

# A Productivity Comparison of AutoCAD and Autodesk Building Systems

This study looks at how Autodesk® Building Systems extends the functionality of AutoCAD® software to offer a simpler, more natural approach to the design and documentation of building mechanical, electrical, and plumbing (MEP) engineering projects.

More than 20 years after the first release of the AutoCAD, many users still rely on lines, arcs and circles to design and document their work. Autodesk Building Systems extends the functionality of AutoCAD to offer a simpler, more natural approach to the way building mechanical, electrical, and plumbing drafters, designers, and engineers produce their construction documentation. This study provides details on the discipline-specific design tools provided in Building Systems and demonstrates the productivity gains Building Systems provides over traditional AutoCAD when it comes to designing and documenting MEP engineering projects.

Designed by Autodesk and completed in conjunction with independent contractor and consultant A.C. Tedder July 2005, this study consisted of the design of the mechanical, electrical, and plumbing systems for a three-story lab/research facility in both AutoCAD and Building Systems applications. (Tedder and Autodesk worked with 2006 versions of both AutoCAD and Building Systems.) The design was broken down into nine tasks and a series of subtasks that represented the typical stages in the design of the MEP engineering systems. All of the subtasks were timed and recorded. Although it took relatively the same amount of time in both applications to create the CAD standards leveraged for this project and to layout the basic building floor plan, significant productivity gains were seen in the editing of the design and in the creation of construction documents when using Building Systems. A detailed description of the study follows.

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## Task 1: Standards

Defining CAD standards is the first step than any engineering firm will perform before starting design of their mechanical, electrical or plumbing systems. Defining standards includes tasks such as creating block libraries for symbology and equipment, creating layer standards, establishing default annotation tags, creating schedules and so forth. For our study it was imperative that we start with an even slate for AutoCAD and Building Systems. For the purpose of this study, it is assumed that the majority of the standards required to complete a design are already in place.

To get a good feel for how long it might take to create some of these standards two tasks were undertaken, creating layer standards and developing a custom schedule. These tasks are normally performed prior to software implementation and need only be performed once.

In AutoCAD, Tedder created a series of layers used for HVAC and Piping design and saved them to a template file. Layer name, color and linetype were the only characteristics specified. In Building Systems, the identical layers were created using layer key styles and HVAC System Definitions, and saved to a template file as well.

It took 9 minutes to create a simple layer standard in AutoCAD; however it took 27 minutes in Building Systems due to creating layer key styles and defining a collection of HVAC System Definitions. While it takes more time to create these additional standards in Building Systems it pays off big during the design phase. And remember, creating Layer Keys and System Definitions only has to happen once while the savings in productivity occur each and every time you design an HVAC ductwork or piping system.

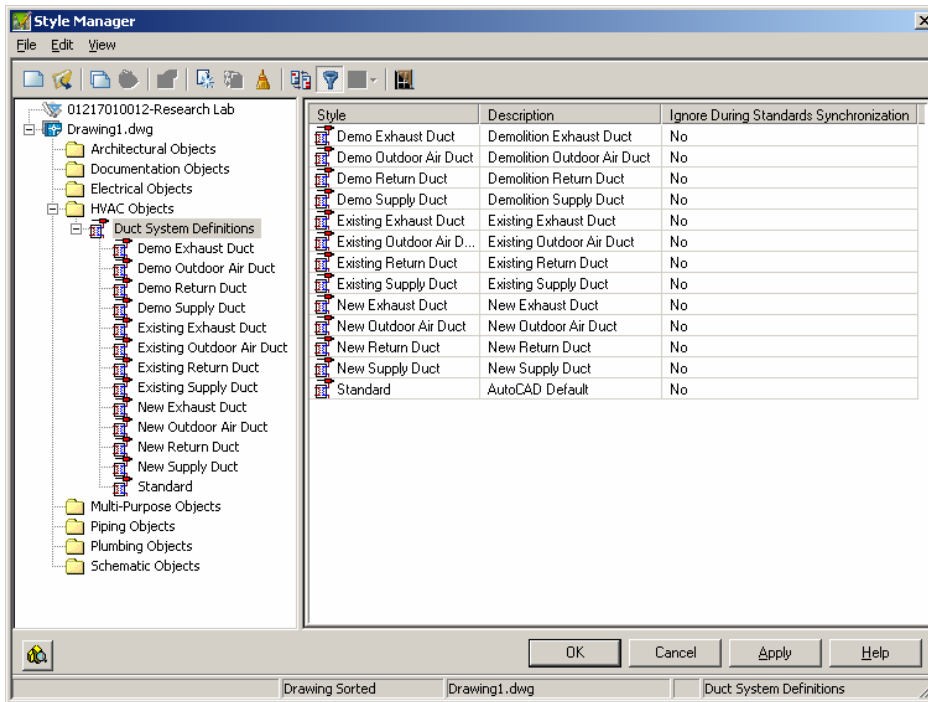
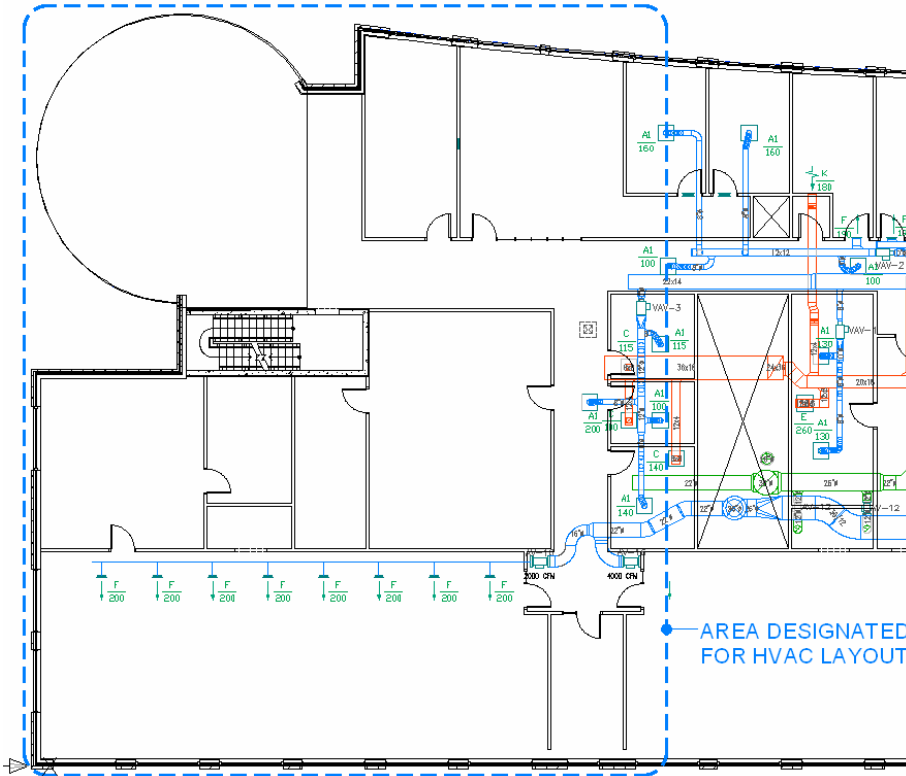


