

BLD125063-L

## CFD meets VR lab

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A2K Technologies

### Learning Objectives

- Digital Prototyping and Simulation is essential for a healthier environment and sustainable economy.
- VR is not only a marketing tools but allows the full confirmation of the right decision made through full immersion.
- We have seamless cross discipline interacting tools for no rework at hand.
- Full immersion is not science fiction and technology is accessible and ready to be used.

### Description

Dynamic modelling and generative designs pathed the way for sophisticated digital prototyping. While software got better and better, it is often that stakeholder and clients are struggling to understand the design and plans not granting the use of the latest tools especially not accepting new solutions. New simulation methods will only path the way when the results are being communicated and well received. The presentation of 'CFD meets VR' addresses a well-designed workflow where critical facility data can be communicated to stakeholder to make the right decision about comfort supporting equipment and costs confirming the success of the architecture. The workflow describes the export of a Revit model to CFD Simulation making use of a CFD data translation within 3ds Max preparing it for its final destination Stingray. A second option is offered using Dynamo and Revit Live. The result offers a full immersion and experiencing of CFD data, which can be presented on VR rigs and mobiles. CFD data is 3D data, which is often difficult to communicate through 2D gates such as screens or paper.

### Speaker

Florian Neumayr received postgraduate degrees in business and engineering with majors in product lifecycle management (PLM) and controlling in Germany. He offers 20 years of outstanding industry experience in Building Information Modelling for multistory buildings and warehouses. Living in New Zealand, he is counted to the top BIM, Sim and Viz experts of the Southern Hemisphere which leads him to speak and teach internationally. He has been working for the last 7 years as consultant for a top 5% Global Autodesk Reseller in the Asia Pacific, consulting multiple generations regarding a diversity of projects ranging from \$100k to \$1 billion. His focus as an application engineer is to optimize the computer as a communications tool. His expertise is to realize workflow studies that offer the flexibility to make room for options and changes while reducing costly repetition.

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## Foreword to the tutorial

The tutorial covers all aspects of the workflow you want to follow when in need of presenting CFD data three dimensional with the help of a virtual reality solutions.

This tutorial shall not be a training tutorial of each software used. It describes how models and data can be conveyed from one software to another without rework. Hence, the training is about import, export and inspecting data and only little about software features.

There are over 100+ screenshots documenting the workflow. It is about an advanced but also light weight tutorial to experience Autodesk Software offering to tackle extreme workflows.

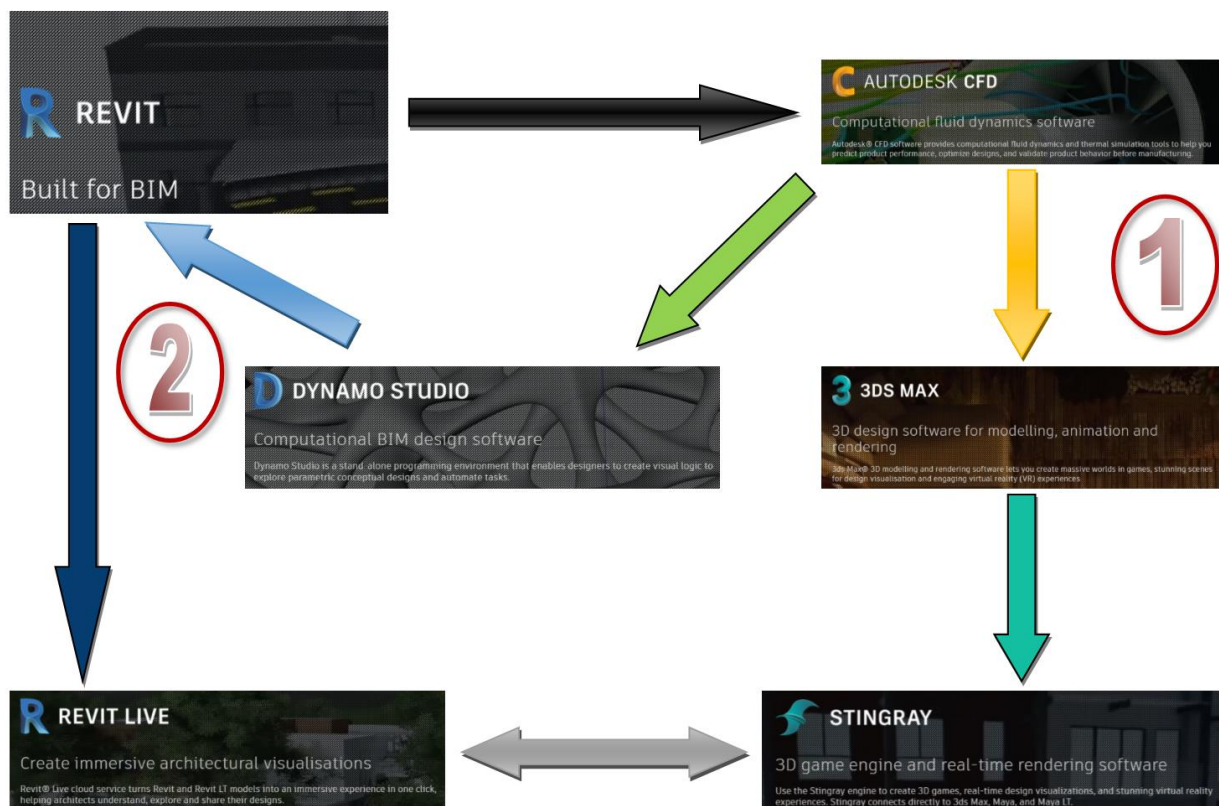
Browse, export, import and enjoy! All files have already been prepared for you.

Cheers,  
Florian

Contact me on: [contact@bim2.tv](mailto:contact@bim2.tv)

Visit me at: <http://www.bim2.tv>

## THE TREASURE MAP

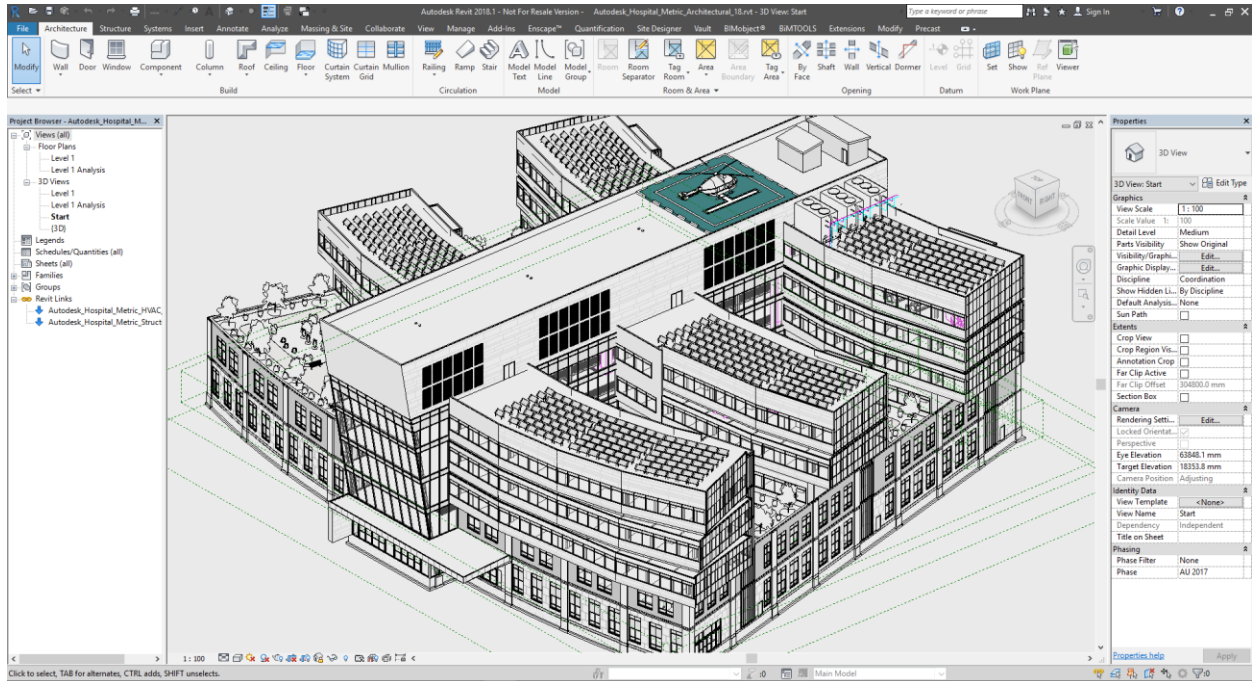




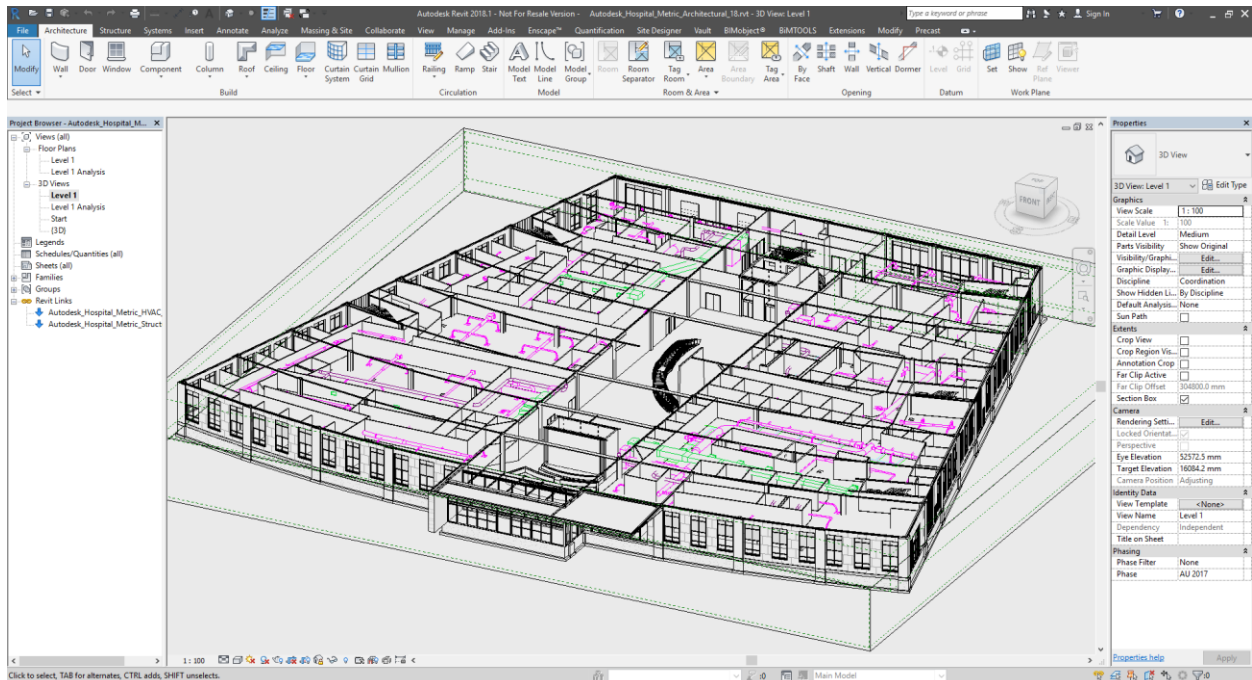
# Preparing the model in Revit

Find the example files in: 10 Revit Models

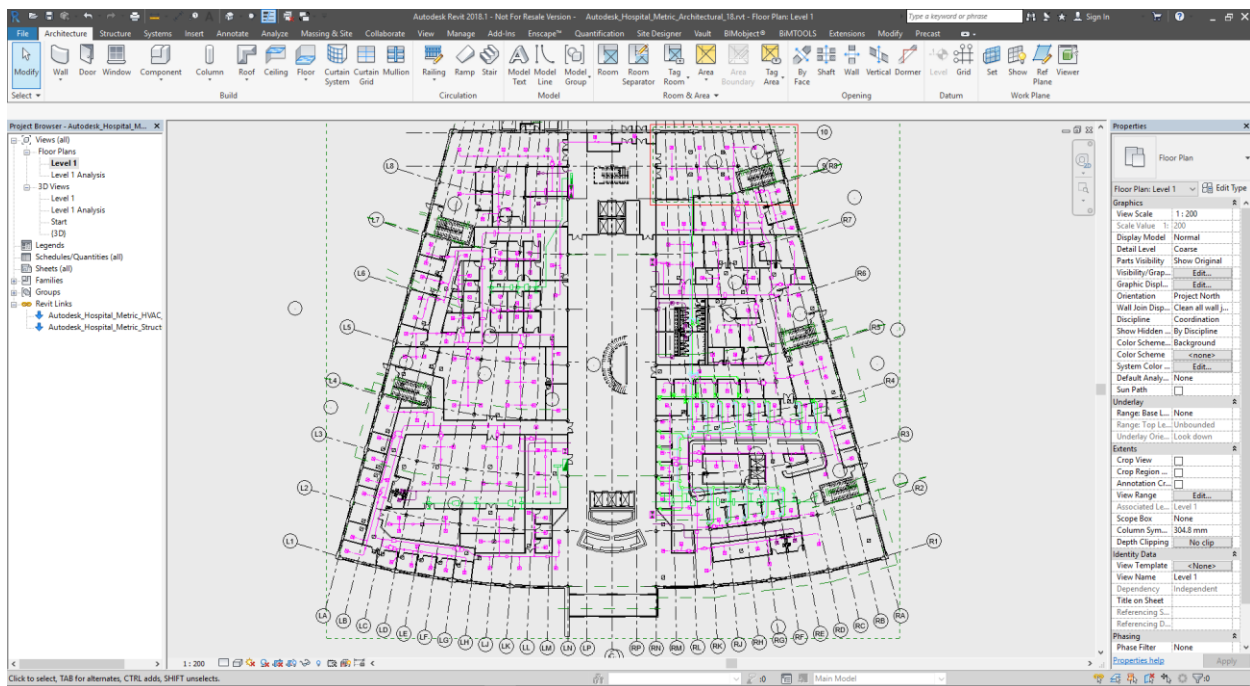
Find the screenshots in: 15 Screenshots



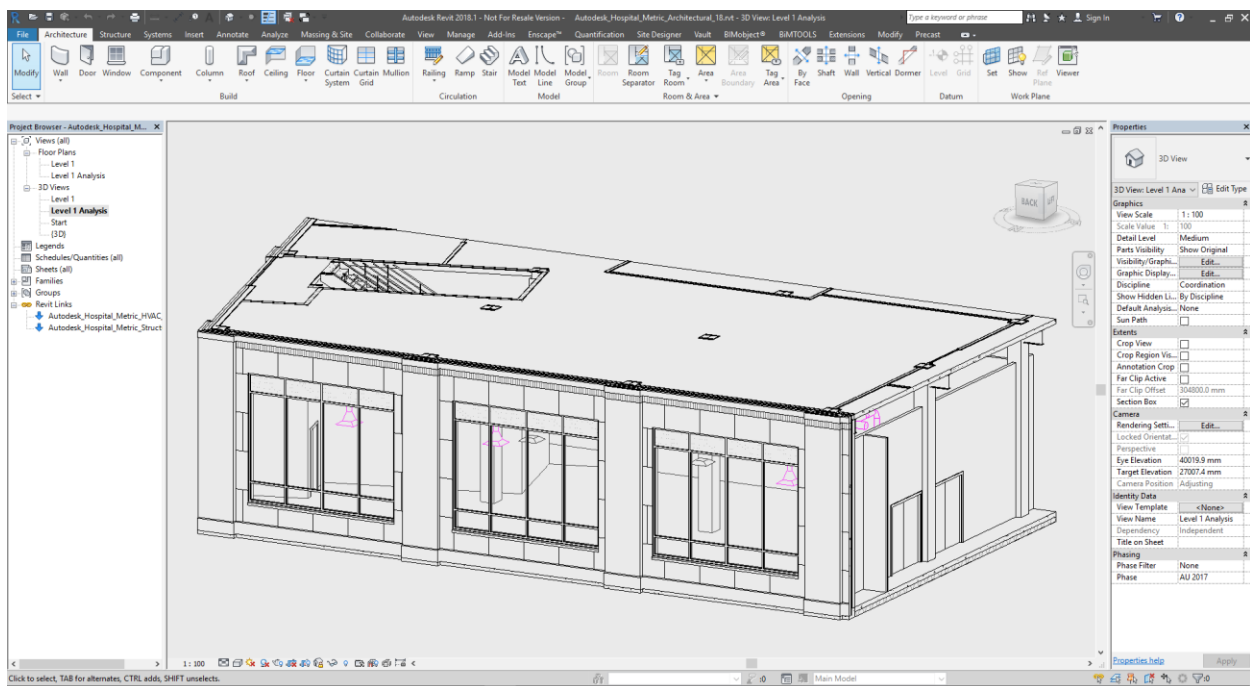
01 Start view opening the Revit project



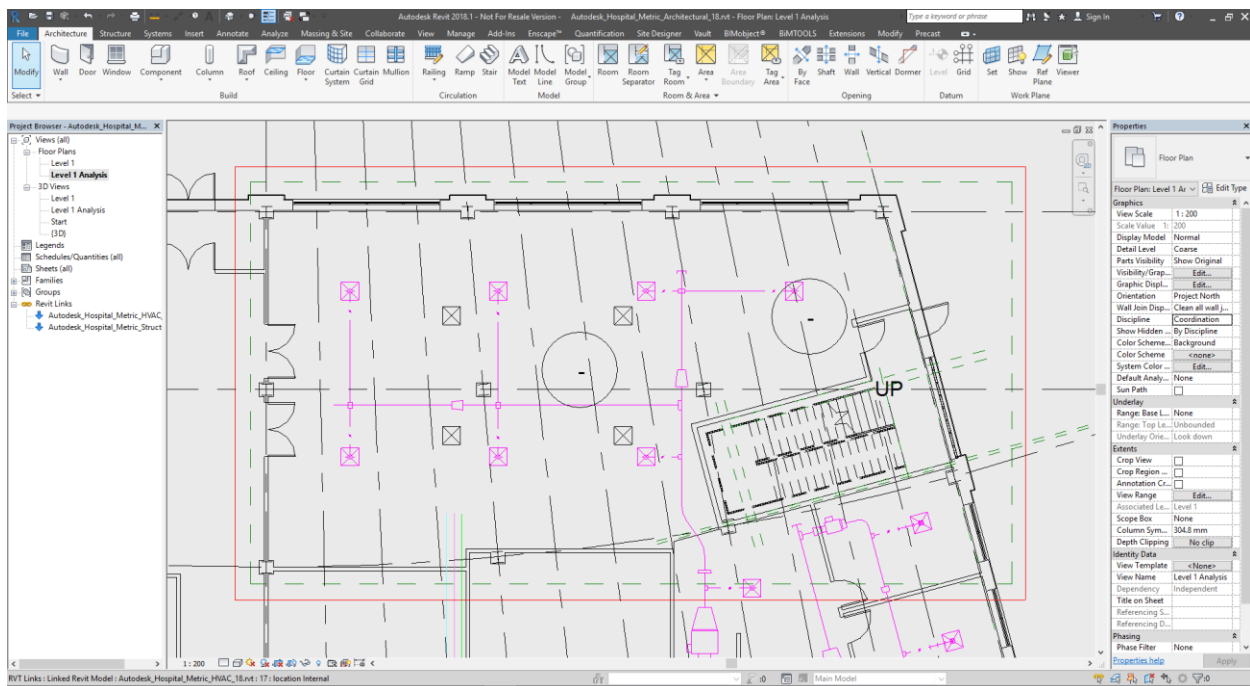
02 Level 1 in a 3D view



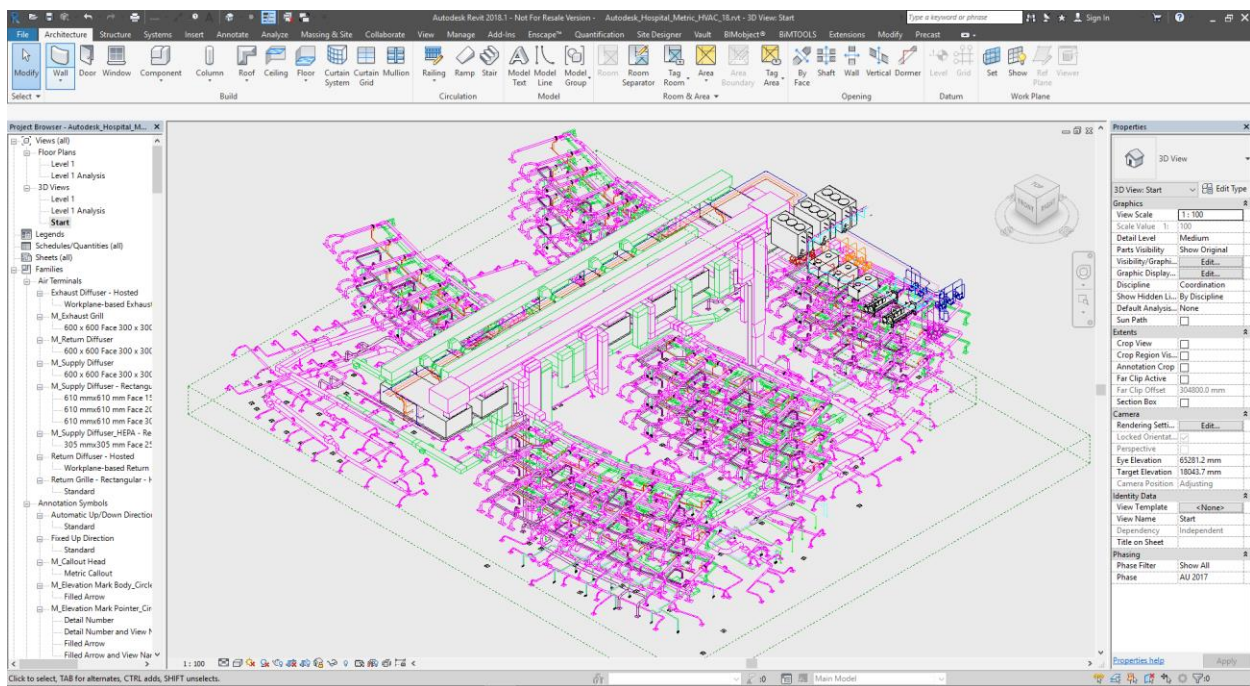
03 Level 1 in a 2D view



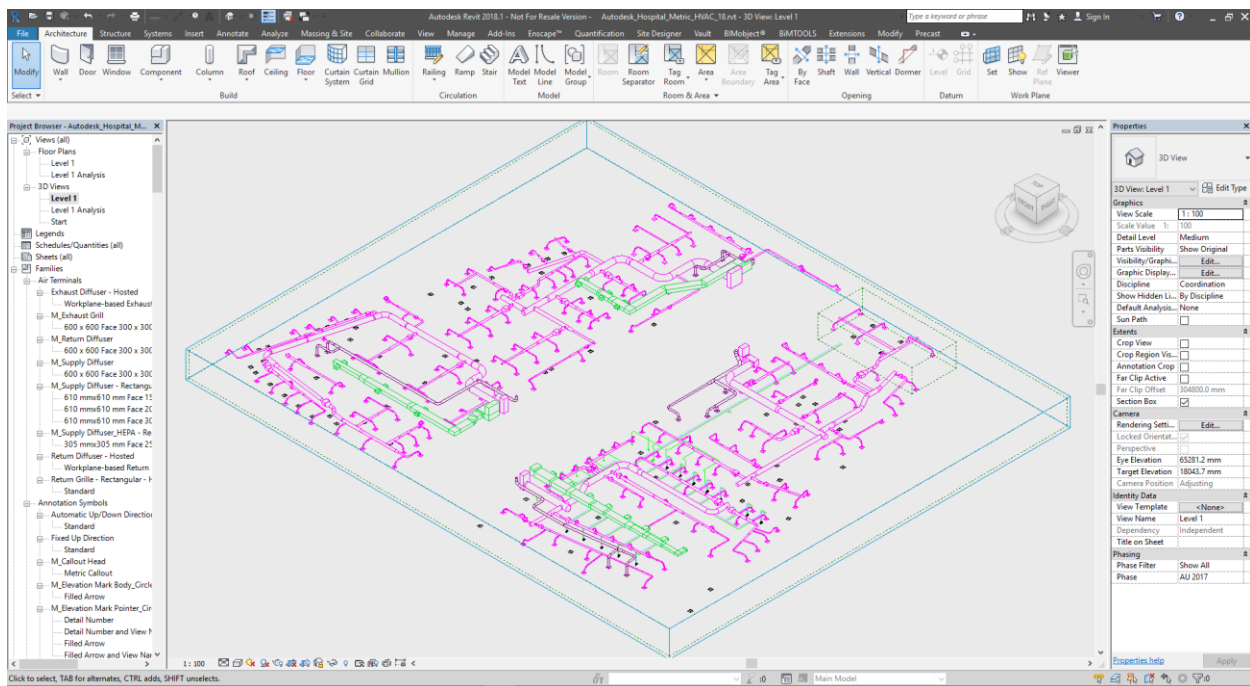
04 Level 1 3D view of the room to analyze



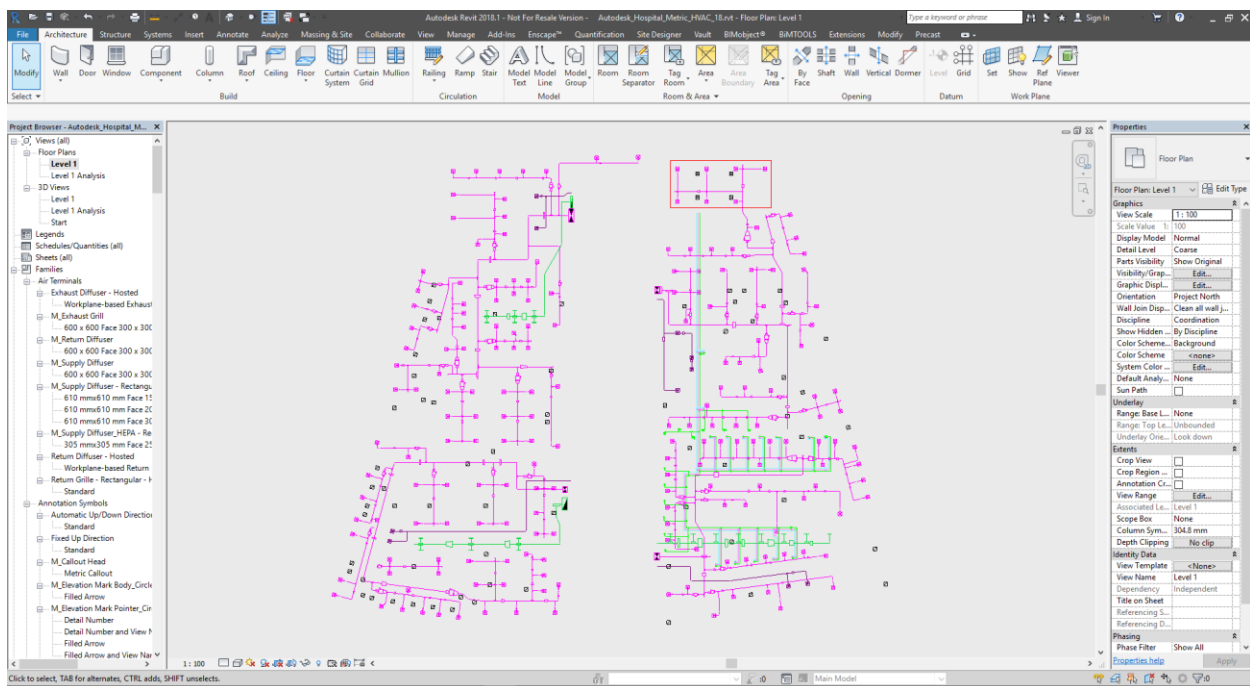
05 Level 1 2D view of the room to analyze



