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More Tips, Tricks, and the Future of the Forge Model Derivative Service

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About the speaker

Kevin Vandecar – Developer Advocate

A Forge developer advocate and also the manager for the Media & Entertainment and Manufacturing Autodesk Developer Network Workgroups. His specialty is 3ds Max software customization and programming areas, including the new Forge Design Automation for 3ds Max service.

About the speaker

Denis Grigor – Developer Advocate

Denis likes to know how everything works under the hood, and is not afraid of low-level stuff like bits, buffers, pointers, stack, heap, threads, shaders and of course Math. He is interested in 3D for Web, from raw WebGL to libraries and frameworks with different levels of abstractions, as well as how virtual entities from 3D world can be linked to things from real world. In the end, "For an artificial mind, all reality is virtual" [The Animatrix]. To achieve my goals, he prefers to speak C/C++ mostly with modern dialect, Go, Python, and I have to speak Javascript/Node.js.

More Tips, Tricks, and the Future of the Forge Model Derivative Service

Learning Objectives

- Learn how to compare the data sets coming from the Model Derivative service.
- Learn details about the Revit `generateMasterViews` flags to get room and space information.
- See a preview of coming new features in Model Derivative service.
- Learn about how and when to use the new SVF2 format.

Last year we brought you “Tips, Tricks, and the Future for Forge Model Derivative Services.” We’re bringing even more goodies to this year’s presentation. We will include more details around the Revit flag to generate rooms and spaces for viewing. We will cover how you can use the model derivative data to do model version comparison. Finally, again we will preview some of the coming features in Model Derivative Service, including the improved SVF2 Forge Viewer format.

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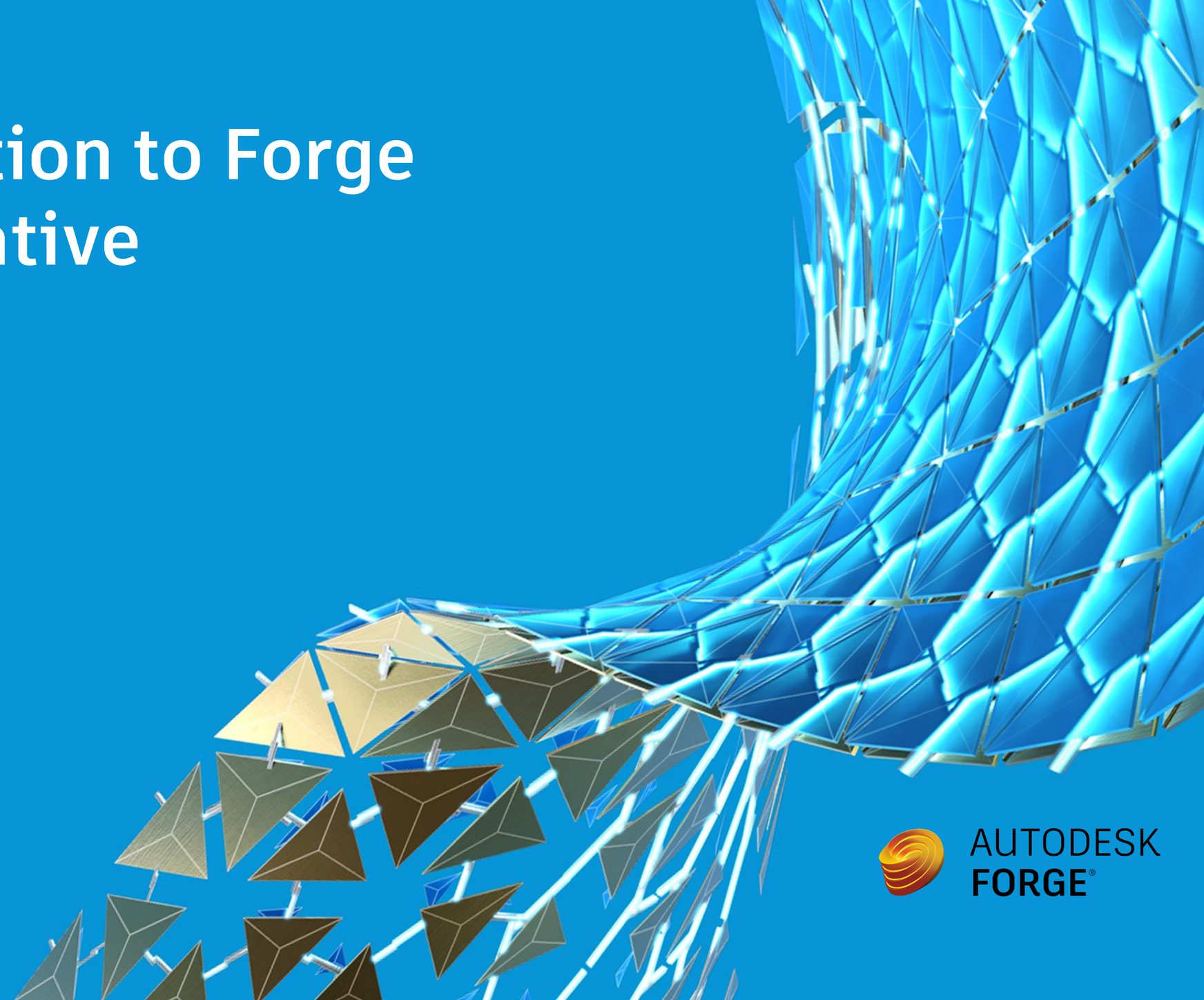
Re-Introduction to Forge Model Derivative



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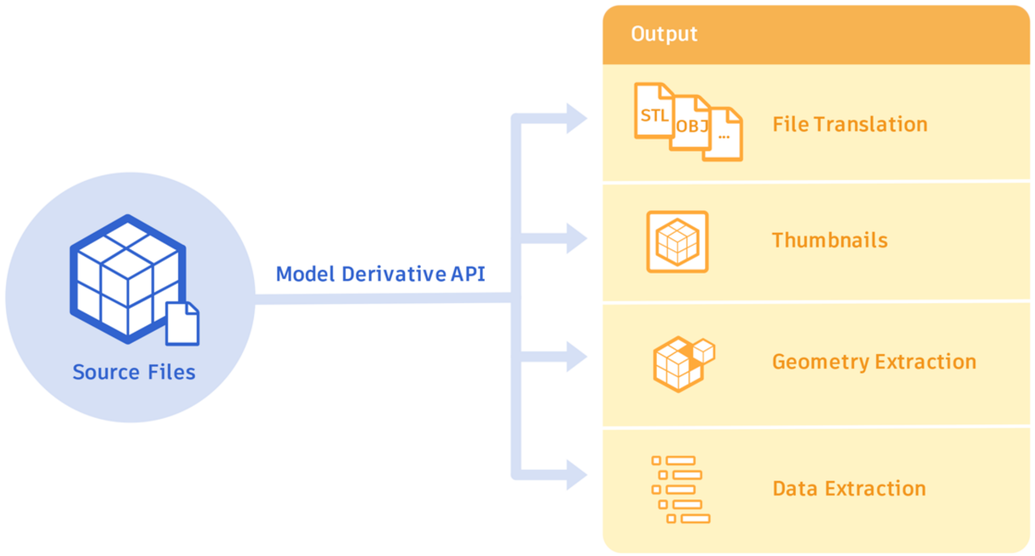
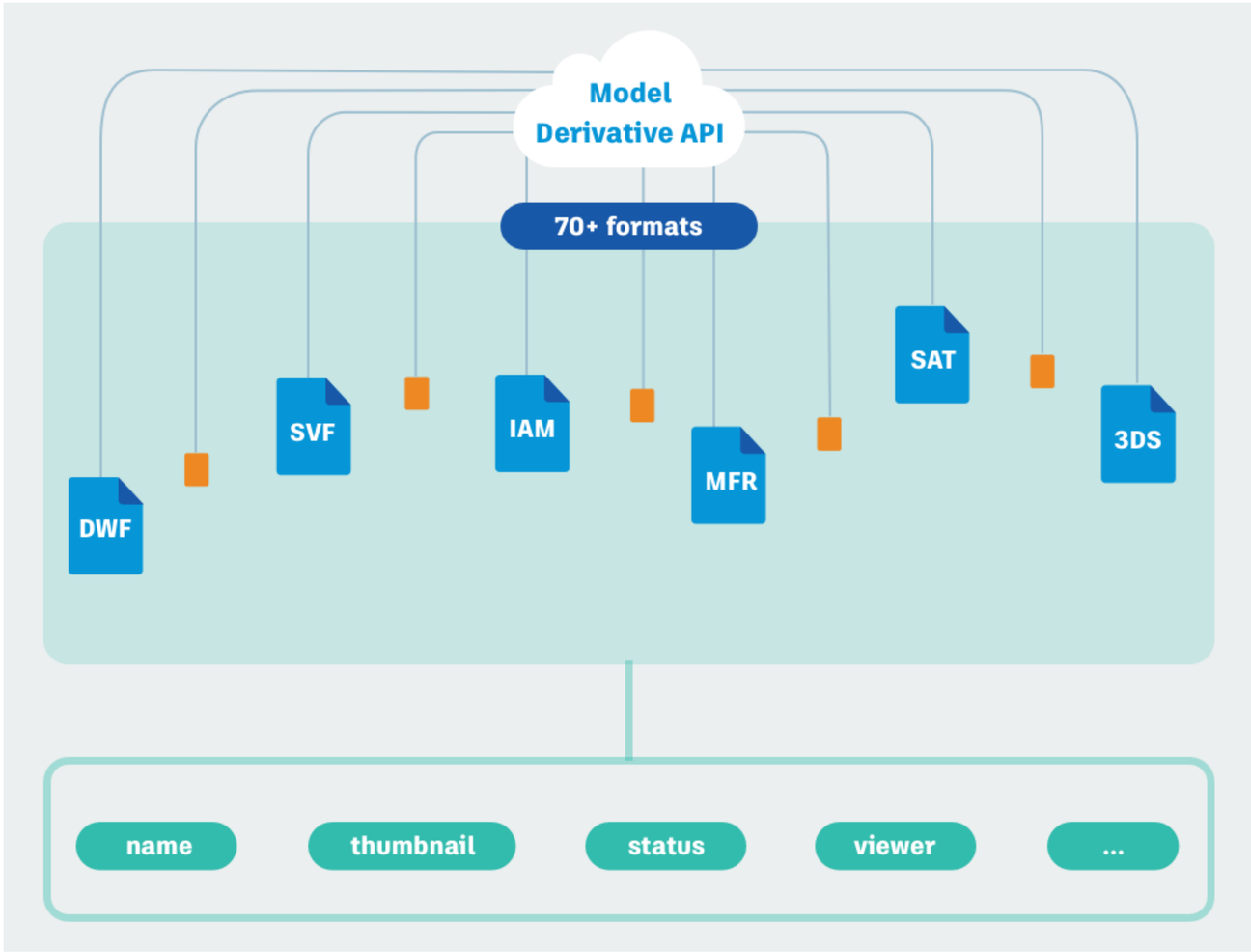
What is Model Derivative?