Figure 1. HVAC System Definitions for ductwork



## Task 2: HVAC Plan

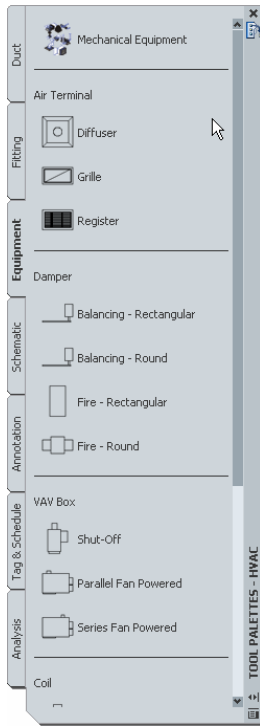
Once standards have been established, the mechanical, electrical and plumbing plans can be laid out. Tedder chose to start by laying out the mechanical HVAC plan. The area selected to layout included a lab, support rooms, offices and an atrium area (this area was used for Task 3: Lighting Plan and Task 4: Power Plan as well).



**Figure 4.** Area chosen for HVAC layout

The test was broken down into several subtasks that depict a normal HVAC design: laying out equipment and diffusers, labeling equipment, and drawing ductwork. Two additional subtasks were chosen to better illustrate the differences between AutoCAD and Building Systems: labeling ductwork and creating hidden line representations for crossing objects. Normally these two tasks would fall under the subtask of drawing design. The final subtask performed, creating a double line duct from a schematic layout, helps demonstrate the difference between Building Systems and AutoCAD in their ability to leverage existing data from design development for construction documentation.

In AutoCAD, Tedder completed the first task of laying out diffusers and equipment by following the time honored tradition of inserting blocks into the drawing. This didn't take very long, only 2.6 minutes. In Building Systems, MvParts were used to represent diffusers and VAV boxes. MvParts are intelligent model based parts that behave like their real-world counterparts. Selecting and inserting MvParts takes no more time than inserting standard blocks into a drawing, however this task took longer in Building Systems because additional data was specified upon insertion which facilitates auto-labeling and linked scheduling. It is important to note that entering such additional data for the MvParts can take place at anytime during the design process and only has to be entered once.



The second task of labeling equipment and diffusers was pretty straightforward in AutoCAD. A tag with attributes was used for the diffusers, while simple text sufficed for labeling VAV boxes. This task took 6.2 minutes.

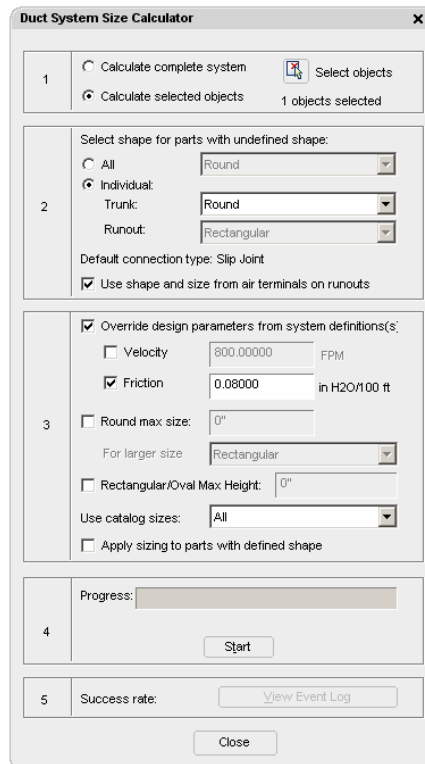
In Building Systems, labeling was even easier. From the tool palette a diffuser tag was chosen and diffusers were selected for labeling. The tag automatically linked to the data from each object selected and filled out the tag appropriately. Tagging VAV boxes was accomplished using the same method. Completion of labeling took 2.9 minutes in Building Systems. Tags can also be added automatically when the MvParts are added to the drawing if desired, which would have eliminated this step all together in Building Systems.

The third task of laying out ductwork is where Building Systems intelligent objects really begin to show their worth. The productivity gains in this stage are quite substantial. In AutoCAD, Tedder used lines, arcs and circles to complete the geometry that represents supply duct, return duct and exhaust duct layouts. Because the AutoCAD used was a standard install with no customization there were no real options for drawing flexible duct other than using a pline. This was a notable difference between the AutoCAD layout and the Building Systems layout.

In Building Systems, the layout of the ductwork went much quicker than with AutoCAD. The time spent actually drawing ductwork in Building Systems was 25.9 minutes while AutoCAD took much longer at 58.8 minutes. That's a difference of just under 33 minutes on a very small portion of a building. Seeing the size of our study, just imagine how much time could be saved on a much larger project.

The next two subtasks, labeling ductwork and creating hidden lines, were broken out from ductwork design to get a good idea of how much time is actually needed to perform them manually in AutoCAD. Since Building Systems performs both of these tasks for you automatically there was no time ascribed to either. It's easy to see from looking at the times logged why Building Systems increases productivity dramatically. Had this been done on a larger scale the results would have been staggering.

The last subtask to complete was creating a double line duct layout using an existing single line layout. With AutoCAD it was much of the same thing - using the offset command, the trim command and the line command. Tedder was able to create the double line layout of the ductwork serving LAB 247 in 3.7 minutes with AutoCAD. In Building Systems Tedder used the Duct System Size Calculator. By selecting the single line representation of the ductwork and making some decisions about shape of duct, sizing parameters and runout shape Tedder was able to complete this task in 1.8 minutes - half the time it took in AutoCAD.



