AUTODESK UNIVERSITY

CS124677

HOLODECK
Virtual Reality for the Construction Industry

Lejla Secerbegovic
Autodesk GmbH, Germany

Michael Göhring
Autodesk GmbH, Germany

Learning Objectives

- Learn about using VR for construction scenarios
- Learn how to integrate different design phases and LODs in Stingray
- Learn how to display BIM data in VR
- Learn how to integrate advanced topics like timeline and 4D in VR

Description

Virtual reality (VR) is currently one of the most discussed architecture, engineering, and construction topics, and there are already many interesting use cases for architects and design presentation. But how can this technology be used for real construction scenarios? This session is based on a VR scenario for a shopping center designed and constructed by a major German construction company. It will show the power of the VR technology using different design phases, levels of development, and timelines. VR is much more than a playful presentation instrument—it can significantly improve the construction process, and help optimize the work on-site.

Speaker(s)

Lejla Secerbegovic is a licensed architect in Germany and working as a technical specialist for BIM-related topics at Autodesk in Central Europe. Before joining Autodesk in 2015, Lejla collected valuable practical experience not only at various architectural practices but also as a Revit specialist and BIM project manager at Max Bögl, the largest private construction company in Germany. Lejla also regularly speaks at various non-Autodesk events, like RTC and independent BIM conferences. She blogs on the official Autodesk German BIM Blog http://blogs.autodesk.com/bimblog as well as on her private blog http://bim-me-up.com. You can follow Lejla on Twitter (@archBIM) for regular updates around various BIM topics.

Michael Goehring works in Central Europe as a technical specialist for the mechanical, electrical, and plumbing industry. His interest in new technologies, combined with industry know enables him to decide about what's helping his customers to become more successful. A good combination of deep technical knowledge and explanation skills make him a good teacher on topics where he is subject matter expert.

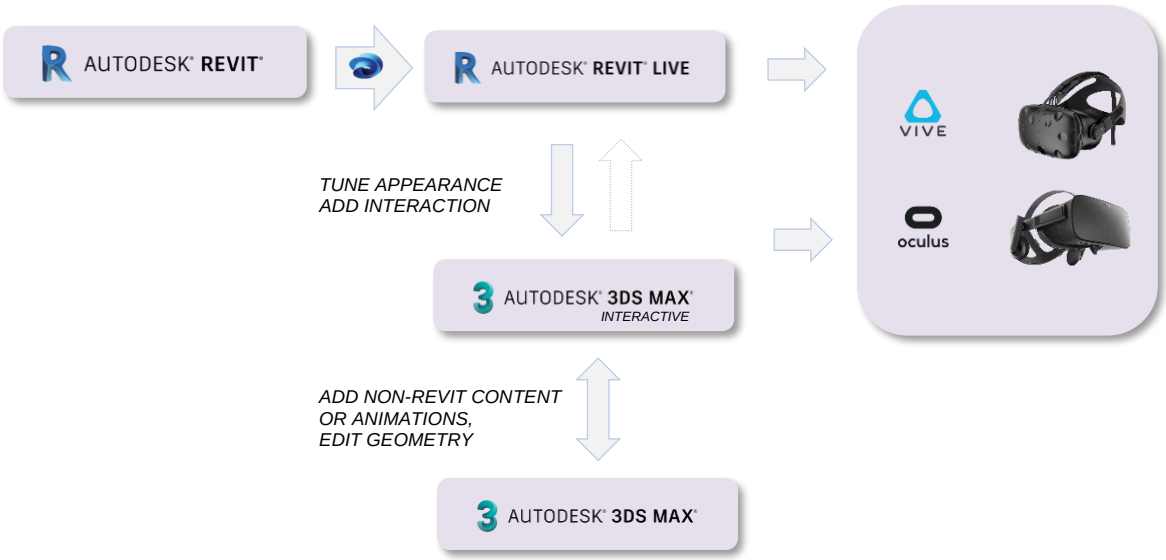
Introduction

This document describes workflows with Revit LIVE and 3ds Max (+Interactive) for creating interactive AEC VR scenarios using animation techniques in 3ds Max and basic Flow Scripting in Interactive.

The project shown in this session is a Shopping Mall Neuer Markt constructed by Max Bögl in Neumarkt, Germany.

Virtual Reality has been around for a while in the Gaming Industry / Media & Entertainment and the current VR solution for AEC are based on gaming technology as well.
After Autodesk acquired the gaming engine *Bitsquid* some years ago, it was renamed to *Stingray* and is being implemented in the AEC solutions, which are all a part of the Autodesk AEC Collection:

- *Revit LIVE* is a cloud service based on the Stingray gaming engine, working similar to Cloud Rendering and automatically turning the Revit model into a VR scene.
- *3ds MAX Interactive* is the full version of the Stingray editor, developed especially for the AEC industry and offering AEC templates and a direct link to 3ds Max.

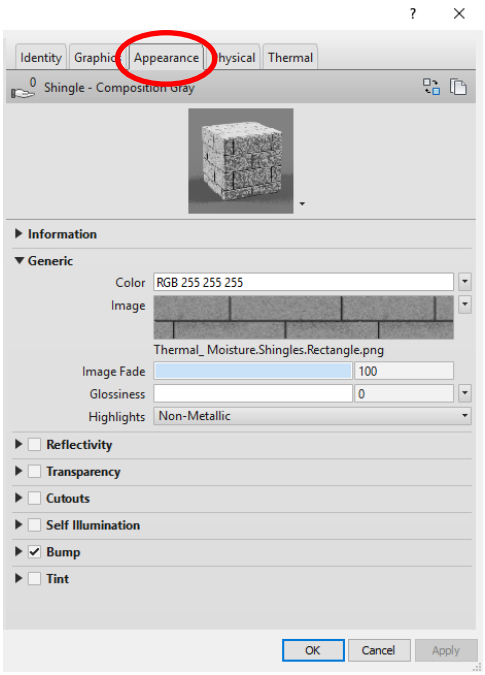


LIVE DESIGN WORKFLOW

Model data preparation (Revit)

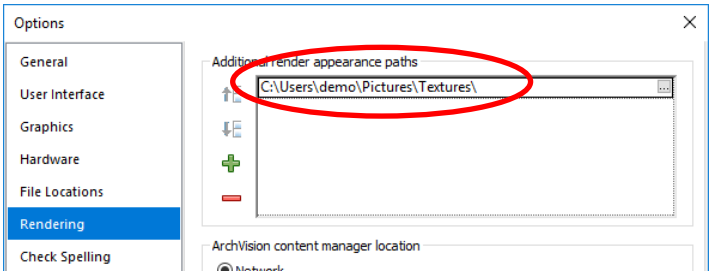
The advantage of the Revit LIVE service is the fact that you can prepare your Revit model in your well known Revit environment and that will automatically takes some things into consideration for you, like optimizing the navigation, recognizing doors and importing the BIM Data. Following aspects are important for the model preparation:

- Assign **materials with appearance** – Revit LIVE will only use the Color and the settings from this tab!
  Take care that not all channels are currently fully supported, like Tint, Self Illumination or Cut Outs (this may be subject to change). For best performance, try to avoid having too many similar materials and try to use as few materials as possible instead. This will also make further tweaking inside of Interactive easier.



APPEARANCE DIALOG FOR REVIT MATERIALS

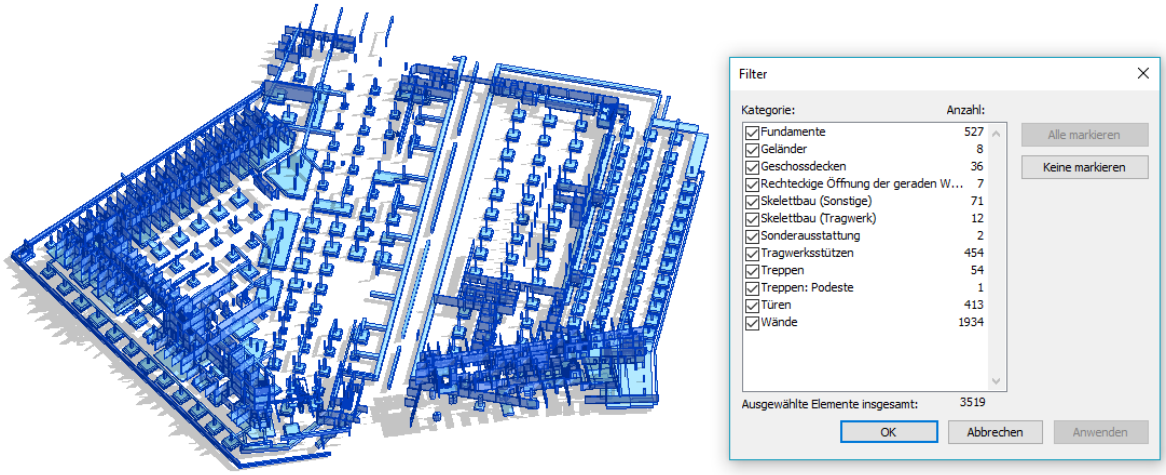
You can use custom textures from the Autodesk library. When adding own textures, keep in mind to scale them according to the *power of two* (512 x 512, 512 x 1024, etc.) and to add their path to Revit:



ADDING CUSTOM TEXTURE PATHS

- Place some **artificial lights** in your for higher quality and night illumination – however keep in mind that too many lights will have a direct impact on the calculation time and overall performance

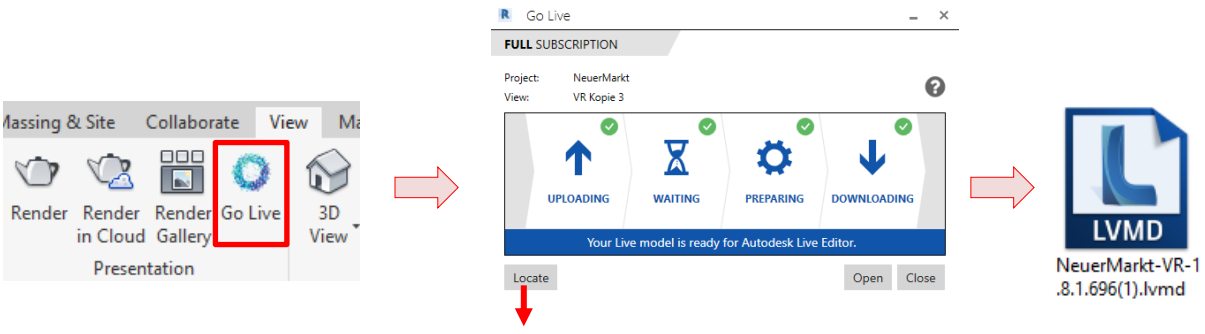
- Hide elements not visible in your VR scene, like not accessible areas or elements which are covered by others (e.g. parts of HVAC) and remember that only the elements visible in your current 3D view will be exported - this includes the Revit detail level (coarse / medium / fine)!



