

Inventor 助力BIM解决方案

邵 纳

高级资深用户体验设计师 | Autodesk



关于讲师

邵 纳

邵纳毕业于同济大学, 机械设计与制造研究生学历, 2006年加入汉略信息科技有限公司, 于2008年并购入Autodesk; 入职职务为产品设计师, 后更名为用户体验设计师, 目前为高级资深用户体验设计师。邵纳及团队立志于为用户打造最满意的产品和解决方案, 在解决专业问题的基础上, 提供最优质的用户体验. 她参与的项目包含, 模具设计模块、AEC/BIM 交互方案、设计简化、T-spline自由造型、钣金多实体方案、DWG导入与参照、草图/建模/装配易用性项目、Inventor现代化方案等。邵纳及团队在产品开发过程中, 大量的进行用户调研和方案验证, 在各种线上线下活动中, 跟全球的客户保持密切的交流和沟通, 加速设计方案迭代, 跟用户共同打造更优质的解决方案。同时, 利用大数据, 进行多维度分析, 作出更精准的方案决策。

议程（Agenda）

1. 典型场景和流程（Typical Workflow）
2. 核心功能和工具 (Key Functions and Tools)

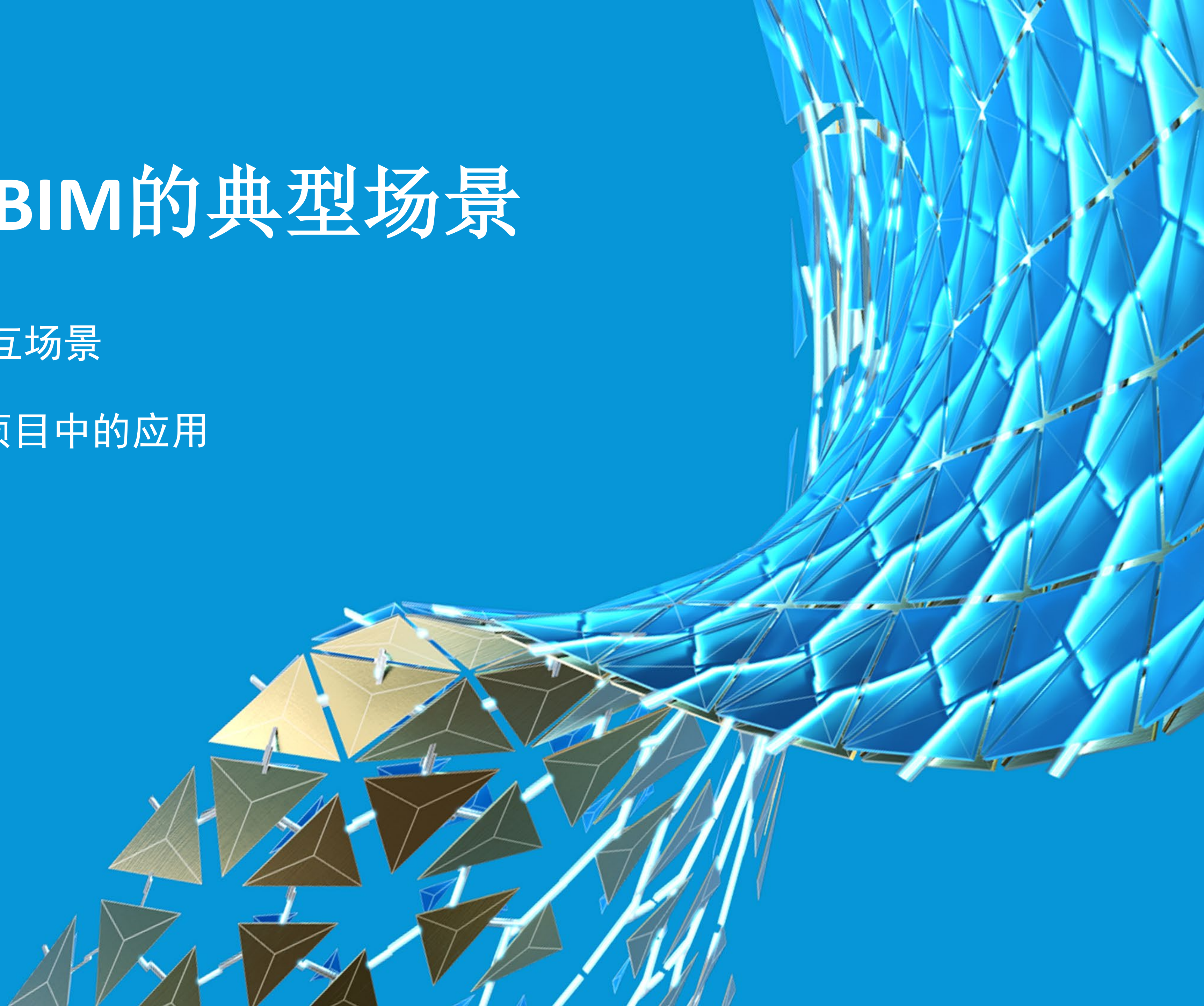
学习目标（Key Learnings）

1. 在BIM不同场景中灵活运用Inventor
2. 定制不同细节等级的Inventor模型
3. 掌握常用的Inventor和Revit交互流程

Inventor助力BIM的典型场景

Inventor与Revit的数据交互场景

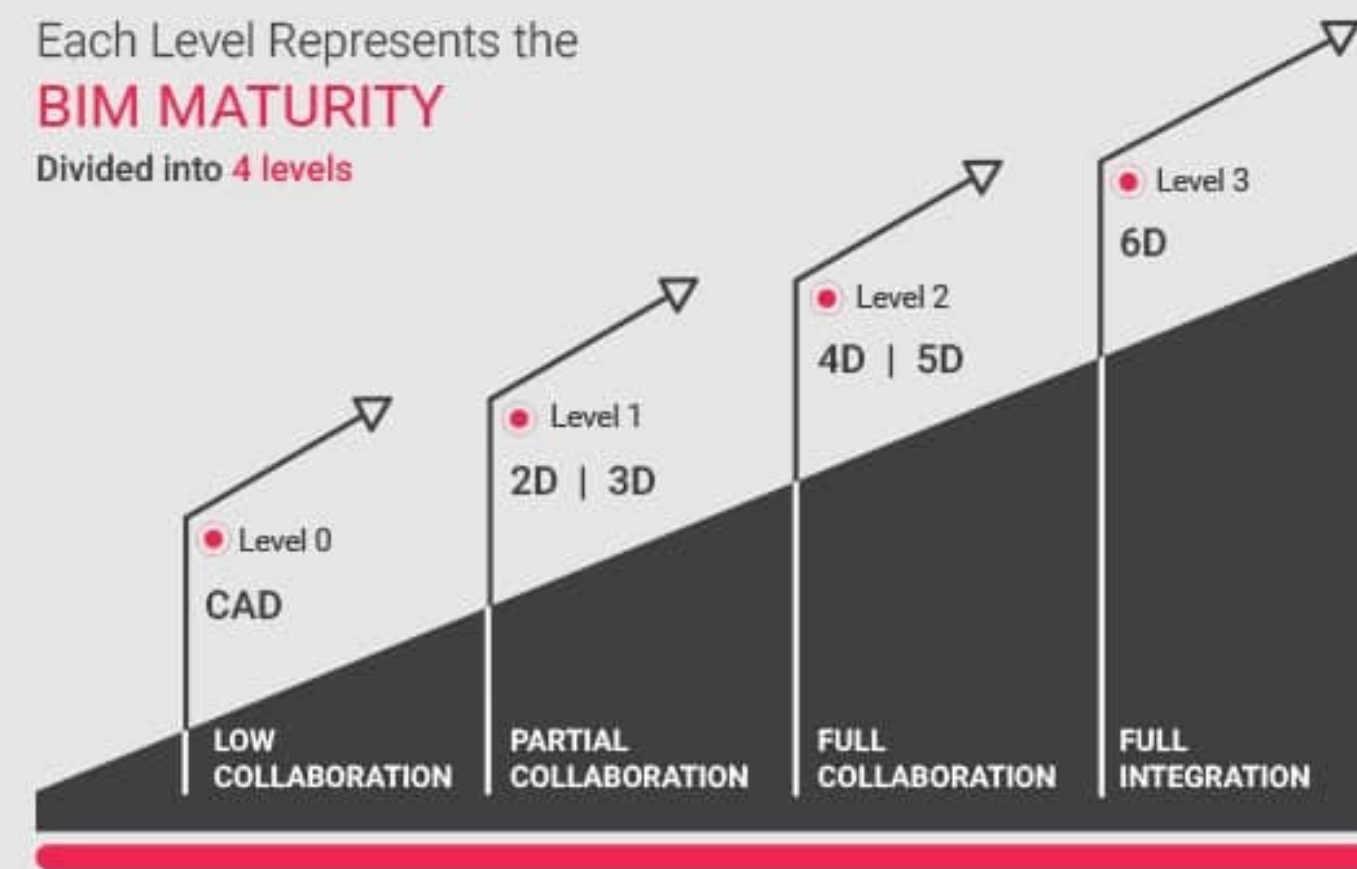
Inventor在基础设施设计项目中的应用



BIM 2.0/3.0 推进深层次协作和全数据整合

BIM Levels Explained

Each Level Represents the
BIM MATURITY
Divided into 4 levels





62%

of general contractors cited coordination and communication between project teams to negatively impact labor productivity

68%

of trades cited poor schedule management to negatively impact labor productivity

61%

of general contractors cited quality of construction documents to negatively impact labor productivity



© New World Development Company Limited via CTBUH



Inventor / Revit 数据交互专注的5个领域

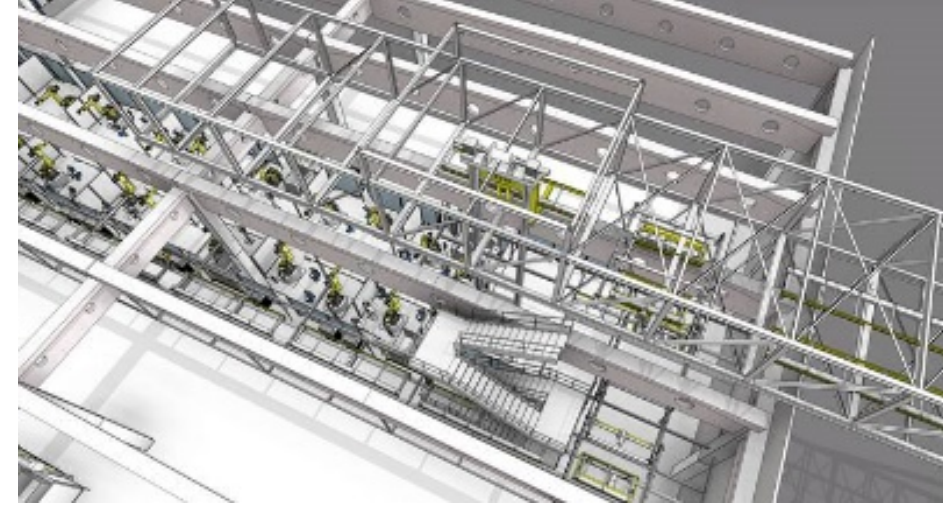
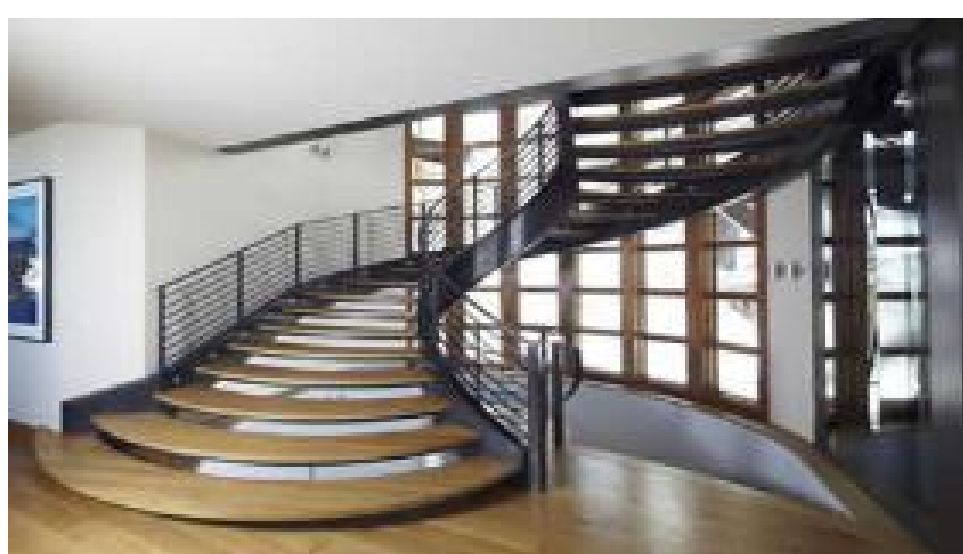
**Building Products /
Equipment**
建筑产品和设备

Custom Fabrication
定制加工

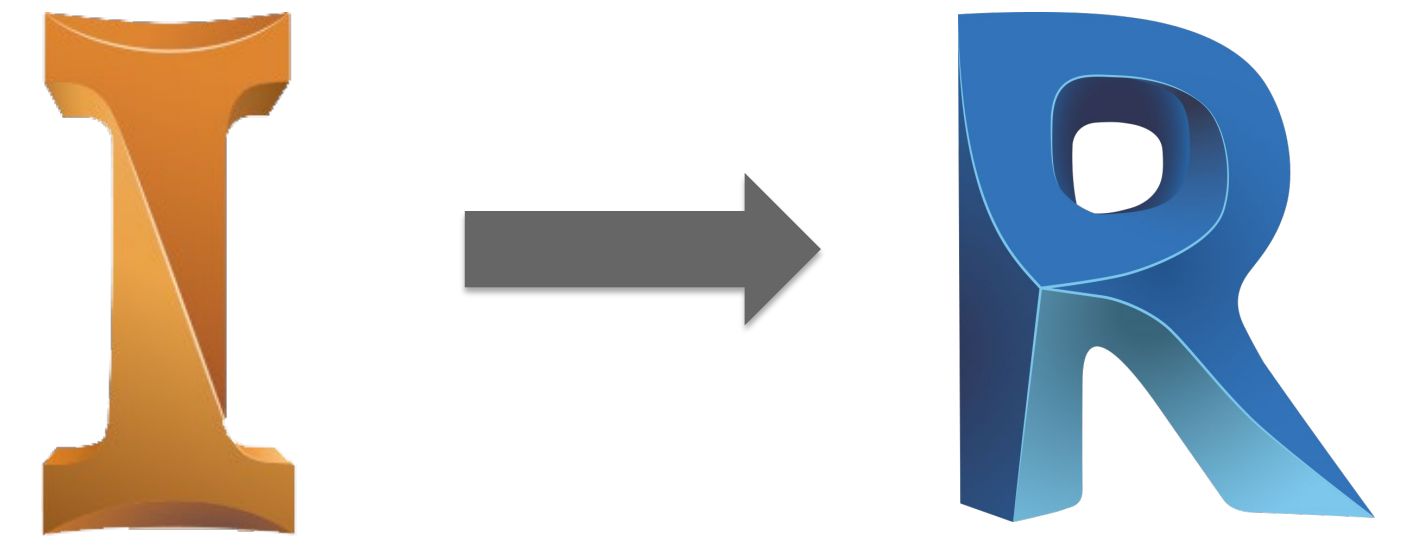
**Building / Equipment
Layout**
建筑/厂房/产线布局

