

SHIP, THE STADIUM**!**

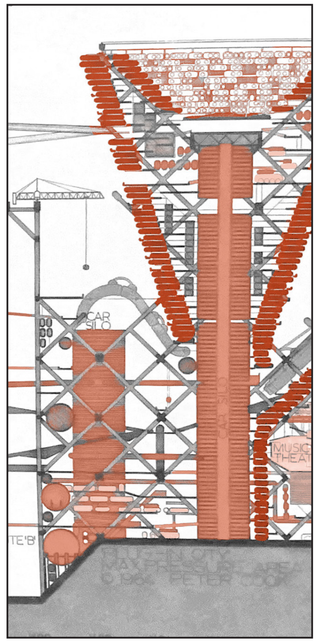
Transforming Event Spaces: Embracing Temporality and Multifunctionality through Modular and Circular Design

P5 Graduation | June 19, 2023
Tijmen Smith | 4534956
Architectural Engineering | TU Delft

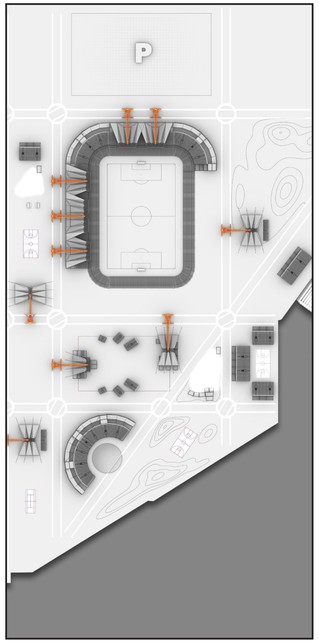
INTRODUCTION //



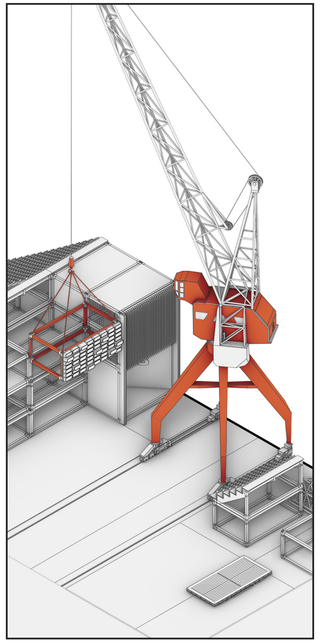
Problem Statement



Why Modularity?



Design Concept



Re-configurations



Further Suggestions + Conclusions

UNITE OR DIVIDE // Problem Statement



















URBAN IMPACT OF HOSTING CITIES // Problem Statement



PREVIOUS WORLD CUPS // Problem Statement

2010 South Africa

"In South Africa, which hosted the World Cup in 2010, stadiums are **underutilised** and are a **burden** **on public finances**"



2014 Brazil

"The World Cup before that, in 2014 in Brazil, saw several **new stadiums** being built, but these are **struggling** **today**. One stadium in the Amazon is **barely used**, while another one is partly used as a bus parking lot"



2018 Russia

"Similarly to Qatar, Russia's stadiums - which hosted the 2018 World Cup - were **not home to major football teams**, which raised serious **concerns** regarding their **financial viability**"

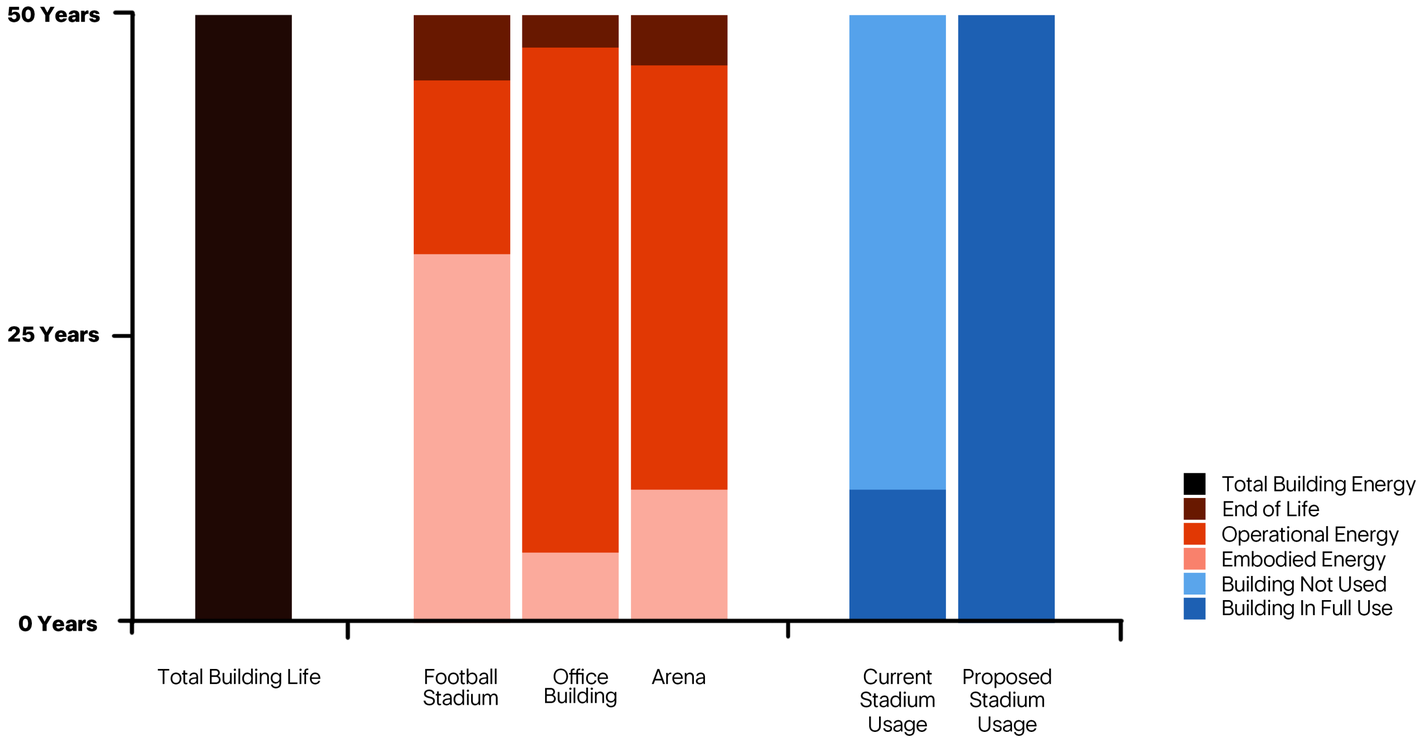


2022 Qatar

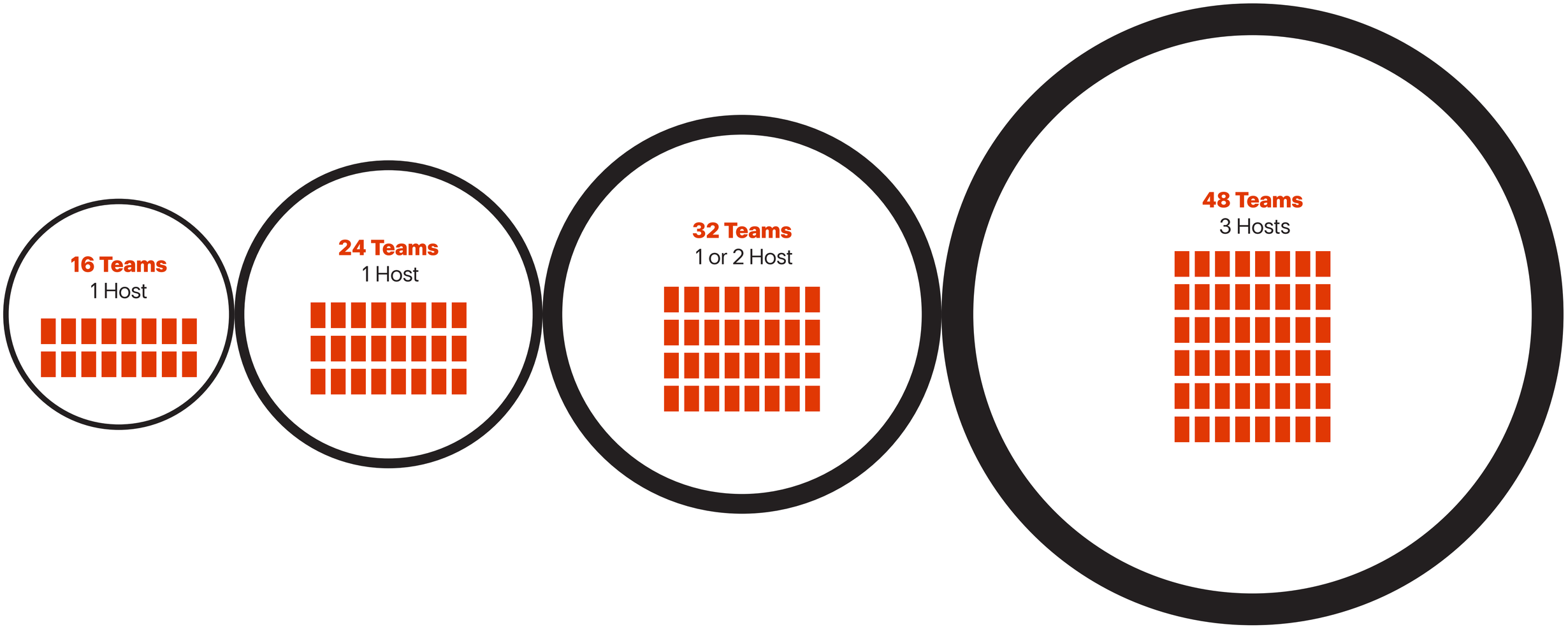
"Overall, there is a **lack of evidence** that the stadiums built for the 2022 World Cup will continue **to be used effectively and optimally** **after the event**. Even if the legacy uses do materialise, it is likely that the construction of stadiums is **not the most efficient way** of creating new infrastructure for many of the stated purposes"



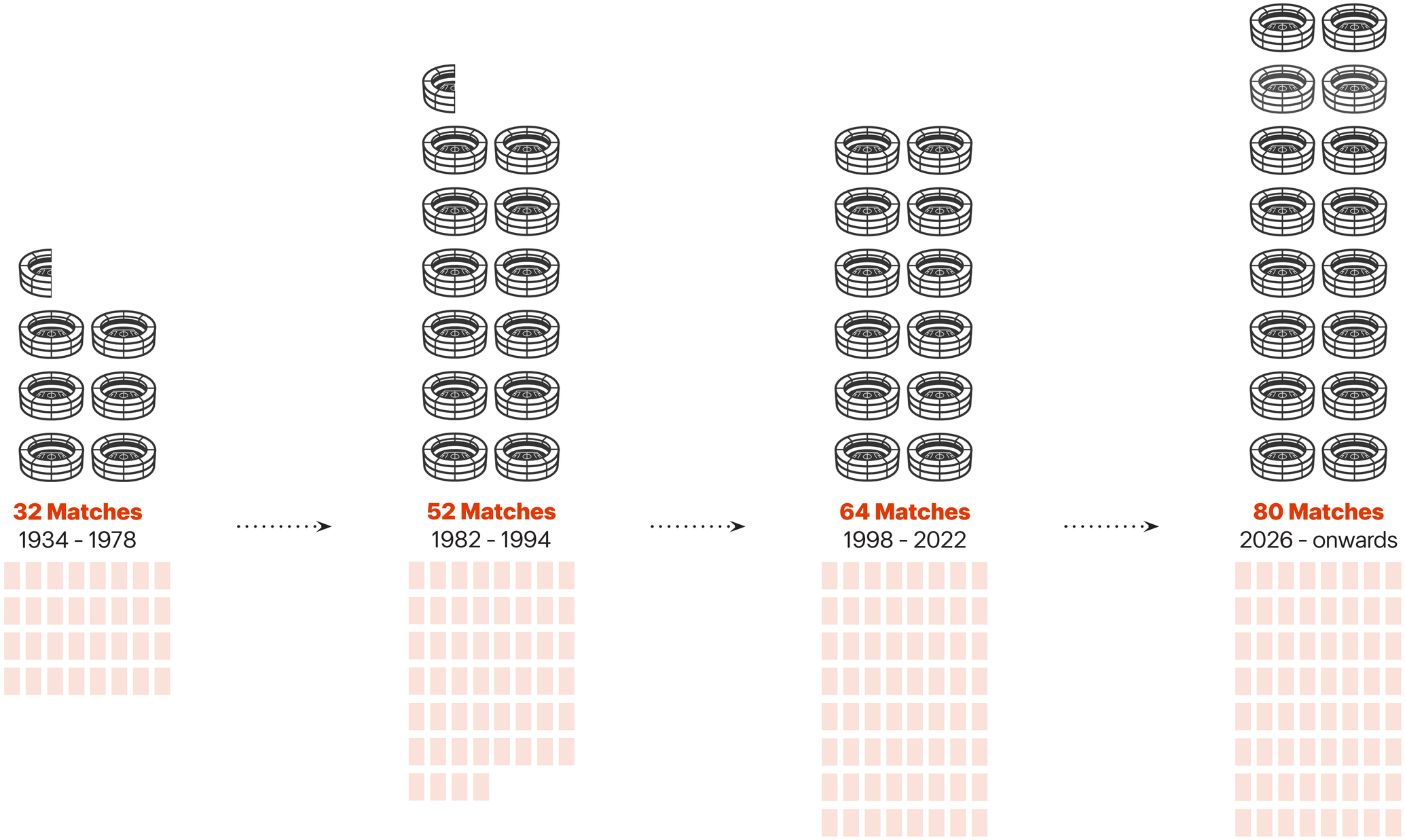
ENERGY USE // Problem Statement



EXPANSION OF FORMAT // FIFA World Cup



EXPANSION OF FORMAT // FIFA World Cup



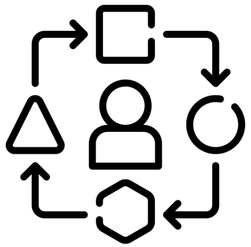
GOALS //



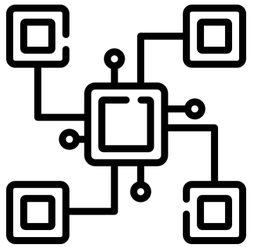
Contemporary Icon



Reconfigurable



Afterlife Benefit

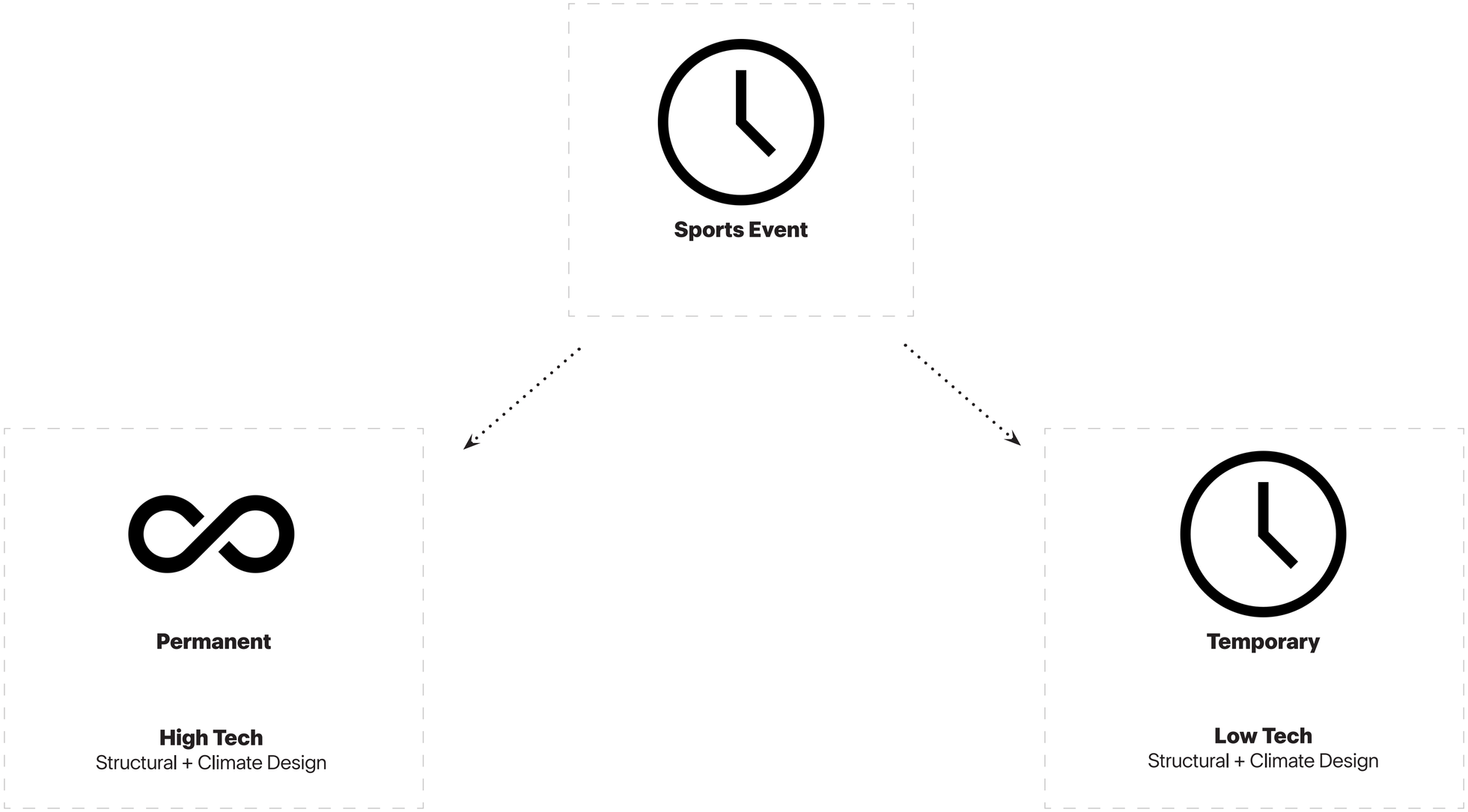


Urban Cohesion

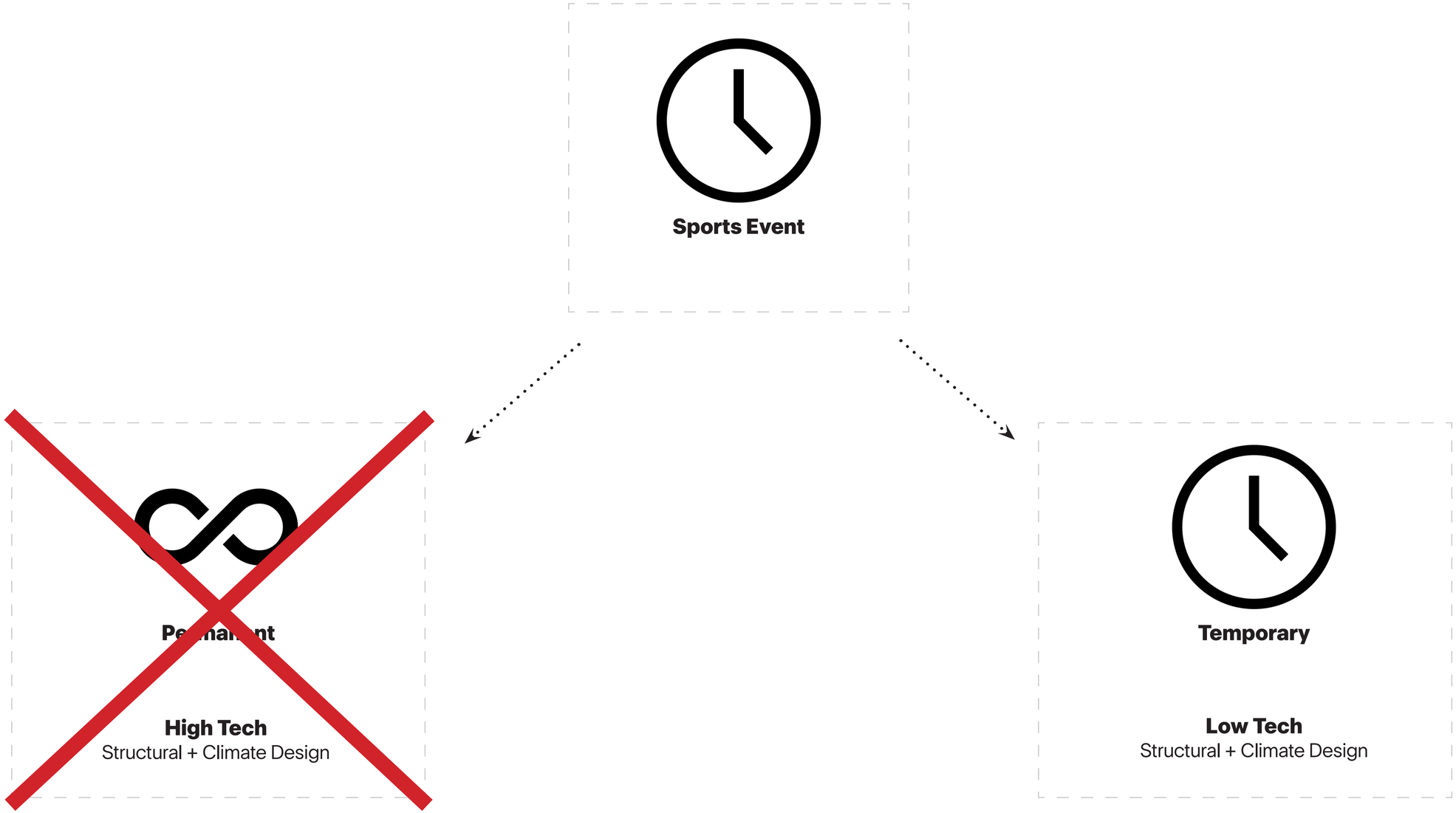


Increase usage

VISION //


Sports Event
Permanent
High Tech
Structural + Climate Design
Temporary
Low Tech
Structural + Climate Design

VISION //


Sports Event
Permanent
High Tech
Structural + Climate Design
Temporary
Low Tech
Structural + Climate Design

POSITION //



Listen!

+

Flexible and Humble

=

POSITION //



Listen!

+

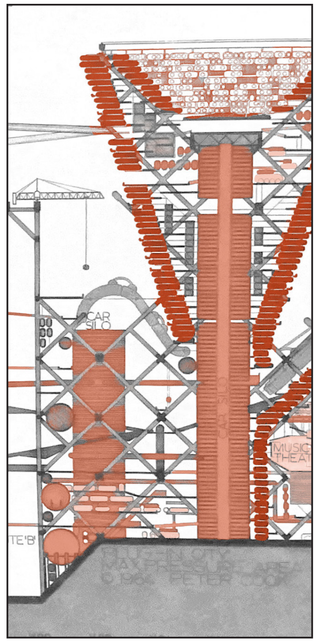
Flexible and Humble

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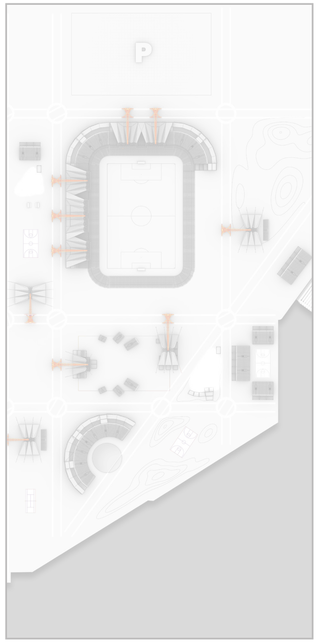




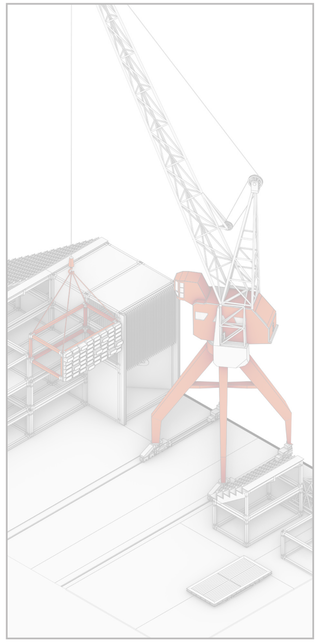
Problem Statement



Why Modularity?



Design Concept

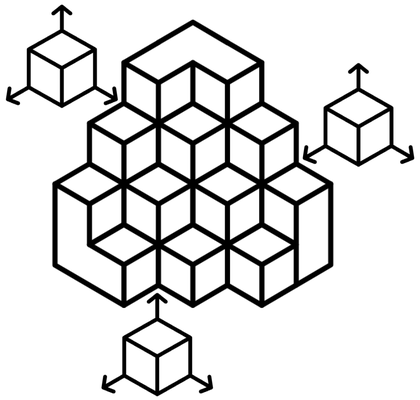


Re-configurations



Further Suggestions + Conclusions

MODULARITY



The degree in which a system’s bundle of repeating modules may be separated and recombined

1. Design for Disassembly + Re-configuration

2. Ease of Maintenance + Repairs

3. Controlled off-site production

4. Time efficient

5. Portability

Limitations

Climate design

Circulation

Structural

High standardization + Repeatability

1. Design for Disassembly + Re-configuration
2. Ease of Maintenance + Repairs
3. Controlled off-site production
4. Time efficient
5. Portability

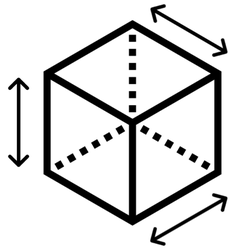
Limitations

- Climate design
- Circulation
- Structural

STADIUM

Technical

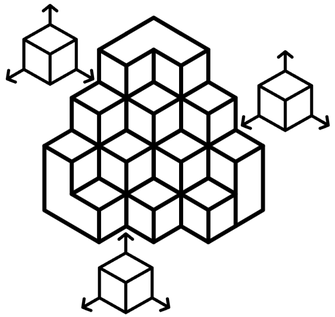
Standardization of building components

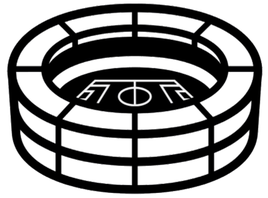


STADIUM

Spatial

Re-configuration of space and program



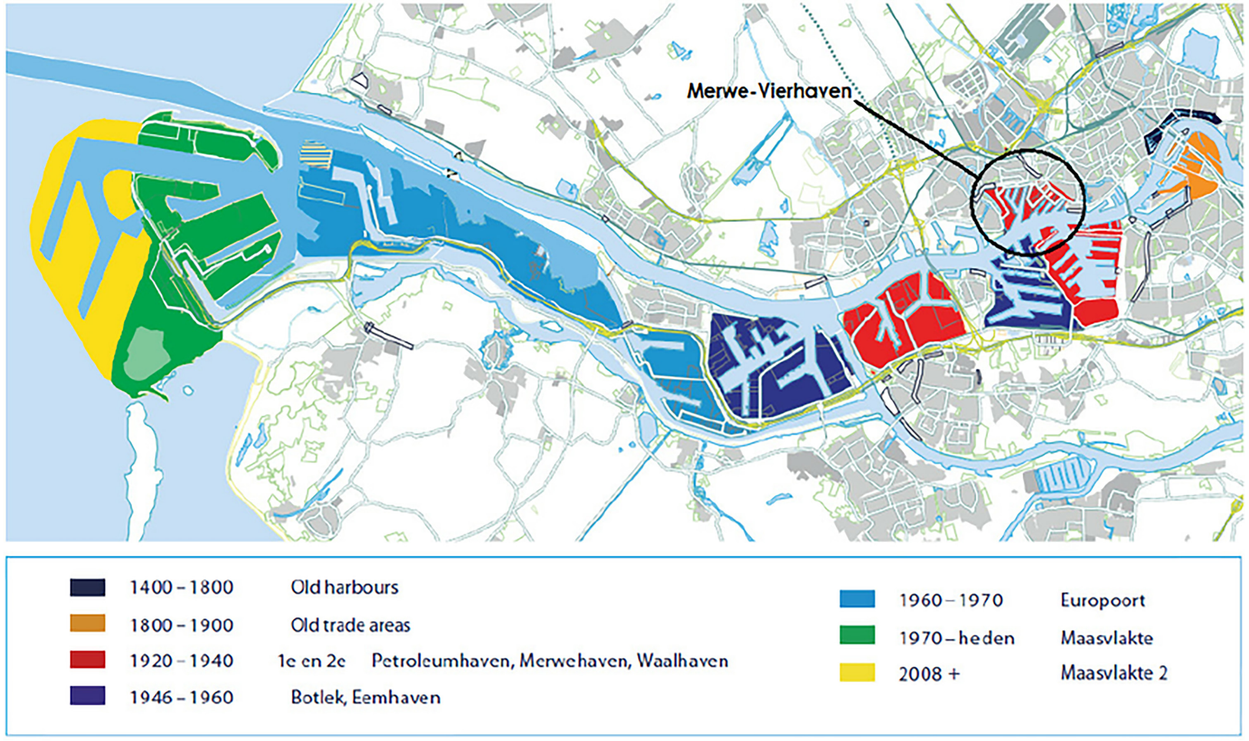


STADIUM

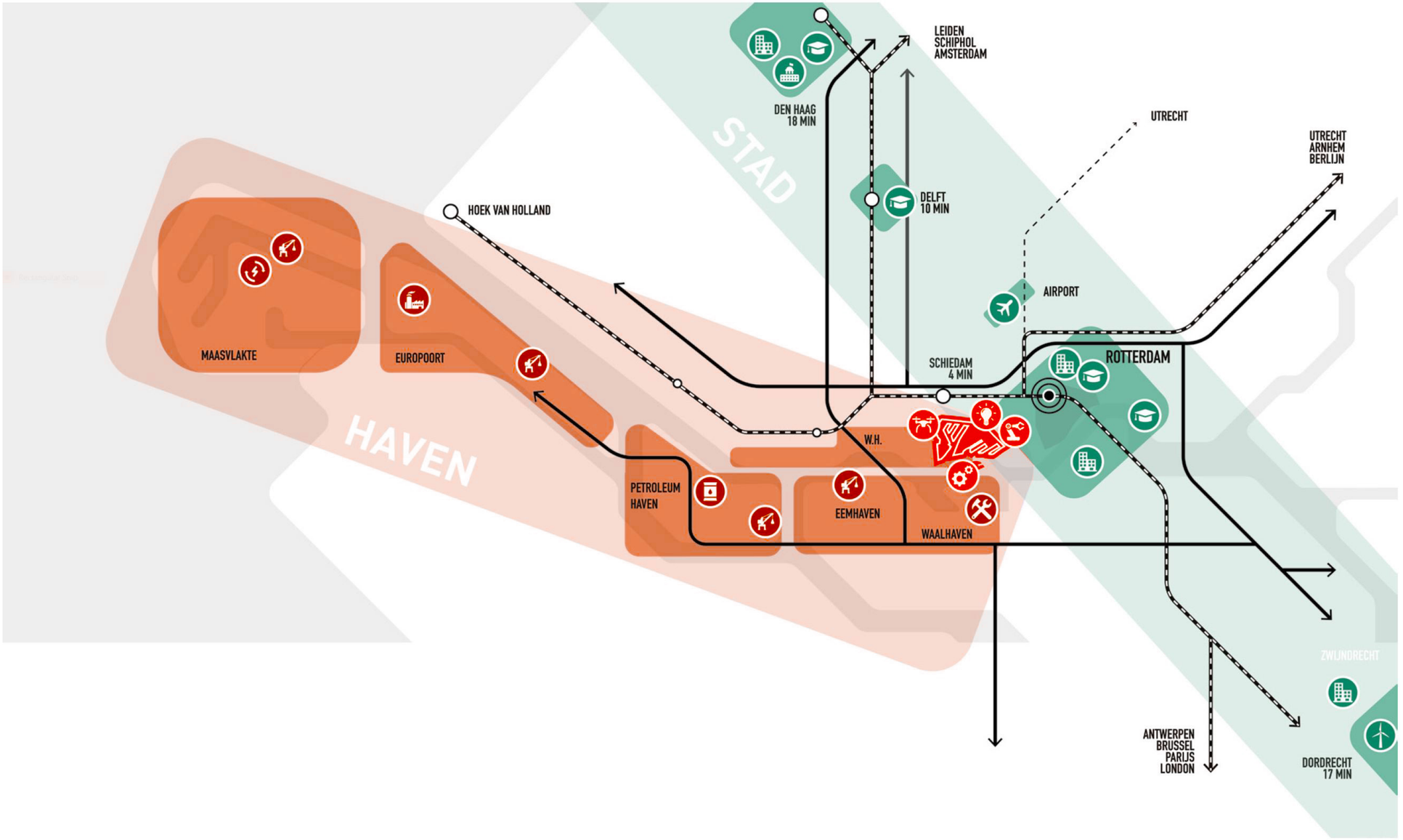
What if?


NAi
MVRDV
Berlage Institute
AVBR
NL28
OLYMPIC FIRE
Future
Games
NAi Publishers


NL50
FIFA WORLD CUP


Merwe-Vierhaven
1400 – 1800 Old harbours
1800 – 1900 Old trade areas
1920 – 1940 1e en 2e Petroleumhaven, Merwehaven, Waalhaven
1946 – 1960 Botlek, Eemhaven
1960 – 1970 Europoort
1970 – heden Maasvlakte
2008 + Maasvlakte 2

CONTEXT // Merwevierhaven M4H



CONTEXT // Merwevierhaven M4H



CONTEXT // Merwevierhaven M4H



CONTEXT // Merwevierhaven M4H



16x **32 Tonnes Figee Cranes**



CONTEXT // Merwevierhaven M4H



N

500m

CONTEXT // Access Routes

By Foot

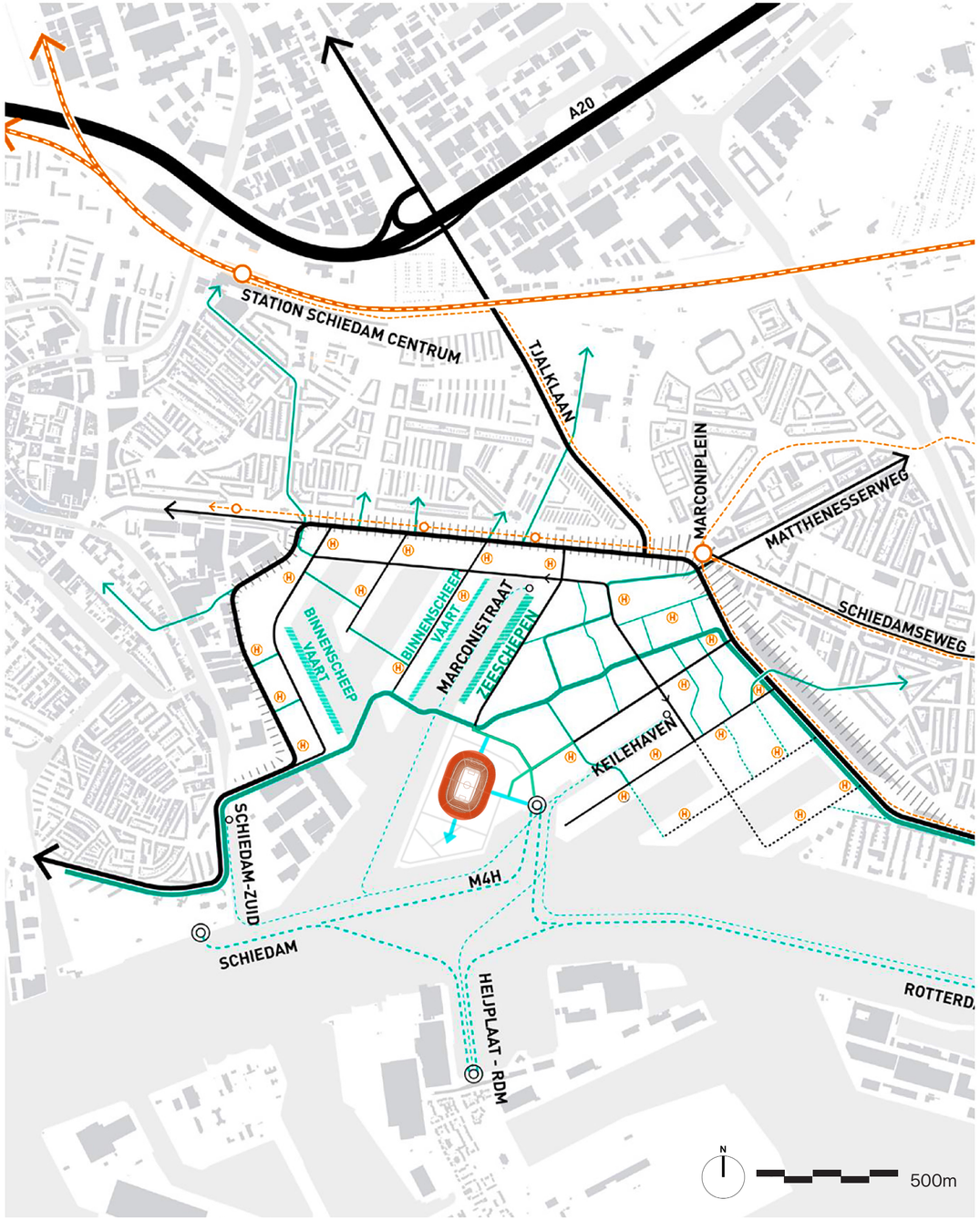
Bycicle

Water Taxi / Bus

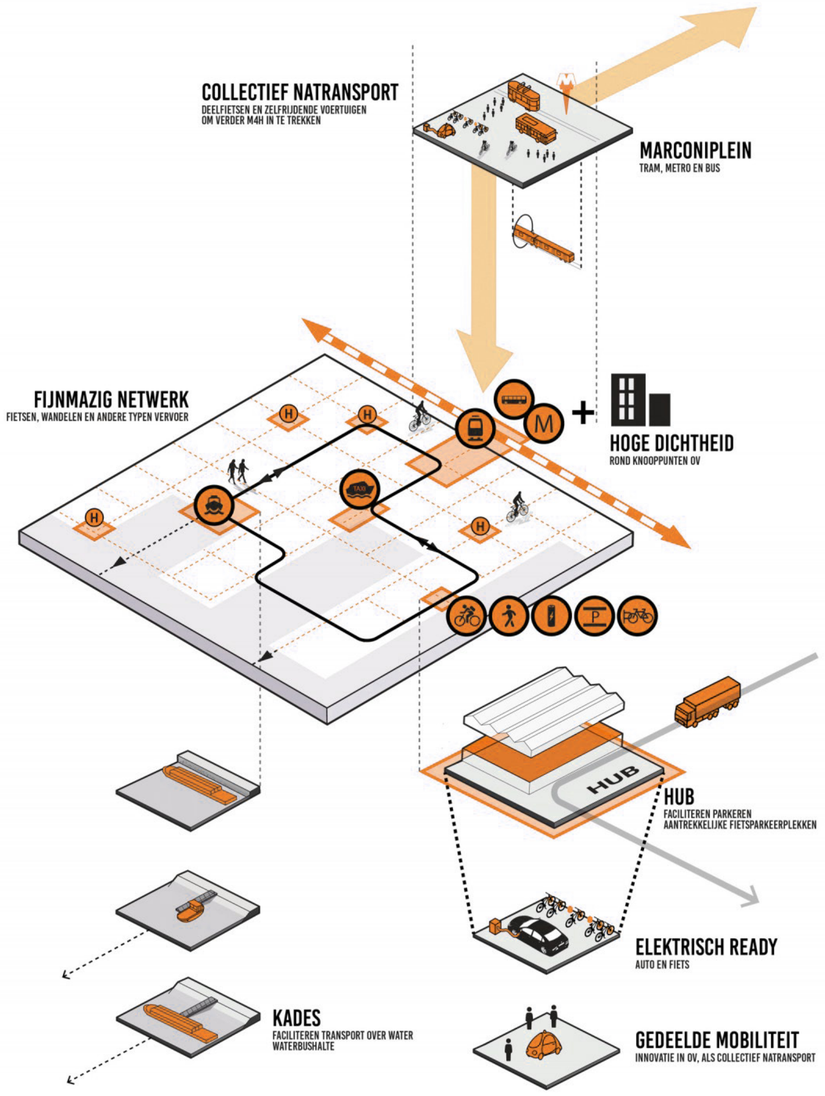
Tram

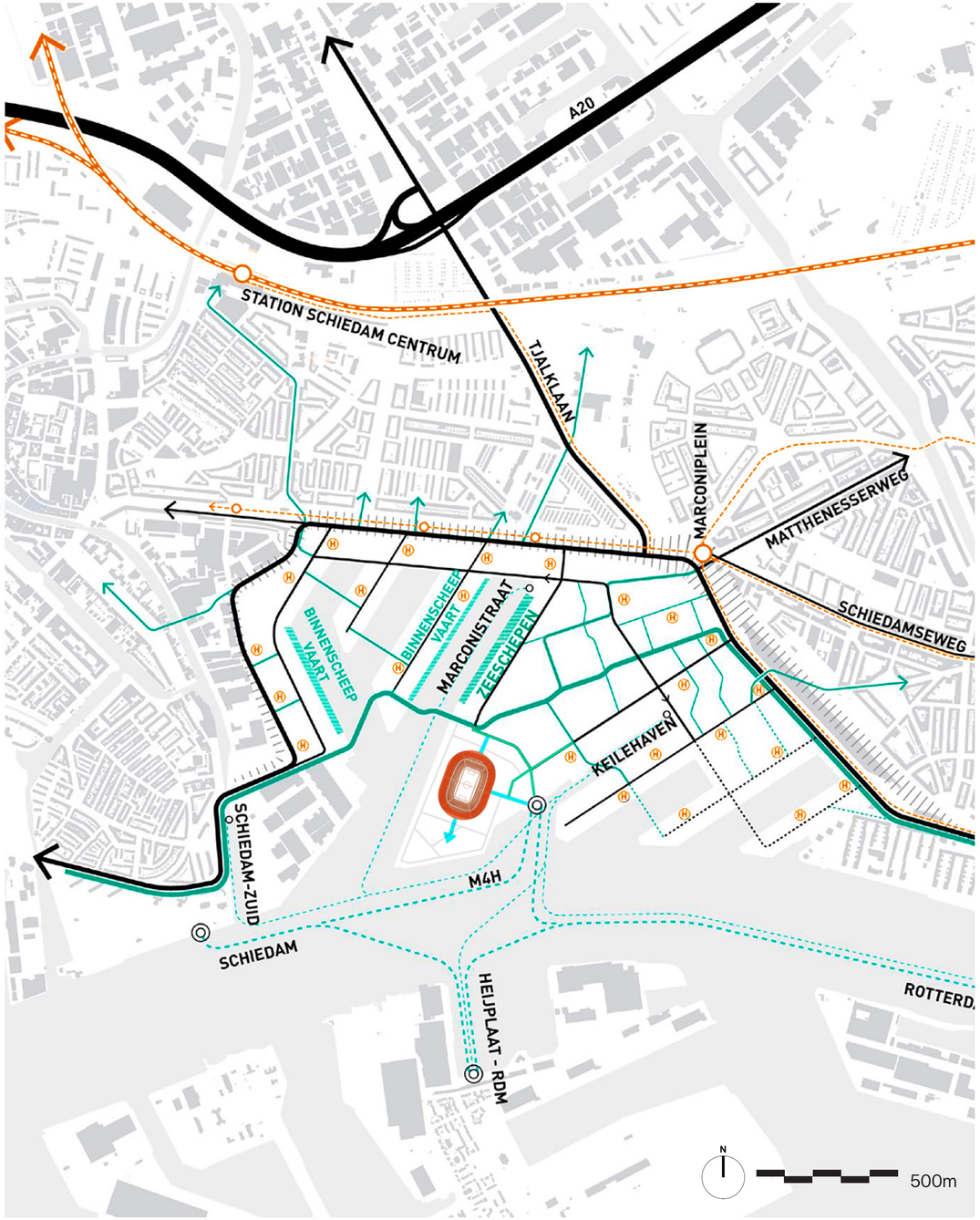
Metro

Car



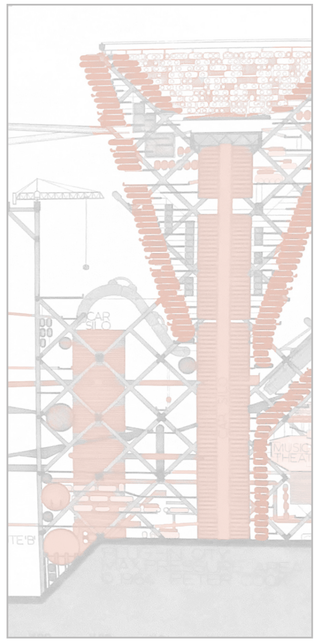
CONTEXT // Access Routes



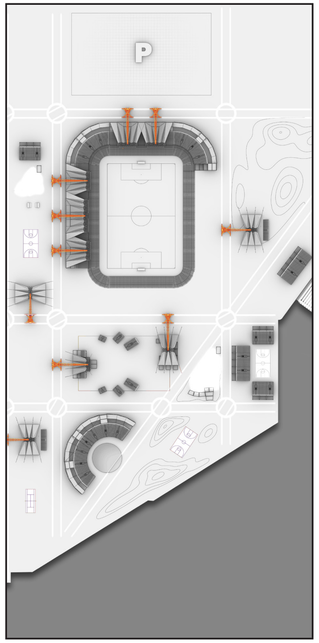




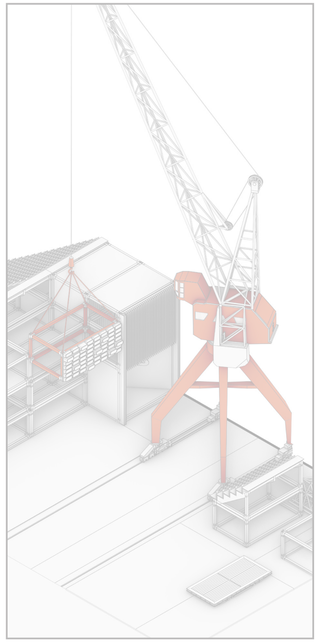
Problem Statement



Why Modularity?



