

# How Computational Thinking Is Reshaping Engineering Theory

Dr.Siradech Surit

Faculty of Architecture, Kasetsart University

TBIM BIM Showcase 2026

14 March 2026, SCG, Bangkok, Thailand

## ผศ.ดร.ศิรเดช สุริต

### ความเชี่ยวชาญ

Structural Optimization, BIM, FEM,  
Generative Design, AI, Virtual Environment

- Doctor in Engineering, Kasetsart University
- อาจารย์ประจำภาควิชาวิศวกรรมอาคาร คณะสถาปัตยกรรมศาสตร์ มหาวิทยาลัยเกษตรศาสตร์
- อาจารย์ประจำหลักสูตร ป.โท วิศวกรรมโครงสร้างเพื่อสิ่งแวดล้อมสรรค์สร้าง คณะวิศวกรรมศาสตร์ มหาวิทยาลัยเกษตรศาสตร์
- อาจารย์พิเศษ คณะวิศวกรรมศาสตร์ มหาวิทยาลัยเกษตรศาสตร์
- ผู้ก่อตั้งเพจ <https://www.facebook.com/StructuralStudio>



# Architect



CAD for Arch  
Presentation

## Revit

Anusorn Petchtiam  
Siradech Surit



Adv. BIM for  
Architect

## Rhino + Grasshopper Revit + Dynamo

Walaiporn Nakaphan  
Anusorn Petchtiam  
Siradech Surit



BIM/CAE

## Revit + Robot + Dynamo Fusion 360

Siradech Surit



Computer  
Application in  
Product Design

## Fusion 360 Stable Diffusion

Siradech Surit



BIM for Bld.  
Innovation Design

## Revit + Robot + Dynamo Insight / Ecotech Naviswork

Parames Kamhangritriong  
Pattaranan Takkanon  
Siradech Surit

# Engineering



Computer  
Application for  
Structure Engineer

## Revit + Robot + Dynamo Fusion 360 / Python

Benjaphon Wethyavon  
Siradech Surit



Structural System  
Modeling

## Robot Fusion 360

Benjaphon Wethyavon  
Siradech Surit



BIM for Sustainable  
Design

## Revit + Robot + Dynamo Insight / Ecotech Naviswork

Parames Kamhangritriong  
Pattaranan Takkanon  
Siradech Surit



Multi Disp. Dsn.  
Optimization

## Revit + Robot + Dynamo Fusion 360

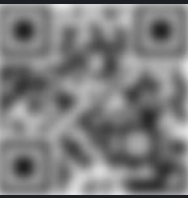
Siradech Surit

**Fac Arch** bbit: bachelor in building innovation and technology (arch)  
mbit: master in building innovation and technology (arch)

**Fac Eng** ce: bachelor in civil engineering (civil)  
stbe: structural technology in build-environment (civil)

# How Computational Thinking Is Reshaping Engineering Theory

**Interactive Live Demo →**

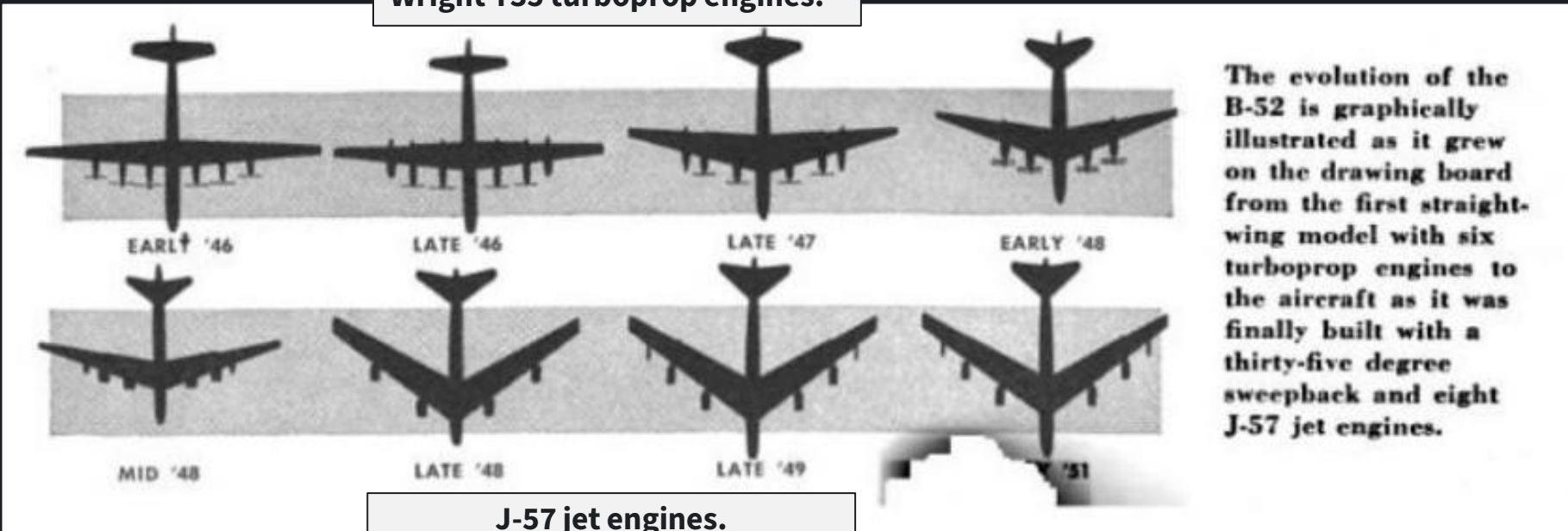




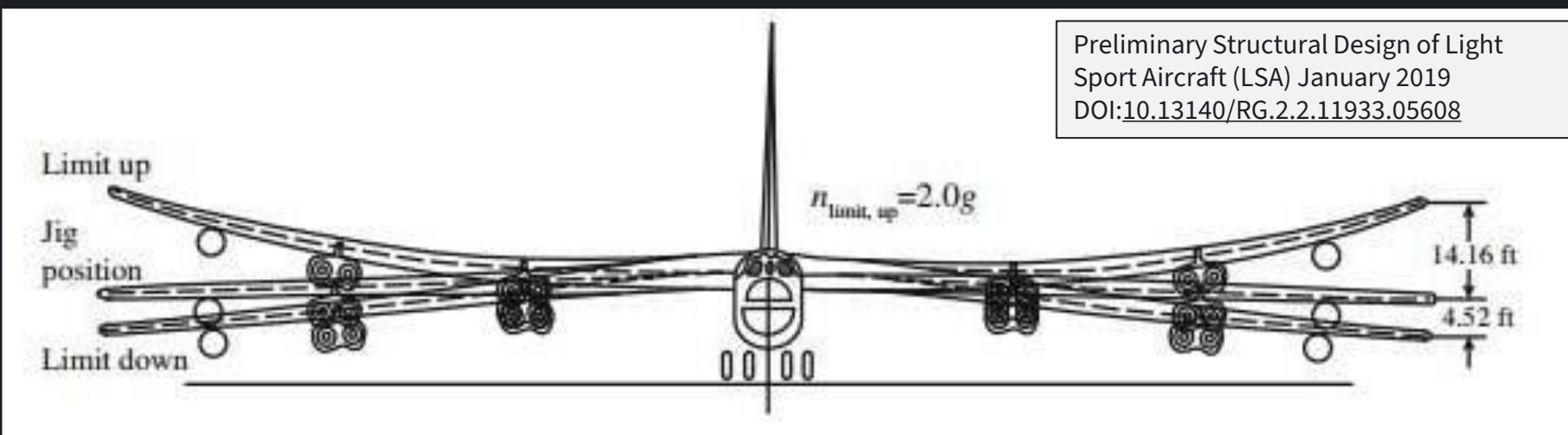
A video from british pathé FILM ID:2622.19 (XB-52 Stratofortress Test flight 1940s)

# The Origins of the Finite Element Method

Wright T35 turboprop engines.



Preliminary Structural Design of Light Sport Aircraft (LSA) January 2019  
DOI:10.13140/RG.2.2.11933.05608

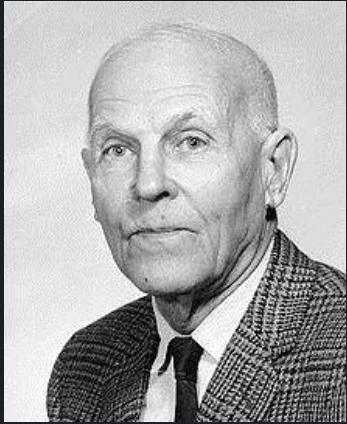


# The Origins of the Finite Element Method



B-52 Stratofortress  
April 15, 1952: B-52 first flight

# The Origins of the Finite Element Method



**Alexander Hrennikoff**

Hrennikoff, A. "Solution of Problems in Elasticity by the Framework Method", *Journal of Applied Mechanics*, 8, pp. 169-175, 1941.

1941 – 1943

Rectangular Plate  
- Membrane

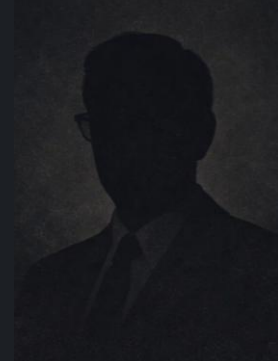


**Richard Courant**

Courant, C., "Variational Methods for Solution of Equilibrium and Vibration", *Bull. Am. Math Soc.*, Vol. 49, 1943, pp. 1-43.

1943

Constant  
Strain  
Triangle; CST



**M. J. Turner**



**R. W. Clough**



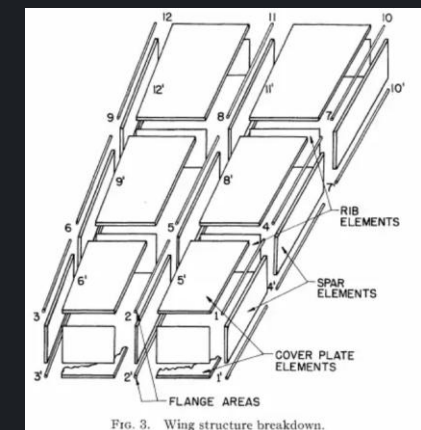
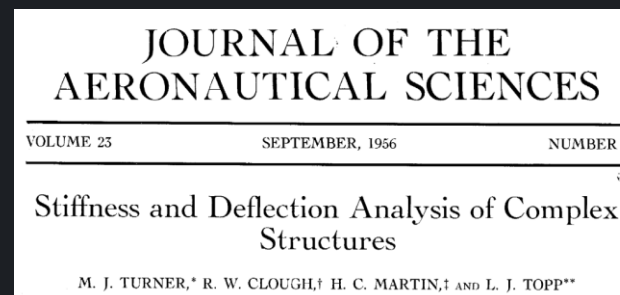
**H. C. Martin**



**L. J. Topp**

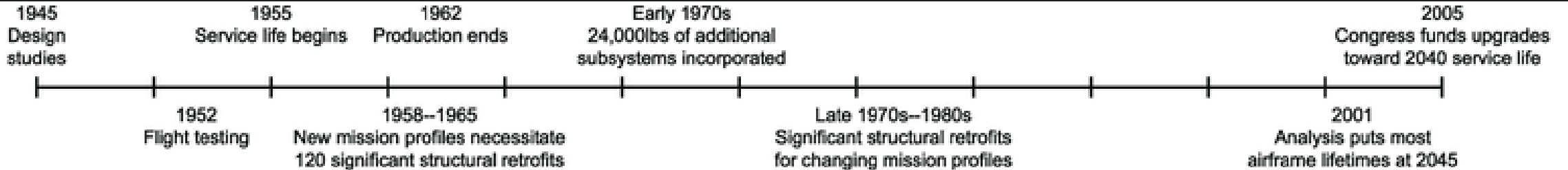
**M. J. Turner, R. W. Clough, H. C. Martin, and L. J. Topp** "Stiffness and Deflection Analysis of Complex Structures," *Journal of the Aeronautical Sciences*, one of the **first articles concerning the application of the finite element method.**

1954 → Published 1956

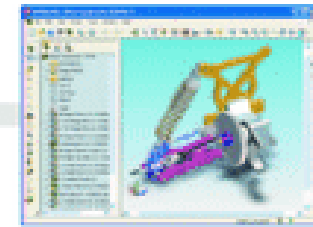
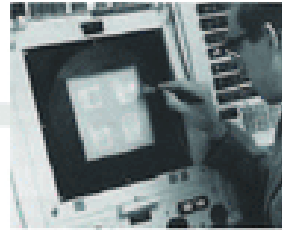


# The Origins of the Finite Element Method

**B-52**



**1945**



**2005**

**CAD**



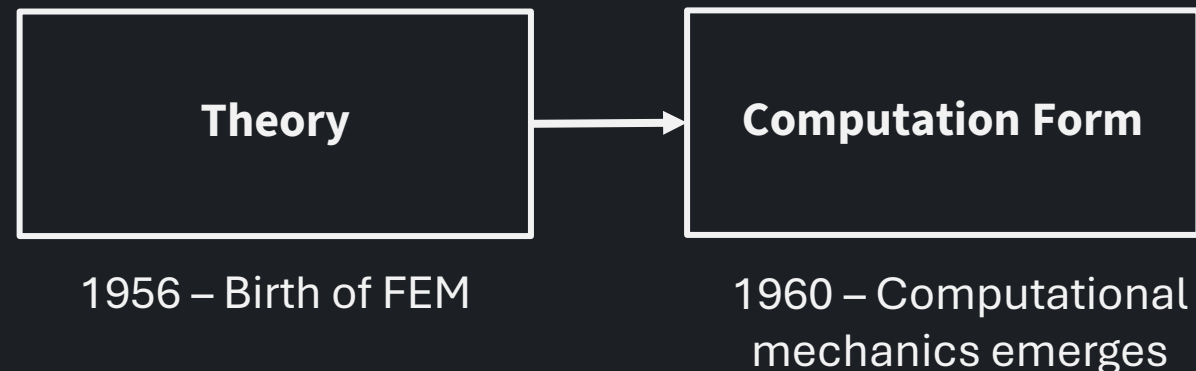
CAD ARCHIVES BASED ON OAIS. Proceedings of IDETC/CIE 2006  
 ASME 2006 International Design Engineering Technical Conferences &  
 Computers and Information in Engineering Conference  
 September 10–13, 2006, Philadelphia, USA

<https://cradle.co.th/cradle-cfd/>

# John Argyris (1913-2004) one of the pioneers of computational mechanics

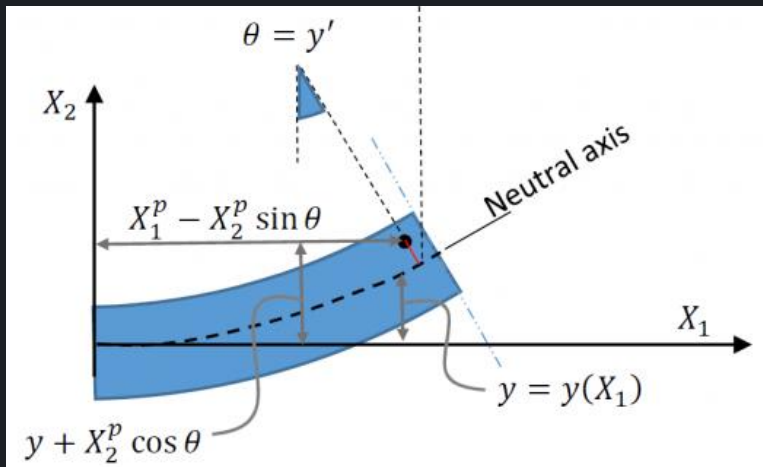
- Matrix structural analysis
- Energy-based FEM formulation
- Nonlinear finite element development
- Large-scale computational mechanics

