A Deeper Look at Revit's New Site Tools

Revit 2024

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With the new 2024 release of Revit, one of the major new features is the improved site tools environment. Comparing the old 2023 site tools panel with the 2024 interface now seems less cluttered. The old Toposurface entity has been replaced by the new Toposolid object, which is compatible with more Revit categories. Given this is the first release of Revit featuring Toposolids, there are some limitations and considerations, so when checking results in properties and schedules some checks should be made on the data before issuing information.

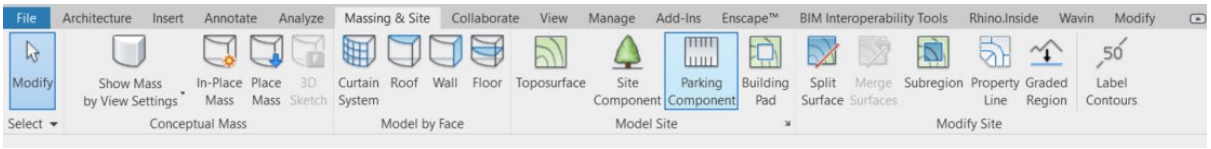
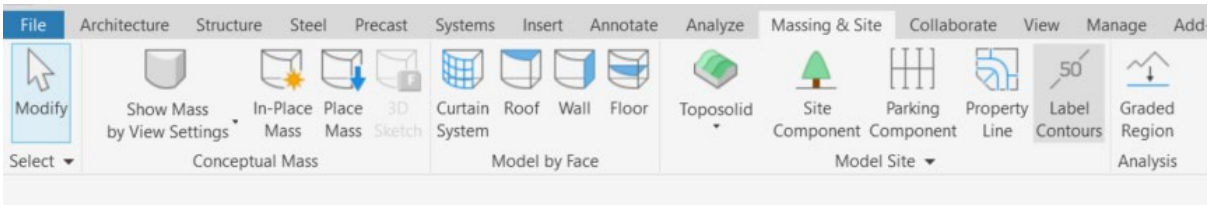


Fig 1. Out with the old, toposurface in 2023 (above), in with the new, toposolid with 2024 (below)



As well as the removal of toposurface, building pads, split surface and sub regions have also gone and are now integrated with the toposolid modelling tools.

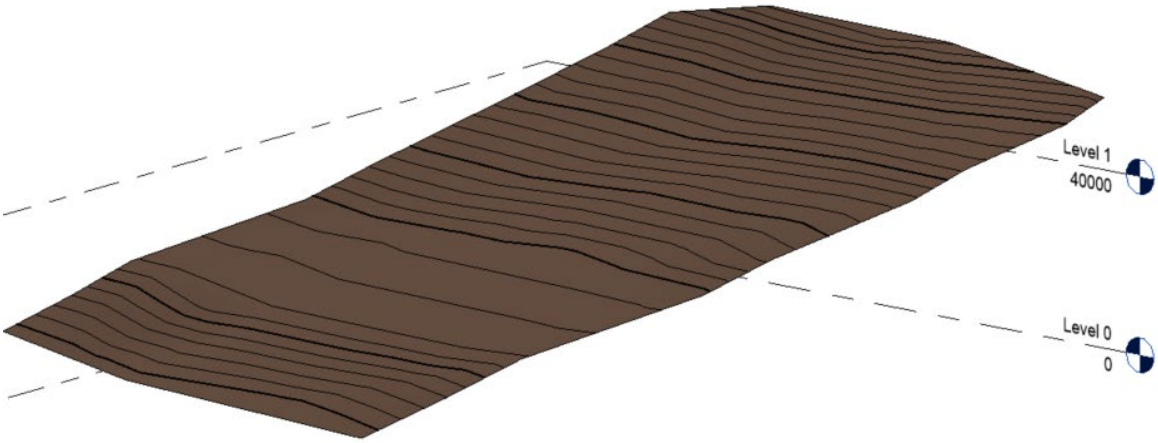


Fig 2. Toposurface element in Revit 2023

The toposurface tool in Revit 2023 and earlier was only a “surface” element and had no depth. It wasn’t possible to set a thickness or do any kind of 'boolean' cut operation.

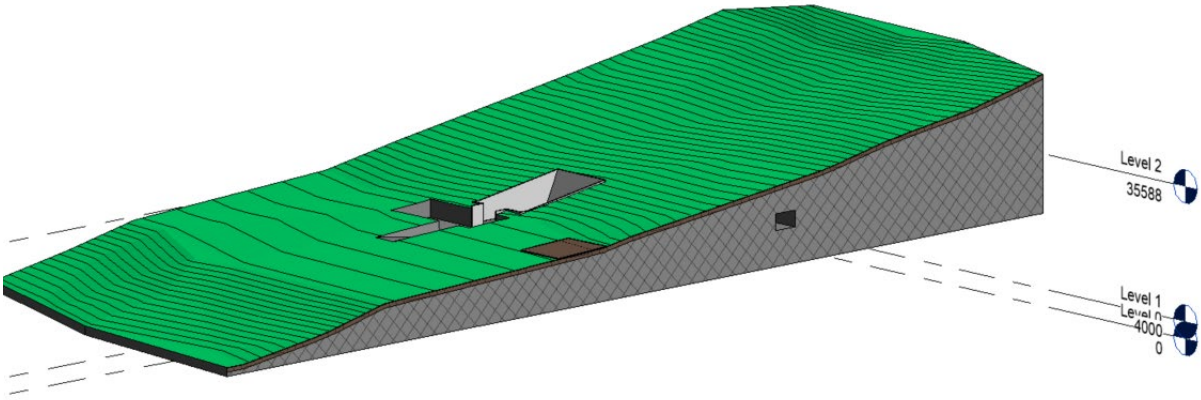


Fig 3. The new toposolid in Revit 2024

The new toposolid tool works in a very similar way to floors. Like floors a toposolid can be defined by an extrusion boundary via manual sketching. Alternatively, the toposolid can be formed by an imported CAD or CSV points file to form a complex element, very much like the legacy toposurface tool. Toposolids can also be created via Autodesk Docs and define an element from a Civil 3D surface.

