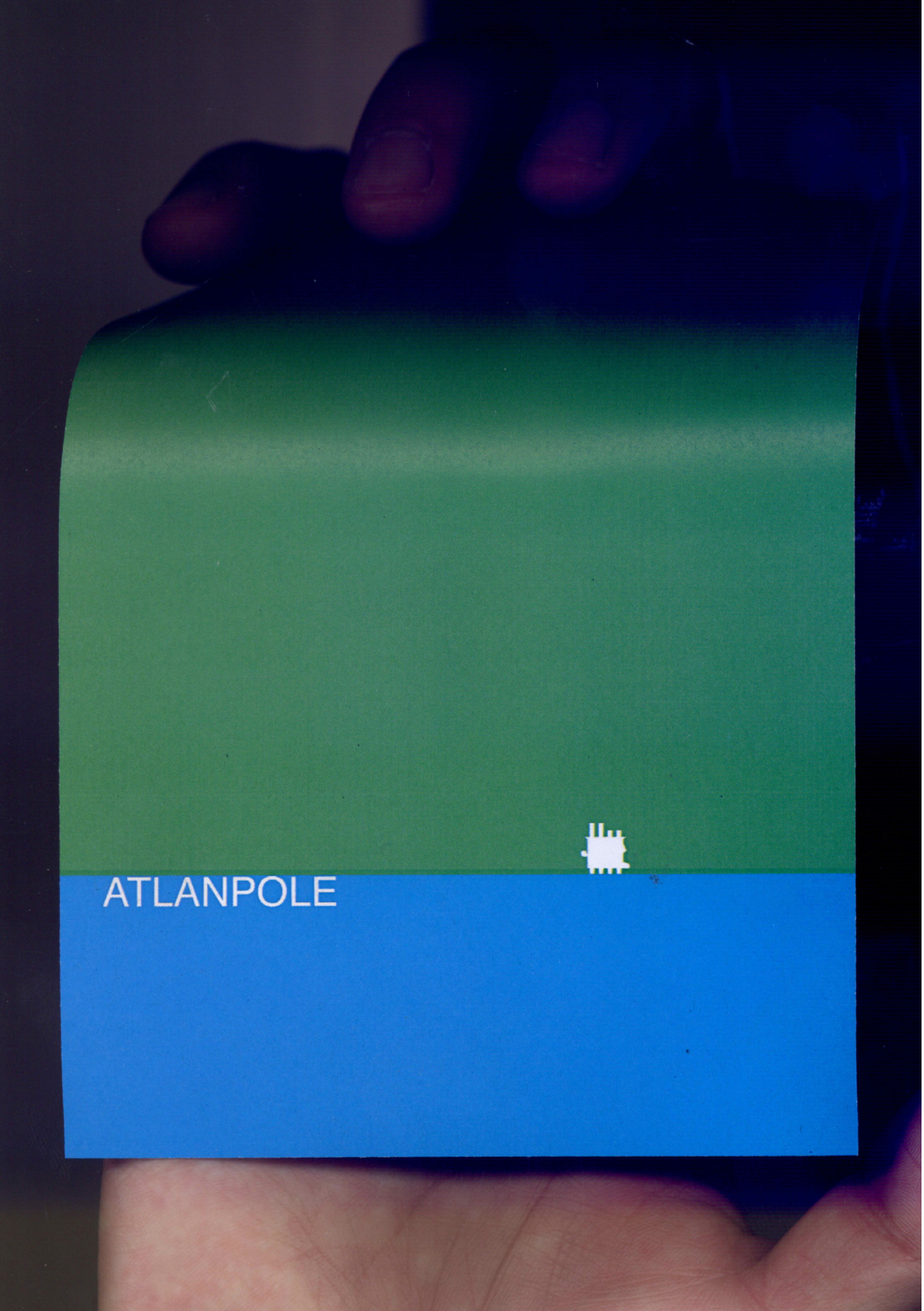
ATLANPOLE

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Master Thesis FS23
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VOLUPTAS, *Prof. Charbonnet / Prof. Heiz*
Chair for the Theory of Architecture *Prof. Laurent Stalder*

Assisted by Davide Spina and Marina Montresor

Exordium

In 1988, Nantes was going through its third industrial revolution and was trying to regain its economic power of the last centuries. The call to launch an urban design competition with the intention of creating a leading technopole in France led to a controversial submission at the time. Hans Kollhoff created a vertical neighborhood for the District Ia Chantrerie, showing visions of a city living in the middle of nature without touching it. The design would face many obstacles today if it were implemented exactly as planned at the time. Material emission and energy consumption, but also living together and interacting on a daily basis in such a high-rise typology can quickly reach its limits. In the following, an experimental high-rise typology and its added value for the city of Nantes is examined. Following the example of Hans Kollhoff's design, a multifunctional building is planned on the riverbank of the Erdre.

I

Geometry

Natural lighting is defined according to DIN standards up to the area that is twice the room depth of the window height. Consequently, the available data has been evaluated to find a ratio between unexposed rooms and the naturally exposed rooms. Natural light is essential for the well-being of users and occupants, and relevant for the reduction of energy consumption.

lighting requirements	Usage	Average Value [%]	Minimum Value [%]
small	wardrobes, traffic zones	1	1 - 2
moderate	restaurants	2	2 - 3
high	office, living spaces	5 - 7	4
very high	laboratories, clock industry	7 - 12	5 - 7
extremly high	special usage	+ 12	10

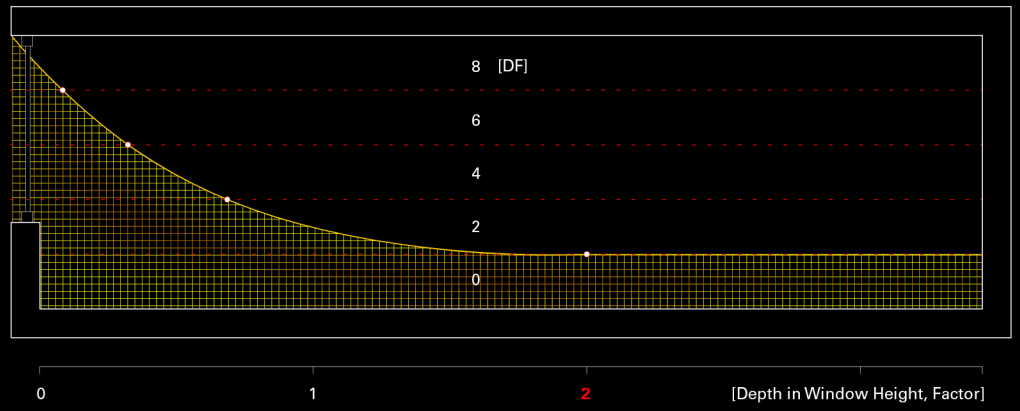
DIN 5034

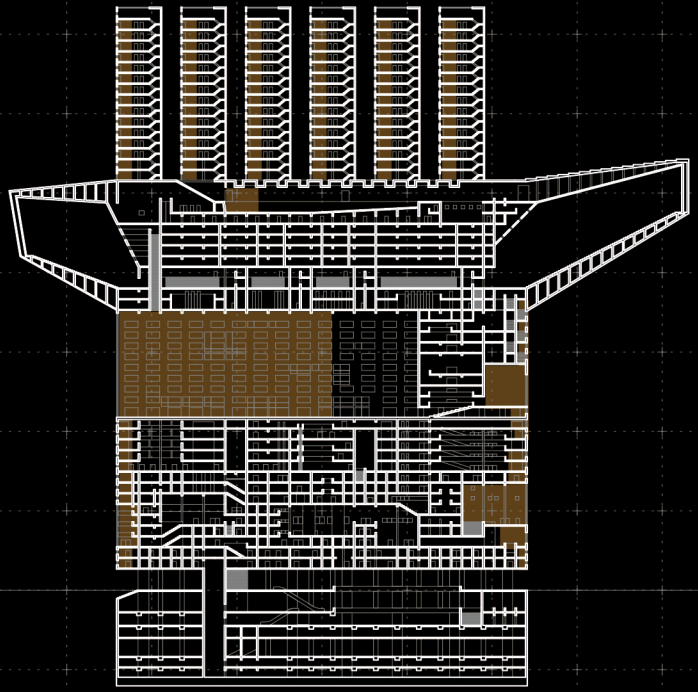
$$DF = (E_i - E_o) * 100\%$$

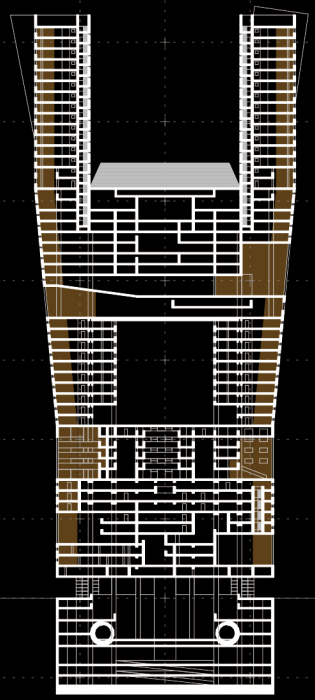
Daylight Factor DF

illuminance due to daylight at a point on the indoors working plane E_i

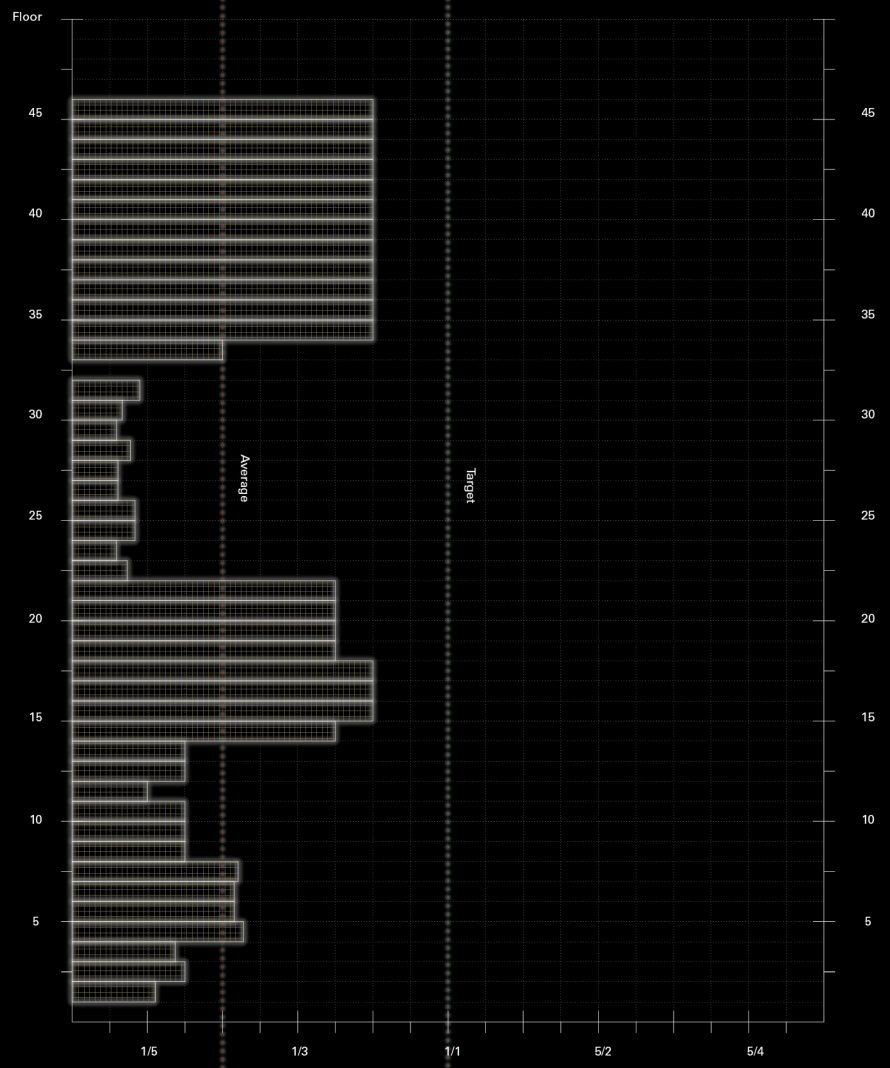
simultaneous outdoor illuminance on a horizontal plane from an unobstructed hemisphere of overcast sky. E_o



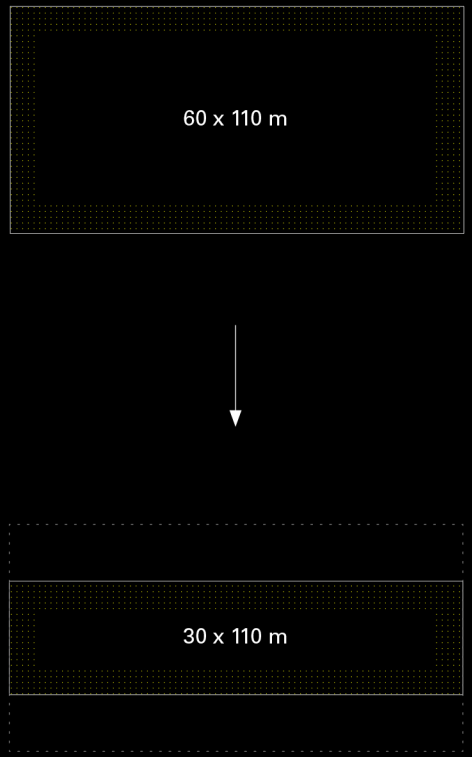




I.I Daylight Factor



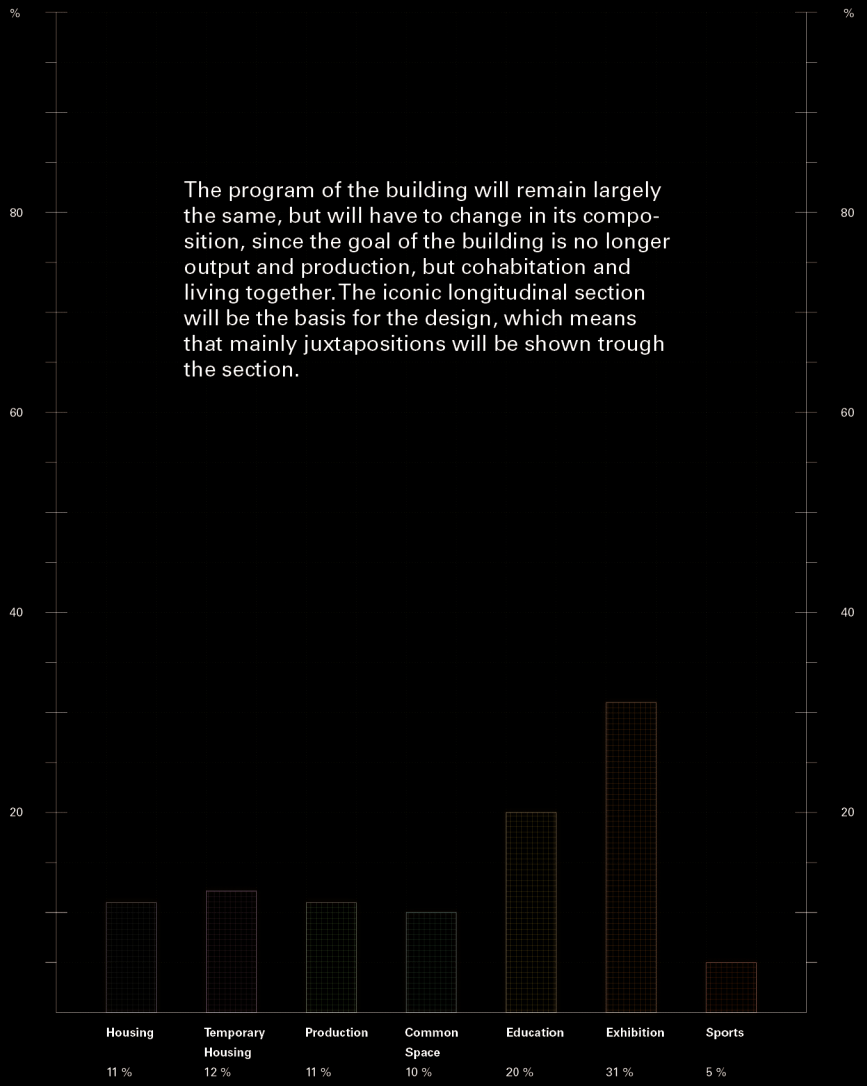
The average ratio in Hans Kollhoff's design is 2/5. The standard for public buildings should aim for a 1/1 ratio and optimally exceed it.



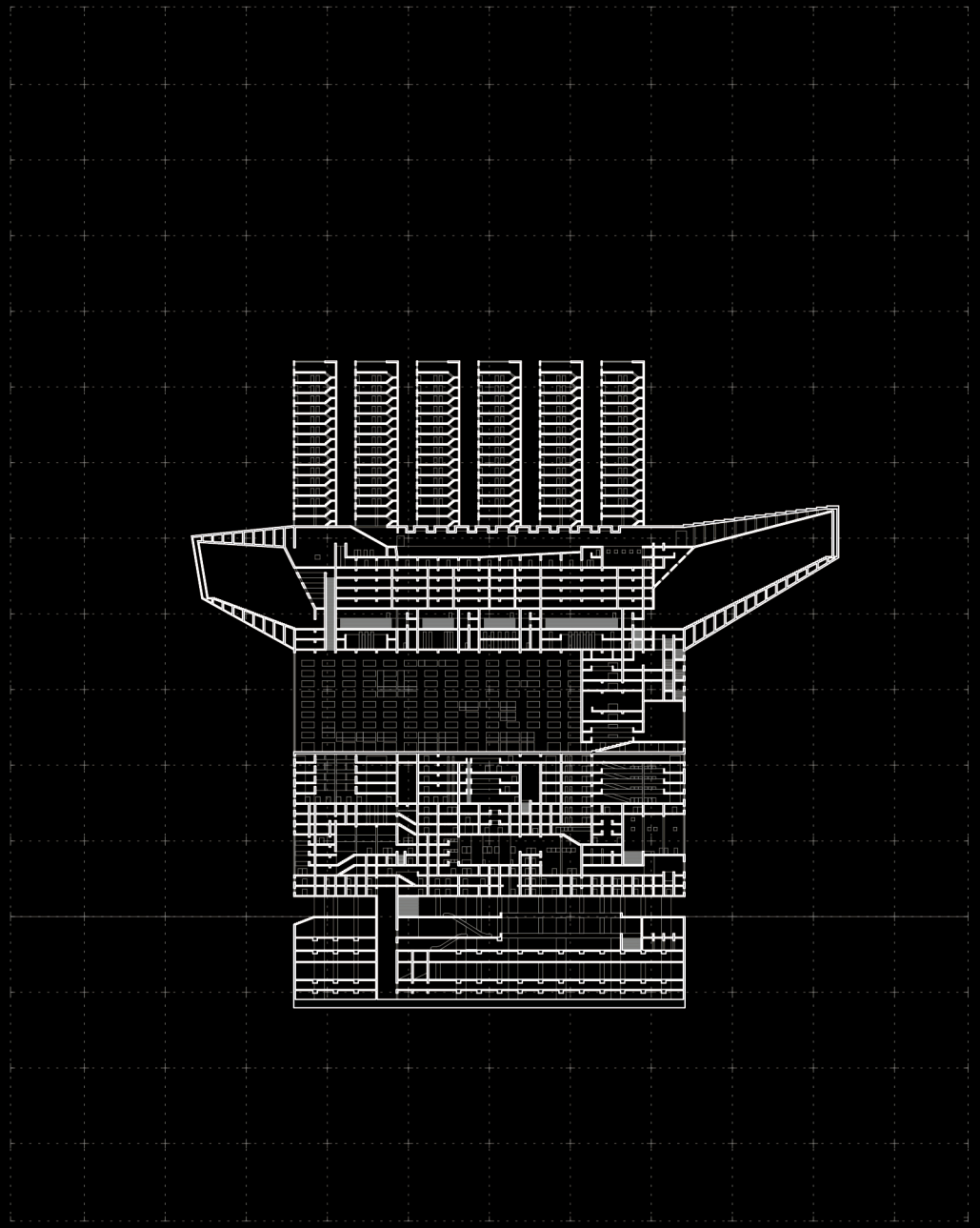
The first intervention foresees a reduction of the building depth in order to achieve the desired ratio while maintaining the same room height.

