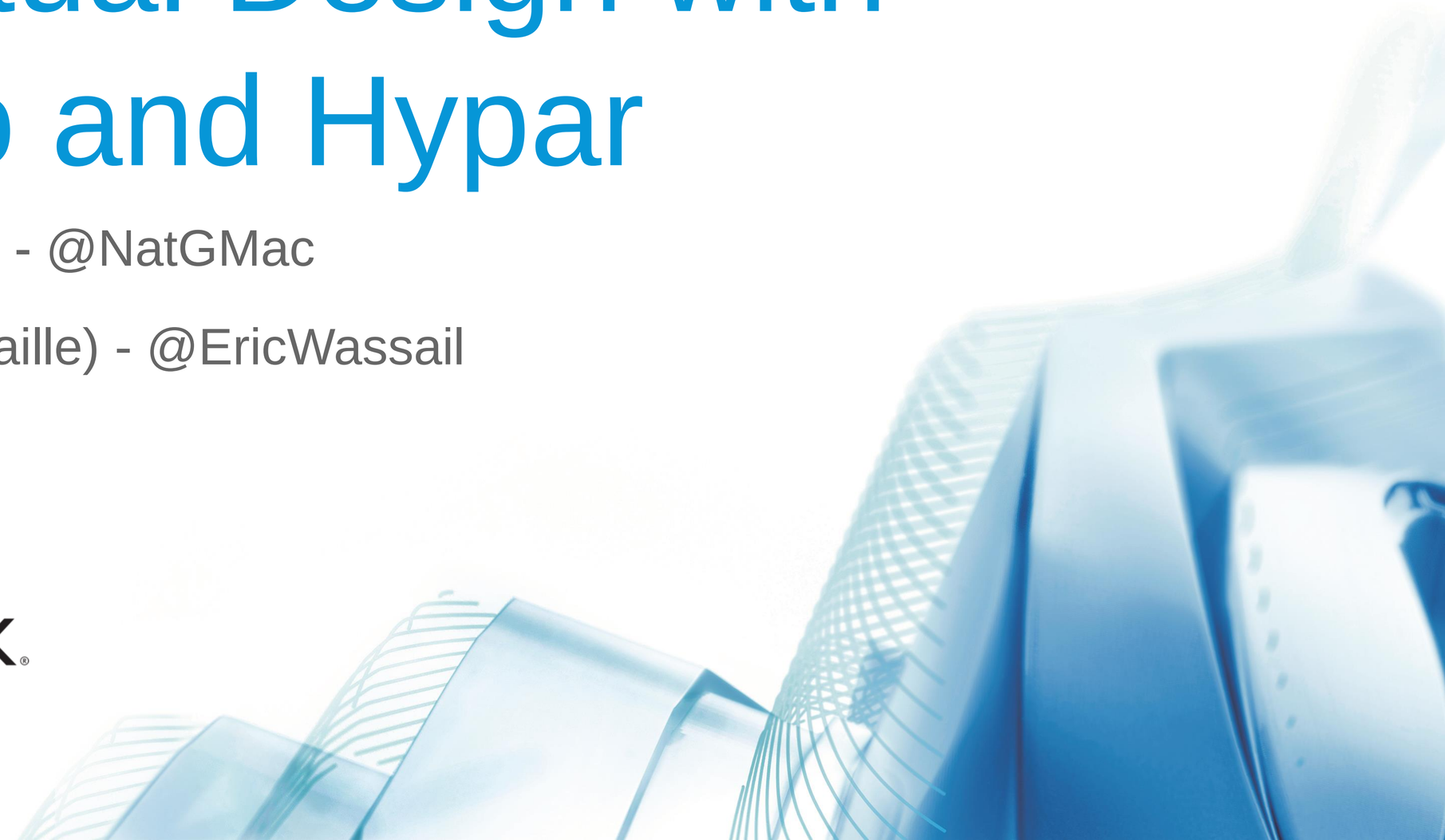
White Blank Page: MEP Conceptual Design with Dynamo and Hypar

Nat MacDonald, PE - @NatGMac

Eric Wassail (Rudisaille) - @EricWassail

AUTODESK. UNIVERSITY



Outline

Who We Are

What is Generative Design

What is Hypar

Dynamo and Hypar Together

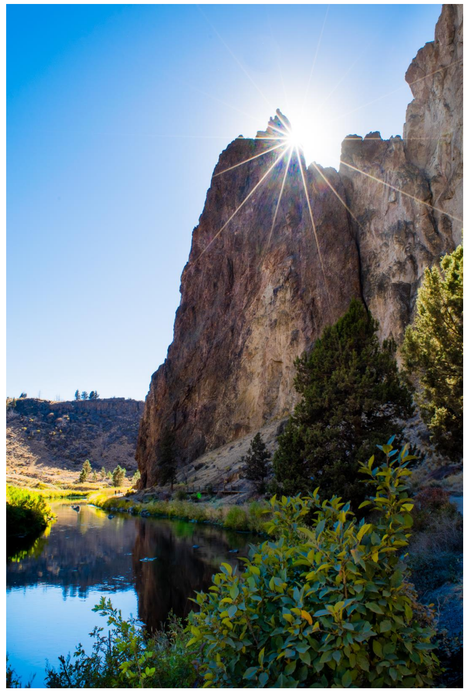
Our Approach

Using Hypar MEP

Hypar MEP in Dynamo

The Future

Who We Are



Nat MacDonald

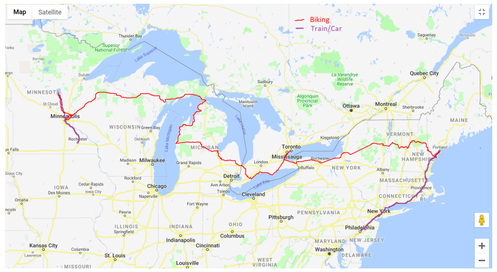
Mechanical Engineer, PE

BuroHappold Engineering (NYC)

Co-Founder – ENCODE Boston

Former Co-Chair Dynamo-litia Boston

Enjoy photography, mountain biking, hiking



Eric Wassail (Rudisaile)

Cosentini

Microdesk

Intersection of Design and Programming

World Traveler

HOW THIS BEGAN

- Met in Boston 3 years ago
- Starting hacking on Hypar at BeyondAEC spring 2018
- Began writing our current code a year ago

OUR MISSION

- Code our Mechanical Engineering knowledge
- Fix void in conceptual design

Who Are You?

Generative MEP Design

Generative Design

ANTHONY HAUCK / HYPAR

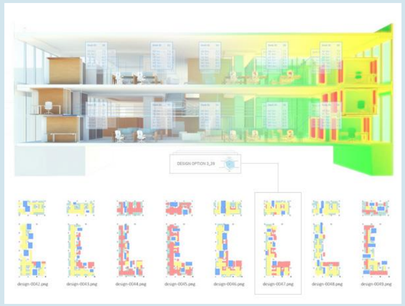
The automated algorithmic combination of goals and constraints to reveal solutions

