Fiber/Ground
Innovation Complex

Problem Definition

Agricultural waste **with no destination** | Housing **Unaffordability**

URBAN VS. RURAL SPLIT — QENA 2024

Egypt national urban rate is 42.8% — Qena is more than twice as rural as the national average.

Qena's **81% rural** majority means that informal, **self-built**, and **agriculturally-adjacent** housing is not the exception but **the dominant built condition** the project must answer to.

81%
RURAL POPULATION
3.01M of 3.7M residents

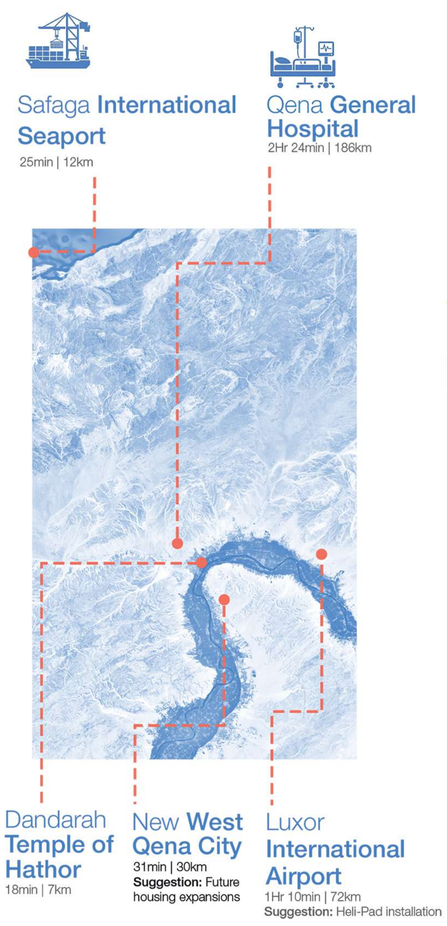
The project's prototype village **directly** serves the demographic majority, **not a marginal edge case**.

51%
BUILT-ENV. DEPRIVATION
Highest in Egypt · BEDI 2020

Qena is the **most deprived** governorate in Egypt by built environment indicators, making the case for **affordable** agro-fiber housing not aspirational but **urgent**.

48%
EGYPT'S SUGARCANE AREA
36% of national production

The raw material **supply chain** for **CAF** production is **not imported** or assumed — it is structurally **embedded** in **the site's** own agricultural economy.

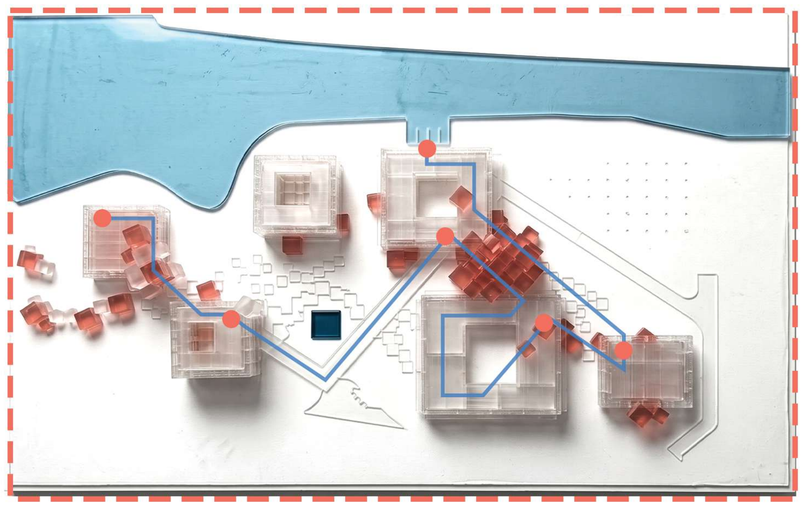


Layout | 1:750

Fibrous Agricultural Crops
Most to Least Grown

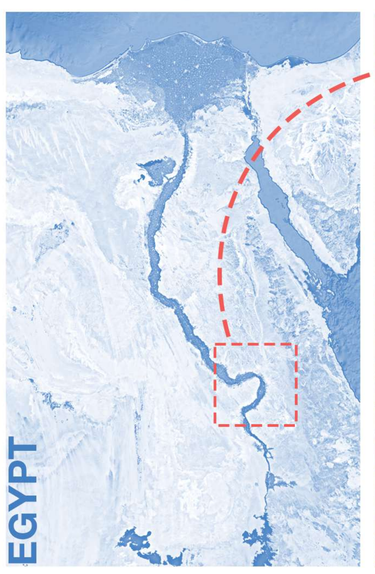
- Sugarcane — bagasse, 64% of all cultivated land in Qena and 48% in Egypt
- Date Palms — fronds, leaf stalks, and trunk fiber
- Maize (Corn) — stalks, husks, and cobs
- Wheat — straw
- Berseem Clover — stem fiber
- Cotton — stalks and seed hull fiber
- Sesame — dry stalks
- Banana — pseudo-stem fiber
- Hibiscus (Karkadeh) — dried stems

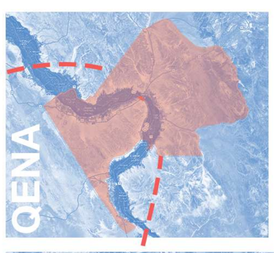
Product Circulation

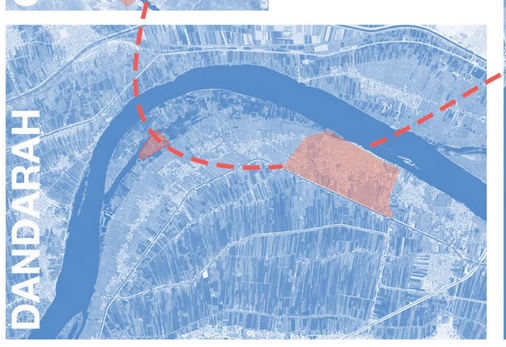


- River **Dock**
- Processing **Building**
- Production **Building**
- Logistics **Building**
- Product **Bridge**
- Adminstration **Building**
- Exhibition **Pavilion**

Location | North Qena - Dandarah







Area
87,500m2 | 20.8 Fd

Floodplain %
70% ~62,000m2

Lat 26.170069
Long 32.627868

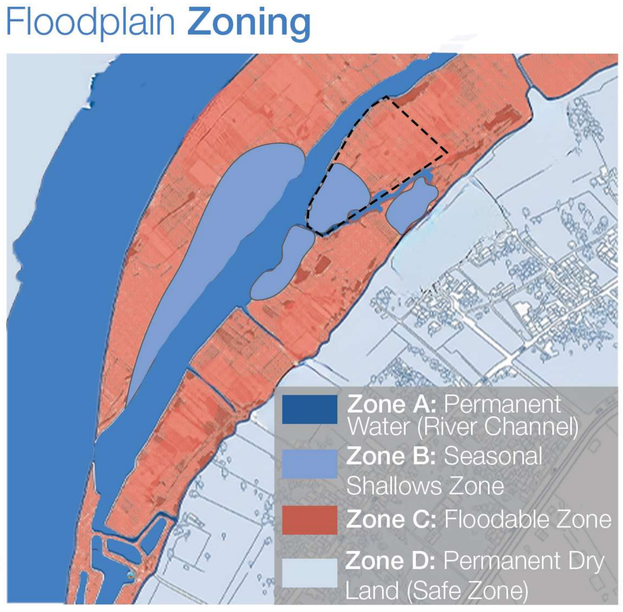
Site Selection Reasoning

Site Advantages
- Geotechnically stable Qena Sands
- Massive university workforce pool
- Strategic tri-modal logistics hub