## “The Computer Shapes the Theory”

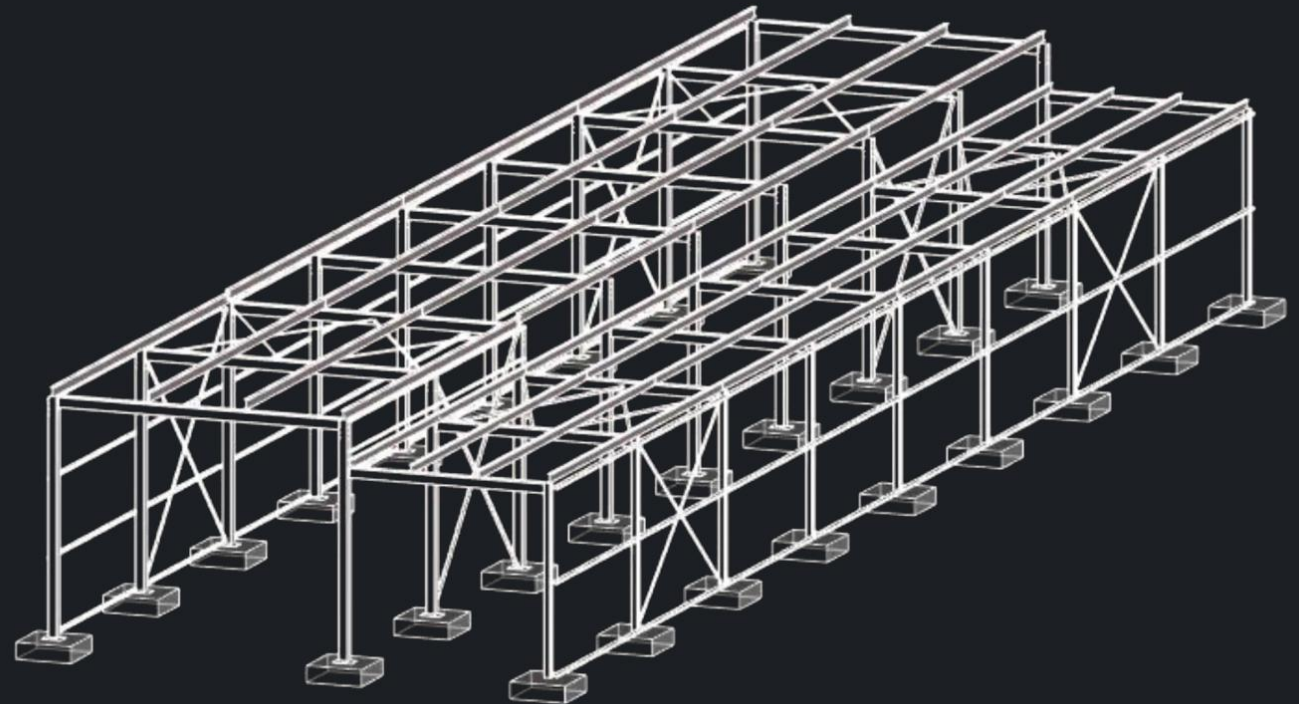


# From Analytical Thinking to Algorithmic Thinking

$$\frac{d^2}{dx^2} \left( EI \frac{d^2 \Delta}{dx^2} \right) = w$$



Euler-Bernoulli Beam Theory



Real world structure

# Computational Mechanics and Structural Reformulation

$$\frac{d^2}{dx^2} \left( EI \frac{d^2 \Delta}{dx^2} \right) = w$$

Analytical (Differential Equation)



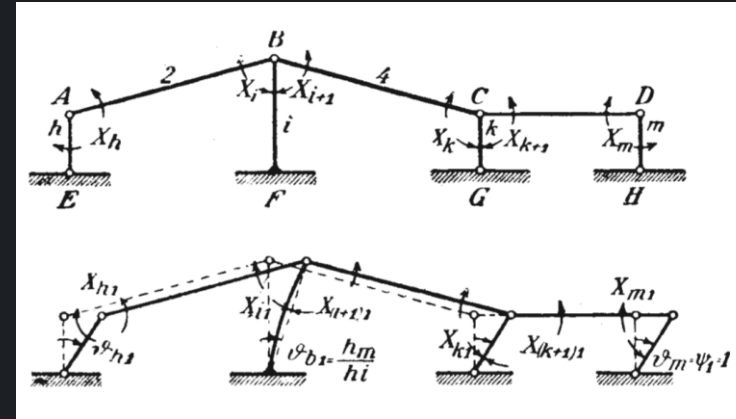
$$M_{AB} = \frac{2EI}{L} (2\theta_A + \theta_B - 3\psi) + \frac{2EI}{L^2} (2\Delta_{A/B,ext} - \Delta_{B/A,ext})$$

$$M_{BA} = \frac{2EI}{L} (\theta_A + 2\theta_B - 3\psi) + \frac{2EI}{L^2} (\Delta_{A/B,ext} - 2\Delta_{B/A,ext})$$

Algebraic formulation  
(No Differential Equation)

**Slope Deflection Method**

George Alfred Maney (1915)



Human Calculator

$$(K_{AB}2 + K_{AE}2)\theta_A + K_{AB}\theta_B - 3K_{AE}\psi_A = -(M_{AB}^F + M_{AE}^F)$$

$$K_{AB}\theta_A + (2K_{AB} + 2K_{BC} + 2K_{BF})\theta_B + K_{BC}\theta_C - 3K_{BF}\psi_B = -(M_{BA}^F + M_{BC}^F + M_{BF}^F)$$

$$K_{BC}\theta_B + (2K_{BC} + 2K_{CD} + 2K_{CG})\theta_C + K_{CD}\theta_D - 3K_{CG}\psi_C = -(M_{CB}^F + M_{CD}^F + M_{CG}^F)$$

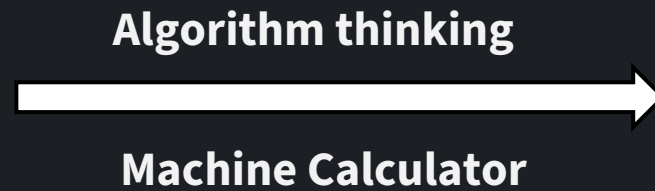
$$K_{CD}\theta_C + (2K_{CD} + 2K_{DH})\theta_D - 3K_{DH}\psi_D = -(M_{DC}^F + M_{DH}^F)$$

**Simultaneous equations**

# Computational Mechanics and Structural Reformulation

$$\frac{d^2}{dx^2} \left( EI \frac{d^2 \Delta}{dx^2} \right) = w$$

Analytical Method

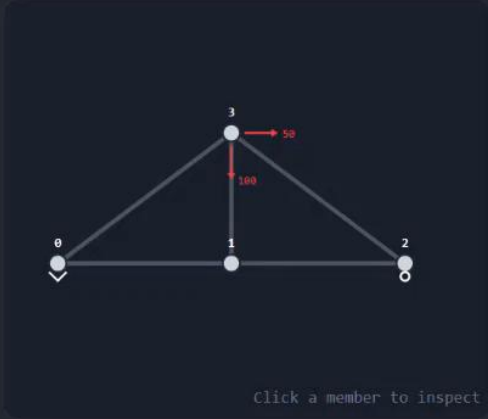


$$\mathbf{k} = \begin{bmatrix} u_i & v_i & \theta_i & u_j & v_j & \theta_j \\ \frac{EA}{L} & 0 & 0 & -\frac{EA}{L} & 0 & 0 \\ 0 & \frac{12EI}{L^3} & \frac{6EI}{L^2} & 0 & -\frac{12EI}{L^3} & \frac{6EI}{L^2} \\ 0 & \frac{6EI}{L^2} & \frac{4EI}{L} & 0 & -\frac{6EI}{L^2} & \frac{2EI}{L} \\ -\frac{EA}{L} & 0 & 0 & \frac{EA}{L} & 0 & 0 \\ 0 & -\frac{12EI}{L^3} & -\frac{6EI}{L^2} & 0 & \frac{12EI}{L^3} & -\frac{6EI}{L^2} \\ 0 & \frac{6EI}{L^2} & \frac{2EI}{L} & 0 & -\frac{6EI}{L^2} & \frac{4EI}{L} \end{bmatrix}$$

Numerical Method

# Computational Mechanics and Structural Reformulation

## STRUCTURE



## MEMBERS

Member 0

Member 1

Member 2

Member 3

Member 4

## MEMBER ANALYSIS



Select a member to view  
analysis details

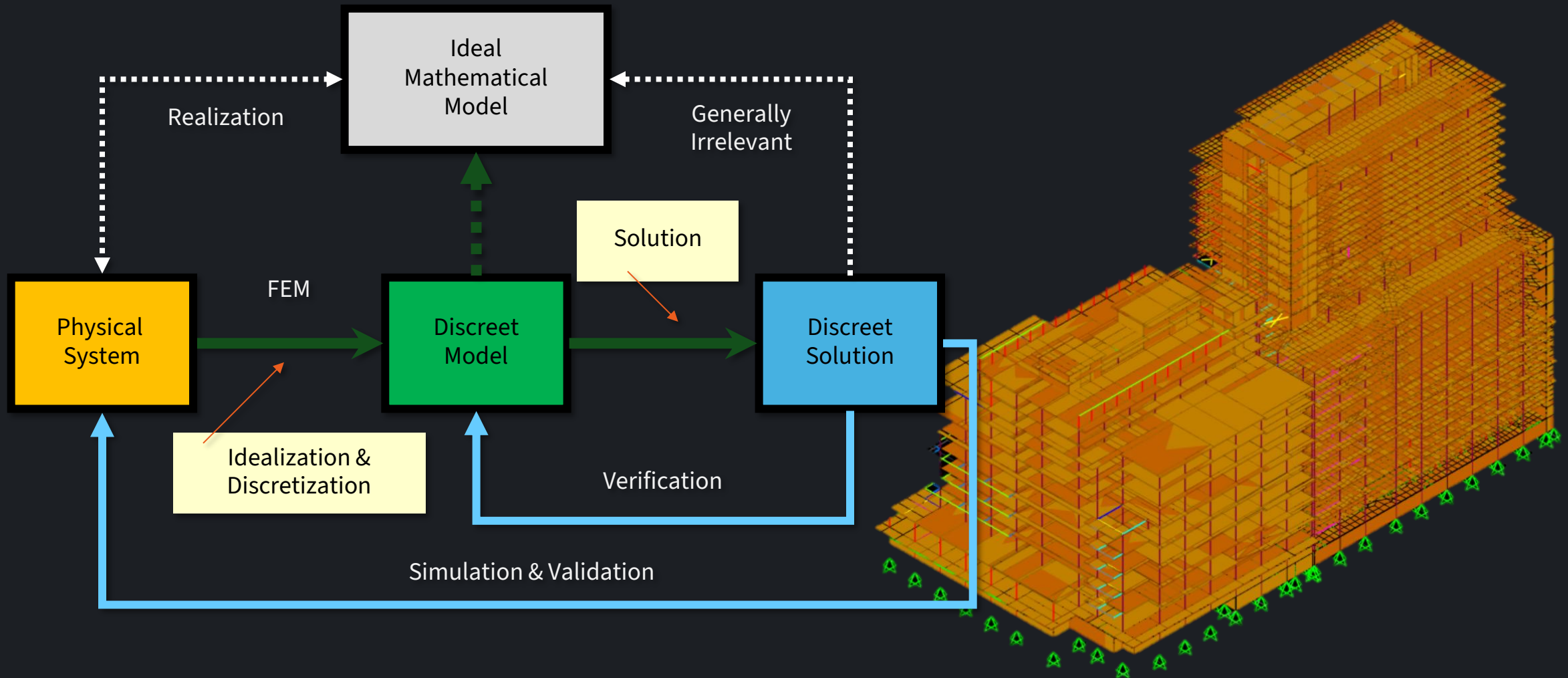
## GLOBAL STIFFNESS MATRIX [K]

0 / 5 Assembled

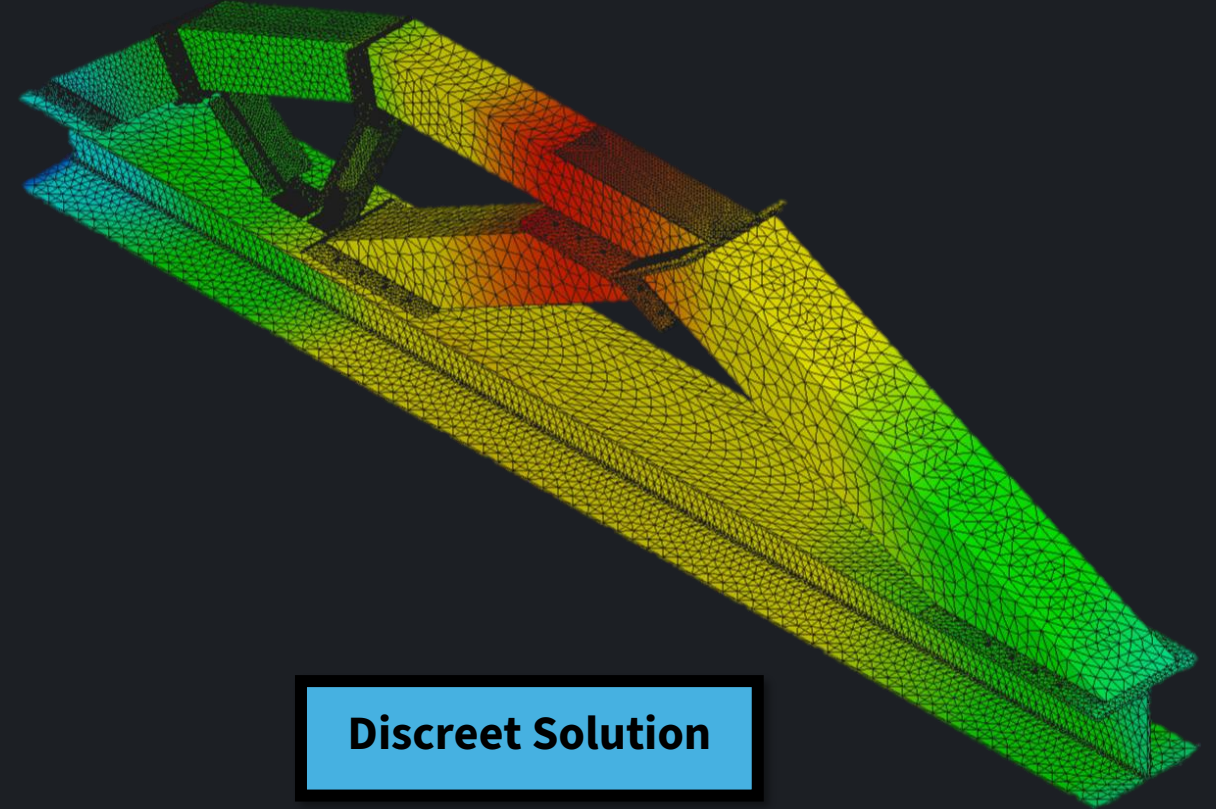
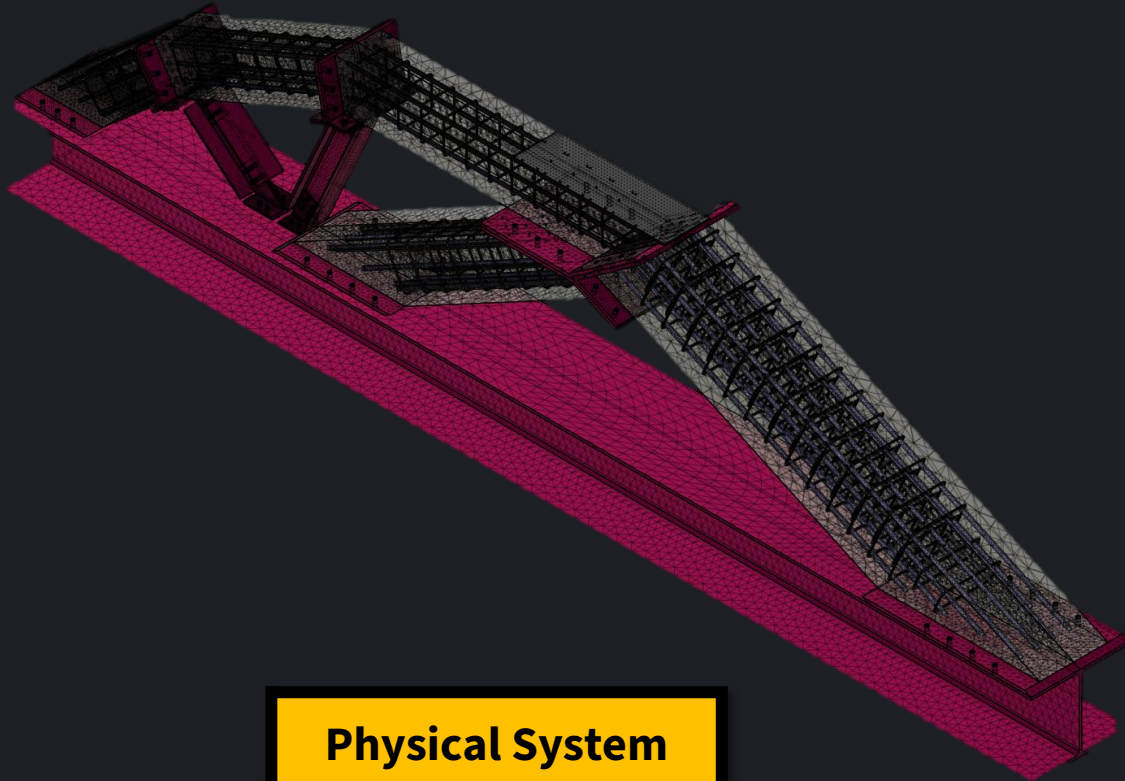
	u0	v0	u1	v1	u2	v2	u3	v3
u0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

