



FORM – FINDING  
=  
ARCHITETTURA+INGEGNERIA

20 GENNAIO 2016  
TOR VERGATA - ROMA



## COSA È IL FORM FINDING?

- È un termine che si riferisce in particolare alle tensostrutture
- Si ricerca la geometria della tensostruttura in grado di essere stabile
- Ci si può riferire alla ricerca della forma che meglio risponde ad un dato sistema di forze
- Si può estendere il concetto alla ricerca della forma che meglio risponde ad una data funzione
- Il concetto può diventare ampio e generico
- Il Form Finding può essere visto come un processo di ottimizzazione



# LEGAME TRA FORMA E FUNZIONE

- Il Form Finding è un processo iterativo che non ha necessariamente una soluzione univoca
- La «stabilità strutturale» di una forma dipende strettamente dal suo stato di sforzo
- La composizione architettonica non può prescindere dal funzionamento strutturale
- La forma strutturale è influenzata dalle condizioni al contorno



# PARAMETRI DEL FORM-FINDING

Il risultato del processo del Form Finding dipende da molteplici fattori:

- Tipo di Ottimo al quale deve tendere il Form-Finding
- Stato di Sforzo
- Condizioni di vincolo
- Resistenza dei Materiali
- «Costruibilità» della geometria ottenuta
- Scelta del Sistema di forze di riferimento



# PARAMETRI DEL FORM-FINDING

Definizione di Ottimo e dei parametri da utilizzare:

- Scelta del Sistema di forze di riferimento
- Minimo Peso (Elimino parti non efficaci)
- Minimo Costo (Attenzione!! Il costo non è proporzionale solo al peso, ma anche alla complessità)
- Struttura solo compressa (Arco)
- Struttura solo tesa (Tensostruttura)



# PARAMETRI DEL FORM-FINDING

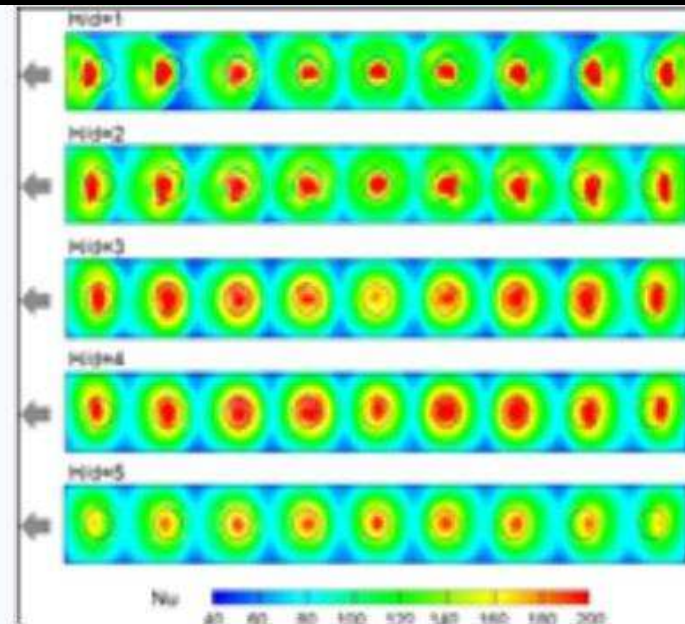
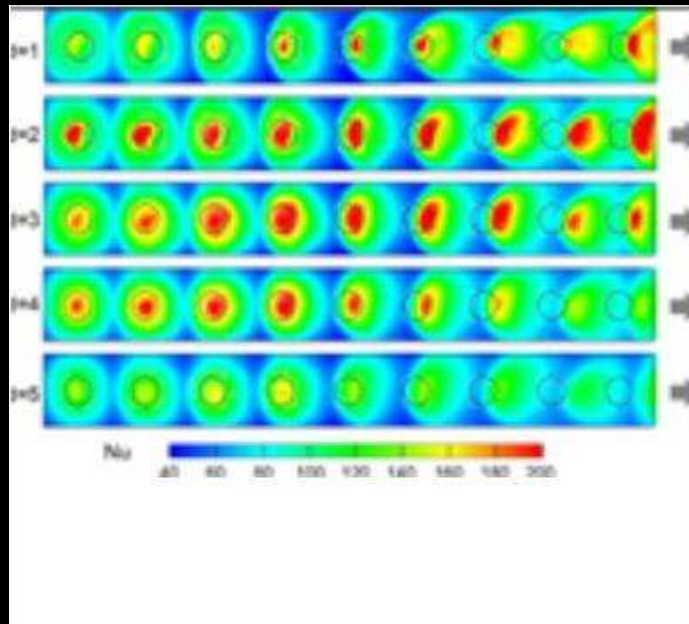
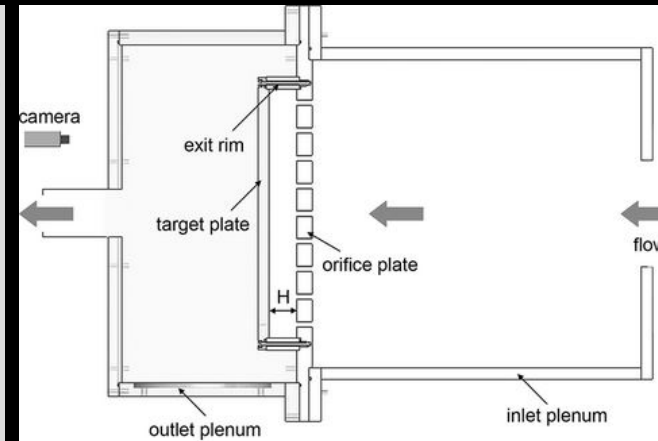
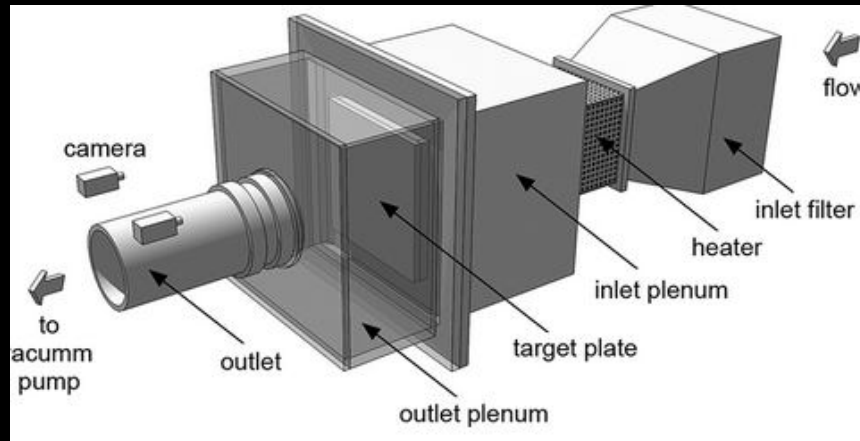
Il Form Finding non è solo riferito alle strutture:

- Termodinamica: esempio ottimizzazione della forma che disperde minor calore (Sfera vs Cilindro nei corpi caloriferi)
- Elettromagnetismo: forma dell'antenna che massimizza l'emissione del segnale
- Sistemi di Shading: massima illuminazione ma minima energia termica (persiane, brise soleil etc...)



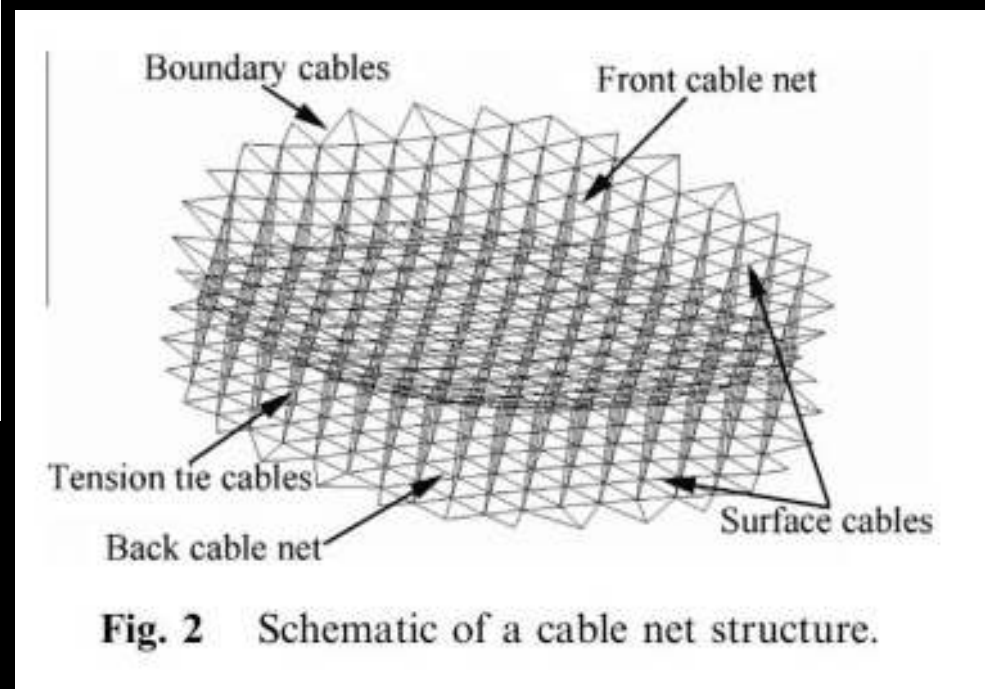
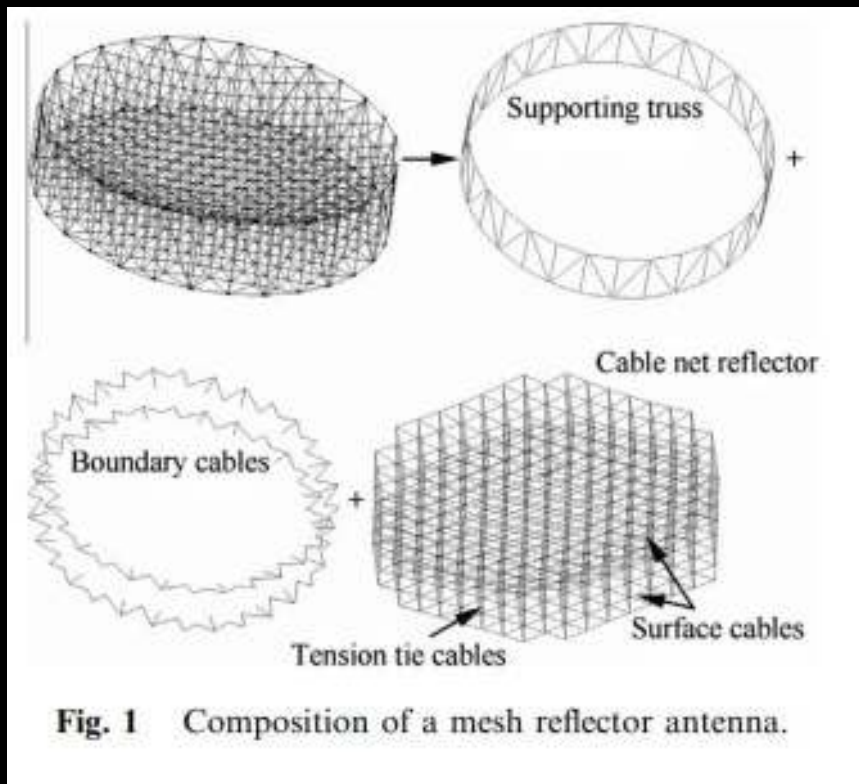
# ESEMPIO TERMODINAMICO

## Ottimizzazione piastra di raffreddamento motore Jet



# ESEMPIO ELETTROMAGNETISMO

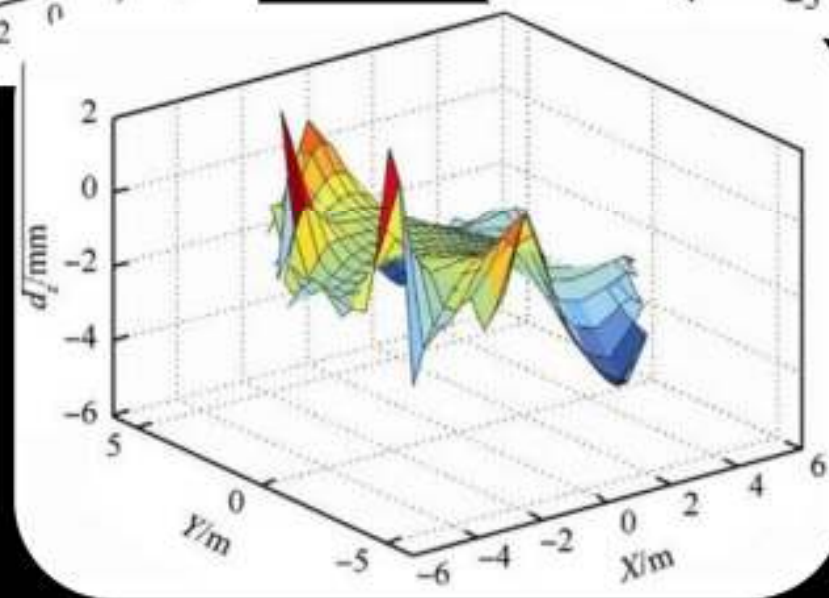
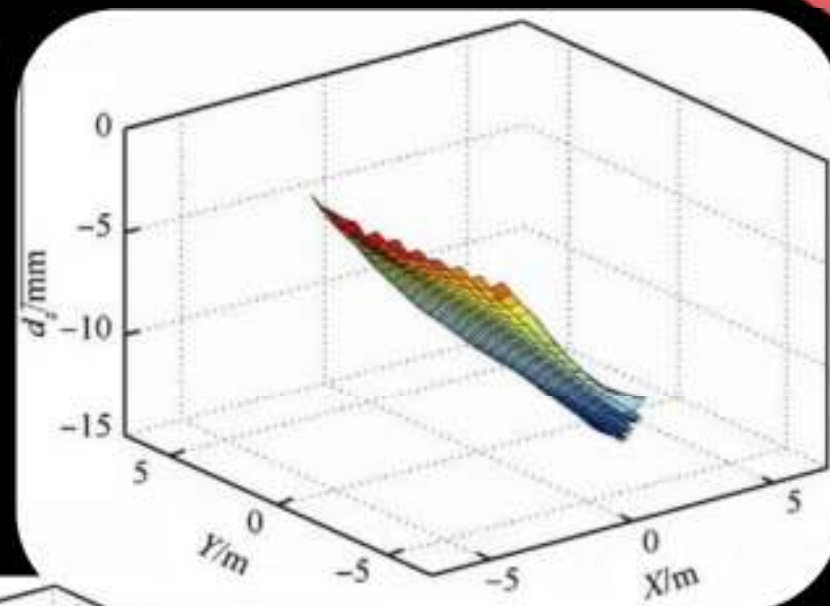
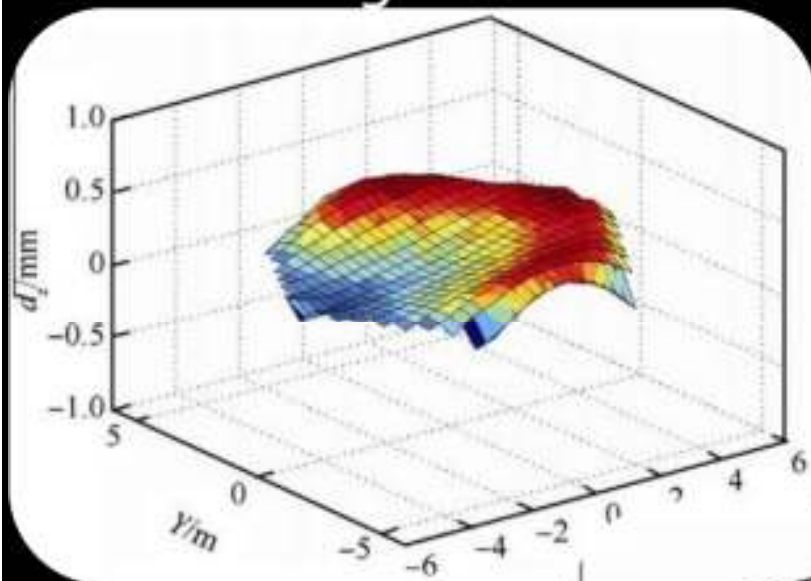
## Form Finding di Antenna Piegabile