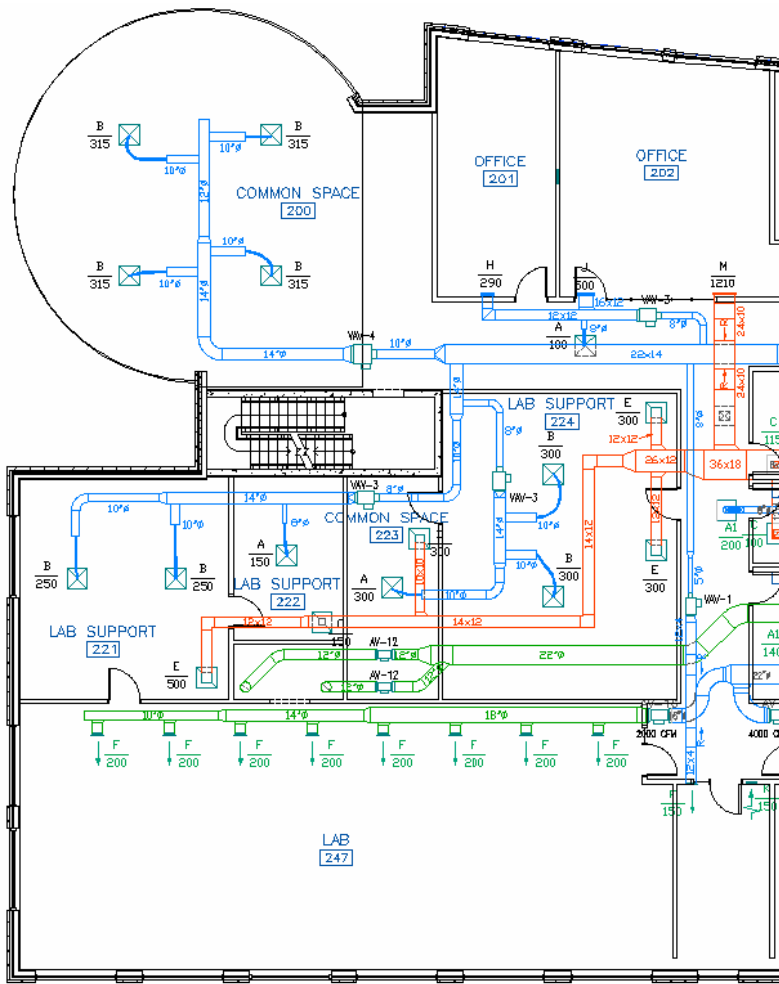


Figure 5. Completed layout for HVAC

The total time Tedder spent on this task using AutoCAD was 67.6 minutes, while Building Systems enabled him to finish in 36.3 minutes. It's easy to see how customers who have made the switch from AutoCAD to Building Systems have increased their productivity while minimizing costly errors found in manual drafting techniques.

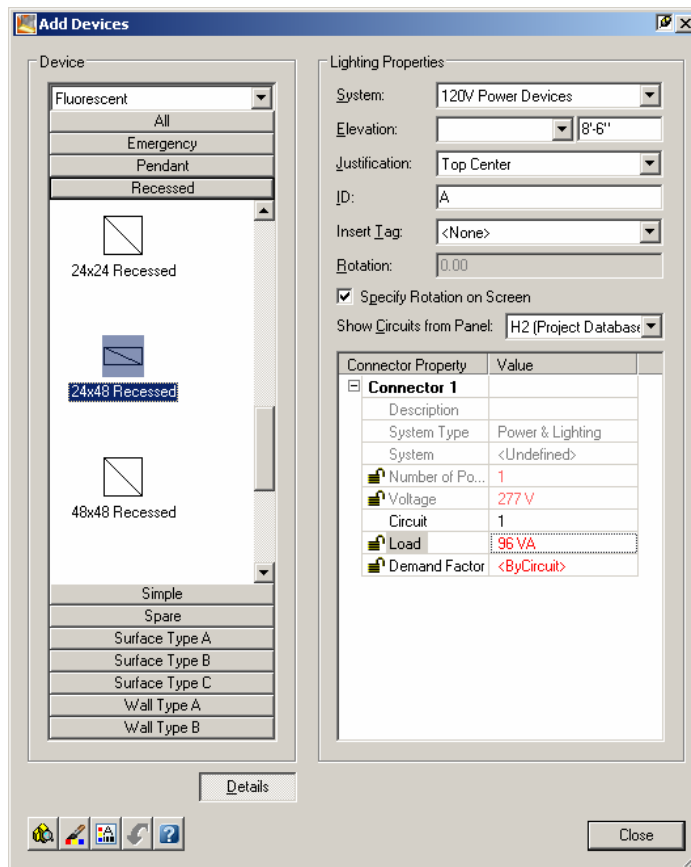
Task 2: HVAC Plan	Subtasks	AutoCAD (min)	Building Systems (min)
	Laying out diffusers and VAV boxes	2.6	7.5
	Tagging diffusers and boxes	6.2	2.9
	Drawing ductwork (supply, return, exhaust)	38.2	24.1
	Adding labels to ductwork (ABS performs this automatically)	9.8	0.0
	Drawing haloed lines (ABS performs this automatically)	7.1	0.0
	Creating double line duct layout using single line schematic as guide	3.7	1.8
	<b>Total Time</b>	<b>67.6</b>	<b>36.3</b>

### Task 3: Lighting Plan

Following the ductwork layout Tedder moved onto the lighting plan. The first subtask was to layout the light fixtures, junction boxes and switches. AutoCAD seemed to have a slight edge in the time required to layout the different lighting fixtures and electrical devices. This was due to the fact that information such as circuit number, ID, elevation, connected panel and other electrical data was specified for the Building Systems objects, while AutoCAD used simple blocks with no intelligence. Although placement of devices took longer, assigning this data up front ultimately led to a quicker overall time for Building Systems. It's important to note here that not only were the fixtures and devices being located, but a logical circuit model was being created at the same time. The foundation for creating panel schedules and circuit sizing is being done automatically by Building Systems with no extra effort.

*“Autodesk Building Systems has created the next jump in productivity. It's definitely faster for creating drawings, eliminating mistakes, and saving on drawing time. With Autodesk Building Systems, we estimate our engineers are creating construction documents 50% faster and modifying those 70% quicker.”*

**Reg Monteyne, Senior Vice President  
Flack+Kurtz**



**Figure 6.** Specify electrical data used for scheduling and circuiting

Next subtask was tagging light fixtures. Even though the time doesn't show a huge difference between the two applications, what's going on behind the scenes with Building Systems is quite significant. As Tedder tags each light fixture, Property Set Definitions are automatically attached to the objects. These property sets are what Building Systems uses to populate schedules. The link between the design data and the schedule is dynamic and updates automatically, minimizing inconsistencies in your project and increasing productivity.

