders with duct sizes will produce a note with a leader from the center or side of the duct based on the next option as follows:



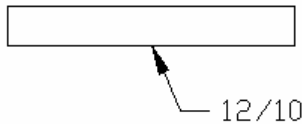
This option takes the least amount of drawing space when using leaders. When not selected, the noting will be created without leaders as follows:



No leader takes the least amount of space, but could be the most confusing. The leader will be eliminated and the duct size will be placed in line with the duct if the size can not be placed inside the duct.

Leader from center of duct:

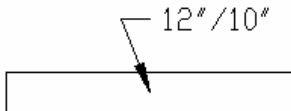
When selected, the leader will be drawn from the center of the duct as displayed above; otherwise, it will be extended from the side of the duct as follows:



When the note is positioned from the side of the duct section, it will take the most space in your drawing.

Use inch symbol in English size:

When this option is selected, the inch symbol will be used when noting the duct size.

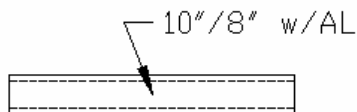


Use mm symbol in Metric size:

When this option is selected, mm will be used when noting the duct sizes in metric units, similar to the inch symbol discussed above.

Liner Note (w/AL):

This allows you to provide the noting method for the liner. Experiment with the note and you will get exactly what you want.



In this example, the duct size is actually 12"x10", but clear inside dimensions was selected. The display inch symbol was selected and the liner note was "w/AL". You can make it "w/1" AL" or anything you wish to use.

Size Delimiter (x or /):

This is similar to the Liner Note described above. You can define the delimiter to use between the width and depth of the duct. The examples in this document typically use / as in **24/12** to minimize the space on the drawing. You may want to use an x without the inch marks as in **24x12** or an x with inch

marks as in **24"x12"**. As you can see, you can define the note to match your company standards for your final drawing.

Runout Options

The Runout Options provide a means of setting the Runout Drawing for Round Runouts, Square Runouts, the Offset Distances and the Noting Method. When Runout LT Options is selected from the HVAC LT Options menu, the following dialog is displayed.

Round Runouts

Outlet elbow type:

This is the elbow to use at the connection to the diffuser. There are currently 5 outlet elbow types available for round runouts. They are Rigid Short Radius, Rigid Long Radius, Flex Short Radius, Flex Long Radius, and Gored. Select the elbow to use for all runout outlet elbows.

Offset elbow type:

This is the elbow to use when extending the runout to a trunk and an elbow is required. If the first elbow is calculated to be flexible based on the length of flexible duct to be used, then this setting is not used at the first elbow. There are currently 5 offset elbow types available for round runouts. They are Rigid Short Radius, Rigid Long Radius, Flex Short Radius, Flex Long Radius, and Gored. Select the elbow to use for all runout offset elbows.

Trunk tap type:

This is the tap to use at the trunk for all round runouts. The options are Straight Spin-in, Conical Spin-in, and 1-1/2 square to round tap.

Flexible Length:

This is the flexible duct length to use for the runout. The length is calculated along the centerline of the duct run starting at the connection to the diffuser and extending in the direction of the main trunk. If the flexible distance is met at the middle of an elbow, the entire elbow will be drawn as flexible ductwork. If the entire runout is to be flexible ductwork, enter 999 for the length.

Include damper at discharge of tap:

If this option is selected, a damper will be placed at the discharge of the tap. The damper is drawn as a single line symbol representing a volume or hand damper.

Square Runouts

Outlet elbow type:

This is the elbow to use at the connection to the diffuser. There are currently 3 outlet elbow types available for rectangular ductwork. They are Square, Short Radius, and Long Radius. Select the elbow to use for all runout outlet elbows.

Offset elbow type:

This is the elbow to use when extending the runout to a trunk and an elbow is required. There are currently 3 offset elbow types available for rectangular runouts. They are Square, Short Radius, and Long Radius. Select the elbow to use for all runout offset elbows.

Trunk tap type (fixed): 1-1/2 square to square:

There is only one tap available for square runouts. This is a 1-1/2 square to square tap.

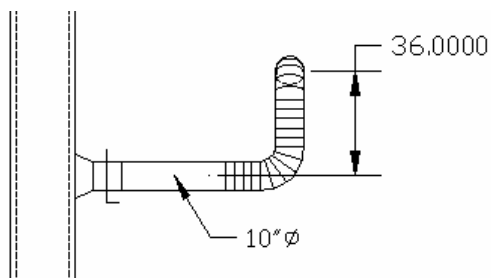
Include damper at discharge of tap:

If this option is selected, a damper will be placed at the discharge of the tap. The damper is drawn as a single line symbol representing a volume or hand damper.

Distances

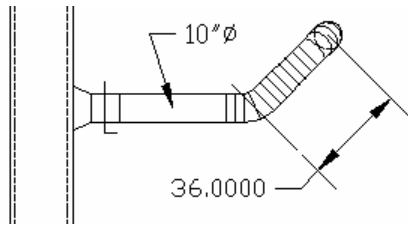
90 offset length:

This is the distance from the center of the outlet to the center of the first elbow. If the distance is 36", the results are shown below:



45 offset length:

This is the distance from the center of the outlet to the center of the first elbow. If the distance is 36", the results are shown below:



Use default values:

The default-offset length is 36" for both 45 and 90 degree offsets.

Noting Method

The noting method determines whether duct sizes will be placed in the drawing and how to place them.

Manual:

The manual method requires you to place the note in the appropriate position. This requires an additional selection of points during the processing of a duct section. It provides the means of placing the note in the drawing in a location that will not interfere with other entities in the drawing.

Automatic:

The automatic method automatically places the leader and note in the drawing.

No sizes:

No sizes will shut off noting altogether.

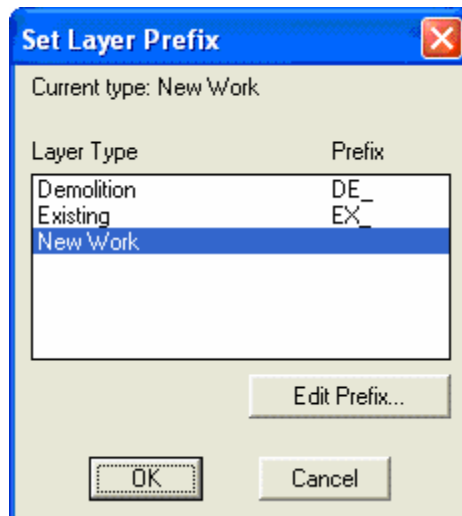
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Layer Management

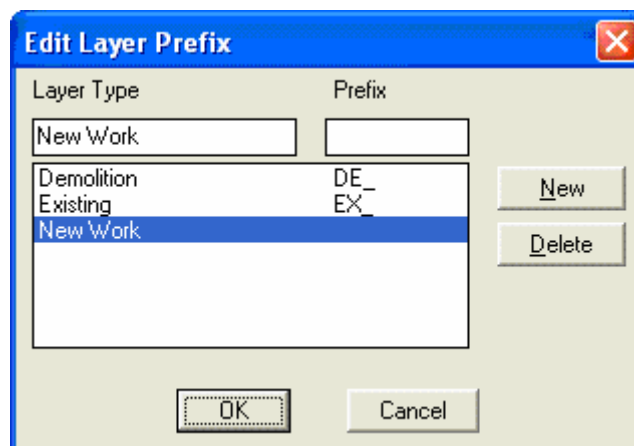
Layer management consists of two dialogs. One is used to set a layer prefix to be added to all layers. The second is to maintain the layer names, colors, and linetypes. Each has a separate function, and each is very important to make the system work for you.

Layer Prefix

A layer prefix is a tag that is appended to the front end of the layer name. For example, if you wanted all demolition layers to be isolated from the new work layers, simply add the prefix DE_. This makes filtering of the layers very easy, and keeps the layers in a manageable form. You can also set demolition to be different linetypes and colors based on your needs. When you select the Set Layer Prefix... option from the menu, you will see the following dialog:



Select the prefix to use, or the Edit Prefix... button. When you select Edit Prefix, an edit dialog will be displayed.



This dialog provides two entry areas at the top of the dialog. One is to edit the Layer Type (or description), and the other is to edit or enter the Prefix to be used. The current layer type and prefix will be in the edit boxes.

New: To create a new prefix, select the “New” button. When New is selected, the Layer Type “New type 1” will be created. If selected again, the Layer Type “New type 2” will be entered, etc. Edit the layer type to create your custom Layer Type. Enter the appropriate Prefix and select Enter, OK or another layer type to save the changes.

