

Site and Topography

When it comes to adding a site to a model, the Autodesk® Revit® Architecture software is well equipped to take on the challenge. However, in many cases Revit is dependent on Autodesk® AutoCAD® or MicroStation to provide a real-case scenario for a site that can be imported (similar to importing a plan or a detail). Fortunately, Revit provides tools to add a topographic surface to an imported CAD site.

This chapter covers the following topics:

- ▶ Adding a site in Revit
- ▶ Splitting the surface
- ▶ Creating subregions
- ▶ Adding site components
- ▶ Adding building pads to displace earth
- ▶ Adding a property line
- ▶ Creating a toposurface by instance
- ▶ Creating a graded region

Adding a Site in Revit

To get started, let's do something easy and then migrate into the more difficult areas, such as importing a CAD file. The first item you'll tackle will be to start a site using datum points that you'll manually pick using the Toposurface function on the Ribbon's Massing & Site tab.



N O T E Metric users should not type in *mm* or other metric abbreviations when entering amounts suggested in the exercises. Revit will not accept such abbreviations. Simply enter the number provided within the parentheses.

Let's get cracking. First, open the model you've been using to follow along. If you missed the previous chapter, go to the book's web page at www.sybex.com/go/revit2017ner. From there, you can browse to the Chapter BC3 folder and find the `NER-BC3.rvt` file.

The objective of this procedure is to add a topographical surface by choosing datum points and elevations. Follow these steps:

1. In the Project Browser, find the Site floor plan and open it.
2. Type VG for Visibility Graphics.
3. On the Annotation Categories tab, deselect Callouts, Elevations, Grids, Matchline, Stairs, and Sections, and click OK.
4. On the Massing & Site tab, click the Toposurface button, as shown in Figure BC3.1.

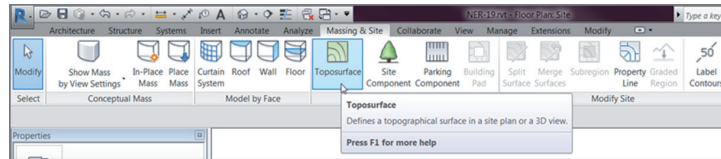


FIGURE BC 3.1: Click the Toposurface button on the Massing & Site tab of the Ribbon.

5. On the Options bar, set the elevation to $-2'-6''$ (-750 mm) (that's negative $2'-6''$ [negative 750 mm]).
6. Pick points in a pattern to the right half of the building, as shown in Figure BC3.2.

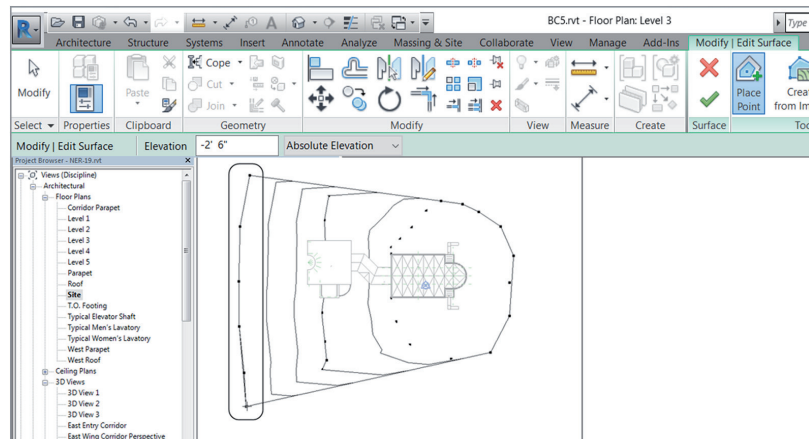


FIGURE BC 3.2: Adding the first contours



NOTE Notice that after you click the Toposurface button, Revit launches Sketch Mode. The Place Point button is selected by default in Toposurface Sketch Mode.

7. With the Place Point command still running, set Elevation on the Options bar to $-1'-0'$ (-300 mm).
8. Pick five or six points in a line, similar to Figure BC3.3.

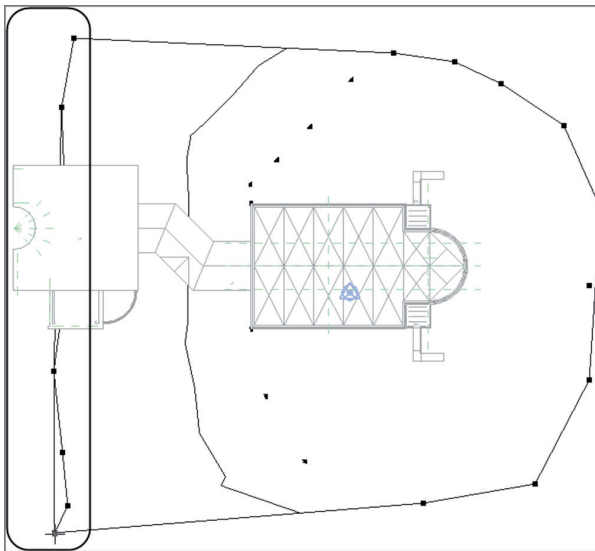


FIGURE BC3.3: Adding the second contour to the site

9. With the Place Point command still running, set Elevation on the Options bar to $2'$ (600 mm).
10. Add a third contour line to the left of the second, as shown in Figure BC3.4.
11. Click Finish Surface (the green check mark).
12. Select the topographical surface; then, in the Properties dialog box, click into the Material field, and click the [...] button.
13. At the top of the Material Browser, enter the word grass.
14. When the Grass material appears in the search results window, select it as shown in Figure BC3.5.

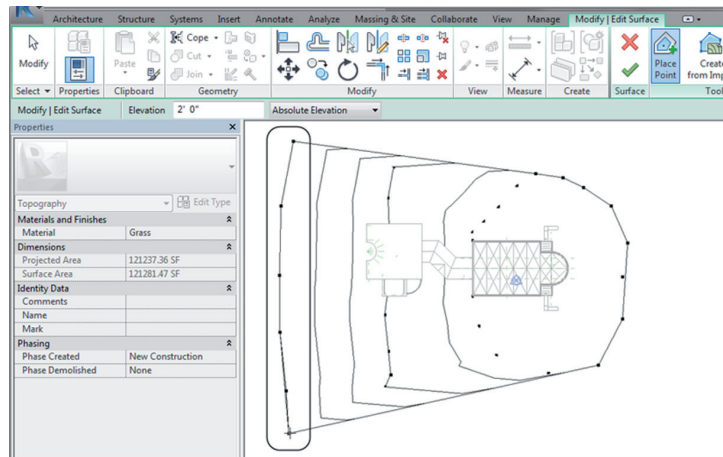


FIGURE BC 3.4: Adding the third set of contours

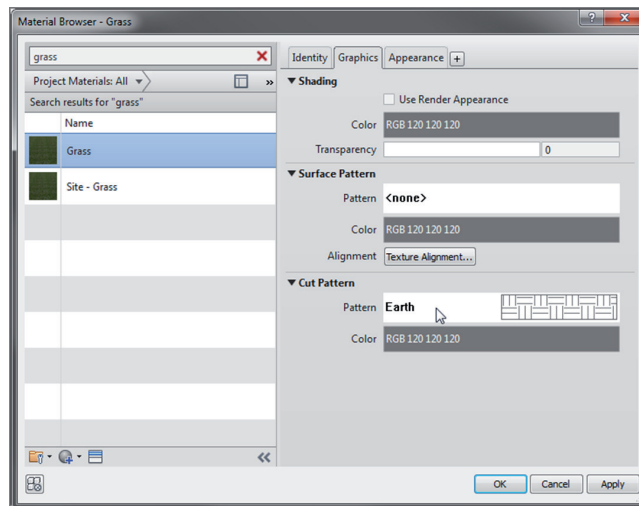


FIGURE BC 3.5: Finding some grass

15. Select the Graphics tab, and change Cut Pattern to Earth.
16. Click OK.
17. Go to a 3D view, and check out your site.