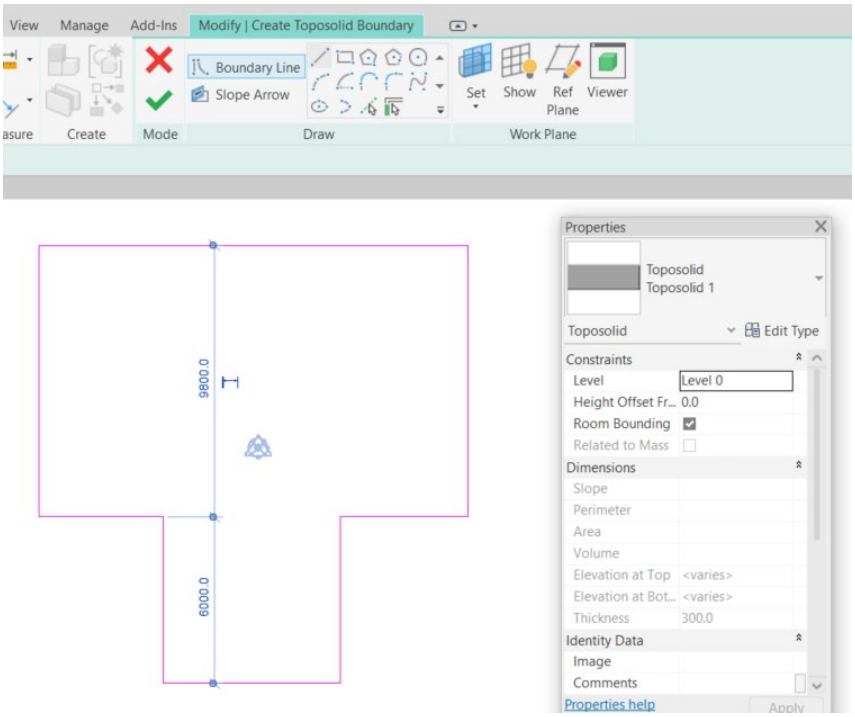
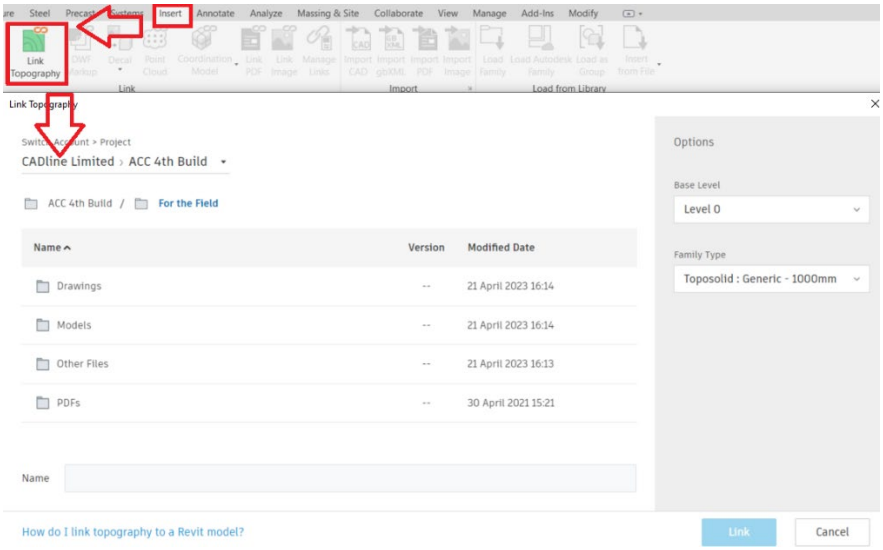


Fig 4. Toposolids can be drawn like floor or roof slabs or imported from the ACC (below)



Toposolid objects can be modified via Sub Elements in a similar way to Roof and Floor objects. Add points at specific heights to create the slopes. Split and fold lines will be added to the solid which can be edited in turn as required.

