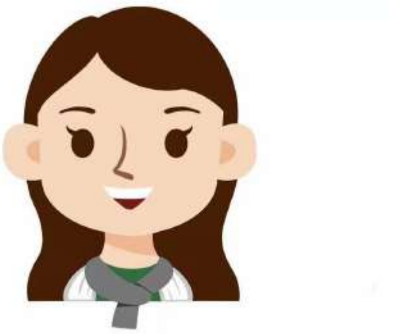
Beaurfort Project

Deep Retrofit

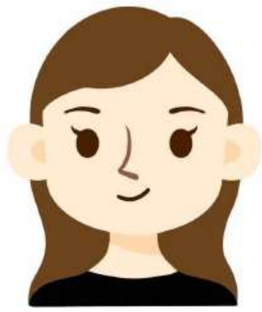
ARC6842 SUSTAINABLE ARCHITECTURE DESIGN PROJECT 2

Anushka | Beatrice | Chacha | Mingyu | Wenjin

About us

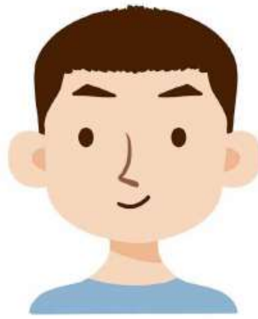


Anushka Singla



Beatrice Tartaglini

Samuel Okwemba



Mingyu Gao

Wenjin Luo

0

Introduction

0.1 | Background

“ SYHA would like you to design a new building on the Beaufort site, which is more sustainable, meets our newbuild standard and is a fantastic environment for these customers to live in. ”

Demolition and New Design

Activities

Walking groups

Football

Art sessions

Gardening

Breakfast club

Cooking sessions

IT group

Vocational activities

The project budget is **£4,000,000**

Our Client

The **Beaufort Project** supports adults with long-term mental health needs under the Care Programme Approach (CPA), to live independently in the security and privacy of their own home. It is owned and managed by **South Yorkshire Housing Association** and is part of the **LiveWell** group of services across the region.

At the moment, the project offers:

- High quality accommodation and support for 18 individuals.
- Fully furnished bedsits, flats and houses.
- Access to own kitchen and bathroom.
- One-to-one support from specialist keyworkers.
- A personalised support programme tailored to suit individual needs.
- Support staff on site daily from 8.00am until 10.00pm.
- Concierge on site every night from 9.45pm until 8.15am.
- Assuarance of home, with your own front door.

The Beaufort Project has an on-site support team available 7 days a week. The customers regularly meet with their keyworkers who ensure that they are happy, their needs are met and the appropriate support is being delivered. By staying at Beaurfort, the customer is assisted to identify the skills and support they need to live safely and independently, and work together to build on their strengths and talents.

Project Brief

Our client has established that the building as it is currently is not reflecting the high quality of service that they offer to their customers. The energy rating of the building is also not satisfactory, rated at ‘D’. The interiors also need to be improved to meet the needs of the customers, with modern specification and space standards. This has been confirmed by other previous studies by University of Sheffield students.

Our key considerations for this project will be:

- Customer needs
- Value for money
- Communal facilities
- Staff facilities
- Improving energy performance

0.2 | SYHA Sustainablity Journey

SYHA Strategic plan 2020 - 2023

> “We will embed environmental, social and economic sustainability in all our operations. We will lighten our environmental footprint, help our customers to do the same, and support communities by tackling fuel poverty.”

- SYHA sustainability vision -

Supporting the Beaufort community through wholistic sustainable design decisions.

Theme 04: Tacklling the climate emergency

SYHA as an organization is committed to addressing the climate change problem by actively reducing the 25% carbon emissions statistic in the UK of houssing projects. As guardians of many homes in the UK, thier business approach should contribute to meeting the UK’s 2050 zero carbon target. As climate change affects people’s health and wellbeing, this directly includes SYHA’s clients at Beaufort. Therefor, the approach is to future proof already existing SYHA housing stock and provide homes that are comfortable and affordable to run, positively contributing to decarbonization.

Through the solutions that we will develop for Beaufort, we belive they will act as a guide of solutions that are affordable, adaptable, scalable and wholistically sustainable.

SYHA’s aproach to meet climate emergency that align with our project include:

1. Providing more energy efficient homes to meet government’s Future Homes Standard for retrofit and tackle fuel poverty.
2. Reduce fossil fuel use, shift dependance to renewable alternatives.
3. Prioritising the weelbeing of customers in all projects.
4. Significantly reduce energy use.
5. Cutting down on carbon footprint of projects and monitor progress.
6. Reduce waste and recucle nd reuse more.
7. Encourage active sustainable travel.

Energy | Wellbeing | Low Impact

Summary

As established in the design brief, our client SYHA’s priority for the Beaufort project is for the building to reflect the high quality of services offered to its customers, improve the energy efficiency and design the interior spaces to meet the recovery and wellbeing needs of the customers. These requirements will be developed within the bounds of guiding our client in their climate emergency response actions, and ensuring a wholistic approach to sustaianability.

Reference

https://www.syha.co.uk/who-we-are/what-we-do/our-strategic-plan/#theme4
https://www.syha.co.uk/homes/investing-in-homes/sustainability/

0.3 | Approach to Sustainability

Understanding Needs

Carrying out **Research** to understand the facts about the project/building context, users, requirements and potential challenges and opportunities in achieving sustainability.

Methodology & Process

Outlining the **Approach** to be considered in addressing the project brief and possible **Tools** to validate solutions and ensure objectives are well achieved.

Vision

This step involves setting of the broader goal to be achieved at the end of the project aligning to the project interests which will guide the design process.

Environmental Architecture

Brainstorming to outline specific project delivery markers as **Primary and Concrete Objectives** in line with the environmental sustainability requirements of the building. This will also be used as guides during the validation stage.

Wellbeing Architecture

Brainstorming to outline specific project delivery markers as **Primary and Concrete Objectives** in line with the wellbeing and comfort requirements of the building users. This will also be used as guides during the validation stage.

Implementation

Innovating appropriate sustainable design **Solutions** through architectural concepts and ideas in line with the outlied process, vision and objectives.

Validation

Testing and proving the achieved results through the tools outlined in the methodology, based on appropriate building physics calculations, simulation, modeling and analysis.

Post Implementation

Very crucial step of obtaining Feedback by carrying out Post-Occupancy Evaluation to understand user satisfaction and monitoring to establish actual performance of zero carbon and sustainable design.

1

Contextual Research

Climate

Site Analysis

The Role of Architecture in Humans Mind

Use Analysis

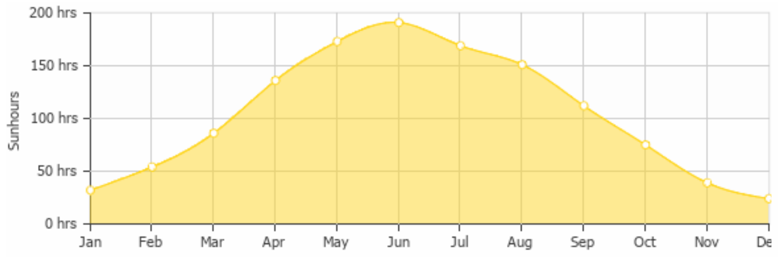
Existing Buildings

Simulations

Drawbacks and Benefits of Existing Buildings

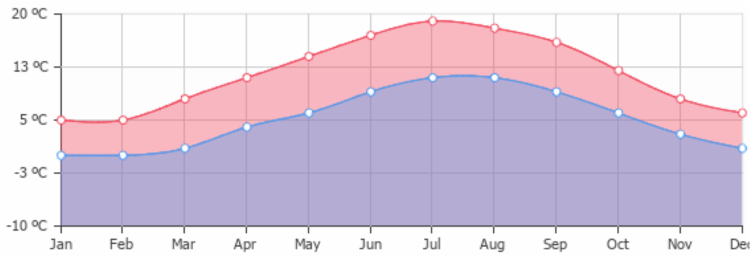
1.1 | Climate Analysis of Sheffield, Cfb

Monthly Hours of Sunshine



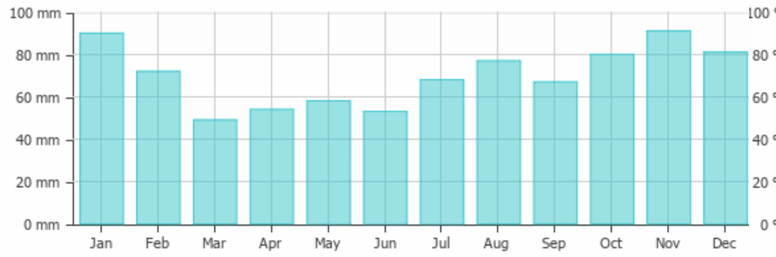
In summer months, the sunshine hours in a day are prolonged, in comparison with winter months. This increases the chance overheating in summer, particularly from May to July.

Average Day and Night Temperature



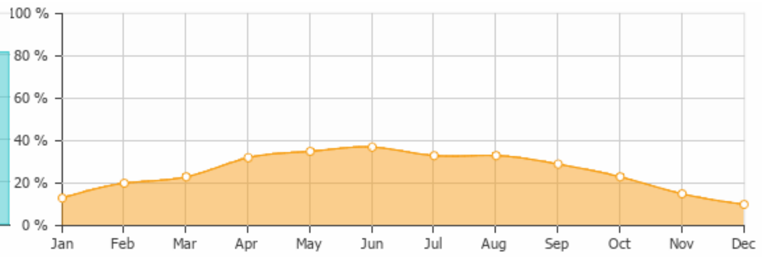
Maximum External Temp. is 20 °C in July. Minimum External Temp. is reaches below 0 °C in winter months. In future Climate changes, the summer months are going to get warmer.

Monthly Precipitation



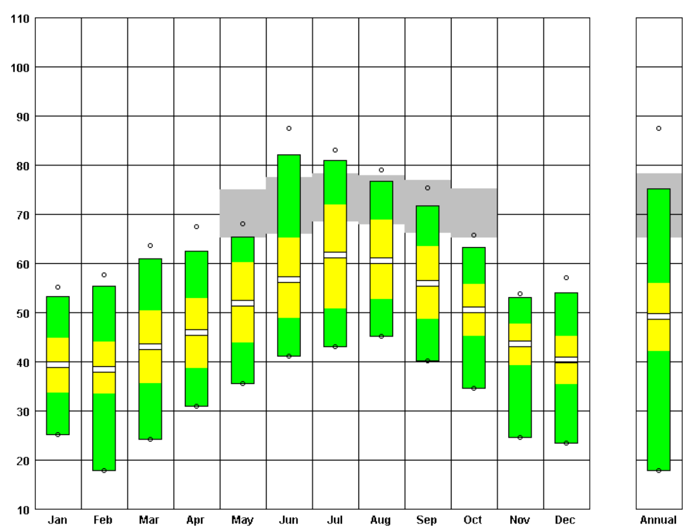
Maximum External Temp. is 20 °C in July. Minimum External Temp. is reaches below 0 °C in winter months. In future Climate changes, the summer months are going to get warmer.

Daily Percent of Sunshine



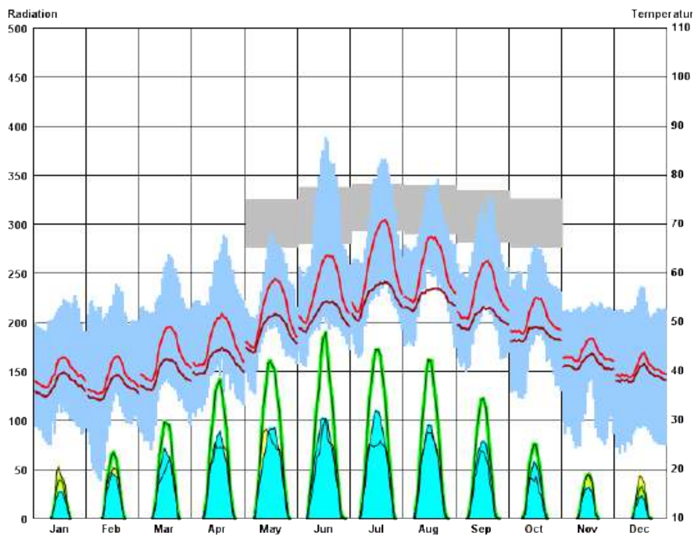
In month of May to July, sunlight is the highest. Solar radiation from sunlight can lead to overheating in the buildings.

Temperature Range



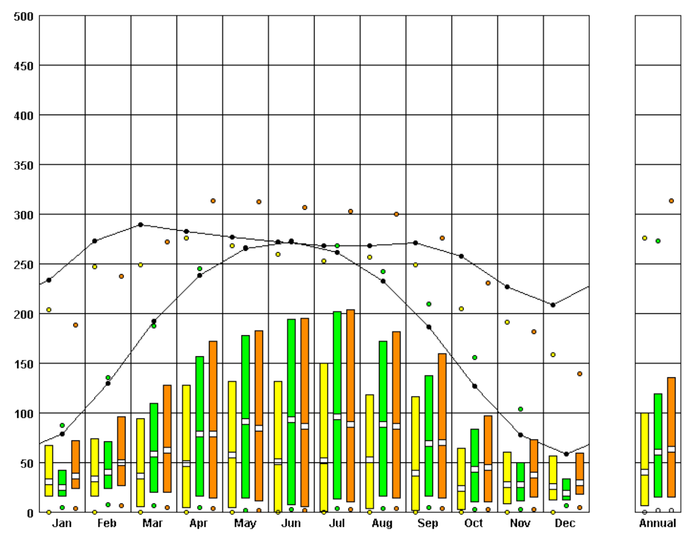
The mean temperature is 10 °C. The heat wave starts in July, when the temperature exceeds 30 °C

Mothly Diurnal Range



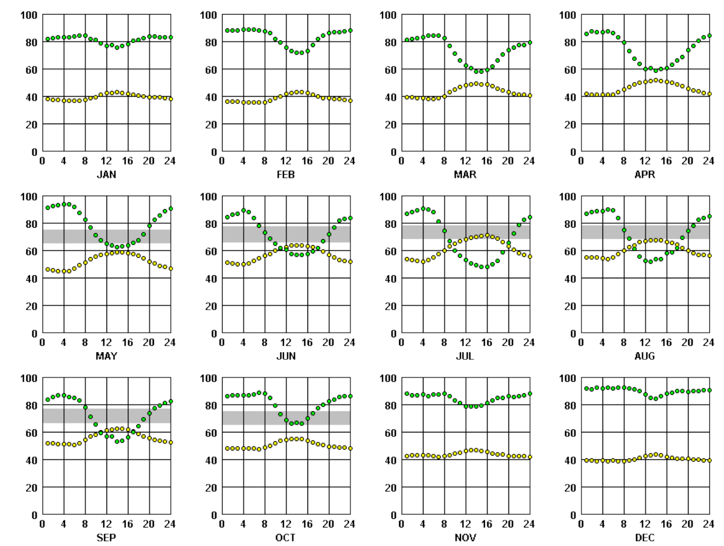
The graph of dry bulb temperature and wet bulb temperature, highlights the high humidity level in the atmosphere. Global Horizontal solar radiation is high especially in the summer months,use of PV panels.

Radiation Range



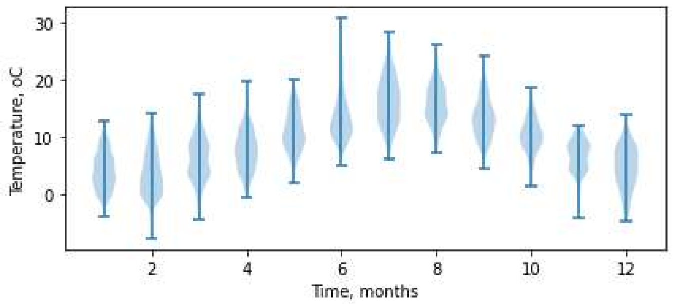
When the surface is tilted at 40 ° horizontallyand 30 ° towards south, maximum radiation can be collected i.e. 135 Btu/sq.ft. per hour.

Dry Bulb and Relative Humidity



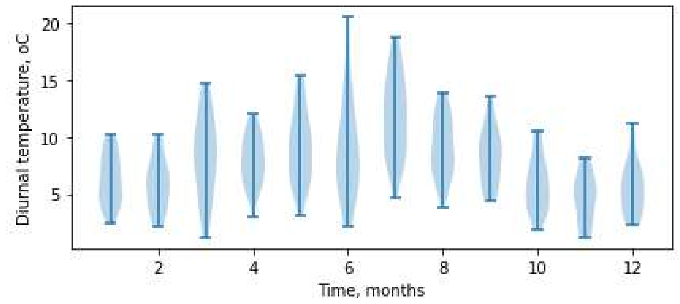
In winter months, the gap in humidity and dry bulb graph is high, suggesting high humidity in air, with low temperature. However, In summer months, the the graphs are intersecting.

Annual Temperature



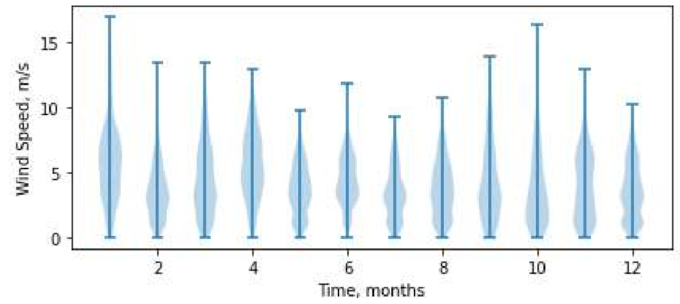
The temperature reaches 30 ° in summers, however mean temperature is 10 °C

Diurnal Temperature



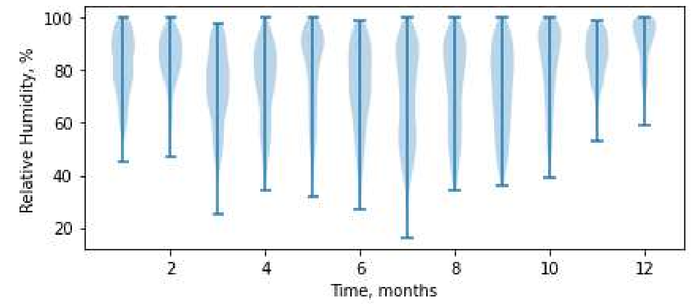
In july, the variation of diurnal temperature, suggesting high potential of nightime cooling through high thermal mass

Wind Speed



Wind Speed is high in Sheffield, crossing 15m/s

Relative Humidity

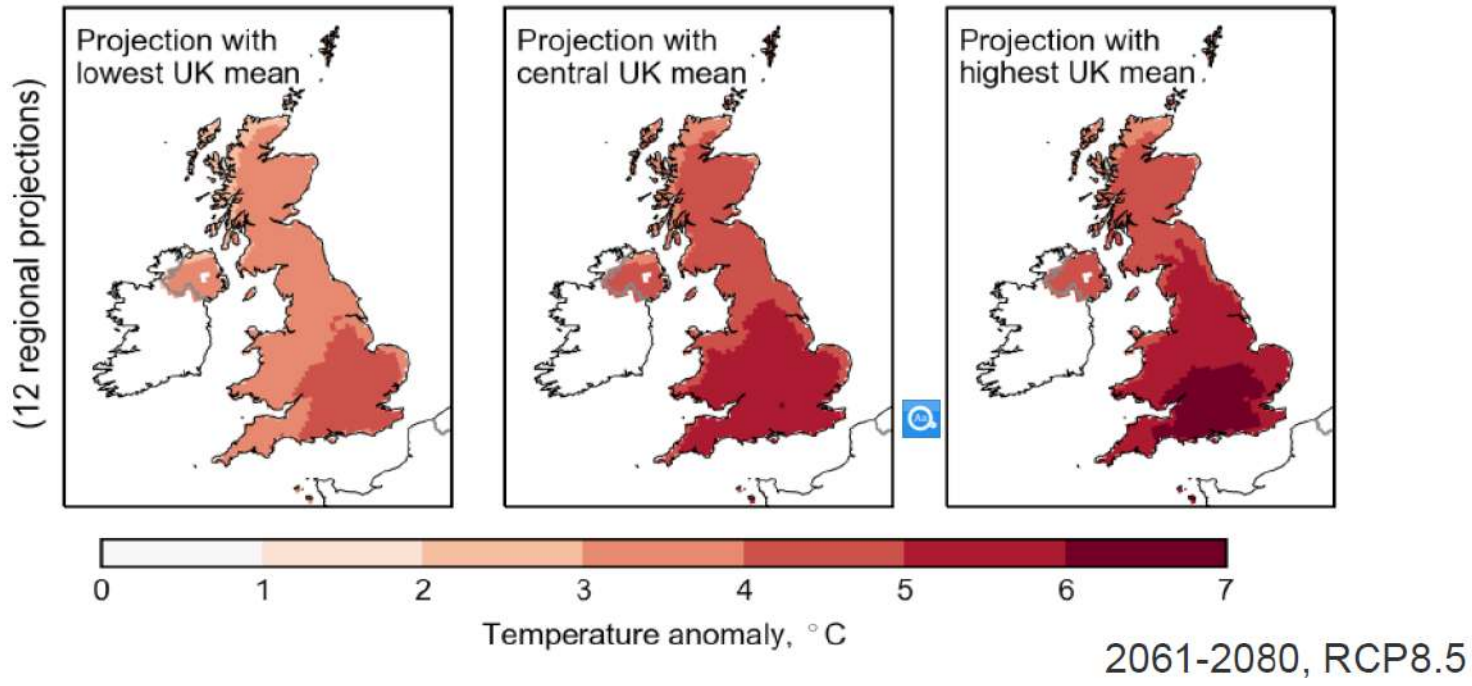


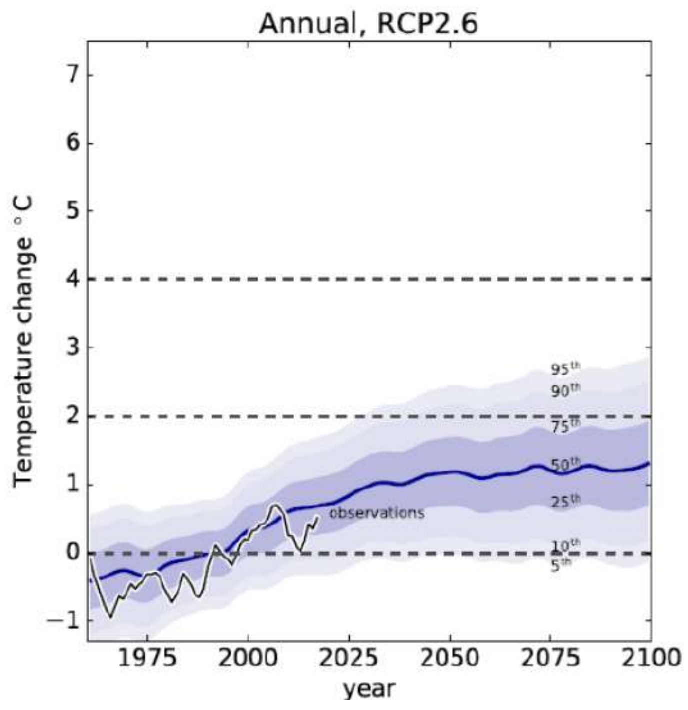
Relative humidity is high in winter months. Especially in January its consistent throughout the month.

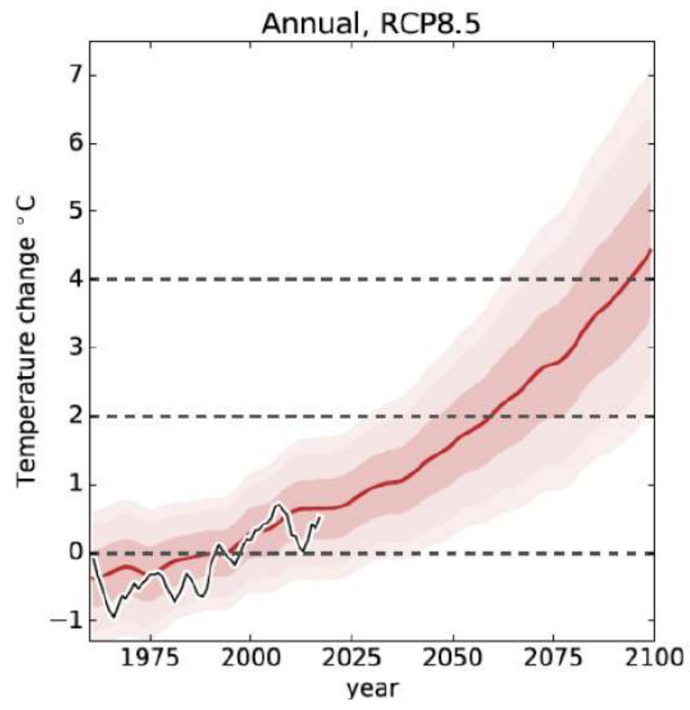
Source: Climate Consulatant and Pyclim Software

1.2 | Future Climatic Change in the UK

Future UK Temperatures







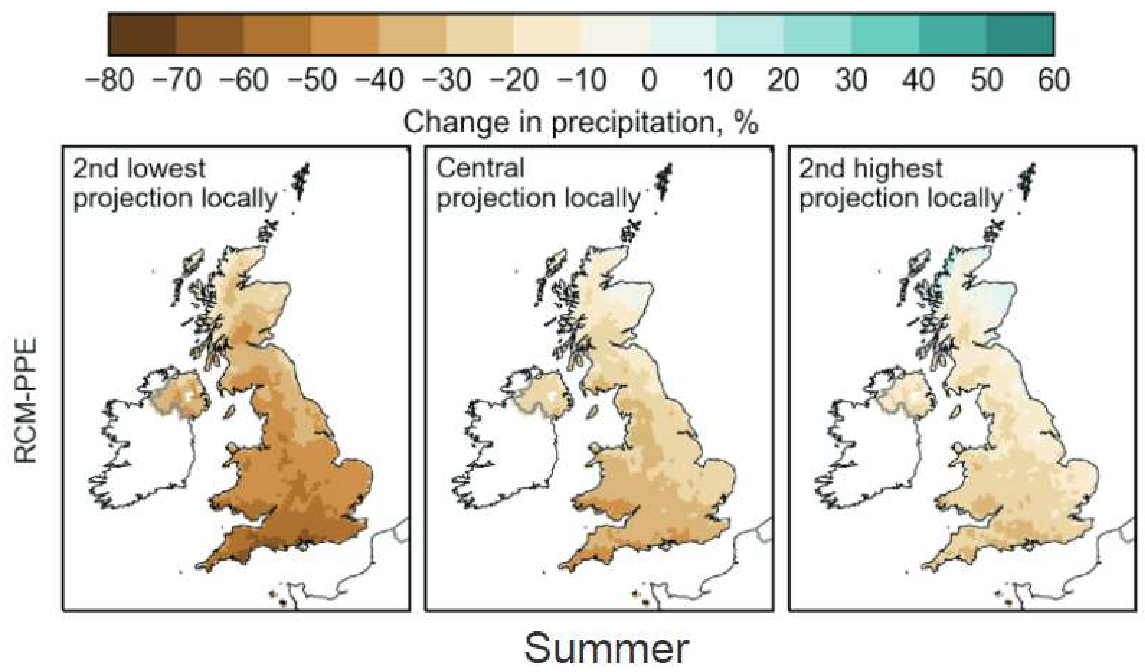
1. All areas of the UK are projected to experience warming.
2. Warming is greater in the summer than the winter.
3. Future rise depends on the amount of greenhouse gases the world emits.
4. The lowest scenario is compatible with aims to limit global warming since pre-industrial levels to below 2 degrees. 5. The highest scenario will likely require significant further adaptation.

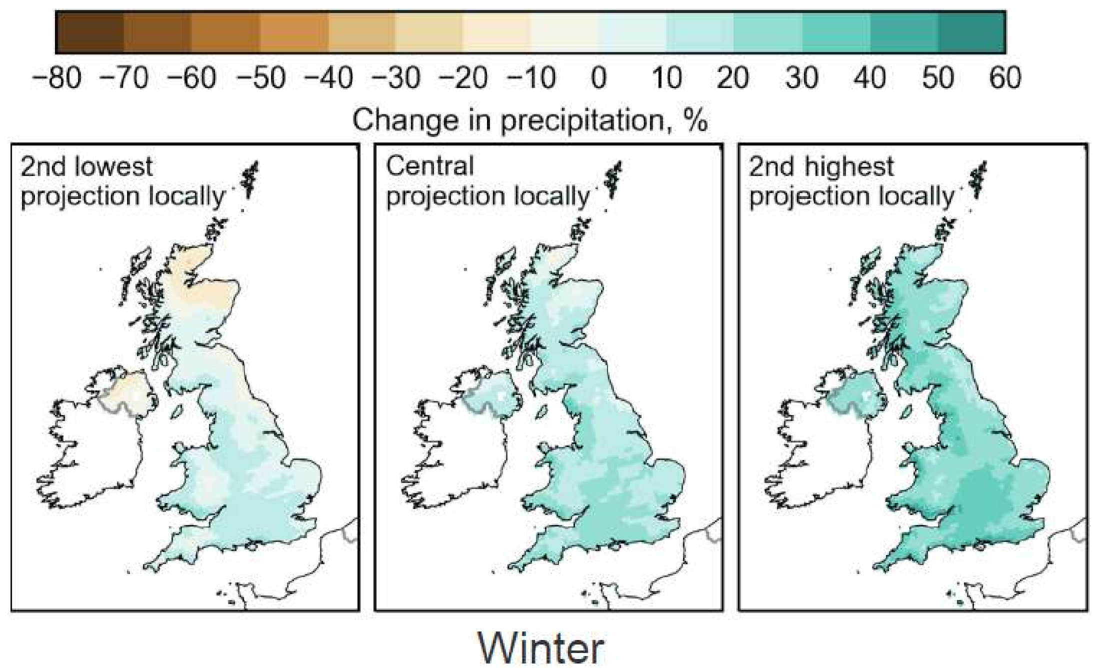
Similarity between scenarios over next couple of decades

In RCP 2.6 fastest fate of change in near future

In RCP 8.5 fastest fate of change at end of century

Pattern of Precipitation Change





The spatial pattern of change to 2061-2080 shows detailed structure over the UK (RCP 8.5). Compare SE England and N Scotland.

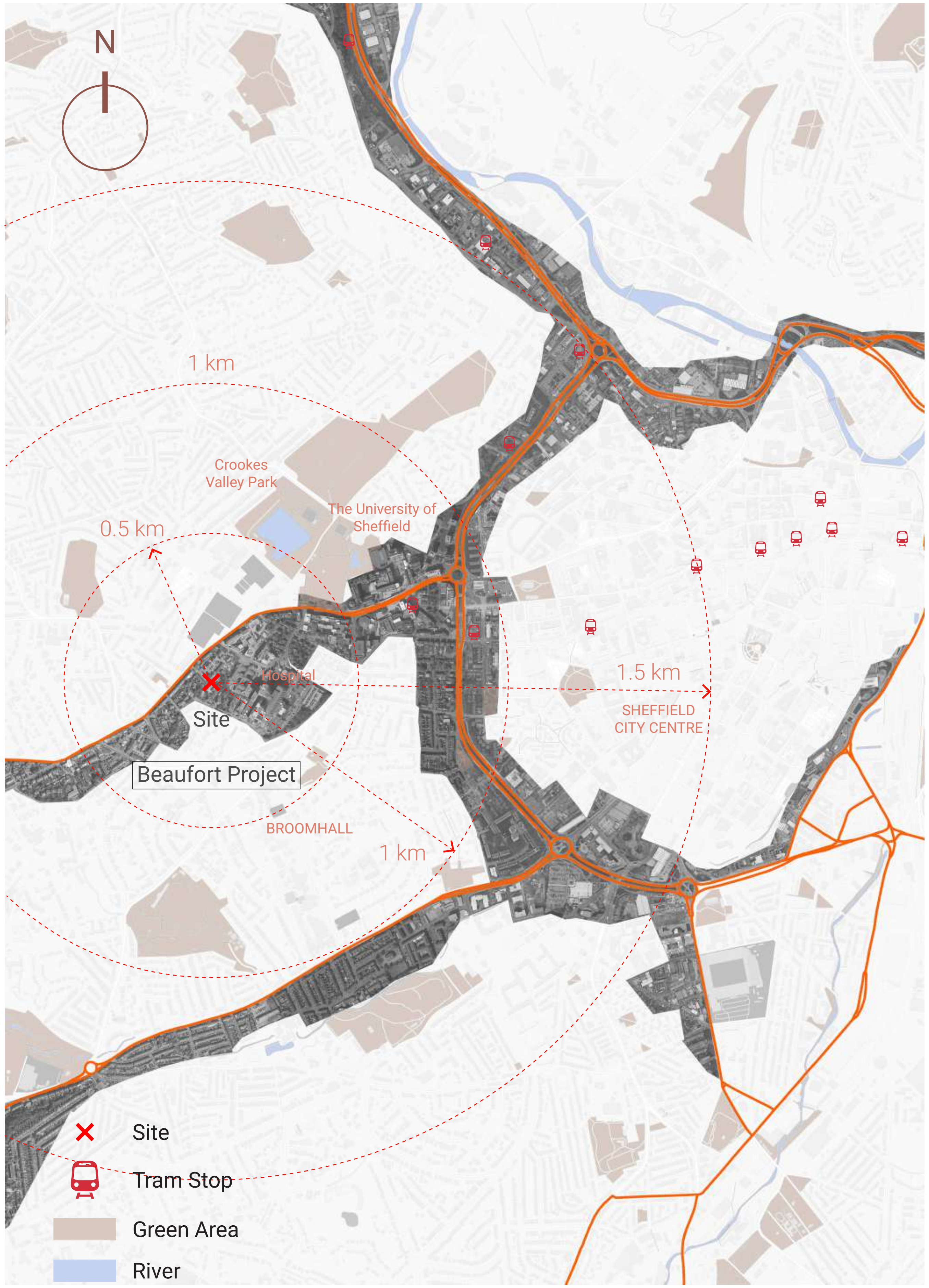
Summary

The main problems facing the climate in the future are higher flooding and average temperatures, as well as an increase in the frequency of extreme weather events.

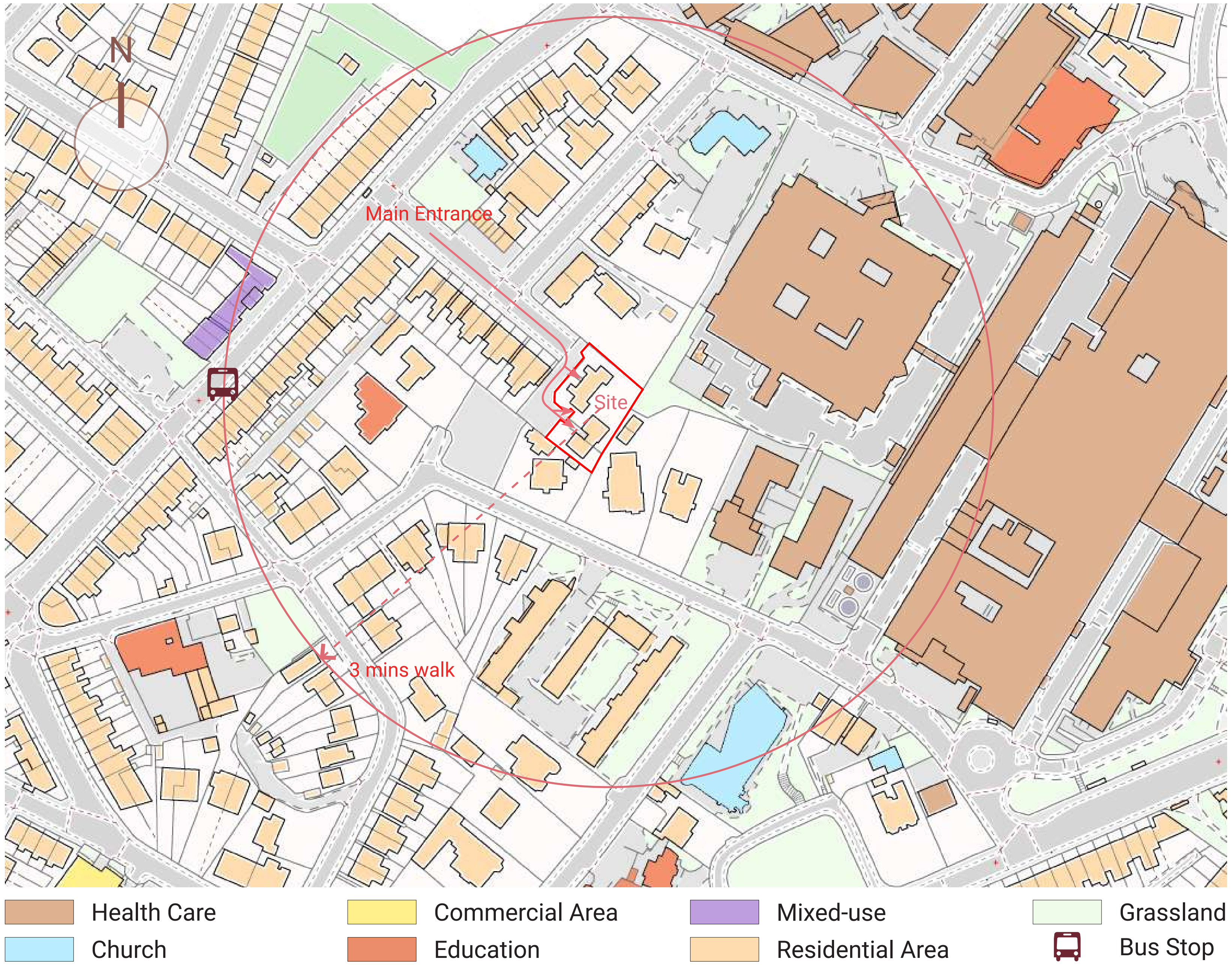
Reference: Met Office

1.3 | City Mapping and Site Introduction

City Mapping, Sheffield



Transportation and Access to Site



Summary

Entrance: The complex has three main entrances . Each building has a north-facing main entrance and there is also an entrance on the side of Building A for to get into the back courtyard.

Public facilities: The base and its surrounding public facilities are relatively complete. There are indoor and outdoor playgrounds, as well as cultural facilities such as libraries and theaters. There is also a church in the southeast corner of the site.

Landscape: The basis surrounded by the city's public green space and adjacent to the city's important open spaces. However, the building itself is in a relatively quiet environment and will not be disturbed by public spaces.

Transportation: The periphery of the site is adjacent to the main city road, while the building itself is slightly away from it. This not only guarantees the accessibility, but also meets the needs of the privacy of the building to a certain extent.

