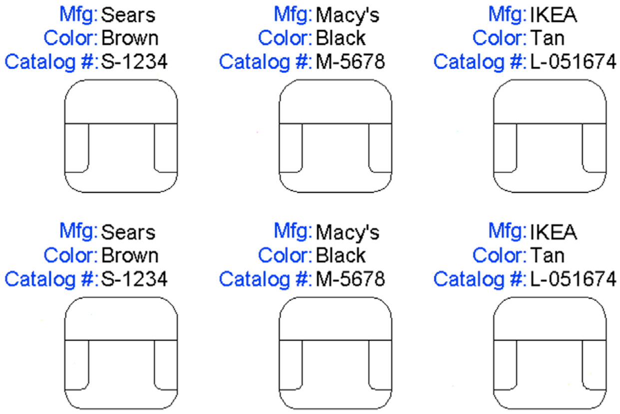
Chapter 18

Attributes



Learning Objectives

In this chapter, we introduce and thoroughly cover the concept of attributes. We specifically discuss

- The purpose of attributes
- Defining attributes
- Editing attributes and properties
- Extracting data from attributes
- Invisible attributes

By the end of this chapter, you will be well versed in applying this critical concept to your design work.

Estimated time for completion of this chapter: 1–2 hours.

18.1 INTRODUCTION TO ATTRIBUTES

Attributes is an important advanced topic. An attribute is defined in AutoCAD as information inside a block. The key words here are *information* and *block*. You can have a block without information—you have done this many times before; it is called a *block* or *wblock* but not an attribute. You can also have information in the form of text sitting in your drawing. That is just text or mtext but also not an attribute. However, put the two concepts together and you have what we are now about to explore: Essentially an "intelligent" block, one that has useful embedded information.

What is the reason for creating attributes in the first place? Why would you want information inside of blocks, and what can you do with this information? The information itself can be anything of value to the designer or client. For an office chair in a corporate floor plan, one may want to know it's make, model, color, and catalog number. Then, if there are a variety of chair types for this office, the designer can keep track of all of them. Another example is a list of connections going into an electrical panel. It would be nice to know what and how many. All this information can be entered into the attribute and displayed on the drawing if you wish.

However, this is only half the story, and displaying information is not the main reason for creating attributes. As a matter of fact, this information is often completely hidden, so as not to clutter up the drawing. So, what is the main reason? The key is that this information can be extracted out of the attributes and sent to a spreadsheet (among other destinations). Now you have a truly useful system in place, where extensive information is hidden unobtrusively in the drawing yet can be accessed

Up and Running with AutoCAD 2017: 2D and 3D Drawing and Modeling. DOI: http://dx.doi.org/10.1016/B978-0-12-811058-4.00018-9

if needed at the touch of a few buttons and put into an Excel file or other very useful form for cost analysis or just plain old keeping track and organizational purposes.

You may have already heard of these tools in use or envisioned a need for them in architecture with such items as doors and windows schedules. The software keeps track of each door and window in the drawing and links the information to a database that is updated as you add or remove the objects from your design. While basic AutoCAD does not do this automatically, other add-on software does. Underneath it all is the concept of embedded attributes, similar to those we discuss here.

You should have a good understanding of the preceding few paragraphs. As always, the button pushing is far easier once the concept is crystal clear. We now go ahead and do the following:

- Create a simple design.
- Create a basic attribute definition.
- Make a block out of the simple design and the attribute definition.
- Extract information out of our new attribute.

The information is extracted via a multistep process to two locations, an Excel spreadsheet and a table. In both cases, the information is in an organized tabular form and, while not linked bidirectionally, is an exact reflection of drawing conditions. Let us give it a try.

18.2 CREATING THE DESIGN

We need nothing complicated drawn to learn the basics of attributes. Go ahead and draw a simple chair made up of several rectangles and rounded corners, as shown in Fig. 18.1. Make the chair 30″ × 30″ and approximate the rest of the dimensions relative to those.

We would like to embed the following information in it—manufacturer, color, and catalog number—and put these three items just above the chair. Let us first add some text, a header of sorts, indicating what the three categories are, as seen in Fig. 18.2. Use regular text of any appropriate size, font, and color.

This is not yet the attribute definition, merely the name of the categories, so we know what we are looking at. You do not have to do this, but it helps clarify things initially, as the attributes are just plain Xs. You now have a simple design and the start of some useful information. We are now ready to make an attribute definition.

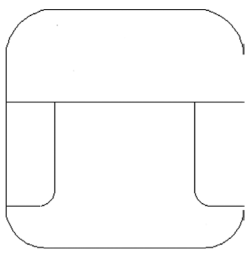


FIGURE 18.1 Basic chair design.

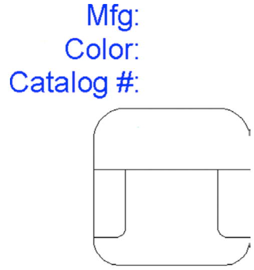


FIGURE 18.2 Basic chair design text.

18.3 CREATING THE ATTRIBUTE DEFINITIONS

Here, we define the new attributes that contain the actual information. The idea for now is to simply assign them all a value of X and change the X to meaningful data later in the process, so we are creating generic definitions, which allow us to create multiple sets of data from one template.

Keyboard: Type in **attdef** and press Enter.
Cascading menus: Draw→Block→Define Attributes…
Toolbar icon: none
Ribbon: Insert tab→

Start the attribute definition via any of the preceding methods. The dialog box in Fig. 18.3 appears.

We are interested in only the upper right of the dialog box for now. Under the Attribute category, let us focus on Tag:, Prompt:, and Default:.

- For Tag, type in `Mfg` for `Manufacturer` (this is the actual category).
- For Prompt, type in `Please enter manufacturer` (this is just a reminder for the user).
- For Default, type in `X` (this is the generic placeholder), as seen in Fig. 18.4.

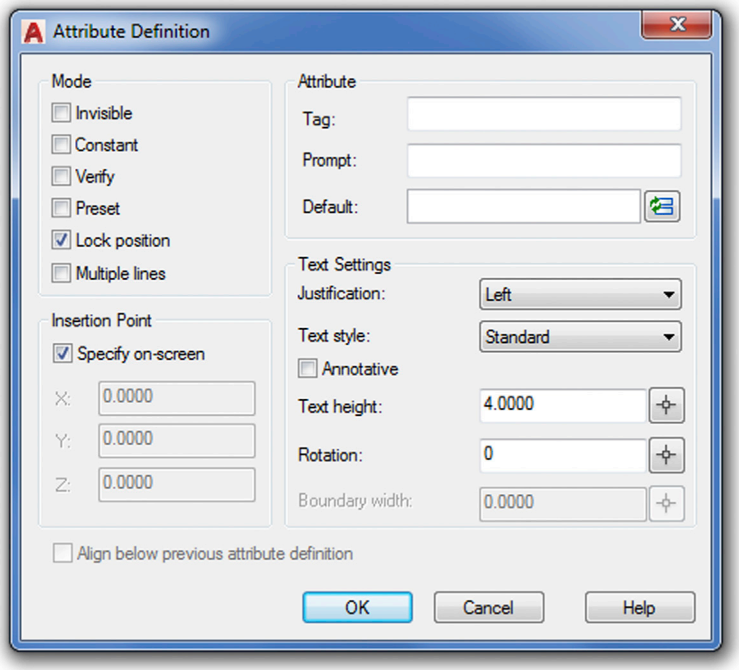


FIGURE 18.3 Attribute Definition.