Next was wiring the lights, junction boxes and switches which was fairly straightforward in AutoCAD and actually took about 30 seconds less than it did in Building Systems. What enabled Building Systems to outperform AutoCAD during this task is the fact that it automatically adds homerun arrows and tick marks when specified. Drafting aside and stop watches down, let's take a look at the engineering aspect of Tedder's wiring. Now that he's drawn the circuits Building Systems can size the wiring for him based on sizing tables from the National Electric Code. There are a couple of different ways to size wiring: one is to perform a wire modify on the desired wires and pick on the Calculate Wire Size button, or the user can size entire circuits using the Circuit Manager. Tedder chose the latter.

The last subtask was to label home runs. Tedder followed the same procedure that most would follow in AutoCAD - placing text next to each home run arrow and editing the text. In contrast, this process is completely automated with Building Systems. Simply grab the home run tag from the tool palette and pick on the home run. It took Tedder almost three times longer to perform this task in AutoCAD than it did with Building Systems.

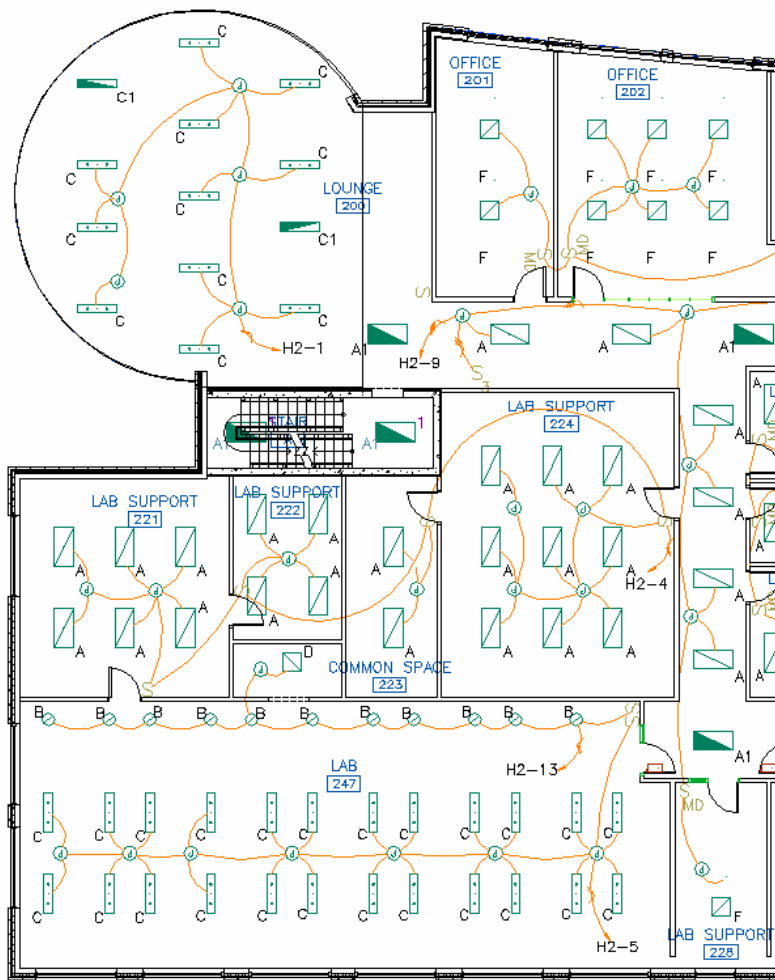


Figure 7. Completed layout for lighting

The lighting design took 22.9 minutes with AutoCAD and 20.5 minutes with Building Systems. Tedder used similar techniques in both applications to create the lighting plan, hence the time difference for completion was negligible. The Building Systems model however, contains valuable information used downstream in the design saving time on the project overall.

<b>Task 3: Lighting Plan</b>	<b>Subtasks</b>	<b>AutoCAD (min)</b>	<b>Building Systems (min)</b>
	Laying out light fixtures, switches and junction boxes	9.5	11.2
	Tagging light fixtures	3.8	2.1
	Wiring lights, junction boxes and switches	8.5	6.8
	Labeling home runs	1.1	0.4
	<b>Total Time</b>	<b>22.9</b>	<b>20.5</b>

### Task 4: Power Plan

The same methods and procedures used to create the lighting plan were used to generate the power plan as well. The placement of receptacles and junction boxes took a little longer in Building Systems for the same reasons stated in Task 4: Lighting Plan.

Something interesting to note here is the amount of time spent drawing the circuiting and labeling home runs. Even though the number of circuits in the power plan increased quite a bit over the lighting plan, Building Systems required about the same amount of time to complete the wiring for each plan. AutoCAD needed about 30% more time to circuit the devices in the power plan.

Similar comparisons of home run labeling times show Building Systems enabled Tedder to label home runs 4 times faster than when using AutoCAD. Even though labeling times recorded are much smaller than times registered for wiring or laying out devices, on a project of considerable scale this could mean quite a few man hours.

Tedder spent 26.4 minutes drawing the power plan in AutoCAD and 22.1 minutes using Building Systems. Neither application had a significant advantage in total time spent drawing the power plan, yet the Building Systems design contains circuiting data that can be automatically turned into a panel schedule.

<b>Task 4: Power Plan</b>	<b>Subtasks</b>	<b>AutoCAD (min)</b>	<b>Building Systems (min)</b>
	Laying out receptacles and junction boxes	10.4	13.7
	Wiring receptacles and junction boxes	10.8	7.1
	Labeling home runs	5.2	1.3
	<b>Total Time</b>	<b>26.4</b>	<b>22.1</b>

## Task 5: Plumbing Plan

For the plumbing plan Tedder chose to concentrate on the Men's and Women's restrooms located in the center of the building. Four subtasks were chosen based on the standard procedures many plumbing engineers follow when designing domestic hot and cold water systems – locating plumbing fixtures (Building Systems only, explained later), labeling those fixtures, drawing the hot and cold water piping and finally sizing the systems.