1.4 | Conservation Area and Surroundings

Surrounding Photos

1

Royal Hallamshire Hospital

2

Charles Clifford Dental Hospital

3

Weston Park Cancer Charity

4

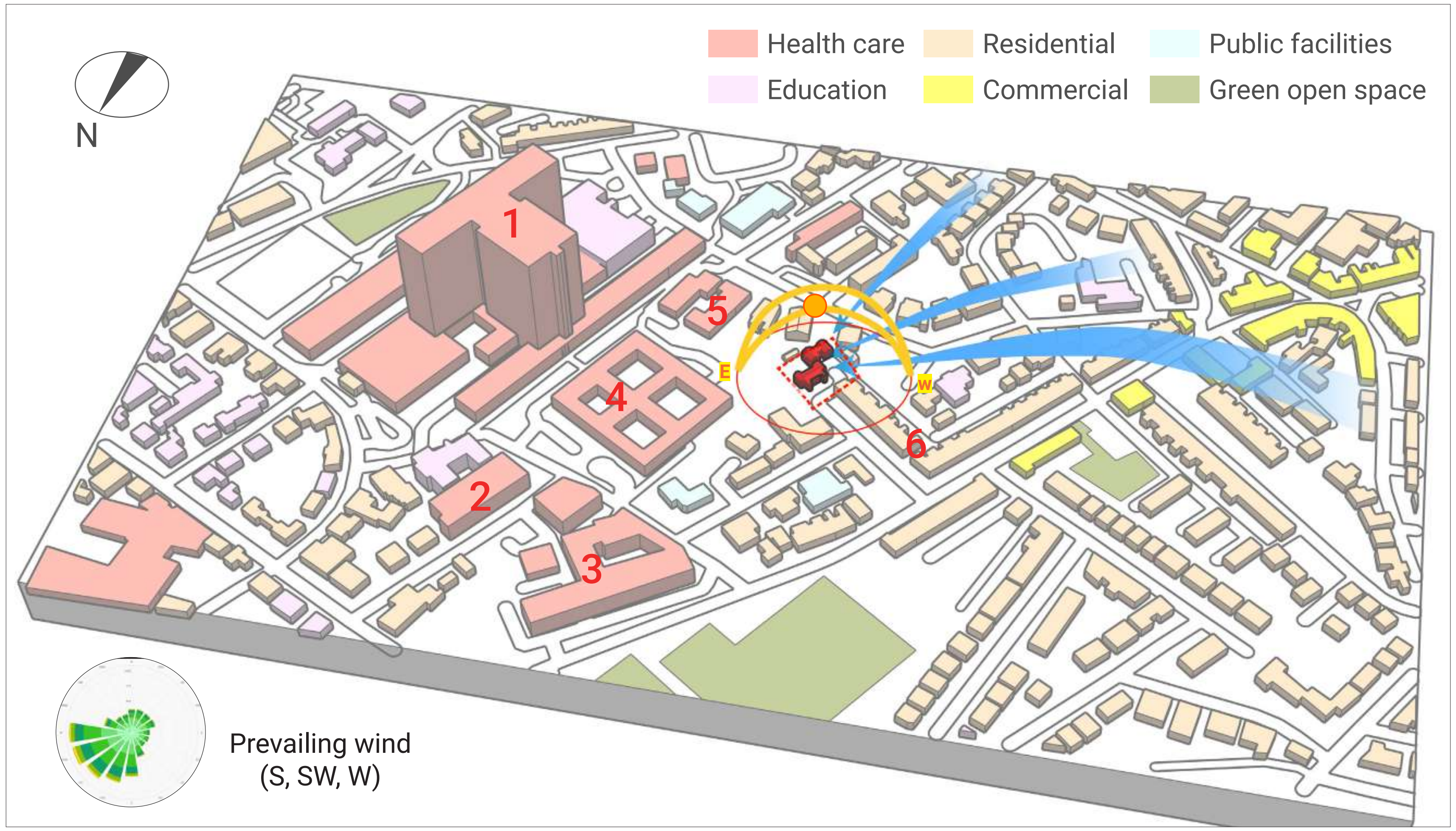
Jessop Wing

5

Sunshine Day Nursery

6

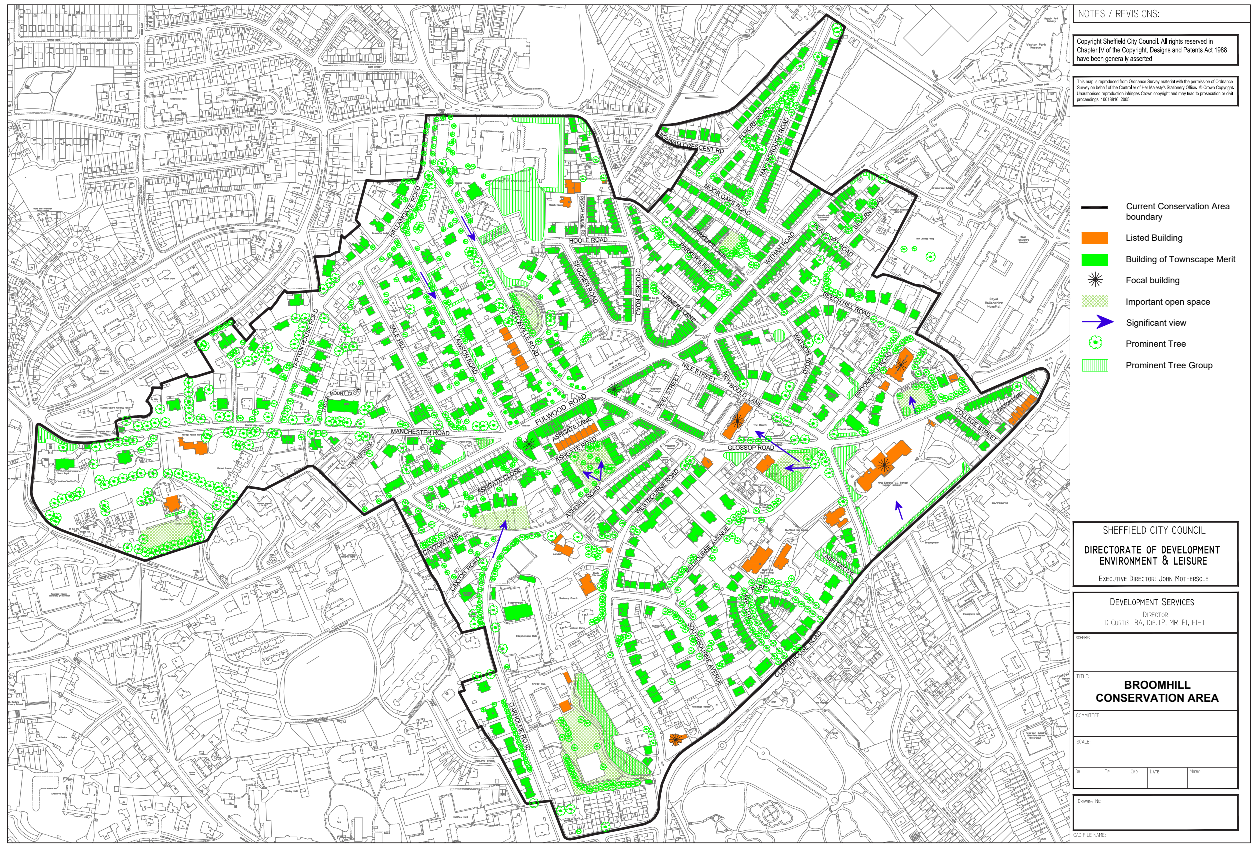
Residential



Summary

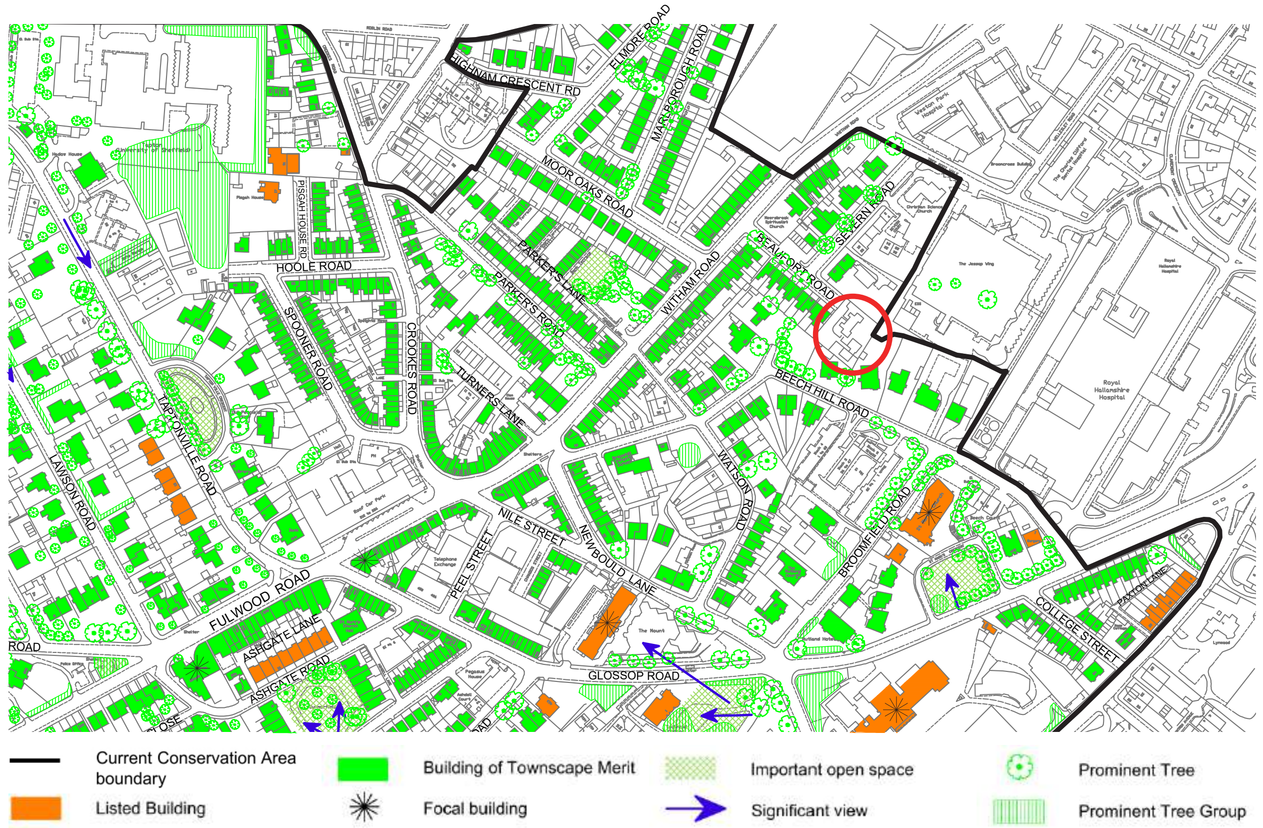
The site is located in a residential area, with a small number of churches and a three-minute walk from a large hospital, while the building (Beaufort Project) is not part of the protected building.

Broomhill Conservation Area boundary Layout



(Source from: https://www.sheffield.gov.uk)

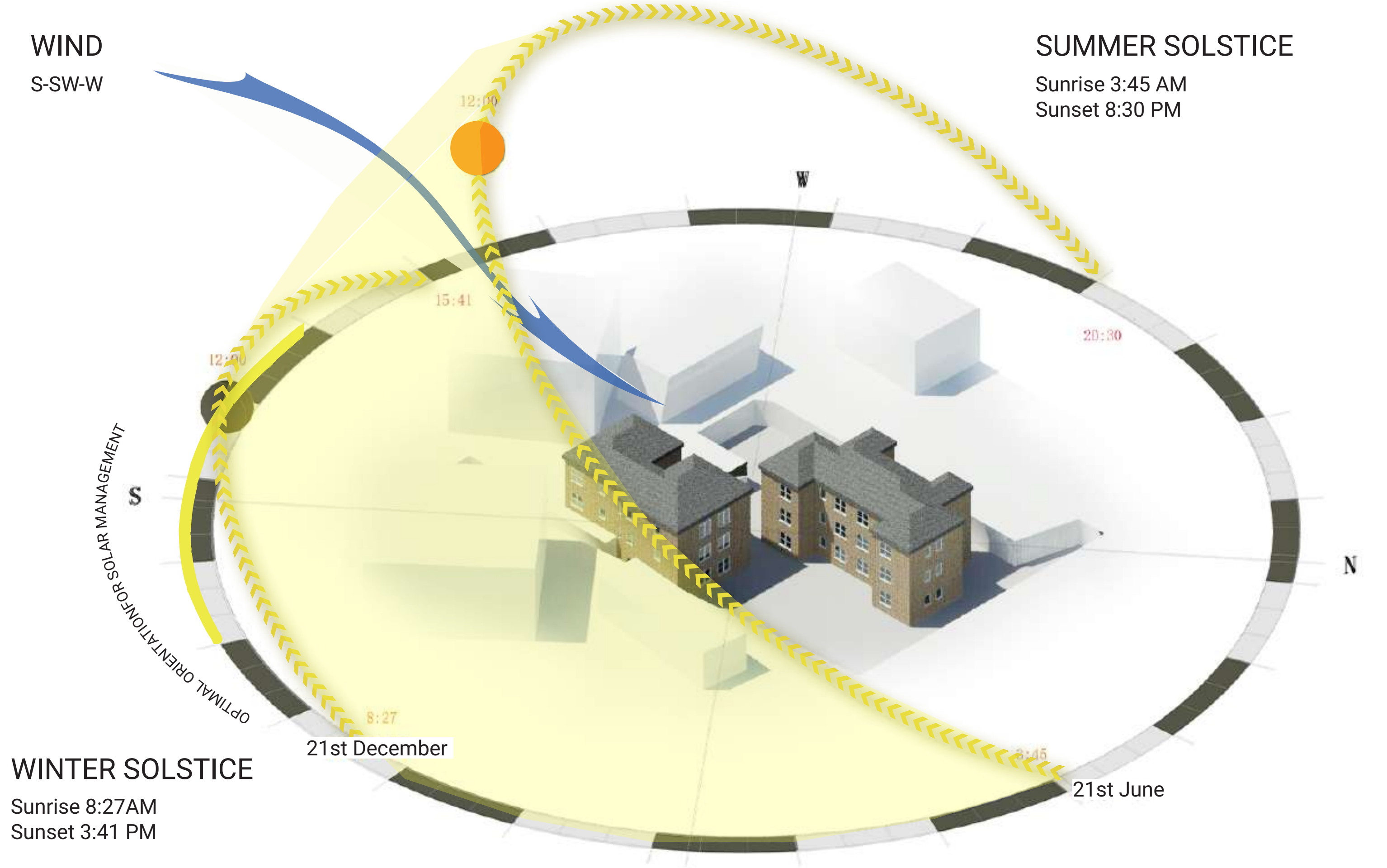
The Broomhill Conservation Area is located in the suburbs of Sheffield about 2km west of the city centtre. It lies in a wholly urban setting just north of a public park, the Botanical Gardens.



1.5 | Site Views and Microclimatic Conditions

Site Plan

Microclimatic Conditions Analysis



Site Views

View 1

View 2

View 3

View 4

View 5

View 6

Summary

In terms of microenvironment, the south facade of the building receives sufficient light, while the north facade receives less light. The prevailing wind direction in winter is northwest. The prevailing wind direction is southwest in summer. The building has a small outdoor space – a small garden.

1.6 | User Analysis

Mental Health Disorders in United Kingdom

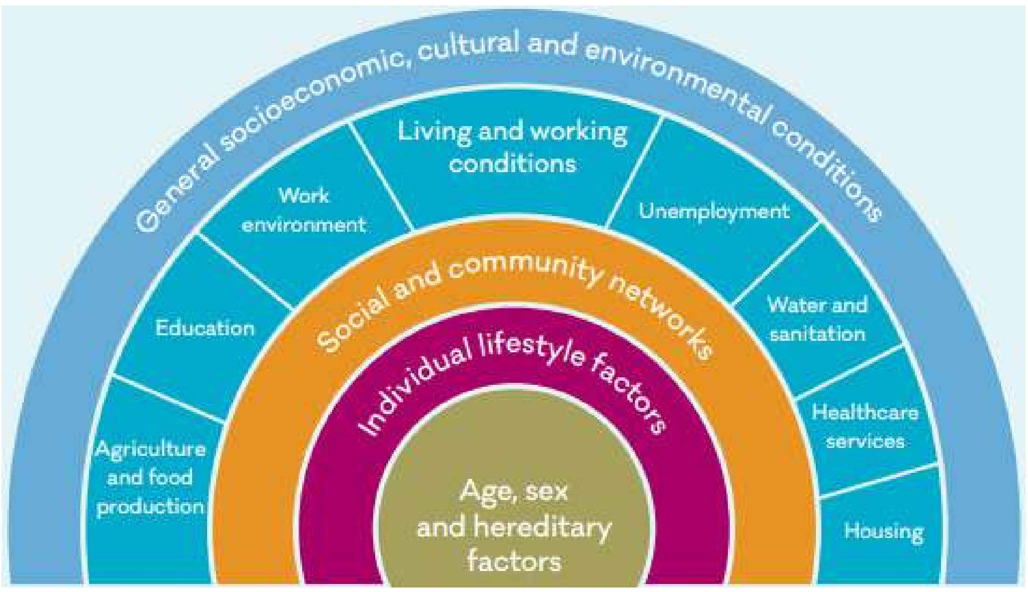
'Mental health is defined as a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community.' -World Health Organisation

Psychotic Patients	Neurotic Patients
Severe mental disorder that can be identified by loss of contact with reality and deep disturbance in social relationships.	Set of neuro-physical disorder that are generally due to the absence of psychical phenomena
Changes in personality of the patients are evident.	Does not affect the personality of the patient.
Contact with reality is drastically changed or lost.	Contact with reality is not entirely lost but it is affected.
The person diagnosed with it is not aware of his/her disorder or the surrounding.	The person diagnosed with it is aware of his/her disorder and of the surrounding.
There is an inconsistency in language and communication.	There is no alteration in language and communication.
The person is not able to take care of themselves.	The person is able to take care of themselves.
Antipsychotic medicines, social support, psychological therapy are mandatory.	Psychological treatment is needed for social and moral support.

According to Sigmund Freud, the father of psychoanalysis, diagnosable mental disorder can be classified in two main categories: neurosis an psychosis.

1. Psychotic patients experience a radical fracture between the external world and their imaginary and they are not aware of their mental illness.
2. Neurotic patients are aware of their conditions and still hold a relationship within the external real world.

Social Determinants of Mental Health adapted from The Determinants of Health



Mixed anxiety and depression represent the most common mental disorder in United Kingdom.

- 7.8% of the population meets the criteria for the diagnosis of a mental condition.

- 1 out of 6 adult has or have had a common mental health disorder.

Most Common typologies of Mental Disorders:

Anxiety

Phobias

Depression

Paranoia

Dissociative Disorder

OCD

(Federico Babina)

There are several typologies of mental disorders under this category. The most commons are the following:
a. Anxiety disorder including phobias, panic disorders and obsessive-compulsive disorder (OCD)
b. Depression including bipolar disorder and other mood disorders)
c. Eating disorder
d. Personality disorder
e. Post-traumatic stress disorder

Summary

In order to achieve our goal to provide a space that can improve the quality of life of our patients, our group tried to understand what typology of mental disorder our clients are or were diagnosed with and its consequences on their behaviour. Because of the nature of the existing building, our team understood that our clients have been diagnosed with neurosis.

Reference

https://www.mentalhealth.org.uk/sites/default/files/fundamental-facts-about-mental-health-2016.pdf

1.7 | Neurosis

'Neurosis is (...) a diagnosable psychological disorder that interferes with quality of life without disrupting an individual's perception of reality.' (Felman, 2018)

According to some psychologists and psychiatrists the term neurosis is used to describe anxious symptoms and behaviors, while others use it to refer to a spectrum of mental illnesses outside of psychotic disorder.

Symptoms and Behaviour of Neurotic Patients

Scientists do not agree on what constitutes neurosis, although with time it has been possible to trace a scheme of common traits belonging to people with neurotic disorders:

Depression

Anxiety

Distress

Unhappiness

General Therapies

Neurotic disorders can be treated by using different approaches:

Psychoanalytic therapy

It consists of helping the patient to become aware of the repressed impulses, feelings, and traumatic memories that underlie his symptoms and develop a deeper self-understanding.

Cognitive-Behavioural therapy

The doctors will develop a functional analysis of the patient and will trace a hierarchy of his fears. The therapy consists of the repeated self-exposure to fear stimuli that with time it will alleviate.

Color and Mental Health

Colours	Improves	Helpful for	Helpful for
Red	Energy, strength, motivation and confidence	Depression and anxiety	Anger and irritability
Orange	Stimulation for mind and body, self-esteem, optimism, revitalization	Depression, negativity, trauma, stress and loss	
Yellow	Self-confidence, self-respect, self-control	Depression, despair, negativity, lack of confidence	Insomnia, hyperactivity
Green	Balance, self-acceptance, personal development	Stress, anxiety, self-pity and confusion	
Turquoise	Calmness, cleansing, healing	Stress, anxiety and anger	
Blue	Calmness, self-expression, creativity, relaxation, peace	Insomnia, stress, anxiety, anger and over excitement	
Indigo	Understanding, spirituality, peace, calm, inspiration	Anger, obsessions, psychosis, insomnia and anxiety	Depression and lonliness
Violet	Inspiration, empathy, self-respect, dignity, imagination	Stress, anxiety, obsession, low self-esteem, severe depression	
Magenta	Letting go the past or anxiety-provoking thoughts	Aggression	
Pink	Calmness, clarity of thought, compassion, kindness, nurturing	Insomnia, anger, aggression and over-sensitivity	

'Patients with acute mania were put in black rooms, patients with melancholia in red rooms; blue and green rooms for the boisterous, and a white room for the person who is practically well.'
- Use Colors to Cure Insane, 1902

Whether it happens consciously or unconsciously, colors can have an impact on humans psyche, on humans feelings and behaviour.
The table above illustrates which colors can have calming effect and in particular what psychological mind set they can have an impact on.

Summary

Because of the nature of the existing building, our team understood that our clients have been diagnosed with neurosis. General neurotic behaviours are fiiled by depression, anxiety and majorly distress. Therefore for the design of Beaufort Project it is important to design places able to fight those feelings in order to guarantee a better quality of life to our residents.

Reference

https://www.urbandesignmentalhealth.com/blog/the-links-between-colour-architecture-and-mental-health#:~:text=The%20colour%20red%20is%20generally,sense%20of%20harmony%20and%20effective

1.8 | Spatial Analysis

Architectural Elements Triggers of Stress

Stress per se does not represent a psychiatric diagnosis, but it's closely linked to humans mental health.
In fact, over stress can be one of the causes of mental health problems, and it can worsen existing problems turning them in diagnosable mental health disorders.
Furthermore, mental health problems can be the cause of additional stress. The need of dealing on a daily basis with your own mental disorder and its symptoms will cause a lot of stress, as well as the stress due to dealing with medications, therapies and other required treatments.
Because of the importance of stress management for people and particularly for people with mental disorder, it is important to investigate whether and how the built environment can affect humans health by altering their level of stress.
Some researches demonstrated that there are five possible dimension of the designed environment that can cause stress.

Stimulation

Lack of Stimulation

- Boredom
- Sensory deprivation

Excess of Stimulation

- Distraction
- Interferrement with cognitive processes that demantss effort

Physical Factors

- Loud noises
- Bright light
- Bright colors
- Close interpersonal distances

Built Factors

- Layout
- Circulation
- Shape and orientation of the interior of a space

It is intended as the amount of informations that a space share with the user. Projected in the built environment, it is represented by design qualities like complexity, novelty, variety and intensity.
A space that results too complex or misterious to understand and analyze creates stress in the users.
The physical factors listed in the table above increase stimulation.
The built factors instead are the architectural elements that contribute and cause stress.

Restorative

It is represented by the potential of the built environment to function therapeutically. In other words, a building that is able to minimise the cognitive fatigue of its residents.
View of nature and other elements that are able to readily attract the users attention and curiosity help the building to become restorative.

Affordances

Another dimension of architectural elements that can alter the level of stress within a person is represented by the facility of interpretation of the spaces' functionaliy.
When the user is not able to easiliy understand the function of the place he is in, stress will occur.
This dimension is projected in a building through corners, entryways, stairs or an immediate change in visual access. .

Coherence

Built Factors

- Circulation
- Regular geometric shape
- Views of the external environment of a building
- Pattern of spaces
- Legibility
- Distinctive interior marking

Impediments to Coherence

- Ambiguity
- Disorganisation
- Disorientation

Coherence is intended as the clarity and legibility of a building and its elements. In this situation, stress will happen when people are not able to make sense our of the place. The stress is caused by sense of ambiguity and disorientation.
A building is considered inchoherent when its spaces are too homogeneous, its signs contain too much informations and therefore it is hard for the building users to create a mental plan of the place and it is easy to get lost or feel disorientied.
This problme occures often within hospitals and care houses.

Control

Physical Constraints

- Insufficient spatial resources
- Flexibility of spaces
- Amount of available spaces
- Visual exposure
- Privacy
- Responsiveness
- Structural depth
- Openness of perimeter
- Lack of lighting and temperature control

In this topic control is intended as the ability of the user to modify the physical environment and\or regulate his exposure to the sorroundings.
In fact, when a person is feeling physical constrained he will feel helpless which will cause psychological distress.

Summary

The environment plays a crucial role in humans mental health, therefore it is crucial for architects to understand in which way and intensity the built environment affect humans mind. Because humans spend the majority of their life within buildings, it is important to understand what elements of the interior space can harm humans psyche.

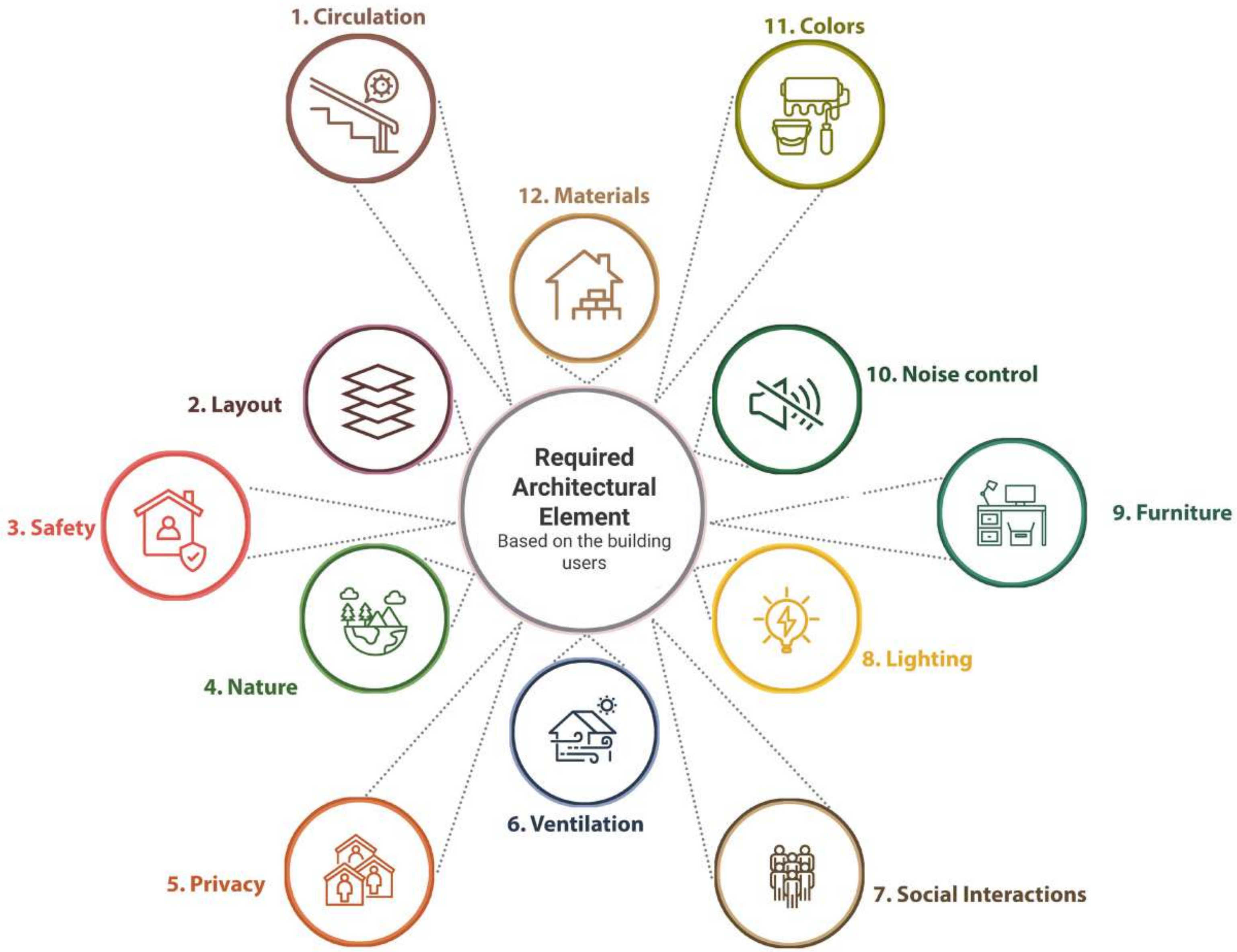
Reference

Evans,G. and McCoy, J. (1996), When buildings don't work: the role of architecture in human health, Journal of Environmental Psychology, vol. 18, p. 86.94

1.9 | Required Architectural Elements

Scheme of the Required Elements

It 1. It is important that the circulation of the building is designed keeping in mind the needs of the users. The circulation needs to be easy to understans and it is essential to avoid the deign of narrow and long corridors.
2. The physical layout of the building is an important component of constructing a therapeutic and safe environment. Generally, The layout of the building should be continuous without separations, allowing staff to walk around the core of the building and with lines of sight to easily see every bedroom and activity on that floor.
3. It is important to provide to the residents of the Beaufort Project a balance between freedom and control in order to ensure safety but also help the inhabitans to develop more independence.
4. The outdoor environments positively affect the physical and psychological health outcomes of patients and can serve as a resource for recovery and rehabilitation.
5. The residents need private bedrooms and bathrooms. This will ensure them privacy and will encourage them to gain more indipendence for the future.
6. Ventilation is very important in ensuring your mental health facility is as energy efficient and safe as possible. Designs that have good natural ventilation are important in helping to create a positive, therapeutic environment.

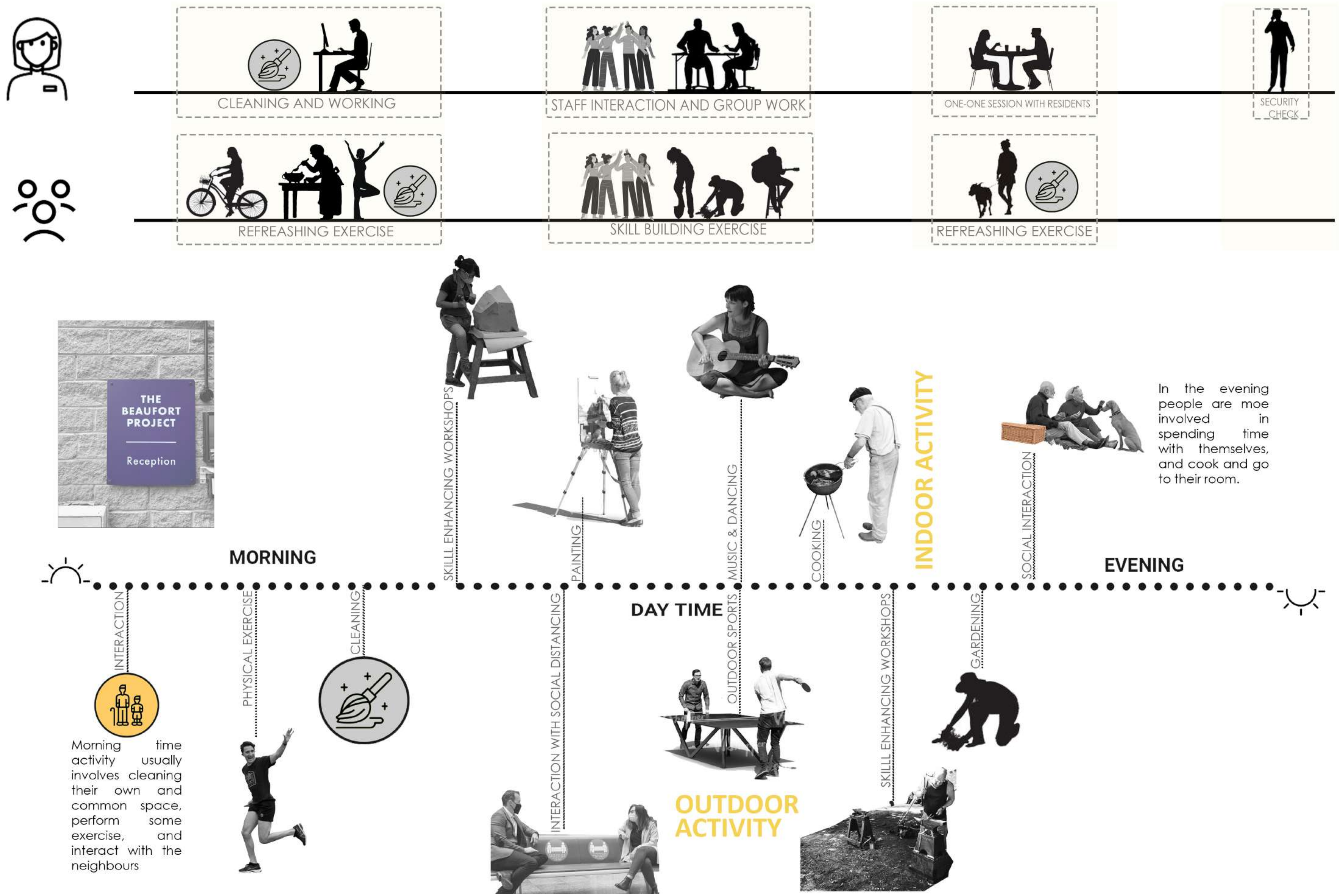


7. Social interactions break the feeling of isolation and lower stress among patients.
They can be achieved through several methods including, seating areas should be provided liberally within the building, well-designed dayrooms, gardens which create extra activities.
8. Both daylighting and electrical lighting can elicit a strong human biological response and therapeutic effect. Daylighting is important for the recovery and rehabilitation of patients, as well as the well-being of staff.
9. Furnishing design helps reduce the feeling s associated with institutional atmospheres, that is in turn associated with enhancing emotional and intellectual wellbeing improving patients' behavior.
10. Minimizing noise will enhance the treatment and healing of patients.
11. Color can have a big influence on the residents of Beaufort Project. For example, using a contrasting color to highlight stairs, thresholds, doorways and other possible impediments makes them stand out, keeping residents safer. Generally, it is prefered to use bright colors in a therapeutic building.
12. The choice of materials is crucial for the design of a therapeutic project. The use of natural and sustainable materials has been proved to be more beneficial to the residents of the building because they create a connection between the residents and nature.

Reference

https://scholarworks.rit.edu/cgi/viewcontent.cgi?article=11094&context=theses
https://academic.oup.com/swr/article-abstract/39/3/167/1639498?redirectedFrom=fulltext
Granerud, A. and Severinsson, E. (2006)The struggle for social integration in the community –the experiences of people with mental health problems, *Journal of Psychiatric and Mental Health Nursing,* vo. 13, p. 288-293

1.10 | User Activity Analysis

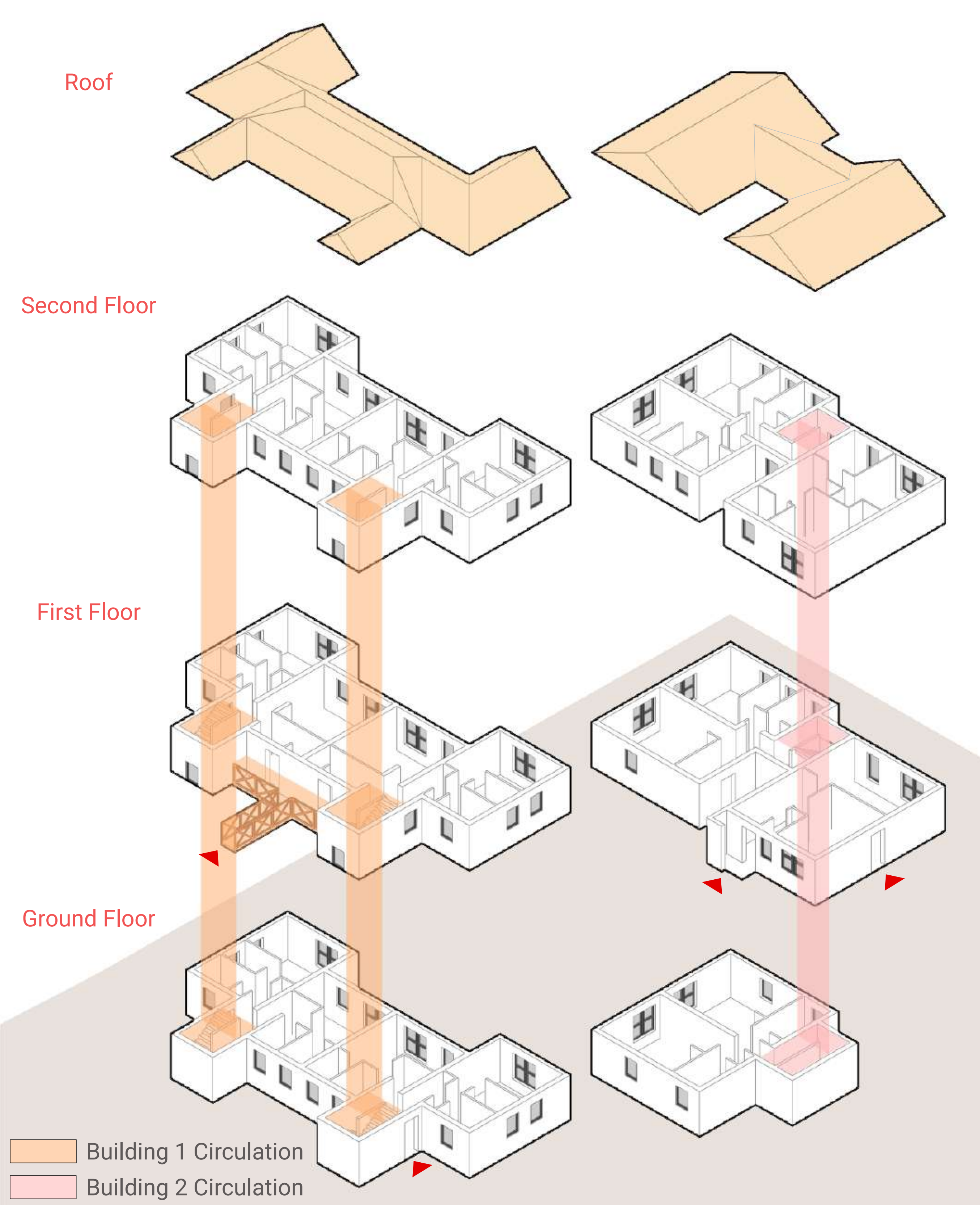


Morning time activity usually involves cleaning their own and common space, perform some exercise, and interact with the neighbours

In the evening people are moe involved in spending time with themselves, and cook and go to their room.

1.11 | Circulation and Function Analysis

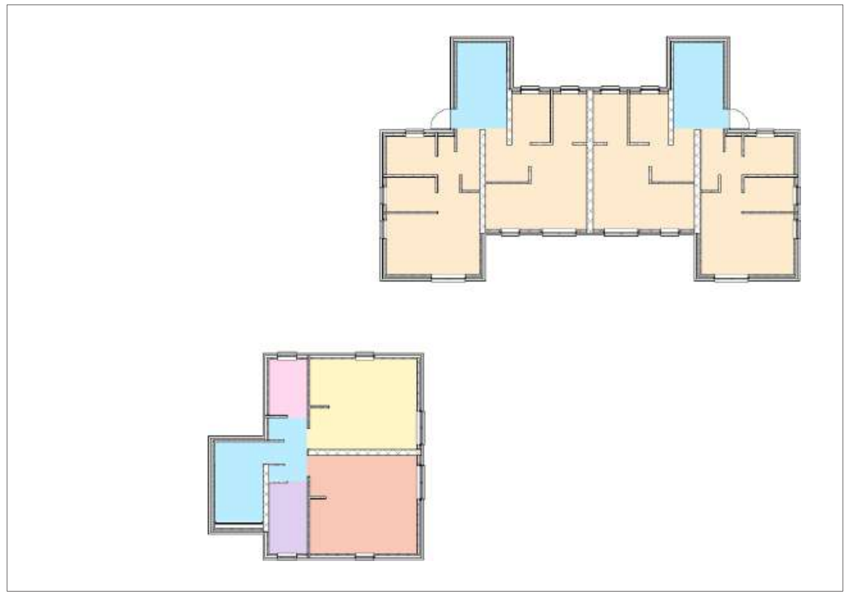
Circulation Analysis



Summary

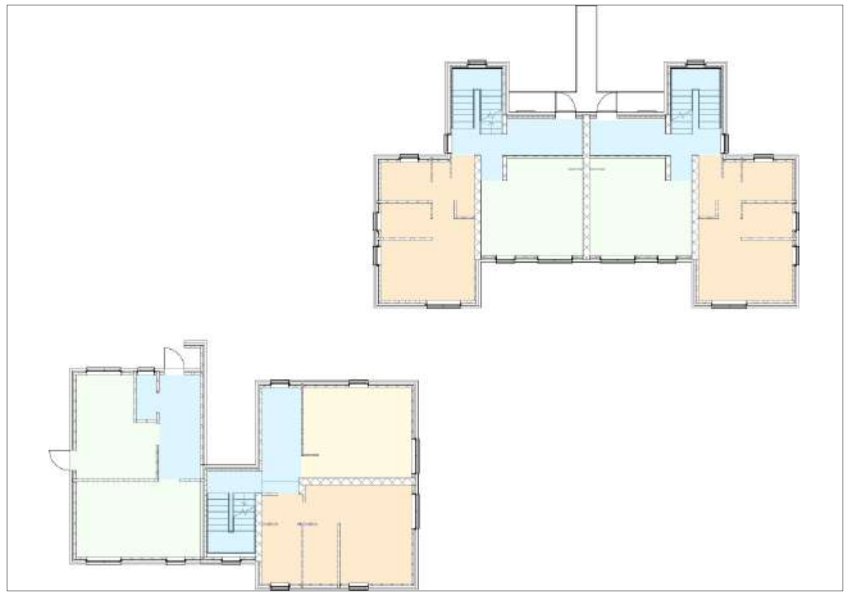
The larger building has two entrances, two circulation cores, for the other building, it has one circulation core. Flat living spaces are narrow, and the streamline is not convenient to residents.

Floor Plan and Functions Analysis



Ground Floor

- Private Resident: Self Contained Falt
- Private Resident: Bedroom Only
- Private Staff
- Circulation
- Shared Bathroom
- Shared Kitchen



First Floor

- Private Resident: Self Contained Falt
- Common Space
- Private Staff
- Circulation

Second Floor

- Private Resident: Self Contained Falt
- Private Resident: Bedroom Only
- Circulation
- Shared Bathroom

1.12 | Building Materials and Structural Analysis

Materials Photos

Clay Tiles

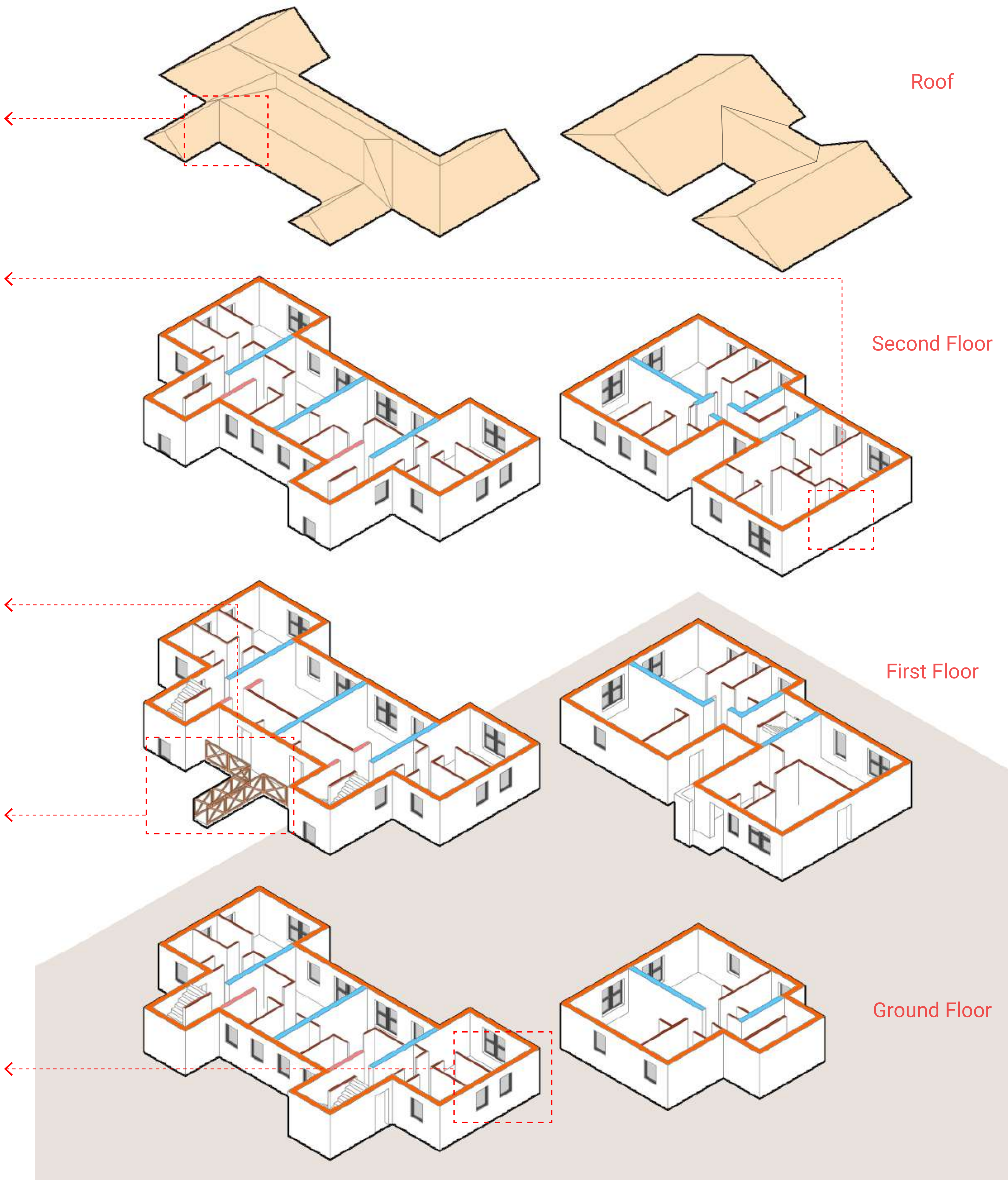
Brick

Timber

Entrance

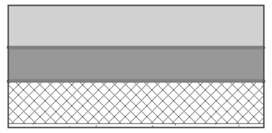
Corner

Structure Analysis



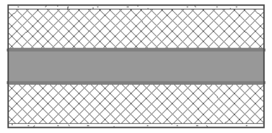
Detail Analysis

Exterior Wall Load-Bearing Walls



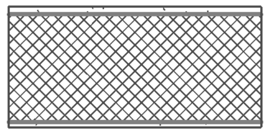
100mm Brick
80mm Cavity
100mm Concrete Masonry Unit
10mm Gypsum

Interior Wall 1 Load-Bearing Walls



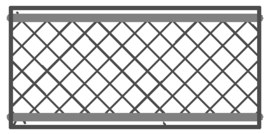
10mm Gypsum
100mm Concrete Masonry Unit
60mm Cavity
100mm Concrete Masonry Unit
10mm Gypsum

Interior Wall 2 Load-Bearing Walls



10mm Gypsum
100mm Concrete Masonry Unit
10mm Gypsum

Interior Wall 3 Partitions



10mm Gypsum
100mm Brick
10mm Gypsum

Summary

The main structure of the building is a load-bearing wall structure made of bricks, concrete blocks. Timber is used for the bridge at entrance. The roofs are made of clay tiles.