Next let's see how you can modify a site after you create it. You'll have to deal with the fact that the ramps at the east entry are now buried in your site.

Modifying a Toposurface

Because you must always make modifications to a toposurface, you need to learn how to do so. The method is basic. Select the site, click Edit, and away you go!

In this procedure, you'll modify the toposurface to allow for the ramps to land on earth. Follow these steps:

1. Go back to the Site plan.
2. Set Visual Style to Wireframe.
3. Zoom in on the west wing area where the slanted curtain wall resides, as shown in Figure BC3.6.

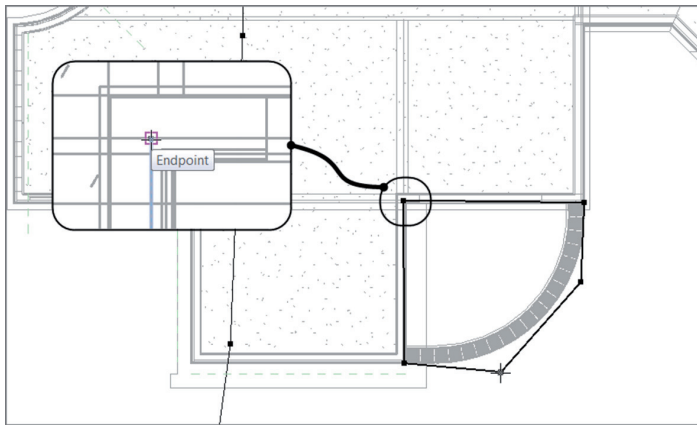


FIGURE BC3.6: Adding the 0 elevation points

4. Select the site (you may have to find an edge).
5. On the Modify | Topography tab, click Edit Surface.
6. On the Tools panel, click the Place Point button.
7. On the Options bar, set Elevation to 0.
8. Pick five points (see Figure BC3.6).
9. Click Finish Surface on the Surface panel.
10. Change Visual Style to Realistic.
11. Go to a 3D view to make sure it looks correct.
12. Save the model.

Excellent! You're getting the hang of this. Next, you need to create some raised areas (small hills) where you can eventually add plantings and different materials. The problem is, to create a small hill, you need the site to rise sharply to the new elevation. To achieve this, you have to split the surface physically.

Splitting the Surface

When you need to make a drastic change to the surface's elevation without influencing the rest of the site, you must split the surface. Just to warn you up front—be deliberate about when and where you do this, because you're physically cutting a hole in the surface and adding a secondary toposurface to the void. Although you can merge these surfaces back together, in some situations it can be difficult to merge cleanly.

Let's split the toposurface and create smaller toposurfaces. Follow these steps:

1. In the Project Browser, go back to the Site plan.
2. On the Massing & Site tab, click the Split Surface button, as shown in Figure BC3.17.
3. Select the toposurface.
4. Zoom in on the corridor area that links the east and west wings.

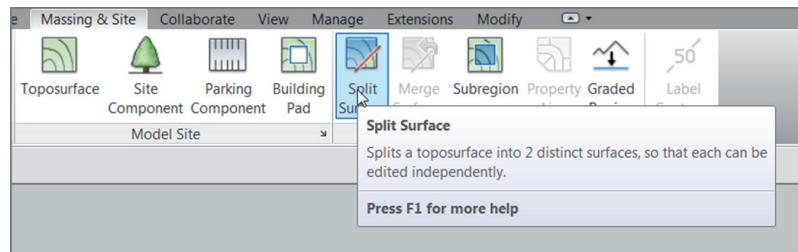


FIGURE BC3.7: The split surface button

5. On the Draw panel, click the Start-End-Radius Arc button. On the Options bar, click the Chain toggle on.

6. Sketch a perimeter similar to the one in Figure BC3.8.
7. Click Finish Edit Mode. You have a new toposurface.

You can manipulate this surface without influencing the main topography. This is the ideal situation for creating bumps and berms.

Next you'll raise this toposurface to an elevation of 4' (1200 mm). You do this by using a point and placing the datum in the middle of the berm. Follow these steps:

1. Select the newly formed toposurface, as shown in Figure BC3.8.

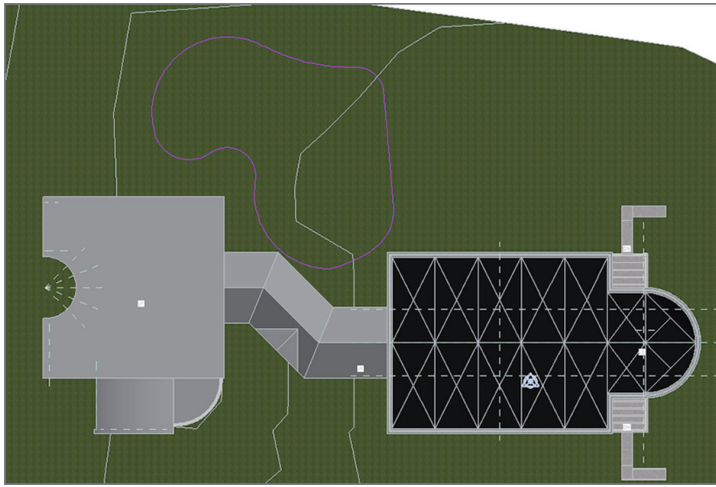


FIGURE BC3.8: Adding a new datum elevation

2. Click the Edit Surface button on the Modify | Topography tab.
3. On the Tools panel, click the Place Point button.
4. On the Options bar, enter a value of 4'-0" (1200 mm) in the Elevation field.
5. Pick four points near the center of the hill (see Figure BC3.9).
6. Click Finish Surface.
7. Select the split surface again.
8. In the Properties dialog box, change the material to Earth.

After you place the points in the model, you can still pick the points and drag them left and right as well as up and down. Also, if you look at the site in section or elevation, you can pick the points and drag them up and down, too.



