PASSIVHAUS
Student Competition

in partnership with

TARMAC
A CRH COMPANY

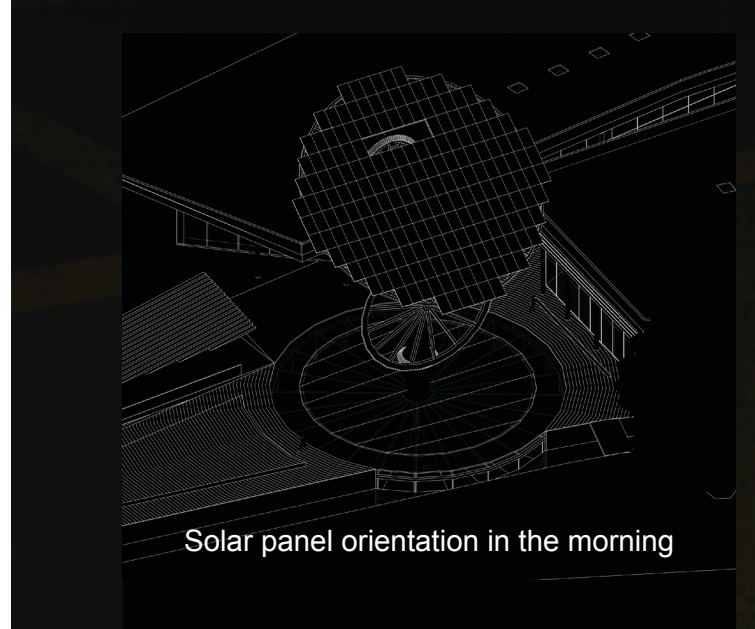
KATIE DE SILVA

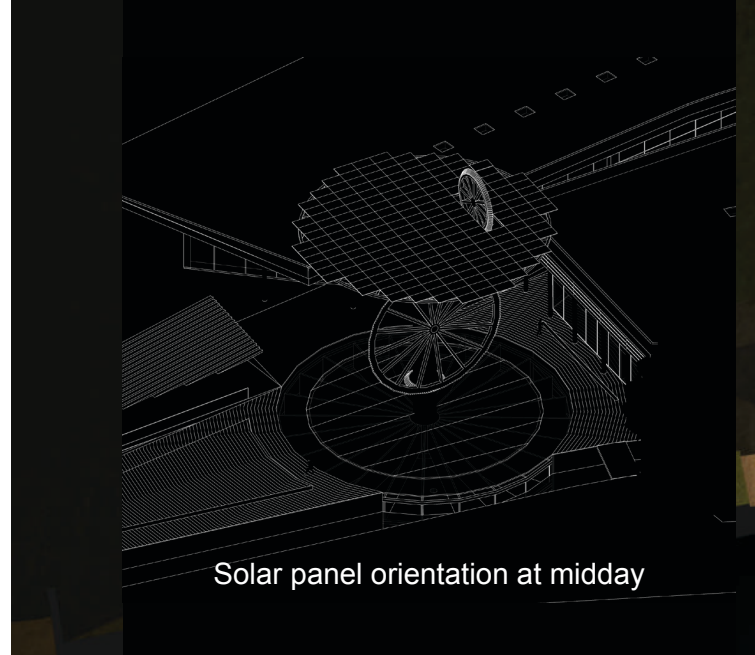
Piazza Fluente

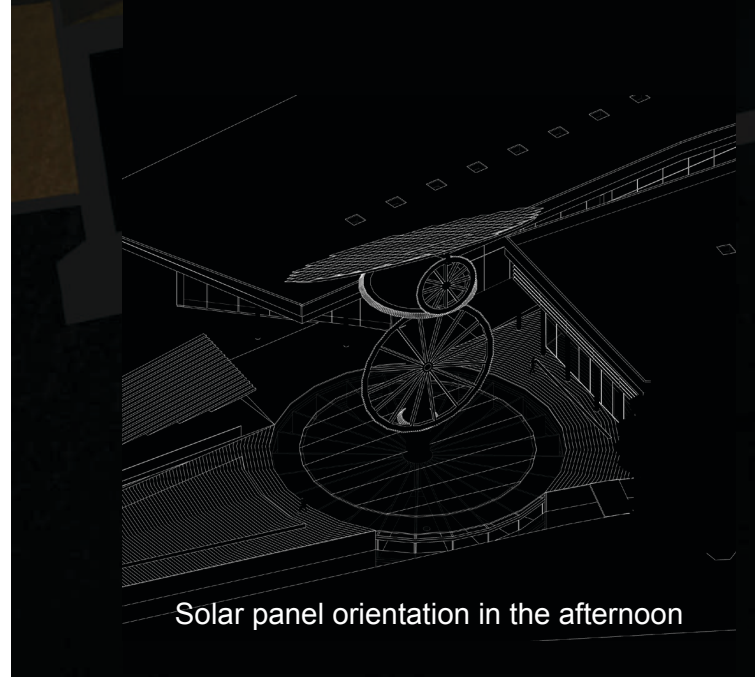
As Piazza Fluente is designed to Passivhaus standard, it requires less than 15kWh/m²/year energy for heating and less than 18kWh/m²/year for cooling. Electricity usage is not taken into account, so could lower the sustainable integrity of the project if not considered carefully. The solar