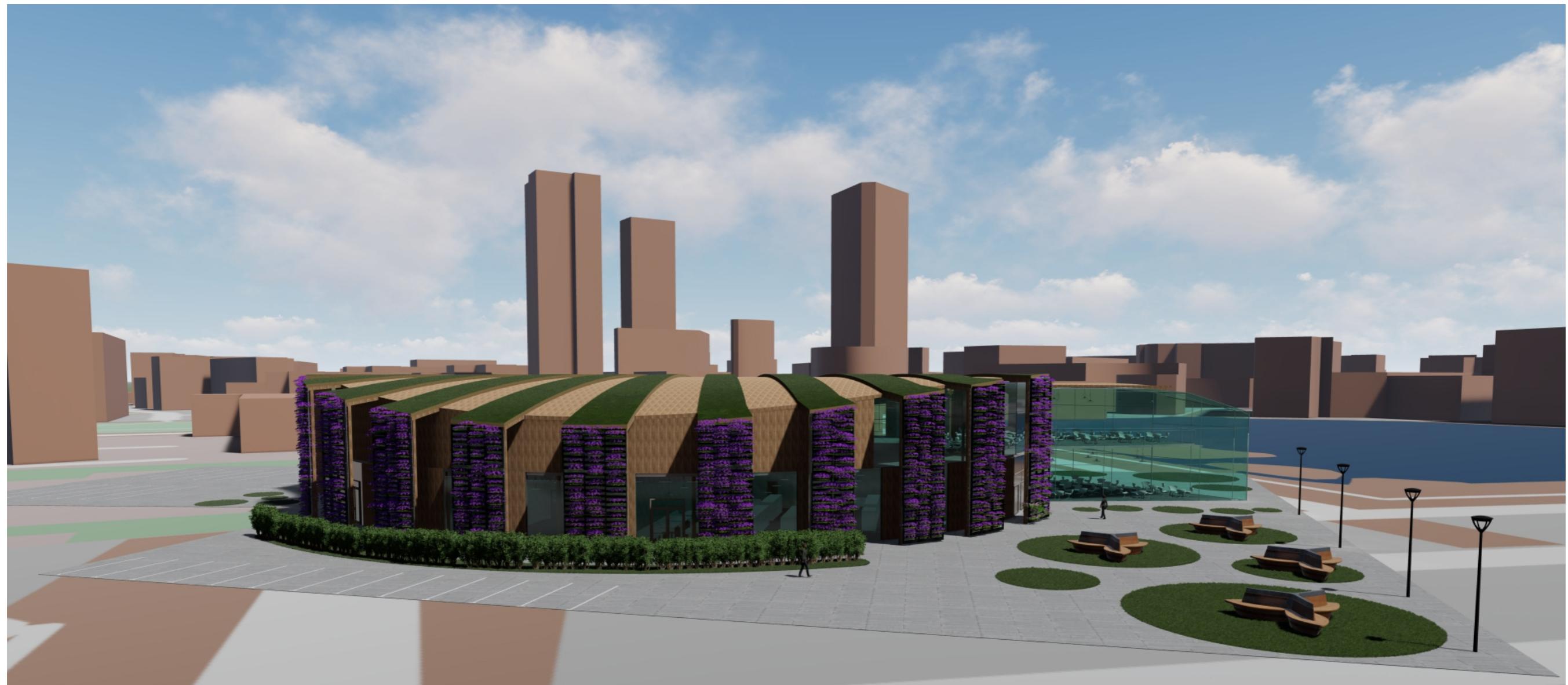


# Nutmeg Shell Canada Water Leisure Centre



BSc Architectural Technology PDE3730 Graduation Project Report

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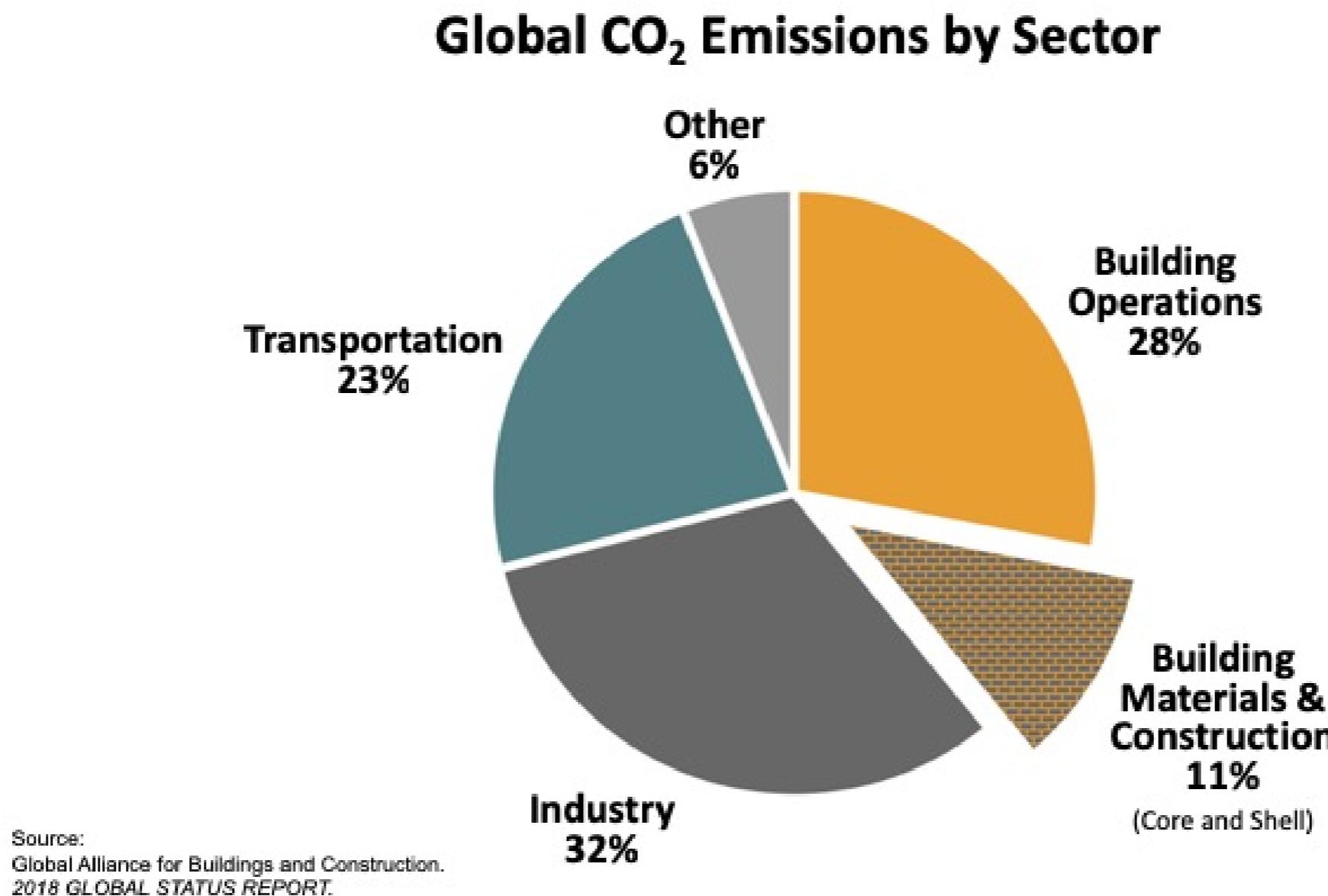
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# 1 Introduction

The building and construction sector is responsible for 39% of the world's total carbon dioxide emissions, with 11 percent coming from the construction process (over the entire life cycle) and material selection, with a further 28% coming from the energy used to cool, insulate and illuminate buildings. The World Green Building Council (WGBC) has proposed restrictive rules for the architecture, engineering and construction (AEC) industry to make a significant contribution to environmental protection and prevent global warming. The WGBC aims to reduce carbon dioxide emissions by 40% by 2030 and to eliminate it completely by 2050 [1].



## 2 Brief

The building is a multifunctional facility designed mainly for young people and adults. It will be built in central London, in the Southwark district. It will be located with access to public transport and a very good connection of main city roads with a size of about 5176 m<sup>2</sup>. The design is as part of the British Land and London Borough of Southwark. The aim is to create a new recreation and art centre at Canada Water. The building will provide access to a variety of art and sporting activities. The main purpose is to promote physical and mental health, well-being and passion.

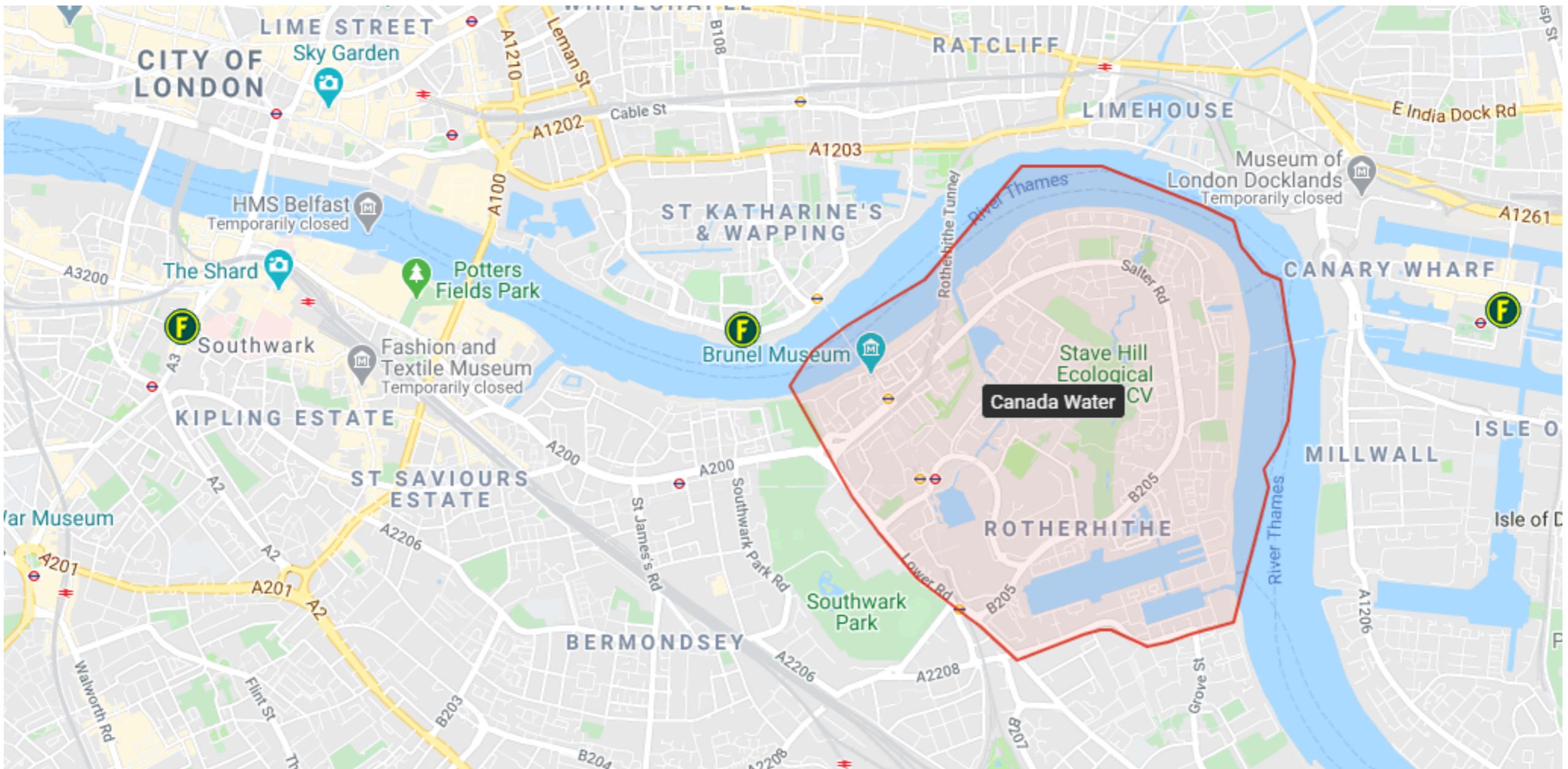


Figure 1: Canada Water Location

### **3 Client requirements**

The design of a sustainable, low-energy Recreation Centre. The minimum space requirements should include:

- Socialisation areas
- Facilities
- Recreation areas(e.g. Pool, gym, jacuzzi, solarium)
- Courts
- Cafeterias
- Parking
- Admin rooms
- First aid
- Reception or information centre
- Multi-functional rooms(e.g. Theatre, conference room)
- Storage

## 4 Site analysis

### 4.1 Location: Longitude $-0.050^{\circ}$ W, Latitude $51.50^{\circ}$ N

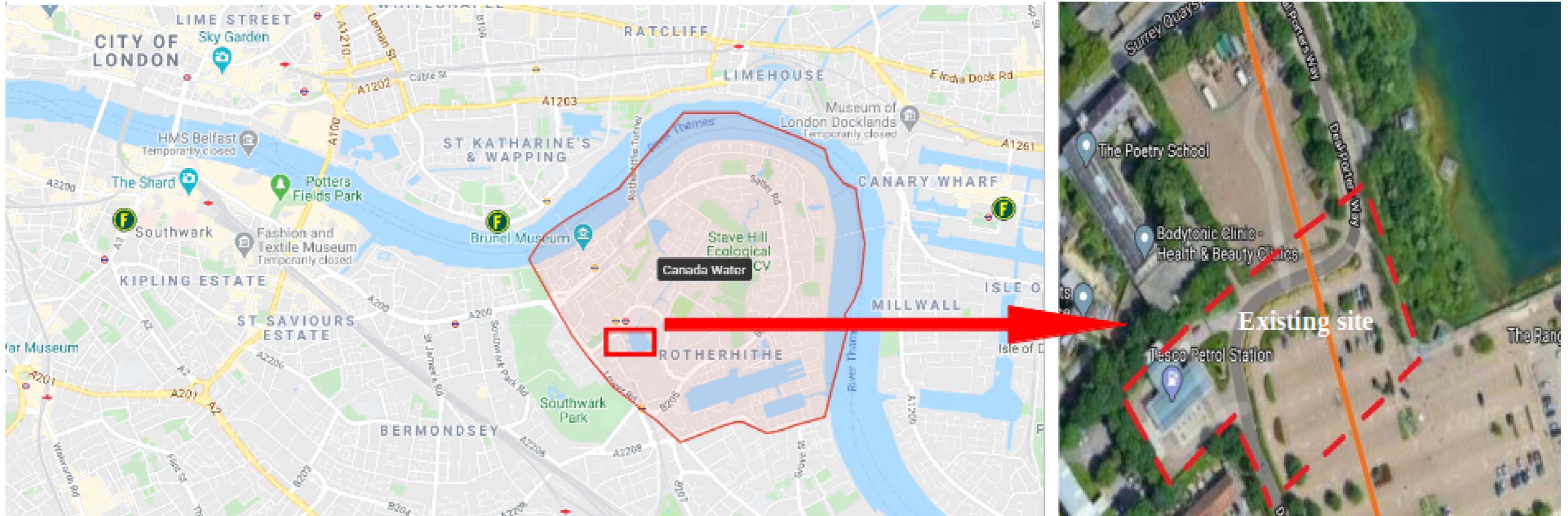


Figure 2: Location in London

Canada Water is an area located in the south-eastern part of London, on the south bank of the Thames. It is located in the second zone, about 3 miles from the very centre of London (City of London).