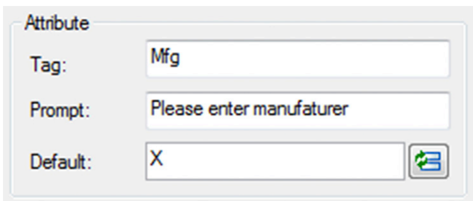


FIGURE 18.4 Attribute fields.

The rest of the information in the dialog box can be left as is for now, although we discuss a feature under Mode (upper left) later in this chapter. One thing you can adjust, however, is the text height, matching the attribute size to the size of the text over the chair. The text is 4″ in height, so you can enter that value into the field.

Press OK and your attribute definition appears attached to your crosshairs. Go ahead and place it next to the Mfg: text. Note that it is in capital letters by default. Go ahead and go through the same procedure for the remaining two categories, changing the Tag value and slightly modifying the Prompt. The default remains as `X`. Note also that you cannot have blank spaces in the tag, hence the `CATALOG_#` underscore. The final results are shown in Fig. 18.5.

We are almost done creating the attribute definitions. Note the differences between the text and the attribute. Double-click on the original text, and you get the standard text editing field. Double-click on the attribute definition and you get a different, Edit Attribute Definition, field, as shown in Fig. 18.6.

At this point, it may not be obvious why we have two identical sets of categories next to each other or why we entered the `X`. After the next step, what we are doing should become much clearer.

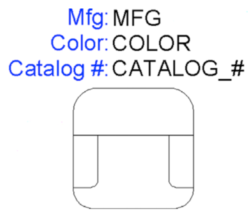


FIGURE 18.5 Attribute fields completed.

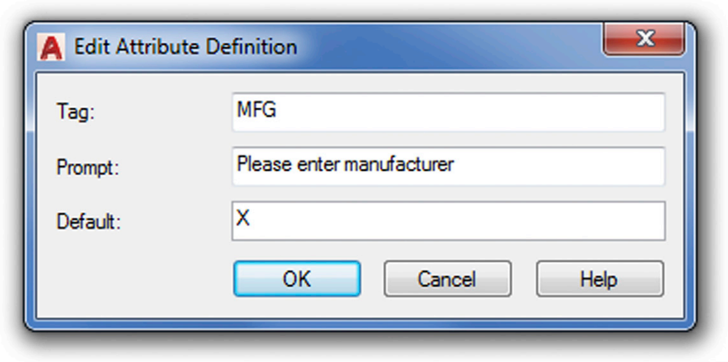


FIGURE 18.6 Edit Attribute Definition.

18.4 CREATING THE ATTRIBUTE BLOCK

This next step should be familiar: Create a regular block named `Sample_Chair` via any method you prefer. Give it a name, select the objects (both the chair and all the text), and pick an insertion point. Finally, click on OK, and the dialog box shown in Fig. 18.7 appears. This dialog box was upgraded for AutoCAD 2017 to allow for more attributes to be listed without having to flip to another page—the previous version if AutoCAD had just 8 lines total; this one now has 15. In the interest of time and clarity we stick to just the three attributes shown here, but keep in mind you can enter many more if needed.

The Edit Attributes dialog box allows you to enter specific values for those placeholders (marked as `X`), but we do not do that at this point. Simply press OK and your new attribute is officially born (Fig. 18.8). Notice all the previous categories are now just `X` and ready for customization. This is the process for creating a generic attribute. In the example of the office chairs, you create several copies (the different types of chairs) and customize the information for each. Then, copy and distribute the types as needed on the floor plan, as we do next.

18.5 ATTRIBUTE PROPERTIES AND EDITING

Now that you have a block with attributes, you need to learn how to edit its fields to add or delete information from an attribute as well as change its color, font, and just about any other property. Some of these techniques overlap each other and duplicate effort, so we need to clearly state what is used for what.

First of all, if you want to change only the content of an attribute (in other words, what it says), you need to get back to the dialog box shown in Fig. 18.7. It is basic and simple but does not change fonts and colors. Also, the only way to get to it is by typing. The command, `attedit`, takes care of the content. Indeed, this is the way you should "populate," or fill in, the fields once we start copying the chair. Try it right now and edit the chair to say `Sears` for the manufacturer, `Brown` for color, and `S-1234` for catalog number.

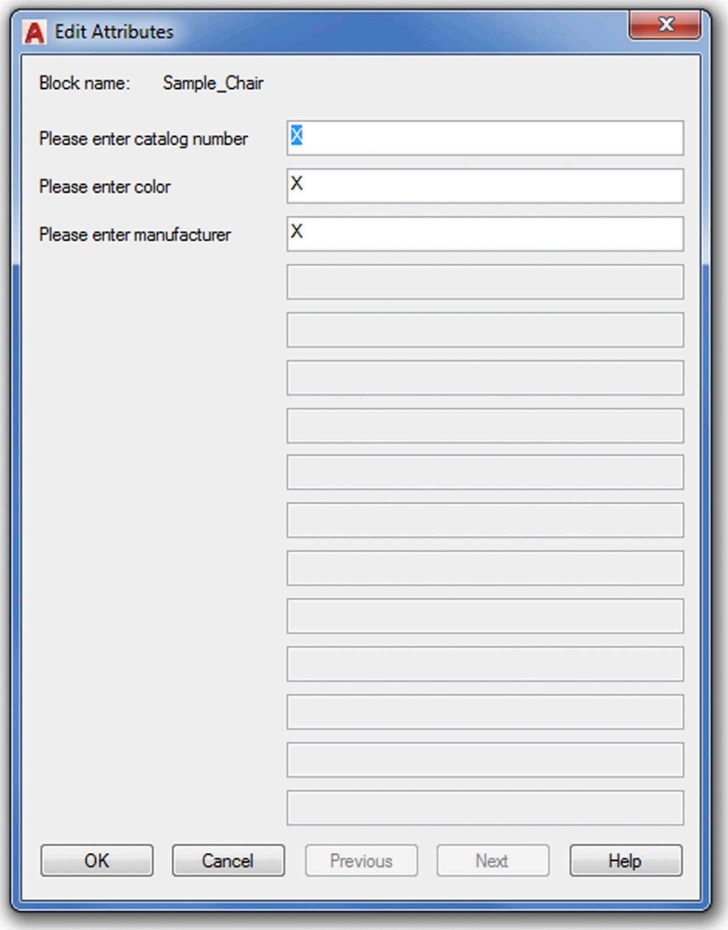


FIGURE 18.7 Edit Attributes.

