Revit for Simulation CFD

Tommy Mello

Co-Founders, Sim Specialists

Background

Background

- BRNI
  - Developers of Cfdesign
  - Acquired by Autodesk as Simulation CFD
- Sim Specialists LLC
  - Consulting Services
  - Training
- Developed Simulation CFD for AEC Course Content

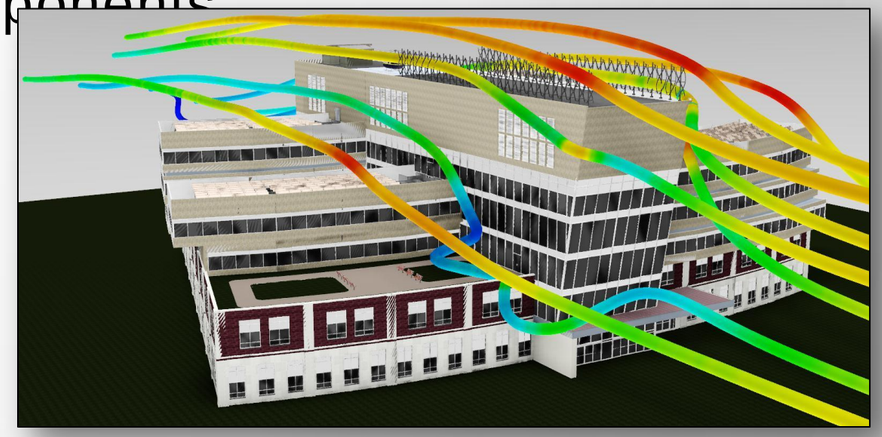
Now Available!

Simulation CFD Courses for AEC Applications

1. **Simulation CFD Fundamentals 1:** Simulation Process, Geometry, and Materials
2. **Simulation CFD Fundamentals 2:** Boundary Conditions and Meshing
3. **Simulation CFD Fundamentals 3:** Solving and Results Interpretation
4. **Simulation CFD Applied:** Characterizing AEC Components
5. **Simulation CFD Applied:** Datacenters
6. **Simulation CFD Applied:** HVAC Layout

A new series of free, online courses developed for practicing engineers within the AEC industry.

Learn more: **http://academy.autodesk.com/courses**



Class summary

A process of idealizing Revit geometry for Simulation CFD will be presented, along with analysis characterization techniques.

Key learning objectives

At the end of this class, you will be able to:

- Learn the process of CFD for AEC applications using Revit software
- Leverage Revit for Simulation CFD
- Explore Revit software for CFD
- Learn about simulation results interpretation

Data Set

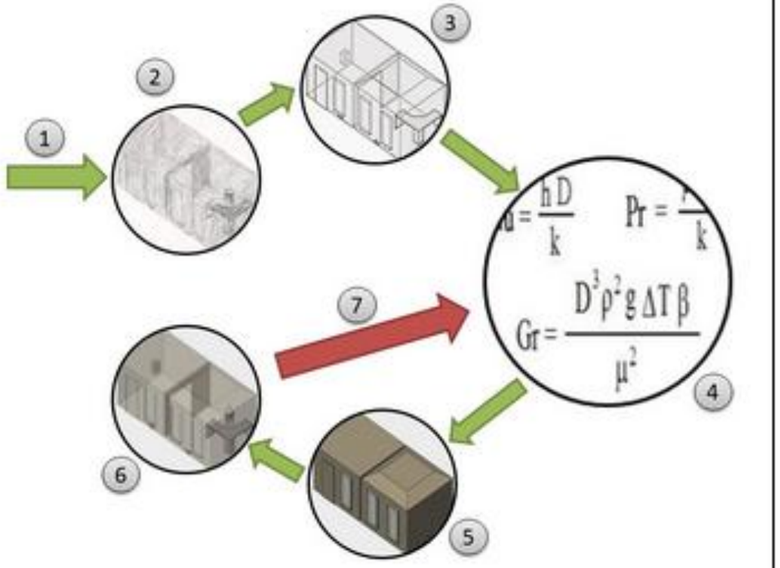
- Autodesk_Hospital_Architectural_Central.rvt
- Rac_advanced_sample_project.rvt
- rme_advanced_sample_project
  - HVAC Ducting

Impact of CFD on AEC

Traditional Design Process

- CFD traditionally performed by dedicated analysts

1	Start
2	Concept
3	Preliminary CAD
4	Engineering
5	Final CAD
6	Construction/Testing
7	Fail - Rework Required

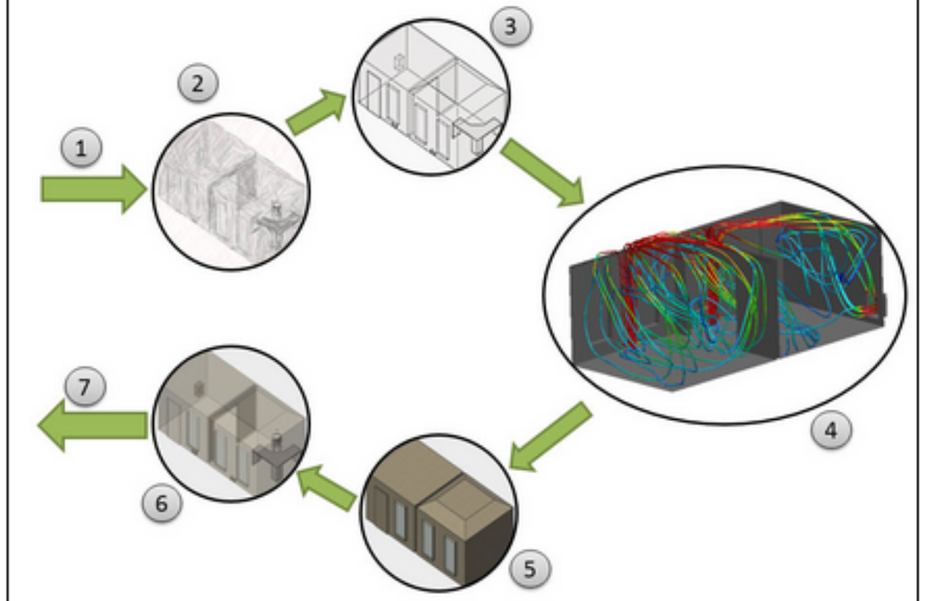


Traditional design process without CFD.

Upfront Design Process

- Paradigm shift to CFD by engineers and designers

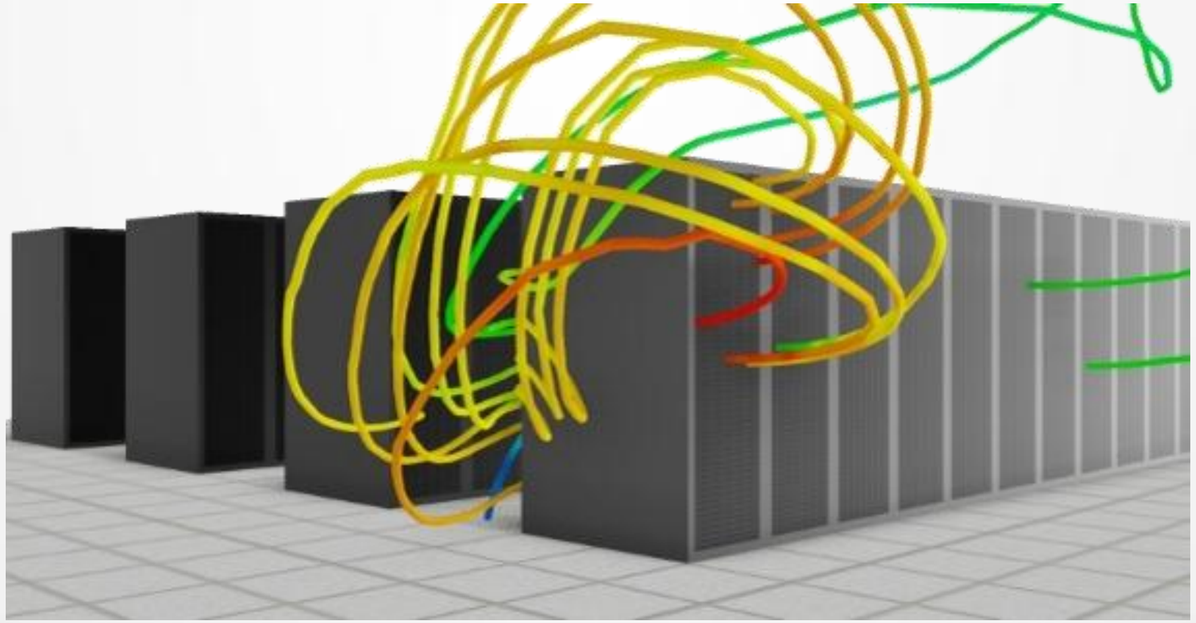
1	Start
2	Concept
3	Preliminary CAD
4	Engineering with CFD
5	Final CAD
6	Construction/Testing
7	Pass



CFD upfront Design Process

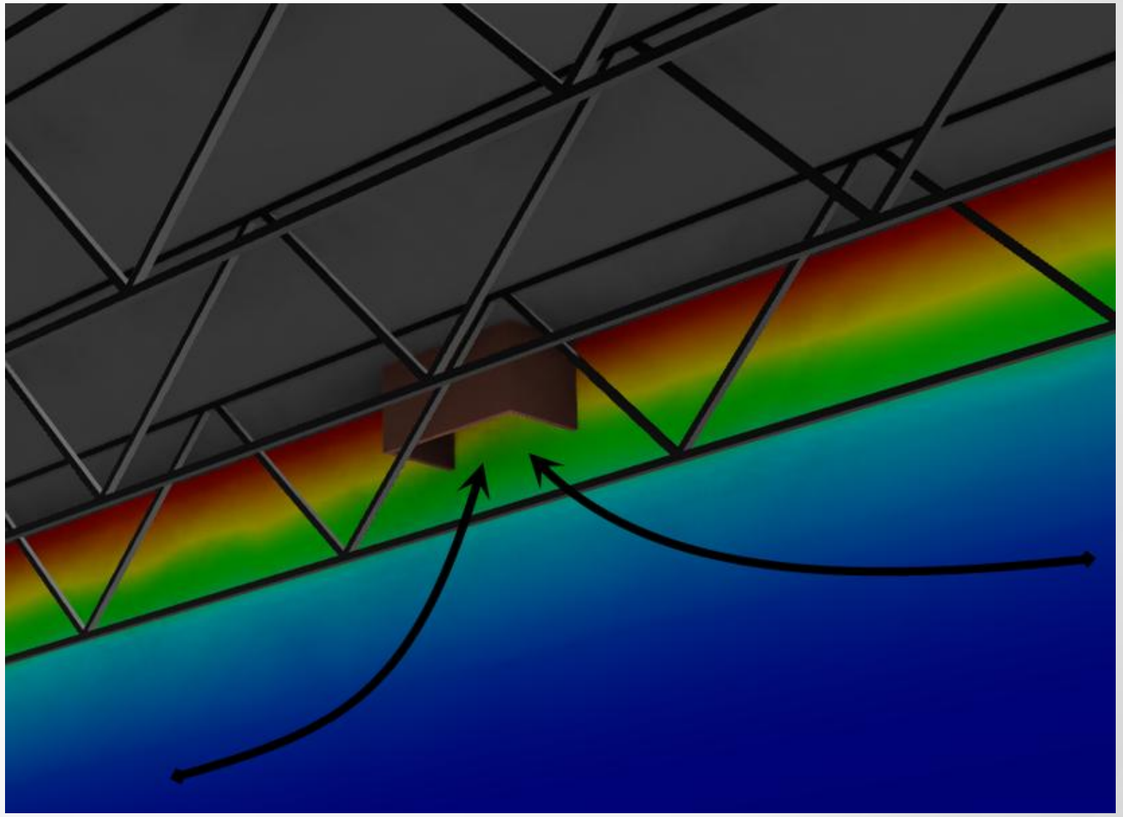
Air Management

- Controlling air flow
  - Temperature, velocity, humidity,…etc.
- Predicting flow paths



