Econtainer Student Living

Team 52- Mexico
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June 2022

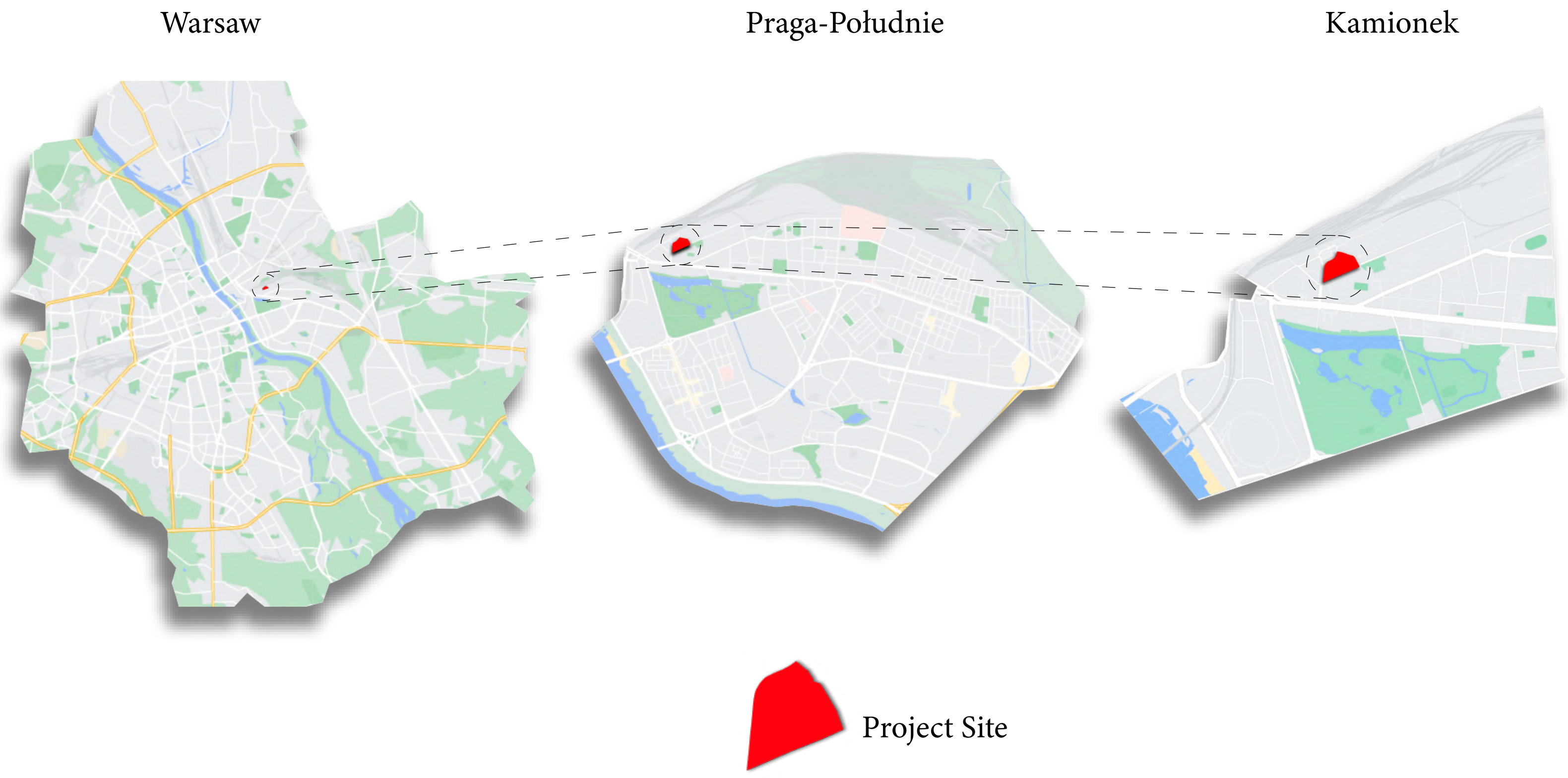
SAINT-GOBAIN

ARCHITECTURE STUDENT CONTEST

Project description

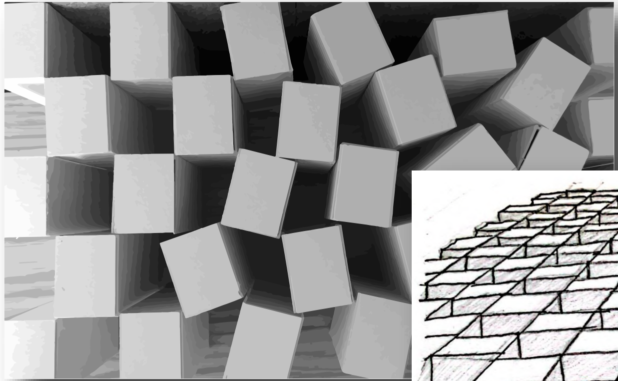
We integrate the most important factors from the context, analyzing climate and environment as well as the essence of Warsaw, to create a green and vibrant student housing project designed with passive strategies and energy efficient systems, as well as, achieving thermal, lighting, and acoustic comfort. We used sustainable St. Gobain materials and lower carbon emissions from its life-cycle, specially in the manufacturing stage by recycling shipping containers, giving life to Econtainer project.

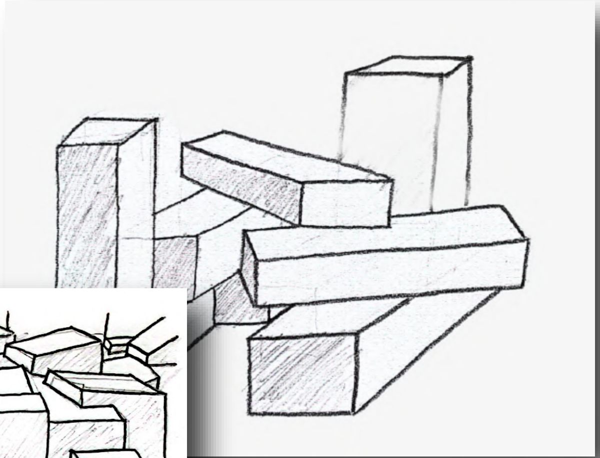
Project Location

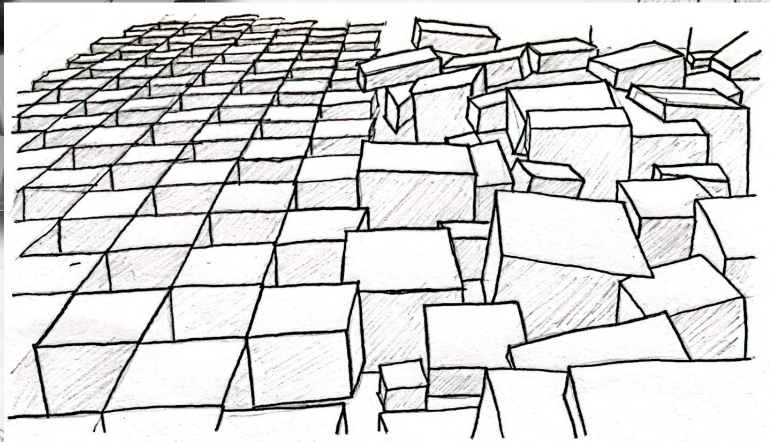


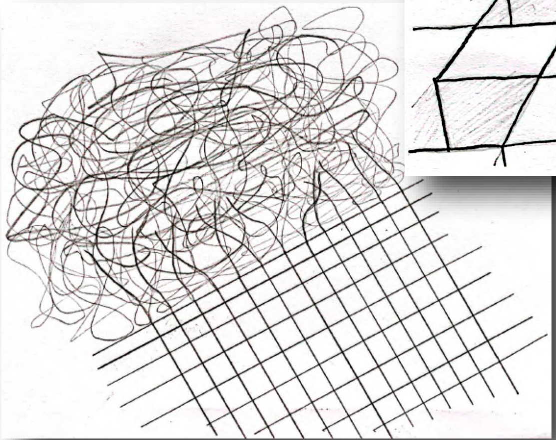
Concept

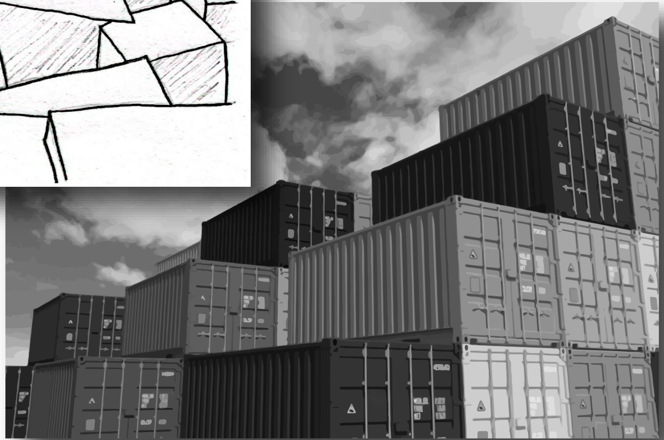
“Order within the Disorder”







