

Creating Construction Documentation with Autodesk Building Systems

Autodesk® Building Systems software provides a simplified process for the creation of construction documentation, by providing discipline specific engineering tools that automate both the production and organization of your project documentation.

Every engineering firm, architectural firm, contractor, and building owner who uses AutoCAD®-based software has their own specific method for saving drawings, storing projects, and creating construction documentation. Of the many pain points Autodesk has focused on addressing, creating construction documentation and drawing management are two of the most important to users. With each new release of AutoCAD®, Autodesk® Architectural Desktop, and Autodesk® Building Systems software applications, Autodesk has improved upon these processes by providing easy-to-use tools that users can incorporate into their work cycle at their own pace.

The purpose of this white paper is to spell out the steps to be taken by a user to create construction documentation using Building Systems software. Although architects normally handle project setup, this paper assumes that the engineering firm using Autodesk Building Systems is the main consultant on the job and is therefore responsible for setting up project information. Other procedures, such as scheduling and creating sections, are described using best practice methods.

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Traditional Methods

Over the years the AEC industry has adopted many different processes to produce construction documentation including:

- Using a combination of external references (xrefs), working drawings, and plot sheets
- Having all data reside in model space in one drawing—architectural base sheet, engineering work, border
- Creating layout tabs for plot sheets
- A combination of any of these methods

Each method has its strengths and weaknesses, some more than others. In fact, some of the techniques used to create construction documentation should have gone the way of the dinosaur, but many traditional engineers have kept alive the same tried-and-true procedures that have worked in the past.

With the many improvements to AutoCAD software over the years, the method that seems to outshine the rest in efficiency and accuracy is using a combination of xrefs, architectural base sheets, working drawings, and plot sheets. A typical project setup may look something like this:

- Architect or engineer, depending on circumstances, creates a project directory on the server where drawing files are to be stored (see Figure 1).
- Architect creates floor plans for small two-story office building (1st Floor Base, 2nd Floor Base).
- Engineer uses xrefs to reference base sheets into working drawings (1st Floor HVAC Plan, 2nd Floor HVAC Plan).
- Engineer creates plots sheets that reference the working drawings and a border (HVAC Plan 1st Floor M2.1, HVAC Plan 2nd Floor M2.2).
- Schedule sheets and detail sheets are created that reference the same border (HVAC Details 6.1, HVAC Schedules M7.1).
- Architect or engineer, depending on who is the main consultant on the project, creates an index or cover sheet.

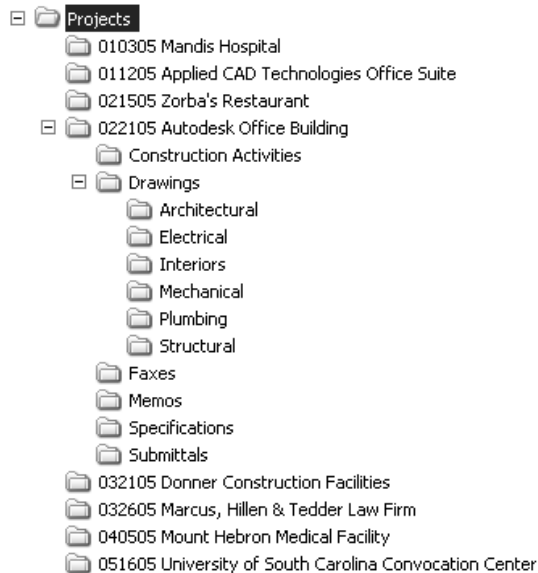


Figure 1. Typical project directory.

Traditionally, all of the preceding steps are performed manually. From creating directories to manually drawing sections and details, there is virtually no automation. And on larger projects with many different sheets, scheduling can be extremely cumbersome.

Project Navigator

Originally designed for Architectural Desktop, the Project Navigator has been included with Building Systems since 2005 version of the software. AutoCAD has a similar tool called the Sheet Set Manager.

