Interoperability between Revit Structure and AutoCAD Architecture

Structural engineers who use Revit® Structure software can better coordinate their work with architects who use AutoCAD® Architecture.

This paper examines the strong integration between the two applications, and describes the benefits to architectural and structural firms using these solutions together.

Traditional structural processes begin with the architectural drawings, usually CAD-based. The structural engineering team interprets the architectural design to create an overall structural design, and then creates specialized analytical models to check the stability of the structure. Structural construction documents are then created, and usually delivered in a CAD-based digital format.

With well over 350,000 users of AutoCAD Architecture worldwide, structural engineers will find many opportunities to use Revit Structure to coordinate their design and collaborate with architects using the DWG file format or the intelligent real-world building objects from AutoCAD Architecture.

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Importing 2D Architectural Backgrounds

The most common starting points for a structural firm are 2D CAD files provided by the architect.
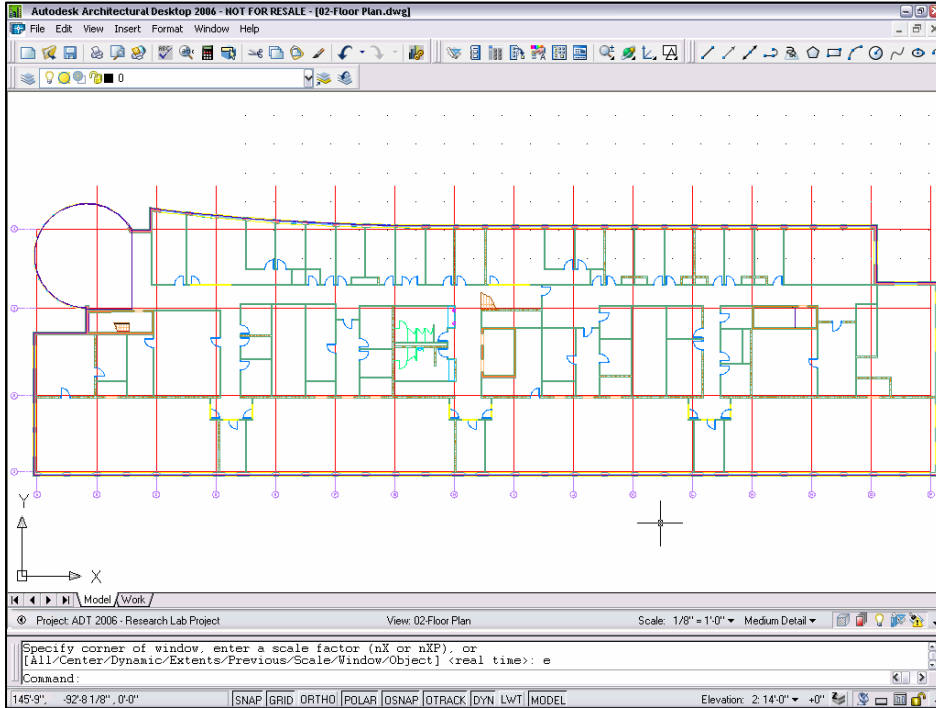

Figure 1:

The architectural
 floor plan in
AutoCAD Architecture
is going to be sent to
Revit Structure for
reference.

Revit Structure lets firms import or link DWG files from AutoCAD® software and AutoCAD Architecture directly into Revit Structure.

If the 2D CAD file is linked while being imported, it remains within Revit Structure as a backdrop and can be refreshed if the architect supplies an updated version. The engineer would use the Manage Links option in Revit Structure to reload a new version of the architectural background.

Within AutoCAD Architecture, the architect has several ways to give the project information to the engineer:

1. If the architect has designed a floor plan without linked files (also known as external references), the first step towards exporting the files for use in Revit Structure would be to enable proxy graphics by setting the system variable to 1. With proxy graphics enabled, users who do not have AutoCAD Architecture but do have another application that can read DWG files (AutoCAD 2000 or newer, Revit Structure), can view and plot AEC objects created in AutoCAD Architecture. Finally, the drawing should be saved and sent to the engineer.