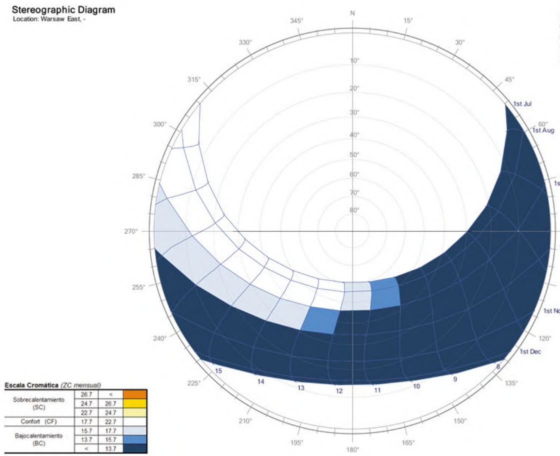


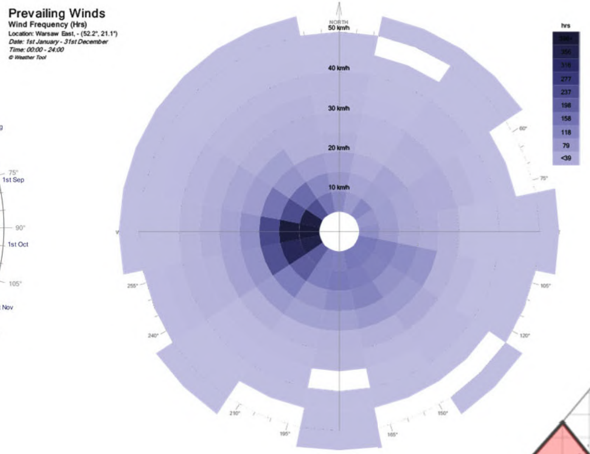


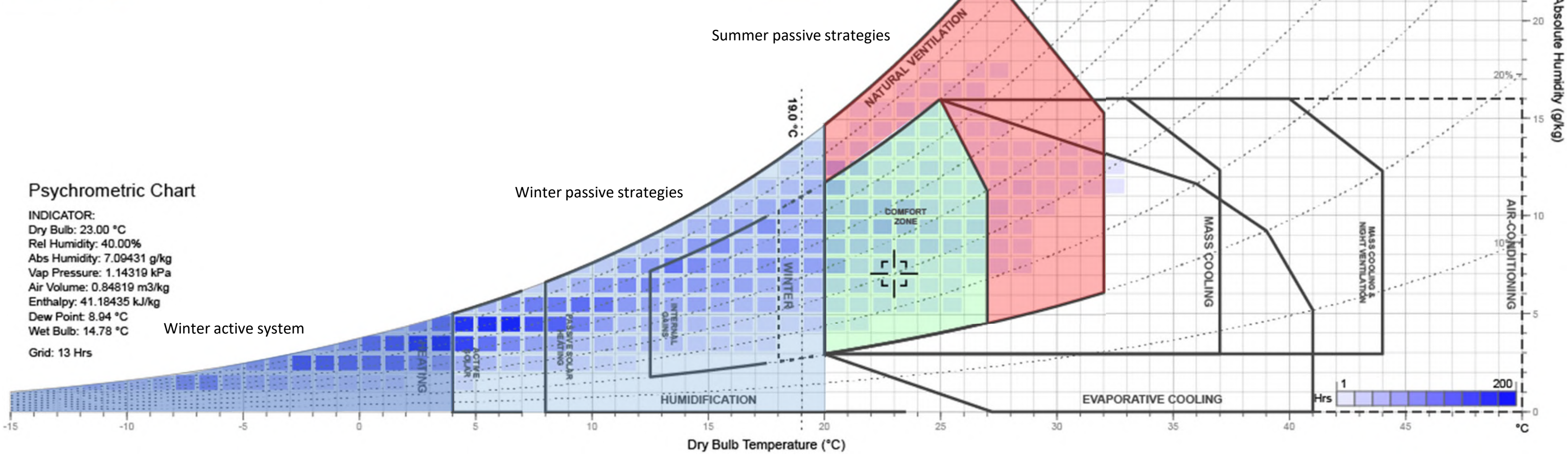
Master Plan


Zone B2-B3
-Student dorms
-Restaurant
-Cafeteria
-Offices
-Laundry
-Building services
-Atrium
-Parking spaces
Zone B1
-Community sports complex
-Multipurpose court
-Gym
-Climbing wall
-Yoga studio
-Cycling studio
-Bicycle racks
-Snack bar
Zone A
-Community complex
-Exhibition spaces
-Workshops

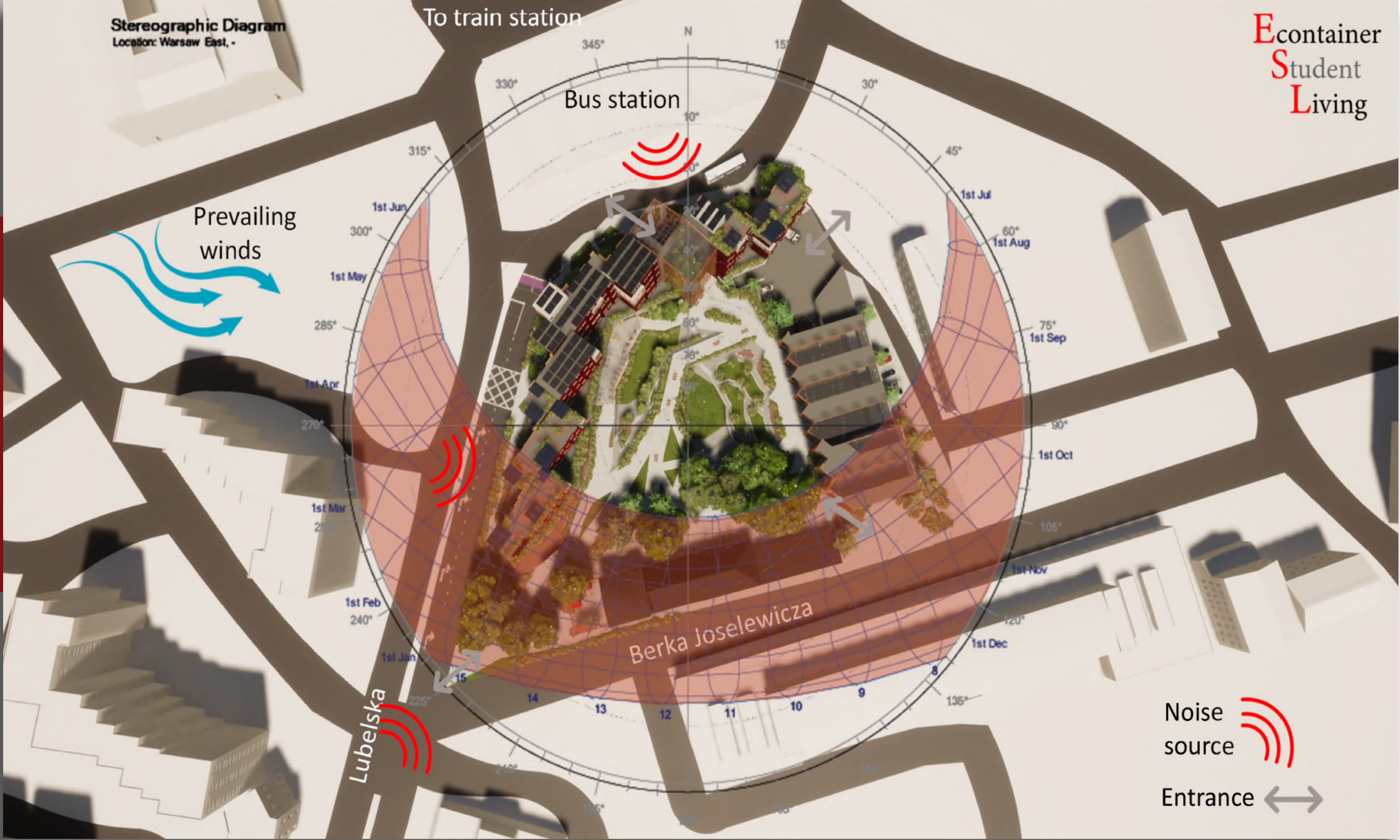
Climate analysis







Site analysis



Design Approach

Main Design Approach

Econtainer Student Living

Energy and environment

- Energy Efficiency (13.2 kWh/m^2)
- Low Embodied Energy
- Carbon sequestration
- 75% less Global Warming Potential

Bioclimatic Architecture

- Passive Design for heating and cooling
- Sustainable materials

User Comfort

- Thermal, acoustic, lighting, visual and odor comfort
- Wellbeing and quality of life
- Inclusive and accessible design
- Adaptable uses

Program


Amphitheater
Offices
Student rooms
Atrium
Reception
Cafeteria
Laundry
Picnic
Kitchen
Storage
Running Track
Parking
Multipurpose room
Food stalls/chilling area
Sport rooms
Snack bar
Workshops
Atrium
Offices
Reception
GYM
Exhibition spaces
Offices
Storage
Reception

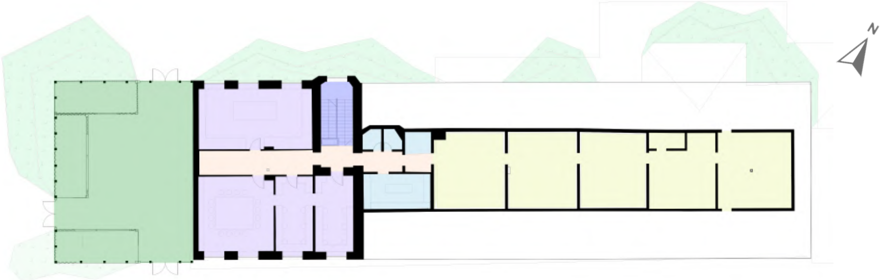
Illustrated Plans

Zone A

Ground Floor

- Mechanical rooms/maintainance
- Circulation
- Reception/waiting rooms
- Food stalls/ Dining room
- Stairs
- Restrooms
- Reception area
- Storage rooms
- Exhibition spaces
- Workshops

Level 1



Location plan

* To keep the historic atmosphere of the structure, it was decided to avoid demolition of the interior walls of the factory.

