

# THE DIGITAL DIGITAL TRANSFORMATION OF **STRUCTURAL ENGINEERING**

## 1. PARAMETRIC & ALGORITHMIC DESIGN

- Optimize shapes, structures, and systems iteratively
- Complex geometries, Material optimization

## 2. ADVANCED BUILDING INFORMATION MODELING (BIM)

- Integrated collaborative environment (3D, 4D, 5D, 6D)
- Shared digital representation
- Real-time coordination

## 3. FEA & COMPUTATIONAL SIMULATION

- Complex non-linear analysis, Seismic performance simulation
- Detailed analysis of structural behavior

## 6. ADVANCED CONSTRUCTION TECHNOLOGY

- 3D Concrete Printing, Prefabrication & Modular Construction
- Robotic assembly, Automation

## 5. ARTIFICIAL INTELLIGENCE (AI) & MACHINE LEARNING

- Generative Design
- Optimized structural solutions
- AI-powered risk assessment
- Pattern recognition

## 4. INTERNET OF THINGS (IoT) & SENSORS

- Structural Health Monitoring (SHM)
- Real-time data collection
- Predictive maintenance, Safety alerts

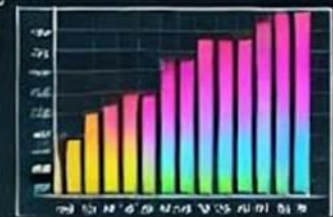
SMART,  
SUSTAINABLE,  
EFFICIENT  
STRUCTURES

**ENGINEERING:  
1900**

SLIDE RULE

**-2050**

ENGINEERIAL  
EVOLUTION



**AD**

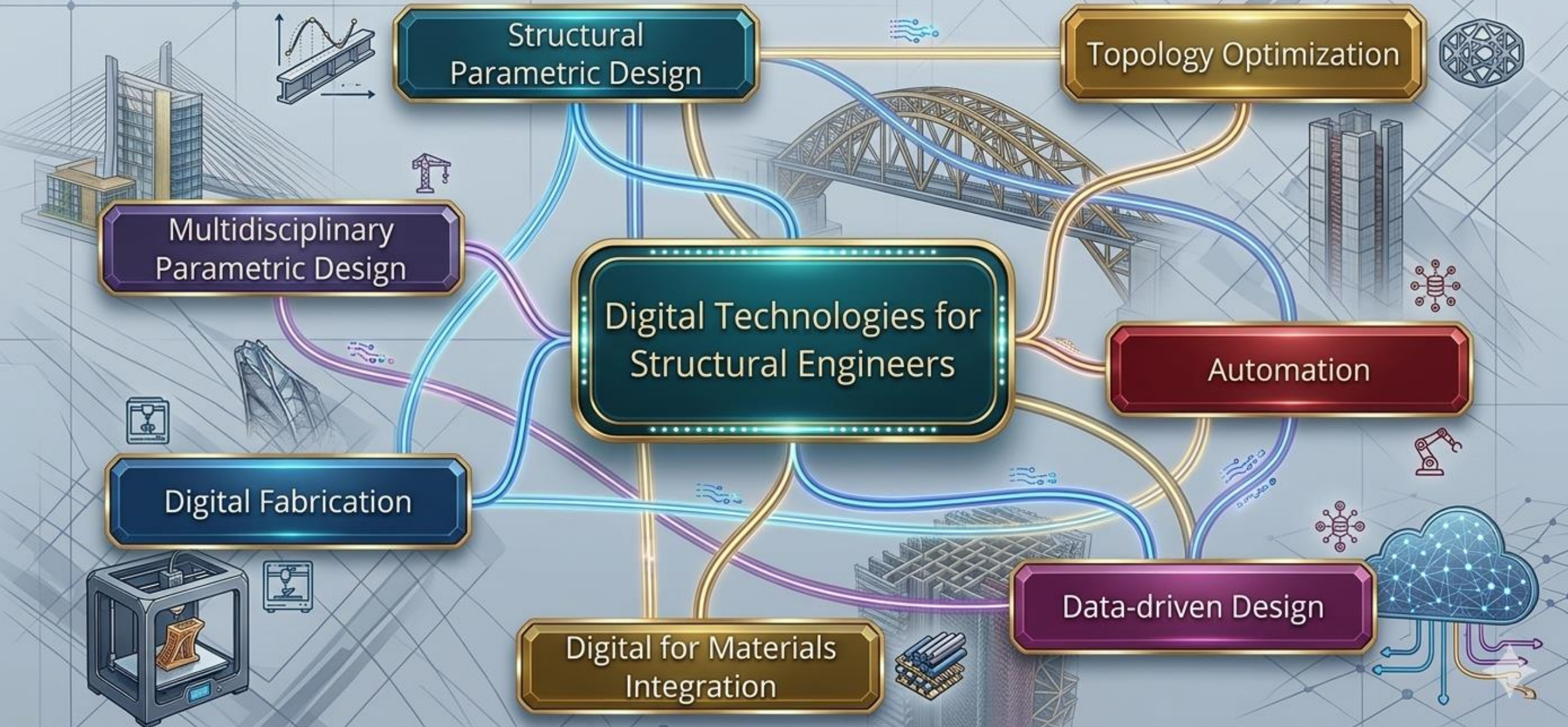
**3D**

ENGINEERIAL  
EVOLUTION

**THE DIGITAL TRANSFORMATION OF STRUCTURAL ENGINEERING**

**AI**

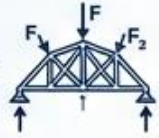
# THE DIGITAL TRANSFORMATION OF STRUCTURAL ENGINEERING



# WHY SOFTWARE MATTERS IN STRUCTURAL ENGINEERING

Key Areas Covered:

1. Structural Analysis Software



2. Parametric Structural Design



3. BIM Coordination



4. Performance-Based Design



5. Automation of Calculations and Documentation



# WHY SOFTWARE MATTERS IN STRUCTURAL ENGINEERING



Software has transformed structural engineering by:

1



Improving accuracy and reliability

2



Reducing design time

3



Enhancing collaboration among disciplines



4



Supporting complex structural systems

5



Automating repetitive engineering tasks



# STRUCTURAL ANALYSIS SOFTWARE

Analyze structural behavior under various loads and conditions.

- **Static analysis**
- **Dynamic analysis**
- **Seismic analysis**
- **Wind load analysis**
- **Finite Element Analysis (FEA)**






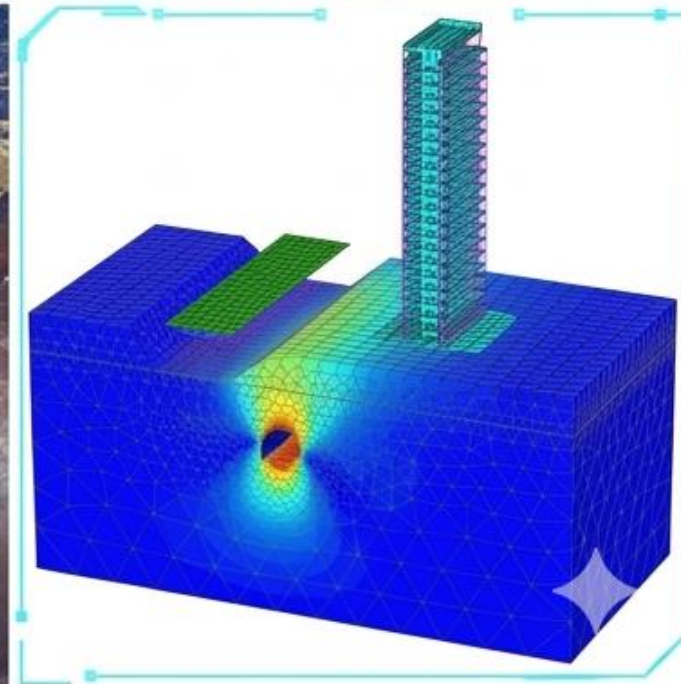
# STRUCTURAL ANALYSIS SOFTWARE

## Popular Software

-  ETABS
-  SAP2000
-  Plaxis 2D & 3D
-  Strand7
-  RAM Concept
-  STAAD.Pro
-  MIDAS Civil

