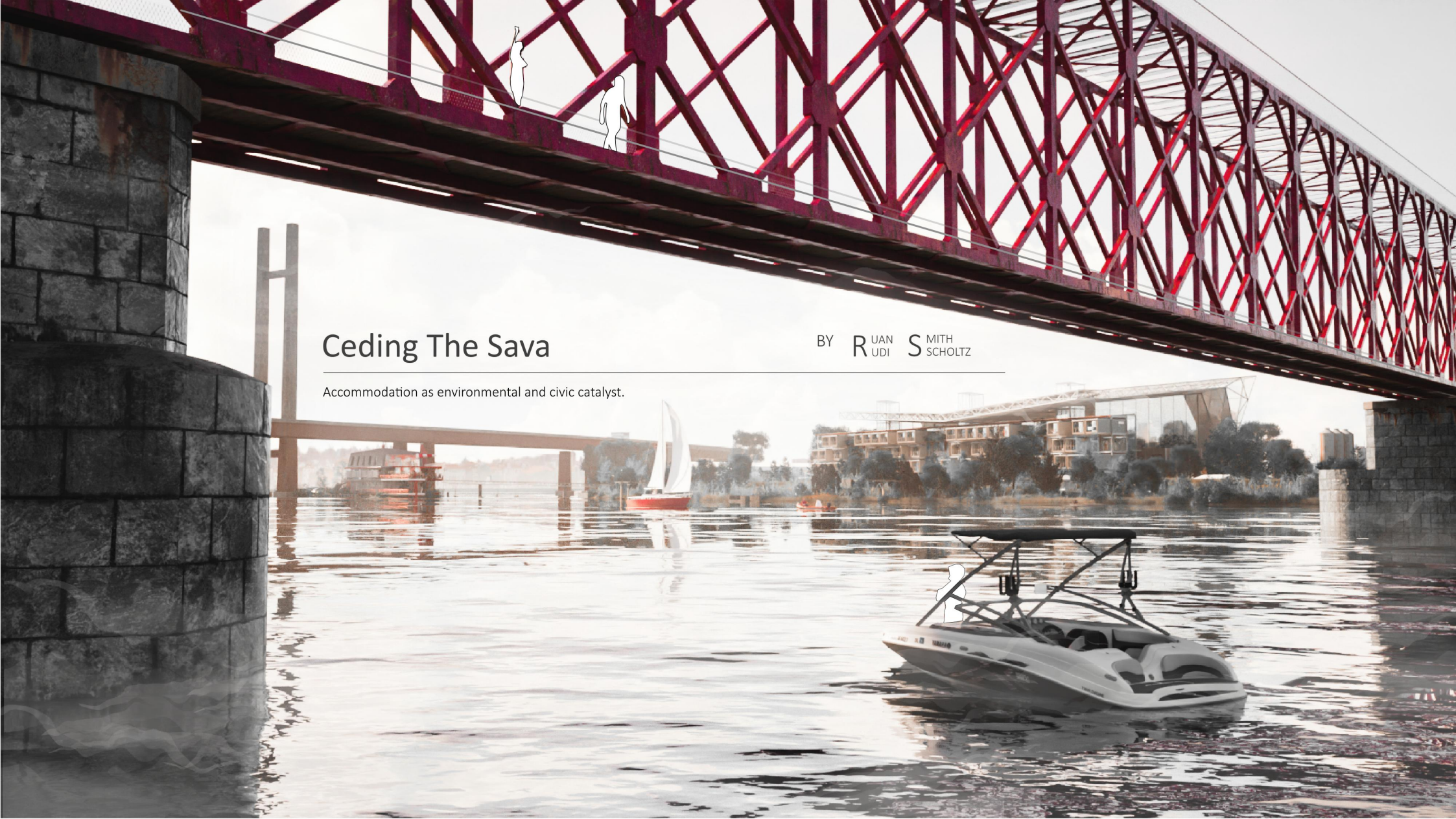

Ceding The Sava

BY RUAN SMITH UDI SCHOLTZ

Accommodation as environmental and civic catalyst.

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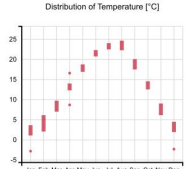
INDEX

NATURAL

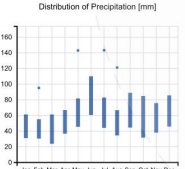
Belgrade, Central Serbia, Serbia

44.813N, 20.461E | Elevation: 129 m | Climate Class: Cfa | Years: 1993-2022

Distribution of Temperature [°C]

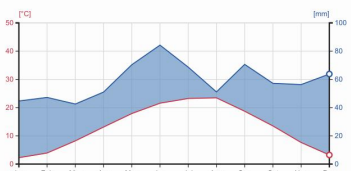


Distribution of Precipitation [mm]



Belgrade, Central Serbia, Serbia

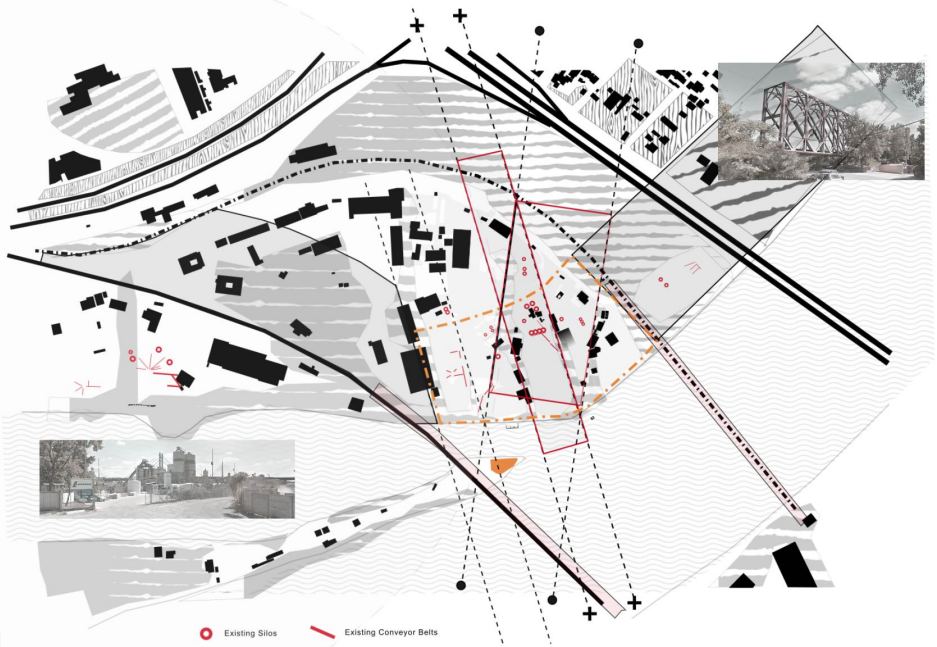
44.813N, 20.461E | Elevation: 129 m | Climate Class: Cfa | Years: 1993-2022

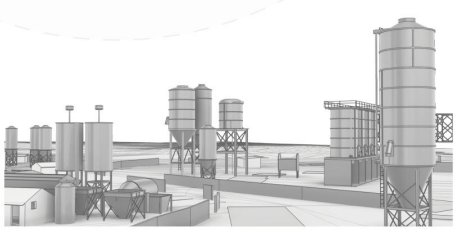


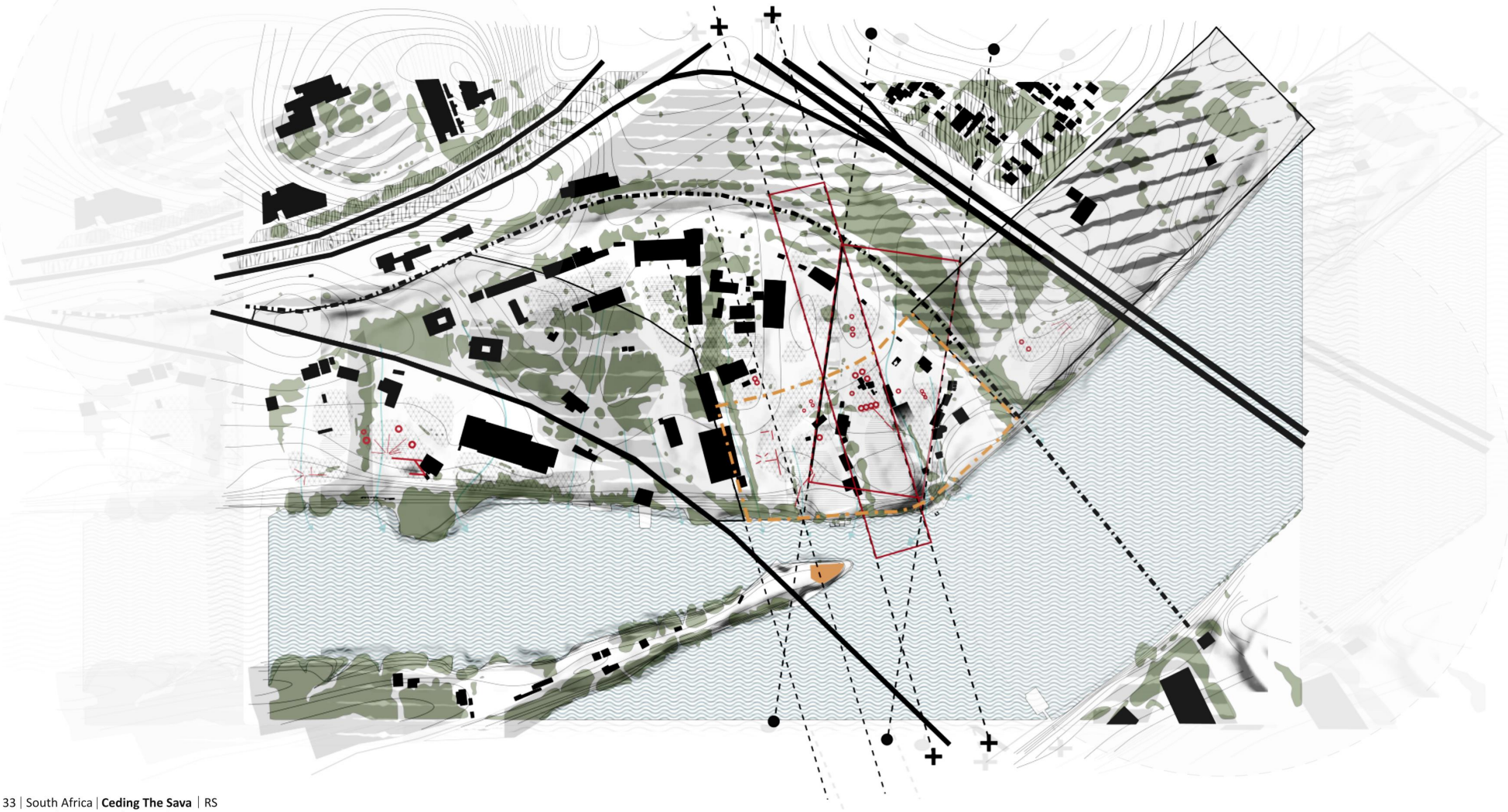
Month	Temp	Precip
Jan	2.3	44.7
Feb	3.9	47.2
Mar	8.2	42.5
Apr	13.1	51.0
May	17.9	70.4
Jun	21.6	84.2
Jul	23.2	68.7
Aug	23.4	51.1
Sep	18.7	70.6
Oct	13.5	57.2
Nov	7.6	56.3
Dec	3.2	63.8

Temperature Mean: 13.1 °C Precipitation Sum: 707.7 mm

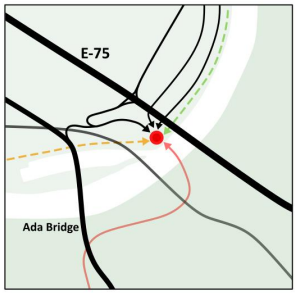
MAN-MADE







FINDING AN ECOLOGICAL AND URBAN CATALYST

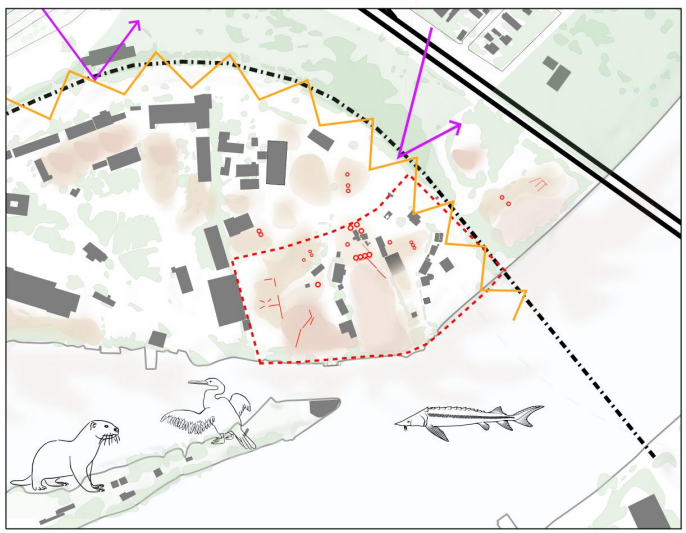


THE MACRO CONFLUENCE

The site exists at the critical intersection of the Trans-European E-75 corridor and the Sava River. As a point of concentrated regional energy, it demands a primary architectural anchor to organize these converging infrastructural and ecological flows into a new urban center.

Deriving an apt site strategy

THE EXISTING DISCONNECT



The current urban fringe operates as a fractured industrial barrier, creating a total physical and ecological disconnect between the city and the river.

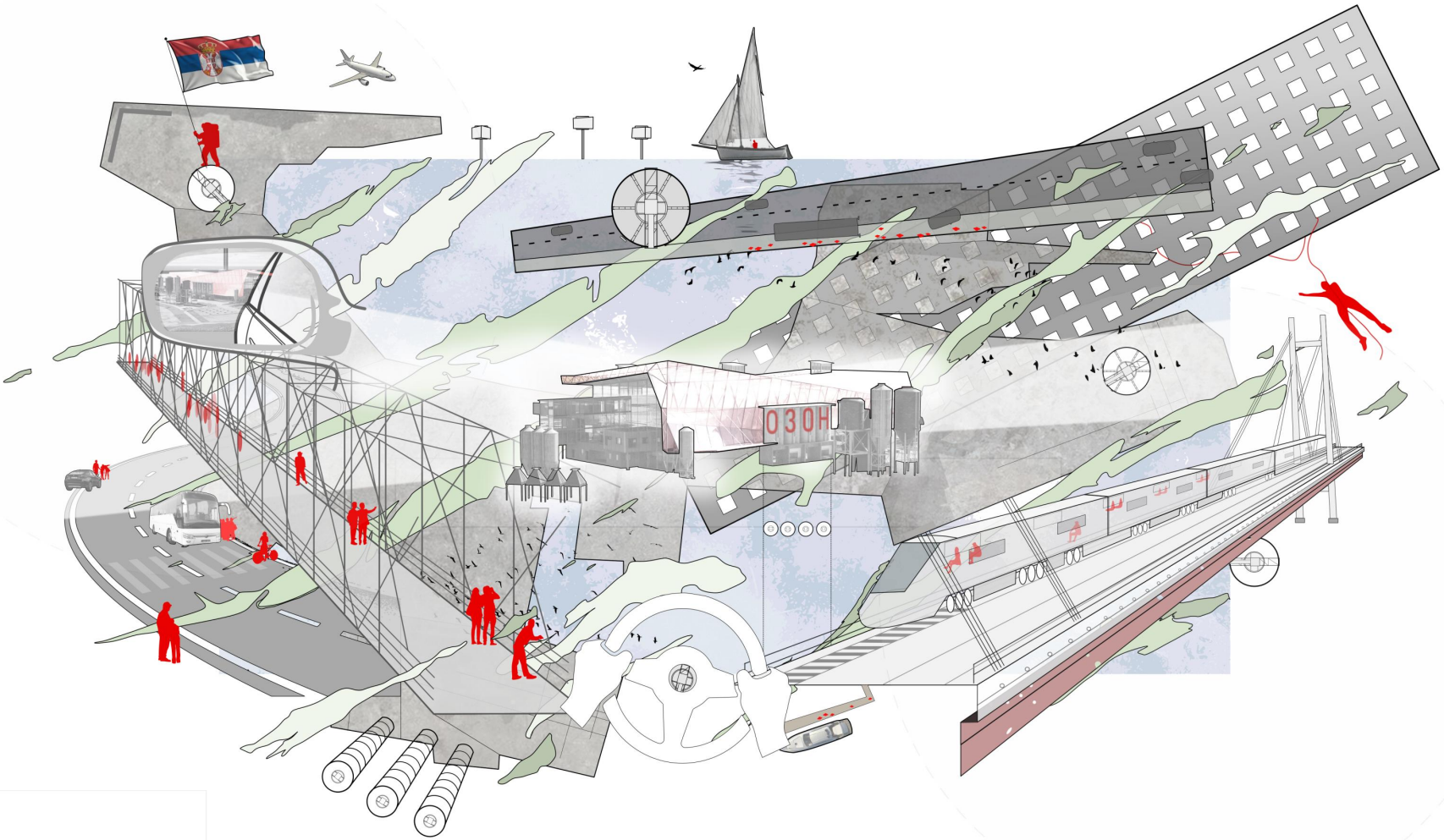
NATURAL SYSTEMS

Shattering the industrial hardscape restores the continuous green belt, establishing a transverse bio-remedial sponge that filters urban runoff before it reaches the Sava.

PEOPLE SYSTEMS

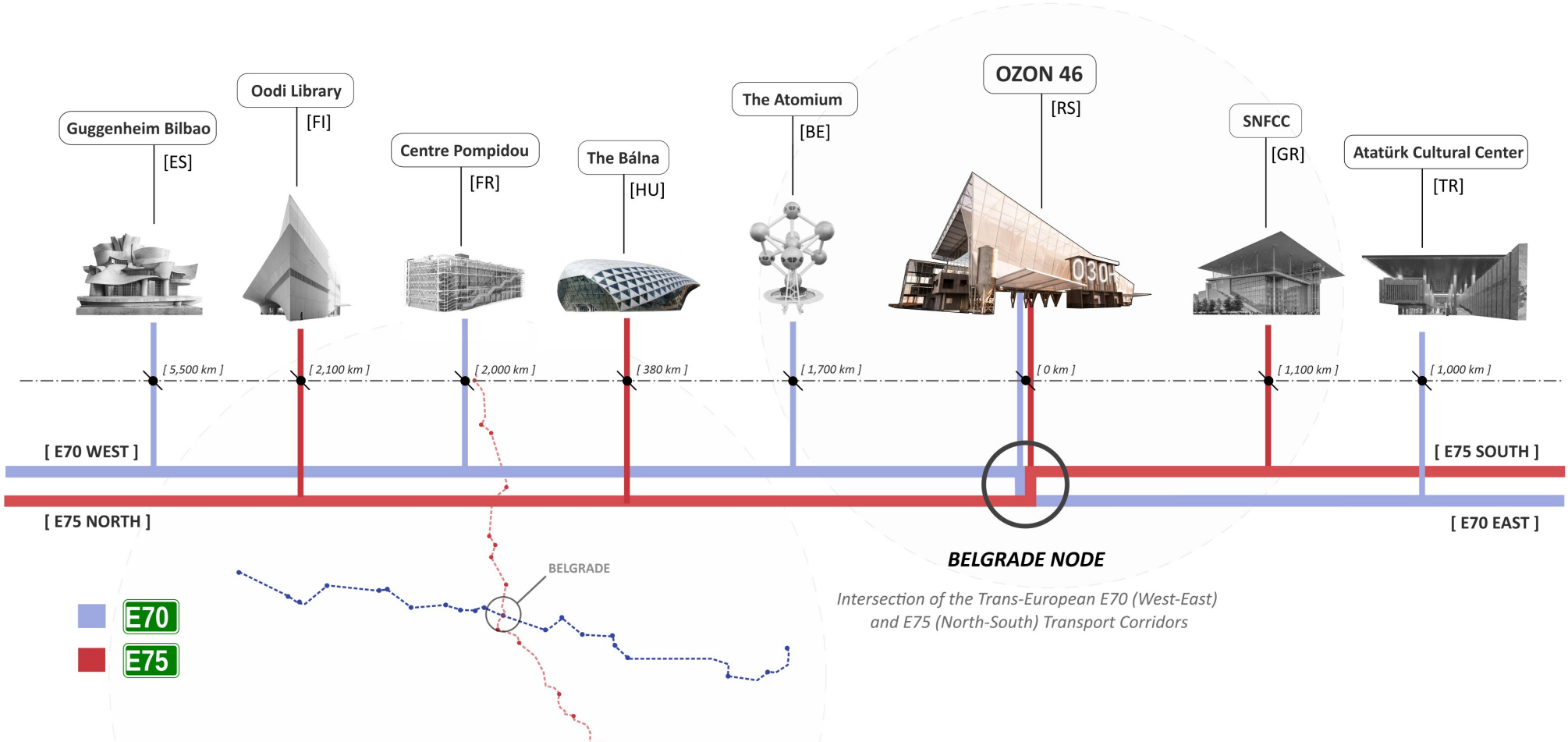
A new movement framework converges on a central architectural pin, establishing the civic square and organizing future urban blocks while preserving the restored ecology.

POSSIBILITY OF VISIBLE ICON?

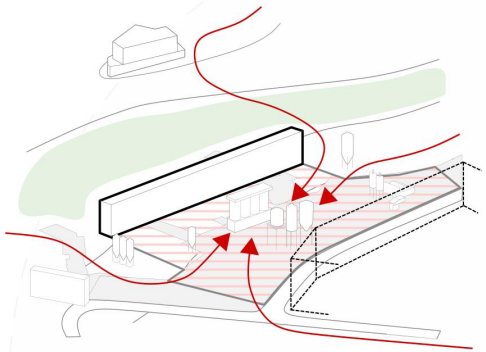


NODE 46: A BELGRADE ICON

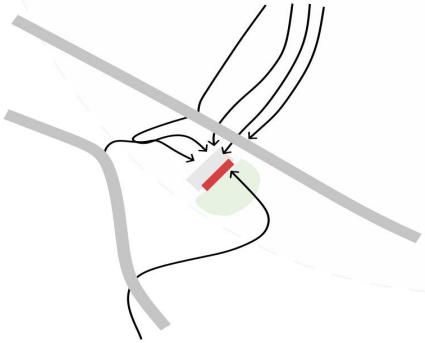
Anchoring Ozon 46 on the map.



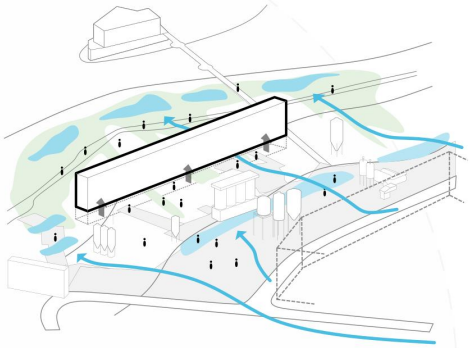
01 / URBAN EDGE & CONFLUENCE



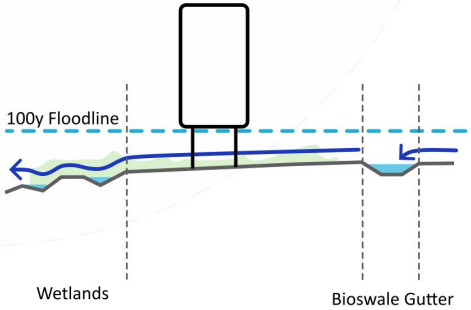
Positioned at the confluence of urban vectors, the primary volume is pushed to the perimeter to establish a hard urban edge and frame a protected public plaza while ceding nature to the other half.



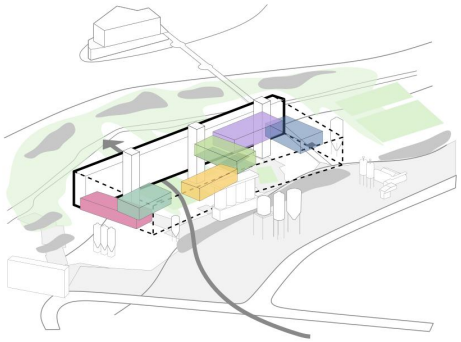
02 / ECOLOGICAL PERMEABILITY
(THE LIFT)



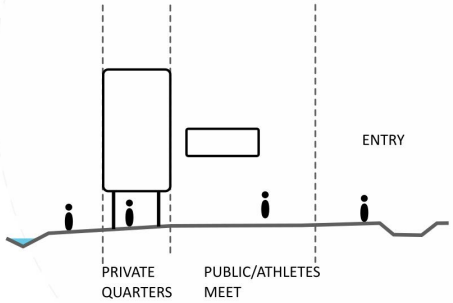
Elevated safely above the 100-year flood line, the architecture allows the Sava River's regenerative sponge landscape and public pathways to seep uninterrupted beneath it.