Design Concept



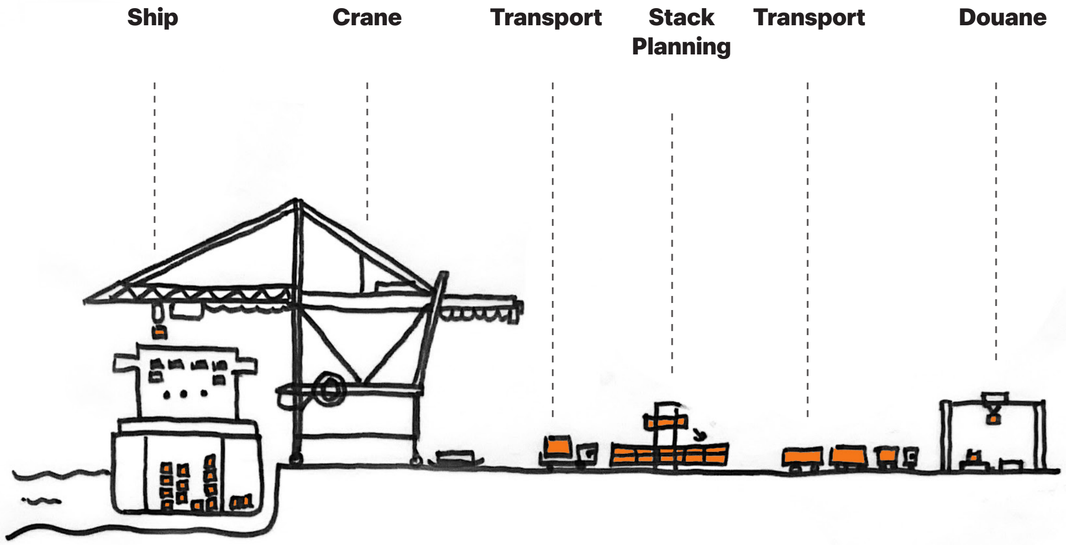
Re-configurations



Further Suggestions + Conclusions

LOGISTICS PLAN // Concept

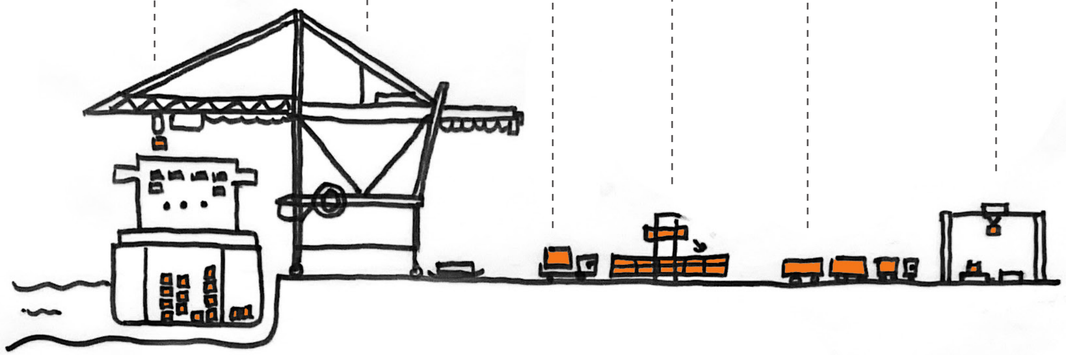
HARBOUR



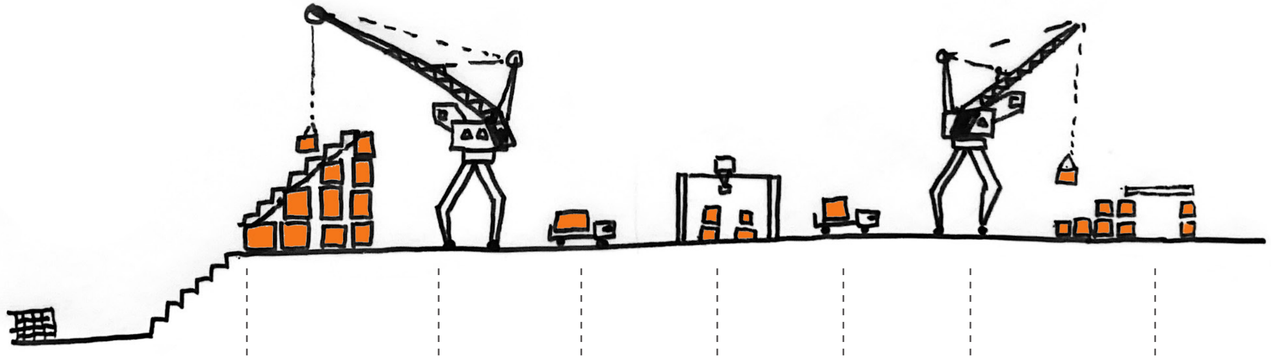
LOGISTICS PLAN // Concept

HARBOUR

Ship
Crane
Transport
Stack Planning
Transport
Douane



EVENT



Stadium
Crane
Transport
Orga Control
Transport
Crane
In another Stadium

AREA VIEW // Local Sports Area

Base Location

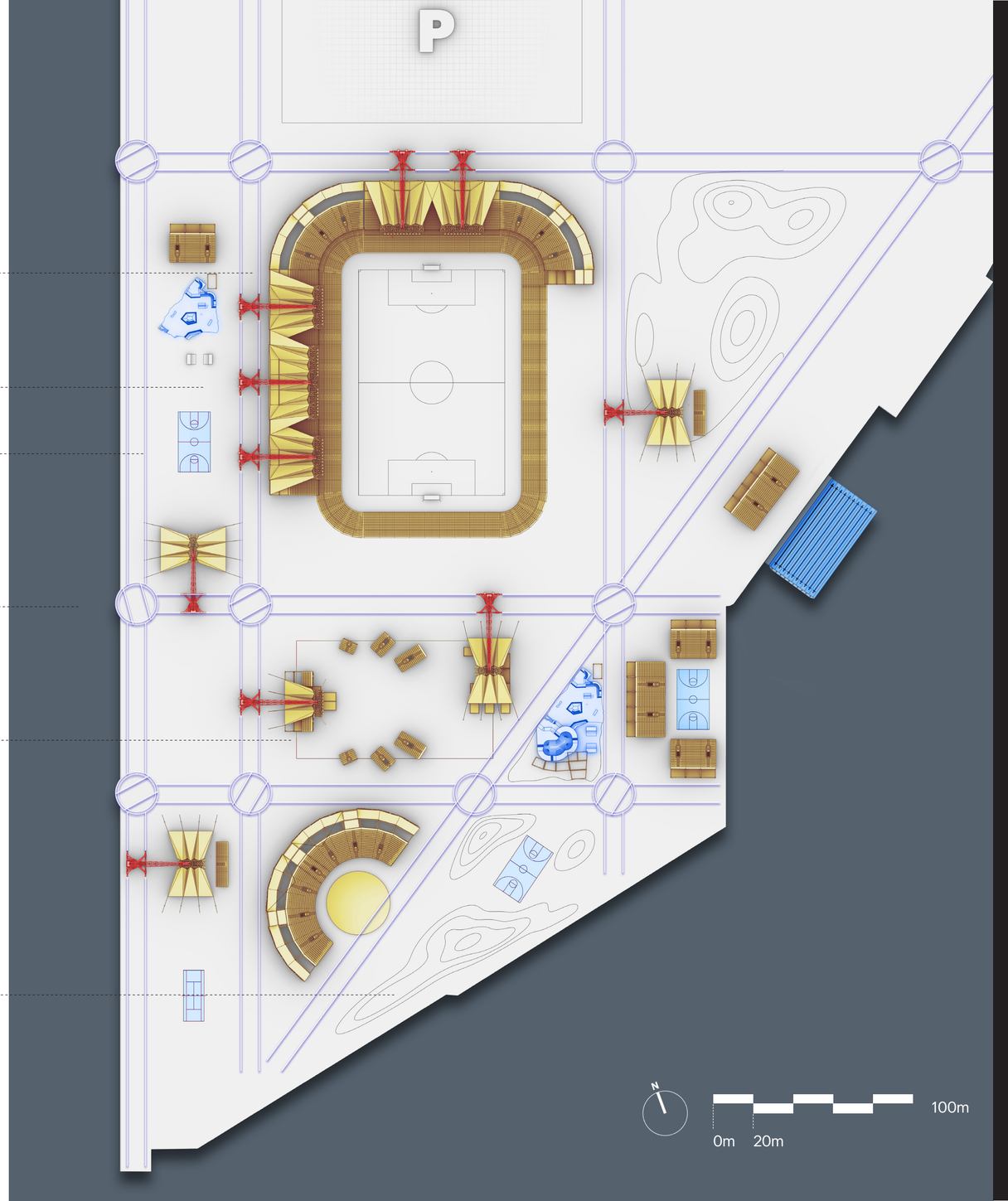
10 Figee Cranes

Varying Sports Fields

Railway Network

Festival Area

Undulating Park



AREA VIEW // Local Sports Area

Base Location

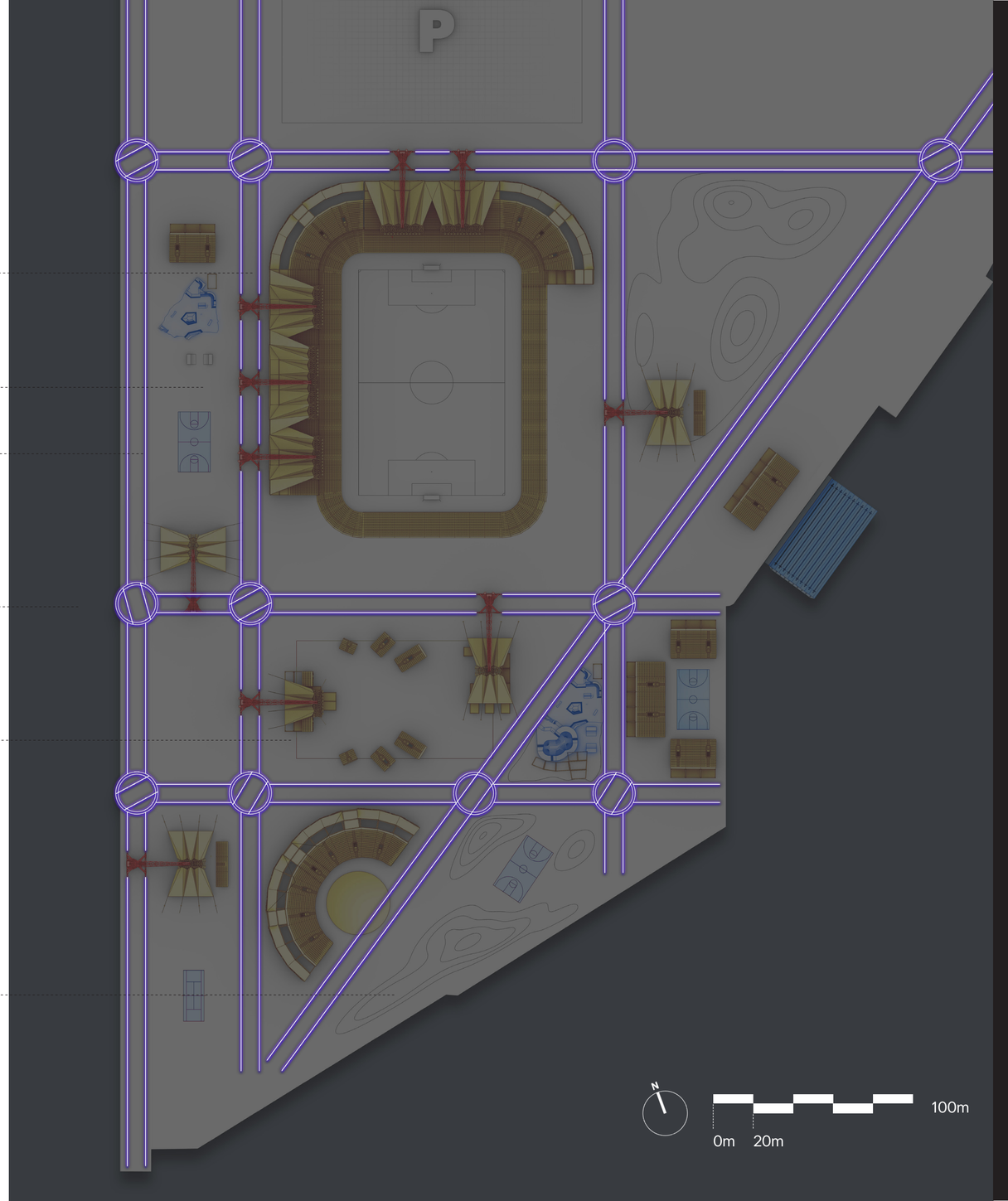
10 Figee Cranes

Varying Sports Fields

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AREA VIEW // Local Sports Area