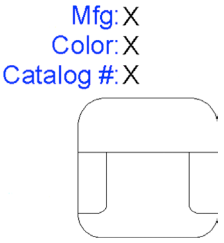


FIGURE 18.8 Edit Attribute.

Now, what if you wanted to change an attribute's properties, as discussed earlier? Well, the method here changes slightly, as you need to deal with the Enhanced Attribute Editor. Although a full command matrix is shown next, the easiest way to get to it is just to double-click on the attribute.

Keyboard: Type in **eattedit** and press Enter.
Cascading menus: Modify→Object→Attribute→Single…
Toolbar icon: Modify II toolbar 
Ribbon: Home tab→Block→ 

What you get after either double-clicking or using the previous methods is Fig. 18.9. Here, you can do quite a lot. This Editor not only allows you to fill in the fields but also a variety of properties (colors, layers, fonts, etc.). Click through the three tabs, Attribute, Text Options, and Properties, to explore all the options. Here are some additional pointers on attributes.

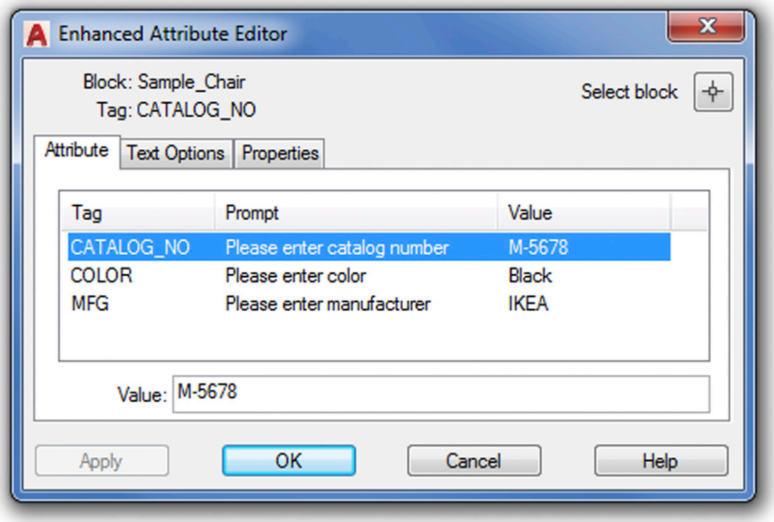


FIGURE 18.9 Enhanced Attribute Editor.

Exploding Attributes

Attributes can be easily exploded, but this action destroys the blocks and turns them into what you see in Fig. 18.8, where you have just generic placeholders unattached to a physical design. You can change a few fields and reassemble the block, which is a perfectly valid technique, especially if the attribute is giving you a hard time. Be careful though; exploding complex attributes can suddenly fill your screen with an enormous amount of data, so keep one finger on that Undo button.

Inserting Attributes

As you learned in this chapter, attributes are blocks; therefore, you can insert them as needed, as an alternative to copying them. When you insert a block that contains an attribute, you are prompted to fill in the X placeholders at the command line. Indeed, this is how title blocks are often filled out when a generic template block is inserted into a specific job file.

Ideally, everything makes sense now that you see the big picture of what was done. Review this chapter up to now if not. Our next step is to learn how to extract the useful information. For this, you need to duplicate the attribute to simulate having a number of them in a real drawing. Then, go ahead and change some of the values. The final result is shown in Fig. 18.10.

18.6 ATTRIBUTE EXTRACTION

Extracting the information is a multistep process, necessarily so because of the number of options offered along the way. Our target extraction is both an Excel spreadsheet and a table embedded in AutoCAD. Remember, of course, that this is a basic generic extraction and more complex spreadsheets and tables can be created to hold such data, which is left to you to explore.

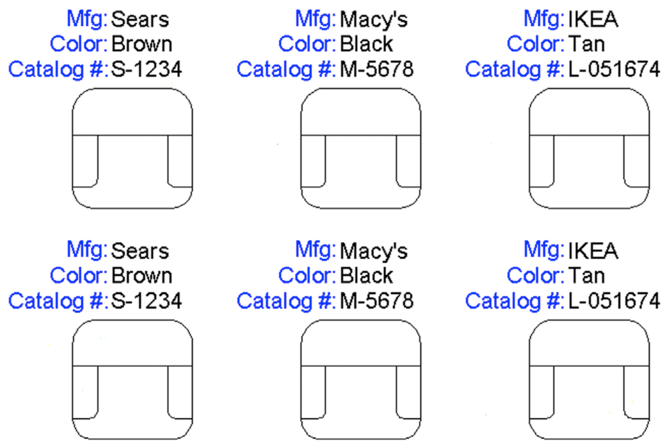


FIGURE 18.10 Various attributes.

Step (Page) 1. Begin

Keyboard:	Type in **eattext** and press Enter.
Cascading menus:	**Tools→Data Extraction…**
Toolbar icon:	**Modify II toolbar**
Ribbon:	**Insert tab→Linking & Extraction→**

Start up the data extraction process via any of the methods shown in the command matrix. The Data Extraction - Begin (Page 1 of 8) dialog box shown in Fig. 18.11 appears. You are going to create a new data extraction, so leave the default top choice but uncheck the Use previous… box. Then, press Next > and you are taken to the Save Data Extraction As dialog box. Save your file as `Sample.dxe` anywhere you will find it easily on your drive. You are then taken to the next page.

