

Flow Dynamics: A CFD Implementation Case Study

Leonardo Chonkan

BIM Coordinator / Circuito - JCI



Learning Objectives

After this class, you will be able to:

- Make a compelling business case in order to get approval for implementation
- Access learning materials, documentation and other valuable resources available
- Gather the necessary information for successful validation of your results
- Pick an appropriate project to solve and take CFD for a test drive

What this class is NOT about

This class ***will not*** cover the following subjects:

- Software specifics
- Costs / Pricing
- Physical Models / CFD's equations



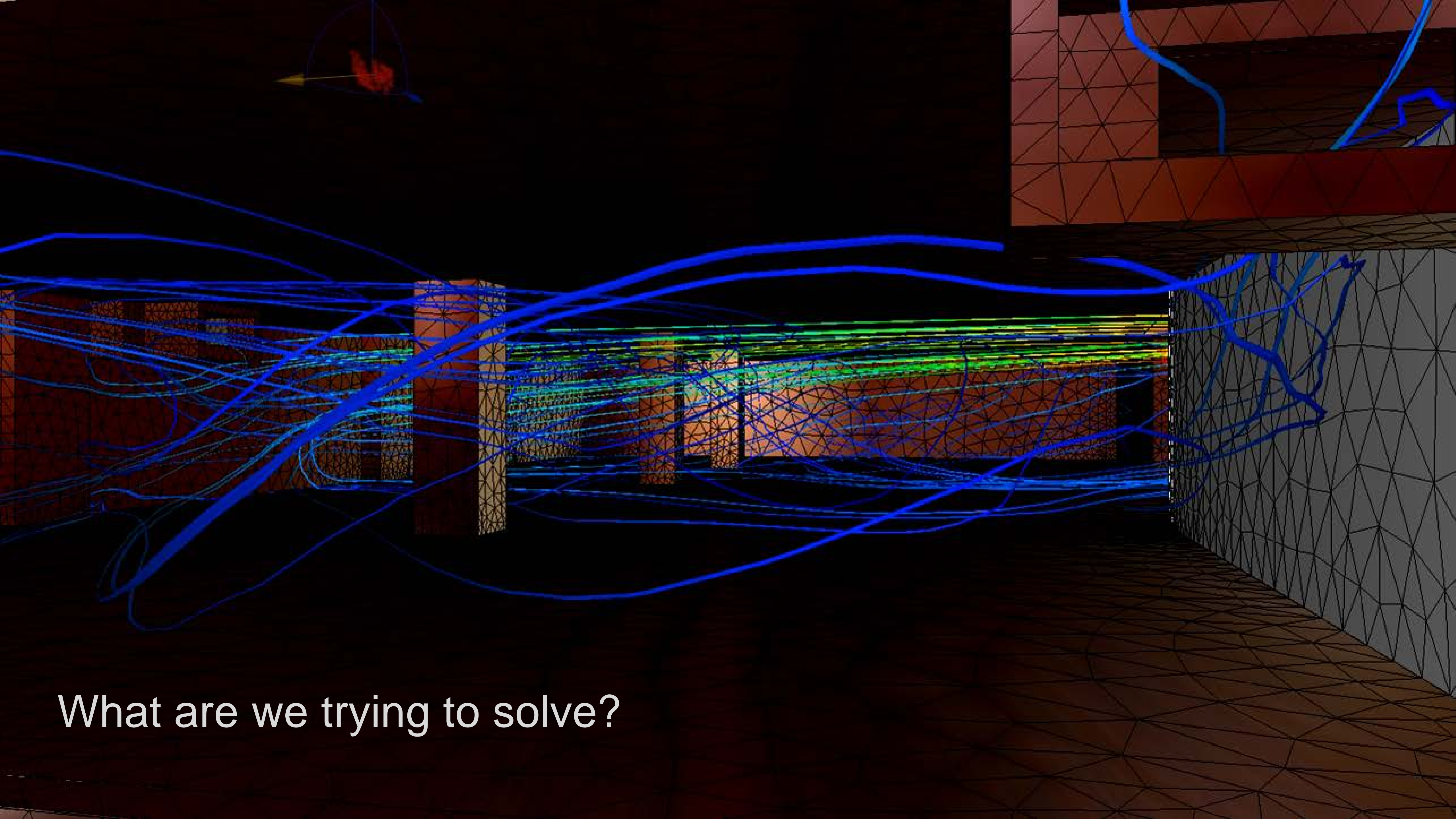
About the speaker

Leonardo Chonkan

- Civil Engineer
- BIM Coordinator
- Loves programming
- Made in Costa Rica

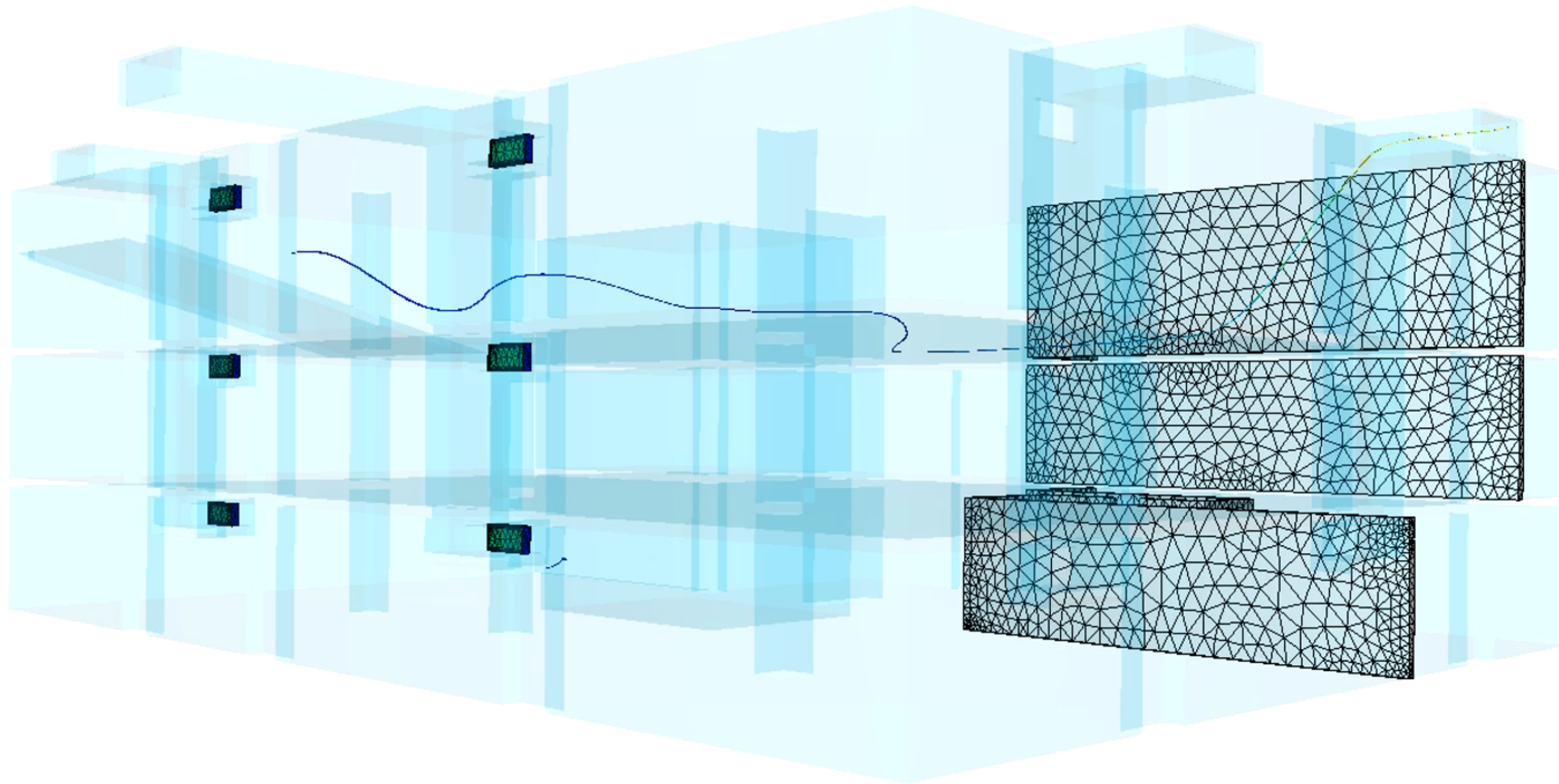
Introduction





What are we trying to solve?

What is CFD?



Continuity Equation:

$$\frac{\partial \rho}{\partial t} + \frac{\partial \rho u}{\partial x} + \frac{\partial \rho v}{\partial y} + \frac{\partial \rho w}{\partial z} = 0$$

X-Momentum Equation:

$$\begin{aligned} & \rho \frac{\partial u}{\partial t} + \rho u \frac{\partial u}{\partial x} + \rho v \frac{\partial u}{\partial y} + \rho w \frac{\partial u}{\partial z} \\ &= \rho g_x - \frac{\partial p}{\partial x} + \frac{\partial}{\partial x} \left[2\mu \frac{\partial u}{\partial x} \right] + \frac{\partial}{\partial y} \left[\mu \left(\frac{\partial u}{\partial y} + \frac{\partial v}{\partial x} \right) \right] + \frac{\partial}{\partial z} \left[\mu \left(\frac{\partial u}{\partial z} + \frac{\partial w}{\partial x} \right) \right] \\ & \quad + S_\omega + S_{DR} \end{aligned}$$

Y-Momentum Equation:

$$\begin{aligned} & \rho \frac{\partial v}{\partial t} + \rho u \frac{\partial v}{\partial x} + \rho v \frac{\partial v}{\partial y} + \rho w \frac{\partial v}{\partial z} \\ &= \rho g_y - \frac{\partial p}{\partial y} + \frac{\partial}{\partial x} \left[\mu \left(\frac{\partial u}{\partial y} + \frac{\partial v}{\partial x} \right) \right] + \frac{\partial}{\partial y} \left[2\mu \frac{\partial v}{\partial y} \right] + \frac{\partial}{\partial z} \left[\mu \left(\frac{\partial v}{\partial z} + \frac{\partial w}{\partial y} \right) \right] \\ & \quad + S_\omega + S_{DR} \end{aligned}$$

Z-Momentum Equation:

$$\begin{aligned} & \rho \frac{\partial w}{\partial t} + \rho u \frac{\partial w}{\partial x} + \rho v \frac{\partial w}{\partial y} + \rho w \frac{\partial w}{\partial z} \\ &= \rho g_z - \frac{\partial p}{\partial z} + \frac{\partial}{\partial x} \left[\mu \left(\frac{\partial u}{\partial z} + \frac{\partial w}{\partial x} \right) \right] + \frac{\partial}{\partial y} \left[\mu \left(\frac{\partial v}{\partial z} + \frac{\partial w}{\partial y} \right) \right] + \frac{\partial}{\partial z} \left[2\mu \frac{\partial w}{\partial z} \right] \\ & \quad + S_\omega + S_{DR} \end{aligned}$$

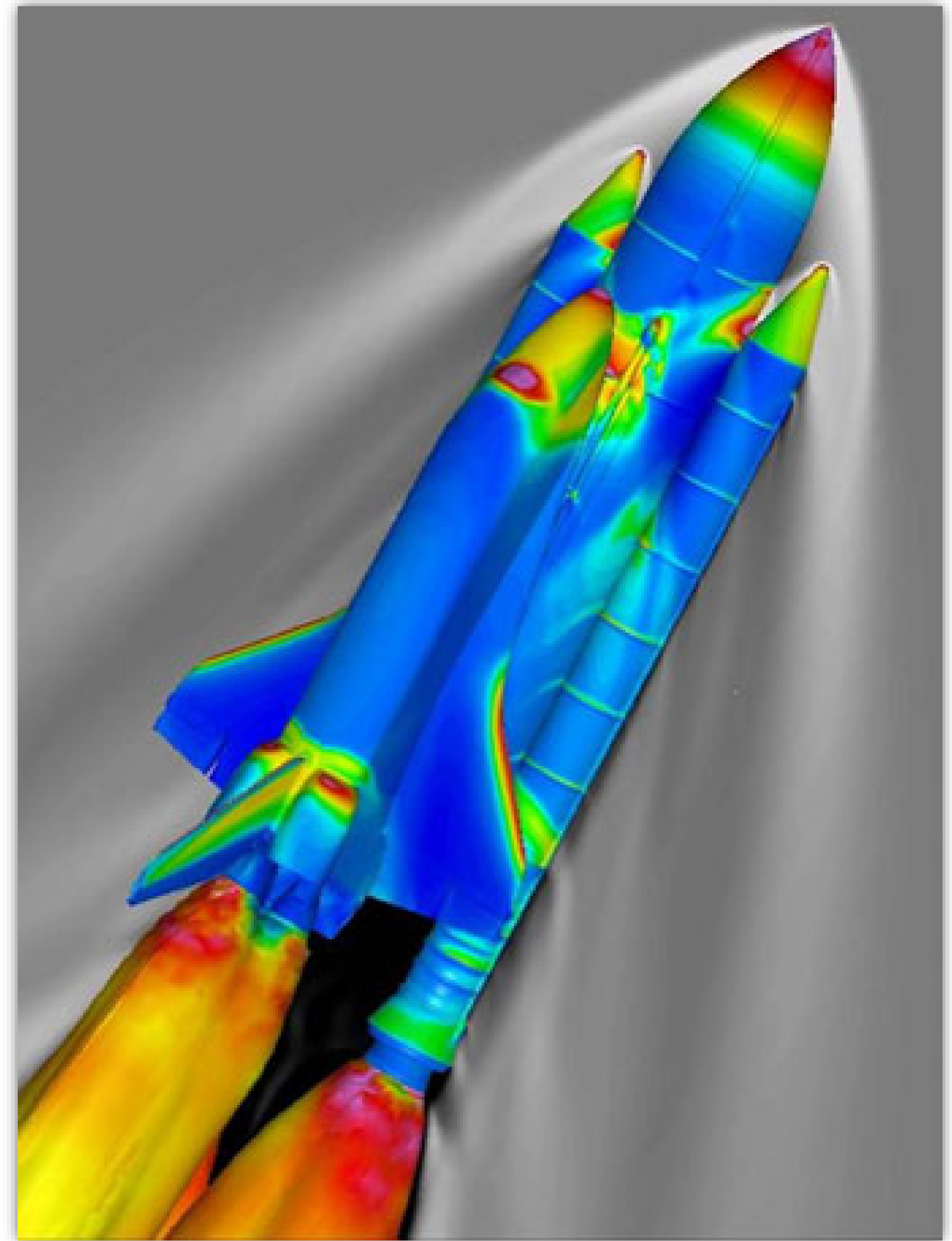
The Business Case for CFD



Who uses CFD?

Some examples include:

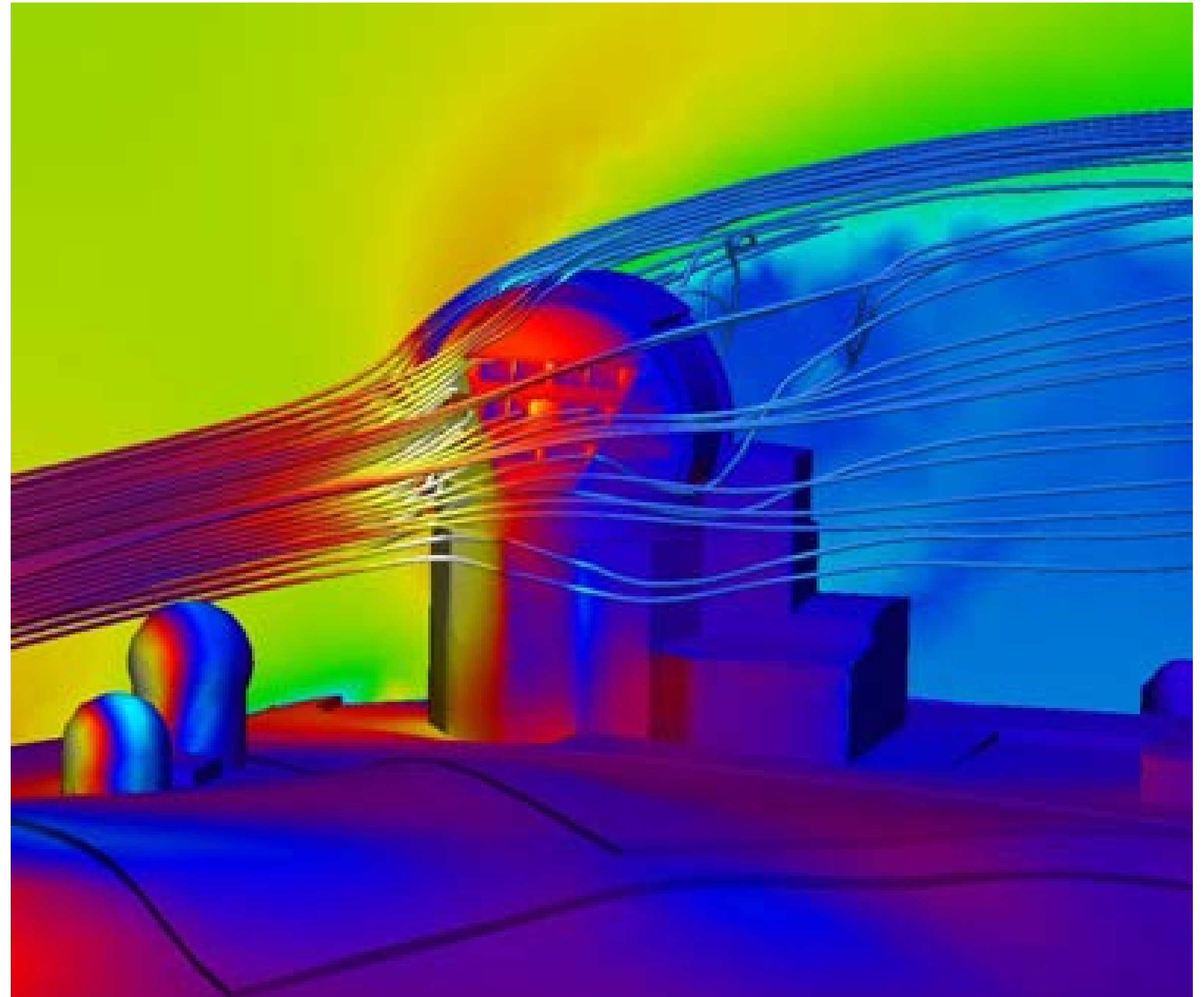
- **Aircraft Engineers**
- Structural Engineers
- MEP Engineers
- Product Designers
- Maybe you?



