Urban Engitecture

Square Megastructure vs Conventional Skyscrapers

A comparative study of one city-scale structure that frees the ground it stands on.



~23.5 M m²	0.5%	1,015 m	0.78 km²
floor area, about 76 Burj Khalifas	of the ground touched by its 84 legs	tall, over an 1,800 × 1,800 m plan	open core through the full height

Ale Girá
diffjustdiff

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ale@diffjustdiff.com









Concept visualisations of the macro-structure.

Summary

The square preset, with a 500 m core left open at its centre, holds about 23.5 million m² of floor area — roughly 76 Burj Khalifas — on 84 legs that touch only 0.5% of its 3.24 km² plan. It rises to about 1,015 m over an 1,800 × 1,800 m grid, so as a whole it is squat and stiff, while each 1,000 m column on its own would be about twice as slender as the world's thinnest tower.

Measure	Square megastructure	Equivalent skyscrapers
Gross floor area	~23.5 M m²	~76 × Burj Khalifa (309,473 m² each)
Residents	~235,000–670,000 (~73,000–208,000 per km² of plan)	Manhattan ~28,300 per km²
Height	~1,015 m	Burj Khalifa 828 m
Ground contact	~16,800 m² (0.5% of plan)	~157,000–392,000 m² of tower floor plates
Open core	~0.78 km² void at the centre (500 m radius)	—
Whole-form slenderness	~1 : 0.56 (width : height)	111 West 57th St 1 : 24
Weight	~42–76 Mt	~38 Mt
Construction cost	~$137–228 B	~$114 B
Embodied carbon	~9–19 Mt CO2e, plus tall-building premium	similar per m²

All figures are order-of-magnitude estimates from the tool's geometry, not an engineering design.

Configuration

The preset is a 9 × 9 bay square grid of 200 m bays: 84 tapered columns around a 500 m open core carry 10 horizontal decks of beam-buildings, one every 100 m.

Parameter	Value
Grid	9 × 9 bays, 10 × 10 nodes; 84 columns after the core
Bay span	200 m (centre to centre)
Plan	1,800 × 1,800 m (3.24 km²)
Core exclusion	On: 500 m radius, 24 sides (~0.78 km²); removes the central 16 columns and the 40 beams per deck that touch them

Parameter	Value
Total height	1,000 m to the top deck axis, ~1,015 m to the top of its beams
Decks	10, at 100, 200 … 1,000 m
Ground clearance	100 m to the first deck axis, ~85 m free height under its beams
Column section	Square; side 14.1 m at base → 28.3 m at top of each 100 m segment, linear taper
Beam-building section	20 m wide × 30 m deep, constant
Floors	20 per column segment (5.0 m), 6 per beam-building (5.0 m); plates overhang 3 m beyond every face as terraces, not counted in floor area
Horizontals removed	50% on the 9 lower decks; top deck complete
Legs	Every column reaches the ground