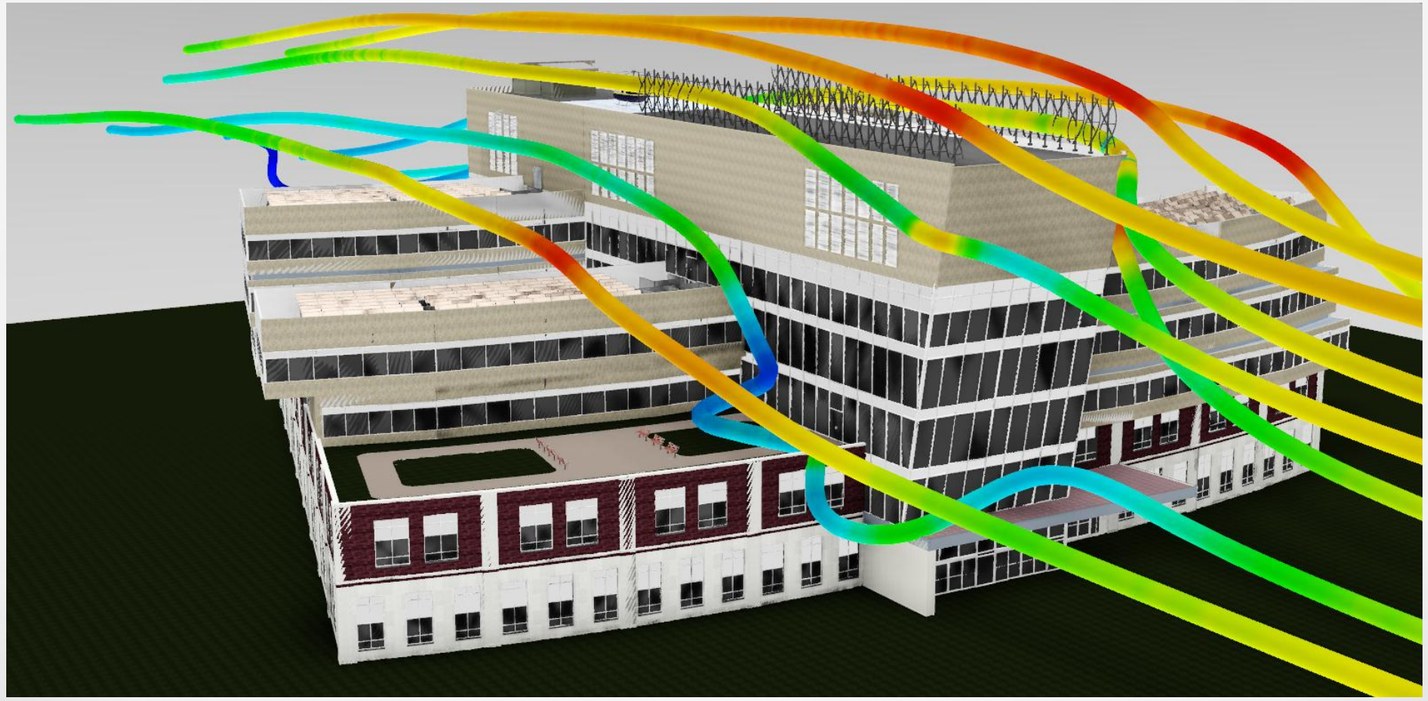
Energy Consumption

- Energy is consumed by equipment which moves and conditions air



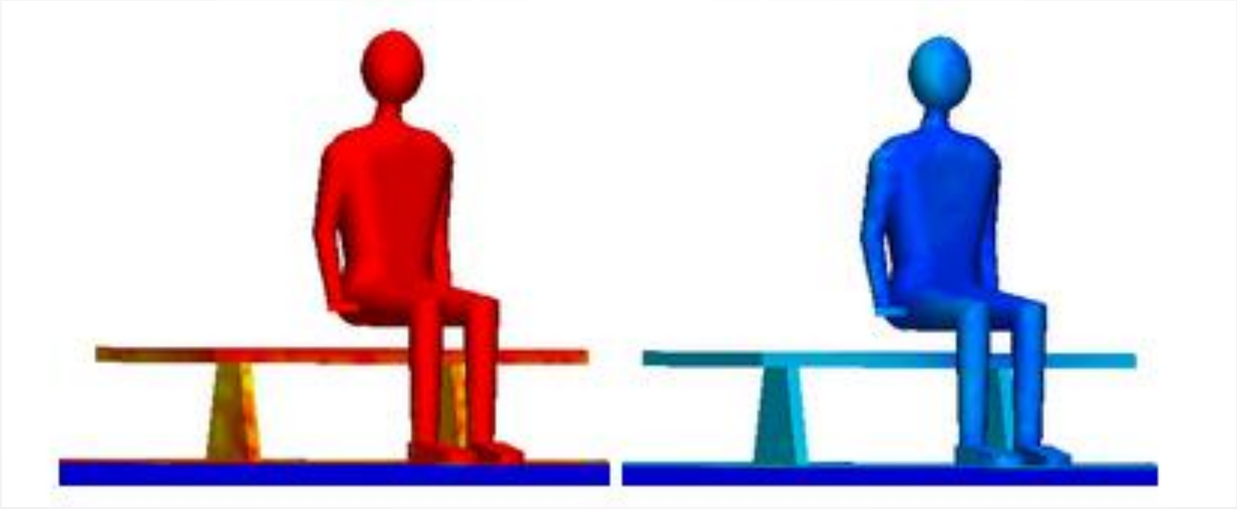
Contaminant Entrainment

- Building or equipment exhaust, should be evacuated without re-entering the ventilation system



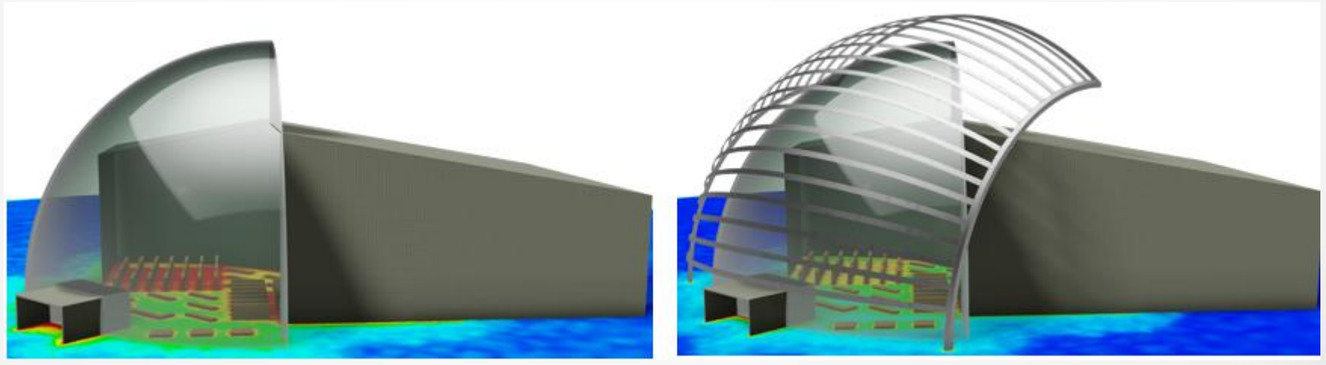
Human Comfort

- Design performance relating to air temperature, velocity, humidity, clothing, and metabolic rate can all be assessed in CFD to impact human comfort.



Solar Influence

- Walls and roof tops absorb energy while windows absorb and transmit it into buildings.
- CFD helps designers understand the implications of solar radiation to either harness or block it.