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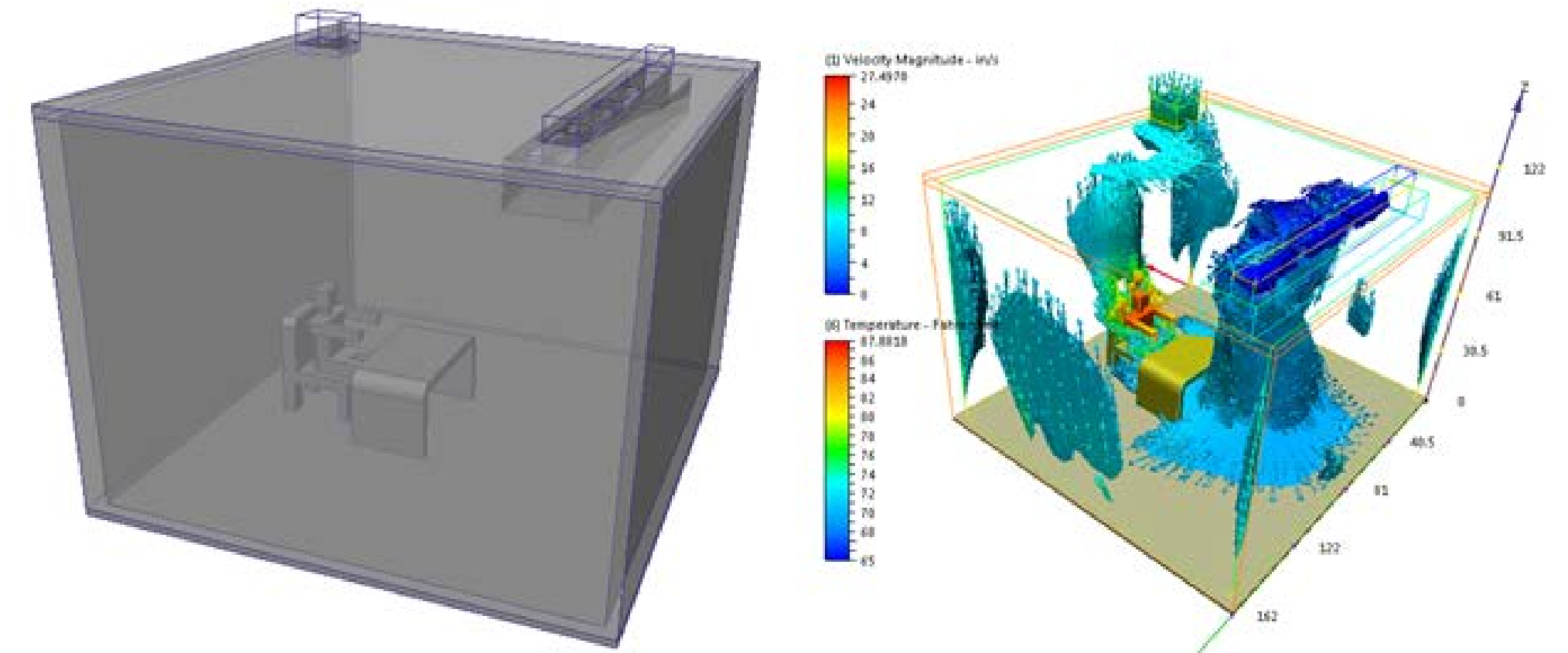
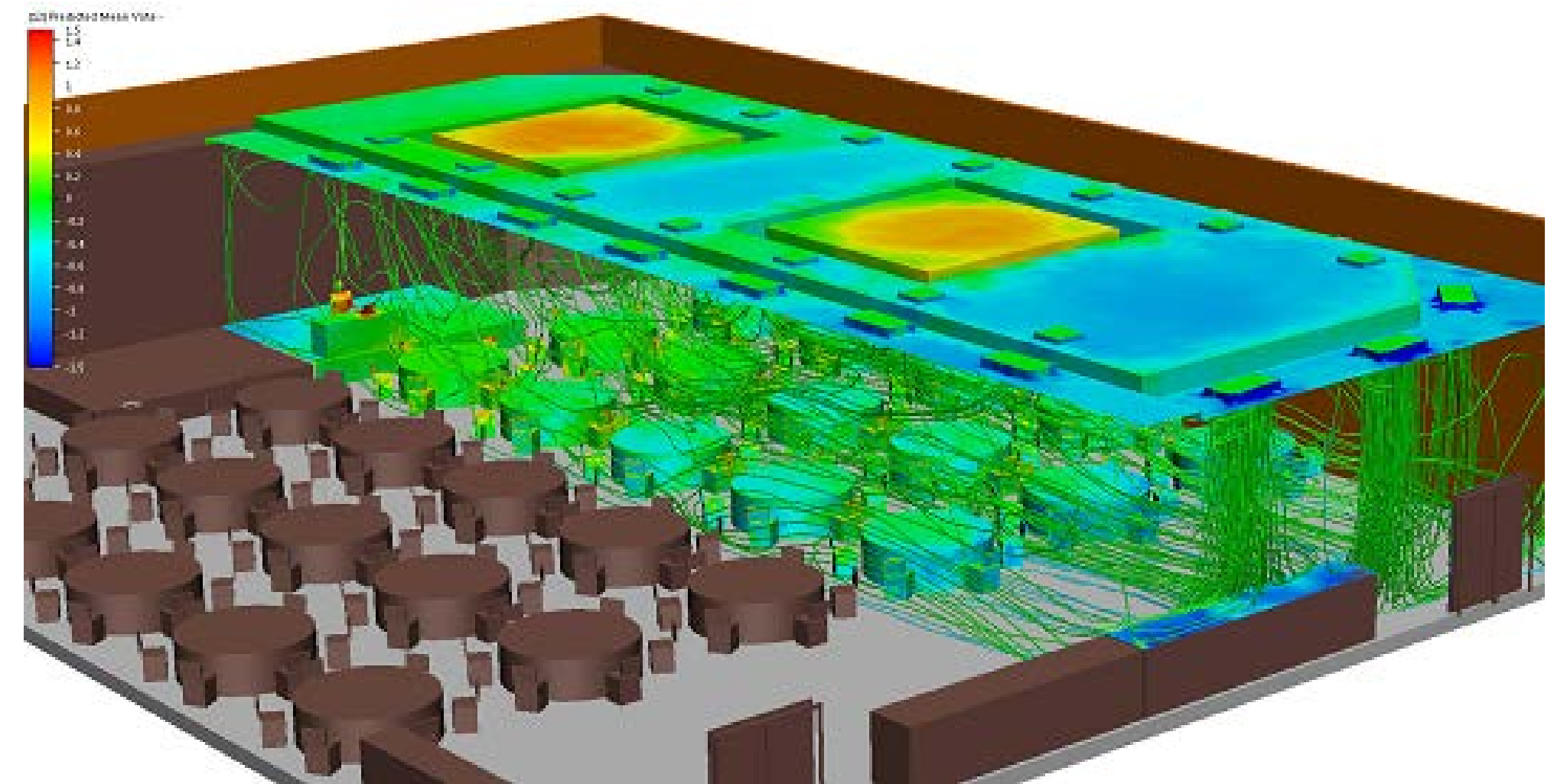


<http://help.autodesk.com/view/SCDSE/2019/ENU/?guid=GUID-C7CCFA3C-63C4-44DF-9698-B0220A8A3CF8>

Who uses CFD?

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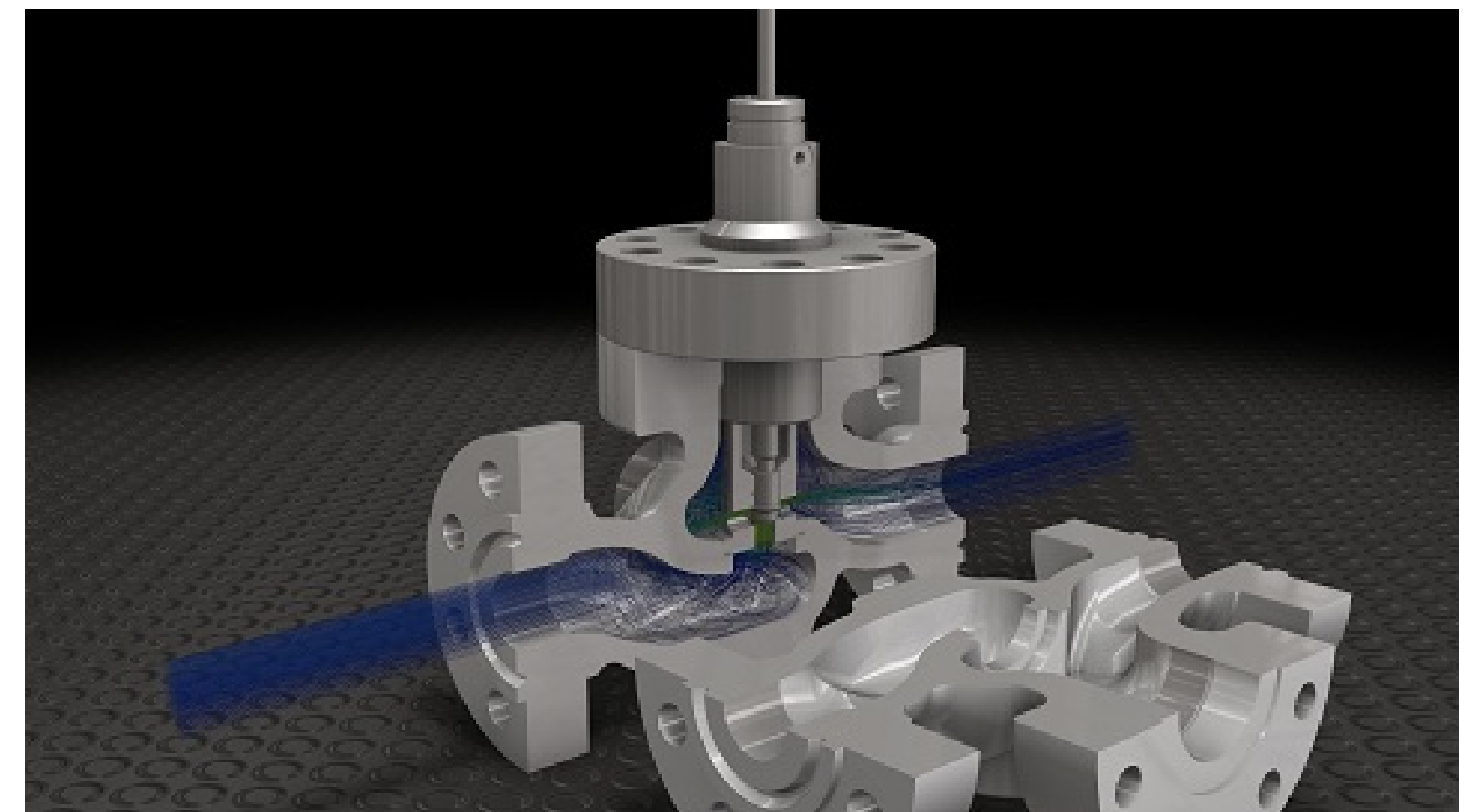
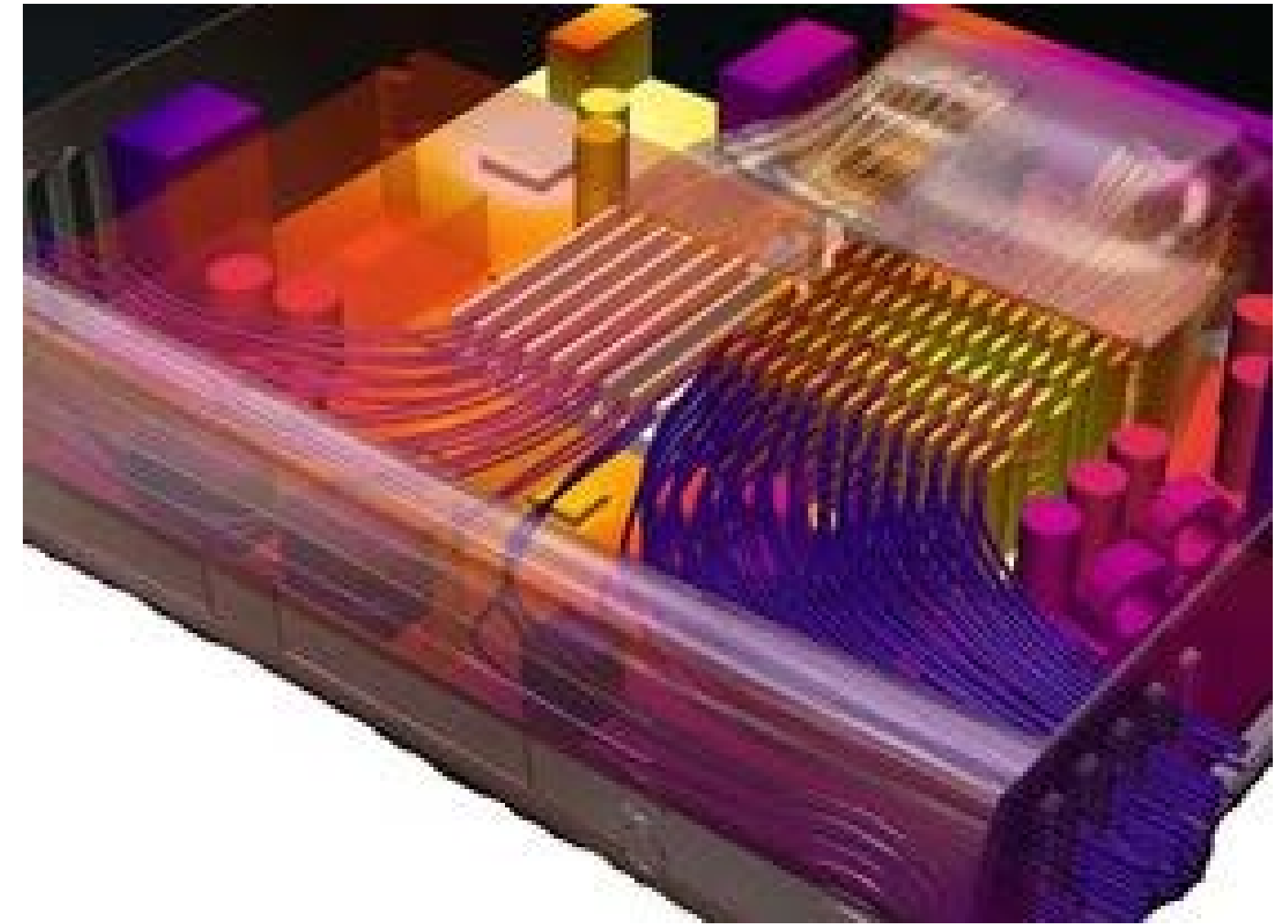
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- Aircraft Engineers
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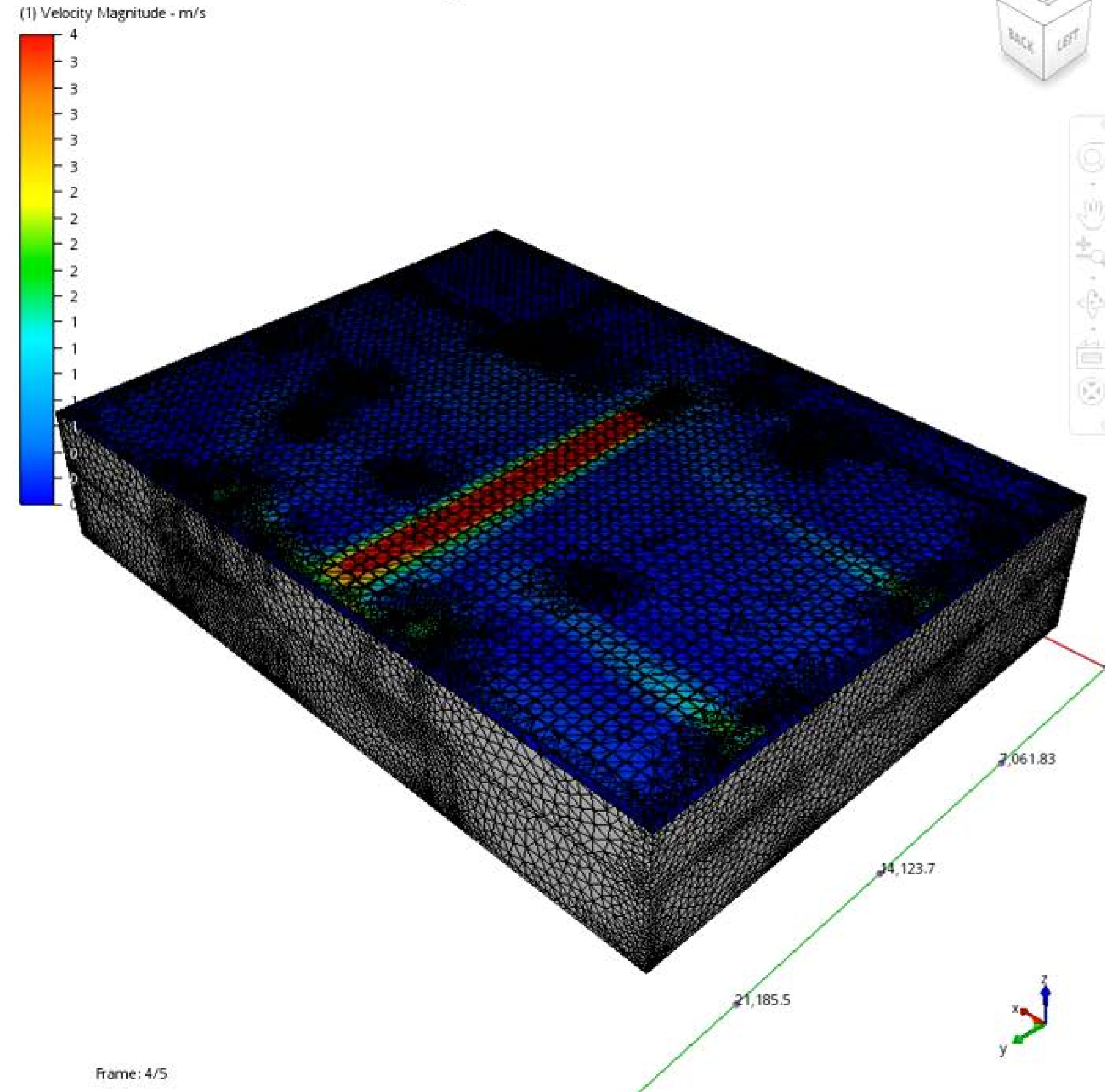
<http://help.autodesk.com/view/SCDSE/2019/ENU/?guid=GUID-79AA9A74-FCAC-42CE-B835-0BF3DEA36EFA>