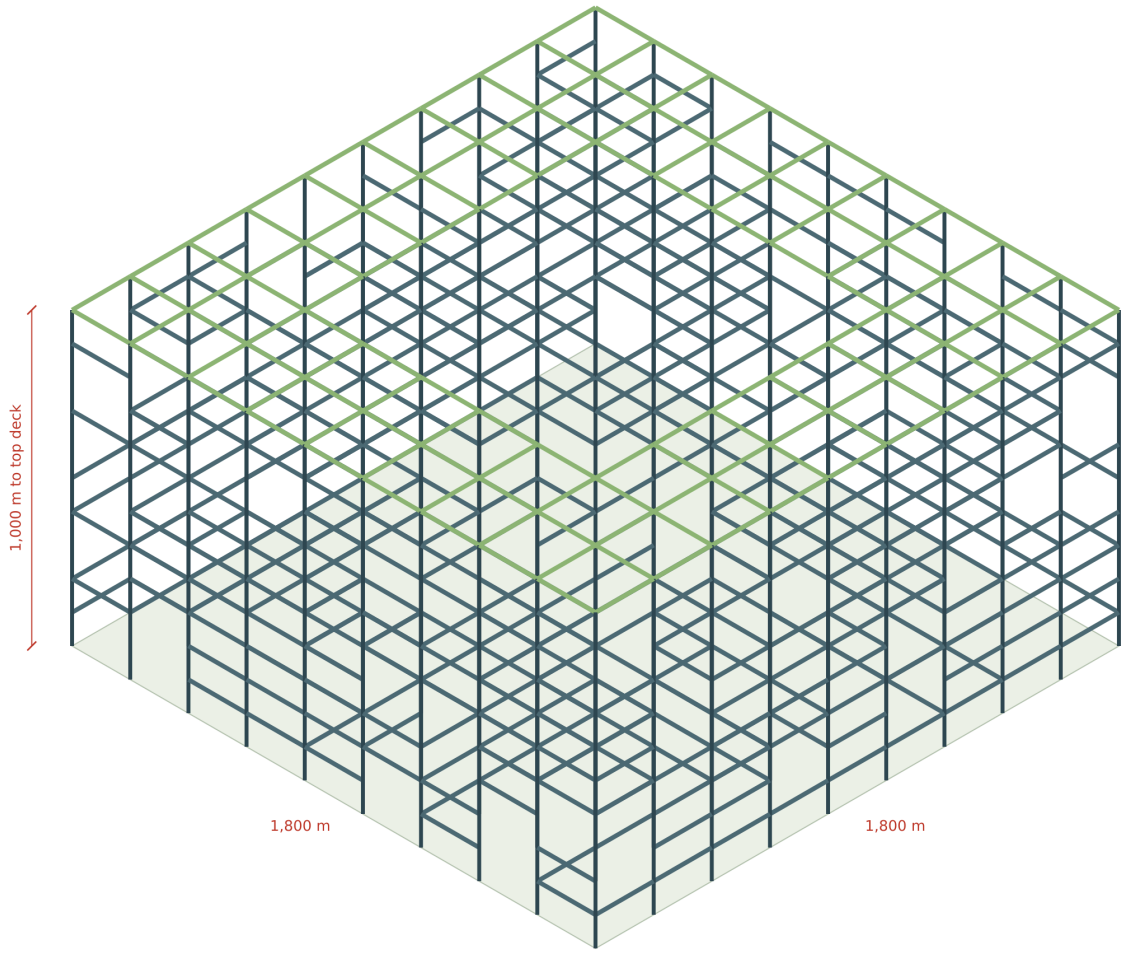
One tool unit is read as one metre throughout.

Drawings with dimensions

Six drawings fix the preset's geometry: an overview, plan, elevation, a typical bay, the element sections and a same-scale comparison with Burj Khalifa and 111 West 57th Street. Dimensions are in metres; the lower-deck removal pattern is illustrative, since the tool's 50% removal is random. The plan and overview show the 500 m open core; the elevation is the outer row, which the core does not reach.

