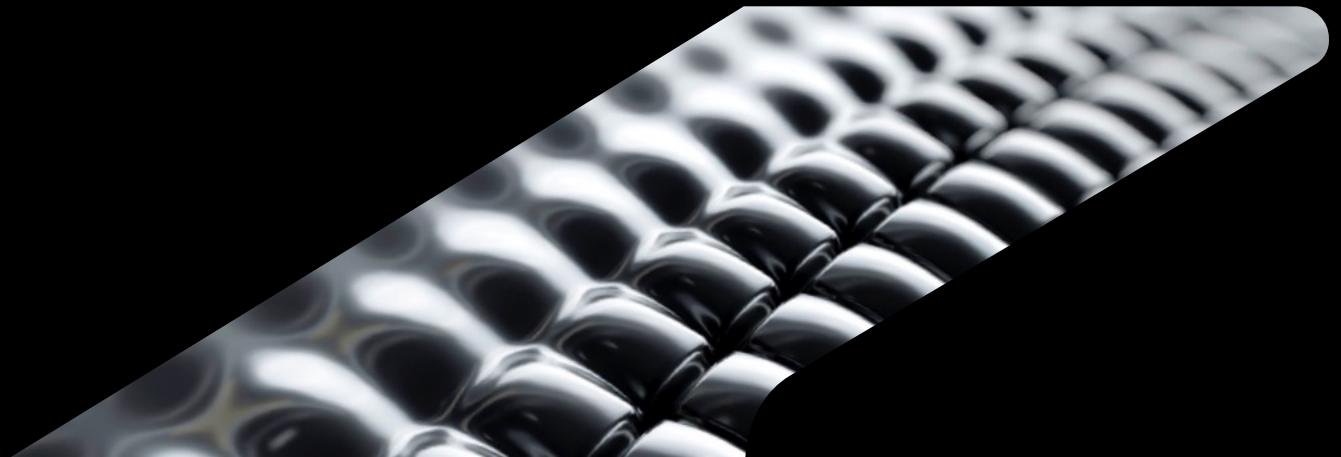
AUTODESK UNIVERSITY

Manufacturing Informed Design API On Autodesk Forge

Andy Akenson
Distinguished Software Architect
Autodesk



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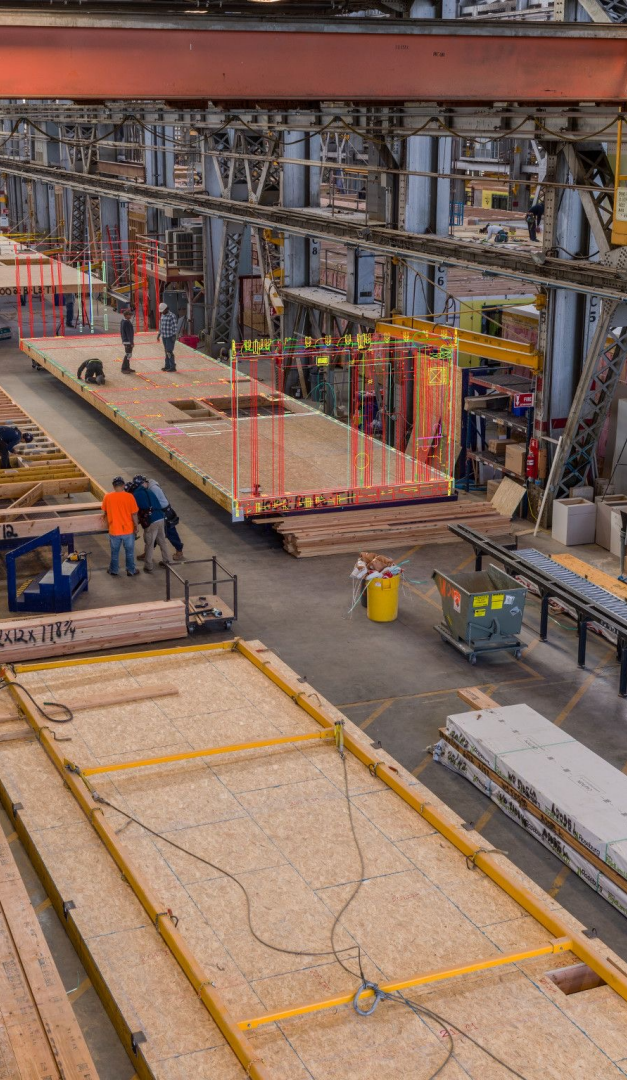
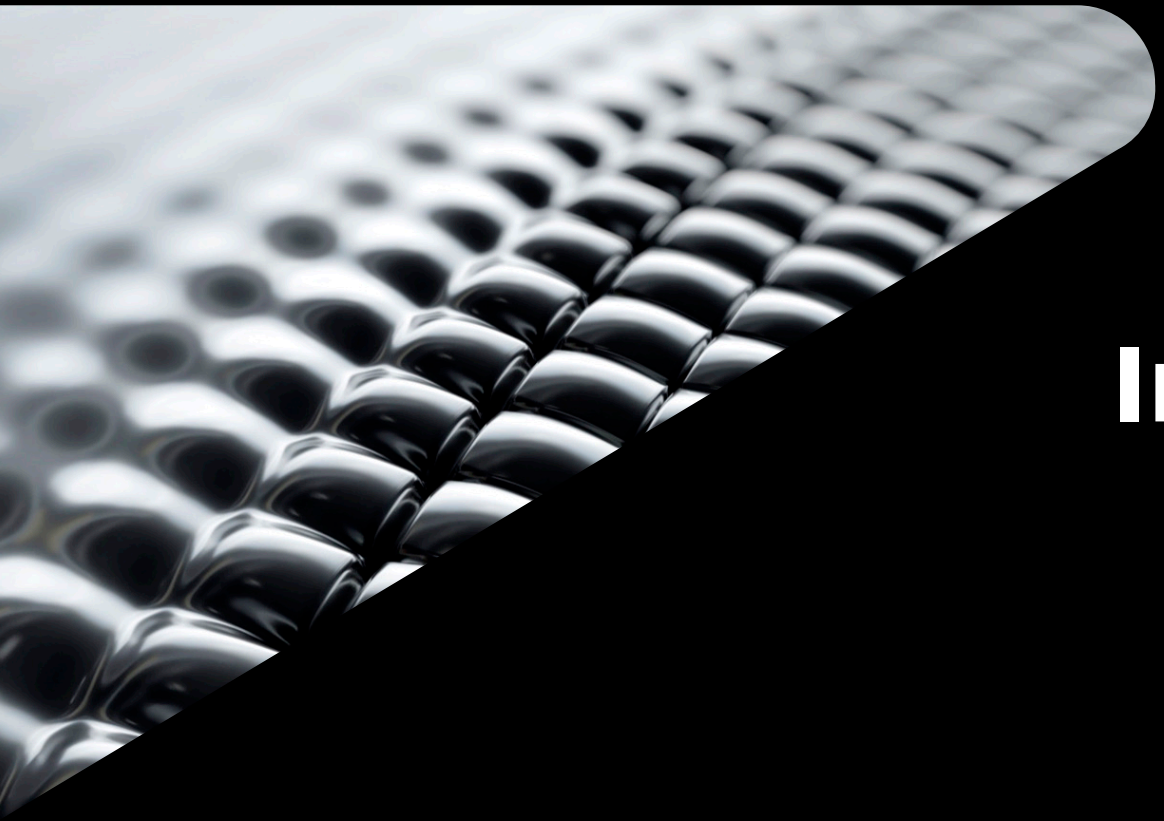


Agenda

- Productization for Construction
- Manufacturing Informed Design
- Well-formed Revit Families
- MID API Example
- Looking Ahead



Industrialized Construction

IC Mission Statement

TO DELIVER NEW CONNECTED SOLUTIONS AND SERVICES, ENABLING THE AECO INDUSTRY TO ACHIEVE INDUSTRIALIZED CONSTRUCTION AND IMPROVE CERTAINTY, PRODUCTIVITY AND SUSTAINABILITY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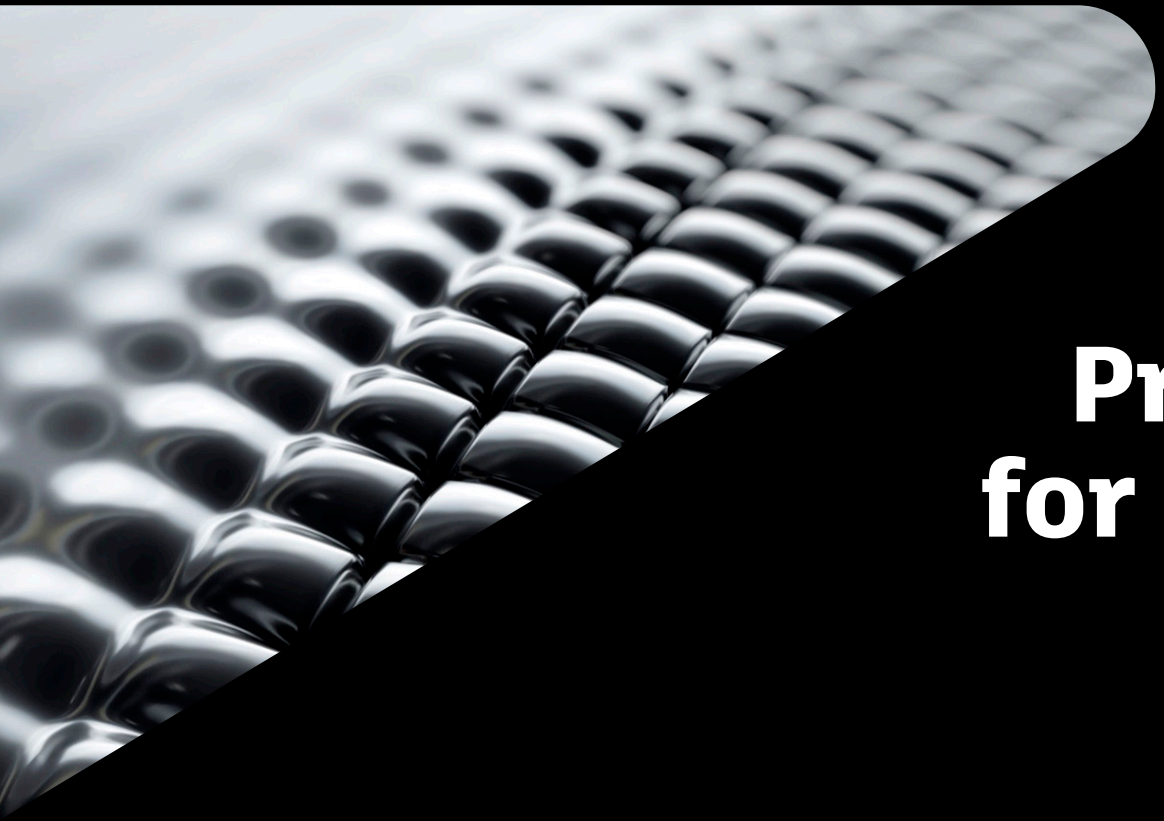
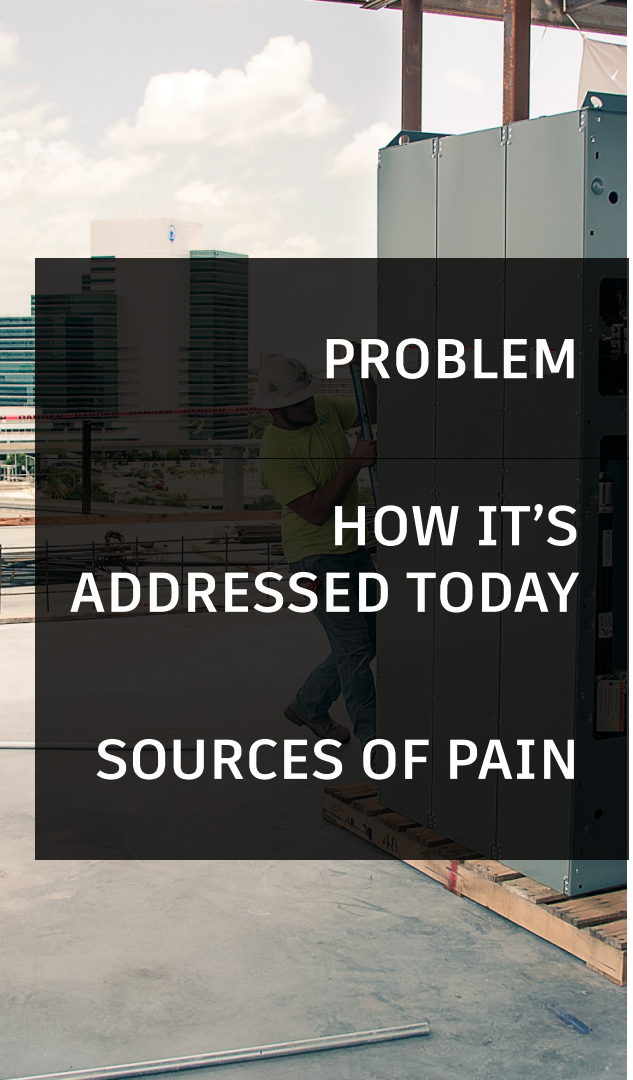
KONECRANES
FOOD
Warning
STOP



