Tips and Tricks of Revit to Autodesk CFD: A-Z Tools for an Optimum Transition

Gilberto Fernandez & Nabil Nougha

Designated Support Specialists

Customer Success Services, AUTODESK

AUTODESK UNIVERSITY

About the speaker

Gilberto Fernandez

Gilberto Fernandez is a Designated Support Specialist within the Autodesk Customer Success Services organization. Having an engineering background, he has vast experience in the field of Computational Fluid Dynamics. Mainly Gilberto's role is to lead the way technically with Autodesk Premium Customers, in terms of Simulation solutions. He is based in Barcelona, and is heavily focused in being an advocate for the use of CFD for AEC/BIM.

AUTODESK SIMULATION

AUTODESK CFD

About the co-speaker

Nabil Nougha

Nabil is a Piping Engineer working as Designated Support Specialist at Autodesk WWFO since 2011. He is actively supporting piping interoperability features in Autodesk products portfolio such as AutoCAD MEP, Revit MEP, AutoCAD Plant 3D, Inventor Routed Systems and BIM 360 family. Previously 11 years background in various projects as consultant for EPC in Oil & Gas, Water, Chemical and R&D for food industries, from the process to design implementation including superintendent roles. He is currently based in Dubai.

Summary

Taking architectural models into simulation software is becoming a hot topic in the industry as companies are starting to include simulation in their BIM efforts. This class will describe the different tools involved in going from a full Revit model to Autodesk CFD results, optimizing both transition and setup. The class can be taken as documentation and a great set of tips and tricks to take models from Revit software to Autodesk CFD software for future AEC projects.

Learning objectives

- See how Revit models are launched and interpreted in CFD
- Recognize the tools available to prepare a real model to simulate
- Apply the changes to Revit models so they are ready for simulation
- Keep the class materials as documentation for future Revit projects

Agenda

INTRODUCTION

- CFD Description
- CAD Model and the need to associate
- Revit Model

LAUNCHING FROM REVIT TO CFD

- Launching from Revit
- Designs and Scenarios
- Direct versus export

CFD INTERPRETATION OF A REVIT MODEL

- View - hidden objects
- Families and instances
- Interferences
- Errors in translation

TOOLS FOR PREPARING REVIT MODELS

- Active view set up – Hiding objects
- Section box and selection box
- Interferences – detect and solve
- Simplify families
- Closing gaps
- Dynamo Automation

WORKING WITH CFD- HOW TO…

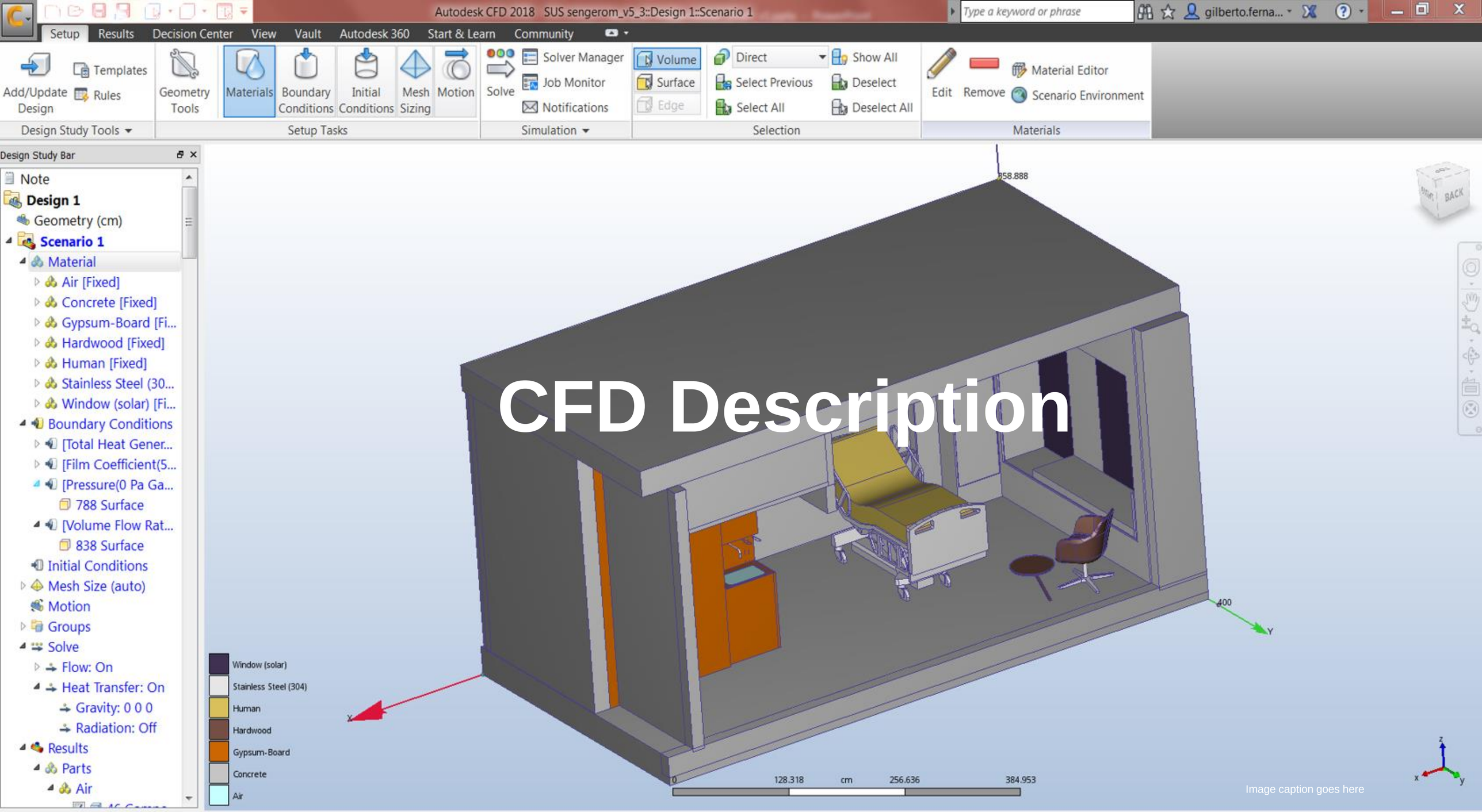
- How to set up a simulation in CFD
- Set up tasks of a basic CFD study
- Results in CFD – Learning what we did not know
- Decision Centre- Comparisons and decision-making

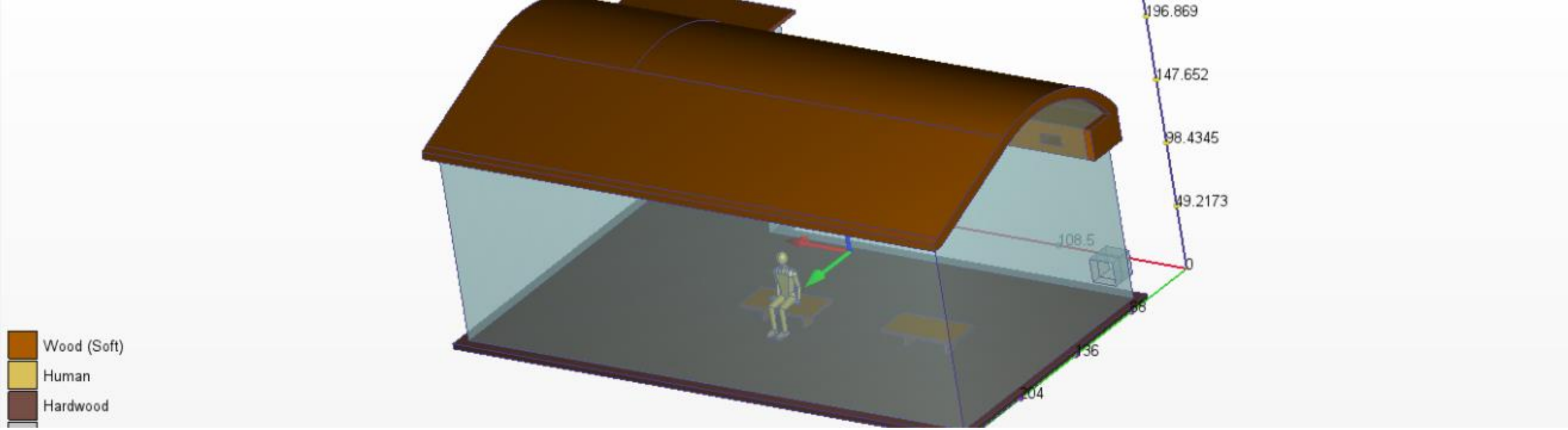
ADDITIONAL RESOURCES

Q&A

Introduction

CFD Description





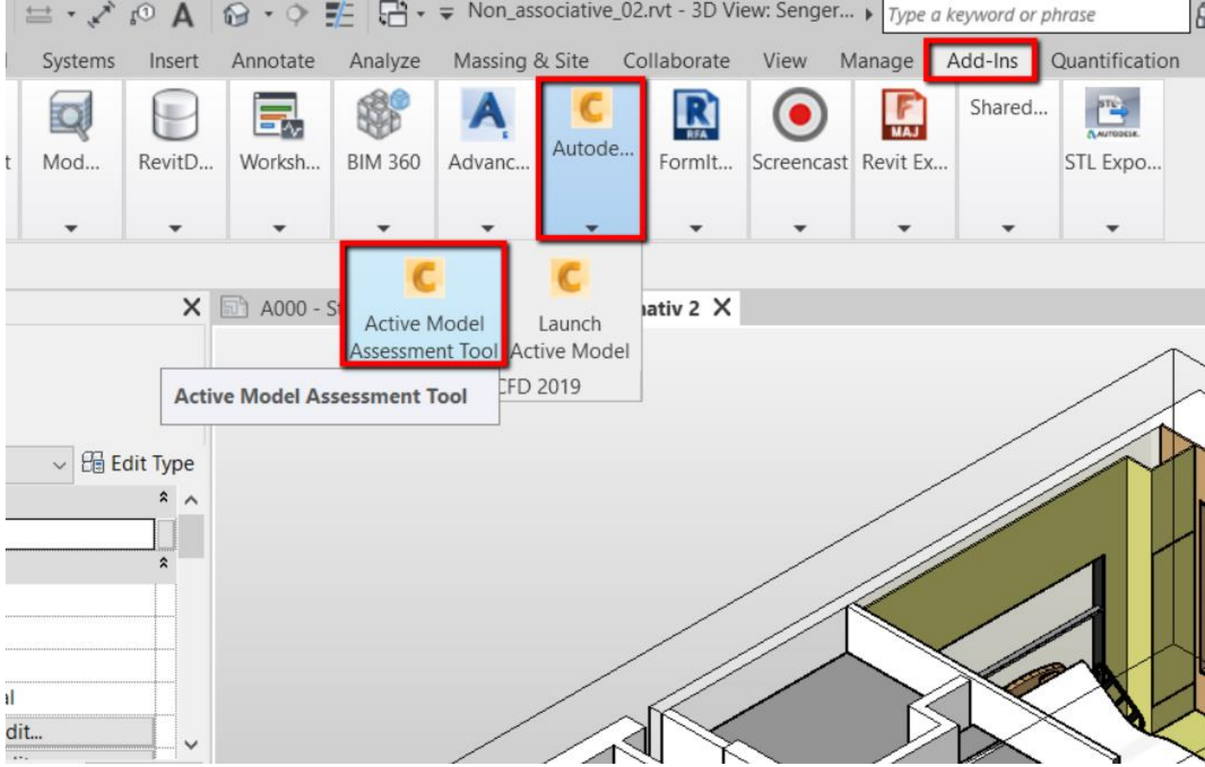
CFD Description

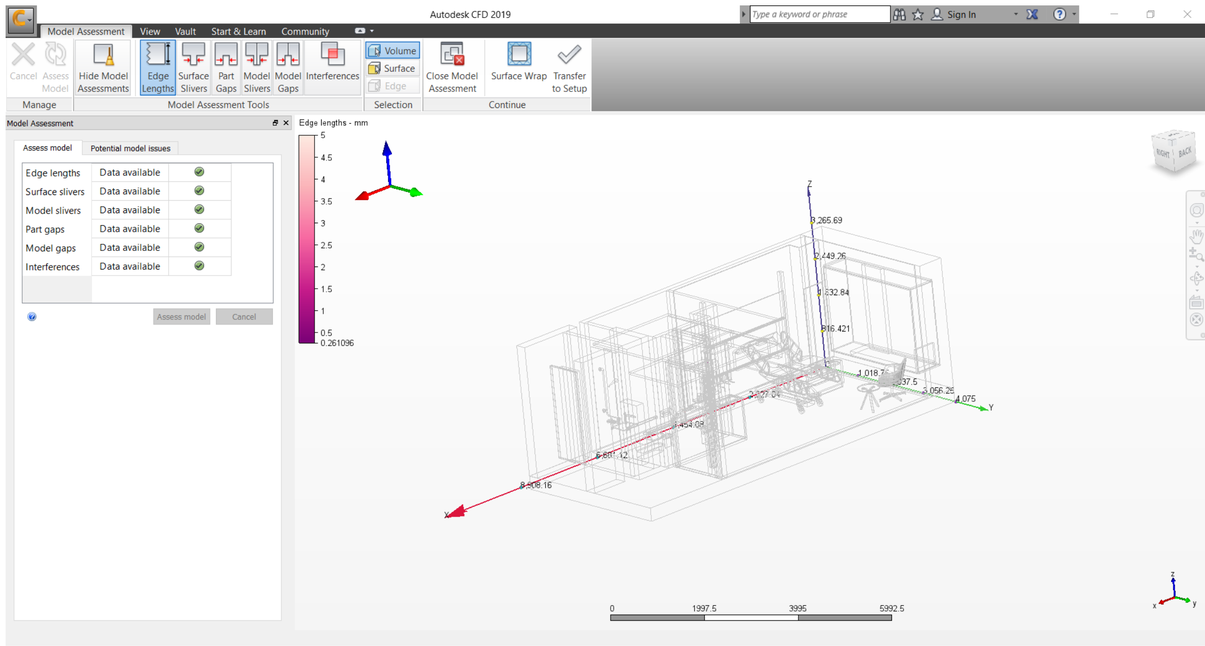
- CFD is a Simulation software – Numerical analysis tool
- Solving fluid flow + heat transfer problems
- Helps predict performance and behavior
- Needs a volume of control and a mesh

- Used throughout the design process
  - Concept Phase
  - Development Phase
  - Marketing Phase

CAD Model - Need to associate

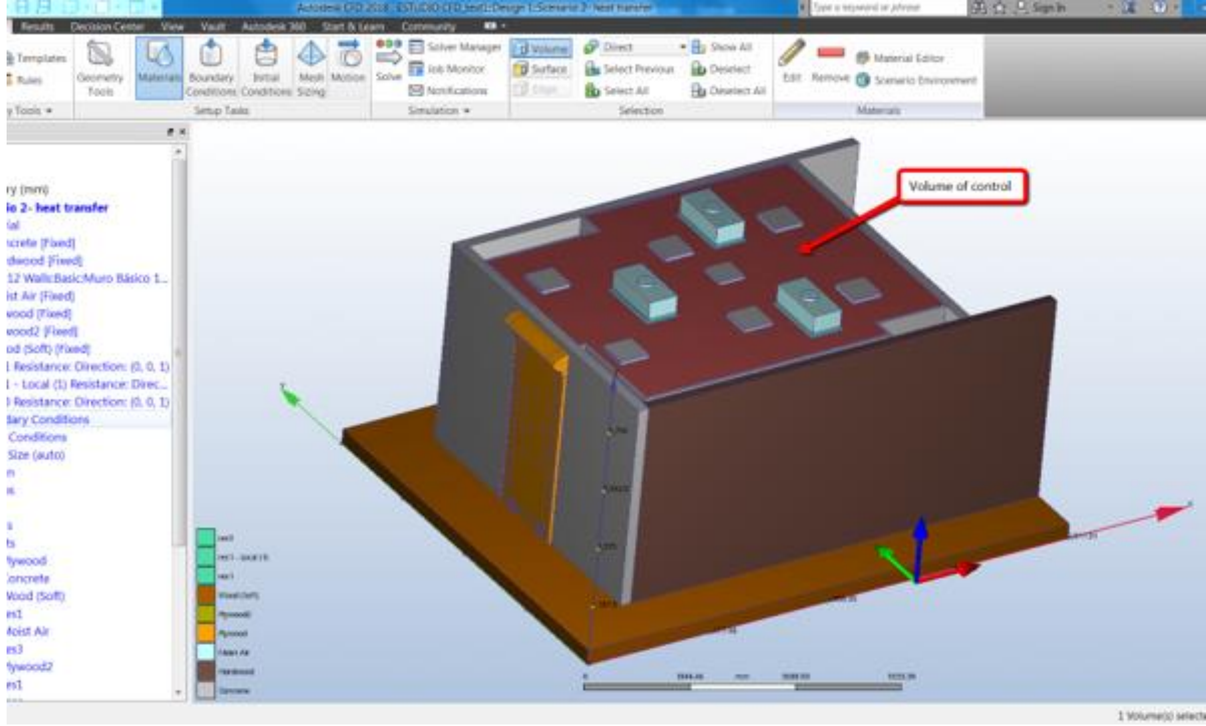
- Need a 3D mesh, and a volume of control
- Volume of Control generation can be an issue
- Optimisation of the model for simulation
  - Production-level is too detailed
  - Keeping significance but dropping some detail
- Model Assessment tool
  - Accessed through launcher
  - Identifies and locates but does not fix
  - Checks for:
    - Slivers
    - Interferences
    - Gaps
  - Quantifies – spots smallest