- Translator for 2D and 3D Design files
- 70+ formats
- SVF = Precise geometry and property data





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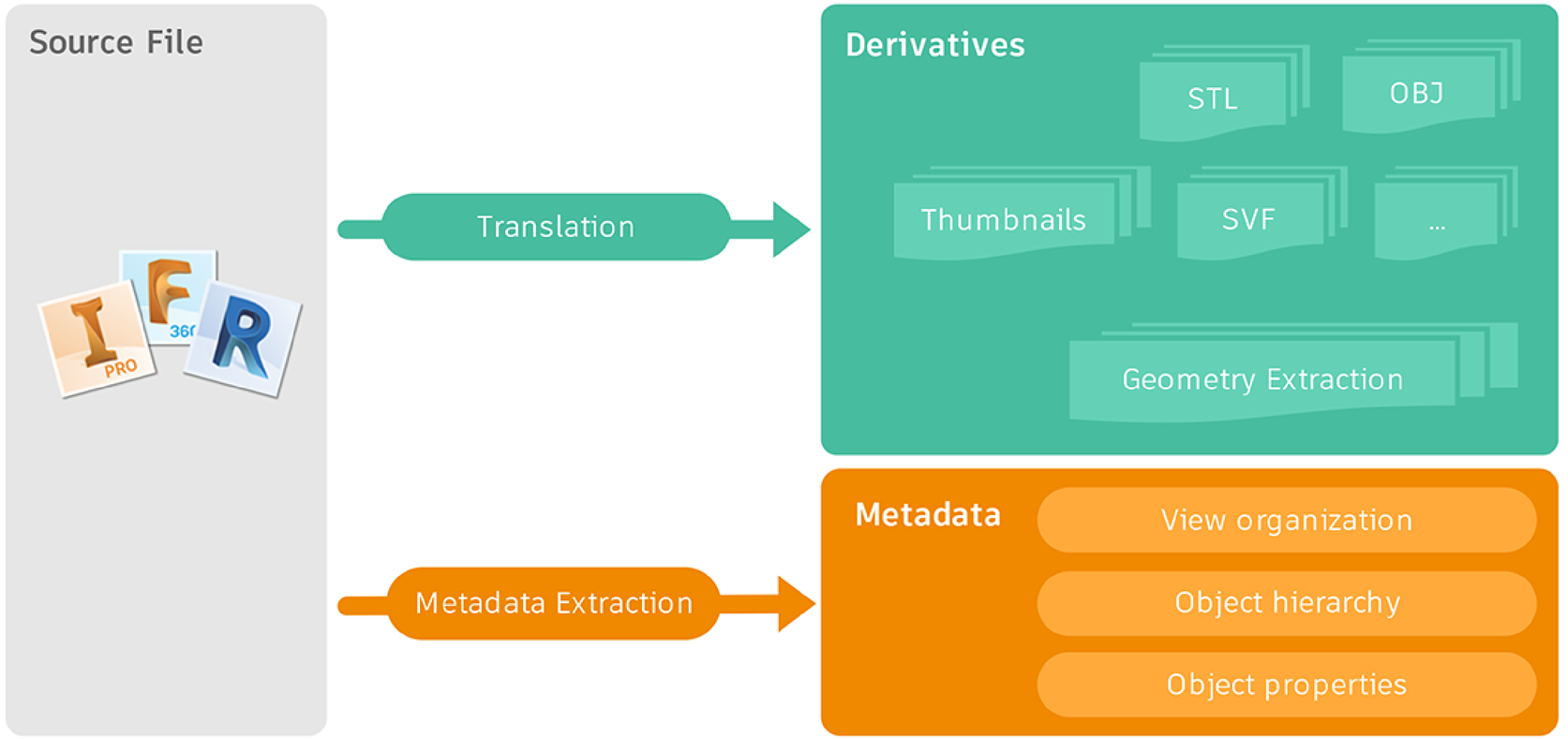
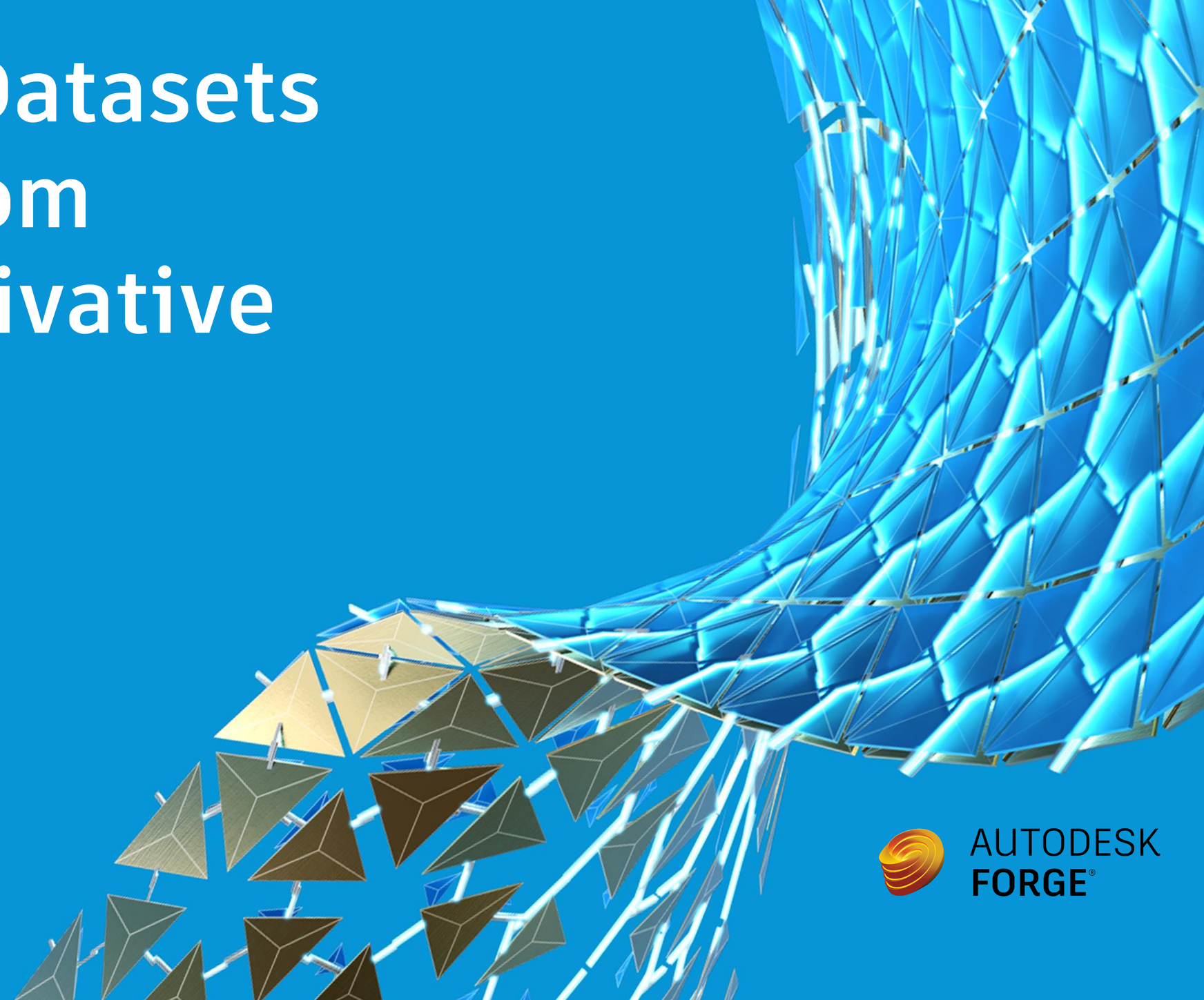
What is Model Derivative?

- AU 2019 class “Tips, Tricks, and the Future for Forge Model Derivative Services”
- Forge Developer Portal improvements
- Improved Change Notes
- Improved Tutorials



Compare Datasets coming from Model Derivative



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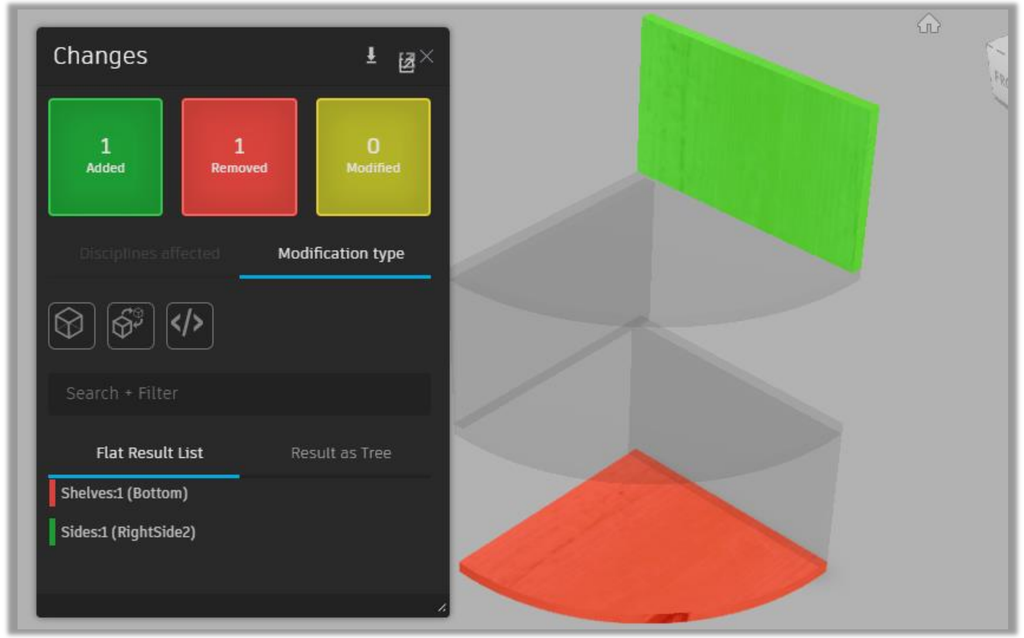
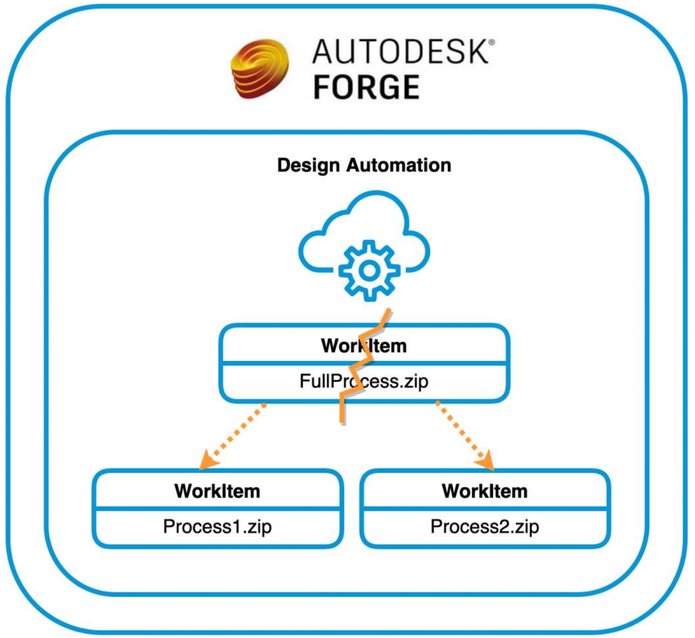
Identify changes in models