Zone A


Atrium
acting as protected entrance
with photovoltaic glass
Preservation and restauration
of original structure with:
Eco 0.32 Glass Wool
Habito gypsum board
Placo
SAINT-GOBAIN
Operable windows
for stack effect and
natural ventilation
in summer
SAINT-GOBAIN
Triple glazing window
PLANITHERM LUX
U-Value= 0.80 W (m2•K)

Zone A

Zone A

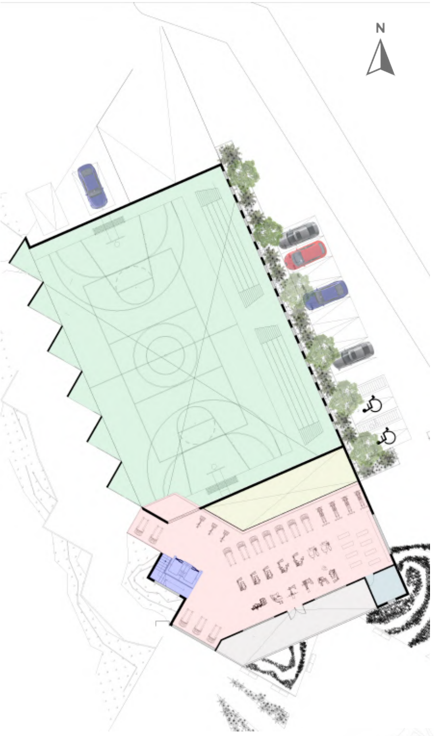
Illustrated Plans

Zone B1

Ground Floor

Level 1

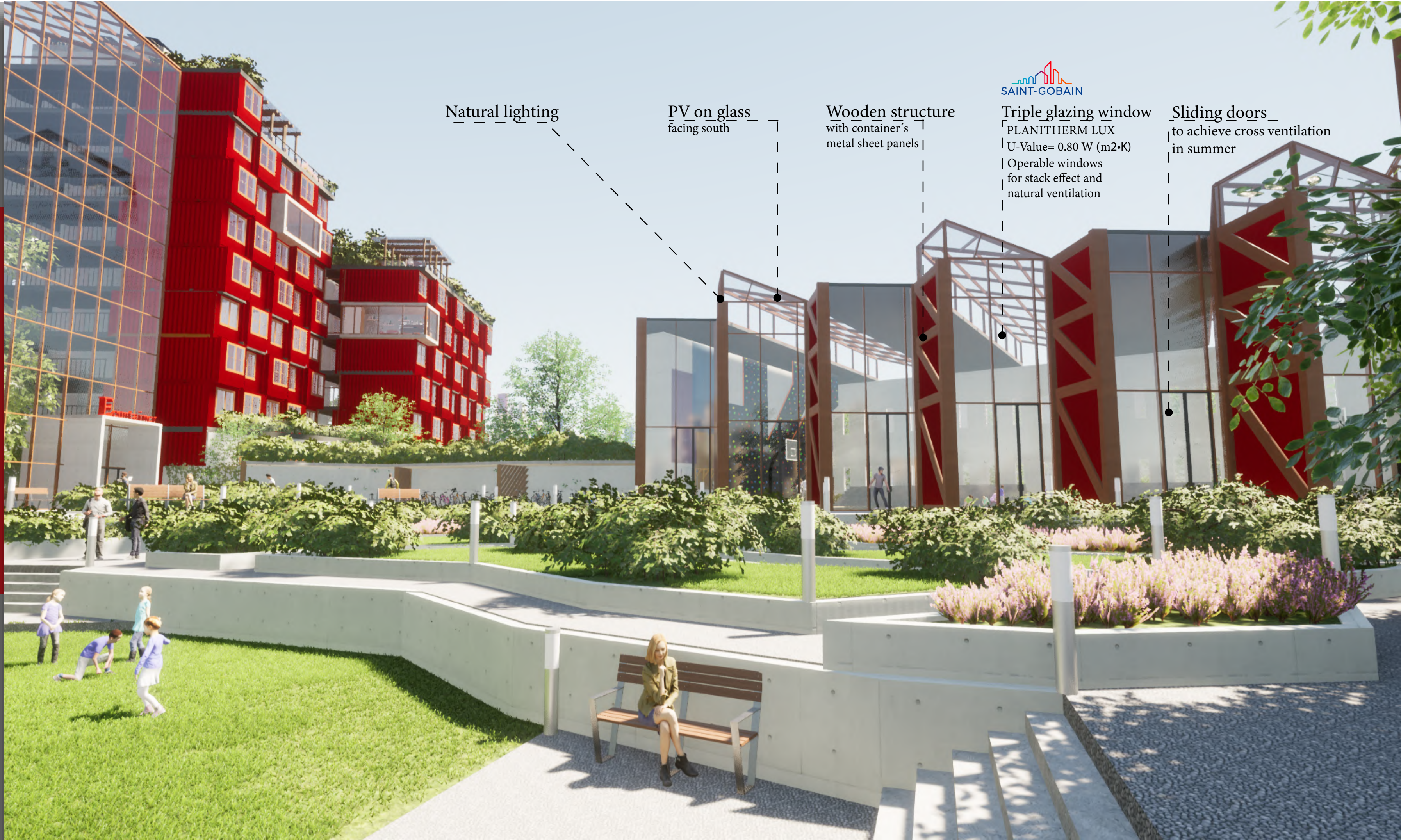
Level 2



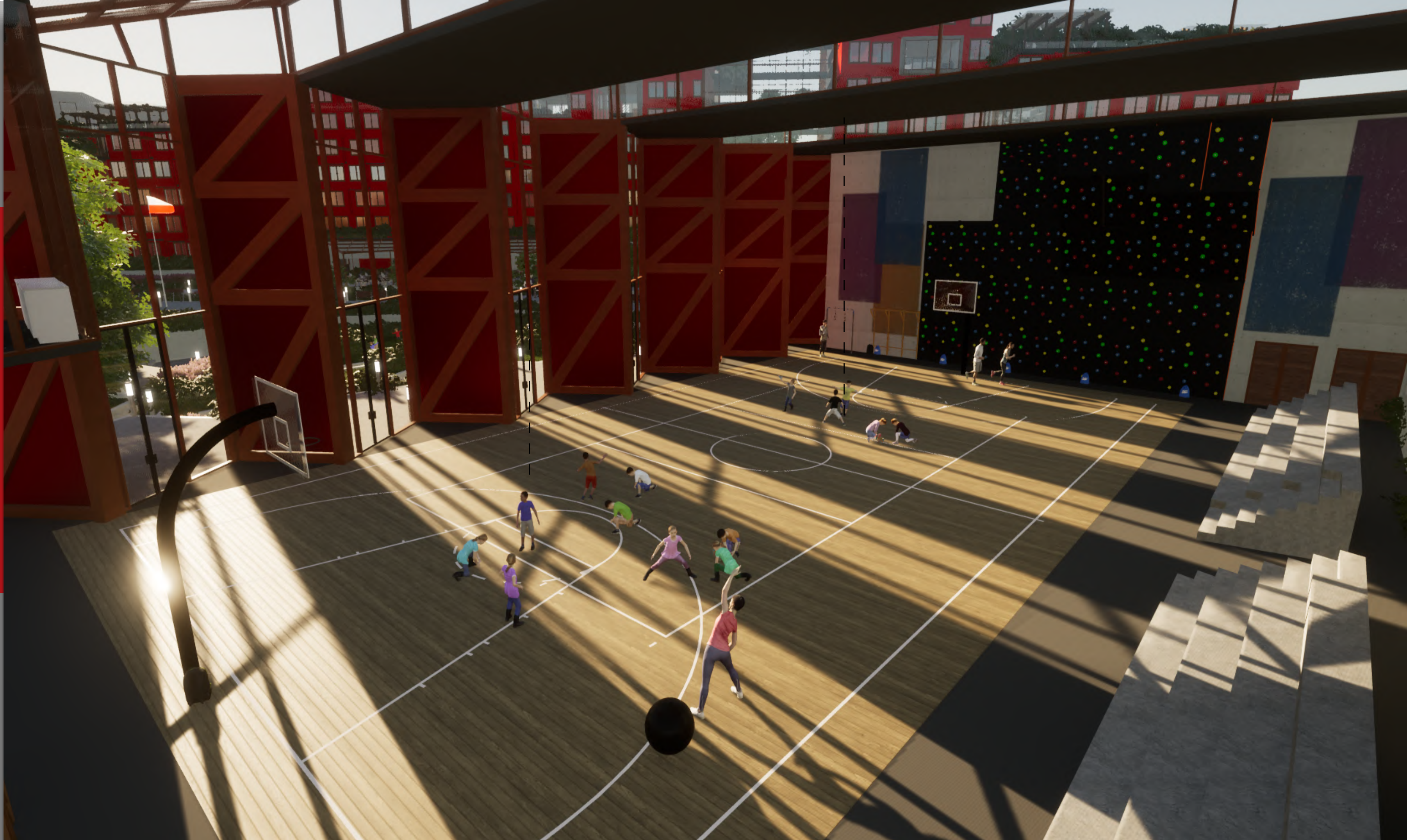
- GYM
- Circulation
- Multipurpose court
- Snack bar
- Stairs/Elevators
- Restrooms
- Reception area
- Sports rooms
- Buffer
- Mechanical room/Laundry
- Greenhouse
- Parking/Service access
- Storage rooms