AUTODESK

Input Goals and Parameters

Output All Possible Solutions

Test what works and doesn’t work

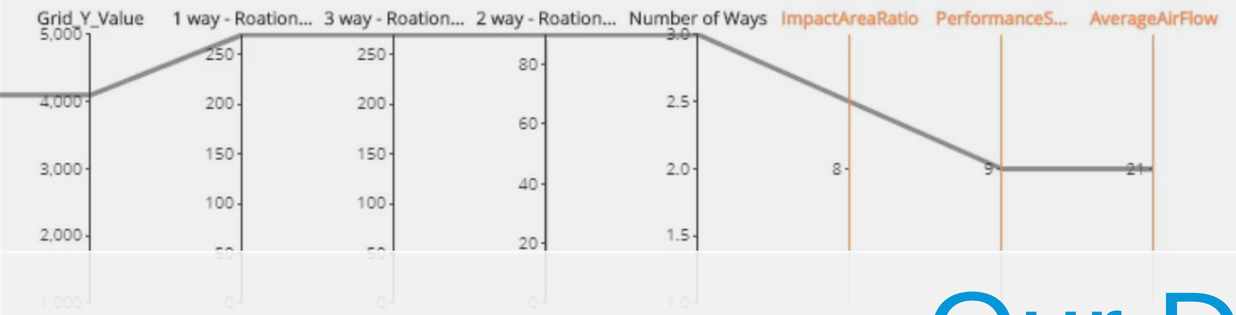


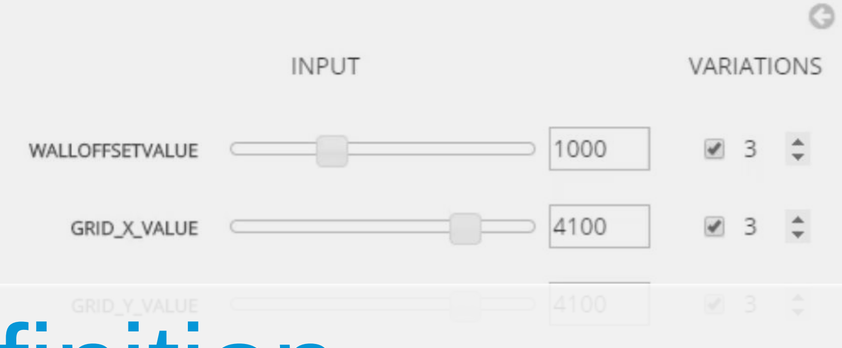
NATHAN MILLER / PROVING GROUND

Evolutionary solvers and genetic algorithms

Don’t over fetishize it

pg





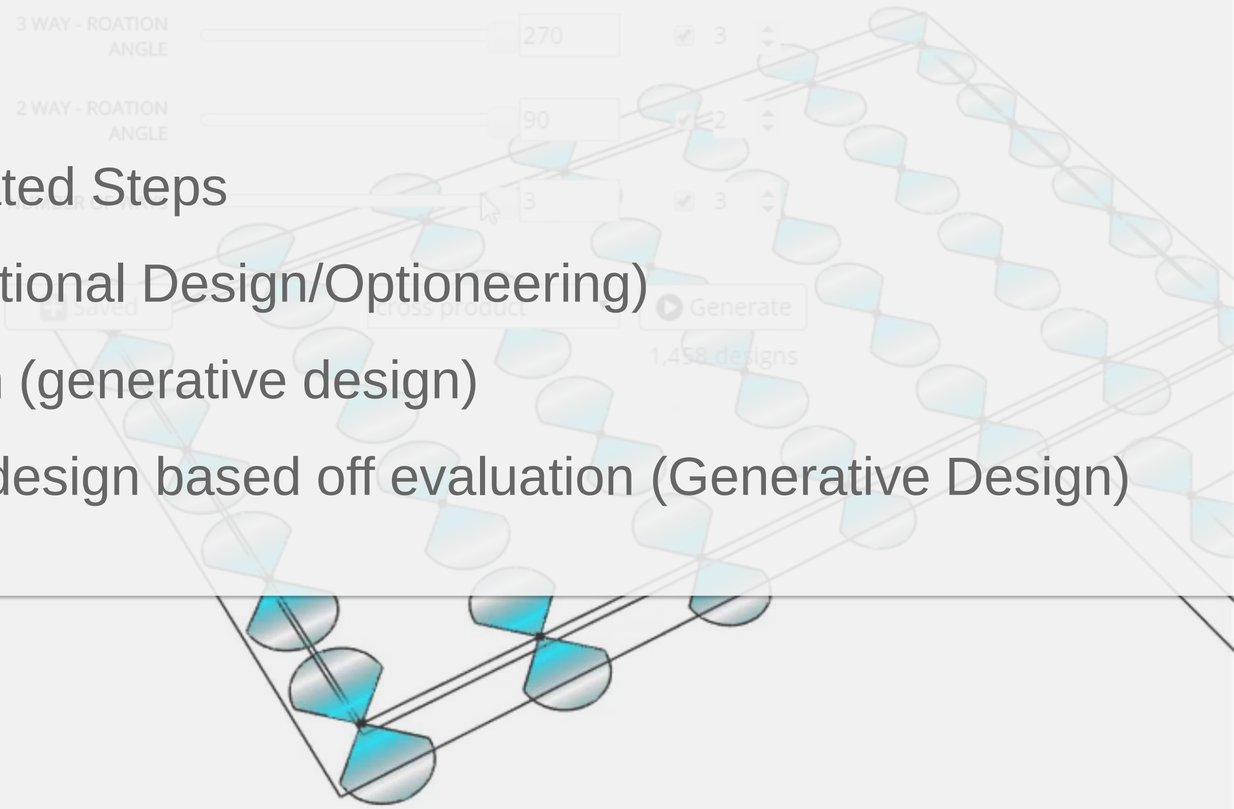
Our Definition

Three Automated Steps

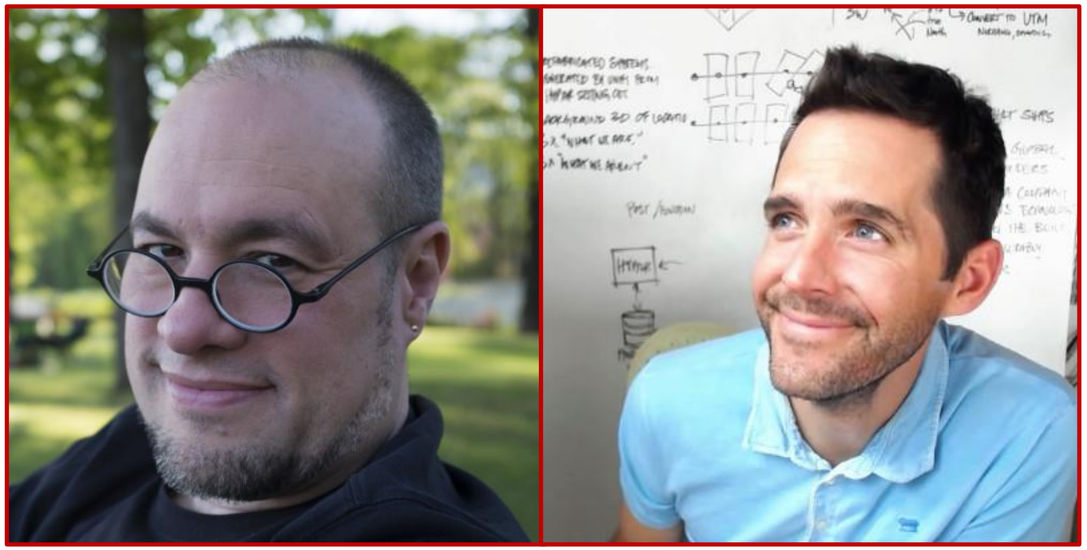
1) Generate a design (Computational Design/Optioneering)

2) Evaluating that design (generative design)

3) Creating a feedback loop that tweaks a selected design based off evaluation (Generative Design)