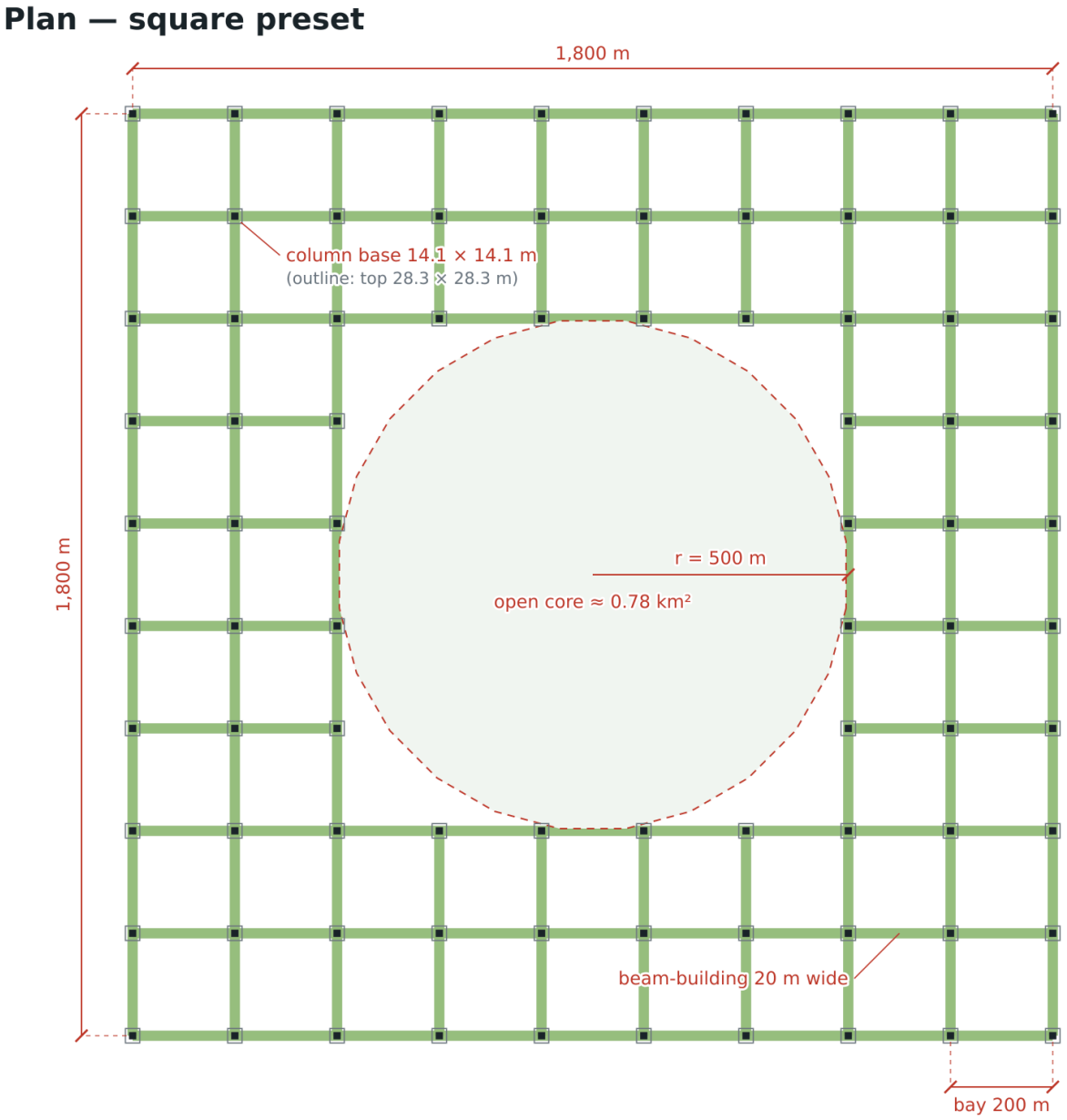
Overview

Overview — square preset



Isometric overview · 500 m open core · top deck green · illustrative 50% removal on lower decks