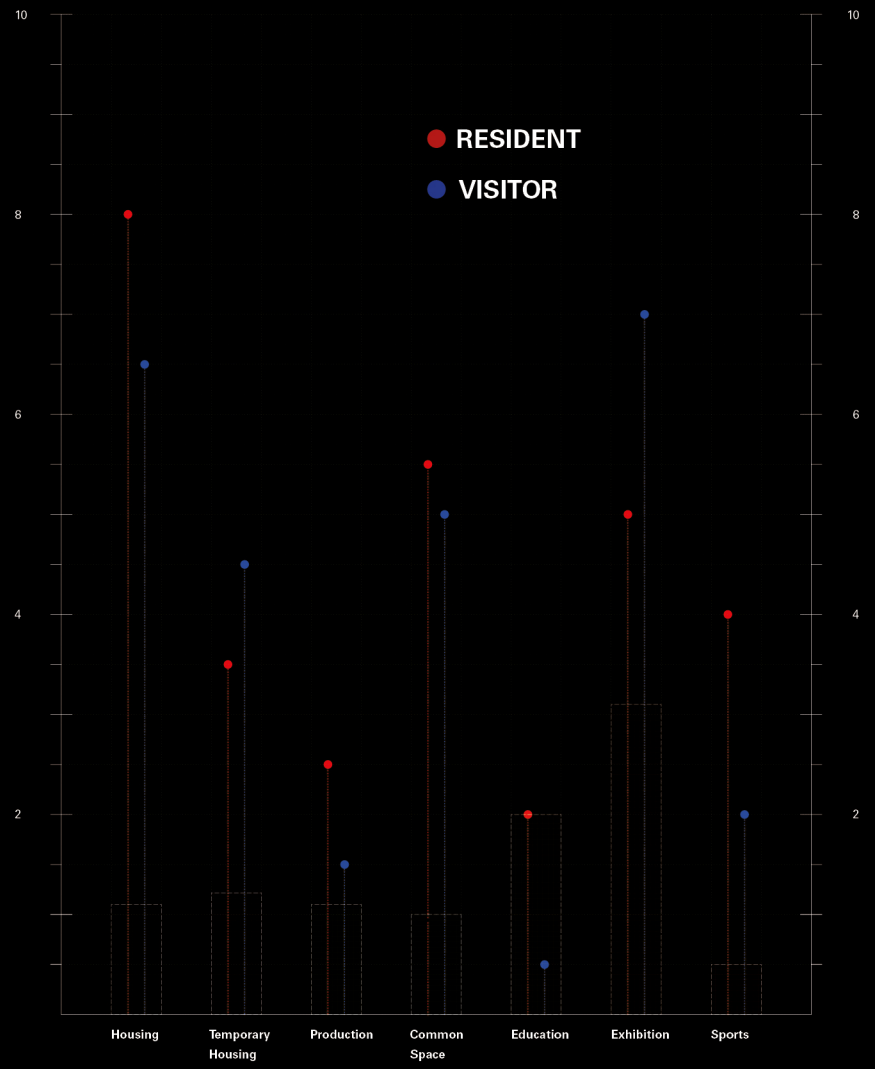
II

Program

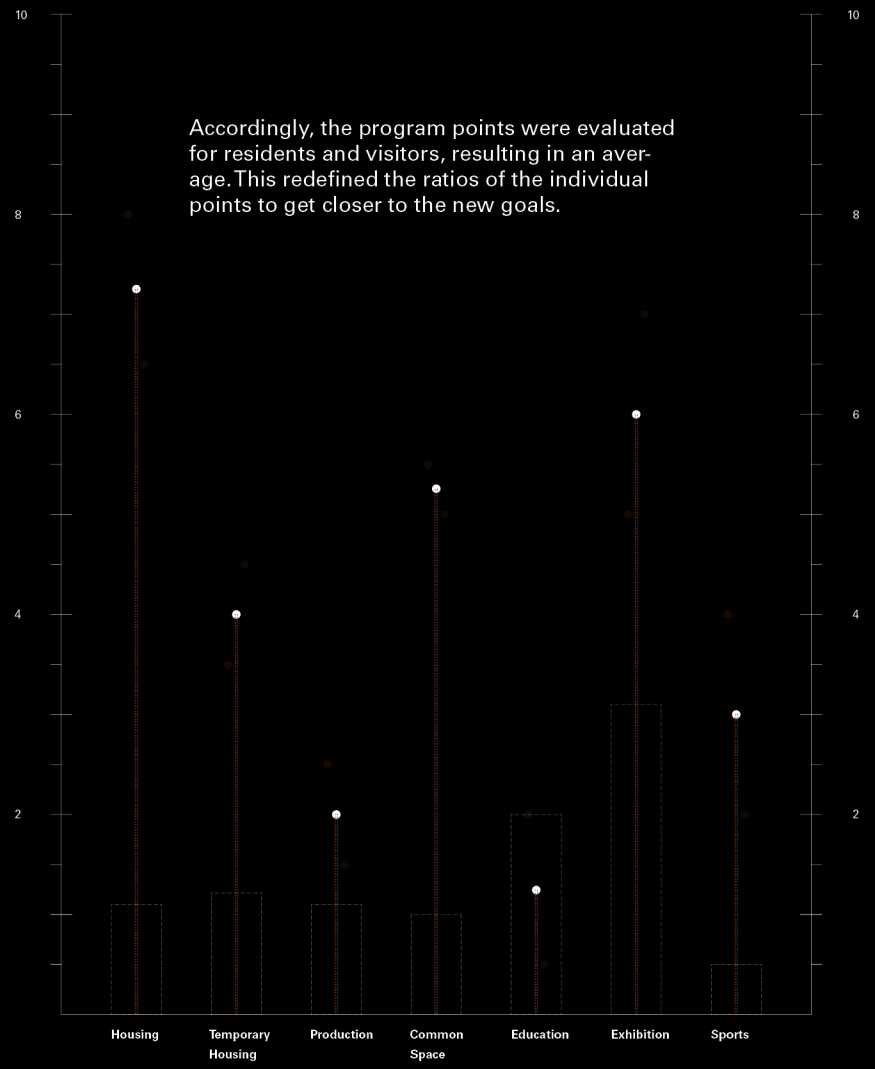


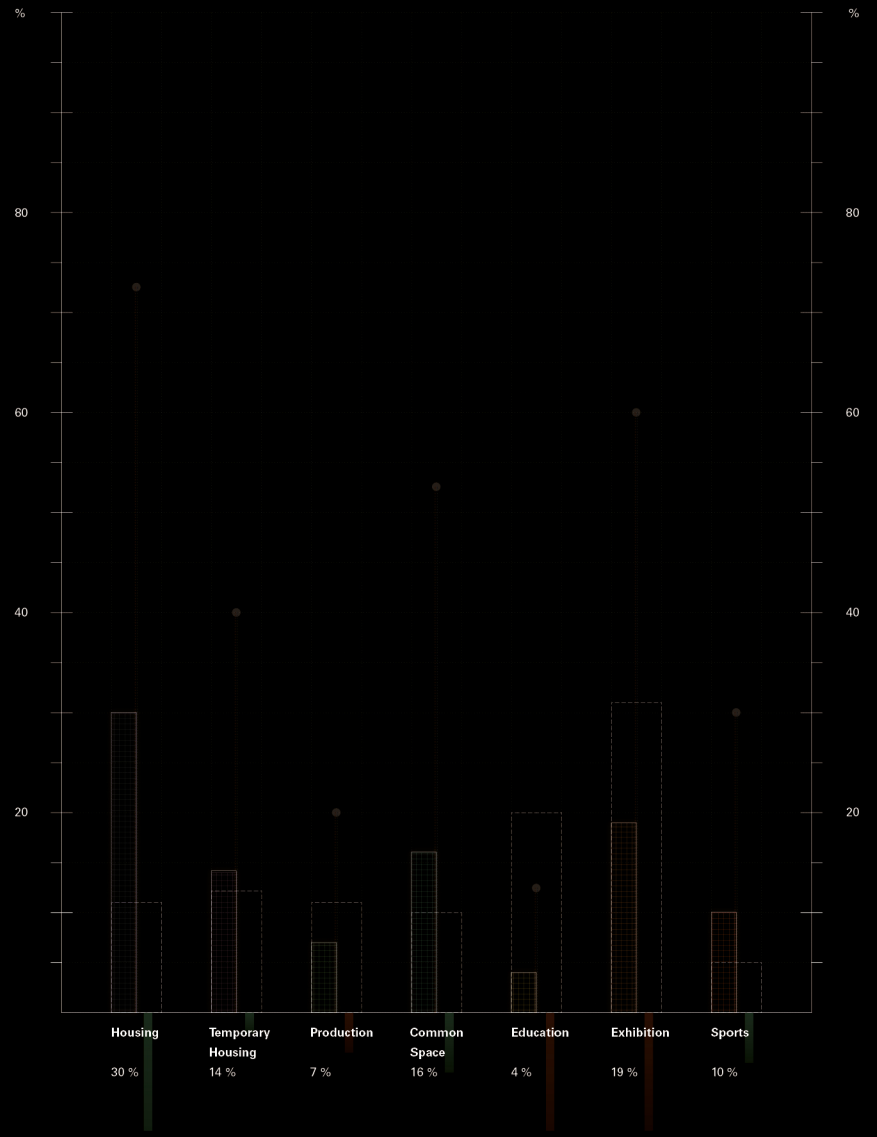
The program of the building will remain largely the same, but will have to change in its composition, since the goal of the building is no longer output and production, but cohabitation and living together. The iconic longitudinal section will be the basis for the design, which means that mainly juxtapositions will be shown trough the section.





Accordingly, the program points were evaluated for residents and visitors, resulting in an average. This redefined the ratios of the individual points to get closer to the new goals.





Using Nantes' urban growth forecast for 2035, the number of residents expected to be newly settled in La Chantrerie by that year will be the number of residents for the design, to leave the surrounding nature untouched and still give an answer to the challenge of city growth. Compared to Hans Kollhoff's design, this is an increase of 50% of citicen, creating a stronger sense of density and urbanity while maintaining the same building area.

II.II

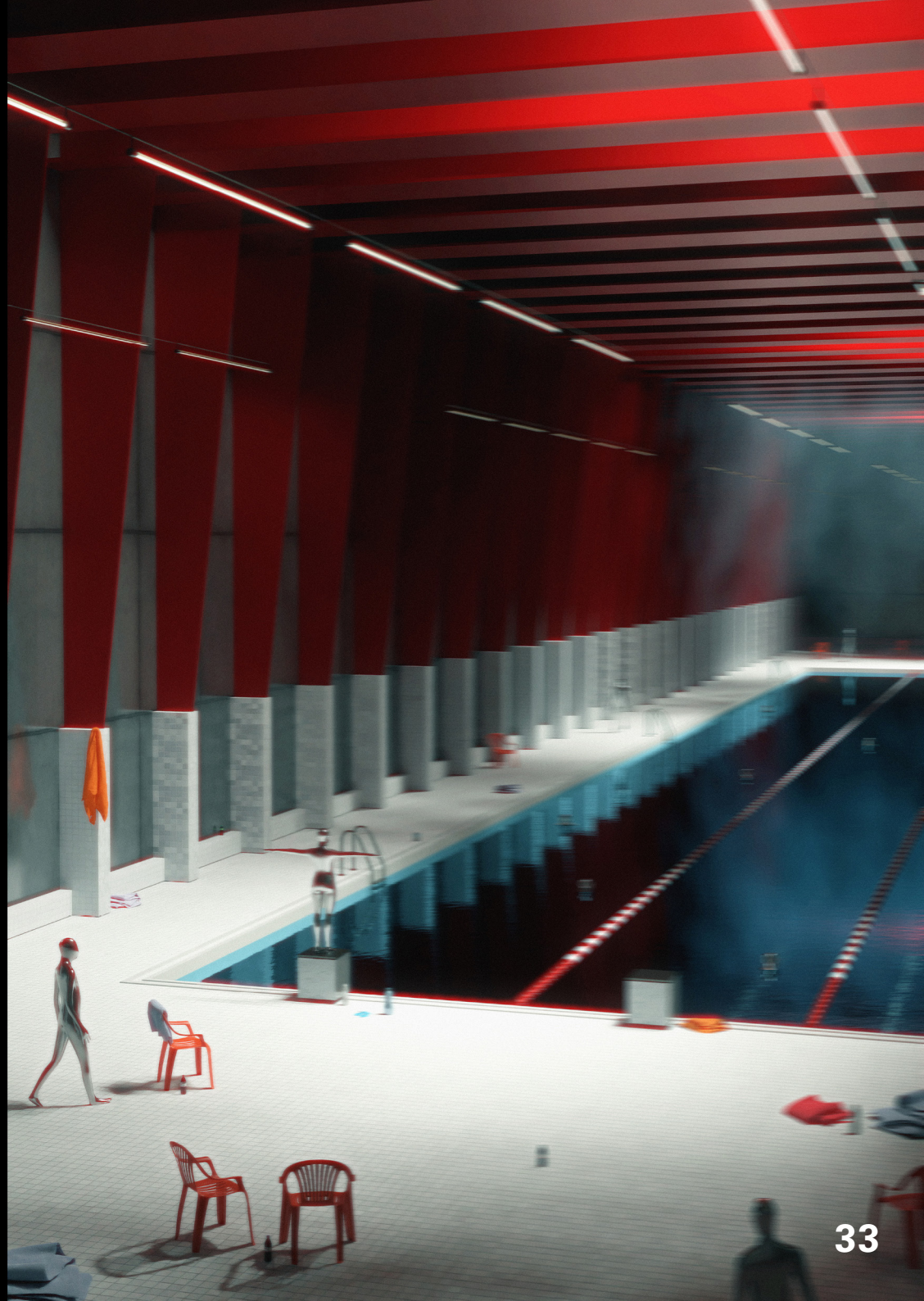
Net Area

$$R_A = P_{G35} * (S_C / S_N)$$

Residents R_A
Population Growth Nantes until 2035 P_{G35}
Surface La Chantrerie S_c
Surface Nantes S_N

=

1000 Residents



$$S_{HA} = R_A * AS_{AN}$$

Residents R_A
Average Aparment Share Nantes AS_{AN}
Net Surface for Housing S_{HA}

=

35000 m² Housing

35000 m² Housing

16300 m² Temporary Housing

8150 m² Co Working

18600 m² Common Space

4600 m² Education

22160 m² Arts and Music

11660 m² Sports

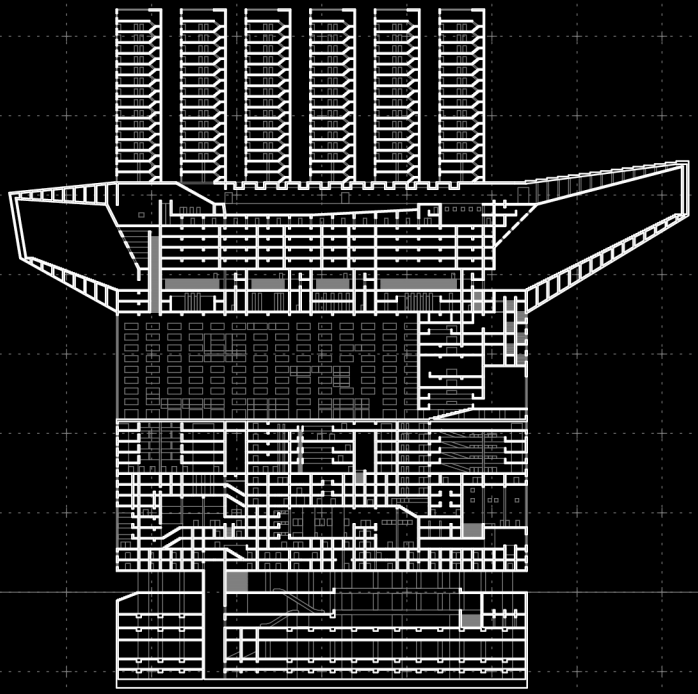
/ 3300 m²

=

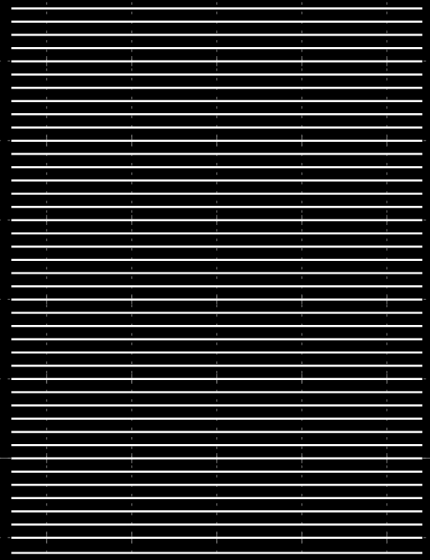
39 Floors

III

Mass

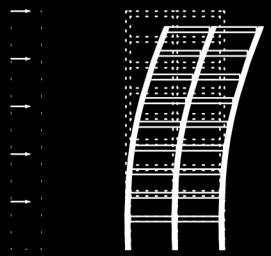


39 FLOORS

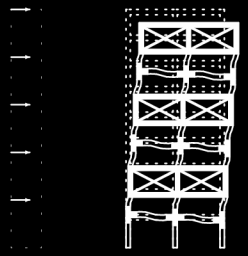


BIOMASS HIGH RISES

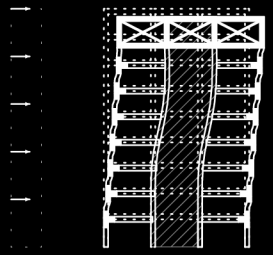
In skeleton construction, the rigitness of the joints is essential for an even load distribution. If the connections are not rigid, the columns bear all the load.

