BLD225500

A Coming Convergence? Revit 2019 and Advance Steel Interoperability

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Learning Objectives

- Explain the importance of level of detail/development (LOD) for structural steel design and fabrication.
- Compare how complex steel connections, custom plates, bolts, and welds are created in Revit and Advance Steel.
- Understand the extent to which construction and fabrication documents are created in Revit and Advance Steel.
- Develop a complete design to fabrication workflow using the interoperability features of Revit and Advance Steel.

Description

Are you an Autodesk Revit structural user interested in the fantastic new steel fabrication tools now in 2019? Do you want to know how it interacts with Autodesk Advance Steel? Or are you an Autodesk Advance Steel user who is now being sent Autodesk Revit model files? How can you make the most of them without replicating what has already been done? If you are asking these questions, then this is the class for you!

In this class, we will examine the level of detail (LOD) that can be virtually modeled in each software. We will import and export models using the Advance Steel Extension for Revit. To help identify the differences, we will apply connections, add plates, bolts and welds, and create construction/fabrication documents using both Autodesk Revit and Autodesk Advance Steel. By the end of this class, you will have a good sense of when you need to use the steel fabrication tools in Revit vs. Advance Steel.

Speakers

Martha Hollowell incorporates her passion for building design and education into all her projects, including the training guides she creates on Autodesk Revit for Architecture, MEP, Structure, and landscape design as well as Advanced Steel. She has worked with Autodesk products since the 1990s and has focused primarily on Autodesk Revit for the last 18 years.

After receiving a B.Sc. in Architecture from the University of Virginia, she worked in architectural offices and consulted with firms setting up and customizing AutoCAD for their companies. Martha has over 20 years' experience as a trainer and instructional designer. She is skilled in leading individuals and small groups to understand and build on their potential. Martha is trained in Instructional Design and has achieved the Autodesk Certified Professional designation for Revit Architecture. She has taught several times at Autodesk University.

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Veredith Keller has more than 18 years technical expertise in software installation, customization, training, as well as small and large scale software implementation solutions. She has worked in the Autodesk reseller channel for over eight years and has provided customization and multimedia consulting for various Architectural and Engineering companies throughout United States and Canada. She has also worked at various firms as a designer/CAD manager. Veredith has extensive experience and is considered an expert in Building Information Modeling (BIM). She has implemented BIM for Architectural, Structural, MEP and Construction firms and has spent four months in Singapore consulting with various Architectural and Engineering firms on their BIM strategy. Veredith also specializes in Multimedia and Entertainment software. She has also presented on the topic of BIM at various seminars in Malaysia, Singapore and in the United States and Canada.

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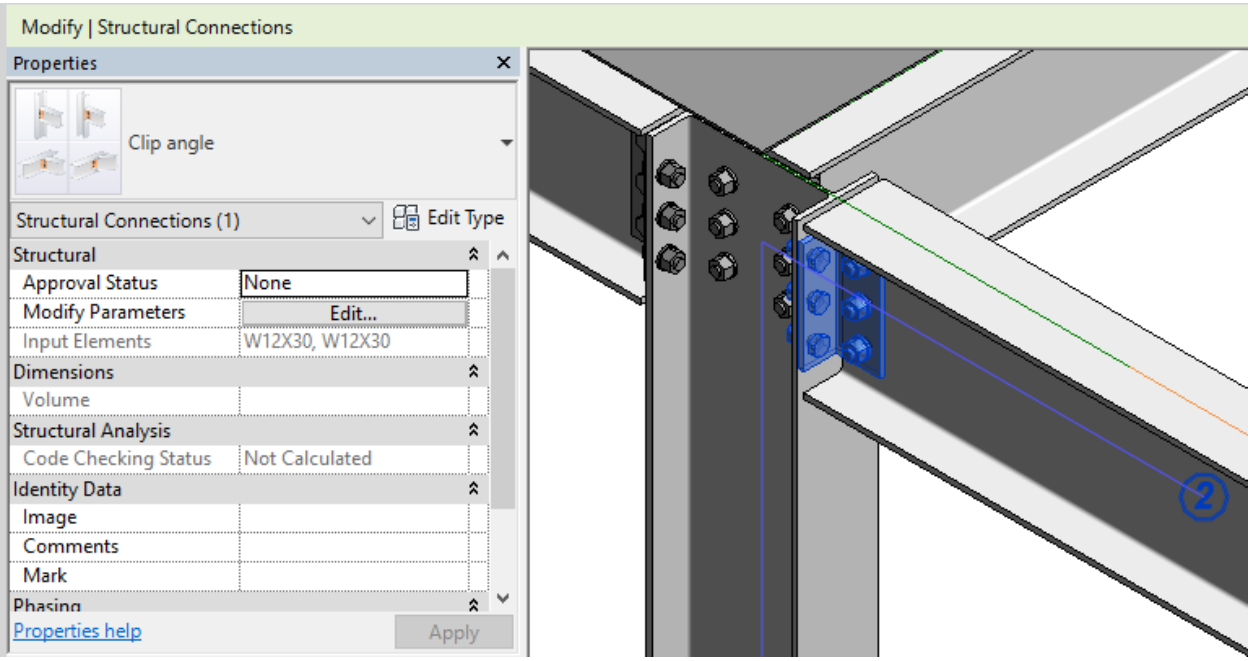
Introduction

Sometimes it seems like we are living in a science fiction movie with technology changing so fast that we can't keep up. We haven't yet reached a convergence of human and machine, but the process doesn't seem so implausible these days. On a much smaller scale, we are seeing a convergence of software where more and more detail can be applied with great precision. This saves time, money, and change orders both in design development and in construction and fabrication. This class is going to look at a major convergence for the structural steel industry: Autodesk Revit and Advance Steel working hand in hand.



Level of Development (LOD)

- Explain the importance of level of detail/development (LOD) for structural steel design and fabrication.

Way back when you were using paper drawings or even 2D AutoCAD, you didn't need to worry about LOD. Working drawings, and then shop drawings, were the highest level of development. But with 3D building models, you can host so much more information in the model. The question is, is it accurate enough for what you need it to do at this point in the project? That is where Level of Development comes in.

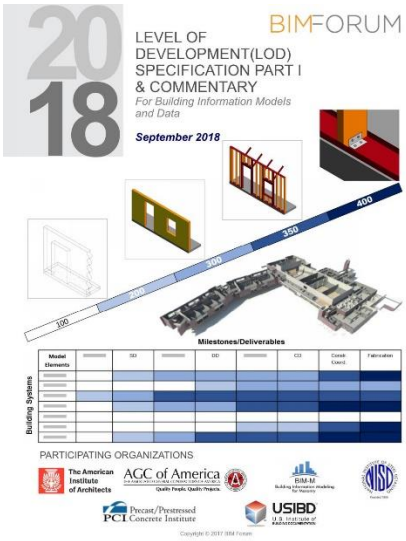
What is LOD?

The general concept of Level of Development (LOD) is that model elements are gradually detailed with more accurate and reliable information through the life cycle of a project. As time goes on, the content is more complete and can be used for more specific measurement. It helps you know how far you need to detail at specific points in the projects.

History of LOD

- LOD first started as “Level of Detail” as outlined by Vico Software (Now part of Trimble Buildings). It is used to specify the reliability of model elements used in automatic model-based cost estimating. For example, at a lower level of detail, you may specify a water fountain. All you know is the number of water fountains in a project. Then, at a higher level of detail, you specify the make and model of the water fountain and can get a much more accurate estimate of the cost.
- Later, the American Institute of Architects (AIA) renamed the concept to “Level of Development” and expanded it to include not just the geometric features but all the BIM content hosted in the elements. Individual elements can be tracked according to the LOD at specific points in the project.
- BIMForum has expanded even on this and created a Level of Development (LOD) Specification which is included in the US National BIM standard.

TIP: LOD Specification 2018 and Structural Steel



You can download the latest version of the Level of Development Specification at https://bimforum.org/lod/ For structural steel, most of the information is stored under Floor Construction under Uniformat B10 Superstructure with more precise information about the following subcategories.

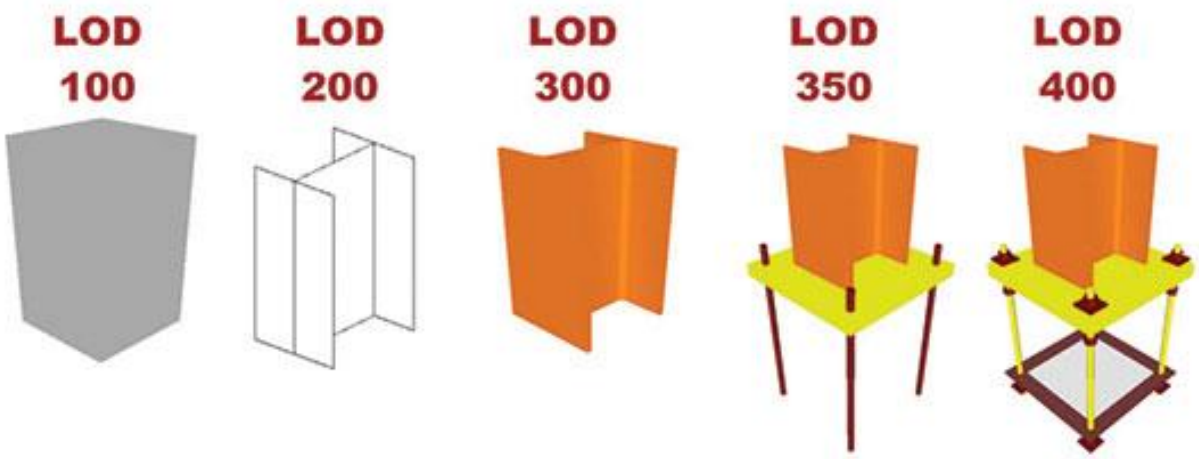
- Steel Framing Columns B1010.10.30
- Steel Framing Beams B1010.10.40
- Steel Framing Bracing Rods B1010.10.50
- Steel Joists B1010.10.60
- Cold-Formed Metal Framing B1010.10.70

How much do you need to know about LOD?

For this class, you just need to know it exists, what the levels are, and that it impacts your workflow. But, it is much more powerful than can be covered here. LOD can be incorporated in contracts and BIM execution plans and it can help Architects/Engineers/Fabricators/Facilities Managers/Owners start working together at an earlier point in the life cycle of a project and pass on that information with fewer mistakes.

What are the Levels in LOD?

LOD is typically specified with numbers and the higher the number, the more detailed the level of development. The example of a column from the 2018 Level of Development (LOD) Specification is shown below:



LOD 100 - Conceptual Design

At this level of development, structural framing is assumed to be modeled with other building elements. For example, a mass floor may include the structural framing depth but not specific beams or materials. The thickness and size as well as the exact location is flexible.

LOD 200 – Design Development

At this level of development, structural framing includes approximate dimensions and sizes of framing members as generic placeholders. Structural grids should be accurate. For example, there is a steel column at this grid location or a truss is placed between these columns.

LOD 300 – Documentation

At this level of development, sizes of the main structural members are specified on the defined structural grid with correct orientation, slope, and elevation.

LOD 350 – Coordination

At this level of development, more member connections are specified including typical connections for base plates, gusset plates, anchor rods, etc. Miscellaneous steel members are included as well as reinforcement such as stiffeners and sleeve penetrations.

LOD 400 – Construction

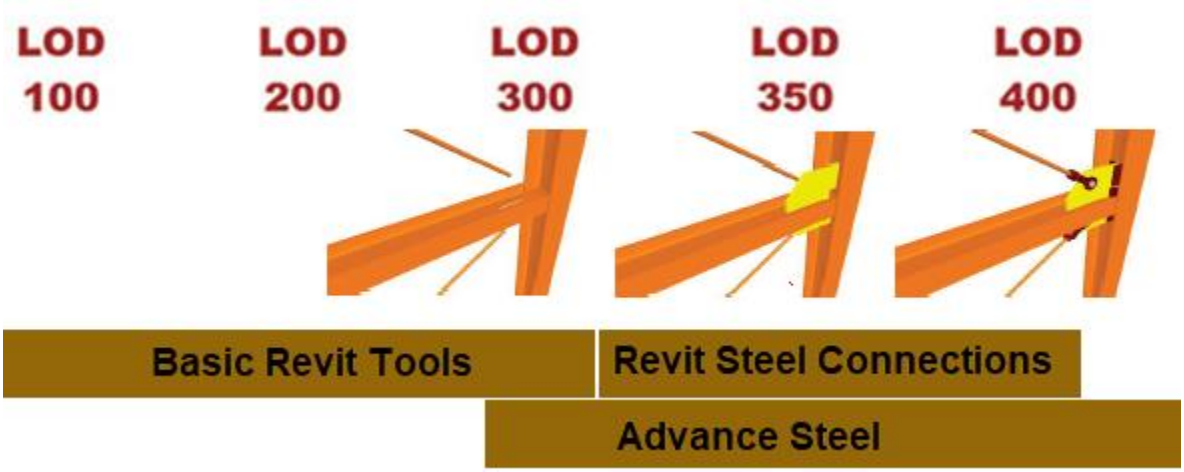
At this level of development, the model is ready for detailing, fabrication, and installation. The structural model includes welds, coping, washers, nuts, etc. and all assembly elements.

