AUTODESK. UNIVERSITY

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)

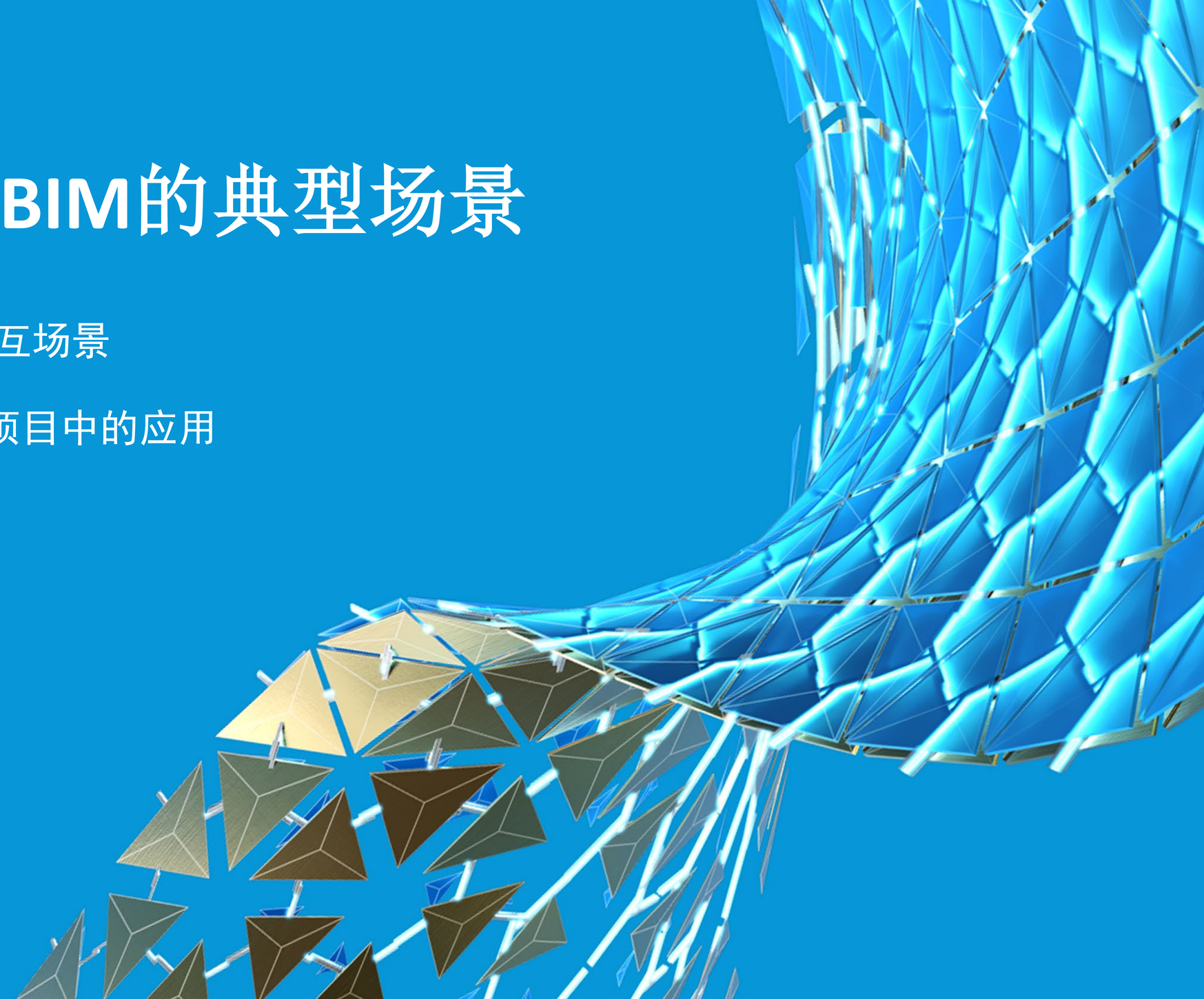
学习目标（Key Learnings）

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

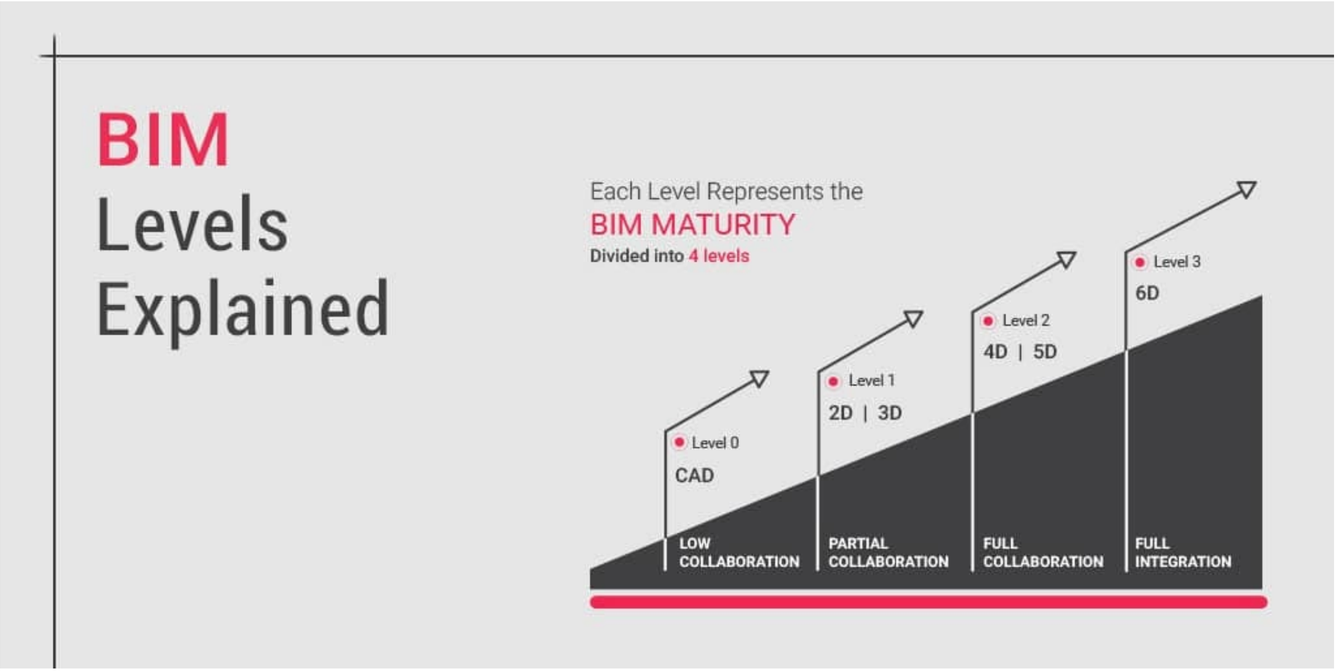
Inventor助力BIM的典型场景

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



https://www.united-bim.com/bim-maturity-levels-explained-level-0-1-2-3/

62%

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

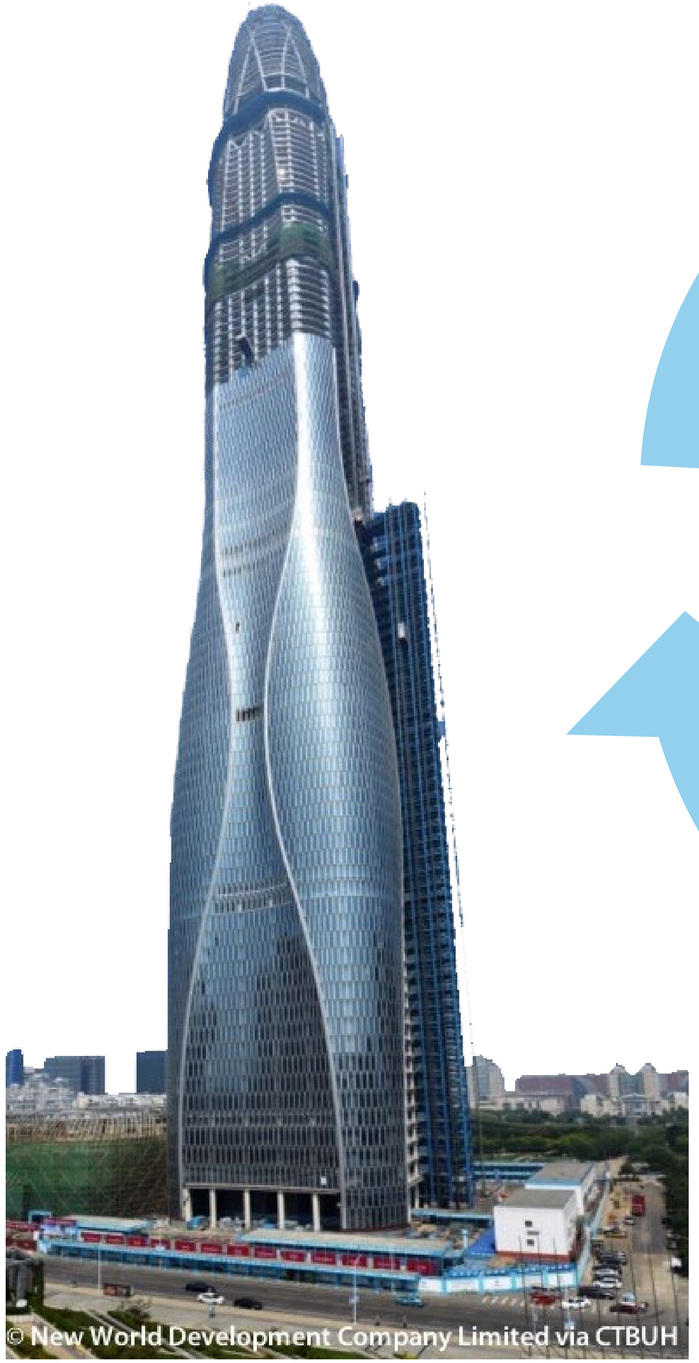
68%

of trades cited poor schedule management to negatively impact labor productivity

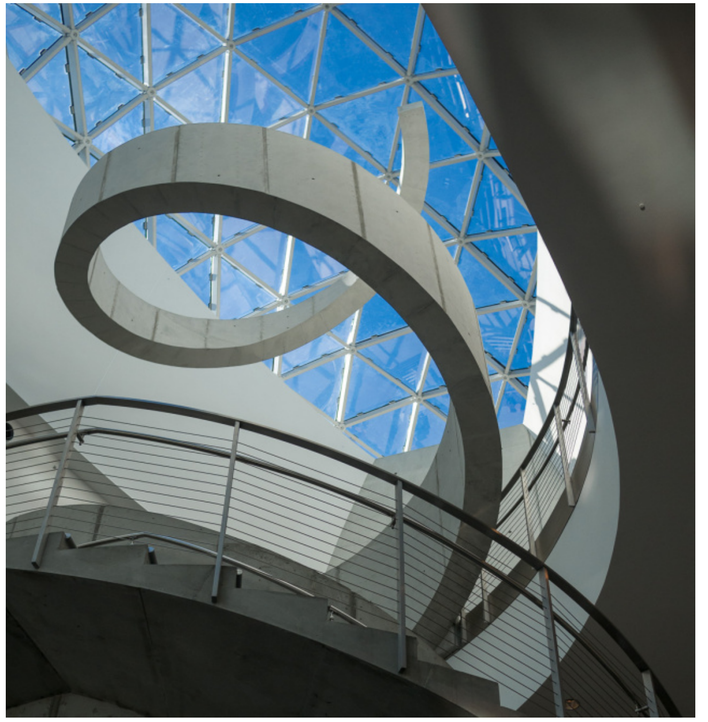
61%

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

https://constructionblog.autodesk.com/construction-productivity/

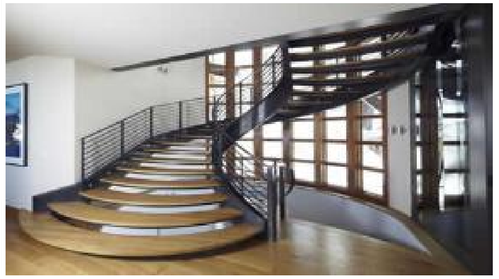