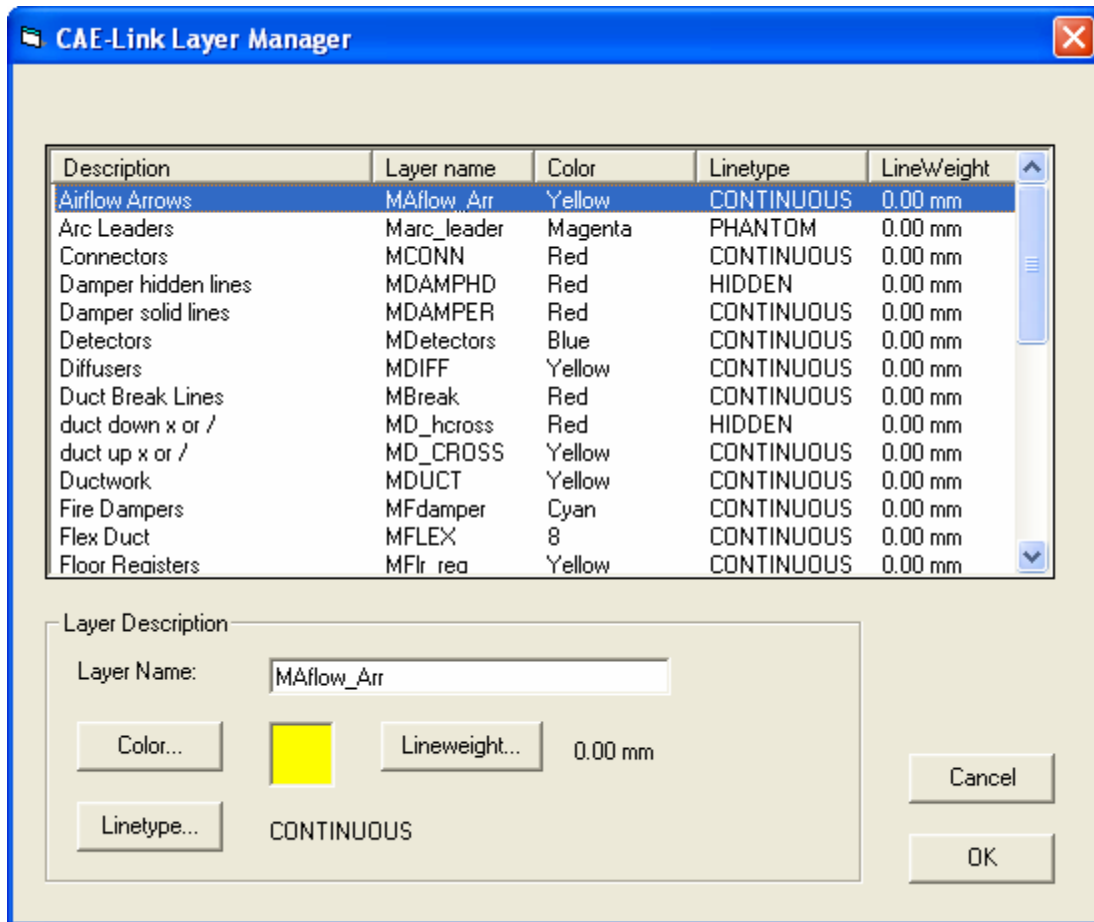
Delete: To delete a prefix, highlight the prefix to be deleted and press the Delete button.

Edit: To edit a prefix, highlight the prefix and edit the Layer Type or Prefix in the edit boxes. When complete, press Enter, highlight another type, or select OK to save and exit the dialog box.

Use care when editing the Layer Type and Prefix. As you make the changes and accept them by pressing Enter, the change is saved. If you make a mistake, simply correct your error and save the final changes.

Layer Manager

The layer manager is a dialog designed to allow you to customize the Layer name, Color, and Linetype of the pre-defined layers to match your company standards. All pre-defined layers are listed along with their associated settings as displayed below.



To edit a layer, highlight the layer and you will have access to modify the name, color, and linetype. Once changed, the change will not take effect until OK is selected. At that point, all changes will take effect. If, for example, you change the Arc Leaders Layer Name, then decide you do not like the change, simply select the same layer again and you will see it revert back to the original settings. Make the required modifications and select OK.

We will not go into all the details of using the Color or Linetype dialog here. These are standard ACAD dialogs and should be familiar to you. The Edit Prefix button will bring up the Prefix dialog discussed above.

Manual Layer Management

If you are comfortable with a text editor and file editing, you can manually edit the layer settings. This may prove to be the fastest way if you have major changes. Also, if you are running HVAC Designer on more than one machine, then you will want to copy the lyr file to all the other machines after changing it. That way, you only change it once.

The file to modify is: **C:\Program Files\Caelink\lt-hvac\cl-hvac.lyr**

The format of the file is as follows:

```
(("Ductwork" "MDUCT" 2 "CONTINUOUS") ("Hidden Duct liner" "MLINER" 6 "DASHED")
("Connectors" "MCONN" 1 "CONTINUOUS") ("Flex Duct" "MFLEX" 8 "CONTINUOUS") ("Damper
```

solid lines" "MDAMPER" 1 "CONTINUOUS") ("Damper hidden lines" "MDAMPHD" 1 "HIDDEN") ("Turning Vanes" "MTVS" 1 "CONTINUOUS").....

If you make changes that are not correct and you want to return to the original settings, simply delete the file. HVAC Designer will create the file upon a re-boot using the default settings.

The file format is a list of lists. It contains an entry (list) for each layer name. You can change any entry in the sub-list, but keep in mind that the layer "Ductwork" is ductwork. HVAC Designer relates to position in the file, not to the name in the file. So if you want Ductwork to say My Ductwork, HVAC Designer does not care. The entries are as follows:

("Ductwork" "MDUCT" 2 "CONTINUOUS")		Layer definition list
"Ductwork"	layer description.	Must be in "", quotes.
"MDUCT"	layer name	Must be in "", quotes.
2	layer color	must be an integer.
"CONTINUOUS"	layer linetype	must be in "", quotes.

The format must remain as displayed above, or the file will become corrupt and the results will be unpredictable.

Please note, the layer name does not have to be unique for each description. As stated above, the position in the file is what HVAC Designer uses to determine the layer to place information on. The layer names can be the same for multiple entries. As an example, you can place "Ductwork" and "Connectors" on the layer "Mech_Duct" and they will take on the exactly the same settings. We have provided a layer for each entry so you can easily define your final drawing to match your company standards.

If you attempt to create layers with the same name, but assign different colors and linetypes, the first layer definition used will be the one that will define the layer. All others will simply use the layer (based on the name) when encountered. We highly recommend using the same color and linetype for all layers with the same name.

Default Layer Configuration

The following listing describes the layer description, name, color, and linetype. This is built into the system and will be created as the default settings whenever this file is deleted.

Description	Layer Name	Layer Color	Linetype
Ductwork	MDUCT	2	CONTINUOUS
Hidden Duct liner	MLINER	6	DASHED
Connectors	MCONN	1	CONTINUOUS
Flex Duct	MFLEX	8	CONTINUOUS
Damper solid lines	MDAMPER	1	CONTINUOUS
Damper hidden lines	MDAMPHD	1	HIDDEN
Turning Vanes	MTVS	1	CONTINUOUS
Sup/Ret/etc hatching	MHATCH	1	CONTINUOUS
sq-rnd etc. shading	MSHADE	1	CONTINUOUS
duct up x or /	MD_CROSS	2	continuous
duct down x or /	MD_hcross	1	hidden
Turning Vanes Dashed	MTVSD	1	HIDDEN
Joint or Weld	MJOINT	1	CONTINUOUS
Hidden Joint or Weld	MHJOINT	6	HIDDEN
Hidden connectors	MHCONN	3	HIDDEN
Hidden Ductwork	MHDUCT	5	DASHED
Solid Duct Liner	MSLINER	6	CONTINUOUS
Duct Break Lines	Mbreak	1	CONTINUOUS
Flow Arrows	MFlow_arr	2	CONTINUOUS
Hidden Objects	Mhobjects	3	HIDDEN
Fire Dampers	Mfdamper	4	CONTINUOUS
Detectors	Mdetectors	5	CONTINUOUS
Arc Leaders	Marc_leader	6	PHANTOM
Thermostats	Mtstats	7	CONTINUOUS
Labels	Mlabels	1	CONTINUOUS
Noting	Mnote	5	CONTINUOUS
VAV Terminal Units	Mvav_tu	6	CONTINUOUS
Diffusers	MDIFF	2	CONTINUOUS
Floor Registers	MFlr_reg	2	CONTINUOUS
Sidewall Outlets	Msidewall	2	CONTINUOUS
Airflow Arrows	MAflow_Arr	2	CONTINUOUS

This listing is provided as a starting point for your modifications.

HVAC Designer Tutorial

This chapter will teach you the basics of using the CAE-Link HVAC Designer module. It explores the commands required to create and finish an HVAC project. While not all commands can be covered in this tutorial, the reference chapters provide a complete description of every command.