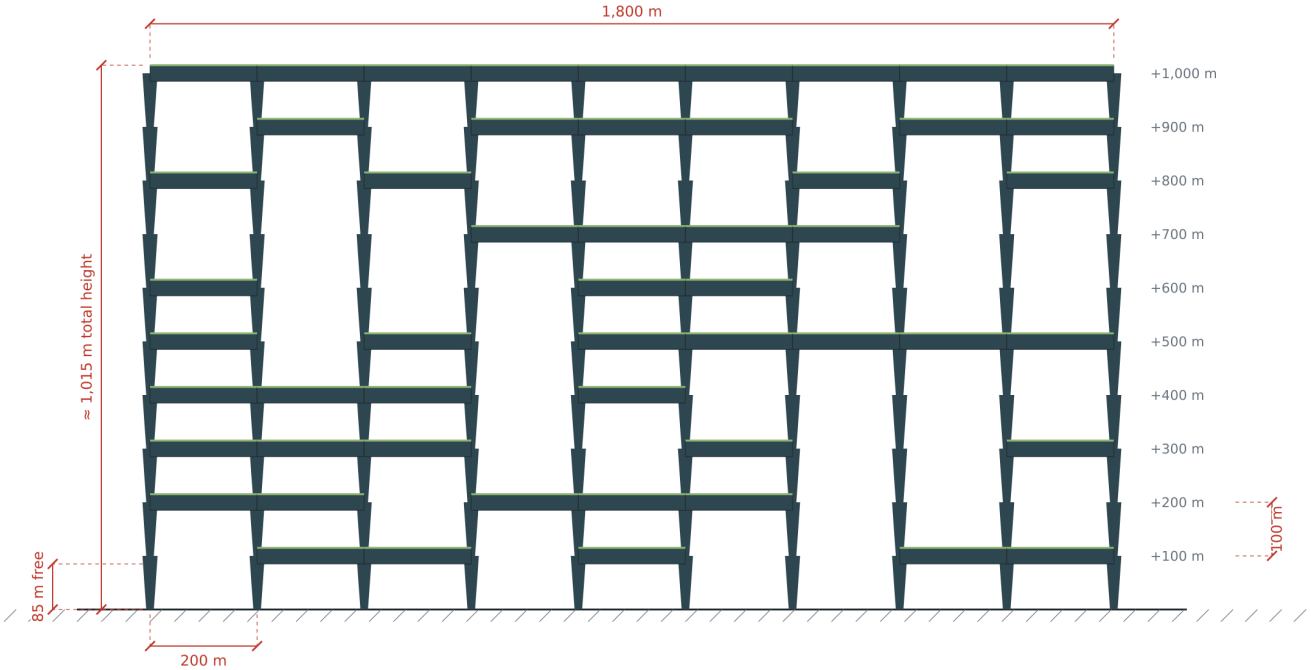
Plan



84 columns on a 9 × 9 grid of 200 m bays · plan 3.24 km² · legs cover ~16,800 m² (0.5%)
Core exclusion on: 500 m radius, 24 sides · top deck shown (green); lower decks keep ~50% of beams