Why would you?

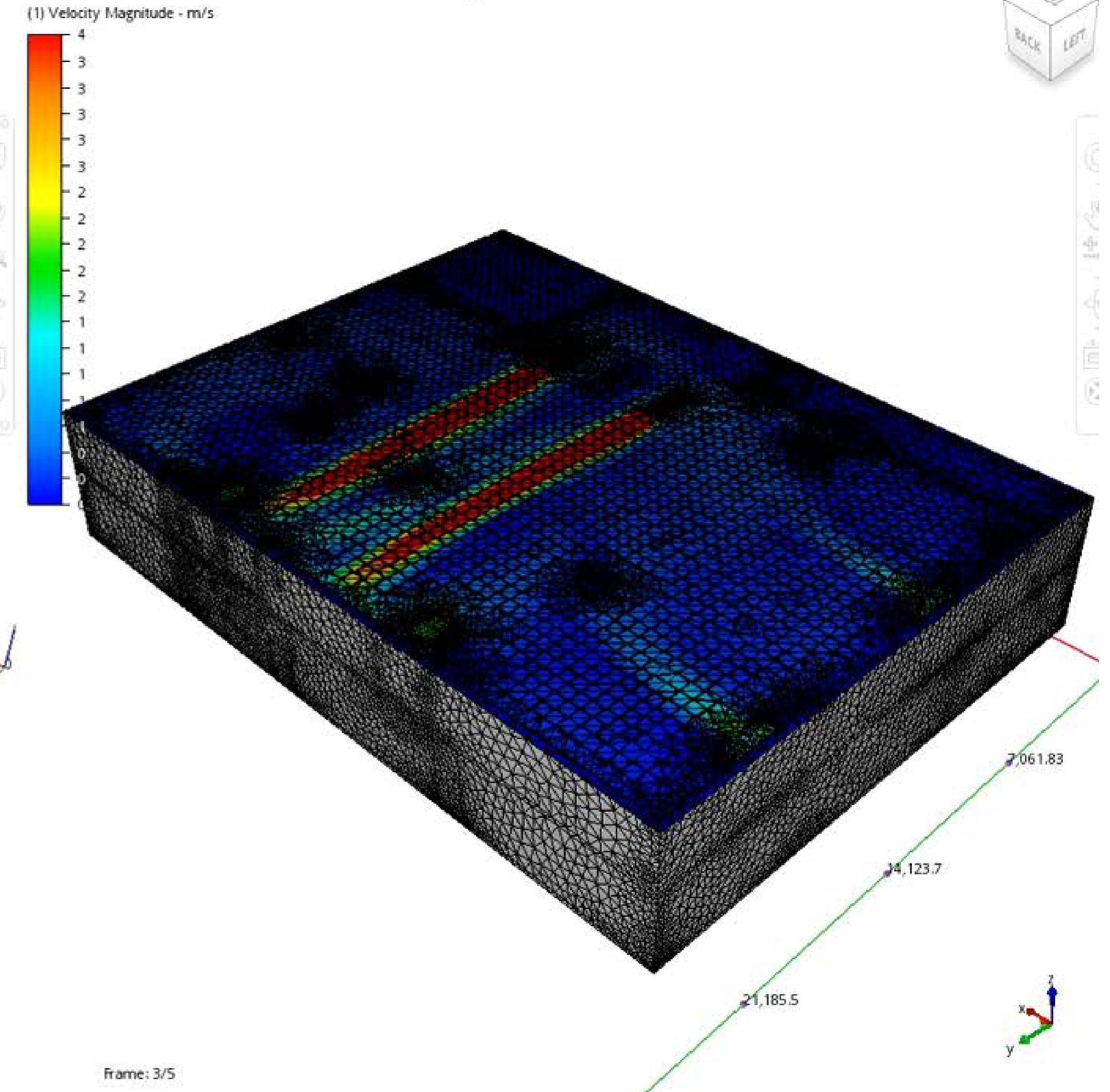
- Improved Decision Making
- Responding to Design Changes
- Beautiful Results