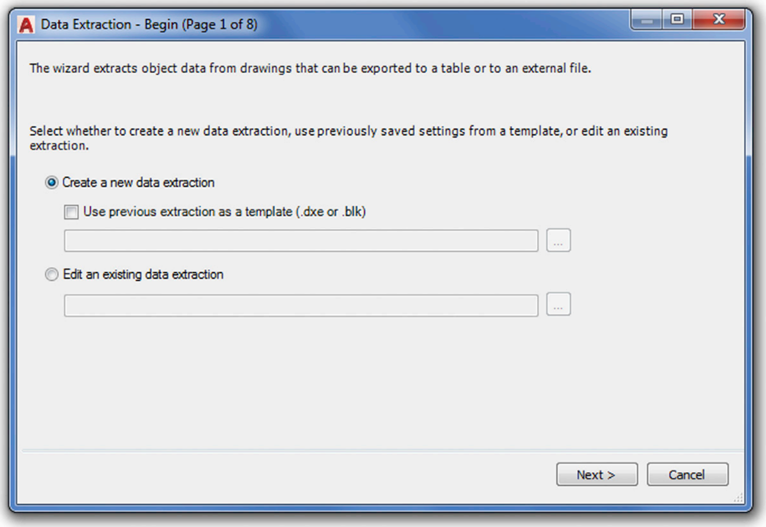


FIGURE 18.11 Data Extraction—Begin (Page 1 of 8).

Step (Page) 2. Define Data Source (Fig. 18.12)
Here, we are interested in the data source, or location, of the file to be looked at. Leave the default choice with the Include current drawing box checked off. Press Next >.

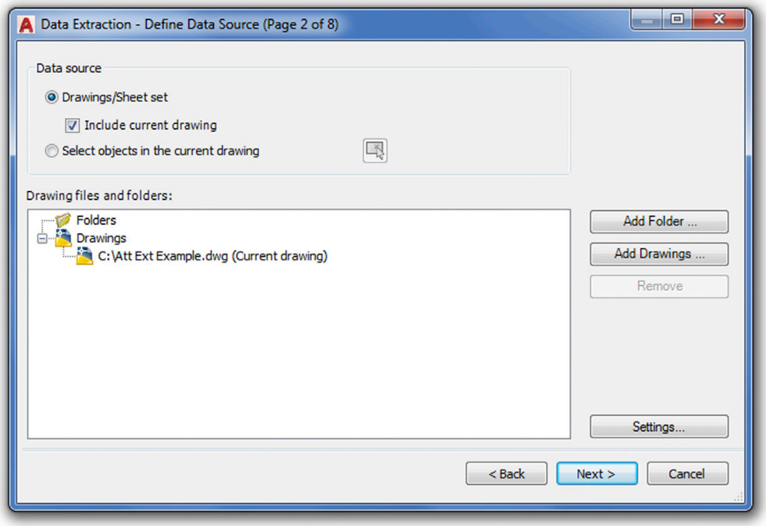


FIGURE 18.12 Data Extraction—Define Data Source (Page 2 of 8).

Step (Page) 3. Select Objects (Fig. 18.13)
Here, we are interested in selecting from what we want to extract the data. In our case, there is only one choice, the sample chair, as it is the only available block (as seen under the type column). You can also click on Display blocks only, under the Display options, to isolate the chair. In either case, select it and press Next >.

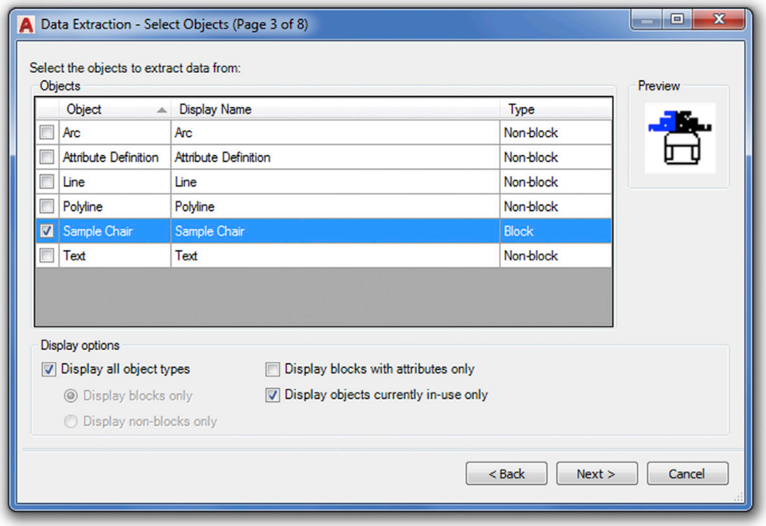


FIGURE 18.13 Data Extraction—Select Objects (Page 3 of 8).

Step (Page) 4. Select Properties (Fig. 18.14)
Here, you initially see many property choices. Use the category filter on the right to uncheck all the choices except Attribute. You then easily see the three properties on the left that we created earlier. Check off all three and press Next >.

Step (Page) 5. Refine Data (Fig. 18.15)
This step is for you to refine the data, if needed. It contains some interesting features, such as Link External Data… (to tie in this output to another Excel file) as well as some tools for adjusting and tweaking the columns. Much of this and more can be done in Excel itself after extraction is completed, but it can be useful to adjust the look and content of the table extractions, as tables are less flexible. If you want to change nothing, press Next > for the final few steps.

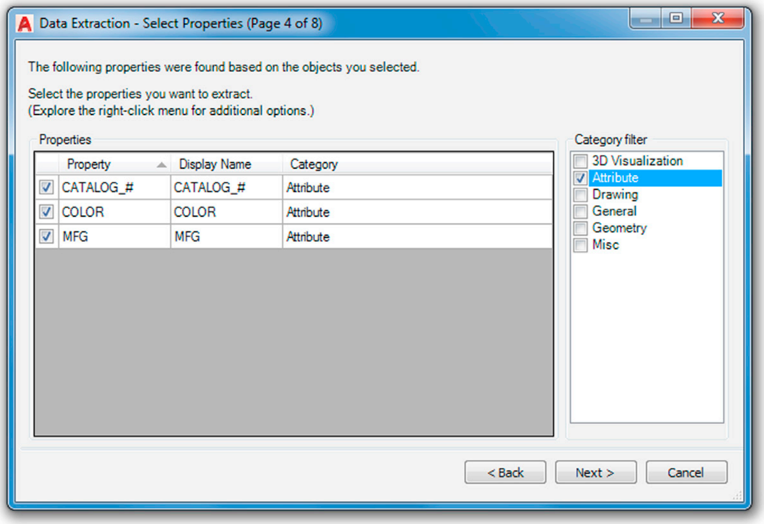


FIGURE 18.14 Data Extraction—Select Properties (Page 4 of 8).