Modular Construction
模块式建筑

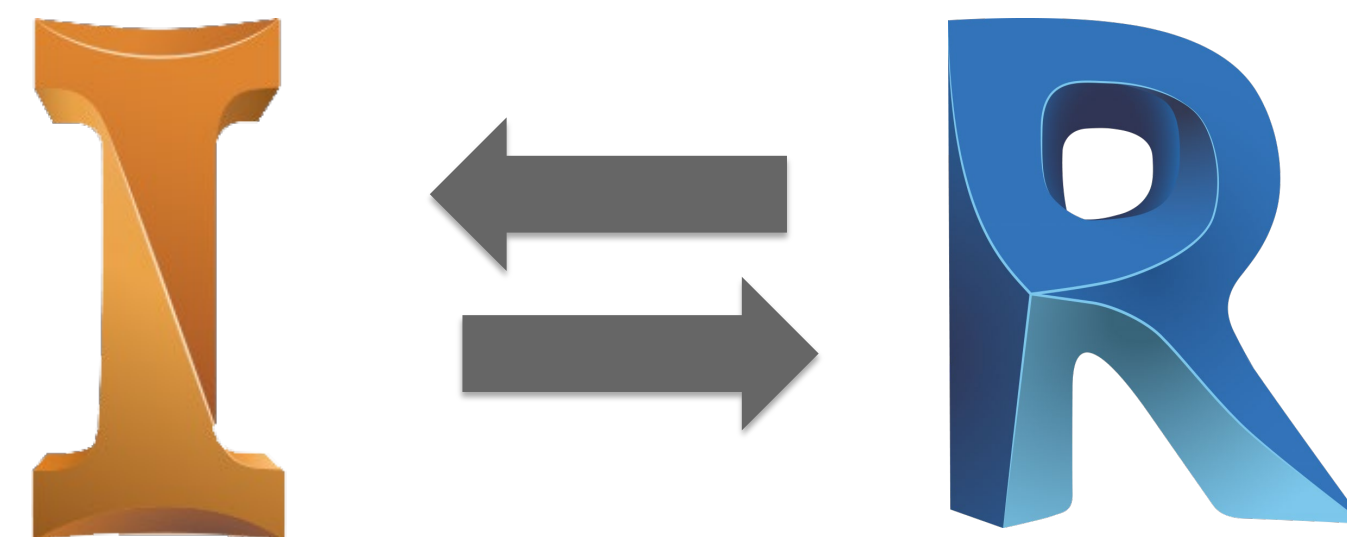
AEC Engineering
AEC 工程建设行业



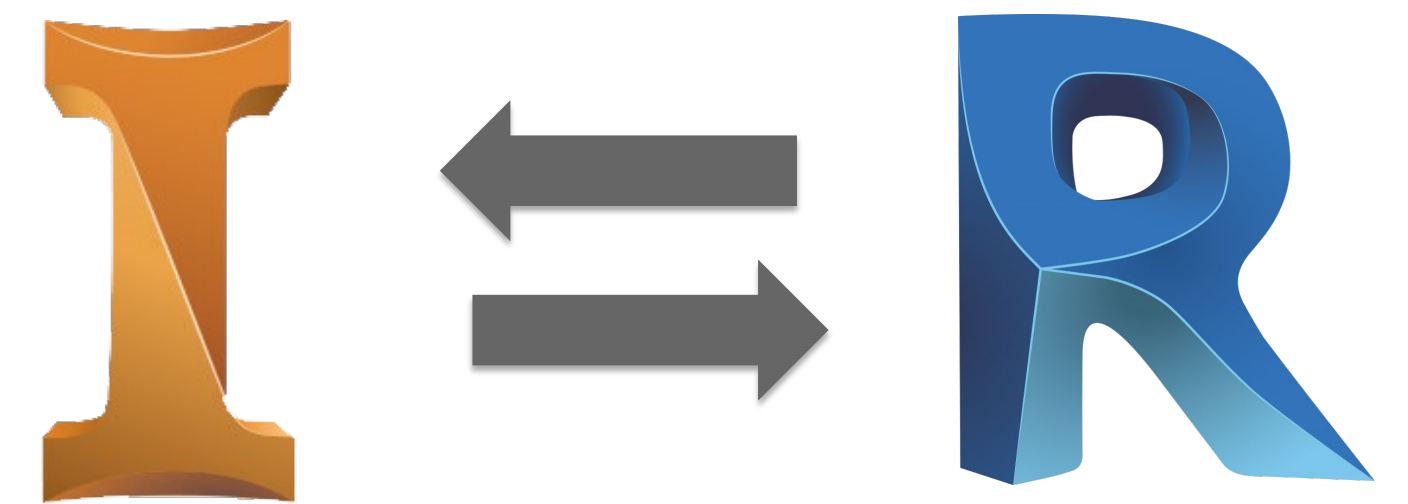
Building Products / Equipment 建筑产品和设备



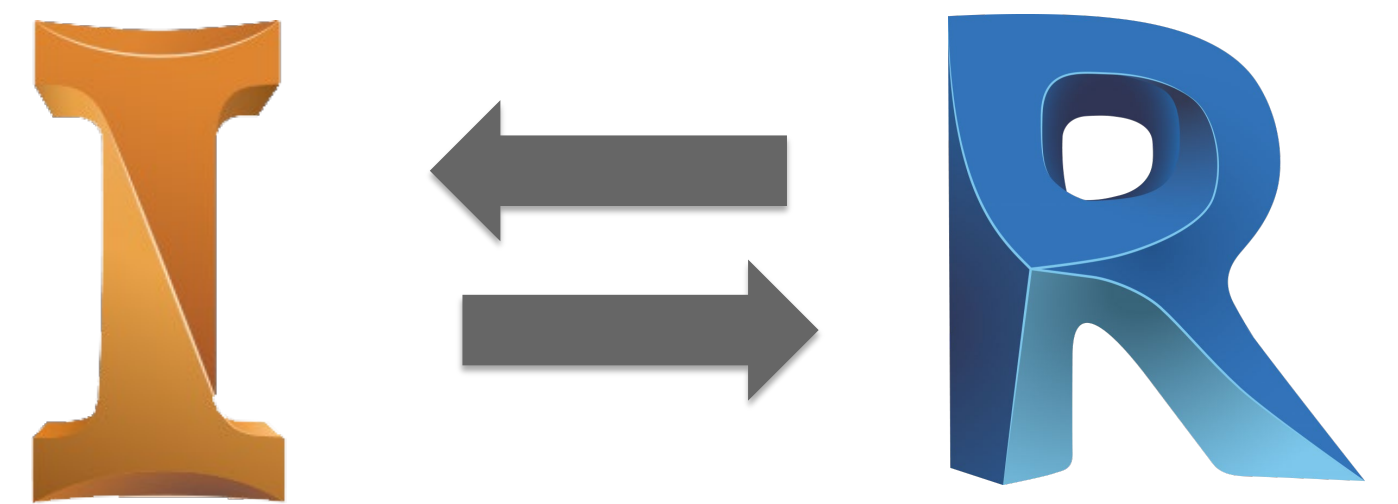
Custom Fabrication 定制加工



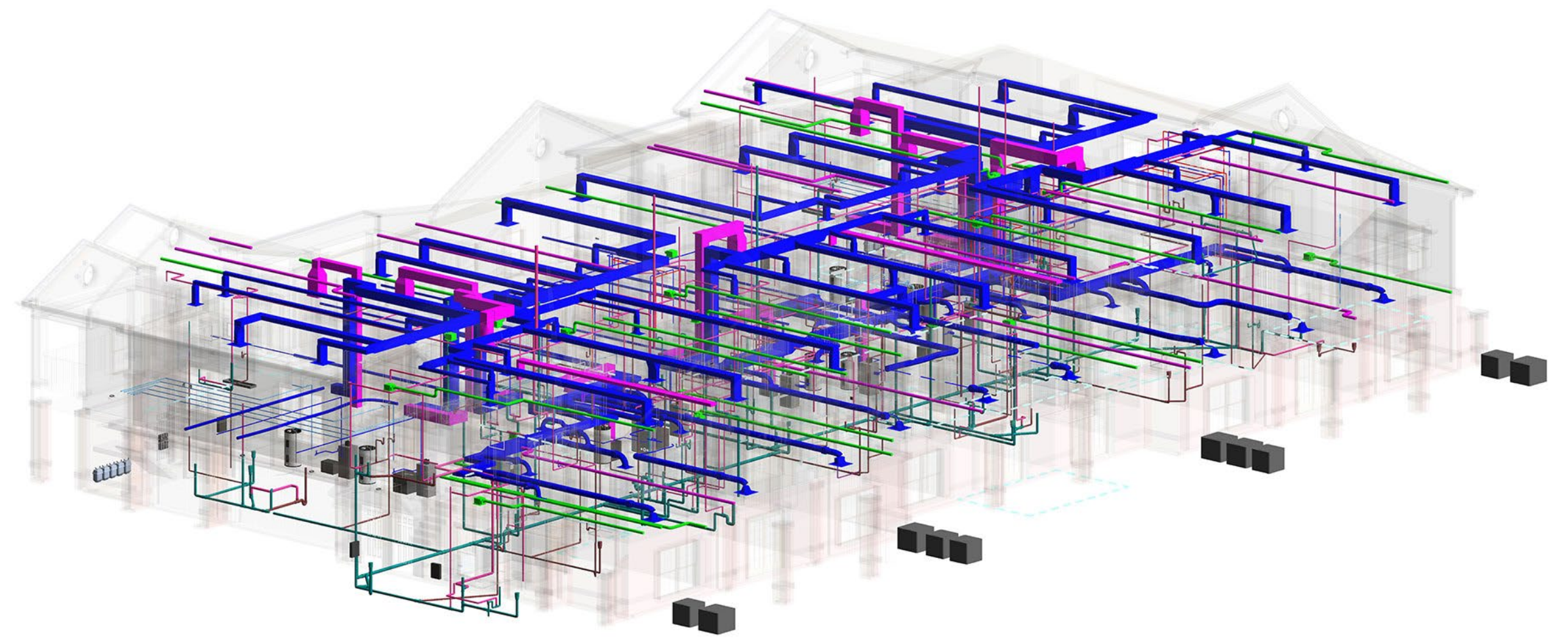
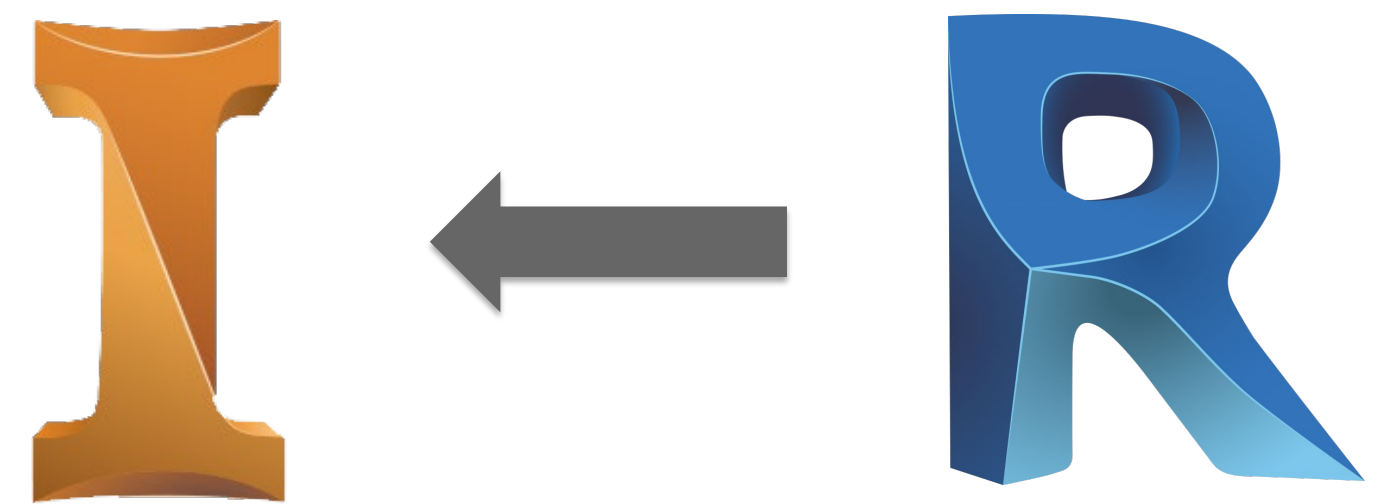
Building / Equipment Layout 建筑/厂房/产线布局



Modular Construction 模块式建筑



AEC Engineering AEC 工程建设行业



Inventor 在建筑各项目中的运用

- 建筑设计 (BIM Content)
- 工程建设 (水、暖通、电)
- 施工 (模块式建筑、预制加工)
- 分包商 (定制设计和加工)
- 建筑产品制造 (HVAC标准设备)
- 工程机械制造 (定制机械)
- 产线设计和工程 (厂房设计)



Inventor 在基础设施设计项目中的运用



 INVENTOR®

pier, girder,
abutment, deck,
foundation, or
tunnel cross-section
支座, 桥墩, 塔
柱, 隧道截面



 AUTODESK® INFRAWORKS®

用Inventor创建桥梁和隧道组件参数化模型 (Create Parametric Bridge and Tunnel Components with Inventor)

Help Home

Nina Shao

English

AUTODESK® INFRAWORKS™

What's New

Getting Started

Data Exchange

InfraWorks Basics

Roadway Design

Civil Structure Design

- Bridge Design
- Tunnel Design
- Parametric Civil Structure Models
 - About Parametric Bridge and Tunnel Components
 - To add parametric bridge or tunnel components to the Style Palette
 - To modify parametric bridge and tunnel components
 - Parametric Civil Structure Models - Model Details Tab Reference
 - Parametric Models - Part Sizes Tab Reference
 - Parametric Models - UI Appearance Tab Reference
 - To share parametric components
 - Civil Structures Workflows
 - To use spreadsheets to modify structures

Drainage Design

Glossary

About This Help System

About Parametric Bridge and Tunnel Components

SHARE

Autodesk InfraWorks supports the use of parametric bridge and tunnel component parts and assemblies, as well as parametric road decorations for component roads and bridges. You can find these parametric parts and decorations in the Parametric Models tab of the Style Palette. For further customization, you can use the Infrastructure Part Shape Utilities tools for Autodesk Inventor to export .IPT parametric model shape templates for use in InfraWorks civil structure design.

Note: Currently, Autodesk Inventor 2017, 2018 and 2019 (both Pro and LT versions) support the Infrastructure Part Shape Utilities tools as long as the Autodesk Inventor Infrastructure Modeler plugin is installed. See [About Add-ins for Autodesk InfraWorks](#) for more information.

Sample Parametric Bridge Components

Download sample parametric bridge component models. You can use sample parametric bridge component models to add parametric bridge components to the style palette.

Recommended Workflow

The creation of parametric bridge components for use in InfraWorks does require some knowledge of shape modeling and use of Autodesk Inventor. It is highly recommended that the creator of the .IPT or .IAM parametric model files also adds these parametric bridge or tunnel component part or part assemblies to InfraWorks and validates them before sharing the resulting parametric bridge or tunnel component models with other users of InfraWorks. Parametric bridge and tunnel component part or part assemblies models for use in InfraWorks should be shared between InfraWorks users in STYLES.JSON format, rather than .IPT or .IAM format.

1. Open Autodesk Inventor.
2. Create a parametric model in Autodesk Inventor that represents a bridge or tunnel component, such as a pier, girder, abutment, deck, foundation, or tunnel cross-section.
3. Specify which dimensions to expose to Autodesk InfraWorks. These dimensions that can be viewed and modified in InfraWorks are called key dimensions.
4. Export the parametric bridge or tunnel component model as a shape template using the Infrastructure Part Shape Utilities tools for Autodesk Inventor.
5. Close Autodesk Inventor.
6. Open Autodesk InfraWorks.
7. Open the Style Palette. See [Style Palette](#).
8. Add the parametric bridge or tunnel component model to the Parametric Models tab of the Style Palette. See: [To add parametric bridge and tunnel components to the Style Palette](#).

Sketch

The image shows the 'Sketch' ribbon in Autodesk Inventor. It includes the 'Start 2D Sketch' button, a 'Sketch' button, and a 'Create' dropdown menu. The 'Create' menu contains tools for Line, Circle, Arc, Rectangle, Fillet, Text, Point, Copy, Rotate, Split, and Modify.

3D Model

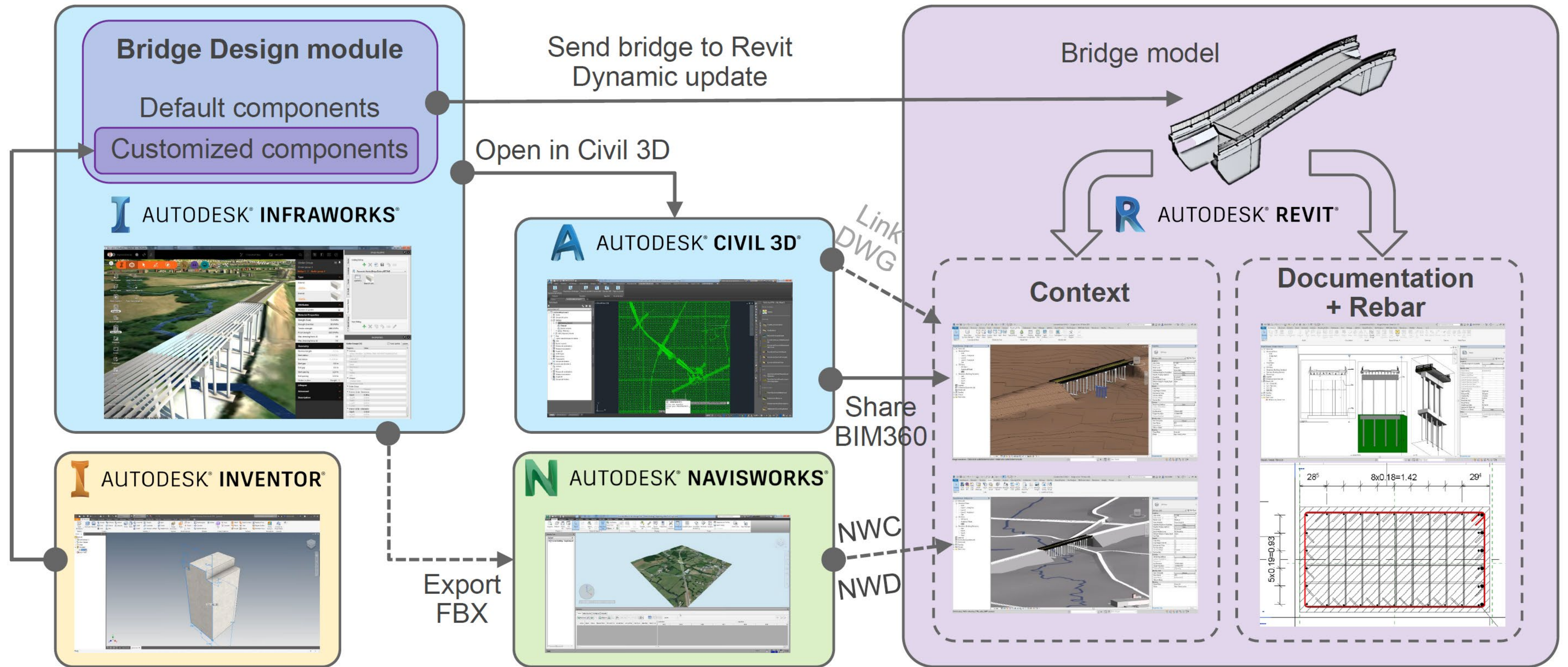
The image shows the '3D Model' ribbon in Autodesk Inventor. It includes the 'Extrude' button, a 'Revolve' button, and a 'Create' dropdown menu. The 'Create' menu contains tools for Sweep, Loft, Coil, Emboss, Derive, Rib, Decal, and Import.

Infrastructure Part Shape Utilities add-in

The image shows the 'Infrastructure Part Shape Utilities' add-in ribbon in Autodesk Inventor. It includes the 'Infrastructure Part Shape Utilities' button, a 'Begin' button, and a 'Convert' button. The 'Convert' button is labeled 'Convert to Sheet Metal'.