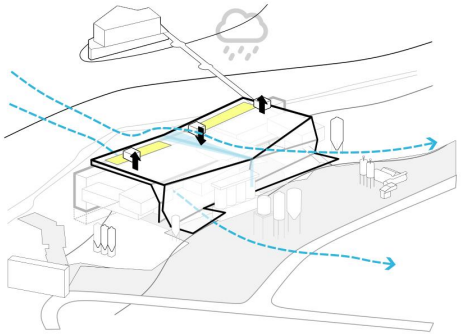
03 / URBAN FRINGE



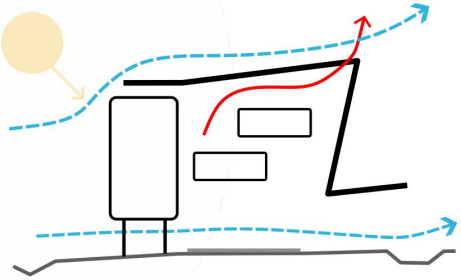
Acting as a civic mediator, the architecture filters the city into nature, zoning the ground plane from a dense urban entry through to active sports fields and a quiet nature retreat.



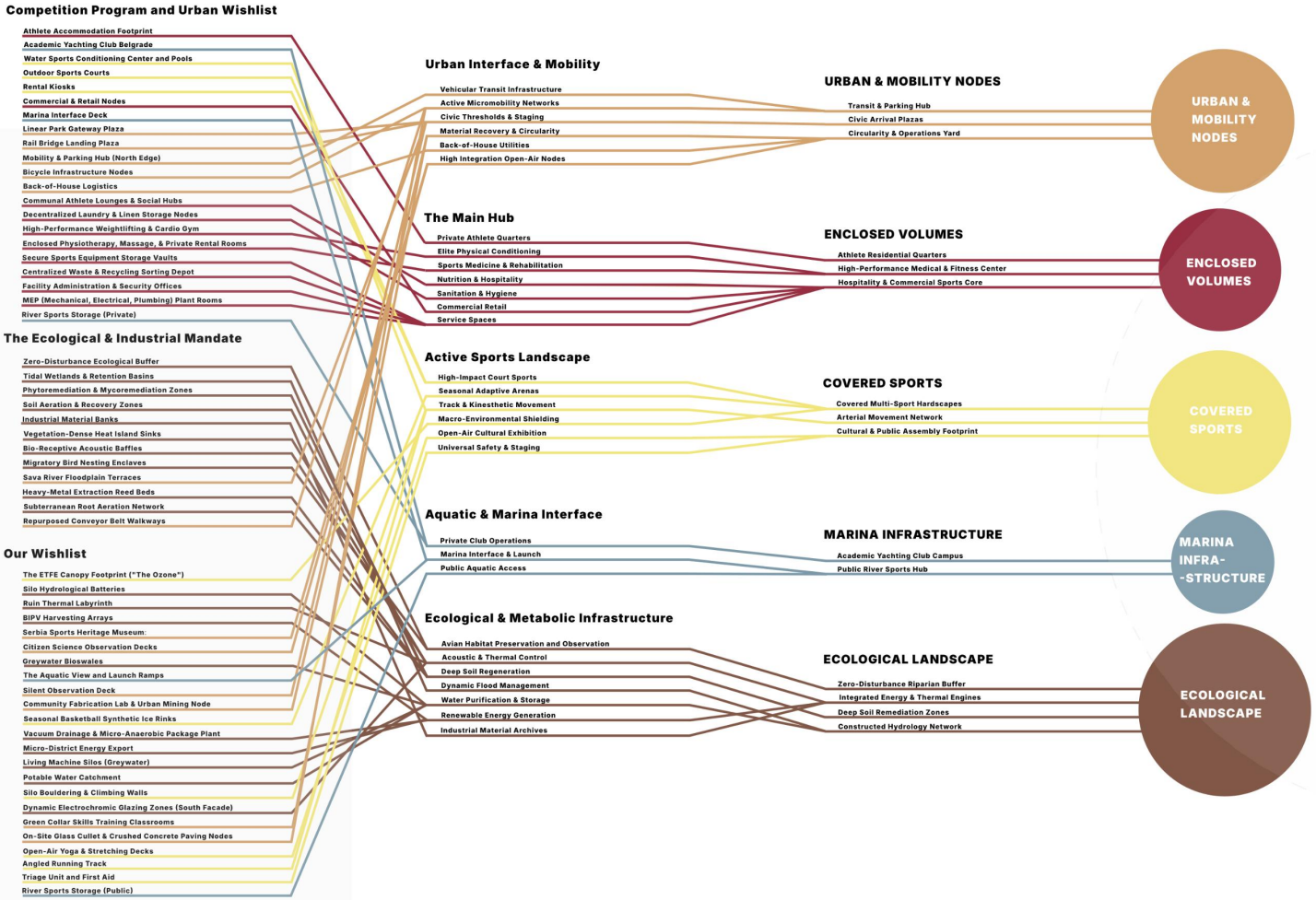
04 / ENVIRONMENTAL CANOPY

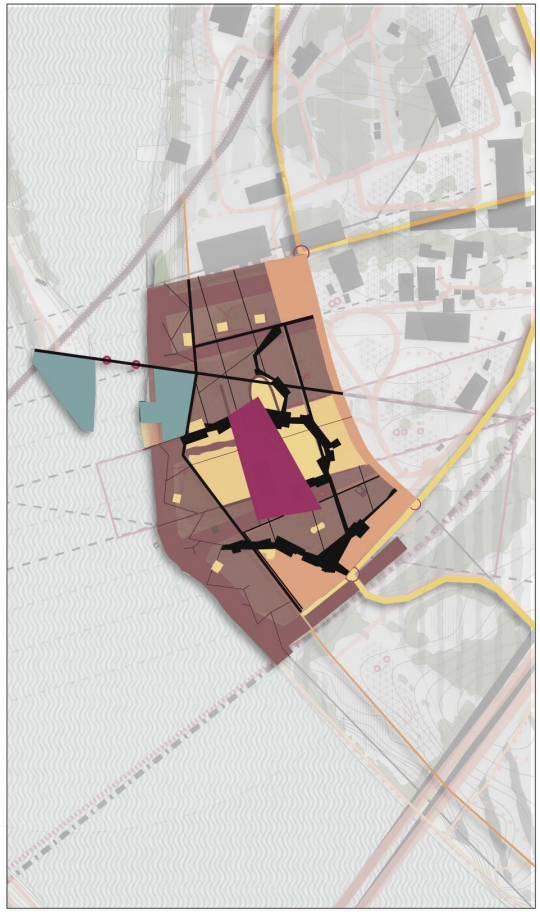


A unified ETFE climatic canopy is draped over the programmatic volumes, establishing a protected, year-round verandah optimized for solar harvesting, passive ventilation, and water catchment.



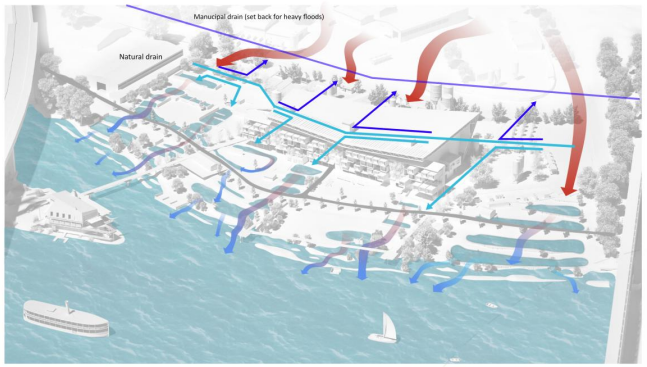
UNDERSTANDING AND DISTILLING PROGRAM ACCORDING TO MAPPED ENERGIES



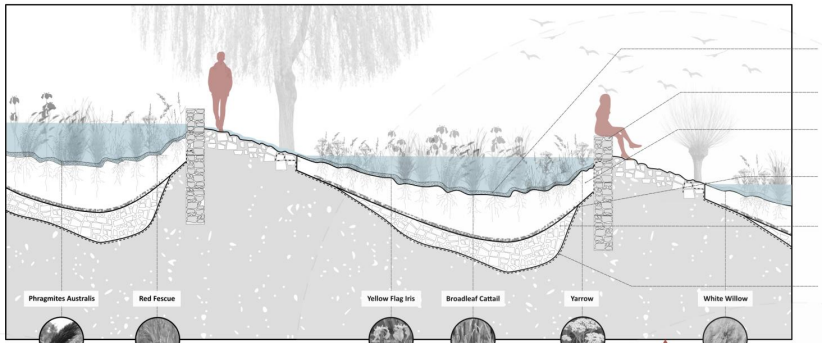


HYDRO- REDMEDIATION

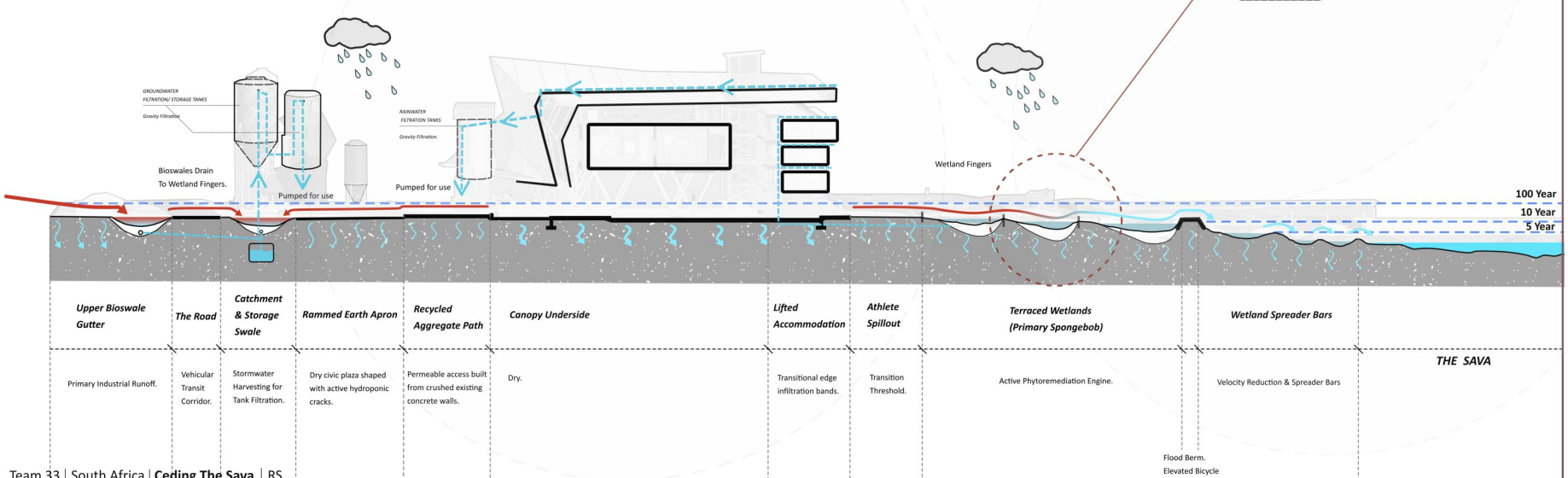
Terraced Stormwater & Active Phytoremediation



100 year floods are absorbed and drained through wetlands, swales improved manucipal drainage



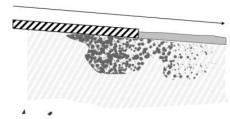
*ALL PLANT SPECIES USED ARE **NATIVE***



BIOSWALE LOGIC

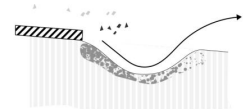
1. THE INDUSTRIAL SCAR

Impermeable contaminated paved surfaces traps toxic heavy metals and prevents natural site drainage.



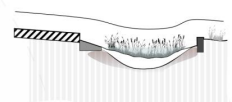
2. THE INTERVENTION

Toxic topsoil is excavated while existing concrete is crushed on-site to serve as sustainable drainage aggregate.



3. THE LIVING ENGINE

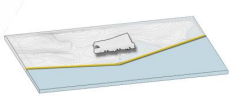
Hyperaccumulating pioneer species extract soil toxins and act as a heavy-duty biological filter for runoff.



FLOODLINES

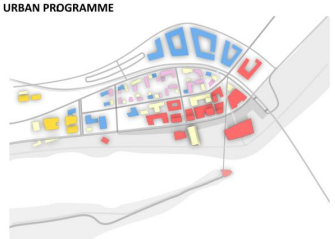
5 Year Flood Simulation

10 Year Flood Simulation



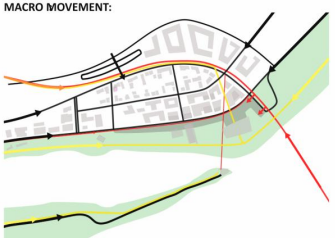
100 Year Flood Simulation

URBAN PROGRAMME



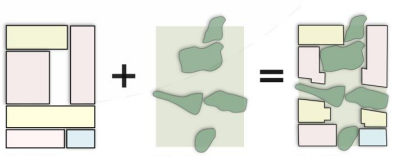
- Civic & Hospitality Core / Civic Plinth
- Hybrid Corporate / Retail Plinth
- Hybrid Residential / Retail Plinth
- Commercial Core / Active Frontage
- Soft Industry / Public Interface

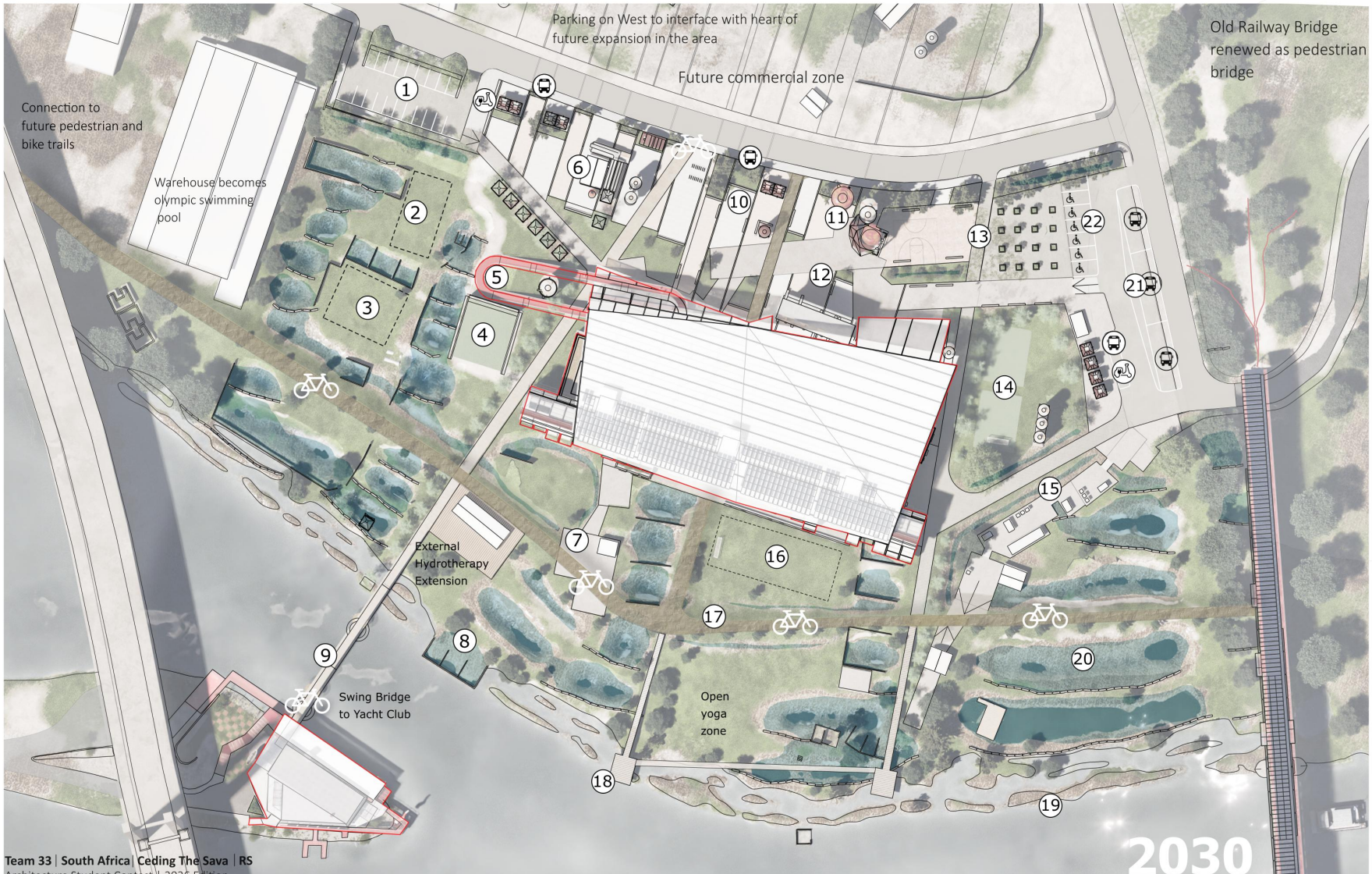
MACRO MOVEMENT:



- Green Band
- Building footprints
- Primary Pedestrian
- Road Networks
- Bicycle Routes

URBAN STRATEGY:





THE MASTER PLAN

1. Primary car parking
2. Outdoor
3. Trim trial/ fitness trial
4. Rebound Tennis
5. Hill running track
6. MEP battery storage
7. Fixit stop for bicycles
8. Water retension/filtration dam
9. Rotating bridge to Yacht Club
10. Bus Stop (recylced hoppers)
11. Bouldering tanks
12. Market plaza
13. Bus zone spillout and 3x3 basketball
14. Open Tennis/ flexible hard-court
15. Open air sports museum walk on retained plinths
16 Flexible open sportscape, suitable for half field soccer.
17. Raised bike and pedestrian 10 year flood protector connecting the park in the east.
18. Yoga and bird watching quiet zone
19 The Horizontal current level spreader.
20. Phytoremediation wetlands placed according to mapped hydrology and existing topography
21. Compliant parallel bus parking
22. Accessible parking

Net-Positive Solar Canopy encased in Saint-Gobain STADIP glass.

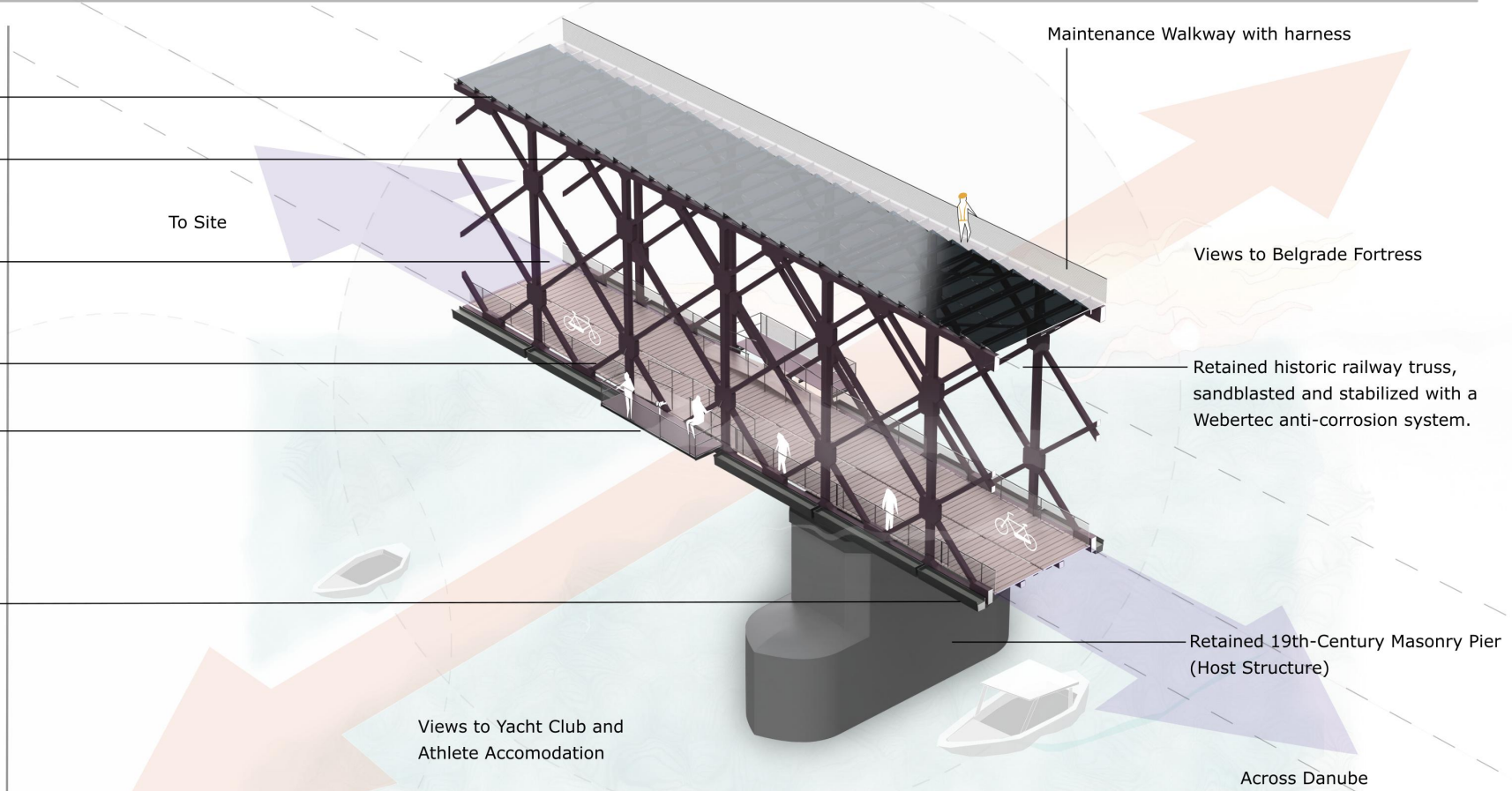
Recycled aluminium extrusions

Recycled railway sleepers laid directly over the existing track bed grid to form the floor plane.

Upcycled steel mesh balustrades

Integrated viewing platforms extending from the primary chord to frame sightlines of Kalemegdan Fortress and the 030H Hub.

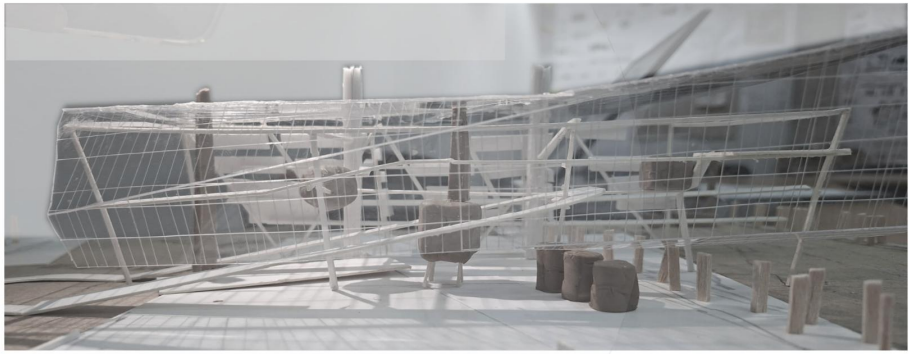
Linear vegetation beds waterproofed with weberdry PUR seal and filled with Leca® LWA to support native flora without overloading the historic structural dead weight.