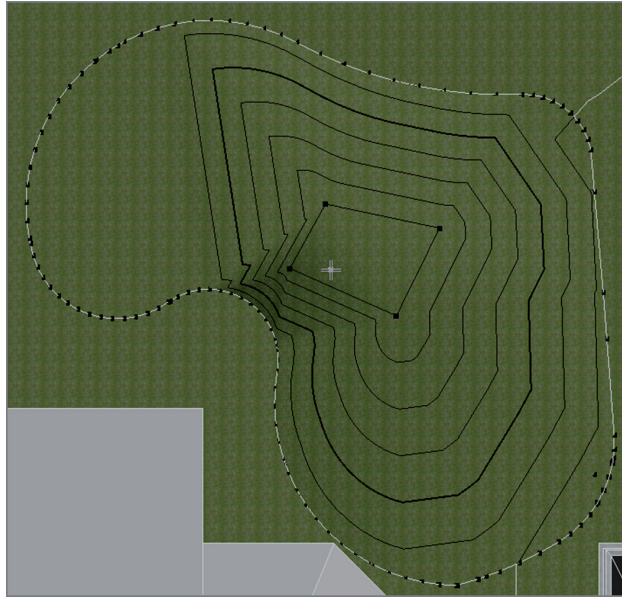


FIGURE BC3.9: The split surface sketch

9. Deselect the topography. Your site should resemble Figure BC3.10.

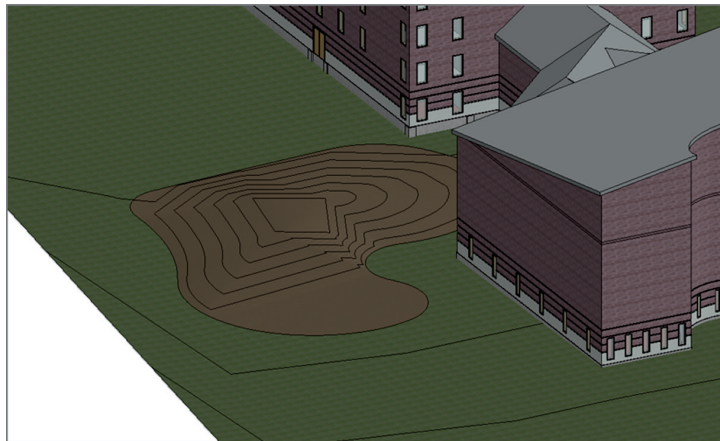


FIGURE BC3.10: The raised area of the site



NOTE Yes, you can copy these little hills just like anything else in Revit—I'm glad you asked! After you copy the hills, you can edit them like any other toposurface.

Well, I think you can see where this is going. When you work with sites, it's good to have some kind of procedure. This takes you to the next perplexing situation. Suppose you want to keep the contours and the dips and hills intact, and you only want to specify a new material in a subregion of the main topography. Is this possible? Yes, it is!

Creating Subregions

The purpose of a *subregion* is to match two surface materials so that any change in elevation or lateral movement is reflected in both regions. You need this ability for walks and most roadways. When you divide the toposurface into subregions, you give yourself the freedom to manipulate two different materials in the same datum. Another benefit of subregions is that the file size remains as if there were still one toposurface. If you were to split the surface every time you needed a path or a roadway, your file size would bloat.

In the following procedure, you'll create a walkway path using the Subregion command. Follow these steps:

1. Go to the Site plan.
2. Zoom in on the east entry.
3. On the Massing & Site tab, click the Subregion button as shown in Figure BC3.11.

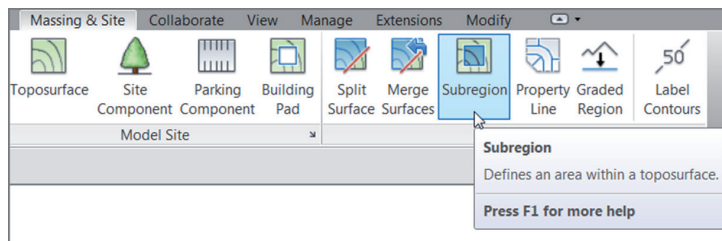


FIGURE BC3.11: The Subregion Button

4. Change the view to Wireframe, and start sketching away.
5. Draw a region similar to the one shown in Figure BC3.12. (It doesn't have to be exact.) This image shows a parking area with some pedestrian access. The inside of the parking area follows the building footprint. Pick Finish Edit Mode.

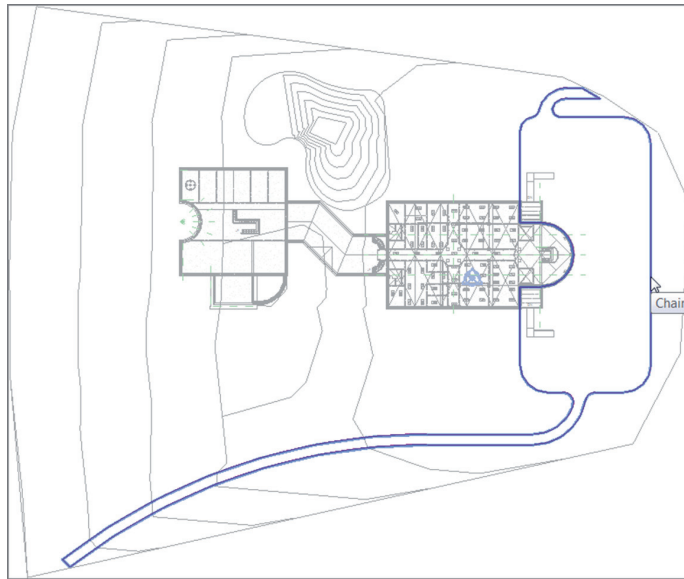


FIGURE BC3.12: Sketching the subregion

6. In the Material row in the Properties dialog box, change the material to Brick, Pavers from the AEC Materials list in the lower panels.
7. Change the view back to Realistic.
8. Go to a 3D view, and compare yours with Figure BC3.13.

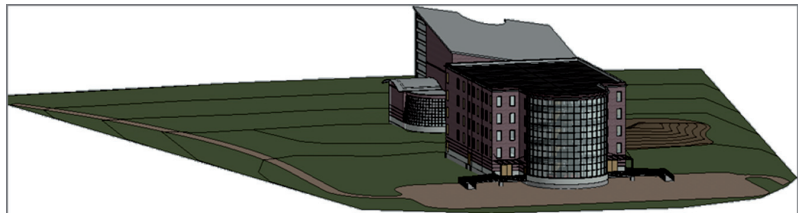


FIGURE BC3.13: The sidewalks in 3D



NOTE You can't cross over and exceed the extents of the original boundary. If you do, Revit won't allow you to finish the sketch. Also, this subregion must form a continuous loop with no gaps or overlapping lines. You need a straight line at each end of the path.

How did you do? If you aren't happy with your parking lot layout, go back and redo it. Not too shabby! There is definitely something missing from this parking lot, though. Perhaps some actual parking spaces would be nice. And a parking island or two would make the parking lot stand out.

Adding Site Components

Adding a site component to Revit is no different than adding a desk or a door. A component is a component, as far as Revit is concerned. As you've learned, a component is hosted by a system component. For example, when you're inserting a window, there needs to be a wall, or Revit won't allow such a foolish transaction to occur. In Revit, you can host a site component to a level, but it's a bad idea to do so. When you add a site component, you always want to host that component to the actual topography.

In this procedure, you'll add parking components and plantings to the Revit model. Follow these steps:

1. On the Insert tab, click the Load Family button.
2. Scroll to the Parking directory in the Site folder.
3. Load every file in the directory. If you get a Family Already Exists message about Parking Space, click Overwrite The Existing Version.
4. In the Project Browser, go to the Site plan.
5. In the View Control bar, set Visual Style to Realistic.
6. On the Massing & Site tab, click the Site Component button, as shown in Figure BC3.14.

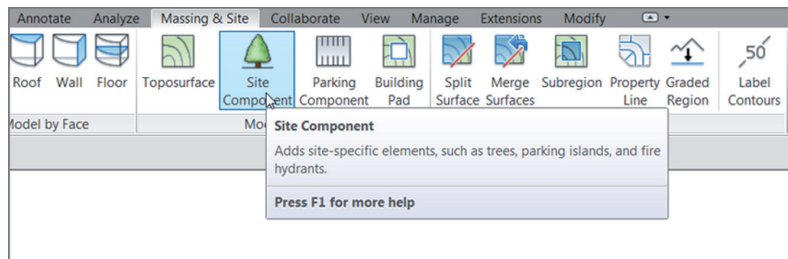


FIGURE BC3.14: The Site Component button

7. In the Type Selector, select Parking Island – Single Sided 15 Spaces per row.
8. In the Properties dialog box, change Parking Width to 138'–8" (41600 mm).
9. Place the parking island in a location similar to that shown in Figure BC3.15. Note that you'll have to press the spacebar to orient the component correctly. Click Modify.