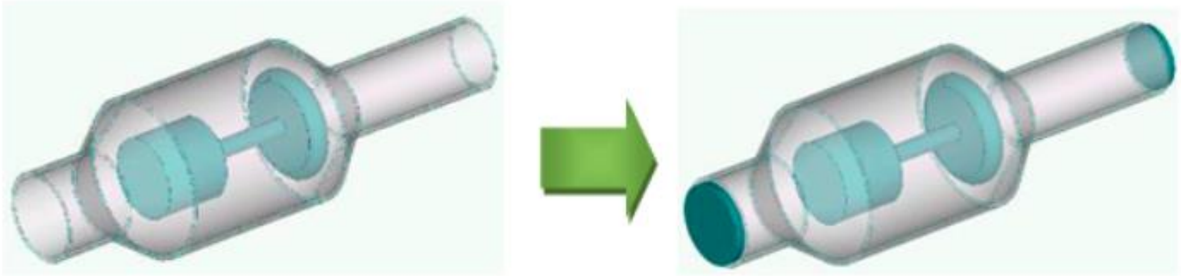


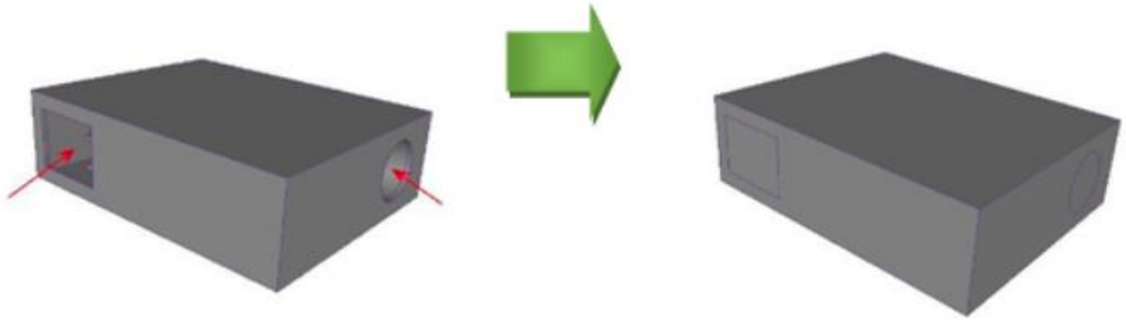


Modelling the flow region

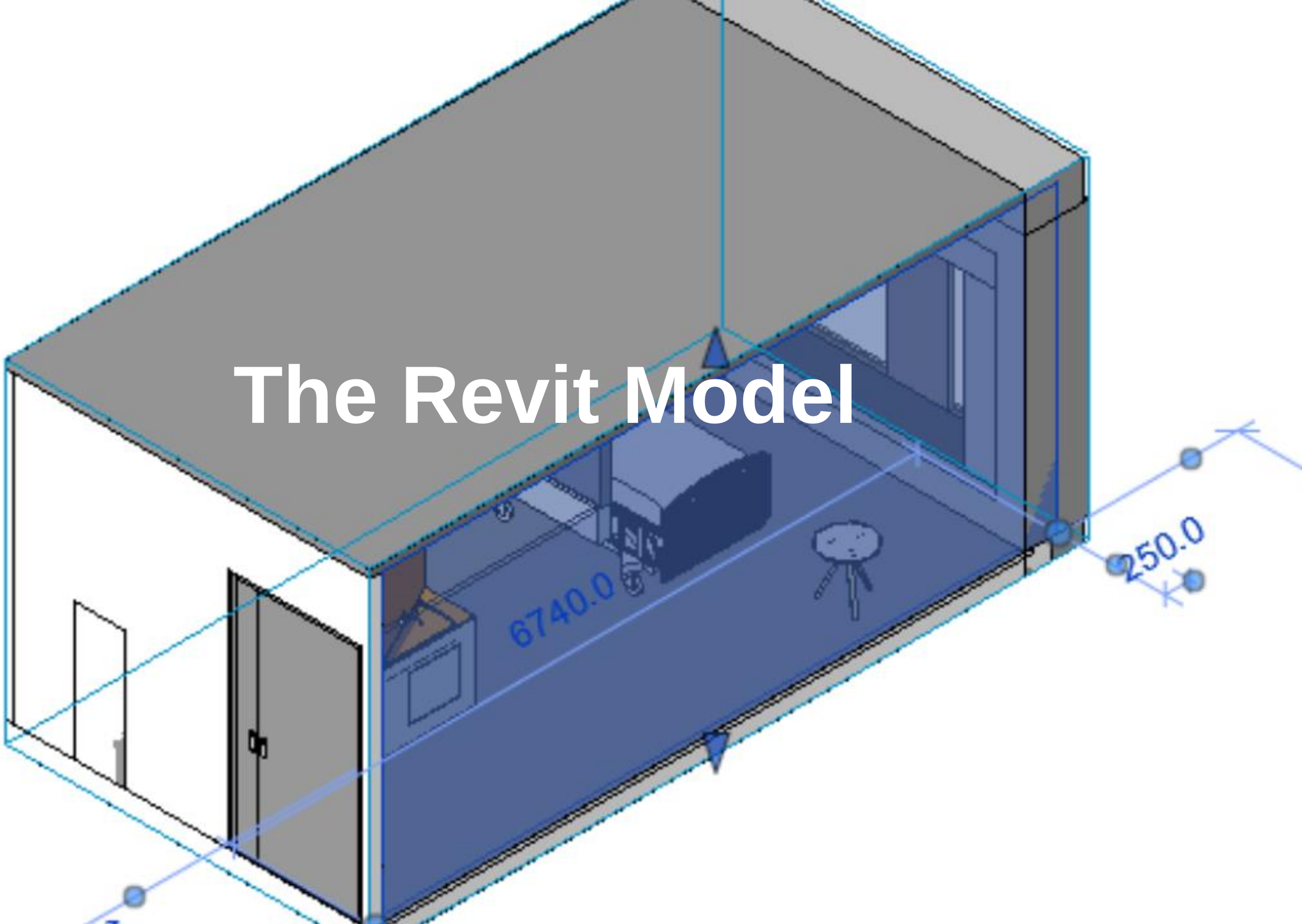
- CFD needs a flow region to be defined
- Ways to create the flow region:
  1. Generate in CAD
     - Good control
     - Complex task in some CAD
  2. Having a void airtight- CFD void-fills it
     - Simple and flexible- relies on CAD skills
     - Includes extra parts
  3. Create the region with Geometry Tools in CFD
     - Not using the CAD
     - Shaping and planar limitations
- For Revit, method 2 will be the best





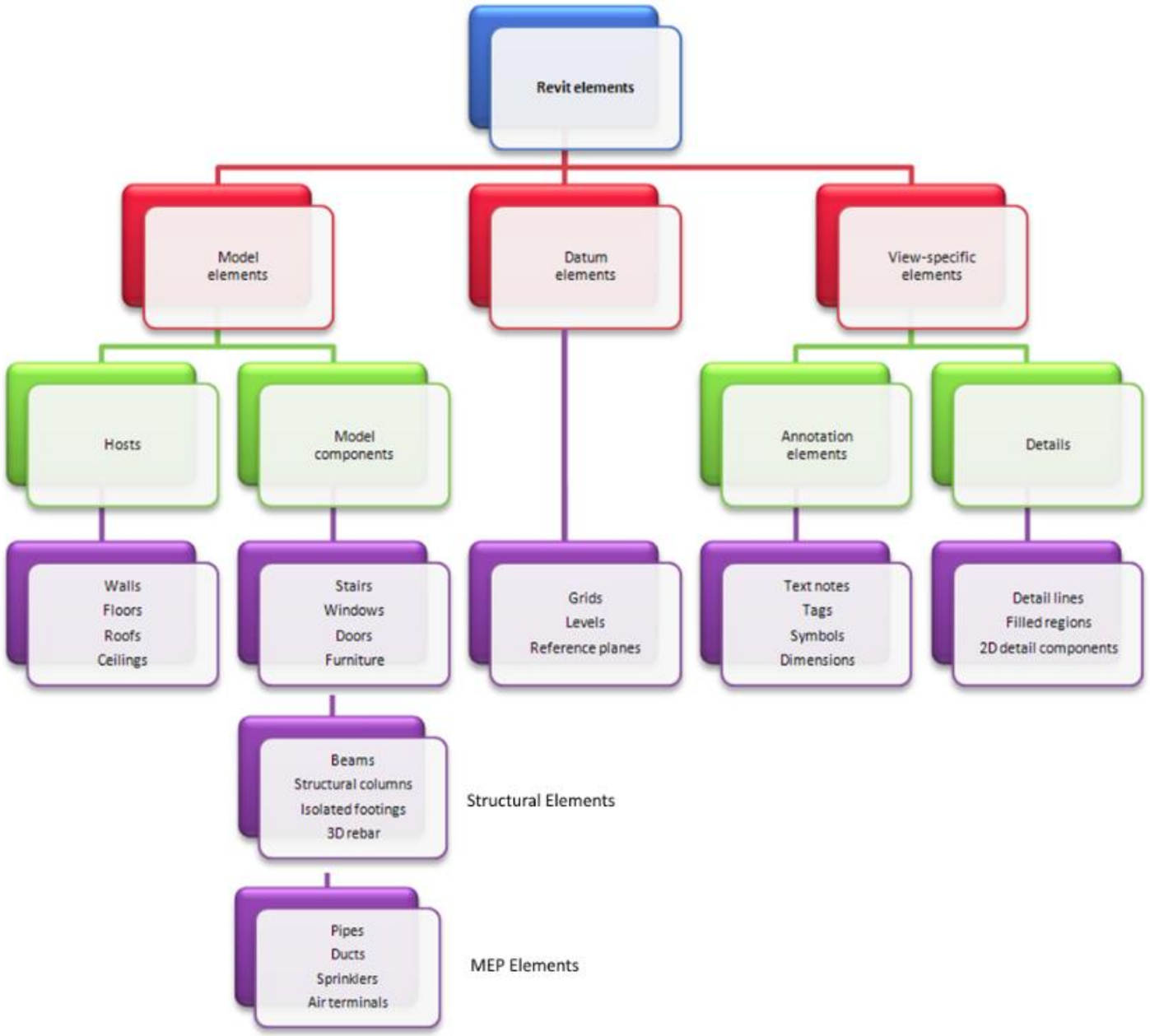


The Revit Model



Revit Model

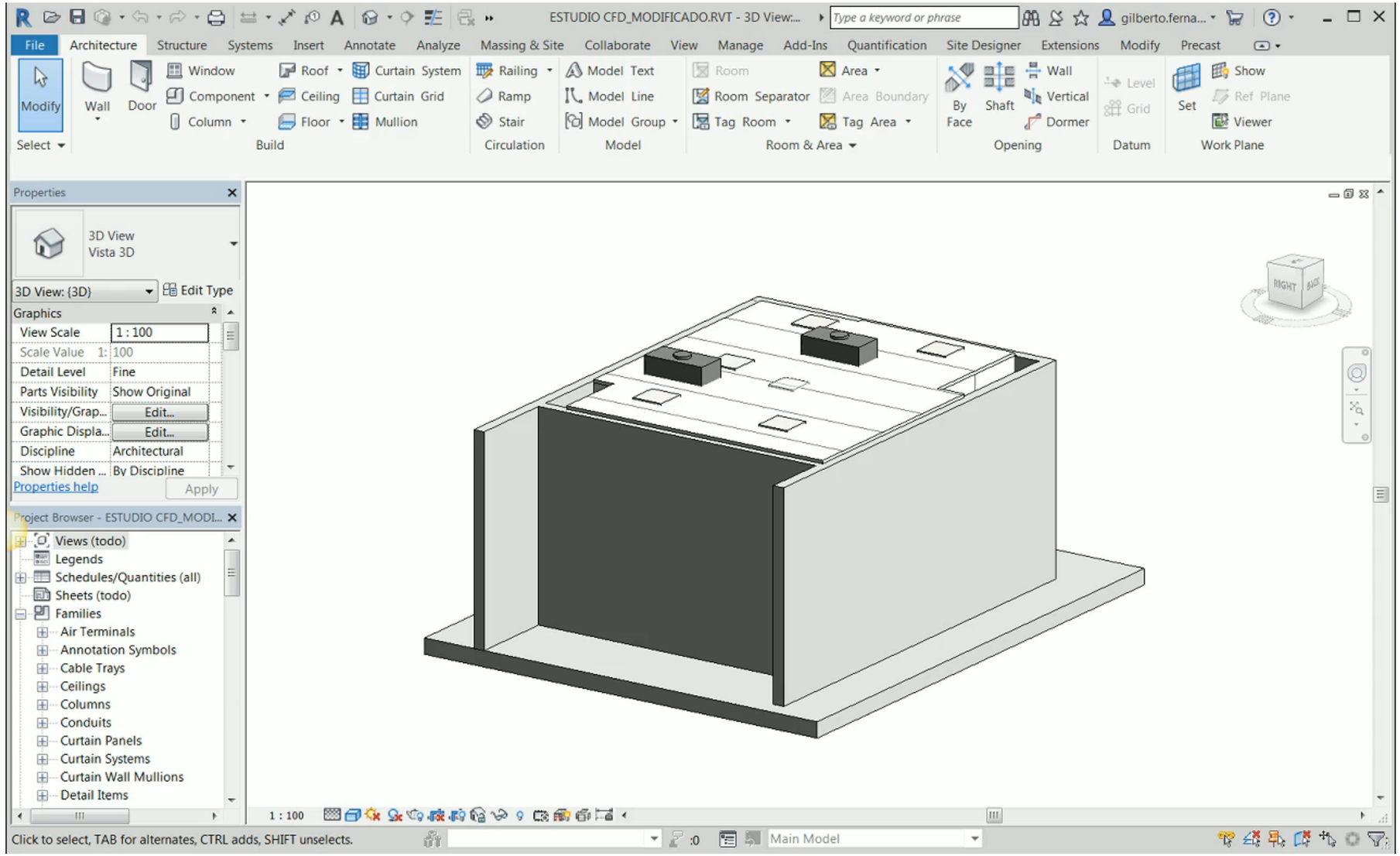
- Design and documentation platform
- Supports designs, drawing and schedules for BIM
- Collects info for all representations of a project
- Parametric engine- applies changes everywhere
- Works with projects
- Inside, it works with elements or families
  - Model elements
  - Datum elements
  - View-specific elements
- Behaviour of elements depend on context within the building