# ESEMPIO ELETTROMAGNETISMO

## Form Finding di Antenna Piegabile



# ESEMPIO SHADING

Brickell Center Miami – Florida – (Hugh Dutton Associés)





# ESEMPIO SHADING

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### PARAMETRIC PERFORMATIVE DESIGN

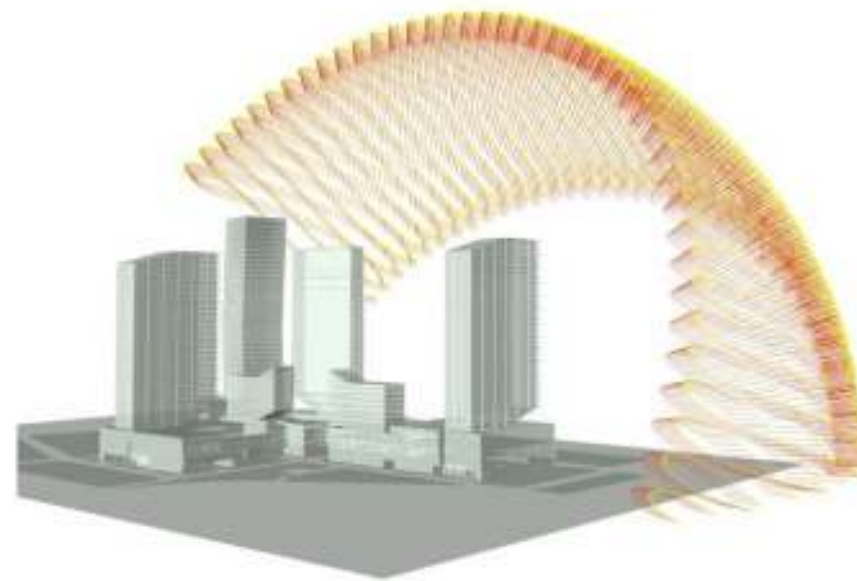
Digital quantitative and qualitative performance-based simulations are used as a technological foundation for a comprehensive new approach to the design of the built environment.

The performative design thinking is supported by a range of digital performance analysis and simulation tools. Its key challenge is to determine the different performative aspects.

By superposing various analytical evaluations, design alternatives could be compared with relative simplicity to select a good solution.

Performance-based generative design guides the imagination towards forms that reflect rather than contradict real design constraints.

The tools used lead to new synergies between architecture and engineering in a collaborative quest to produce unimaginable built forms that are multiply performative.