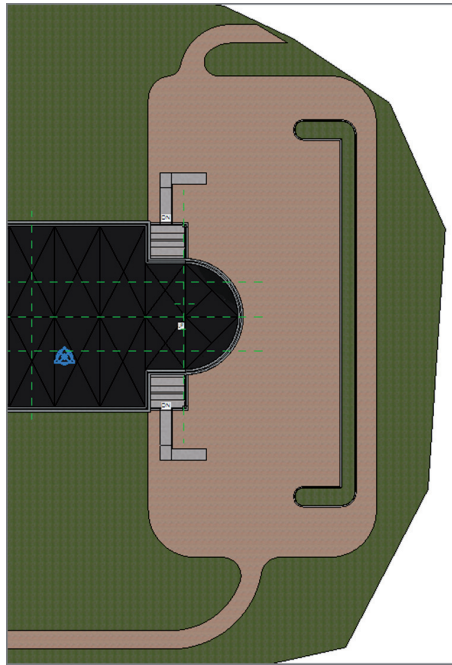


FIGURE BC3.15: Adding the component to the parking lot

10. Select the parking component.
11. Click the Edit Family button on the Modify | Site tab.
12. Select both the curb and the grass extrusions.
13. In the Properties dialog box, click the Edit button in the Visibility/Graphics Overrides row.
14. In the Display In 3D Views menu, select all four items.

15. Click OK.
16. Click the Load Into Project button. Click Overwrite The Existing Version if prompted to do so. Your model should resemble Figure BC3.13.

Now that the island is in place, it's time to add the parking spots. You'll need an ADA (parking for disabled drivers, required by the Americans with Disabilities Act) space as well as some general parking spaces. Follow these steps:

1. On the Massing & Site tab, click the Parking Component button.
2. Select Parking Space – ADA 9' × 18' (5' Aisle) (2743 mm × 5486 mm). Place an instance as shown in Figure BC3.16. Use the spacebar to rotate it properly.

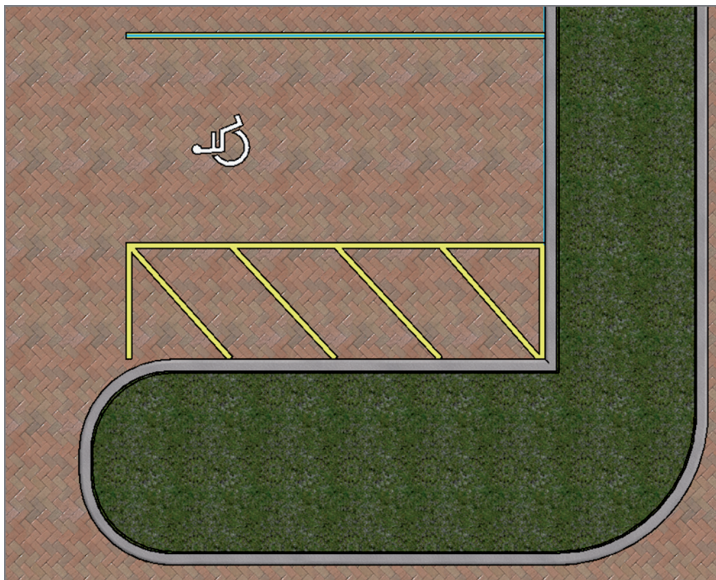


FIGURE BC3.16: The ADA parking space

3. Click the Site Component button.
4. Add Parking Symbol – ADA, and place it as shown in Figure BC3.14.
5. Mirror the ADA space and the ADA symbol to the north of the parking island, as shown in Figure BC3.17.

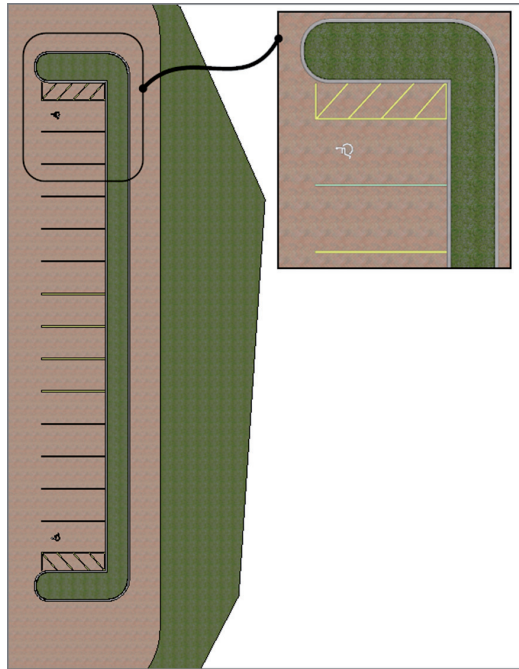


FIGURE BC 3.17: The parking spaces

6. Add a parking space $9' \times 18'$ – 90 deg (2743 mm \times 5486 mm), and copy it up to fill the island with parking (see Figure BC3.17).

The parking lot is somewhat complete, so let's add some trees and shrubs to the site. This will be a lot easier! Follow these steps:

1. On the Insert tab, click the Load Family button.
2. Browse to the Planting folder.
3. Select everything available, and load it into the model. Overwrite any existing versions.
4. On the Massing & Site tab, click the Site Component button.
5. Place trees and shrubs on the parking island and on the berm you created. Notice that the plantings always follow the grade of your site. Be creative.

6. Go to a 3D view and check it out, as shown in Figure BC3.18.

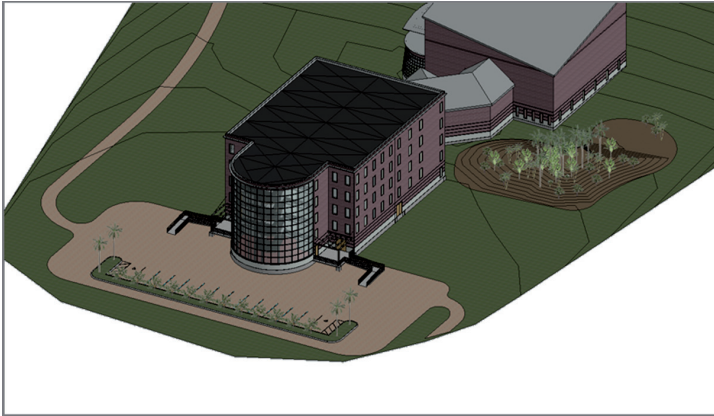


FIGURE BC3.18: Adding the plantings

With all the contours and plantings in place, you need to knock out a small maintenance issue. There is a function that will allow you to add contour labels to the site automatically; this is a great feature in Revit Architecture.

Adding Contour Properties and Labels

Because nothing in Revit Architecture is dumb, you can take advantage of a topographic surface having some smarts as well. Even the contour lines of a site are smart.

The objective of this procedure is to examine some site settings and throw some labels into the contours. It's a quick set of steps but important nonetheless.

1. Click the arrow in the lower-right corner of the Model Site panel, as shown in Figure BC3.19.
2. In the Site Settings dialog box that opens is a field that contains additional contours. In the Increment panel, change the value 1'–0" (300 mm) to 6" (150 mm) (see Figure BC3.19).
3. Click OK. Notice that the contours are tighter.