The Project Navigator appears to follow the same steps as the traditional method described earlier, but with one main difference: automation. Scheduling is more accurate, sections are created with the click of a button, and overall productivity is increased dramatically. So how does one start a project and produce construction documentation with Autodesk Building Systems? Simple. Just follow these steps.

Step 1: Project Setup

Open Building Systems and select Project Navigator. If a previous project does not exist, then the Project Browser appears automatically. In the bottom-left corner of the dialog box is an icon to start a new project. Click this icon.

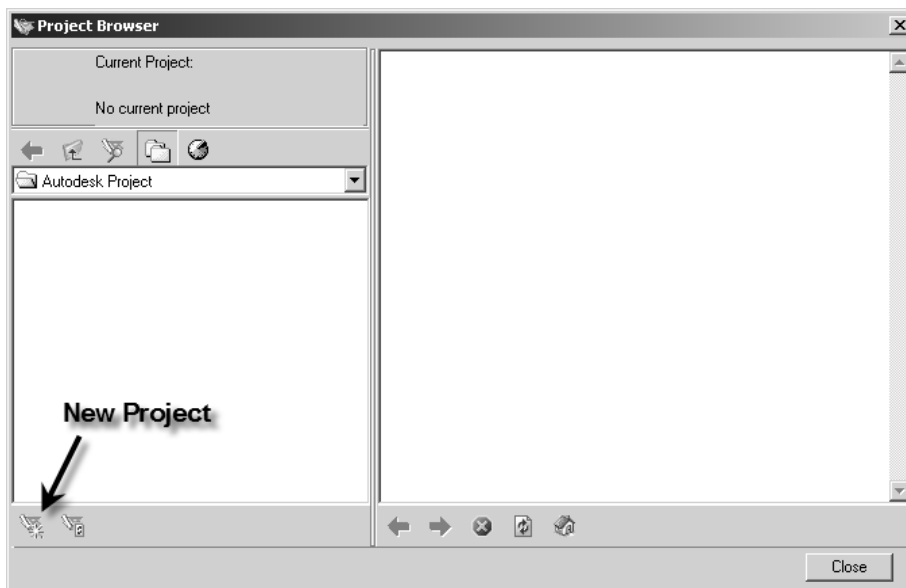


Figure 2. Project Browser.

Next you are asked to enter your project number (022105), the name of the project (Autodesk Office Building), and a description. Click OK. Once created, your new project is current and you can click the Close button. This activates the Project Navigator palette. You can toggle this palette on or off to free up design space on your screen if needed.

The first thing you may want to do is edit project data. Click the pencil icon in the top field. A Modify Project dialog box appears. For the purpose of this paper, you will not edit any data, but be aware that you can modify different project details from this dialog box. Close the dialog box.

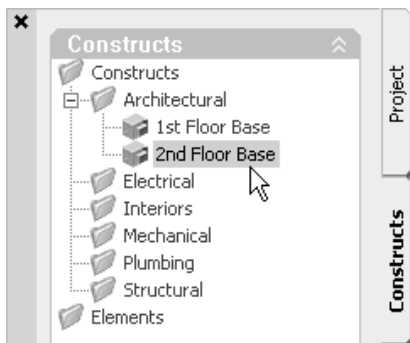
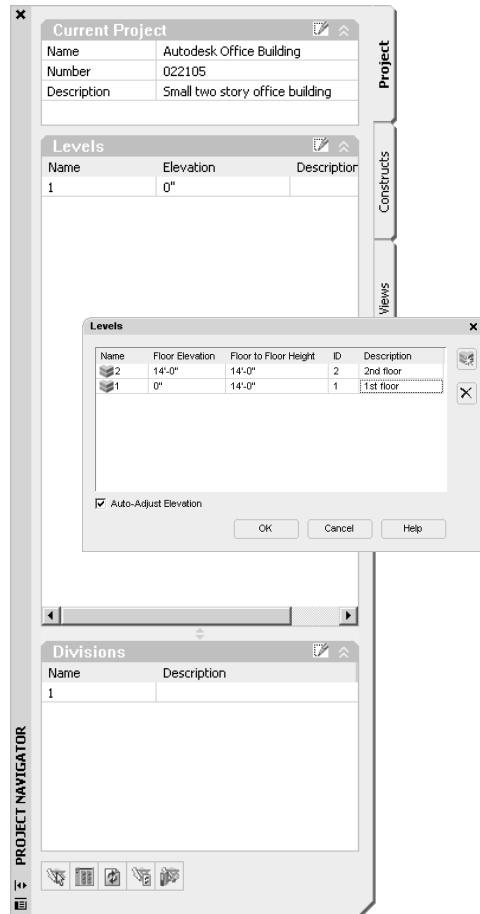
You do, however, perform edits in the next dialog box. Select the next pencil icon in the Levels section of the Project Navigator palette. Here you add as many levels as needed for your job. The sample project is a two-story office building. The first floor has a floor elevation of 0 inches. Edit the floor-to-floor height of the first floor to be 14 feet, 0 inches. Now click the Add Level icon in the top-right corner of the dialog box. Notice that as you add the level, the floor elevation for the second floor is automatically calculated. Floor-to-floor height for the second floor should be 14 feet, 0 inches. You can add a description for each level if you want. Click OK to close the dialog box.