Launching from Revit to CFD

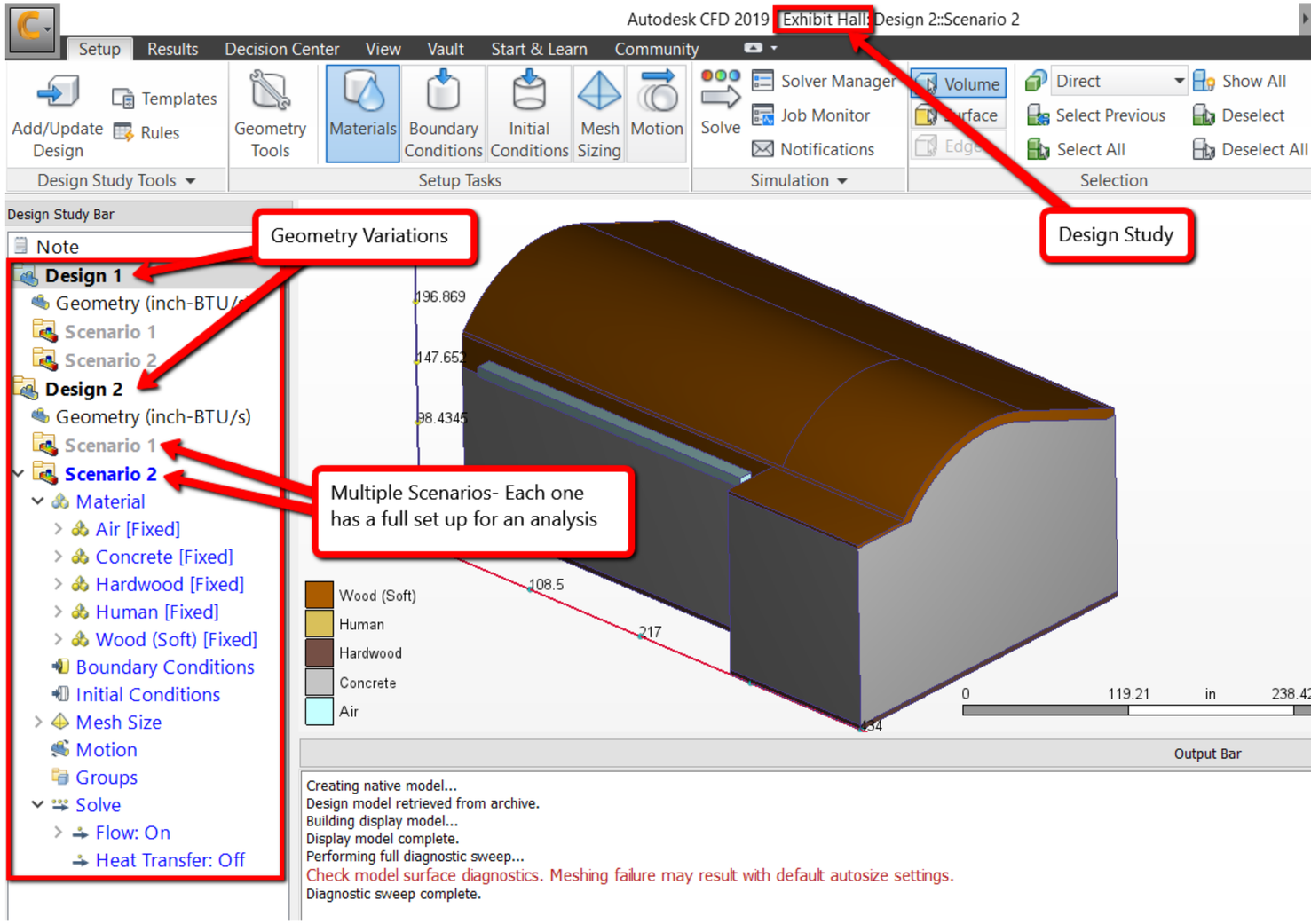
Launching from Revit

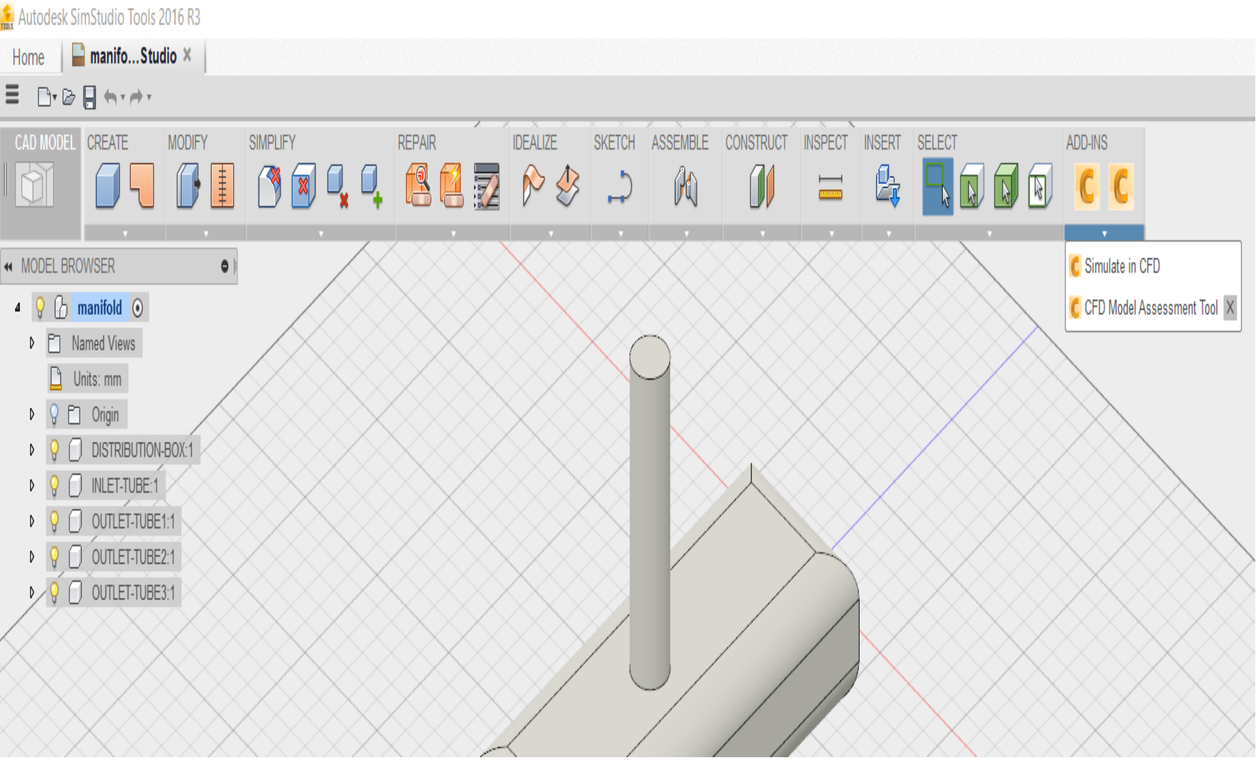
- CFD Launcher
- Located in Add-Ins
- Install
- Options:
  - Model Assessment Toolkit
  - Launch direct
- Void fill

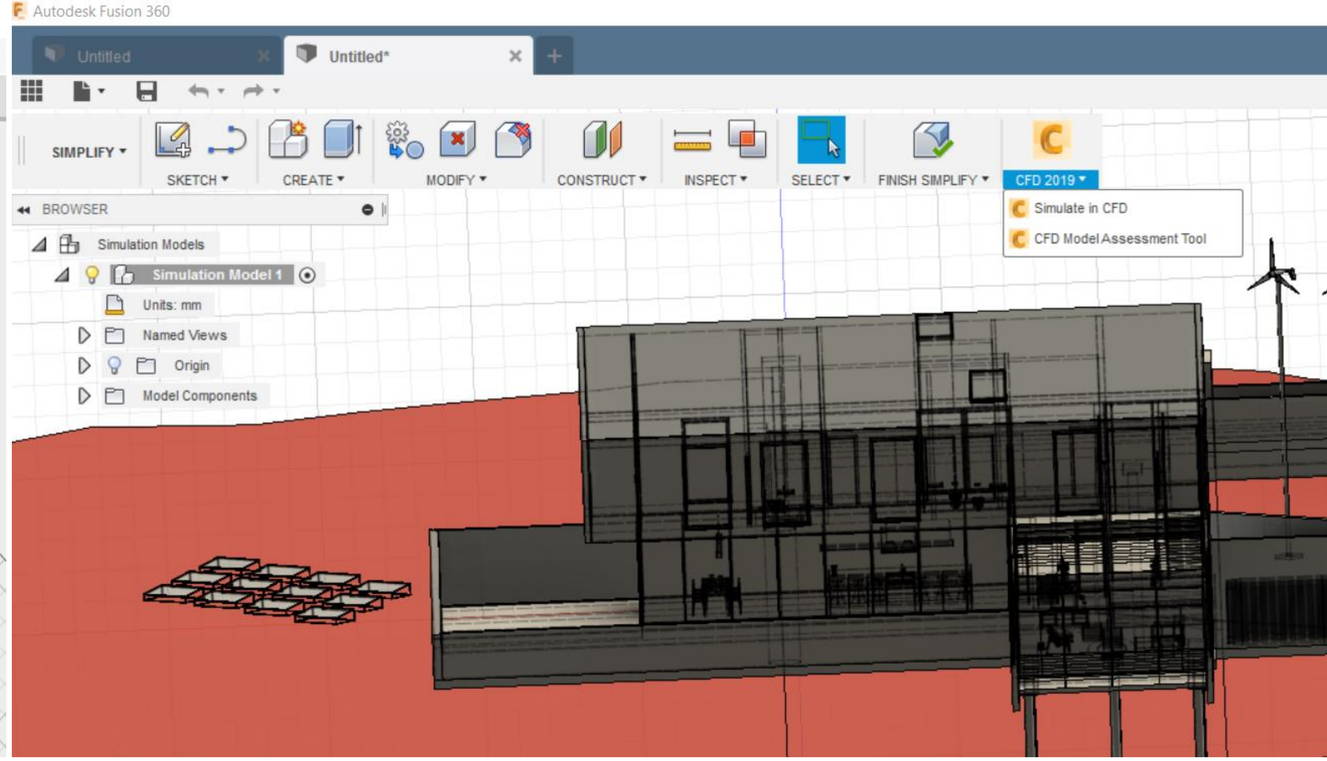


Designs and scenarios

- CFD works with design studies
- Hierarchy:
  - DESIGN STUDY
    - Main container
    - Framework structure
  - DESIGNS
    - Every unique geometrical variation
    - Can contain multiple scenarios
  - SCENARIOS
    - Individual analysis
    - Variation: operating conditions





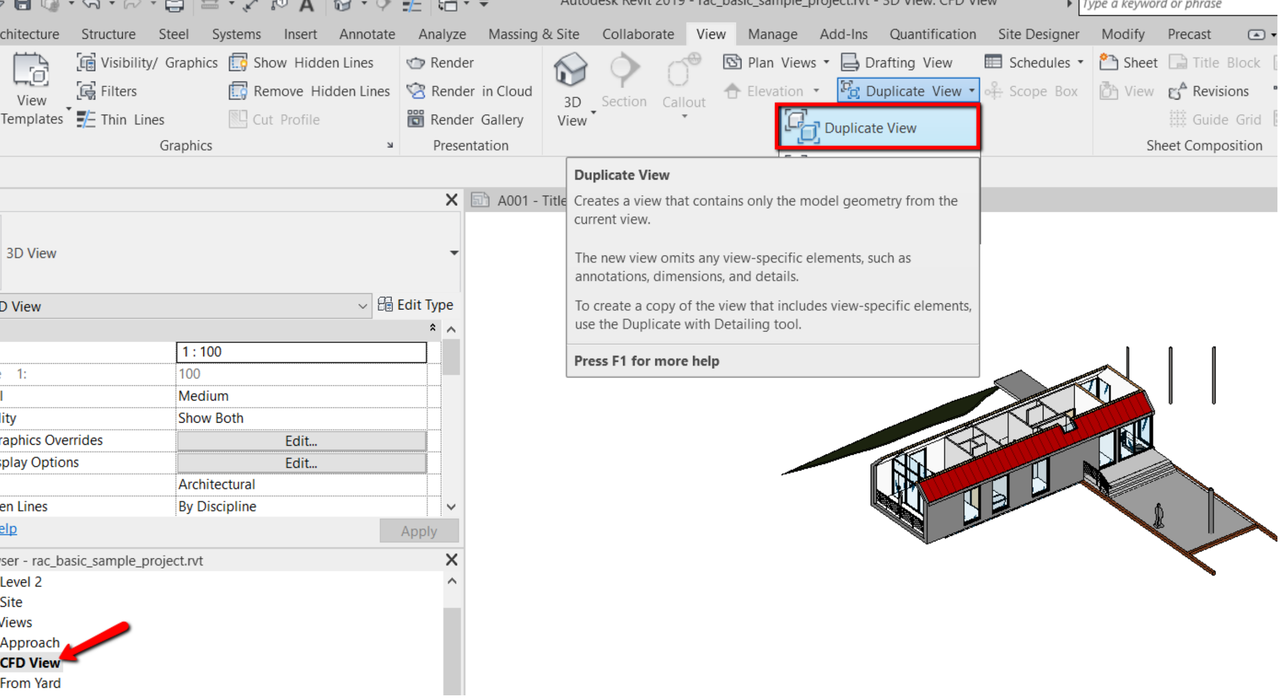


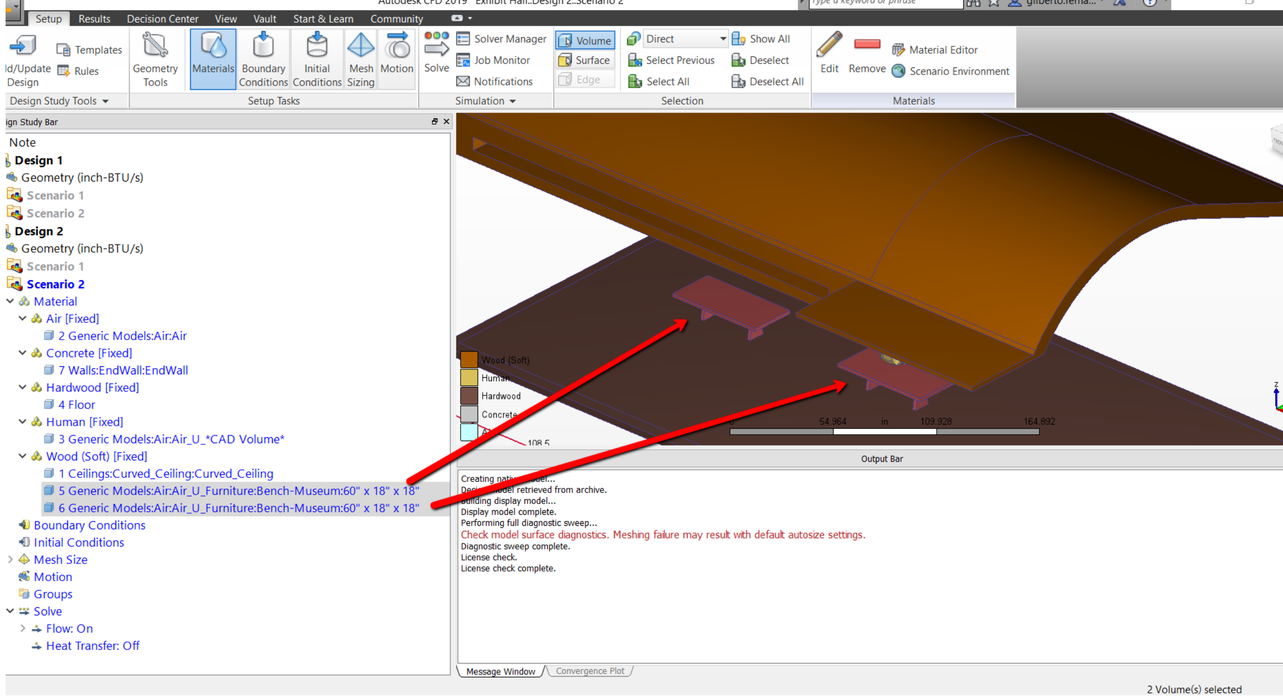
Direct launch vs Export as SAT file

- Options: direct launch/open in SStudio/Fusion
- SAT file – makes it lose associativity
- Tagging system- Part XX or Component XX

- Revit launch is preferred
- Is export as a SAT, we recommend SS/fusion
- Reason: even though naming is bad, we can still have associativity