Productization for Construction



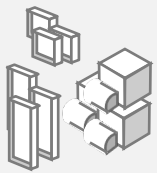
Customer Challenge

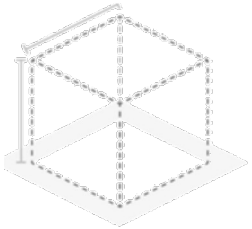
Building design decisions are not informed by what can be made

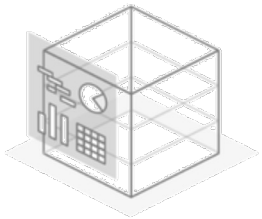
Iterative processes that are manual, slow, and reactive, with high risk and uncertainty

Data and tools are disconnected and don't allow processes to work at scale

Bringing Manufacturing to Building Workflows







PRODUCTIZE

DESIGN

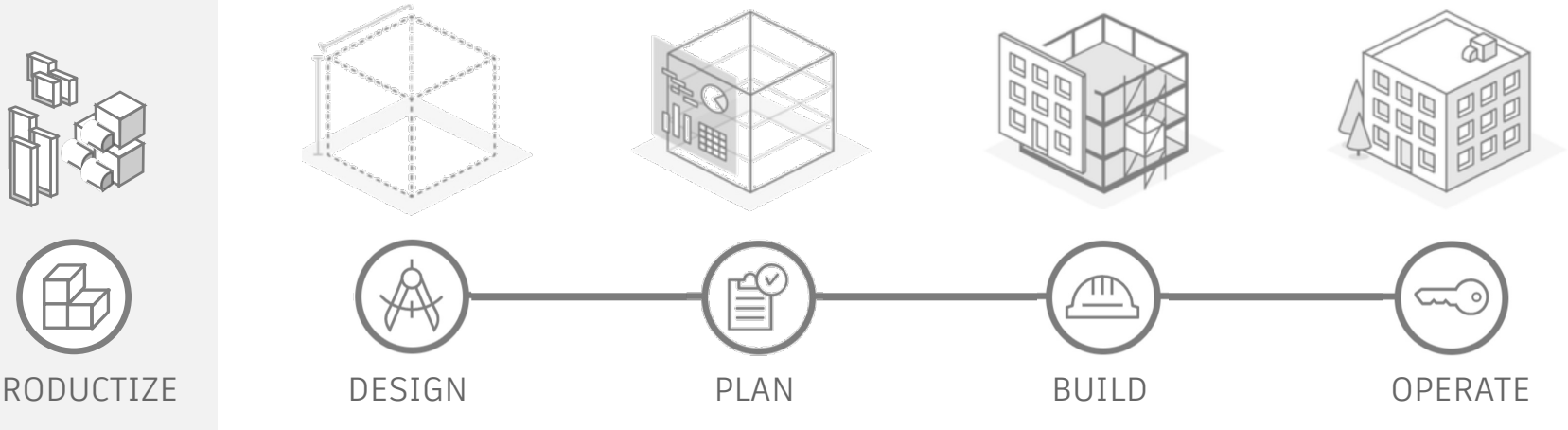
PLAN

BUILD

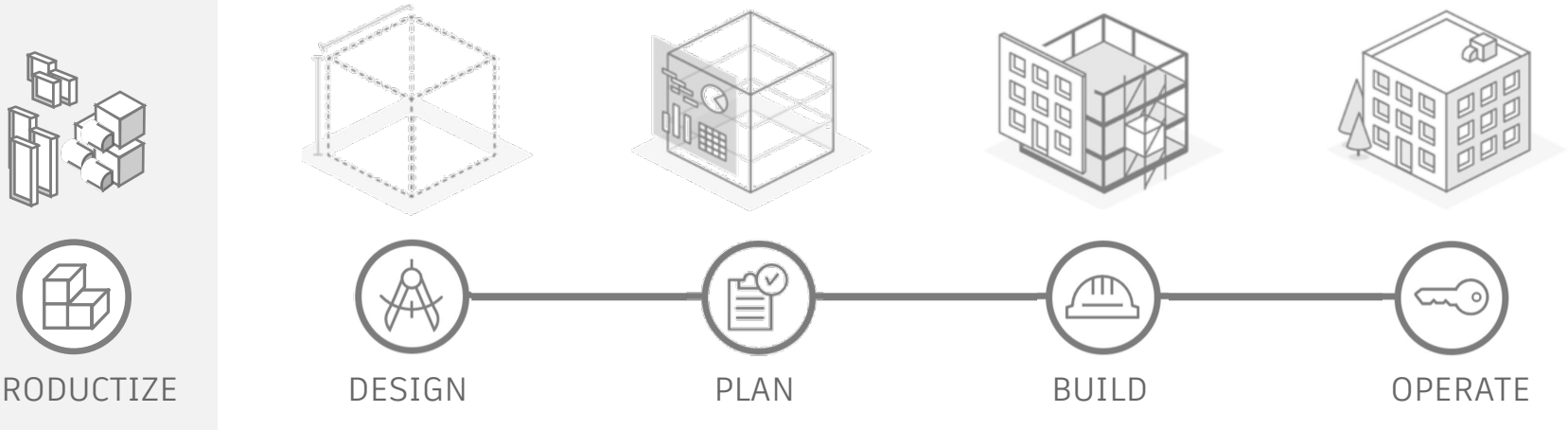
OPERATE

Enables predefined constructability

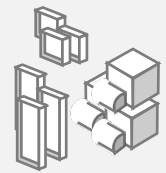
Bringing Manufacturing to Building Workflows

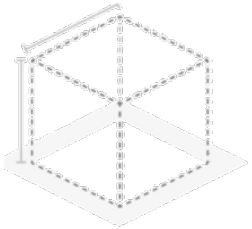


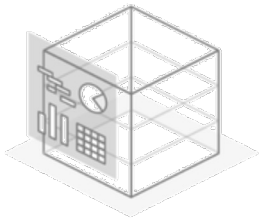
Bringing Manufacturing to Building Workflows



Broad Portfolio to Building Workflows







PRODUCTIZE

DESIGN

PLAN

BUILD

OPERATE

Building Products

- Inventor
- Fusion 360
- Vault
- UPCHAIN

Specific Project

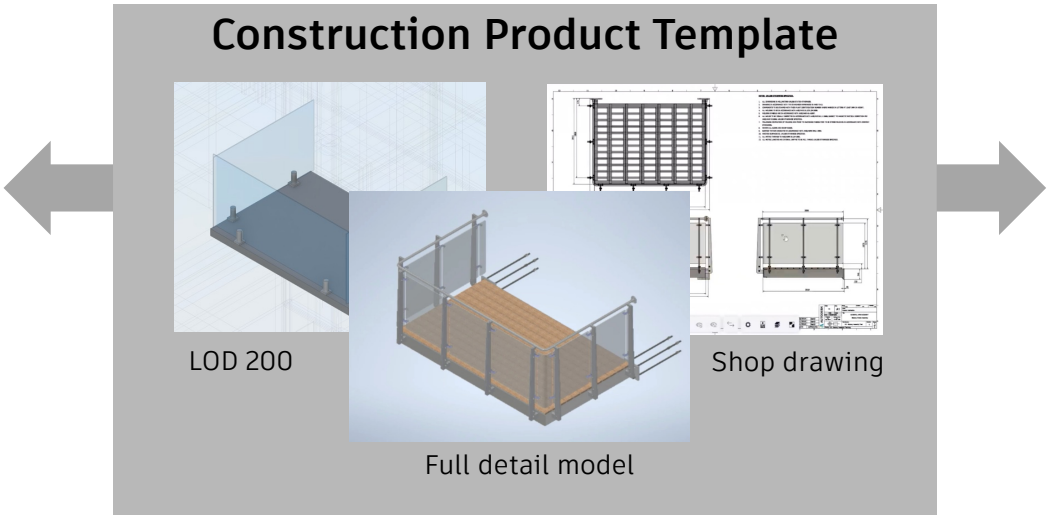
- Revit
- AutoCAD
- BIM Collaborate
- Fusion 360 Manage
- Factory Design Utilities
- Navisworks
- Advance Steel
- BIM 360 Ops
- Fabrication

AUTODESK Construction Cloud

BUILDINGCONNECTED

Productization Bridges Design and Manufacturing

Design and customize predefined assemblies



Automate manufacturing documentation

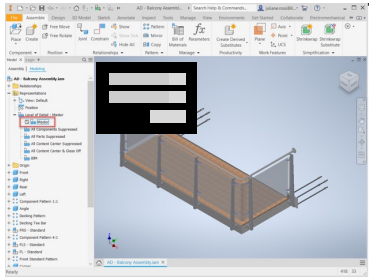
Defines products and their allowable variation

AUTODESK Forge

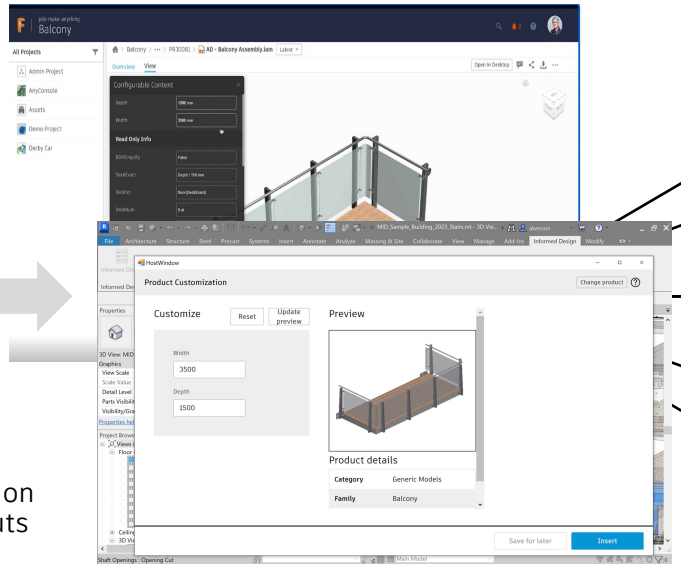
Productization Connects Workflow

1. Non-CAD user can access models and generate content
2. Can derive a wide variety of information from source template
3. 1:m – generate many unique, linked instances from source templates

Dynamic Product Template



- Full Fabrication level details
- Defined key parameters for variation
- Defined alternate views and outputs



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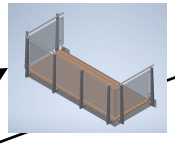

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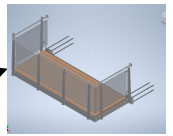

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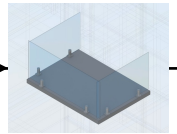
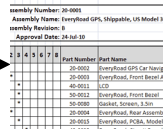


