



CTBUH Nordic Presents:

# Fusion Engineering – Holistic Approach to Architecture + Structure + Environment

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global design director

**RAMBOLL**

SUSTAINABLE HIGH-RISE CONSTRUCTION

# 01

## Ramboll Highrise

tall, super-tall, and mega-tall across the globe



# HIGH RISE BUILDINGS

## LIST OF PROJECTS

**BELLA SKY HOTEL**  
Copenhagen, Denmark  
76m



# HIGH RISE BUILDINGS

## LIST OF PROJECTS

**HOLIDAY INN PUDONG KANGQIAO**  
Shanghai, China  
85m



# HIGH RISE BUILDINGS

## LIST OF PROJECTS

CITYLIFE II  
Milan, Italy  
110m



# HIGH RISE BUILDINGS

## LIST OF PROJECTS

### **WILLIS BUILDING**

London, United Kingdom

125m



# HIGH RISE BUILDINGS

## LIST OF PROJECTS

**TOKIO MARINE CENTRE**  
Singapore  
125m

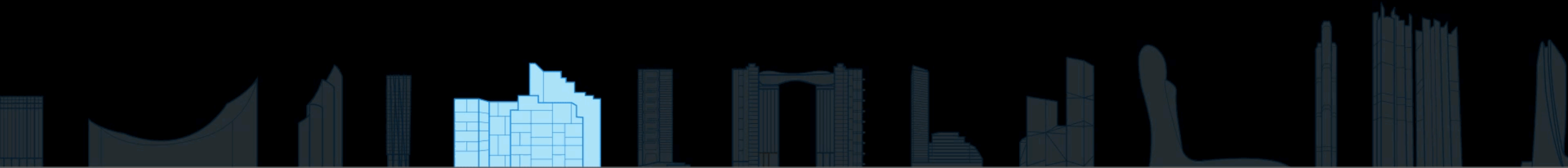




# HIGH RISE BUILDINGS

## LIST OF PROJECTS

**ARCORIS MONT KIARA**  
Kuala Lumpur, Malaysia  
130m



# HIGH RISE BUILDINGS

## LIST OF PROJECTS

**ARDMORE RESIDENCE**  
Singapore  
136m



# HIGH RISE BUILDINGS

## LIST OF PROJECTS

**ATMOSPHERE**  
Kolkata, India  
145m



# HIGH RISE BUILDINGS

## LIST OF PROJECTS

### LIGHTHOUSE TOWER

Aarhus, Denmark

145m



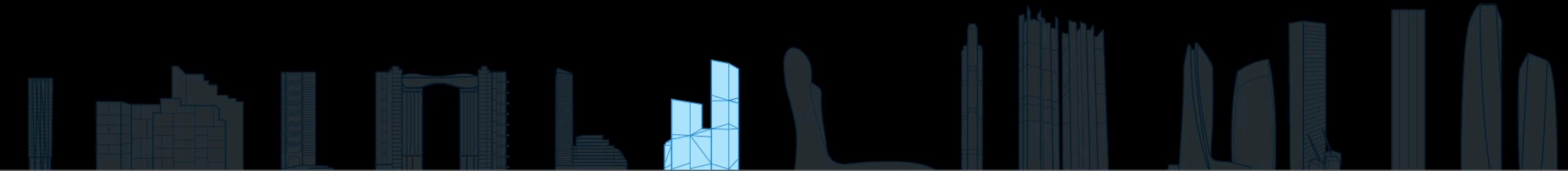
# HIGH RISE BUILDINGS

## LIST OF PROJECTS

### 2 FINSBURY AVENUE

London, United Kingdom

156m



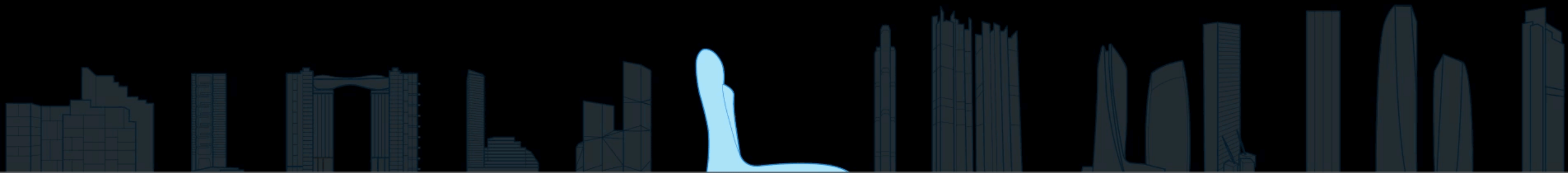
# HIGH RISE BUILDINGS

## LIST OF PROJECTS

### CAPITAL GATE

London, United Kingdom

156m



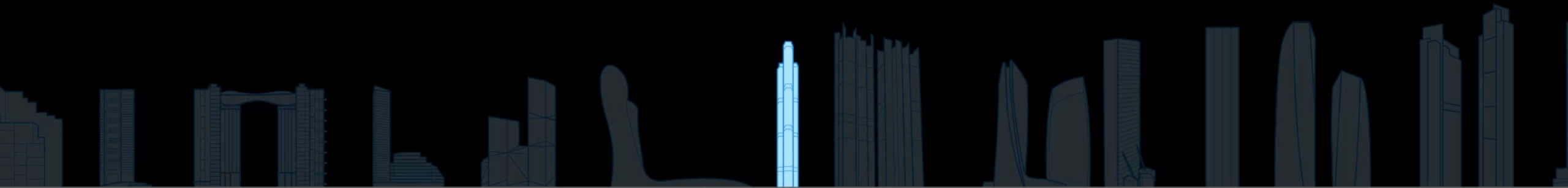
# HIGH RISE BUILDINGS

## LIST OF PROJECTS

### ORCHARD GATE RESIDENCE

Singapore

200m



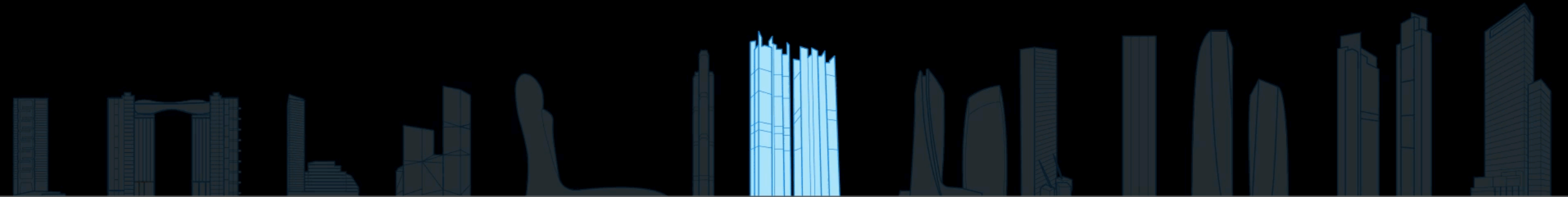
# HIGH RISE BUILDINGS

## LIST OF PROJECTS

### THE TROIKA

Kuala Lumpur, Malaysia

204m

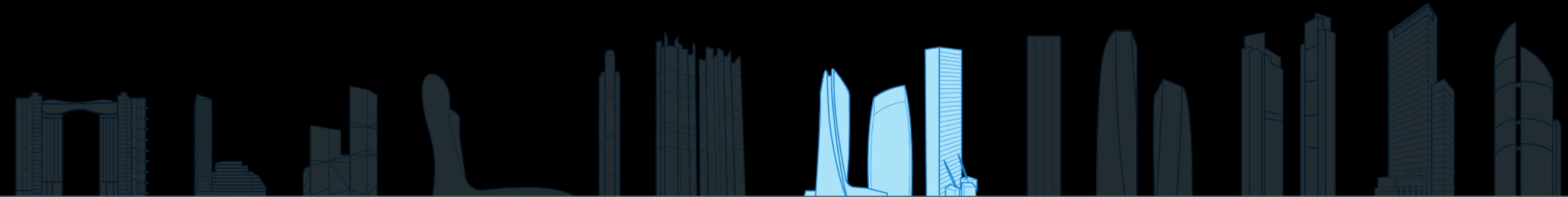




# HIGH RISE BUILDINGS

## LIST OF PROJECTS

**CITYLIFE**  
Milan, Italy  
176-209m



# HIGH RISE BUILDINGS

## LIST OF PROJECTS

### BANGKOK TOWER

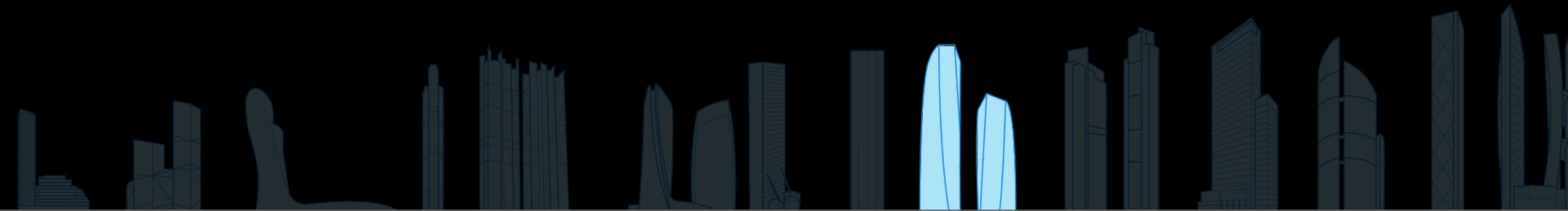
Thailand  
210m



# HIGH RISE BUILDINGS

## LIST OF PROJECTS

**PLATINUM PARK**  
Kuala Lumpur, Malaysia  
214m



# HIGH RISE BUILDINGS

## LIST OF PROJECTS

**NORTH POINT**  
Pattaya, Thailand  
177-226m



# HIGH RISE BUILDINGS

## LIST OF PROJECTS

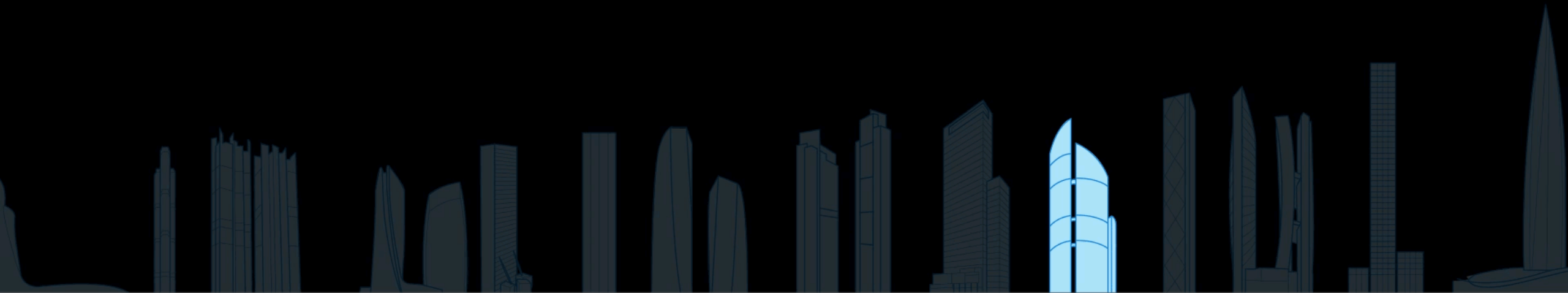
**EQUATORIAL PLAZA**  
Kuala Lumpur, Malaysia  
230m