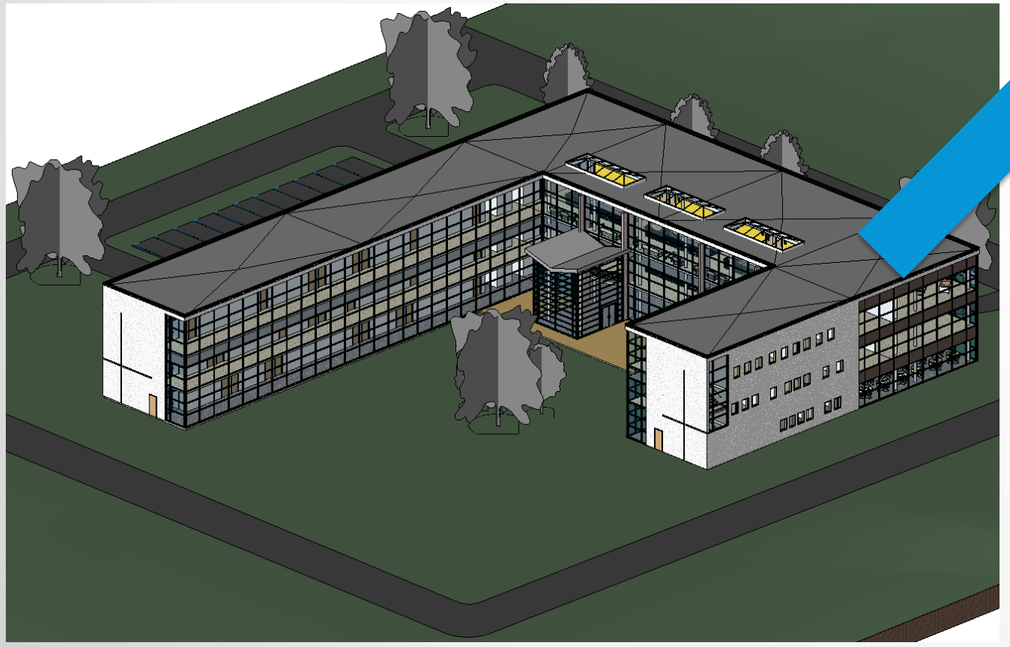


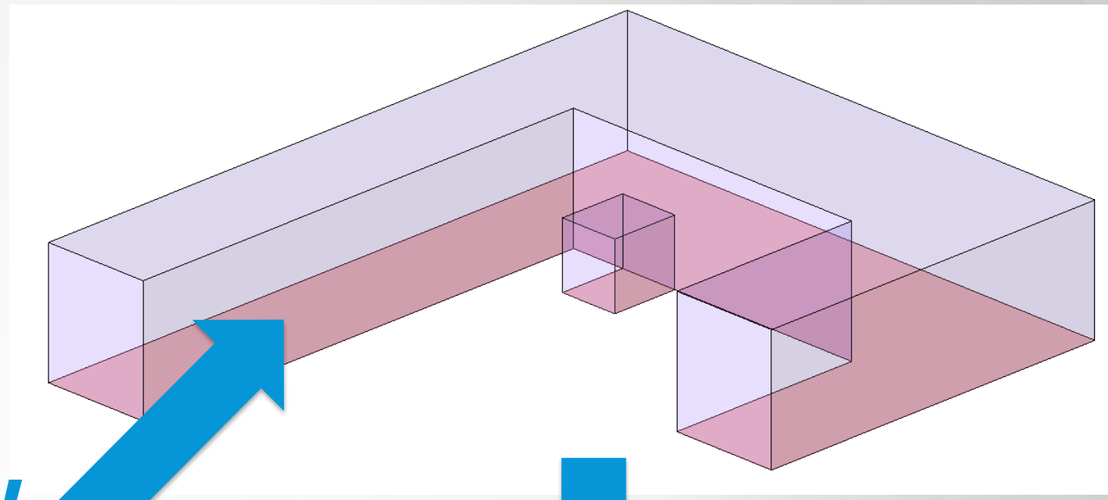
Guidelines for Success

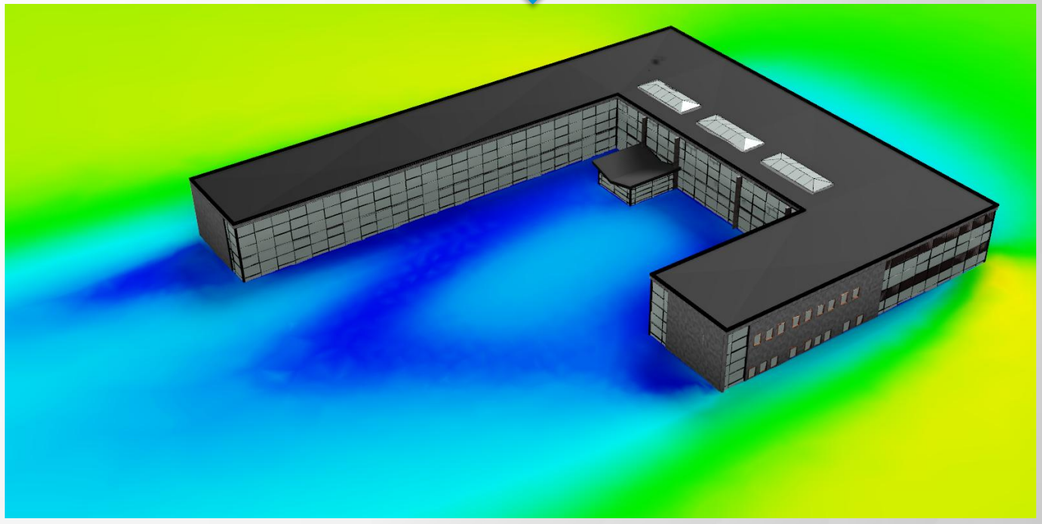
Best Practices and Effective Habits

- First, understand the problem and objectives
- Strategize a path forward
- Keep the tool sharp
- **Start simple**
- Put on your engineering hat

Simple External Air Flow





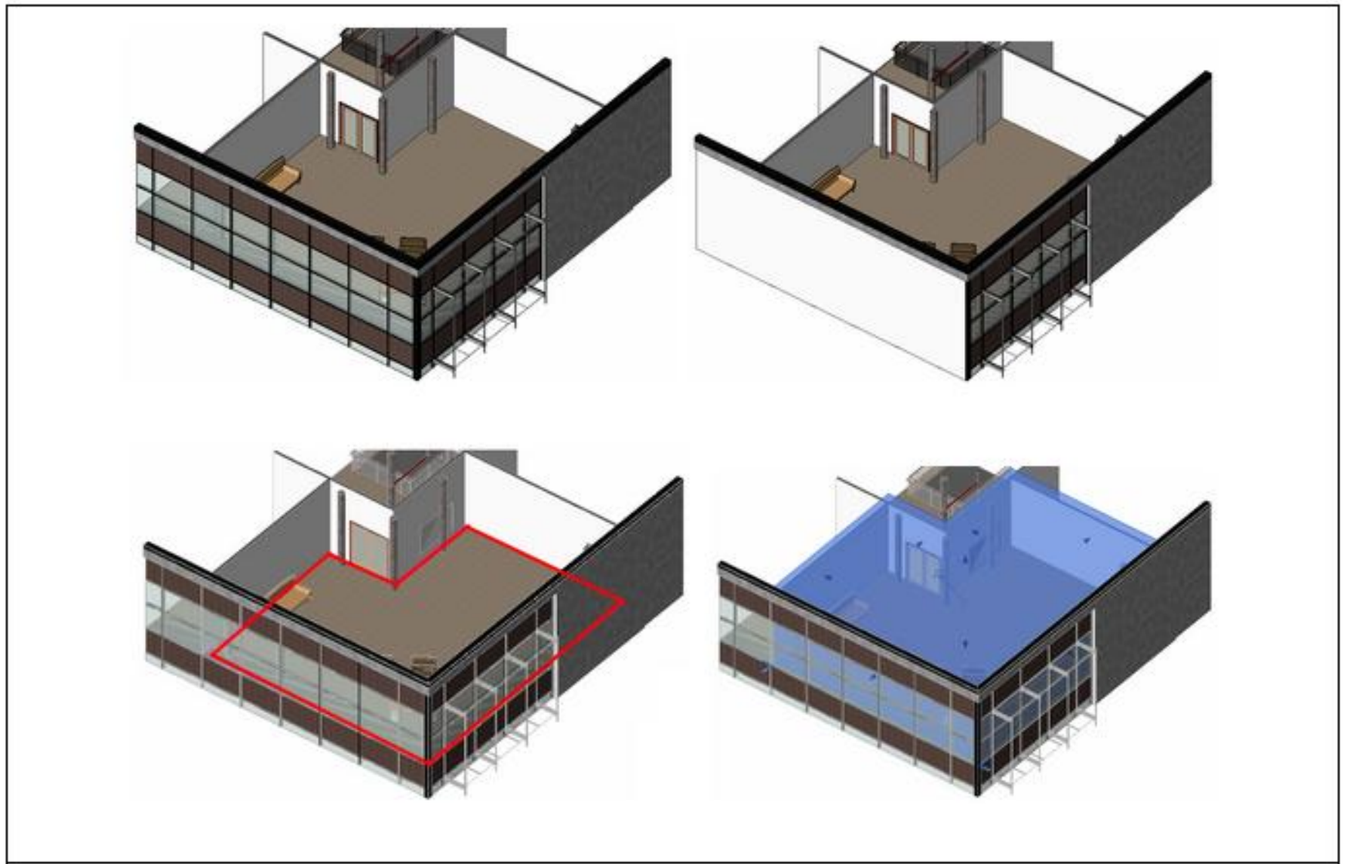


Data Set

- Rac_advanced_sample_project.rvt

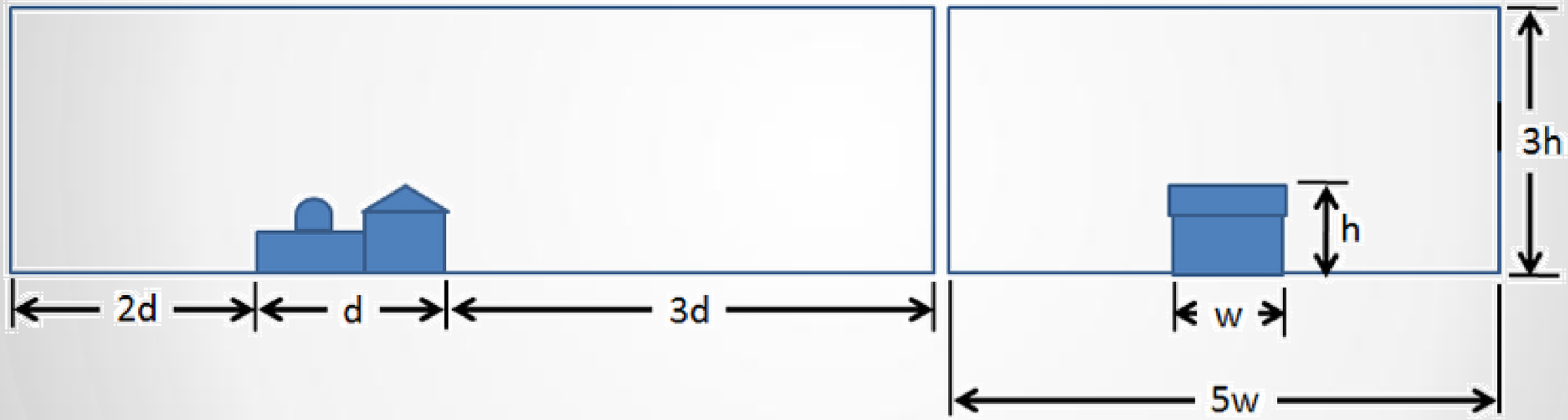
Process

- Create new component in place
  - Used for simulation
  - Add to known category (typically an empty one)
- Pick lines of existing elements
- Hide all non-simulation specific geometry
- Launch in CFD

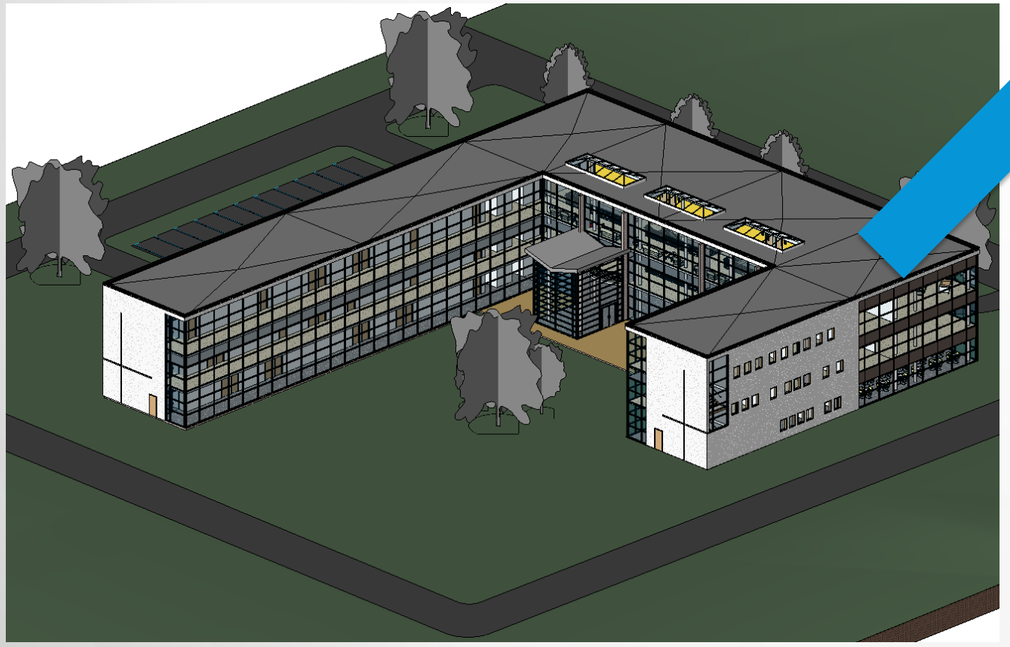


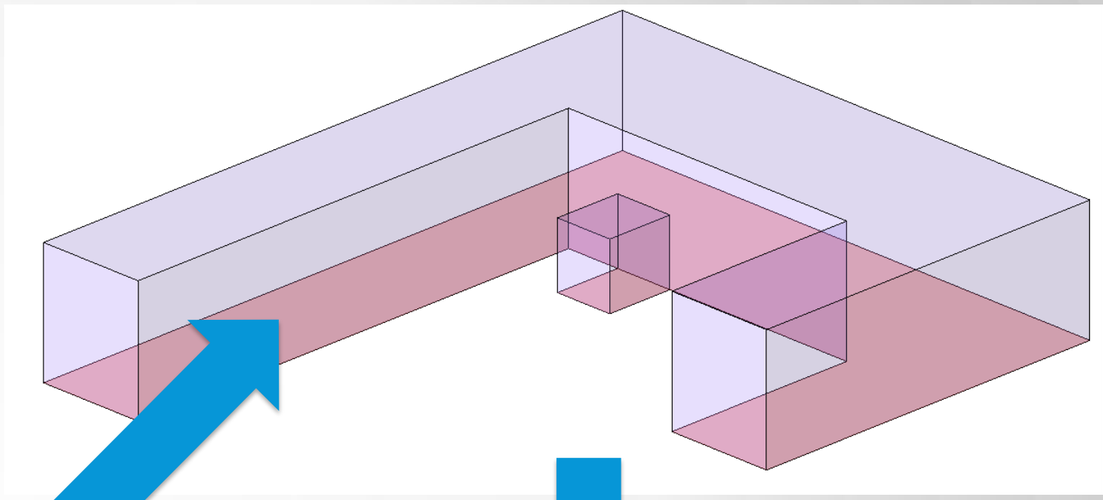
Office space to be simulated (top left) with an idealized wall (top right).
Sketch referencing inner walls (bottom left) is used to create air volume extrusion (bottom right).