2. If the architect has designed a floor plan using external references, the recommended method is to enable proxy graphics and then bind all external references files to make the entire architectural data visible to the engineer after export. To do this, go to Insert / Xref Manager / select all the Reference Names / Bind and choose Insert in the Bind Xrefs.
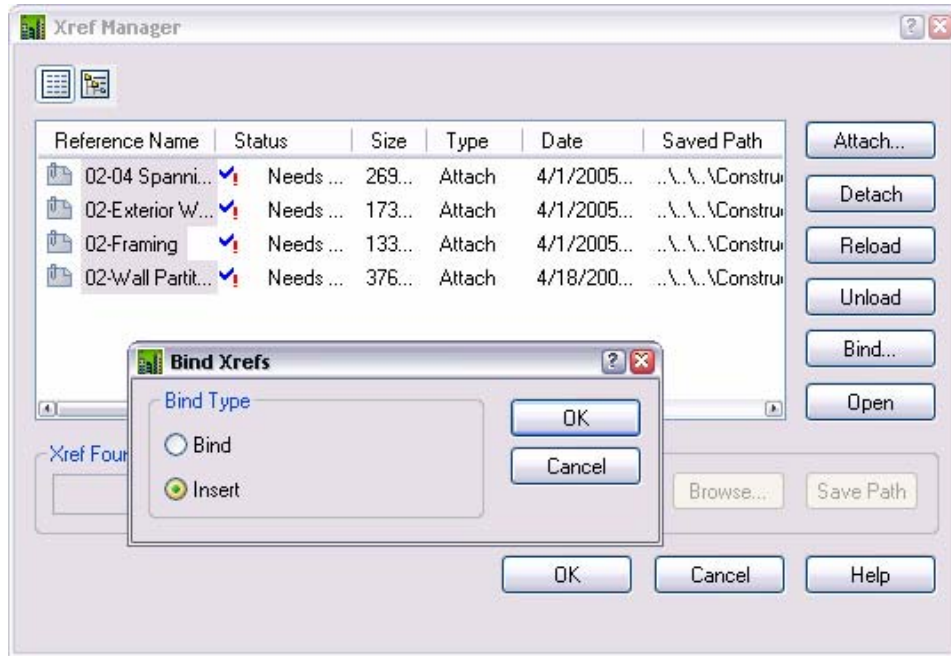

Figure 2:

Binding an architectural drawing with xrefs ensures that the engineer gets all of the supporting design data in one drawing.

The file is then ready to be saved as DWG, or export to AutoCAD, or export as a DWG block.
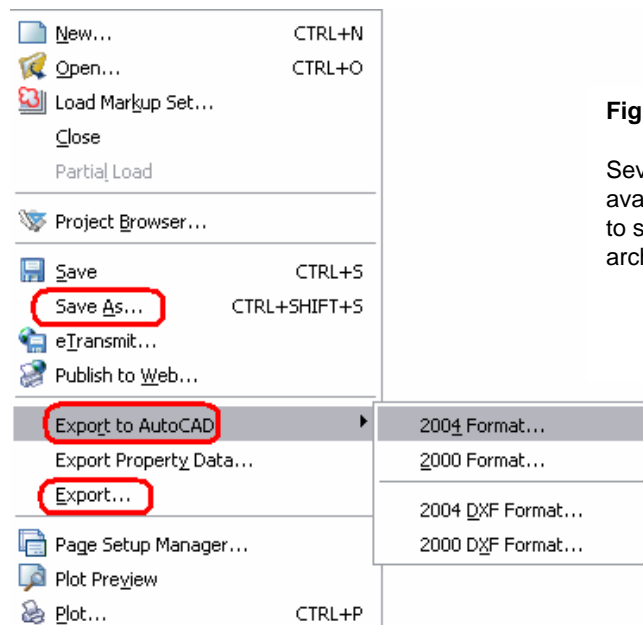
Figure 3:

Several options are available to the architect to save and export their architectural file.

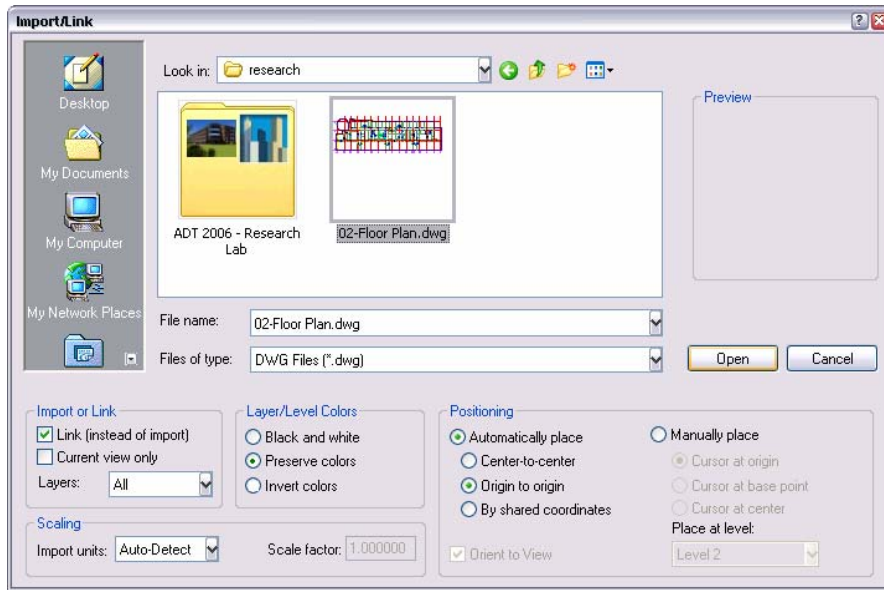In Revit Structure, import the DWG file.

Figure 4:

The DWG file can be imported or linked. Convenient colors and positioning options are also available.

The imported geometry can be referenced or converted directly to create new structural components. For example, the lines representing an architectural grid on a DWG file can be used to create a new structural grid either by digitally tracing the lines (referencing endpoints, midpoints, etc.) or by selecting the appropriate line, using the pick tool, and converting them directly to Revit Structure grid lines.