LOD 500 – Facilities Management

At this level of development, the BIM model is created “as-built” with information that supports on-going operations.

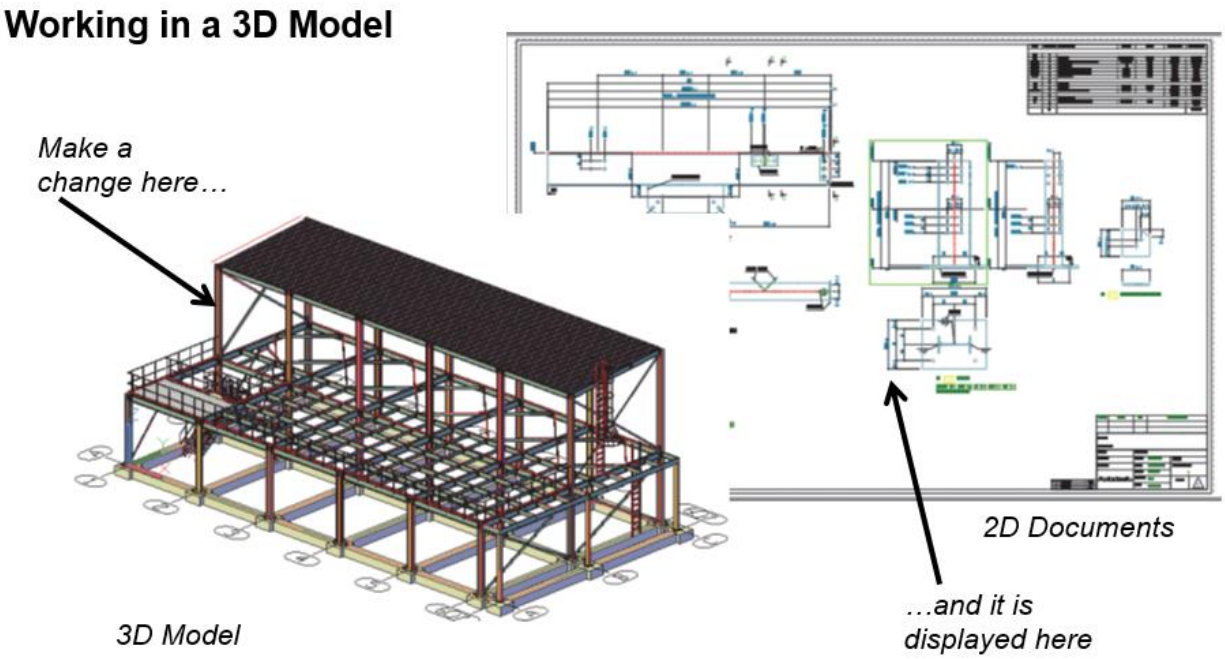
Where are Revit and Advance Steel on the LOD continuum?

The software you use will depend on the Level of Development you need at that time. Revit and Advance Steel are both excellent tools, but they do not do exact the same thing. And at this point, both are needed. Earlier versions of Revit only included information up to LOD 300. Then, an add-in called Steel Connections for Autodesk Revit opened the way to start incorporating connections at a higher LOD of 350. A big change came about in Revit 2019 that includes even more connections and that is what the rest of the class is about. (Spoiler alert: You still need Advance Steel.)



Working with Steel Connections in Autodesk Revit and Advance Steel

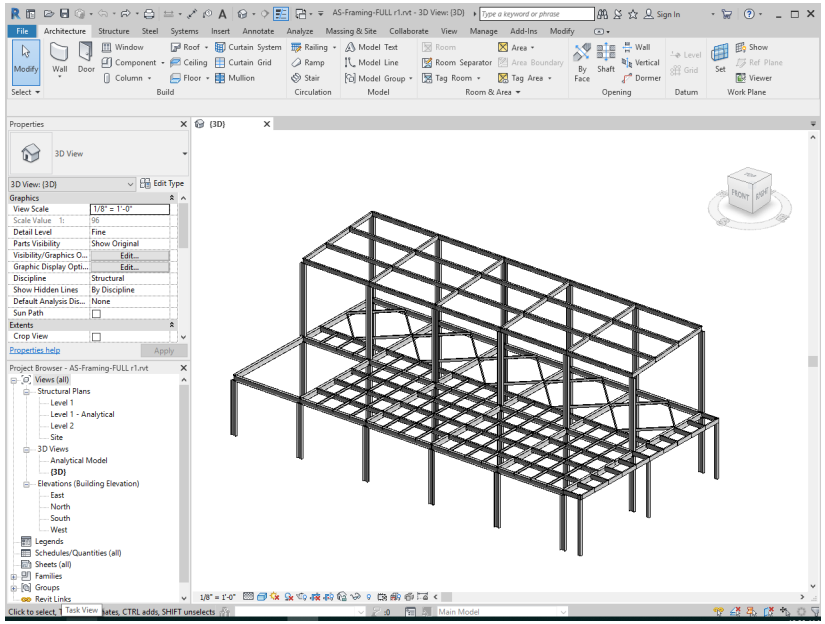
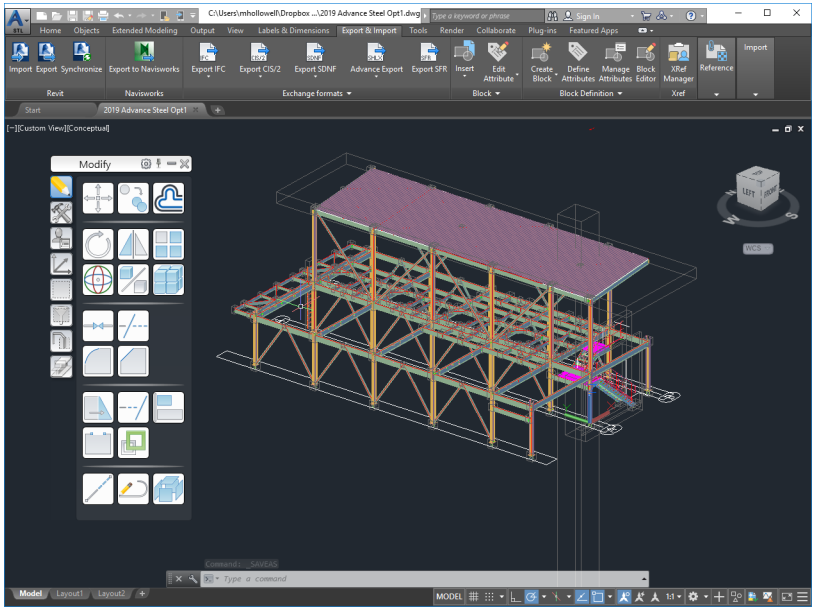
- Compare how complex steel connections, custom plates, bolts, and welds are created in Revit and Advance Steel.
- Understand the extent to which construction and fabrication documents are created in Revit and Advance Steel.



With the coming convergence of software in so many places, let's take a look at how Autodesk Revit and Advance Steel work and where they overlap. We will look at:

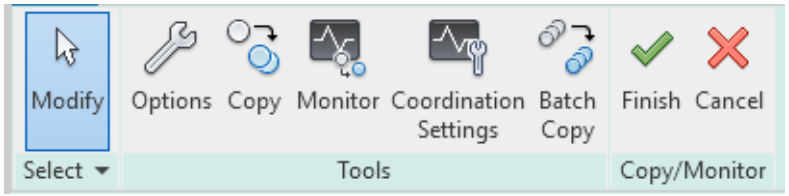
- Platform, Interface, and Datums
- Basic Steel Modeling
- Steel Connections
- Other Connection Tools
- Documentation and Fabrication Tools

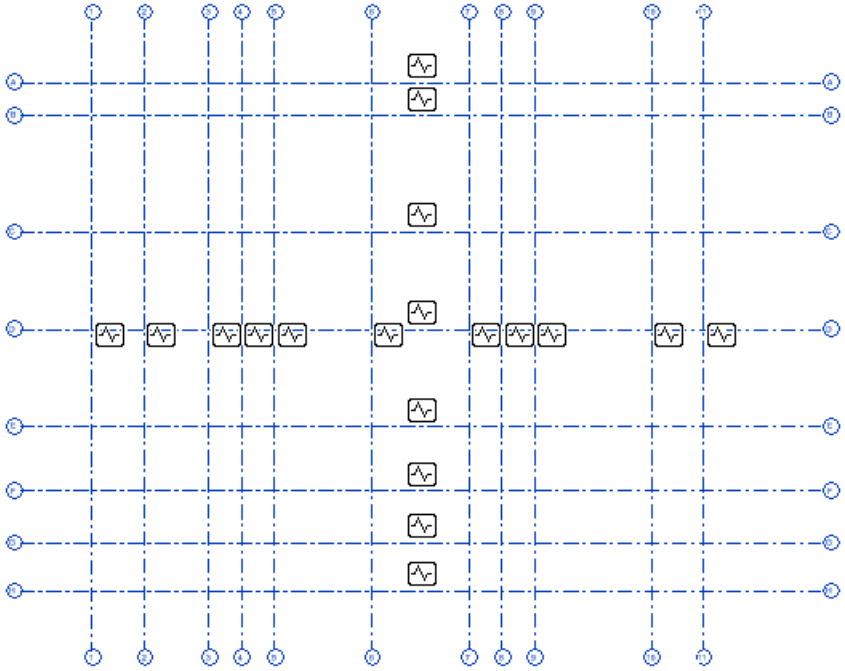
Platform, Interface, and Datums

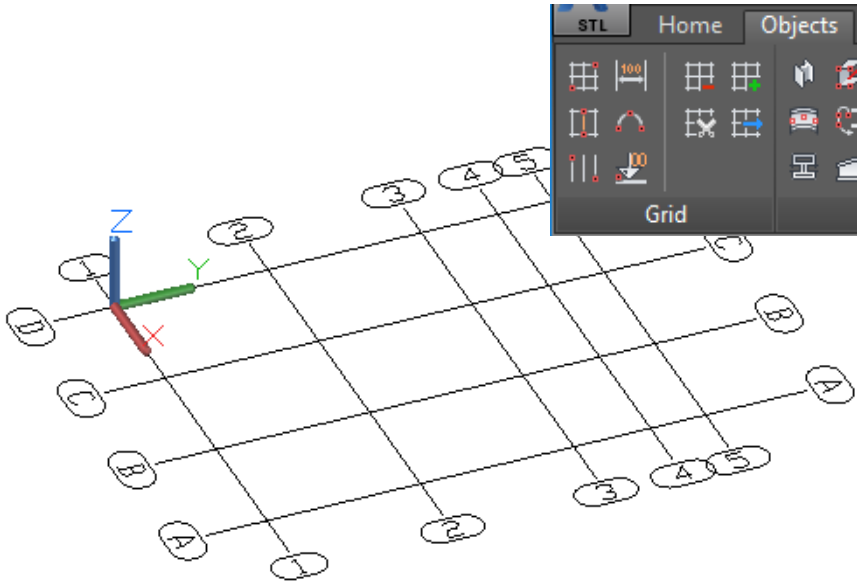
Autodesk Revit	Advance Steel
	
The Autodesk Revit platform is used by architects, MEP engineers, and structural engineers. Interaction between disciplines is seamless. Autodesk Revit models can be shared with Advance Steel using the Advance Steel Extension Add-in.	The Advance Steel platform is built on AutoCAD and is highly customized for steel fabrication. Autodesk Revit models can be imported, but the process requires importing and exporting to a separate file format.

