Reducing Waste in Structural Steel Fabrication with BIM

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Learning Objectives

- Discover how structural engineers and steel fabricators are reducing rework through BIM
- Learn how you can turn a design model into a ready for fabrication detailed model
- Discover how the problems can be identified prior to fabrication
- Understand how you can drive and automate the fabrication off-site

Description

In this class we will explore how prefabricated parts for structural steel can be designed with BIM-based integrated workflows and how this process helps reduce waste in steel fabrication, decrease the risk of costly errors and increase quality and speed in the construction.

Speaker

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Discover how structural engineers and steel fabricators are reducing rework through BIM

This chapter will explain how you can easily create a 3D model using a BIM workflow.

Structural steel design

Steel frame modelling

Structural engineers can model steel frame in the Revit environment.

![Steel frame model in Revit](image)

Detailed steel design

With Revit 2019, you can use edit tools to more easily modify structural framing & column elements and apply custom parametric cuts to better accommodate the geometry of elements at a connection.

![Edit tools in Revit](image)

Steel components like plates, bolts, anchors, shear studs, and welds can now be placed in the 3D model to connect structural members together.
Standard steel connections

Revit users have access to a comprehensive library of 125+ parametric connections, which helps speed up modeling steel connections with an elevated level of detail in the Revit environment. Remark: there is no more need to install the separate “Steel Connections for Revit” add-in like it was with the previous Revit releases, as these connections are available out-of-the-box in Revit 2019.

Integrated code checking

Most common steel connections include a built-in steel connection design engine based on US (AISC) and European (EC3) codes which allows structural engineers to verify the connections in Revit before the model is sent to the steel detailer for final detailing.
General arrangement drawings

You can use a set of dedicated tools to create detailed engineering drawings where steel connections are represented accurately. These structural drawings are easily created, complete with dimensions, tags & schedules.

Schedules

You can get a better understanding & evaluation of steel components with accurate schedules automatically generated out of the 3D model.

These schedules can include information for steel elements such as beams & columns, and (new in Revit 2019) also bolts and plates.
From steel design to steel detailing

The Advance Steel Extension for Revit enables you to import/export/synchronize a model between Revit and Advance Steel.

Model without steel connections

The Advance Steel Extension for Revit enables you to import a Revit model containing steel columns & steel framing into Advance Steel so that you can easily insert all steel connections in the Advance Steel environment.

Model with steel connections

The Advance Steel Extension for Revit enables you to import not only the structural members but also the steel connections into Advance Steel so that you can continue to work where the designer left off.

Preliminary list

You can generate a Material list summary for ordering steel elements.
Changes management

The Revit user can use the Synchronization feature to load the file and see the differences between the Revit model and the Advance Steel model. The different colors clearly show what has been added, modified or deleted. The Revit user has a full control of these changes and can either accept them one by one or apply all of them in one click.

Working with BIM 360

BIM 360 Docs helps connect Autodesk’s AEC products and customers.
Learn how you can turn a design model into a ready for fabrication detailed model

Advance Steel offers various tools to complete and validate the 3D model before creating all the documentation required to start the fabrication at the workshop.

Speed up the modelling of connections

Connection vault

Advance Steel offers a large library of ready-to-use parametric steel connections which can be accessed through the Connection vault.

Transfer properties

You can transfer properties (parameters) of a connection to another existing connection of the same type.
Create a group of connections

Advance Steel offers the possibility to create a group of connections which makes the modifications easier to manage.

If you modify one of these grouped connections, it will automatically update all the steel connections which are in this group.

This is very helpful in case you have the same connections occurring multiple times in your project.
Standardize with standard connections

With Advance Steel connections, you can save any joint configuration to the library of each joint, the saved values will then be available for use in the current project and for future projects.

Learn more with this video: https://www.youtube.com/watch?v=E0pja8gMFLE

Miscellaneous steel

Advance Steel has powerful tools for miscellaneous steel creation.

You can create straight and spiral stairs, straight and curved railings, and cage ladder with the use of special wizards.
You can easily modify their properties using a large selection of customizable parameters.

For example, you can choose from the properties dialog box if components (e.g. treads, elbows) are shop-bolted or shop-welded components.

Learn more with this video: https://www.youtube.com/watch?v=YGrBciSojP8
Specific tools for advanced fabrication

You can create punch marks in the 3D model by using dedicated tools available in (some of the) automatic connections such as the base plate connection. These punch marks will help assembly steel parts more efficiently at the workshop.

You can control the hole definition (e.g. slotted hole) in the bolts properties dialog box, it lets you decide on which connected parts these specific holes must be created.
Automatic equal part detection

If the fabricator is using the same (standard) parts in multiple projects, it is a good idea to create a library file (Advance Steel DWG file) containing one example of each standard part or assembly. This reference file(s) must be saved in the “StandardPartTemplate” sub-folder.

Then when running the Numbering, you just need to go to the Standard Part Template tab in the Numbering dialog box and select the template file(s) containing your standard parts.

If a part found in this project matches a part (or an assembly) from one of the template files, then it will automatically receive the same number as it has in the reference file.
Discover how the problems can be identified prior to fabrication

It is always a good thing to check your model before creating the documentation out of it, in Advance Steel you will find different tools for checking e.g. if elements are well-connected together and if the numbering has been run correctly.

Validating a structure

Advance Steel includes a range of tools to help you validate your 3D model.

Clash check

You can run clash detection to know if the 3D model contains any collisions or errors - for instance if some beams remain unconnected. You can then easily display the interferences one by one and zoom to the interference volume displayed in red color.