Base Location

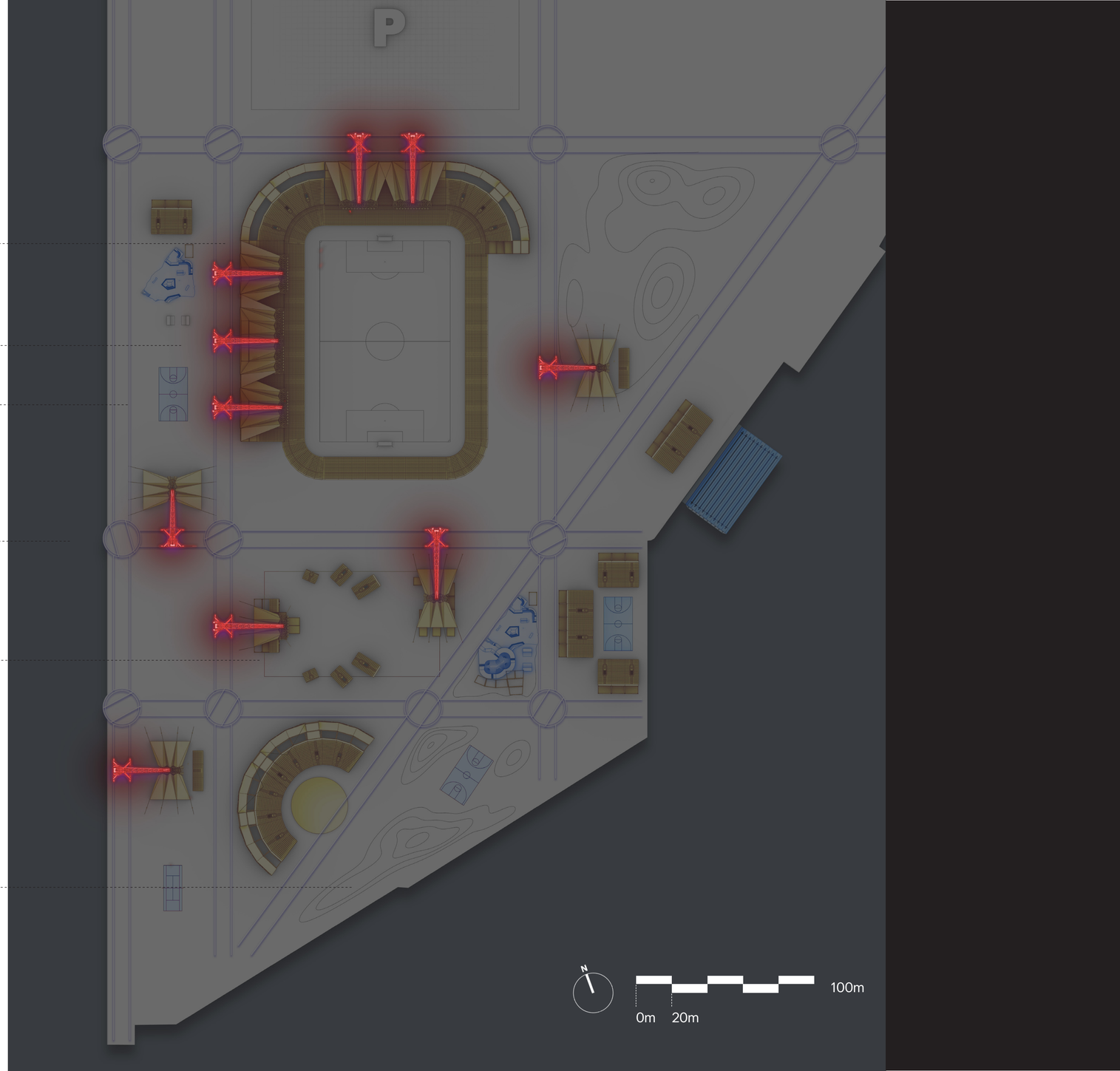
10 Figee Cranes

Varying Sports Fields

Railway Network

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Undulating Park



AREA VIEW // Local Sports Area

Base Location

10 Figee Cranes

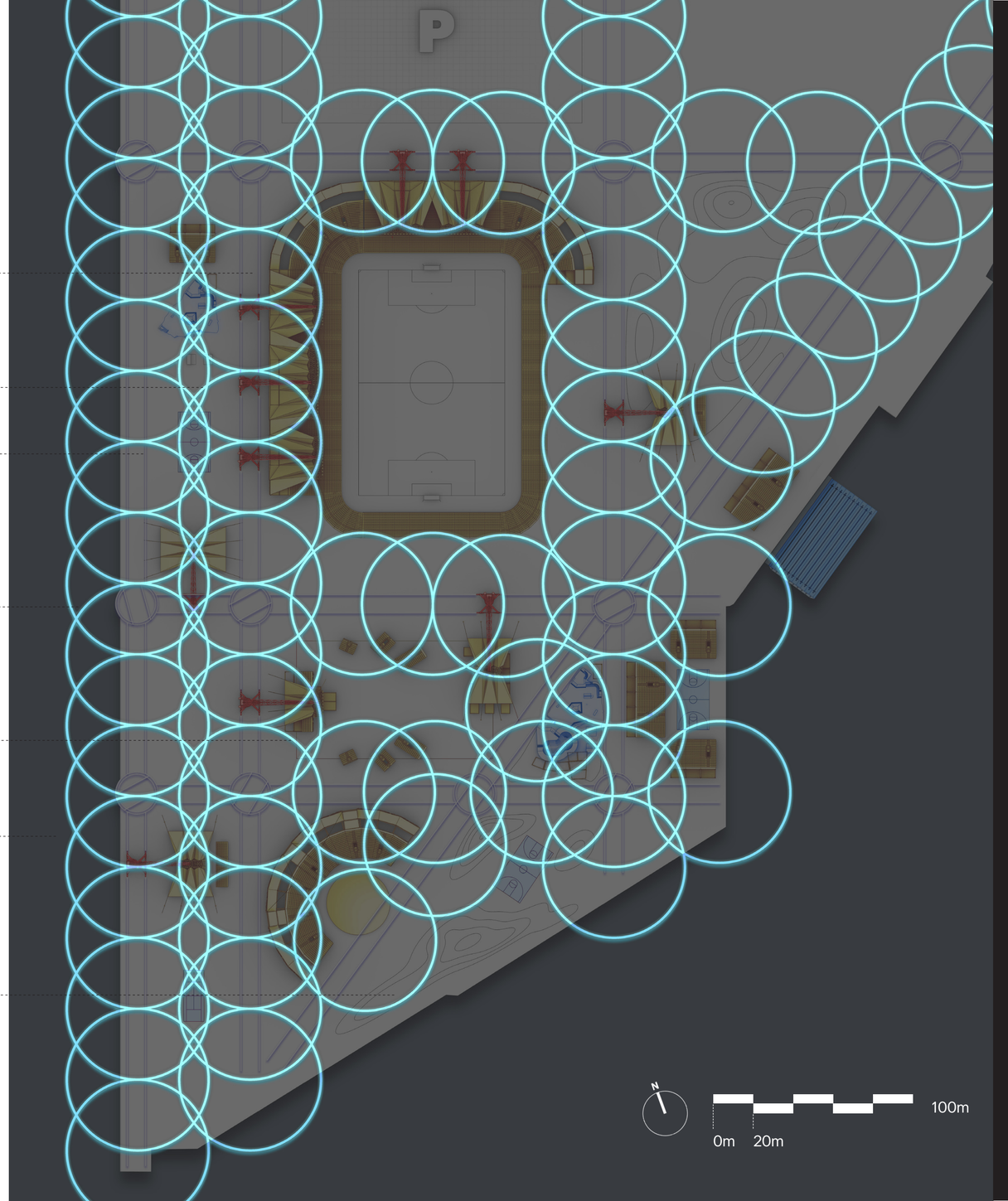
Varying Sports Fields

Railway Network

Festival Area

Reach of Cranes

Undulating Park



AREA VIEW // Local Sports Area

Base Location

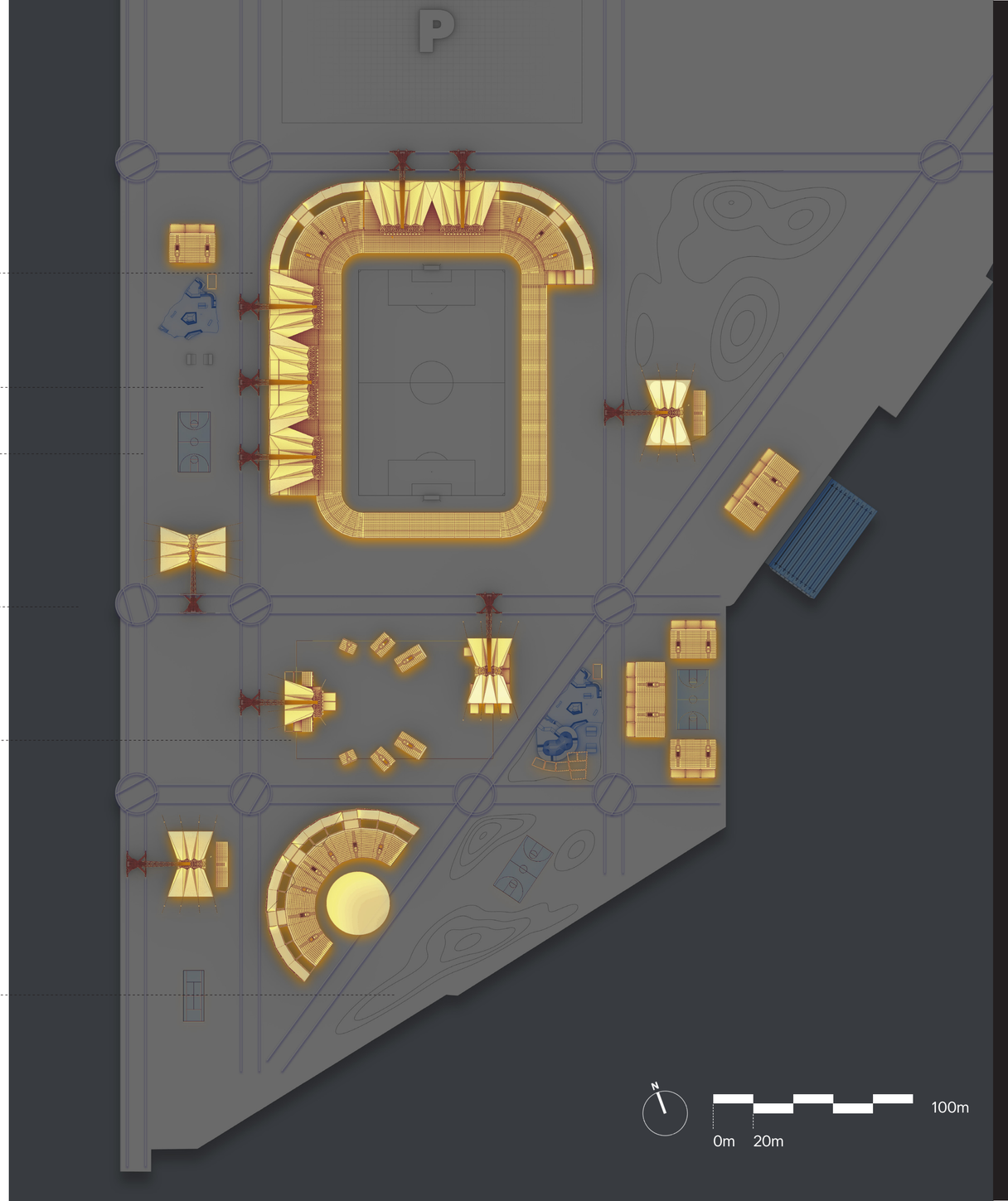
10 Figee Cranes

Varying Sports Fields

Railway Network

Festival Area

Undulating Park



AREA VIEW // Local Sports Area

Base Location

10 Figee Cranes

Varying Sports Fields

Railway Network

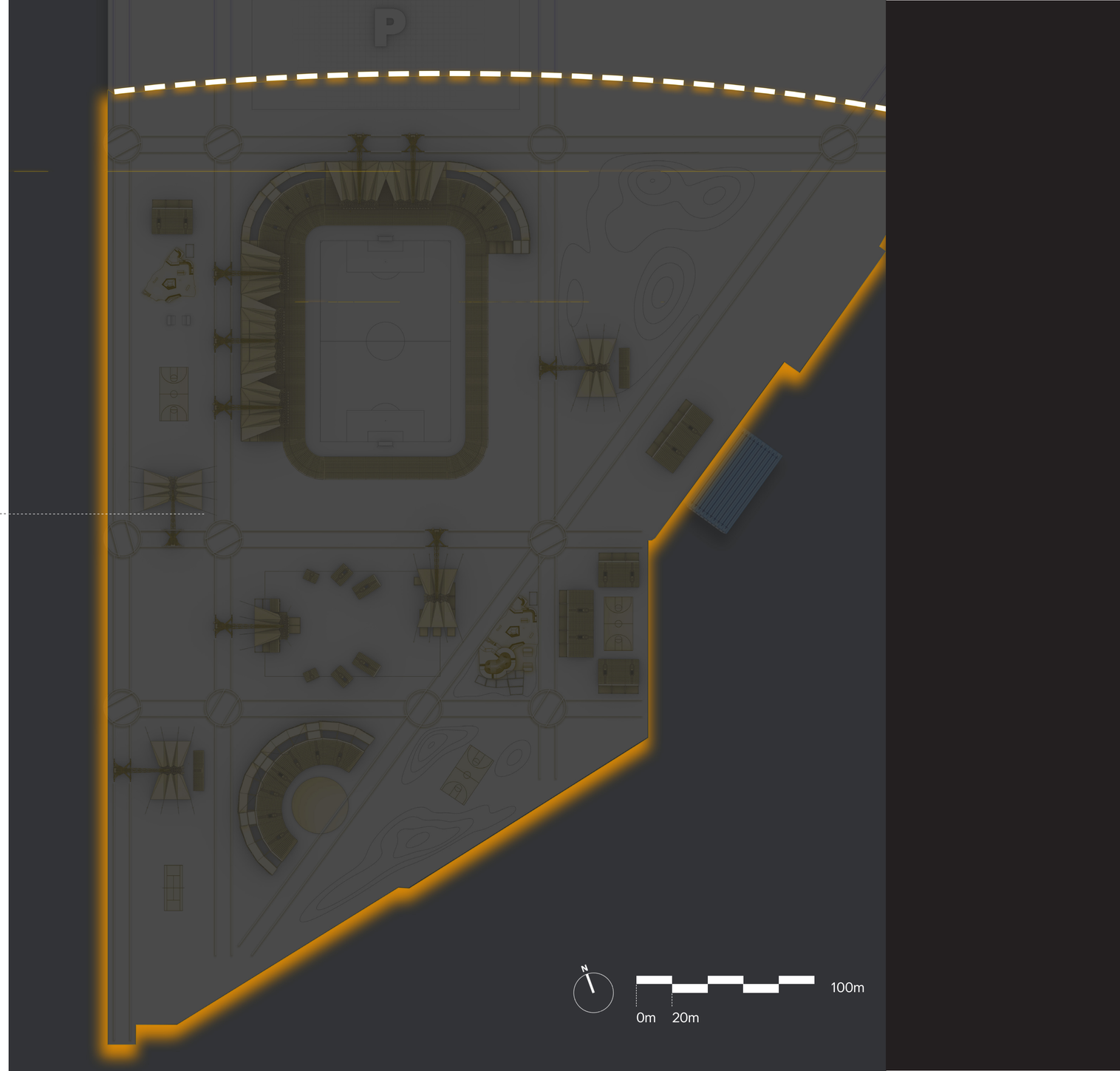
Festival Area

Undulating Park

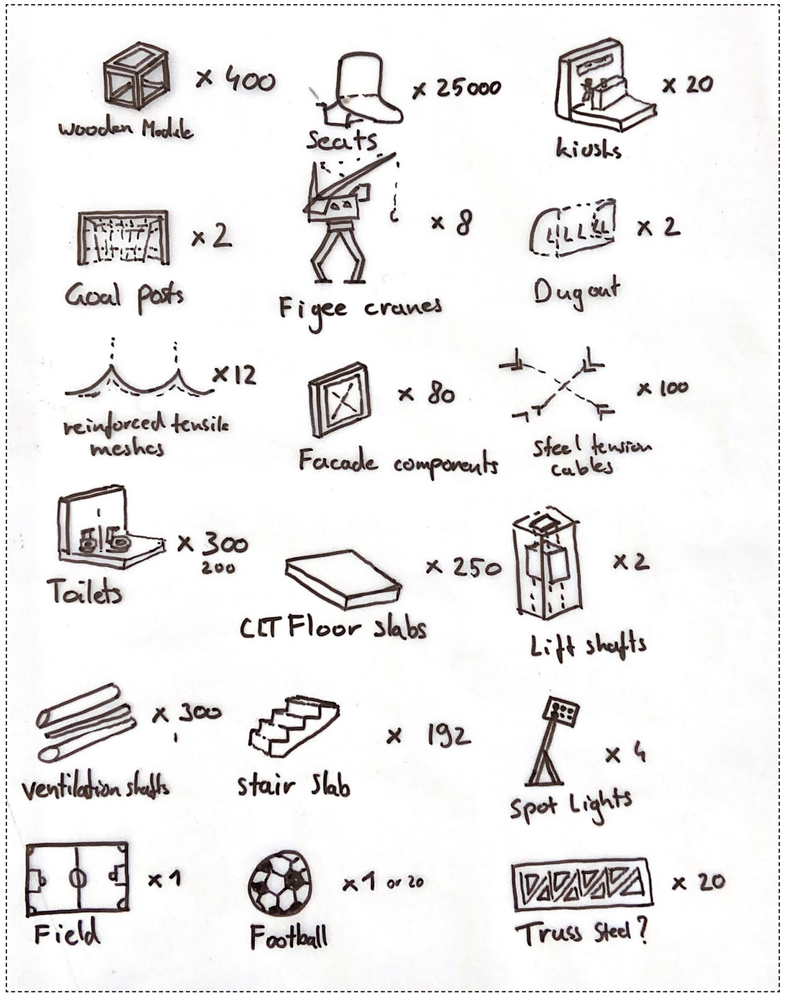


AREA VIEW // Local Sports Area

Enclosed Space

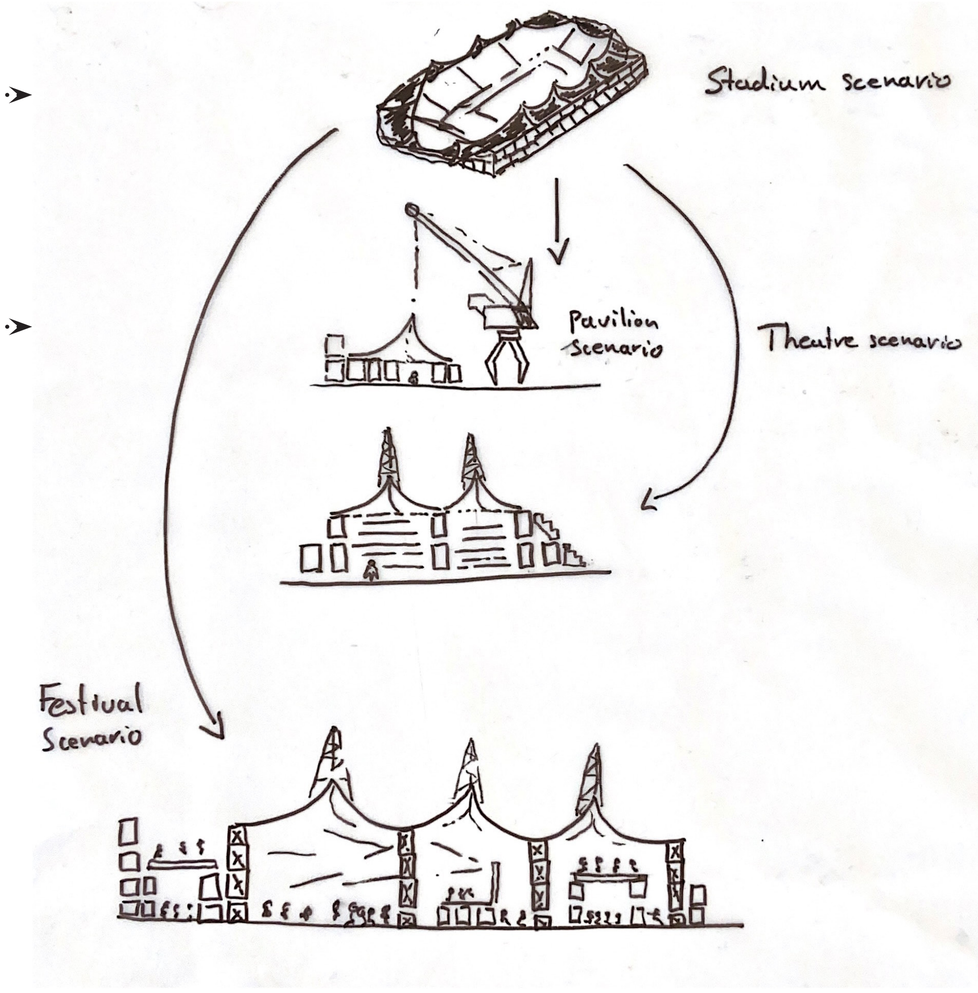


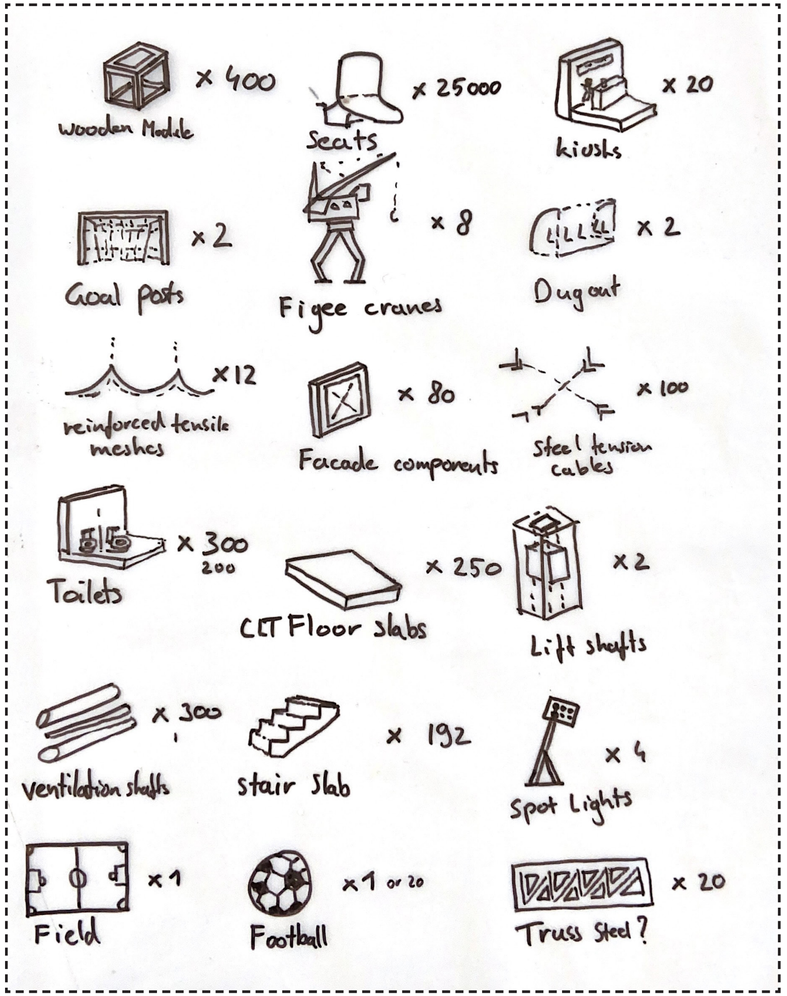
APPROACH DESIGN PROCES // Module Size



Large Scale

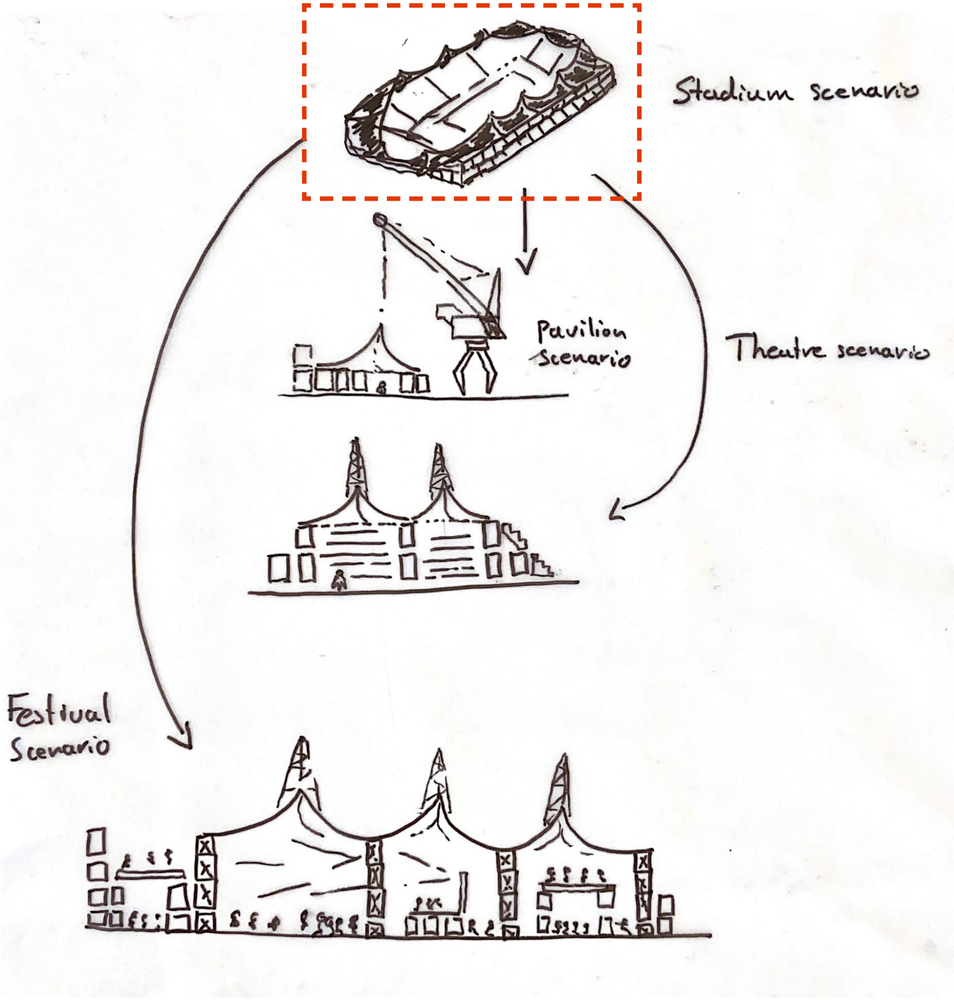
Small Scale



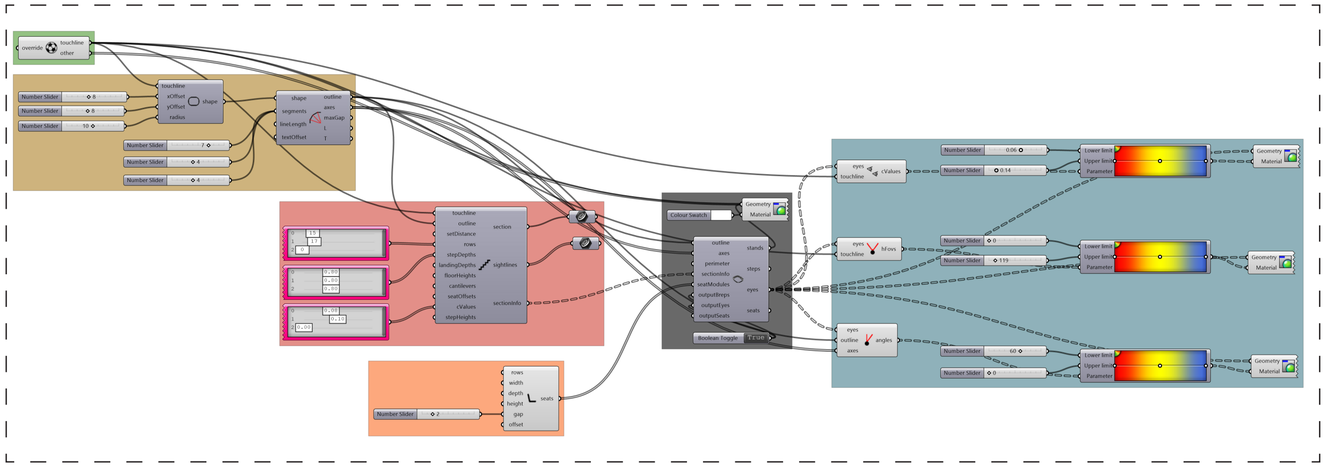


Large Scale

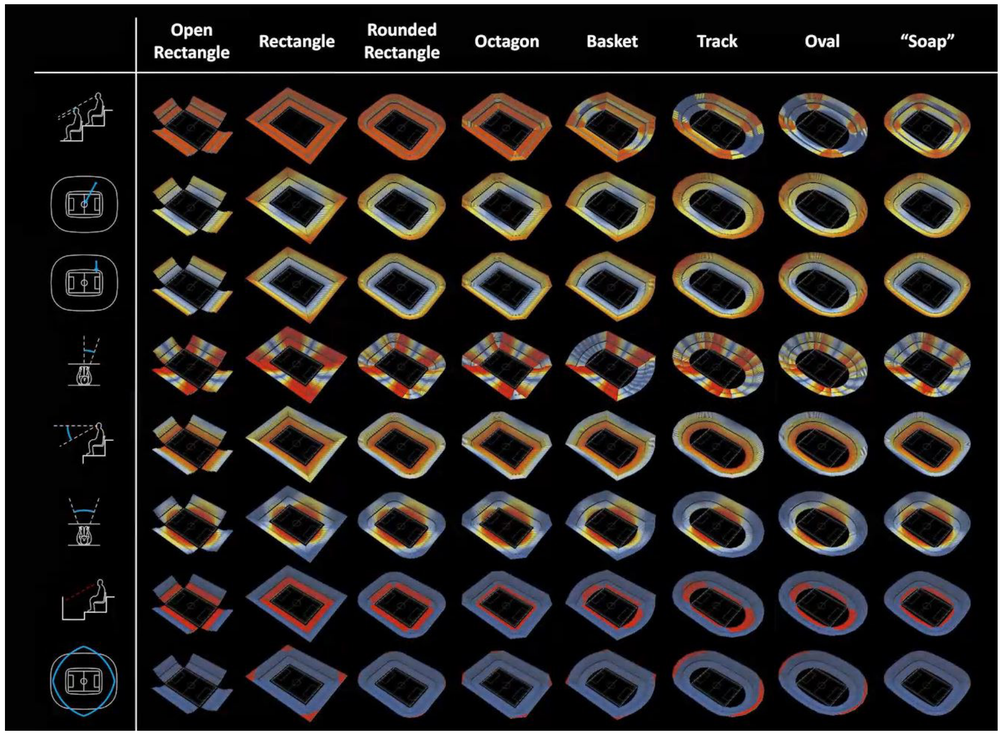
Small Scale



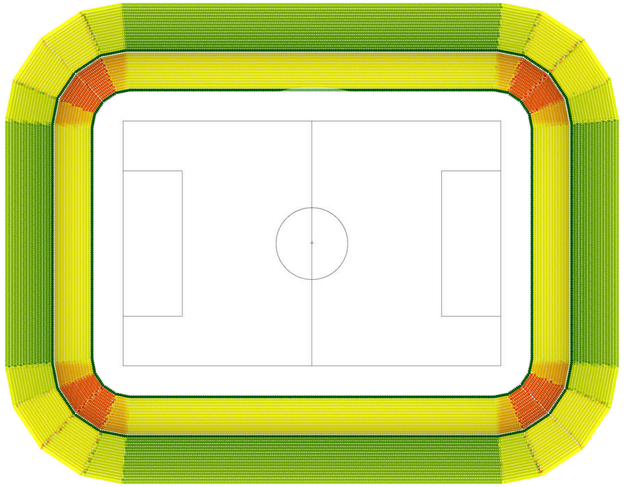
CONCEPT // Definining the Bowl



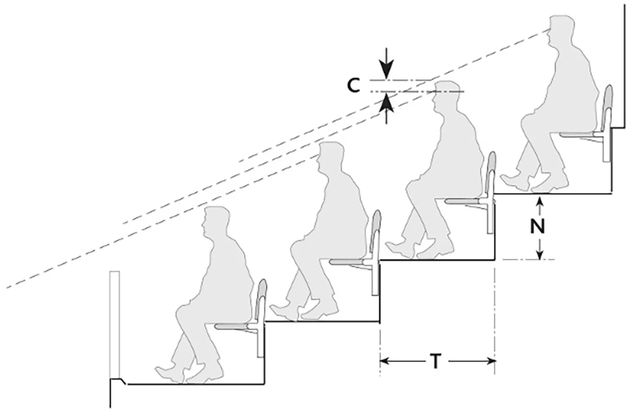
Grasshopper Definition

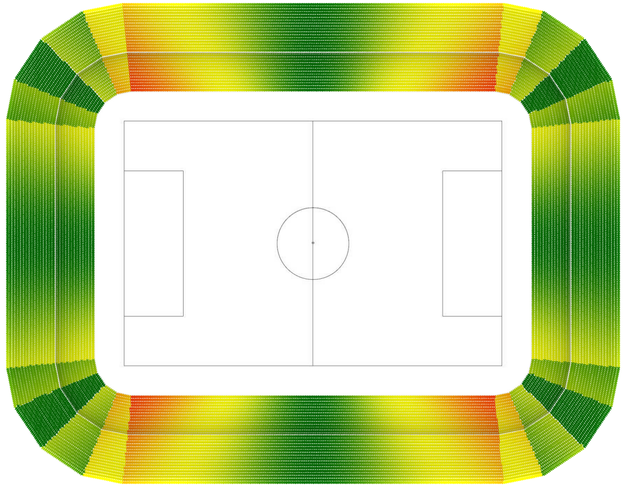


Analysis

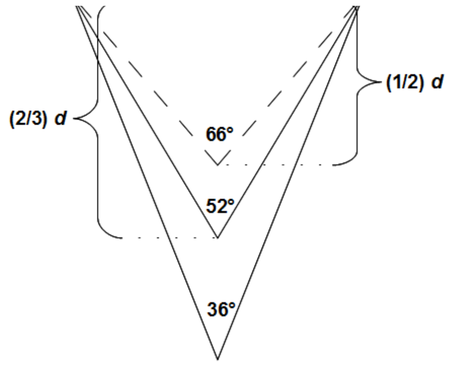


C-value

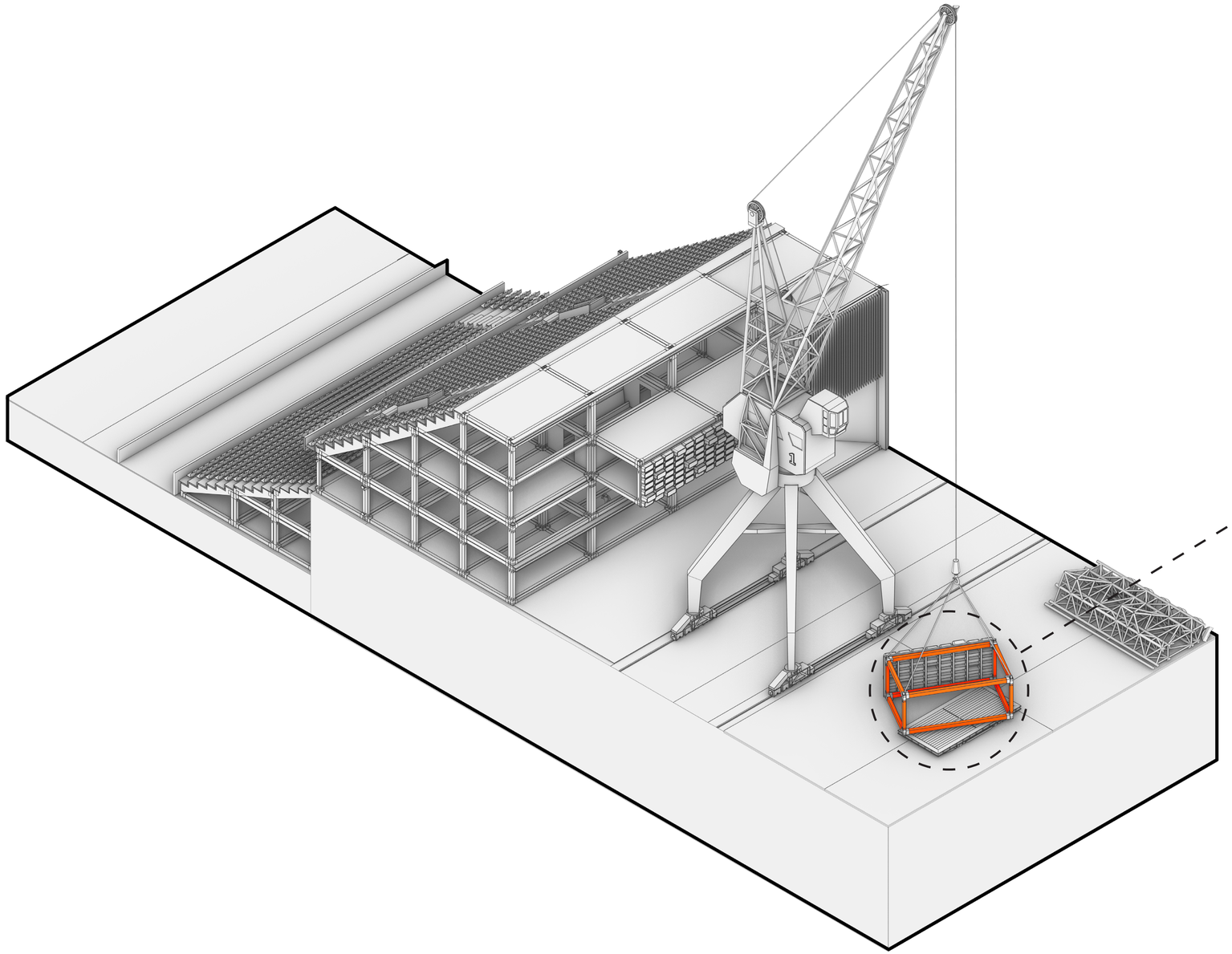


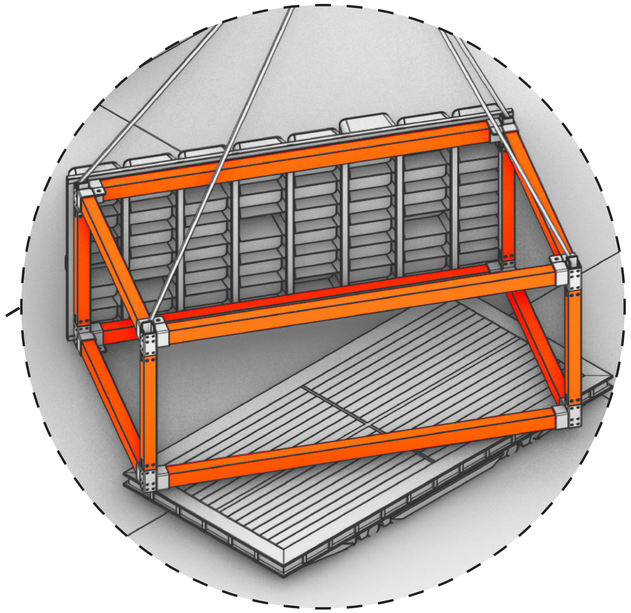


Horizontal Viewing Angle



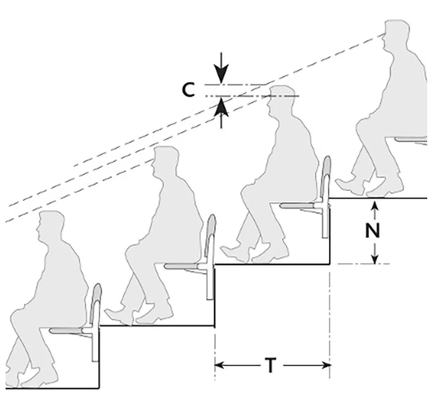
CONCEPT // Definining the Modules





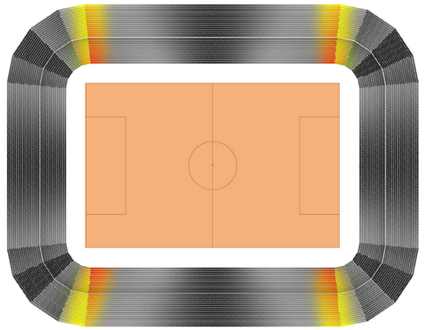
L: **7m** x W: **4.2m** x H: **3m**

MODULE // Unit Size



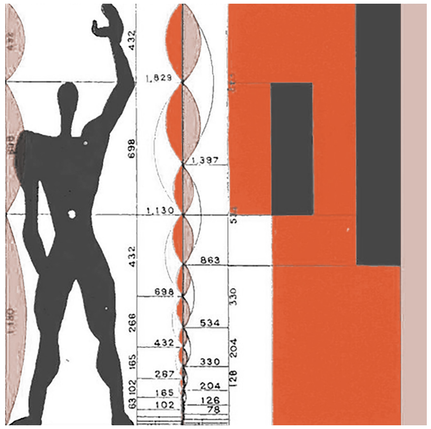
1. C-value Grandstand

Width: **4.2m**



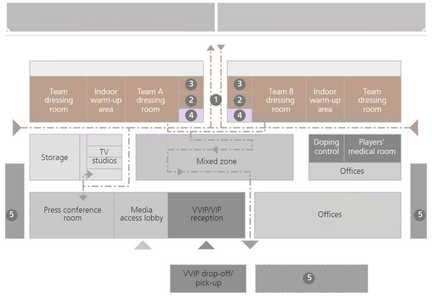
2. Field Dimensions

Length: **7m**



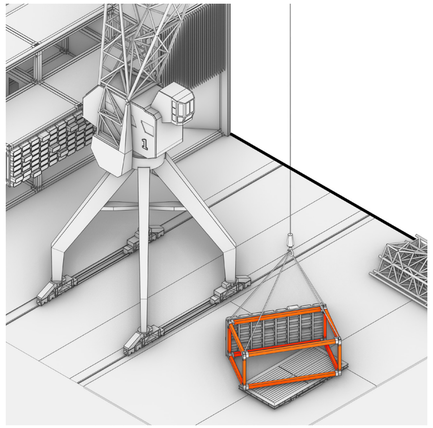
3. Human proportions

Height: **3m**



4. Stadium Program

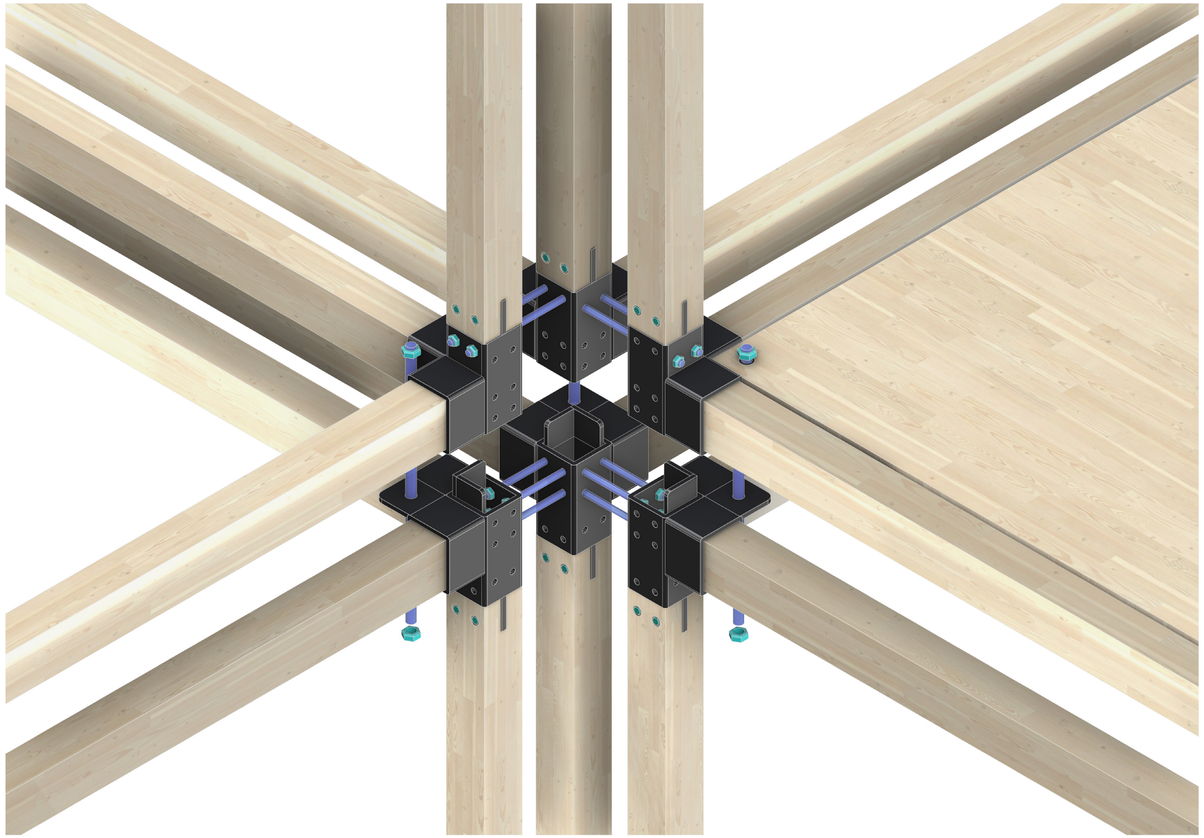
Toilets
Kiosk
Dressing Room
Office
First-Aid
Referee
Doping
Warm-up
Skybox
Conference room