FORGE VIEWER APPROACH



DESIGN AUTOMATION APPROACH



Model Derivative Service

MODEL TREE

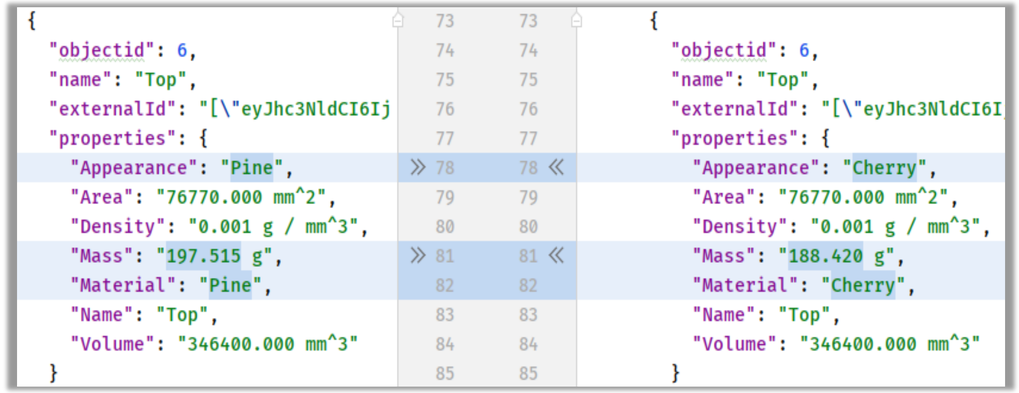

```
"type": "objects",
"objects": [
    {
        "objectid": 1,
        "name": "Model",
        "objects": [
            {
                "objectid": 2028,
                "name": "Floors",
                "objects": [
                    {
                        "objectid": 2029,
                        "name": "Floor",
                        "objects": [
                            {
                                "objectid": 2031,
                                "name": "Generic 150mm",
                                "objects": [
                                    {
                                        "objectid": 2032,
                                        "name": "Floor [176804]"
                                    },
                                    {
                                        "objectid": 2915,
```


OBJECT PROPERTIES


```
    "externalId": "[\"eyJhc3NldCI6IjZmOTFmODdlLWEzNDgtNGFiZC1hZTUyLTcyYzE5NzhjNjg1
        \"eyJhc3NldCI6IjZmOTFmODdlLWEzNDgtNGFiZC1hZTUyLTcyYzE5NzhjNjg1YSIsImVudGl0
    "properties": {
        "Area": "230300.000 mm^2",
        "Component Name": "Shelves",
        "Mass": "583.449 g",
        "Material": "",
        "Name": "Shelves:1",
        "Volume": "1039000.000 mm^3",
        "File Properties": {
            "Part Number": "Shelves",
            "Title": "Shelves"
        }
    }
},
{
    "objectid": 4,
    "name": "Bottom",
    "externalId": "[\"eyJhc3NldCI6IjZmOTFmODdlLWEzNDgtNGFiZC1hZTUyLTcyYzE5NzhjNjg1
        \"eyJhc3NldCI6IjZmOTFmODdlLWEzNDgtNGFiZC1hZTUyLTcyYzE5NzhjNjg1YSIsImVudGl0
        \"eyJhc3NldCI6IjZmOTFmODdlLWEzNDgtNGFiZC1hZTUyLTcyYzE5NzhjNjg1YSIsImVudGl0
    "properties": {
        "Appearance": "Pine",
        "Area": "76770.000 mm^2",
        "Density": "0.001 g / mm^3",
        "Mass": "197.515 g",
        "Material": "Pine",
        "Name": "Bottom",
        "Volume": "346400.000 mm^3"
```

