Making and Modifying Terrain

Continuing in the grand tradition of building extremely powerful tools and then hiding them so you'll never find them, the people at SketchUp introduced the *Sandbox* way back in version 5 of the software. We introduce the Sandbox here because it helps people to model *terrain* — the stuff your buildings sit on (or in, if what you're making is underground).

The Sandbox isn't new, but owing to its less-than-obvious location, most SketchUp users have never used it. Here are the facts:

- **The Sandbox is a collection of tools.** Each tool serves a fairly specific purpose and is meant to be used at a particular stage of the terrain-modeling process. That said, like all SketchUp's tools, they're incredibly flexible. You can use them to model anything you want.
- **The Sandbox is in both Make and Pro.** Despite what many people think, the Sandbox tools aren't just for Pro users; people who use the free version of SketchUp can use them, too. They're just hidden, which brings you to our next point.
- **The Sandbox is hidden.** The reasons for this are complicated, but the tools in the Sandbox are a little bit special; they're *extensions* — you have to find them and turn them on before you can use them. If you're using SketchUp Pro, you can skip the first two steps in the following list — they're already turned on.

  Follow these steps to switch on the Sandbox tools:

  a. *Choose Window ⇒ Preferences from the menu bar to open the Preferences dialog box.*

     Choose SketchUp ⇒ Preferences if you're on a Mac.

  b. *In the Extensions panel, make sure the Sandbox Tools check box is selected and then close the Preferences dialog box.*

  c. *Choose View ⇒ Toolbars ⇒ Sandbox from the menu bar to show the Sandbox toolbar.*

Creating a new terrain model

Whether you're modeling a patch of ground for a building or redesigning Central Park, you need one of two terrain-modeling methods:

- **Starting from existing data:** This existing data usually arrives in the form of *contour* or *topo* lines; see the next section to read more about them.
- **Starting from scratch:** If you don't have any data to start or if you're beginning with a perfectly flat site, you can use SketchUp's From Scratch tool to draw a grid that's easy to form into rolling hills, berms, and valleys. Skip ahead to "Modeling terrain from scratch" for more information.

TIP There's a neat trick Aidan learned for modeling small (yard-sized) amounts of terrain — the piece of land immediately surrounding a building, for example. You *could* use the From Scratch tool to start with a flat site, but there's a better way: See "Roughing out a site" a little later in this chapter.

Modeling terrain from contour lines

You know the squiggly lines on topographical maps that show you where the hills and valleys are? They're *contour lines* (or *contours*) because they represent the contours of the terrain; every point on a single line is the same height above sea level as every other point on that line. Where the lines are close together, the ground between them is steep. Where the lines are far apart, the slope is less steep. Cartographers, surveyors, engineers, and architects use contour lines to represent 3D terrain in flat formats like maps and site drawings.

Sometimes, you have contour lines for a building site that you want to model in 3D. You can use the From Contours tool in the Sandbox to automatically generate a three-dimensional surface from a set of contour lines, as shown in Figure 6-17.

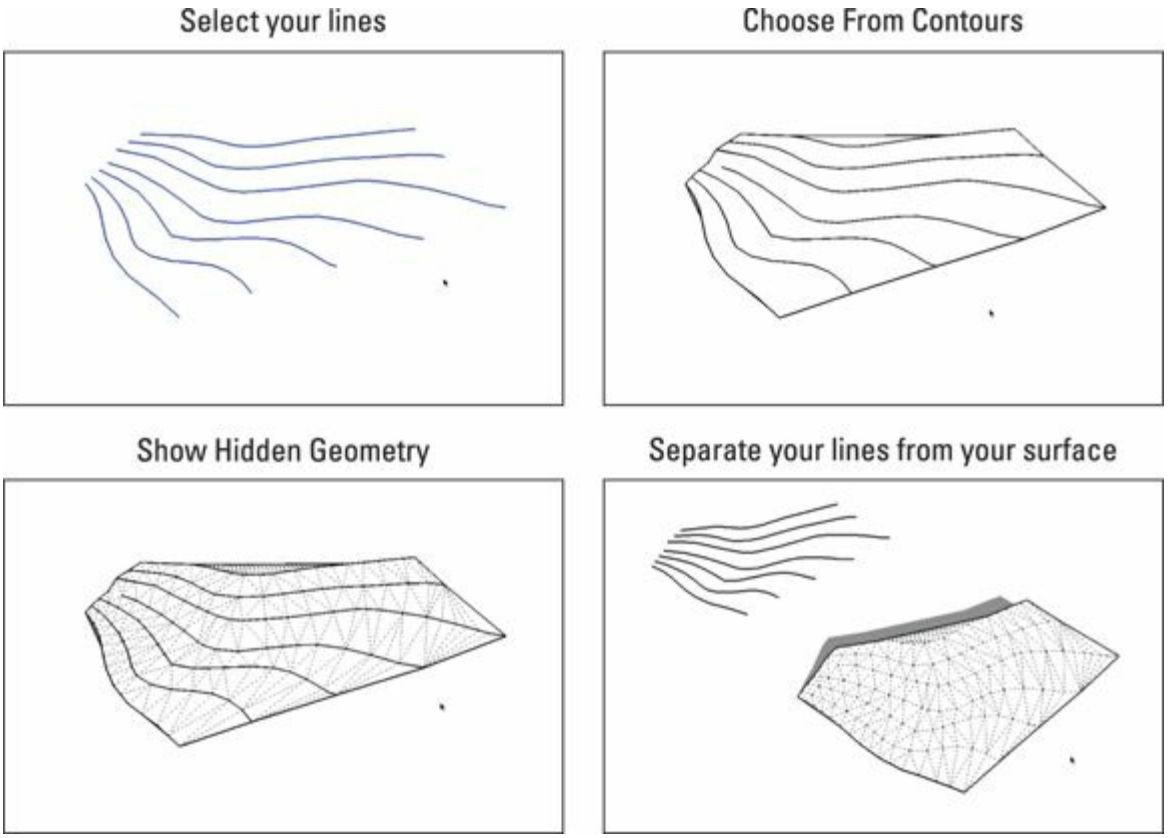


FIGURE 6-17: Use the From Contours tool to turn a set of contour lines into a 3D surface.

Here are some things to keep in mind about the From Contours tool:

- **It's a two-step tool.** Using From Contours is simple after you get the hang of it:

    a. *Select all the contour lines you want to use to create a surface.*

    b. *Choose Draw ⇒ Sandbox ⇒ From Contours from the menu bar (or click the From Contours tool button, if the Sandbox toolbar is visible).*

  Note: If you can't see the Sandbox tools in your menus, you haven't turned them on yet. See the beginning of this section, "Making and Modifying Terrain," to rectify the situation.

- **Your contour lines need to be lifted up.** The From Contours tool creates a surface from contour lines that are already positioned at their proper heights in 3D space. Most of the time you work with contours that are part of a 2D drawing, and that means you probably have to lift them up yourself using the Move tool — one at a time. It's tedious but necessary. Just oil up the Select tool, put on some music, and get to work. For a refresher on selecting things, take a look at the last part of Chapter 3.

- **Download and install Weld.** The Weld SketchUp extension turns selections of individual line segments into *polylines* — this makes them much, much easier to work with. If you work with contour lines imported from a computer-aided drawing (CAD) file, using Weld makes your life a little easier. To add Weld to SketchUp, visit the Extension Warehouse, introduced in Chapter 16.

- **You end up with a group.** When you use From Contours, SketchUp automatically makes your new surface (the one you generated from your contour lines) into a group. It leaves the original lines themselves completely alone; you can move them away, hide them, or delete them if you want. We recommend making another group out of them, putting them on a separate layer (see Chapter 7 for more on this), and hiding that layer until you need it again.

  REMEMBER To edit the faces and edges inside a group, double-click it with the Select tool. Chapter 5 has all the details on groups and components.

- **To edit your new surface, turn on Hidden Geometry.** The flowing, organic surface you just created is actually just a bunch of little triangles. The From Contours tool smooths the edges that define them, but they're there. To see them, choose View ⇒ Hidden Geometry from the menu bar.

- **Try to keep your geometry reasonable.** The From Contours tool is super useful, but it has its limits. The trouble is that it's too easy to use it to create enormous amounts of geometry (faces and edges) that can really bog down your system. If it takes forever for your contours to turn into a surface, or if that surface is so big that your computer turns blue and curls up into a fetal position (so to speak), you need to go back a few steps and do one (or perhaps all) of the following:

    - *Work on a smaller area.* As nice as it'd be to have the whole neighborhood in your SketchUp model, you may have to narrow your scope. Creating only what you need is good modeling policy.

- *Use only every other contour line.* Doing this effectively halves the amount of geometry in your resulting surface.
- *Dumb down the contour lines.* This is a little bit hard to explain, but here goes: The From Contours tool works by connecting adjacent contour lines together with edges that form triangles. How many triangles it creates depends on how many individual edge segments are in each contour line; Figure 6-18 provides an illustration. Unless you created the contour lines to begin with — there's a good chance you imported them as part of a CAD file — you have no control over how detailed they are. Redrawing each contour line is a major bummer, but luckily, you can download a great Simplify Contours extension that makes the process much simpler.

» **You don't have to start with existing contour lines.** In fact, drawing your own edges and using From Contours to generate a surface from them is one of the most powerful ways to create organic, nonboxy forms in SketchUp. The next section, "Modeling terrain from scratch," has more details.

» **Get ready to do some cleanup.** The surfaces that From Contours creates usually need to be cleaned up to some extent. Use the Eraser to delete extra geometry (you'll find lots along the top and bottom edges of your surface). Use the Flip Edge tool to correct the orientation of your triangular faces. See the nearby sidebar "Don't flip out — Flip Edge" for the lowdown.