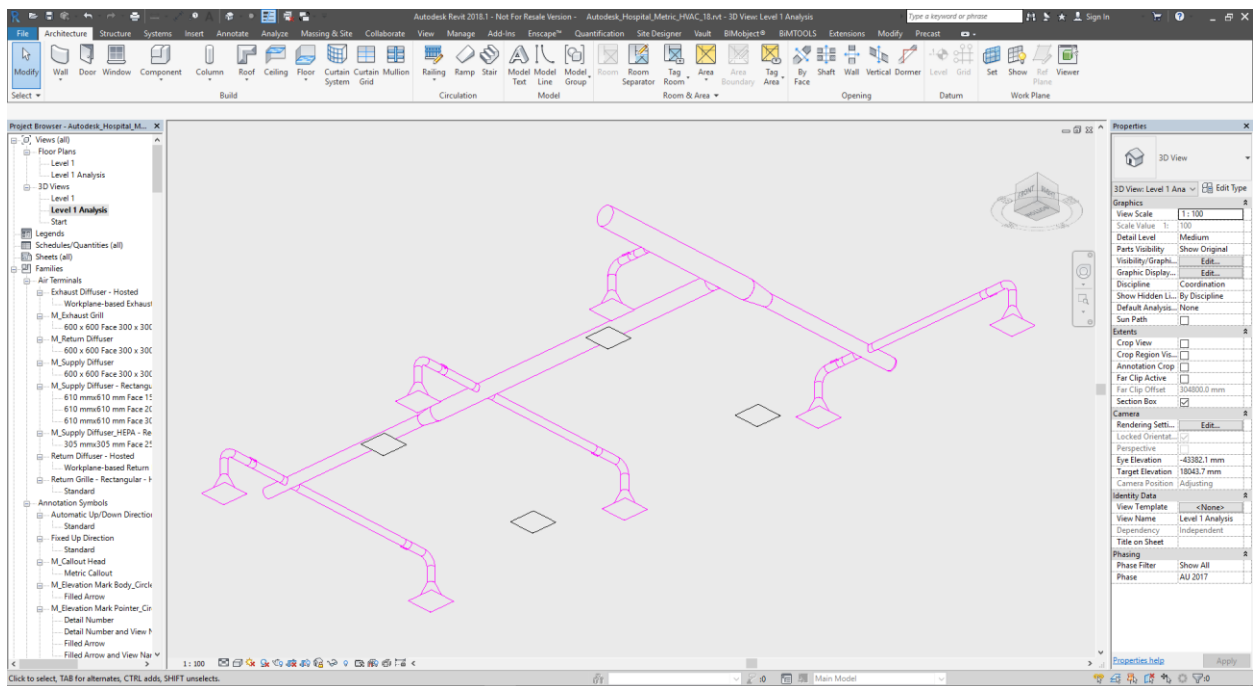
06 Start view of the HVAC model



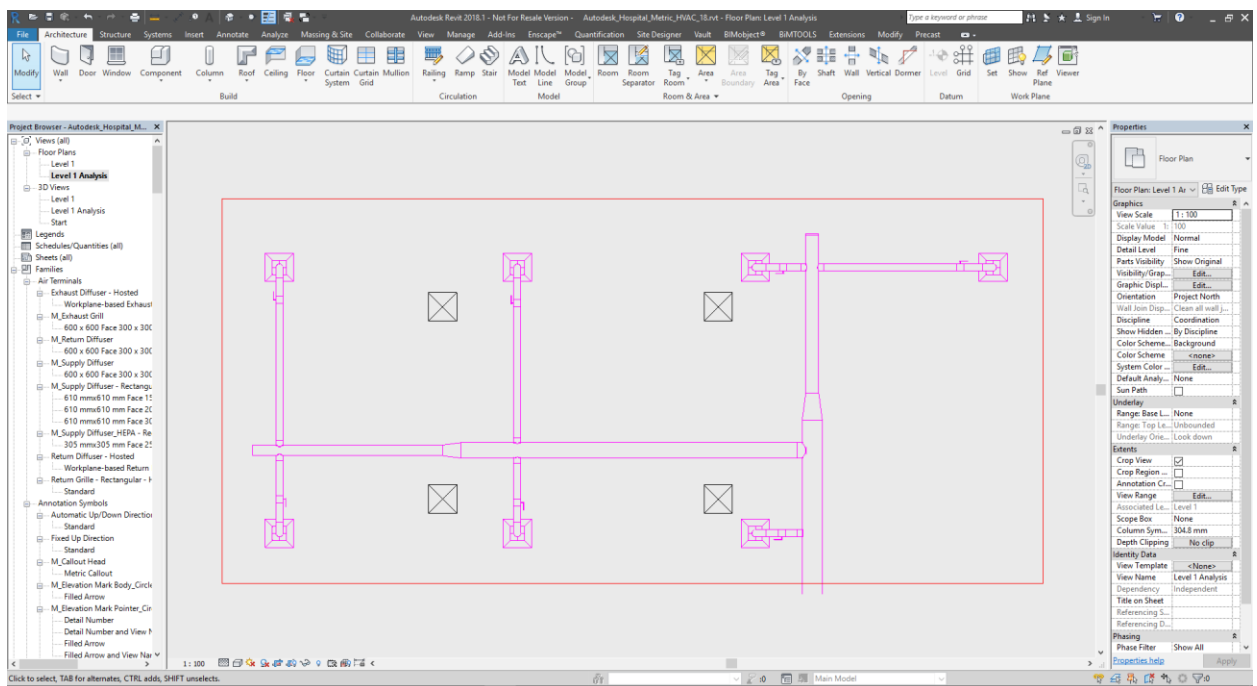
07 Level 1 3D view of the HVAC model



08 Level 1 2D view of the HVAC model



09 Level 1 3D view of the HVAC model and room to analyze

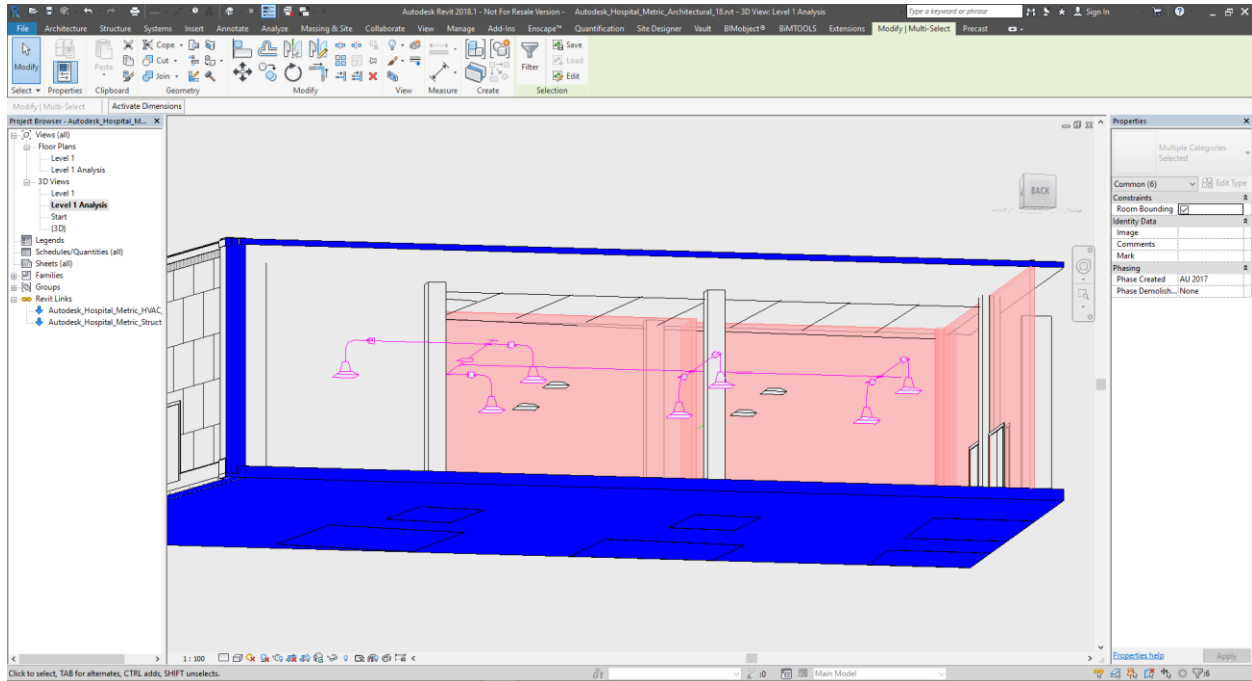


10 Level 1 floor plan of the HVAC model and room to analyze

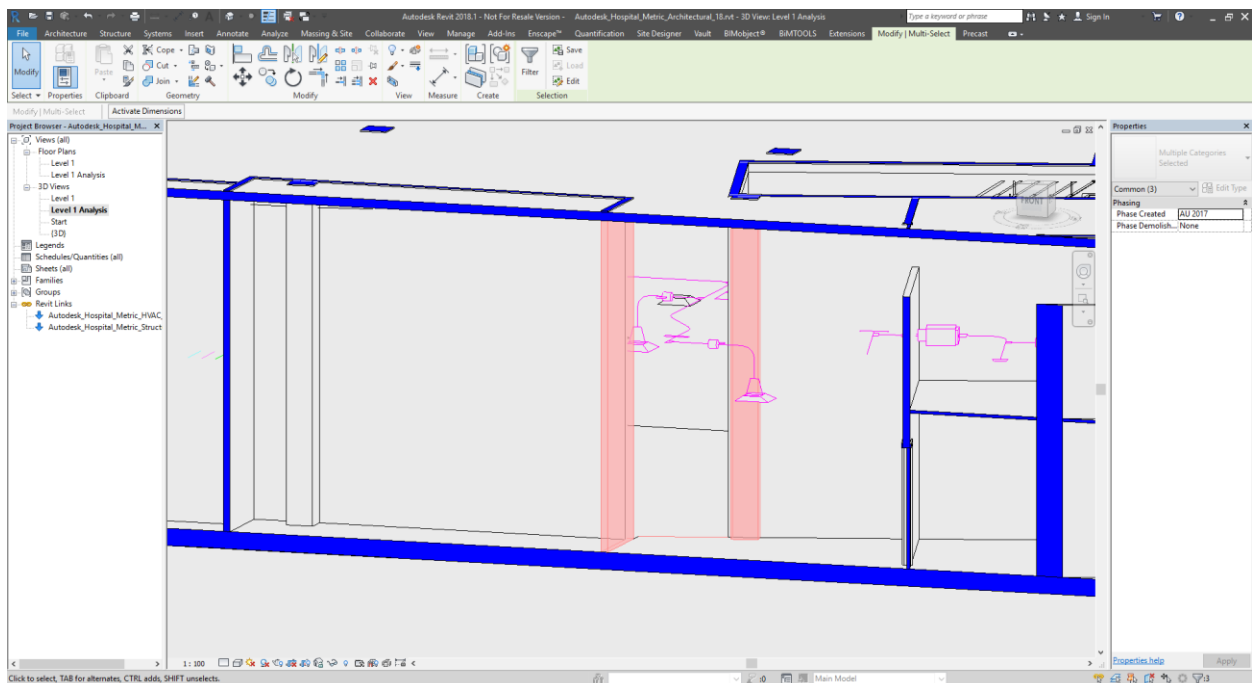
## Export to the CFD Study Environment

Find the example files in: 20 Exports to CFD

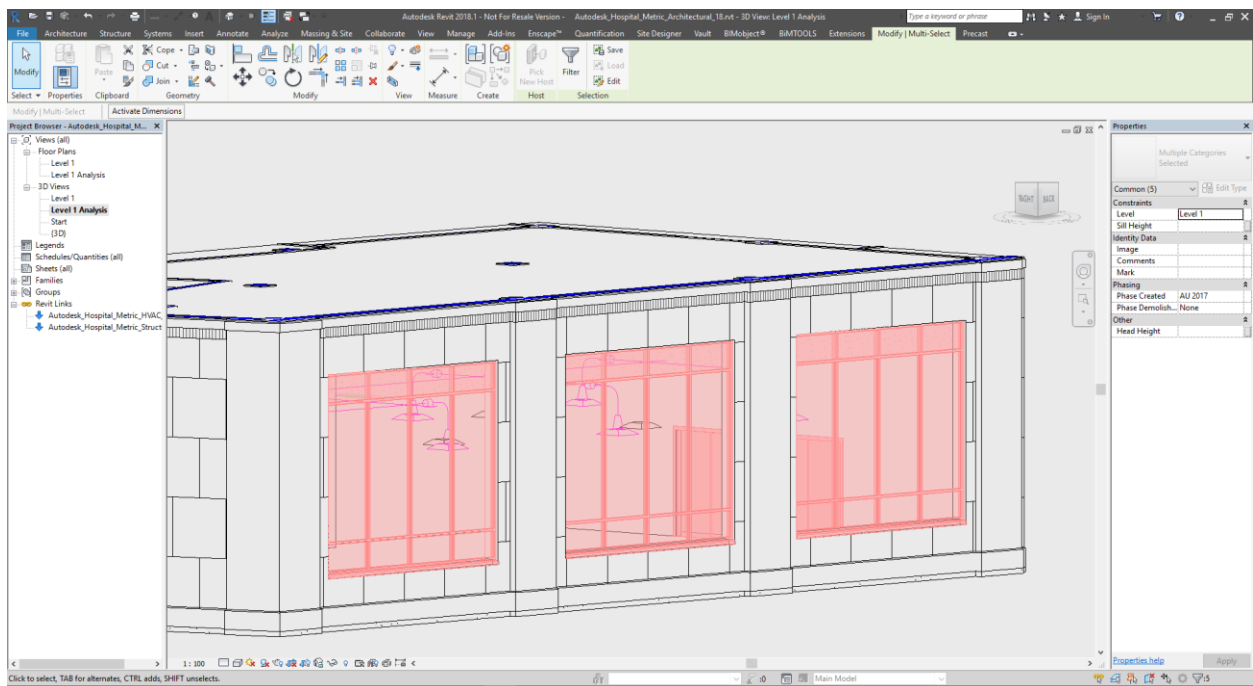
Find the screenshots in: 25 Screenshots



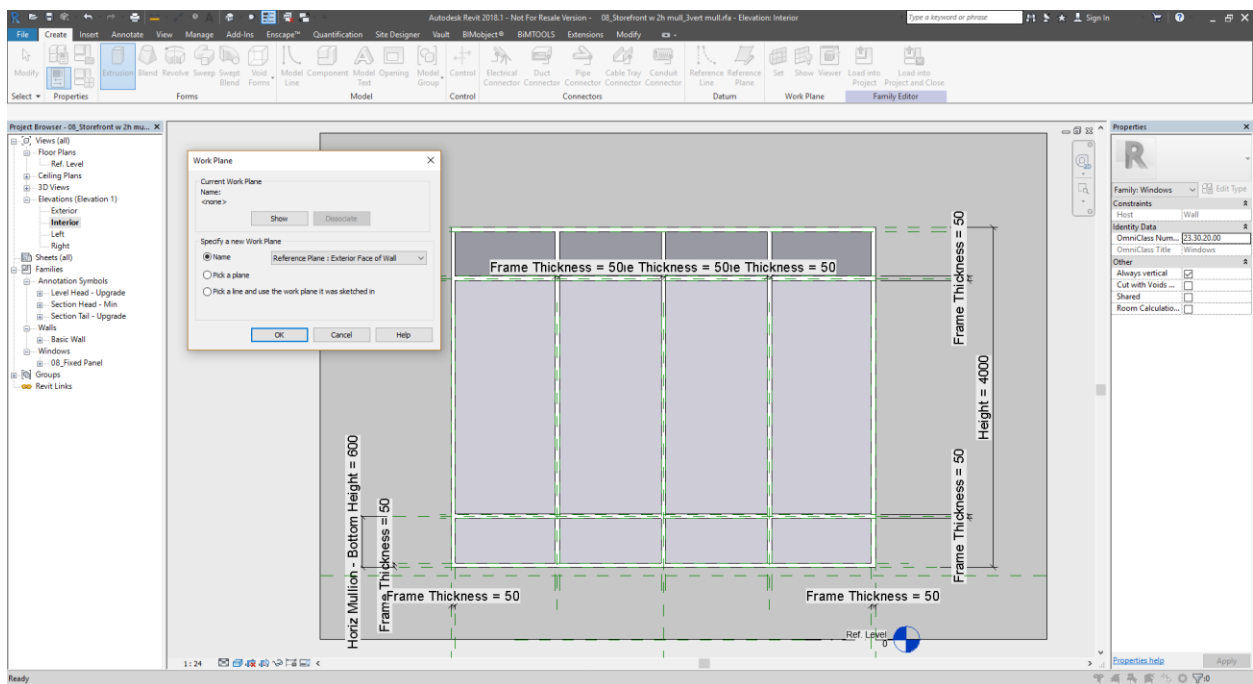
11 Simple geometry with attached walls



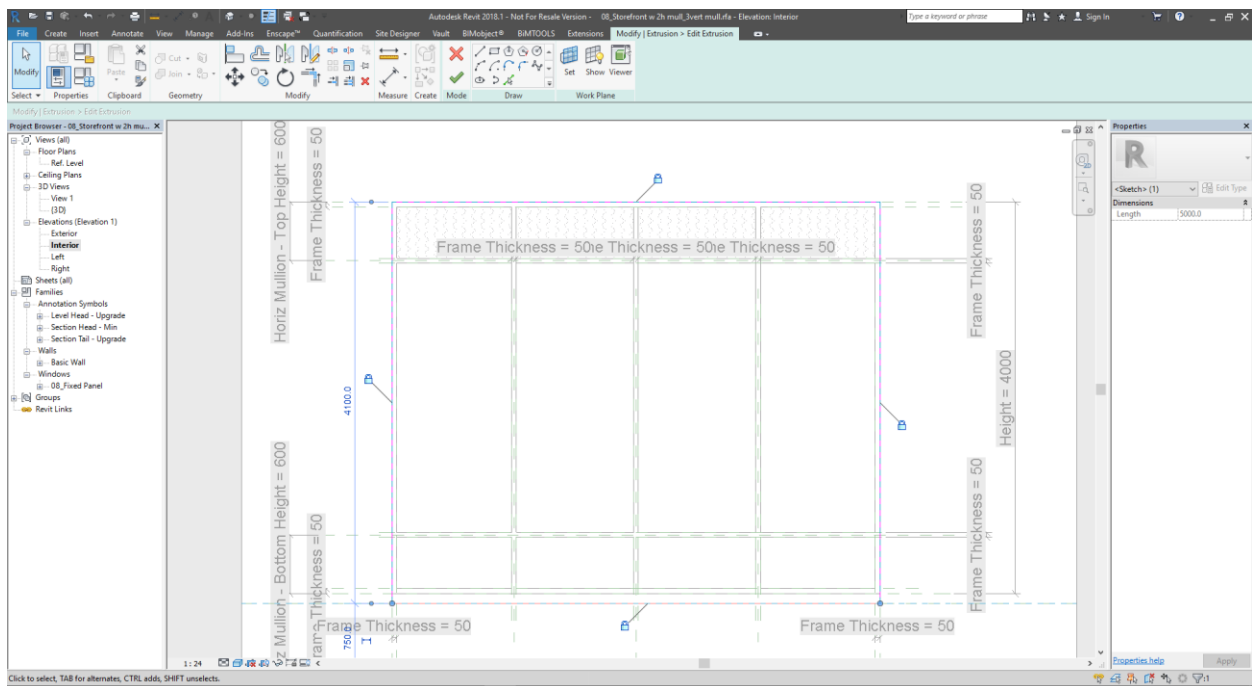
12 Any access can be closed within the CFD Design Study Environment



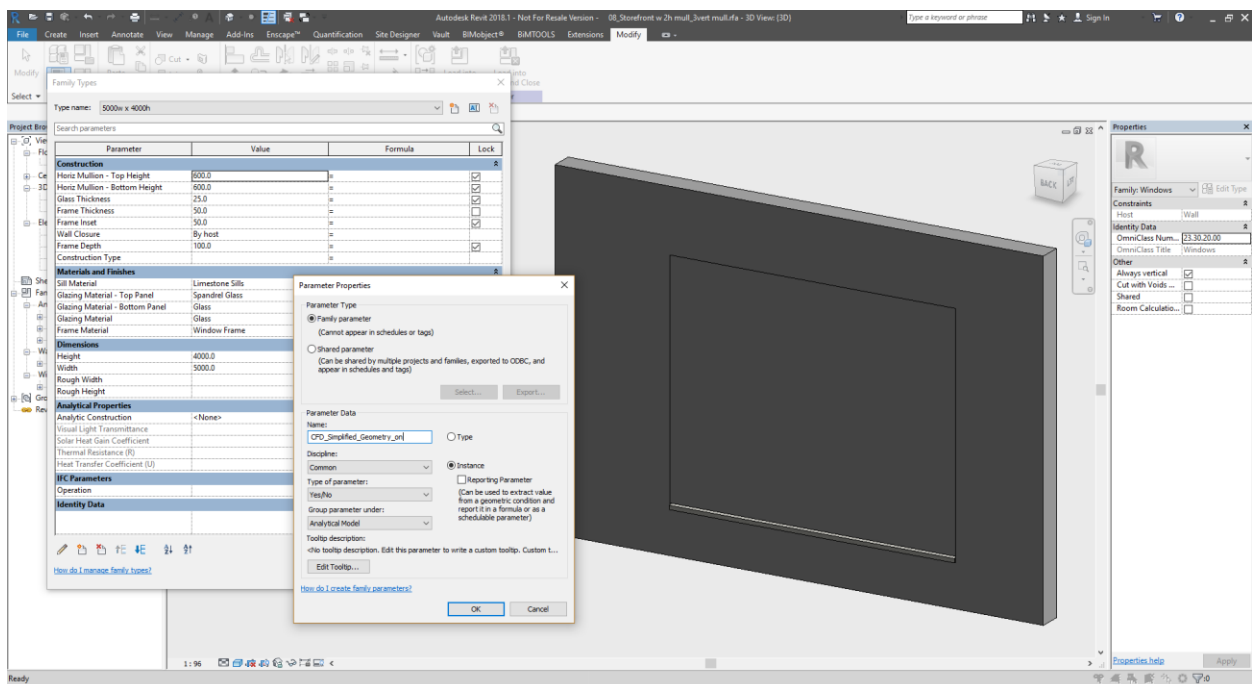
13 Try to simplify windows and doors



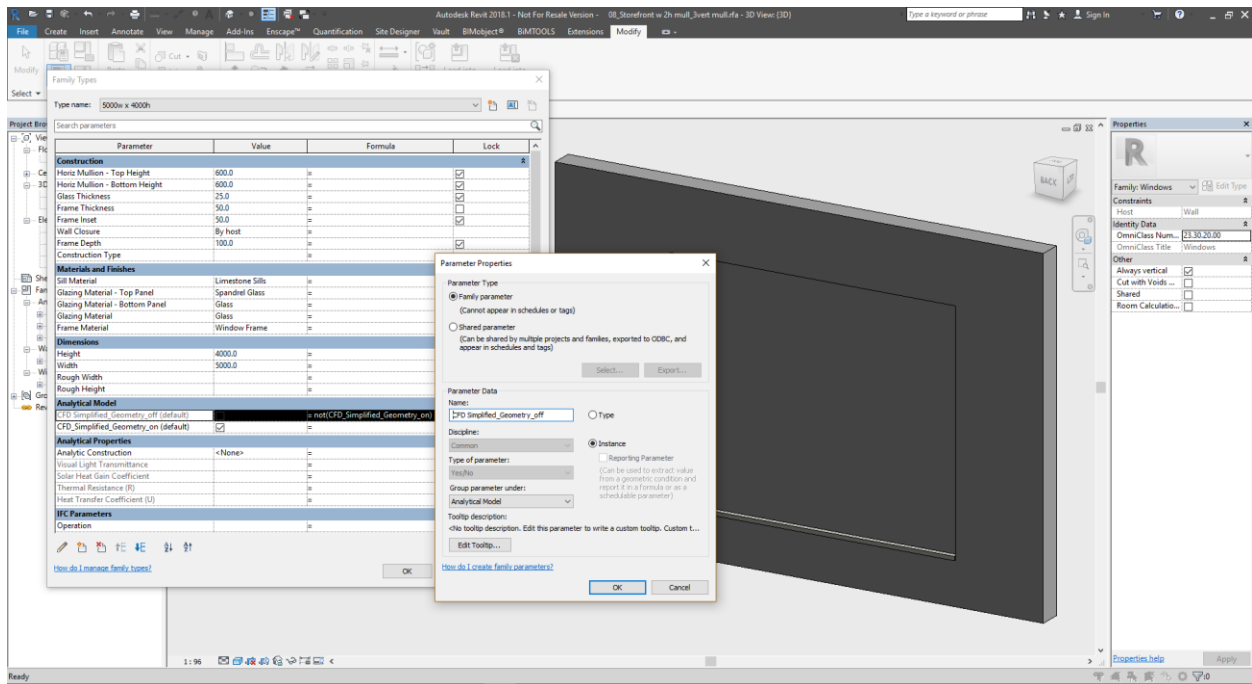
14 We can edit the family and add simple geometry



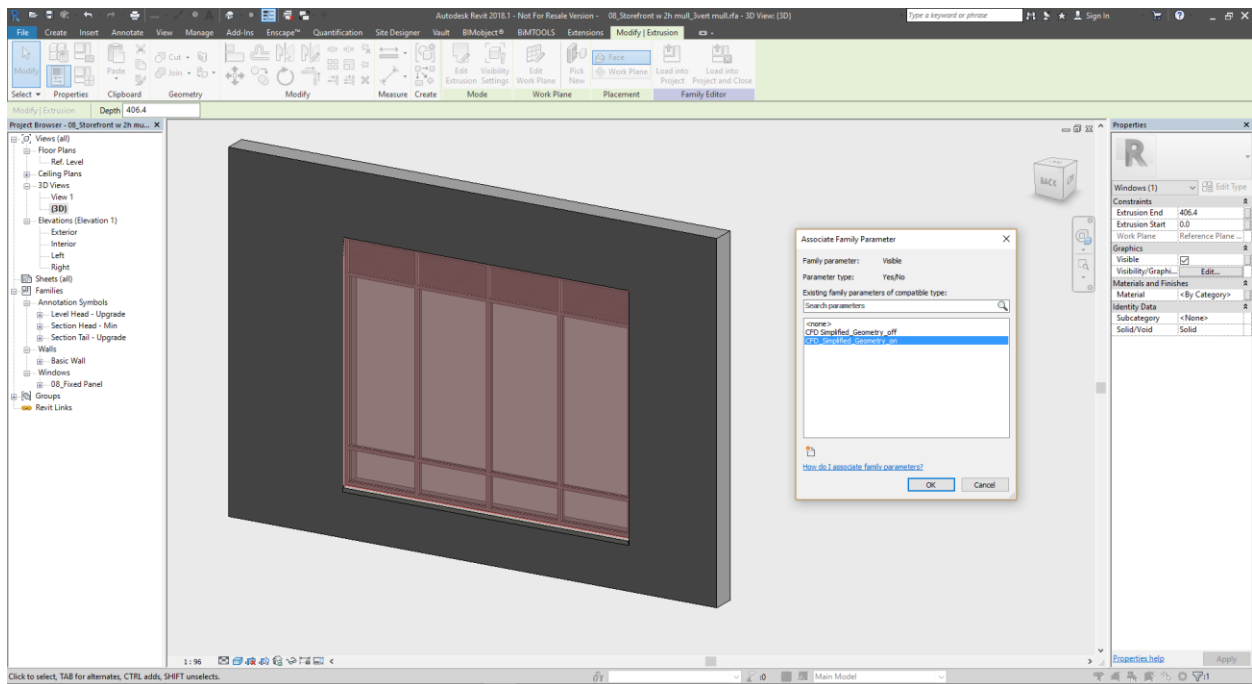
15 For example, create extrusions to cover windows



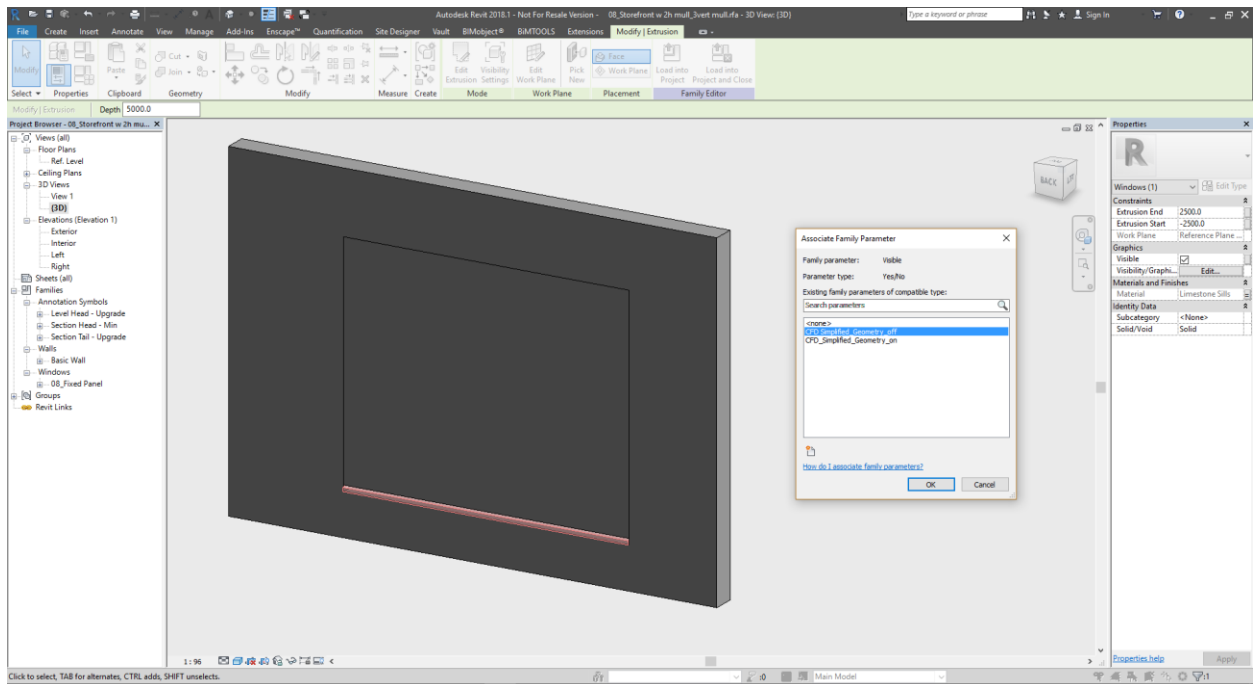
16 Create simplified geometry for the CFD analysis using visibility parameter



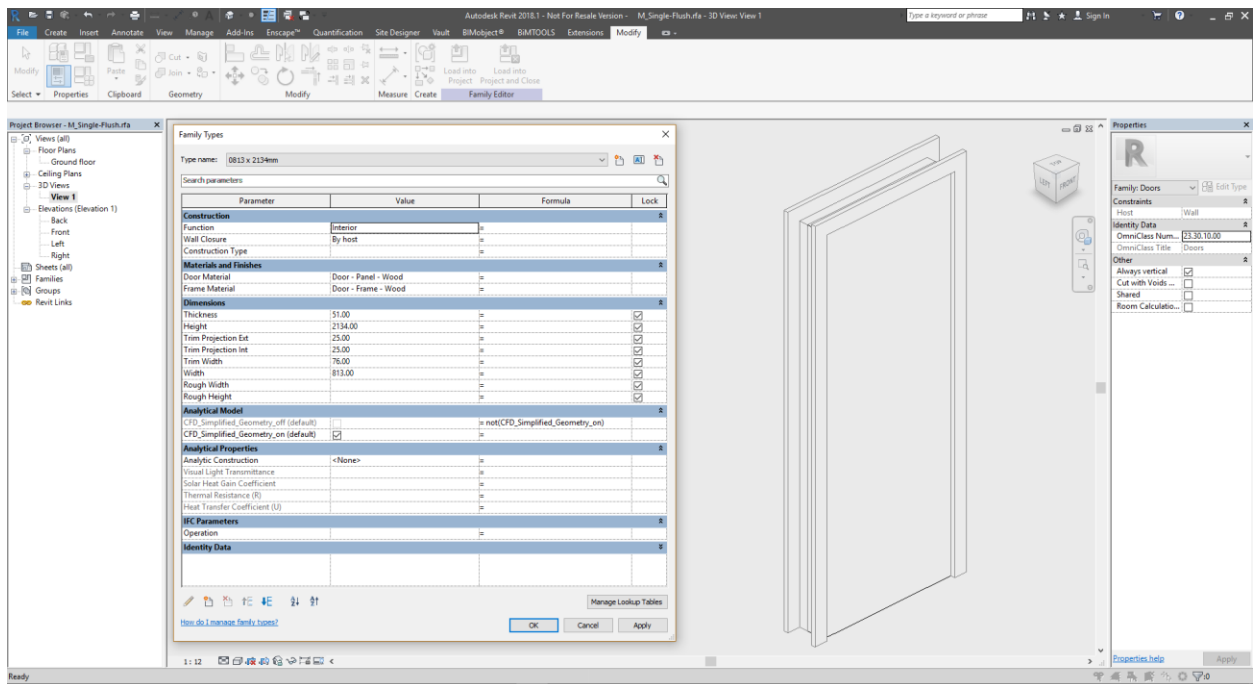
17 Create the parameter to turn on and off the geometry required



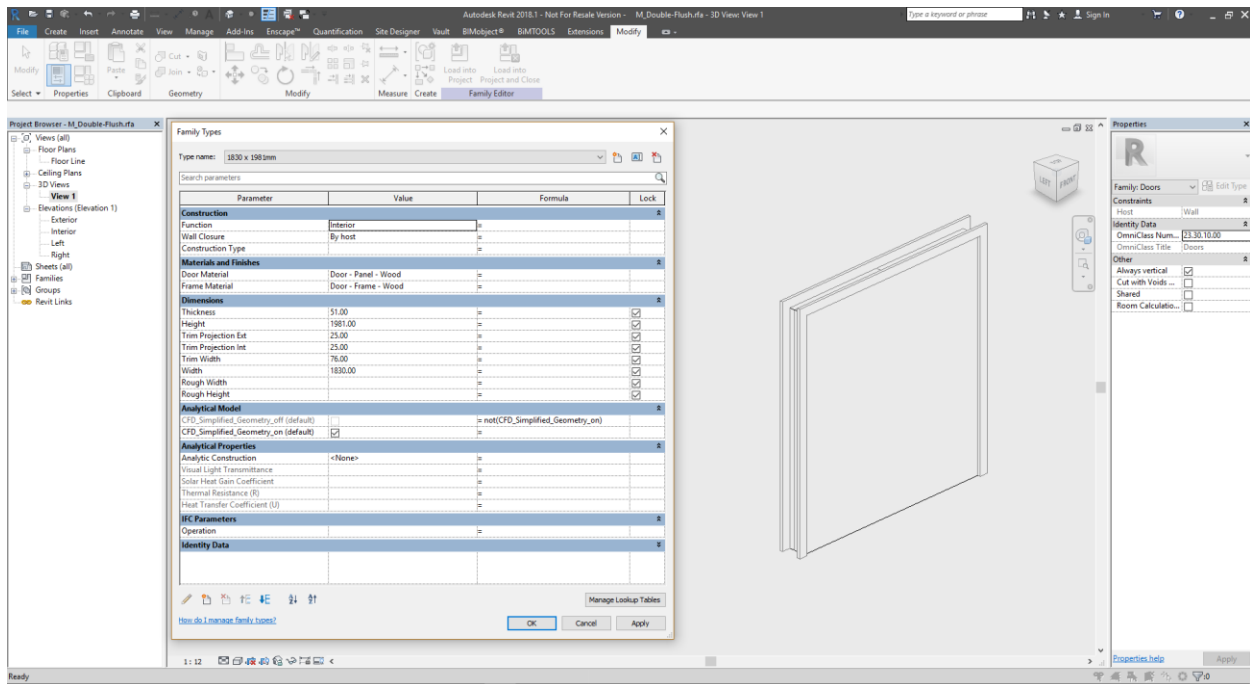
18 Connect the parameter ON



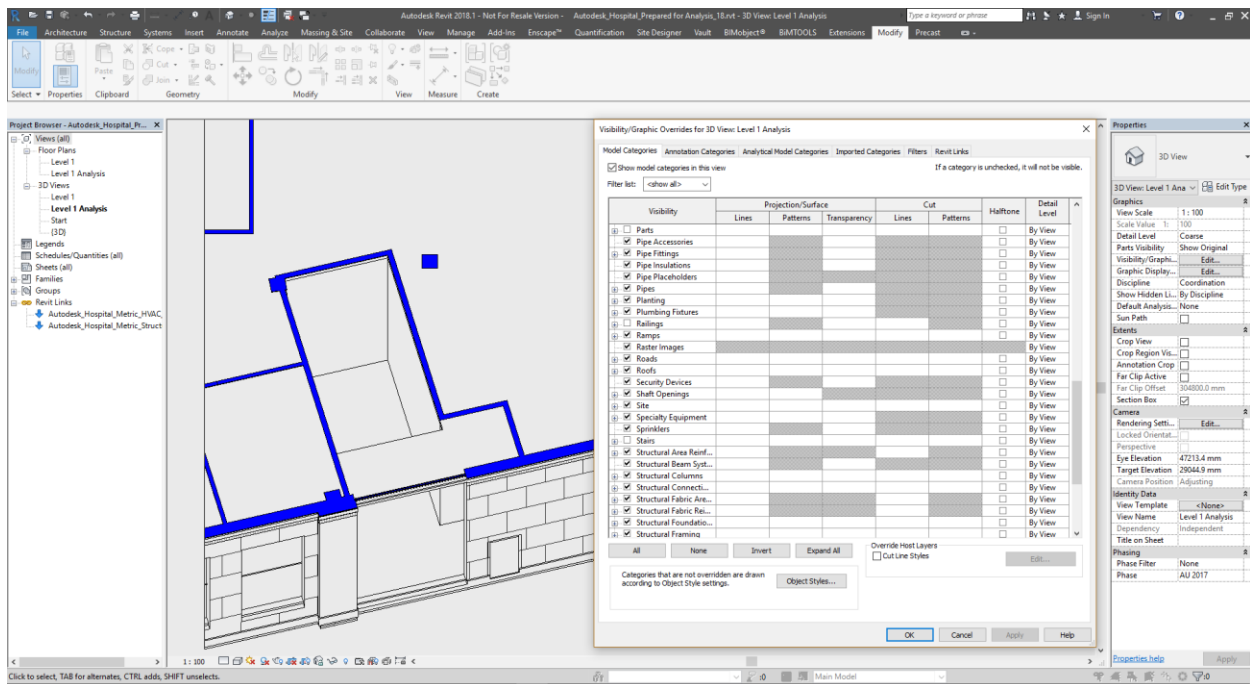
## 19 Connect the parameter OFF



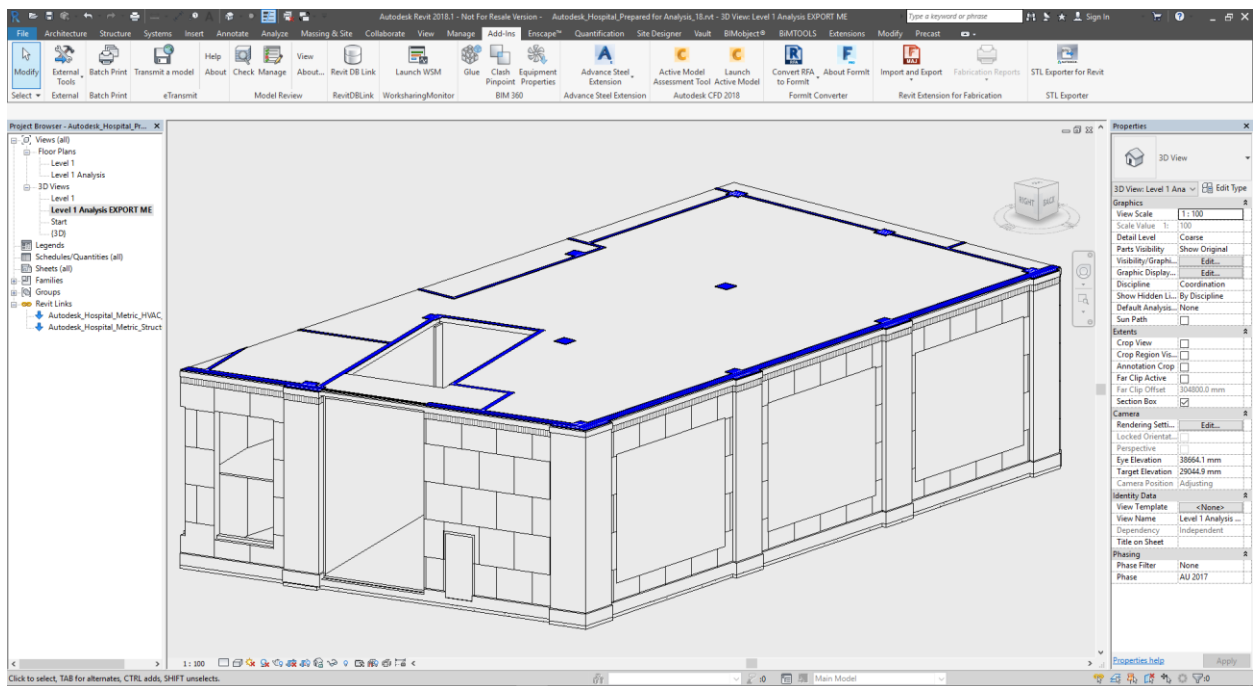
## 20 Another door example



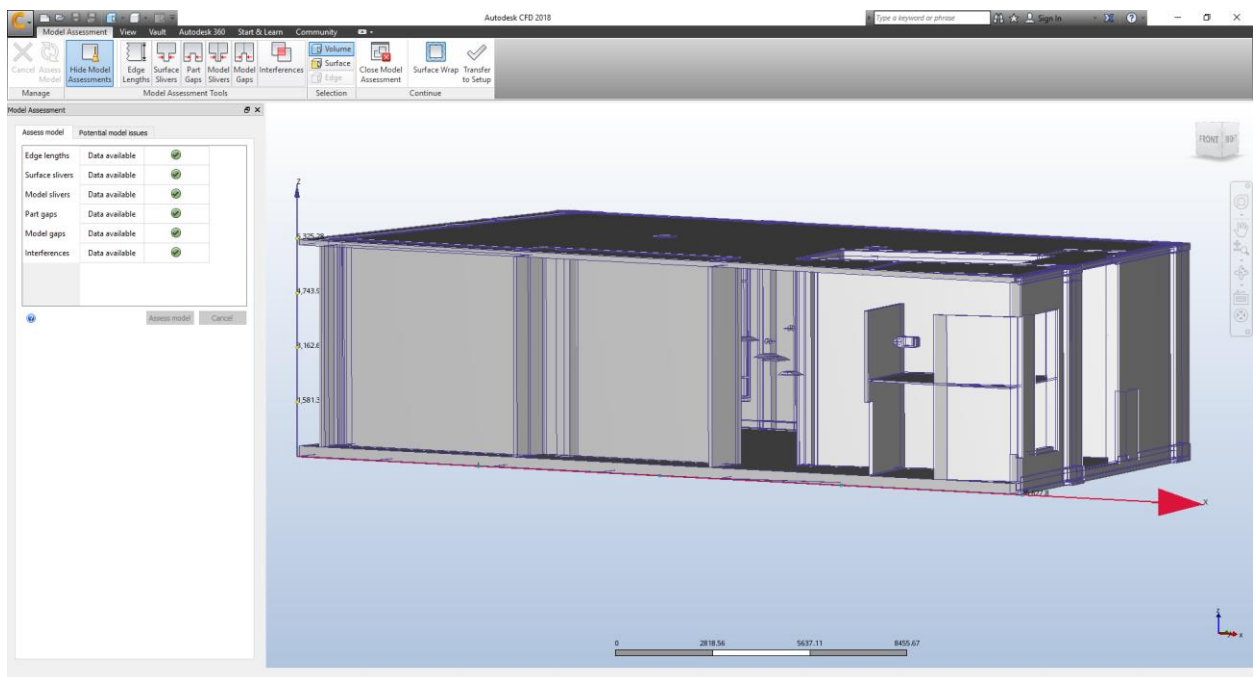
20a More examples



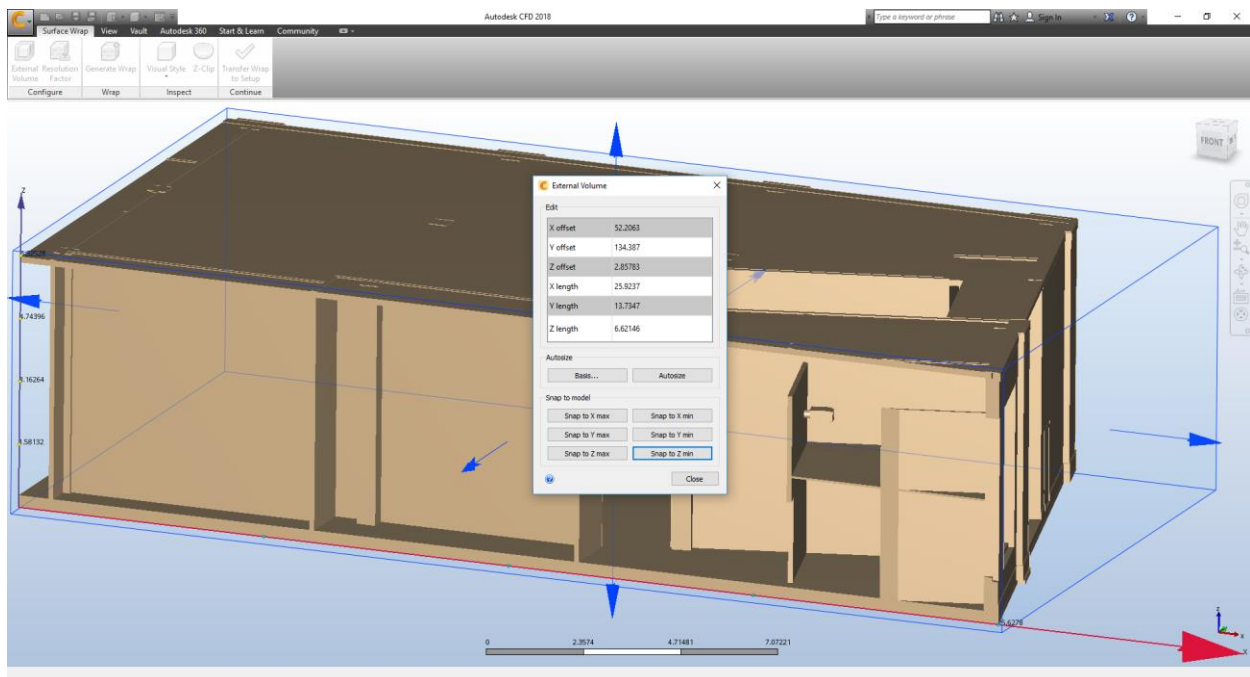
21 Prepare the view, hiding elements by category and consider view filter for the future