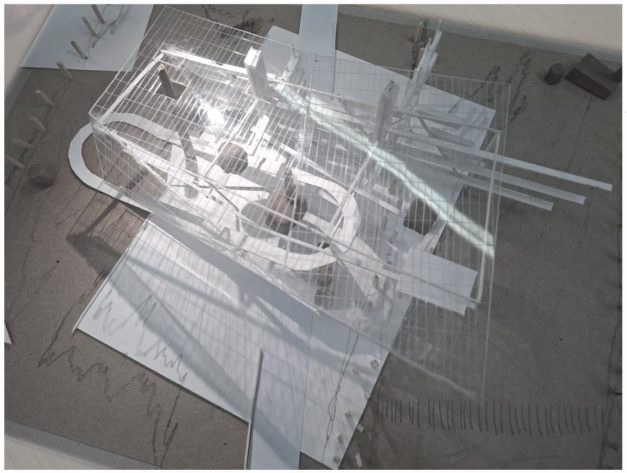


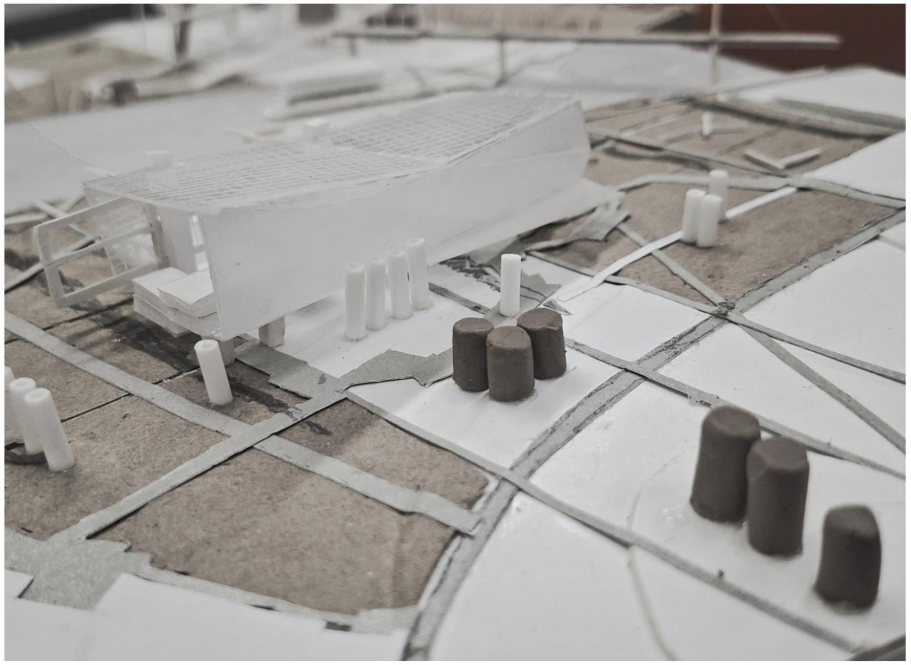
Total Active PV Area: 1,850 m²
PV Specification: Bifacial N-Type TOPCon Monocrystalline cells with Saint-Gobain STADIP® laminated safety glass.
Effective Yield: 270 kWh/m²/year (Accounts for bifacial underside gains and system losses)
Total Annual Generation: 499,500 kWh/year


OZON 46
SPORTS HUB
A
STRUJA
YACHT CLUB
B

MODEL EXPLORATION








ОЗОН

INTRODUCTION TO "OZON"

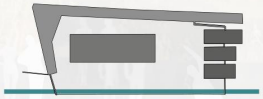
OZON, (Serbian Cyrillic 030H), works as a climatic machine designed to repair the elite athlete and the damaged section of the Sava riverbank simultaneously. Acknowledging the floodplain, the building employs a lifted typology, where it yields it's permeable ground floor to severe floods, sacred program remains protected in the canopy's atmosphere. This ensures ecological resilience while elavating the programmatic cores as an array of panoptic Passivhaus envelopes that visually celebrate the sport of Belgrade.

Above the passive sportscape, a large canopy establishes civic scale with the surrounding bridges and existing tanks. The unified volume is a thermodynamic flute, facilitating passive ventilation for the unconditioned sportsape below for year-round operation as well as operating with the adjacent pedestrian bridge as a unified solar array to achieve a net-positive energy report.

Driven by performative regionalism, "OZON", written "030H" locally, uses a 80/20 structural split, where 80 percent of the building is cooled passively and program where Passivhaus comfort is needed becomes insulated and mechanically controlled. The sports accomodation is a material bank engineered for maximum dissasembly at the end of it's life using recycled steel from an adjacent industrial facility storage which is planned to be demolished in the city's future. It utilizes a completely open ground plane, typologically the most flexible spaces available.

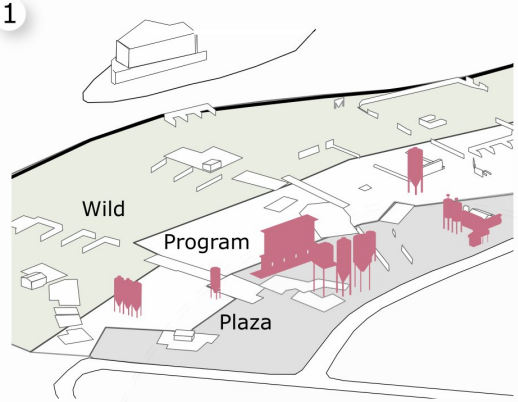
Anchoring the buiding's narrative to it's industrial past, existing tanks are repurposed as housing for water filtration, anaerobic waste digestion and recreational sports such as bouldering, while existing concrete walls are selectively demolished into terraces for bioswales and wetlands.

OZON negotiates a civic-scale architecutre with a flood prone landscape and the need for ultimate flexibility, which allow it to operate as a highly efficient and restorative recognisable machine.



MORPHOLOGICAL DIAGRAMS

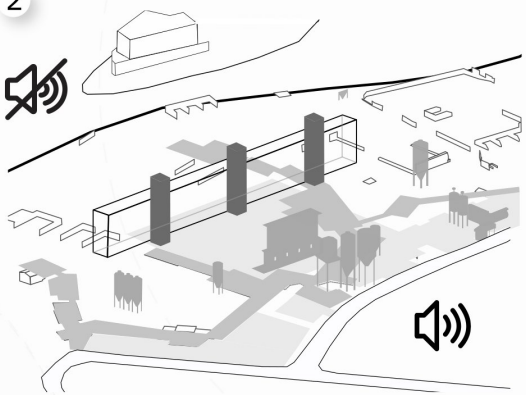
1



THE REMNANTS AND THE TIERS

The intervention begins by retaining useful concrete foundations and industrial remnants, anchoring the site to it's history while consolidating a strict riperian edge along the riverbank that actively heals the scarred landscape.
The Northern edge is given to the city. A functional gradient is formed.

2

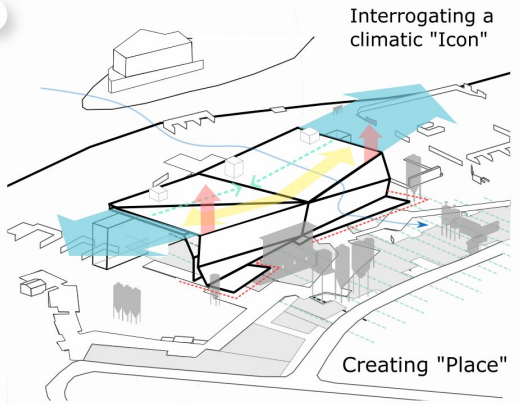


ACOUSTIC DECOUPLING

The beautiful and quiet South is given to accomodation, informed by the quiet edge created as well as it's seperation from the loud urban tier.

Connecting a meandering pedestrian route, the existing concrete plinths are linked together, resonant of Stan Allen's "linked assemblies".

3

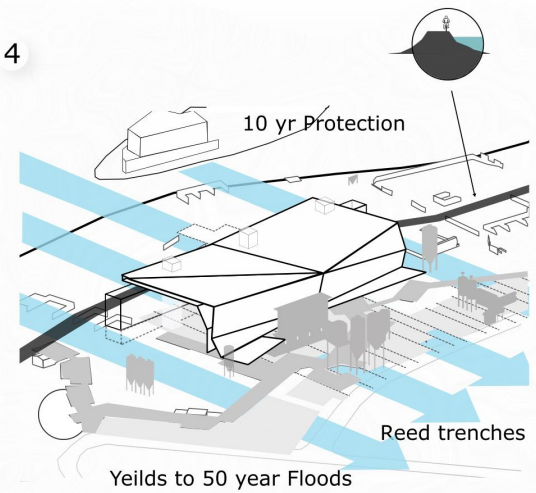


THE THERMODYNAMIC CIVIC BOUNDARY

Inspired by thermodynamics, the need for sports to be accomodated all year round, surrounding new waterfront buildings as well as a potential for OZON to become a iconic civic anchor, a large lightweight canopy is draped over the plinths.

The drape, shaped by the stack effect, becomes a double-skinned engine for a passively controled sportscape within.

4

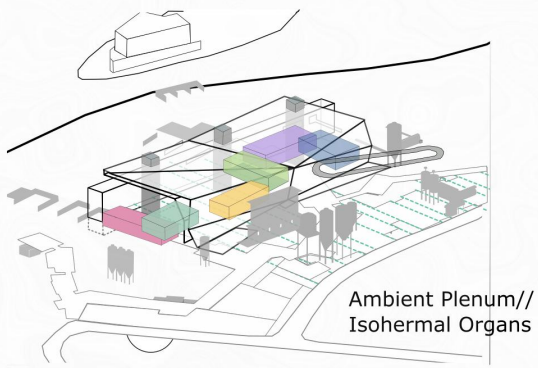


KINETIC HYDROPERMEABILITY

In a site marred by floods, the ground plane needs to become 100% permeable, and the building lifts to accomodate the surges below.

A lifted pedestrian and bike lane connecting the nearby routes becomes a 10 year flood barrier, 50 year floods are allowed to run their course as all sacred program is relegated to the "atmosphere".

5

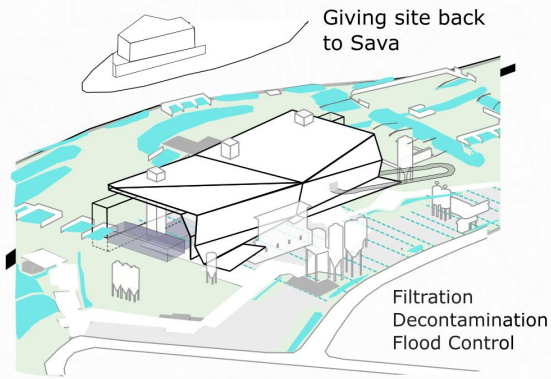


PROGRAMMATIC ORGANS

Just like a local jellyfish, the Craspedacusta, OZON lays bare it's organs, Program that requires insulation are physically lifted and seperated, while still maintaining 100% permiability as well as allowing the whole building to become a panoptic love letter to the Serbian sport favourites within.

- Logistics
- Tactical
- Hydrotherapy
- Athlete Nutrition
- Admin
- Cardio

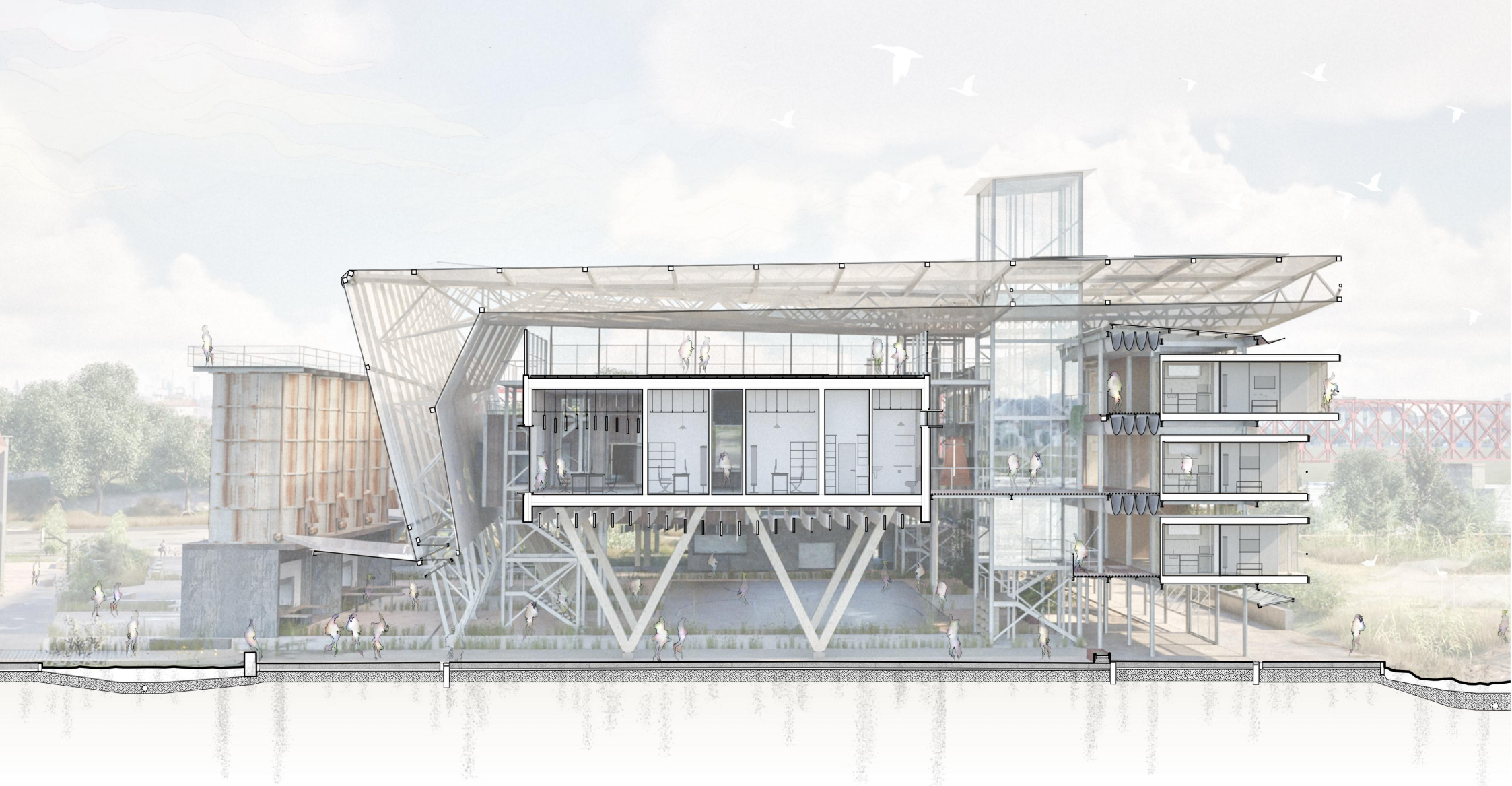
6



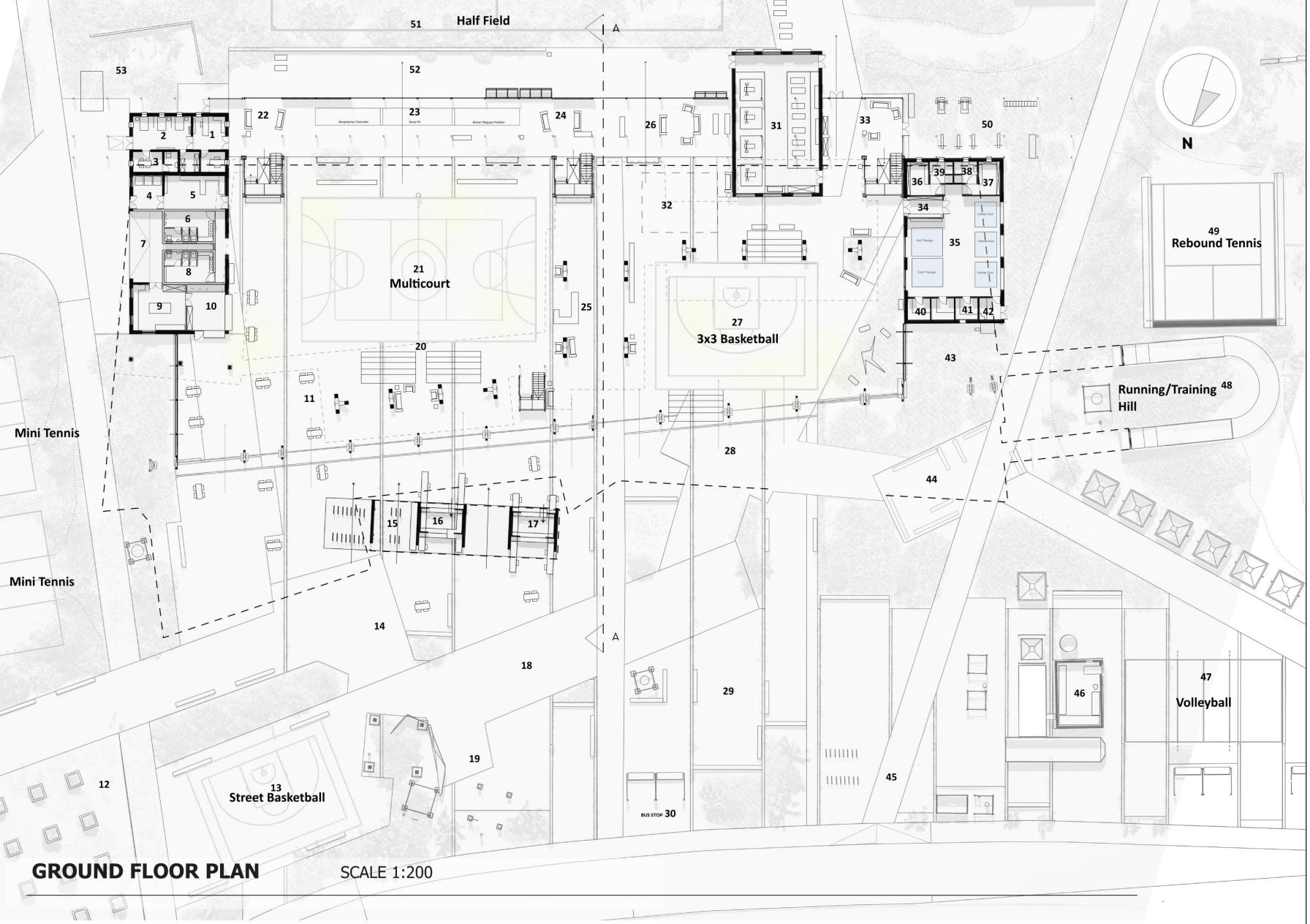
THE NATURAL RECLAMATION

Now balanced, the building gives it''s surrounds back to the Sava, allowing natural flora and fauna like the Pygmy Cormerant, to reclaim it's home from the industry.

The buffer becomes a sump for Sava litter to be collected and reused. Actively cleansing the Sava river by using plants to "catch" plastics.

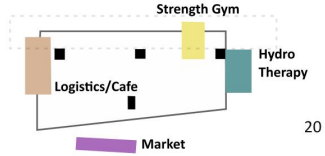


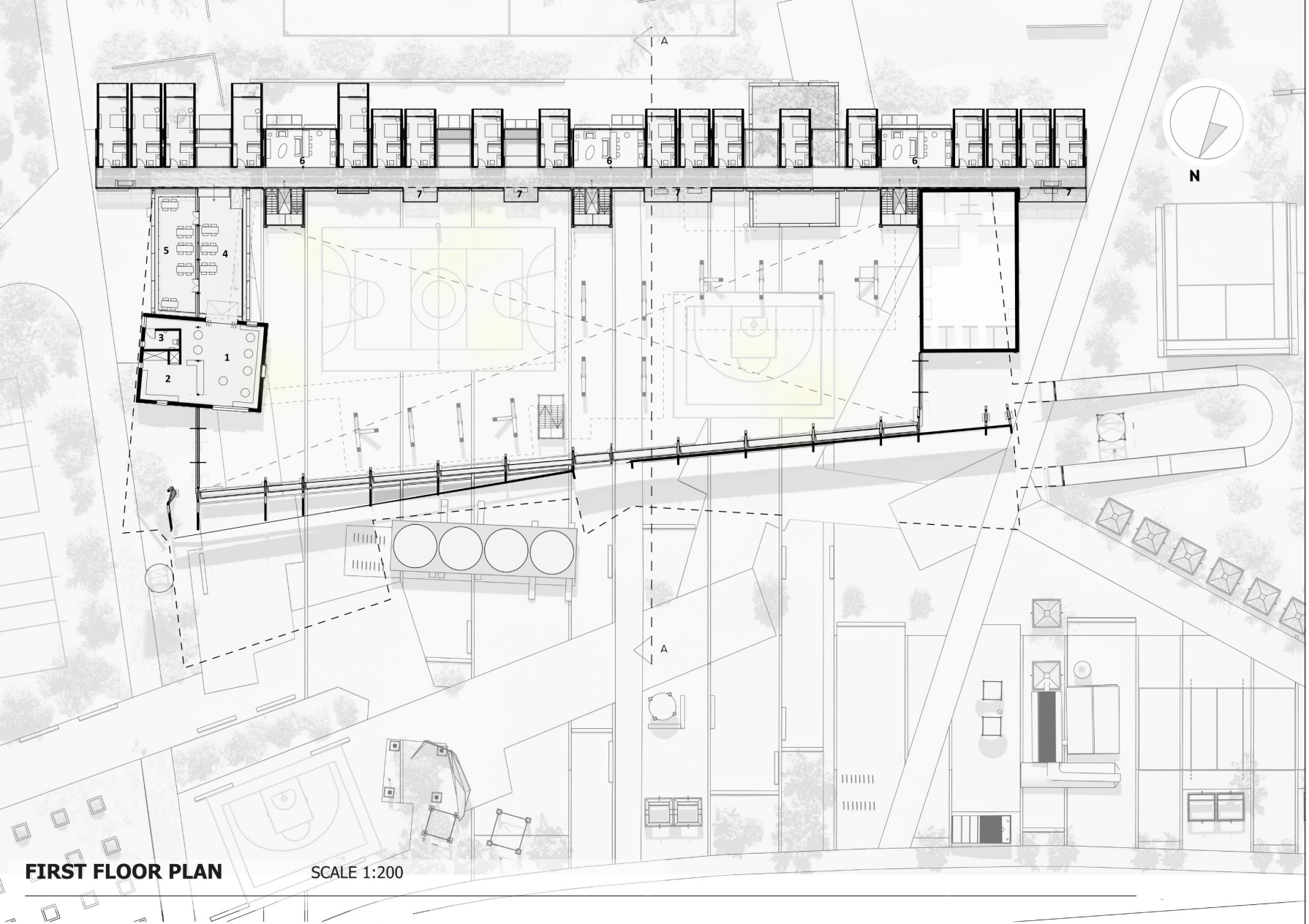
SECTIONAL PERSPECTIVE A-A SCALE 1:200



GROUND FLOOR PLAN SCALE 1:200

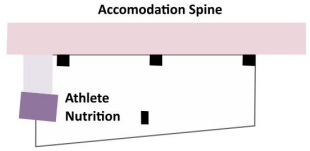
1. Triage Reception
2. Medical Triage
3. Doping Station
4. Recycling
5. Janitor Closet
6. Male Ablutions
7. Yard
8. Female Ablutions
9. Kitchen
10. Cafe
11. Eating space
12. Bus Spillout
13. Street Basketball
14. Riperian Plaza
15. Bike Repairs
16. Shop 1
17. Shop 2
18. Repurposed Silo market
19. Silo Bouldering
20. Spectators
21. Multicourt, Ice Skating
22. Team 1 Staging
23. Proprioceptive Track
24. Team 2 Staging
25. Reception
26. Lounge
27. 3x3 Basketball/ Volleyball
28. Gallery Spilloit
29. Teqball/
30. Bus Stop
31. Strength Cond.
32. Table Sports
33. Decompression
34. Thermal lock
35. Hydrotherapy
36. Male Lockers
37. Female Lockers
38. Female Showers
39. Male Showers
40. Saunas
41. Accessible Sauna
42. Plant room
43. Backwash swale
44. Social plinth
45. Bike Storage
46. MEP Batteries
47. Street Volleyball
48. Hill Practice
49. Rebound Tennis
50. Outdoor Gym
51. Graded for Crane
52. Sprint Corridor
53. Ambulance