## Benefits

-  Faster calculations
-  Higher accuracy
-  Ability to model complex structures



# Structural Analysis Software



การตอบสนองต่อแรงลม



แผ่นดินไหวแกน X



แผ่นดินไหวแกน Y



โหมด 1



โหมด 2



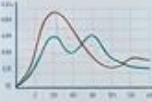
โหมด 3



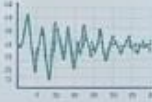
ฐานรากรับแรง



คาบการสั่นไหว

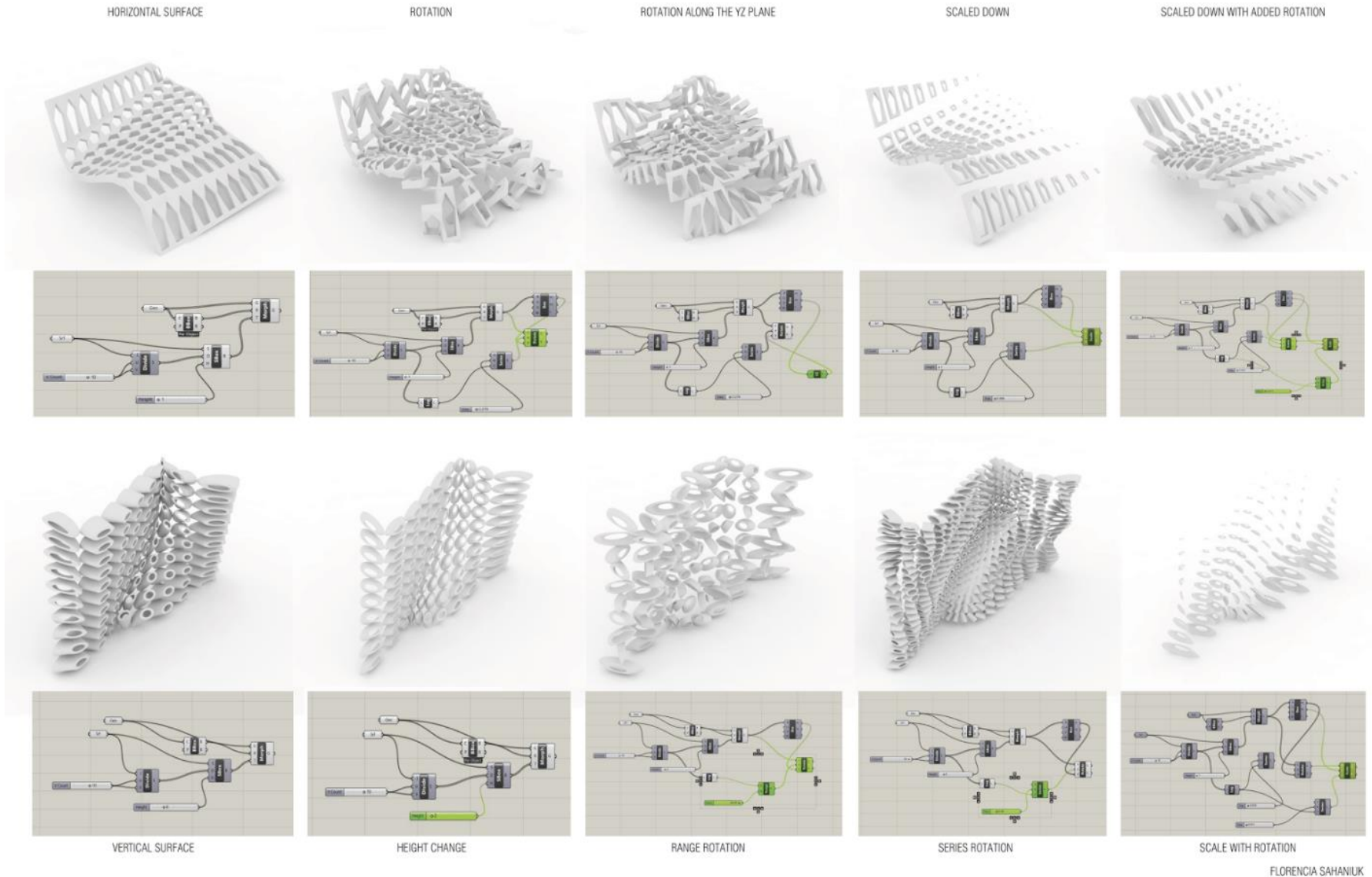


คาบการสั่นไหว



ครกแรง ต่ำ  สูง

# PARAMETRIC STRUCTURAL DESIGN



Parametric workflows allow engineers to generate and optimize complex structural geometries through algorithm-based design.

# PARAMETRIC STRUCTURAL DESIGN

## Advantages



**RAPID GENERATION**  
of Design Alternatives



**OPTIMIZATION**  
of Structural Forms



**EFFICIENT HANDLING**  
of Complex Geometries



AI  
2024

# PARAMETRIC STRUCTURAL DESIGN

A design approach where geometry and structural properties are controlled through parameters and algorithms.