System Size: 8x8 • Total DOFs: 8

# Computational Mechanics and Structural Reformulation



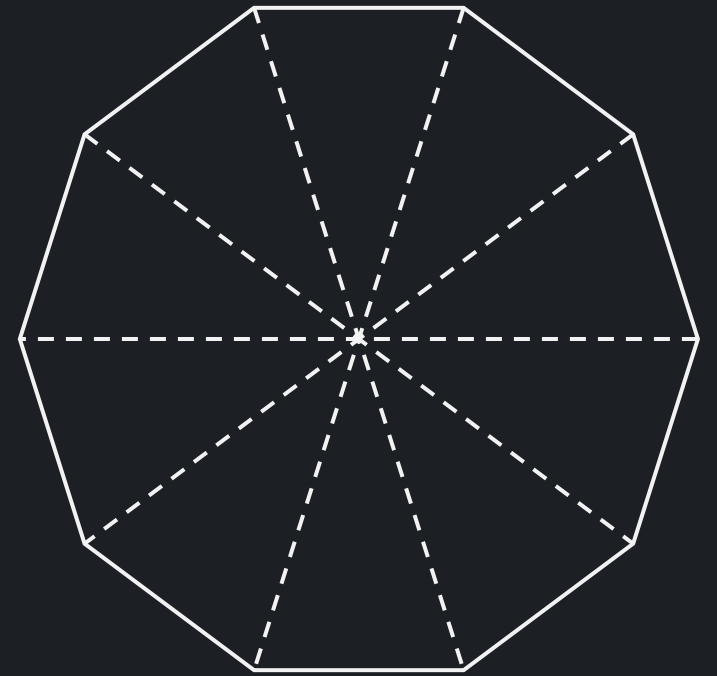
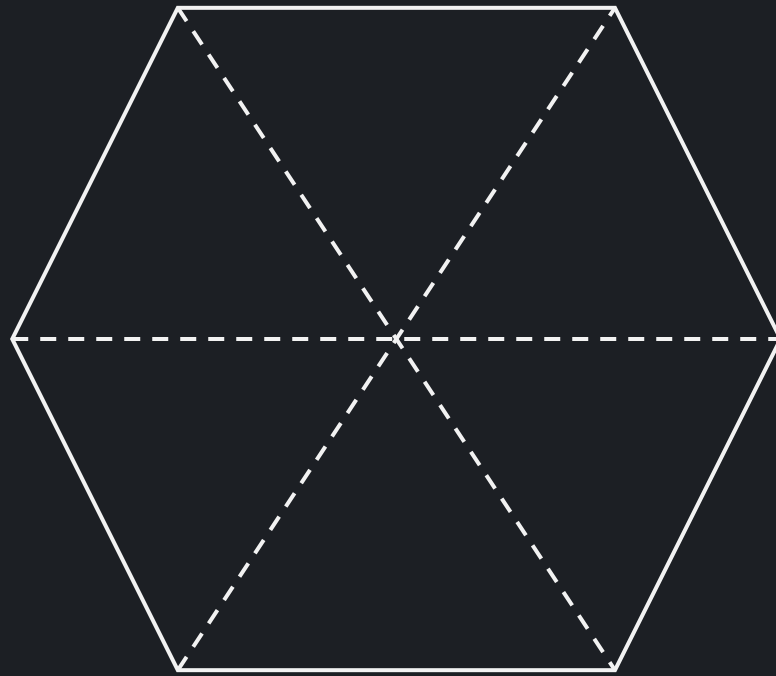
# Computational Mechanics and Structural Reformulation



# From Analytical Thinking to Algorithmic Thinking



Analytical Thinking



Algorithmic Thinking

Note Today is Pi day = 3.14

# From Analytical Thinking to Algorithmic Thinking



*“Do not disturb my circles.”*

Archimedes of Syracuse, 287–212 BCE

Define Parameters



Generate Model



Evaluate Performance

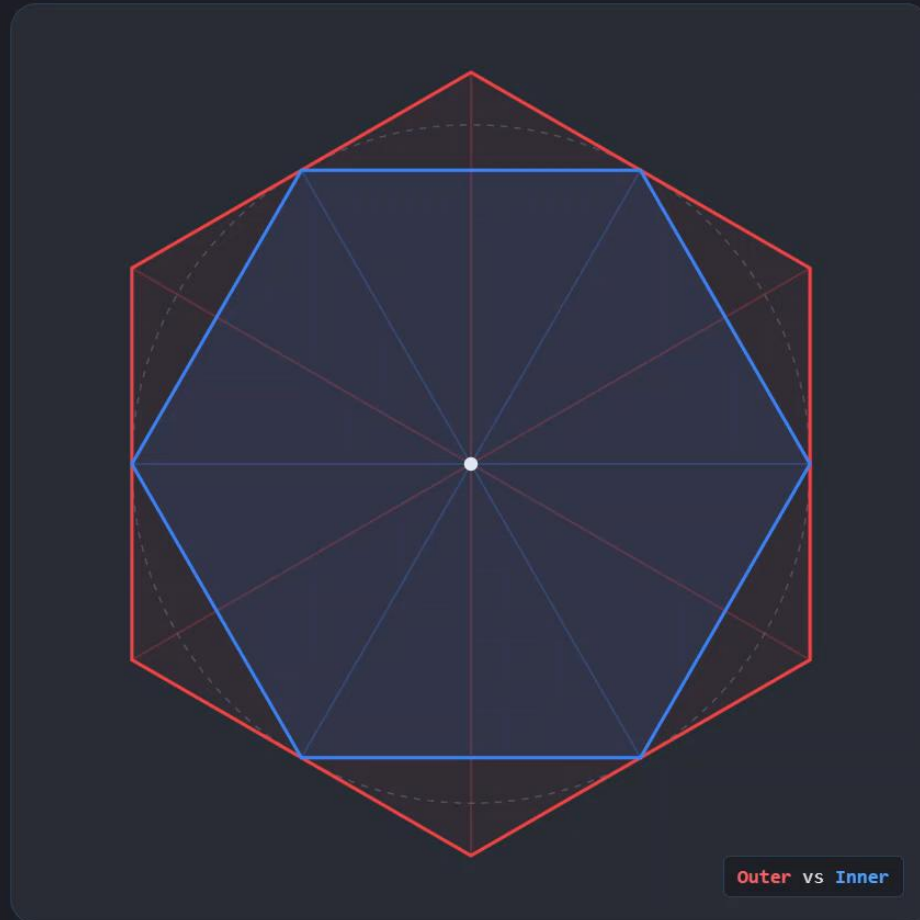


Update Variables



Converge

# From Analytical Thinking to Algorithmic Thinking



▶ Auto Run

> Step (2n)

↻ Reset

Sides (n)

6

Accuracy

9.05e-2

Approximation Values

Target: 3.141592654...

Upper Bound (Circumscribed)

3.464101615138

Lower Bound (Inscribed)

3.000000000000

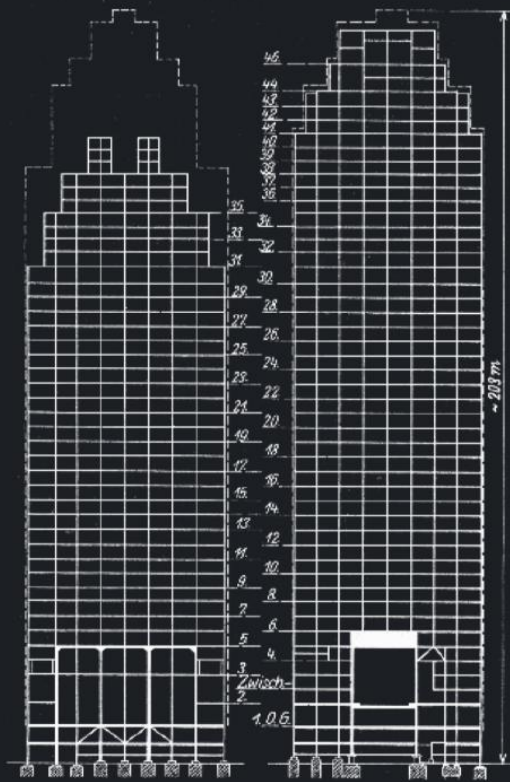
Average

3.232050807569

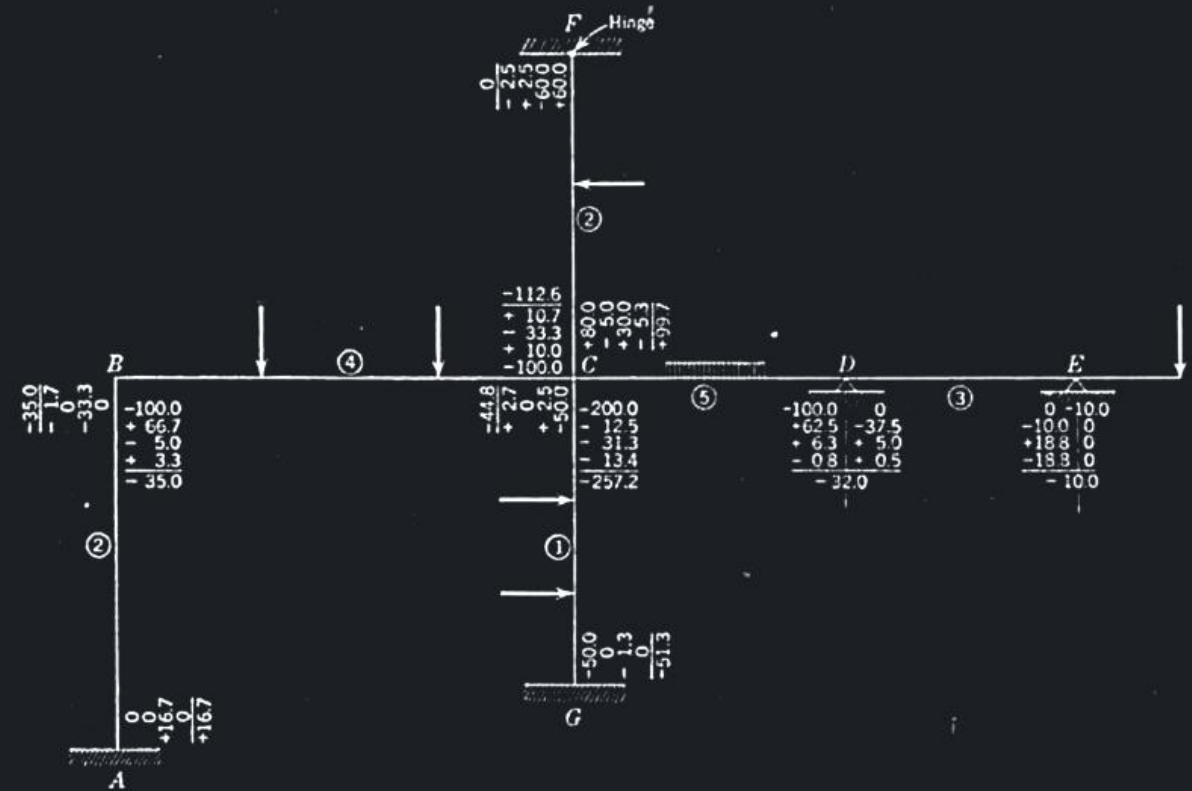
Convergence History



# From Analytical Thinking to Algorithmic Thinking



Hardy Cross

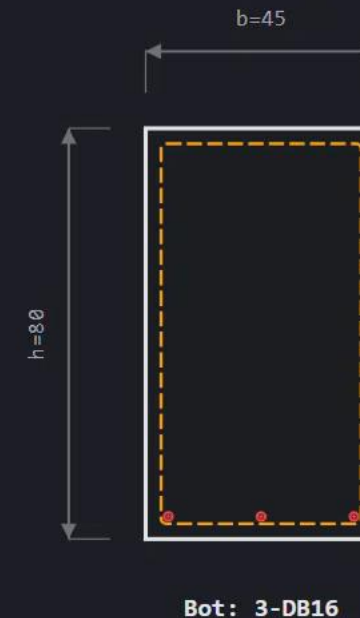


Moment Distribution, 1932

# Defining Objectives and Constraints

## Classic Structural optimization Process

- 1. Implementation of the design variables** : May be continuous or discrete, but commonly treated as discrete
  - Geometry
    - Cross-sectional
    - Dimensions or Member sizes
  - Material Properties
- 2. Collect all design constraint** → Constraint function (s)
- 3. Establish the objective function (s)**
  - Maximizing stiffness
  - Minimizing cost