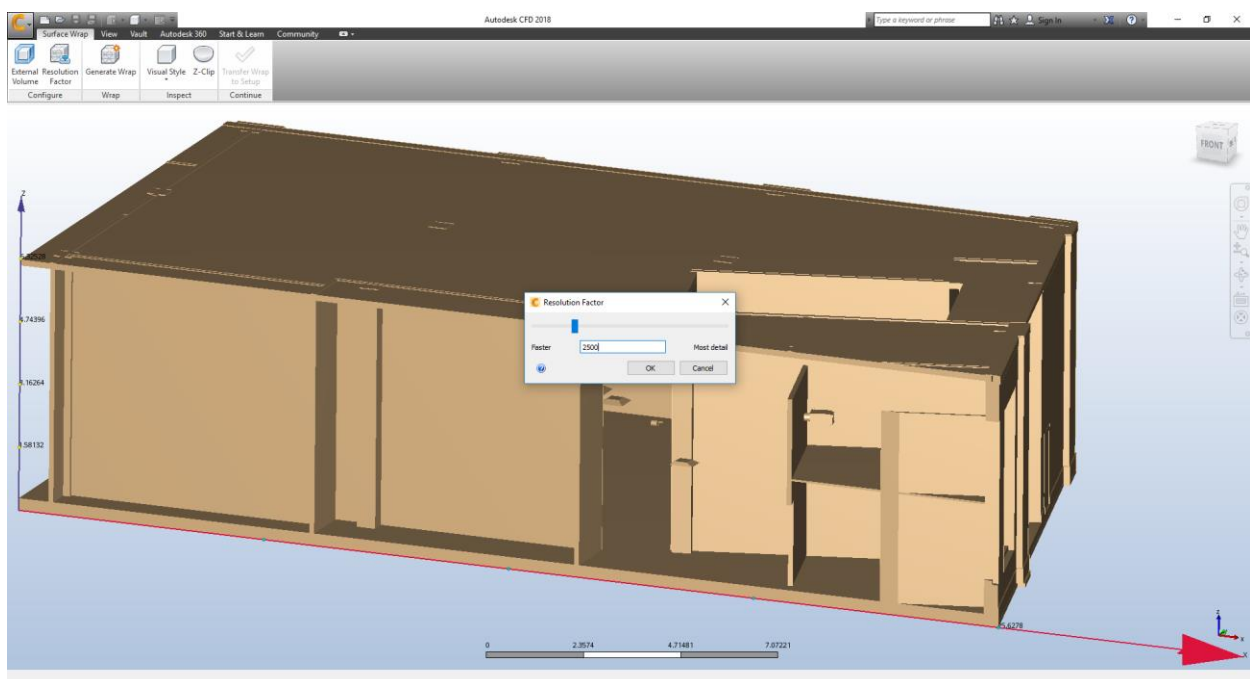
22 Launch the assessment tool



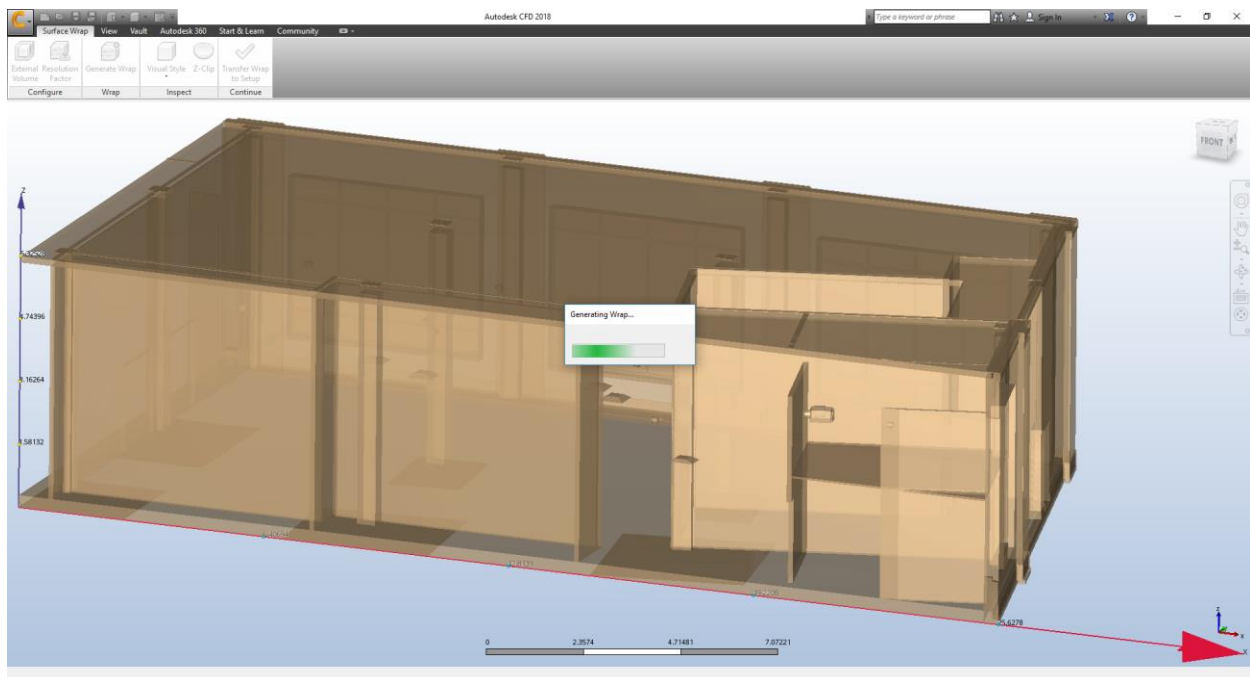
23 Review the model using the assessment tool



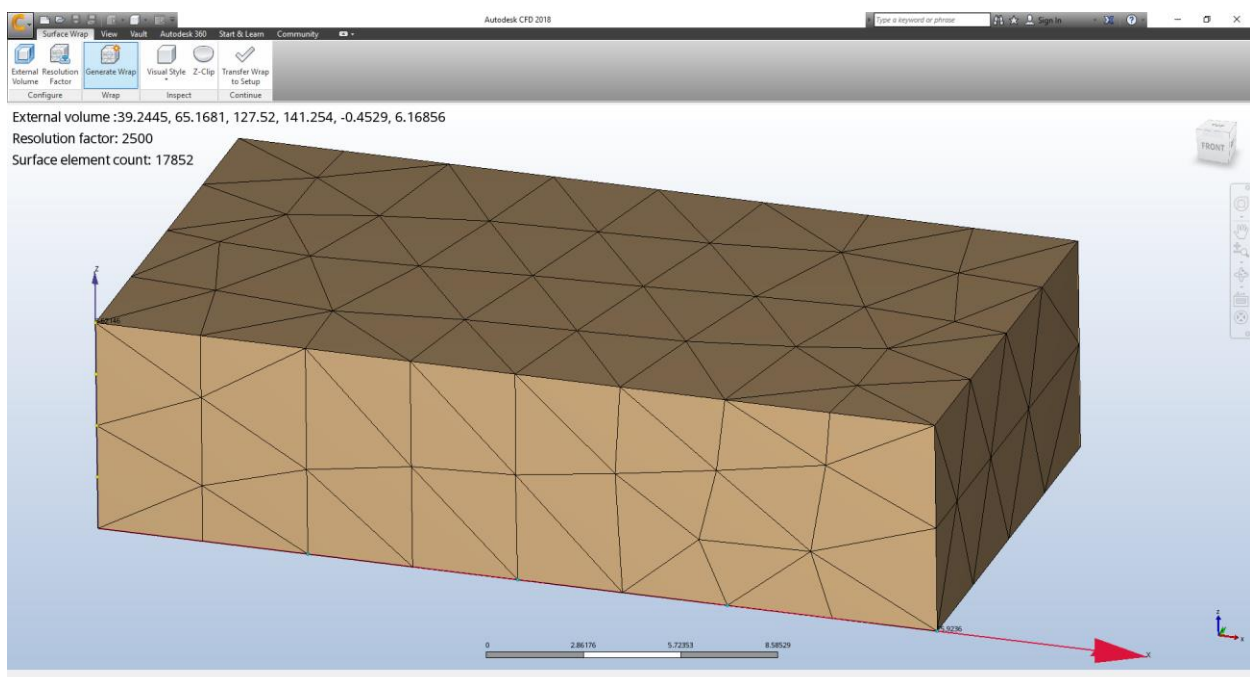
24 We can set already external volumes



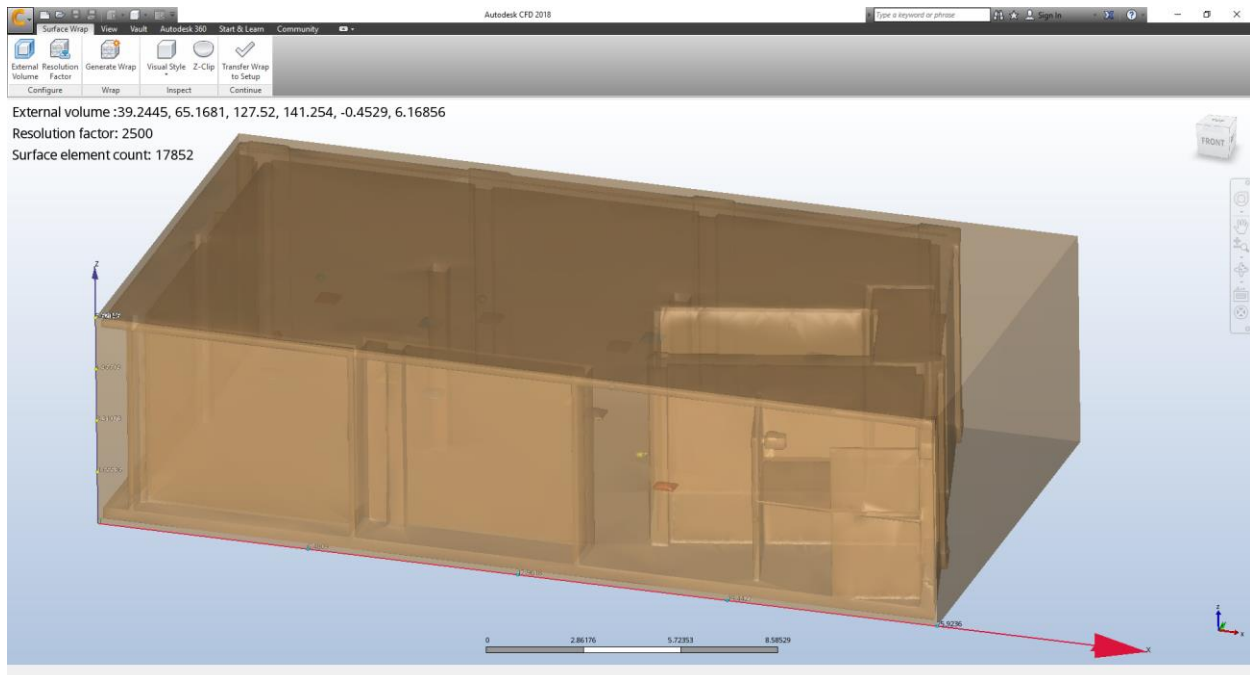
25 We can set the resolution for the meshing of our geometry



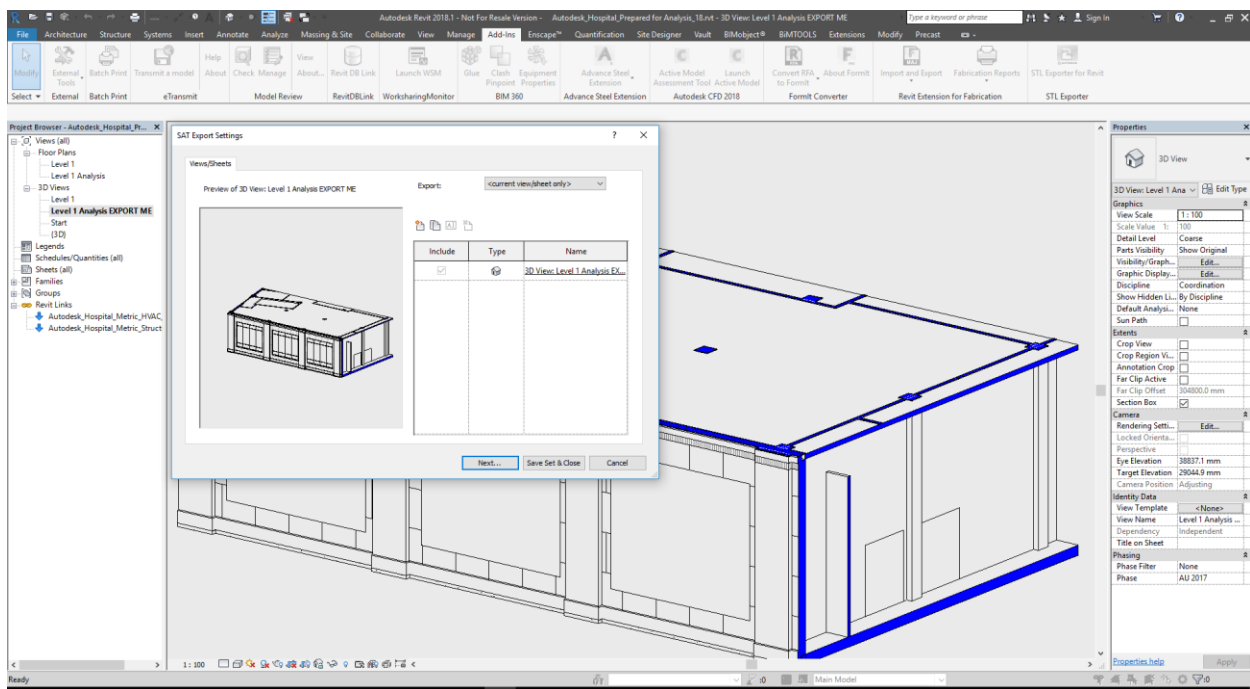
26 We can generate a wrap around our geometry. This simplifies the geometry heavily.



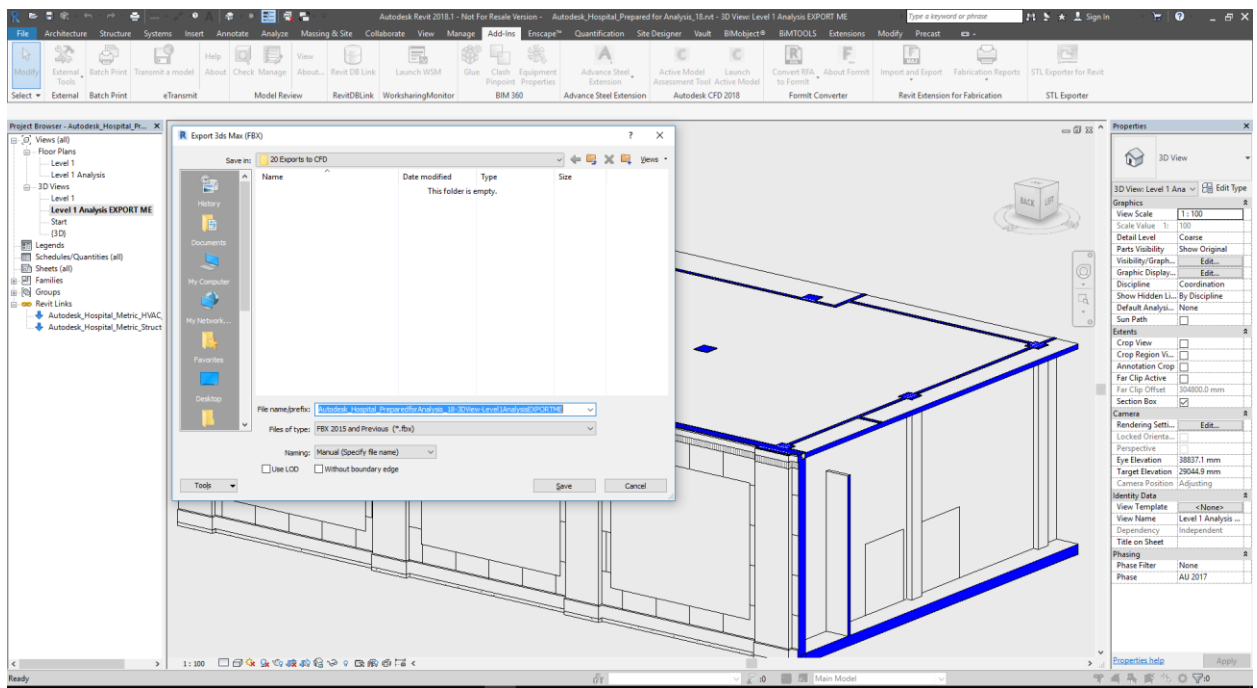
27 This shows a possible view with meshed geometry



28 This shows the meshed geometry semi-transparent



29 Another option is a SAT export

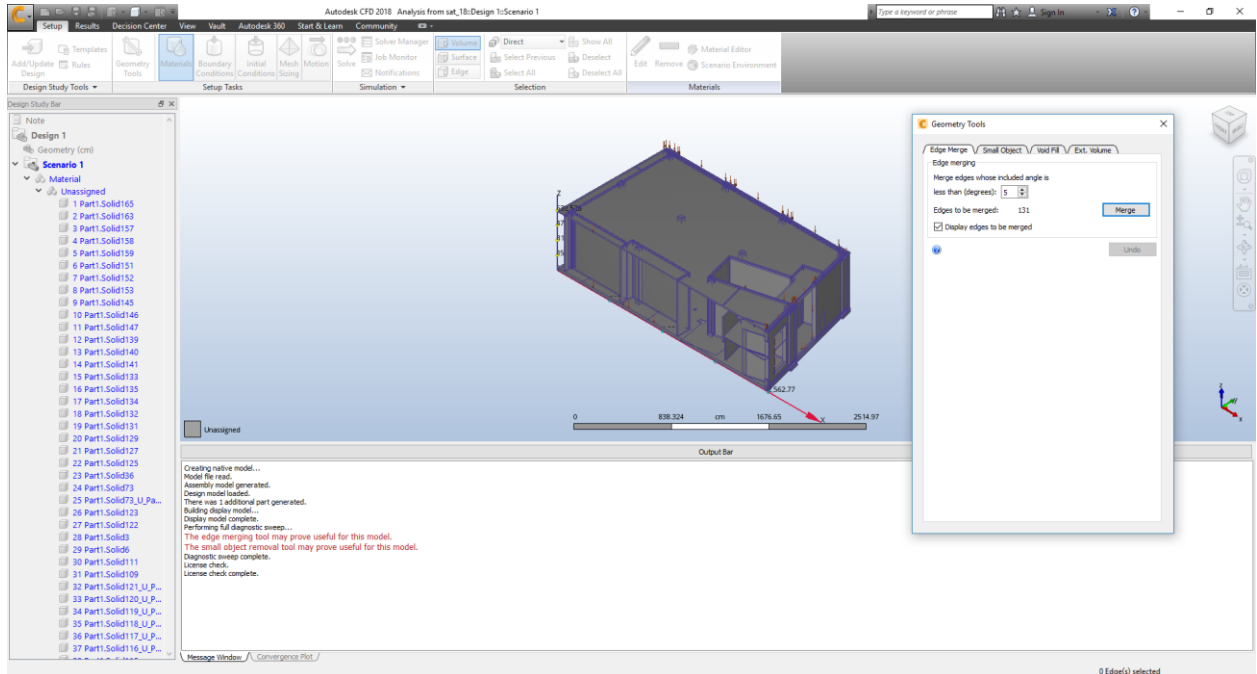


30 Another option is also a FBX export from Revit

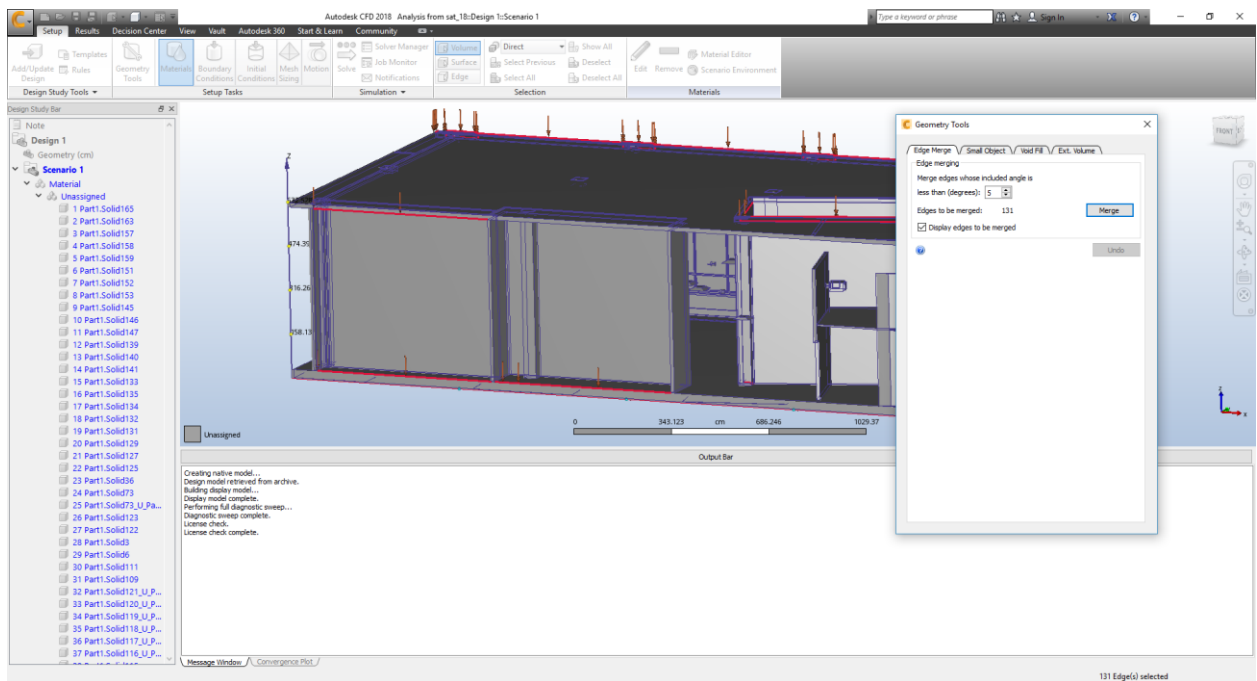
# Using the CFD Study Environment

Find the example files in: 30 CFD Projects

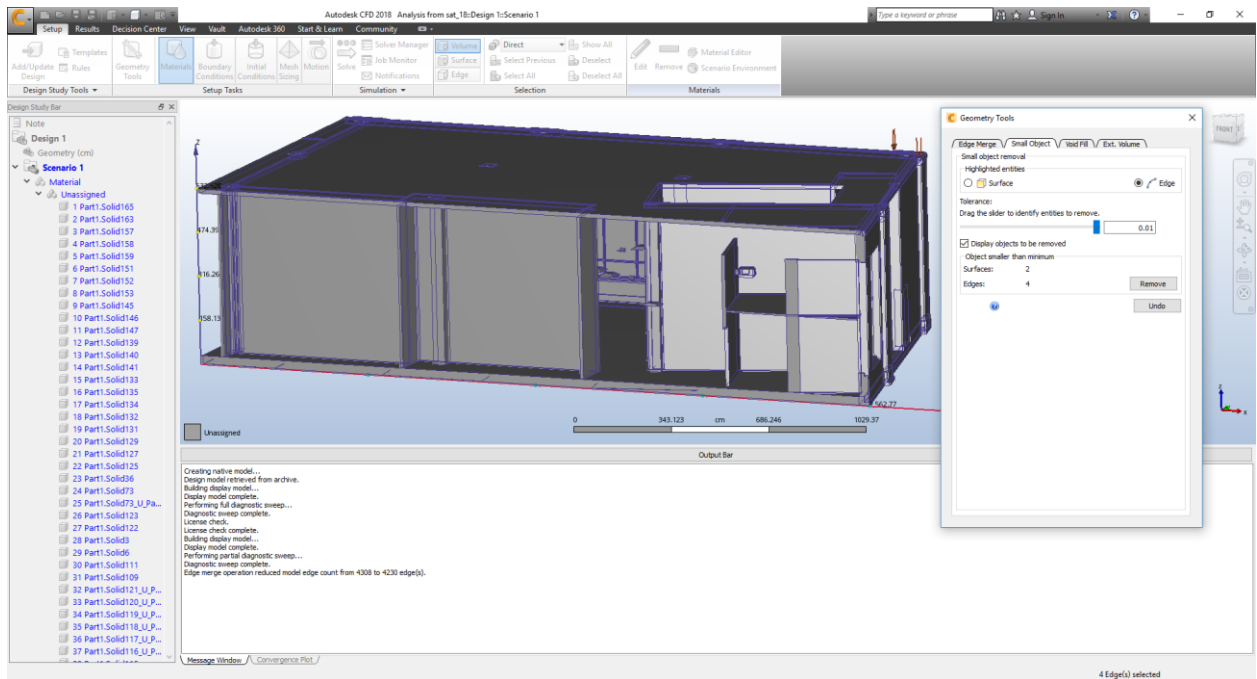
Find the screenshots in: 35 Screenshots



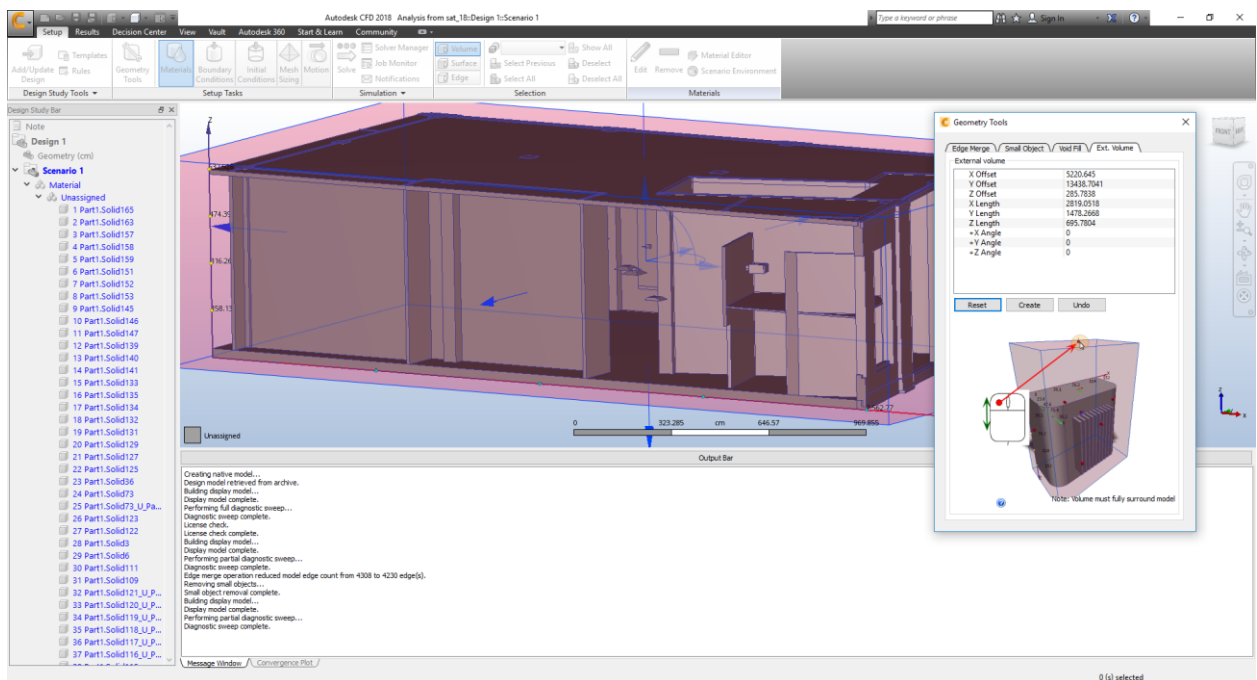
## 31 Working with the SAT file importing the geometry