ADSK, IFC, RFA, RVT



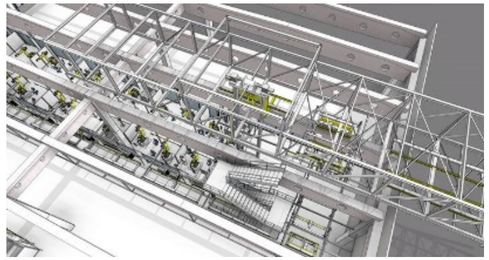
Inventor / Revit 数据交互专注的5个领域

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



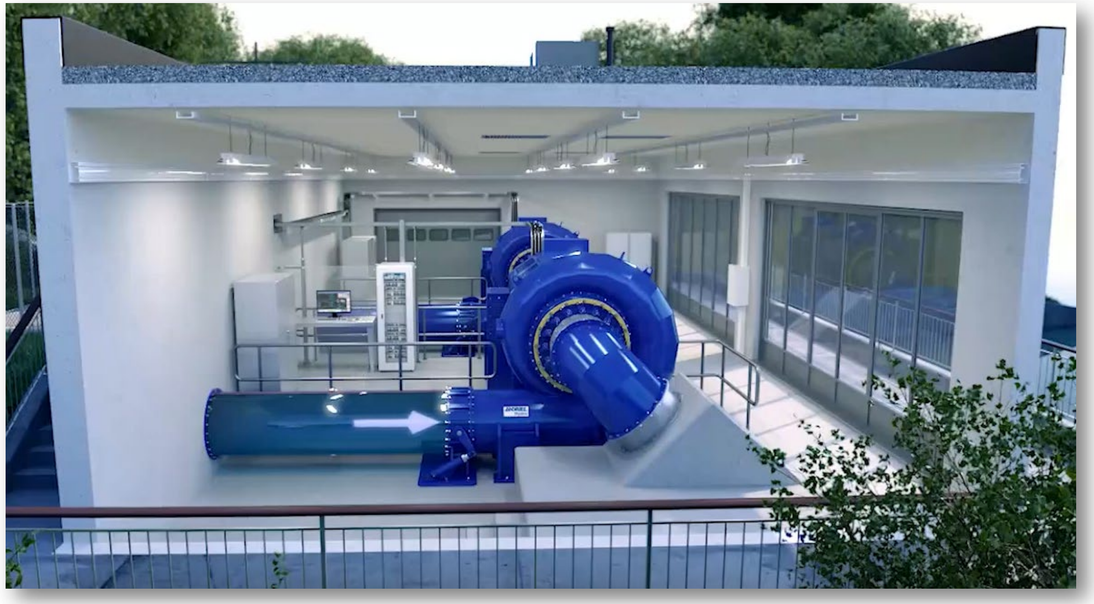




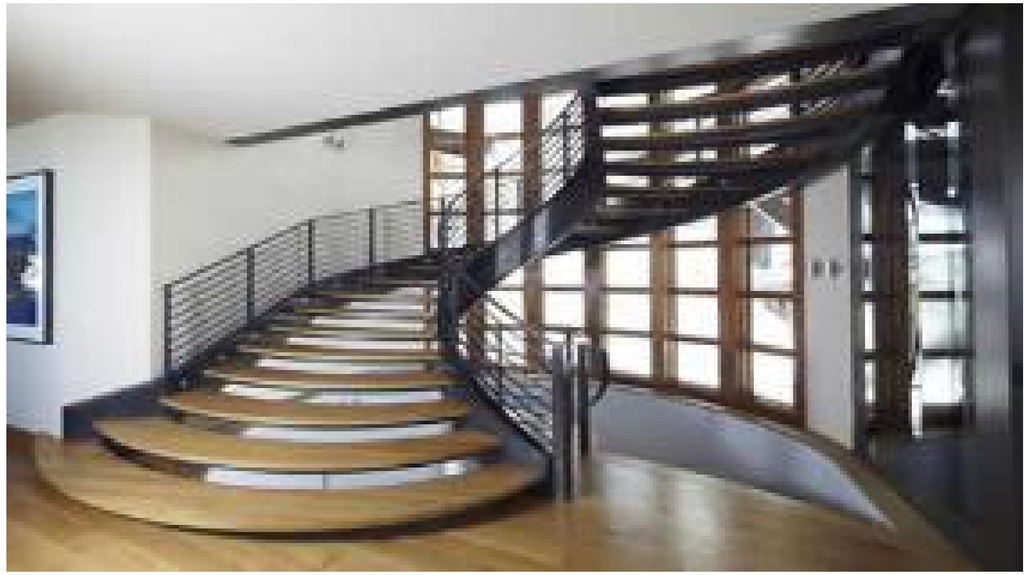





Building Products / Equipment
建筑产品和设备



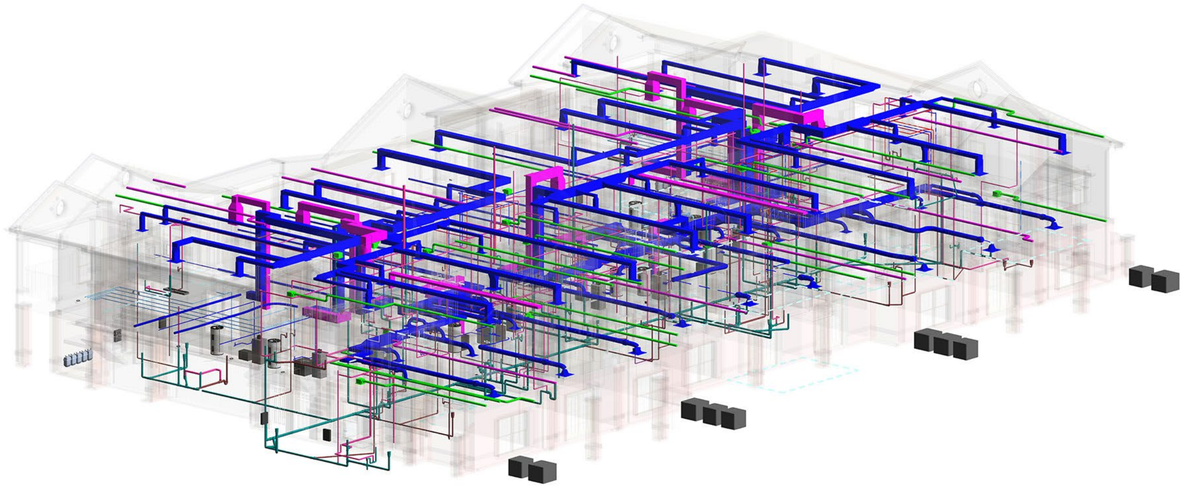
Custom Fabrication
定制加工



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）

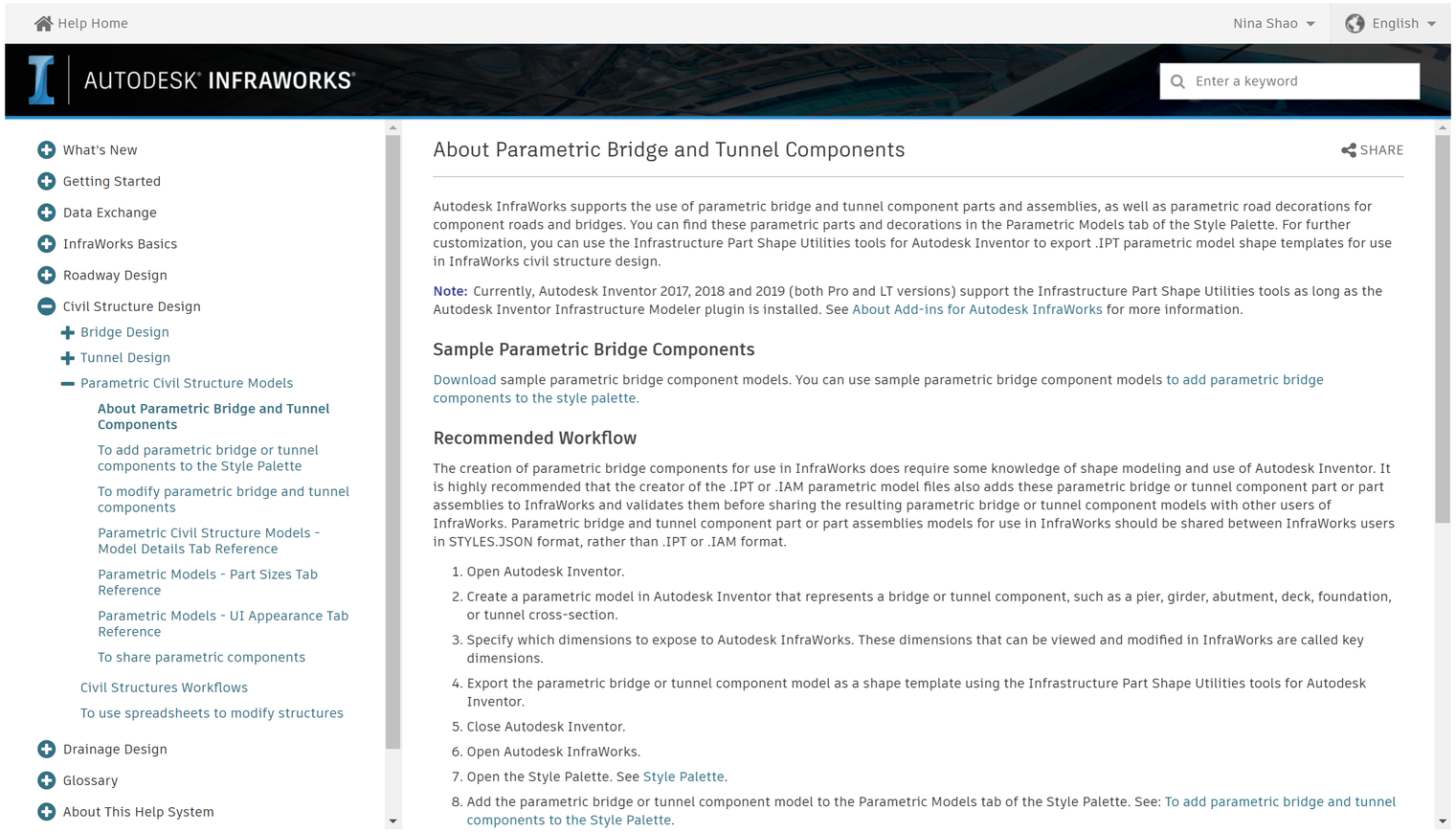
Inventor 在基础设施设计项目中的运用

INVENTOR®

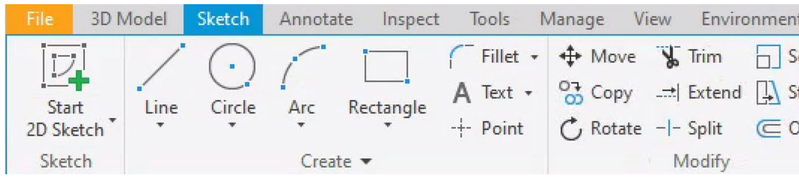
pier, girder, abutment, deck, foundation, or tunnel cross-section
支座，桥墩，塔柱，隧道截面

AUTODESK® INFRAWORKS®

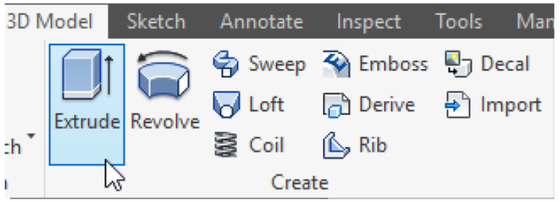
用Inventor创建桥梁和隧道组件参数化模型
（Create Parametric Bridge and Tunnel Components with Inventor ）