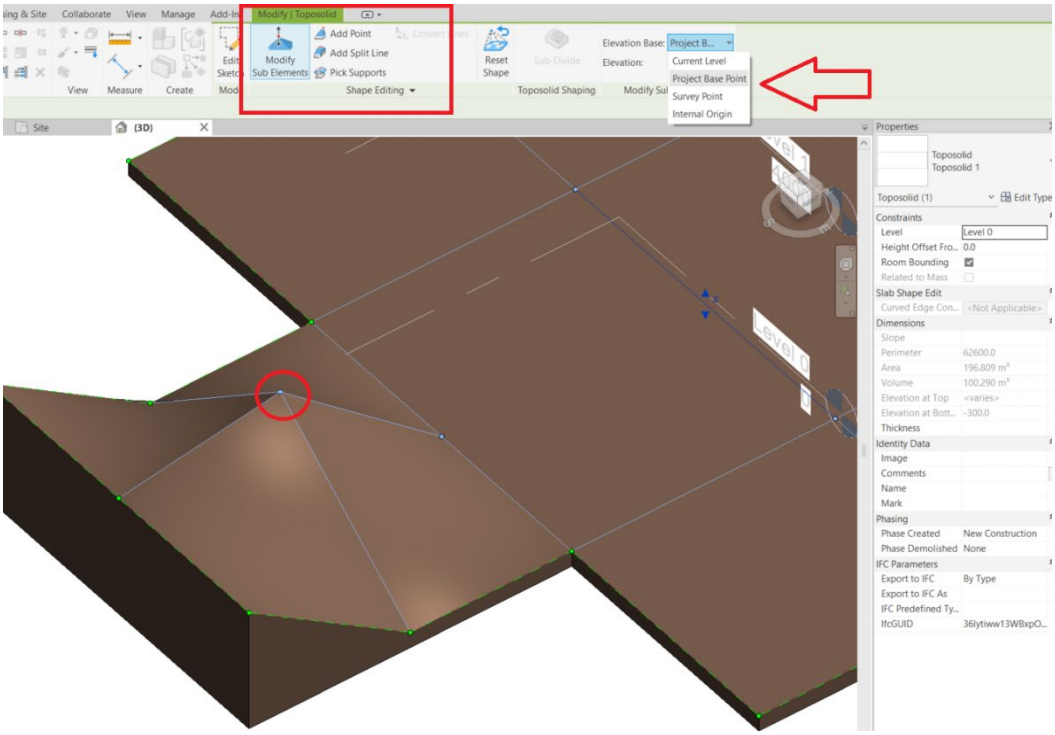


Fig 5. Toposolids are basically floors in a site context.

This functionality was introduced to floors in Revit 2023.1 and allows users to pick which height datum to use for heights (Internal Origin, Project Base Point or Survey Point).

When adding a point, the point can be placed relative offset to Surface or in an absolute Height context. It is also possible to import a CAD or CSV file to automatically create the shape of the topography. This tool now works with concave site shape boundaries.

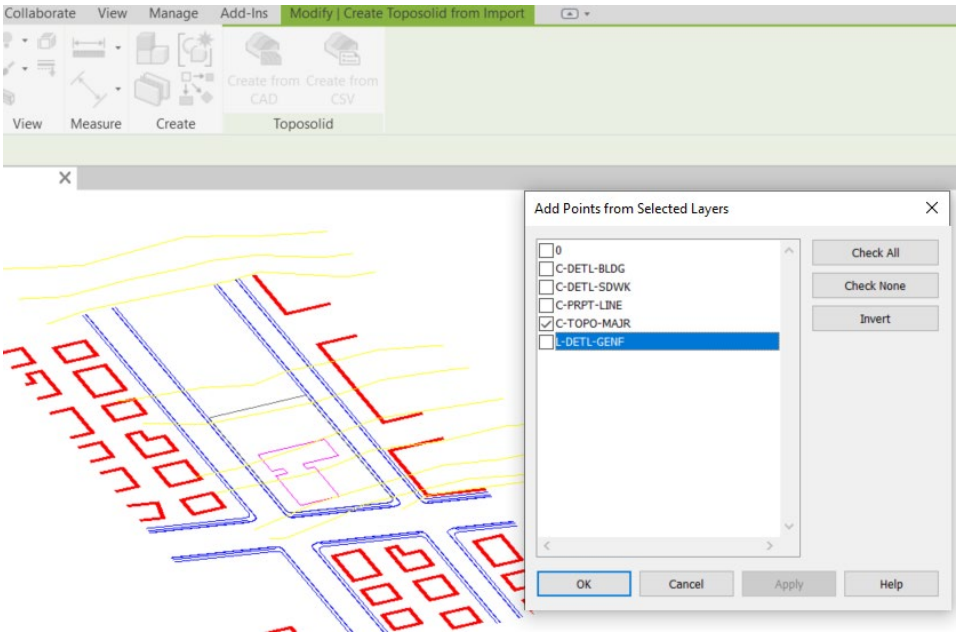


Fig 5. Creating a toposolid is almost an identical process to the legacy toposurface creation.

Like floors and slabs it is possible to modify the structure with materials of various thicknesses. Below are a few sample family types from Revit's default 'Architectural' template.

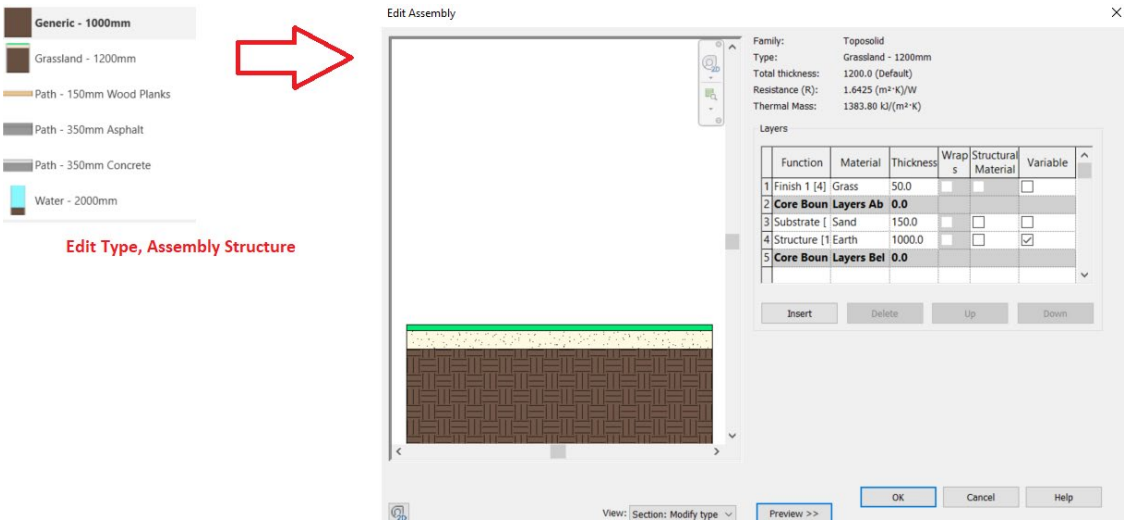


Fig 6. Toposolid, assembly editor is almost identical to floors/slabs/roof families.