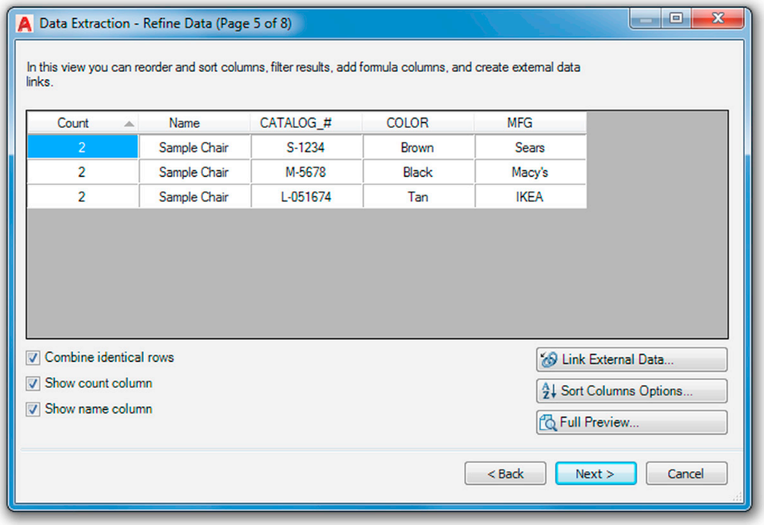


FIGURE 18.15 Data Extraction—Refine Data (Page 5 of 8).

Step (Page) 6. Choose Output (Fig. 18.16)
Here, we are interested in our destination output. Although the Excel spreadsheet gets all the attention, you can also extract to a table that will be inserted into the drawing itself. Tables are first introduced in Chapter 15, Advanced Design and File Management Tools, so review that section, if necessary. Check off both boxes if you have not done so as yet, and finally select the location of the Excel file by using the three dot browse button. When ready, press Next >.

Step (Page) 7. Table Style (Fig. 18.17)
We do not do anything to the table, leaving it as is, but you should review the options available and press Next > when done.

Step (Page) 8. Finish (Fig. 18.18)
On the final page, there is little to do except read what AutoCAD is telling you and press Finish. You are asked for an insertion point and notice the table attached to the mouse. You may have to zoom in to see it better. Finally, when you can see it, click to place the table. The table is inserted into your drawing, as shown in Fig. 18.19.

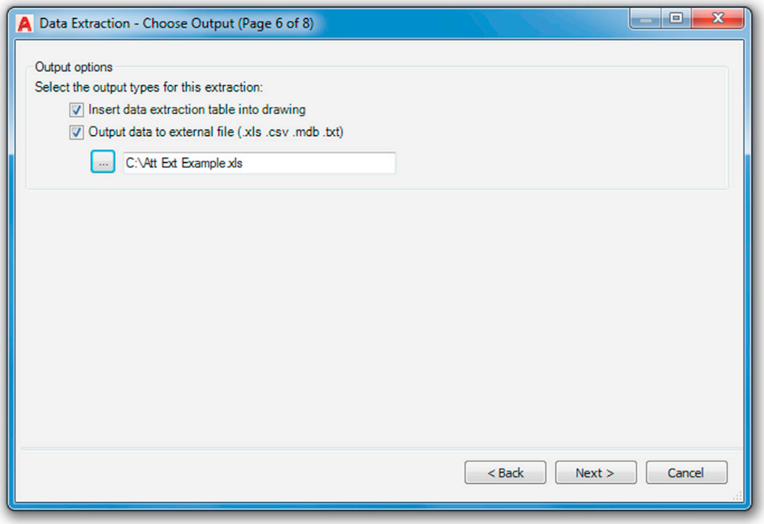


FIGURE 18.16 Data Extraction—Choose Output (Page 6 of 8).

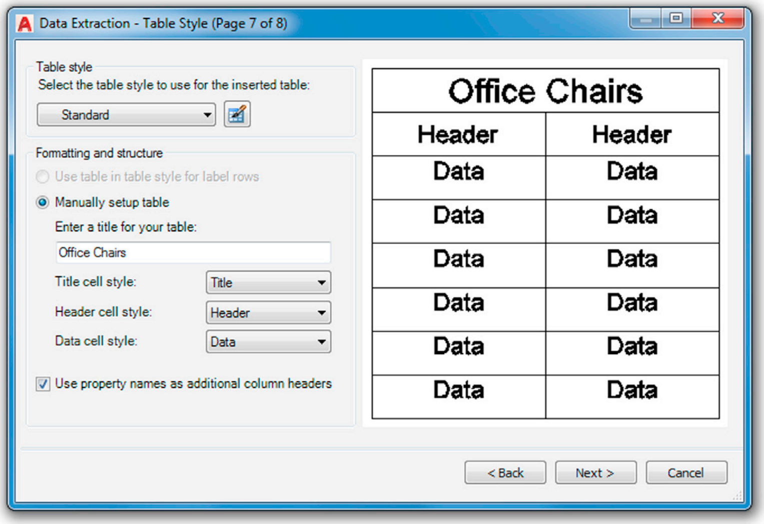


FIGURE 18.17 Data Extraction—Table Style (Page 7 of 8).

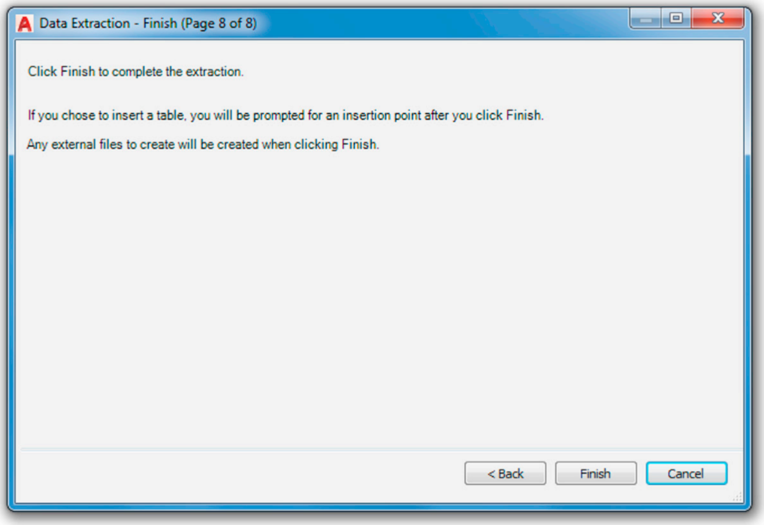


FIGURE 18.18 Data Extraction—Finish (Page 8 of 8).

Count	Name	CATALOG_#	COLOR	MFG
2	Sample Chair	L-051674	Tan	IKEA
2	Sample Chair	M-5678	Black	Macy's
2	Sample Chair	S-1234	Brown	Sears

FIGURE 18.19 Table insertion (AutoCAD).

It is not fancy, but it gets the information across. The main output, however, is the Excel file. Look for it wherever you may have dropped it off, and double-click on it to start Excel. Then, after some cleanup (cell borders, column width, fonts, colors, etc.), select the cells and Copy/Paste them into AutoCAD, as you did in Chapter 16, Importing and Exporting Data. It looks like Fig. 18.20.