## General form of Optimization problem

Minimize

$f(x)$

Such that

$g_j(x) > 0$

$h_k(x) = 0$

$j = 1, \dots, n_g$

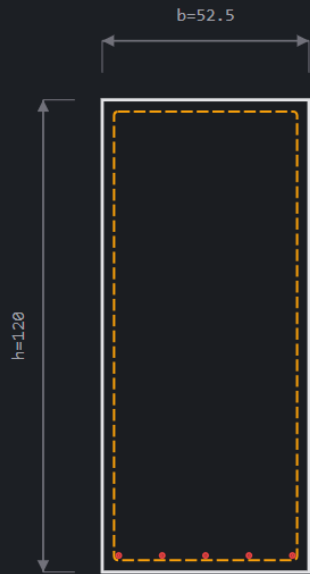
$k = 1, \dots, n_k$

Objective function

Constraint functions

# Scale Changes Design Logic

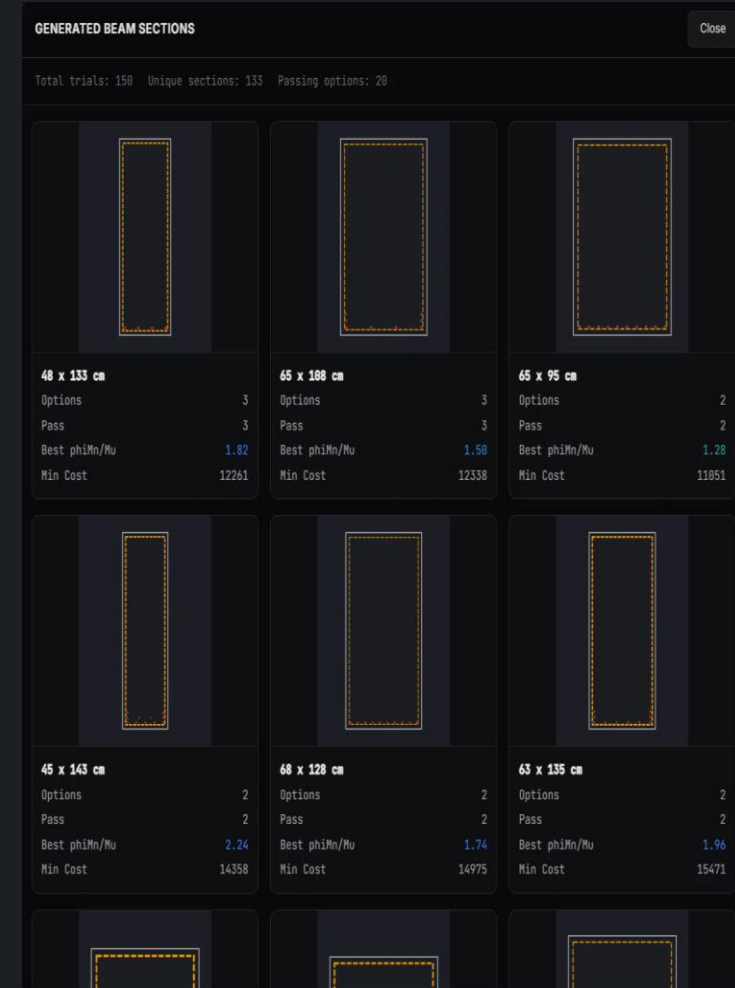
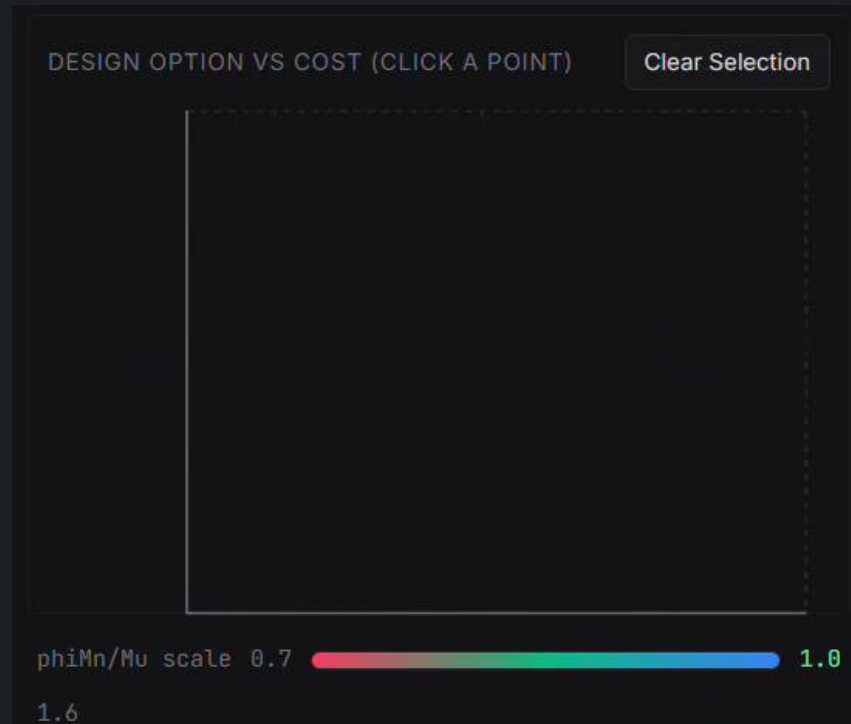
The difference is not speed.  
The difference is scale.



Bot: 5-DB12

1 solution

VS



1000x solutions

# Reinforcement Optimization



RC BeamDesigner
RC BEAM DESIGNER   RC COLUMN DESIGNER   RC SLAB DESIGNER   RC FOUNDATION

**LOAD DEFINITION**

Structure: Supported Beam | Category: Heavy

Span(m): 8 | Count: 3 | Trib(m): 3.9

SDL(kg/m<sup>2</sup>): 100 | Wall(kg/m): 0

**DESIGN FORCES**

Mu (+): 42246.143999999986

Mu (-): 52808

Shear Vu: 37956

**GEOMETRY & MATERIALS**

Width (cm): 40 | Depth (cm): 80

f'c (ksc): 240 | Grade: SD40

**REINFORCEMENT**

**BOT REBAR**

1 | 5 | DB28

**TOP REBAR**

No reinforcement

**STIRRUPS**

Bar Size: DB12 | Spacing (cm): 15

**CROSS SECTION**

Bot: 5-DB28

**STRESS & STRAIN**

phiMn (+) 74125 kg-m   phiMn (-) 0 kg-m   Governing   0 kg-m

**SPAN ANALYSIS (SFD / BMD)**

Elastic:  $V(x) = w_0 \cdot x - w_0 \cdot L \cdot x^2 / 2L$   
 Continuous equal spans:  $M_{max} = +w_0 \cdot L^2 / 8$     $M_{min} = -w_0 \cdot L^2 / 8$   
 Click value to set as load/element

**VERIFICATION (ACI 318)**   CALCULATIONS   GENERATIVE

MAX DESIGN RATIO **64%** PASS

**Flexural Strength (+)** OK

$\phi M_n \geq M_u$    **74125** / 42246 kg-m  
 57%

**Shear Strength** OK

$\phi V_n \geq V_u$    **58882** / 37956 kg  
 64%

**Min Reinforcement** OK

$\rho \geq \rho_{min}$    **0.0103** / 0.0035

**Max Reinforcement** OK

$\rho \leq \rho_{max}$    **0.0103** / 0.0197

*Ensures tension-controlled failure*

**Strain (Ductility)** OK

$\epsilon_t \geq \epsilon_{0.004}$    **0.0096** / 0.004

**Stirrup Spacing** OK

$s \leq s_{max}$    **15** / 37.2 cm

**Min Stirrup Area** OK

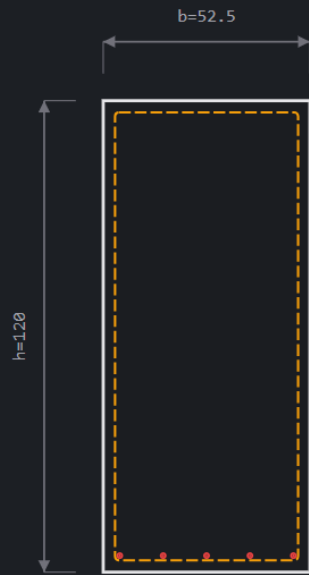
$A_v \geq A_{v_{min}}$    **2.26** / 0.53 cm<sup>2</sup>

**CRITICAL WARNINGS**

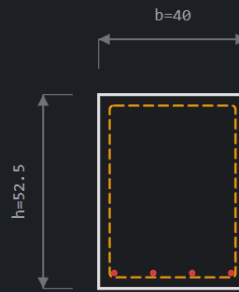
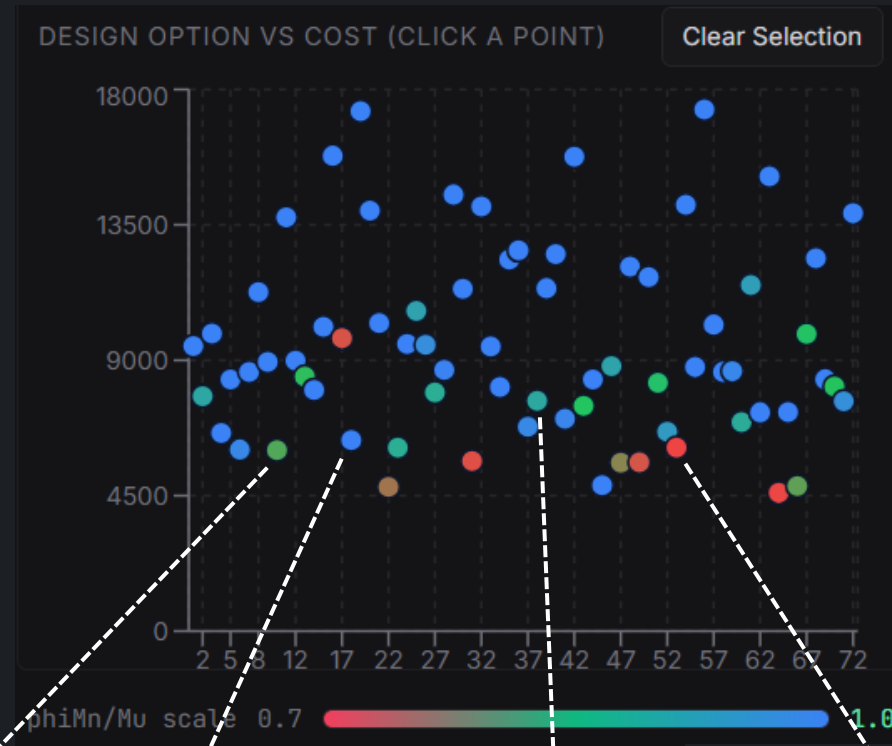
- Custom Moment values active.

Developed by: Dr. Siradech Surit, Faculty of Architecture, Kasetsart University

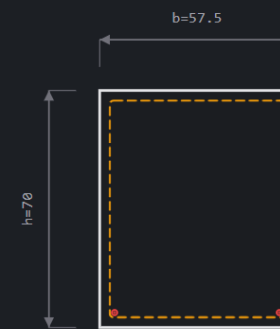
# From Checking to Searching



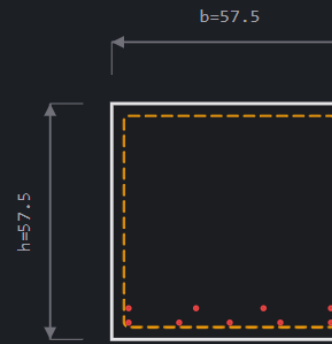
Bot: 5-DB12



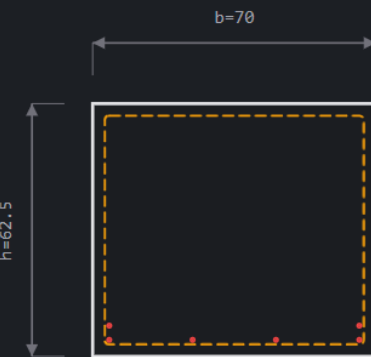
Bot: 4-DB12



Bot: 2-DB16



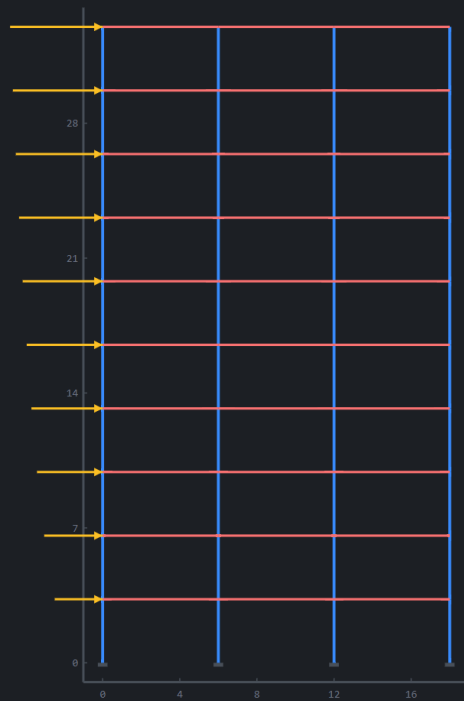
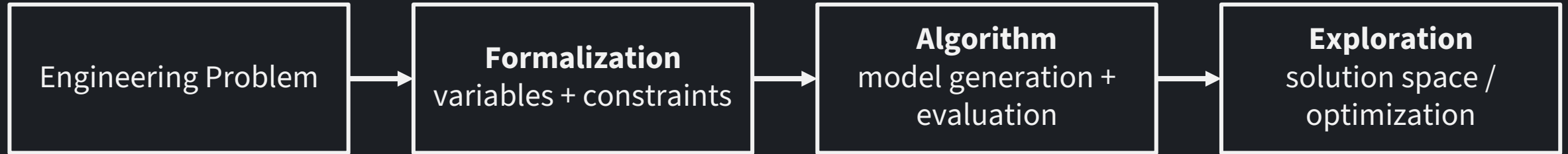
Bot: 5-DB10 + 4-DB10



Bot: 4-DB10 + 2-DB10



# Computational Thinking in Practice

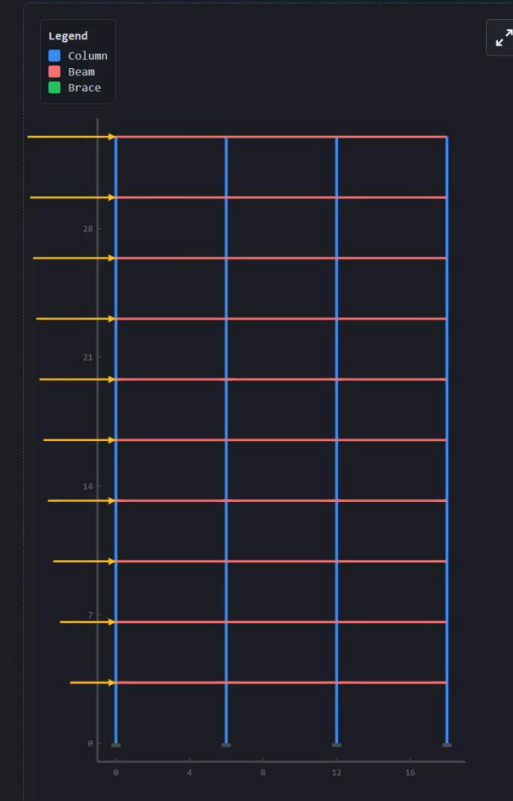


Number of Stories

Number of Bays

Typical Story Height (m)