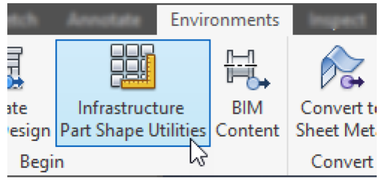
Sketch



3D Model

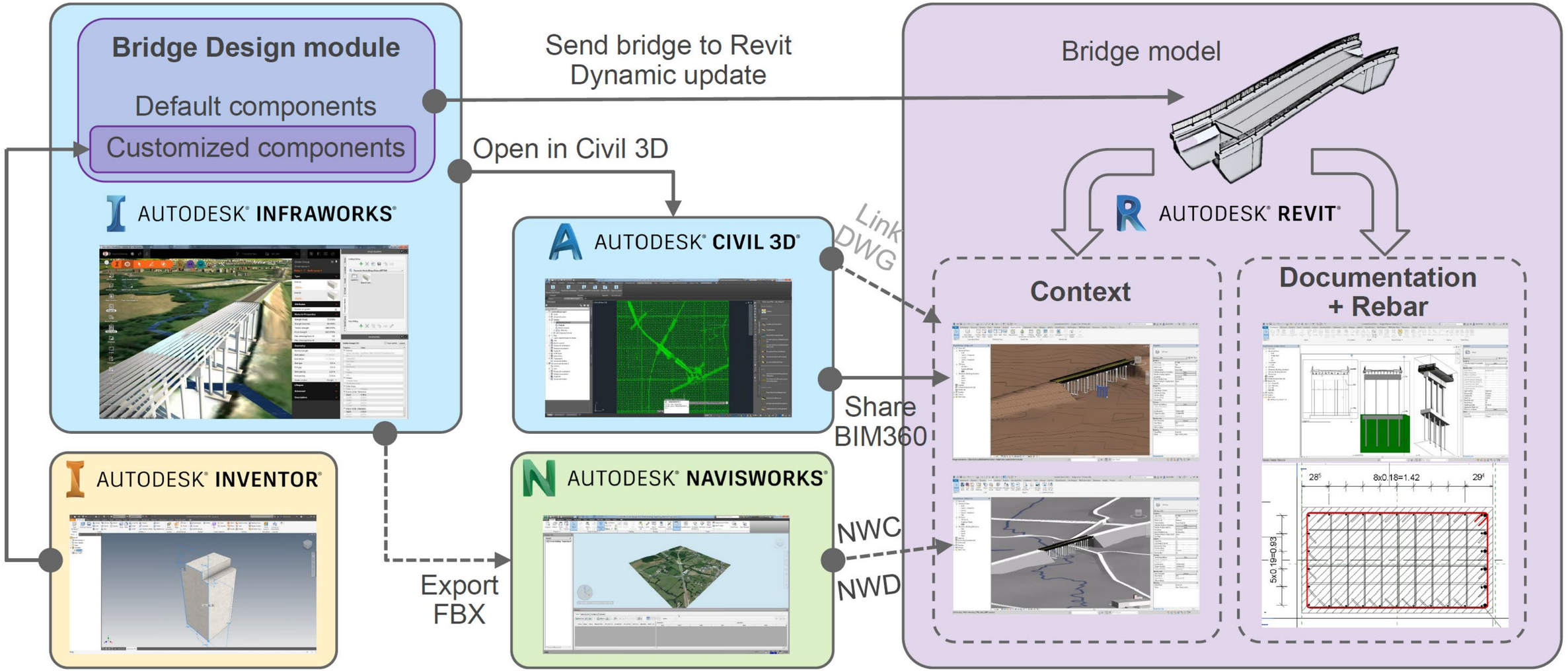


Infrastructure Part Shape Utilities add-in



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

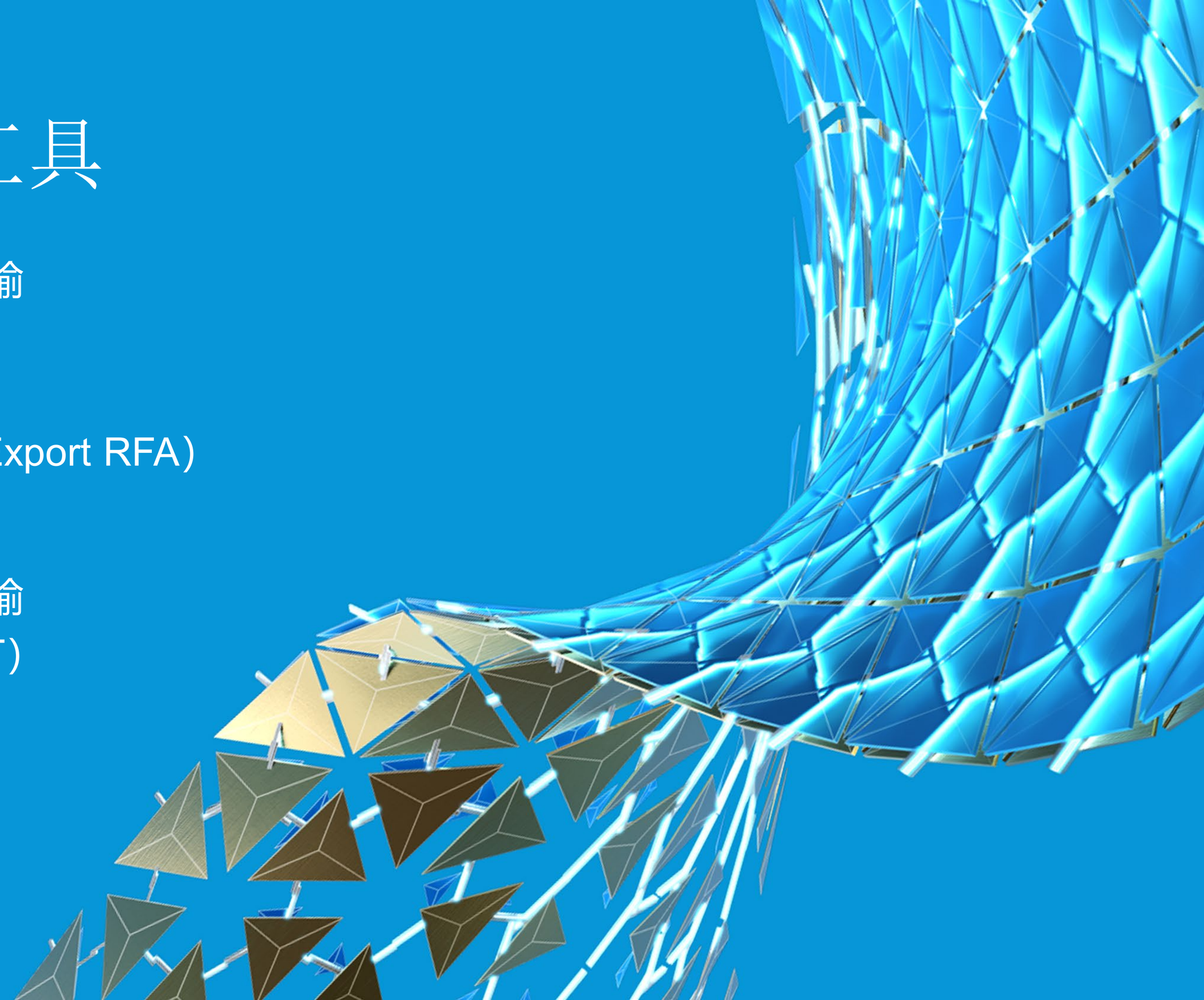
Inventor → Revit 数据传输

- 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

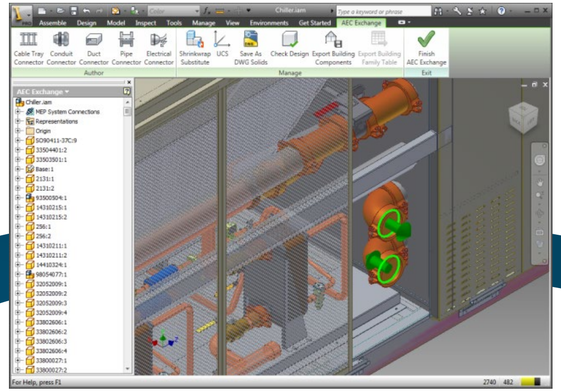
Revit → Inventor 数据传输

- 导入Revit模型（ RVT）

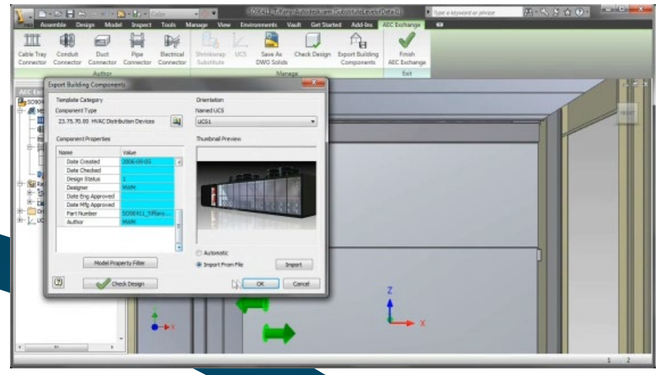
Inventor参数化配置



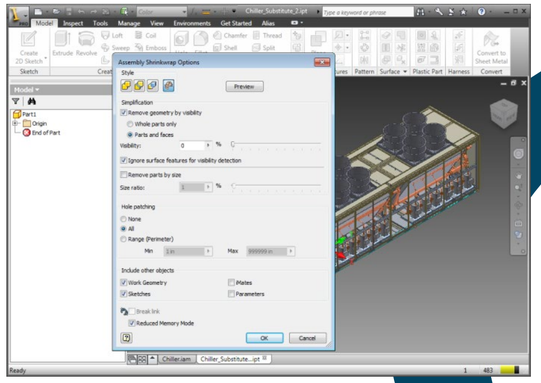
Inventor → Revit 数据传输流程



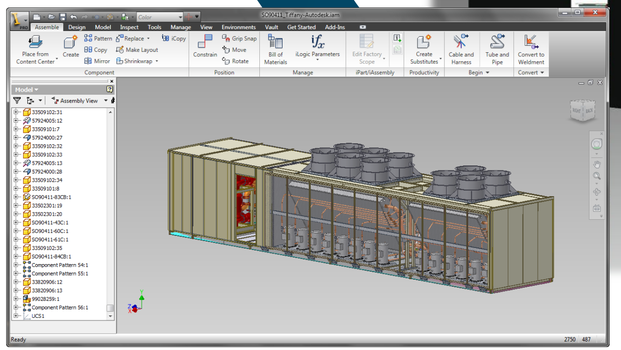
定义连接件及其它属性



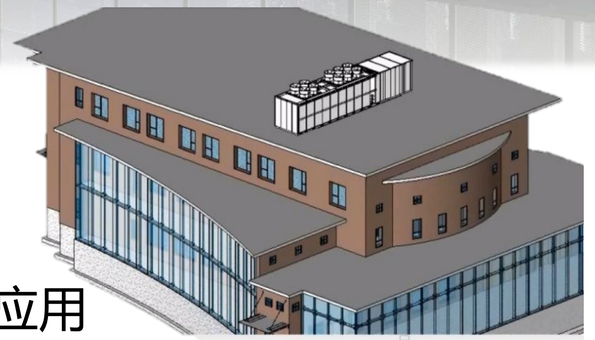
导出ADSK/RFA文件



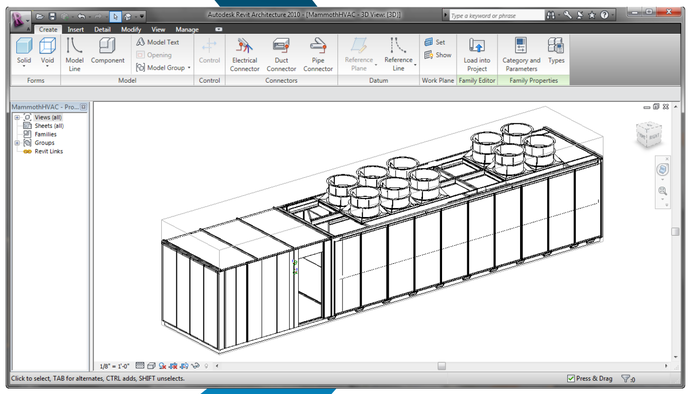
模型简化



3D模型



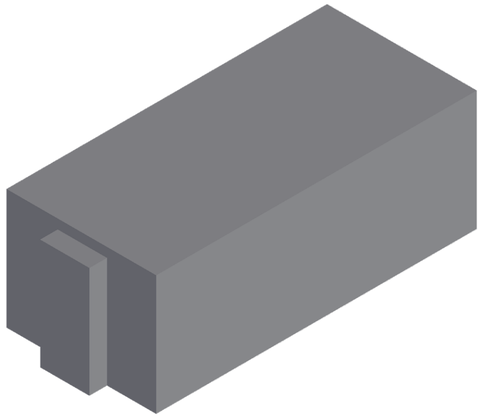
Revit族应用

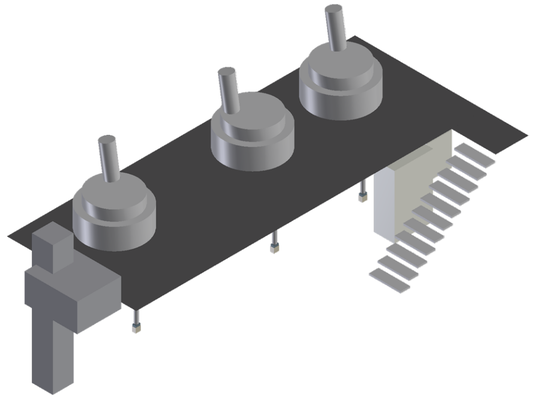


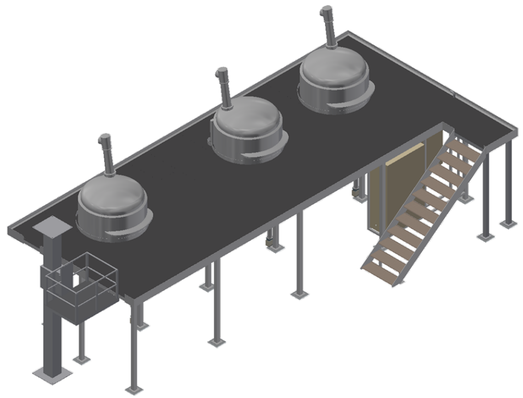
导入Revit

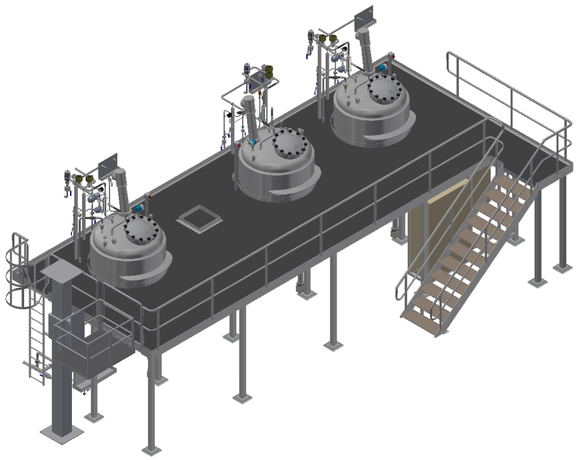
模型简化

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

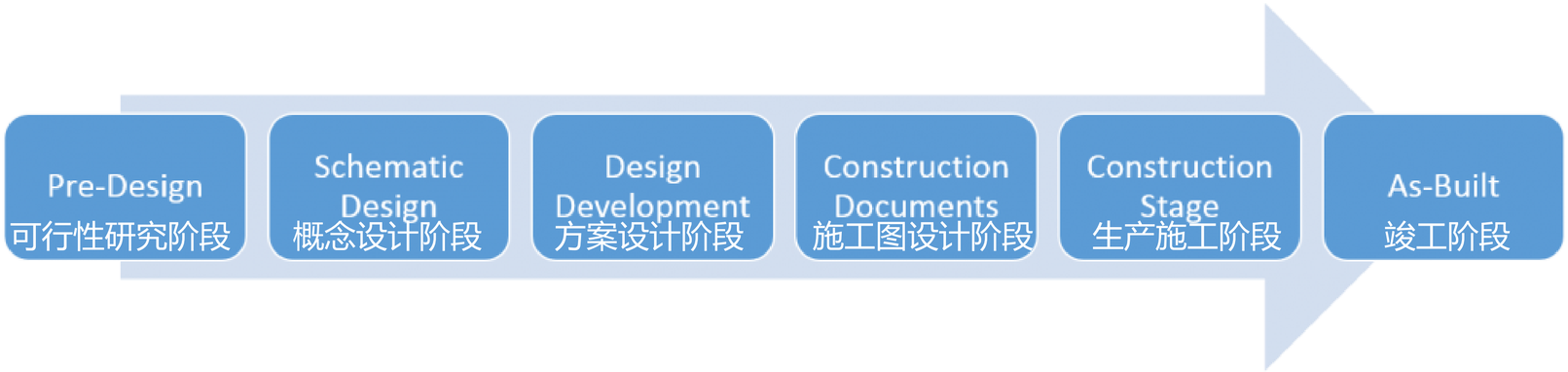


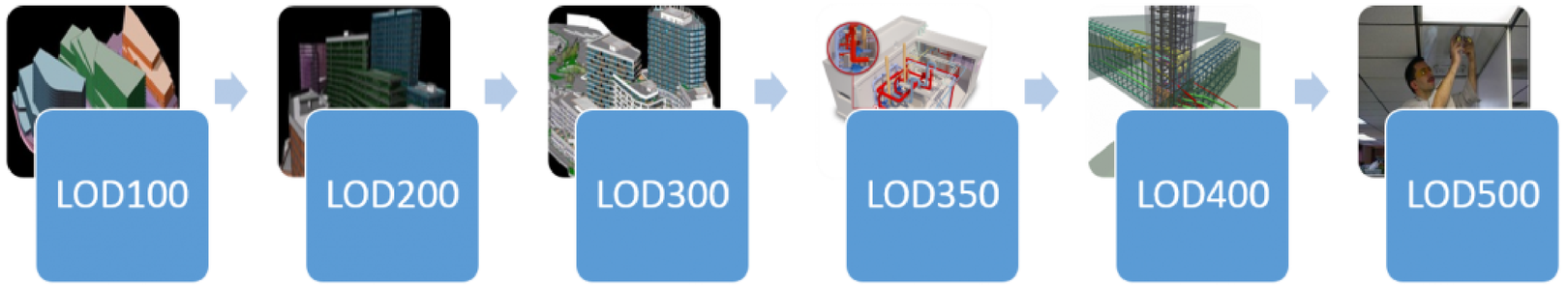


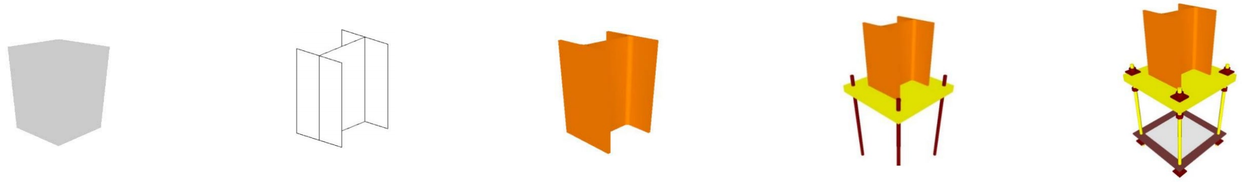




如何在实际使用情况中准确的表达模型?