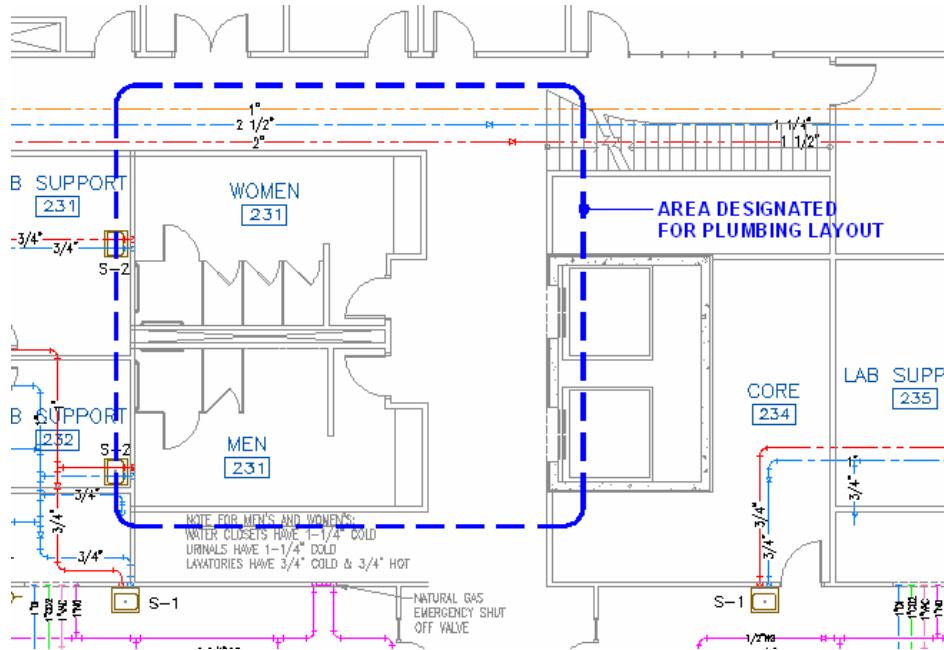
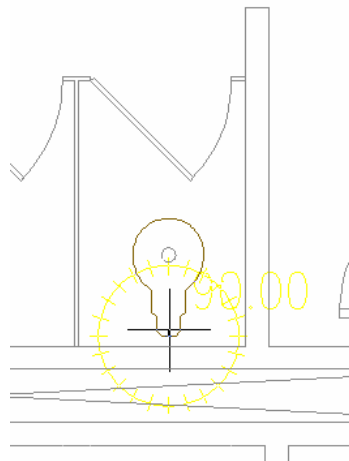


Figure 8. Site for plumbing design

The first subtask was to locate plumbing fixtures in the drawing. Typically architectural plans will have blocks in their drawings representing plumbing fixtures; as a result no time was assessed against AutoCAD for this subtask. Building Systems, however, required the use of MvParts, not standard AutoCAD blocks, in order to benefit from the automated sizing routines later in the design. There were a couple of ways to accomplish this – convert the blocks in the xref'd architectural plan to MvParts, or simply insert the MvParts into the plumbing drawing. Tedder found that it was quicker to simply insert the MvParts into the plumbing drawing due to the size of his designated area. However, on larger projects converting the blocks into MvParts with a single conversion process would be faster. It took Tedder 3.5 minutes to insert all of the plumbing fixtures at the correct elevations. These plumbing fixtures have fixture units associated with them that facilitate pipe sizing which is covered in subtask 4.



Next is tagging the plumbing fixtures. Using simple text in AutoCAD Tedder placed a label next to a fixture. He copied that text to the next fixture and edited the text in place, and so on. This process took 2.1 minutes to complete. In Building Systems he inserted a plumbing fixture tag that was accompanied by a property set. This data will be used later when scheduling. Tagging plumbing fixtures in Building Systems took 1.1 minutes.

There was very little difference when routing water piping. Building Systems gained time by auto-inserting elbow, tees and transitions, but lost time specifying pre-defined elevations and establishing valid connections between objects. In complete contrast, AutoCAD lost time having to insert and rotate elbows, tees and transitions, while gaining time not specifying elevations and connecting to nothing. The losses and gains by each application evened out which is evident by viewing the times recorded: 10.4 minutes with AutoCAD, 10.2 minutes with Building Systems.

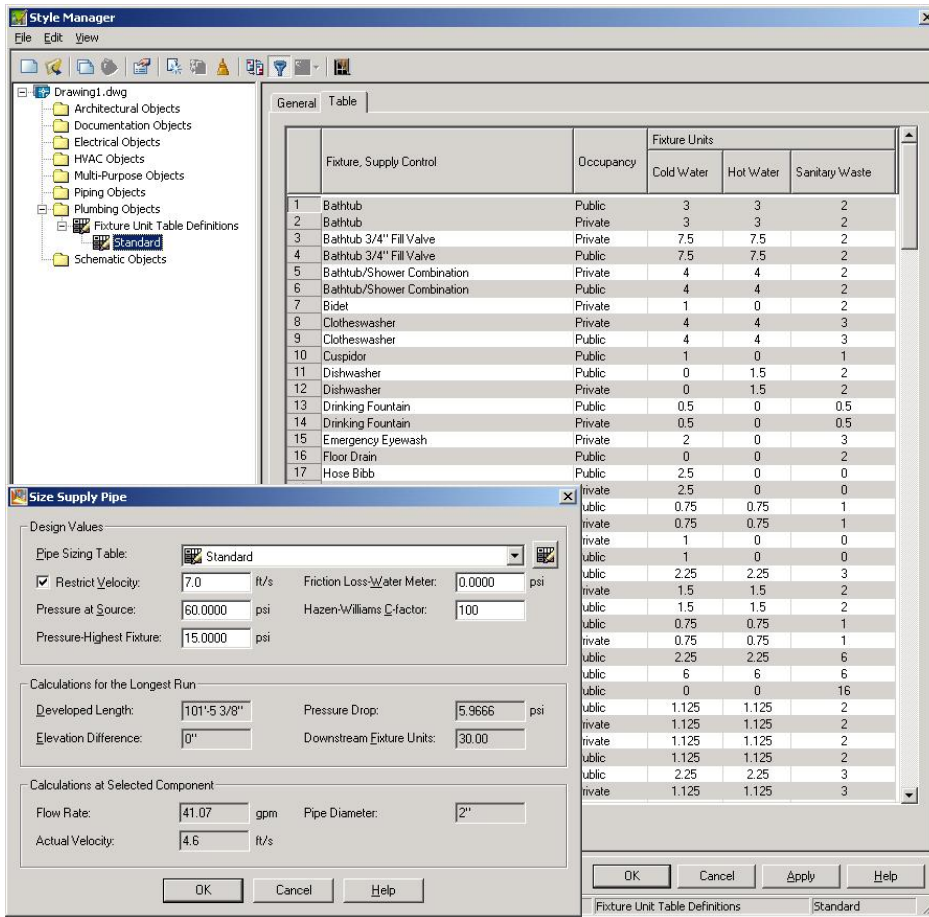


Figure 9. Customizable Fixture Unit Table and Pipe Sizing Calculator

The final subtask for plumbing was to size and label the domestic hot and cold water piping. Building Systems really outpaces AutoCAD here. Because the plumbing fixtures inserted by Building Systems are MvParts and not standard AutoCAD blocks, they contain all the fixture unit information you need to size your piping. Using the Pipe Sizing Calculator, Building Systems extracts the total fixture unit information from the drawing and calculates a pipe size using the Hazen-Williams friction loss formula and a derivation of the Hunter's Curve referenced from ASPE. This task took 1.2 minutes in Building Systems.