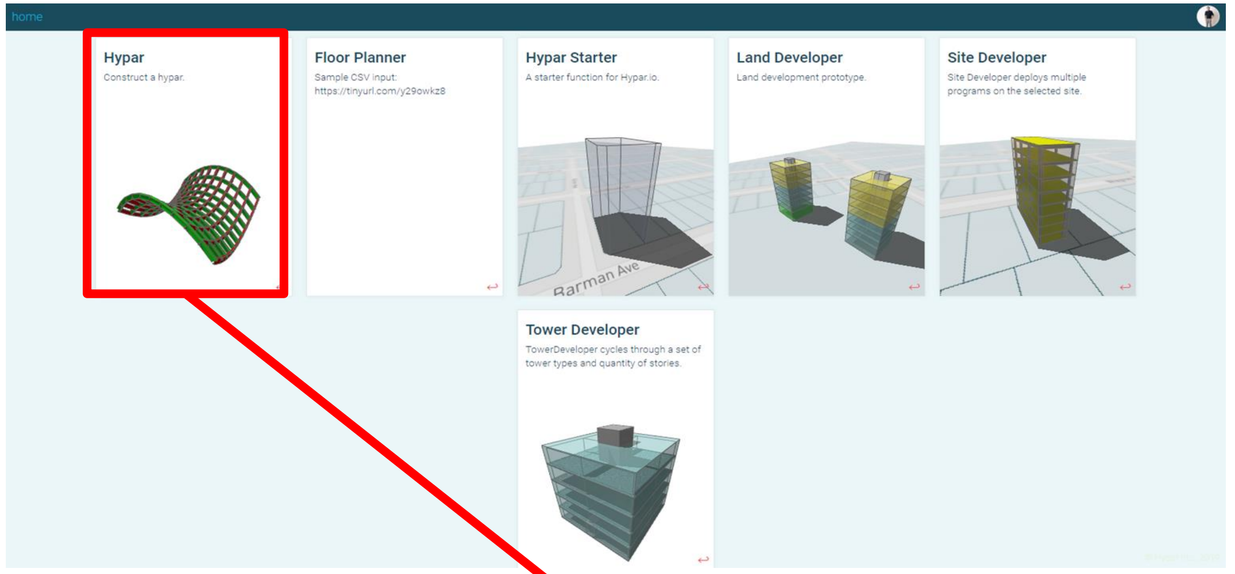


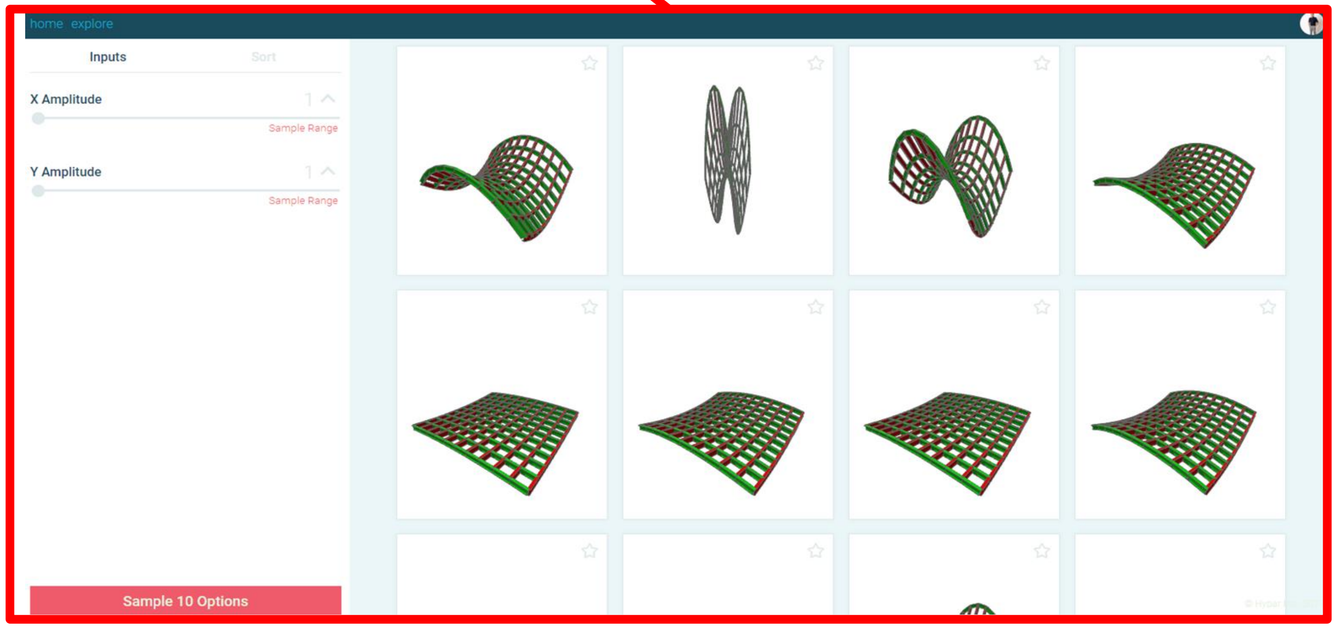
Hypar



HYPAR

Buildings. Generated.





- Online cloud computing platform to store AEC knowledge
- Web based
- App Ecosystem and Incentives
- C#
- Amazon Webservices

Why We Chose to Work in Hypar

- Free
- Open Source
- Incredibly Responsive
- Clean Slate
- Cloud computation allows upward mobility into Generative Design
- Connection to:
  - IFC
  - Revit
  - Forge / Design Automation API
  - Unity

Eric Rudisaile

I know you all have tons on your plate, but

Anthony Hauck

Give me an hour or so.

Anthony Hauck

Or 20 minutes. Try it now. --a.

Hypar Elements Library

- Create Building Elements
- Create Custom Types
  - ECS

https://hypar-io.github.io/Elements/api/Elements.Beam.html

Getting Started | Types | Elements | Search

Enter here to filter...

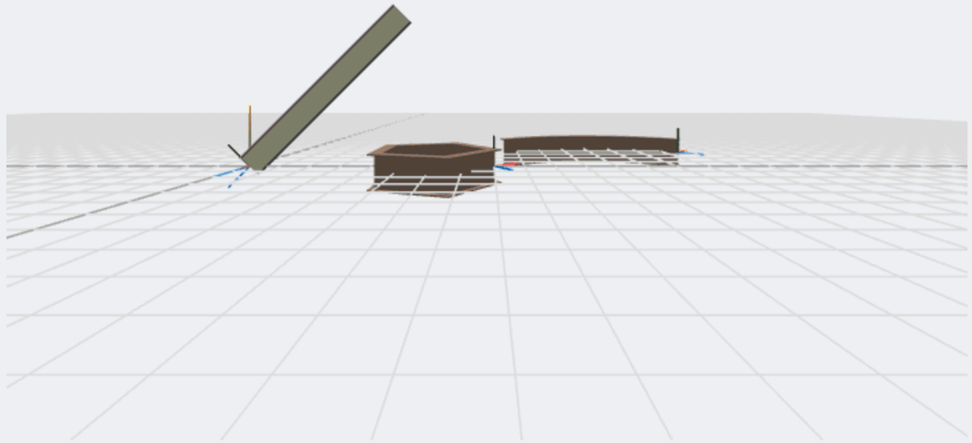
What is Elements?

- Elements API
  - Elements
    - Beam
    - Brace
    - BuiltInMaterials
    - Column
    - Element
    - Floor
    - Frame
    - GeometricElement
    - Mass
    - Material
    - Model
    - ModelCurve
    - ModelCurveExtensions
    - ModelPoints
    - Opening
    - Panel
    - Space
    - StandardWall
    - StructuralFraming
    - Topography
    - UserElement
    - Wall
  - + Elements.GeoJSON
  - + Elements.Geometry
  - + Elements.Geometry.Interfaces
  - + Elements.Geometry.Profiles
  - + Elements.Geometry.Solids
  - + Elements.Interfaces
  - + Elements.Properties
  - + Elements.Serialization.glTF
  - + Elements.Serialization.JSON
  - + Elements.Validators

Class Beam

A structural framing element defined by a center line curve and a profile.

Constructors

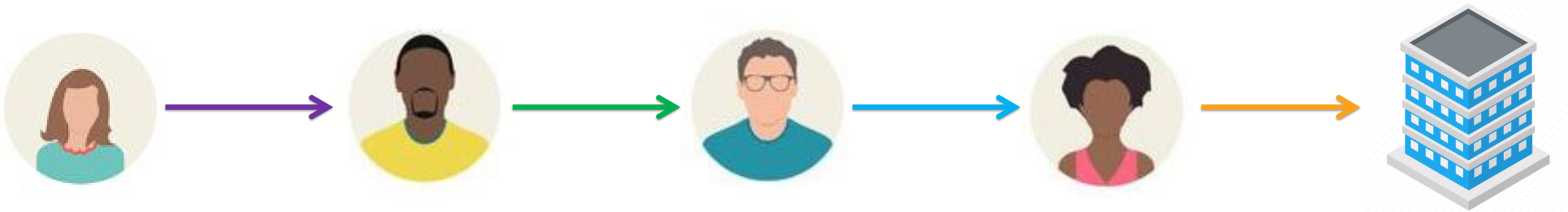


Examples

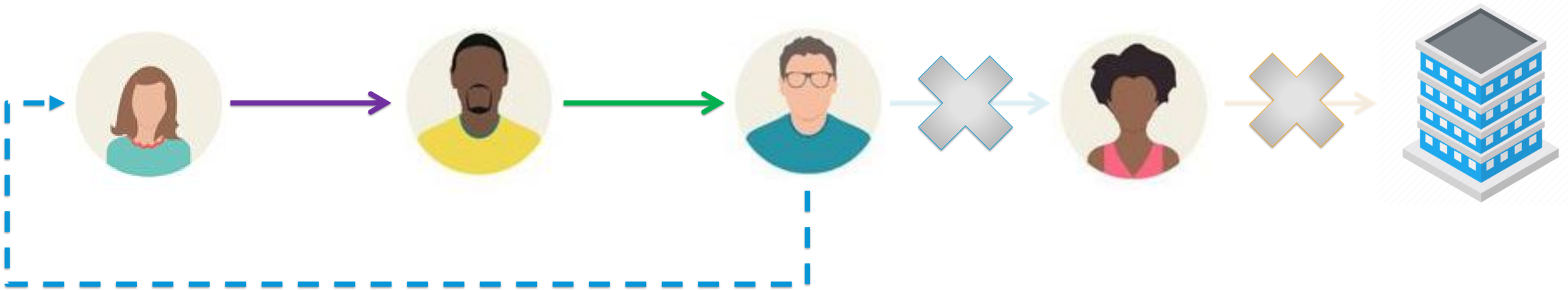
```
// Create a framing type.
var profile = WideFlangeProfileServer.Instance.GetProfileByName("W44x335");

// Create a straight beam.
var line = new Line(Vector3.Origin, new Vector3(5,0,5));
var linearBeam = new Beam(line, profile, BuiltInMaterials.Wood, 0, 0, 15);
var lineT = line.TransformAt(0).ToModelCurves(linearBeam.Transform);
```