Improved Decision Making

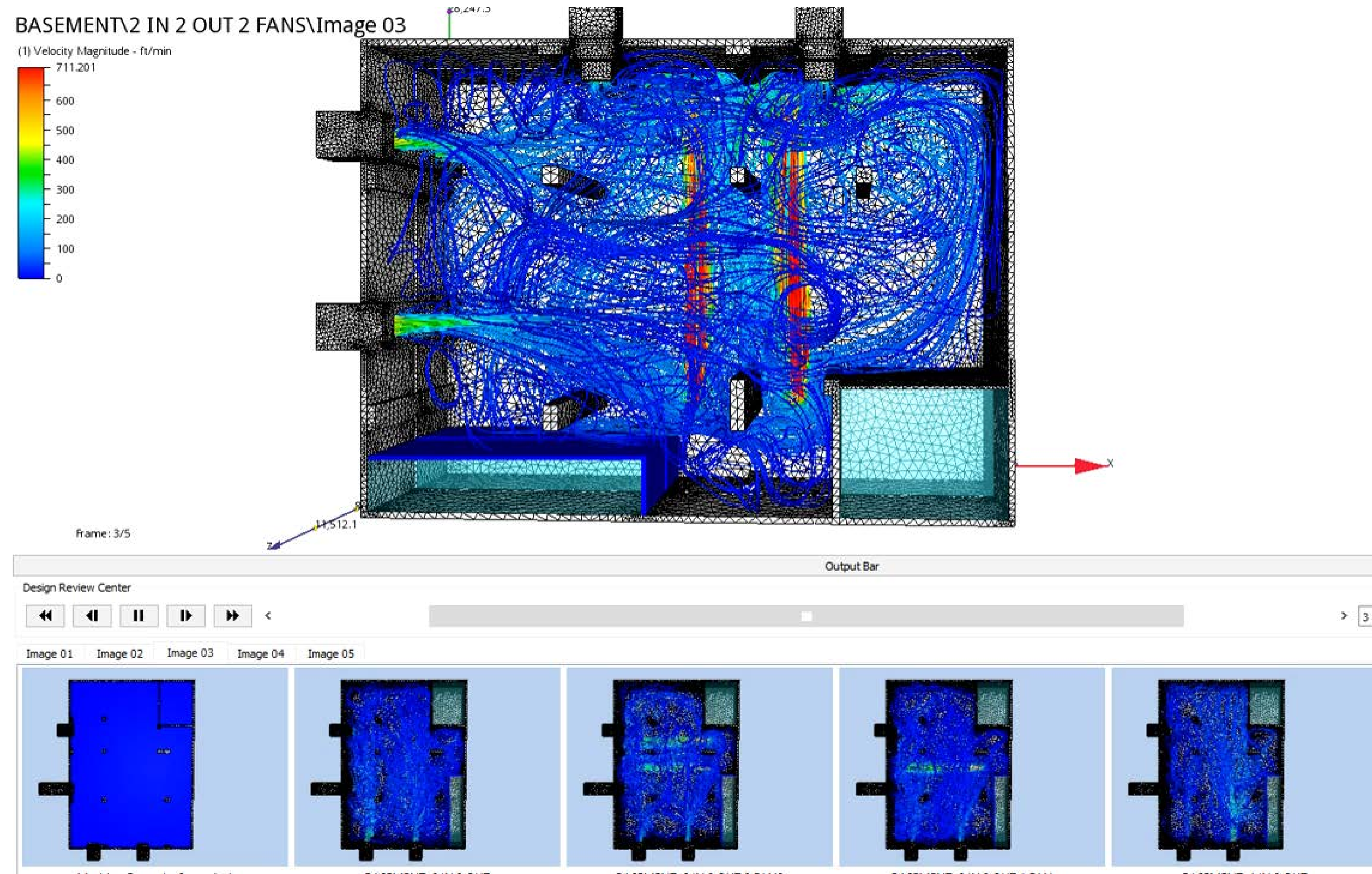
BASEMENT\2 IN 2 OUT 1 FAN\Image 04



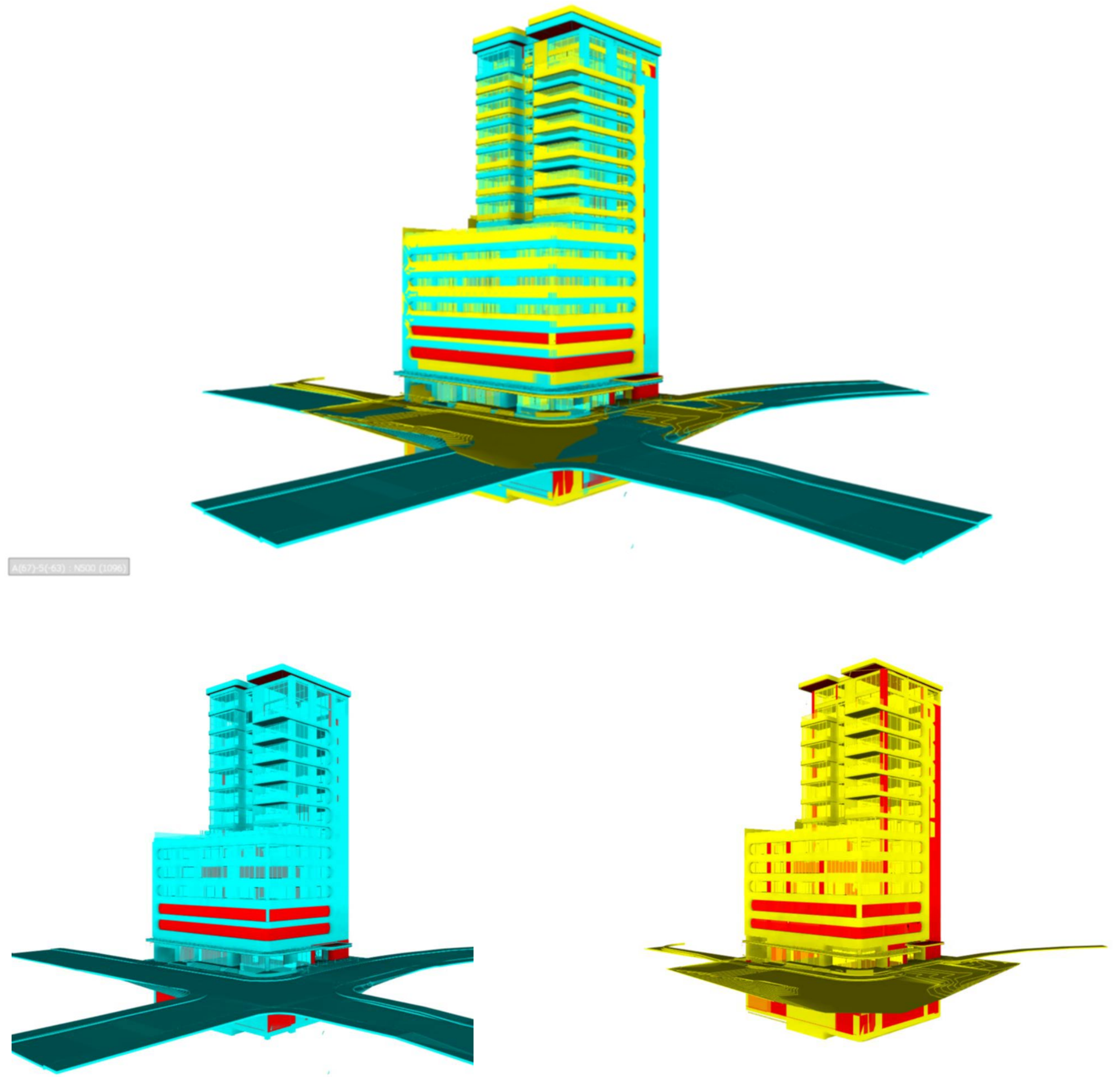
BASEMENT\2 IN 2 OUT 2 FANS\Image 04

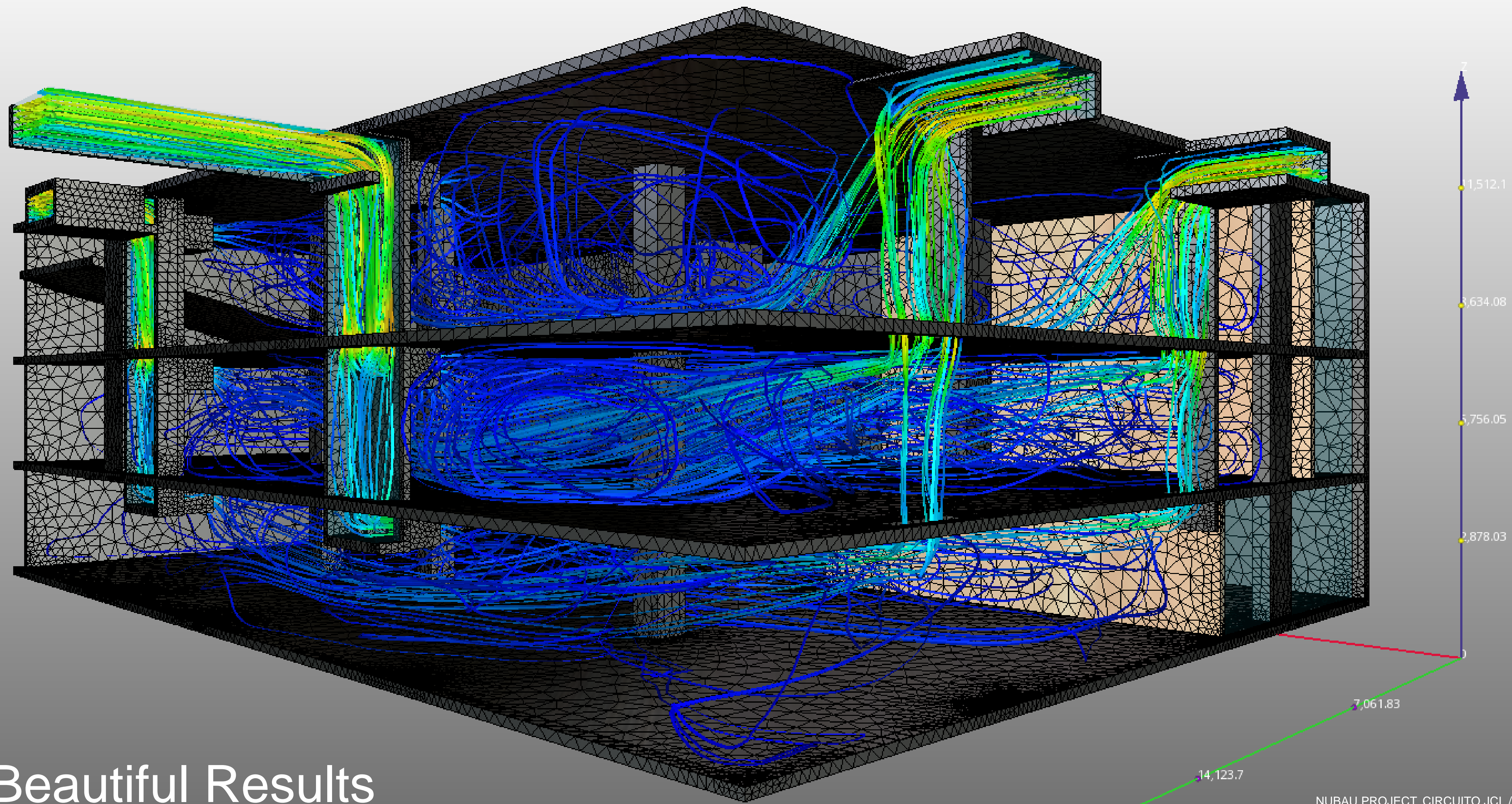


Improved Decision Making



Responding to Design Changes





Beautiful Results

Learning CFD



Free curiosity is of more
value in learning than
harsh discipline.

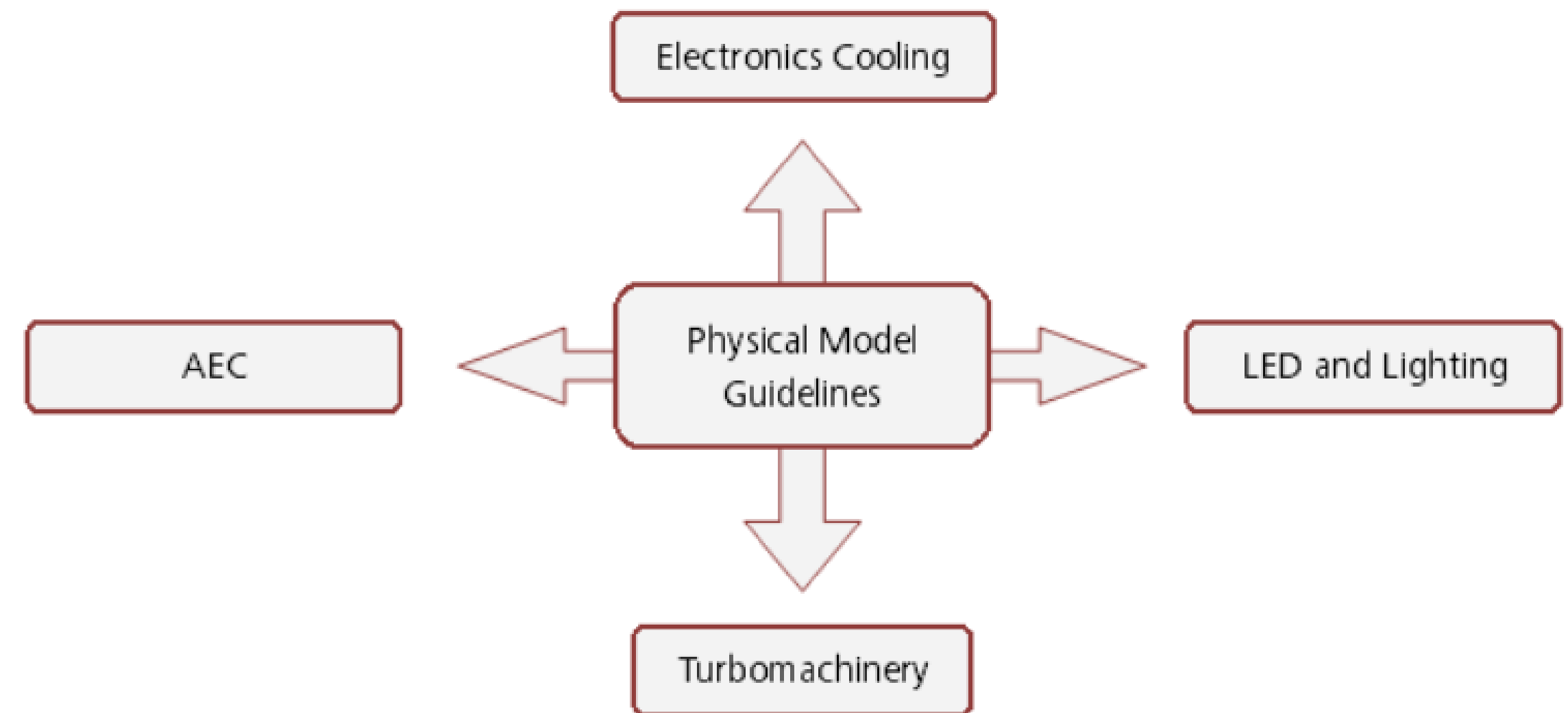
Saint Augustine

Resources

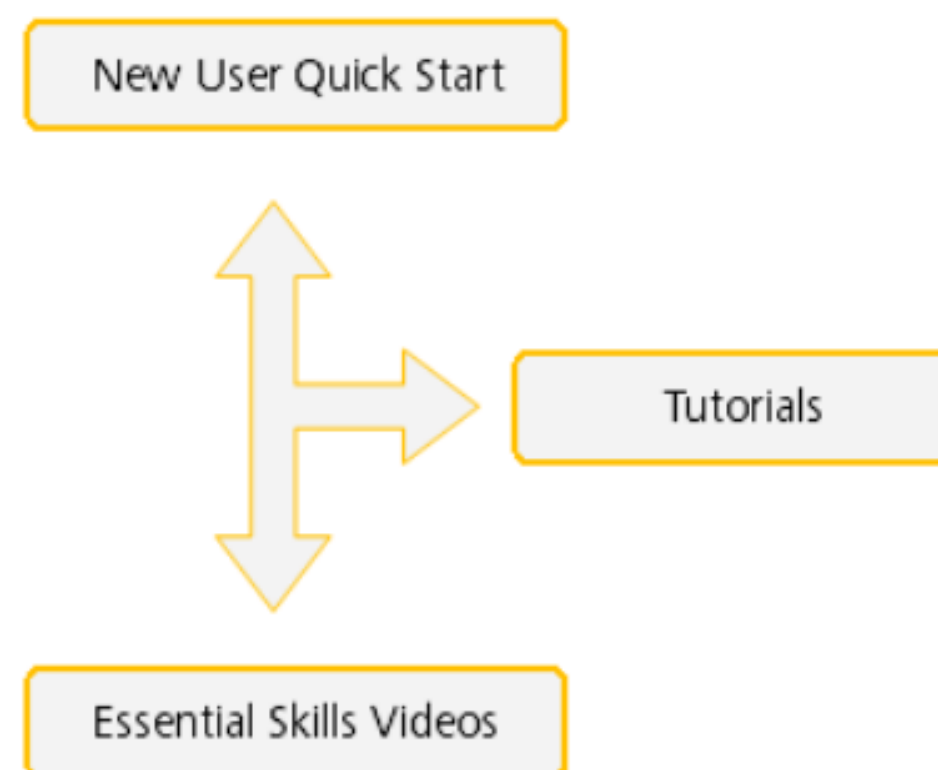
- Official Product Documentation
- Third Party Content
- Autodesk YouTube Channels
- Other Support Channels

Official Product Documentation

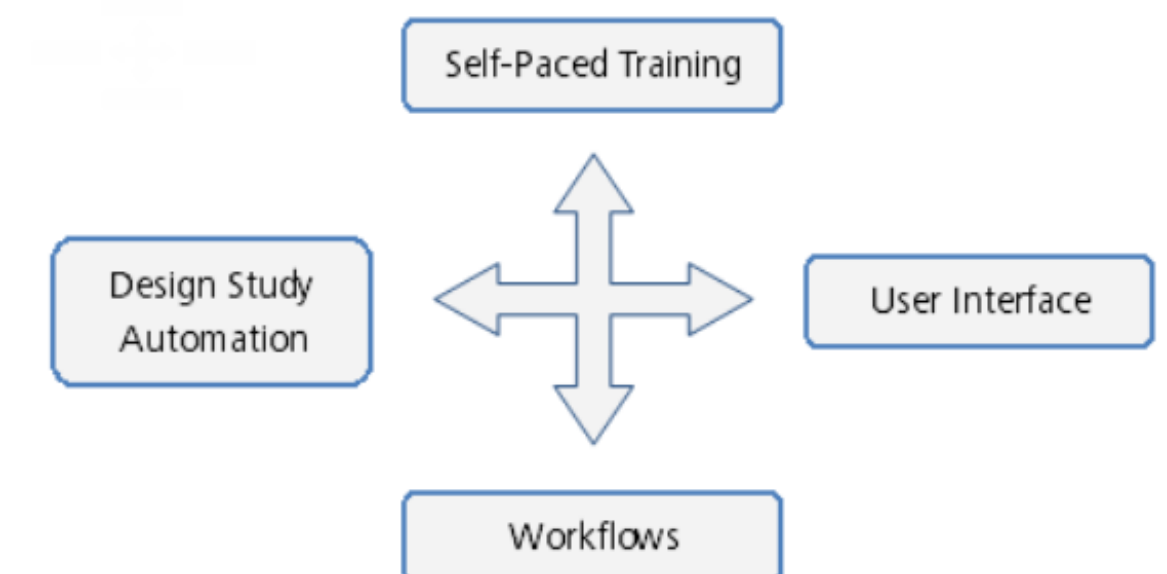
Best Practices and Techniques



Resources for New Users



Training Resources



Third Party Content

- ASCENT Books
- Autodesk Training Centers

2017

Autodesk CFD 2017 Essentials (▼)

Autodesk CFD 2017 Essentials (1st Edition)

Total number of pages: 400

Total Hours: 16



The Autodesk® CFD 2017 Essentials student guide instructs students in the use of the Autodesk® CFD software. The software provides computational fluid dynamics and thermal simulation tools to predict product performance, optimize designs, and validate product behavior before manufacturing. Through a hands-on, practice-intensive curriculum, students acquire the knowledge required to work in the Autodesk CFD environment to setup and conduct thermal and flow analyses on part and assembly models. Exercises are provided that cover electronic cooling, flow control, and AEC type models.

► Pricing

► eBook Description

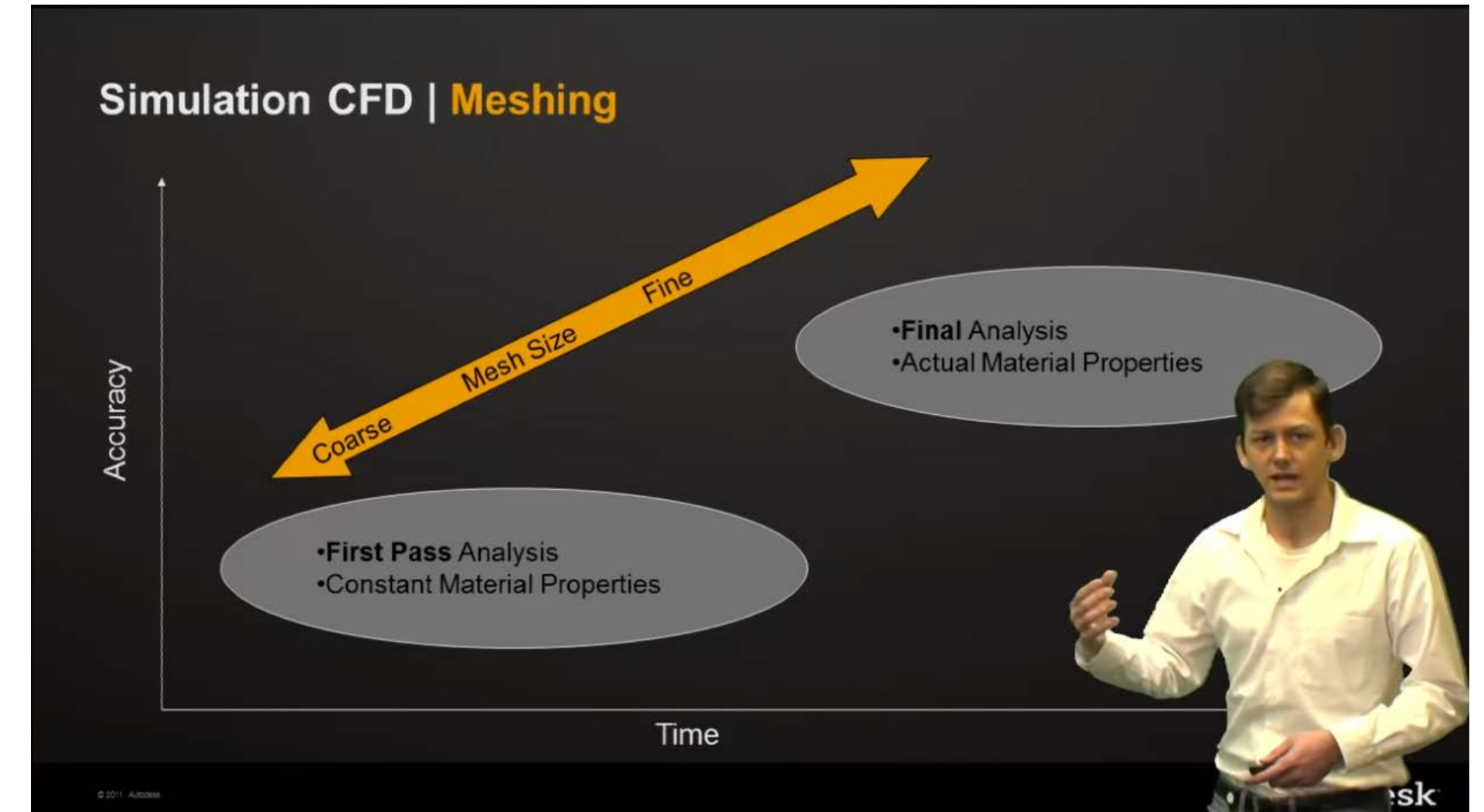
► Instructor Guide


▼ Class Files

The class files for this training guide were released on July 29, 2016 (part number AS-CFD1701-ESS1MU-CF.exe). Please refer to the link in your training guide to download the latest class files.




Autodesk YouTube Channels

- Playlists dedicated to Autodesk CFD
- Webinar recordings
- CFD Hangout Recordings
- Success Stories
- Tutorials



 **Autodesk Simulation**
14,7 mil suscriptores

INICIO VÍDEOS **LISTAS DE REPRODUCCIÓN** COMUNIDAD

 20 ▶ REPRODUCIR TODO	 32 ▶	 68 ▶
Autodesk CFD Autodesk Simulation VER LISTA DE REPRODUCCIÓN COMPLETA	Autodesk Nastran In-CAD Autodesk Simulation VER LISTA DE REPRODUCCIÓN COMPLETA	Autodesk Moldflow Autodesk Simulation VER LISTA DE REPRODUCCIÓN COMPLETA

Other Support Channels



Support & Learning

Find documentation, tutorials, downloads, videos, and more resources.