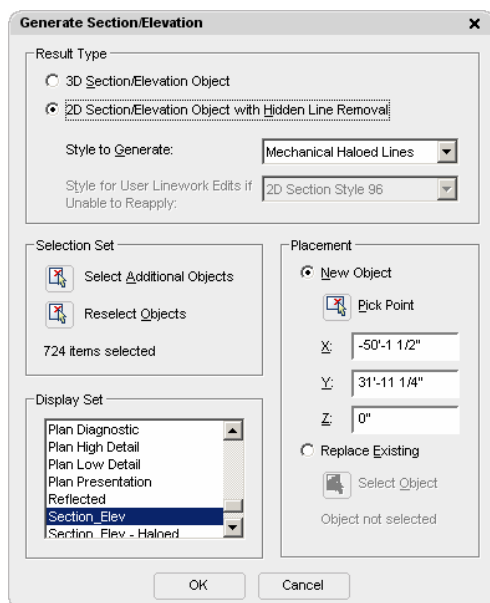
AutoCAD, on the other hand, had no tools to assist in sizing plumbing piping. Tedder had to do it the old fashioned way - pull out the International Plumbing Code and flip to Appendix E. The time spent looking up fixture units, converting those units to gallons per minute using demand tables, reading sizes from the friction loss diagram and transferring those sizes to the drawing took 7.3 minutes. Six times longer than Building Systems. The total time spent on Task 5 - 19.8 minutes for AutoCAD, 16.0 minutes for Building Systems.

Task 5: Plumbing Plan	Subtasks	AutoCAD (min)	Building Systems (min)
	Inserting plumbing fixtures	0.0	3.5
	Labeling fixtures	2.1	1.1
	Drawing hot and cold water lines	10.4	10.2
	Sizing and labeling hot and cold water lines	7.3	1.2
	<b>Total Time</b>	<b>19.8</b>	<b>16.0</b>

## Task 6: Sections and Elevations

When it comes to creating sections and elevations is where you see significant productivity gains with Building Systems over AutoCAD. Task 6: Sections and Elevations, was comprised of three subtasks: defining the section cut, creating the section and editing the section. Only subtask two pertains to AutoCAD (explained below). Instead of using the second floor of the lab/research facility Tedder chose the mechanical room on the penthouse floor of the building.

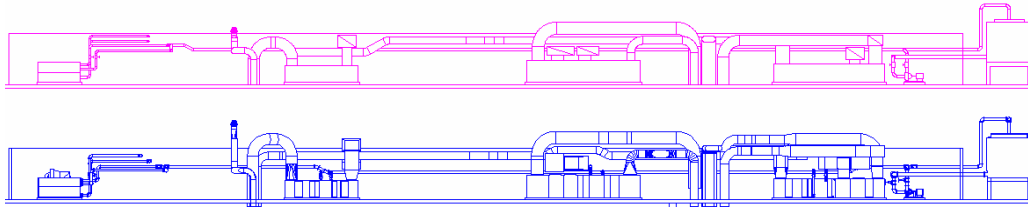
In Building Systems, Tedder defined a section cut by simply specifying the cutting plane and direction to project the section. This took 1.4 minutes.



Next, he specified a 2D section, the style of section, what objects he wanted to include in the section and the placement. At this point Building Systems spent 1.8 minutes generating the section.

Tedder needed to edit the display representation of the section slightly to get the exact look he desired. He achieved this by right clicking on the section object and picking Edit 2D Section Style. After turning off various hatch components of the display representation the section was complete. To alter the final display of the section took only 24 seconds.

In AutoCAD there were no routines to help with this task, just lines, arcs and circles. Creating sections and elevations is strictly a manual process of assigning elevations to linework from a referenced plan view. It took Tedder 92.1 minutes to complete this task with AutoCAD, and upon full investigation of the section, it's apparent that the AutoCAD section doesn't contain the amount of detail that the Building Systems section does.



**Figure 10.** Top Section – AutoCAD, Bottom Section – Building Systems

The total time spent using AutoCAD was 92.1 minutes. The total time spent using Building Systems was 3.6 minutes. Even though the time spent by each application was so disproportionate performing this task, the comparison is quite conclusive – Building Systems increases productivity.

Task 6: Sections and Elevations	Subtasks	AutoCAD (min)	Building Systems (min)
	Defining section cut (Building Systems only)	0.0	1.4
	Creating Section or drawing section	92.1	1.8
	Editing Section (Building Systems only)	0.0	0.4
	<b>Total Time</b>	<b>92.1</b>	<b>3.6</b>

## Task 7: Schedules

In Task 1: Standards, Tedder created custom VAV box schedules in AutoCAD and Building Systems. In AutoCAD he used Tables and in Building Systems he used property set definitions and the schedule table styles. Tedder used the same techniques in both applications to create a Light Fixture Schedule and a Plumbing Fixture Schedule. So why does Building Systems outperform AutoCAD when filling out the Light and Plumbing Fixture Schedules but falls behind when creating the VAV Box Schedule? The answer is object based property sets vs. style based property sets.

Object based property sets is data attached to objects that will change from object to object as VAV boxes do. **Example:** Your design can have many VAV boxes of the same style (e.g. 8" diameter inlet, shut-off VAV box) all with different airflow requirements. In fact, it's probable. The airflow requirement for each box would be an object based property.

Those same boxes would have style based property set data associated with them as well. **Example:** Normally an engineer will schedule the same manufacturer for all VAV boxes on a project. Each instance of an 8" diameter inlet, shut-off VAV box would have the same data defined for the manufacturer property set. The manufacturer would be a style based property set.