CFD Interpretation of a Revit Model



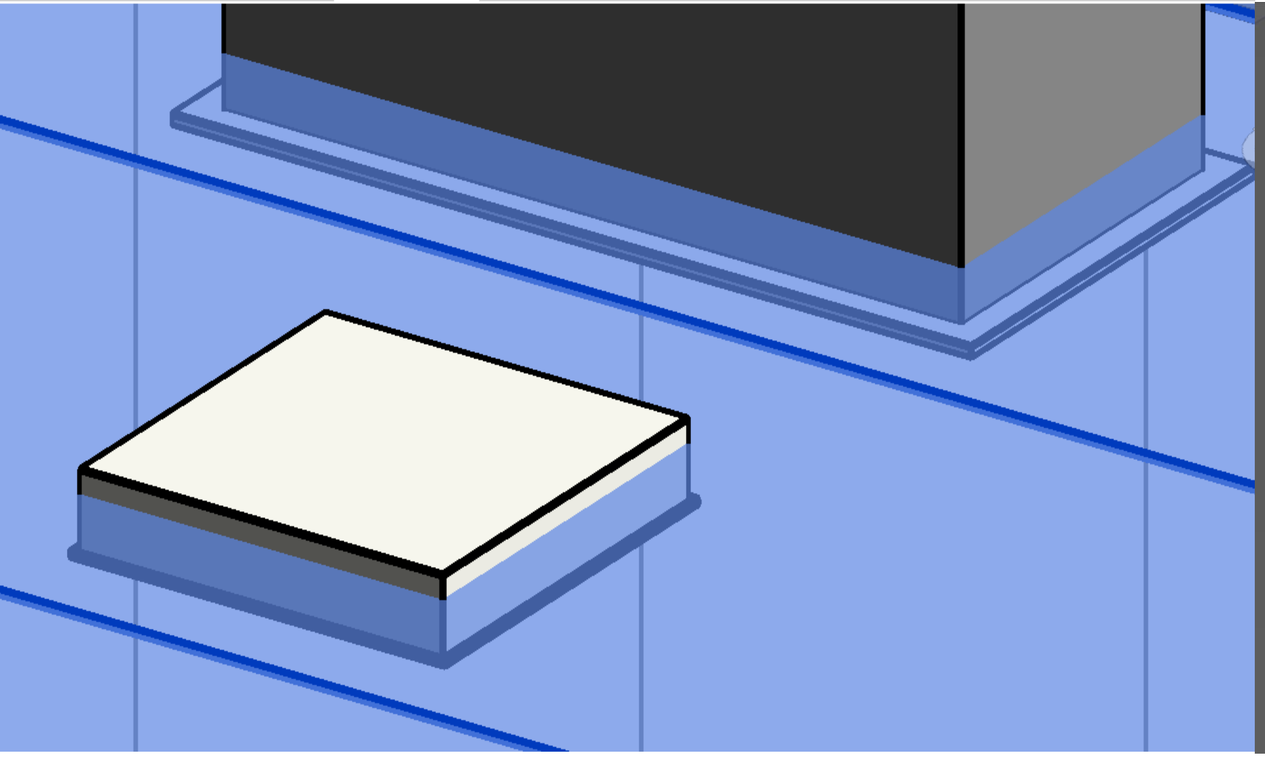


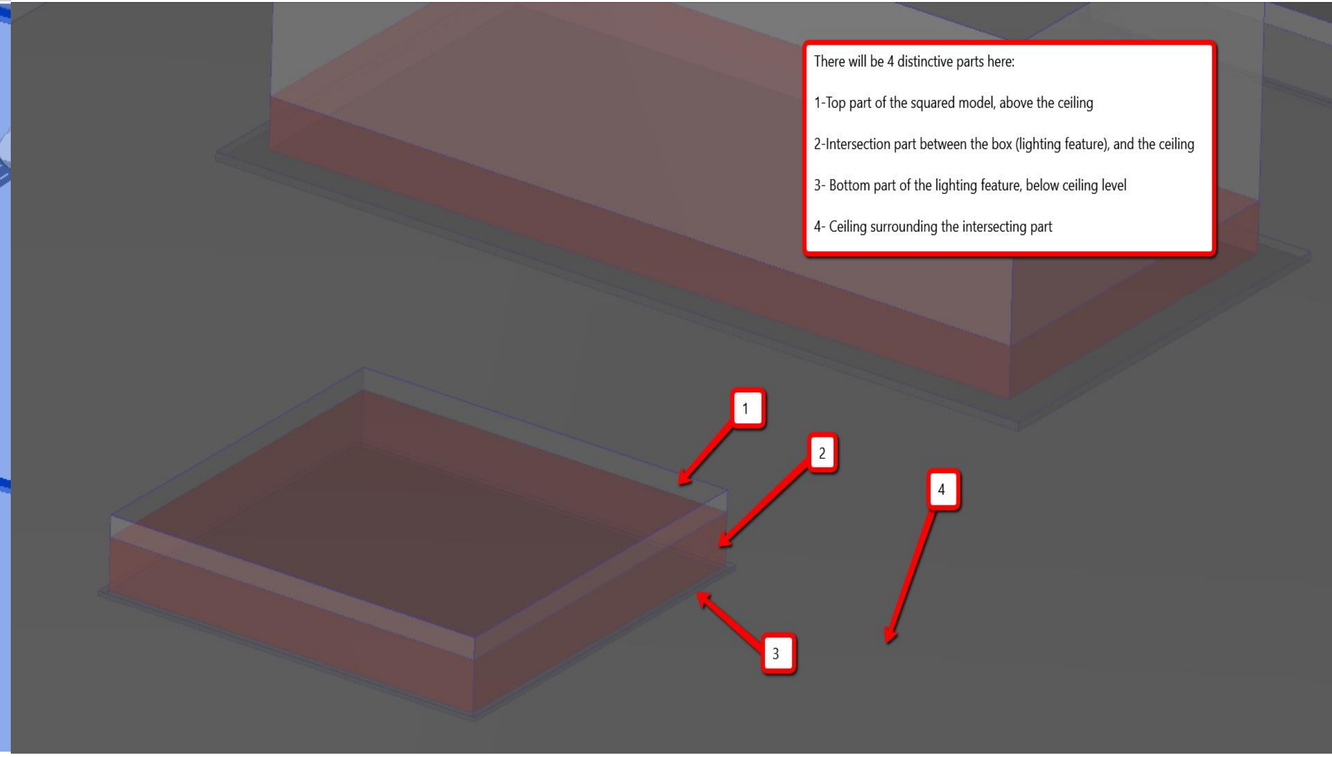
View – Hidden Objects

- CFD interprets only ACTIVE VIEW
- Only visible elements
- Hidden elements
- Annotations and references at editing – NOT TAKEN

Families and instances

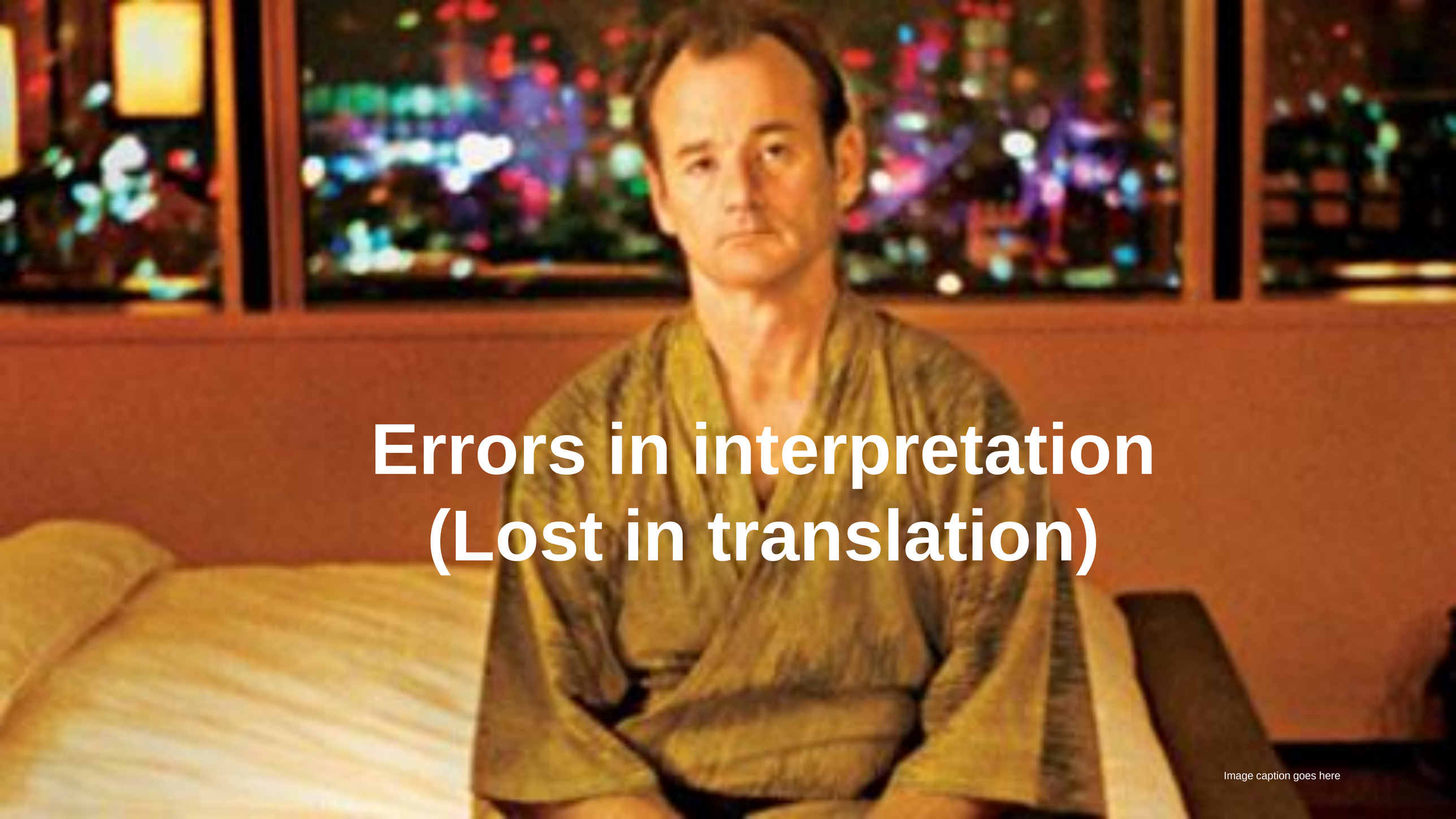
- Families interpreted as separate parts, and its subparts too
- Families and instances- completely detached and unlinked
- Family names: Taken into account type, name and sub-name
- Instance name: Same name, different tag ID in CFD





Interferences

- Interferences re allowed and understood → No need at first to take them out
- Way of interpretation – Separate parts for each family not in touch with the other, and one/several for the intersections
- Naming: Family1 Type:Family1 Name_U_Family2 type:Family2 Name – Names can be long
- Multiple intersections – Same name, different tags in CFD
- Intersections of different instances – same name, different tags

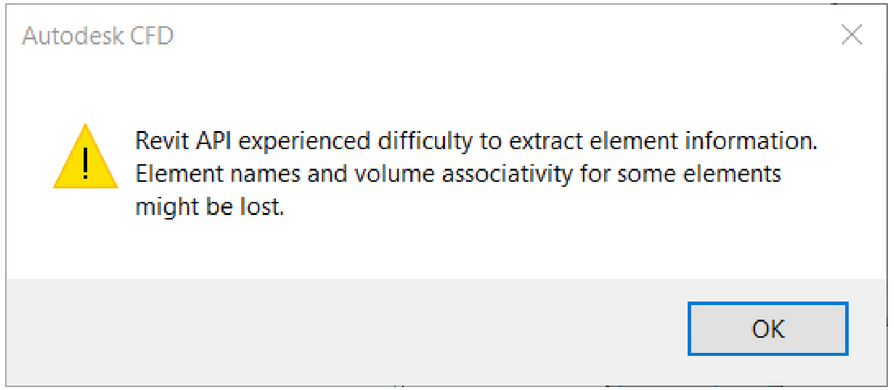


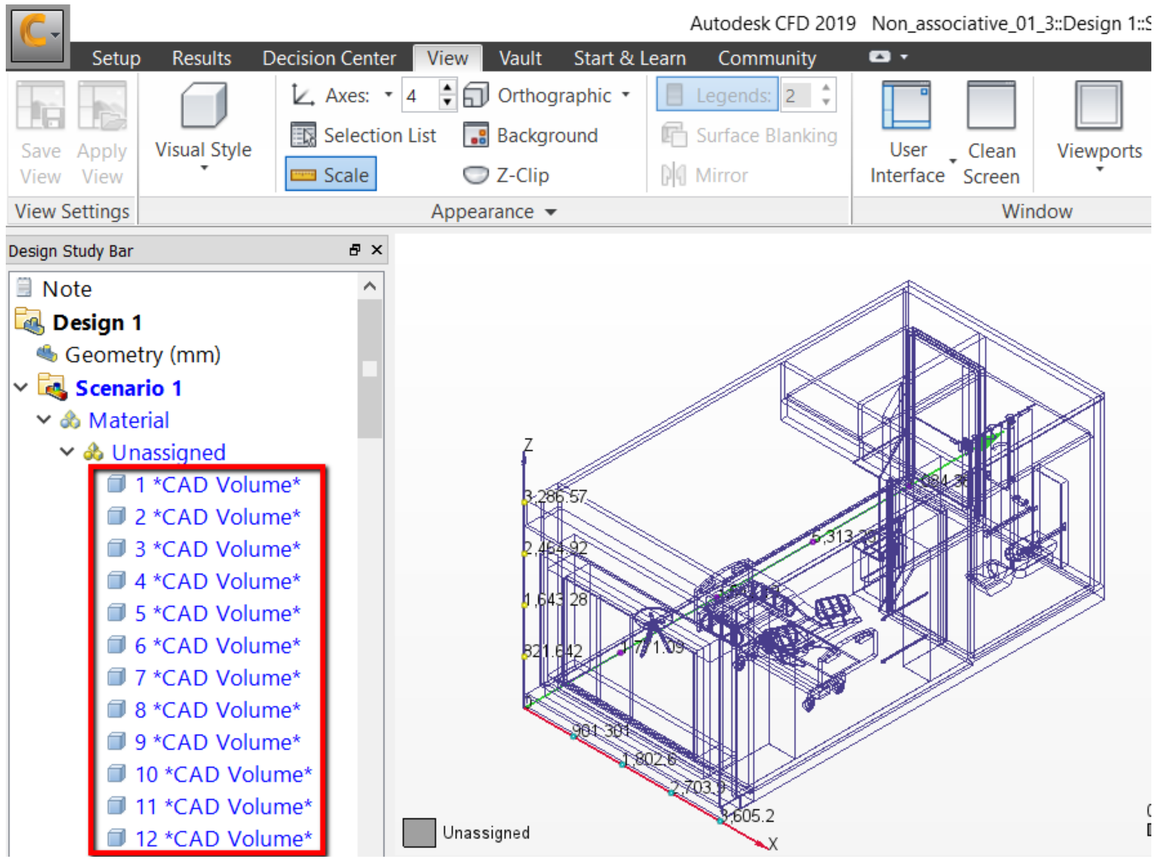
Errors in interpretation (Lost in translation)