1.13 | Statistics of Main Components of Buildings

Walls Schedule

Schedule of Walls

	U-value	Volume(m^2)	Thickness	Height	Thermal Mass	Thermal Resistance(R)	Length(m)	Area(m^2)
1	13.0000 W/(m^2·K)	2.58	280	2630	14.05 kJ/K	0.0769 (m^2·K)/W	4162	9.22
2	13.0000 W/(m^2·K)	1.94	280	2630	14.05 kJ/K	0.0769 (m^2·K)/W	3240	6.93
3	13.0000 W/(m^2·K)	3.99	280	2630	14.05 kJ/K	0.0769 (m^2·K)/W	6460	14.26
4	13.0000 W/(m^2·K)	2.45	280	2630	14.05 kJ/K	0.0769 (m^2·K)/W	4435	8.75
5	13.0000 W/(m^2·K)	1.41	280	2630	14.05 kJ/K	0.0769 (m^2·K)/W	2024	5.02
6	13.0000 W/(m^2·K)	4.93	280	2630	14.05 kJ/K	0.0769 (m^2·K)/W	9626	17.61
7	13.0000 W/(m^2·K)	1.41	280	2630	14.05 kJ/K	0.0769 (m^2·K)/W	2024	5.02
8	13.0000 W/(m^2·K)	2.45	280	2630	14.05 kJ/K	0.0769 (m^2·K)/W	4435	8.75
9	13.0000 W/(m^2·K)	3.99	280	2630	14.05 kJ/K	0.0769 (m^2·K)/W	6460	14.26
10	13.0000 W/(m^2·K)	1.94	280	2630	14.05 kJ/K	0.0769 (m^2·K)/W	3240	6.93
11	13.0000 W/(m^2·K)	2.39	280	2630	14.05 kJ/K	0.0769 (m^2·K)/W	4162	8.52
12	13.0000 W/(m^2·K)	1.75	280	2630	14.05 kJ/K	0.0769 (m^2·K)/W	2522	6.25
13	13.0000 W/(m^2·K)	1.56	280	2630	14.05 kJ/K	0.0769 (m^2·K)/W	2250	5.58

Railings Schedule

	Familiy and Type	Railing Height	Type	Length
1	Railings: 900mm Pipe	900	900mm Pipe	6771
2	Railings: 901mm Pipe	900	900mm Pipe	6771
3	Railings: 902mm Pipe	900	900mm Pipe	8486
4	Railings: 903mm Pipe	900	900mm Pipe	4643
5	Railings: 904mm Pipe	900	900mm Pipe	8486
6	Railings: 905mm Pipe	900	900mm Pipe	4643
7	Railings: 906mm Pipe	900	900mm Pipe	8486
8	Railings: 907mm Pipe	900	900mm Pipe	4643
9	Railings: 908mm Pipe	900	900mm Pipe	8486
10	Railings: 909mm Pipe	900	900mm Pipe	4643
11	Railings: 910mm Pipe	900	900mm Pipe	8486
12	Railings: 911mm Pipe	900	900mm Pipe	4643
13	Railings: 912mm Pipe	900	900mm Pipe	8486
14	Railings: 913mm Pipe	900	900mm Pipe	4643
15	Railings: 914mm Pipe	900	900mm Pipe	8486
16	Railings: 915mm Pipe	900	900mm Pipe	4643
17	Railings: 916mm Pipe	900	900mm Pipe	4219
18	Railings: 917mm Pipe	900	900mm Pipe	8061
19	Railings: 918mm Pipe	900	900mm Pipe	4219
20	Railings: 919mm Pipe	900	900mm Pipe	8061

Stair Schedule

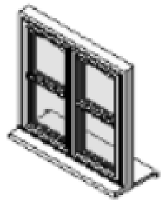
	Actual Pedal Depth	Actual Number of Risers	Actual Riser Height	Platform type	Maximum Riser Height	Minimum Pedal Depth
1	280	15	175	300mm Thickness	180	280
2	280	15	175	300mm Thickness	180	280
3	280	15	175	300mm Thickness	180	280
4	280	15	175	300mm Thickness	180	280
5	280	15	175	300mm Thickness	180	280
6	280	15	175	300mm Thickness	180	280
7	280	15	175	300mm Thickness	180	280
8	280	14	175	300mm Thickness	180	280
9	280	14	175	300mm Thickness	180	280

Windows Schedule

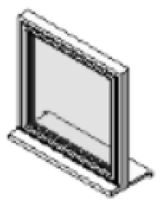
	U-value	Visible Light Transmittance	Width	Bottom Height	Families and Types	Solar Heat Gain Coefficient	Elevation	Thermal Resistance	Rough Width	Rough Height	Top Height	Height
1	3.6886 W/(m^2·K)	0.9	1500	700	Windows_Dbl_Swept_Head: 910x910mm	0.78	Level 0	0.2711 (m^2·K)/W	1500	1500	2200	1500
2	3.6886 W/(m^2·K)	0.9	1500	700	Windows_Dbl_Swept_Head: 910x910mm	0.78	Level 0	0.2711 (m^2·K)/W	1500	1500	2200	1500
3	3.6886 W/(m^2·K)	0.9	1500	700	Windows_Dbl_Swept_Head: 910x910mm	0.78	Level 0	0.2711 (m^2·K)/W	1500	1500	2200	1500
4	3.6886 W/(m^2·K)	0.9	1500	700	Windows_Dbl_Swept_Head: 910x910mm	0.78	Level 0	0.2711 (m^2·K)/W	1500	1500	2200	1500
5	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 0	0.1798 (m^2·K)/W	800	1100	2200	1100
6	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 0	0.1798 (m^2·K)/W	800	1100	2200	1100
7	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 0	0.1798 (m^2·K)/W	800	1100	2200	1100
8	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 0	0.1798 (m^2·K)/W	800	1100	2200	1100
9	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 0	0.1798 (m^2·K)/W	800	1100	2200	1100
10	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 0	0.1798 (m^2·K)/W	800	1100	2200	1100
11	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 0	0.1798 (m^2·K)/W	800	1100	2200	1100
12	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 0	0.1798 (m^2·K)/W	800	1100	2200	1100
13	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 0	0.1798 (m^2·K)/W	800	1100	2200	1100
14	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 0	0.1798 (m^2·K)/W	800	1100	2200	1100
15	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 0	0.1798 (m^2·K)/W	800	1100	2200	1100
16	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 0	0.1798 (m^2·K)/W	800	1100	2200	1100
18	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 0	0.1798 (m^2·K)/W	800	1100	2200	1100
19	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 0	0.1798 (m^2·K)/W	800	1100	2200	1100
22	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 0	0.1798 (m^2·K)/W	800	1100	2200	1100
23	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 0	0.1798 (m^2·K)/W	800	1100	2200	1100
25	3.6886 W/(m^2·K)	0.9	1500	700	Windows_Dbl_Swept_Head: 910x1210mm	0.78	Level 0	0.2711 (m^2·K)/W	1500	1500	2200	1500
26	3.6886 W/(m^2·K)	0.9	1500	700	Windows_Dbl_Swept_Head: 910x1210mm	0.78	Level 0	0.2711 (m^2·K)/W	1500	1500	2200	1500
27	3.6886 W/(m^2·K)	0.9	1500	700	Windows_Dbl_Swept_Head: 910x910mm	0.78	Level 1	0.2711 (m^2·K)/W	1500	1500	2200	1500
28	3.6886 W/(m^2·K)	0.9	1500	700	Windows_Dbl_Swept_Head: 910x910mm	0.78	Level 1	0.2711 (m^2·K)/W	1500	1500	2200	1500
29	3.6886 W/(m^2·K)	0.9	1500	700	Windows_Dbl_Swept_Head: 910x910mm	0.78	Level 1	0.2711 (m^2·K)/W	1500	1500	2200	1500
30	3.6886 W/(m^2·K)	0.9	1500	700	Windows_Dbl_Swept_Head: 910x910mm	0.78	Level 1	0.2711 (m^2·K)/W	1500	1500	2200	1500
31	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 1	0.1798 (m^2·K)/W	800	1100	2200	1100
32	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 1	0.1798 (m^2·K)/W	800	1100	2200	1100
33	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 1	0.1798 (m^2·K)/W	800	1100	2200	1100
34	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 1	0.1798 (m^2·K)/W	800	1100	2200	1100
35	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 1	0.1798 (m^2·K)/W	800	1100	2200	1100
38	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 1	0.1798 (m^2·K)/W	800	1100	2200	1100
39	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 1	0.1798 (m^2·K)/W	800	1100	2200	1100
40	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 1	0.1798 (m^2·K)/W	800	1100	2200	1100
43	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 1	0.1798 (m^2·K)/W	800	1100	2200	1100
44	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 1	0.1798 (m^2·K)/W	800	1100	2200	1100
45	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 1	0.1798 (m^2·K)/W	800	1100	2200	1100
46	5.5617 W/(m^2·K)	0.9	800	0	Windows_Sgl_Plain: 910x910mm	0.86	Level 1	0.1798 (m^2·K)/W	800	1100	1100	1100
47	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 1	0.1798 (m^2·K)/W	800	1100	2200	1100
48	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 1	0.1798 (m^2·K)/W	800	1100	2200	1100
49	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 1	0.1798 (m^2·K)/W	800	1100	2200	1100
50	5.5617 W/(m^2·K)	0.9	800	1100	Windows_Sgl_Plain: 910x910mm	0.86	Level 1	0.1798 (m^2·K)/W	800	1100	2200	1100
51	3.6886 W/(m^2·K)	0.9	1500	700	Windows_Dbl_Swept_Head: 910x1210mm	0.78	Level 1	0.2711 (m^2·K)/W	1500	1500	2200	1500
52	3.6886 W/(m^2·K)	0.9	1500	700	Windows_Dbl_Swept_Head: 910x1210mm	0.78	Level 1	0.2711 (m^2·K)/W	1500	1500	2200	1500

The number of Windows: 88

Type 1



Type 2



The number of Stairs: 9

The number of Railings: 20

The number of Walls: 216

- Wall Types
  - Exterior Wall
    - 280 mm
      - Area: 804.17 m^2
      - Volume: 225.17 m^3
  - Interior Wall
    - 280 mm
      - Area: 176.15 m^2
      - Volume: 49.32 m^3
    - 215 mm
      - Area: 32.33 m^2
      - Volume: 6.95 m^3
    - 100 mm
      - Area: 373.18 m^2
      - Volume: 37.32 m^3

Height of Walls: 2630mm

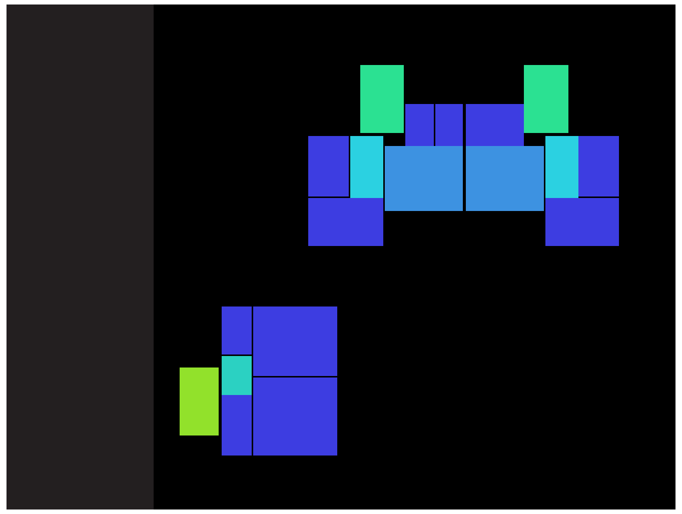
Summary

Firstly, we made the revit model. Second, We use the building information model to count the information of building components and classify the component types, such as windows, stairs and walls etc. The next step is to calculate the total number of components of each type. Then reusing them will be considered at first, then recycling, finally the components that are difficult to reuse or recycle will be demolished.

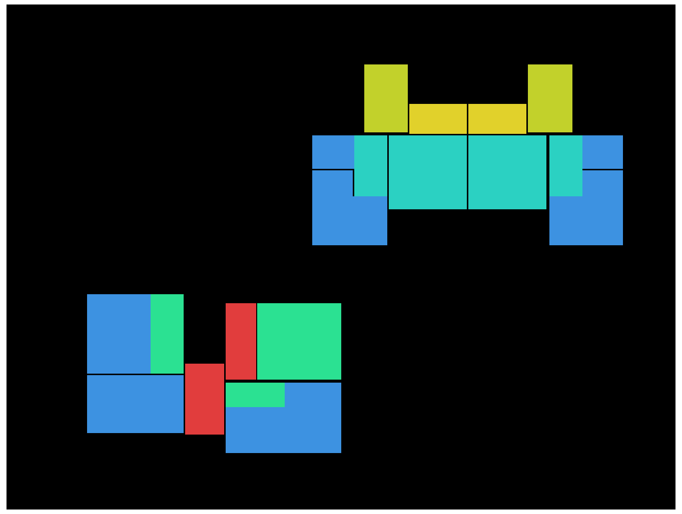
1.14 | Spatial Configuration Analysis

Existing

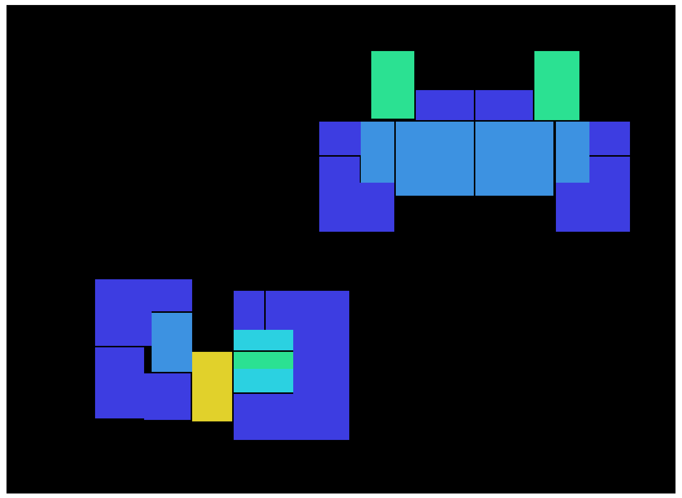
Ground floor



First floor

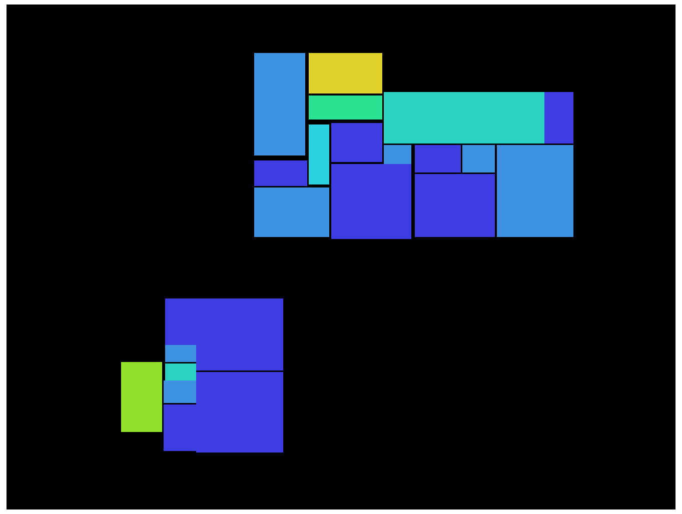


Second floor

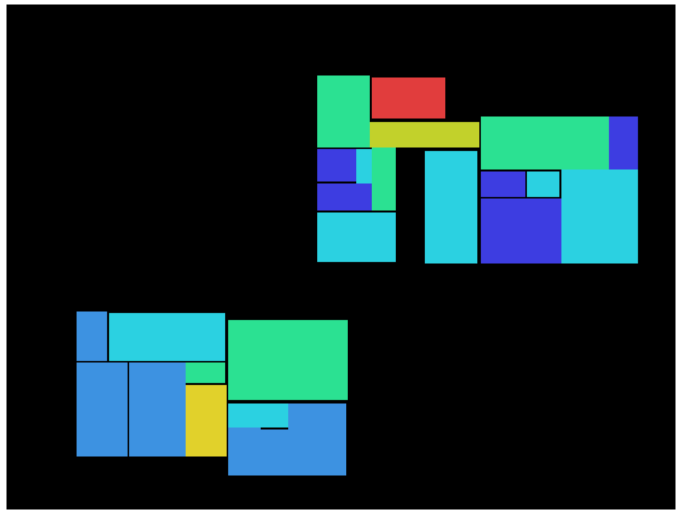


Proposed

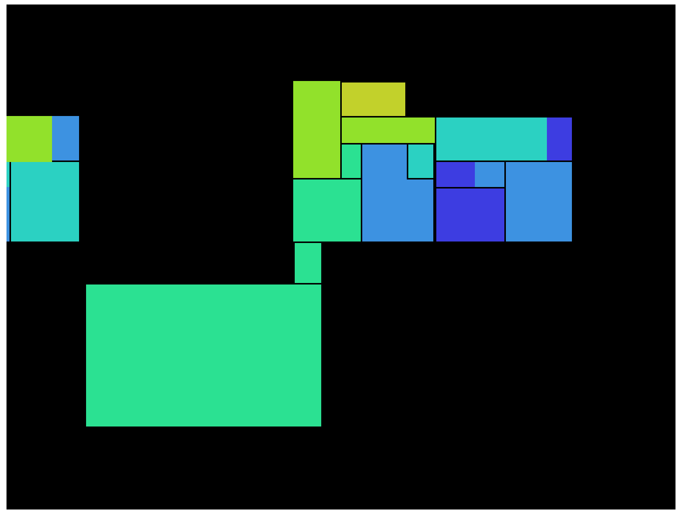
Ground floor



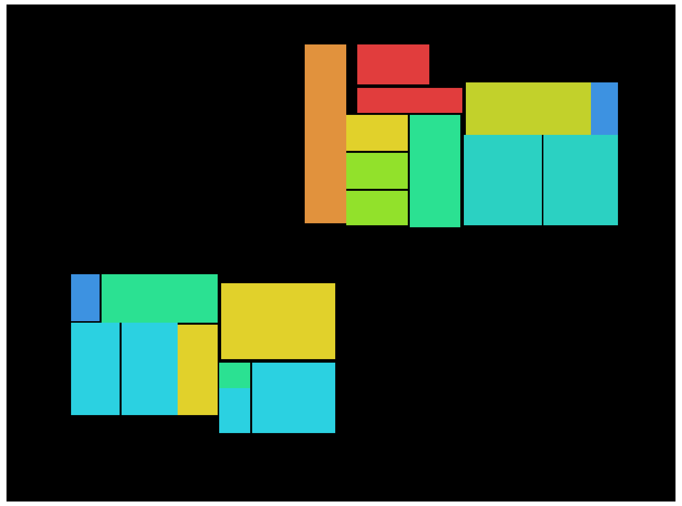
Second floor



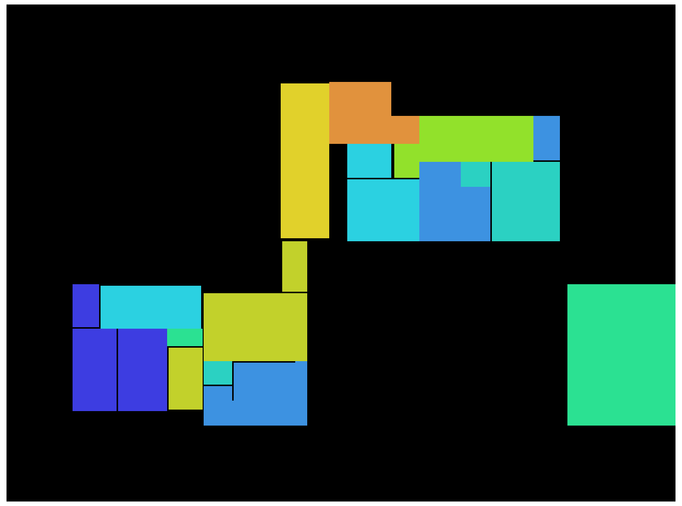
Fourth floor

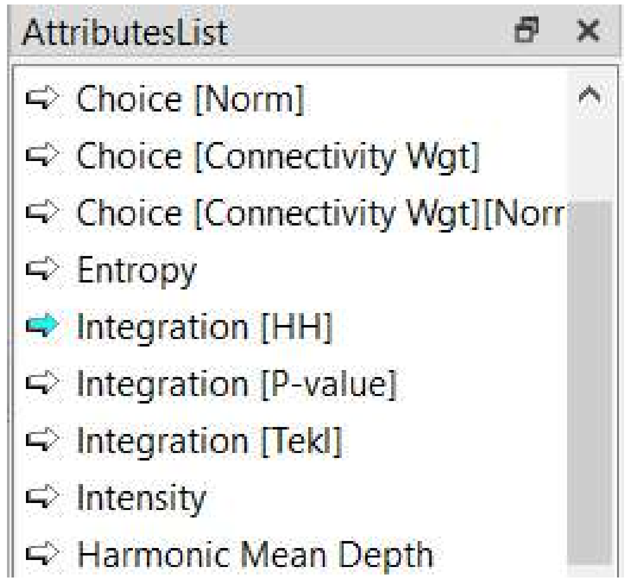


First floor



Third floor





Integration

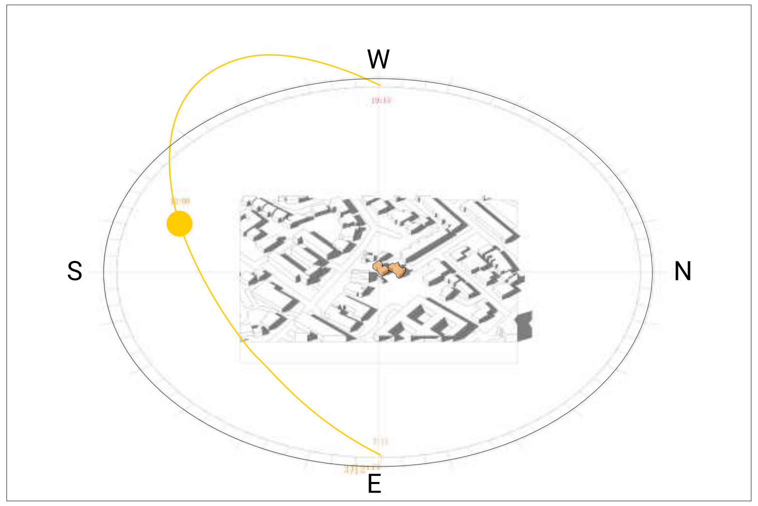
The level of accessibility in the space is generally characterised by the degree of social integration and the larger the degree of social integration, the higher the level of accessibility.(Red- large value / Blue-low value)

Summary

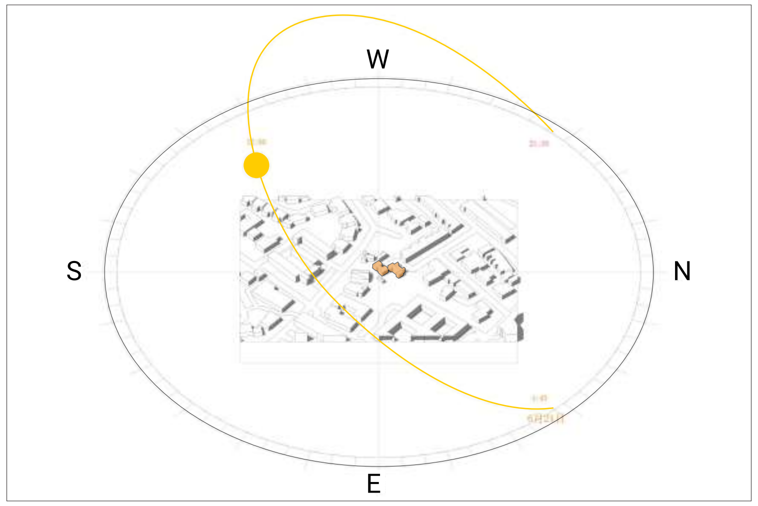
Existing - Spatial hierarchy is simple and lacks common area with high accessibility.
-High value of integration show in red mainly are staircases and entrance and low value show in blue mainly are bedrooms
Proposals:
Connections between the two buildings as well internspace need to be considered to improve accessibility.
Common areas can be expanded and vertical connection like double height space can be introduced.
Some buffer and transition space betweenn private and public can be considered.

1.15 | Solar Study

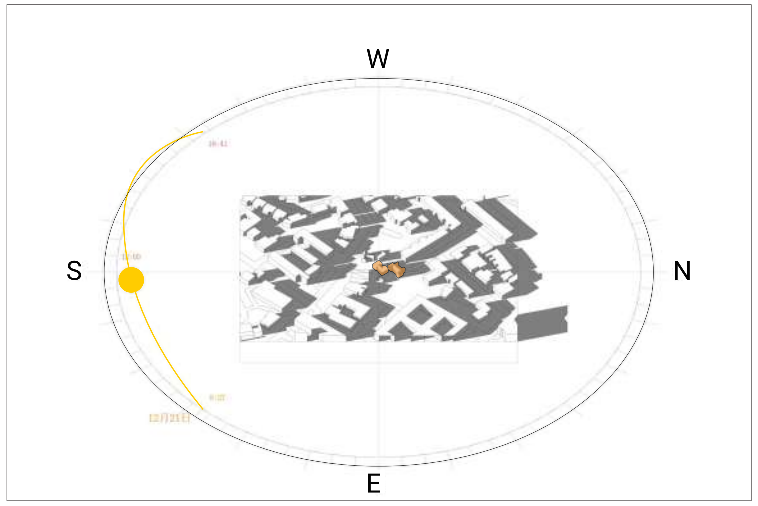
Spring Equinox Sun Path

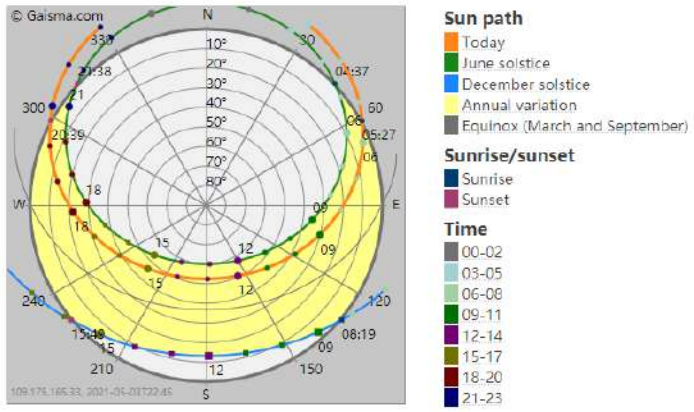


Summer Solstice Sun Path



Winter Solstice Sun Path





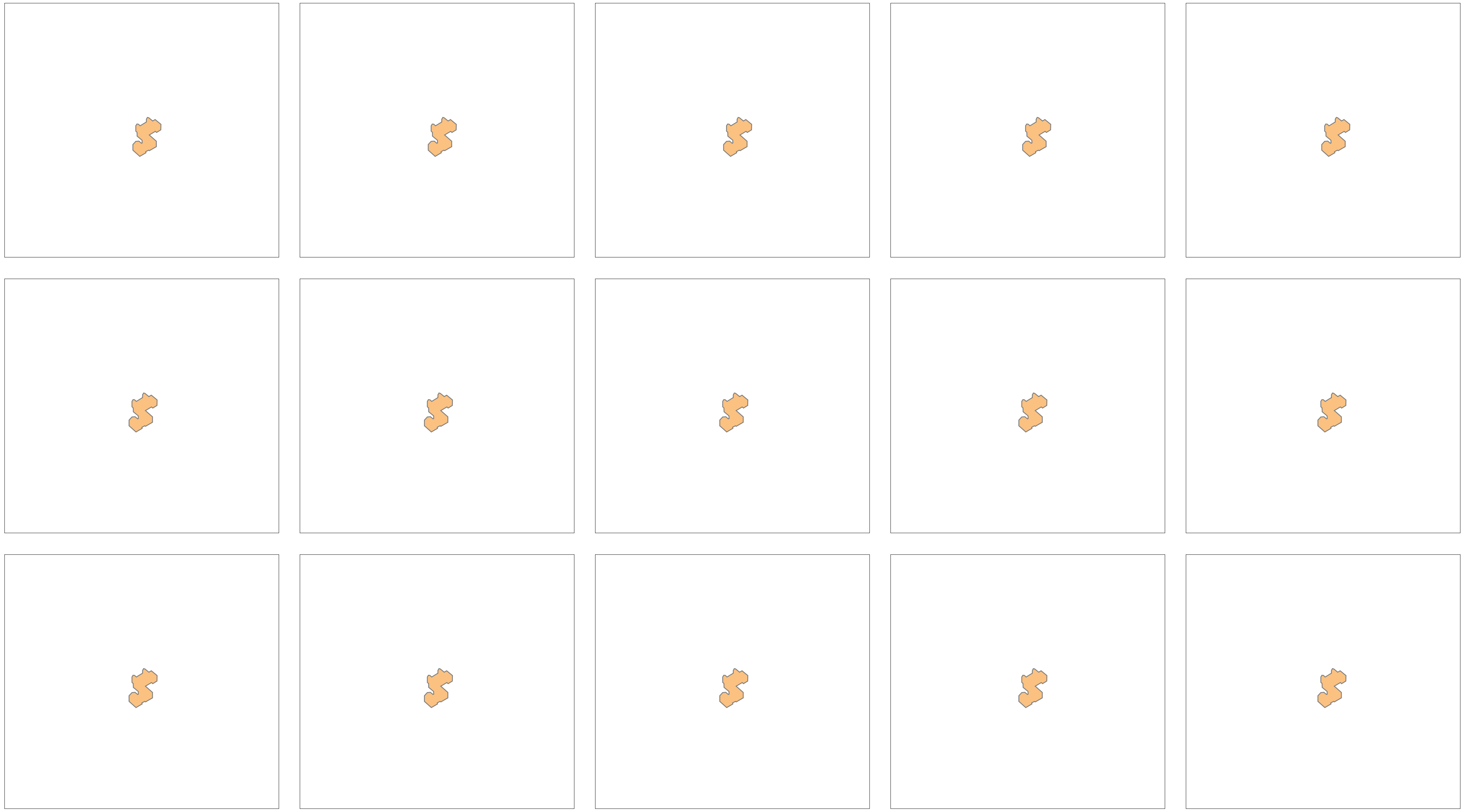
https://www.gaisma.com/en/location/sheffield.html

09:00 | 11:00 | 13:00 | 15:00 | 17:00

Spring Equinox

Summer Solstice

Winter Solstice



Summary

In the summer, the building is fully exposed to sunlight, with long daylight hours throughout the day.

In winter, the daylight is short and the building is in shadow for long periods of time throughout the day.

In general, the building height of the surrounding buildings is not high, with about two to three floors, and the ground floor of the building is not sufficiently insolated.

1.16 | Incident Solar Radiation

Summary

There is an obvious difference in the solar radiation between the south and north directions of the building.

The roof is suitable for solar panels, and the energy conversion efficiency will be higher if the roof is located in the south direction. As can be seen from the north aspect of the building, the solar radiation obtained from the building surface is very small, and it is more obvious in winter.

Annual | North Facade

Annual | South Facade

Spring | North Facade

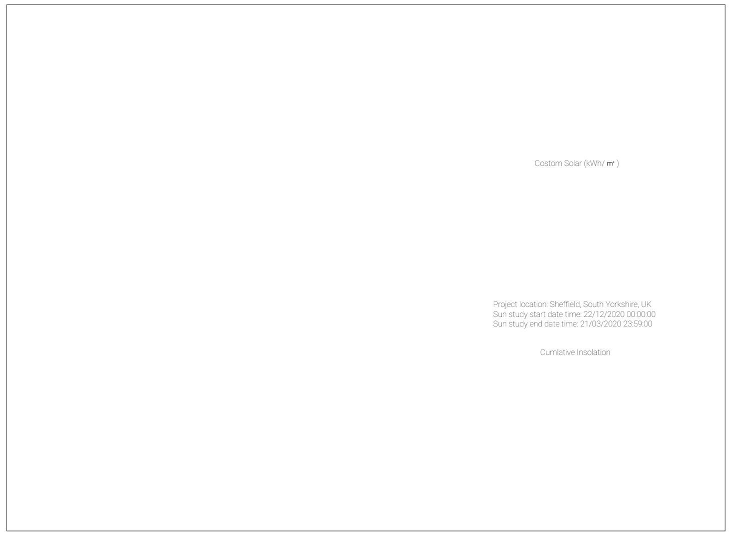
Spring | South Facade

Summer | North Facade

Summer | South Facade

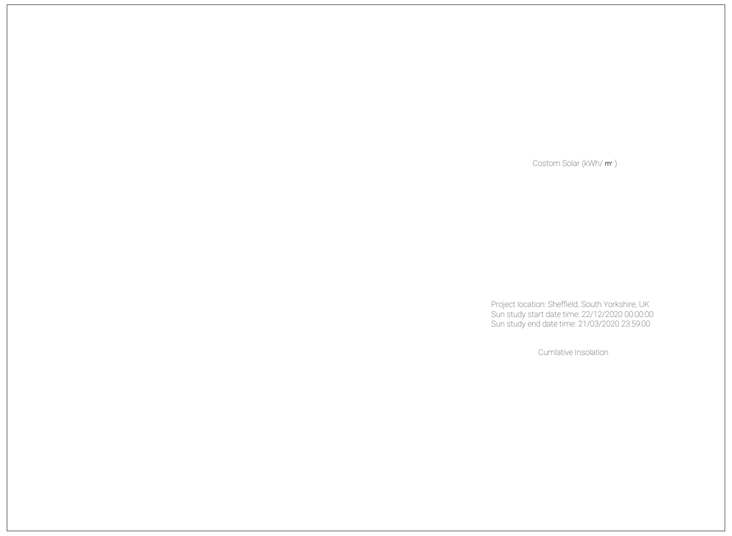
Autumn | North Facade

Autumn | South Facade



Winter | North Facade

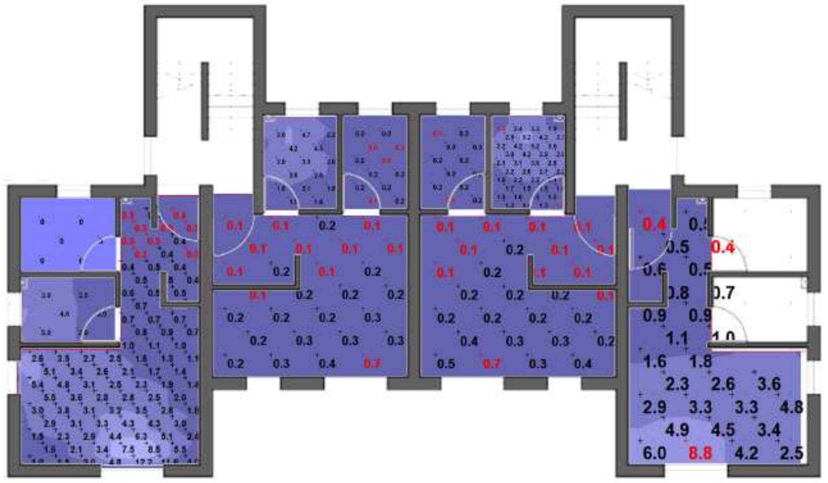
Winter | South Facade



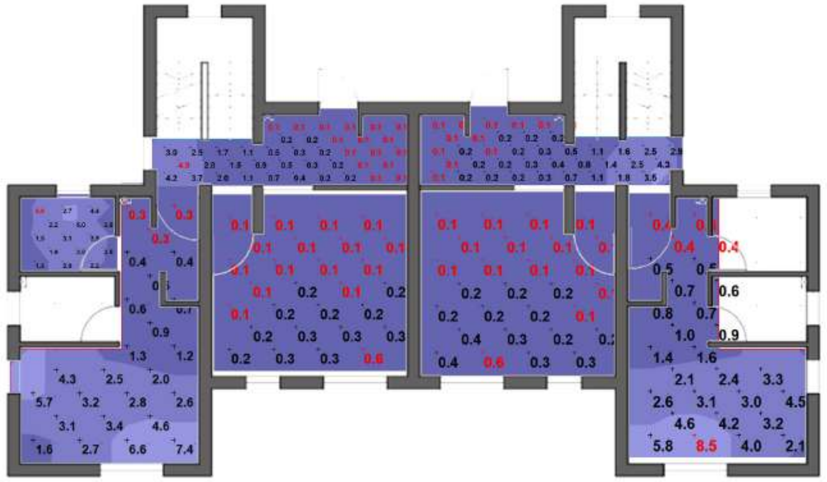
1.17 | Illuminance

DF for CIE Overcast Sky

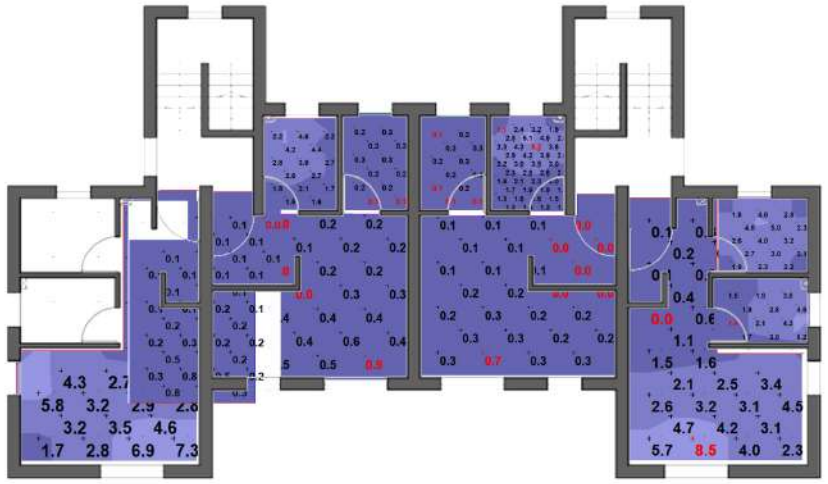
Building A - Lower Ground Floor



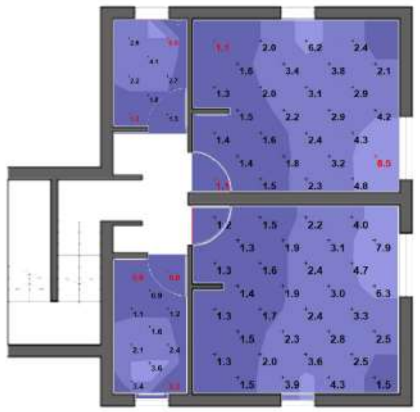
Building A - Ground Floor



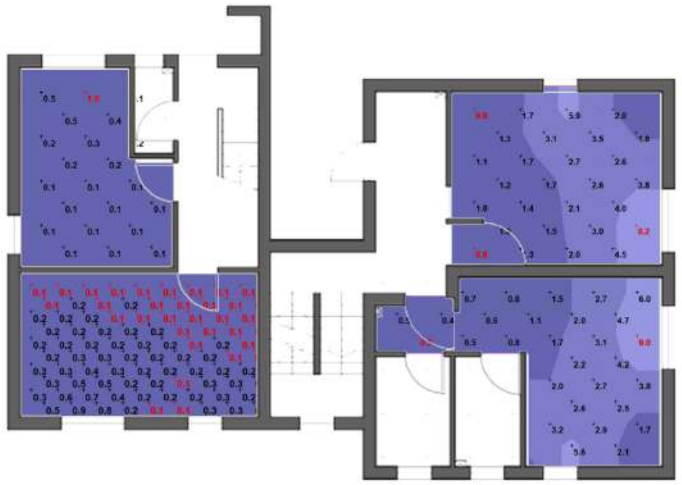
Building A - First Floor



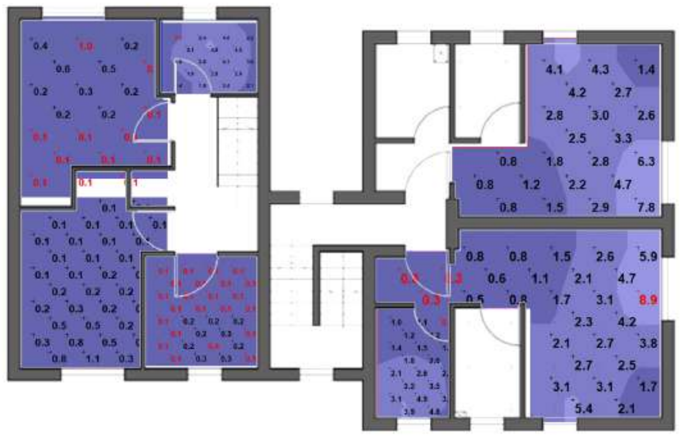
Building B - Lower Ground Floor



Building B - Ground Floor



Building B - First Floor



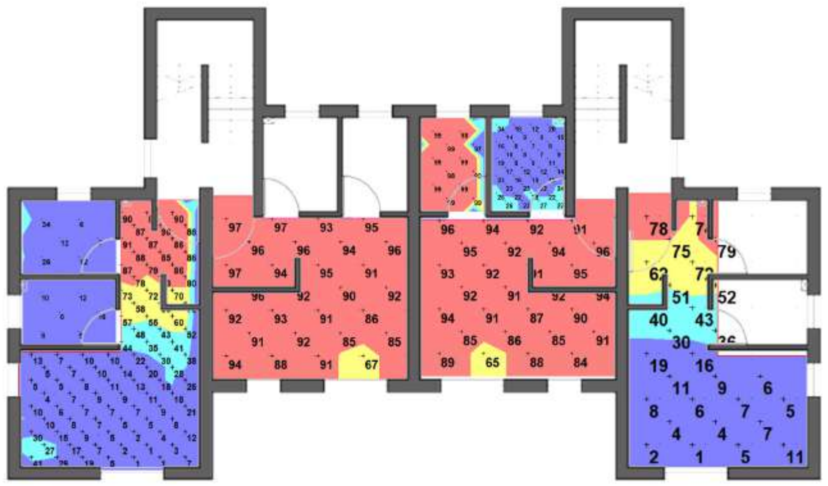
Summary

-The ground garden area is around 300 m² ,which is not enough for typical horizontal system
  Limited to the budget, vertical system is most effective but much more expensive
  Slinky coils are proposed considering the budget and efficiency
-Heating and cooling costs are often 50% less with a GSHP system.
-Colaborated with solar energy system on the roof,can operate the heat pump almost for free