## 5 History

The Canada dock was built in 1876 on the site where the wood warehouses were once located. Its name was taken from the specialization in the English Canadian trade. Next to the newly built dock, a giant grain storage silo was also built. Canada Water is an area of the Docklands, whose name is derived from the sediment of a freshwater lake. This lake is named after the former Canada dock. In the 1980s, the London Docklands Developer Corporation took over and invested in the reconstruction of this area. Half of it was developed and built up, the rest was transformed into a lake and wildlife reserve.

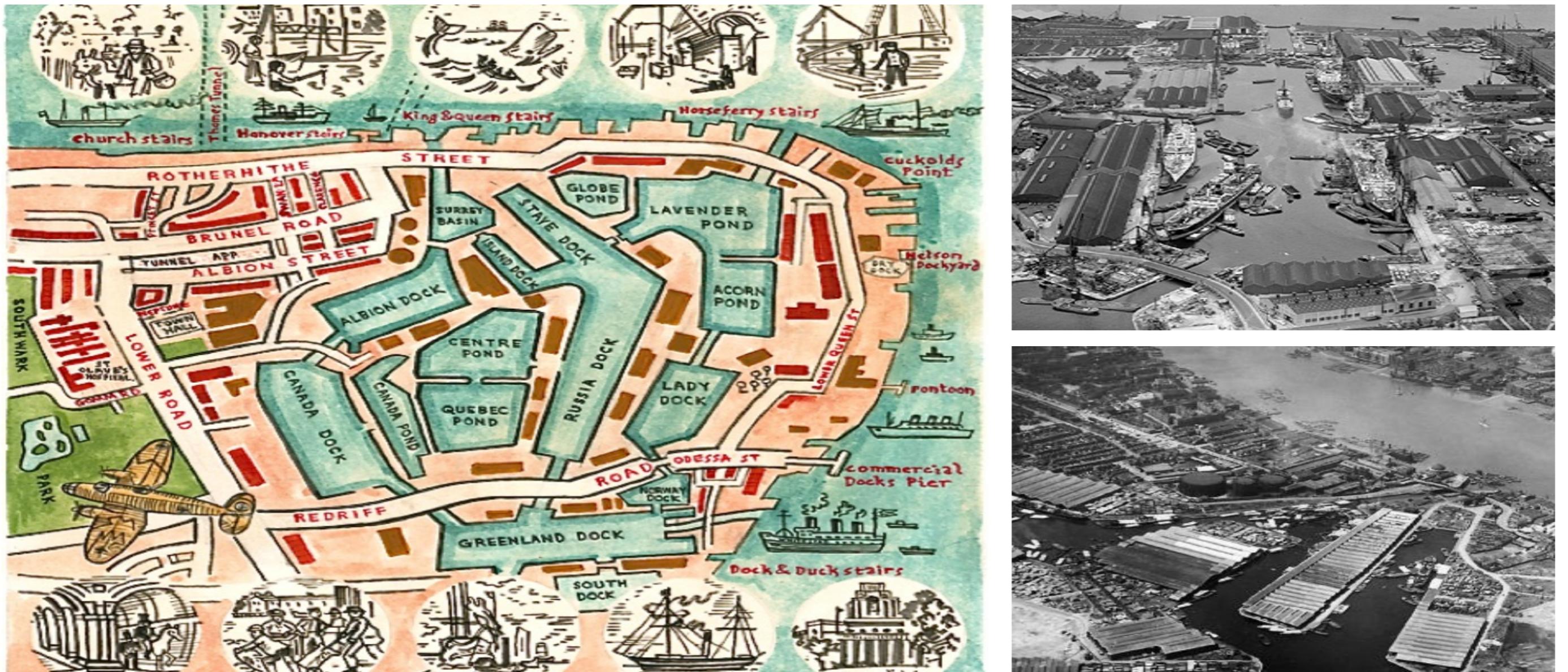
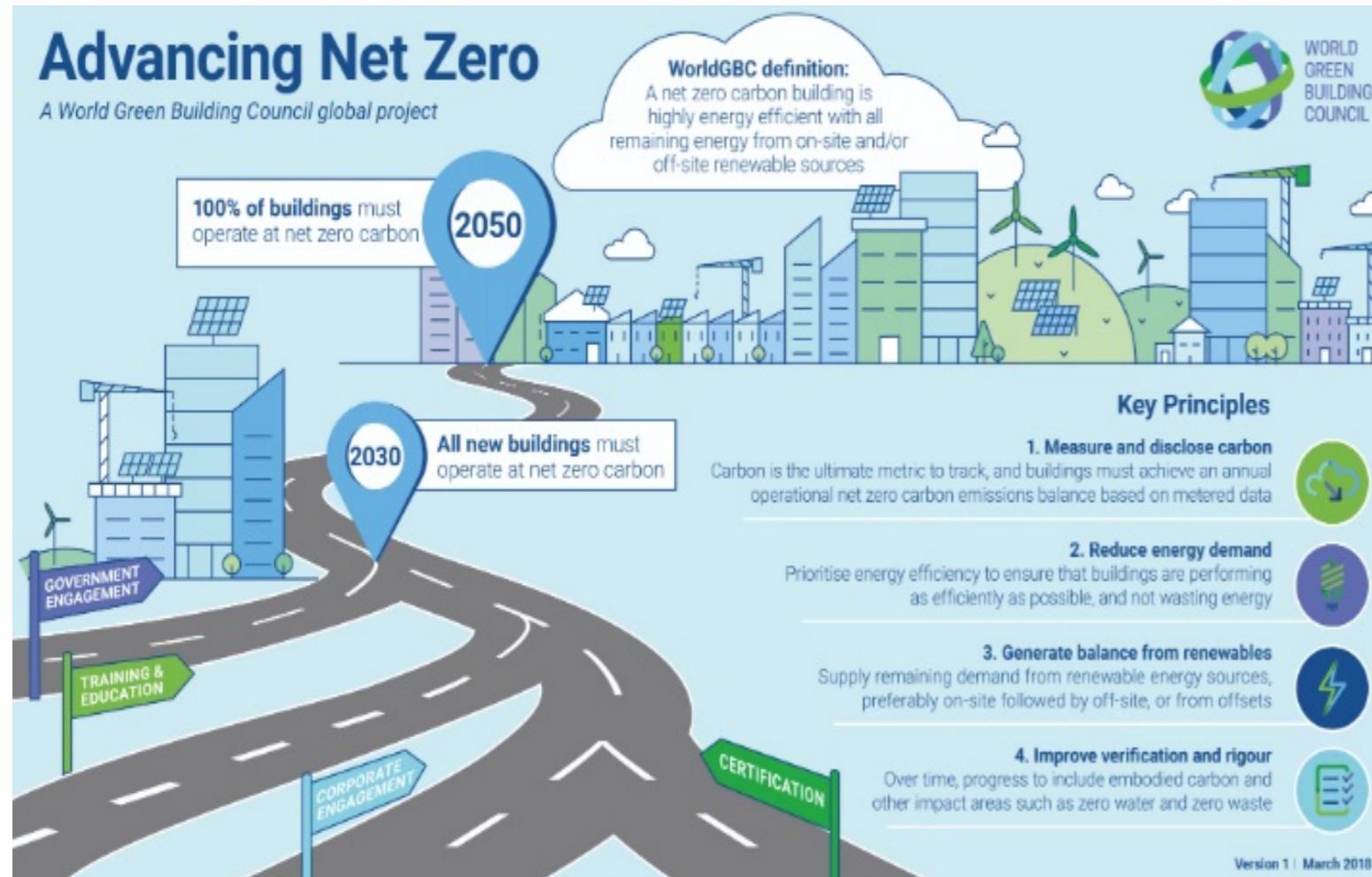


Figure 3: Canada map and historical pictures

# 6 Climate

When designing a building, it is particularly important to consider the environment in which it will be located. The climate, the terrain, the type of ground, the amount and path of natural light, the direction of the wind and the amount of precipitation are some of the most important elements to pay attention to. When the goal is to achieve a net zero energy building, it is particularly important to thoroughly analyse these issues. London is located at an altitude of 18 metres above sea level, its climate qualifies for moderate warmth, eminently oceanic. According to the Köppen-Geiger climate classification, London belongs to the 'Cfb' group, which means 'Temperate, no dry season, warm summer'. The average temperature over the year is 11.1 degrees Celsius and the annual rainfall is around 621 mm. Summers in this climate are quite warm and winters are cold, so depending on the season the building must be cooled or heated.



(a) Net Zero design WGBC

	1st	2nd	3rd
<b>A (Tropical)</b>	f (Rainforest)		
	m (Monsoon)		
	w (Savanna, Dry winter)		
	s (Savanna, Dry summer)		
<b>B (Arid)</b>	W (Desert)		
	S (Steppe)		
		h (Hot)	
		k (Cold)	
<b>C (Temperate)</b>	w (Dry winter)		
	f (No dry season)		
	s (Dry summer)		
		a (Hot summer)	
		b (Warm summer)	
		c (Cold summer)	
<b>D (Continental)</b>	w (Dry winter)		
	f (No dry season)		
	s (Dry summer)		
		a (Hot summer)	
		b (Warm summer)	
		c (Cold summer)	
<b>E (Polar)</b>	d (Very cold winter)		
	T (Tundra)		
	F (Eternal frost (ice cap))		

(b) Köppen-Geiger climate classification

## 6.1 Sunshine path

The sun's path at a given location has a significant impact on the amount of sunshine delivered to the inside. The wind direction also plays a major role in building design. The diagrams below show the daytime light path and the wind sink adapted to the area where the Leisure Centre is to be built.

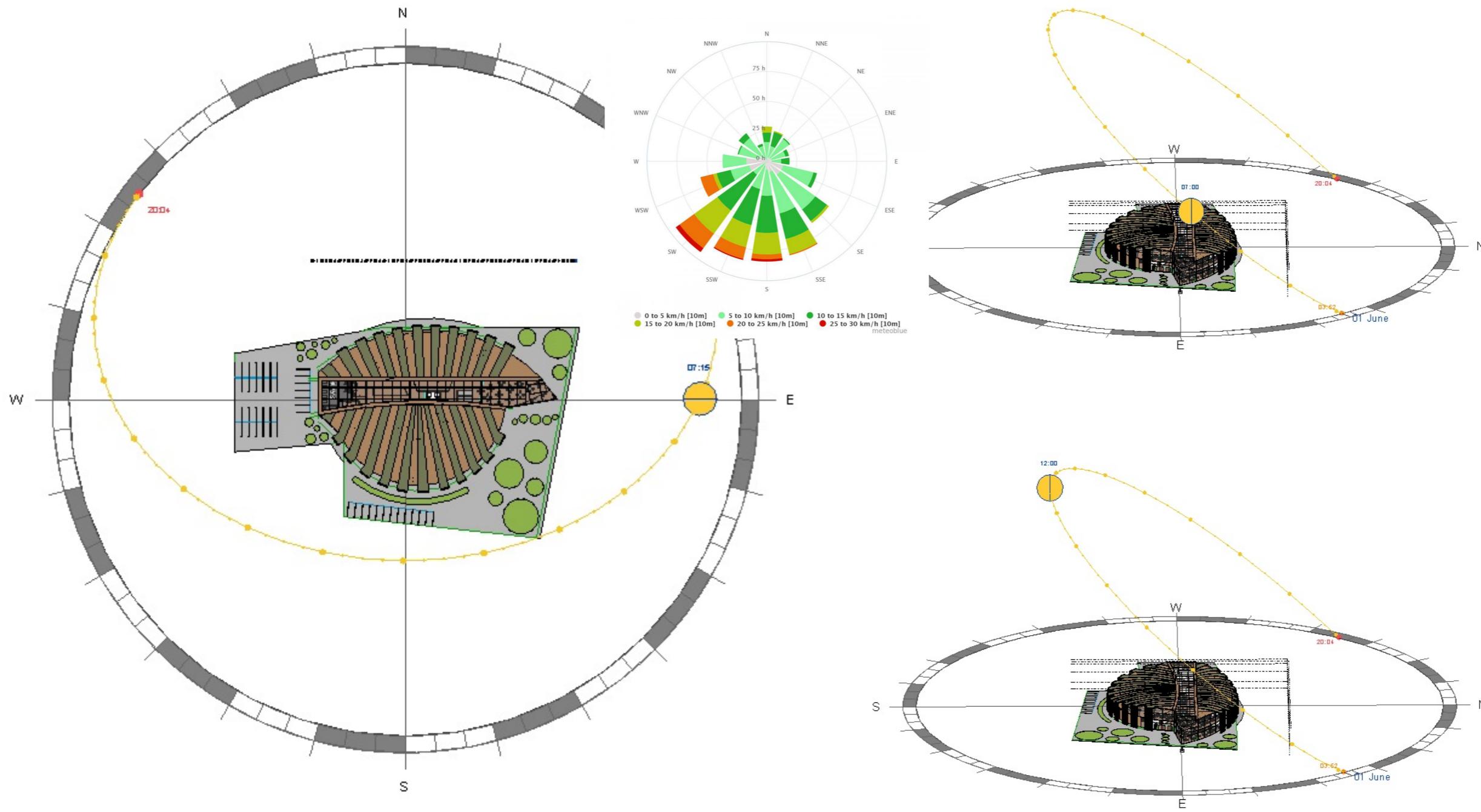
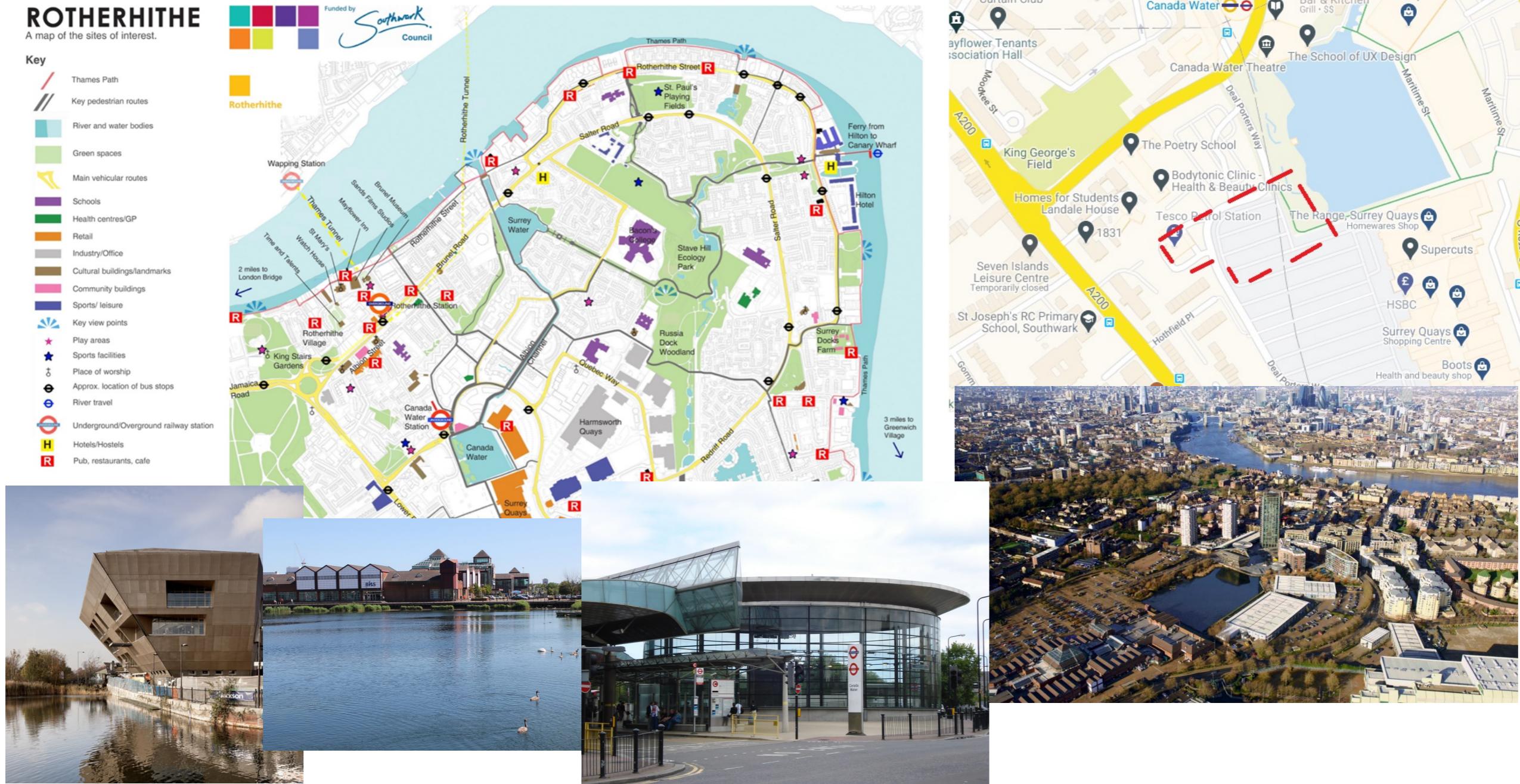