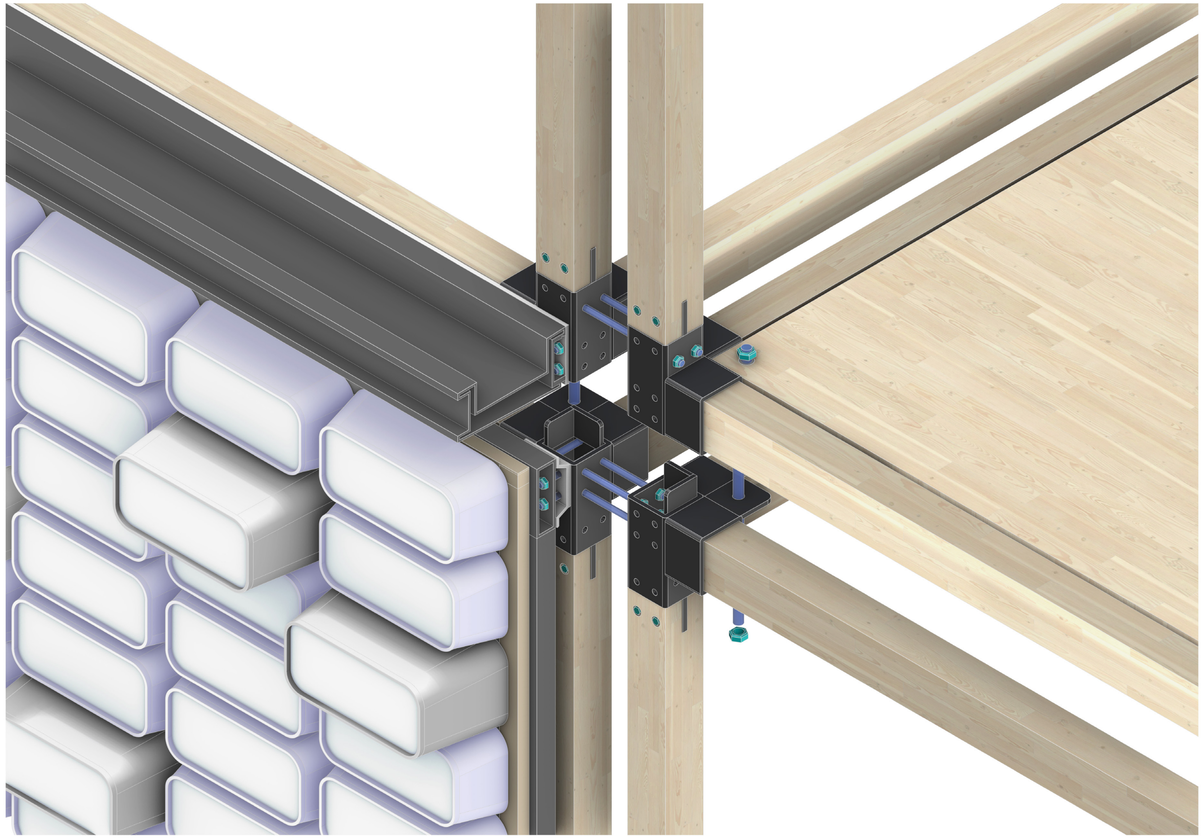


5. Transportation

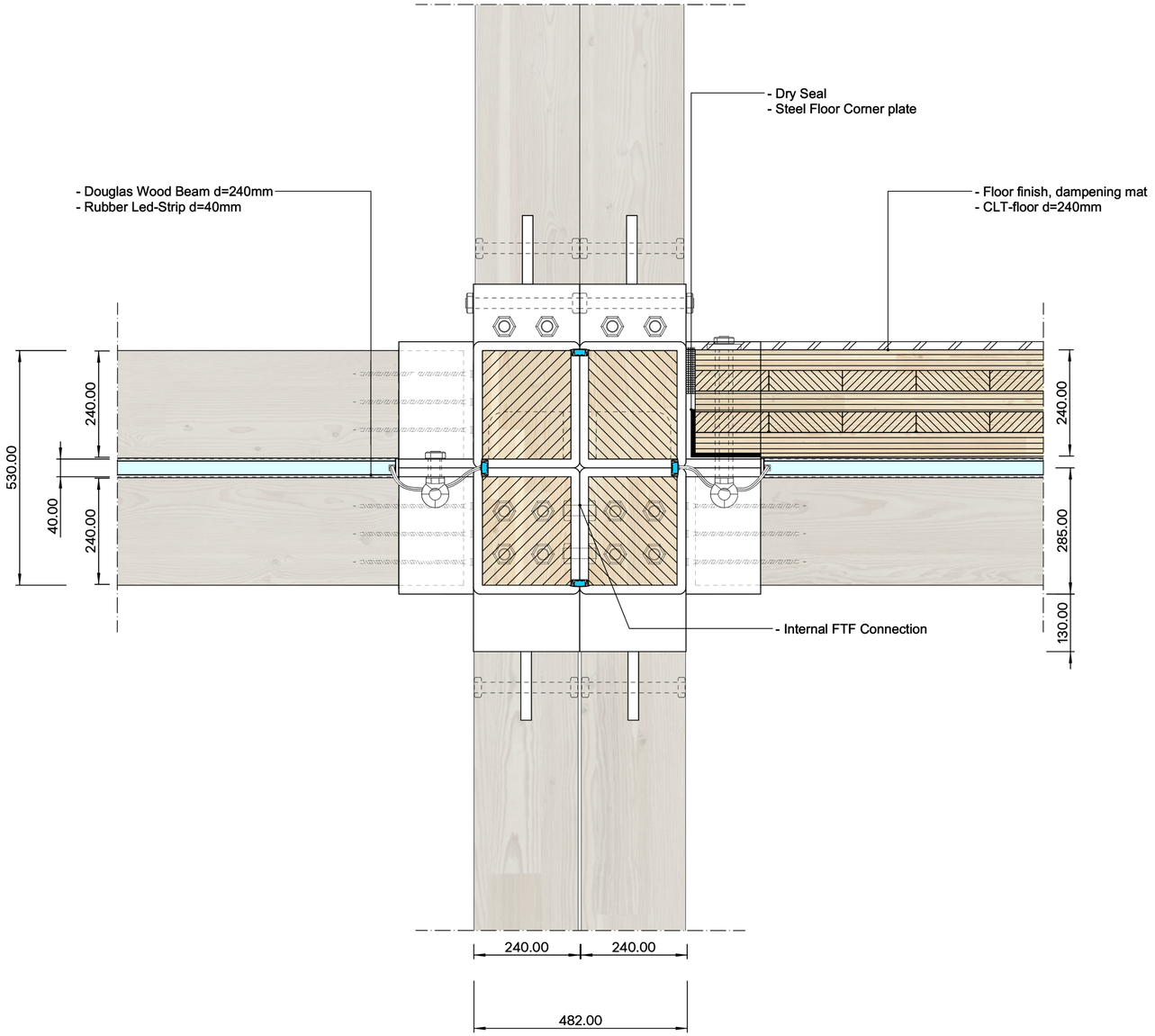
3D on site
2D Storage + Shipping

CONSTRUCTION // Detail 3D

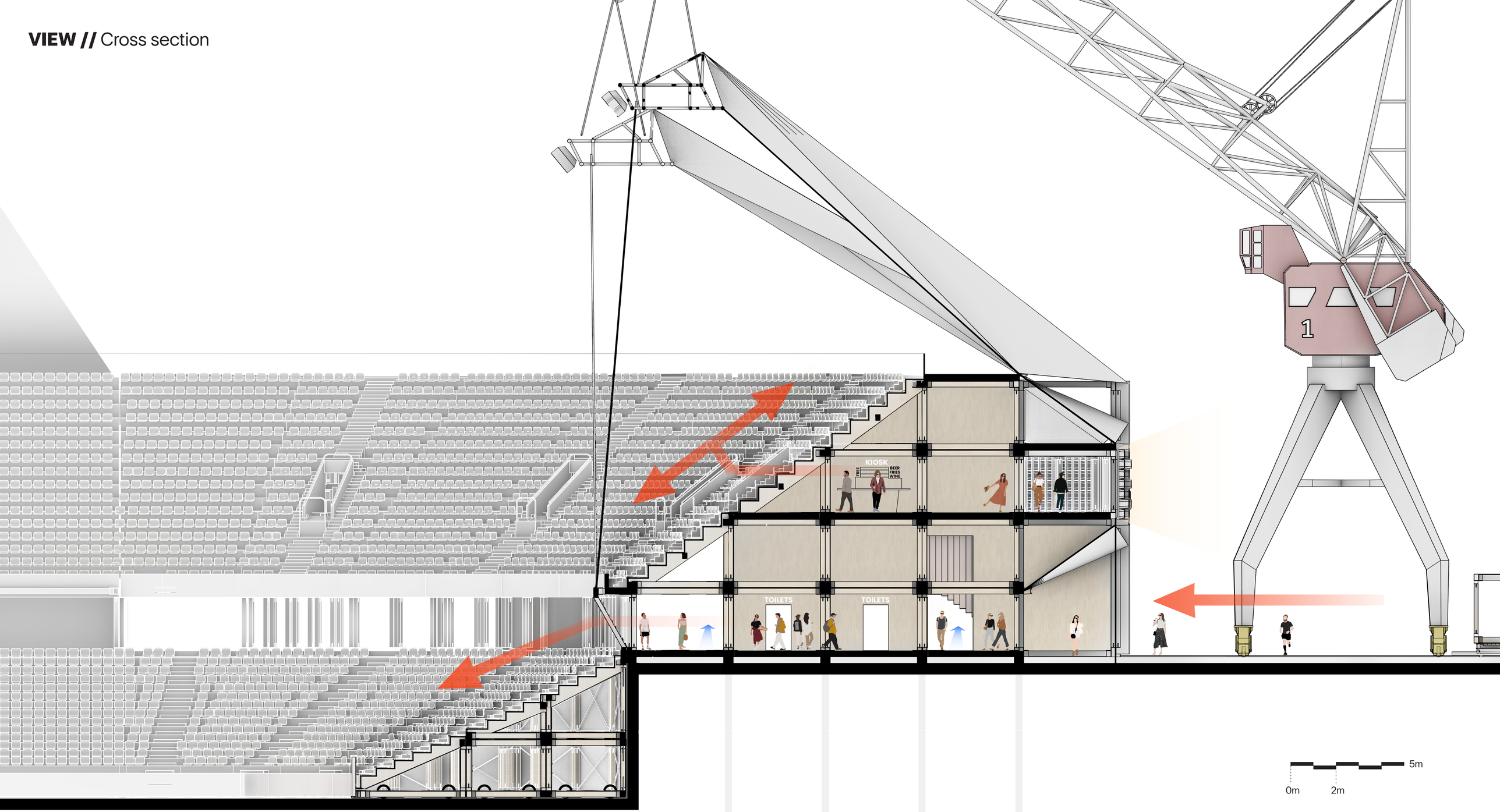




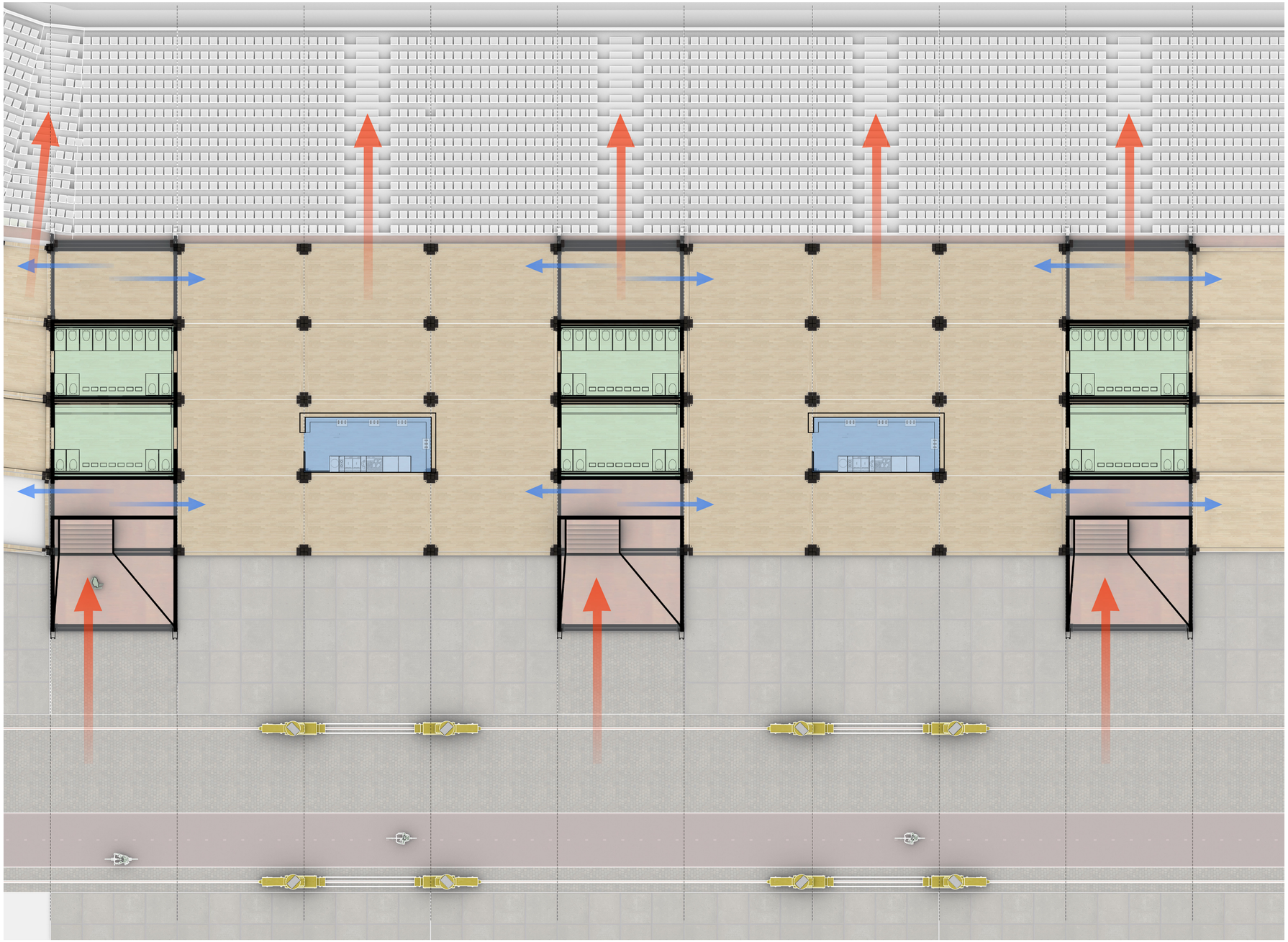
CONSTRUCTION // Detail 2D



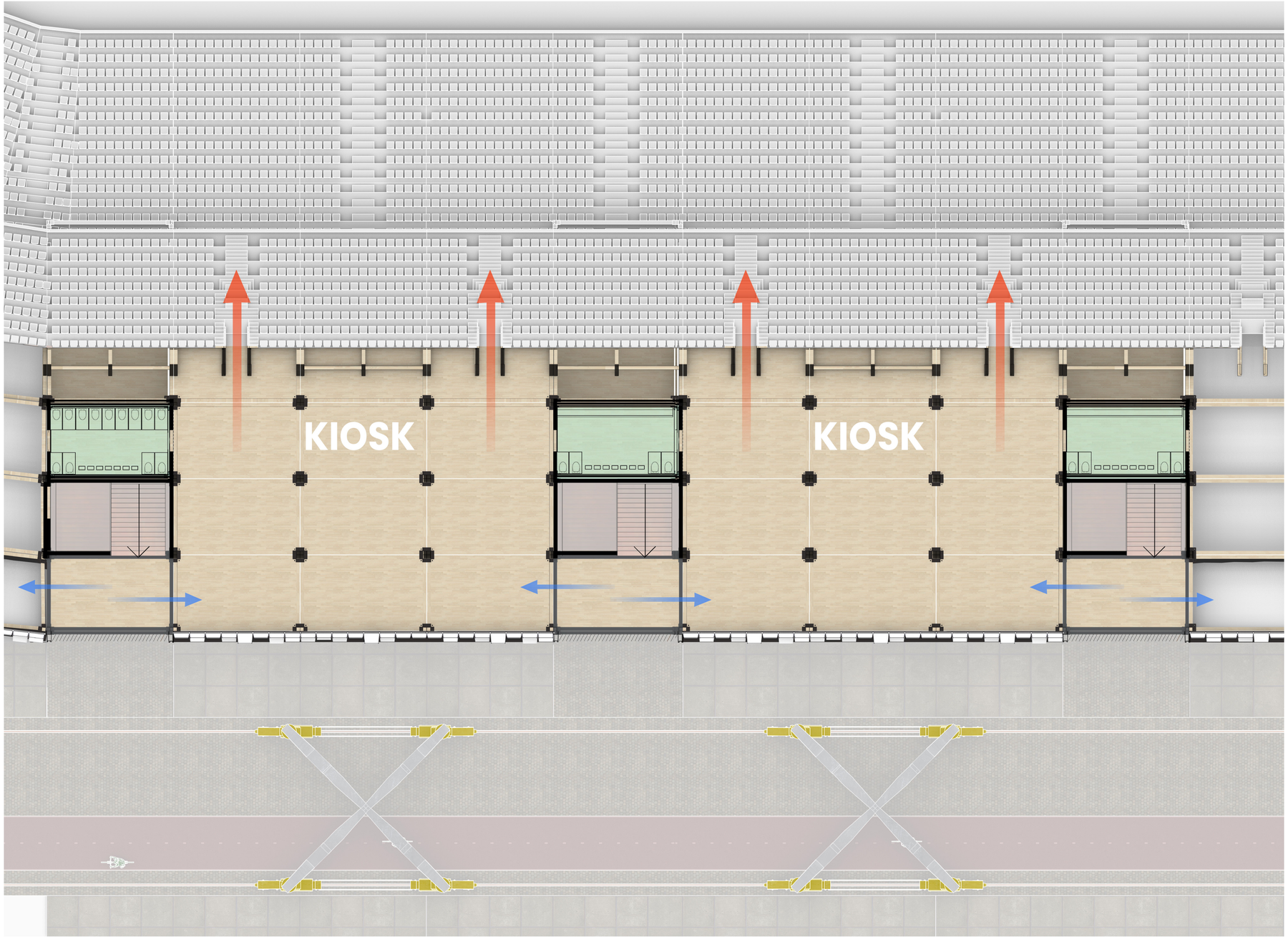
VIEW // Cross section



FIRST FLOOR // Floorplan



SECOND FLOOR // Floorplan

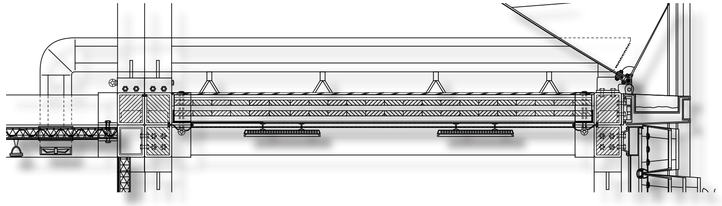


INTERIOR VIEW // Render

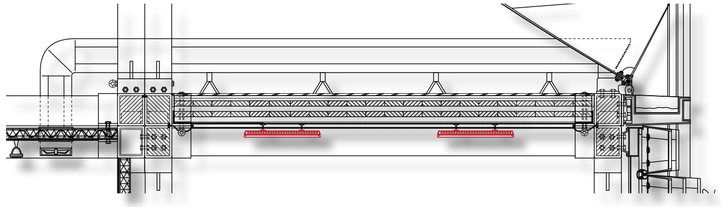


CLIMATE DESIGN

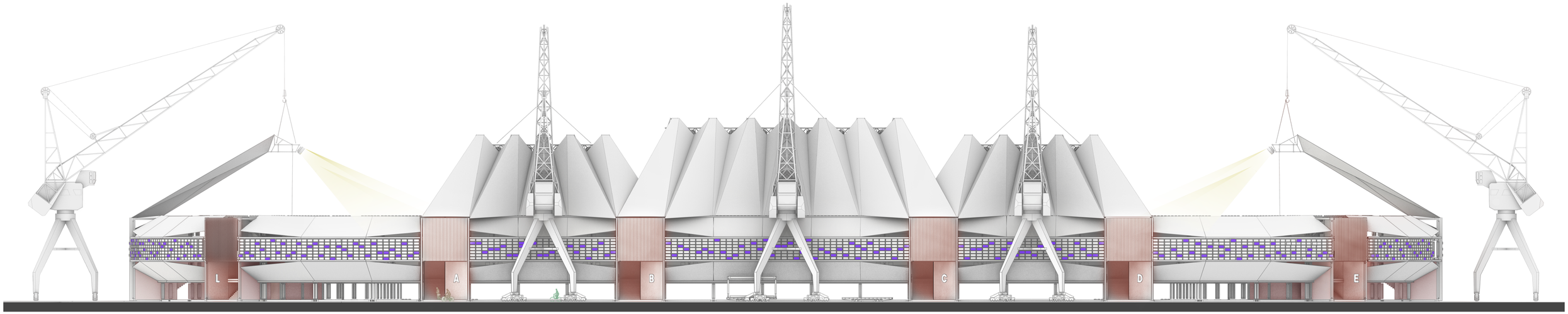
CLIMATE DESIGN // Ventilation



CLIMATE DESIGN // Infrared Heating



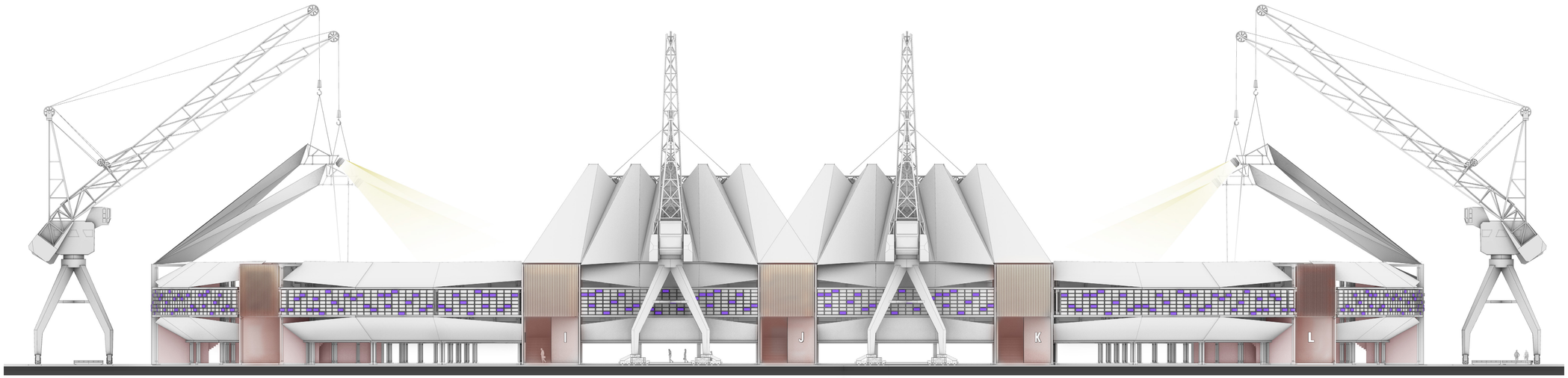
LONG SIDE // Elevation



45m

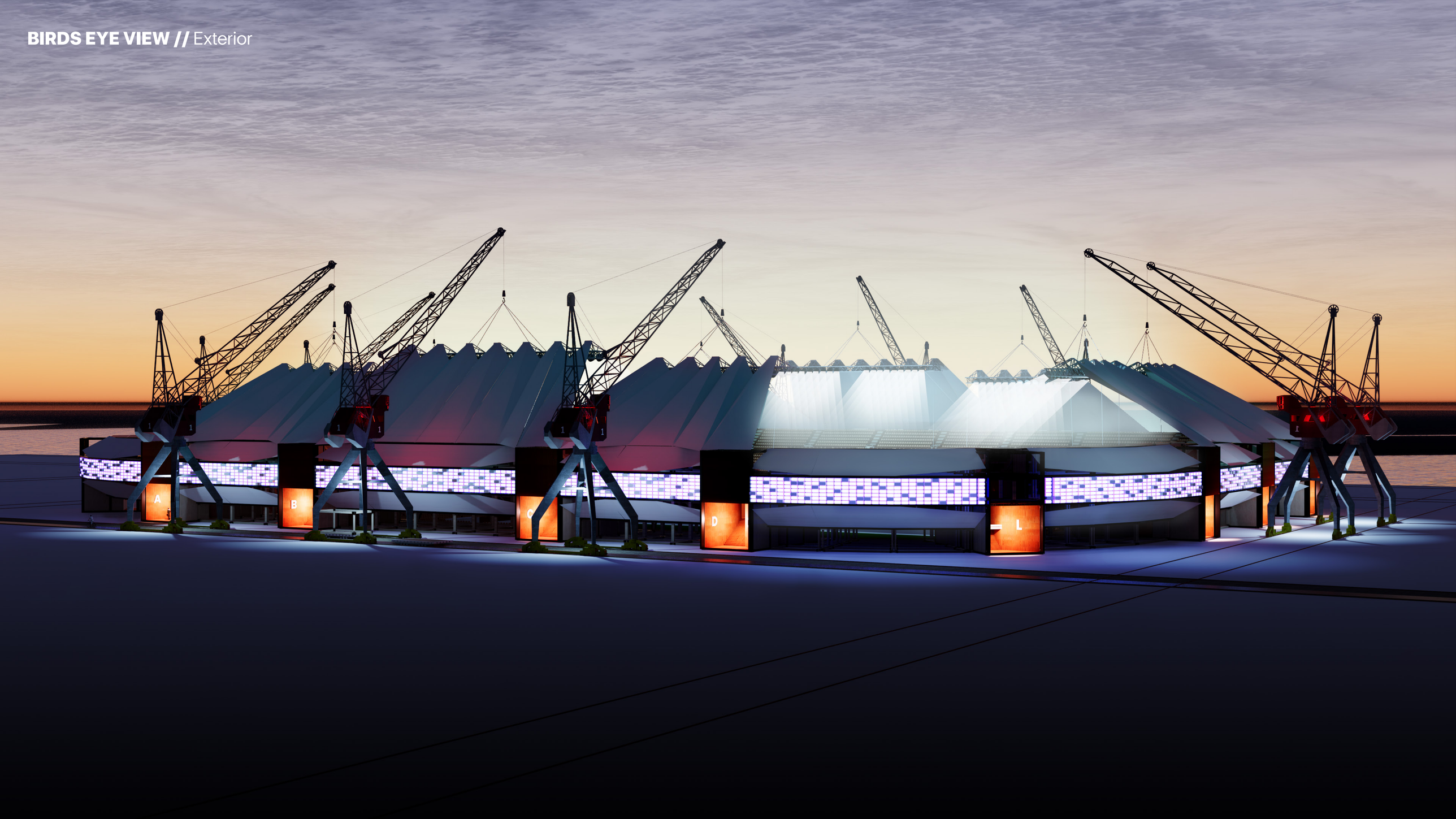
0m 7m

SHORT SIDE // Elevation



0m 7m 45m

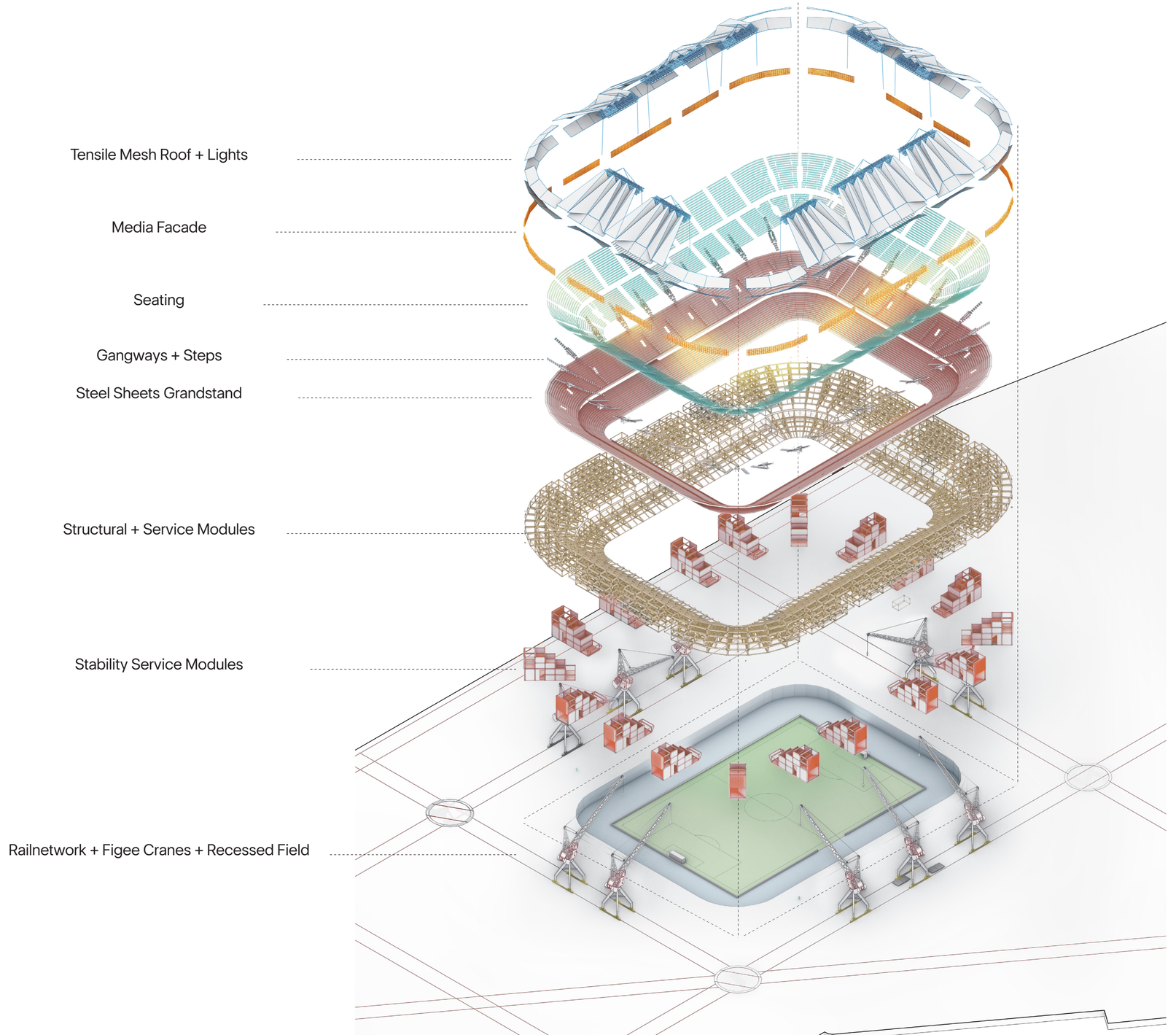
BIRDS EYE VIEW // Exterior



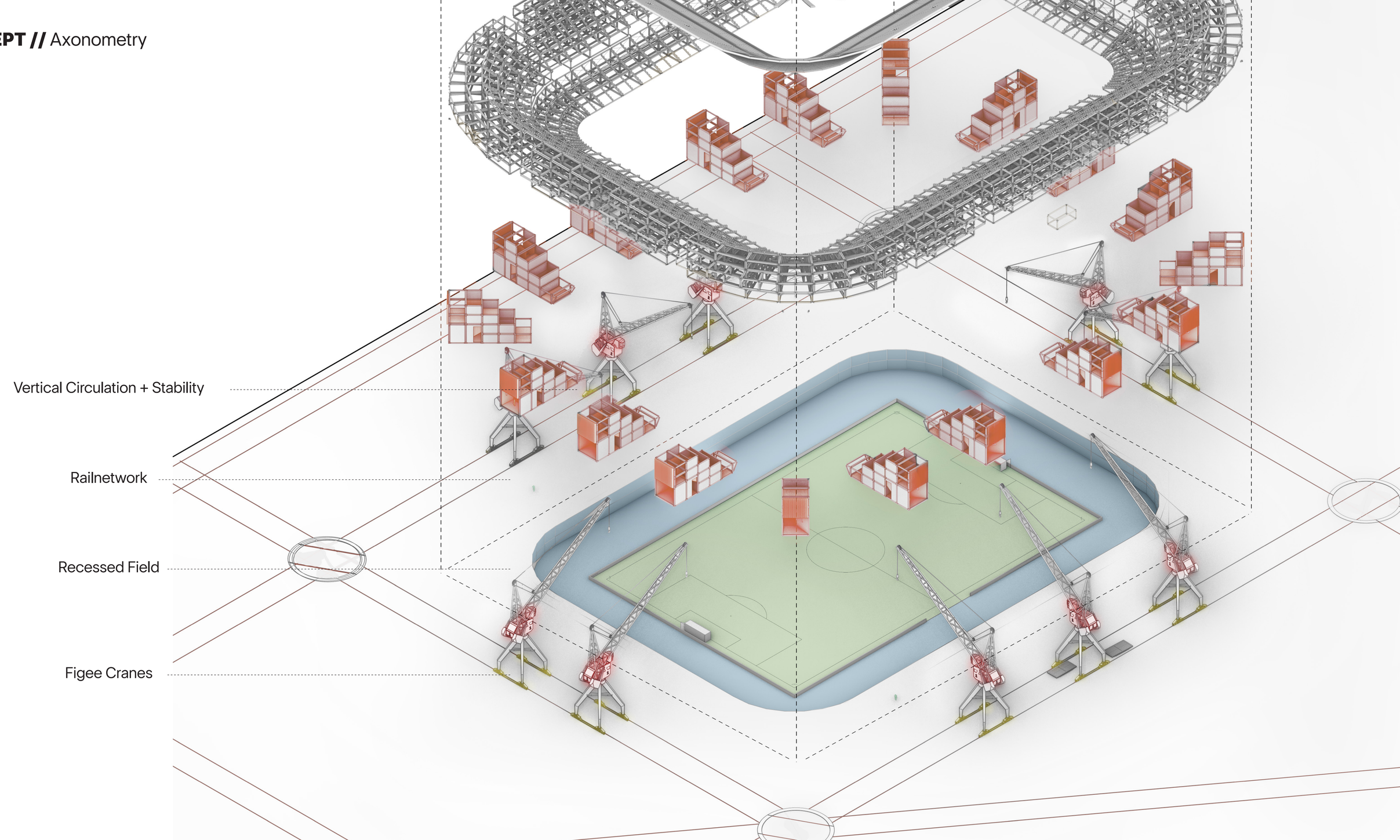
ENTRANCE VIEW // Exterior



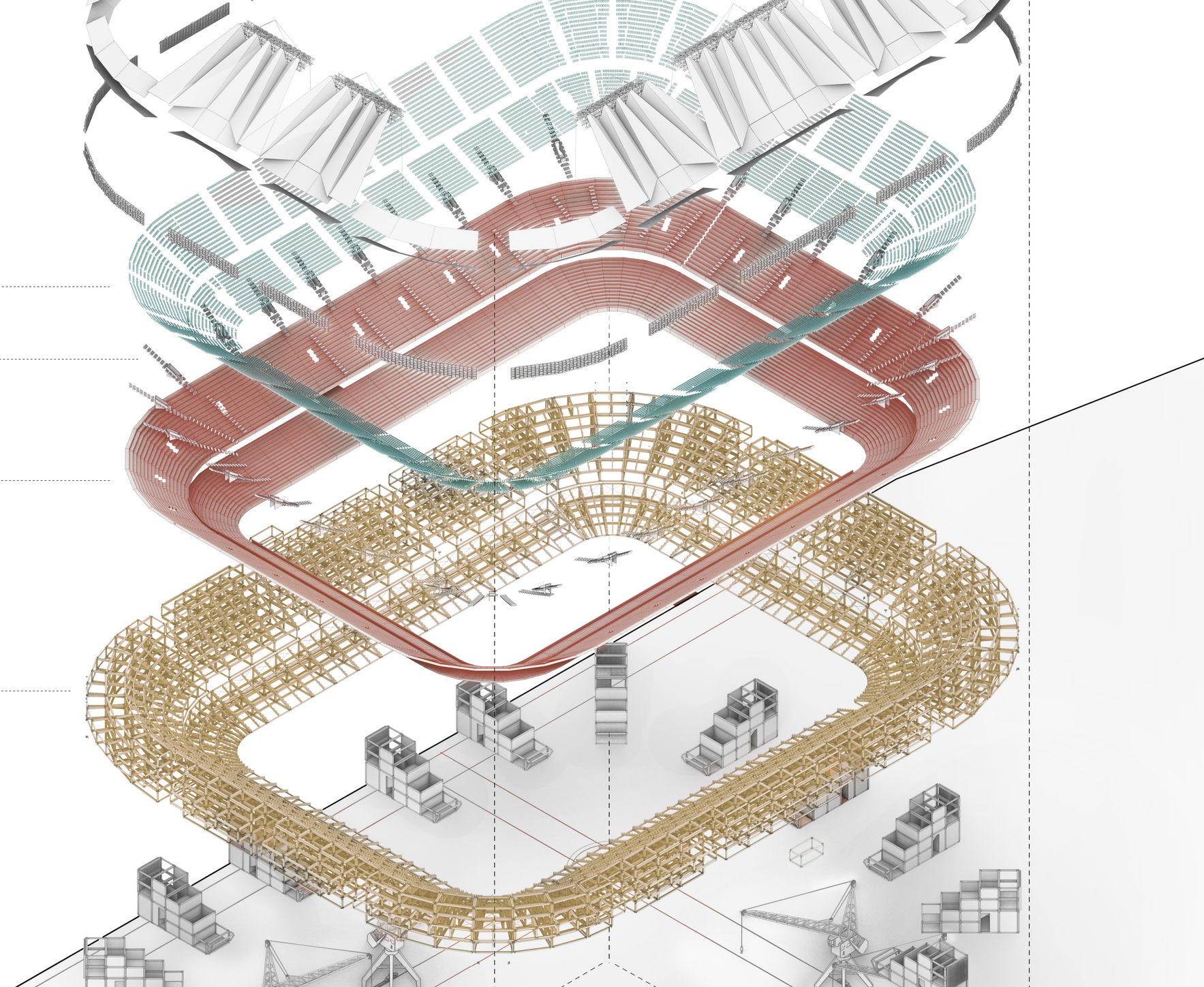
CONCEPT // Axonometry



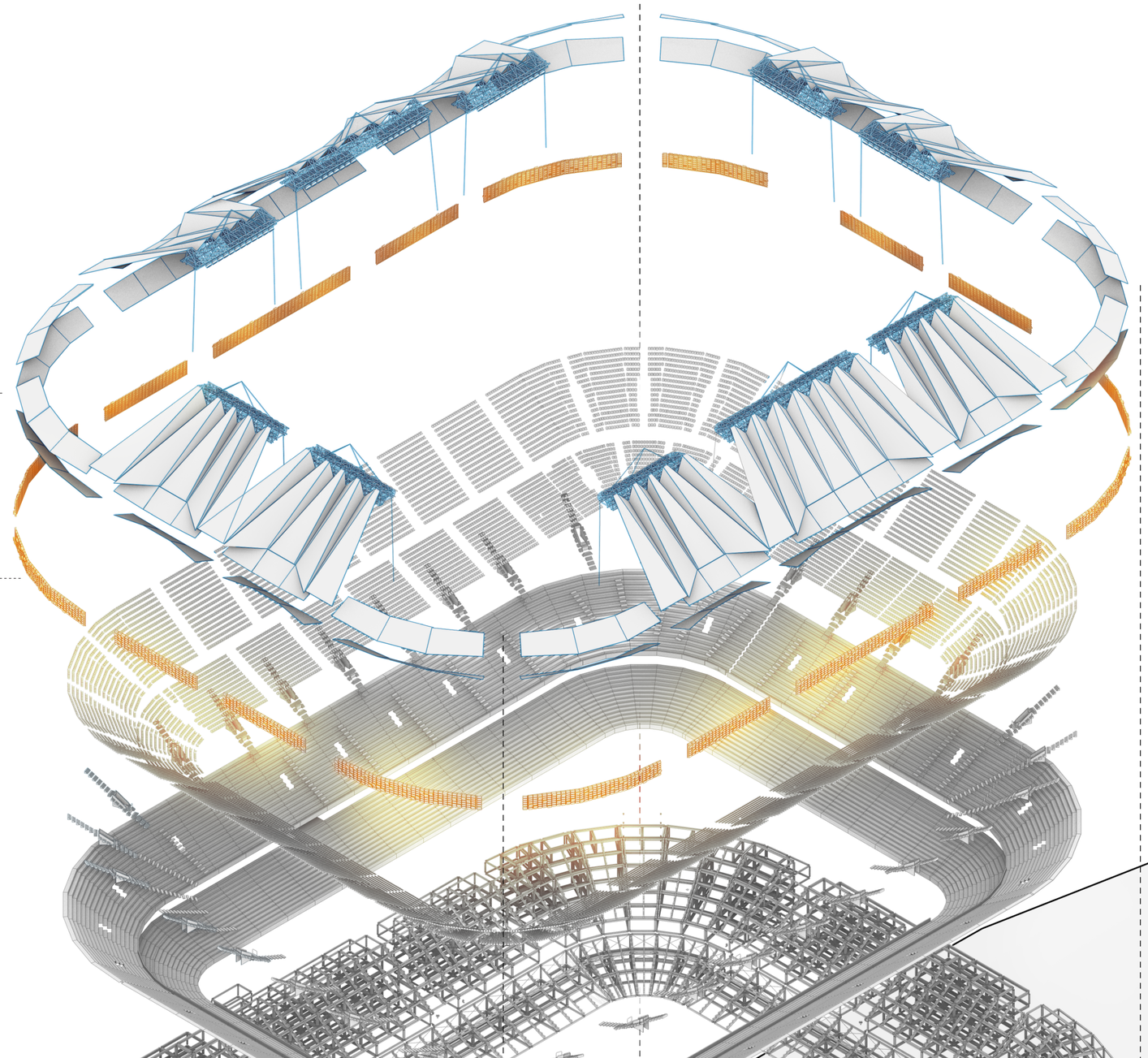
CONCEPT // Axonometry



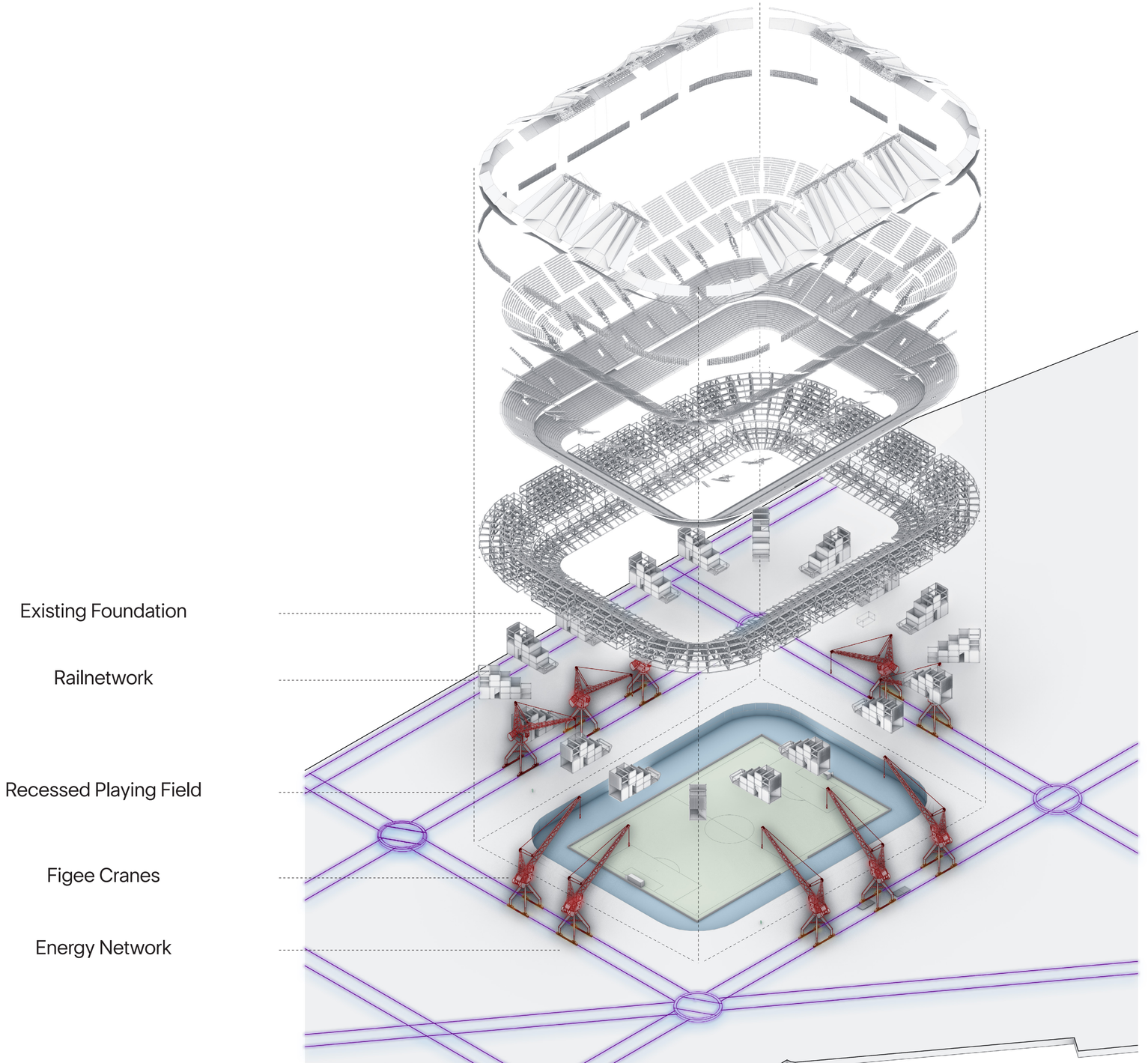
CONCEPT // Axonometry



CONCEPT // Axonometry



WHAT IS FIXED? // Axonometry

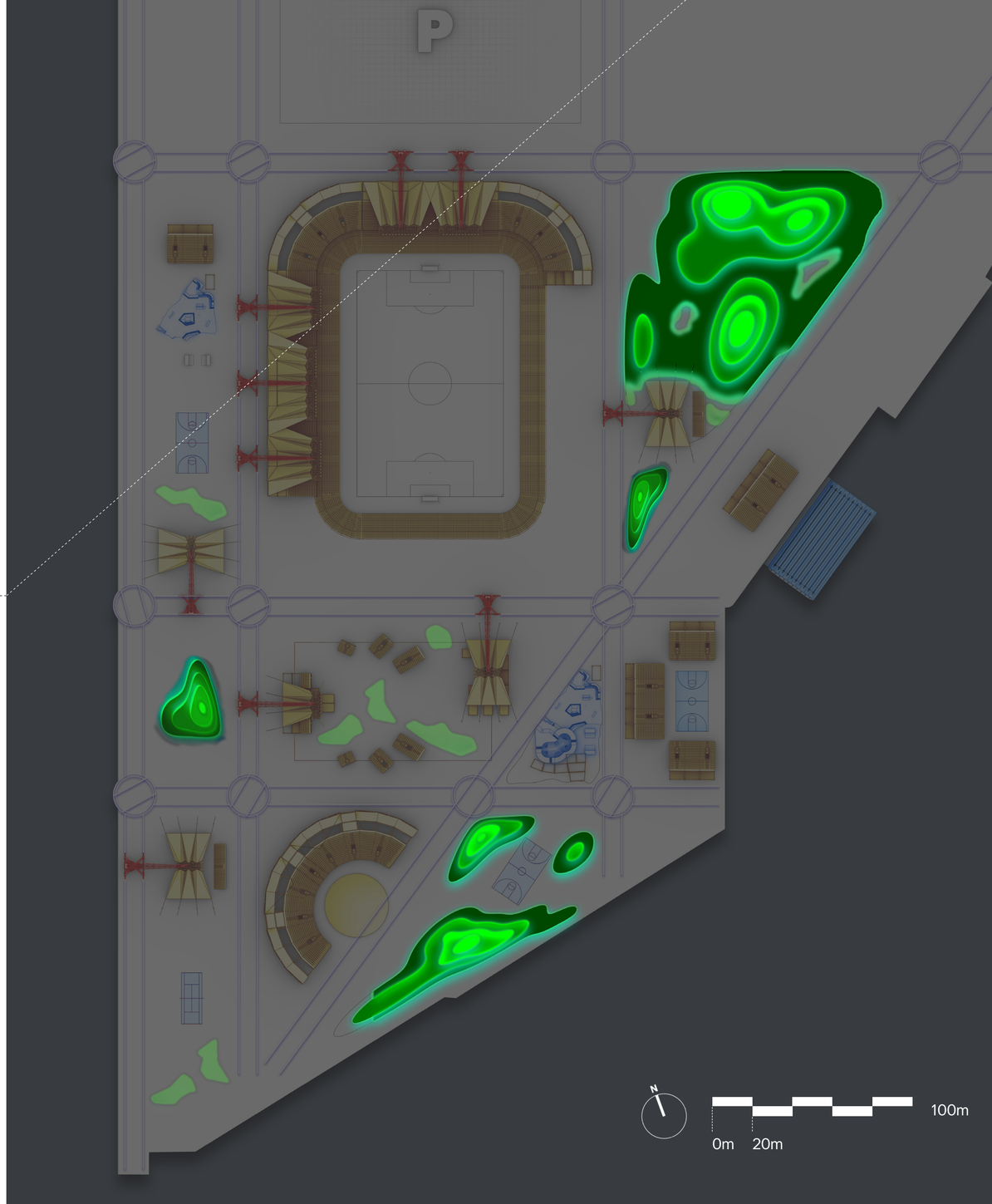


CLOSED SOIL BALANCE

LOCAL SOIL // Undulating Elevation



Land Elevation



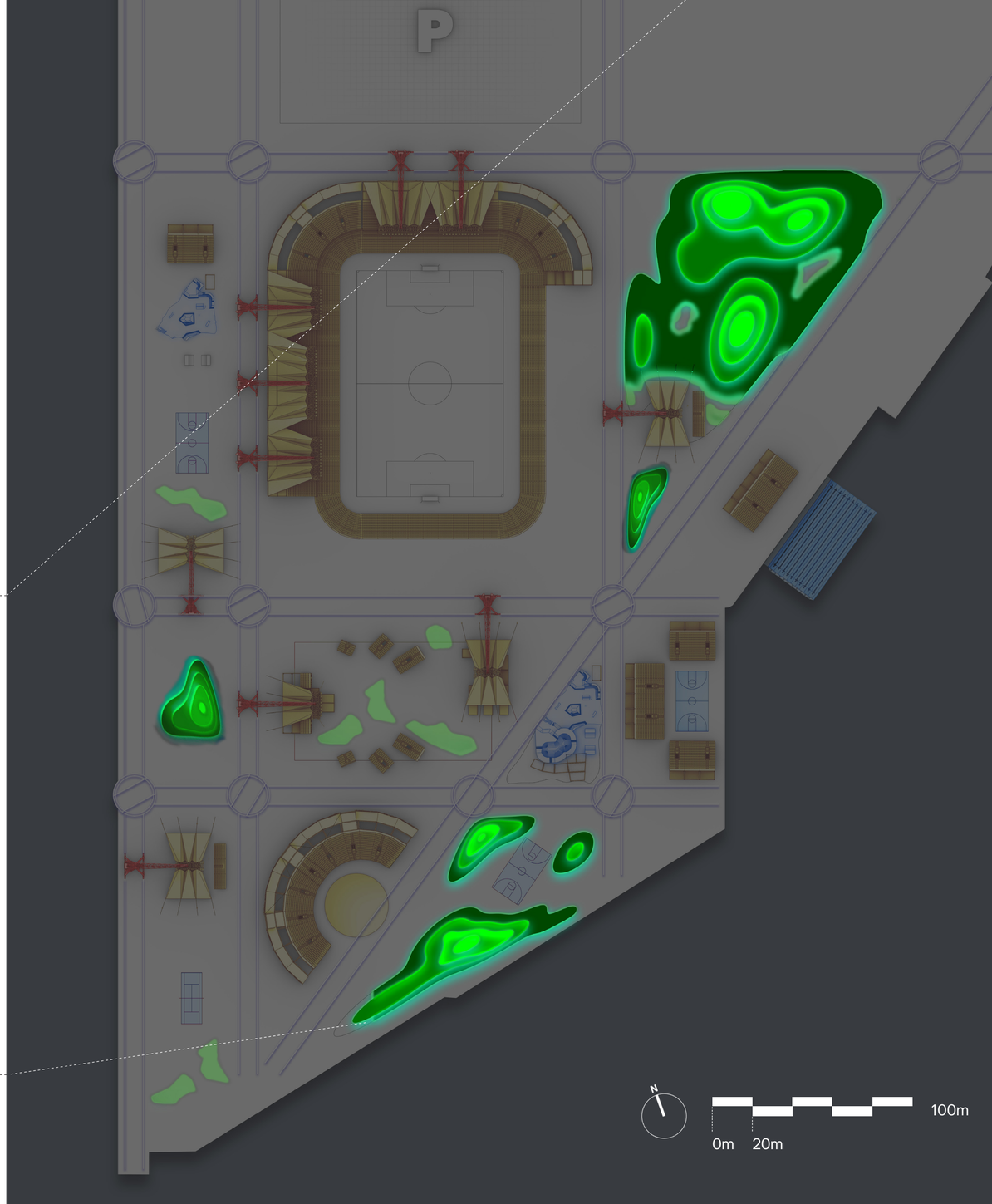
LOCAL SOIL // Undulating Elevation



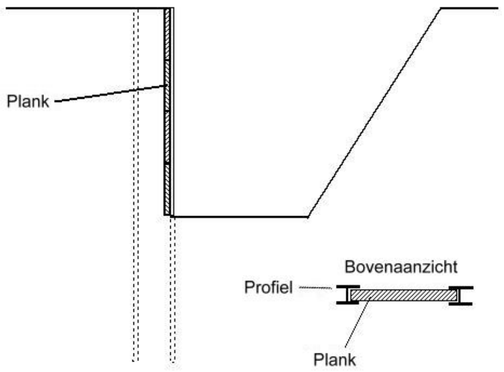
Land Elevation

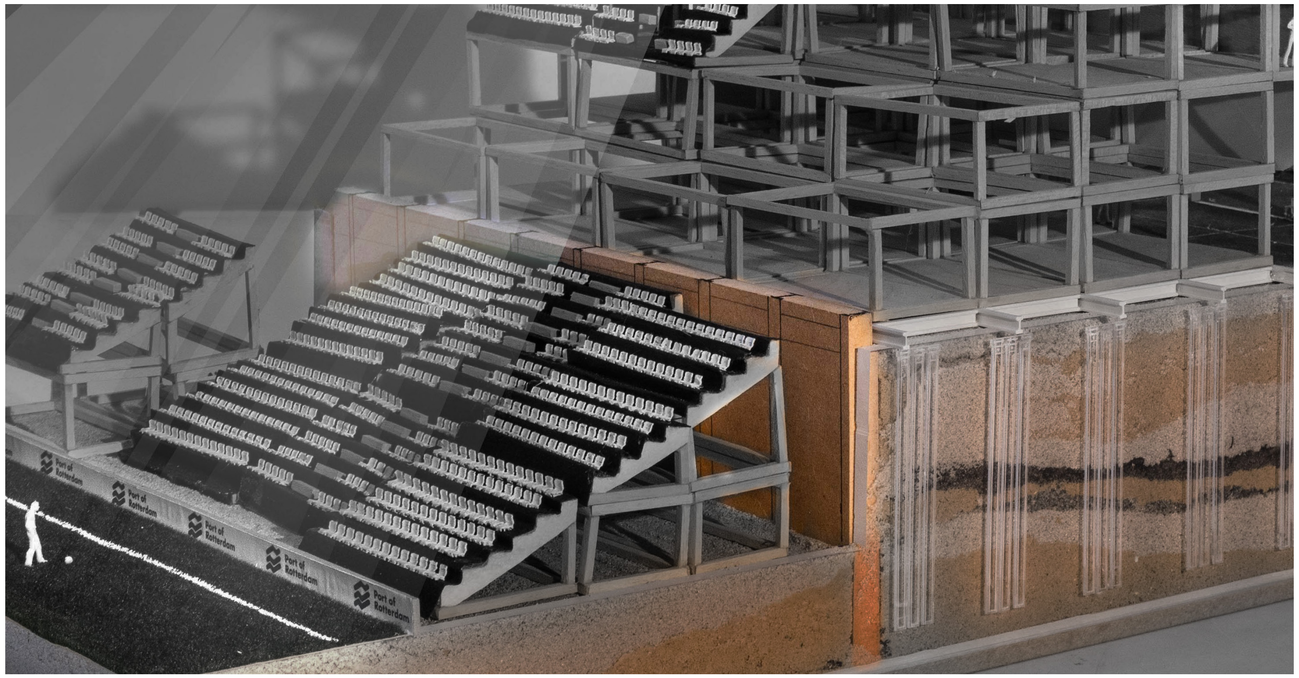


Undulating Park



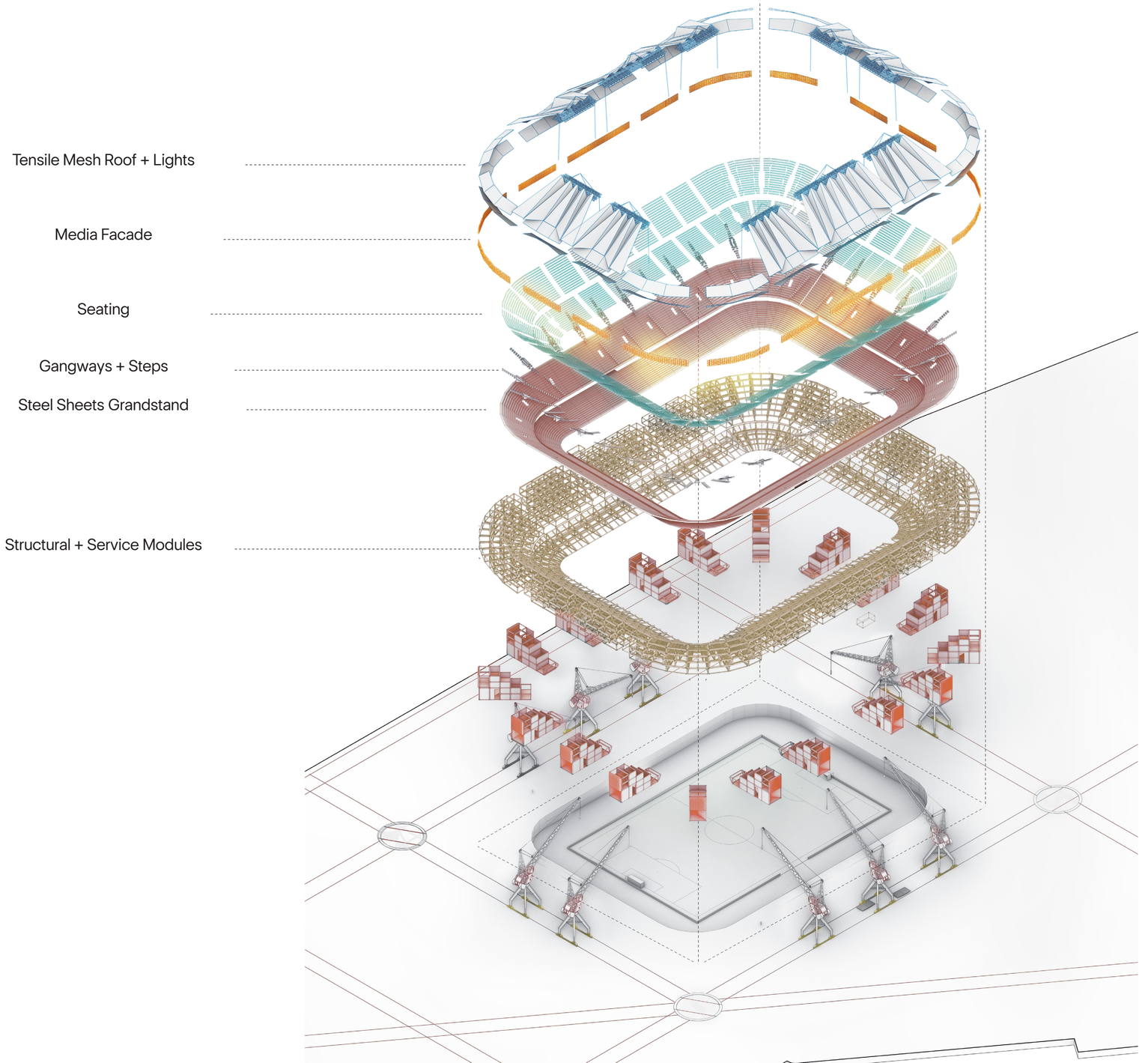
EXCAVATION // Berliner Wall







CONCEPT // Axonometry



MATERIALITY

MATERIALITY // Circularity

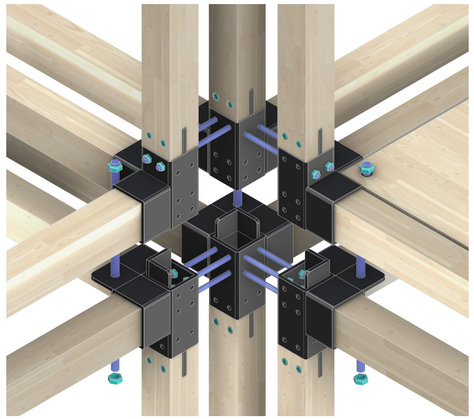


Douglas Wood Beams + Columns

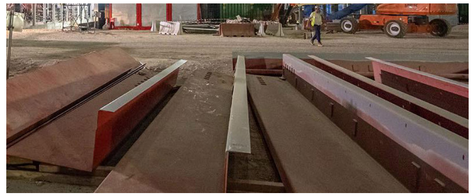


CLT Floors + Walls

MATERIALITY // Circularity

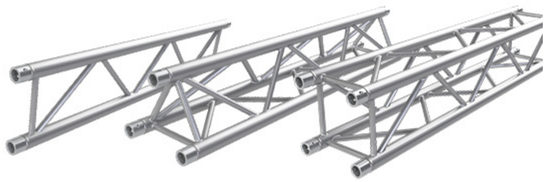


Recycled Steel Components



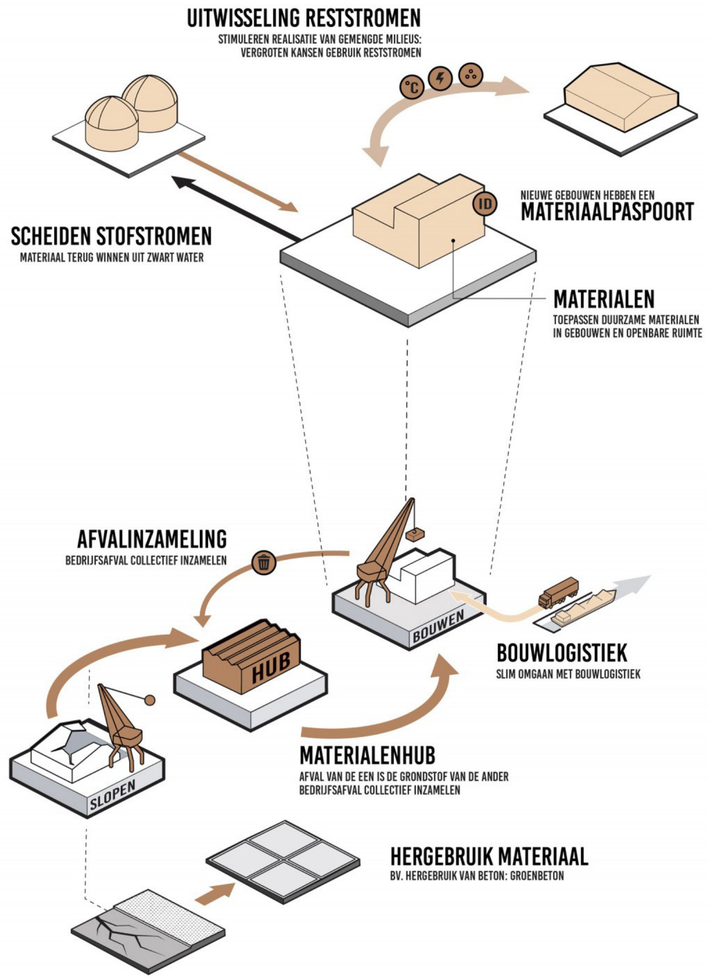
Steel Sheets

MATERIALITY // Circularity



Aluminum Event Truss

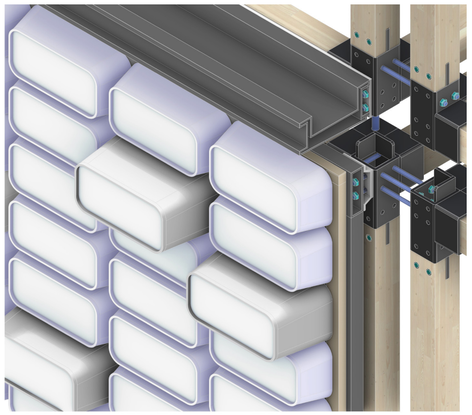
MATERIALITY // Circularity



MATERIALITY // Circularity



Industrial Fish Containers




B

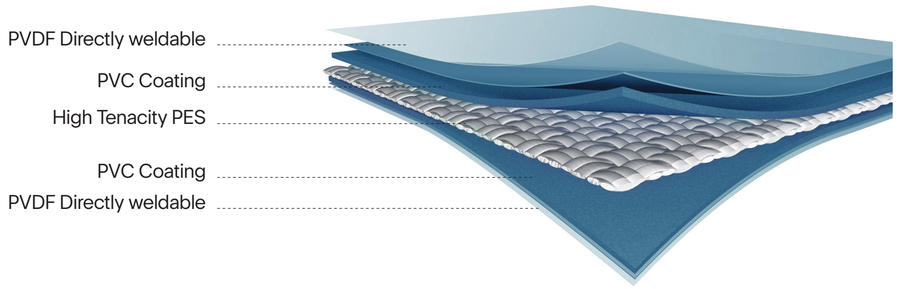
MATERIALITY // Circularity

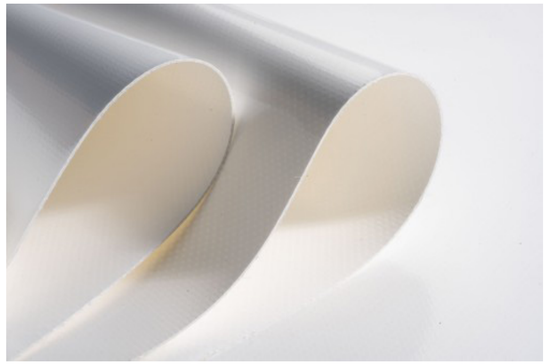


Used PVC Truck Tarp

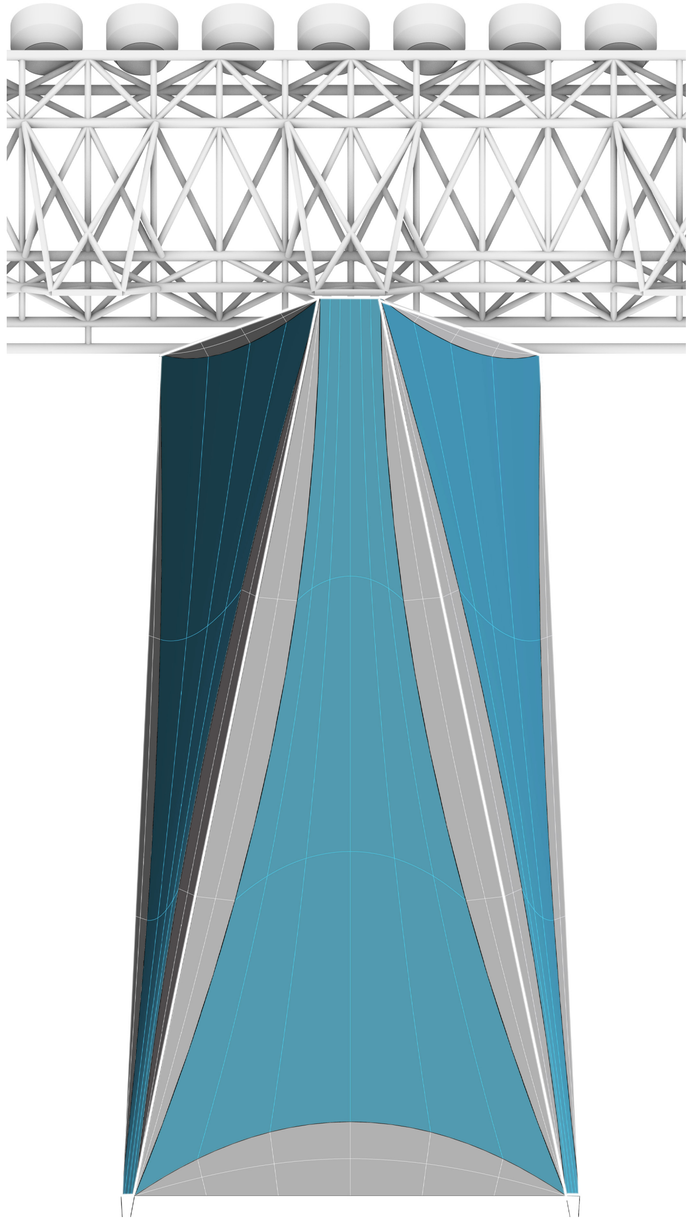


MEMBRANE // Technical Textile

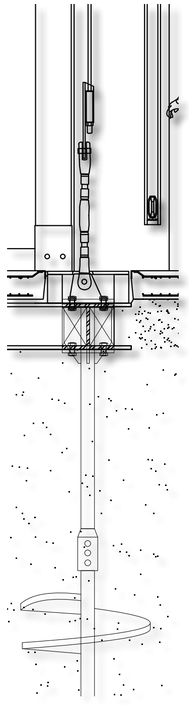




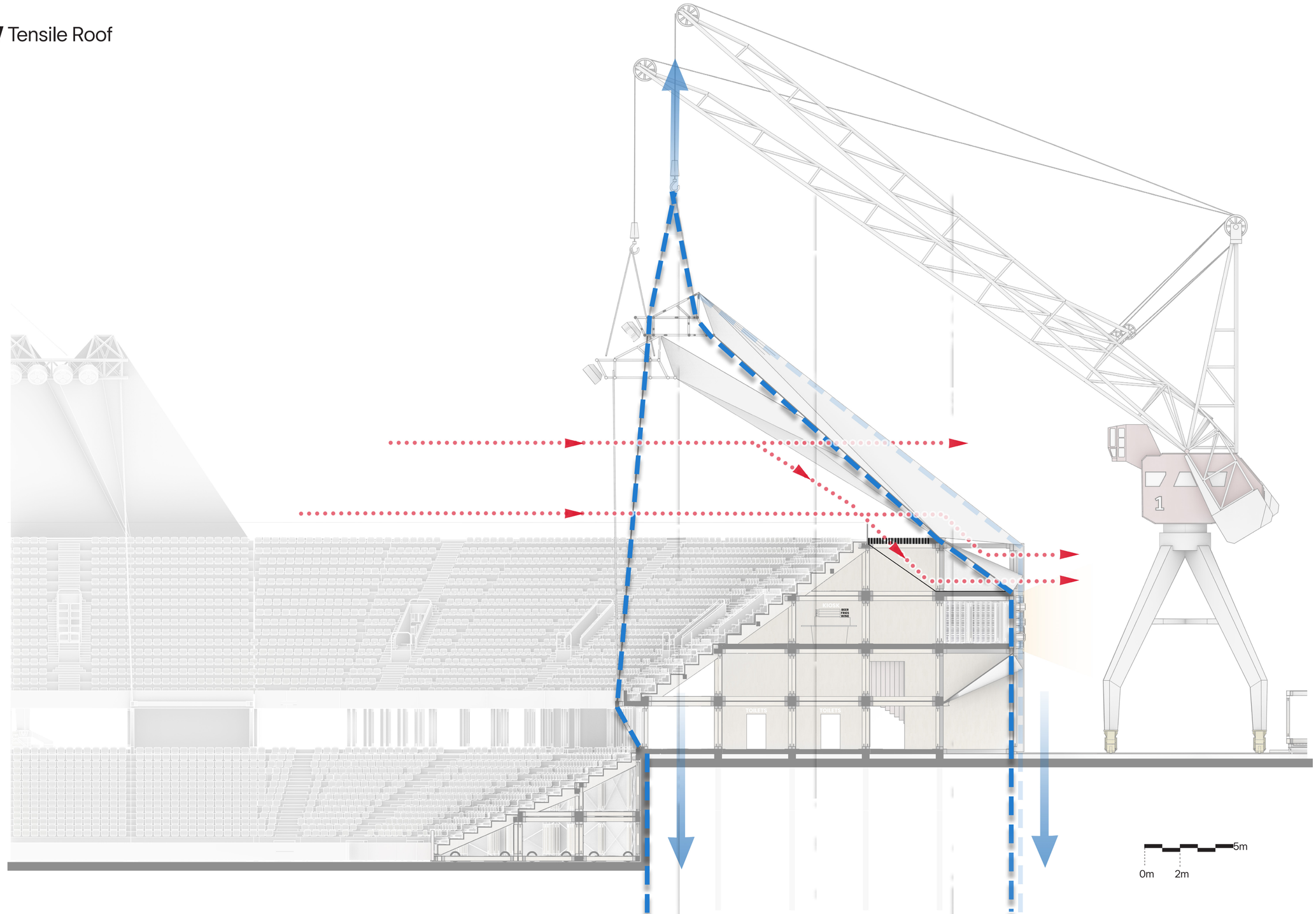
SIOEN FLUOMAX
Type IV T4119F // 1600 g/m^2