2D wall lines or 3D wall faces from AutoCAD Architecture wall objects can be converted directly to 3D structural walls in a similar fashion (using floor elevations to specify height, and wall library for material and thickness of the wall).
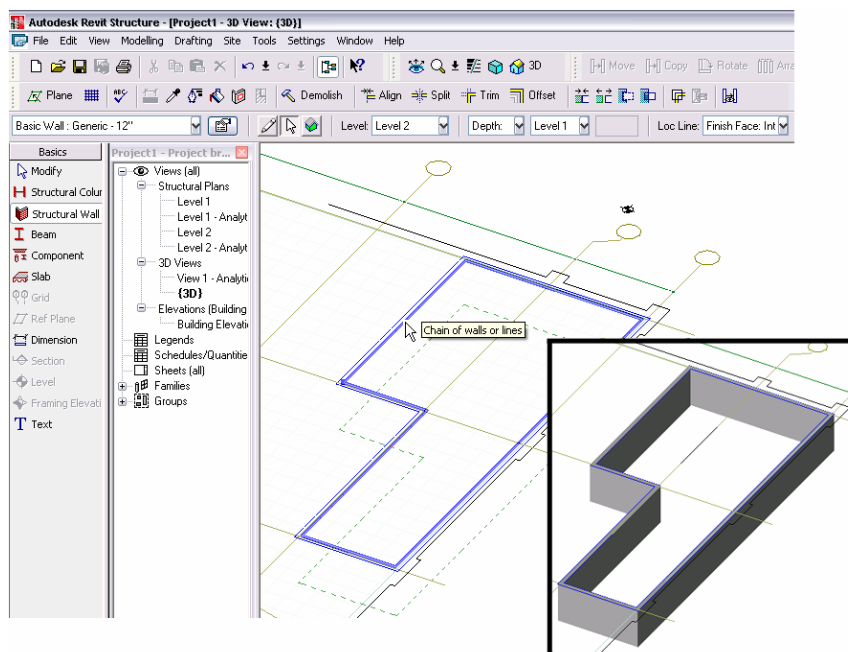

Figure 5:
Use Revit Structure pick tool to select 2D wall contours and convert them into 3D structural walls.

Importing 3D Architectural Models

Revit Structure lets structural engineers navigate through the architectural models made with AutoCAD Architecture.
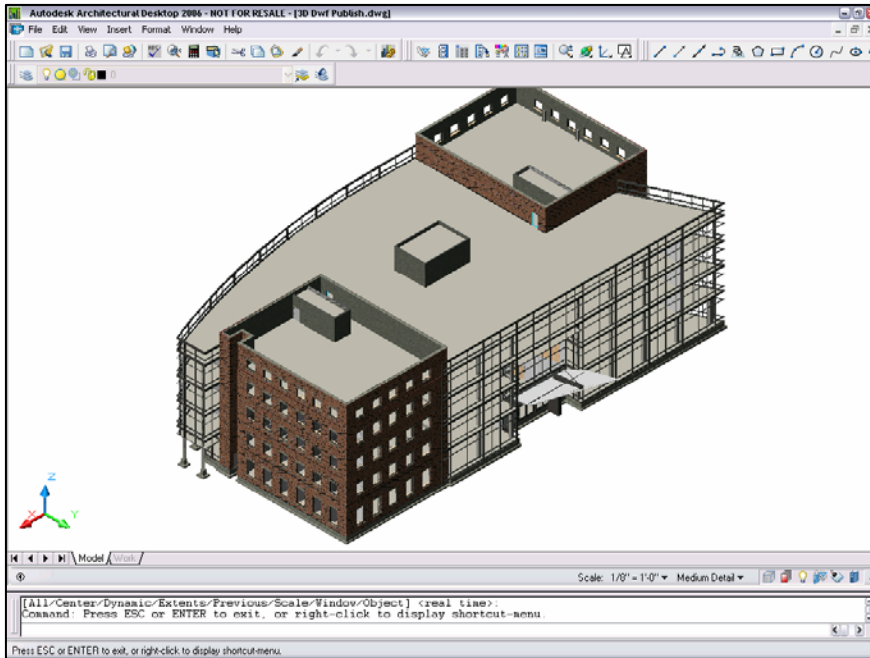
If the 3D Architectural model is composed of several linked files (most likely one file per floor), the recommended method is to set the proxygraphics value to 1, and export the file to AutoCAD.