ELEMENTS WHICH BE FILTERED OUT FOR THE VR SCENE (AS IN NOT ACCESSIBLE AREAS OF OUR PROJECT)

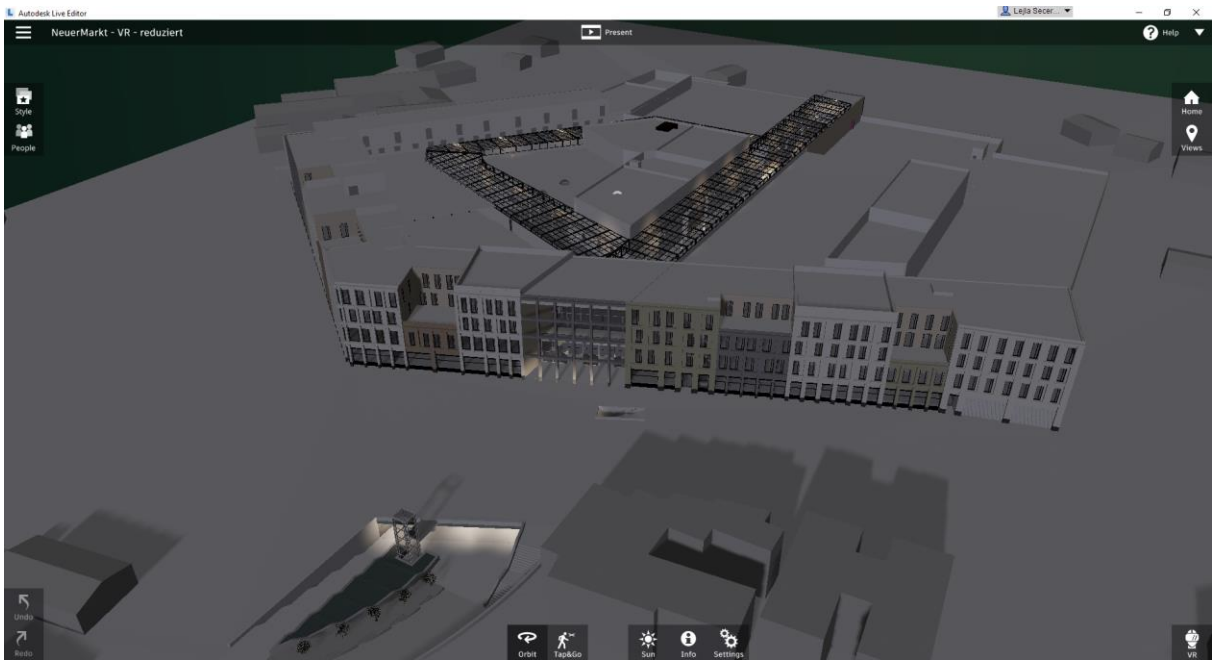
If you follow these steps, the preparation of your Revit LIVE Model should take approx. 5-10 Minutes, though this may become even quicker in the future!

Remember to create 3D views (both camera / perspective will work), as these will be exported as Views in Revit LIVE and will make it easier to navigate through the model:



Default path:
C:\Users\<username>\
Documents\Autodesk Revit Live

LIVE PUBLISHING PROCESS

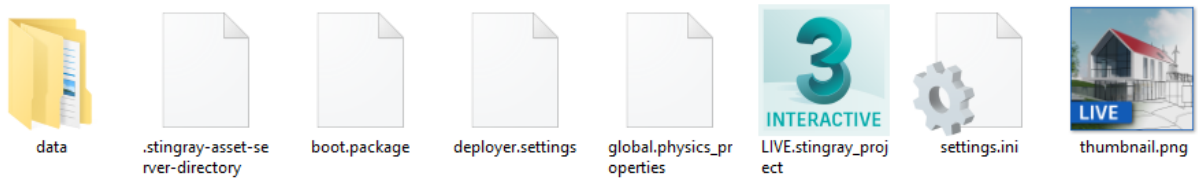


SHOPPING CENTER NEUER MARKT IN REVIT LIVE

Revit LIVE data in 3ds Max Interactive

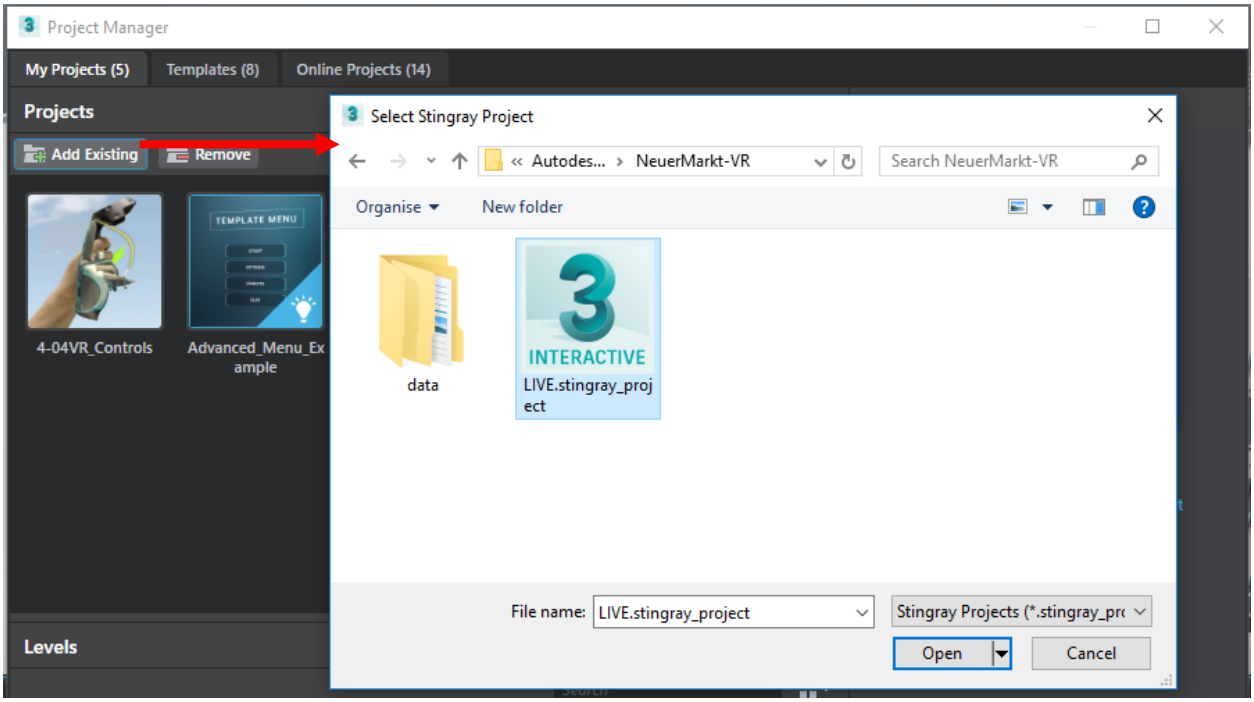
For further editing, you can open your LIVE project easily in 3ds Max Interactive.

The current workflow (Revit LIVE 1.8 + 3ds Max Interactive 1.8) lets you load your Revit LIVE data to 3ds Max Interactive with a little trick. The Revit LIVE Service creates an .lvmd file which is a compressed Stingray project. All you need to do is **change the extension of this file to .zip** and unzip it:



UNZIPPED .LVMD FILE

Now, you can launch 3ds Max Interactive and go to the Project Manager to add the open the LIVE project:

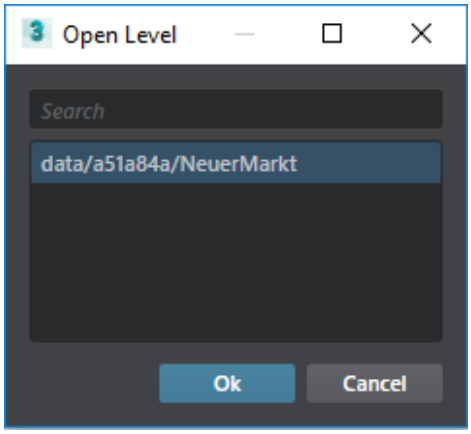


ADDING NEW PROJECTS IN 3DS MAX INTERACTIVE

Please Note: Loading the project for the first time may take some time, so you may want to grab a coffee!