Bay Span (m)



GA Process Monitor

GENERATION	FITNESS
0	0.00
BEST DISP	COST
0.00 mm	0

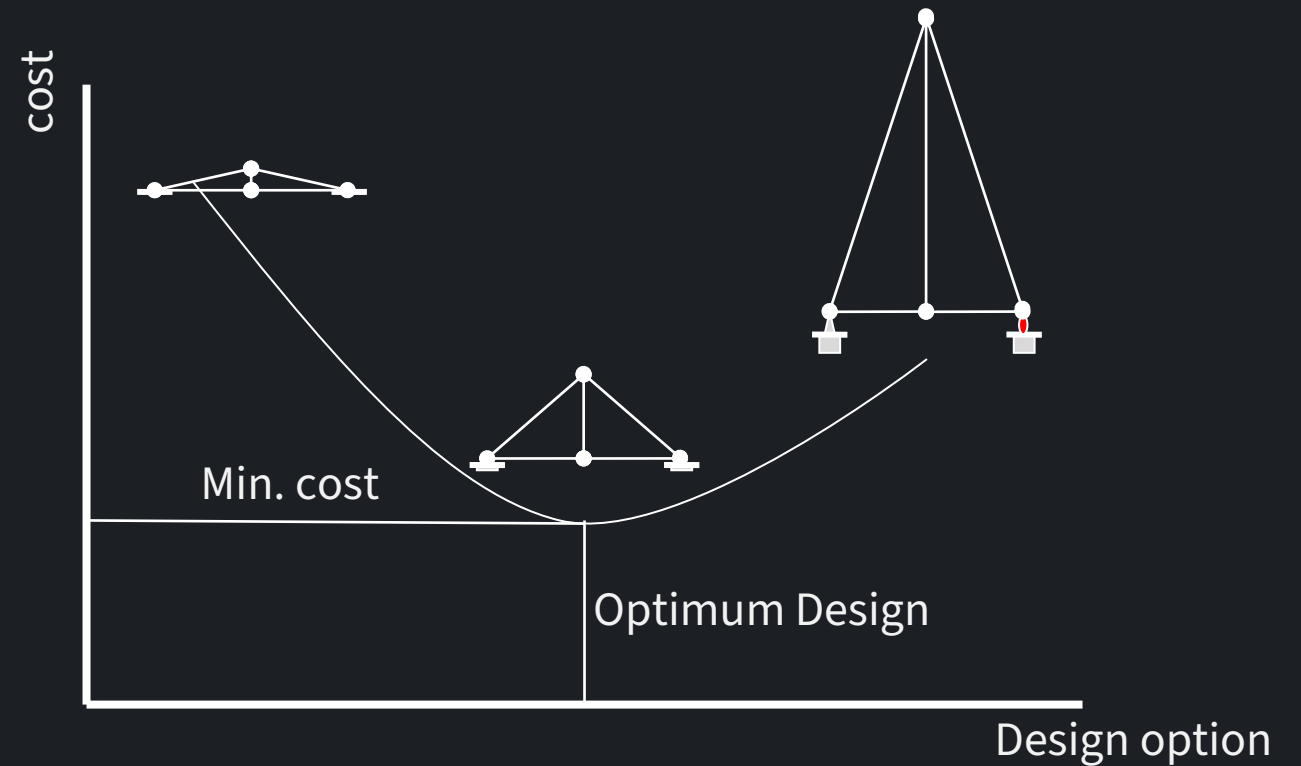
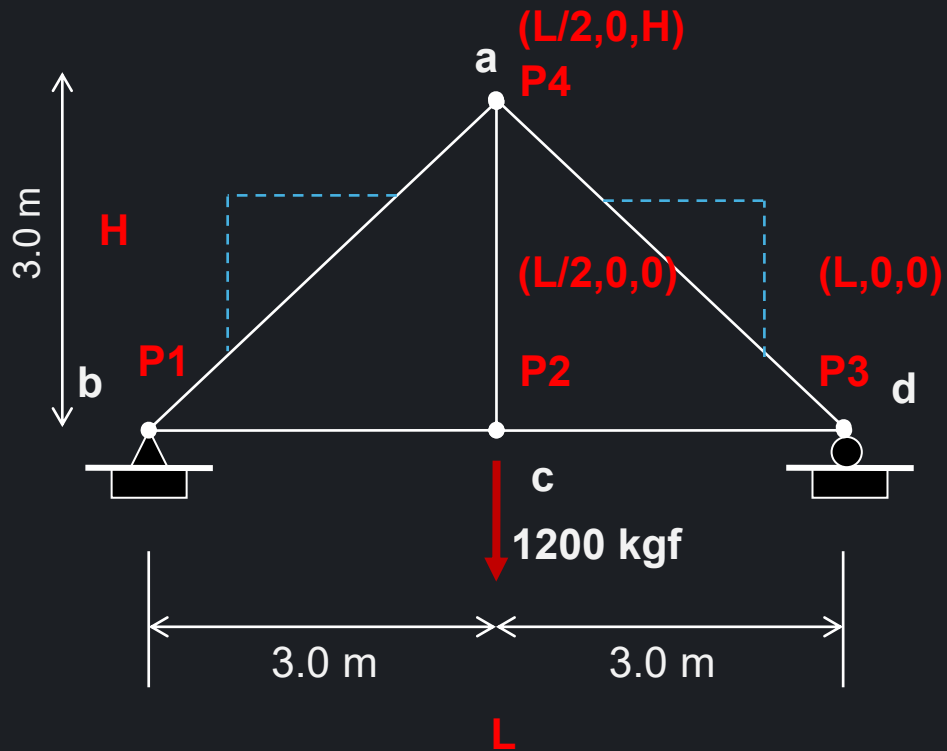
Halting...

Evolution Details [Show Details](#)

POPULATION SAMPLE

# Practical Applications

# Optimization in Structural Design



# Optimization in Structural Design



The screenshot displays the Structural Studio web application interface. At the top, the browser address bar shows the URL `pirun.ku.ac.th/~archsds/_ss/`. The application header includes a navigation menu with icons for File, Edit, Display, Create, and FormForge, along with buttons for 'Select Case', 'Analyze', 'StrucSync', and 'FormFactor'. A 'Log In' button is positioned in the top right corner.

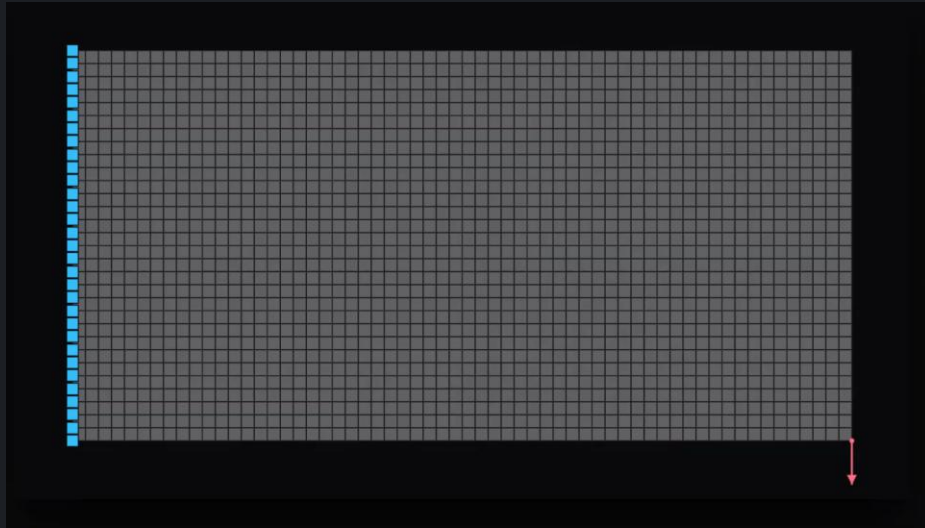
The main workspace is divided into three primary sections:

- Project Explorer:** A sidebar on the left containing a tree view with categories: Parametric Curves (0), Nodes (0), Members (0), Load Cases (1), and Load Combinations (0). The 'Load Cases' section is expanded, showing 'Default Load Case' with ID: 1.
- Structural Model View:** The central canvas area, currently displaying a grid. A tooltip indicates 'Displaying: Case: Default Load Case' and provides instructions: 'Middle-click to pan. Scroll to zoom.' At the bottom of this view, there are four interactive buttons: Select, Pan, Fit View, and Snap.
- Properties:** A panel on the left below the Project Explorer, containing the text 'Select an element to view its properties.'

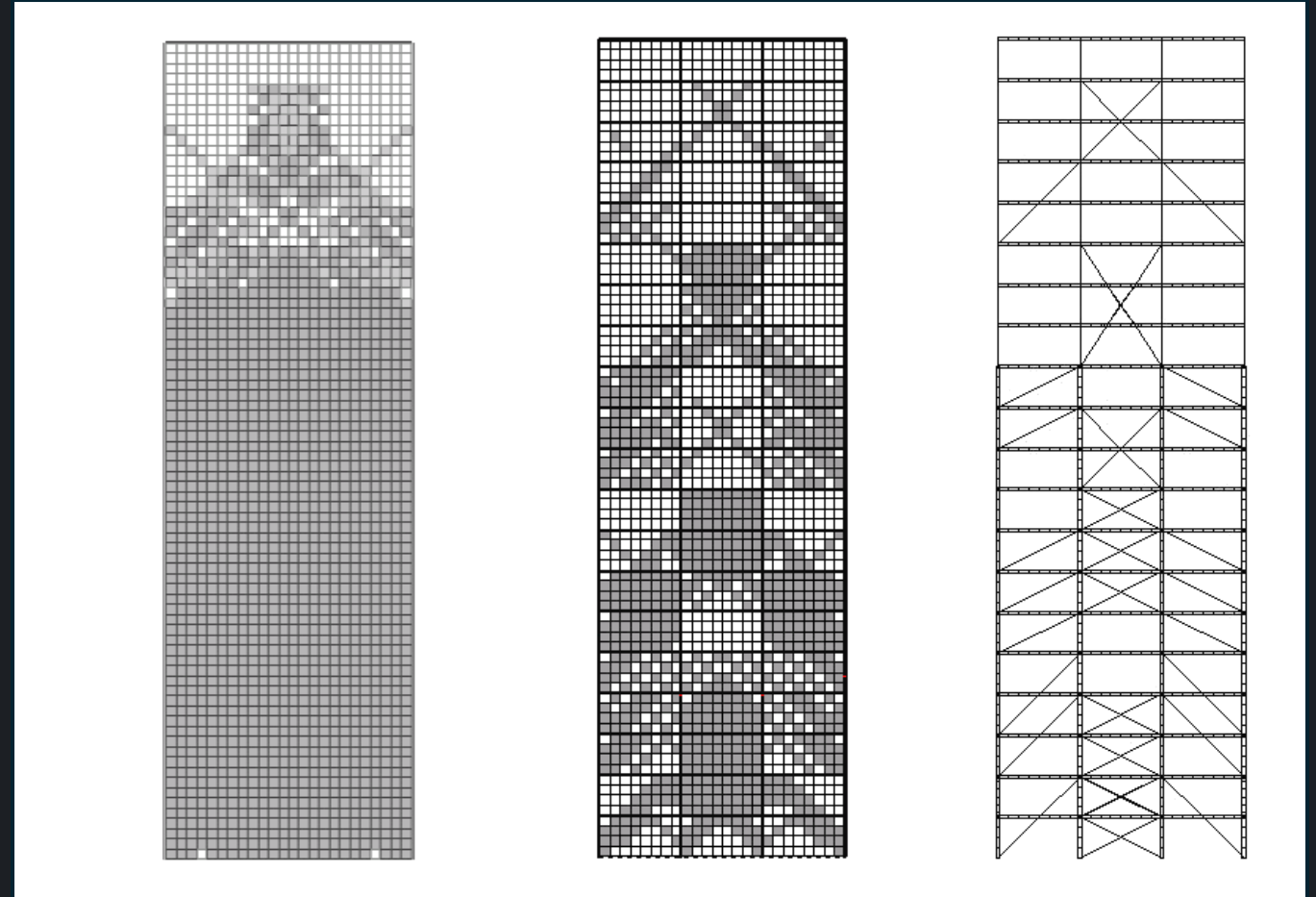
The bottom of the interface features an 'Activity Console' with a log of system messages, including 'welcome to Structural Studio', 'Developed by Dr. Siradech Surit, Faculty of Architecture, Kasetsart University (siradech.s@ku.th)', and 'New project created. The canvas is ready.' Below the console is a command prompt with the text 'Type a command... (try 'help')'.

The Windows taskbar at the very bottom shows the system tray with a temperature of 31°C, a search bar, and various application icons. The system clock indicates the date 2025-07-20 and time 17:23.

# Topology Optimization Toward Buildable Forms



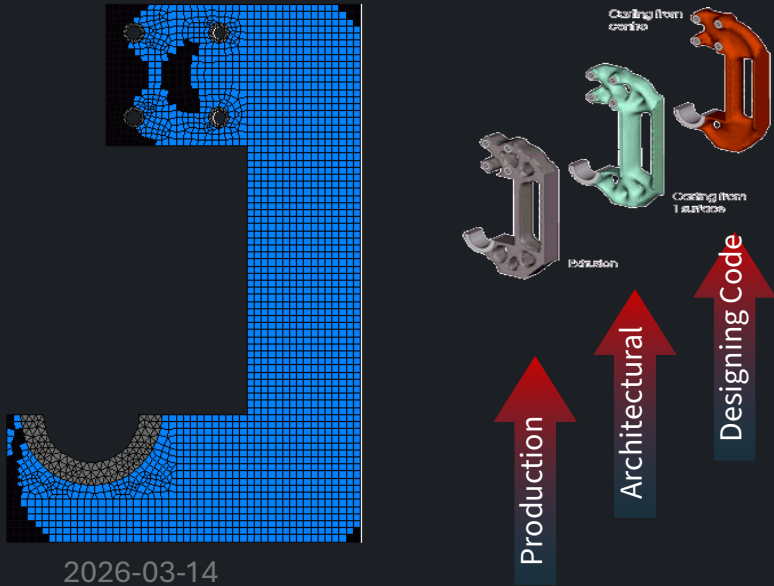
Optimization Engineering logic Construction system



Topology field

Skeleton

Buildable



# Lightweight Panel Optimization



### BoardOptimization

Panel Layout Optimizer

EDITOR MODE

Geometry Openings

Draw Custom Panel

OVERLAY IMAGE

Upload Image

SURFACE TYPE

Wall Ceiling

SNAP GRID (CM)

1 5 10 15 20

25 50 100

OPTIMIZATION TARGET

Min. Waste Min. Seams

CALCULATION SCOPE

All Walls Ceilings

SEAM PREFERENCE

Vertical Horizontal Any

Force Full Height Panels

Auto-Run (1s delay)

Calculate All Walls

Clear Results & Custom Panels

Bed 1 Bed 2 Hall + Room

Export PDF New Save Load

West South 1 South 2 South 3 East North Ceiling 1

View Settings Reset

Scale: 21.3px / cm  
Snap: 10 cm  
X: 17 Y: 251

Wall Width: 438

Height: 240

1 - A 120x240

5 - A 5x240

9 - B 120x53

9 - C 120x53

13 - D 13x53

9 - A 65x240

13 - A 120x74

13 - B 120x74

13 - C 13x74

Material Use

Type:	Wall
Panels:	9
Unique Boards:	4
Net Area:	7.71 m <sup>2</sup>
Panel Area:	7.71 m <sup>2</sup>
Coverage:	100.0%