These tools mean more flexibility in modelling certain site elements such as lakes, cliffs, and undercuts without using floors and other elements such as in-place families.

In a similar way to modifying floor and roof elements, when editing the Sub Elements of a toposolid, it is possible to toggle a preview of all the topography points. As the creation of toposurfaces has been removed from 2024, users can only access the old toposurface tool when opening models from earlier versions.

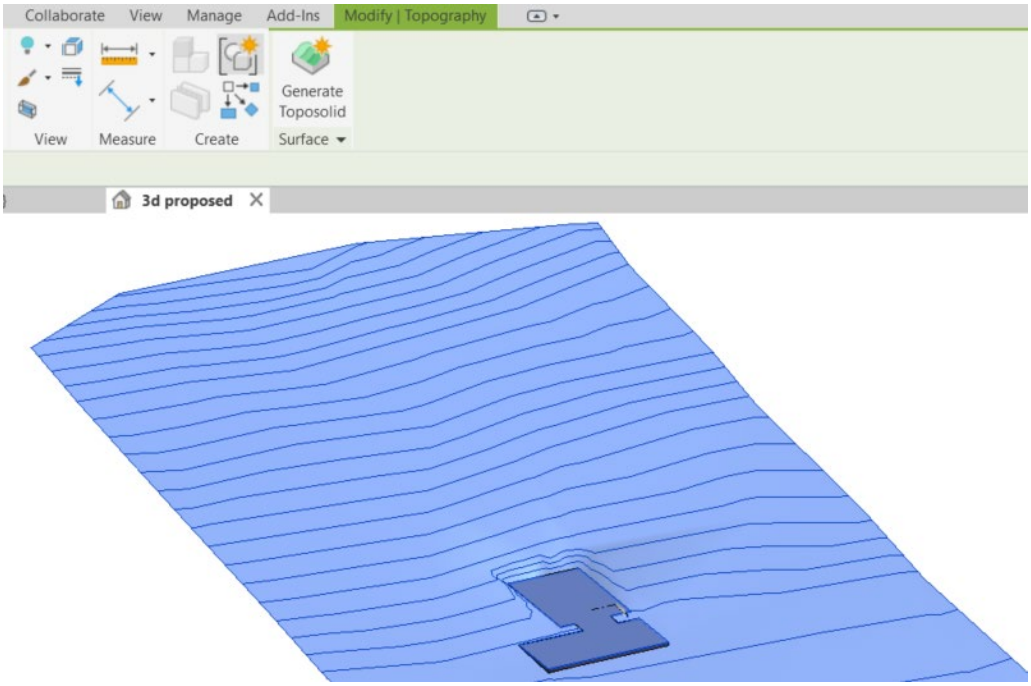


Fig 7. Opening old projects with existing toposurfaces provides an option to generate a toposolid from surface.

When selecting a toposurface, use the Generate Toposolid function to convert to the new object type. The old toposurface is retained for reference. Users can then decide whether to delete or to retain it. With the conversion process building pads are ignored completely but subregions will be converted into Toposolid subdivisions.

When working in Revit 2023 the Subregion feature was used to assign different materials to a toposurface. The limitation was that subregions didn't have a thickness value. This meant users couldn't recess the material or raise it above the ground.

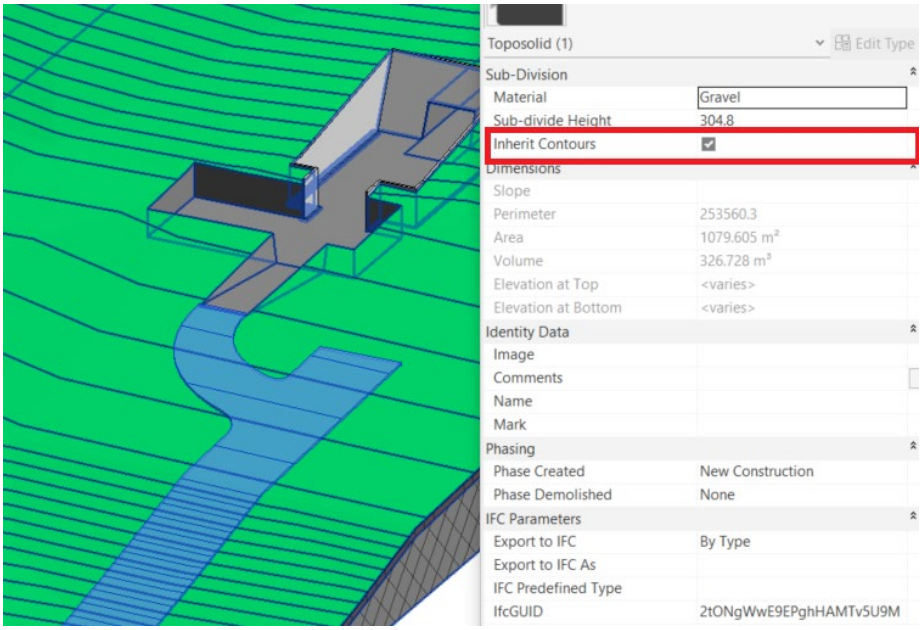


Fig 8. Subdivision tool used for footpaths and roads.