Elevation

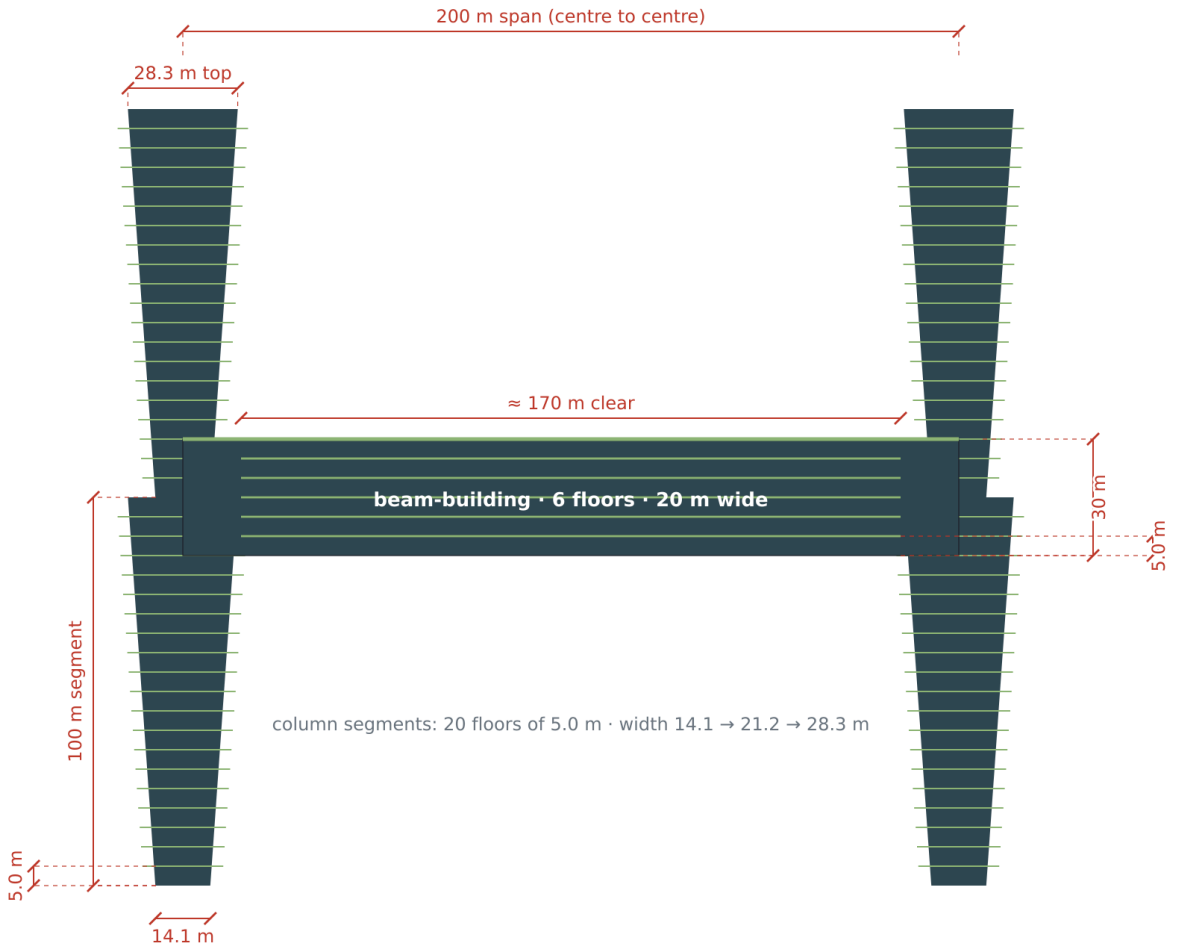
Elevation — square preset



South elevation, front row · 10 decks every 100 m · beam-buildings 30 m deep · illustrative 50% removal on lower decks

Typical bay

Typical bay — dimensions

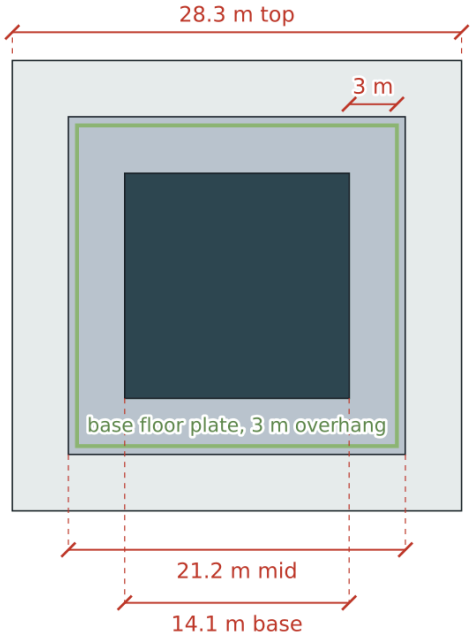


Typical bay at deck +400 m · green lines = floor plates, overhanging 3 m beyond every face · profile repeats on every 100 m segment