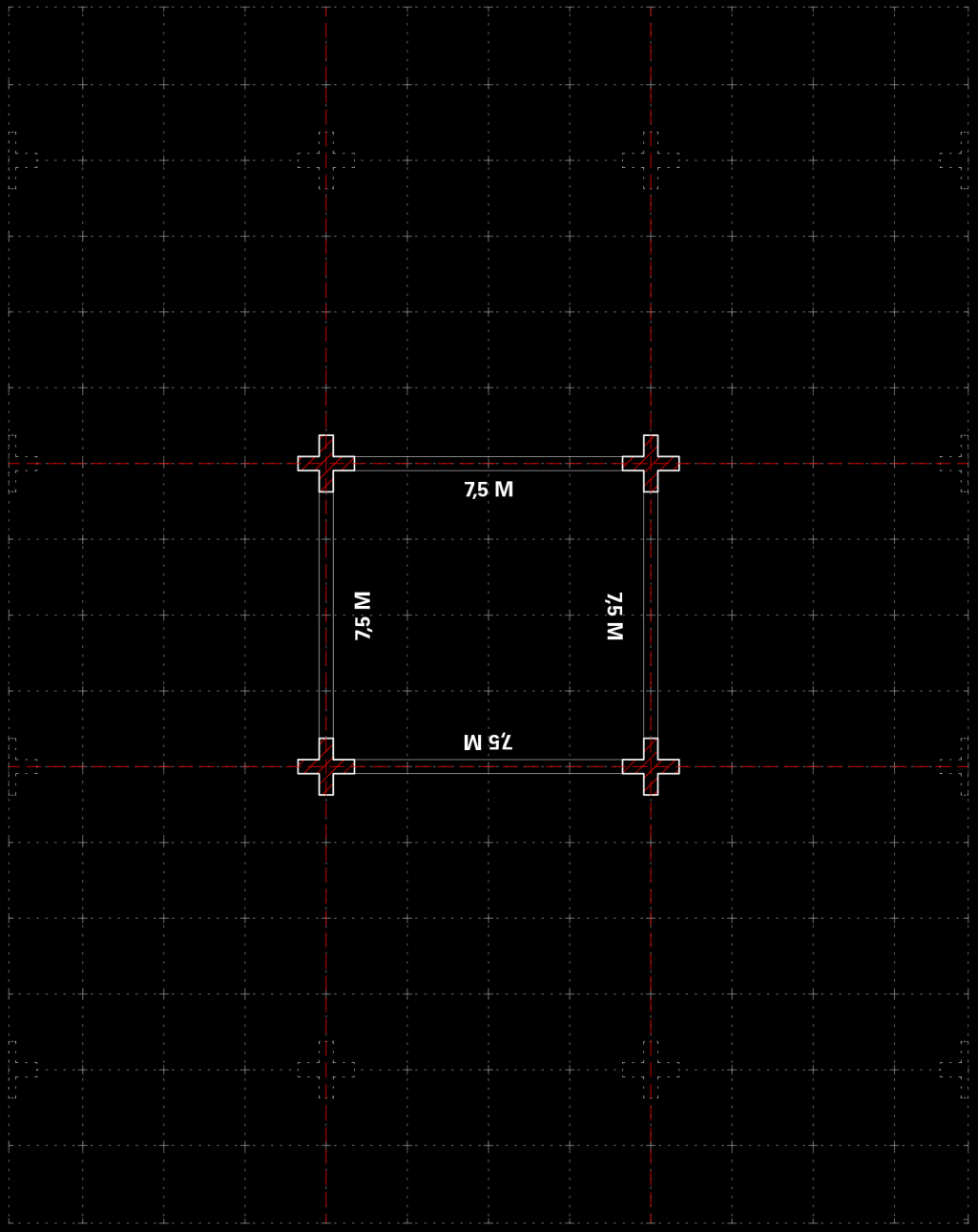


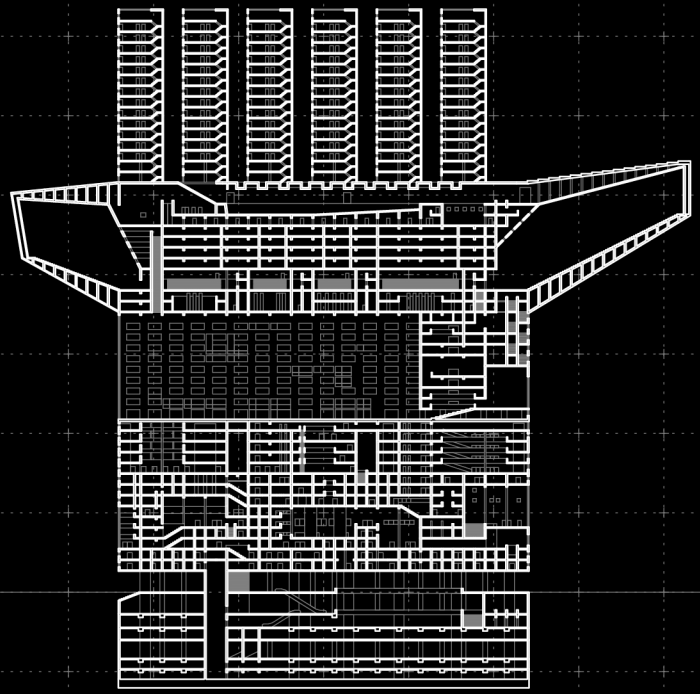
A Belltruss and Outrigger System reduces the yield factor to a minimum for wind loads.



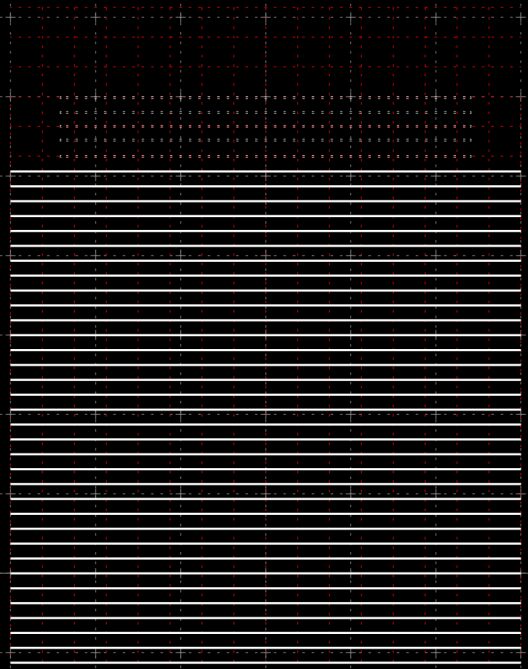
Additionally, for buildings constructed with timber of over 100 meters, a stiffening core is essential. Made of concrete, it has 4.5 times the stiffness while maintaining the same material thickness.

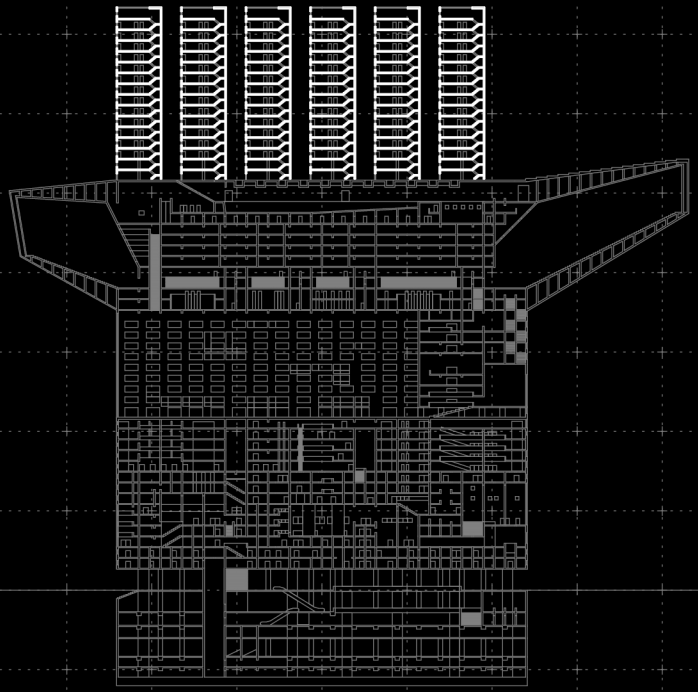




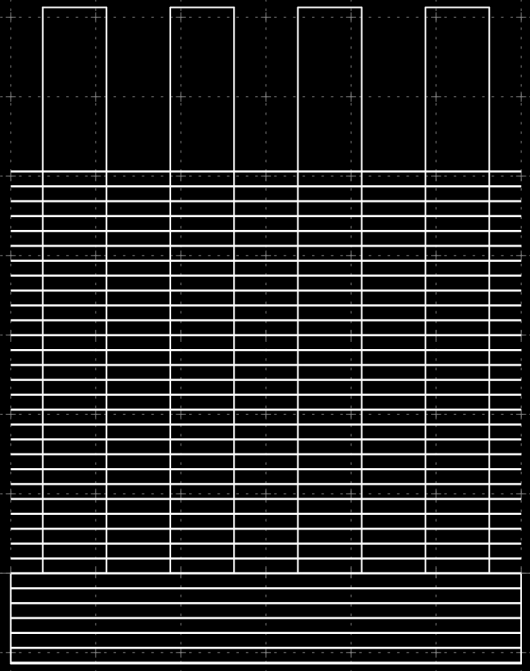


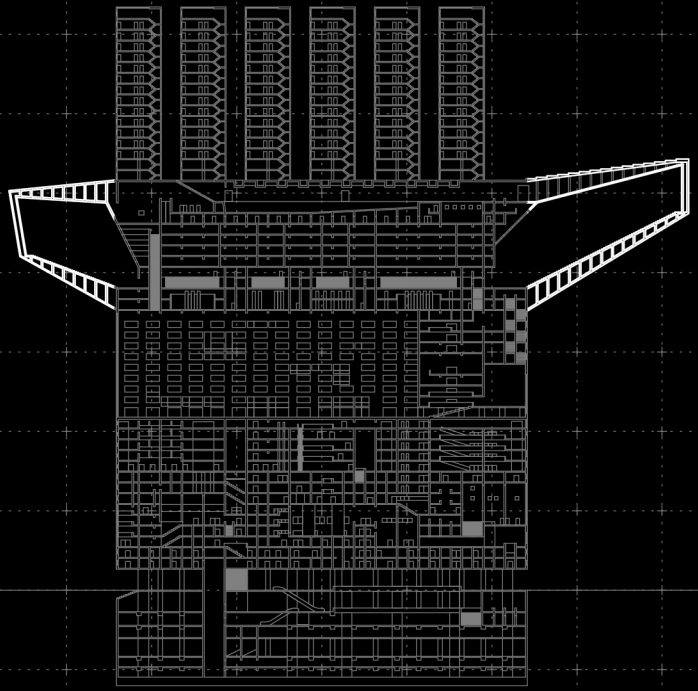
The grid adapts to optimal spans of solid structural timber.



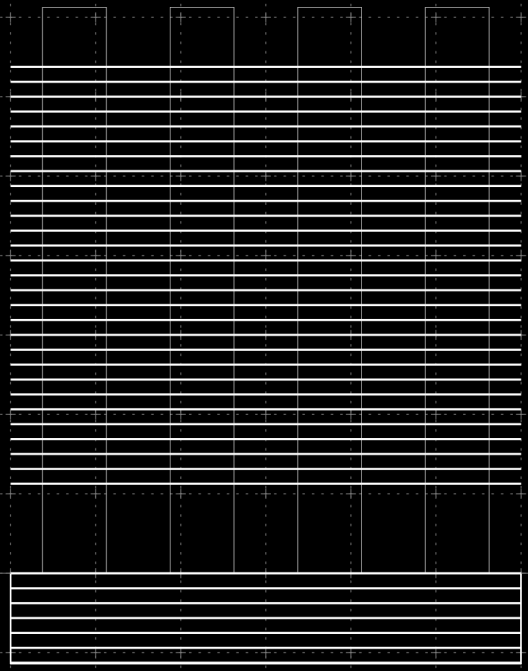


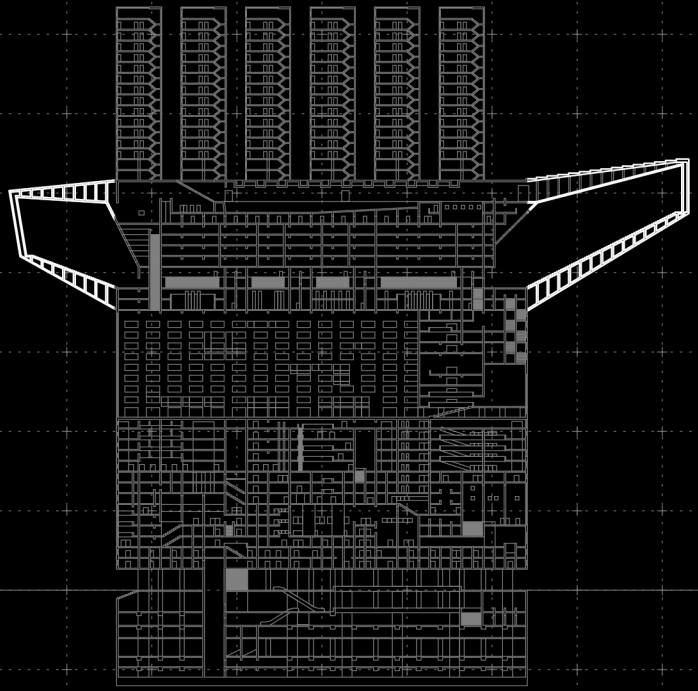
Concrete cores are placed with the highest possible construction height that can be achieved within the system. They are reminiscent of the towers of Kollhoff's design, but follow a static principle.



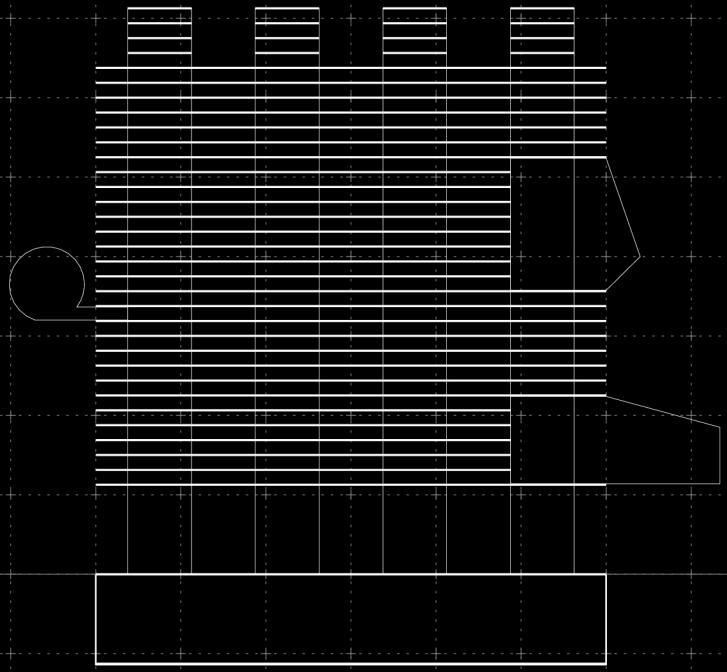


An elevated groundfloor will seperate human life and the surroundings vertically. The nature stays untouched.