钢立柱为例

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

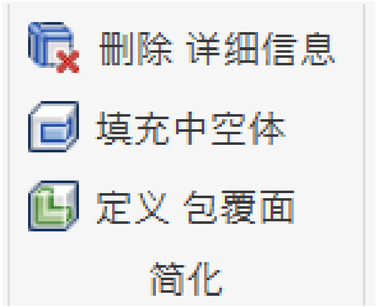
https://bimforum.org/LOD

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**

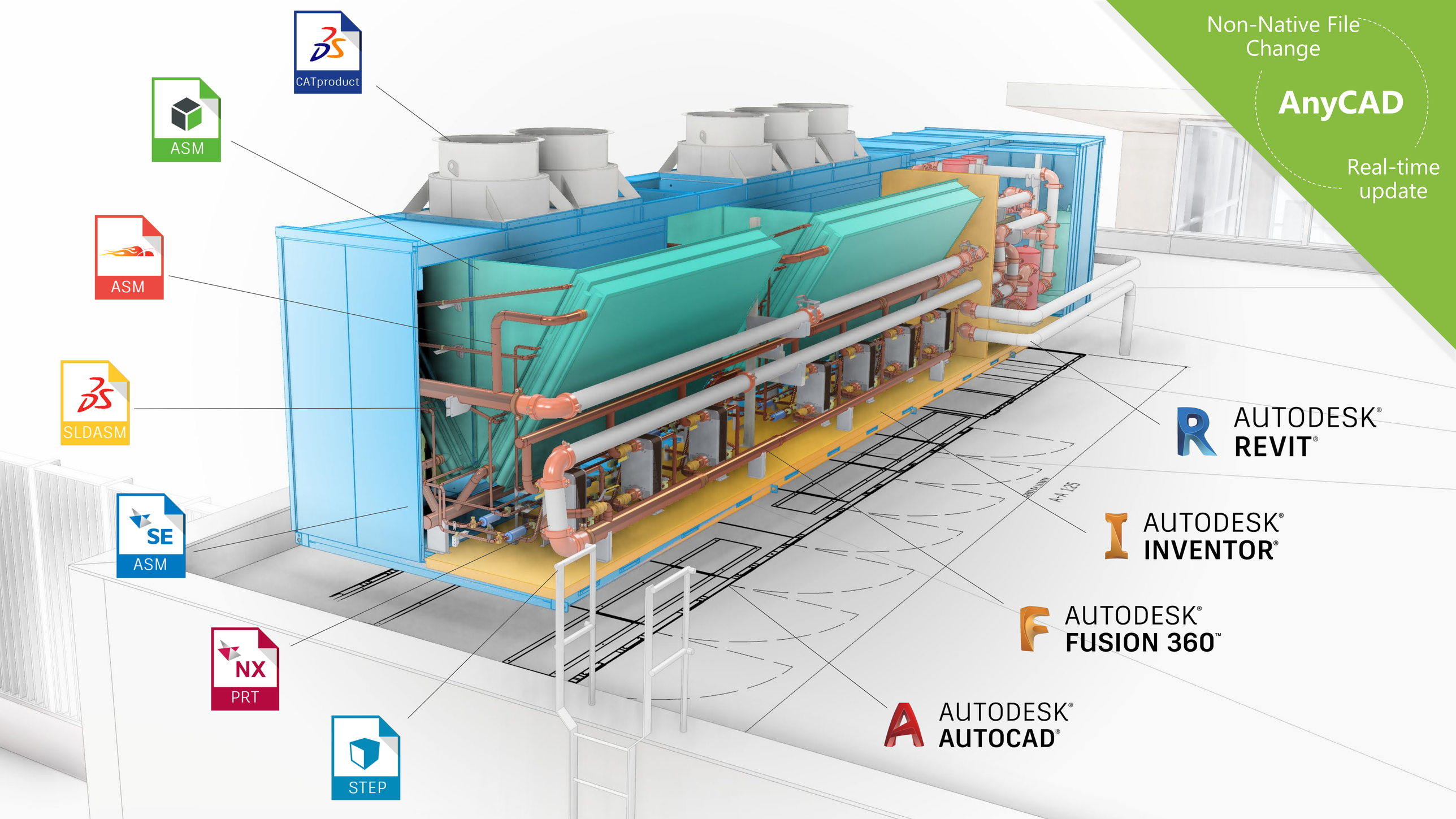
装配



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
CATproduct
ASM
ASM
SLDASM
SE
ASM
NX
PRT
STEP
AUTODESK® REVIT®
AUTODESK® INVENTOR®
AUTODESK® FUSION 360™
AUTODESK® AUTOCAD®