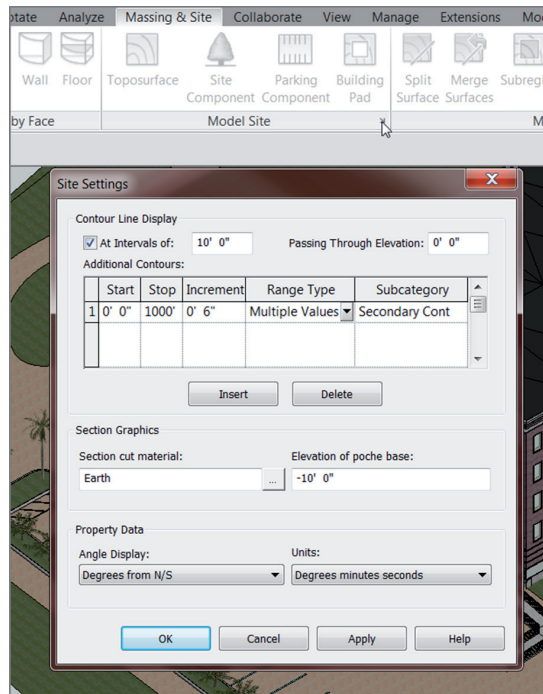


FIGURE BC3.19: Changing the additional contour increment

Now that the contours are in place, you can label them. Luckily, a function in Revit allows you to do this in one shot. All you need to do is draw a *line* specifying the alignment of the contours, and Revit will add the labels automatically.

Follow these steps to add contour labels to the site:

1. On the Massing & Site tab, click the Label Contours button, as shown in Figure BC3.20.
2. Pick a point to the outside of the toposurface, labeled 1 in Figure BC3.18.
3. Pick a second point near the building, labeled 2 in Figure BC3.18. After you pick the second point, the contours are labeled.

Next, you need to address a situation that has arisen unbeknownst to you. You see, you never defined any areas into which you may not want earth to spill, such as the basement. This will affect every section you have. You can place a *pad* to displace the earth in the basement.

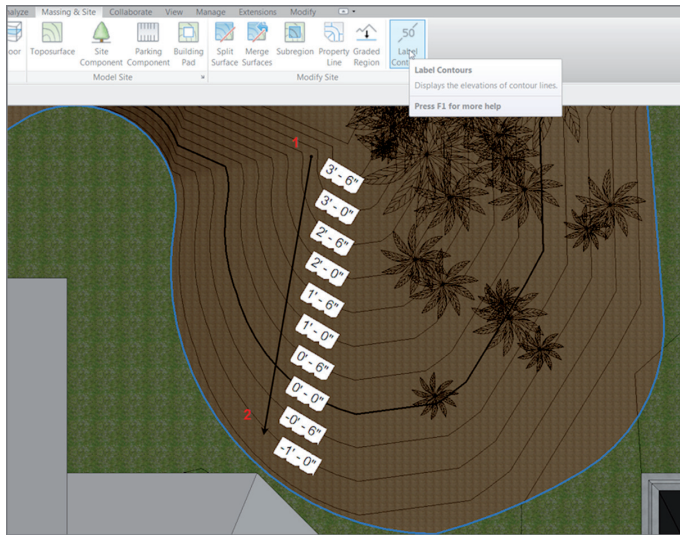


FIGURE BC3.20: Labeling the contours

Adding Building Pads to Displace Earth

When you need to displace a volume of earth, you use a tool exclusive to the Massing & Site tab to do so. By placing a building pad into your model, you tell Revit that you want to cut the earth away from this area while still leaving the earth beneath at a certain elevation. For example, if you want to remove the earth from the basement (which you'll be doing) but you still need the earth to exist beneath the basement, you must place a building pad.

To place a building pad into the model, follow this procedure:

1. In the Project Browser, go to the T.O. Footing plan.
2. On the Massing & Site tab, click the Building Pad button, as shown in Figure BC3.21.

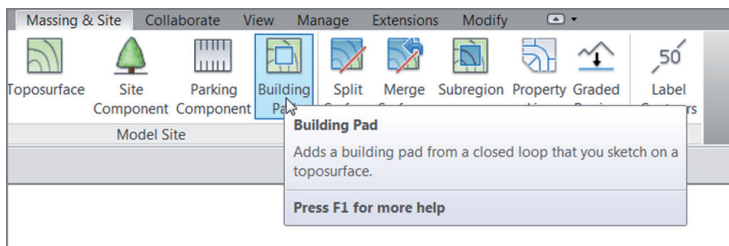


FIGURE BC3.21: The Building Pad button

3. In the Properties dialog box, make sure Pads is current, and click Edit Type.
4. Click Duplicate.
5. Call the pad Footprint, and click OK.
6. For the Structure, click the Edit button.
7. Change Thickness to 6" (150 mm).
8. Click OK twice.
9. Change Height Offset from Level to 6" (150 mm).
10. Set Offset to 1" (25 mm) on the Options bar, and pick walls to place the pad against the outside of the foundation wall underneath the entire model, as shown in Figure BC3.22. Trim the sketch lines as necessary.

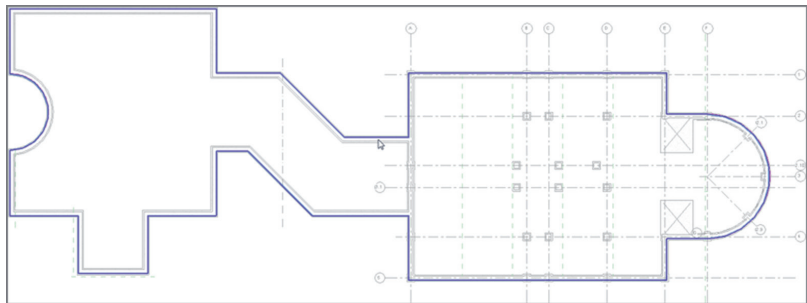


FIGURE BC3.22: Place the pad 1" (25 mm) to the outside of the wall.

11. Click Finish Edit Mode.
12. In the Project Browser, open West Corridor Section. You may have to adjust the crop region to see the footings.
13. You can see the pad sitting on top of the footing extending past the wall, as shown in Figure BC3.23. Select it.
14. Right-click, and select Hide In View > Elements (see Figure BC3.23).
15. Go to the Model Site panel, and click the Site Settings arrow.
16. In the Section Graphics area, change the Elevation Of Poche Base value to -15'-0" (-4500 mm).
17. Click OK. The earth hatch is now beneath the slab area.

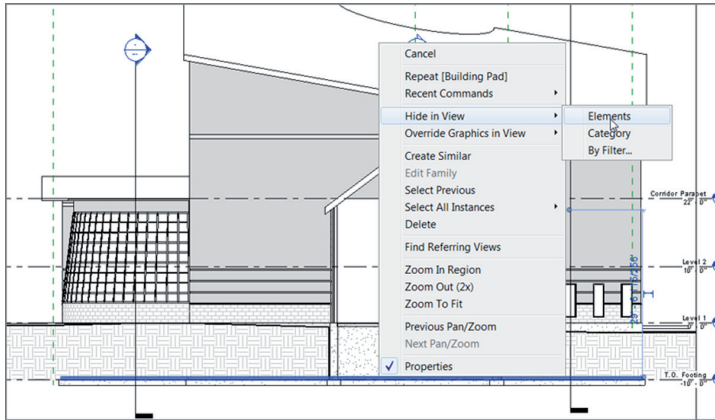


FIGURE BC3.23: Hiding the pad in the view

With the pad in place, you can rest assured that your sections are showing the earth where it's supposed to be.

The next item I'll cover is creating a property line. In most conventional drafting applications, this involves nothing more than adding a polyline around the site. In Revit, this approach is the same, but the property line can tell you much more about the boundary it's enclosing.

Adding a Property Line

If you want to add a property line, Revit provides the tool you need. Of course, this is Revit, so you aren't just adding a dumb line to the model. When you start the Property Line command, Revit will ask if you want to create the property line either by using bearing distances or by sketching (a sketch can be converted to a bearing table after it has been placed).