Agricultural Profile
- Qena ranks #1 in Egypt for sugarcane production (sugarcane bagasse is the main input)
- Sugarcane covers 64% of the governorate's total cultivated area
- Accounts for 60% of national sugar production

Regional Connections
- Aswan Energy Grid · 150–200 km · Regional Power Link
- Sohag Agricultural Cluster · 50–80 km Biomass Supply

Floodplain Zoning



Source of Concept

Moisture

CAF is **hygroscopic** by nature (tending to **absorb moisture** from the air) which causes:

- Dimensional **instability**
- **Degradation** of **binder bonds** holding the fibers together

This leads to **structural failure**

Compressed agro-fibers can **never be water resistant** but compound treatments could be used

Density

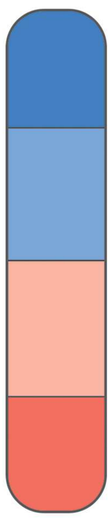
Density is the main factor that affects the **mechanical properties** of **CAF** directly, which means:

- **High** fiber density equals **high structural properties**

- **High** fiber density means **low porosity** which leads to **highier moisture resistance**

Use an inverse Moisture-Density relation |Use low density in high moisture zones

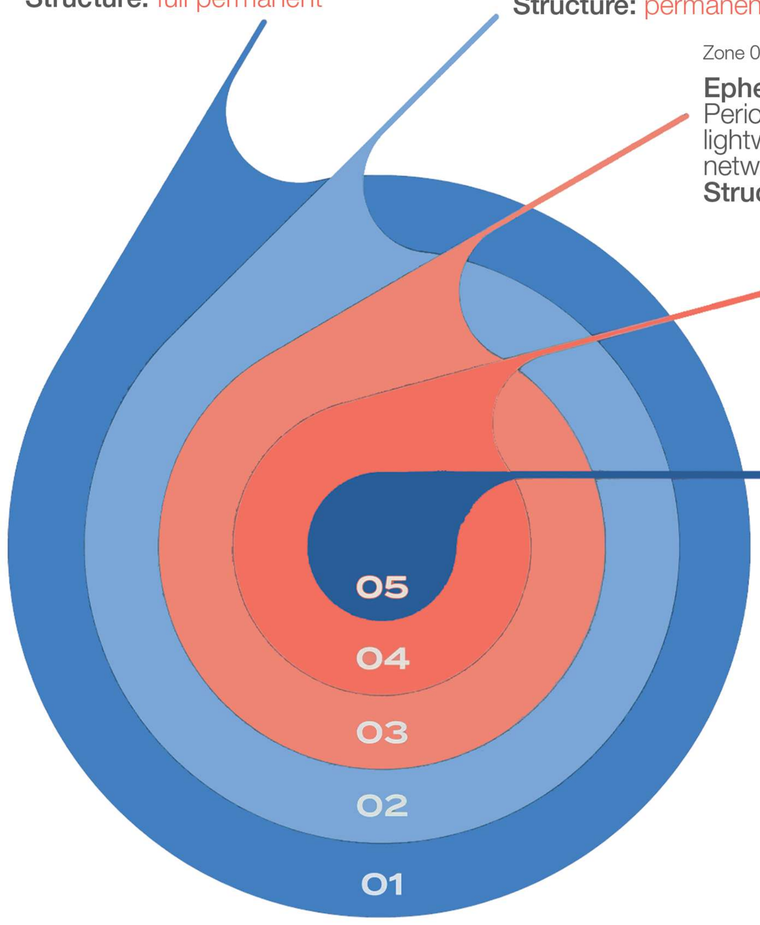
As we move to high moisture zones:



- More water-resistant functions
- Lighter structural solutions
- More perforation ratio in facades
- Low density clustering

Dry Land
Floodable Land
Seasonal Wet Land
Mostly Wet Land

Main Parameters



Zone 01 · d = 0.80–1.00

Permanent Dry Land
Never flooded. Production facility, prototype village, logistics infrastructure. Maximum structural density. Full agro-fiber thermal mass strategy deployed.
Structure: full permanent

Zone 02 · d = 0.55–0.80

Transition Land
Rarely flooded. Farm worker housing, agricultural hub, research building. Thermal mass increases. Foundation depth increases. Bio-fiber wall density peaks.
Structure: permanent / grounded

Zone 03 · d = 0.55–0.80

Ephemeral Floodplain
Periodically inundated. Agricultural test plots, lightweight infrastructure. Elevated walkway network. Seasonal occupation logic applies.
Structure: amphibious / seasonal

Zone 04 · d = 0.15–0.30

Riparian Margin
Annually inundated bank. Pile foundations, demountable structures only. Adaptive Research Pavilion. Floodplain promenade.
Structure: elevated / demountable

Zone 05 · d = 0.00

Permanent Water
The Nile channel itself. No construction. Defines the zero-point of the gradient field. All other distances measured from this boundary.
Structure: none

Distance from the Nile mapped as a continuous **0–1 field** across the site

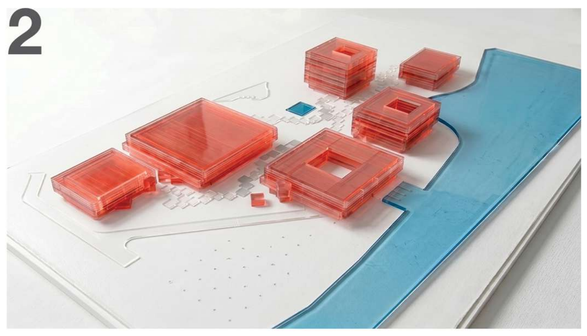
Each building has a **randomness factor** based on the **moisture value**

That one parameter simultaneously drives:

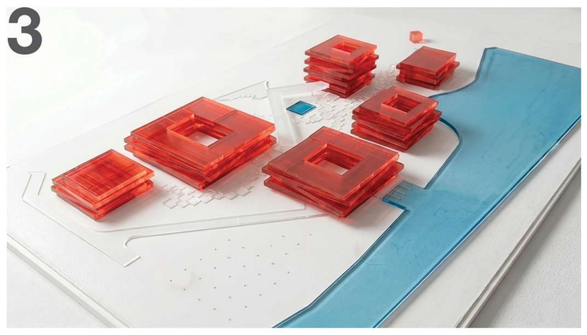
- Panel density (kg/m^3)
- Perforation ratio
- Moisture treatment protocol
- Wall assembly type

Form Development

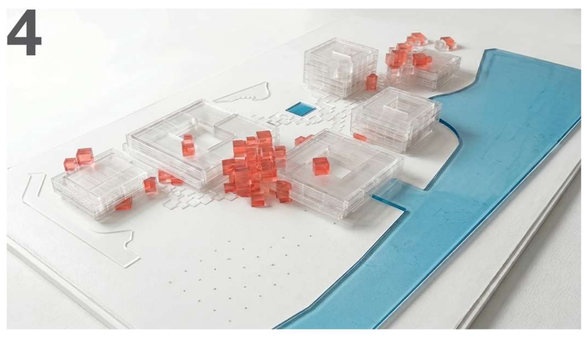
Zoning According to **Adjacency** & **Physical Relations**