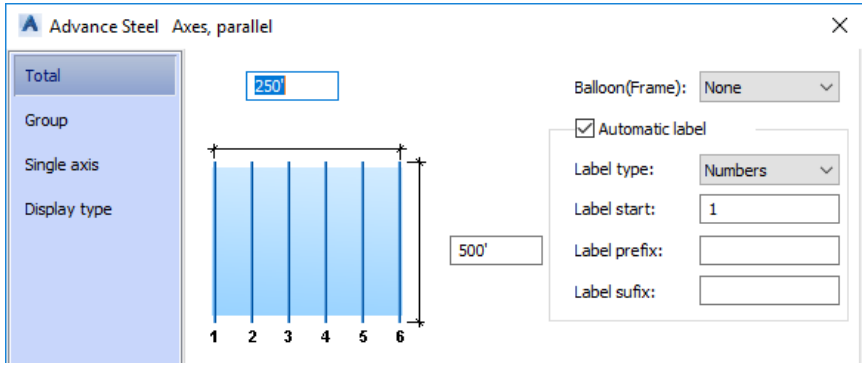
Platform, Interface, and Datums

Autodesk Revit	Advance Steel
Structural grids and vertical levels can be copied and monitored from the architectural model without having to recreate them. You can also add grids and levels graphically.	Structural grids and vertical levels can be added using the various tools and the related dialog boxes. Grids are added using tools on the Objects tab. Levels are added using the Project Explorer.

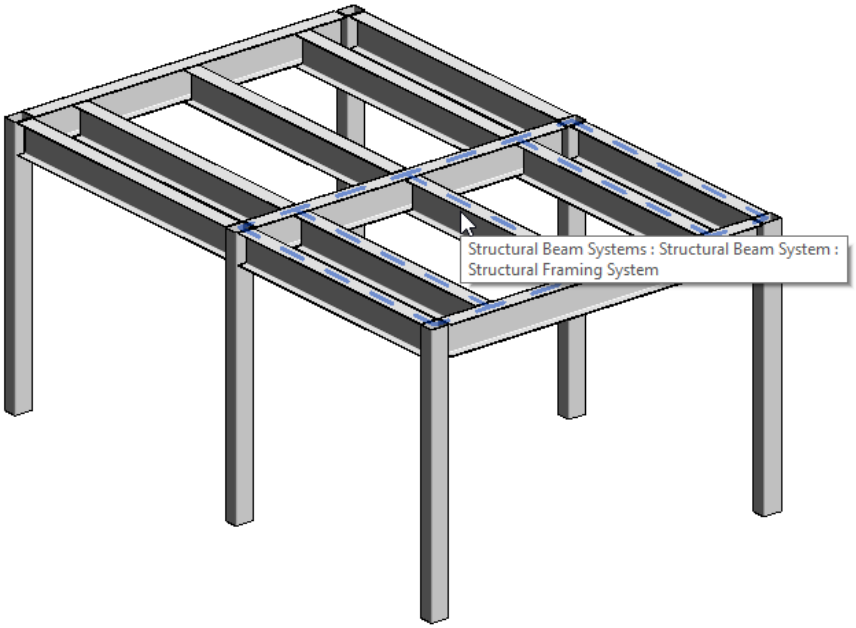
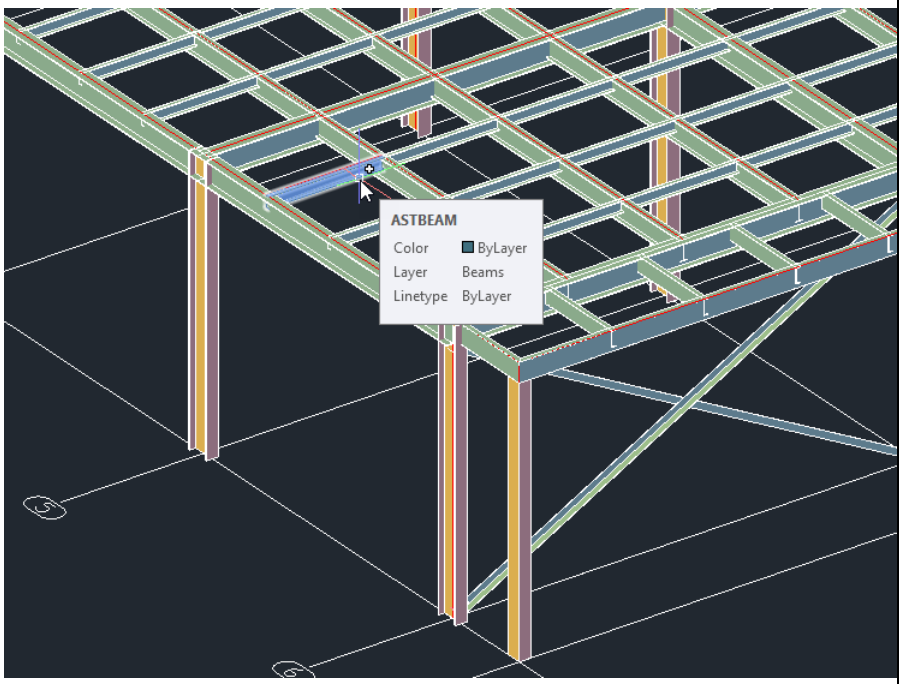






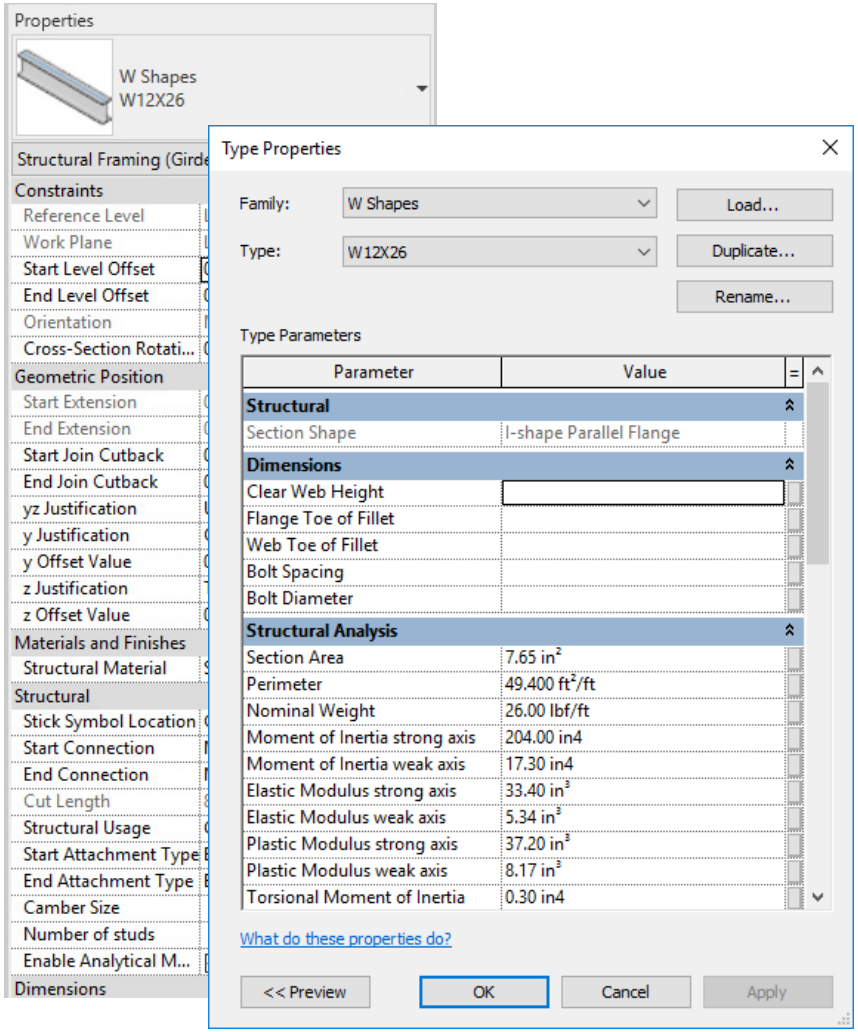


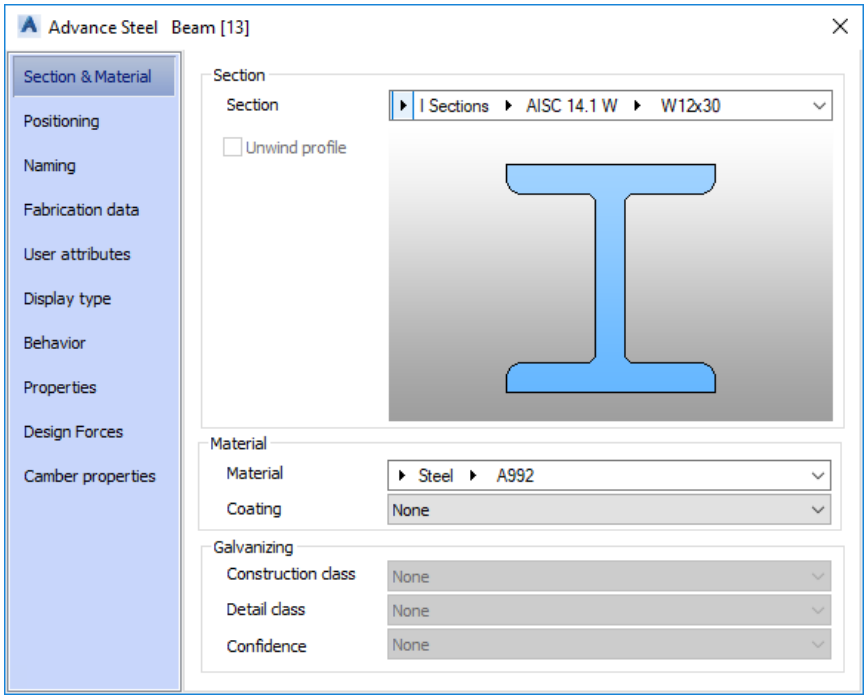
Basic Steel Modeling

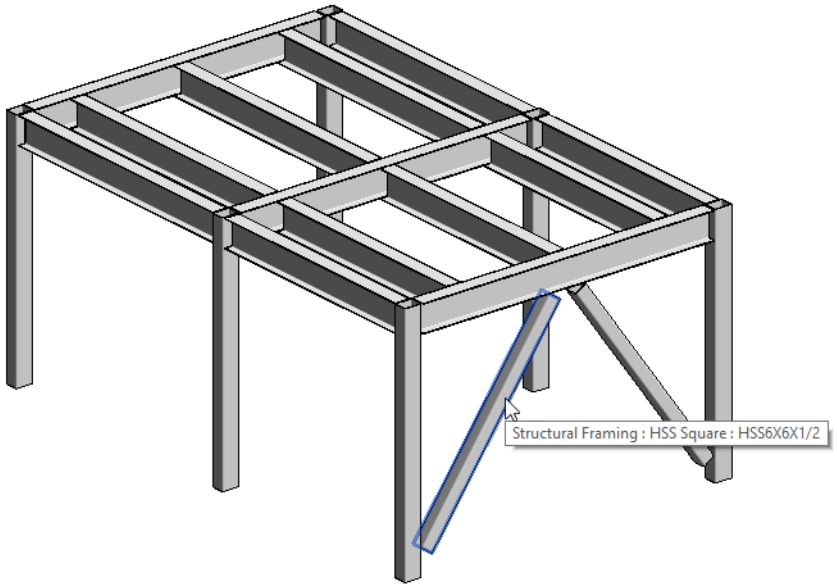
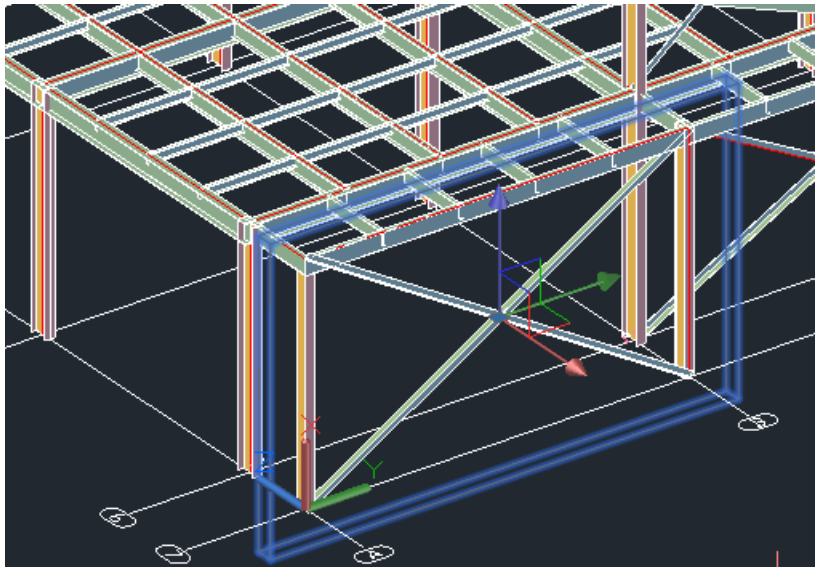
Autodesk Revit	Advance Steel
Columns and beams are placed using standard Autodesk Revit tools. These tools make it easy to place them at grid intersections and create beam systems of joists between girders. 	Columns and beams are placed using custom tools based on the shape of the steel. Joists between girders are created individually. 