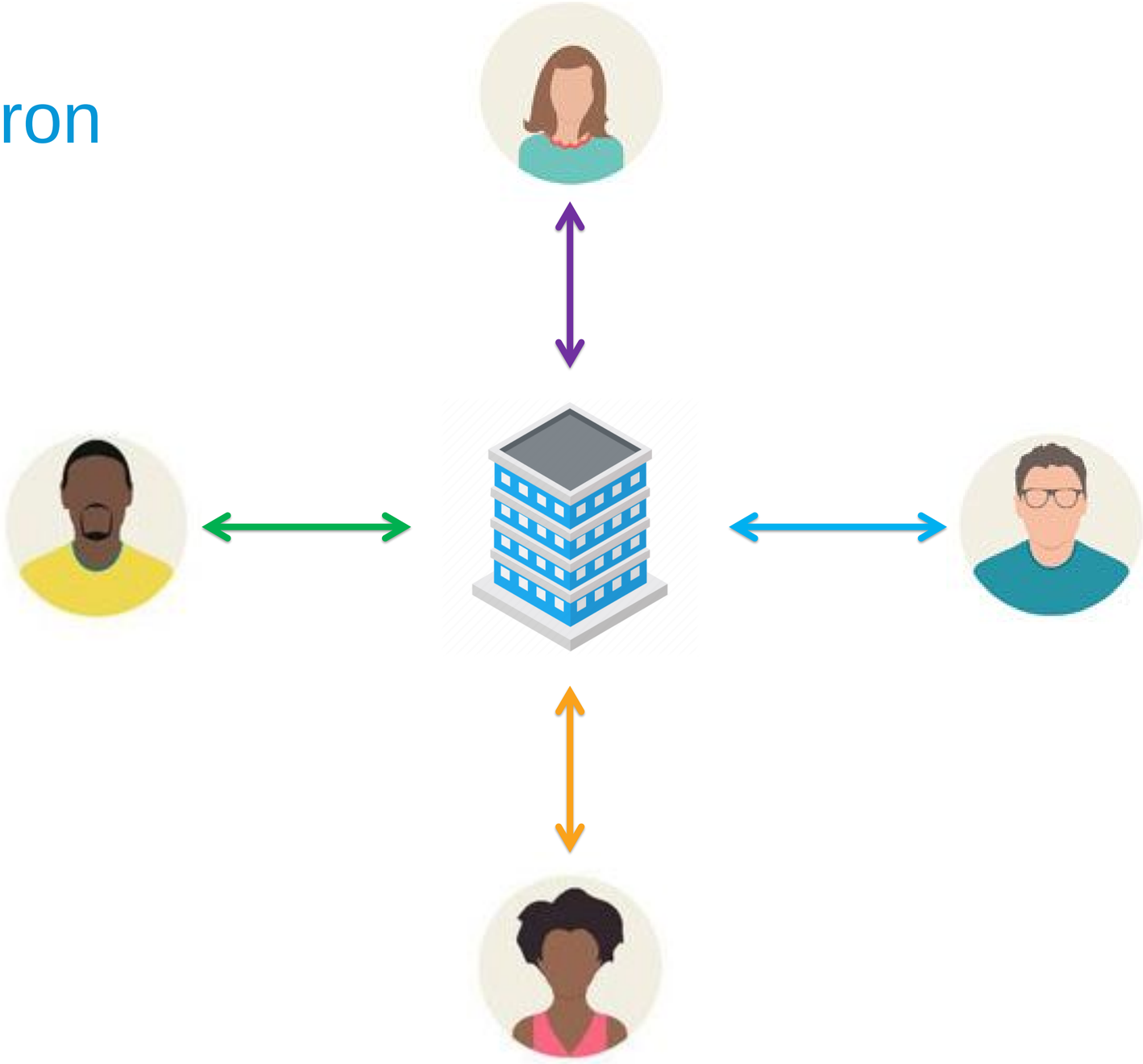
Existing Workflows



Existing Workflows

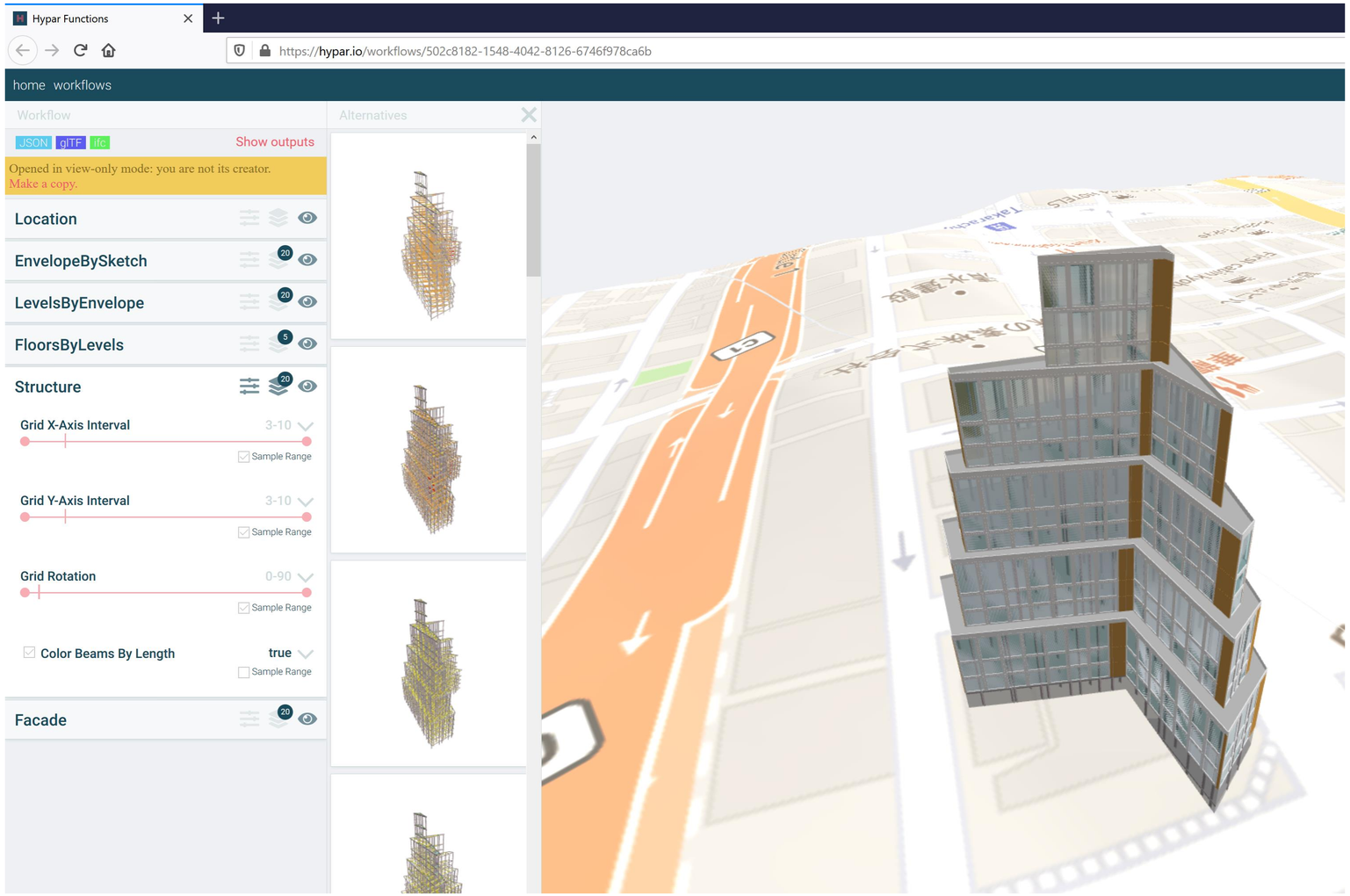


The Cauldron



Cauldron

- Life is no longer linear



[Link]