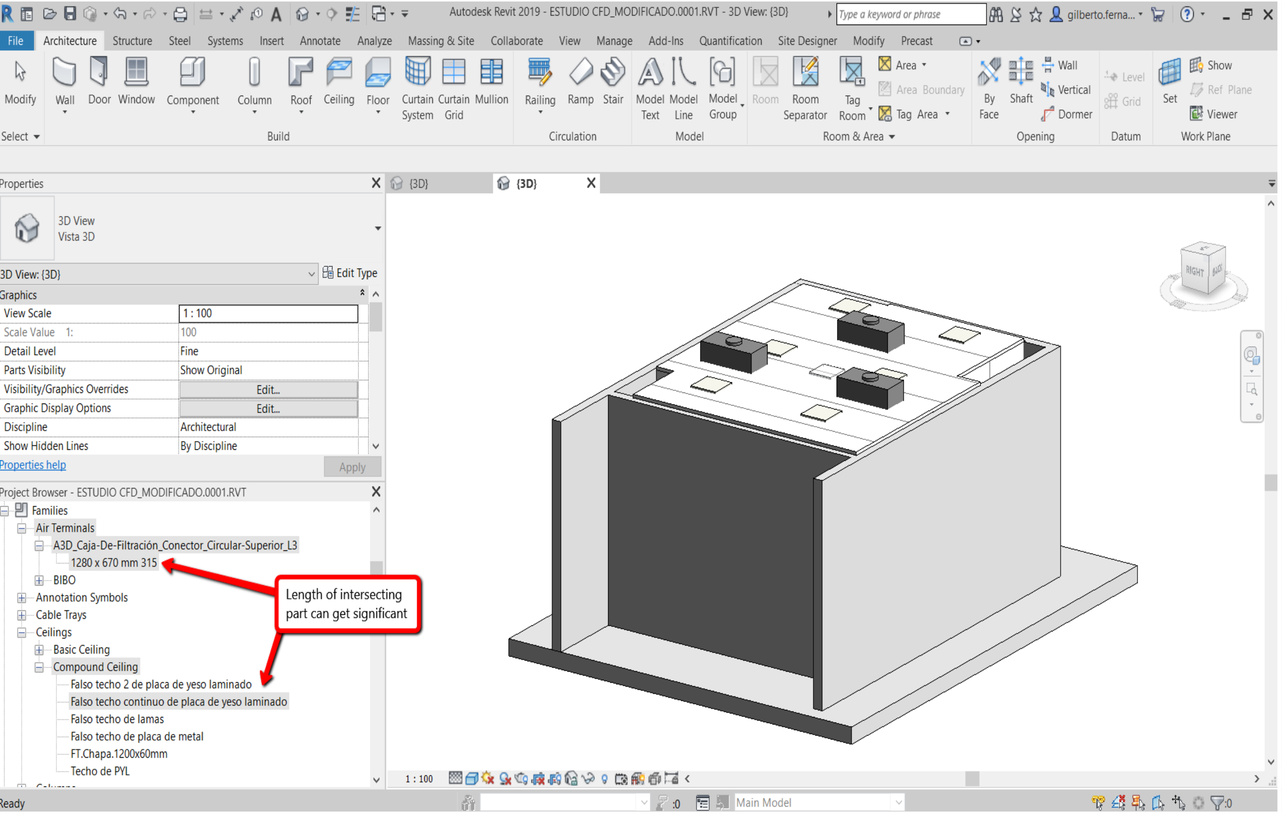
Image caption goes here

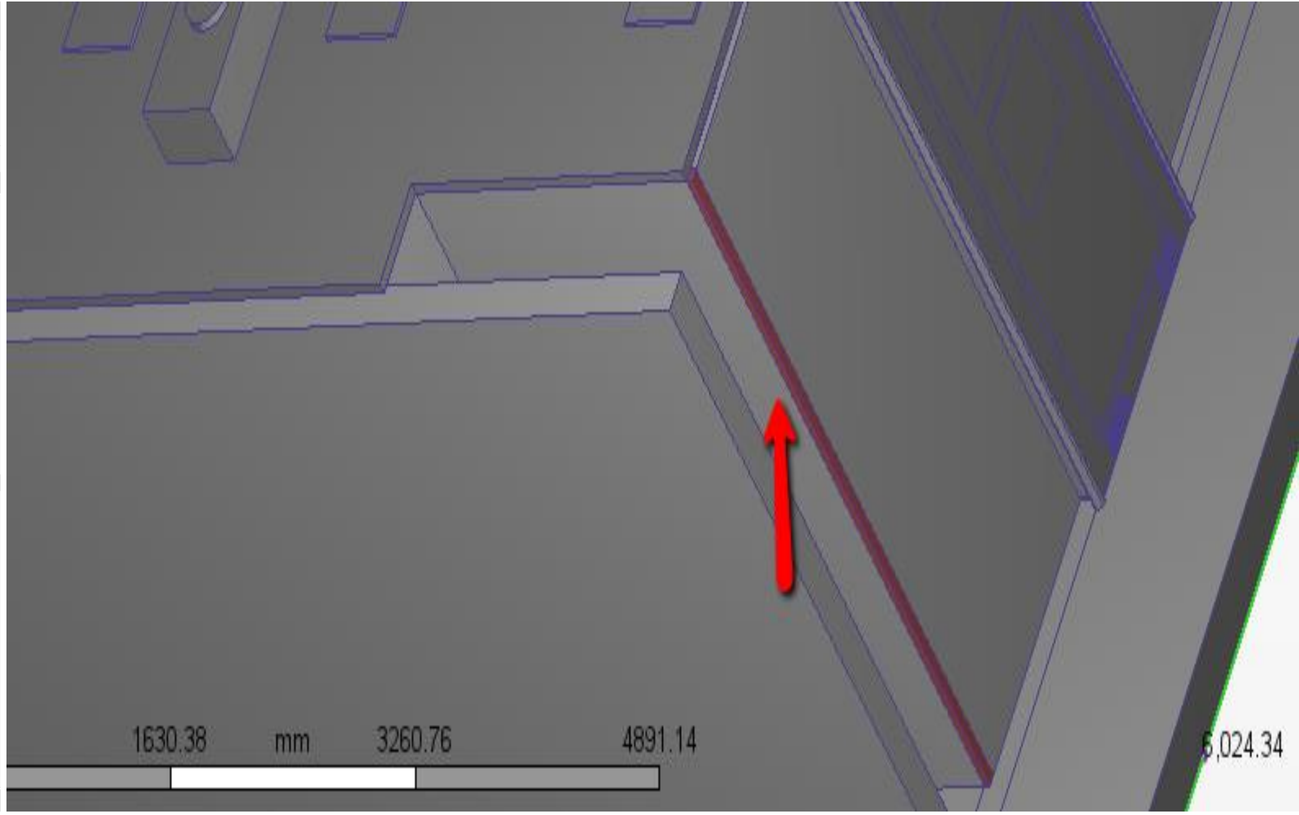
General Associativity

- Error when hitting Launch Active Model
- Revit API difficulties with names – Nothing is being left out
- Every part is *CAD Volume* (CFD unknown volume)
- Issues:
  - Recognize and identify different parts for grouping or selection
  - Associativity more uncertain- tags when changing Revit
- Potential causes:
  - Built-in families
  - Imported drawings in the background
- Solution → Get rid of potential things in the background (particularly legacy drawings)
- Key trick → Copy all visible geometry into a blank project







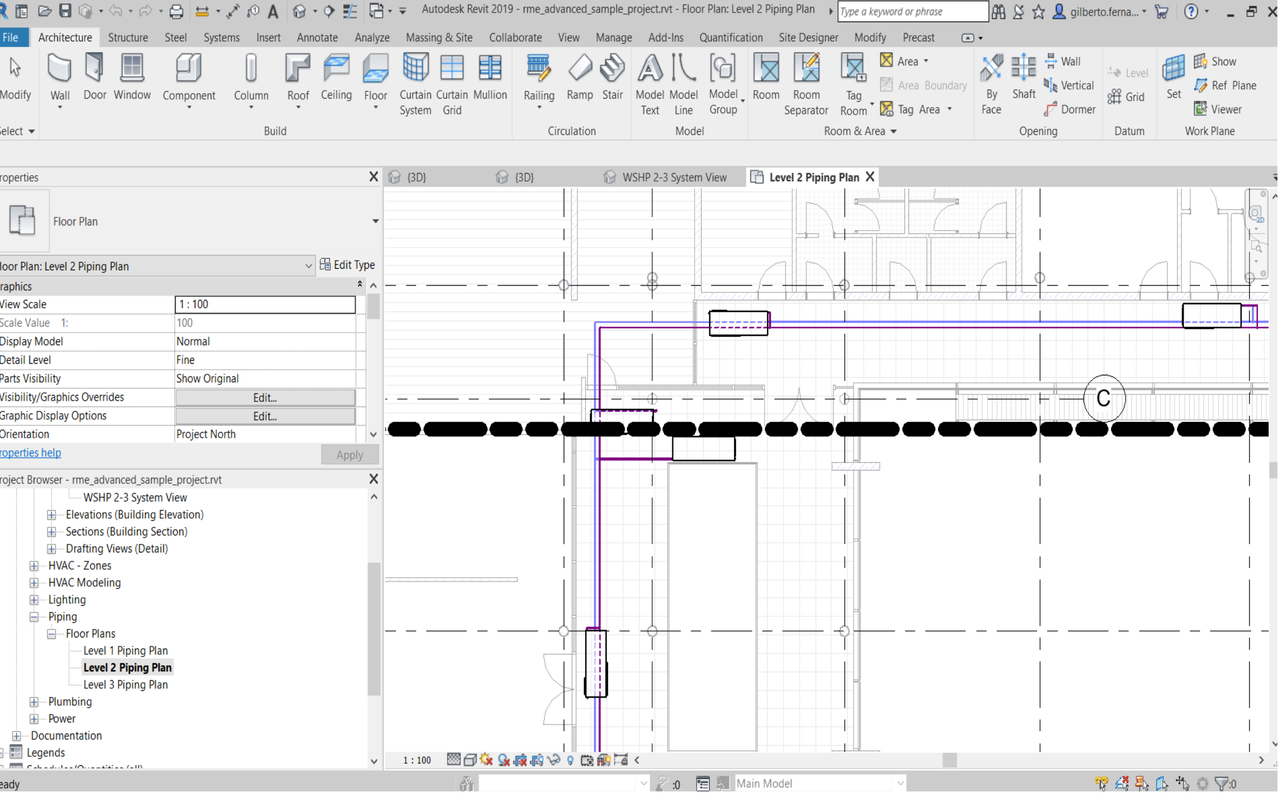


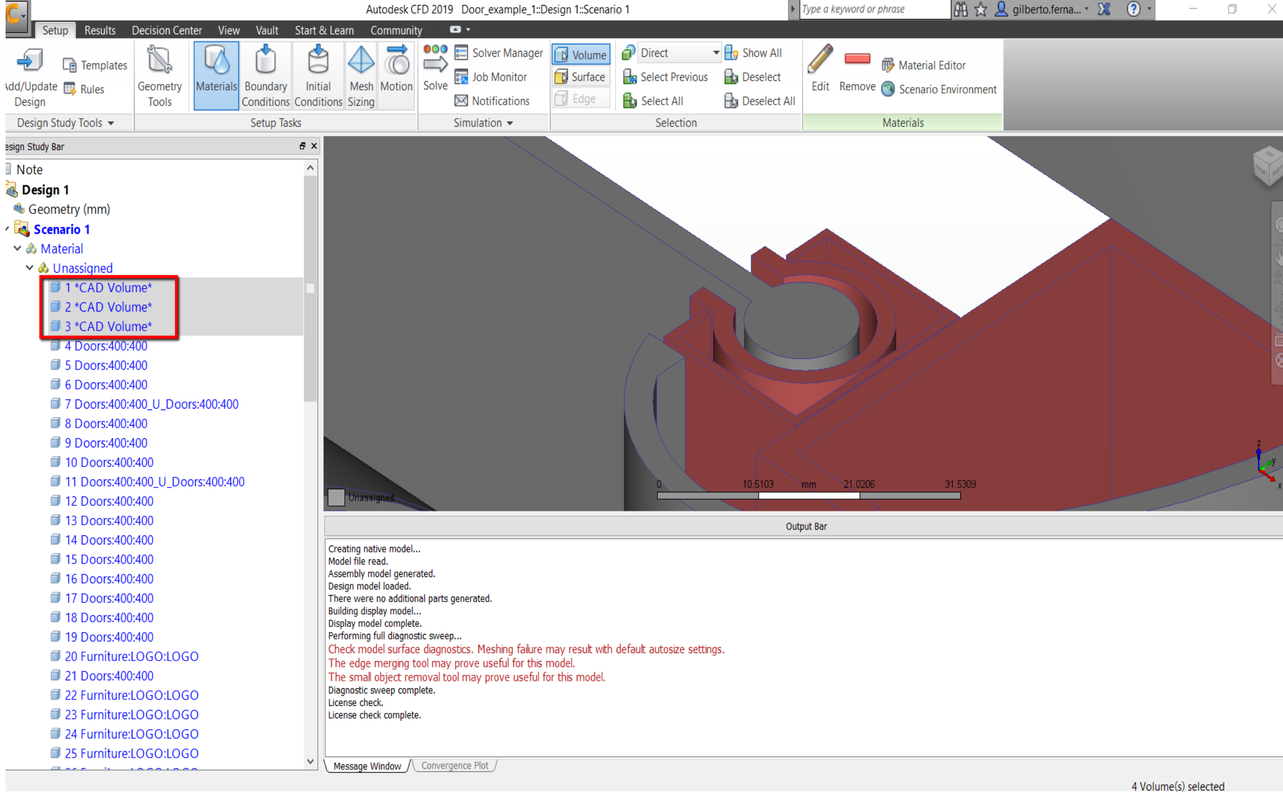
Name length

- Current limitation (WIP)
- Length name of part within CFD- limited to 63 characters
- Careful about handling names in Revit

Interferences

- Not a real issue or an error
- Potential things to be aware of:
  - Interferences can generate very small volumes
  - They can affect the naming length a lot





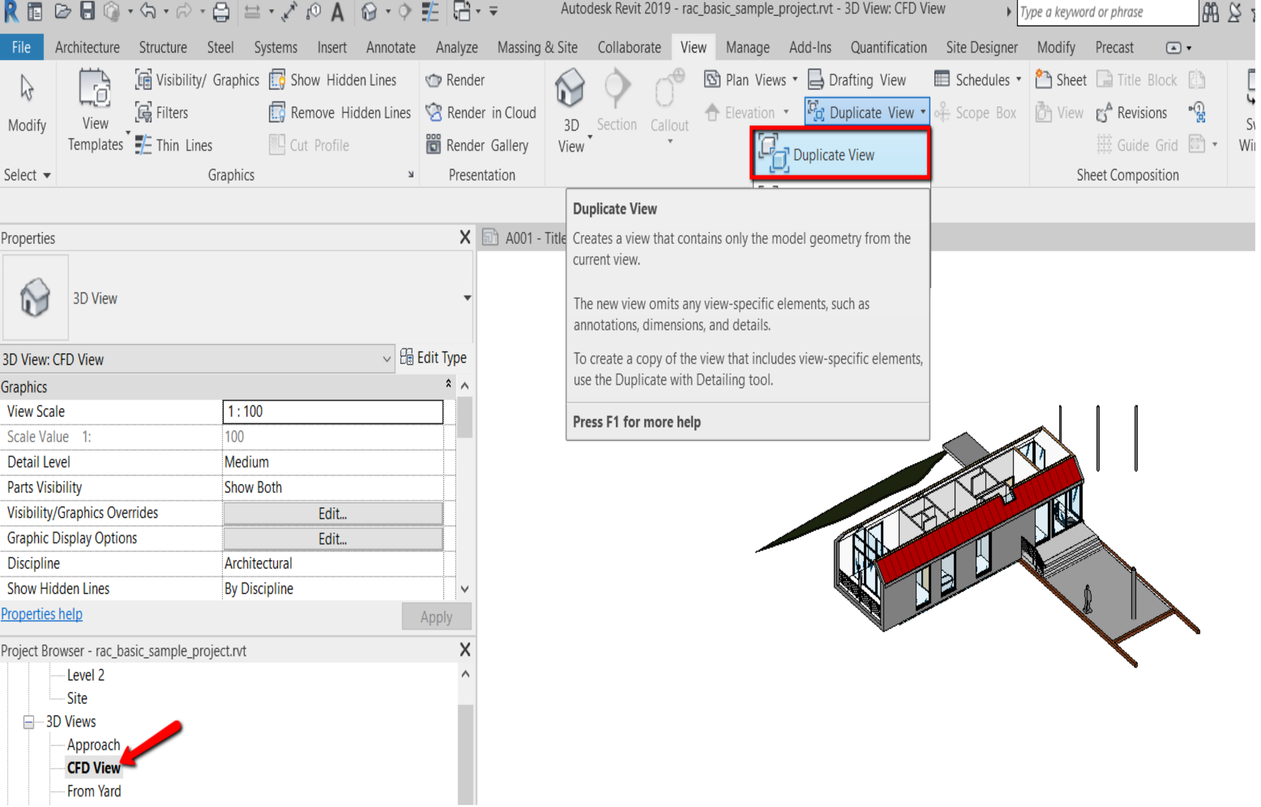
Non-standard objects

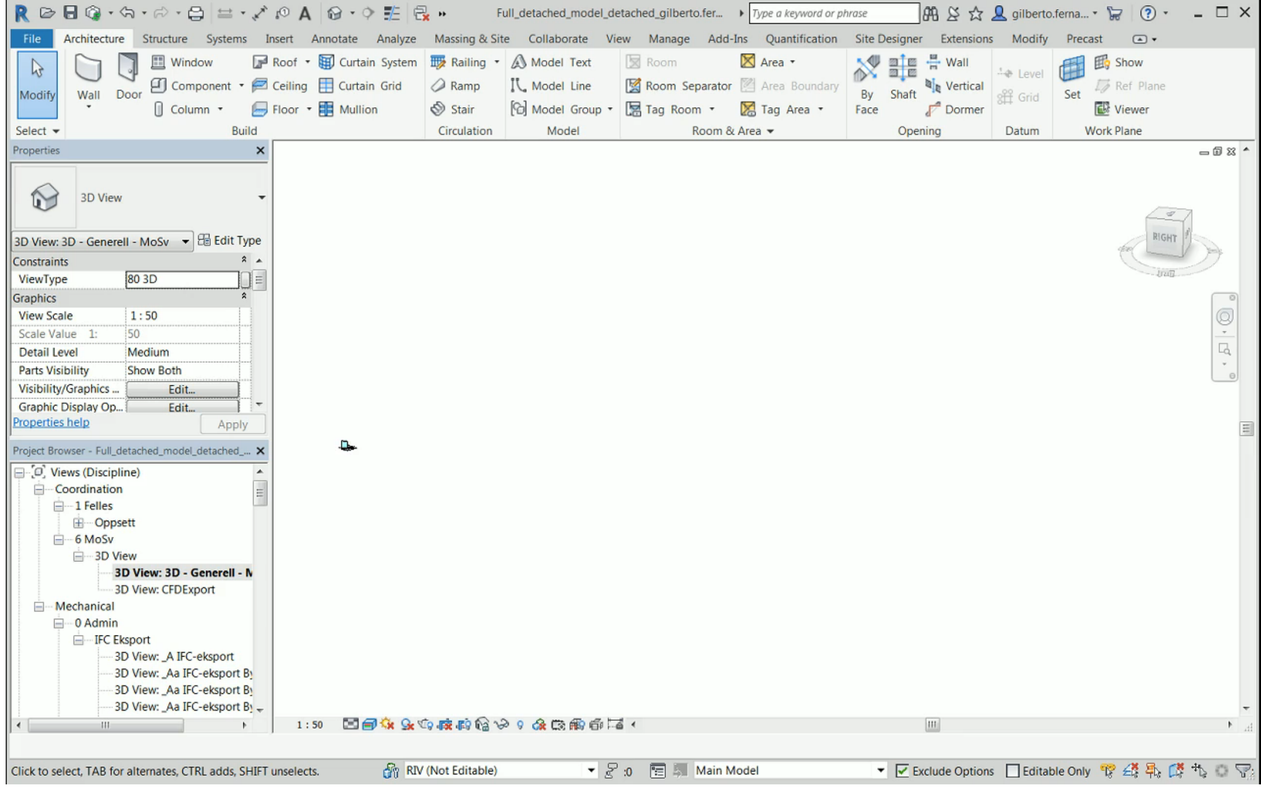
- MEP and Fabrication objects – Recognized OK (2018)
- Linked parts – Taken as regular families (visible ones)
- Pipes and pipe fittings not considered
  - Usually a good thing
  - If significant, change the type