# HIGH RISE BUILDINGS

## LIST OF PROJECTS

**BAZIS RESIDENCE**  
Pattaya, Thailand  
234m



# HIGH RISE BUILDINGS

## LIST OF PROJECTS

**FUBON HEADQUARTERS**  
Taipei, Taiwan  
266m



# HIGH RISE BUILDINGS

## LIST OF PROJECTS

**8 CONLAY**

Kuala Lumpur, Malaysia

277m





# HIGH RISE BUILDINGS

## LIST OF PROJECTS

**BESTSELLER TOWER**  
Brande, Denmark  
320m



# HIGH RISE BUILDINGS

## LIST OF PROJECTS

**OKHTA TOWER**  
St. Petersburg, Russia  
396m



# HIGH RISE BUILDINGS

## LIST OF PROJECTS

**THE EXCHANGE 106**  
Kuala Lumpur, Malaysia  
454m



# HIGH RISE BUILDINGS

## LIST OF PROJECTS

**TRADEWINDS TOWER**  
Kuala Lumpur, Malaysia  
608m



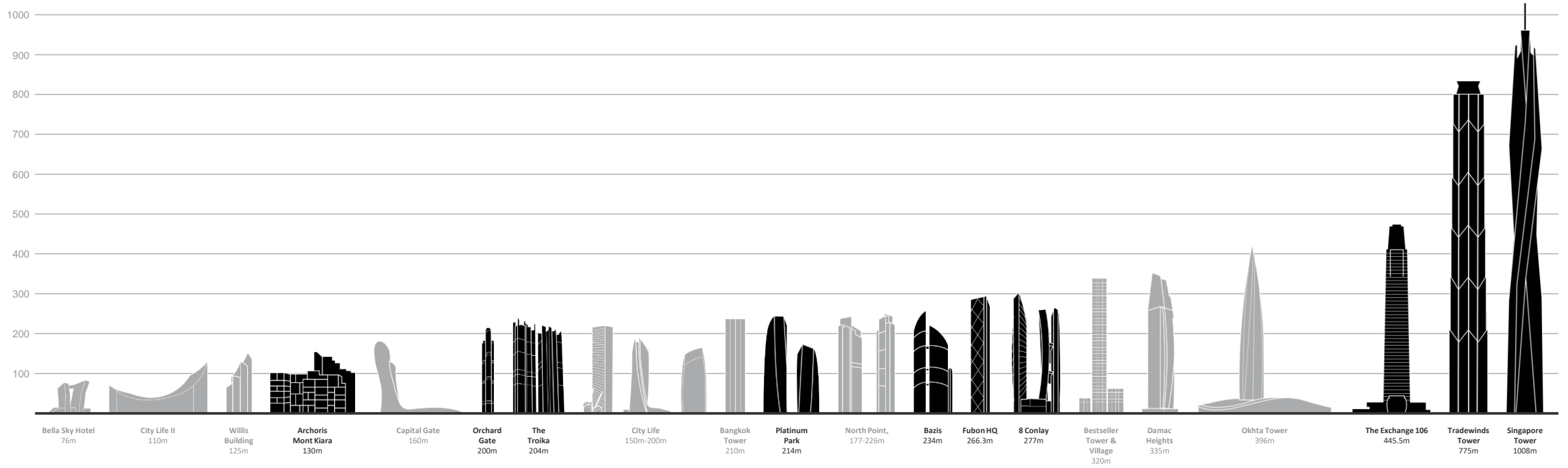
# HIGH RISE BUILDINGS

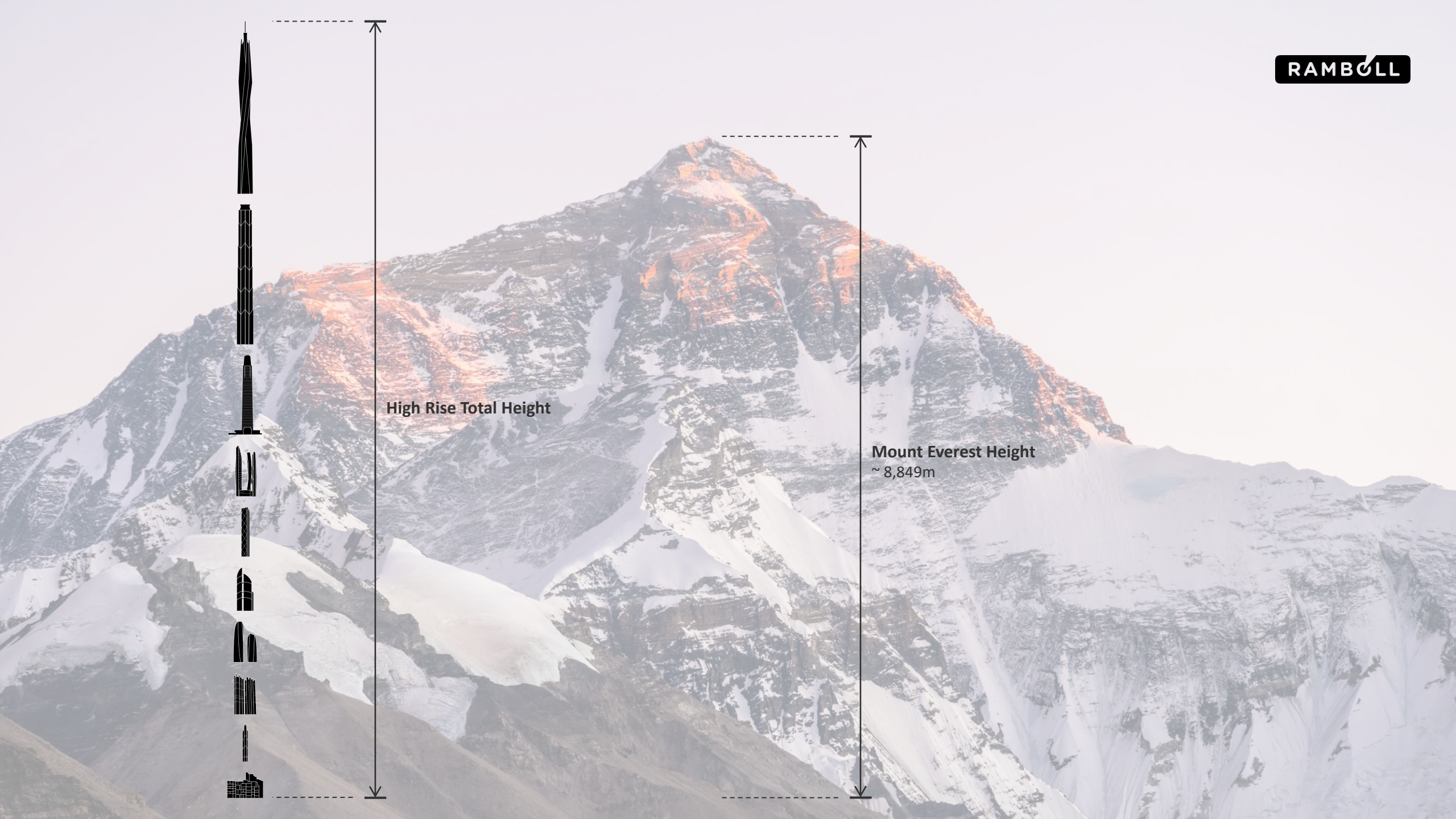
## LIST OF PROJECTS

SINGAPORE TOWER  
1008m



# HIGH RISE HEIGHT CHART





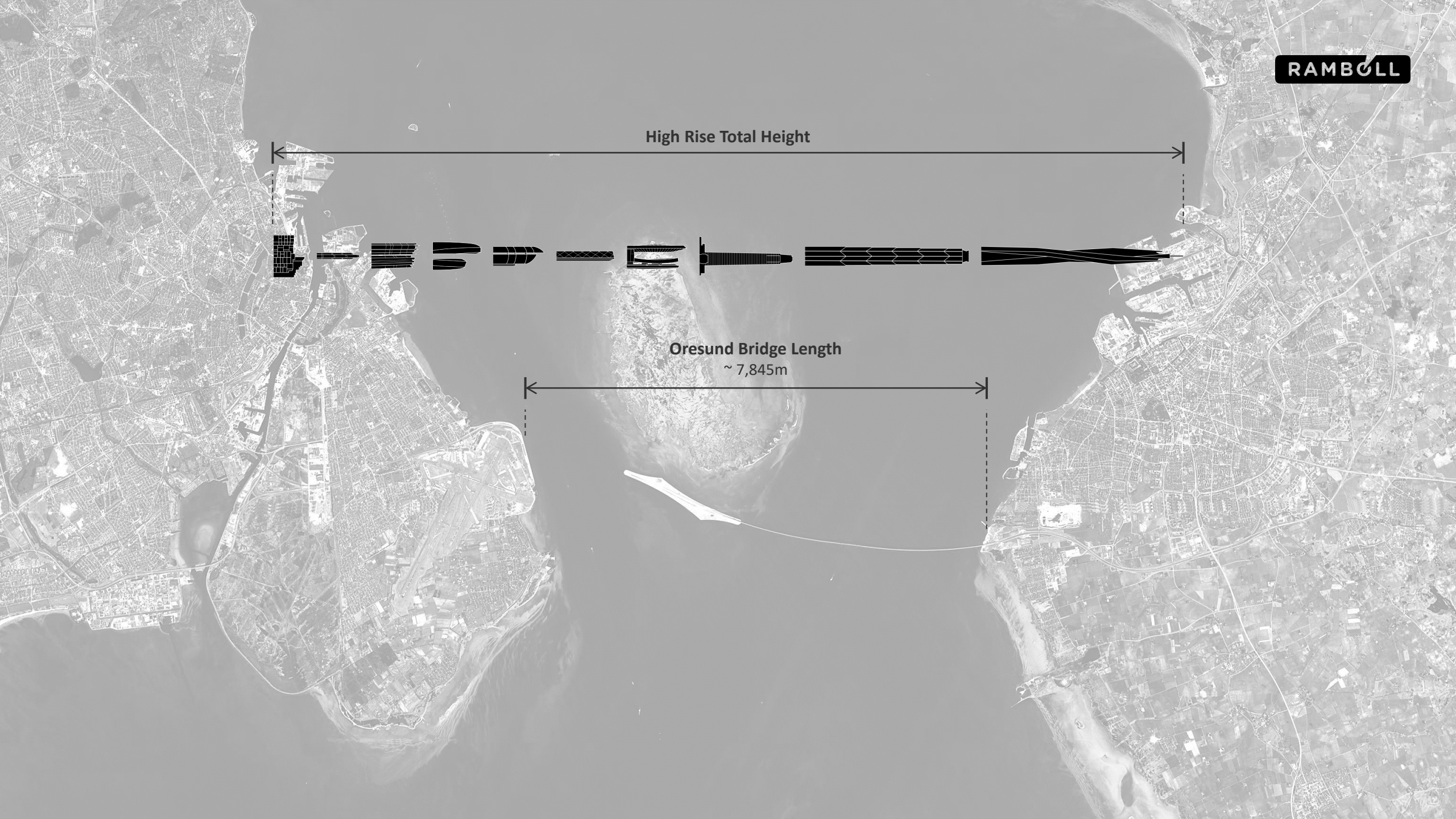
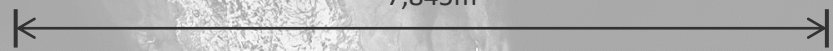
**High Rise Total Height**

**Mount Everest Height**  
~ 8,849m

High Rise Total Height



Oresund Bridge Length  
~ 7,845m





# 01.1

## Tall Buildings

they come in all different shapes, heights, and sizes ...