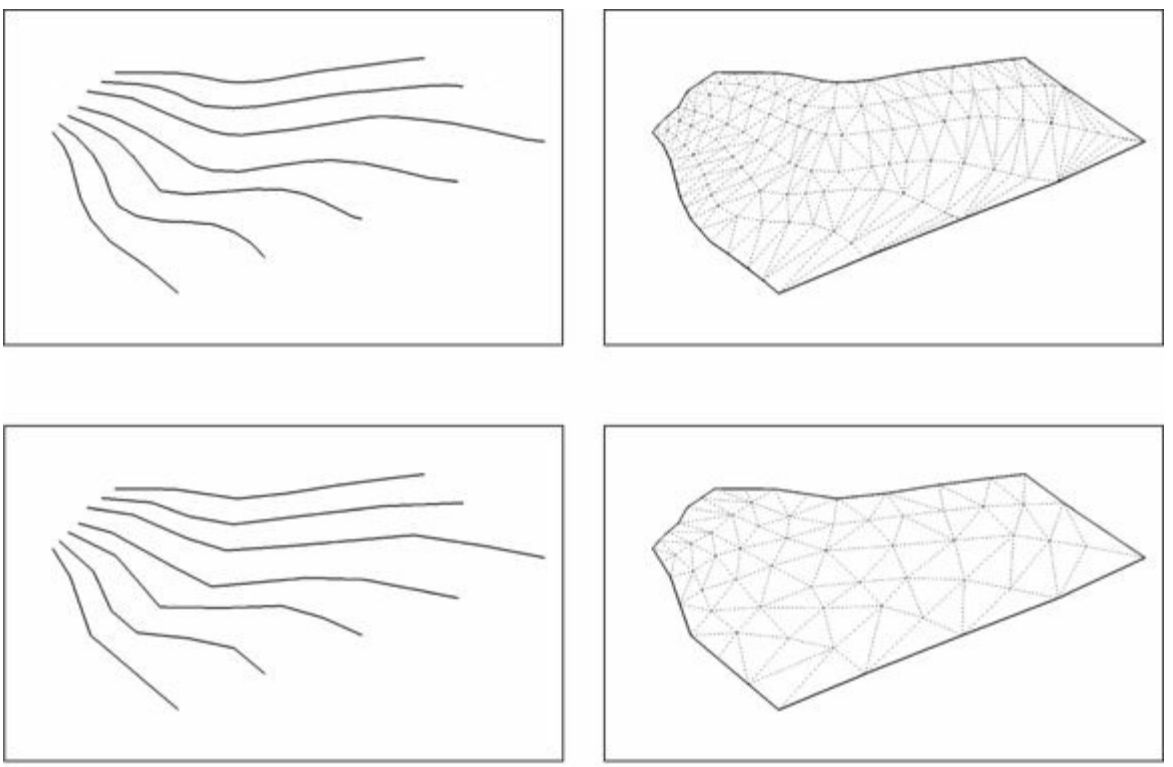


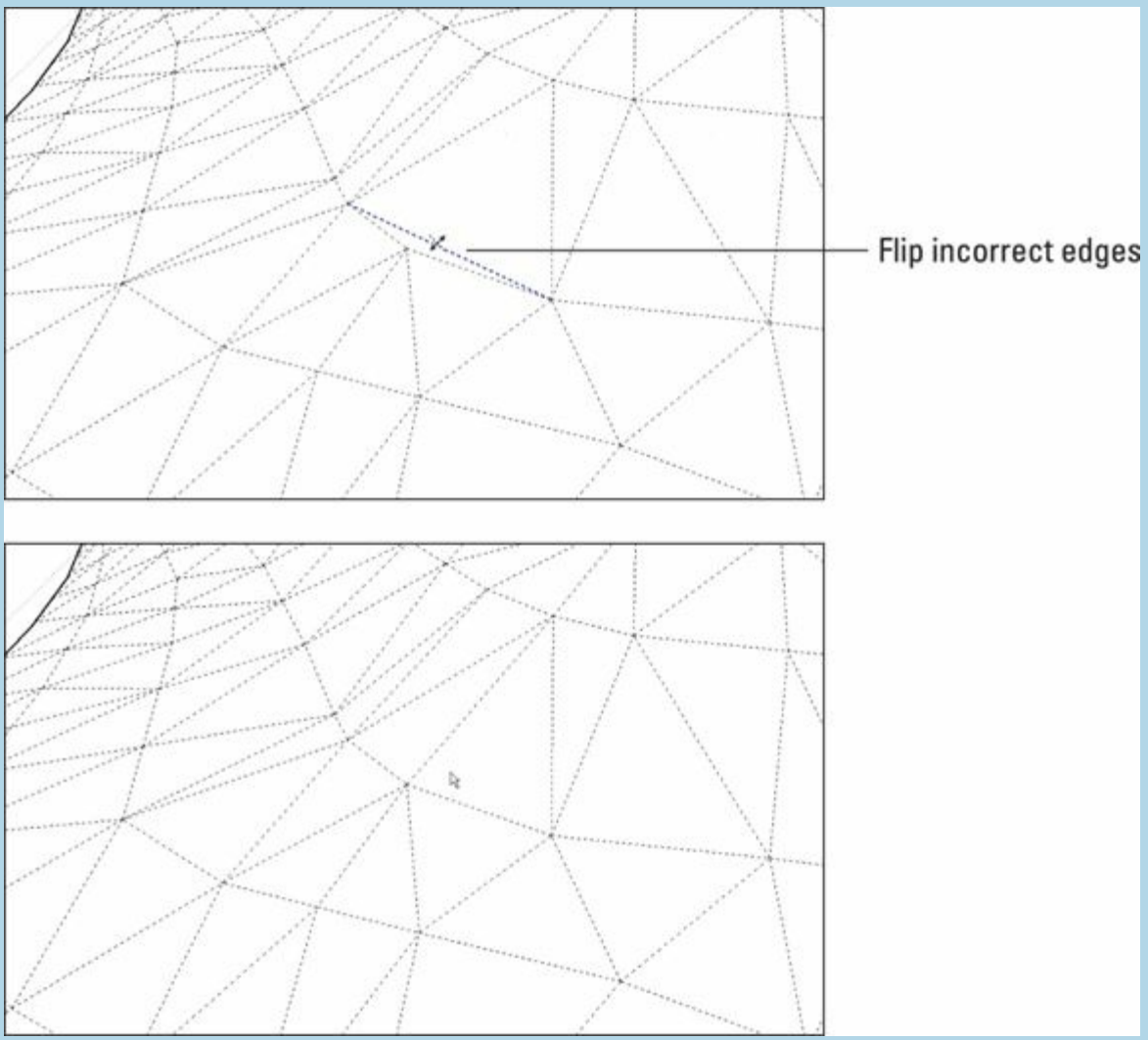
FIGURE 6-18: How many triangles are created depends on the number of edge segments in the contour lines you start with.

DON'T FLIP OUT — FLIP EDGE

The Sandbox's Flip Edge tool is a simple beast, but it's indispensable if you're working with the From Contours tool. Basically, you use Flip Edge to clean up the surfaces that From Contours creates. When you turn contour lines into a surface, lots and lots of triangular faces appear. Sometimes, the From Contours tool decides to draw an edge between the wrong two line segments, creating two triangular faces that form a "flat spot" in your surface. See the following image.

You get rid of these flat spots manually by flipping the edges that create them. Doing so changes the resulting triangular faces, usually making them end up side by side (instead of one above the other).

To use the Flip Edge tool (choose Tools ⇒ Sandbox ⇒ Flip Edge), just click the edge you want to flip. If you're not sure about an edge, go ahead and flip it; then see if things look better. If they don't, you can always undo or flip it back.



Modeling terrain from scratch

Without contour lines that define the shape of the terrain you want to model, you have to start with a

level surface. Use the From Scratch tool to create a big, flat rectangle that represents a chunk of ground. Because the rectangle is already divided into triangular faces, it's easy to use the Smoove tool (discussed next in this chapter) to shape the rectangle into hills, valleys, sand traps, and whatever else you have in mind.

Here's the thing, though: It's a very rare occasion that you have *carte blanche* with a piece of land. Unless you design something like a golf course in the middle of a dry lake bed or terraform a new planet for colonization, you probably have preexisting terrain conditions to contend with. And if that's the case, you're probably better starting off with a set of contour lines that describe those conditions, as discussed earlier in this chapter.

So although the From Scratch Tool works great, you probably won't need to use it much. All the same, here's how to do so, just in case.

Follow these steps to create a new terrain surface with the From Scratch tool and take a look at Figure 6-19 while you're at it:

1. **Choose Draw ⇒ Sandbox ⇒ From Scratch from the menu bar to activate the From Scratch tool.**
2. **Type a grid spacing amount and press Enter.**

   The default grid spacing amount is 10 feet, which means the tool draws a rectangle made up of squares that are 10 feet across. The grid spacing you choose depends on how big an area you're planning to model and how detailed you plan to make the terrain for that model.

   TIP If Aidan were modeling a single-family house on a reasonably sized lot, he would probably use a grid spacing of 2 feet — that'd provide enough detail for elements like walkways and small berms without creating too much geometry for a computer to handle. If he were laying out an 18-hole golf course, on the other hand, he'd choose a grid spacing closer to 50 feet and then add detail to certain areas later.
3. **Click to position one corner of your new terrain surface where you want it.**
4. **Click to determine the width of the surface you're drawing.**
5. **Click to establish the length of your new terrain surface.**

   When you're done, the great big rectangle you've created will automatically be a group. Double-click with the Select tool to edit it and get started. You'll probably decide to use the Smoove tool next; jump ahead to "Making freeform hills and valleys with Smoove" (later in this chapter) to find out how.

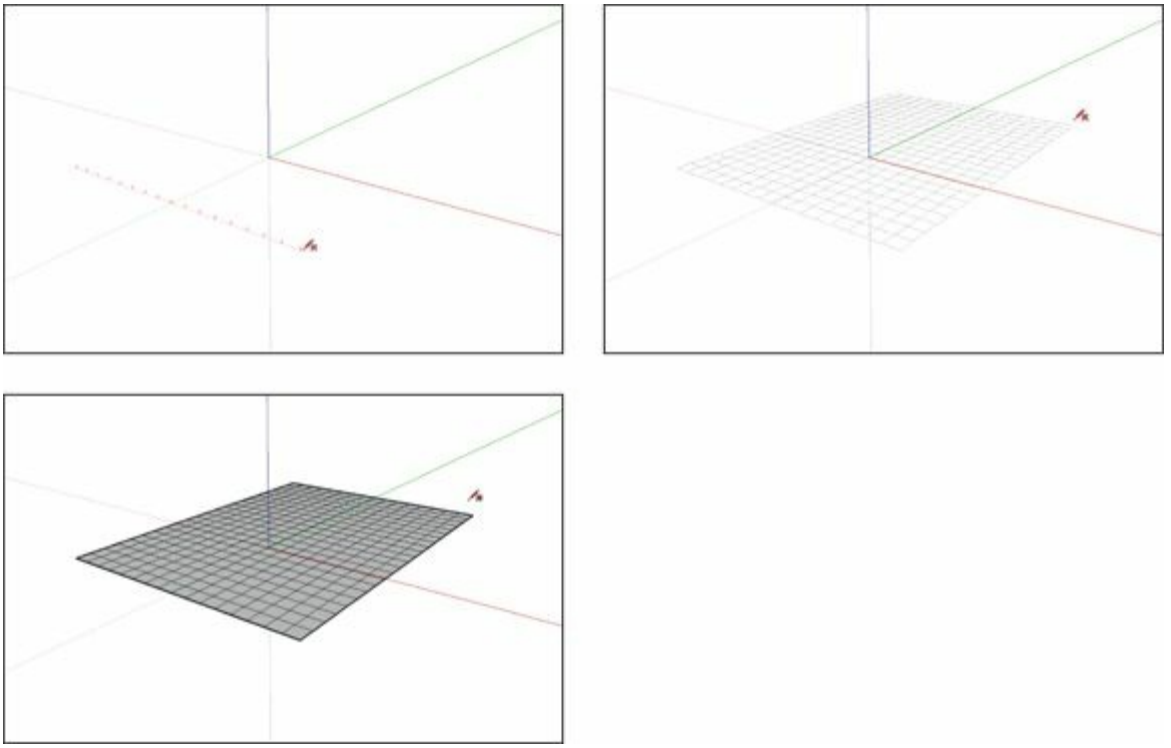


FIGURE 6-19: Use the From Scratch tool to create big swatches of flat terrain. Ah, the possibilities!