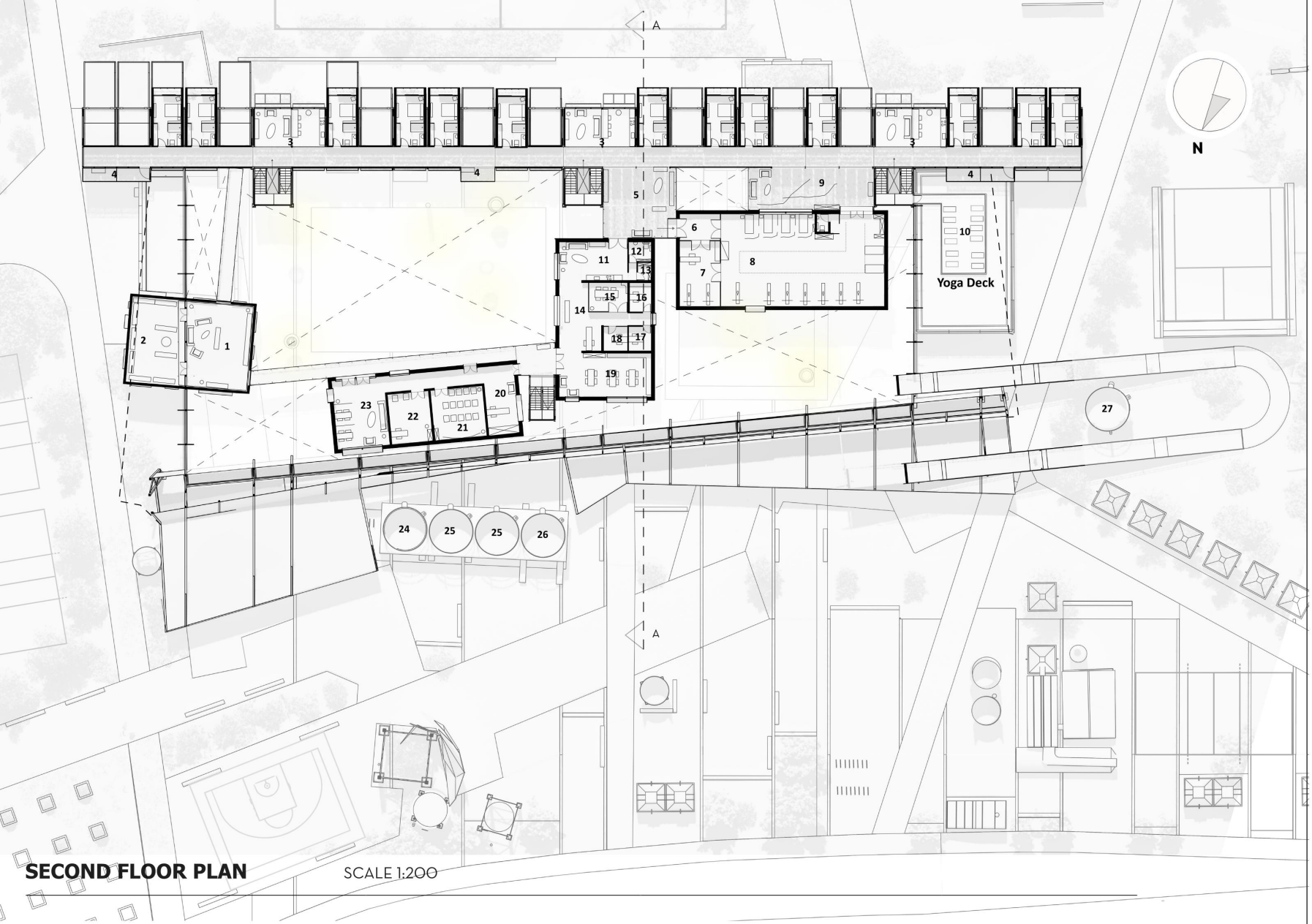




FIRST FLOOR PLAN SCALE 1:200

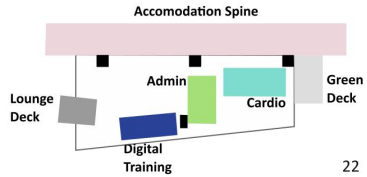
1. Athlete Nutriton
2. Kitchen with Dumbwaiter
3. Ablutions
4. Indoor Dining
5. Outdoor Dining
6. Commons
7. Balcony

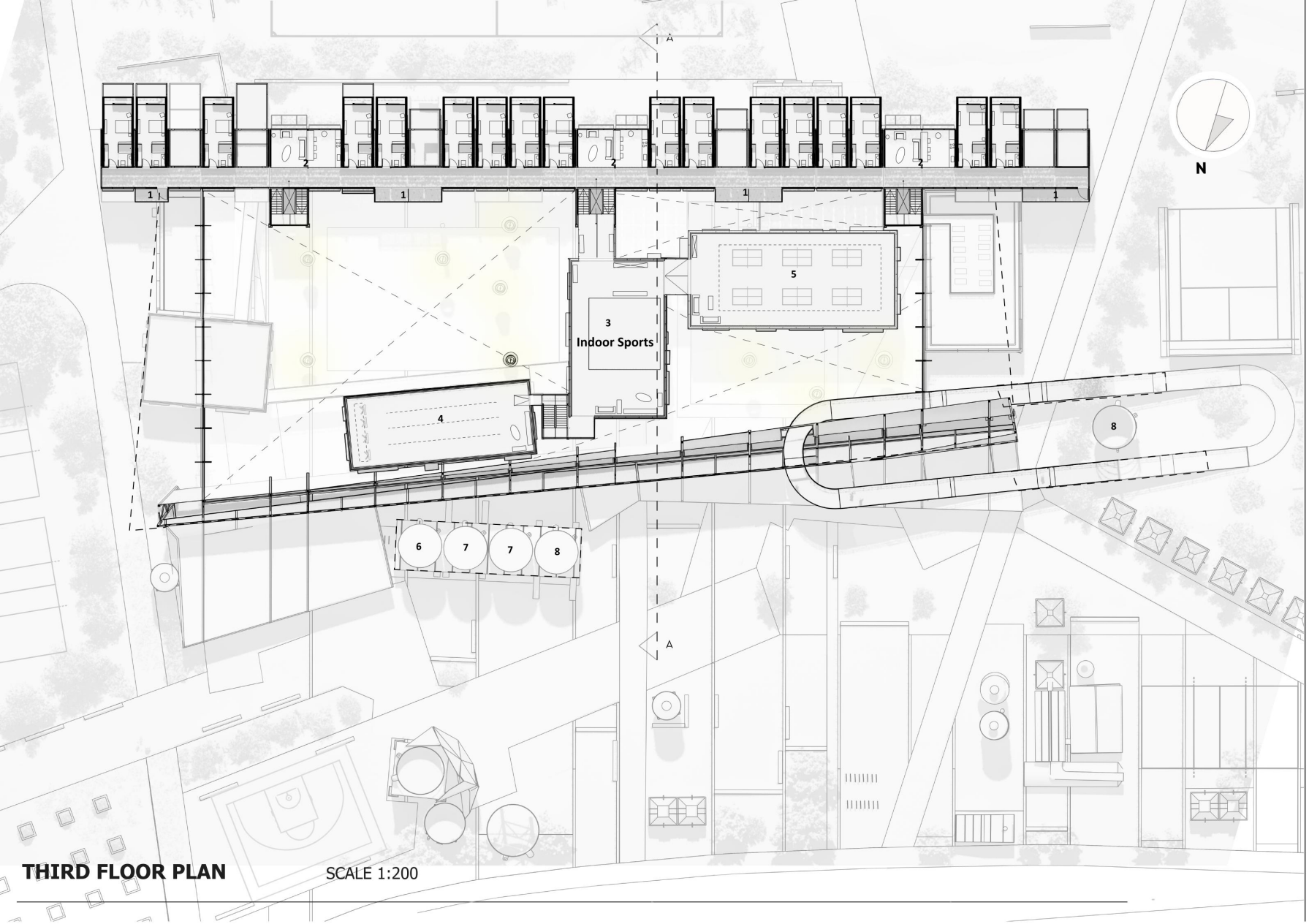




SECOND FLOOR PLAN SCALE 1:200

1. Briefing terace
2. Outside social space
3. Commons
4. Balcony
5. Lounge
6. Coach Vestibule
7. Vo2 Max Training
8. The Cardio Block
9. Rest and Rope training
10. Yoga Phytoremediation Deck
11. Commons Staff
12. Ablutions
13. Storage
14. Viewing
15. Boardroom
16. Coach Office
17. Coach Office
18. Directors Office
19. Administrartive offices
20. Control room
21. Mini review theatre
22. Mocap sim bay
23. Team waiting and briefing
24. Anaerobic Digester
25. Water Storage
26. Filtration Tank (gravity)





THIRD FLOOR PLAN SCALE 1:200

1 Balcony.

2. Commons

3. Taekwondo/ Martial Arts

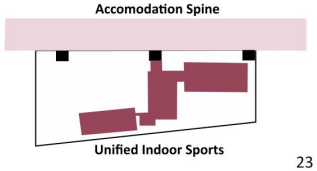
4. Flexible Rooftop, laser pistol/ fencing piste

5. Flexible rooftop, table tennis/ padel

6. Anaerobic Digester

7. Water Storage

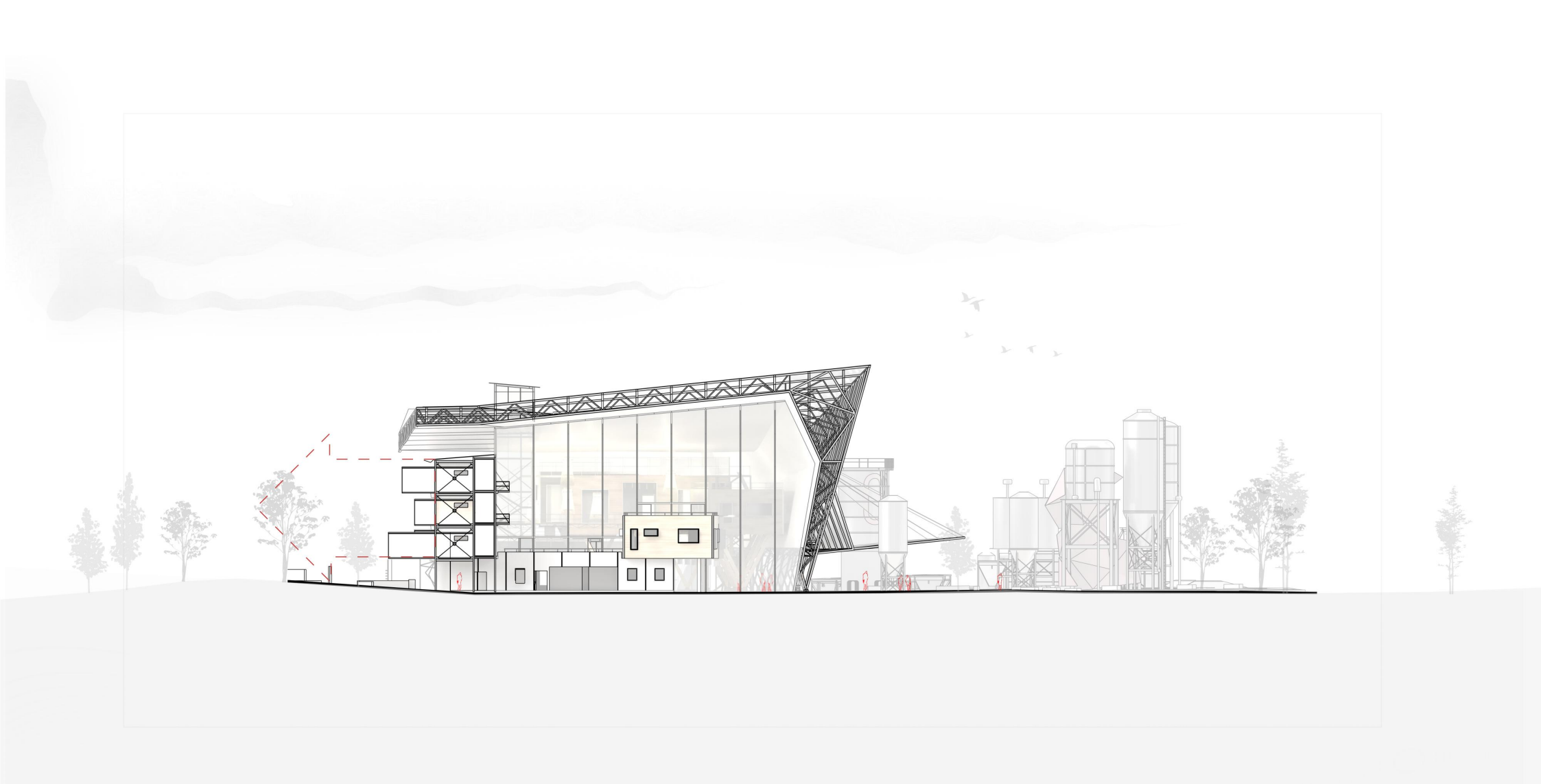
8. Water Filtration



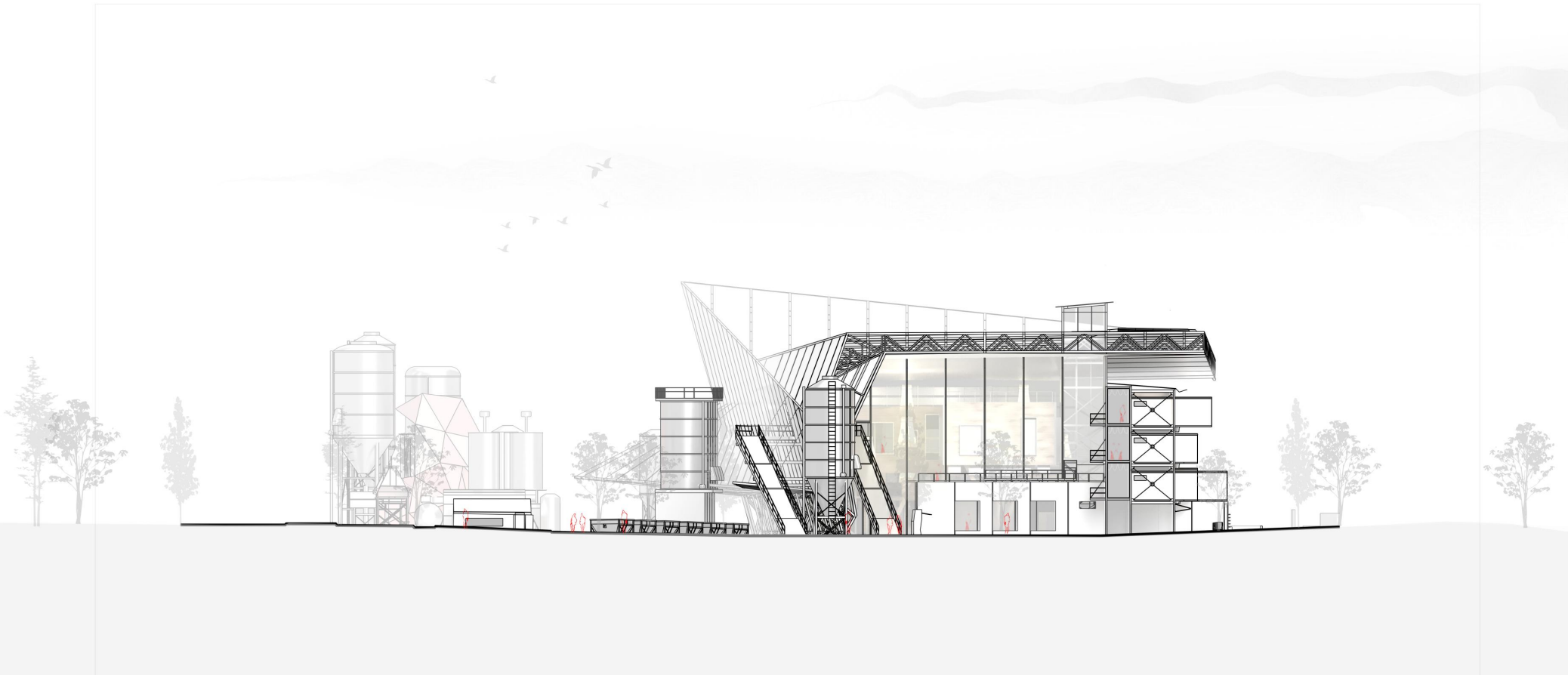
THE NATURAL BACK // THE SPORTSMAN'S RETREAT

NORTH ELEVATION SCALE 1:200

SOUTH ELEVATION SCALE 1:200



EAST ELEVATION SCALE 1:200

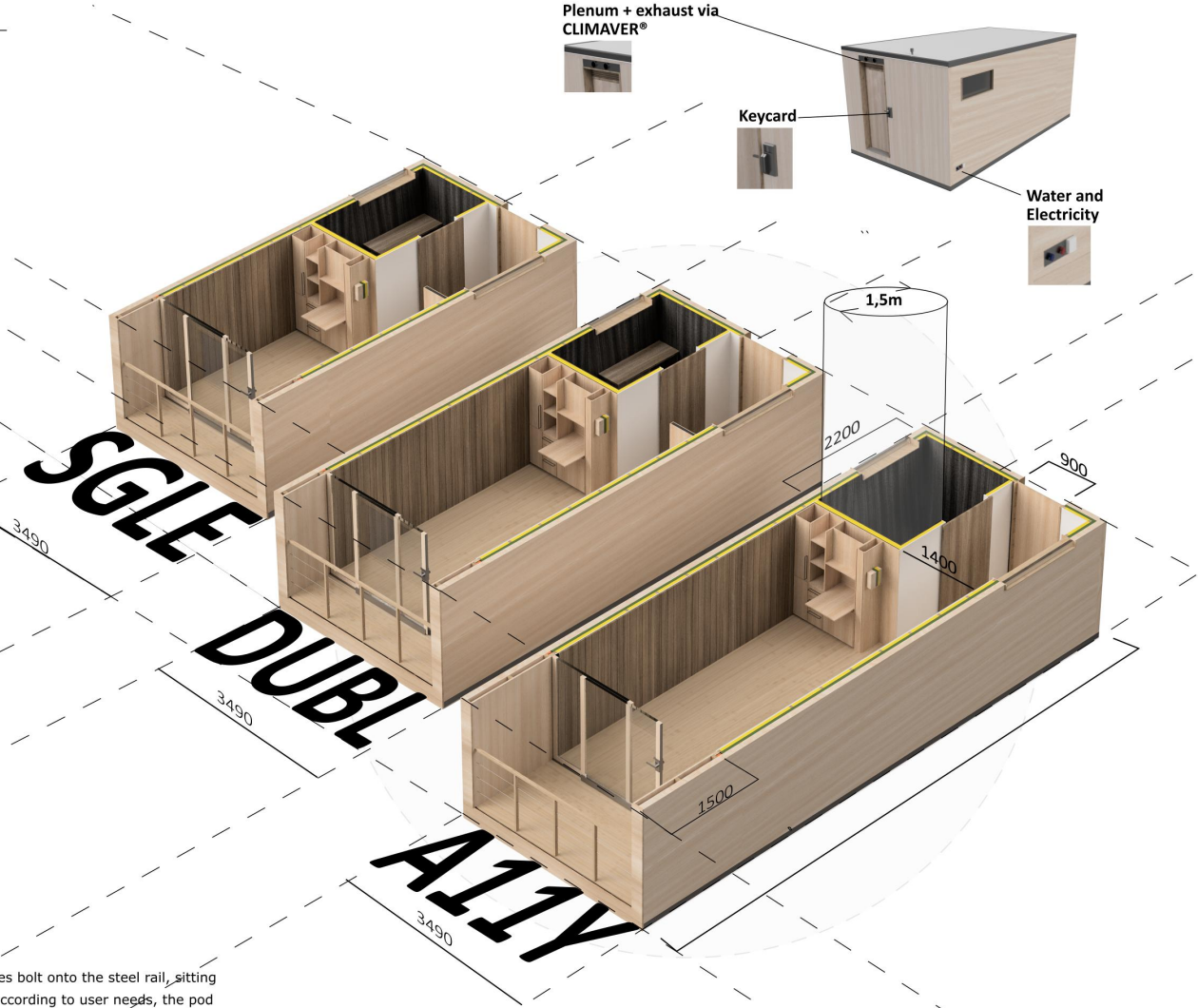


WEST ELEVATION SCALE 1:200

ALL - YEAR - ROUND PROTECTED SPORTS

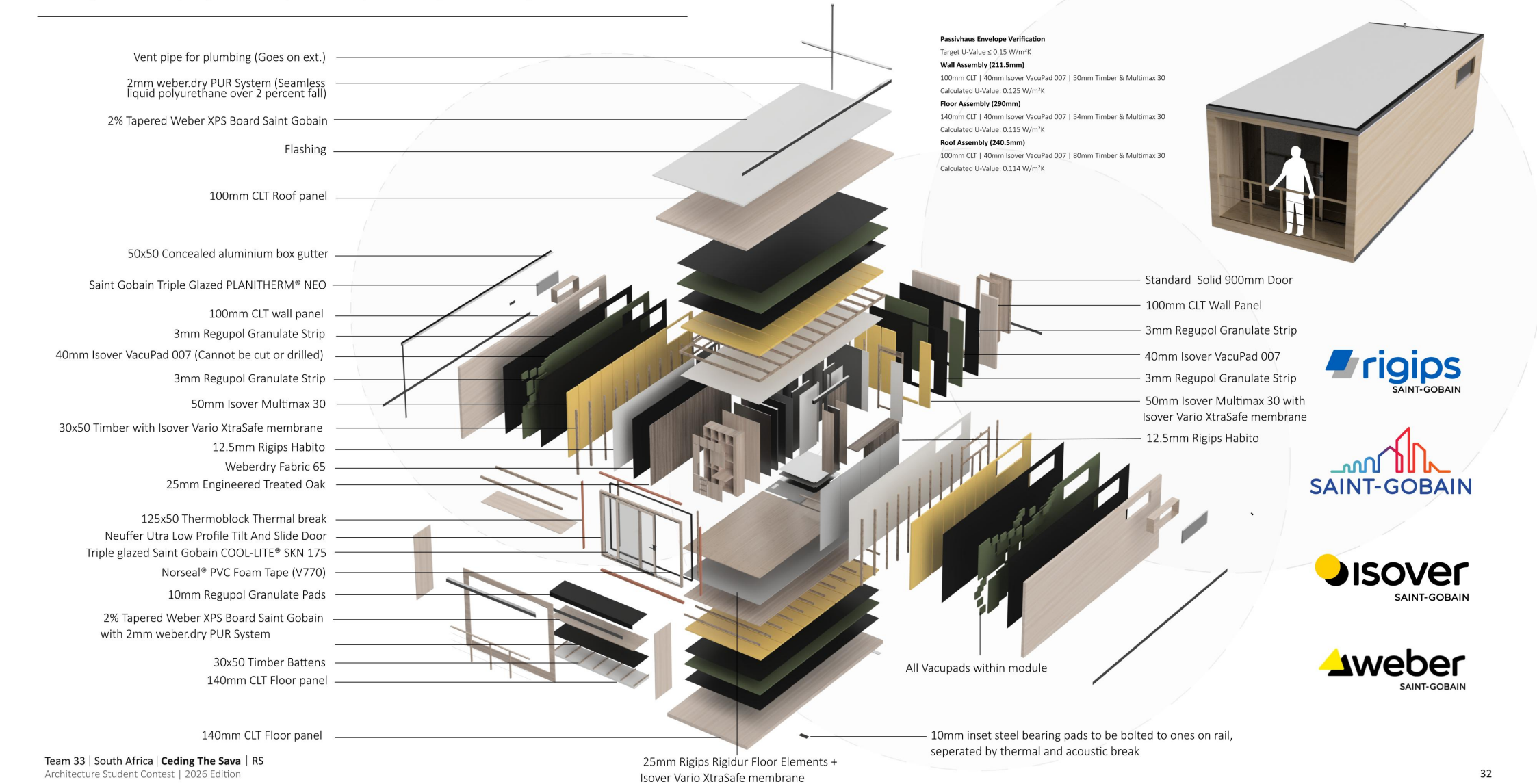
RETREAT WITH VIEWS ONTO NATURE

THE PASSIVEHAUS CARTRIGES



Prefabricated in order to eliminate A5 carbon emissions, these Passivehaus- certified CLT modules bolt onto the steel rail, sitting on 4 acoustically decoupled feet via a 25mm thermal break, they feature adaptable typologies according to user needs, the pod interior is designed for clean extraction, ensuring the unit remains as a material bank. The unit plugs in it's mechanical ventilation via the walkway above it, and flexible water mains allow the pod to be craned in and screwed down in a few hours.