Our Approach in Hypar

Current Issues with Industry

Issue 1: Data Continuity

Current Issues with Industry

Issue 1: Data Continuity

Issue 2: Line Diagrams

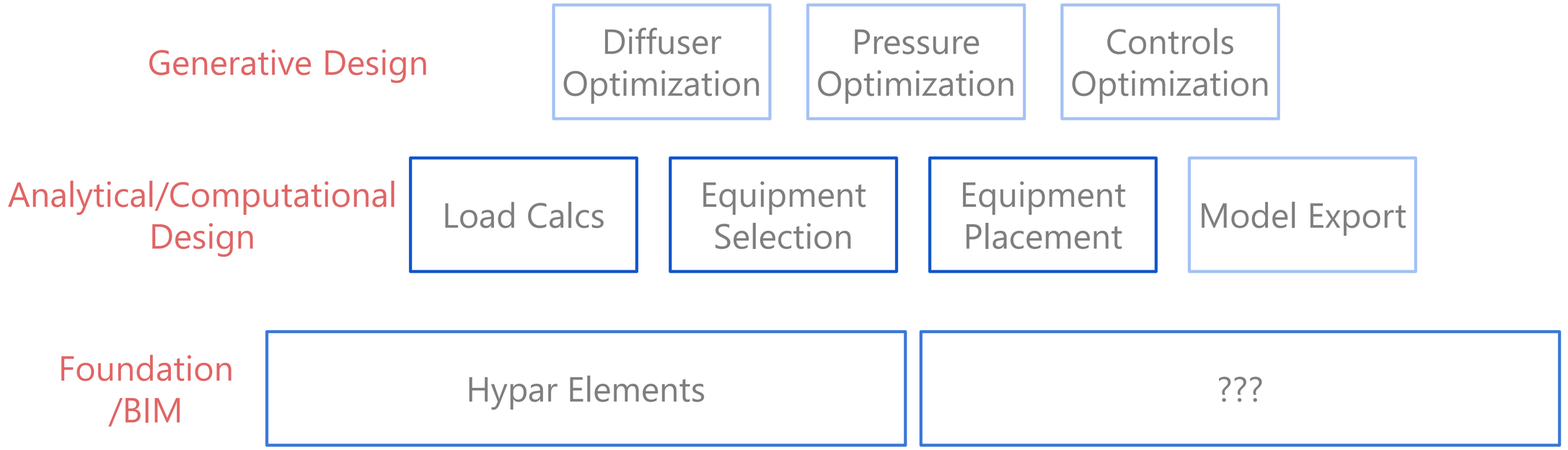
Current Issues with Industry

Issue 1: Data Continuity

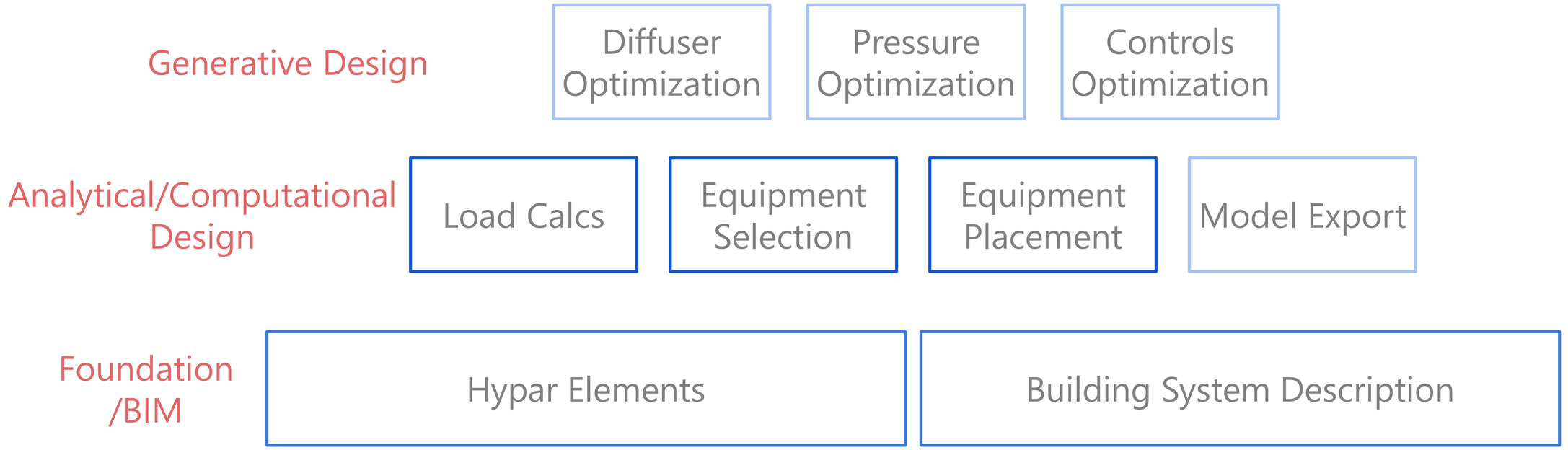
Issue 2: Line Diagrams

Issue 3: White Blank Page

Pyramid of Necessities



Pyramid of Necessities



Pyramid of Necessities

Generative Design

- Diffuser Optimization
- Pressure Optimization
- Controls Optimization

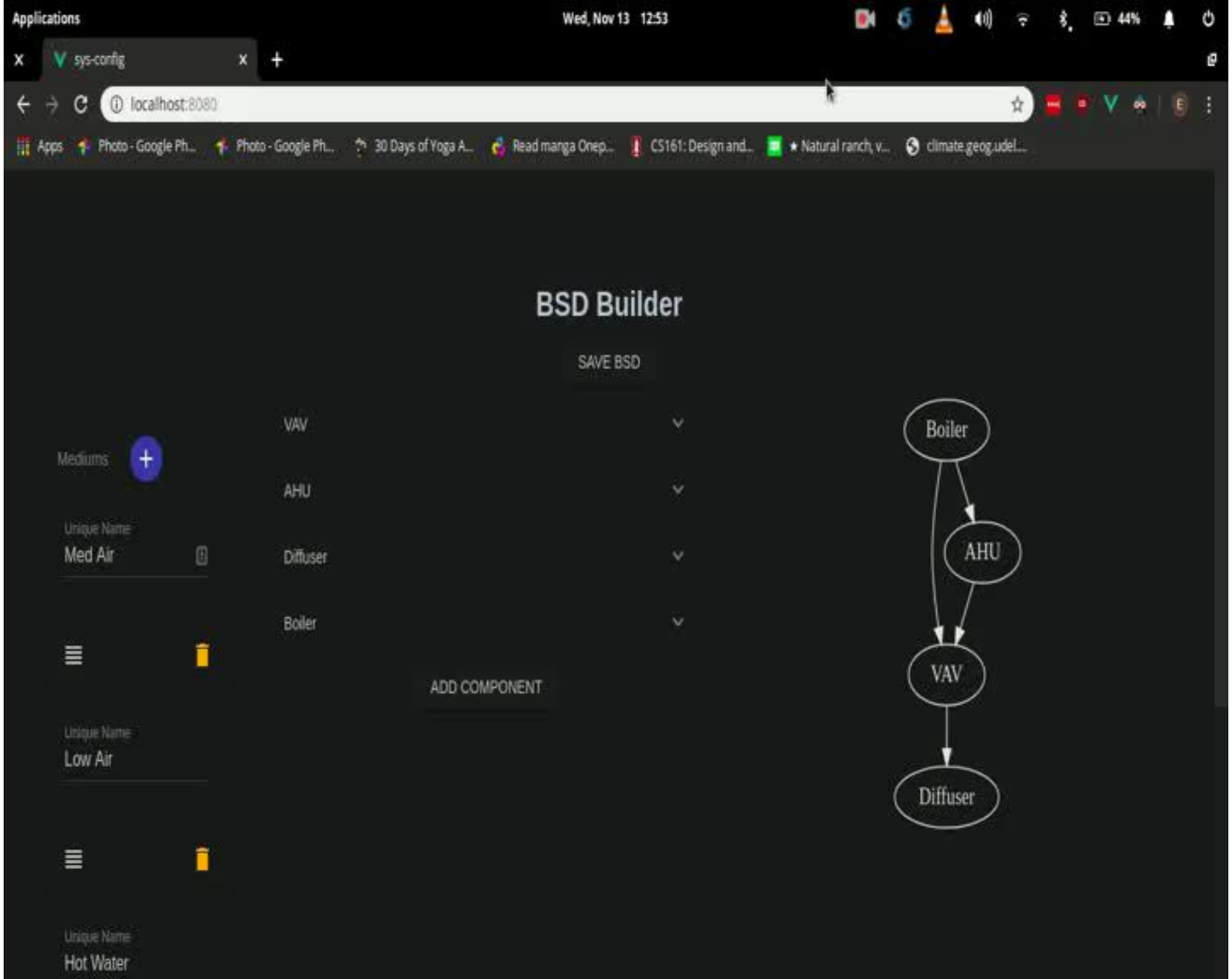
Analytical/Computational Design

- Load Calcs
- Equipment Selection
- Equipment Placement
- Model Export

Foundation /BIM

- Hypar Elements
- Building System Description