Now back to the task. An assumption was made that the data contained in the Light Fixture Schedule and the Plumbing Fixture Schedule is normally style based whether or not you're using AutoCAD or Building Systems. From this we can infer that an engineer using AutoCAD could have a Light Fixture Schedule completely filled out with the different types of light fixtures he or she likes to specify for typical jobs. This schedule could then be edited by deleting the types of light fixtures not used in the project and revise the IDs of the remaining light fixture types. This process took Tedder 1.9 minutes in AutoCAD for both the Light Fixture Schedule and the Plumbing Fixture Schedule (schedules created reflect entire 2<sup>nd</sup> floor).

In Building Systems, Tedder used the Add Schedule Table command to generate both fixture schedules. First he determined the type of table he wanted to generate; then he window selected everything in the drawing (Building Systems will only select the objects in the drawing pertinent to that type of schedule). Building Systems did the rest. This task was completed in 18 seconds for each schedule.

*“After implementing Autodesk Building Systems, we have seen a 50% jump in productivity. It’s giving our engineers the ability to reduce their drafting time and improve accuracy. Because of this, we’re saving time on project revisions and getting accurate construction documents completed on time.”*

**Tom Harris, P.E.,  
President and  
Principal Electrical  
Engineer, Harris  
Consulting Engineers**

LIGHT FIXTURE SCHEDULE								
QTY	ID	DESCRIPTION	MANUFACTURER	MODEL	LAMP		MOUNTING	VOLTAGE
					NUMBER	TYPE		
104	A	2'x4' RECESSED STATIC TROFFER	LITHONIA	SPG-C32	4	F032TB	RECESSED	277
16	A1	2'x4' RECESSED NIGHT TROFFER	LITHONIA	SPG-E48-4	4	F032TB	RECESSED	277
48	B	RECESSED DOWN LIGHT	LITHONIA	GT654	1	F032TB	RECESSED	277
119	C	1'x4' PENDANT HUNG FIXTURE	LITHONIA	DR-87-LK	2	F032TB	PENDANT	277
2	C1	1'x4' PENDANT NIGHT LIGHT	LITHONIA	DR-87-18	2	F032TB	PENDANT	277
12	D	2'x2' RECESSED FLUORESCENT	LITHONIA	RT-765-Y78	2	F032TB	RECESSED	277
1	D1	2'x2' RECESSED NIGHT LIGHT	LITHONIA	RT-765-YT6	2	F032TB	RECESSED	277
35	F	1'x8' PENDANT HUNG FIXTURE	LITHONIA	BG-IU87-98	2	F032TB	PENDANT	277

**Figure 11.** Light Fixture Schedule – Style Based Property Sets

About half the data in the VAV Box Schedule comprised of object based property sets with the other half being style based. AutoCAD can't compete with Building Systems when the data used is style based but has a distinct advantage when the data used is object based AND AutoCAD tables are used. That's a big "and" because AutoCAD tables were the real difference maker here; they are much akin to an Excel spreadsheet. Since object based data must be manually entered for each related object, the procedure that is used to enter this data with Building Systems has a hard time competing with the method used for entering data into a spreadsheet. VAV Box Schedule subtask: AutoCAD 1.8 minutes, Building Systems 4.4 minutes (schedules created reflect entire 2<sup>nd</sup> floor).

VARIABLE AIR VOLUME TERMINAL SCHEDULE													
TAG	MAX CFM	MIN CFM	MIN. INLET S.P. (W.C.)	REHEAT COIL					ELECTRICAL	DESCRIPTION	MANUFACTURER	MODEL NO.	NOTES
				MBH	GPM	LAT	EWI	LWT					
VAV-01	1260	500	1	19.0	2.0	90	140	120	277/1	10 INCH SHUT OFF VAV BOX	NAILOR	30RW	----
VAV-02	650	195	1	8.0	1.0	90	140	120	277/1	8 INCH SHUT OFF VAV BOX	NAILOR	30RW	----
VAV-03	900	270	1	11.0	2.0	90	140	120	277/1	8 INCH SHUT OFF VAV BOX	NAILOR	30RW	----
VAV-04	990	300	1	12.0	2.0	90	140	120	277/1	8 INCH SHUT OFF VAV BOX	NAILOR	30RW	----
VAV-05	150	60	1	3.0	1.0	90	140	120	277/1	5 INCH SHUT OFF VAV BOX	NAILOR	30RW	----
VAV-06	555	225	1	9.0	1.0	90	140	120	277/1	8 INCH SHUT OFF VAV BOX	NAILOR	30RW	----
VAV-07	520	185	1	8.0	1.0	90	140	120	277/1	6 INCH SHUT OFF VAV BOX	NAILOR	30RW	----
VAV-08	260	130	1	5.0	1.0	90	140	120	277/1	5 INCH SHUT OFF VAV BOX	NAILOR	30RW	----
VAV-09	270	110	1	5.0	1.0	90	140	120	277/1	5 INCH SHUT OFF VAV BOX	NAILOR	30RW	----
VAV-10	1180	470	1	18.0	2.0	90	140	120	277/1	10 INCH SHUT OFF VAV BOX	NAILOR	30RW	----
VAV-11	150	45	1	2.0	1.0	90	140	120	277/1	5 INCH SHUT OFF VAV BOX	NAILOR	30RW	----
VAV-12	500	180	1	7.0	1.0	90	180	160	277/1	8 INCH SHUT OFF VAV BOX	NAILOR	30RW	----
VAV-13	880	265	1	11.0	2.0	90	140	120	277/1	8 INCH SHUT OFF VAV BOX	NAILOR	30RW	----
VAV-14	240	100	1	4.0	1.0	90	140	120	277/1	5 INCH SHUT OFF VAV BOX	NAILOR	30RW	----
VAV-15	740	290	1	12.0	2.0	90	140	120	277/1	8 INCH SHUT OFF VAV BOX	NAILOR	30RW	----
VAV-16	1340	410	1	16.0	2.0	90	140	120	277/1	10 INCH SHUT OFF VAV BOX	NAILOR	30RW	----
VAV-17	550	165	1	7.0	1.0	90	140	120	277/1	8 INCH SHUT OFF VAV BOX	NAILOR	30RW	----
VAV-18	150	60	1	3.0	1.0	90	140	120	277/1	5 INCH SHUT OFF VAV BOX	NAILOR	30RW	----
VAV-19	500	130	1	5.0	1.0	90	140	120	277/1	6 INCH SHUT OFF VAV BOX	NAILOR	30RW	----
VAV-20	450	160	1	7.0	1.0	90	140	120	277/1	6 INCH SHUT OFF VAV BOX	NAILOR	30RW	----
VAV-21	780	315	1	12.0	2.0	90	140	120	277/1	8 INCH SHUT OFF VAV BOX	NAILOR	30RW	----
VAV-22	325	125	1	5.0	1.0	90	140	120	277/1	6 INCH SHUT OFF VAV BOX	NAILOR	30RW	----

**Figure 12.** VAV Box Schedule – Object Based & Style Based Property Sets

Even though AutoCAD logged a shorter time for creating the VAV Box Schedule, the total time accrued, 5.6 minutes, is greater than Building Systems total time of 5.0 minutes. As we move onto the next task, Plan Edits, you'll see how the link between the object model and the schedule data pays off when editing.