With Revit 2024 Subregions has been replaced by Sub-Divide. The concept is the same as the previous function, users can draw boundaries over the toposolid and like sub-regions, can extend the boundaries beyond the limit of the toposolid element without receiving a warning.

Sub-Divisions are placed on top of the toposolid. Users can pick a material and set a thickness in the solid's instance properties. Sub-Divisions have a thickness instance parameter. It is not possible to use a negative value or try to "recess" the subdivision into the toposolid. Hopefully this limitation will be addressed in a future version of Revit.

With sub-divisions there is also an inherit Contours parameter. This allows users to decide if they want to see the contours on the subdivision or not. Whichever option is chosen, it doesn't affect the geometry of the subdivision the function is there to help improve clarity of the model in views.

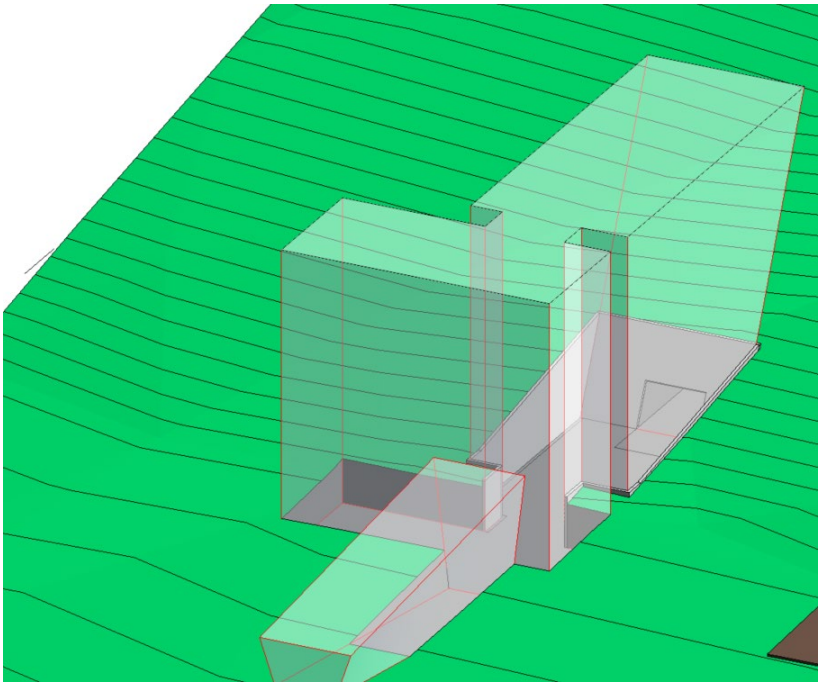


Fig 9. Use Void Mass forms and cut toposolids to create flat areas, cuttings, and tunnels.

With Revit 2023 to create a hole in a toposurface, a building pad was required to form the hole volume. However, with Revit 2024 building pads are no longer available. Instead, the recommended process is to use the Massing tool and create void geometry and then perform cutting operations. Although these tools are more complex than building pads, they permit users to create more complex shapes, like road cuttings and the modelling of tunnels. It is also possible to cut toposolids with other categories like slabs, walls, and foundations.

In Revit 2023, there was a project-wide setting for configuring contour lines, the tool was in a drop-down menu within the Massing & Site tab, but with 2024 each toposolid type can have different kinds of topography contours. These options can be set in the type properties of a toposolid, browse to and then click on Contour Display.

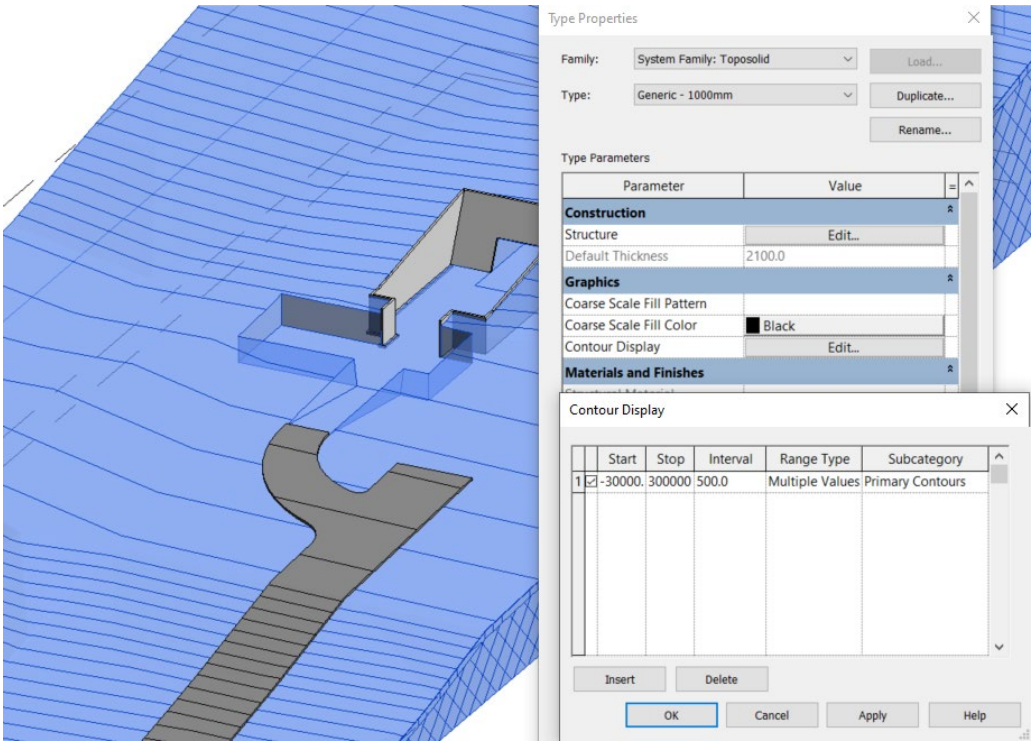


Fig 10. Editing contour display and interval

Users can decide how each toposolid type displays its contours. Users should bear in mind that the contours are not visible when editing the points.