Complex parts – (*CAD_Volume*)

- Sometime, even in associated, still happens
- Multi-sketch profile sweeps
- Most times not significant – if yes, remodel should not be hard

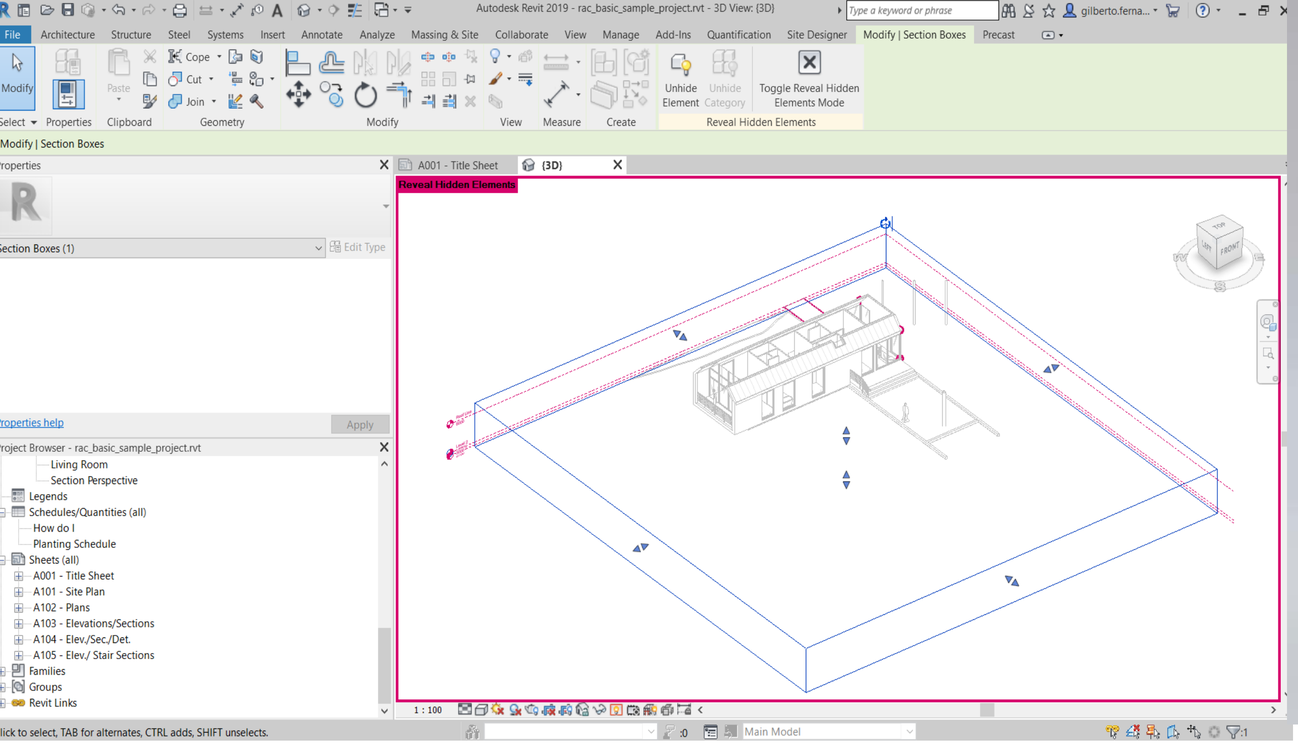
Tools for Preparing Revit Models

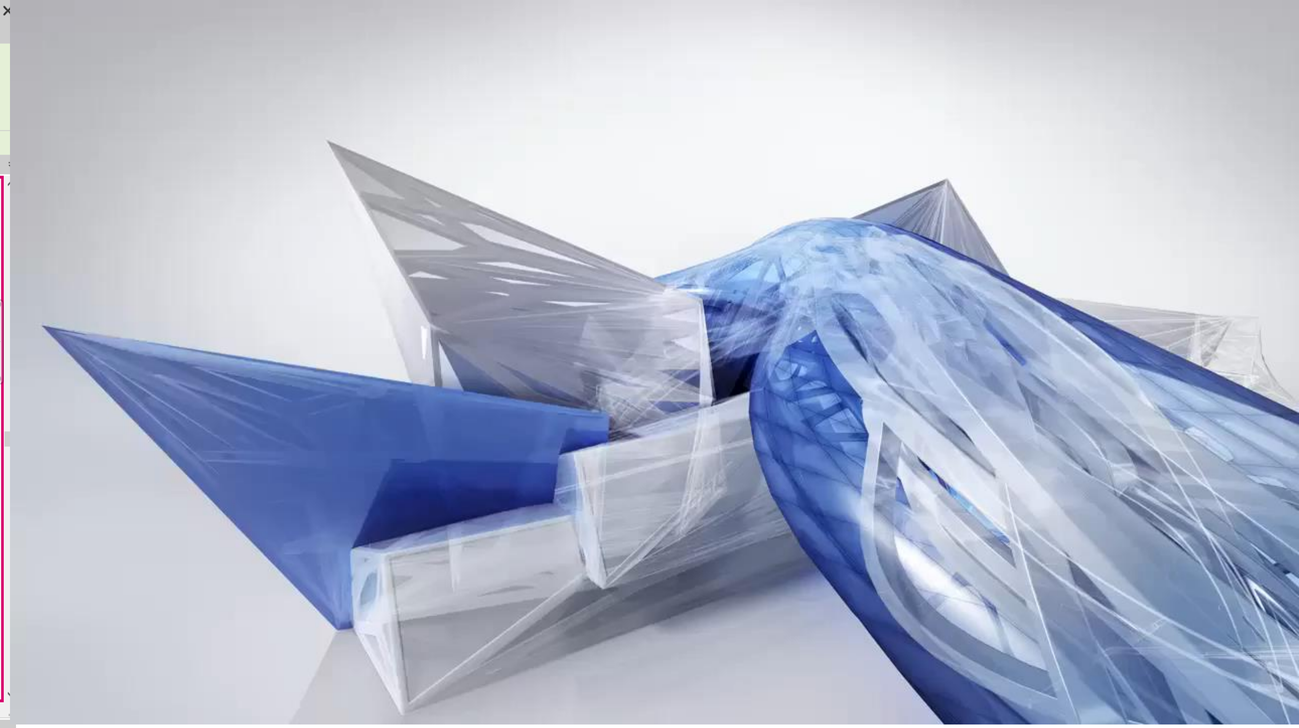




Active view set up – Hiding objects

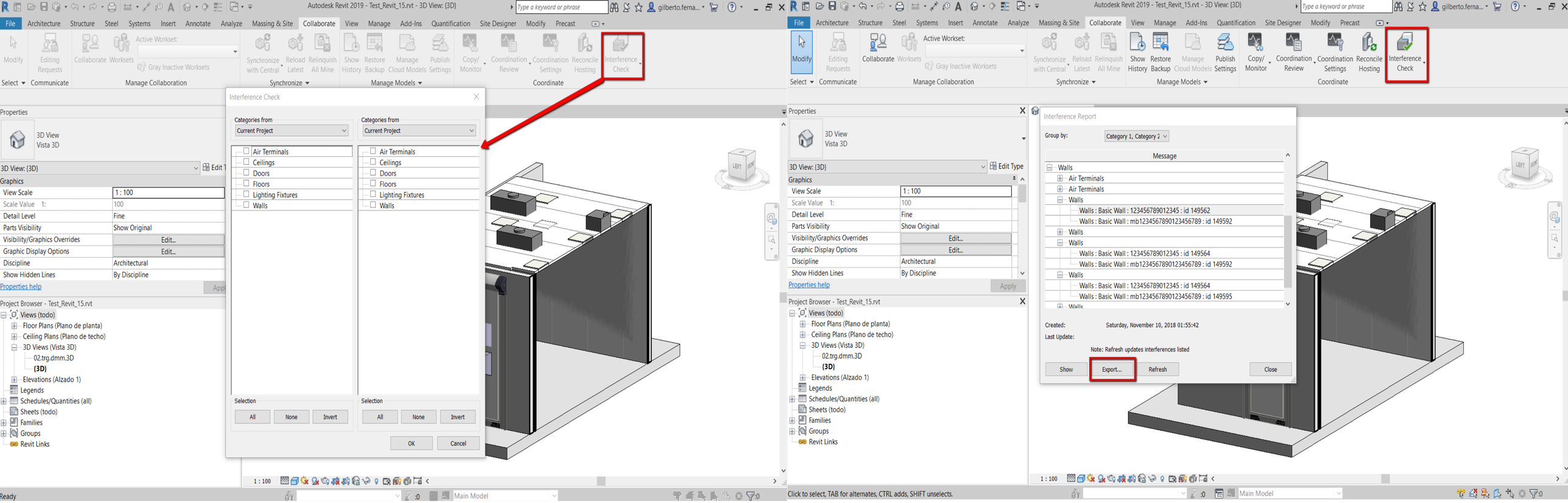
- CFD works only with active visible elements
- Creating a duplicate view to hide right elements
- Specific view for CFD- good idea, as we can work geometrically without disturbing main Revit view





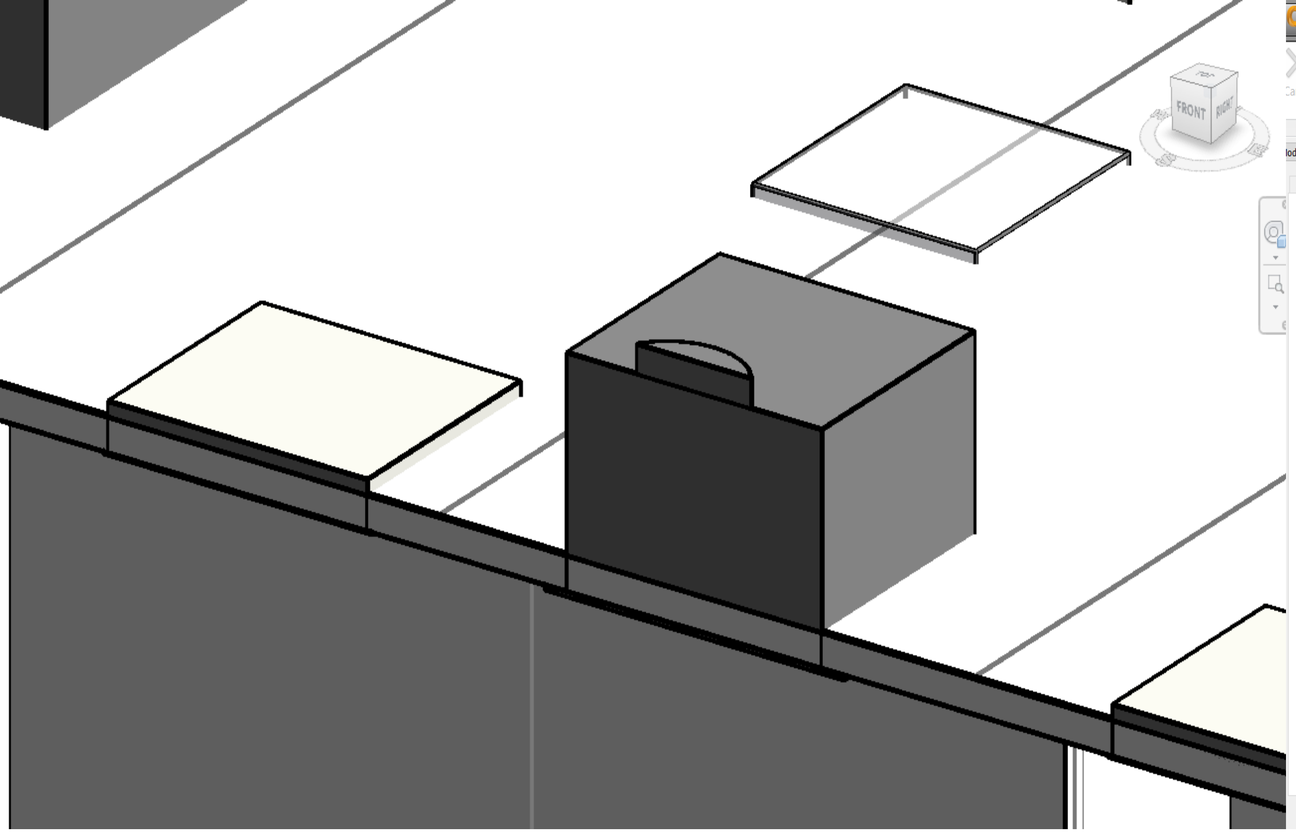
Section box and selection box

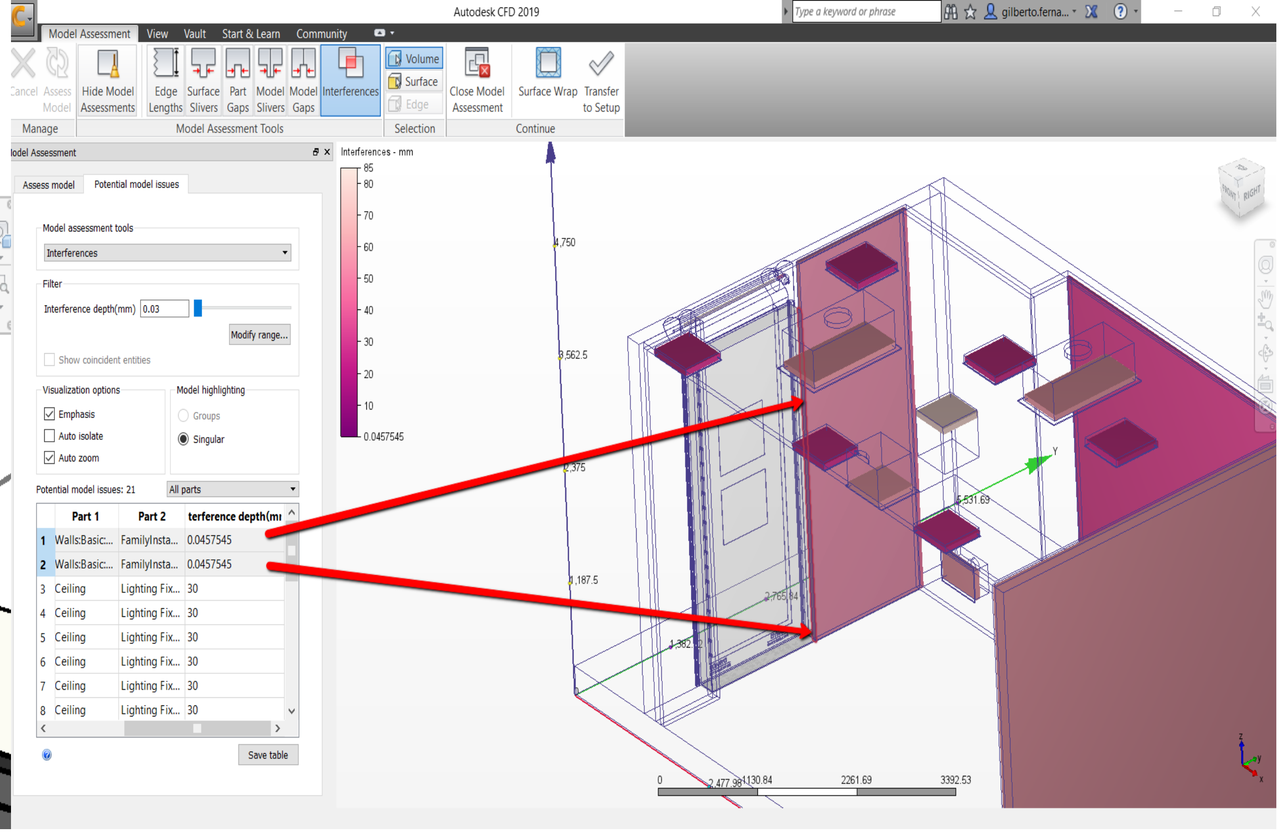
- Key tool – Limit the shown geometry
- Edges of box- cutting edges for elements
- 3D view properties- tick ON – Check hidden
- Modifying with edges – also get help from View Cube
- Selection box – restricted to selected parts – those define the extension of the section box
- Selection box also for 2D views