<http://help.autodesk.com/view/INFMDR/ENU/?guid=GUID-958B3BD8-2C26-4DA7-B578-9CE63FBEAC62>

桥梁设计流程



<https://www.autodesk.com/autodesk-university/class/New-Workflow-Bridge-Design-InfraWorks-Inventor-Civil-3D-and-Revit-2018>

关键功能和工具

Inventor → Revit 数据传输

模型简化 (Simplify)

建筑模型属性配置

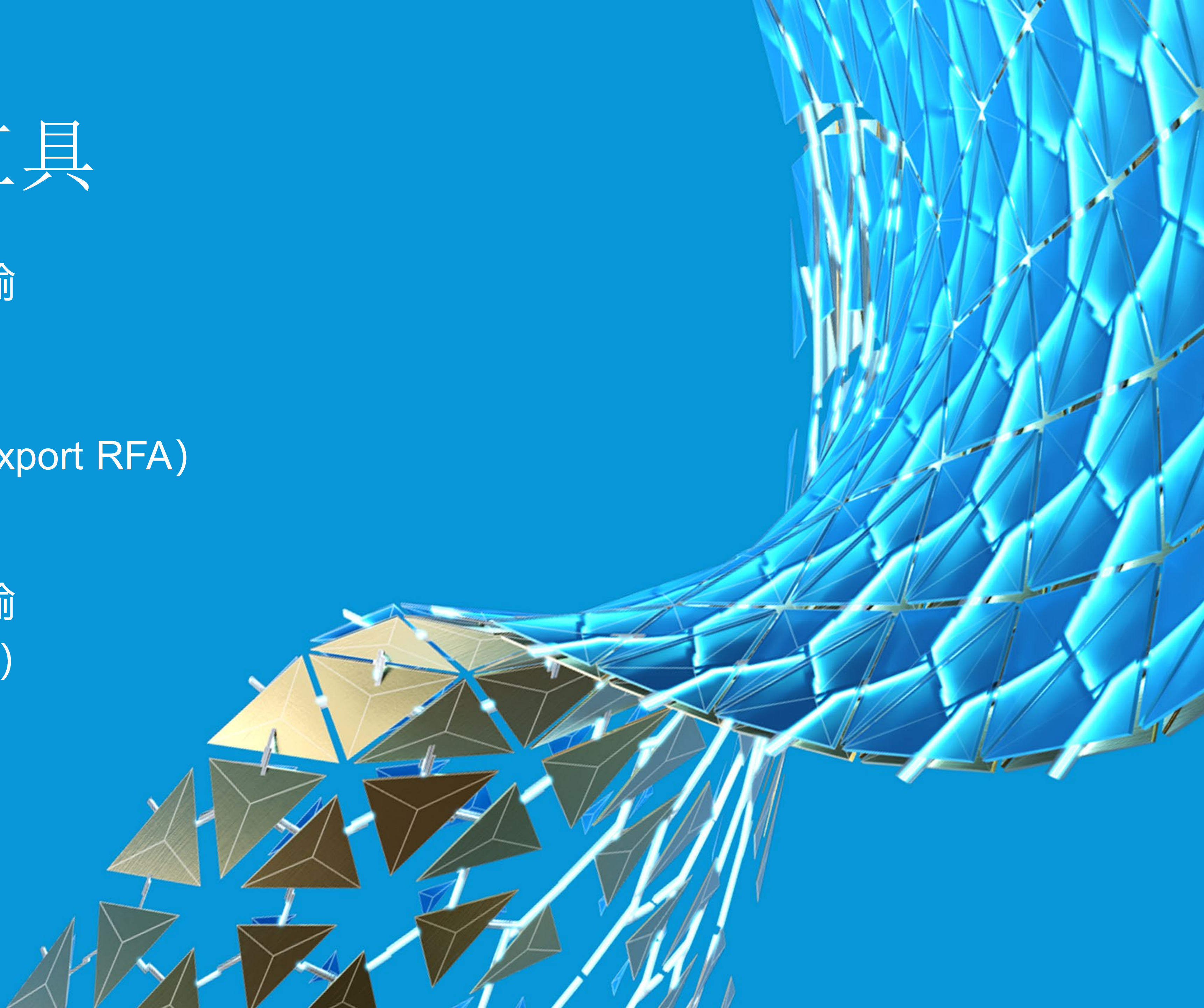
导出Revit 族文件 (Export RFA)

导出 IFC/SAT

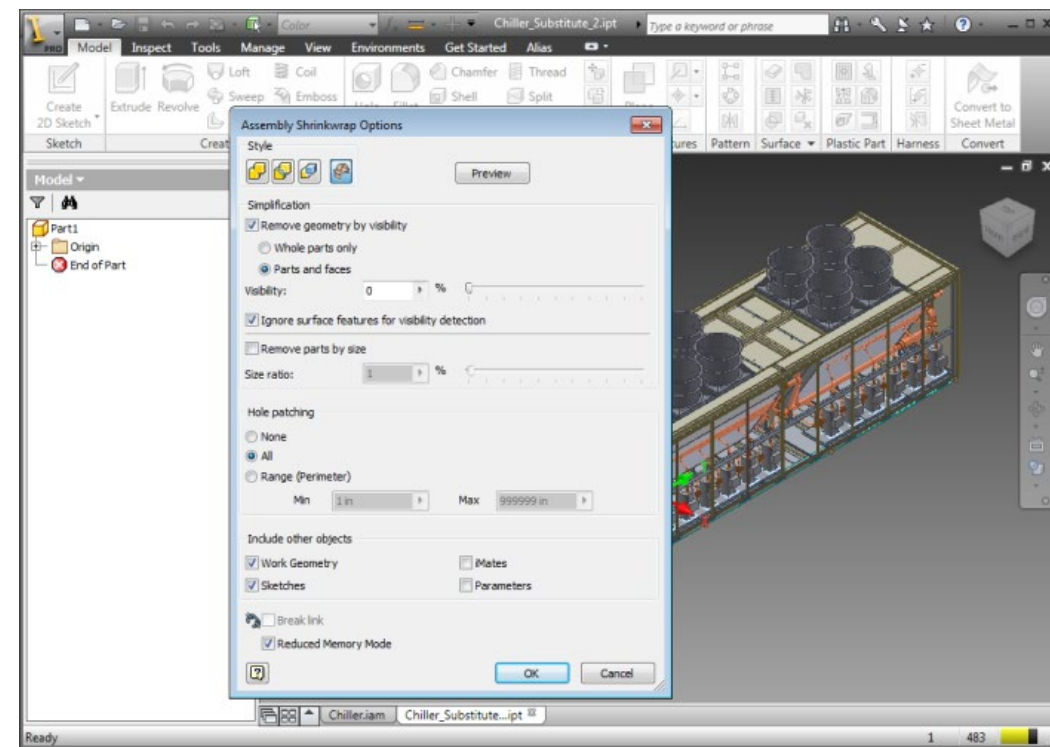
Revit → Inventor 数据传输

导入Revit模型 (RVT)