Alternatively, the previously described method of binding the xref files can be used, so that the imported (not linked) DWG file can be partially exploded and queried inside Revit Structure. Each AEC entity becomes its own Import Symbol and Properties dialog displays important properties of the AutoCAD Architecture objects.
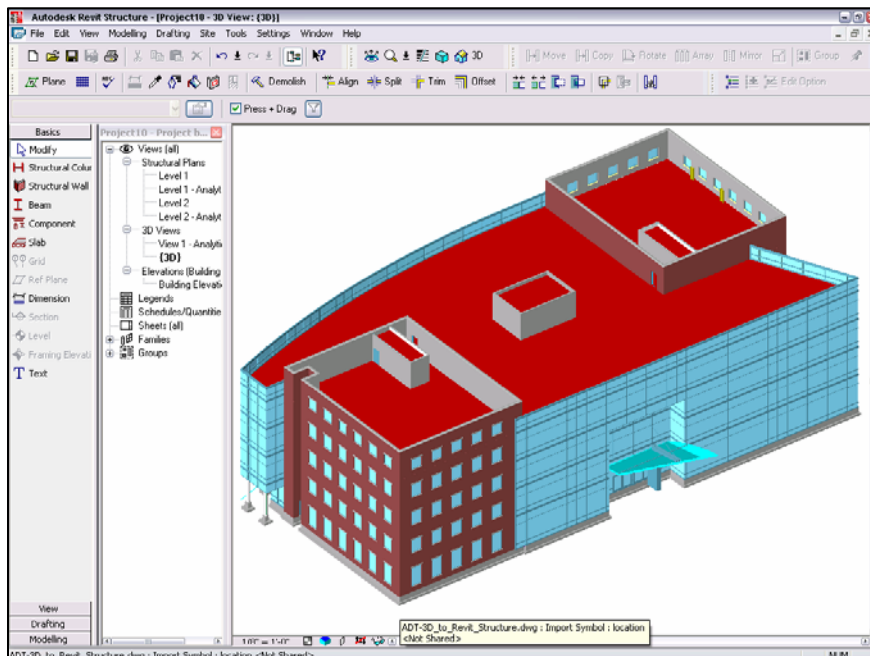

Figure 7:

Structural engineers can view and query the 3D architectural model made in AutoCAD Architecture directly within Revit Structure.

Exporting 3D Structural Models

For improved coordination with architects, Revit Structure exports structural components as intelligent building objects native to AutoCAD Architecture. In Revit Structure, the engineer will select a 3D view of the building structure and export the file into DWG format.
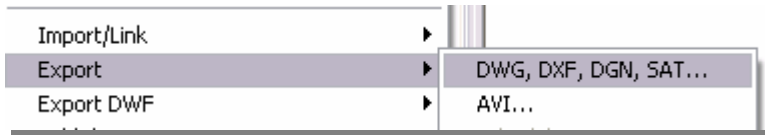

Figure 8:

Revit Structure models can be exported into several formats.

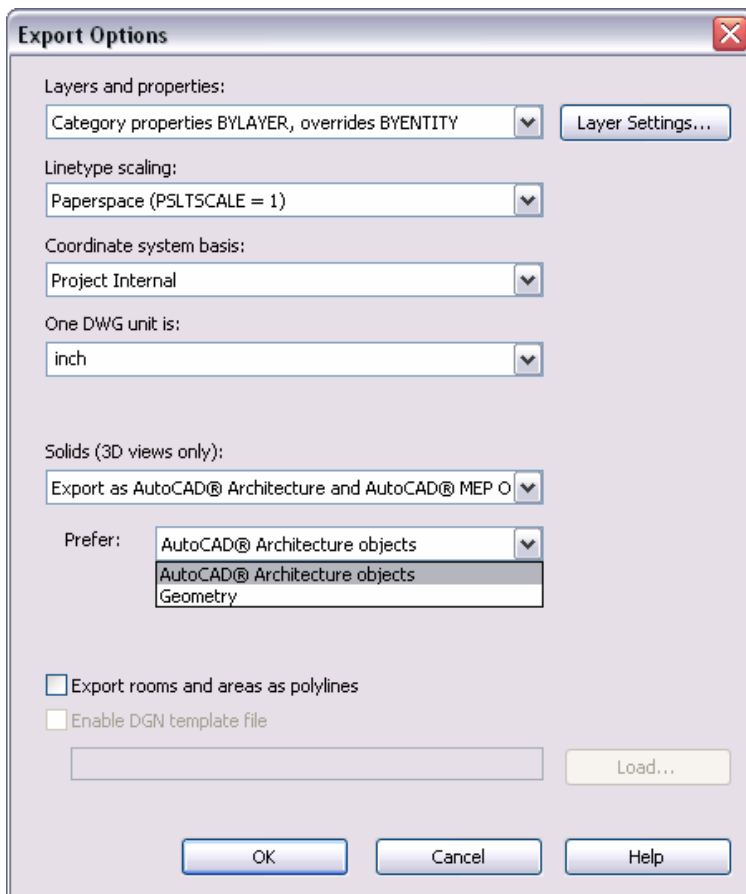The Options button in the Export dialog windows give access to the following.

Figure 9:

For the export of 3D views, engineers have the option to export as AutoCAD Architecture objects.

User can choose to export structural members preferably as native AutoCAD Architecture objects (structural properties kept) or as massing objects to preserve the Geometry without the structural properties.

Because AutoCAD Architecture does not support non-extruded structural members (coped elements, cutbacks, cuts, holes), there is an alternative to preserve the exact shape of objects (loosing the structural properties) or to create simplified AutoCAD Architecture object (loosing some geometry accuracy but keeping the structural properties).

Structural components in Revit Structure that are not of a type supported in AutoCAD Architecture (slabs, footings, and walls with structural characteristics) are exported to AutoCAD Architecture as mass elements.