BOM



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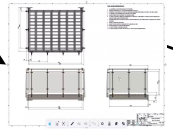
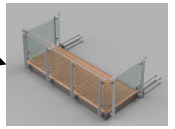
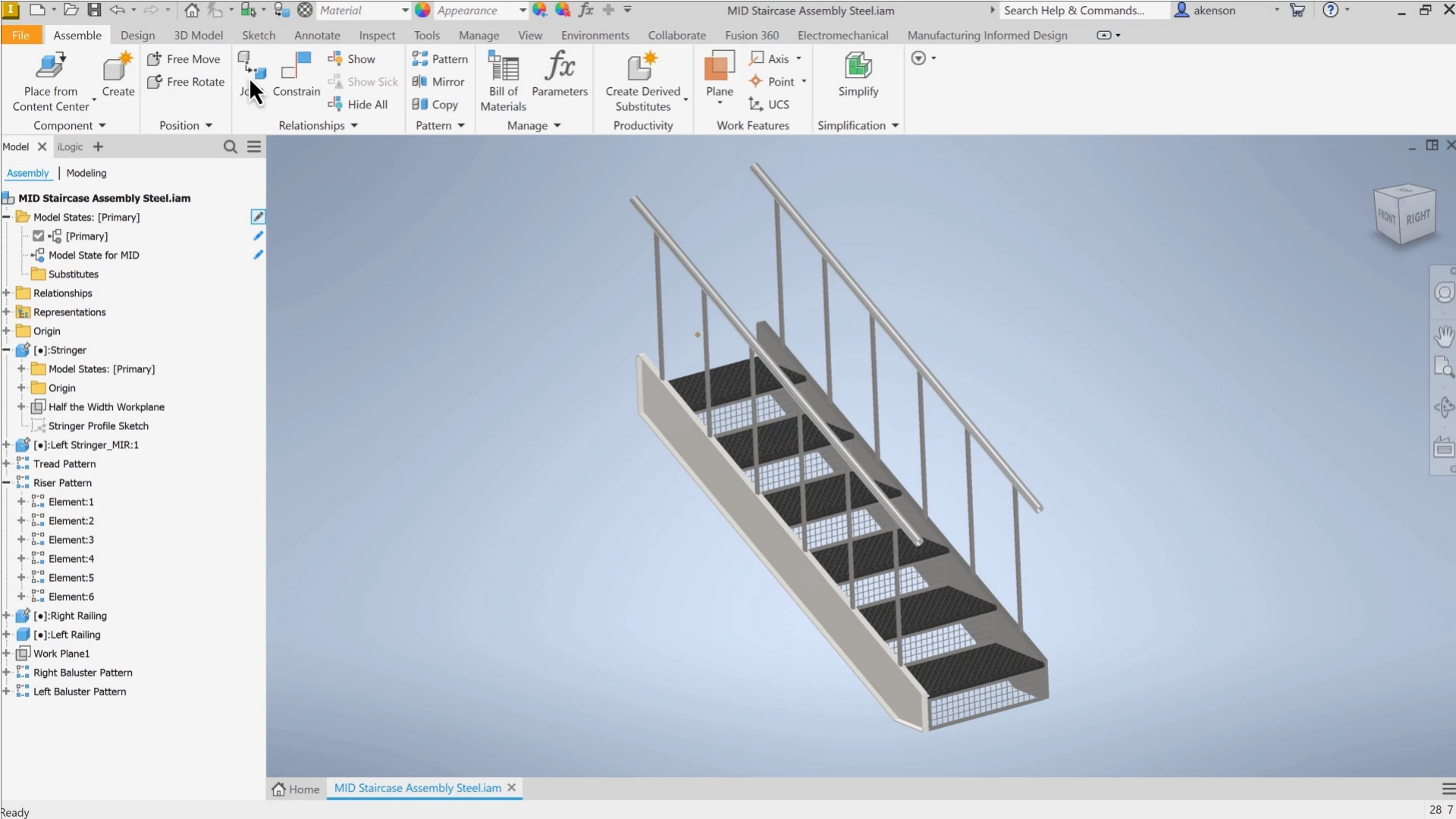


Rendering




MID Staircase Assembly Steel.iam
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Environments
Collaborate
Fusion 360
Electromechanical
Manufacturing Informed Design
Place from Content Center
Create
Component
Free Move
Free Rotate
Position
Constrain
Show
Show Sick
Hide All
Relationships
Pattern
Mirror
Copy
Pattern
Bill of Materials
Parameters
Manage
Create Derived Substitutes
Productivity
Plane
Axis
Point
UCS
Work Features
Simplify
Simplification
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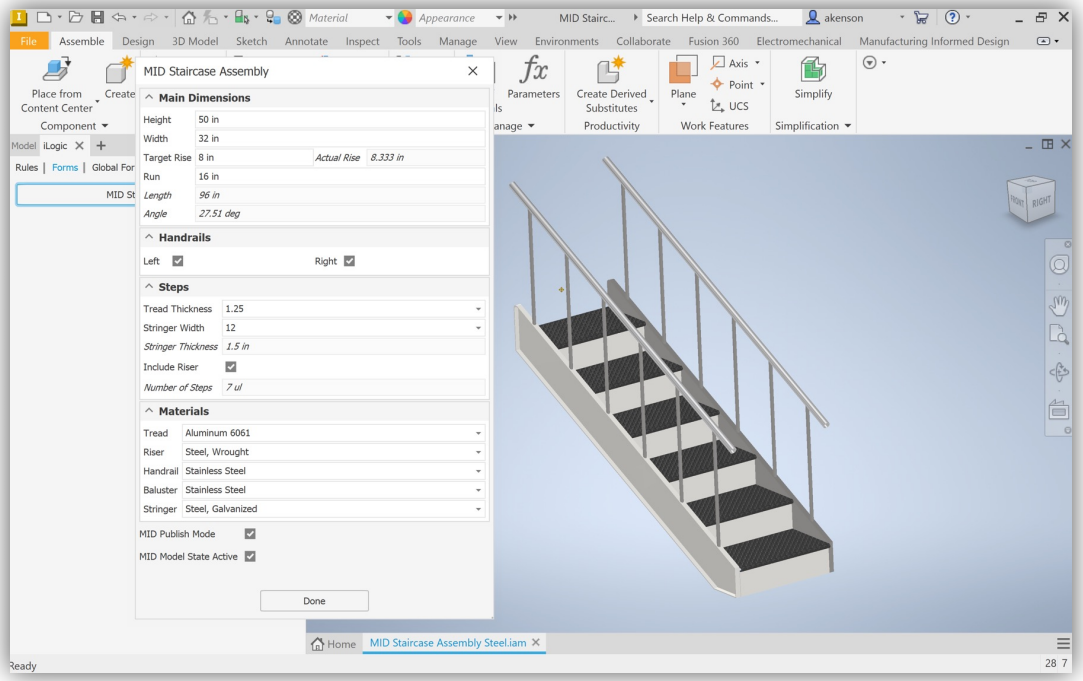
Origin
Half the Width Workplane
Stringer Profile Sketch
[•]:Left Stringer_MIR:1
Tread Pattern
Riser Pattern
Element:1
Element:2
Element:3
Element:4
Element:5
Element:6
[•]:Right Railing
[•]:Left Railing
Work Plane1
Right Baluster Pattern
Left Baluster Pattern
FRONT
RIGHT
Home
MID Staircase Assembly Steel.iam
Ready

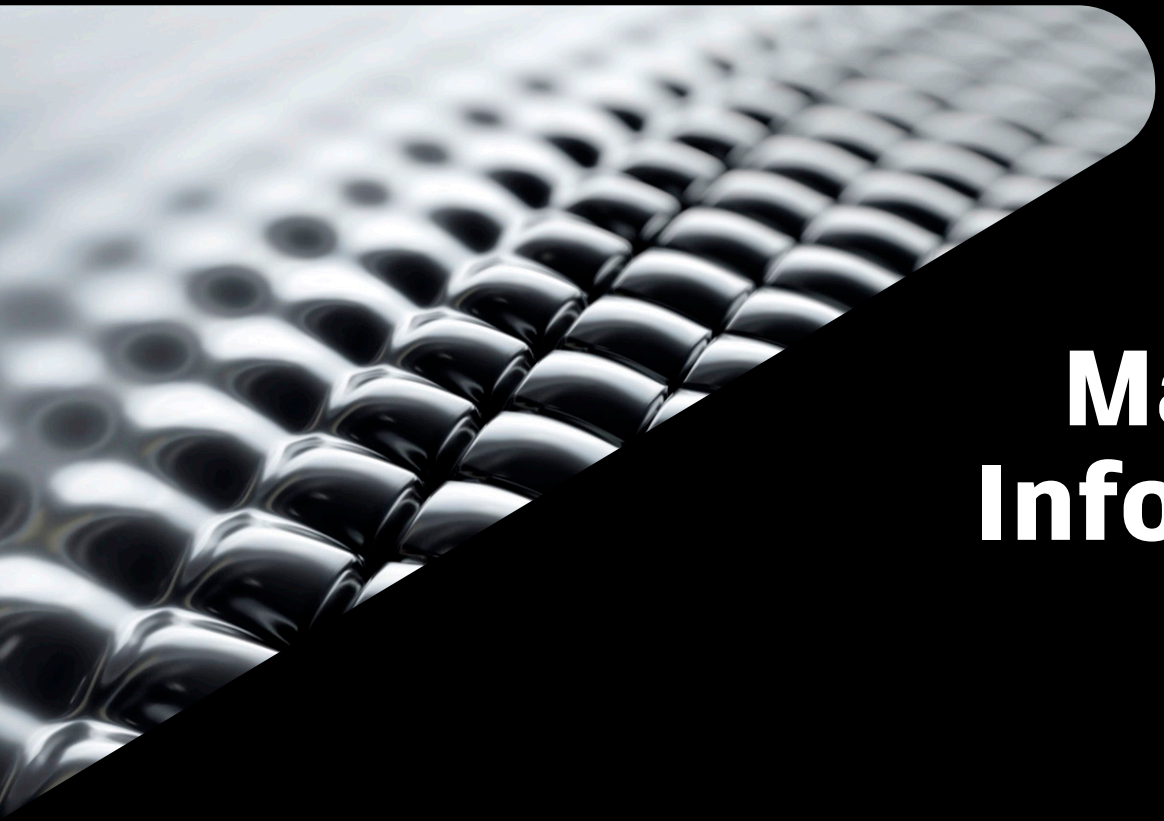
Productization with Inventor

- Define fabrication rules with iLogic
- Constrain to known manufacturable configurations
- Automatically compute updated models and outputs
- Drive manufacturing processes



VIEWRAIL

Adopting automation for configuration of stair systems exponentially grows business



Manufacturing Informed Design Capabilities

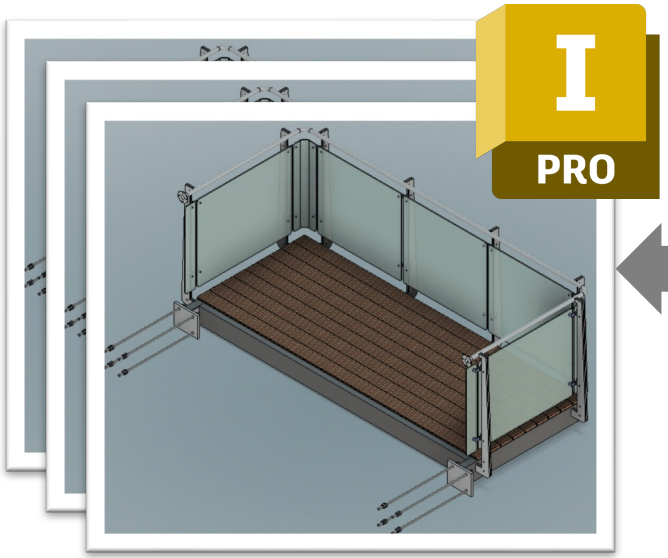
Informing at the Right Time

Today, architects do not have a way to design with manufacturing certainty enabling an industrialized construction workflow