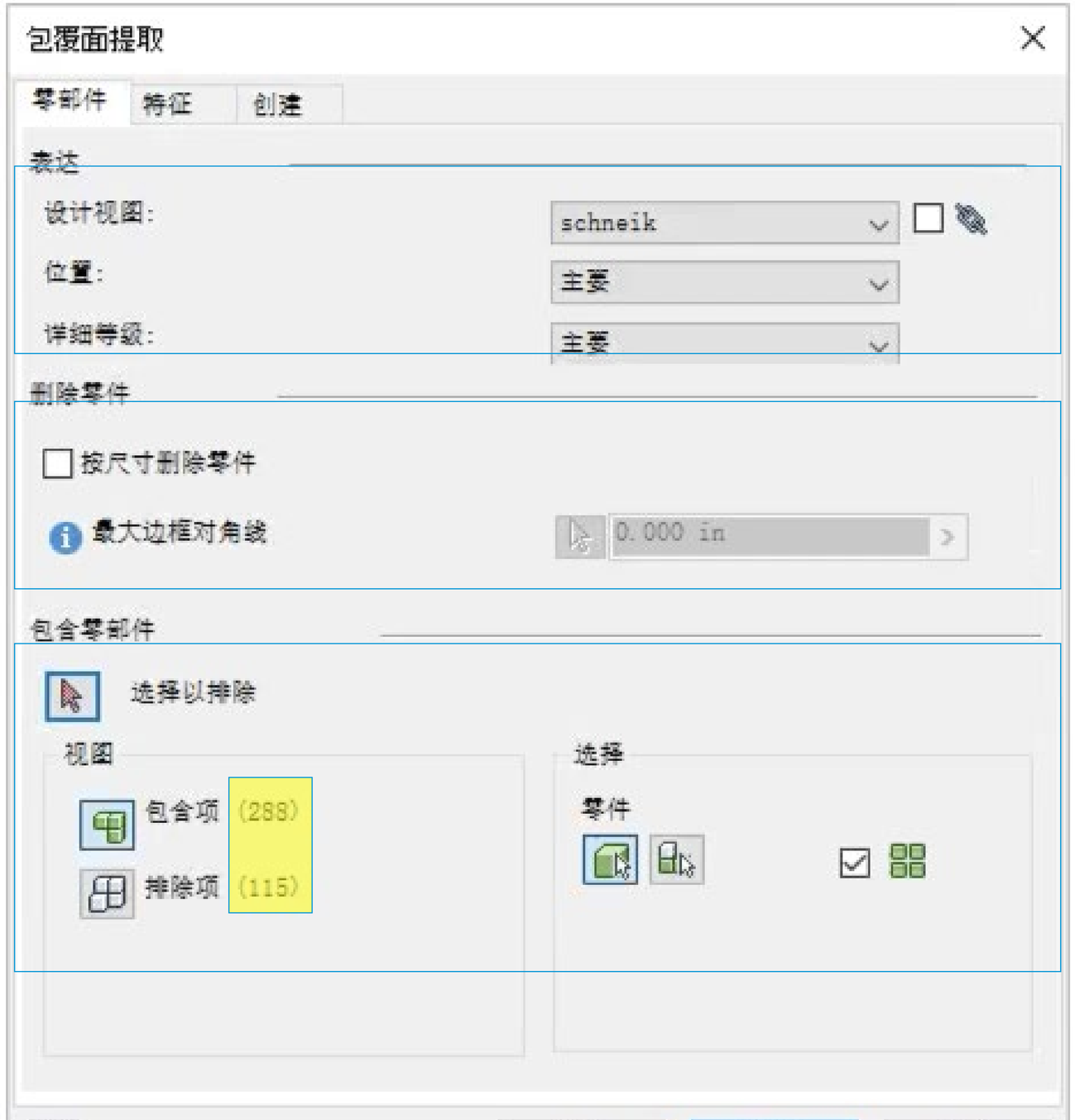
部件页面 （Components Tab）

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



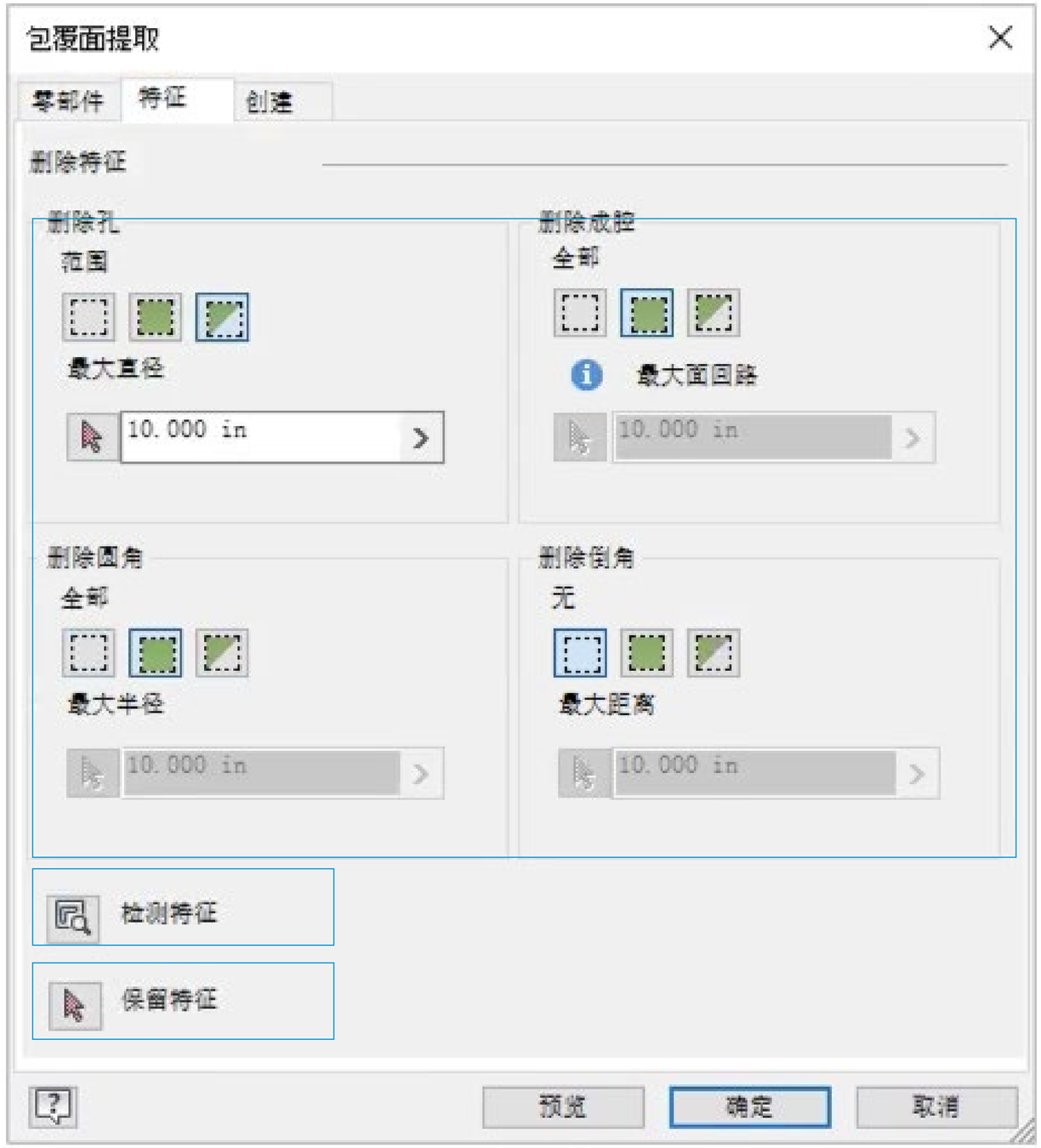
特征界面 （Features Tab）

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



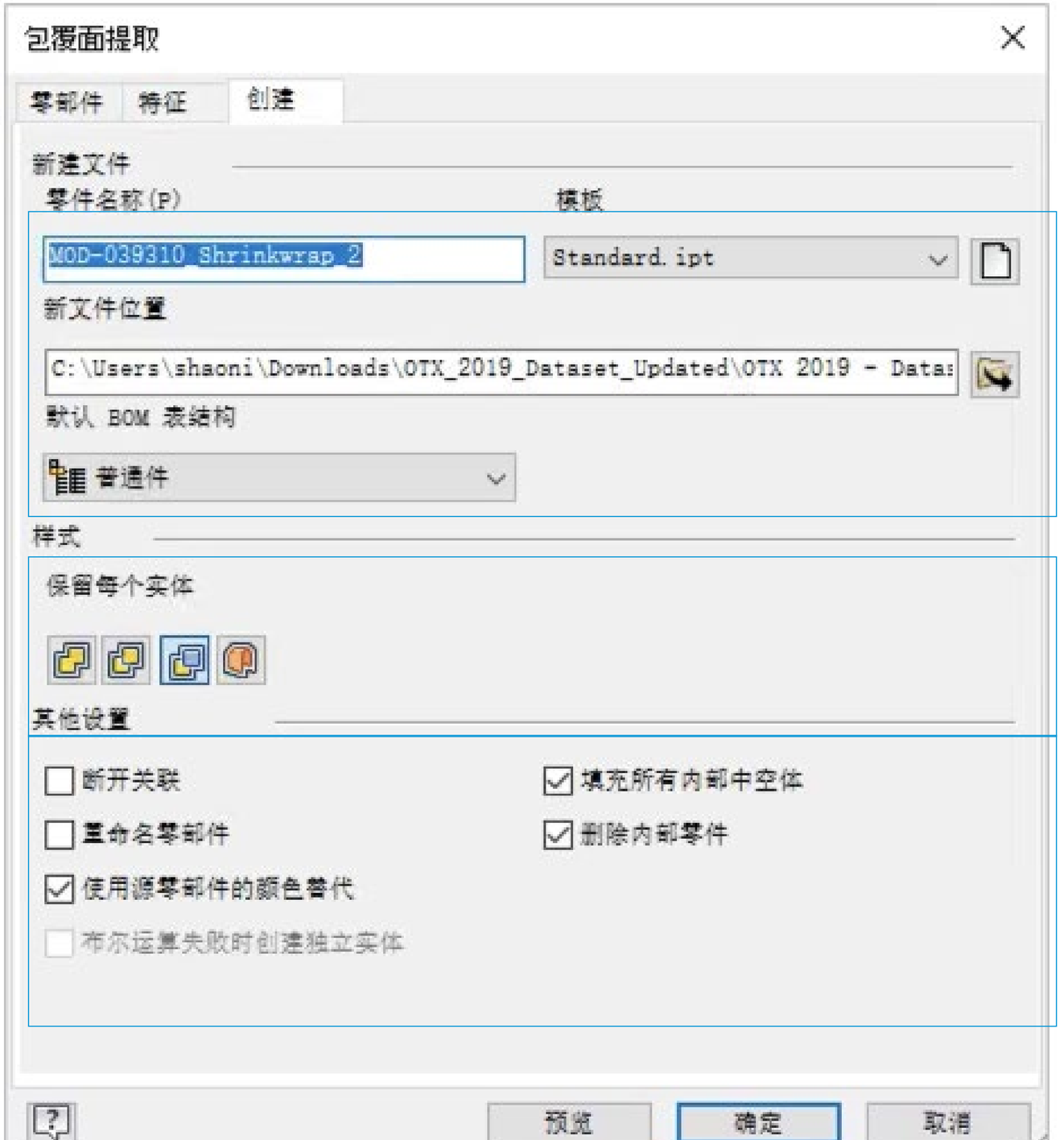
创建页面（Create Tab）

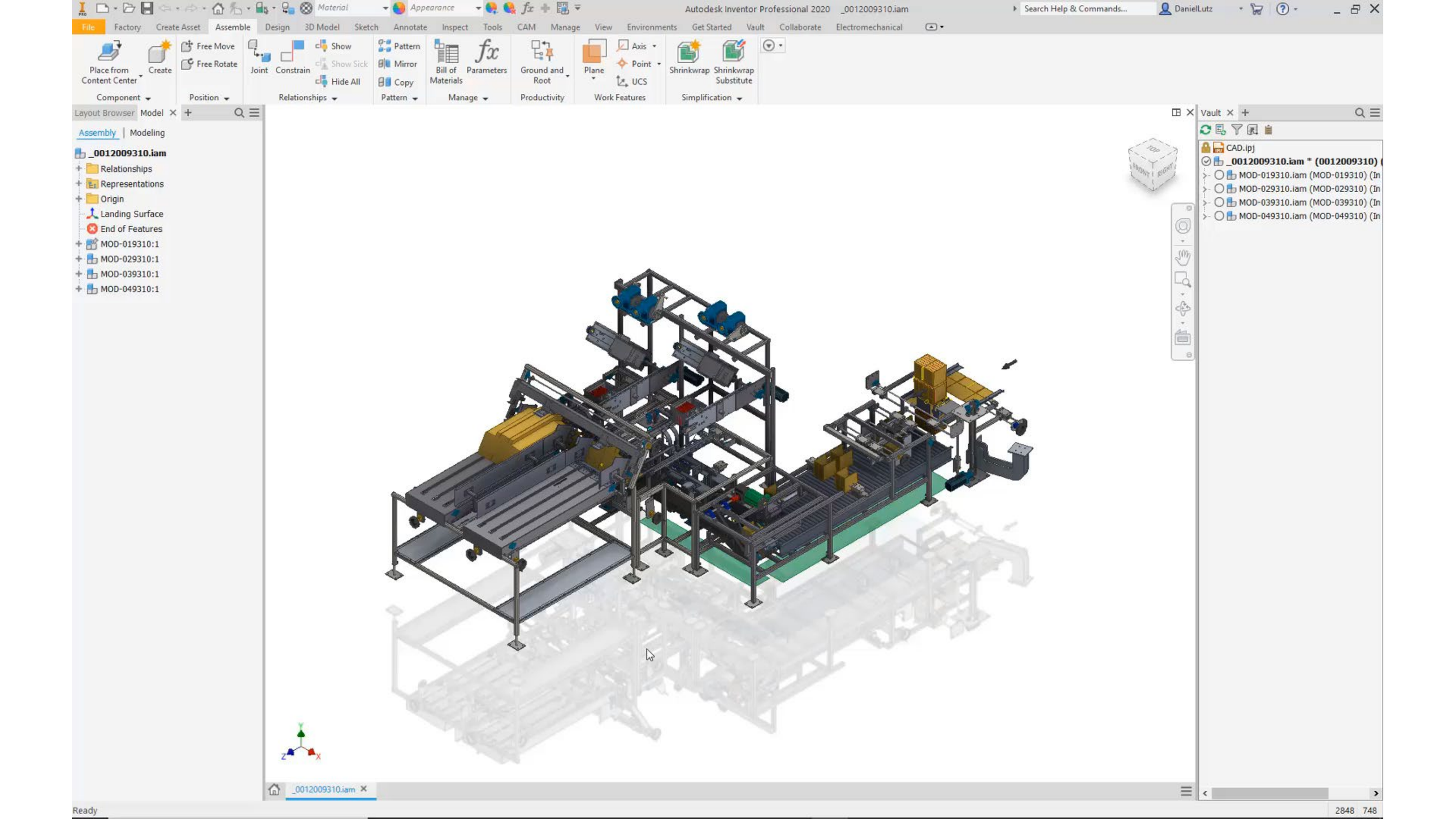
第三步：设置创建选项

- 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

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DanielLutz
File
Factory
Create Asset
Assemble
Design
3D Model
Sketch
Annotate
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Get Started
Vault
Collaborate
Electromechanical
Place from Content Center
Create
Free Move
Free Rotate
Joint
Constrain
Show
Show Sick
Hide All
Pattern
Mirror
Copy
Bill of Materials
Parameters
Ground and Root
Plane
Axis
Point
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Shrinkwrap
Shrinkwrap Substitute
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Position
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Pattern
Manage
Productivity
Work Features
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Layout Browser
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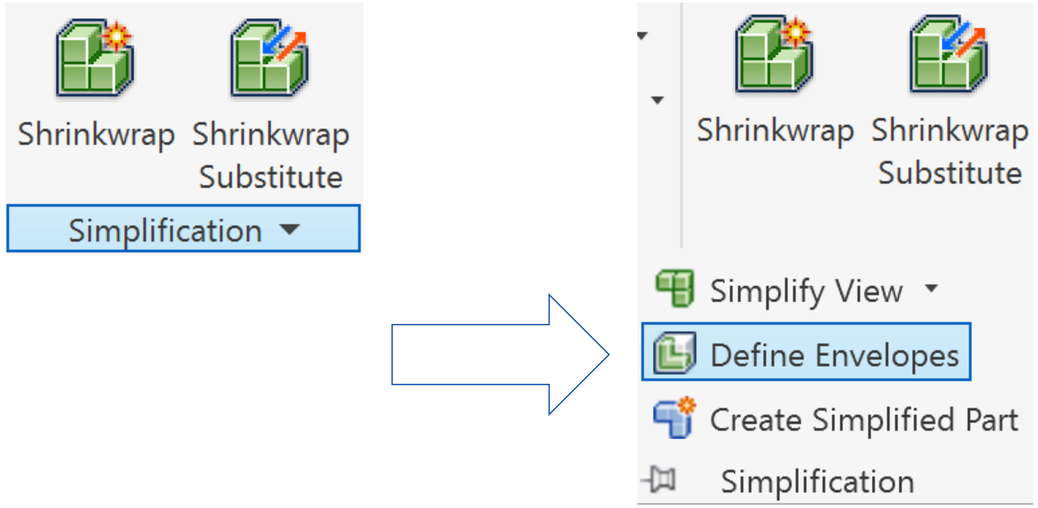
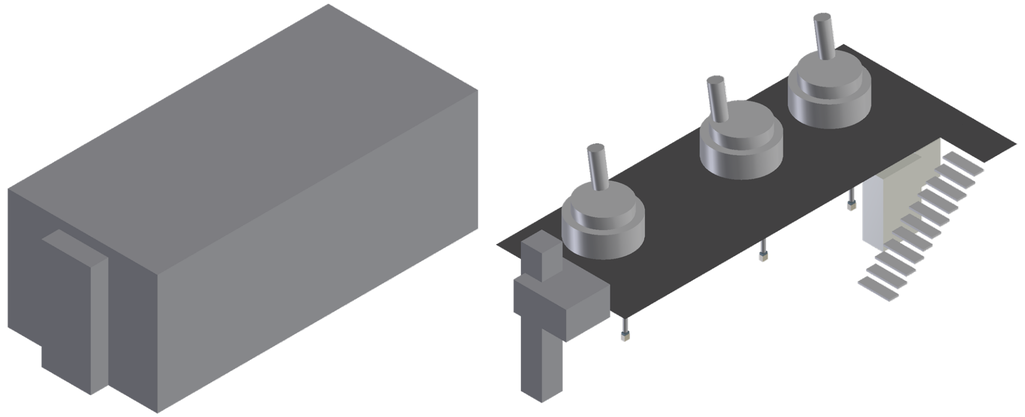
简化 – BIM简化插件