# Tokyo Marine Centre

## Singapore

Architect: CSYA  
Developer: Tokio Marine Asia Insurance  
Project Type: Office  
Completed: 2011  
No. of Floors: 21 floors  
Building Height: 124.5m  
Cost: S\$ 70 Million  
Building GFA: 7,000 sqm



Scan here for video!



# The Troika

RAMBOLL

## Kuala Lumpur, Malaysia

Architect: Foster + Partners,  
GDP Architects

Developer: Bandar Raya Development

Project Type: Residential

Completed: 2010

No. of Floors: 50 floors

Building Height: 204m

Cost: RM 300 Million

Building GFA: TBC

*CNBC International Property Awards 2008*

*RIBA International Awards 2012*

*PAM Awards 2012 Multiple Residential High Rise*



Scan here for video!



# 8 Conlay

## Kuala Lumpur, Malaysia

Architect: RSP Architects

Developer: KSK Group

Project Type: Hotel & Residential

Completed: ~2023

No. of Floors: 72 floors

Building Height: 277m

Cost: RM 2 Billion

Building GFA: 216,700 sqm









RAMBOLL







... and they all/we claim to be sustainable ..

while all environmental indicators are pointing in the wrong direction!

# 02

## the big why

in the beginning ...









Now













DENSITY OF CO<sub>2</sub> IN ATMOSPHERE (UNITS PER MILLION)

400

300

200

100

0





DENSITY OF CO<sub>2</sub> IN ATMOSPHERE (UNITS PER MILLION)

400  
300  
200  
100  
0



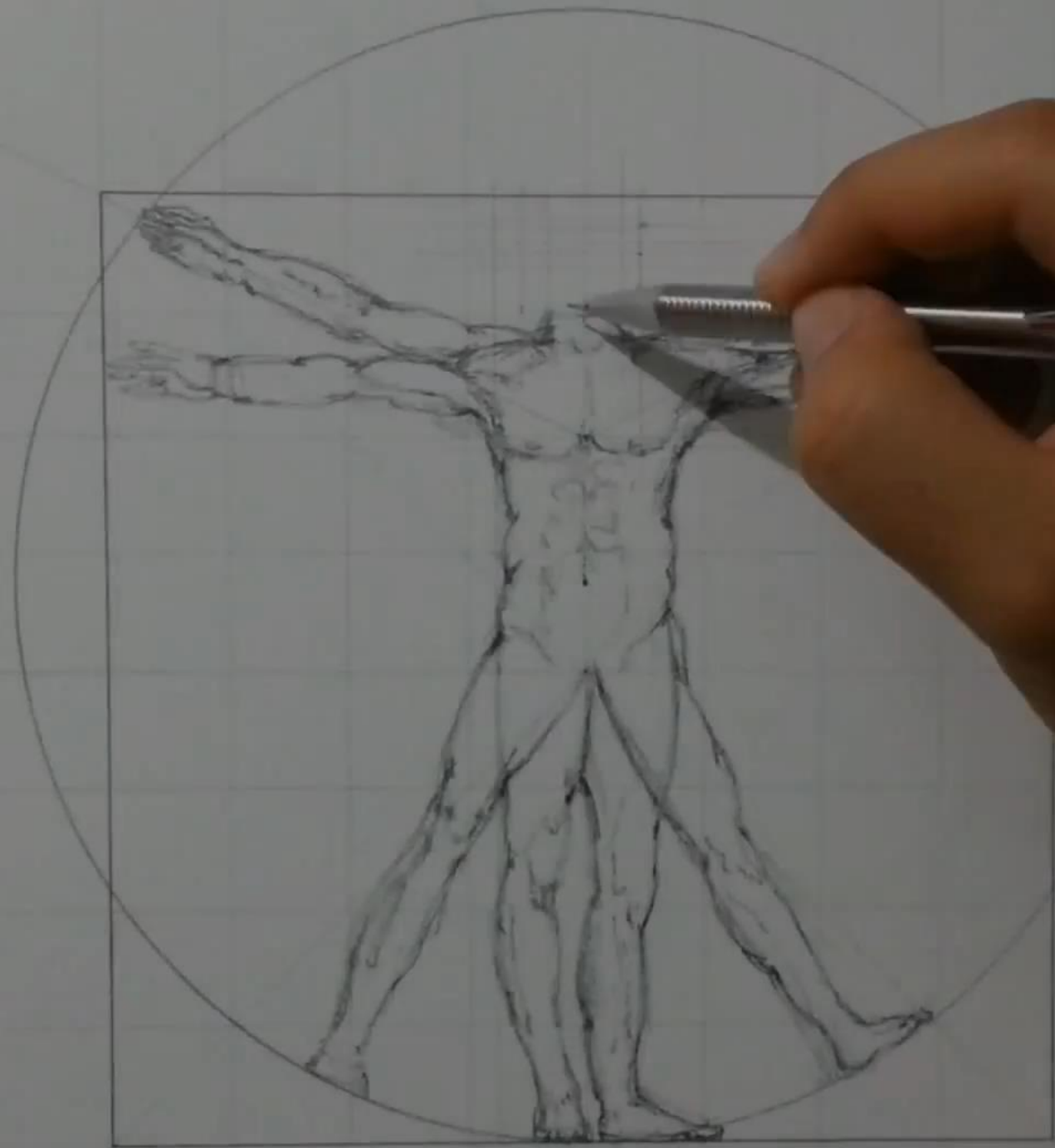














# 03

## Fusion Engineering

when we can have our cake, and eat it too ...

# 03

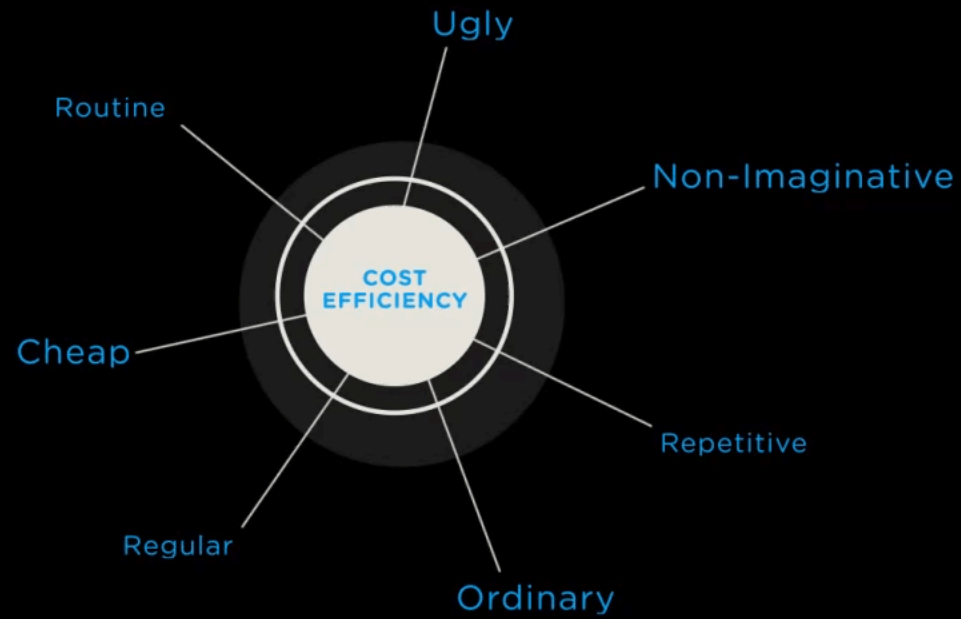
## Fusion Engineering

when too good can be true ...



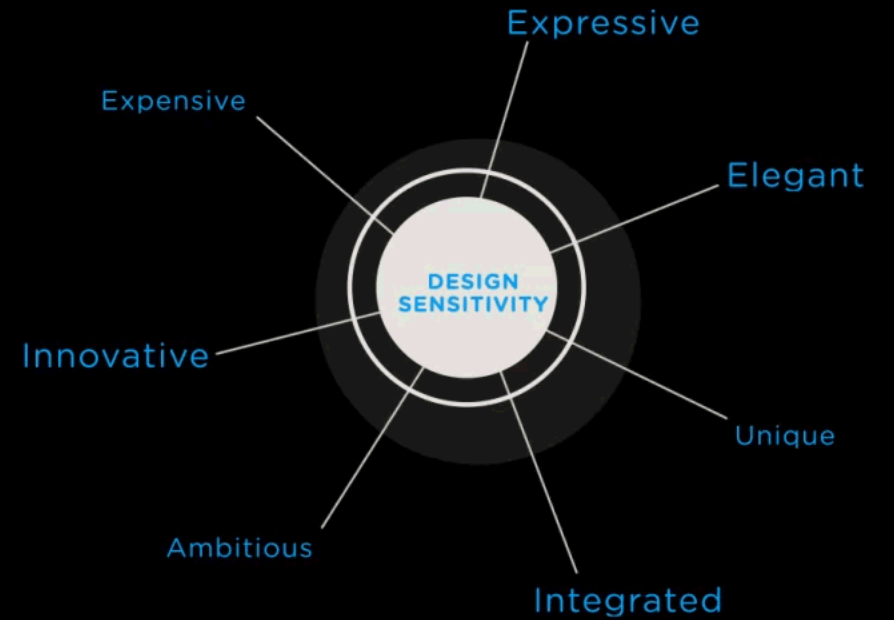
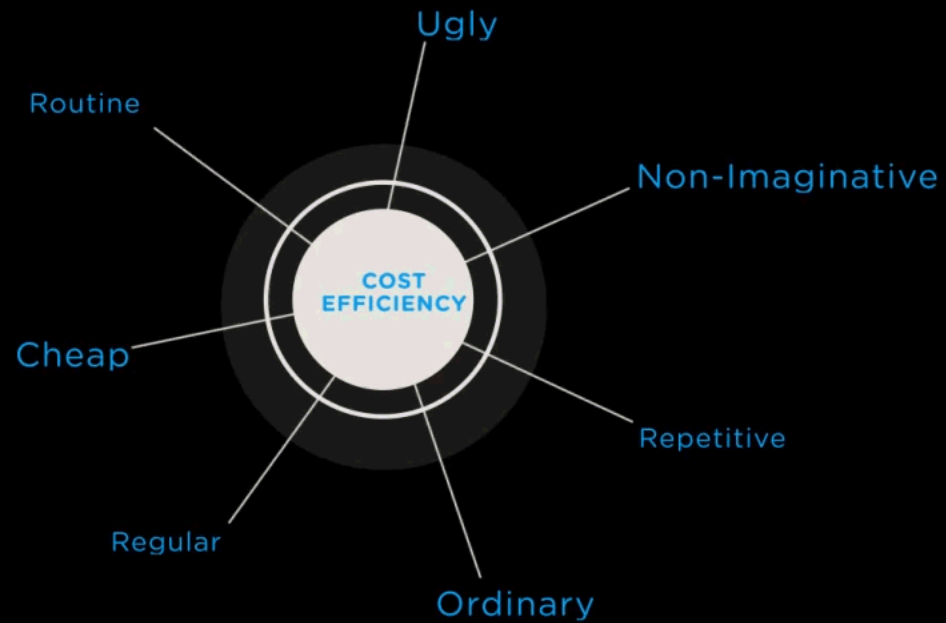
# FUSION ENGINEERING