Interference detection – Revit Interference Check

- Spot interferences- Collaborate tab in Revit
- Customize selection of elements to detect, or All
- Results- can click and it highlights- great tool
- Different formats
- Export to html for further checks

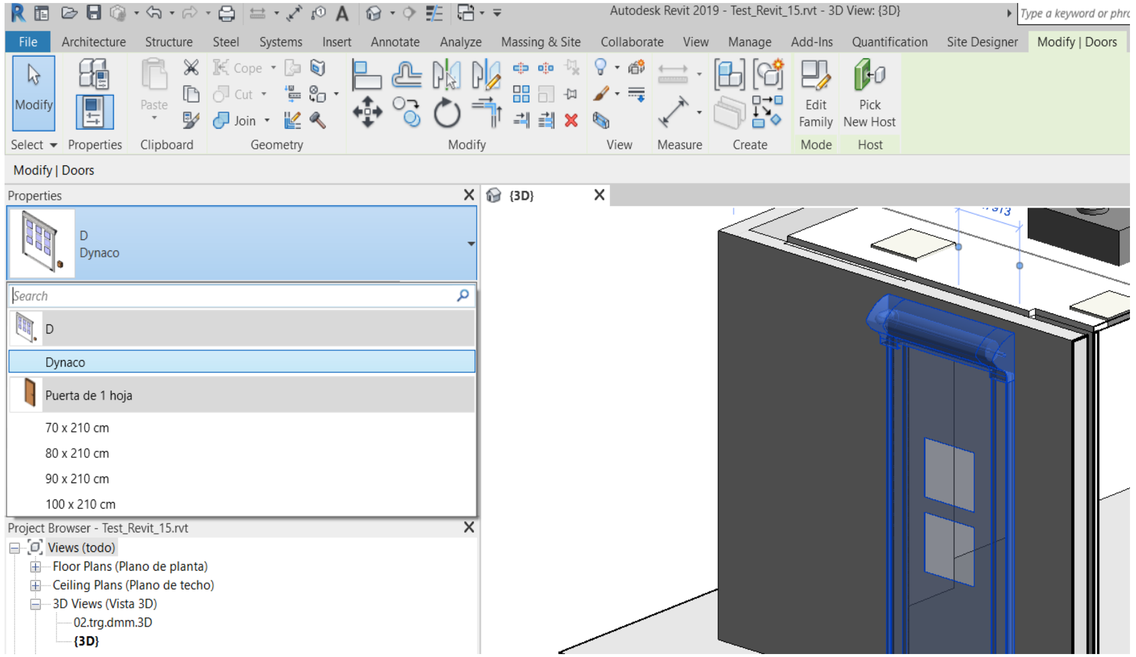


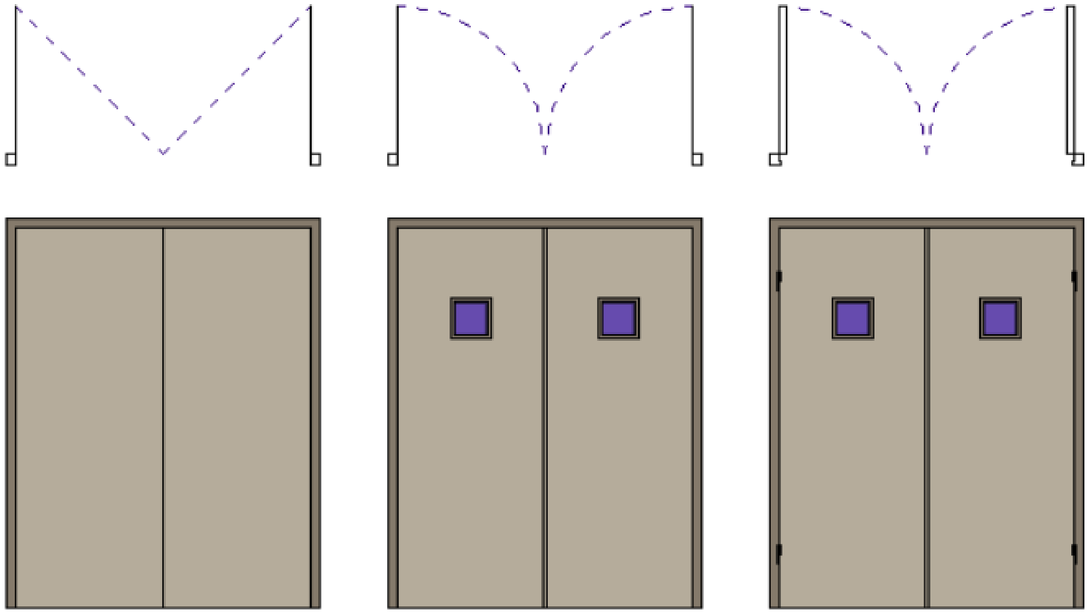


Interference detection – Model Assessment Toolkit

- Can also use the Model Assessment Toolkit – used when launching
- Main advantage – gives us quantifiable numbers – great to assess the difficulty level
- Sort out interferences – Usually moving/redrawing for small parts
- When instances interfering, we may implement something in Revit- Even automation

Simplify families



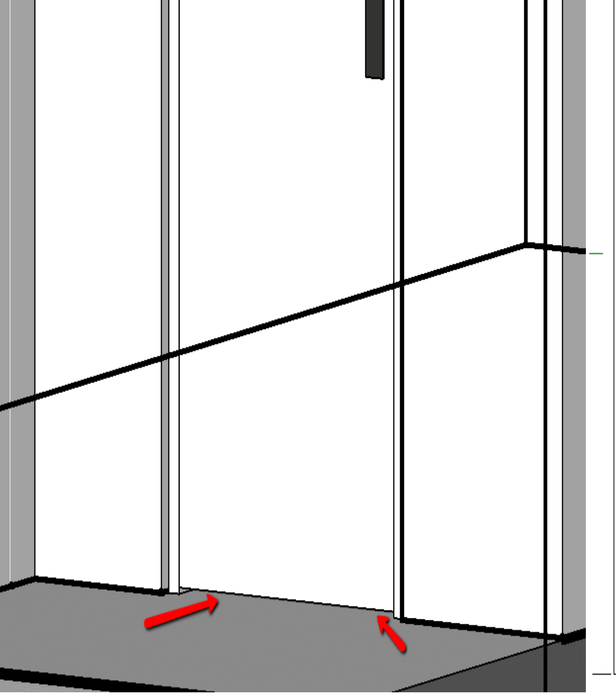


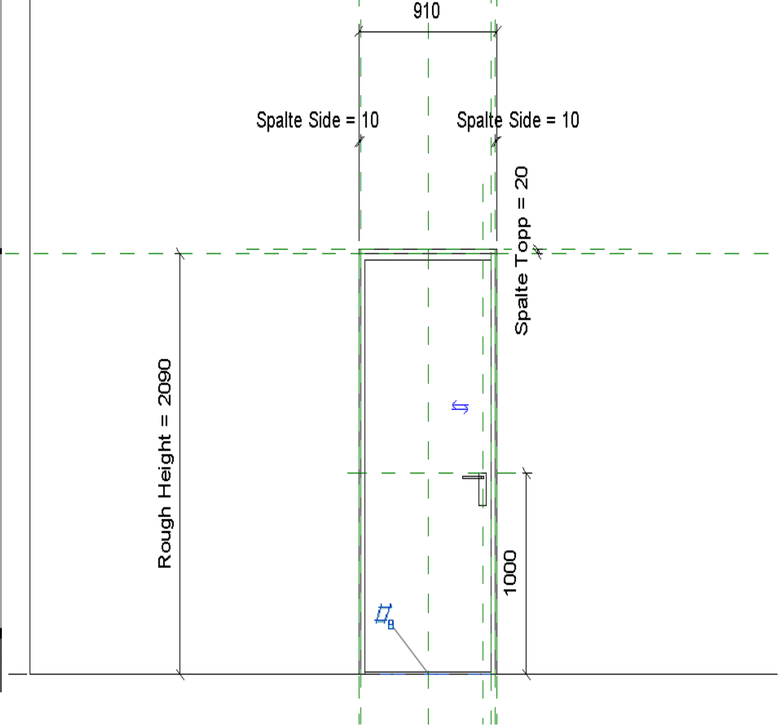
Generic within the family

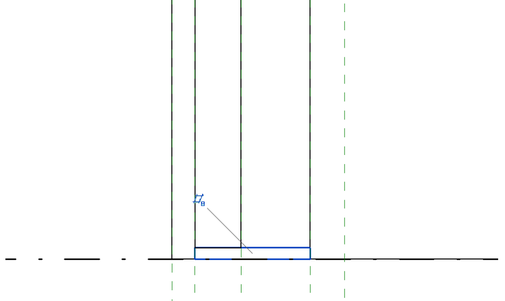
- Defeaturing is KEY important
- Within same family type there are more generics
- Door example- sometimes not even needed to adjust dimensions
- Generic adjust dimensions- important (CFD material)

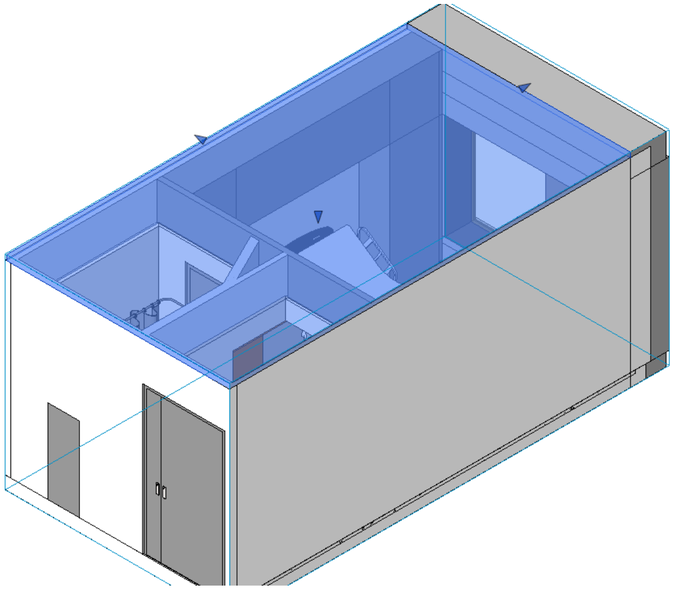
Detail Levels

- View Scales – Level headings – Coarse, Medium and Fine
- Pre-defining detail levels – control over complex features
- Can be used to defeature and/or redraw- windows example
- There are some built-in in templates



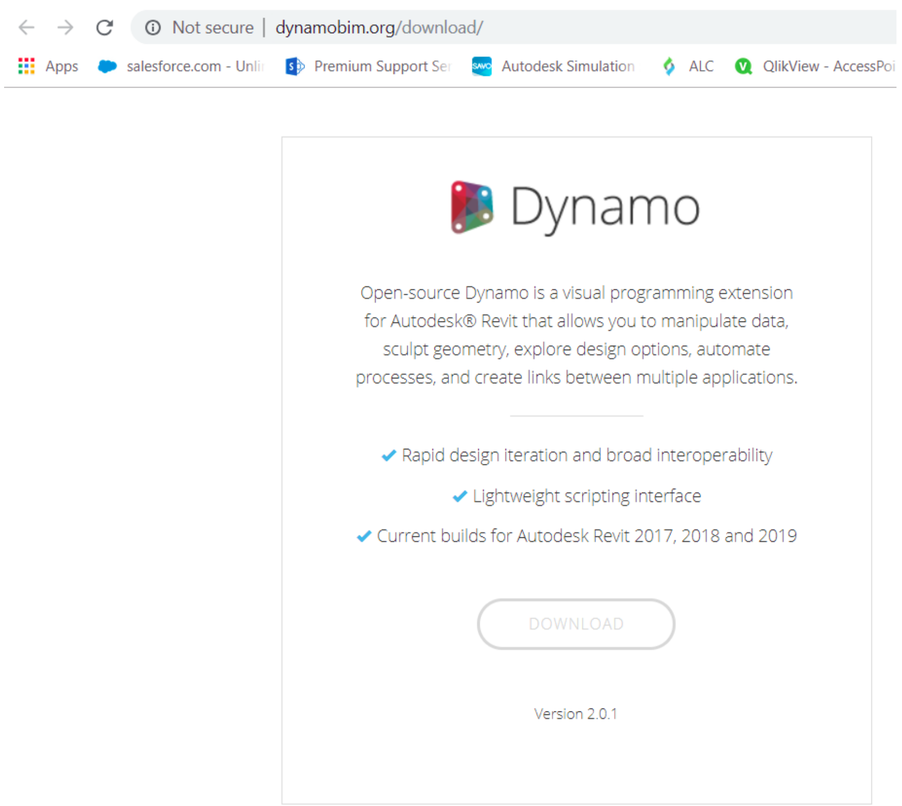


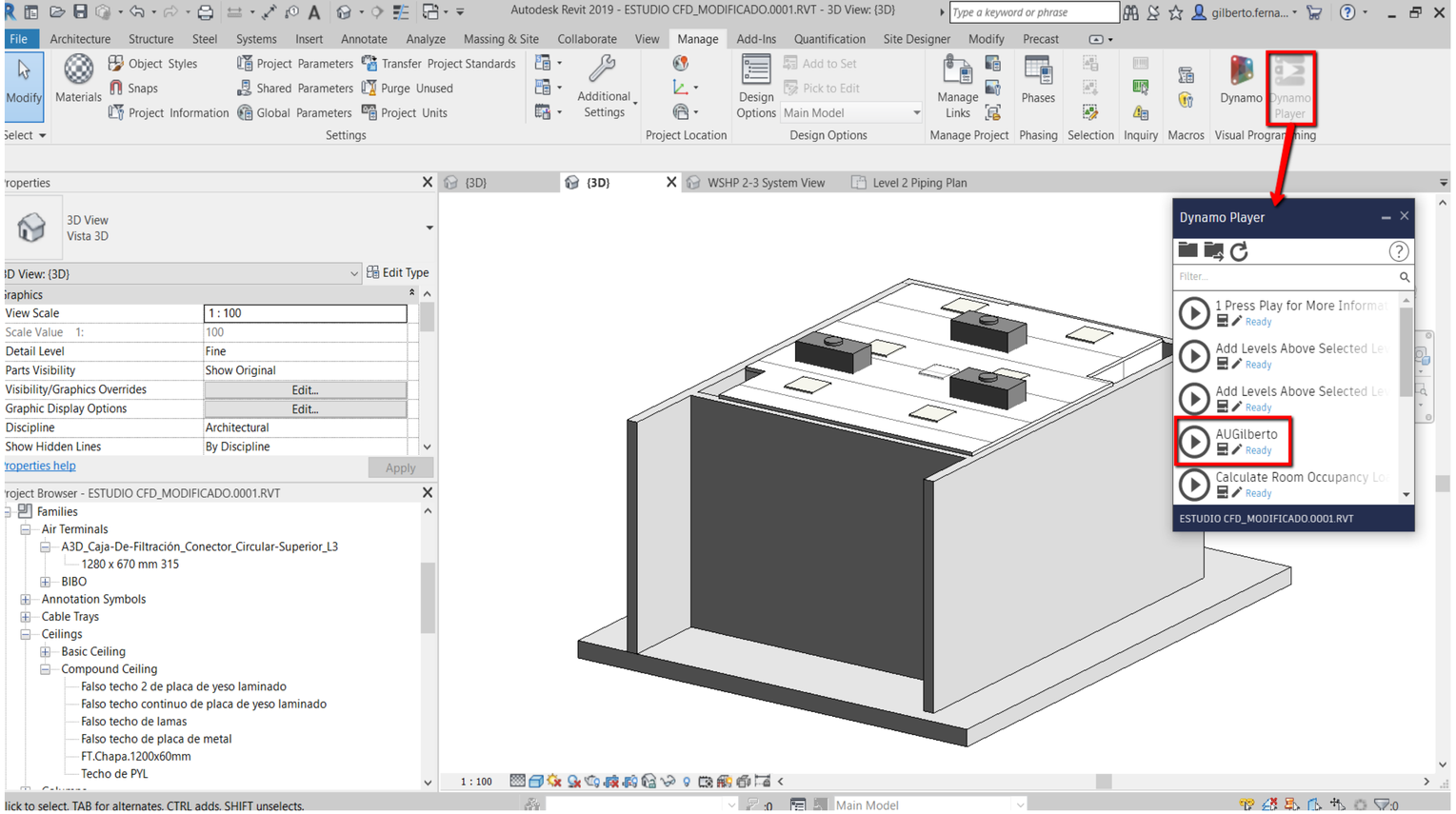




Closing gaps easily

- Key trick- need to close gaps/clearances
- Different mindset in industry – airtight volumes
- Main simple trick- edit family-references/constraints
- Helps to modify families as things are parametric
- Sometimes it is not clearing but defining the gap part
- Door- gap where we need air coming in
- Ceiling/closing wall – built for purpose
- Usually quite free to model it thicker/bigger