EXPLODED AXONOMETRIC VIEW OF THE CARTRIDGE



Passivhaus Envelope Verification
Target U-Value ≤ 0.15 W/m²K
Wall Assembly (211.5mm)
100mm CLT | 40mm Isover VacuPad 007 | 50mm Timber & Multimax 30
Calculated U-Value: 0.125 W/m²K
Floor Assembly (290mm)
140mm CLT | 40mm Isover VacuPad 007 | 54mm Timber & Multimax 30
Calculated U-Value: 0.115 W/m²K
Roof Assembly (240.5mm)
100mm CLT | 40mm Isover VacuPad 007 | 80mm Timber & Multimax 30
Calculated U-Value: 0.114 W/m²K

rigips SAINT-GOBAIN

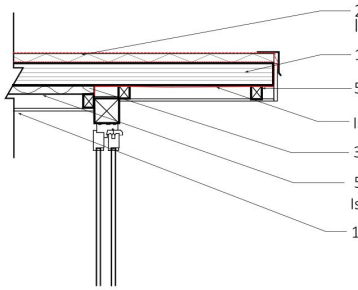
SAINT-GOBAIN

isover SAINT-GOBAIN

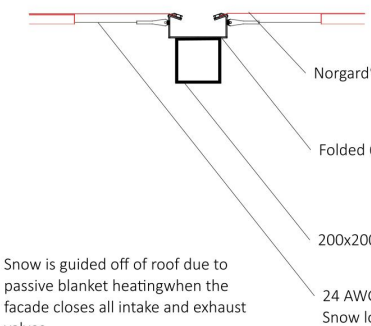
weber SAINT-GOBAIN

DISSECTING THE SHELF//PART WALL

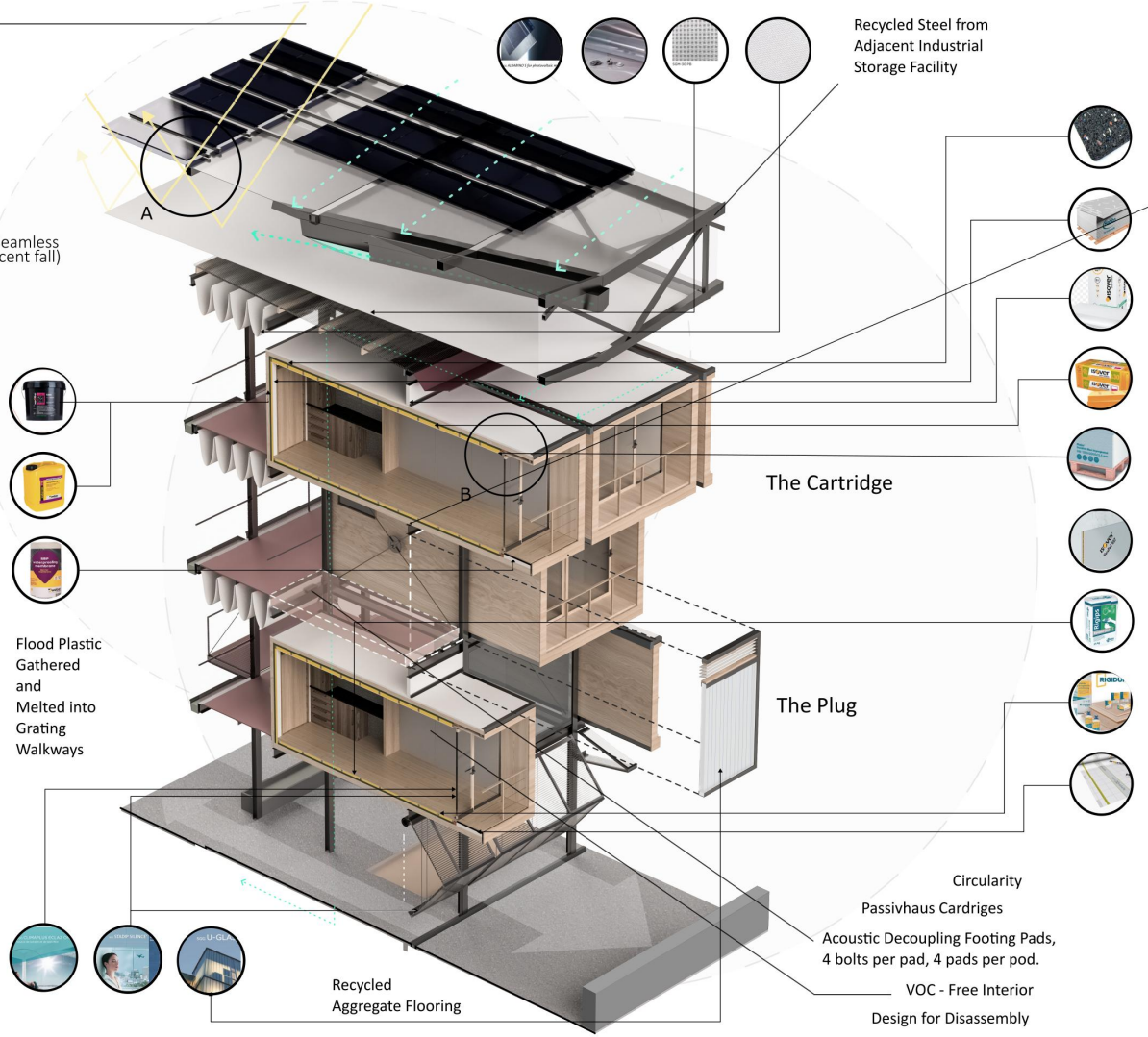
DETAIL A



DETAIL B



Snow is guided off of roof due to passive blanket heatingwhen the facade closes all intake and exhaust valves.



The Feet

Dry-assembled connections utilizing an isolation core to break acoustic and thermal bridging while permitting movement. (Sonus Core)

rigips SAINT-GOBAIN

SAINT-GOBAIN

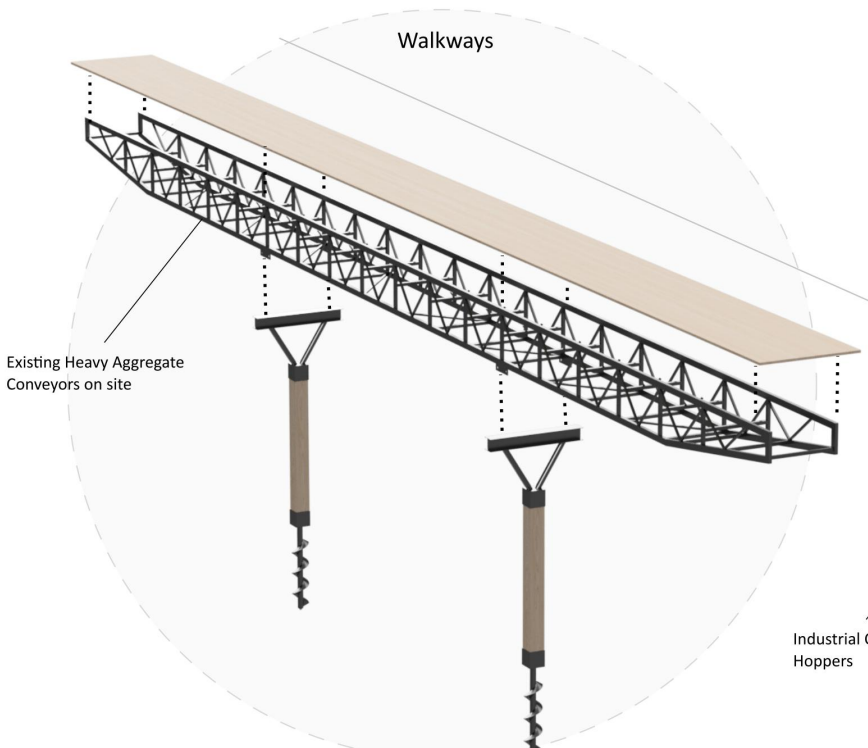
isover SAINT-GOBAIN

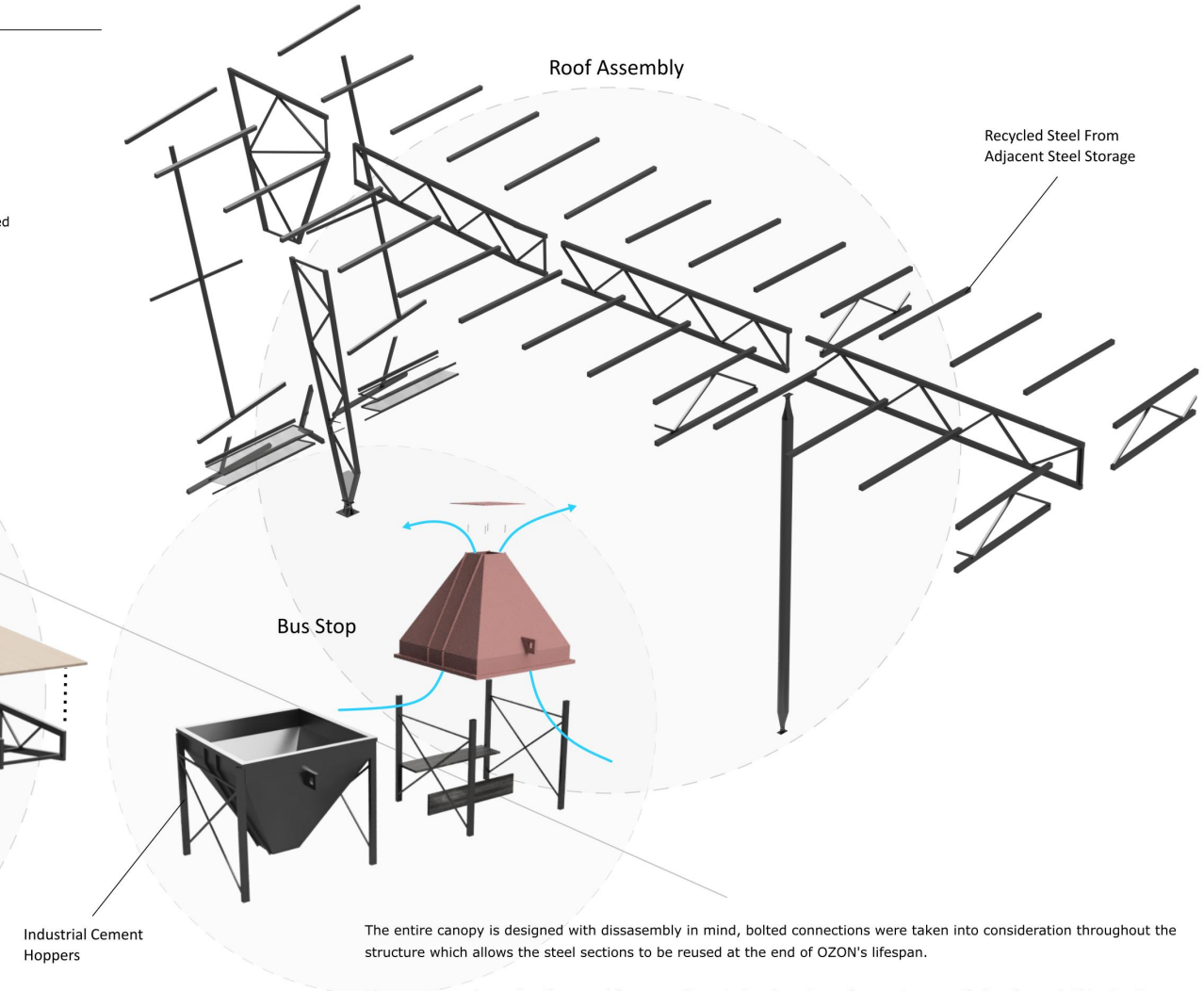
weber SAINT-GOBAIN

DESIGN FOR DISSASEMBLY AND ADAPTIVE REUSE

Catwalks and Boardwalks along the exterior and interior of site are made from stripped industrial conveyors present on site, timber is merely bolted on and for minimum site impact the walkways are held in place with glulam posts that utilize a screw pile, these bolt to the notes that used to be bolted to silos.

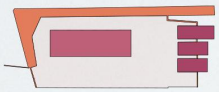
Additionally Bus stops are made from reused industrial hoppers, these hoppers on site are seperated from their lower structure and flipped upside down, bolted back on with the outlet facing the sky, the outlet is then closed with a steel plate, the geometry also allows passive ventilation within the bus stop canopy itself.





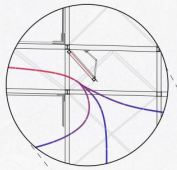
The entire canopy is designed with dissasembly in mind, bolted connections were taken into consideration throughout the structure which allows the steel sections to be reused at the end of OZON's lifespan.

The canopy steel was directly reused form an adjacent site where tons of concrete currently lies dumped, this site sits within belgrade waterfront expansion plans and lies adjacent from OZON, providing the perfect reuse and upcycling scenario.

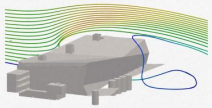


Passively buffering the 80% macro-volume restricts mechanical conditioning to the 20% Passivhaus cartridges, drastically reducing total energy loads.

Snow is guided off of roof due to passive blanket heating when the facade closes all intake and exhaust valves.



Valve Controlled manually and through BMS
Open summer: cold air rushes into heated facade air building.
Closed Winter: air stays still and heats up in facade, blanket effect.



160 kmh fluid simulation shows
Wind Deflection from urban space.

All Valves controlled by BMS

Exhaust at peaks
Open Summer
Closed Winter

Canopy becomes thermal blanket in Winter when all valves close

Passively gathered heat makes snow slide

Sava Wind Intake
Open Summer
Closed Winter

Rainwater filter Tanks

Gravity Feed

25mm Regupol Sonus Core Acoustic and Thermal Break on Pads

Facade Cold Intake
Open Summer
Closed Inter

A fully porous floor assembly utilizing a recycled resin-aggregate finish over pervious concrete, filtering surface water directly into a LECA thermal and attenuation bed.

THE BULK SOURCING LOGIC

Logistical mapping of material distance, embodied carbon, and site-salvaged circularity.

1

- Reclaimed Steel
- Recycled Sava River Plastic
- Crushed Site Aggregate

2

- Concrete Pile Foundations

3

- Saint-Gobain Multiwall Polycarb

4

- Polycarbonate Multiwall (Tuplex SRB)

5

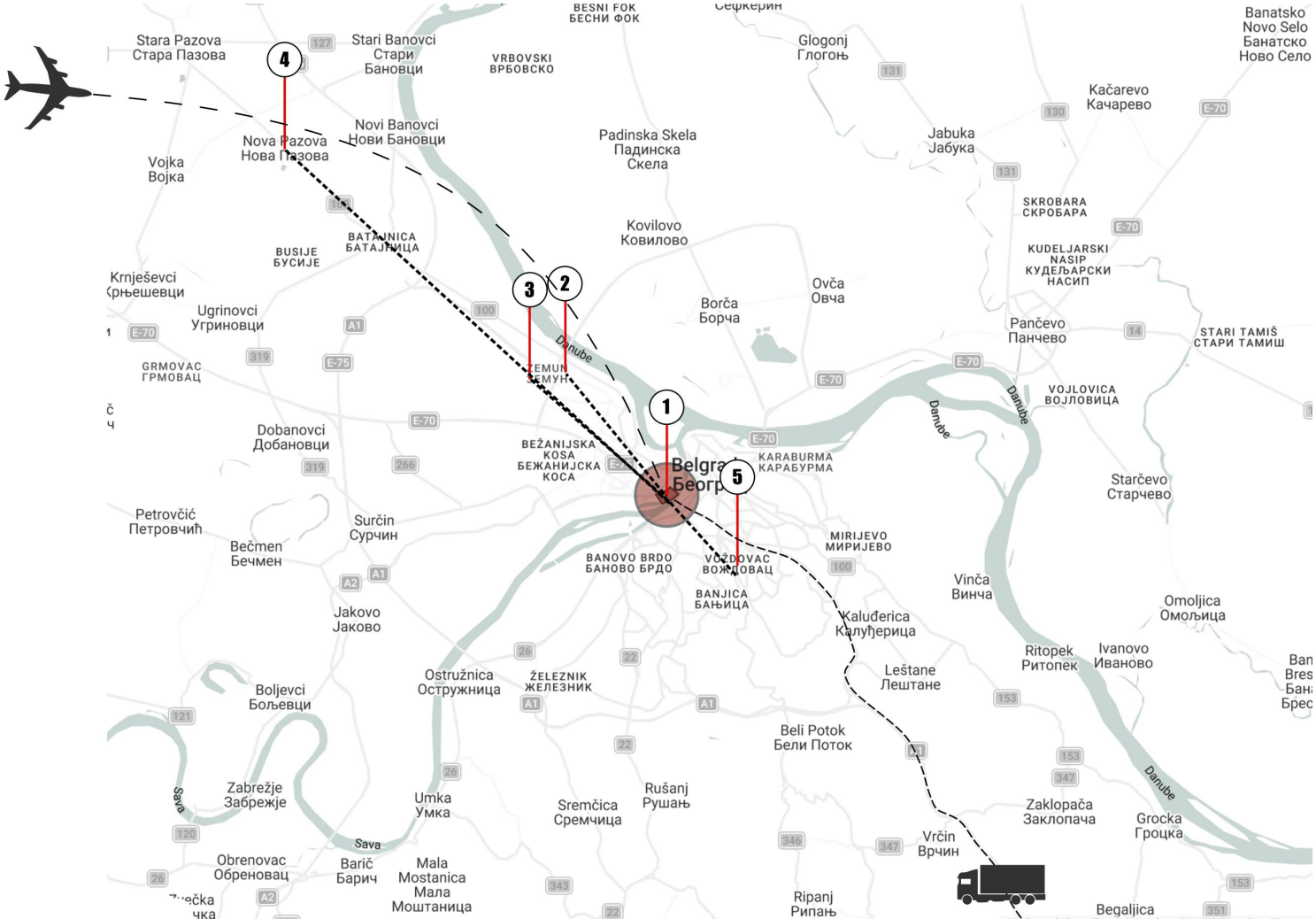
- Saint-Gobain Isover & Rigips

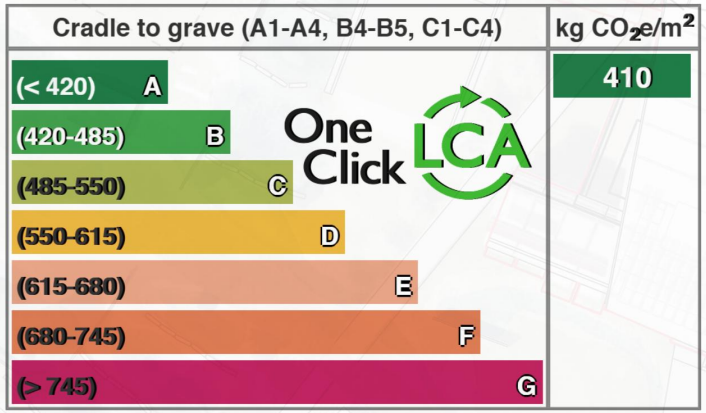
PROJATE

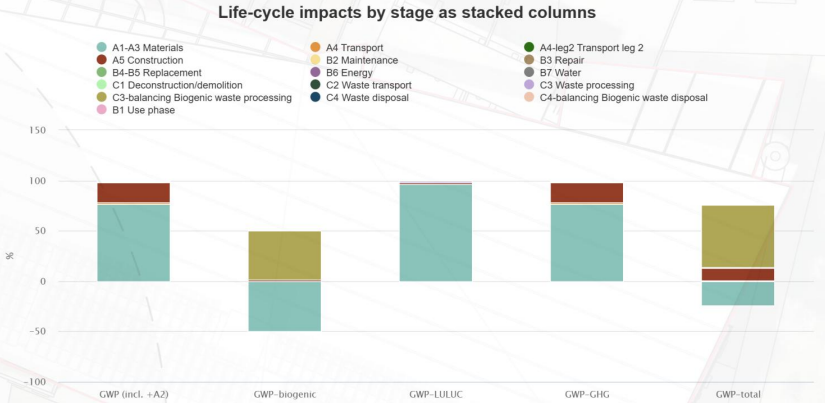
- CLT Timber
- Saint-Gobain Leca
- Saint-Gobain Weber Adhesives

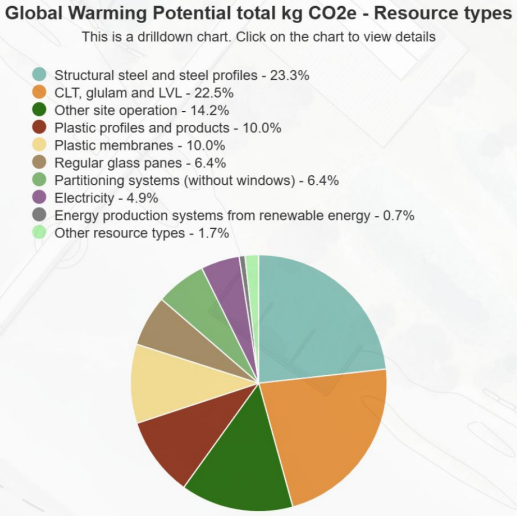
[DE]

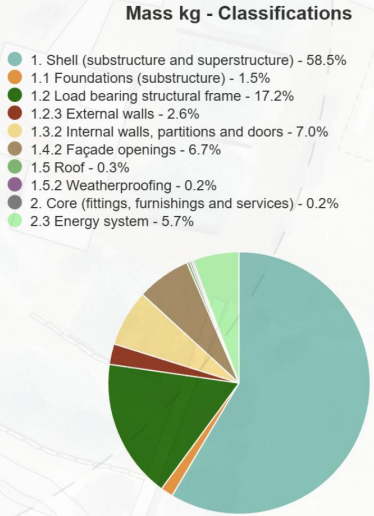
- ETFE Skin
- Vacupad Insulation

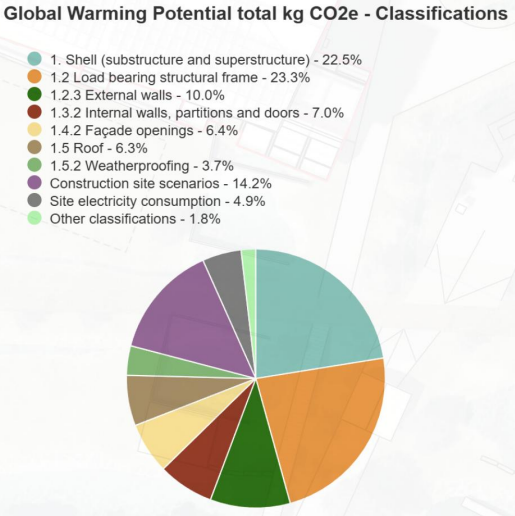



Cradle to grave (A1-A4, B4-B5, C1-C4)
kg CO2e/m2
410
(< 420) A
(420-485) B
(485-550) C
(550-615) D
(615-680) E
(680-745) F
(> 745) G
One Click LCA


Life-cycle impacts by stage as stacked columns
A1-A3 Materials
A4 Transport
A4-leg2 Transport leg 2
A5 Construction
B2 Maintenance
B3 Repair
B4-B5 Replacement
B6 Energy
B7 Water
C1 Deconstruction/demolition
C2 Waste transport
C3 Waste processing
C3-balancing Biogenic waste processing
C4 Waste disposal
C4-balancing Biogenic waste disposal
B1 Use phase
150
100
50
0
-50
-100
%
GWP (incl. +A2)
GWP-biogenic
GWP-LULUC
GWP-GHG
GWP-total


Global Warming Potential total kg CO2e - Resource types
This is a drilldown chart. Click on the chart to view details
Structural steel and steel profiles - 23.3%
CLT, glulam and LVL - 22.5%
Other site operation - 14.2%
Plastic profiles and products - 10.0%
Plastic membranes - 10.0%
Regular glass panes - 6.4%
Partitioning systems (without windows) - 6.4%
Electricity - 4.9%
Energy production systems from renewable energy - 0.7%
Other resource types - 1.7%


Mass kg - Classifications
1. Shell (substructure and superstructure) - 58.5%
1.1 Foundations (substructure) - 1.5%
1.2 Load bearing structural frame - 17.2%
1.2.3 External walls - 2.6%
1.3.2 Internal walls, partitions and doors - 7.0%
1.4.2 Façade openings - 6.7%
1.5 Roof - 0.3%
1.5.2 Weatherproofing - 0.2%
2. Core (fittings, furnishings and services) - 0.2%
2.3 Energy system - 5.7%


Global Warming Potential total kg CO2e - Classifications
1. Shell (substructure and superstructure) - 22.5%
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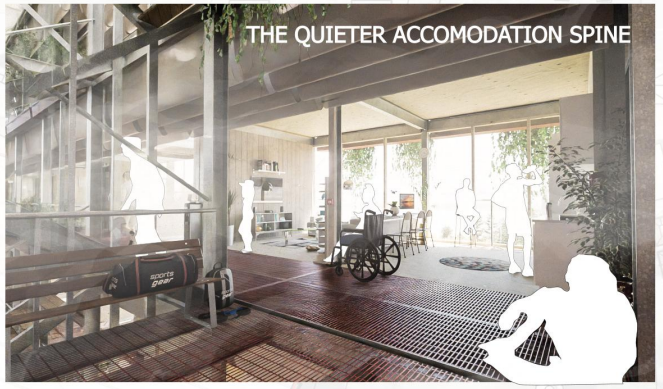
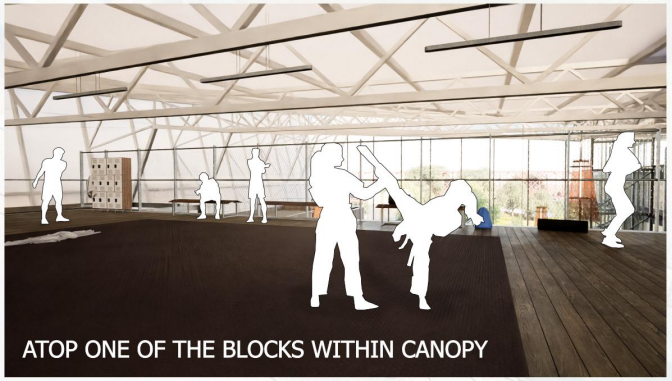
1.2.3 External walls - 10.0%
1.3.2 Internal walls, partitions and doors - 7.0%
1.4.2 Façade openings - 6.4%
1.5 Roof - 6.3%
1.5.2 Weatherproofing - 3.7%
Construction site scenarios - 14.2%
Site electricity consumption - 4.9%
Other classifications - 1.8%


HILL CLIMB TRAINING RAMP


THE QUIETER ACCOMODATION SPINE


ADAPTIVE REUSE AND BIOPHILIA


SPORTS FIELD "ISLAND"


ATOP ONE OF THE BLOCKS WITHIN CANOPY


THE RENEWED BRIDGE

03 | STRUJA

Yacht Club Renovation

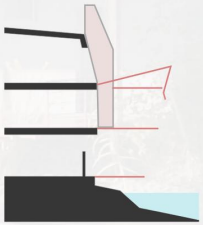
INTRODUCTION TO "STRUJA"

Moving to the water's edge, we confront the site's deepest environmental wounds. The Sava River floods aggressively, depositing heavy plastic pollution along the banks. Instead of fighting this, Struja embraces it. We designed a permeable ground plane that yields to seasonal surges, utilizing external walkways cast entirely from recycled river and ocean plastics.