Solar rays from 9am to 7pm for the entire year

HDA

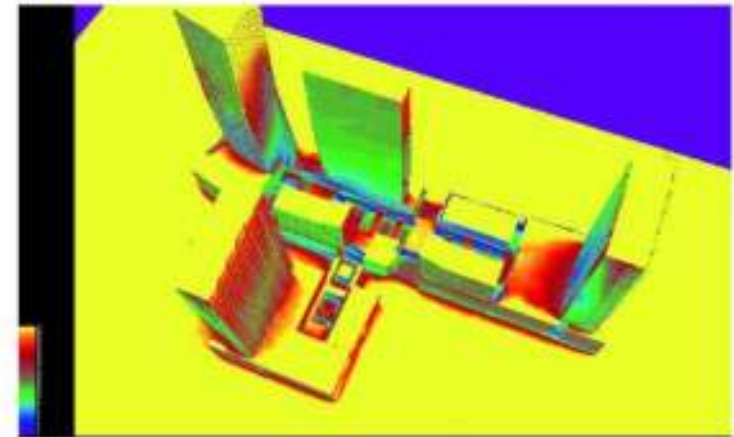
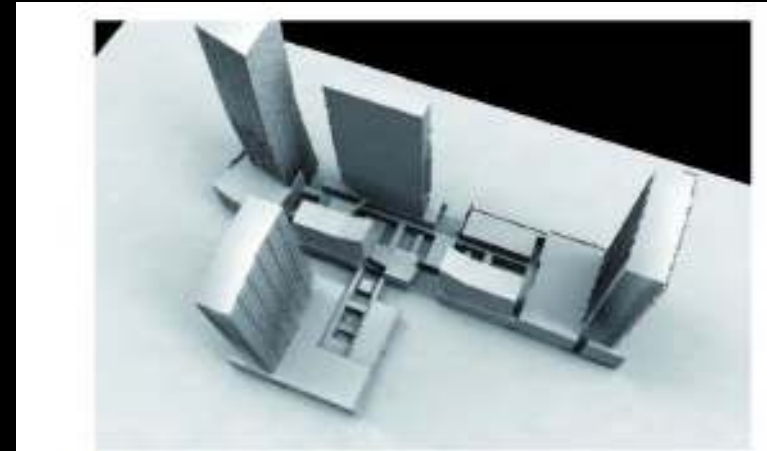
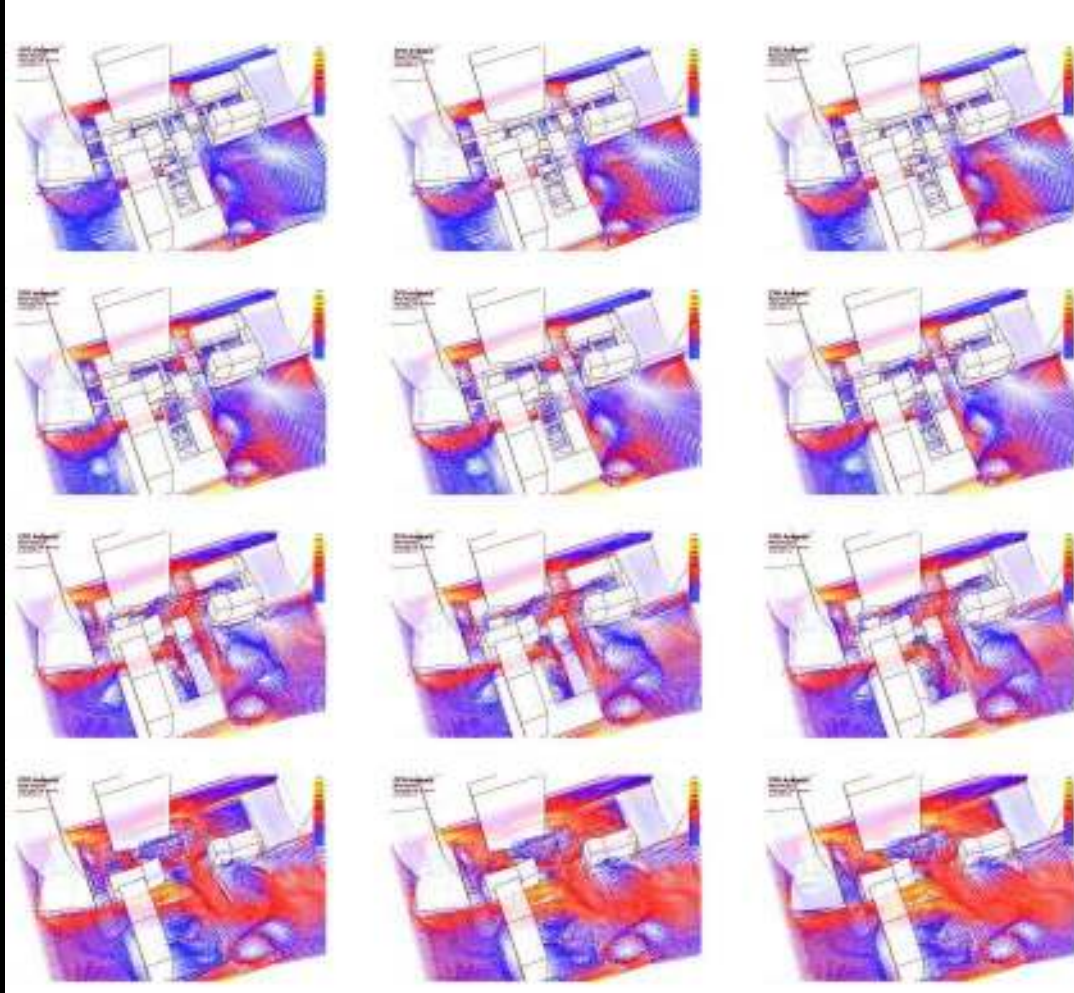
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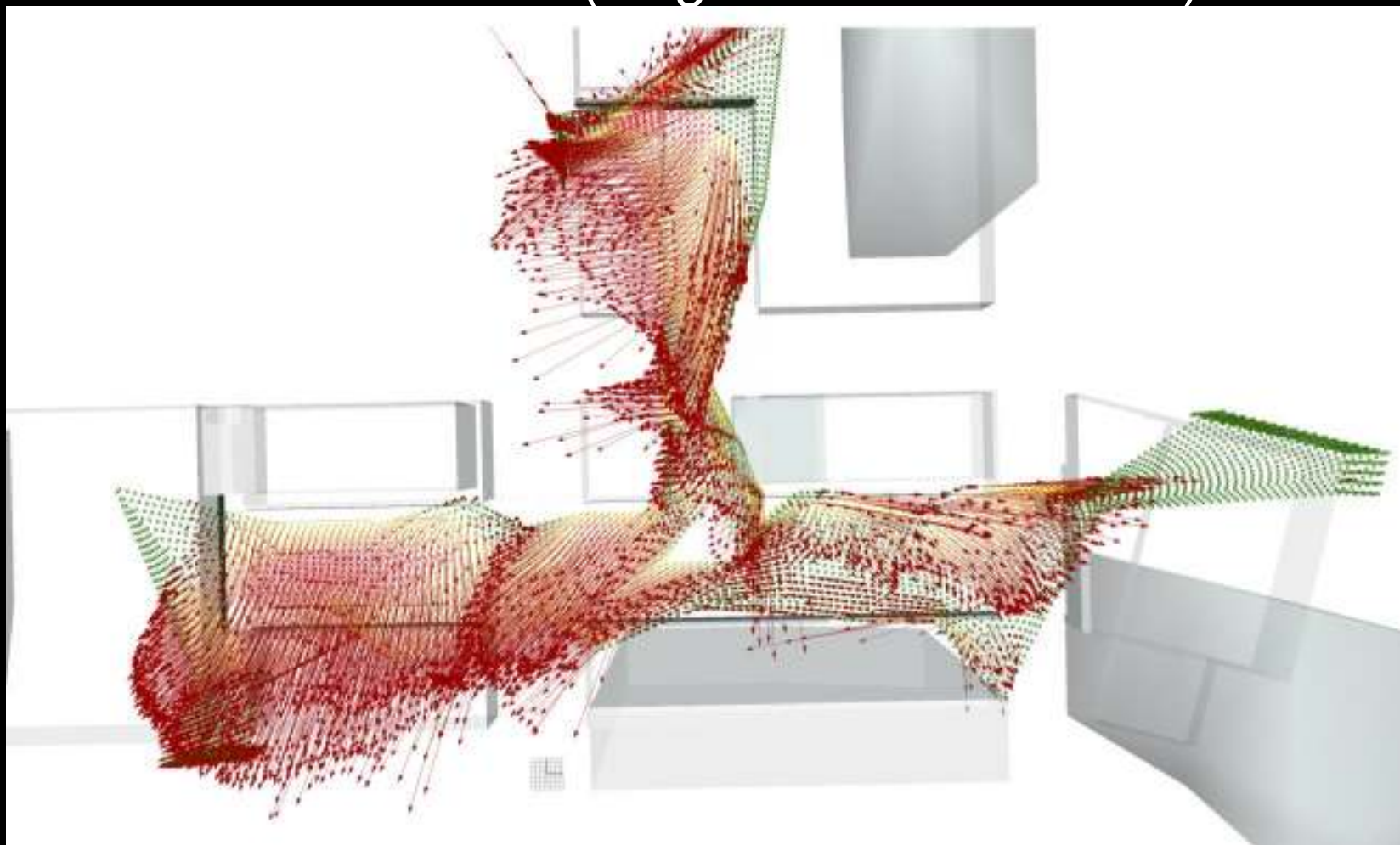
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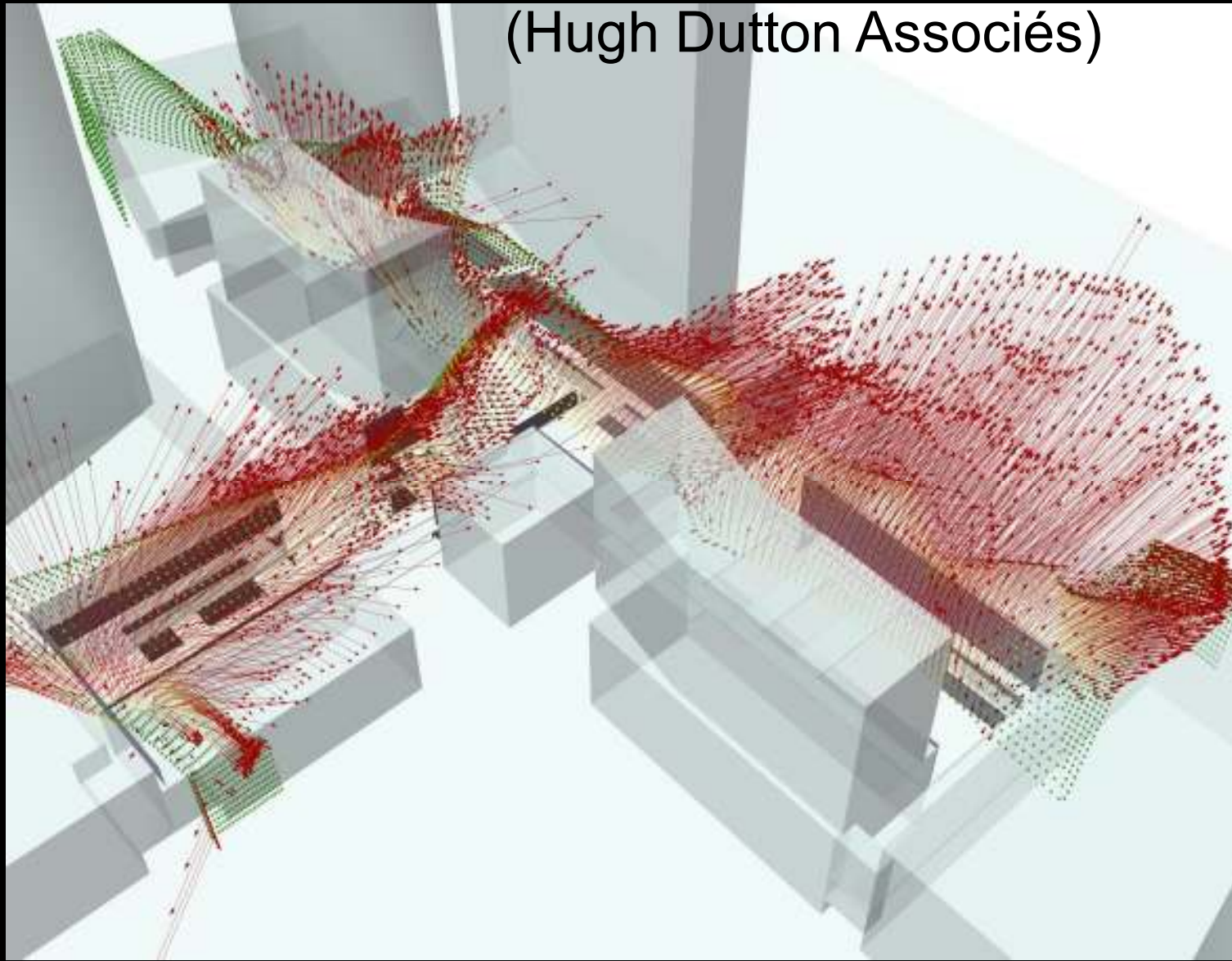
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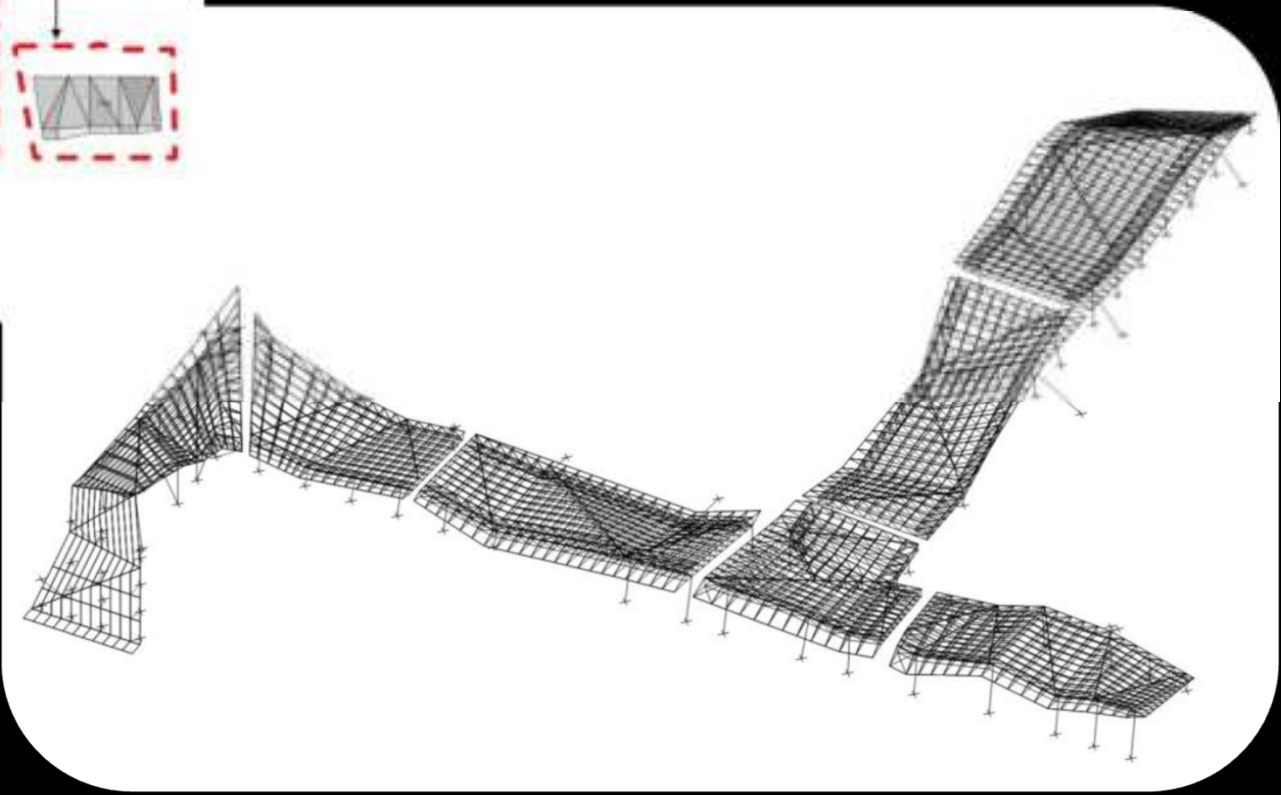
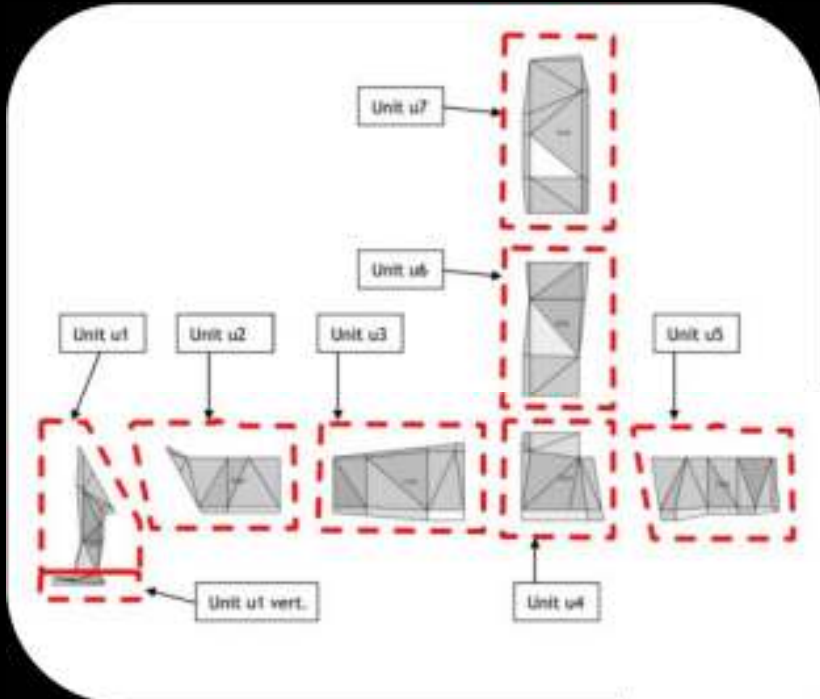
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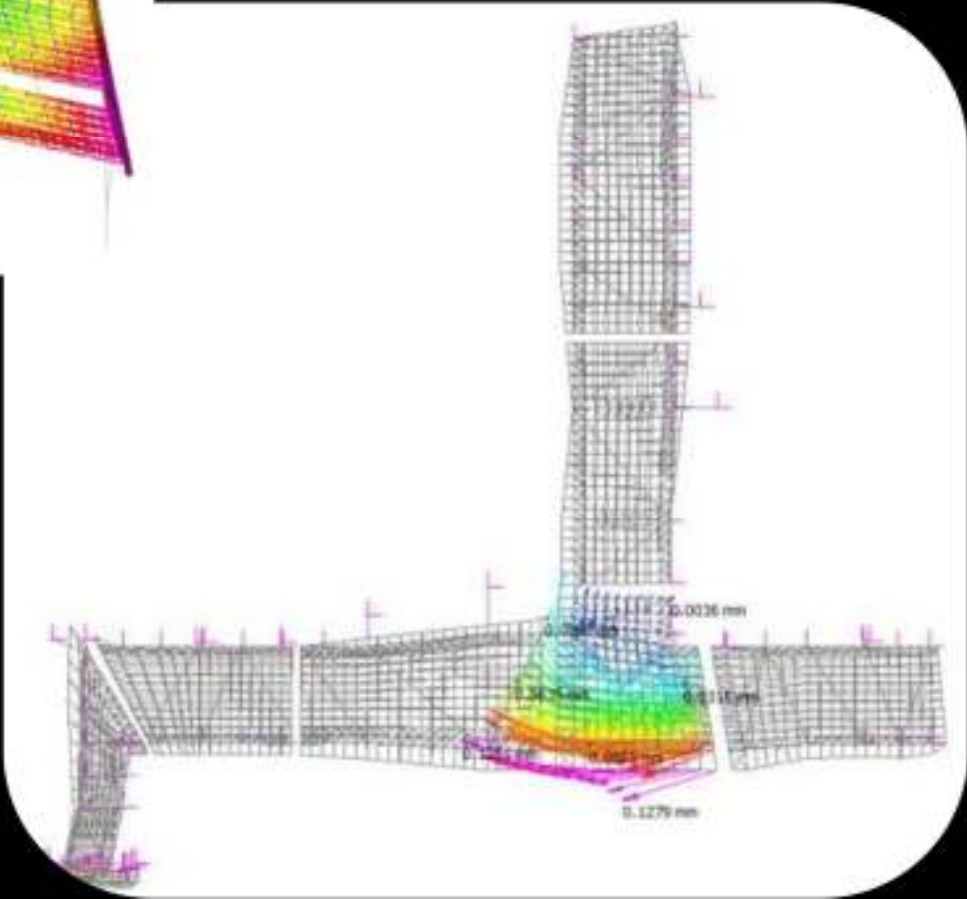