Extrude **Masses** According to Areas



Shift buildings **horizontally** according to **flooding frequency**

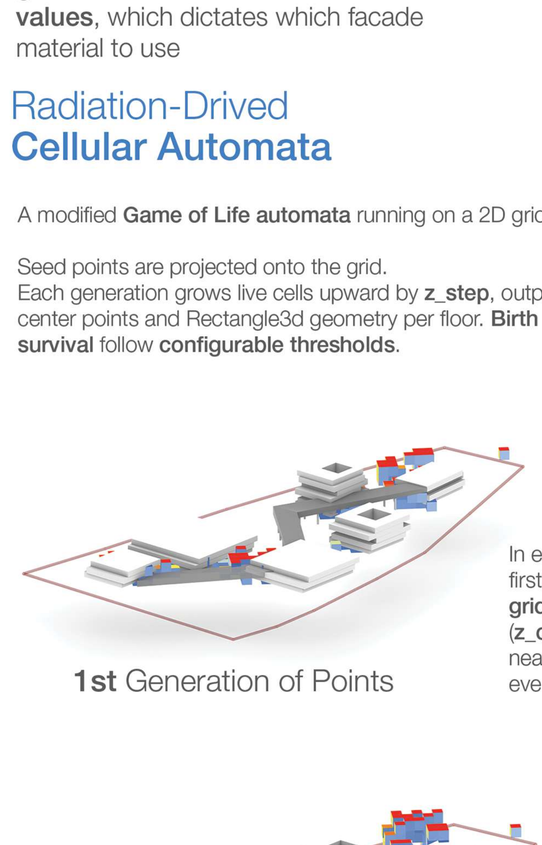


Addition of the Radiation-Optimized **Cellular Automata** Simulation

Adding an **ETFE bridge** showcasing the **finished product** for visitors

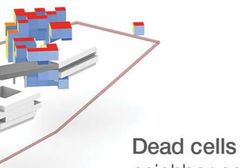
Addition of tensioned **CAF Cables** for **Thermal Comfort**

Factoring in the **Time** element



(According to floodplain zoning in Site Analysis)

Massing Reasoning | **Orchestrated Chaos**



Utilizing the **randomness** aspect of the fiber strands undergoing compression into creating a **site gradient** based on the **moisture values**, which dictates which facade material to use

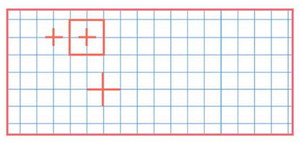
Radiation-Drived **Cellular Automata**

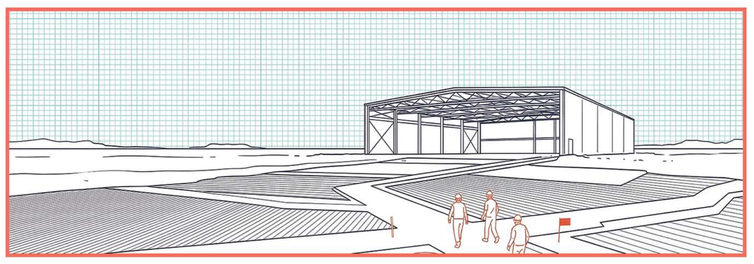
A modified **Game of Life automata** running on a 2D grid.

Seed points are projected onto the grid.
Each generation grows live cells upward by **z_step**, outputting center points and Rectangle3d geometry per floor. **Birth** and **survival** follow **configurable thresholds**.

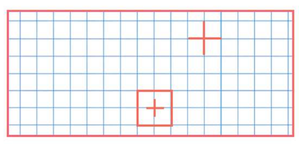
Phasing Plan **Diagram**

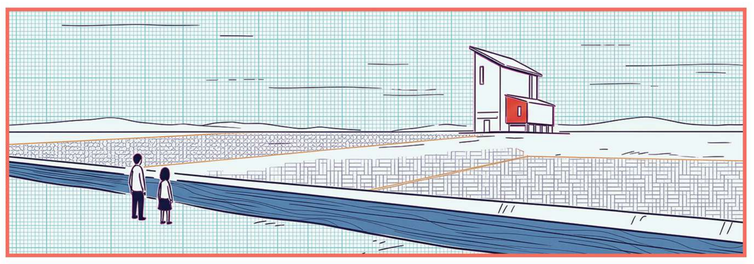
Phase I : The Press
The Press: Production shed and dock are built first, converting bagasse into the first CAF panels.



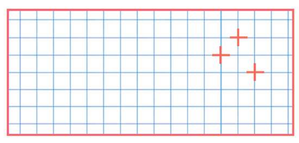


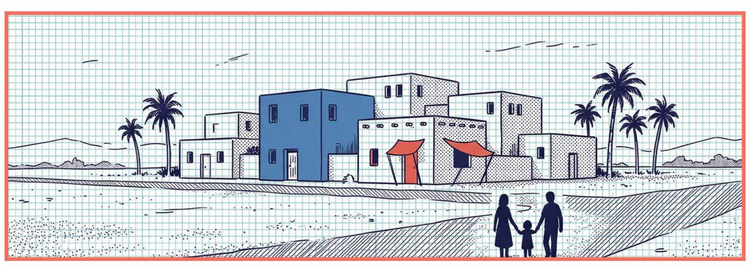
Phase II: The First Cast
The research lab and early innovative production rise canal-side, built using Phase 1's panels. Positioned at the moisture gradient's datum line, it begins testing CAF performance under real site conditions.



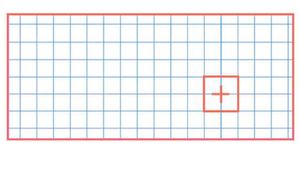


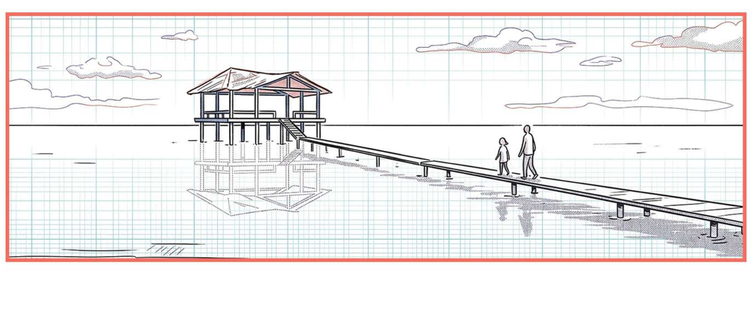
Phase III: The Settlement
A housing cluster is constructed mid-site from proven CAF, the material's first inhabited test.





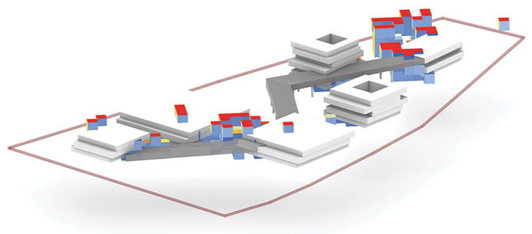
Phase IV: The Flood Response
A floodplain pavilion at the Nile edge pushes the material and form to their most adaptive extreme. Operating in two seasonal modes.