# FUSION ENGINEERING





# FUSION ENGINEERING



# FUSION ENGINEERING



COST  
EFFICIENCY  
+  
DESIGN  
SENSITIVITY

# 04

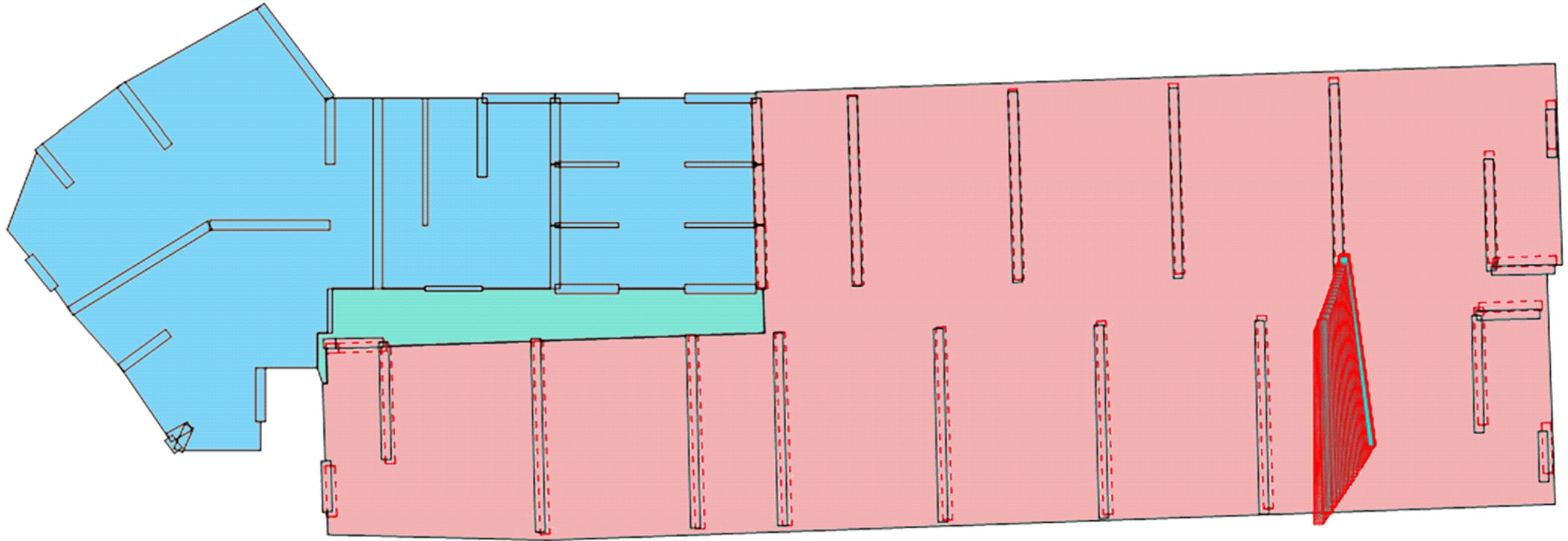
## 8, conlay in kuala lumpur

the world's tallest twin twisting towers ...



# MULTI-OBJECTIVE OPTIMISATION

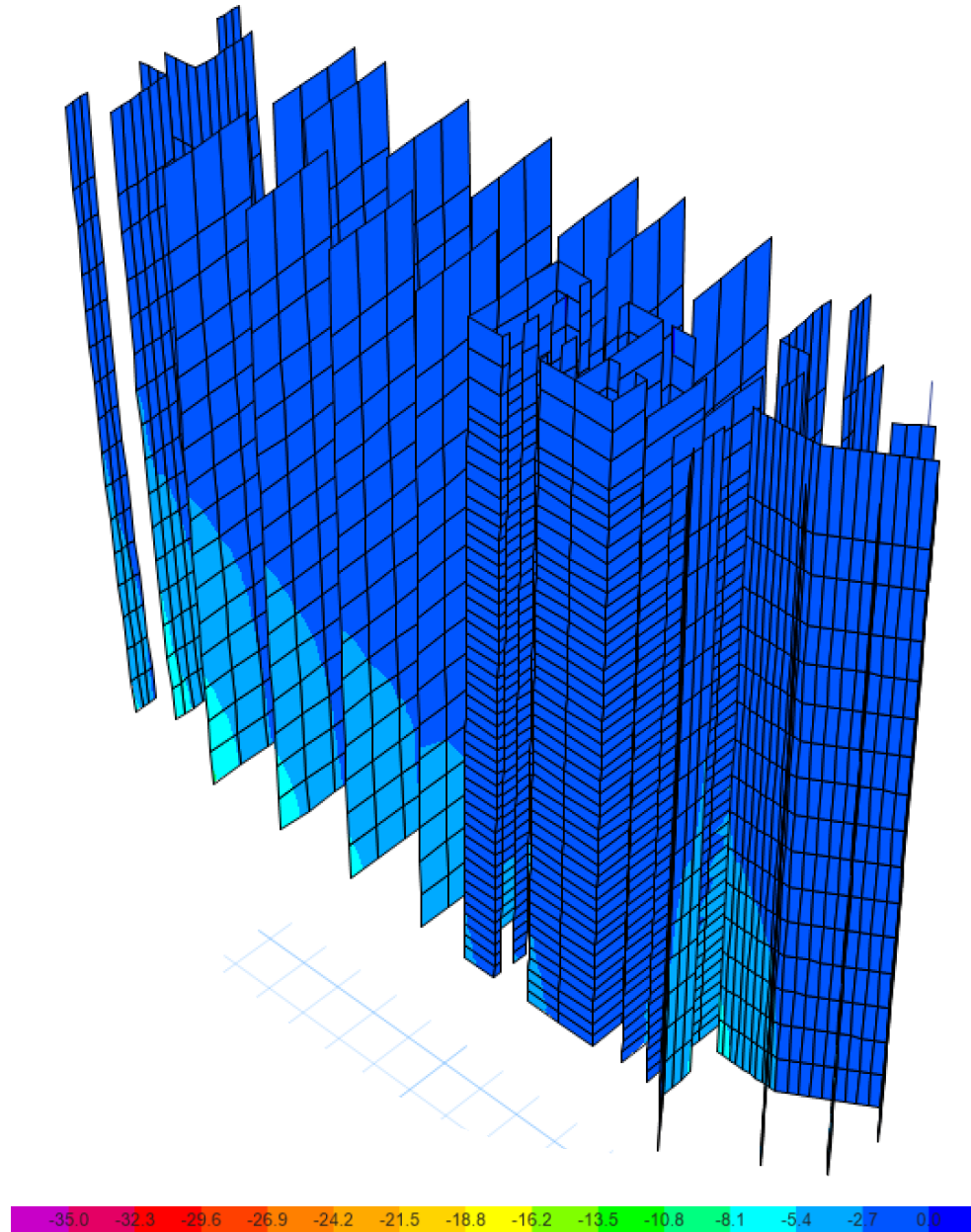




# CONSTRUCTION SEQUENCING STRESS

## TOWER A FREESTANDING WALL STRESS @ L26

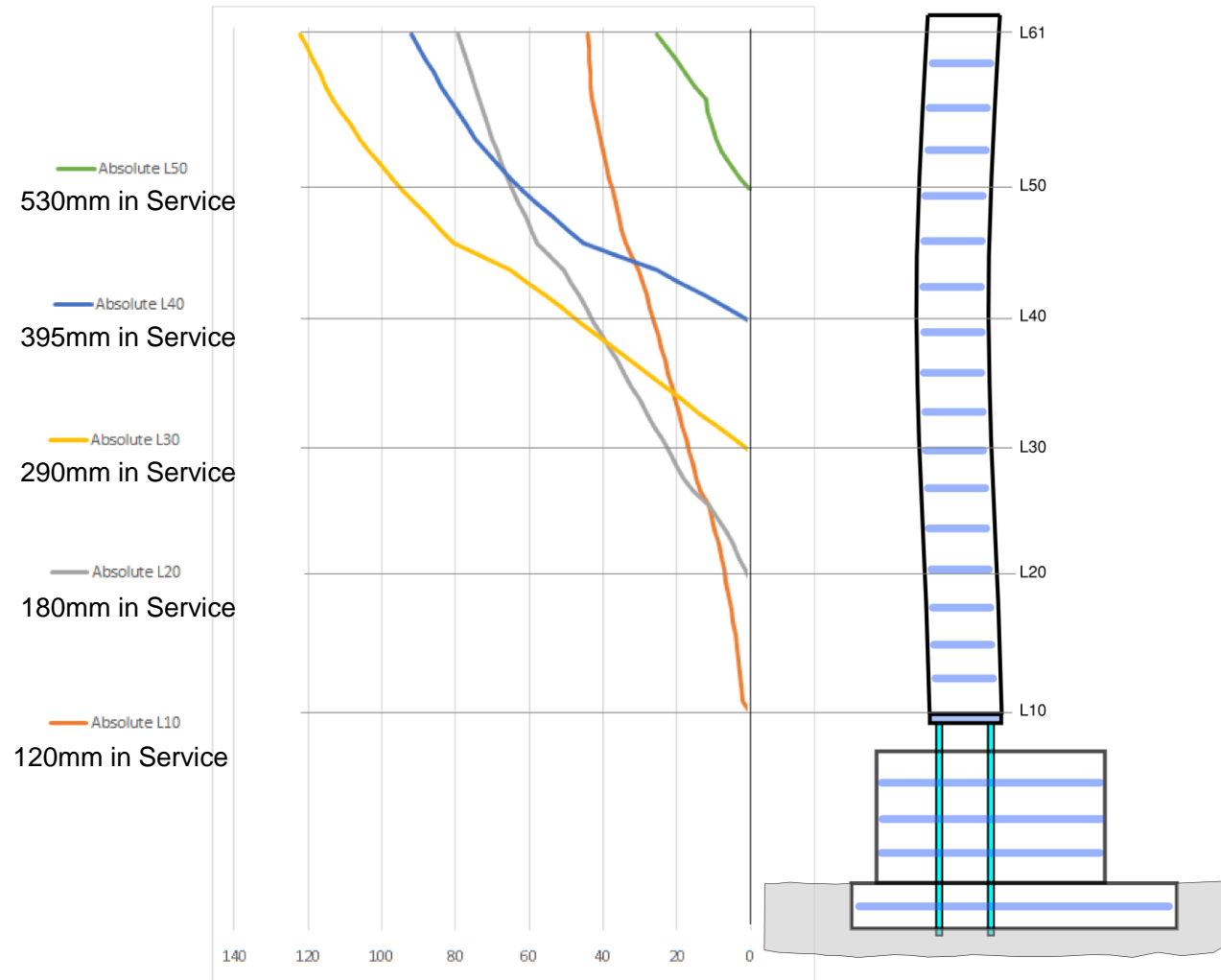
- WALL STRESSES SHOWN FOR TOWER A CONSTRUCTION SEQUENCING WITH CONSTRUCTION LOADING – TOWER A CONSTRUCTED UP TO LEVEL 26 (WITHOUT LEVEL 26 FACILITIES LINK STRUCTURE)
- TOWER A IS FREESTANDING AT THIS STAGE. WALL STRESSES ACCEPTABLE UNDER CONSTRUCTION LOADING