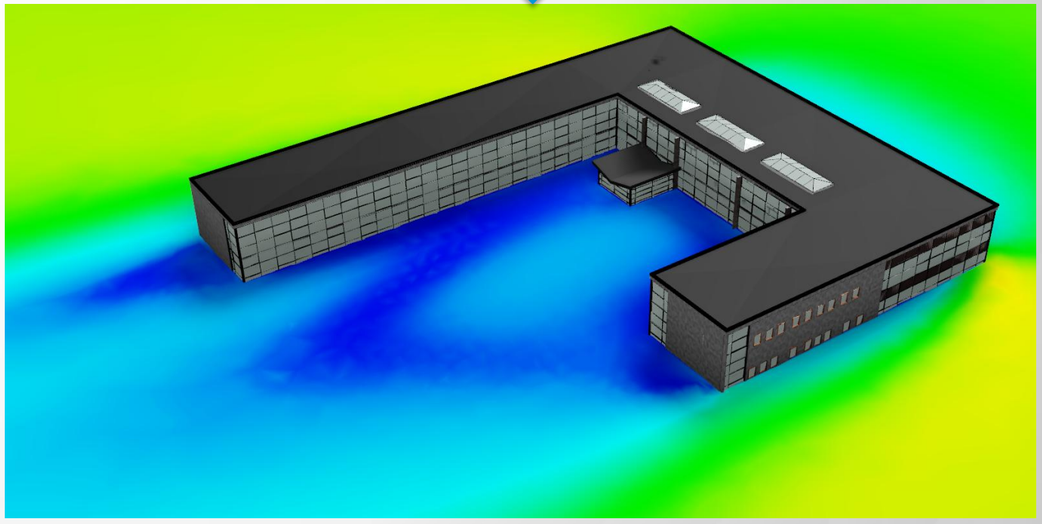
External Domain



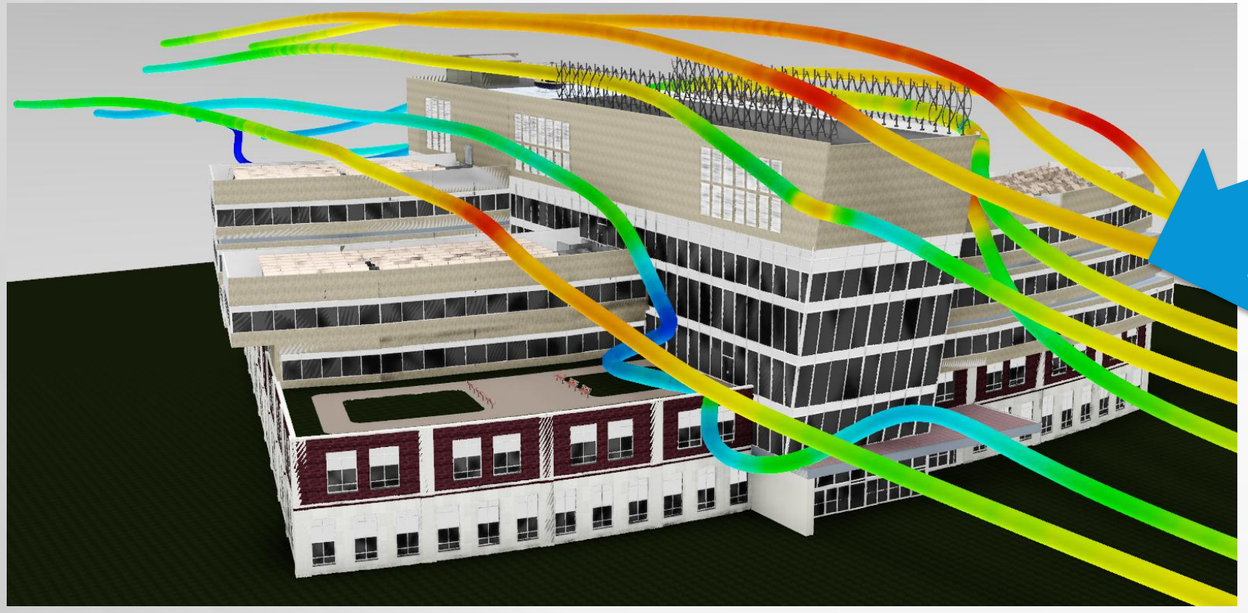
Instructor Led

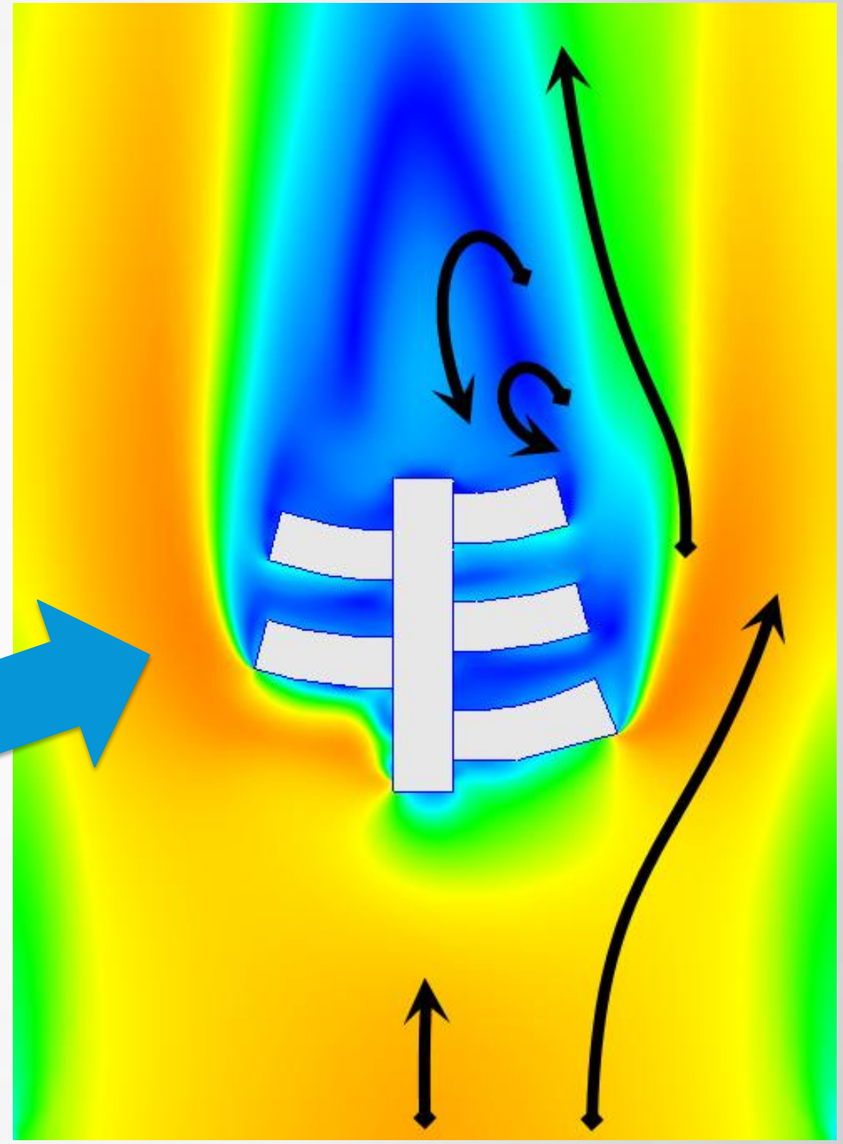






Simple External Air Flow



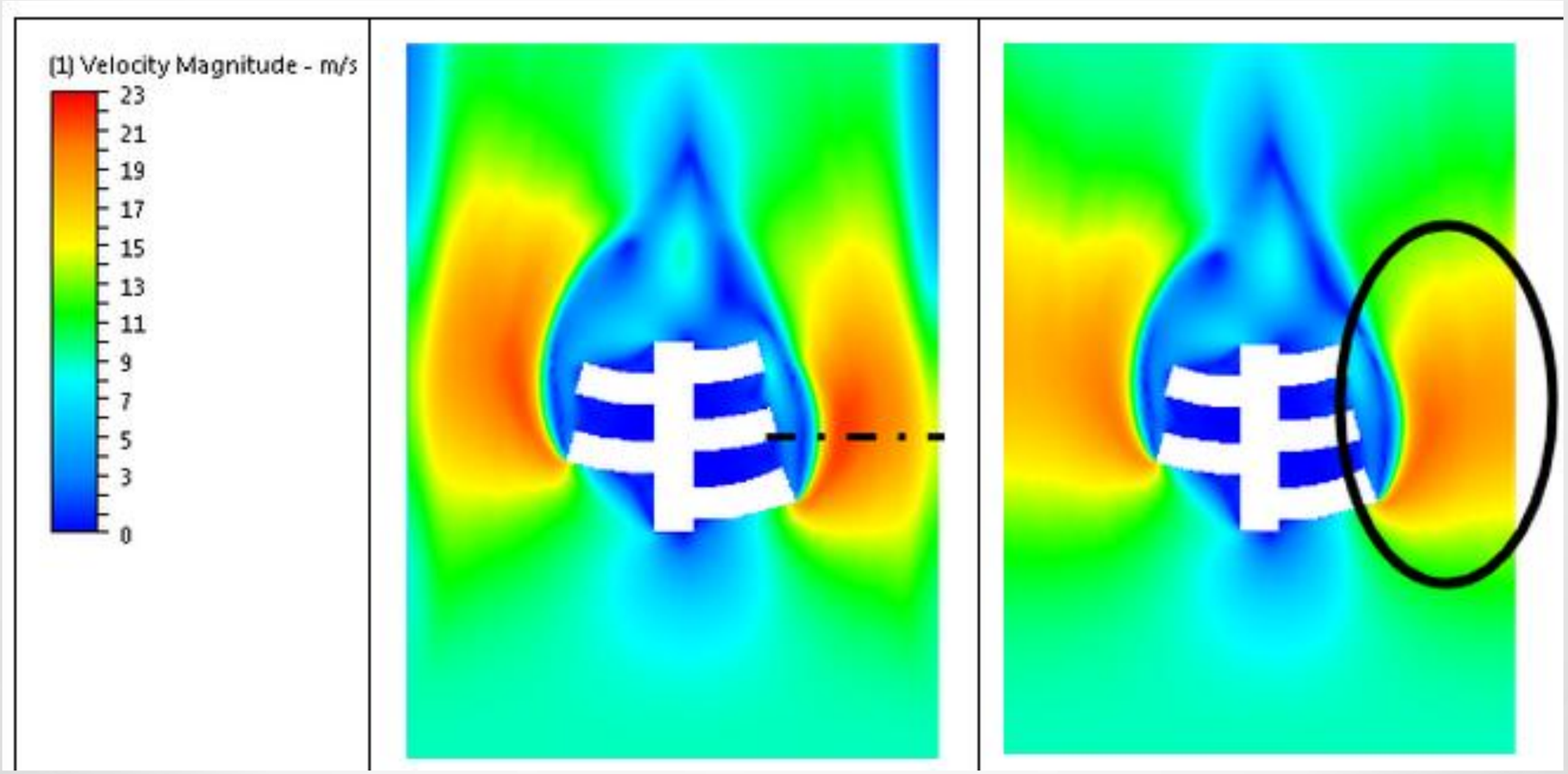


Data Set

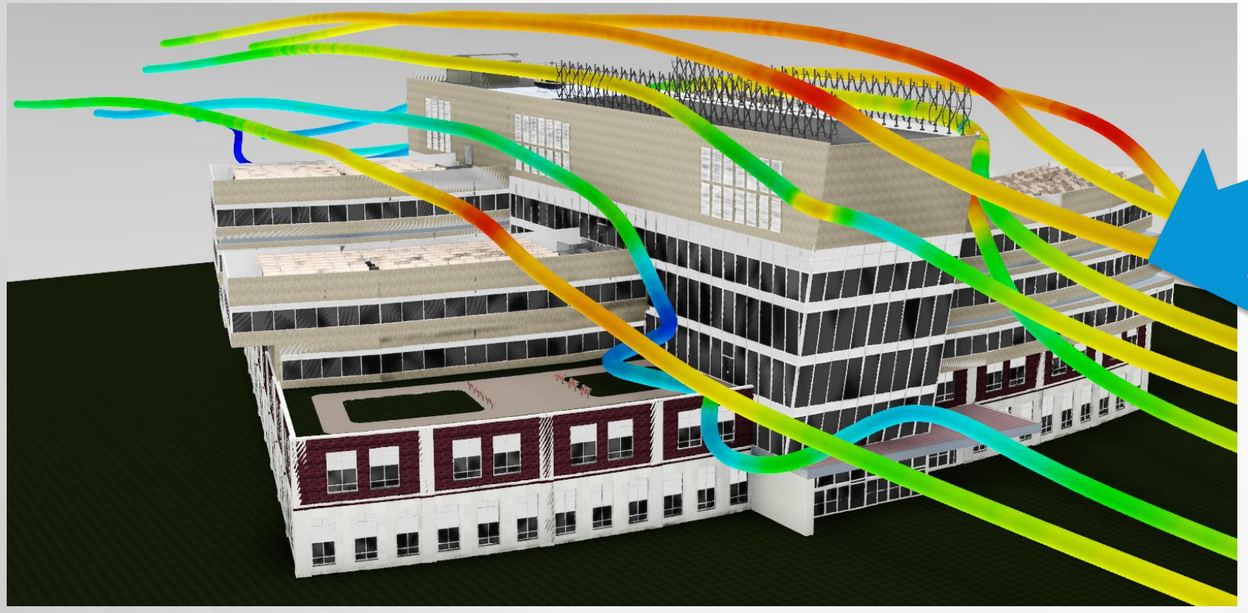
- Autodesk_Hospital_Architectural_Central.rvt

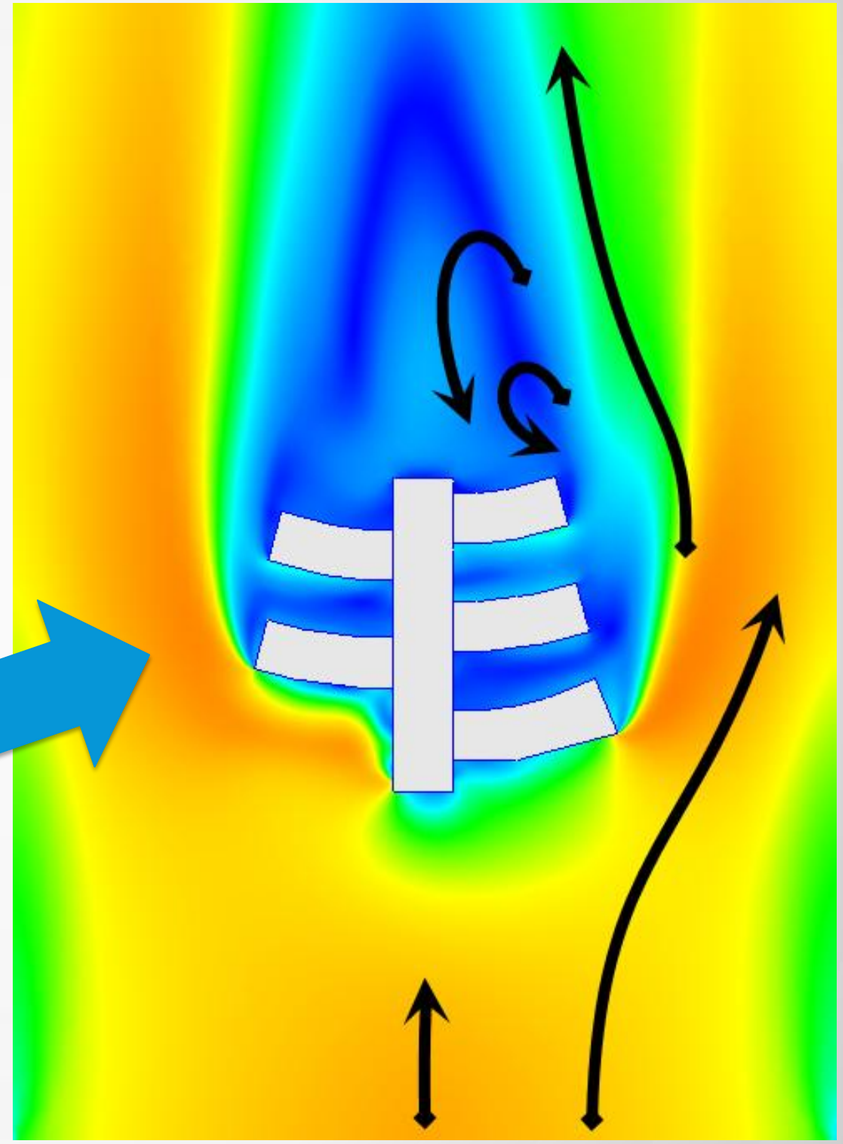
Simulation Considerations