For the non-uniform profiles, AutoCAD Architecture massing objects will also be created instead of the AutoCAD Architecture structural member.
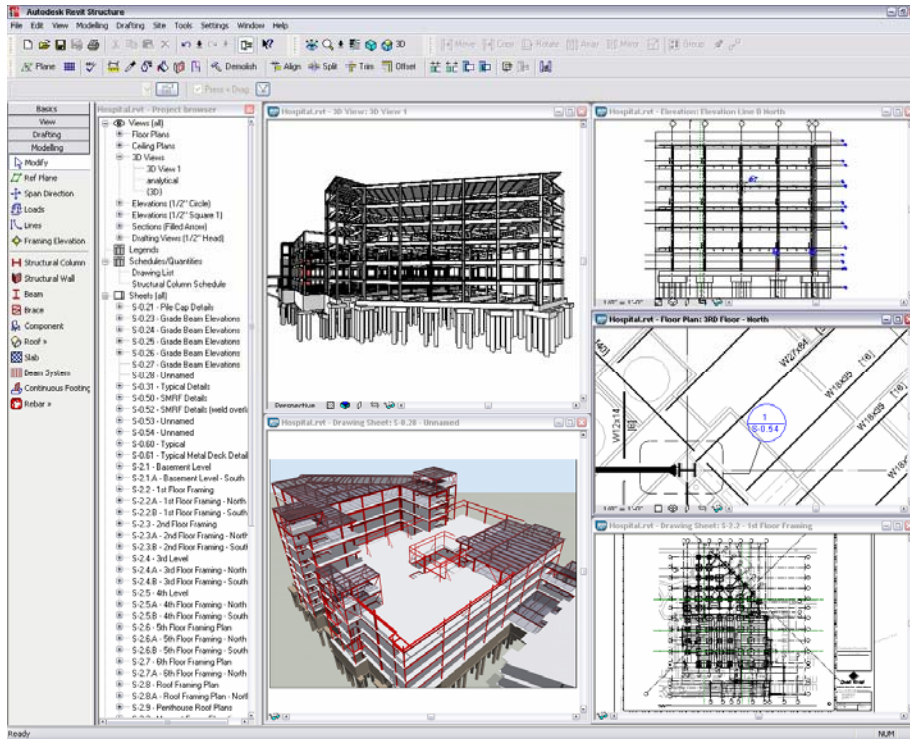
Figure 10:

The structural model in Revit Structure is going to be sent by the engineer to an architect using AutoCAD Architecture.
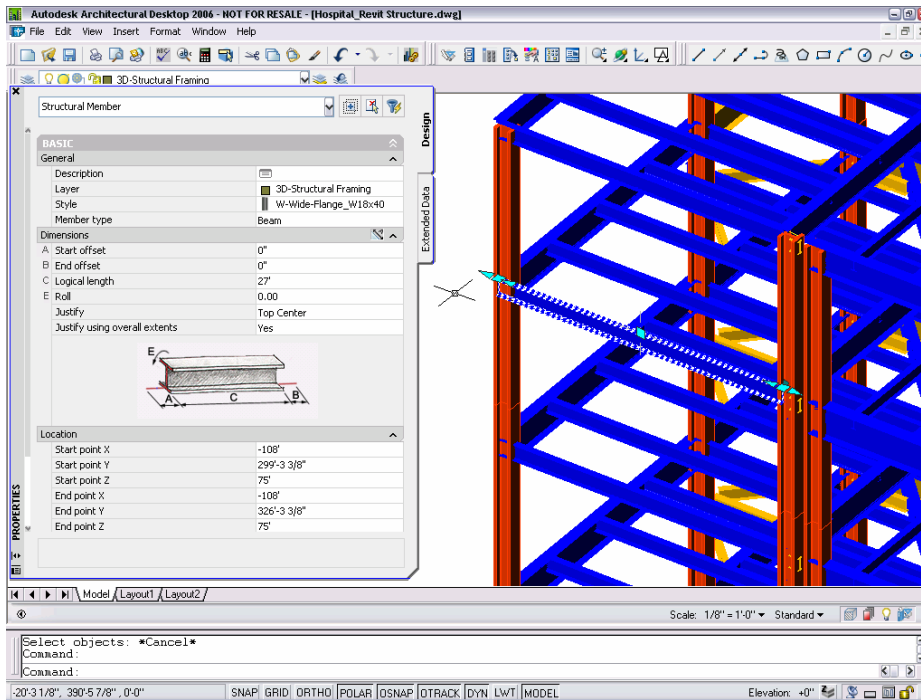

Figure 11:

The same building model exported to AutoCAD Architecture, where the architect can read the structural properties of the elements as true AutoCAD Architecture objects.

A complete structural model from Revit Structure can be shared directly with an architect using AutoCAD Architecture – enabling the architect to review the structural design inside the architectural model and query the structural properties as true AutoCAD Architecture objects.

The architect can now visually see possible interferences between architectural and structural elements, directly inside AutoCAD Architecture.