Figure 5: Sunshine model

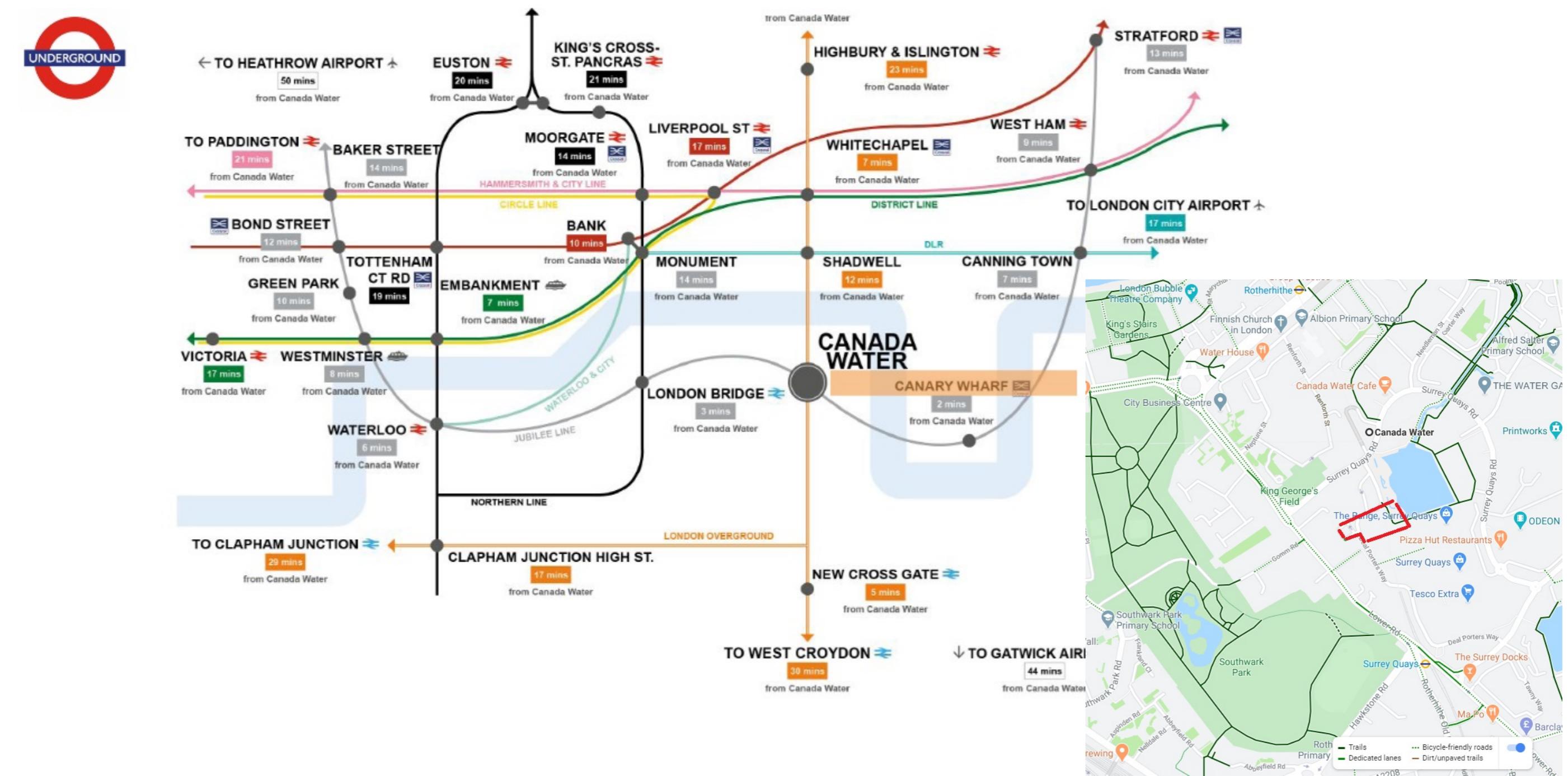
## 6.2 Site context

The area surrounding Canada Water includes green reserves, open water, low-lying suburbs, industrial and entertainment companies. Entertainment facilities include the Surrey Quays Trade Centre. Inside you can find restaurants, multi branch shops, bowling alleys and a cinema. There are plenty of exquisite restaurants and cafes, swimming, Canada Water library and Culture Space. It is also a place that is conducive to education. There are several schools for different age groups in the area, of different character.



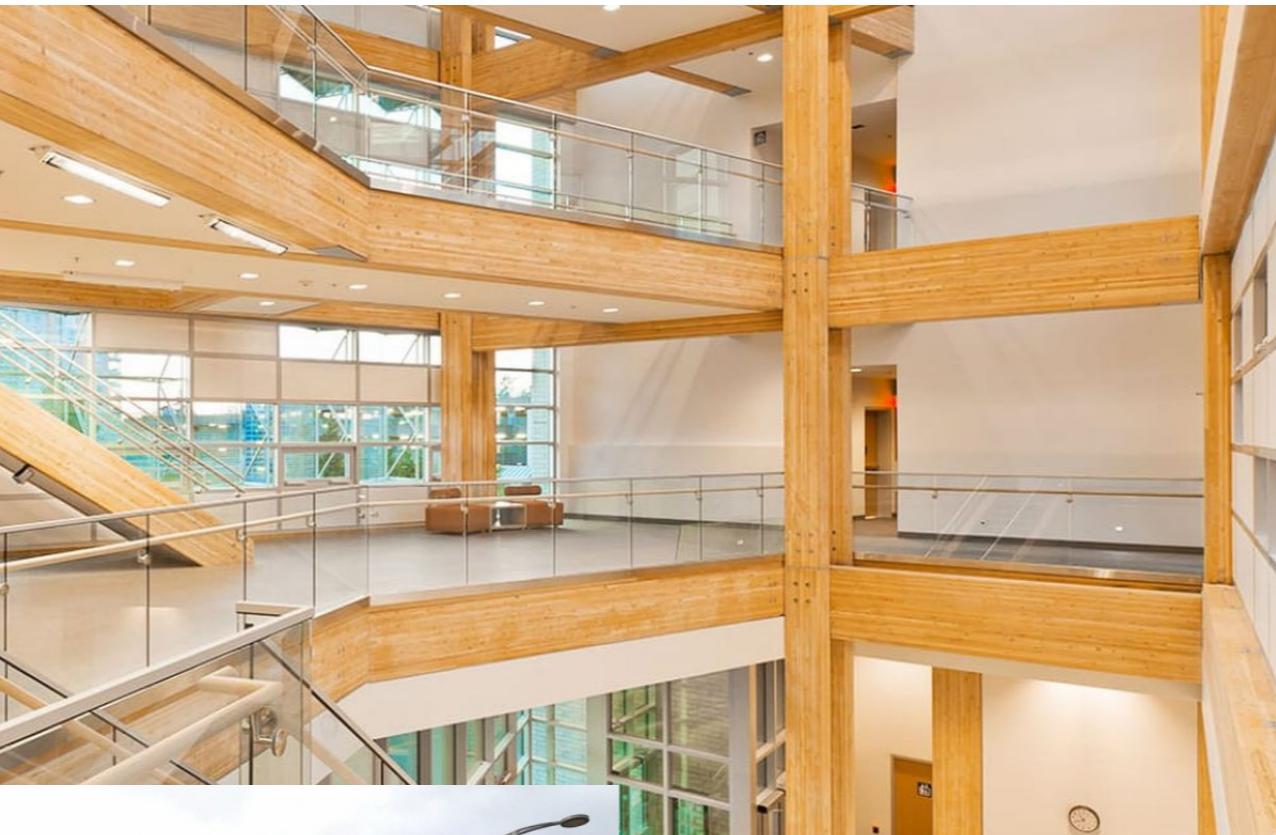
# 7 Building access & Transport

Canada Water has its own underground station (orange line), which is only 3 minutes from Leisure Centre. Another means of public transport for future clients is a bus (47, 188, 381, C10, N381). The advantage is also a perfect connection to main roads and cycle paths.



## 8 Precedents Inspiration



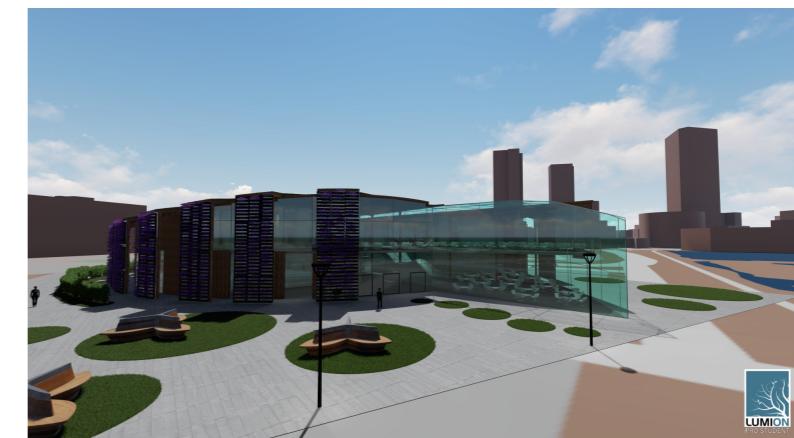
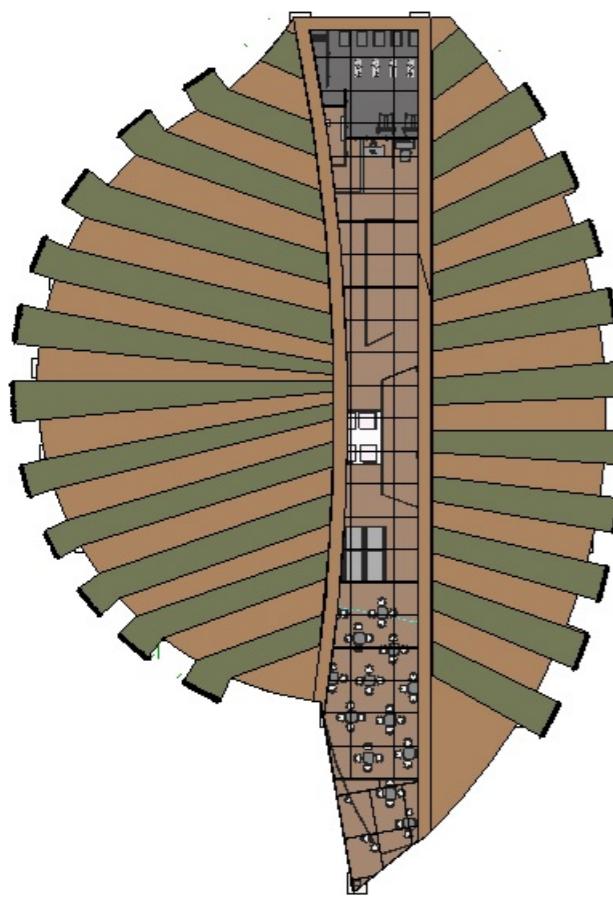