Basic Steel Modeling

Autodesk Revit	Advance Steel
Select styles and sizes in the Type Selector and then modify information in Properties and Type Properties.	Modify information in Advance Properties dialog box. It displays after you place the structural element or right-click on the element and select Advance Properties.

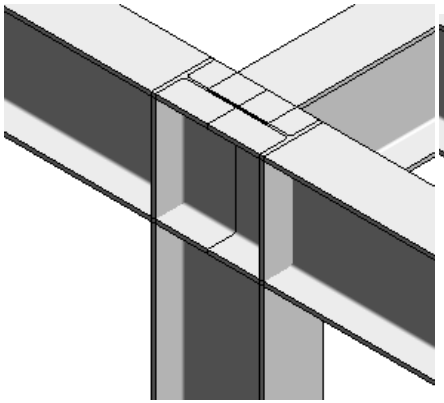




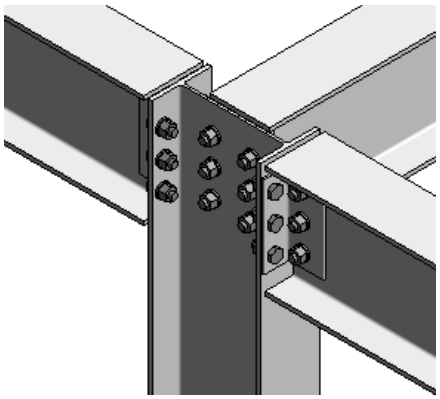
Basic Steel Modeling	
Autodesk Revit	**Advance Steel**
Model bracing by picking points. 	Model bracing using a tool that gives options for types of bracing. 

Steel Connections

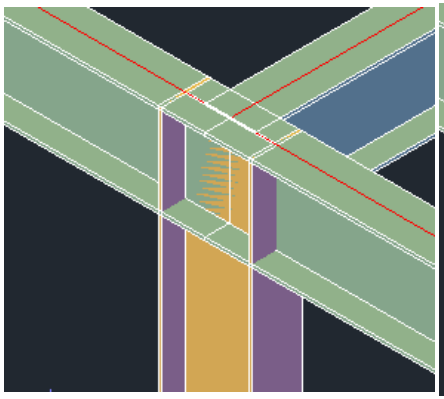
Autodesk Revit	Advance Steel
Steel connections in Autodesk Revit are built on the Advance Steel tools. Connections cut back framing and add plates, bolts, and welds as specified.	Steel Connections are custom macros created specifically for Advance Steel that cut back framing and add plates, bolts, and welds as specified.



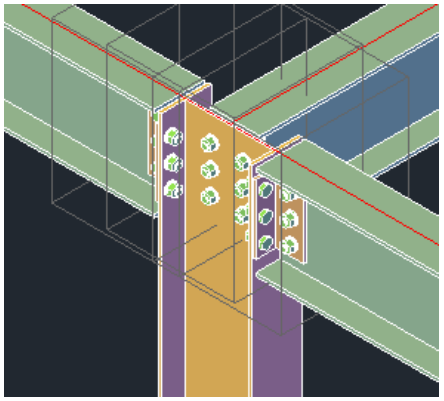
Before Connection



After Connection

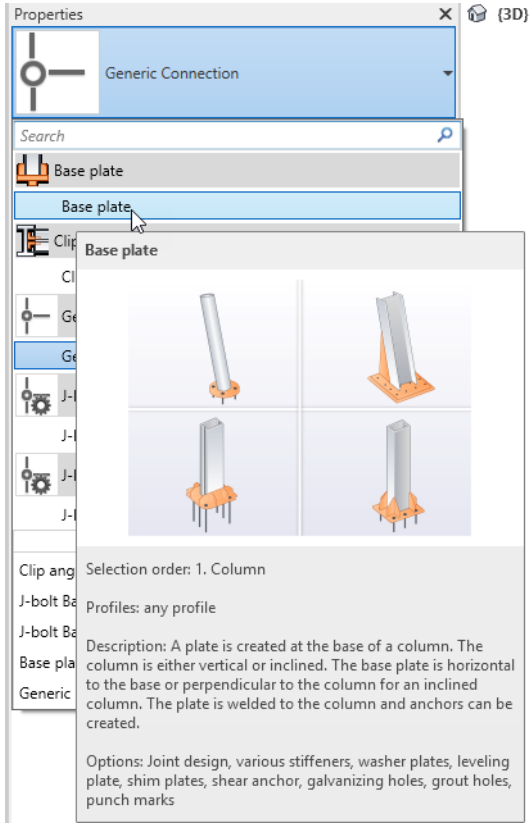
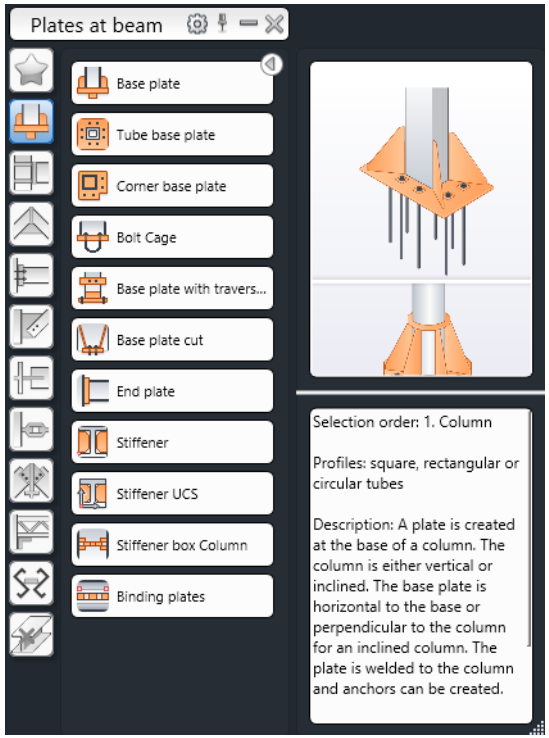


Before Connection

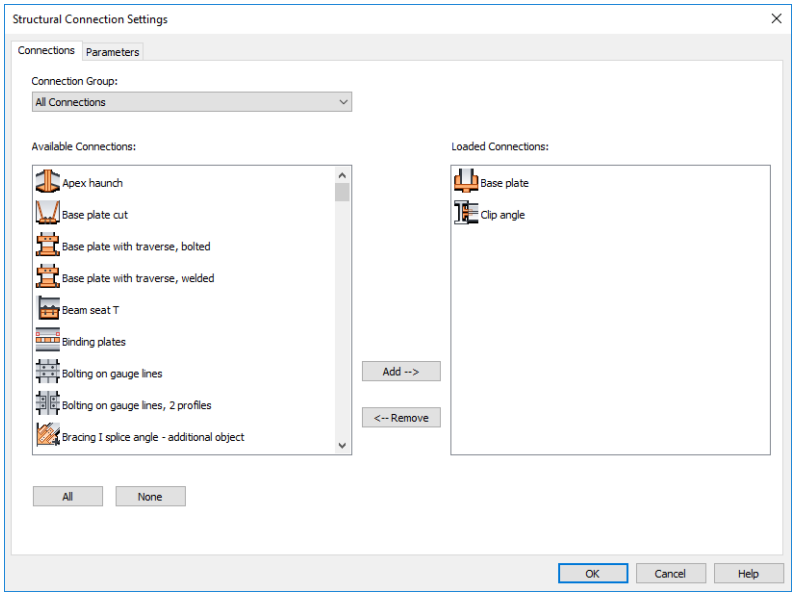
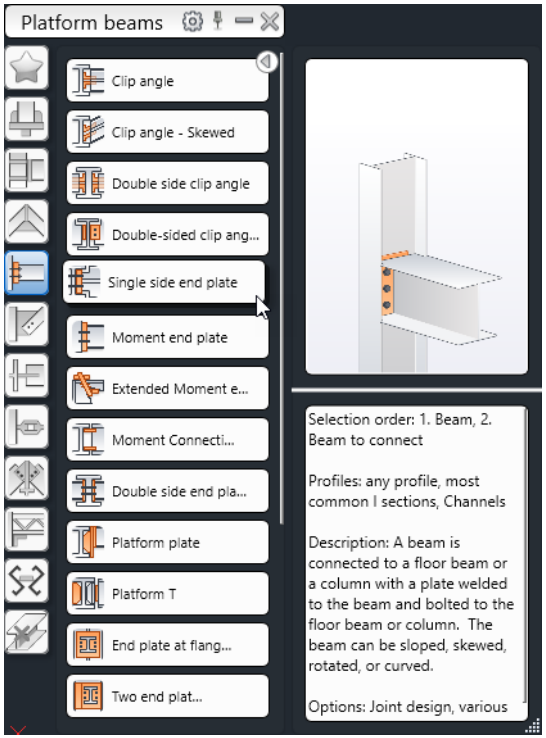


After Connection

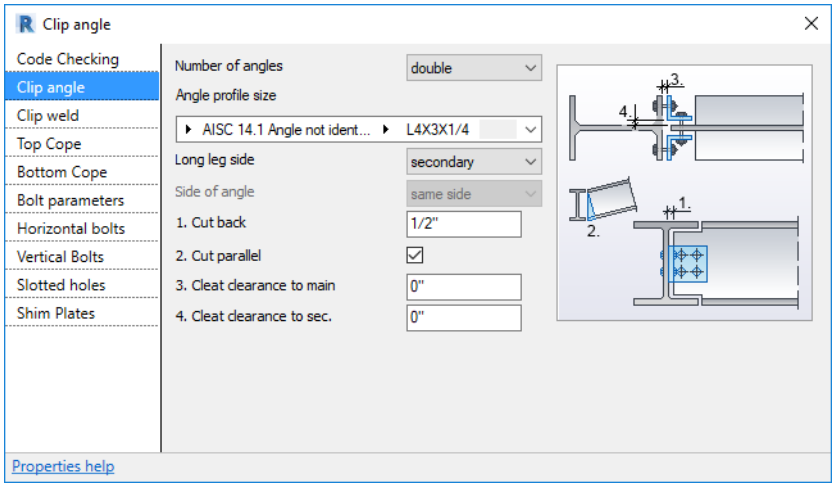
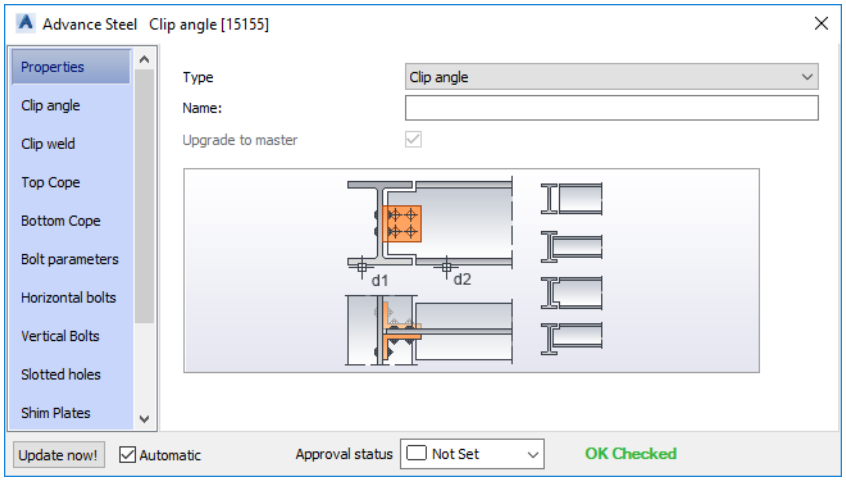
Steel Connections

Autodesk Revit	Advance Steel
Steel connections are available in Autodesk Revit 2019. In previous versions, you needed the Steel Connections for Autodesk Revit add-in. In the *Steel* tab> Connection panel, click (Connection). Then, select the connection you want to use from the Type Selector. Information about the connection displays in the tool tip. 	Connections are available by default in the Connection Vault. Click on the tool you want to use. The tool tip tells you the order in which you need to select the components. 