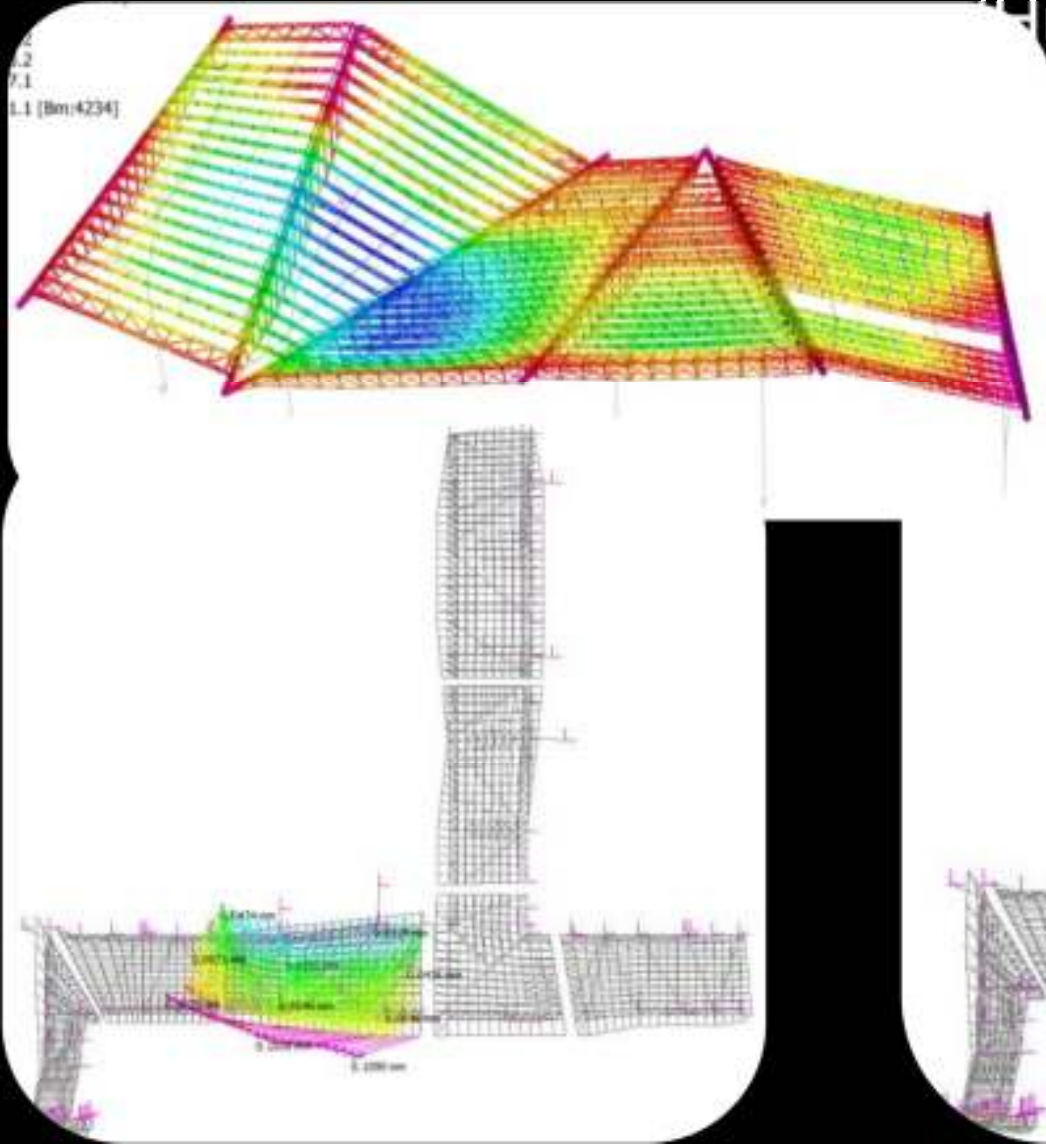
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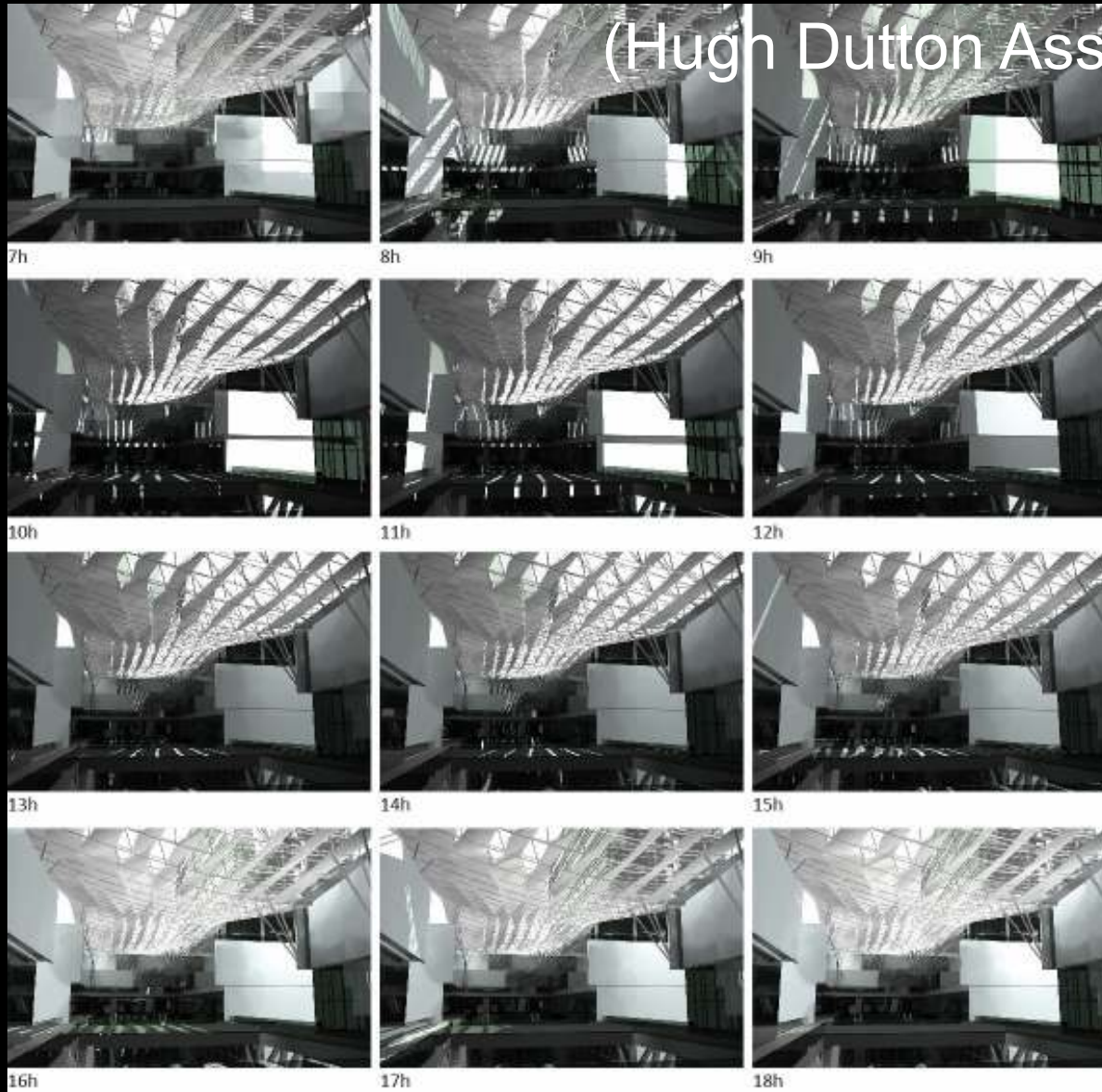
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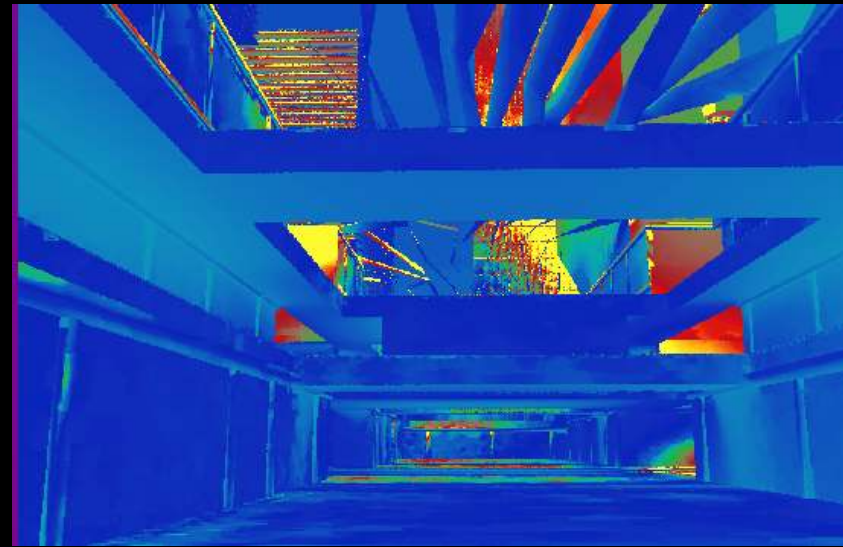
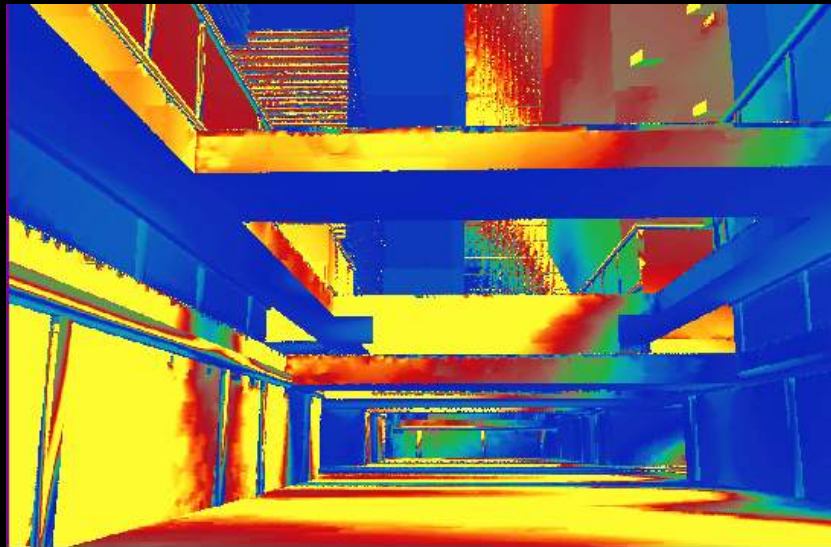
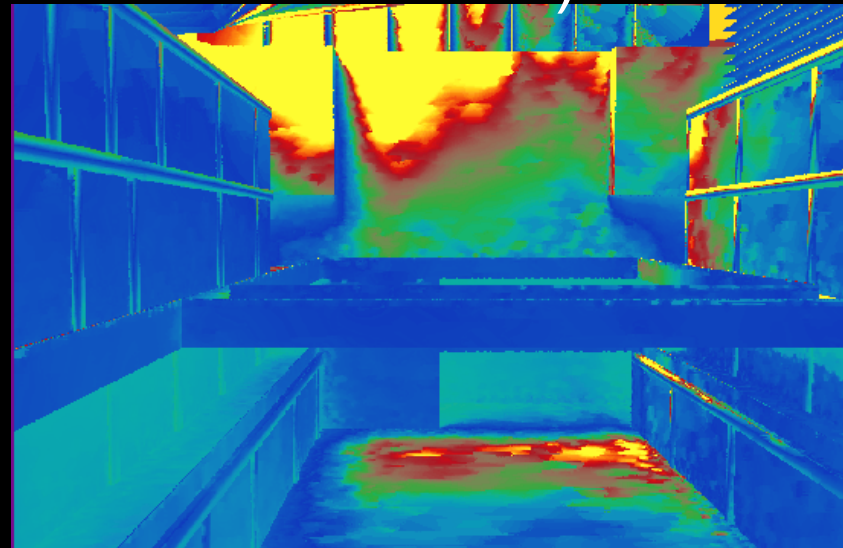
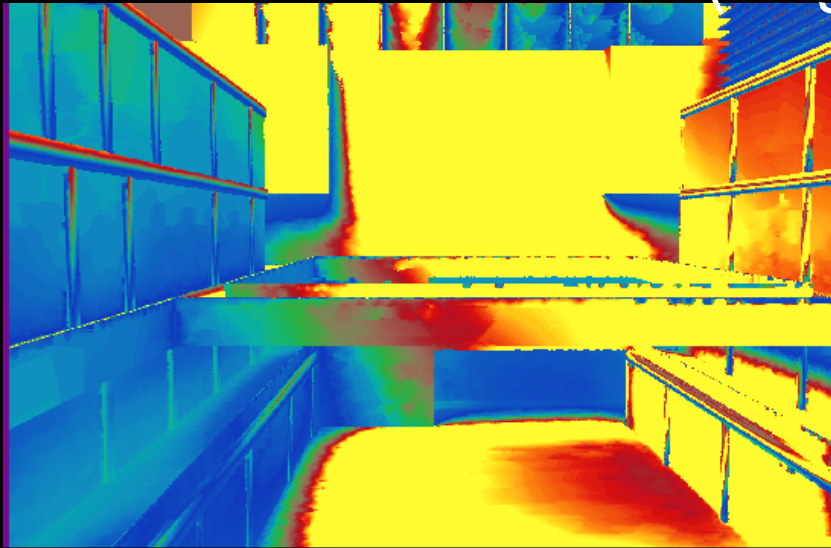
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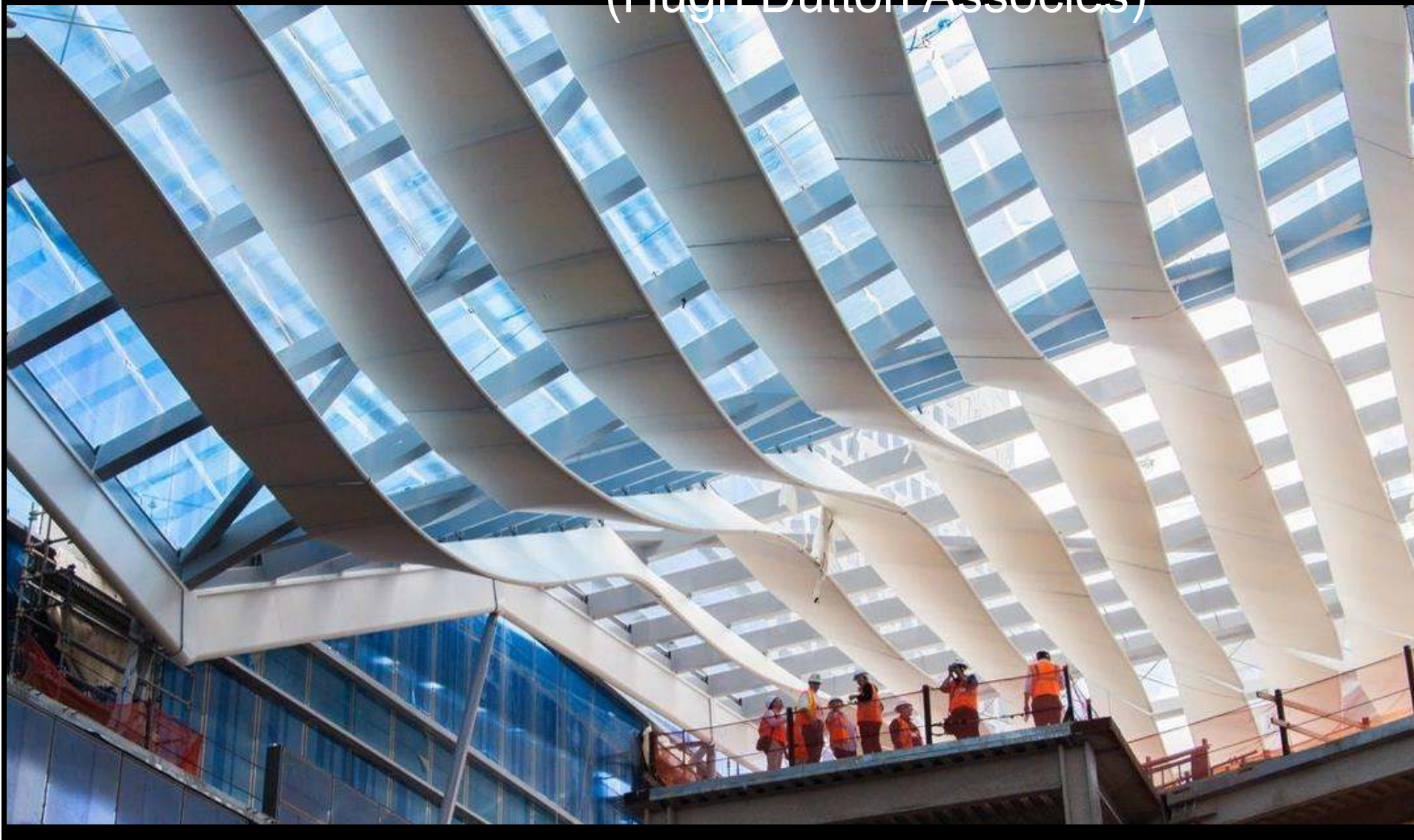
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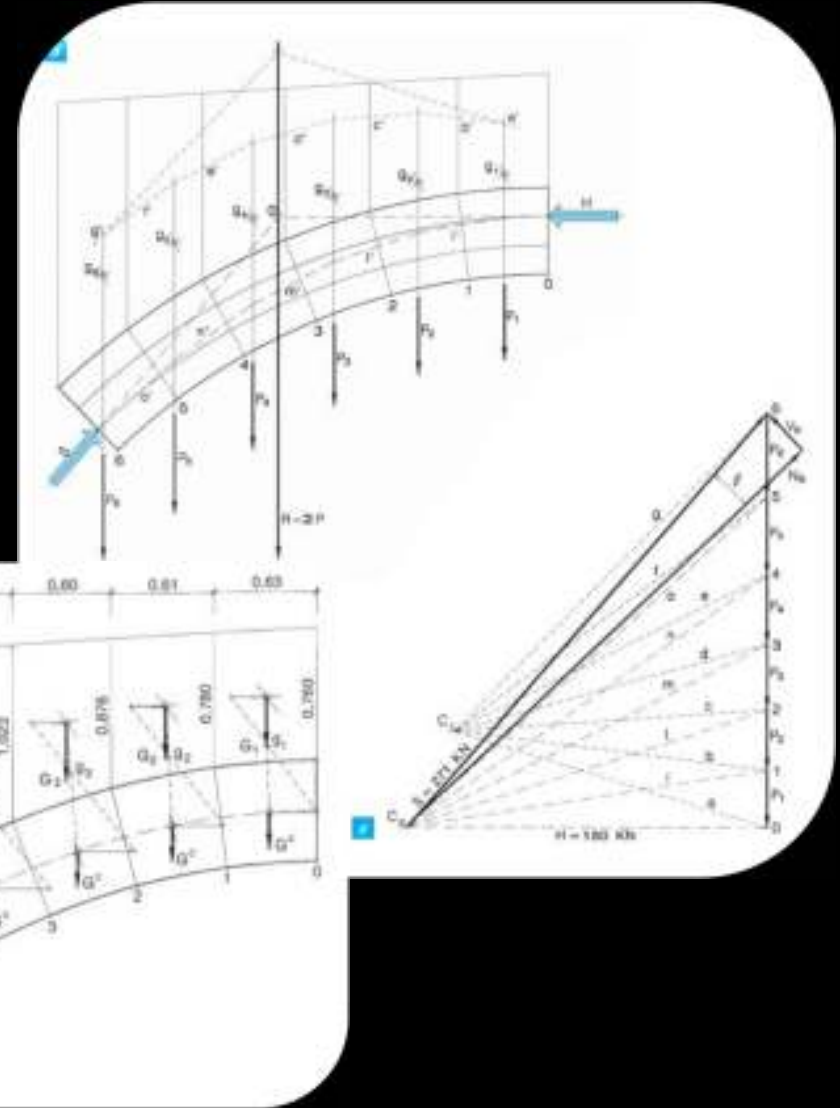
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# STRUTTURE FUNICOLARI