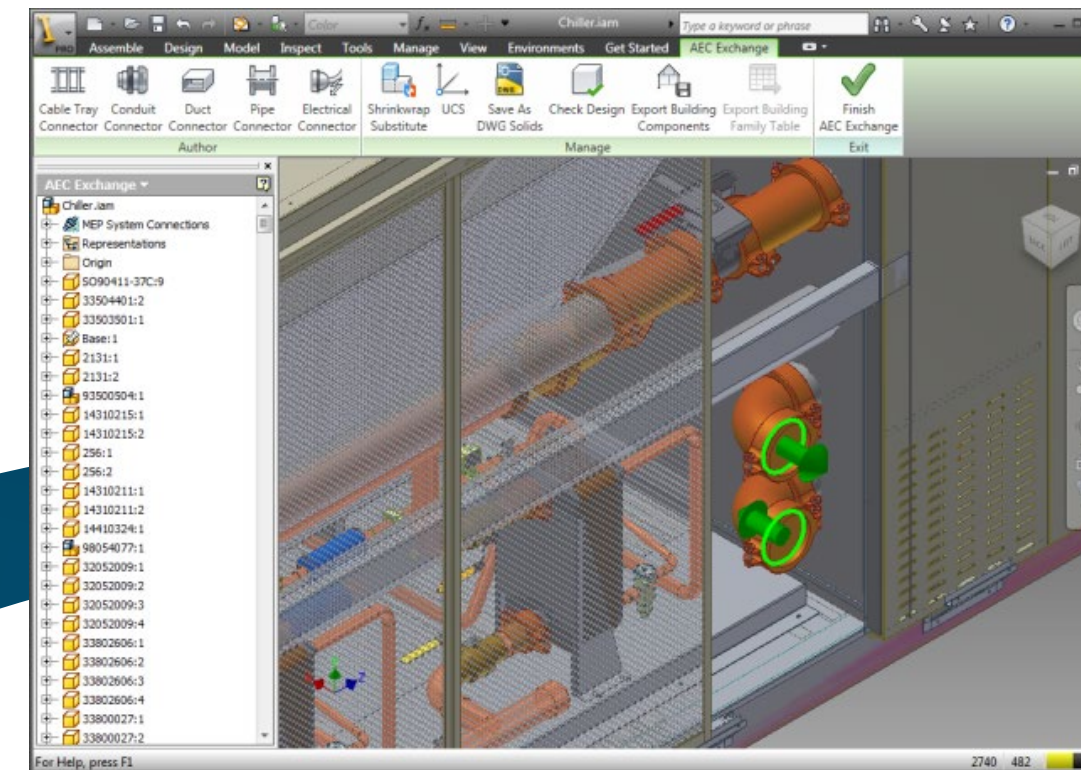
Inventor参数化配置



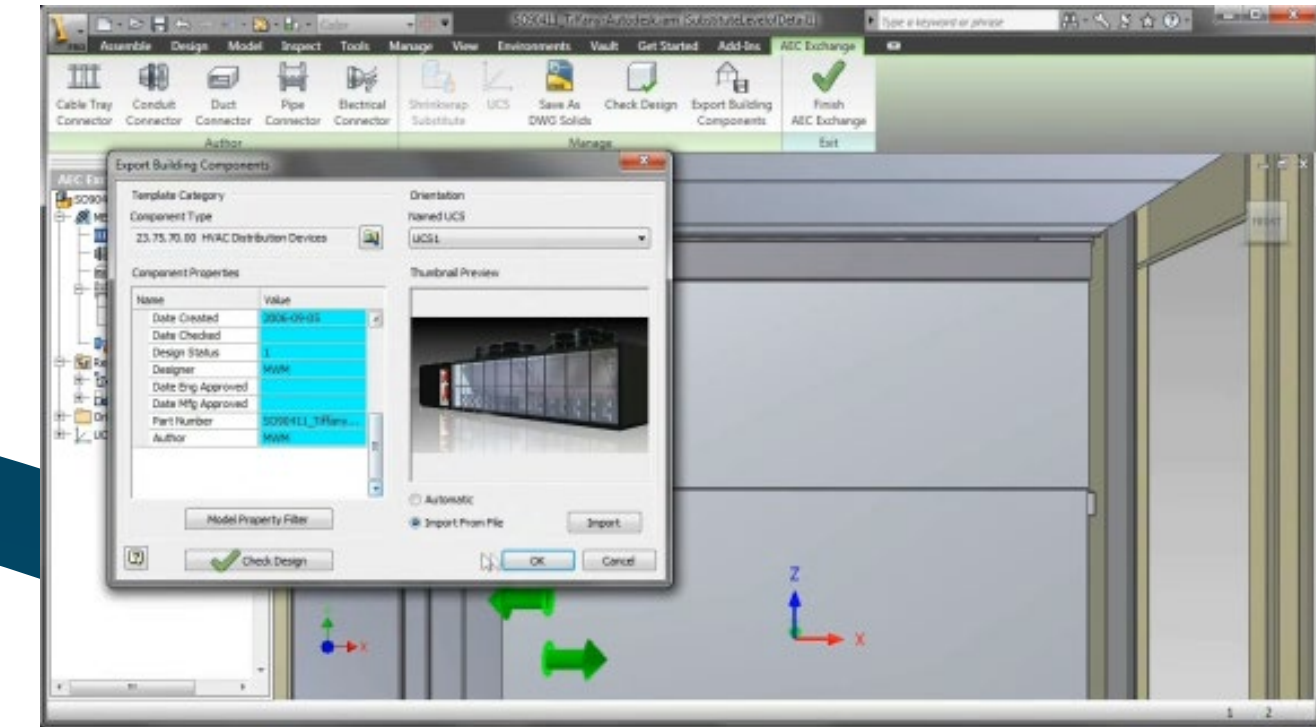
Inventor → Revit 数据传输流程



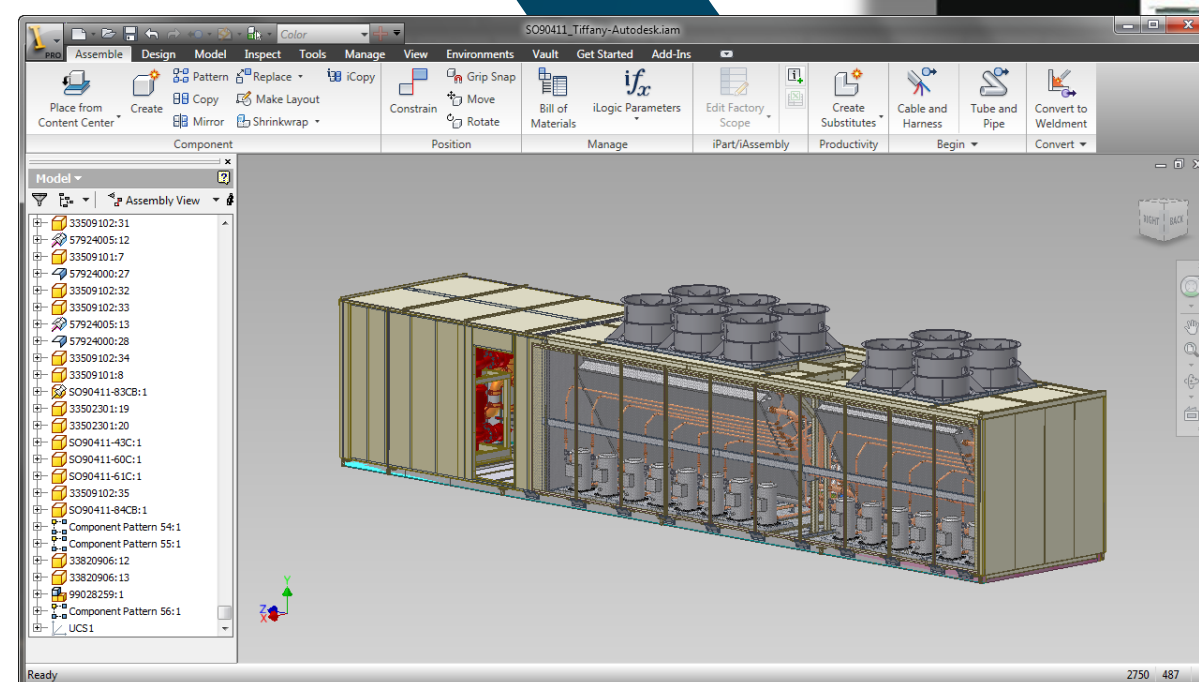
模型简化



定义连接件及其它属性



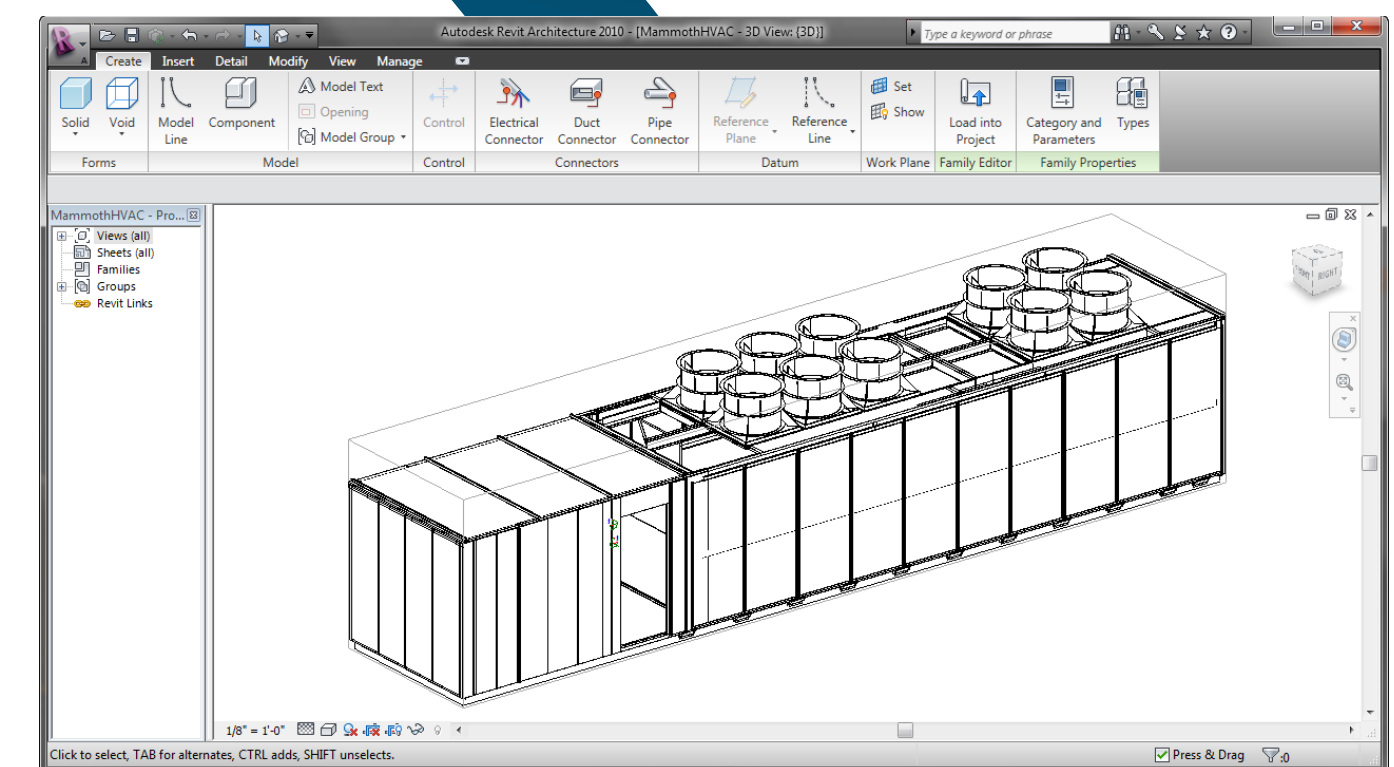
导出ADSK/RFA文件



3D模型



Revit族应用

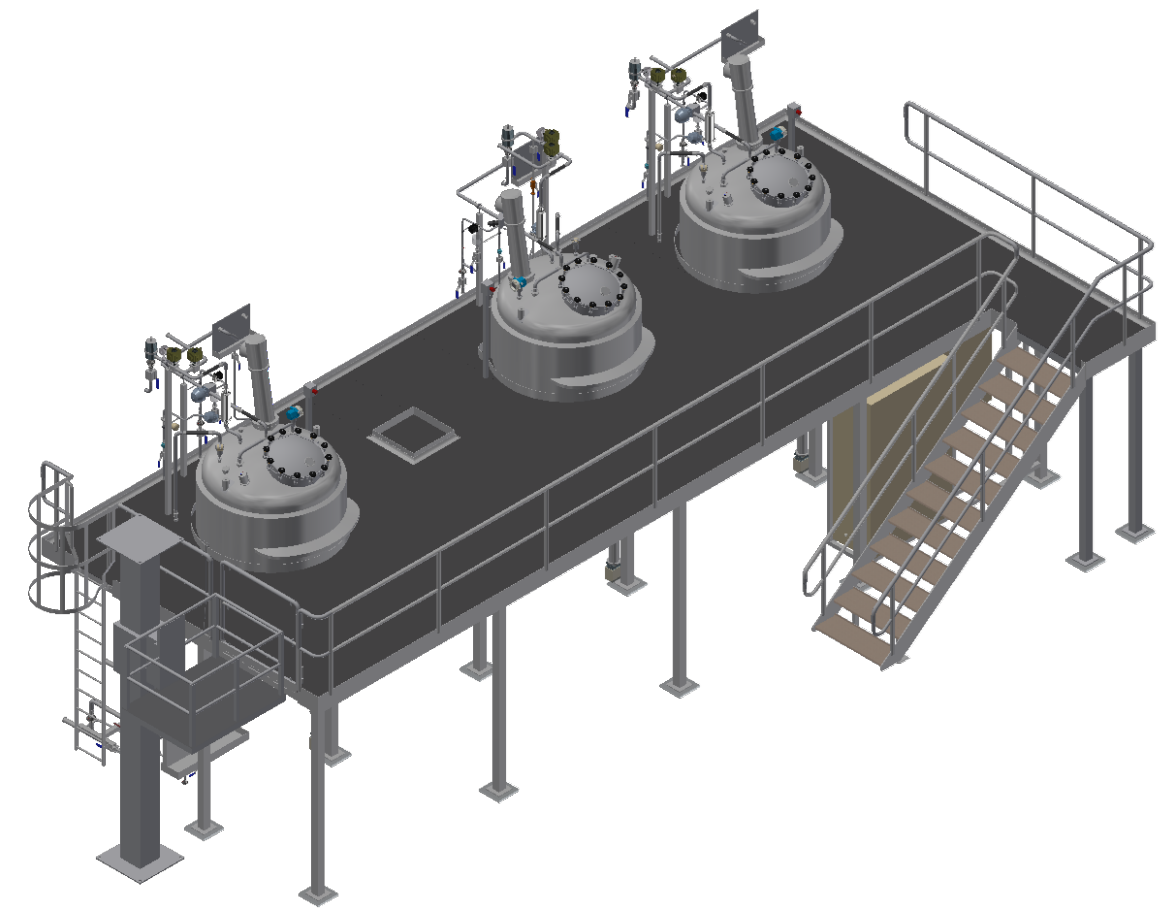
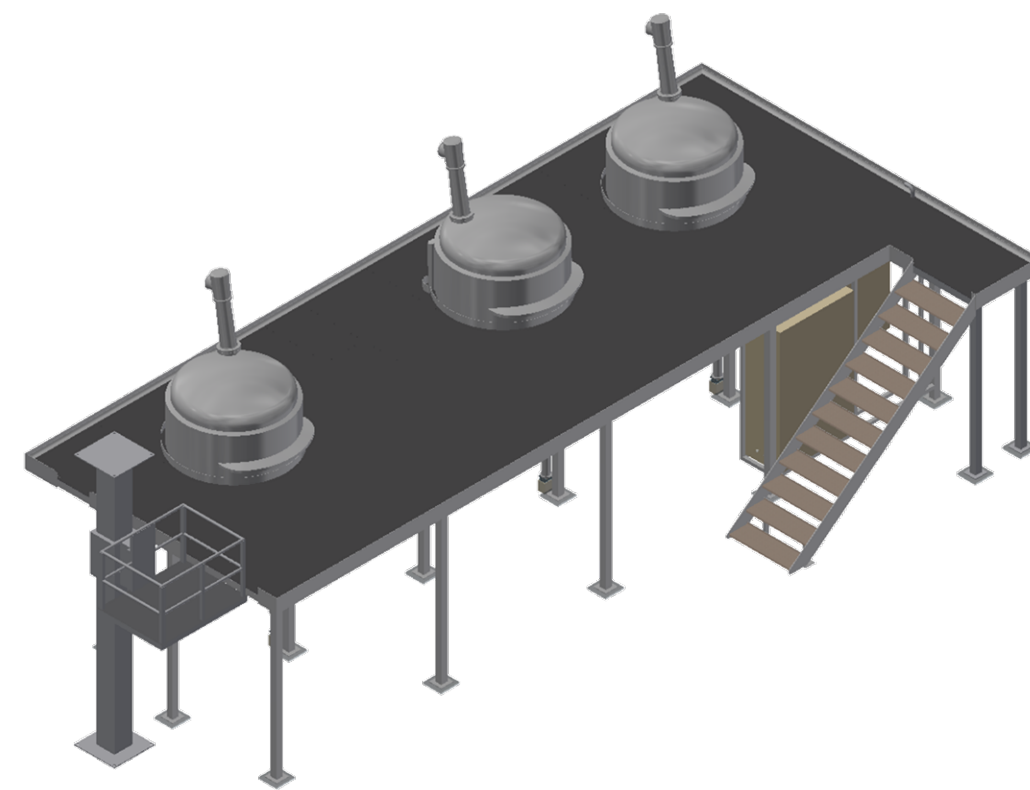
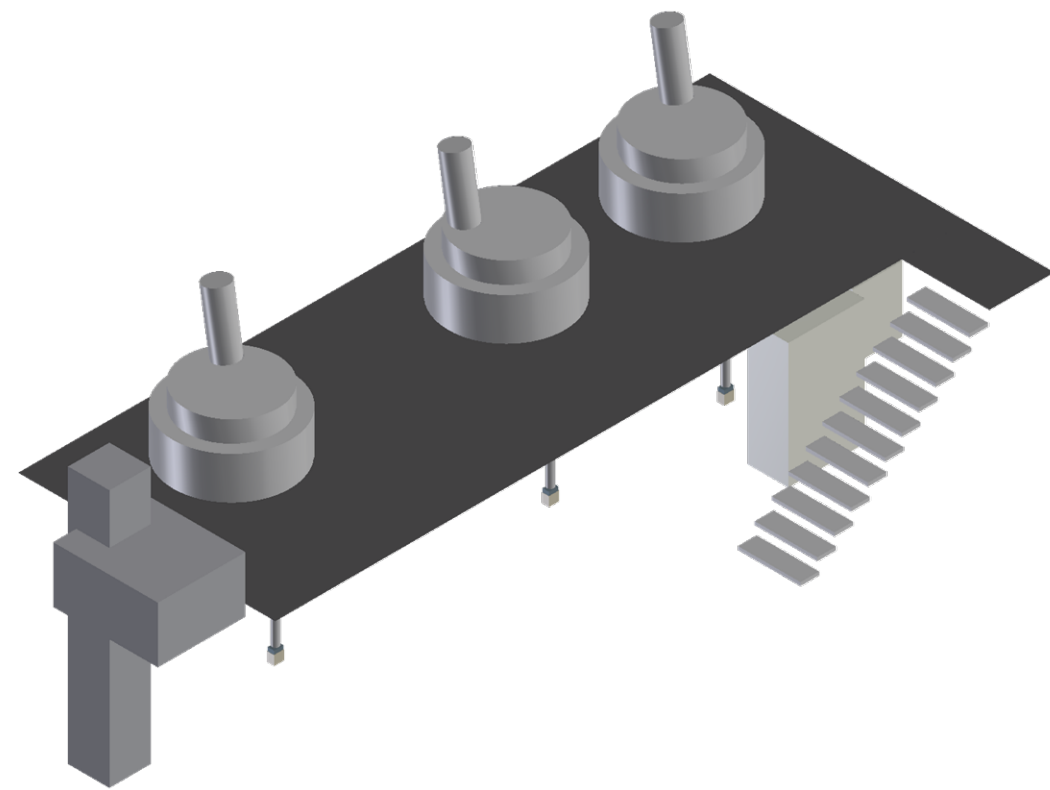
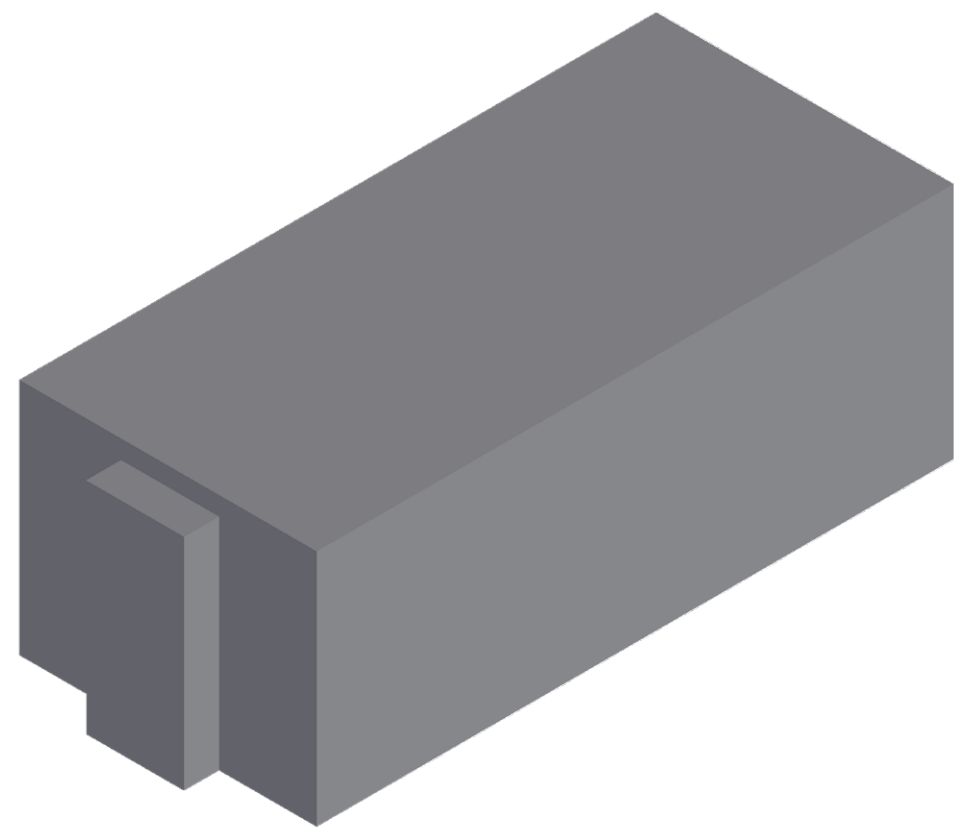


导入Revit

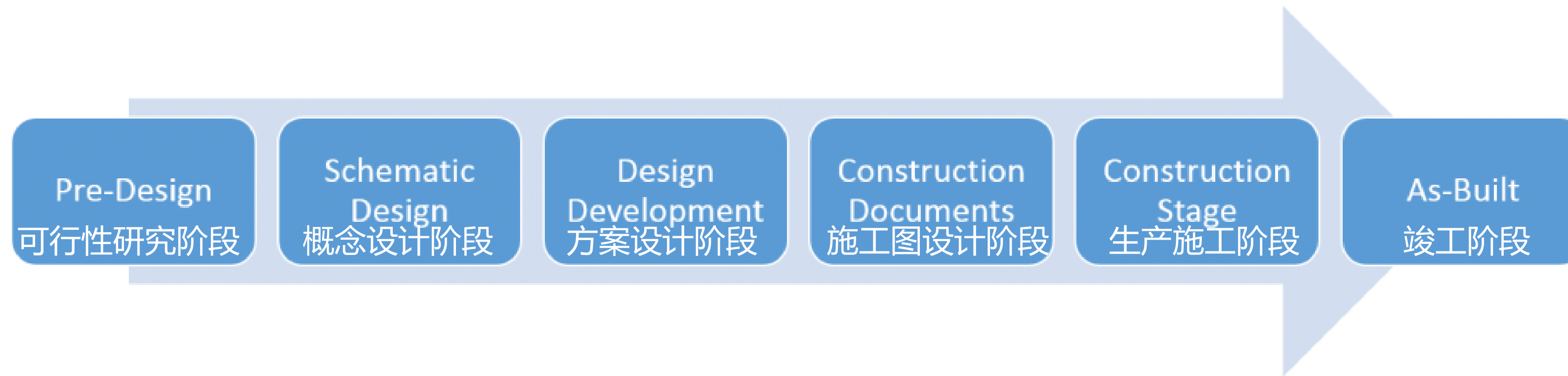


模型简化

满足不同阶段设计需求、保护知识产权从容分享模型、降低大尺寸文件消耗提升性能



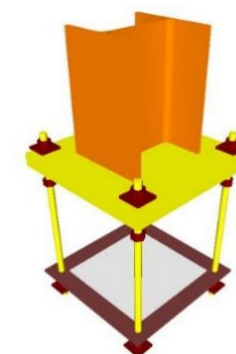
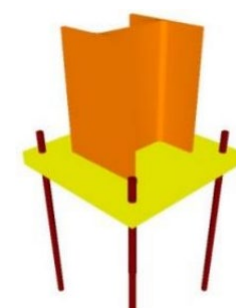
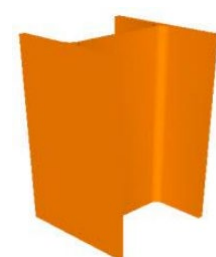
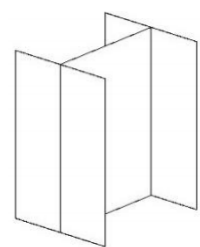
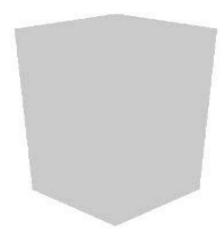
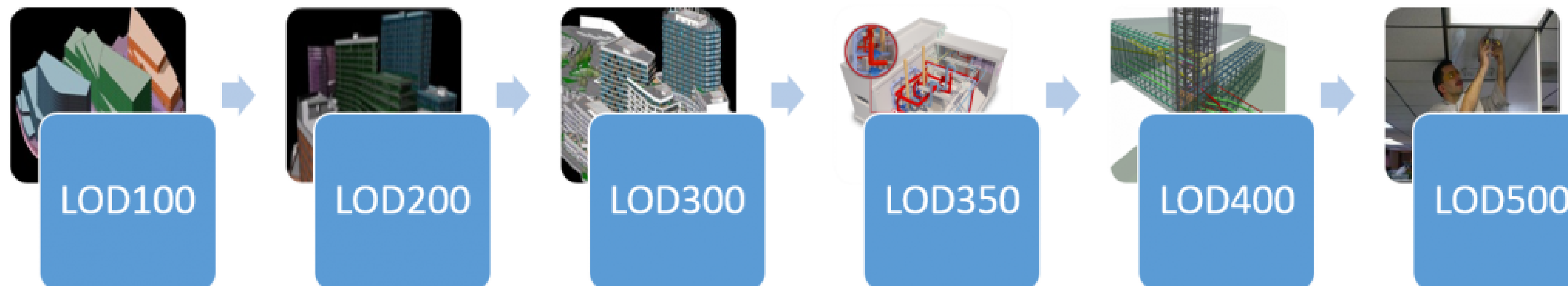
如何在实际使用中准确的表达模型？



熟知模型发展等级

(Level of development) :

- LOD 100, 200 – 存在
- LOD 350/350/400 – 设计模型，含尺寸/属性/结构等，反映设计要求和施工要求
- LOD 500 – 竣工模型



钢立柱为例

<https://bimforum.org/LOD>

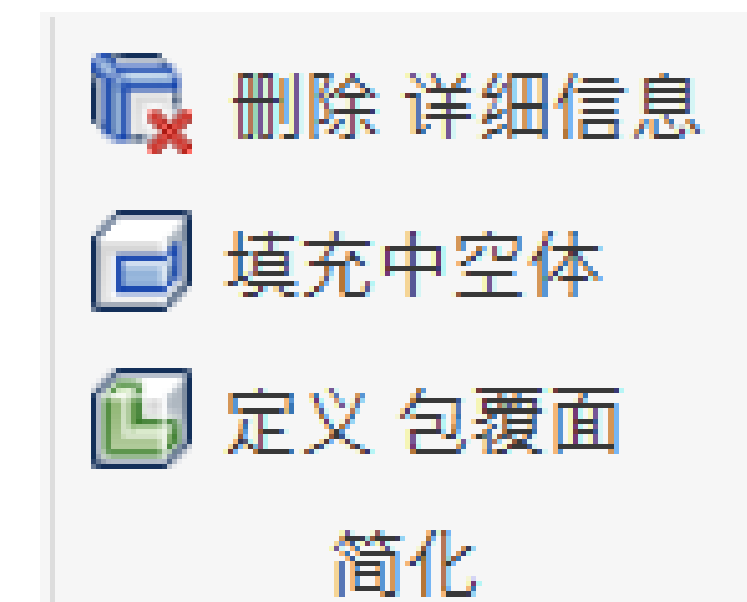
<http://www.cmcs.co/can-building-information-modelling-bim-project-information-management-pim-create-smart-project-sites/>

简化工具

- 包覆面提取/包覆面提取替代表达
- 简化插件
- 或者，重新搭建简易模型



装配



零件

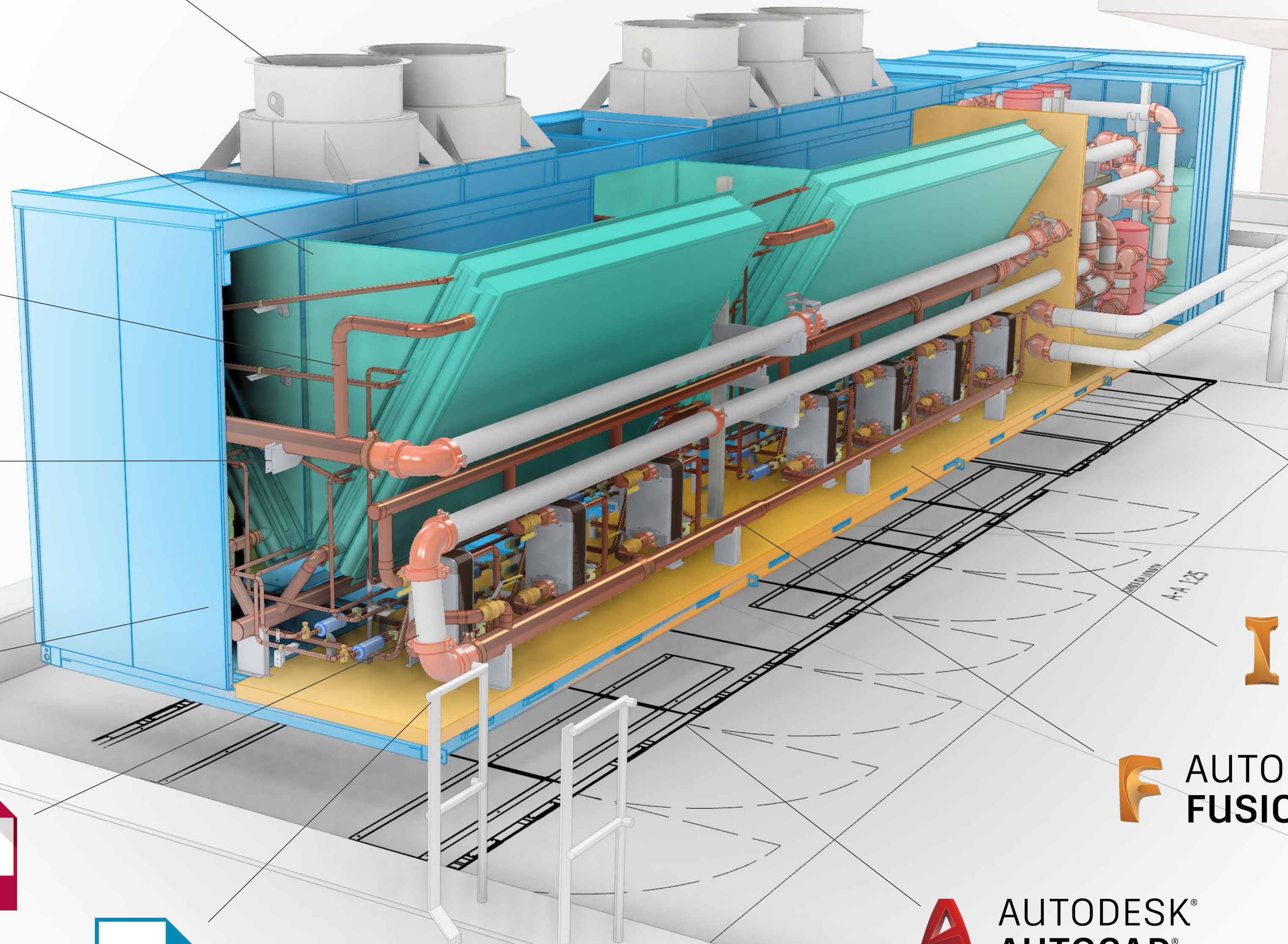
简化 – 包覆面提取

- 使用包覆面提取，定制当前装配文件的细节表达
- 目标:
 - 为Revit提供合理的模型发展等级 (LOD 300/350/400)
 - 保护知识产权 (intellectual property)
 - 保留连接件接口，比如机电设备连接件
- 无差别支持导入文件和Inventor本地文件的简化
 - 使用Inventor AnyCAD技术导入STEP, CATIA, Solidworks, NX, SolidEdge, Creo, AutoCAD
 - 基于导入文件做包覆面提取