- Slip / Symmetry



Instructor Led

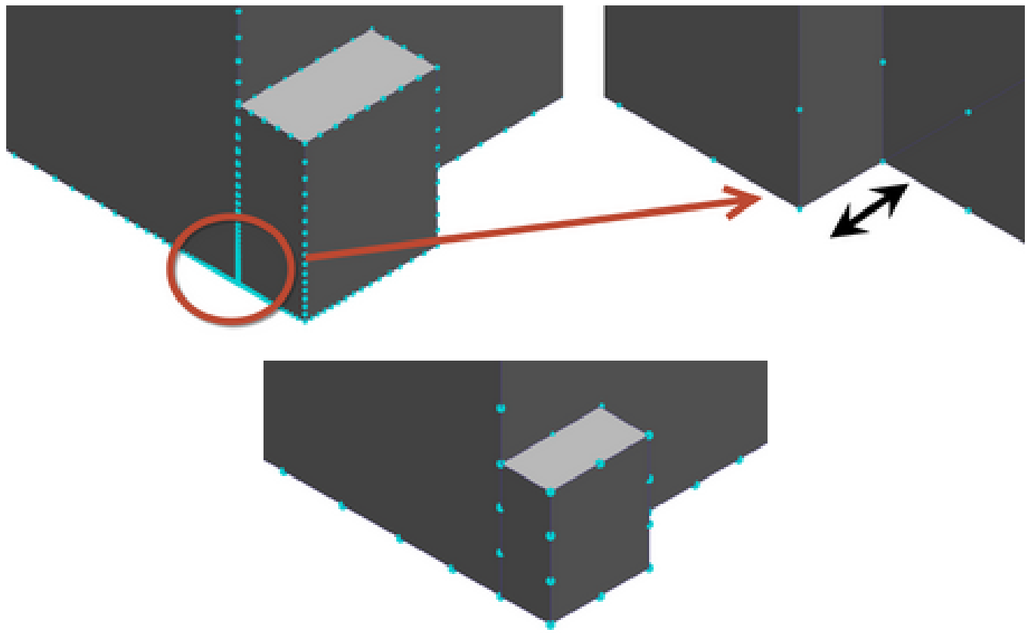




Idealization

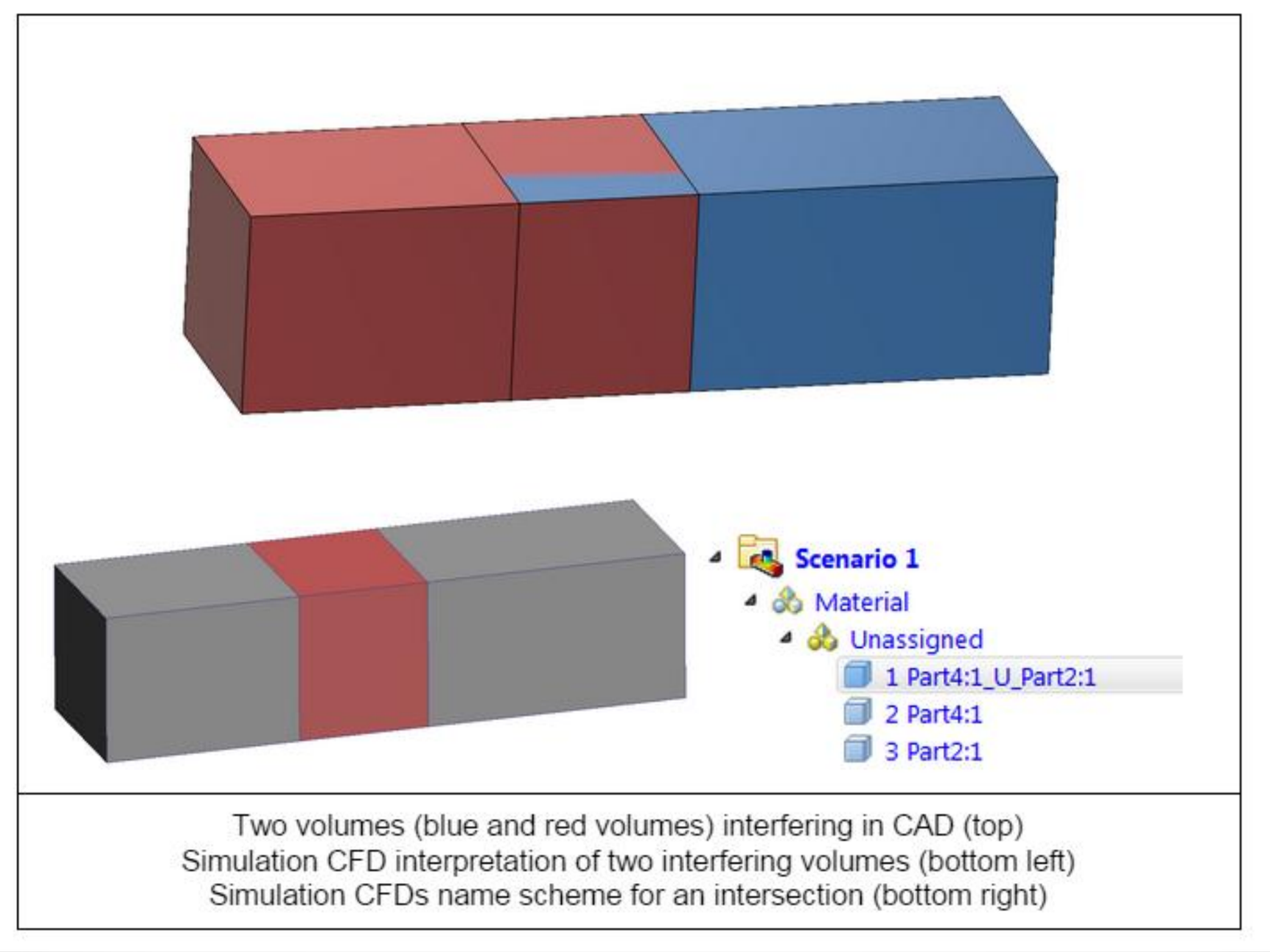
- Start simple and then build up complexity
- Determine the minimum level of detail necessary
  - Consider what assumptions are acceptable
- Evaluate every geometric entity prior to running a simulation
- Leverage geometry to facilitate simulation tasks