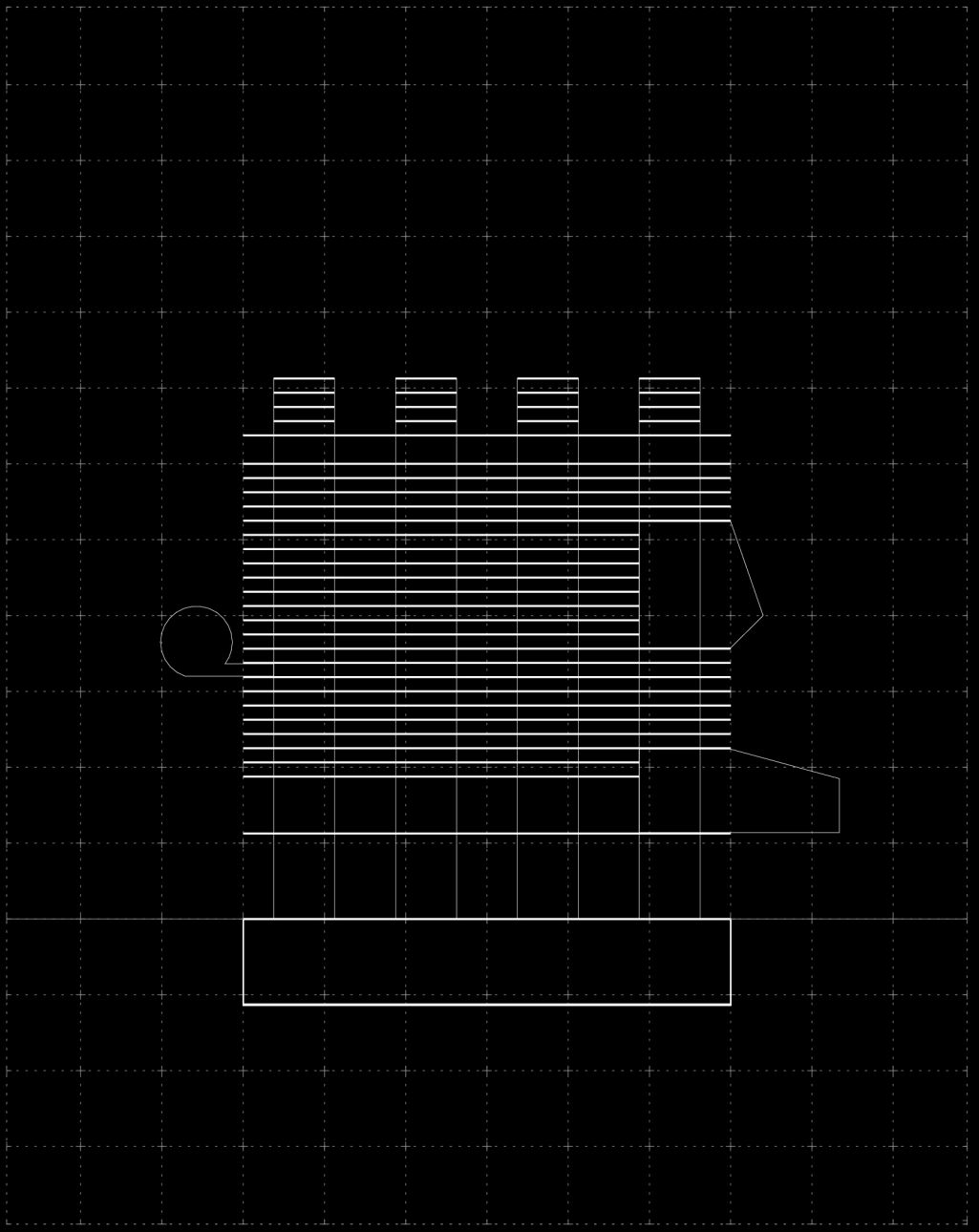




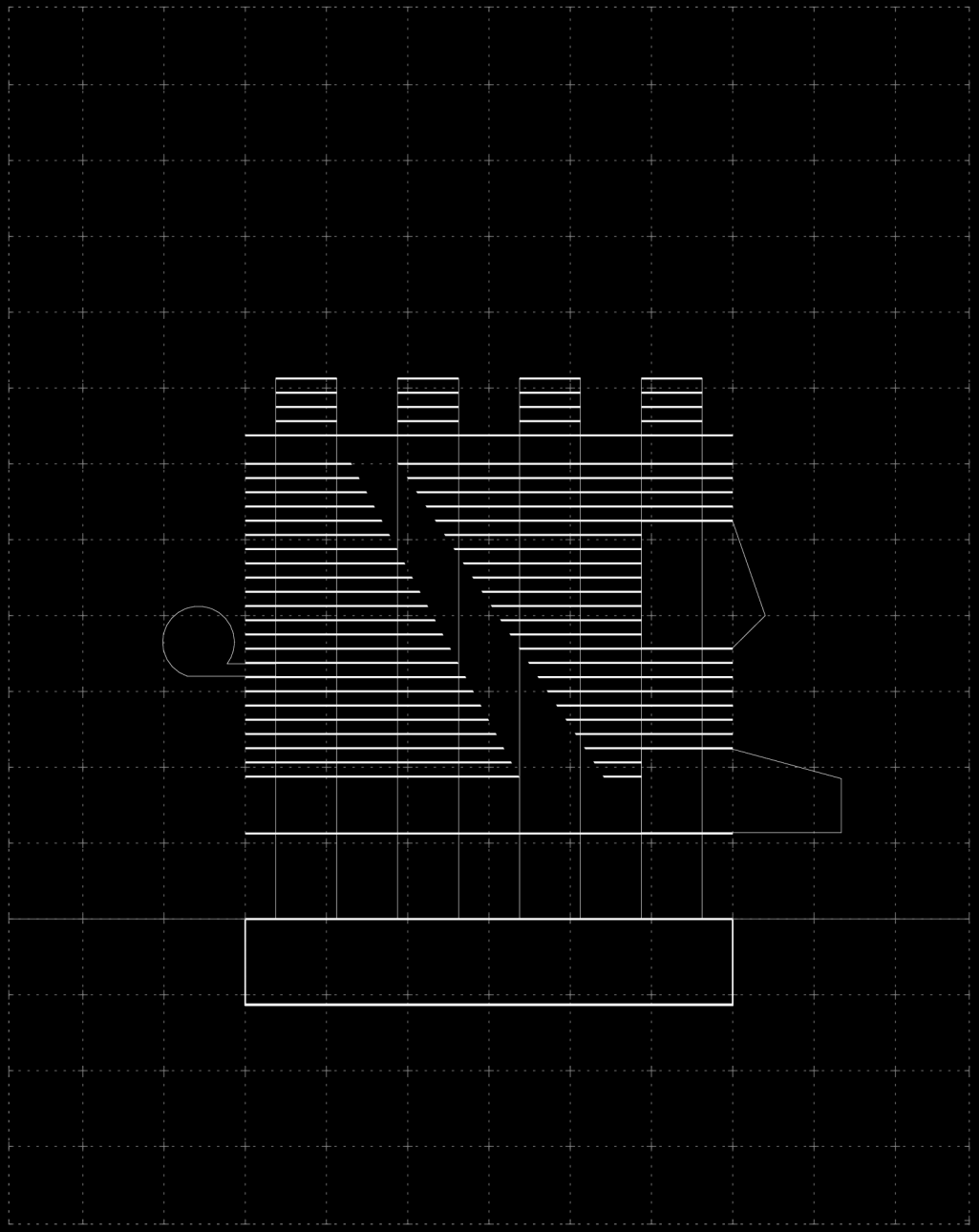
Extensions and additional spaces come in the shape of a train station (arriving from nature), an observatorium (observating nature) and a botanical garden (preserving nature).



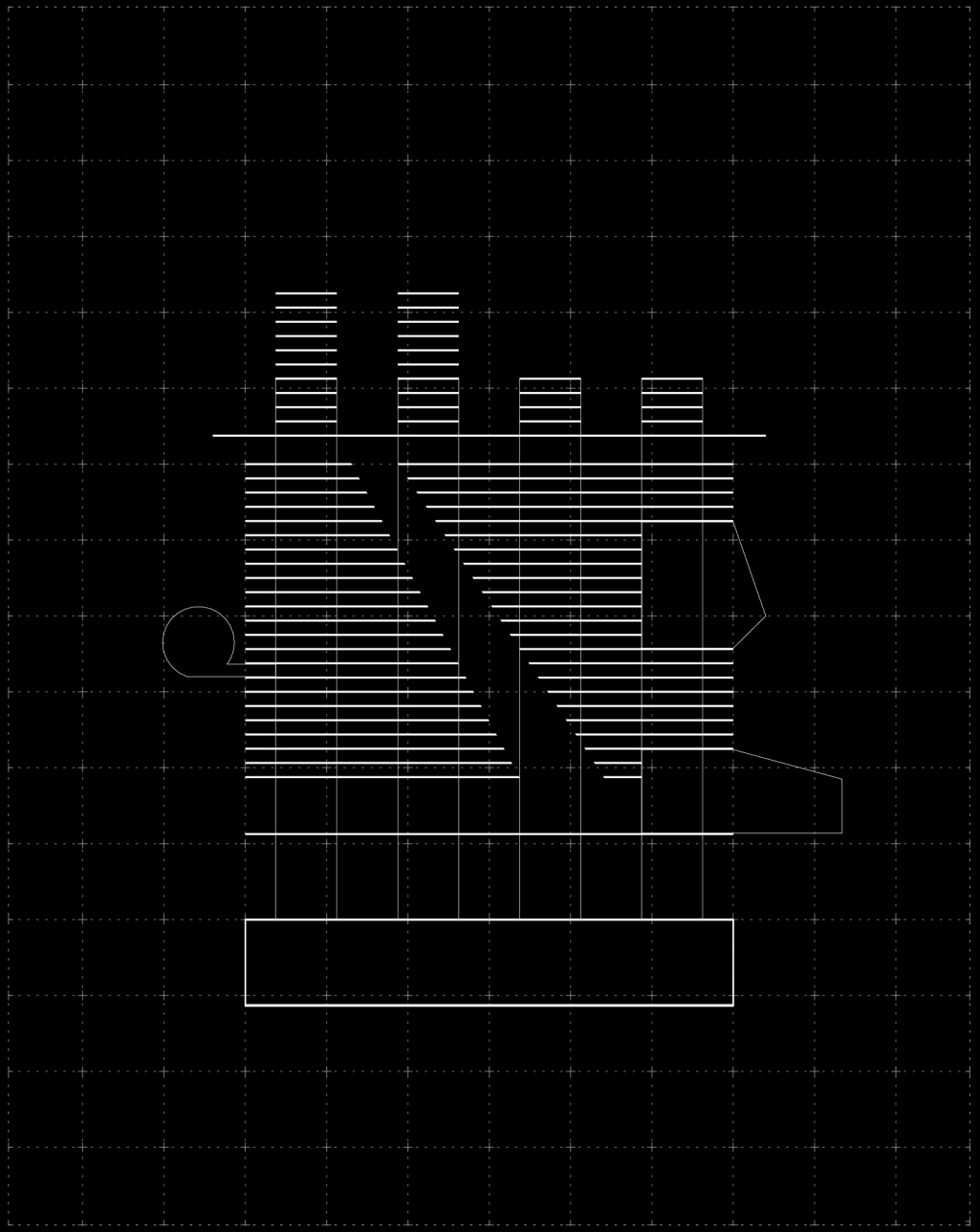
Multi height corridors for common use connect the building on the top floors and on the height of arrival.

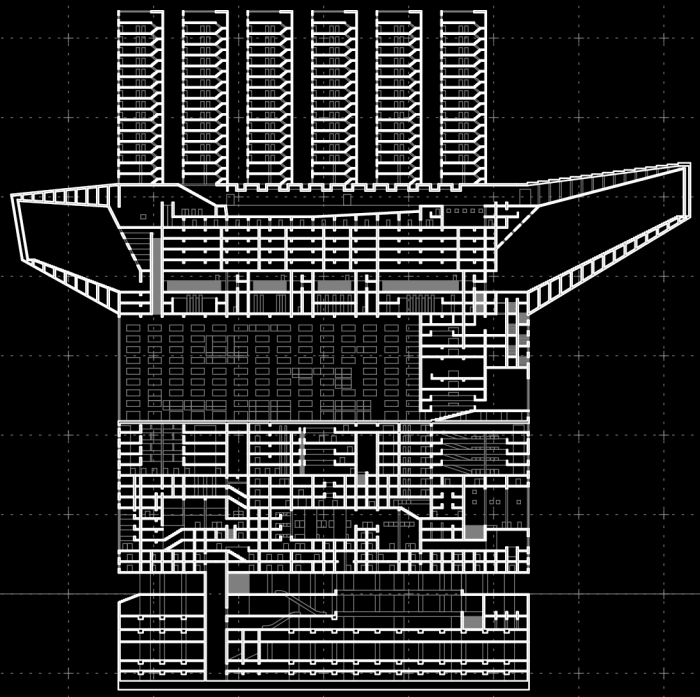


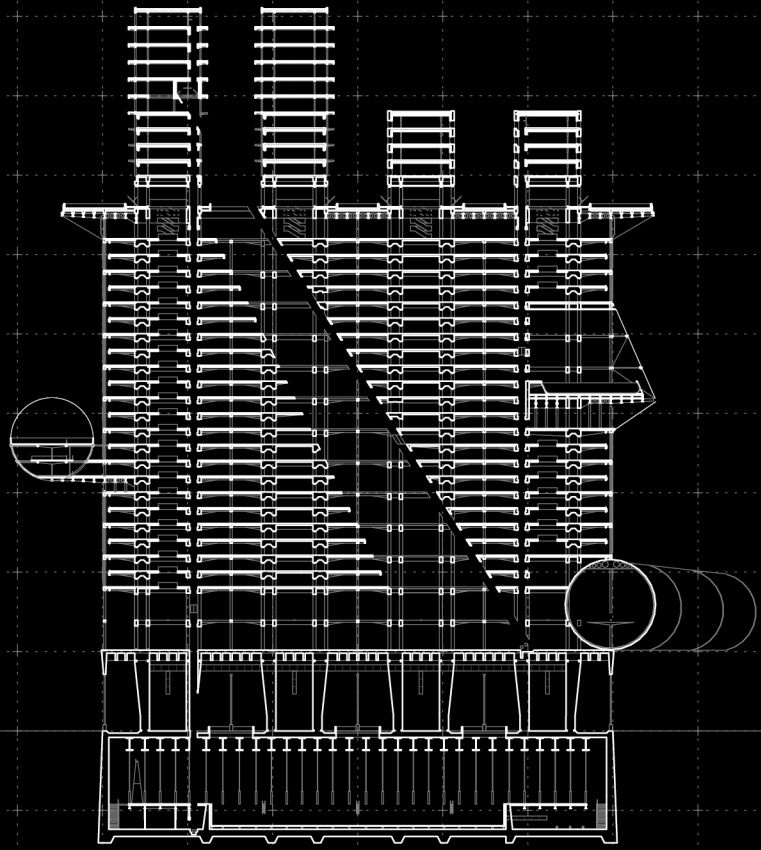
A diagonal void will cut the mass to centralise the circulation of the building and increase the day-light factor of Atlanpole.



To compensate the lost surface, an additional structure will be added on top of the core towers, functioning as a sanatorium living with nature).







The expression of multi-story spaces does not follow the giant halls of the past design, but omnipresently shows their structure in the space.