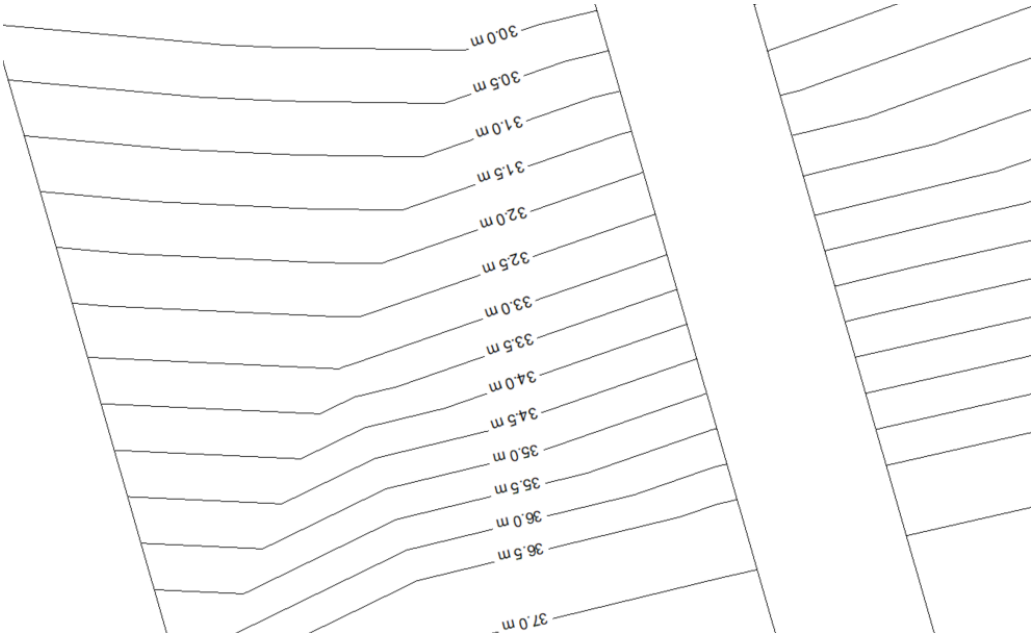


Fig 11. Contours now behave correctly and read up the slope (addressing an error introduced in Revit 2023!)

The new toposolid can be cut by categories, including walls, floors, other toposolids, structural foundations, etc. This wasn't previously possible with the former toposurface element.

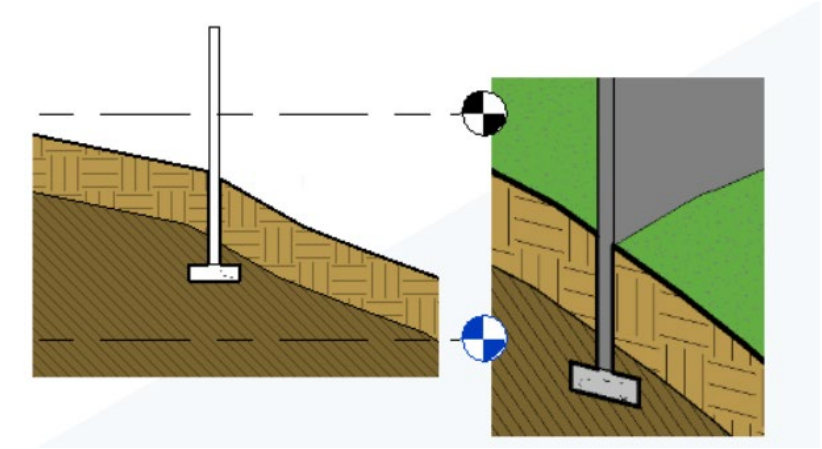


Fig 12. More cutting options for toposolids which update volume properties!

In the example above, the toposolid is cut to accommodate the foundation wall and footing, the volume of the toposolid accurately reflects the subtraction of these elements.

Like floors, users can use the Slab Edge feature on toposolids which could be useful to create kerb features. However, there is a limitation, it is not possible to use this tool on subdivision elements, or on very complex shapes. Hopefully this limitation will also be addressed in a future release of Revit but in the meantime, users could make use of the railing tool to create kerb features.