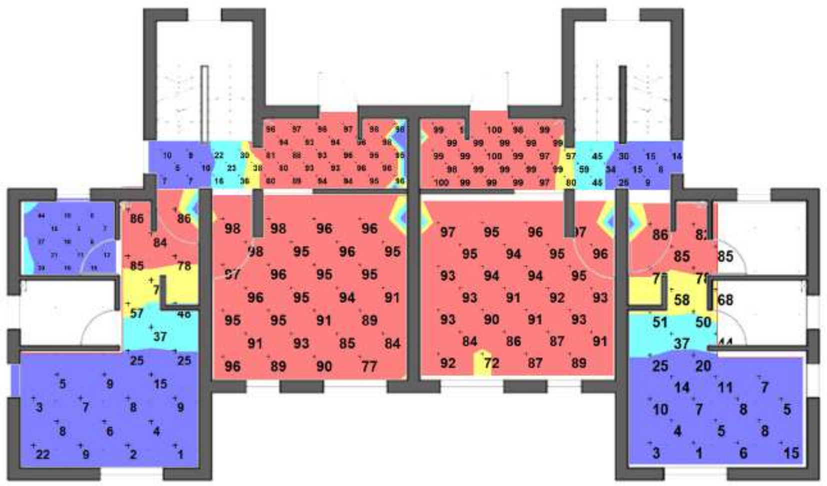
1.17 | Illuminance

[UDI] % < 100 Lux for Occupancy

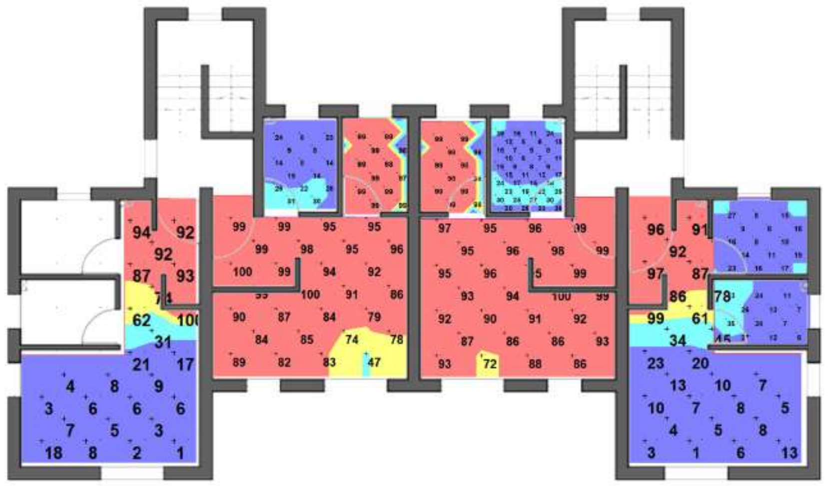
Building A - Lower Ground Floor



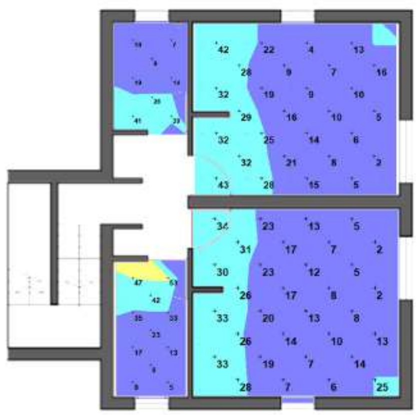
Building A - Ground Floor



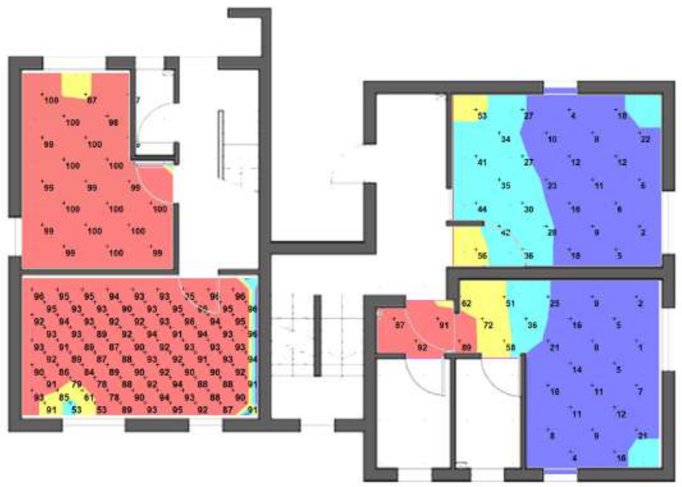
Building A - First Floor



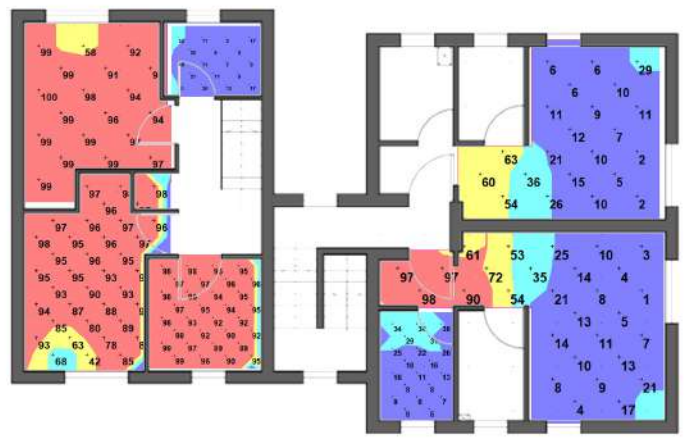
Building B - Lower Ground Floor



Building B - Ground Floor



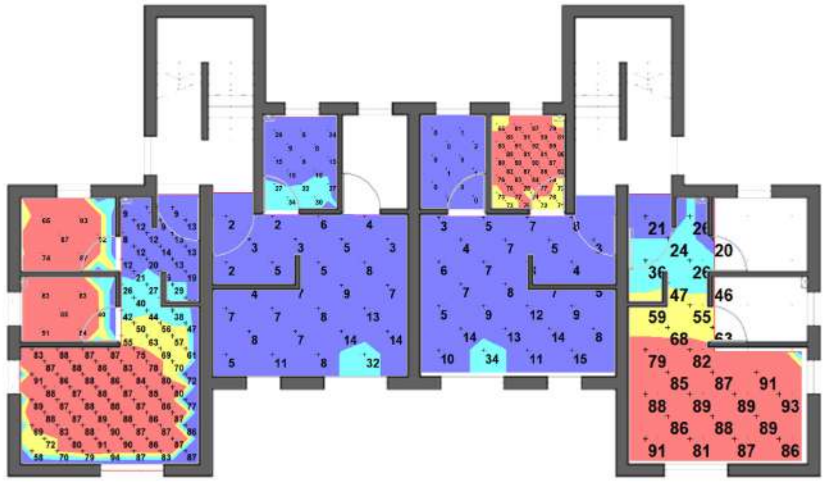
Building B - First Floor



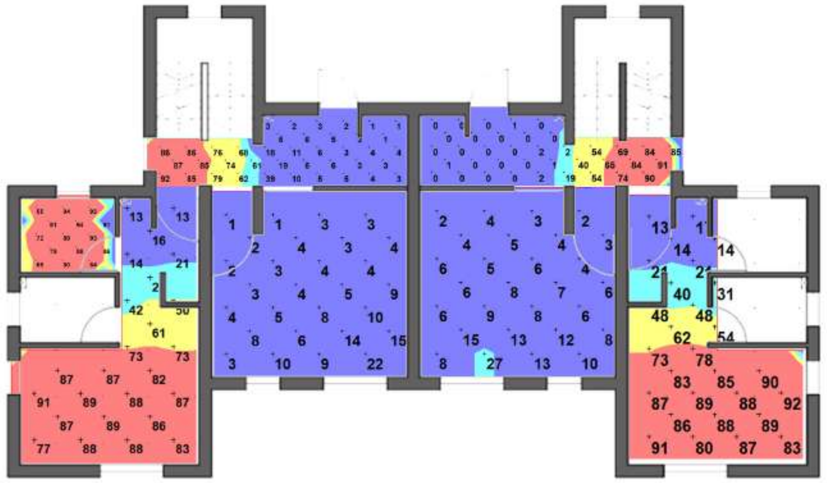
1.17 | Illuminance Analyais

[UDI] % 100-300 Lux for Occupancy

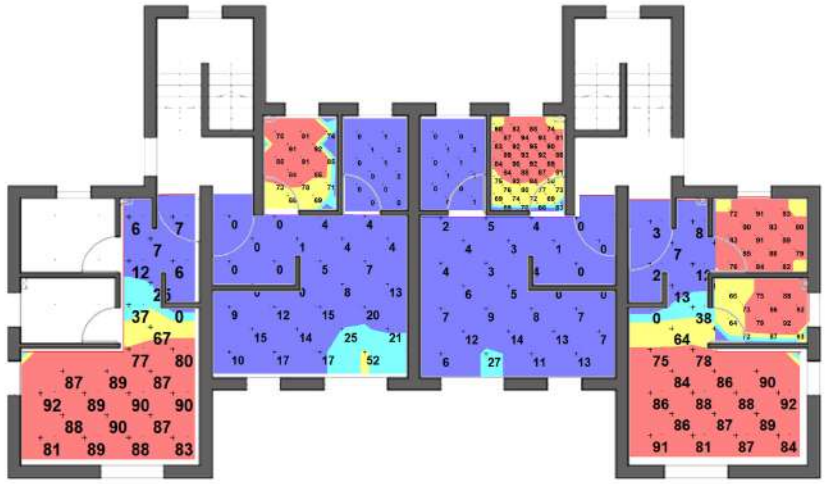
Building A - Lower Ground Floor



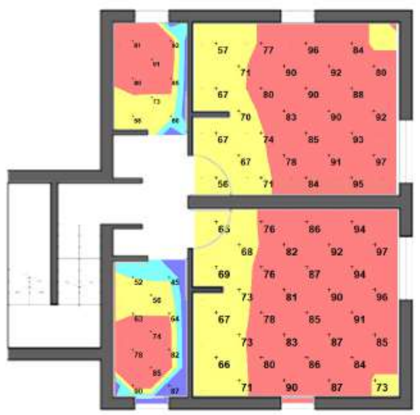
Building A - Ground Floor



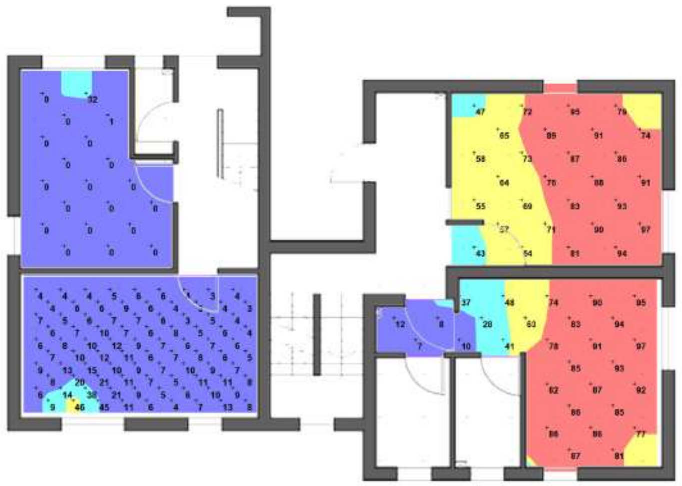
Building A - First Floor



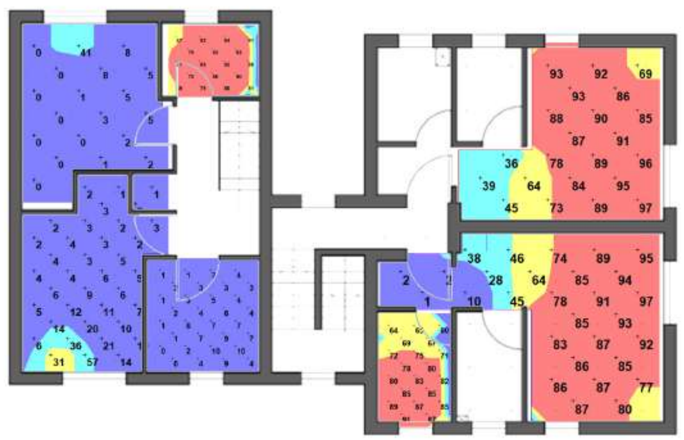
Building B - Lower Ground Floor



Building B - Ground Floor



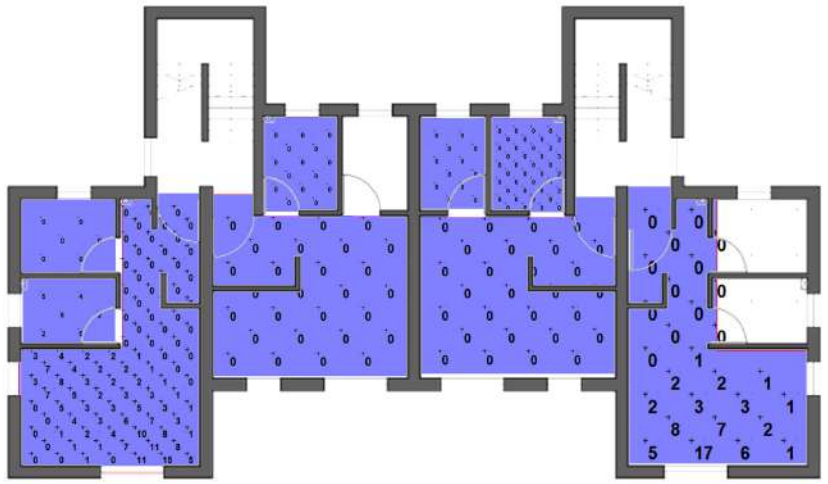
Building B - First Floor



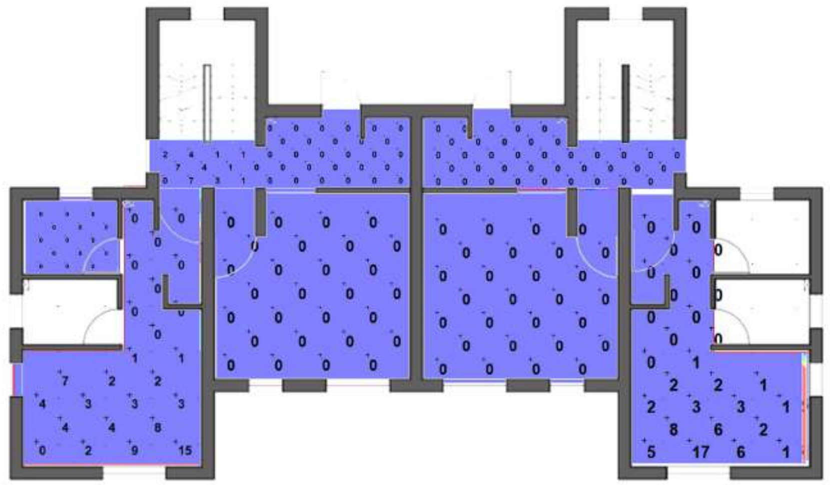
1.17 | Illuminance Analyais

[UDI] % > 3000 Lux for Occupancy

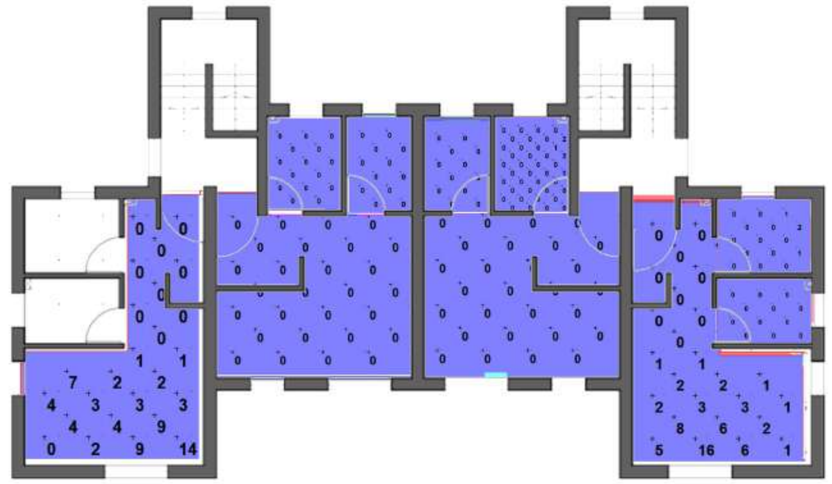
Building A - Lower Ground Floor



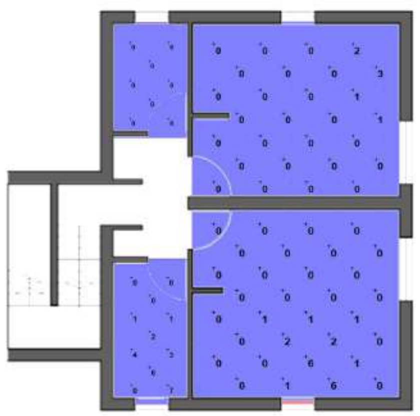
Building A - Ground Floor



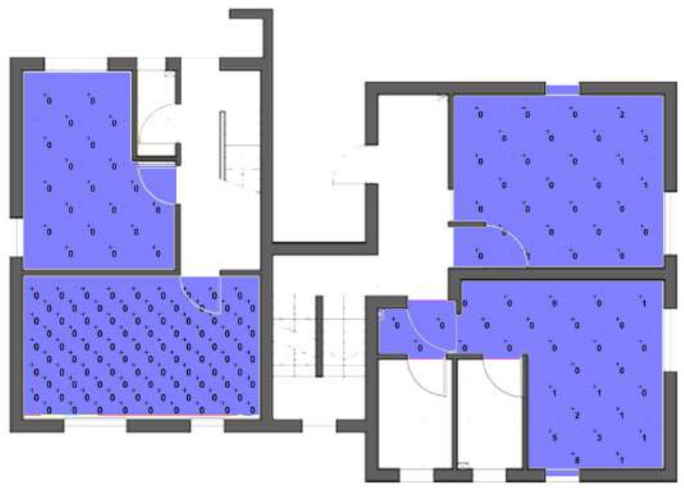
Building A - First Floor



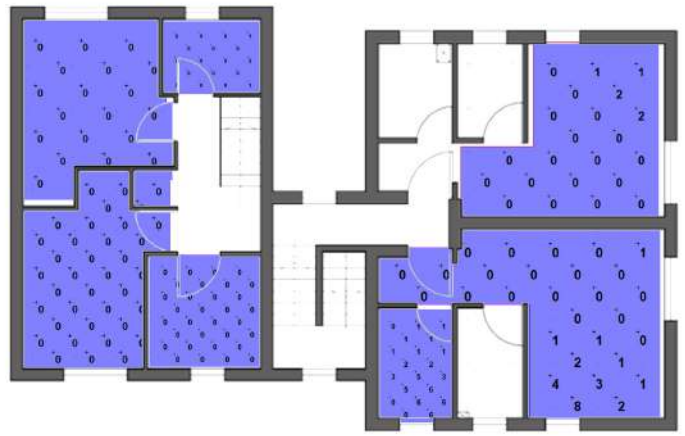
Building B - Lower Ground Floor



Building B - Ground Floor



Building B - First Floor

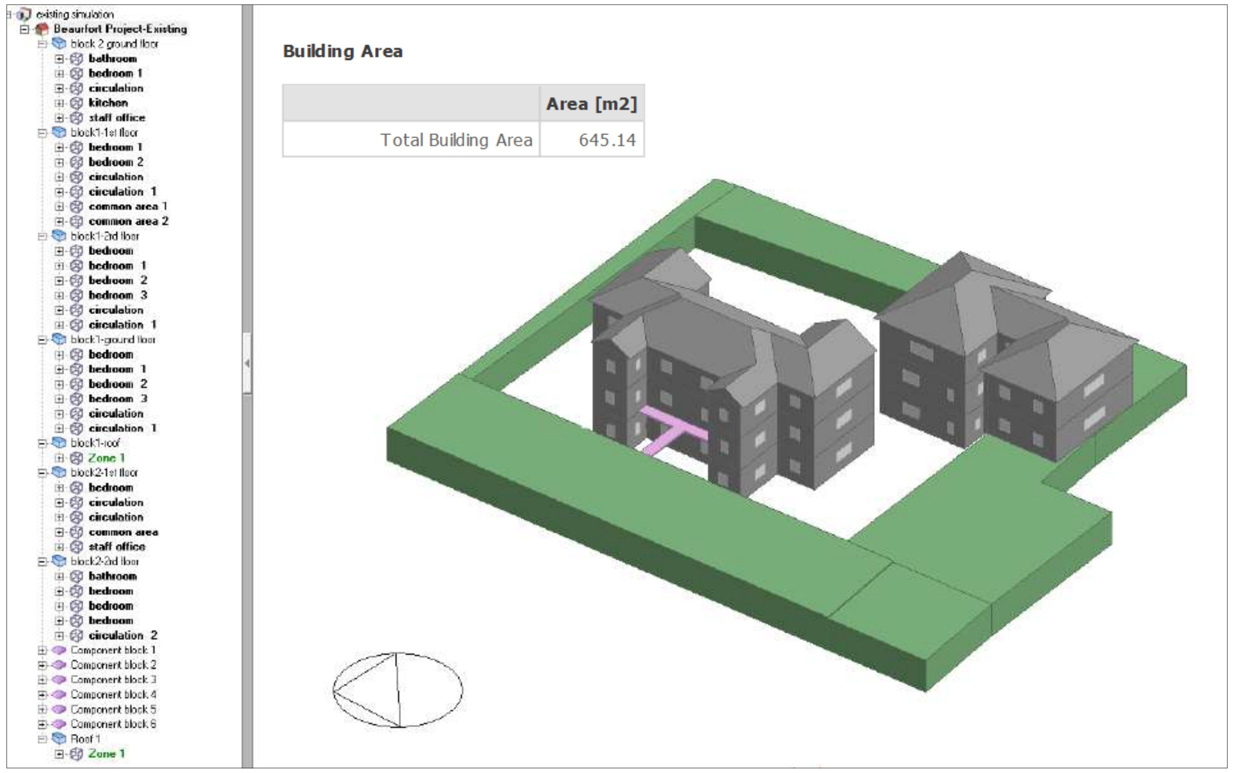


Summary

Each room of the two buildings are evaluated according to CBDM in IESVE. Basically, most of therooms are experiencing insufficient daylight. Only one slef-contained flat and three nbedrooms achieve good average UDI(>80), artificial l lighting and strategies of passive lighting need to be considered.

1.18 | Energy Analysis

Energy Model



Site to Source Energy Conversion Factors

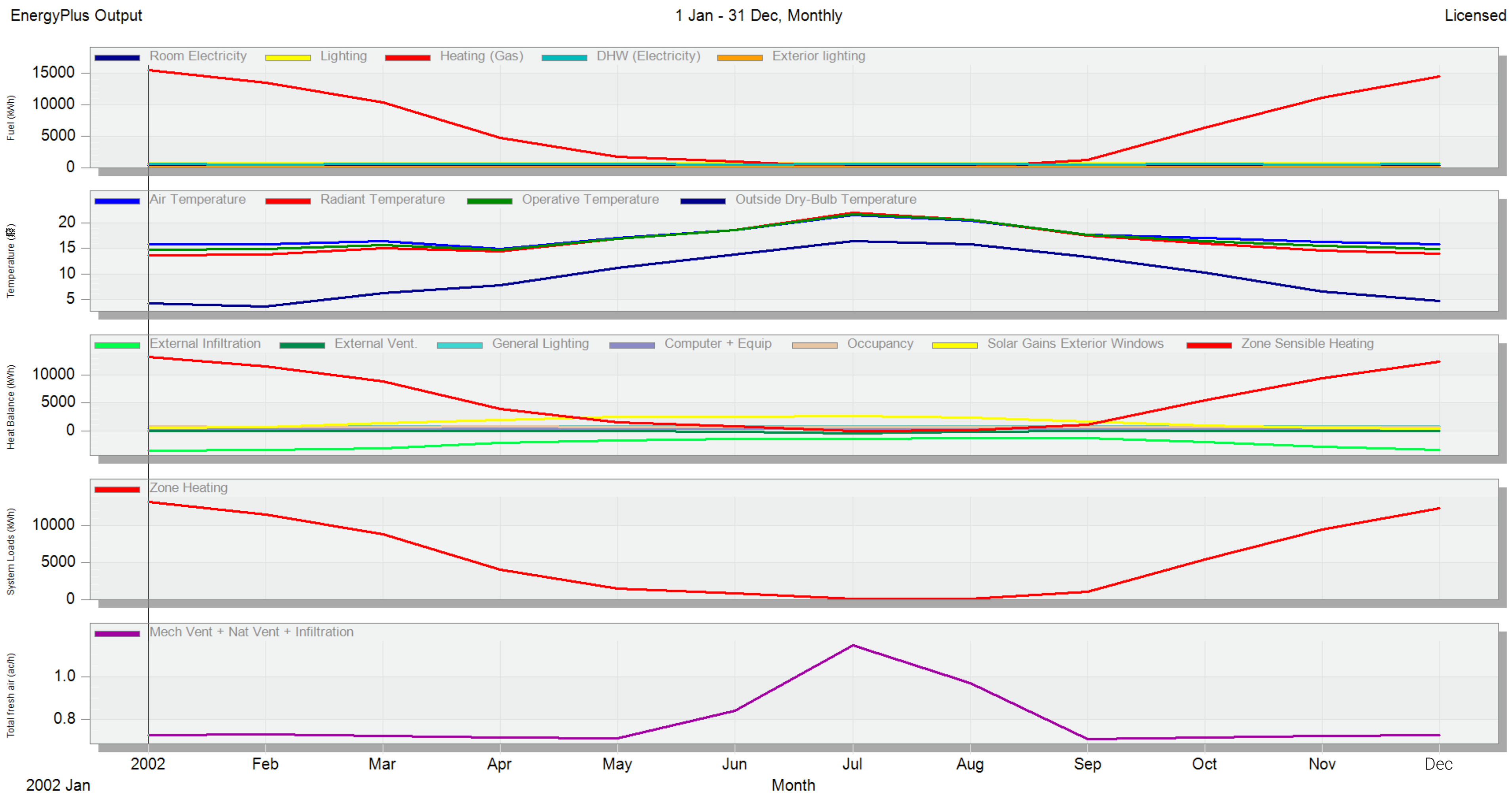
	Site=>Source Conversion Factor
Electricity	3.167
Natural Gas	1.084
District Cooling	1.056
District Heating	3.613
Steam	0.250
Gasoline	1.050
Diesel	1.050
Coal	1.050
Fuel Oil #1	1.050
Fuel Oil #2	1.050
Propane	1.050
Other Fuel 1	1.000
Other Fuel 2	1.000

Site to Source Energy Conversion Factors

Total Site Energy: 134.24 kWh/m^2 yr

	Total Energy [kWh]	Energy Per Total Building Area [kWh/m2]
Total Site Energy	86600.46	134.24
Net Site Energy	86600.46	134.24
Total Source Energy	307061.25	475.96
Net Source Energy	307061.25	475.96

Temperatures, Heat Gains and Energy Consumption existing Simulation, Beaurfort Project-Existing

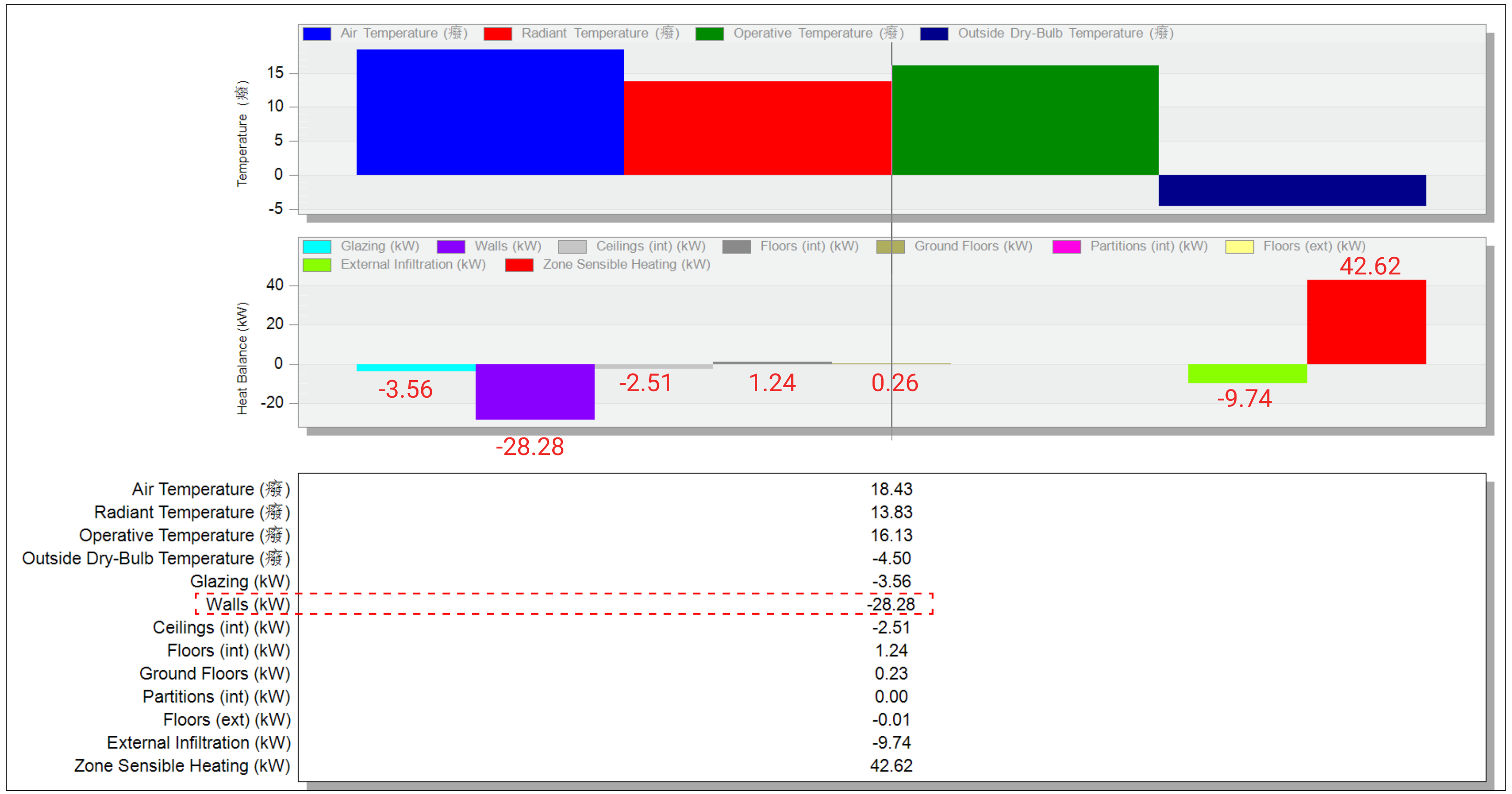


Summary

The energy requirements of the building are analyzed through-out the year by creating an energy model in DesignBuilder. The total construction area is 645.14 square meters. In the Beaurfort project, the main factors affecting energy consumption are the coal and gas consumed by the building's electricity and heating system.

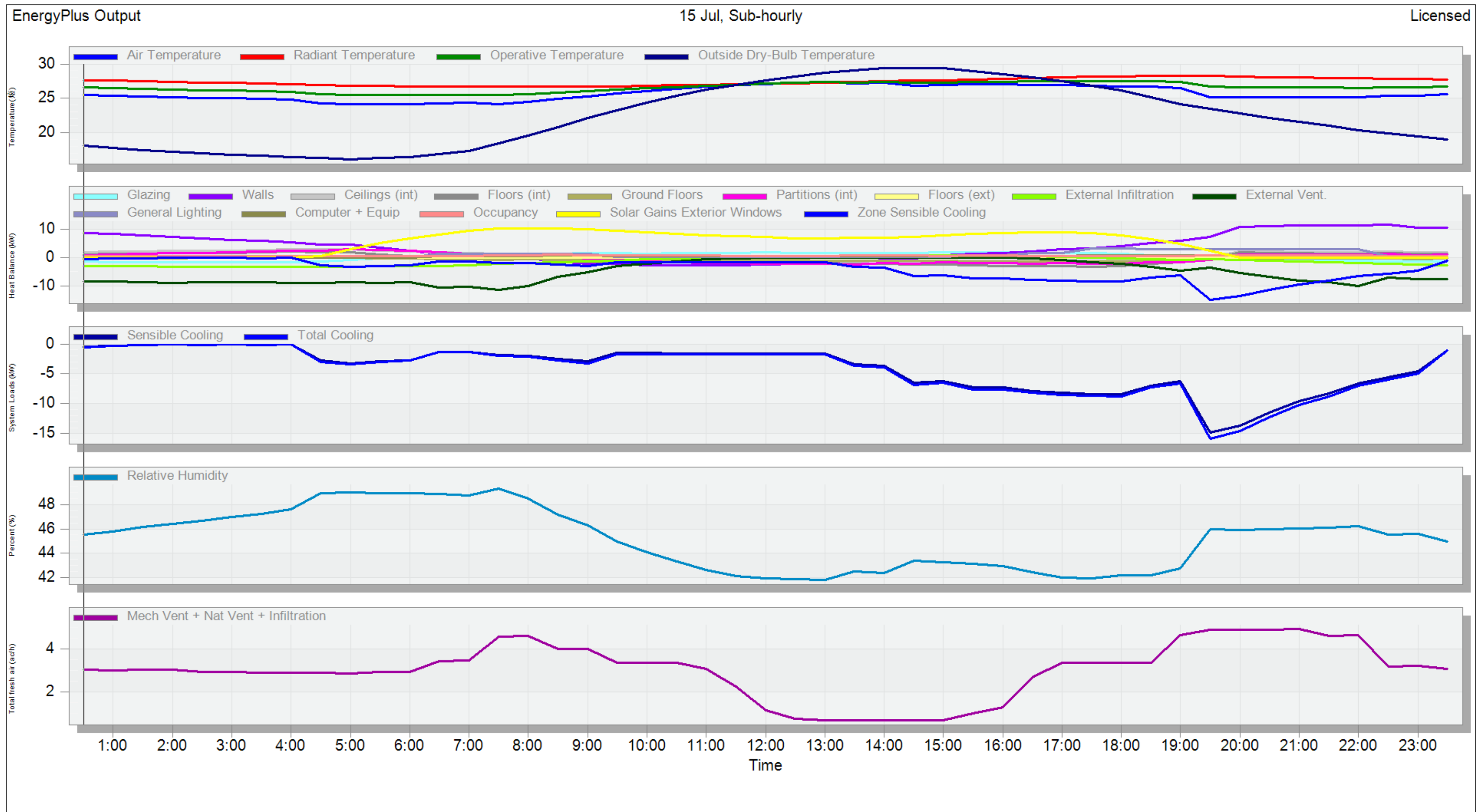
The total energy consumption of the building for the whole year is 503.55 kilowatt hours per square meter. Although there are solar panels on the roof of the building, which are used to obtain renewable energy, it is not enough to meet the existing requirements as a whole. And in summer, buildings have the problem of overheating, which will consume more energy on cooling.