Connecting Design and Make

Component-scale data

Defines details to fabricate components



Execution Detail

Building-scale data

Describes systems of components

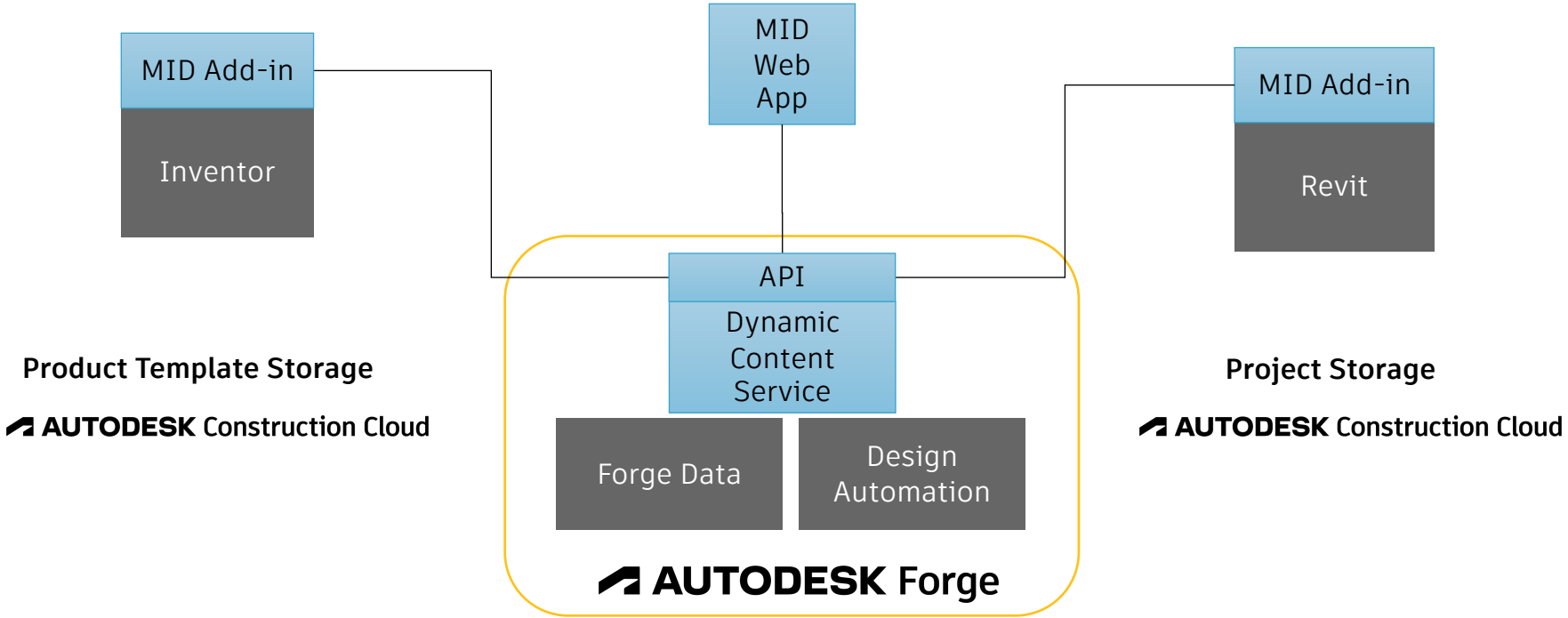
Design Intent

Solution

Manufacturing Informed Design

1	Enable dynamic products
2	Intelligent design decisions
3	Enable automated outputs

MID Solution Architecture

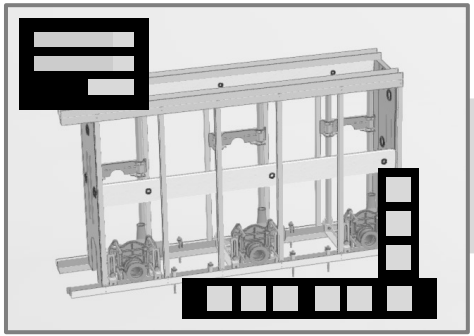


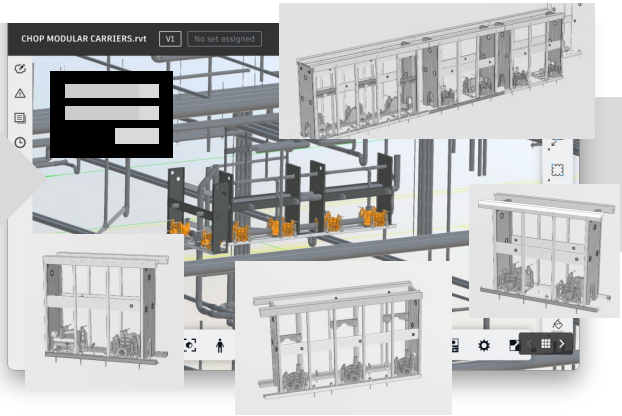
Solution Manufacturing Informed Design

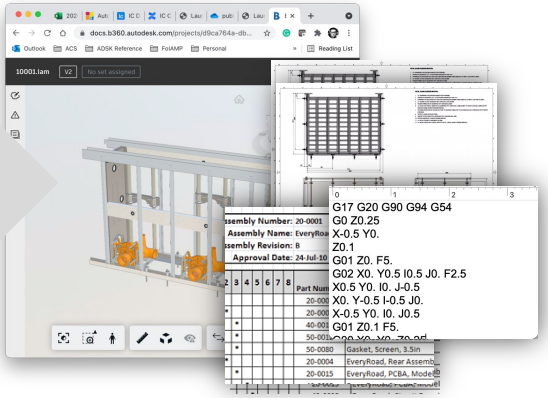
PREFAB SUPPLIER:
Product Engineer

ARCHITECT:
Architect / Designer

PREFAB SUPPLIER:
Project Manager







Catalog

Compute

Project Data

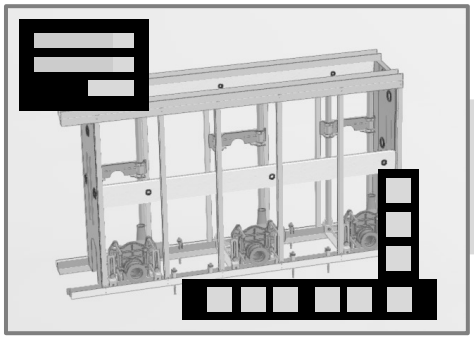
AUTODESK Forge

Publishing Product Templates

PREFAB SUPPLIER:
Product Engineer

ARCHITECT:
Architect / Designer

PREFAB SUPPLIER:
Project Manager



Catalog

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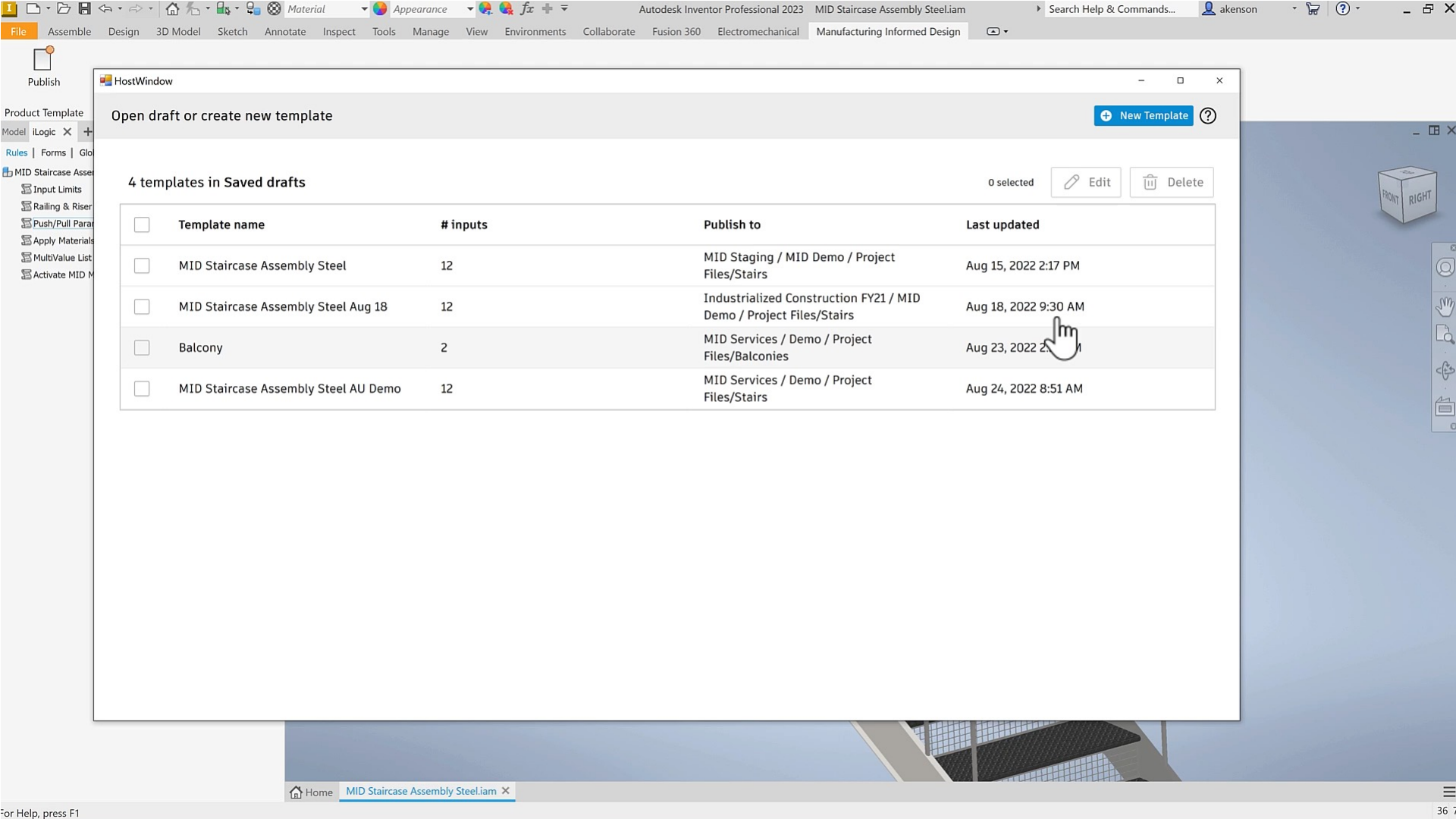
Project Data

AUTODESK Forge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Tools
Manage
View
Environments
Collaborate
Fusion 360
Electromechanical
Manufacturing Informed Design
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Product Template
HostWindow
Open draft or create new template
New Template
4 templates in Saved drafts
0 selected
Edit
Delete
Template name
inputs
Publish to
Last updated
MID Staircase Assembly Steel
12
MID Staging / MID Demo / Project Files/Stairs
Aug 15, 2022 2:17 PM
MID Staircase Assembly Steel Aug 18
12
Industrialized Construction FY21 / MID Demo / Project Files/Stairs
Aug 18, 2022 9:30 AM
Balcony
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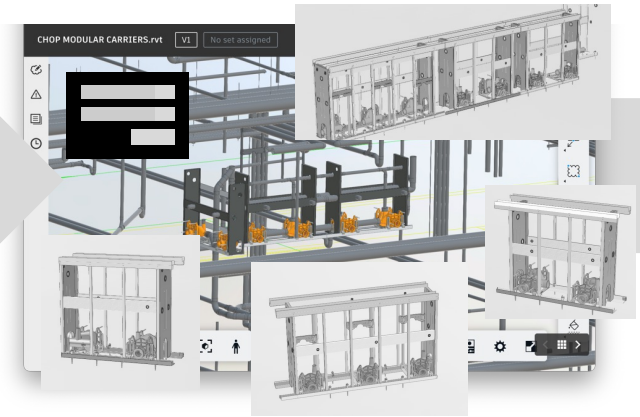
MID Services / Demo / Project Files/Balconies
MID Staircase Assembly Steel AU Demo
12
MID Services / Demo / Project Files/Stairs
Aug 24, 2022 8:51 AM
Home
MID Staircase Assembly Steel.iam
For Help, press F1

Using Products in Design

PREFAB SUPPLIER:
Product Engineer

ARCHITECT:
Architect / Designer

PREFAB SUPPLIER:
Project Manager



Catalog

Compute

Project Data

AUTODESK Forge

Autodesk Revit 2023 - Not For Resale Version - MID_Sample_Building_2023_Stairs.rvt - 3D View: MID - Staircase 1

akenson

File | Architecture | Structure | Steel | Precast | Systems | Insert | Annotate | Analyze | Massing & Site | Collaborate | View | Manage | Add-Ins | Informed Design | Modify