## 9 Design

The first idea was to create an artistic recreation centre-theatre, dance studios, galleries, exhibitions. It is an autumn from the activities that breathe life into the building. The inspiration to choose the shape of the building was a shell, more precisely a nutmeg shell (which appeared in the name of the centre). The entertainment centre is located on a water reservoir, which, although it is a lake, can collide with the shells. The shells can be used in several ways:

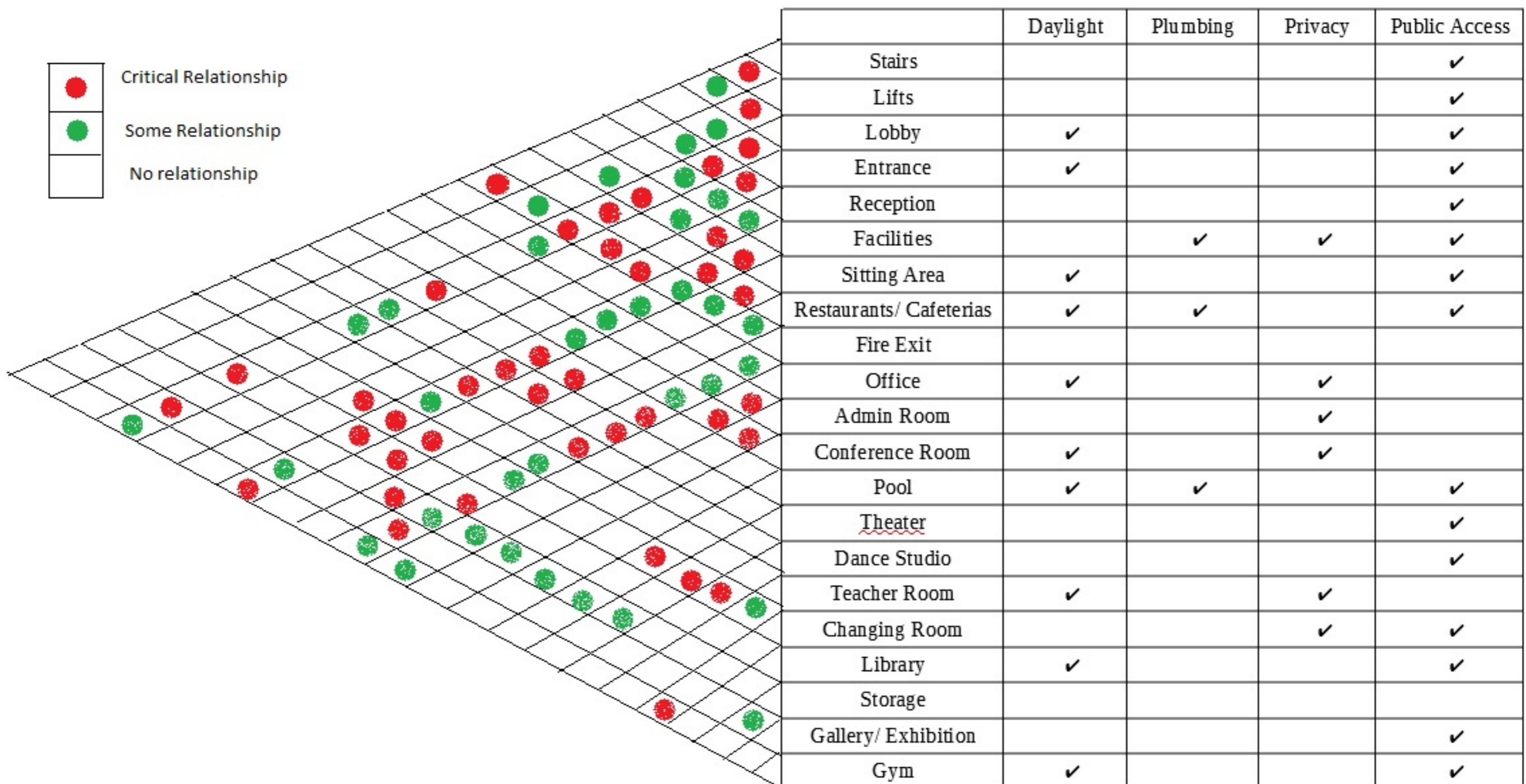
- as something ancient, they often appear reflected or sunk in fossils that we can see at exhibitions,
- water, vacation-miles, warm memories, wanting to return,
- a hideout, a home for the organisms living in them-a feeling of comfort, safety.

However, to make this recreation centre for everyone, it has evolved into a multi-purpose facility. Sports fans will also find something for themselves inside-a gym, a pool.



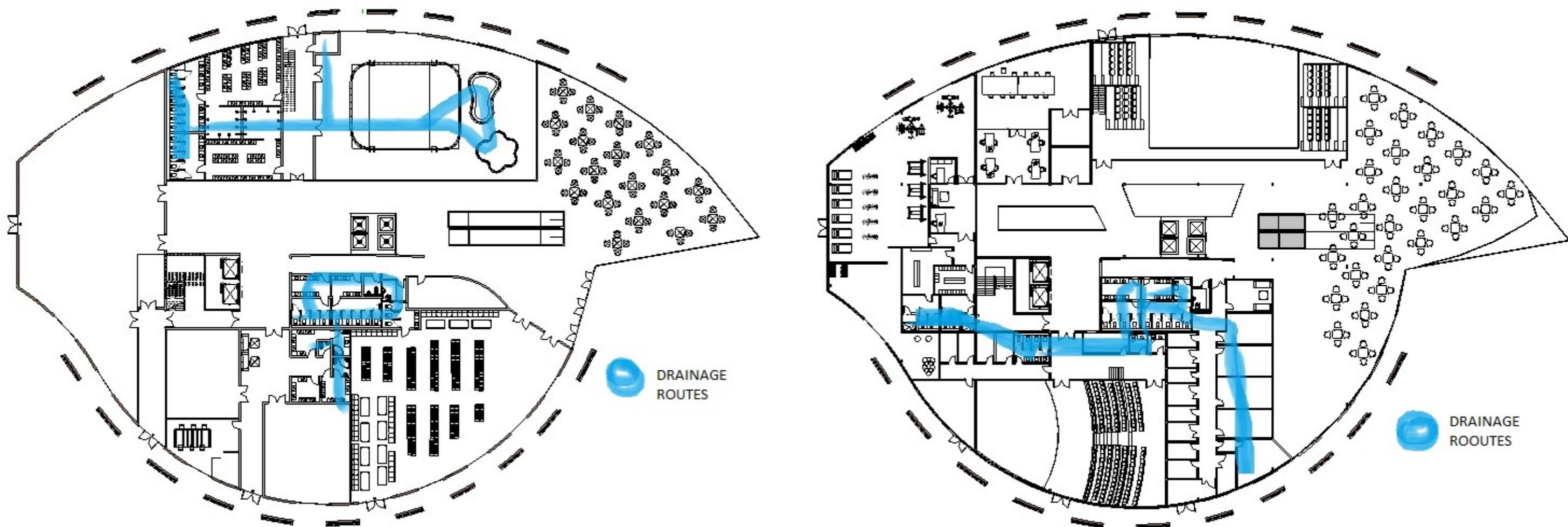
## 9.1 Adjacency Matrix

Since this building is to be multi-purpose, it was necessary to create an adjacency matrix in order to better understand the needs. This makes the design process less clashing and requires fewer changes.



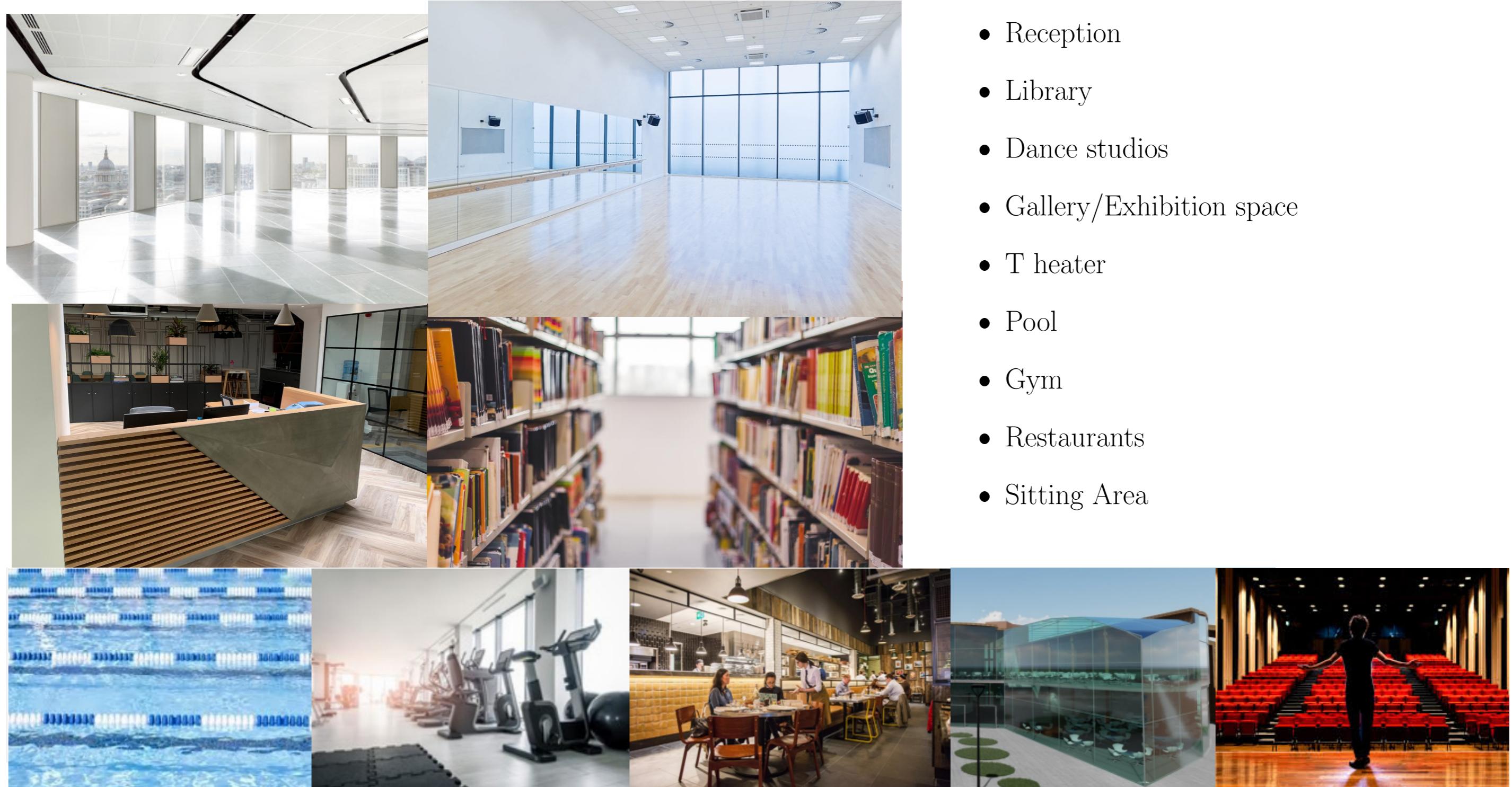
## 9.2 Inside Design

The building is divided into two main wings. The southern part is occupied by an artistic activity (plus restaurants), the other side is sporting. The western end belongs to both activities depending on the floor. On the east end there are seats, because through the glass walls there is a beautiful view of the lake. The main bathrooms are located in the south wing, in the middle of the building. A small corridor separates them from the main lobby. This corridor is open at both ends, which makes it easy to access from all sides of the building. On both floors the bathrooms are in the same place and all other rooms that also require access to water are located in the area to make the installation and installation of service routes easier.



## 9.3 Space & functionality

Socialisation:



## 9.4 Space & functions

The main entrance to the recreation centre is in the eastern part, on the lake side. To the left of the entry there is a library, which has an unisex bathroom and access to an emergency exit. Opposite the entrance is the main lobby with exhibition space and escalators leading to the next floor. On the left side there is a reception and a corridor leading to the main bathrooms and baby station. The corridor is also open on both sides and leads to the second core with two larger lifts, which will also be used as a service route. On the left side of the lifts there is a doorway to the staircase leading to the top floor and to the emergency exit. To the left of the exit from the corridor there is a dance complex, which is divided into: \*waiting area, \*2 dance studios, \*3 changing rooms (2 with private bathroom with shower), \*WC, \*teacher room with first aid, \*corridor to the emergency exit. At the end of the building there is a gallery/exhibition area with access to two fire exits and storage. After leaving the gallery on the left, there is a swimming pool area, which includes the building: \*2 changing with bathrooms and showers, \*big swimming pool, \*small, hot pool, \*kids pool, \* a corridor leading to the emergency exit and sitting area on the next floor.