Count	Name	CATALOG #	COLOR	MFG
2	Sample Chair	L-051674	Tan	IKEA
2	Sample Chair	M-5678	Black	Macy's
2	Sample Chair	S-1234	Brown	Sears

FIGURE 18.20 Table insertion (Excel).

This, in essence, is attribute data extraction. You should recognize the value in what you did and the potential it holds for easy data access and accounting.

There are other uses for attributes. One common use is formatting a full title sheet and block with generic attributes and saving it as a company standard. In this case, the text is the fixed permanent categories, such as Date, Sheet, Drawn by, and other fields; and the attribute definitions are the variables, such as the actual date, sheet number, and the initials of whoever created the drawing. Then, everything is blocked out and saved for future use, with the `X`s representing to-be-filled-in variables. As the need comes up for a new title block, it is inserted as a block into the design's Paper Space with the variables filled out on the spot. We conclude the attributes chapter by briefly going over an important option in the `attdef` command dialog box.

18.7 INVISIBLE ATTRIBUTES

This option appears as the first check-off box in the upper left of the `attdef` dialog box and is the most important of all the ones in that column. It is used to make attributes invisible on creation.

Now, why would you do this? As mentioned at the beginning of this chapter, this is a relatively common way of creating attributes for the simple reason that you do not need to see the text and the attribute information. If you know what you created, then there is no need to clutter up the drawing with that list over and over again. This is especially true if there is a great deal of information (electrical termination panels come to mind) and revealing all would create a dense blanket of text on the drawing, obscuring everything else.

To use the invisible option, simply start the attribute creation process with `attdef`, check off the Invisible option, then proceed as outlined previously. The attribute, of course, remains visible until the block is created and disappears afterward. To see what you have, there is no problem: Simply double-click on the block or type in `attedit`, as outlined previously.

As you can see, being invisible for an attribute is no problem at all, as you can easily access it for editing if needed, and it is unobtrusively out of the way until then, the best of both worlds. The only downside, of course, is that you do not know that the attribute is there if you were not the one who set it up. It is always a good habit to double-click on blocks just to see what pops up on an unfamiliar drawing; and indeed, this is a standard investigative procedure in these cases. Fig. 18.21 shows the Invisible option checked off in the `attdef` dialog box.

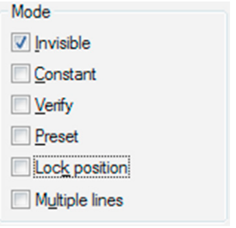


FIGURE 18.21 Invisible option.

18.8 LEVEL 2 DRAWING PROJECT (8 OF 10): ARCHITECTURAL FLOOR PLAN

For Part 8 of the drawing project, we finish up the design by creating an exterior elevation. Elevations are the "head on" views of a building. They are projected from overhead or plan views and are meant to give the client and builder a visual of the architect's design. These elevations feature walls, doors, windows, any other exterior design features (such as columns or fireplace chimneys), and of course the roof design.

Step 1. You need no new layers for this. Open up the floor plan, freeze all layers except the walls and windows, and draw guidelines straight down from each bend or feature in the wall (such as a door or window), as seen in Fig. 18.22.

Step 2. Raise the elevation and add the doors and windows according to the provided dimensions, as seen in Fig. 18.23. For simplicity, some details, such as gutters, are missing.

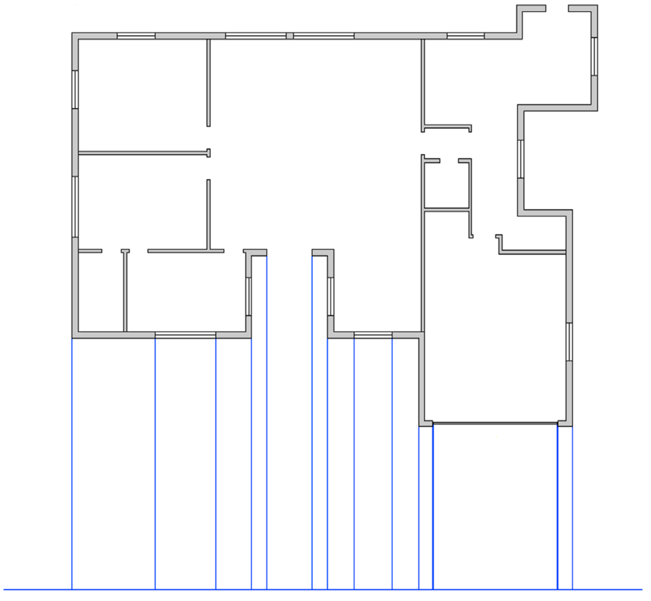


FIGURE 18.22 Elevation, Step 1.

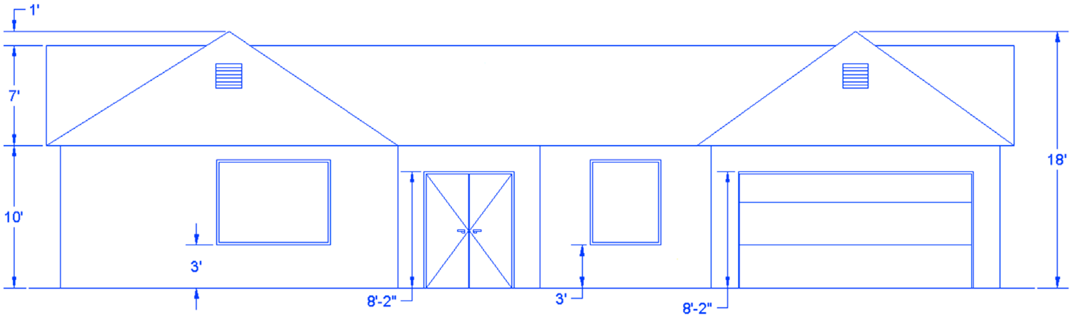


FIGURE 18.23 Elevation, Step 2.

Step 3. Complete the elevation by adding exterior wall hatch and some other finishing touches. Fig. 18.24 shows the final result. Repeat the same procedure for at least one other side of the house or complete all four.

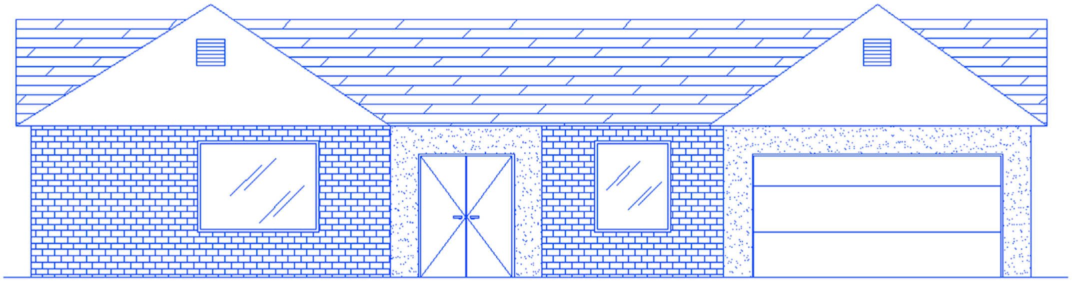


FIGURE 18.24 Elevation, Step 3.