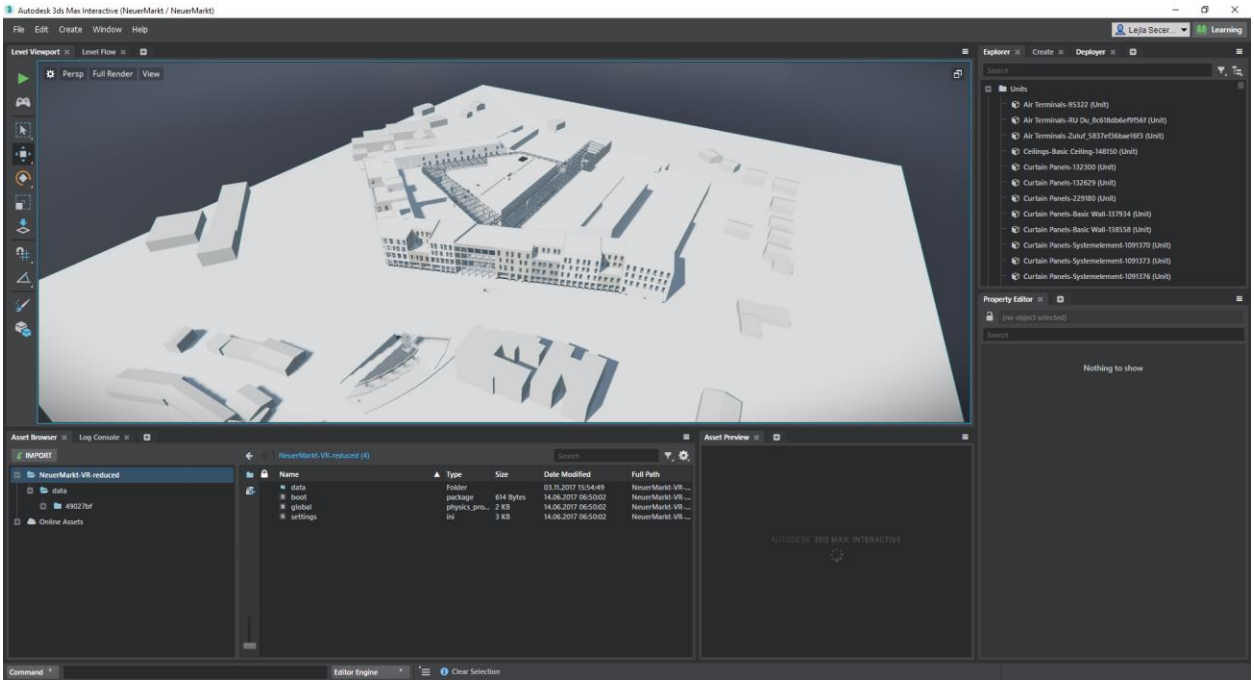
If you are a gamer, the principle of “levels” may be already familiar to you: a project in 3ds Max Interactive can have several levels. After opening your LIVE model, you will see the default (empty) level.

Go to File > Open and select the level where your scene is located:



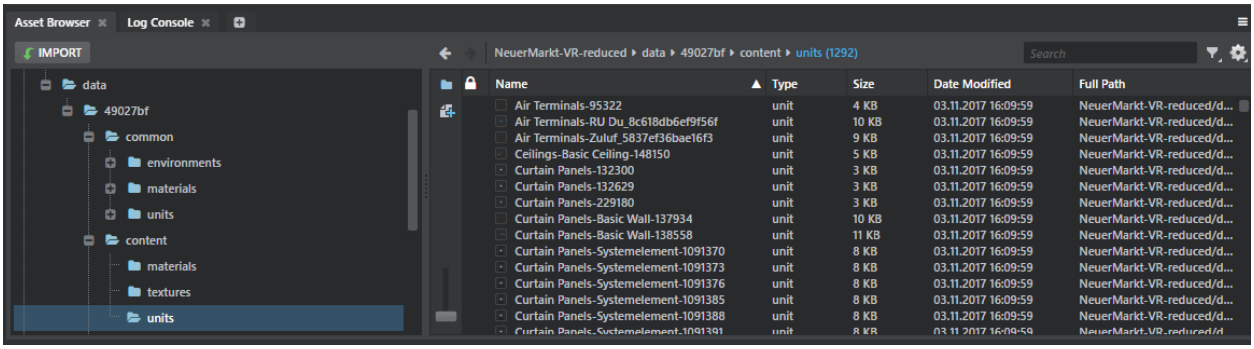
OPEN LEVEL DIALOG IN 3DS MAX INTERACTIVE

SPOILER ALERT:
With Revit Live 2.0 and 3ds Max Interactive 2.0 which are to be released soon, this process will be a lot simpler and you will be able to directly open the file delivered by the LIVE service in Interactive!



LIVE PROJECT LOADED IN 3DS MAX INTERACTIVE

Once open, you will see the same directory structure in the Asset Browser at the bottom of the screen, where all your files are listed:

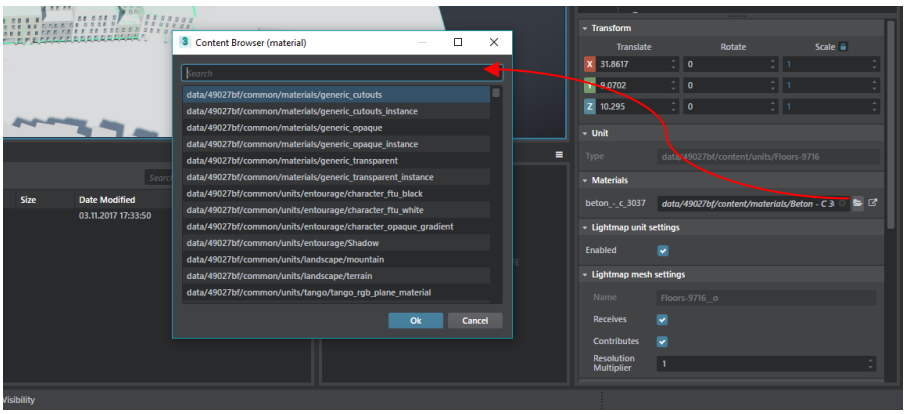


ASSET BROWSER

Once you opened the LIVE file in Interactive, you can use lightbaking to tune the appearance, assign other materials and add assets.

Changing materials

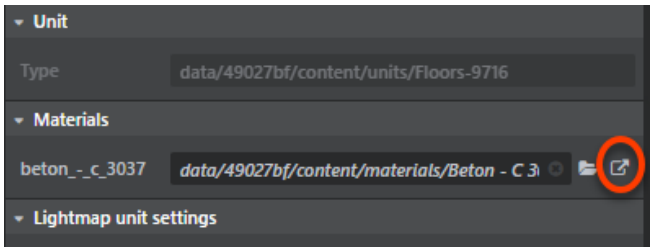
With an element selected, you will see all properties on the right lower side of the screen. Clicking the folder next to the Material allows you to change the material:



CHANGING THE MATERIAL OF AN ELEMENT (UNIT)

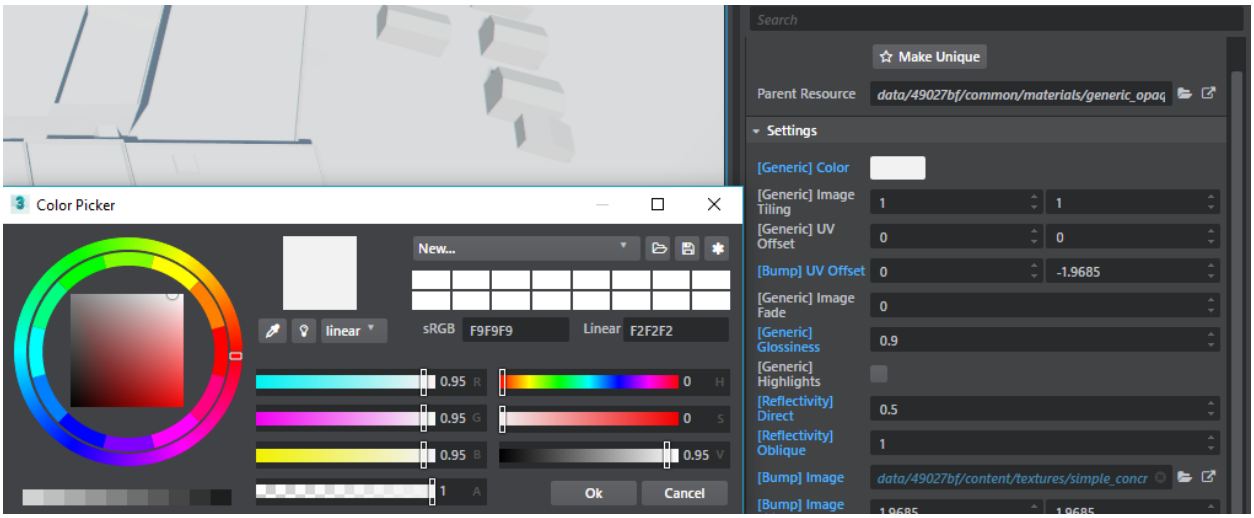
Editing materials

For editing a material, select the second icon Go To Resource:



EDITING A MATERIAL

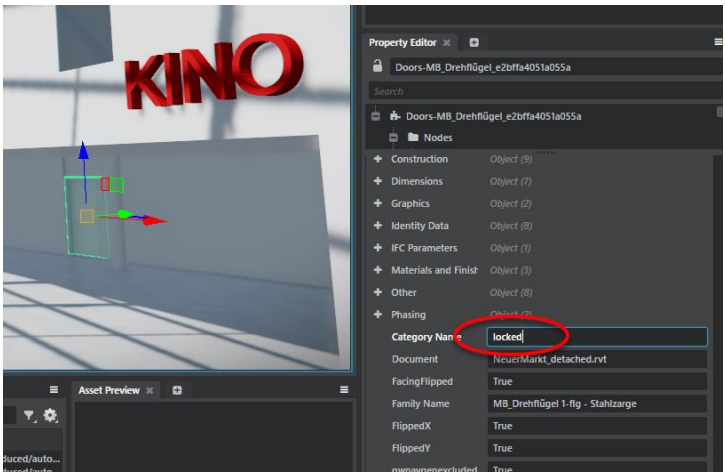
Here you can easily change the properties like the color:



EDITING MATERIAL PROPERTIES

Disable doors

You may have areas in your building which you don't want to be accessible in the LIVE / VR scene. By default, you can walk through all doors – to disable this, simply select the door and change the Category from Doors to locked:



DISABLING DOORS

In order to dive deeper into this process and learn about lightbaking, have a look at this great session by the Autodesk visualization specialist Alex Horst which has been recorded at AU London 2017:

http://au.autodesk.com/au-online/classes-on-demand/class-catalog/classes/year-2017/3ds-max/lo-me08

Adding interaction Elements in 3ds Max Interactive

Flow

All interaction inside of our scene is driven by LUA, the script language on which the Stingray game engine is based.