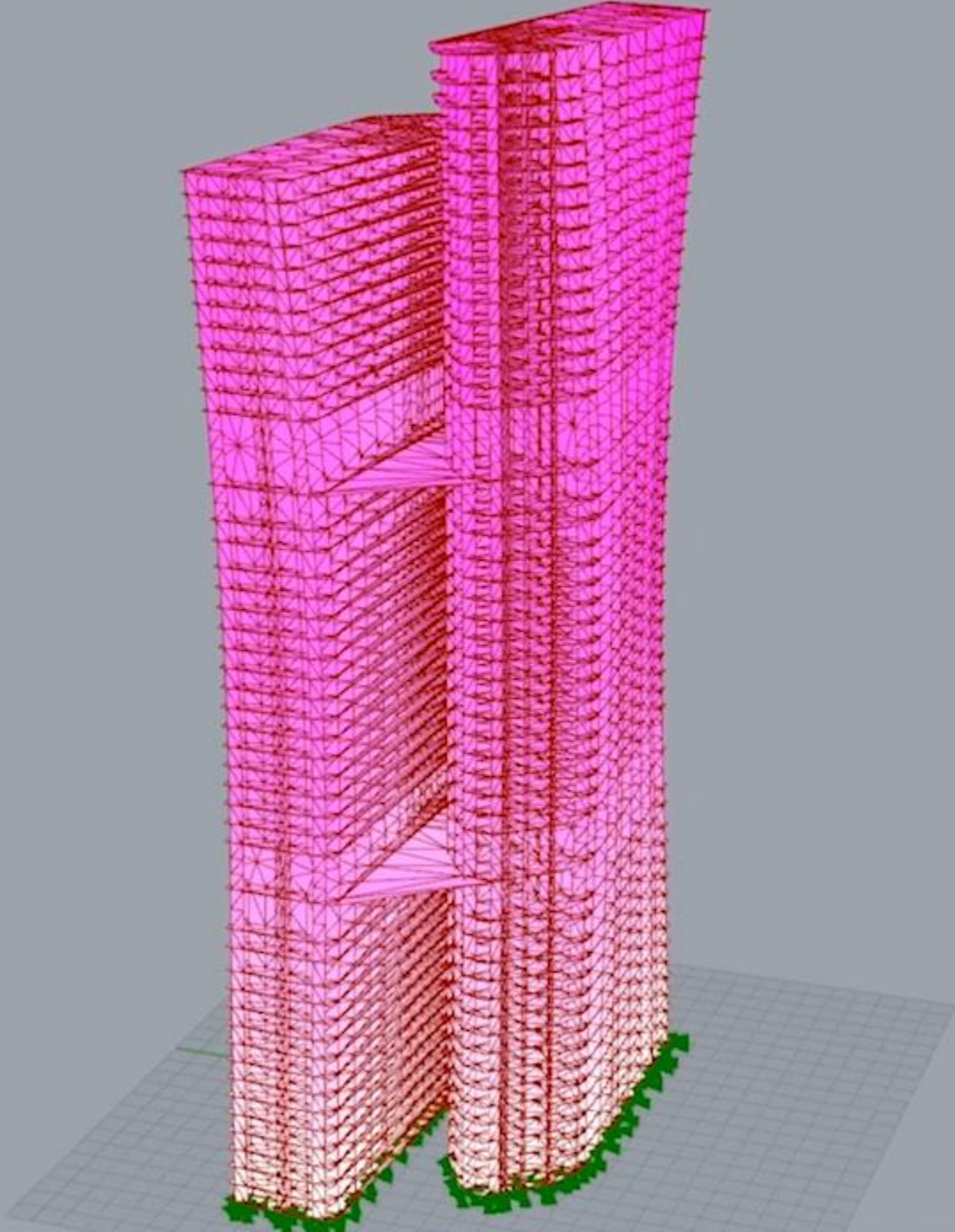
# CONSTRUCTION SEQUENCING DISPLACEMENT

## DETAILED WALL STUDY

- Absolute Lateral Deflection of Wall 5 at specified levels throughout construction sequencing.
- Less than Service Load Drifts



MULTI-OBJECTIVE OPTIMISATION





# Don't panic, the building is NOT falling (updated)

By JUSTIN ZACK



The viral photo that purportedly shows the building is about to "collapse".

KUALA LUMPUR: Keep calm, a building along Jalan Conlay is not collapsing. It's just the unusual design.

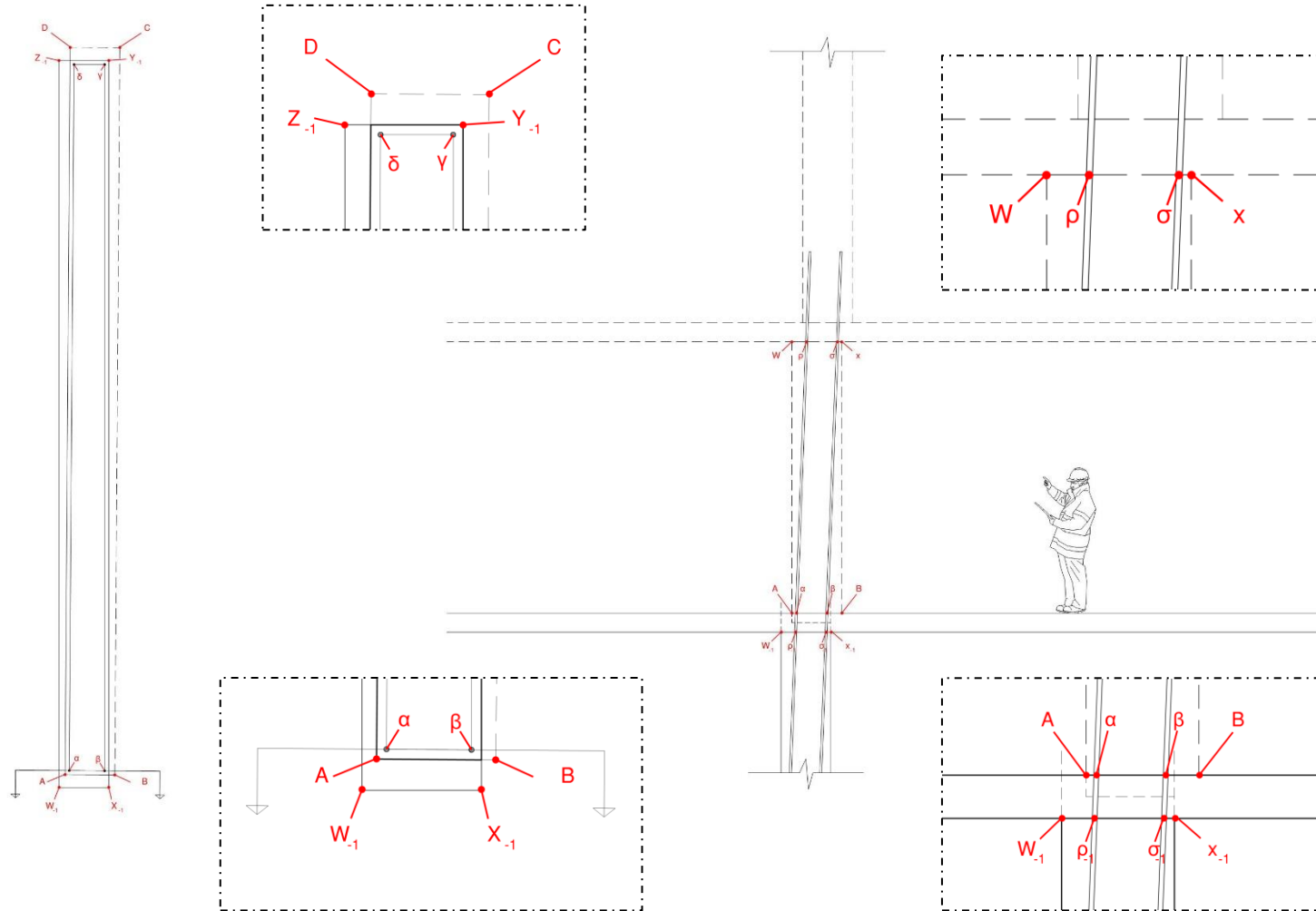
Photos of the still-under-construction YOO8 residence went viral on social media on Monday (Dec 23), with a caption claiming that it was about to collapse and was causing major traffic jams in the city.

However, a pamphlet of the building showed that the curve is intended and is simply a part of its design.