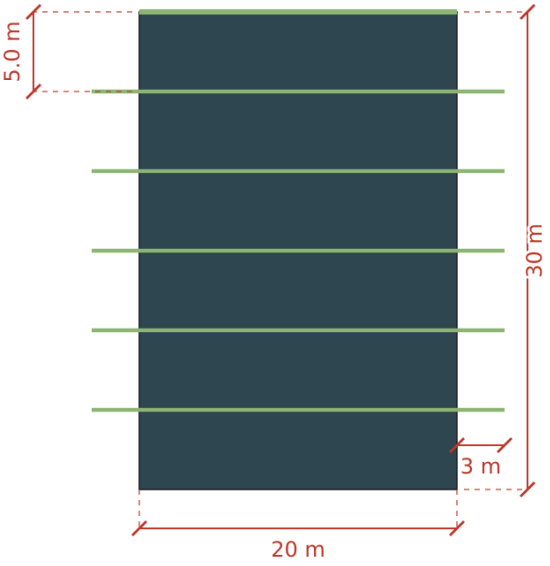
Element sections

Element cross-sections

Column section (square, nested)
interior ~200 / ~450 / ~800 m²



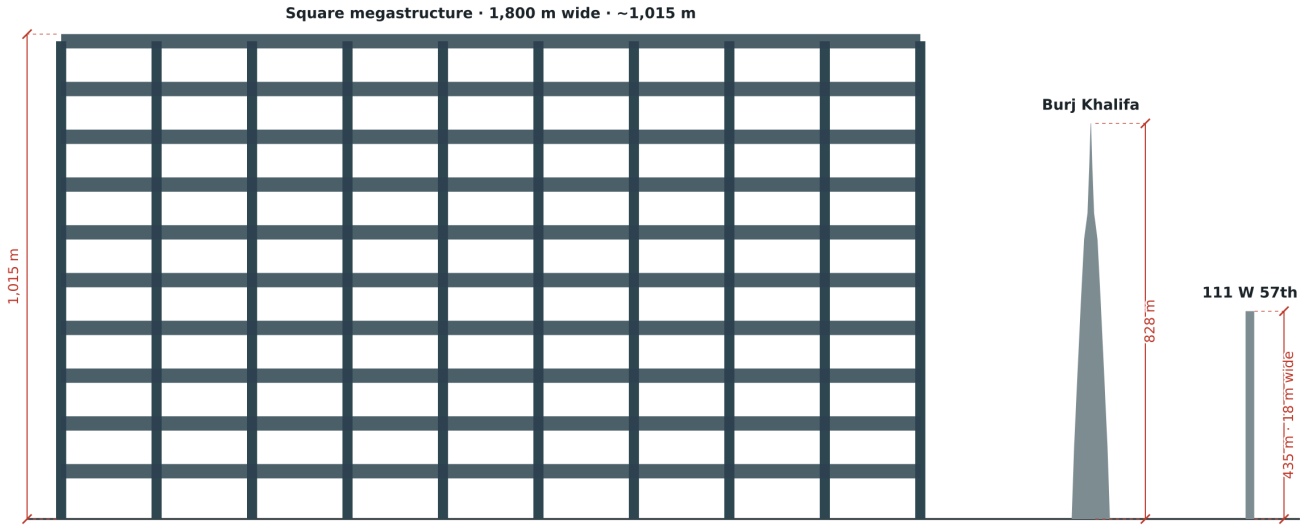
Beam-building section
6 floors of 5.0 m · 20 × 30 m



Both sections at the same scale · glass = vertical faces, green = horizontal faces and floors

Scale comparison

Scale comparison



Same scale. Floor area: megastructure ~29.5 M m² ≈ 95 × Burj Khalifa (309,473 m² each).
Tower silhouettes are schematic; heights are to the architectural top.

Floor area and tower equivalents

About two-thirds of the 23.5 million m² sits in the horizontal beam-buildings, which act as long, narrow slab blocks bridging between the columns.

Component	Count	Area each	Total area
Column segments	840 (84 columns × 10 segments)	~9,300 m² (20 floors × ~467 m²)	~7.8 M m²
Beam-buildings	~770 (140 per deck; half kept below the top)	~20,400 m² (170 m clear × 20 m × 6 floors)	~15.7 M m²
Whole structure			~23.5 M m²

- One column (all 10 segments) holds about 93,000 m², roughly 0.3 Burj Khalifa.
- One beam-building holds about 20,400 m², about the size of a 15-storey office block.
- The whole structure equals about 76 Burj Khalifas (CTBUH gives 309,473 m² of tower GFA).

Ground occupation

The 84 legs touch about 16,800 m² of ground, 0.5% of the plan, leaving ~99.5% of the 3.24 km² below the structure free — including a 0.78 km² open core at its centre.

Option	Ground covered by building	Compared with the megastructure
Square megastructure	~16,800 m² (84 legs × 200 m²)	—
~76 supertalls of ~150 storeys	~157,000 m² of floor plates at grade	~9× more
Conventional towers of ~60 storeys	~392,000 m² of floor plates at grade	~23× more

The tower figures are a lower bound: they count only the buildings themselves, not the spacing, streets and setbacks a field of 76 or more towers would need.

Slenderness

As a whole the structure is squat (about 1 : 0.56), yet each column, read on its own, is about twice as slender as the world's thinnest skyscraper — it is the decks that make this work.

Element	Width : height	Reading
Whole megastructure	1,800 : ~1,015 m → 1 : 0.56	One stiff, low-aspect megaframe; wind sway is a minor issue
One column, full height, if unbraced	~21 : 1,000 m → 1 : 47	Far beyond any tower
One column bay between decks	~21 : 100 m → 1 : 4.7	Effective slenderness, since a deck braces it every 100 m
111 West 57th Street	18 : 435 m → 1 : 24	Most slender building in the world
Engineers' threshold for "slender"	1 : 10 to 1 : 12	Per CNN / The Skyscraper Museum

The beam-buildings span 200 m at 30 m depth, a span-to-depth ratio of about 6.7 — comparable to a deep bridge truss.