1st Generation of Points

In each generation, the script first recomputes the **radiation grid** at the new height (**z_current**), sampling the nearest **radiation_point** for every cell.

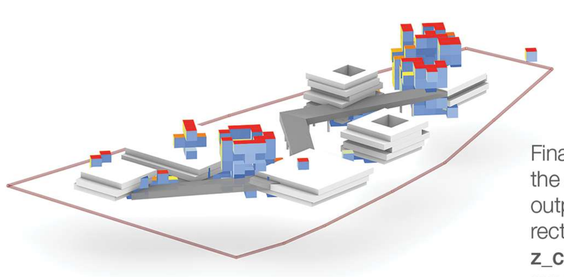


2nd Generation of Points

It then scans every cell's **8 neighbors** to count how many are **alive** and average their **radiation values**. Live cells survive only if their neighbor count falls within **survival_min–survival_max**

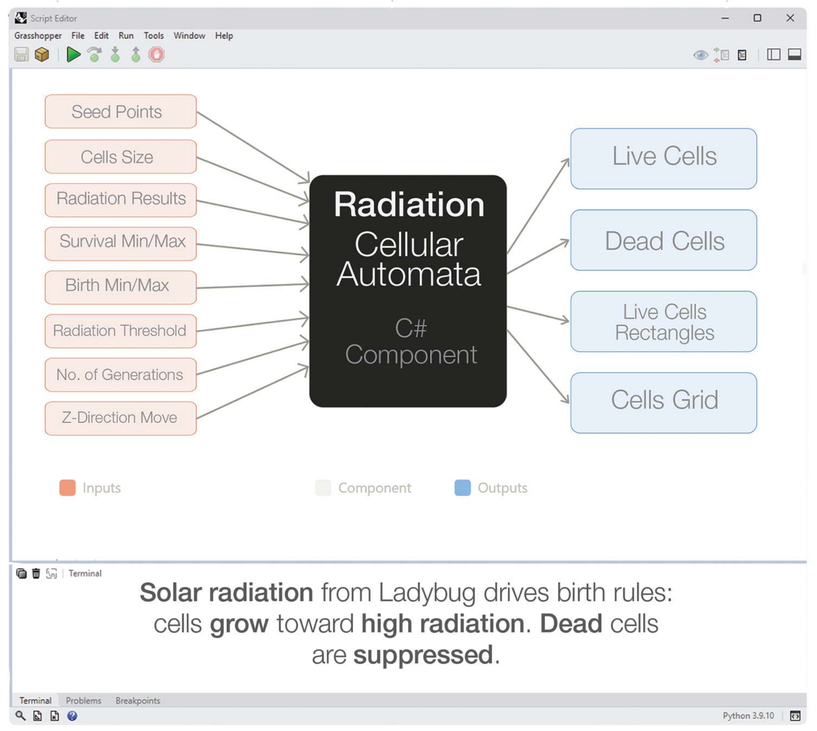
3rd Generation of Points

Dead cells are born only if neighbor count falls within **birth_min–birth_max** and either their own or their neighbors' radiation meets **radiation threshold**

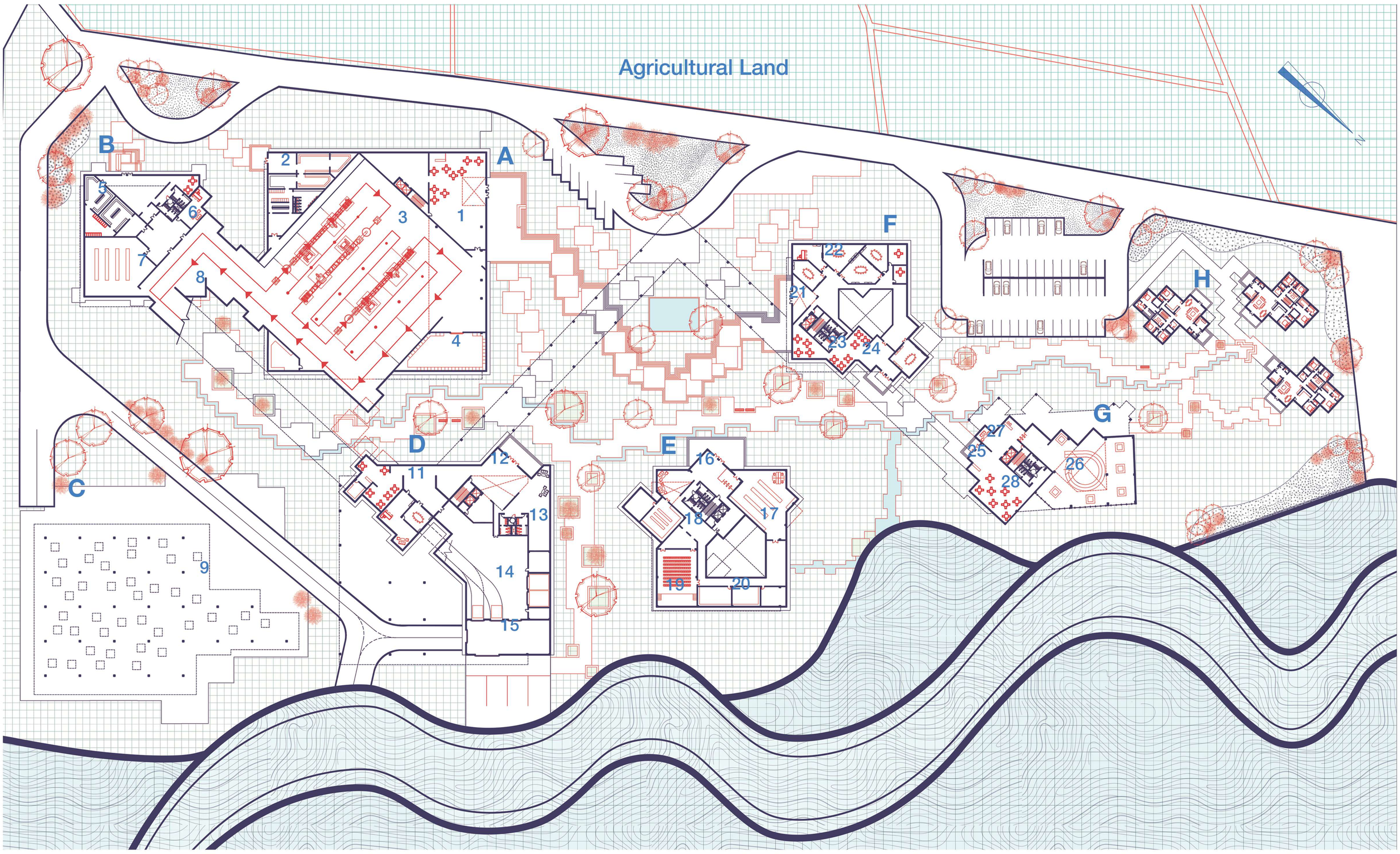


4th Generation of Points

Finally, the **new grid** replaces the old one, **live cells** are output as **points** and rectangles at the **incremented z_current**, and the process repeats for the **next generation**.



Solar radiation from Ladybug drives birth rules: cells **grow** toward **high radiation**. **Dead** cells are **suppressed**.