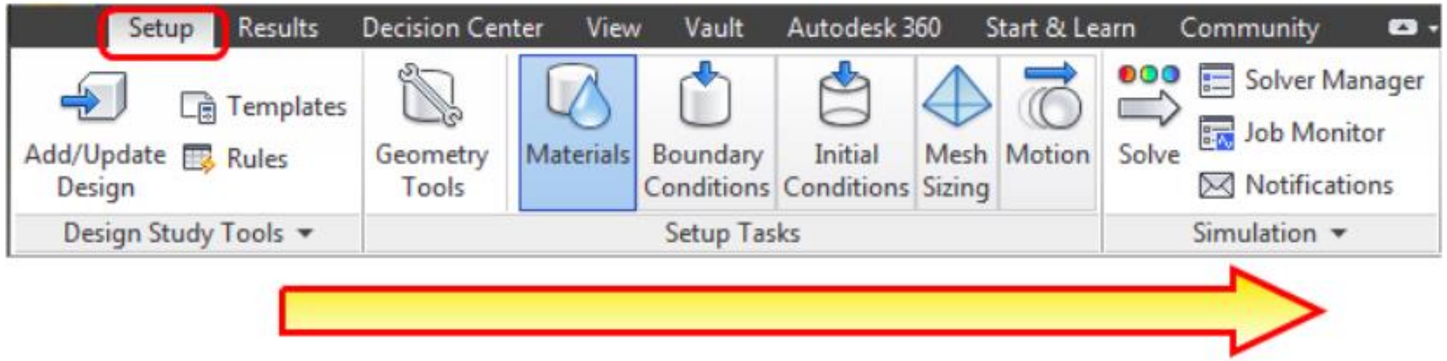


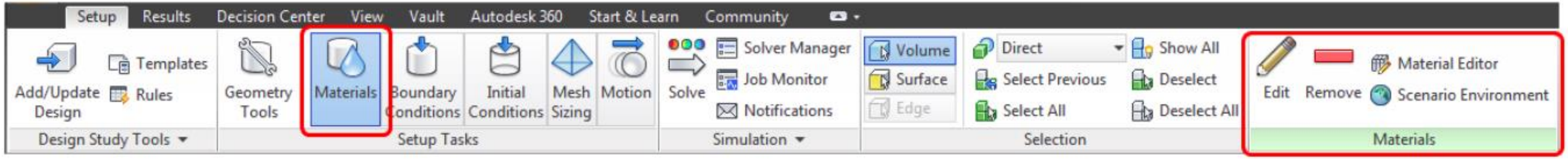


Dynamo Automation

- Graphical programming interface for customization
- Open source code
- Free download – dynamobim.org/download
- Implement automation for simplifying models
- Sample script in handout
- Long name spotting

Working with CFD - How to…





How to set up a simulation in CFD

- Once with CAD- CFD works with set up tasks
- Follow from left to right
- Selection ribbon and a context ribbon – editing and setting up

Set up tasks of a basic CFD study

MATERIALS

DEFINING MATERIALS AND DEVICES

What flows here?

Where are my solids?

Devices- simplified model of physical devices

Resistances, fans, etc..

BOUNDARY CONDITIONS

WHAT WE KNOW ABOUT THE PHYSICS

Inputs to model

What is the driving force for fluid to move?

Surface and Volume BCs

Assumptions

Initial conditions

MESHING

BREAKING THE MODEL TO SMALL PIECES

Elements to apply equations

Defines how good the results will be

Mesh DISTRIBUTION

Automatic process

Advanced controls

RUNNING

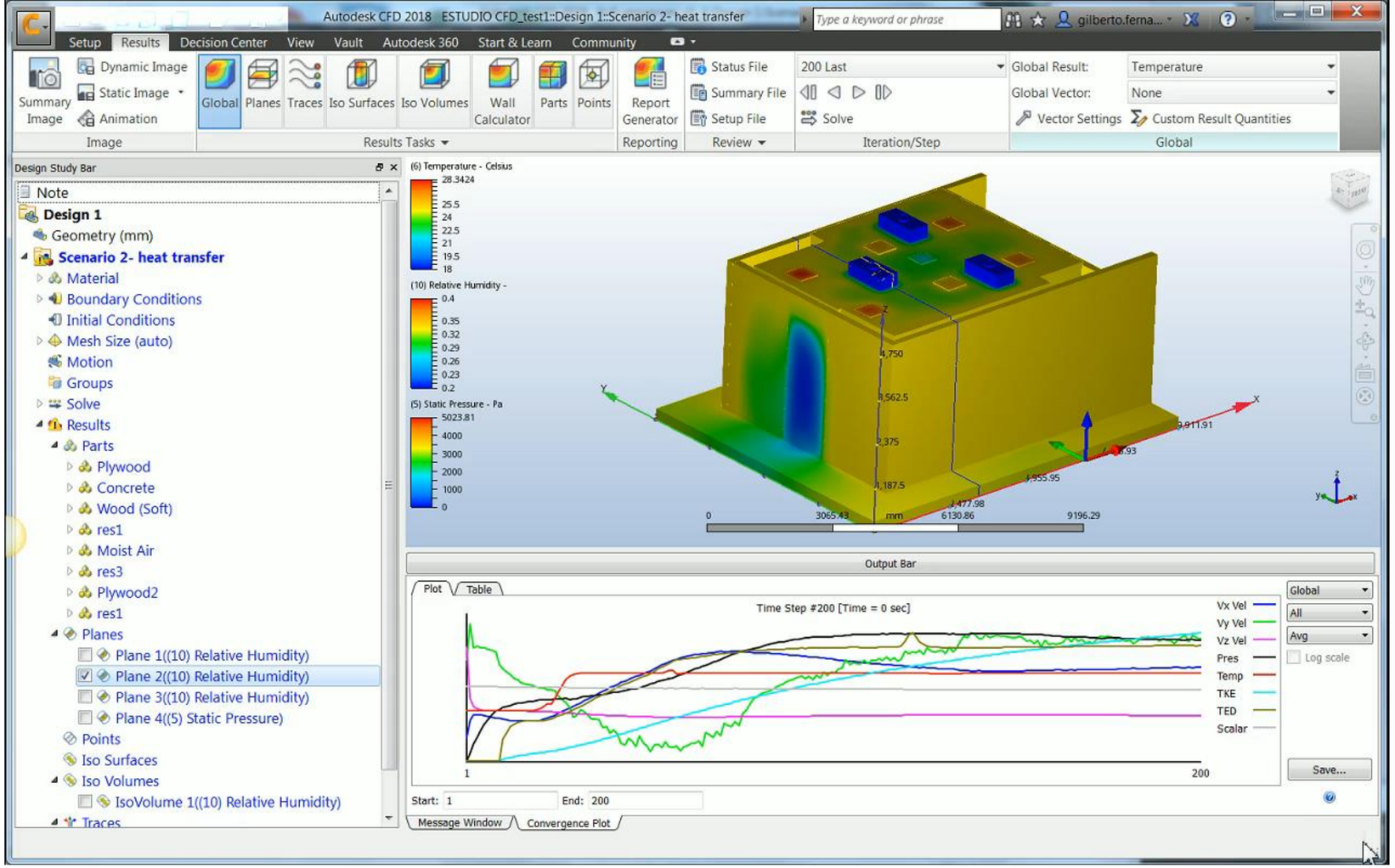
OPERATING CONDITIONS AND RUN PARAMETERS

Set up flow/heat transfer

Added features – radiation, free surface, etc…

Steady state/Transient

Iterations

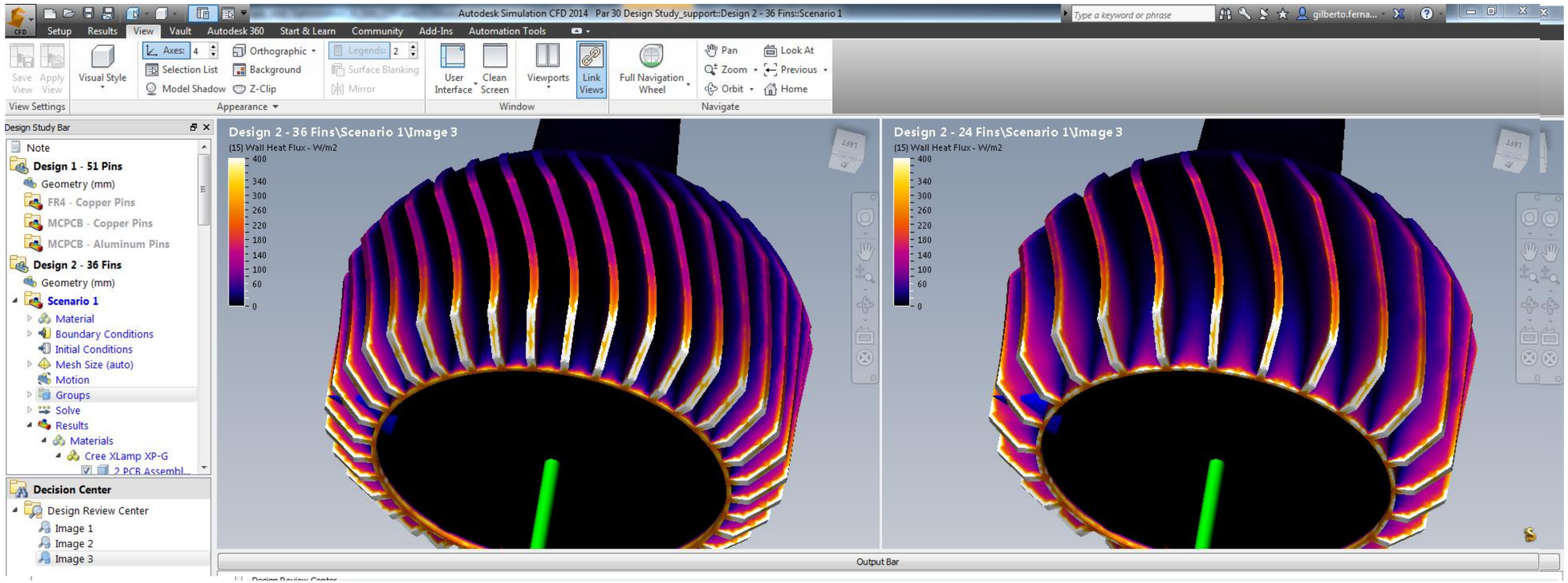


Results in CFD- Learning what you didn´t know

- Visualizing but also quantifying values- bulk values, probing, wall calcs

Decision Centre: Comparisons and decision-taking

- Full design study – we can compare different what-ifs
- Comparing scenarios – decide on material
- Comparing Design 1 and 2 – Set up of heat sink
- Comparing Design 2 and 3 – Number of fins



Real example – Operating Room

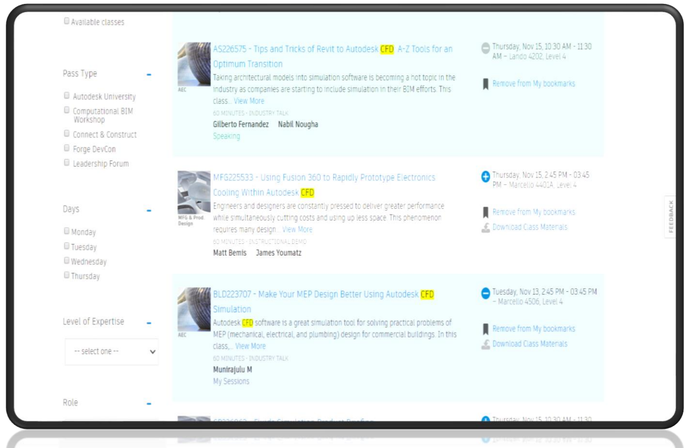
- Real case – Customer wanting to improve ventilation- 1.2 million people in the US get secondary infections
- Redesigning the vent system- helps with the circulation of the air
- Design changes implemented – Problem solved!

Images Courtesy of Huntair

Additional Resources

Further information

CLASS HANDOUT

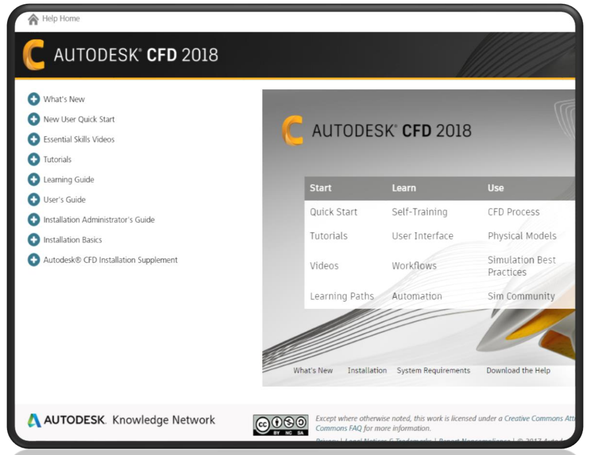


Class Handout

Revit Online Help

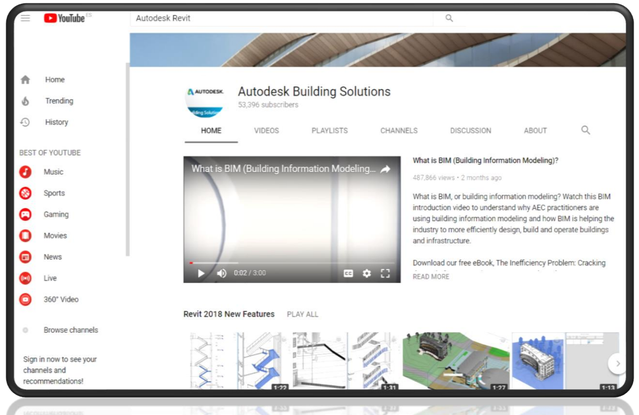
http://help.autodesk.com/view/RVT/2018/ENU/

CFD Online Help



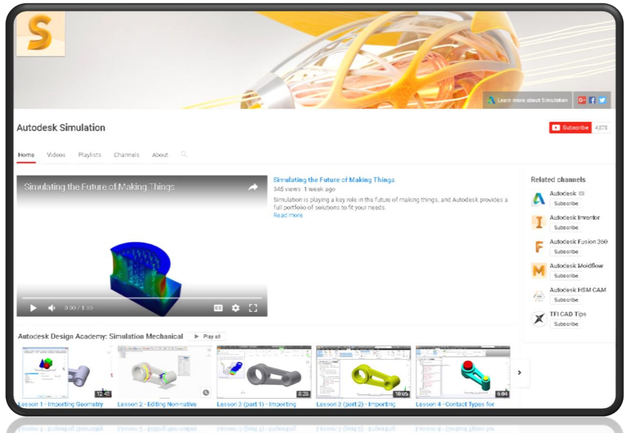
http://help.autodesk.com/view/SCDSE/2018/ENU

Building Solutions YouTube



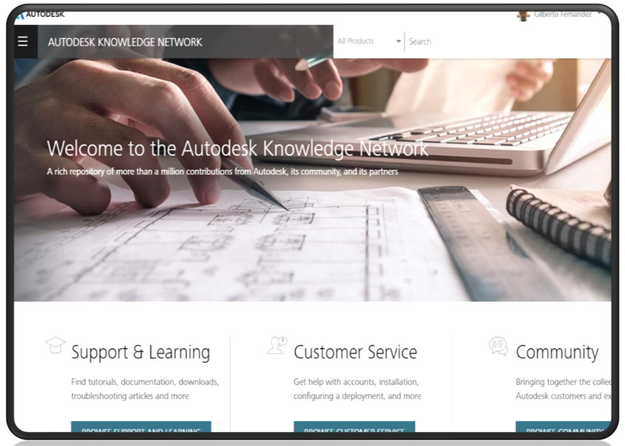
https://www.youtube.com/user/AutodeskBuilding

Simulation YouTube



https://www.youtube.com/user/AutodeskSim360

Knowledge Network



https://knowledge.autodesk.com/

Q&A

THANKS FOR ATTENDING!!!

AUTODESK®

Make anything™

Autodesk and the Autodesk logo are registered trademarks or trademarks of Autodesk, Inc., and/or its subsidiaries and/or affiliates in the USA and/or other countries. All other brand names, product names, or trademarks belong to their respective holders. Autodesk reserves the right to alter product and services offerings, and specifications and pricing at any time without notice, and is not responsible for typographical or graphical errors that may appear in this document.

© 2018 Autodesk. All rights reserved.