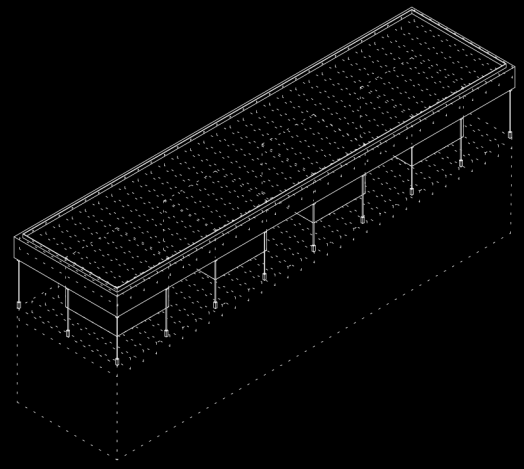
IV

Elements

BASE

concrete C20/25
229 kgCO_2/m^3

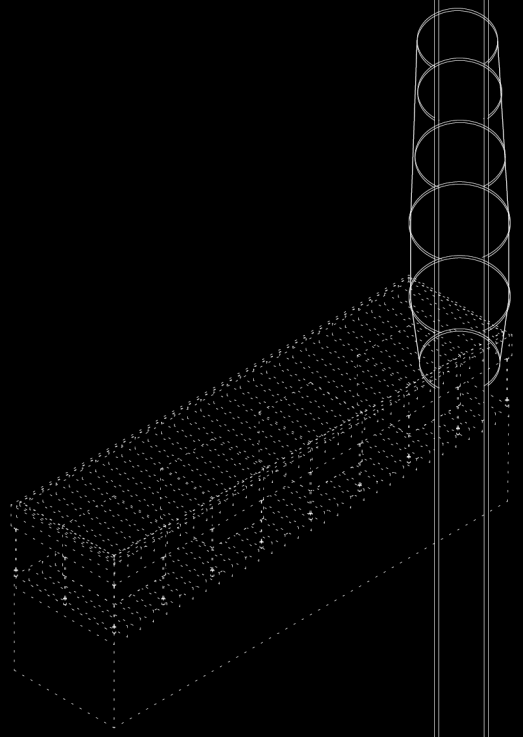
structural steel
8831 kgCO_2/m^3



BASE / TRAIN STATION

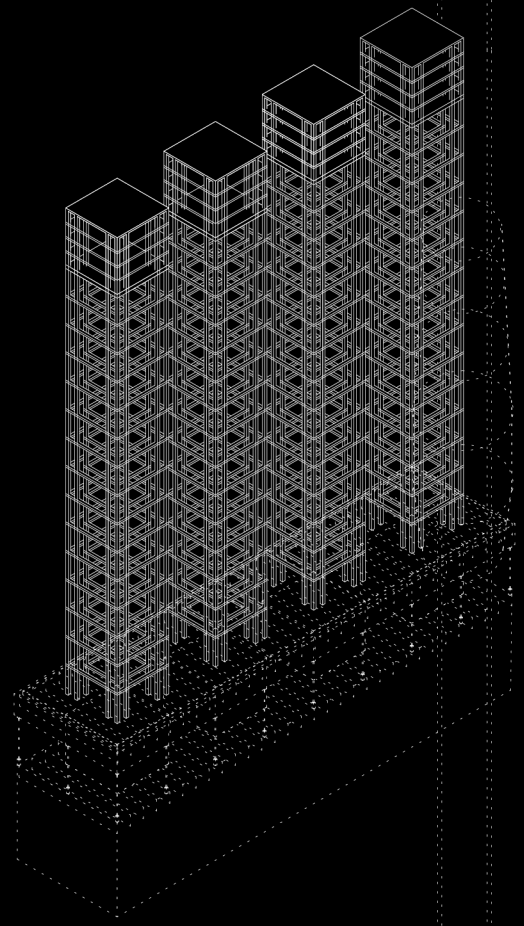
poly carbonate
85,1 $kgCO_2/m^3$

structural steel
8831 $kgCO_2/m^3$



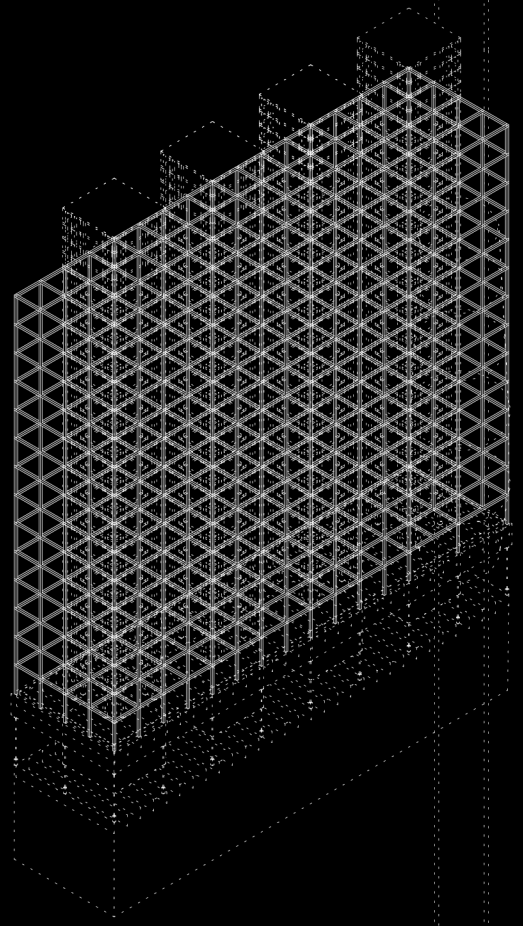
CORE

concrete C20/25
220 kgCO_2/m^3



SKELETON

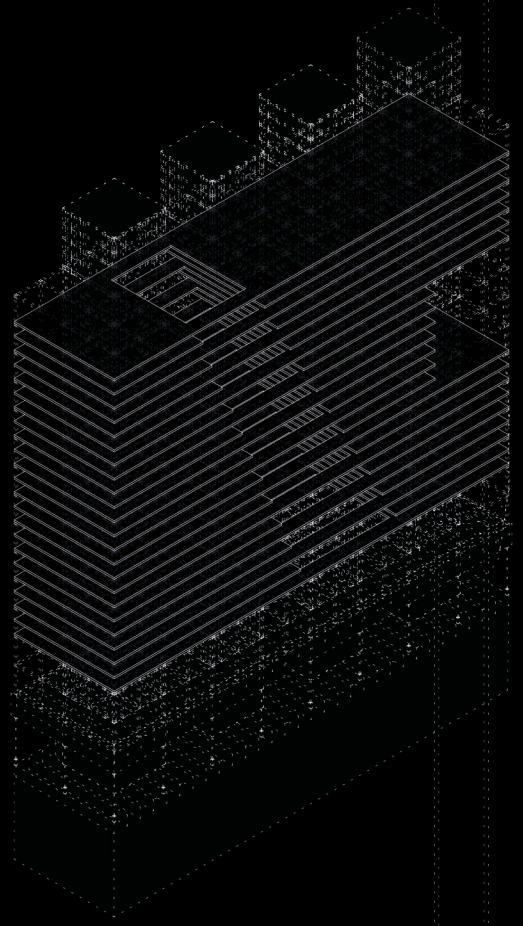
construction timber
- 664 kgCO_2/m^3



FLOORS

plywood
- 649 $kgCO_2/m^3$

glas wool
12.8 $kgCO_2/m^3$



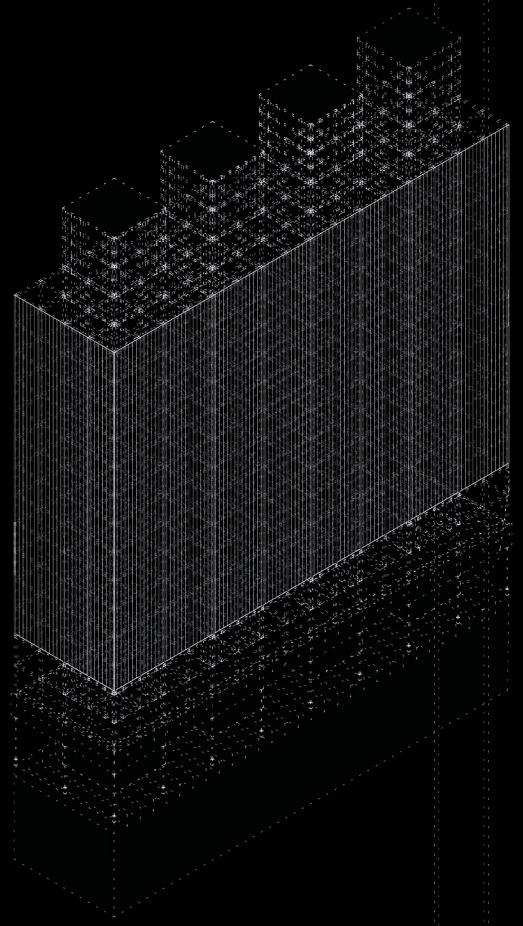
FACADE

poly carbonate
85,1 $kgCO_2/m^3$

glas pane
266 $kgCO_2/m^3$

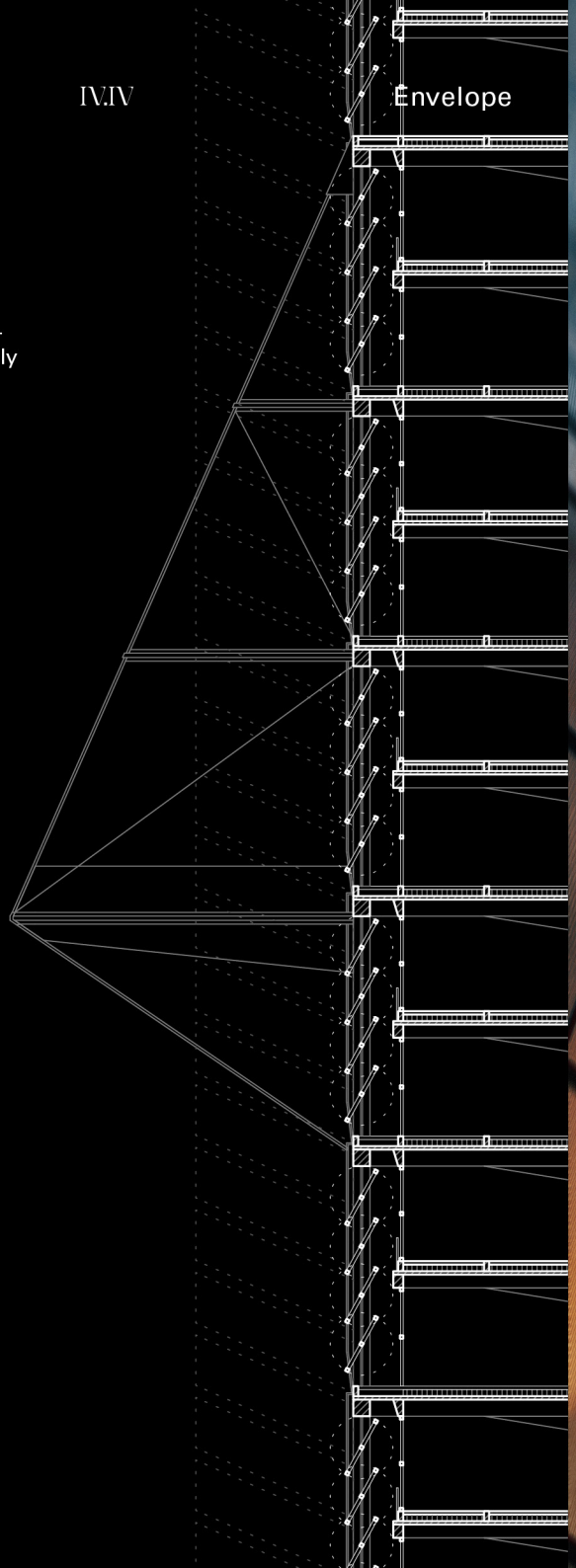
window frame, aluminium
1172 $kgCO_2/m^3$

galvanised steel
22391 $kgCO_2/m^3$



FACADE

Polycarbonate with a steel rear structure to function as a low tech second skin facade, to optimally use the strengths of the seasonal climate.

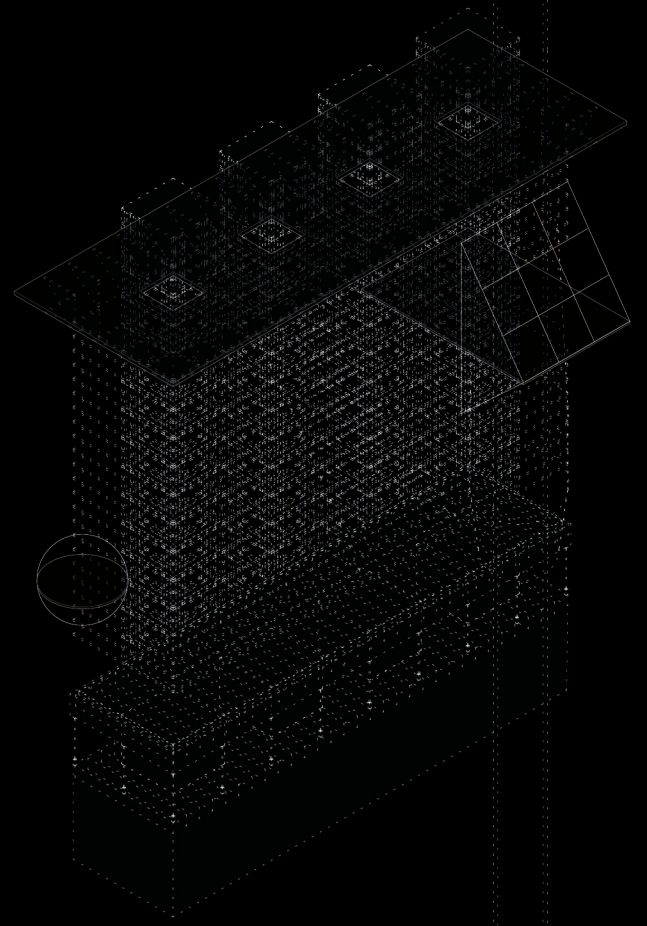


ADDITIONS

glas pane
266 $kgCO_2/m^3$

window frame, aluminium
1172 $kgCO_2/m^3$

galvanised steel
22391 $kgCO_2/m^3$

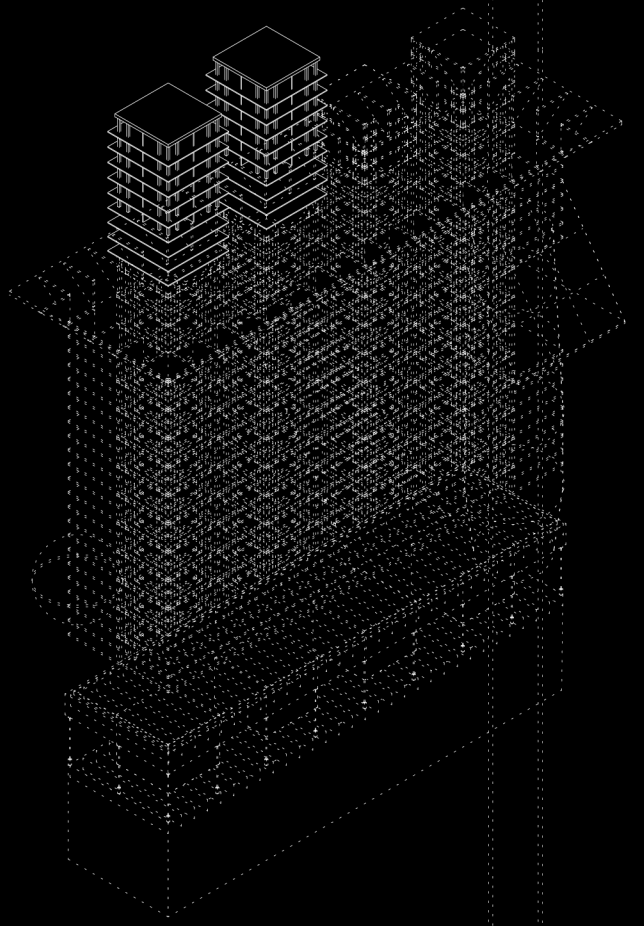


ADDITIONS

construction timber
- 664 kgCO_2/m^3

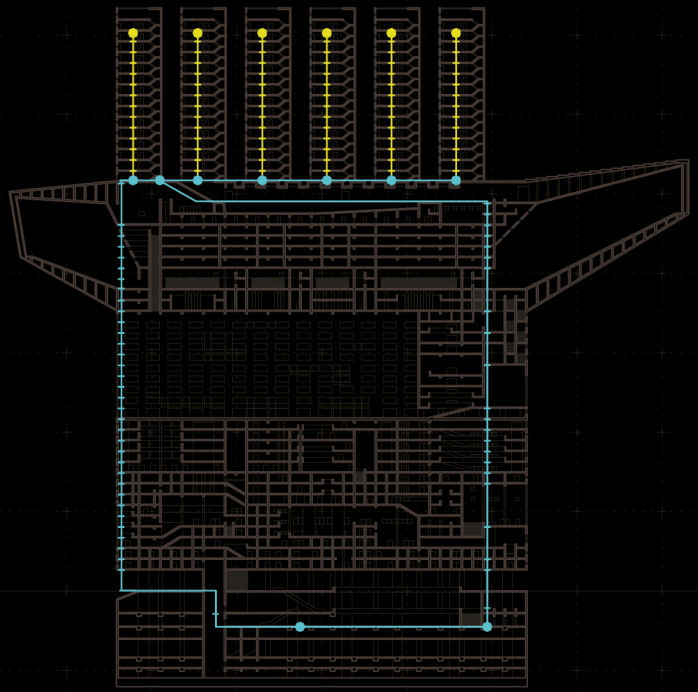
plywood
- 649 kgCO_2/m^3

glas wool
12.8 kgCO_2/m^3

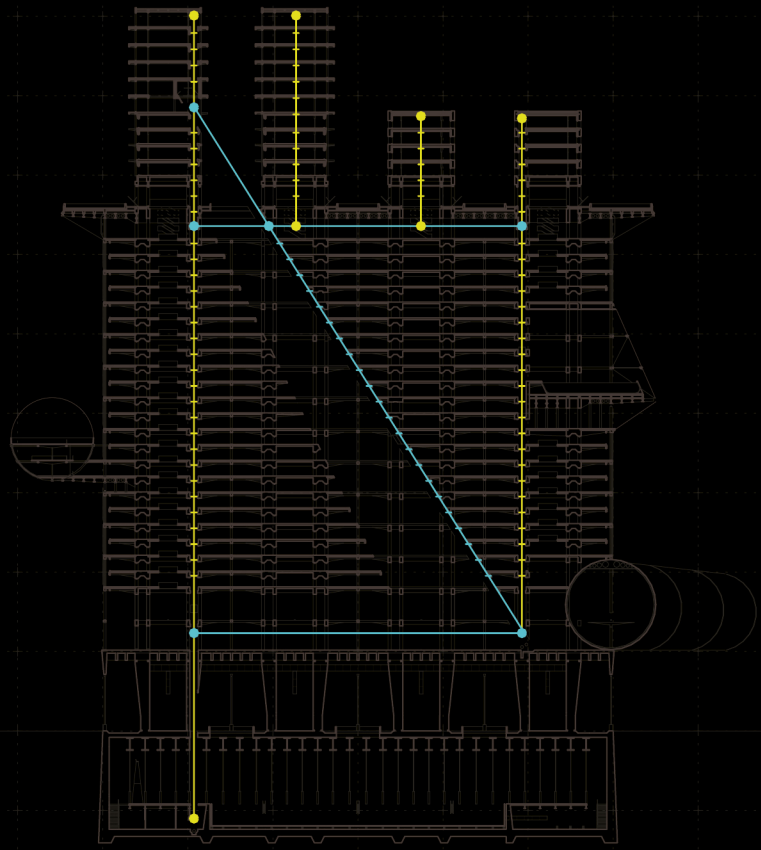


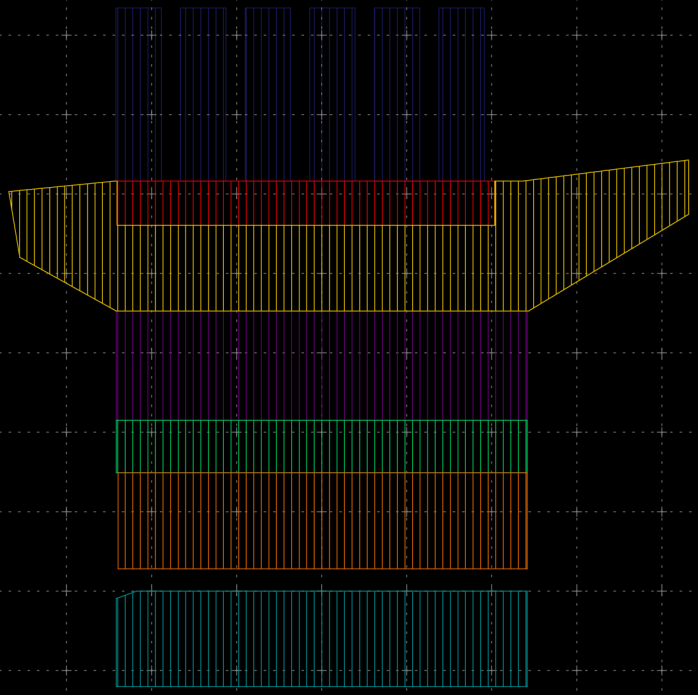
V

Usage

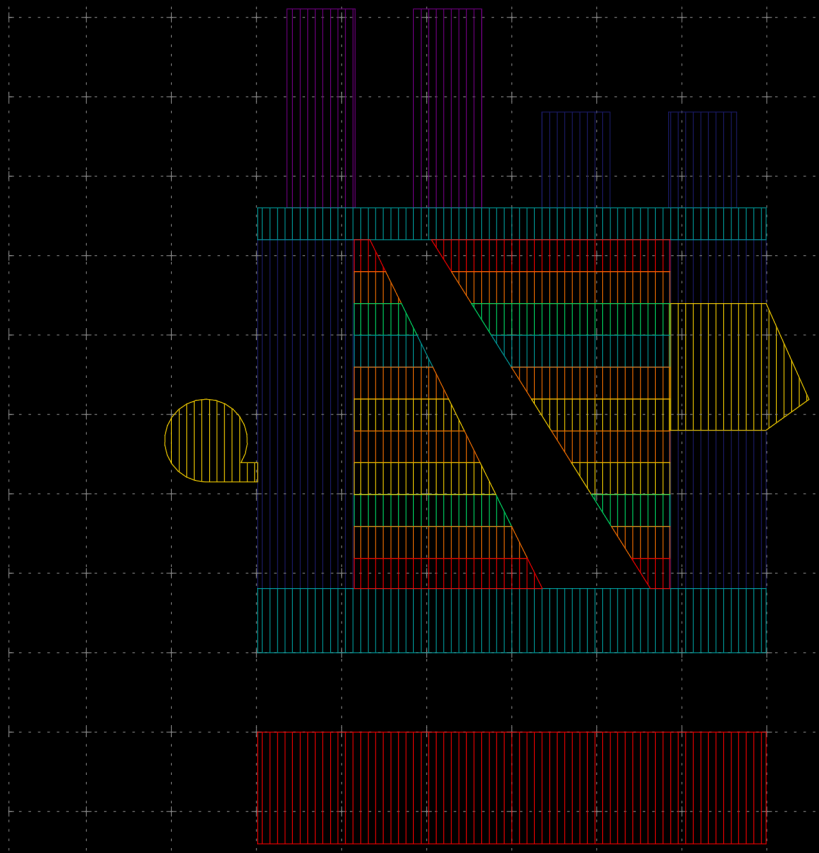


The addition of a diagonal connection within the building will enhance the interaction between the different usages. The yellow elevator routes represent residential connections; blue lines are public.