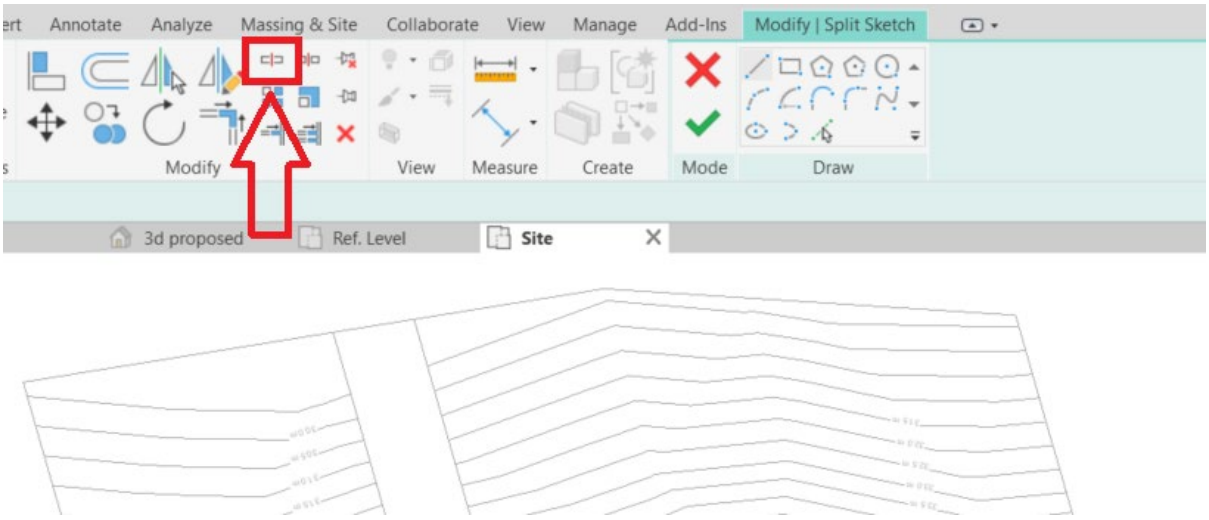


Fig 13. Use the regular Split command to break toposolids into parts, note this is currently irreversible!

The split surface tool has gone, but users can use the regular Split tool on toposolids. As toposolids are like floors, it is possible to change family type and create a variety of site features while retaining the original topography height points. However, once the toposolids are split, you can't merge them back together. Hopefully this limitation will also be addressed in a future Revit release.

In Revit 2023 Graded regions were created by users modifying an existing toposurface using the Graded Region tool. This duplicated the toposurface in the subsequent phase and sets the original one as "demolished".

With Revit 2024 it is a similar process, as users can use the same Graded Region tool on a toposolid object. Place the existing solid into the existing phase and do the point modifications and cut operations if required within the new construction phase(s).

Once complete, the Net cut/fill values will be accessible in the instance properties.

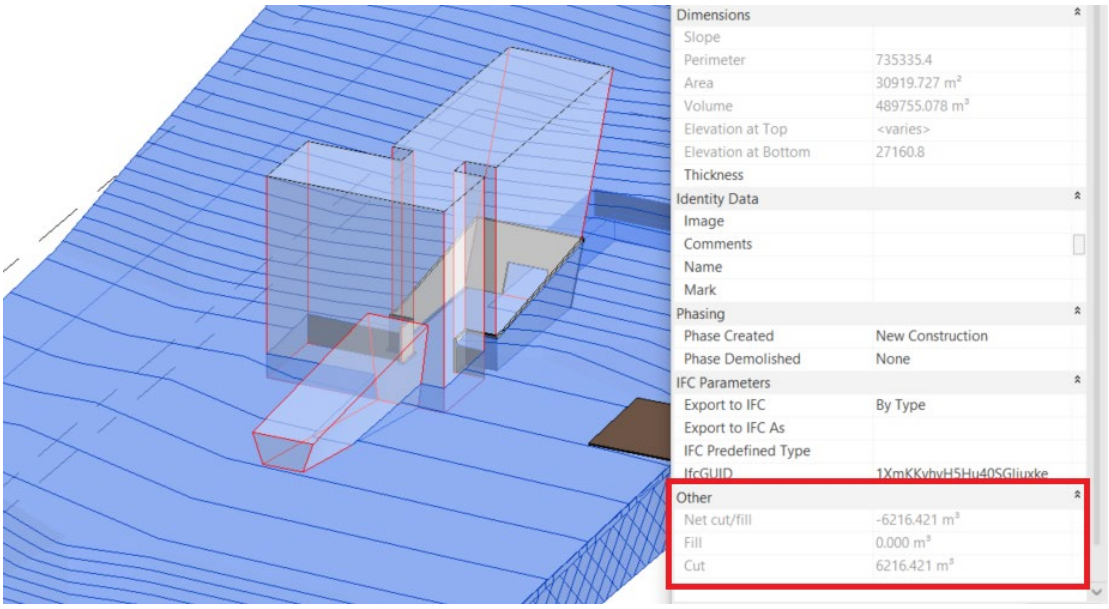


Fig 14. A Graded modified toposolid showing net cut and fill values. Caution should be exercised, and checks made!

It's important to note that users shouldn't rely on native cut and fill values for separated toposolid elements as the method for cut and fill calculation has changed. This may lead to significant discrepancies with the grading that occurs on the site during construction.