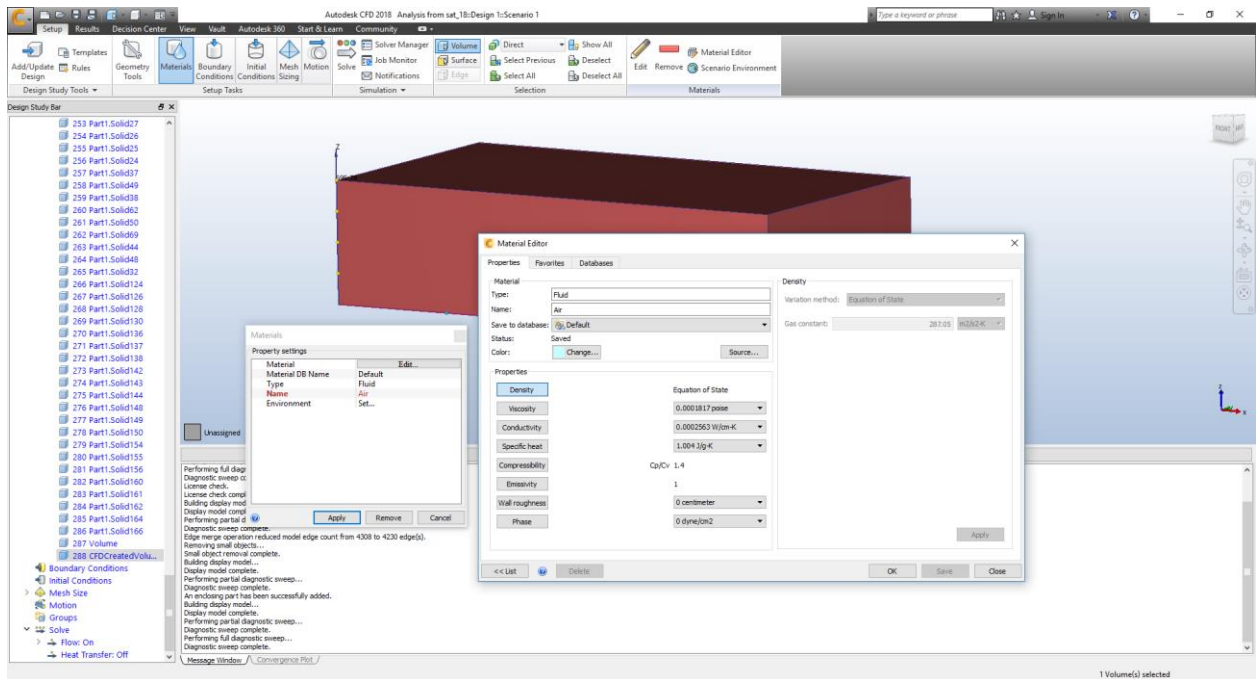
## 32 Merging complex edges



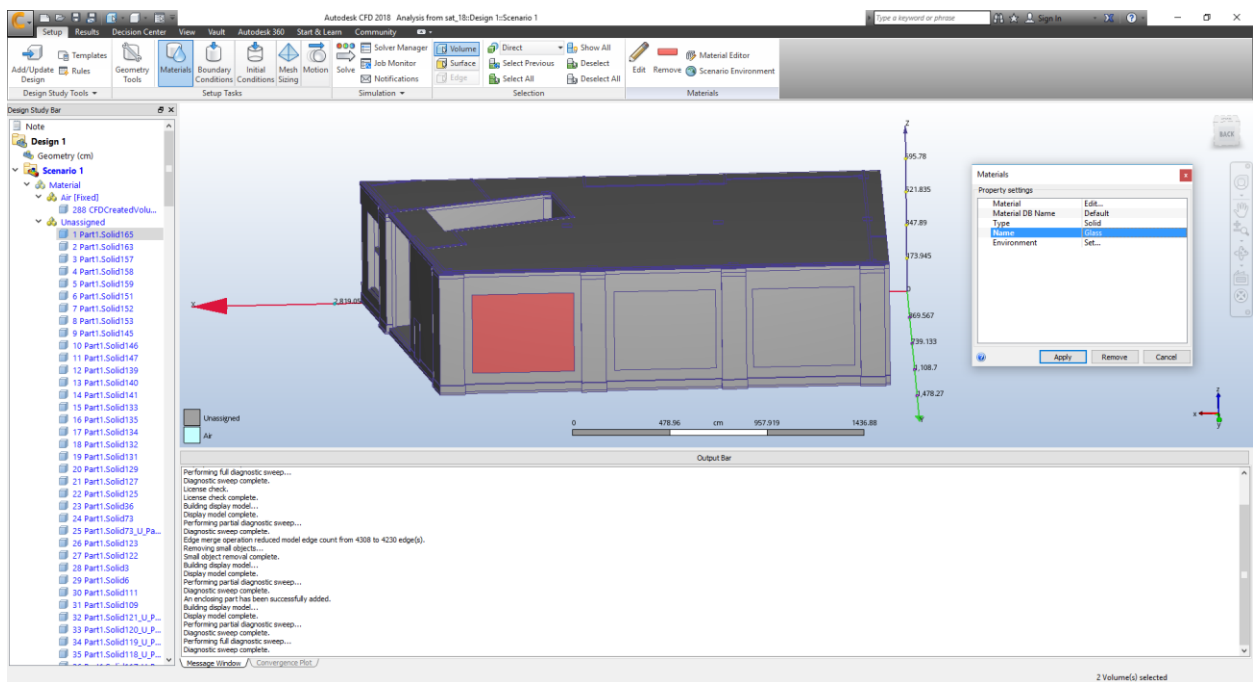
### 33 Removing of small objects



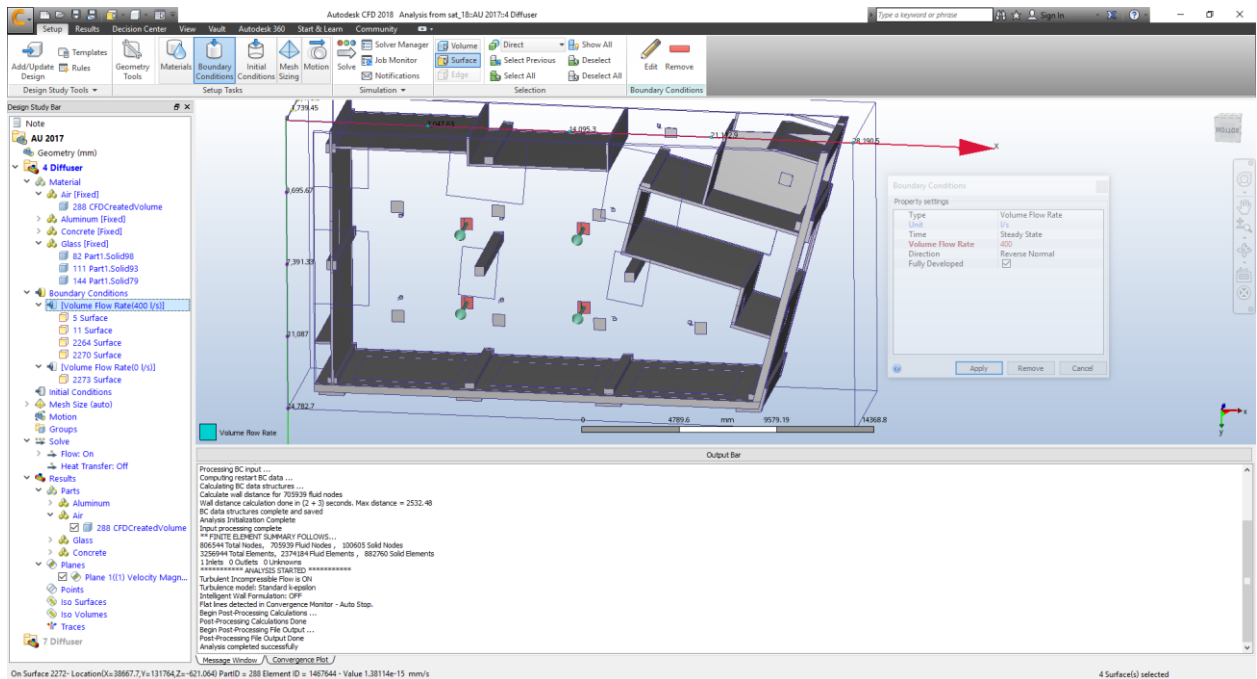
### 34 Creating an external volume



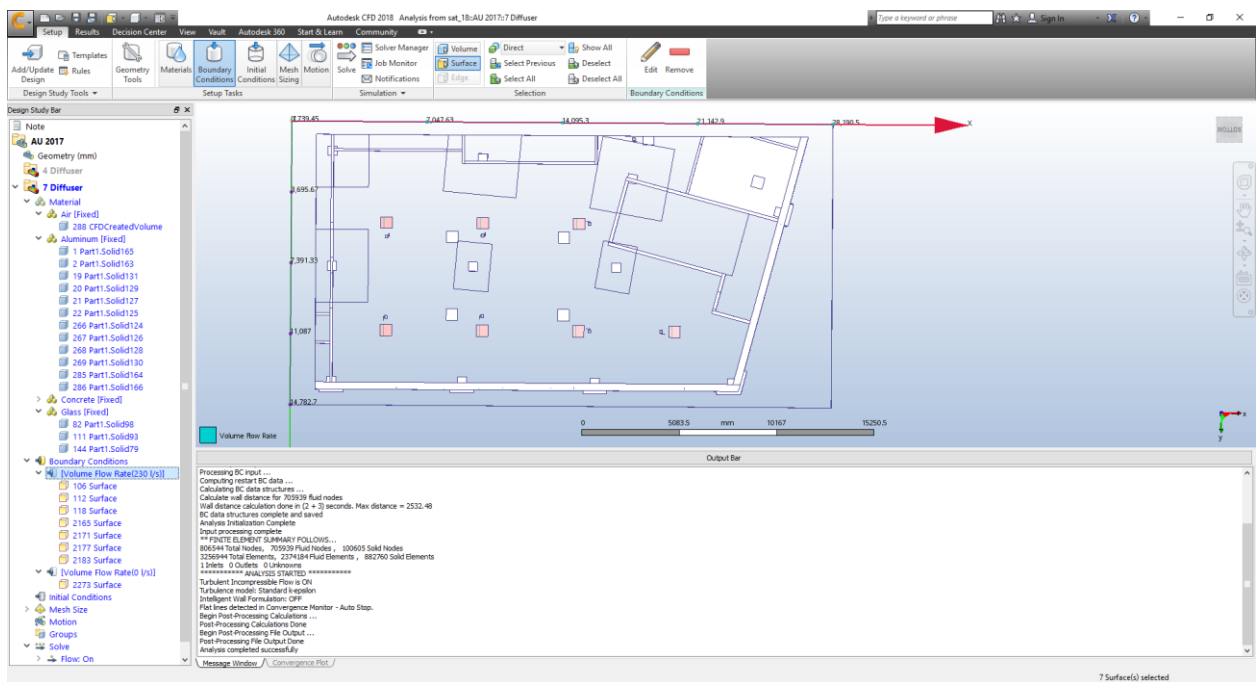
### 35 Apply the material AIR



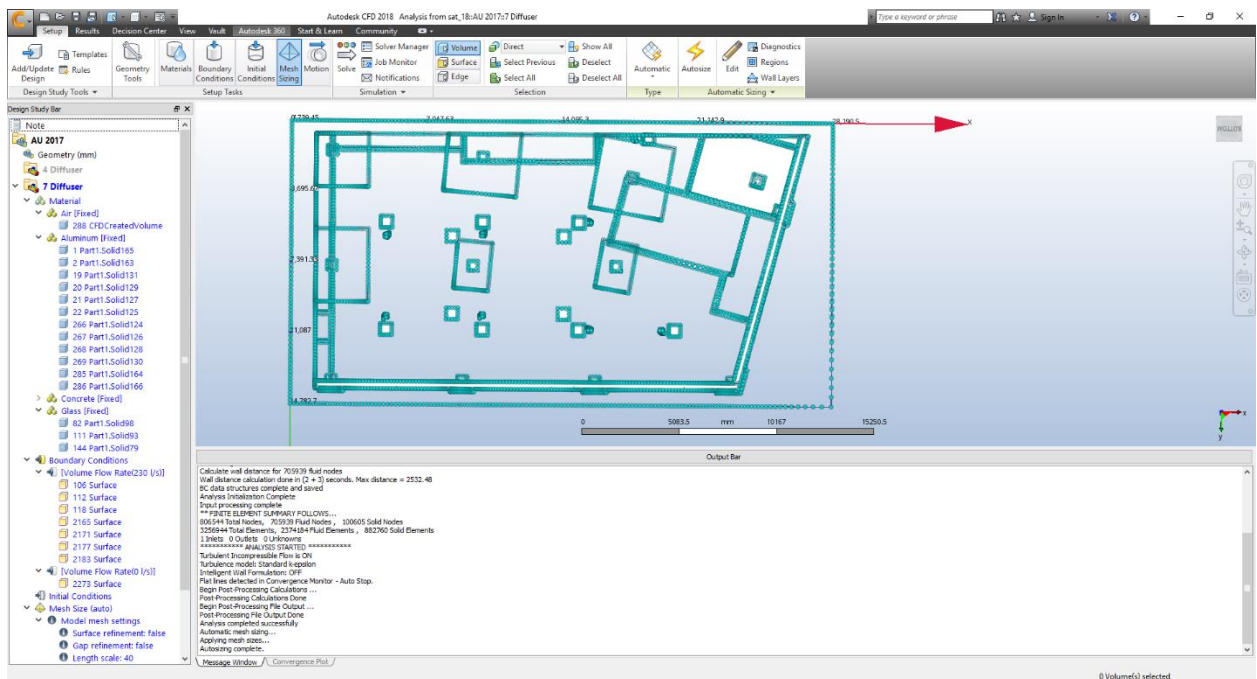
### 36 Apply other materials and hide not required geometry



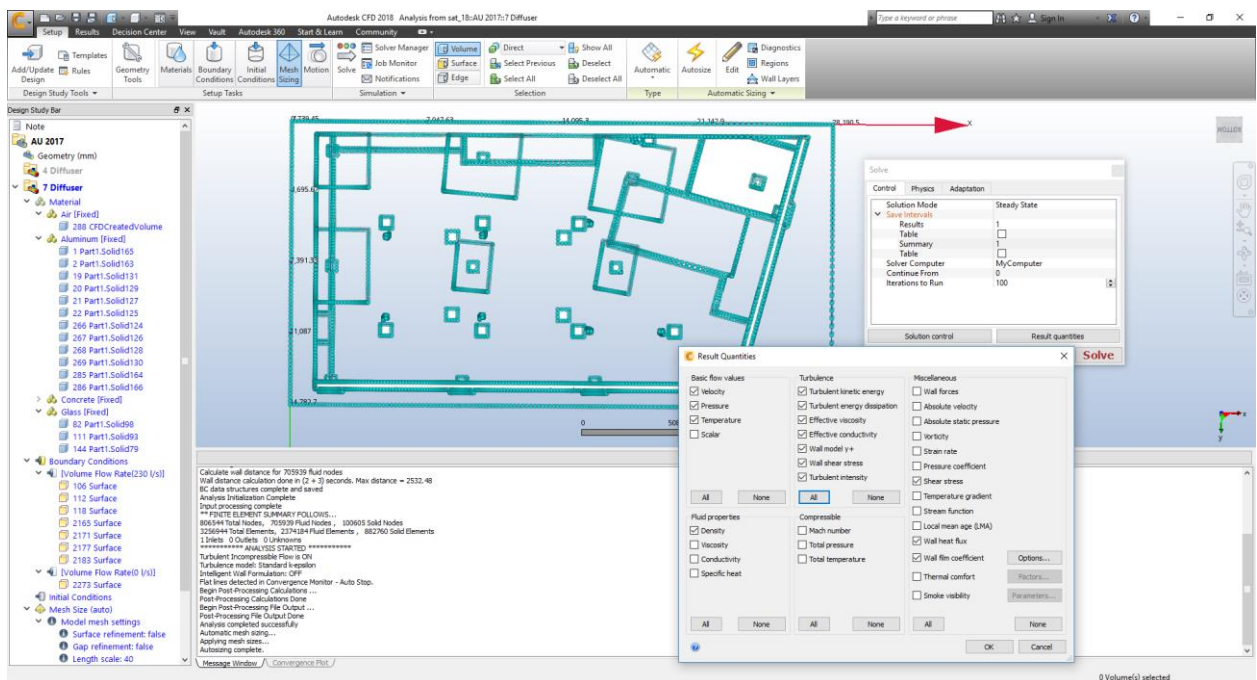
### 37 Set up the boundary conditions



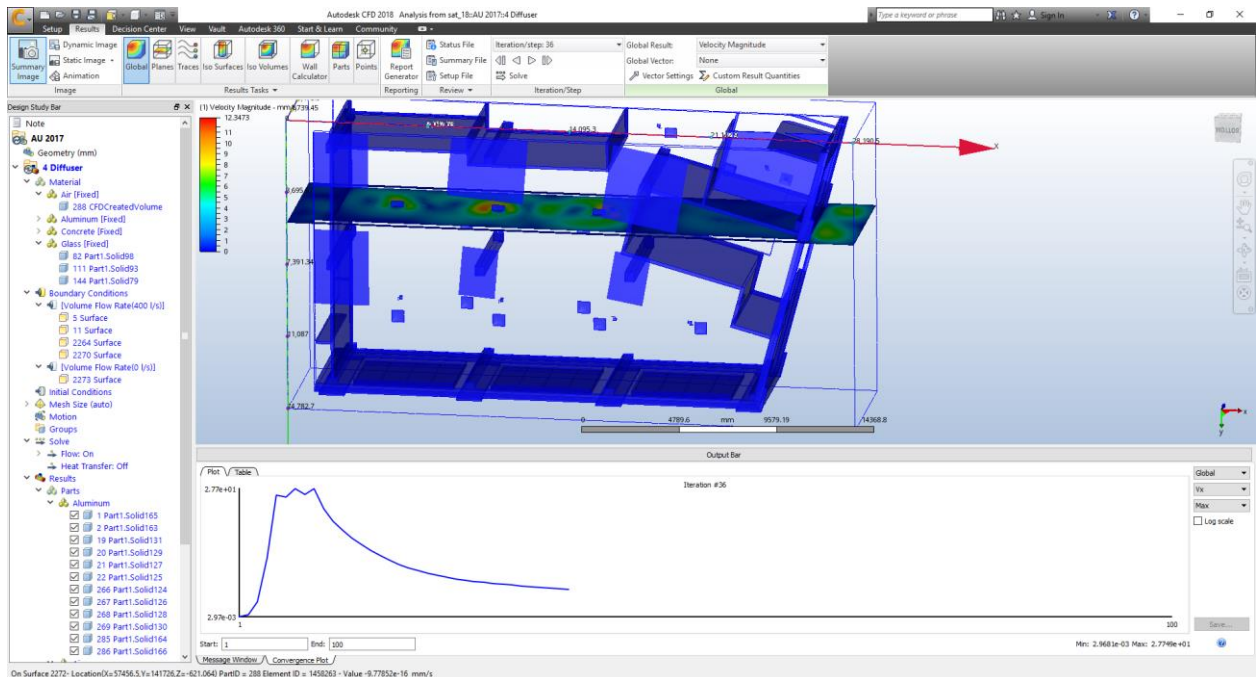
### 38 We can clone the case to compare studies



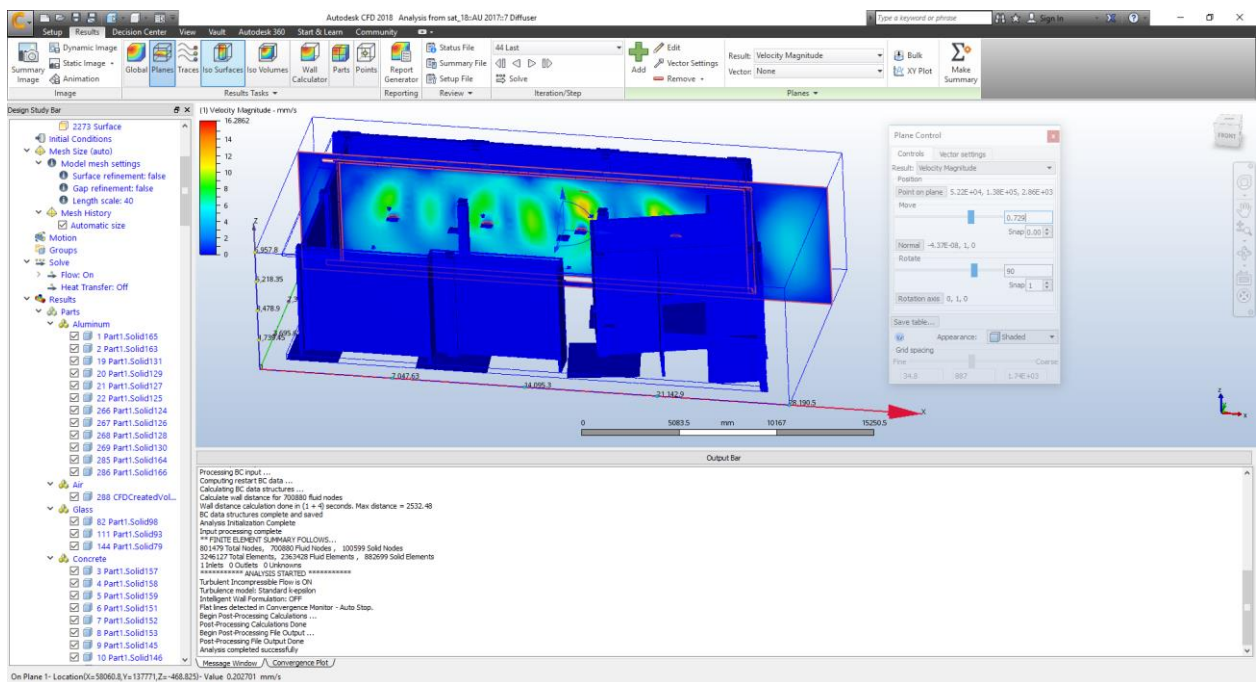
### 39 Setup the mesh for the analysis to run



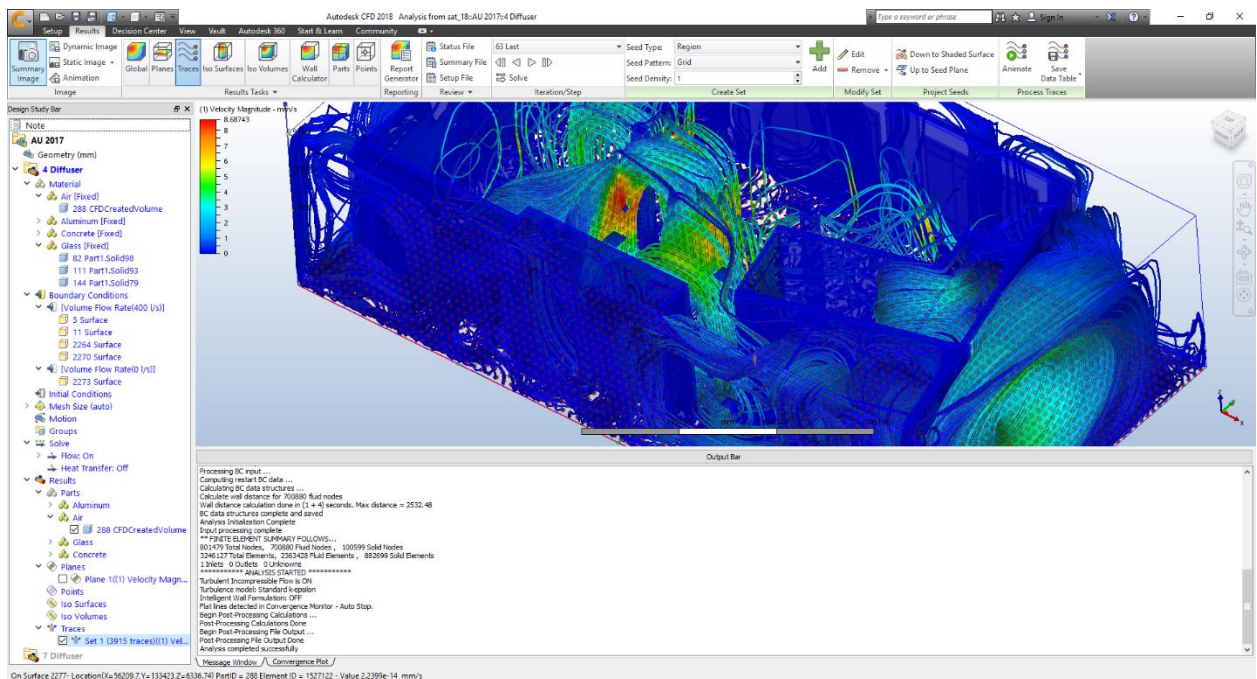
### 40 Check SOLVE and the required quantities



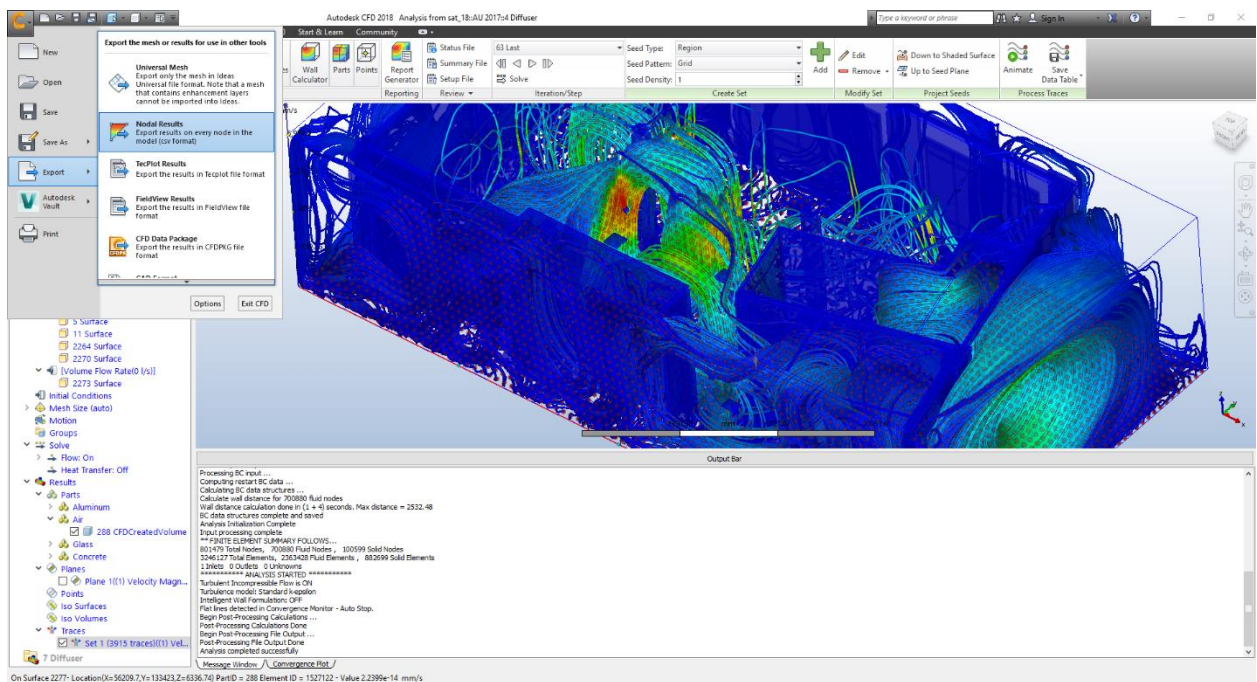
41 Review the convergence plot



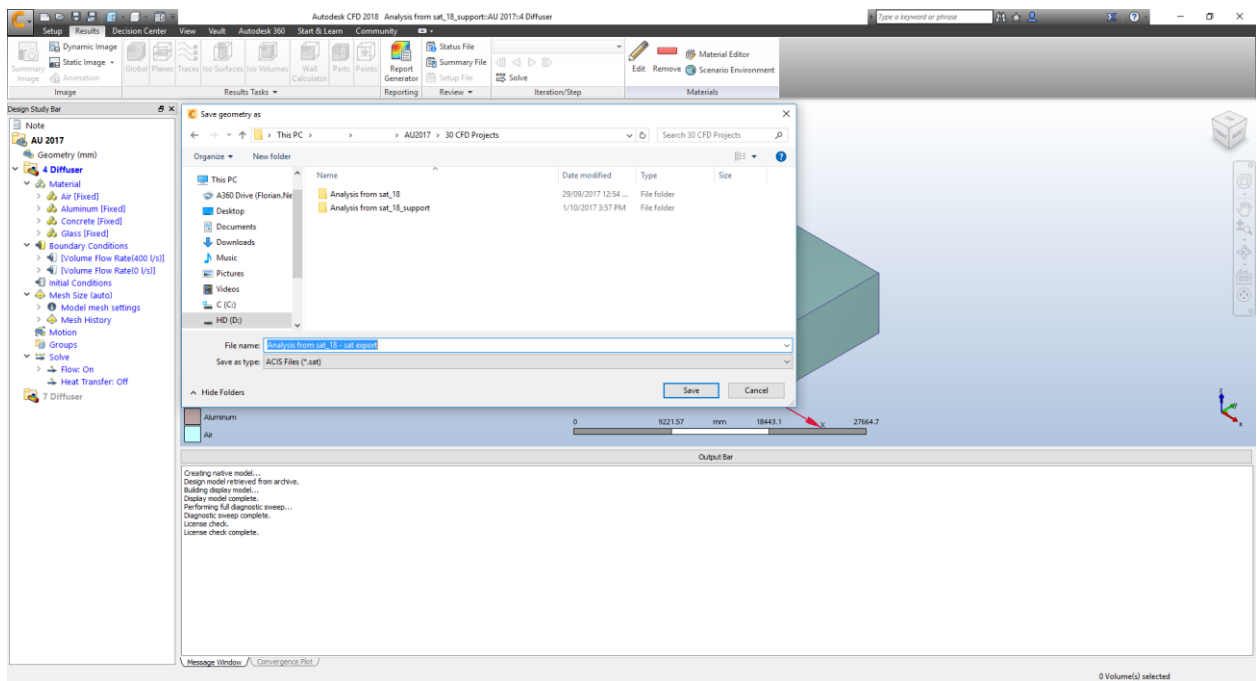
42 Review the complete analysis



43 We can trace the flows



44 Export the nodal results

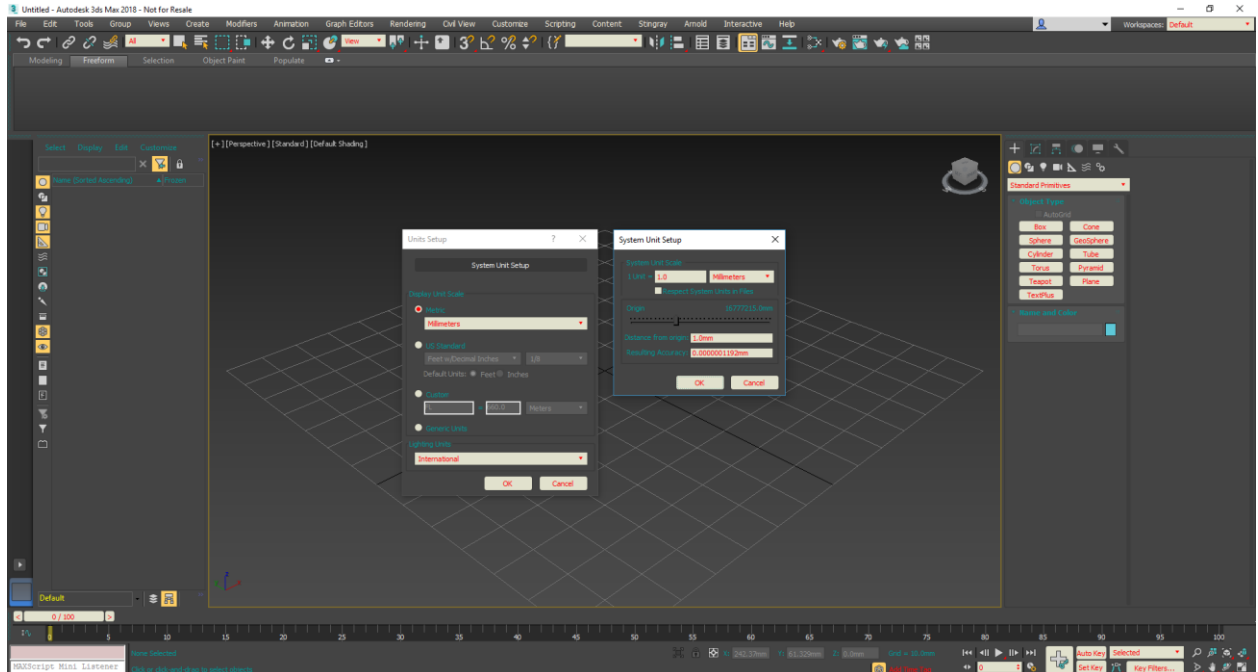


45 Also export the touched-up geometry from the CFD Study Environment

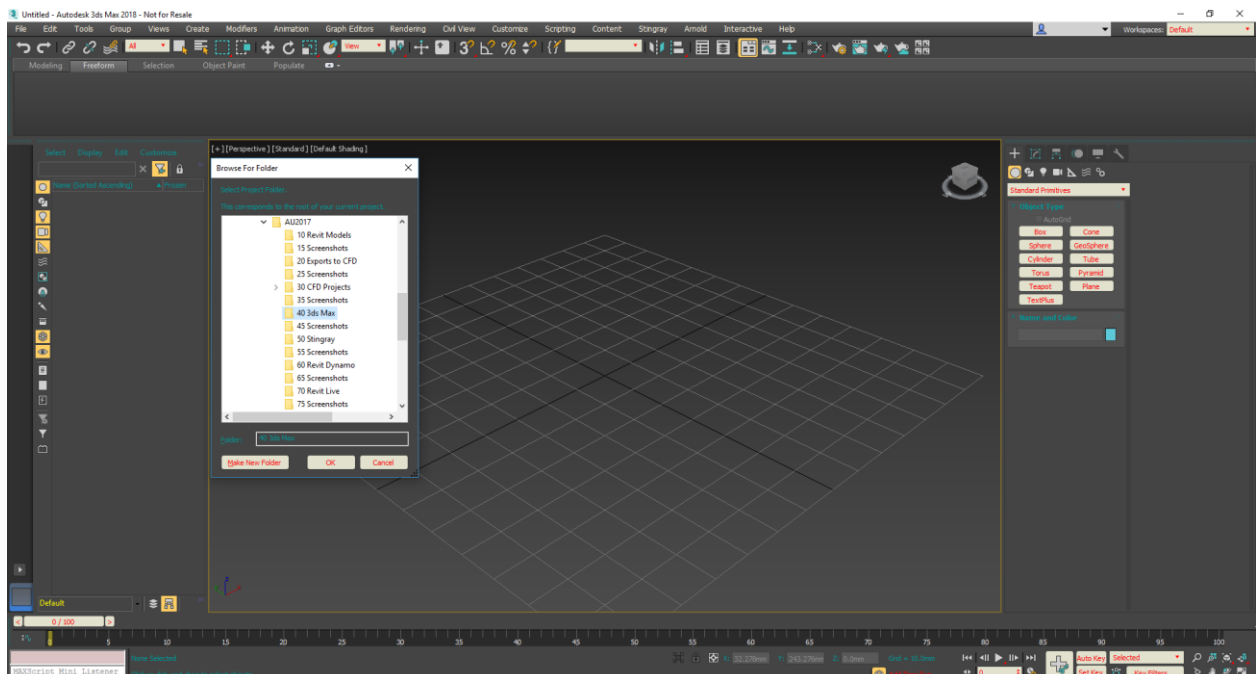
## Preparing the results with 3ds Max

Find the example files in: 40 3ds Max

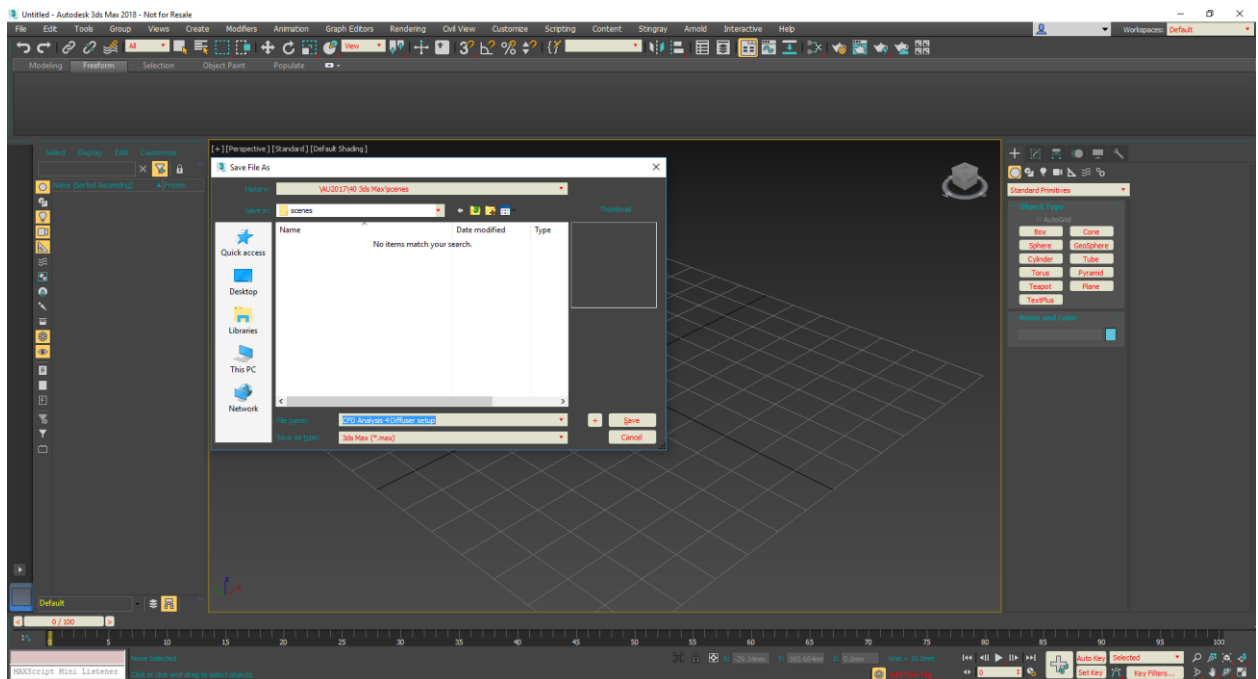
Find the screenshots in: 45 Screenshots



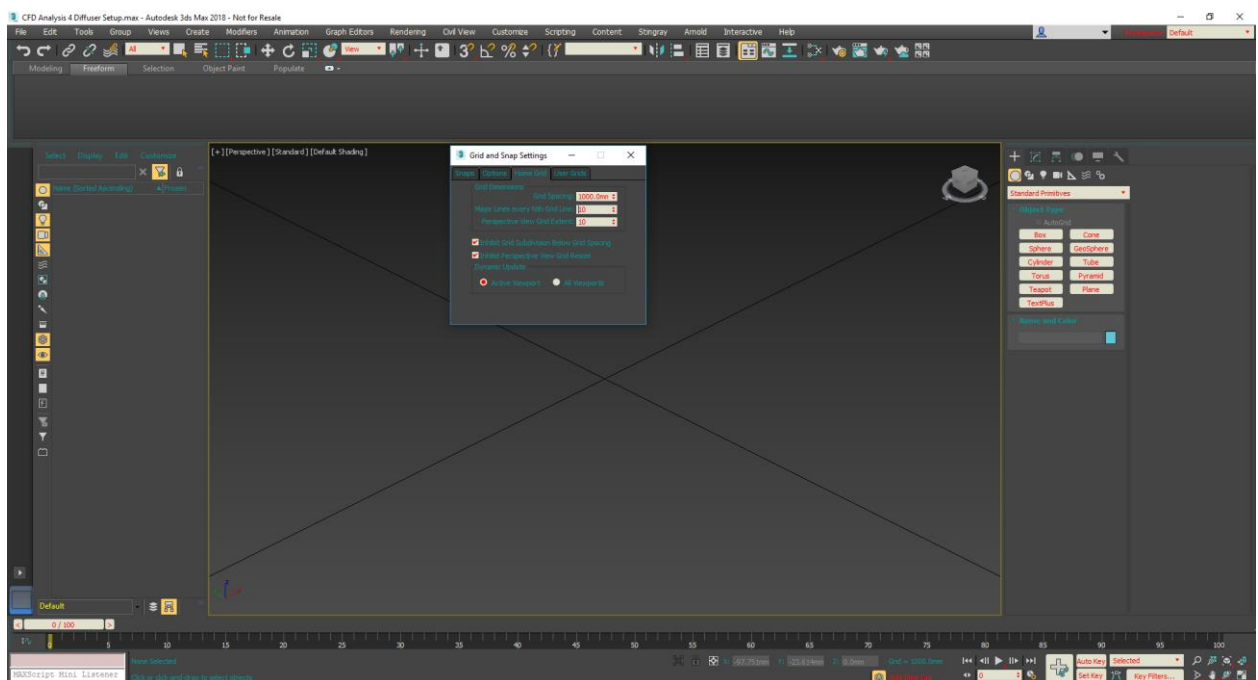
46 Always check the units first when opening 3ds Max