Luckily, we can access most of the functions also through FLOW, the visual scripting interface in 3ds Max Interactive / Stingray.

FLOW EDITOR IN 3DS MAX INTERACTIVE

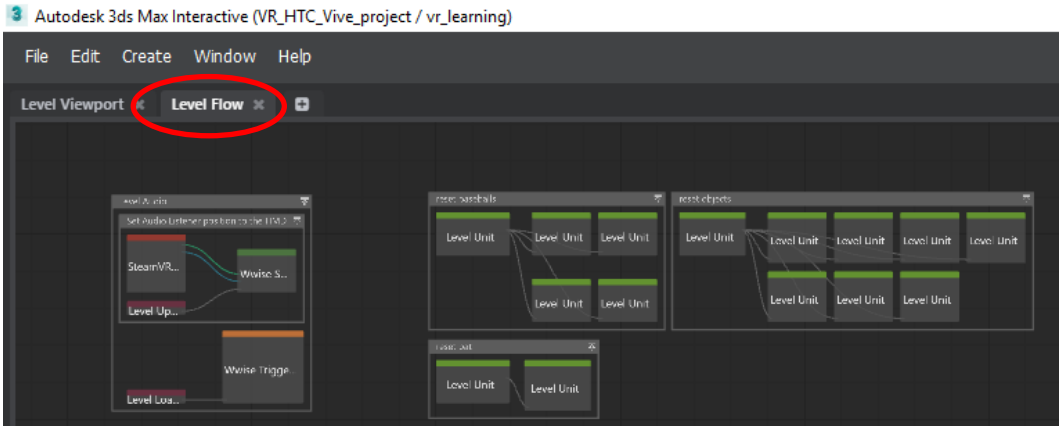
There are two places to access and define Flow: in the Level and in the Unit Editor.

Interactions defined in the Level flow editor are valid for the entire scene (level), while the Unit Editor specifies interactions valid for specific units only.

For a general overview you can also refer to the Flow section in the Stingray online help: http://help.autodesk.com/view/Stingray/ENU/?guid=__stingray_help_creating_gameplay_visual_prog_with_flow_html

Accessing the Level Flow Editor

Once 3ds Max Interactive is open, switch the tab next to the Level Viewport to view the level flow:



LEVEL FLOW

Use the **Level Flow** Editor for tasks like spawning units, applying level effects, or triggering events which happen when loading level or while the game is running.

To create a node

- Right-click in the Flow graph area, then select a node category, sub-category, and node name.
  The node is added to the flow graph, with no connections by default.
- From existing nodes, you can also create nodes by dragging from a port to an empty area of the graph, then selecting a new node category and node type from the pop-up menu. (This menu is automatically populated with node types appropriate for the current connection.)

To connect nodes

- Click a port, or Ctrl-click to grab multiple ports, then drag to a port on another node.

To delete connections

Do either of the following:

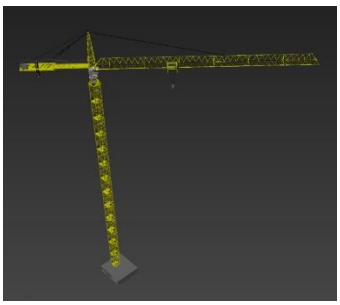
- Alt+click the port or attribute name.
- Select the connection and press Delete.

To modify connections

- Ctrl+click a slot to remove its connection, then drag the connection to a new port.

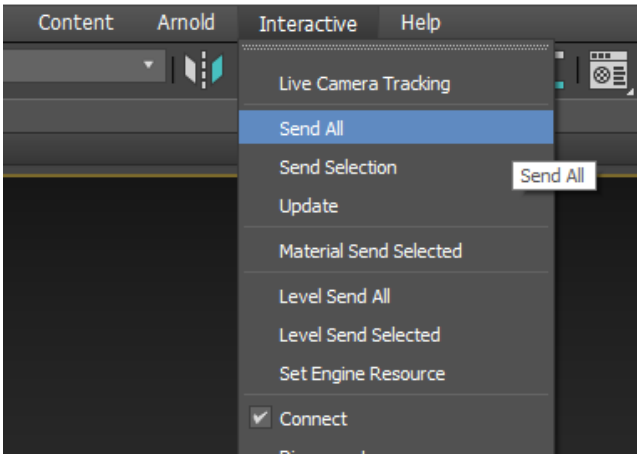
Triggering Animation with Level Flow

As a very simple usecase for level flow editor we will import an animated asset, which contains a looping animation created inside of 3ds Max.



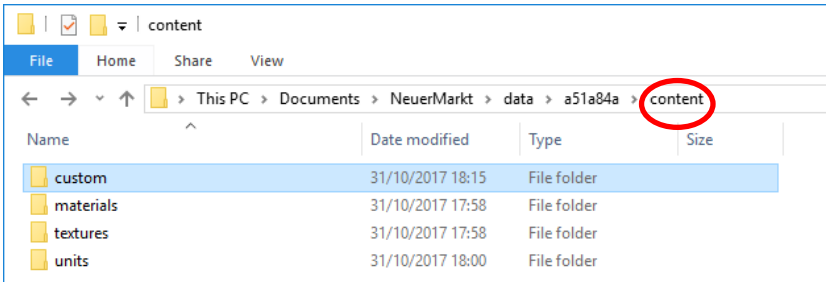
CRANE WITH A SIMPLE ROTATING ANIMATION

Leave your scene open in Interactive and load your animated file in 3ds Max. Make sure Connect at the bottom is checked, which means your 3ds Max is connected to Interactive.



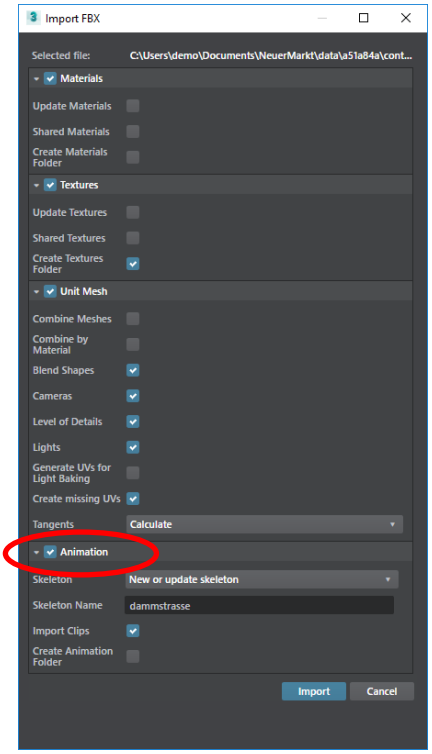
INTERACTIVE MENU IN 3DS MAX

Select Send All and 3ds Max will automatically locate the project folder. Inside the data folder you will find a folder with a 7 digit ID, which is the ID of your LIVE project. It is recommended to create an own folder for custom assets in order to keep a clean project structure.



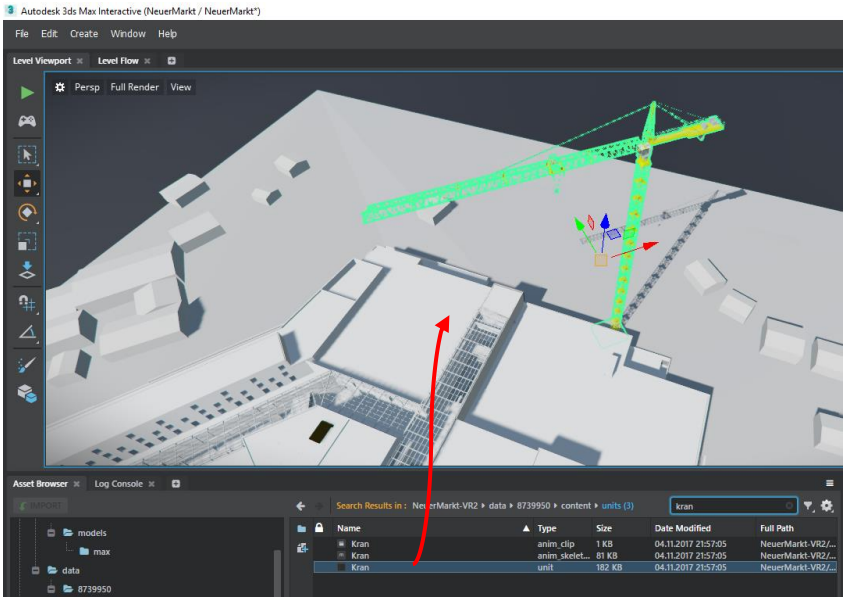
CREATE THE CUSTOM FOLDER EITHER FROM THE ASSET BROWSER IN INTERACTIVE OR FROM THE WINDOWS EXPLORER

You can leave all settings on default, just check that the Animation is ON:



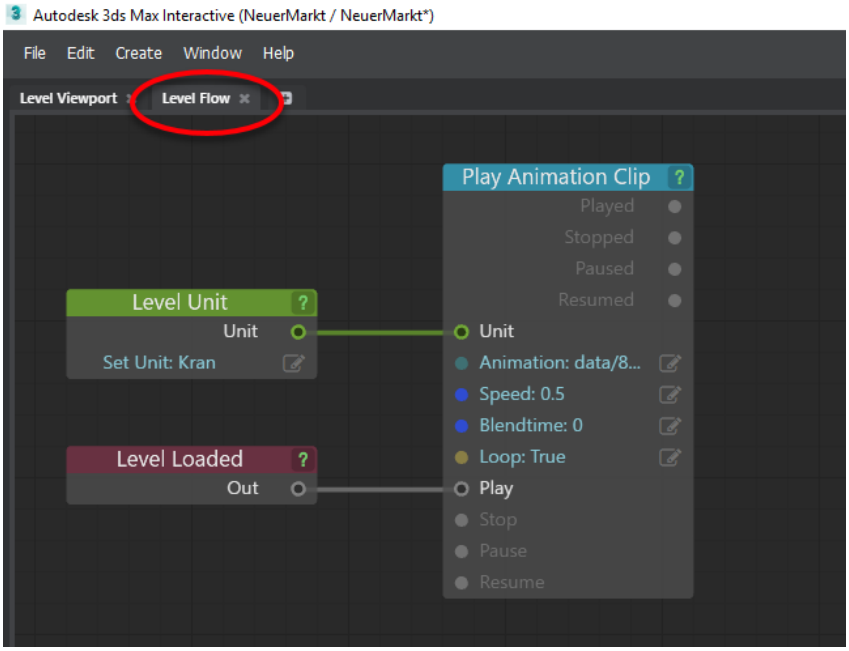
SEND TO INTERACTIVE OPTIONS

Once your asset has been loaded, you can find it in the same folder you specified previously. Drag and drop the unit into your scene:



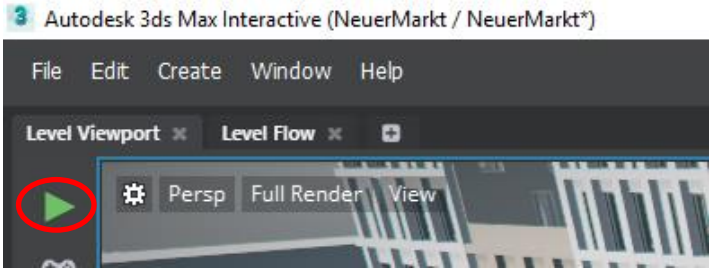
DRAG AND DROP YOUR ASSETS FROM ASSET BROWSER TO THE SCENE

Now, switch to your Level flow and create following nodes by either right clicking in the canvas and looking for them or by using the search field which appears after you press TAB:



LEVEL FLOW

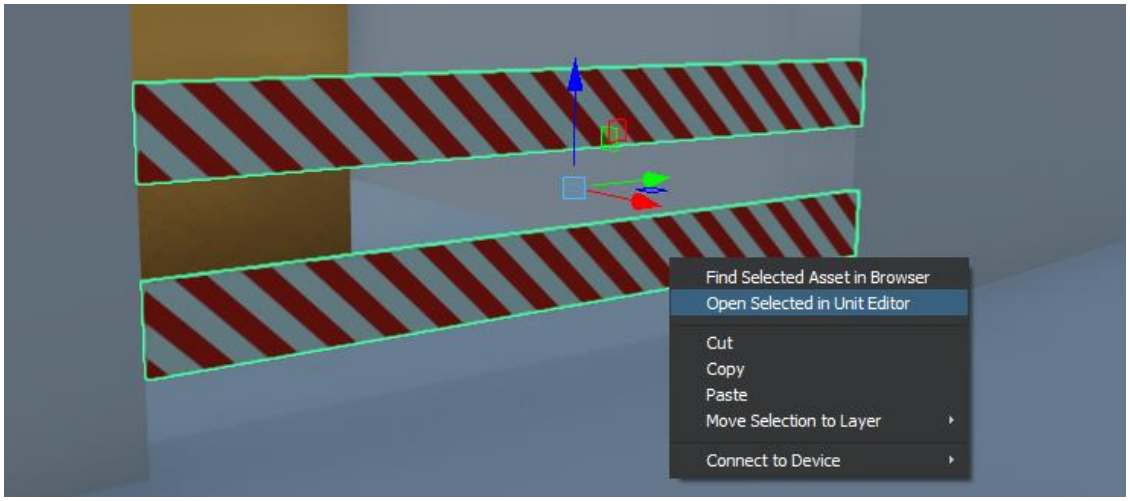
Once you hit Test Level in your level Viewport, you'll notice the animation running:



TEST LEVEL ANYTIME TO SEE YOUR INTERACTION

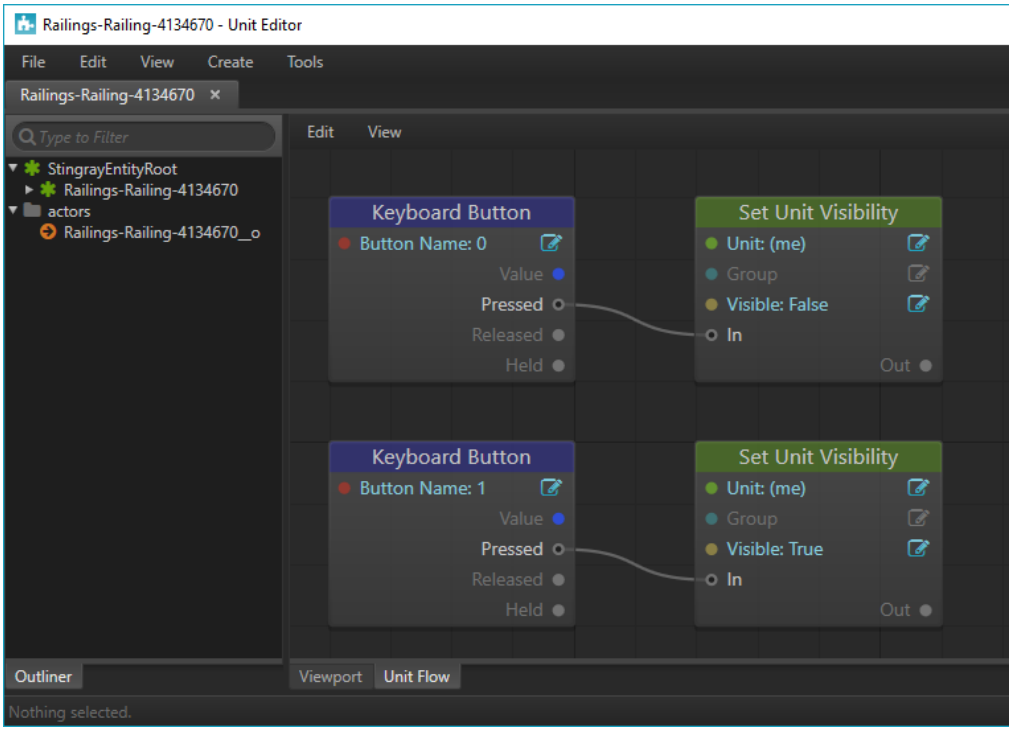
Accessing the Unit Flow Editor

Right click a unit and select *Open in Unit Editor*:
The Unit Editor offers a variety of settings as well as the access to the Unit Flow:



ACCESSING THE UNIT FLOW EDITOR

With Unit Flow you can trigger specific elements, like doors which will open when you approach them or elements which will change when you press a button. Here you can see a simple Flow defining that the unit can be set invisible by pressing 0 on keyboard, and visible by pressing 1:

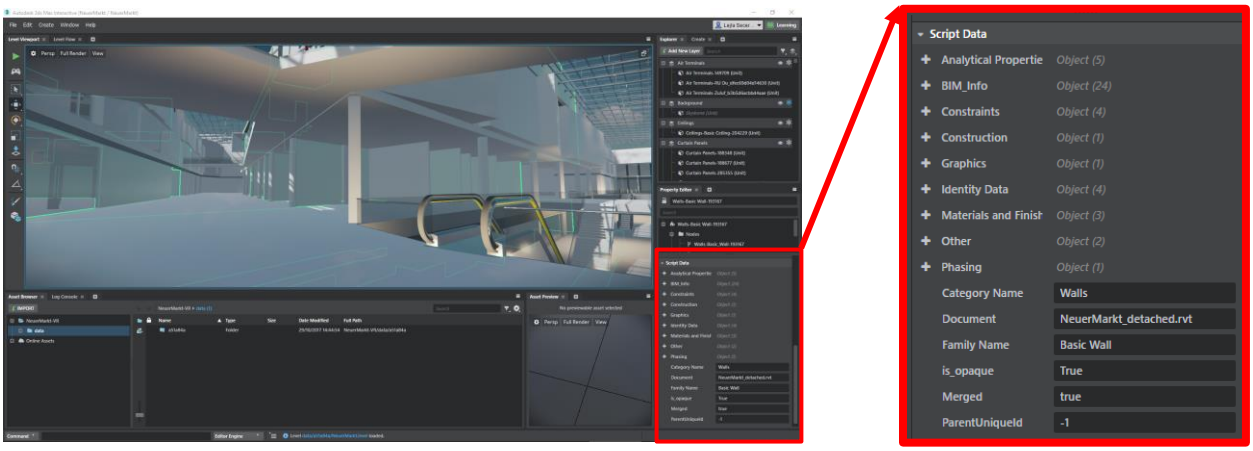


UNIT FLOW EXAMPLE

NOTE: THIS WON'T WORK IN LIVE IF YOU DECIDE TO PUSH THE MODEL BACK!