Roughing out a site

Perhaps you want to model a smallish chunk of nonflat terrain that surrounds a building. Maybe you're trying to reproduce existing site conditions, or maybe you're in the process of designing the landscape for a project. There's a neat technique for cases like this one: You can use From Contours to quickly generate a surface from just a few simple outlines.

Follow these steps to model a simple terrain surface with the From Contours tool, as shown in Figure 6-20:

1. **Extend the bottom of your building down so the exterior walls drop below ground level.**
2. **Make your building into a group.**

   See Chapter 5 if you need help.
3.  **Use the Tape Measure and Line tools to draw the outline of the chunk of terrain you want to model around the building.**

   Keep in mind that the resulting horizontal face is flat; just pretend you're drawing in 2D space. It doesn't matter if the outline you draw is below, above, or in line with the building, as you see in the next step.
4. **Use the Push/Pull tool to extrude the face you drew in Step 3 into a box that extends above and below your building, and then delete the top and bottom faces of the box you just drew.**

5. **Paint the walls of your box with a translucent material.**

   You can find some in the Translucent library, in the Materials panel. See Chapters 2 and 3 for help.

6. **Draw edges on the sides of the box that represent where the ground should intersect them.**
7. **Draw edges on the sides of the building that represent where the ground meets the building.**
8. **Delete the box you created in Step 4, leaving the edges you drew in Step 6.**
9. **Select all the edges you drew in Steps 6 and 7.**
10. **Choose Draw ⇒ Sandbox ⇒ From Contours from the menu bar to generate a surface based on the edges you selected in the preceding step.**

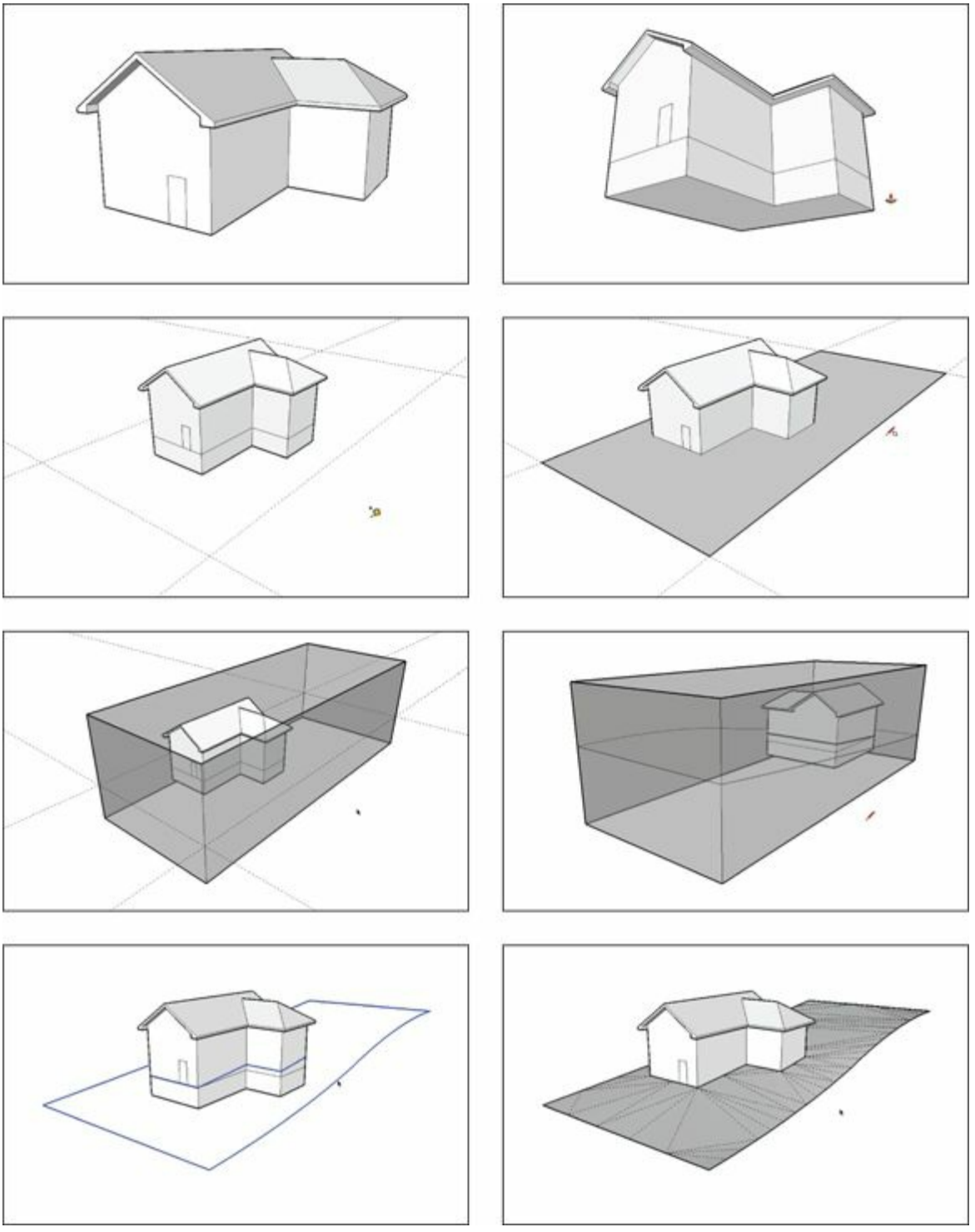


FIGURE 6-20: You can create irregular terrain surfaces very quickly with the From Contours tool.

Take a look at the section "Modeling terrain from scratch" for tips on using From Contours; at this point, you need to use the Flip Edge tool and the Eraser to clean up your terrain model — particularly where your building is supposed to go.

Editing an existing terrain model

No matter how you make a terrain model, there's a 99-percent chance that it consists of lots and lots of triangles. Switch on Hidden Geometry (choose View ⇒ Hidden Geometry) to see them. As long as you have triangles, you can use the Sandbox's terrain editing tools. This section shows you how to do the following:

- Shape (or reshape) your terrain with the Smoove tool.
- Create a flat spot for a building with the Stamp tool.
- Draw paths and roads with the Drape tool.

REMEMBER Keep in mind that both From Contours and From Scratch create terrain objects that are groups. To edit a group, double-click it with the Select tool. When you're done, click somewhere else in your modeling window.

Making freeform hills and valleys with Smoove

Smoove is a tool *for moving smoothly* — get it? Smooth + Move = Smoove. We'll wait while you compose yourself.

Smoove is actually one of the coolest tools in SketchUp; it lets you shape terrain (or any horizontal surface that's made up of smaller, triangular faces) by pushing and pulling (sort of) bumps and depressions of any size. Smoove is fun to use and yields results that you'd be hard-pressed to produce with any other tool in SketchUp. Figure 6-21 shows what Smoove can do.

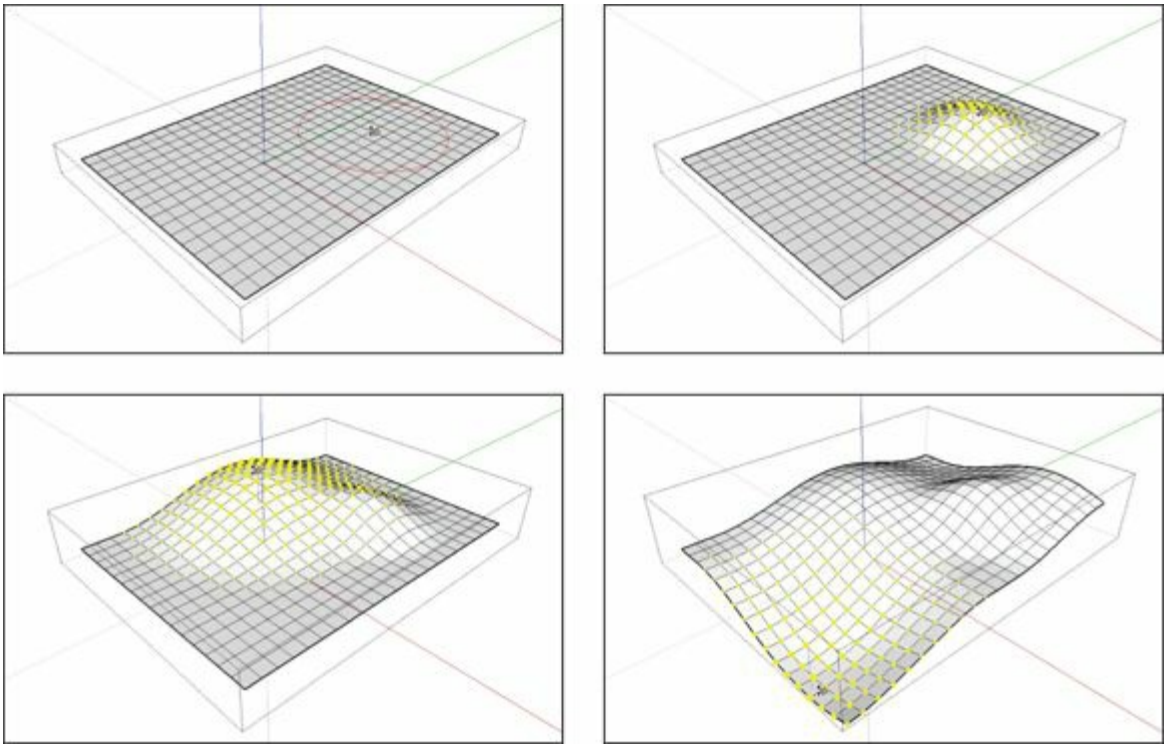


FIGURE 6-21: Smoove creates shapes that are unlike anything else you can make with SketchUp.