panel mechanical sculpture at the focal point of Piazza Fluente will generate energy which can help offset the electric energy demand, in addition to the heating and cooling demand.

There will be 304 LG NeON R 370W mono solar panels (each 1700 x 1016 x 40mm)
Summer generation: 3781 KWh/day
Winter generation: 2063 KWh/day
Total demand: 970 KWh/day

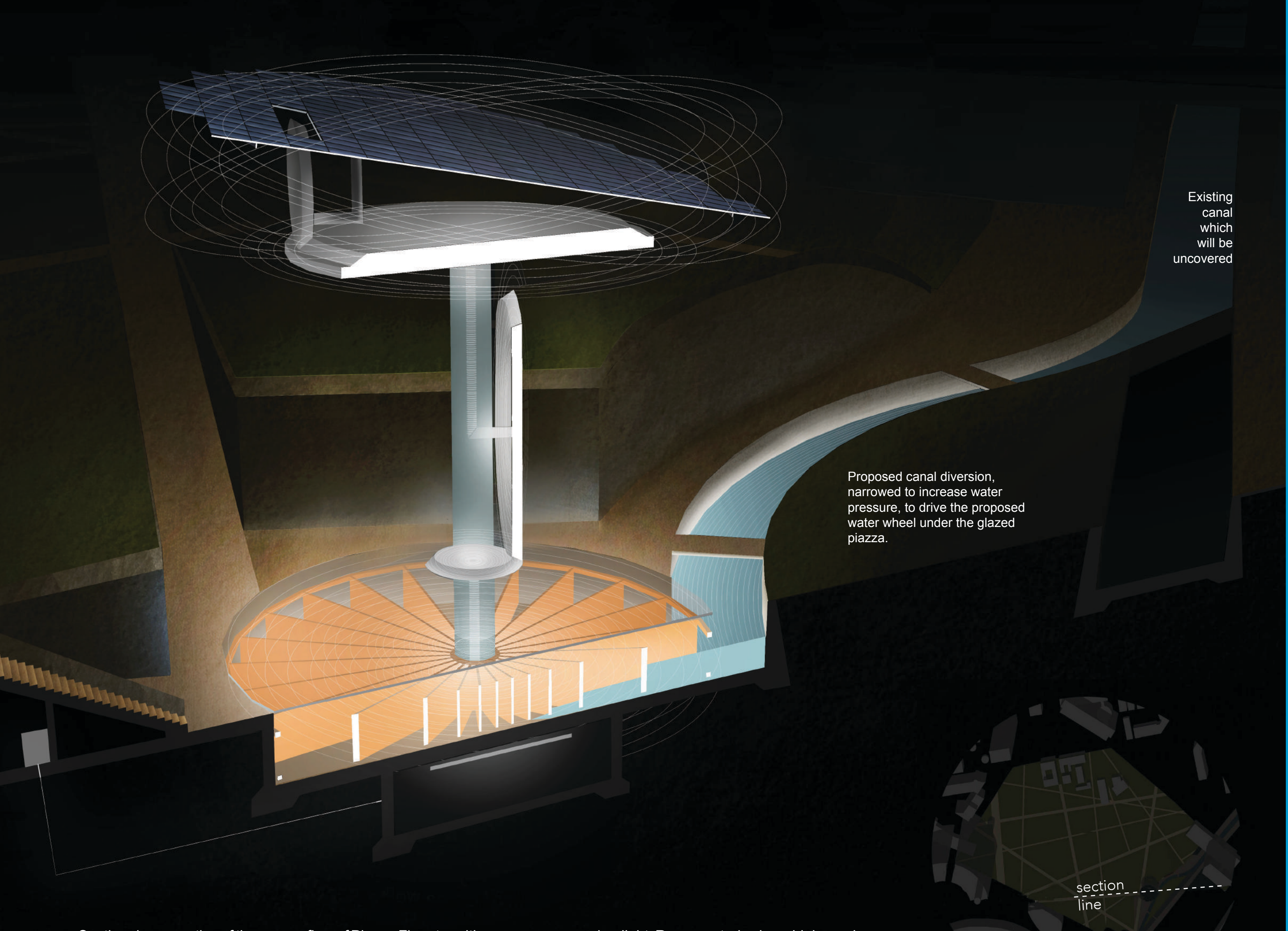
Therefore the energy generated by the solar panels will exceed the demand throughout the year, and any excess can be redistributed.