Small Edges



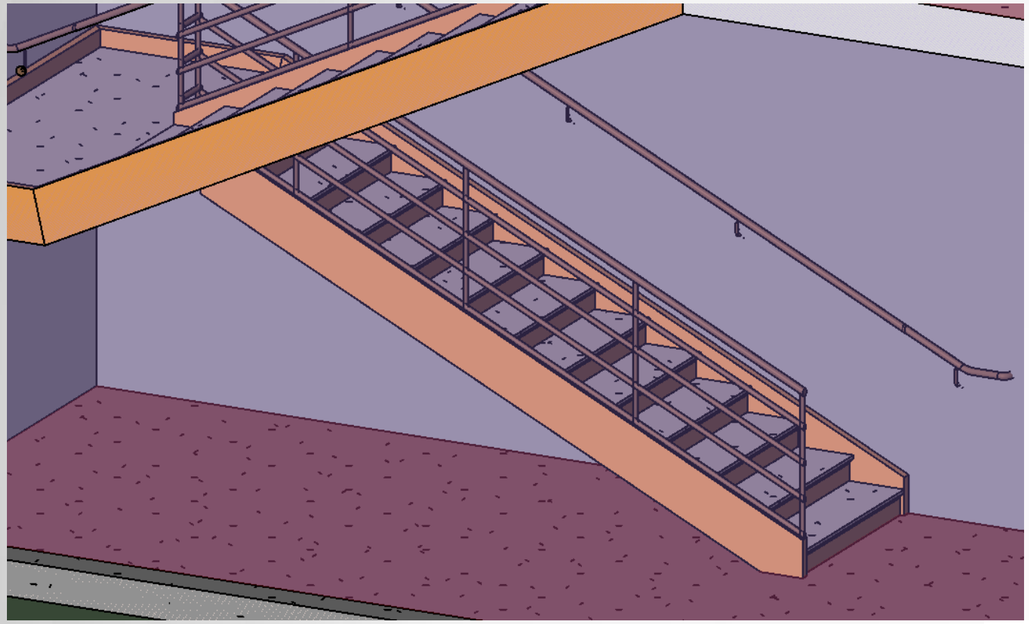
Mesh Seeds in Simulation CFD reveal a higher density of nodes in the region circled (top left)
Zooming in exposes a small edge from volumes that are not aligned (top right)
Properly aligning the volumes in CAD removes the small edge and reduces element count by 100,000 elements (bottom).

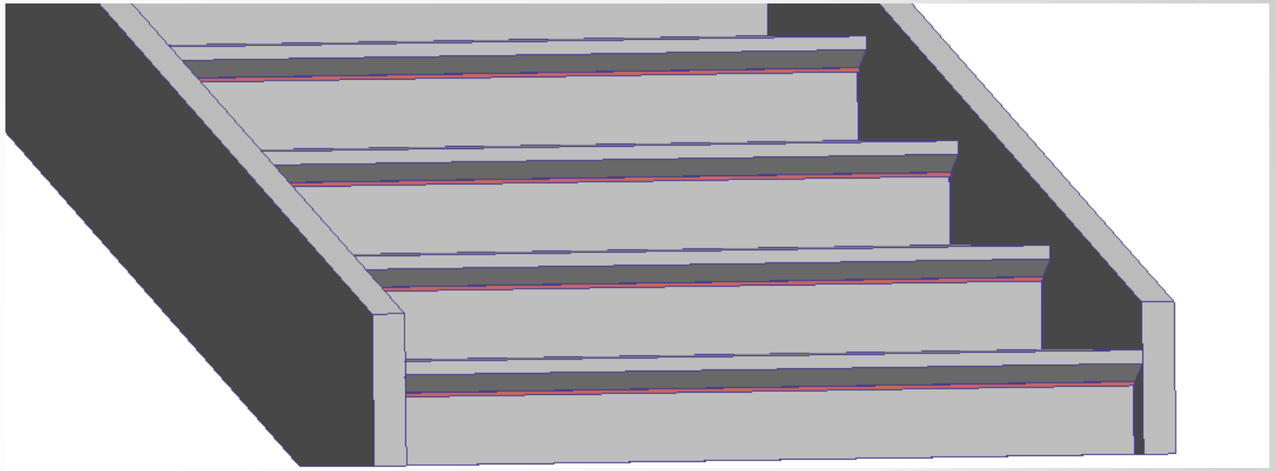
Interferences

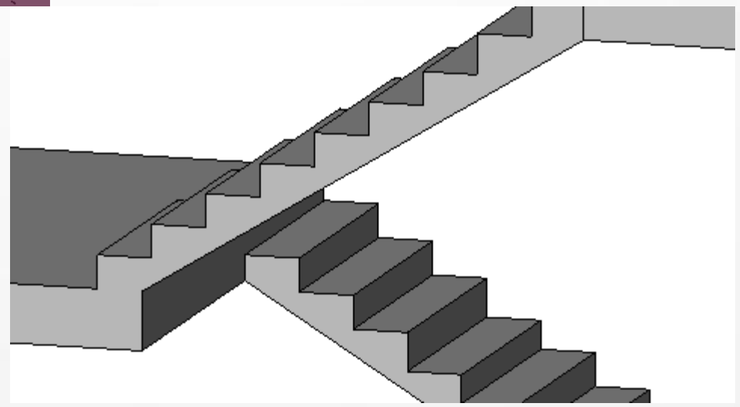


Two volumes (blue and red volumes) interfering in CAD (top)
Simulation CFD interpretation of two interfering volumes (bottom left)
Simulation CFDs name scheme for an intersection (bottom right)

CAD



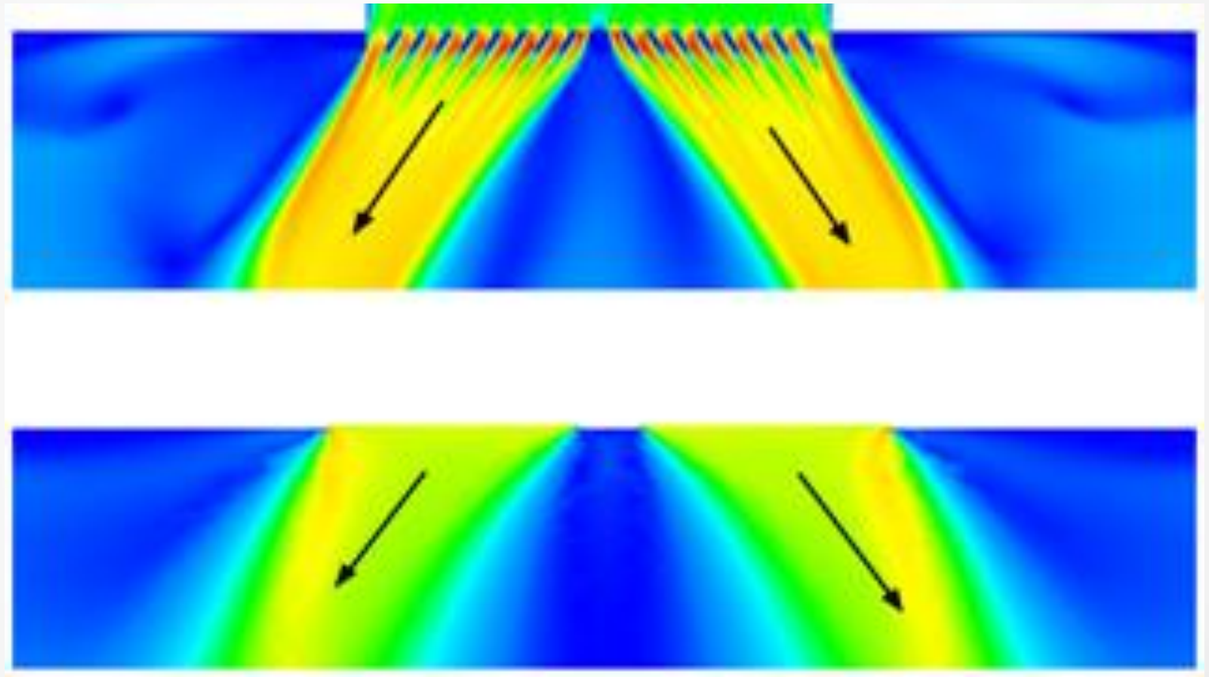




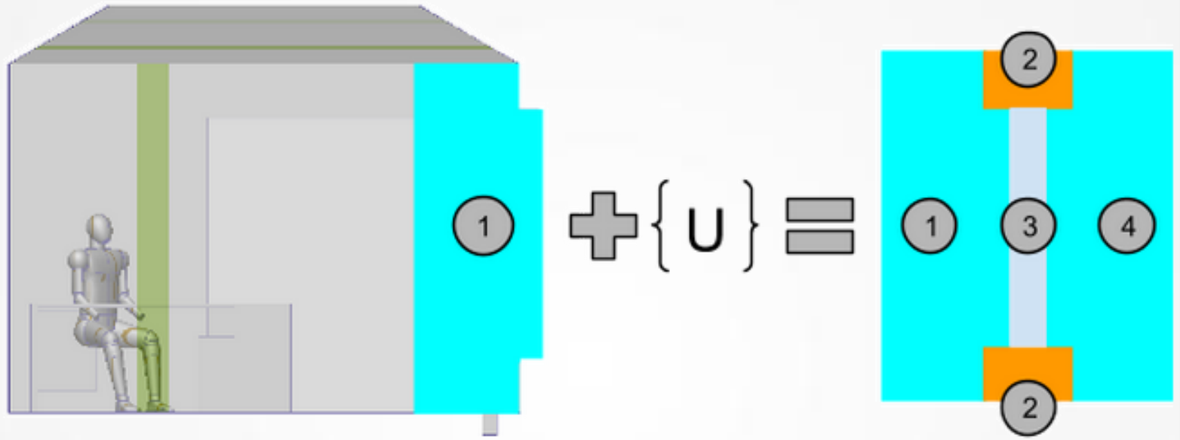
Characterization

- Diffusers
- Air Handlers
- Heat Exchangers
- Walls and Windows
- Occupants

Diffusers



Walls & Windows



1: Internal air
2: Walls
3: Windows
4: External air
U: Film coefficients defined on internal air volume surfaces

Top: An internal air volume with film coefficients defined can replace externally facing components such as walls and windows.