Informed Design

Informed Design

Properties

3D View: MID - Staircase 1 | Edit Type

Graphics

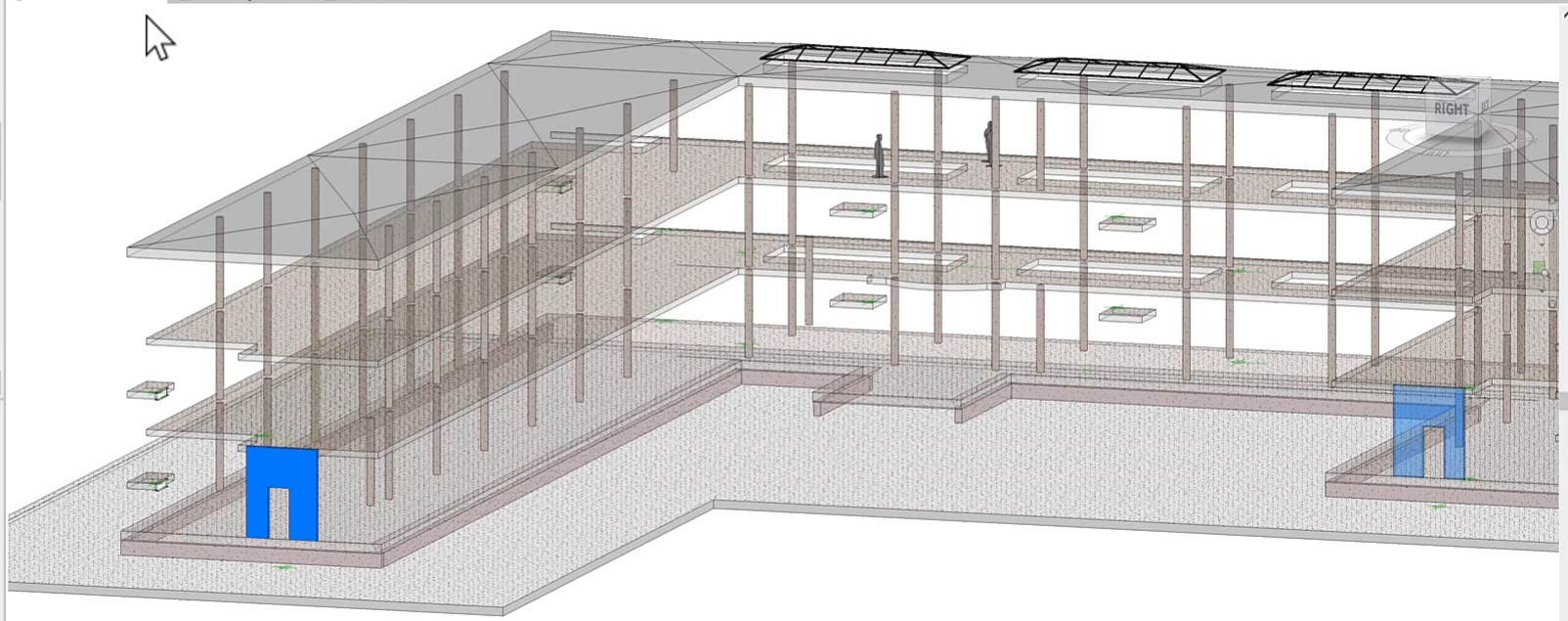
View Scale	1 : 100
Scale Value 1:	100
Detail Level	Medium
Parts Visibility	Show Original
Visibility/Graphics ...	Edit...
Graphic Display Op...	Edit...
Discipline	Architectural
Show Hidden Lines	By Discipline
Default Analysis Dis...	None
Show Grids	Edit...
Sun Path	

Properties help | Apply

Project Browser - MID_Sample_Building_2023...

- Floors
- Furniture
- Generic Models
  - Balcony
  - Balcony_1
  - IC_Panel_A
  - IC_Panel_A_with_Door
  - MID_Stairs1000x1000
  - MID_Stairs3600x1800
  - MID_Stairs3600x1800_NoRail
  - MID_Stairs3800x2000
  - MID_Stairs3800x2000_NoRail
  - SHADE SUPPORT
- Lighting Fixtures
- Mass
- Parking
- Pattern
- Pipes
- Piping Systems
- Planting

MID - Staircase 1 | 01 - Entry Level | 02 - Floor



1 : 100

Click to select, TAB for alternates, CTRL adds, SHIFT unselects.

Main Model

Products in Projects

PREFAB SUPPLIER:
Product Engineer

ARCHITECT:
Architect / Designer

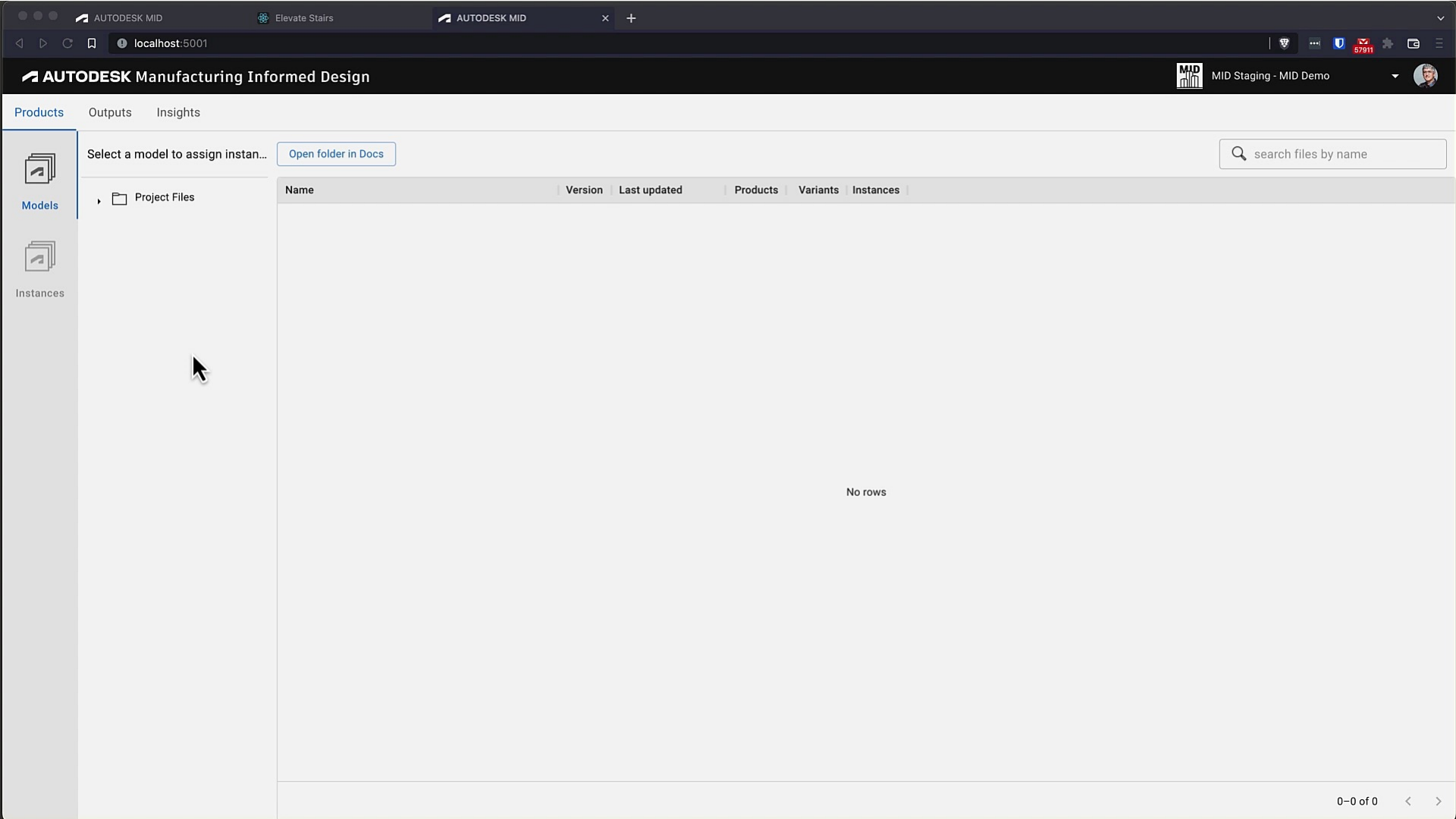
PREFAB SUPPLIER:
Project Manager

Catalog

Compute

Project Data

AUTODESK Forge


AUTODESK MID
Elevate Stairs
AUTODESK MID
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AUTODESK Manufacturing Informed Design
MID Staging - MID Demo
Products
Outputs
Insights
Models
Instances
Select a model to assign instan...
Open folder in Docs
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Project Files
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Version
Last updated
Products
Variants
Instances
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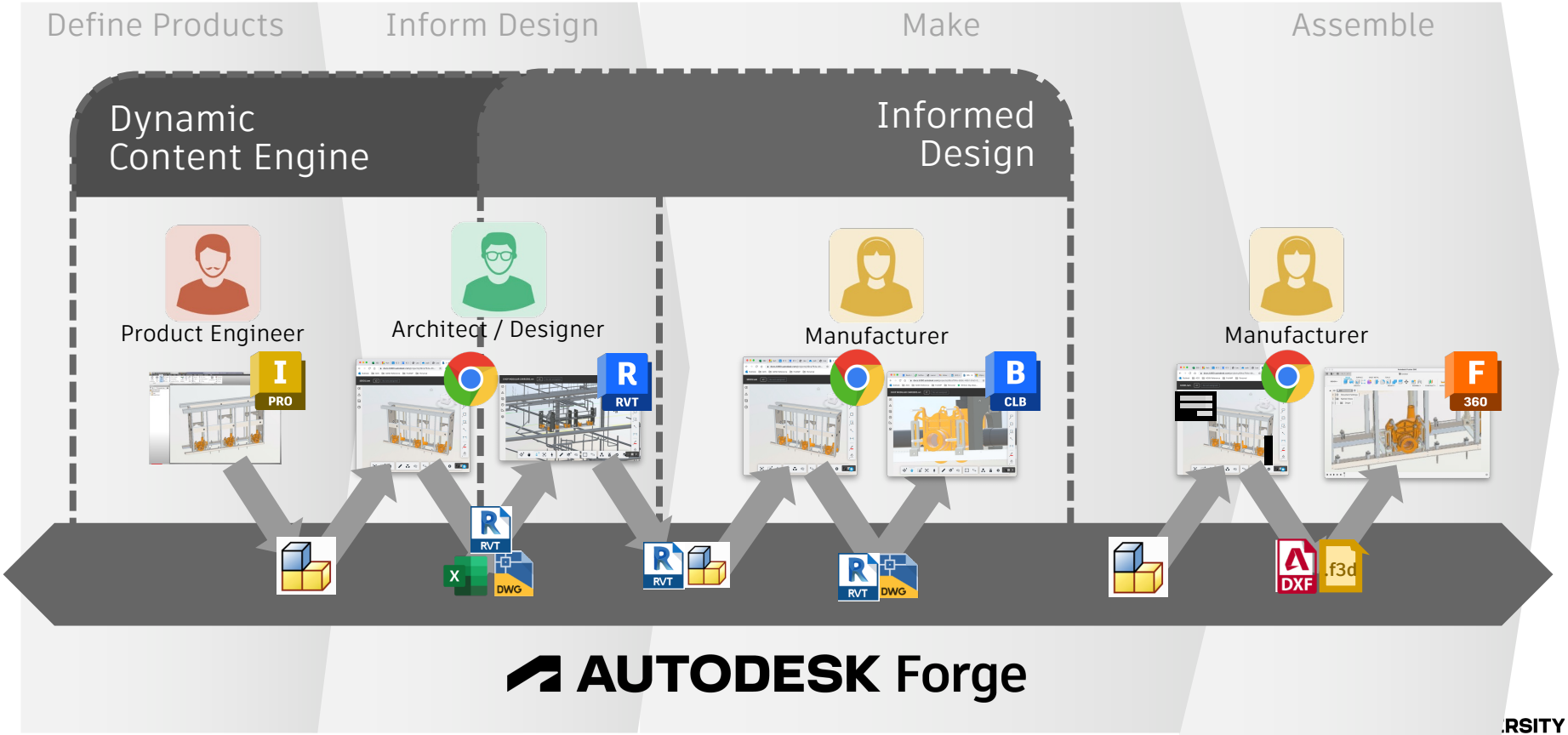
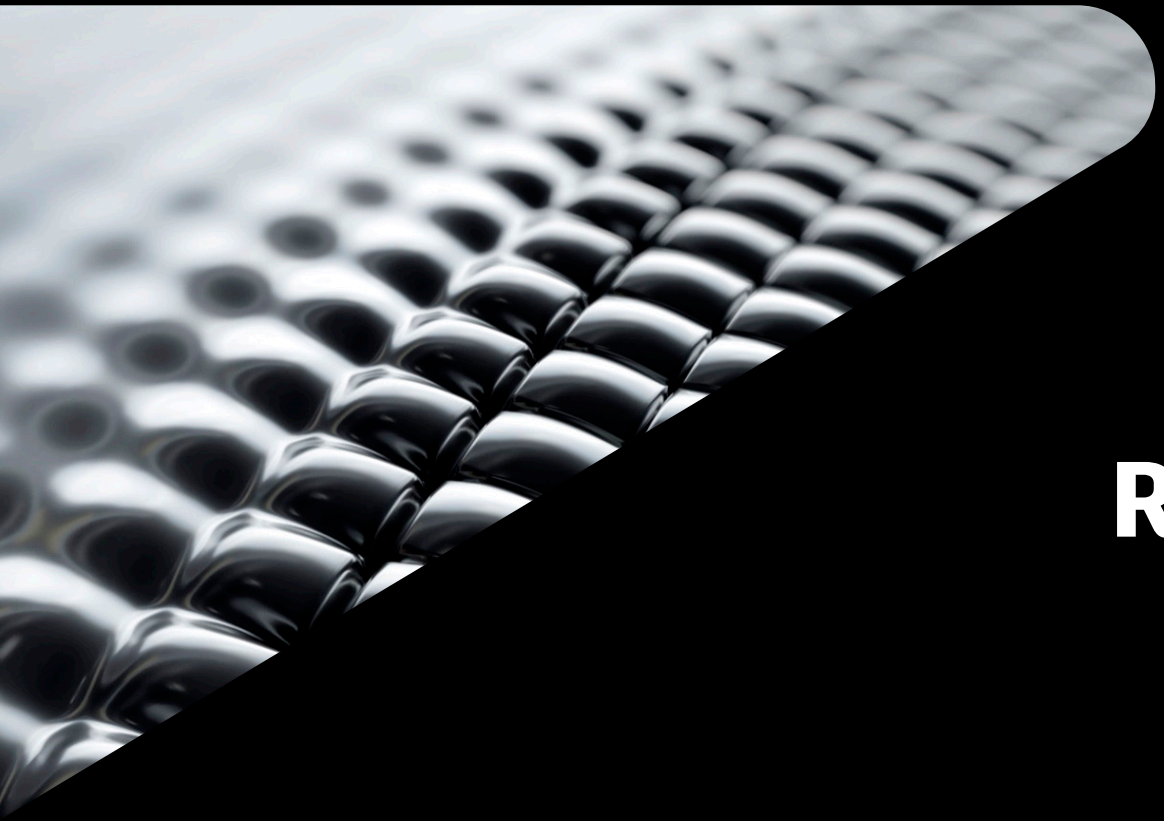
Delivering a Connected Workflow