Non-Native File
Change

AnyCAD

Real-time
update



AUTODESK®
REVIT®

AUTODESK®
INVENTOR®

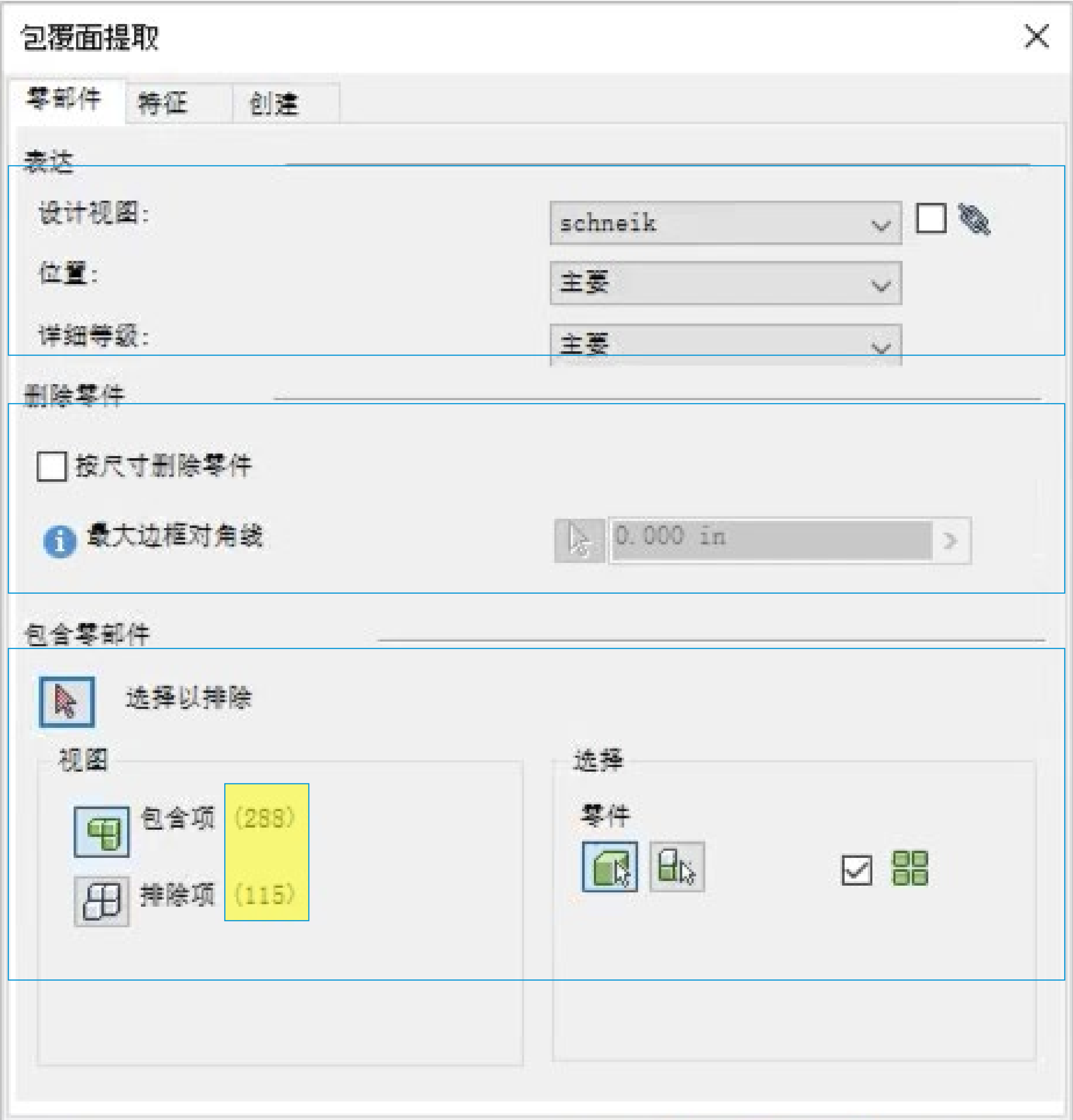
AUTODESK®
FUSION 360™

AUTODESK®
AUTOCAD®

部件页面 (Components Tab)

第一步：删减零部件

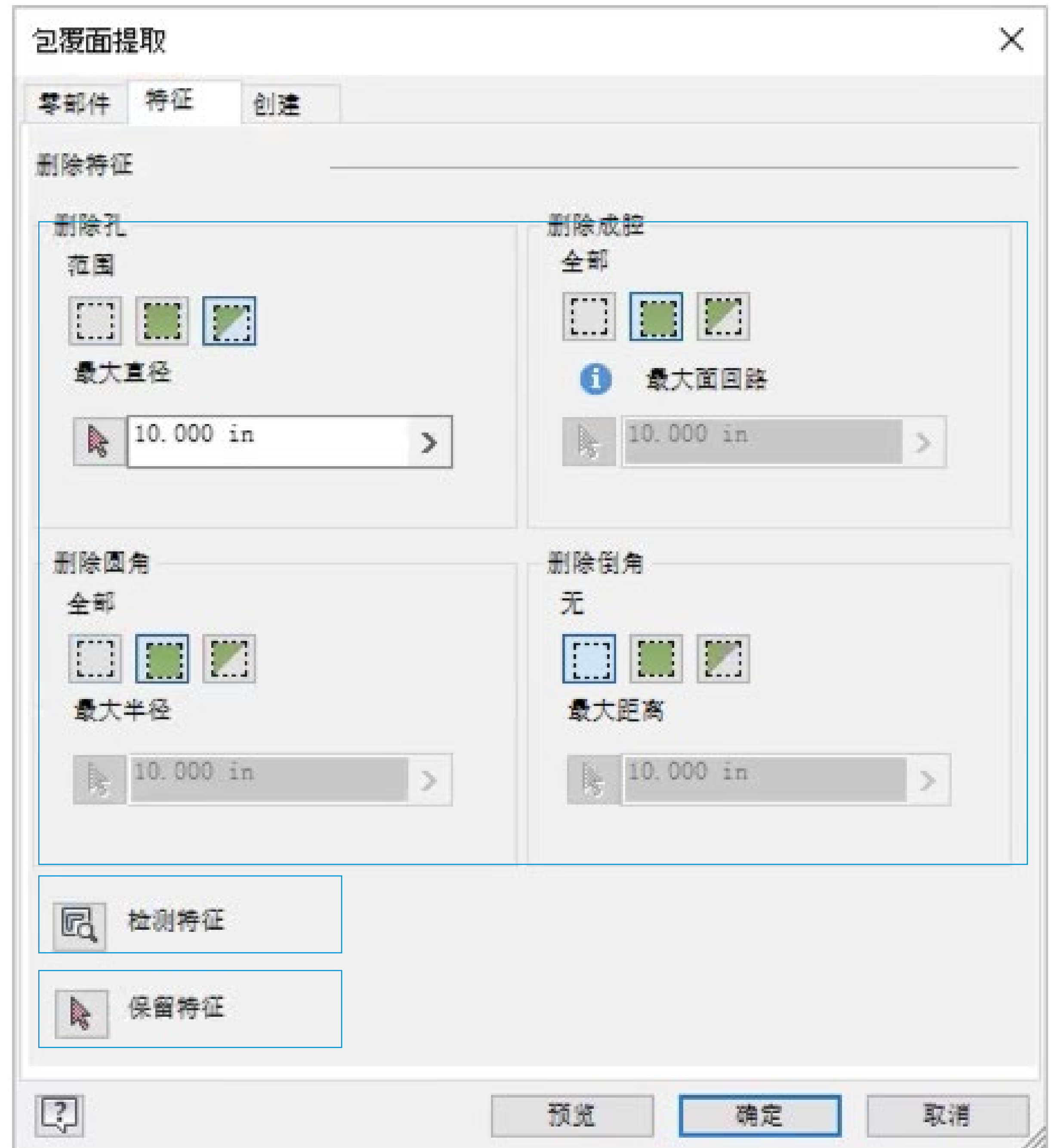
- 选取合适的模型表达作为简化基础:
 - 视图表达
 - 位置表达
 - 细节表达
- 删减小尺寸零件
 - 基准：零件边界盒对角线尺寸
- 选择零部件
 - 在图形区点选零部件 删减或增加
 - 切换视图，包含的零部件/删减的零部件
 - 零部件数量
 - 高亮手动点选的零部件



特征界面 (Features Tab)

第二步：删减细节特征

- 删减特征类型
 - 孔/腔体
 - 圆角 / 倒角
 - 去除全部或者规定尺寸细节
- 搜索特征— 在图形区高亮待删减特征
- 保留细节特征 — 如果搜索到的特征不需要被删除，支持在图形区选择保留



创建页面 (Create Tab)

第三步：设置创建选项

- 新文件设定
 - 名称、模板、路径、BOM结构
- 格式
 - 单实体、多实体、曲面
- 其他设定：
 - 产权保护：填充所有内部中空体
 - 产权保护：删除内部零件
 - 产权保护：重命名零部件

包覆面提取

零部件 特征 创建

新建文件

零件名称 (P) 模板

MOD-039310 Shrinkwrap_2 Standard.ipt

新文件位置





C:\Users\shaoni\Downloads\OTX_2019_Dataset_Updated\OTX 2019 - Data:

默认 BOM 表结构

普通件

样式

保留每个实体

其他设置

☐ 断开关联 ☒ 填充所有内部中空体

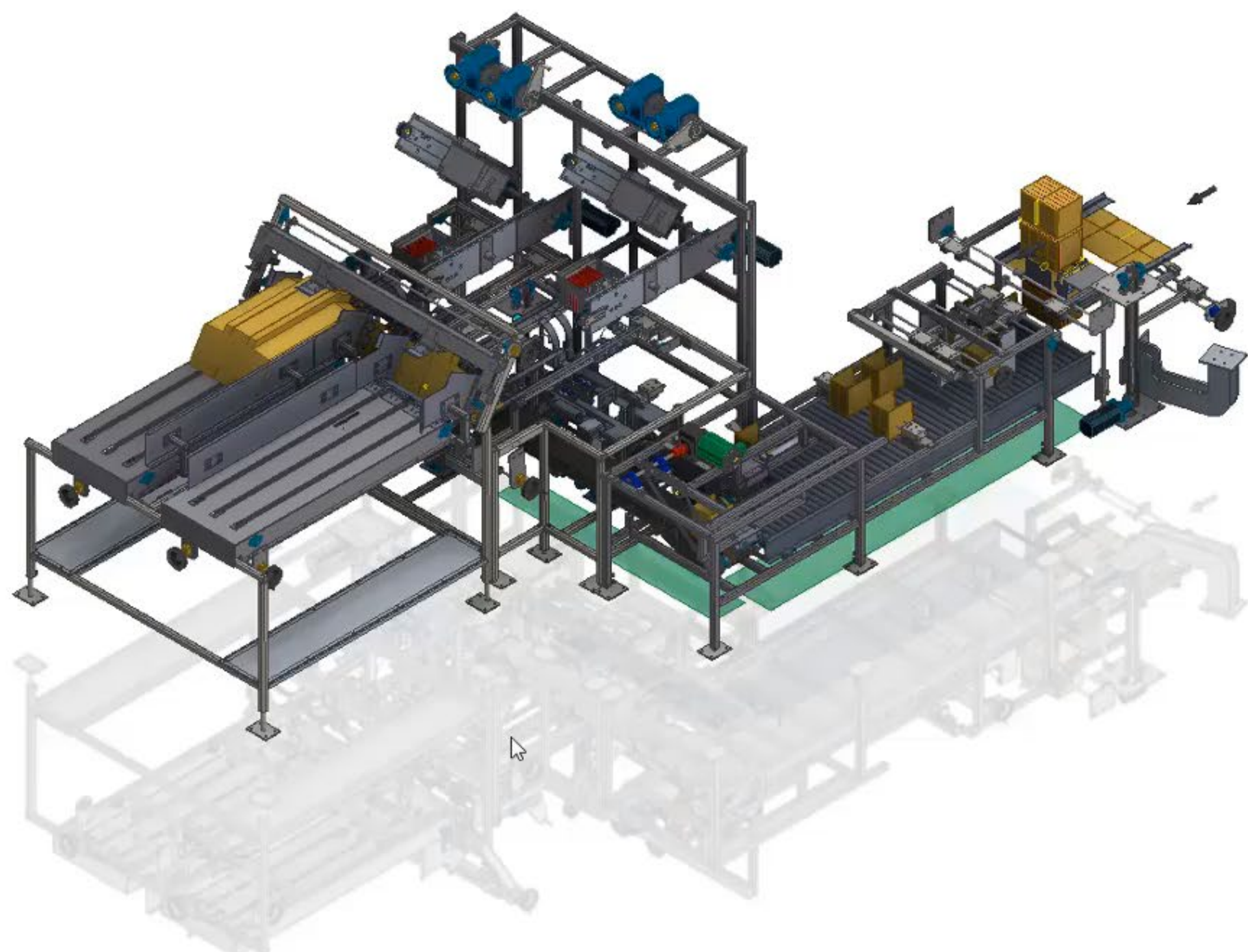
☐ 重命名零部件 ☒ 删除内部零件

☒ 使用源零部件的颜色替代

☐ 布尔运算失败时创建独立实体

? 预览 确定 取消

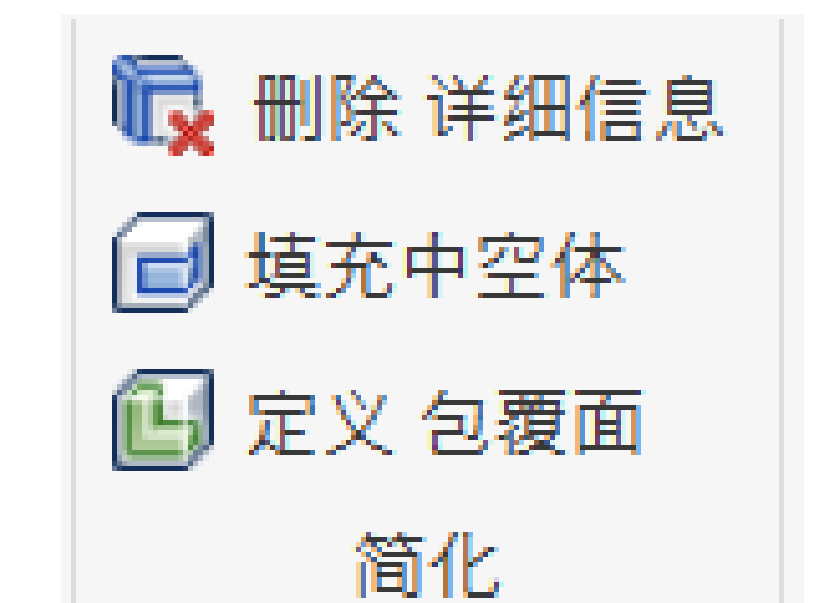
- Layout Browser Model x +
- Assembly | Modeling
- + _0012009310.iam
 - + Relationships
 - + Representations
 - + Origin
 - + Landing Surface
 - + End of Features
 - + MOD-019310:1
 - + MOD-029310:1
 - + MOD-039310:1
 - + MOD-049310:1



- Vault x +
- CAD.ipj
- + _0012009310.iam * (0012009310) (In)
 - + MOD-019310.iam (MOD-019310) (In)
 - + MOD-029310.iam (MOD-029310) (In)
 - + MOD-039310.iam (MOD-039310) (In)
 - + MOD-049310.iam (MOD-049310) (In)