Temperature and Heat Loss



Temperatures, Heat Gains and Energy Consumption existing Simulation

Beaufort Project-Existing | Summer



Heating Summary

Block	Zone	Comfort Temperature (°C)	Steady-State Heat Loss (kW)	Design Capacity (kW)	Design Capacity (W/m2)	Glazing Gains (kW)	Wall Gains (kW)	Floor Gains (kW)	Roof and Ceiling G...	Ventilation Gains (...	Infiltration Gains (k...
Beaufort Project-Existing Total Design Heating Capacity = 53.250 (kW)											
block 2 ground floor Total Design Heating Capacity = 5.180 (kW)											
block 2 ground floor	bathroom	16.31	0.41	**0.52**	81.2656	-0.029	-0.273	0.006	-0.020	0.000	-0.096
block 2 ground floor	circulation	16.36	0.75	**0.93**	72.5920	-0.055	-0.474	0.012	-0.034	0.000	-0.195
block 2 ground floor	bedroom 1	15.98	1.18	**1.48**	69.5185	-0.104	-0.741	0.022	-0.037	0.000	-0.323
block 2 ground floor	kitchen	15.71	0.44	**0.55**	131.4830	-0.045	-0.340	0.006	0.002	0.000	-0.064
block 2 ground floor	staff office	17.48	1.36	**1.70**	90.0825	-0.107	-0.902	0.013	-0.051	0.000	-0.312
block1-1st floor Total Design Heating Capacity = 10.540 (kW)											
block1-1st floor	circulation 1	15.71	1.30	**1.63**	88.9777	-0.123	-0.920	0.041	-0.034	0.000	-0.267
block1-1st floor	common area 2	18.57	1.15	**1.43**	85.1885	-0.056	-0.593	-0.080	-0.139	0.000	-0.279
block1-1st floor	bedroom 2	15.44	1.77	**2.21**	85.8116	-0.159	-1.209	0.048	-0.072	0.000	-0.376
block1-1st floor	bedroom 1	15.44	1.77	**2.21**	85.8352	-0.160	-1.215	0.050	-0.070	0.000	-0.377
block1-1st floor	circulation	15.70	1.30	**1.63**	89.6061	-0.123	-0.918	0.040	-0.035	0.000	-0.265
block1-1st floor	common area 1	18.58	1.15	**1.43**	84.6617	-0.056	-0.594	-0.079	-0.137	0.000	-0.280
block1-2rd floor Total Design Heating Capacity = 9.950 (kW)											
block1-2rd floor	circulation 1	15.40	0.95	**1.19**	112.3897	-0.087	-0.693	0.043	-0.061	0.000	-0.155
block1-2rd floor	bedroom 2	16.27	1.17	**1.46**	59.9297	-0.086	-0.723	0.129	-0.134	0.000	-0.357
block1-2rd floor	bedroom 1	15.32	1.85	**2.32**	90.3249	-0.158	-1.254	0.072	-0.139	0.000	-0.375
block1-2rd floor	bedroom	15.33	1.89	**2.36**	88.2728	-0.161	-1.263	0.073	-0.143	0.000	-0.390
block1-2rd floor	circulation	15.36	0.93	**1.16**	121.8491	-0.086	-0.689	0.042	-0.056	0.000	-0.139
block1-2rd floor	bedroom 3	16.27	1.17	**1.46**	59.9634	-0.086	-0.722	0.127	-0.134	0.000	-0.357
block1-ground floor Total Design Heating Capacity = 9.640 (kW)											
block1-ground floor	circulation 1	15.46	0.93	**1.16**	109.5472	-0.089	-0.688	0.015	-0.006	0.000	-0.161
block1-ground floor	bedroom 2	16.35	1.12	**1.39**	57.1052	-0.089	-0.721	0.020	0.045	0.000	-0.370
block1-ground floor	bedroom 1	15.38	1.81	**2.27**	88.3564	-0.163	-1.248	0.035	-0.048	0.000	-0.389
block1-ground floor	bedroom	15.40	1.84	**2.30**	86.2371	-0.166	-1.256	0.036	-0.051	0.000	-0.405
block1-ground floor	circulation	15.42	0.91	**1.13**	118.8161	-0.088	-0.683	0.014	-0.003	0.000	-0.145
block1-ground floor	bedroom 3	16.35	1.12	**1.39**	57.0659	-0.089	-0.720	0.020	0.043	0.000	-0.371
block1-roof Total Design Heating Capacity = 0.000 (kW)											
block1-roof	Zone 1	-4.50	0.00	**0.00**	0.0000	0.000	-0.011	0.667	-0.654	0.000	-0.002
block2-1st floor Total Design Heating Capacity = 9.470 (kW)											
block2-1st floor	common area	18.01	2.72	**3.40**	102.3230	-0.203	-1.668	0.017	-0.297	0.000	-0.573
block2-1st floor	staff office	17.38	1.39	**1.73**	93.5558	-0.103	-0.889	0.049	-0.149	0.000	-0.295
block2-1st floor	bedroom	15.92	1.59	**1.99**	67.3263	-0.132	-1.019	0.063	-0.069	0.000	-0.431
block2-1st floor	circulation	15.94	0.78	**0.98**	91.2175	-0.079	-0.510	0.005	-0.036	0.000	-0.163
block2-1st floor	circulation	16.06	1.10	**1.37**	85.4035	-0.099	-0.751	0.031	-0.044	0.000	-0.235
block2-2rd floor Total Design Heating Capacity = 8.470 (kW)											
block2-2rd floor	bathroom	15.55	0.58	**0.72**	126.1524	-0.052	-0.433	0.025	-0.035	0.000	-0.084
block2-2rd floor	bedroom	15.61	1.69	**2.11**	80.8906	-0.152	-1.191	0.177	-0.142	0.000	-0.382
block2-2rd floor	bedroom	15.77	1.74	**2.18**	70.3130	-0.132	-1.065	0.073	-0.165	0.000	-0.453
block2-2rd floor	bedroom	15.77	2.22	**2.77**	71.6244	-0.195	-1.554	0.308	-0.209	0.000	-0.565
block2-2rd floor	circulation 2	16.04	0.55	**0.69**	90.3248	-0.043	-0.363	0.013	-0.045	0.000	-0.111
Roof 1 Total Design Heating Capacity = 0.000 (kW)											
Roof 1	Zone 1	-4.54	0.00	**0.00**	0.0000	0.000	0.000	0.597	-0.596	0.000	-0.001

Total Design Heating Capacity =53.250 [kw]

Cooling Summary

Zone	Block	Design Capacity (kW)	Design Flow Rate (m3/s)	Total Cooling Load (kW)	Sensible (kW)	Latent (kW)	Air Temperature (°C)	Humidity (%)	Time of Max Cooli...	Max Op Temp in Day (°C)	Floor Area (m2)	Volume (m3)	Flow/F
Beaufort Project-Existing													
Zone 1	Roof 1	0.00	0.000	0.00	0.00	0.00	-	-	Jul 15:00	56.73	130.006	98.365	0.000
bathroom	block2-2rd floor	**0.29**	**0.018**	0.25	0.25	0.00	25.00	44.7	Jul 18:30	27.64	5.740	14.521	3.190
bedroom	block2-2rd floor	**0.65**	**0.038**	0.57	0.52	0.05	24.99	46.6	Jul 19:30	27.87	26.129	66.107	1.455
bedroom	block2-2rd floor	**1.90**	**0.121**	1.65	1.65	0.00	25.00	41.8	Aug 20:00	29.82	38.664	97.821	3.132
circulation 2	block2-2rd floor	**0.31**	**0.020**	0.27	0.27	0.00	25.00	42.6	Aug 17:30	27.67	7.586	19.194	2.639
bedroom	block2-2rd floor	**0.96**	**0.061**	0.84	0.84	0.00	25.00	42.6	Aug 19:30	28.54	30.983	78.386	1.978
common area	block2-1st floor	**1.82**	**0.116**	1.58	1.58	0.00	25.00	42.4	Aug 17:30	28.97	33.277	87.518	3.480
staff office	block2-1st floor	**1.15**	**0.078**	1.00	0.90	0.09	23.00	52.5	Jul 16:00	26.99	18.519	46.853	4.221
bedroom	block2-1st floor	**0.88**	**0.056**	0.77	0.77	0.00	24.99	42.6	Aug 19:30	28.47	29.491	74.612	1.909
circulation	block2-1st floor	**0.40**	**0.025**	0.35	0.34	0.01	25.00	45.4	Jul 18:30	27.08	10.709	28.164	2.293
circulation	block2-1st floor	**0.54**	**0.034**	0.47	0.47	0.00	25.00	42.9	Aug 18:00	27.22	16.067	40.648	2.143
Zone 1	block1-roof	0.00	0.000	0.00	0.00	0.00	-	-	Jul 15:00	54.35	141.089	109.162	0.000
circulation	block1-ground floor	**0.37**	**0.022**	0.32	0.31	0.01	25.00	45.4	Jul 18:30	26.97	9.532	25.070	2.347
bedroom	block1-ground floor	**0.73**	**0.047**	0.64	0.64	0.00	24.99	42.6	Aug 19:30	28.18	26.704	70.232	1.752
bedroom 3	block1-ground floor	**0.60**	**0.038**	0.52	0.52	0.00	24.98	42.6	Aug 19:30	28.00	24.430	64.250	1.563
bedroom 1	block1-ground floor	**1.17**	**0.074**	1.02	1.02	0.00	25.01	42.5	Aug 19:30	29.48	25.662	67.492	2.894
bedroom 2	block1-ground floor	**0.61**	**0.039**	0.53	0.53	0.00	24.98	42.6	Aug 19:30	27.97	24.417	64.217	1.599
circulation 1	block1-ground floor	**0.50**	**0.032**	0.44	0.44	0.00	25.00	42.5	Aug 17:30	27.71	10.593	27.860	3.020
circulation	block1-2rd floor	**0.42**	**0.026**	0.36	0.35	0.01	25.00	45.3	Jul 18:30	27.43	9.532	24.116	2.691
bedroom	block1-2rd floor	**0.84**	**0.054**	0.73	0.73	0.00	25.00	42.6	Aug 19:30	28.44	26.704	67.561	2.012
bedroom 3	block1-2rd floor	**0.67**	**0.043**	0.59	0.59	0.00	24.99	42.6	Aug 19:30	28.18	24.430	61.807	1.754
bedroom 1	block1-2rd floor	**1.35**	**0.086**	1.18	1.18	0.00	25.00	42.5	Aug 20:00	29.61	25.662	64.926	3.358
bedroom 2	block1-2rd floor	**0.70**	**0.045**	0.61	0.61	0.00	24.99	42.6	Aug 19:30	28.23	24.417	61.775	1.835
circulation 1	block1-2rd floor	**0.52**	**0.033**	0.45	0.45	0.00	25.00	42.8	Aug 18:00	27.88	10.593	26.801	3.124
circulation 1	block1-1st floor	**0.71**	**0.043**	0.62	0.59	0.02	25.00	45.4	Jul 18:30	27.39	18.299	46.297	2.370
common area 2	block1-1st floor	**0.65**	**0.042**	0.57	0.57	0.00	25.00	42.5	Aug 17:30	27.99	16.825	42.568	2.473
bedroom 2	block1-1st floor	**1.33**	**0.085**	1.16	1.16	0.00	25.00	42.5	Aug 20:00	29.50	25.749	65.144	3.292
bedroom 1	block1-1st floor	**0.78**	**0.050**	0.68	0.68	0.00	24.99	42.6	Aug 19:30	28.33	25.804	65.284	1.924
circulation	block1-1st floor	**0.63**	**0.038**	0.55	0.53	0.02	25.00	45.5	Jul 18:30	27.18	18.163	45.953	2.117
common area 1	block1-1st floor	**0.63**	**0.040**	0.54	0.54	0.00	25.00	42.5	Aug 17:30	27.82	16.906	42.773	2.353
bathroom	block 2 ground floor	**0.30**	**0.019**	0.26	0.26	0.00	25.00	41.8	Aug 17:00	28.05	6.359	16.725	2.957
circulation	block 2 ground floor	**0.40**	**0.025**	0.35	0.35	0.00	25.00	42.6	Aug 17:30	27.05	12.866	33.837	1.965
bedroom 1	block 2 ground floor	**0.71**	**0.045**	0.62	0.62	0.00	25.00	41.8	Aug 20:00	28.45	21.264	55.926	2.138
kitchen	block 2 ground floor	**0.23**	**0.014**	0.20	0.20	0.00	25.00	44.7	Jul 18:30	27.11	4.204	11.056	3.413
staff office	block 2 ground floor	**1.12**	**0.076**	0.98	0.88	0.10	23.00	52.6	Jul 16:00	26.66	18.858	49.597	4.040
Totals	-	**24.91**	**1.585**	**21.66**	**21.33**	**0.33**	**22.11**	**38.7**	**N/A**	**56.73**	**916.235**	**1862.617**	**1.730**

Total Cooling Capacity =24.91 [kw]

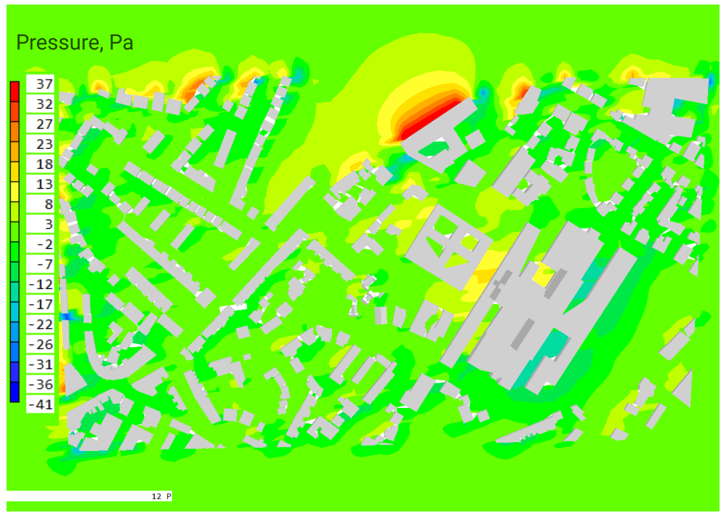
Summary

Through the analysis results, the existing wall is the main cause of heat loss, it is necessary to transform the wall, through a series of measures such as increasing thermal insulation to reduce heat loss and improve energy efficiency. Although there is no air conditioning and other refrigeration equipment in this building, the energy needed for refrigeration is also simulated, which provides a reference for HVAC design in the process of transformation.

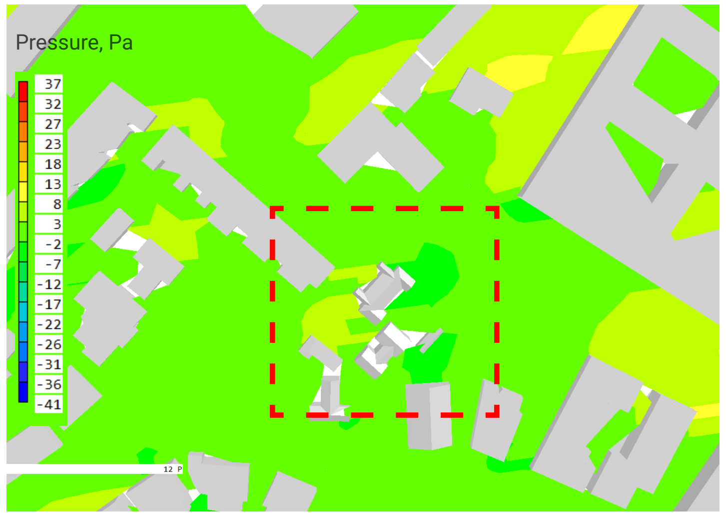
1.20 | Wind Analysis, Outdoor Wind Environment

Winter Wind Analysis

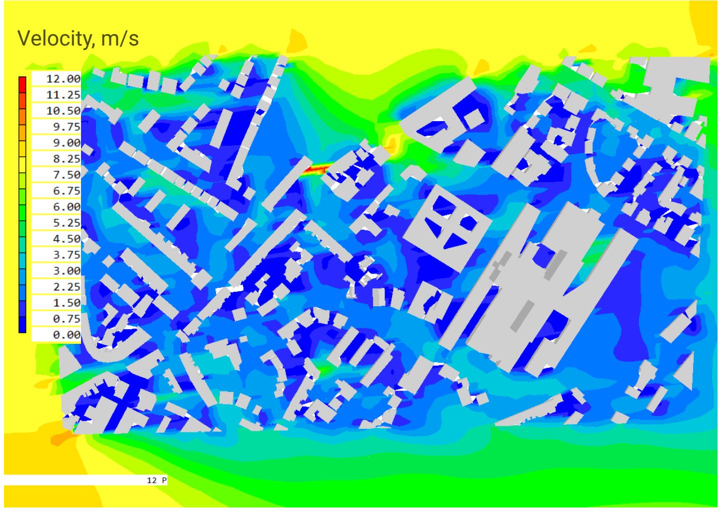
Winter | Wind Pressure



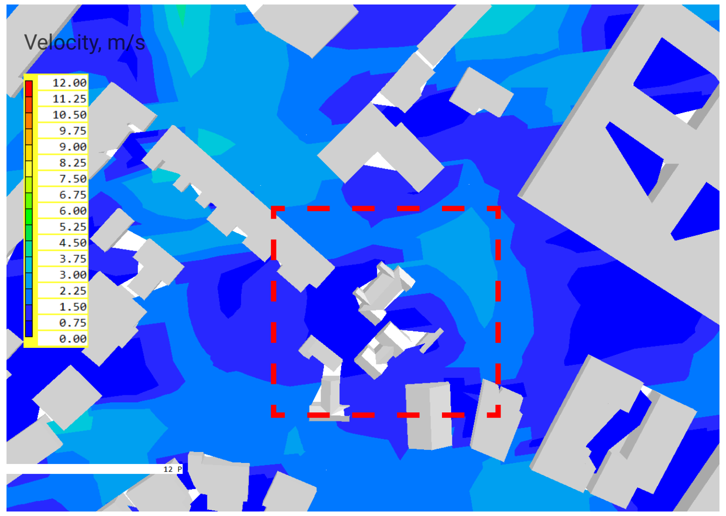
Winter | Wind Pressure



Winter | Wind Velocity

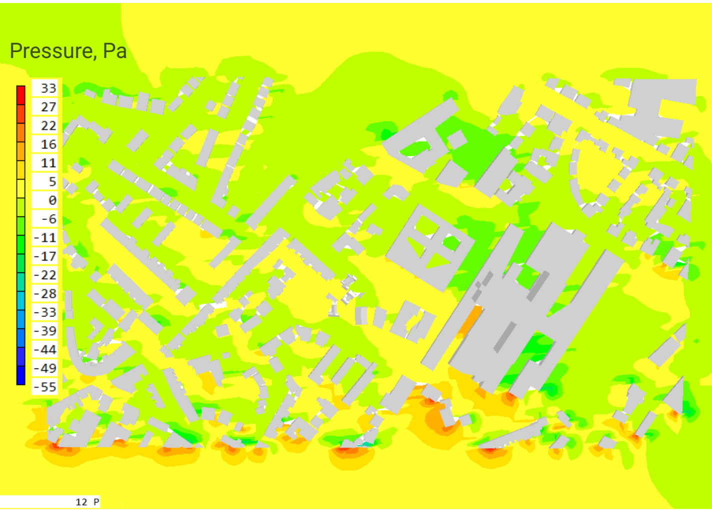


Winter | Wind Velocity

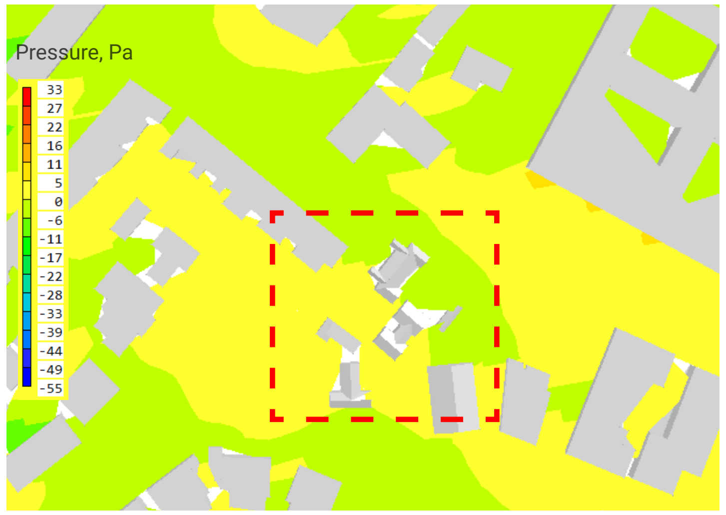


Summer Wind Analysis

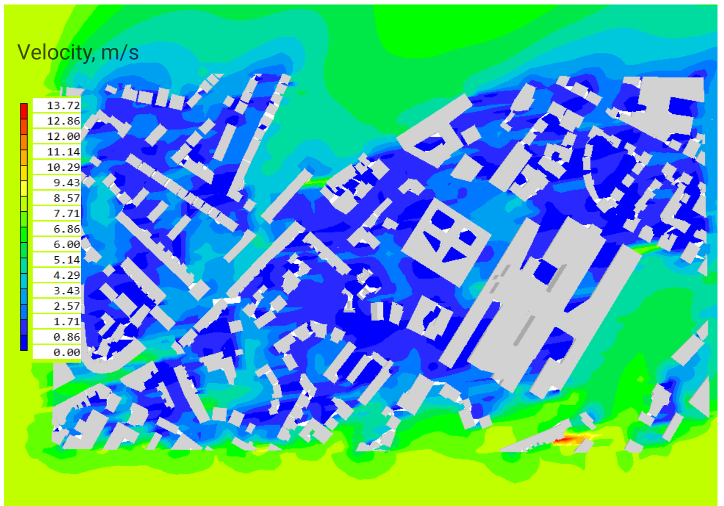
Summer | Wind Pressure



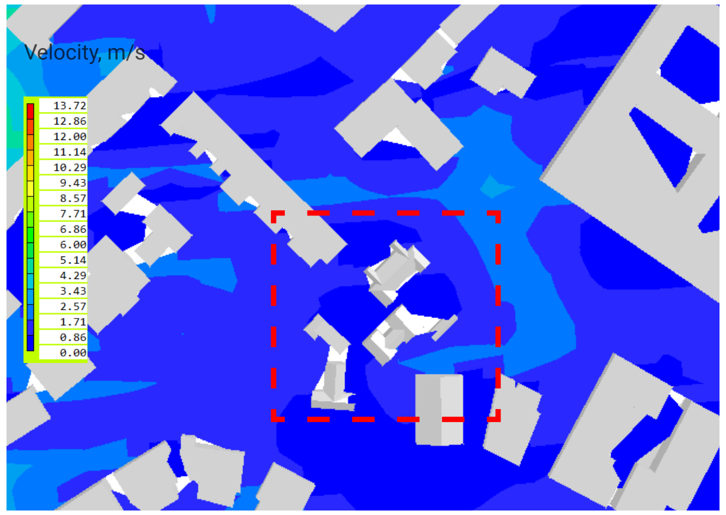
Summer | Wind Pressure



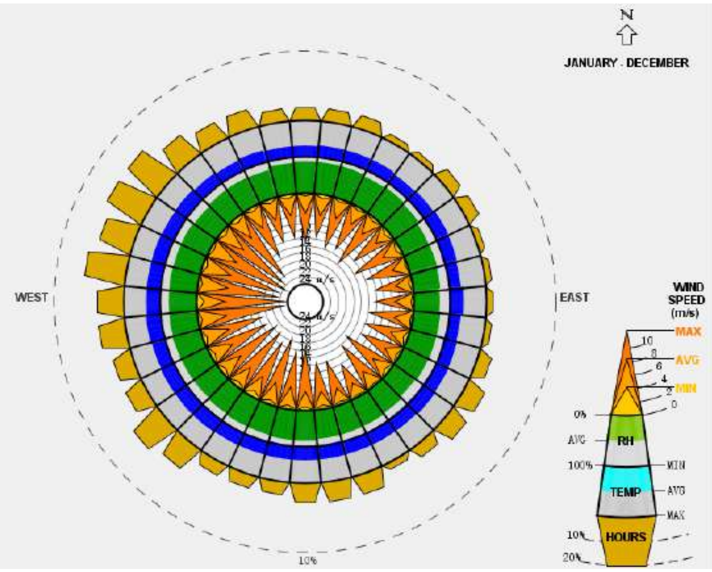
Summer | Wind Velocity



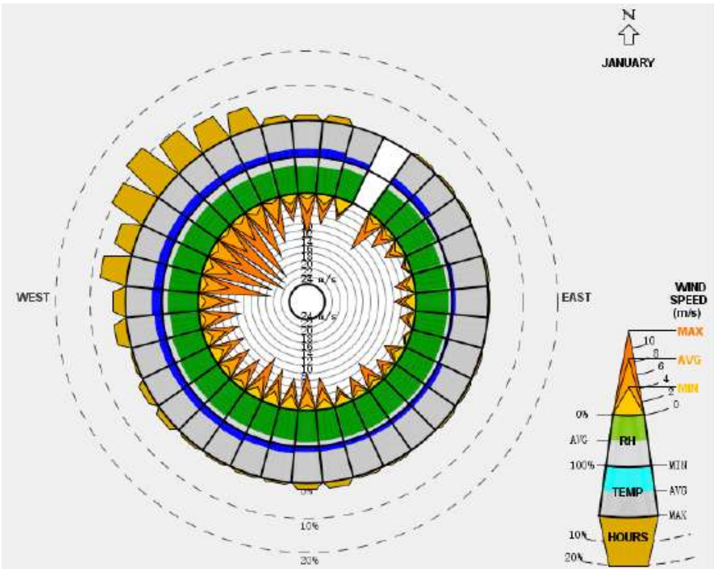
Summer | Wind Velocity



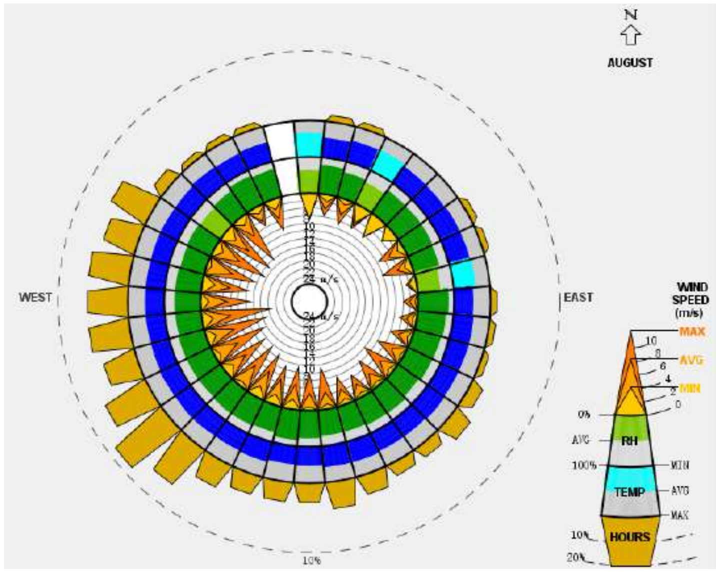
Annual | Wind Wheel



January | Wind Wheel



August | Wind Wheel



Summary

In winter, the main prevailing wind is northwest wind, the maximum wind pressure around the building is 8 Pa, and the minimum wind pressure is 7Pa, which is located on the south side of the building. Cross ventilation can be used for natural ventilation. The wind speed around the building is 1.5 meters per second. In summer, the main prevailing wind is southwest wind, the maximum wind pressure around the building is 5Pa, which is located on the south side of the building, and the minimum wind pressure on the north side of the building is-6 Pa. The wind speed of the building is 2.57 meters per second.

1.21 | Drawbacks of Exisiting Building Design

Environmental Section A-A | Problems

Biodiversity
The outdoor garden of the building lacks biodiversity and suitable landscape design

Well-being
1. Lack of contact with nature.
2. The interior design is not friendly to mental health, such as lacks color design.
3. Air quality did not perform very well.
4. Poor thermal comfort performance.

Airtightness
The poor airtightness of the building increases energy demand.

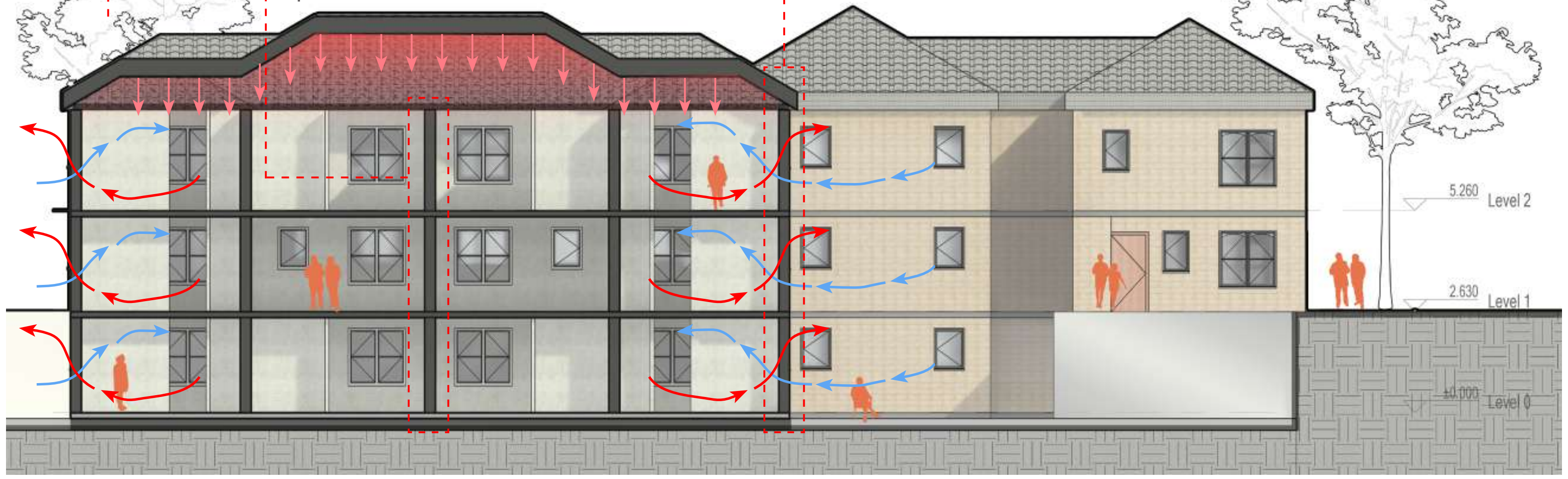
Lighting
The illuminance level of the building is very low, as the northen side of the building has cooridor, hence no source of sunlight.Throughout the year the spaces experineces no light. Artificial lighting is inefficient.

Internal Layout
The internal living space is narrow, and the load-bearing walls within the building divide the two sides into separate spaces. The streamline is complex.

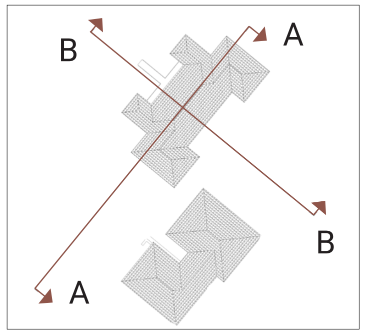
Use of Boilers for Heating
The exisitng building is using boilers to heat the spaces, which is not a sustanable solution. In the solutions, seniors provided MVHR as an alternative, the challenge is how to bring the change practically.

Overheating
The south-facing Windows are unshaded and have overheating problems in the summer.

Heat Loss
The lack of insulation on the exterior walls resulted in significant heat loss



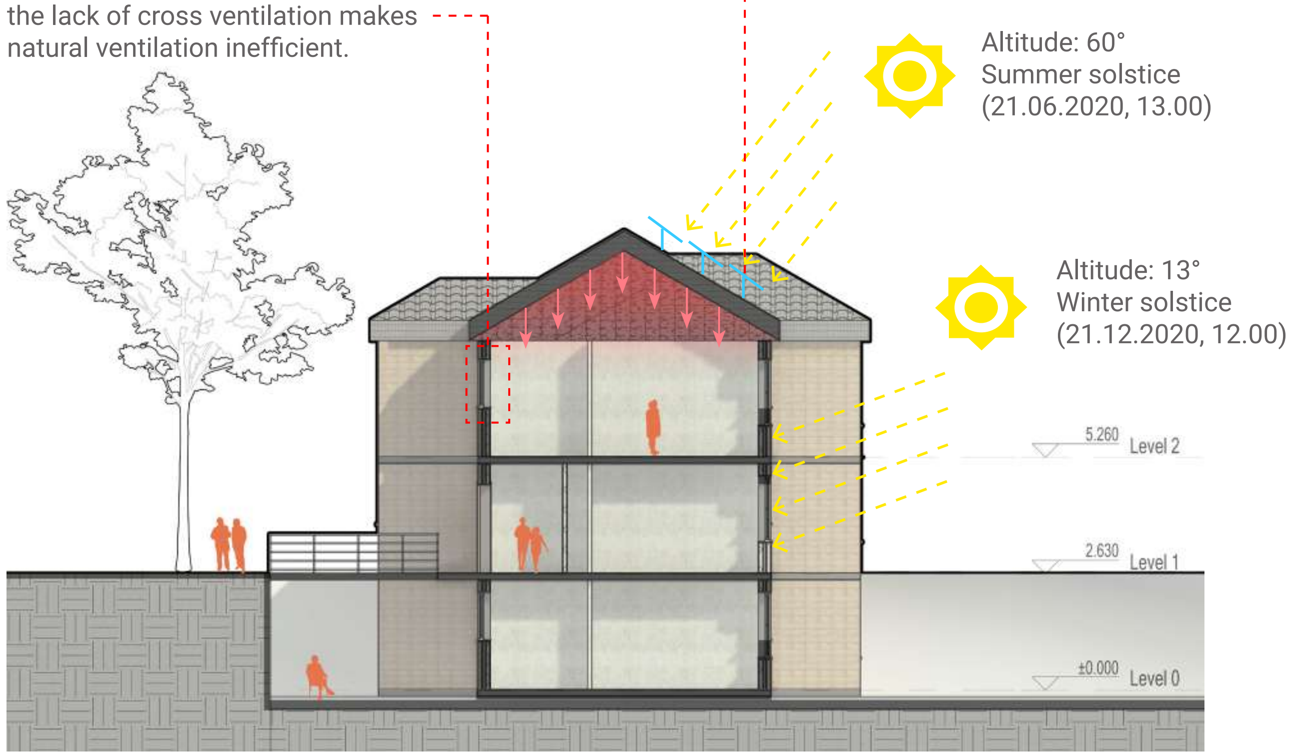
Environmental Section B-B | Problems



Energy Performance
According to previous studies and client's brief, the building is consuming way more energy than prescribed energy consumption standard. As per EPC standard, the building received D rating, which further mentions the concerns. Some of the factors leading to this performance are:
1. Poor Building Envelope with bilding brides and infiltrations
2. Poor PV Panel Performance
3. Rooms are not designed according to building orientation
4. Building components like windows are not suitable-leading to poor ventilation.

Previous studies suggest that wall construction and WWR of southern wall and better HVAC system can improve the performance

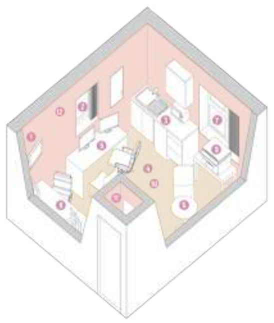
Ventilation
Due to the size of the windows, the lack of cross ventilation makes natural ventilation inefficient.



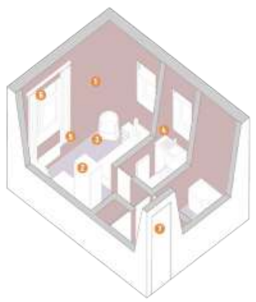
Interior Spaces Typologies

Source: MAAD Live Well Project 2019-2020

1. Kitchen+Lounge
Lounge and kitchen areas are very small according to the number of users. Also extra spaces like library, one-one sessions space, need to be added.



2. Staff Office
Staff Area has a benefit of kitchenette, but the space is cramped up, making it difficult to utilize the efficiently.



3. One Bed Flat
A self contained rooms have pale colors and furniture is not upto mark as well. Also doesn't provide the users to adopt it according to themselves.

Comments from residents

"A lot of stairs. Extension block doesn't work" - Staff Member

"Small office-not enough space for extra activities" - Staff Member

"I would change the shared flats into self contained flats. Also change the colours, they are a bit dim at the moment." - Staff Member

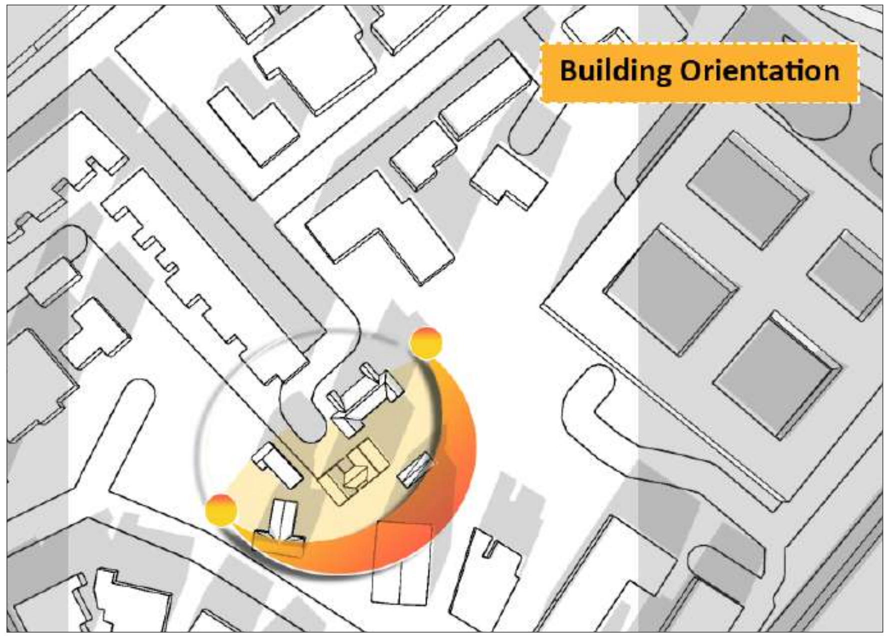
"Extension isn't good as you have to go outside" - Staff Member

"There is not enough space for extra activities" - Staff Member

"Private rooms need refurbishing. All rooms need to be of the same standard. All rooms need to be desired equally." - Staff Member

Unequal Distribution of Spaces
Spaces are not uniformly divided according to the needs. The Staff Office is over utilized and there is no scope of expansion. Self Contained rooms and attached communal spaces are not open enough to accomodate new residents. The windows are fully fuctional leading to ver heating issues.

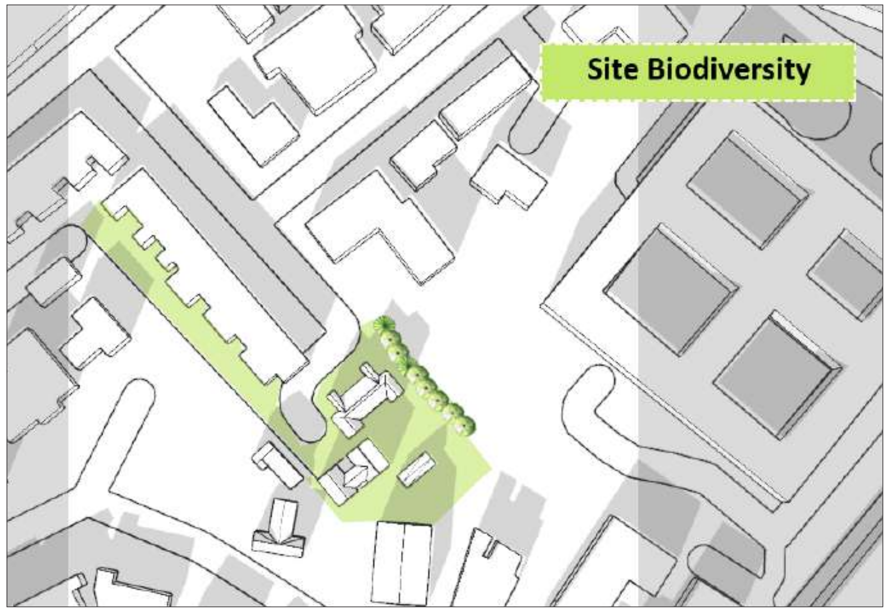
1.22 | Benefits of Exisiting Building Design



Orientation and Building Form

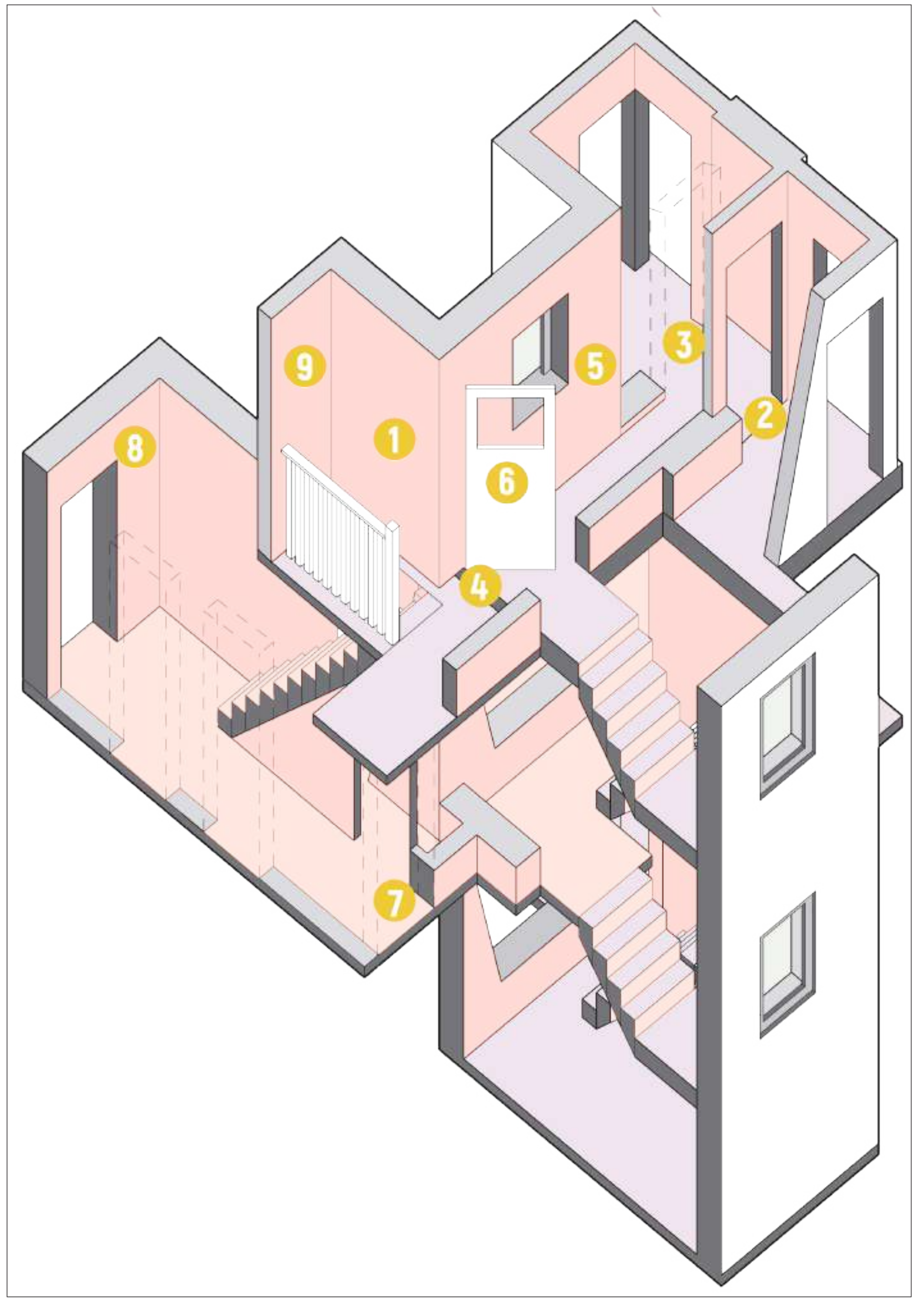
1.Building Orientation and the surroundings favour winter sun. Surrounding buildings are not tall enough to cast shadows on the building. Most of the residents' rooms are south- facing, thus invite ample sunlight to the room.

2.Site is designed considering the slope. It provides it's personal parking spot and green areas, that gives the residents some luxuries to enjoy.



Biodiversity

1. The site already has rich biodiversity on site. The site is surrounded with tall trees also working as accoustic barrier.
2.The residents also developed a pond in the backyard that encourages lots of flaura and fauna to develop.



Security and Survelliance

As the circuation spaces are very confined and limted, it is easy for keep a check on the users.

Effiecient Programs

The programs designs to improve the mental health of the residents are very efficient. According to the client, the users are more confident and feel secure. They are ready to live an independent life.

Building Interiors

1. Spaces designed are in favor of the passive stratefies to reduce the energy demand.
a. All rooms are South Facing
b. The ancillary spaces like Back of the house activities cater to the rquiremets of the user.

Summary

Drawbacks:

1. Irregular spaces, as the spaces are not equally distributed
2. Poor Energy Performance, The building fabric has themal bridges and other air gaps
3. Use of boilers as operative energy

Benefits:

1. The buildng orientation is in according to passive design strategies.
2. The Building Security and Survellance is strong
3. The room orientaton and spaces are correctly placed
4. The residens value the biodiveristy.

Source: M.Arch Livewell Live Project 2019
Source: SAS Studio Project 2019-2020

1.23 | SWOT Analysis

S

Fairly new
(Strong structure)

Rich biophilia

Quiet neighbourhood

W

Building fabric
(Poor insulation)

Spatial layout

Poor ventilation

Lighting in north facing rooms

Architetural aesthetics

Universal access

O

Renewable Energy

Sufficient budget

Retrofit

Improve biodiversity

Existing community

T

Daylighting

Disruption of community during construction

2

Methodology and Process

To have a holistic apporach, We adopted the 10 climate emergency themes, suggested by Prof. Sophie Pelsmaker's Workshop. The petal consider 10 holistic approaches to produce the sustainable design. Though the design project is same, but the approaches gave us different overview and helped to make a decision by touching all the perspectives.

10 Climate Emergency themes

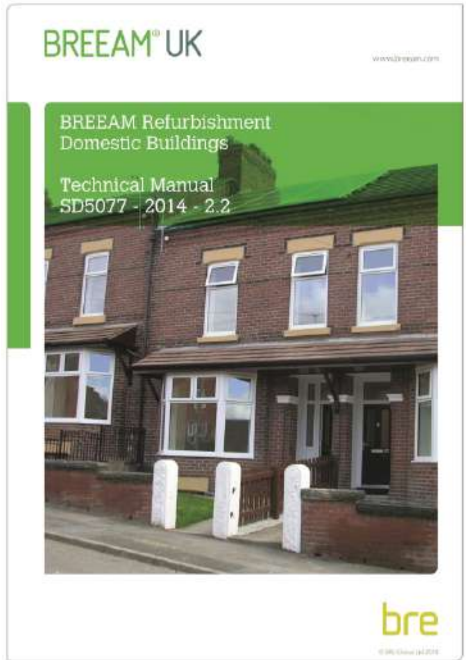
1. Environment 2. (Urban) Infrastructure 3. Passive Resillience 4. Materials 5. People and Community
6. Health & Well Being 7. Future and lobal Responssibiltiy 8. Energy & C02 9. Delight 10. Performance

Apart from these approaches, we considered **the practical considerations**.