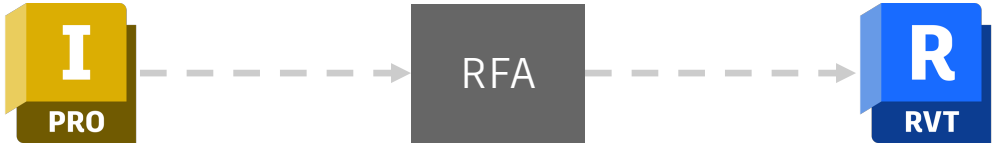


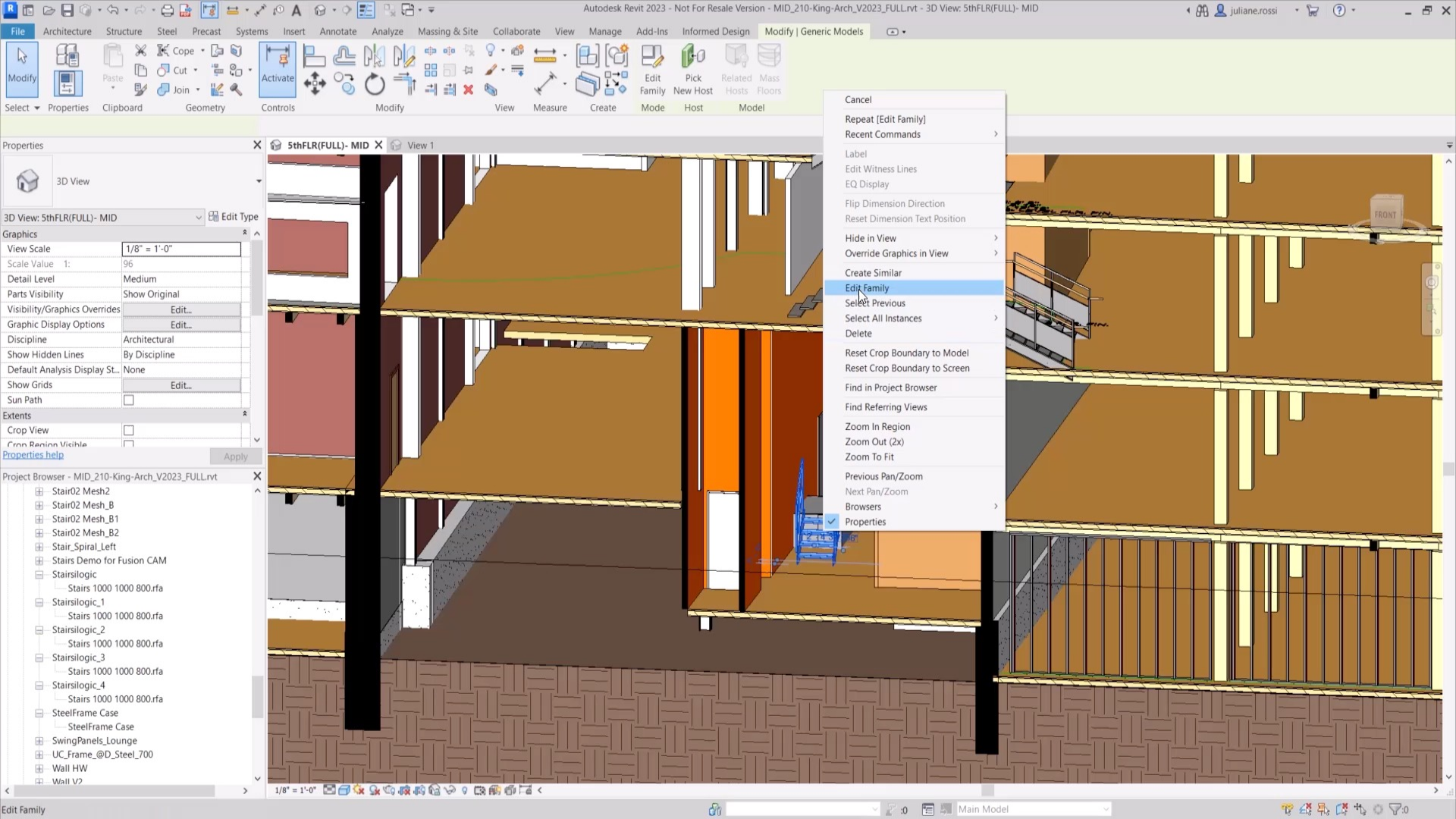
Well-formed Revit Families

Image courtesy of Systecon

The BIM Data Gap

Even with a connected workflow, we can't get a well-formed Revit Family out of Inventor (or any other CAD) today




Autodesk Revit 2023 - Not For Resale Version - MID_210-King-Arch_V2023_FULL.rvt - 3D View: 5thFLR(FULL)- MID
juliane.rossi
File
Architecture
Structure
Steel
Precast
Systems
Insert
Annotate
Analyze
Massing & Site
Collaborate
View
Manage
Add-Ins
Informed Design
Modify | Generic Models
Modify
Select
Properties
Paste
Clipboard
Cope
Cut
Join
Geometry
Activate
Controls
Modify
View
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Create
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Mode
Pick New Host
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Related Hosts
Mass Floors
Model
Properties
3D View
3D View: 5thFLR(FULL)- MID
Edit Type
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Detail Level
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Parts Visibility
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Discipline
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Show Hidden Lines
By Discipline
Default Analysis Display St...
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Crop View
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Apply
Project Browser - MID_210-King-Arch_V2023_FULL.rvt
Stair02 Mesh2
Stair02 Mesh_B
Stair02 Mesh_B1
Stair02 Mesh_B2
Stair_Spiral_Left
Stairs Demo for Fusion CAM
Stairsilogic
Stairs 1000 1000 800.rfa
Stairsilogic_1
Stairs 1000 1000 800.rfa
Stairsilogic_2
Stairs 1000 1000 800.rfa
Stairsilogic_3
Stairs 1000 1000 800.rfa
Stairsilogic_4
Stairs 1000 1000 800.rfa
SteelFrame Case
SteelFrame Case
SwingPanels_Lounge
UC_Frame_@D_Steel_700
Wall HW
Wall V2
5thFLR(FULL)- MID
View 1
Cancel
Repeat [Edit Family]
Recent Commands
Label
Edit Witness Lines
EQ Display
Flip Dimension Direction
Reset Dimension Text Position
Hide in View
Override Graphics in View
Create Similar
Edit Family
Select Previous
Select All Instances
Delete
Reset Crop Boundary to Model
Reset Crop Boundary to Screen
Find in Project Browser
Find Referring Views
Zoom In Region
Zoom Out (2x)
Zoom To Fit
Previous Pan/Zoom
Next Pan/Zoom
Browsers
Properties
FRONT
1/8" = 1'-0"
Edit Family
Main Model

Starting with BIM in Inventor

Enhance BIM Content Add-in

Existing Functionality

UCS

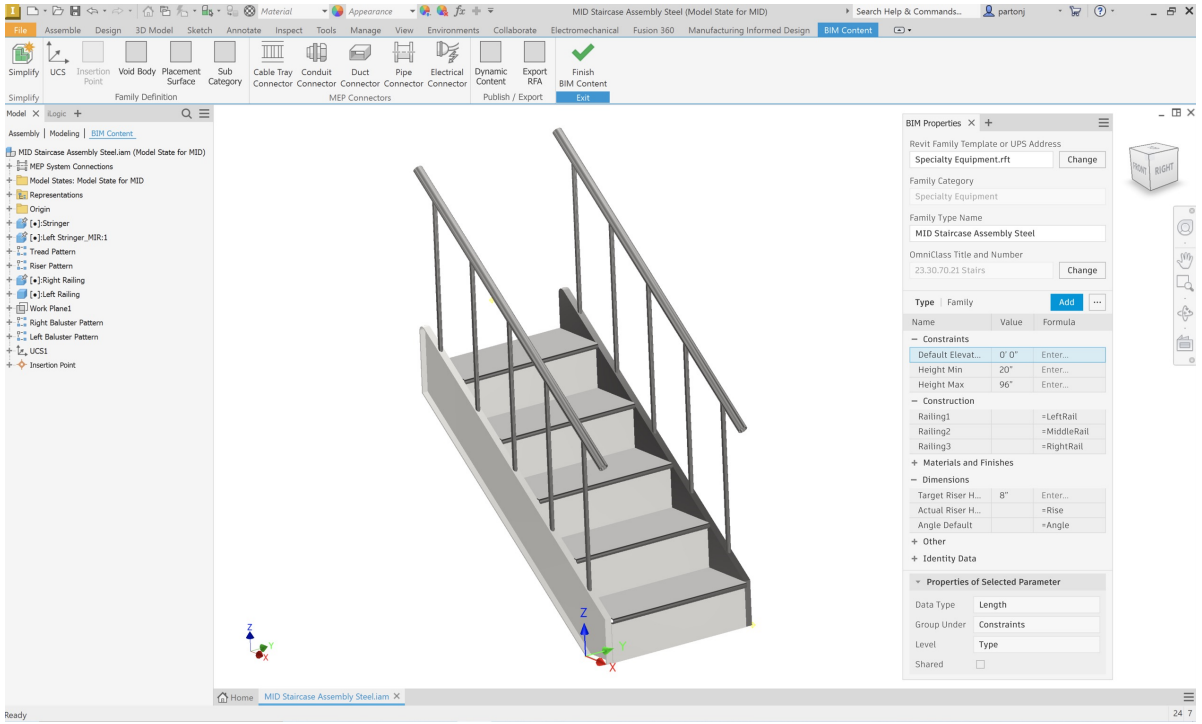
MEP Connectors

Initial Improvements

Insertion Point

BIM Category

BIM Parameters



Well-Formed Revit Families

BASICS

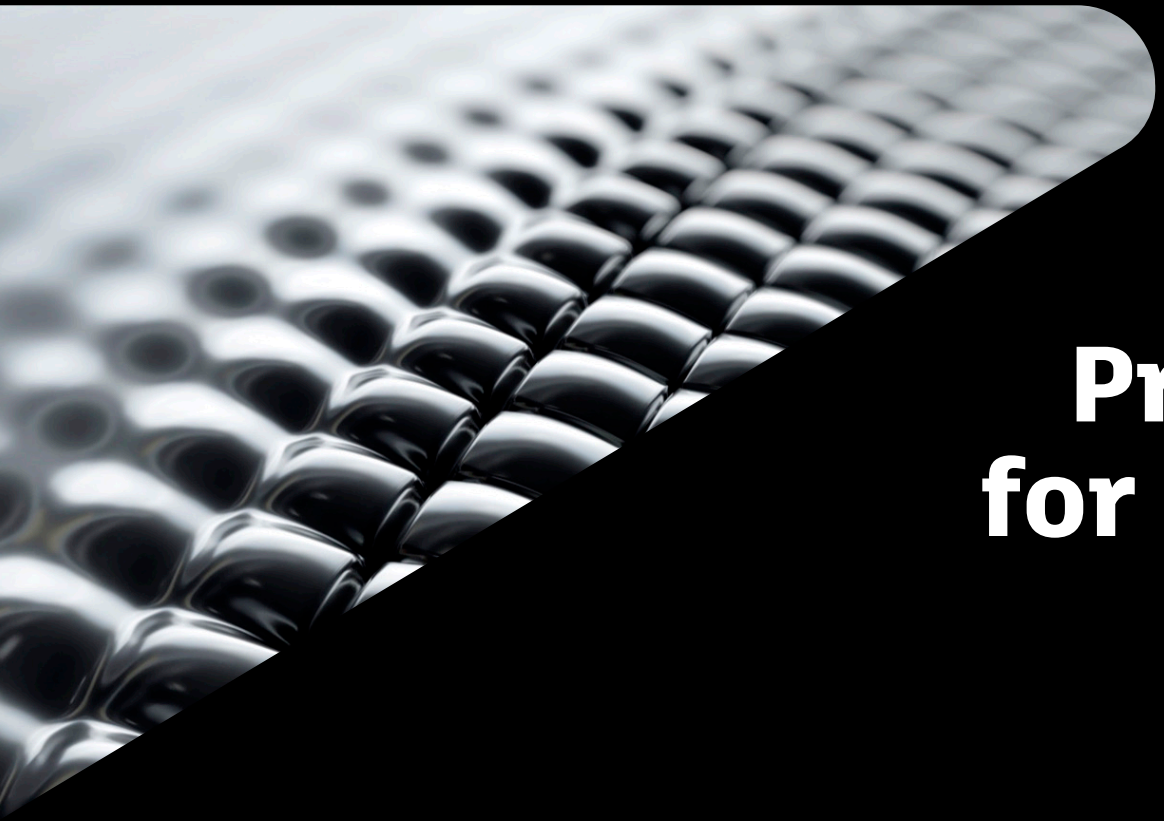
- Insertion Point
- UCS
- MEP Connectors
- BIM Category
- Parameters