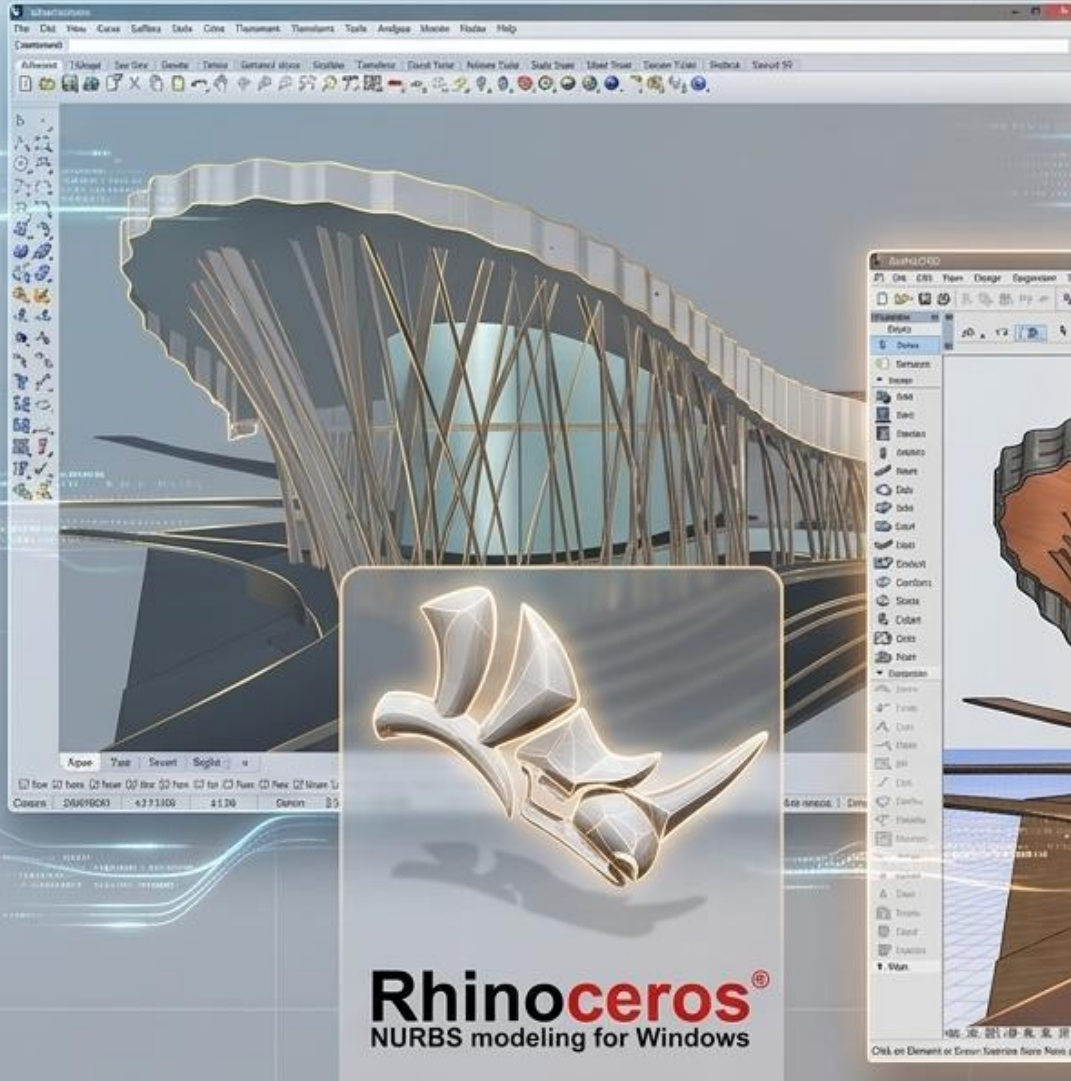
## Tools

- Grasshopper
- Rhino 
- Dynamo 

Rhino

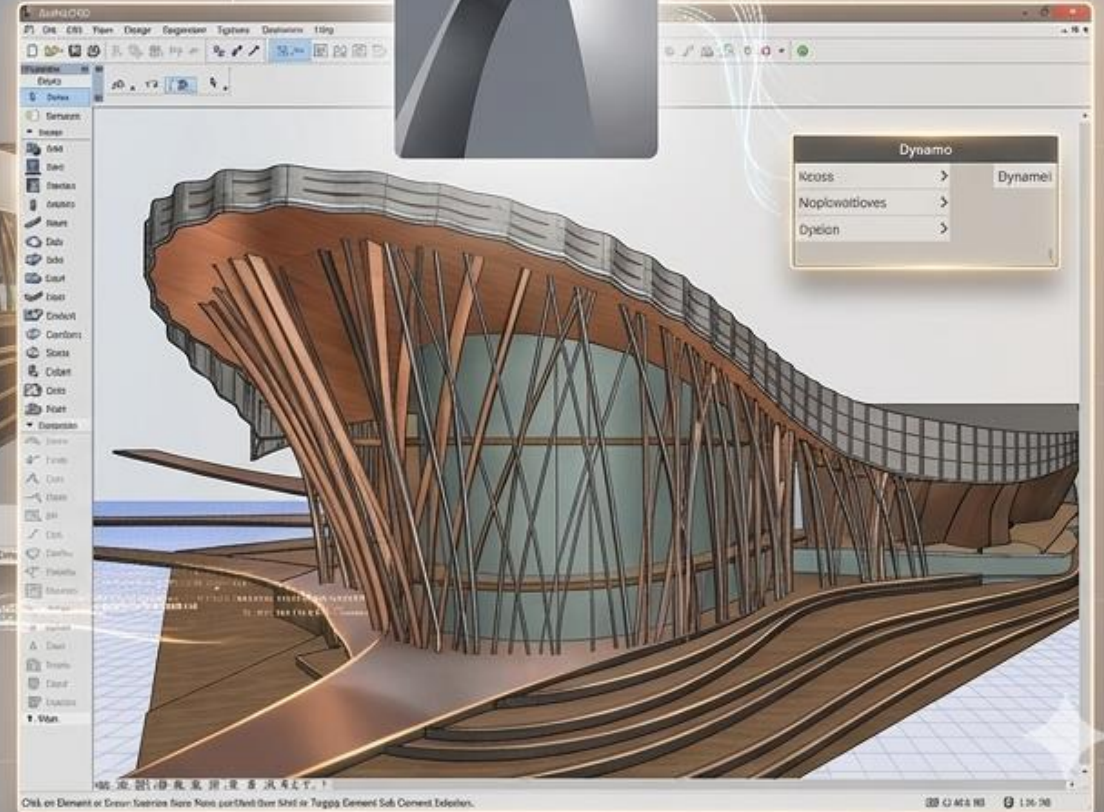


Dynamo

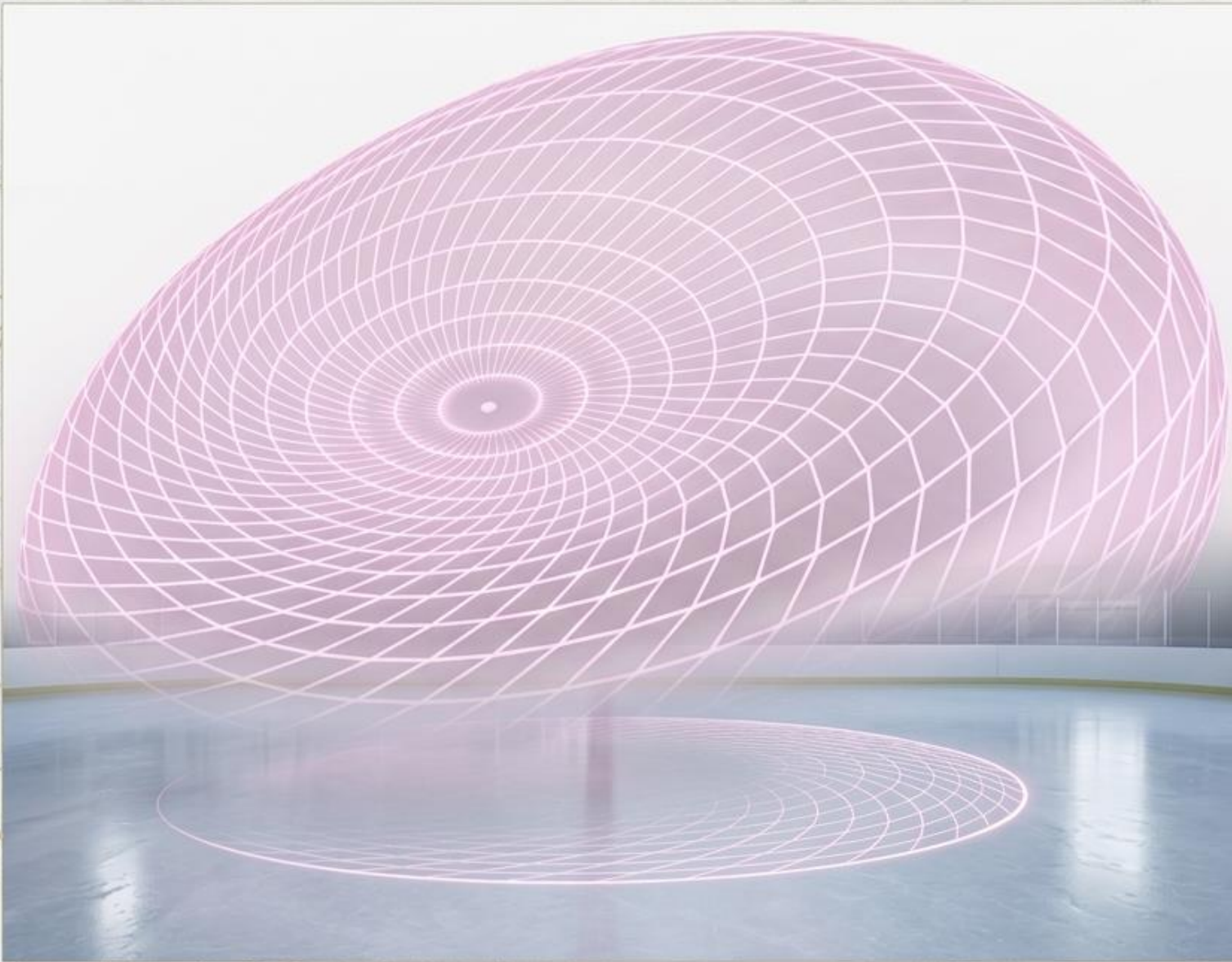


**Rhinoceros**<sup>®</sup>  
NURBS modeling for Windows

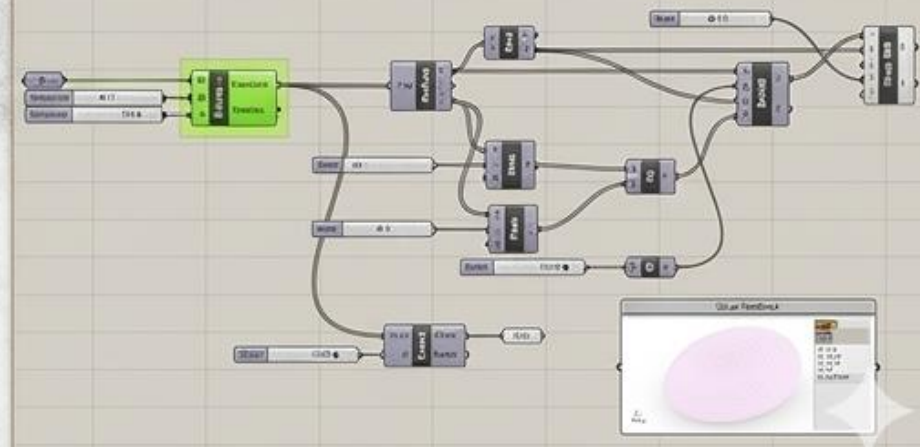
GRAPHISOFT.  
**ARCHICAD**



# PARAMETRIC STRUCTURAL DESIGN



## ICE RINK + GRASSHOPPER SCRIPTING



# PARAMETRIC STRUCTURAL DESIGN



BIOMIMICRY ROOF FORM