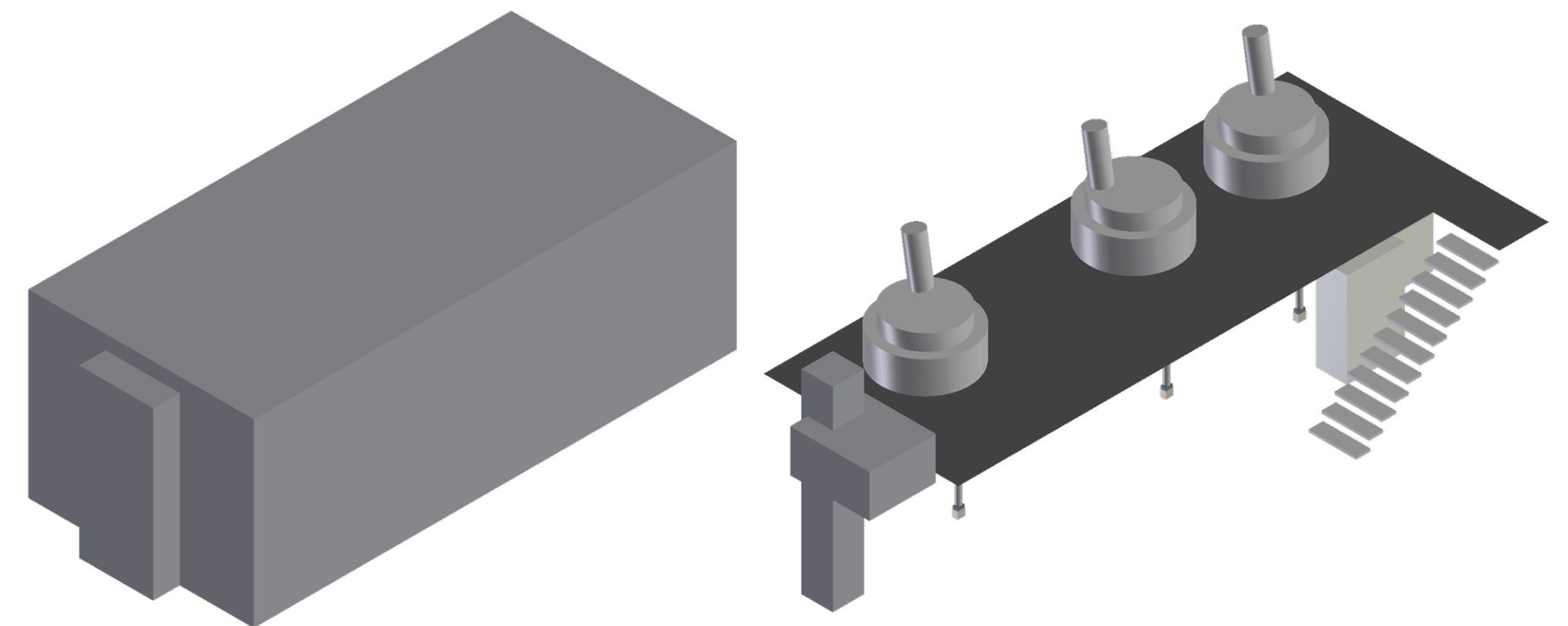
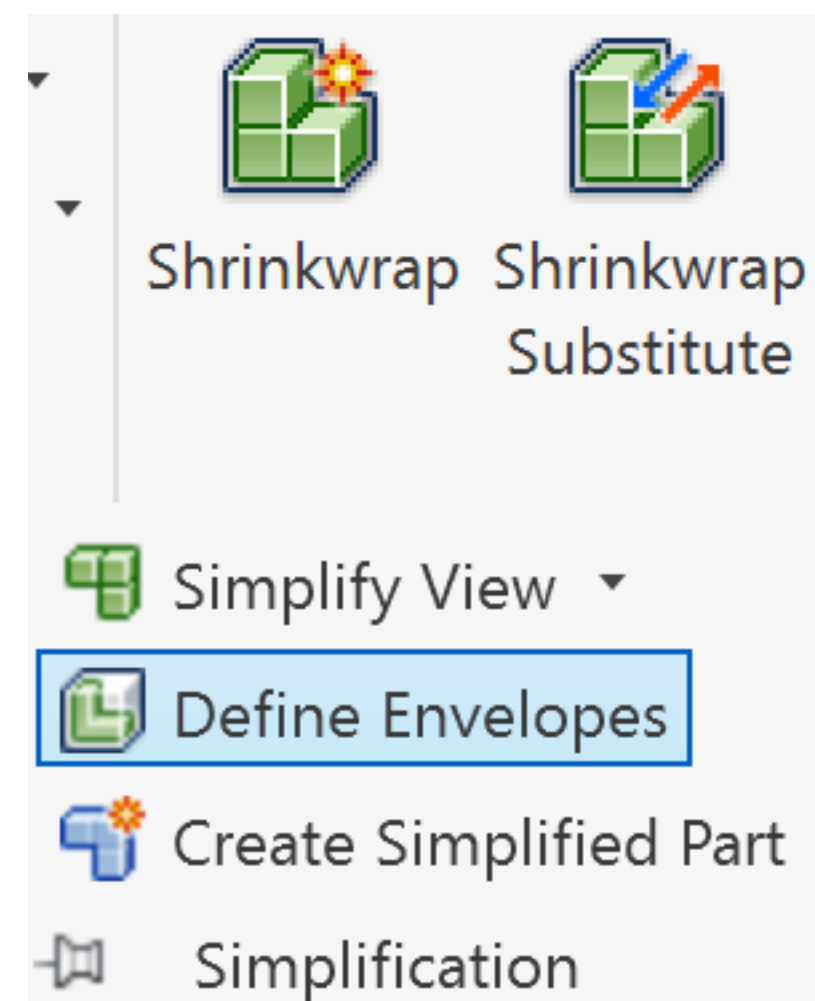
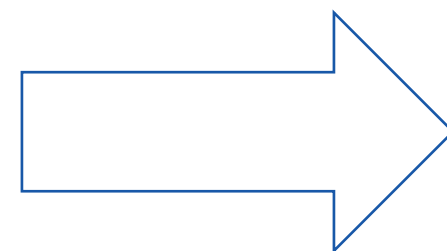
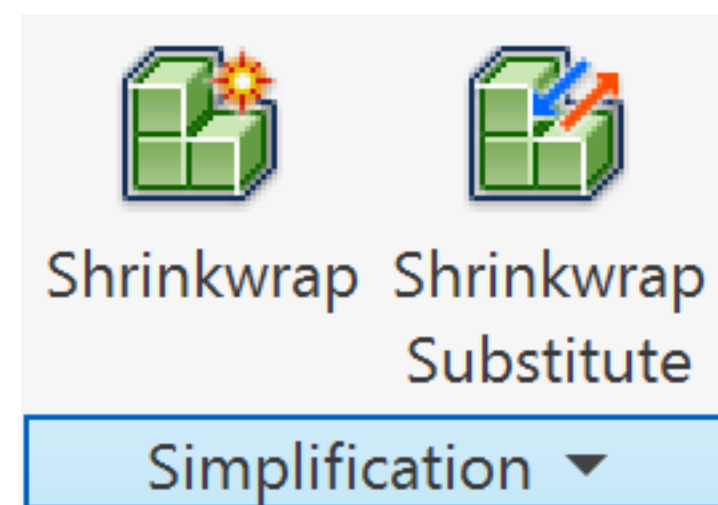
简化 – BIM简化插件

- 使用BIM简化插件，定制当前装配文件的简化表达
- 目标:
 - 为Revit提供合理的模型发展等级 (LOD 100/200/300/350/400)
 - 保护知识产权 (intellectual property)
 - 保留连接件接口，比如机电设备连接件
- 无差别支持导入文件和Inventor本地文件的简化
 - 使用Inventor AnyCAD技术导入STEP, CATIA, Solidworks, NX, SolidEdge, Creo, AutoCAD
 - 基于导入文件做简化



简化 – 包覆体 (Envelopes)

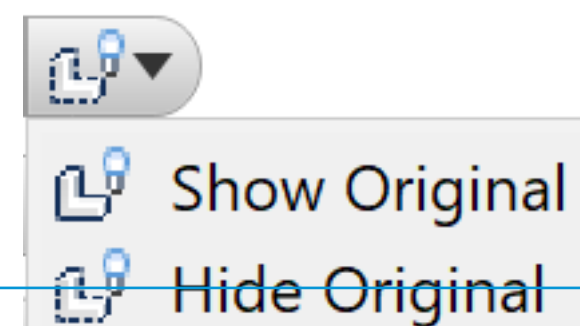
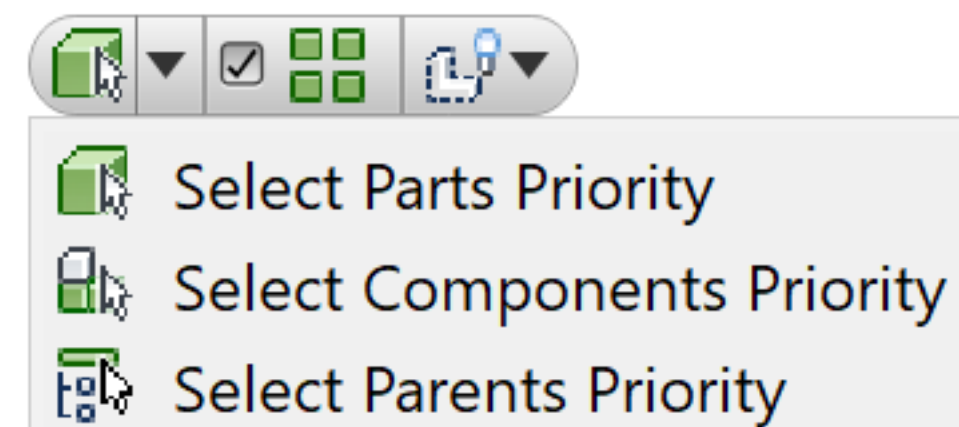
- LOD 100 – 200
- 空间占位, 近似几何, 产权保护
- 在Inventor 2021及之前的版本, 包覆体 (Envelope) 与包覆面提取 (Shrinkwrap) 分属不同的流程, 不可合并使用。



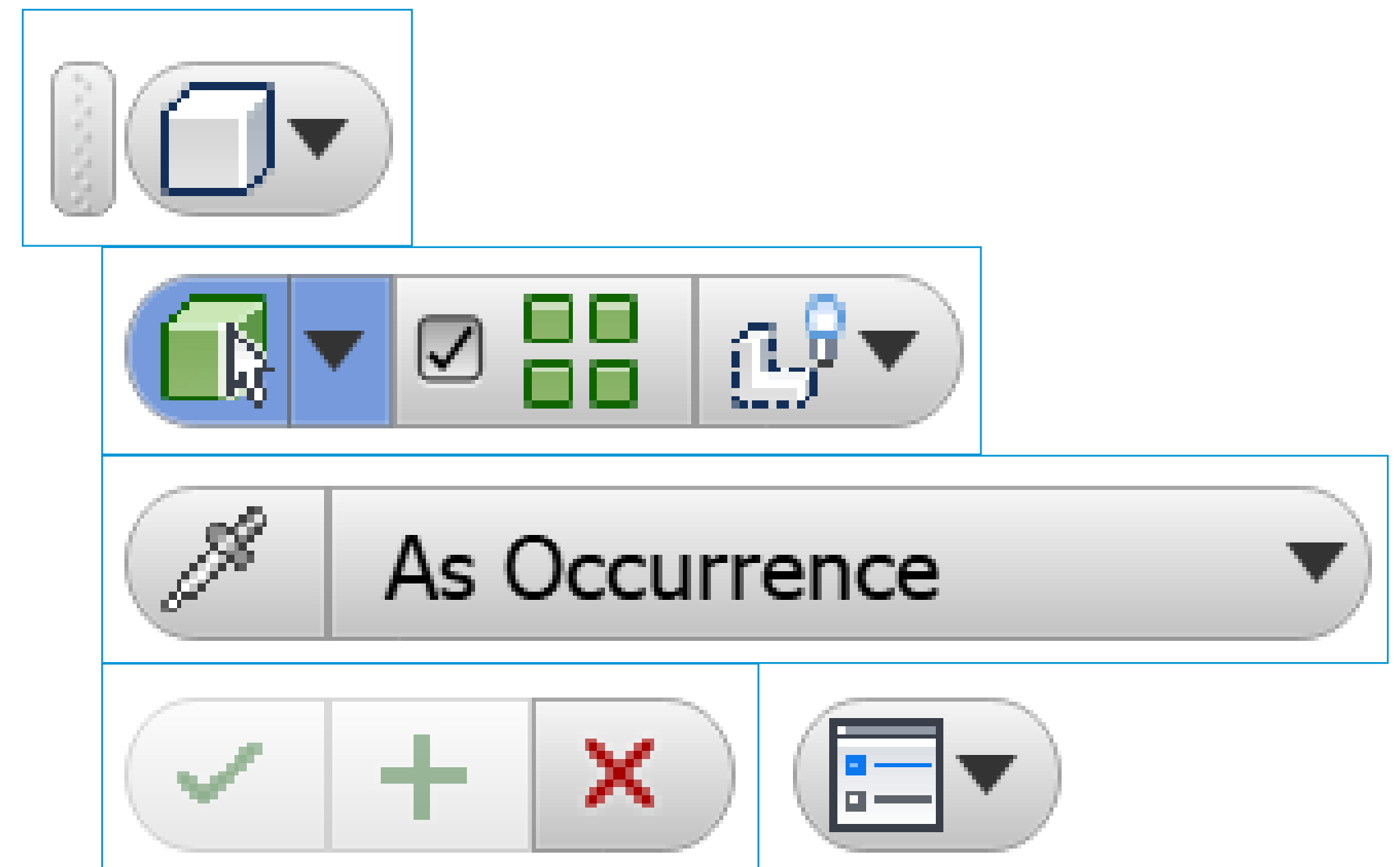
简化 – 包覆体 (Envelopes)

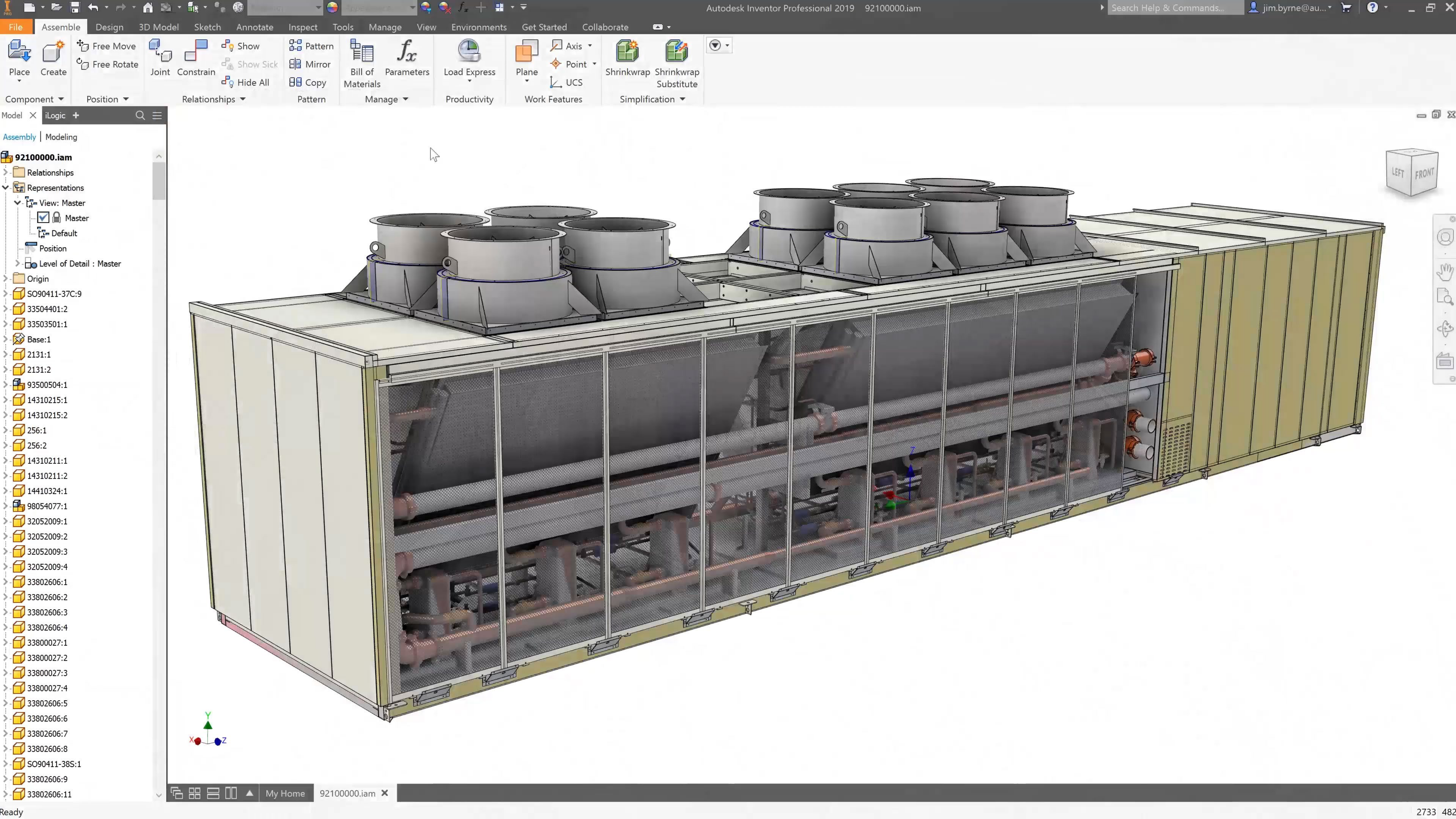
- 边界盒 (长方体或者圆柱)
 - 通过拖拽箭头进行尺寸调整

- 选择集
- 显示/隐藏原模型



- 定义模型颜色

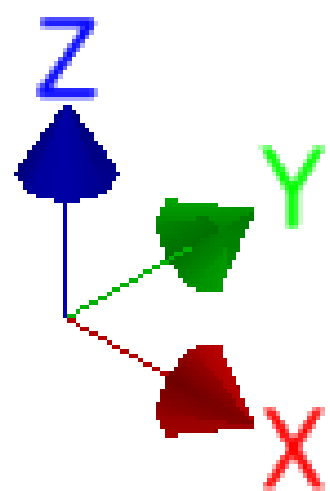




建筑模型属性配置

BIM Content 环境

- 方位 – Z轴向上!
- OmniClass/Revit 类别
- 族类型名称Family Type Name – 仅支持单类型族
- 模型属性-列表选择
- MEP 连接头