Wall Framing (4m)

U-frame (horizontal) C-stud (vertical)

Lines: 4 Segs: 15

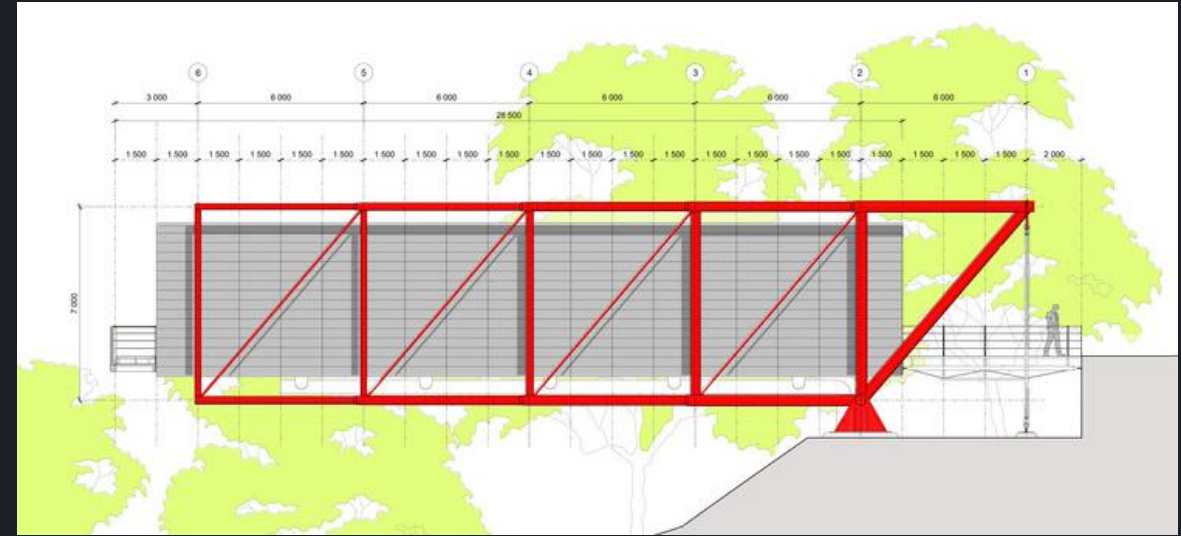
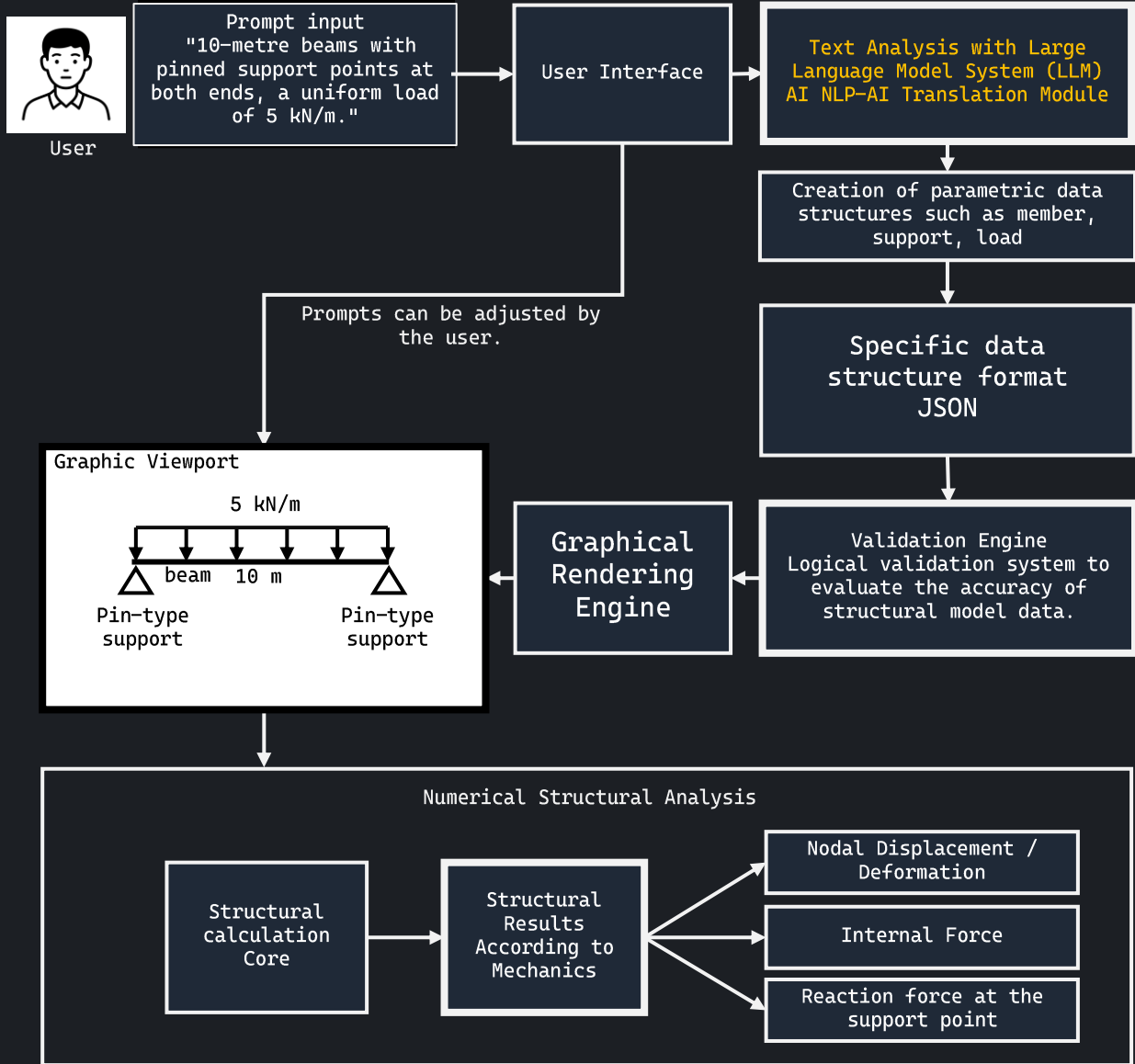
Bars: 4 Bars: 7

L: 13.7 m L: 21.9 m

Legend

U-frame C-stud

# AI-Assisted Implementation in Engineering Workflow



courtesy of RSHP

<https://rsdp.com/projects/culture-and-leisure/the-richard-rogers-drawing-gallery/>

## Prompt input

Model a cantilever steel gallery structure using a rectangular box truss. The building is about 27 m long, 6 m wide, and 4 m high, with roughly 15 m cantilever beyond the main support. Use two longitudinal trusses connected by floor and roof beams, with vertical members and diagonal bracing. The support is located at one end on a pile foundation and should be modeled as fixed. Add tension cables near the cantilever tip and apply a uniform floor load.

# AI-Assisted Implementation in Engineering Workflow



**Structural Studio**

File Edit Display Underlay Create FormForge FormFactor StrucSense

Case: Default Load Case Analyze Structural Sync: Stale Results Results Admin

Search model...

N	0	M	0	S	0	L	0
Mt	21	Sc	8	P	0	D	1

MATERIALS 21

- S235 210GPa
- S275 210GPa
- S355 210GPa
- S450 210GPa
- High-Stren 200GPa
- Fe24 Steel 210GPa
- C20/25 30GPa
- C25/30 31GPa
- C30/37 33GPa
- C40/50 35GPa
- C50/60 37GPa

Select an element to view its properties.

Structural Model View  
Displaying: Case: Default Load Case  
Plane: XZ @ Y = 0.000 m

Select Pan Crop Fit View Snap 3D

```
[21:33:46] > Welcome to Structural Studio!  
[21:33:46] > App loaded in 0.16 seconds.  
[21:34:18] > New project created.
```

Command...

Copy Verbose Clear

# AI-Assisted Implementation in Engineering Workflow

The image displays a software interface for AI-assisted structural engineering. On the left, the **FormForge AI** panel is active, showing a **FormForge Prompt Builder** where a user has defined a **Portal frame** structure with **Steel** material and a **Span (m)** of **10**. The height is set to **6** meters, and the load pattern is **Point loads at top nodes**. The AI Activity Console shows the process of generating a structural model with 40 nodes, 152 members, 2 supports, and 10 loads.

The main workspace is **Structural Studio**, which displays a **Structural Model View** of the generated portal frame. The model is shown in a 2D view (XZ plane at Y = 6.000 m) and a 3D perspective view. The 2D view shows a truss-like structure with nodes N1 through N11 and members colored in a gradient from red to green. The 3D view shows the full structure with a red frame and green members. The interface includes a toolbar with options like **Select**, **Pan**, **Crop**, **Fit View**, **Snap**, and **3D**. The bottom right corner has **Copy**, **Verbose**, and **Clear** buttons.

**FormForge AI** AI: Operational Credits: 999999/999999

**FormForge** FormLynx CIM

**FormForge Prompt Builder**  
Describe the structure you want to generate.

Structure Type: Portal frame Material: Steel Span (m): 10  
Height (m): 6 Supports: Fixed at bases  
Load Pattern: Point loads at top nodes Point Load (N): 1  
 Auto-sync prompt from builder

Apply a uniform floor load to represent the gallery floor load.  
Return a simplified beam-frame structural model with nodes, beam elements, cable elements

**AI Activity Console**

- > FormForge [1/5] Prepared prompt (1,117 bytes)
- > FormForge [2/5] Submitting payload to AI compute service for inference
- > FormForge [3/5] Received response (6,985 bytes)
- > FormForge [4/5] Parsed JSON (6,985 bytes)
- > FormForge [5/5] Built model (31,085 bytes) - nodes: 40, members: 152, supports: 2, loads: 0, memberloads: 10
- > Model generation completed.

**Structural Studio** File Edit Display Underlay Create FormForge FormFactor StrucSense

Case: Default Load Case Analyze Structural Sync: Stale Results Results Siradech SURIT

Search model...  
N 28 M 93 S 4 L 9  
MT 26 Sc 8 P 0 D 1

**NODES**  
N1 0.0,0.0,0.0  
N2 0.0,0.4,0.0  
N3 0.0,0.8,0.0  
N4 0.0,0.4,0.0  
N5 3.0,0.0,0.0  
N6 3.0,0.4,0.0  
N7 3.0,0.8,0.0  
N8 3.0,0.4,0.0  
N9 6.0,0.0,0.0  
N10 6.0,0.4,0.0  
N11 6.0,0.8,0.0

Structural Model View  
Displaying: Case: Default Load Case  
Plane: XZ @ Y = 6.000 m

Select Pan Crop Fit View Snap 3D

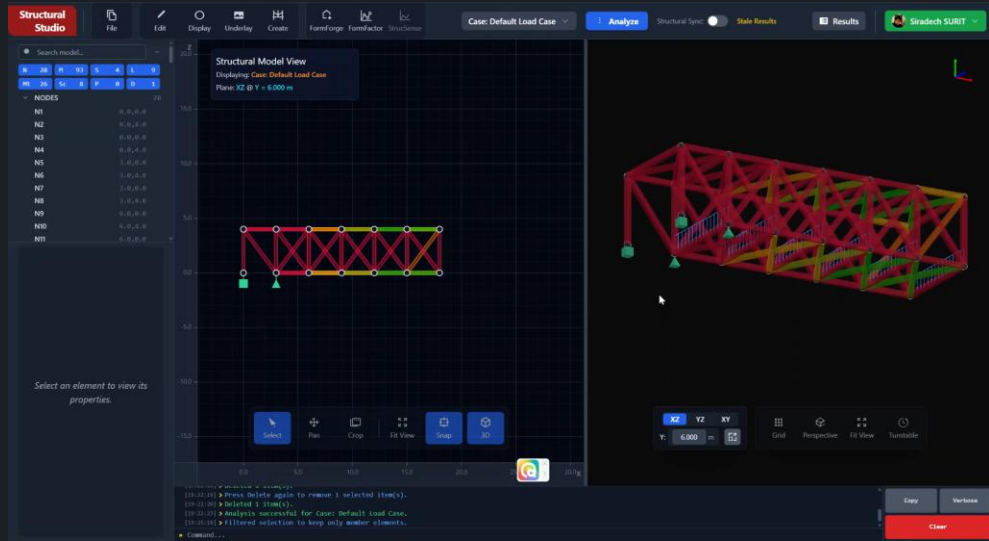
XZ YZ XY  
Y: 6.000 m Grid Perspective Fit View Turntable

[19:22:19] > Press Delete again to remove 1 selected item(s).  
[19:22:20] > Deleted 1 item(s).  
[19:22:23] > Analysis successful for Case: Default Load Case.  
[19:25:18] > Filtered selection to keep only member elements.

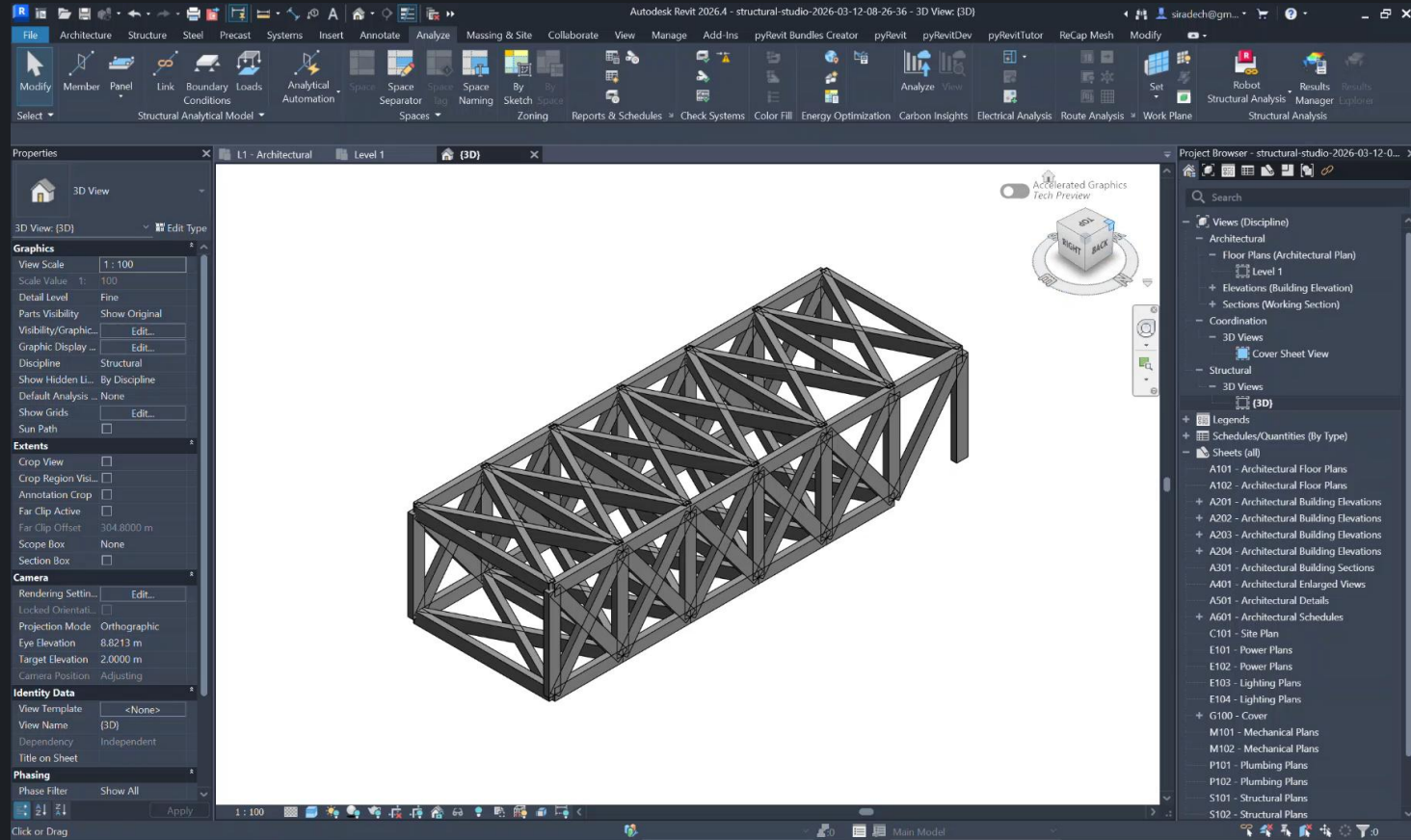
Command...