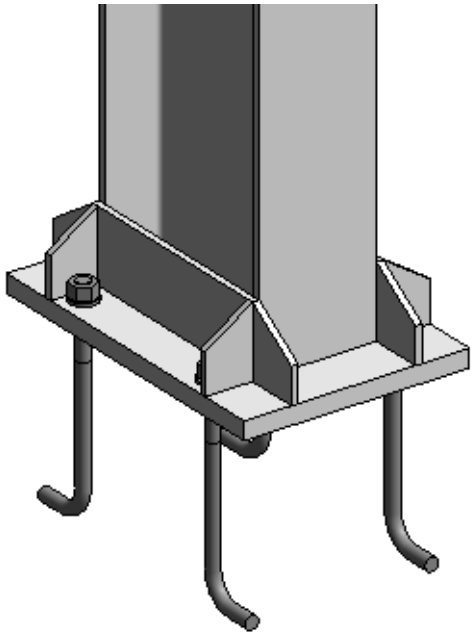
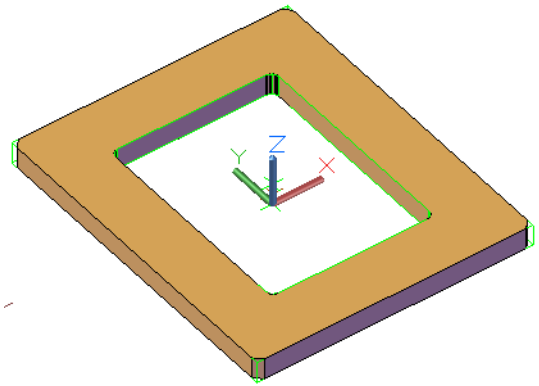
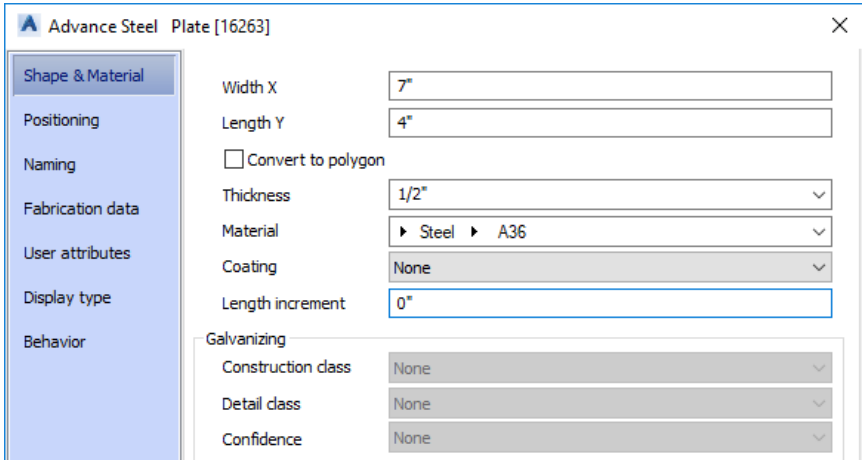
Steel Connections

Autodesk Revit	Advance Steel
Load Connections through the Connection Settings dialog box. 	The standard connections are available through the Connection Vault without you having to load them. The connections are divided into categories. 

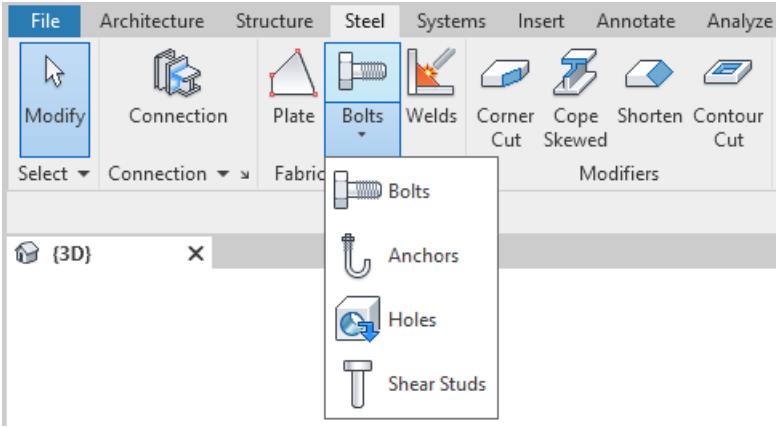
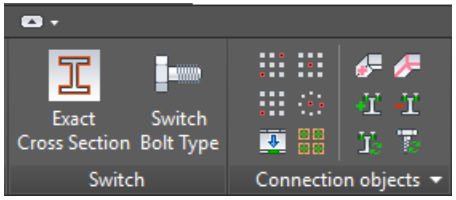
Steel Connections

Autodesk Revit	Advance Steel
Modify parameters:  To save changes, you need to create custom types. Custom connections have to be built on an existing connection.	Modify Joint Boxes:  Changes can be saved to the library and applied to other locations. You can create custom connections from scratch. An additional tool, Joint Groups, enables you to change one joint, and the related joints change accordingly.

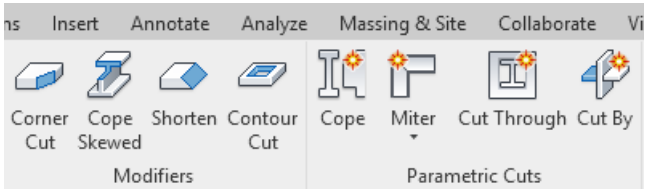
Other Connection Tools

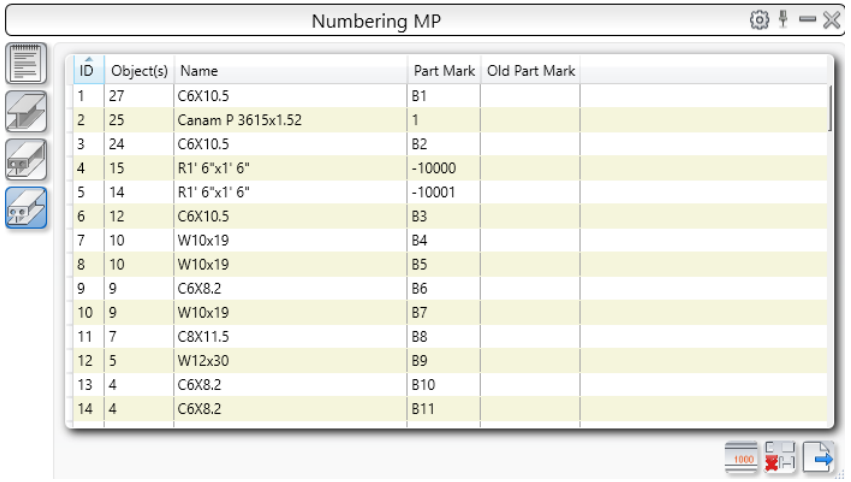
Autodesk Revit	Advance Steel
You can create flat plates within the Autodesk Revit model. Typically, you would do this to add to a custom connection such as the stiffeners, added to the base plate shown below. 	A variety of plate tools are included in the Autodesk Advance Steel software, including flat plates, conical and twisted plates.  

Other Connection Tools

Autodesk Revit	Advance Steel
You can add Bolts and Welds using tools found on the *Steel* tab. 	You can add Bolts and Welds using tools found on the *Objects* tab. Click on the Switch Bolt Type icon to toggle through the different types. 

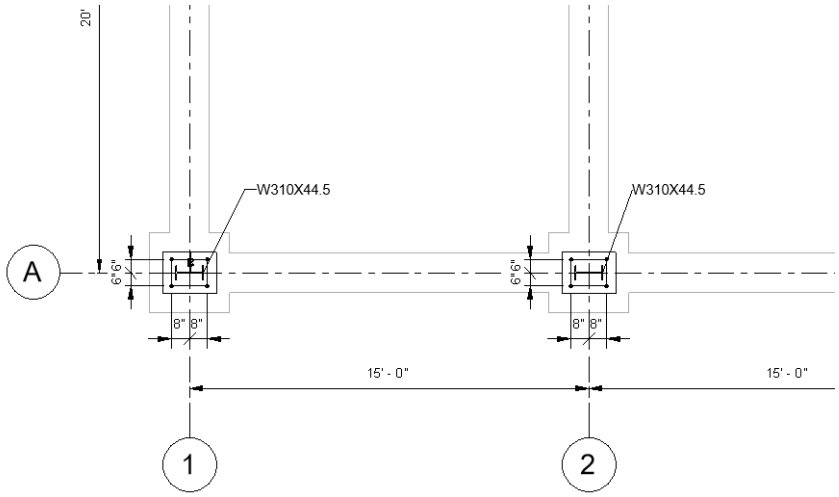
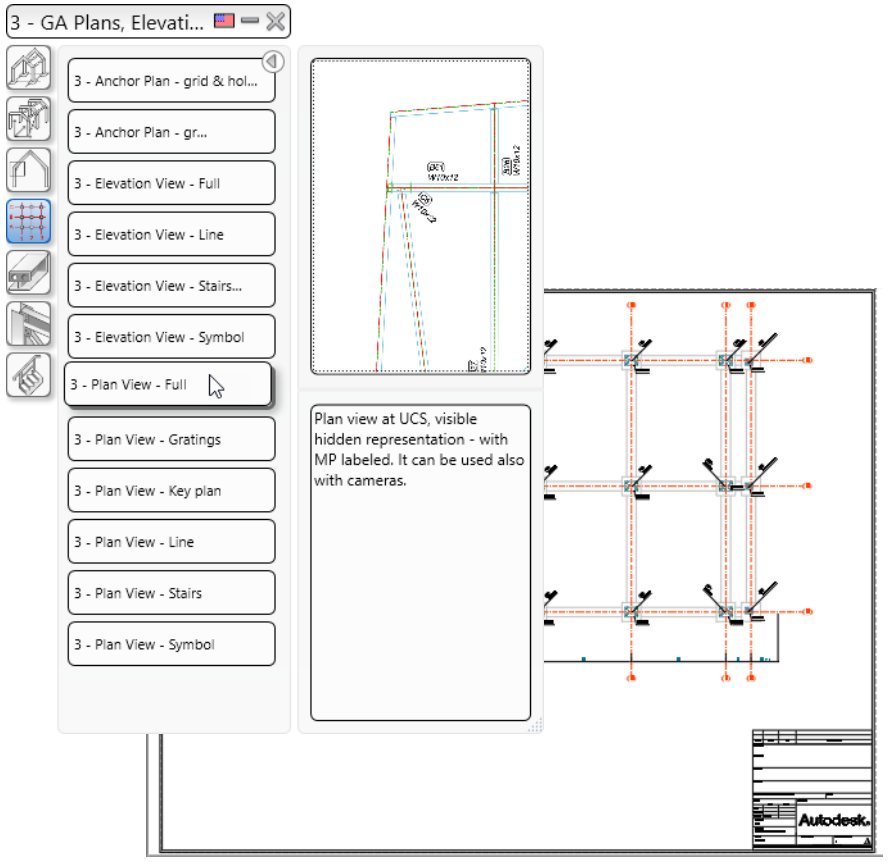
Other Connection Tools

Autodesk Revit	Advance Steel
You can add Modifiers and Parametric cuts to beam and plate elements using the tools found on the *Steel* tab. 	Features tools help you create coping, cutbacks, corner cuts, miters and more. They are available in the Advance Tool Palette on the *Features* category.

Documentation and Fabrication Tools	
Autodesk Revit	**Advance Steel**
Autodesk Revit connections do not have part marks or assembly marks.	Number objects assign part marks and assembly marks. 