Solar panel orientation in the morning


Solar panel orientation at midday


Solar panel orientation in the afternoon

Energy flow representation using chiaroscuro



Sectional perspective of the energy flow of Piazza Fluente, with energy expressed as light. Represented using a high renaissance painting technique which was used by Leonardo da Vinci, called 'chiaroscuro', which emphasises the contrast between light and dark. Kinetic energy from the newly uncovered canal is transferred to the proposed water wheel and gearing system, which slows the rotational energy so it can be used by the solar panel platform to rotate with the sun, improving efficiency.

PROJECT FACTS

Cultural	Milan	38.4m²
Building Use	Location	TFA (for tested portion)

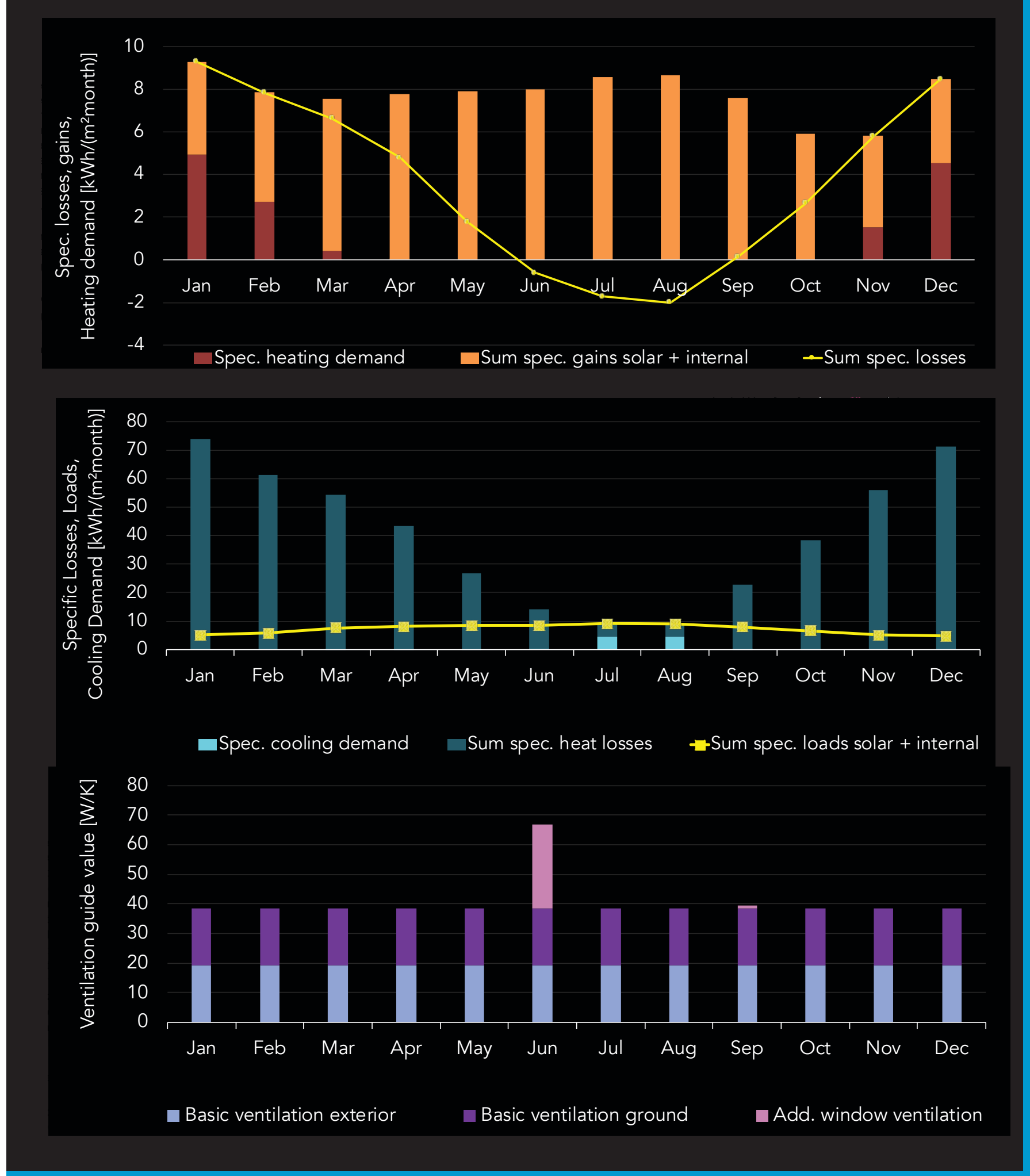
PASSIVHAUS STRATEGY

- Materials have been chosed for their sustainable properties (please see 'Materials' below).