If you want to run the clash check only on a small portion of your model, just select those parts (e.g. with a window selection) before running the collision check tool. If nothing is selected, the entire model is checked.

Remark: the result is most effective in the 2D Wireframe visual display mode.
Loose parts

You can mark loose parts (= standalone parts) in red color by clicking Mark loose parts icon. In the Output tab, Parts marks, press Mark Loose Parts icon.

Model browser

The Model Browser provides complete control of all the elements of the model. You can open the Model Browser at any time to get up-to-date information on each object. The list of elements and their properties are displayed as a table. The set of displayed properties can be customized by adding or removing columns.
Project explorer

With the project explorer you can more easily display some parts of your 3D model.

Model views

If you want to limit what is on screen to just the relevant objects in the required area, you can create model views & level views in the Project Explorer. Then just click the light bulb icon in front of the name in the Project Explorer to toggle it on.

You can select more than one light bulb icon in front of the model views in the Project Explorer to get several model views being displayed at the same time.
Create a query

The Project Explorer offers the possibility to create a Query (e.g. search for Advance Steel objects which model role is “Column”).

Visual filters

When creating a query, you can assign a color to the marked objects.
Preassembled steel components

Advance Steel offers tools to manage preassembled steel components.

Display shop-welded assemblies

You can pick any part of your 3D model and display what is shop-bolted or shop-welded with this part by using the “Show only selected assemblies” icon.

Center of gravity

The Center of Gravity point of an object can be found in the model by using the “Center of gravity and total weight calculation” command. As a result, an AutoCAD point is displayed in the model showing the center of gravity of that part.
Understand how you can drive and automate the fabrication off-site

Advance Steel users can leverage ready-to-use templates available out-of-the-box to automatically create shop drawings

Shop drawings

Steel detailers and/or steel fabricators need to create documents that provide information necessary for shop personnel to fabricate & assemble the steel components.

Dedicated drawing styles & processes

Shop drawing templates can be used to create more accurate single part and assembly drawings at any time.

Single part drawings

Single part drawings can be generated automatically for selected parts by using dedicated drawing processes. The single part drawings get labelled and dimensioned automatically to help support more accurate fabrication in the shop.

Assembly drawings

Assembly drawings can be generated automatically for selected assemblies by using dedicated drawing processes. The assembly drawings get labelled and dimensioned automatically to help support more accurate assembly in the shop.
3D view

You can easily add an isometric view of a (complex) assembly to its shop drawing.

Just isolate the entire assembly in the 3D model and then use a dedicated drawing style to add the 3D view on the existing assembly drawing of the beam.

The result will give something like that:
Changes management

Advance Steel is intuitive enough to inform the user in real time if documents such as drawings, bill-of-materials and CNC data require an update.

Advance Steel offers the possibility to update the drawings with an integrated revision control.

Just enter all necessary information about the revision and get the drawing updated with changes highlighted by the automatically created revision clouds.
Link to CNC machines and MIS software

You can use Advance Steel to drive steel machines in the shop, Advance Steel automatically generates fully-compliant files for CNC machines at workshop.

NC-DSTV files

You can use dedicated commands to automatically generate the NC-DSTV files for steel elements, exporting tools are found in the Output tab in the NC&DXF panel.

In the Document Manager, expand DSTV-file, then DSTV-NC in the file tree. In the Up to date folder, you can assess and preview each of the NC files created.
NC-DXF files

You can use filters to get access to all the plates and create their NC-DXF files: in the Advance Steel tool palette, choose the Selection filters tab and the Plates filter. This will select every plate in the model.

Exporting tools are found in the Output tab in the NC&DXF panel.

In the Document Manager, expand DSTV-NC-DXF in the file tree. In the Up to date folder, you can assess and preview each of the DXF files created.
Scribing in NC files

Settings

Scribing works for beams, and recognizes any element attached to them (beams or plates). It does not work for tubes or round elements because they do not have straight surfaces.

The attached elements must touch the profile on the NC surfaces. Generally, the NC surfaces are the main sides of a beam. For example, the NC surfaces of an I-profile are the sides of the web and the outer side of the flanges, thus only the elements attached to those surfaces generate data for the scribing option.

Scribing is obtained only for the Main Parts. In the NC settings dialog box, the behavior must be defined as NC Based on Main Part Numbers.

Result in NC files

Scribing information will appear in the NC-DSTV file in the block called PU and as a text in the SI block. Also there will be a contour detailed in the NC-DXF file.

MIS software

Advance Steel can interface with most of the Manufacturing Information Systems (MIS) solutions available the structural steel fabrication.
Automatic nesting in Inventor

You can automatically create files in Advance Steel, which can be read into Autodesk Inventor Nesting Utility for automatic steel plates nesting, and then leveraged in Inventor HSM for fabrication simulation.

Import NC-DXF files

The Inventor Nesting Utility is a nesting solution that helps manufacturers optimize material yield and minimize waste from flat raw material cutting operations. As a part of Inventor, Nesting Utility allows you to import the DXF files previously created in Advance Steel.

Plate optimization

The Process Material Library gives you access to a set of options to configure your packaging with specific rectangular dimensions.
Specify the value for plate thickness and define some rules for the automatic nesting, such as the deviation and increment, or the gap around the edge of the sheet and between the plates.

Once you press the Create button and press OK to confirm the settings, the automatic nesting starts.

Tool path

This nest study can then be used within Inventor HSM to generate the tool path needed to ensure the parts are manufactured quickly and effectively.

You can easily select all the plates and begin the simulation of the tool-path.

By clicking the play button, you can see the 3D tool-path.