Eric’s Video: BSD Builder


Applications
Wed, Nov 13 12:53
44%
sys-config
localhost:8080
Apps
Photo - Google Ph...
Photo - Google Ph...
30 Days of Yoga A...
Read manga Onep...
CS161: Design and...
★ Natural ranch, v...
climate.geog.udel...
BSD Builder
SAVE BSD
Mediums
VAV
AHU
Diffuser
Boiler
Unique Name
Med Air
Unique Name
Low Air
Unique Name
Hot Water
ADD COMPONENT
Boiler
AHU
VAV
Diffuser

Disclaimer / What Can We Generate

SYSTEM CONNECTIVITY

Very deterministic

Line diagram

Engineer bread and butter

GEOMETRY

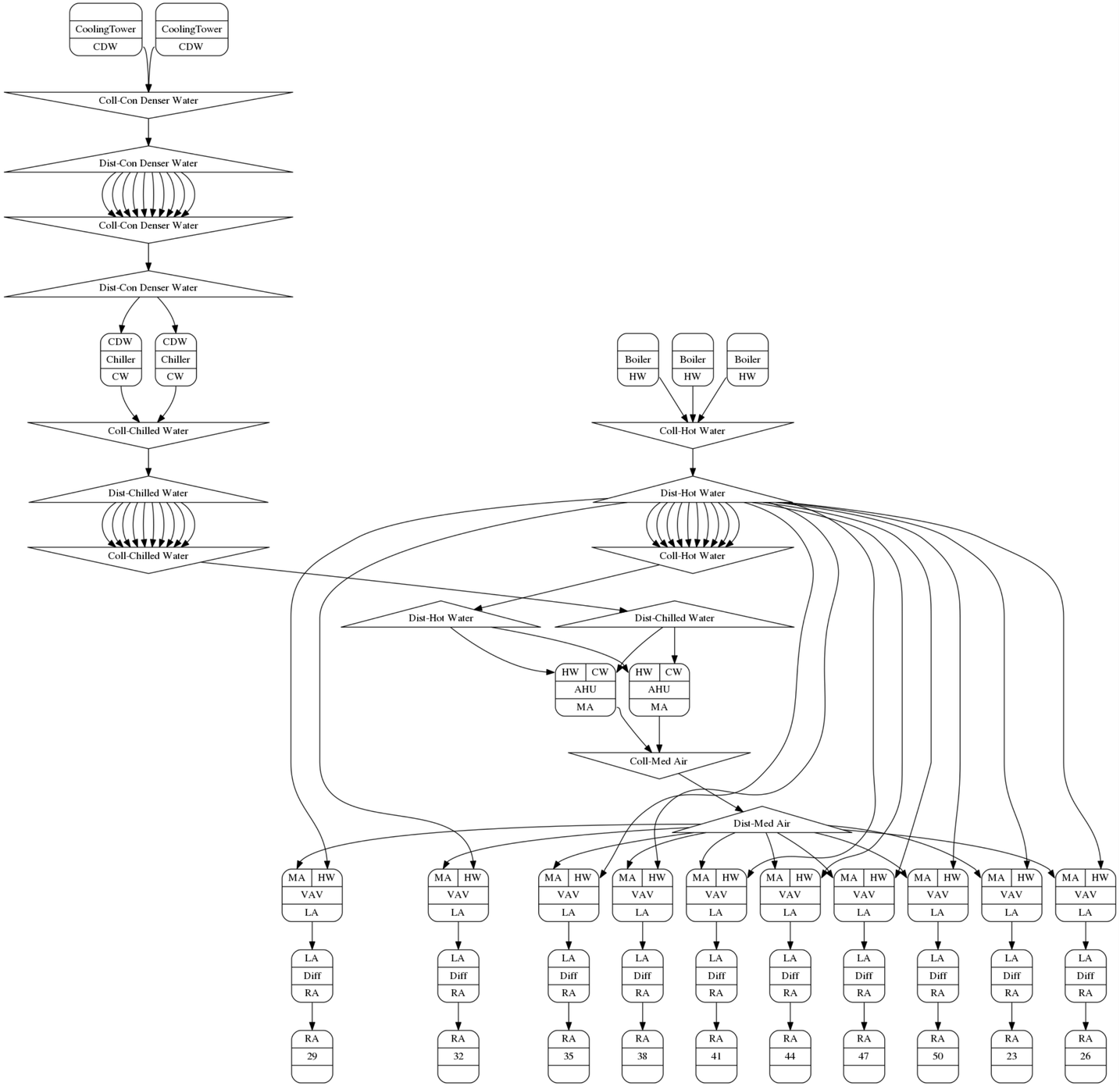
3D “Drafting”

Coordination Exercise

Let’s Use Hypar

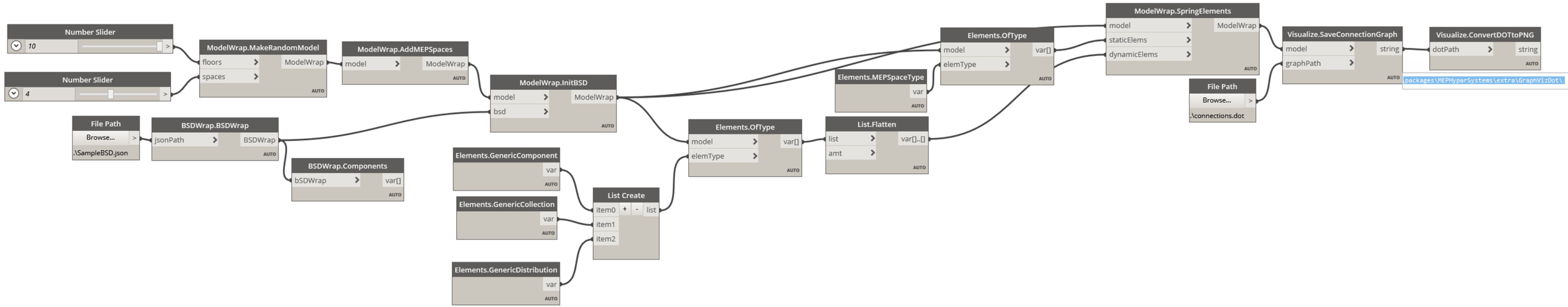
https://hypar.io/functions/tower-developer/executions