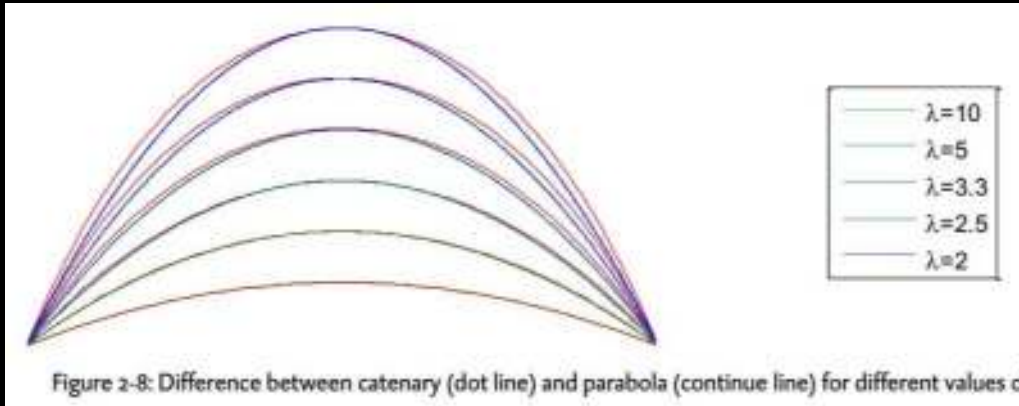
# STRUTTURE FUNICOLARI



*“Una grid shell (gitterschale in tedesco) è una struttura di barre, curva nello spazio. Le barre formano una griglia piana con maglia rettangolare e distanza costante tra ciascun nodo. La forma della grid shell è ottenuta per inversione di una rete sospesa. Nel modo in cui una griglia sospesa dà la curva ideale di un arco senza flessione, così l’inversione della rete conduce ad una forma funicolare nella quale il grid shell non presenta flessione.”*