BETTER

- Family Type Name (Rule Driven)
- BIM Parameter mapping
- Extensible BIM parameters
- Instance Parameters
- Material

BEST IN CLASS

- Placement Plane (Hosted Families)
- Void Bodies
- Sub-Categories (2D, 3D)
- Alternative Insertion Points

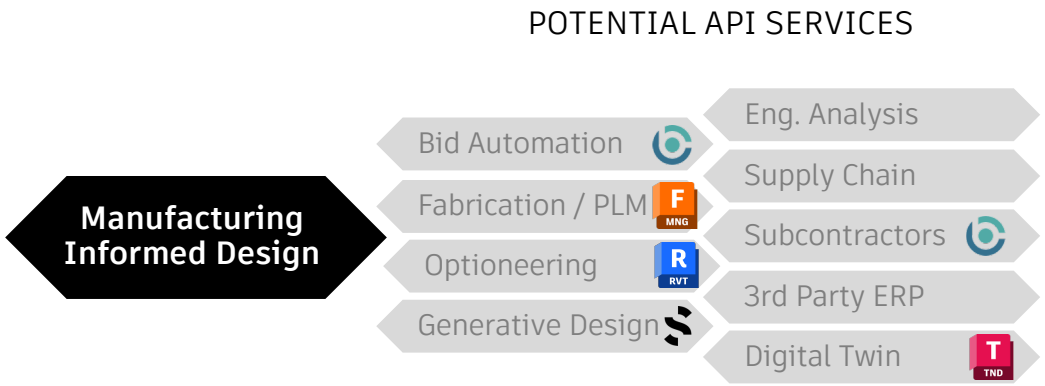


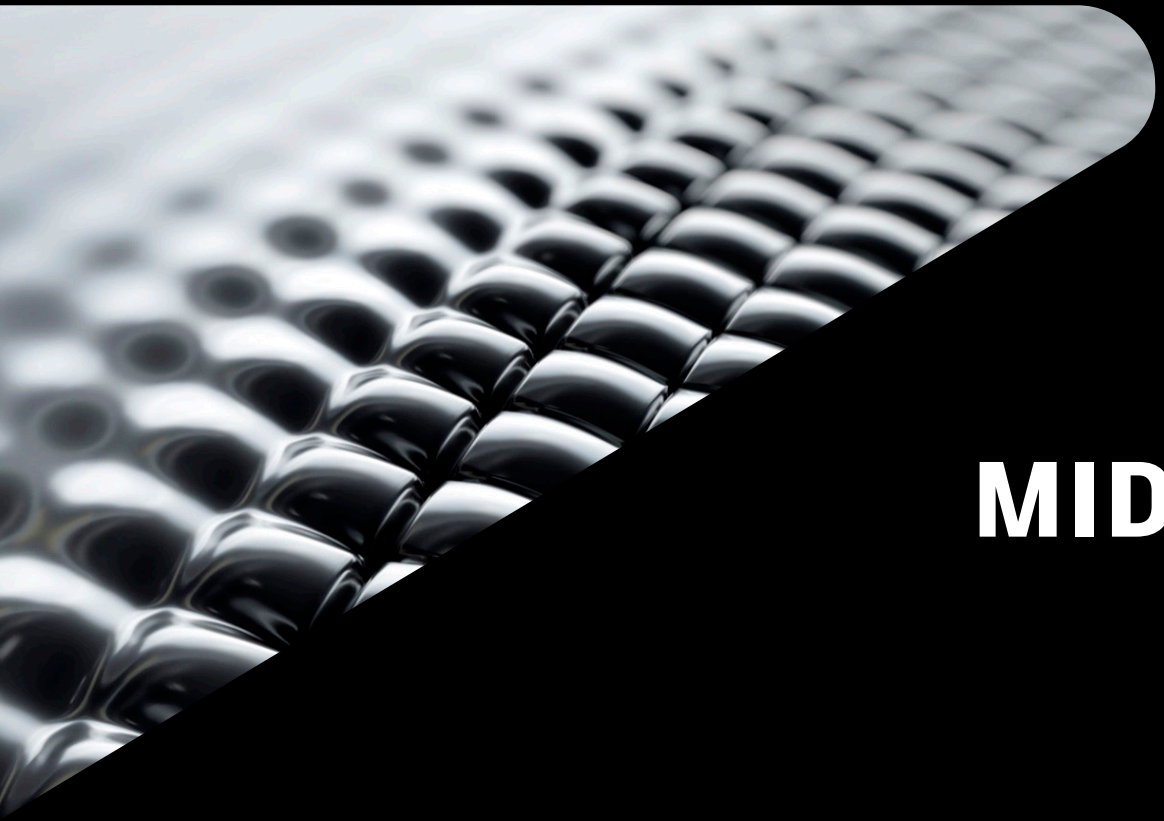
Vision of Productization for Construction

VISION - Enable Productization for Construction

Expand platform services to simplify productization and deliver connected IC workflows

- Connect Autodesk tools in novel ways
- Build foundational capabilities that enable digitization and automation
- Deliver new customer value with extended services

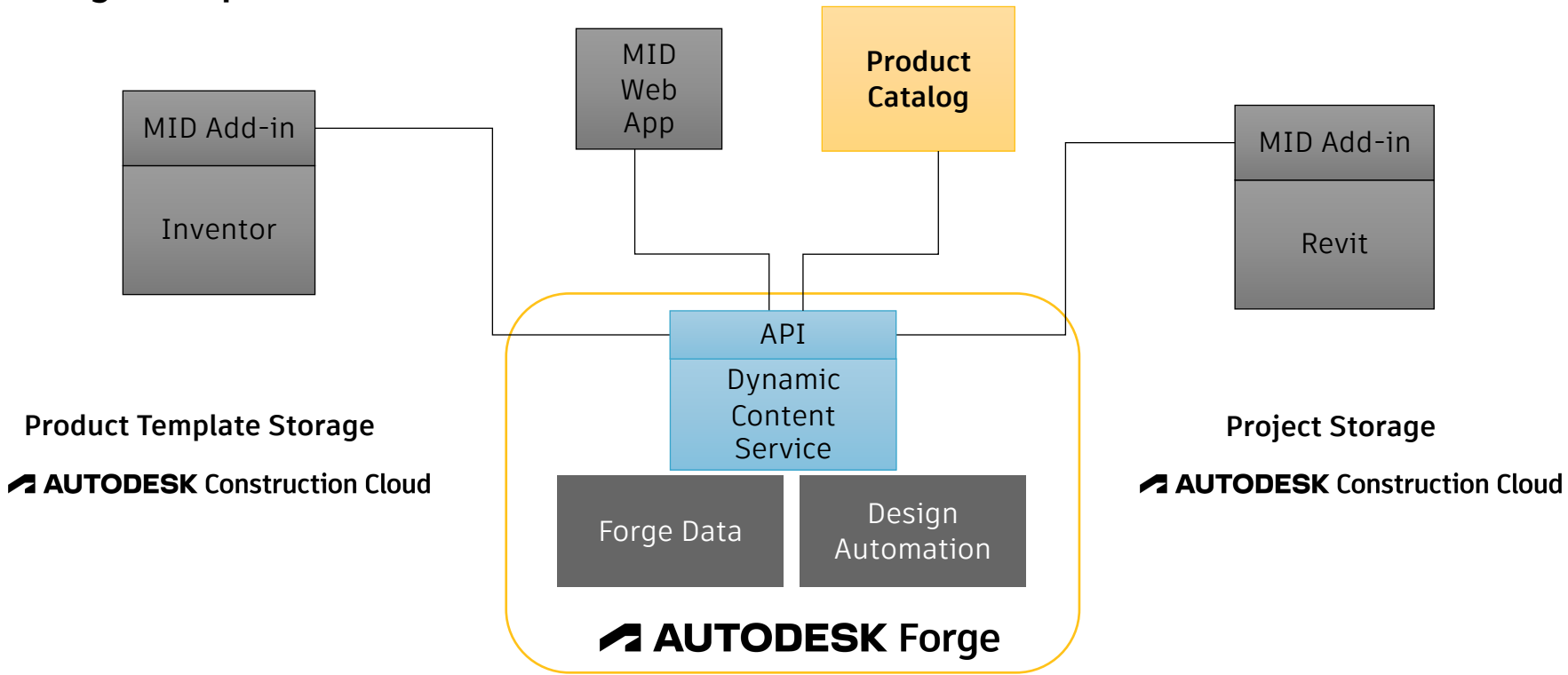


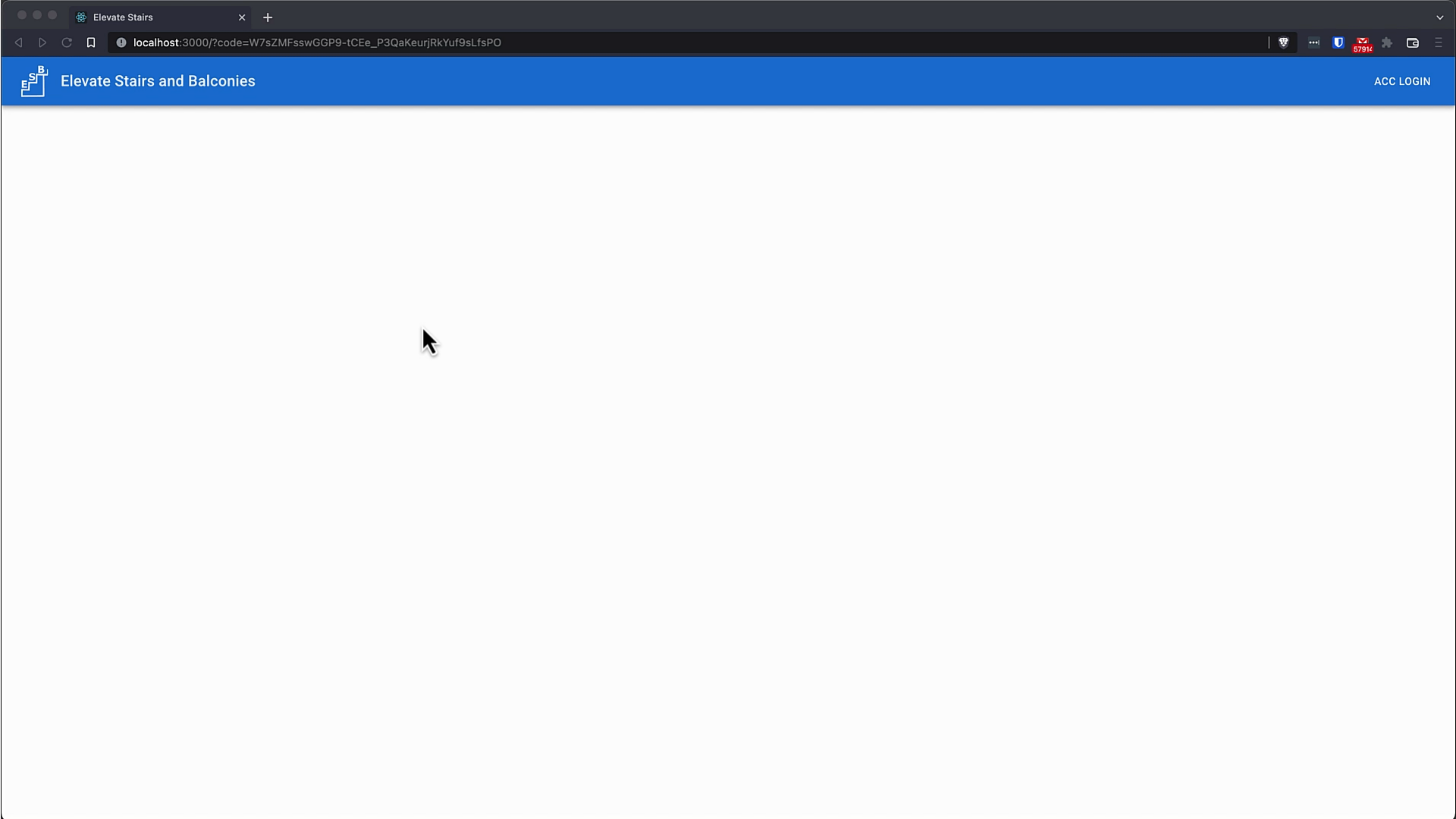


MID API Example

MID Solution Architecture

Forge Components




Elevate Stairs
localhost:3000/?code=W7sZMFsswGGP9-tCEe_P3QaKeurjRkYuf9sLfsPO
Elevate Stairs and Balconies
ACC LOGIN