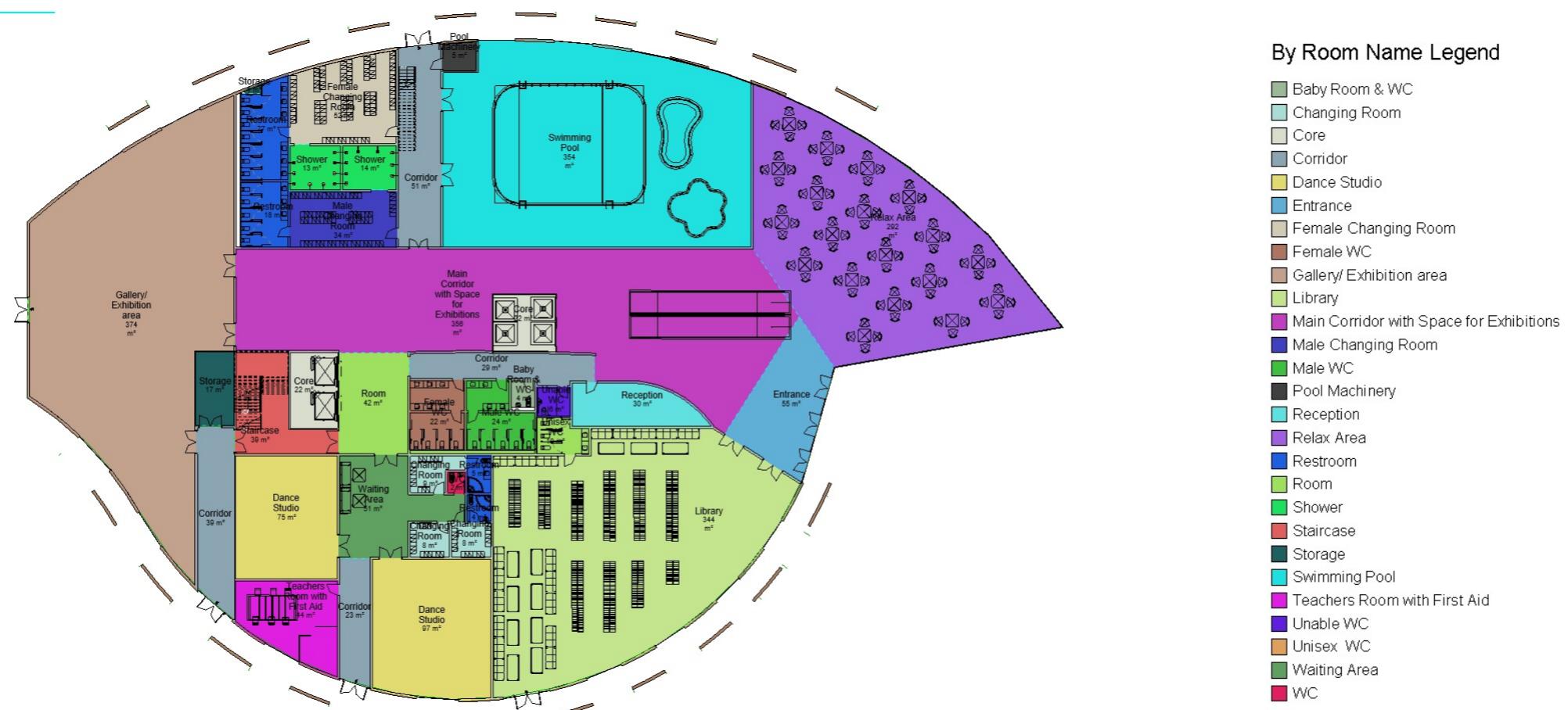


Figure 6: Ground floor

The first floor can be accessed using escalators or stairs and two cores with a total of 6 lifts. The western part of the building occupies a sitting/dining area with a beautiful view of the lake from the top. In the north wing there is a second floor of the swimming pool area with seats for e.g. fans. The main exit from the pool area leads through a staircase to the lower floor, but if there is an emergency exit there. In the further part of the wing there is an office connected to the admin room, conference room and two storages. The western part of the building is occupied by the gym, two changing rooms with baths and showers, reception and waiting room. The majority of the south wing is occupied by the theatre: \*reception with locker room, \*WC's, \* changing rooms for artists, \*backstage, \*stage with audience area. The main bathrooms are in the same place as the floor below. The last stagment is the restaurant complex. Each of the restaurants will be divided into kitchens and front and will have a file room/storage room and a staff room.