Using LOD for displaying BIM Information

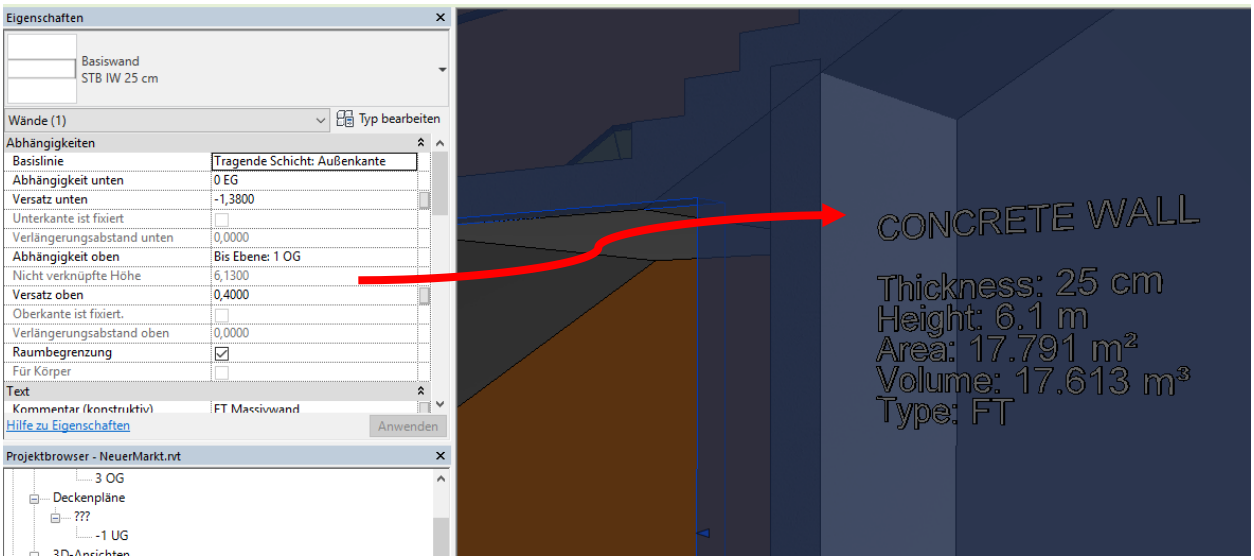
When you open your LIVE project in Interactive, your BIM data will still be visible when you select a unit:



BIM DATA IN 3DS MAX INTERACTIVE

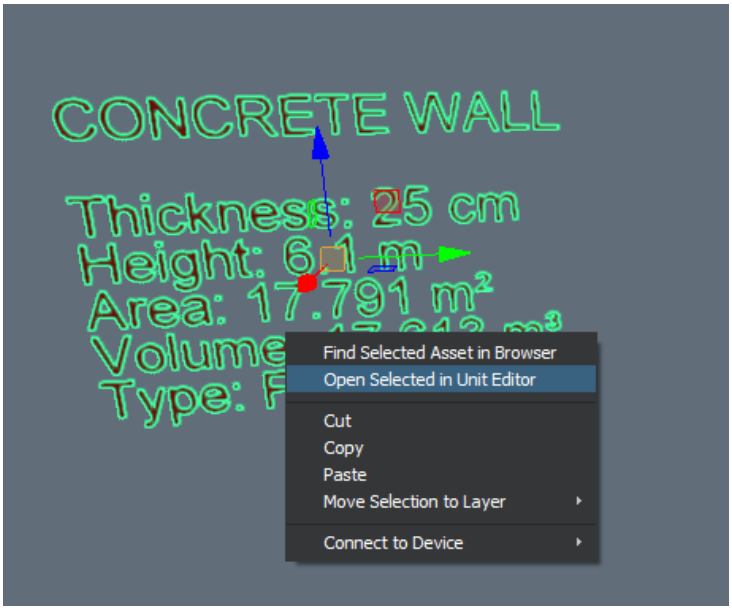
At the moment, there are no simple out of the box solutions to display this data in VR, though there are ways to script this inside with LUA.

Here we will try a very simple workaround which can be useful for many other usecases as well. For BIM data, we inserted simple Modeltext in Revit (you can also automatize this with Dynamo!) before sending the file to the LIVE service.



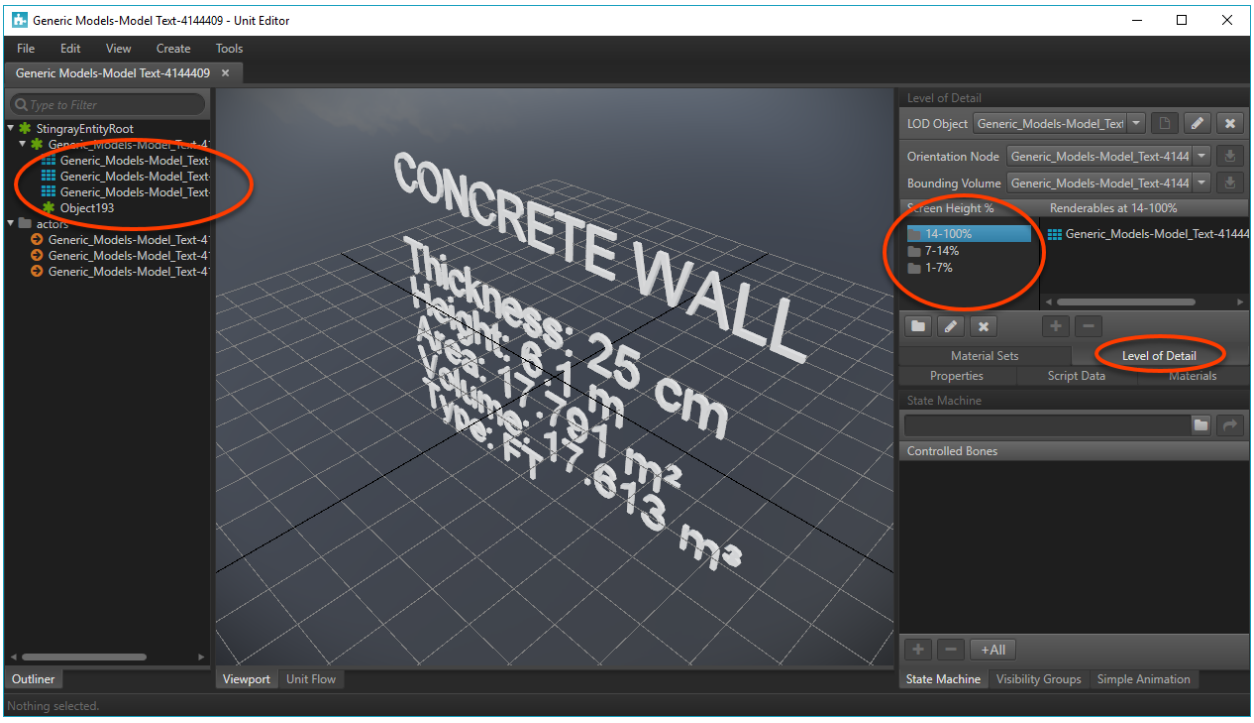
PUSH YOUR BIM DATA TO A MODELTEXT OBJECT IN REVIT

In 3ds Max Interactive, open the text in Unit Editor:



OPEN A UNIT IN UNIT EDITOR

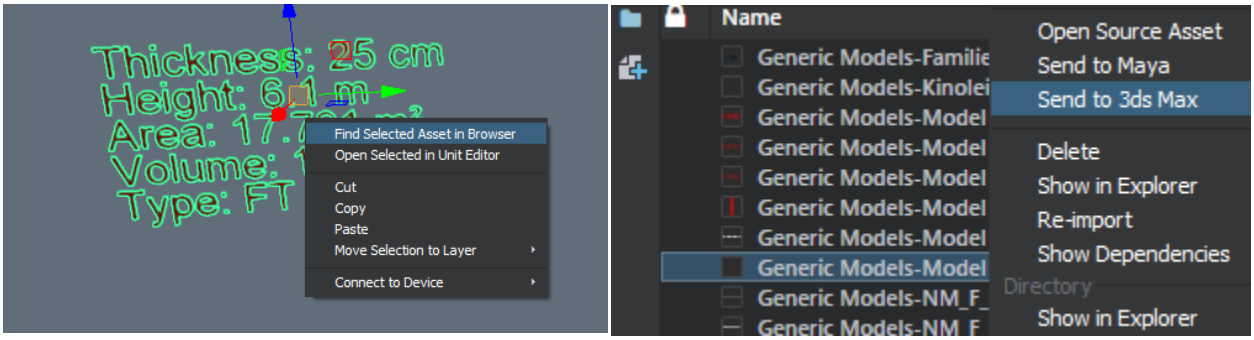
Notice that the LIVE Serivce has automatically created 3 Levels of Detail:



LEVEL OF DETAIL IN UNITE EDITOR

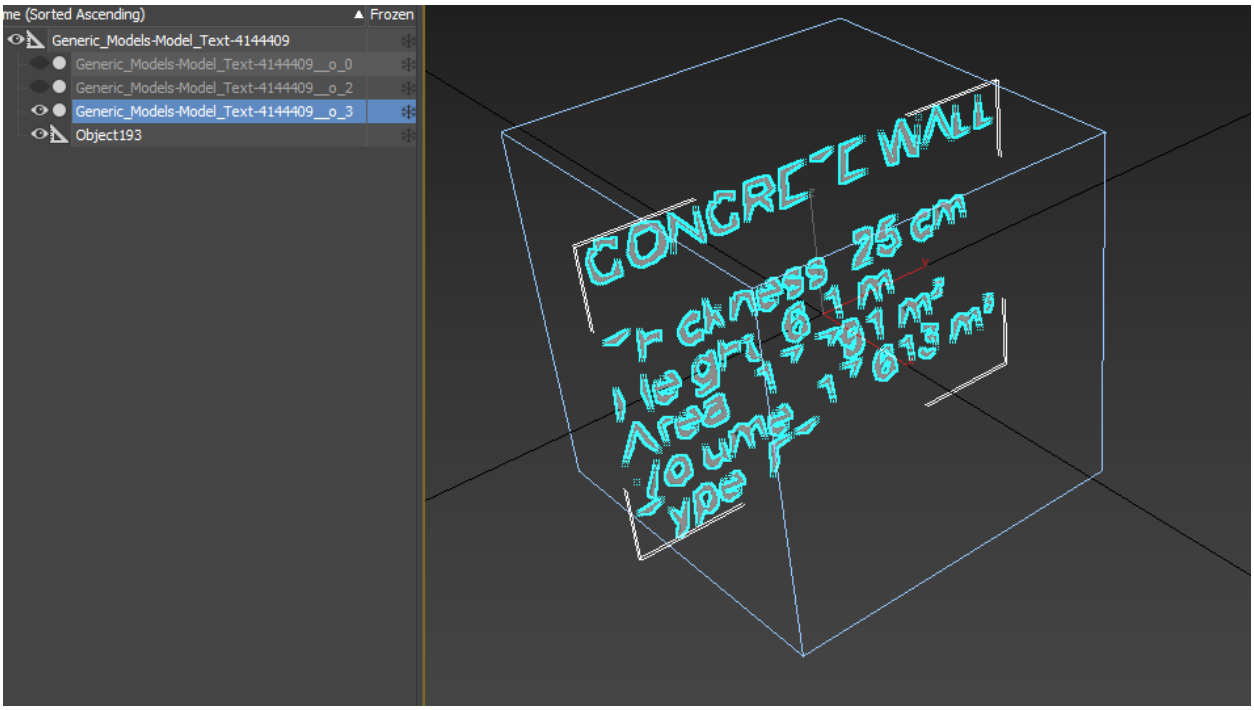
This means that depending on the distance from the object, you will see another representation. The distance is given in percentage of the screen space In the dialog box on the right side.