Location plan

Sports complex



Sports complex



Illustrated Plans

Zone B2-B3

Ground floor

- Student apartments
- Circulation
- Cafeteria/Working area
- Kitchen
- Stairs/Elevators
- Restrooms
- Offices
- Main access
- Garbage chute/Installation ducts
- Mechanical room/Laundry
- Greenhouses
- Parking/Service access
- Storage rooms

Level 1

Location plan

Room plans

Double room (2 shipping containers)

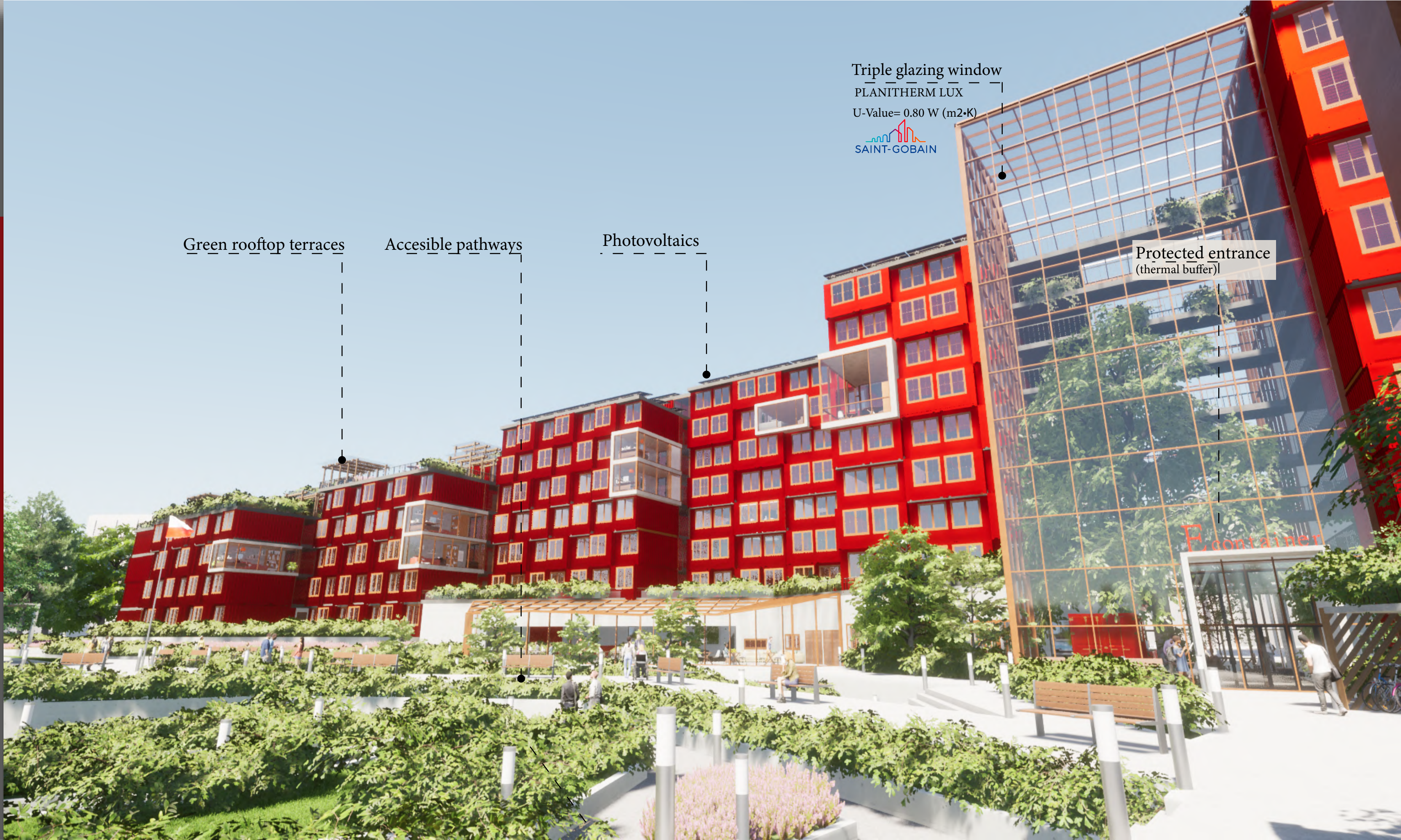
* Heating system by floor through linear diffuser

Room plans

Single room

* Bed folds into wall to create more space (murphy bed)
* Heating system by floor through linear diffuser

Zone B2-B3


Triple glazing window
PLANITHERM LUX
U-Value= 0.80 W (m2•K)
SAINT-GOBAIN
Green rooftop terraces
Accesible pathways
Photovoltaics
Protected entrance
(thermal buffer)

Zone B2-B3


Student gathering area
with operable windows
Operable windows
for stack effect in summer
SAINT-GOBAIN
Triple glazing window
PLANITHERM LUX
U-Value= 0.80 W (m2•K)
Protected entrance
(thermal buffer)
Bicycle racks

Student gathering area

Main entrance

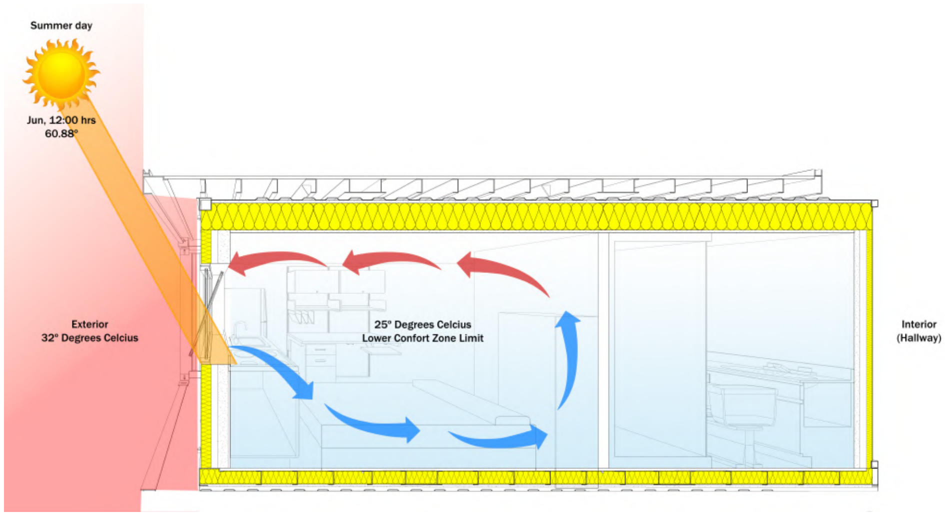
Dining room (facing south-east)

Green rooftop

Shipping container

Summer comfort analysis

SUMMER (DAY)

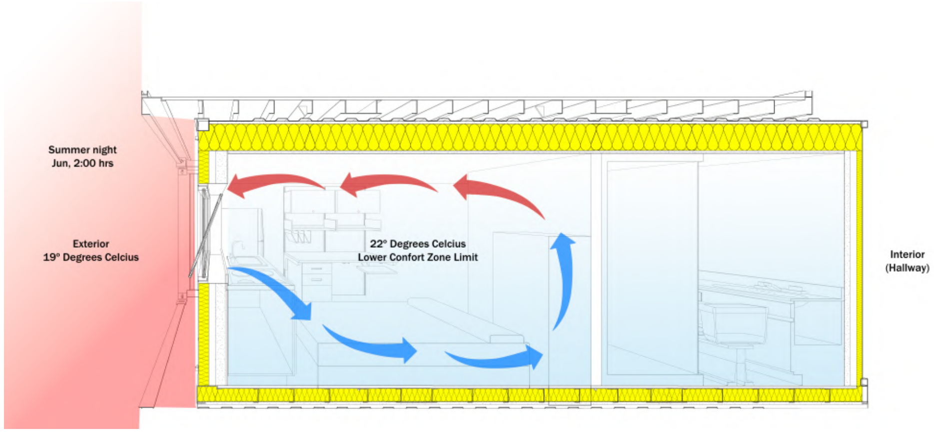


*No air conditioning system supplied (natural ventilation strategy)

*Opening windows during the day allows air renewal, letting hot air out.