# INCLINED SHEER WALL REINFORCEMENT STUDIES

## WALL AND REBAR SETTING OUT POINTS



# INCLINED SHEER WALL REINFORCEMENT STUDIES

## SETTING OUT POINTS

### TABLE OF POINT CO-ORDINATES 1

Level	Setting Out Points On Slab												Setting Out Points For Rebars On Slab																																			
	A			B			C			D			α				β				γ				δ																							
	x	y	z	x	y	z	x	y	z	x	y	z	x	y	z	x	y	z	x	y	z	x	y	z	x	y	z	x	y	z																		
155	-28.418	-8.066	179.9	-28.746	-8.568	179.9	-21.415	-13.371	179.9	-21.087	-12.869	179.9	-28.403	-8.135	179.9	-28.677	-8.554	179.9	-21.430	-13.302	179.9	-21.156	-12.883	179.9	-28.418	-8.066	179.9	-28.746	-8.568	179.9	-21.415	-13.371	179.9	-21.087	-12.869	179.9	-28.358	-8.290	176.4	-28.573	-8.622	176.4	-21.430	-13.302	176.4	-21.188	-12.932	176.4
154	-28.418	-8.066	176.4	-28.746	-8.568	176.4	-21.415	-13.371	176.4	-21.087	-12.869	176.4	-28.358	-8.290	176.4	-28.573	-8.622	176.4	-21.430	-13.302	176.4	-21.188	-12.932	176.4	-28.330	-8.221	172.9	-28.699	-8.725	172.9	-21.342	-13.488	172.9	-21.016	-12.984	172.9	-28.314	-8.438	172.9	-28.530	-8.775	172.9	-21.357	-13.418	172.9	-21.115	-13.045	172.9
153	-28.330	-8.221	172.9	-28.699	-8.725	172.9	-21.342	-13.488	172.9	-21.016	-12.984	172.9	-28.272	-8.577	169.4	-28.489	-8.920	169.4	-21.286	-13.529	169.4	-21.045	-13.153	169.4	-28.288	-8.508	165.9	-28.609	-9.015	165.9	-21.204	-13.703	165.9	-20.948	-13.093	169.4	-28.272	-8.577	169.4	-28.489	-8.920	169.4	-21.286	-13.529	169.4	-21.045	-13.153	169.4
152	-28.330	-8.221	169.4	-28.653	-8.874	169.4	-21.271	-13.598	169.4	-20.948	-13.093	169.4	-28.221	-8.709	165.9	-28.449	-9.057	165.9	-21.219	-13.634	165.9	-21.094	-13.254	165.9	-28.247	-8.641	162.4	-28.566	-9.149	162.4	-21.139	-13.802	162.4	-20.820	-13.294	162.4	-28.192	-8.834	162.4	-28.411	-9.187	162.4	-21.155	-13.734	162.4	-20.914	-13.350	162.4
151	-28.288	-8.508	165.9	-28.609	-9.015	165.9	-21.204	-13.703	165.9	-20.883	-13.196	165.9	-28.211	-8.709	165.9	-28.449	-9.057	165.9	-21.219	-13.634	165.9	-21.094	-13.254	165.9	-28.209	-8.765	158.9	-28.525	-9.275	158.9	-21.078	-13.896	158.9	-20.761	-13.386	158.9	-28.155	-8.951	158.9	-28.375	-9.309	158.9	-21.094	-13.827	158.9	-20.854	-13.440	158.9
150	-28.247	-8.641	162.4	-28.566	-9.149	162.4	-21.139	-13.802	162.4	-20.820	-13.294	162.4	-28.192	-8.834	162.4	-28.411	-9.187	162.4	-21.155	-13.734	162.4	-20.914	-13.350	162.4	-28.172	-8.882	155.4	-28.486	-9.394	155.4	-21.020	-13.983	155.4	-20.705	-13.472	155.4	-28.120	-9.061	155.4	-28.341	-9.424	155.4	-21.036	-13.915	155.4	-20.796	-13.524	155.4
149	-28.209	-8.765	158.9	-28.525	-9.275	158.9	-21.078	-13.896	158.9	-20.761	-13.386	158.9	-28.155	-8.951	158.9	-28.375	-9.309	158.9	-21.094	-13.827	158.9	-20.854	-13.440	158.9	-28.137	-8.992	151.9	-28.449	-9.505	151.9	-20.965	-14.065	151.9	-20.652	-13.553	151.9	-28.087	-9.163	151.9	-28.309	-9.531	151.9	-20.981	-13.997	151.9	-20.741	-13.603	151.9
148	-28.172	-8.882	155.4	-28.486	-9.394	155.4	-21.020	-13.983	155.4	-20.705	-13.472	155.4	-28.120	-9.061	155.4	-28.341	-9.424	155.4	-21.036	-13.915	155.4	-20.796	-13.524	155.4	-28.110	-9.035	144.9	-28.414	-9.608	144.9	-20.913	-14.141	144.9	-20.603	-13.628	144.9	-28.055	-9.258	144.9	-28.279	-9.631	144.9	-20.930	-14.073	144.9	-20.690	-13.676	144.9
147	-28.137	-8.992	151.9	-28.449	-9.505	151.9	-20.965	-14.065	151.9	-20.652	-13.553	151.9	-28.087	-9.163	151.9	-28.309	-9.531	151.9	-20.981	-13.997	151.9	-20.741	-13.603	151.9	-28.104	-9.189	144.9	-28.381	-9.704	144.9	-20.865	-14.212	144.9	-20.557	-13.698	144.9	-27.963	-9.531	144.9	-28.122	-9.801	144.9	-20.882	-14.143	144.9	-20.679	-13.804	144.9
146	-28.104	-9.095	148.4	-28.414	-9.608	148.4	-20.913	-14.141	148.4	-20.603	-13.628	148.4	-28.055	-9.258	148.4	-28.279	-9.631	148.4	-20.930	-14.073	148.4	-20.690	-13.676	148.4	-27.947	-9.462	132.7	-28.285	-9.980	132.7	-20.725	-14.415	132.7	-20.422	-13.897	132.7	-27.928	-9.632	132.7	-28.145	-10.004	132.7	-20.743	-14.346	132.7	-20.510	-13.948	132.7
145	-28.073	-9.189	144.9	-28.381	-9.704	144.9	-20.865	-14.212	144.9	-20.557	-13.698	144.9	-27.963	-9.531	144.9	-28.122	-9.801	144.9	-20.882	-14.143	144.9	-20.679	-13.804	144.9	-27.947	-9.462	126.7	-28.248	-10.083	126.7	-20.673	-14.490	126.7	-20.371	-13.971	126.7	-27.911	-9.682	126.7	-28.145	-10.085	126.7	-20.691	-14.422	126.7	-20.449	-14.006	126.7
144	-27.947	-9.564	126.7	-28.248	-10.083	126.7	-20.673	-14.490	126.7	-20.371	-13.971	126.7	-27.911	-9.682	126.7	-28.145	-10.085	126.7	-20.691	-14.422	126.7	-20.449	-14.006	126.7	-27.930	-9.613	123.2	-28.230	-10.132	123.2	-20.647	-14.526	123.2	-20.346	-14.007	123.2	-27.893	-9.734	123.2	-28.125	-10.136	123.2	-20.665	-14.458	123.2	-20.425	-14.043	123.2
143	-27.930	-9.613	123.2	-28.230	-10.132	123.2	-20.647	-14.526	123.2	-20.346	-14.007	123.2	-27.893	-9.734	123.2	-28.125	-10.136	123.2	-20.665	-14.458	123.2	-20.425	-14.043	123.2	-27.911	-9.666	118.7	-28.211	-10.186	118.7	-20.620	-14.565	118.7	-20.320	-14.046	118.7	-27.881	-9.767	118.7	-28.120	-10.181	118.7	-20.685	-14.497	118.7	-20.394	-14.075	118.7
142	-27.911	-9.666	118.7	-28.211	-10.186	118.7	-20.620	-14.565	118.7	-20.320	-14.046	118.7	-27.881	-9.767	118.7	-28.120	-10.181	118.7	-20.685	-14.497	118.7	-20.394	-14.075	118.7	-27.900	-9.698	115.2	-28.190	-10.219	115.2	-20.589	-14.589	115.2	-20.303	-14.069	115.2	-27.873	-9.792	115.2	-28.113	-10.210	115.2	-20.621	-14.521	115.2	-20.376	-14.096	115.2
141	-27.900	-9.698	115.2	-28.190	-10.219	115.2	-20.589	-14.589	115.2	-20.303	-14.069	115.2	-27.873	-9.792	115.2	-28.113	-10.210	115.2	-20.621	-14.521	115.2	-20.376	-14.096	115.2	-27.891	-9.724	111.7	-28.190	-10.244	111.7	-20.589	-14.608	111.7	-20.290	-14.088	111.7	-27.866	-9.810	111.7	-28.109	-10.233	111.7	-20.608	-14.540	111.7	-20.362	-14.112	111.7
140	-27.891	-9.724	111.7	-28.190	-10.244	111.7	-20.589	-14.608	111.7	-20.290	-14.088	111.7	-27.866	-9.810	111.7	-28.109	-10.233	111.7	-20.608	-14.540	111.7	-20.362	-14.112	111.7	-27.885	-9.742	108.2	-28.183	-10.262	108.2	-20.580	-14.622	108.2	-20.281	-14.101	108.2	-27.862	-9.821	108.2	-28.107	-10.248	108.2	-20.598	-14.553	108.2	-20.352	-14.123	108.2
139	-27.891	-9.724	108.2	-28.183	-10.262	108.2	-20.580	-14.622	108.2	-20.281	-14.101	108.2	-27.862	-9.821	108.2	-28.107	-10.248	108.2	-20.598	-14.553	108.2	-20.352	-14.123	108.2	-27.881	-9.753	104.7	-28.179	-10.273	104.7	-20.574	-14.630	104.7	-20.276	-14.109	104.7	-27.861	-9.825	104.7	-28.108	-10.256	104.7	-20.593	-14.561	104.7	-20.345	-14.129	104.7
138	-27.885	-9.742	108.2	-28.183	-10.262	108.2	-20.580	-14.622	108.2	-20.281	-14.101	108.2	-27.862	-9.821	108.2	-28.107	-10.248	108.2	-20.598	-14.553	108.2	-20.352	-14.123	108.2	-27.881	-9.753	104.7	-28.179	-10.273	104.7	-20.574	-14.630	104.7	-20.276	-14.109	104.7	-27.861	-9.825	104.7	-28.108	-10.256	104.7	-20.593	-14.561	104.7	-20.345	-14.129	104.7
137	-27.881	-9.753	104.7	-28.179	-10.273	104.7	-20.574	-14.630	104.7	-20.276	-14.109	104.7	-27.861	-9.825	104.7	-28.108	-10.256	104.7	-20.593	-14.561	104.7	-20.345	-14.129	104.7	-27.880	-9.756	101.2	-28.178	-10.277	101.2	-20.572	-14.632	101.2	-20.274	-14.111	101.2	-27.861	-9.825	101.2	-28.108	-10.256	101.2	-20.593	-14.561	101.2	-20.345	-14.129	101.2
136	-27.880	-9.756	101.2	-28.178	-10.277	101.2	-20.572	-14.632	101.2	-20.274	-14.111	101.2	-27.861	-9.825	101.2	-28.108	-10.256	101.2	-20.593	-14.561	101.2	-20.345	-14.129	101.2	-27.881	-9.753	97.7	-28.179	-10.273	97.7	-20.574	-14.629	97.7	-20.276	-14.109	97.7	-27.862	-9.821	97.7	-28.107	-10.248	97.7	-20.598	-14.553	97.7	-20.352	-14.123	97.7
135	-27.881	-9.753	97.7	-28.179	-10.273	97.7	-20.574	-14.629	97.7	-20.276	-14.109	97.7	-27.862	-9.821	97.7	-28.107	-10.248	97.7	-20.598	-14.553	97.7	-20.352	-14.123	97.7	-27.885	-9.742	94.2	-28.183	-10.262	94.2	-20.580	-14.621	94.2	-20.281	-14.101	94.2	-27.866	-9.810	94.2	-28.109	-10.233	94.2	-20.608	-14.540	94.2	-20.362	-14.112	94.2
134	-27.885	-9.742	94.2	-28.183	-10.262	94.2	-20.580	-14.621	94.2	-20.281	-14.101	94.2	-27.866	-9.810	94.2	-28.109	-10.233	94.2	-20.608	-14.540	94.2	-20.362	-14.112	94.2	-27.891	-9.724	90.7	-28.190	-10.244	90.7	-20.589	-14.608	90.7	-20.291	-14.088	90.7	-27.873	-9.792	90.7	-28.113	-10.210	90.7	-20.621	-14.521	90.7	-20.377	-14.096	90.7
133	-27.891	-9.724	90.7	-28.190	-10.244	90.7	-20.589	-14.608	90.7	-20.291	-14.088	90.7	-27.873	-9.792	90.7	-28.113	-10.210	90.7	-20.621	-14.521	90.7	-20.377	-14.096	90.7	-27.900	-9.698	87.2	-28.199	-10.218	87.2	-20.603	-14.589	87.2	-20.303	-14.069	87.2	-27.882	-9.766	87.2	-28.120	-10.180	87.2	-20.638	-14.497	87.2	-20.39		



# 05

## The reward for competence and rigor

the 5% or the 30% ...