Close the unit editor and let's have a look at this unit in 3ds Max. With the Text still selected, go to Finid Selected Asset in Browser. From here you can send the Unity to 3ds Max:



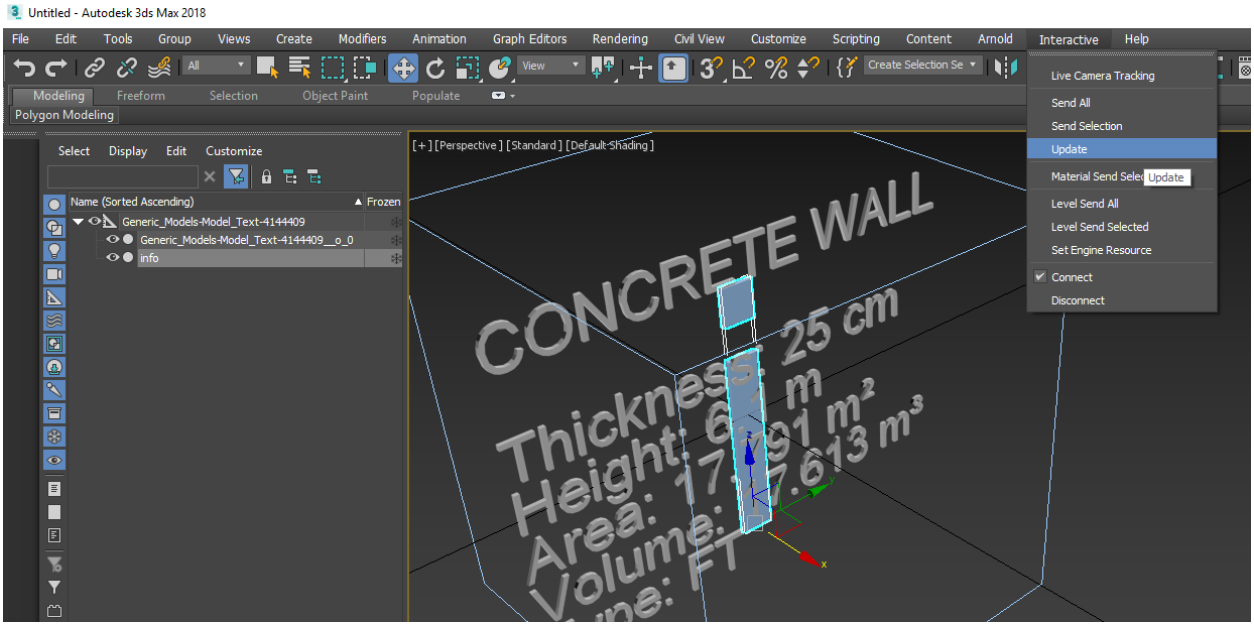
SENDING A UNIT TO 3DS MAX

Notice that in 3ds Max you will find the 3 elements driving the Level of Detail:

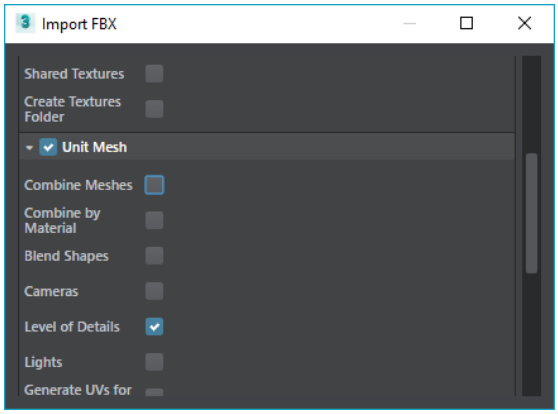


UNIT WITH INTEGRATED LODS

Delete all except the original and create something that should be visible in default state, before you approach the wall. I used an I as a symbol for Information and send the unit back to 3ds Max Interactive using the Update button and make sure that in the Import options "Level of Details" is checked:



UPDATE THE UNIT IN 3DS MAX INTERACTIVE

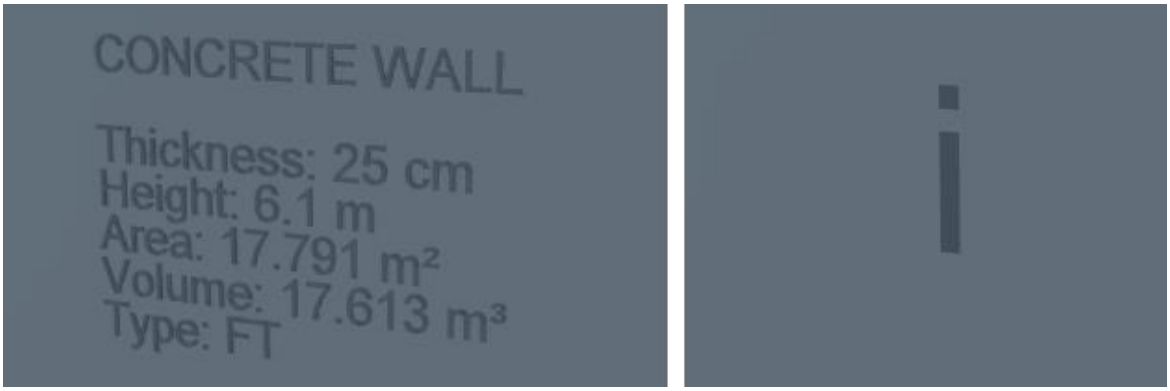


DURING IMPORT, MAKE SURE LEVEL OF DETAILS IS CHECKED

Finally, set the Levels of Details in the Unit Editor – I chose to have text displayed in a range between 50-100%, and in the remaining range I have the I for Info:

LOD SETTINGS IN THE UNIT EDITOR

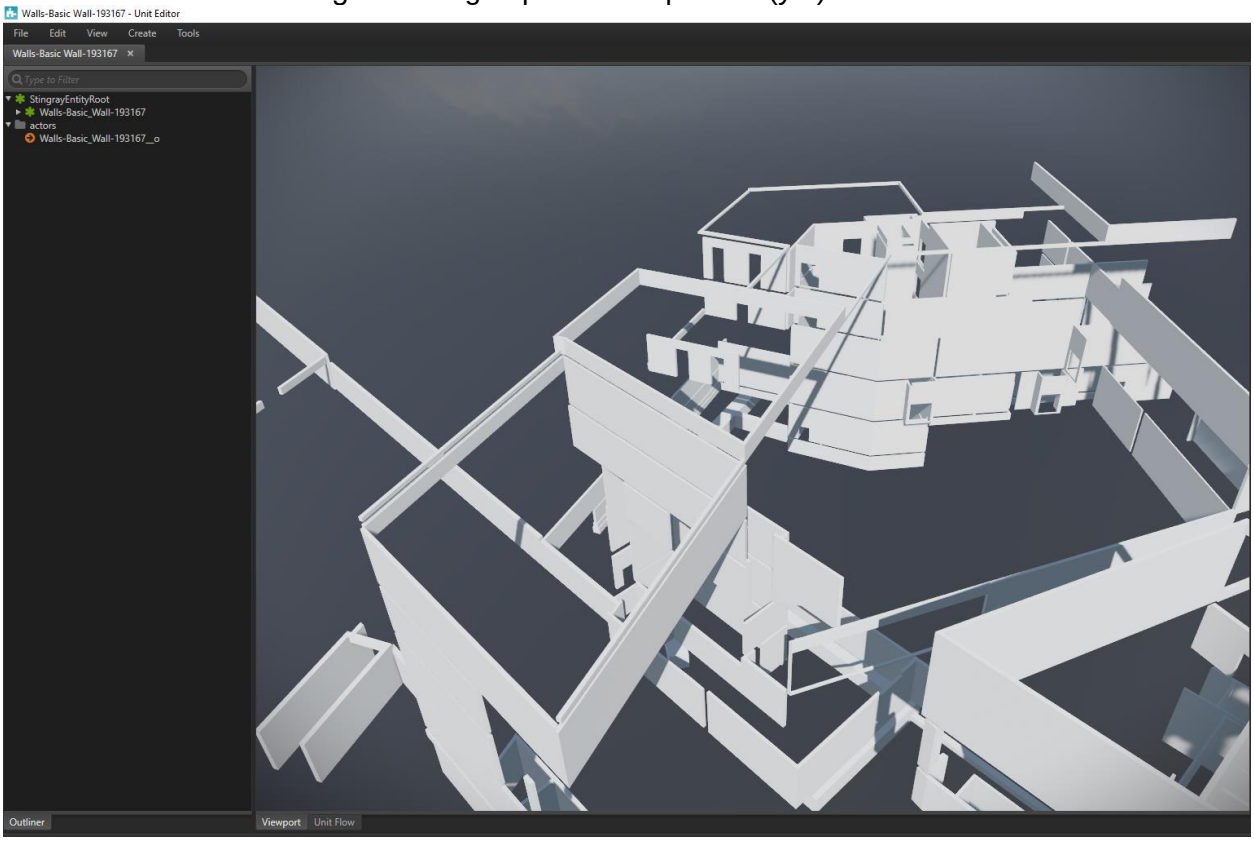
Now, notice when you navigate towards and away from the wall how the display will adapt!