แรงบันดาลใจจากธรรมชาติ  
(Inspired by Nature)

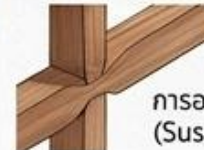


SUSTAINABLE FOUNDATIONS

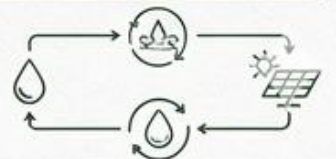


COMMUNITY FOCUS

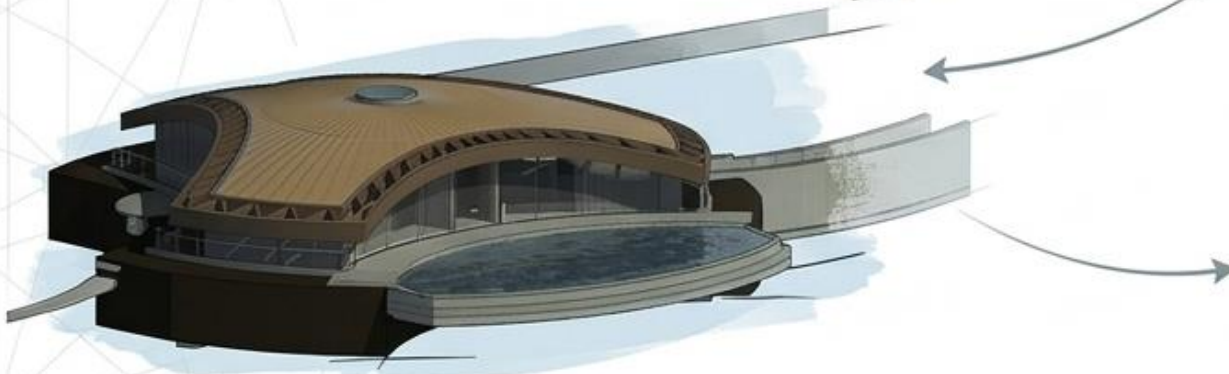
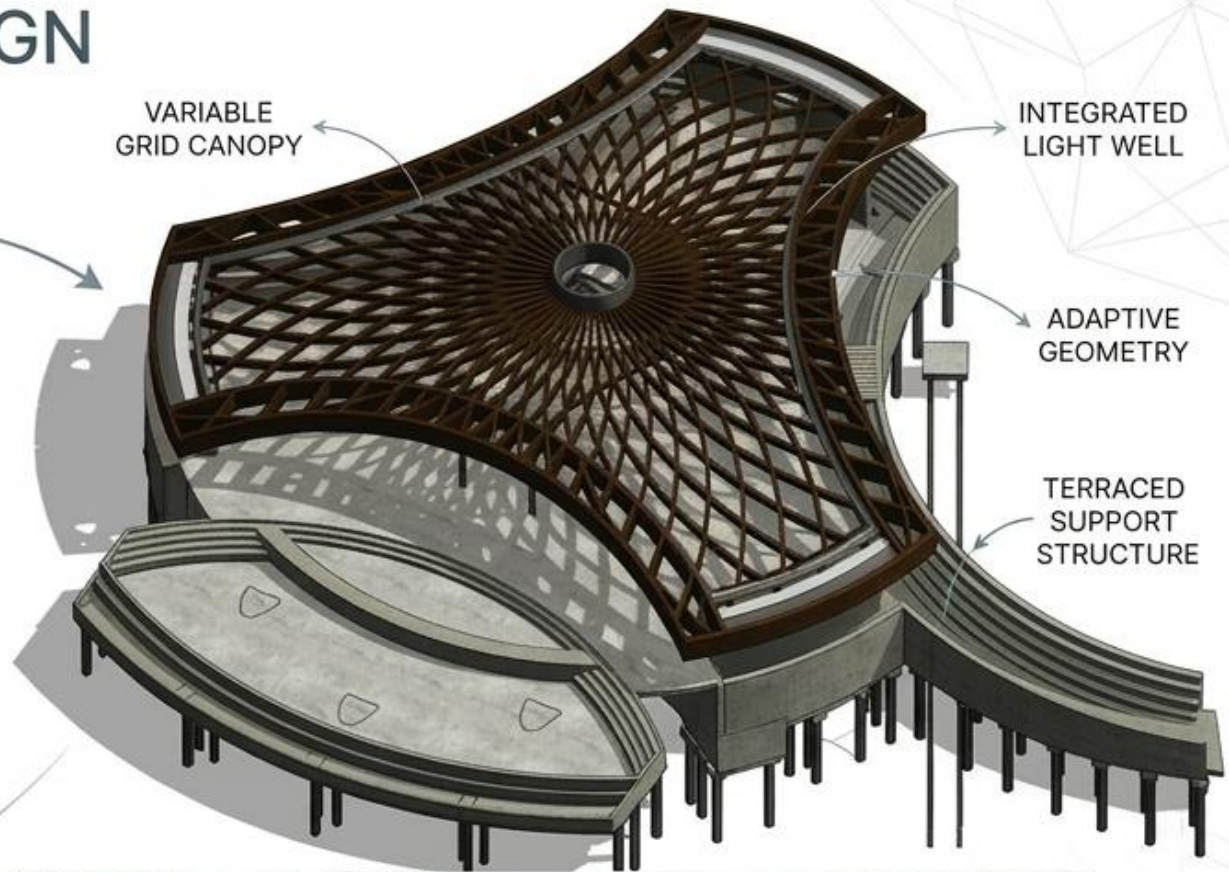
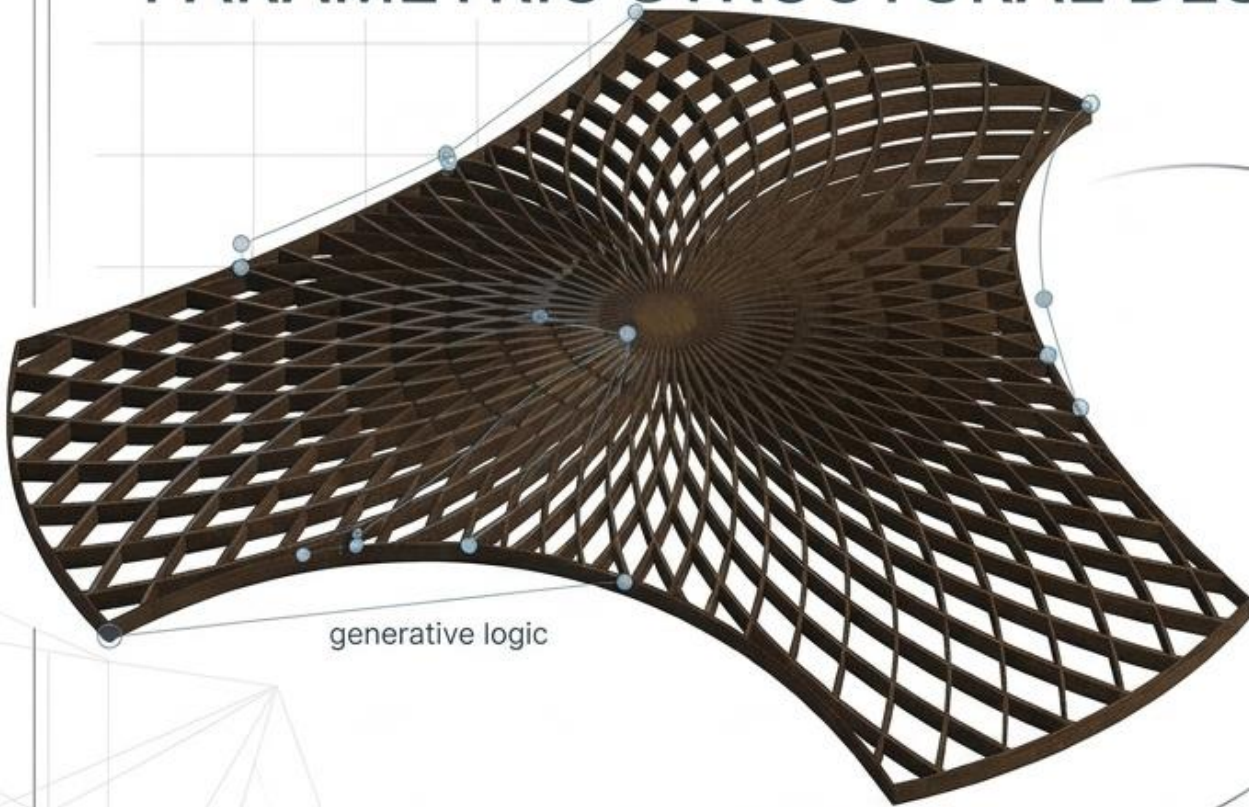
แรงบันดาลใจจากธรรมชาติ  
(Inspired by Nature)