# QUANTIFYING EMBODIED CO<sub>2</sub>

±30 STRUCTURAL COSTS



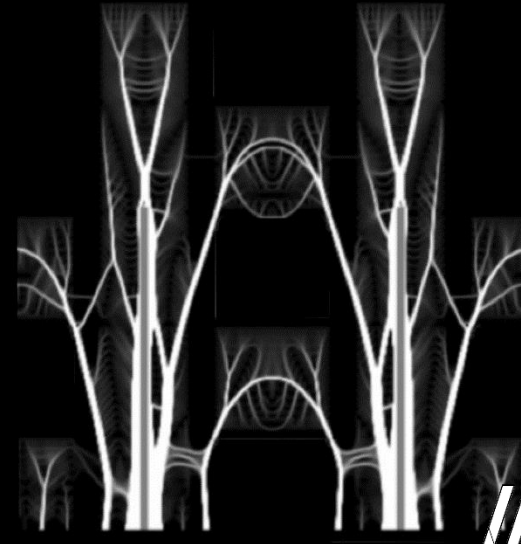
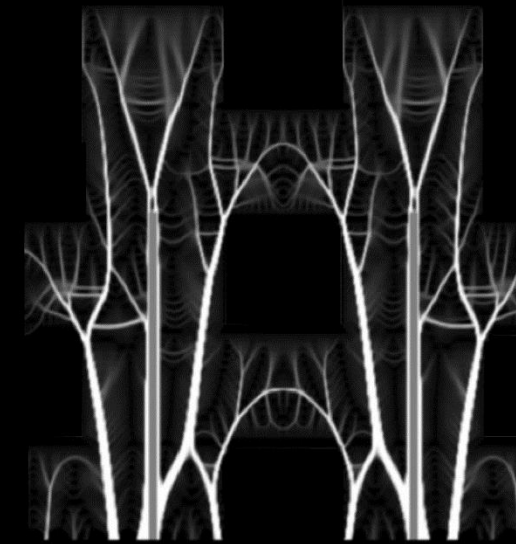
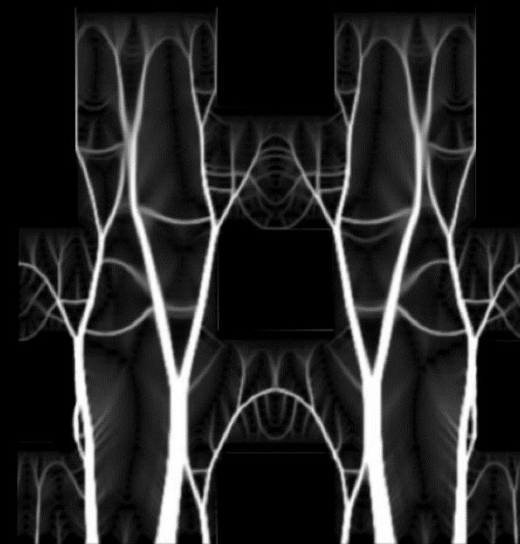
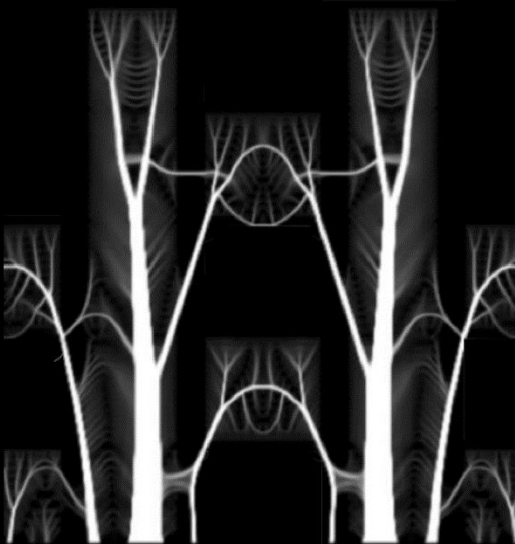
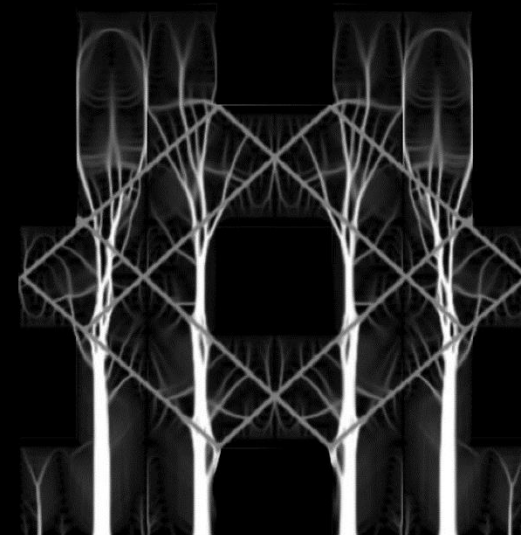
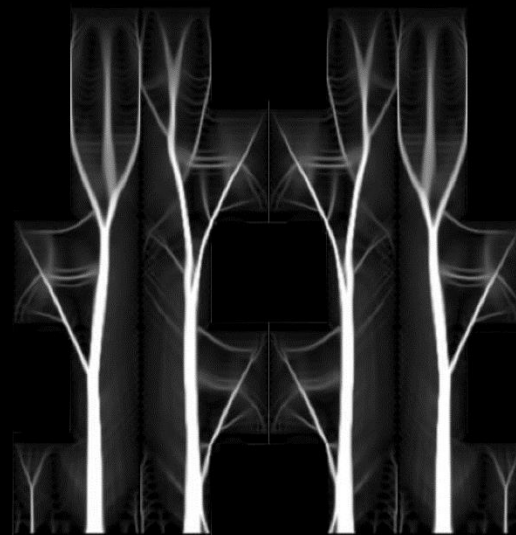
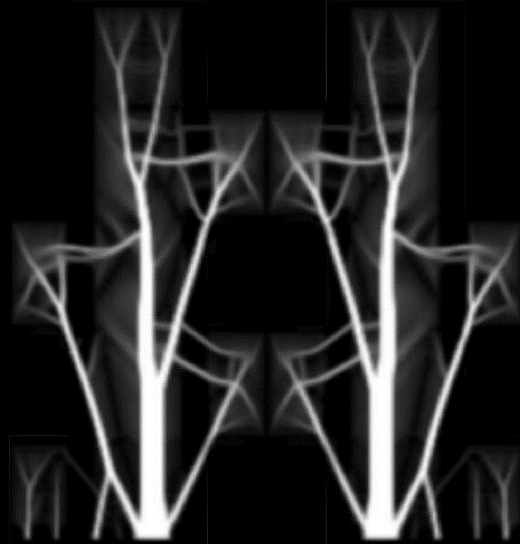
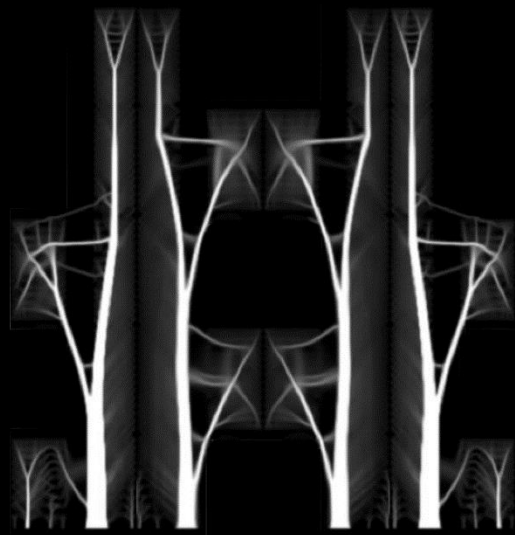
# 06

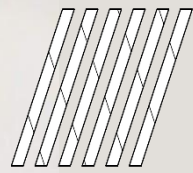
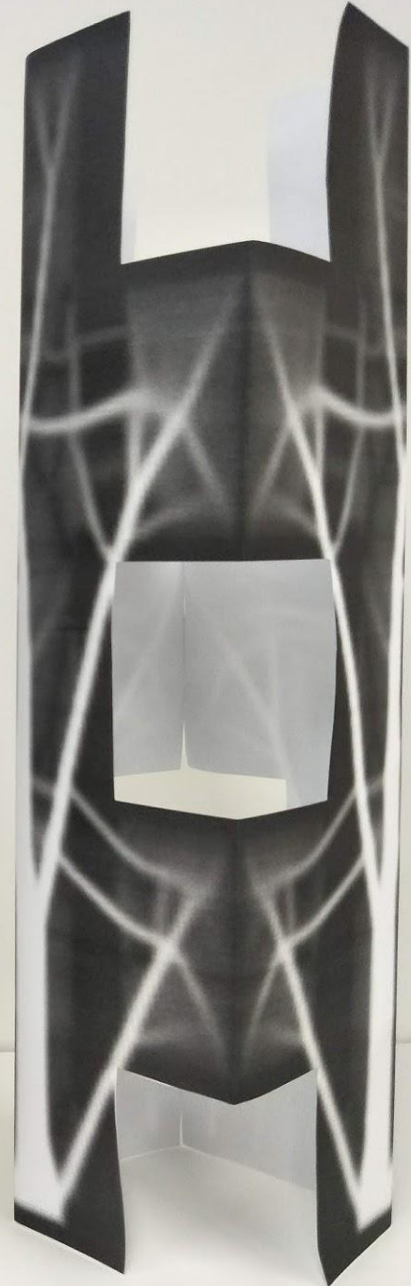
## Technology is our friend

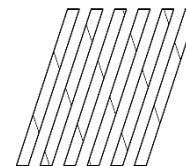
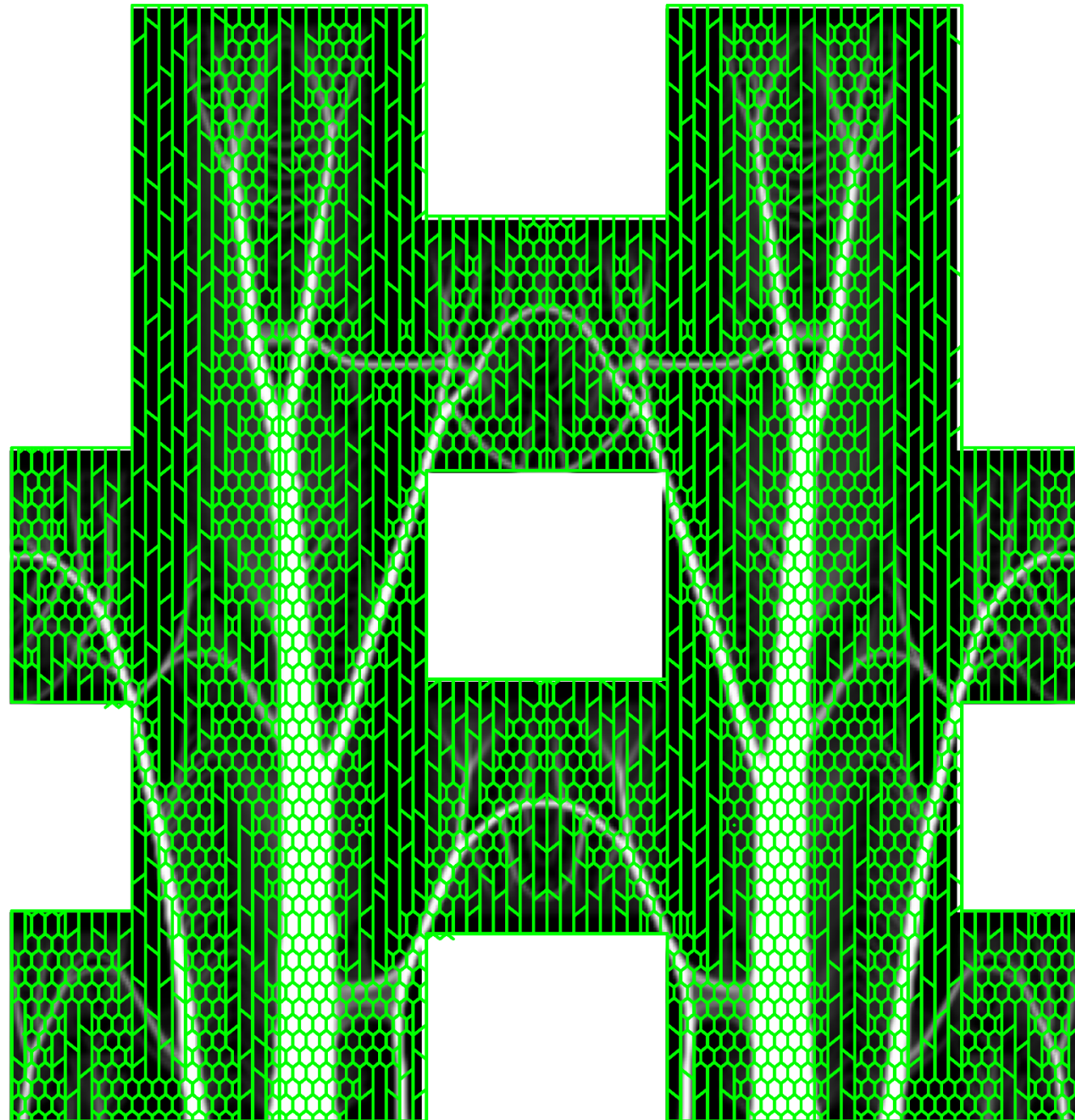
more case studies ...