Line Diagram



Hypar MEP in Dynamo

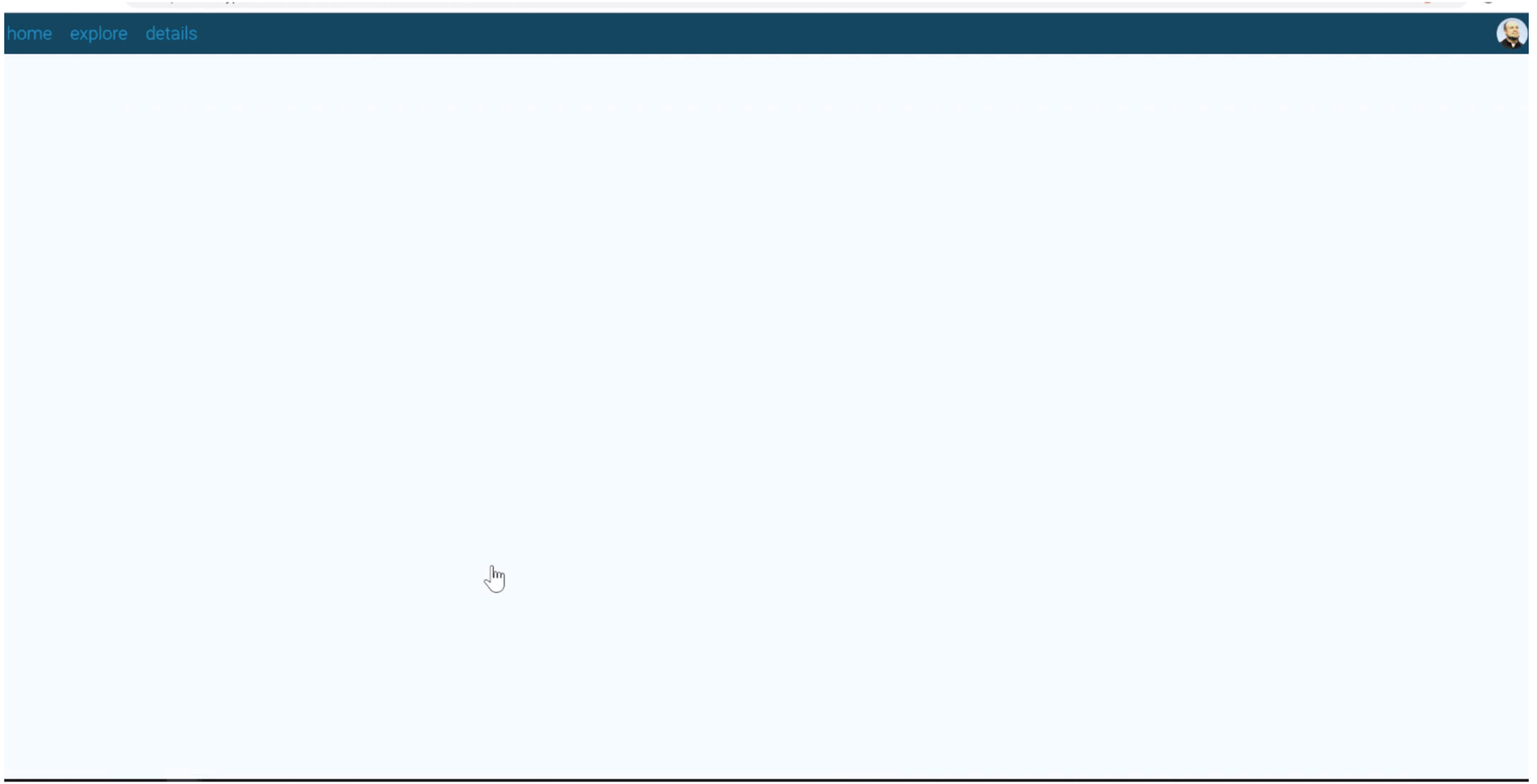
Dynamo and Hypar Can Be Friends



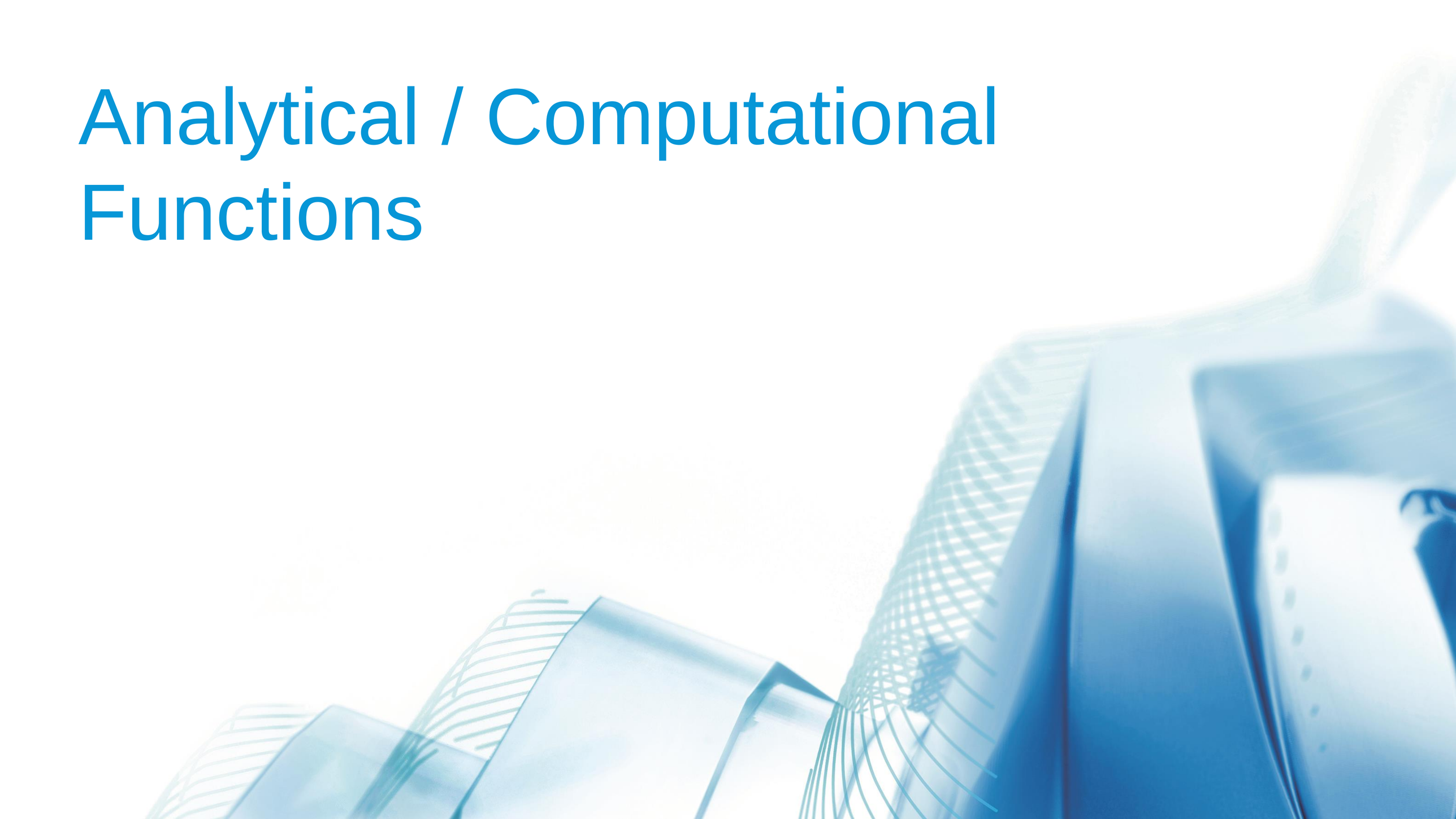
- Elements Library (Zero Touch Nodes)
- View Extension
- Why Dynamo is Good
  - Accessible to a lot of people
  - Links Hypar World to Revit

- Portable
- Include in existing workflows
- Easier manipulation

Forge and Hypar Can Be Friends



Analytical / Computational Functions



Analytical / Computational Functions

SIMPLE LOAD CALCULATION

Floor area cooling and heating loads

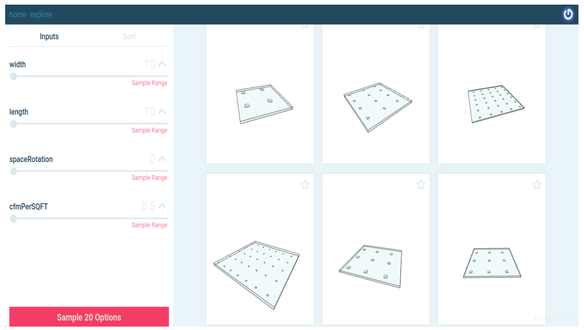
Future: Basic exterior walls, roof heat gain, etc.