การออกแบบอย่างยั่งยืน  
(Sustainable Design)



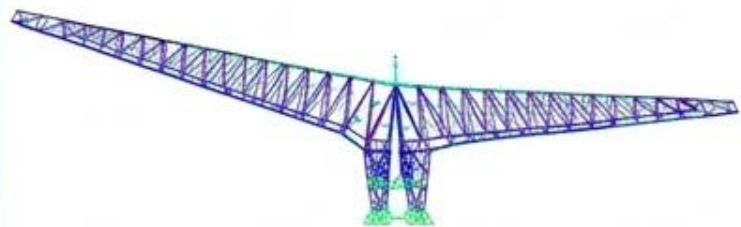
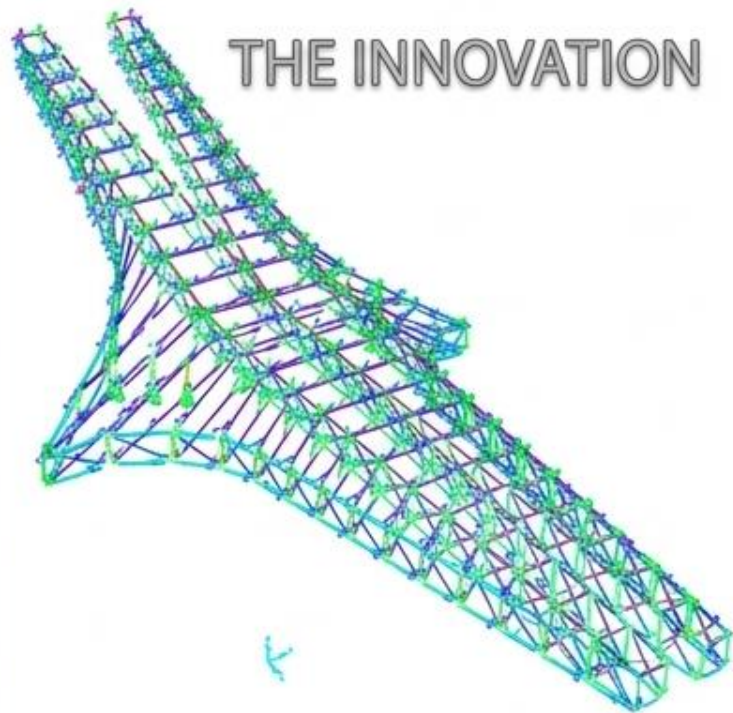
# PARAMETRIC STRUCTURAL DESIGN



FROM COMPUTATIONAL GEOMETRY TO NATURAL INTEGRATION

# THE JOURNEY OF DESIGN

## THE INNOVATION



STRUCTURAL 3D ANALYSIS



THE REALIZATION

Physical Prototype, Early Stage Construction.



THE RESULT

The Iconic Design, Complete and Illuminated.