To add a property line, follow this procedure:

1. In the Project Browser, go to the Site floor plan.
2. On the Massing & Site tab, click the Property Line button, as shown in Figure BC3.24.
3. In the Create Property Line dialog box that appears, click the Create By Sketching option.
4. Draw a series of lines around the perimeter (see Figure BC3.24). Close the sketch by returning to the starting point, but note that you don't have to close a property line.

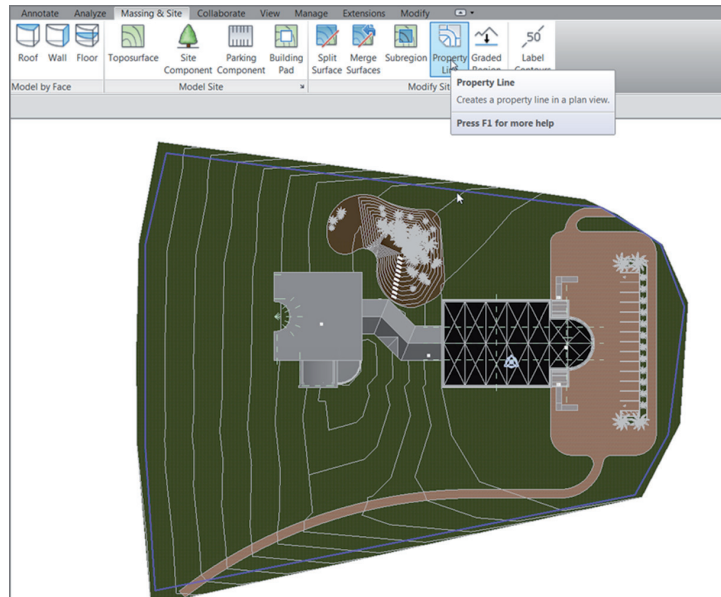


FIGURE BC 3.24: Adding a property line

5. Click Finish Edit Mode.
6. Select the property line.
7. On the Modify | Property Lines panel, click the Edit Table button.
8. Click Yes if you get a “Do you want to continue?” dialog box.
9. Close the Property Lines dialog box, and save the model.

You now have a table of deed data that can be modified as you see fit. If your property line is open, there is an option in the table to create a line to close it so that you can calculate area.

The next item on the agenda is a powerful tool when it comes to creating a site in Revit. As nice as it would be never to depend on CAD, most of your topographical information will come from the CAD world. Revit has a By Instance function that can facilitate this procedure.

Creating a Toposurface by Instance

Creating a toposurface by instance requires that you import a CAD file. After you do so, you can go to the Toposurface command, which offers the choice to use an imported instance to drape a surface from Revit.

To get started, either you can choose a site that was created in CAD and with which you want to experiment or you can go to the book's web page at www.sybex.com/go/revit2017ner. From there, you can browse to the Chapter BC3 folder and find the `contours.dwg` file.

The first thing you need to do is think about coordinates. That's right: coordinates. You're bringing in a file from AutoCAD, right? How do you know where this site will be placed? You must consider two things: where the project base point is in AutoCAD and where the survey point is located. When you know these two things, you can work more logically between AutoCAD and Revit. The next set of procedures will show you how to coordinate your Revit site with an AutoCAD site:

1. Start a new Revit model.
2. Go to the Site plan.
3. Notice the two blue icons in the model. Pick a window around them, and click the Filter button.
4. Deselect Project Base Point, as shown in Figure BC3.25.

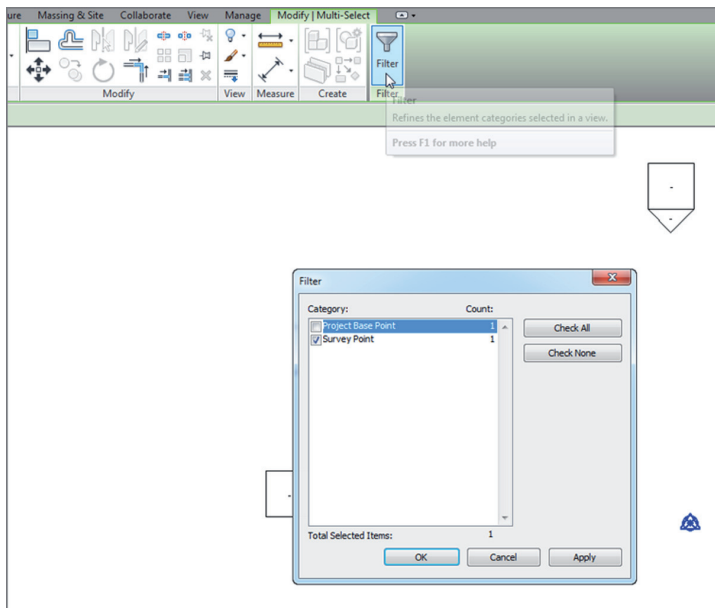


FIGURE BC3.25: Selecting the project datum

5. Click OK.
6. Deselect the blue paper clip, as shown in Figure BC3.26.

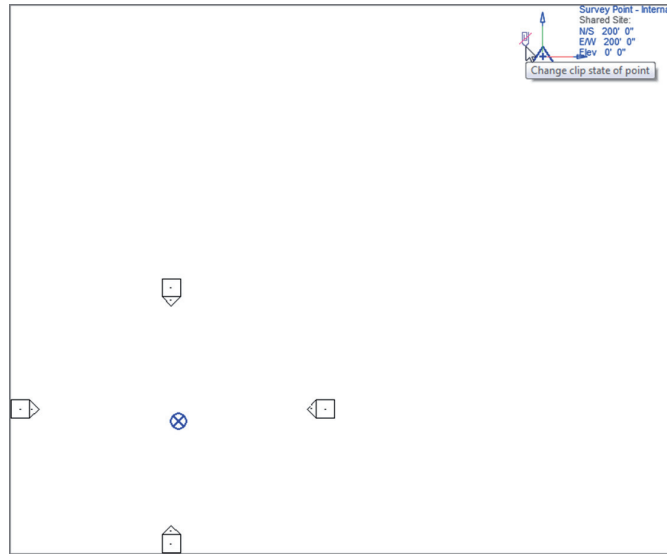


FIGURE BC3.26: Altering the survey point

7. Change N/S to 200' (60000 mm).
8. Change E/W to 200' (60000 mm).

WHAT ARE YOU CHANGING, AND WHY?

What you're changing here is a survey point. You don't know the survey point of the practice file you're bringing into the model, so for now you're making one up. The project base point always wants to be 0,0.

9. Click the Survey Point – Internal link (see Figure BC3.24).
10. In the Location Weather And Site dialog box that opens, on the Site tab, click the Duplicate button.
11. Call the new location Site Datum. Click OK.
12. Click the Location tab.
13. Using the Internet Mapping Service, set the location for Syracuse, NY USA (see Figure BC3.27). You can also use your own location.