- MVHR to ensure adequate ventilation & also provide minimal heating & cooling where necessary.
- Airtightness layer and thermal-bridge-free detailing reduce heat loss through the building fabric.
- Earth tubes draw air to a depth of 1.5m to pre-cool it in summer and pre-heat in winter.
- Solar sculpture & proposed oak trees offer shading from the summer sun.
- Varied heights of the buildings create step-up notch which increases wind turbulence, removing heat and pollutants from ground level.
- Skylights provide daylighting & cross-ventilation.
- Uncovered canal water provides evaporative cooling in summer.

PREDICTED PERFORMANCE

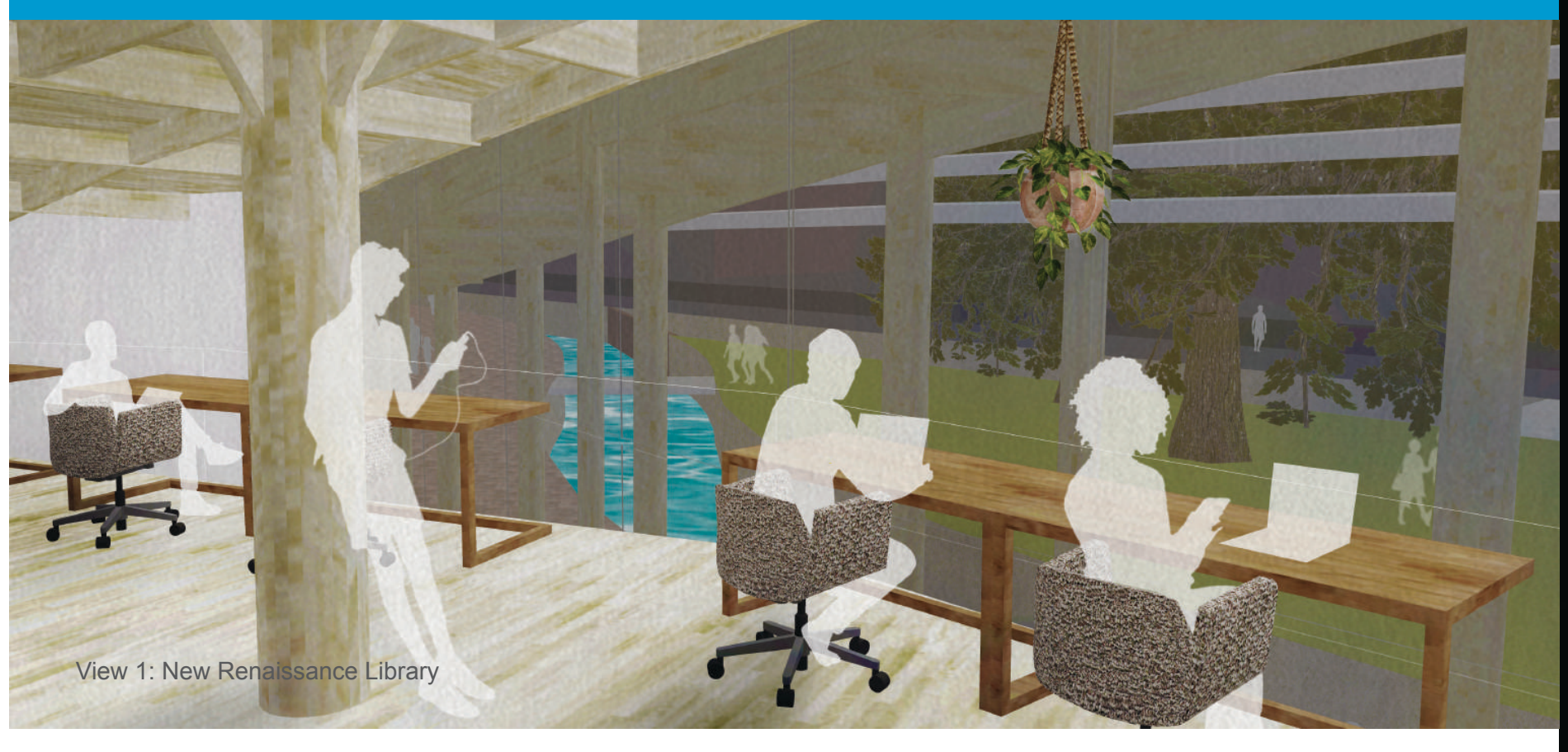
14 kWh/m²a	16 kWh/m²a	2.87
Heating Demand (for tested portion)	Cooling Demand (for tested portion)	Form Factor (for tested portion)