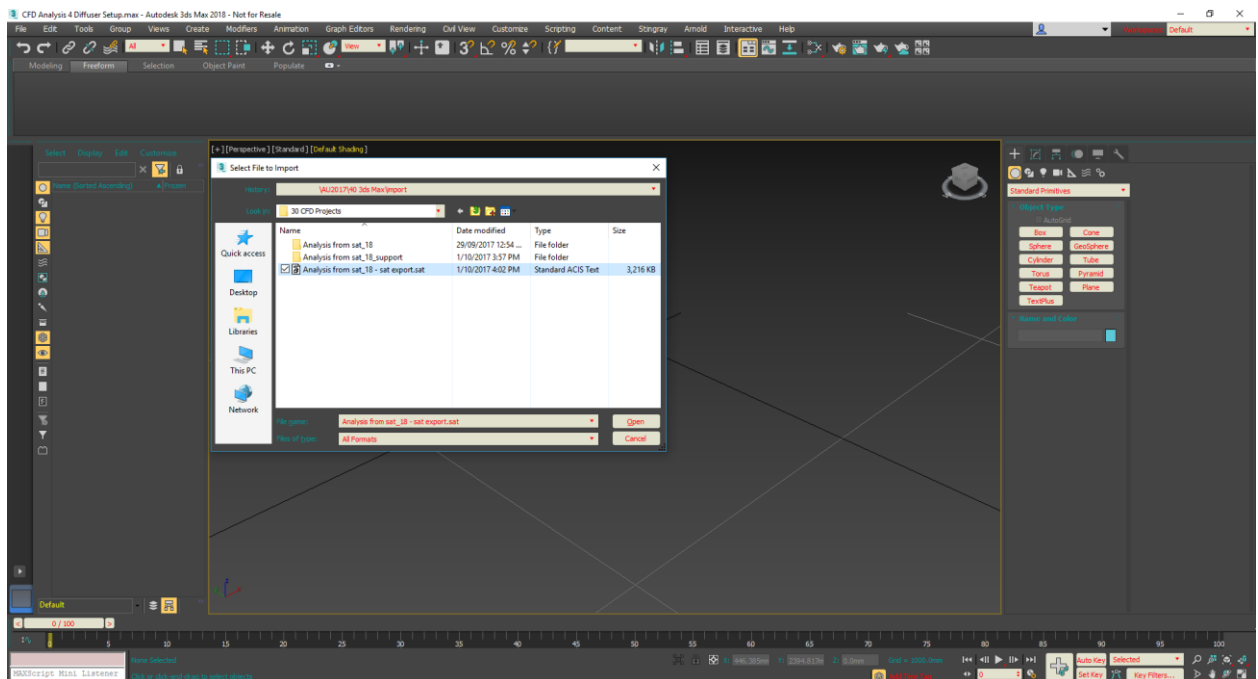
## 47 Always check the project folder when starting to work with 3ds Max



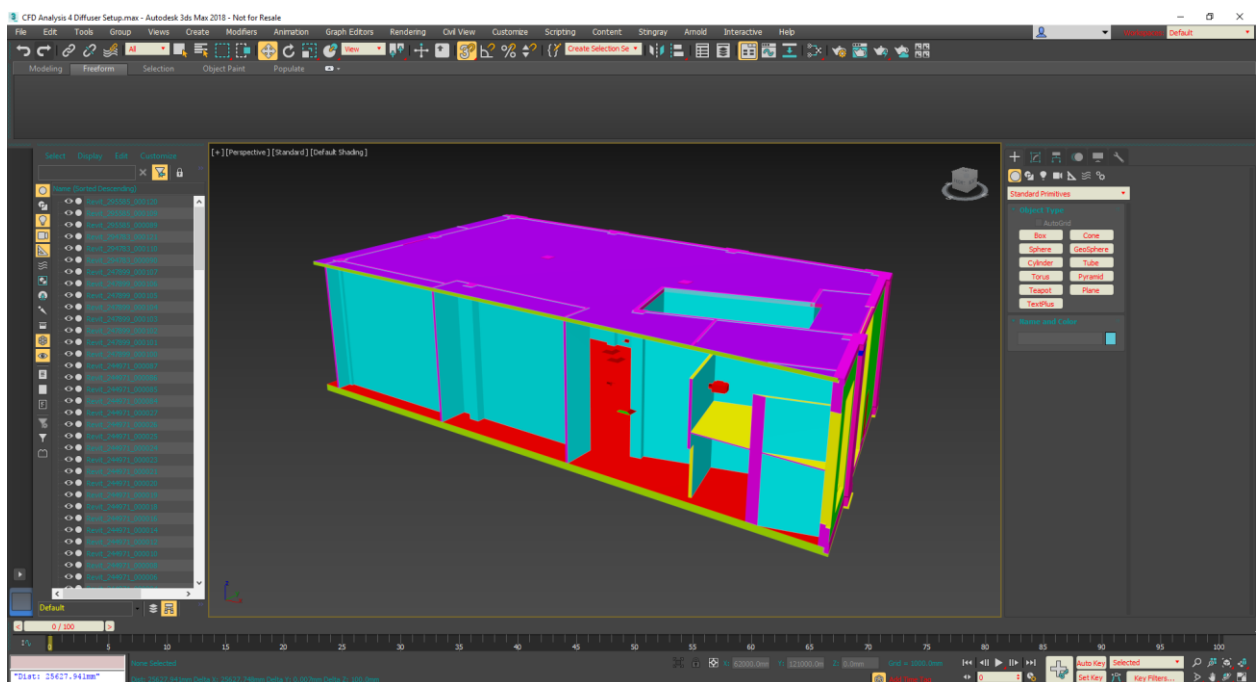
48 Save the project as the 4 diffuser configuration



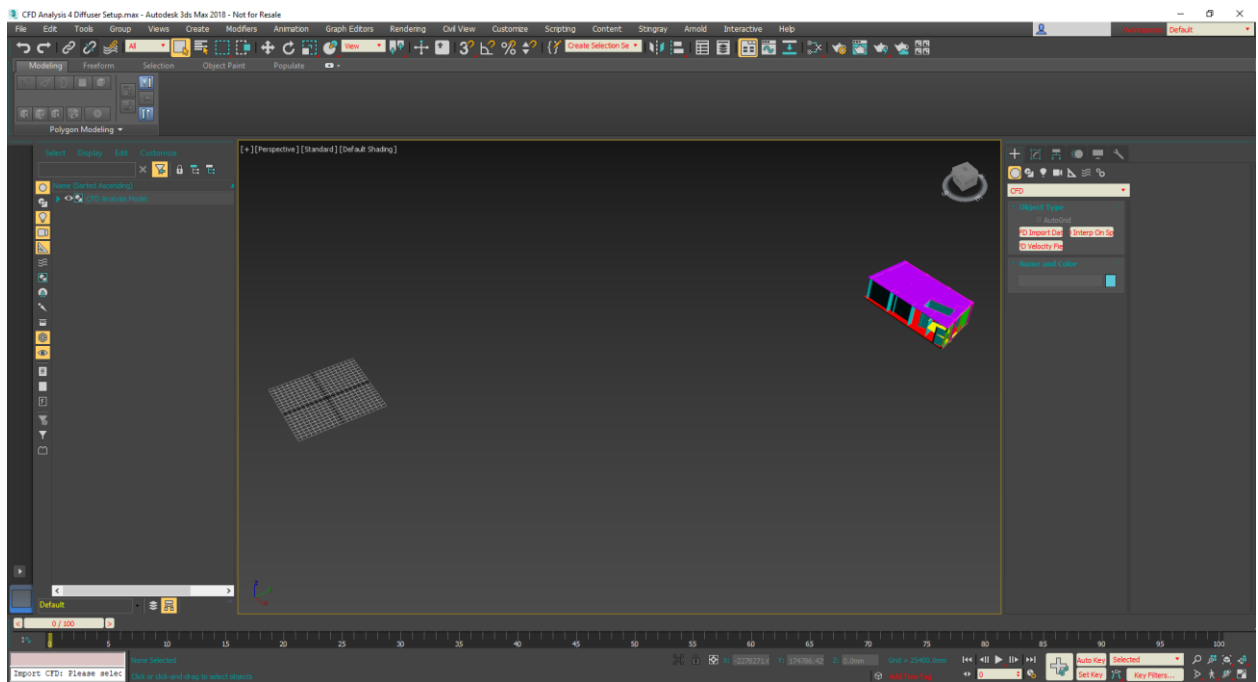
49 Setup the grid to suit the project



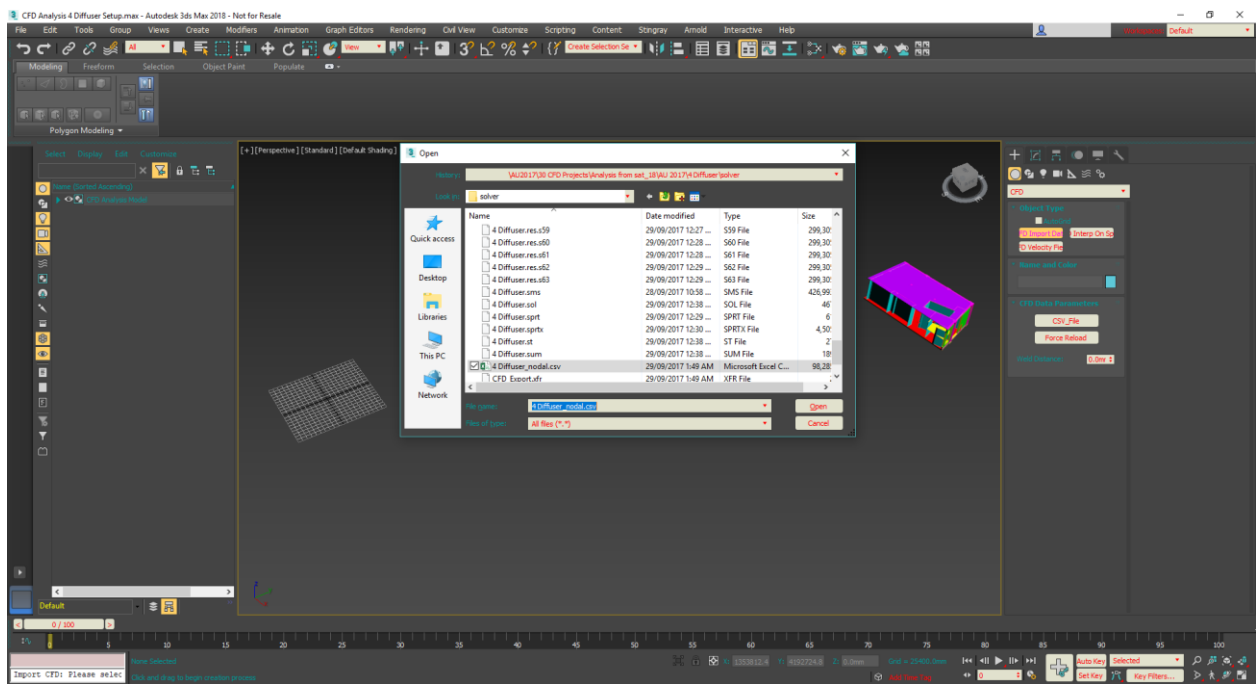
50 Import the SAT file



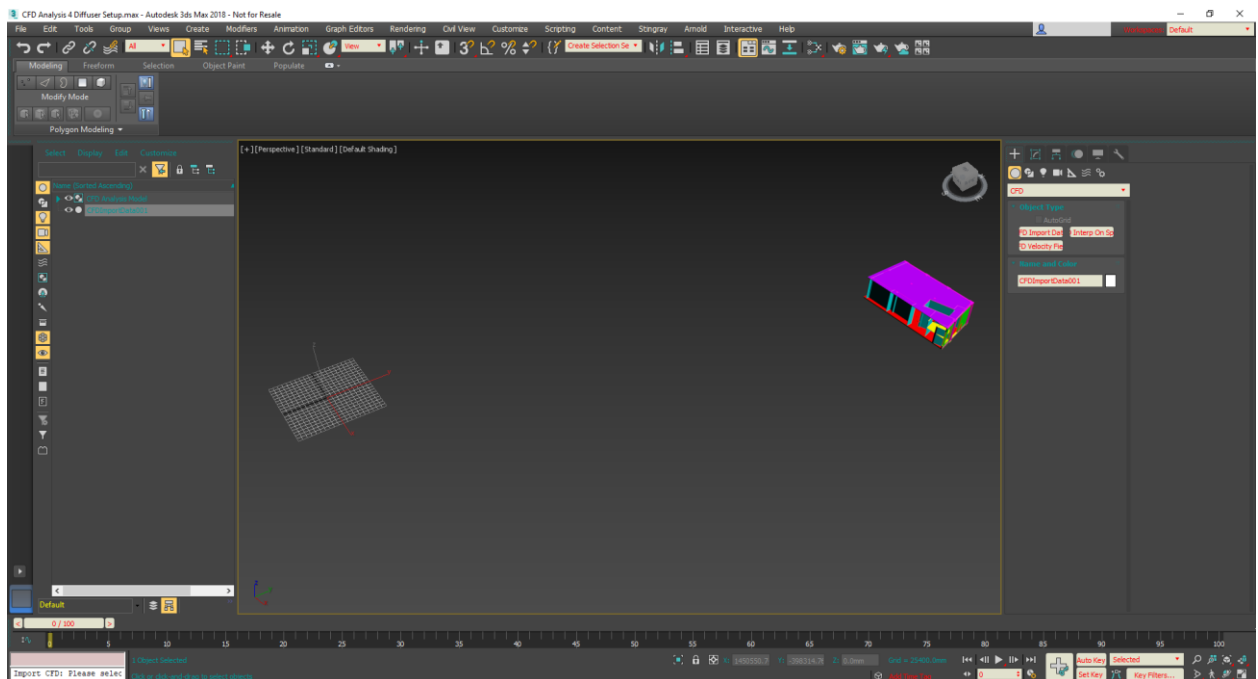
51 Check the dimensions measuring the geometry



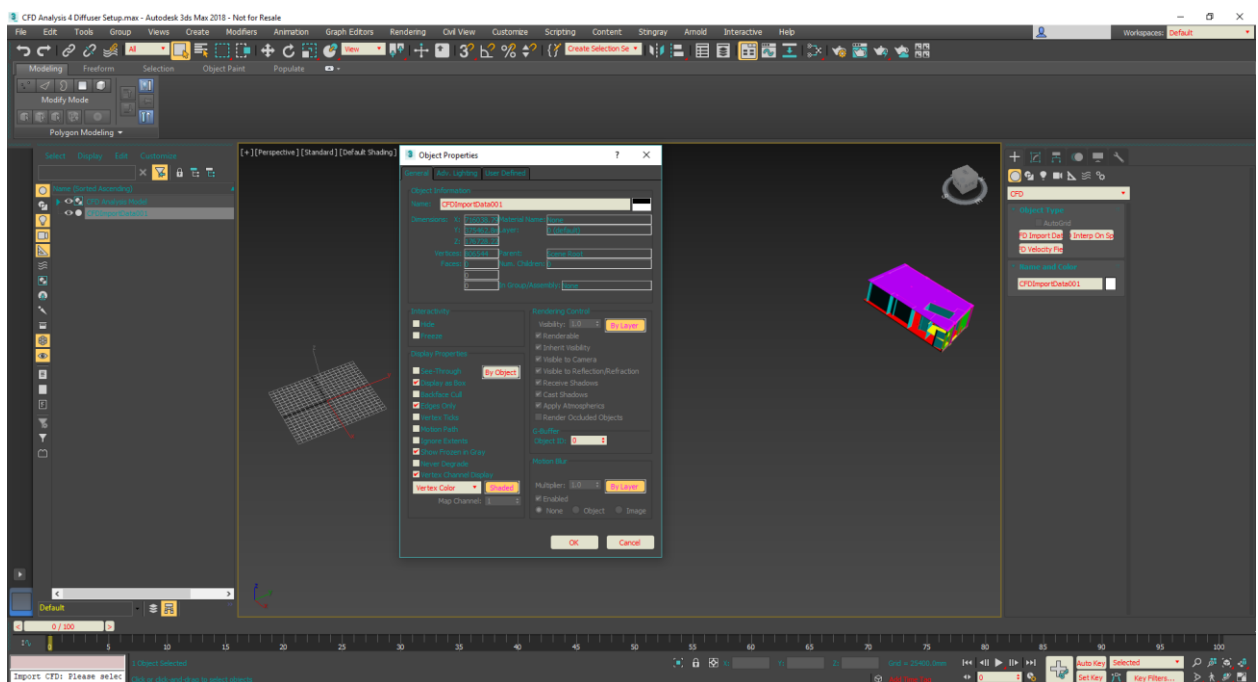
52 Prepare your working view



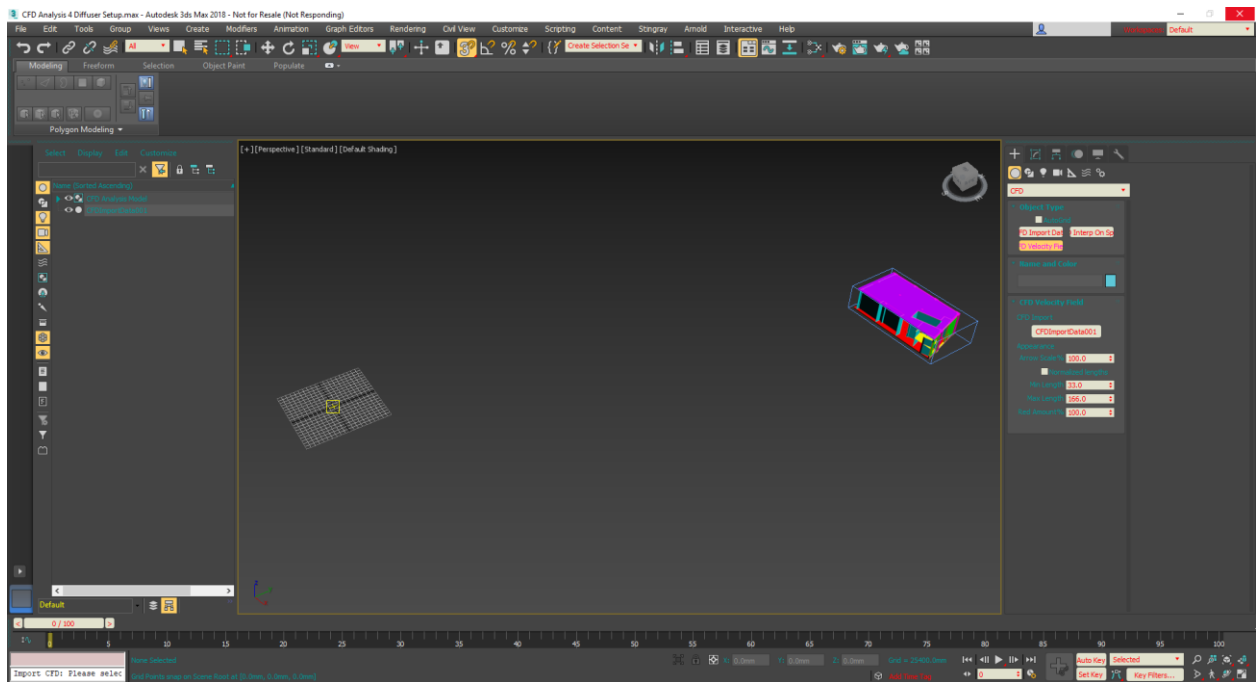
53 Import the CFD csv file



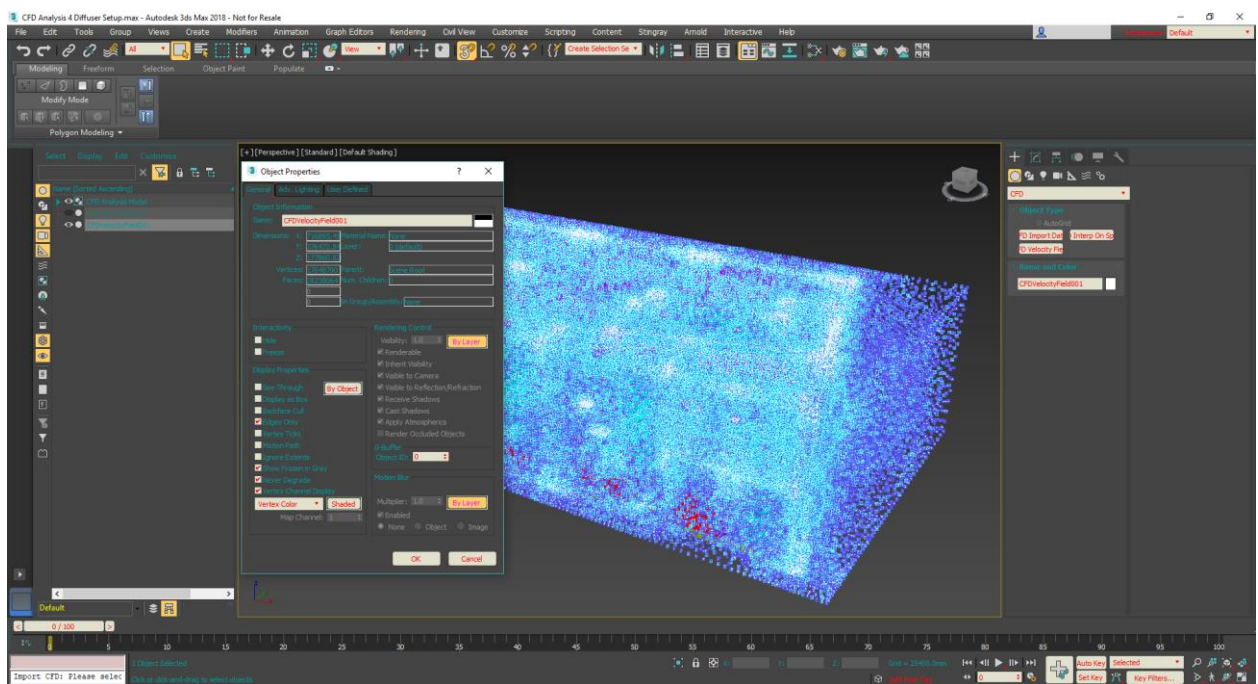
54 Place the object on the origin, even if you don't see it immediately



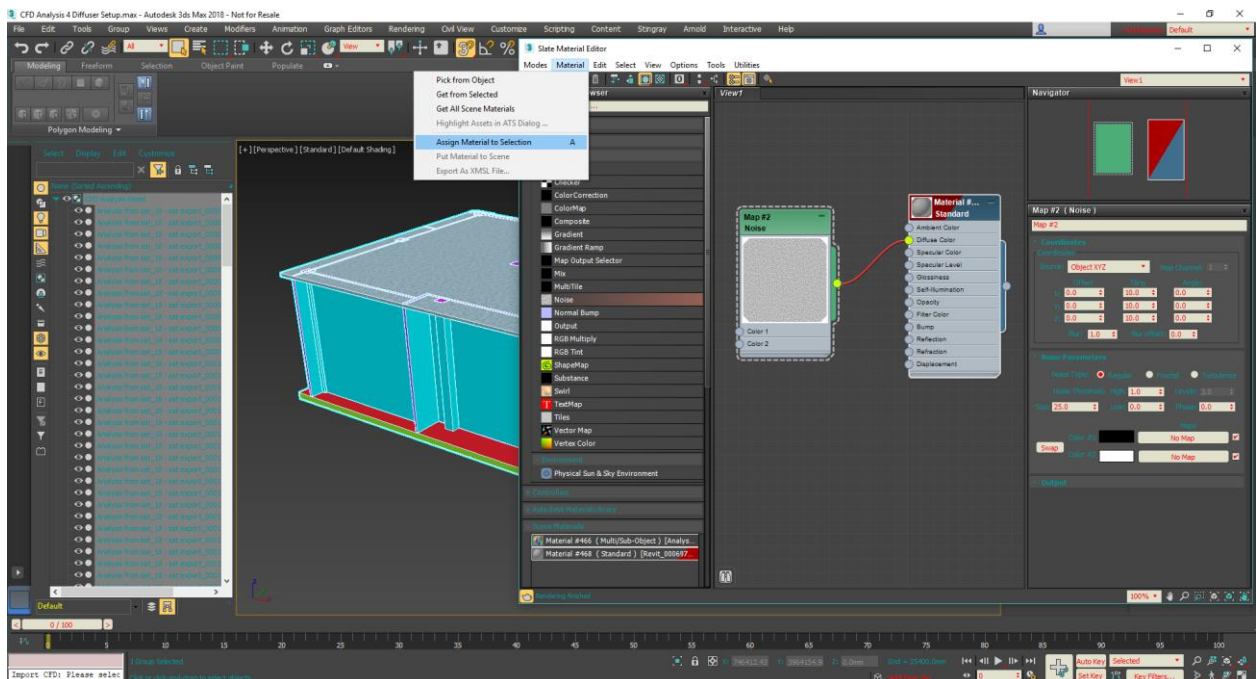
55 Update the properties



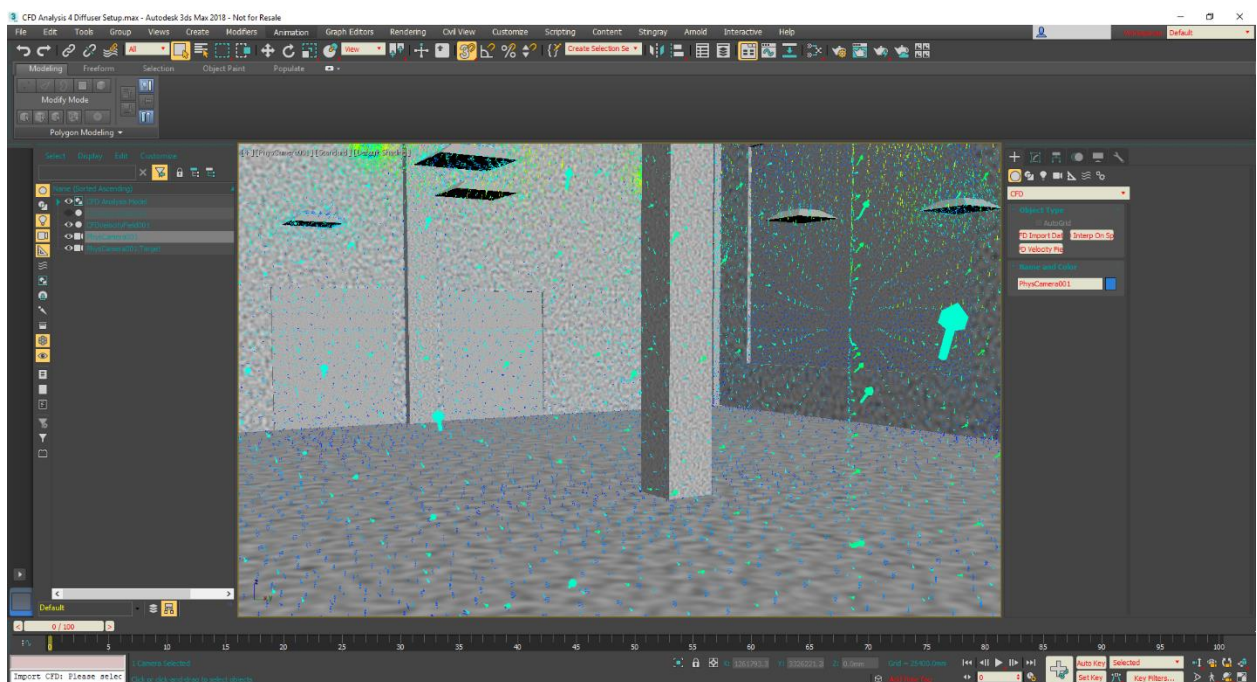
56 Create the velocity field on the origin



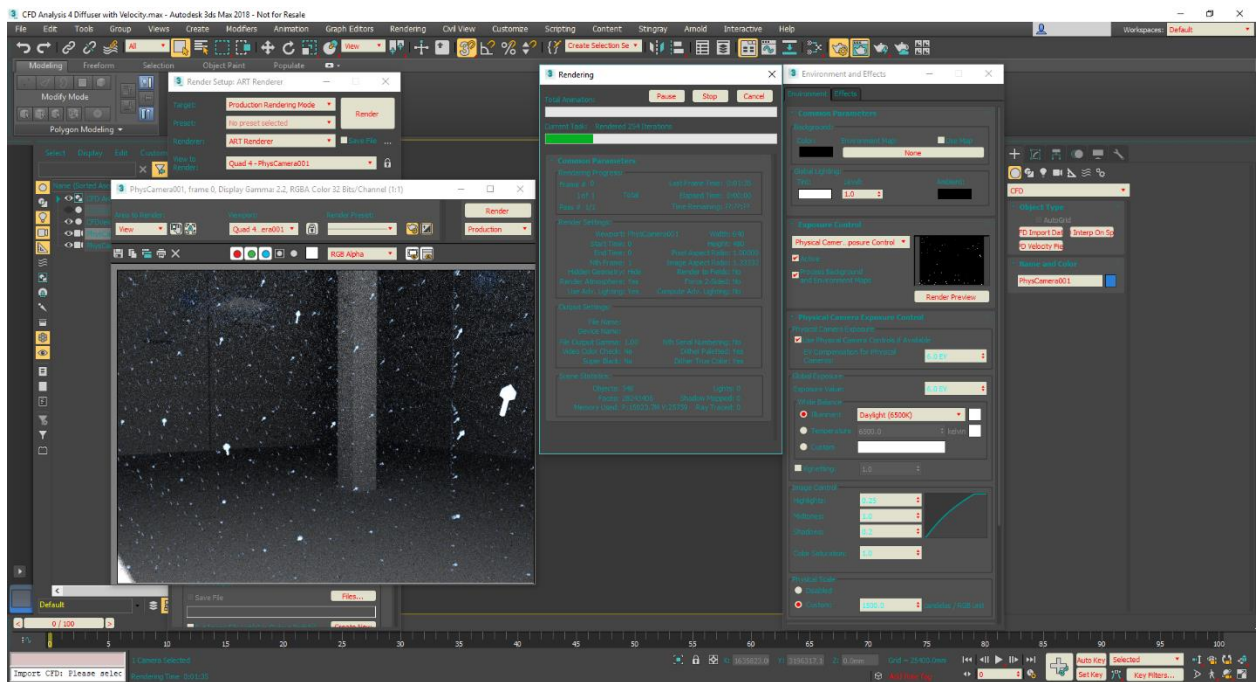
57 Update the properties of the field



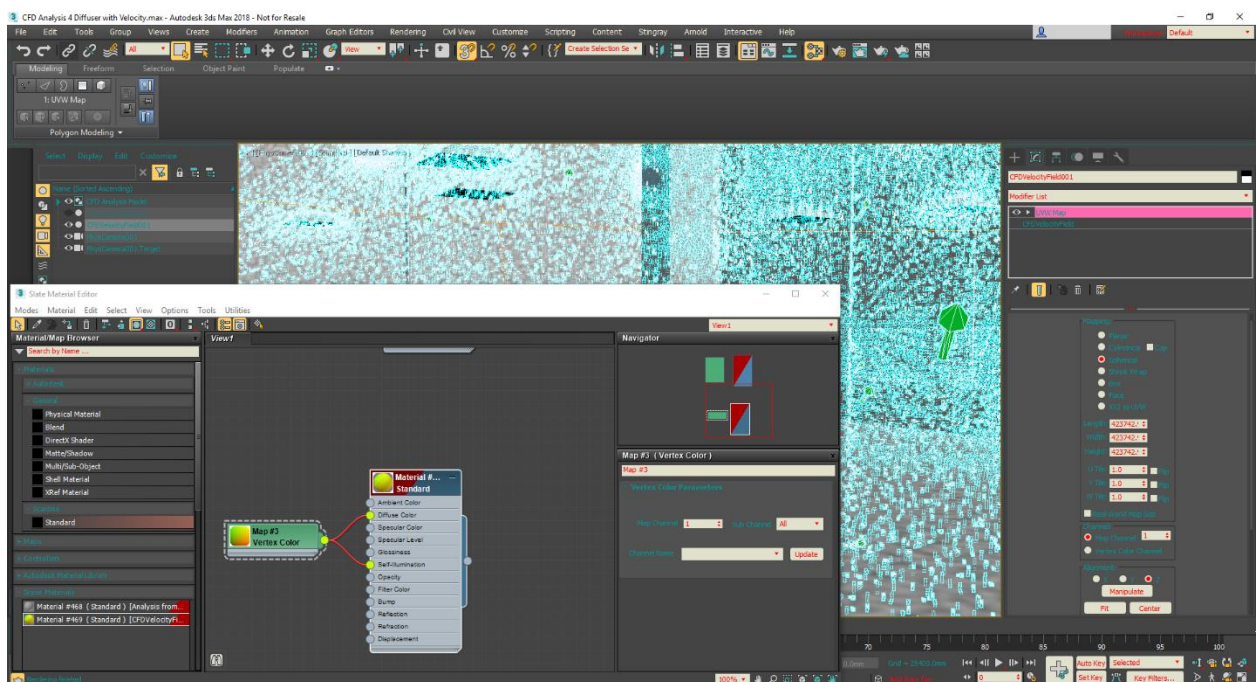
58 We can work with materials



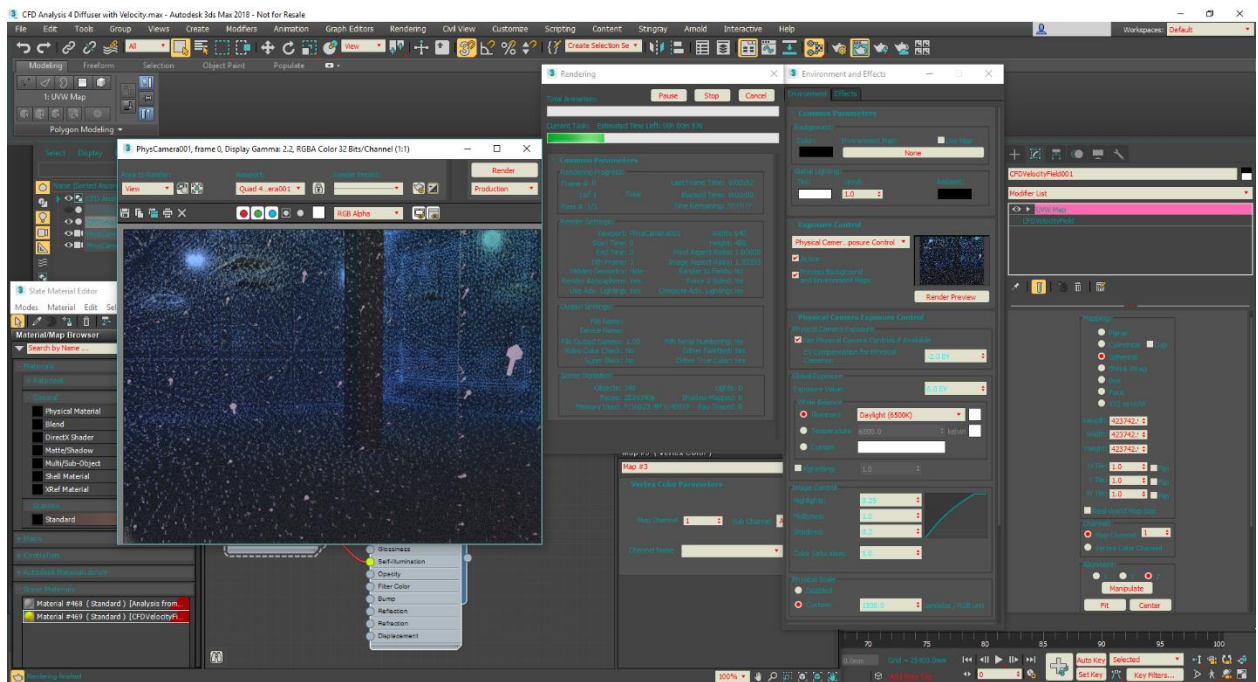
59 Setup a camera for your reference (ideally use a physical camera)