1. Time taken to execute the project 2. Finances 3. Execution of the project like displacement of residents
4. Labour and technicians involved in the whole process.

2.1 | BREEAM

BREEAM UK Refurbishment
Domestic Buildings



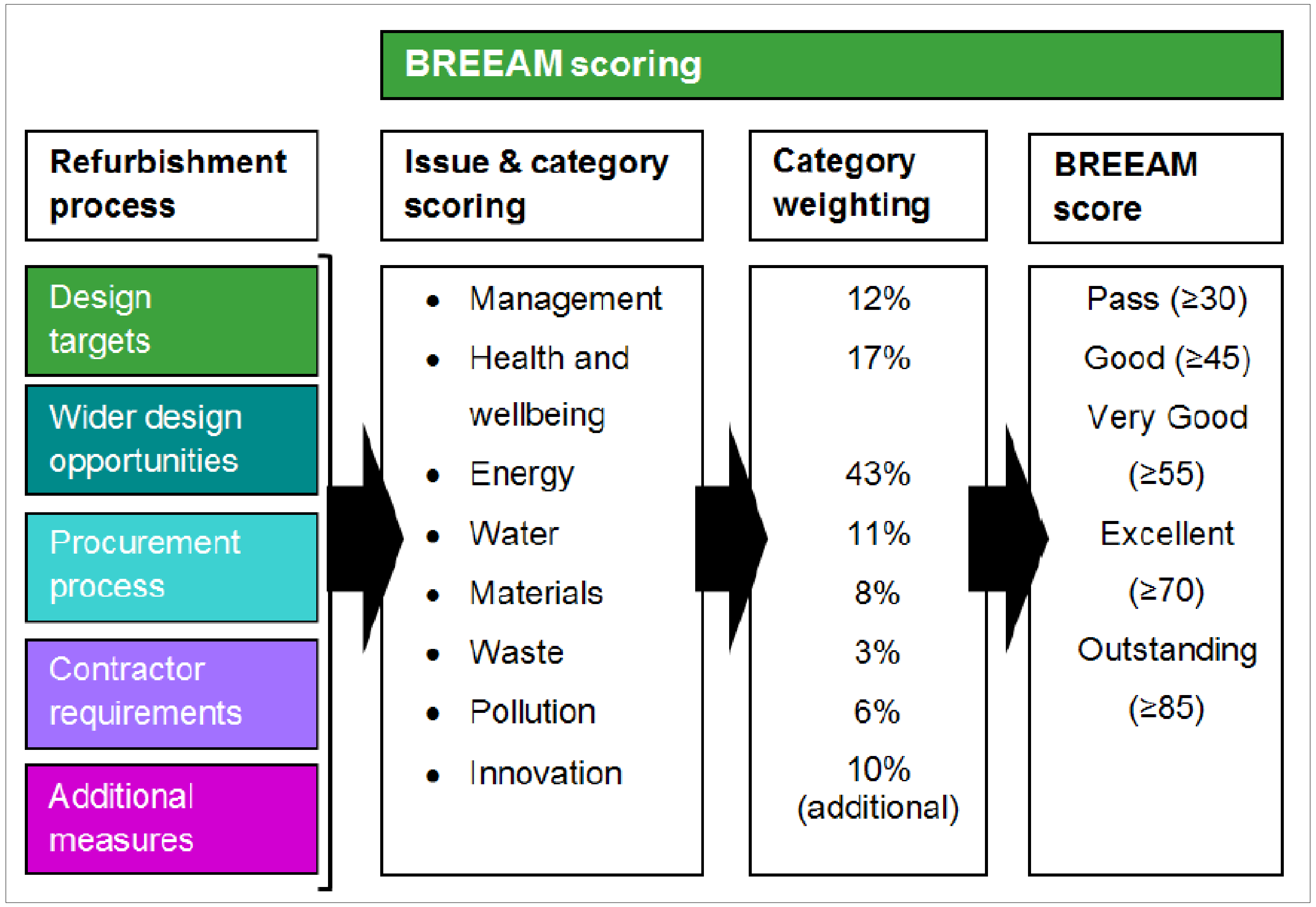
Factors Affecting the Final Score - Rating Benchmarks

BREEAM RATING	SCORE % (except In-Use)	SCORE % (only In-Use)	NO. OF STARS
ACCEPTABLE (only In-Use scheme)	n/a	≥ 10	★☆☆☆☆☆
PASS	≥ 30	≥ 25	★★☆☆☆☆
GOOD	≥ 45	≥ 40	★★★☆☆☆
VERY GOOD	≥ 55	≥ 55	★★★★☆☆
EXCELLENT	≥ 70	≥ 70	★★★★★☆
AIM: OUTSTANDING	≥ 85	≥ 85	★★★★★★

The BREEAM Domestic Refurbishment 2014 scheme can be used to assess the environmental life cycle impacts of refurbishment projects including, existing dwelling's, undergoing refurbishment, extensions, domestic conversions and change of use projects in the UK only. The following section sets out the project types for which the scheme should be used.

BREEAM Categories

BREEAM Domestic Refurbishment Scoring Methodology



Minimum BREEAM Domestic Refurbishment standards by rating level

BREEAM issue	Minimum standards by rating level				
	Pass	Good	Very Good	Excellent	Outstanding
Ene 02 Energy efficiency rating post-refurbishment	0.5 Credits	1 Credit	2 Credits	2.5 Credits	3.5 Credits
Wat 01 Internal water use	-	-	1 Credit	2 Credits	3 Credits
Hea 05 Ventilation	1 Credit	1 Credit	1 Credit	1 Credit	1 Credit
Hea 06 Safety	1 Credit	1 Credit	1 Credit	1 Credit	1 Credit
Pol 03 Flooding	-	-	-	2 Credits	2 Credits
Mat 01 Environmental impact of materials	Criterion 1 only	Criterion 1 only	Criterion 1 only	Criterion 1 only	Criterion 1 only

The BREEAM Domestic Refurbishment scheme sets minimum standards that are deemed to be achievable across the UK housing stock given current refurbishment practice. The minimum standards of performance apply to all building types, including listed buildings and buildings within a conservation area; however, listed buildings and buildings within a conservation area should refer to the additional guidance provided in the minimum standards for listed buildings and conservation areas section, which provides flexibility for where there are statutory restrictions that prevent a building from achieving the minimum standards.

To achieve a particular BREEAM rating, the minimum overall percentage score must be achieved and the minimum standards, detailed above table, applicable to that rating level complied with.

Source: https://www.breeam.com/domrefurb2014manual/#resources/output/pdf/breeam_domestic_refurb_manual_2014.pdf

2.2 | Passivhaus

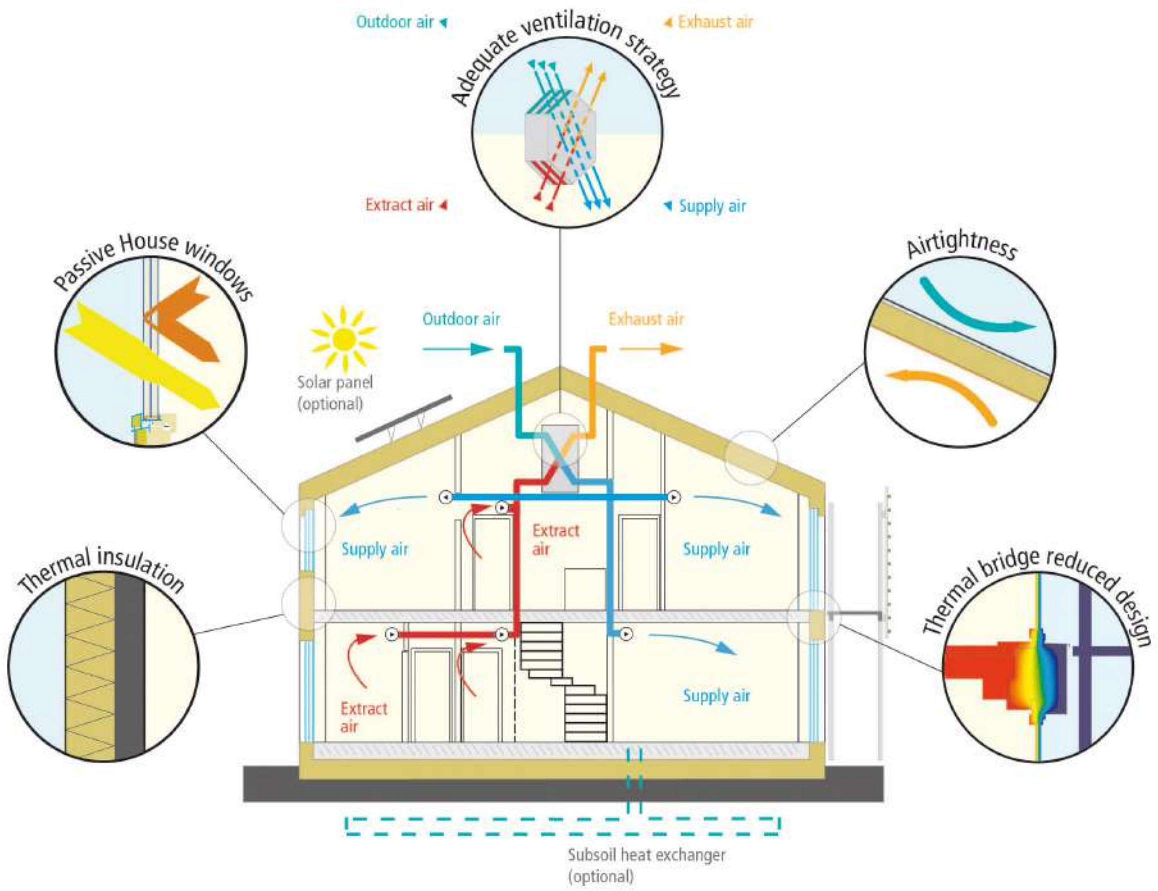
What is Passive House?

Passivhaus buildings provide a high level of occupant comfort while using very little energy for heating and cooling. They are built with meticulous attention to detail and rigorous design and construction according to principles developed by the Passivhaus Institute in Germany, and can be certified through an exacting quality assurance process.

Why Passive House?

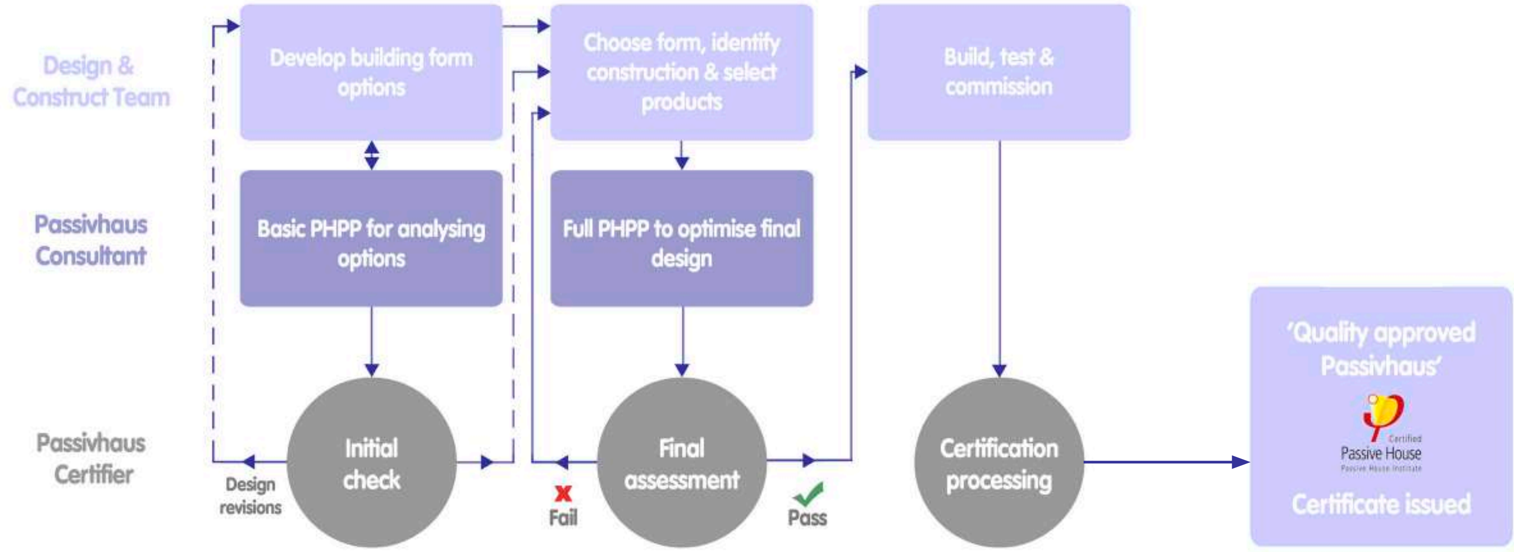
Passivhaus buildings achieve a 75% reduction in space heating requirements, compared to standard practice for UK new build. The Passivhaus standard therefore gives a robust method to help the industry achieve the 80% carbon reductions that are set as a legislative target for the UK Government. Passivhaus also applies to retrofit projects, achieving similar savings in space heating requirements.

Evidence and feedback to date shows that Passivhaus buildings are performing to standard, which is crucial, given that the discrepancy between design aspiration and as-built performance for many new buildings in the UK can be as much as 50-100%.



https://www.passivhaustrust.org.uk/what_is_passivhaus.php
https://passiv.de/en/02_informations/02_passive-house-requirements/02_passive-house-requirements.htm

Building Certification Process



How to achieve the Passivhaus Standard in the UK

To achieve the Passivhaus Standard in the UK typically involves:
1. accurate design modelling using the Passive House Planning Package (PHPP) 2. very high levels of insulation 3. extremely high performance windows with insulated frames 4. airtight building fabric 5. 'thermal bridge free' construction 6. a mechanical ventilation system with highly efficient heat recovery

The following Five Basic Principles Apply for the Construction of Passive Houses

Thermal insulation

All opaque building components of the exterior envelope of the house must be very well-insulated. For most cool-termperate climates, this means a heat transfer coefficient (U-value) of 0.15 W/(m²K) at the most, i.e. a maximum of 0.15 watts per degree of temperature difference and per square metre of exterior surface are lost.

Passivhaus Standard Energy Performance Requirements (UK Climate)	
Specific Heating Demand	≤ 15 kWh/m².yr
Specific Cooling Demand (non-domestic buildings only)	≤ 15 kWh/m².yr
or, Specific Heating Load	≤ 10 W/m²
Entire Specific Primary Energy Demand	≤ 120 kWh/m².yr
Airtightness	n50 ≤ 0.6 ach @50pa

AIM *Passivhaus Standard Energy Performance Requirements (UK Climate)*

Passive House windows

The window frames must be well insulated and fitted with low-e glazings filled with argon or krypton to prevent heat transfer. For most cool-termperate climates, this means a U-value of 0.80 W/(m²K) or less, with g-values around 50% (g-value= total solar transmittance, proportion of the solar energy available for the room).

Ventilation heat recovery

Efficient heat recovery ventilation is key, allowing for a good indoor air quality and saving energy. In Passive House, at least 75% of the heat from the exhaust air is transferred to the fresh air again by means of a heat exchanger.

Airtightness of the building

Uncontrolled leakage through gaps must be smaller than 0.6 of the total house volume per hour during a pressure test at 50 Pascal (both pressurised and depressurised).

Absence of thermal bridges

All edges, corners, connections and penetrations must be planned and executed with great care, so that thermal bridges can be avoided. Thermal bridges which cannot be avoided must be minimised as far as possible.

2.3 | Energy Performance Certificate (EPC)

Energy Performance Certificate (EPC) Review:

The client highlighted the reason for choosing demolishing instead of retrofitting is because the building received D rating from EPC Evaluation. Thus to understand the reasons for D rating, we studied EPC standards and how it affects Beufort Building.

Defination:

In short, an EPC rating is a review of a property's energy efficiency. They're primarily used by would-be buyers or renters to quickly see how much their energy bills will cost in their new house or flat.

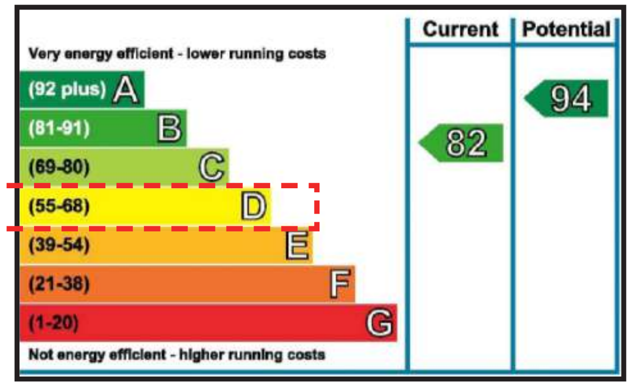
EPCs are carried out by EPC assessors or 'Domestic Energy Assessors' (in Scotland, they must be government-approved organisations). The EPC assessor will carry out a bri ef survey of your home before producing the EPC. The house is then placed on a colour-coded scale from A to G, A being the most efficient with the cheapest fuel bills.

The ratigs depend on:

The amount of energy used per m²

The level of carbon dioxide emissions (given in tonnes per year)

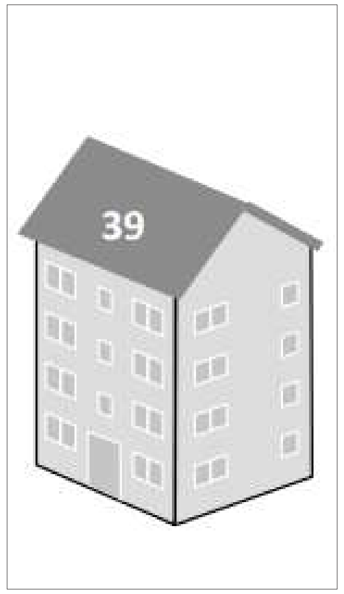
Valid only for 10 years



Graph showing the annual energy performance

This scale spans from A to G, A being the most efficient, and G the worst. The higher the efficiency, the lower the running costs.

Alongside the current energy efficiency rating of the house is a 'potential rating', which indicates how efficient the house could be if the suggested improvements are installed



	Dwelling type: 4-storey apt. block	Mid terrace	End terrace / Semi	Detached
Target Fabric Energy Efficiency Standard (kWh/m²/yr)[†]	39	39	46	46
Wall U-value (W/m²K)	0.18	0.18	0.18	0.18
Floor U-value (W/m²K)	0.18	0.18	0.18	0.14
Roof U-value (W/m²K)	0.13	0.13	0.13	0.11
Window U-value (W/m²K)	1.4	1.4	1.4	1.3
Air permeability (m³/m²/hr @ 50Pa)	3	3	3	3
Thermal bridging y-value (W/m²K)	0.05	0.05	0.05	0.04

Considering FEES for rating:

Section of the Energy Performance Certificate breaks down the various elements of the building, for instance the walls, windows, floors, heating etc, before describing its type and energy efficiency rating.

As per FEES, our building can emit (39 kWh/m.sq/K)

Performance and Recommendations

Summary of this home's energy performance related features

Element	Description	Energy Efficiency
Walls	Solid brick, as built, no insulation (assumed)	★☆☆☆☆
Roof	Pitched, 100 mm loft insulation	★★★☆☆
Floor	Suspended, no insulation (assumed)	—
Windows	Single glazed	★☆☆☆☆
Main heating	Boiler and radiators, mains gas	★★★★☆
Main heating controls	Programmer, no room thermostat	★☆☆☆☆
Secondary heating	None	—
Hot water	From main system, no cylinder thermostat	★★☆☆☆
Lighting	Low energy lighting in 7% of fixed outlets	★☆☆☆☆

Current primary energy use per square metre of floor area: 461 kWh/m² per year

Your home's heat demand

For most homes, the vast majority of energy costs derive from heating the home. Where applicable, this table shows the energy that could be saved in this property by insulating the loft and walls, based on typical energy use (shown within brackets as it is a reduction in energy use).

Heat demand	Existing dwelling	Impact of loft insulation	Impact of cavity wall insulation	Impact of solid wall insulation
Space heating (kWh per year)	17,742	(658)	N/A	(7,506)
Water heating (kWh per year)	5,296			

You could receive Renewable Heat Incentive (RHI) payments and help reduce carbon emissions by replacing your existing heating system with one that generates renewable heat, subject to meeting minimum energy efficiency requirements. The estimated energy required for space and water heating will form the basis of the payments. For more information, search for the domestic RHI on the www.gov.uk website.

Recommendations

The measures below will improve the energy performance of your dwelling. The performance ratings after improvements listed below are cumulative; that is, they assume the improvements have been installed in the order that they appear in the table. Further information about the recommended measures and other simple actions you could take today to save money is available at www.gov.uk/energy-grants-calculator. Before installing measures, you should make sure you have secured the appropriate permissions, where necessary. Such permissions might include permission from your landlord (if you are a tenant) or approval under Building Regulations for certain types of work.

Measures with a green tick ✓ may be supported through the Green Deal finance. If you want to take up measures with an orange tick ✓ through Green Deal finance, be aware you may need to contribute some payment up-front.

Recommended measures	Indicative cost	Typical savings per year	Rating after improvement	Green Deal finance
Internal or external wall insulation	£4,000 - £14,000	£ 510	E51	✓ (green)
Floor insulation (suspended floor)	£800 - £1,200	£ 73	E53	✓ (orange)
Increase hot water cylinder insulation	£15 - £30	£ 94	D56	✓ (green)
Low energy lighting for all fixed outlets	£70	£ 49	D58	
Heating controls (room thermostat and TRVs)	£350 - £450	£ 108	D62	✓ (green)
Replace boiler with new condensing boiler	£2,200 - £3,000	£ 314	C72	✓ (orange)
Solar water heating	£4,000 - £6,000	£ 46	C74	✓ (orange)
Replace single glazed windows with low-E double glazed windows	£3,300 - £6,500	£ 86	C77	✓ (orange)
Solar photovoltaic panels, 2.5 kWp	£5,000 - £8,000	£ 284	B85	✓ (orange)

Alternative measures

There are alternative measures below which you could also consider for your home.

- Biomass boiler (Exempted Appliance if in Smoke Control Area)
- Air or ground source heat pump
- Micro CHP

Low Carbon Energy

This page gives you a detailed breakdown of each element of your property, with a description and an energy rating from one to five stars (with five being the best) to help you understand the effectiveness of its construction, heating and hot water system, and lighting.

Heat Demand

This section looks at how much heat you're expected to use in the property and how you can reduce that by improving the insulation.

This section is used to calculate Renewable Heat Incentive (RHI) payments, so is helpful if you're considering renewable heating options.

Recommendations

The most important section of the EPC: the recommendations.

Numbers on a page mean nothing unless you take action. Here you get a detailed breakdown of the recommended measures, costs, savings and how much each measure could improve the property's energy efficiency rating.

The recommended measures are shown in order of importance, and the energy efficiency improvements figures are based on making the improvements in that order. Of course, you might not be able to complete them all, or in the order listed, but it's a good guide.

The number of recommended measures will vary, depending on which ones are applicable to your property. In this example, the first priority is wall insulation, and if the homeowner is really committed to bringing the rating up to B, the checklist ends with the installation of solar PV panels.

https://energysavingtrust.org.uk/advice/guide-to-energy-performance-certificates-epcs/

2.4 | Embodied Carbon Caculation | Demolition of Building

Embodied Carbon (Calculated by HBERT)							
Material: Name	Material: Volume	Material : Density (ton/m^3)	Material : Weight (ton)	Material : Waste rate (%)	Overall material weight (waste inc.) (tons)	Material : Embodied Carbon (tonCO2/ton)	Overall material EC (tonCO2e)
HBA_Brick	81.58 m³	1.92	156.631077	0.2	187.957293	0.21	39.471031
HBA_Concrete - Precast Block	161.72 m³	2.3	371.958586	0.2	446.350304	0.093	41.510578
HBA_Concrete in situ - Reinforced RC 25/30	55.64 m³	2.3	127.96083	0.05	134.358872	0.129	17.332294
HBA_Gypsum Plasterboard	31.19 m³	0.8	24.952796	0.225	30.567175	0.39	11.921198
HBA_Insulation - Polyurethane Rigid Foam (PUR)	31.55 m³	0.03	0.946637	0.15	1.088632	4.26	4.637573
HBA_Wood_ Average	71.00 m³	0.48	34.078918	0.1	37.48681	0.493	18.480997
Grand total: 514	**432.68 m³**		**716.528844**		**837.809085**		**133.353672**

Material: Name	Material: Transport coefficient (%)	Overall transport EC (tonCO2e)	Material: Construction coefficient (%)	Overall Construction EC tonCO2e)	Material: End of life coefficient (%)	Overall End of life EC (tonCO2e)	Material: Replacements over 60 years	Overall EC sum (tonCO2e)
HBA_Brick	0.03	1.184131	0.07	2.302477	0.02	0.789421	0	43.74706
HBA_Concrete - Precast Block	0.03	1.245317	0.07	2.42145	0.02	0.830212	0	46.007558
HBA_Concrete in situ - Reinforced RC 25/30	0.03	0.519969	0.07	1.155486	0.02	0.346646	0	19.354395
HBA_Gypsum Plasterboard	0.03	0.139127	0.07	0.681211	0.02	0.238424	1	26.396939
HBA_Insulation - Polyurethane Rigid Foam (PUR)	0.03	1.184131	0.07	0.282287	0.02	0.092751	0	5.151738
HBA_Wood_ Average	0.03	0.55443	0.07	1.176063	0.02	0.36962	1	41.162221
Grand total: 514		**4.00061**		**8.018975**		**2.667073**		**181.819911**

Overall EC sum (tonCO2e)=181.819911

2.5 | Embodied Carbon Caculation | Demolition of Building

Supposition

1 — **Total embodied carbon of the building → 181,000 kgCO2e**

2 — **For example: If we use a kind of renewable energy to balance embodied carbon from demolition**

3 — **Each PV panel reduces carbon per m^2 → 52 kgCO2/m^2**

4 — **1 PV panel = 7.5 m^2 → 1 PV panel reduces carbon overall → 52*7.5=390 kgCO2**

5 — **Total area of the roof=315.53m^2**
1 PV panel = 7.5 m^2
→ Total PV panels that can be installed = 42

6 — **1 Year carbon reduced 42*390 → 16,380 kgCO2**

7 — **It would take 11 years to balance out the carbon footprint of the demolition, which is a long time over the whole building lifecycle. As this example shows, the carbon footprint of demolishing buildings is huge.**

Summary

Through the hypothetical calculation of the carbon footprint, the hidden carbon brought by the demolition of this building is huge, and it takes a long time to achieve carbon neutralization. What is more noteworthy is that this time accounts for many parts of the life cycle of the building. Therefore, it is not recommended to demolish the building. In contrast, the modified design is more in line with the concept of sustainable design.

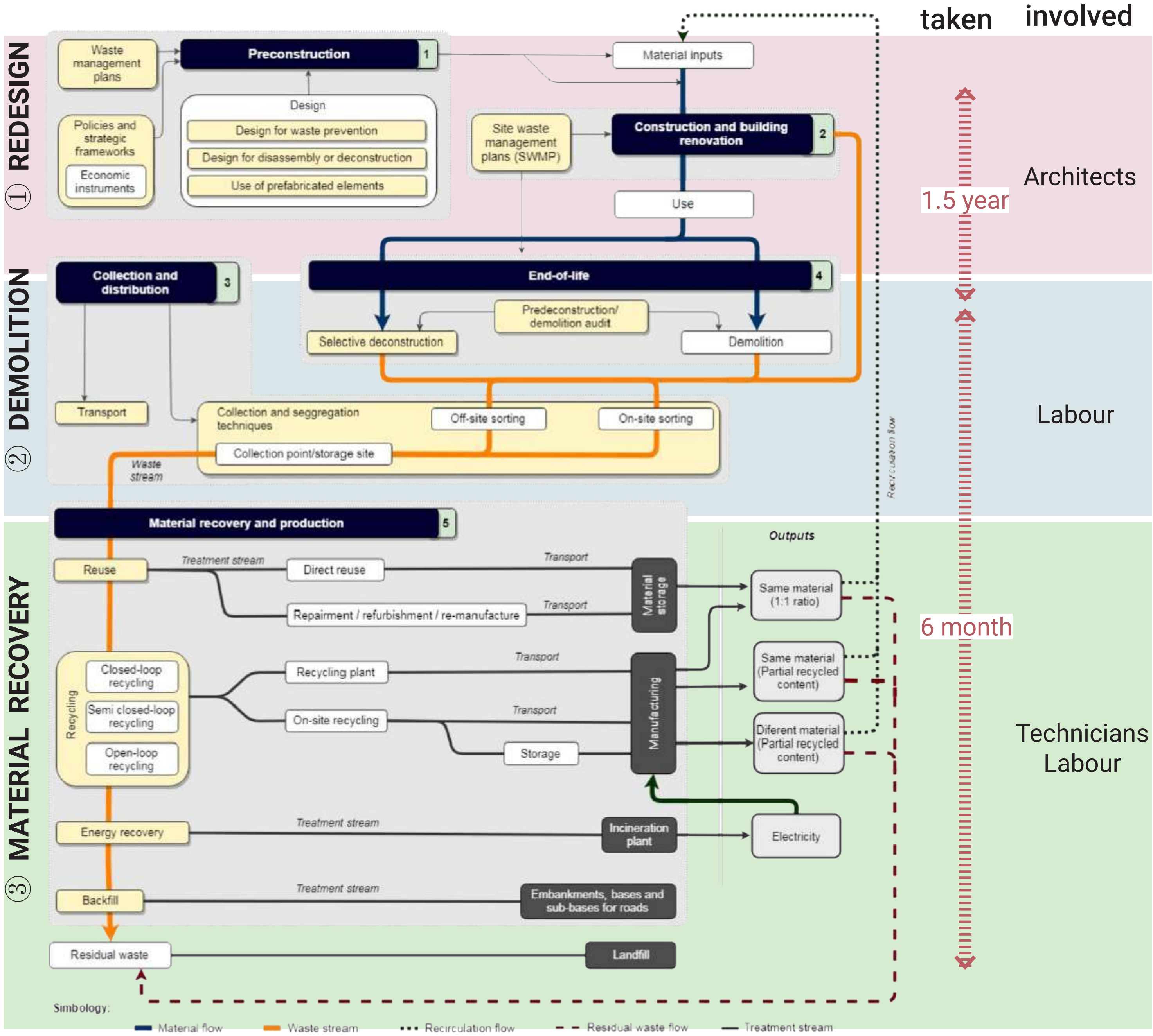
Reference: Environmental Design Pocketbook

2.6 | Construction | Demolition vs Retrofit

Demolition & Rebuild

3 Stages - linear

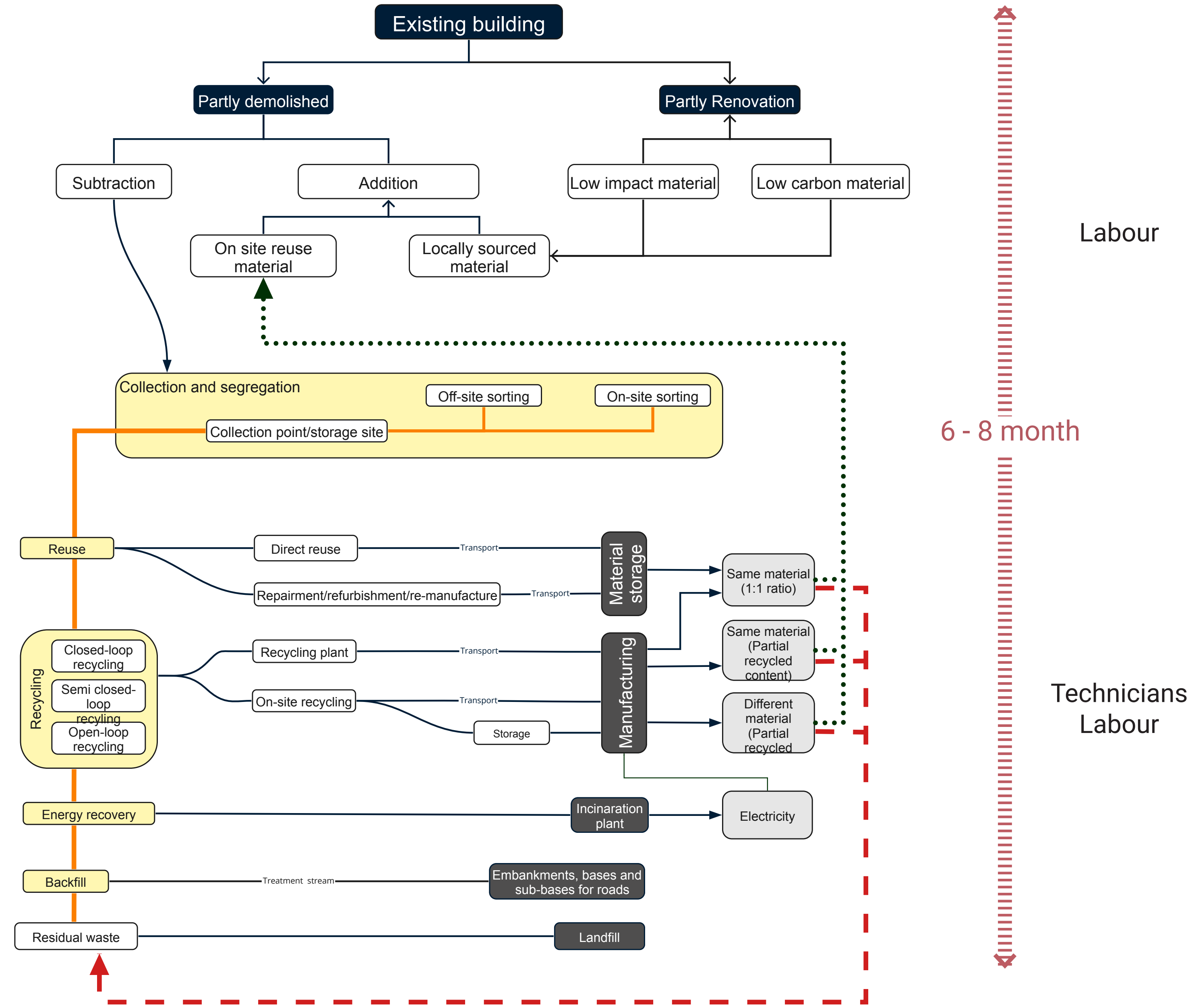
Time taken | People involved



Retrofit & Renovate

3 Stages - parallel

Time taken | People involved



Finances

1+2+3 stage | Displacement of the residents | Labour and technicians salary

Finances

1+2 stage | Labour and technicians salary

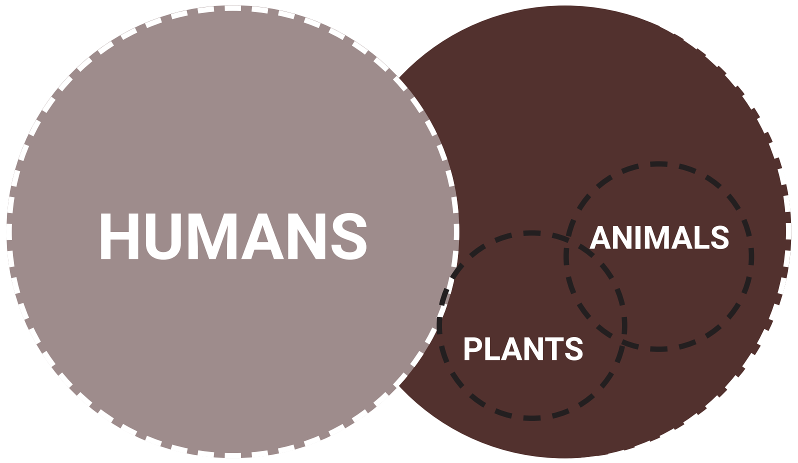
Summary

Site is compared between demolish and retrofit on some practical criterias like- time taken in construction, people involved and construction and site management strategies. The analysis convey that Demolition takes more time and resources as compared to Retrofit. More labour, technicians and site contractors are required to manage the site. Further, in terms of money, demolition will require displacement of residents as it is very difficult for them to reside in hard conditions, this adds up the further cost. The resources like staff, will have to divided to handle the displaced temporary site.

2.7 | People and Community & Health and Well-being

People and Community

People and community are inter- related. While discussing the demolishing or retrofitting, It is important that we consider how the process is going to effec the residents of the site. The site comprises of two users- humans and bio- diversity.
Humans:
Residents with mental problems have to be dealt sensitively. Design needs to address the special considerations like open spaces with efficient ventilation and sunlight. In architecture terms, some spaces has to be designed in a way that promotes independent living and community understanding as well. Previous studies demarcates the strategies that can be used to promote healthy environment for the residents.
Bio- diversity:
But the community does not just mean the people using the space, but the biodiversity on site that helps restoring the character of the site, also plays a vital role in bringing the community together. Impact of vegetation in urban area is high. Urban area are 4-5 °C warmer leading to **over heatng in summer.** Vegetation also works as a noise buffering. Trees can reduce the noise upto - 5-10 DbA, if put next to the noise source.



Components of Site

Demolish and Rebuild

Impact on Biodiversity:

1. The site has interesting features like trail of Trees next to the site and ponds on site. These features not only improve urban greenery but also improve residents' well being and provide cruial habitat for local wildlife.

2, Further, the spaces like roof garden, balcony plantation encourage the principles of " food miles" illustrates the the carbon reductions that can be achieved by growing food locally.

Retrofit and Renovate

Impact on Biodiversity:
Strategies that can be adopt to improve the habitat opportunities Designing ponds, bee keeping roof, roof gardens, green walls can bring the diversity back.

Amphibians	Frog	Ponds with tall herb plants
Birds	House Sparrow Black Redstart Starling Skylark	Nesting place on roofs Manufactured systems embedded in the wall Restore mossland
Insects	**Butterflies** Stag Bettle Bee	**Brown roof, roof Wild-flower meadow, create heap of dead wood in shaded area, or plant wild flowers**

Health and Well-being

Demolition and Rebuild is a time taken process, which will demand due consideration in shifting the residents, as they have special lifestyle. There are two strategies that we can use to design -
1. To deplace the residents partially building wise- But the site conditions may not be suitable for the residents as it creates more noise, that can lead to mental distress. Further the dirt in executing the building, can cause further breathing problems for the residents.
2. To demolish it entirely in one go- For this, the residents will be shifted to another place for 2 years, again the expenses involved in parallely running the place are some the extra expenditure that the clients will have to bear

In retrofitting, the labour can be asked to renovate the building from the inside, so the noise can be controlled and further, the time consumed in retrofitting is less, so expenses wll be less even if we want to displace the residents.
Further Off site consruction techniques can be used like pre fabricated and modular timber design, that makes the construction process easy and neat, created less problems on the site.
This measure also helps residents, as they dont have to be displaced anywhere.

2.8 | Materials

Demolition

The existing building consists of three main materials: bricks, concrete and clay tiles.

Bricks

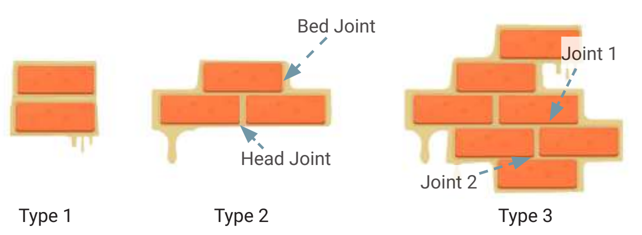
The structure of the Beaufort Project consists of exterior **bricks masonry walls with cavity.**
In UK they generally use two types of mortar to link the bricks together: lime mortar and cement-based mortar. The first one creates weaker bindings compared to the second mortar which is considered to be harder to break without damaging the bricks. In fact, attempting to deconstruct brick masonry built using cement-based mortar is considered time-consuming, labour-intensive and risk damaging. Also the relatively low unit cost and availability of bricks makes the reclaiming of bricks more unattractive.

In the case of the Beaufort Project, the bricks are linked together with OPC which is highly tenacious and retains relatively high bond strength with the brick face. Therefore is difficult to remove bricks by existing mechanical or chemical reclaiming methods which are also likely to cause damage to the units. Therefore, when such constructions reach their end of life, the bricks are usually crushed and recycled.

New researches brought up that reclaiming bricks bonded by cement-based mortar is technically possible and that there are two advanced methods to reclaim bricks: saw-cutting and punching reclaim.

Saw-Cutting Reclaim

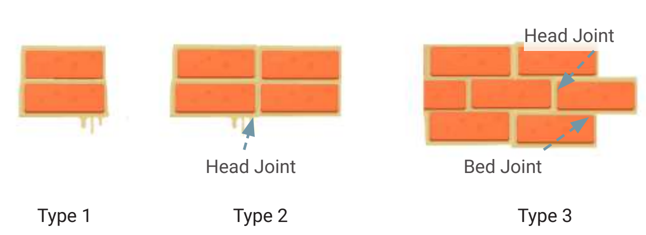
It consist in the adaptation and extension saw-cutting techniques



Schematic diagram of specimens for saw-cutting method

Punching Reclaim

It was inspired by the hole punching approach in manufacturing goods using thin steel sheets.