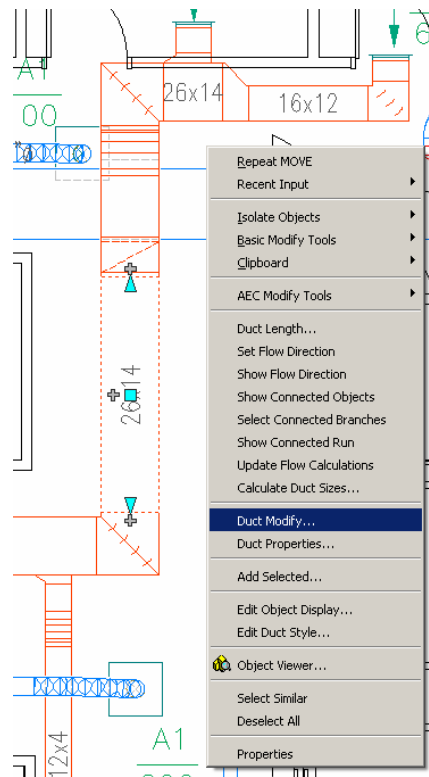
<b>Task 7: Schedules &amp; Schedule Edits</b>	<b>Subtasks</b>	<b>AutoCAD (min)</b>	<b>Building Systems (min)</b>
	Light Fixture Schedule	1.9	0.3
	Plumbing Fixture Schedule	1.9	0.3
	VAV Box Schedule	1.8	4.4
	<b>Total Time</b>	<b>5.6</b>	<b>5.0</b>

## Task 8: Plan Edits

Most, if not all, engineering designs experience some sort of change during the design process. In this study, a series of minor edits were performed to see how each product handled revisions. The subtasks were chosen to compare different types of modifications: design changes that are localized and design changes that propagate through construction documents.

The first plan edit was localized, meaning it affected the current working drawing only. Tedder selected a return duct to be resized that has three taps, two elbows, a transition and an offset in the vertical plane not the horizontal plane. Tedder started with AutoCAD to revise the plan. Using the offset command he increased the duct size throughout the run, which of course affected tap locations, elbow sizes, the transition size and don't forget, duct labels. The offset didn't affect AutoCAD's completion time greatly except for some adjustment to the hidden lines representing the supply duct below. This task took 6.3 minutes to complete in AutoCAD.

With Building Systems, Tedder made the same revision by simply right clicking on the duct, picking Duct Modify and specifying the duct width. This task took 20 seconds to complete in Building Systems.



The next modification involved removing a VAV box from the HVAC design and corresponding schedule changes. Tedder used the same procedures to remove the VAV box in both applications. Where they differed was editing the VAV Box Schedule. With AutoCAD, Tedder had to manually remove the row from the table, renumber the VAV boxes trailing the deleted one in the schedule and change the tags for the boxes affected on the plans. This process took 3.3 minutes in AutoCAD.

In Building Systems, once Tedder erased the VAV box from the drawing the schedule was updated by removing the VAV box data and deleting the row automatically. The VAV Box Schedule was then used as an editing tool to revise the tags in the drawing and the schedule at the same time. This process took 1.7 minutes in Building Systems.

The last subtask Tedder performed involved the section cuts he created earlier with AutoCAD and Building Systems. He edited the mechanical room layout in the Penthouse and transferred those changes to the section cuts. The two edits he carried out were modifying two duct sizes and relocating an exhaust fan. With AutoCAD, the plan edits alone were quite time consuming. Of the 12.9 minutes it took to complete the subtask, 7.2 of those minutes are attributed to editing the plans. The remaining time, 5.7 minutes, was spent editing the section.

With Building Systems, the plan edits took almost no time at all, only 1.3 minutes. Editing the section cut required 2.0 minutes, resulting in a total time for completion of 3.3 minutes.

<b>Task 8: Plan Edits</b>	<b>Subtasks</b>	<b>AutoCAD (min)</b>	<b>Building Systems (min)</b>
	Ductwork modification	6.3	0.3
	HVAC modification affecting VAV Box Schedule	3.3	1.7
	Plan modification and section edit	12.9	3.3
	<b>Total Time</b>	<b>22.5</b>	<b>5.3</b>

## Task 9: Sheet Layouts

Sheet layouts are the bid set construction documents contractors use to build the engineering systems designed. Final plots of the bid documents are usually produced when the engineer has completed his design, filled out all schedules, created sections as needed and completed his engineering details sheet. Both AutoCAD and Building Systems use sheet sets to create construction documentation so the procedure was similar in both products. Other advantages to using sheets sets were that both AutoCAD and Building Systems can drag and drop sections to create new views, and in addition, Building Systems can create an index sheet automatically from the existing sheet set created.

<b>Task 9: Sheet Layouts</b>	<b>Subtasks</b>	<b>AutoCAD (min)</b>	<b>Building Systems (min)</b>
	Create Sheet Sets	32.0	32.0
	<b>Total Time</b>	<b>32.0</b>	<b>32.0</b>

## Bottom Line

Adding up the total times of all the tasks gives us 5.2 hours for completion in AutoCAD, as compared to 3.1 hours in Building Systems. That's over one-and-half times faster using Building Systems. On a project of larger scale, given the versatility and efficiency of Building Systems, the time savings seen here would represent a tremendous boost in productivity. The bottom line is that if you're still using AutoCAD to design building mechanical, electrical, or plumbing systems, the time is now to consider moving to Autodesk Building Systems for the design and documentation of your projects.

<b>Total</b>	<b>AutoCAD (hrs)</b>	<b>Building Systems (hrs)</b>
Total time for project	<b>5.2</b>	<b>3.1</b>

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