The tutorial is organized so that each section covers a major component of the system. The first section sets up the drawing and system variables. The second section places the diffusers into the reflected ceiling plan. The third section creates a single line schematic of the duct system. The final section shows how to create the two line drawings.

Getting Started

Before starting the tutorial, your system should be configured to run CAE-Link HVAC Designer. For complete installation instructions, see Chapter 2. The tutorial files supplied with HVAC Designer are located in the directory `c:\Program Files\CAELINK\HVAC\Tutorial`. Do not use this directory for saving your work. Instead, make a new directory so that the original files remain in tact. Copy all of the files into your new directory.

When using HVAC Designer, simply open the toolbars and select the appropriate fitting. You will be prompted at the Command line for each step in creating the fitting. When in doubt, read the prompts on the Command line.

The following tips can be very helpful when using the system:

- All selections can be repeated by pressing the space bar or the enter key.
- When prompted for an angle, the angle can be typed in or the angle selected. When entering the angle, the angle must be the actual angle. For example, if you enter an elbow at 180 degrees and leave at 270 degrees to form a 90-degree elbow, you must enter 270 as the elbow angle, not 90.
- When prompted for a distance or end point, you can type in the distance. The distance can be entered as in coordinate units as `@12'<90` to draw a duct section 12' long in the 90 degree direction. An easier method to specify a length quickly, without entering coordinate values, is to a point by moving the cursor to indicate a direction and then entering the distance from the first point. Always be sure the proper direction is selected and the distance is in the proper units.
- Be sure when working in a drawing the DIMSCALE variable is set properly for the scale you will be plotting. This is used to insure the proper text height is plotted.
- Be sure you have set the proper text height in the drawing. To change the text height, enter the HVA LT Options from the menu and reset the Text Height value. This value is multiplied by the DIMSCALE variable to get the final text height. For example, if a text height of 0.125 is used, then at a DIMSCALE of 48 will result in 6" high text in the drawing. When the drawing is plotted, the text will be 0.125" high (or 1/8"). The same is true for 1/8" scale, the text height in the drawing will be 12" for a plotted text height of 1/8" in height.

Starting A New Drawing

HVAC Designer does not include a drawing setup feature. This can be found in the Noting module. Start the Drawing Setup and insure your system is defined for the way you work.

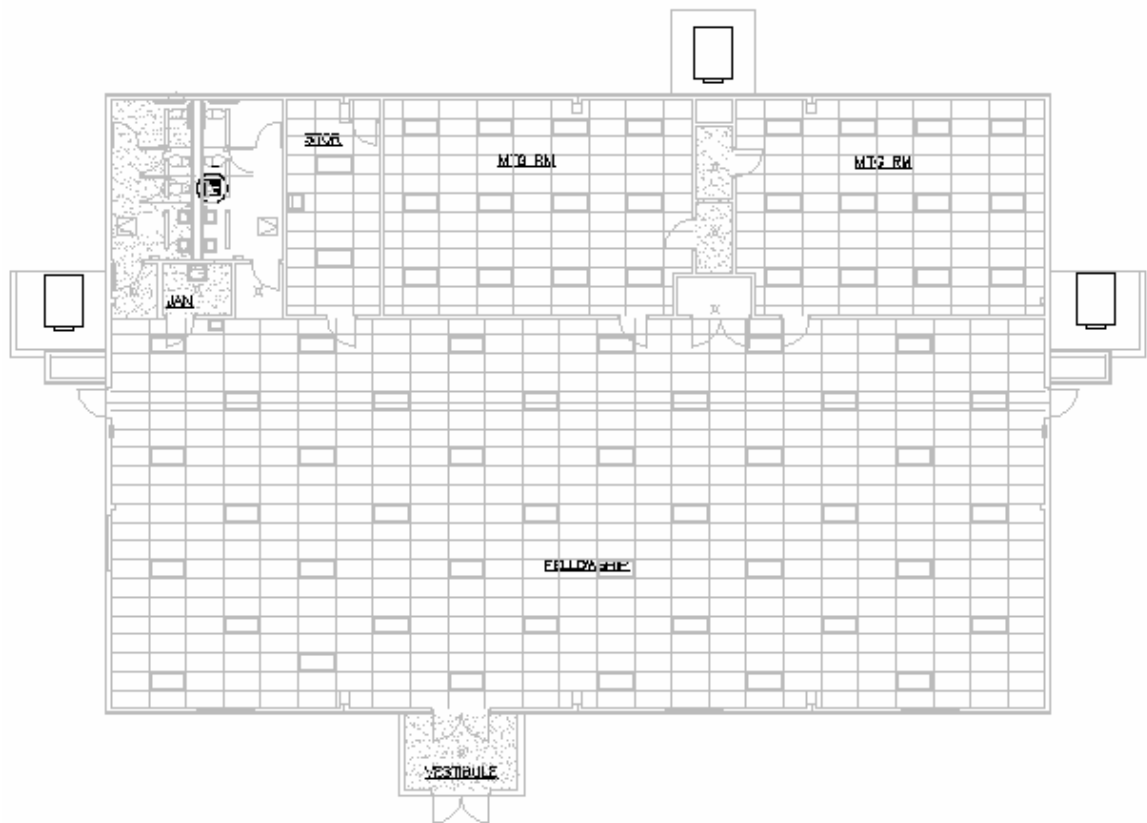
Floor Plan

The base floor plan contains an actual building layout. The building is a prefab metal building used as a fellowship hall at a church. We will create three zones of air conditioning and exhaust the toilets and janitors closet. You will find everything is located on layers and we will turn them on and off as needed to create duct system.

The following layout is provided in the drawing:

c:\Program Files\CAELINK\HVAC\Tutorial\HVAC_Tutorial

When you open the drawing, you will find the units have been located and the ceiling grid and lighting is in place.



Starting the duct system:

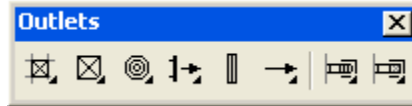
For this example, you have already run the load calculations, determined the air quantities for the rooms, and have located the mechanical equipment. As discussed above, the most efficient method to create HVAC drawings is to follow the same basic steps that we have followed for years and years as follows.

1. Calculate the building loads and air distribution requirements.
2. Select the air handling equipment.
3. Locate and tag all outlets on the drawing.
4. Create a schematic design (one-line layout) of the duct system.
5. Size all ductwork.
6. Draw, coordinate, and note the two-line duct system.

For our tutorial, we will start with step 3, Locate and tag all outlets on the drawing.

Locating the Lay-in Outlets

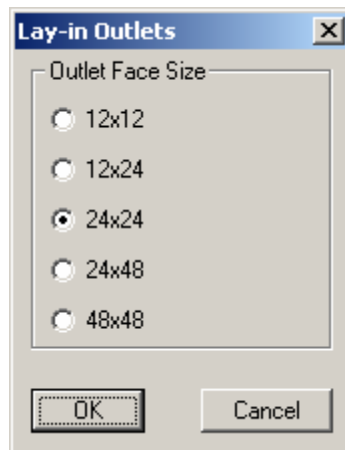
Select the HVAC-LT ⇒ Toolbars ⇒ Outlets to open the outlet toolbar.



This toolbar will be used to insert the outlets. In this drawing, we are only using surface and lay-in outlets. Select the first image from the toolbar.