To view all CFD offerings go to the [CFD page](#).



Learn

Get started quickly, and then find videos, articles, and tutorials explaining how to use CFD.

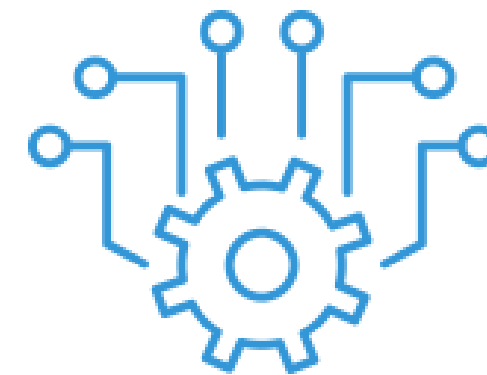
[→ Search the learning database](#)



Downloads

Get service packs, hotfixes, and updates. Download software, free trials, free software for students and educators, and viewers for CFD.

[→ Downloads](#)



Troubleshooting

Search for solutions to common issues using CFD.

[→ Solutions](#)



Forums

Look for forums, idea boards, and groups about CFD.

[→ Forums](#)

Things you will need



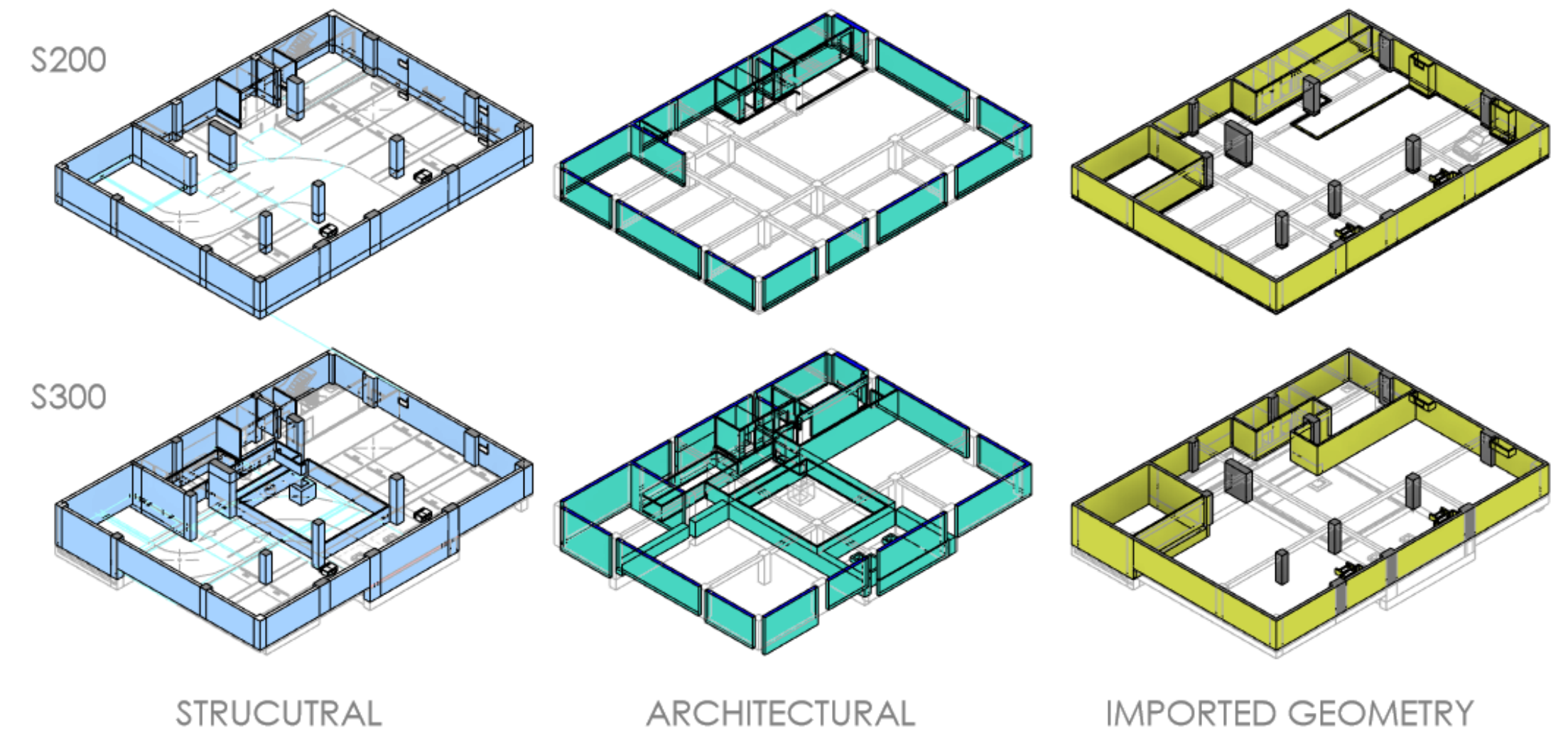
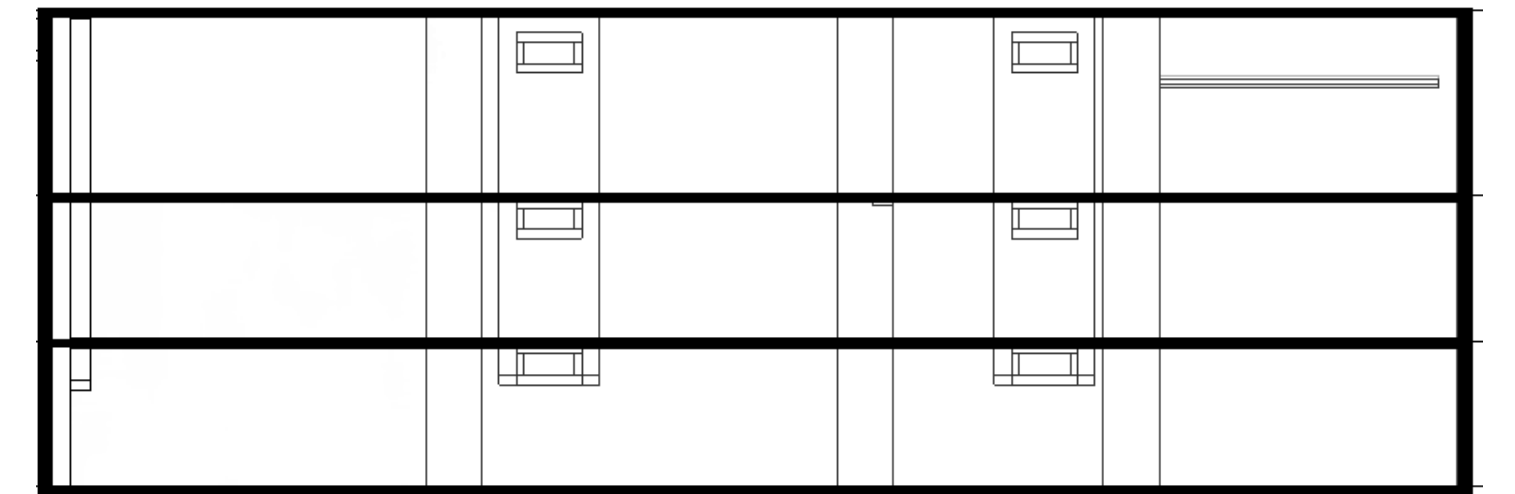
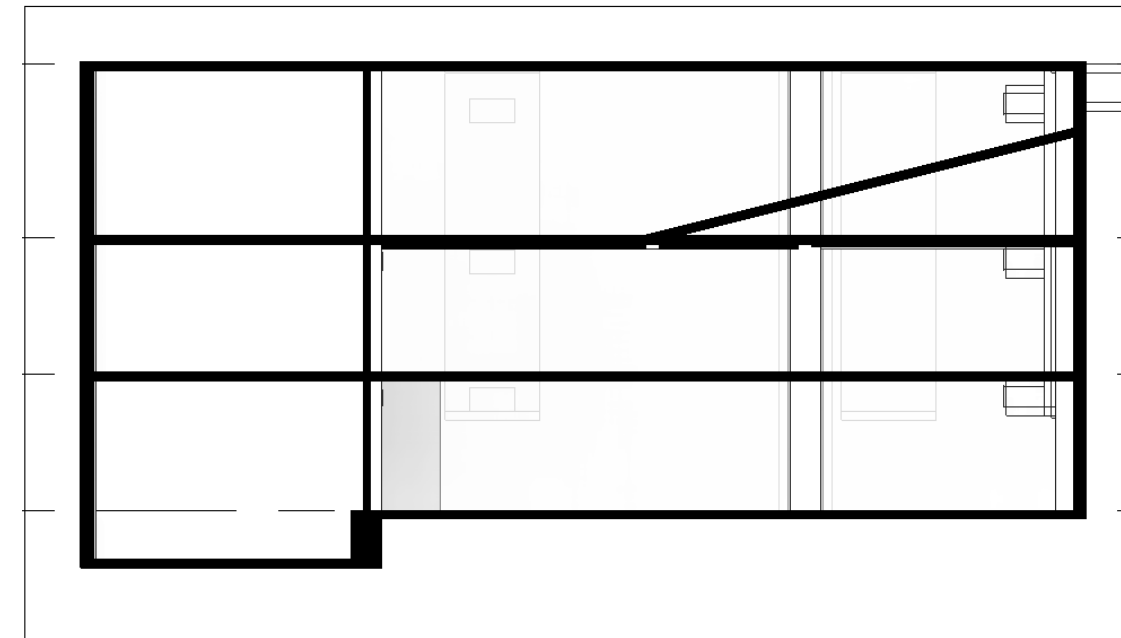


Building the Right Team

- Having the right people is key for a successful implementation
 - Be realistic about your team's capabilities.
 - Consider hiring an implementation expert.
 - Be careful about your implementation expert.
 - Set deadlines!

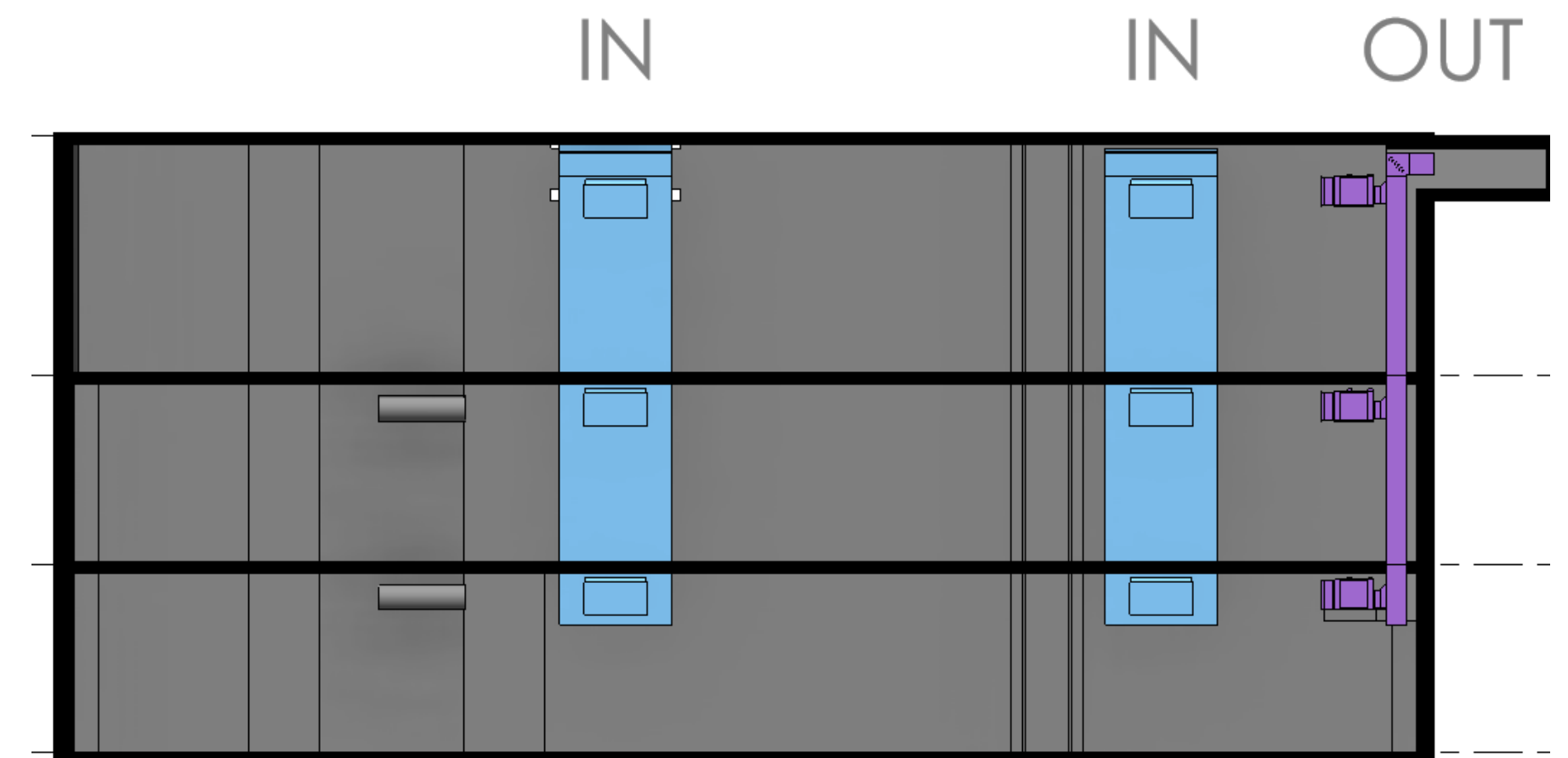
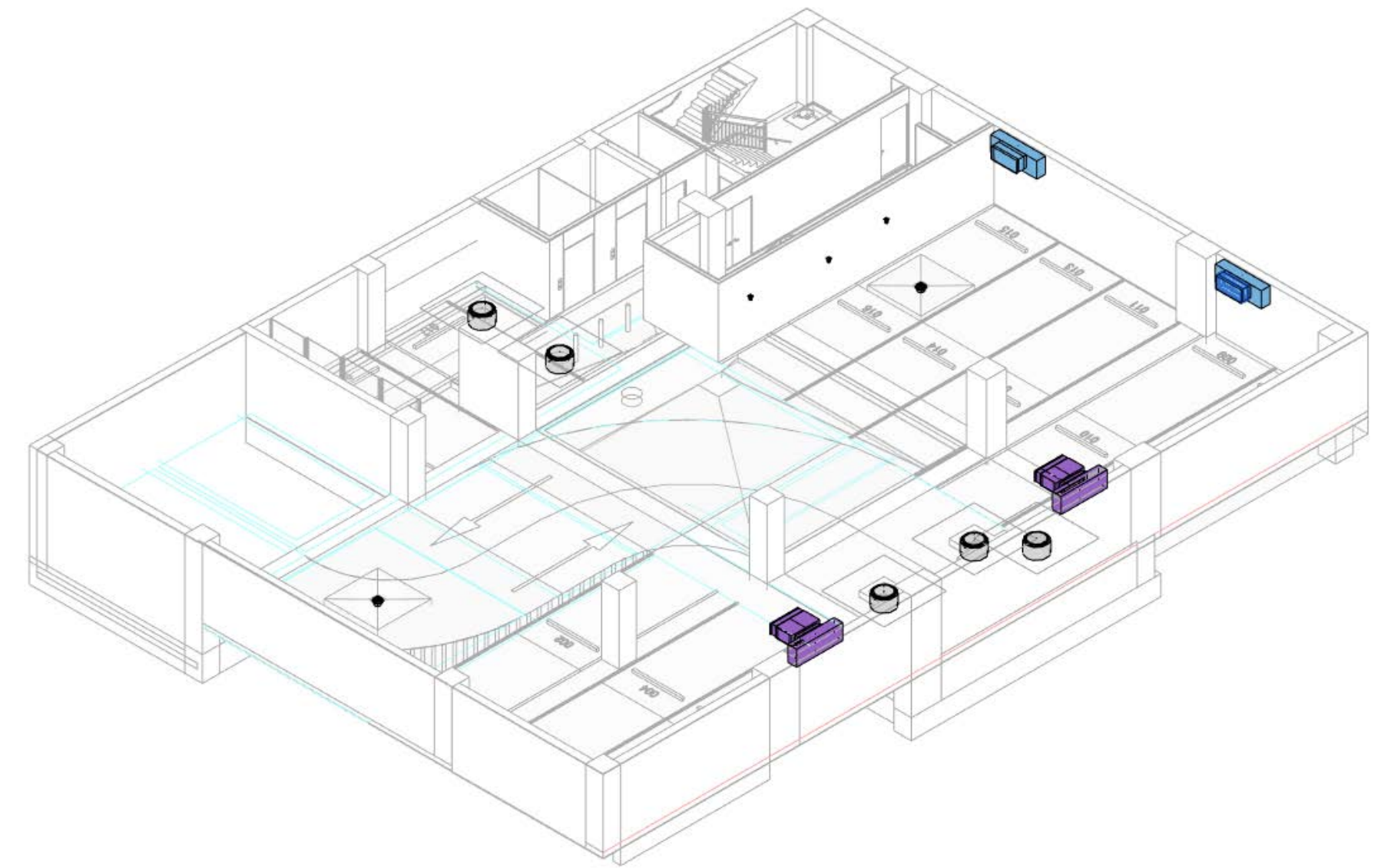
Understanding the Problem