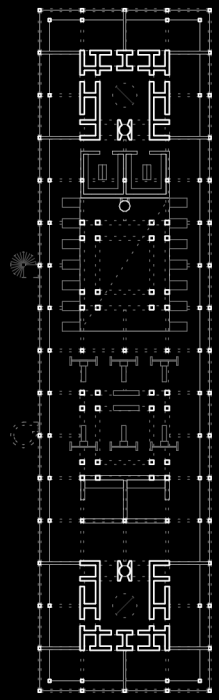




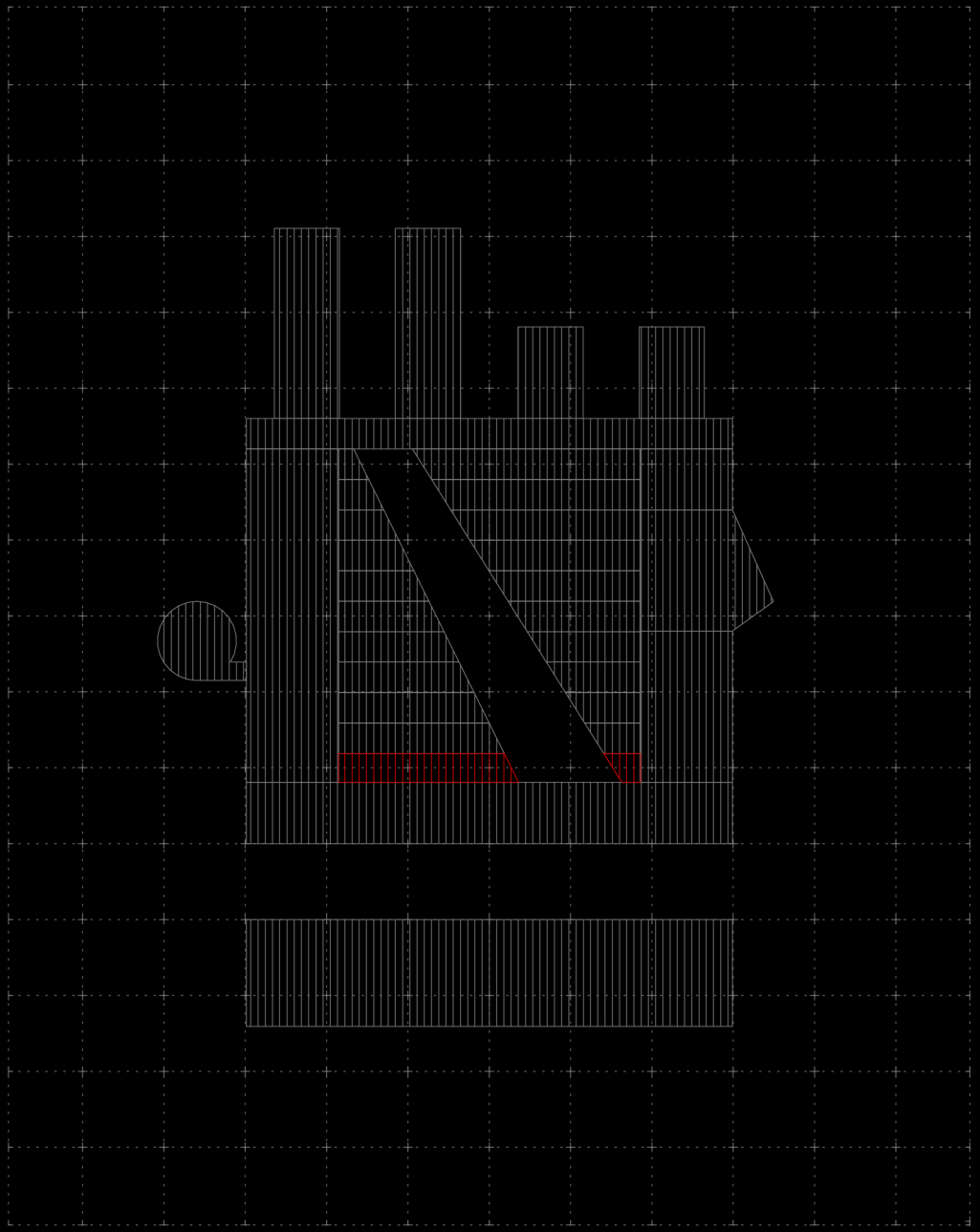
Housing
Interim
Production

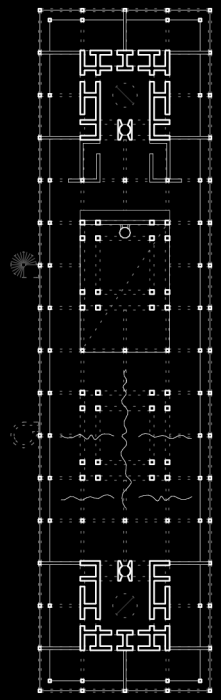


Education
Common
Exhibition
Sport

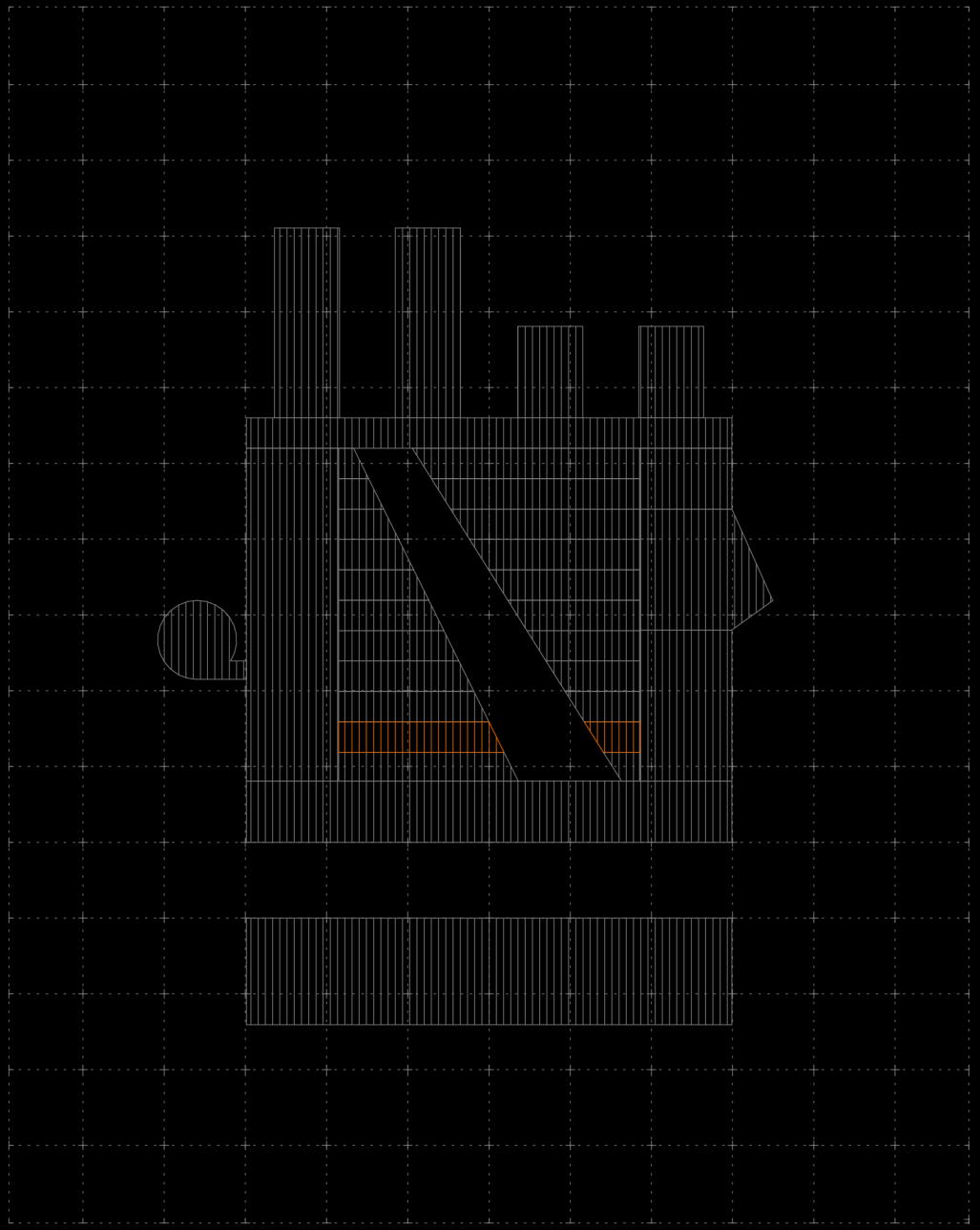


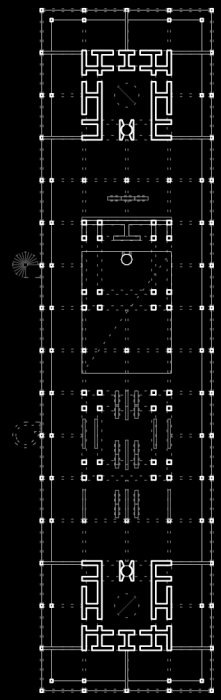
GYM



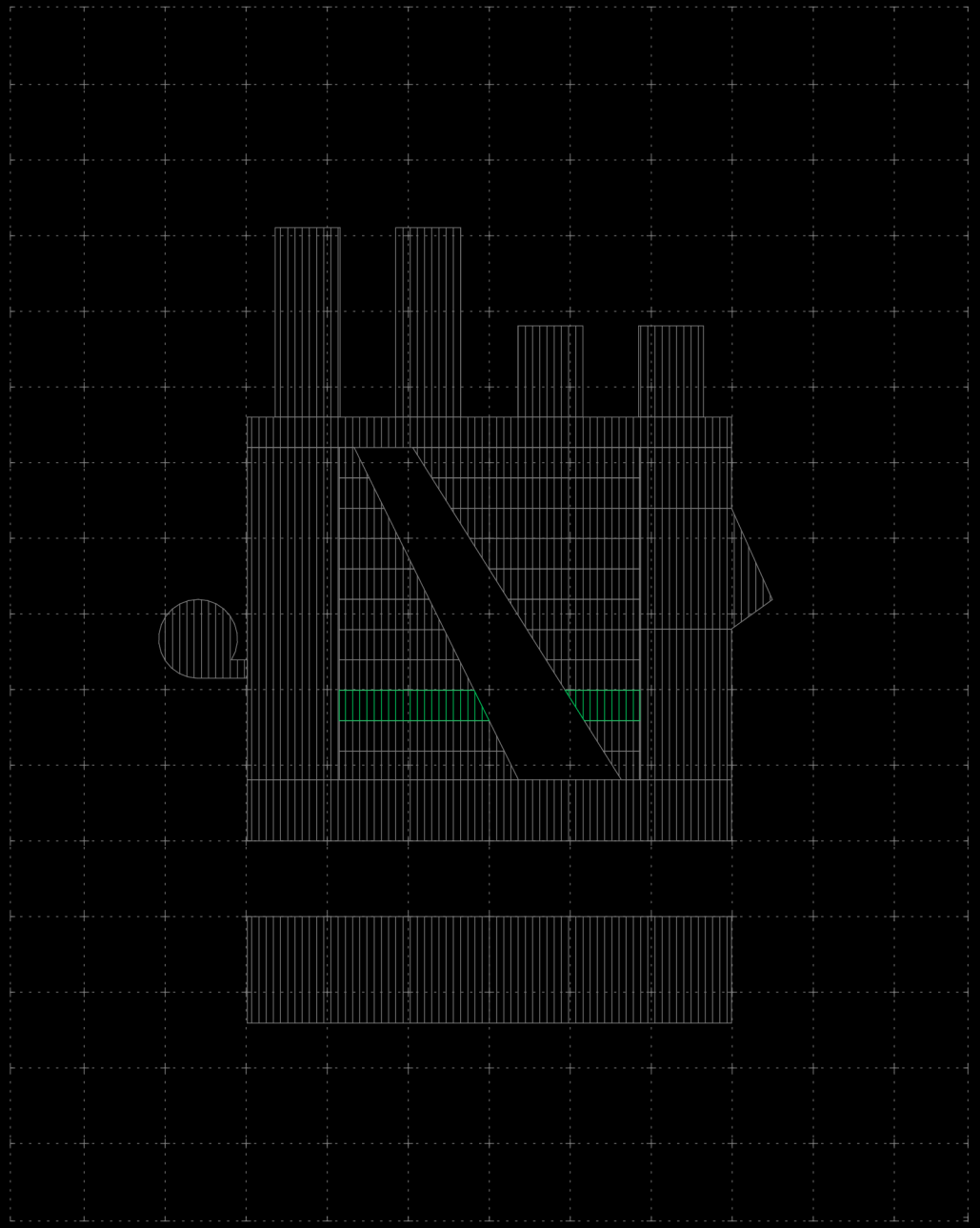


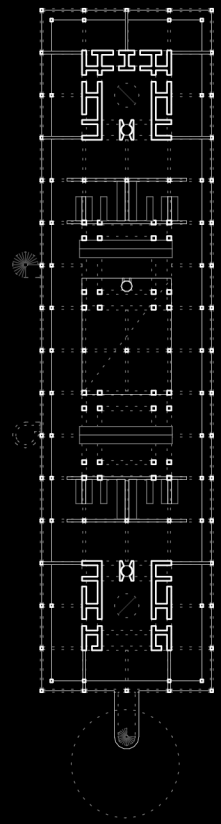
ATELIER



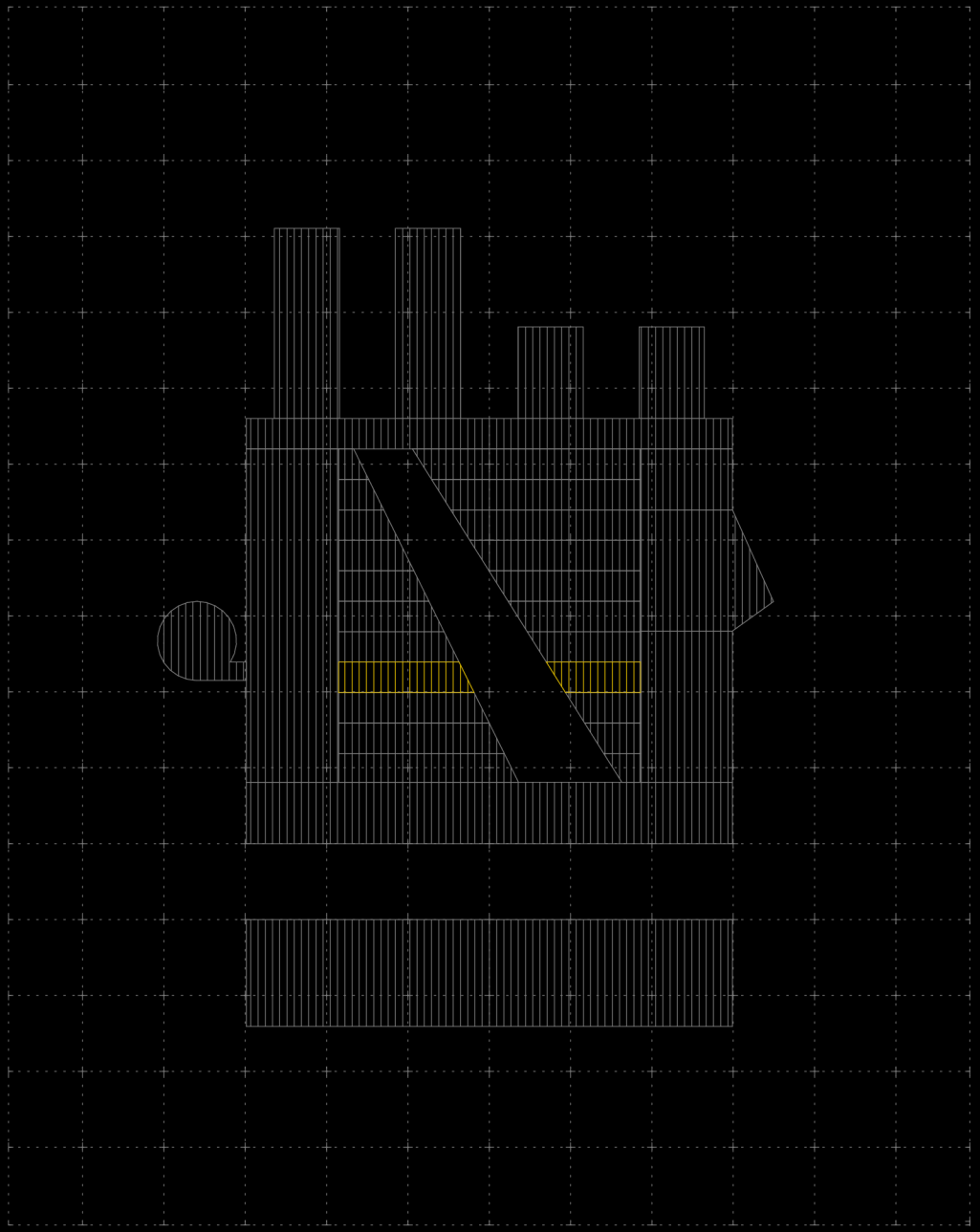


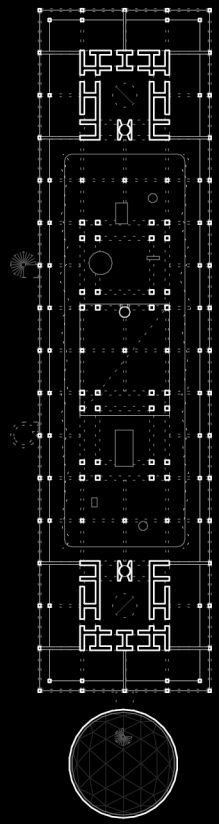
ADMINISTRATION



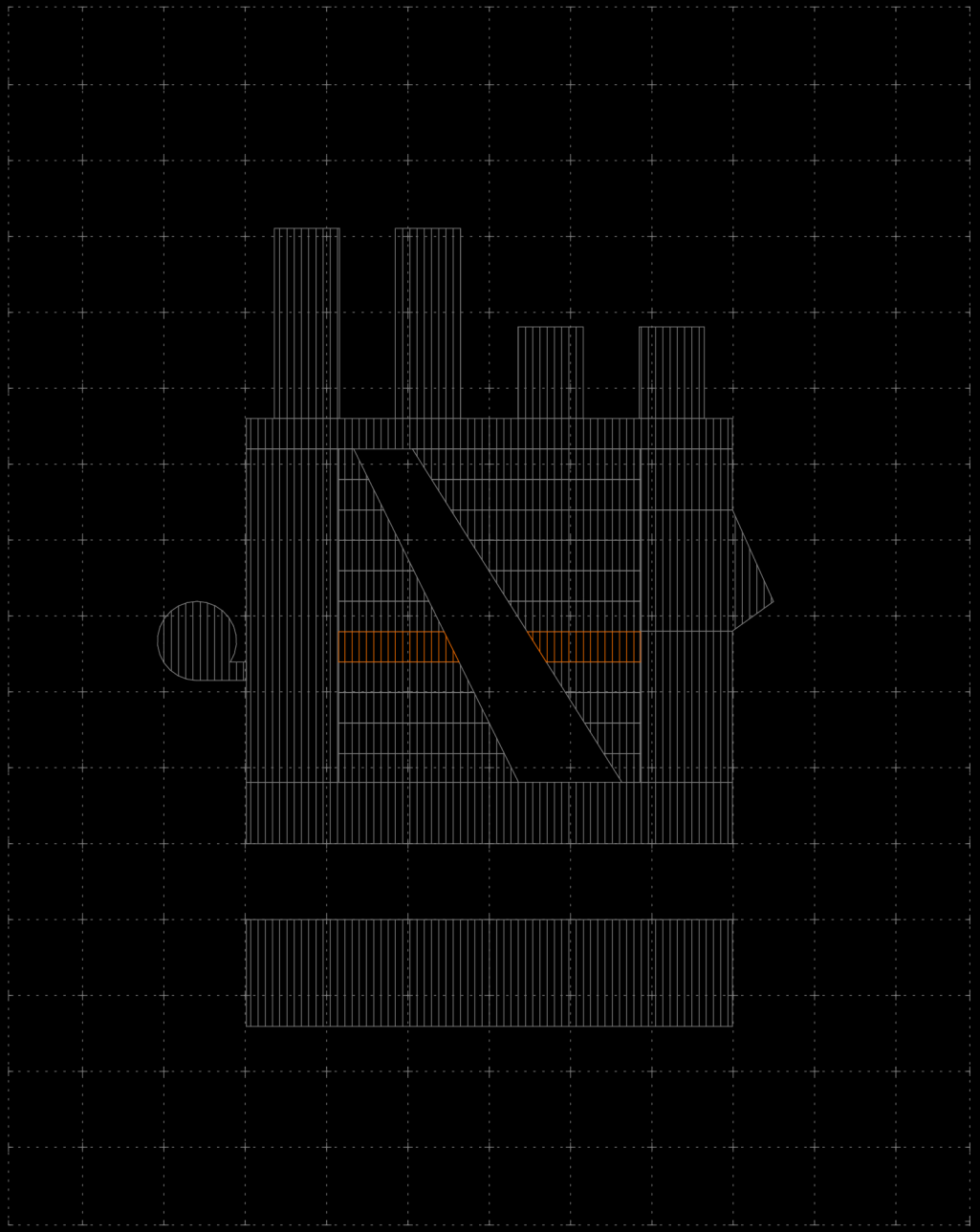


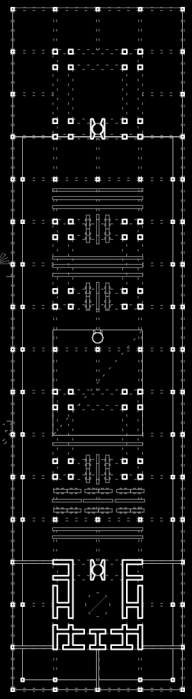
LABORATORIES



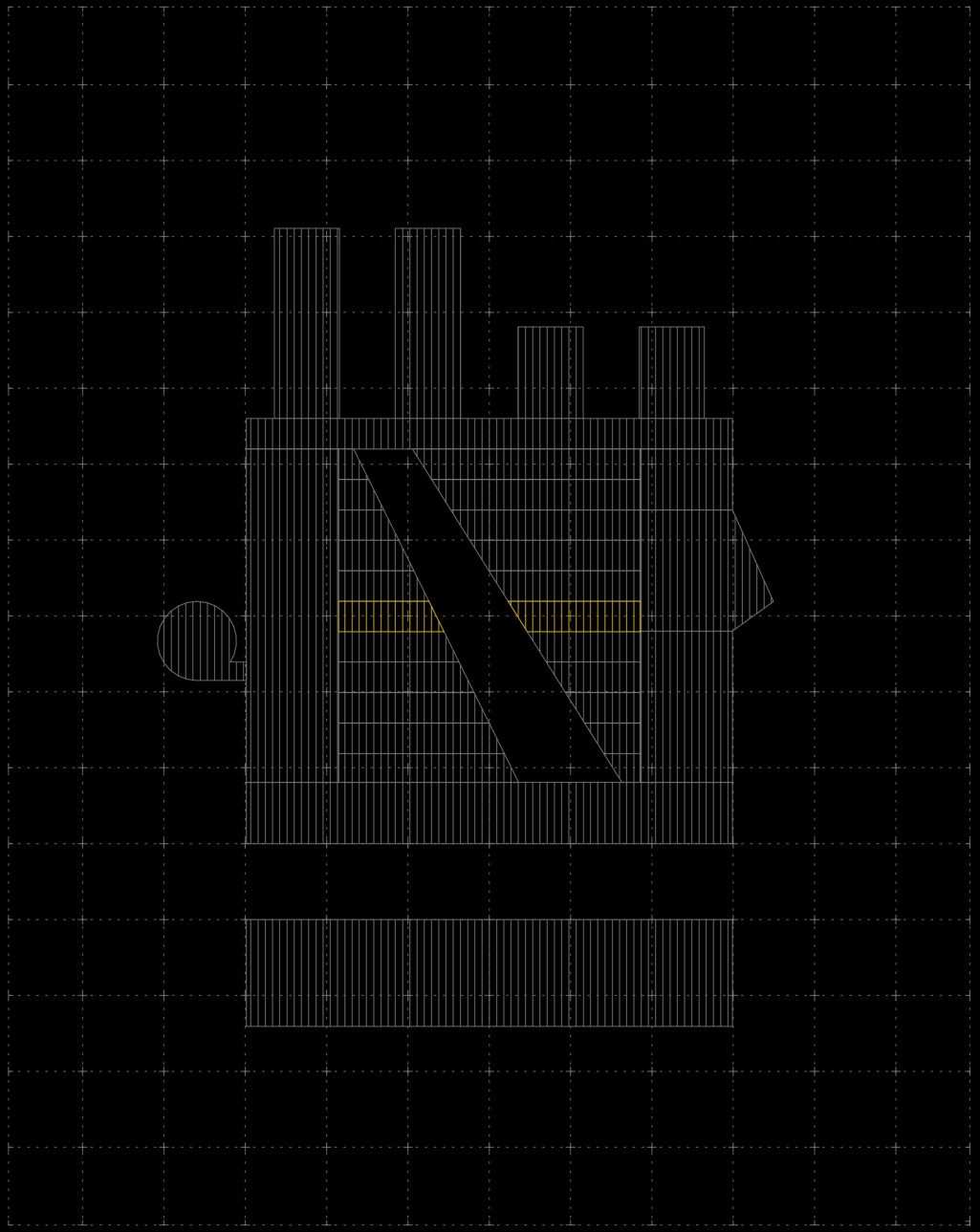


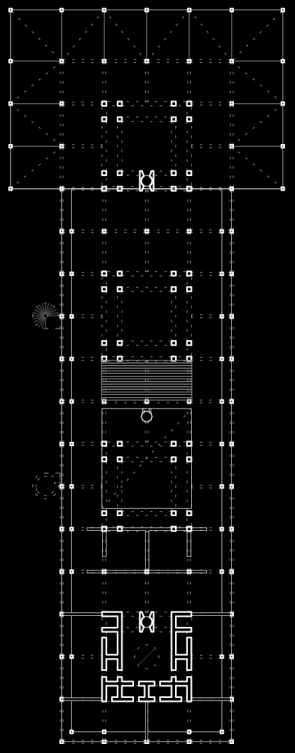
EXHIBITION



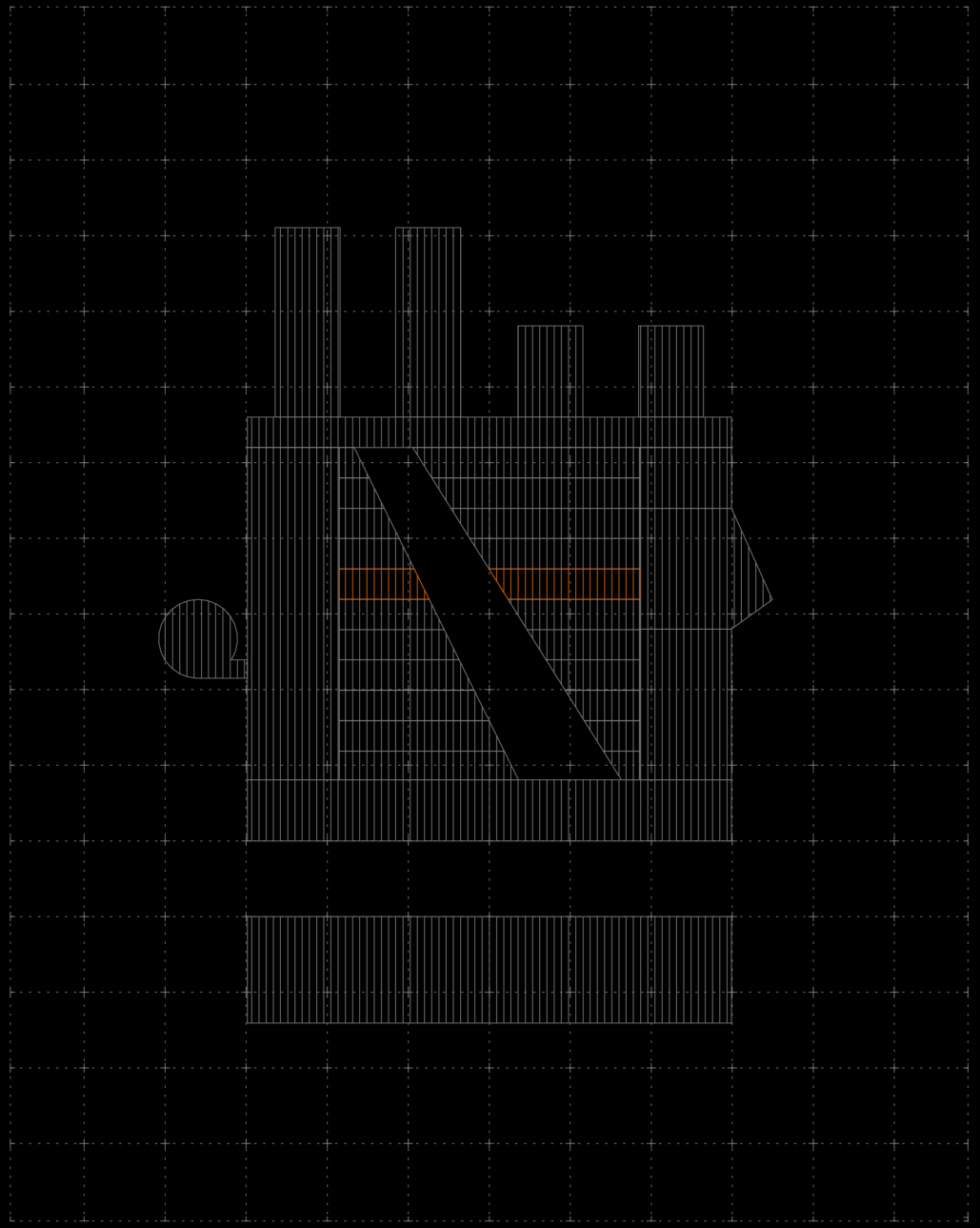


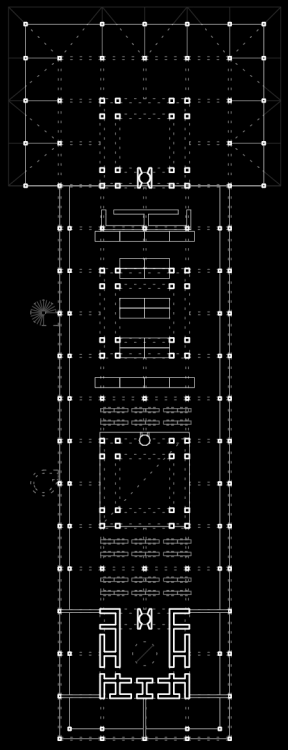
LIBRARY



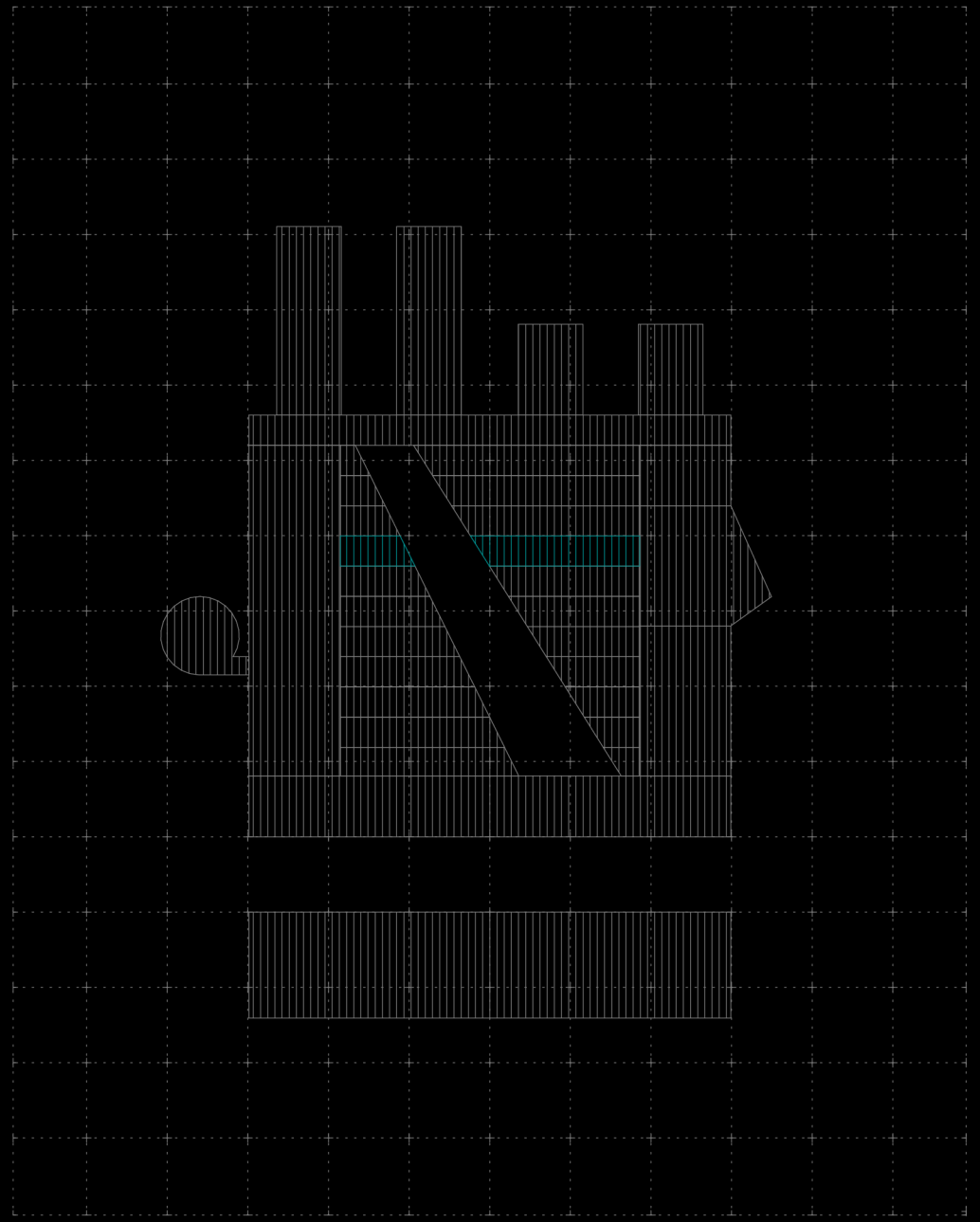


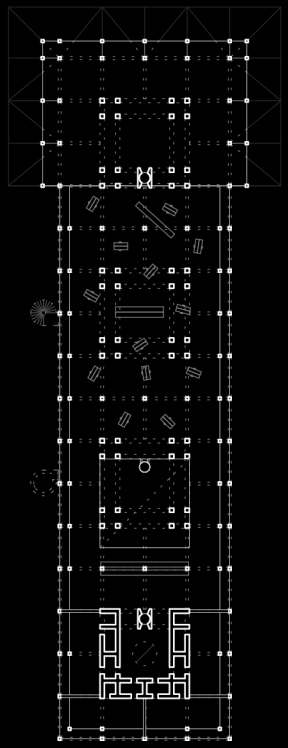
PERFOMANCE



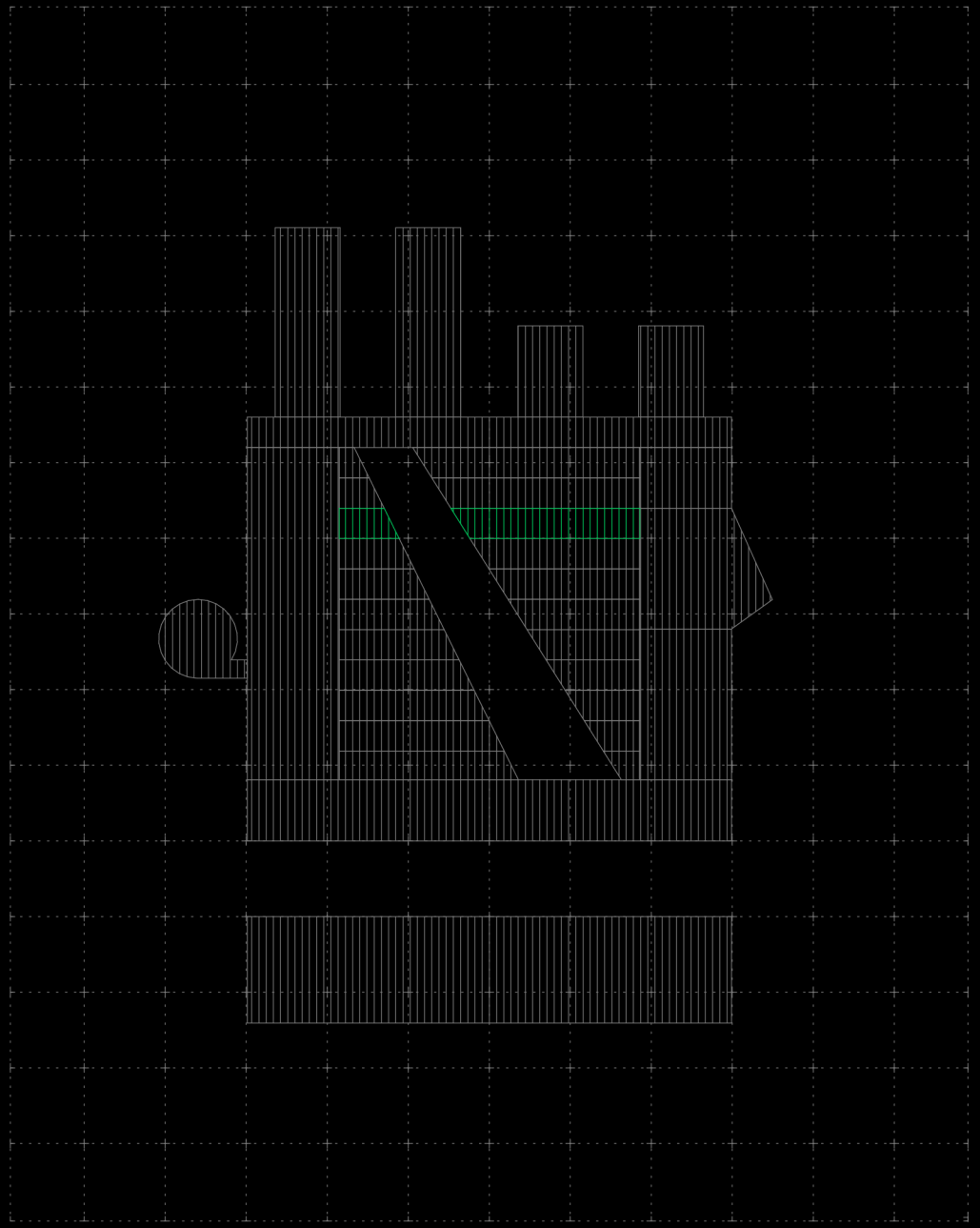


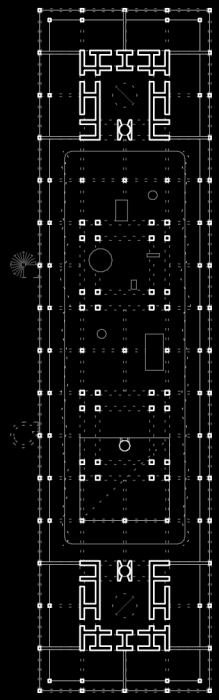
CULINARICS





CO WORKING





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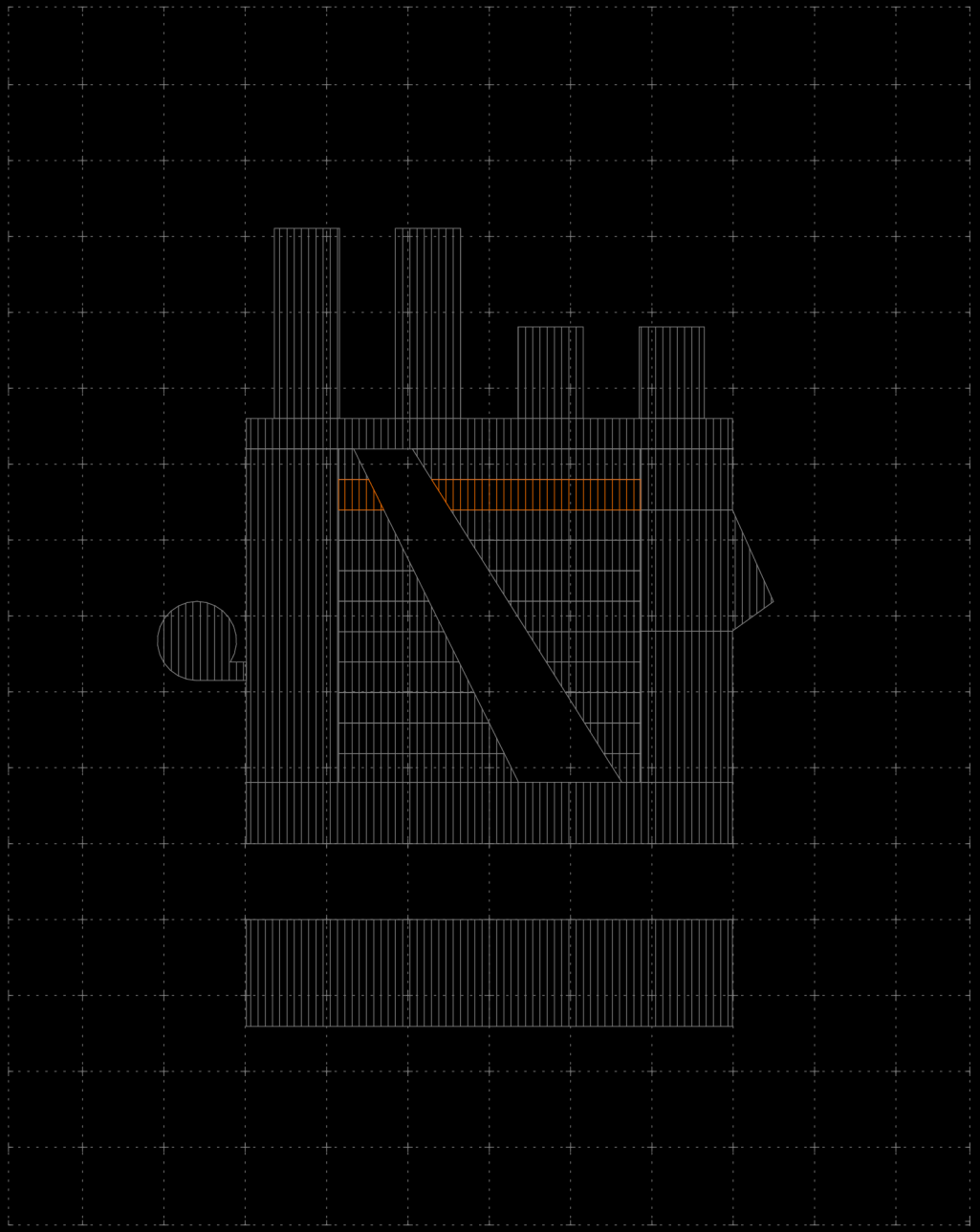