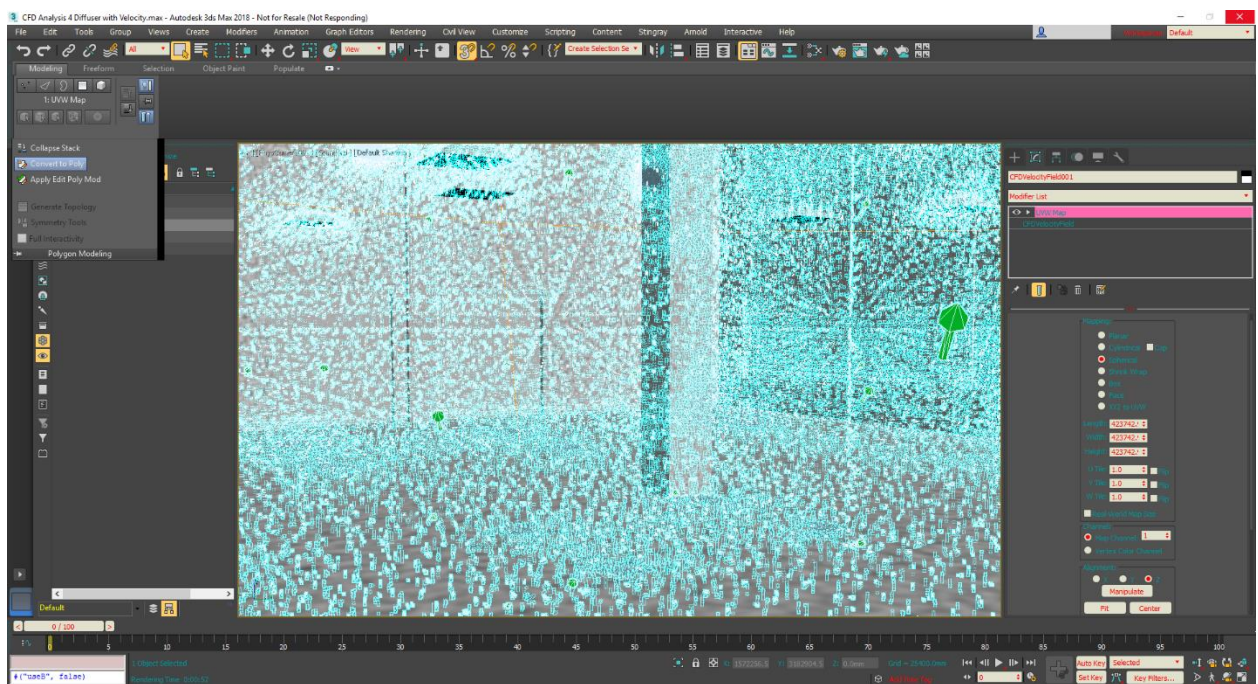
60 Why not trying for a motivational test render



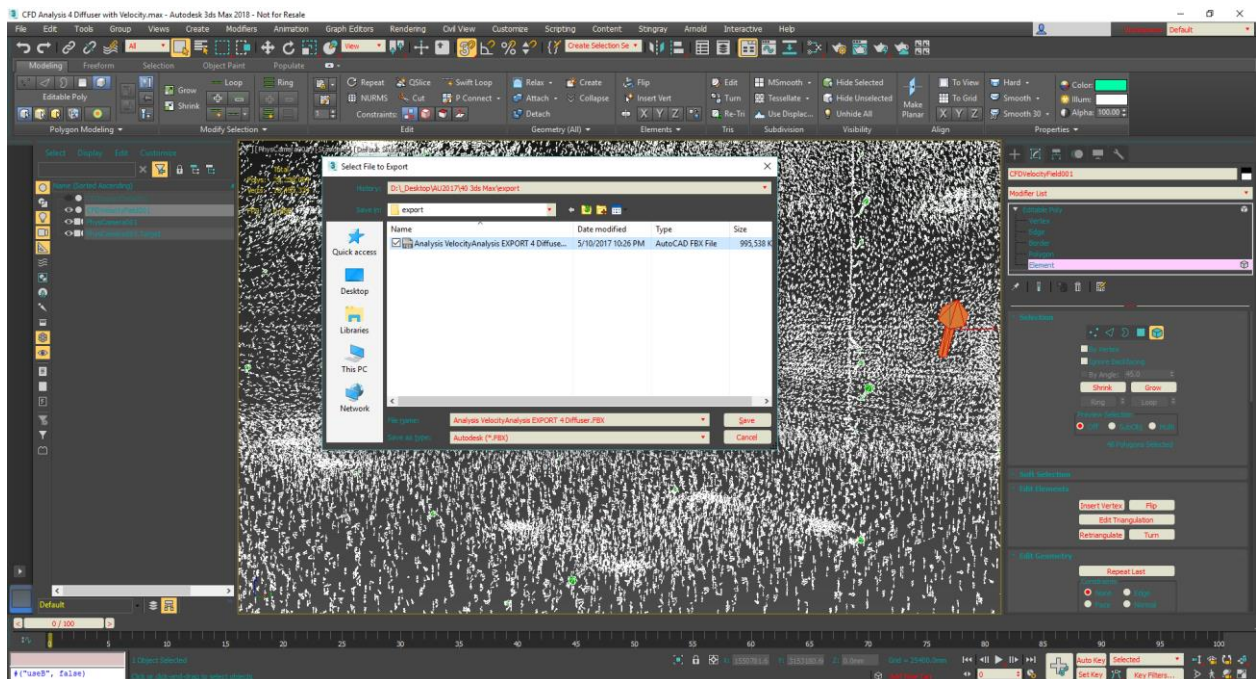
61 Work with materials and a uvw map



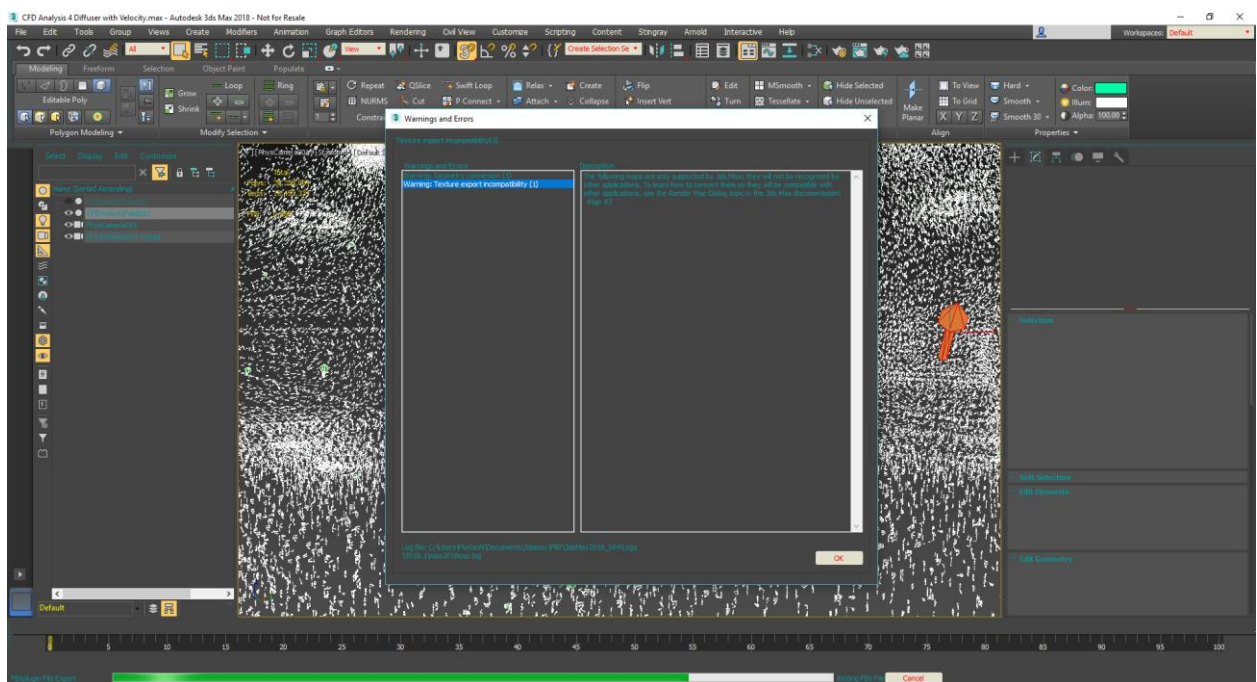
62 Render with the map applied



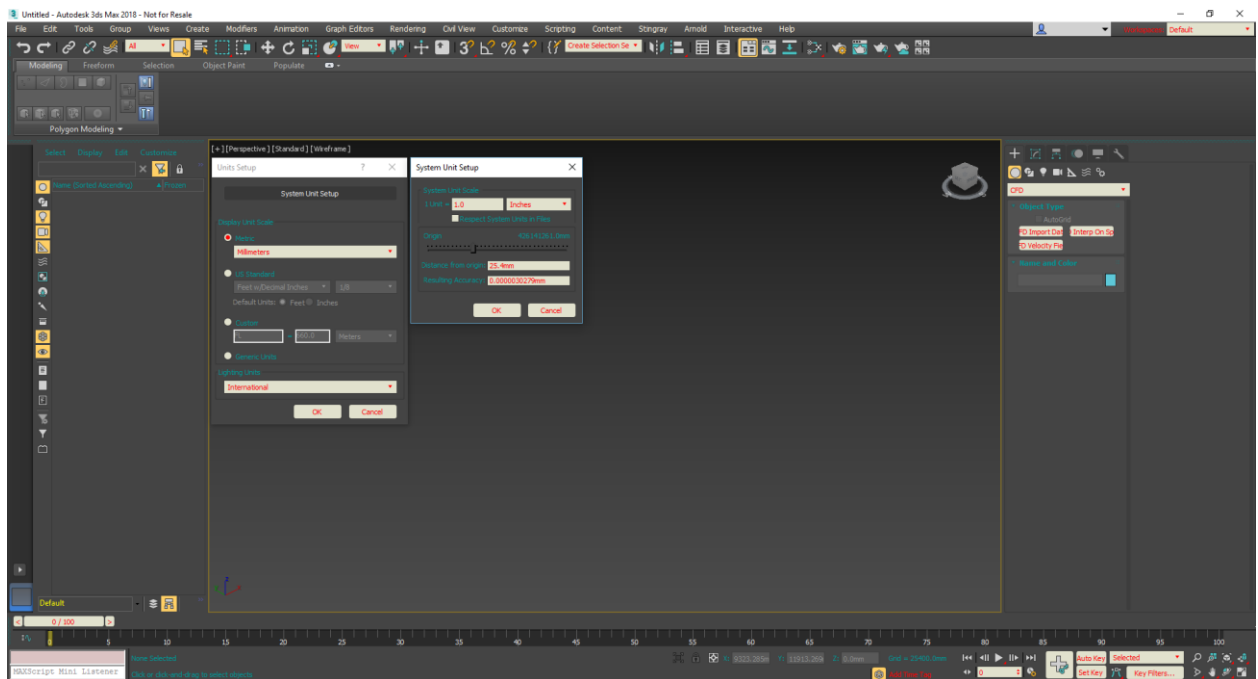
63 Convert the geometry to polygons, which can be exported



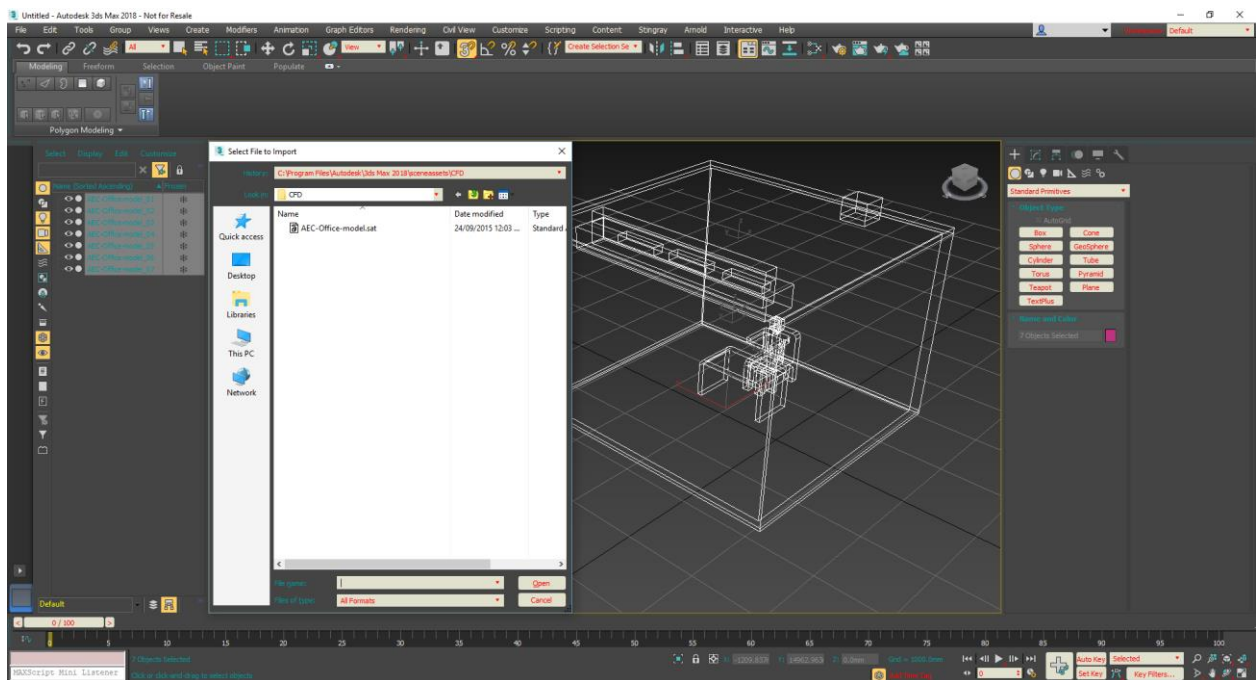
64 Export the vectors



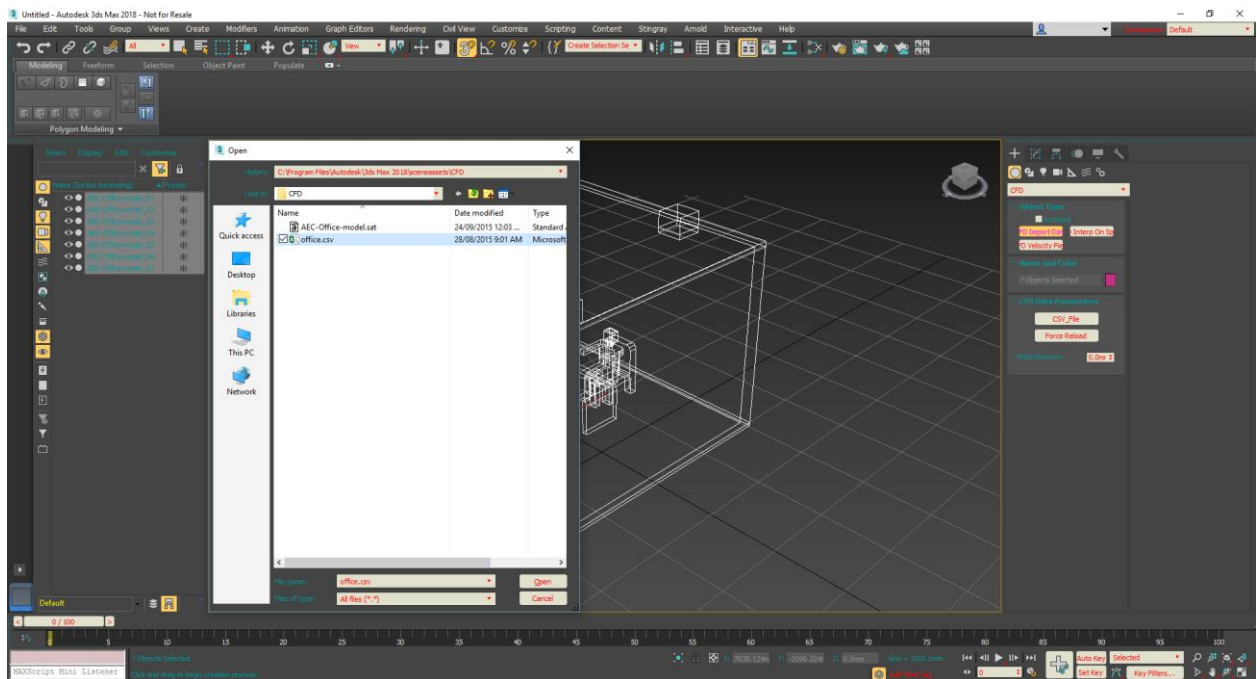
65 Master the export challenges



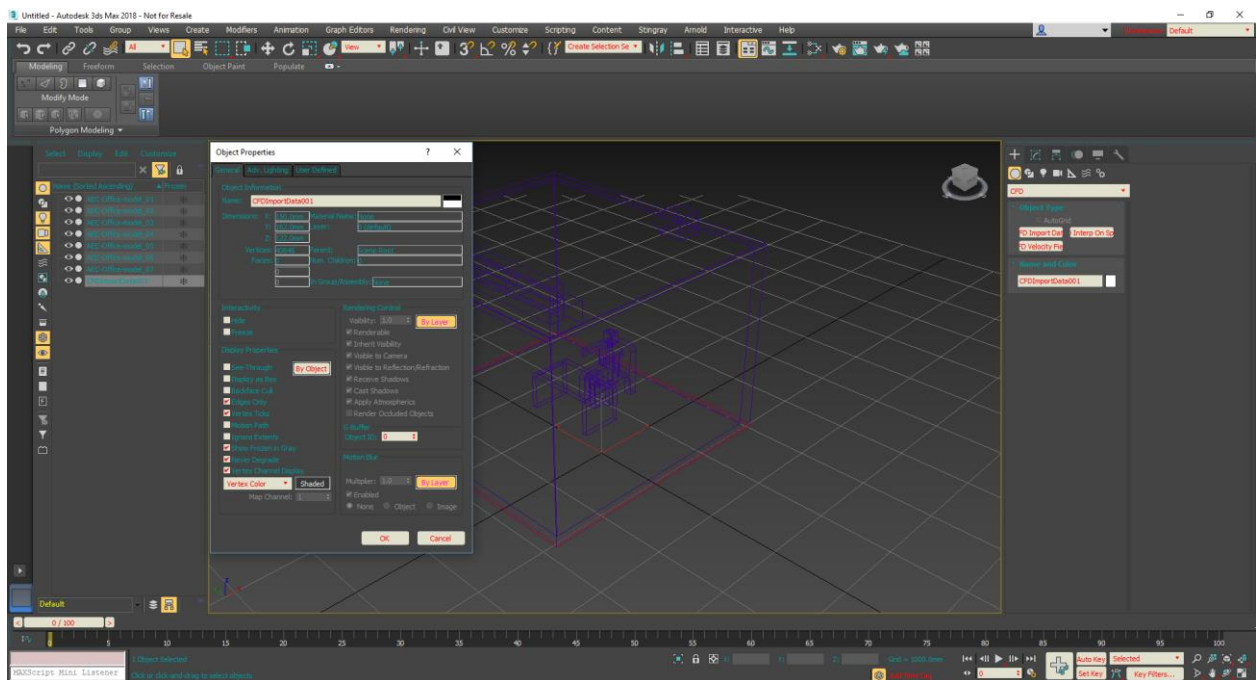
66 Round 2, let's change the system units to inch



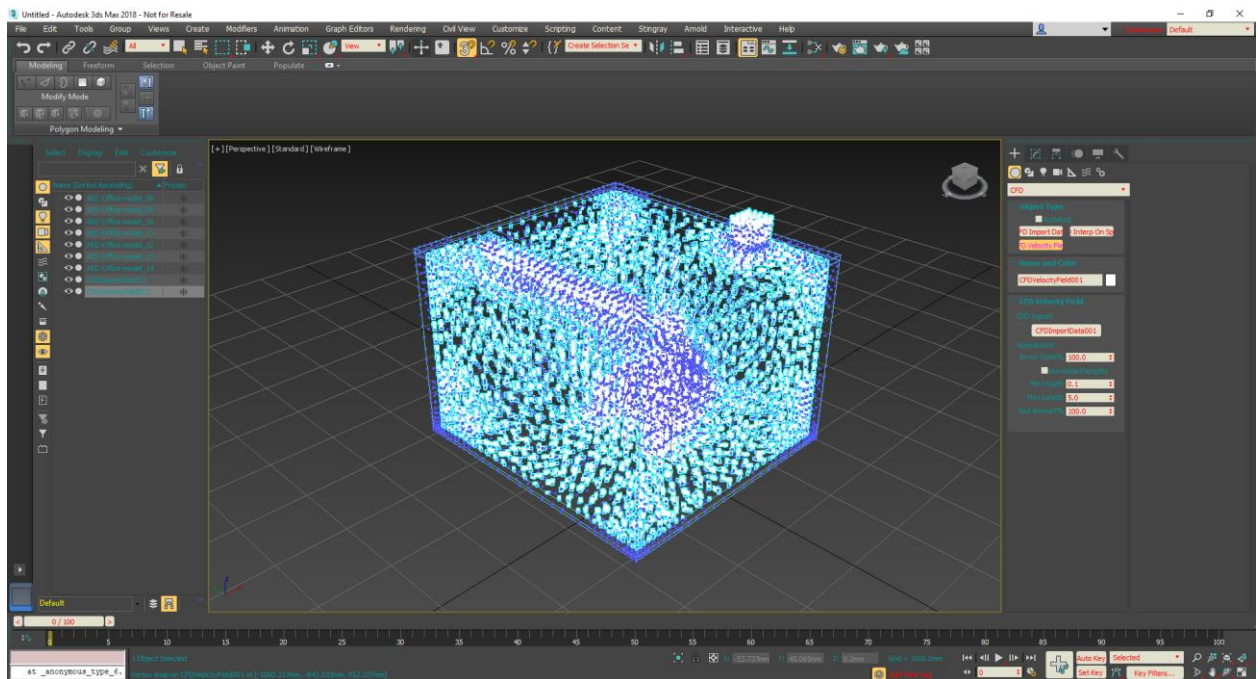
67 Import the SIMPLE example to practice