Copy Verbose Clear

# AI-Assisted Implementation in Engineering Workflow



IFC



# Carbon-Intelligent Objective Functions



**Structural Studio**

Case: Dead Load | Analyze | Structural Sync:

Results | Siradech SURIT

Structural Model View  
Displaying: Case: Dead Load  
Plane: XZ @ Y = 0.000 m

Nodes: N1 (0,0,0), N2 (6,0,0), N3 (12,0,0), N4 (0,0,0), N5 (6,0,0), N6 (12,0,0), N7 (0,0,4), N8 (6,0,4), N9 (12,0,4), N10 (0,0,4), N11 (6,0,4)

FormFactor Dashboard

Summary

Weight	22.91 N (-417 (-95%))	Cost	3,547.08 (+183 (5%))	EC (kgCO2e)	116.82 kgCO2e (-16,738 (-99%))
--------	-----------------------	------	----------------------	-------------	--------------------------------

Charts

Optimization history

Export CSV | Trend | Pareto

Weight (N) vs EC (kgCO2e) chart showing optimization progress.

Run log: carbon-auto showing last 40 of 40

Step 1 - Chosen: M18 ΔEC 4

Utilization... | Run Optimization

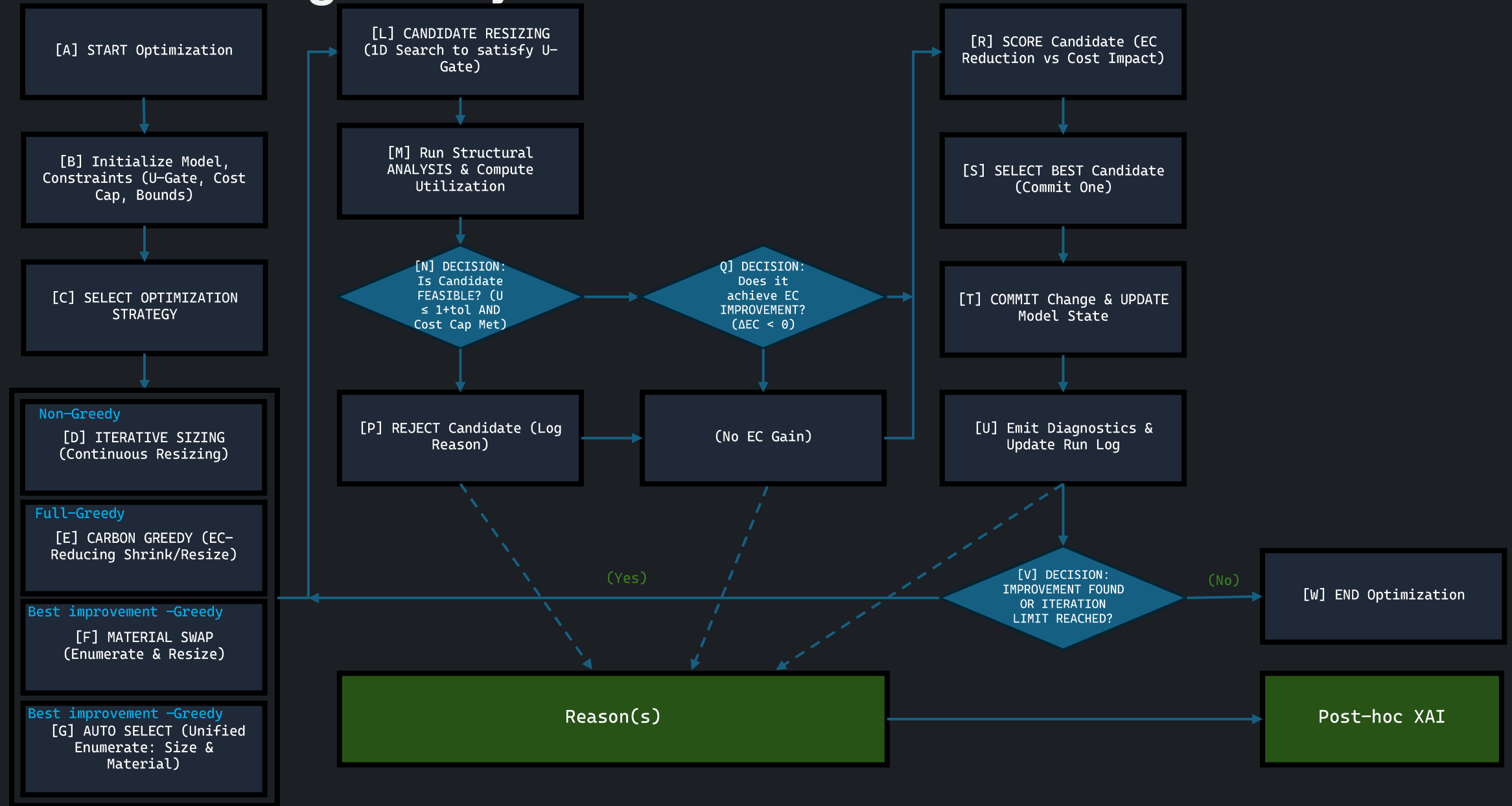
Live Optimization:

Select | Pan | Crop | Fit View | Snap | 3D

Command log:

```
[16:58:42] > Analysis successful for Case: Dead Load.  
[16:58:42] > Optimization complete. Weight=28.210, Cost=2875, EC=144 kgCO2e (baseline cost 2307, limit Infinity)  
[16:58:43] > Analysis successful for Case: Dead Load.  
[17:00:50] > Optimization complete. Weight=22.913, Cost=3547, EC=117 kgCO2e (baseline cost 2953, limit Infinity)  
[17:00:50] > Analysis successful for Case: Dead Load.
```

# Carbon-Intelligent Objective Functions



# Constructability as a Computable Metric

The screenshot displays the Structural Studio interface. The top navigation bar includes 'Structural Studio', 'File', 'Edit', 'Display', 'Underlay', 'Create', 'FormForge', 'FormFactor', 'StrucSense', 'Case: Dead Load', 'Analyze', 'Structural Sync', 'Stale Results', 'Results', and a user profile 'Siradech SURIT'.

**Structural Model View**  
Displaying: Case: Dead Load  
Plane: XZ @ Y = 0.000 m

**Nodes List:**

N	M	S	L	26
N1	0.0,0.0,0.0			
N2	6.0,0.0,0.0			
N3	12.0,0.0,0.0			
N4	0.0,0.0,0.0			
N5	6.0,0.0,0.0			
N6	12.0,0.0,0.0			
N7	0.0,4.0,0.0			
N8	6.0,4.0,0.0			
N9	12.0,4.0,0.0			
N10	0.0,4.0,0.0			
N11	6.0,4.0,0.0			

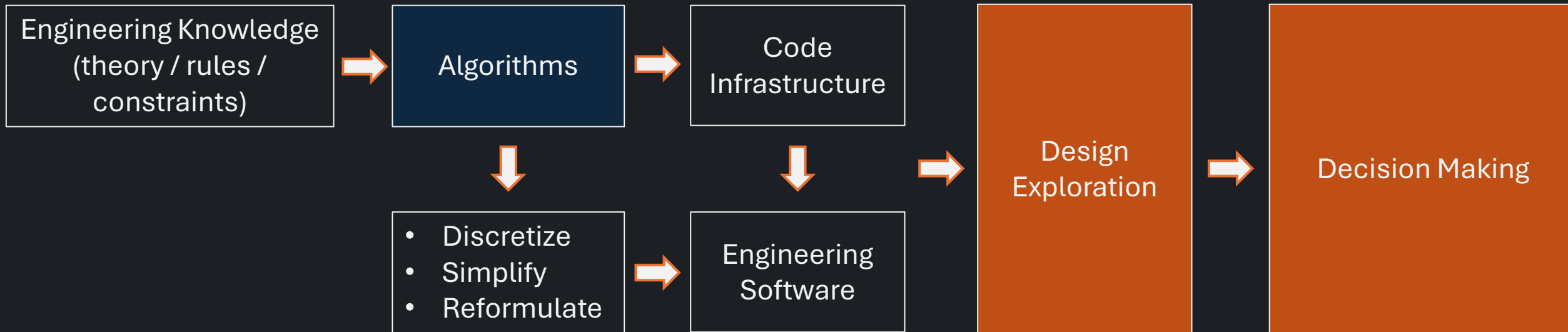
**2D View (Left):** Shows a trapezoidal frame structure with nodes 1-19. Members are labeled M0-M30. A uniform load of 5,000.00 N/m is applied to the bottom horizontal members (M13 and M14). Point loads are shown at nodes 13, 16, and 19: Fz: -1,500.00 N, Fz: -3,000.00 N, and Fz: -1,500.00 N respectively.

**3D View (Right):** Shows the same structure in a perspective view, highlighting the trapezoidal roof and the vertical supports. The point loads are clearly visible at nodes 10, 16, and 20.

**Bottom Panel:** Includes a command line with logs: [13:22:14] > App loaded in 1.33 seconds. [13:22:15] > Material library normalized (24 entries). Filled 24 fields, 24 warnings. [13:22:15] > Project "prelogin.json" loaded successfully. [13:22:15] > Restored current project after login (reload). Command... and buttons for Copy, Verbose, and Clear.

# Theory Under Computational Constraint

Across engineering disciplines, theories evolve when they must become computable.



# Coding as Design Infrastructure



Engineering Knowledge  
(theory / rules /  
constraints)