*FREI OTTO*

# STRUTTURE FUNICOLARI



$$y = h \cdot \cosh\left(\frac{x}{h}\right) = \frac{h}{2} (e^{x/h} + e^{-x/h})$$





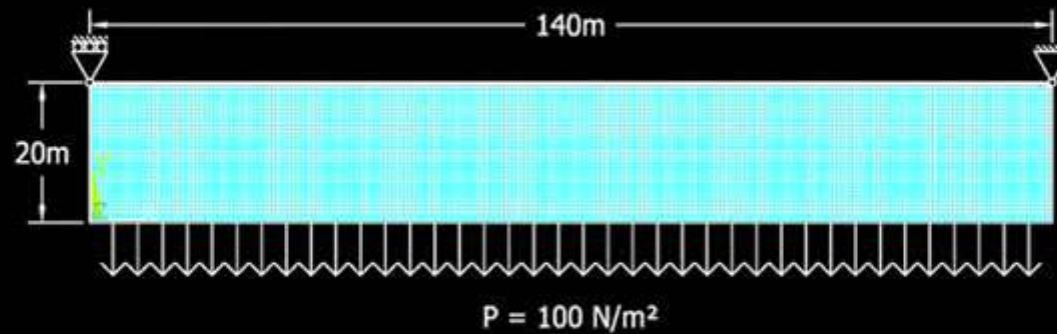
# STRUTTURE FUNICOLARI



# STRUTTURE A RESISTENZA VARIABILE



Algoritmi ESO: Evolutive Structural Optimization

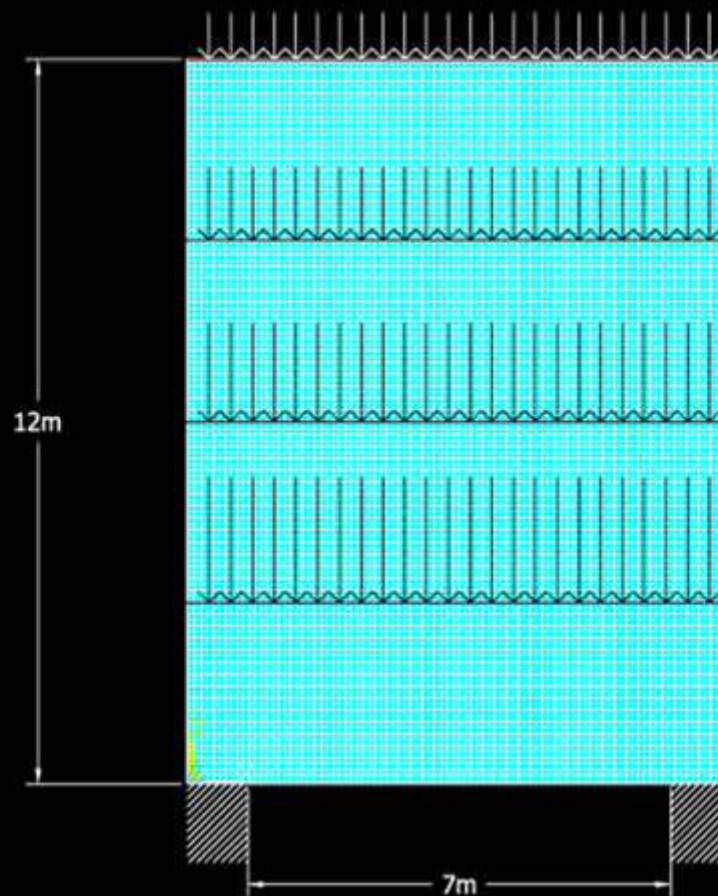


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Algoritmi ESO: Evolutive Structural Optimization



ANSYS



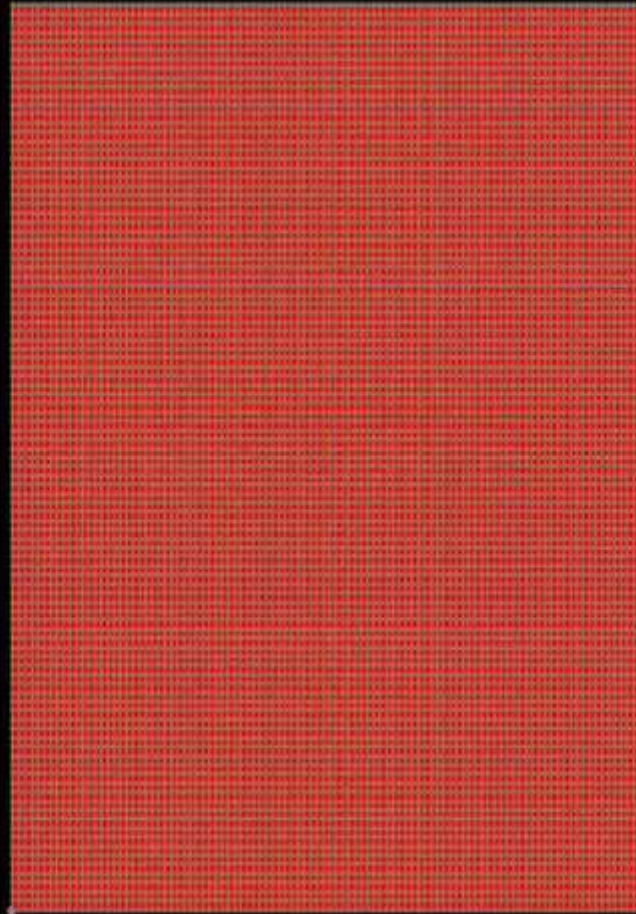


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Algoritmi ESO: Evolutive Structural Optimization



ESD



# STRUTTURE A RESISTENZA VARIABILE

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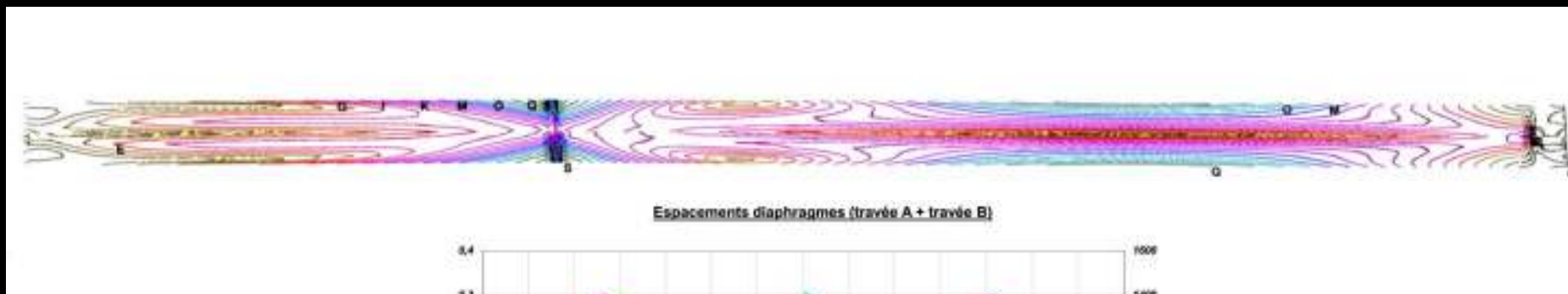
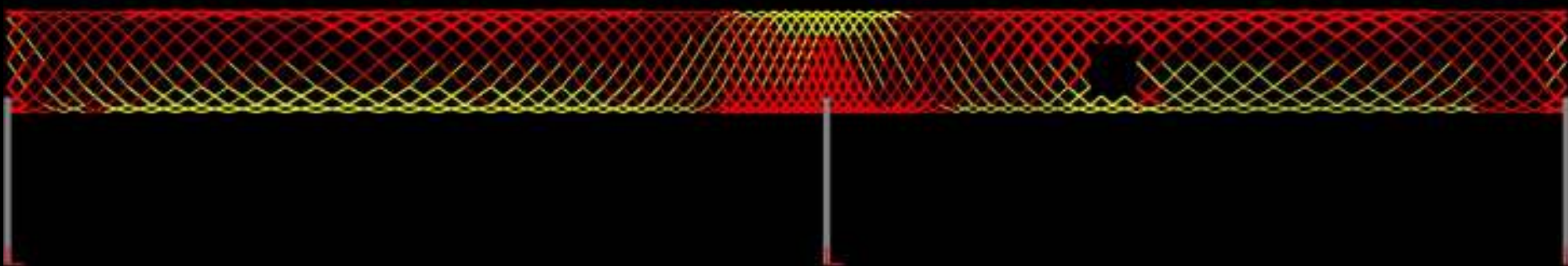
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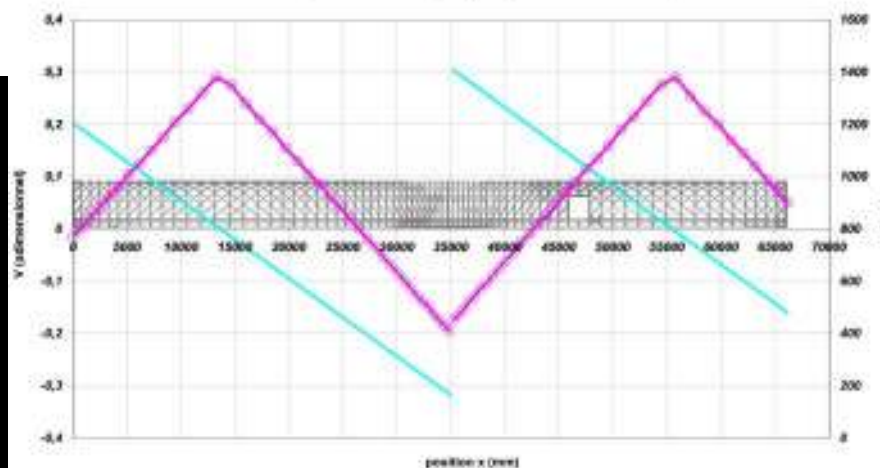


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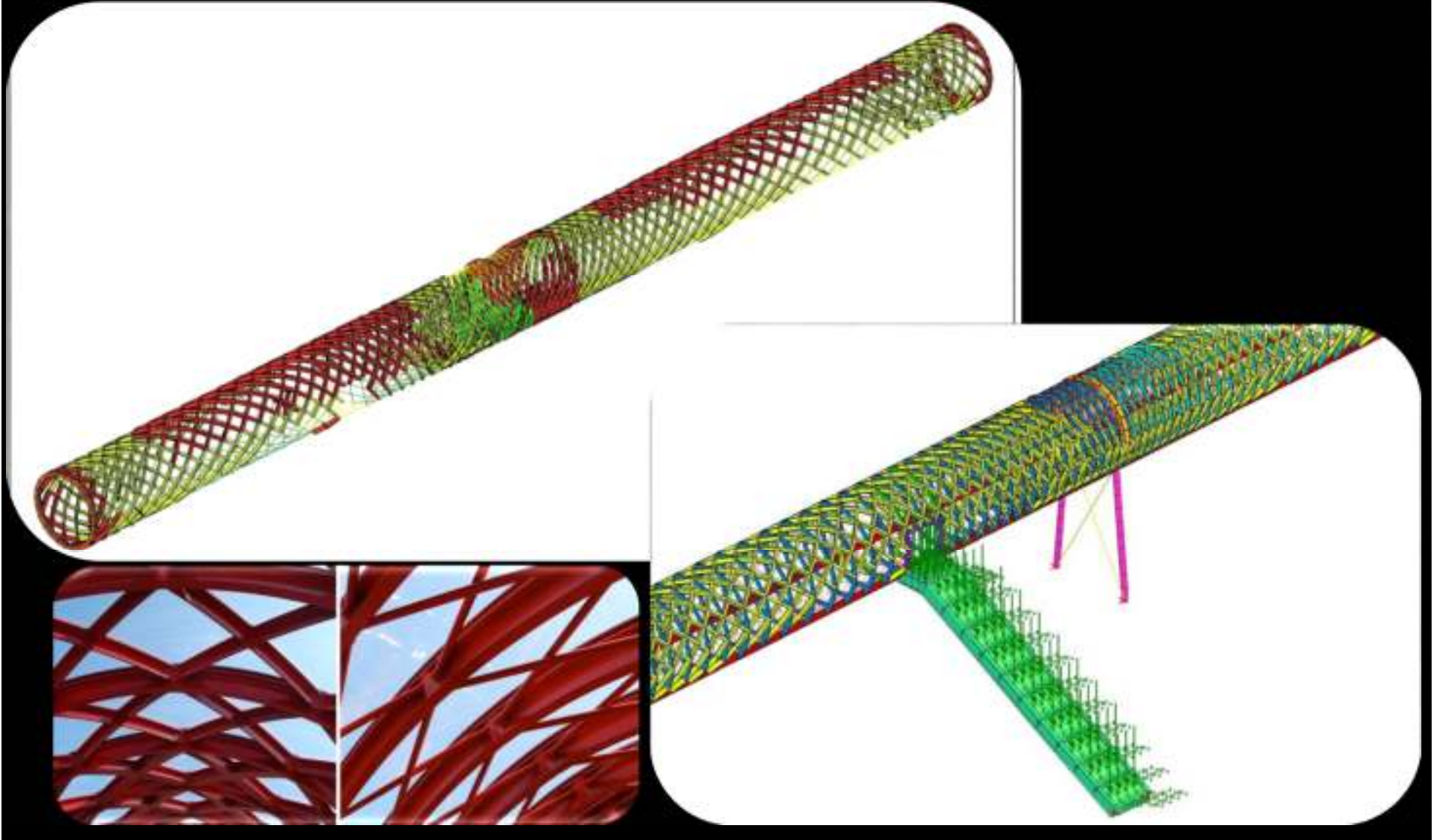


Espacements diaphragmes (travée A + travée B)