Exporting Structural Views and Drawings

For collaboration purposes, the ability to export any view or structural drawing from Revit Structure into a 2D CAD file is, obviously, very important. Autodesk Revit Structure can produce DWG deliverables just as AutoCAD software can, producing well-organized and layered DWG files using any layering standard the user wants.
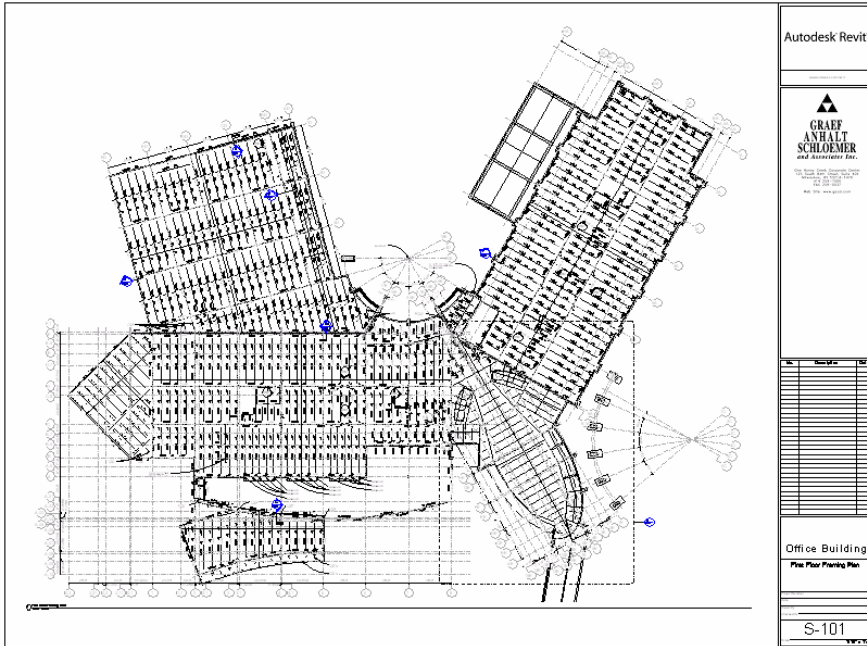

Figure 12:

Revit Structure drawings do not have layers. Drawing sheets can be plotted directly. Line weights are established in Revit Structure Objects Styles.

Before exporting your Revit Structure view as a DWG file, you'll also want to consider a layering scheme. Right out of the box, Autodesk Revit Structure supports both local and international layering conventions with built-in AIA (US), BS1192 (UK), ISO 13567 (Europe), and CP 83 (Asia) formats.

For those architects who have spent time developing their own layering conventions, Revit Structure supports them as well with a convenient mapping table that maps a Revit Structure design element 1-to-1 with an appropriate AutoCAD layer name.

To access this layer mapping table, go to the File pulldown and choose Import/Export Settings→ Export Layers DWG/DXF.
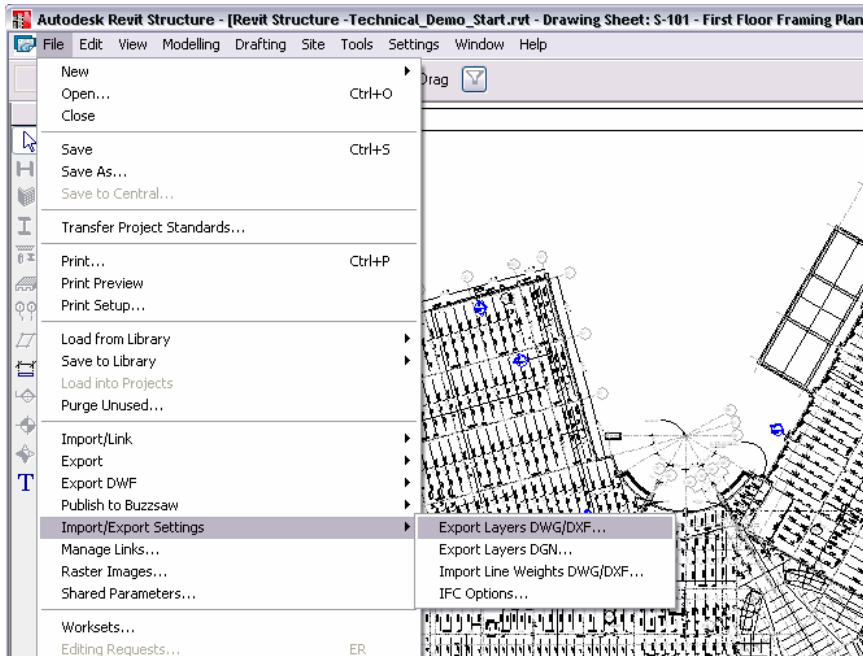
This table takes every Revit Structure element and matches it to an appropriate layer name and color ID.

Figure 14:

Each Revit Structure object category is associated to a layer and a color for projection or cut views.