Master Plan 1: 500

Building A | **Production Plant**
1 Entrance
2 Workers Entrance
3 Production Line
4 Mechanical Room

Building B | **Material Processing**
5 Workers Service Area
6 Lounge
7 Storage
8 Production Entrance

Building C | **Agricultural Testing Land**
9 Guided Fiber Growth Mechanism

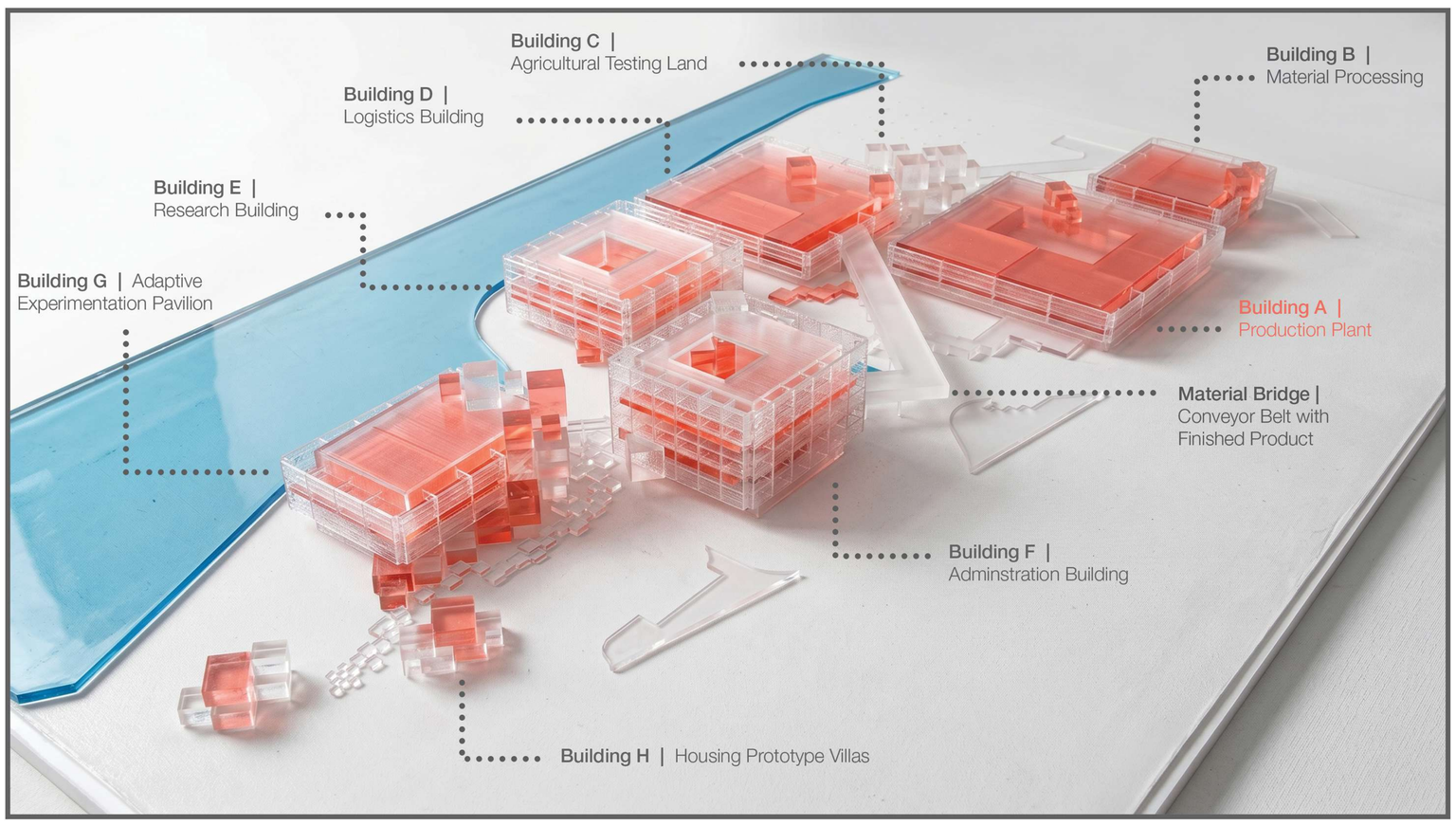
Building D | **Logistics Building**
11 Facility Management
12 Entrance
13 Workers Service Area
14 Conveyor Belt
15 Loading/Unloading Dock

Building E | **Research Building**
16 Entrance
17 Material Preparation Lab
18 Service Area
19 Conference Room
20 Documentation Room

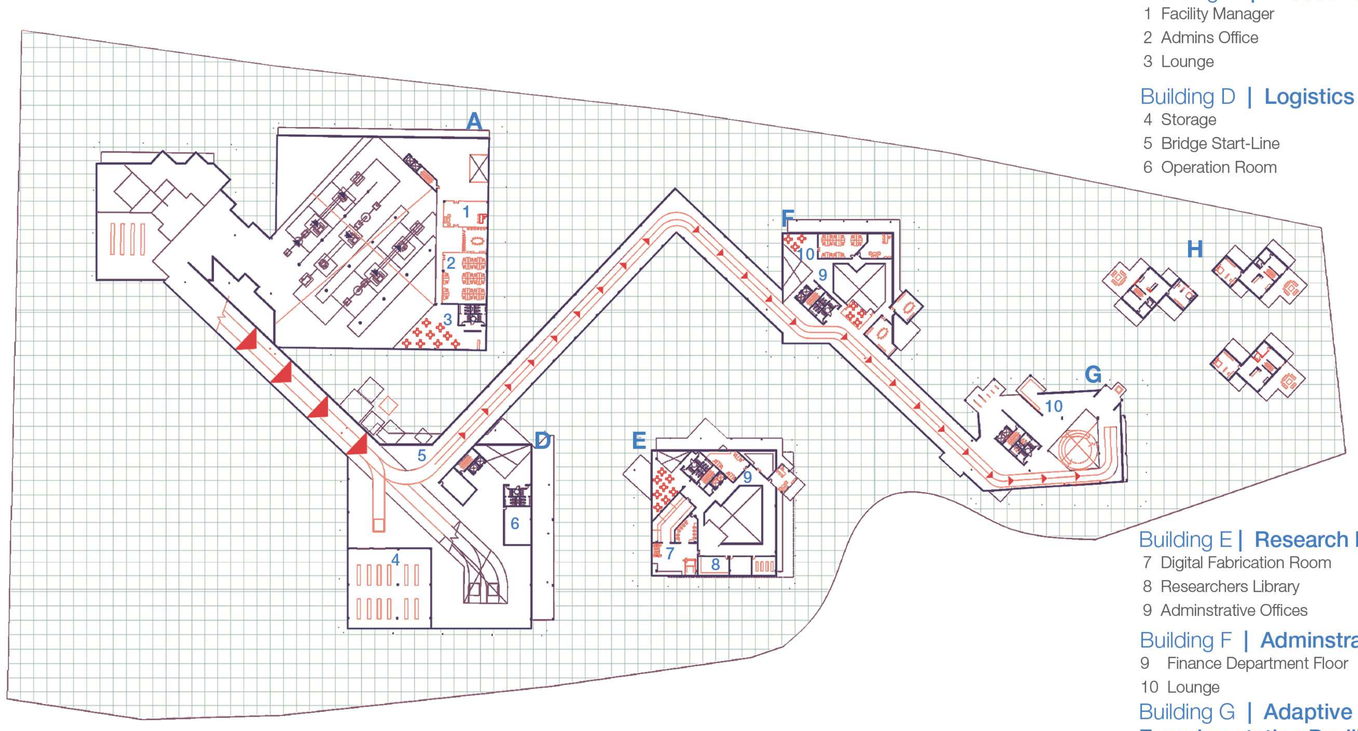
Building F | **Adminstration Building**
21 Entrance
22 Meeting Rooms Area
23 Services & Lounge
24 Secondary Entrance