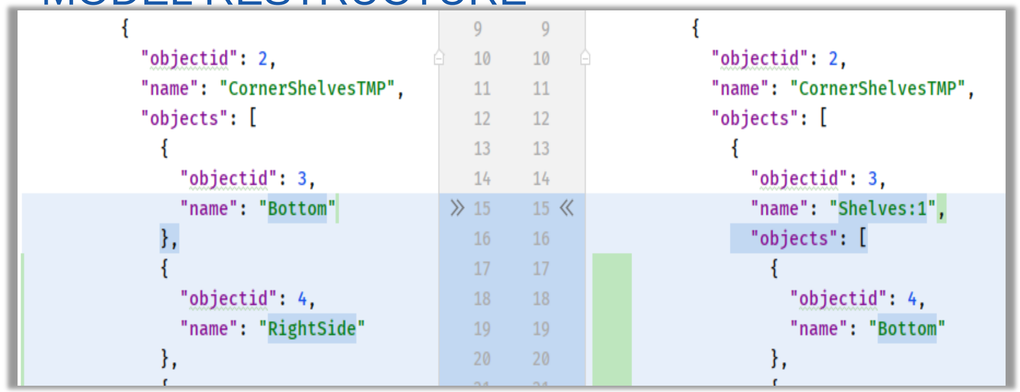
Identify changes in models

PROPERTY CHANGE

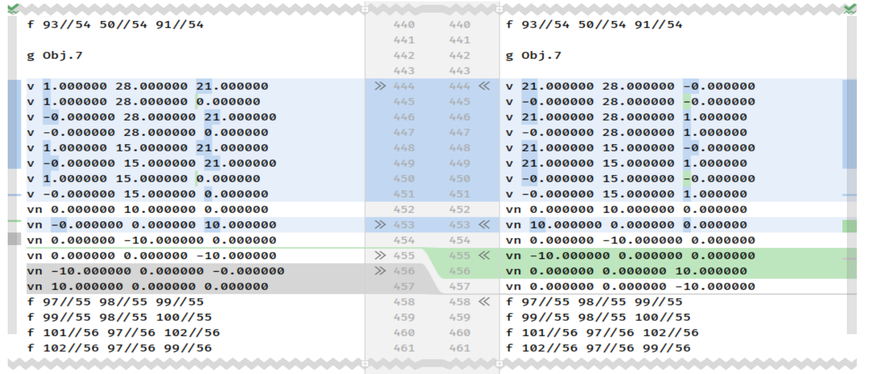


COMPONENT CHANGE

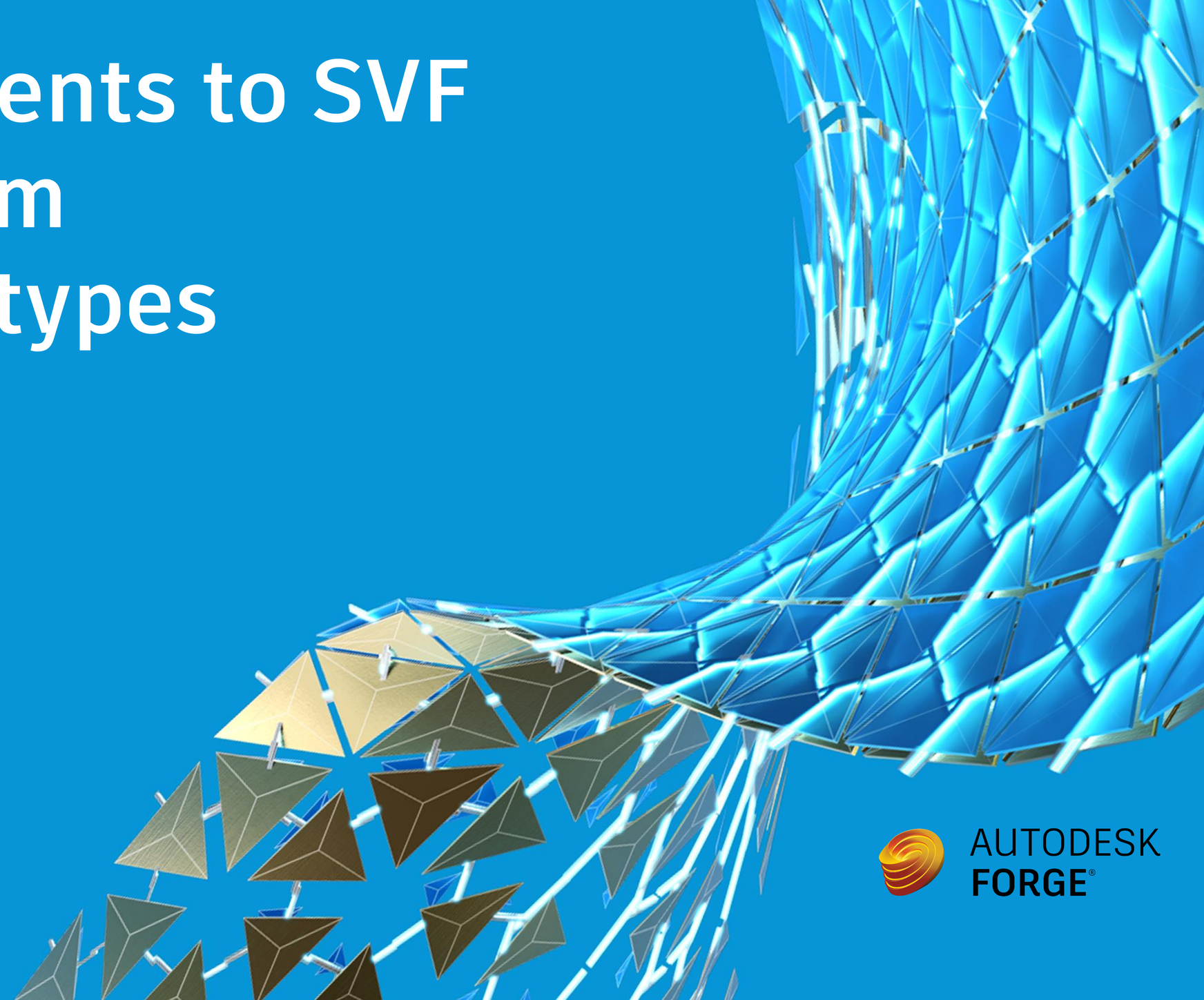
MODEL RESTRUCTURE



GEOMETRY CHANGE



Improvements to SVF output from AEC input types



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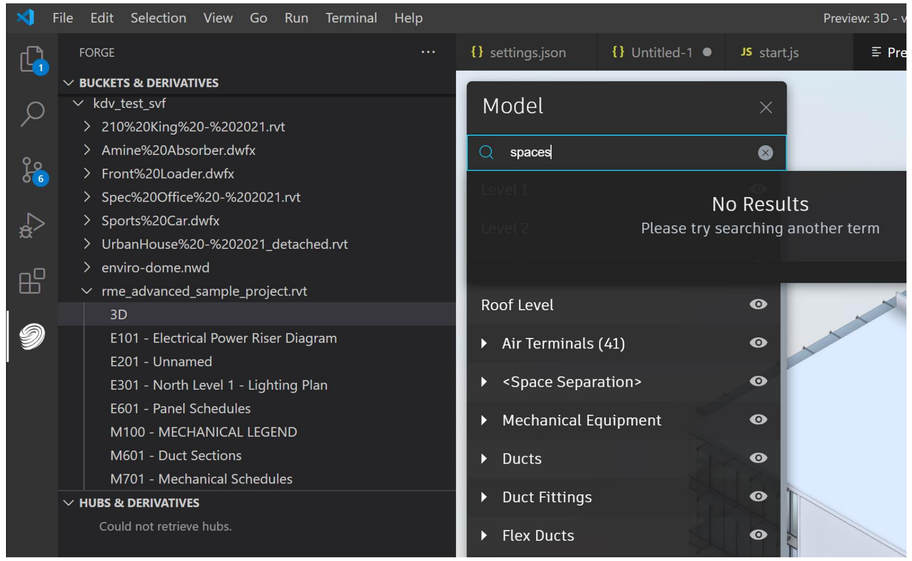
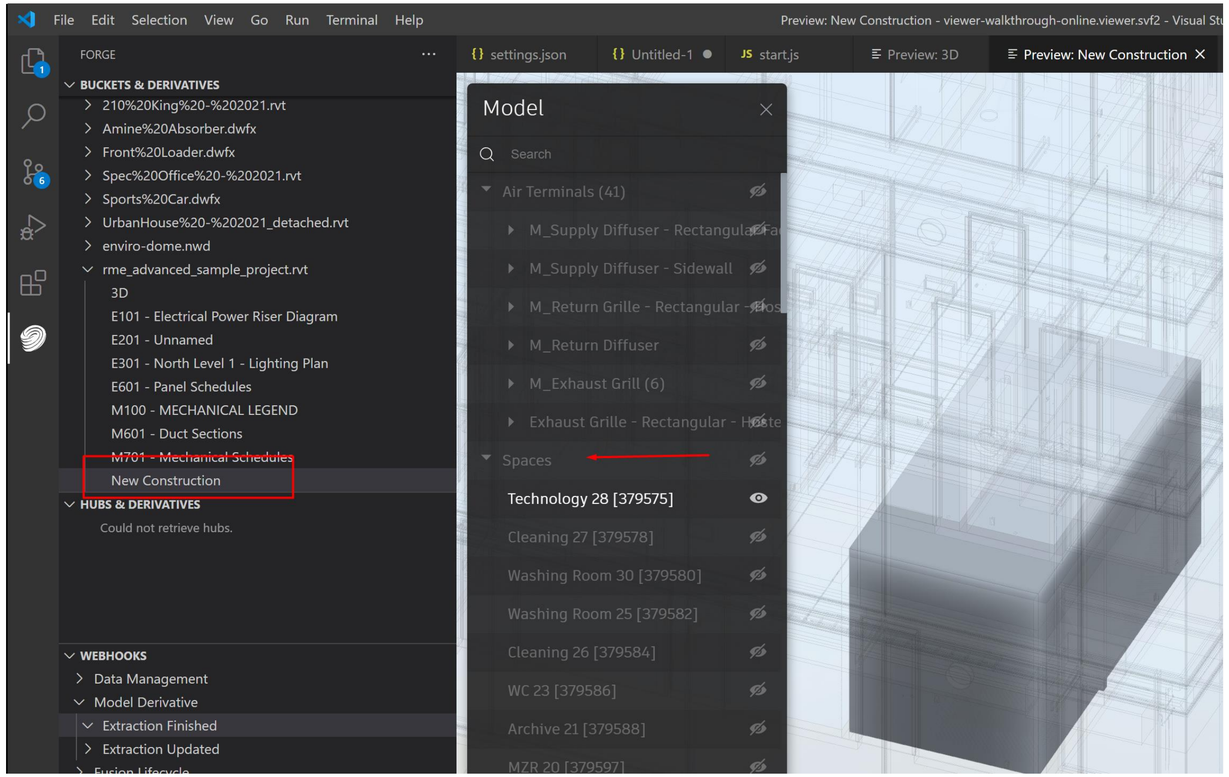
Using the `generateMasterViews` attribute

- allow Revit models to also translate the room/space and zone information
- “master view” is a Viewable that is generated for each phase of the Revit model
- Works with Visual Studio Code Forge Extension
- Well documented and have Tutorial
- Caveat – irregular shaped geometry





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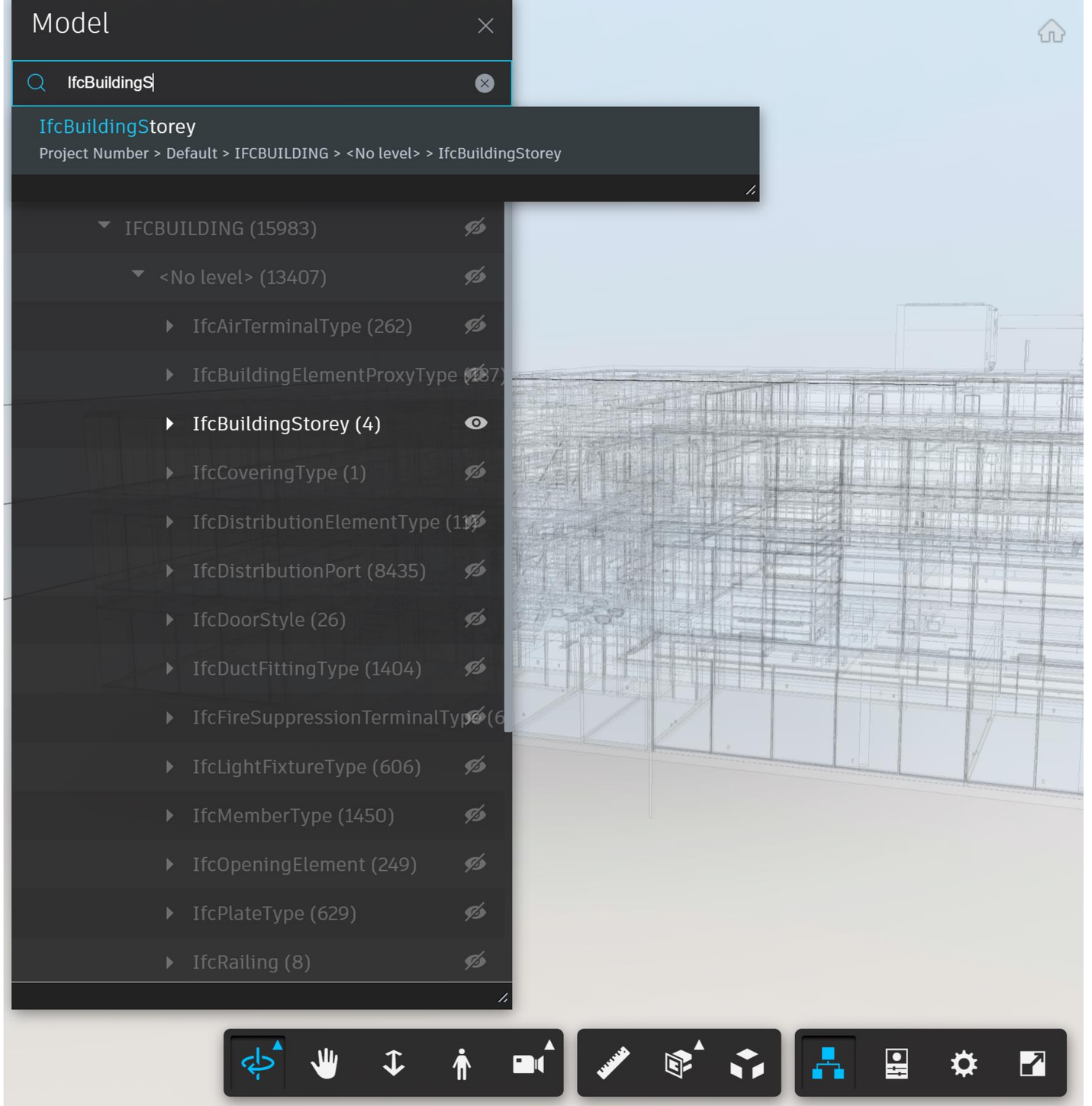
September AEC Updates

- Deprecated IFC switchLoader
- New IFC -> SVF Translation Options
- Updated Navisworks Translation Engine
- Documentation updated for each case



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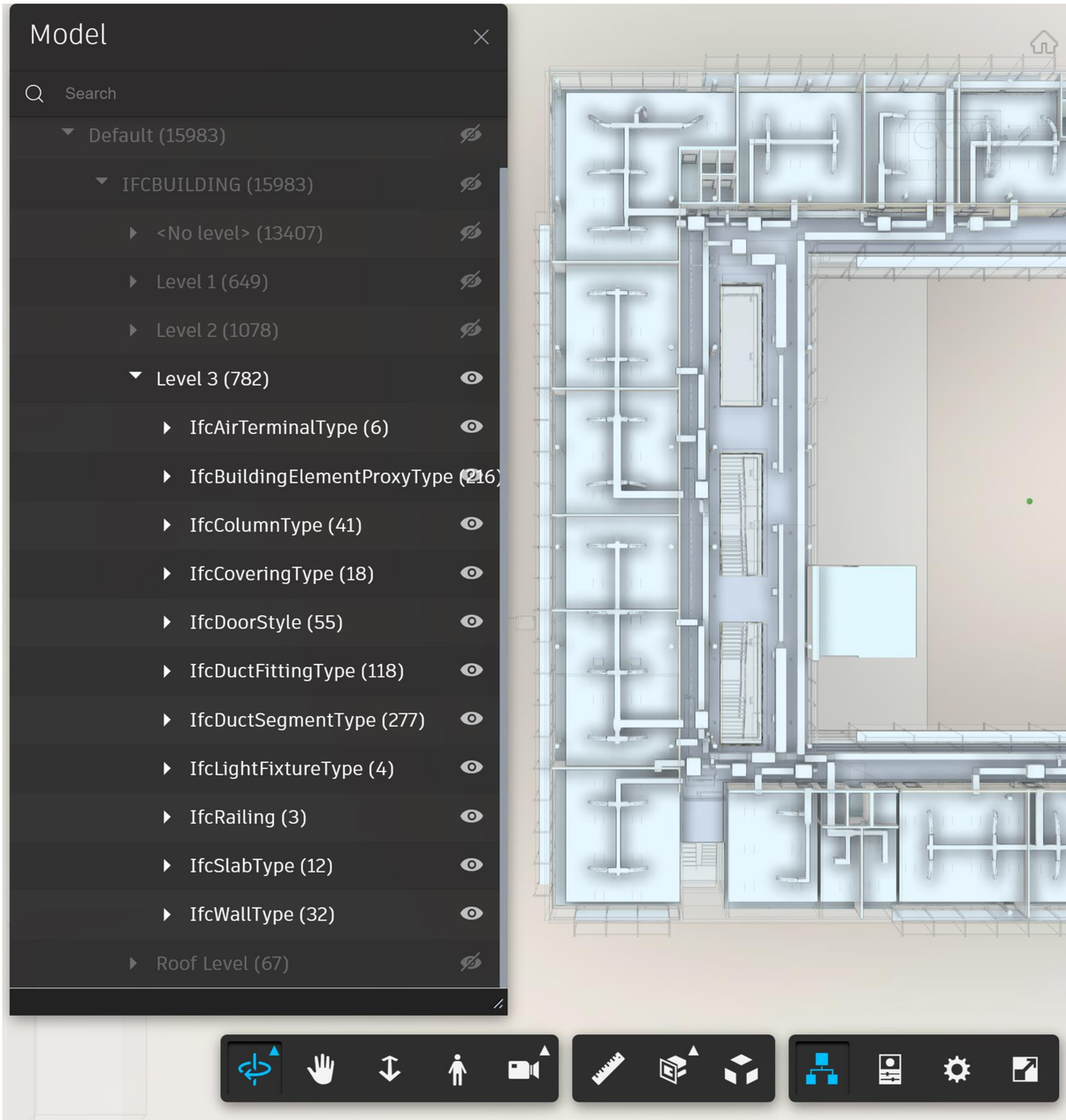
Deprecated IFC `switchLoader`