Algorithms



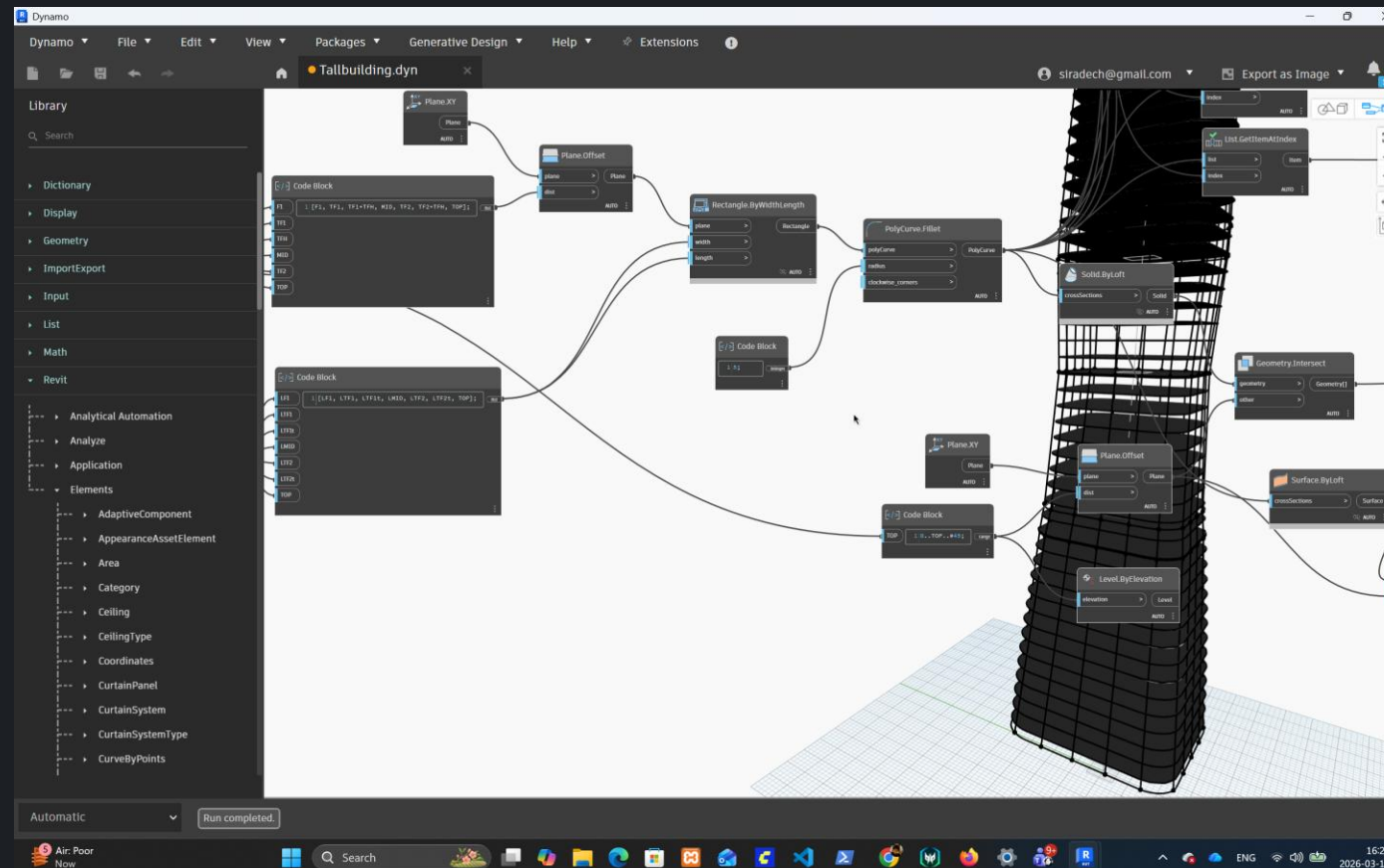
Code  
Infrastructure



Design  
Exploration



Decision Making



# Coding as Design Infrastructure

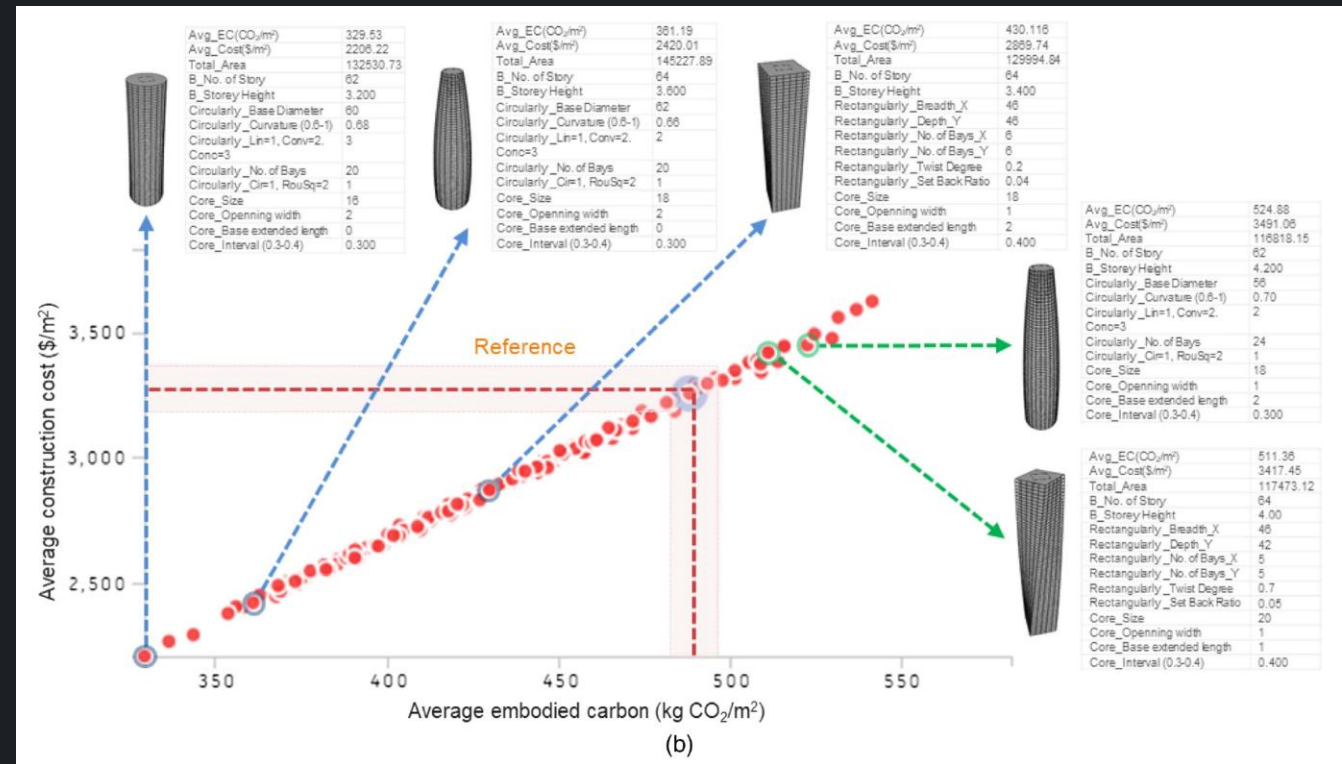
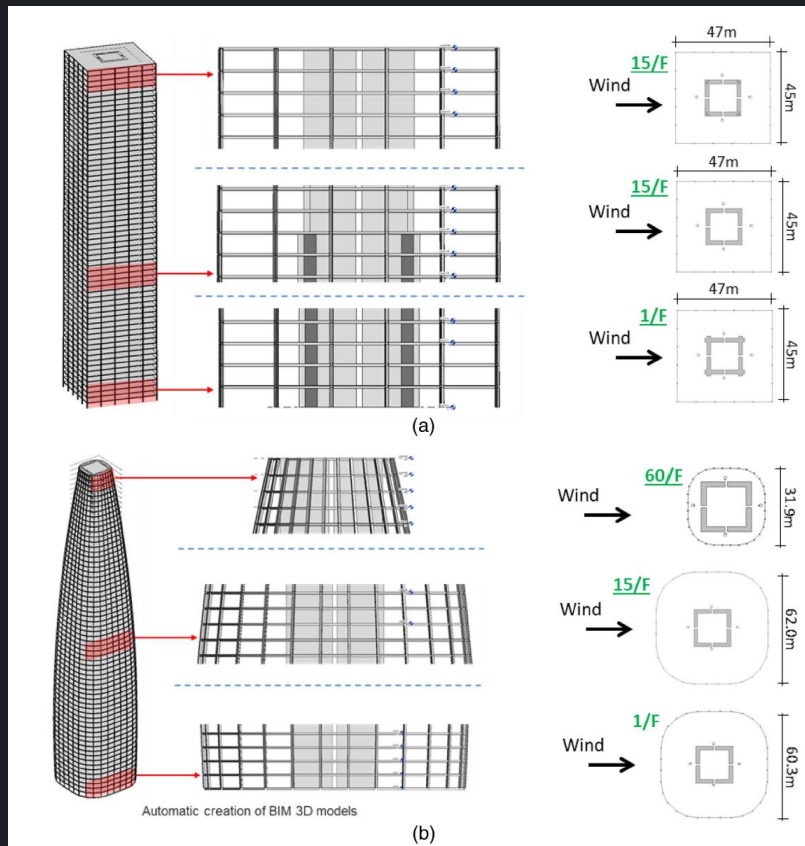
Engineering Knowledge  
(theory / rules /  
constraints)

Algorithms

Code  
Infrastructure

Design  
Exploration

Decision Making



BIM-Based Building Geometric Modeling and Automatic Generative Design for Sustainable Offsite Construction; (2022) Vincent J. L. Gan, Ph.D., A.M.ASCE1

# Coding as Design Infrastructure



## 2D Rectangular Frame FEM Analyzer

• READY

Frame Design GA Optimization

### Input Parameters

Number of Stories

10

Number of Bays

3

Typical Story Height (m)

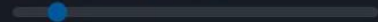
3.5

Bay Span (m)

6

### Visualization

Deformation Scale: 50x



Show Loads

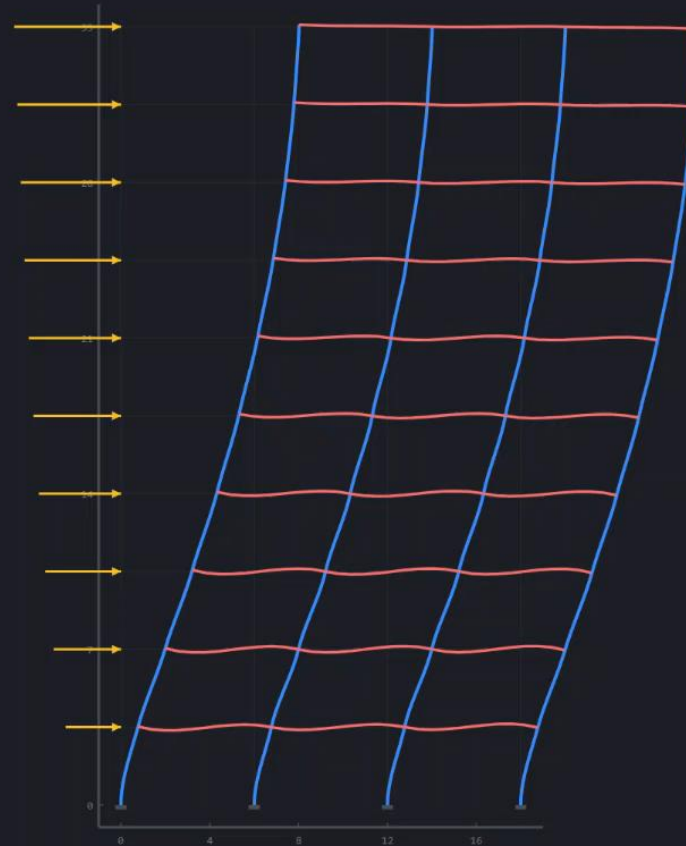
### Global Results

Max Lateral Disp: 160.50 mm

Nodes: 44

Elements: 70

Legend  
■ Column  
■ Beam  
■ Brace



# Education

# Teaching Algorithmic Reasoning



## Traveling Salesman Problem solver

Optimization & Visualization

ALGORITHM

Tree search Genetic

VIEW STYLE

Graph City Grid

BEST DISTANCE 0

CO<sub>2</sub> (KG) 0.00

STEPS 0

CITIES (N) 10

\* Limited to 10 cities for Tree Search visualization

Start Restart

New Problem

v1.0.2 • Tree search


Tree search

TREE VISUALIZATION

Nodes: 1  
Steps: 0

# Teaching Algorithmic Reasoning

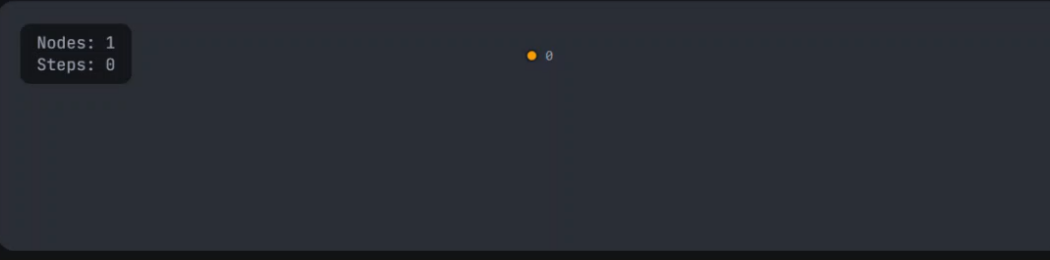
• Tree search



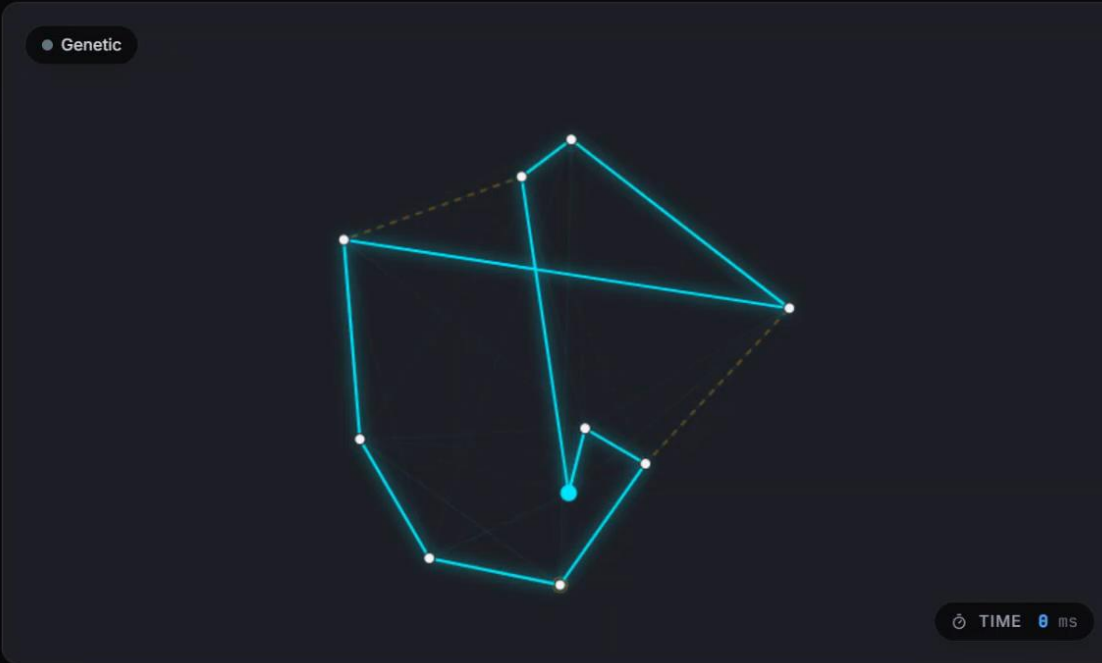
TIME 0 ms

↳ TREE VISUALIZATION ⓘ

Nodes: 1  
Steps: 0



• Genetic



TIME 0 ms

↳ ANALYSIS ⌵ Progress ⓘ Internals ⓘ

# AI as Assistant, Not Replacement

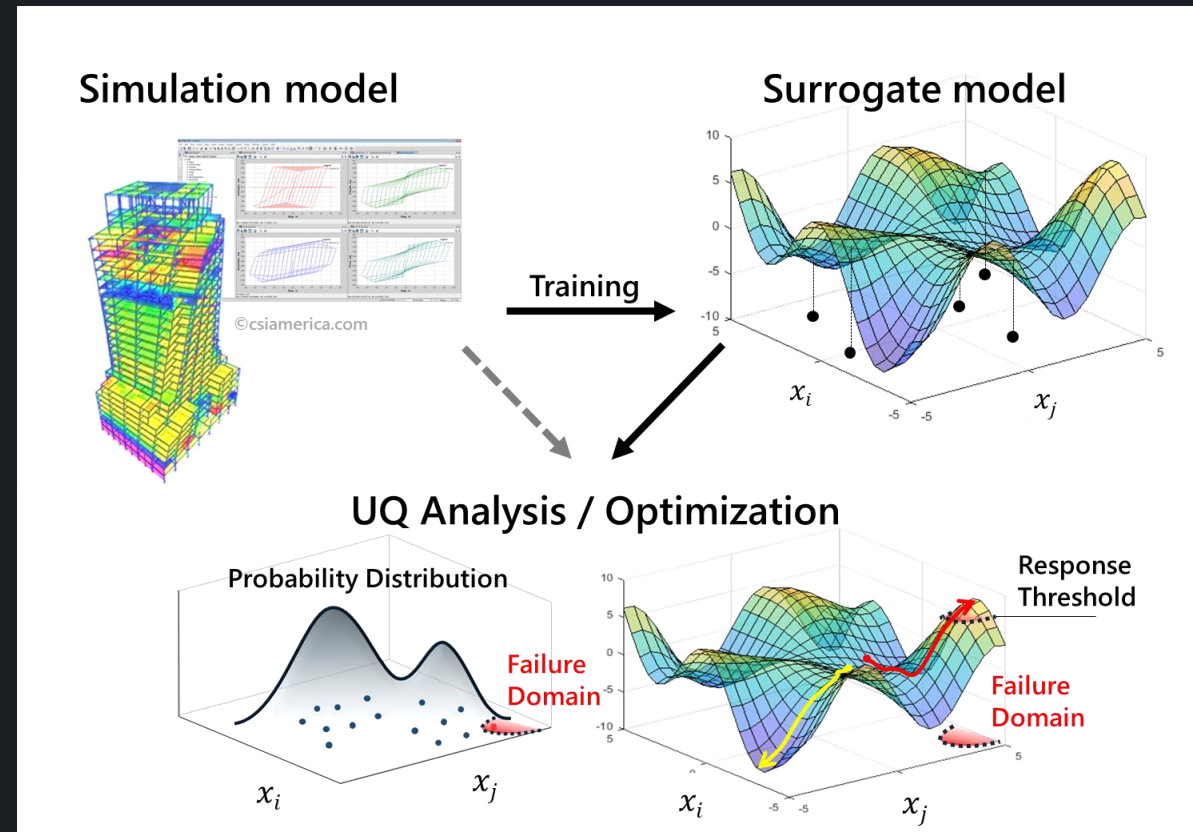
Data-driven and AI-assisted algorithms do not replace structural theory. They extend our ability to predict, approximate, and explore.

Data



Surrogate Modeling  
Neural Networks  
Reinforcement Learning  
Approximate | Predict |  
Decide  
Fast evaluation |  
Complex mapping |  
Sequential action

AI assists computation when engineering problems become too large to explore directly



<https://github.com/NHERI-SimCenter>

# Revisiting Argyris: Does Computation Shape Theory Today?

- ❑ Engineering theory becomes operational through computation.
- ❑ Computational thinking transforms design from solving to searching.
- ❑ Engineers design the rules → computers explore the possibilities.

Engineering is no longer about solving a problem.  
It is about designing the space of possible solutions.

Computational thinking does not replace engineering knowledge.  
It gives us a new way to structure it.

And perhaps that is what Argyris meant when he said:  
***the computer shapes the theory.***



25<sup>th</sup>  
anniversary  
architecture  
KU

## Faculty of Architecture Kasetsart university



## Faculty of Engineering Kasetsart university