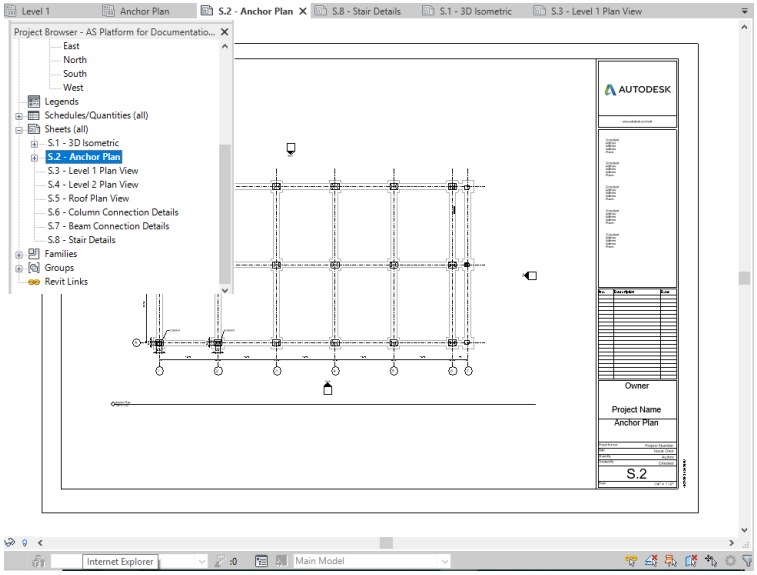
ID	Object(s)	Name	Part Mark	Old Part Mark
1	27	C6X10.5	B1	
2	25	Canam P 3615x1.52	1	
3	24	C6X10.5	B2	
4	15	R1' 6"x1' 6"	-10000	
5	14	R1' 6"x1' 6"	-10001	
6	12	C6X10.5	B3	
7	10	W10x19	B4	
8	10	W10x19	B5	
9	9	C6X8.2	B6	
10	9	W10x19	B7	
11	7	C8X11.5	B8	
12	5	W12x30	B9	
13	4	C6X8.2	B10	
14	4	C6X8.2	B11	

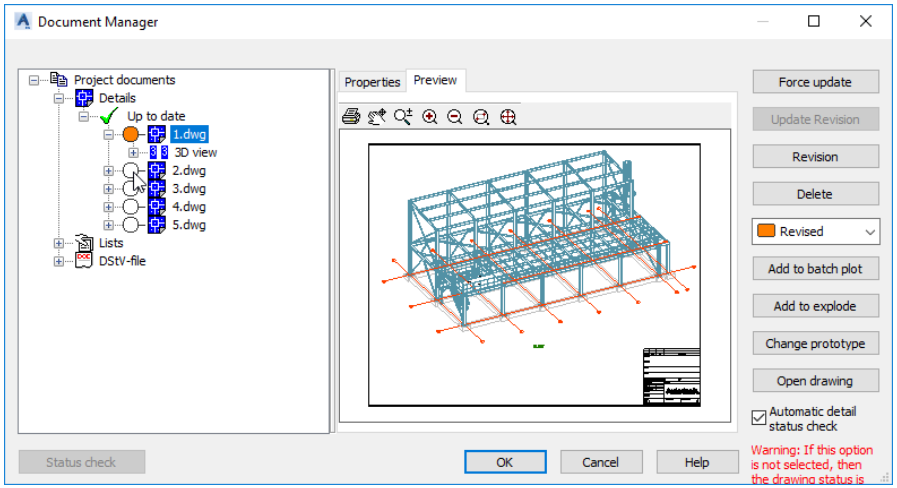
Documentation and Fabrication Tools

Autodesk Revit	Advance Steel
Creating 2D drawings from the 3D model is possible but everything has to be done manually: • Duplicate views, cut sections and/or make 2D drafting views for detailing. • Change the status of items such as concrete beams to halftone. • Hide any elements you don't want to show. • Add tags, dimensions, text. • Place the view on a sheet. 	Creating 2D drawings from the 3D model is highly customized and most of the information is automatically applied. 

Documentation and Fabrication Tools

Autodesk Revit	Advance Steel
Revisions are managed by sheet and must be manually applied. All of the sheets are part of one project file and can be accessed through the Project Browser.	Use the Document Manager to review, update, and set revisions.





Documentation and Fabrication Tools

Autodesk Revit

You can create Bill of Material (BOM) schedules in Autodesk Revit. Once the schedule is created, the items automatically populate the schedule.

Some custom parameters may need to be created to gather the expected information.

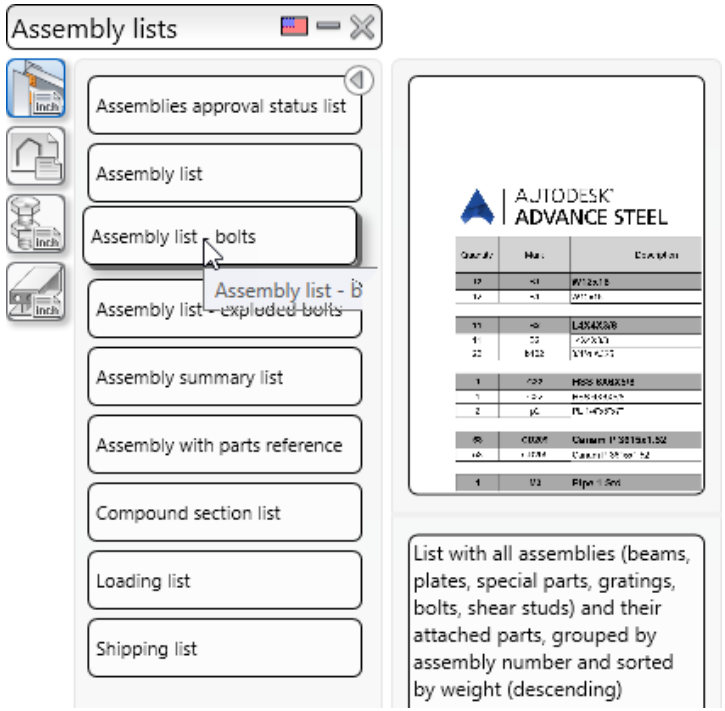
Steel Framing Material Takeoff

<Steel Framing Material Takeoff>

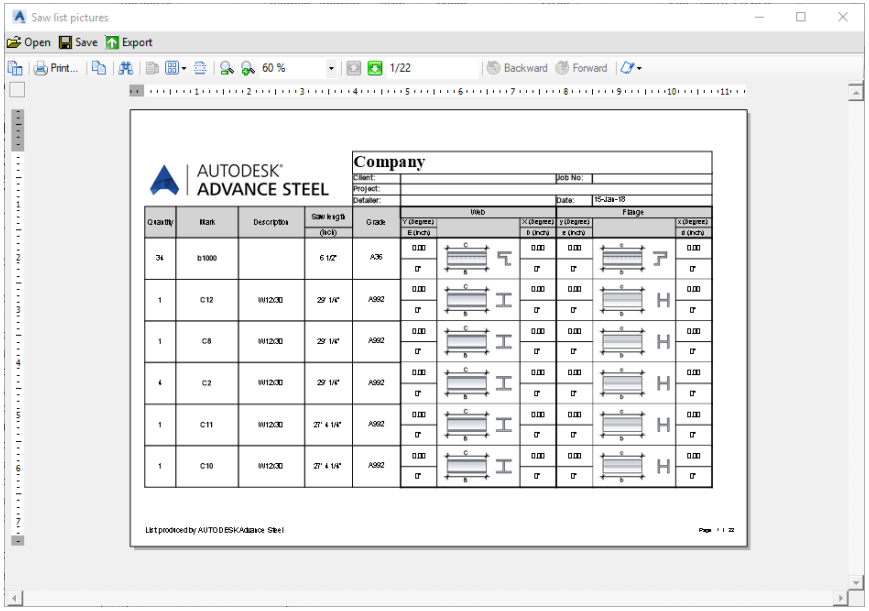
A	B	C	D	E	F
Count	Type Mark	Family and Type	Material: Unit weight	Material: Area	Material: Description
20		C Shapes: C6X8.2	490.00 lb/ft³	16 SF	Structural steel, ASTM A36 Grade B, mill finish
63		C Shapes: C6X10.5	490.00 lb/ft³	8 SF	Structural steel, ASTM A36 Grade B, mill finish
8		C Shapes: C8X11.5	490.00 lb/ft³	8 SF	Structural steel, ASTM A36 Grade B, mill finish
9		C Shapes: C10X15.3	490.00 lb/ft³		Structural steel, ASTM A36 Grade B, mill finish
2		HSS Square: HSS3X3X1/4	490.00 lb/ft³	9 SF	Carbon steel
12		L Equal Angles: L3-1/2X3-1/2X1/4	490.00 lb/ft³		Structural steel, ASTM A36 Grade B, mill finish
34		L Equal Angles: L3X3X1/4	490.00 lb/ft³	1 SF	Structural steel, ASTM A36 Grade B, mill finish
26		M_Flat Bars: FL 6.35X101.6	490.00 lb/ft³		Structural steel, ASTM A36 Grade B, mill finish
3		M_HSS Rectangular-Column: HSS203.2X152.4X7.9	490.00 lb/ft³		Carbon steel
12		M_MC Shapes: MC310X15.8	490.00 lb/ft³		Structural steel, ASTM A36 Grade B, mill finish
220		M_Pipe: Pipe25STD	490.00 lb/ft³		Structural steel, ASTM A36 Grade B, mill finish
18		M_W Shapes-Column: W310X44.5	490.00 lb/ft³		Structural steel 50ksi
44		M_W Shapes: W250X28.4	490.00 lb/ft³		Structural steel 50ksi
27		M_W Shapes: W310X44.5	490.00 lb/ft³		Structural steel 50ksi
17		PL 14x9 516x3": Folded	490.00 lb/ft³	5 SF	Structural steel, ASTM A36 Grade B, mill finish

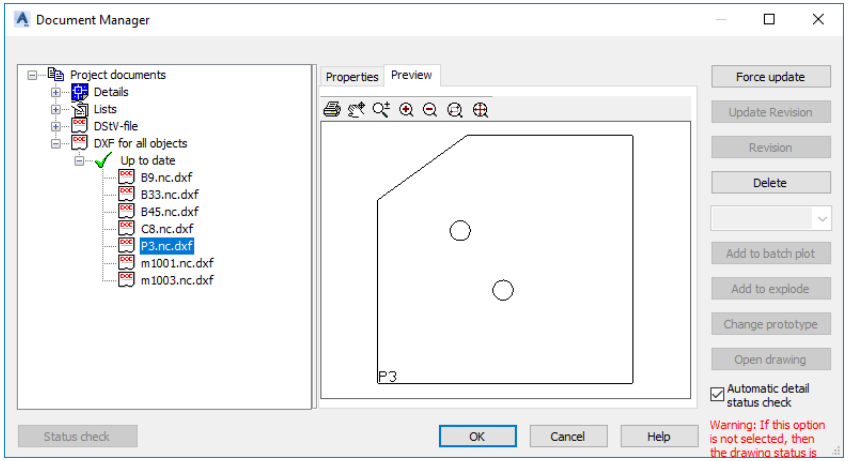
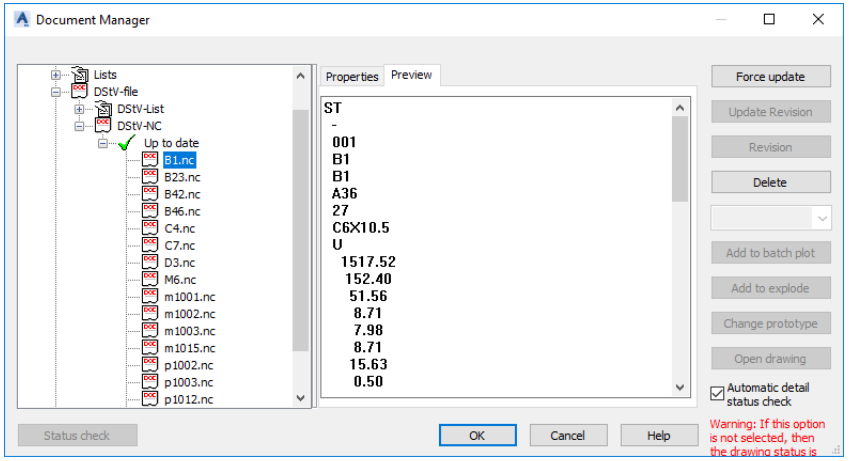
Advance Steel

Bill of Material (BOM) files can be exported and saved to .PDFs or to files that can be reviewed in the Document Manager. These BOMs can provide you with many types of lists, including lists of all of the bolts in the model, to all of the items that need to be shipped to a site.