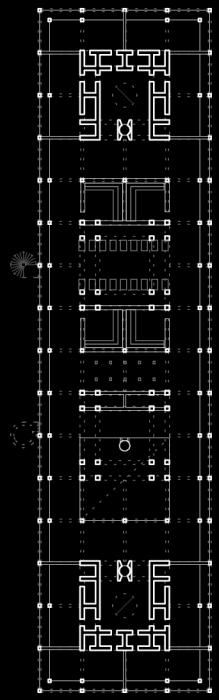
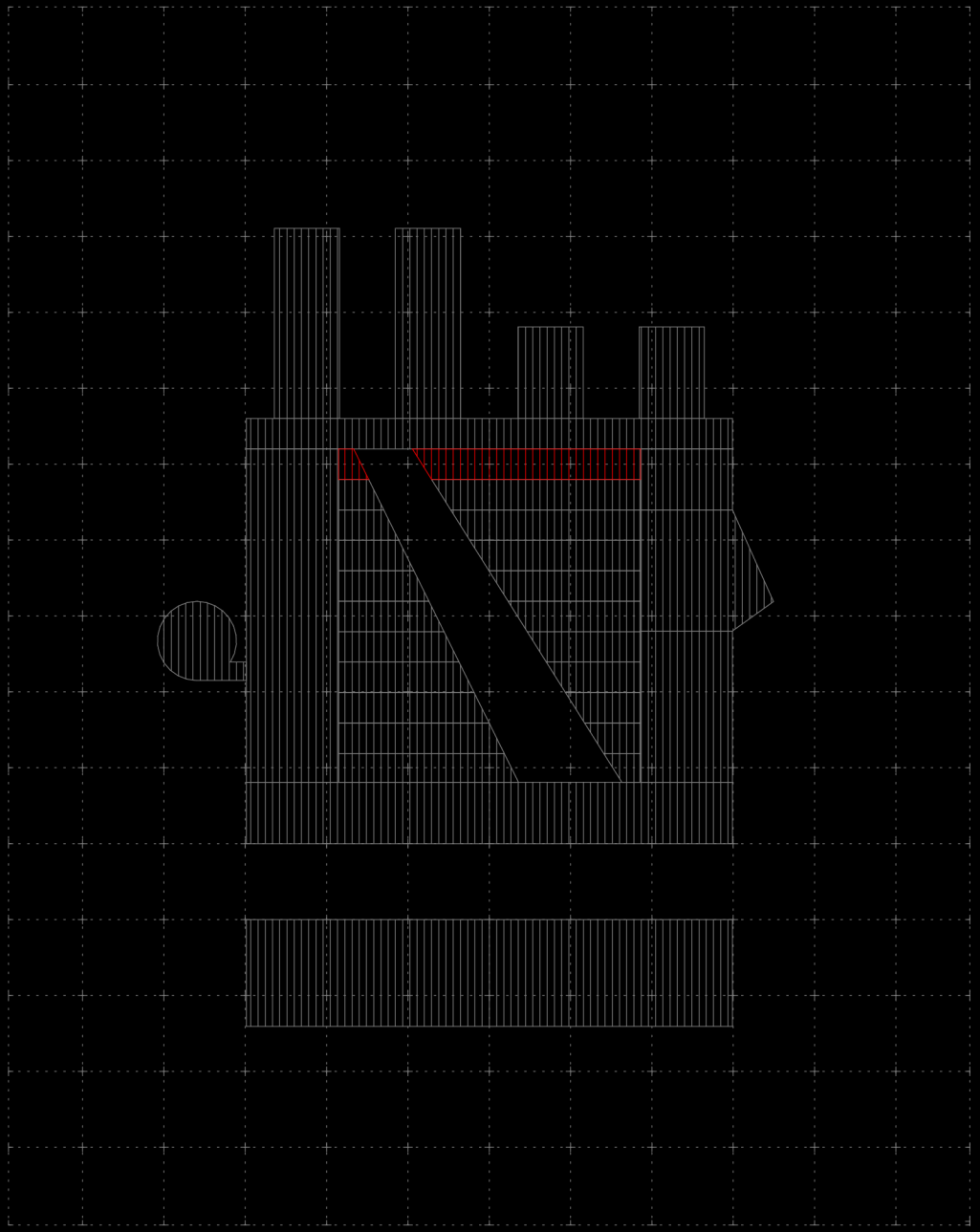


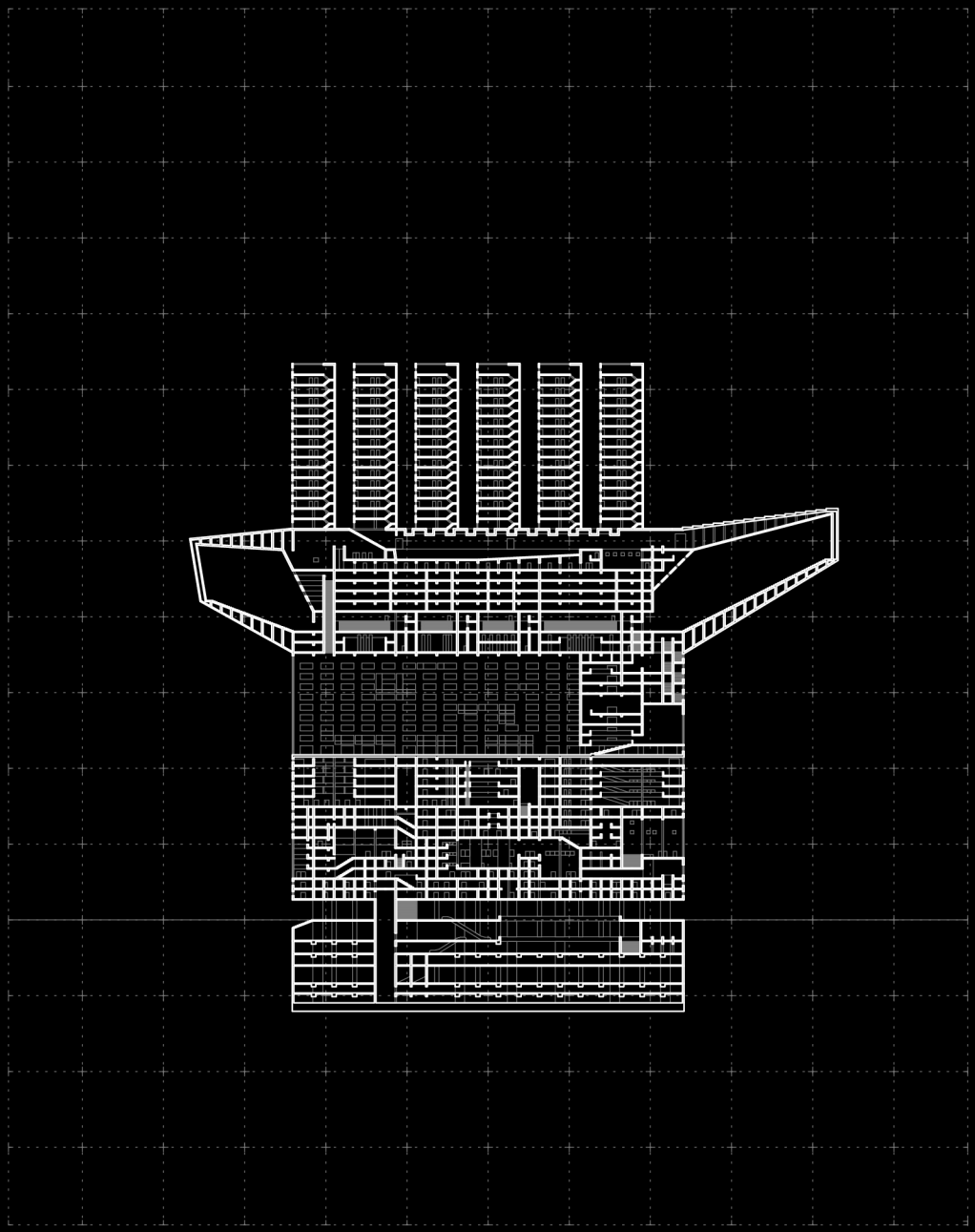


WELLNESS

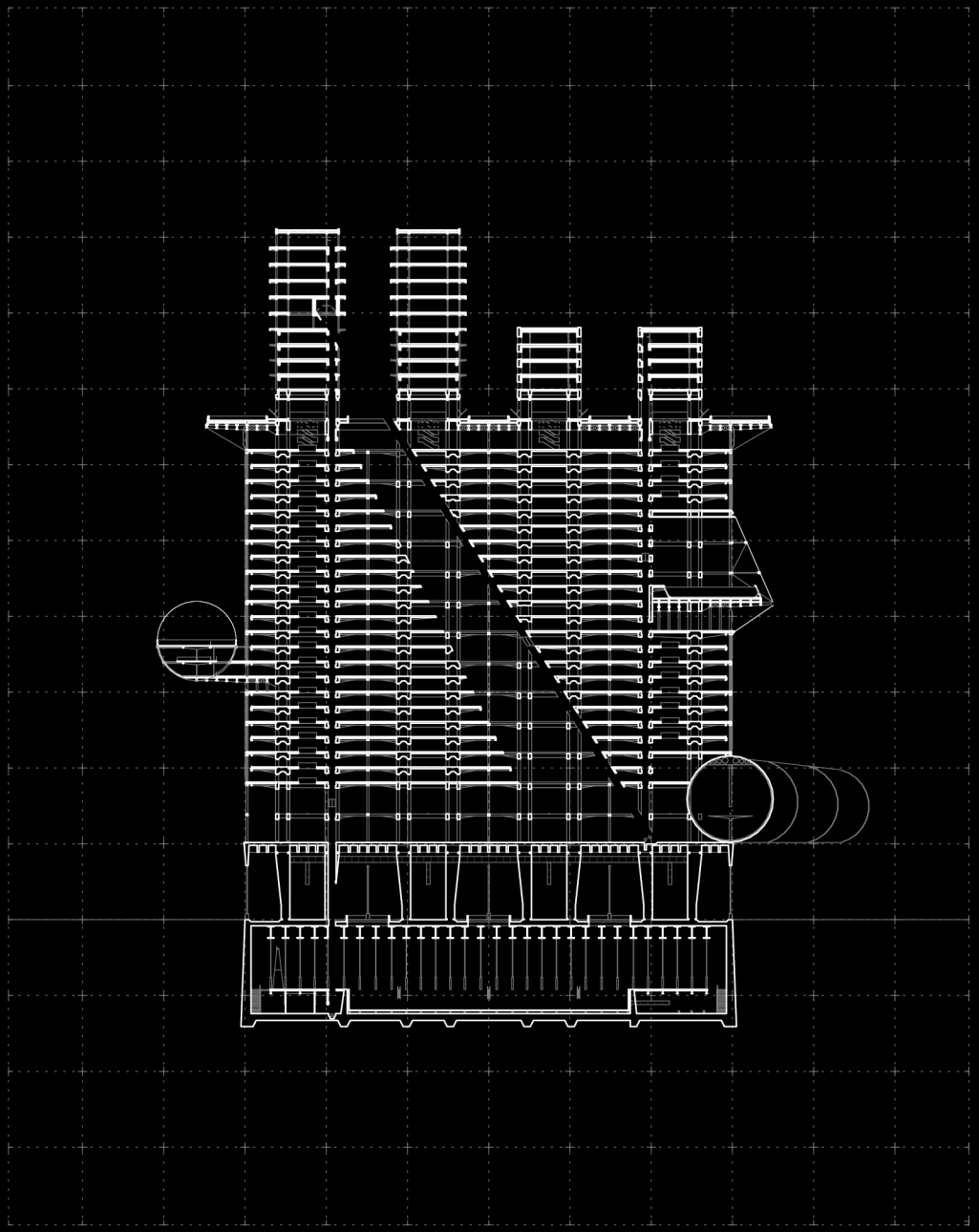


VI

Evaluation



Space	public	8.352m²
	common	9.786m²
	private	267.147m²
	heated	233.082m²
	total	**285.285m²**
Energy	heating energy demand	12.542.898 kWh
	domestic hot water heating demand	3.401.464 kWh
	electrical demand for devices	3.614.055 kWh
	electrical demand for lightning	1.275.549 kWh
	electrical demand for ventilation	425.183 kWh
	total	**21.259.150 kWh**
Emissions	**concrete panels**	630.104 $kgCO_2$
	glass wool	114.564 $kgCO_2$
	concrete C30/37	50.981.160 $kgCO_2$
	glass pane	859.233 $kgCO_2$
	window frame, wood	120.292 $kgCO_2$
	gypsum board	2.157.462 $kgCO_2$
	stairs, concrete C20/25	343.693 $kgCO_2$
	doors, wood	-134.199 $kgCO_2$
	PVC	1.202.926 $kgCO_2$
	mineral wool	642.712 $kgCO_2$
	XPS insulation	563.256 $kgCO_2$
	total	**57.282.203 $kgCO_2$**
Capita	inhabitants	624
	users	2633
	usage density	11416 U/km²
	total	**3257**
distribution	energy / capita	6527 kWh