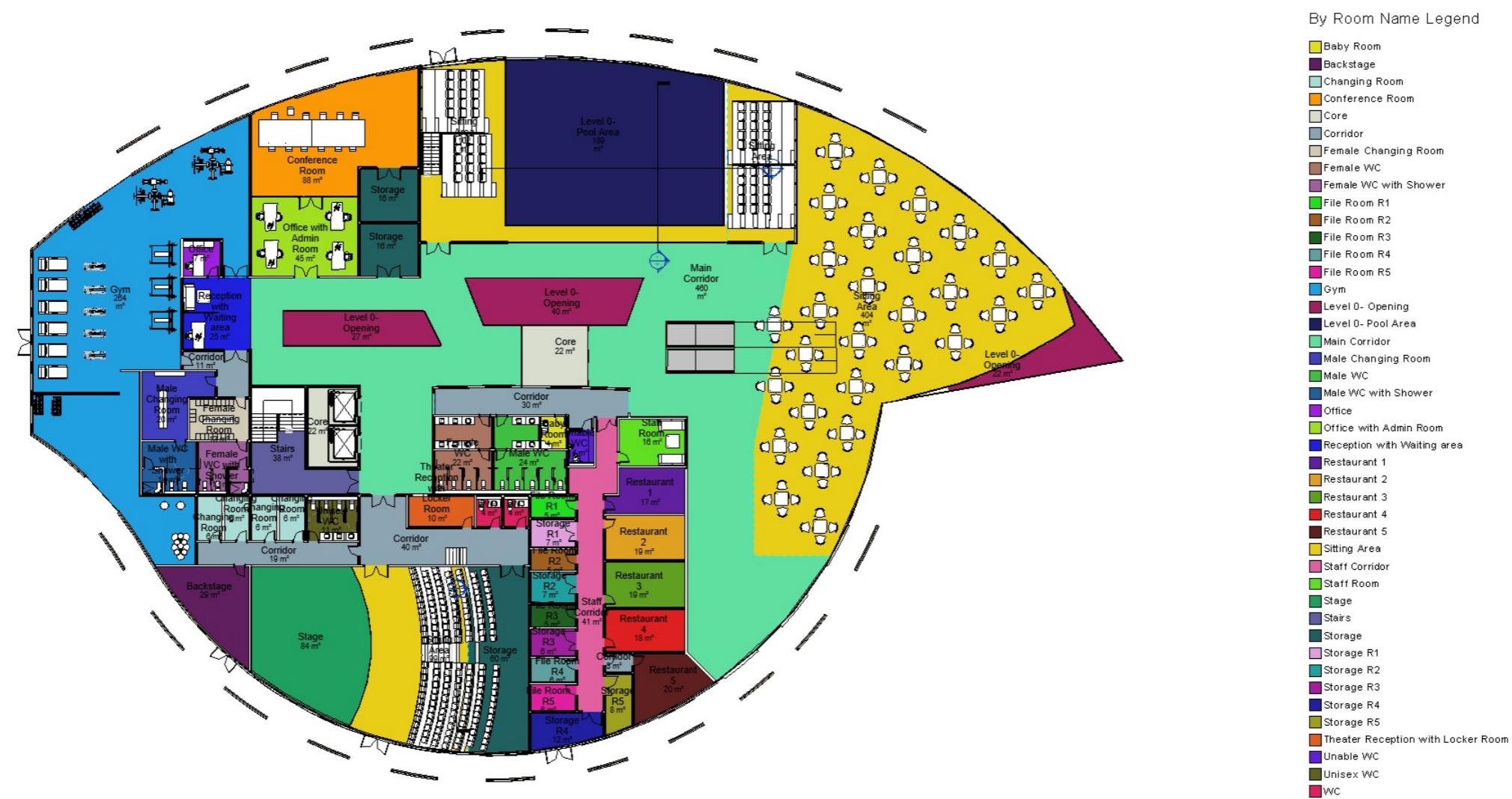


Figure 7: First floor

# 10 Final Design

## 10.1 Sections

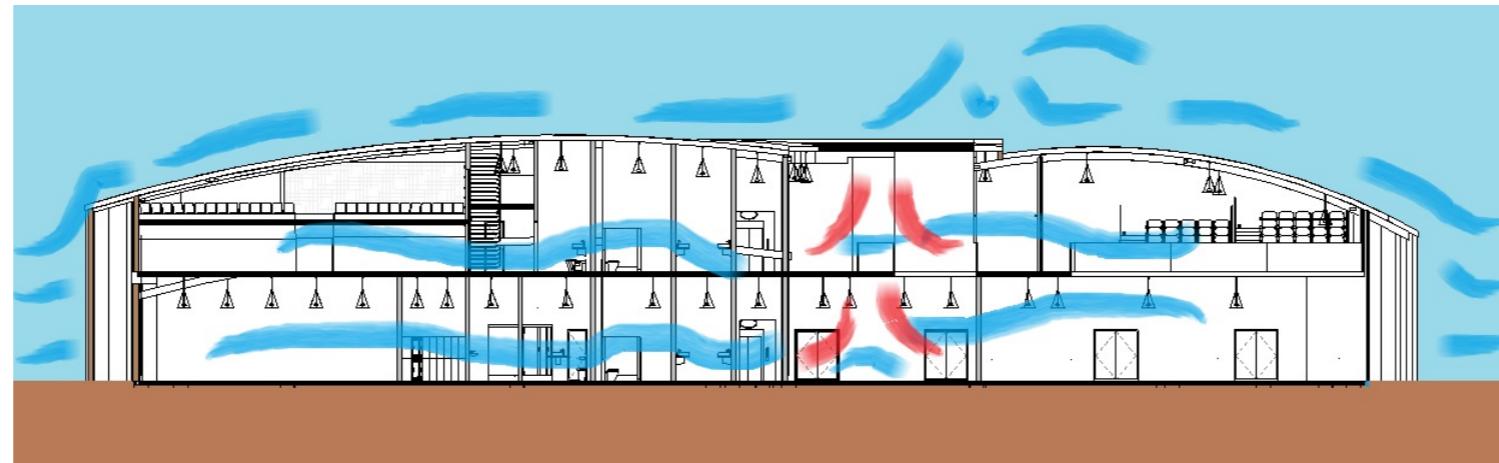


Figure 8: Short section with airflow



Figure 9: Short section with sunlight

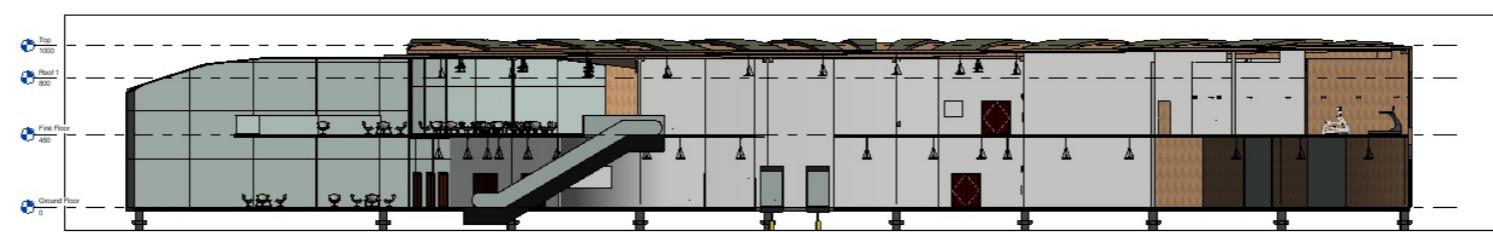


Figure 10: Long section

## 10.2 Elevations

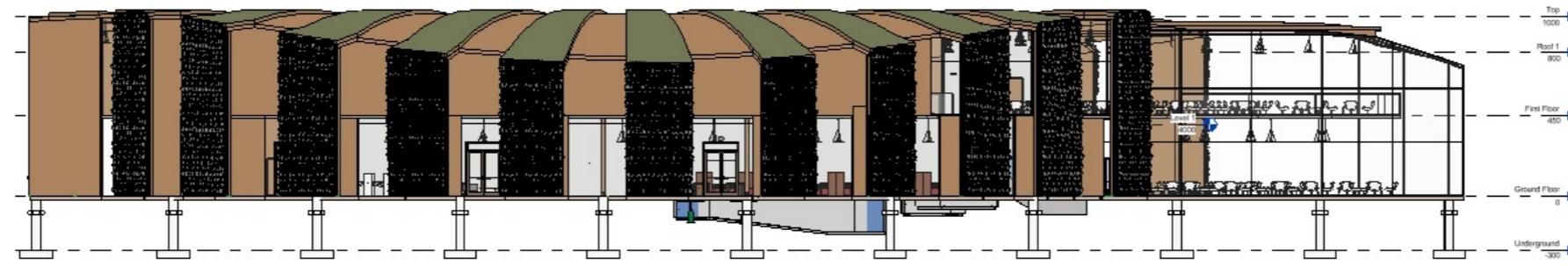


Figure 11: South elevation

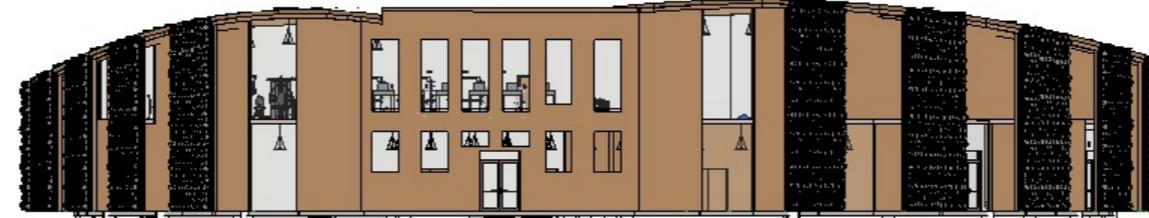


Figure 12: West elevation

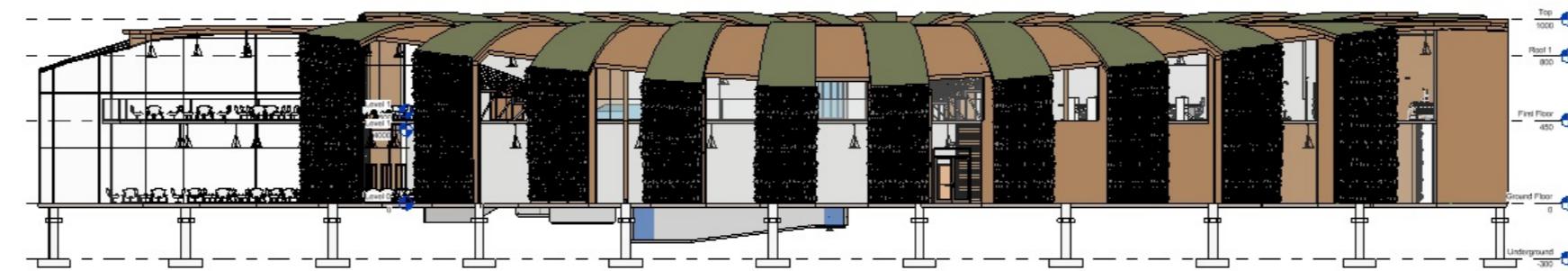


Figure 13: North elevation



Figure 14: East elevation

### 10.3 Exploded isometric

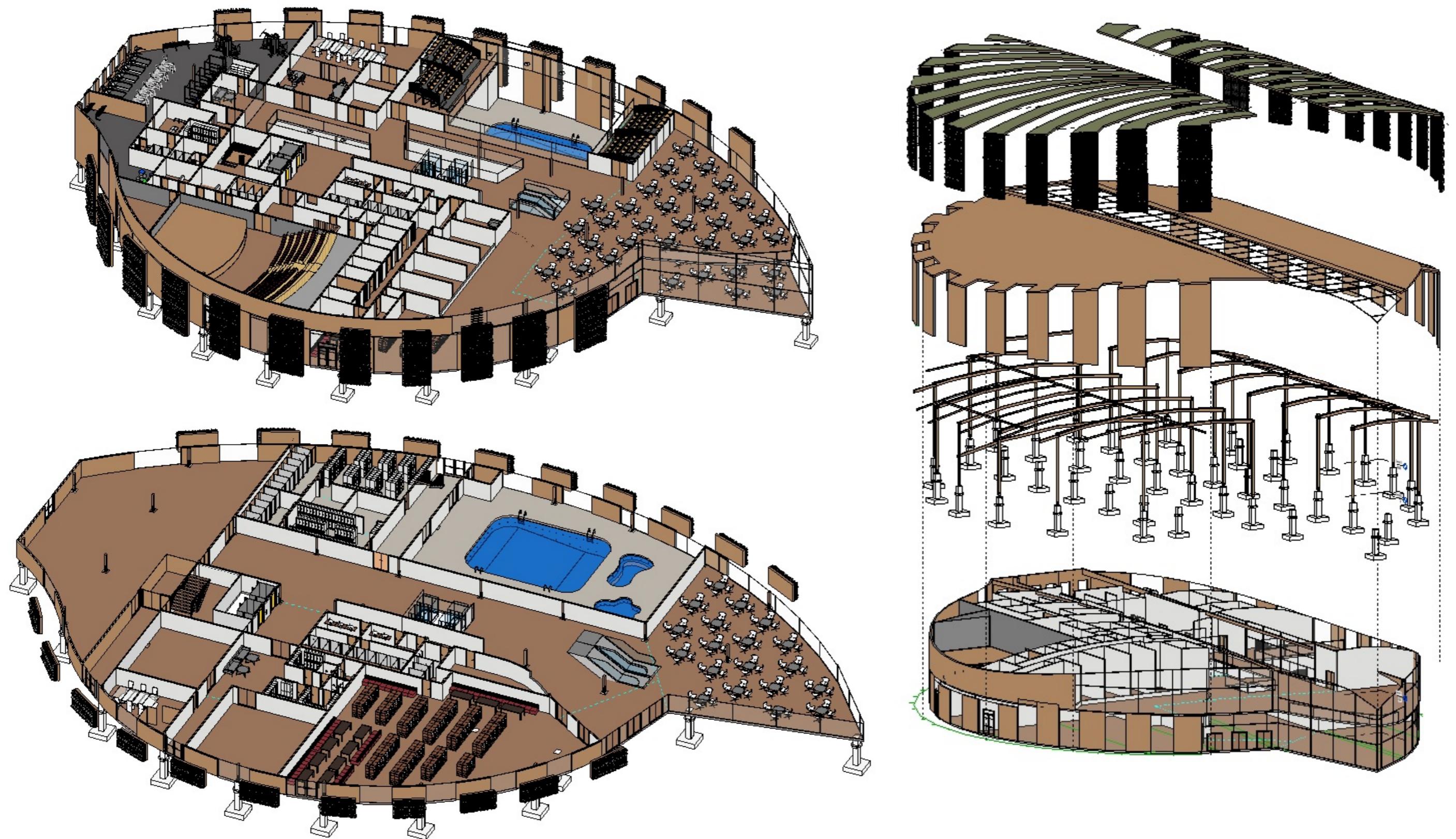
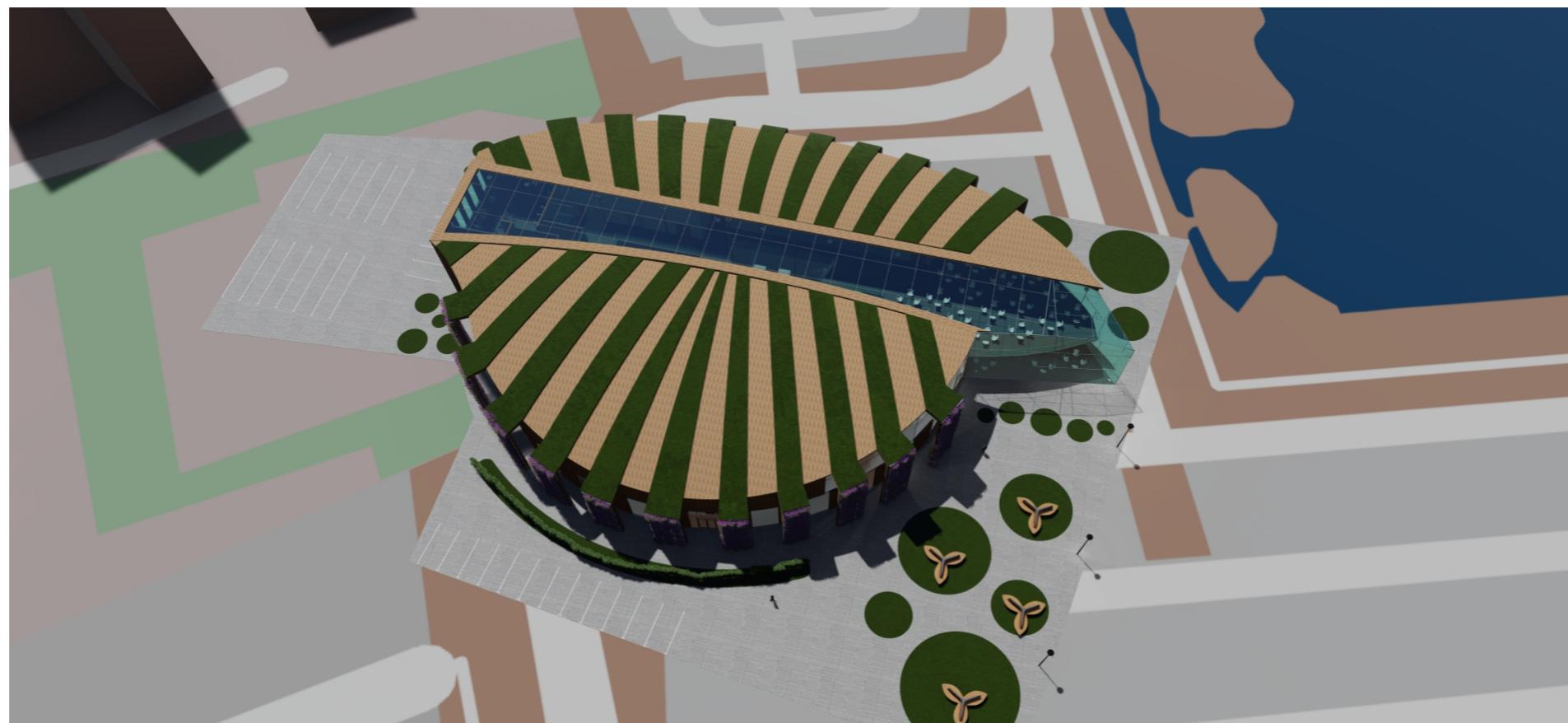
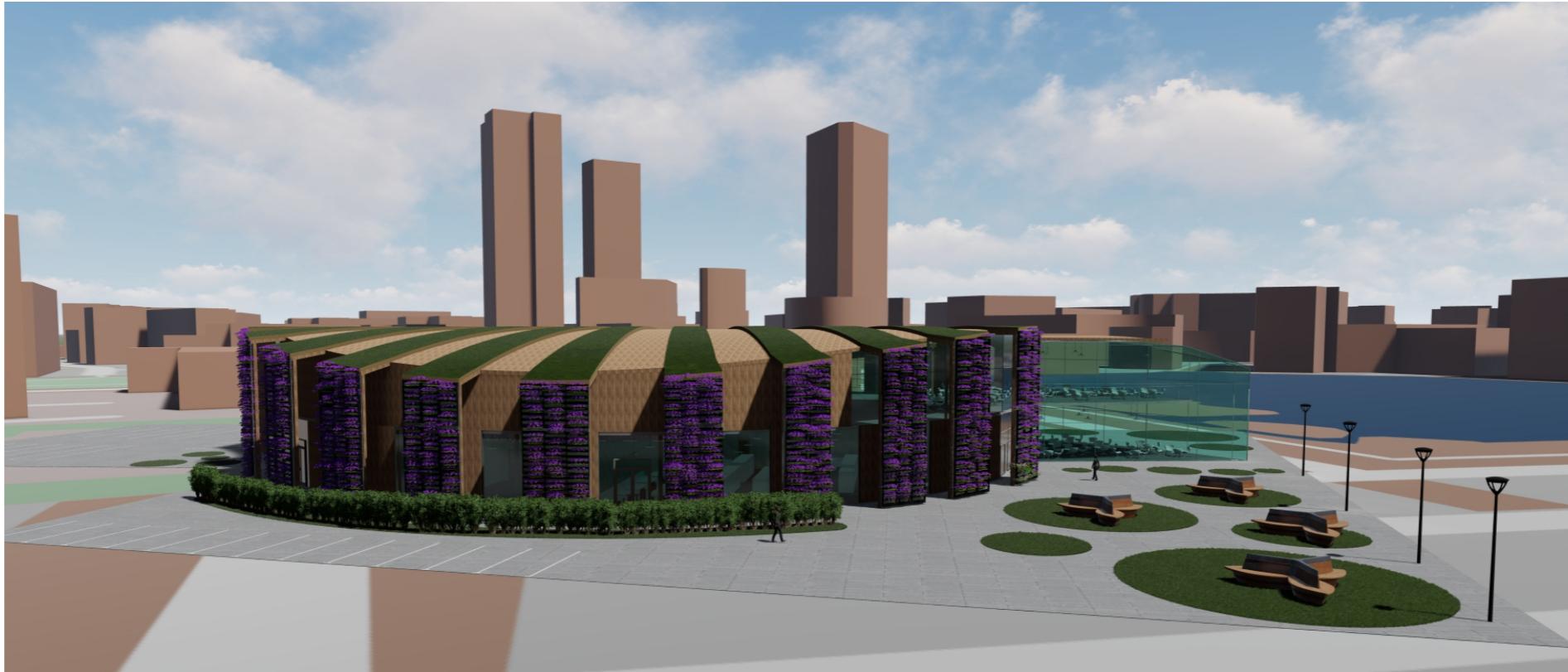
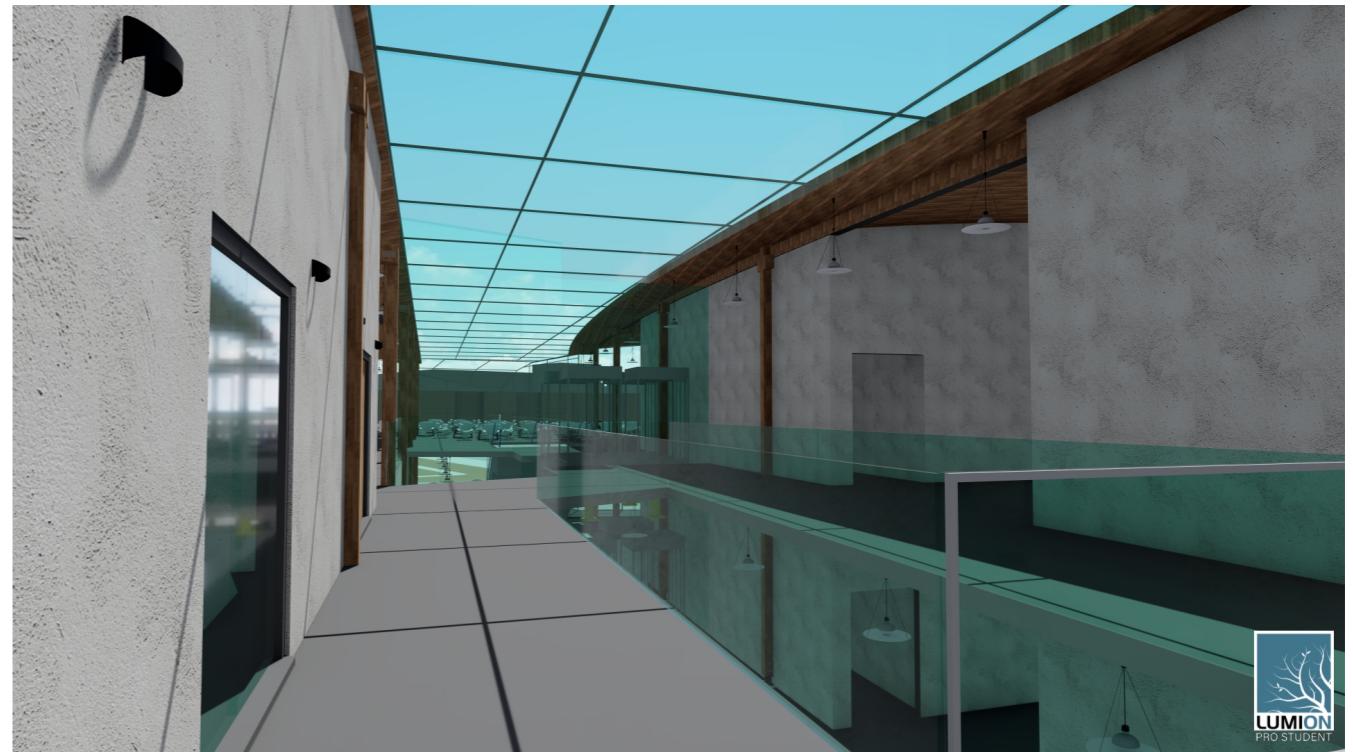
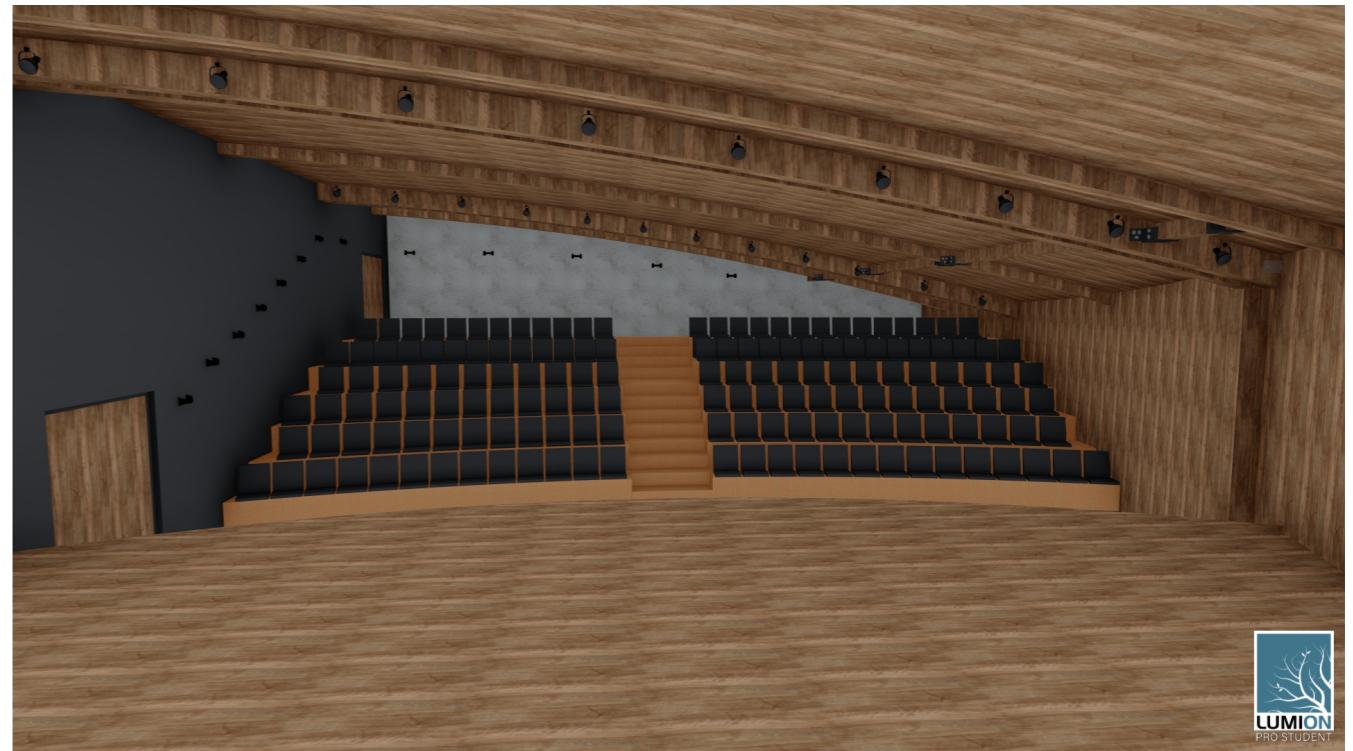