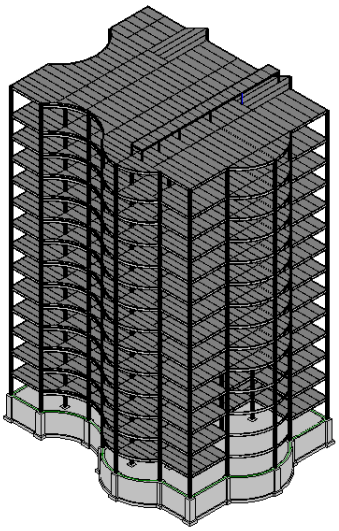
Documentation and Fabrication Tools

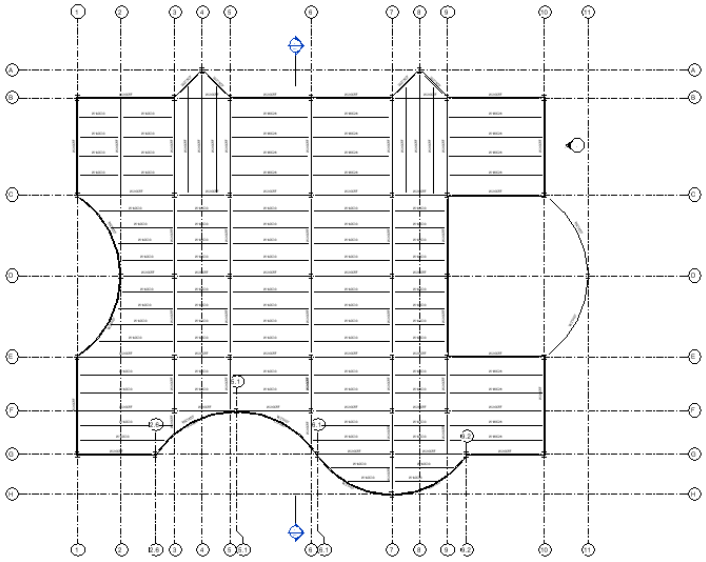
Autodesk Revit	Advance Steel
	

Documentation and Fabrication Tools	
Autodesk Revit	**Advance Steel**
Autodesk Revit does not have direct-to-fabrication tools.	Numerical Control (NC) machines can take data from the Autodesk Advance Steel model and fabricate the materials without requiring someone to read the drawings. You can export .DXF or .NC files from the model through simple commands. 
	

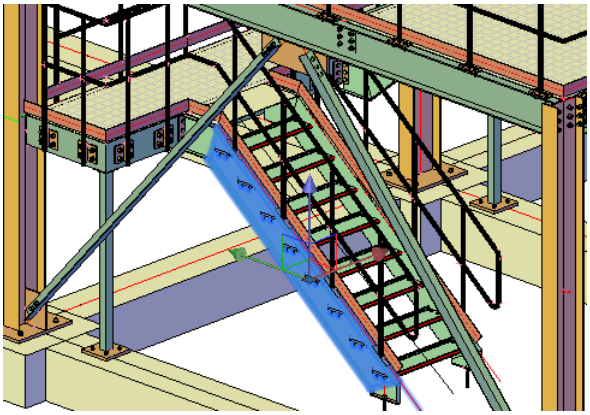
Steel Connections in Autodesk Revit and Advance Steel Conclusion

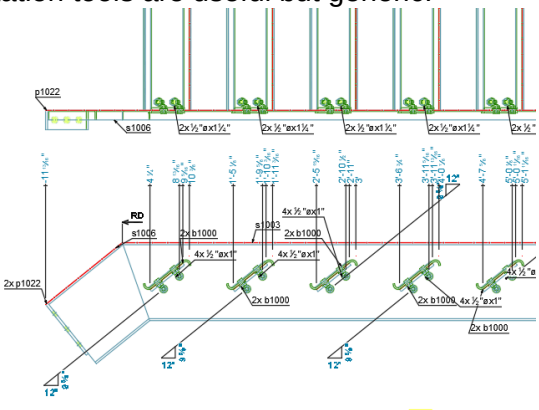
As you look through all the comparisons between Autodesk Revit and Advance Steel, you can see that the process of Level of Development (LOD) can impact which software needs to be used. The fact that you can build on an architectural model without having to recreate datums and even column locations from scratch is a big asset to using Autodesk Revit for the Design Development Phase of a project. Adding most of the basic steel structural elements is also a smoother process in Autodesk Revit than in Advance Steel. The fact that you can now add detailed connections to Autodesk Revit allows for even more control over the design by the structural engineers.





Advance Steel, on the other hand, has tools that make the model so much easier to develop to the full LOD 400 needed for construction and fabrication. For example, creating steel stairs and railings to this full level of detail should not even be attempted in Autodesk Revit. The documentation tools are especially helpful as well. They are designed specifically for this high level of detail while the Autodesk Revit documentation tools are useful but generic.



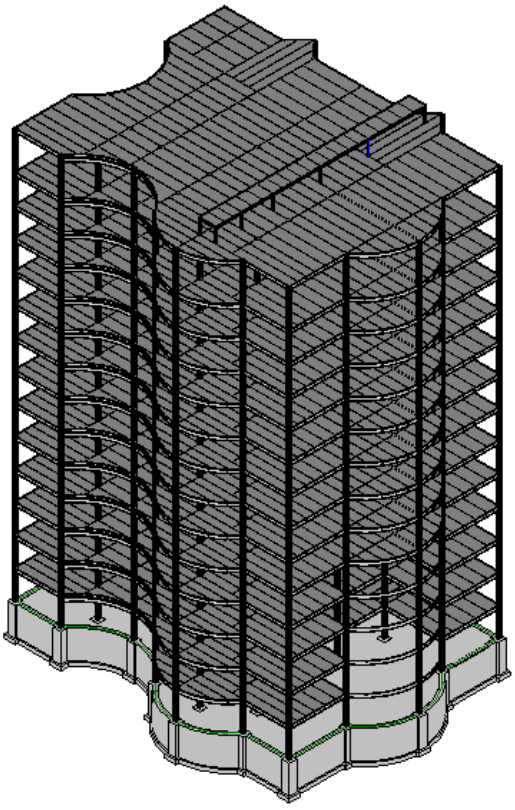


The basic outcome is that a proper workflow between the two programs, where you model the structural framework and some level of connections in Autodesk Revit and add more precision and documentation in Advance Steel, is a smart way to work.

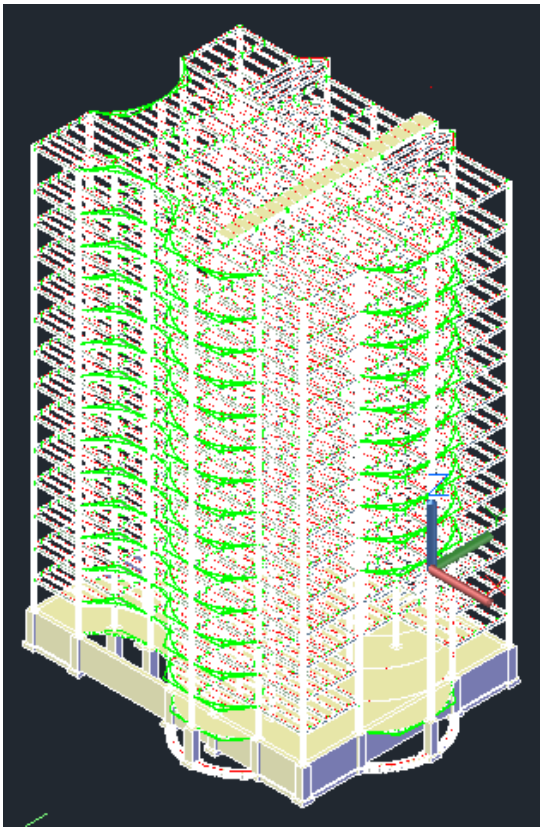
Design to Fabrication Workflow

- Develop a complete design to fabrication workflow using the interoperability features of Autodesk Revit and Advance Steel.

As you can see from the Level of Development and comparison of Autodesk Revit 2019 with steel connections and Advance Steel, there is still plenty of room to use both software applications in the design to fabrication workflow. It helps to use the right one at the right time, so a critical path is to work together using the proper export, import, and synchronization processes.



Autodesk Revit Model at LOD 300

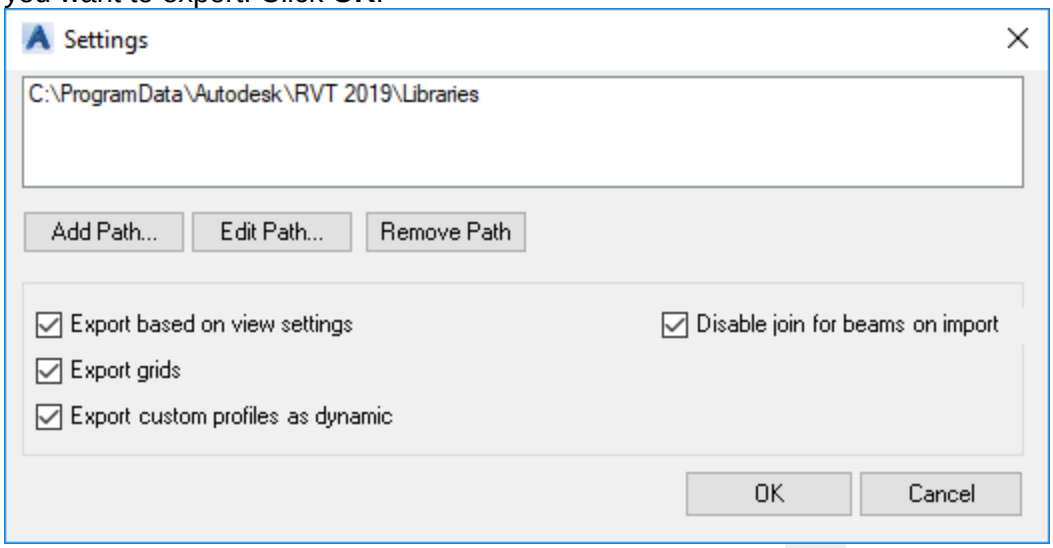


Imported into Advance Steel

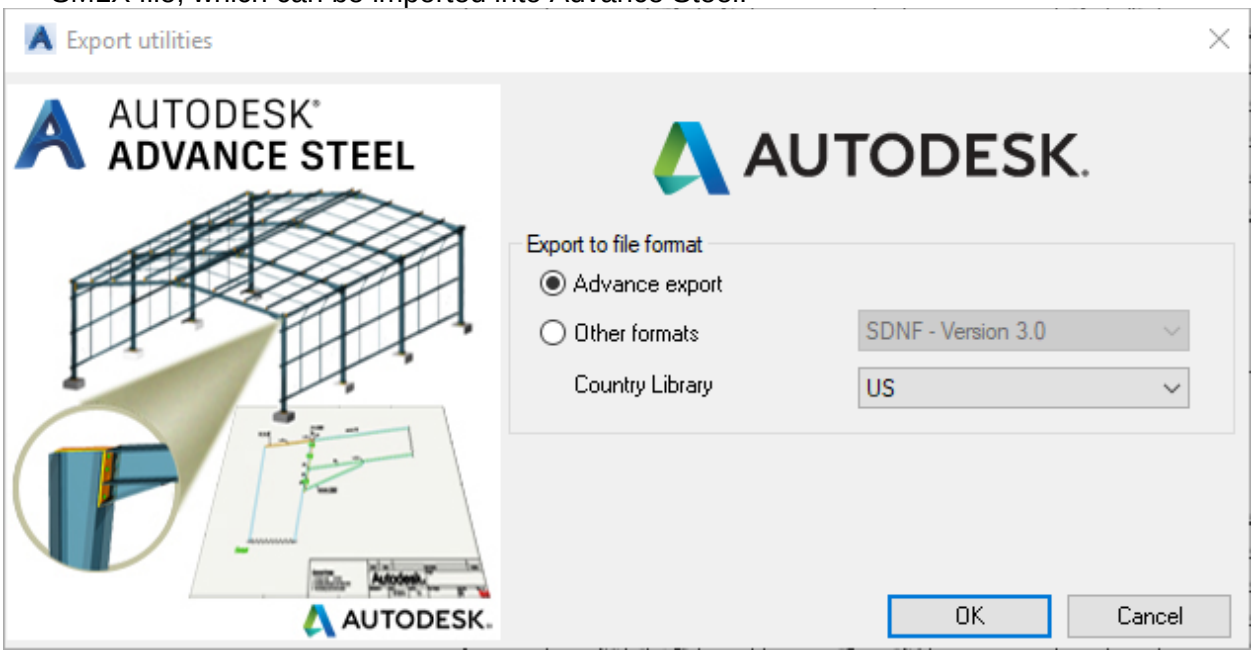
How To: Export from Autodesk Revit to Advance Steel

1. Start Autodesk Revit and open the project you want to share with Advance Steel.
2. Open a 3D view if you want the entire project exported. Open a 2D view if you want only one level exported.

3. In the *Add-ins* tab> Advance Steel Extension panel, expand (Advance Steel Extension) and click (Settings).
4. In the Settings dialog box, specify the location where you want the file saved and what you want to export. Click **OK**.