- Key aspects
 - Design
 - Flow Volume
 - Boundary Conditions
 - Materials



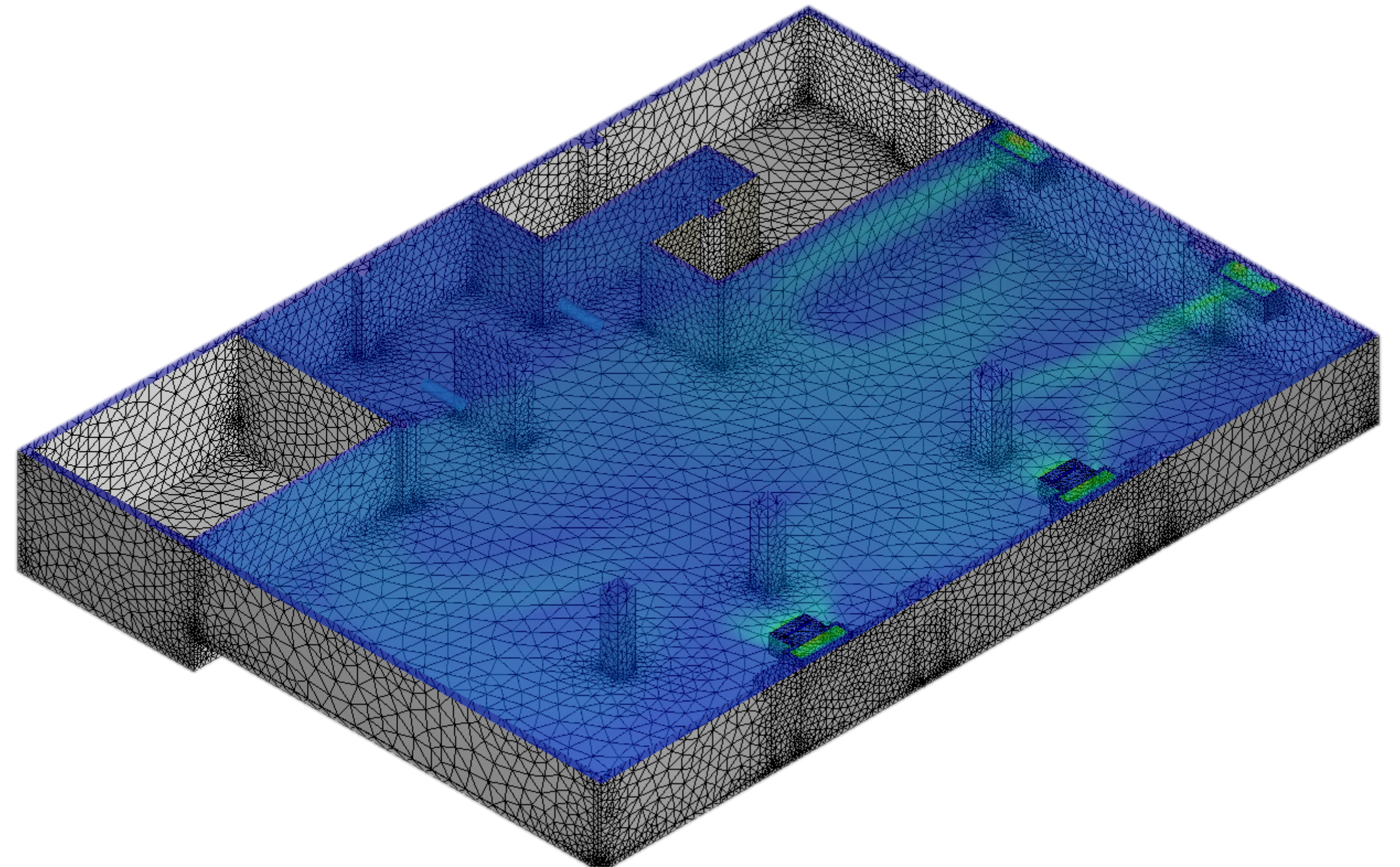
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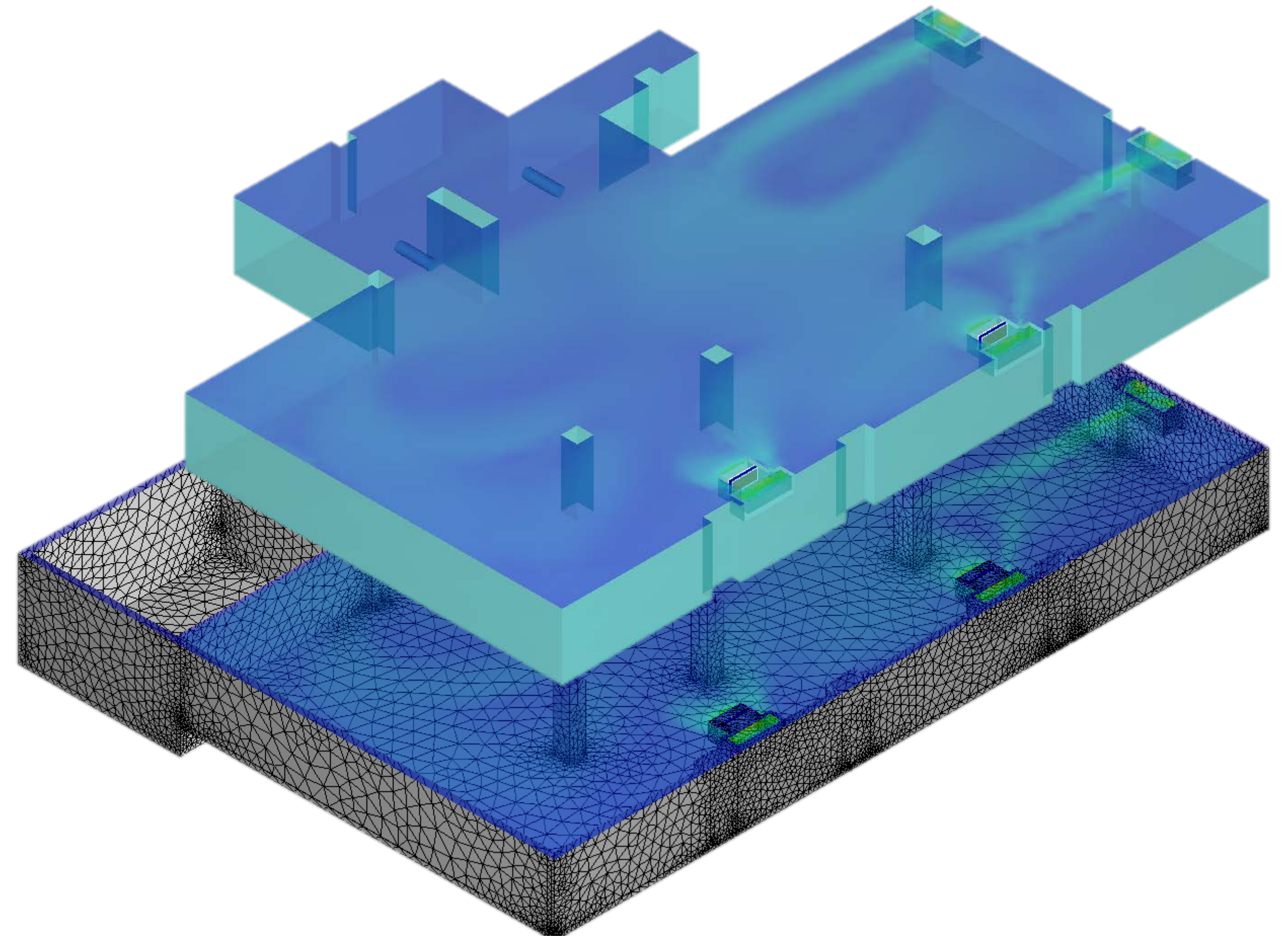
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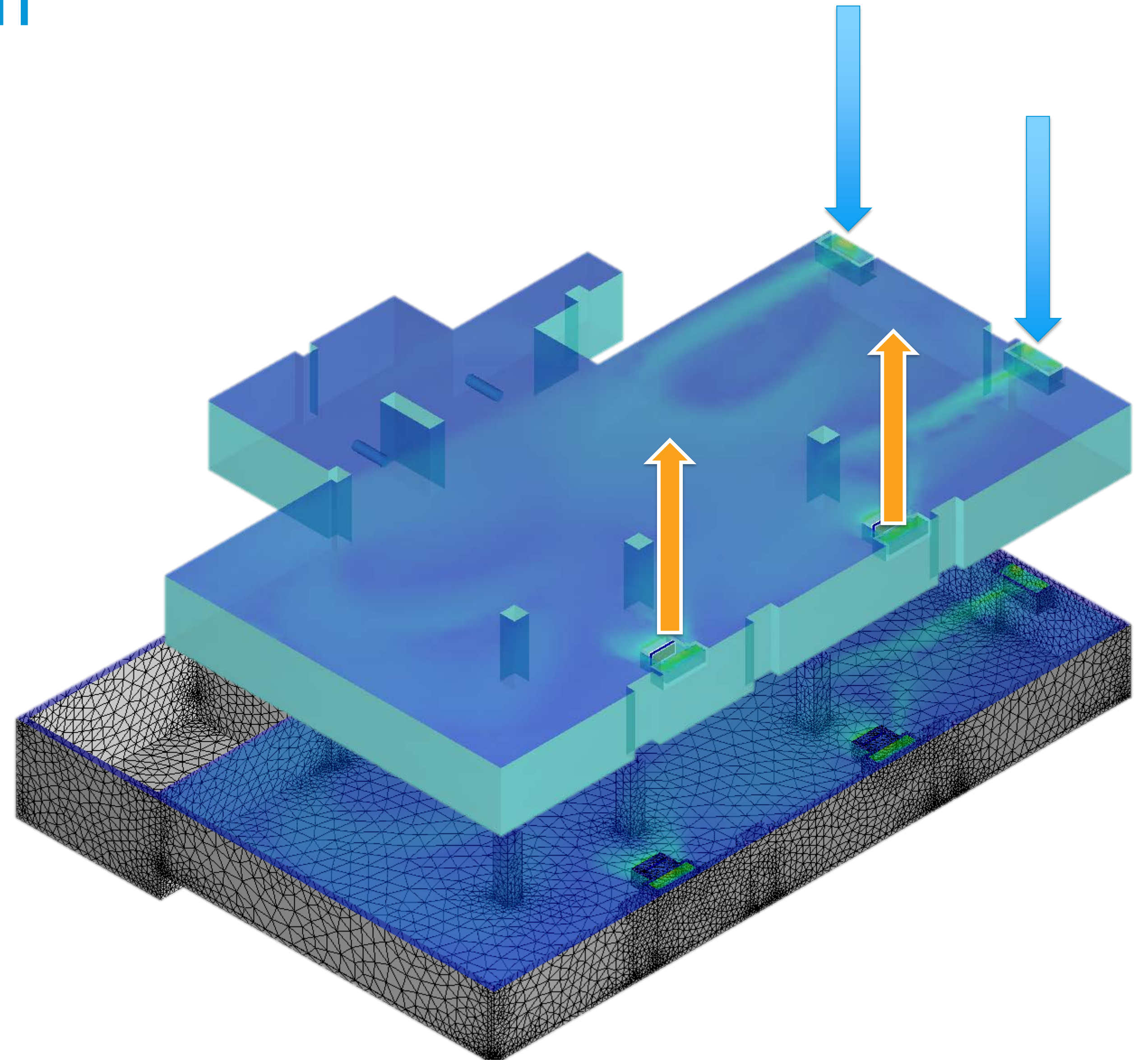
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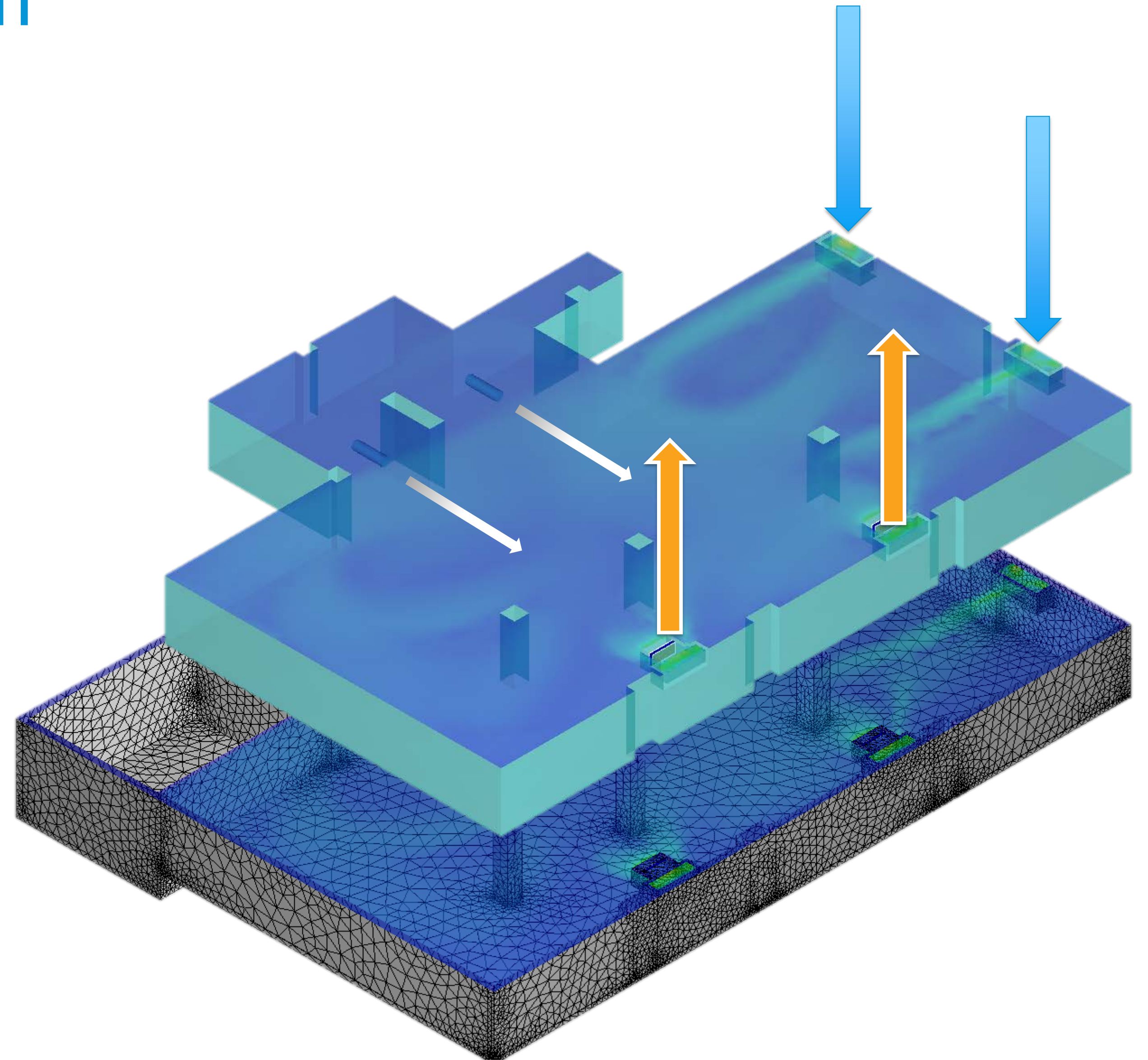
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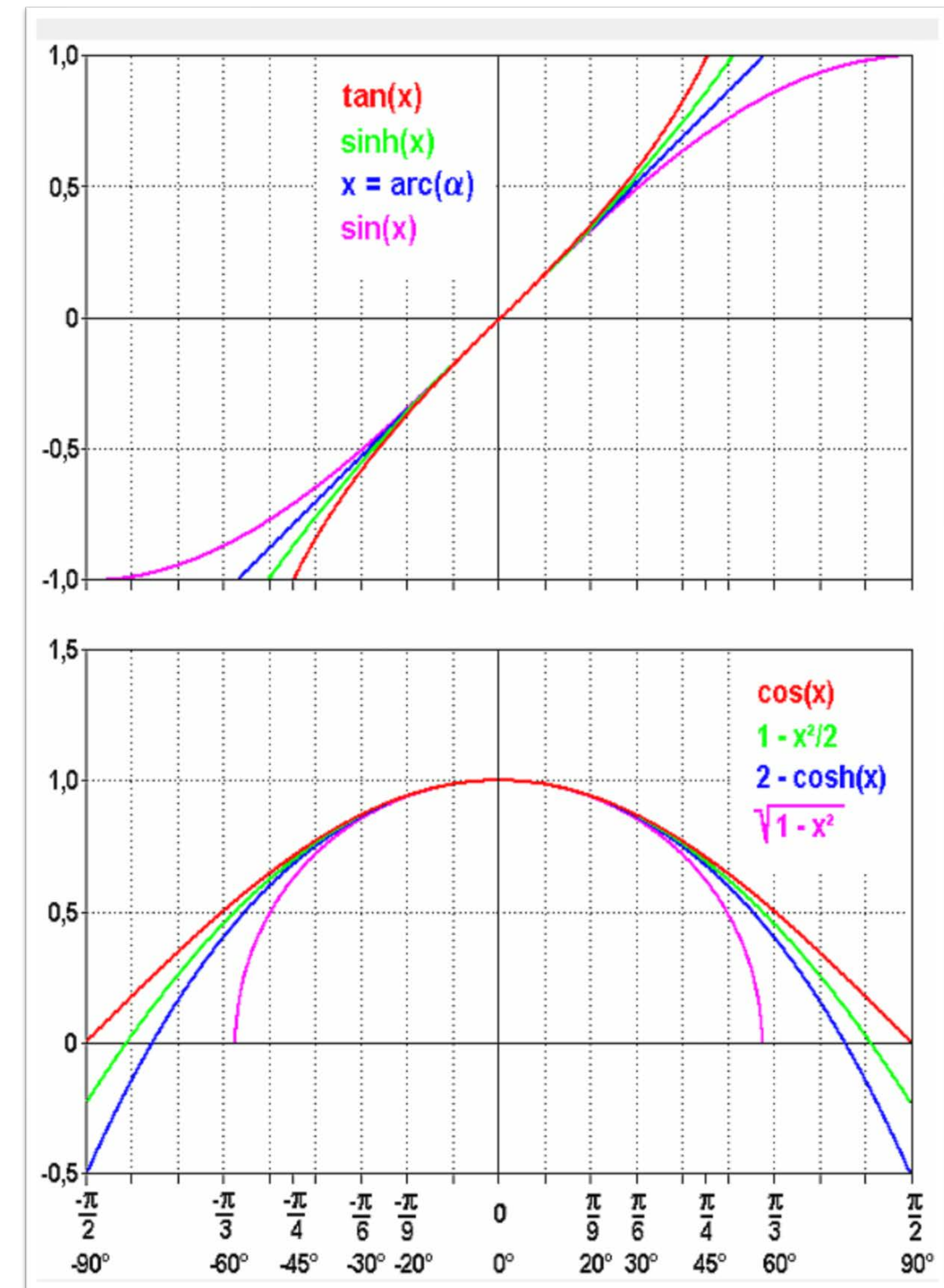
Understanding the Problem