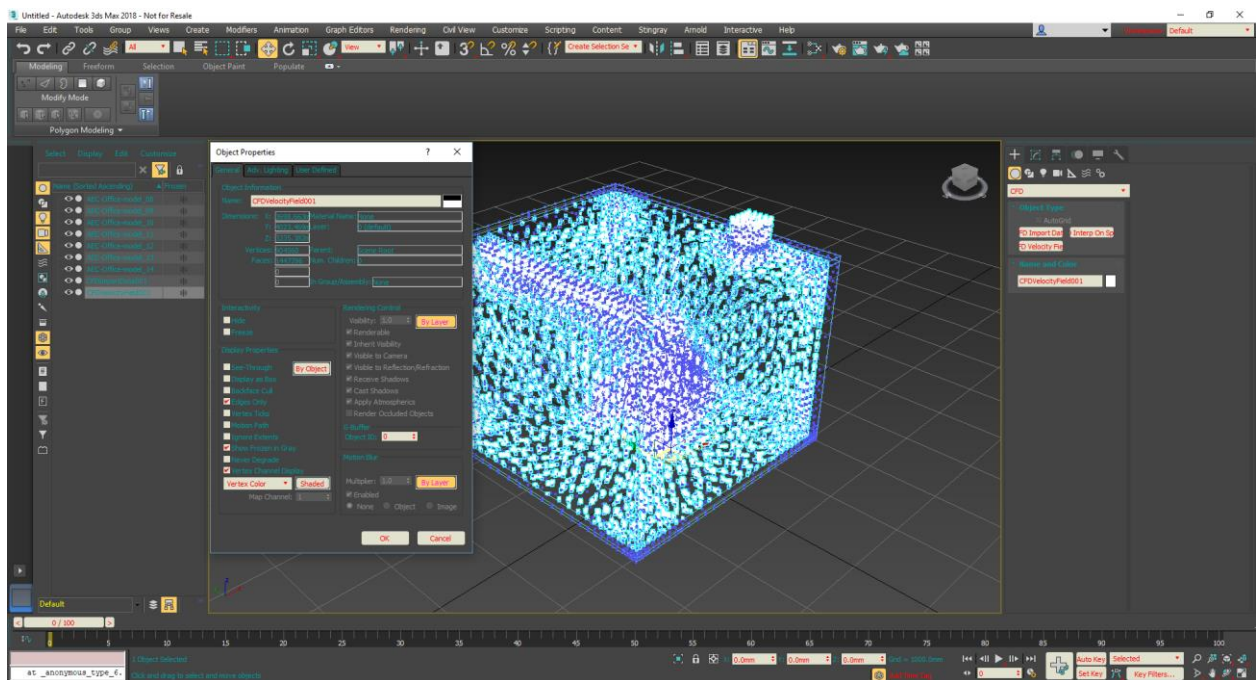
68 Import the SIMPLE csv dataset



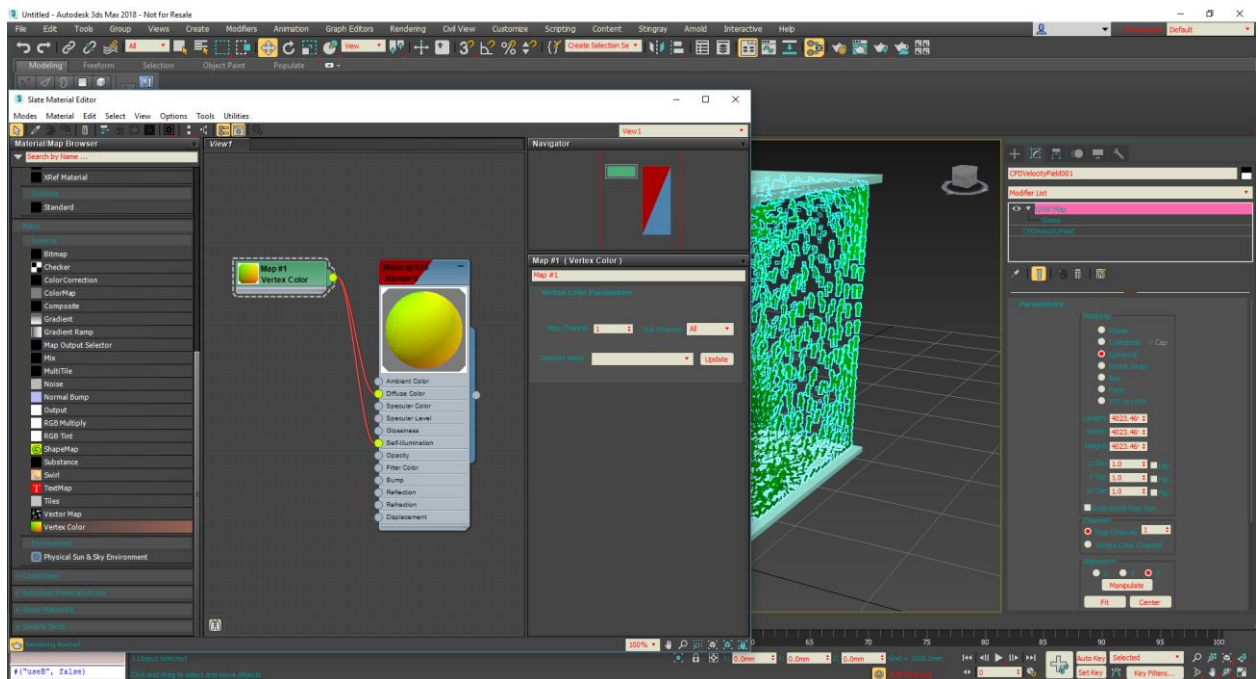
69 Update the object properties



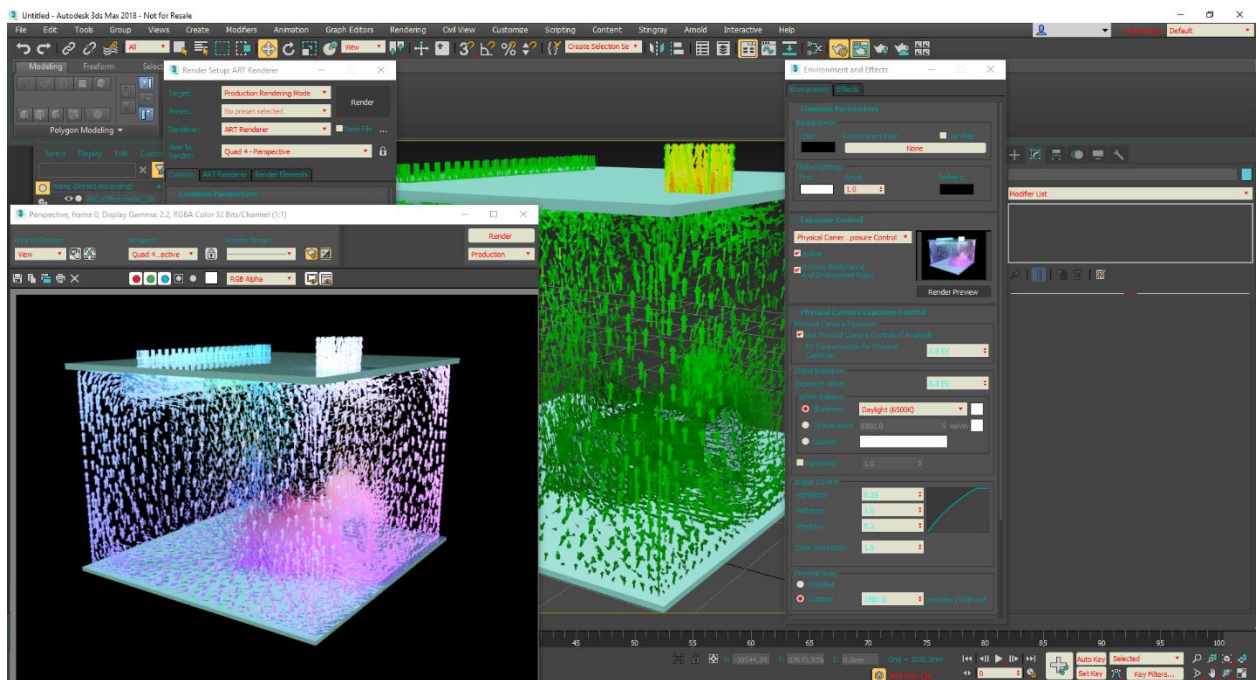
70 Create the velocity field



71 Update the vertex field properties



72 Apply the material and UVW Map modifier

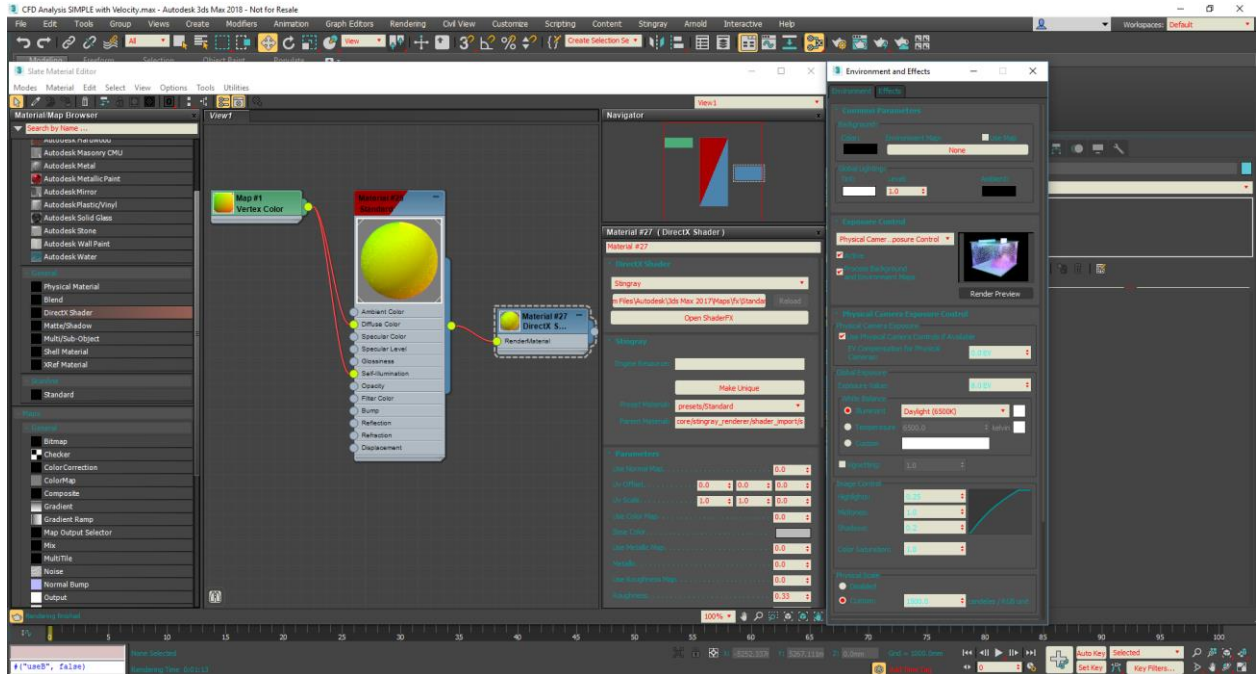


73 What about a motivational test render

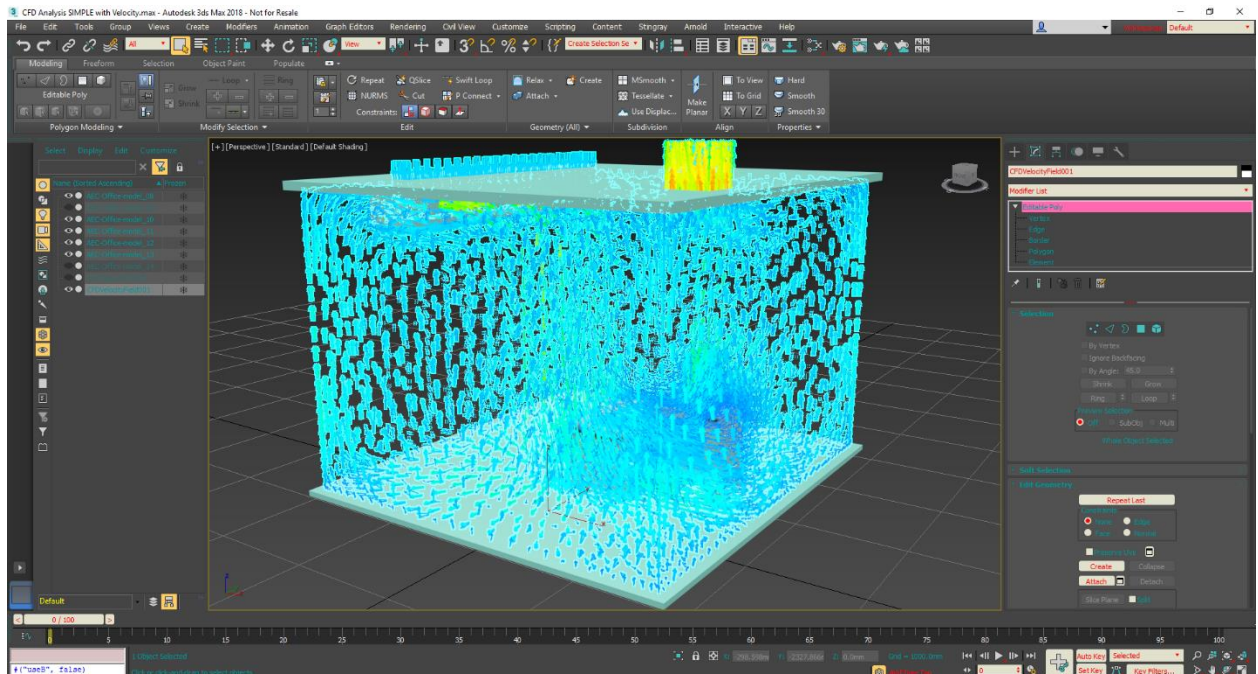
## Presenting the results with Stingray

Find the example files in: 50 Stingray

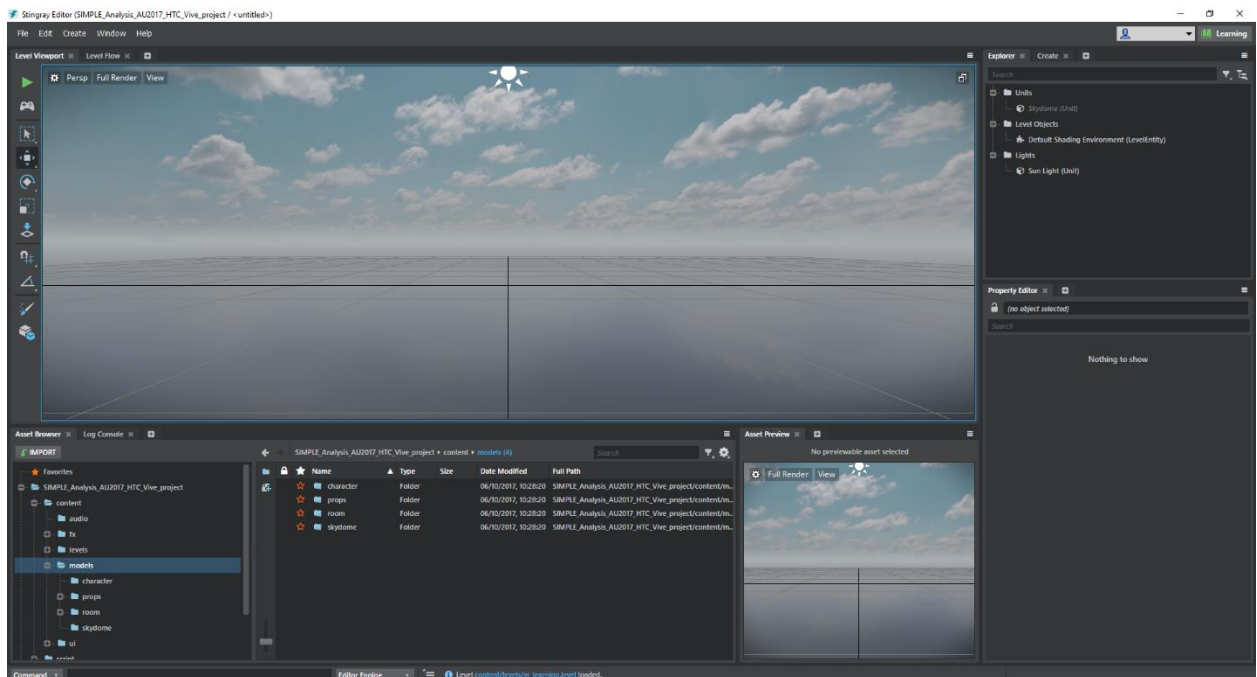
Find the screenshots in: 55 Screenshots



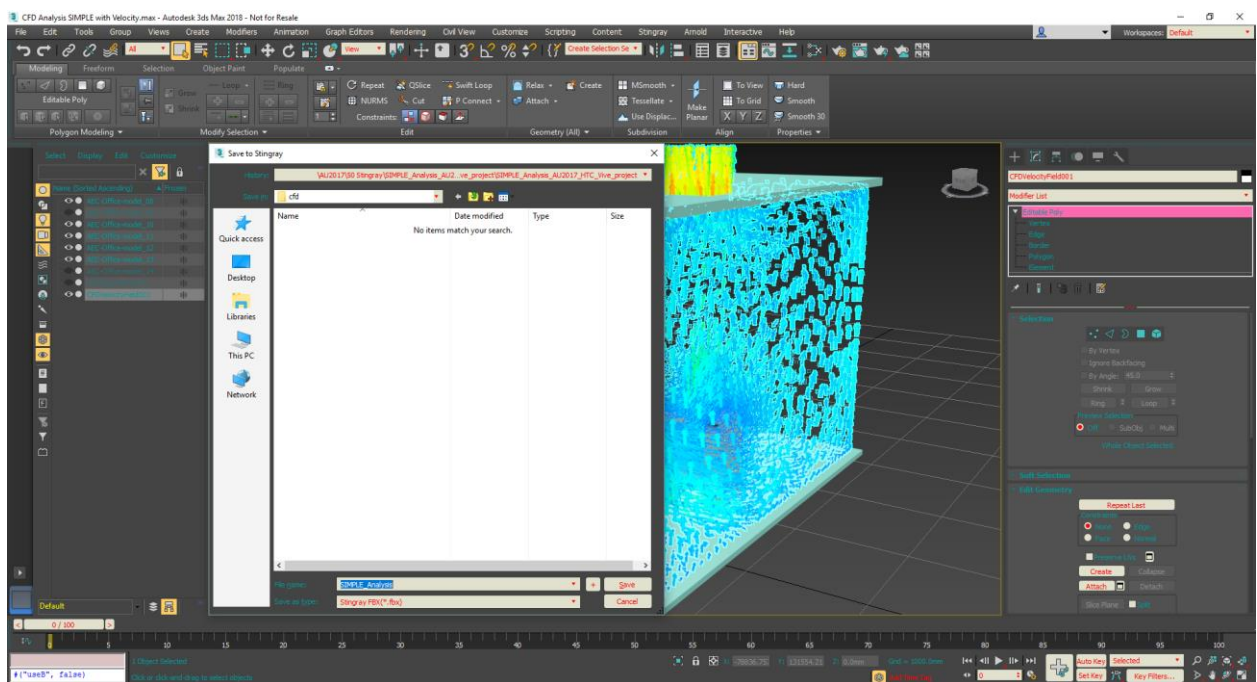
74 In 3ds Max, we need to apply a shader material for Stingray



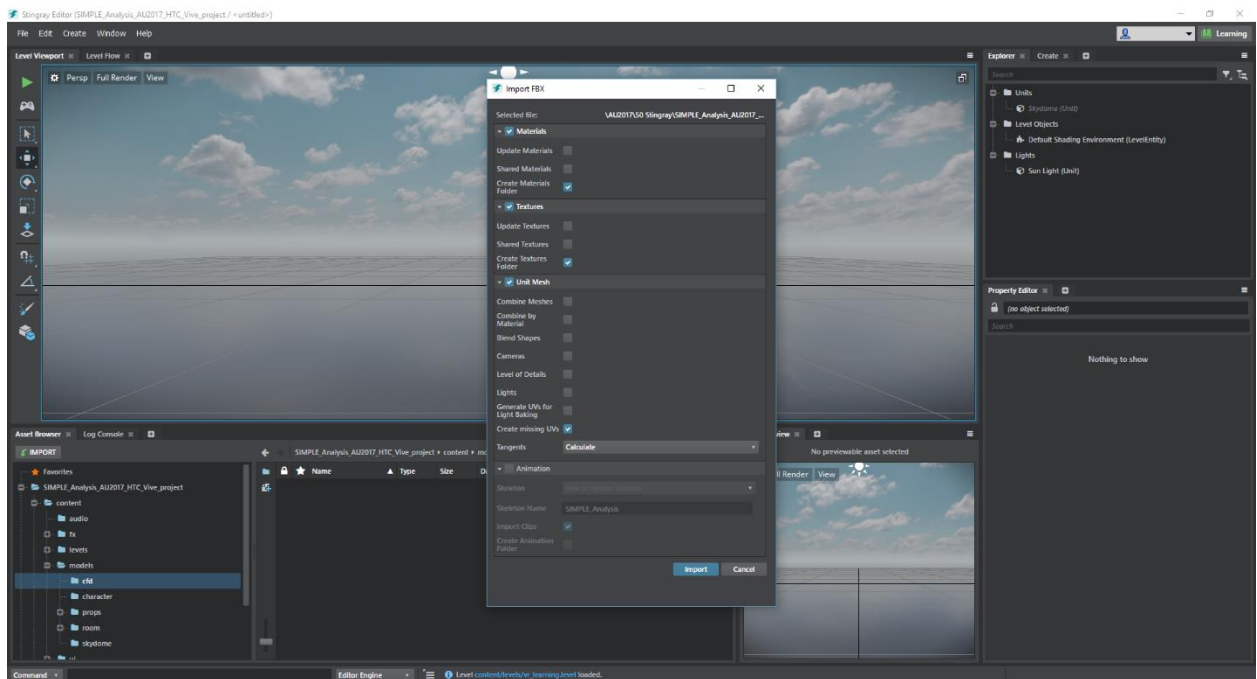
75 We would need to convert all objects to polygons



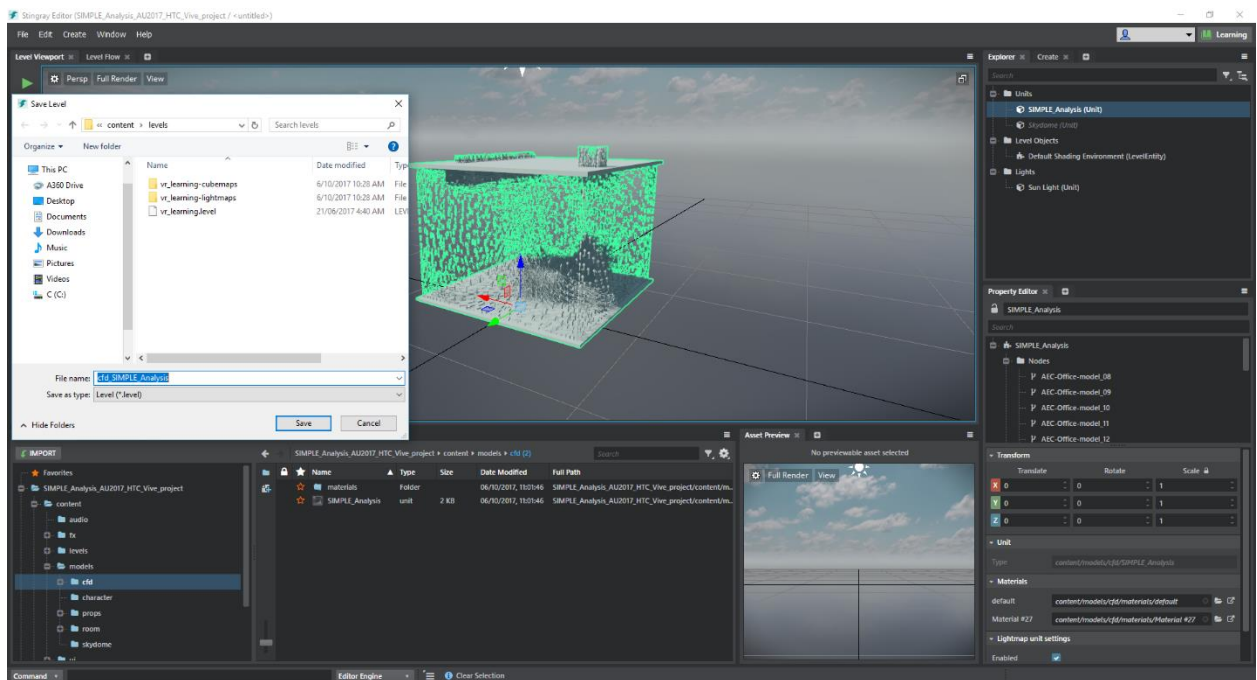
## 76 Start Stingray (3ds Max Interactive) using your VR template and create a new level



77 Connect with 3ds Max and send all elements to a new created CFD folder



78 Accept the import settings

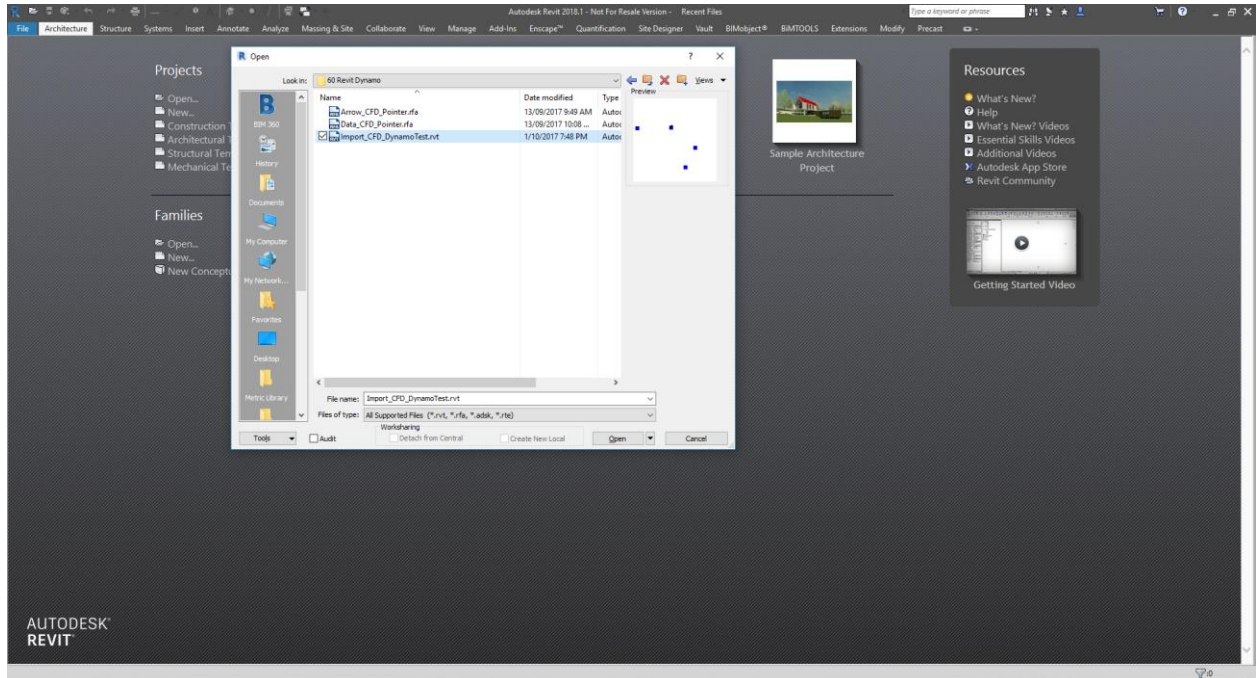


79 Drag and drop your model on to the origin and save the level

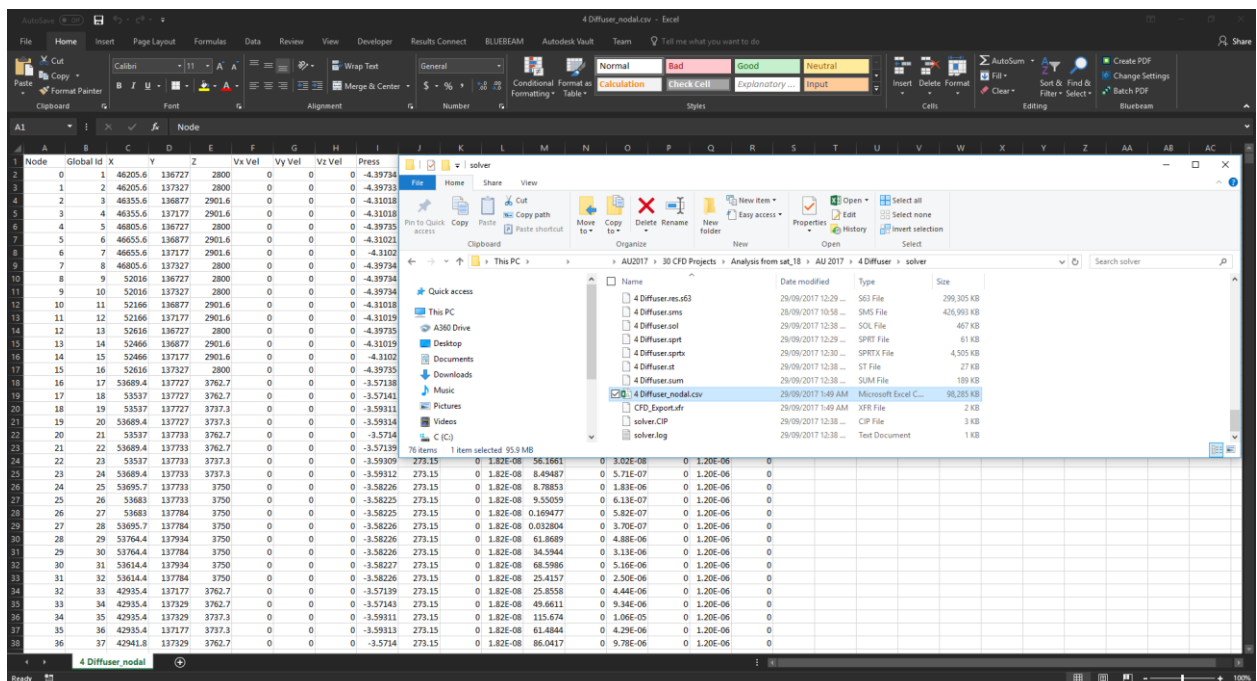
# Preparing the results with Revit and Dynamo

Find the example files in: 60 Revit Dynamo

Find the screenshots in: 65 Screenshots



85 Open Import\_CFD\_DynamoTest for a practice round



86 Convert the csv to xlsx

Autodesk® QTOB® 4 Diffuser\_modules - Saved

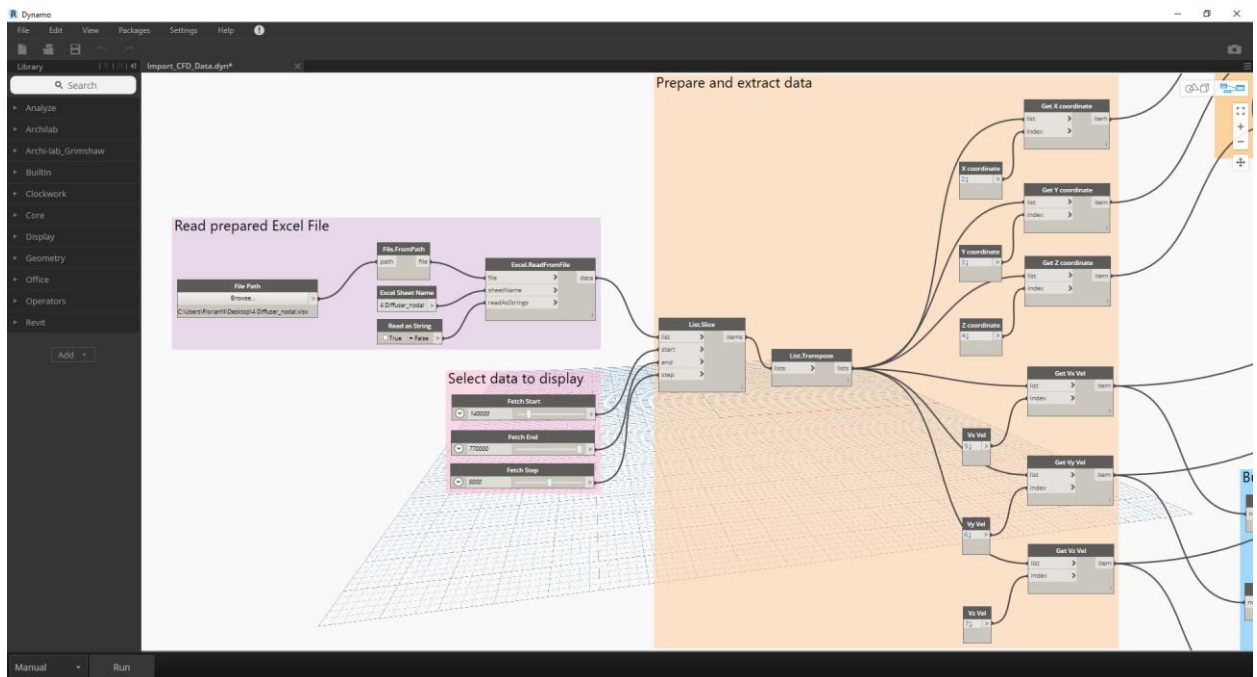
File Home Insert Page Layout Formulas Data Review View Developer Results Connect BLUEBEAM Autodesk Vault Team Tell me what you want to do

Clipboard Font Alignment Number Styles

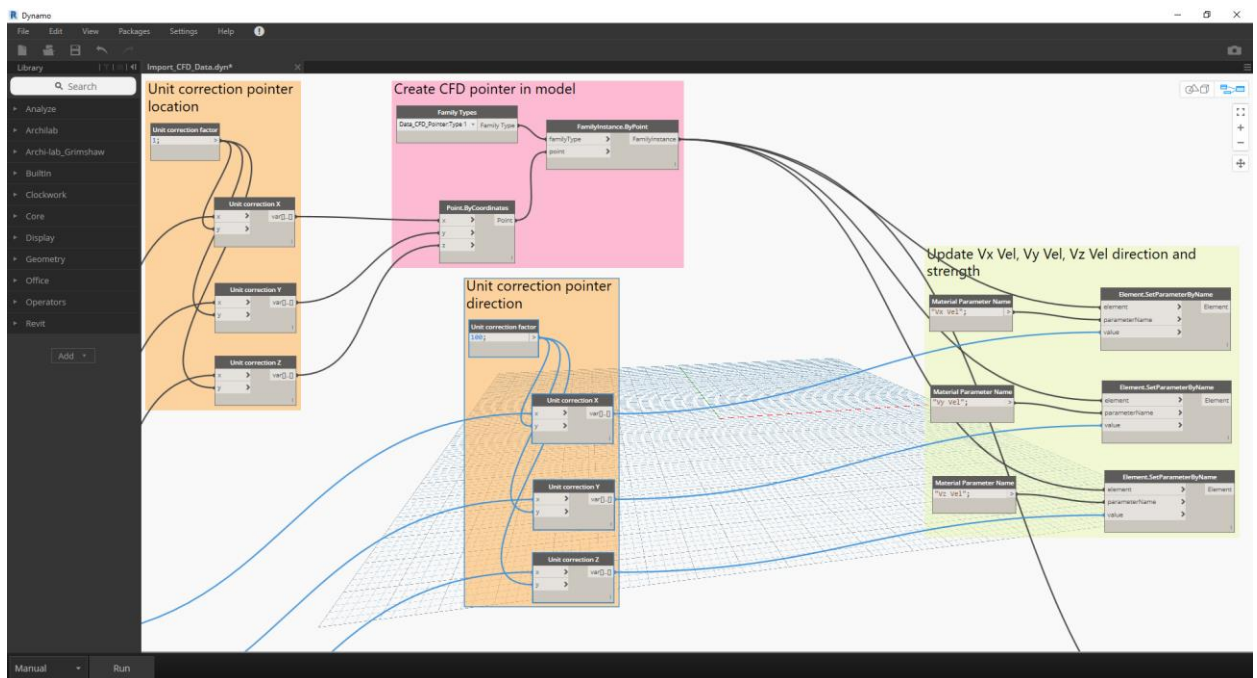
Normal Bad Good Neutral Calculation Check Cell Exploratory Input

AutoSum Fill Sort & Find & Filter Select Create PDF Change Settings Batch PDF Bluebeam

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
806520	806518	806519	63359.2	133096	6021.63	-0.03038	0.003967	-0.00107	-1.63324	273.15	0	0.702823	0.095402	0	1.18E-07	0	1.20E-06	0											
806521	806519	806520	63239.8	133459	5745.72	-0.68219	0.813333	0.093732	-1.86996	273.15	0	11.2071	0.297621	0	7.38E-08	0	1.20E-06	0											
806522	806520	806521	62656.8	132823	2780.56	0.552762	-0.28882	1.64547	-4.41403	273.15	0	2.00889	0.025918	0	3.07E-07	0	1.20E-06	0											
806523	806521	806522	63538.1	132447	5841.01	-0.04007	-0.0653	-0.00584	-1.78821	273.15	0	6.89895	1.07007	0	2.99E-08	0	1.20E-06	0											
806524	806522	806523	64912.3	141099	6024.77	0.092353	-0.02441	0.090232	-1.63055	273.15	0	1.38583	0.016505	0	7.96E-10	0	1.20E-06	0											
806525	806523	806524	64813.2	133425	2768.43	0.896222	0.650375	3.67283	-4.42442	273.15	0	14.2284	0.151254	0	5.43E-08	0	1.20E-06	0											
806526	806524	806525	64512.3	136647	2739.94	0.468665	-0.45793	2.41897	-4.44887	273.15	0	1.26281	0.005783	0	1.78E-07	0	1.20E-06	0											
806527	806525	806526	64350.8	137506	121.503	-0.03347	0.824594	0.014487	-6.69543	273.15	0	13.725	0.054715	0	0	0	1.20E-06	0											
806528	806526	806527	63418	132924	5835.6	-0.17197	0.001339	-0.00587	-1.79285	273.15	0	8.96282	1.62277	0	1.25E-07	0	1.20E-06	0											
806529	806527	806528	63006.2	134413	6021.63	-0.02954	0.014899	-0.00056	-1.63324	273.15	0	0.842252	0.129556	0	1.01E-07	0	1.20E-06	0											
806530	806528	806529	63142.9	133903	6021.63	-0.028	0.008433	-0.00071	-1.63324	273.15	0	0.723789	0.105322	0	9.79E-08	0	1.20E-06	0											
806531	806529	806530	62916	134750	6021.63	-0.02023	0.018375	0.000385	-1.63324	273.15	0	0.785211	0.121591	0	5.85E-08	0	1.20E-06	0											
806532	806530	806531	63076.3	133940	4821.28	1.72059	1.21466	3.34148	-2.66311	273.15	0	20.2265	0.060034	0	1.38E-08	0	1.20E-06	0											
806533	806531	806532	39731.9	141107	5762.94	0.489114	0.000698	0.069303	-1.85519	273.15	0	3.55012	0.094062	0	2.07E-08	0	1.20E-06	0											
806534	806532	806533	40357.7	141135	5735.8	0.778193	-0.00964	-0.10032	-1.87847	273.15	0	3.34547	0.050231	0	6.54E-09	0	1.20E-06	0											
806535	806533	806534	47269.4	141132	5744.09	0.097213	0.002798	0.090702	-1.87136	273.15	0	1.93881	0.010111	0	6.38E-09	0	1.20E-06	0											
806536	806534	806535	44209.7	137623	183.124	-0.12783	0.90849	0.029636	-6.64256	273.15	0	16.0895	0.04822	0	2.96E-09	0	1.20E-06	0											
806537	806535	806536	63286.8	133419	5837.81	-0.18415	0.174529	-0.01132	-1.79095	273.15	0	11.8633	1.7596	0	1.20E-07	0	1.20E-06	0											
806538	806536	806537	39950.4	141115	5728.86	0.0699	0.000548	0.044715	-1.88443	273.15	0	1.41086	0.009225	0	2.54E-09	0	1.20E-06	0											
806539	806537	806538	58634.6	140991	6028.45	-0.1226	-0.00788	0.010416	-1.62719	273.15	0	1.05223	0.008223	0	4.61E-09	0	1.20E-06	0											
806540	806538	806539	46515.6	138579	2805.19	0.734687	0.050357	2.85664	-4.39289	273.15	0	11.468	0.041024	0	8.46E-08	0	1.20E-06	0											
806541	806539	806540	63338.5	133323	5823.32	-0.28635	0.284464	-0.00953	-1.80338	273.15	0	10.2568	1.1772	0	1.32E-07	0	1.20E-06	0											
806542	806540	806541	47031.5	141132	5759.51	0.06829	0.00091	0.015481	-1.85813	273.15	0	1.36044	0.013744	0	3.35E-09	0	1.20E-06	0											
806543	806541	806542	47202.9	141133	5787.32	0.091738	0.005851	0.056561	-1.83427	273.15	0	1.83951	0.01218	0	9.17E-09	0	1.20E-06	0											
806544	806542	806543	40262.8	141120	5749.23	0.630708	-0.00798	-0.08125	-1.86695	273.15	0	3.20192	0.064815	0	1.12E-08	0	1.20E-06	0											
806545	806543	806544	63076.3	134367	5810.91	0.16694	0.207165	-0.00973	-1.81403	273.15	0	7.2671	0.491908	0	4.91E-08	0	1.20E-06	0											
806546																													
806547	Minimum	0	38111.2	126996	-621.064	-5.00602	-3.91232	-6.37014	-7.33253	273.15	0	1.82E-08	9.81E-08	0	0	0	1.20E-06	0											
806548	Maximum	0	66301.7	141778	6336.74	3.79676	4.67425	8.6158	-1.36287	273.15	0	7.95E+09	4.24E+14	0	1.86E-05	0.002707	0												
806549	Means+0	0	52579.1	135186	3155.47	-0.01918	0.010559	0.169723	-4.4629	273.15	0	20928.5	9.03E+08	0	7.38E-08	0.000291	0												
806550	Stan Dev+0	0	8134.1	4944.57	2424.42	0.345302	0.312719	0.862446	2.23959	3.82E-09	0	1.02E+07	5.17E+11	0	3.49E-07	0.00077	0												
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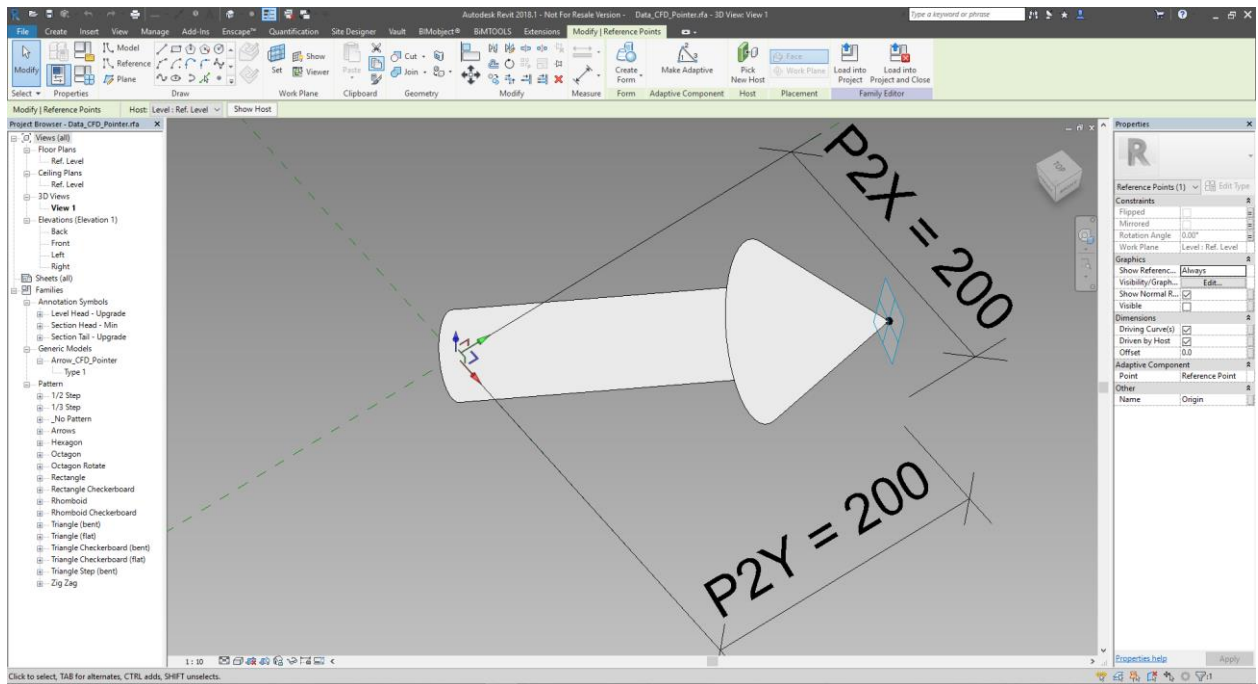