- 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。

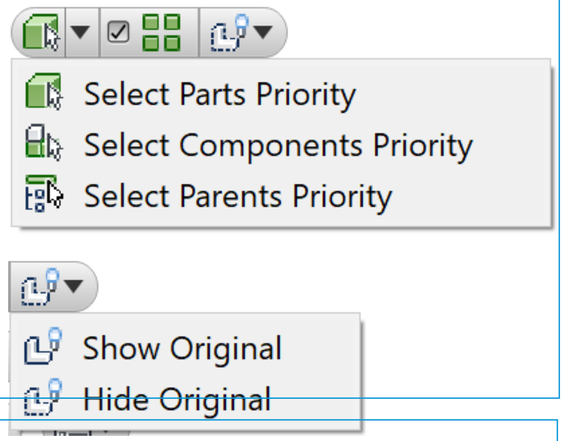




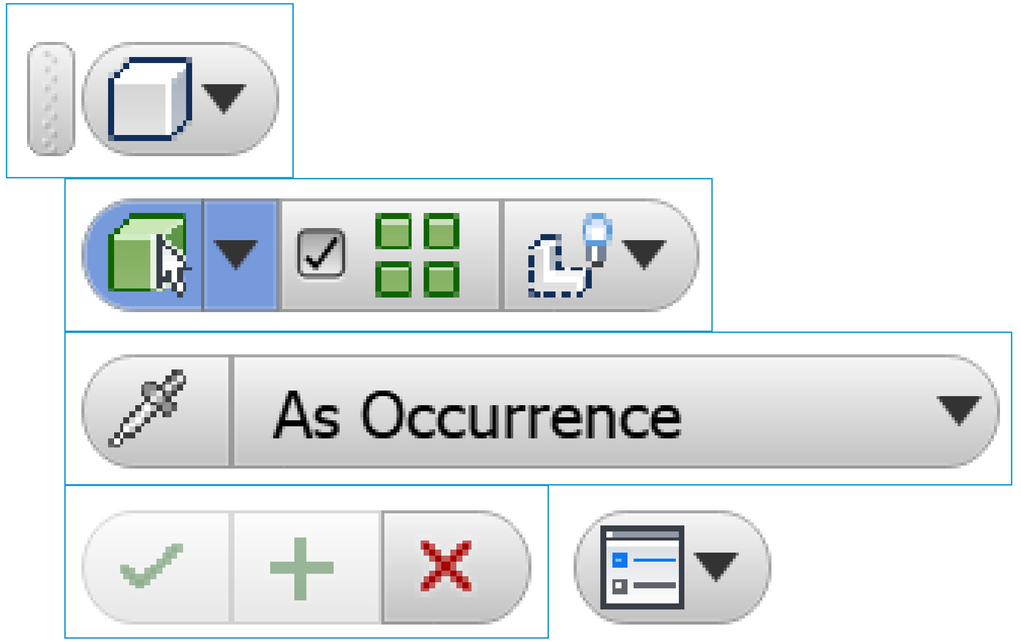
简化 – 包覆体（Envelopes）

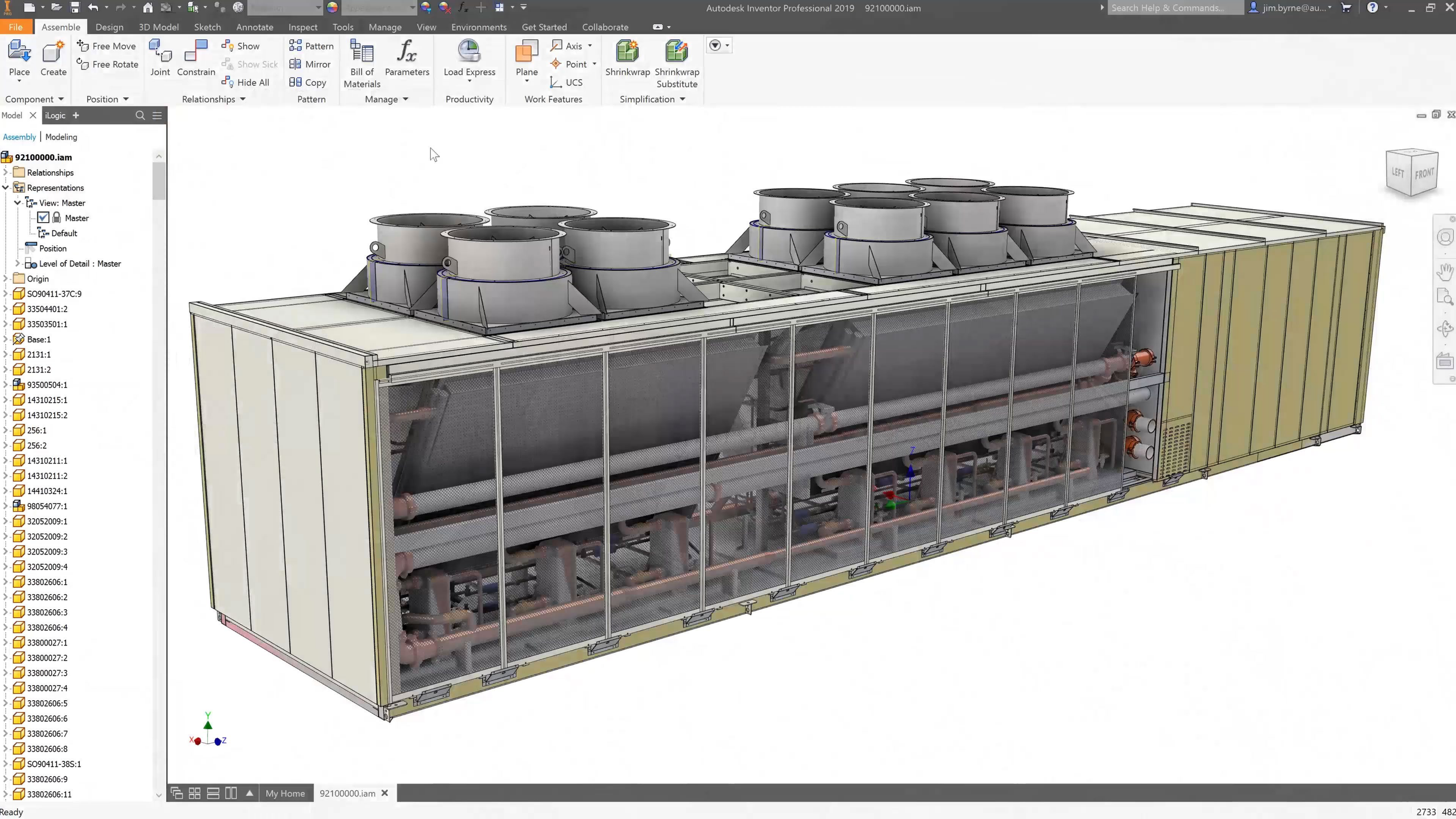
- 边界盒 （长方体或者圆柱）
  - 通过拖拽箭头进行尺寸调整

- 选择集
- 显示/隐藏原模型



- 定义模型颜色

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32052009:2
32052009:3
32052009:4
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33802606:3
33802606:4
33800027:1
33800027:2
33800027:3
33800027:4
33802606:5
33802606:6
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SO90411-38S:1
33802606:9
33802606:11
LEFT
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My Home
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Ready
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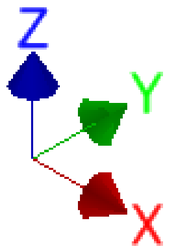
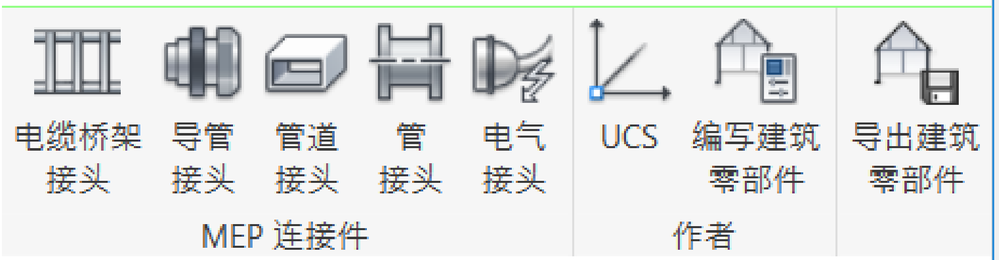
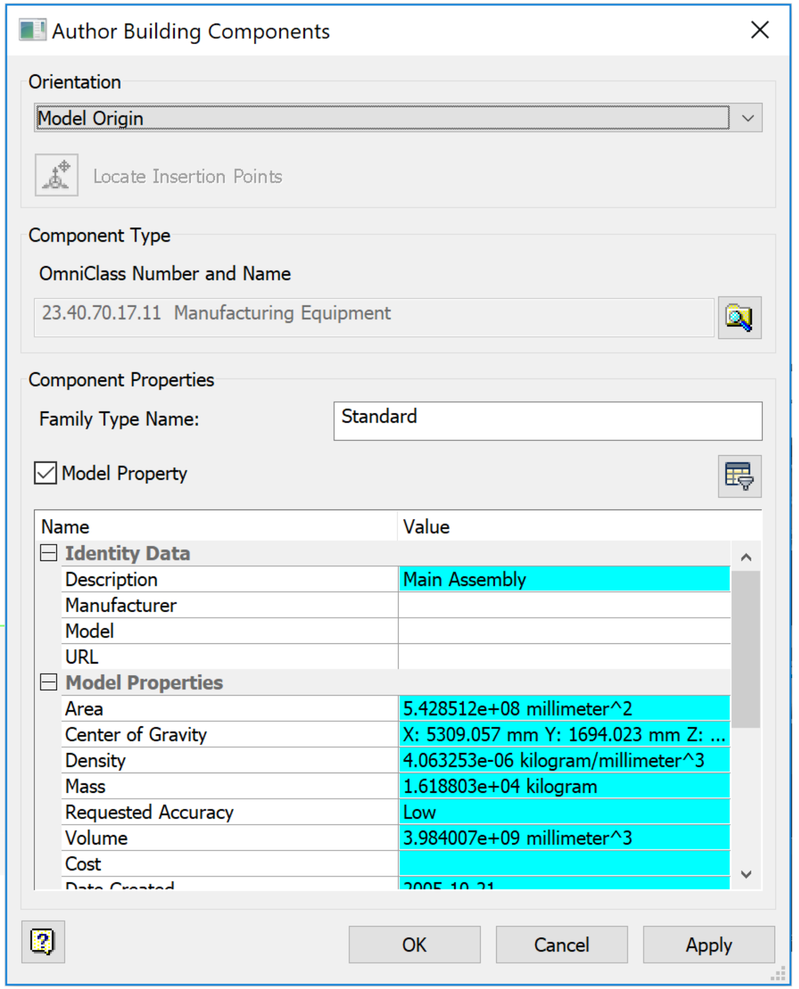
建筑模型属性配置

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







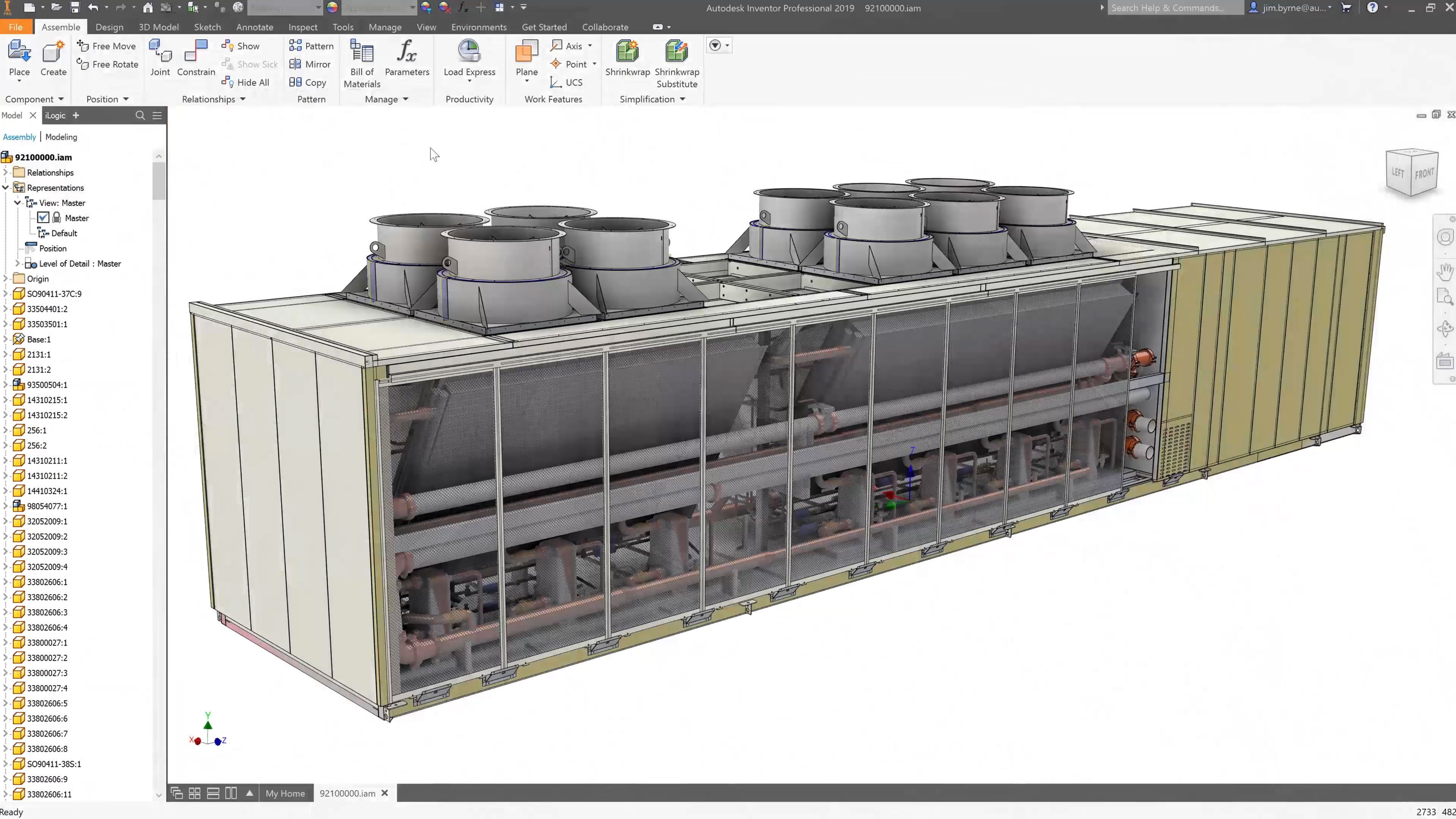
建筑模型导出

- **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

RFA

IFC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Collaborate
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Free Move
Free Rotate
Joint
Constrain
Show
Show Sick
Hide All
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33802606:8
SO90411-38S:1
33802606:9
33802606:11
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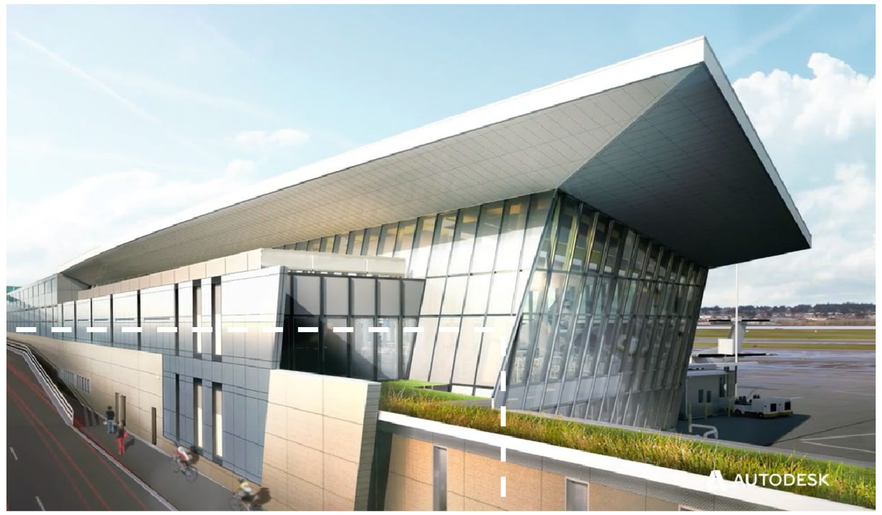
导入Revit模型（RVT）