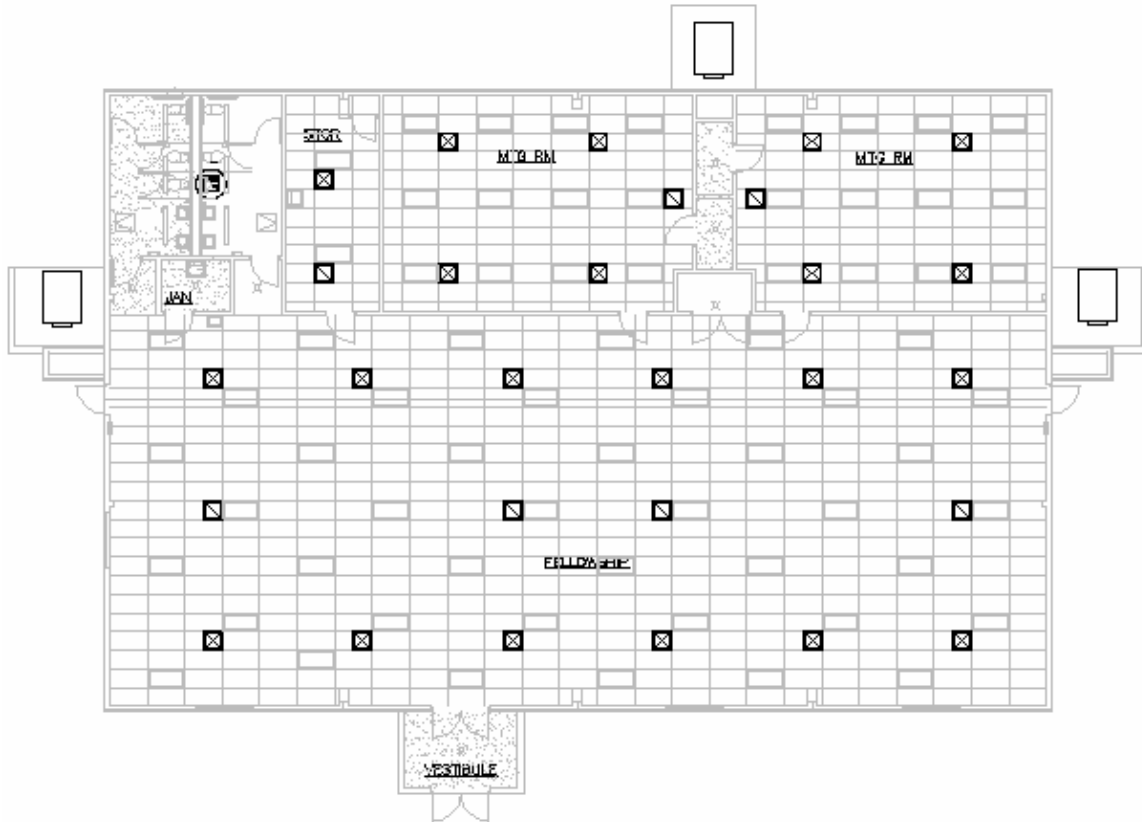
This is used to start the lay-in type supply diffuser function. The system will prompt for the following information:



Select the face size for the outlet. In this case, we will be using 24x24. Pick this option and then press the OK button to continue. The entire command sequence will be as follows:

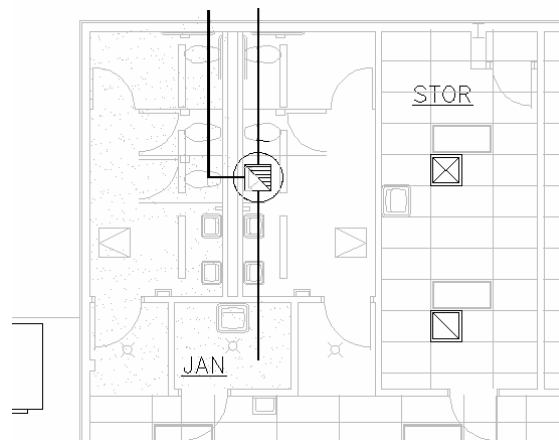
Command: <code>cl-lay-in_outlet</code>	Function name to insert a lay-in outlet
Select insertion point (end,int):	Select the intersection point on the grid for the insertion point of the outlet. Note the location of the insertion point. This will be the point you will rotate around to position the outlet properly in the grid.
Rotation angle (nea):	Rotate the outlet to the proper location in the grid. To aid in rotating the outlet properly, select a point on the grid line for the proper rotation angle.
Command:	When complete, you will return to the Command prompt.

Continue using this selection to insert the remainder of the lay-in outlets. You will find the lay-in return grilles use exactly the same steps. Once all the diffusers and return air grilles are located, your drawing should be similar to the one below:



Locating the Surface Outlets

Next, insert the surface outlets. To do this, we will take a little different approach. We will draw some guidelines from the exhauster to the location for the exhaust registers. To accomplish this, create a layer named SKETCH. Insure you are on the sketch layer and draw the lines. This is very important because we will want to turn off the lines later in the tutorial. The supply will be placed in the room to be symmetric with the lights and will require no guidelines. Your drawing will look like the following:



Notice, we extended lines from the midpoint of each side of the exhauster in the general direction of the exhaust grille. We made no attempt to stop where the grill will be installed. Instead, we simply created a couple of guidelines to aid in their placement.

In our examples, we used polylines with a 1” thickness to make them display properly. We do not recommend using polylines. If you do, each intersection point must consist of two polylines, now a single continuous polyline. Otherwise, the centerline method can not determine you are at an intersection point.

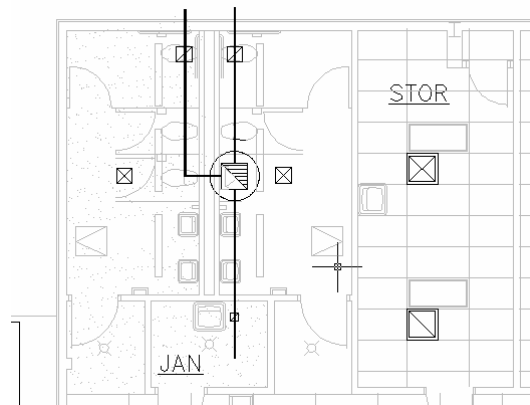
- This is used to start the surface type supply diffuser function. The system will prompt for the following information:

Command: cl-insert_outlet	Start the process.
Width (12):	Type in the grille width. If the width is 12, press Enter or Space to accept the default value. If the width changes, the new value will become the default value the next time you insert a grille.
Length (12):	Type in the grille length.
Insertion point (end):	Select the insertion point. The center of the grille is the insertion point; thus, the rotation angle is used only to get the orientation correct, not align with a grid system. If the sketch line was indeed in place, you could select the end of the line for the insertion point.
Rotation angle:	Rotate the grille into the proper position.

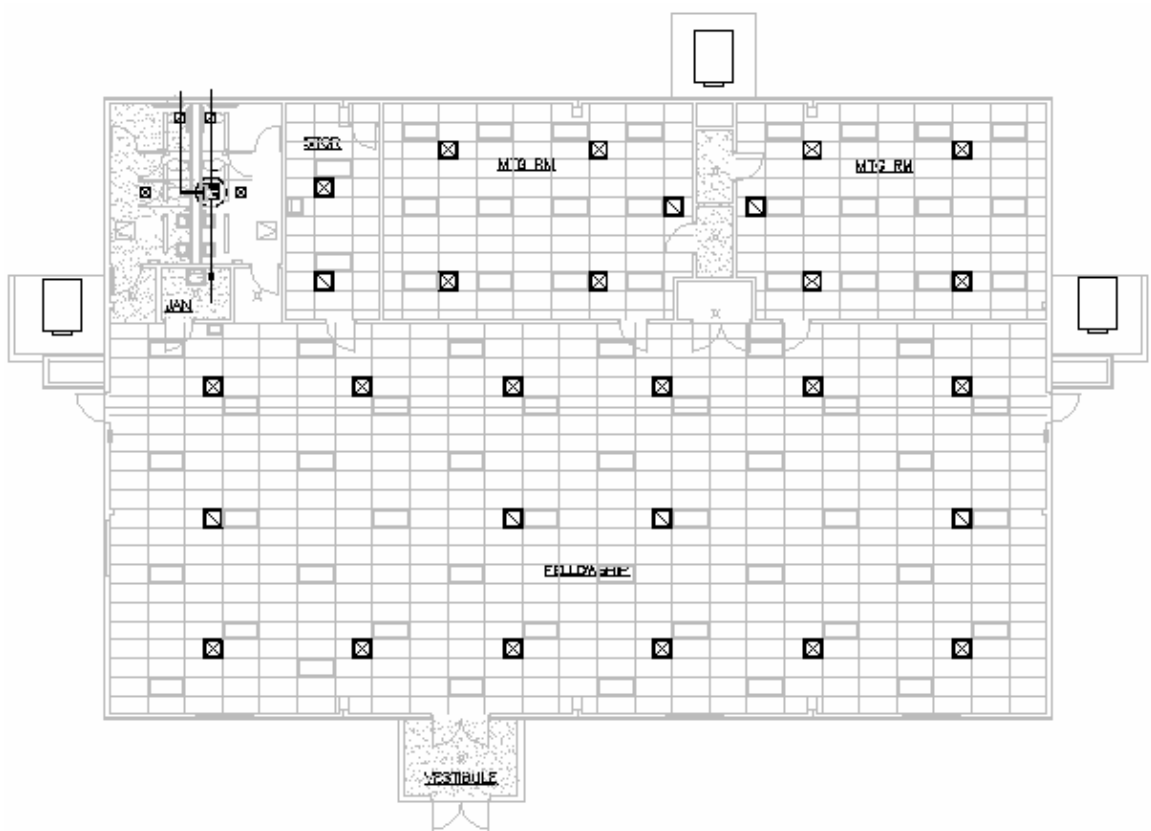
- This is used to start the surface type return / exhaust grille function. The system will prompt for the following information:

Command: cl-insert_outlet	Start the process.
Width (12):	
Length (12):	
Insertion point (end):	
Rotation angle:	
Command:	The first exhaust grill is in place over the toilet.
Command:	Press the space bar.
Command: cl-insert_outlet	Start the process
...	
...	
...	
Command:	The next two grilles are in place