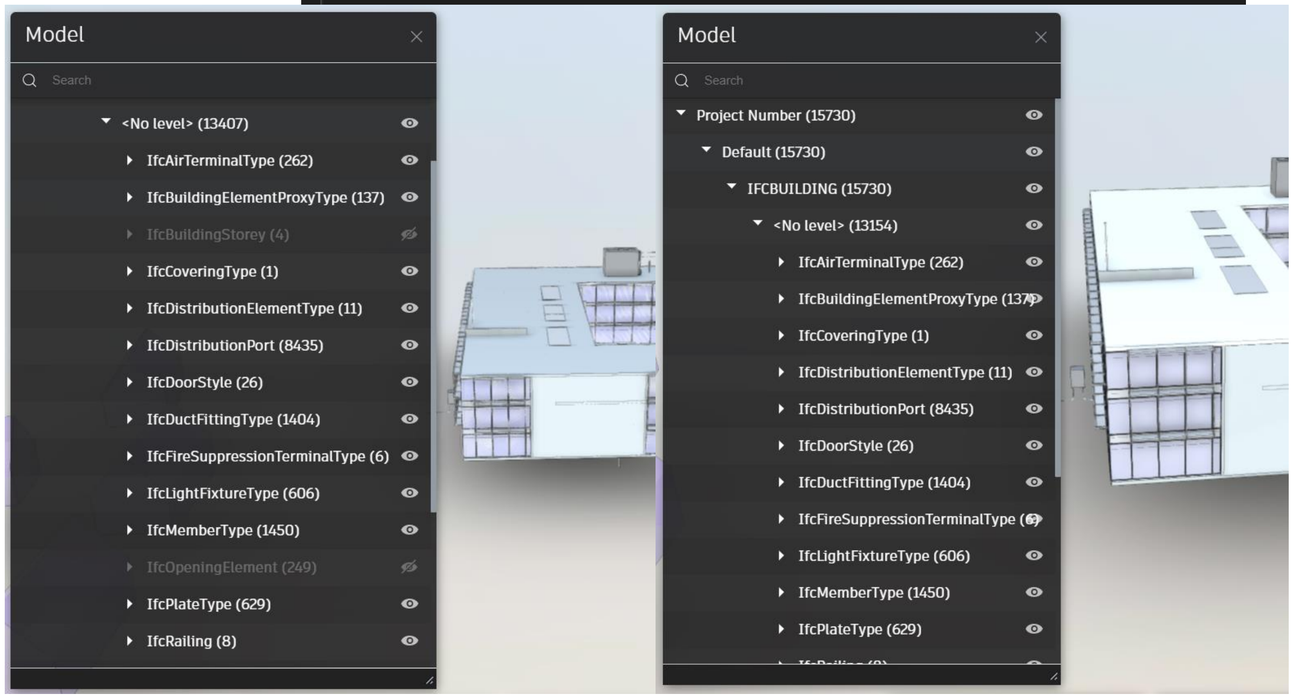
- **switchLoader was introduced last year**
- **allowed switching between Revit and Navisworks IFC extractor**
- **The name was not clear, so moving to conversionMethod now to be clearer**
- **Use conversionMethod now and remove switchLoader**
- **The Navisworks extractor is still the default when no options are provided**
  - Navisworks (legacy) translator is still faster
  - Revit translator (modern) translator more complete



New IFC -> SVF Translation Options

- `conversionMethod` rules!
- `buildingStoreys` - allows you to hide, show or skip storeys (note the spelling is matching the IFC specification)
- `spaces` - allows you to hide, show or skip spaces
- `openingElements` - allows you to hide, show or skip openings
- Example: On Left, is default where IfcBuildingStoreys and IfcOpeningElements are ‘hide’ and on right they are ‘skip’ (not translated at all)

```
data: JSON.stringify({
    'input': {
        'urn': urn
    },
    'output': {
        'formats': [
            {
                'type': 'svf',
                'views': ['2d', '3d'],
                'advanced' : {
                    'conversionMethod' : 'modern',
                    'buildingStoreys' : 'skip',
                    'openingElements' : 'skip'
                }
            }
        ]
    },
```



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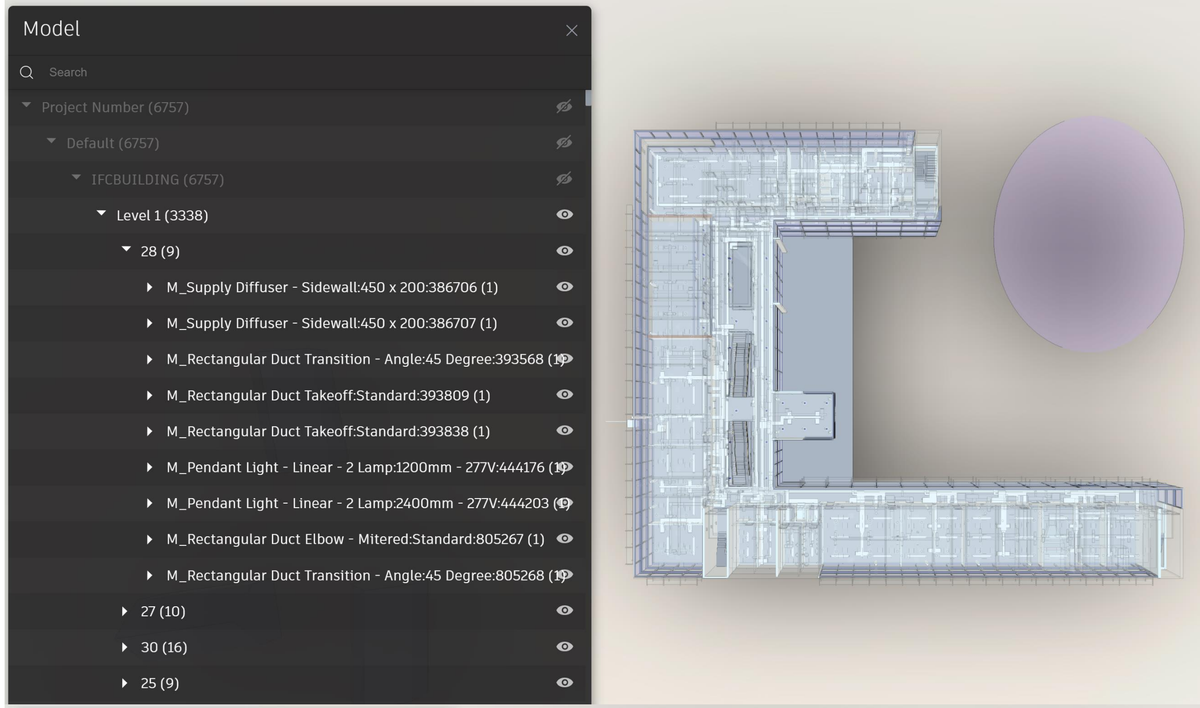
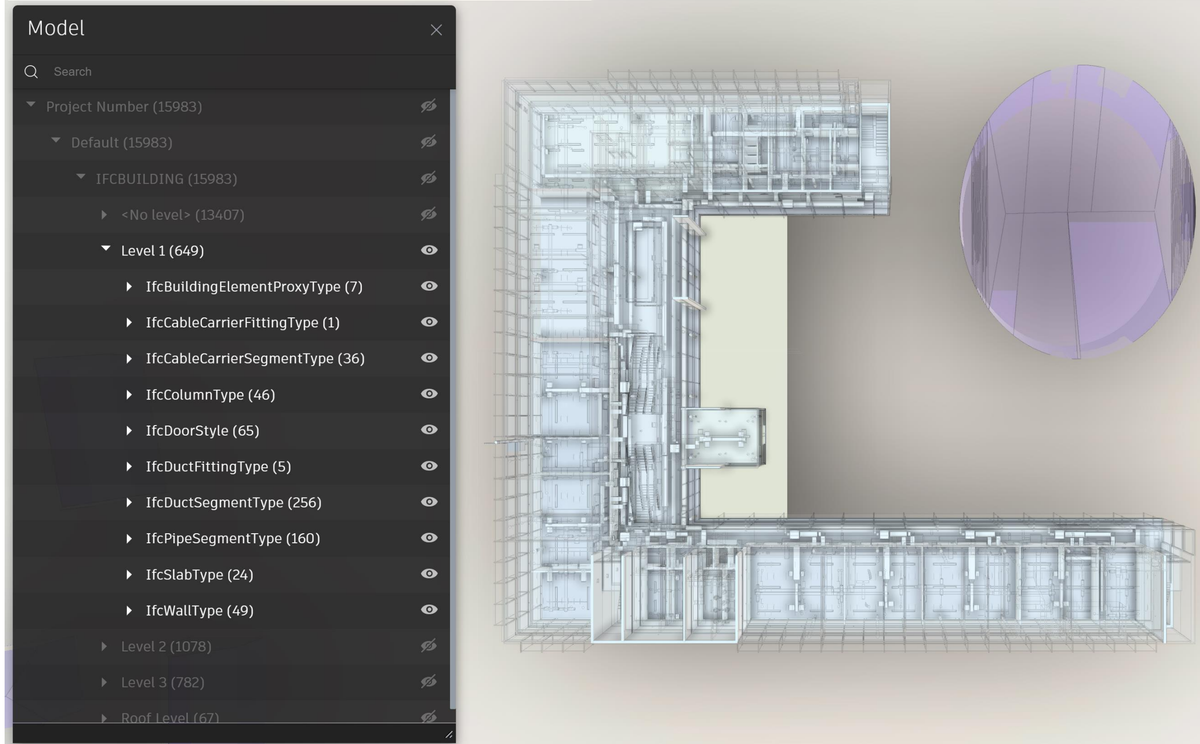
What’s the difference?