*Overhangs avoid direct radiation from the summer sun

SUMMER (NIGHT)

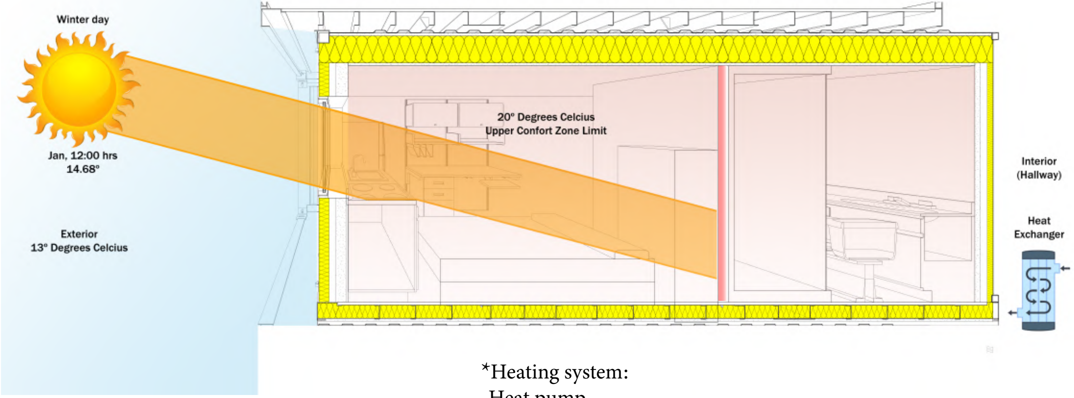


*Night ventilation to cool down structure

*Thermal insulation helps to keep low temperatures inside of the room

Winter comfort analysis

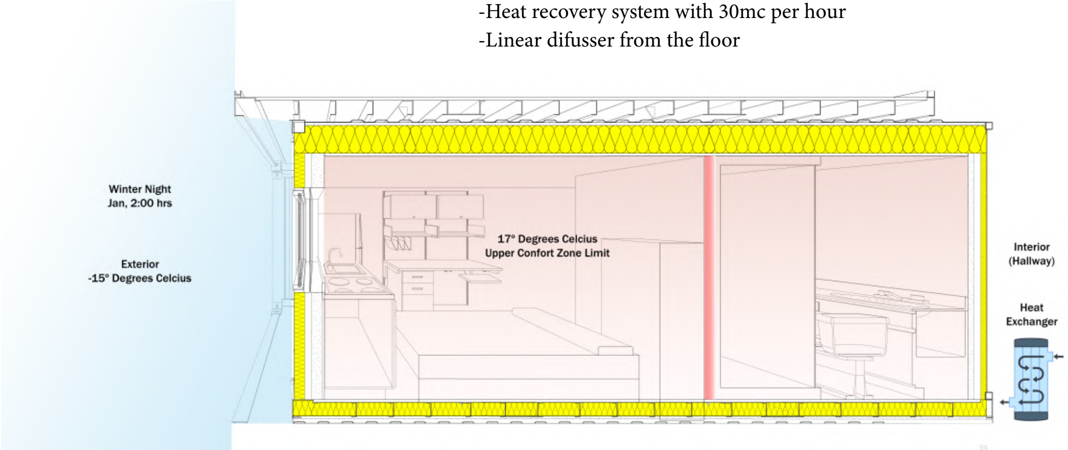
WINTER (DAY)



*The angle of the winter sun allows it to flood the room with solar radiation

*Heating system:
-Heat pump
-Heat recovery system with 30mc per hour
-Linear difusser from the floor

WINTER(NIGHT)



*Low height between stories and compact rooms help to keep the space warm

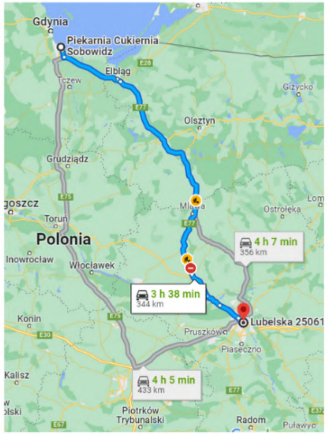
*Insulation: Materials like double windows, walls, floors and roofs with low U-values keep the heat inside the room

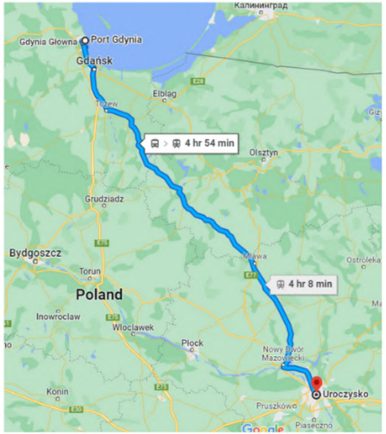
Transportation

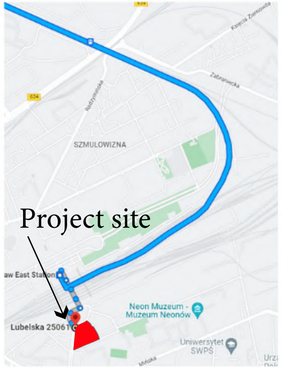
Potential suppliers and container ports

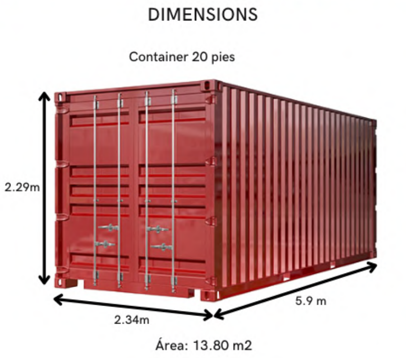
Recycling

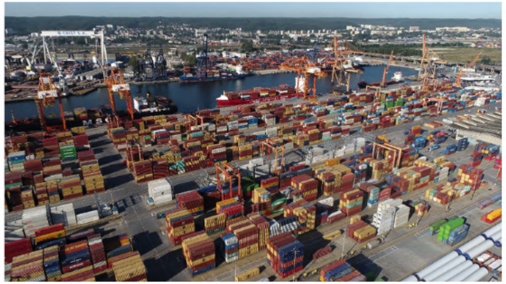
Distance from Gdansk and Gdynia ports:
-3:40 hr by lorry drive
-4:00 hr by train with direct access to the project site







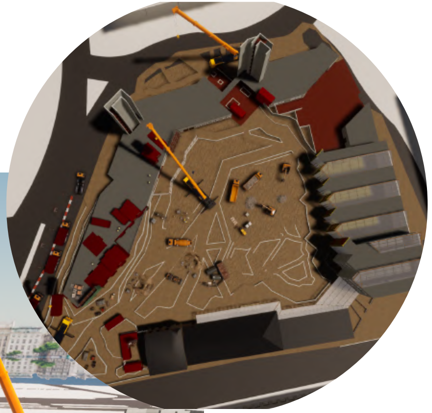




Assembly

Assembly benefits:

- Off site dorm manufacture
- Fast assembly by cranes
- Easy disassembly for reuse
- Lower carbon emissions during construction stage than conventional structures
- Possible future growth for students and/or immigrants if necessary