In addition to levels, you can specify divisions of levels as well. If a single floor of a building is too large to fit on a single drawing, you can break it down into divisions. This project does not require any divisions to be specified.

Step 2: Constructs

Next, click the Constructs tab on the palette. Constructs are your project drawings. During the traditional project setup, base sheets and working drawings were discussed; these drawings represent constructs.

Another item related to constructs is elements. Elements are drawings that have no predetermined insertion point with respect to the current user coordinate system (UCS). Elements are generally used for repeating objects in a design. A good example of an element would be a gang toilet that is identical for each floor in a multistory building.



If you right-click the *Constructs* folder, you notice there a couple of different ways to create constructs: create a new construct from scratch or save the current drawing as a construct. You can also create subcategories under the *Constructs* folder to organize your project. Create a few new subcategories under constructs: Architectural, Electrical, Interiors, Mechanical, Plumbing, and Structural. Now right-click the *Architectural* folder, and choose *New>Construct*. You are going to create first-floor and second-floor base sheets. The name of

the first construct is 1st Floor Base. Type a description if you want. Next, check the box for Level 1. Click OK. This creates your first construct, 1st Floor Base. Follow the same procedure to create 2nd Floor Base, select the box for Level 2 instead.

Now double-click 1st Floor Base. For this brief tutorial, it's not necessary to create an intricate floor plan for the base drawing. Draw some simple walls and add a door or two so you can distinguish between the first- and second-floor base plans. At the command line type *WallAdd* (or choose the *WallAdd* command from the Architectural tool palette). Before drawing the wall, change the Base Height to 14 feet. When asked for a start point, use 0, 0. Next, provide an end point. Drag your cursor to the right and type 50' at the command line, drag your cursor straight up and type 30' at the command line, you're your cursor to left and type 50' at command line. Type *C* at the command line to close the wall. Type *DoorAdd* at the command line, and select a wall or walls to add a door to. Drag the door or doors to the desired locations.

Double-click 2nd Floor Base and create this simple plan. Type WallAdd at the command line. Change wall height to 14'. Start point should be 0, 0. Drag your cursor to the right, and type 30' at the command line. Drag your cursor straight up and type 30' at the command line. Drag your cursor to the left and type 30' at the command line. Type C at the command line to close the wall. Save both base drawings.

Next, you create two more constructs, this time under Mechanical. Right-click Mechanical and create a new construct. The first is 1st Floor HVAC Plan. Associate this drawing with Level 1. The second construct is 2nd Floor HVAC Plan. Associate this drawing with Level 2. Now double-click 1st Floor HVAC Plan. Drag the 1st Floor Base into the drawing. By dragging, you've basically referenced the base drawing into your plan. Double-click the 2nd Floor HVAC Plan to open the drawing. Drag the 2nd Floor Base into the drawing. Now you have your two base drawings and your HVAC working drawings automatically organized in an easy-to-understand file structure, without having to know a thing about xrefs.