Schematic diagram of specimens for punching method

Bricks Typology and Reclaimed Methods	Energy Consumption (MJ\Bricks)	Emissions Contributing to Global Warming Potential
Manufacture of New Bricks	9.2	757
Saw-cutting Reclaming	0.6	0.54
Punching Reclaming	0.36	3.22

Comparison of energy consumption and climate change inducing environmentalemissions for brick manufacturing and reclamation

Reclaiming method	Saw-cutting	Punching
Current Est. n. of bricks PPPD	200	97.8%
Rate of Success	140	96.6%

Comparison of time, rate of success for reclaiming method of bricks with cement-based morta

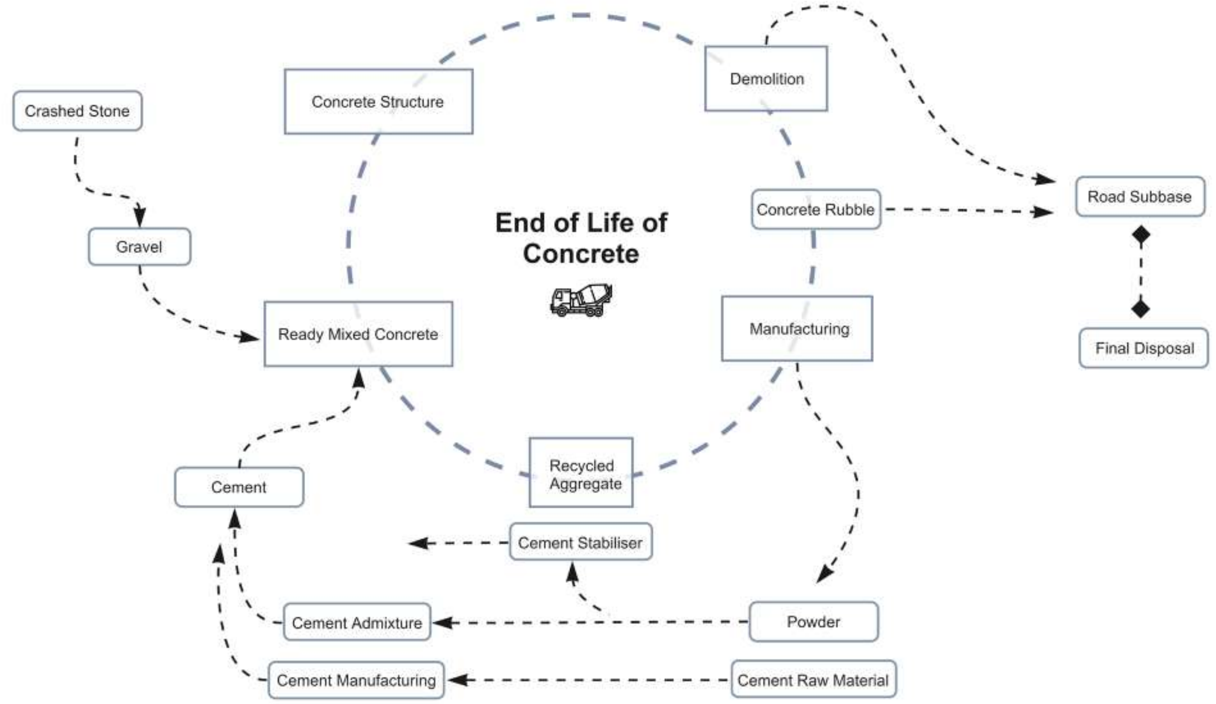
The new researches concluded that bricks reclaimed by both methods have similar aesthetic appearanceas compared to new bricks. They also have similar mechanical properties as new bricks.
The reclamation process using these methods have lower energy and carbon requirements compared to new bricks. Consequently they have high potential to mitigate greenhouse gas emissions. Imporvements are required for the speed of separation and reclaim of the material which needs to become more time and cost efficient.

Concrete

The construction industry in the UK accounts for the use of 295 million tonnes of virgin material per year, displaces 22 million tonnes of industrial 'by-product' by industrial ecology each year and produces approximately 150 million tonnes of construction and demolition waste annually. Concrete's inherent robustness, flexibility and minimal need for additional finishes mean that concrete buildings are particularly well-suited to the ethos of reuse
Recycled concrete is a viable source of aggregate and it can be classified under two categories:
1. Recycled Aggregate (RA) 2. Recycled Concrete Aggregate (RCA)
The reclamation of concrete can happen if the following standards are applicable:
1. BS 8500-1: 2006 2. WRAP (2005), the Waste and Resources Action Programme

Factors to be taken in consideration when reclaiming concrete:
Recycled concrete as aggregate will typically have higher absorption and lower specific gravity than natural aggregate and will produce concrete with slightly higher drying shrinkage and creep.
The chloride content of recycled aggregates needs to be taken into accountif the material will be used in reinforced concrete.

Reusing concrete represents a suitable way to reduce construction costs while providing some benefits to the environment. Infact, reclaimed concrete stays out of landfills and it replaces other materials such as gravel that must otherwise be mined and transported for use. It also reduces transportation costs because the material can often be recycled in areas near the demolition or construction site.



Reclaimed concrete can be utilised in different ways:

1. Permeable paving for walkways, driveways, and other outdoor hard surfaces
2. Base for new asphalt paving through a process called rubblization
3. Bed foundation material for trenches containing underground utility lines
4. Aggregate for mixing new concrete
5. Controlling streambank erosion
6. Landscaping mulch, it can replace river rock or other gravels used as ground covers and mulch
7. Fill for wire gabions: Wire cages filled with crushed gravel can make
8. Material for building new oceanic reef habitats

2.8 | Materials

Demolition

Construction materials account for 20% of the UK's ecological footprint, 19% of the UK's total greenhouse gas emissions, and 30% of all UK freight transport. Unsustainable materials such as concrete, resin and plastic are in widespread use in the roofing industry in the UK, therefore the need to reuse and reclaim of such materials is really high when talking about demolition.

Construction and demolition waste are one of the heaviest and most voluminous waste streams generated in the EU accounting for approximately 25%-30% of all waste generated. Demolition recycling is an important step in a building's life cycle, as material reclamation and good recycling practices can divert over 90% of the building's material from the landfill.

Clay Tiles

Usually in UK the material used for the construction of roofs are slate, clay and concrete tiles.
Clay and concrete tiles provide excellent life cycle performance with a lifespan in excess of 60 years, during which, they require very low levels of maintenance.
This means that during a demolition or a re-roof, the slates and roof tiles can be salvaged and re-used, either on the same property or, more commonly on another project. It is more common for clay tiles, particularly traditional clay pantiles, to be re-used for full roofs, rather than concrete tiles.

Materials	Life Expectancy
Clay	60 years minimum
Concrete	60 years minimum
Natural slate	80-100 years minimum
Fibre Cement Slate Man Made Slate	50-60 years minimum

These are the most common factors that reduce the life expectancy roof tiles:

1. Roof colour The darker the colour of the roof, the more it absorbs the heat, which in turn shortens the lifespan of the tile. This also applies to the orientation of the roof. If facing south, it will gain more exposure to sunlight which can also have an effect over time.
2. Roof slope angle
The angle of the roof of your property will test the durability of roof tiles, with higher pitch roofs tending to last longer.
3. Walking on the roof
Roof tiles are easily cracked if not walked on carefully.
4. Poor installation
Incorrect installation of a tiled roof will usually lead to repairs and replacements in a shorter period. Sometimes it can be the fault of the manufacturer, but on most occasions, the contractor will be at fault.
5. Building ventilatio Lack of ventilation or no ventilation can affect the lifespan of roof tiles.
6. Hostile environmentA well installed tiled roof will be able to withstand the 'average' amount of wind, sun, rain, snow and hail throughout the course of the year. Harsh winters and summers, along with large temperature swings in short time periods will test the durability of roof tiles.

Disadvantages of reusing tiles:
1. A common problem that occurs when using reclaimed materials is that there are simply not enough of the particular tile or slate available from a single batch to complete a roof.
2. Old clay pantiles were generally originally handmade, therefore not particularly dimensionally accurate.
3. The age of second-hand materials may not be known to any degree of accuracy, consequently predicting the remaining lifespan is difficult, if not impossible. Of course, there is no assurance, whereas new tiles or slates will come with a supplier's guarantee.

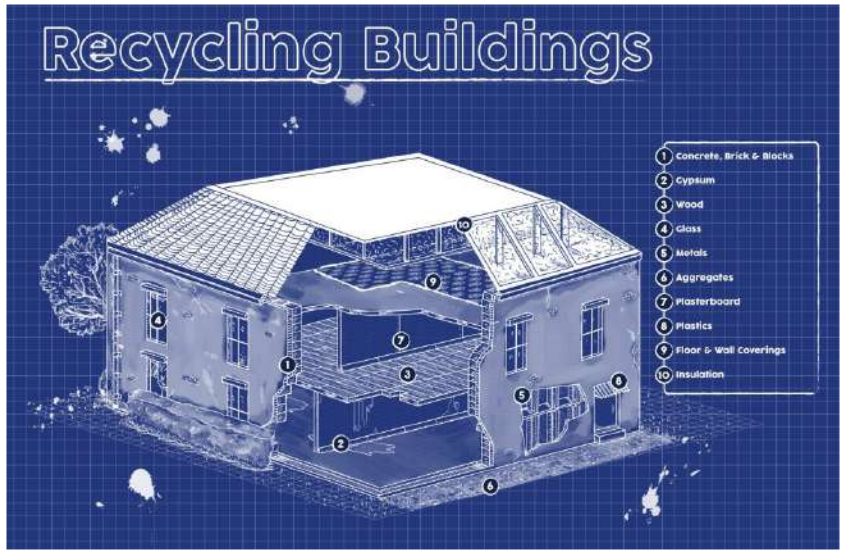
Generally, it is possible to reuse and reclaim tiles. Even broken or chipped reclaimed tiles can be used.

In the case of the Beaufort Project, the building has a ventilated clay tiles roof.

Clay and concrete tiles require very low levels of maintenance.

There is a thriving second hand market facilitating the reuse of clay roof tiles, however when roof tiles do eventually reach the end of their life, both clay and concrete tiles can be recycled as crushed aggregate in a wide range of applications.

Other Materials



In some cases, it is possible to reuse insulation. In fact, in just 23 housing projects in the UK, the average amount of insulation wasted was 1.0m3 per 100m2 floor area.
Insulation can be recycled by returning materials through take-back schemes offered by manufacturers, but reclamation and reprocessing can only happen after removing impurities such as nails and screws.
Similarly, materials involved in insulation such as glass and stone wool, polystyrene, sheep's wool, spray foam, polyurethane and fibreboard can be transformed into concrete blocks, fibreglass board and fibreglass ceiling tiles.
In addition, when a building is demolished, it is possible to save and reuse wood, glass, metals, floor and wall coverings.

2.8 | Materials

Retrofit

In the case of radical retrofit, one of the main decision to be made is which part of the building will be retained and which part will be demolished. This decision will be taken by considering the age and condition of the existing structure. It is also necessary to take into account the expected life of the building.
In order to minimise the environmental impact of materials during a retrofit process, it is necessary to take into account the following factors:

1. Resource Depletion
2. Water Consumption
3. Waste
4. Water Pollution
5. Energy Use
6. Air Pollution

The general principles of sustainable materials selection can be summarised as follows:

1. Conserve existing building fabric; repair rather than replace

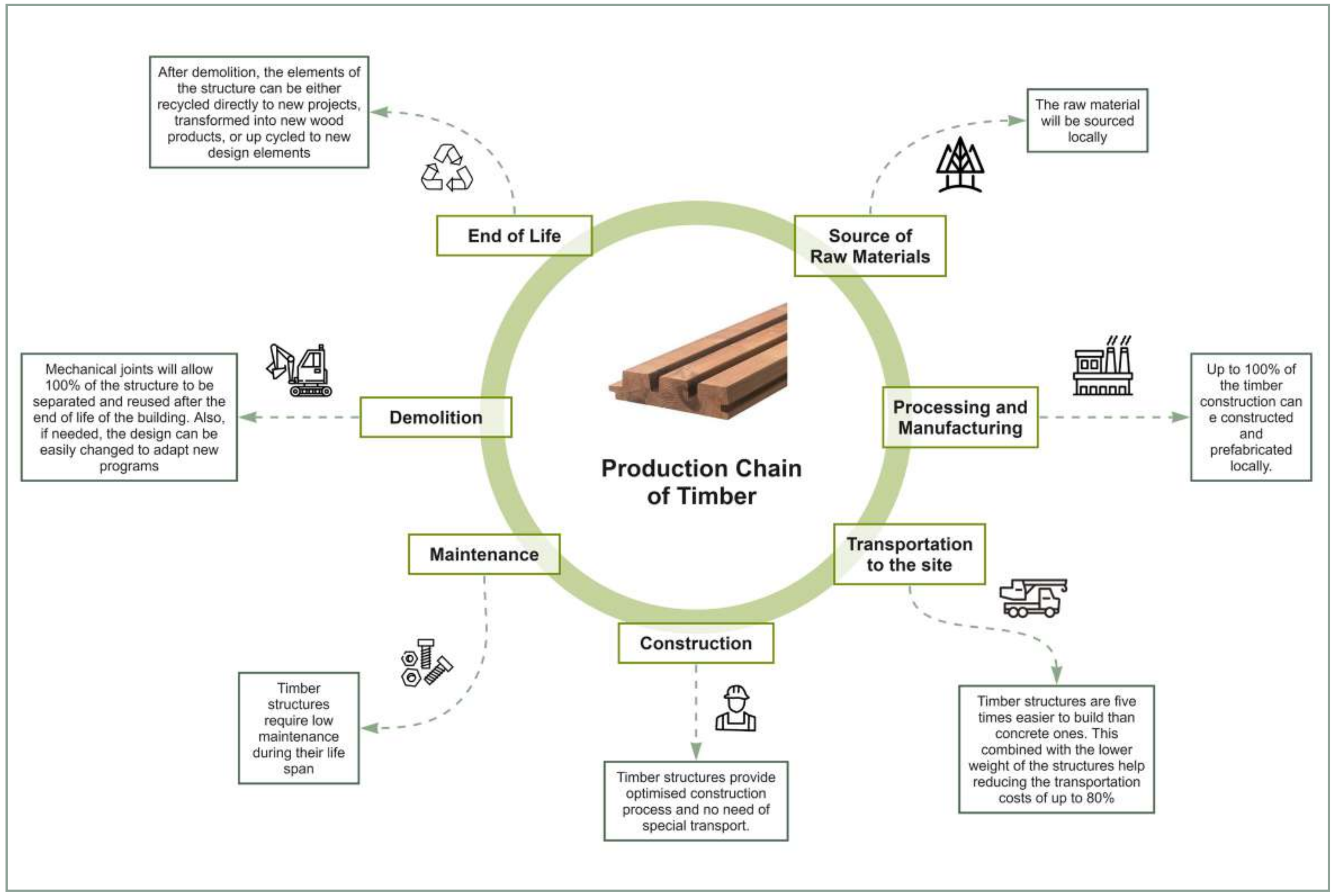
3. Use sustainable and locally sourced materials

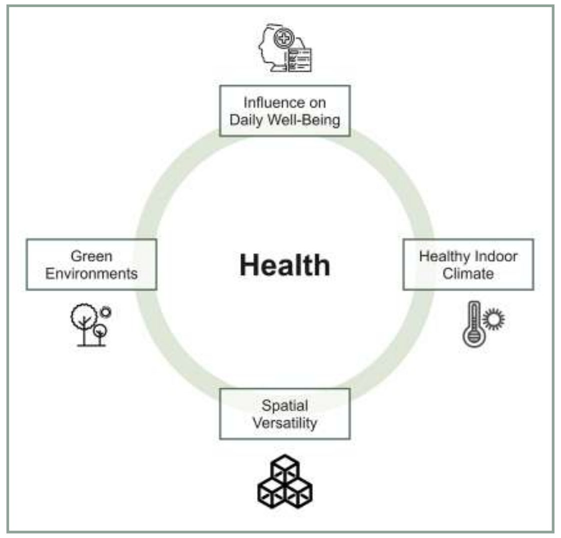
3. Select materials that maintain or enhance the appearance of the building

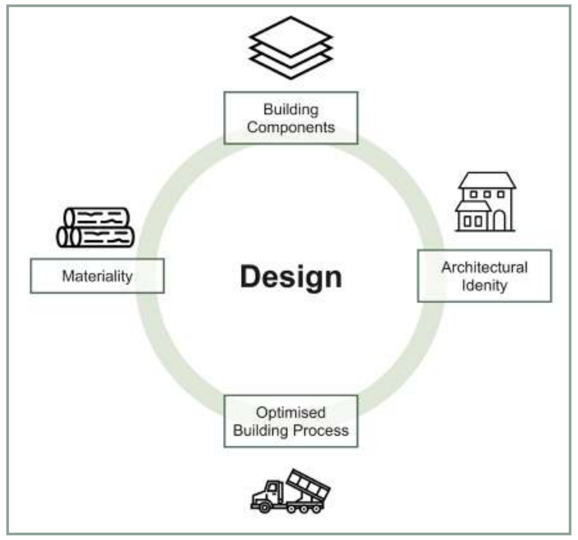
4. Reuse materials; specify reclaimed and recycled building materials.

5. Avoid building materials that have potential health risks

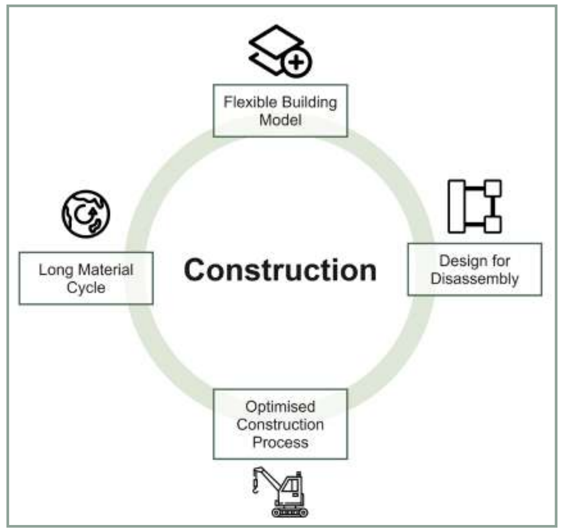
TImber Structure

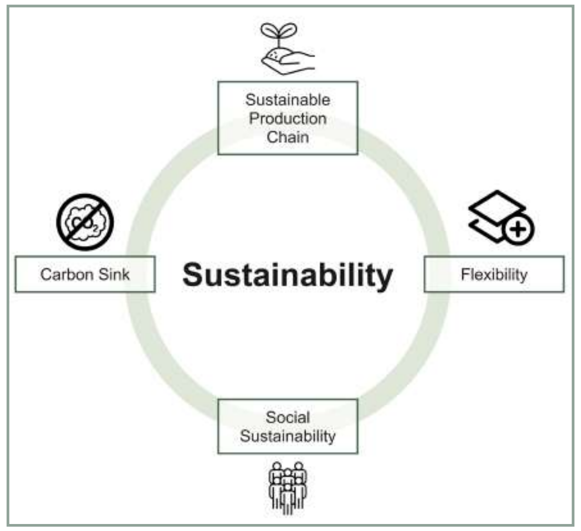






'We believe that timber contributes to a human sense of well-being and is an enviable solution in the quest for a resilient way forward' - Mads Kaltoft





Advantages:

1. Great structural strenght
2. High insulation capacity achievable with thin wall constructions
3. Vapour open approach
4. Trees absorb and bind CO2 as they grow, giving the wood as a building material a negative carbon footprint. During the life of the building, new forests can replace the wood used for construction, thereby absorbing new CO2.

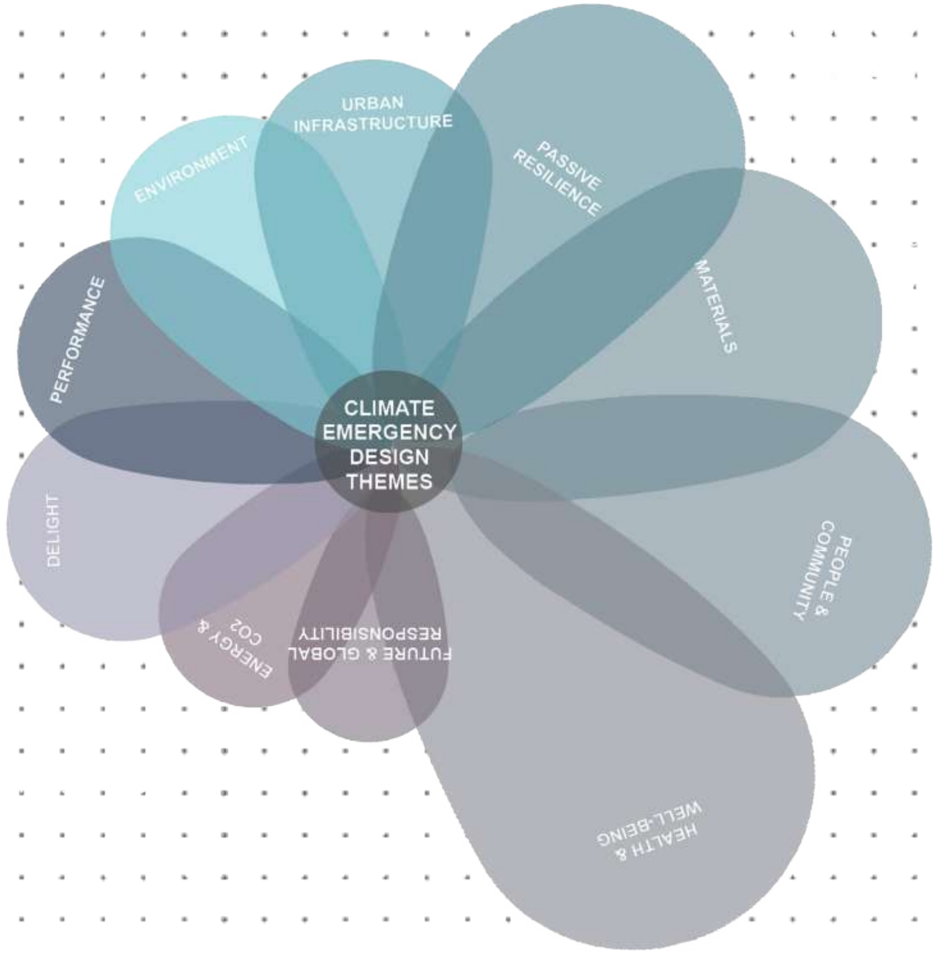
Summary:

Through the study of the end of life of the existing materials we realised that it is possible to reclaim in part the materials but not their entire quantity. Also through the use of wood structure and a new design proposal it is possible to improve the performance of the existing building without demolishing it entirely.

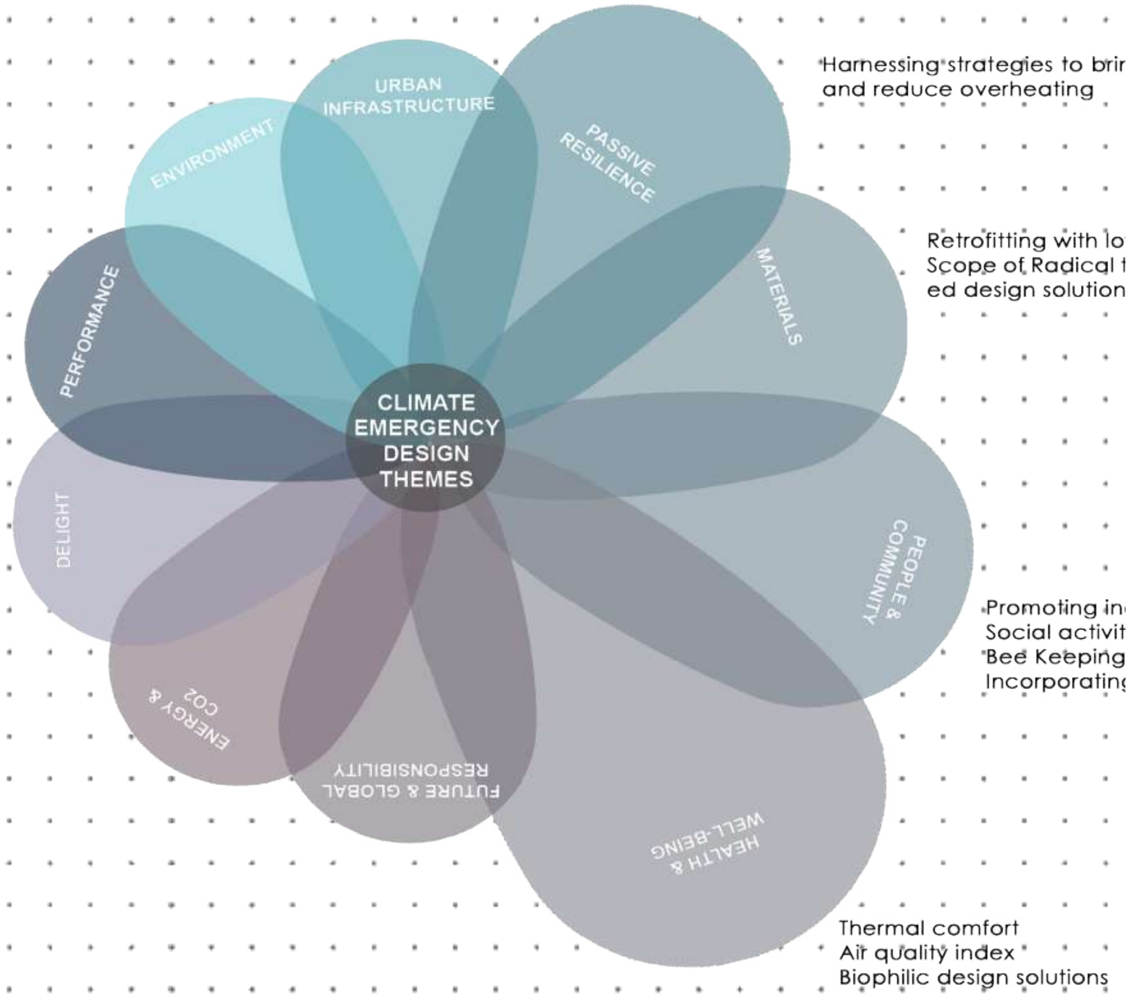
2.9 | Comparison between Retrofit & Demolish

Holistic approaches needed for Sustainable Architecture:
Through Sophie's Lecture we were able to have a wide perspective to decide if retrofit is better option than demolishing.

Demolish and Rebuild



Retrofit and Renovate



Source: Sophie Pelsmaker's Lecture

Summary

The Demolish has positive and negative effect both on the environment.As the project will be starting from the scratch, we have to consider the reusing materials and design a framework of the demolition and waste management. Also, the proces opens lots of new opportunities to play with the forms and site considerations, and consider passive resillience.

However, we have negative imact on the embodied carbon and furture responsibilties. To execute the design, the embodied energy of the exisiting building. Further, the project questions our responsibilty towards the profession, that is to consider the future and global impact towards future environment.

Summary

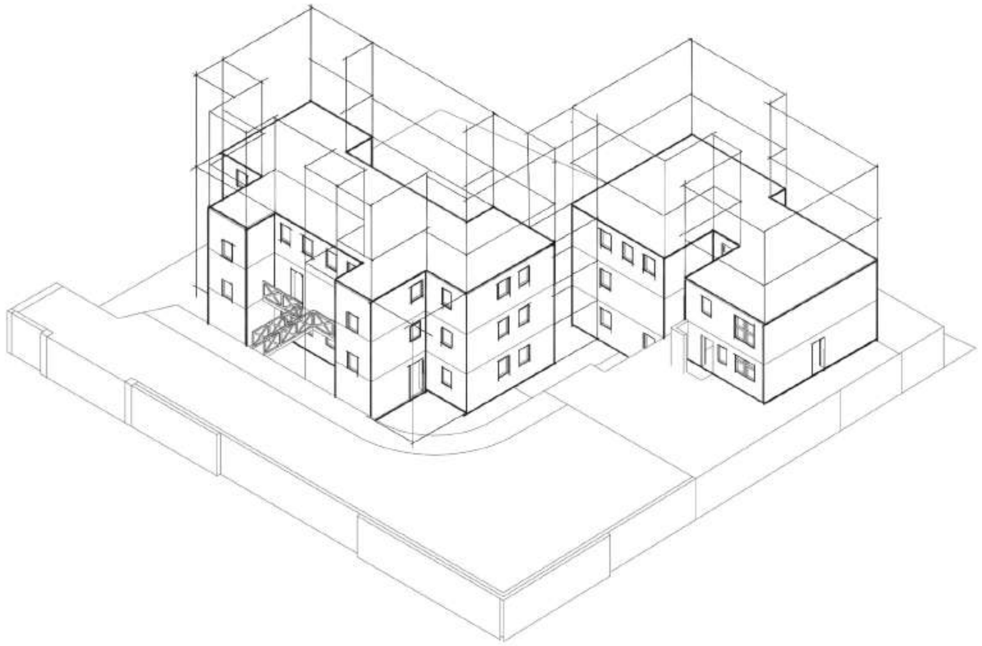
The retrofit solutions are designed to build for the net zero energy. But apart from this, the building faces some architectural problems related to the spatial organisation. Hence, radical architectural changes required to improve the spces and encourage residents to adopt their own hobby. Startegies like pre fabrication and timber structures can be used to subsquete the carbon.

2.10 | Conclusion

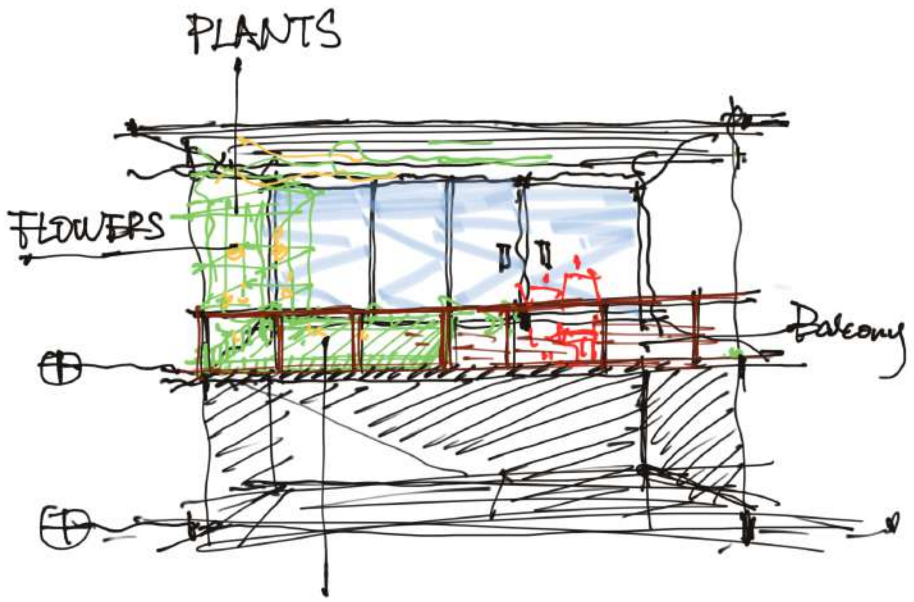
Retrofit & New-Build

In order to establish the approach to consider to meet the client brief and provide for the needs of the customers, we explored potential low impact and low carbon solutions that are best fit to for the Beaufort project. Through this section, we have outlined our decision making process and how we ended up proposing a retrofit approach for the project. The key factors we considered we the disruption of services at during construction, the age and strength of the exisiting building structurs on site, climate emergency priorities and the overall wellbeing of the customers.

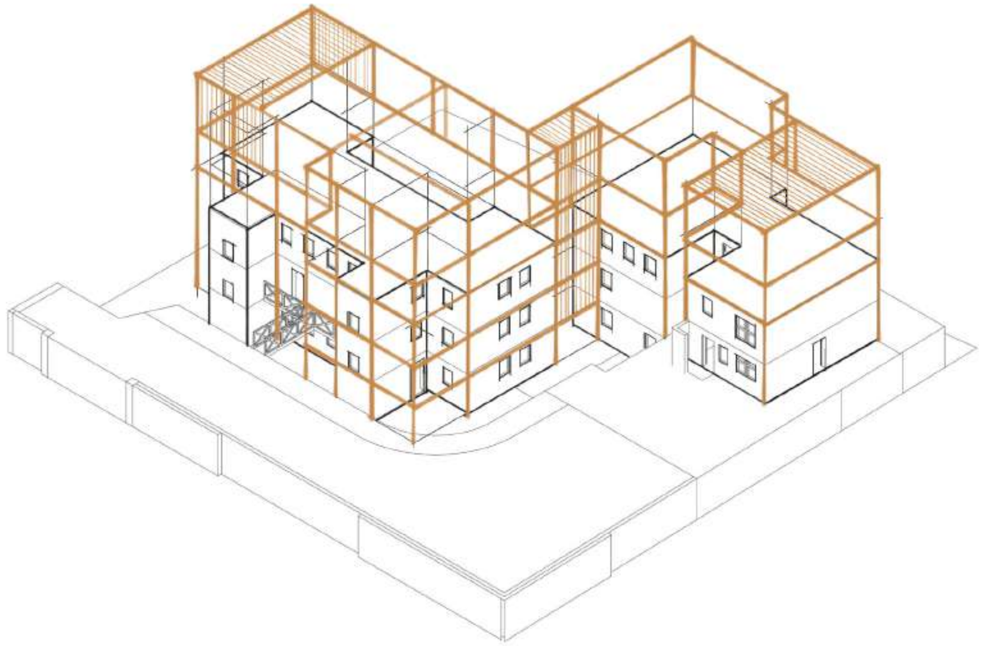
01 Existing building on site. Farely new with potential to retrofit and improve quality of spaces and fabric energy efficiency.



02 Deconstructing the roof and use current roof space for more accomodation spaces. Applying MMC's for new structure above existing building.



Proposed solution of private gardens for residential spaces.



03 Using an external structural support that doubles up as fabric insulation for retrofit part

04 Providing intergrated spaces that enhane a sense of community, encourage indipendent living and support wellbeing of customers.

Using timber for the proposed exo-structure, as it is a low impact material and low carbon. This also offers the possibility of offsite prefabrication and onsite assembly, significantly reducing the time of construction and waste, making it sustainable overally. However, this may be a bit costly and require specialised technology in some instances.

New construction can then be done above the existing buildings in a short while leveraging on off-site construction methods. These will offer accomodation for the current customers, ensuring Beaurfort programs are not interrupted.

The roof will be useful to offer outdoor comunal activities' space, besides the ones provided indoors. The green roof will also be as insulation from heat loss.The roof will be useful to offer outdoor communal activities' space, besides the ones provided indoors. The green roof will also be as insulation from heat loss and used for solar photovoltaic panels.
Current building form retrofited to provided balconies for individual care actvities such as gardening and views to biophilia.

3

Precedents

Upycle House
Parc Hadau & Springfield Meadows
The Mental Health House & Maggie's Leeds Centre
Trillium Secure Adolescent Inpatient Facility

Upcycle House

Location
Nyborg, Denmark

Architects
Lendager Arkitekter

Year
2013

Area
129sqm

Source
www.archdaily.com

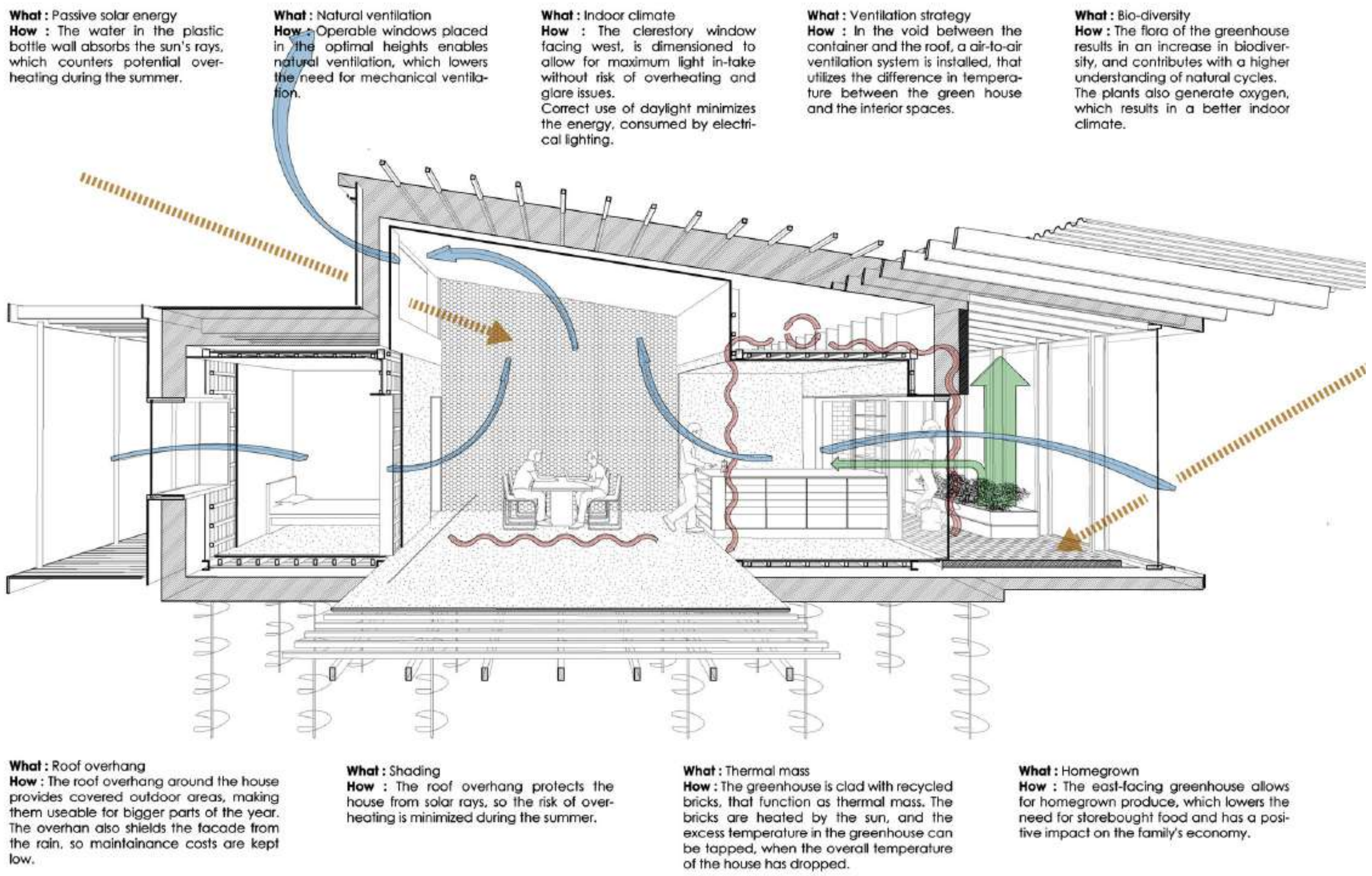


Figure 01: Passive sustainability.

Learning Point

The experimental project aimed at exposing potential carbon-emission reductions through the use of recycled and upcycled building materials. In the case of Upcycle House, the reduction was 86% compared to a benchmark house. The house is built of processed recycled materials and Upcycle House investigates how much it's actually possible to reduce the CO2 footprint by using upcycled materials to the extent possible.

Aesthetics - Although they used recycled materials, they have been blended well for greater aesthetics, despite the low budget.
Reducing carbon footprint - The CO2 emission from Upcycle House is 0,7 KG CO2/M2/YR
Passive sustainability - designed with orientation, temperature zones, daylight optimization, shading and natural ventilation in mind.

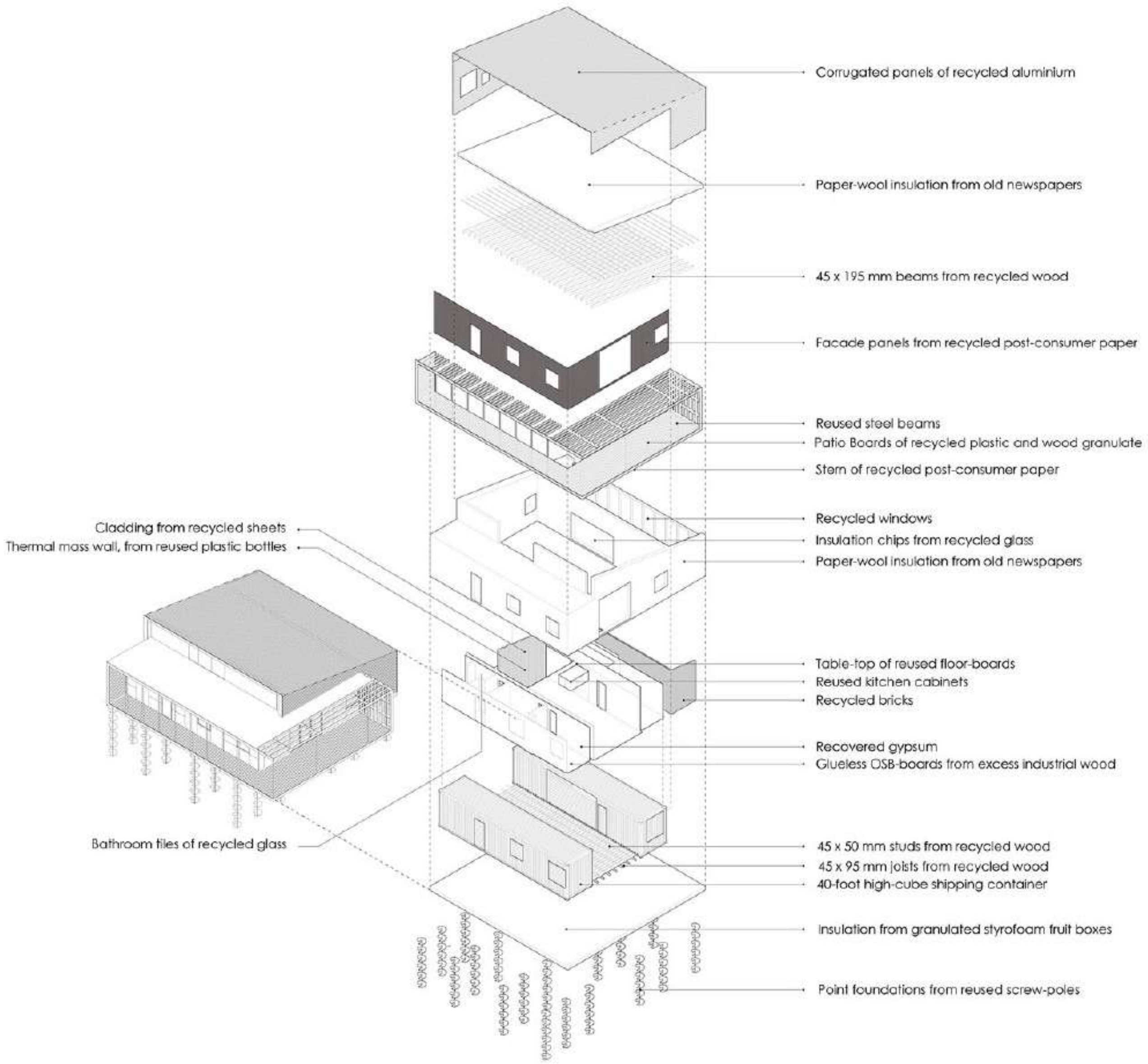


Figure 02: Upcycling diagram

3.2 | Parc Hadau & Springfield Meadows

Parc Hadau

Location
Rhydyfro, Pontardawe, Wales

Architects
Farrer Huxley, Loyn + Co

Year
2021

Source
www.dezeen.com
www.ukgbc.org

Design Background

This is a **community-focused** development of 35 homes that will utilize time-of-use grid emission factors to demonstrate an annual net zero carbon balance. First neighbourhood in the UK to actively monitor time-of-use grid emission factors. This will be measured using live emissions factors from the grid.