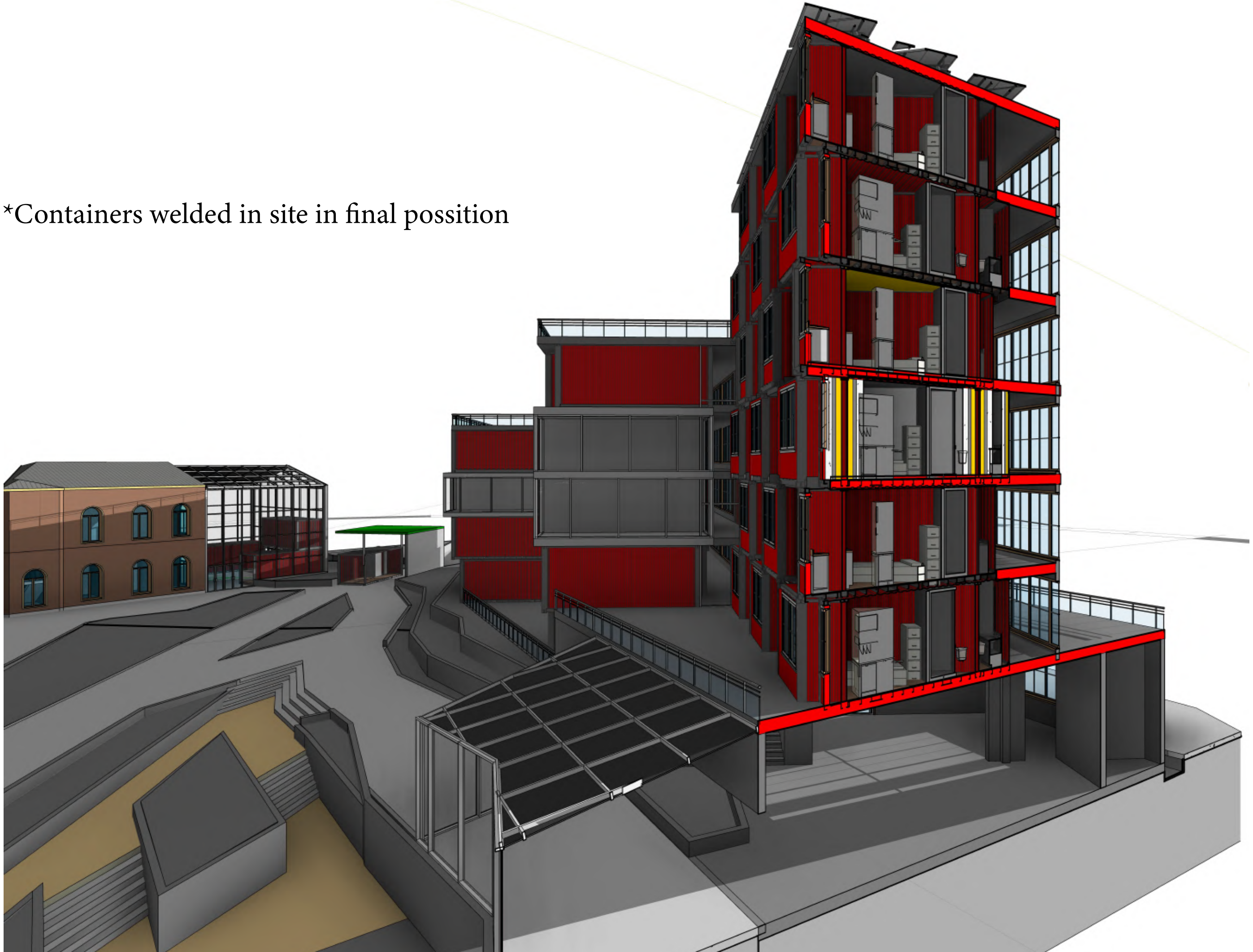


Construction site

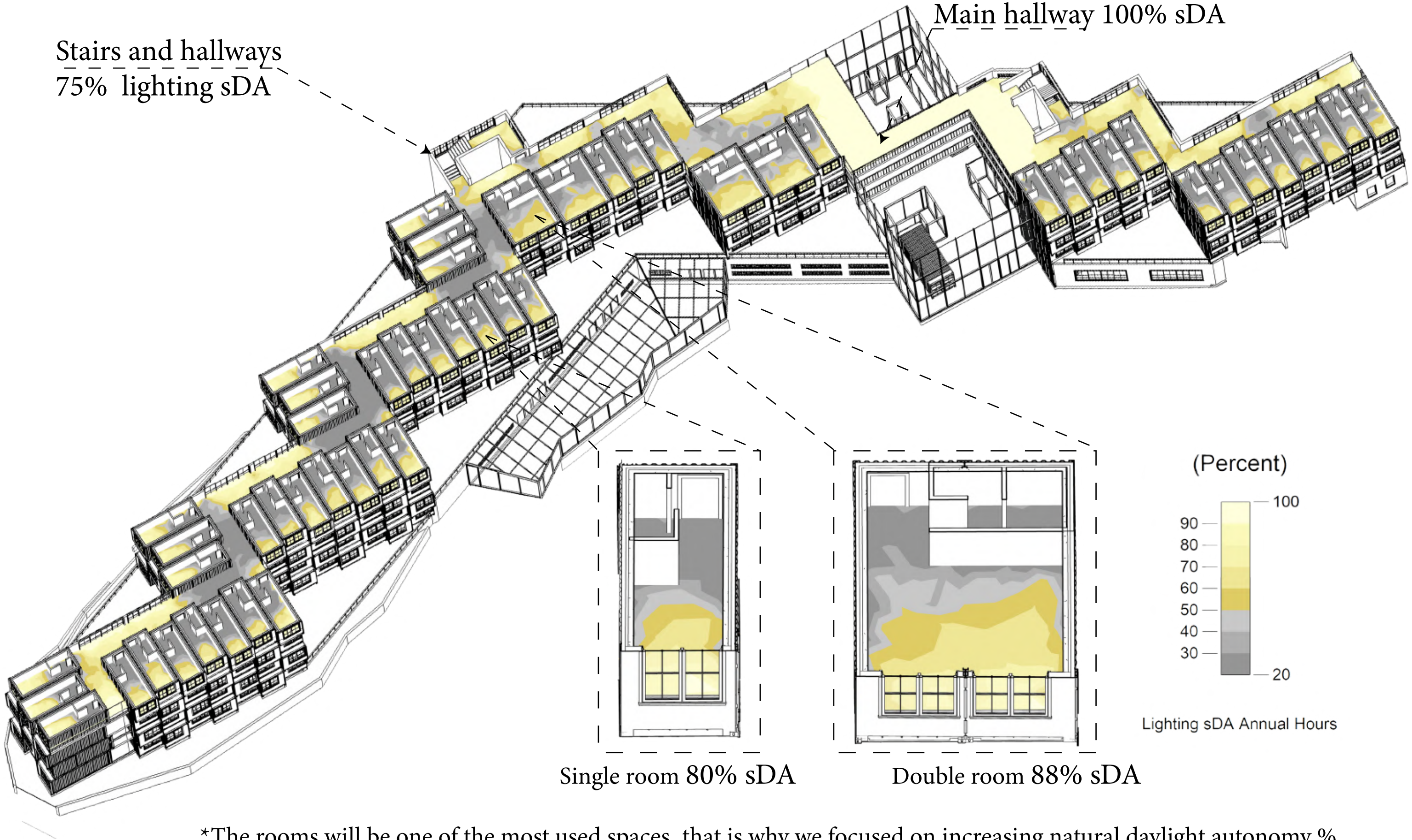
*B2-B3 zone during construction phase

Assembly

*Containers welded in site in final possition



Natural daylight autonomy



Single room 80% sDA

Double room 88% sDA

*The rooms will be one of the most used spaces, that is why we focused on increasing natural daylight autonomy %

*Bathrooms, which are less used, will be illuminated with artificial lights with energy generated by photovoltaics

Technical parameters

FACADE WALL

Layer 1: Shipping container metal sheet
Layer 2: Eco 032 Glass Wool k=0.032 W/m*K
Layer 3: Habito gypsum board k=0.25 W/m*K

Thickness= 17.7 cm

Analytical Properties

Heat Transfer Coefficent (U)= 0.1989 W (m2•K)

Thermal Resistance (R)= 5.0273 (m2•K)/W

ROOF

Layer 1: Shipping container metal sheet
Layer 2: (3x)Arena Absorción Glass Wool k=0.032 W/m*K
NRC=0.752
Layer 3:Acustik- Soundproof gypsum board k=0.25 W/m*K

Thickness= 28.2 cm

Fire Safety: Non-combustible materials

Analytical Properties

Heat Transfer Coefficent (U)= 0.1587 W (m2•K)

Thermal Resistance (R)= 6.3016 (m2•K)/W

INTERIOR WALL

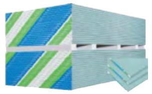
Fire Safety: Non-combustible materials

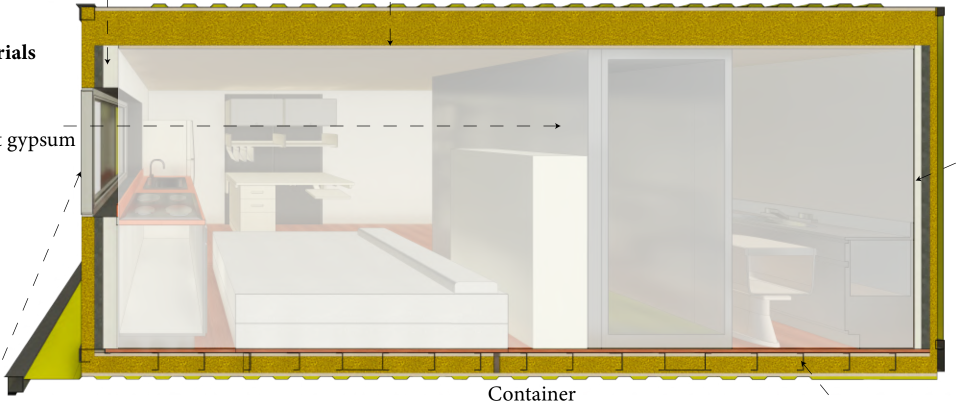
Layer 1: Habito gypsum board
Layer 2: Eco 0.32 Glass Wool
Layer 3:Placo RH- Moisture resistant gypsum board

INNER WALL

Layer 1: Shipping container metal sheet
Layer 2:
Layer 3: Placo RH- Moisture resistant gypsum board

Thickness: 12,7mm

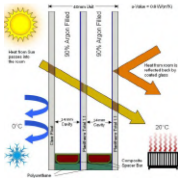




Container

TRIPLE GLAZING WINDOW

Glazing 1: PLANITHERM Lux 4mm
Cavity 1: 14mm arg 90%
Glazing 2: Planiclear
Cavity 2: 14mm arg 90%
Glazing 3: PLANITHERM Lux 4mm

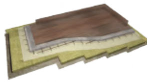


Analytical Properties

Heat Transfer Coefficent (U)= 0.8 W (m2•K)

FLOOR

Layer 1 : Flooring system- laminated wood
Layer 2: Concrete leveling layer
Layer 3: PANEL SOLADO Isover k=0.036 W/m*K
Layer 4: Wood sheathing
Layer 5: Shipping container metal sheet



Analytical Properties

Heat Transfer Coefficent (U)= 0.30 W (m2•K)

Thermal Resistance (R)= 3.3 (m2•K)/W

Double room


Placo
SAINT-GOBAIN
Acustik- Soundproof gypsum board k=0.25 W/m•K
with Arena Absorción glass wool
Sprinkler system
SAINT-GOBAIN
Triple glazing window
PLANITHERM Lux
U-Value= 0.80 W (m²•K)
Non-combustible materials
Habito gypsum board with Eco 0.32 Glass Wool
Placo
SAINT-GOBAIN
Placo RH- Moisture resistant gypsum board
with Eco 0.32 Glass Wool
Placo
SAINT-GOBAIN
ISOVER
SAINT-GOBAIN
PANEL SOLADO Isover k=0.036 W/m•K with laminated wood