18.9 SUMMARY

You should understand and know how to use the following concepts before moving on to Chapter 19, Advanced Output and Pen Settings:

- Attribute definitions
- Attribute blocks
- Editing fields and properties
- Attribute extraction
- Invisible attributes

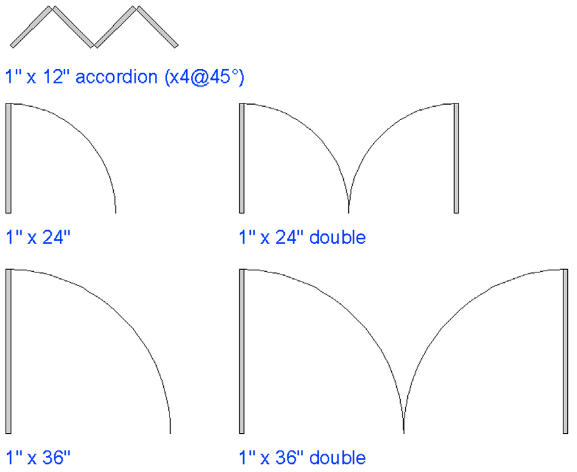
Review Questions

Answer the following based on what you learned in this chapter:

1. What is an attribute and how do you create one?
2. How do you edit attributes?
3. How do you extract data from attributes? Into what form?
4. How do you create an invisible attribute? Why can this be important?

Exercise

1A. Draw the following doors:



1B. Next, add text attributes to each, as shown by the sample that follows for the 1″ × 12″ accordion:

- *Type:* Accordion double.
- *Size:* 1″ × 12″.
- *Color:* Natural wood.
- *Mfg.:* XYZ Door Company.
- *Stock #:* 654-A-1 × 12.

1C. Create similar attribute data for the remaining four doors. Vary the colors and the stock numbers.

1D. Make a block out of each one and fill in the attribute information.

1E. Copy the entire set once for a total of ten doors.

1F. Extract the data to Excel.

(Difficulty level: Intermediate; Time to completion: 30 minutes.)

Spotlight On: Aerospace Engineering

Aerospace engineering is a specialized branch of mechanical engineering that evolved relatively recently in our history, as humankind took to flight, first in the atmosphere then into space. Formally defined, it is the science behind the design and construction of aircraft (aeronautical engineering, Figs. 1 and 2) and spacecraft (astronautical engineering). These engineers conceptualize, build, and test everything from gliders to missiles, to jet fighters and space rockets. Many also work in naval design, as many of the principles guiding the flow of air around an aircraft (a fluid) readily transfer to the flow of water (also a fluid) around a ship or submarine.

FIGURE 1 Grumman X-29 Experimental.

Aerospace engineers need a mastery of a wide variety of engineering sciences, such as fluid dynamics, structures, control systems, aeroelasticity, thermodynamics, materials, and electrical engineering. It is perhaps one of the more diverse engineering disciplines and specialization is necessary. Three broad areas of specialization include aeronautics, propulsion, and space vehicles.

FIGURE 2 Airbus A380 Airliner.

Education for aerospace engineers starts out similar to that for the other engineering disciplines. In the United States, all engineers typically have to attend a 4 year ABET-accredited school for their entry level degree, a Bachelor of Science. While there, all students go through a somewhat similar program in their first 2 years, regardless of future specialization. Classes taken include extensive math, physics, and some chemistry courses, followed by statics, dynamics, mechanics, thermodynamics, fluid dynamics, and material science. In their final 2 years, engineers specialize by taking courses relevant to their chosen field. For aerospace engineering, this includes aerodynamics, structures, controls, propulsion, and orbital mechanics, among others.

Upon graduation, aerospace engineers can immediately enter the workforce or go on to graduate school. Although not required and not common in the aerospace industry, some engineers choose to pursue a Professional Engineer (P.E.) license. This would typically be in related mechanical engineering, as there is no aerospace P.E. exam. The process first involves passing a Fundamentals of Engineering (F.E.) exam, followed by several years of work experience, and finally the P.E. exam.

Aerospace engineers can generally expect somewhat higher starting salaries than civil, mechanical, and industrial engineering graduates but on par with electrical and lower than petroleum engineering and some computer science degrees. A master's degree is usually the path to higher starting pay, which with a bachelor's, averaged around $69,600 nationwide (in 2011) and with a median pay of $105,380 (in 2014) according to the Bureau of Labor Statistics. This, of course, depends highly on locality, market demand, and even GPA on graduation. Aerospace engineers often work for government or defense contractors, and as such need to get and maintain a security clearance, a somewhat unique requirement that may not be necessary in other fields.

So how do aerospace engineers use AutoCAD and what can you expect? Industrywide, AutoCAD use is not widespread due to the nature of the profession, which relies on more sophisticated software to model parts directly in 3D. The industry standard is CATIA, though NX and Pro/Engineer (Creo) are also used. Aerospace engineering also relies heavily on software for initial testing or design validation. Examples include finite element analysis (FEA) and software such as NASTRAN or ANSYS to model loads, deflections, and heat propagation. MATLAB can be used to model vibrations and stresses, while computational fluid dynamics (CFD) and software such as Fluent are used to model the flow of air around the design at various speeds and temperatures (also applicable to the flow of water). See Appendix B, Other CAD Software, Design and Analysis Tools, and Concepts if you would like to learn more about these techniques.

AutoCAD, however, can still be found for small part design, aerospace electrical schematics, and overall system layouts. Smaller companies that have little to no modeling, testing, and manufacturing needs also may use AutoCAD due to the associated cost savings. Many home kit airplane designers or builders turned to AutoCAD to produce drawings or just to document ideas. The general trend is to move away from AutoCAD as design requirements become more sophisticated and testing and manufacturing are involved.

AutoCAD layering is far simpler in aerospace engineering than in architecture. There is no AIA standard to follow, only an internal company standard, which may not be as detailed. As always, the layer names should be clear as to what they contain. Fig. 3 shows an aerospace application of AutoCAD for a set of composite wings for a small unmanned aerial vehicle (UAV) design.