Author Building Components

Orientation

Model Origin

Locate Insertion Points

Component Type

OmniClass Number and Name

23.40.70.17.11 Manufacturing Equipment

Component Properties

Family Type Name: Standard

☒ Model Property

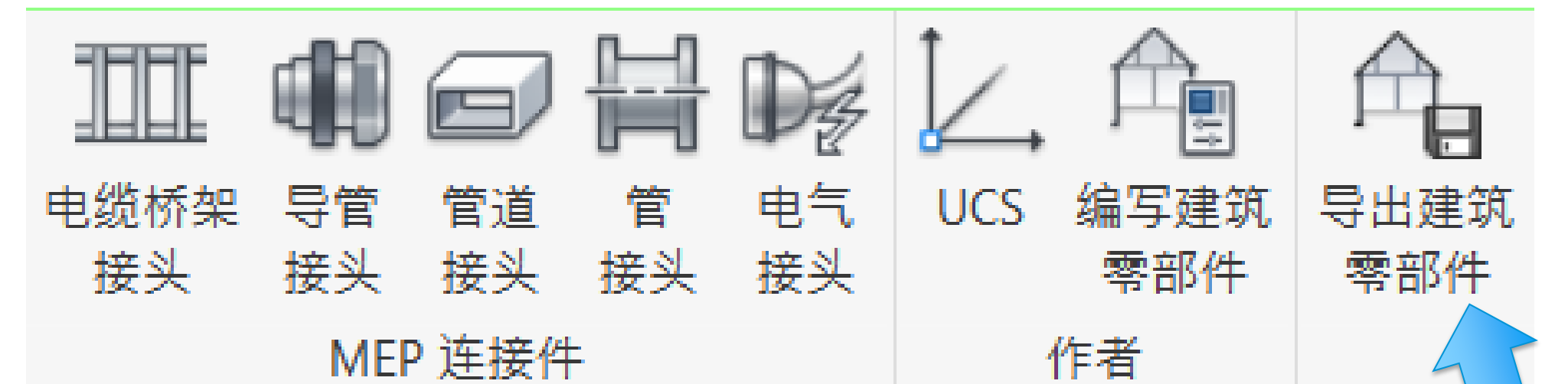
Name	Value
Identity Data	
Description	Main Assembly
Manufacturer	
Model	
URL	
Model Properties	
Area	5.428512e+08 millimeter^2
Center of Gravity	X: 5309.057 mm Y: 1694.023 mm Z: ...
Density	4.063253e-06 kilogram/millimeter^3
Mass	1.618803e+04 kilogram
Requested Accuracy	Low
Volume	3.984007e+09 millimeter^3
Cost	
Date Created	2005-10-21

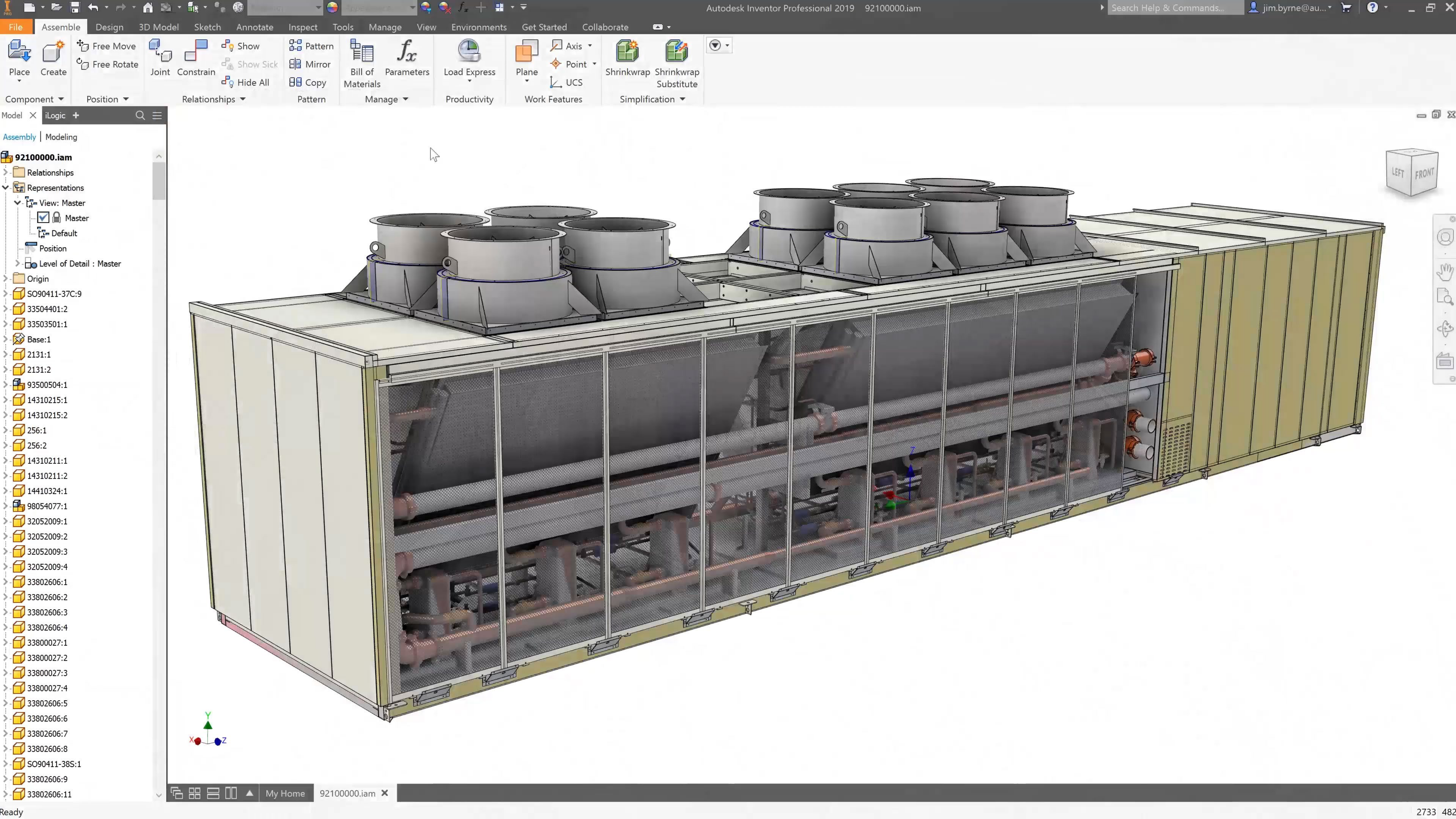
OK Cancel Apply

建筑模型导出

- 单一文件单类型导出: ADSK/RFA / IFC / SAT
- RFA不支持嵌套族，需要单个零部件导出，然后在Revit内组装

ADSK 文件
For Revit and
AutoCAD
Architecture/MEP

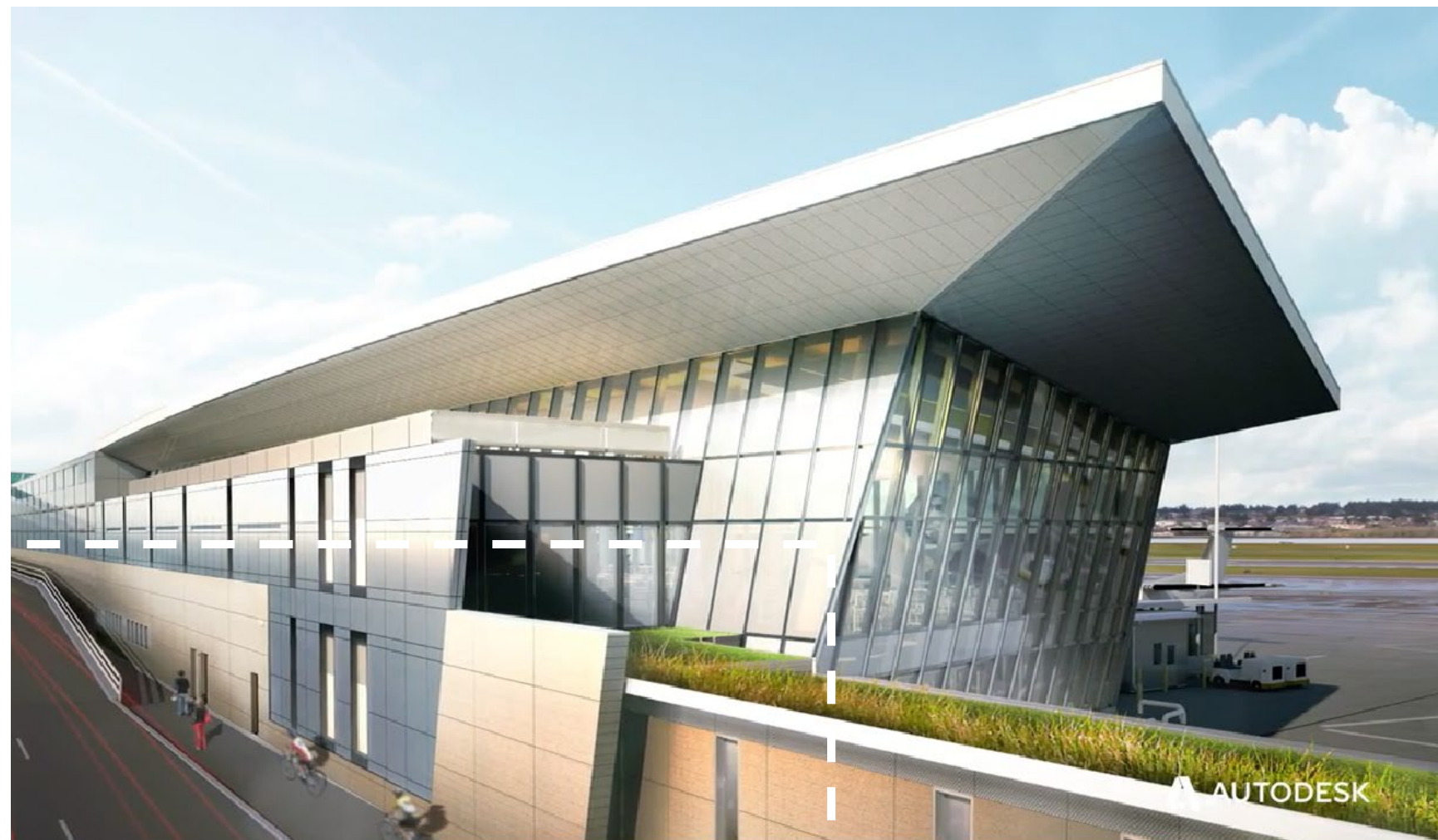




导入Revit模型 (RVT)



提供场景支持

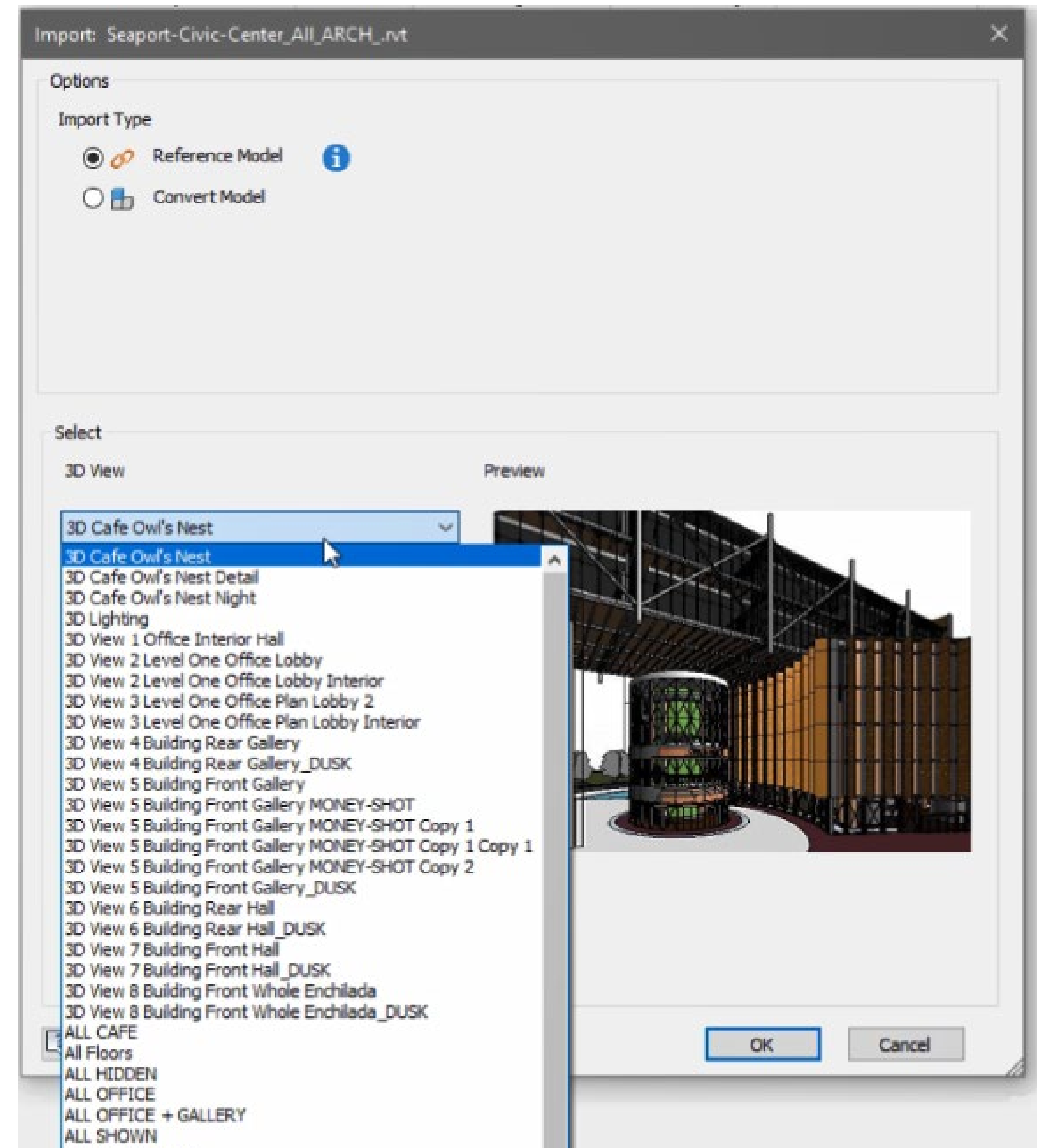
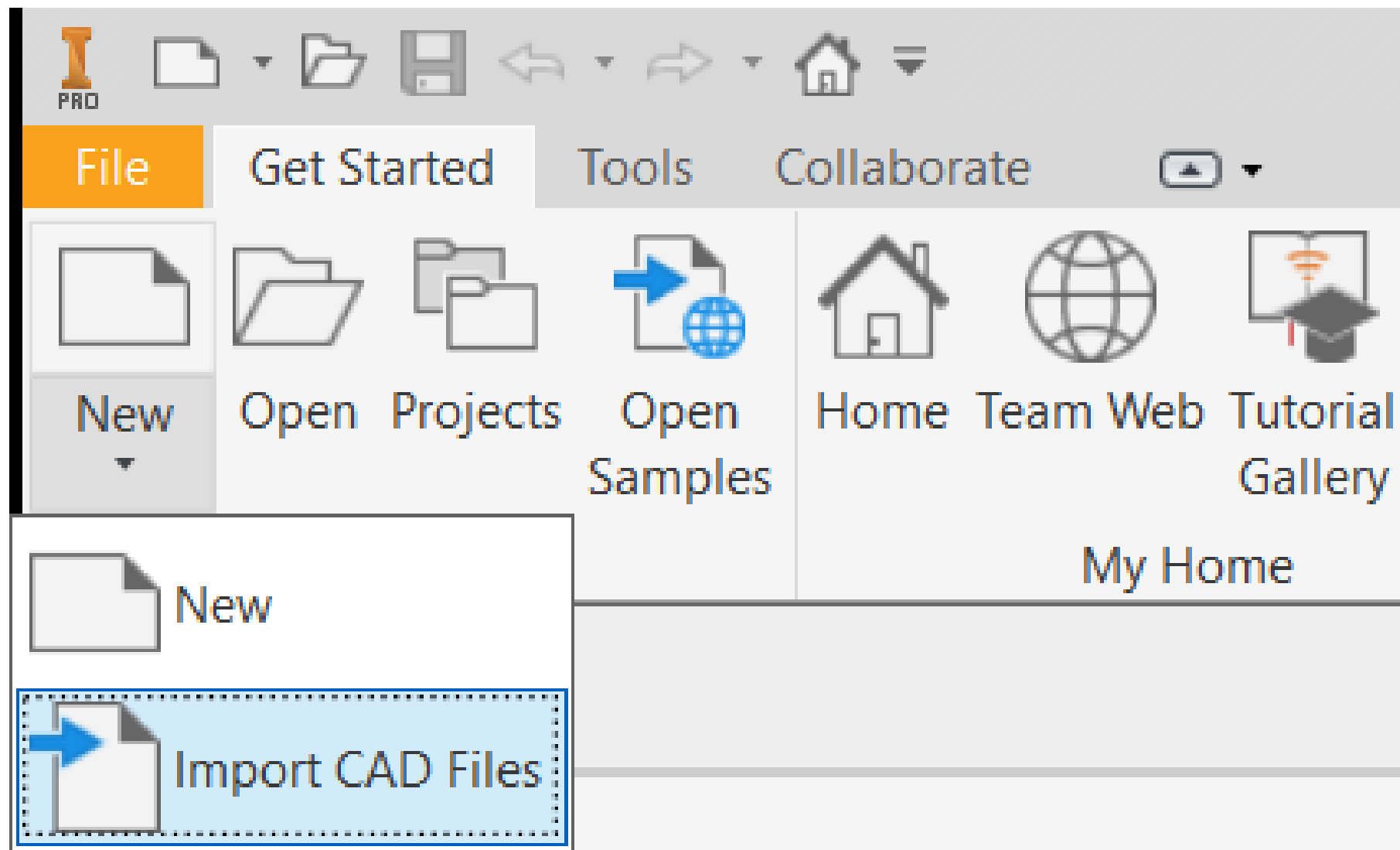