Now the drawing should look as follows:



Now that the diffusers and exhaust grilles are all in place and we can create the schematic design (one-line layout) of the duct system. At this point, the drawing will look like the following:

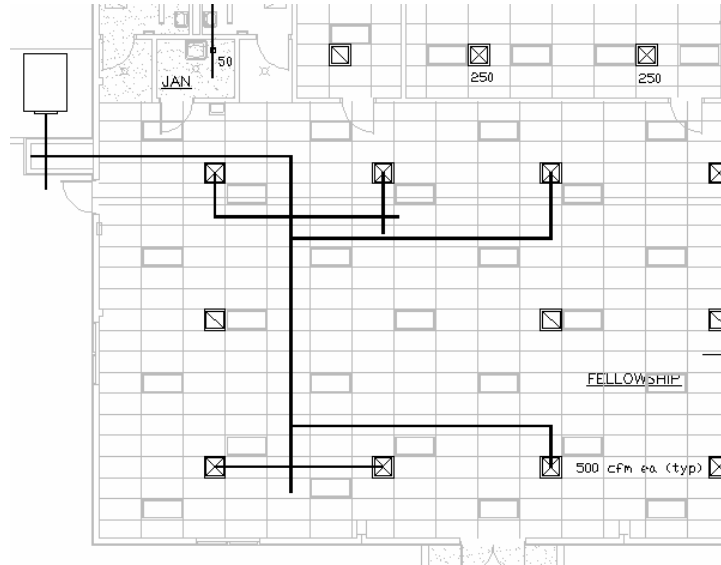


For the outlet tags, all we have provided is the air volume for each outlet and placed them on the layer CFM. This will be used to size the ductwork in future steps. Your drawing will have the outlet tag along with size and air volume in the manner you normally note your drawings.

Schematic Design

The next step in the process is the schematic design. You have already created a part of the schematic design when you created the sketch layer and placed the guidelines on it for the exhaust duct. In our system, the schematic design is nothing more than a single line sketch of the duct runs.

We have taken the left half of the Fellowship room and created a single line sketch by drawing lines for the main trunk and runouts. Our basic sketch will look like the following:



What we must do is create intersection points. When we are placing fittings, we will use the intersection points. The lines do not have to be exact. They can extend beyond the mains, or terminate at the mains. Just make sure we have an intersection point to work with.

We will continue the sketch process until the entire system is laid out as displayed below:

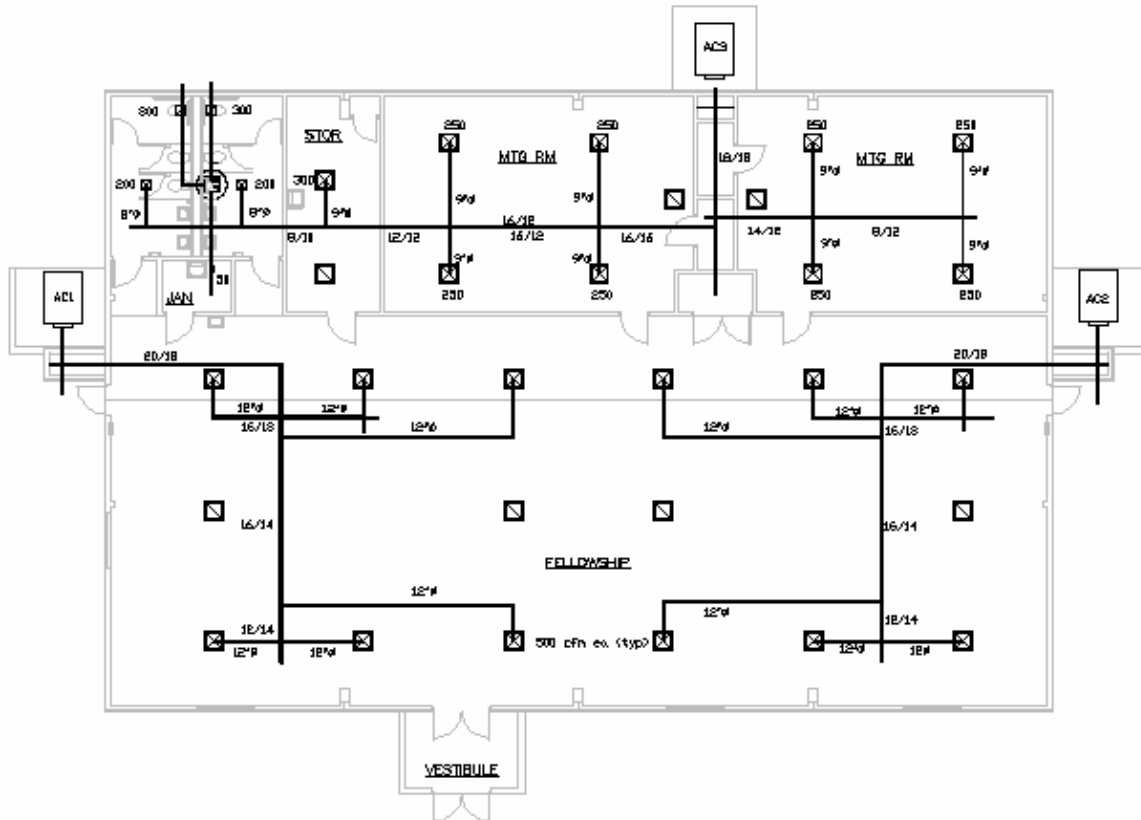
There are only a couple of tricks we used. Where we are extending the ducts up in a chase, we placed a line from the center of the air-handling unit through the chase. Next, we selected the mid point of the chase to extend out of the chase. The unit at the top of the plan was a little different. We extended a line across the chase and one from the unit into the storage room. The reason? Simple, we have to have an intersection point from which to draw our duct system from. The fittings will be drawn from a connector unless an intersection point is selected. The system automatically assumes that anytime an intersection is selected, the centerline method of drawing is to be employed.

Size All Ductwork

The next step is to size the ductwork. This can be best achieved by plotting the drawing and sizing the duct on the plot. Once sized, you can use the sized plot to draw the two-line duct system.

In the tutorial, we have done that for you. Simply turn on the layer Sizes to display the duct sizes.

At this point, we can turn off the layers 0, Ceiling, Defpoints, and Lighting. These are no longer needed and will just get in the way. Also, if you have changed the original settings, lock the layer Floorplan. This will keep us from selecting points from the floor plan when we do not want them. Our floor plan will now look like the following:



Draw, Coordinate, and Note the Two-line Duct System.

You are probably thinking, when are we going to draw the duct system. Up until now you haven't shown us anything we don't already know. We perform the above steps, but we hardly ever do it in AutoCAD. If we are required by our contract to create a schematic layout, then we go to the effort, but normally this is more work than it is worth.

Well, as you will see, this is a very quick and easy process. This is where we determine the design and layout for our entire system. This is where the work is done. The next few pages will show you that it is certainly worthwhile, so lets continue.

Rectangular Ductwork



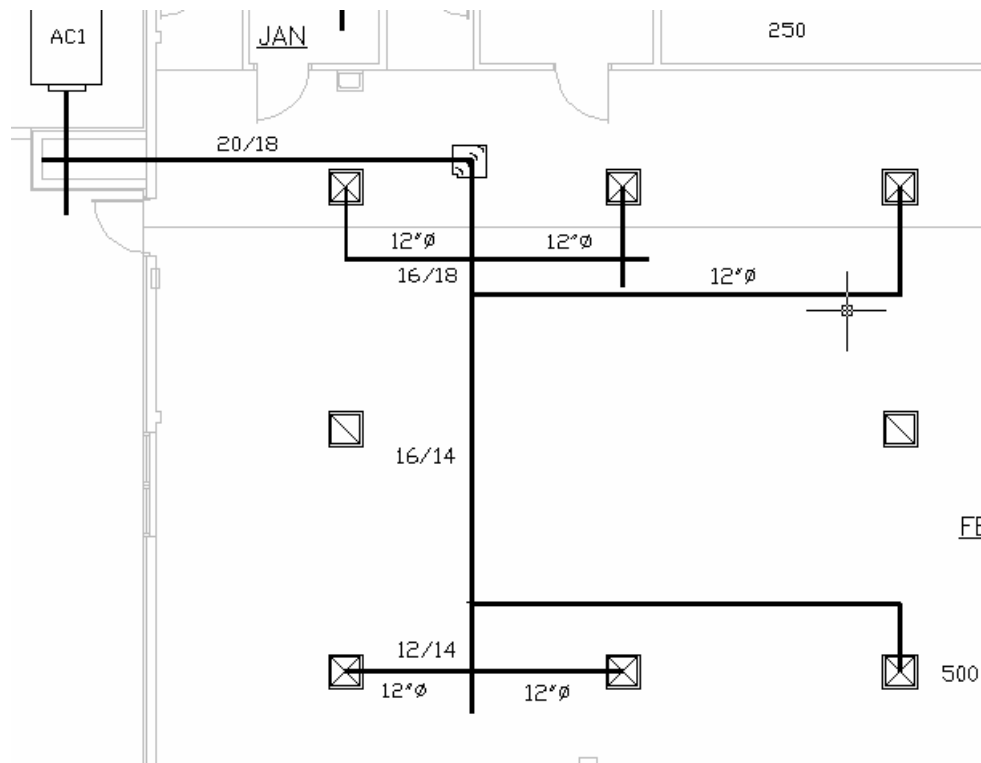
The first step in drawing the duct system will utilize rectangular ductwork. We will open the Rectangular Ductwork toolbar and start creating our system with AC1 (on the left side of the drawing).