Figure 15: Final design render photos

## 10.4 Render photos outside



## 10.5 Render photos inside



# 11 Sustainable Technologies

## 11.1 Double Facade

The north and south walls will be built from a double façade, which is 2 m apart. It is an additional pedestrian crossing during rain or heat (shadow). The walls of the building are made of wood, which is a natural material, gives a delicate appearance and is closely connected with the history of the area. The walls of the second façade are also made of wood and are covered with green walls, which collect water during rains and filter excess water. These walls are placed in distances which control the amount of sunlight coming into the middle of the building. This reduces the possibility of the building overheating and uncomfortable light falling. Green walls contribute to the biophysical design principle and create better air quality.

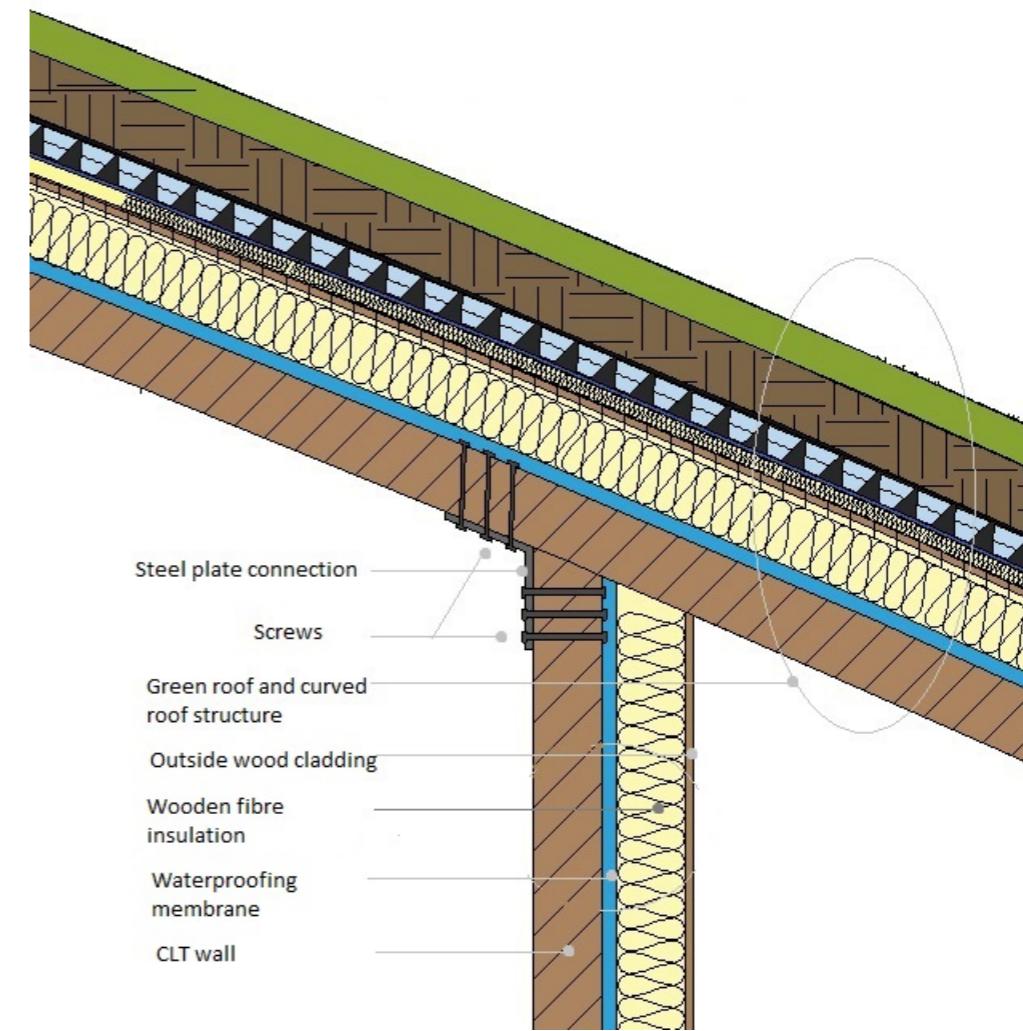
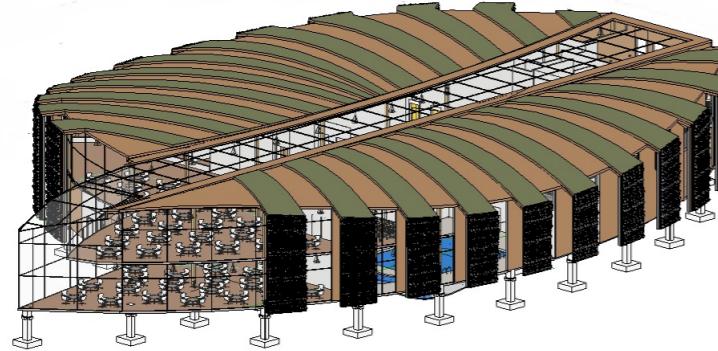


Figure 16: Roof-wall details

## 11.2 Green roof

The partially green roof collects rainwater during a downpour and mitigates the effects. Built from recycled materials, it is lightweight, has no adverse effects on the environment and can be reshaped. The green roof serves as an additional protection against heat loss from the inside. The green roof supports the principle of biophysical design and produces better air quality.

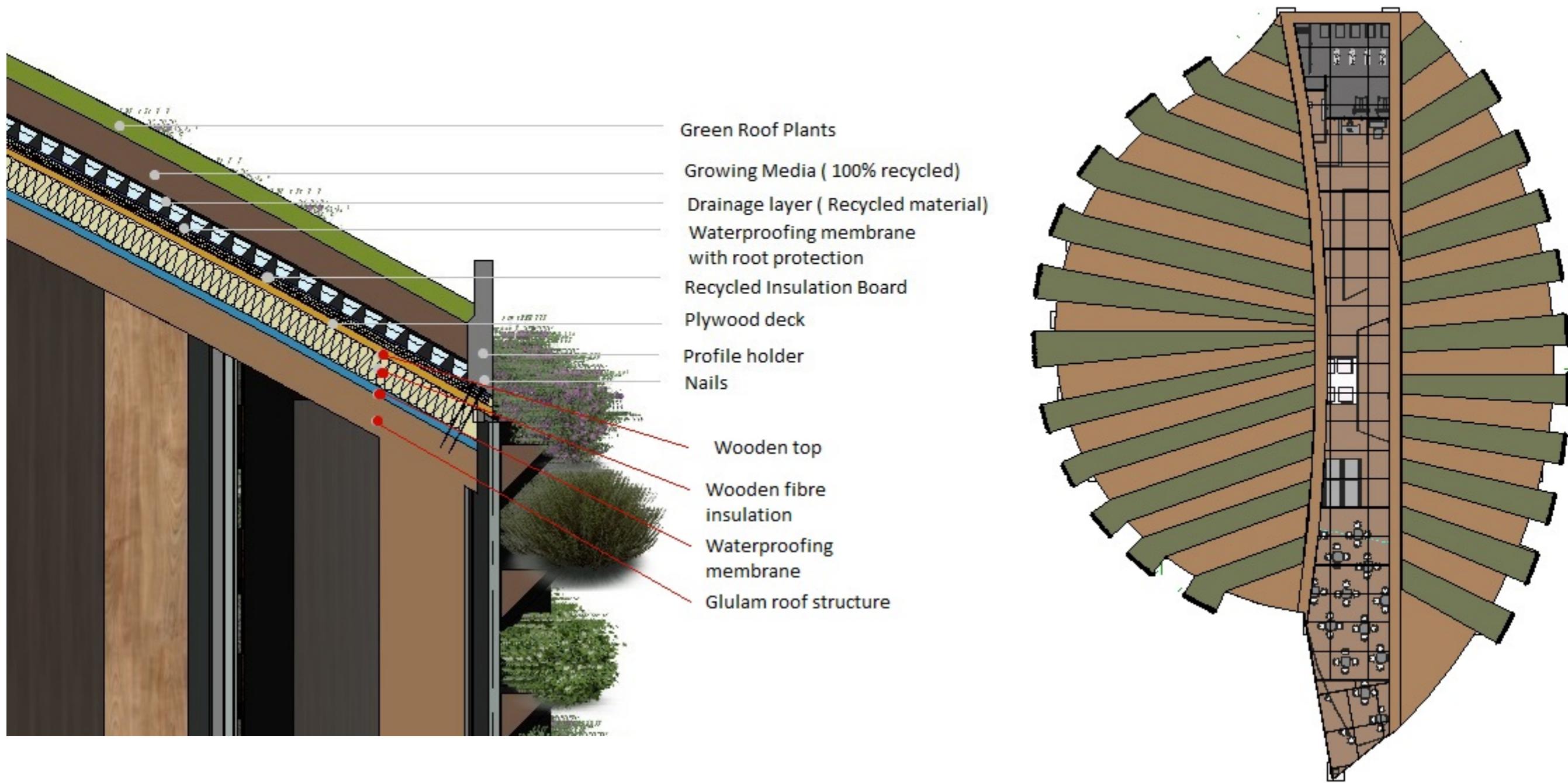


Figure 17: Green roof-curved roof details

### 11.3 Glulam structure

The structure of the building is made up of glulam beams and columns, which can be opened to avoid having additional support in the hall with swimming pools and in the theatre. It is a sustainable material, thanks to which a significant amount of CO<sub>2</sub>, which has been removed from the atmosphere during the life of the tree, is permanently enclosed in the structural timber. The advantages of this material are its ability to take on a variety of shapes, size, appearance and slow combustion, good strength to weight ratio and durability.

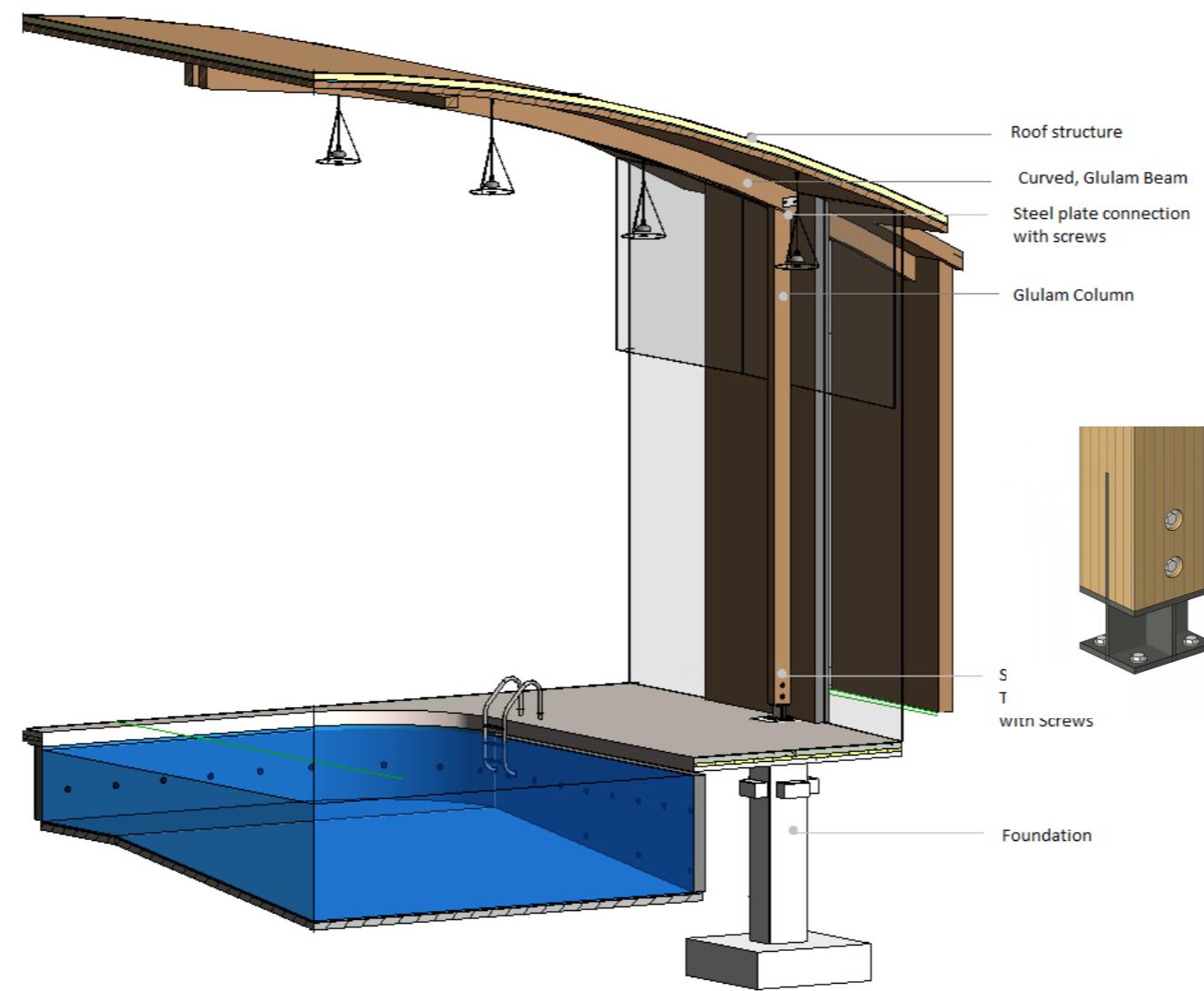


Figure 18: Glulam structure and flood details details

## 11.4 Rainwater collection

The roof is designed to make it easy to collect rainwater. Installed gutters collect water and redirect it to vertical pipes, which direct water straight into the tank. The water taken is filtered there and this will be used to irrigate the plants and in the toilets.