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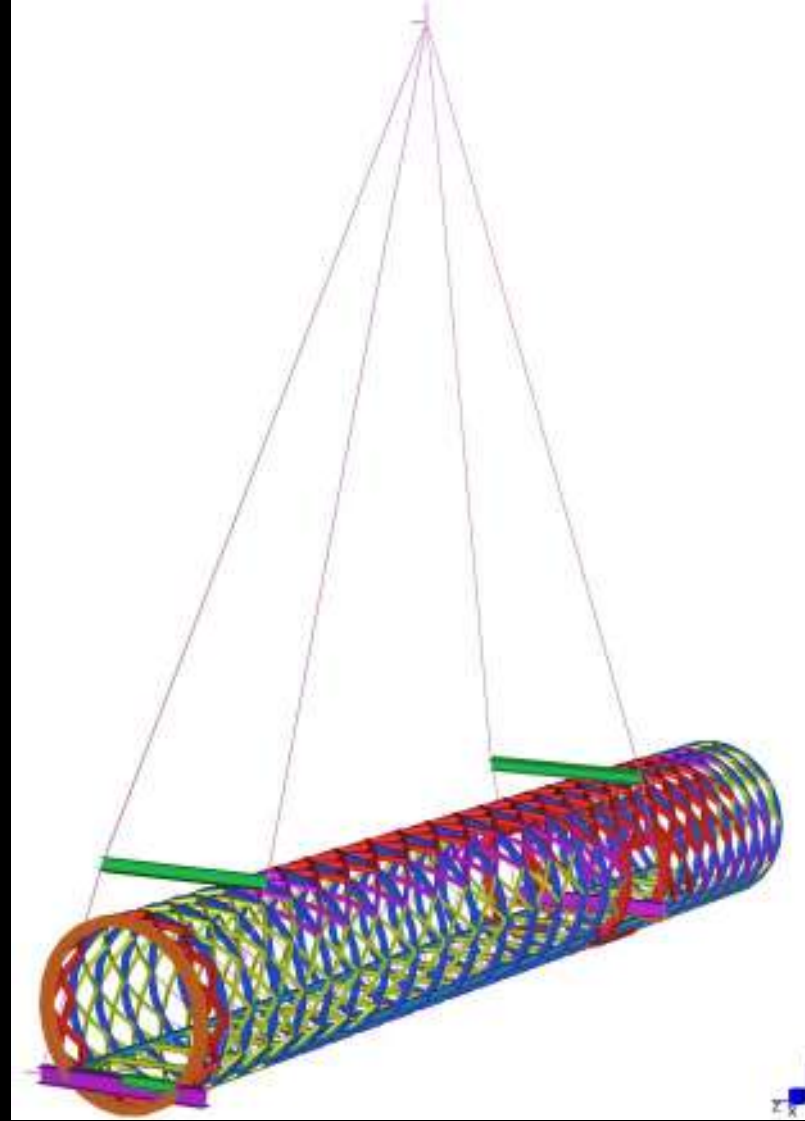
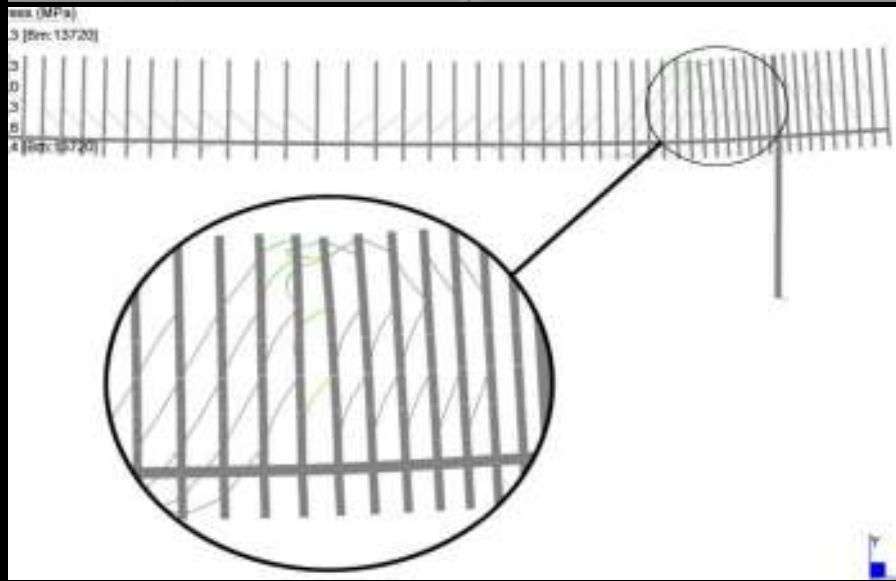
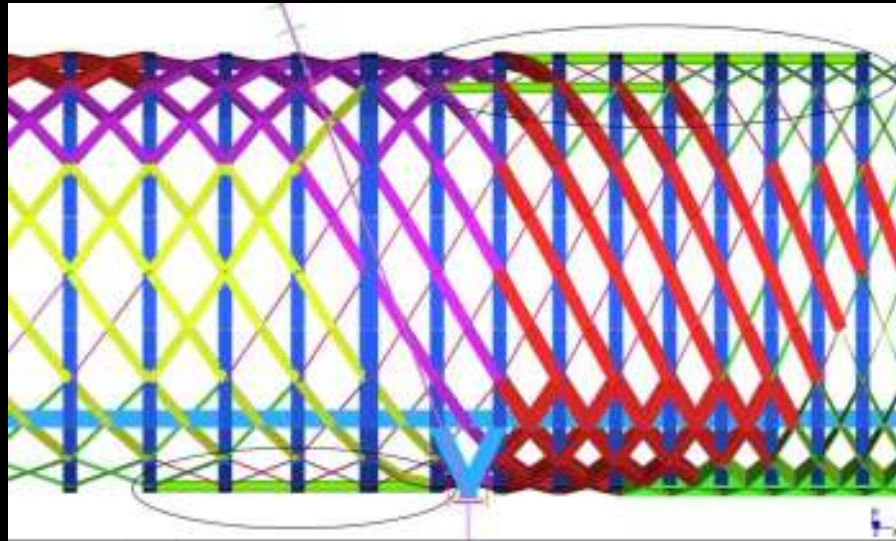
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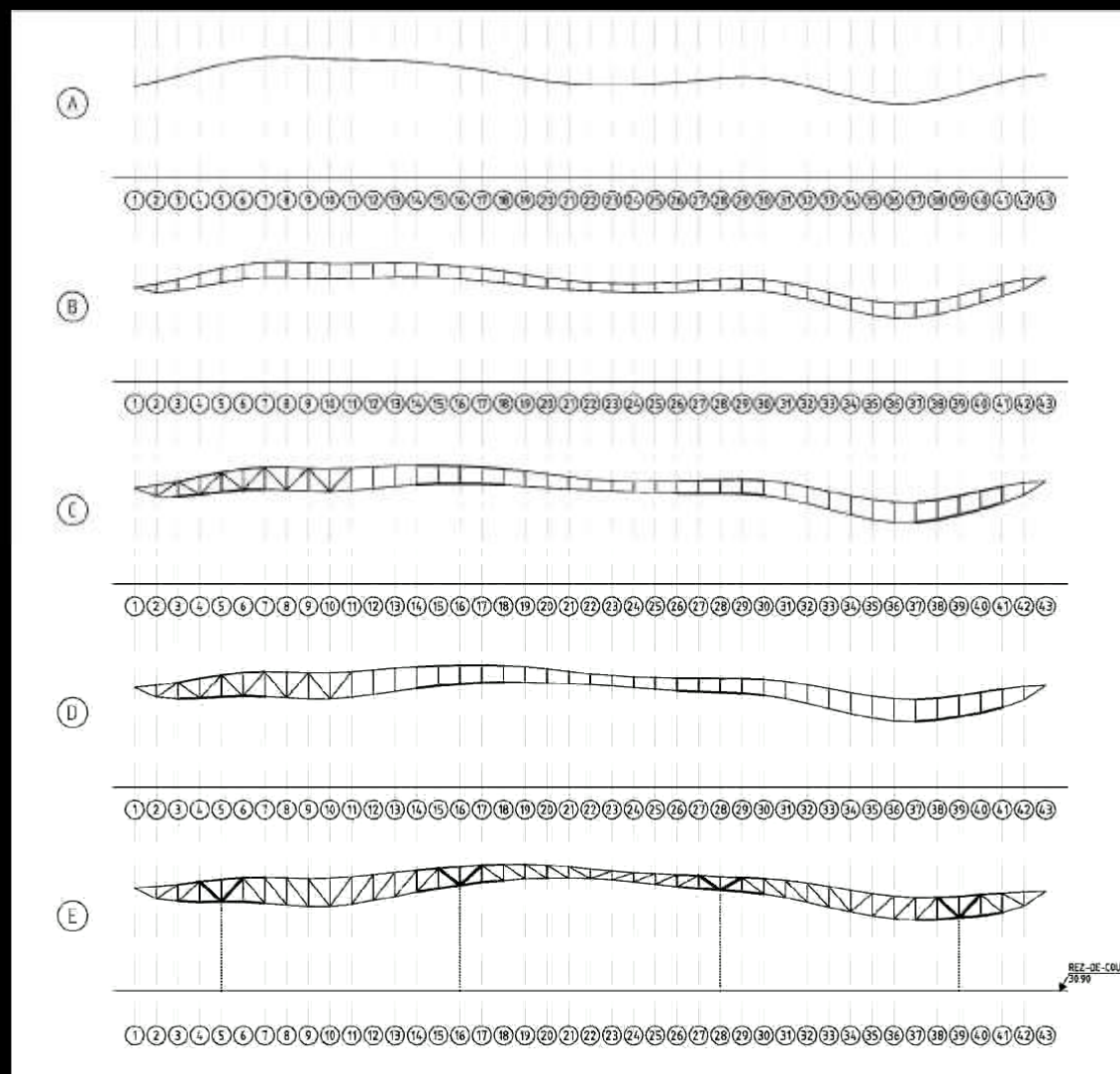
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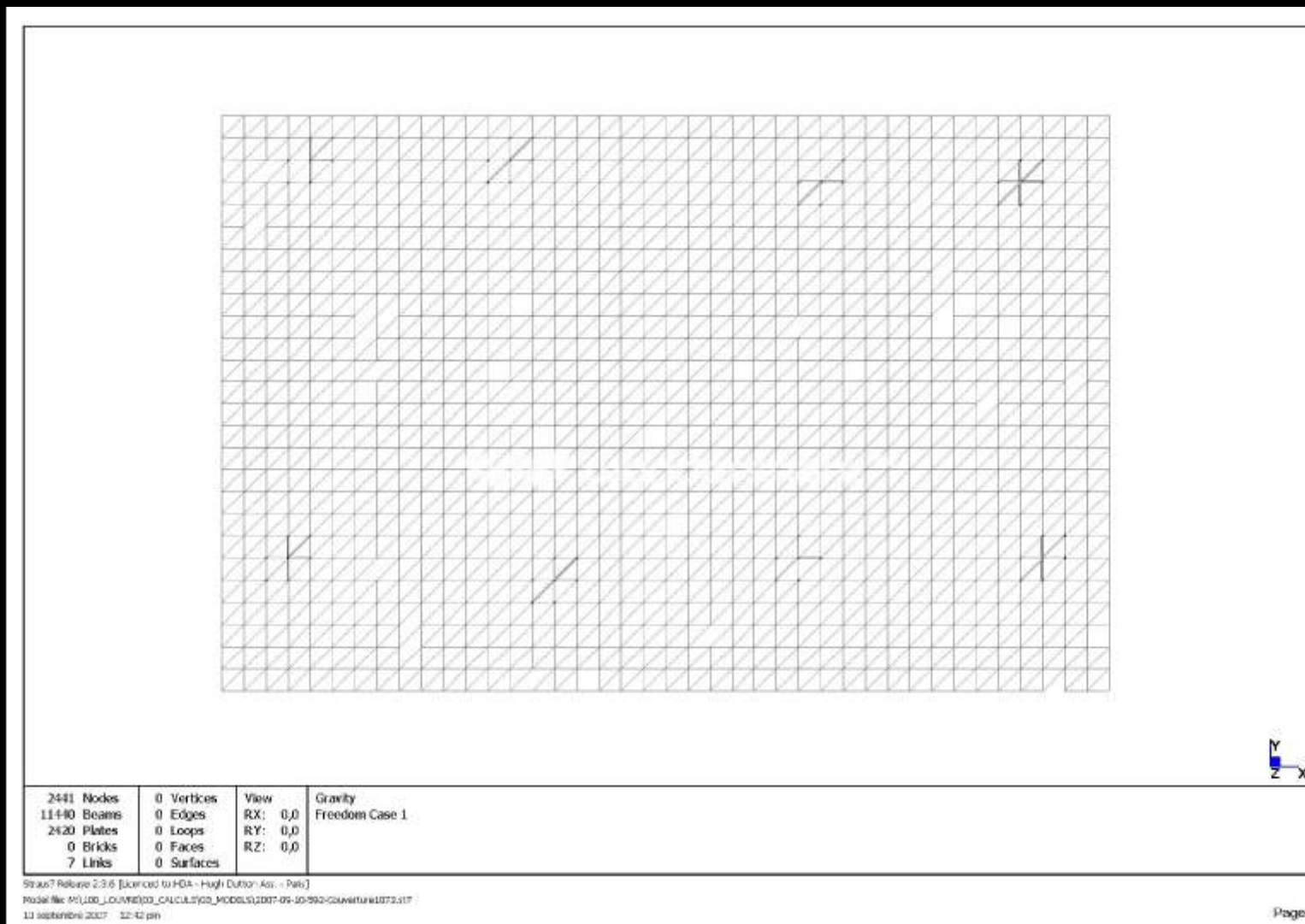
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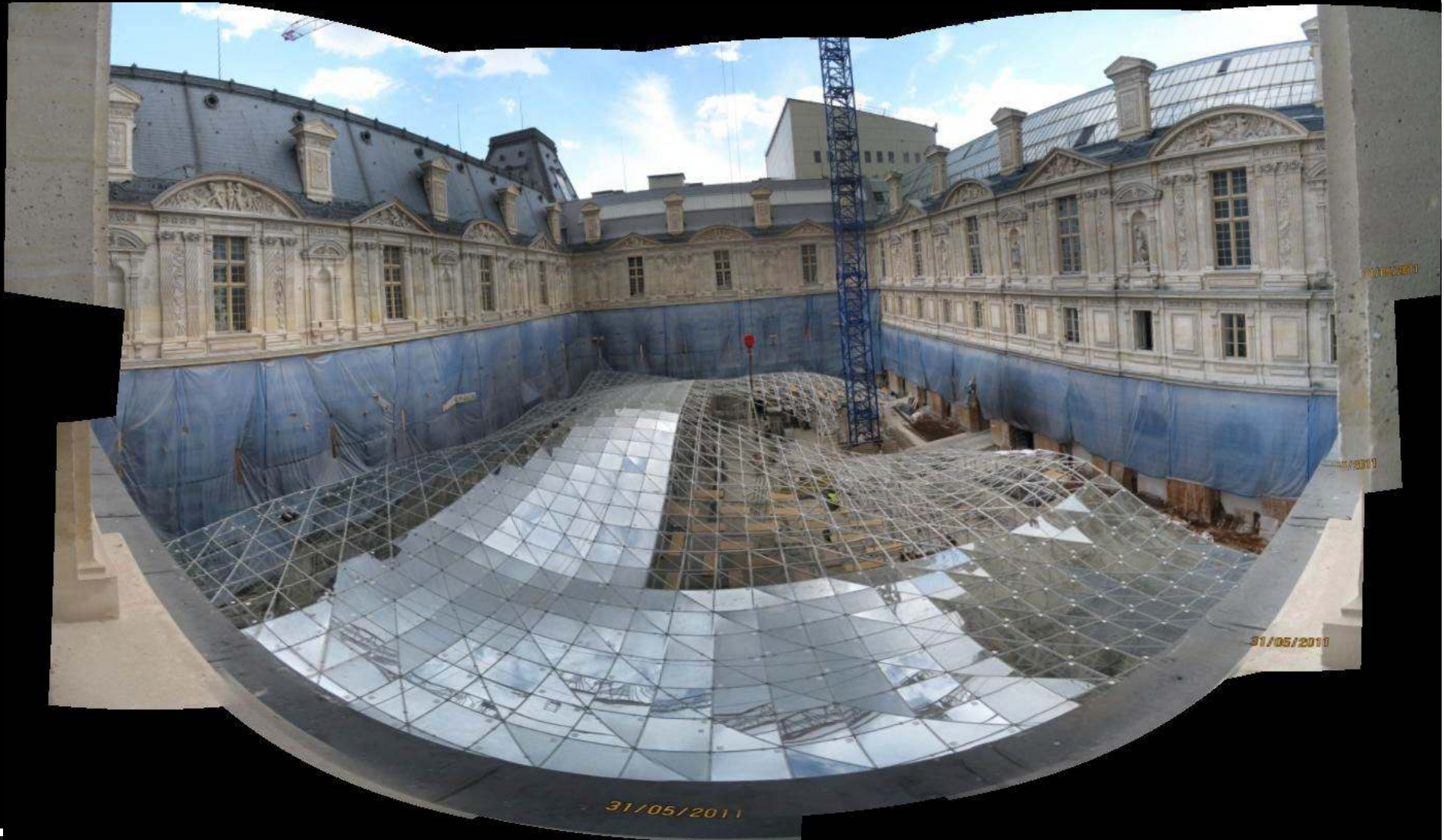
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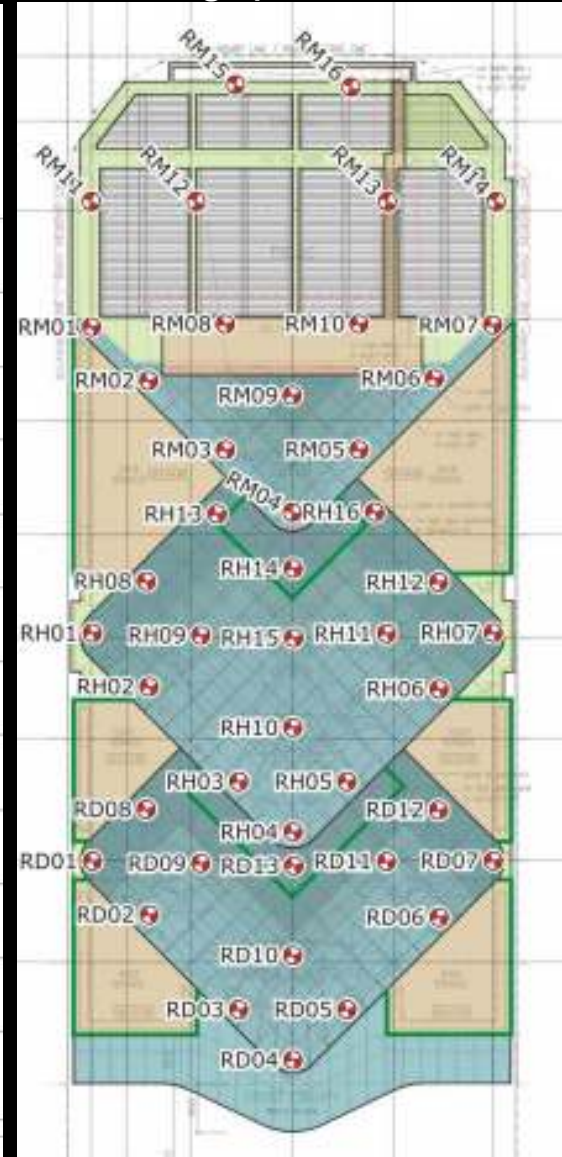
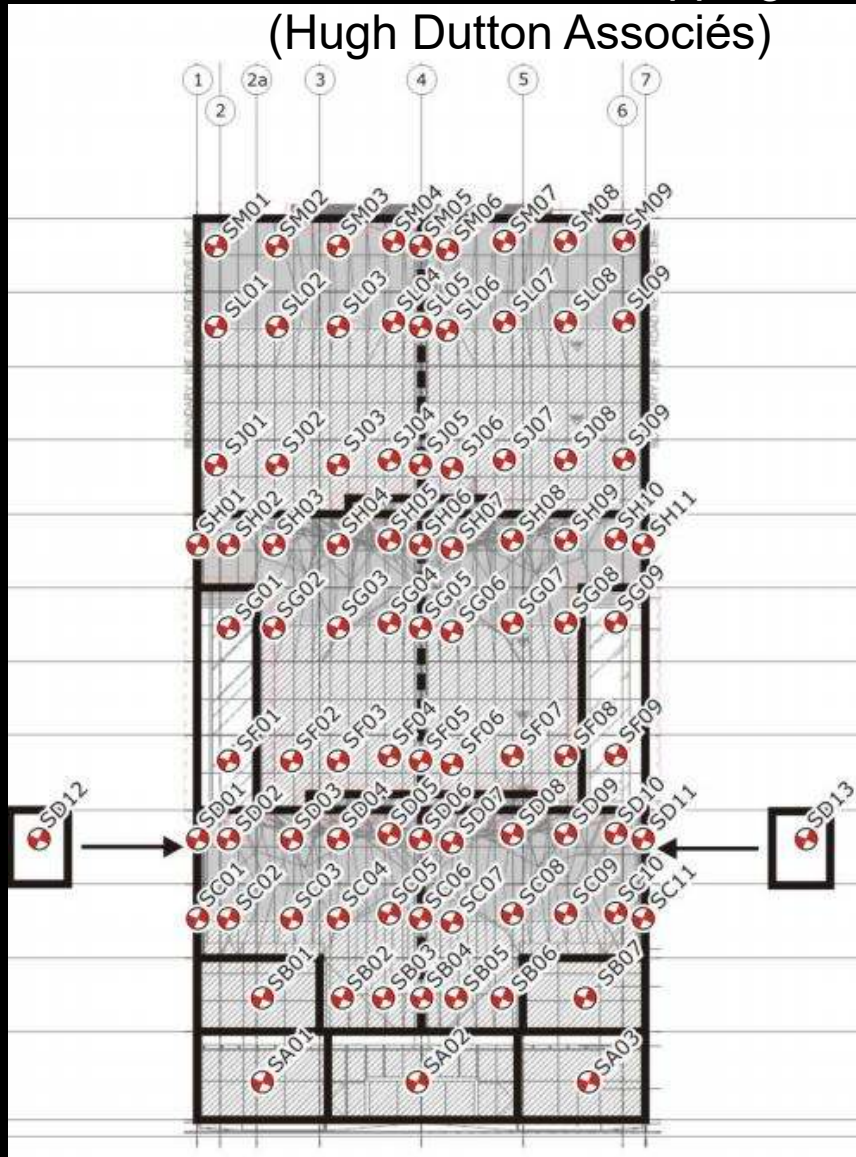