Weight

The megastructure would weigh roughly 42–76 million tonnes, against about 38 million tonnes for the same floor area built as Burj Khalifa–type towers.

Option	Intensity	Total
~76 Burj Khalifa–type towers	~1.6 t/m² (500,000 t over 309,473 m²)	~38 Mt
Square megastructure	~1.8–3.2 t/m² (1.1–2× premium)	~42–76 Mt

The benchmark is Burj Khalifa's empty weight of 500,000 tonnes from its fact sheet. The premium covers the 200 m transfer spans; it is partly offset because the squat megaframe needs far less wind-bracing than 76 slender towers.

Cost

At Burj Khalifa's all-in rate the square preset would cost about $137–228 billion, against ~$114 billion for the same area as conventional supertalls.

Basis	Rate	Equivalent towers	Megastructure (1.2–2× premium)
All-in, Burj Khalifa ($1.5 B / 309,473 m²)	~$4,850/m²	~$114 B	~$137–228 B
Shell and core, Dubai towers over 60 floors	~$1,600–1,900/m² (AED 550–650/ft²)	~$38–45 B	~$46–90 B

Sources: Burj Khalifa cost from Wikipedia; Dubai 2025 shell-and-core ranges from Turner & Townsend, converted at ~0.27 USD per AED. Land is excluded, and the megastructure would need about 3.24 km² of air rights rather than 76 or more building plots.

Other comparisons

The narrow beam-buildings give excellent daylight, but the generous storey heights waste section and the horizontal spans make circulation the main planning problem.

Topic	Square megastructure	Conventional towers
Embodied carbon	~9–19 Mt CO2e at 400–800 kgCO2e/m², before a height premium	Same per-m² range; tall buildings run up to ~60% higher
Daylight	Beam-buildings 20 m wide: no desk more than ~10 m from a façade	Deep tower floor plates often 12–15 m from glass
Storey height	5.0 m in columns and beam-buildings alike: room for ~25% more floors at a 4 m floor-to-floor	~3.5–4.2 m
Vertical transport	Lifts only in the 84 columns	Lifts in every tower core
Horizontal transport	Up to 1.8 km along a deck; needs people-movers	Short corridors
Height class	Megatall (over 600 m), taller than Burj Khalifa's 828 m	Mostly supertall (300–600 m)

Carbon ranges from IStructE (whole building) and the tall-building premium from Helal, Trabucco & Savovic.

Population density

The square megastructure could house roughly 235,000–670,000 residents, a density of about 73,000–208,000 people per km² of plan — from Manila's level up to above Mong Kok, and 3–7× Manhattan.

Scenario	Floor area per resident	Residents	People per km² of plan (3.24 km²)
Compact, all residential	~35 m² gross	~670,000	~208,000
European standard, all residential	~60 m² gross	~390,000	~121,000
Mixed use, 60% residential	~60 m² gross	~235,000 (plus jobs and services)	~73,000

Place	People per km²	Year	Source
Kowloon Walled City, Hong Kong (demolished)	~1,300,000	~1990	Wikipedia
Square megastructure (this study)	~73,000–208,000	—	Estimate above
Mong Kok, Hong Kong	~130,000	recent	Culture Trip
City of Manila	73,920	2020	Philippine Statistics Authority
Manhattan, New York	~28,300 (73,293 per mi²)	2024	Census Reporter
Paris	20,054	2022	INSEE
Barcelona	16,454	2007–2009	UCL INEQ-CITIES Atlas

The ~60 m² gross figure assumes Switzerland's 46.5 m² of living space per occupant (FSO, 2022) plus ~25% for circulation, cores and services; ~35 m² reflects compact Asian housing. Unlike those cities, almost none of the megastructure's plan is built on at ground level, so its density comes with 99.5% open ground.

Urban Engitecture advantages

Urban Engitecture reconnects urban planning, architecture and engineering into a single system: the structure, the buildings and the city are designed as one element rather than as separate towers on separate plots.