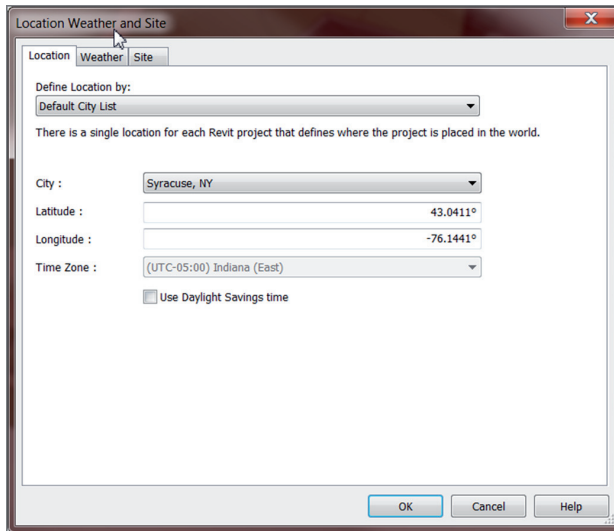


FIGURE BC 3.27: Setting the site

14. Click OK.
15. Press Esc.

Now you'll set the project orientation. In Revit, you can rotate the site plan to true north while leaving the other views oriented to project north. Let's do it:

1. In the Properties dialog box for the view, change Orientation to True North, as shown in Figure BC3.28.

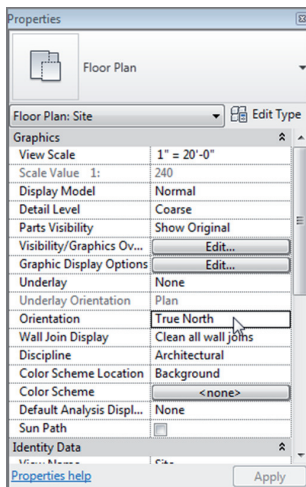


FIGURE BC 3.28: Orienting the site to true north

- On the Manage tab, click Position > Rotate True North, as shown in Figure BC3.29.

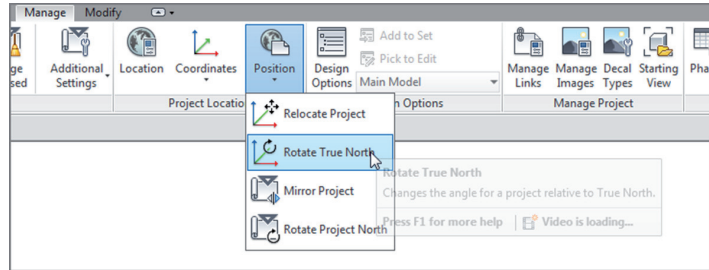


FIGURE BC 3. 29: Rotating true north

- Pick the node on the Survey point, as shown in Figure BC3.30.

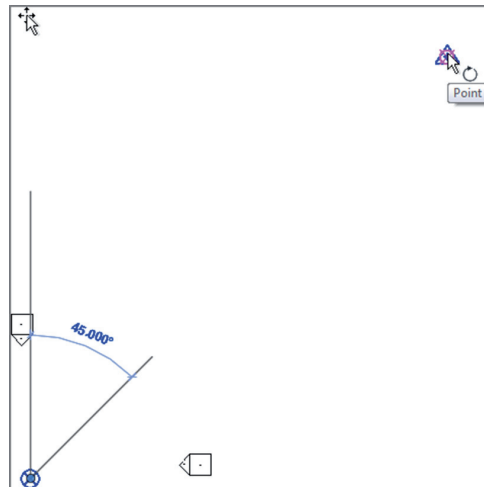


FIGURE BC 3. 30: Finalizing the rotation

- Pick a second point at 45° left (which lands you straight up—see Figure BC3.28). Your site view is now facing true north, and all your other views are project north.

Next, you'll import a site from CAD. To use an imported instance to create a toposurface, follow these steps:

1. Save your model as **Imported Site.rvt**.
2. In the Project Browser, go to the Site plan if you aren't there already.
3. On the Insert tab, click the Link CAD button.
4. Browse to the contours.dwg file you downloaded. (If you have your own site DWG file, that's fine, too.)
5. Before you click Open, change Colors to Black And White, Layers to All, and Import Units to Feet. Also, change Positioning to Auto – By Shared Coordinates. Be sure Current View Only is deselected.
6. Make sure Orient To View is selected. (See Figure BC3.31.)

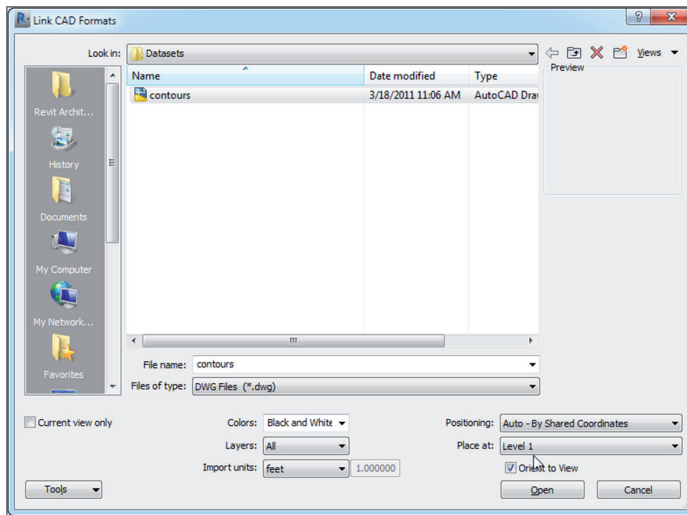


FIGURE BC3.31: Changing the link settings

7. Click Open.
8. The Differing Coordinate Systems For Project And File dialog box opens. Click Close.

9. Click the existing coordinate choice, and click OK.
Your site should be positioned as shown in Figure BC3.32.

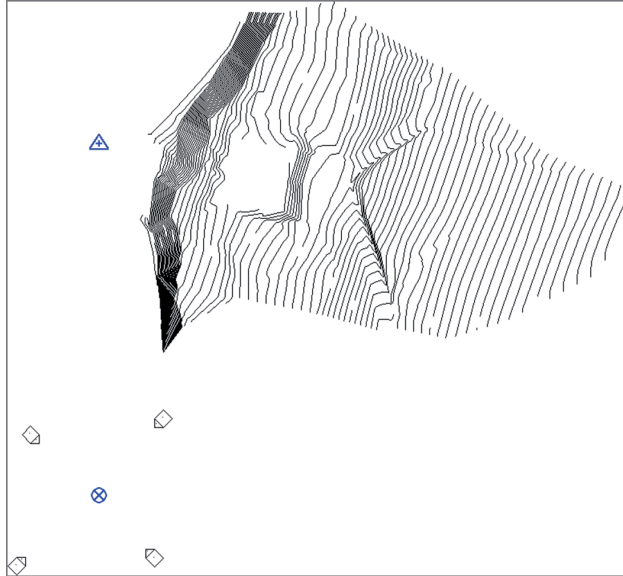


FIGURE BC3.32: The linked site

Because you didn't know the actual survey point of your site, AutoCAD gave you one. It's obviously off the grid. You can move the site to a specific point and create an actual survey point in the native AutoCAD file. Follow these steps:

1. Select the imported site.
2. Click the Move button.
3. Move the site to a position similar to that shown in Figure BC3.33.
4. Save the file. A dialog box opens, asking about your shared position.
5. Click Save. Doing so adds a new position in the site DWG file. You're now coordinated with your site people. (See Figure BC3.31.)

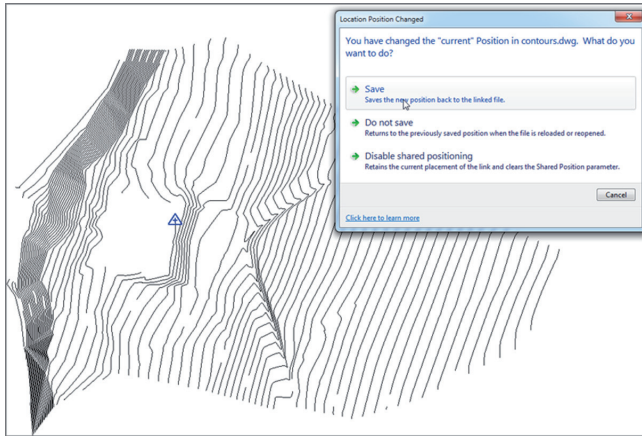


FIGURE BC 3.33: Saving the shared position back to the drawing

It’s time to add a Revit surface to the contours. This is pretty easy; follow these steps:

1. On the Massing & Site tab, click the Toposurface button.
2. On the Tools panel, click Create From Import > Select Import Instance, as shown in Figure BC3.34.