- **Consider the *rme_advanced_sample_project.rvt* as an IFC dataset (exported from Revit as IFC)**
- **Legacy (Navisworks)**
  - translation time 172.33 seconds
  - Model Structure is not clear IFC organization
- **Modern (Revit)**
  - translation time 340.05 seconds
  - Model Structure shows IFC* elements





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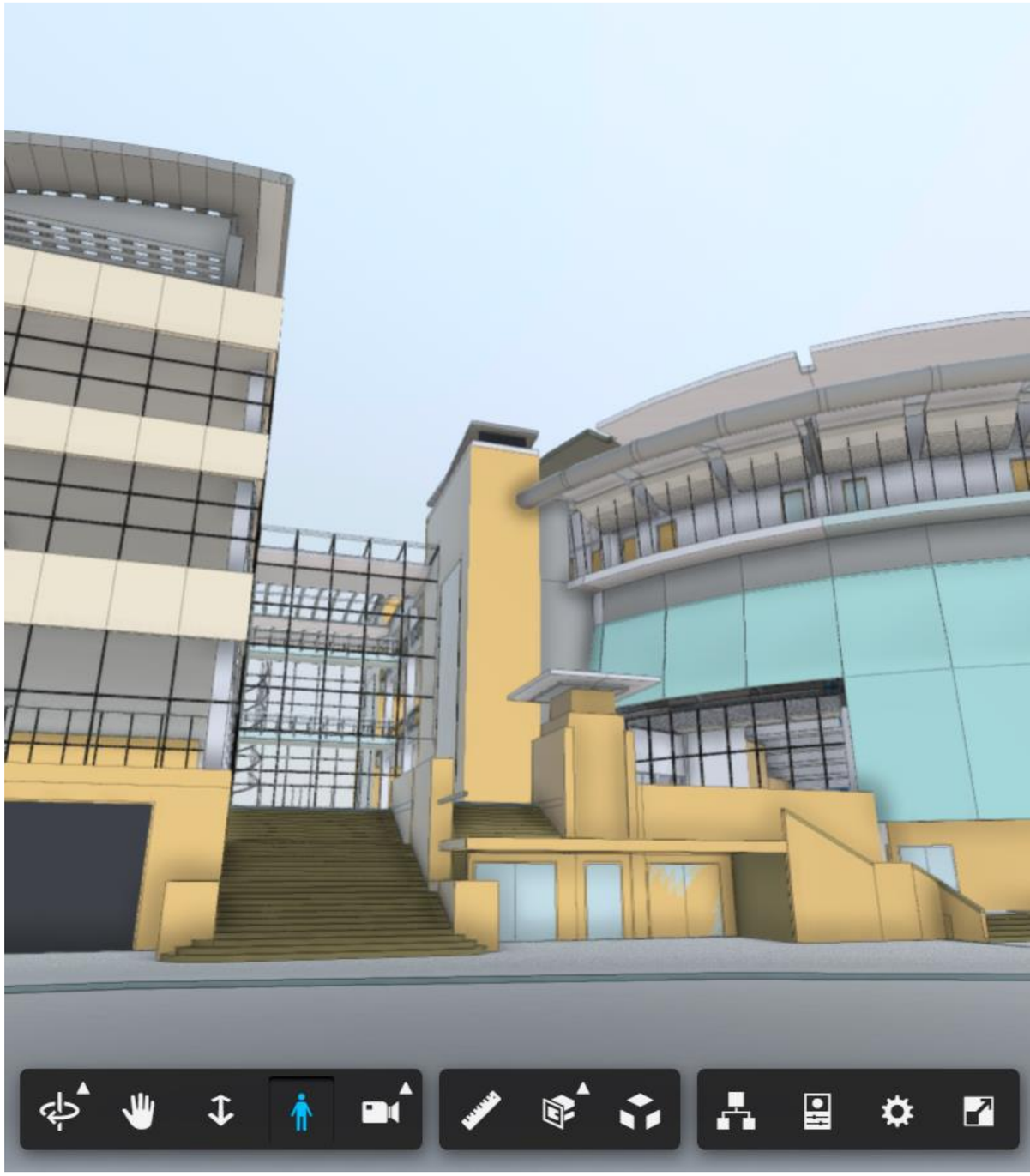
Updated Navisworks Translation Engine

- Improved Performance
- Render-style settings are also being considered now
- materialMode
- hiddenObjects
- basicMaterialProperties
- autodeskMaterialProperties
- timelinerProperties



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Model Derivative specific Webhooks

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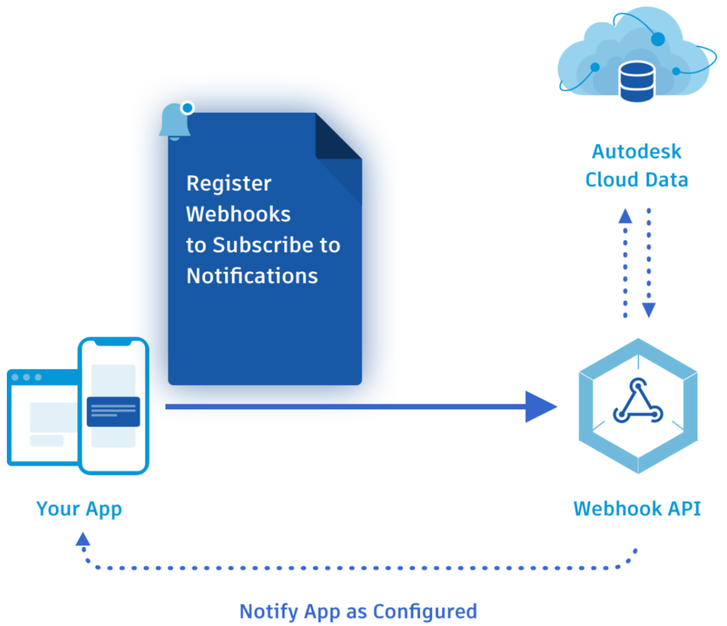
Model Derivative Webhooks

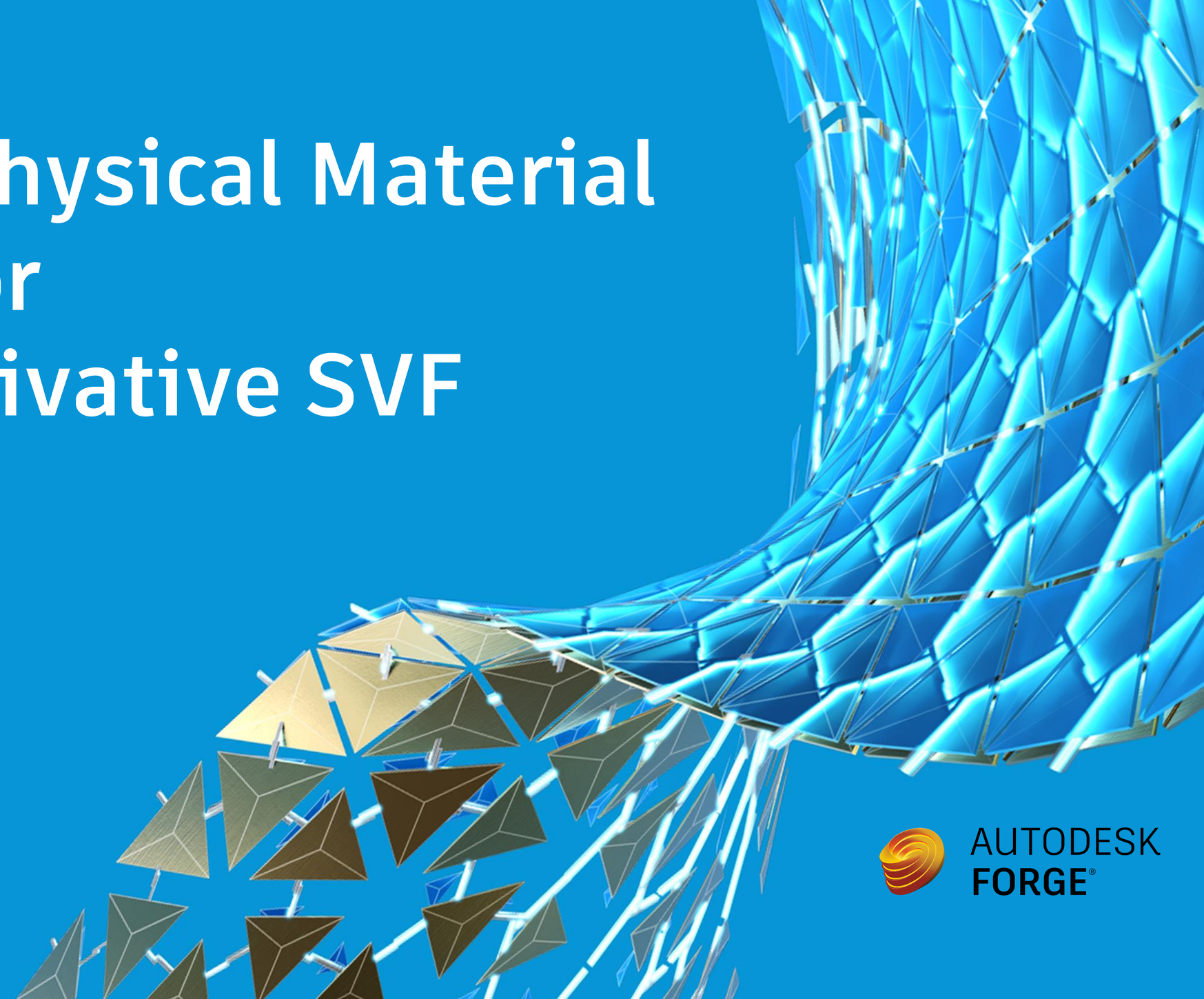
- **Webhooks for Model Derivative introduced in 2018**
- **eliminates the need for polling to check events**
- **`extraction.finished`**
- **`extraction.updated`**



Model Derivative API

Webhooks API

3ds Max Physical Material support for Model Derivative SVF format



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3ds Max Physical Material support for Model Derivative SVF format

- Multi-phase support for PBR materials – more coming
- Same functionality is available in shared-views feature
- Automatic, no additional attributes needed
- Use 3ds Max archive format to easily include the maps