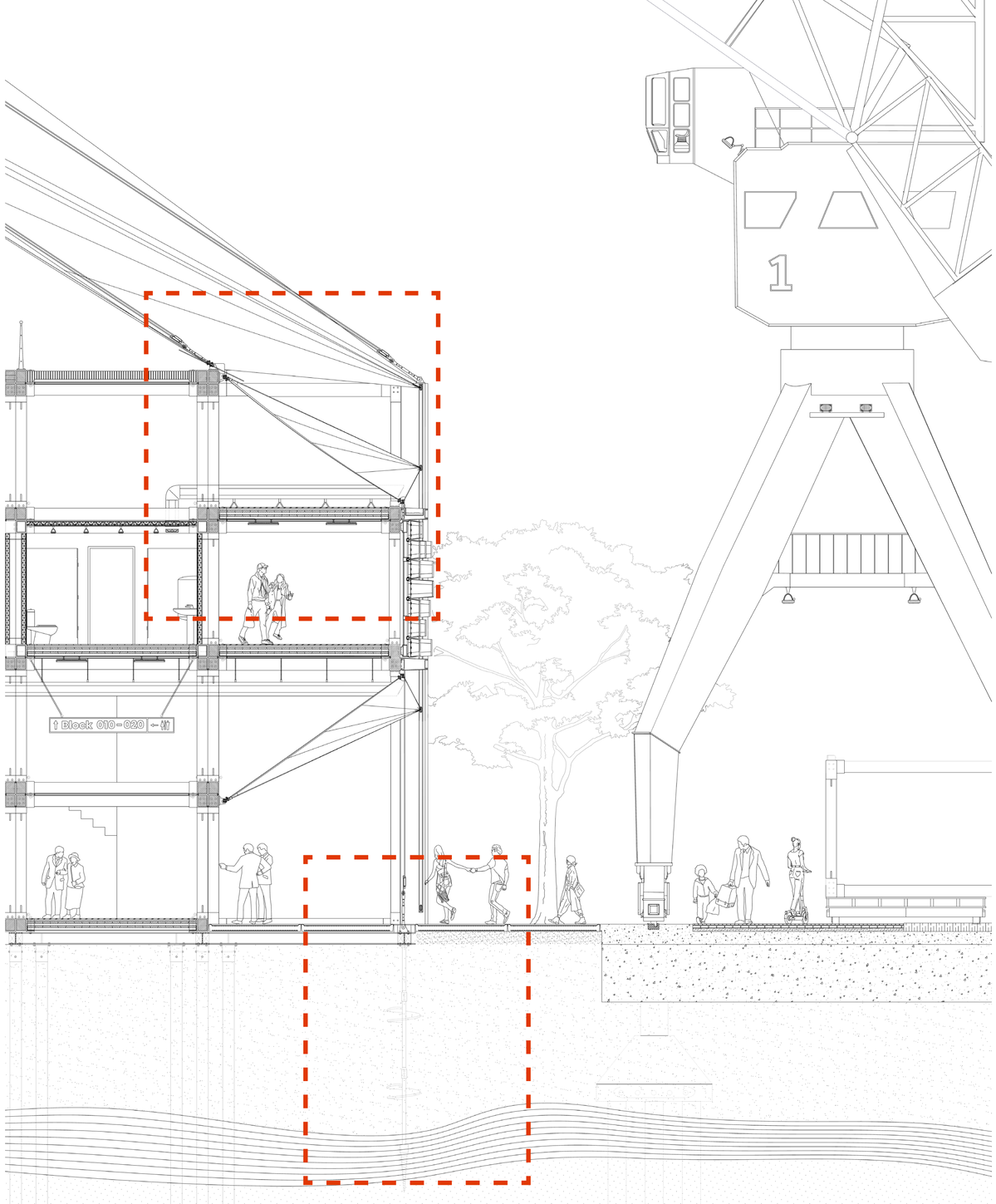
L: 20m **x** **W:** 7m



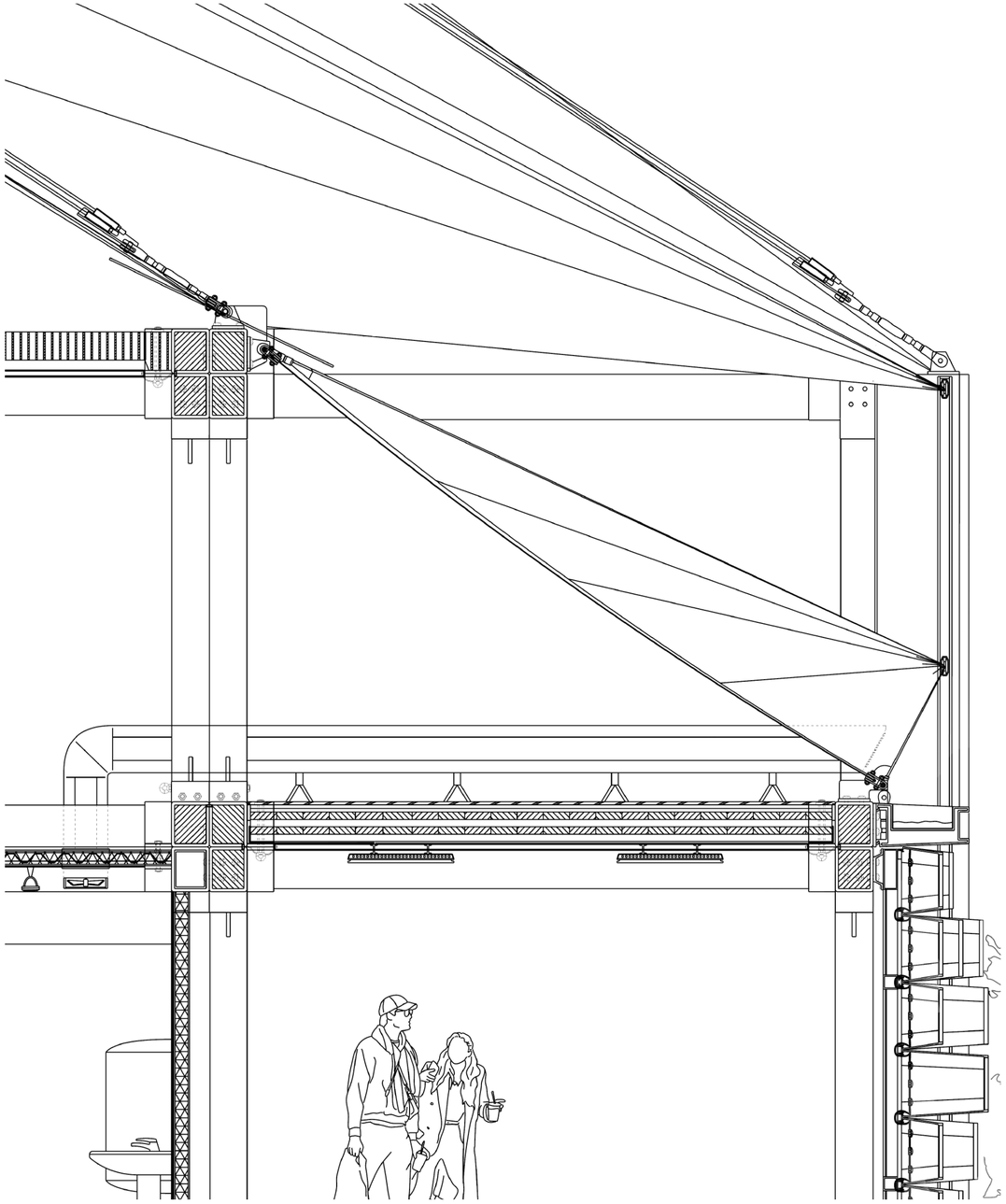
STRUCTURE // Tensile Roof

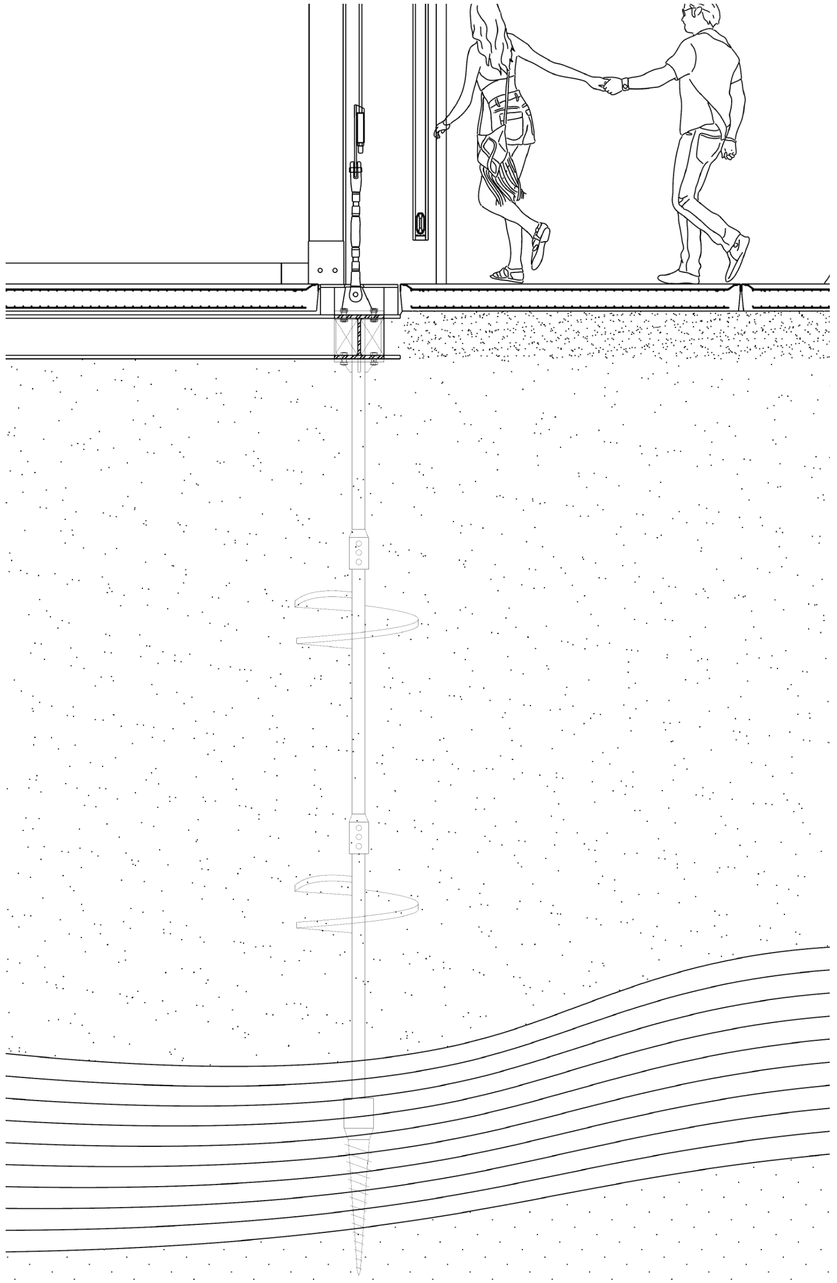


MEMBRANE // Technical Textile



MEMBRANE // Technical Textile





FIELD VIEW // Render



FIELD VIEW // Render



ENERGY SYSTEM

ENERGY // Area Solution

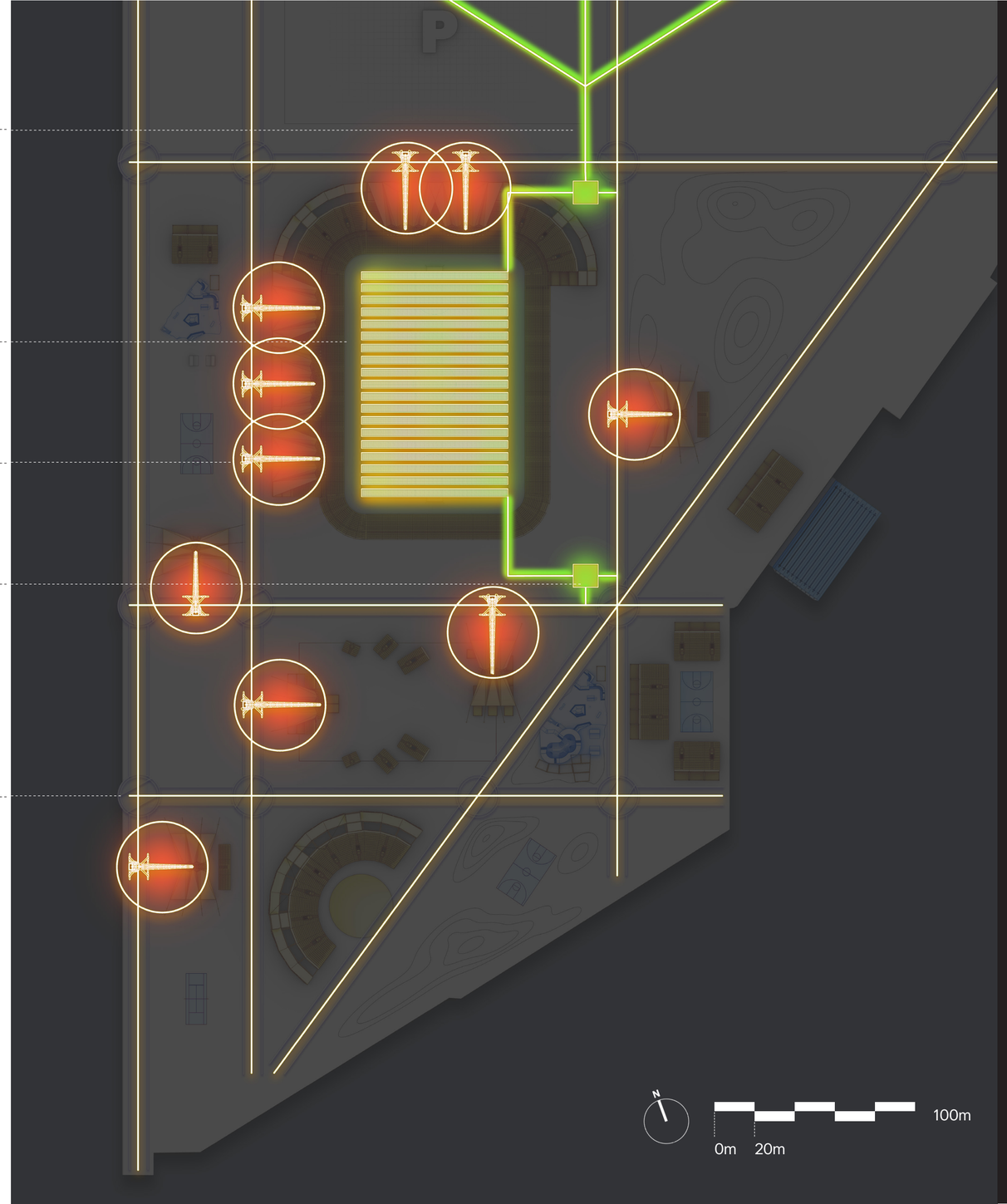
Output to rest of M4H

PV Panel Field

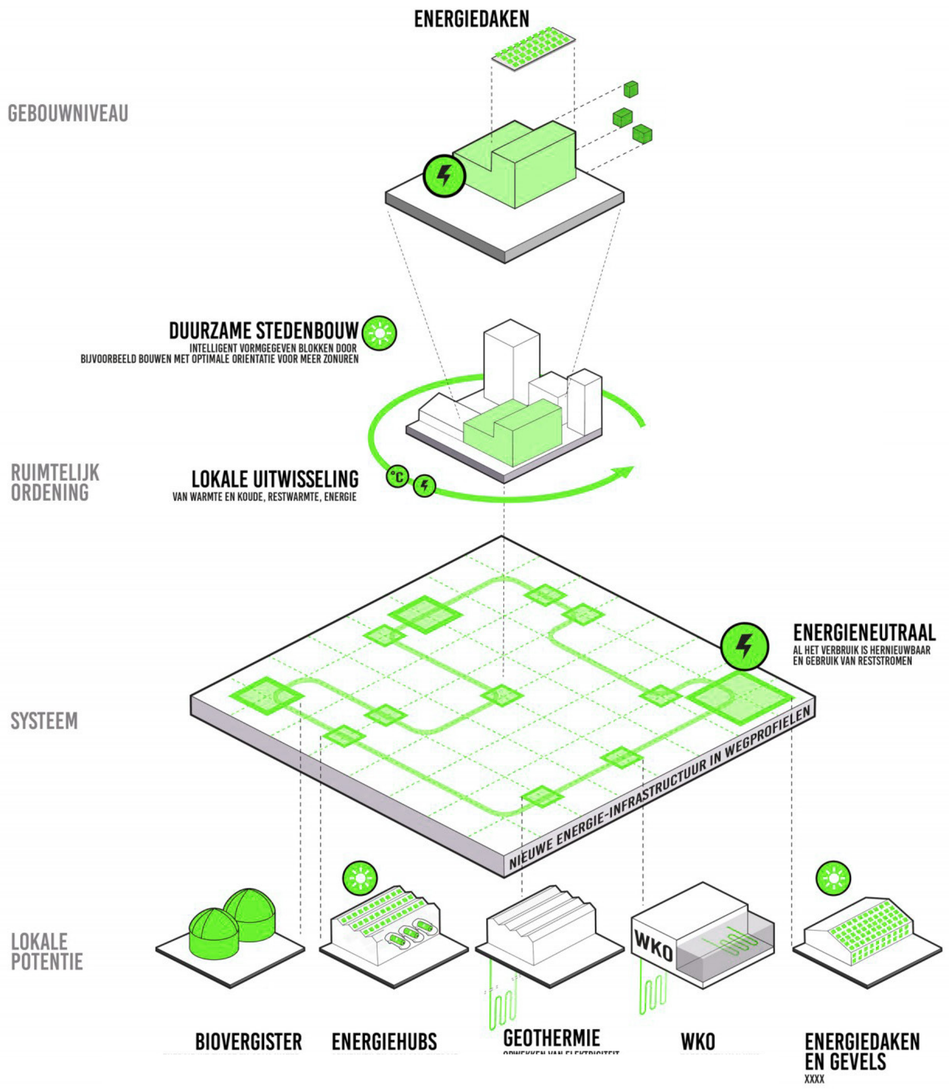
Output via Cranes

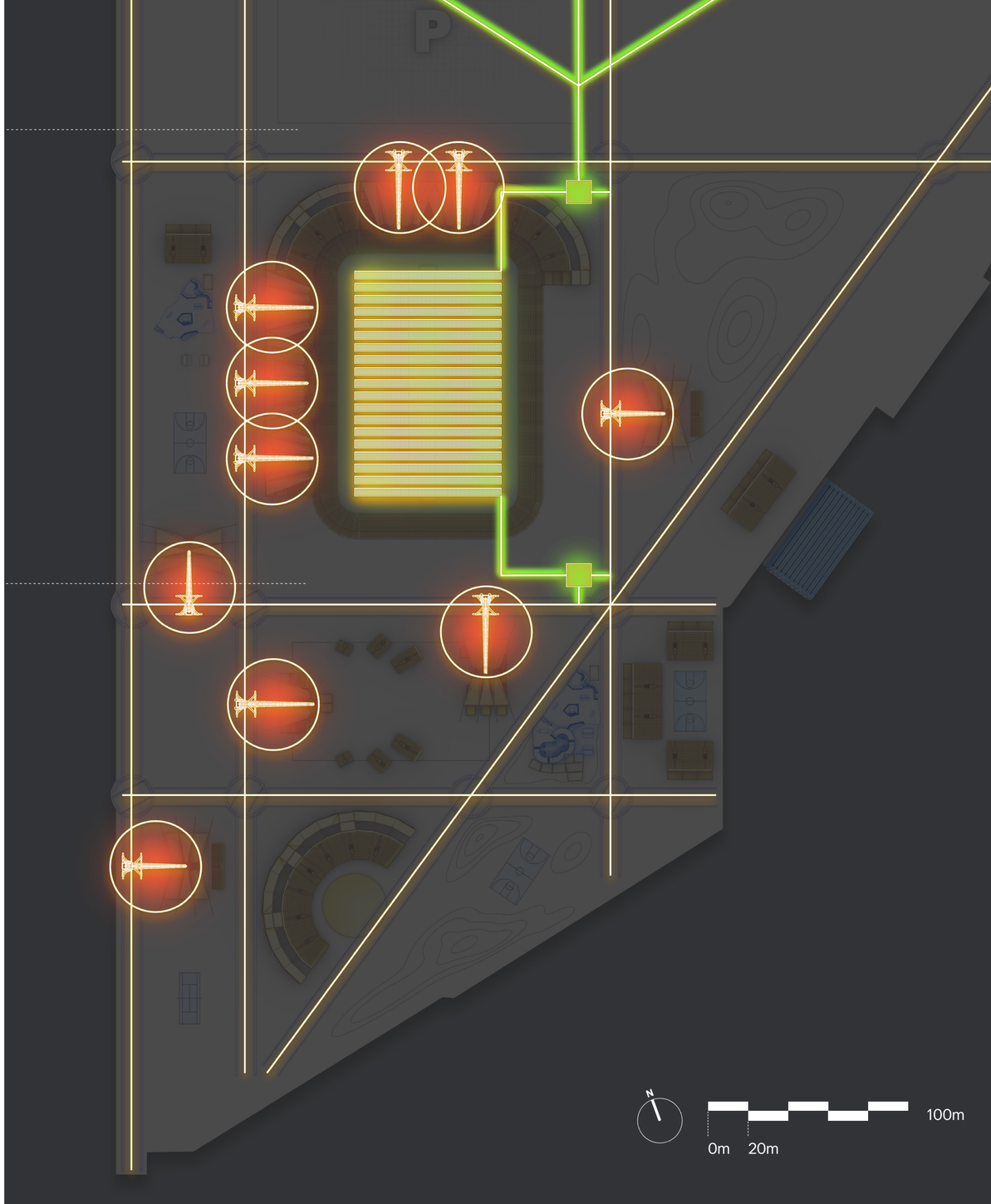
Energy Storage

Transport via railnetwork

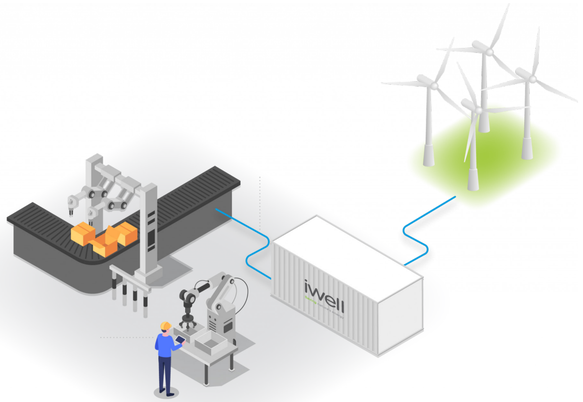


ENERGY // Area Solution

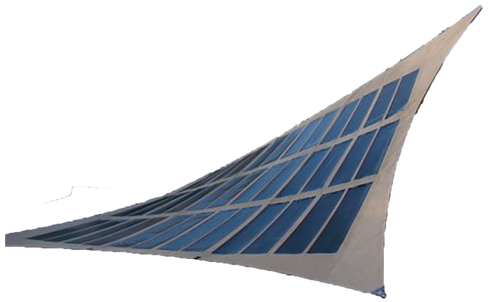




ENERGY // Building Solution

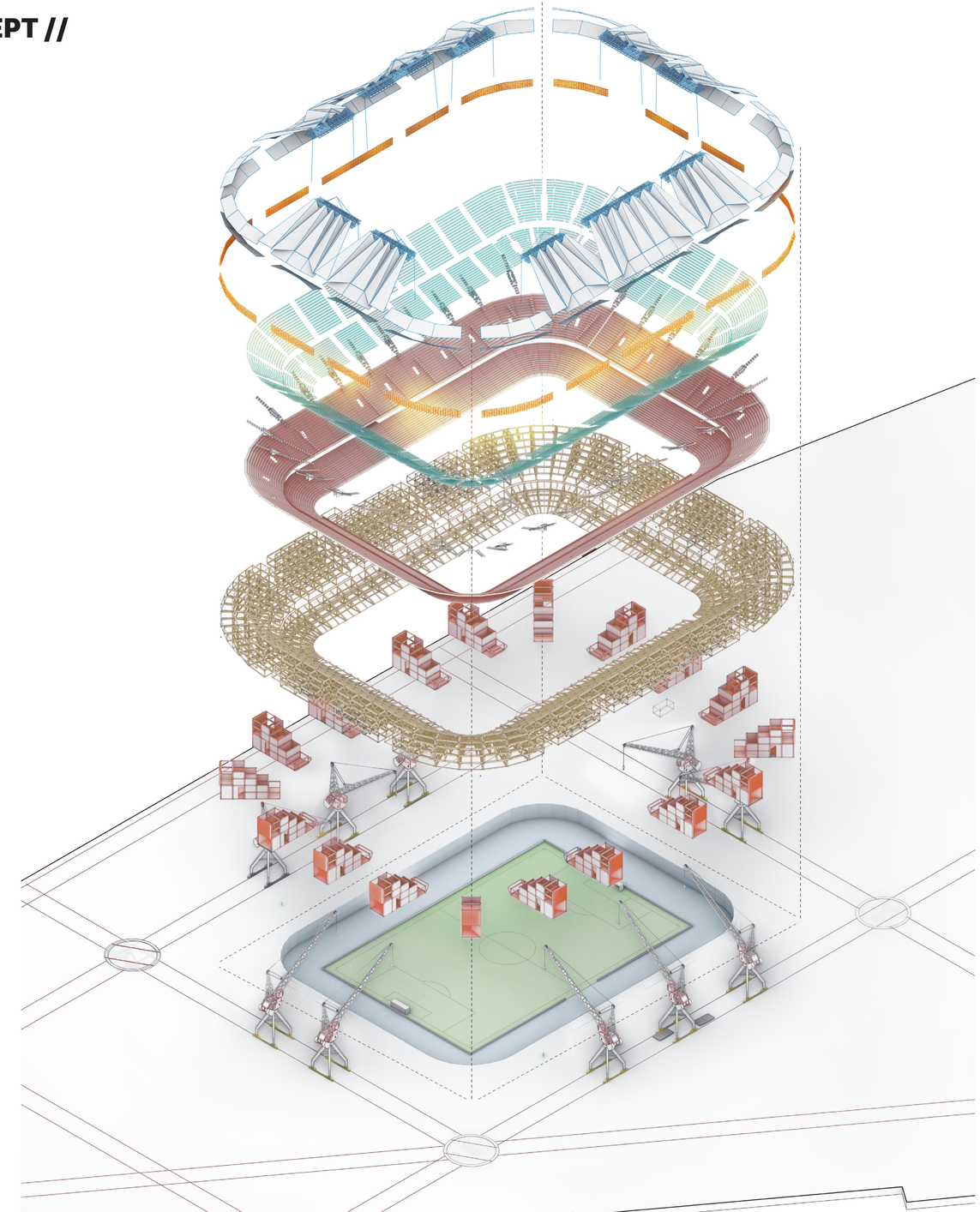


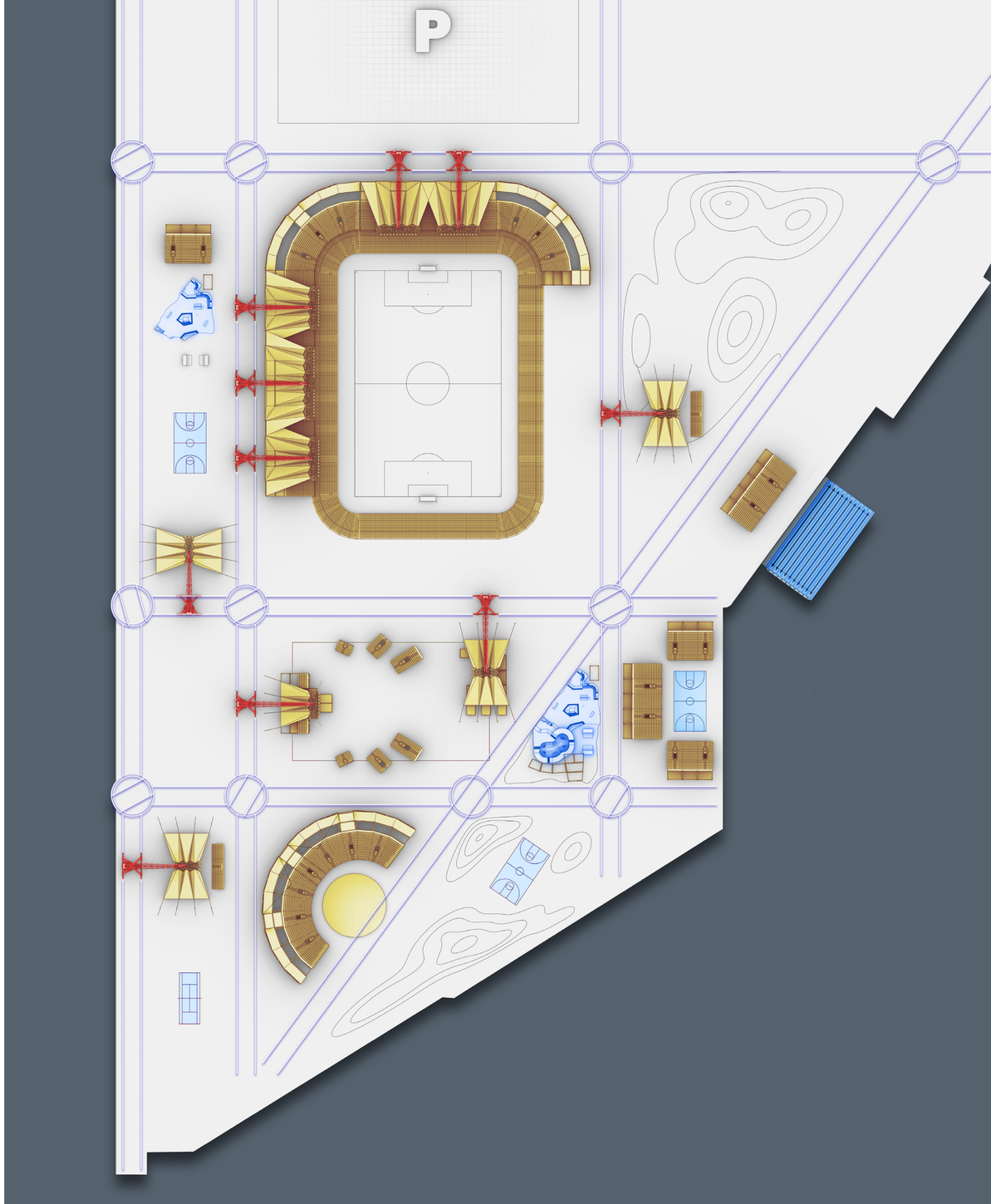
IWELL Battery Module



Solar Panel Fabric

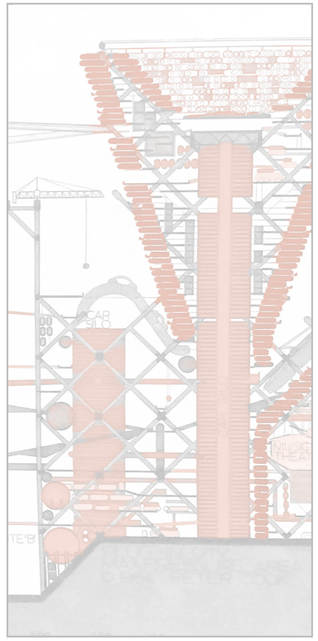
CONCEPT //



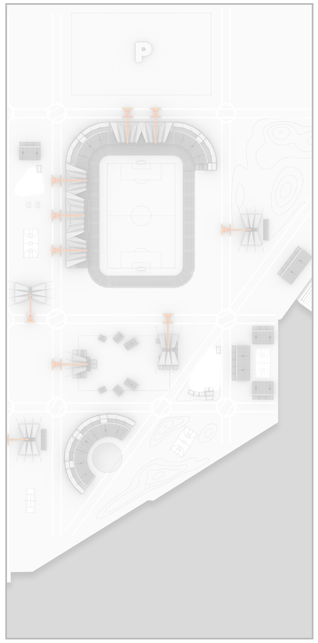




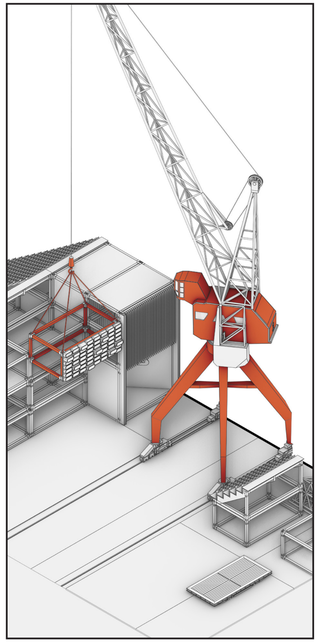
Problem Statement



Why Modularity?



Design Concept



Re-configurations

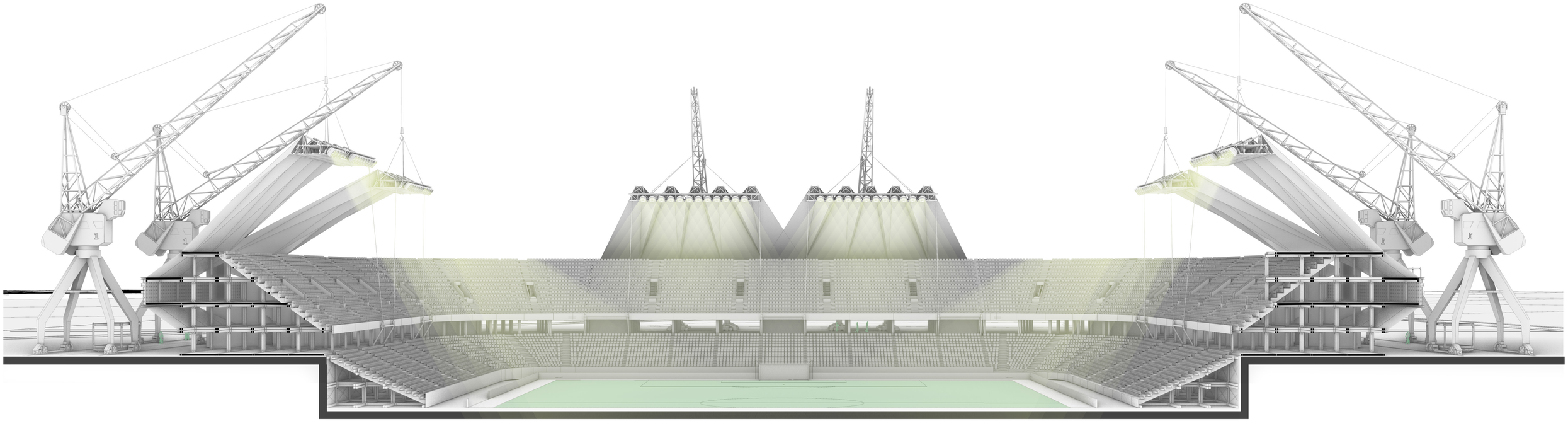


Further Suggestions + Conclusions

HOW DO WE TRANSFORM?