Advantage	What this study shows
Structural stability in high-rise building	Whole form ~1 : 0.56 against 1 : 24 for the slenderest tower; columns braced by a deck every 100 m, an effective 1 : 4.7
Safety: multiple escape routes	Every deck links each column to 2–4 neighbours, so people can escape sideways to another core instead of only downwards
Free ground level for public space, transport and mobility	99.5% of the plan left open; the legs cover ~16,800 m², while an equivalent tower field covers 9–23× more

Advantage	What this study shows
More and better urban public space	A 0.78 km² open core through the full height, the free ground plane and planted deck roofs
Better and wider living conditions	Every floor within ~10 m of a façade, 5 m storey heights and 3 m terraces
Social and community belonging	Connected decks and shared roofs give each neighbourhood common ground at every level
Higher quality of life	Daylight, open ground and nearby services at city-scale density (~73,000–208,000 people per km²)

Two of these need design to hold. The connections that create escape routes can also carry fire and smoke between buildings, so decks up to 1.8 km long need compartments and fire breaks. Community and belonging can be designed for, but not measured in this study.

Conclusion

The megastructure's decisive advantage is land: it delivers the floor area of about 76 Burj Khalifas while leaving 99.5% of the ground free, including a 0.78 km² open core, at a weight and cost premium of roughly 1.1–2×.

1. **Free ground.** The legs cover ~16,800 m² of a 3.24 km² plan; an equivalent tower field covers 9–23× more ground with buildings alone, before streets and spacing. The ground can stay park, farmland, water or infrastructure.
2. **An open heart.** The 500 m core leaves a ~0.78 km² void through the full height — a central park, plaza or lake ringed by the structure, with daylight reaching the inner façades.
3. **One structure instead of ~76.** A single megaframe replaces 76 or more separate towers, each with its own core, foundations, façade and lateral system.
4. **Stability through form.** The whole is squat (~1 : 0.56), so wind sway is minor; columns that would be 1 : 47 alone are braced every 100 m, giving an effective 1 : 4.7 — far less demanding than a 1 : 24 pencil tower.
5. **Better daylight.** Beam-buildings 20 m wide keep every floor within ~10 m of a façade, closer than most deep tower floor plates.

6. **Density at a city scale.** ~23.5 million m² in one connected volume — room for roughly 235,000–670,000 residents, 3–7× Manhattan's density — puts homes, work and services within one structure, linked horizontally along the decks.
7. **Adaptable growth.** Decks, spans and the removed-beam pattern can be added or left open over time, so the city can grow inside a fixed frame.

The trade-offs to resolve are the long-span weight and cost (~42–76 Mt and ~$137–228 B against ~38 Mt and ~$114 B), horizontal circulation around the core and along long decks, and generous 5 m storey heights that leave room for ~25% more floors.

Assumptions and sources

- 1 tool unit = 1 m; square preset defaults, core on (500 m, 24 sides).
- Floor area counts every floor plate the tool draws; overlaps at column–beam junctions and lift cores are not deducted.
- Removal of horizontals is random, so beam counts are expected values (50% kept on the 9 lower decks).
- Legs count as occupied floors; free ground excludes the legs.
- Weight and cost premiums (1.1–2× and 1.2–2×) are judgement ranges, not structural calculations.

Sources:

- Burj Khalifa – CTBUH Skyscraper Center
- Burj Khalifa Fact Sheet
- Burj Khalifa – Wikipedia
- Turner & Townsend Tall Buildings Guide 2026 – Dubai
- Guinness World Records – Most slender building
- CNN – New York's slender skyscrapers
- IStructE – Carbon footprint benchmarking data for buildings
- Embodied carbon premium for vanity height
- Kowloon Walled City – Wikipedia
- Culture Trip – Mong Kok density
- Philippine Statistics Authority – Manila 2020 census
- Census Reporter – Manhattan
- INSEE – Paris population 2022
- UCL INEQ-CITIES Atlas – Barcelona
- Swiss FSO – Floor space per occupant

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Density doesn't have to consume the ground.
It can lift off it.

Ale Girá
diffjustdiff

diffjustdiff.com
ale@diffjustdiff.com