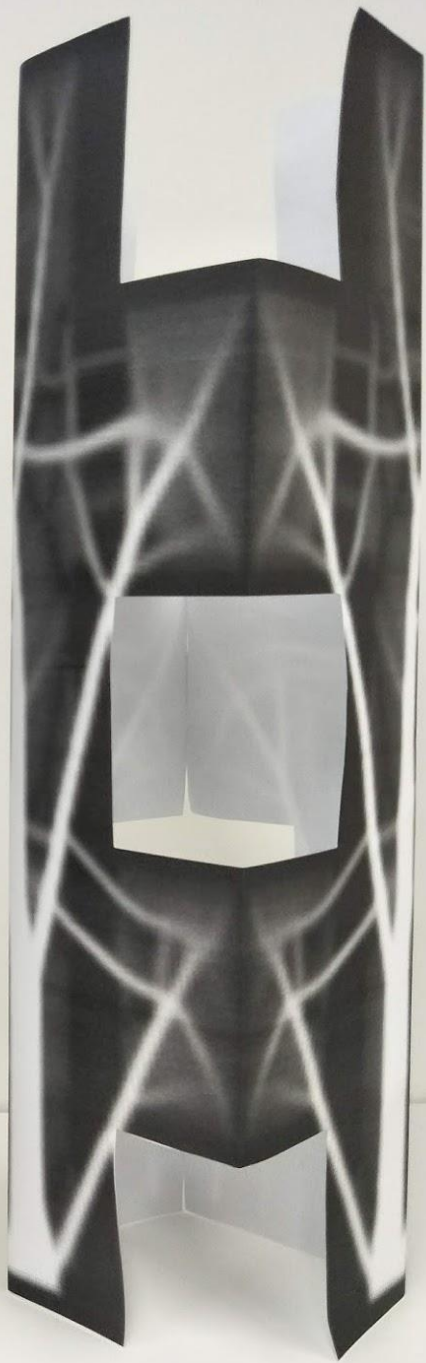












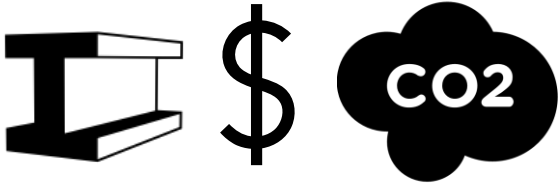


# 07

## The case for regeneration

fusion of everything, everywhere, all at once ...

# HIGH-RISE VS SUBURBAN



215 STORY



123 STORY



58 STORY



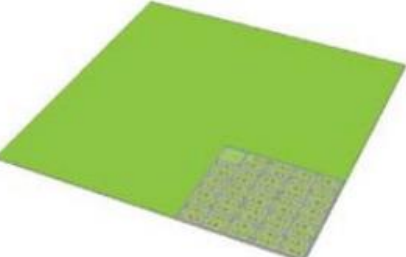
34 STORY



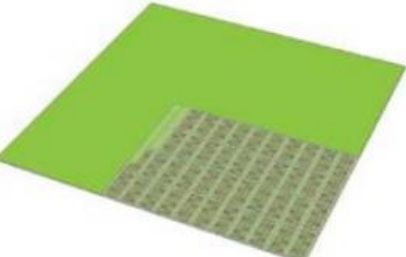
16 STORY



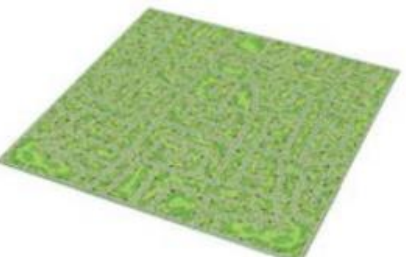
4 STORY COURTYARD



3-STORY 3FLAT



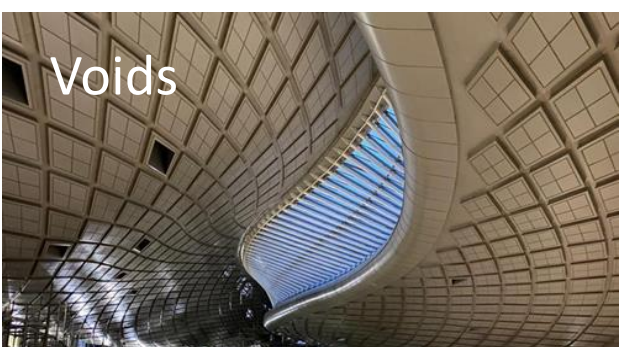
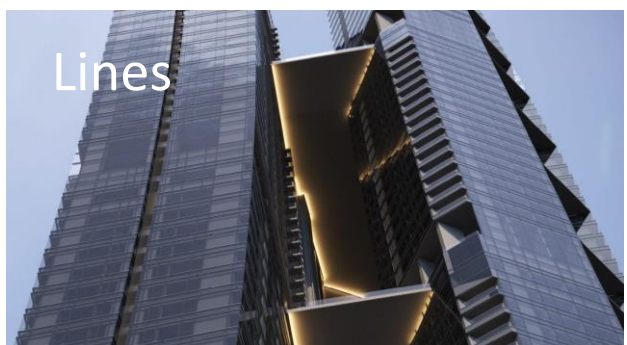
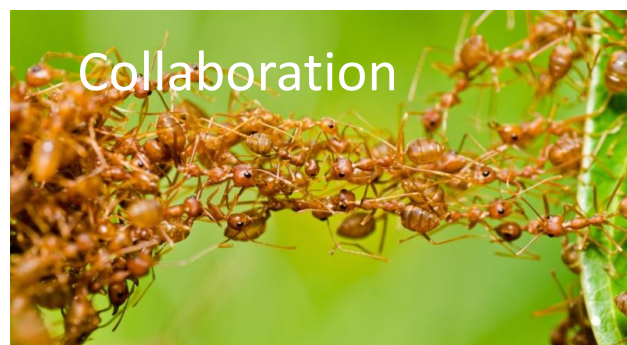
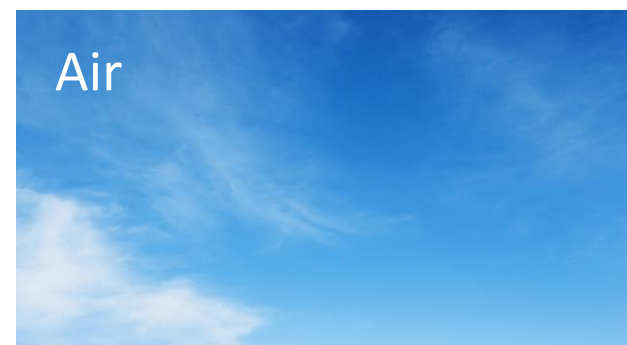
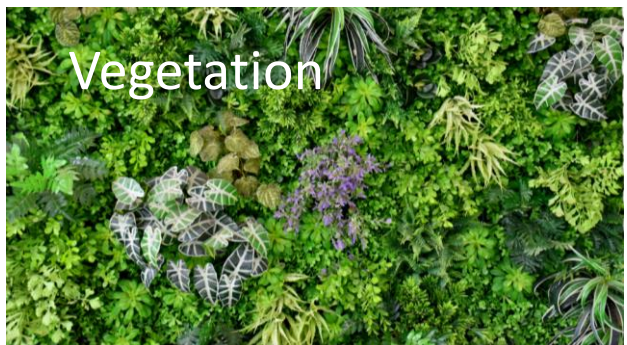
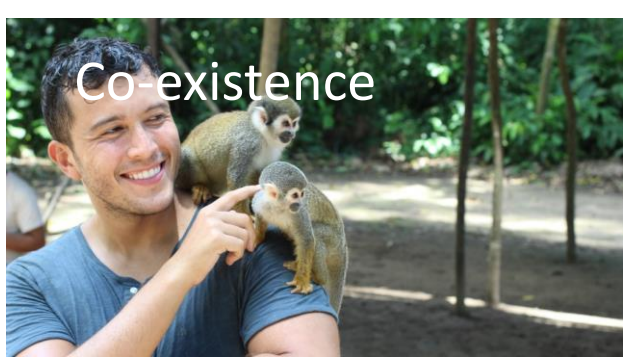
URBAN HOME



SUBURBAN HOME



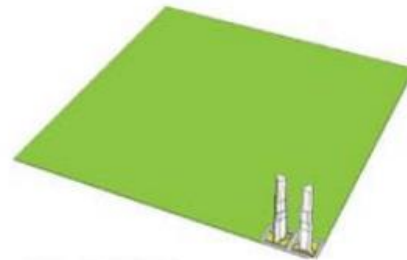




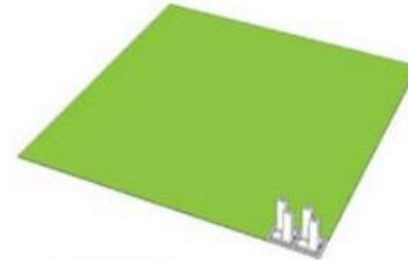
# HIGH-RISE VS SUBURBAN



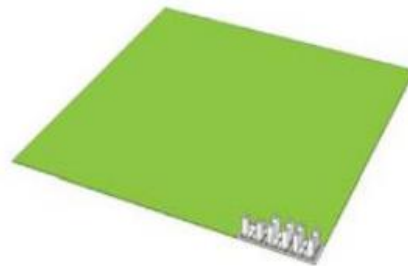
215 STORY



123 STORY



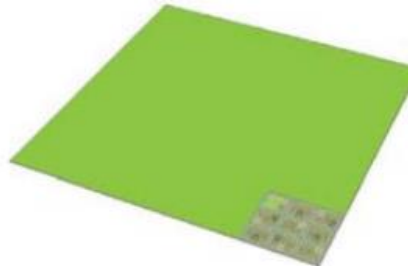
58 STORY



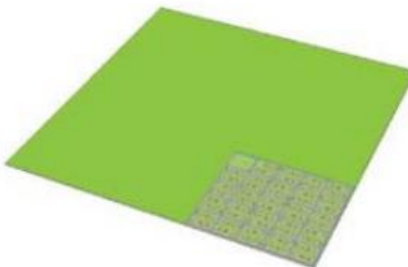
34 STORY



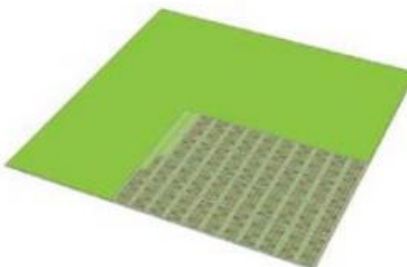
16 STORY



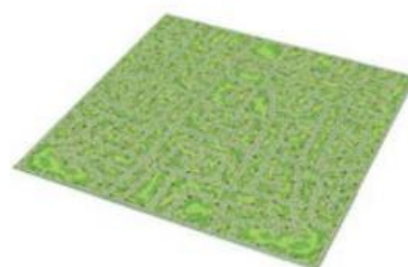
4 STORY COURTYARD



3-STORY 3FLAT



URBAN HOME



SUBURBAN HOME



... and a final thought ...

Ramboll **DESIGN** publications

# Ramboll Design Excellence Publications



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Creating value  
January 2023



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Design Excellence  
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