Follow these steps to shape a surface with Smoove:

1. **Double-click the group containing your terrain to edit it.**
   If your terrain isn't part of a group, forget this step.
2.  **Choose Tools ⇒ Sandbox ⇒ Smoove from the menu bar to activate the Smoove tool.**
3. **Type a radius and press Enter.**
   Smoove creates lumps, bumps, and dimples that are circular. The radius you enter here determines how big those lumps, bumps, and dimples should be.
4. **Click somewhere on your terrain surface to start smooving.**
5. **Move your mouse up or down (to create a bump or a depression, respectively), and then click again to stop smooving.**

Fun, huh? Here are some more things to keep in mind when you use Smoove:

- **Use the From Scratch tool beforehand.** You don't have to, but creating a surface with the From Scratch tool (described earlier in this chapter) is by far the easiest way to end up with terrain that you can smoove easily.
- **Try smooving to edit other terrain surfaces.** You can also use Smoove after you create a

terrain surface with the From Contours tool.

- **Double-click to repeat your previous smoove.** As with Push/Pull, double-clicking tells SketchUp to carry out the same operation as you did the last time you used the tool.
- **Preselect to smoove shapes other than circles.** Any faces and edges you select before you use the Smoove tool will move up (or down) by a constant amount. This means you can use Smoove to create things like ridges and ditches by selecting the right geometry beforehand. Figure 6-22 provides a much-needed picture.

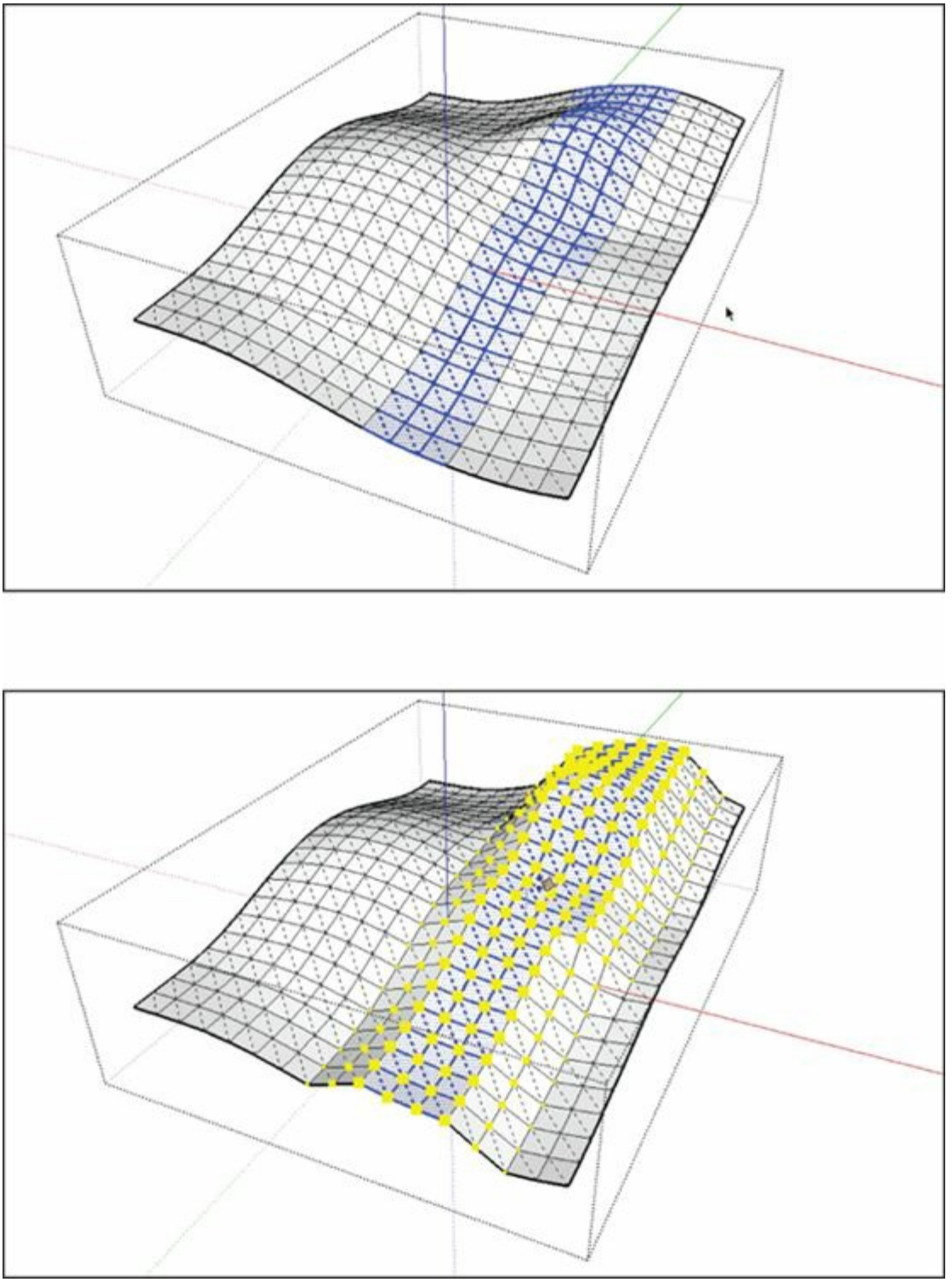


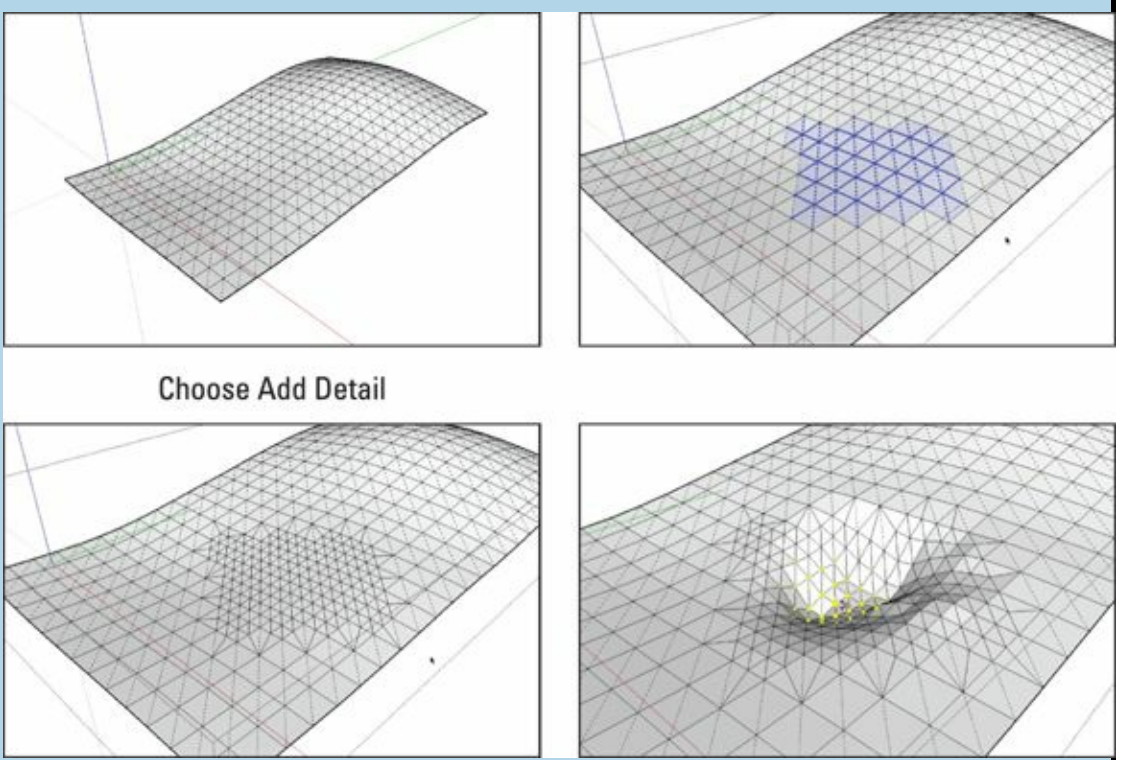
FIGURE 6-22: Preselect faces and edges to smoove shapes other than circles.

NEED MORE TRIANGLES? ADD DETAIL

Like the Flip Edge tool, Add Detail is kind of a one-trick pony. Use it to add triangles to areas of your terrain surface that need more detail. That way, you can save geometry (and file size, and waiting) by having lots of faces only in the areas of your terrain that require it. As Aidan mentions elsewhere in this chapter, if he were designing a golf course, he'd use very big triangles for the vast majority of it. He'd use the Add Detail tool to add triangles to areas where he planned to have smallish things like sand traps.

You can use the Add Detail tool in two ways:

- **Add detail to faces one at a time.** To be honest, you may never have a reason to use the tool this way, but here goes: You can activate the tool (see the next bullet) *without* having any geometry selected. Then click faces or edges on your terrain to divide them into more faces. This method might be handy when you model something very precisely.
- **Add detail to an area all at once.** Simply select the faces on your terrain you want to subdivide and choose Tools ⇒ Sandbox ⇒ Add Detail from the menu bar. Take a look at the figure to see what happens when you do.



Placing a building on your terrain with Stamp

Eventually, you may need to plunk down a building (or some other structure) on the terrain you've lovingly crafted. The Stamp tool provides an easy way to — you guessed it — stamp a building footprint into a terrain surface, creating a flat "pad" for something to sit on. This tool also provides a way to create a gently sloping offset around the perimeter of your stamped form. This creates a smoother transition between the new, flat pad and the existing terrain.

Follow these steps to use the Stamp tool; check out Figure 6-23 to see the corresponding pictures:

1. **Move the building you want to stamp into position above your terrain surface.**

   The building shouldn't touch the terrain but float in space directly above it. Also, turn the building into a group before you start moving anything; take a look at Chapter 5 to find out all about groups and components.