MID API Overview

PROJECTS

All APIs work within the context of a project ID

PRODUCTS

Product Template published from Inventor

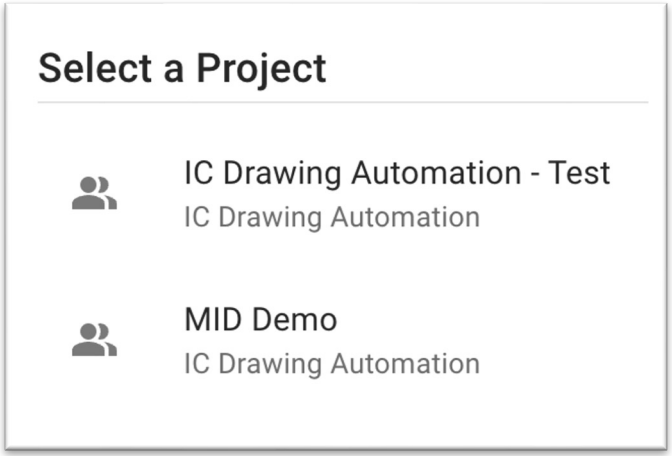
VARIANTS

Specific instance of a Product in a design

Projects

GET /projects

Returns list of projects with published templates



Products

POST /products

Publish a new Product

PATCH /products/PRODUCT_ID

Updates an existing Product

GET /products

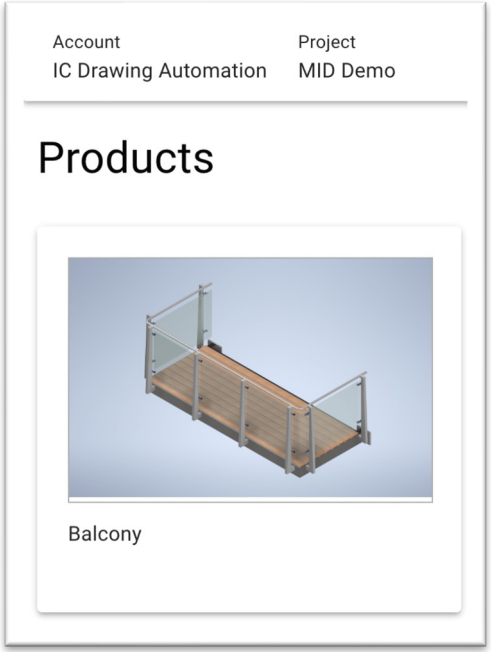
Get all the published Products

GET /products/PRODUCT_ID

Get an existing Product

DEL /products/PRODUCT_ID

Delete an existing Product



Variants

POST /variants

Post a new variant for specified inputs

GET /variants

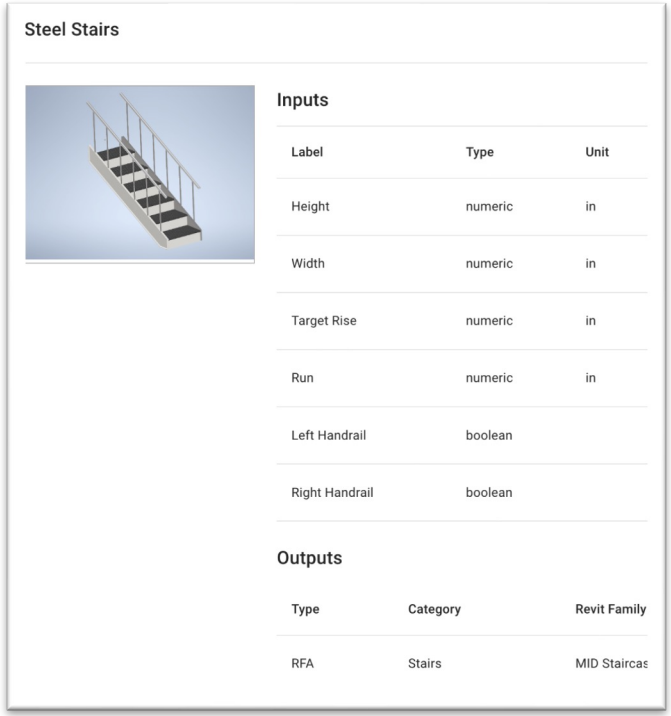
Get all the Product Variants

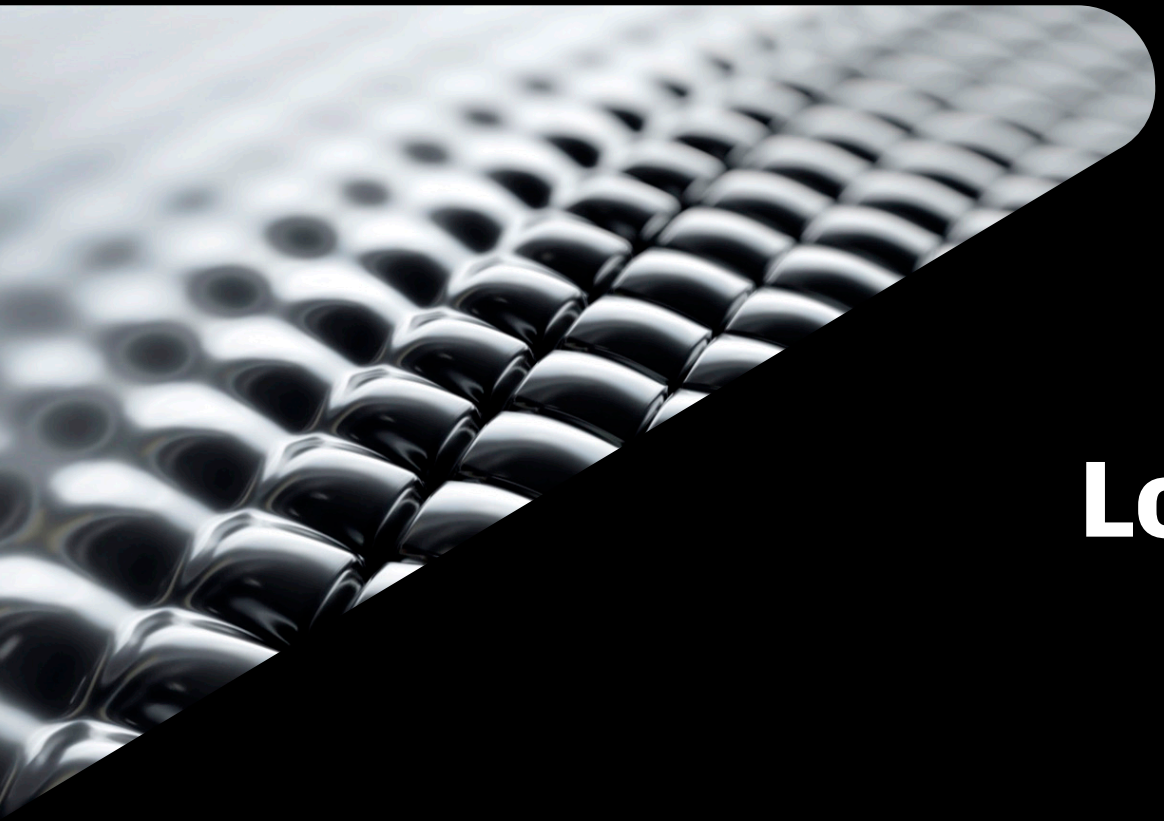
GET /variants/VARIANT_ID

Get an existing Product Variant

GET /variants/VARIANT_ID/outputs

Get the outputs for a Product Variant

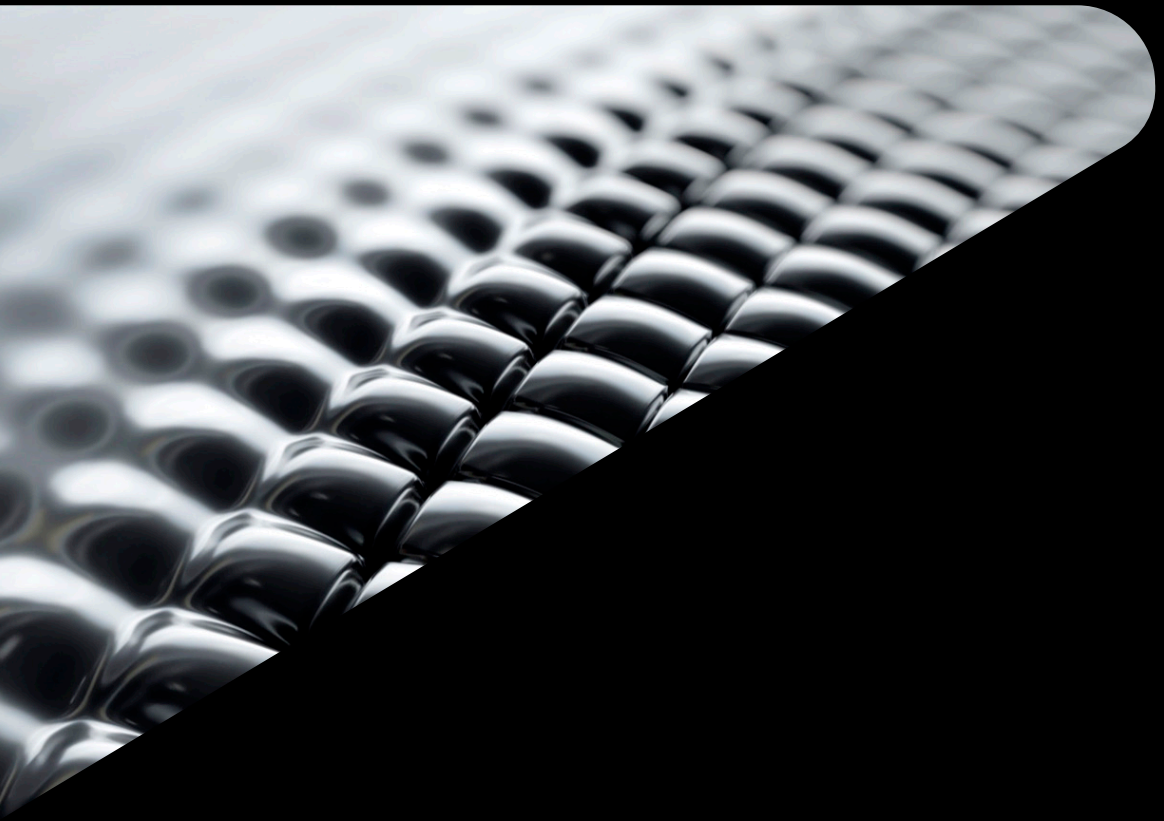




Looking Ahead

What’s next

- API part of Forge
- Sample Apps
- SDK (C#, Javascript…)
- Fusion Team for Product Templates
- PDM/PLM integration



Conclusion

Wrapping up

Productize with MID

Well-Formed Revit Families

MID API Example