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 - **Materials**



Making Assumptions

- Key aspects
 - Assumptions
 - Flow
 - Compressibility
 - Thermal Variables
 - Do we need them all?



Taking CFD for a Test Drive



Picking the *right* project

- Choosing a appropriate project will greatly impact your chances of success when implementing a new tool.
- Timing
- Complexity
- Risk
- Retrofits



Duration – Sample Project

16 h

TRAINING

Estimated training time
required to run your first
analysis

30 h

MODELING

Measured amount of
time

6 h

SOLVING

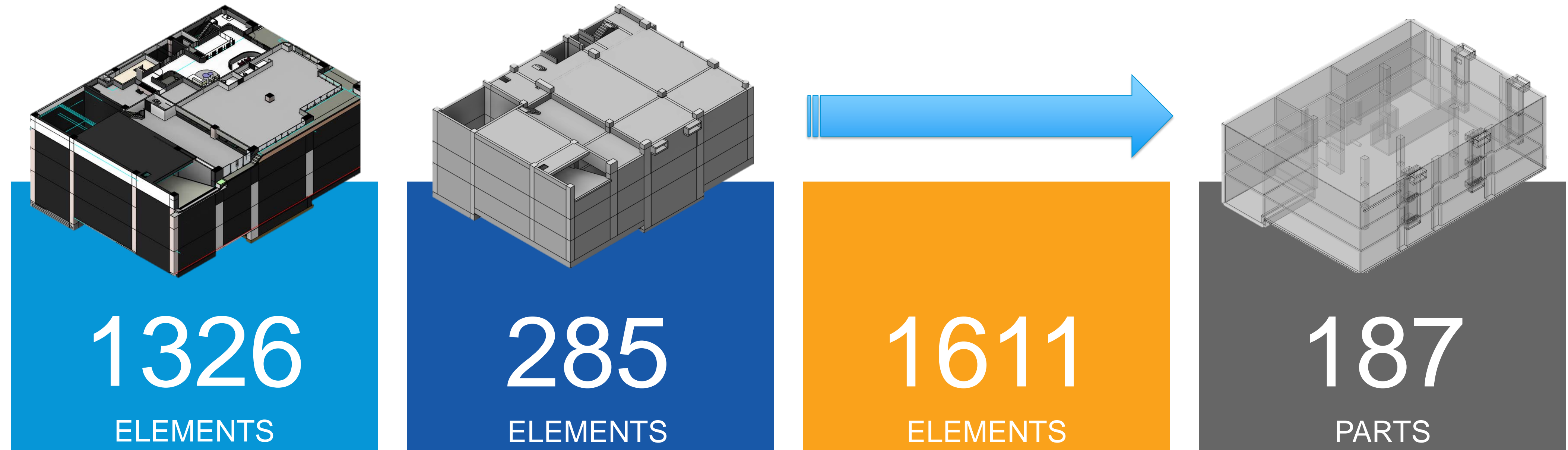
3-5 Design Scenarios,
plus testing.

8 h

ANALYSIS

Includes the collection of
initial data and results
interpretation

Complexity – Sample Project



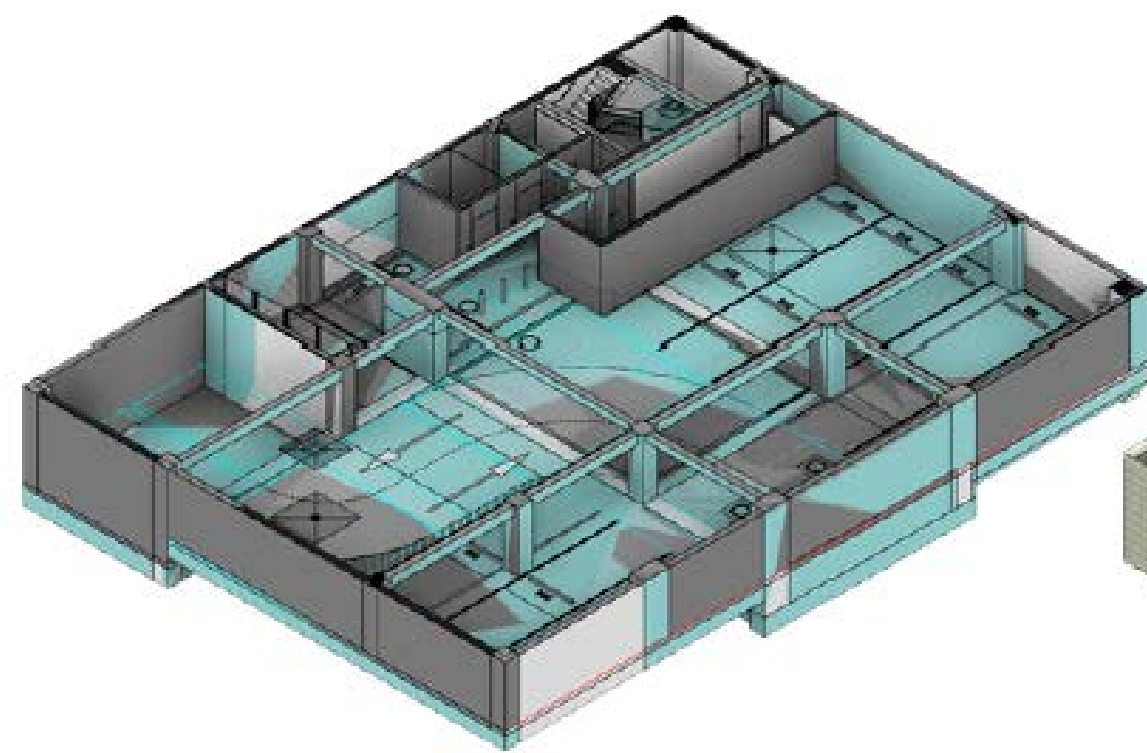
Elements in Architectural
Model, Same Scope

Elements in Structural
Model, Same Scope

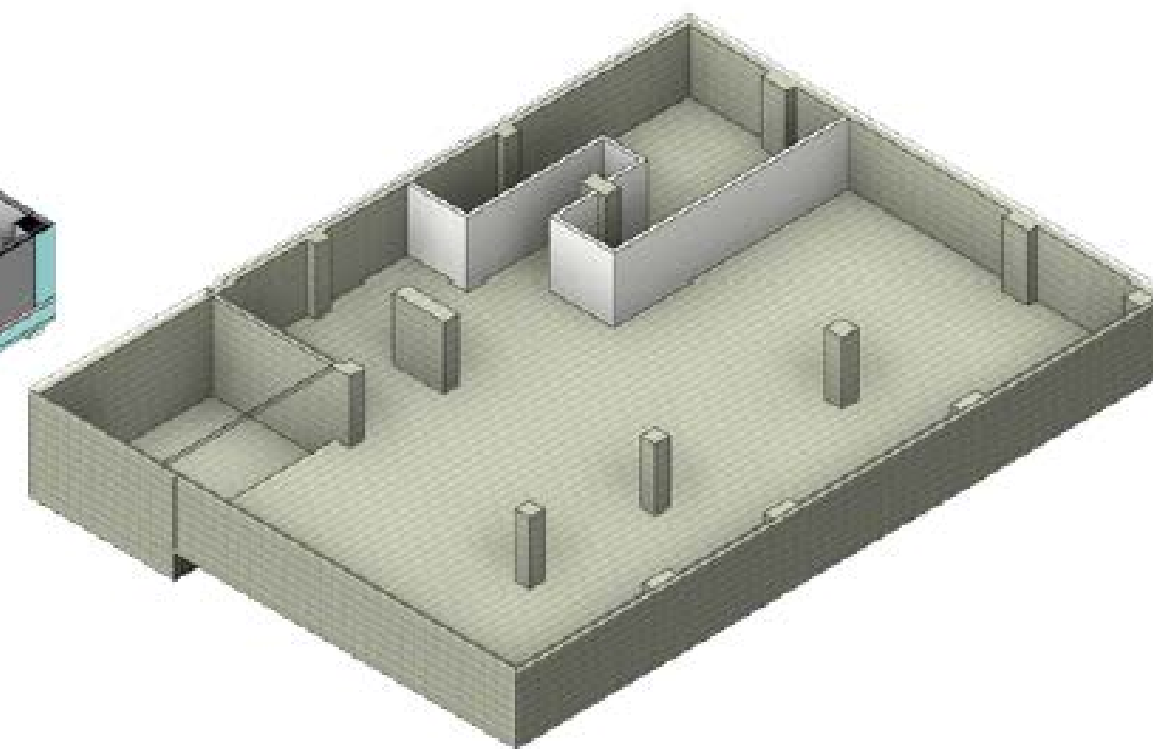
Elements in Architectural
and Structural Model,
Same Scope