   TIP If you're having trouble moving your building into position accurately, move it to the correct height first and then switch to a top, no-perspective view to finish the job. Look in the Camera menu for both these commands.

2. **Choose Tools ⇒ Sandbox ⇒ Stamp from the menu bar to activate the Stamp tool.**
3. **Click the floating object to tell SketchUp what you want to use as the stamp.**
4. **Type an offset distance and press Enter.**

   The *offset distance* is the amount of space around the perimeter of whatever you're stamping that SketchUp uses to smooth the transition between the flat spot it's creating and the existing terrain. The offset amount you choose depends entirely on what you're stamping. Go nuts, and thank your lucky stars for Undo.

5. **Move your cursor over your terrain surface and click again.**
6. **Move (but don't drag) your mouse up and down to position the flat pad in space. Click again to finish the operation.**

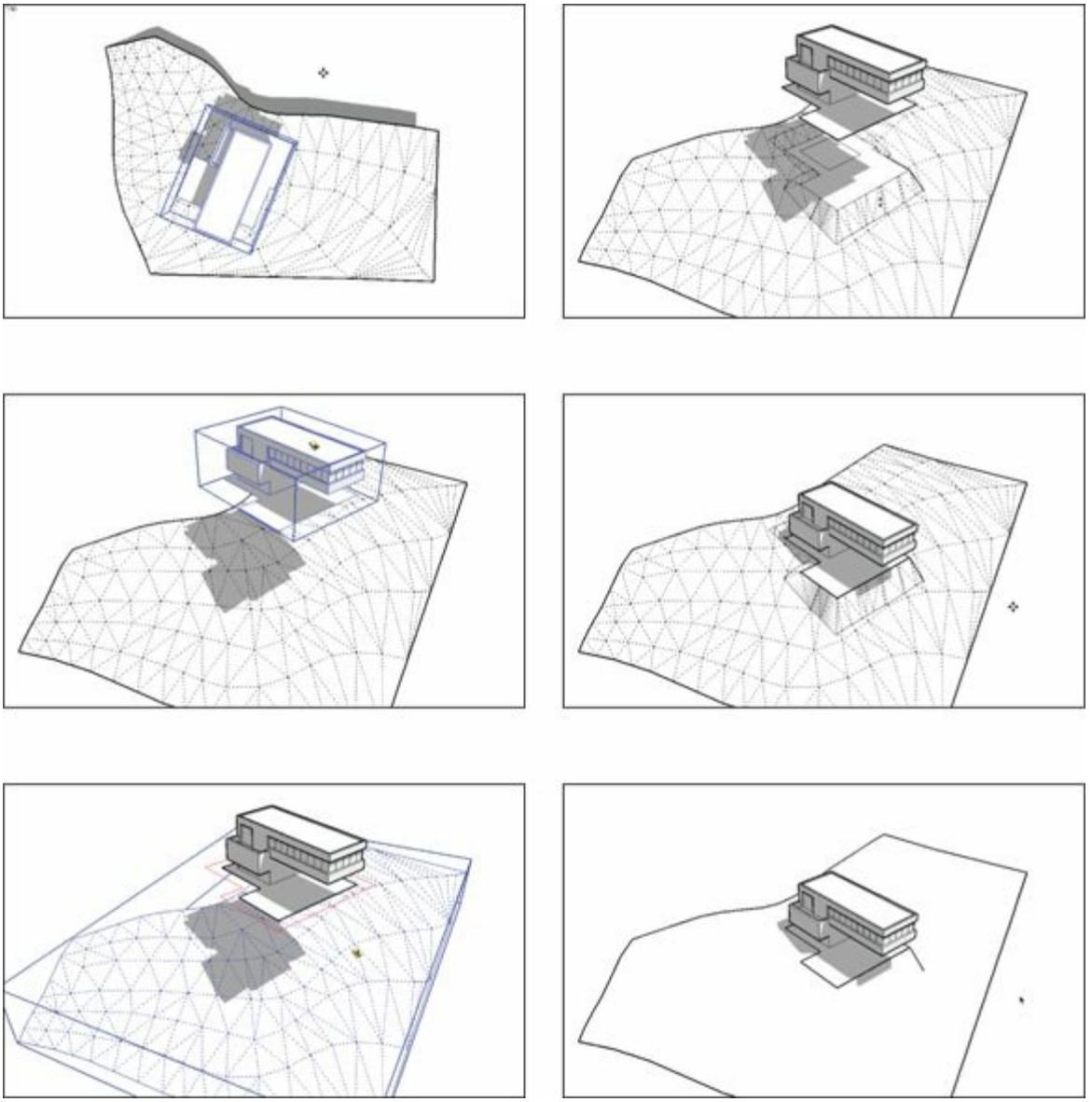


FIGURE 6-23: Use the Stamp tool to create a nice, flat spot for your building.

Here are a couple things that are handy to know when you use Stamp:

- SketchUp uses the bottommost face in your stamp object as the template for the flat pad it creates in your terrain.
- Read the "Don't flip out — Flip Edge" sidebar, earlier in this chapter; Stamp creates triangular faces that sometimes need cleaning.

Creating paths and roads with Drape

The Drape tool works a little like a cookie cutter; use it to transfer edges from an object down onto another surface, which is directly beneath it.

Perhaps you have a gently sloping terrain and you want to draw a meandering path on it. The path has to follow the contours of the terrain, but because you want to paint it with a different material, it needs to be a separate face. In this case, you'd draw the path on a separate face and use the Drape tool to transfer it to your terrain surface.

Taking the preceding example, follow these steps to use the Drape tool to draw a path on a nonflat terrain surface. Figure 6-24 illustrates the steps:

1. **Use the Line tool (see Chapter 2) to draw a flat face somewhere directly above your terrain surface.**

   If you can, make your flat face exactly the same size as your terrain. Just make sure it's big enough for whatever you plan to draw next (in this example, a path).

2. **Paint the face you just created with a translucent material.**

   I find that a light gray works well; there's a good one in the Translucent library, inside the Materials panel.

3. **Use the Line tool to carry up any important points on your terrain surface.**

   In this case, make sure the path begins precisely at the door of the building, so draw vertical lines from the sides of the door to the flat face directly above. That way, you have something to inference to in Step 6.

4. **Choose Camera ⇒ Standard Views ⇒ Top from the menu bar to switch to a top view.**

5. **Choose Camera ⇒ Parallel Projection from the menu bar to turn off perspective.**

6. **On the upper face, draw the edges you want to drape.**

   REMEMBER Make sure that your edges form closed loops to create faces. If they don't, you'll have a miserable time trying to paint the path (in this case) after it's draped onto your terrain surface.

7. **Orbit your model so you can see both the upper and lower surfaces.**

8. **Soften/smooth the edges of the triangles in your terrain surface (if they aren't already).**

   To do this, follow these steps:

   a. *Select all the edges and faces in your terrain, and then choose Window ⇒ Soften Edges from the menu bar.*

   b. *In the Soften/Smooth Edges panel, move the slider to the far right and make sure that both the Smooth Normals and Soften Coplanar check boxes are selected.*

9. **Select the edges you want to drape.**

   If your edges define closed faces, you can select those faces instead; sometimes that's easier than selecting a bunch of individual edges. Take a look at Chapter 3 for tips on selecting things.

10.  **Choose Draw ⇒ Sandbox ⇒ Drape from the menu bar to activate the Drape tool.**
11. **Click once on your terrain surface to drape the edges you selected in Step 9.**
    It doesn't matter if your terrain is inside a group — the Drape tool works anyway.

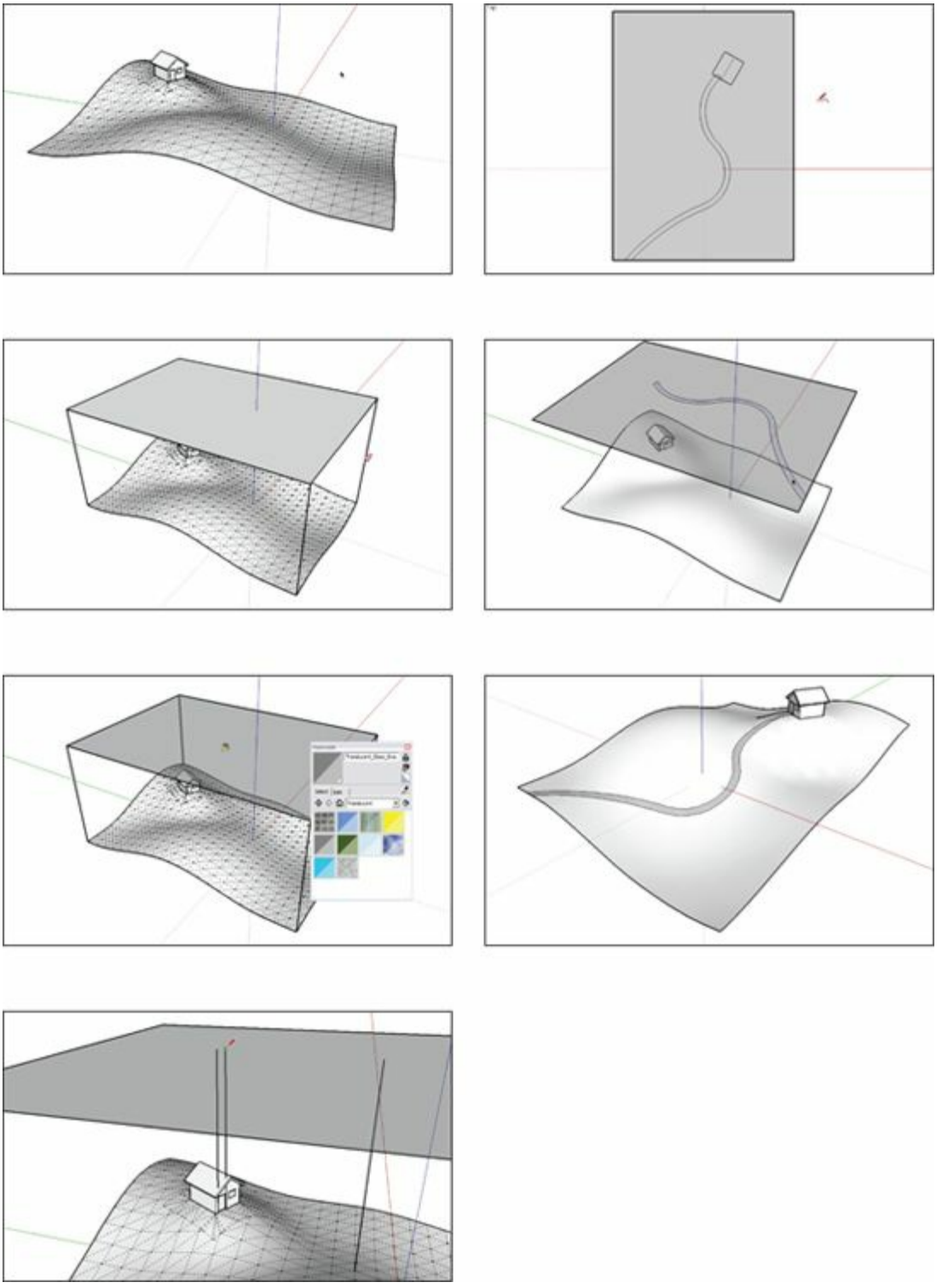


FIGURE 6-24: Use Drape to transfer edges onto your terrain surface.