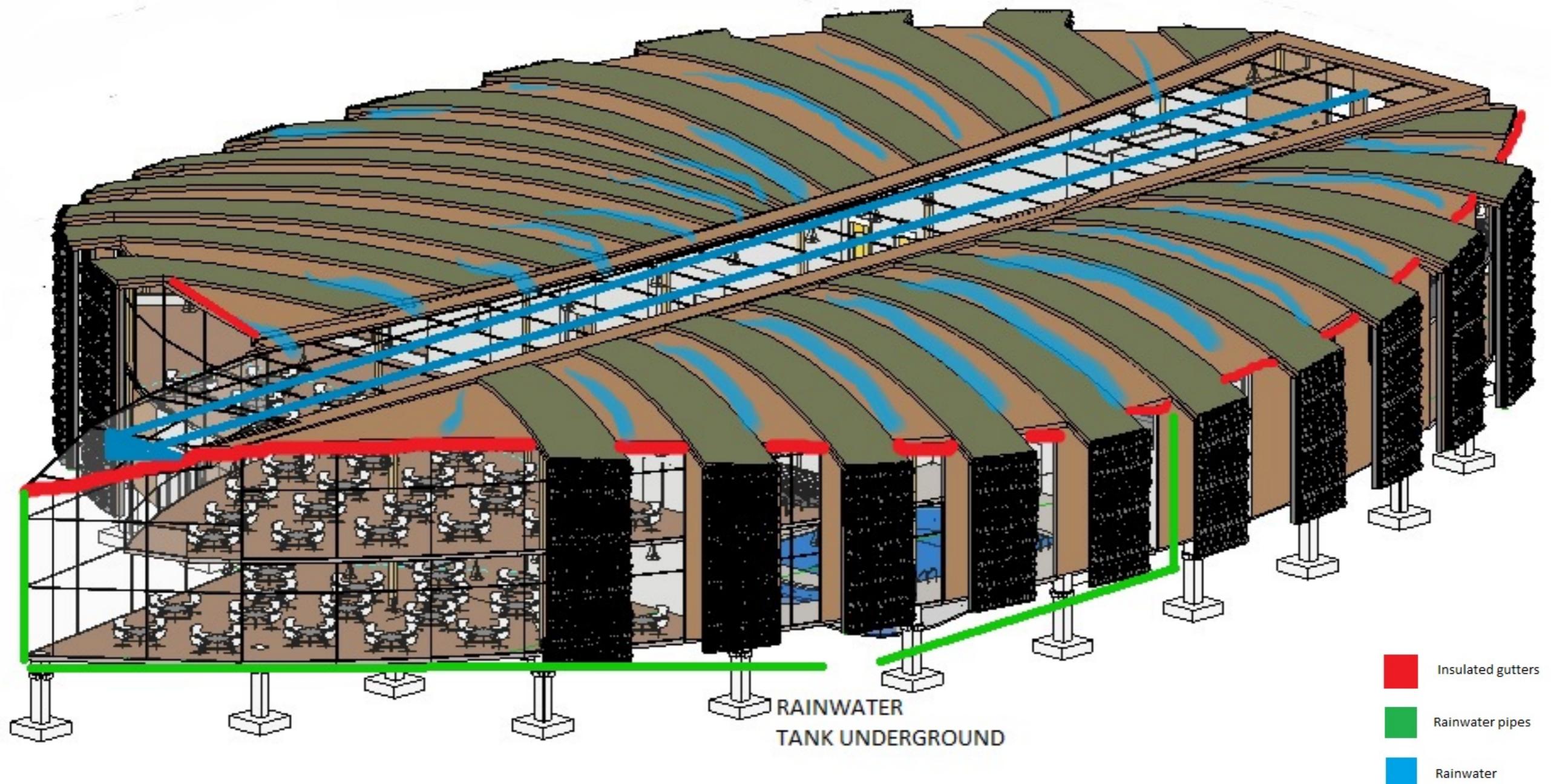


Figure 19: Glass structure details

## 11.5 Sunlight

In order to reduce the use of artificial light, the whole central strip of the roof and a large part of the facade is made of glass, self-supporting construction, which does not need additional support. In addition, in order for the light to reach the centre of the building, holes in the floor of the upper floor have been specially designed. To reduce energy costs by using artificial light and cooling, the panels will be made of solar reflective glass, which allows the sun's rays to pass through and blocks the heat it generates.

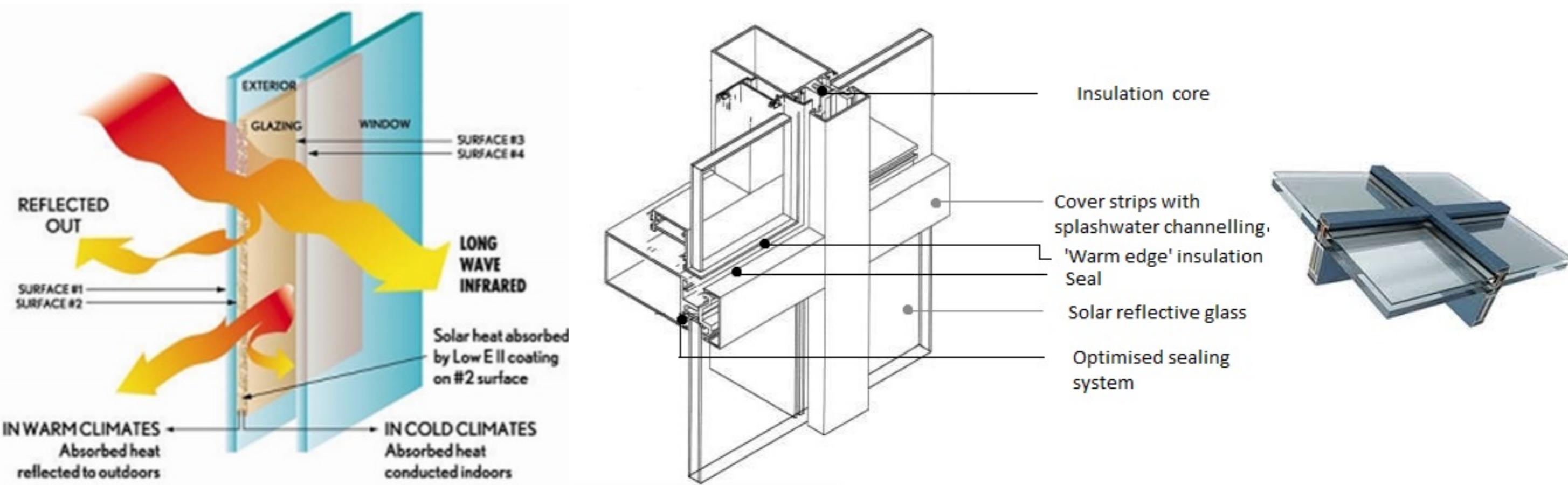
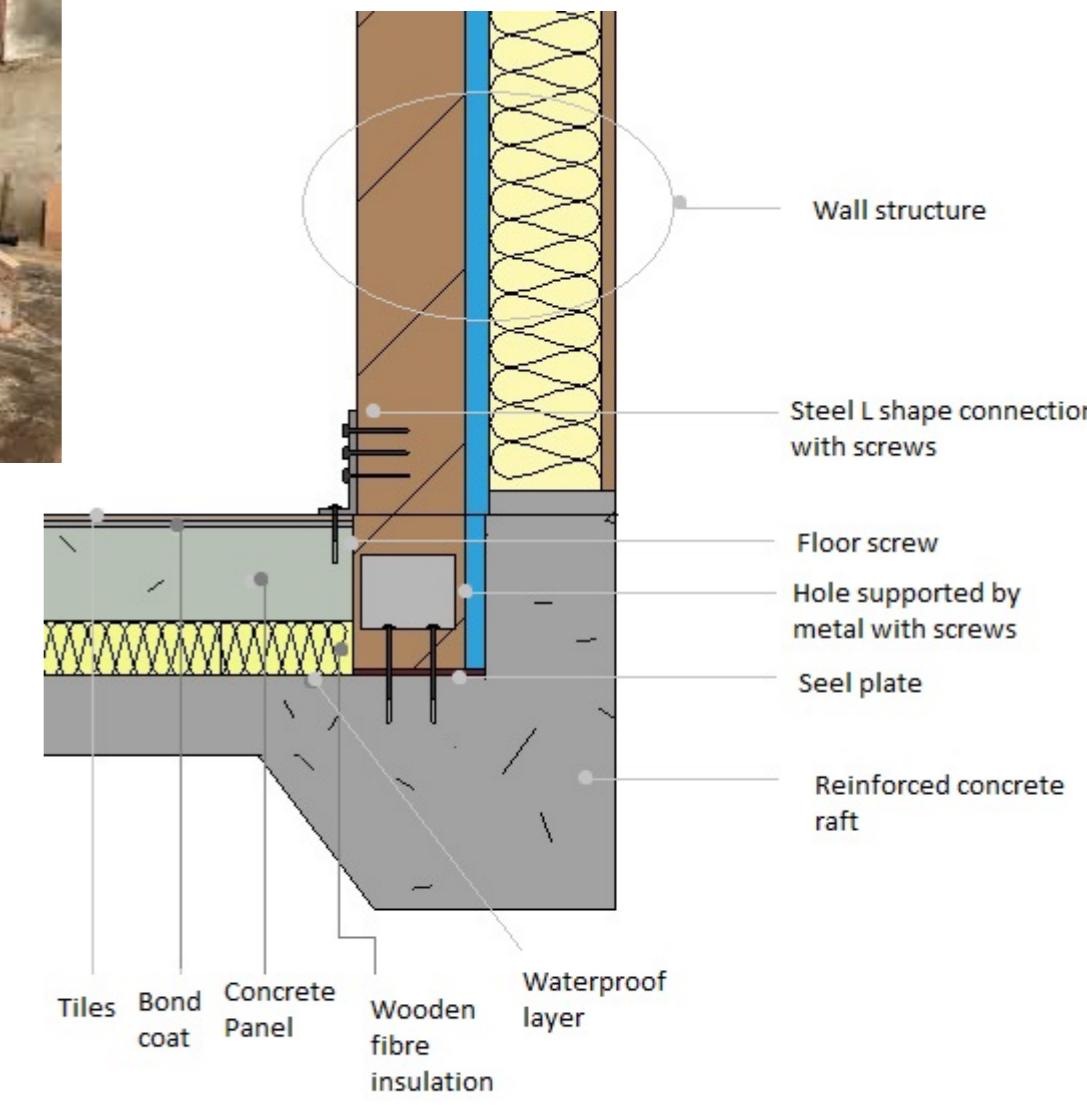
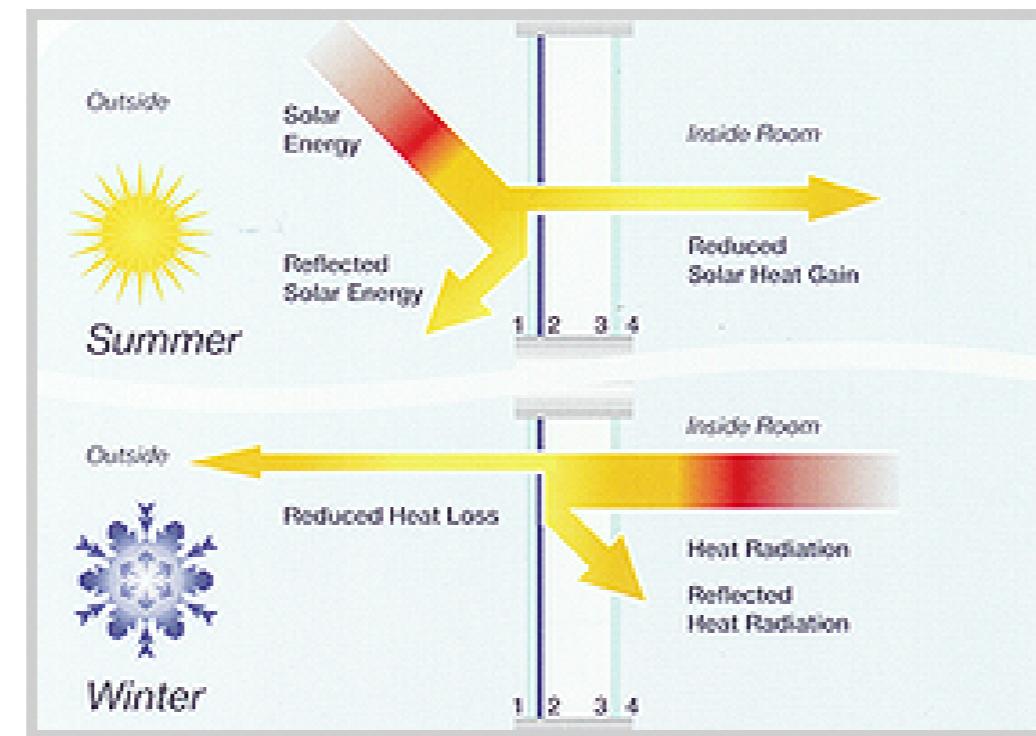


Figure 20: Glass structure details

## 11.6 Materials

1. Structure: Glulam beams and columns to create strong, curved shape of the roof and recycled steel elements
2. Insulation: Wooden fibre insulation is made of recycle wood waste.
3. Glass: Solar reflective glass that control heat loses and gains.
4. Foundation: Recycled concrete is a very efficient, durable material.



## **12 Conclusion**

This project will implement solutions that will not only be environmentally neutral, but will even improve the environment. The building is to be built as part of the Canada Water reconstruction master plan and help the local community to unite, develop their passions and interests and help the environment together.

## 13 References

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