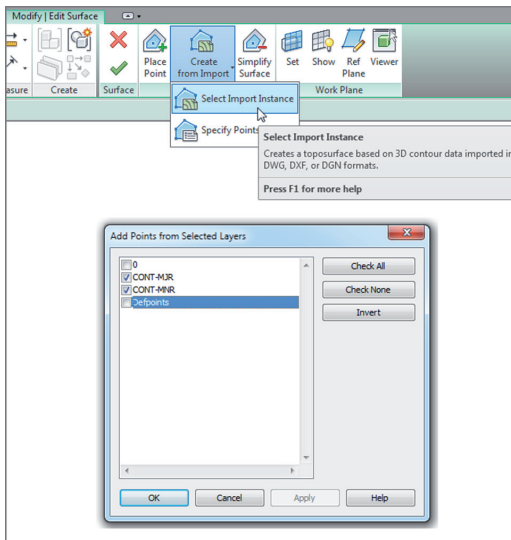


FIGURE BC 3.34: Adding the toposurface

3. Select the imported CAD file.
4. Deselect Layer 0 and Defpoints in the Add Points From Selected Layers dialog box.
5. Click OK.
6. In the Properties dialog box, change Material to Grass.
7. Click OK to get back to the model.
8. Click Finish Surface.
9. Go to a 3D view. Your topography should look like Figure BC3.35.

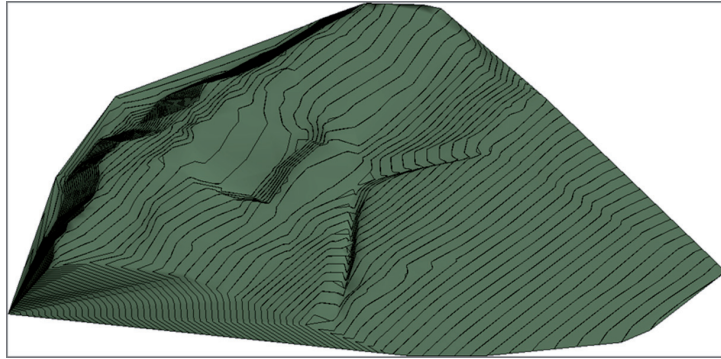


FIGURE BC3.35: The new toposurface in Revit

That would be a difficult toposurface to create entirely in Revit! The next item you need to explore is how to grade a surface, yielding areas of cuts and fills. The process is straightforward, but as you're about to learn, you need to first deal with *project phasing*.

Creating a Graded Region

This section of the chapter will focus on creating cuts and fills in a site. You do this by lowering and raising points that already exist in the topography. The problem is, after you alter the site, you don't know which part of the site is original or existing and which part is new.

The objective of the following procedure is to move the site to an existing phase to prepare it for the grading process. Follow these steps:

1. Go to your Site plan, and type VG.
2. In the Visibility/Graphics Overrides dialog box, click the Imported Categories tab.
3. Deselect contours.dwg.
4. Click OK.
5. Select the toposurface.
6. In the Properties dialog box, change Phase Created to Existing.
7. On the Massing & Site tab, click the Graded Region button, as shown in Figure BC3.36.

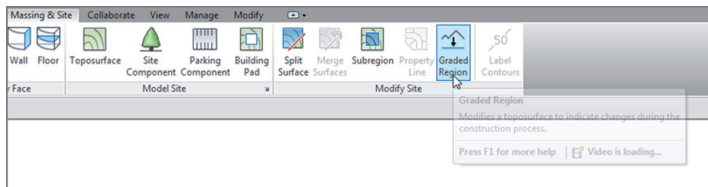


FIGURE BC3.36: Graded Region

8. In the next dialog box, click Create A New Toposurface Exactly Like The Existing One.
9. Draw a selection window around the center of the site (doing so selects a bunch of points), as shown in Figure BC3.37.
10. In the Properties dialog box, enter a value of 0 for the elevation.
11. Click Finish Surface.
12. Verify that your site appears similar to Figure BC3.38.
13. Select the newly graded surface, and notice in the properties that you can get the volumes for Net Cut/Fill.
14. Save the model, and close it.

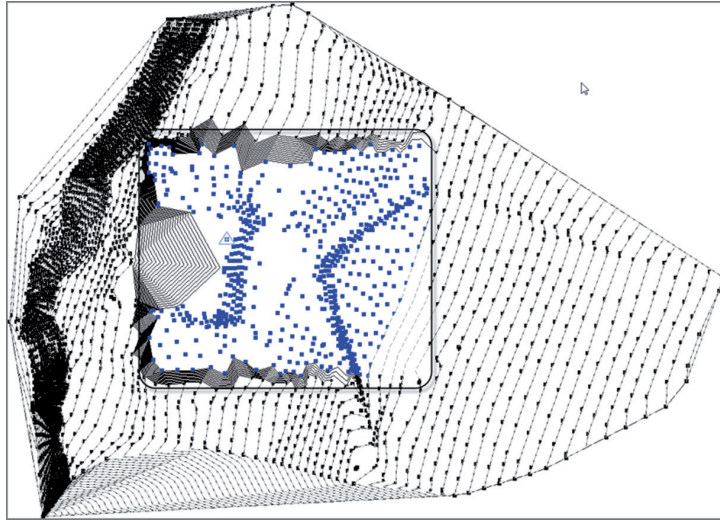


FIGURE BC3.37: Selecting a range of points

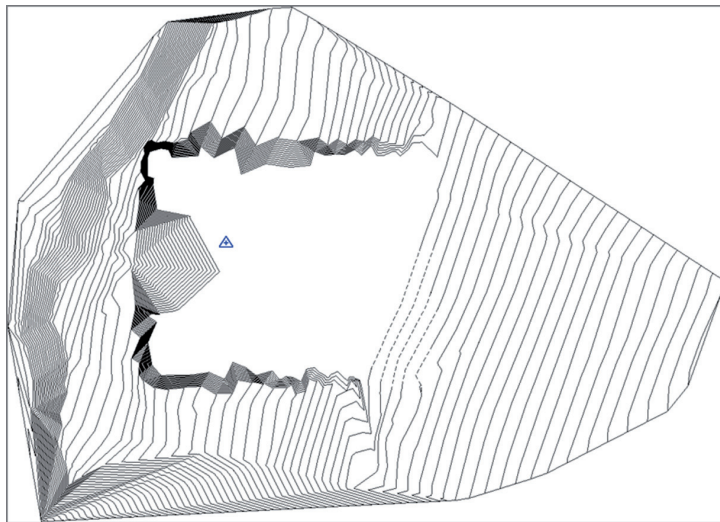


FIGURE BC3.38: The site with cuts and fills

That's quite a bit of information regarding sites. It's nice that Revit allows some level of site manipulation, but it would be handy if there were a Revit Site application. I, for one, could see the value in that.

Are You Experienced?

Now you can...

- ✓ add a topographical surface to your site by using points
- ✓ create a topographical surface in your site by using an imported CAD file
- ✓ add site components
- ✓ split and divide a site's topography
- ✓ rotate a project to true north
- ✓ relocate a project's datum elevation