Daniel Tal (a landscape architect and SketchUpper extraordinaire who regularly builds models that defy explanation) has written *SketchUp for Site Design: A Guide to Modeling Site Plans, Terrain and Architecture* (published by Wiley), which is available online and at your local bookstore. If you're a site designer, we *highly* recommend checking it out.

Building a Solid Tools Foundation

So-called *solid modeling operations* (fancy people refer to them as *Boolean operations*) give you the ability to create the shapes you need by adding or subtracting other shapes to or from each other. In the next few pages, you discover how to use all six of SketchUp Pro's Solid Tools, giving detailed examples for the three that are the most useful.

REMEMBER Five of the six Solid Tools are only in the Pro version of SketchUp. Take a look at Table 6-1 (later in this chapter) to see what's available to you.

TABLE 6-1 The Solid Tools

Tool	*What It Does and How to Use It*	*Start With*	*End With*
Union	*What:* Combines two or more solids into a single solid. Deletes overlapping geometry. Preserves internal pockets.* *How:* Select the solids you want to use and then activate the tool.	Two+ solids	One solid
Outer Shell	*What:* Combines two or more solids into a single solid. Deletes overlapping geometry, including internal pockets.* *How:* as Union tool.	Two+ solids	One solid
Intersect	*What:* Makes a single solid in which two or more solids overlap. Deletes everything else. *How:* Same as Union tool.	Two+ solids	One solid
Subtract	*What:* Uses one solid to cut away part of another solid. Deletes the first solid when it's done. *How:* Activate the tool, click "cutting" solid, and then click solid to be cut.	Two solids	One solid
Trim	*What:* Uses one solid to cut away part of another solid. Keeps what's left of both solids. *How:* Same as Subtract tool.	Two solids	Two solids
Split	*What:* Cuts two solids where they overlap and creates a new solid from the overlap. Doesn't delete anything. *How:* Same as Union tool.	Two solids	Three solids

* *An internal pocket is like a solid within a solid — it's a completely enclosed volume that happens to be located inside the main volume of a solid. Picture a SketchUp model of a tennis ball. Because tennis balls have a thickness, you'd need two surfaces to model one: one for the inside, and one for the outside. If you selected both and made a group, you'd have a solid with an internal pocket inside.*

Understanding solids

Before you can use the Solid Tools, you need *solids*. Here are six things you need to know about solids; you can think of them as the Solid Rules:

- **A solid is nothing more than an object that's completely enclosed.** It has no holes or other gaps; if you filled it with water, none would leak out. For this reason, solids are sometimes referred to as being *watertight*. Here's another way to think about it: Every edge in a solid must

be bordered by two faces.

- **No extra edges or faces allowed.** You wouldn't think that one or two edges or faces would make much of a difference, but it does — solids can't contain *any* extra geometry, period. Figure 6-25 shows some examples of things that can disqualify otherwise completely enclosed shapes from being solids.

  A few SketchUp extensions make it easier to figure out why a particular group or component isn't solid. For starters, check out Solid Inspector^2 by ThomThom. For an introduction to the Extension Warehouse, see Chapter 16.

- **Only groups and components can be solids.** This one's a biggie. For SketchUp to *realize* something is a solid, you have to make it into either a group or a component first. Another thing: Solid groups and components can't have other groups and/or components nested inside them.

- **Making a solid doesn't require any special tools.** You don't have to pick from a special list of objects to create solids; you make them with the same SketchUp tools you use all the time. Case in point: Every time you've pushed/pulled a rectangle into a box, you've created a solid.

- **Check Entity Info to see if your object is a solid.** The easiest way to tell whether a group or component is a solid is to select it and choose Window ⇒ Entity Info. If it's solid, this panel will say either "Solid Group" or "Solid Component." Figure 6-26 shows you where to look.

- **Solids have volumes.** Manually calculating the volume of a simple shape like a rectangular box is straightforward, but try it for anything more complicated and you'll see why the Volume readout in Entity Info is so great. Figure 6-26 shows where to look.

- **Solids can be made up of multiple shapes.** This one is confusing at first. As long as each individual cluster of geometry within a group or component is completely enclosed, SketchUp considers that group or component to be a solid. It doesn't matter that they're not connected or touching in any way; what's important is that an area of space is fully surrounded by faces.

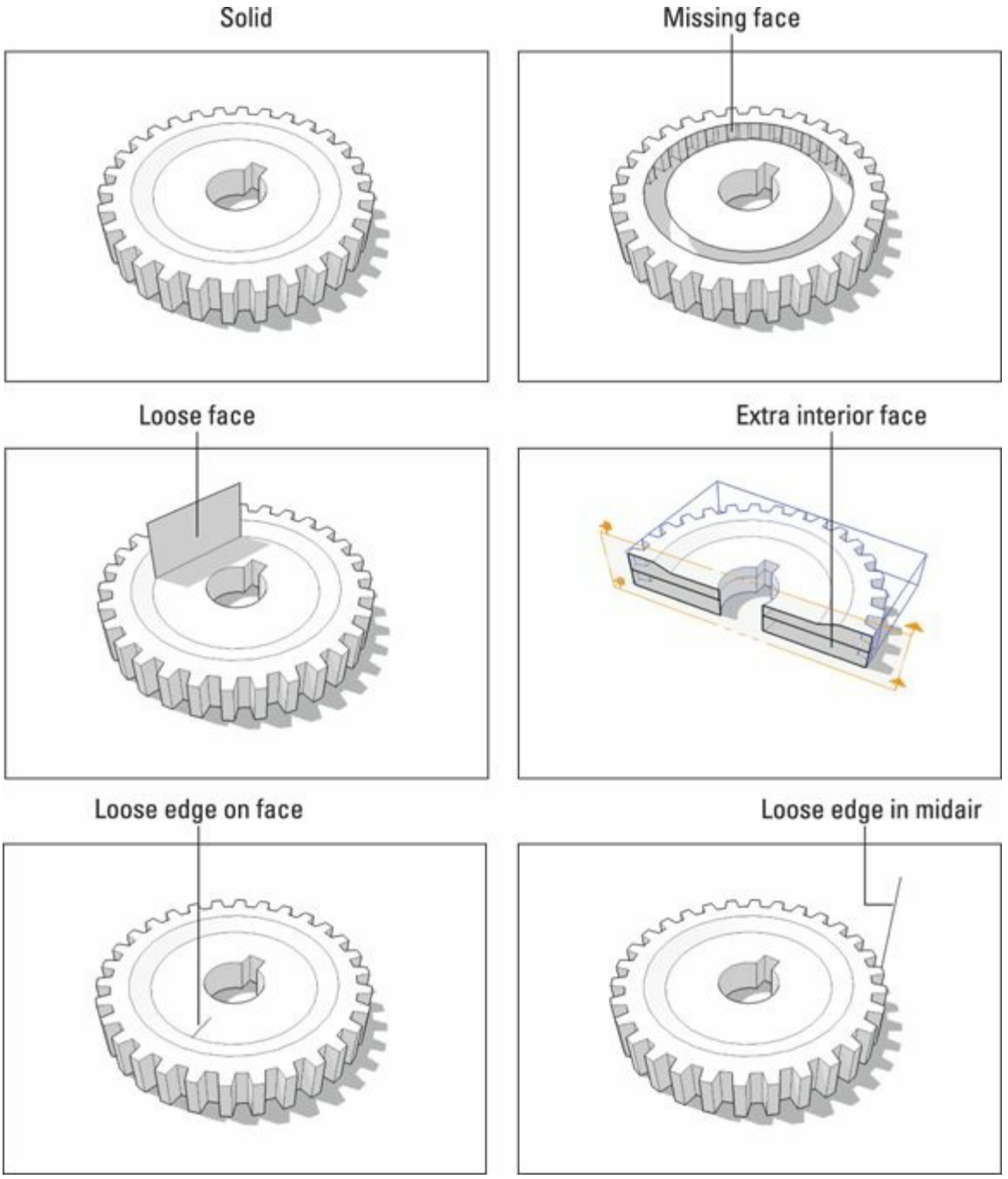


FIGURE 6-25: Solids can't contain any extra edges or faces.