Number of parts actually
exported to CFD

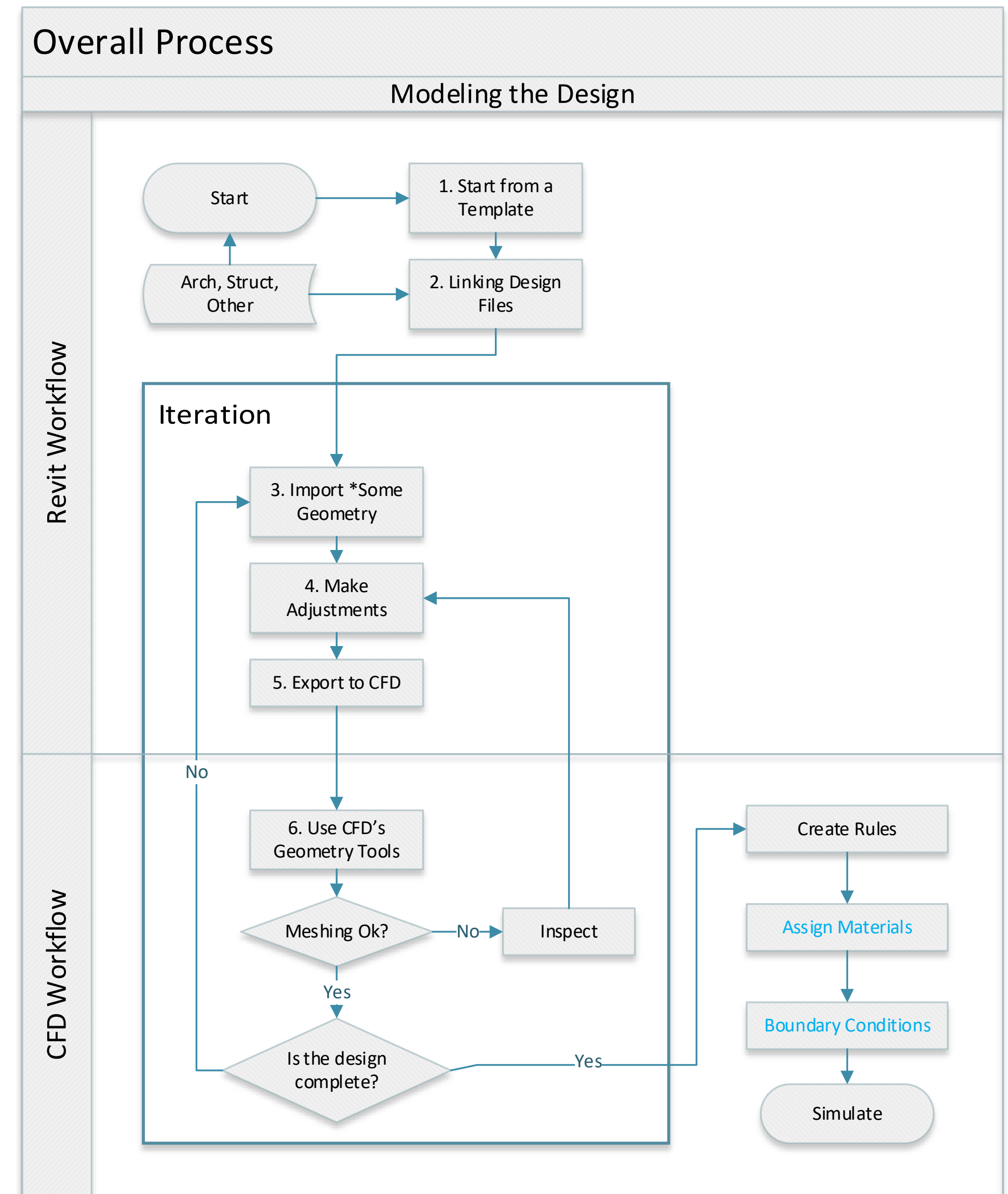
Overview of the Modelling Process



Linked Models

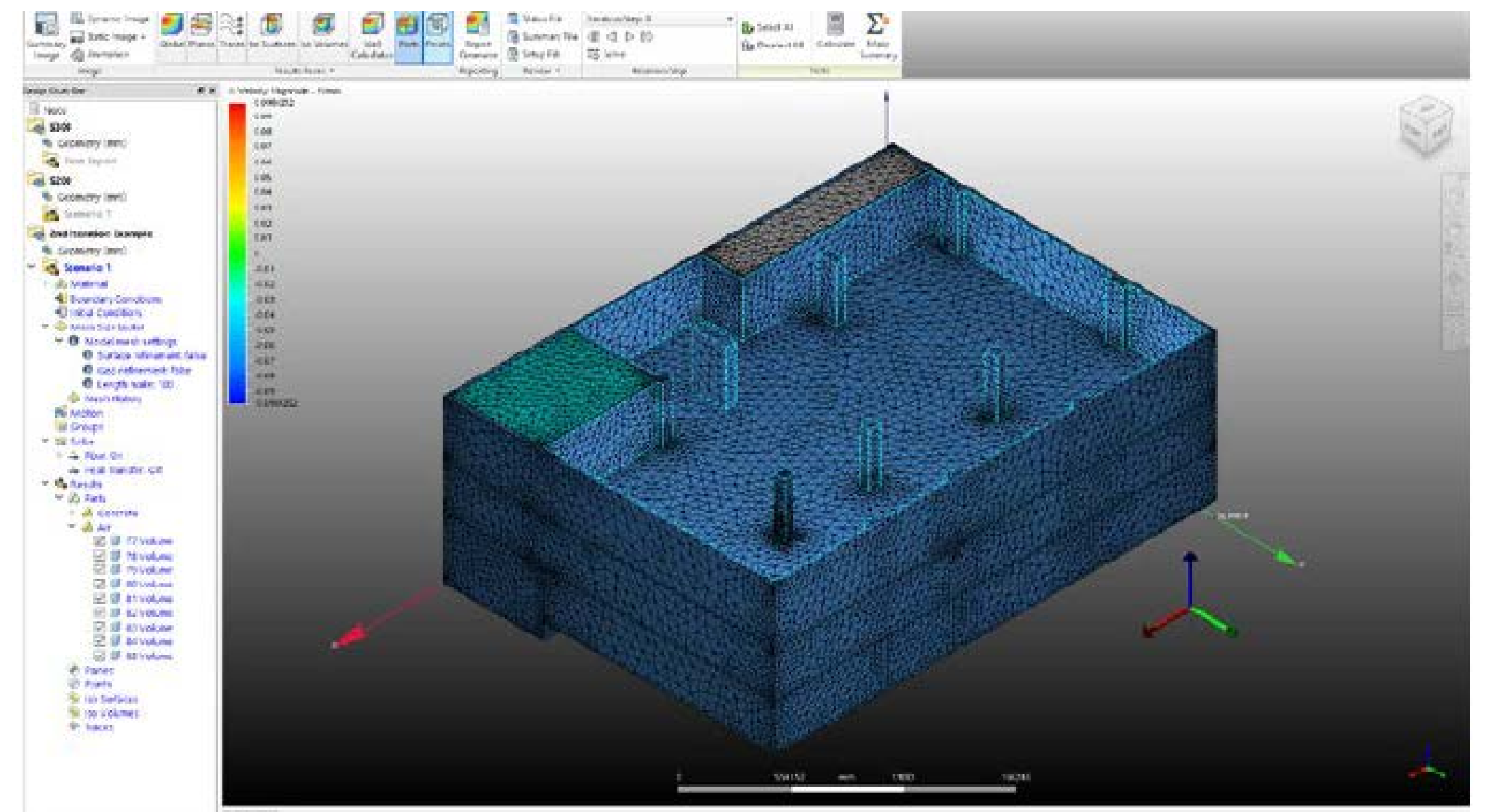
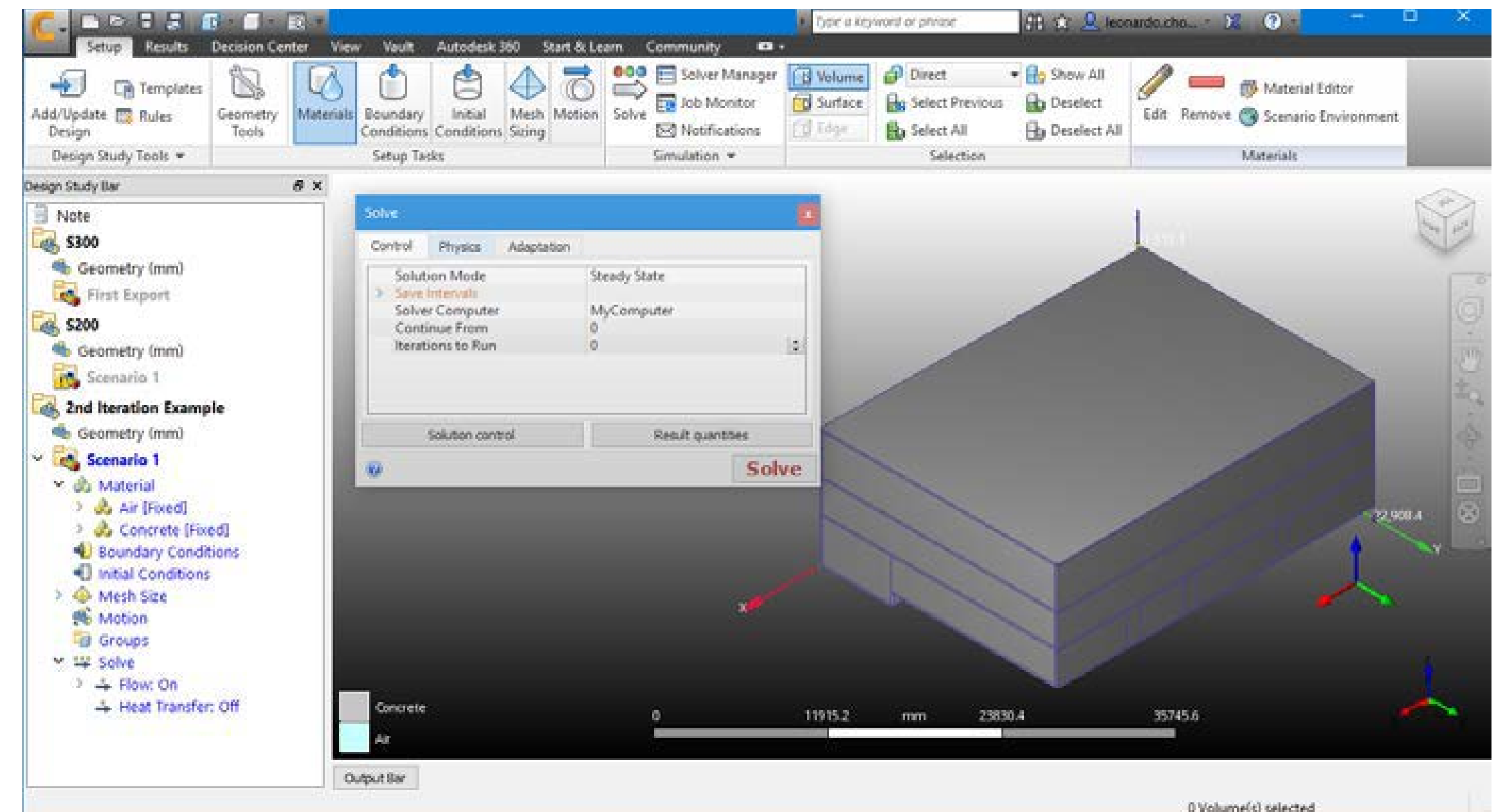


CFD Model





Meshing Challenges



Model Assessment

Active Model Assessment Tool

Use the "Transfer Set Up" button option in the MAT.

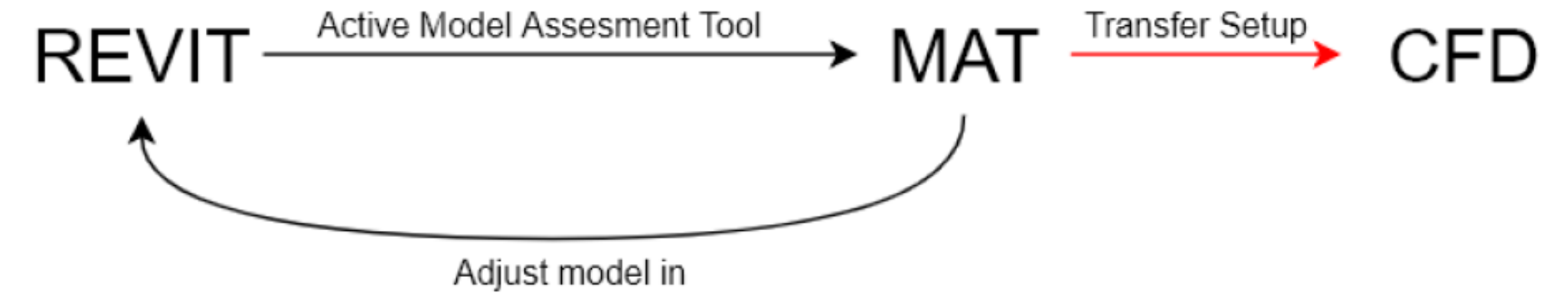


Figure 21a. Active Model Assessment Tool

Launch Active Model

Use the Launch Active Model tool to transfer the Design directly into CFD.

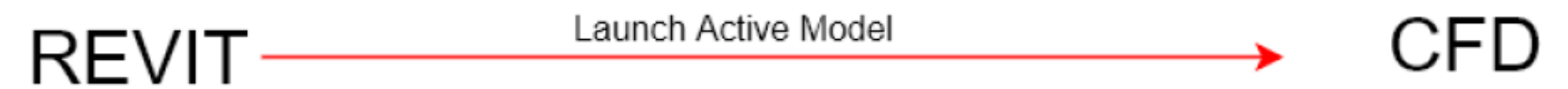
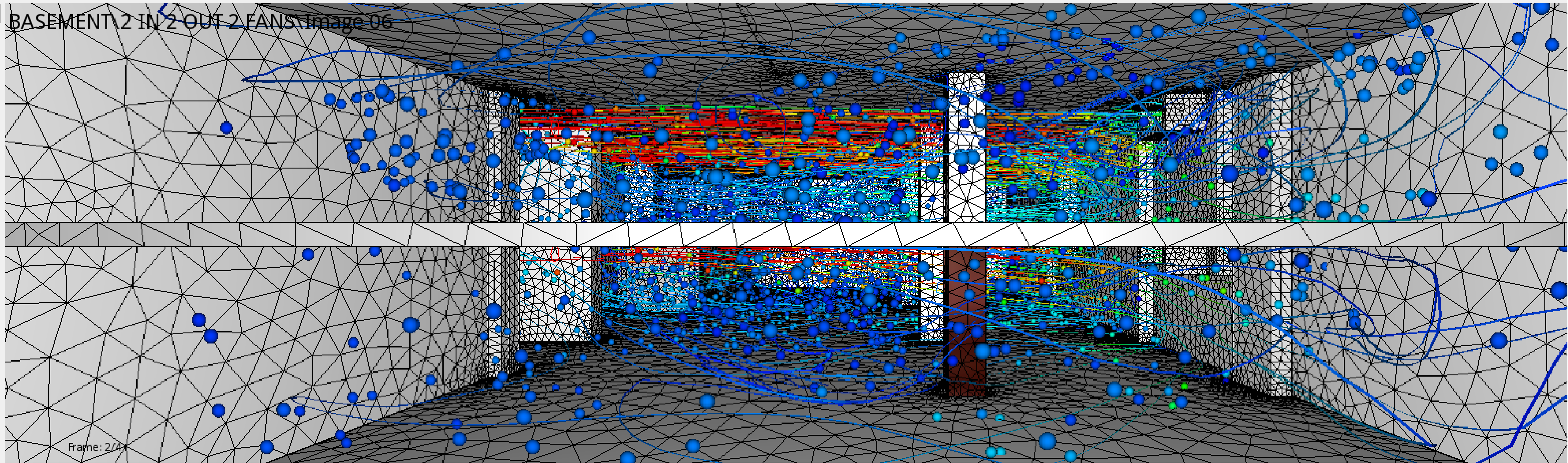


Figure 22b. Launch Active Model Tool

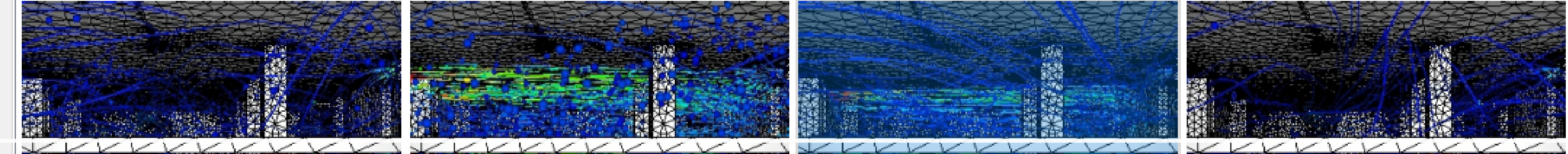


Output Bar

Design Review Center

Navigation controls: Previous, Play, Next, and other controls. Frame delay: 1000

Image 01 Image 02 Image 03 Image 04 Image 05 Image 06



BASEMENT-2 IN 2 OUT

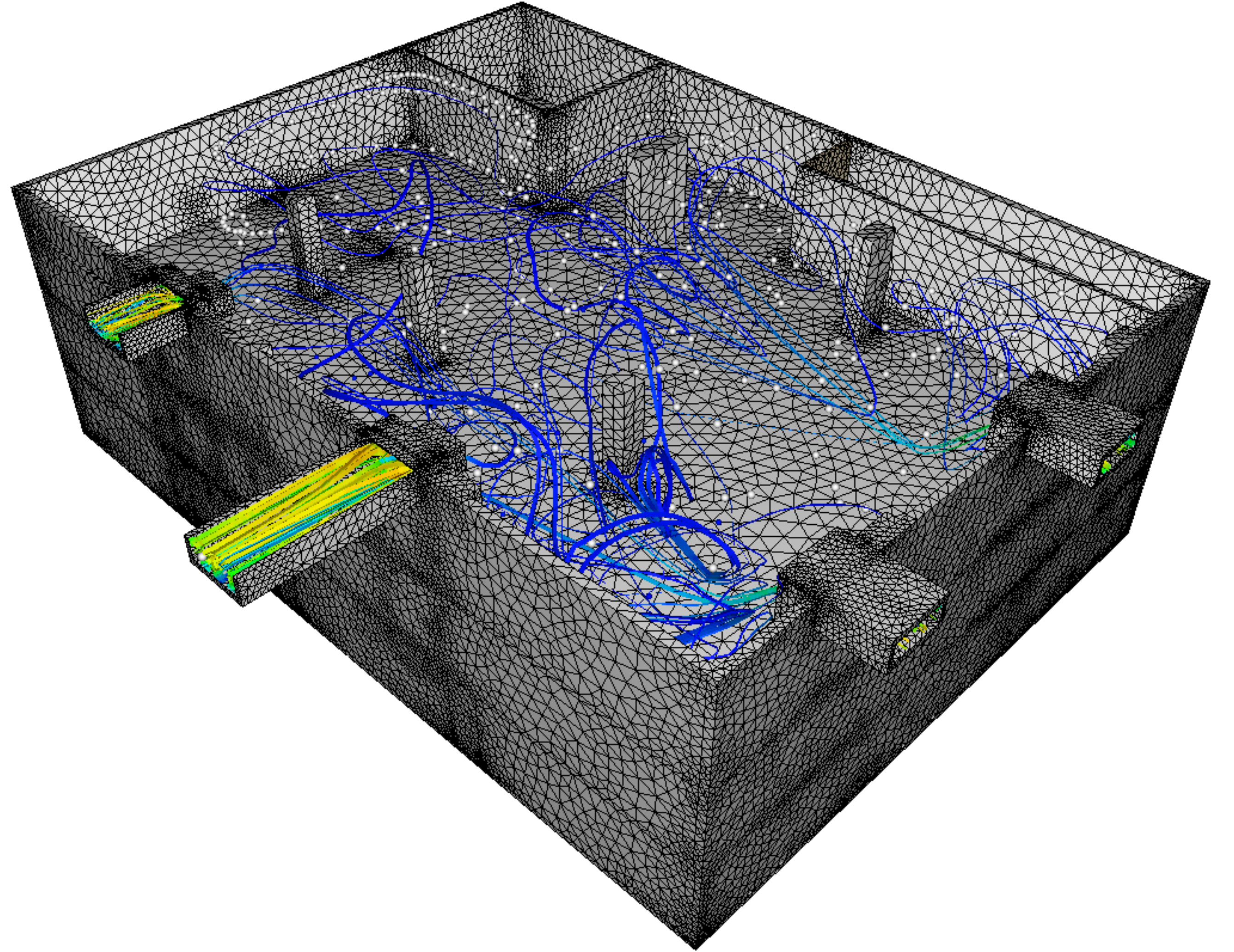
BASEMENT-2 IN 2 OUT 2 FANS

BASEMENT-2 IN 2 OUT 1 FAN

BASEMENT-1 IN 2 OUT

Results

Thank you





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Make anything™

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