Port of Rotterdam
Port of Rotterdam
Port of Rotterdam
Port of Rotterdam
Port of Rotterdam

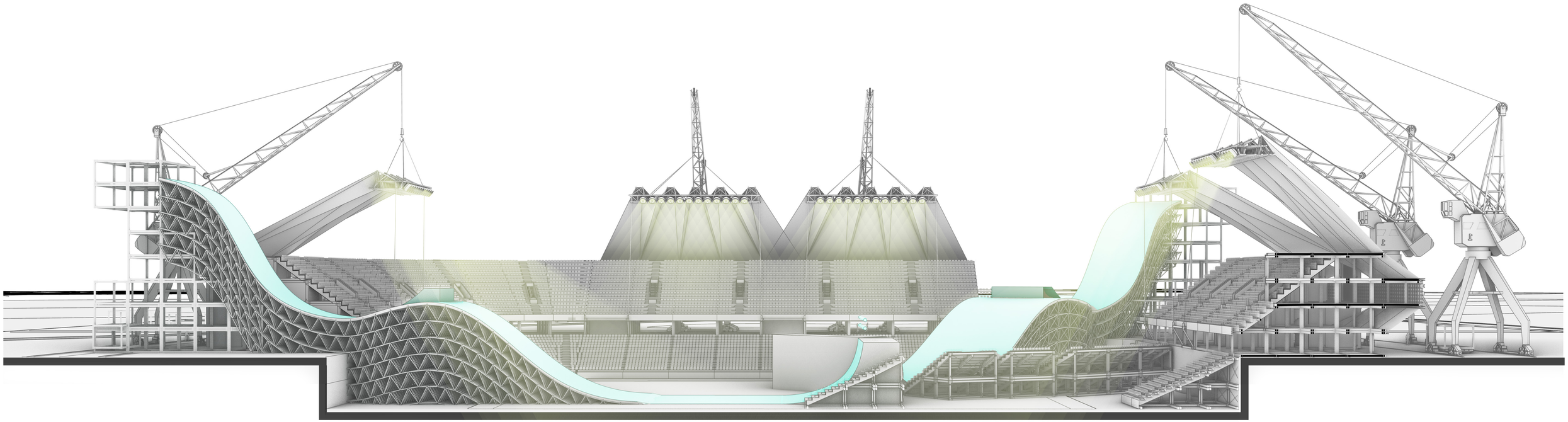
SCENARIO 1 // Football



0m 7m 45m

Summer / Winter Event

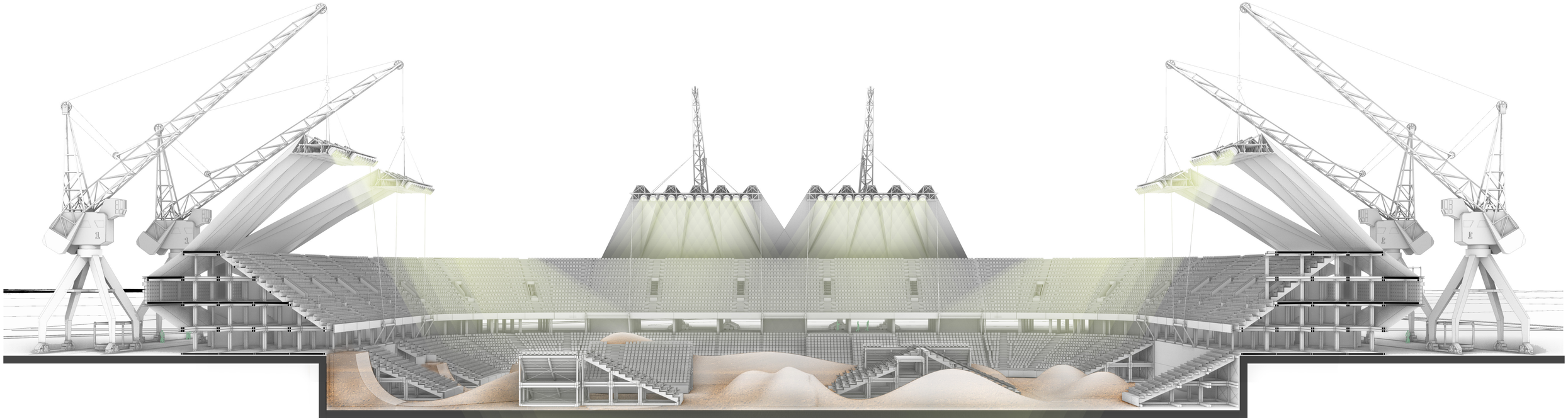
SCENARIO 2 // Extreme Sport



0m 7m 45m

Winter Event

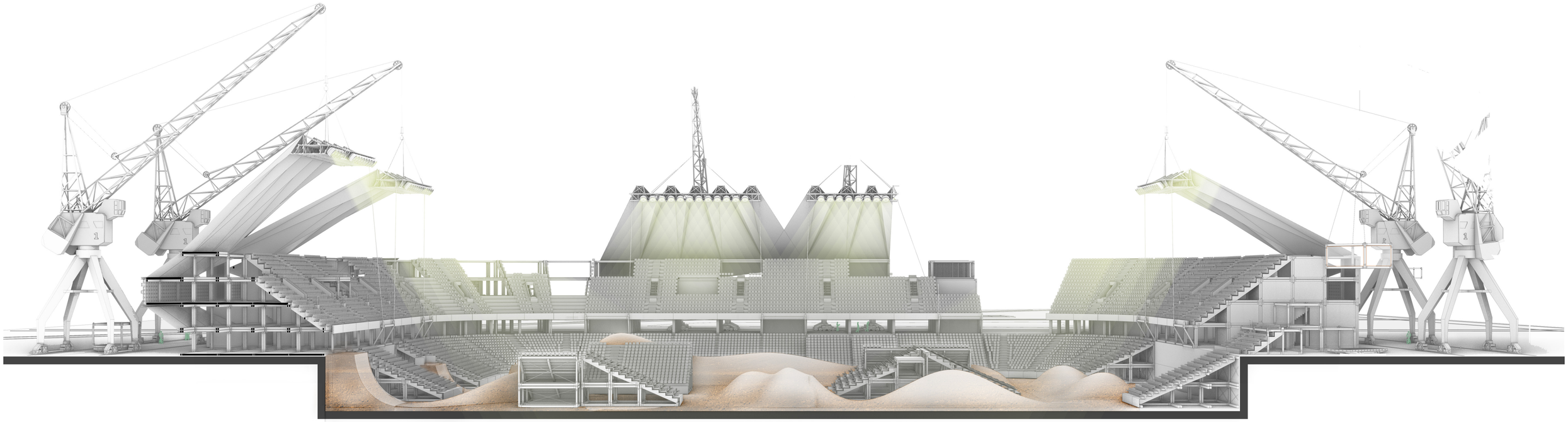
SCENARIO 3 // BMX Mudtrack



0m 7m 45m

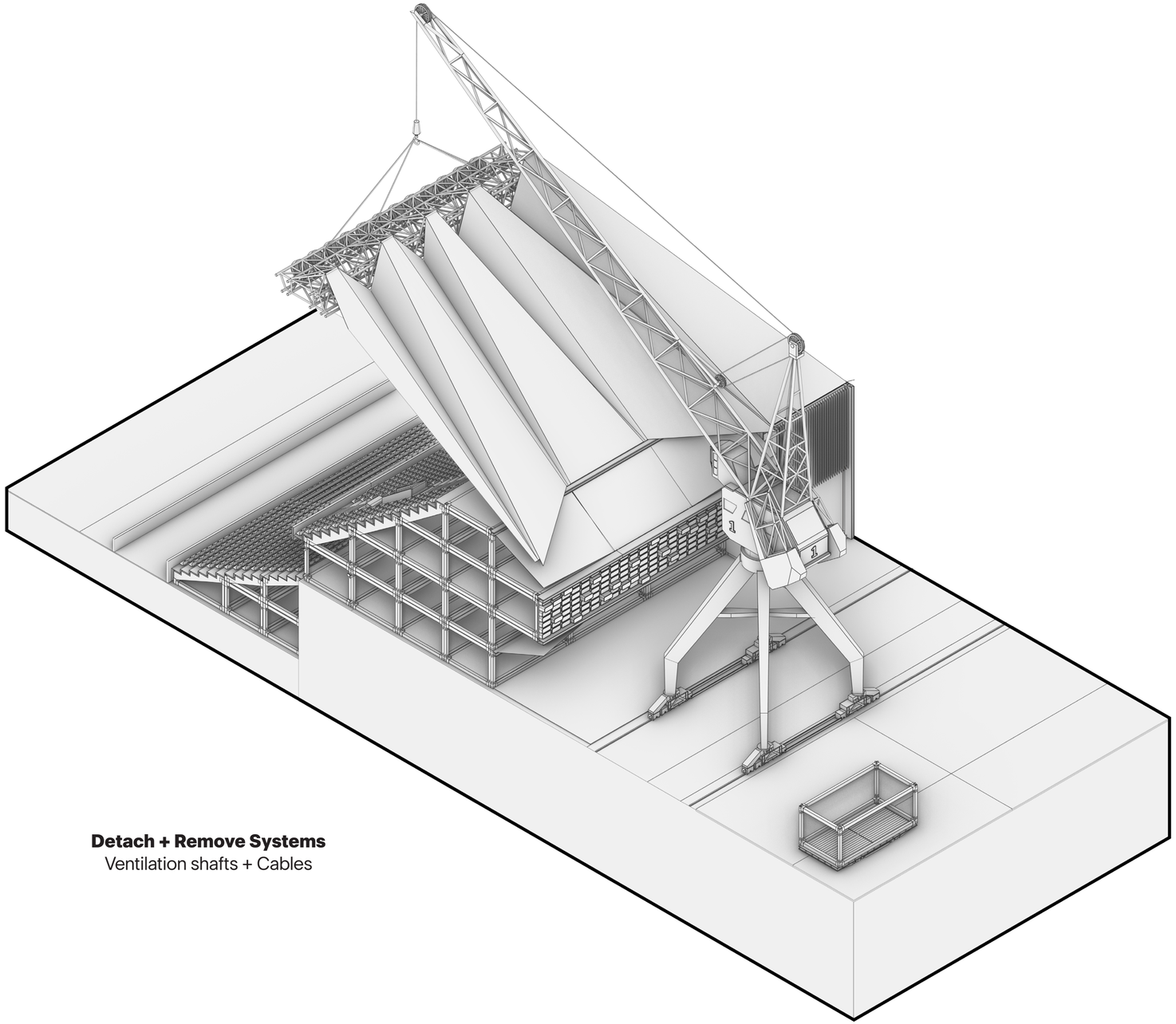
Summer Event

SCENARIO 3 // Artificial Erosion



0m 7m 45m

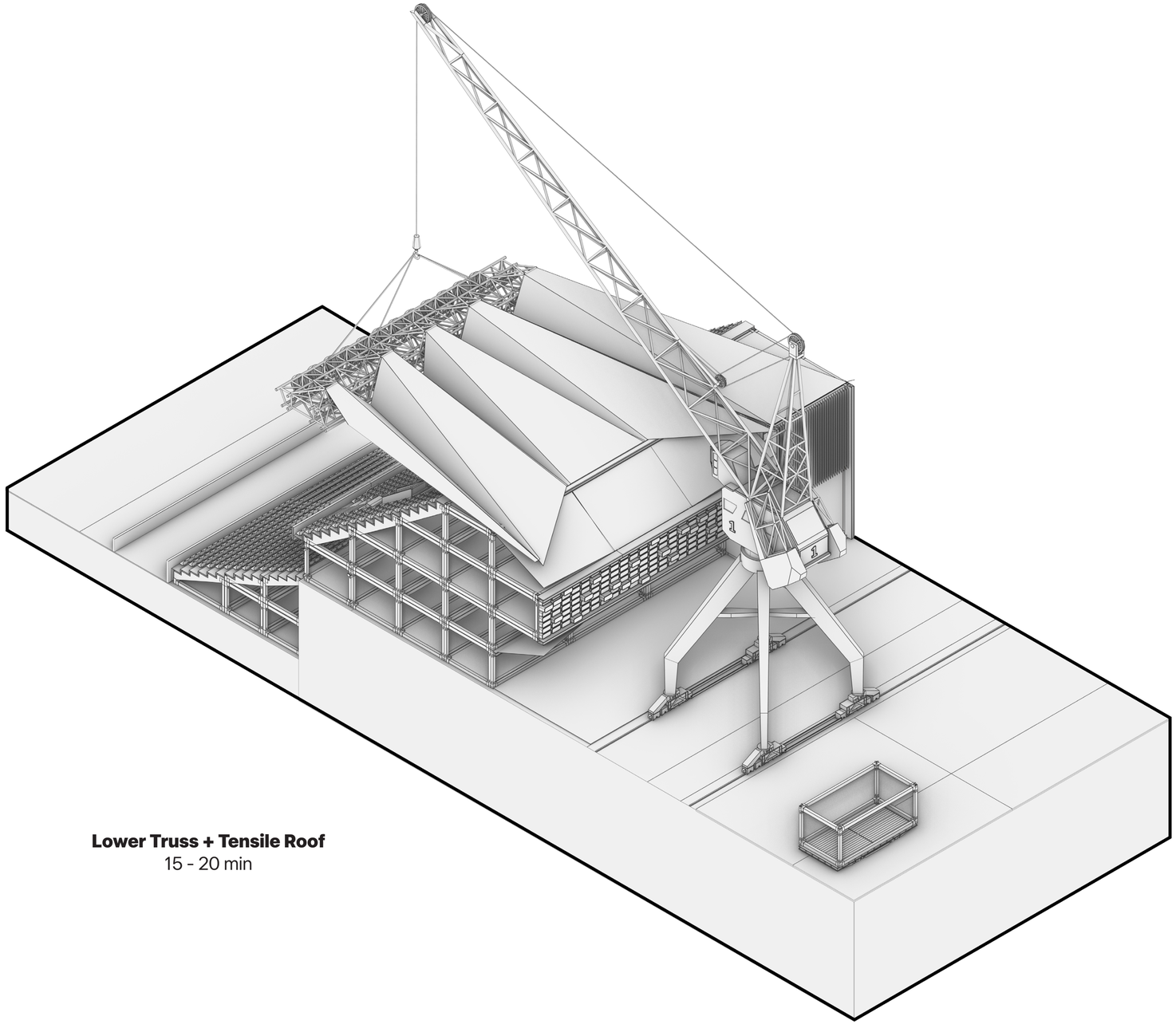
LOGISTICS // Stadium Disassembly



Detach + Remove Systems
Ventilation shafts + Cables

PROGRES BAR

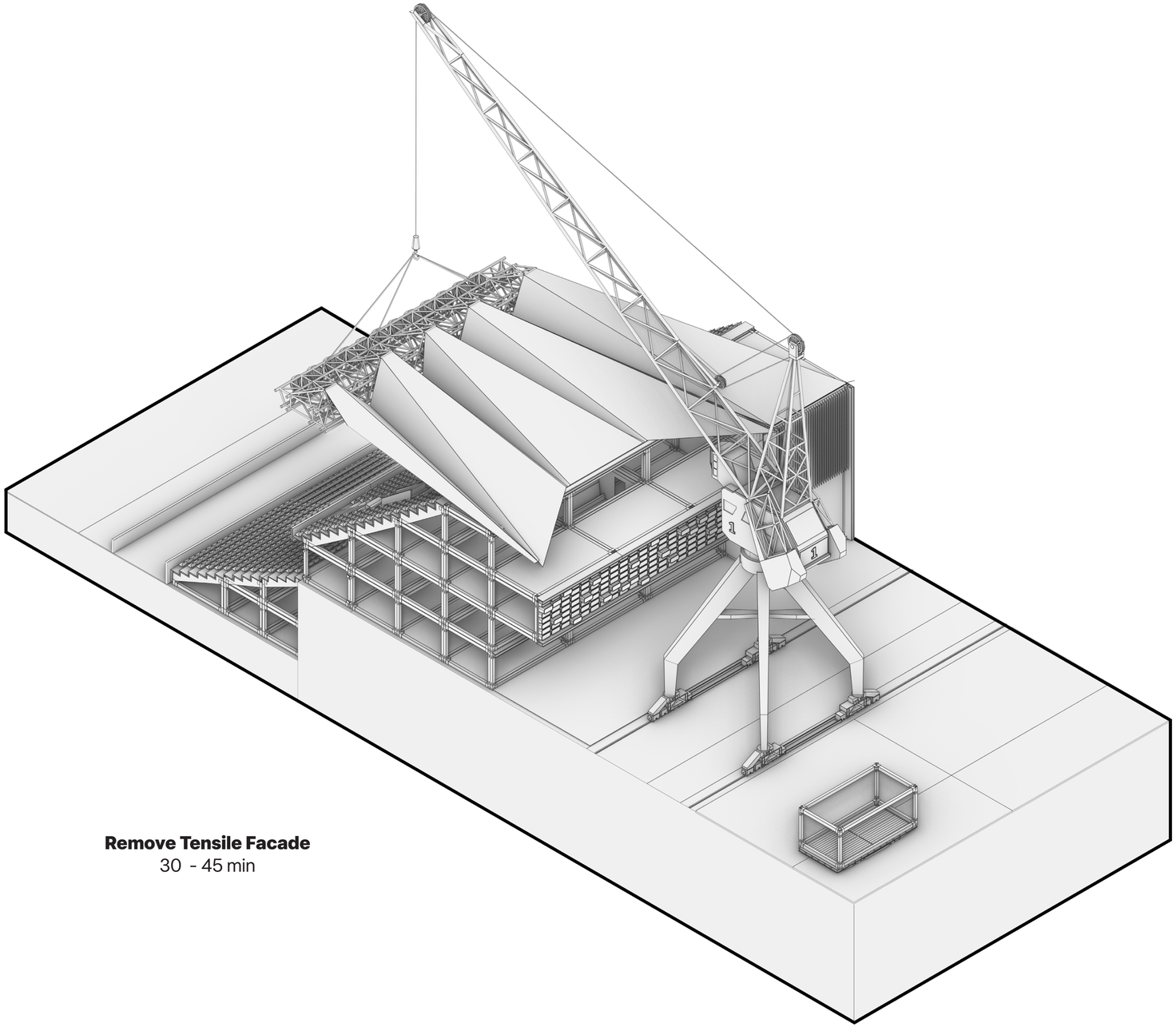
LOGISTICS // Step 1



Lower Truss + Tensile Roof
15 - 20 min

PROGRES BAR

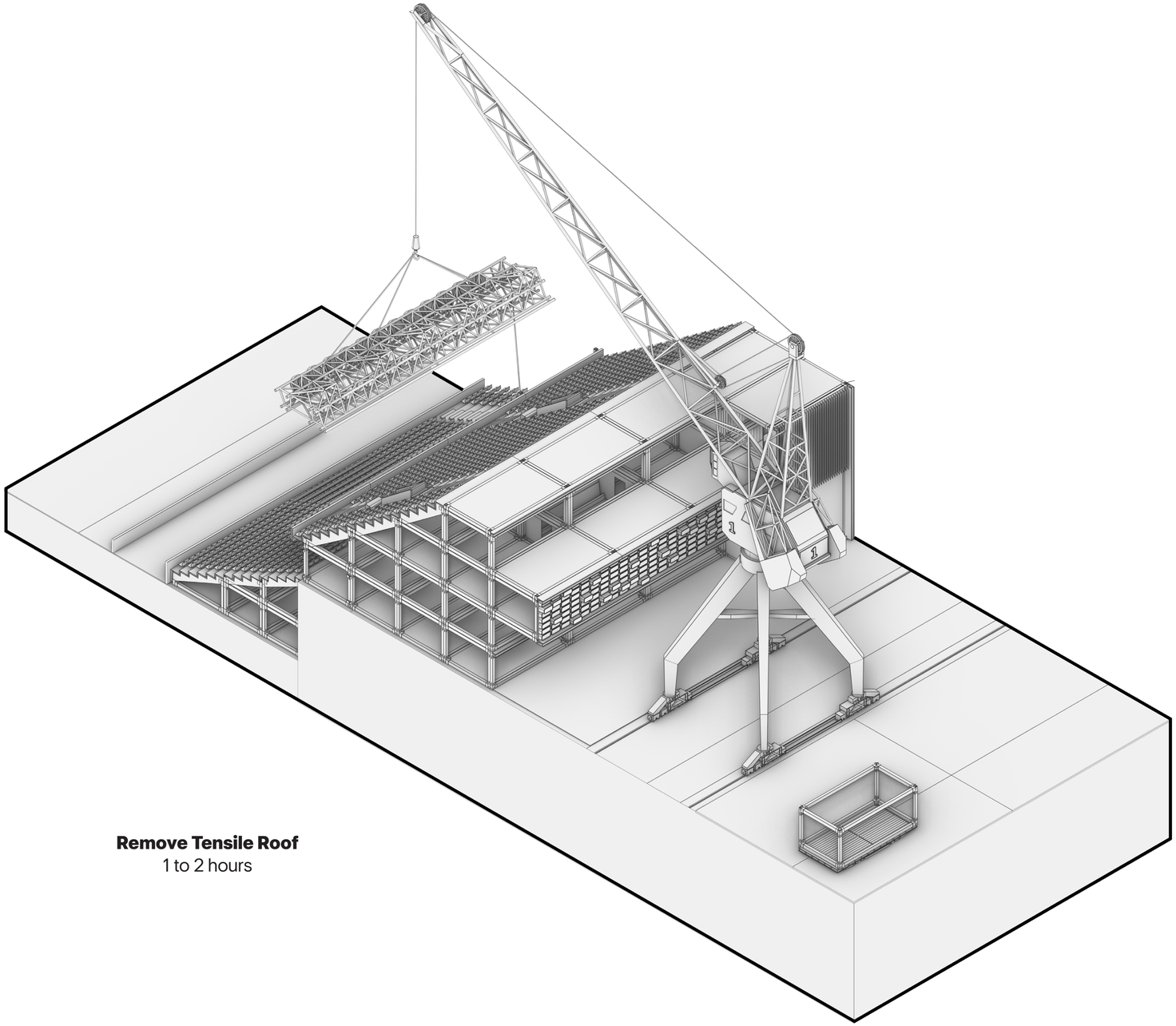
LOGISTICS // Step 2



Remove Tensile Facade
30 - 45 min

PROGRES BAR

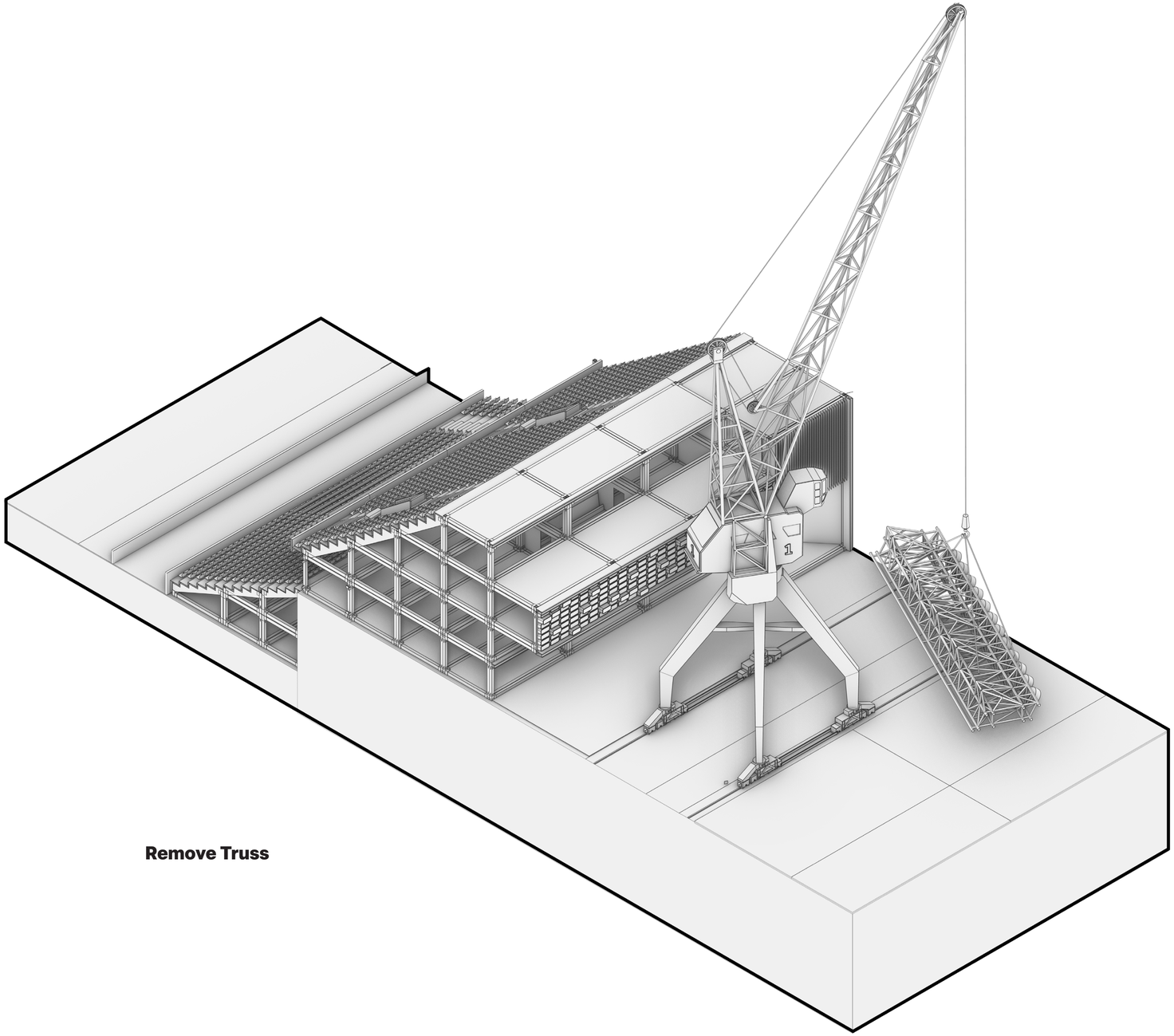
LOGISTICS // Step 3



Remove Tensile Roof
1 to 2 hours

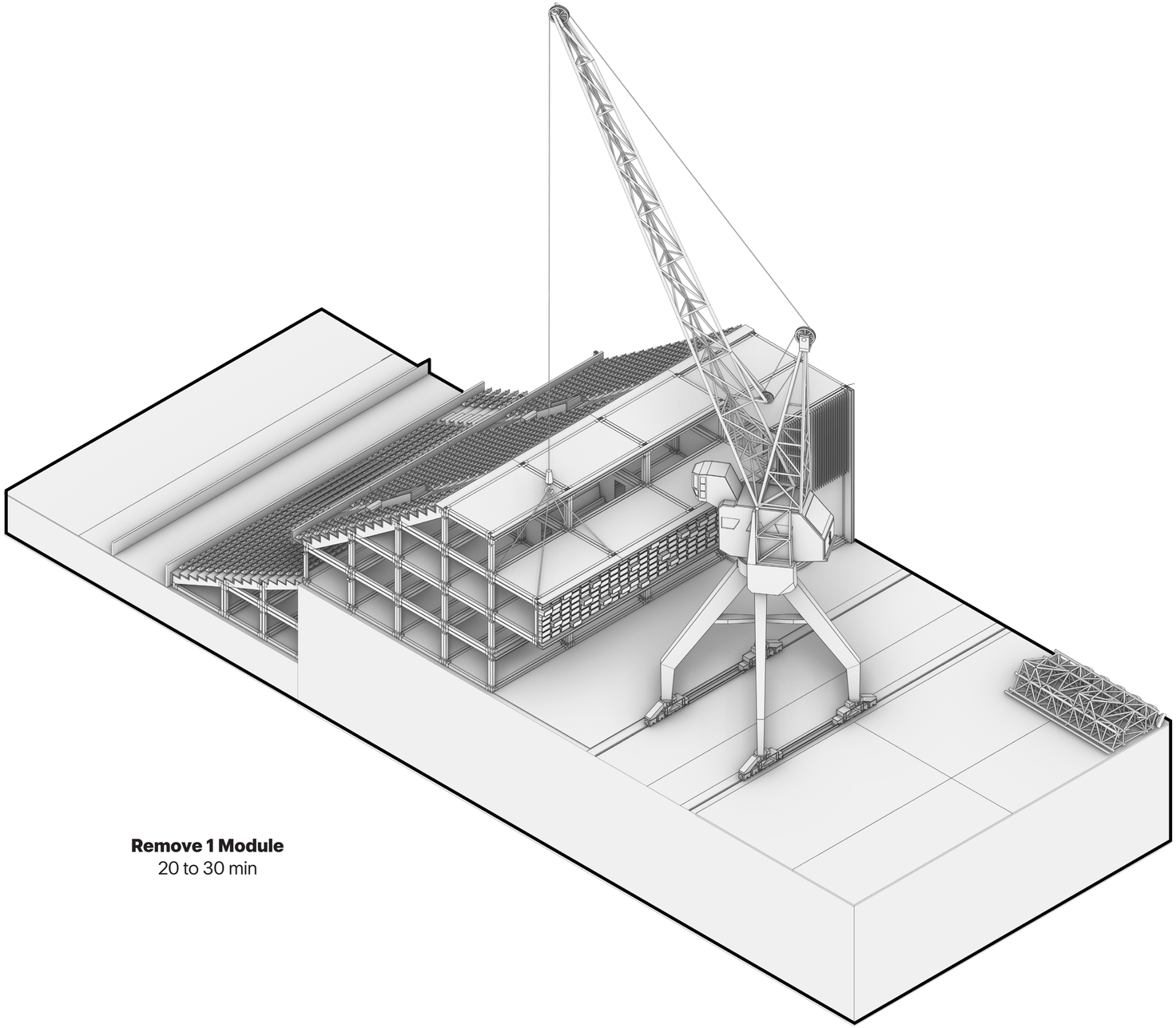
PROGRES BAR

LOGISTICS // Step 4



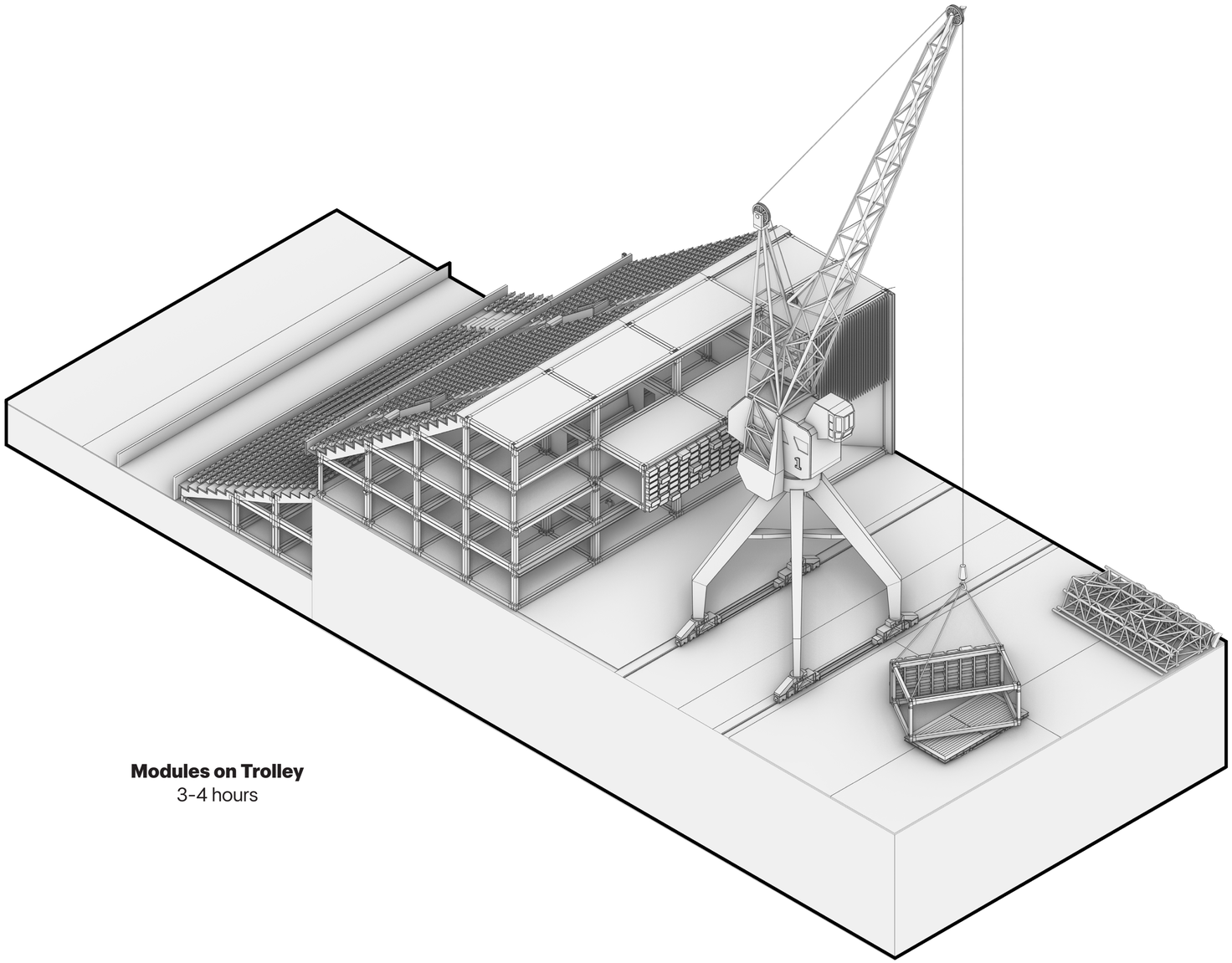
Remove Truss

PROGRES BAR



Remove 1 Module
20 to 30 min

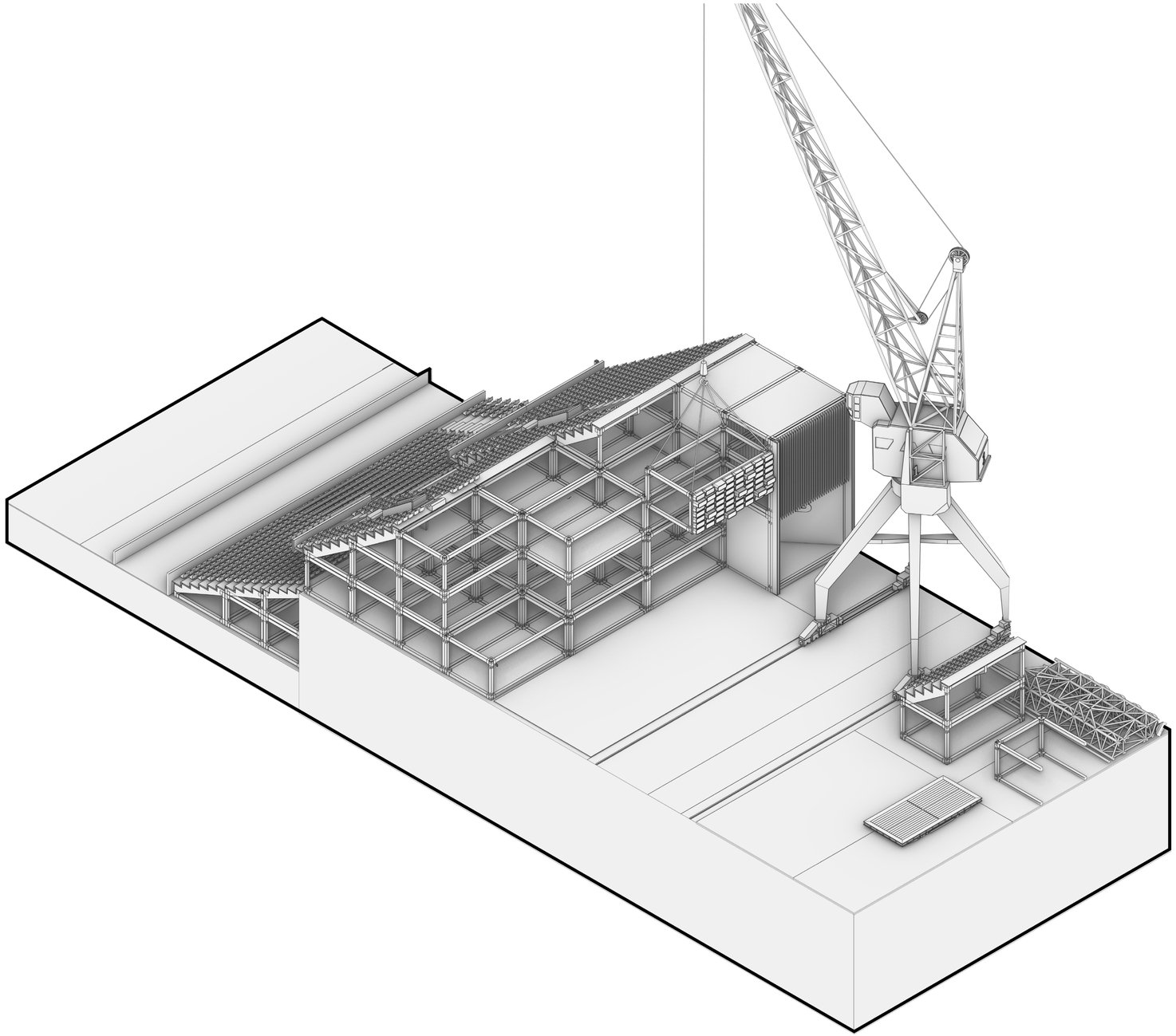
PROGRES BAR



Modules on Trolley
3-4 hours

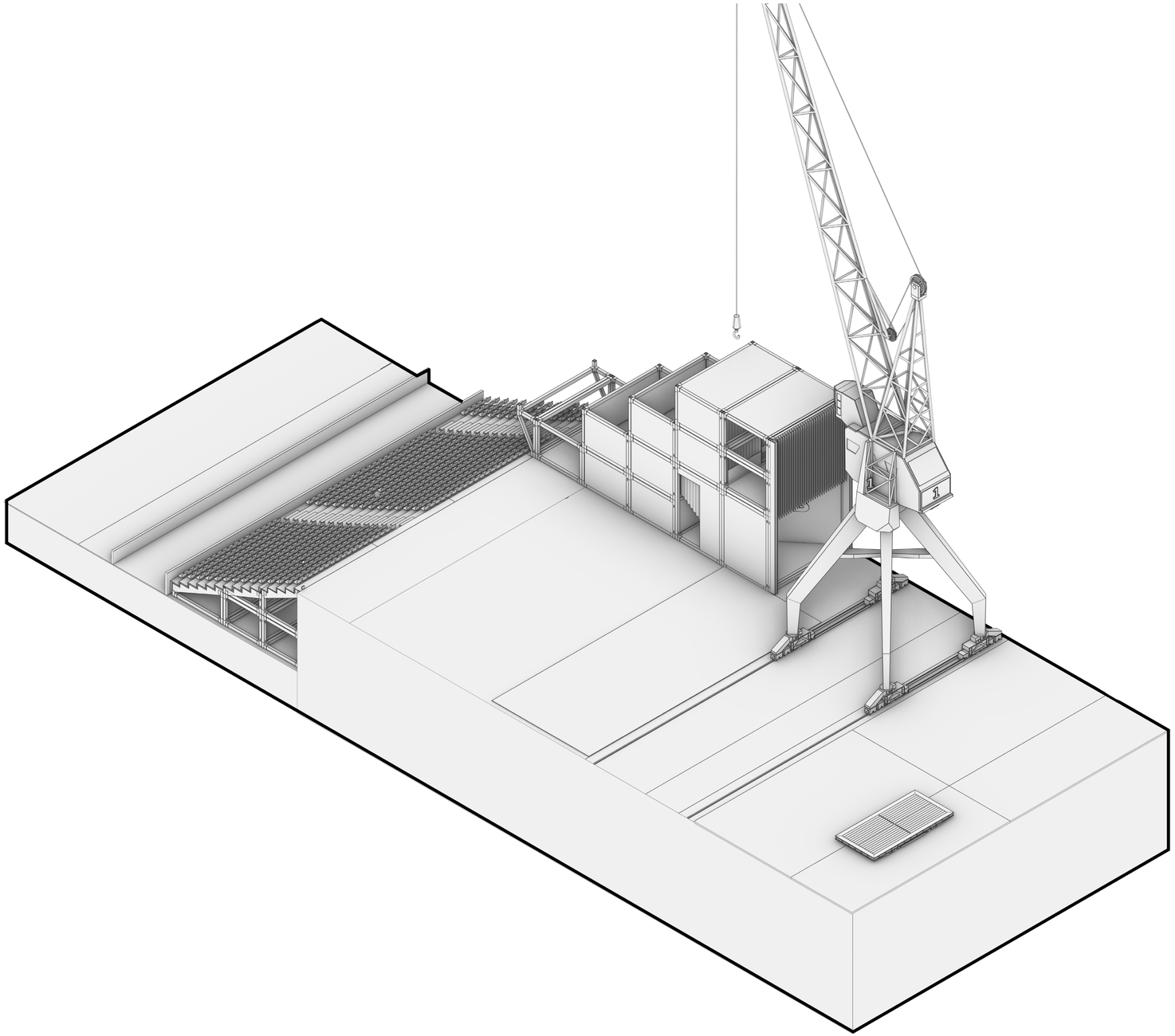
PROGRES BAR

LOGISTICS // Step 6

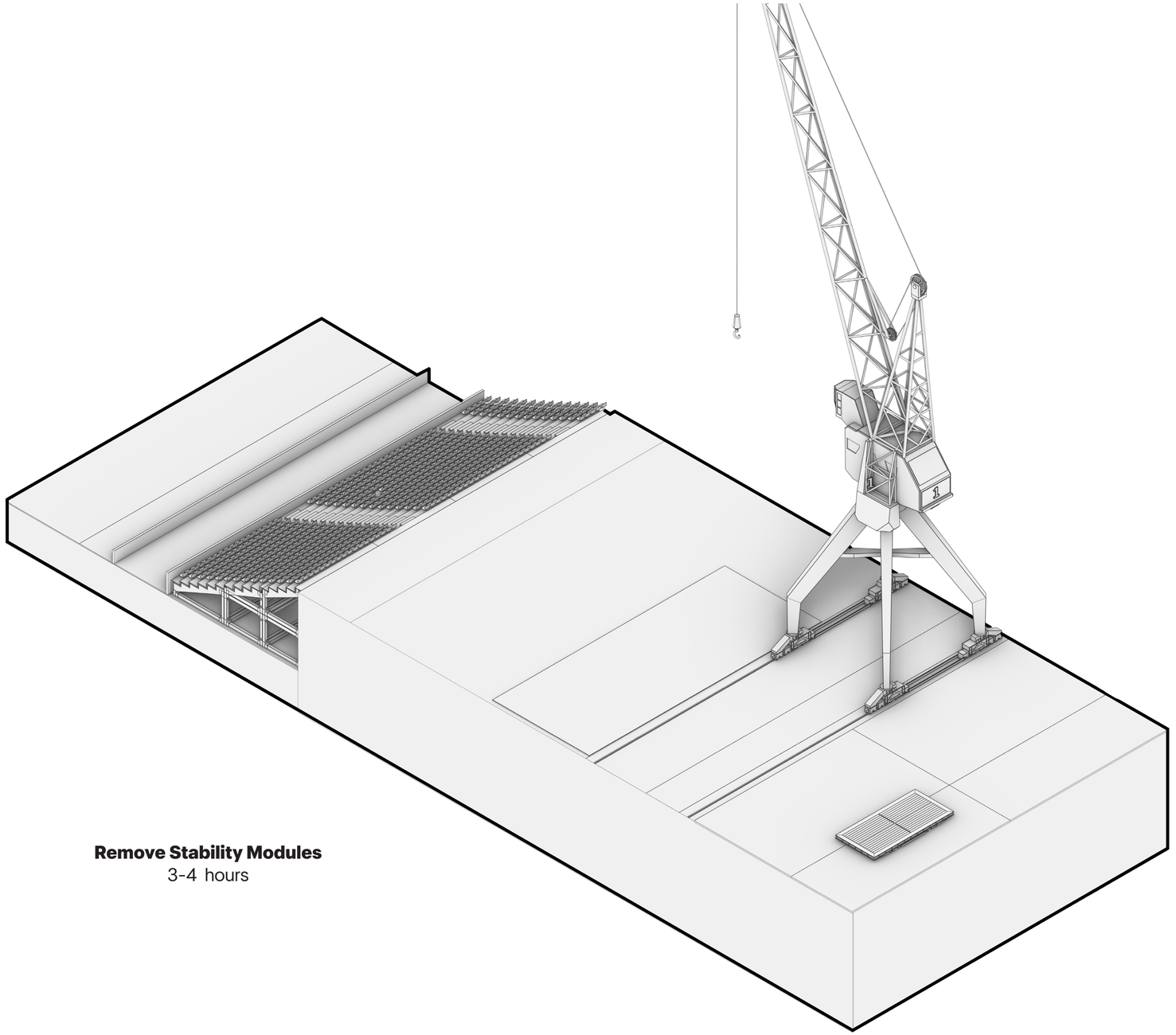


PROGRES BAR

LOGISTICS // Step 6

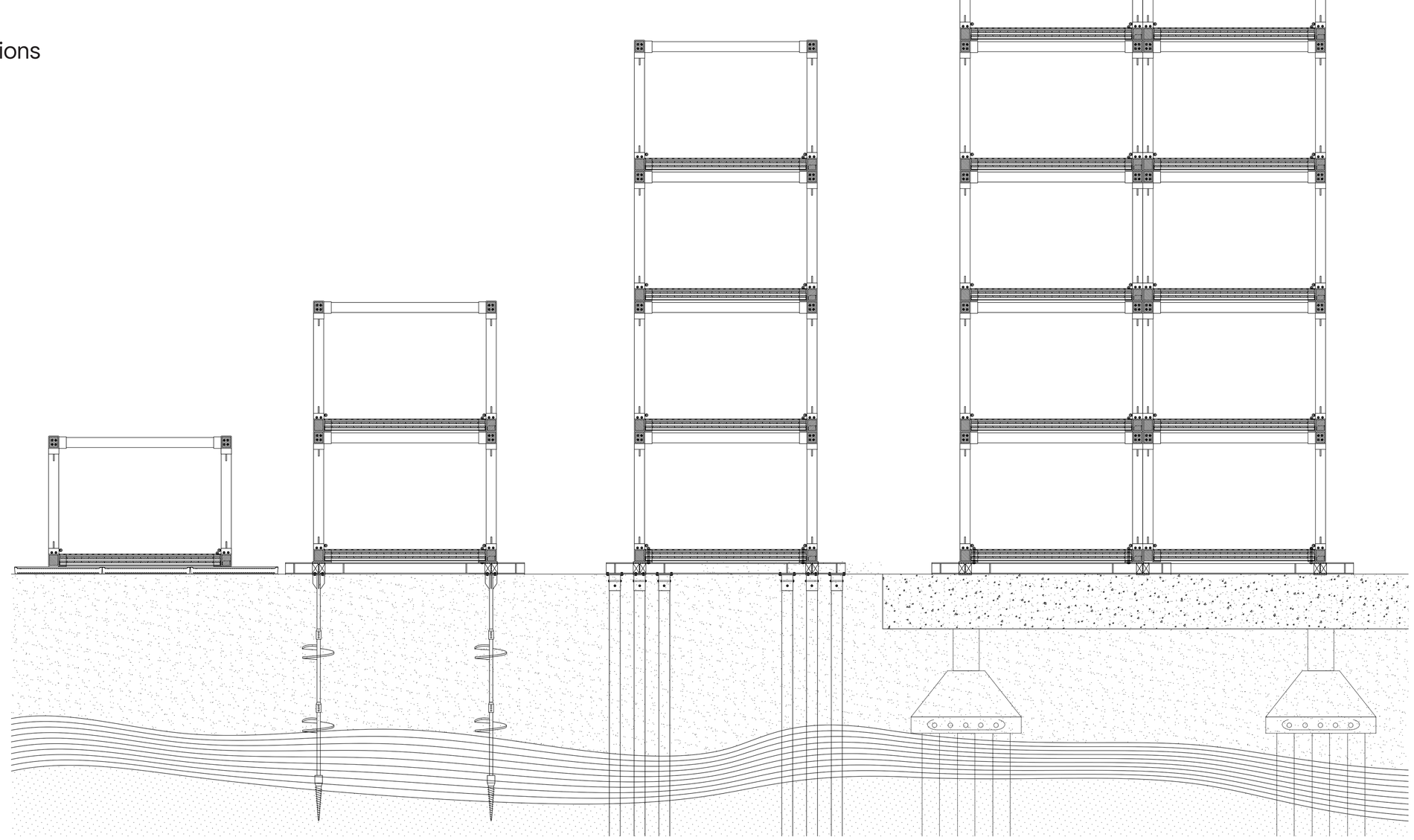


PROGRES BAR



Remove Stability Modules
3-4 hours

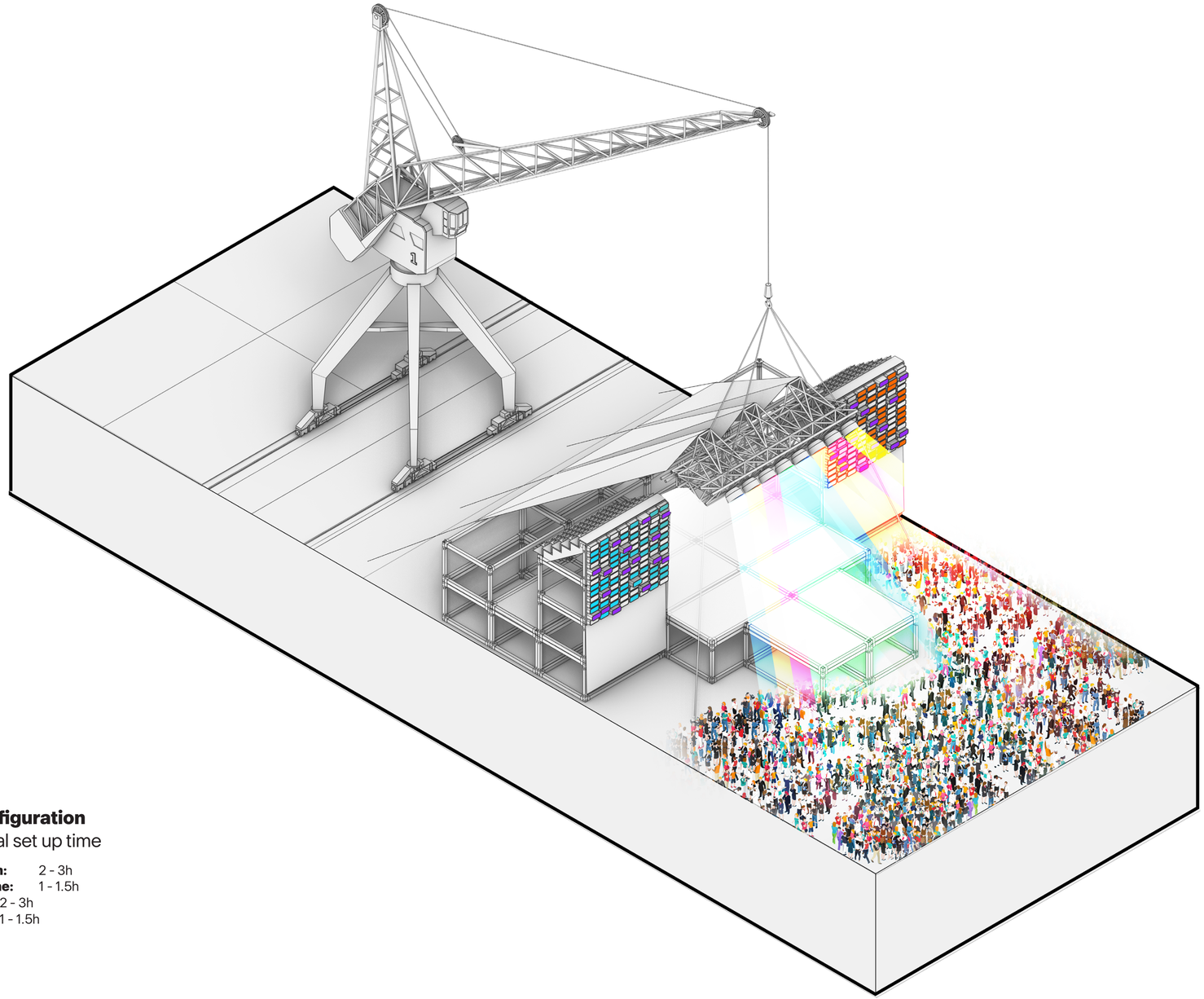
PROGRESS BAR



Stelcon	Screw Pile Foundation	Tree Trunks	Concrete Foundation
1	1-2	3-4	4-...