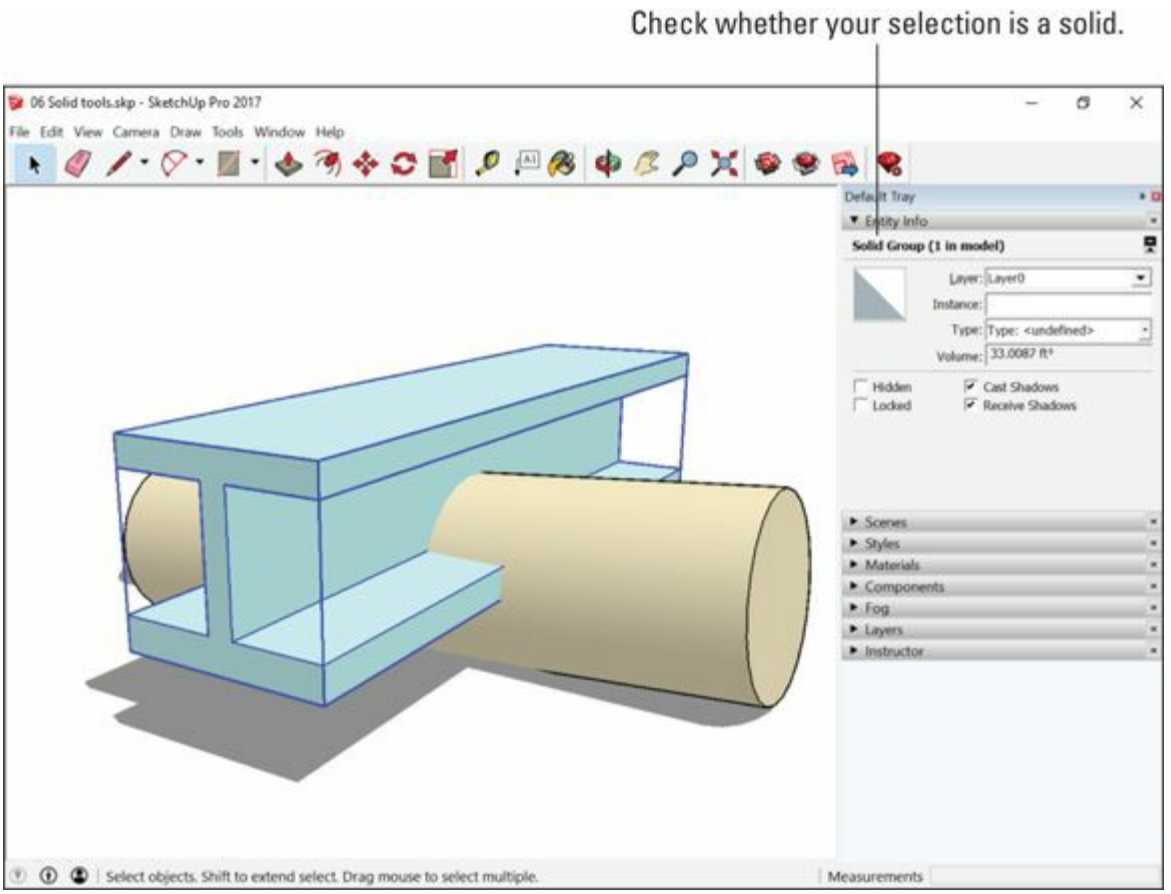


FIGURE 6-26: Check the Entity Info panel to see whether your selection is a solid.

Checking out the Solid Tools

When you have a solid object or objects, you can use SketchUp's Solid Tools in powerful ways to create shapes that'd otherwise be very complicated and time-consuming to make. For example:

- Add two solids together to create a new one.
- Use one solid to cut away part of another one.

TIP With the SketchUp Intersect Faces tool, you can achieve many of the same things that the Solid Tools do. Intersect Faces takes longer because it requires an awful lot of cleanup; however, it's still useful for two very important reasons: It's available in both the free and Pro versions of SketchUp, and it works on any face in your model — not just on solids. You can read about Intersect Faces in Chapter 4.

Two things you need to know before you start using the Solid Tools:

- **Open the dedicated toolbar.** Choose View ⇒ Toolbars ⇒ Solid Tools to open the toolbar that contains all six tools. You can also find them on the Tools menu. Keep in mind that five of them — all but the Outer Shell tool — are available only if you have SketchUp Pro.
- **To use the Solid Tools, preselect — or don't.** Pick the tool you want to use either *before* or *after* you've told SketchUp which solid objects you want to affect. Like most "order of operations" issues (are you listening, Follow Me tool?), this can be confusing for some folks.

  
  TIP The easiest way to use the Solid Tools is to preselect the solids and *then* choose the tool to carry out the operation. The glaring exceptions to this rule are the Subtract and Trim tools; both of these depend heavily on the *order* in which you pick your solids. Take a peek at Table 6-1 for more specifics.

Without further ado, here's Table 6-1 with a rundown of the Solid Tools. (Check out Figure 6-27 for a visual.)

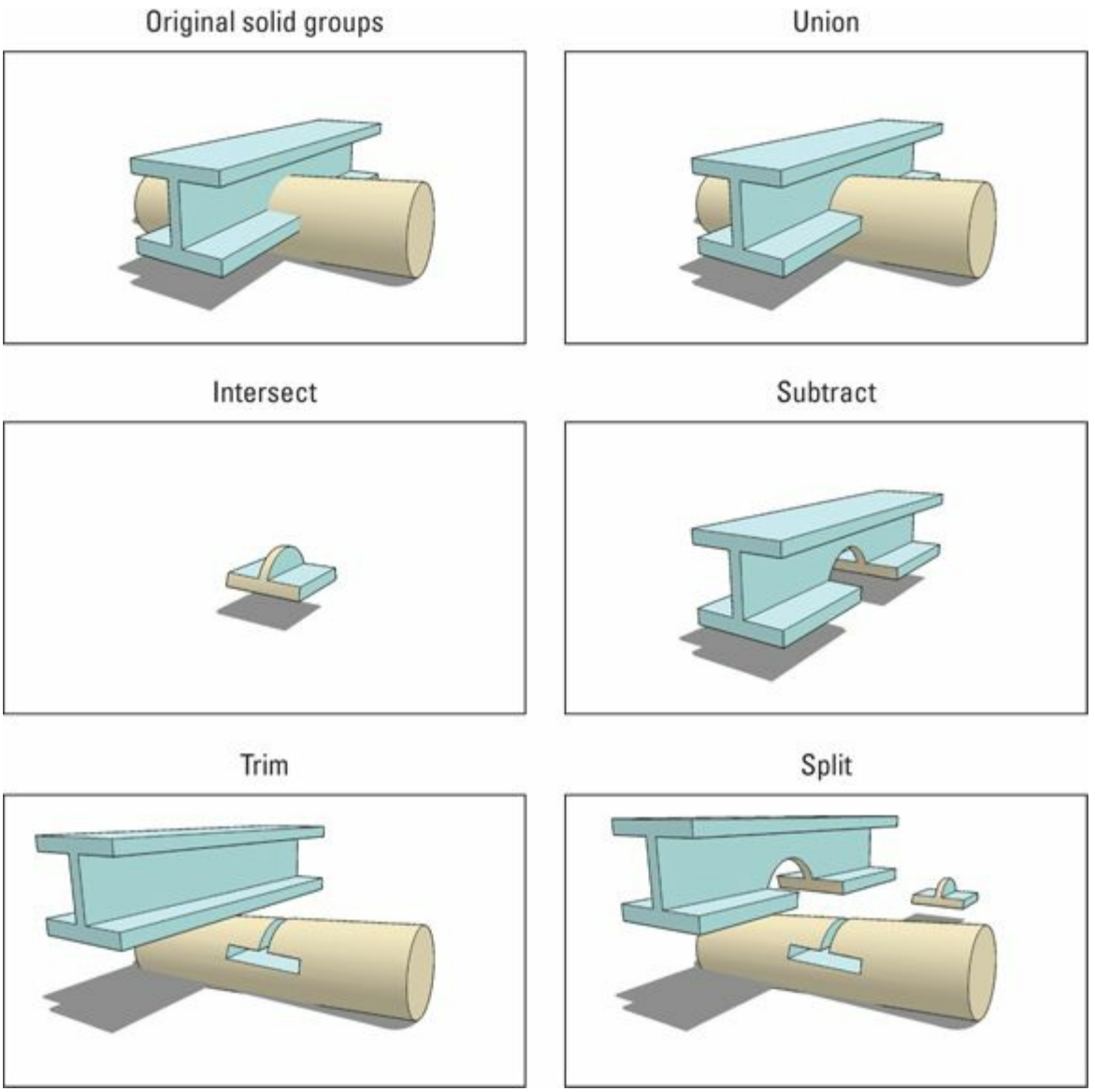


FIGURE 6-27: The Solid Tools let you do additive and subtractive modeling operations.

TIP Note that the Split tool actually does three operations every time you use it: It yields two subtractions and an intersection. That is to say, using Split is like using both Subtract *and* Intersect on your solids. For this reason, you might want to use Split full-time. It's easier to keep track of what's going to happen, and the only downside is that you have to delete a couple extra objects when you're done.

Putting the Solid Tools to work

In this section, you find a few examples of everyday modeling challenges that the Solid Tools can help make less challenging. You're almost certain to encounter these tricky situations while you climb the ladder toward ultimate SketchUp ninjahood.

Assembling complex objects with Union or Outer Shell

Chapter 4 has a section about using the Intersect Faces tool to combine multiple roof pitches into a single, solitary roof. If all those gables, hips, dormers, and other roof elements are solids, you can absolutely use SketchUp's Union or Outer Shell tools to make quick work of the problem.

The same goes for anything that's composed of several disparate elements that you've assembled by moving them together until they overlap. In the spacecraft in Figure 6-28, the *hull* (or body) combines different pieces. Notice the lack of edges where the components intersect? We think edges add detail and definition, especially when a model is displayed using a lines-only style (as it is here). There's also the issue of all the geometry hidden inside the hull. Combining everything together into a single solid helps it shed weight and look better, all at the same time.

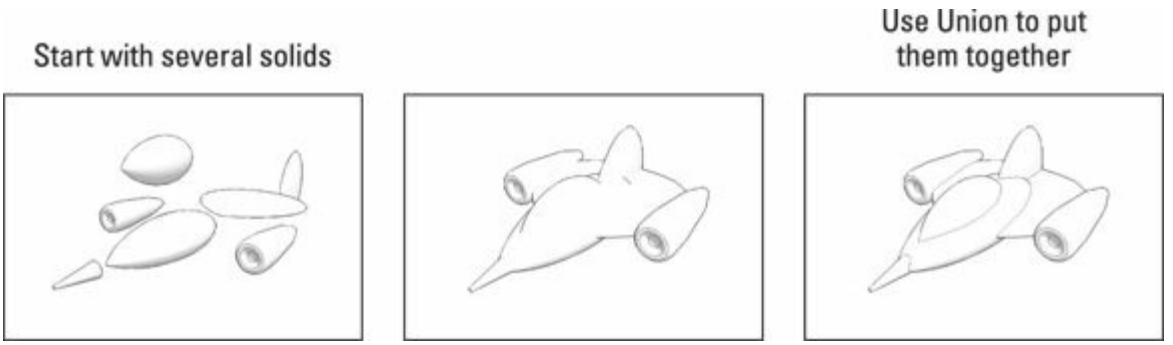


FIGURE 6-28: Using Union or Outer Shell to combine several solids gets rid of internal geometry and adds edges where faces intersect.

Using Intersect in combination with front, top, and side views

Anyone who's ever tried to model a car with SketchUp knows it's a tricky undertaking. The problem is that cars (and most other vehicles) are kind of curvy; worse yet, they're curvy in several directions.