EnergyPlus Integration

DIFFUSER LAYOUT

Placing based on airflow and 2x4 grid

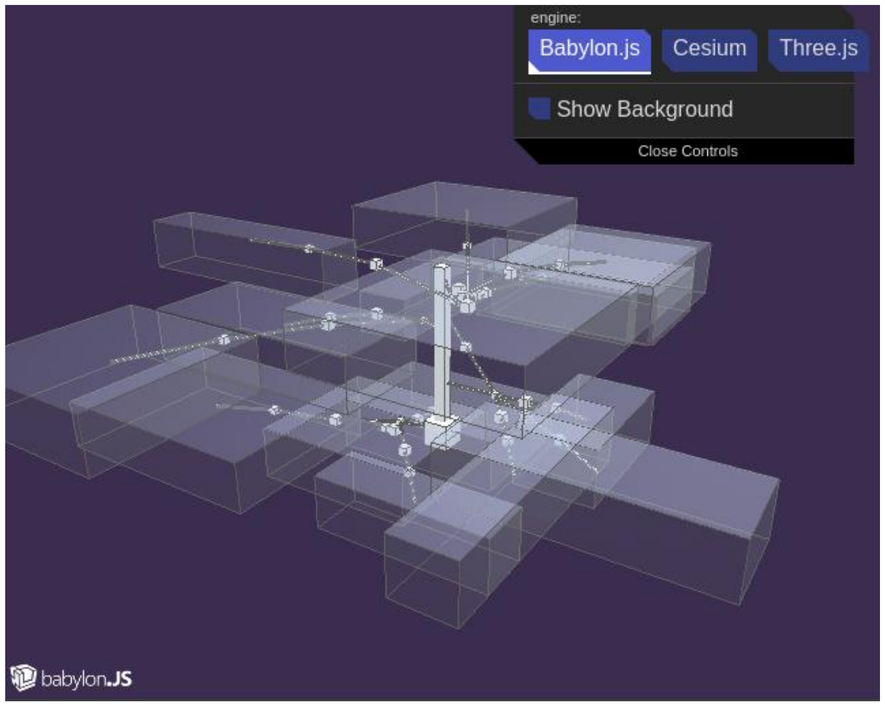
Future: Optimize with flow, velocity and throw



RISER PLACEMENT

Place number of risers by Hypar UI input

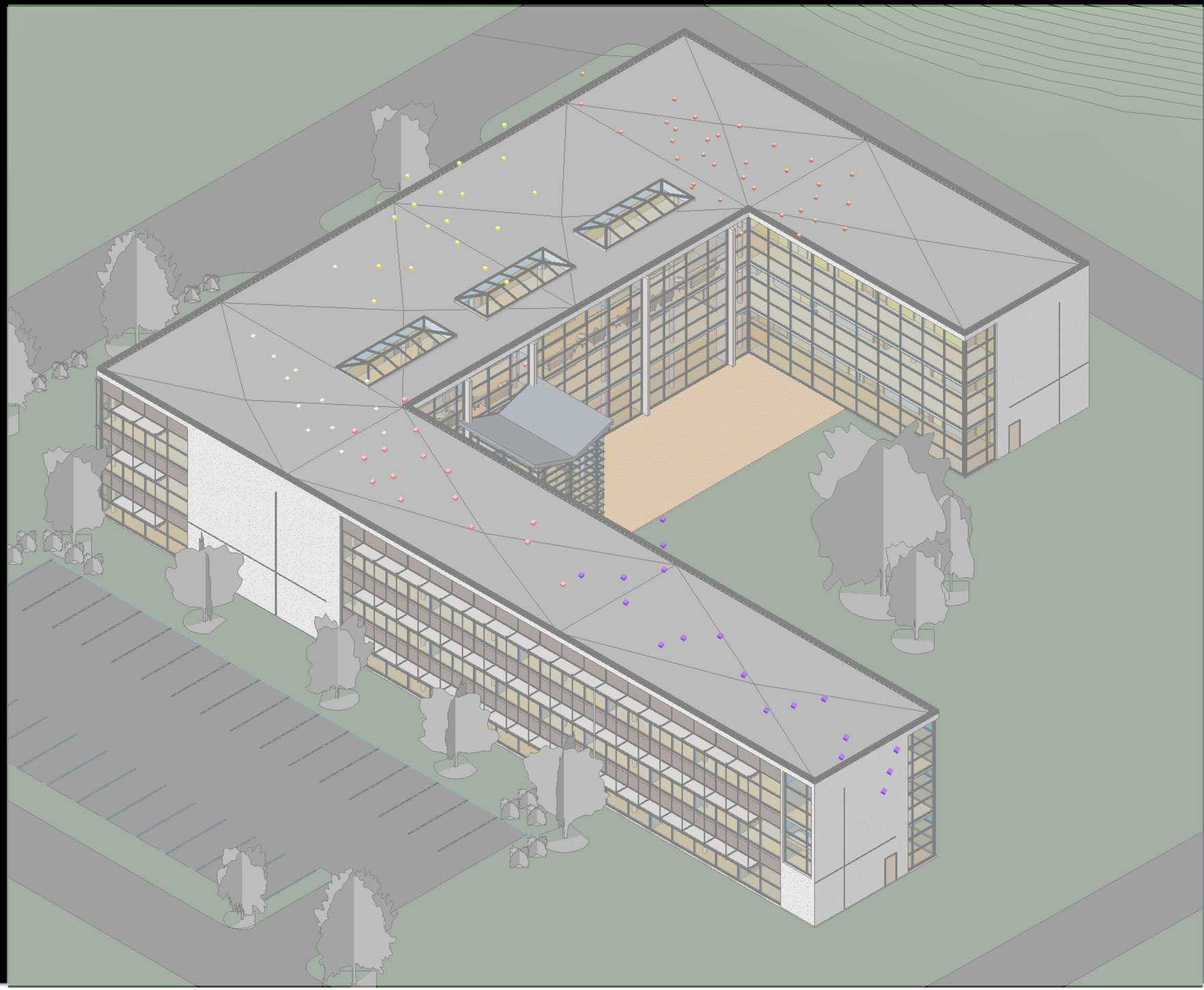
Future: Determine necessary number of risers by total building airflow, place near elevator/stairs



Updates

Updates

- Zoning
- Connection between zoning and connected systems



Future Hypar MEP (What Could it Be?)

Future of Hypar MEP

- Robust system types and optimization
- Multiple BSD Relationship Optimization (Think Mech & Elec)
- Manufacturer APIs
  - Equipment Selection/Sizing
  - Cost Comparison

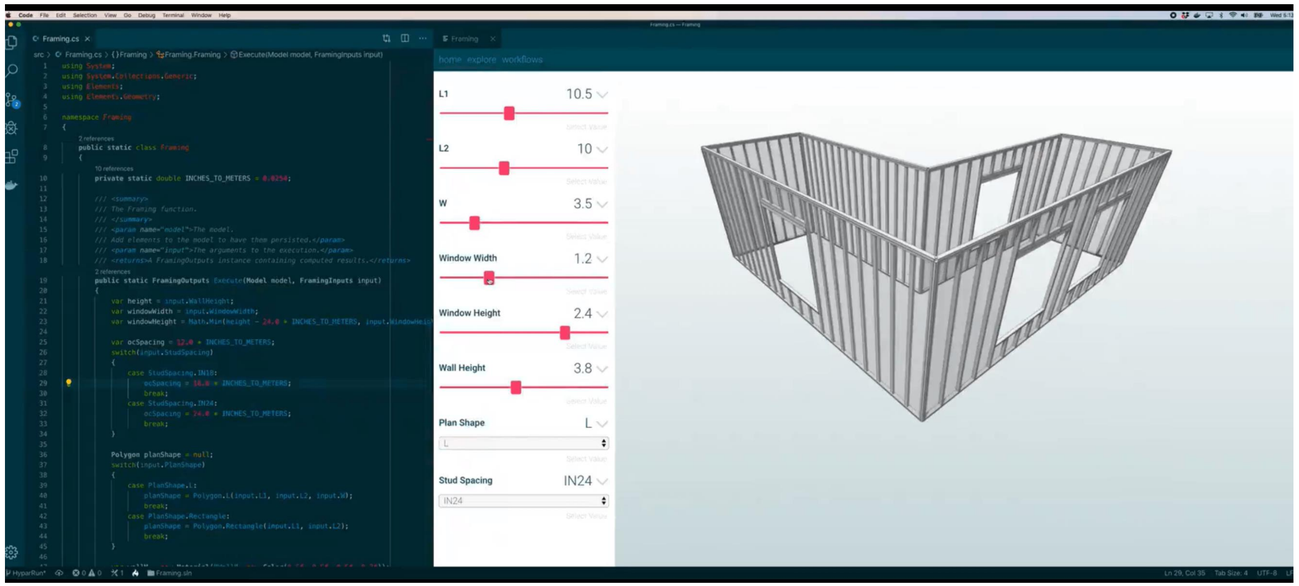
Is Hypar Still the Right Tool?

So Far Yes…

- Intuitive process to get multiple options of a function
- Easily scales
- No package management issues once function is published
- Ability to combine functions together

Could Improve With…

- More accessible “coding language”
- More accessible UI (getting there)
- Reliability



Resources

Resources

Hypar Starter

https://github.com/hypar-io/function

Hypar Github

https://github.com/hypar-io

Hypar Website

https://hypar.io/

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Please submit feedback on the app!

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