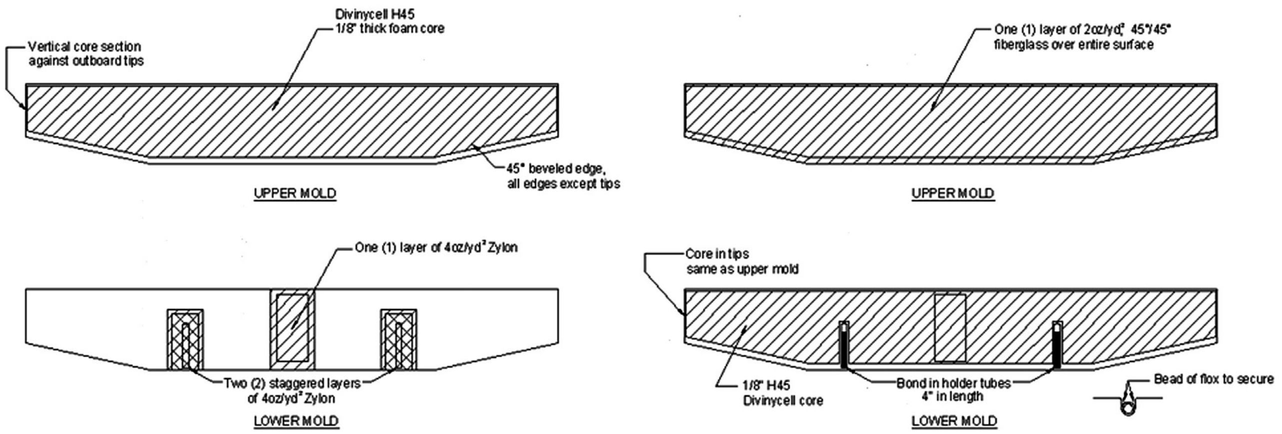


FIGURE 3 Wings for a small unmanned aerial vehicle drawn with AutoCAD.

Fig. 4 shows a typical design of a small general aviation (GA) aircraft wing, with overall dimensions and specs.

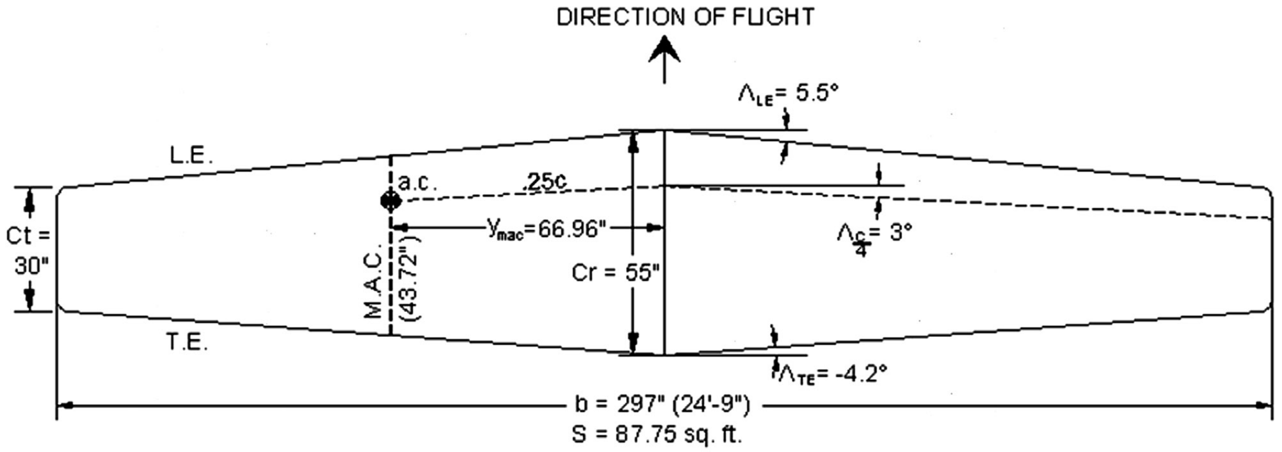


FIGURE 4 Wing specifications for a small, general aviation aircraft drawn with AutoCAD.

Finally, Fig. 5 shows a side profile of a small private plane (a Lancair Legacy) drawn in AutoCAD for a student project. This side profile study was used for sizing while learning design; the vertical and horizontal numbers are inch position from the tip of the propeller cone and the ground. Note the use of a thicker polyline in the outline to accentuate the profile.

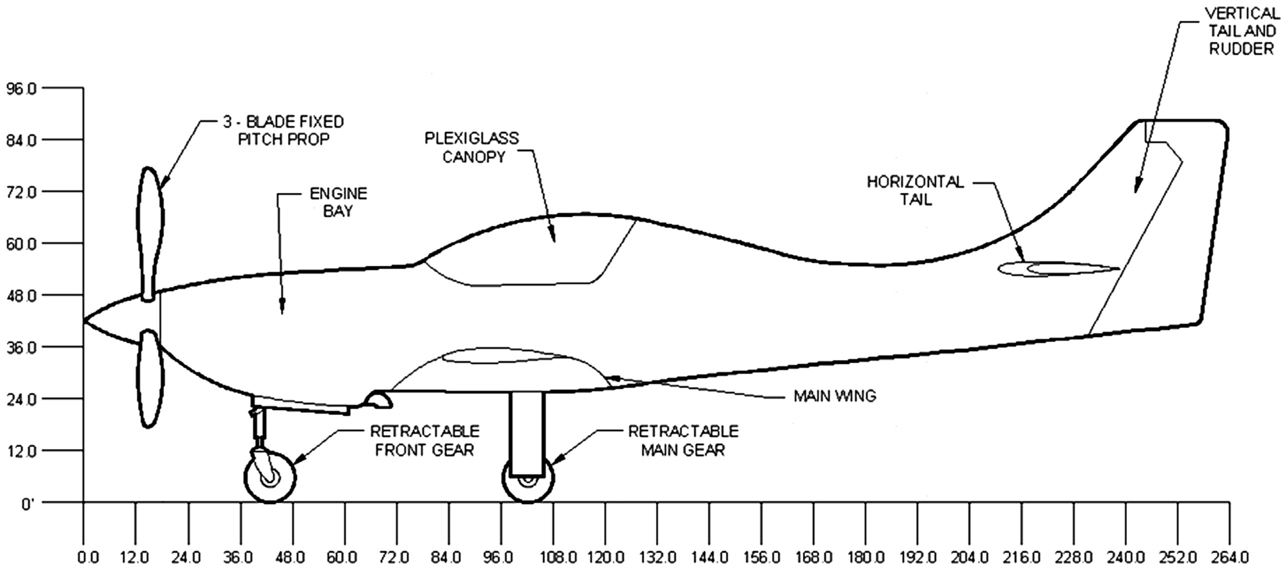


FIGURE 5 A small, general aviation aircraft (Lancair Legacy) drawn with AutoCAD.