Air Space

- Domain where flow and thermal performance will be evaluated.
- Explicitly modeled or automatically created from void (empty space between walls, windows, ceiling, and floor).

Wall, Windows, Doors, and Other Exterior Elements

- Contain the air space and influence system performance by absorbing and transferring energy.
- Represented as boundary conditions or simple geometry.

Supply / Return

- Provide or remove air and thermal energy from the space.
- Boundary conditions on surfaces are used, ducting is not typically modeled.

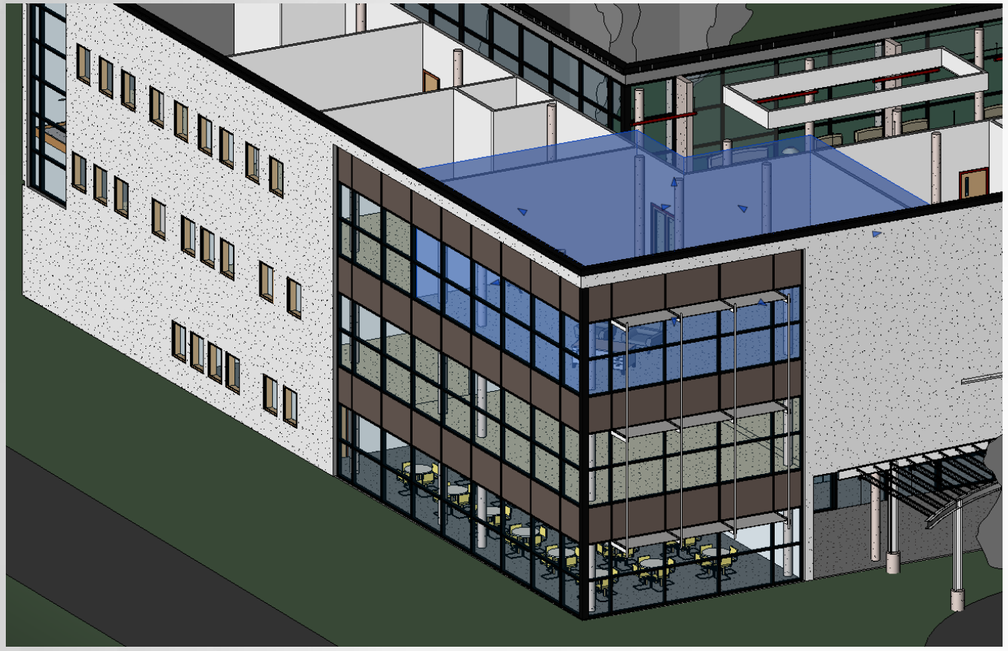
Equipment

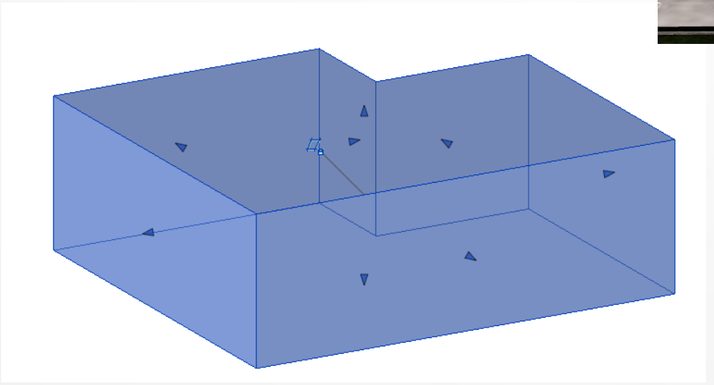
- Machinery, computers, or any other pieces of equipment that add heat and/or influence air movement.
- Devices or simple shapes with heat generation or temperature boundary conditions are typically used to represent equipment.

Occupants

- Add heat, act as flow obstructions, and are considered for thermal comfort predictions.
- Are only modeled when thermal comfort predictions are necessary; otherwise, their heat generation is applied to the air space volume.