Operating as a lightweight, parasitic intervention, we retain the existing concrete host. We clip on a dynamic exoskeleton of reclaimed steel using reversible bolted connections, transforming the static ruin into a vibrant civic anchor with a public cafe, athlete gym, and repair workshops.

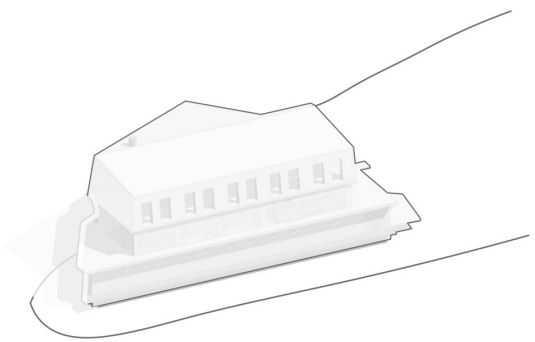
To achieve our strict 'A' rating of 332 kilograms of embodied carbon, the pavilion operates as a highly tuned climatic machine. We combat 125 kilometer-per-hour Kosava winds using micro-porous PTFE baffles, synergized with a solar updraft shaft for passive thermal exhaust. / For energy, submerged micro-hydrokinetic turbines and a closed-loop Water-Source Heat Pump extract relentless thermal mass directly from the river.

To ensure continuous winter operation, the primary ETFE canopy integrates active structural trace heating, safely routing harvested water into a subterranean thermal reservoir. / Finally, Struja is engineered exclusively for Design for Disassembly. By eliminating destructive welds, the entire pavilion can be cleanly unbolted, salvaged, and repurposed, delivering a true net-positive lifecycle for the city of Belgrade.



MORPHOLOGICAL DIAGRAMS

1

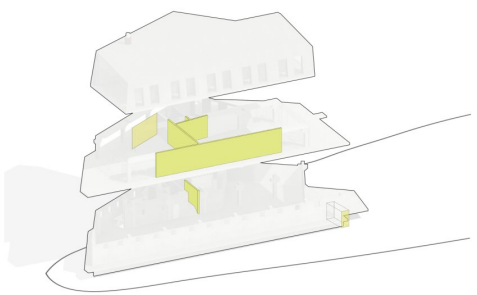


THE HOST

The intervention begins by adopting the existing building mass as the primary structural host.

Retaining this monolithic foundation
anchors the project to its historical context while instantly neutralizing the massive embodied carbon cost associated with new groundwork.

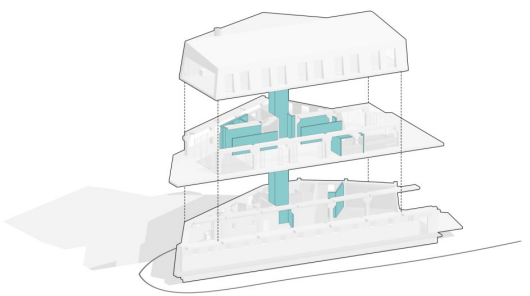
2



SUBTRACT

Strategic subtraction strips away obsolete interior partitions and restrictive barriers.
This targeted clearing opens the internal floor
plates, maximizing natural cross-ventilation paths and preparing the host for a highly flexible, open-plan layout.

3



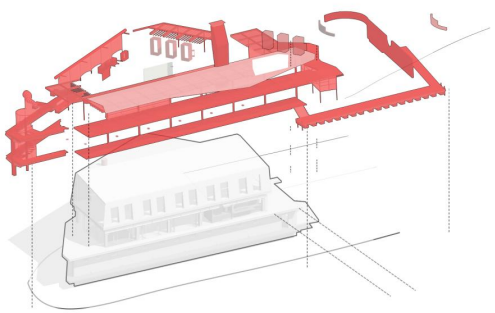
INSERTION

A consolidated circulation and service core is precisely inserted into the newly cleared volume.

This centralized engine houses essential
mechanical routing and vertical movement, acting as the functional spine of the building.

4

Design for Disassembly

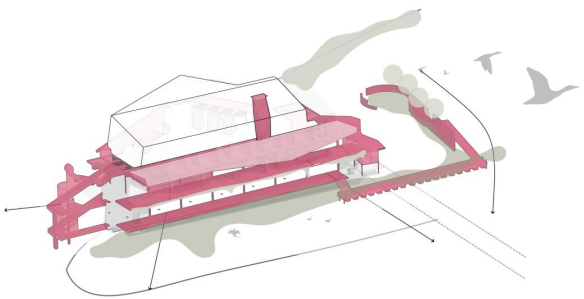


CLIP ON

Operating under a strict Design for Disassembly (DfD) framework, a lightweight exoskeleton of reclaimed steel and recycled polymers is mechanically clipped onto the host.

Utilizing reversible bolted connections,
this dynamic wrapper provides external circulation without destructive, permanent welds

5



CIVIC HABITAT

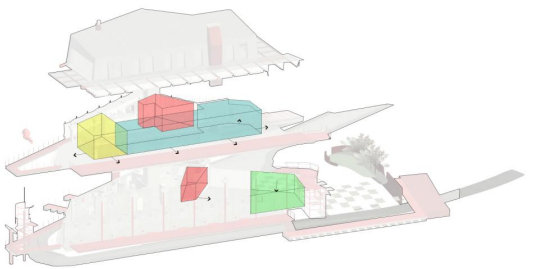
Rather than resisting the river's natural cycles, the architecture embraces them. The permeable ground plane intentionally yields to the Sava River, accommodating seasonal flooding without structural compromise.

To ensure rapid programmatic recovery, engineered scupper drains are integrated into the slab, accelerating water dispersion and immediately returning the civic ground to the public the moment the floodwaters recede

red steel & plastic exoskeleton

ecologocal integration

6



CIVIC ACTIVATION

With the climatic and structural engines established, the volume is injected with targeted civic programming.

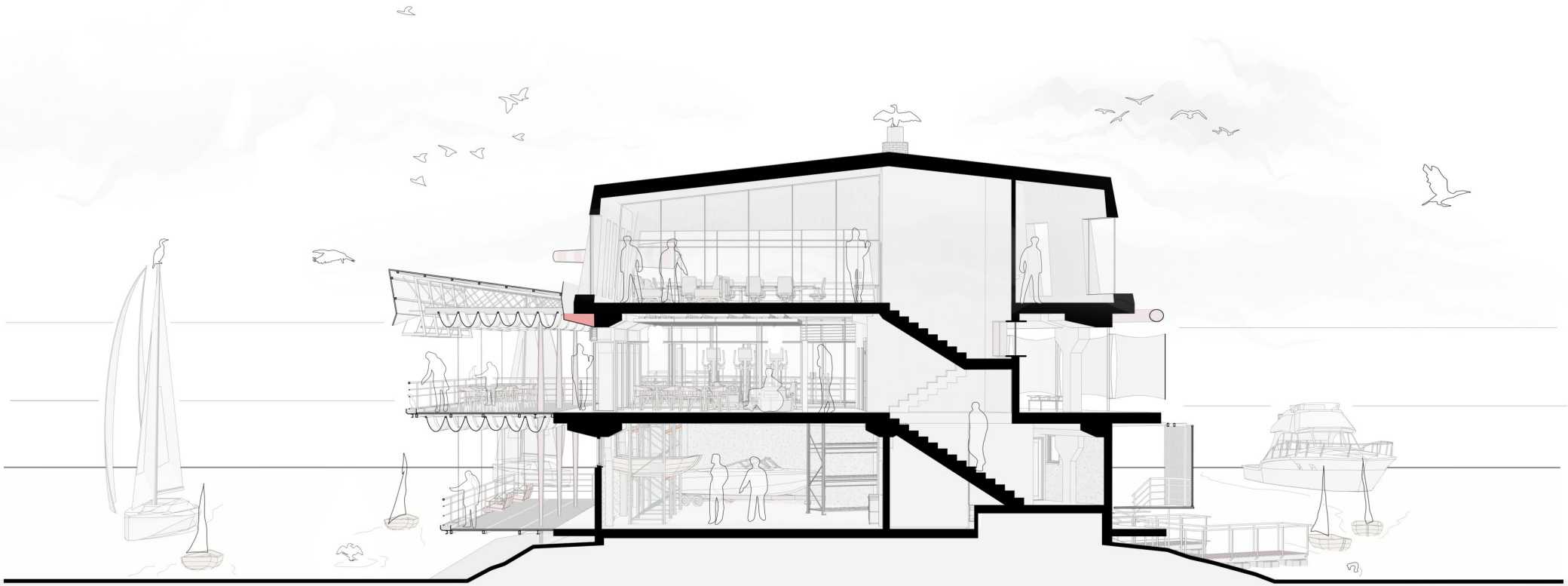
The public cafe, elite athlete gym, and tactical repair workshops plug seamlessly into the matrix, transforming the static host into a vibrant social anchor

meeting space

public cafe

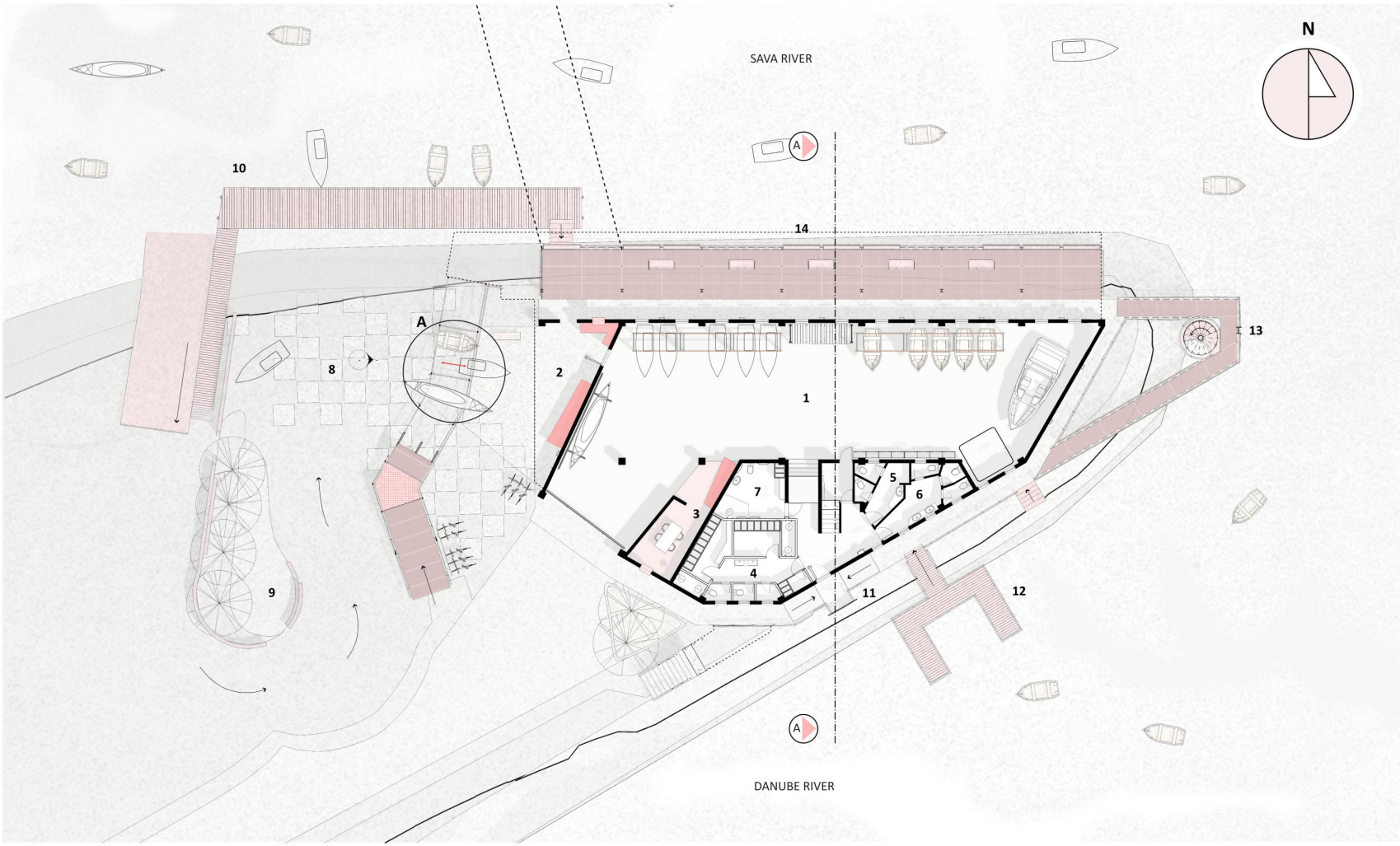
athlete gym

repair workshop



PERSPECTIVE SECTION

0 1 2 3 4 5 10 m

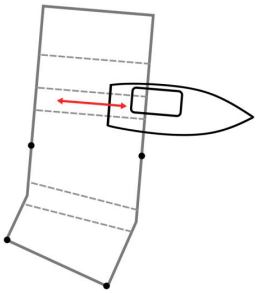


GROUND FLOOR

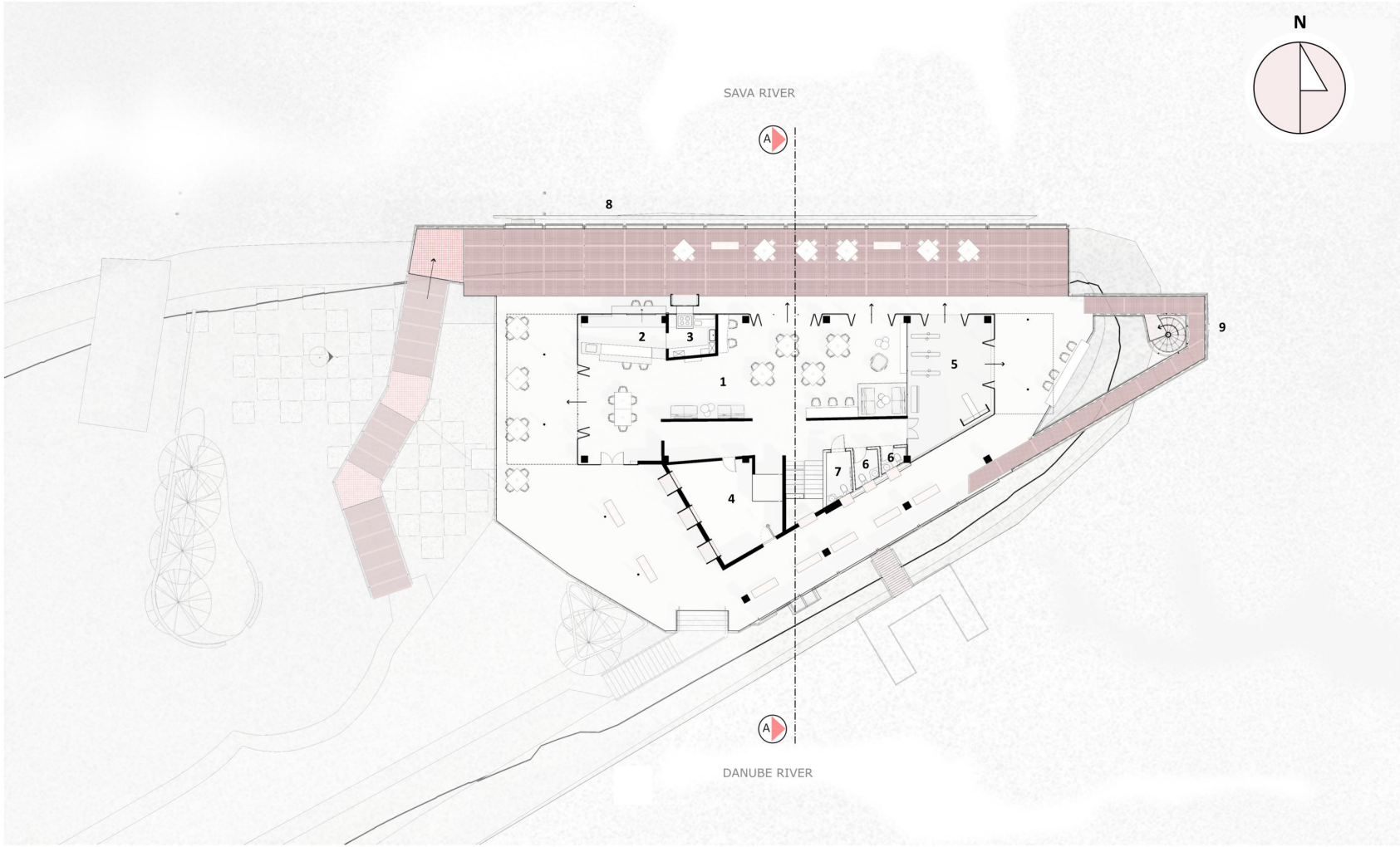
0 1 2 3 4 5 10 m

1. Primary Aquatic Storage Hall
2. External Sailboat & Cycle Repair Workshop
3. Meeting & Kitchenette
4. Shower Rooms
5. Male Ablutions
6. Female Ablutions
7. Universal ADA Facility
8. Deployment Zone
9. Ecological Transit Terrace
10. Deployment Pontoon
11. Wetsuit Drying Wall
12. Angler's Pier / Fisherman Dock
13. Wind Sock & Ascent Ramp
14. Observation Promenade & Judging Promontory

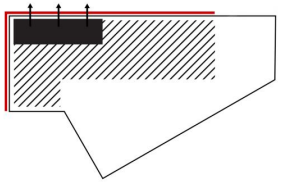
A



The ramp scaffolding doubles as a structural cradle system, providing a secure, elevated framework where sailboats can be dry-docked and stabilized for specialized hull repairs and maintenance.



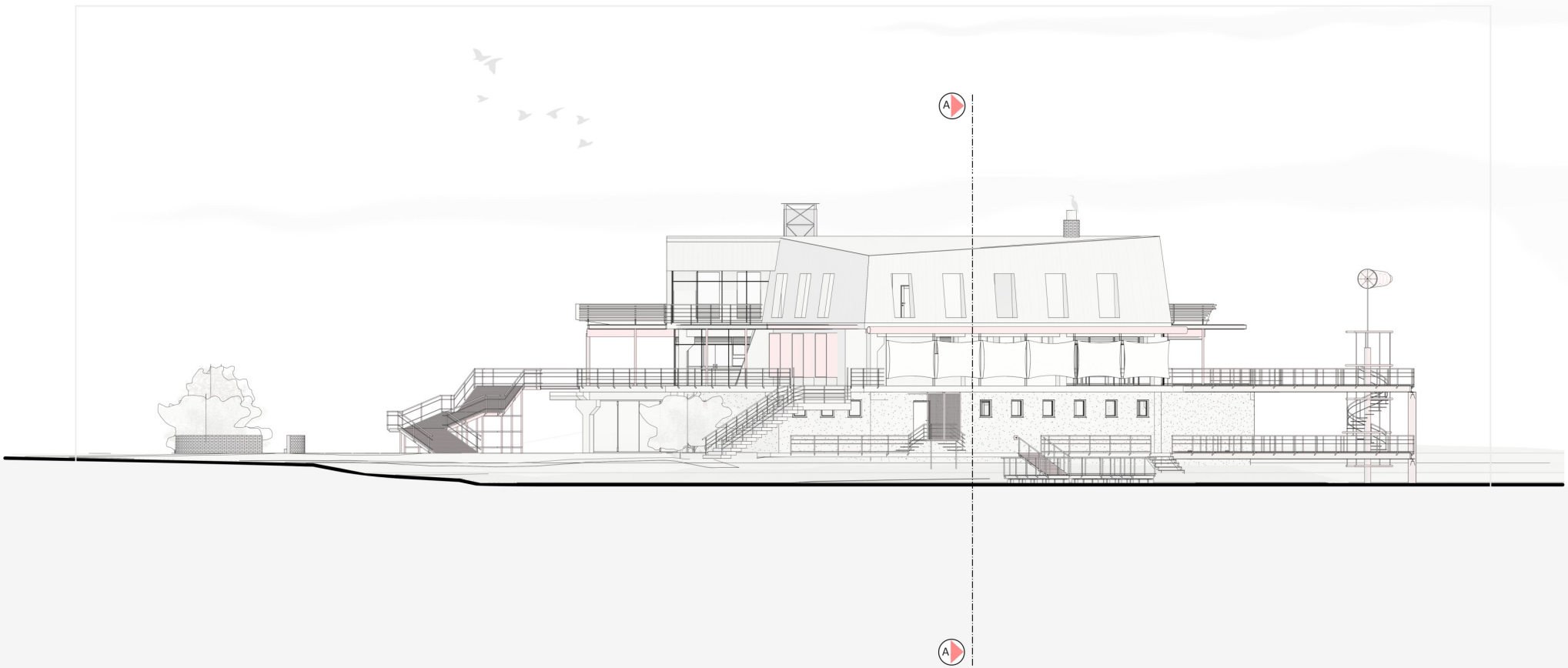
1. Cafe & Health Bar
2. Serving Hatch
3. Kitchen
4. Meeting/monitoring space
5. Athletes Gym
6. Ablutions
7. Universal ADA Facility
8. Observation Promenade
9. Wind Sock & Ascent Ramp



Inside, the entire first-floor café utilizes retractable partitions to transform into a private, expansive meeting hall, while an integrated corner serving hatch allows the exterior deck to continue functioning as an active café for outdoor patrons.