Elbows

Select the square elbow from the Rectangular Ductwork toolbar and follow the prompts on the command line as follows:

Command: cl-elbow_plan	Start the process
Select start point (mid,int):	Select the intersection point
Centerline selected	Selection Indicator
Select direction to fan (nea):	Select the duct section extending in the direction of the fan. This provides the angle entering the elbow. This provides the angle of the elbow.
Select direction of opposite leg (nea):	Select the duct section extending in the direction of airflow. This provides the angle of the elbow.
Duct width <20.00>:	Input the duct width.
Duct depth <18.00>:	Input the duct depth.
Line Ductwork [Yes/No] <No>:	Is lining required?
Draw Tv's [Yes/No] <Yes>:	Are turning vanes required?



The elbow is now drawn based on the center point selected (selecting the intersection point).



Vertical Offset Using Square Elbows

Select the vertical offset from the toolbar. This will be used to create the riser in the chase from the air-handler unit. The following prompts will be issued:

Command: cl-vert_offset	Start process.
Select start point (mid,int):	Select the intersection point.
Centerline selected	Selection indicator.
Select entering duct (nea):	For this case, the entering duct will be the section between the offset and the previously drawn elbow. This is to make the width of the duct 20" starting the drop, and as we will see, the discharge will be 18" going to the fan. This is due to the elbow turning

Rotation angle (Enter if same as airflow):

Vertical offset distance <96.00>:

Offset direction [Up/Down] <Up>: d

Duct width <20.00>:

Duct depth <18.00>:

Line Ductwork [Yes/No] <No>:

Turning Vanes [Yes/No] <Yes>:

down is 20x18. The elbow at the bottom when it turns out becomes 18x20.

Select the line extending to the fan to get the proper rotation angle. If any other angle is selected, say 45 towards the fan, the angle will automatically become the angle to the fan since rectangular offsets can only turn at 90 degrees to the incoming angle. Round offsets can rotate at any angle. Give one a try.

Offset distance. Any logical distance will work, but if a material listing is required, this should be the proper value.

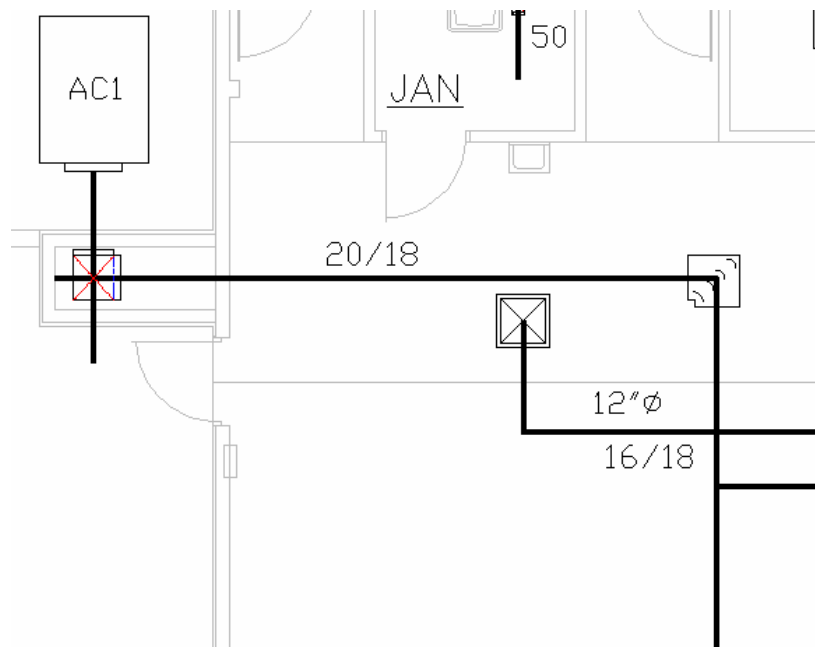
In this case, we are working from the discharge duct towards the fan. We are turning down in the chase.

The default is correct, press Enter.

The default is correct, press Enter.

No lining is required.

Yes, use turning vanes in the elbows.



As noted above, the duct extending from the chase to AC1 is not 18x20, so the next step is to place a transition at the discharge of AC1.



Concentric Transition

Select the concentric transition from the toolbar. This will be used to create the reducer at the discharge of the AC unit. To turn off the centerline method, erase the line from the discharge of the AC unit to the duct. This will allow the system to automatically get the size of the discharge collar to start the fitting. If you have Polar tracking turned off, turn it on. Also, for drawing ductwork, an increment angle of 45 is generally the best. Once the command is started, the following prompts will be issued:

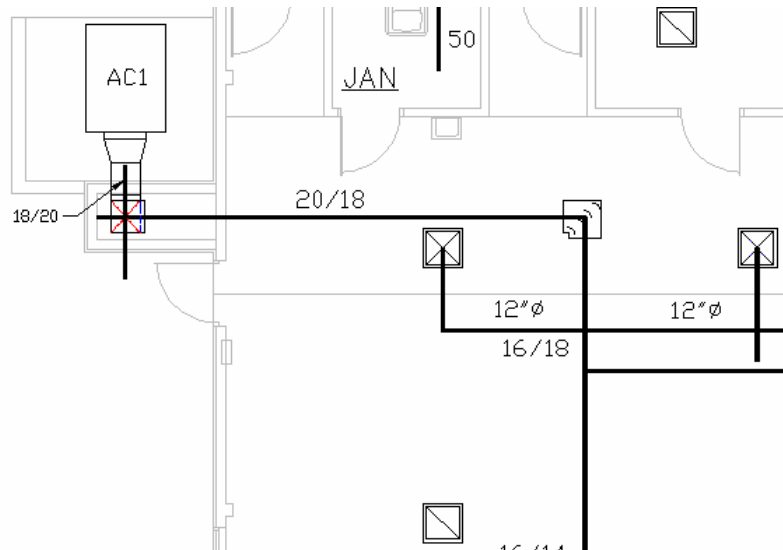
Command: cl-draw_reducer

Start process.

Select duct start point (mid,int):
 Select direction of airflow:
 Outlet width <26.00>: 18
 Outlet depth <18.00>: 20
 Line Ductwork [Yes/No] <No>:
 Select duct end point: mid

Select the mid point of the AC discharge collar.
 Select the direction of airflow. In this case
 The width is now 18 inches.
 The depth is 20 inches.
 No lining is required.
 The fitting is drawn and the Continue Duct from
 Fittings option is on. The next selection is the end
 point of the duct. In this case, we want to attach the
 end of the duct to the offset up in the chase, so we
 input mid to get the midpoint of the duct connector.
 Select the connector.
 The duct is drawn and ACAD is waiting for the next
 command.

of
 Command:



In our settings, the duct size was set to manual and we found a location for the note that would not interfere with any of the linework.

For this system, all that is left is to draw the ductwork, runouts, and place a couple of reducers into the system to create the appropriate changes in duct sizes.