Below are the final annual heating, cooling & ventilation demand graphs.



DESIGN PHILOSOPHY

Piazza Fluente is a cultural centre for lifelong education addressing the skills shortage for the New Renaissance (STEM subjects + Art /'STEAM'). The cultural centre is inspired by Leonardo da Vinci, who spent many years in Milan, and is widely recognised for his expertise in the sciences & arts. Piazza Fluente will function as an active museum, where inventions/ artwork will be created and displayed simultaneously. This will help strengthen Milan's cultural identity as one of the major cities in the Renaissance period as well as a driving force of the New Renaissance. The piazza, at the focal point, will be fully glazed, revealing a large water wheel below, driven by the newly uncovered canal. Above, this rotational energy will be used to improve the efficiency of 304 solar panels.


View 1: New Renaissance Library


View 2: 2D Art Studio


View 3: Digital Fabrication Suite

MATERIALS

Terracotta:

- Natural material with low embodied energy.
- Cultural significance, being a traditional Italian material and associated with arts & crafts.
- Creates continuity between internal and external spaces.
- Internally terracotta acts as thermal mass to regulate indoor temperatures.
- Hygroscopic and therefore regulates internal relative humidity.

Timber:

- A glulam gridshell provides the main structure for this project.
- Internal walls are timber-framed & wood fibre wool insulation is used as it is natural & hygroscopic.
- External steps are constructed in timber.

Concrete:

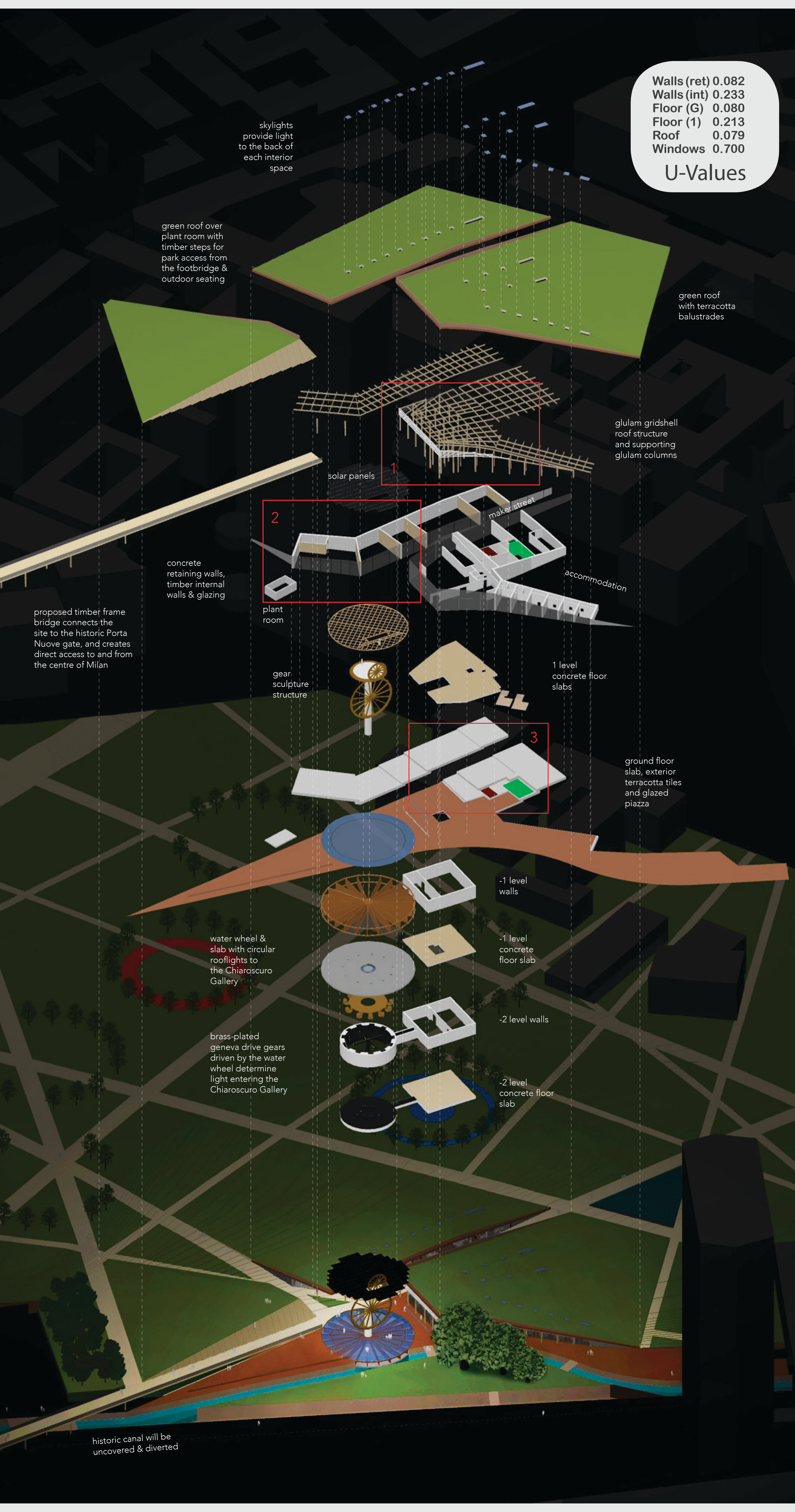
- Has been used for the earth-sheltered retaining walls, for its' structural/watertight properties and effectiveness as thermal mass.

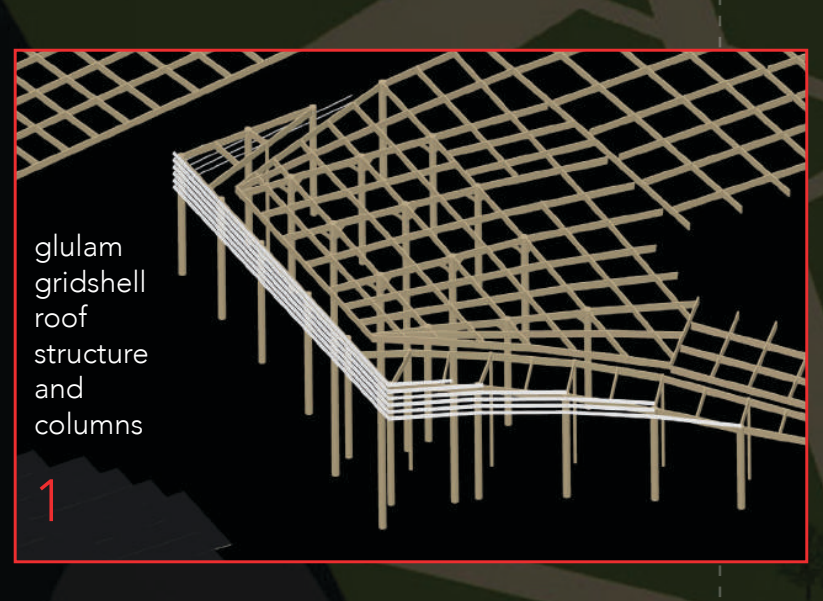
EPS insulation:

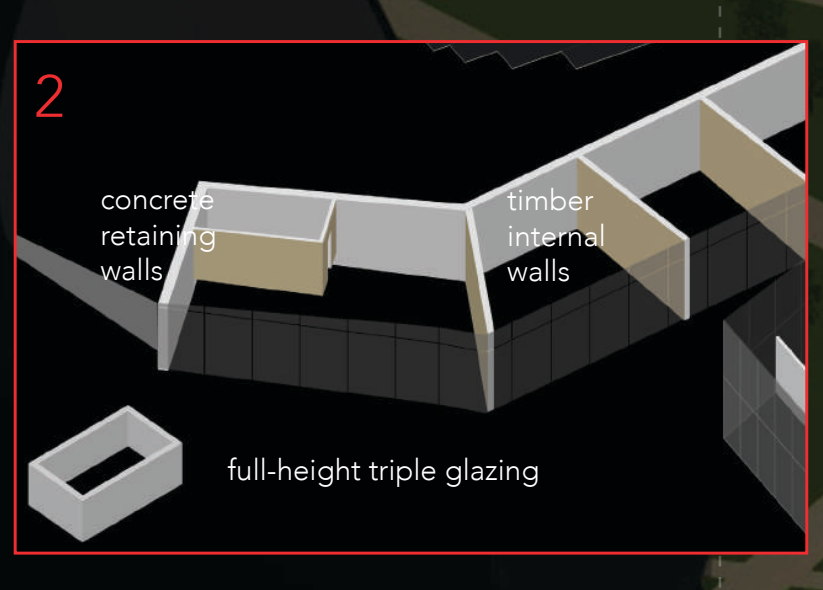
- 360mm grey Plustherm EPS Insulation has been used for the thermal envelope as it has a low U-value (0.030 W/mK) and is resitant to water leaks (suitable for underground use).

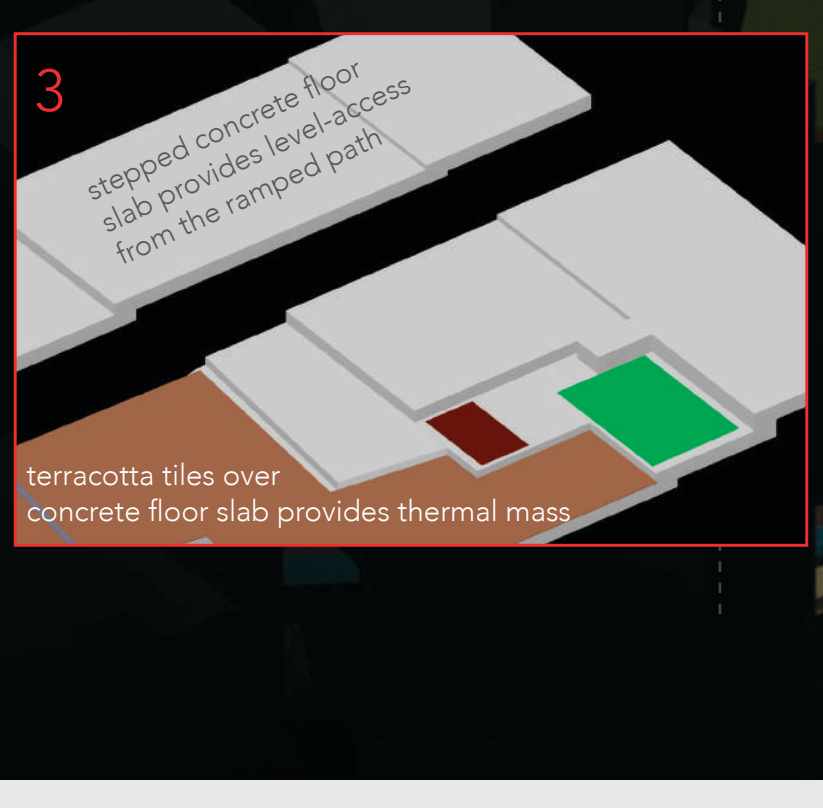
Specific Building Demands	Achieved	Required	Fulfilled?
Heating demand kWh/(m²a)	14	15	yes
Heating load W/m²	13	10	-
Overall specific space cooling demand kWh/(m²a)	16	18	yes
Cooling load W/m²	10	-	-

Walls (ret) 0.082
Walls (int) 0.233
Floor (G) 0.080
Floor (1) 0.213
Roof 0.079
Windows 0.700
U-Values









Acknowledgements

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OXFORD BROOKES UNIVERSITY

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