One trick lots of modelers use to block out a basic shape for things like cars is to start with *orthographic* — straight-on top, front, and side — views of the thing they're trying to model. Here's how the method works:

1. **Position each 2D view where it belongs in 3D space.**
2. **Push/pull them all so their extrusions overlap.**
3. **Use the Intersect tool (Tools ⇒ Solid Tools ⇒ Intersect) to find the object that the extrusions all have in common.**

This method doesn't always produce perfect results, but it's a lot better than guessing. Plus, it's fun. Figure 6-29 shows the technique in action.

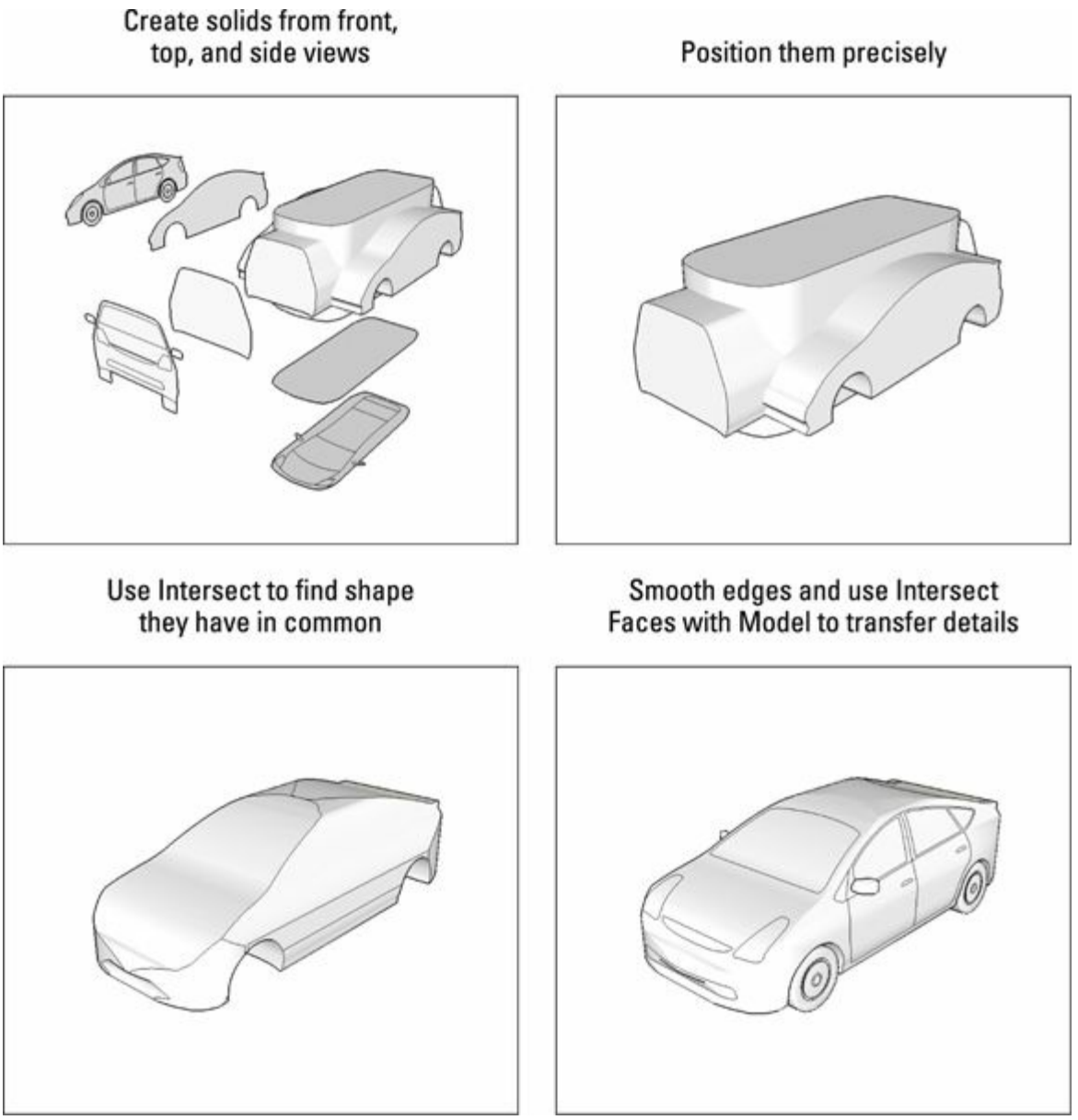


FIGURE 6-29: If you have orthographic views of the thing you're trying to model, you can use Intersect to give yourself a head start.

Modeling close-fitting parts with Trim

Woodworkers and industrial designers, take heed: SketchUp Pro's Trim tool saves you literally hours of work. Anytime you need to build a model with parts that interlock or otherwise fit together closely, Trim is where you should look first.

Trim basically tells one part to "take a bite" out of another, which is perfect for joinery (dovetails, finger joints, dadoes, and so on), machine parts, ball-and-socket joints, and any other positive/negative conditions where two parts meet.

Figure 6-30 shows how to build a small wooden box with dovetailed sides and a dadoed bottom.

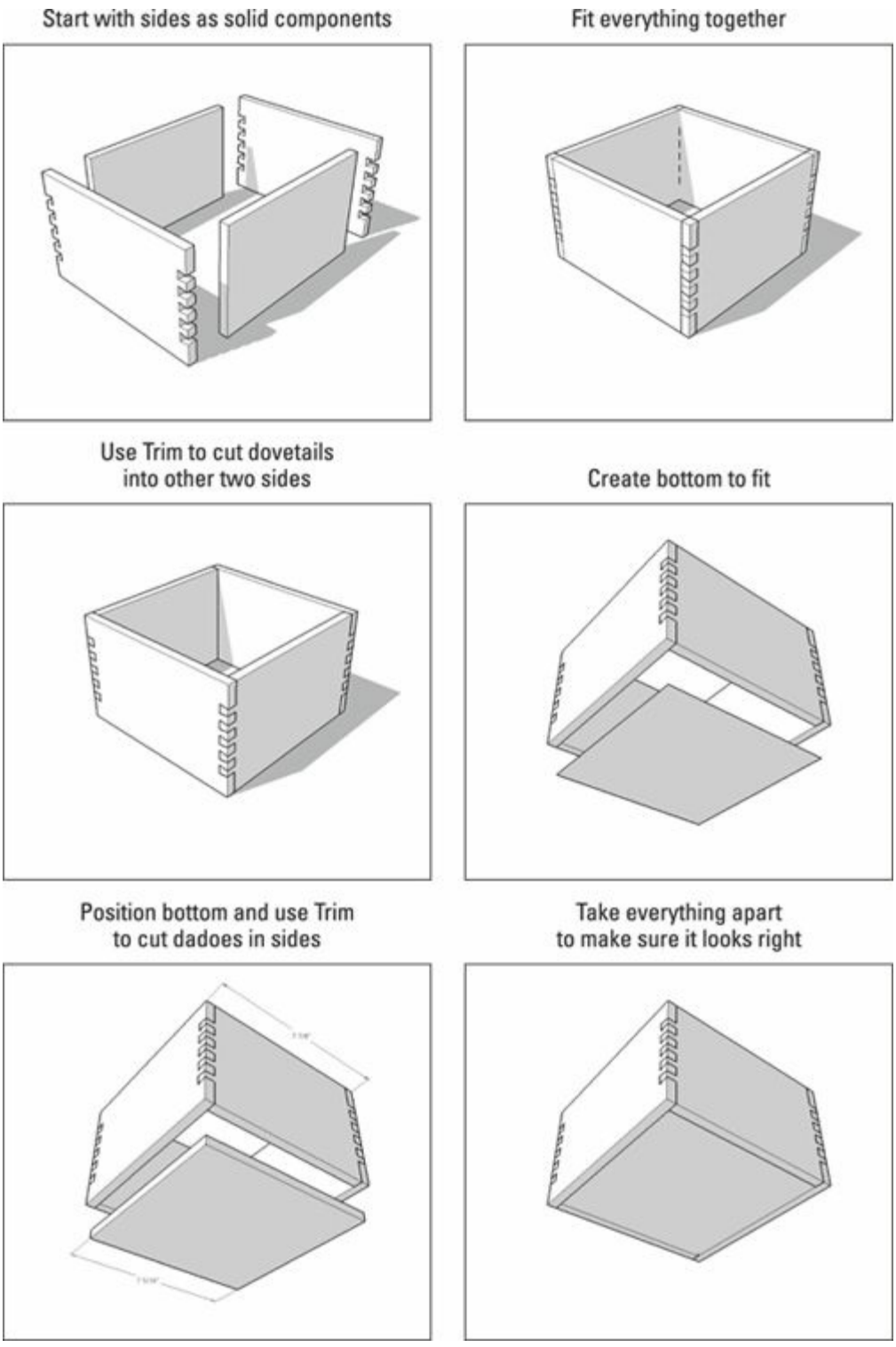


FIGURE 6-30: The Trim tool is perfect for modeling joinery and other close-fitting parts.

REMEMBER The only tricky thing about using the Trim tool is remembering which solid to pick first. Remember that the first thing you pick (or click) is the one you want to use to cut with. In the case of the box in Figure 6-30, that would be the side with the dovetails. When you select the dovetails and then select the blank side, the Trim tool cuts the dovetails into the second piece. You get the hang of it after a few tries.

TIP The Trim tool has a neat trick up its sleeve: You can keep using your cutting solid on multiple other solids. To cut the *dado* (or groove) into the sides of the box in Figure 6-30, follow these steps:

1. **Choose Tools ⇒ Solid Tools ⇒ Trim to activate the Trim tool.**

   Your cursor has the number 1 on it.

2. **Select the box bottom.**

   Your cursor changes to show the number 2.

3. **Select one side on the box.**

   You just cut a dado using the box bottom you picked in Step 2. Your cursor still says 2.

4. **Select another of the box's sides to create another dado.**

5. **Select the remaining two sides to cut dadoes in them, too.**

   Fun!

TIP A question that comes up pretty frequently concerning what happens when you use one of the Solid Tools on a component instance. Why doesn't the effect of what you just did affect all the other instances of that component? It should, shouldn't it? Anyone who's read Chapter 5 of this book should know that … .

Here's the thing: As soon as you use a Solid Tool on a component instance, SketchUp makes that instance unique; it's still a component — it just isn't connected to the other instances anymore.