Double-click the 1st Floor HVAC Plan. You're going to add an exhaust fan to the first floor roof. With your tool palette open and set to Mechanical, click the HVAC Equipment tab. Select Add Fan. The MvPart dialog box appears. Choose Rooftop Downblast Fan Imperial from the available fan types. Select a 2181-2740 CFM fan, and be sure the elevation is set to 14 feet. Place the fan on the right side of the building near the right-most exterior wall (see Figure 3). Now select a Fan Tag from the same tool palette, and select the fan just placed. Place the tag next to the fan. The Property Set dialog box appears. Select the check box next to Location, and type First Floor Roof. Select the box next to Service, and type First Floor. Change the Static Pressure to 0.5, and click OK. This tags the first fan. Save the drawing and exit.

Double-click the 2nd Floor HVAC Plan. Following the same procedures, add a rooftop downblast fan, 0-1100 CFM, on the second-floor roof at the same elevation of 14 feet (a common mistake would be to place the fan at an elevation of 28 feet. View drawing handles elevations later. See Step 3: Views). Place the fan at any location on the roof. Tag the second fan using "Second Floor Roof" for Location, "Second Floor" for Service, and 0.25 for Static Pressure. Change the Unit # to EF-2 (Figure 4). Click OK. Save the drawing and exit.

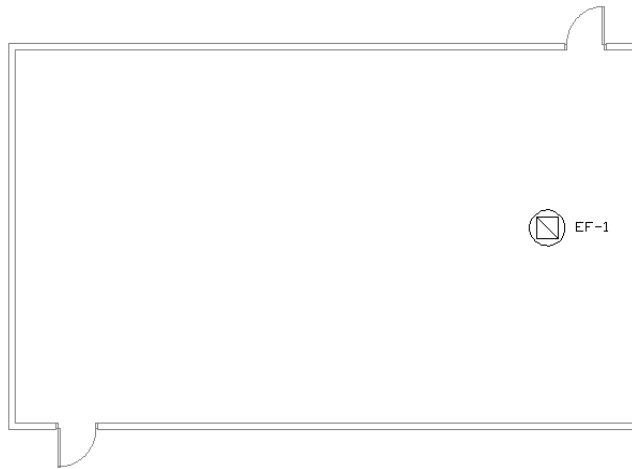


Figure 3. 1st Floor HVAC Plan



Figure 4. 2nd Floor HVAC Plan

Step 3: Views

The next step is to create a view drawing of the HVAC design. View drawings are DWG™ files that automatically reference the appropriate constructs according to their location within the building. For multistory buildings, each construct is referenced at its level height. There are three different types of view drawings: general, section/elevation, and detail. A general view drawing contains constructs referenced from the project, representing a specific view of the building model. A section/elevation view drawing contains one or more model space views that show a defined portion of the section/elevation view drawing. A detail view drawing contains one or more model space views that show a defined portion of the detail drawing in the level of detail you specify. Both section/elevation and detail views can be associated with a callout.

The type of view drawing of interest here is a general view drawing. View drawings can be organized by categories exactly like constructs, but because only one discipline is being addressed here, there's no need to create categories under Views. To create the first view drawing, right-click Views, choose New View DWG>General. In the Add General View dialog box, enter HVAC Building Model for the name of the drawing, and click Next. Next you select which levels to associate with your new view drawing. Select both 1st and 2nd Floor, and click Next. Now you see the directory structure expanded to include the files created in the project. Only the architectural and mechanical constructs are relevant here, so clear the other disciplines and click Finish. The view drawing is created.