LEVEL OF DETAIL AUTOMATICALLY CHANGING DEPENDING ON THE DISTANCE FROM THE OBJECT

Integrating Phases / Timeline

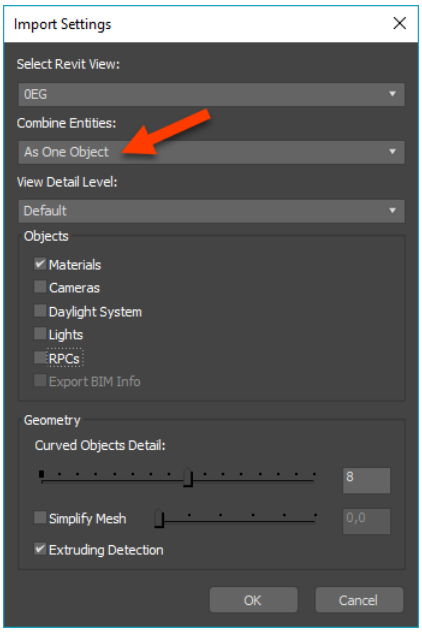
The Revit LIVE service structures your Revit model according to an internal logic, mostly based on materials. It will take your BIM data and this will be available to Interactive, however it doesn't understand the logic of design options and phases (yet):



ONE UNIT CREATED FOR WALLS OF THE SAME TYPE IN OUR MODEL

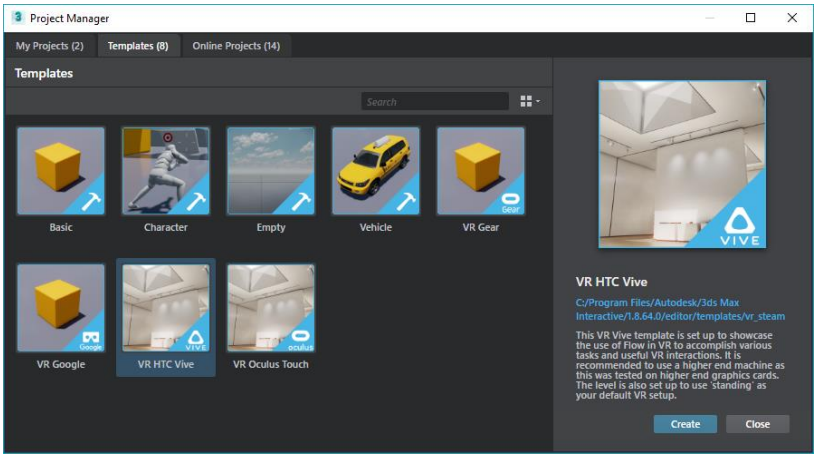
Of course, you can go ahead and edit the unit in 3ds Max, which will work fine for altering the material of a wall segment or making small changes. But in order to structure the model in a certain way, we will this time run it through 3ds Max.
This step assumes you have your phases for your design options and/or timeline set up in your Revit project. You need to prepare views showing only the phases / parts of the model you want to trigger separately.

In 3ds Max, go to Import > Revit, select one of the views you prepared and make sure you import it as One Object. Repeat this for all of your views / phases. You won't need Cameras, Daylight System etc., so you can switch these off in the export settings:



REVIT IMPORT SETTINGS IN 3DS MAX

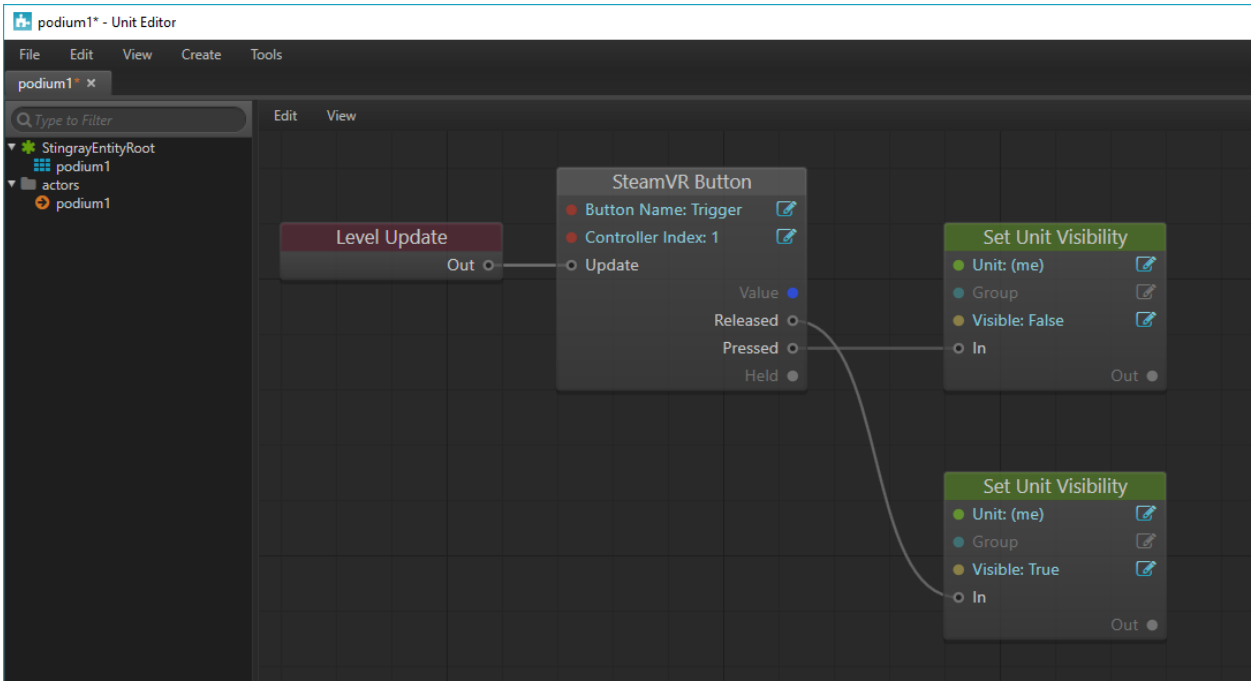
In Interactive, start a new project based on one of the templates. If you wish to create a VR scene for HTC Vive or Oculus Rift, select the respective template as these already contain the Flow nodes you will need to set up the interaction.



CREATE A NEW PROJECT BASED ON A TEMPLATE

Finally, you can use the Unit Flow Editor to set up the logic for switching the visibility for certain phases on and off, which will allow you to simulate different phases, design options or a timeframe.

To toggle the visibility of a unit with an HTC Vive Controler, you can set up a Flow like this to hide the unit when you press the trigger on controller 1 and to show it again when the trigger is released:



SIMPLE VISIBILITY TOGGLE USING AN HTC VIVE CONTROLER

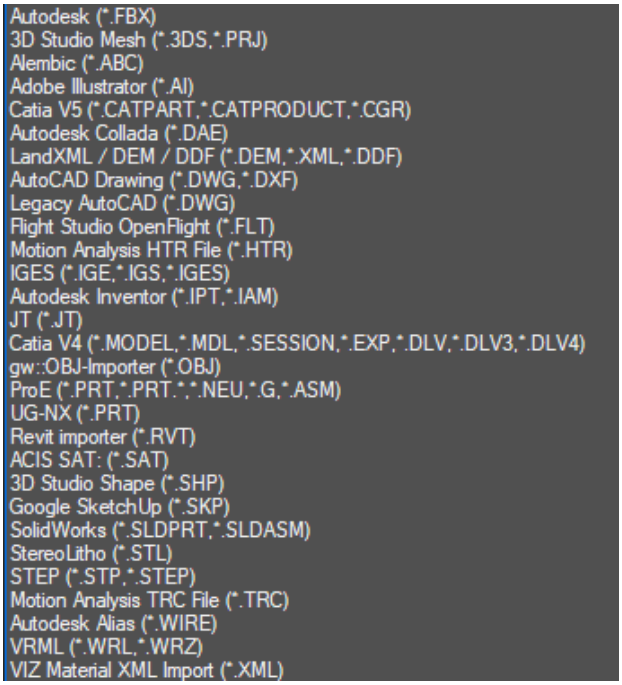
Data from other sources

It often happens that you have data created in other software and which is not available in Revit. This can be MEP or structural components, Infraworks models or even simulation and scan data. The great thing is that using the power of 3ds Max you can basically integrate any 3D data very easily, and even optimize it if needed.

3ds Max Interactive is based on the FBX file format, which means you can directly load FBX files into the gaming engine. However, it is recommended to optimize the geometry in 3ds Max for better performance.

There are different methods for handling non-Revit files:

- Import the model inside for 3ds Max, if it is among the natively supported formats.
- Export an FBX directly from the native software
- Use a viewer like Autodesk Navisworks, which can read 50+ different file formats and is able to export FBX



Note that FBX will turn all smooth surfaces into polygons and depending on the software and its exporter, you should have the option to set the quality or to limit the total number of polygons.

Here you can find further recommended options for the FBX export:
https://help.autodesk.com/view/Stingray/ENU/?guid=__stingray_help_importing_assets_recommended_fbx_html

Hardware Requirements for VR

For running big construction scenes in VR you should not try saving on hardware! AEC datasets are typically much heavier than traditional game scenes, which contain only optimized geometry specifically built for gaming purposes.

For a VR setup, you will need an Head Mounted Display (HMD), currently supported by Autodesk products:
- HTC Vive (approx. 800 USD)
- Oculus Rift (approx.. 600 USD)

Both are excellent HMDs offering the same resolution of 2160 x 1200 with 90Hz with some differences:
- HTC Vive offers a slightly better tracking and is ideal for a stable setup in a VR room
- Oculus Rift is slightly lighter and better for mobile setups

The official minimal hardware requirements for VR are:
- Intel Core i5 4590 or AMD 8350
- 4GB RAM
- Nvidia GeForce GTX 970 or AMD Radeon R9 290

Please be aware that this configuration won't make you happy If you wish to run professional AEC demos. A good VR experience is highly depending on high frame rates (ideal: 90 fps) which are highly affected by your graphic card You can find a good comparison here: https://www.videocardbenchmark.net/high_end_gpus.html