	emissions / capita	17.587 $kgCO_2$



Space

public	11.645m²
common	16.874m²
private	81.295m²
heated	43.228m²
- 62% // **total**	**109.814m²**

Energy

heating energy demand	1.687.562 kWh
domestic hot water heating demand	459.153 kWh
electrical demand for devices	486.017 kWh
electrical demand for lightning	172.125 kWh
electrical demand for ventilation	57.399 kWh
- 85% // **total**	**2.862.256 kWh**

Emissions

poly carbonate	4.347 $kgCO_2$
construction timber	- 2.475.060 $kgCO_2$
concrete C20/25	5.129.632 $kgCO_2$
glass pane	201.335 $kgCO_2$
window frame, aluminium	72.483 $kgCO_2$
gypsum board	25.364 $kgCO_2$
beams, steel	132.465 $kgCO_2$
doors, wood	-67.354 $kgCO_2$
glas wool	115.243 $kgCO_2$
slabs, walls, timber	- 3.984.452$kgCO_2$
XPS insulation	385.364 $kgCO_2$
- 58 mio. $kgCO_2$ // **total**	**-460.633 $kgCO_2$**

Capita

inhabitants	1085
users	1263
+ 90% // usage density	21345 U/km²
total	**2348**

distribution

- 82% // energy / capita	1219 kWh
- 18.000 $kgCO_2$ // emissions / capita	-196 $kgCO_2$

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