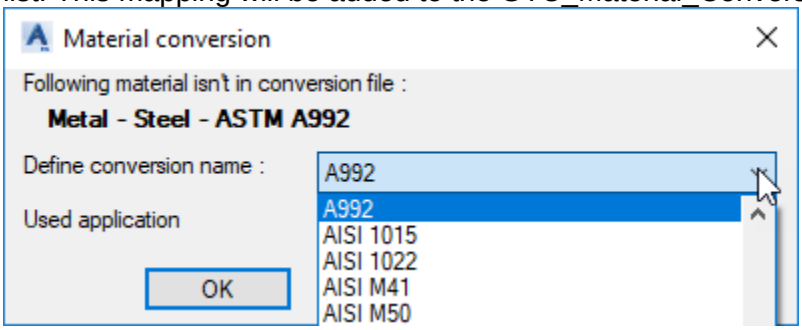


5. In the *Add-ins* tab> Advance Steel Extension panel, expand (Advance Steel Extension) and click (Export).
6. In the Export utilities dialog box, select **Advance export** and click **OK**. This creates a SMLX file, which can be imported into Advance Steel.

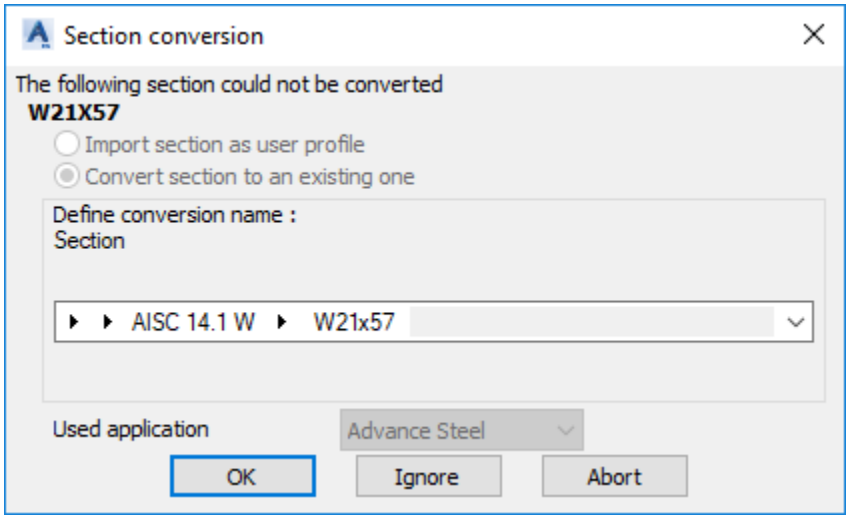


How To: Import from Autodesk Revit to Advance Steel

1. Start Advance Steel.
2. Start a new drawing based on a template file. The default is ASTemplate.dwt.
3. In the *Export & Import* tab>Revit panel, click (Import).
4. In the Open dialog box, navigate to the appropriate file folder, select the .SMLX file and click **Open.**
5. If the Material conversion dialog box appears, select a *Define conversion name* from the list. This mapping will be added to the GTC_Material_Conversion table.



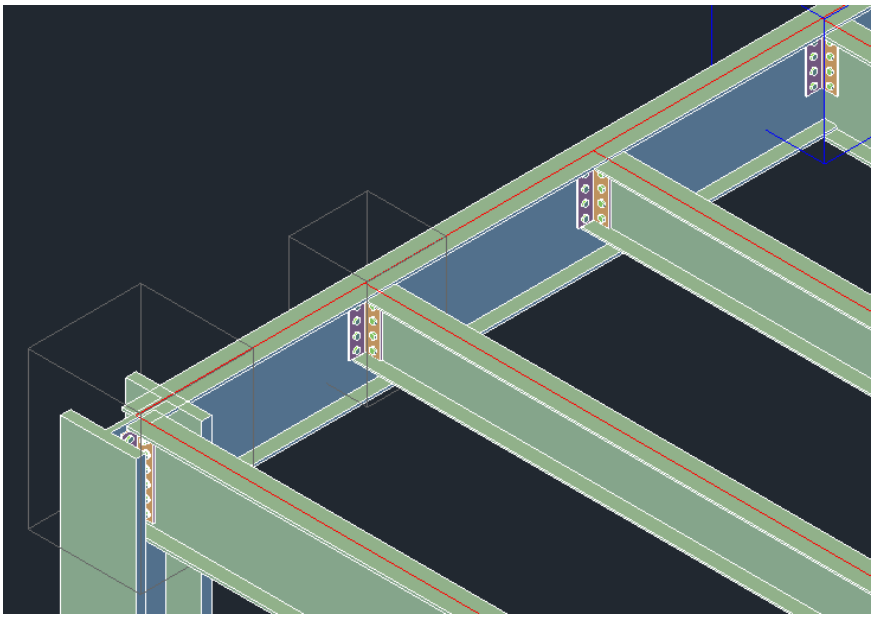
6. If the Section conversion dialog box appears, select an appropriate section name and click **OK**.



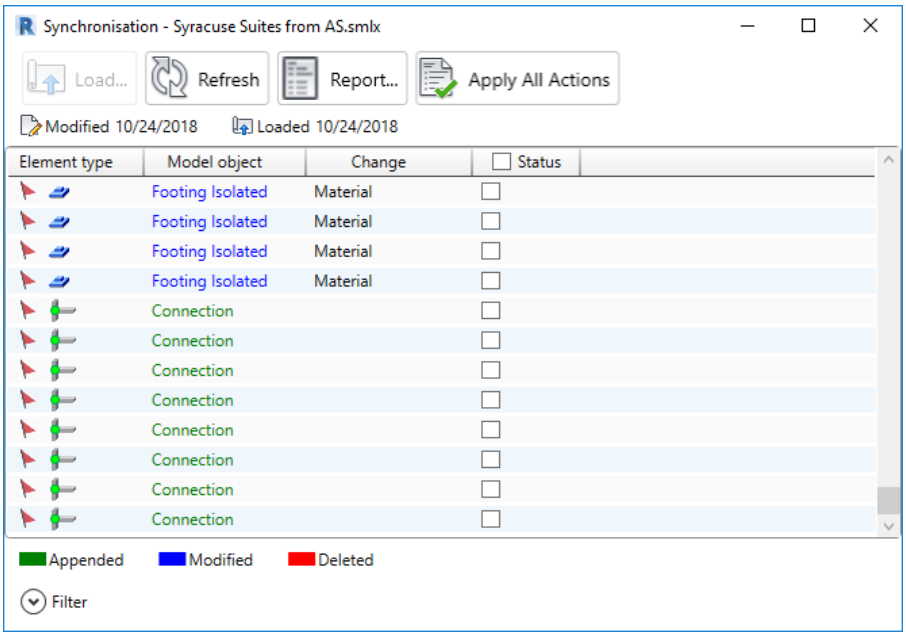
7. Steel members and steel connections get imported into Advance Steel.
8. Save the file.

How To: Synchronize Changes from Advance Steel to Autodesk Revit

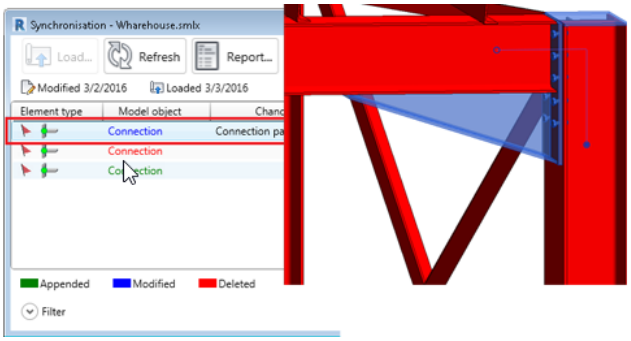
1. Make changes and add connections to the Advance steel model such as the clip angles shown in the figure below.



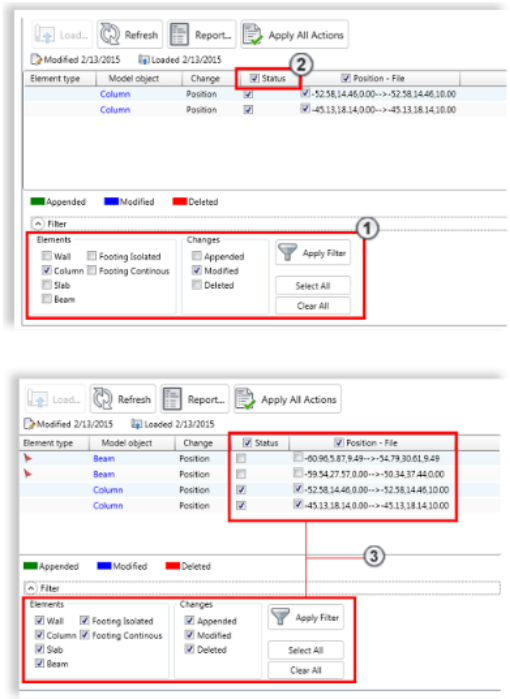
2. In the *Export & Import* tab>Revit panel, click (Export).
3. Save to .SMLX file.
4. Open Autodesk Revit and the original file you first exported to Advance Steel.
5. In the *Add-ins* tab>Advance Steel Extension panel, expand (Advance Steel Extension) and click (Synchronize).
6. In the Synchronisation dialog box, click (Load…) and select the SMLX file you want to synchronize the project with.



a. The modifications for each object will appear in a list which can be filtered. You can add or remove columns in the list, by right clicking in the dialog and selecting options from the contextual menu.
b. You can apply the changes for the selected modifications or for the entire set.
c. To quickly spot the Autodesk Revit model objects, you can double-click on the lines inside the Synchronisation dialog box to highlight and zoom in on the objects in the model.



d. In the Synchronisation dialog box, the main tick boxes work with applied filters. If the objects are selected using the filters and a main tick box is activated, only those lines will have the individual tick box selected.

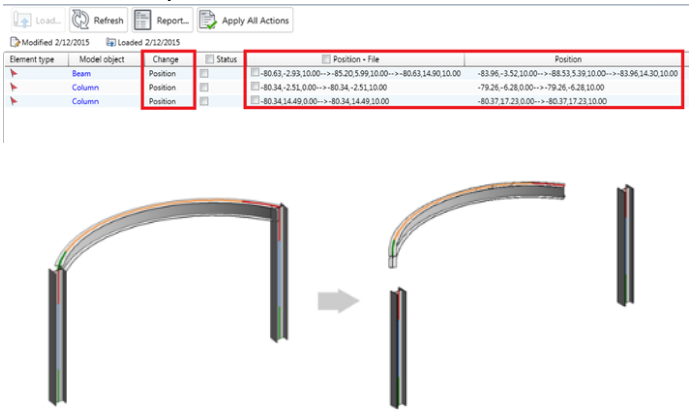


① Column elements were selected to be displayed.

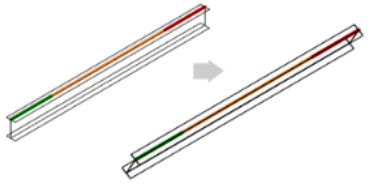
② Status main tick box was selected.

③ All objects were made visible again.

e. The Synchronisation dialog box displays both Position and Offset changes in a single modification line. You are prompted with the coordinate points of the start and end points of the system axis. This applies to all linear elements, including curved beams. Straight axes are defined by 2 points with the following syntax "0,0,0->1500,0,0" and curved beam axes are defined by 3 points "0,0,0->1500,1500,0->3000,0,0", where the middle coordinates represent the midpoint of the curved beam.



f. Beam and Column section rotations are spotted and applied by the Synchronisation dialog box in Autodesk Revit. The change is displayed with the word Angle.



Conclusion

From our review of the features found in Autodesk Revit and Advance Steel, you can see the importance of level of development (LOD) when deciding which software you should use as you move from structural steel design to fabrication.

We looked at how complex steel connections, custom plates, bolts, and welds are created in Autodesk Revit and Advance Steel and reviewed the extent to which construction and fabrication documents are created in each program. As you develop a complete design to fabrication workflow, you can use the interoperability features of Autodesk Revit and Advance Steel to move seamlessly from Autodesk Revit (used primarily for design) to Advance Steel (used primarily for fabrication). Both programs work together to expedite the process of steel design to fabrication.

References

- https://blog.areo.io/level-of-development/
- https://network.aia.org/HigherLogic/System/DownloadDocumentFile.ashx?DocumentFileKey=6a27a32c-93e0-4ebc-8ec1-f31c52cf71a4
- https://bimforum.org/lod/