# THE FOREST PAVILLION


## 60m. Cantilever Span




Truss

60m. Cantilever

 Dipterocarp

 Albizia

 Native Ferns

### Sustainability Score



Solar Power



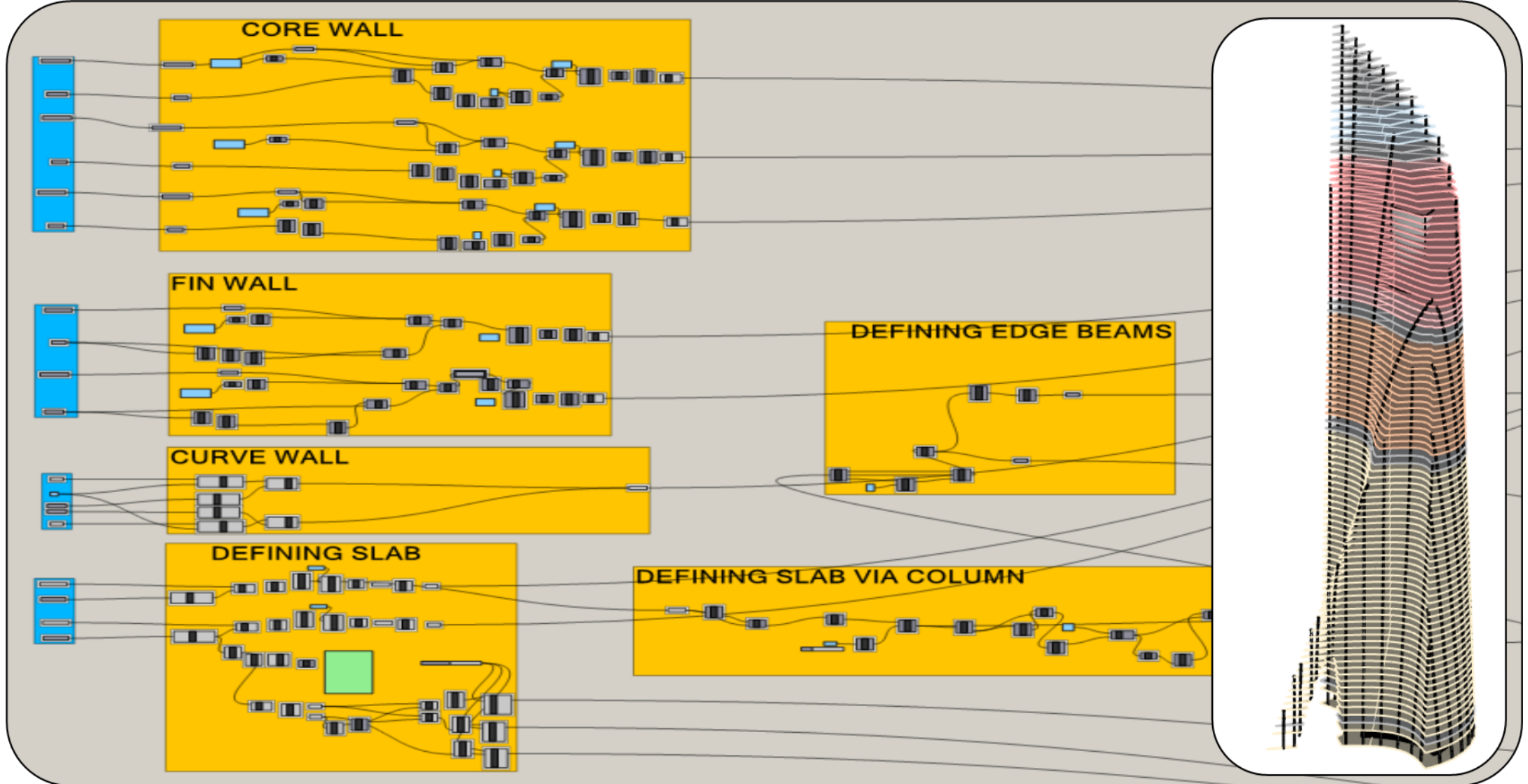
Rainwater Harvest



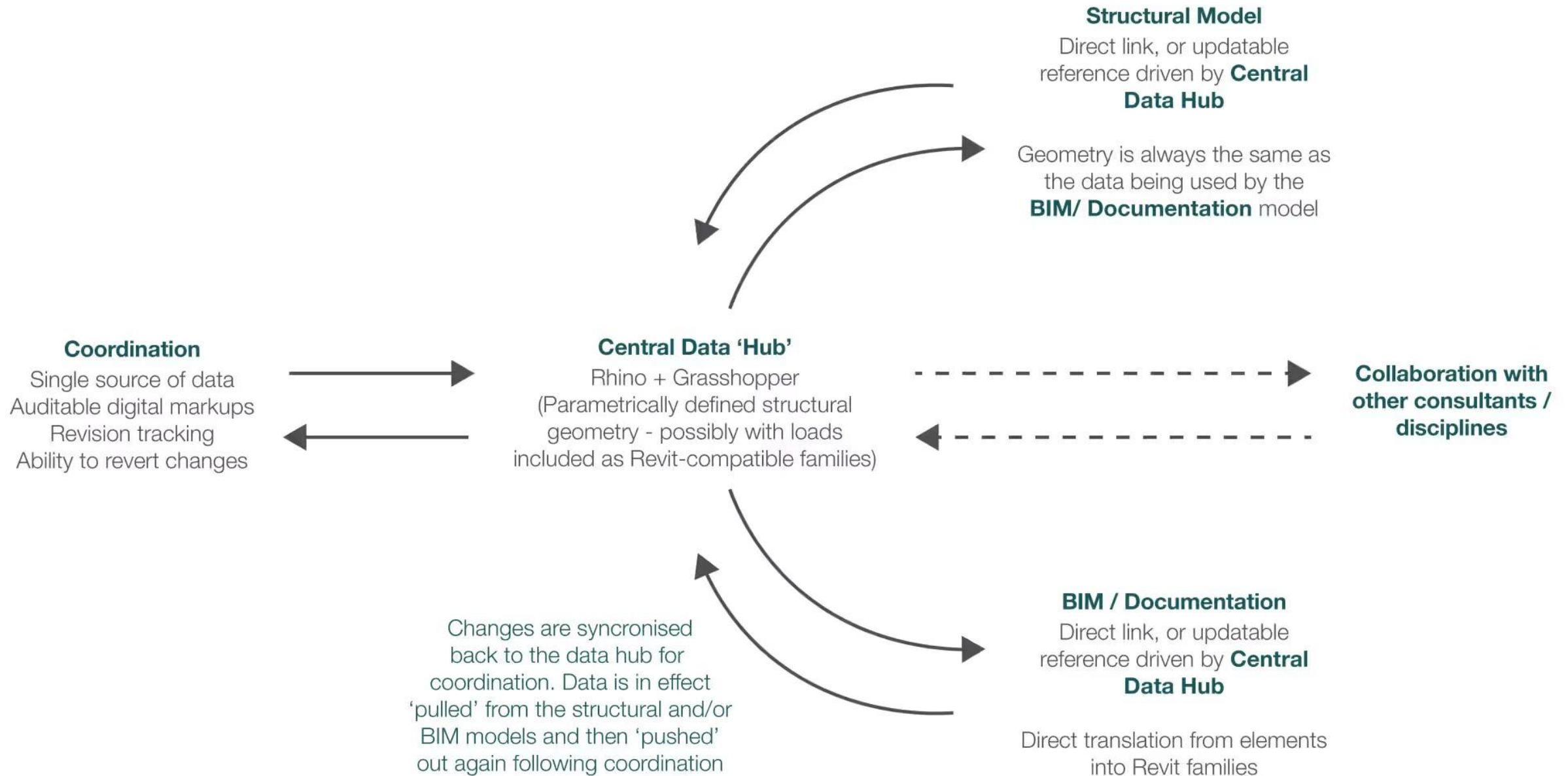
Green Roof



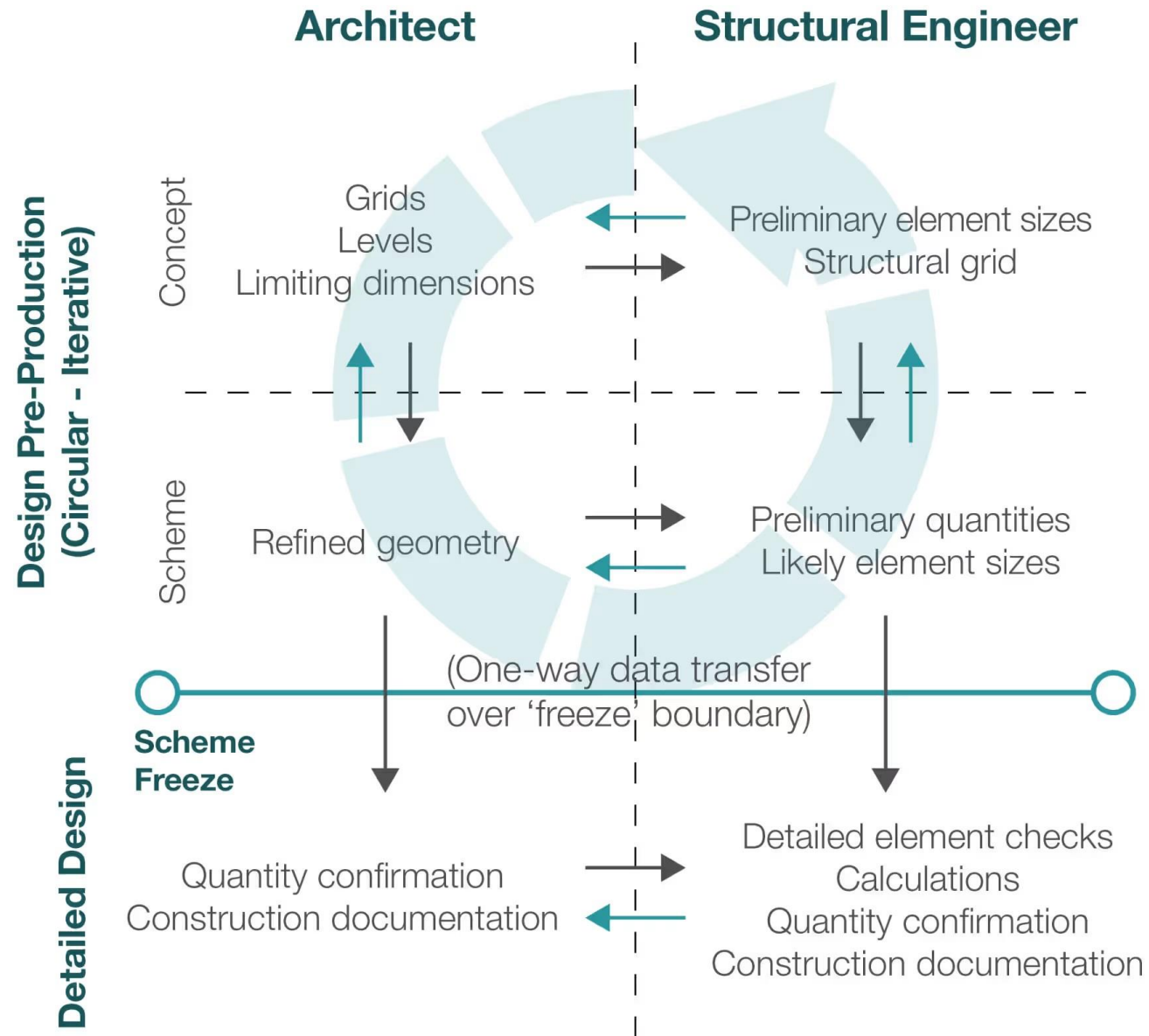