Building G | **Adaptive Experimentation Pavilion**
25 Entrance
26 Exhibition Ramp
27 Lounge
28 Restaurant

Building H | **Housing Prototype Villas**



Spatial Land Zoning



First Floor Plan 1: 1000

Building A | **Production Plant**
1 Facility Manager
2 Admins Office
3 Lounge

Building D | **Logistics Building**
4 Storage
5 Bridge Start-Line
6 Operation Room

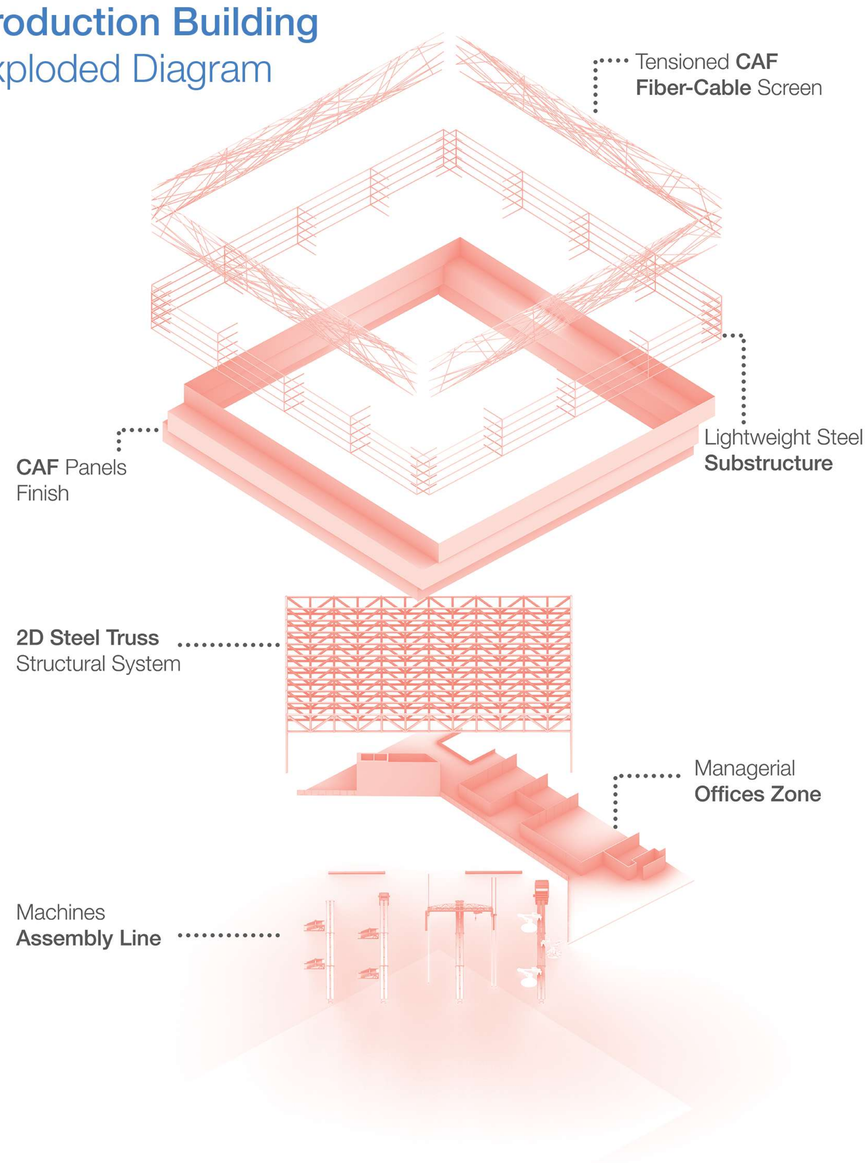
Building E | **Research Building**
7 Digital Fabrication Room
8 Researchers Library
9 Adminstrative Offices

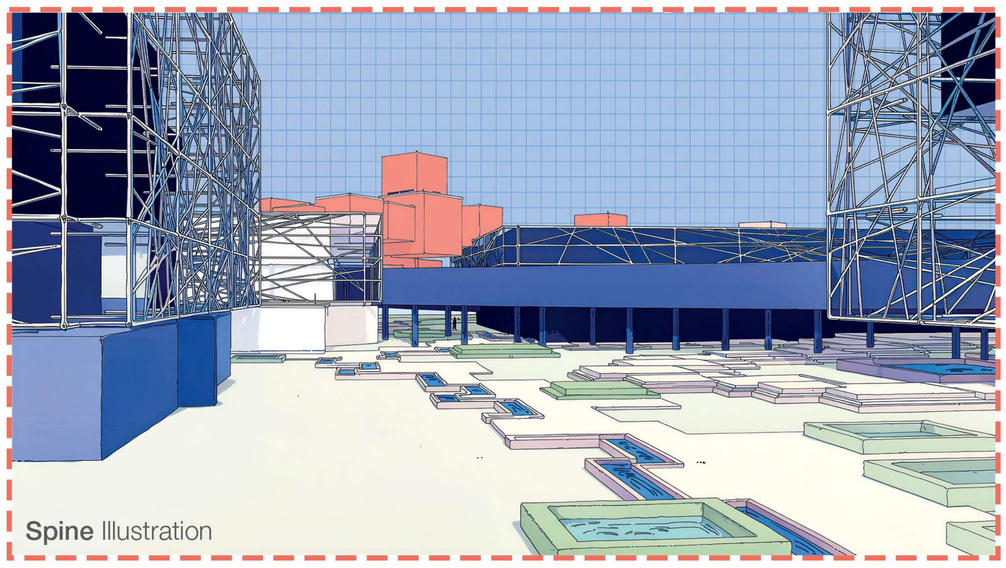
Building F | **Adminstration Building**
9 Finance Department Floor
10 Lounge

Building G | **Adaptive Experimentation Pavilion**
11 Products Sculpture Exhibition