High Degree of Modularity ← - - -

LOGISTICS // What else it can be

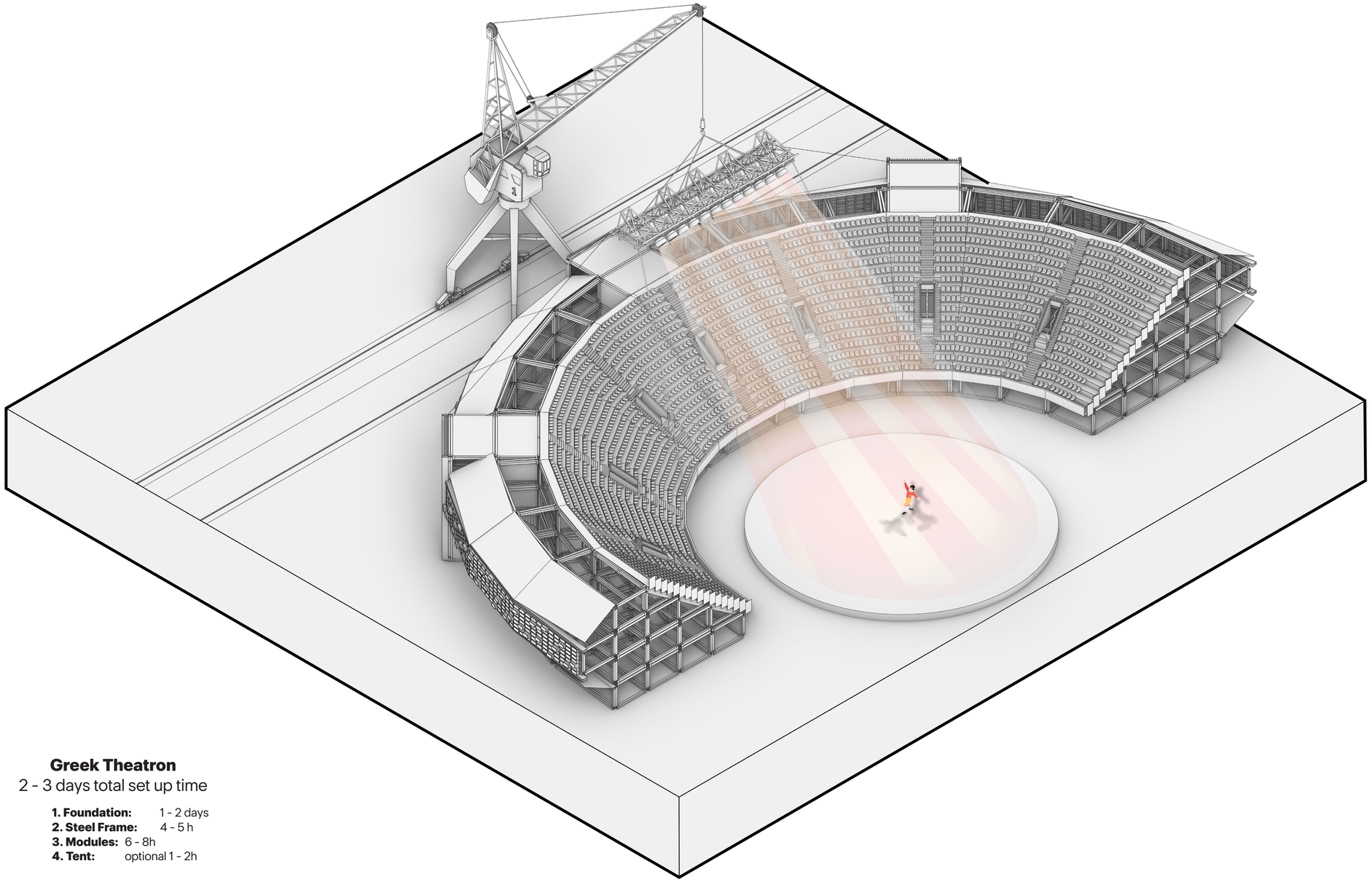


Festival Configuration

6-8.5 hours total set up time

1. Foundation: 2 - 3h
2. Steel Frame: 1 - 1.5h
3. Modules: 2 - 3h
4. Tent: 1 - 1.5h

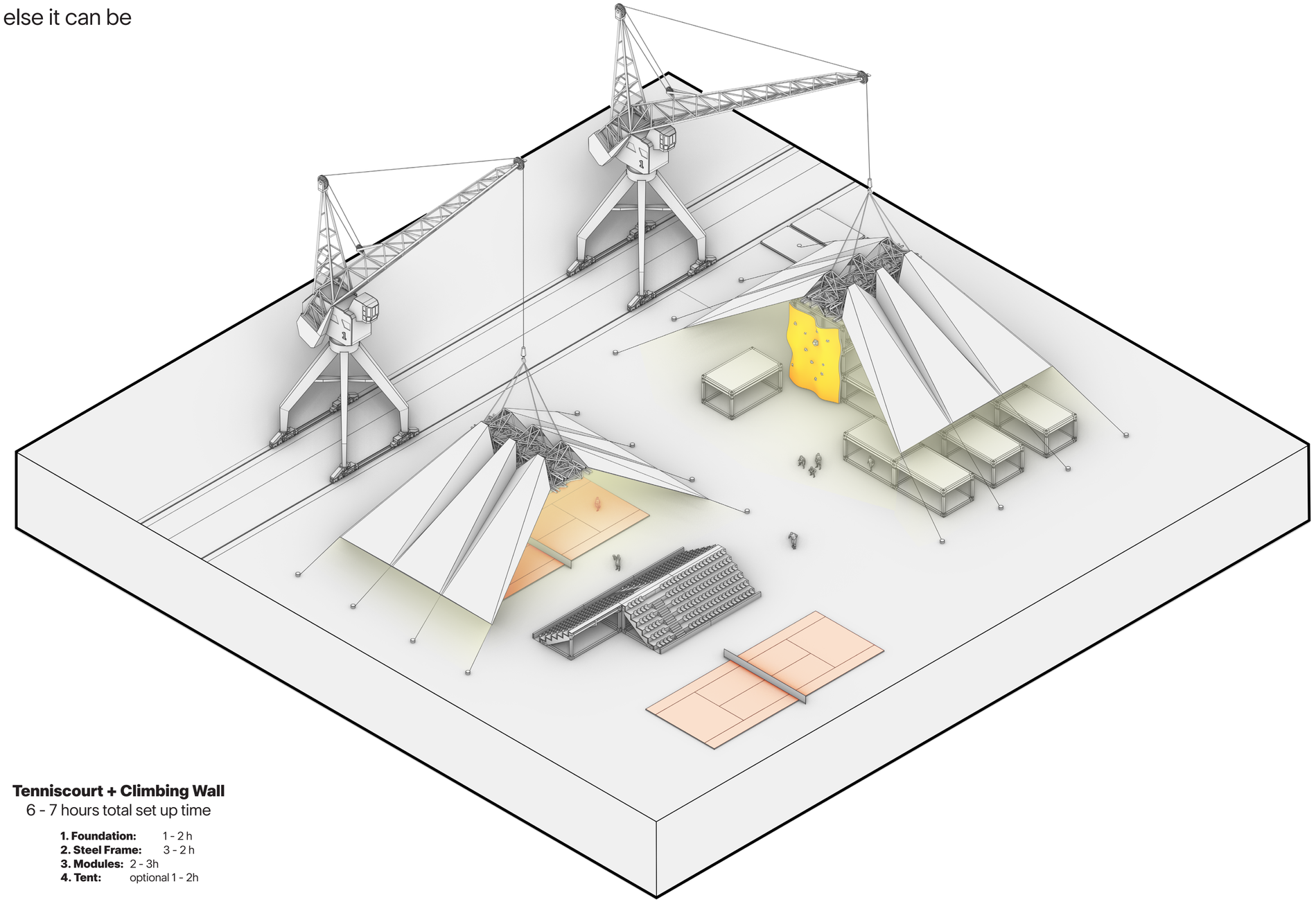
LOGISTICS // What else it can be



Greek Theatron
2 - 3 days total set up time

1. Foundation: 1 - 2 days
2. Steel Frame: 4 - 5 h
3. Modules: 6 - 8h
4. Tent: optional 1 - 2h

LOGISTICS // What else it can be

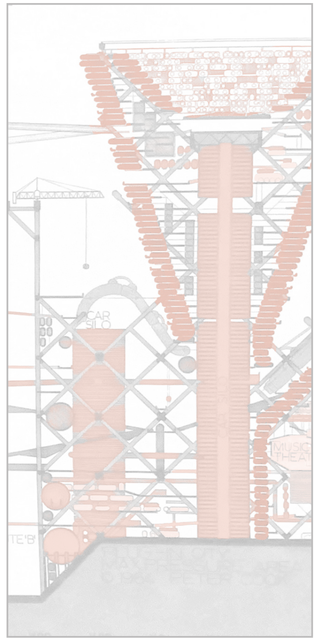


Tenniscourt + Climbing Wall
6 - 7 hours total set up time

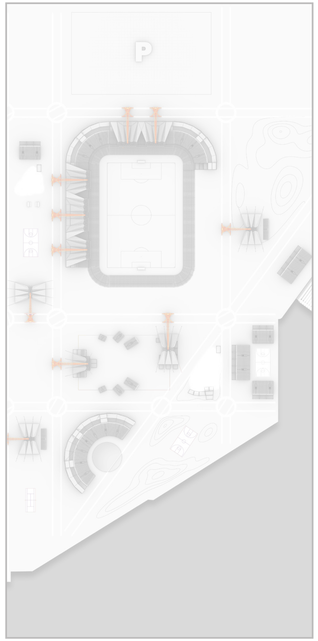
1. Foundation: 1 - 2 h
2. Steel Frame: 3 - 2 h
3. Modules: 2 - 3h
4. Tent: optional 1 - 2h



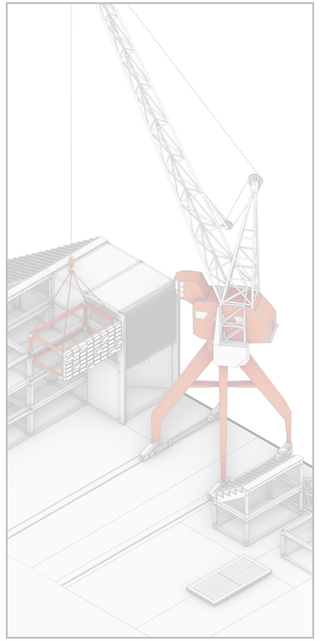
Problem Statement



Why Modularity?



Design Concept



Re-configurations

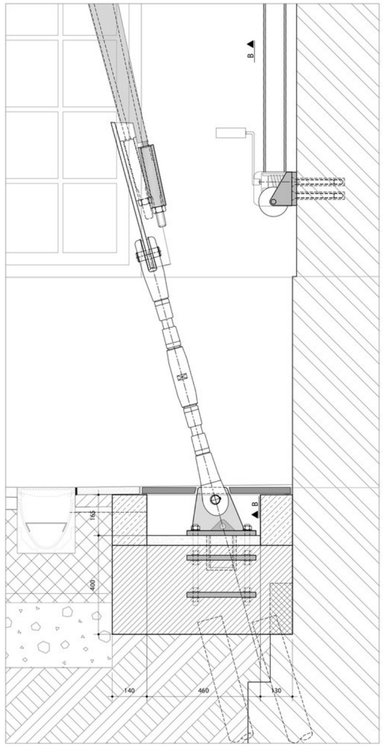


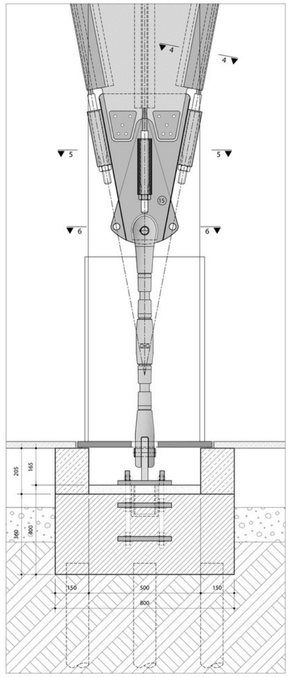
Further Suggestions + Conclusions

Next Iteration + Further Research Suggestions

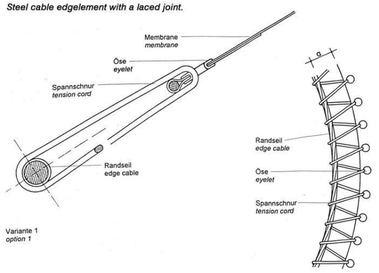
- Different columns and beams material
- Design Approach from different programs
- Modular system with logical sizes
- Existing Foundation affect the design
- Business Case
- Experiment possible configurations


THANK YOU ALL FOR LISTENING!



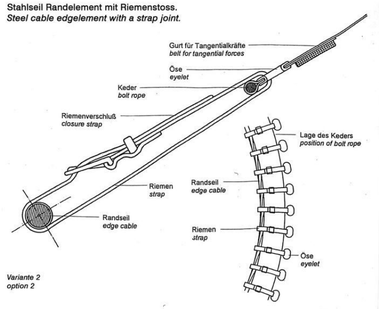


Stahlseil Randelement mit Schnürstoss.
Steel cable edgelement with a laced joint.



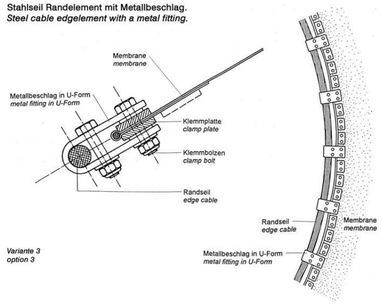
Variante 1
option 1

Stahlseil Randelement mit Riemenstoss.
Steel cable edgelement with a strap joint.



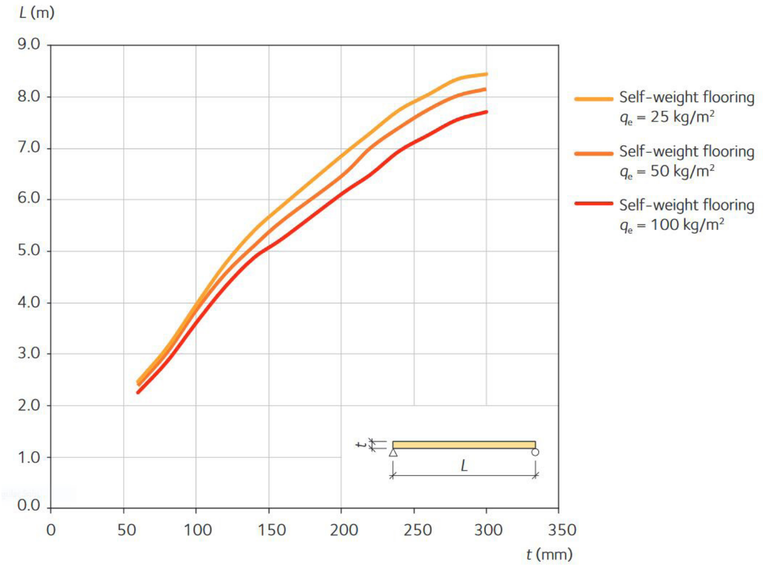
Variante 2
option 2

Stahlseil Randelement mit Metallbeschlag.
Steel cable edgelement with a metal fitting.

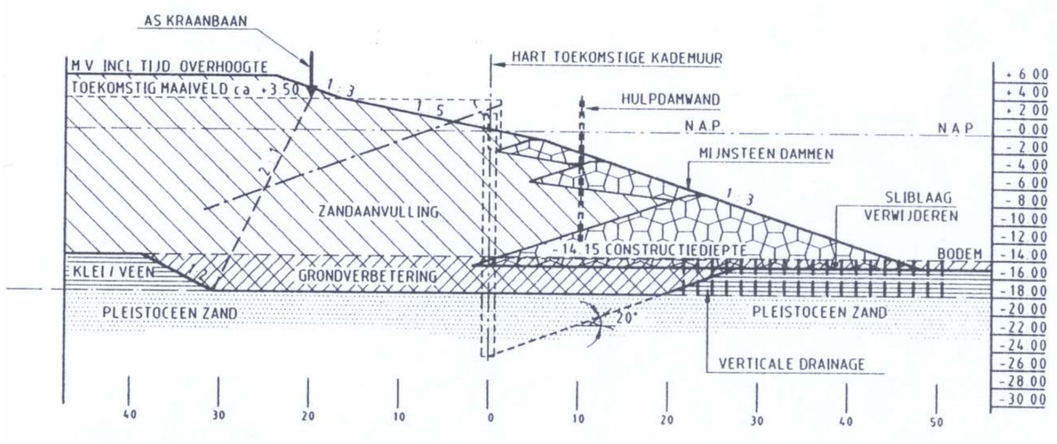


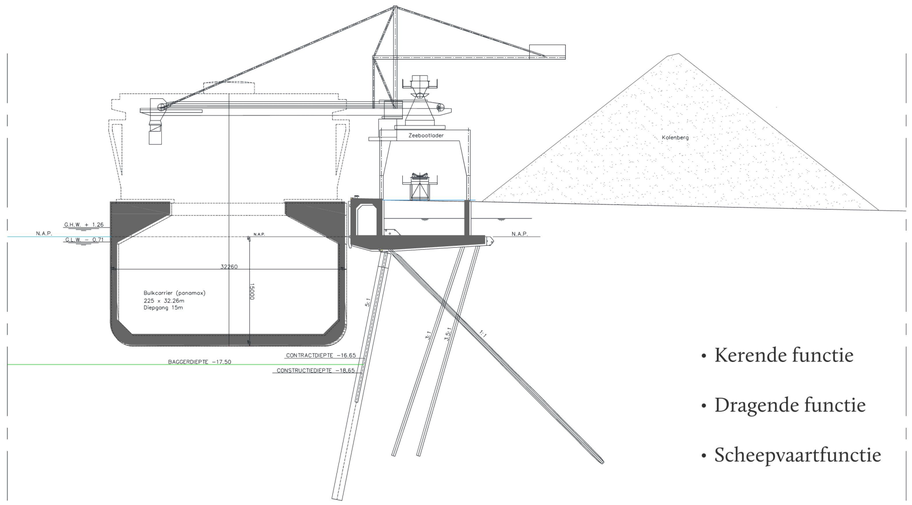
Variante 3
option 3



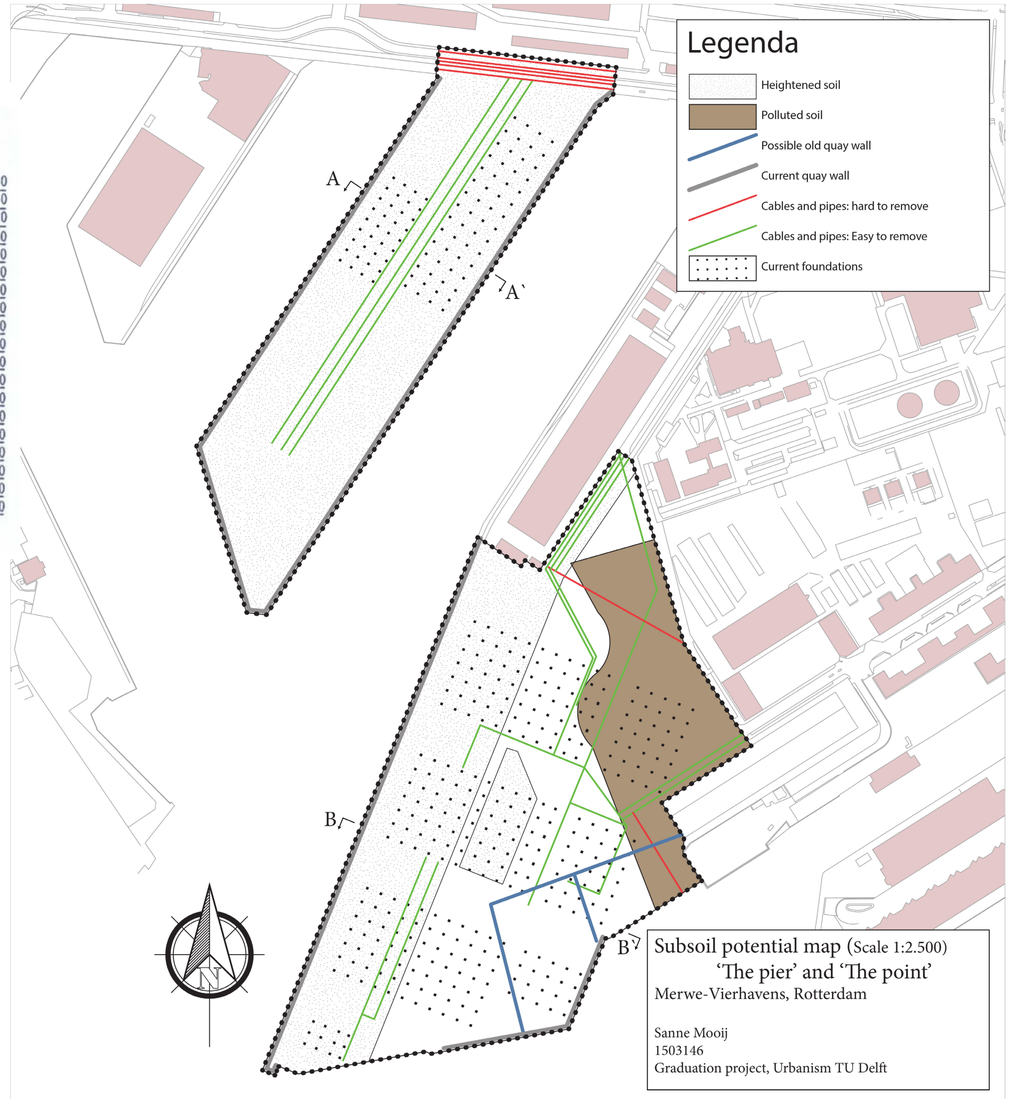


Subsoil potential map





- Kerende functie
- Dragende functie
- Scheepvaartfunctie

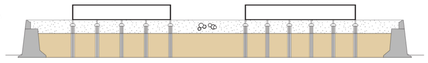


Subsoil potential map (Scale 1:2.500)
'The pier' and 'The point'
Merwe-Vierhavens, Rotterdam

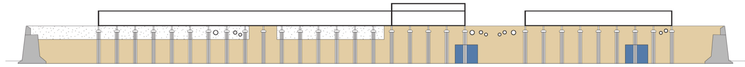
Sanne Mooij
1503146
Graduation project, Urbanism TU Delft

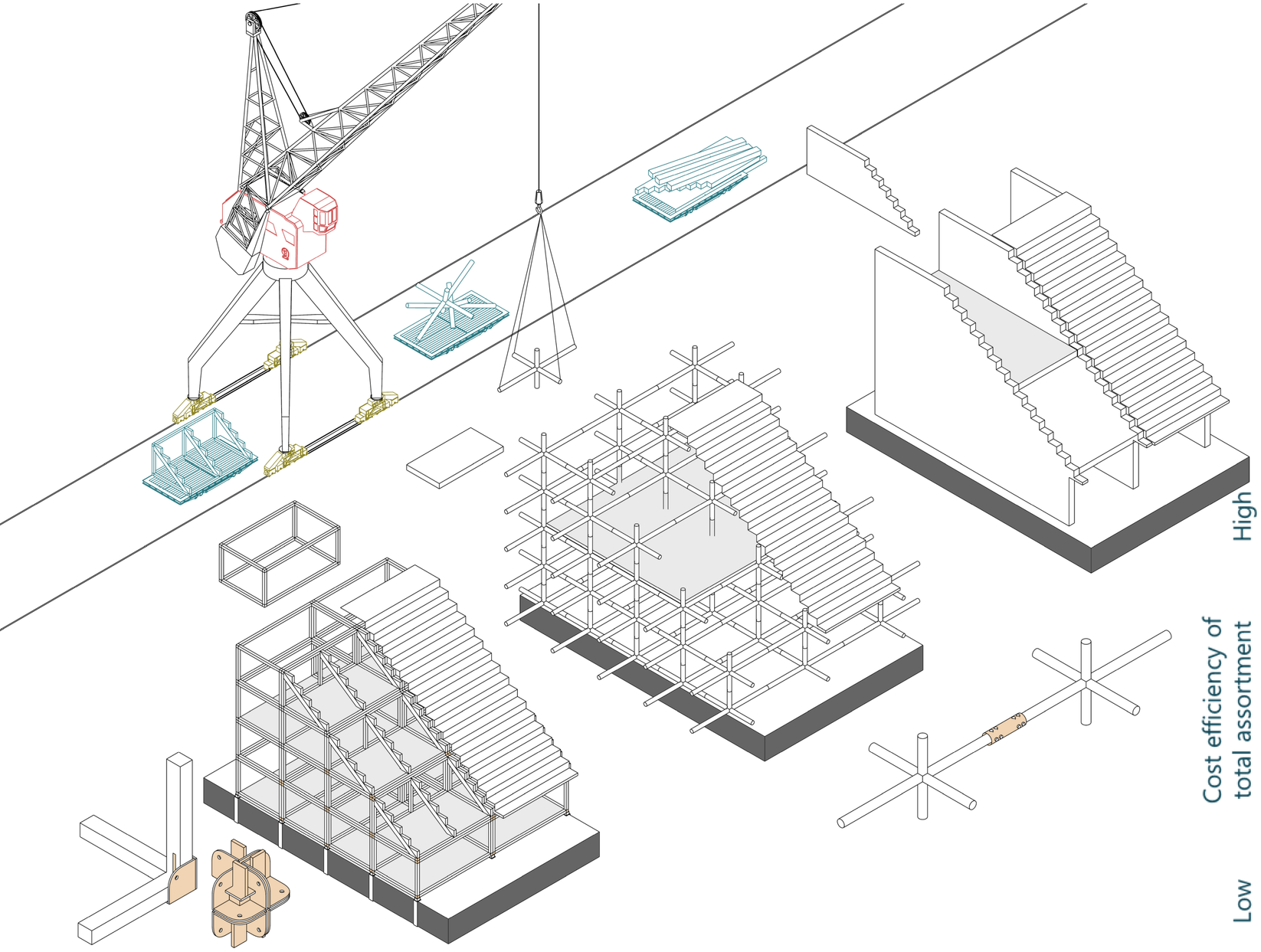
Sections (1:1.000)

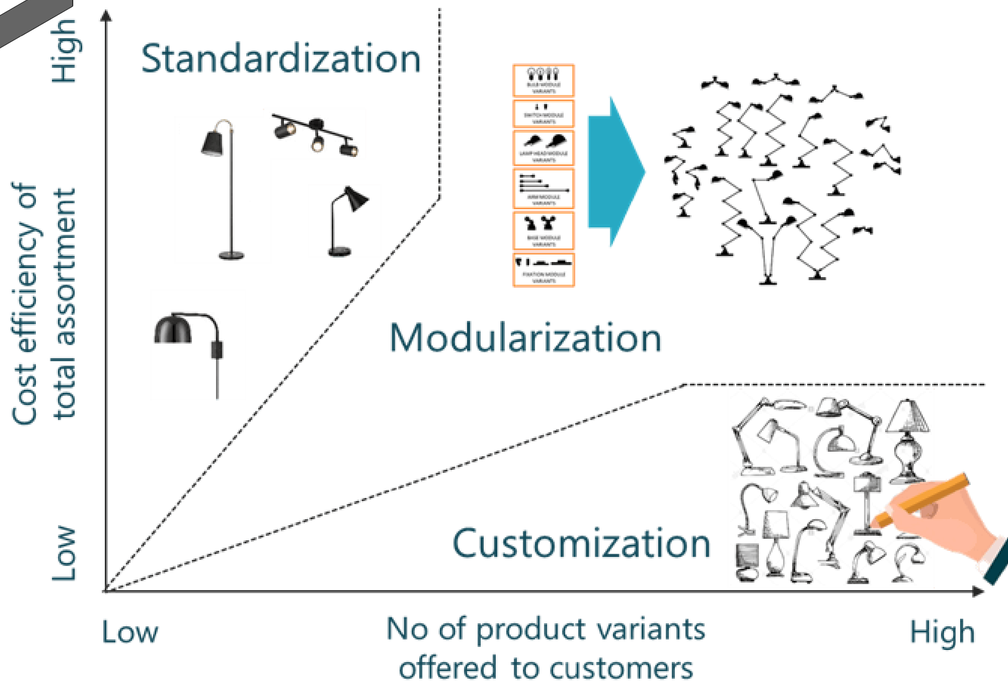
A-A`



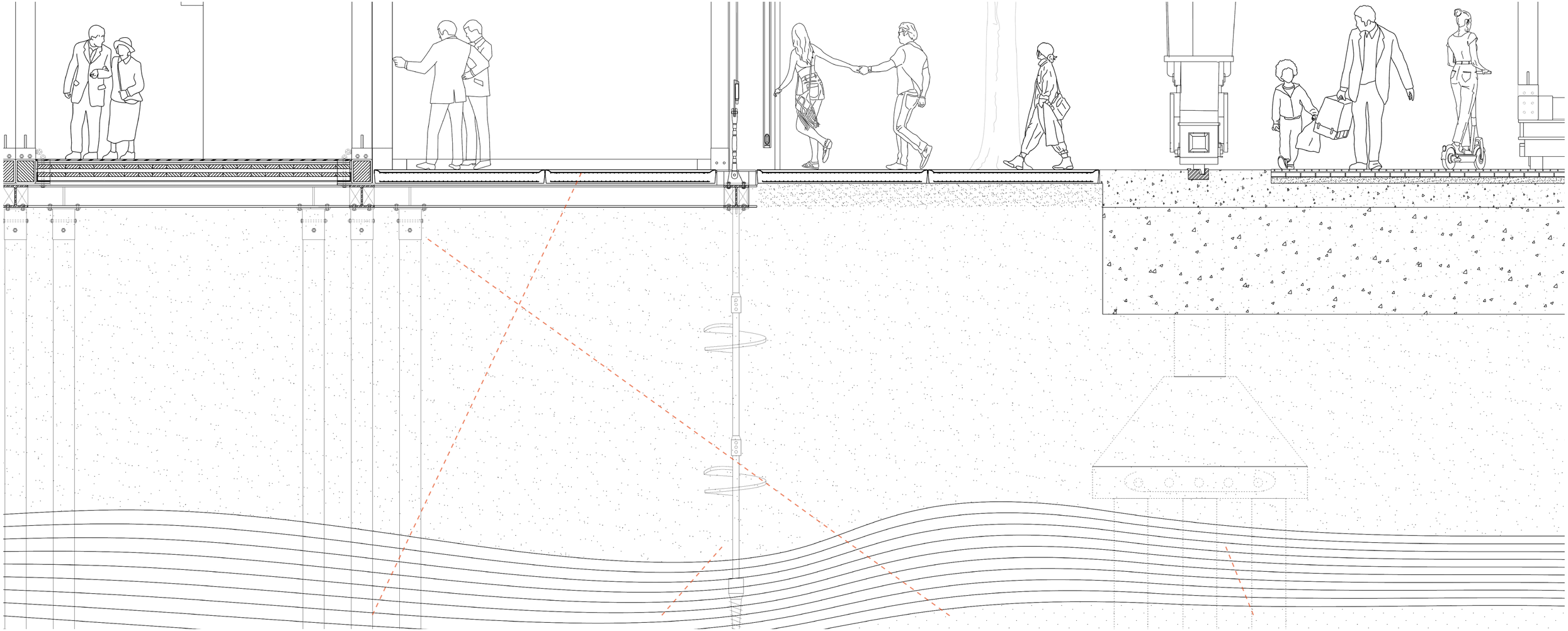
B-B`





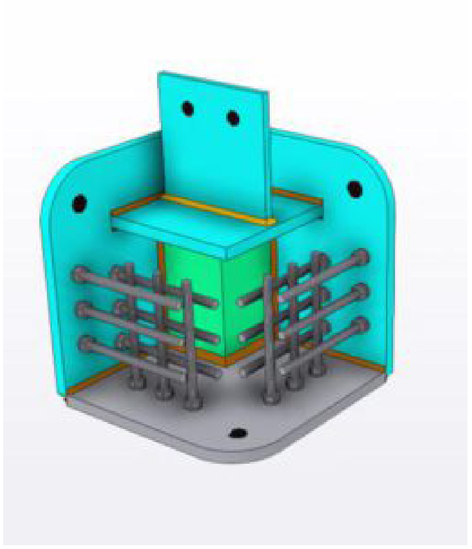

Standardization
Modularization
Customization
Cost efficiency of total assortment
High
Low
Low
No of product variants offered to customers
High

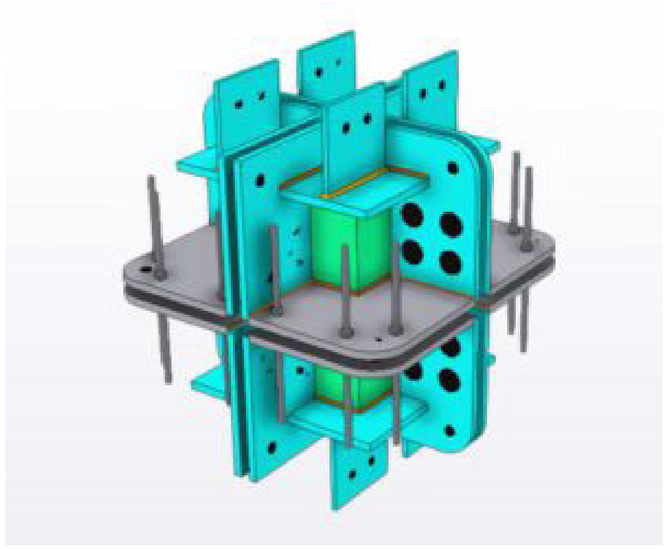
LOGISTICS // Foundations

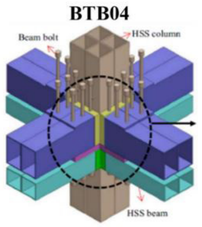


Stelcon	Screw Pile Foundation	Tree Trunks	Concrete Foundation
1	1-2	3-4	4-...