Once the view has been prepared for export, simply go to the File pulldown and select
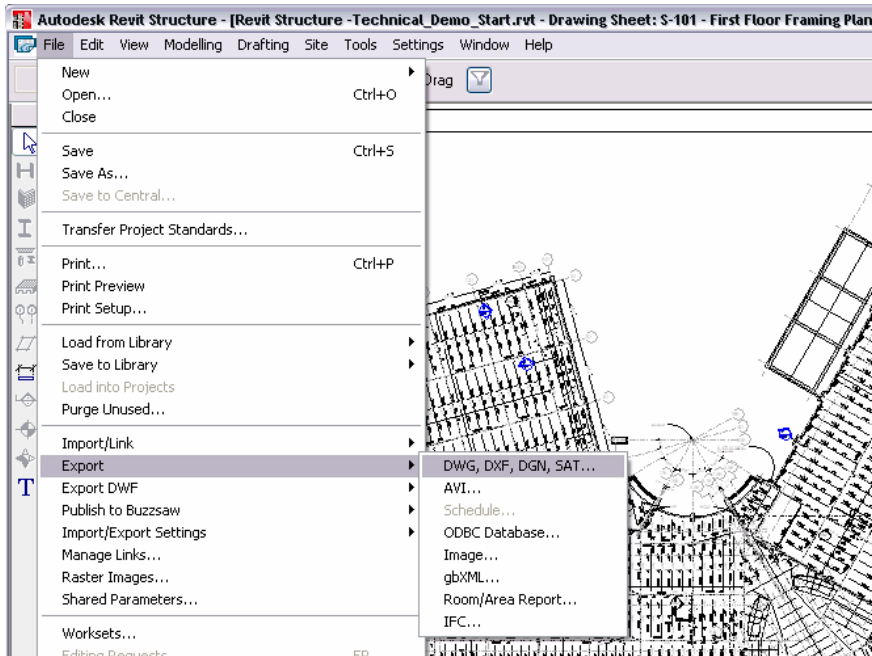Export → DWG, DXF, DGN.

Figure 15:

The structural view or drawing sheet can now be exported as a DWG format and sent to the architect.

Also, there is an option to save the Revit Structure view in either an AutoCAD 2004 or AutoCAD 2000 file format.
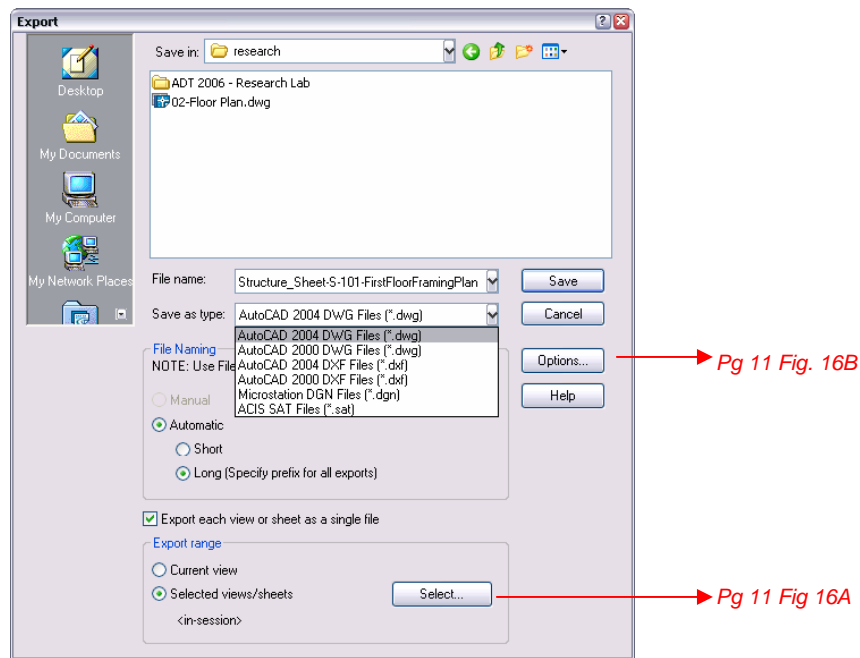

Figure 16:

Several options can be selected by the engineer when he exports the structural file.

Pg 11 Fig. 16B

Pg 11 Fig 16A

Additionally, multiple views, such as each level's Floorplan, can be exported all at once by changing the Export Range from Current View to Selected views/Sheets.
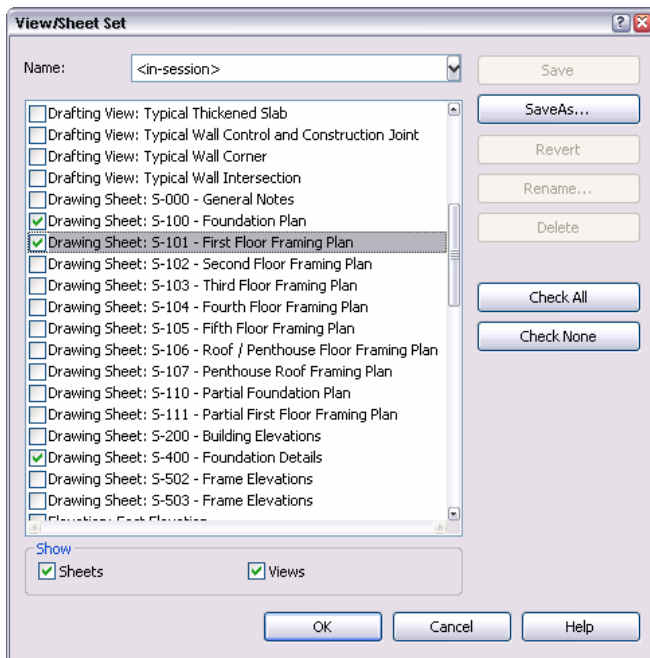

Figure 16A:

The engineer can choose to export a single or multiple views and drawing sheets.