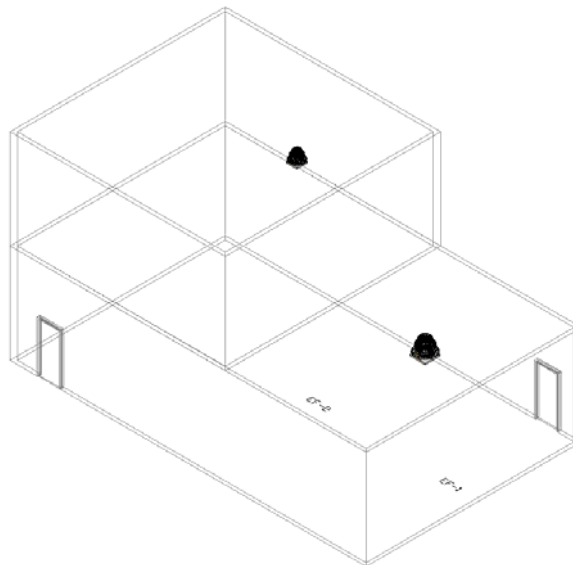


Figure 5. HVAC building model.

The next view drawings created are of the first- and second-floor HVAC plans individually. Right-click Views, and choose New View DWG>General. Name the new drawing 1st Floor HVAC View, and click Next. Associate the file with the first level only. Clear the disciplines not used, and click Finish. Follow the same method to create the 2nd Floor HVAC View, except associate the file with the second level only. You should now have a total of three view drawings.

Step 4: Sheets

Creating a sheet set is the next task. Sheet set drawings are the actual files you send to a plotter. Some architects and engineers refer to these drawings as composite drawings. Click the Sheets tab on the Project Navigator tool palette. Notice that some default subsets already created here: General, Architectural, Mechanical, Electrical, and Plumbing. Click the + (plus) symbol next to Mechanical to expand the directory tree. Notice that the subsets are broken down into even more specialized categories. You will produce a cover sheet, two plan sheets, a section sheet, and a schedule sheet, five sheets in all.

Right-click General, and choose New>Sheet. Number your sheet M0.0, and type Cover Sheet for the Sheet title. You'll come back to the cover sheet as the last step. Save the sheet and exit.

Right-click Plans under Mechanical, and choose New>Sheet. The Number of the sheet is M2.1, and the Sheet Title is 1st Floor HVAC Plan. Click OK. Again, right-click Plans and create a second sheet with number M2.2 and title 2nd Floor HVAC Plan. Right-click Sections, and create a section sheet with number M6.1 and title HVAC Sections. Right-click Schedules and Diagrams and create a sheet with number M7.1 and title HVAC Schedules.

Double-click M2.1 1st Floor HVAC Plan to open the file. Notice that a border has already been set up in paper space. Your company border can be assigned as the template border in project setup, which automates this process for you. While in sheet M2.1 1st Floor HVAC Plan, click the Views tab in the Project Navigator palette. Drag the 1st Floor HVAC View into the drawing. When a model space view is placed onto a sheet, a sheet view is created. The sheet view—display configuration, drawing scale, and layer settings—is defined by the model space view. If you hold the cursor motionless before selecting an insertion point, a tooltip appear, letting you know to change the view scale. Right-click and change the scale to $\frac{1}{4}'' = 1'-0$ before selecting an insertion point. Locate the viewport in the upper-right corner of the sheet. Repeat this process for M2.2 2nd Floor HVAC Plan. Scheduling and Sections are covered in Steps 5 and 6.