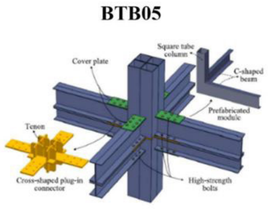
High Degree of Modularity ← - - -



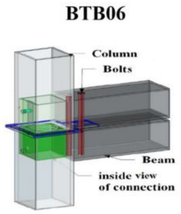




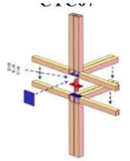
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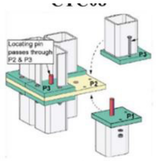


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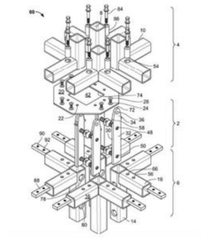
BTB06


CTC10

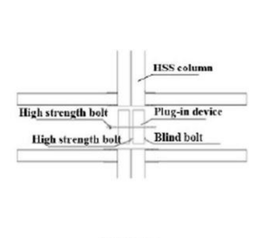


CTC11

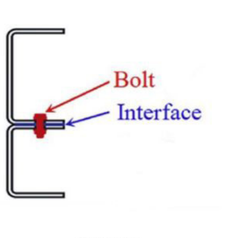

CTC12


BTB07

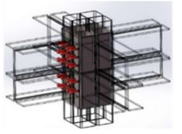
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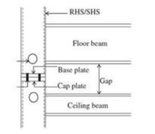


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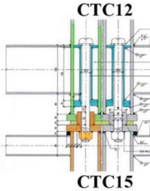


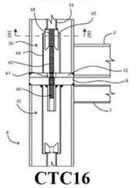
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CTC13

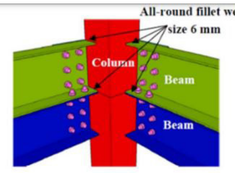


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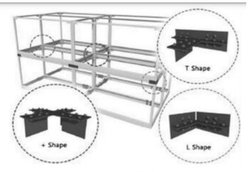

CTC15


CTC16

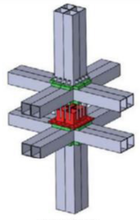

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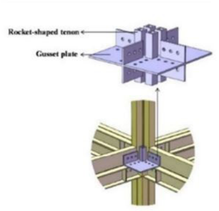


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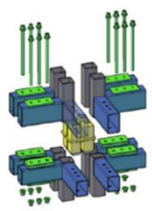


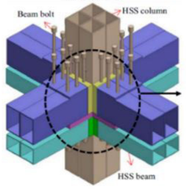
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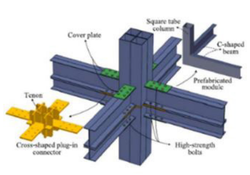


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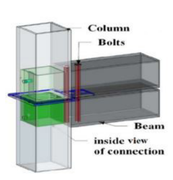

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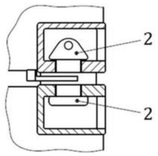
BTB07



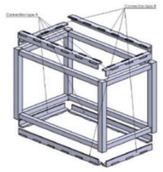
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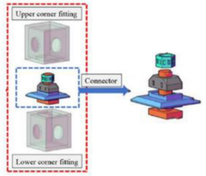


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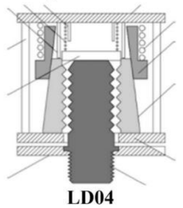


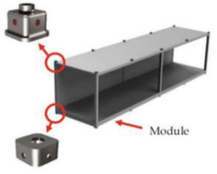
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LD02

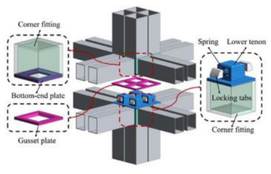


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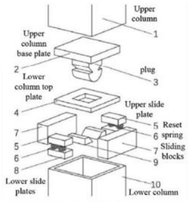

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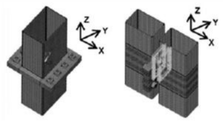
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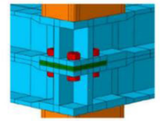


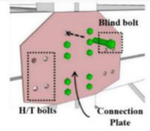
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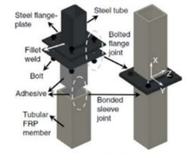
LD07


CTC01

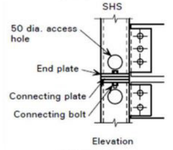

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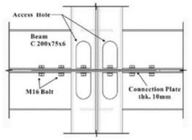
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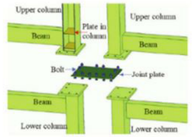
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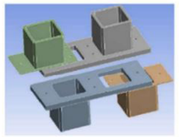
CTC05



CTC06



CTC07

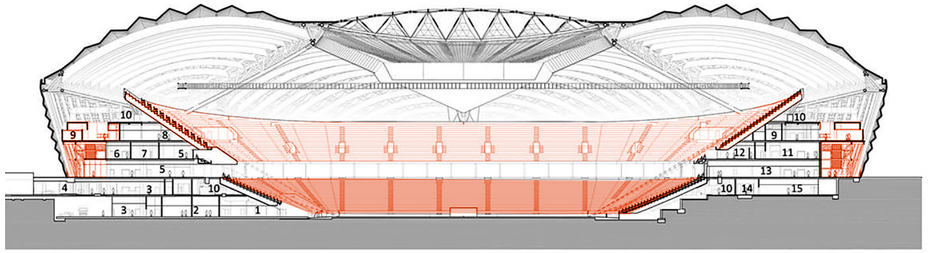

CTC08

CTC09

CTC10

CTC11

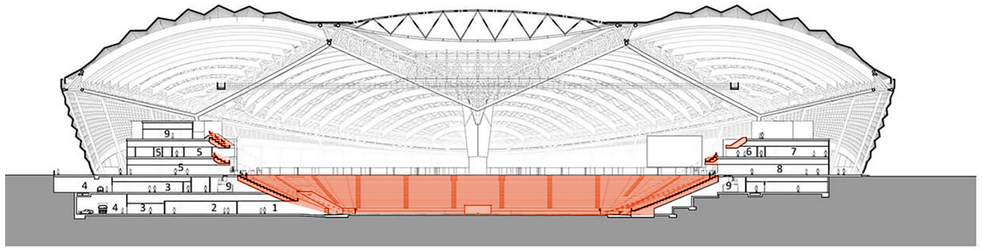
CTC12



East-West Section - Tournament Mode
Capacity: 40,000

1. Player Tunnel
2. Media Mix Zone
3. VIP Entrance
4. VIP Drop Off
5. VIP Lounge
6. VIP Lobby
7. Kitchen
8. Media Concourse
9. Prayer Room
10. Plant
11. Hospitality
12. Hospitality Box
13. Hospitality Lounge
14. Service Road
15. Squad Room

5 10 25 50m

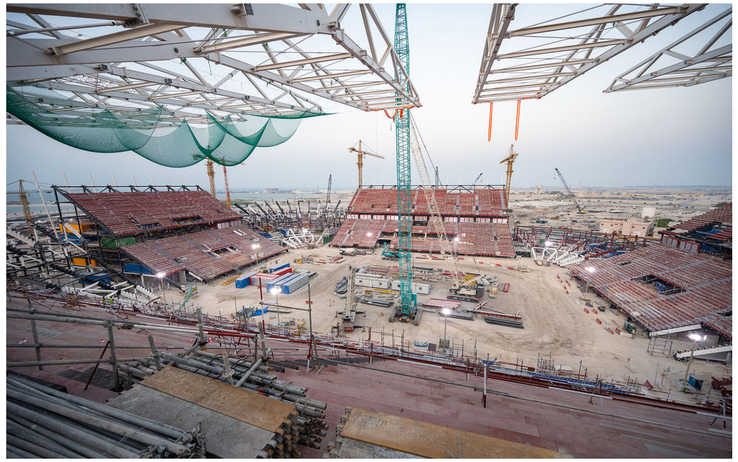


East-West Section - Legacy Mode
Capacity: 20,000

1. Player Tunnel
2. Media Mix Zone
3. VIP Lobby
4. VIP Drop Off
5. VIP Lounge
6. Hospitality Box
7. Hospitality
8. Hospitality Lounge
9. Media Concourse

5 10 25 50m







Wilde Westen

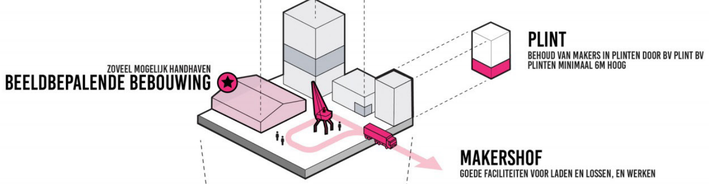
Stakeholder Inclusion

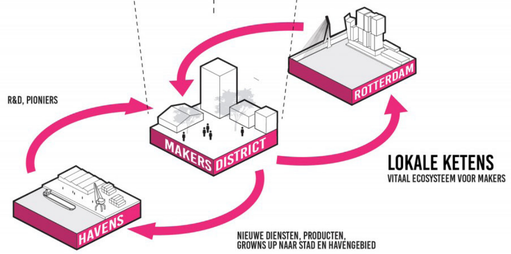
Participatory Planning

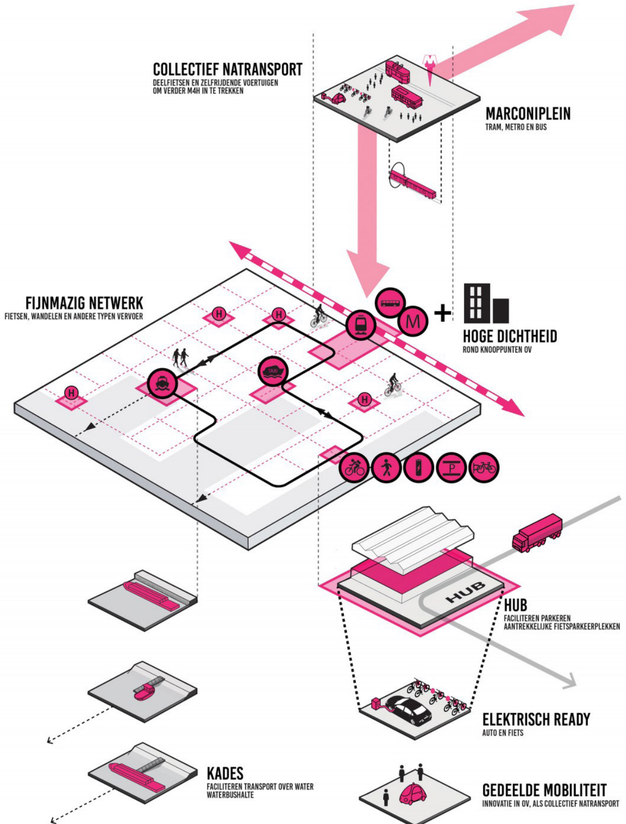
Transparency in Decision

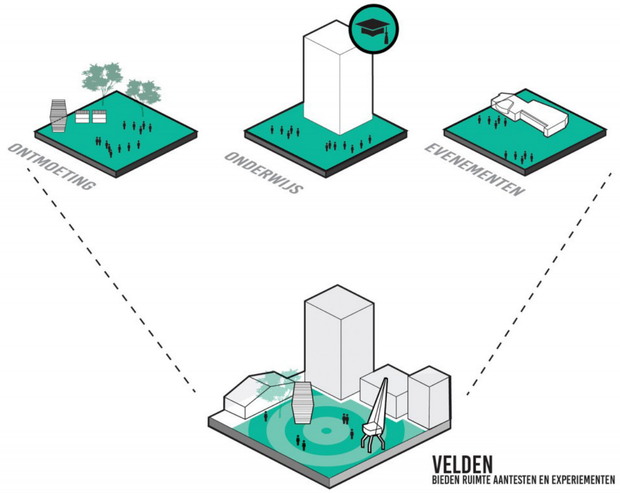
Feedback / Review

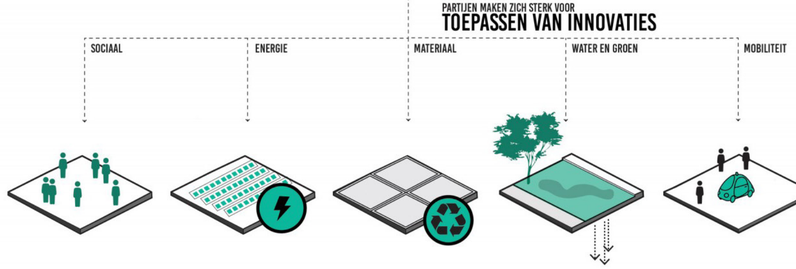


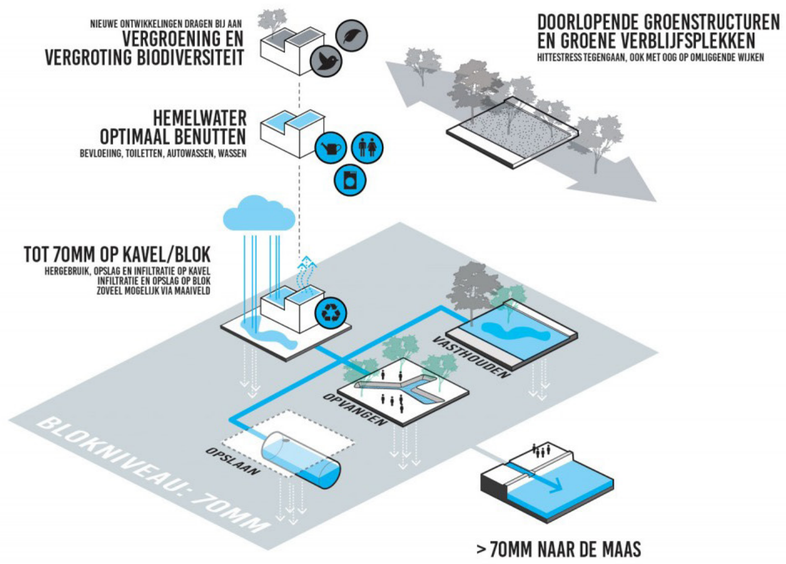

ZOVEEL MOGELIJK HANDHAVEN
BEELDBEPALENDE BEBOUWING
PLINT
BEHOUD VAN MAKERS IN PLINTEN DOOR BV PLINT BV
PLINTEN MINIMAAL 6M HOOG
MAKERSHOF
GOEDE FACILITEITEN VOOR LADEN EN LOSSEN, EN WERKEN

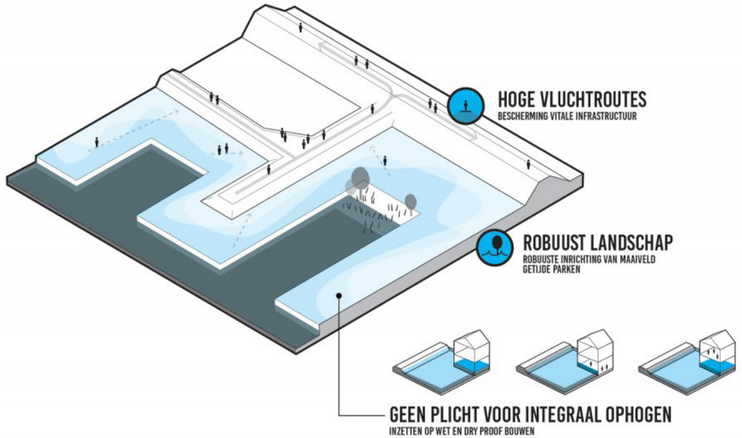

R&D, PIONIERS
ROTTERDAM
MAKERS DISTRICT
HAVENS
LOKALE KETENS
VITAAL ECOSYSTEEM VOOR MAKERS
NIEUWE DIENSTEN, PRODUCTEN,
GROWNS UP NAAR STAD EN HAVENGEBIED

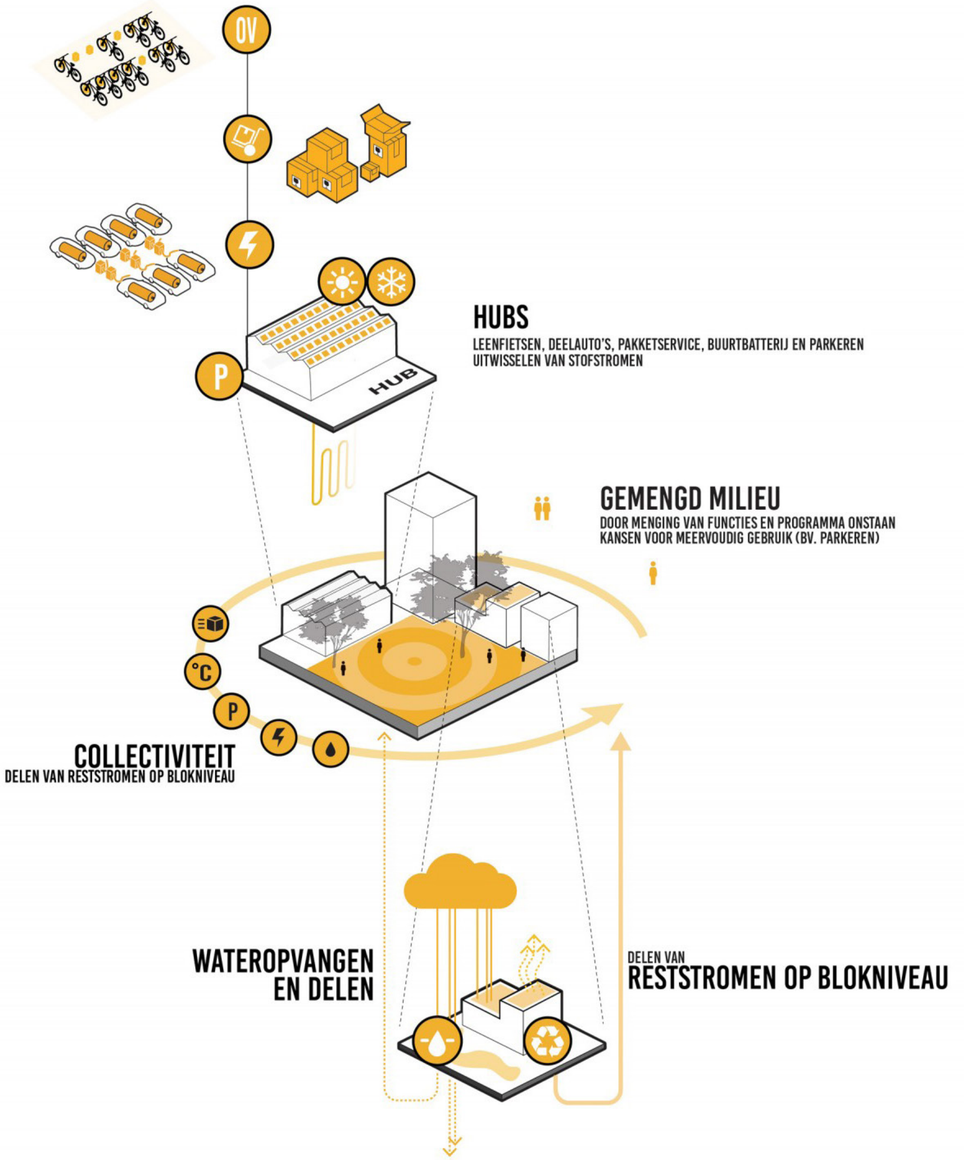

COLLECTIEF NATRANSPORT
DEELFIETSEN EN ZELFRIJDENDE VOERTUIGEN
OM VERDER M4H IN TE TREKKEN
MARCONIPLEIN
TRAM, METRO EN BUS
FIJNMAZIG NETWERK
FIETSEN, WANDELEN EN ANDERE TYPEN VERVOER
HOGE DICHTHEID
ROND KNOOPPUNTEN OV
HUB
HUB
FACILITEREN PARKEREN
AANTREKKELIJKE FIETSPARKEERPLEKKEN
ELEKTRISCH READY
AUTO EN FIETS
KADES
FACILITEREN TRANSPORT OVER WATER
WATERBUSHALTE
GEDEELDE MOBILITEIT
INNOVATIE IN OV, ALS COLLECTIEF NATRANSPORT


ONTMOETING
ONDERWIJS
EVENEMENTEN
VELDEN
BIEDEN RUIMTE AANTESTEN EN EXPERIEMENTEN


PARTIJEN MAKEN ZICH STERK VOOR
TOEPASSEN VAN INNOVATIES
SOCIAAL
ENERGIE
MATERIAAL
WATER EN GROEN
MOBILITEIT


NIEUWE ONTWIKKELINGEN DRAGEN BIJ AAN
VERGROENING EN
VERGROTING BIODIVERSITEIT
HEMELWATER
OPTIMAAL BENUTTEN
BEVLOEIING, TOILETTEN, AUTOWASSEN, WASSEN
DOORLOPENDE GROENSTRUCTUREN
EN GROENE VERBLIJFSPLEKKEN
HITTESTRESS TEGENGAAN, OOK MET OOG OP OMLIGGENDE WIJKEN
TOT 70MM OP KAVEL/BLOK
HERGEBRUIK, OPSLAG EN INFILTRATIE OP KAVEL
INFILTRATIE EN OPSLAG OP BLOK
ZOVEEL MOGELIJK VIA MAAIVELD
VASTHOUDEN
OPVANGEN
OPSLAAN
BLOKNIVEAU: 70MM
> 70MM NAAR DE MAAS


HOGE VLUCHTROUTES
BESCHERMING VITALE INFRASTRUCTUUR
ROBUUST LANDSCHAP
ROBUUSTE INRICHTING VAN MAAIVELD
GETIJDE PARKEN
GEEN PLICHT VOOR INTEGRAAL OPHOGEN
INZETTEN OP WET EN DRY PROOF BOUWEN


OV
P
HUB
HUBS
LEENFIETSEN, DEELAUTO'S, PAKKETSERVICE, BUURTBATTERIJ EN PARKEREN
UITWISSELEN VAN STOFSTROMEN
GEMENGD MILIEU
DOOR MENGING VAN FUNCTIES EN PROGRAMMA ONSTAAN
KANSEN VOOR MEERVOUDIG GEBRUIK (BV. PARKEREN)
°C
P
COLLECTIVITEIT
DELEN VAN RESTSTROMEN OP BLOKNIVEAU
WATEROPVANGEN
EN DELEN
DELEN VAN
RESTSTROMEN OP BLOKNIVEAU



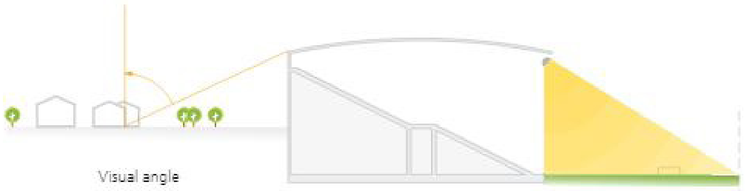


Diagram 1e:
Possible solution for reducing environmental impact

Bad example:
Construction impact on residential buildings

Good example:
Possible solution for reducing environmental impact

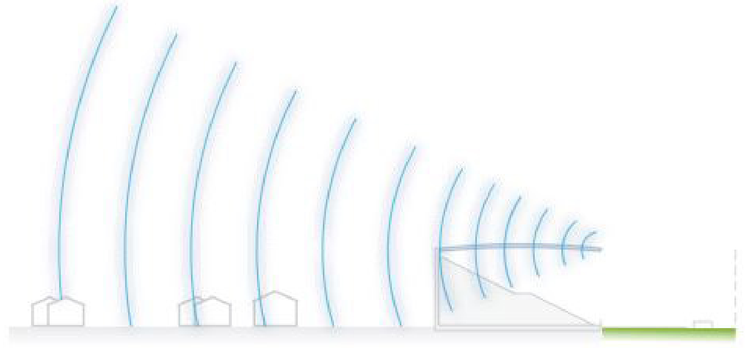
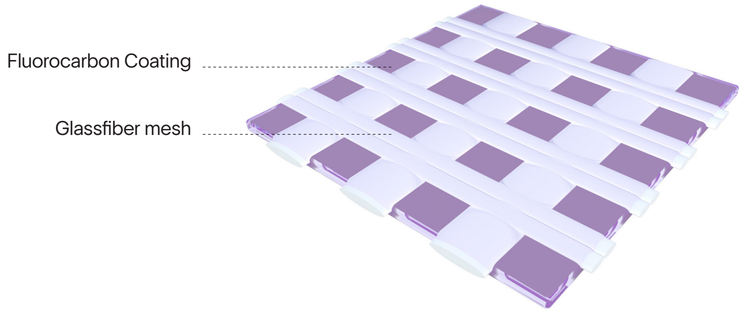


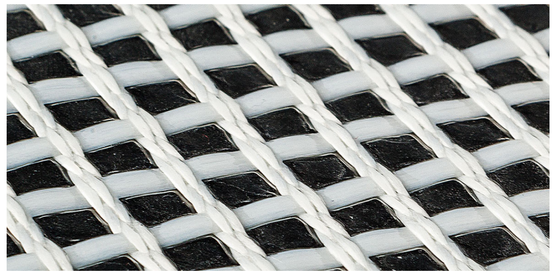
Diagram 1f:
Possible solution for reducing impact on surrounding areas

Bad example:
Noise impact on surrounding areas

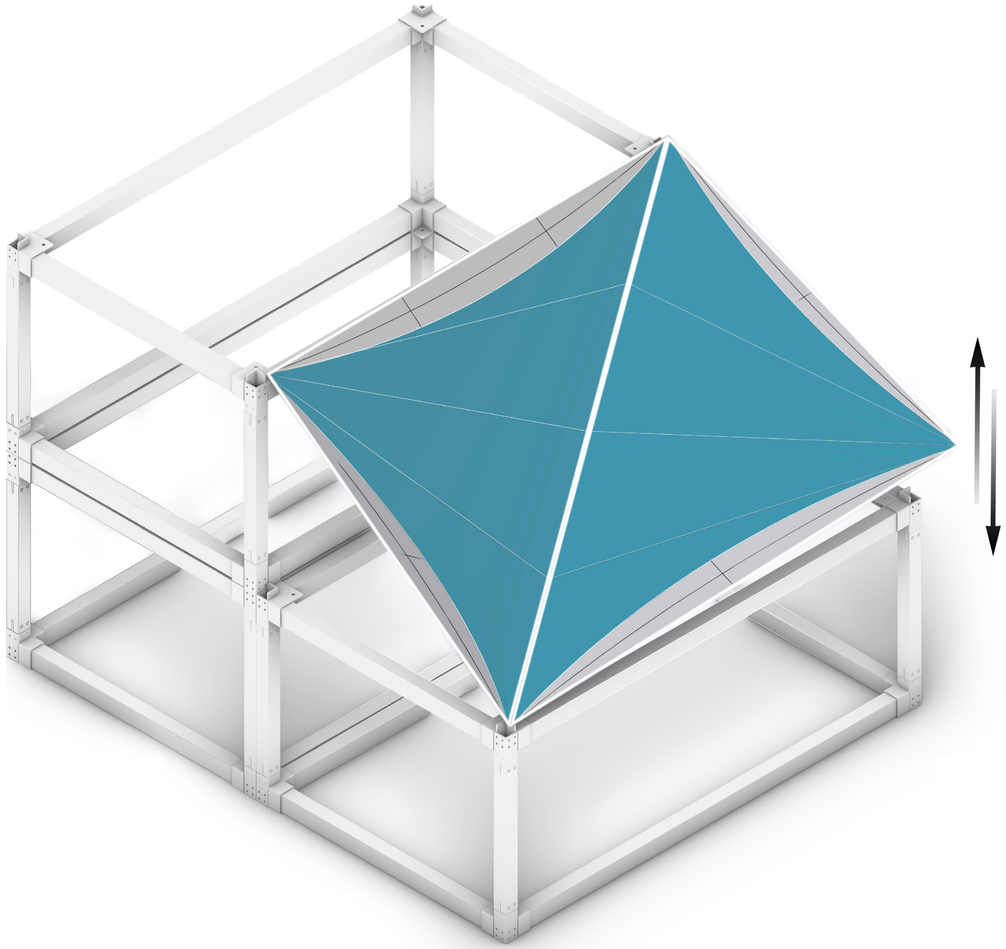
Good example:
Possible solution for reducing noise impact on surrounding areas

MEMBRANE // Technical Textile

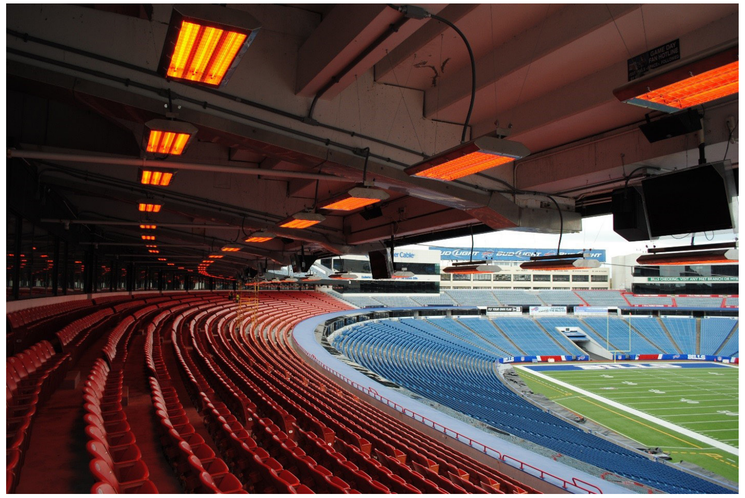




SIOEN FLUOSCRIM
Type II // 850 g/m^2



L: 5m **x** **W:** 7m



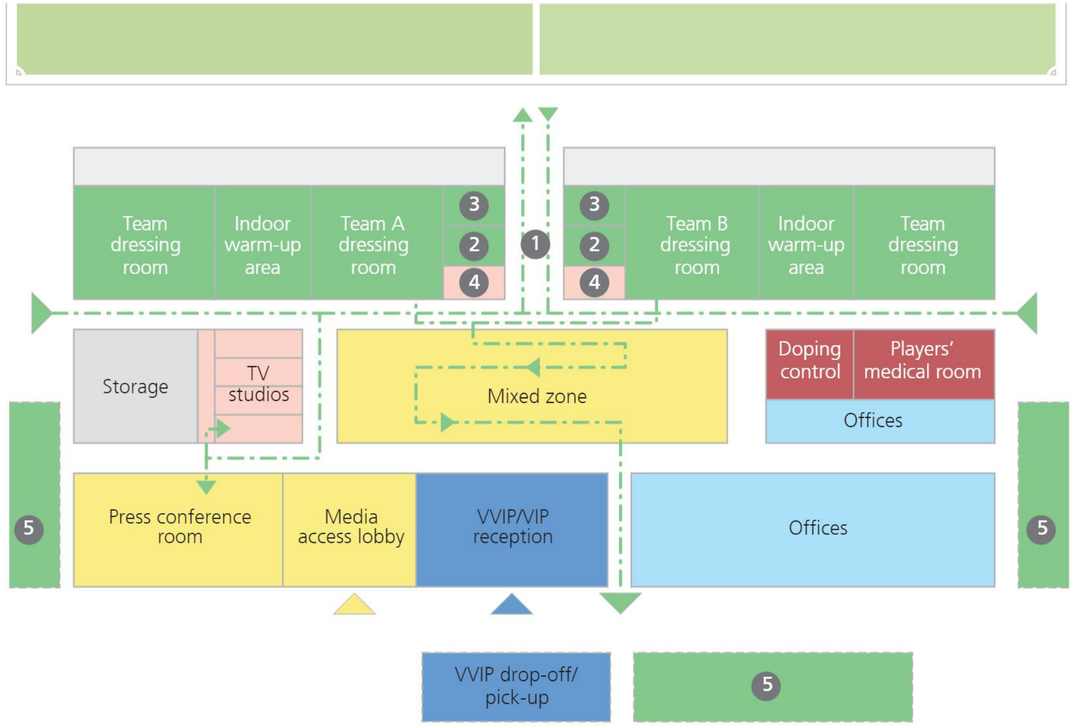


Diagram 5b: Team area

1. Players' tunnel
2. Coaches' office
3. Referees' dressing room
4. Flash interview
5. Player drop-off/pick-up

Players' route

Team access/exit

VIP/VVIP access

Media entry

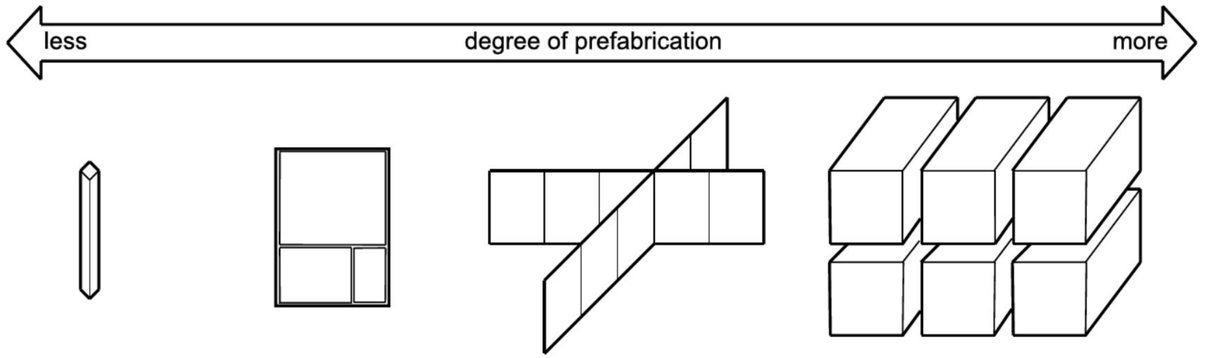
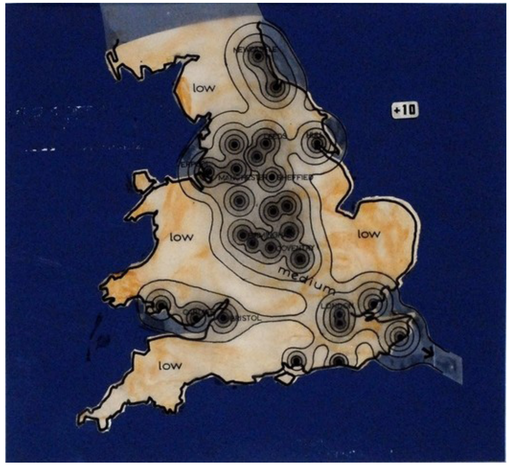
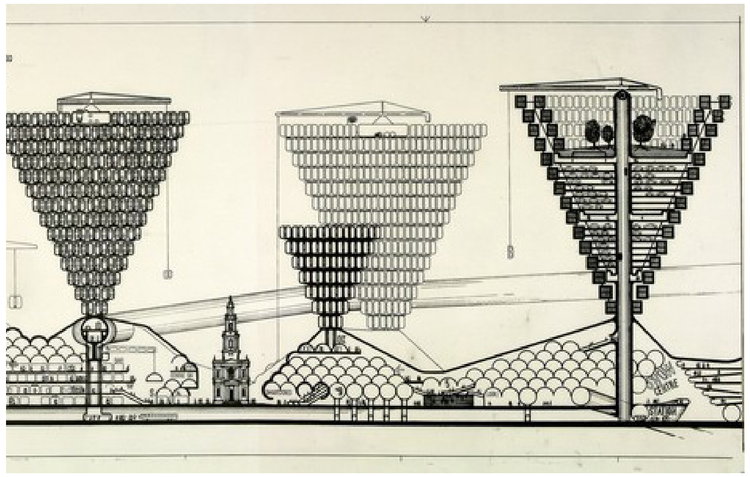
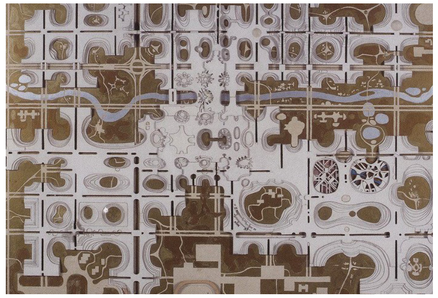


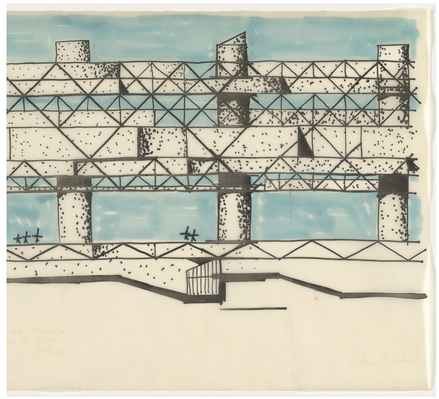
Figure 6.1 Prefabrication can be classified by the extent to which elements are completed prior to assembly onsite. *From left to right: materials, components, panels, and modules.* Generally, the benefits of prefabrication can be realized as projects move to increasingly greater degrees of prefabrication.

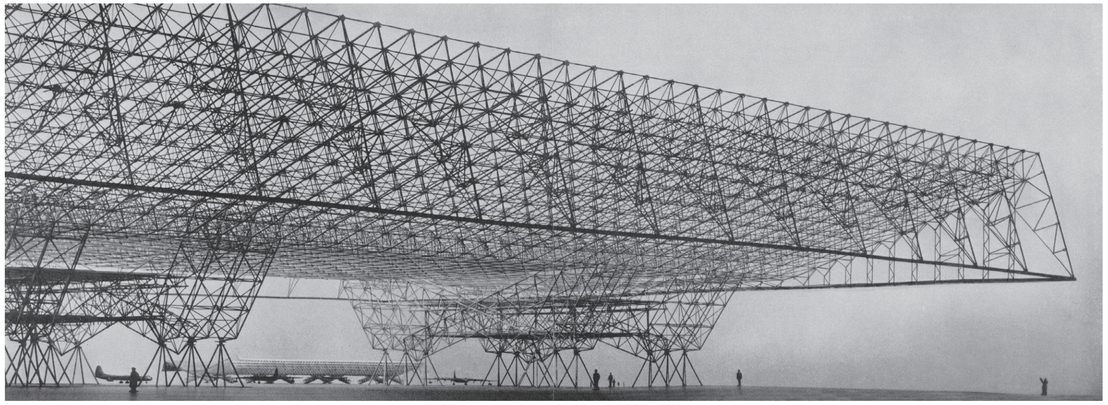

low
+10
low
low
medium
low

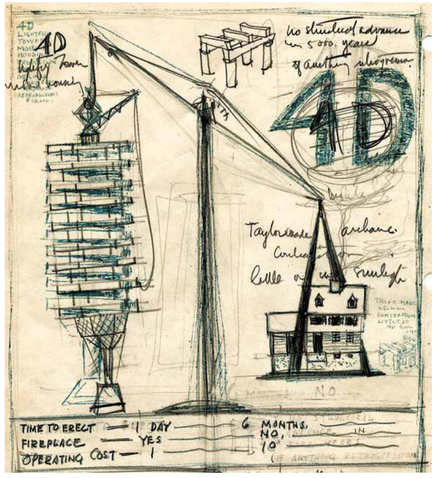


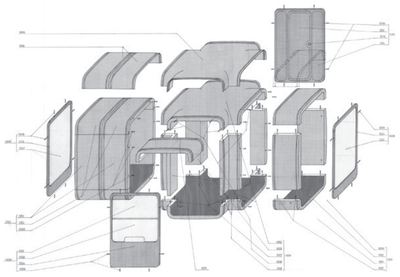


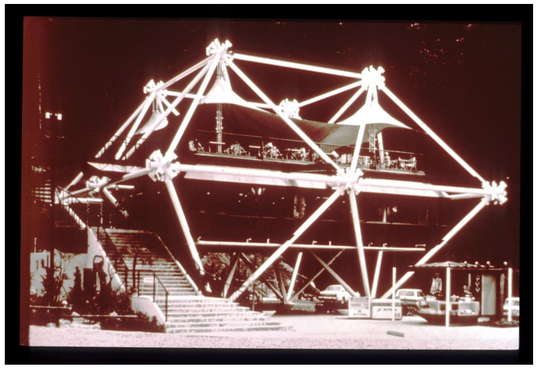


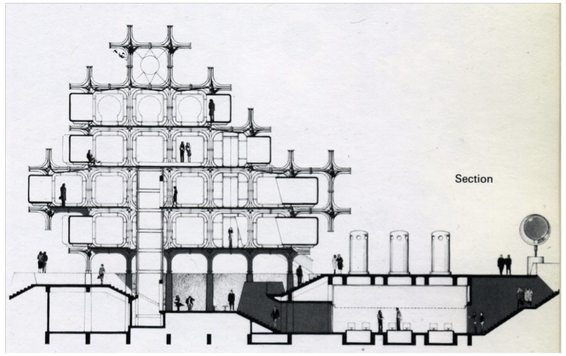


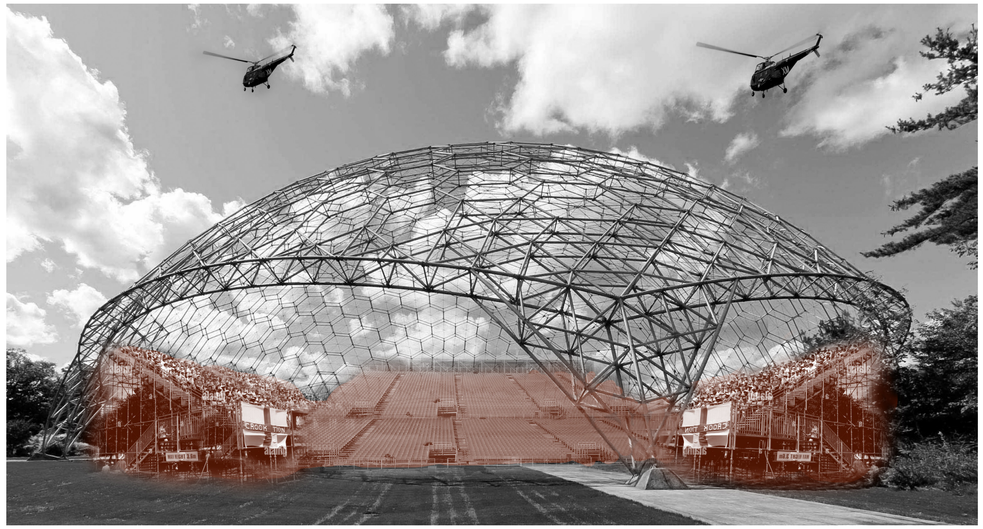



4D
4D
TIME TO ERECT — 1 DAY
FIREPLACE — YES
OPERATING COST — 1
6 MONTHS
NO,
10

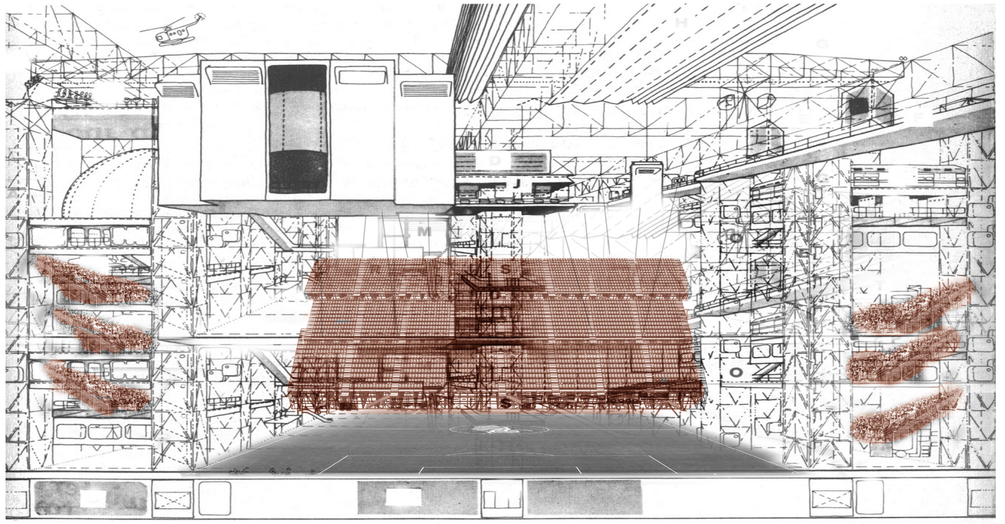




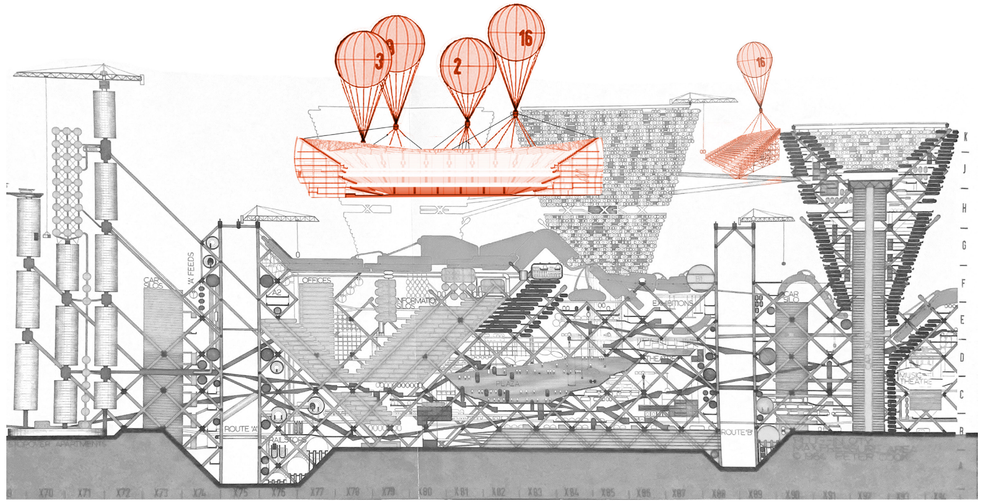

Section



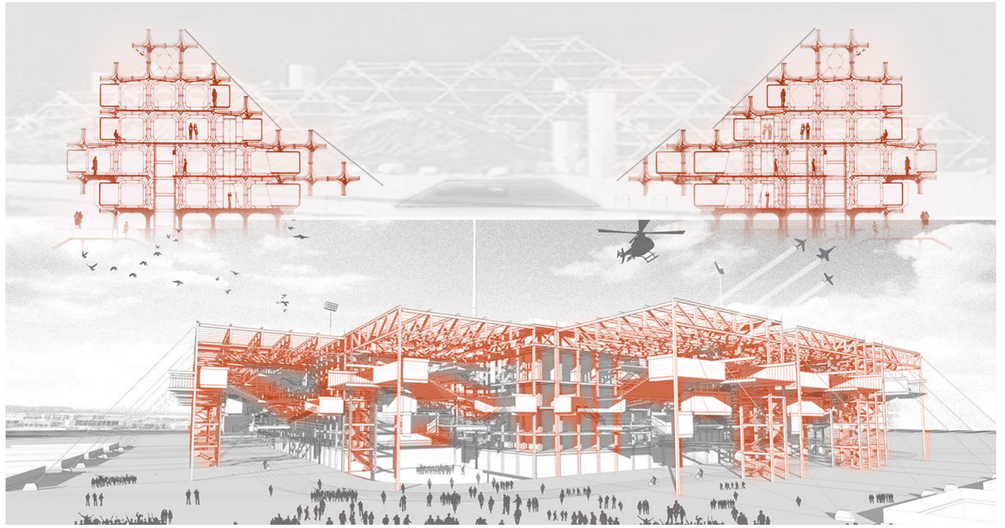
Buckminster Fuller



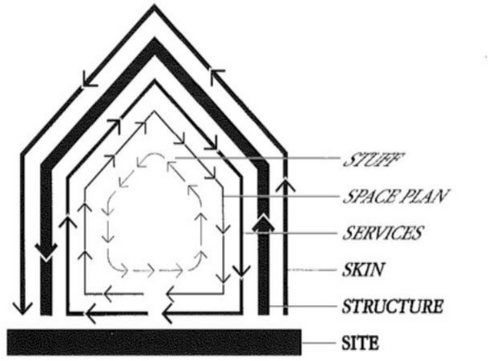
Cedric Price



Peter Cook



Kisho Kurokawa



SHEARING LAYERS OF CHANGE. Because of the different rates of change of its components, a building is always tearing itself apart.

Figure 1 (Brand, 1994, p. 13)

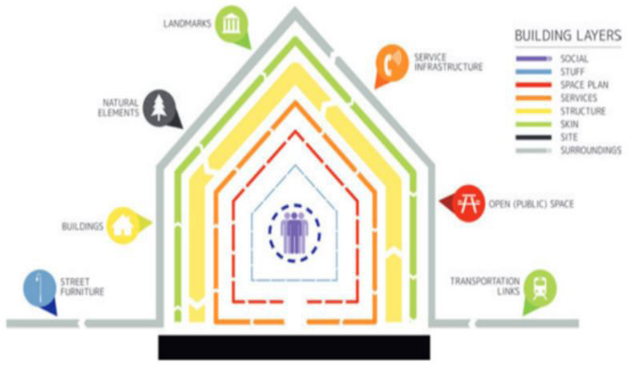


Figure 2 (Schmidt & Austin, 2016, p. 56)