Corner Office Internal Space

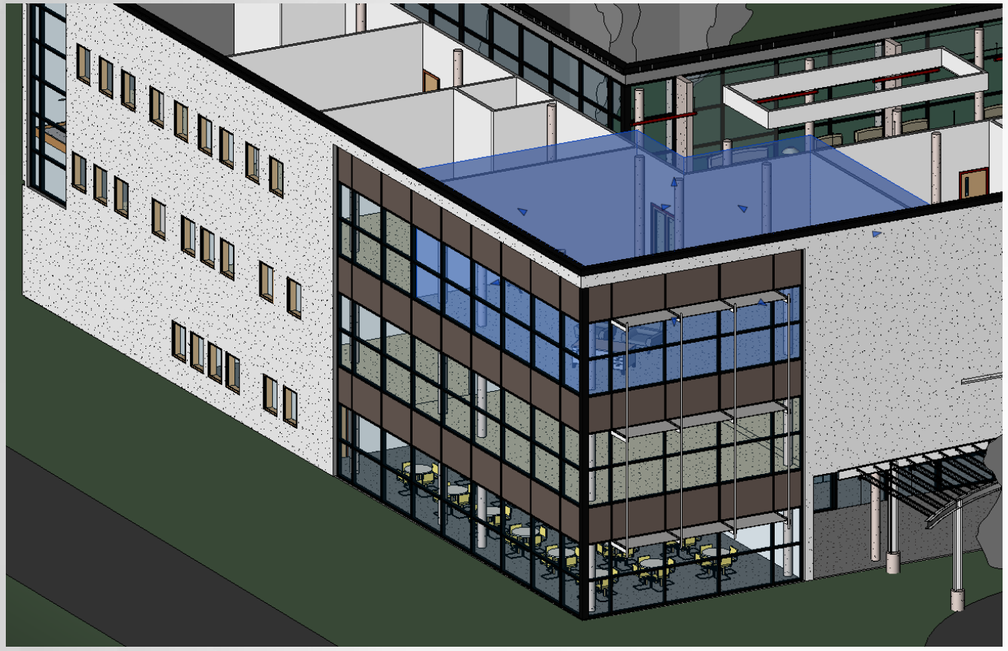


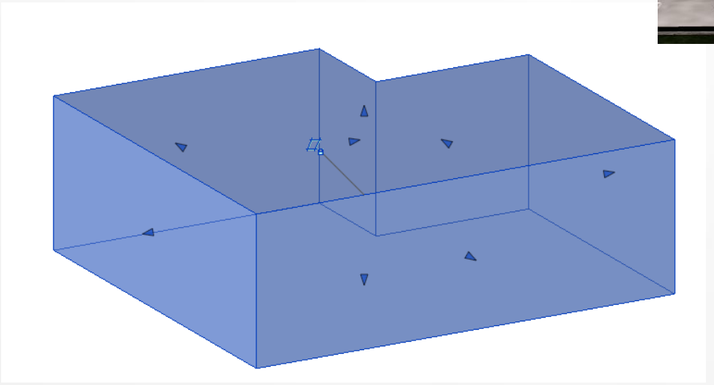


Data Set

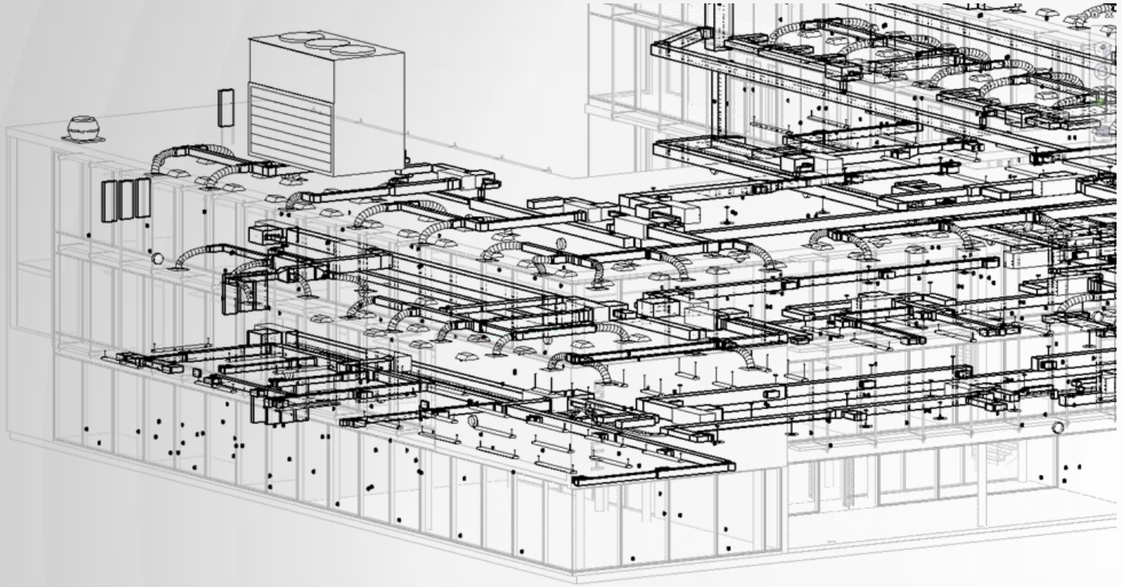
- Rac_advanced_sample_project.rvt

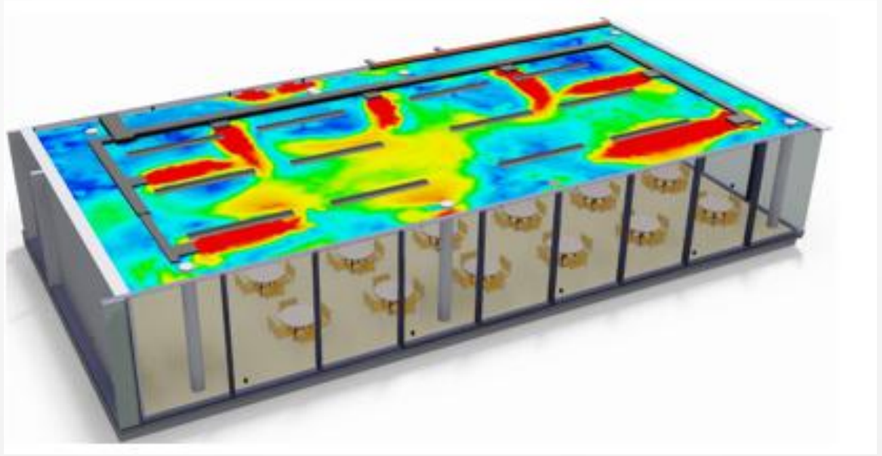
Instructor Led





Cafeteria Space

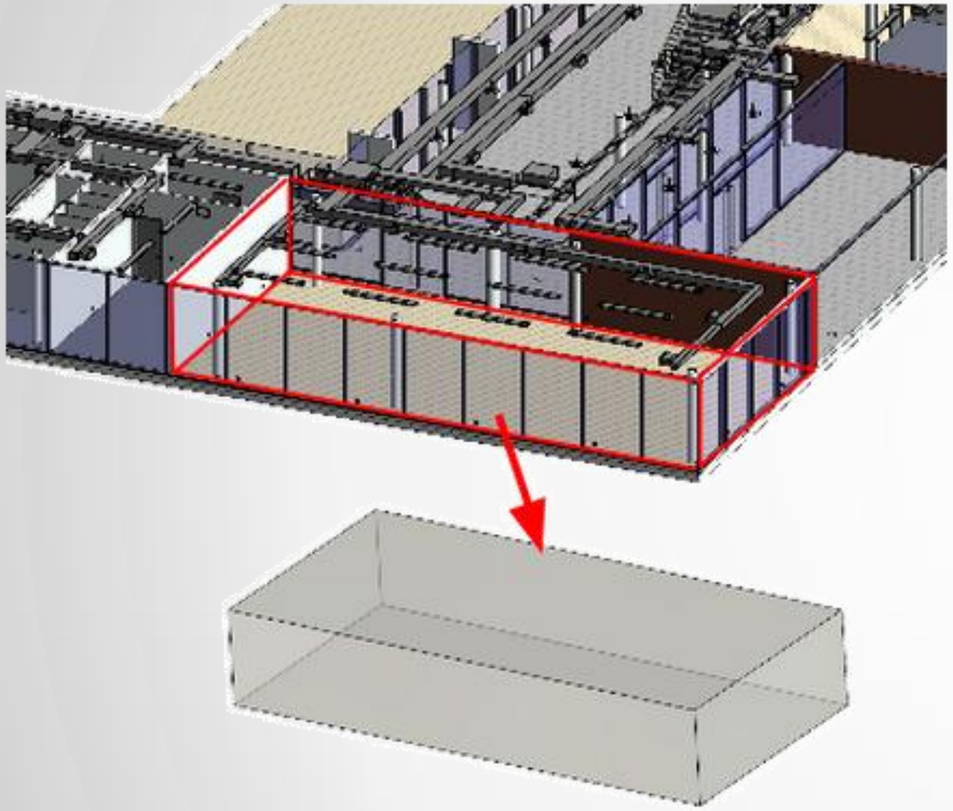


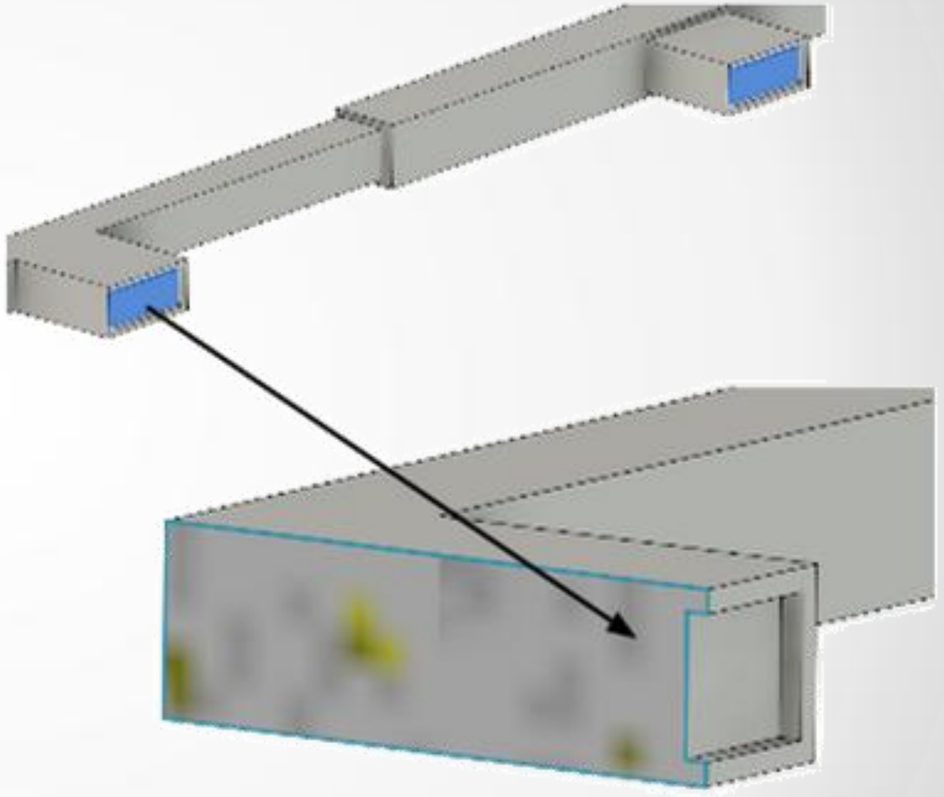


Data Set

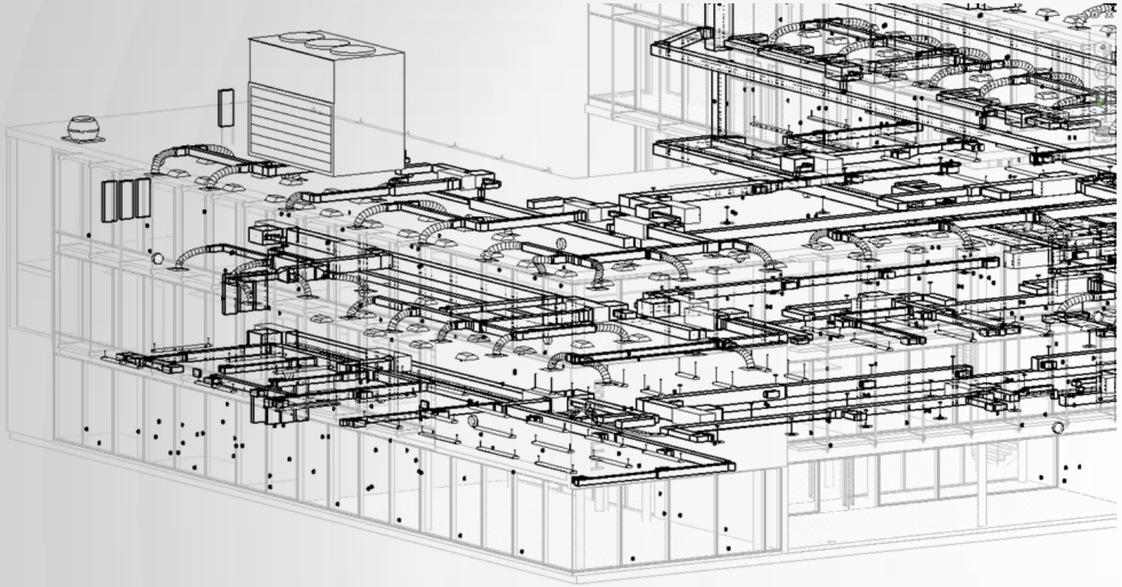
- rme_advanced_sample_project
  - HVAC Ducting

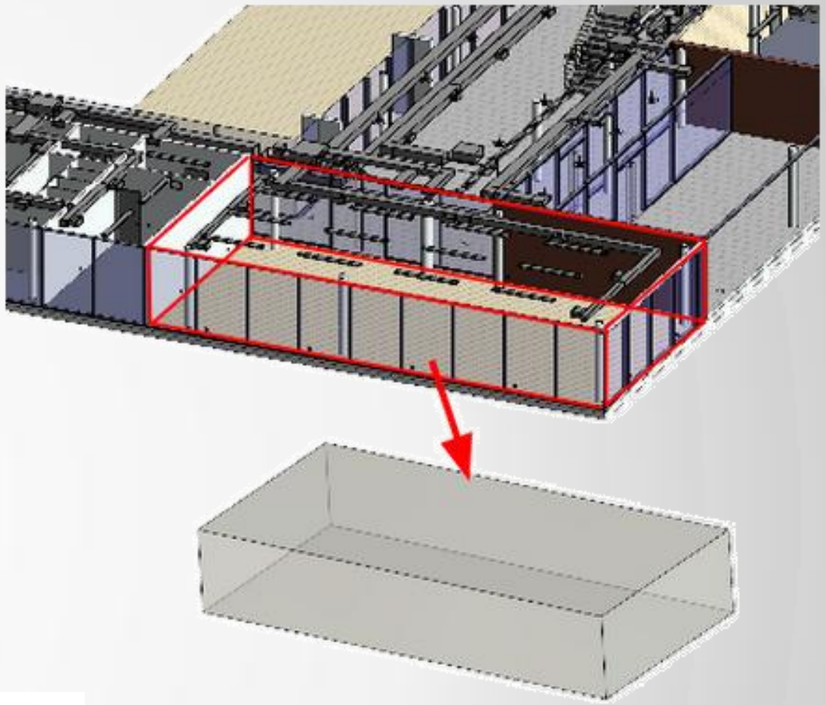
Process

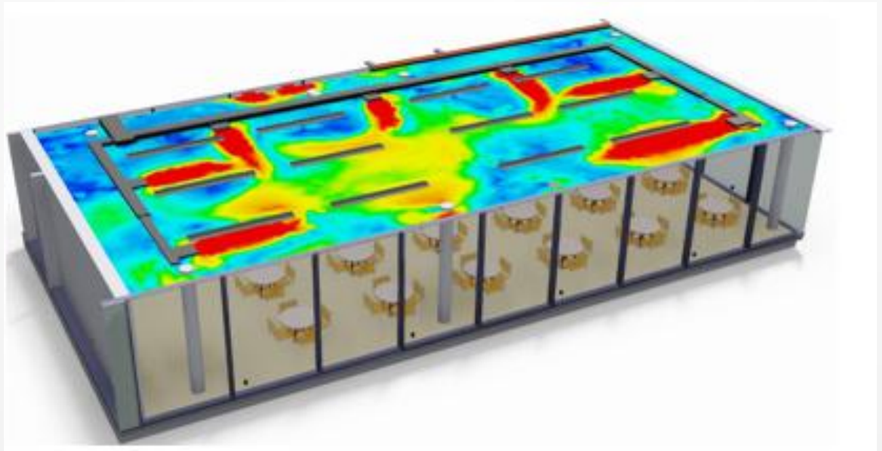




Cafeteria Space







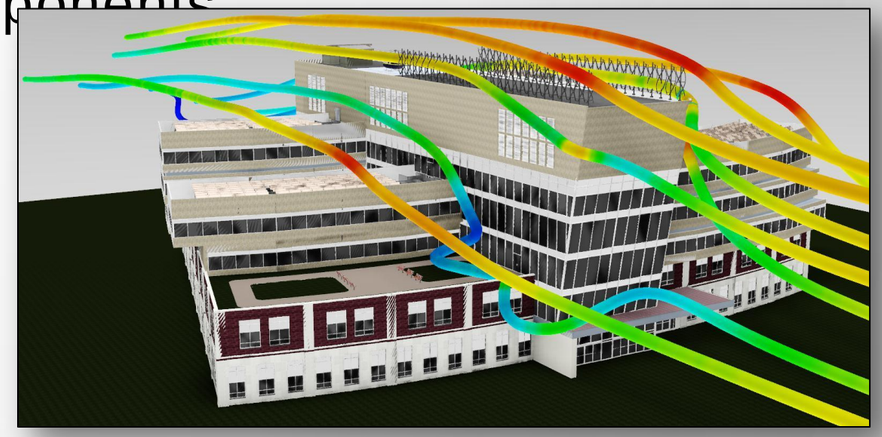
Now Available!

Simulation CFD Courses for AEC Applications

1. **Simulation CFD Fundamentals 1:** Simulation Process, Geometry, and Materials
2. **Simulation CFD Fundamentals 2:** Boundary Conditions and Meshing
3. **Simulation CFD Fundamentals 3:** Solving and Results Interpretation
4. **Simulation CFD Applied:** Characterizing AEC Components
5. **Simulation CFD Applied:** Datacenters
6. **Simulation CFD Applied:** HVAC Layout

A new series of free, online courses developed for practicing engineers within the AEC industry.

Learn more: **http://academy.autodesk.com/courses**



Questions

Open Lab