Double room

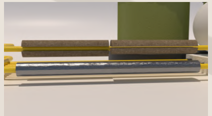

Placo
SAINT-GOBAIN
Acustik- Soundproof gypsum board k=0.25 W/m•K with Arena Absorción glass wool
Sprinkler system
Habito gypsum board with Eco 0.32 Glass Wool
Placo
SAINT-GOBAIN
Placo RH- Moisture resistant gypsum board with Eco 0.32 Glass Wool
Placo
SAINT-GOBAIN
ISOVER
SAINT-GOBAIN
PANEL SOLADO Isover k=0.036 W/m•K with laminated wood

Double room

Rainwater harvesting

SYSTEM:
-Precipitation goes down through rainwater colection pipes
-Water storage tanks for toilet use and watering green areas

-Water storage tanks
-Water filtering systems

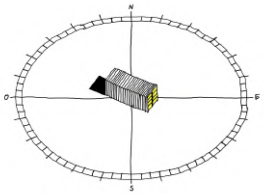


-Use of Q TECH, Mineral Wool FiberGlass Isover to prevent frozen water pipes

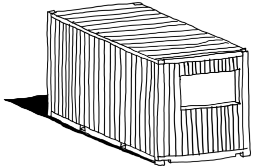
Photovoltaic Analysis

Step by step measures for reducing energy consumption

1. **Orientation (SE)-** The secion of the student rooms buiding is mostly oriented to the south-east, giving it more natural light and solar radiation, avoiding artificial lights and heating systems



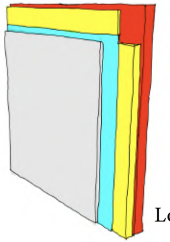
2. **Window to wall ratio= 30%** An appropriate window size for the rooms helps to reduce the energy loss from the inside, but also allows radiation to go inside the room



3. **Choosing the right materials-** Proper insulation for the walls, floors, and roofs help to avoid energy loss from transmition through the solid surfaces

ISOVER SAINT-GOBAIN

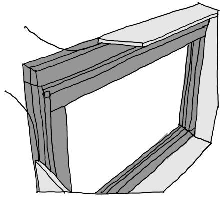
Placo SAINT-GOBAIN



Low U values

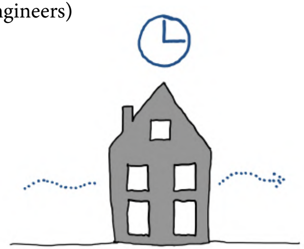
4. **Air tightness-** We paid special attention in construction joints in order to accomplish air tightness. As leaky buildings tend to have higher heating loads

0.0001m³/s per m² facade

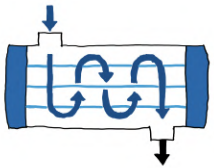


5. **Air changes-** We applied the minimum air changes per hour according to the ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) recomendations

0.35 ach



6. **Implementation of heat exchanger**- This allows to pre-heat fresh outdoor air before it enters the rooms, reducing the heating load

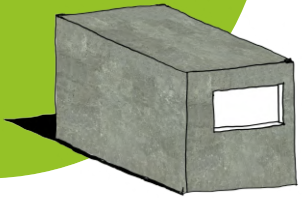


Annual energy demand comparison

Conventional building vs Econtainer Student Living

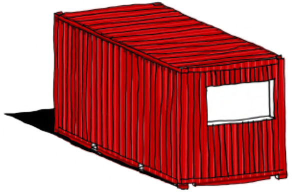
In-situ concrete module

100 kWh/m²



Recycled container module

13.2 kWh/m²

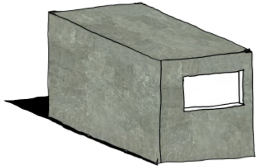


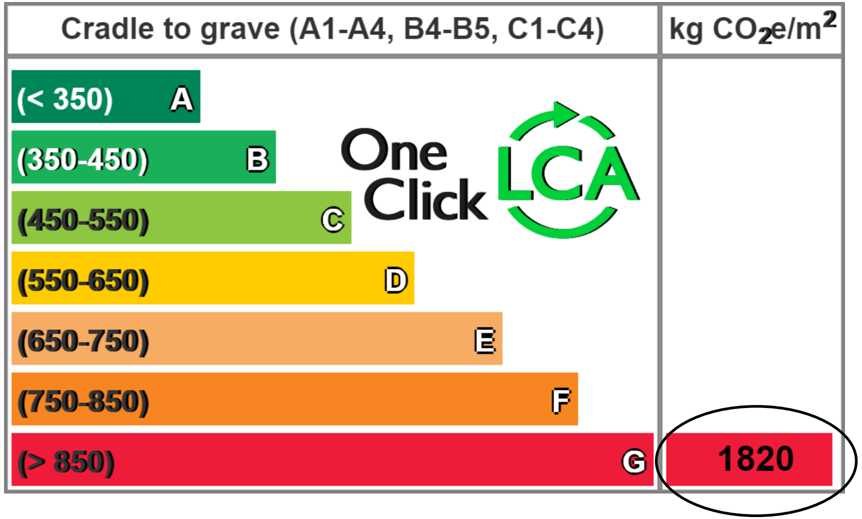
*200m2 analysis, 8 storey building

CO2 Footprint

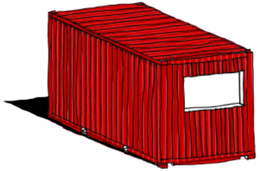
Embodied carbon benchmark

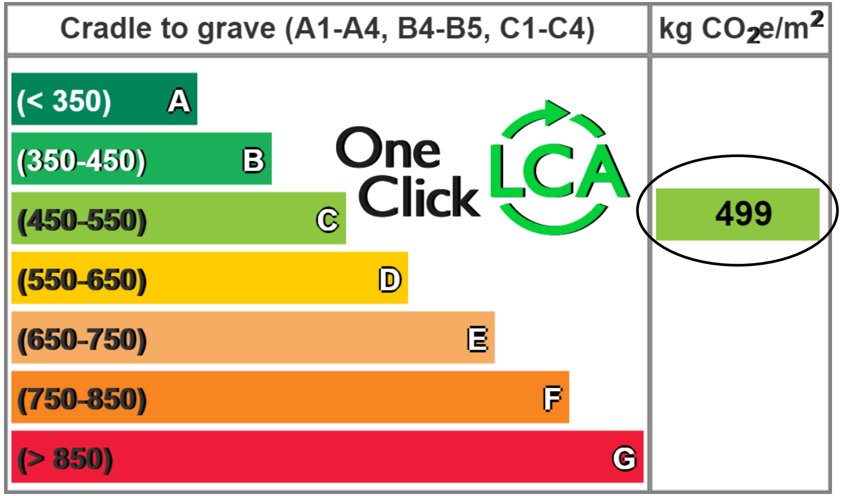
Conventional concrete in-situ building





Econtainer Student Living



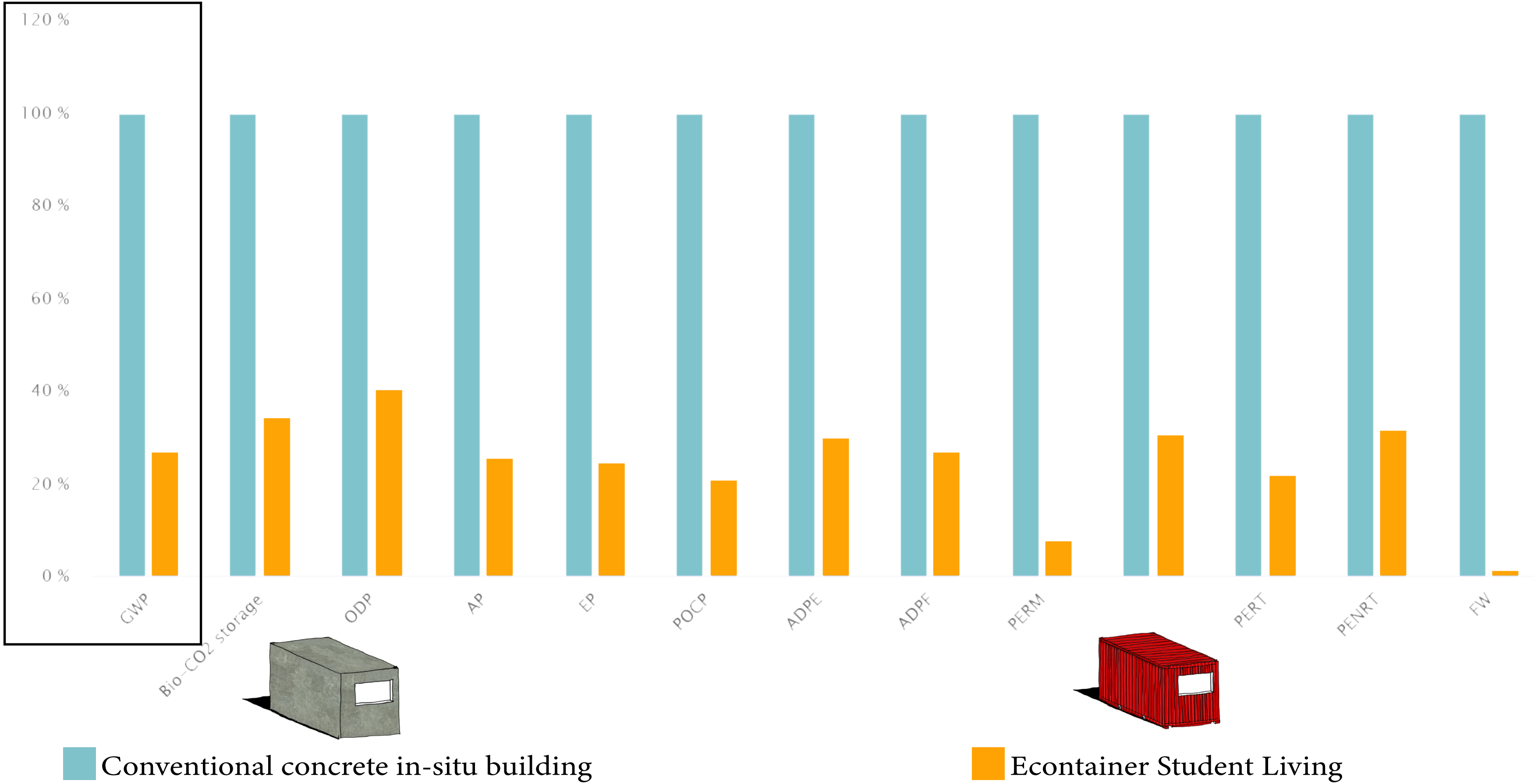


After running the analysis on OneClick with our materials, we compared our section of building which has a category C of carbon emissions with 499 CO2e/m2 vs a conventional building that has a category G and 820 CO2e/m2