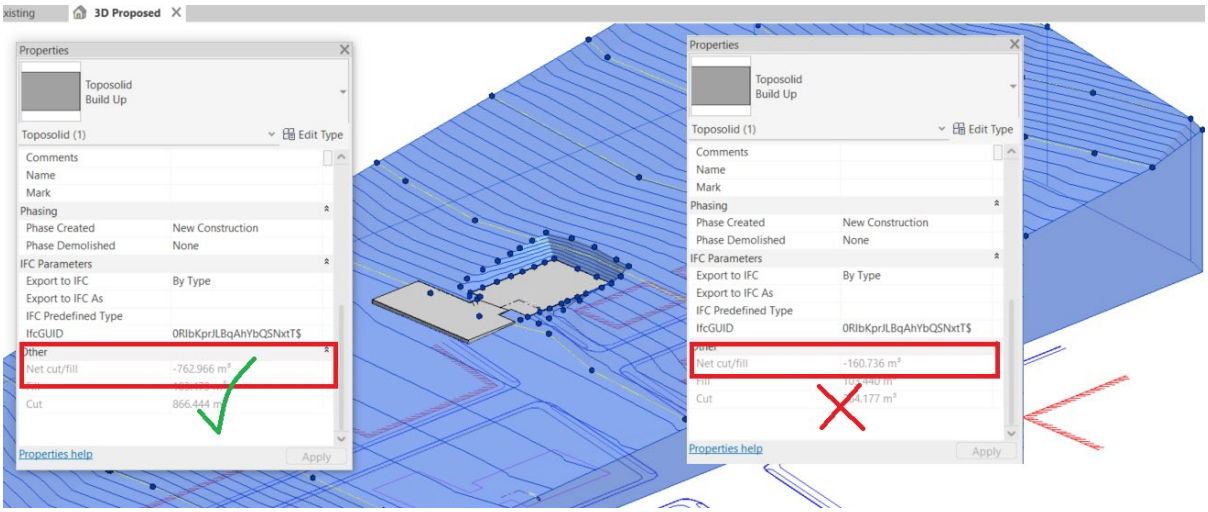
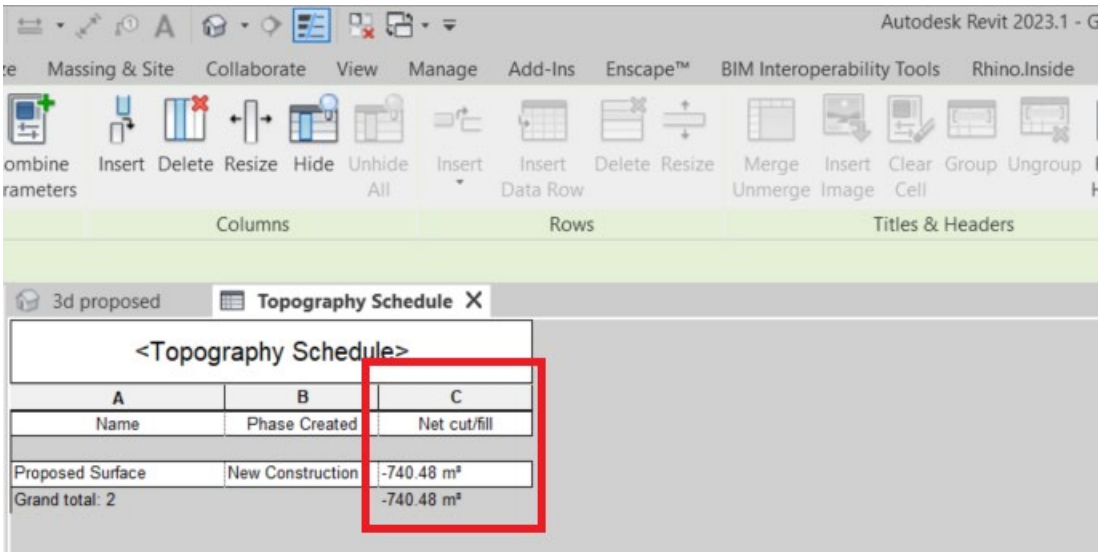


Fig 15. Like Civil 3D the 'picking order' for grading calcs matters! The correct value tallies with results obtained with legacy Revit versions. (Image below obtained from 2023's Toposurface and Pad tools)



Instead of calculating the volume difference between the top faces of the existing and proposed surfaces in previous versions of Revit, the feature now uses a Boolean operation to calculate the actual difference between the two toposolid objects. Users will need to remember that since existing ground is also a toposolid, with its own thickness and type, a continuity is needed between existing and new construction. Revit 2024 earthwork calculation will only work as expected if you use the proper graded region workflow, using a toposolid type with a Variable Material set within the Type structure. Any changes made to the proposed toposolid's boundary or type throughout the project without referencing the existing solid element will result in the wrong calculation being made! Care should also be taken in the order of the cut/join operation. If joining a slab foundation to a toposolid, the selection order should be toposolid FIRST and the slab/foundation SECOND.

If like me, you have difficulty visualising what the correct volume should be, a tip is to model some crude Mass volumes and a rough check of the expected net/cut fill result.

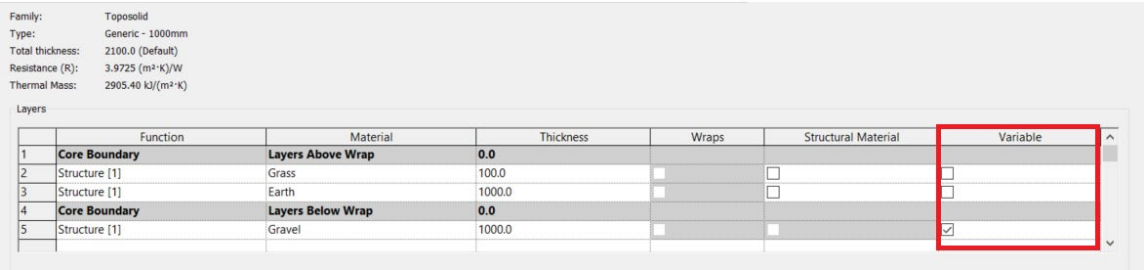


Fig 15. Setting materials with a variable thickness within a solid.

While the boolean operation method allows us to calculate the cut volume in cases such as an underground structure, which wasn't possible previously, this method is not designed for accurate site grading. For the best results for grading and cut and fill calculations I would recommend using Autodesk Civil 3D or a third-party application like Environment for Revit.