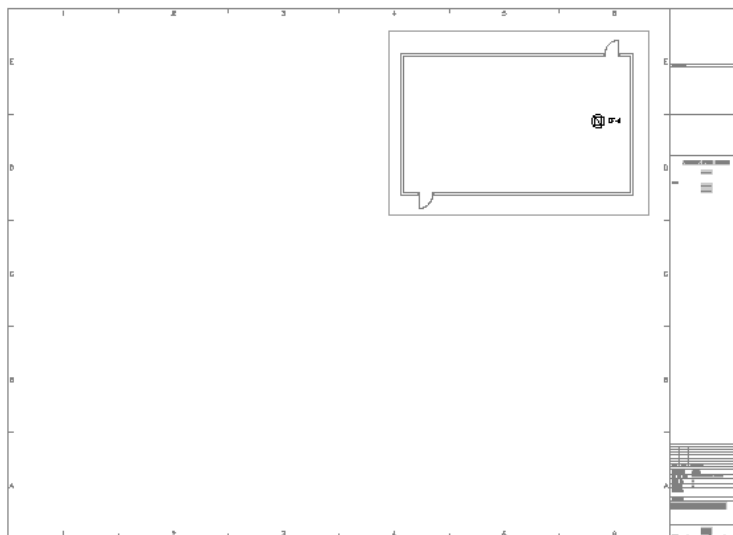


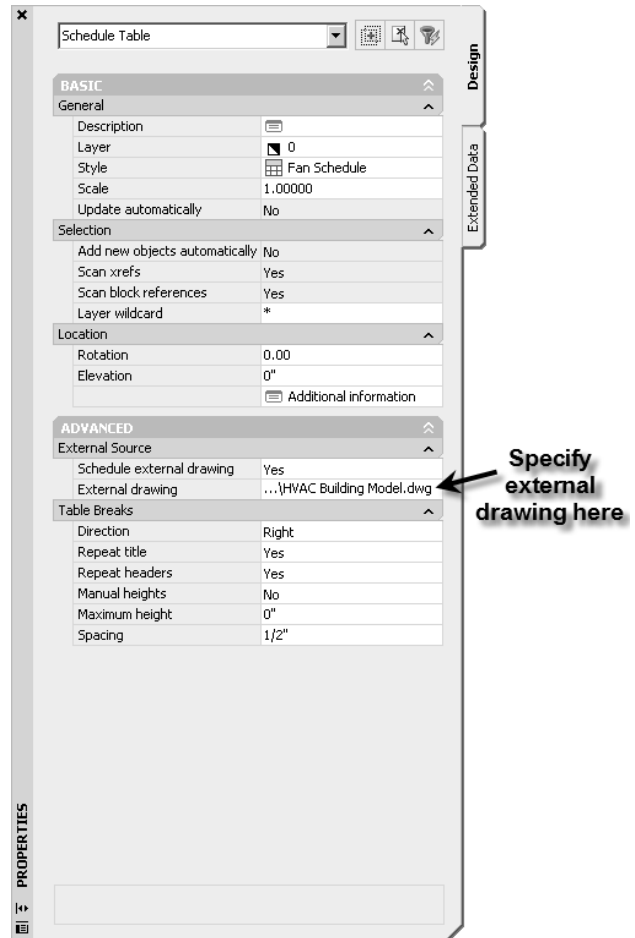
Figure 6. Inserting a model space view into a sheet

Step 5: Schedules

Next, you create schedules for the project. Open M7.1 HVAC Schedules. From the mechanical tool palette, click the HVAC Equipment tab. Choose the Fan Schedule on that palette (provided with a default installation of Building Systems software). The schedule you are choosing is for demonstration purposes only. Schedules can be customized to include any property sets that you want and made to look just like the schedules you use today.

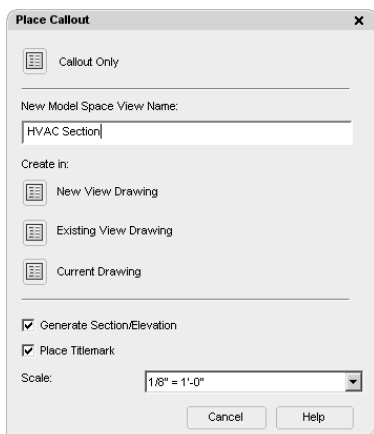
You are asked to select the objects used for scheduling or to press Enter to schedule an external drawing. Press Enter. Pick the insertion point for the upper-left corner of the schedule and press Enter. Zoom into the schedule to get a better look. Click the schedule to activate grips, and select Properties. The Properties dialog box has a Design tab and an Extended Data tab. Click the Design tab. Under the Advanced section where it reads External Source, the software asks if you want to schedule an external drawing. Change the text box to Yes. When this is done, another option appears: External Drawing. Click in the *NONE* textbox and browse to find the HVAC building model drawing under Views.