Forge Viewer showing 3ds Max format with PBR materials

Credits for these models come from artists publishing on https://www.turbosquid.com/

Digital Camera SLR Generic - by 3d_molier International
https://www.turbosquid.com/3d-models/digital-camera-slr-generic-3d-model/934661

Male Sci-Fi Suit - by Dyasharuku
https://www.turbosquid.com/FullPreview/Index.cfm/ID/1121012

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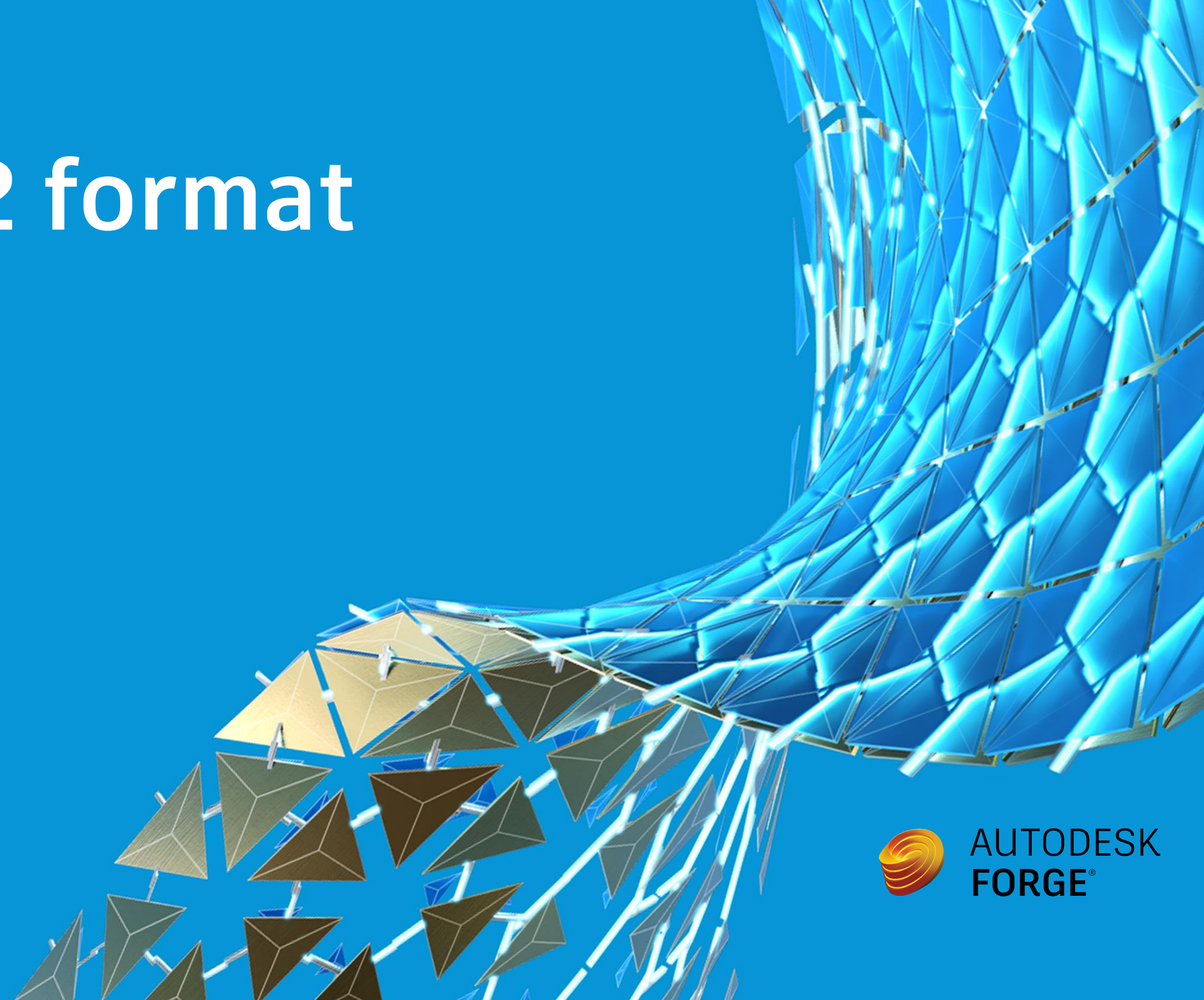
New SVF2 format



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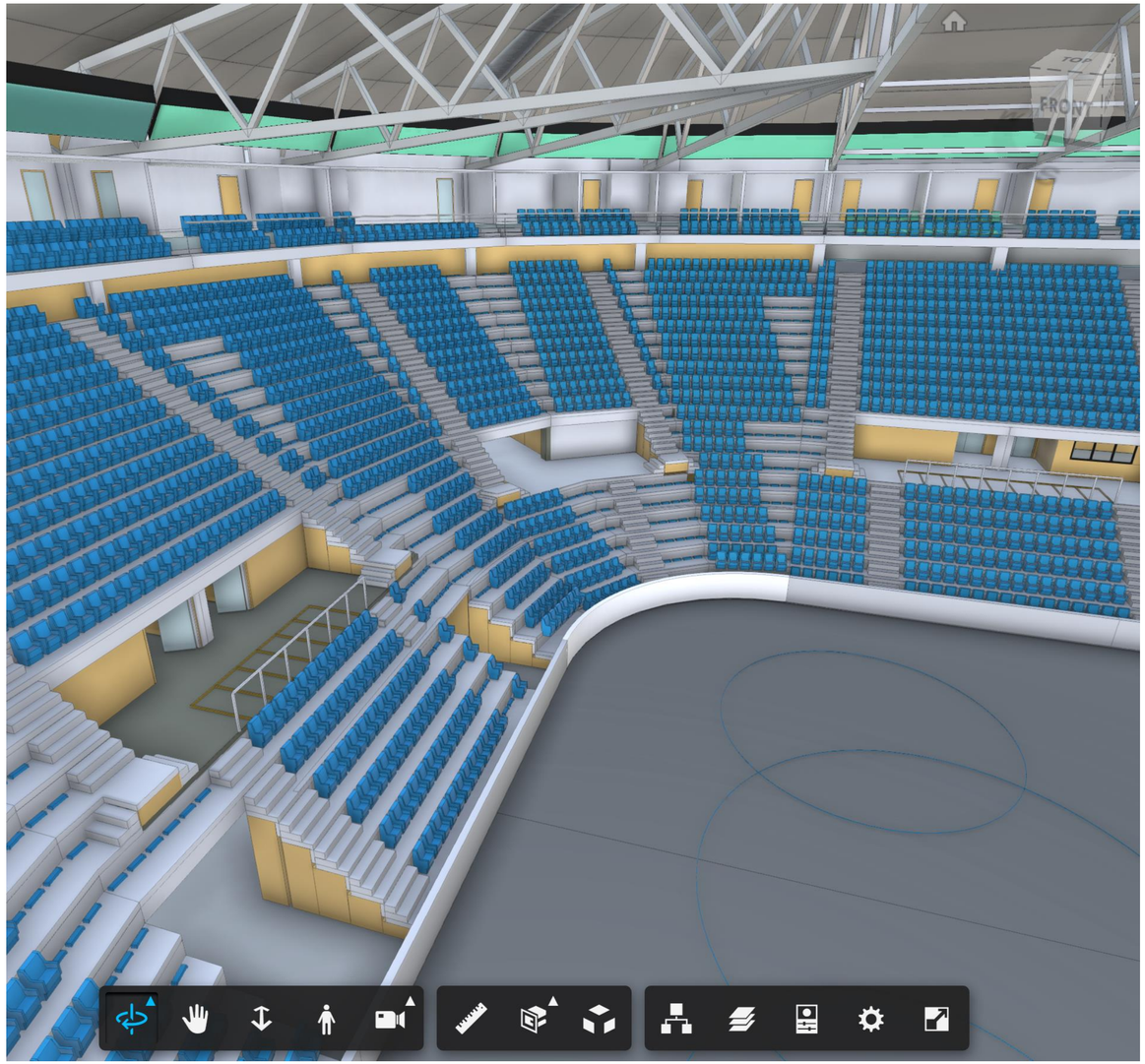
What is SVF2?

New!

BETA

- **Previously code named “OTG”**
- **First discussed at AU last year**
- **SVF2 is optimizing the SVF format**
  - Models containing repetitive geometry shapes
  - Improves loading times
  - incremental loading
  - fast switching among multiple versions
  - finer granularity in comparing different versions
- **Because SVF2 is processed after SVF, there is naturally a longer translation time.**
- **SVF2 should be in public beta during AU timing. Check the Forge blog for latest details.**



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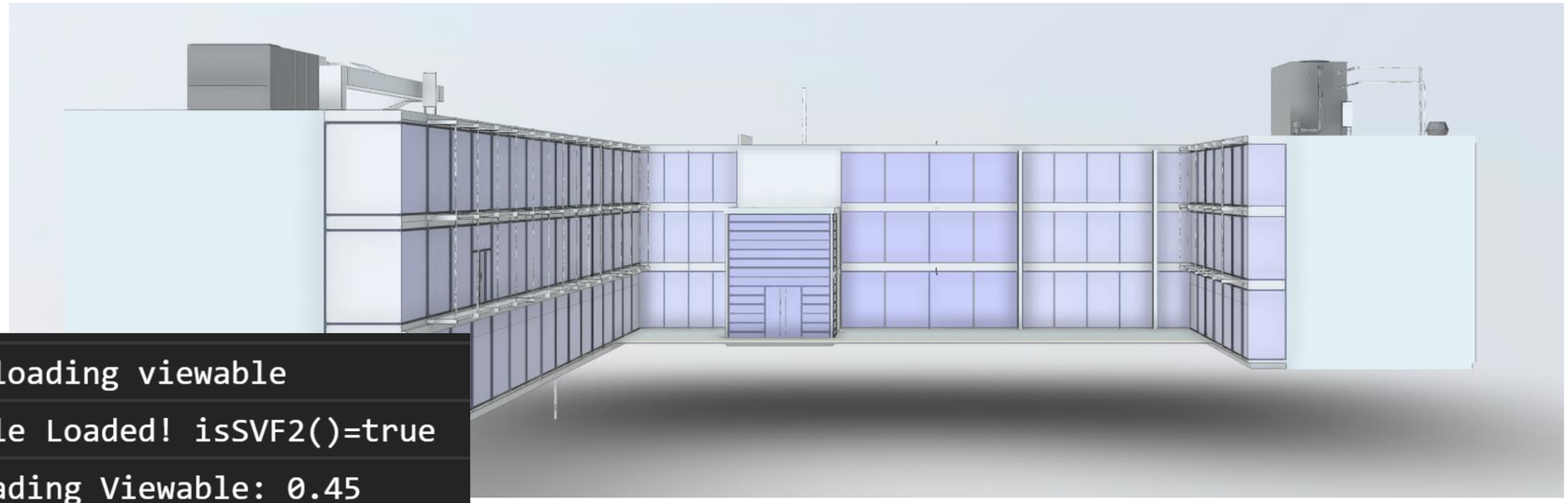
How to work with SVF2?