Building H | **Housing Prototype Villas**

Production Building Exploded Diagram





Spine Illustration

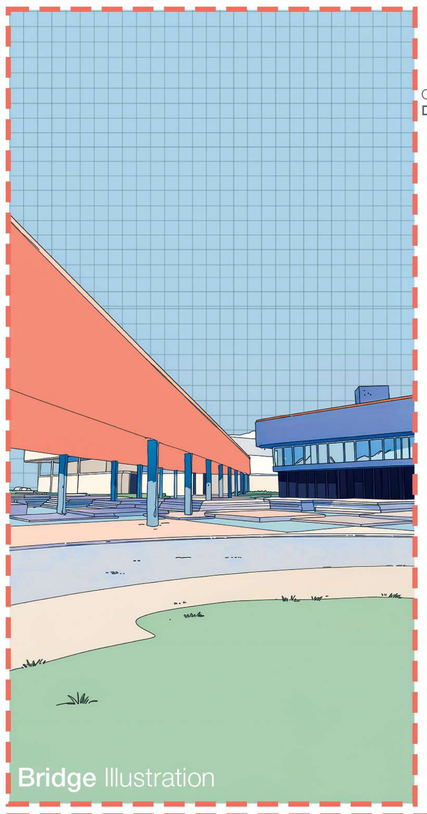
Main Entrance

Production Building

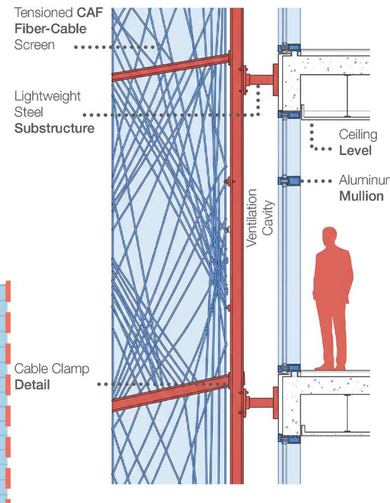
Prototype Villa

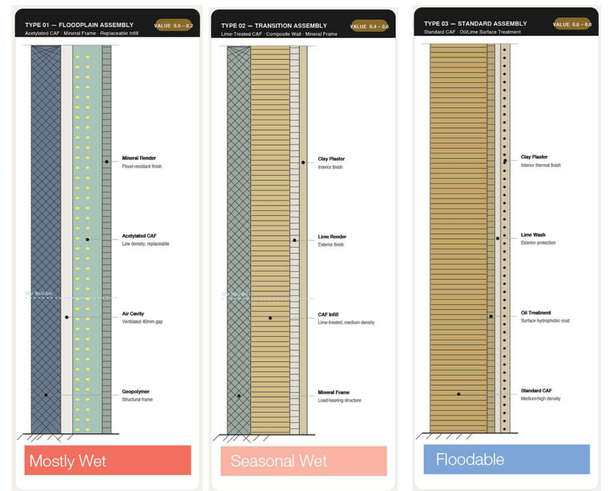
Facade Details & Treatments

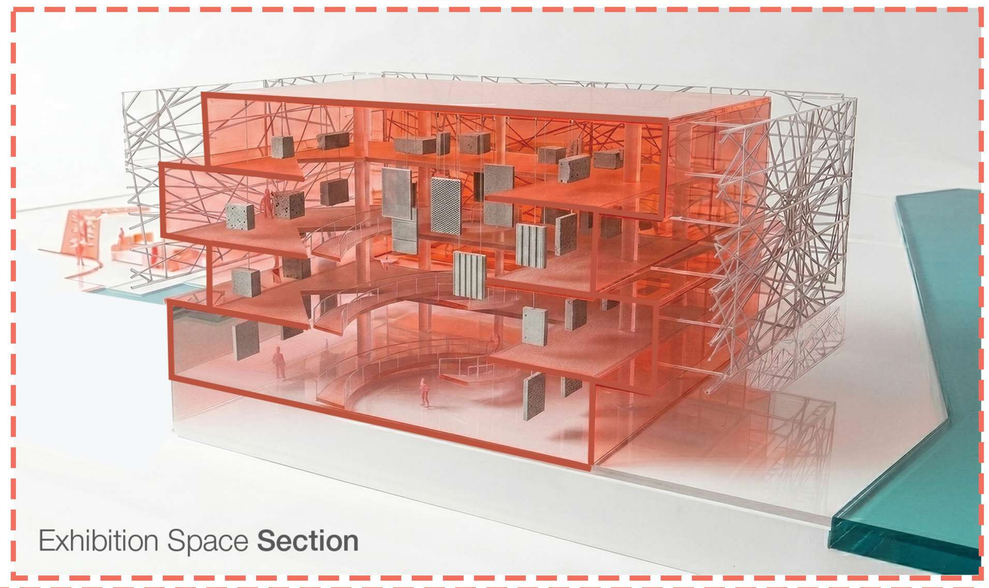
The facade is a second skin of **tensioned CAF ropes** forming a diagonal diamond grid, its spacing driven by **the sun radiation** — **open and ventilated** near the Nile, **tightening** where solar shading is **critical**.