Once selected, the fan schedule displays a slash mark across the schedule to indicate that the schedule needs updating. Right-click the schedule, and choose Update Schedule Table. Both fans EF-1 and EF-2 appear in the fan schedule. Imagine the time you'd save on a large project and the costly errors you'd avoid by using Building Systems.



Step 6: Sections

One of the last sheets to be created is the section sheet. Click the Views tab, and open the HVAC Building Model view drawing. Click the Annotation and Utilities tab on the Mechanical tool palette. Select the Section Mark command, and select the first point just to the left of the building and below the y-coordinate of the exhaust fans. With Ortho on, select the second point just to the right of the building. Press Enter to specify the section extents.



Next, you need to decide what to name your section and where to create it. Name the section HVAC Section. There are three different places to create your section: in a new view drawing, in an existing view drawing, or in the current drawing. You can also determine the scale of the section. Create your section in a new view drawing.

Another dialog box appears, which you can use to create a new view drawing. Name the new drawing HVAC Section View. Building Systems automatically associates the section with the first and second floors.

Now select an insertion point above the building to locate the section (the new view drawing uses these coordinates to locate the section cut). Building Systems creates the new section and the new view drawing. Save and close HVAC Building Model. Double-click HVAC Section View to see the new section. Note the scale of the section in the title tag (1/8" = 1'-0"). Exit the section drawing.

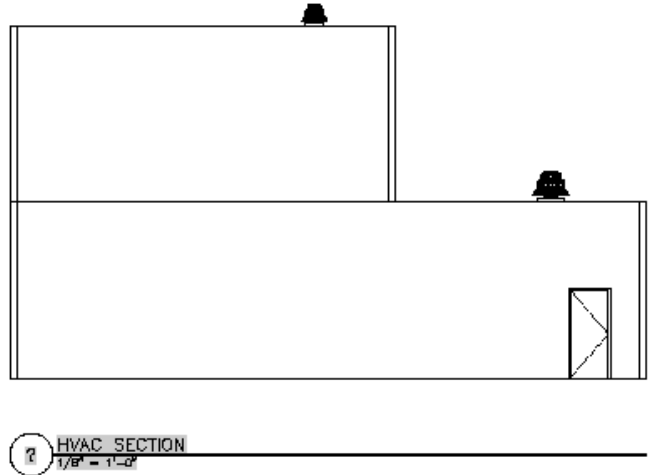


Figure 7. You can create a section in Building Systems in a fraction of the time it takes using traditional methods.

Now to create the final sheet needed for your project. Click the Sheets tab in the Project Navigator tool palette. Open M6.1 HVAC Sections. Proceed to the Views tab and drag HVAC Section View drawing into the sheet. Right-click to change the scale to 1/4" = 1'-0" before selecting an insertion point. Take a look at the title tag for the section cut. Building Systems automatically updates the title, saving you time by not having to manually change the text and helping to ensure a more accurate set of construction documentation. And in case you're wondering, that update to the title tag occurred in the HVAC Section View drawing as well.

Step 7: Cover Sheet

With all of the design sheets created, the last step is to create a sheet index. Open the cover sheet you created earlier. Next, right-click Autodesk Office Building (the name of your project located just above General), and choose Insert Sheet List. From the dialog box you can customize your sheet list and even save those settings for your next project. Change Title Text to Autodesk Office Building, and click OK. Select an insertion point for your table. If one of the sheets needs to be modified or a title changed, the Sheet List Table can be updated automatically. Your project is finished and ready to plot.

Autodesk Office Building	
Sheet Number	Sheet Title
M0.0	Cover Sheet
M2.1	1st Floor HVAC Plan
M2.2	2nd Floor HVAC Plan
M6.1	HVAC Sections
M7.1	HVAC Schedules

Figure 7. Building Systems automatically creates a sheet index for your project.

Conclusion

Automation is the key to productivity with Building Systems. Whether you're creating a project the traditional way or using the Project Navigator in Building Systems, the net result is the same: base sheets, working drawings, composite drawings, and project folder organization. The difference is that Building Systems can help automate processes for creating construction documentation, saving you time and money. In addition, it gives your company a way to standardize the process of creating project folders for your drawing files.

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