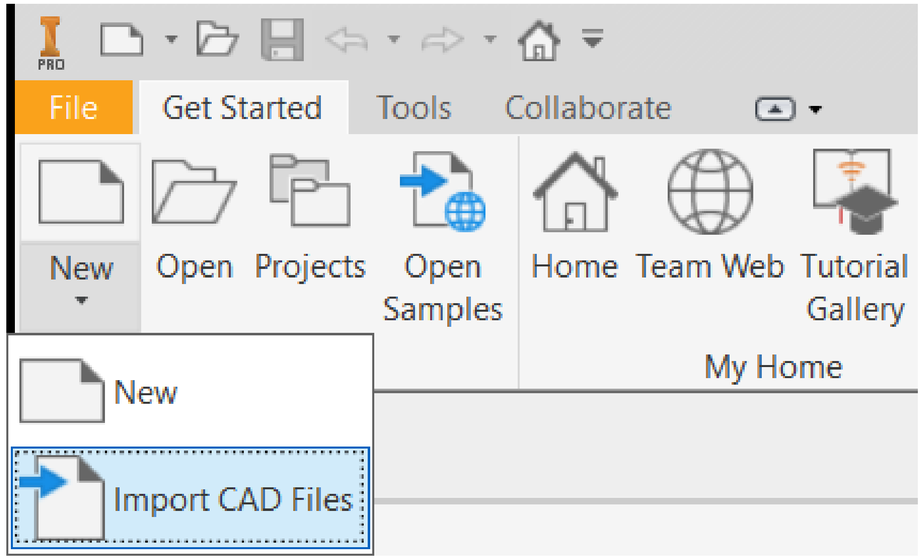
提供场景支持

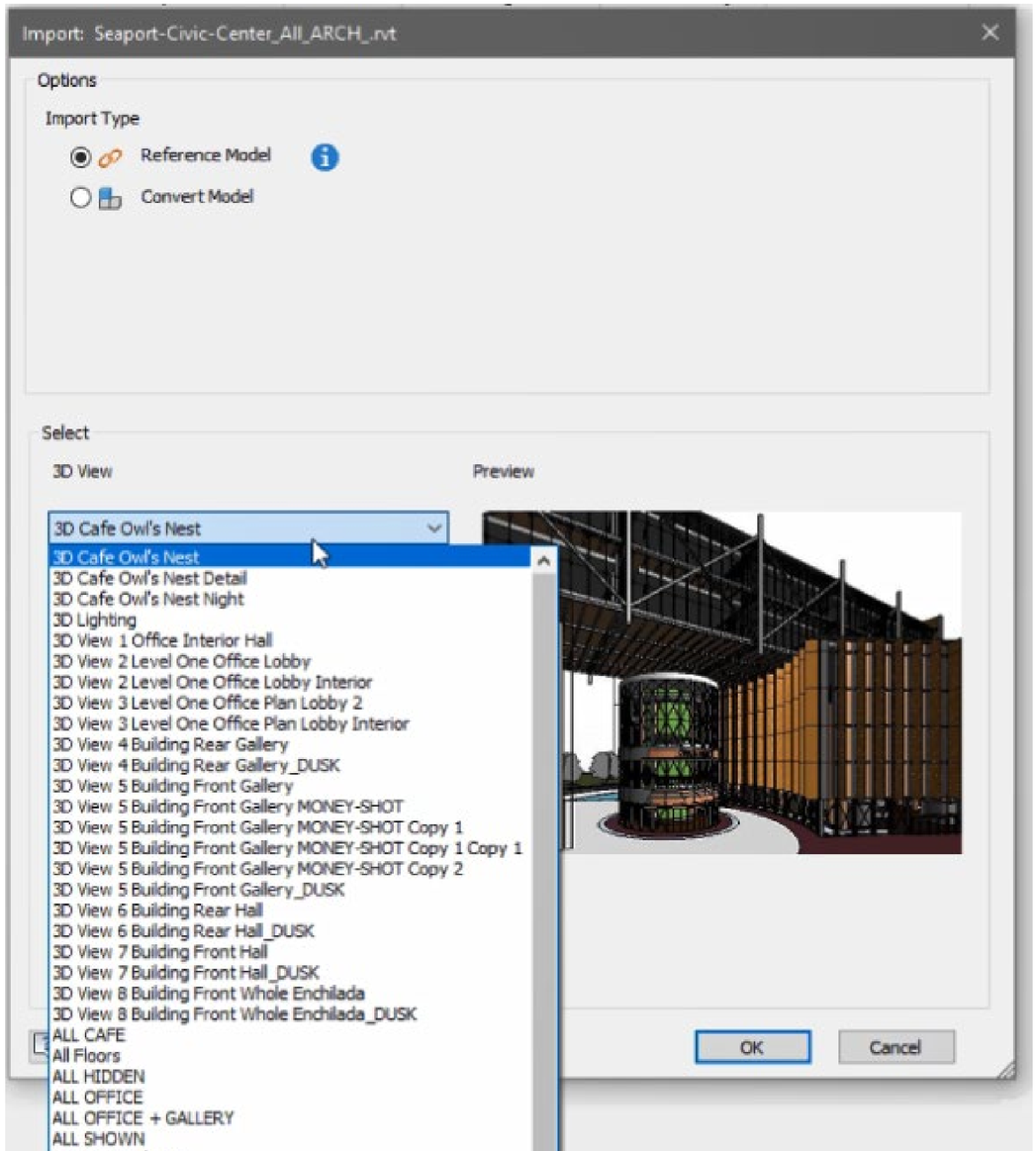


Revit: Building Context

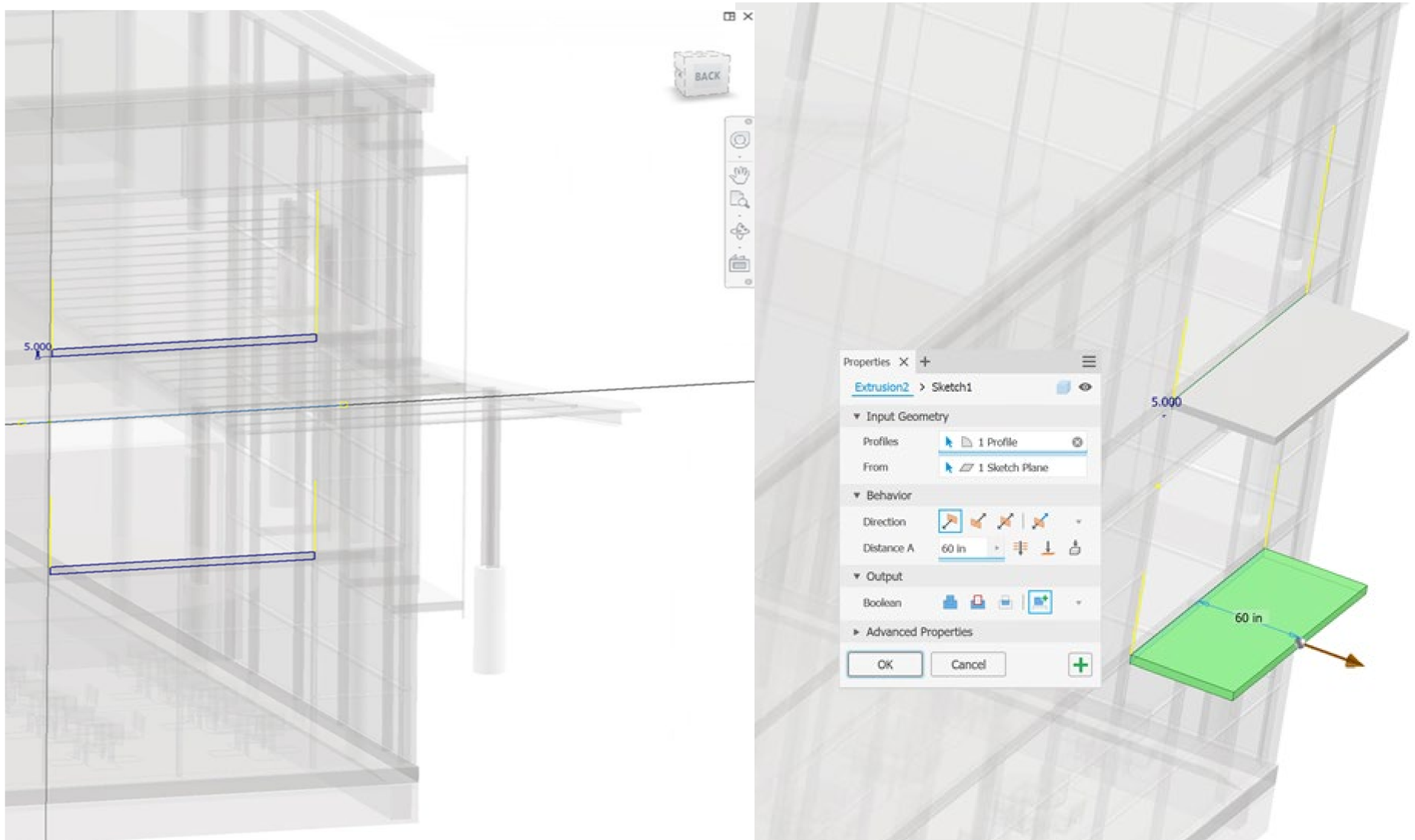
Inventor: System of Products

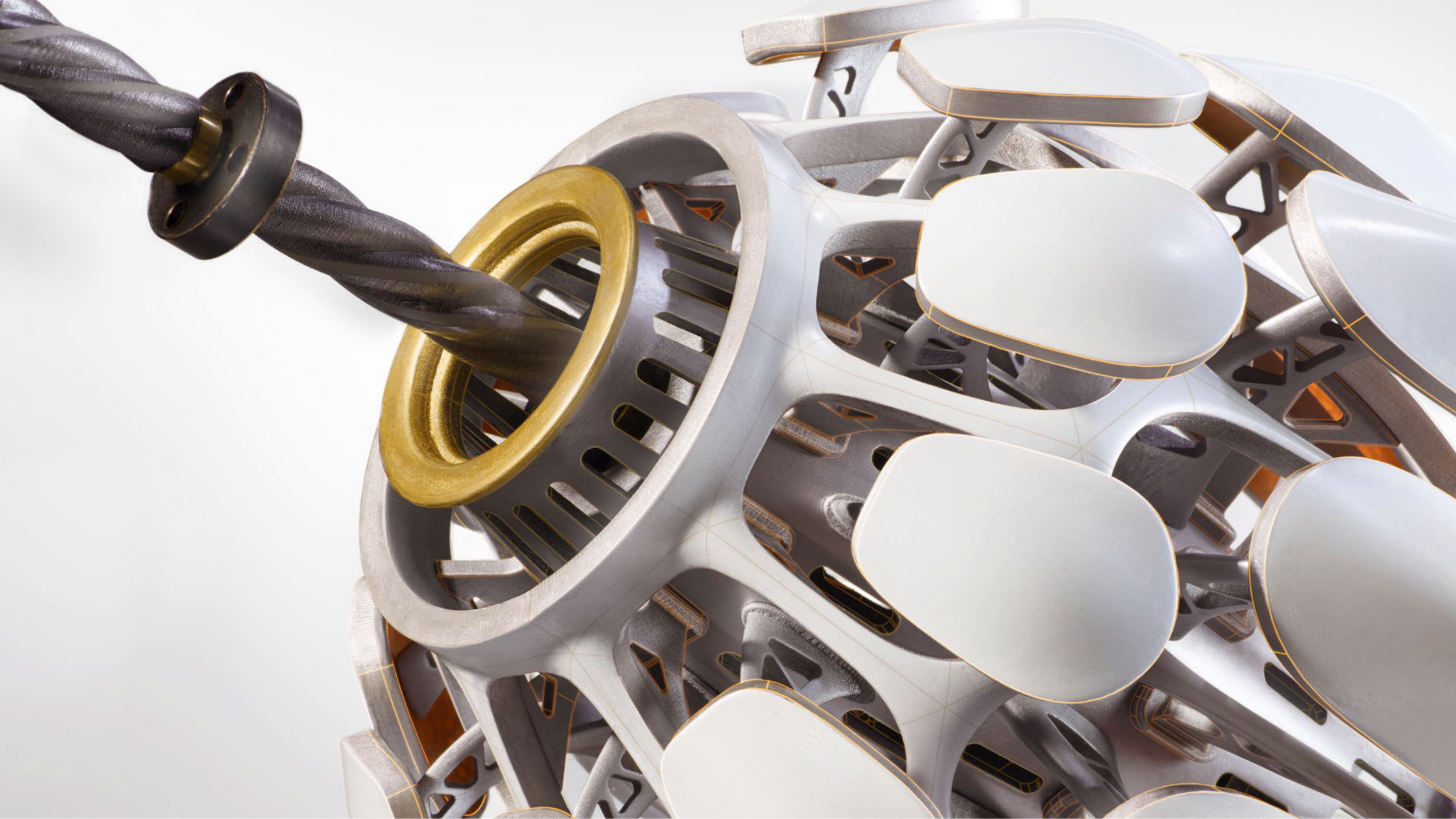
导入文件 – Revit模型（RVT）





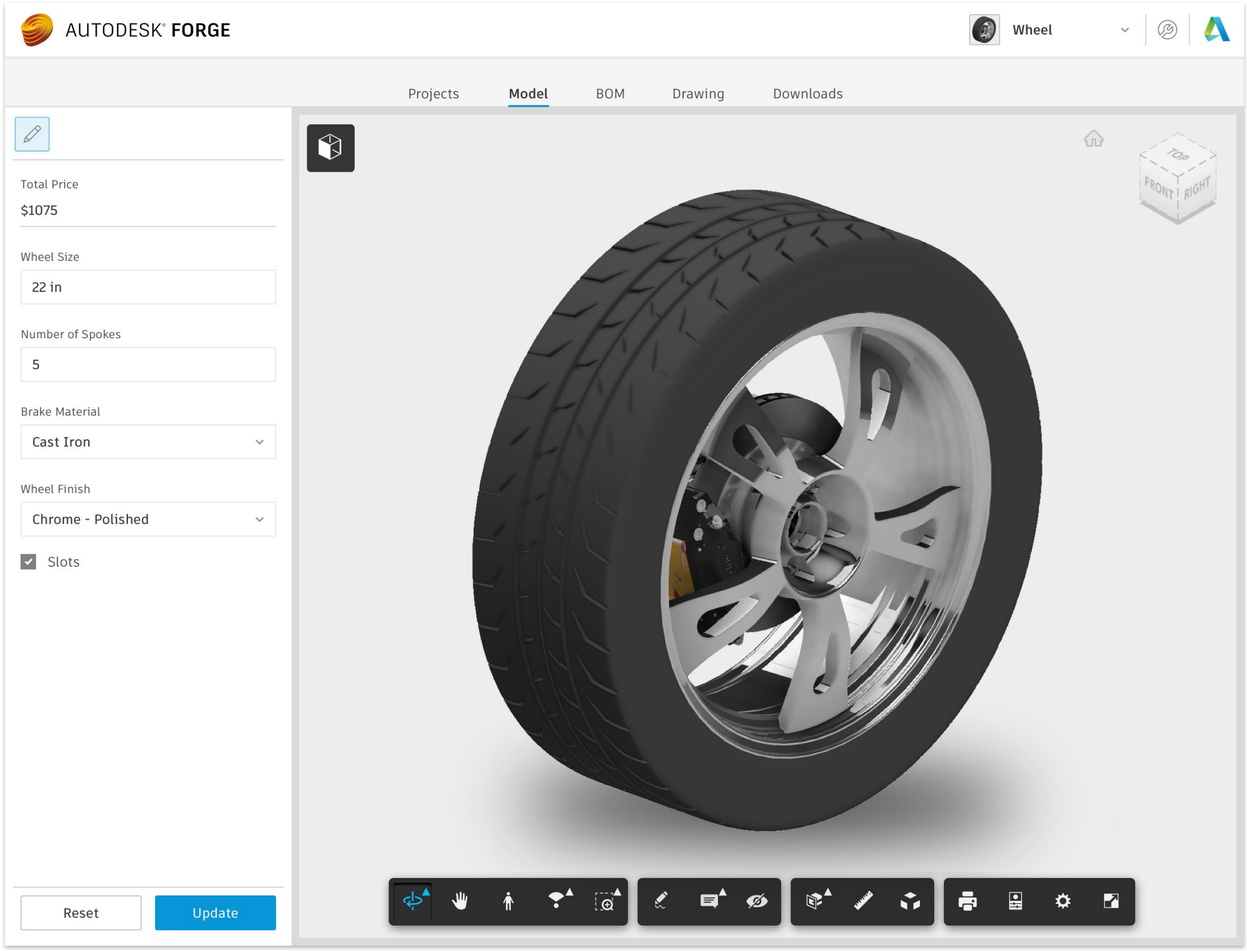
参考Revit数据创建关联的Inventor模型

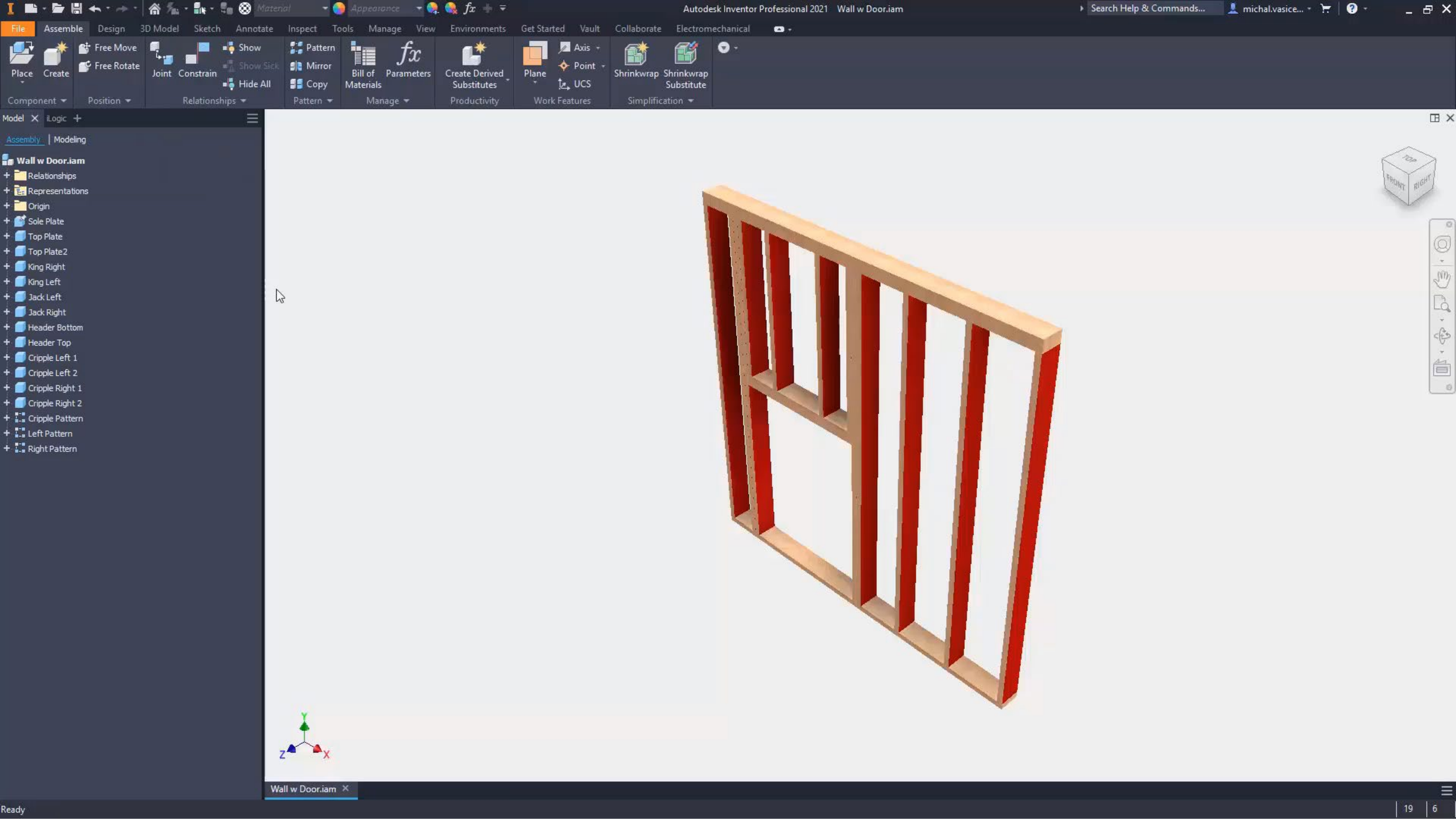




参数化配置

- **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

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Free Move
Free Rotate
Joint
Constrain
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Show Sick
Hide All
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Bill of Materials