Revit: Building Context

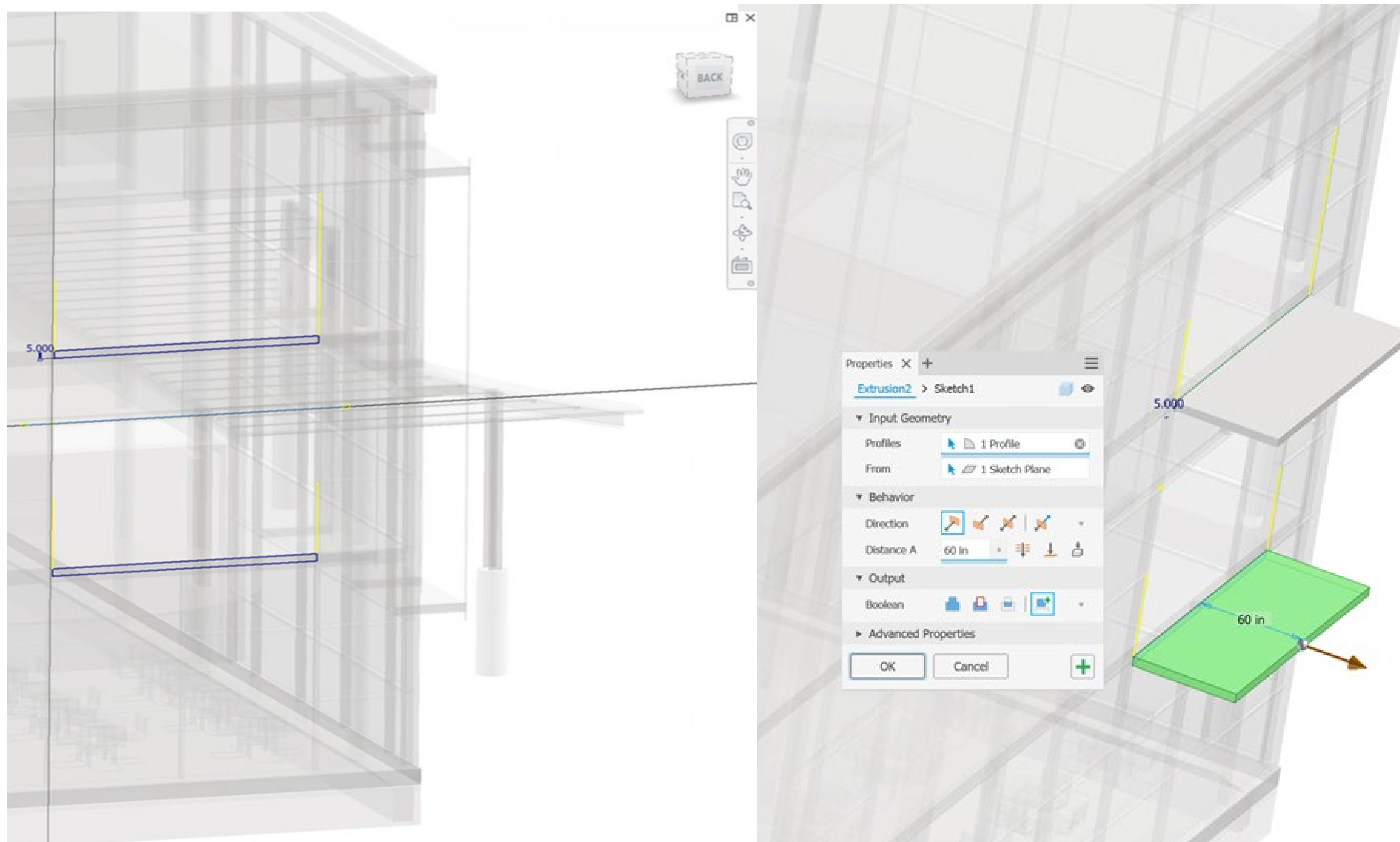


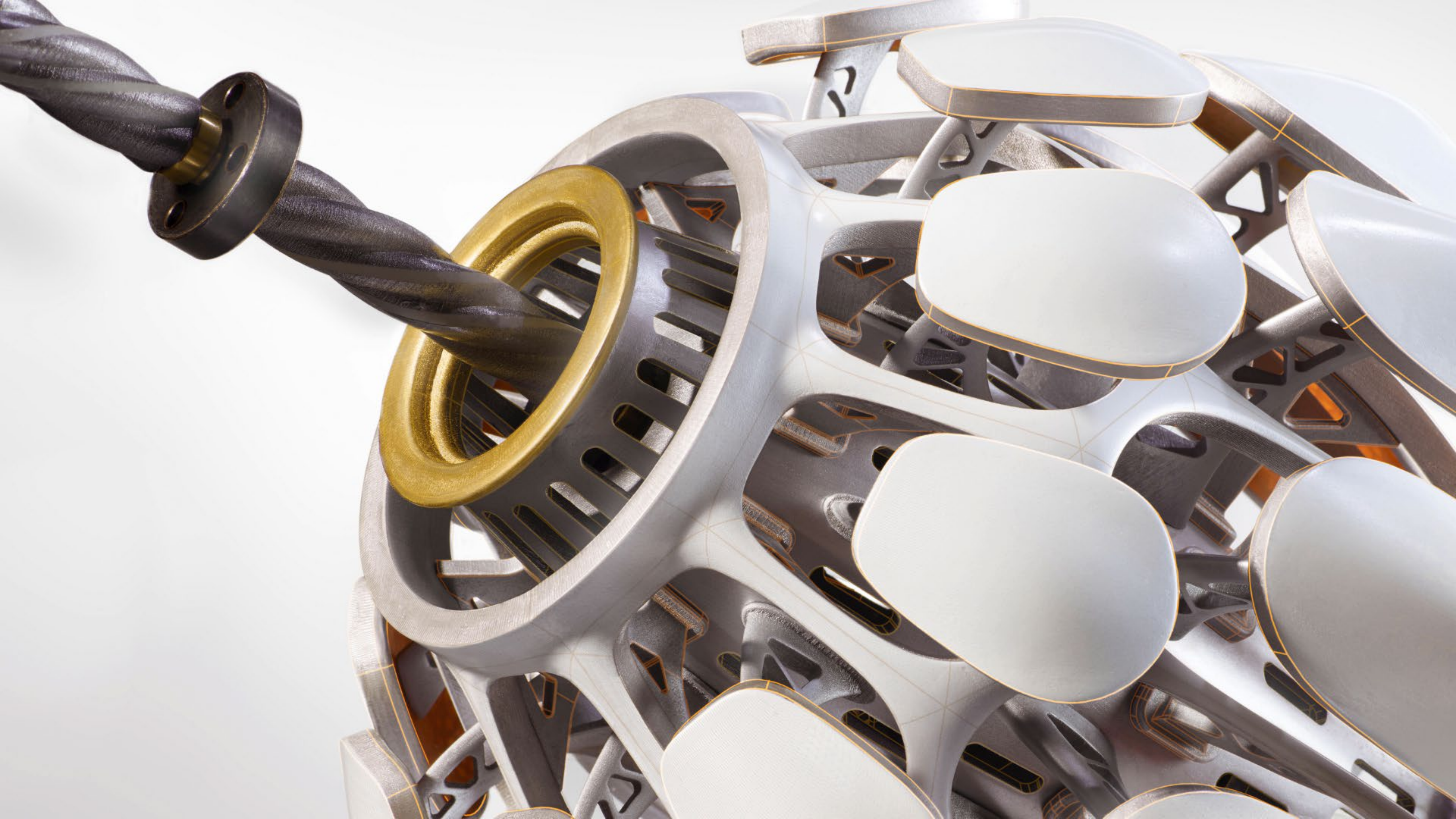
Inventor: System of Products

导入文件 – Revit模型 (RVT)



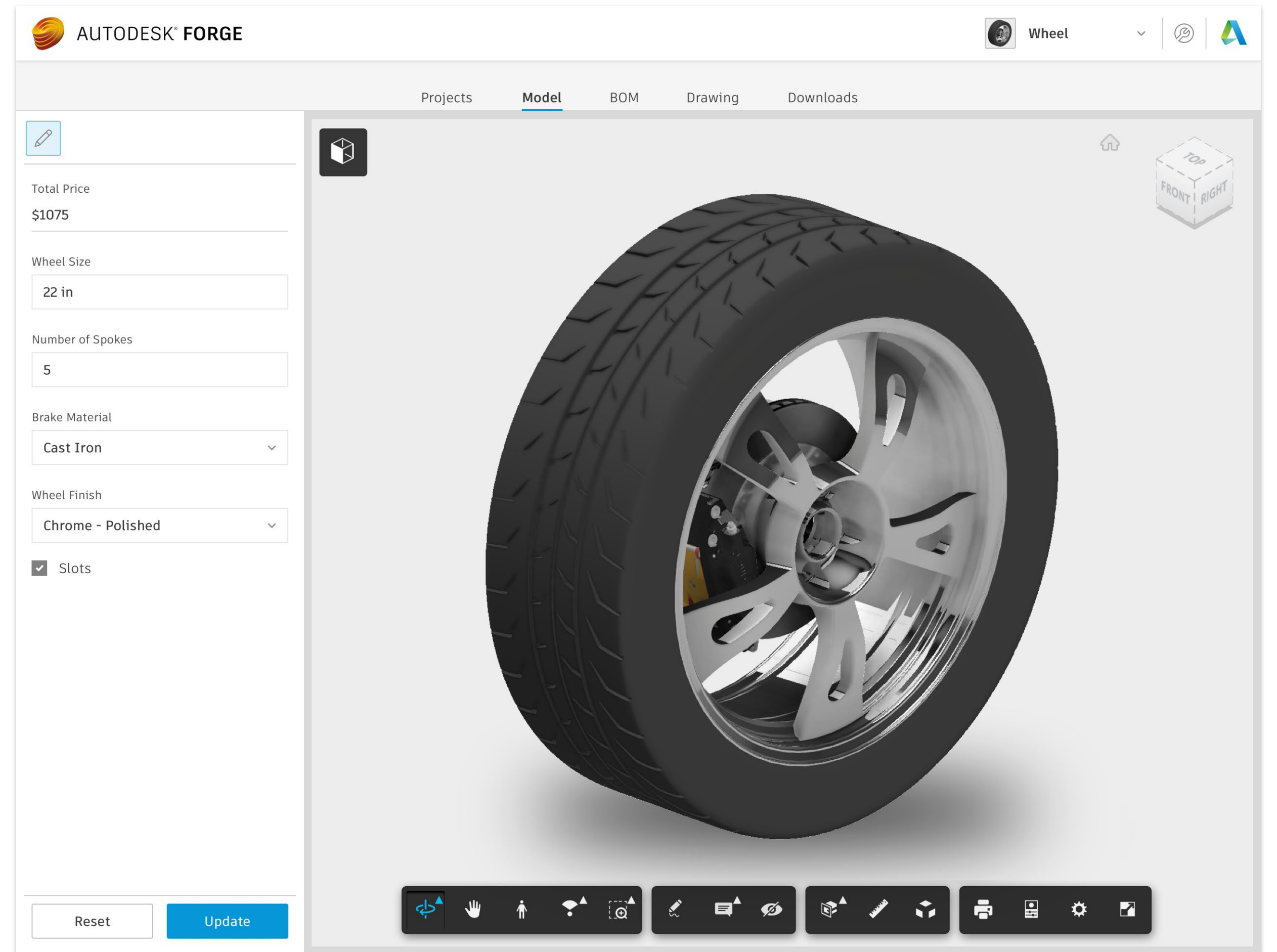
参考Revit数据创建关联的Inventor模型

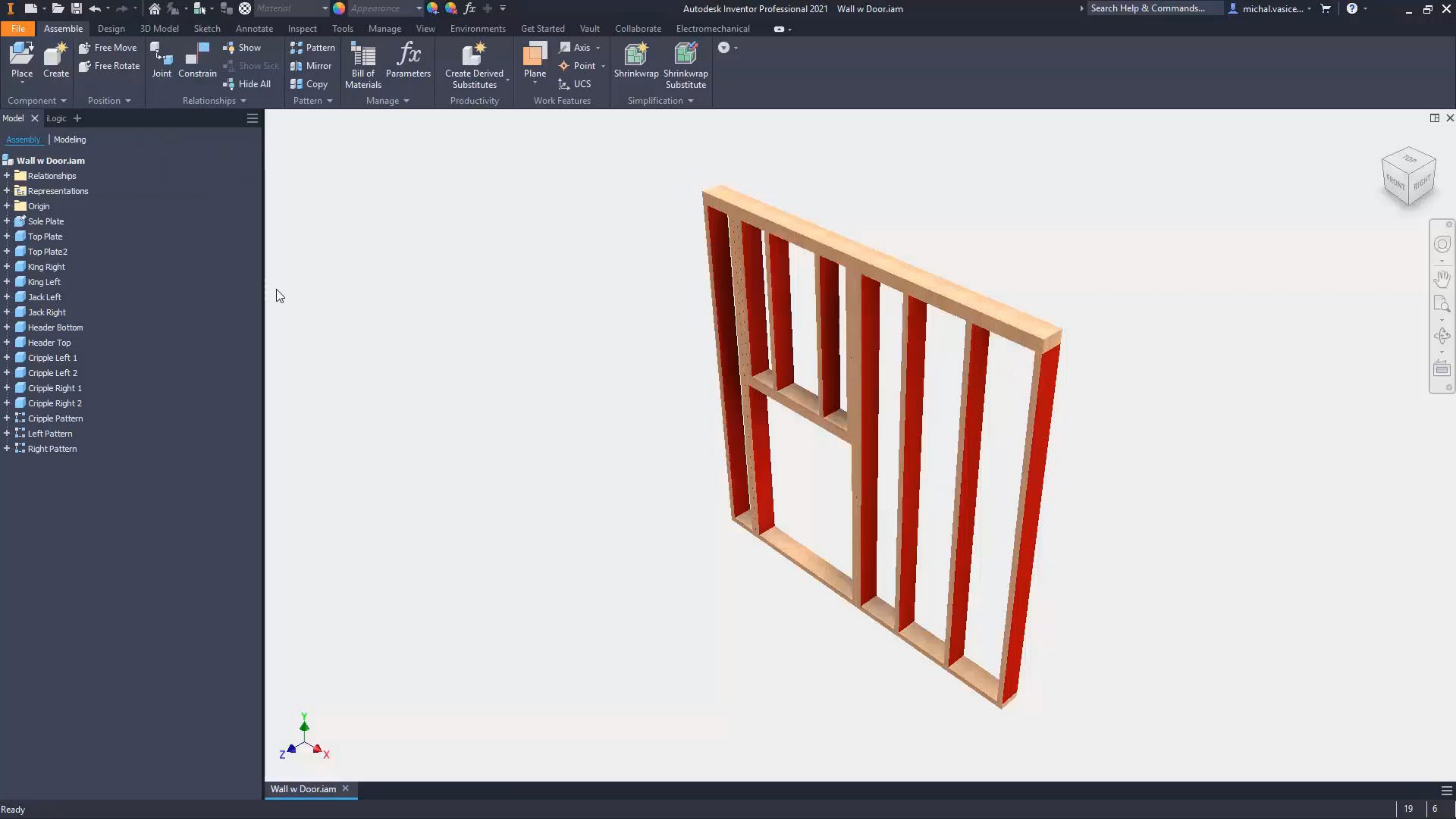


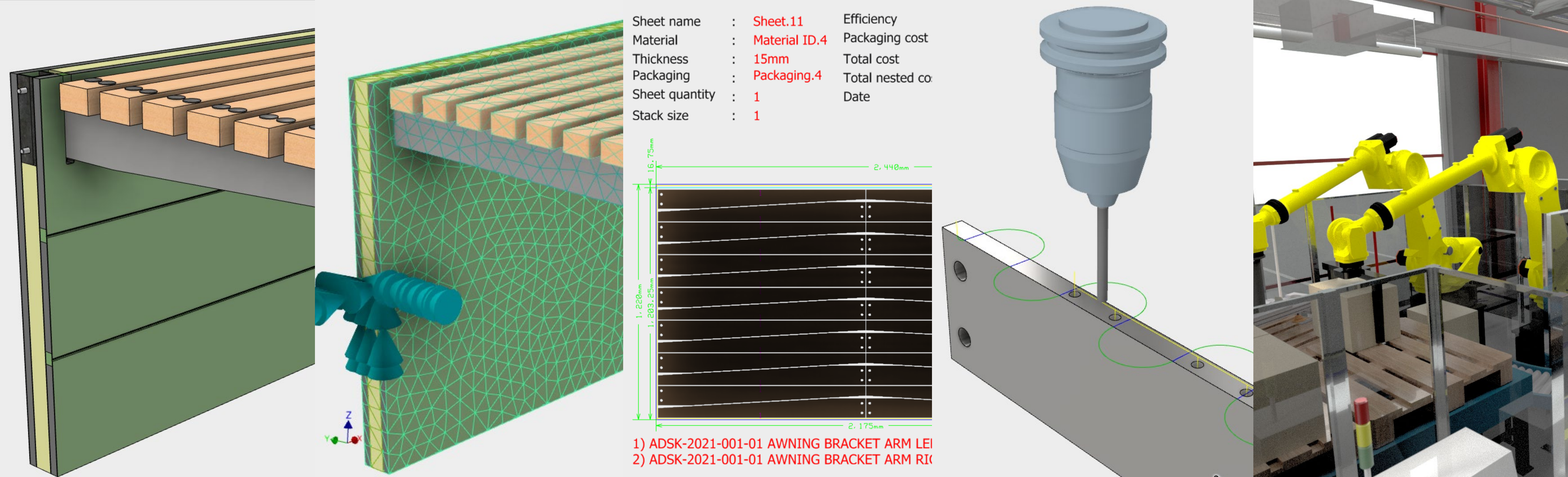


参数化配置

- 在Inventor内对模型进行参数化配置
 - iPart/iAssembly/iLogic/iCopy
- Forge Automation
 - 样例: <http://inventor-config-demo.autodesk.io/>
 - 云端产品配置样例
 - Inventor iLogic/Inventor API/Inventor IO/Forge Viewer
 - 代码分享
 - Github: <https://github.com/Autodesk-Forge/forge-configurator-inventor>







PROFESSIONAL-GRADE
 DESIGN & AUTOMATION
 专业级设计及自动化

ADVANCED & NONLINEAR
 SIMULATION
 仿真

SHEET MATERIAL
 NESTING
 平板原材料嵌套工具

2.5 TO 5-AXIS CAM
 2.5-5轴计算机辅助加工

FACTORY
 DESIGN
 工厂设计

DESIGN

MANUFACTURING

AUTODESK INVENTOR

从设计到制造一站式流程

参考资料

- AU课程Inventor/Revit交互流程最佳实践: <https://www.autodesk.com/autodesk-university/class/Best-Practices-Inventor-and-Revit-Workflows-2019#presentation>
- <https://www.autodesk.com/autodesk-university/class/New-Workflow-Bridge-Design-InfraWorks-Inventor-Civil-3D-and-Revit-2018>
- <http://www.wbdg.org/resources/site-and-modular-construction-explained>
- <https://bimforum.org/LOD>
- <https://www.united-bim.com/bim-maturity-levels-explained-level-0-1-2-3/>
- 在线教程创建BIM模型: <https://www.autodesk.com/solutions/create-bim-content>
- 在线教程BIM服务制造: <https://customersuccess.autodesk.com/disciplines/mechanical/challenges/bim-for-manufacturing>



Autodesk 和 Autodesk 标识是 Autodesk, Inc. 和/或其子公司和/或其关联公司在美国和/或其他国家或地区的注册商标或商标。所有其他品牌名称、产品名称或者商标均属于其各自的所有者。Autodesk 保留随时调整产品和服务、产品规格以及建议零售价的权利，恕不另行通知，同时 Autodesk 对于此文档中可能出现的文字印刷或图形错误不承担任何责任。

© 2020 Autodesk, Inc. 保留所有权利 (All rights reserved)。