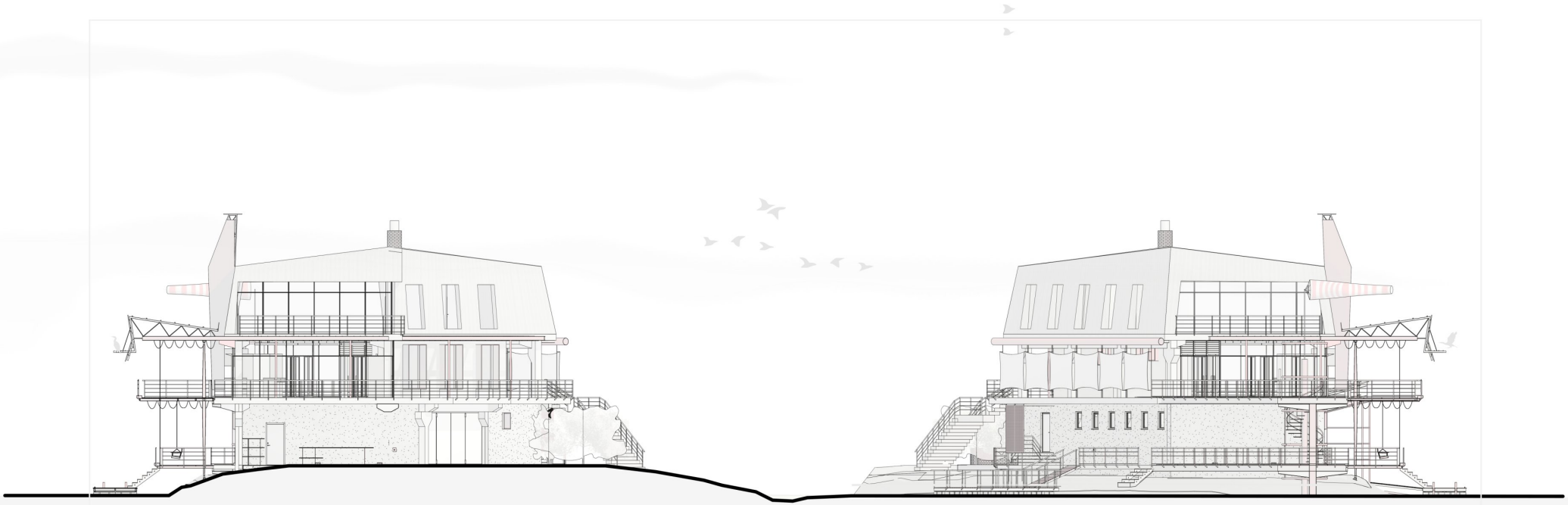
FIRST FLOOR

0 1 2 3 4 5 10 m



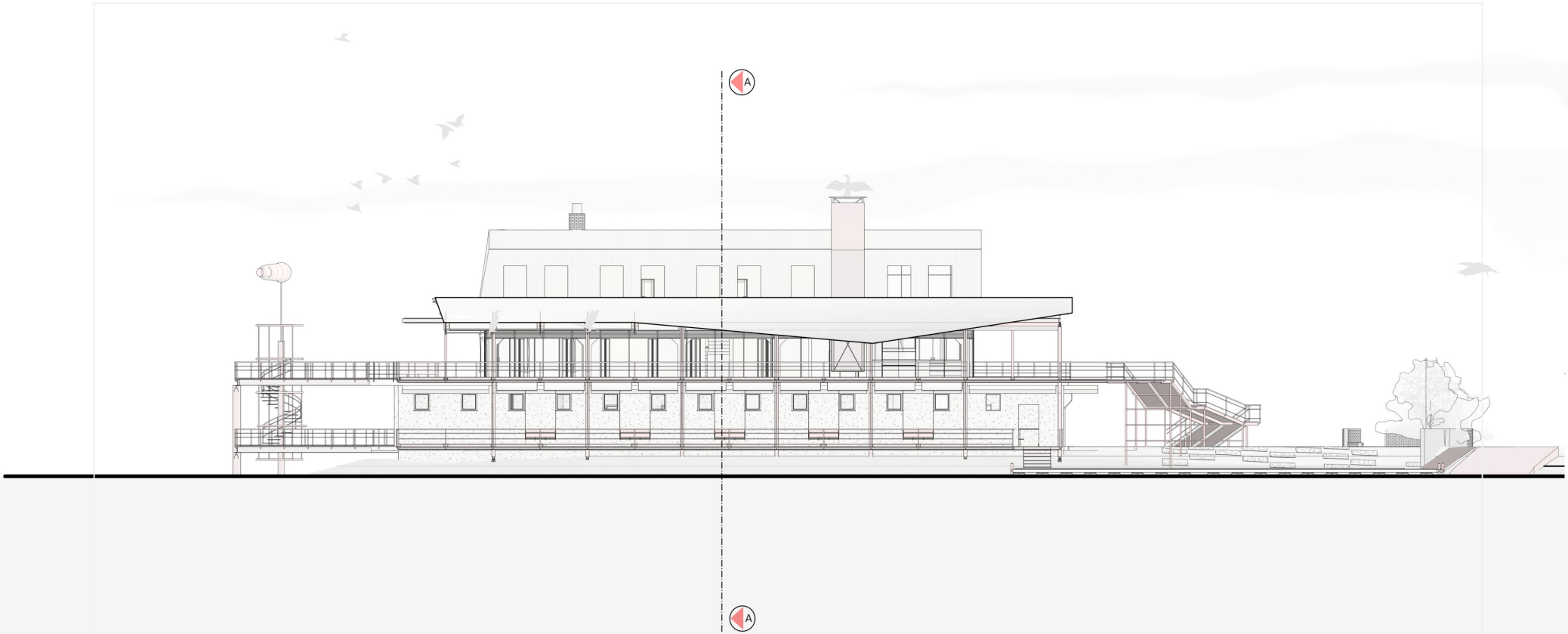
SOUTH ELEVATION

0 1 2 3 4 5 10 m



s ELEVATION

0 1 2 3 4 5 10 m

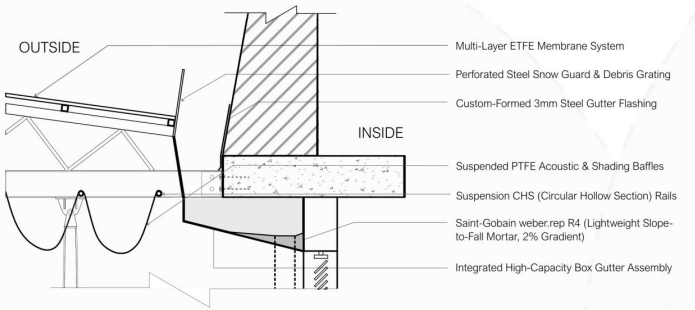


NORTH ELEVATION

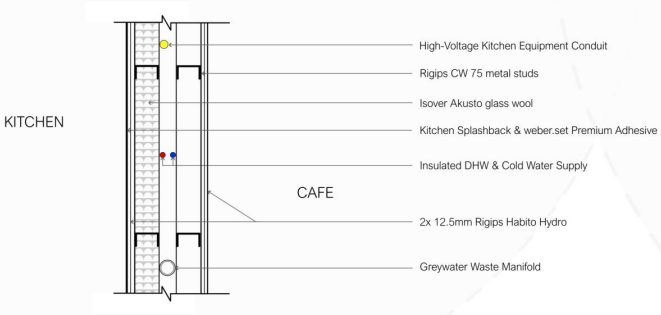
0 1 2 3 4 5 10 m

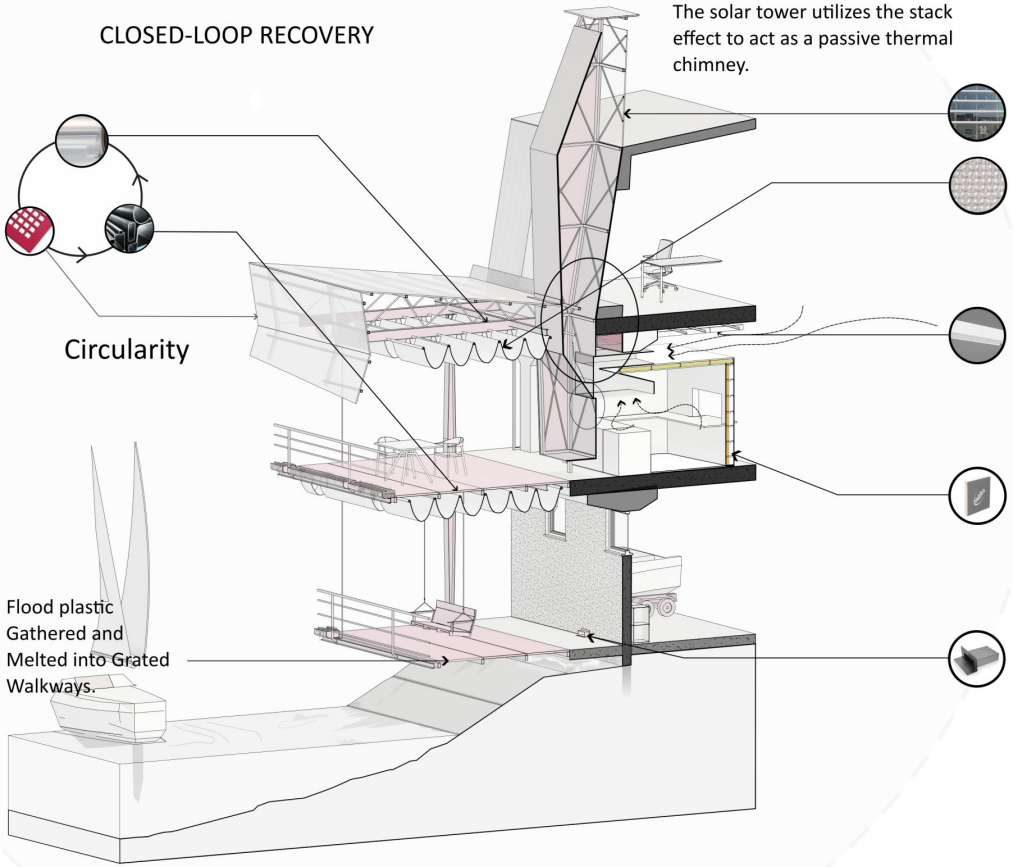
DISSECTING THE PART WALL

DETAIL A

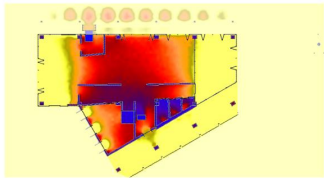


DETAIL B





VENTILATION AND DAYLIGHT



Solar Updraft Shaft

VENTILATION STRATEGY

Harnessing the extreme 125 km/h Kosava winds, the primary facade employs a Micro-Porous PTFE Baffle to diffuse peak gusts into a controlled, low-velocity cross-breeze. This transverse airflow perfectly synergizes with the passive Solar Updraft Shaft, establishing a continuous thermal chimney effect that rapidly exhausts high internal heat gains without requiring mechanical intervention, strictly preserving the 'A' rating carbon budget.

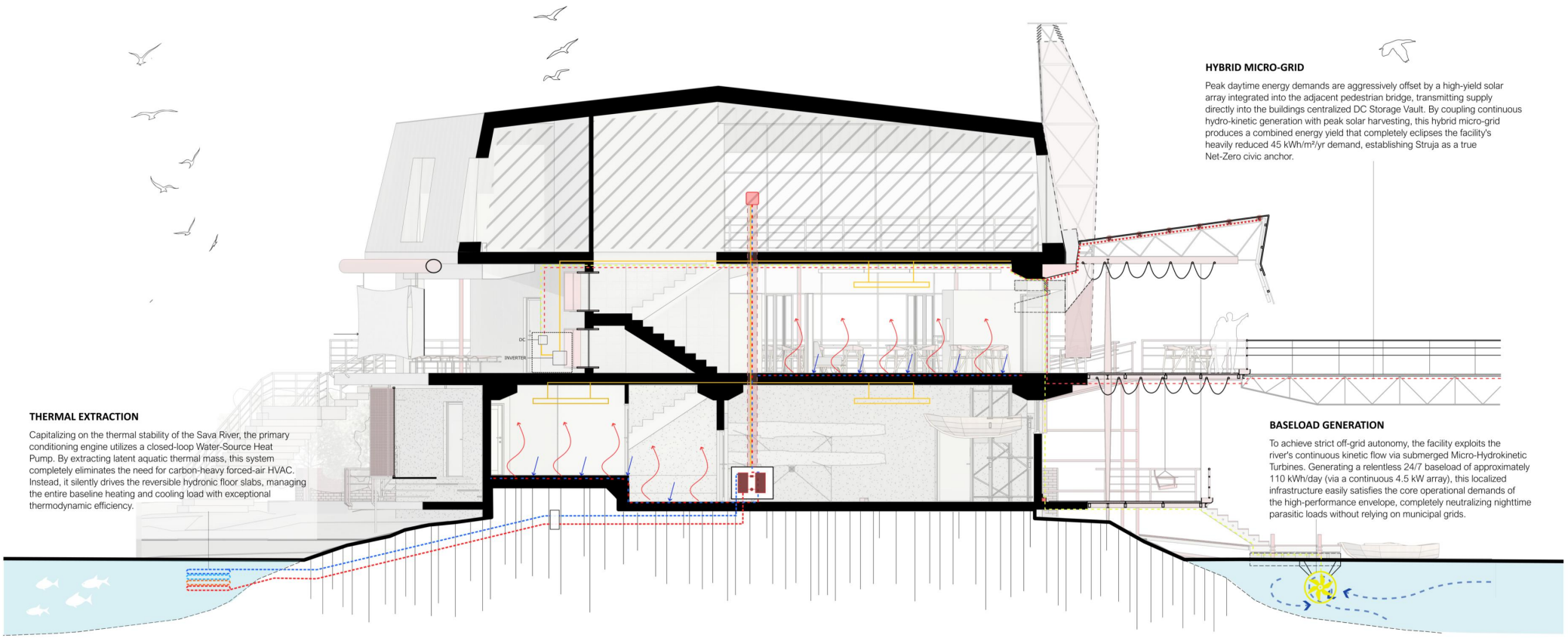
DAYLIGHTING STRATEGY

Deep structural overhangs and suspended canopy baffles operate as a dynamic environmental filter, actively mitigating harsh solar heat gain during peak summer months to prevent interior overheating. Conversely, the calibrated geometry permits deep penetration of low-angle winter sunlight, maximizing natural luminous efficacy while passively charging the interior thermal mass to drastically reduce baseline heating demands.

Kosava Peak Gust ~ 125 km/h

Micro-Porous PTFE Baffle

ENERGY EFFIECIENCY



HYBRID MICRO-GRID

Peak daytime energy demands are aggressively offset by a high-yield solar array integrated into the adjacent pedestrian bridge, transmitting supply directly into the buildings centralized DC Storage Vault. By coupling continuous hydro-kinetic generation with peak solar harvesting, this hybrid micro-grid produces a combined energy yield that completely eclipses the facility's heavily reduced 45 kWh/m²/yr demand, establishing Struja as a true Net-Zero civic anchor.

THERMAL EXTRACTION

Capitalizing on the thermal stability of the Sava River, the primary conditioning engine utilizes a closed-loop Water-Source Heat Pump. By extracting latent aquatic thermal mass, this system completely eliminates the need for carbon-heavy forced-air HVAC. Instead, it silently drives the reversible hydronic floor slabs, managing the entire baseline heating and cooling load with exceptional thermodynamic efficiency.

BASELOAD GENERATION

To achieve strict off-grid autonomy, the facility exploits the river's continuous kinetic flow via submerged Micro-Hydrokinetic Turbines. Generating a relentless 24/7 baseload of approximately 110 kWh/day (via a continuous 4.5 kW array), this localized infrastructure easily satisfies the core operational demands of the high-performance envelope, completely neutralizing nighttime parasitic loads without relying on municipal grids.

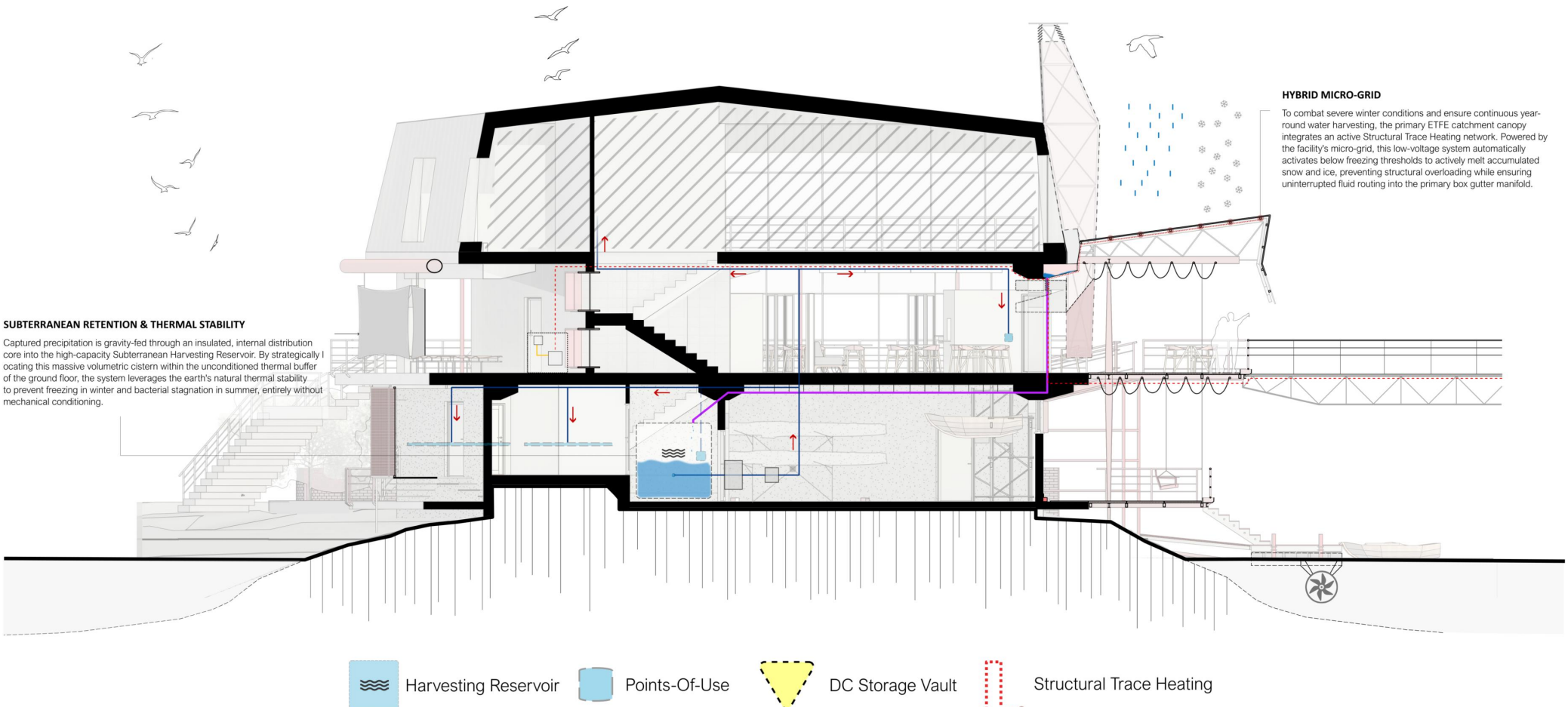
Water-Source Heat Pump

DC Storage Vault

Micro-Hydrokinetic Turbines

Bridge Solar AC Supply

WATER DIAGRAM



SUBTERRANEAN RETENTION & THERMAL STABILITY

Captured precipitation is gravity-fed through an insulated, internal distribution core into the high-capacity Subterranean Harvesting Reservoir. By strategically l ocating this massive volumetric cistern within the unconditioned thermal buffer of the ground floor, the system leverages the earth's natural thermal stability to prevent freezing in winter and bacterial stagnation in summer, entirely without mechanical conditioning.

HYBRID MICRO-GRID

To combat severe winter conditions and ensure continuous year-round water harvesting, the primary ETFE catchment canopy integrates an active Structural Trace Heating network. Powered by the facility's micro-grid, this low-voltage system automatically activates below freezing thresholds to actively melt accumulated snow and ice, preventing structural overloading while ensuring uninterrupted fluid routing into the primary box gutter manifold.

Harvesting Reservoir

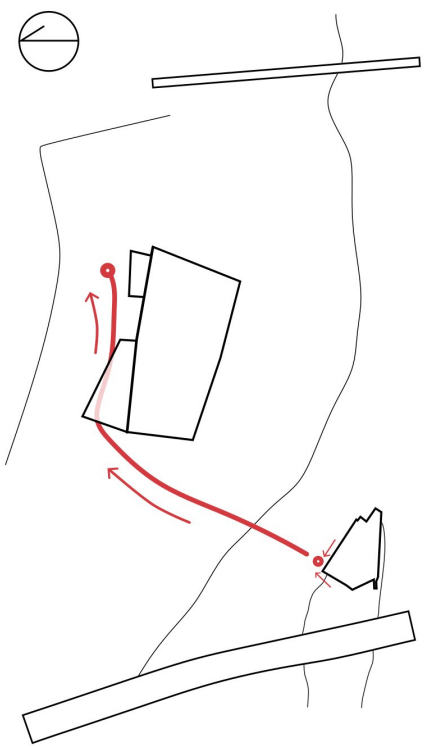
Points-Of-Use

DC Storage Vault

Structural Trace Heating

URBAN CONNECTIVITY

The Ozon-Yacht Club Link



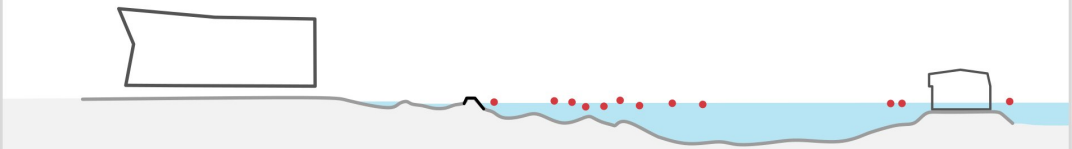
The Riverfront Axis

Connecting the primary high-tech athlete residence to the active waterfront club via a unified civic pathway.

MATERIAL REMEDIATION

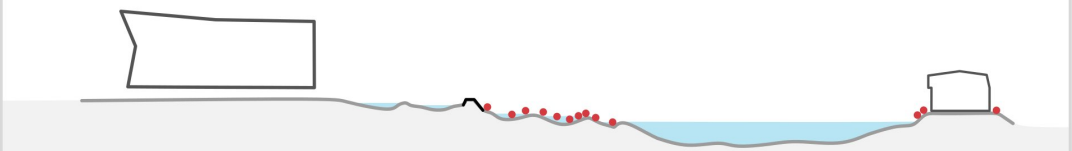
Flood-Harvested Plastic

① The Flood



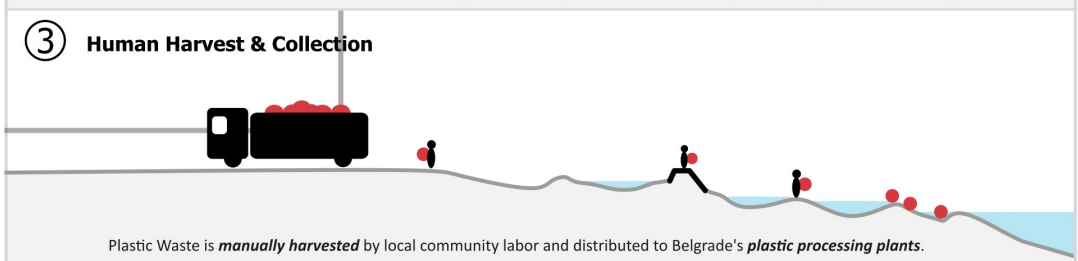
Seasonal overflowing of the Sava River dumps raw ***plastic debris*** along the site's edges.

② Plastic Deposit



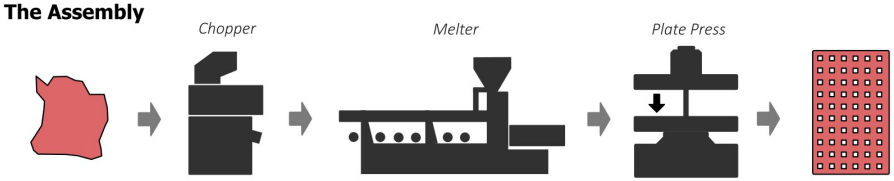
As the floodwaters recede, concentrated layers of chaotic plastic debris are left ***deposited along the riverbank*** edges.