-Our project has 75% less Global Warming Potential than a conventional building

One Click LCA

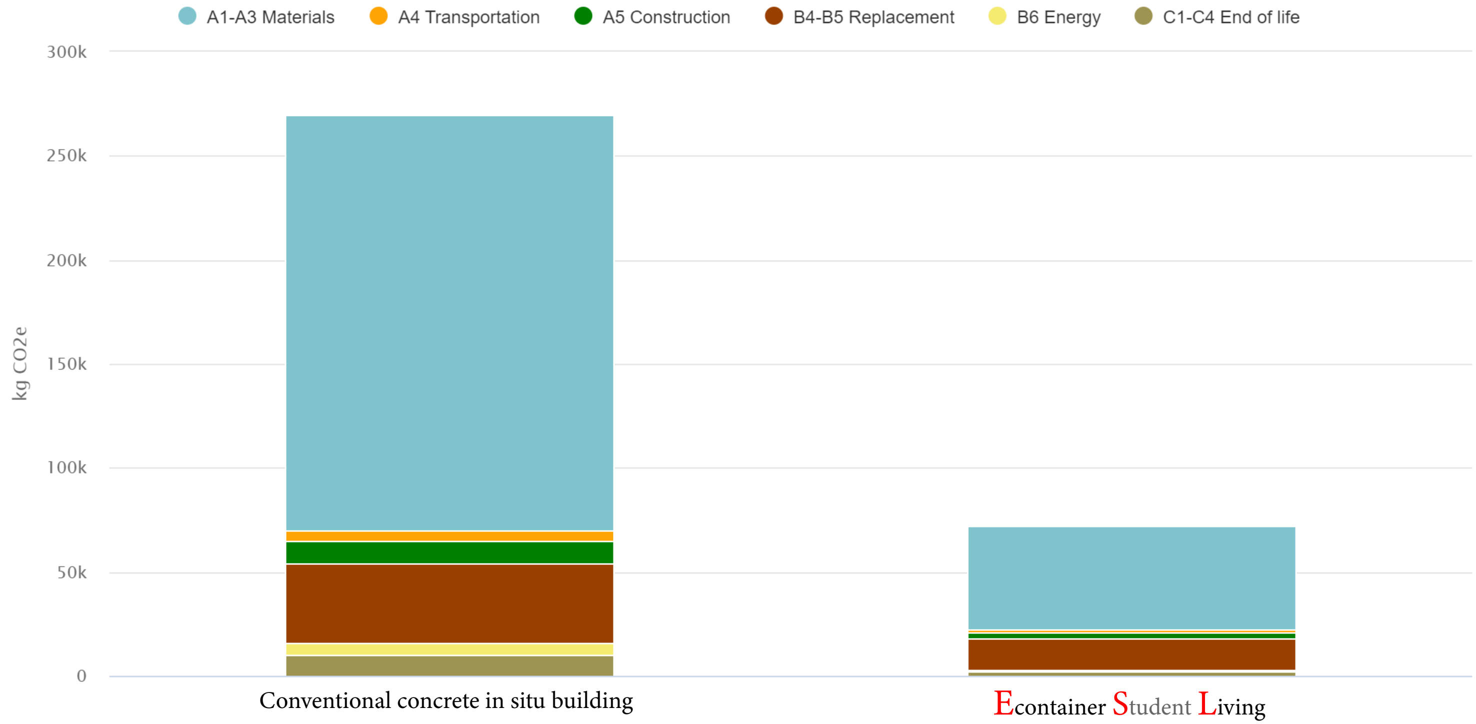
CO2 Footprint

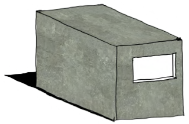


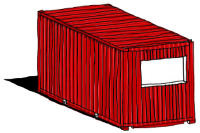
CO2 Emissions in each life stage

One LCA

CO2 Footprint



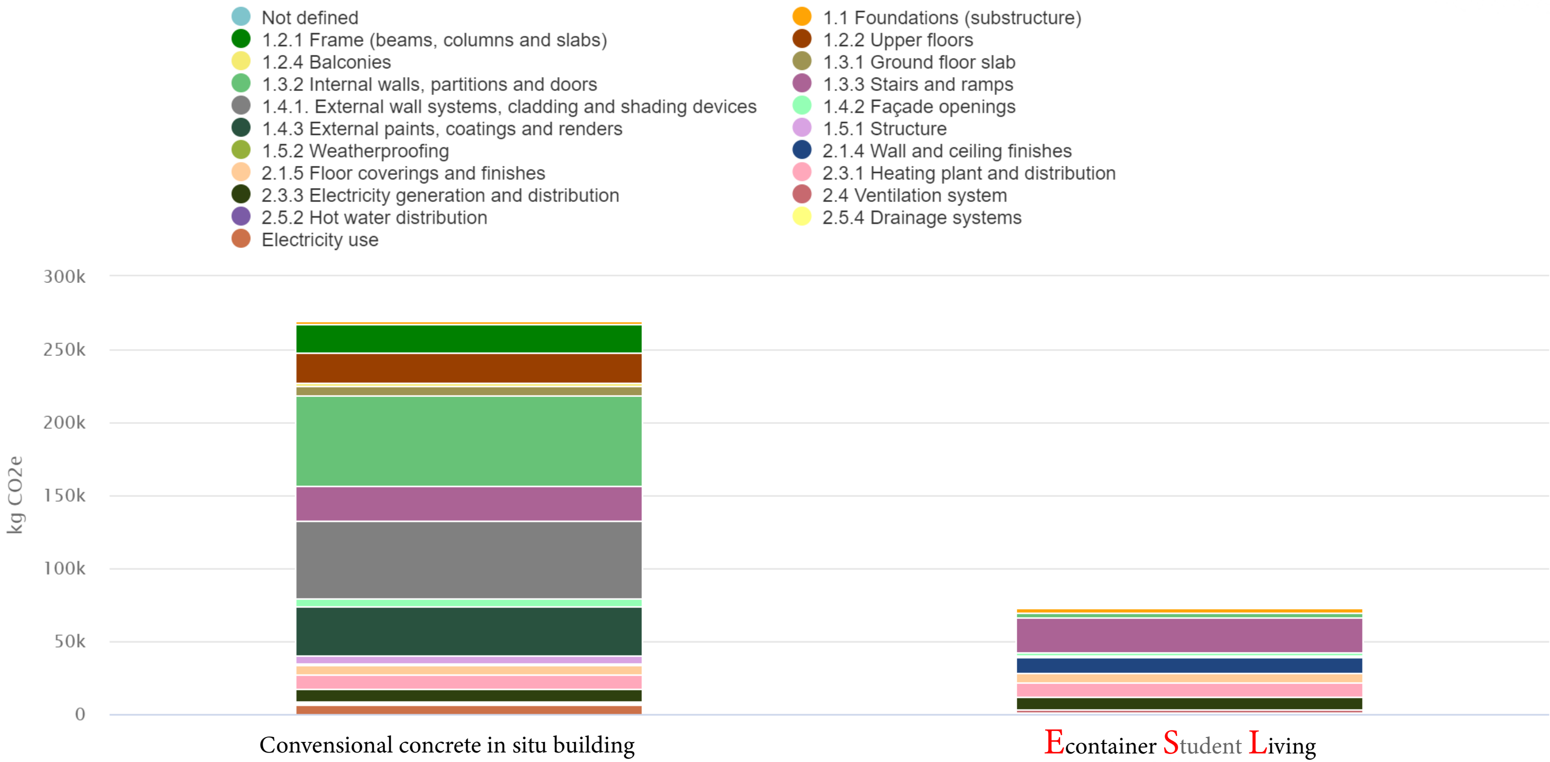


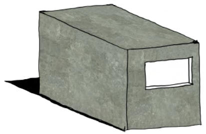


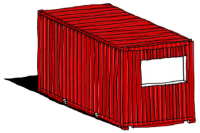
*Because we have a recycled container, the material stage has dramatical lower CO_2 emissions, as well as the end of life stage

CO2 Footprint

CO2 emissions- elements







Econtainer Student Living