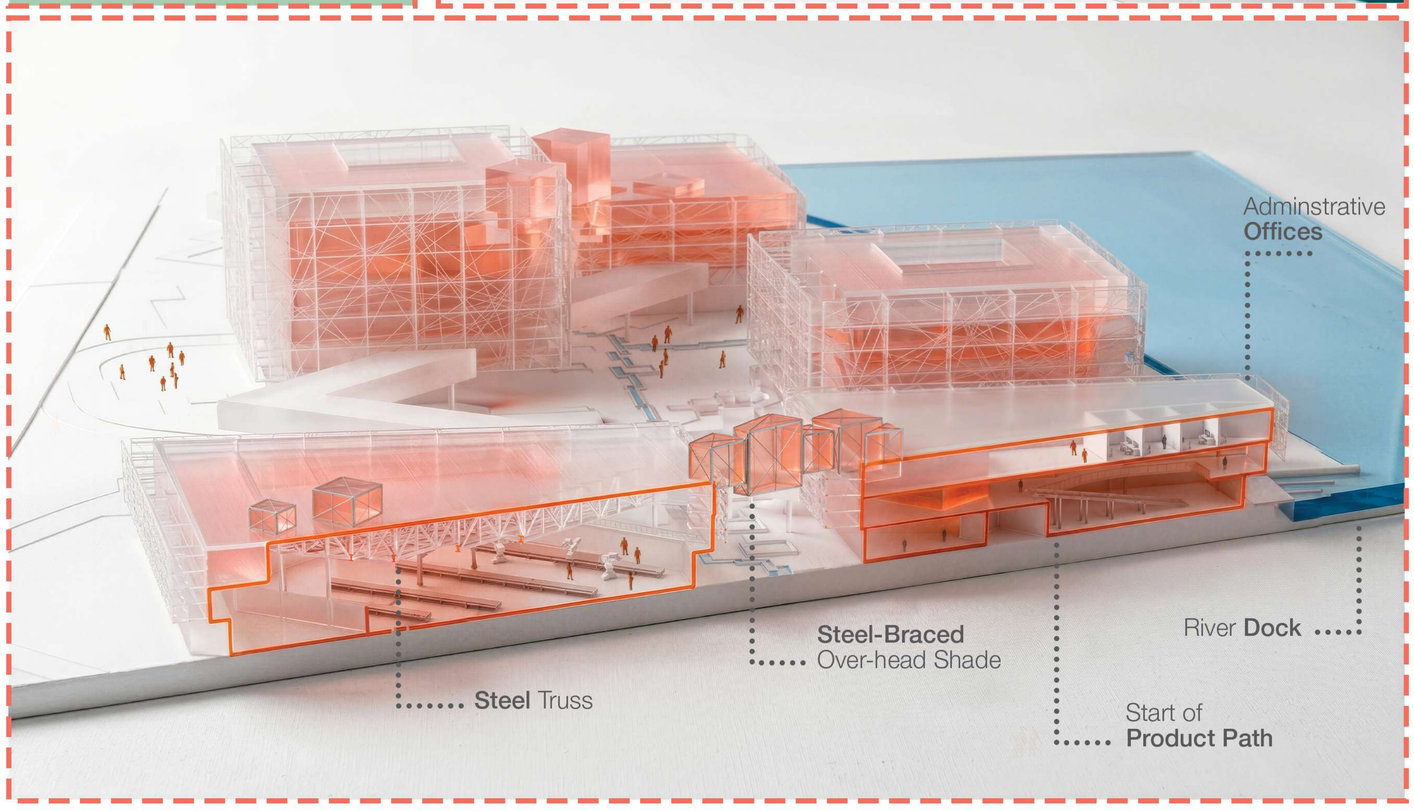
Bridge Illustration



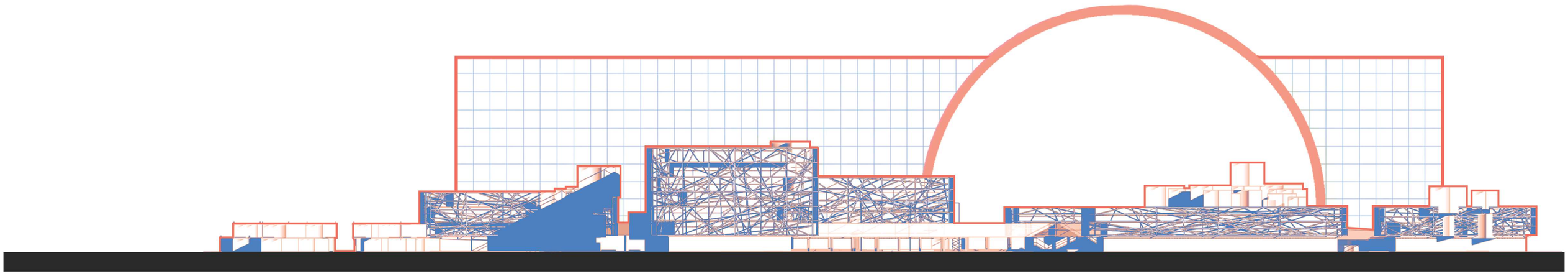




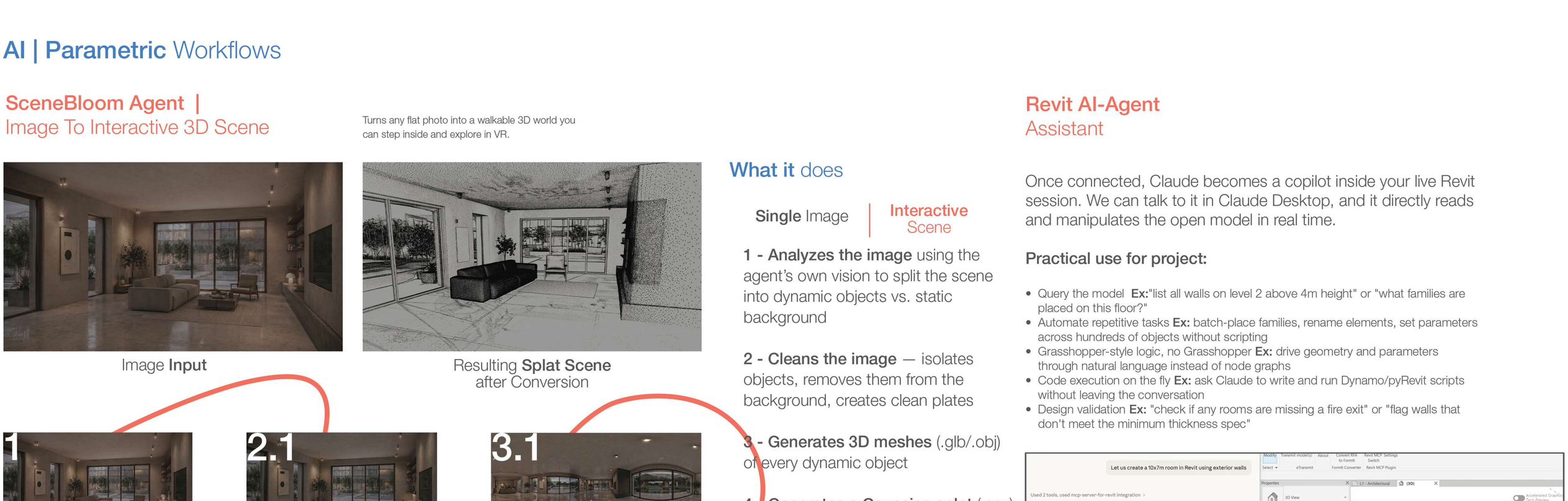
Exhibition Space **Section**



Entrance Elevation



3D Section



AI | Parametric Workflows

SceneBloom Agent | Image To Interactive 3D Scene

Turns any flat photo into a walkable 3D world you can step inside and explore in VR.

Image **Input**

Resulting **Splat Scene** after Conversion

Input **Image**

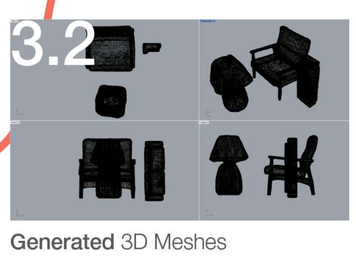
Agent 1 | scene analysis, object detection, SAM3 prompt formatting (Grouping (furniture) for sofa and chair etc.)

Clean **Background**

Segmented Objects

Agent 2 | Output validator
SAM3 ComfyUI — segments objects, saves individual transparent PNG cutouts + combined mask + masked background

Gaussian Splat Environment



Generated 3D Meshes

What it does

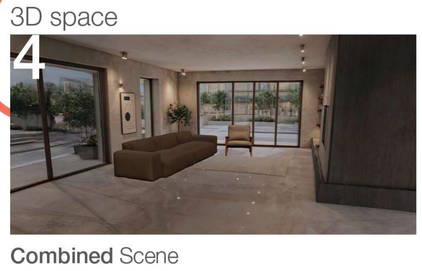
Single Image | **Interactive** Scene

1 - Analyzes the image using the agent's own vision to split the scene into dynamic objects vs. static background

2 - Cleans the image — isolates objects, removes them from the background, creates clean plates

3 - Generates 3D meshes (.glb/.obj) of every dynamic object

4 - Generates a Gaussian splat (.spz) of the static environment via World Labs **marble-1.1** — a fully explorable 3D space



Combined Scene

Revit AI-Agent Assistant

Once connected, Claude becomes a copilot inside your live Revit session. We can talk to it in Claude Desktop, and it directly reads and manipulates the open model in real time.

Practical use for project:

- Query the model **Ex:**"list all walls on level 2 above 4m height" or "what families are placed on this floor?"
- Automate repetitive tasks **Ex:** batch-place families, rename elements, set parameters across hundreds of objects without scripting
- Grasshopper-style logic, no Grasshopper **Ex:** drive geometry and parameters through natural language instead of node graphs
- Code execution on the fly **Ex:** ask Claude to write and run Dynamo/pyRevit scripts without leaving the conversation
- Design validation **Ex:** "check if any rooms are missing a fire exit" or "flag walls that don't meet the minimum thickness spec"