Draw Duct Sections

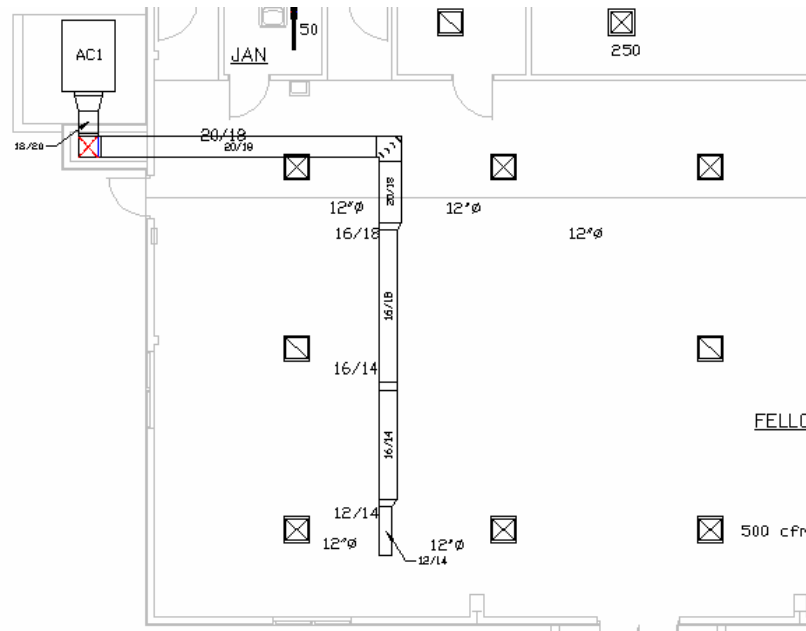
At this point, we can turn off the sketch and create the remainder of the system without it. Be sure to keep the sizes layer on. Select the draw duct sections from the toolbar. This will be used to create the duct sections from fitting to fitting. The first section of ductwork to be drawn will be from the offset in the chase to the first elbow. Once the command is started, the following prompts will be issued:

Command: cl-draw_duct
 Select duct start point (mid):
 Select duct end point (mid):
 Line Ductwork [Yes/No] <No>:

Start process.
 Select the offset connector.
 Select the elbow connector.
 Duct liner is not required.

The duct section is now drawn and noted. In this case, the note fit within the duct, so it was automatically placed in the drawing and the command completed. Next, draw a duct section from the elbow past the first two diffusers. In this case, the note fits in the duct and is rotated to read from the right. In all cases, the noting will be aligned to read from the bottom of the sheet or from the right.

Next, lets place a square-to-square eccentric transition at the end of the duct section. This will transition from 20x18 to 16x18. Continue the duct run to the area of the next duct change. Next, place another transition to 12x14 and extend the duct section as indicated below.



All that is left is to draw the runouts to the diffusers and some minor cleanup to complete this section of the system.

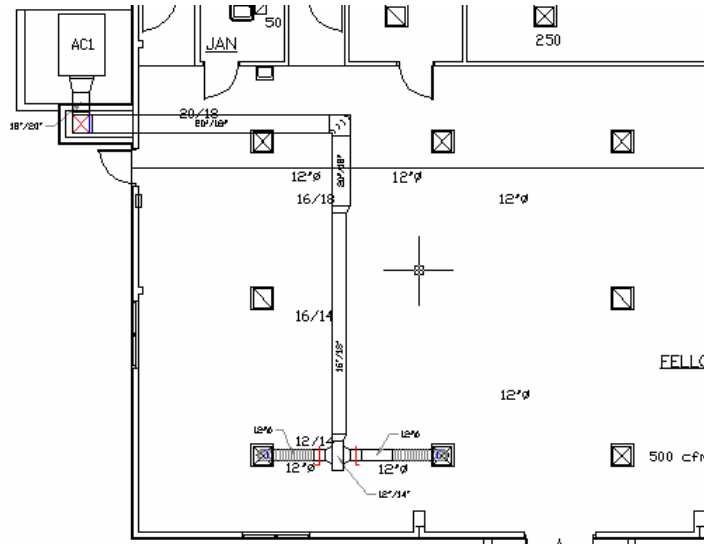


Round Straight Runout

The last two diffusers on the system will be connected to the main trunk with straight round runouts. Select this option from the Outlets toolbar. The following prompts will be issued on the command line:

Command: lt-runout	Start process.
Center of outlet (mid, int):	Select the center of the outlet. The system assumes you either have a single cross or double cross to define supply or return outlets.
Side of duct (per):	Select the side of the duct.
Direction of airflow (nea):	Select the side again to designate the direction of airflow. This direction determines the direction of the damper handle and the direction for the 1-1/2 taps.
Duct diameter <12.00>:	Input the size of the runout.

Complete this procedure for both runouts and your drawing will look like the following:



To complete the section, use the STRETCH command to move the transition and end of the trunk to their proper position.

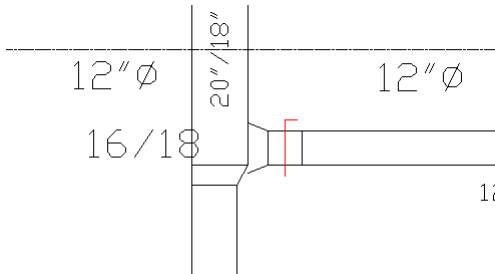


Round Freeform Runout

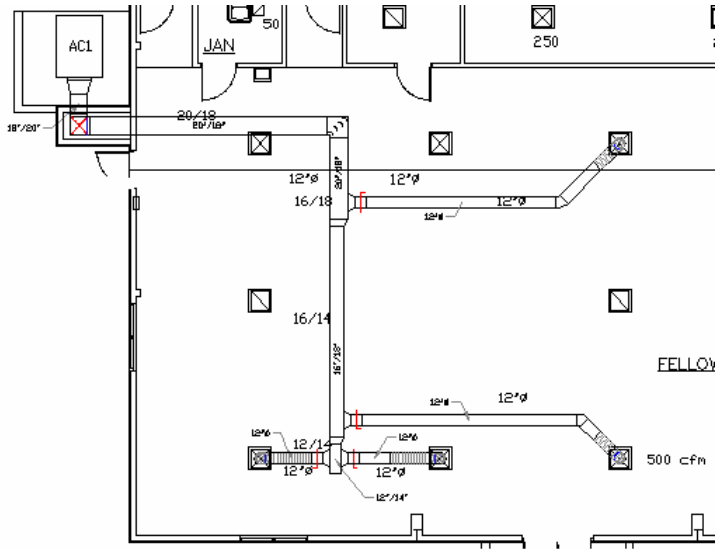
The two diffusers to the right require special treatment. We will use the round freeform runout tool to create the runout. This allows us to define the exact path the runout is to follow. In this case, we will offset at a 45-degree angle and then extend the runout to the trunk. The command sequence is as follows:

- | | |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Command: It-runout | Start process. |
| Center of outlet (mid, int): | Select center of outlet. |
| Next point (per trunk): | Select the first point. In a freeform runout, you can input up to 10 points along a path for the runout to follow. The bottom outlet has two, the point at the 45-degree elbow and the point at the termination on the trunk. |
| Next point (per trunk): | This is the point on the trunk. |
| Direction of airflow (nea): | Select the side of the duct forming the same angle as the trunk. |
| Duct diameter <12.00>: | Input the runout diameter. |

Repeat the sequence for the upper diffuser. When drawn in our system, the tap is not completely on the trunk. Use the STRETCH command to adjust the transition to the proper location.



Once adjusted, your drawing will become the following:



All we have left is the top two runouts. For these, we will use the round 45 runout.

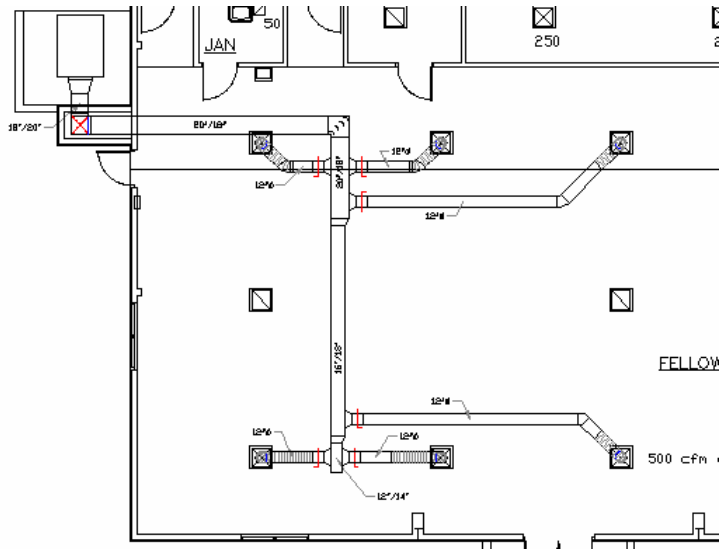


Round 45-degree Runout

The round 45-degree runout is similar to the previous runouts. This tool will draw a runout at a 45-degree angle to the diffuser and then connect it to the trunk. The following prompts are issued:

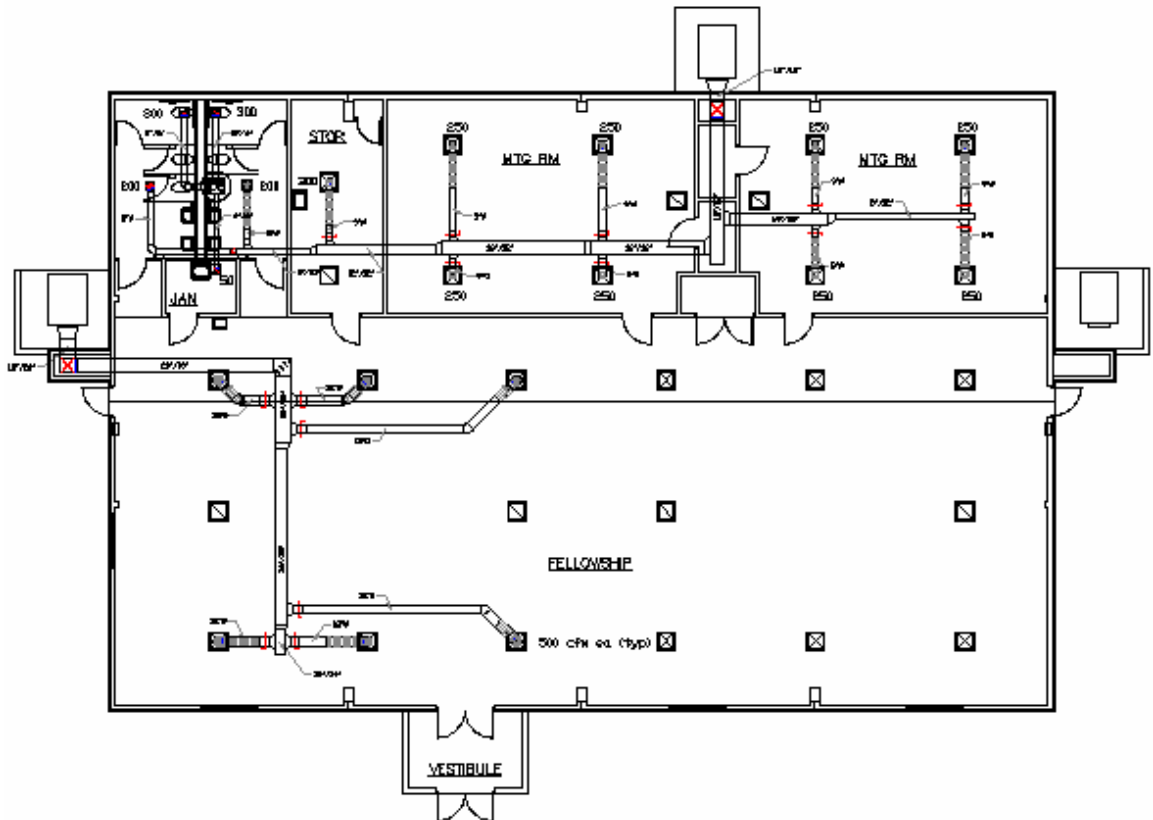
Command: lt-runout	Start process.
Center of outlet (mid, int):	Select the center of the outlet.
Runout offset direction:	Select the direction for the offset. Note, this need not be 45 degrees. Select in the general direction and the system will create the 45-degree offset.
Side of duct (per):	Select the side of the duct.
Direction of airflow (nea):	Select the side of the duct in the direction of the airflow.
Duct diameter <12.00>:	Input the duct diameter.

The offset will be drawn. This portion of our drawing is not complete. All that is left is to turn off the sizes and adjust the noting if required.



Complete the Drawing

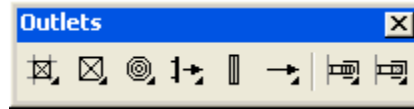
You should now have a good handle on the way the system works. We will leave the remainder of the drawing up to you to complete. When finished, it should be similar to the following:



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Outlets Toolbar

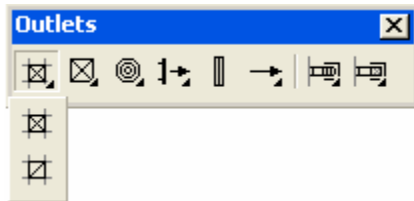
Selecting HVAC from the drop-down menu, then Toolbars will provide a list of the available toolbars. Select Outlets to display (show) the Outlets toolbar.



All of the functions found on the toolbar are also included in the menu under HVAC/Outlets. You may work from the drop-down menu or show and dock the Outlets toolbar. You may turn off the toolbar by selecting the X in the upper right corner. This section will discuss the options available on the toolbar only. The options available from the drop-down menu function in the exact same manner.

Lay-in Outlets

The lay-in outlets fly out contains the options for lay-in supply and return outlets. These features are described in detail within this section



The following describes each option in detail.

- Lay-in Supply**
- Lay-in Return**

Both selections work the same. When the selection is made, the size dialog will be displayed.



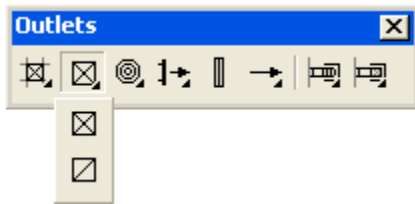
Select the size of the lay-in supply or return and you will then be requested to respond to the following prompts on the command line:

Command: cl-lay-in_outlet	function name
Select insertion point (end,int):	select the insertion point (using end or intersection)
Rotation angle (nea):	rotate the outlet into the proper position
Command:	

When dragging the outlet into position, note the location of the insertion point. This will become the rotation point for the rotation angle. When placed into the grid properly, it will rotate into the position you want with little effort.

Surface Outlets

The surface outlets fly out contains the options for surface supply and return outlets. These features are described in detail within this section



The following describes each option in detail.



Surface Supply

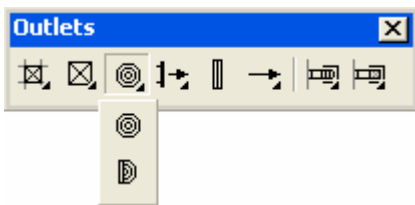
Surface Return

Both selections work the same. When the selection is made, the following prompts will be displayed on the command for your input.

Command: cl-insert_outlet	function name
Width (12):	input width of outlet (or Enter to accept)
Length (12):	input length of outlet (or Enter to accept)
Insertion point (end):	select the insertion point
Rotation angle:	rotate into position
Command:	

Round Outlets

The round outlets fly out contains the options for round supply diffusers. These features are described in detail within this section



The following describes each option in detail.



Round Supply

Half Round Supply

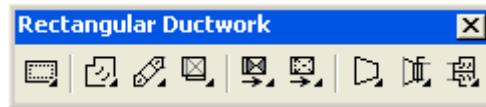
Both selections work the same. When the selection is made, the following prompts will be displayed on the command line for your input.

Command: cl-insert_outlet	function name
Width (12):	input width of outlet (or Enter to accept)
Length (12):	input length of outlet (or Enter to accept)
Insertion point (end):	select the insertion point
Rotation angle:	rotate into position
Command:	

The remainder of the features are to be completed.

Rectangular Ductwork Toolbar

Selecting HVAC from the drop-down menu, then Toolbars will provide a list of the available toolbars. Select Rectangular Ductwork to display (show) the Rectangular Ductwork toolbar.



All of the functions found on the toolbar are also included in the menu under HVAC/Rectangular Ductwork. You may work from the drop-down menu or show and dock the Rectangular Ductwork toolbar. You may turn off the toolbar by selecting the X in the upper right corner. This section will discuss the options available on the toolbar only. The options available from the drop-down menu function in the exact same manner.

The remainder of the features are to be completed.

Round Ductwork Toolbar

Selecting HVAC from the drop-down menu, then Toolbars will provide a list of the available toolbars. Select Round Ductwork to display (show) the Round Ductwork toolbar.



All of the functions found on the toolbar are also included in the menu under HVAC/Round Ductwork. You may work from the drop-down menu or show and dock the Round Ductwork toolbar. You may turn off the toolbar by selecting the X in the upper right corner. This section will discuss the options available on the toolbar only. The options available from the drop-down menu function in the exact same manner.

The remainder of the features are to be completed.

Accessories Toolbar

Selecting HVAC from the drop-down menu, then Toolbars will provide a list of the available toolbars. Select Accessories to display (show) the Accessories and Utilities toolbar.



All of the functions found on the toolbar are also included in the menu under HVAC/Accessories and Utilities. You may work from the drop-down menu or show and dock the Accessories and Utilities toolbar. You may turn off the toolbar by selecting the X in the upper right corner. This section will discuss the options available on the toolbar only. The options available from the drop-down menu function in the exact same manner.

The remainder of the features are to be completed.

HVAC Designer Variables – Appendix A

Caelink Variables

The Caelink variables are retained with the drawing and stored within the drawing. If the external noting variable file (cl-note.var) does not exist, it is created at run time. This file stores the default settings for Noting.

The remainder of the features are to be completed.

HVAC Designer Files – Appendix B

The files listed below are for versions 15 and 16. The ones specific to a version will only ship with that version. If you have installed both versions 15 and 16, then all the files will be located in the same directory and will share common components instead of having duplicate files in two installations.

C:\Program files\Caelink

The remainder of the features are to be completed.