③ Human Harvest & Collection



Plastic Waste is ***manually harvested*** by local community labor and distributed to Belgrade's ***plastic processing plants***.

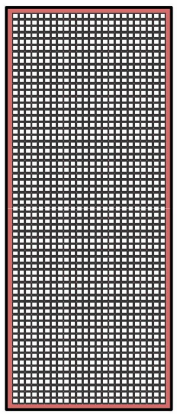
④ The Assembly



Industrial plants thermally extrude the harvested plastics before compression pressing them into dense, ***structural cladding panels***.

ENGINEERED TECTONICS

Plastic Panel Cladding



Panel Specifications:

Material: Recycled High-Density Plastic

Length: 2400 mm

Width: 1200 mm

Depth (Thickness): 38 mm

Perforation Profile: 31 mm x 31 mm Square Aperture

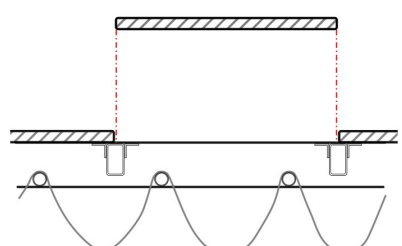
Perforation Spacing: 38 mm (Center-to-Center)

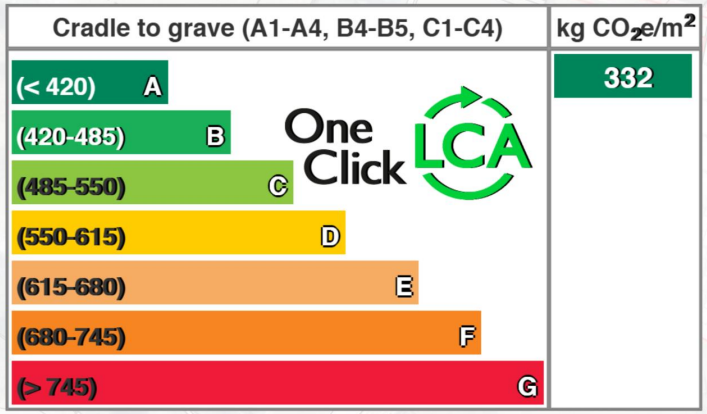
MATERIAL FINISH & ECOLOGY

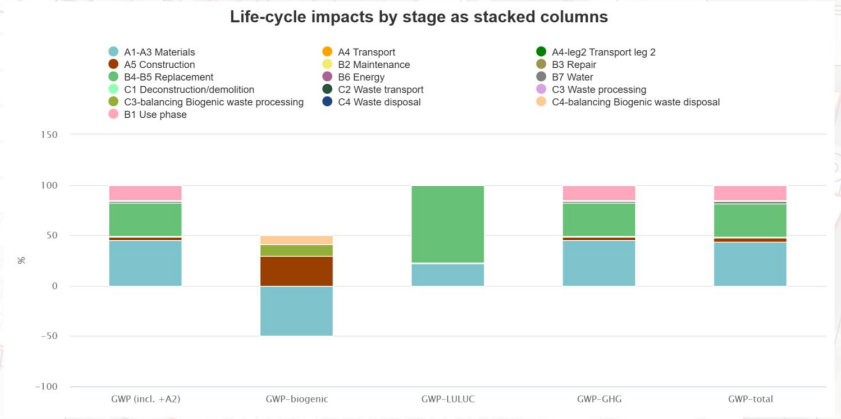
Surface: Mechanically sand-blasted to achieve a high-friction, tactile architectural finish.
Matrix: The recycled plastic is bound with an inert UV-stabilizing additive to prevent microplastic shedding and ensure zero ecological toxicity to the Sava River.

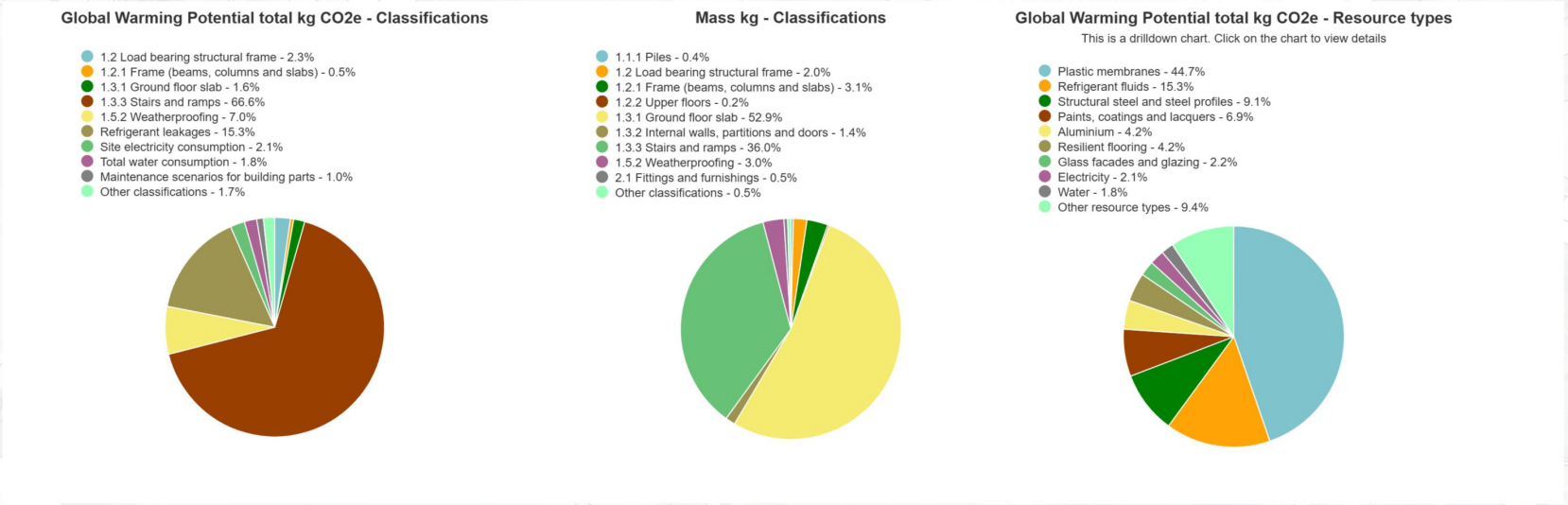
DRY-BOLTED CLADDING

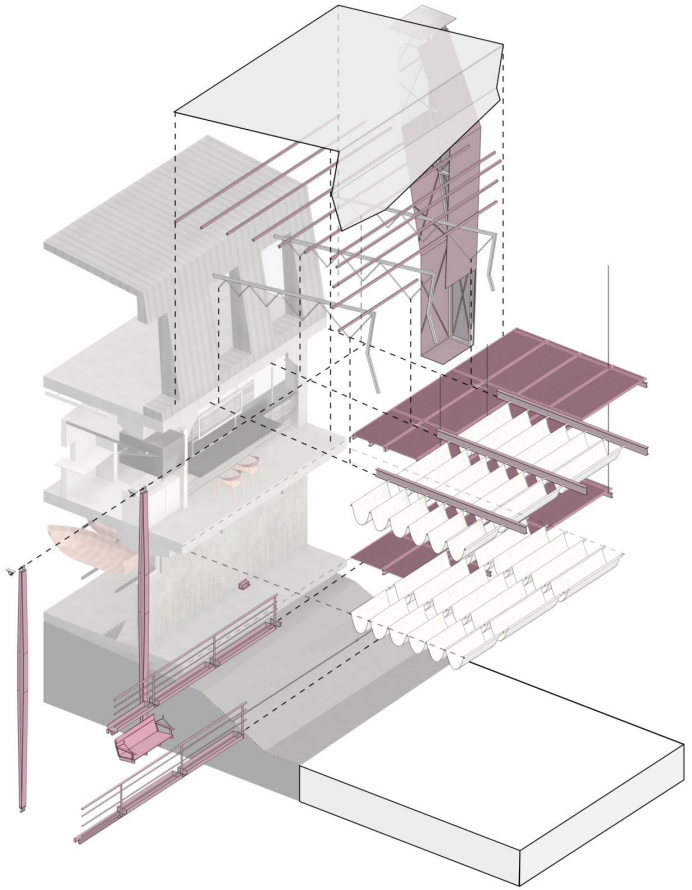
The 38mm plastic panels are dry-bolted to aluminium edge-angles and mechanically anchored through the steel decking into structural joists.




Cradle to grave (A1-A4, B4-B5, C1-C4)
kg CO_2e/m^2
332
(< 420) A
(420-485) B
(485-550) C
(550-615) D
(615-680) E
(680-745) F
(> 745) G
One Click LCA


Life-cycle impacts by stage as stacked columns
A1-A3 Materials
A4 Transport
A4-leg2 Transport leg 2
A5 Construction
B2 Maintenance
B3 Repair
B4-B5 Replacement
B6 Energy
B7 Water
C1 Deconstruction/demolition
C2 Waste transport
C3 Waste processing
C3-balancing Biogenic waste processing
C4 Waste disposal
C4-balancing Biogenic waste disposal
B1 Use phase
150
100
50
0
-50
-100
%
GWP (incl. +A2)
GWP-biogenic
GWP-LULUC
GWP-GHG
GWP-total


Global Warming Potential total kg CO2e - Classifications
1.2 Load bearing structural frame - 2.3%
1.2.1 Frame (beams, columns and slabs) - 0.5%
1.3.1 Ground floor slab - 1.6%
1.3.3 Stairs and ramps - 66.6%
1.5.2 Weatherproofing - 7.0%
Refrigerant leakages - 15.3%
Site electricity consumption - 2.1%
Total water consumption - 1.8%
Maintenance scenarios for building parts - 1.0%
Other classifications - 1.7%
Mass kg - Classifications
1.1.1 Piles - 0.4%
1.2 Load bearing structural frame - 2.0%
1.2.1 Frame (beams, columns and slabs) - 3.1%
1.2.2 Upper floors - 0.2%
1.3.1 Ground floor slab - 52.9%
1.3.2 Internal walls, partitions and doors - 1.4%
1.3.3 Stairs and ramps - 36.0%
1.5.2 Weatherproofing - 3.0%
2.1 Fittings and furnishings - 0.5%
Other classifications - 0.5%
Global Warming Potential total kg CO2e - Resource types
This is a drilldown chart. Click on the chart to view details
Plastic membranes - 44.7%
Refrigerant fluids - 15.3%
Structural steel and steel profiles - 9.1%
Paints, coatings and lacquers - 6.9%
Aluminium - 4.2%
Resilient flooring - 4.2%
Glass facades and glazing - 2.2%
Electricity - 2.1%
Water - 1.8%
Other resource types - 9.4%

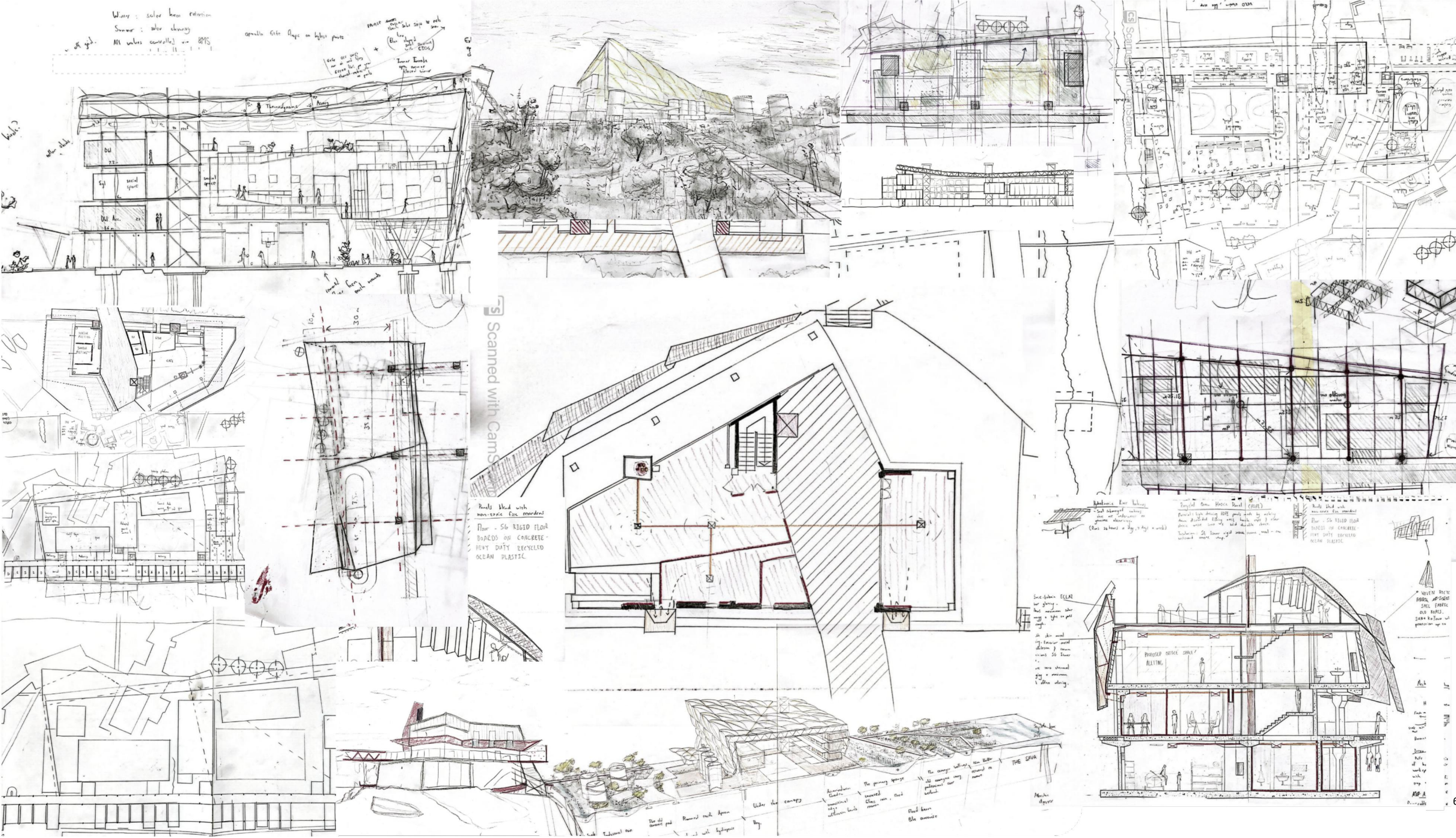


Engineered exclusively with reversible bolted connections and articulated pin-joints, the canopy operates on a strict Design for Disassembly (DfD) framework. This eliminates destructive demolition, allowing the structural steel and ETFE membranes to be cleanly unbolted, salvaged, and repurposed at the end of the building's lifecycle. By ensuring complete material recovery rather than landfill waste, the assembly radically offsets its initial embodied carbon, delivering a highly optimized, net-positive lifecycle footprint

DESIGN FOR DISASSEMBLY

This work is based on the research supported wholly or in part by the Nelson Mandela University Postgraduate Scholarship. The Nelson Mandela University's Office of Research Development accepts no responsibility for the contents of this publication.

The architectural concepts, design outputs, and core arguments presented in this project are entirely our own original work. Artificial intelligence tools were utilized exclusively for grammatical copyediting and the structural refinement of text.


Winter : solar heat retention
Summer : solar chimney
All values controlled via BMS
Panels blend with non-toxic fire retardants
Floor - SG RIGID FLOOR BOARDS ON CONCRETE - HEVY DUTY RECYCLED OCEAN PLASTIC
THE SAVA

DECLARATION OF IMAGE SOURCES

AeroExpo Saint-Gobain Performance Plastics Specialty Films. Available at: https://www.aeroexpo.online/prod/saint-gobain-performance-plastics-specialty-films/product-170459-20584.html (Accessed: 13 May 2026).

Alamy (2022) Rear Entrance of Ataturk Cultural Center. Available at: https://www.alamy.com/istanbul-turkey-september-2-2022-rear-entrance-of-ataturk-cultural-center-or-ataturk-kultur-merkezi-abbreviated-akm-a-concert-hall-theatre-and-cultural-centre-located-on-taksim-square-beyoglu-image515591090.html (Accessed: 13 May 2026).

Allproof Industries Stainless Steel Scupper. Available at: https://allproof.co.nz/product/stainless-steel-scupper/ (Accessed: 13 May 2026).

Apex Polymers Multiwall Polycarbonate Sheets. Available at: https://apexpolymers.co.za/product/multiwall/ (Accessed: 13 May 2026).

ArchDaily AD Classics: Centre Georges Pompidou / Renzo Piano + Richard Rogers. Available at: https://www.archdaily.com/64028/ad-classics-centre-georges-pompidou-renzo-piano-richard-rogers (Accessed: 13 May 2026).

Archiproducts Saint-Gobain Isover Glass Wool Thermal Insulation Felt. Available at: https://www.archiproducts.com/en/products/saint-gobain-isover/glass-wool-thermal-insulation-felt-sound-insulation-felt-isover-ibr-n-4_136305 (Accessed: 13 May 2026).

Bouwkampioen Isover Multimax 30. Available at: https://www.bouwkampioen.be/nl/isover-multimax-30-120.html (Accessed: 13 May 2026).

Budapest By Locals Budapest Whale (Bálna). Available at: https://www.budapestbylocals.com/budapest-whale/ (Accessed: 13 May 2026).

Chamberlains Duroplastic 6mm Clear Multiwall Sheet. Available at: https://www.chamberlains.co.za/duroplastic-6mm-clear-multiwall-sheet-2900-x-1050mm-1074675 (Accessed: 13 May 2026).

CM Metals The Atomium: An Icon of Sustainable Architecture. Available at: https://www.cmmetalsnj.com/post/the-atomium-an-icon-of-sustainable-architecture (Accessed: 13 May 2026).

Dongfu Mesh Punching Hole Plastic PVC Coated Aluminum Perforated Metal Sheet. Available at: https://dongfumesh.en.made-in-china.com/product/SmspUDzPHZcT/China-Punching-Hole-Plastic-PVC-Coated-Aluminum-Perforated-Metal-Sheet-for-Decoration.html (Accessed: 13 May 2026).

Ecophon Solo Baffle Free-Hanging Units. Available at: https://www.ecophon.com/en/products/free-hanging-units-and-baffles/solo/solo-baffle/ (Accessed: 13 May 2026).

Flora of the Southeastern United States [FSUS] Taxon Detail: 2251. Available at: https://fsus.ncbg.unc.edu/show-taxon-detail.php?taxonid=2251 (Accessed: 13 May 2026).

Gardenia Salix alba 'Tristis' (Weeping Willow). Available at: https://www.gardenia.net/plant/salix-alba-tristis (Accessed: 13 May 2026).

Gardenia Typha latifolia (Broadleaf Cattail). Available at: https://www.gardenia.net/plant/typha-latifolia (Accessed: 13 May 2026).

Go Botany Festuca rubra. Available at: https://gobotany.nativeplanttrust.org/species/festuca/rubra/ (Accessed: 13 May 2026).

Isover CZ Isover Vario XtraSafe. Available at: https://www.isover.cz/en/products/doplnky/isover-vario-xtrasafe (Accessed: 13 May 2026).

MM-Holz CLT Cross Laminated Timber. Available at: https://www.mm-holz.com/en/products/clt-cross-laminated-timber (Accessed: 13 May 2026).

P12 Referenzen Isover Vacupad 007. Available at: https://www.p12.de/referenzen/isover-vacupad-007-minimaler-raumverlust-maximale-daemmleistung/ (Accessed: 13 May 2026).

Pavement Materials 6mm-9mm Crushed Stone Aggregate. Available at: https://www.pavementmaterials.co.za/products/6mm-9mm-crushed-stone-aggregate-8-ton-brown (Accessed: 13 May 2026).

Rigips Rigidur Floor. Available at: https://www.rigips.de/en/produkte/rigidur-floor (Accessed: 13 May 2026).

Robhar I-Beam IPE AA Steel Section. Available at: https://robhar.co.za/product/i-beam-ipe-aa-steel-section/ (Accessed: 13 May 2026).

Saint-Gobain Weber Barrier Waterproofing Membrane. Available at: https://www.saint-gobain-africa.com/en/products/weber/weber-barrier-waterproofing-membrane (Accessed: 13 May 2026).

Saint-Gobain Glass Eclaz Zen II. Available at: https://www.saint-gobain-glass.be/nl/products/eclaz/eclaz-zen-ii (Accessed: 13 May 2026).

Saint-Gobain Glass Xtreme 61/29 II. Available at: https://www.saint-gobain-glass.com/xtreme-61-29-II (Accessed: 13 May 2026).

Saint-Gobain Gyproc Gyproc Habito. Available at: https://www.saint-gobain-africa.com/en/products/gyproc/gyproc-habitor#marketing-description (Accessed: 13 May 2026).

Saint-Gobain Poland LECA. Available at: https://www.saint-gobain.pl/leca (Accessed: 13 May 2026).

Saint-Gobain Rigips Rigips Duraline Blue DB. Available at: https://www.saint-gobain.rs/proizvodi/rigips/specijalne-ploce/rigips-duraline-blue-db-ploce (Accessed: 13 May 2026).

Saint-Gobain Rigips Rigips Rimano. Available at: https://www.saint-gobain.rs/proizvodi/rigips/mase-za-izravnavanje/rigips-rimano-gipsani-glet (Accessed: 13 May 2026).

Saint-Gobain Tape Solutions ETFE E2 Extruded Films. Available at: https://www.tapesolutions.saint-gobain.com/en-us/products/specialty-films/extruded/etfe/etfe-e2 (Accessed: 13 May 2026).

Scribd (2020) SGG U-GLAS. Available at: https://www.scribd.com/document/489457809/SGG-U-GLAS-pdf (Accessed: 13 May 2026).

Seeds and Plants Growing Yarrow. Available at: http://seedsandplants.co.za/growing-guides/growing-guides-herbs/growing-yarrow/ (Accessed: 13 May 2026).

Sheerfill Sheerfill Shade Membranes Brochure. [Local PDF document]. (Accessed: 13 May 2026).*

SinoPlant Concrete Mixer 560kg Electric. Available at: https://sinoplant.co.za/products/concrete-mixer-560kg-electric-380v-with-hydraulic-lift/ (Accessed: 13 May 2026).

Spec-Net (2022) Waterborne Intumescent Coating System for Timber or Wood by Mirotone. Available at: https://www.spec-net.com.au/press/1222/mir_141222/Waterborne-Intumescent-Coating-System-for-Timber-or-Wood-by-Mirotone (Accessed: 13 May 2026).

Stavros Niarchos Foundation Cultural Center SNFCC: A Space Open to All. Available at: https://www.snfcc.org/en/event/snfcc-a-space-open-to-all/ (Accessed: 13 May 2026).

Supersound Plasterboard Habito Rigips. Available at: https://www.supersound-bg.com/en/p/plasterboard-habito-rigips-12-5-1200-2000-mm/ (Accessed: 13 May 2026).

Tata Steel Nederland Forcon Tubes. Available at: https://products.tatasteelnederland.com/brands/tubes/forcon (Accessed: 13 May 2026).

The Flooring Guys Regupol Rubber 5mm Acoustic Underlay. Available at: https://theflooringguys.com.au/product/regupol-rubber-5mm-acoustic-underlay-5512/ (Accessed: 13 May 2026).

V2Com Newswire Helsinki Central Library Oodi. Available at: https://www.v2com-newswire.com/fr/salle-de-presse/categories/architecture-institutionnelle/dossiers-de-presse/3977-01/helsinki-central-library-oodi (Accessed: 13 May 2026).

Weber Germany Webertec 770 Surface Protection System. Available at: https://www.de.weber/en/waterproofing-mortars/surface-protection-system/webertec-770 (Accessed: 13 May 2026).

Weber India Weber Epoxy Adhesive. Available at: https://www.in.weber/weber-epoxy-adhesive (Accessed: 13 May 2026).

Wikipedia Guggenheim Museum Bilbao. Available at: https://en.wikipedia.org/wiki/Guggenheim_Museum_Bilbao (Accessed: 13 May 2026).

Yumpu Albarino P Glas Reimann Solar GmbH. Available at: https://www.yumpu.com/de/document/view/4109894/albarino-p-glas-reimann-solar-gmbh (Accessed: 13 May 2026).

Yumpu SGG Stadip Silencer Glassolutions. Available at: https://www.yumpu.com/en/document/view/51737759/sgg-stadip-silencer-glassolutions (Accessed: 13 May 2026).