# PARAMETRIC STRUCTURAL DESIGN



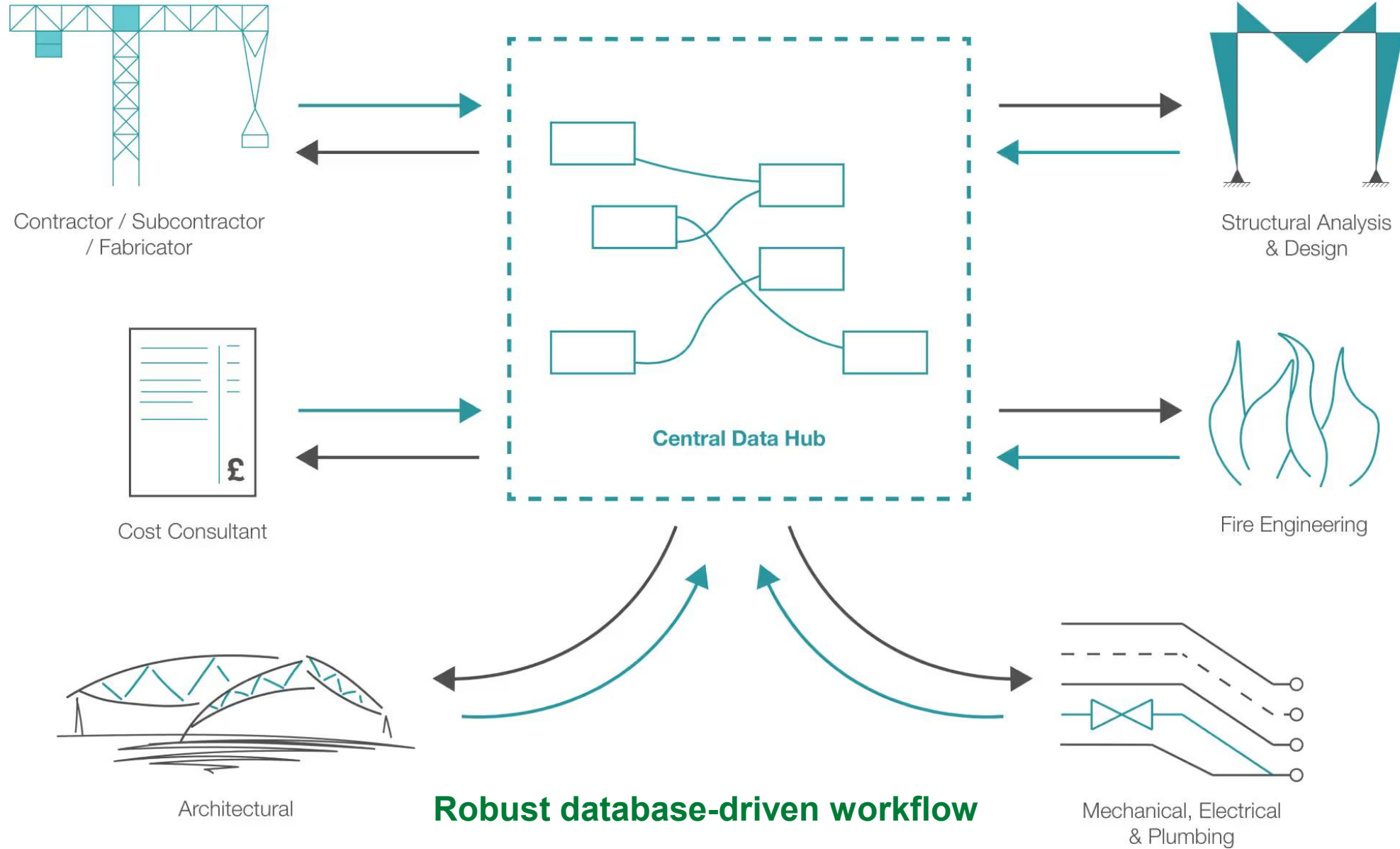
# BUILDING A DIGITAL WORKFLOW IN PRACTICE



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# BUILDING INFORMATION MODELING (BIM) COORDINATION

## What is BIM?

A collaborative digital process that integrates architectural, structural, and MEP information into a shared model.