- **Once it is publicly available, the following API endpoints will be updated:**
  - GET https://developer.api.autodesk.com/modelderivative/v2/designdata/formats
  - POST https://developer.api.autodesk.com/modelderivative/v2/designdata/job
  - GET https://developer.api.autodesk.com/modelderivative/v2/designdata/:urn/manifest

    - or –
  - GET https://developer.api.autodesk.com/modelderivative/v2/regions/eu/designdata/:urn/manifest

- **Forge View API isSVF2**
  - Use to confirm if SVF2 is being loaded
  - the viewer can default back to SVF if SVF2 failed for some reason)



```
Start loading viewable
Viewable Loaded! isSVF2()=true
End loading Viewable: 0.45 seconds
```

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How to work with SVF2 - For Example: POST

https://developer.api.autodesk.com/modelderivative/v2/designdata/job

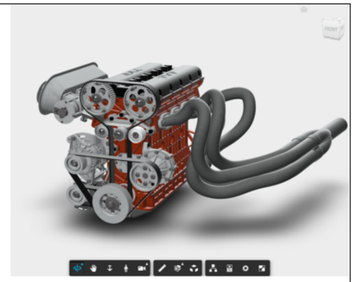
```
Axios({
    method: 'POST',
    url: 'https://developer.api.autodesk.com/modelderivative/v2/designdata/job',
    headers: {
        'content-type': 'application/json',
        Authorization: 'Bearer ' + access_token
    },
    data: JSON.stringify({
        'input': {
            'urn': urn
        },
        'output': {
            'formats': [
                {
                    'type': 'svf2',
                    'views': ['2d', '3d']
                }
            ]
        },
        "misc": { // webhook callback
            "workflow": "workflow-extraction-complete"
        }
    })
})
```


```
Start loading viewable
Viewable Loaded! isSVF2()=true
End loading Viewable: 0.45 seconds
```

What are the benefits, really?

BETA

Model	engine_type_01_2_liter_asm.zip	
Model File Size	62.8 MB	
Translation Type	SVF2	SVF
Translation time	83.04 seconds	53.97 seconds
Loading Viewable	0.77 seconds	1.16 seconds
Total geometry size:	24.084 MB	34.559 MB
Number of meshes:	307	549
Num Meshes on GPU:	307	549
Net GPU geom memory used:	25150610	36053286



Model	ice stadium.nwd	
Model File Size	2.4 MB	
Translation Type	SVF2	SVF
Translation time	60.62 seconds	40.49 seconds
Loading Viewable	0.54 seconds	1.26 seconds
Total geometry size:	4.481 MB	12.342 MB
Number of meshes:	3854	13333
Num Meshes on GPU:	3854	10050
Net GPU geom memory used:	3403678	6572896

Model	210 King - 2021.rvt	
Model File Size	92.8 MB	
Translation Type	SVF2	SVF
Translation time	488.49 seconds	385.35 seconds
Loading Viewable	0.60 seconds	1.51 seconds
Total geometry size:	22.589 MB	166.515 MB
Number of meshes:	3362	29646
Num Meshes on GPU:	3362	10000
Net GPU geom memory used:	22556672	101428240

Model	UrbanHouse - 2021_detached.rvt	
Model File Size	28.4 MB	
Translation Type	SVF2	SVF
Translation time	149.58 seconds	110.2 seconds
Loading Viewable	0.19 seconds	0.86 seconds
Total geometry size:	8.414 MB	17.413 MB
Number of meshes:	776	3090
Num Meshes on GPU:	776	3090
Net GPU geom memory used:	8561832	17221052

```
app.get('/api/forge/webhooks/extraction.finished', function (req, res) {
    timer_start("Start webhook timer for "+ filenameSource);
    ...
    ...

app.post('/callback/jobfinished', jsonParser, async (req, res, next) => {
    timer_end('End webhook timer for ' + filenameSource + ' Job status: ' + mdFinishedStatus);
    ...
    ...
```

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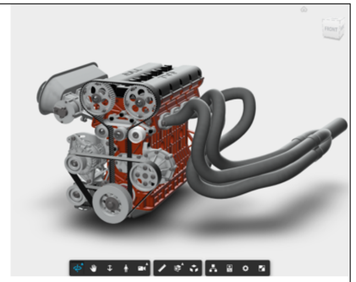

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Translation Time

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```
function onDocumentLoadSuccess(doc) {
    timer_start("Start loading viewable");
    var viewable = doc.getRoot().getDefaultGeometry();
    if (viewable) {
        viewer.loadDocumentNode(doc, viewable).then(function(result) {
            console.log("Viewable Loaded!" + " isSVF2()=" + NOP_VIEWER.model.isSVF2());
            timer_end("End loading Viewable");
        }).catch(function(err) {
            console.log('Viewable failed to load.');
            console.log(err);
        }
        )
    }
}
```

What are the benefits, really?

BETA

Model	engine_type_01_2_liter_asm.zip	
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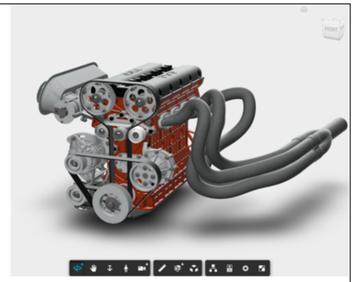

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Total geometry size:	4.481 MB	12.342 MB
Number of meshes:	3854	13333
Num Meshes on GPU:	3854	10050
Net GPU geom memory used:	3403678	6572896

Model	210 King - 2021.rvt	
Model File Size	92.8 MB	
Translation Type	SVF2	SVF
Translation time	488.49 seconds	385.35 seconds
Loading Viewable	0.60 seconds	1.51 seconds
Total geometry size:	22.589 MB	166.515 MB
Number of meshes:	3362	29646
Num Meshes on GPU:	3362	10000
Net GPU geom memory used:	22556672	101428240

Model	UrbanHouse - 2021_detached.rvt	
Model File Size	28.4 MB	
Translation Type	SVF2	SVF
Translation time	149.58 seconds	110.2 seconds
Loading Viewable	0.19 seconds	0.86 seconds
Total geometry size:	8.414 MB	17.413 MB
Number of meshes:	776	3090
Num Meshes on GPU:	776	3090
Net GPU geom memory used:	8561832	17221052

Loading Viewable

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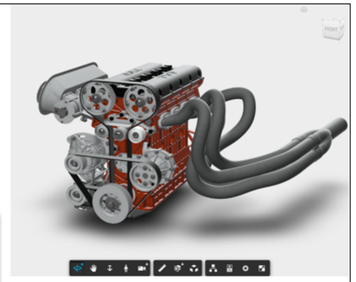
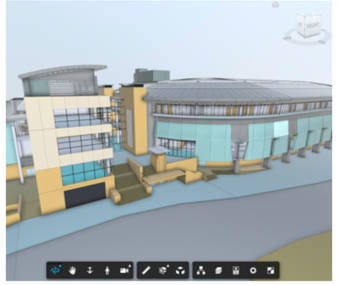
What are the benefits, really?


```
Total geometry size: 12.341802597045898 MB   three.js:33
Number of meshes: 13333                      three.js:33
Num Meshes on GPU: 10050                     three.js:33
Net GPU geom memory used: 6572896            three.js:33
```

Model	engine_type_01_2_liter_asm.zip	
Model File Size	62.8 MB	
Translation Type	SVF2	SVF
Translation time	83.04 seconds	53.97 seconds
Loading Viewable	0.77 seconds	1.16 seconds
Total geometry size:	24.084 MB	34.559 MB
Number of meshes:	307	549
Num Meshes on GPU:	307	549
Net GPU geom memory used:	25150610	36053286



Model	ice stadium.nwd	
Model File Size	2.4 MB	
Translation Type	SVF2	SVF
Translation time	60.62 seconds	40.49 seconds
Loading Viewable	0.54 seconds	1.26 seconds
Total geometry size:	4.481 MB	12.342 MB
Number of meshes:	3854	13333
Num Meshes on GPU:	3854	10050
Net GPU geom memory used:	3403678	6572896



Model	210 King - 2021.rvt	
Model File Size	92.8 MB	
Translation Type	SVF2	SVF
Translation time	488.49 seconds	385.35 seconds
Loading Viewable	0.60 seconds	1.51 seconds
Total geometry size:	22.589 MB	166.515 MB
Number of meshes:	3362	29646
Num Meshes on GPU:	3362	10000
Net GPU geom memory used:	22556672	101428240

Model	UrbanHouse - 2021_detached.rvt	
Model File Size	28.4 MB	
Translation Type	SVF2	SVF
Translation time	149.58 seconds	110.2 seconds
Loading Viewable	0.19 seconds	0.86 seconds
Total geometry size:	8.414 MB	17.413 MB
Number of meshes:	776	3090
Num Meshes on GPU:	776	3090
Net GPU geom memory used:	8561832	17221052

three.js geometry stats

AUTODESK® FORGE

Coming soon:
Enhanced properties API

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Enhanced Properties queries

- **Improved Performance for the GET Properties by objectid API**
  - `/modelderivative/v2/designdata/:urn/metadata/:modelGuid/properties?objectid=:id`
  - Significant work has been done to help when working with very large datasets
  - the performance behind retrieving that data is also greatly improved
- **We will also improve the metadata APIs to allow more granular access to the hierarchy and properties of a model.**


```
{
    "objectid": 21114,
    "name": "arena roof lining",
    "externalId": "7/6/196/0",
    "properties": {
        "Item": {
            "Hidden": "No",
            "Icon": "Geometry",
            "Layer": "3d roof",
            "Material": "arena roof lining",
            "Name": "arena roof lining",
            "Required": "No",
            "Source File": "ice stadium.nwd",
            "Type": "Colour Body"
        }
    }
},
```

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Questions and Resources

Questions?

- **During AU**
  - There will be a scheduled Q&A for the version of this English class.
    - Check the English class page for details
    - English class is identified as SD473709 - More Tips, Tricks, and the Future of the Forge Model Derivative Service
  - Comments / Questions section on the Class page
  - Forge Answer Bar
    - Search for the Answer Bar from AU site, and then find the Forge specific one
    - Time slots will be available around the clock during this year’s Virtual AU event!
    - Also languages and experts will be advertised, so we can help you as much as possible in a “live” setting

Questions?

- **Anytime**
  - Look for related topics in the Forge blog, documentation and code samples:
    - https://forge.autodesk.com/en/docs/model-derivative/v2/developers_guide/overview/
  - Forge Help: https://forge.autodesk.com/en/support/get-help
  - Have an idea for an awesome Forge App, but need help getting started?
    - Join an accelerator: https://forge.autodesk.com/accelerator-program