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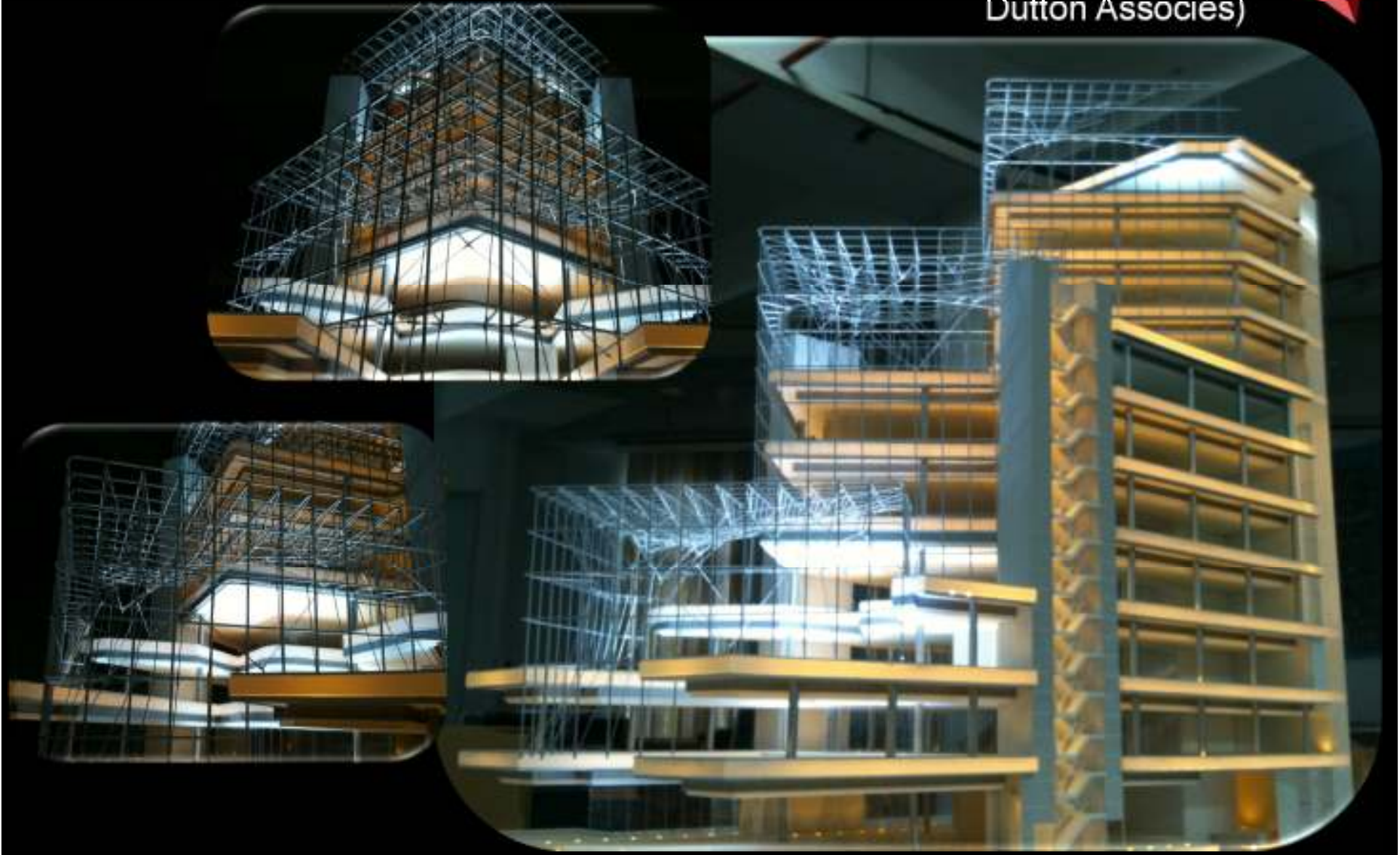
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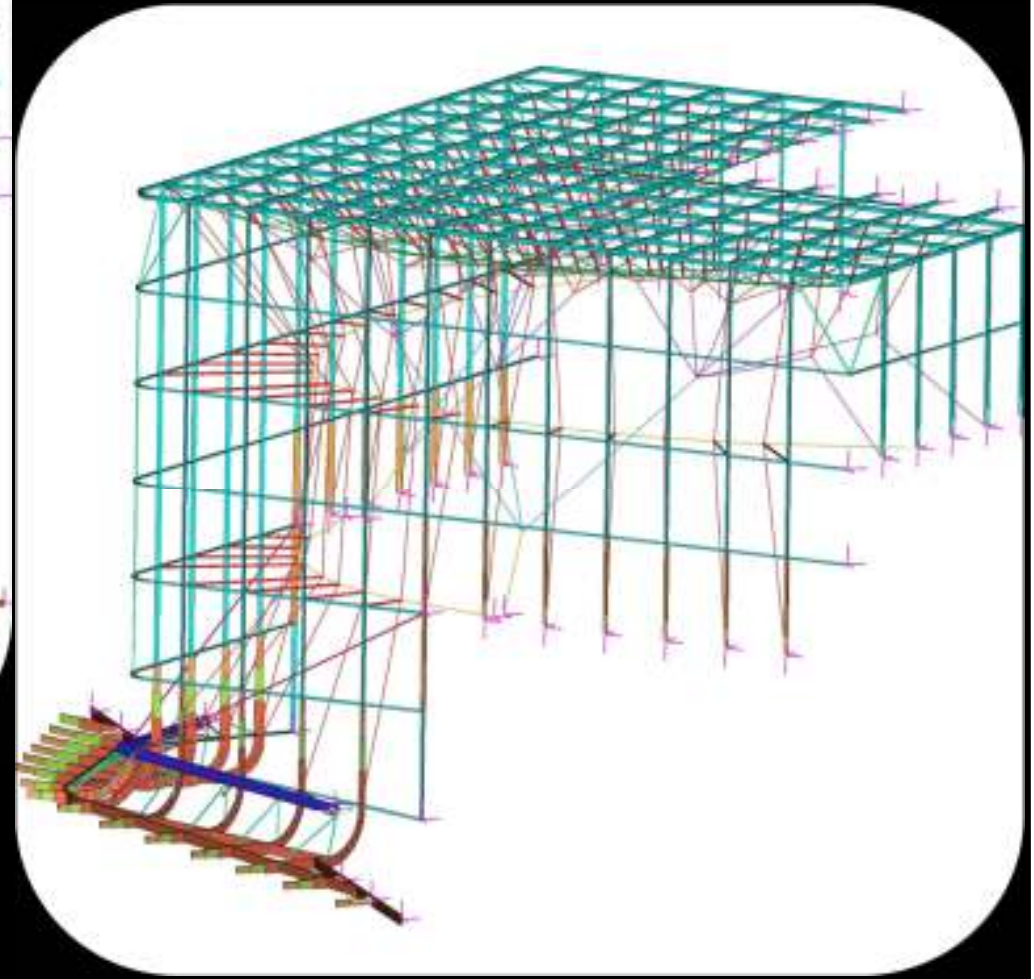
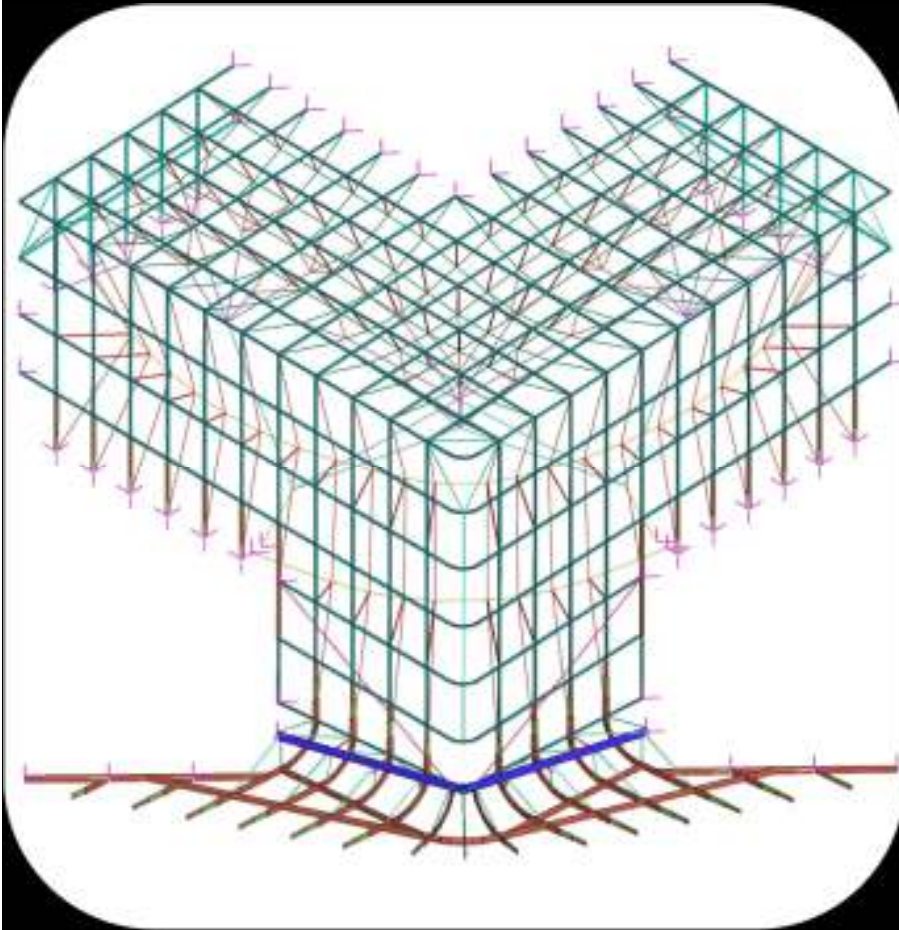
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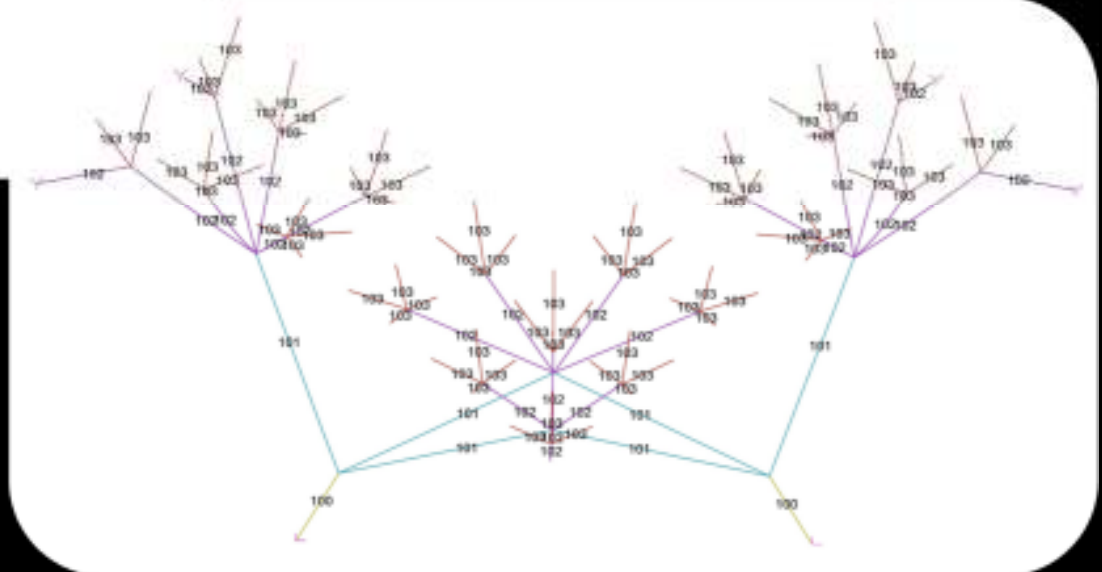
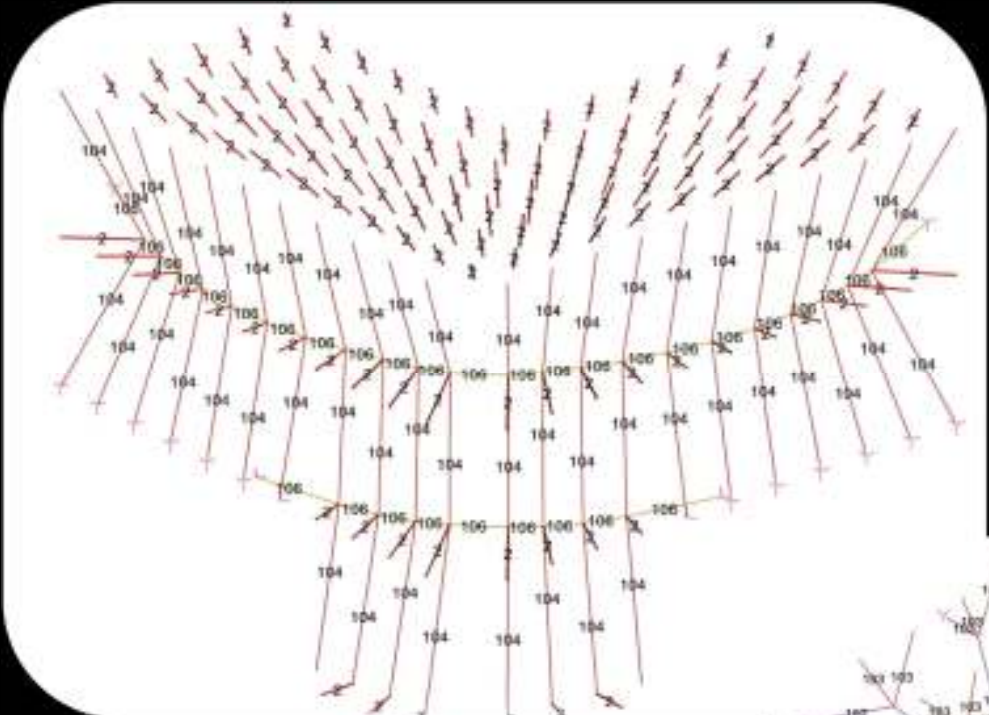
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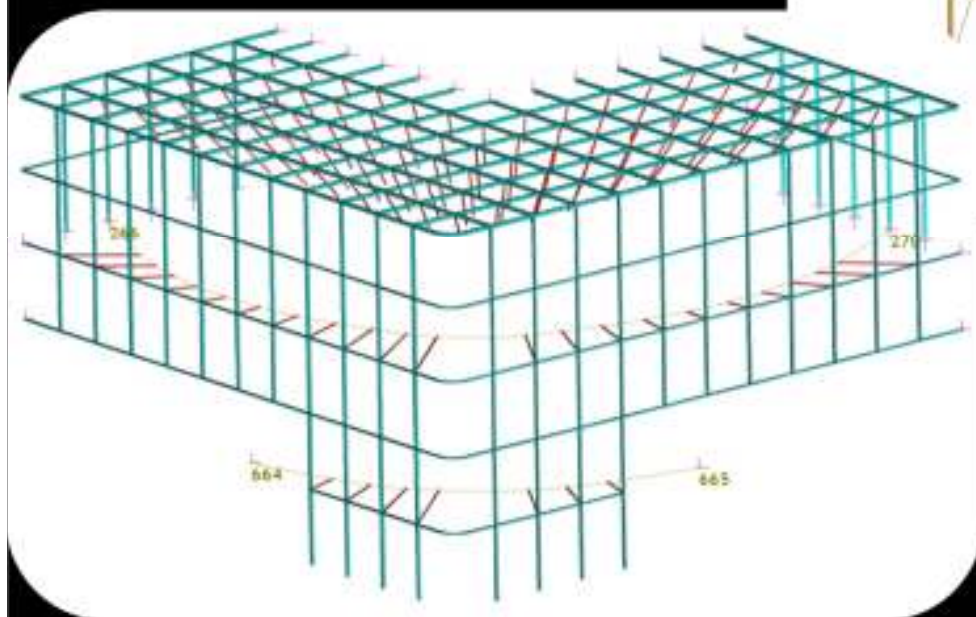
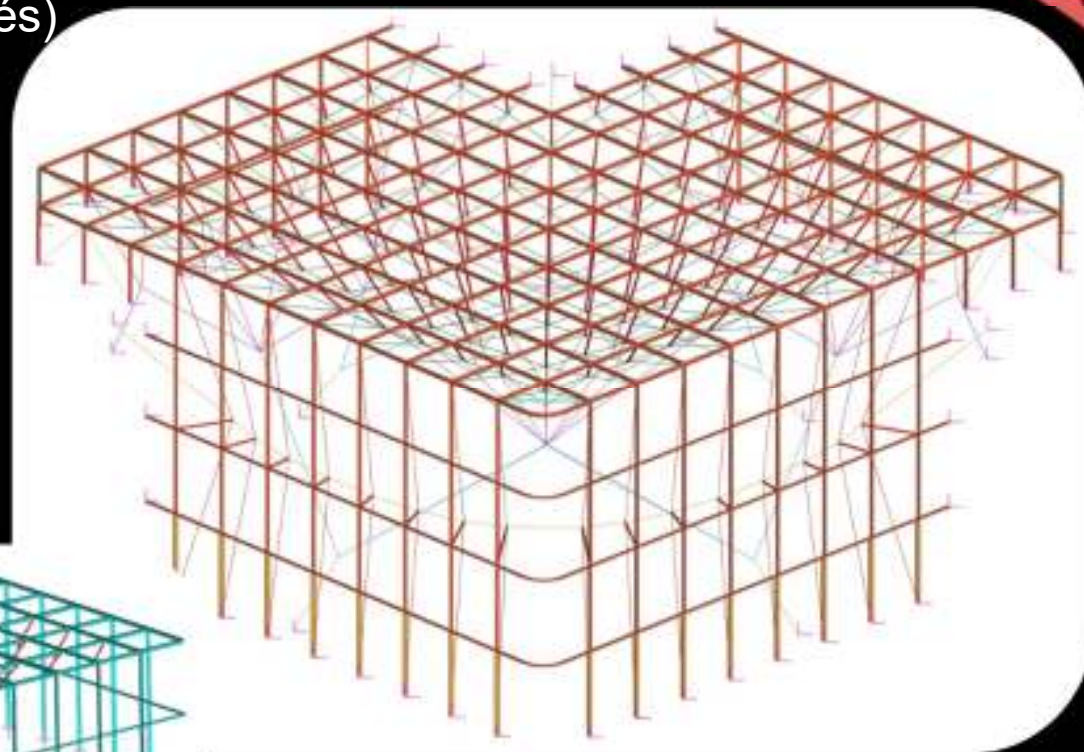
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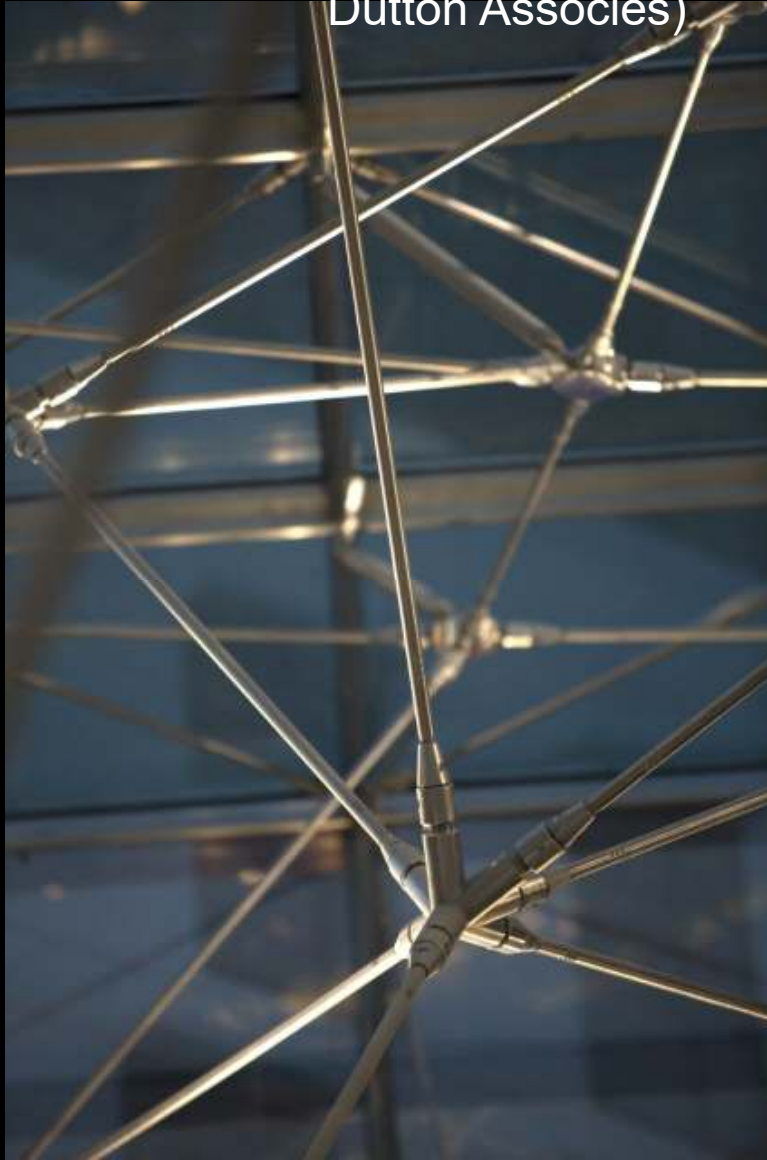
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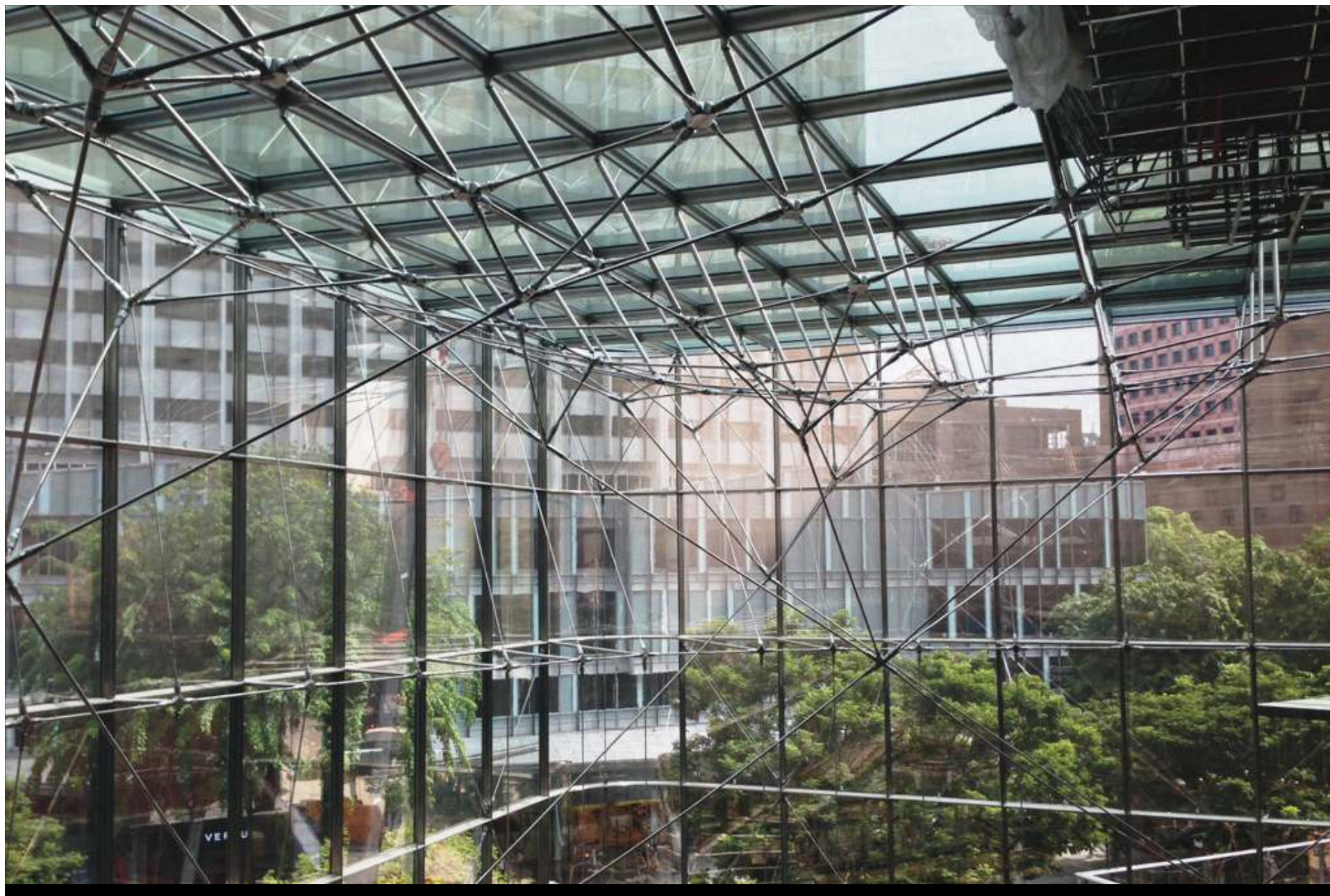
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