Finally, a layering scheme of the final DWG will have to be selected. Right out of the box, there are several layering standards available or a custom layering scheme can be created.
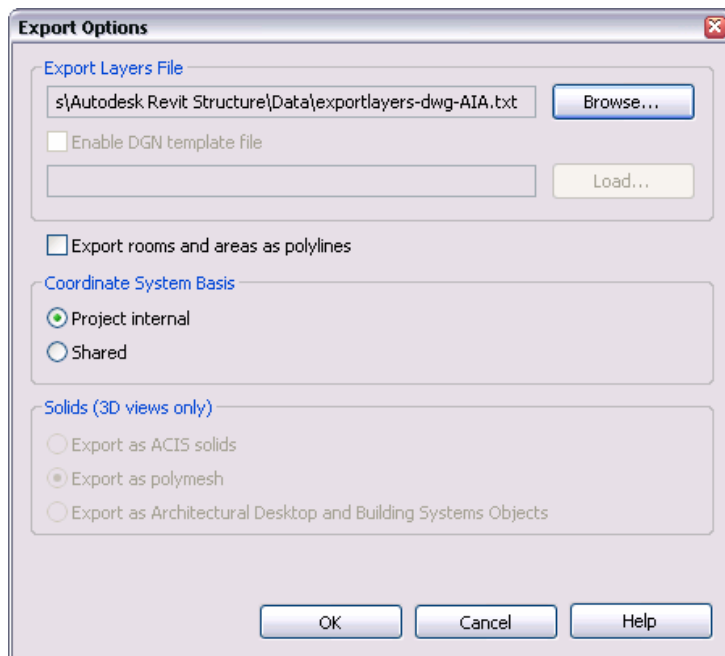

Figure 16B:

Specific layers files can be used.

Save the file in an appropriate directory so that it can be opened in AutoCAD Architecture.
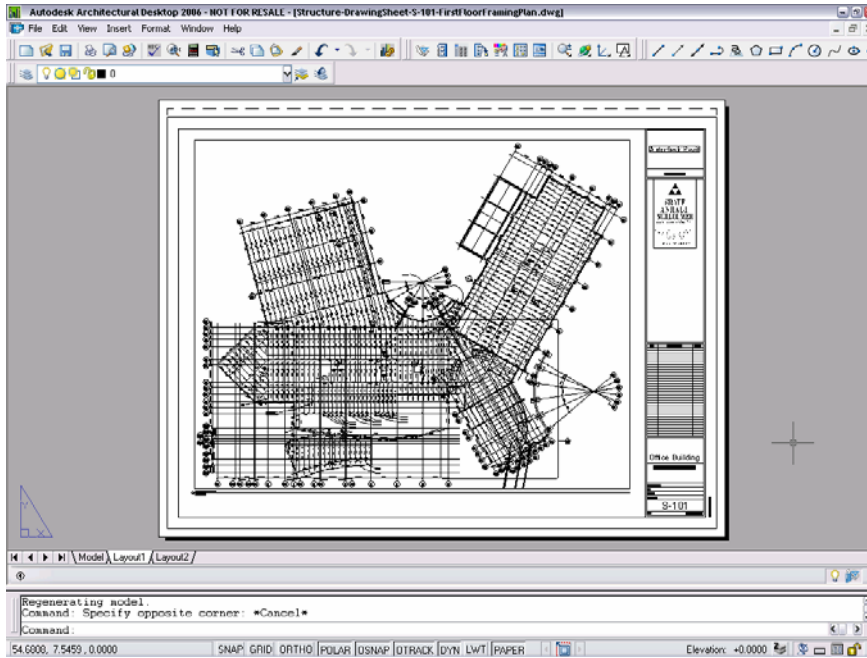

Figure 17:

Architects can now plot the DWG structural drawings generated by Revit Structure.

Once the DWG has been created, the drawing sheet is available to plot in AutoCAD Architecture via the Plot command.

Summary

Revit Structure can import and export DWG files and is also interoperable with AutoCAD Architecture. This improves the way engineers and architects coordinate their respective designs and increase the quality of the final project deliverables to building owners and constructors. The interoperability link between Revit Structure and AutoCAD Architecture is not only a powerful coordination tool but also a great communication tool. The ability to look at the same data in a program that the architects are familiar with, without the loss of information, means the engineers and the architects can make better informed decisions based on clearer communication.

About Revit

The Revit platform is Autodesk's purpose-built solution for building information modeling. Applications such as Revit® Architecture, Revit Structure, and Revit® MEP built on the Revit platform are complete, discipline-specific building design and documentation systems supporting all phases of design and construction documentation. From conceptual studies through the most detailed construction drawings and schedules, applications built on Revit help provide immediate competitive advantage, better coordination and quality, and can contribute to higher profitability for architects and the rest of the building team.

At the heart of the Revit platform is the Revit parametric change engine, which automatically coordinates changes made anywhere — in model views or drawing sheets, schedules, sections, plans… you name it.

For more information about building information modeling please visit us at *http://www.autodesk.com/bim*. For more information about Revit and the discipline-specific applications built on Revit please visit us at *http://www.autodesk.com/revit*.

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