89 The first part will read the Excel data and slice the list

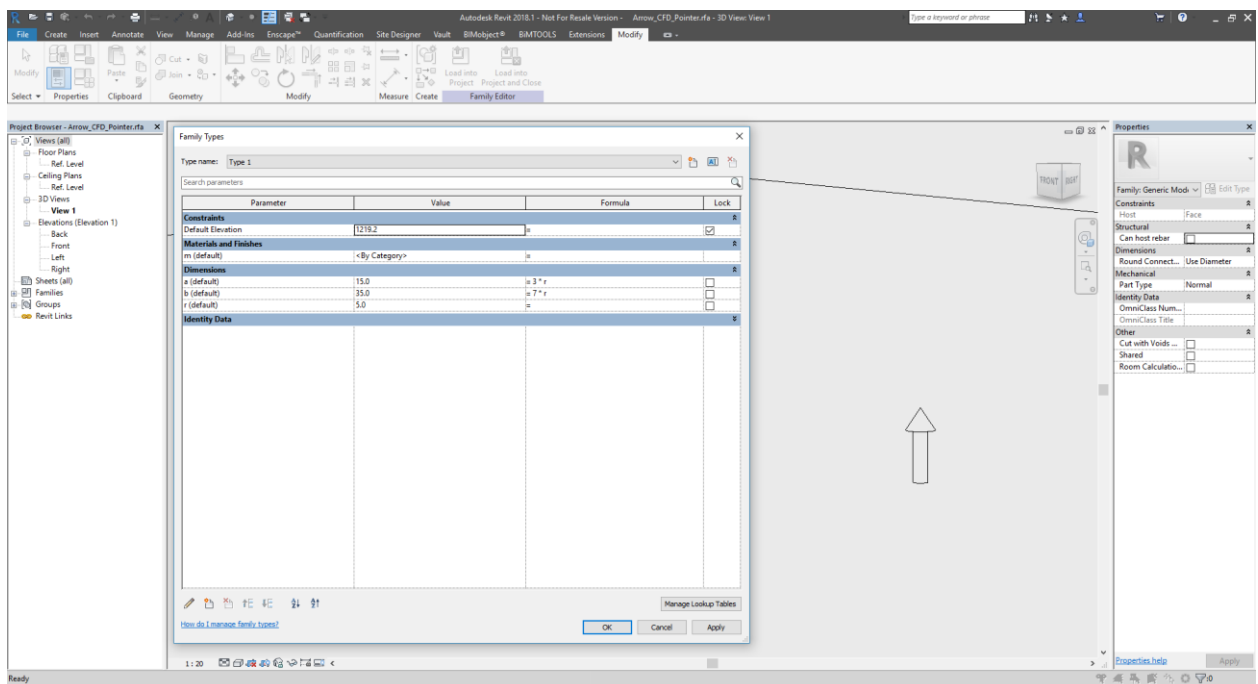


90 Create the pointer and orient it

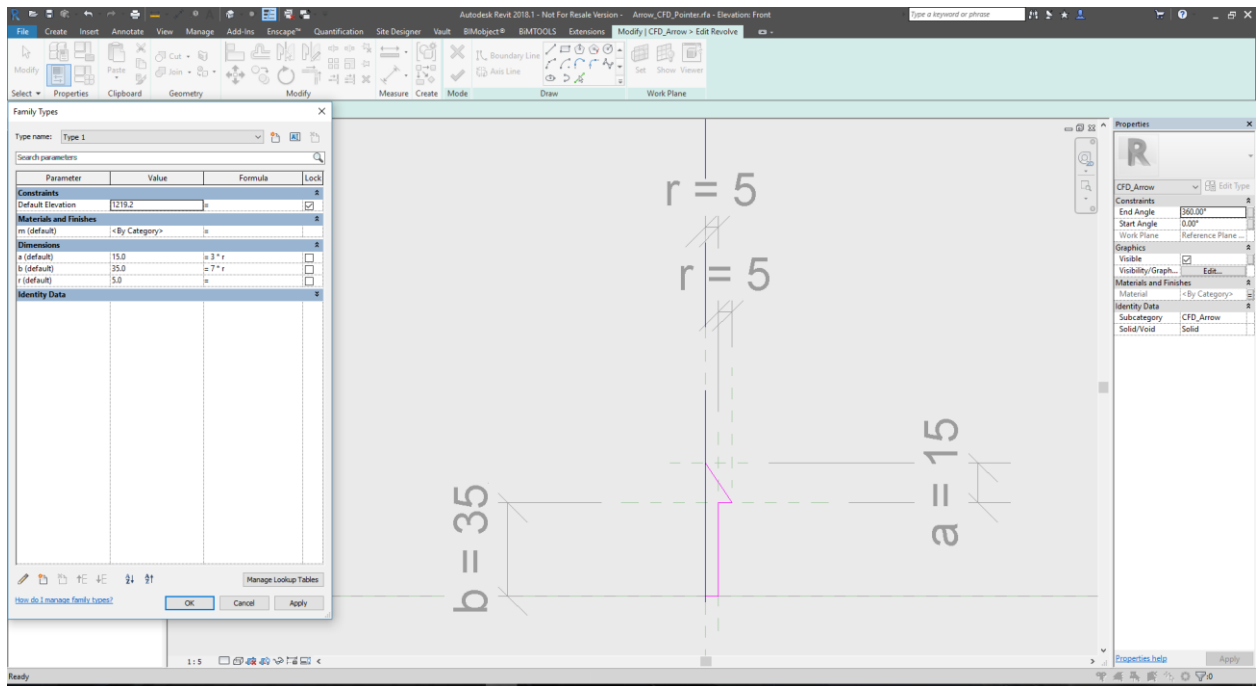
Page 49



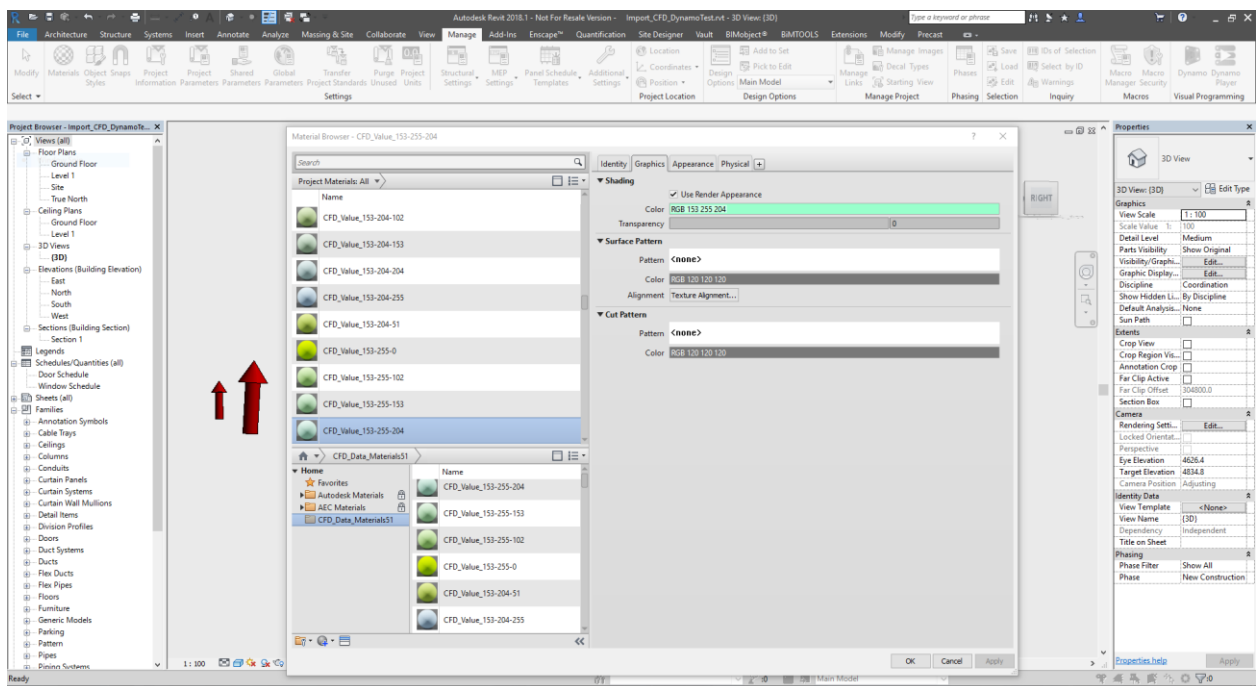
93 the parameters are set from the origin and linked to the nested family



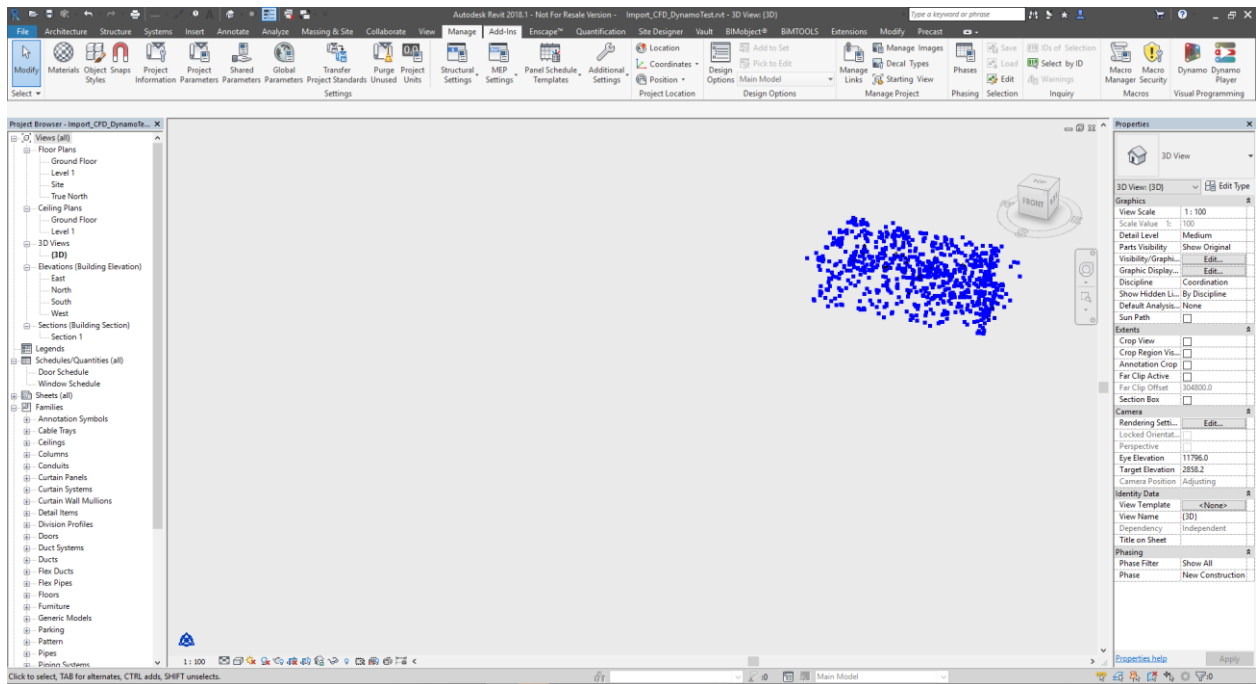
94 Setup the arrow family



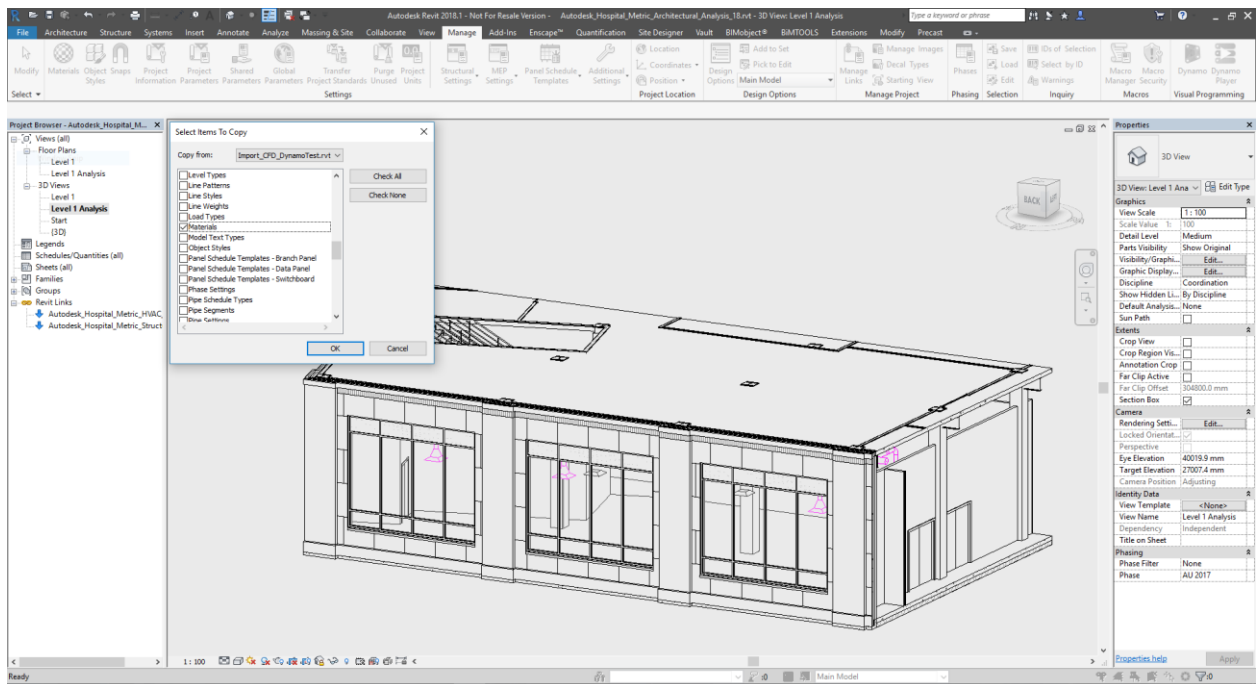
95 Edit and revolve the sketch



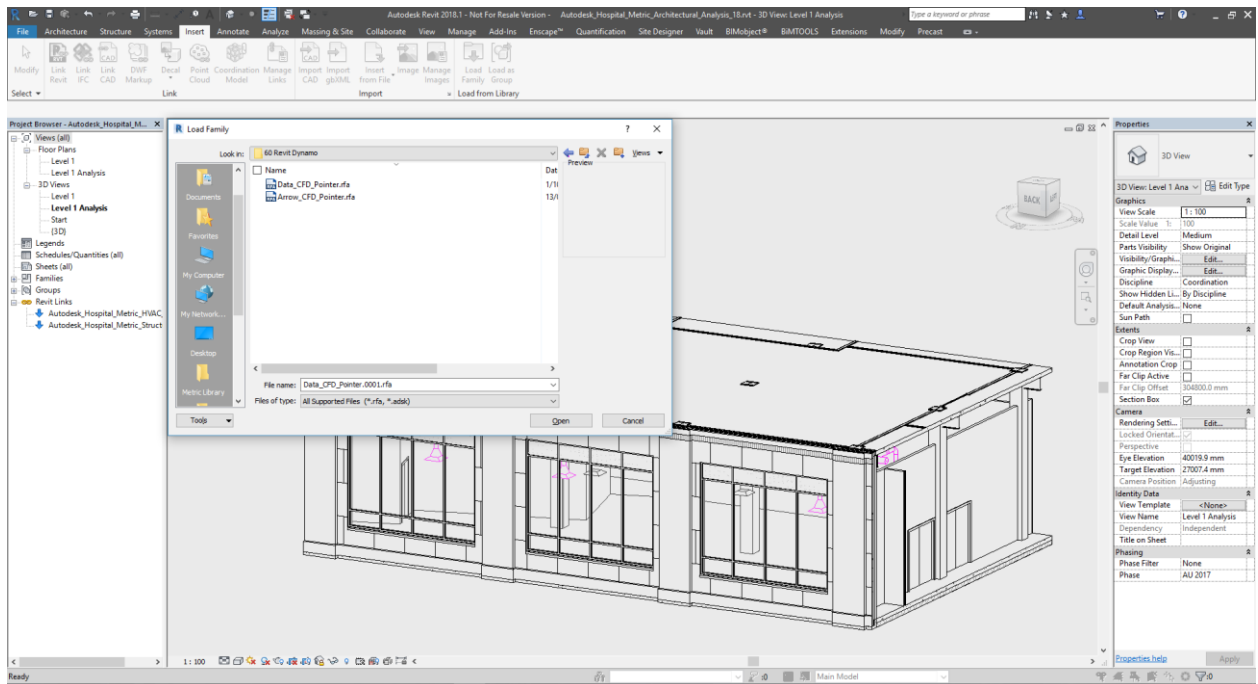
96 The material library has already been created



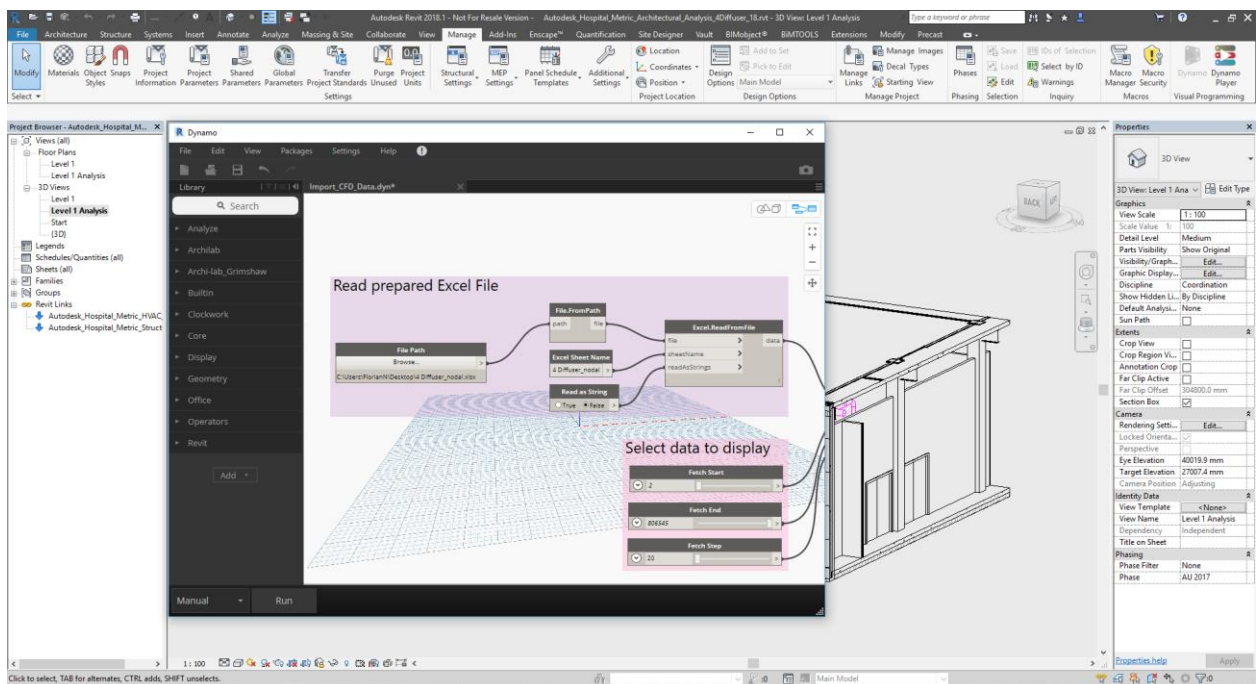
97 Test the creation of the arrow for only a few samples



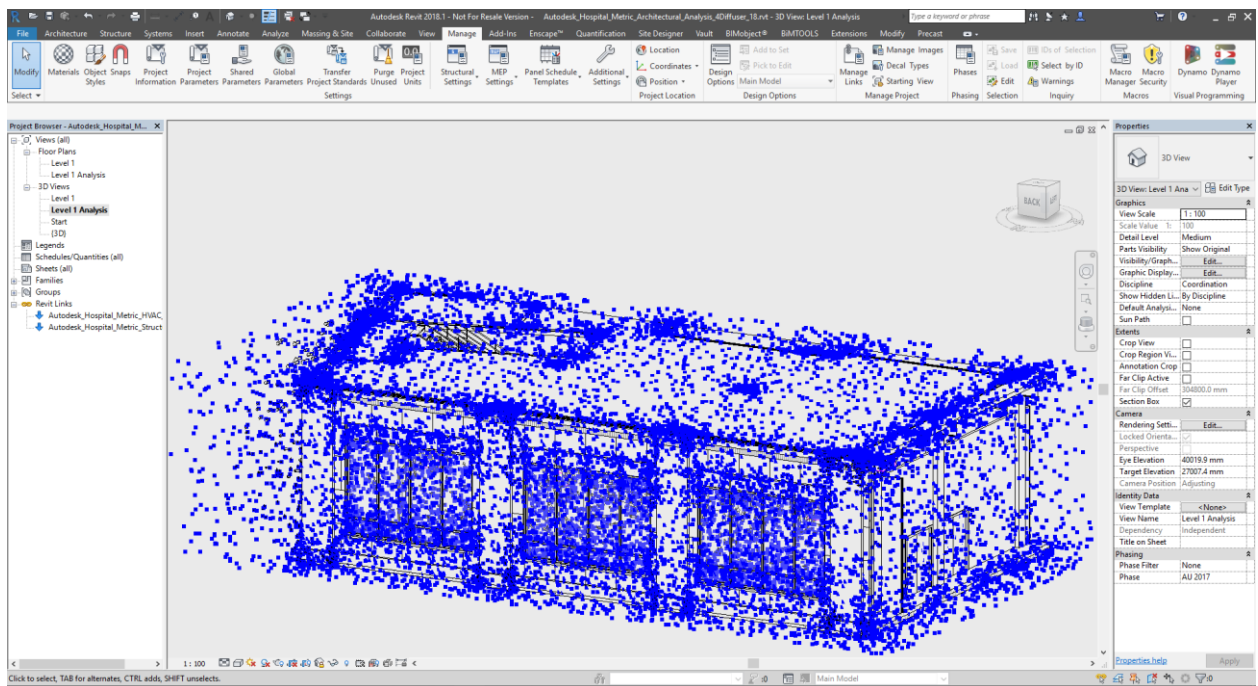
98 We can transfer the materials into our real project



99 Load the arrow family



100 Run the Dynamo script with the full data extend, this might take a very long while (10h?)

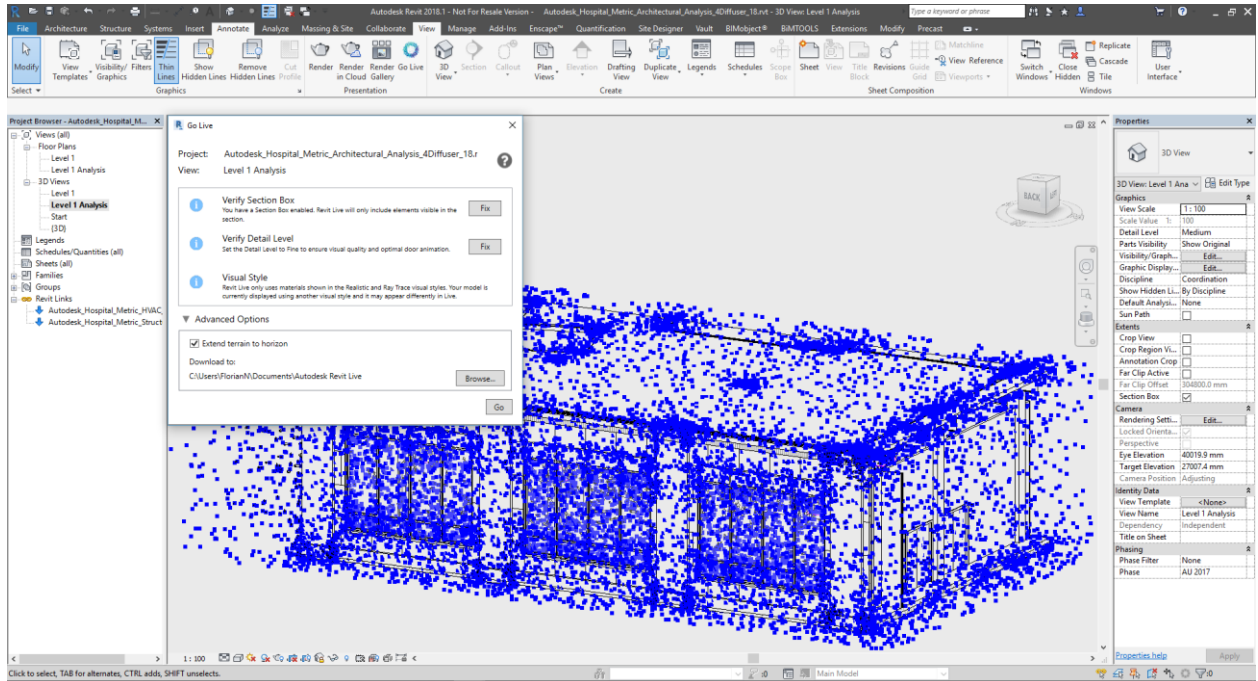


101 Inspect the results

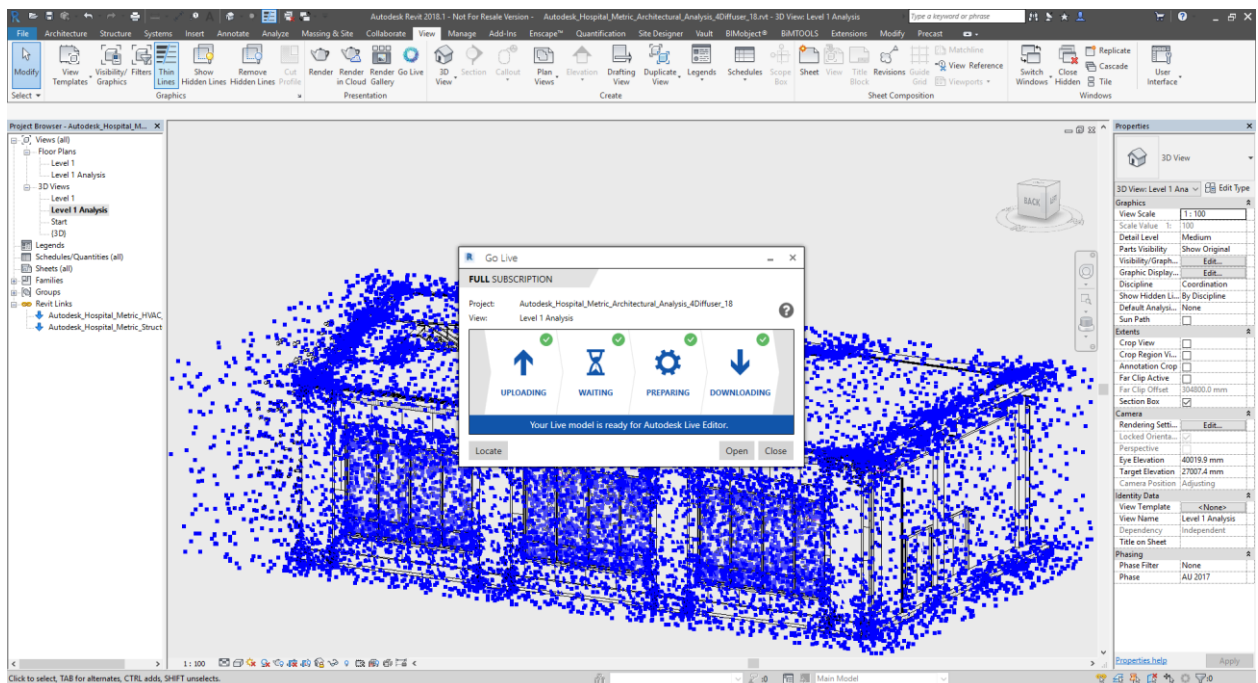
## Presenting the results with Revit Live

Find the example files in: 70 Revit Live

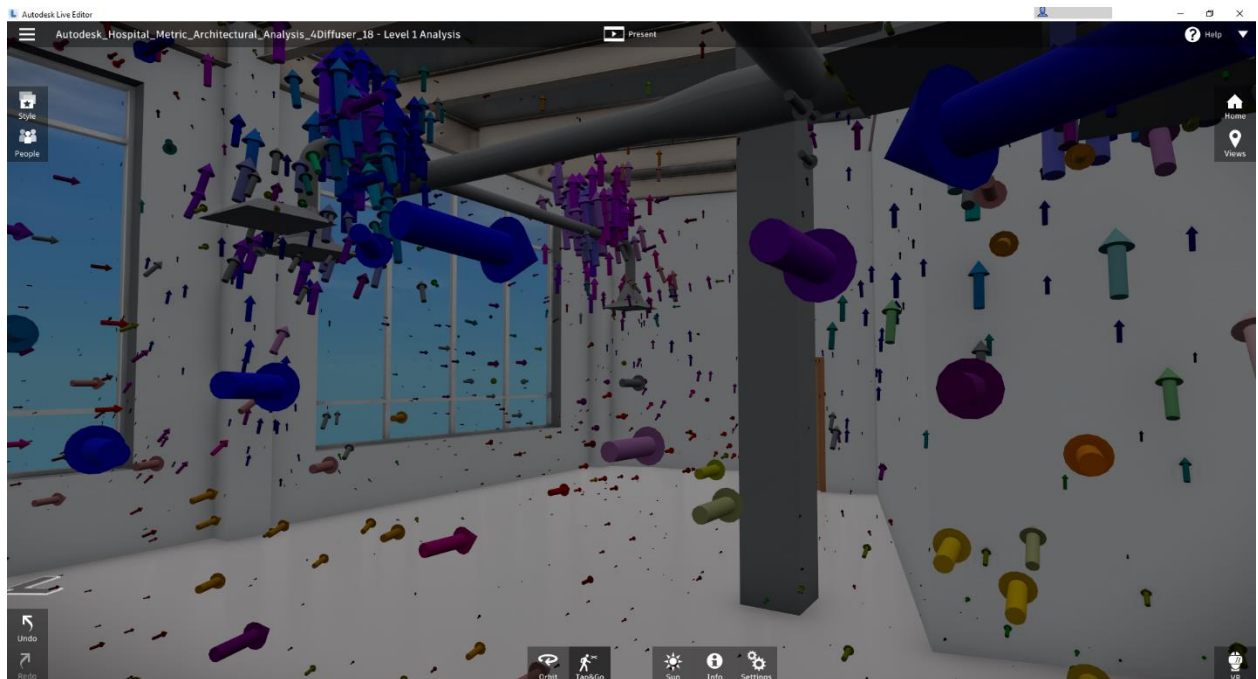
Find the screenshots in: 75 Screenshots



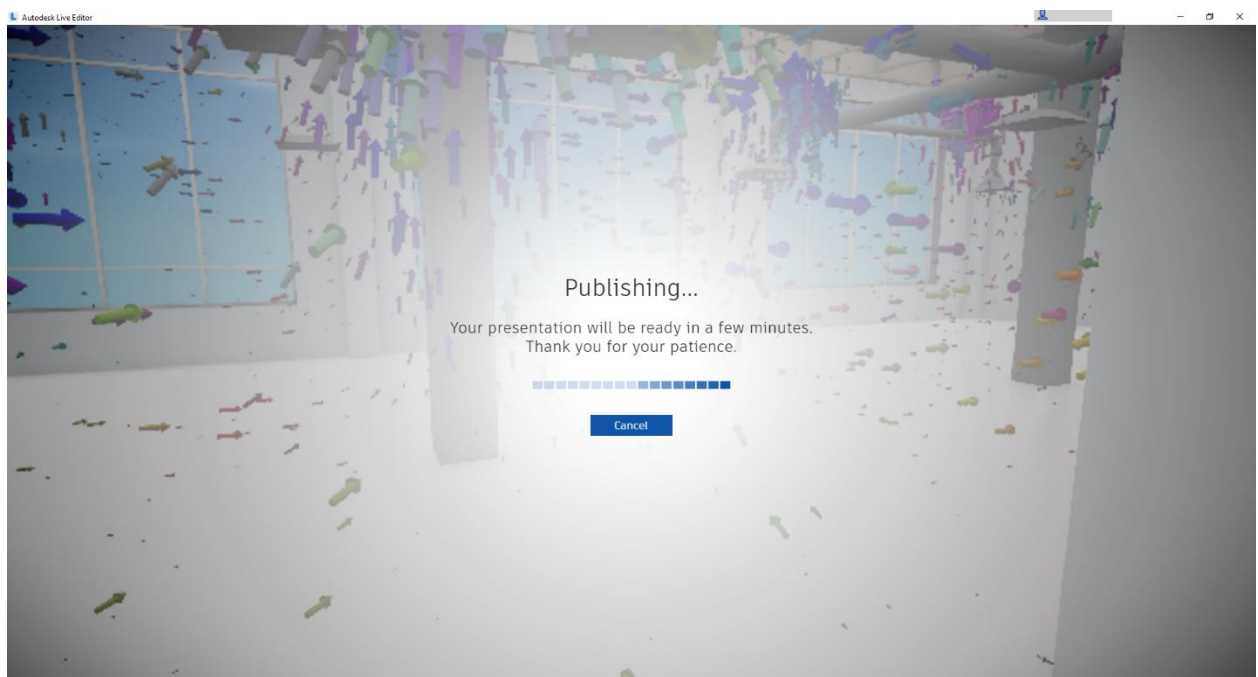
102 Upload the file to Revit Live



103 Wait till the model has been converted



104 Open the model in Revit Live

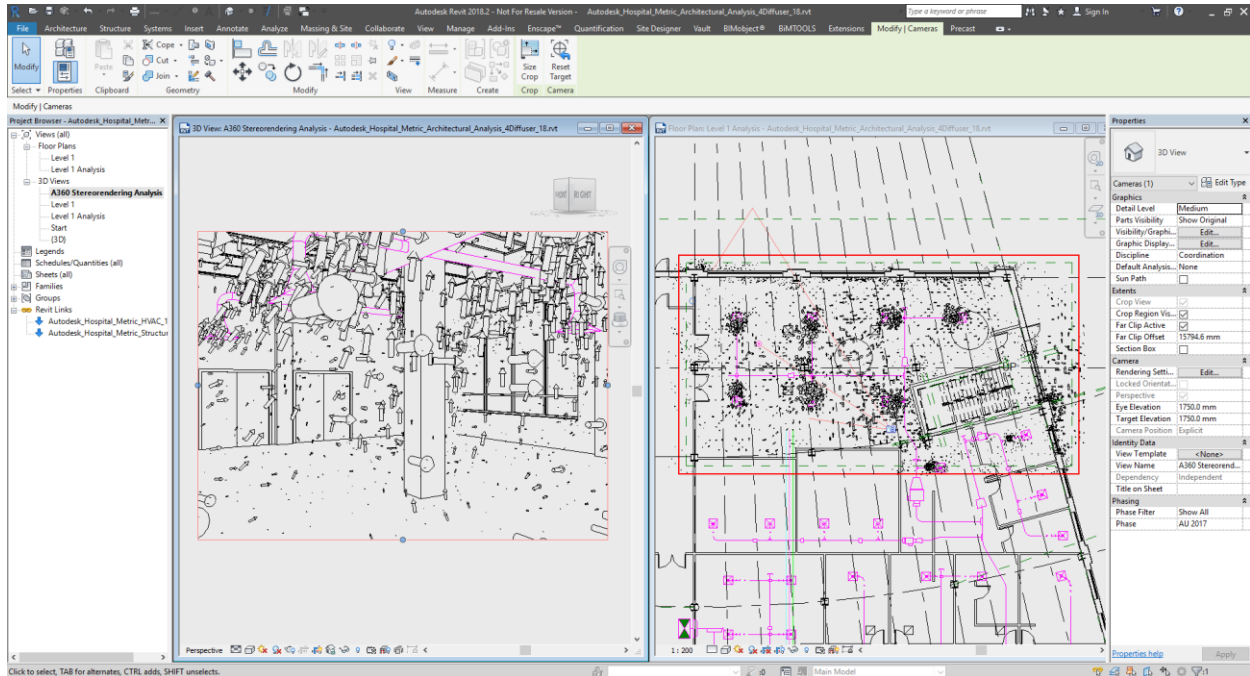


105 Publish it to Windows or other platforms

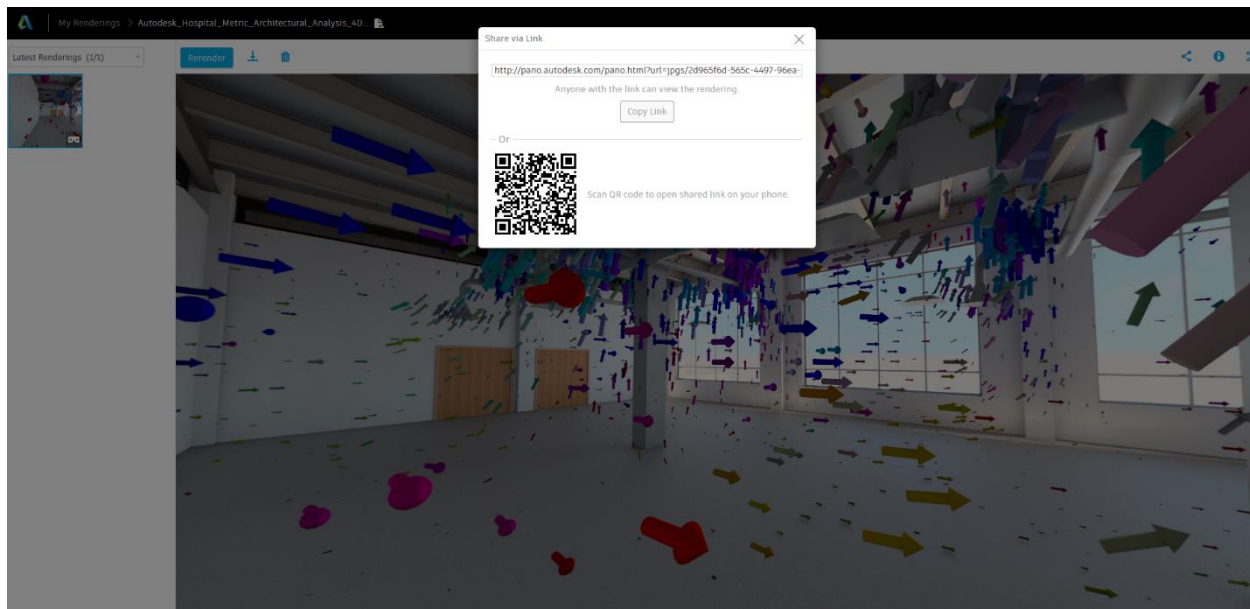
## Using A360 as mobile VR solution

Find the example files in: 80 A360 Stereo Panorama

Find the screenshots in: 85 Screenshots



### 106 Setup a camera



### 107 Render the camera as a Stereo Panorama Rendering with A360