## Common BIM Software

- R** Autodesk Revit
- N** Navisworks
- T** Tekla Structures



# BUILDING INFORMATION MODELING (BIM) COORDINATION

## Benefits

-  Better project visualization
-  Improved collaboration
-  Reduced construction errors
-  Clash detection

## Workflow

การออกแบบ → การประสานงาน → การก่อสร้าง

## Workflow



การออกแบบ → การประสานงาน → การก่อสร้าง

## WHAT IS SEEN

-  3D VISUALIZATIONS
-  COORDINATED DWGS
-  BASIC QUANTITIES

- SOFTWARE
- HARDWARE
- TRAINING



## BIM DELIVERABLES

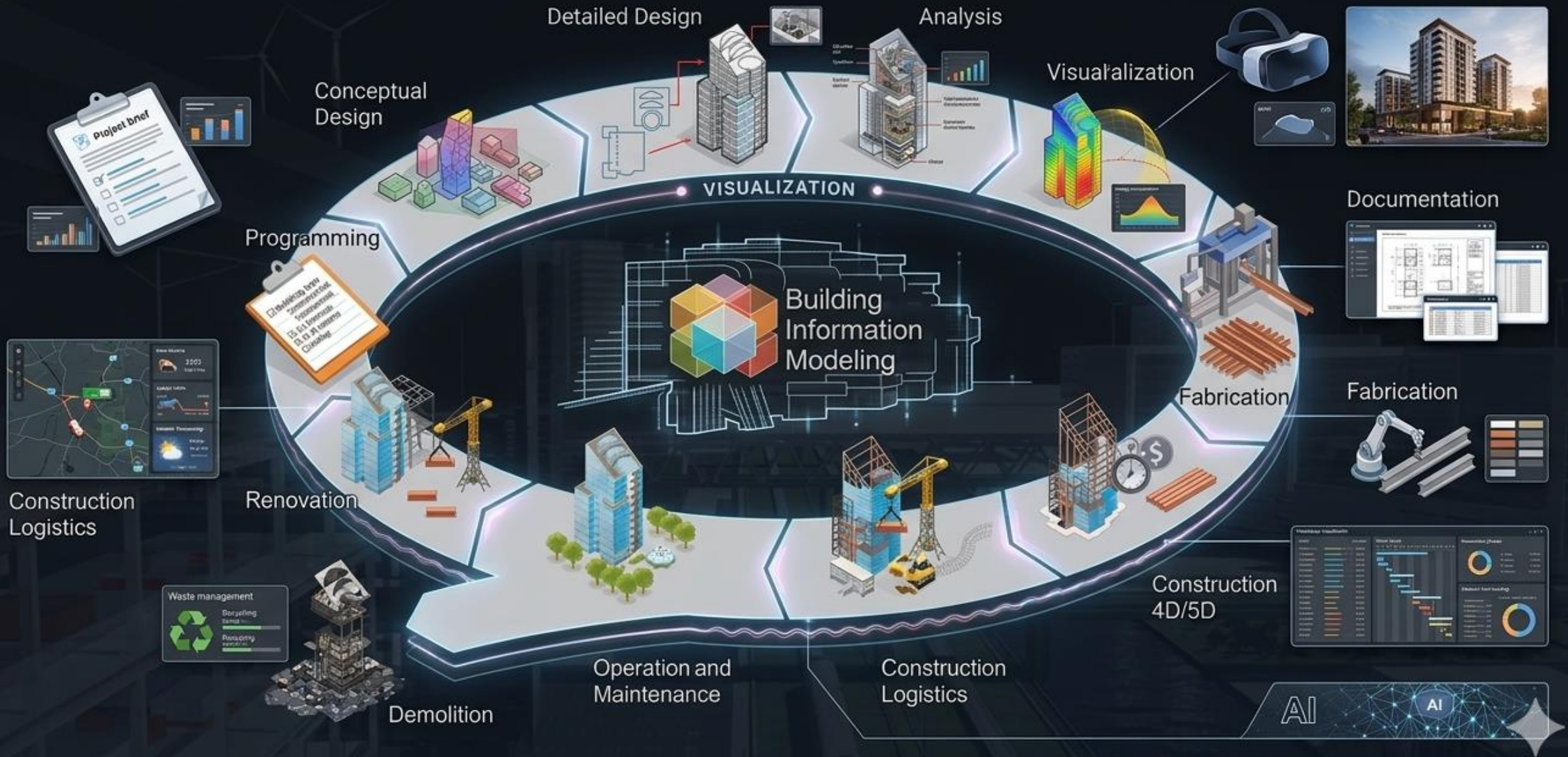
## BIM REQUIREMENTS

## WHAT IS HIDDEN

- THERMAL STUDIES 
- LIGHTING ANALYSIS 
- STRUCTURAL ANALYSIS 
- CONSTRUCTABILITY 
- PREFABRICATION 
- ASSET TRACKING 
- BIM/GIS OVERLAP 
- PHOTOGRAMMETRY 
- FIELD BIM 
- OTHER ...

- STANDARDS 
- GUIDES 
- WORKFLOWS 
- CHANGE RESISTANCE 
- ROLE MUTATION 
- MODELING QUALITY 
- COLLABORATION 
- CONTRACTS 
- METRICS 
- OTHER ...

# BIM WORKFLOW



# PERFORMANCE-BASED DESIGN (PBD) & AUTOMATION

Design structures to achieve specific performance objectives under hazards such as earthquakes, wind, or fire.

## Software Examples

- PERFOR-M3D
- OpenSees

## Advantages

- More realistic assessment
- Enhanced safety
- Optimized structural performance



# PERFORMANCE-BASED DESIGN (PBD) & AUTOMATION

## Automation of Calculations and Documentation Technologies

- Scripting (Python)
- Visual Programming
- API Integration

## Applications

- Automated design checks
- Report generation
- Quantity take-offs
- Drawing production

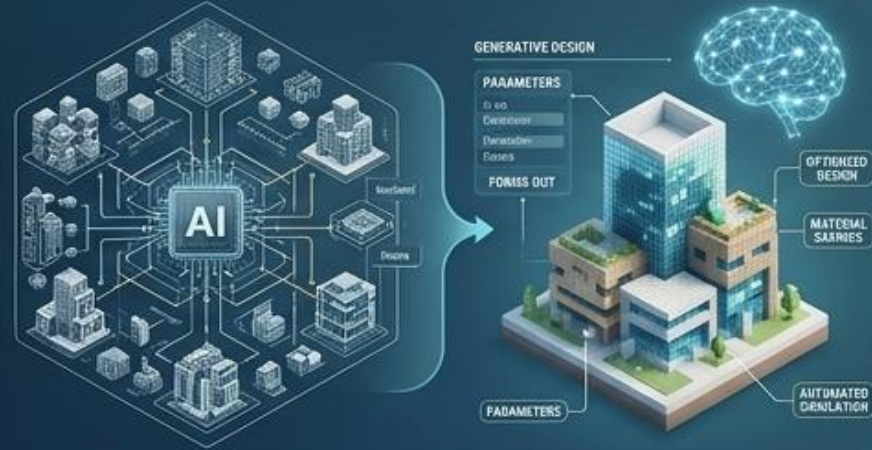
## Benefits

- ✓ Reduced human error
- ✓ Increased productivity
- ✓ Consistent documentation



# FUTURE TRENDS IN AEC

- Artificial Intelligence (AI)
- Generative Design
- Digital Twins
- Cloud-Based Collaboration



## Digital Twin vs BIM

Design, Simulation, Monitoring—All in One Digital Workflow



“The **future structural engineer** is empowered by both **engineering knowledge** and **digital technology**.”





LS

**Gensler**