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King Left
Jack Left
Jack Right
Header Bottom
Header Top
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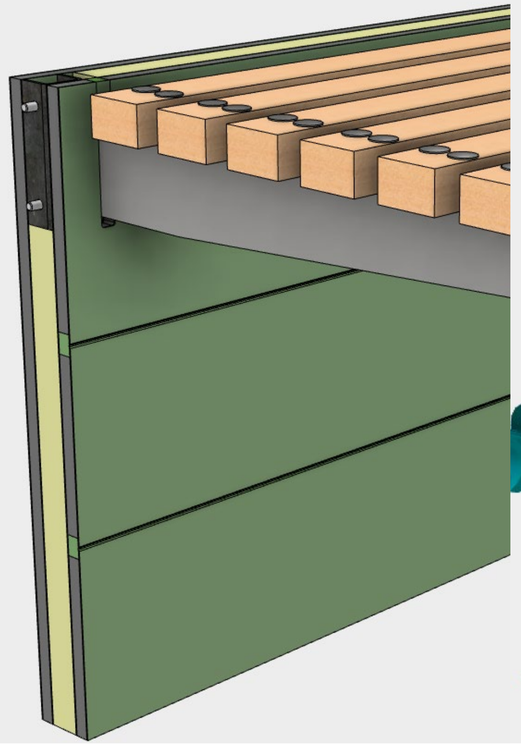

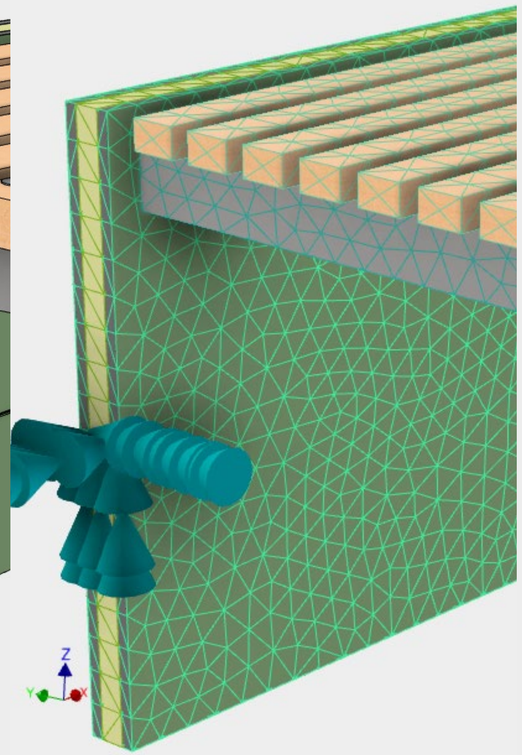

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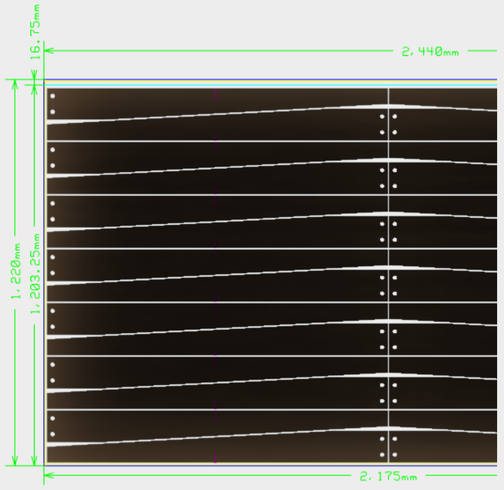
Thickness	:	15mm	Total cost	
Packaging	:	Packaging.4	Total nested co	
Sheet quantity	:	1	Date	
Stack size	:	1		



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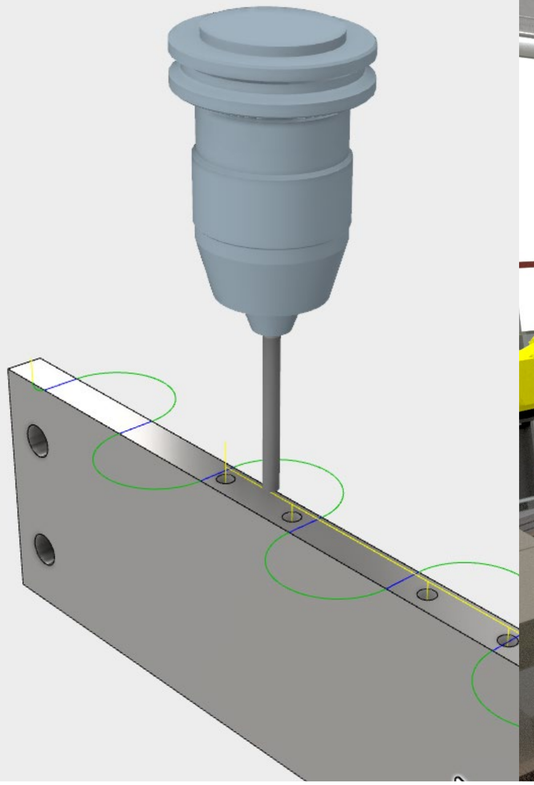
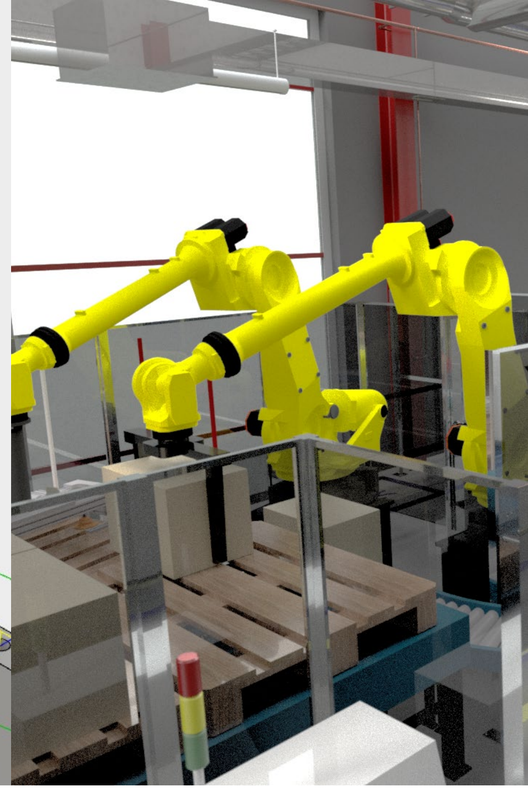
2) ADSK-2021-001-01 AWNING BRACKET ARM RI





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