Learning Points

- **Energy use monitoring** - Intelligent energy management of the homes, together with fabric, storage and on-site renewables.
- **Building fabric** - High performance fabric with integral thermal mass and designed to be flexible in layout internally whilst retaining a long live building envelope and structure.
- **Low embodied carbon** - Materials have also been chosen for their low embodied carbon such as CLT for a strong structure and carbon sequestering.
- **Local sourcing** - Externally, the cladding of the homes will be a blend of timber and masonry – the latter either locally quarried stone or recycled brick, both laid to be reusable at the end of the homes' life.

Figure 01: Community-focused, fostering interaction

Springfield Meadows

Location
Southmoor, Oxfordshire, UK

Team
Greencore construction Ltd
Sassy Property Ltd

Year
2021

Source
www.ukgbc.org
www.greencoreconstruction.co.uk

Design Background

A residential development that comprises of 25 houses that deliver on net zero during construction and for operation energy during the building life.
Passivhaus principles have been applied. Energy demand reduction measures, renewable energy generation through solar PV and supplementing with green energy supply are key in the project.

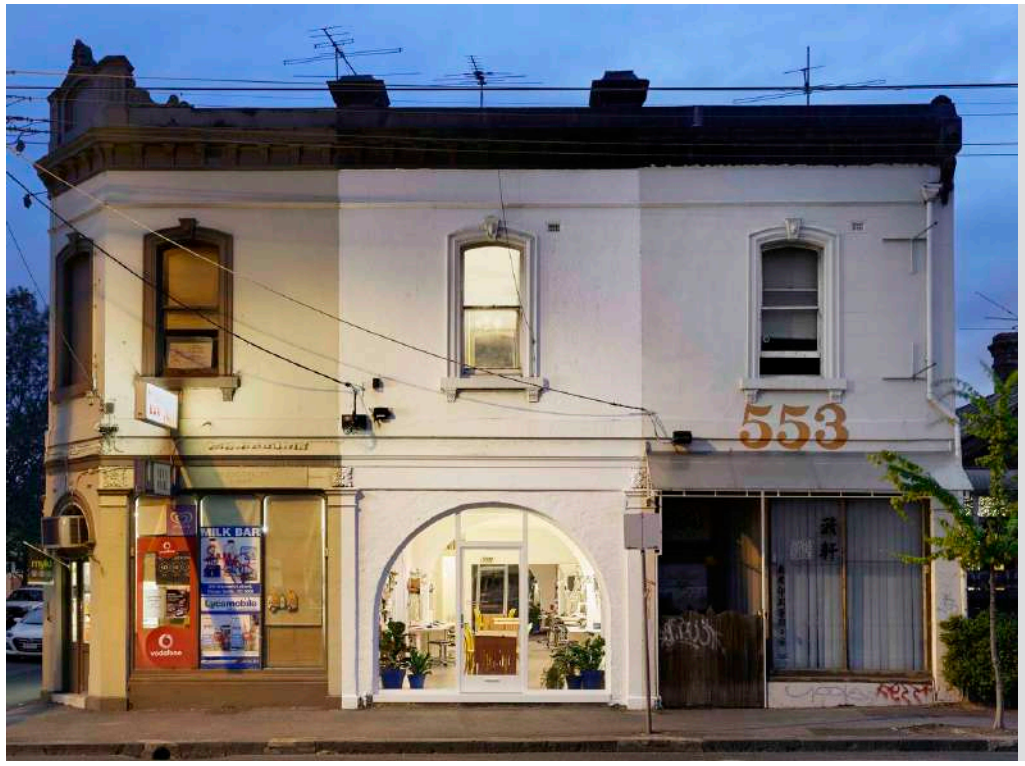
Learning Points

- **Net zero** - The embodied carbon from construction is net zero (or better) which will save an estimated 1,250 tonnes of emissions.
- **Zero waste** - 100% of the waste created during the construction process is recycled and recovered with total diversion from landfill.
- **Passivhaus** - Use less than 15kWhrs/m2/a for heating. Design features include: triple-glazed timber windows, heat pumps serving underfloor heating and domestic hot water, mechanical ventilation with heat recovery (MVHR) system, LED downlights in all rooms, and thermally efficient front doors.
- **Green energy** - 114kW of roof-mounted PV is spread across all 25 houses; supported through use of a green energy supplier when any additional demand is required.

Figure 02: Sufficient indoor lighting optimised by using large windows

3.3 | The Mental Health House & Maggie's Leeds Centre

The Mental Health House



Location
Australia

Architects
Austin Maynard Architects

Year
2016

Area
167sqm

Source
www.archdaily.com

Design Background

An Architect's home/office that initially was dark inside (lack of sunlight and vitamin D), contributing to the mental health challenges of anxiety and stress, redesigned to be provide an environment that encourages healing and productivity.

The new extension is a bright, elaborate greenhouse with a clear Thermoclick roof.

Learning Points

- **Sunlight** - Spaces opened up to allow more sunlight and warm up internal spaces. Walls painted white to make spaces look brighter and cheerful.
- **Greening** - Use of a lot of plants around common interaction sace that has been proven to improve healing and sense of well being.
- **Interaction** - Unconventional open space for the family upstairs to minimise privacy and isolation, and encourge interaction and sharing.

Figure 01: Community-focused, fostering interaction

Maggie's Leeds Centre

Location
Southmoor, Oxfordshire, UK

Team
Heatherwick Studio

Year
2020

Area
462sqm

Source
www.archdaily.com

Design Background

Maggie's Centre is a charity that provides free practical and emotional support for people with cancer. It is designed as a group of three large-scale planters, built on a sloped site, that each encloses a counselling room. These surround the 'heart' of the centre - the kitchen - as well as more social spaces for group activities including a library and exercise room.

Learning Points

- Uses several 'healthy' materials and energy-saving techniques.
- **Community & Healing** - The interior of the centre explores: natural and tactile materials, soft lighting, and a variety of spaces designed to encourage social opportunities as well as quiet contemplation.
- **Natural materials** - Porous materials such as lime plaster help to maintain the internal humidity of the naturally- ventilated building.
- **Activity** - The rooftop garden, inspired by Yorkshire woodlands, provides warmth in the winter months. Visitors are encouraged to participate in the care of the 23,000 bulbs and 17,000 plants on site.
- **Structure** - It is built from a prefabricated and sustainably-sourced spruce timber system.
- **Form & Orientation** - Carefully considered to capitalize on passive ventilation.

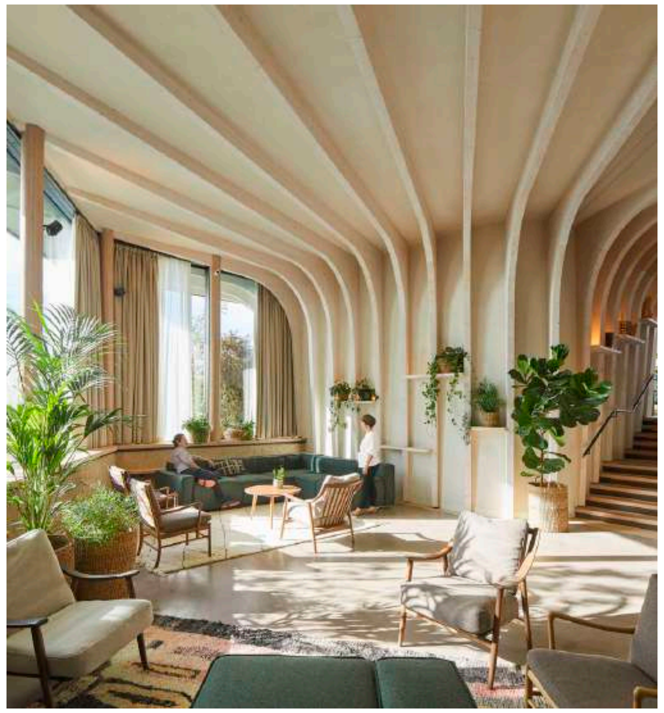


Figure 02: Natural materials for healing

3.4 | Trillium Secure Adolescent Inpatient Facility

Trillium Secure Adolescent Inpatient Facility

Location: Corvallis, USA
Architects : TVA Architects
Year: 2015
Source: www.archdaily.com

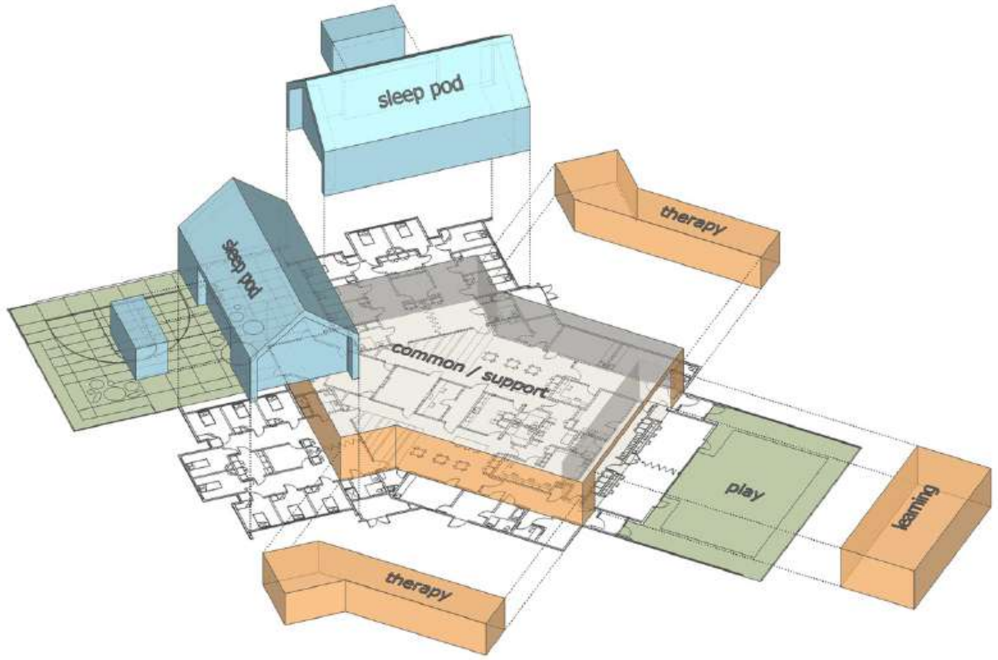


Figure 02: Safe and secure outdoor quad

Design Background

- Facility provides beds, therapy spaces, and classrooms in a single-story inpatient clinic for adolescents suffering from substantial behavioural and mental health issues.
- Hence, the brief for the building was developed to create a facility that was safe, secure and to create a warm, welcoming, recuperative atmosphere that respects the dignity of the patients while appealing to a teenage clientele.
- Staff, patients, and facility groups were engaged throught the design process to help envision and define a building that met physical and emotional needs of the youths while keeping staff safe and operations efficient.

Learning Points

- **Safety & Security** - Priority to provide secure environment for higher acuity clients.Well secure quad that provides external interaction area.
- **Material Choice** - The design process included studying precedent facilities which established that material choice was key in the design of such a building.
- **End User** - It was important to engage all the people who will be using the facility during the design process, in order to understand their needs.
- **Program** - Separation of populations of patients by level of acuity. Understanding spatial requirements and their relationship to ensure effiecient operations.
- **Flexibility** - Necessary to have flexible spaces to accommodate changing needs of users overtime.
- **Material Selection & Furniture** - Using material and textures that are calm and create a natural ambience. Incorporating fixed furniture pieces to minimise on damages.
- **Nature** - Views through skylights and clerestory windows ar used extensively, connecting patients with nature while minimizing the potential damage and safety issues inherent with glazing at lower levels.

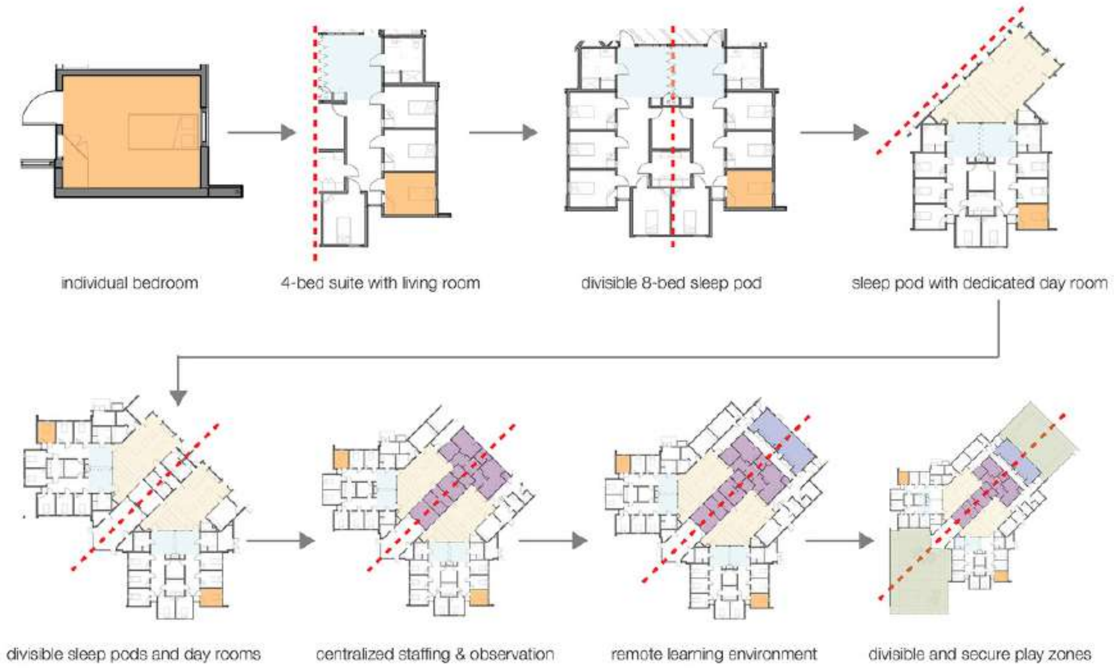


Figure 03: Flexible layout

The ability to separate populations of patients by acuity (or level of agitation) drove a requirement for flexibility and space redundancy that became central to the facility design by using operable partitions This kind of scalability is crucial in responding to myriad situations and clientele, which can change on a daily basis. The layout also encourages staff to be out with the patients, offering opportunity for positive staff/patient interactions.

4

Visions and Objectives

4.1 | Visions and Objectives

"To develop guidelines for our client by applying sustainable design strategies to create an environment, conducive to supporting the healing process, and encourage independent living for the Beaufort community."

Environmental Architecture

Primary Objectives

To reduce energy demand of the building.	To achieve zero net carbon by 2030 by use of renewable energy alternatives.	To improve thermal comfort by reducing overheating of the building.	To improve biodiversity.

Concrete Objectives

To achieve highest fabric efficiency standard according to EnerPHit of 25 $kWh/m^2/a$.	90% dependence on Renewable Energy technologies 90% positive carbon capture material choice for retrofit.	Achieve standards of clothing / PM v PPD / relative humidity 30-70% / relative air velocity 0.2m/s / [MRT-AIR temperature]<4°	30% of balcony space to have increased flora and fauna. Archieve 90% water efficiency.

4.1 | Visions and Objectives

> **"To develop guidelines for our client by applying sustainable design strategies to create an environment, conducive to supporting the healing process, and encourage independent living for the Beaufort community."**

Wellbeing Architecture

Primary Objectives

Space design for healing and independent living.	Promote new activities to reduce level of stress.	Improve indoor lighting quality.	Improve indoor air quality.

Concrete Objectives

Independent balconies gardens for 80% of residential spaces. 20% increase of communal spaces. 100% visual connectivity to surrounding.	Introduce four therapeutic activities.	80% daylighting in residential and community spaces. ASW(200lux 2650 per year 100/3450)UD DF>3	IAQ Rating **EXCELLENT** 61-65 points (IAQUK 2015) CO_2 < 600PPM Intergrated hybrid ventilation. Low impact materials, lower particular matter concentration

5

Solutions

Environmental Sections

Biodiversity

Spatial Design

Rooftop Garden

Balcony

Structure

Overheating

Energy Reduction

Renewable Energy

Well-being

Materiality

5.1 | Environmental Section

Indoor Activity
Indoor activity area for individual and group activities such as games and reading

Low Impact/Carbon
Use of low impact material (timber) for positive carbon capture

Tripple Glazing
Tripple glazed to minimize heat loss and ensure airtight fabric

Large Openings
Large openings on SE facade to maximise on winter solar gain, shading to control gain in summer

Daylighting
Large windows for quality daylighting no NW facade

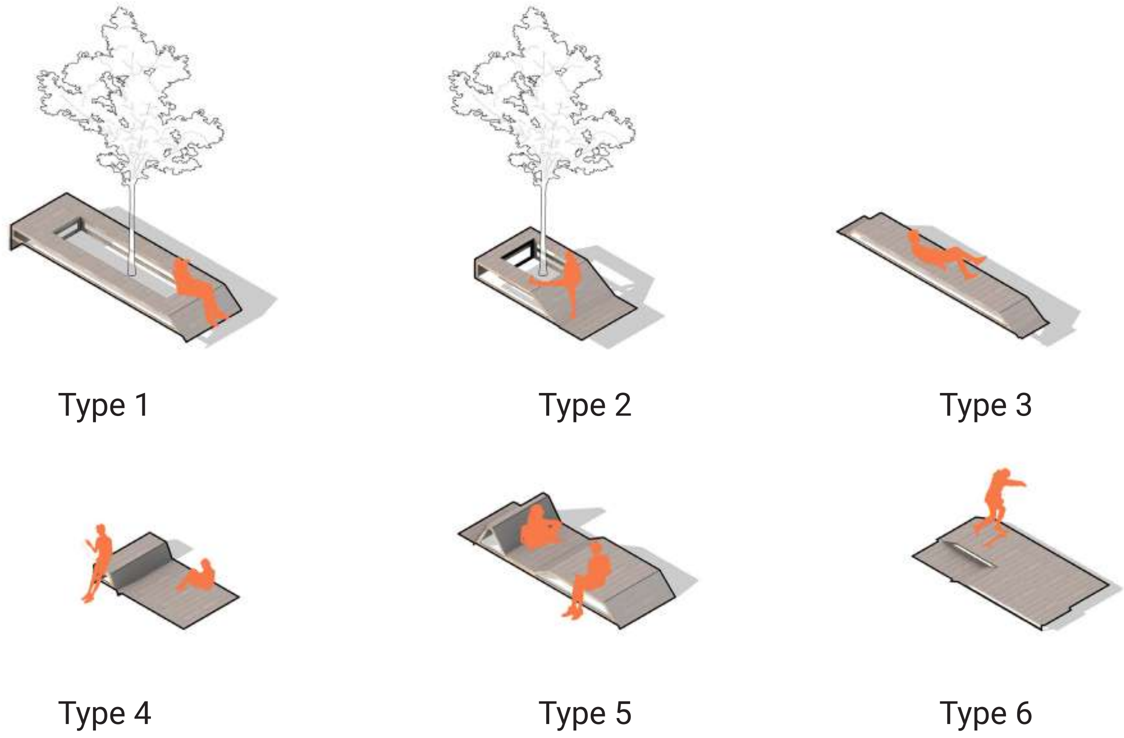
Insulation
Well insulated and highly airtight fabric to minimise heatloss and reduce energy demand

GSHP
Supplementary source of renewable energy for space heating

5.1 | Environmental Section

5.2 | Outdoor Garden Design

Activities in Outdoor Garden



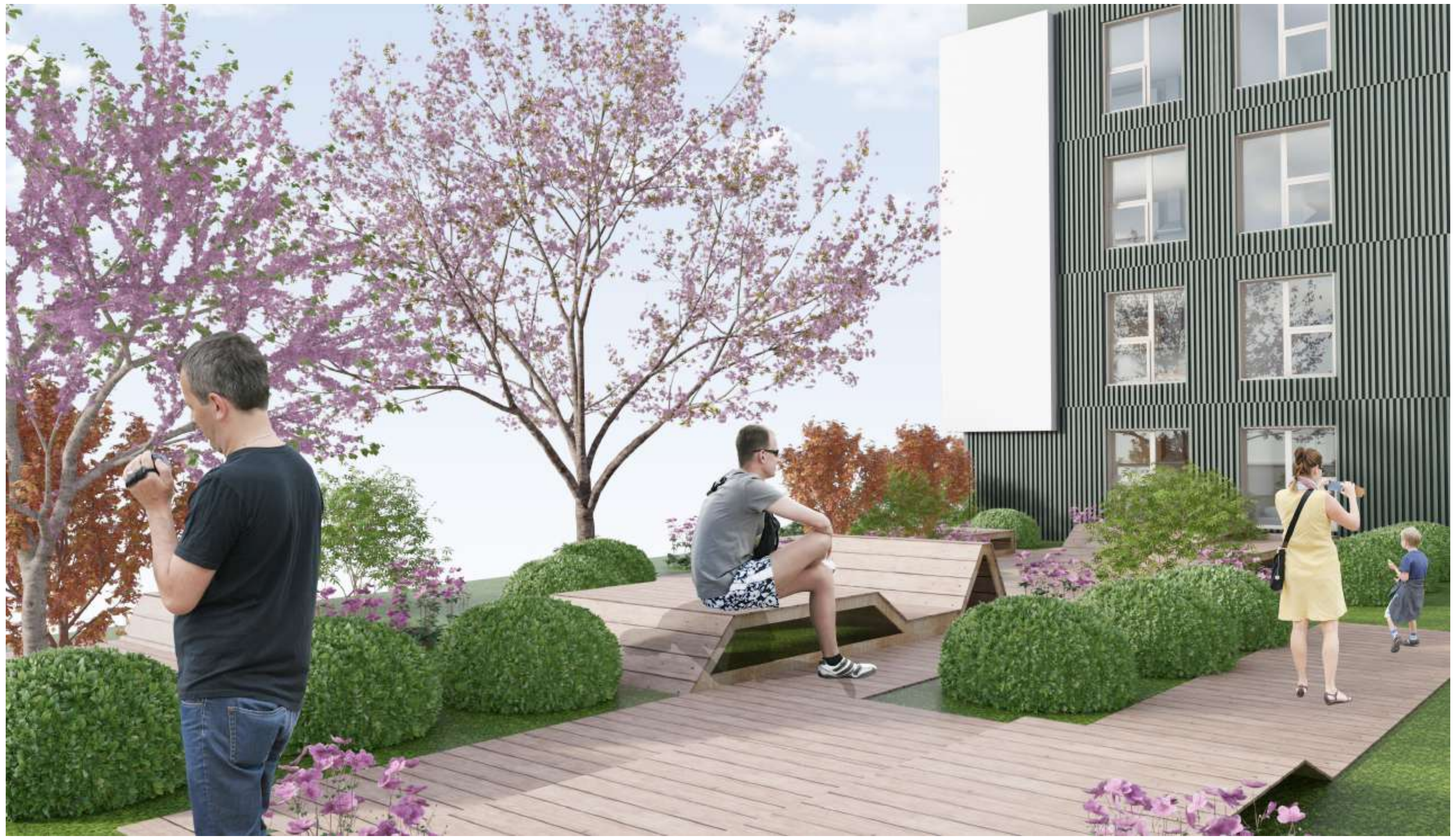
Summary

Through the transformation and design of the outdoor garden, it can provide more abundant activity space for the occupants.

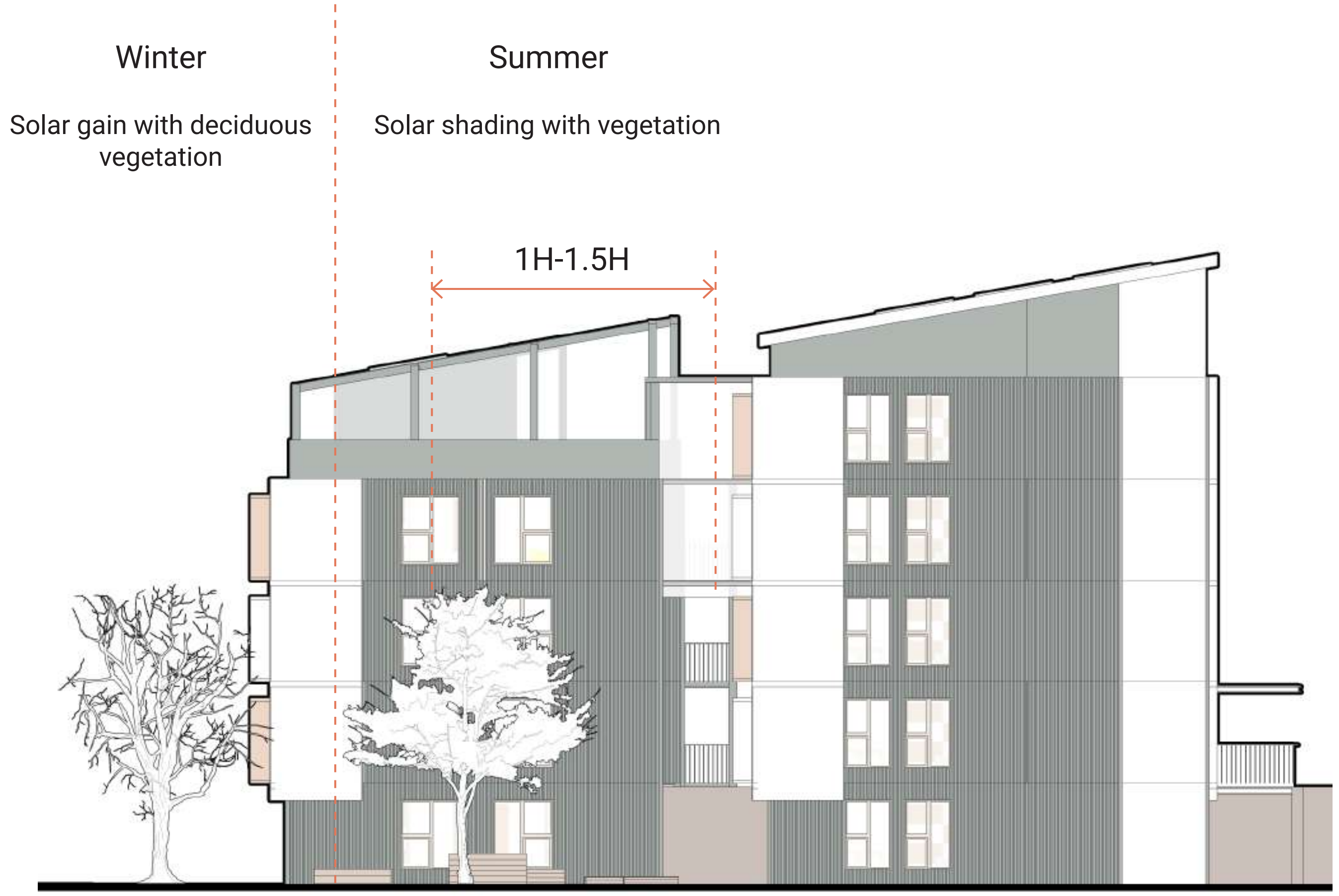
Meanwhile, through plant collocation design, improve the landscape view of the garden during four Seasons , for the mental health healing process, it plays a positive role in this.

On the other hand, deciduous green plants can act as sunshade in summer, but do not affect indoor lighting in winter.

Vegatation Design



Vegetation as Solar Shading



5.2 | Reccommended Plant Species

buddleia

bostion ivy

virginia creeper

ceanothus

caryopteris

cistus


clematis

echinops

escallonia

geranium

san-guineum

helichcrysum


honeysuckle

jasmine

juniper

lavender

phlomis

potentilla (rosaceae)


exotic rose

St John's wort

santolina

sea holly

sedum

snapdragon


fennel

oregano

rosemary

sage

thyme

chamomile

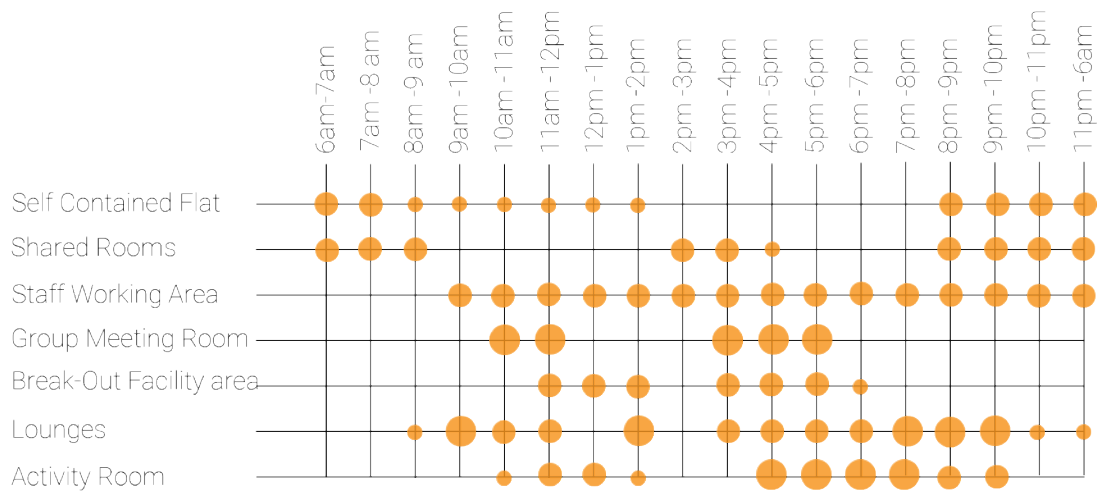

Summary By planting a variety of plants, we can enhance biodiversity, improve the landscape of the four seasons and play a essential positive role in the mental health healing process of residents. The rich collocation of plants will make the garden have different landscapes throughout the year, and the grassland plays a positive role in the conservation of rain water.

Reference: Environmental Design Pocketbook

5.3 | User Analysis in Context to the Spaces

Daily Activity Chart

Daily activity chart gives an idea about the usage of private, sem- private spaces. This analysis open options to merge some rooms according to their routine usage.

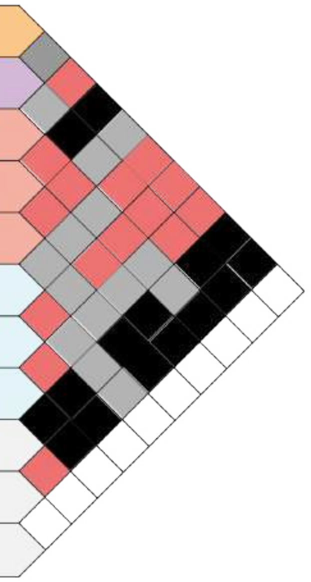


Space Adjacency Matrix

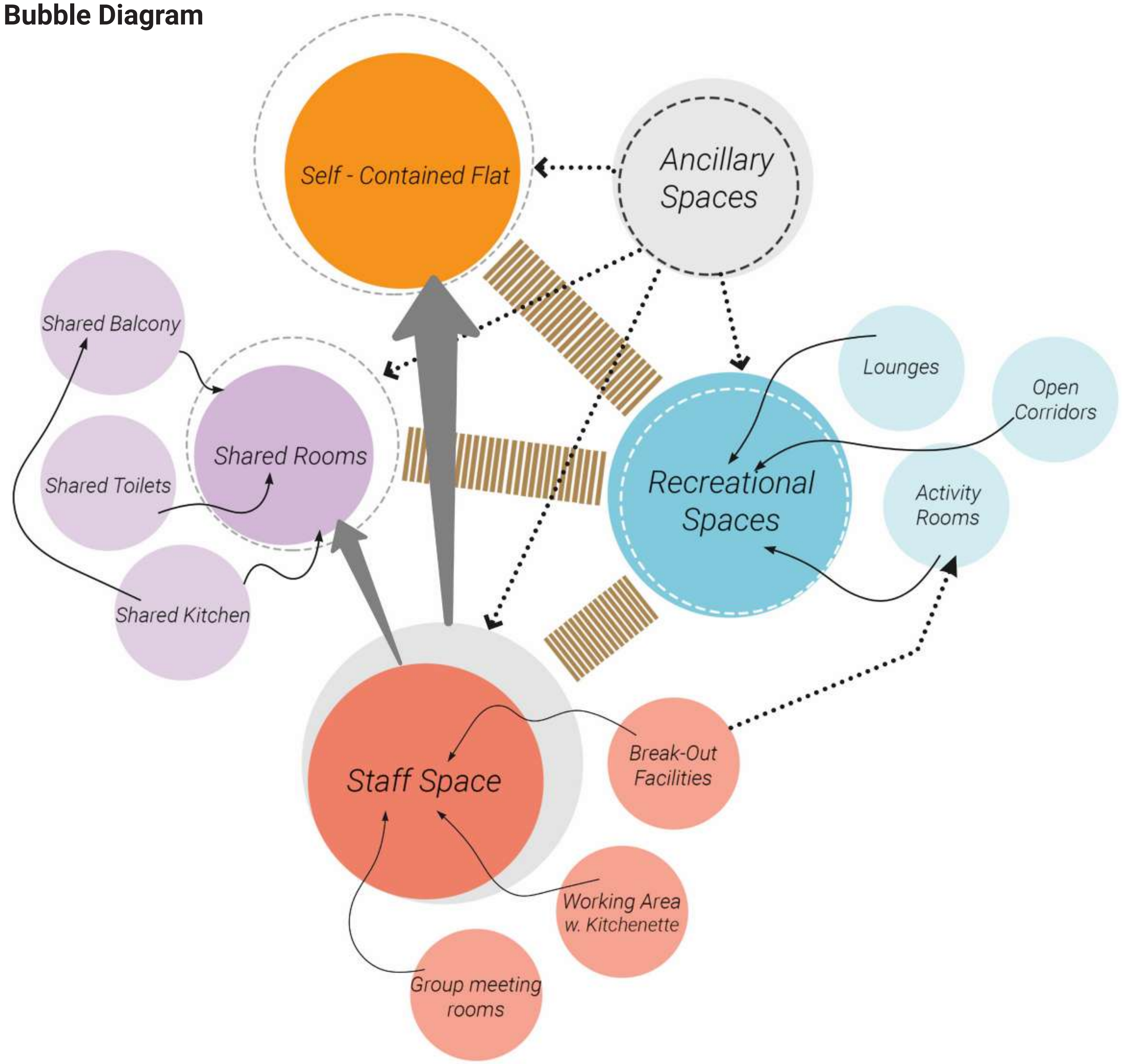
The matrix is used to understand the inter-relationship of buildings and further to analyse the factors like daylight, ventilation, privacy, entrance.

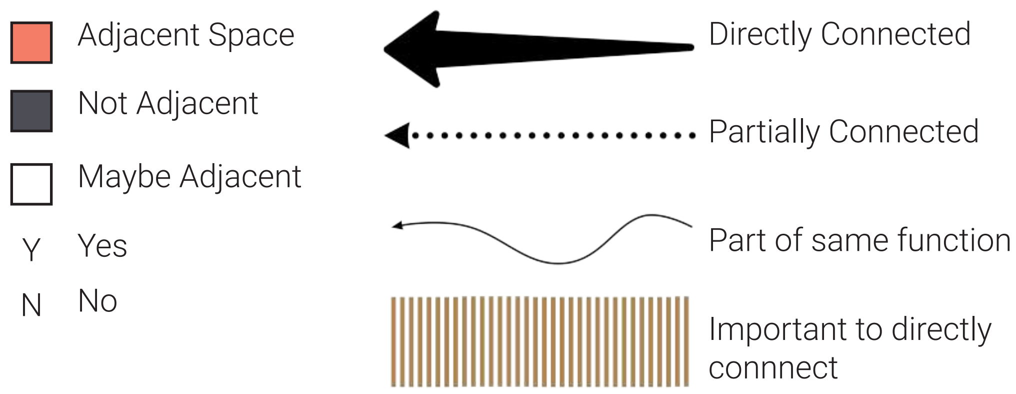
Speciality, View of Open Spaces, Adjacent, Direct Entrance, Public Access, Privacy, Natural Ventilation, Daylight

							Spaces
Y	4	Y	N	Y	Y	Y	Self Contained Flat
Y	3	Y	N	Y	Y	Y	Shared Rooms
Y	3	Y	Y	N	Y	Y	Staff Working Area
Y	2	N	N	N	Y	Y	Group Meeting Room
Y	2	N	N	Y	Y	Y	Break-out Facility
Y	2	N	Y	N	Y	Y	Lounges
Y	5	Y	N	N	Y	Y	Open Corridors
Y	3	N	N	N	Y	Y	Activity Rooms
N	1	N	N	N	N	N	Storage Spaces
N	1	N	N	N	N	N	Janitor Room



Bubble Diagram





Summary:

The analysis helped us to understand the relationship between spaces and human activity. As we are designing to upgrade the living standards of the users, it is important to consider their choice.

5.4 | Design of Room Typology

S. NO.	Existing Building Spaces	Area	No. of Units	Defination
1	Private Staff	44	1	
2	Lounge Area	19.61		
3	Kitchen	19.61		
3	Communal Area	19.61		
4	Private Resident: Self Contained	25.6	8	
5	Private Resident: Bedroom Only	19.3	10	
S.No.	**New Building Spaces**	**Area**	**No. Of Units**	**Defination**
1	En-Suite Rooms	26	21	Ensuite Rooms has balconies and undefined spaces to encourage the users to design the spaces according to their needs.
2	Studio Rooms	33	7	Studio Rooms are fully equipped rooms with balcony, washroom and kitchen in the same room
3	Semi Private Areas	26	8	Semi Private areas are the common areas shared by ensuite room residents. It includes the kitchen and TV lounge area. The idea of encouraging independent living.
4	Activity Lounges	25	4	Activity Lounges are the rooms dedicated to a particular activity like TV, Library that encourage small number of groups to interact
5	Communal Activity Lounges	58	1	Communal Activity Spaces are workshop spaces where all the residents can work together
6	Staff Reception	40	1	Staff Reception Include the one to one interaction spaces with kitchen and workstation for staff

Concept of Human Side of Sustainability:

Just as we prioritize environmental sustainability, should we not also consider how we design for human sustainability? A building's longevity depends as much on the comfort and happiness of its human users as it does its HVAC system. Curbing loneliness is more than a passing consideration – It is a critical component of a larger discussion on designing enduring, inclusive spaces. Loneliness is a matter of human health.

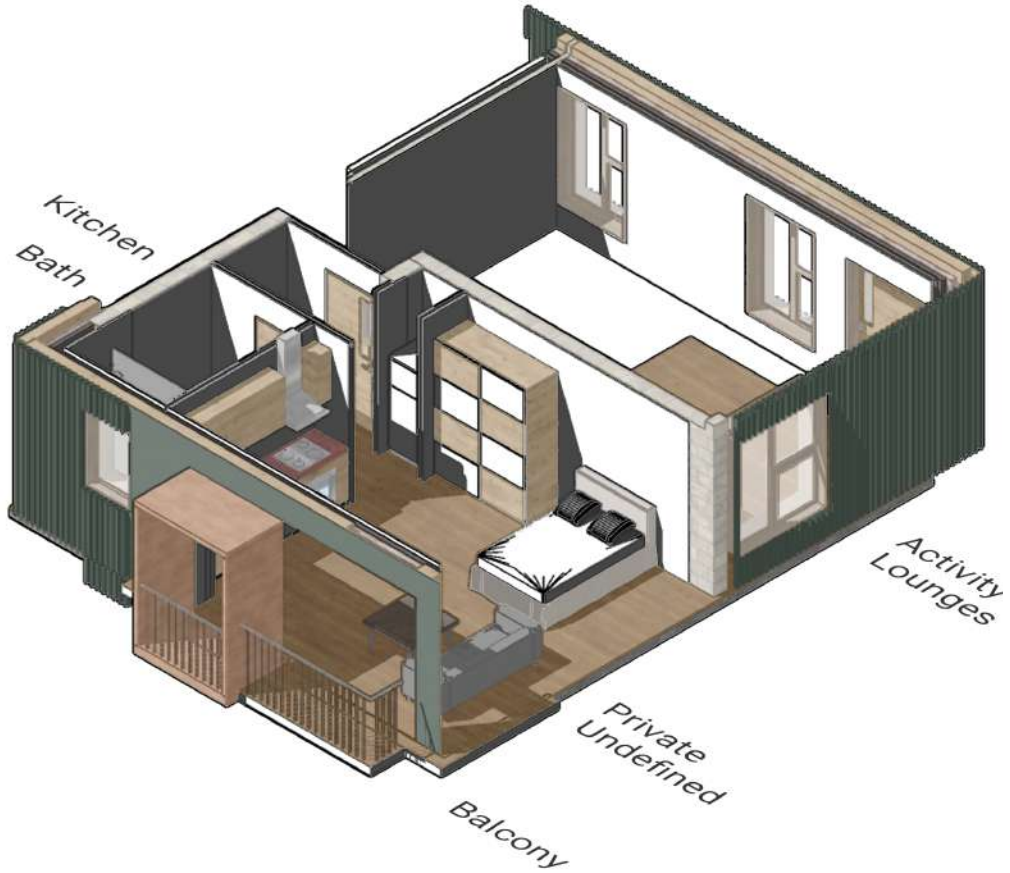
When a building's users feel that space adapts to their terms, as opposed to the inverse, they are more likely to linger, to feel at ease and to connect with their peers. Architecture succeeds when it rises to meet individual needs, interests, and inclinations – all factors that are highly dependent on local context. As such, we begin our designs with conversations: We seek out neighborhood locals and future building users to gain personal insights on how to serve local climatic, cultural and practical conditions.

Undefined Spaces:

we must design a framework that accommodates individual preferences. Shaping architecture to curb loneliness requires answering the why and how of human behavior. As we develop our designs, we consider why: Why do people gravitate to certain spaces? Why are certain spaces used or neglected in the way that they are? Understanding architecture as a product of human behavior, rather than the determinant, drives us to seek personal perspectives to inform our designs. Once our designs are completed, we must address 'the how': How do people move, act, and interact in the spaces we design? How have we met, or how could we improve, our ambition to create inviting social spaces?

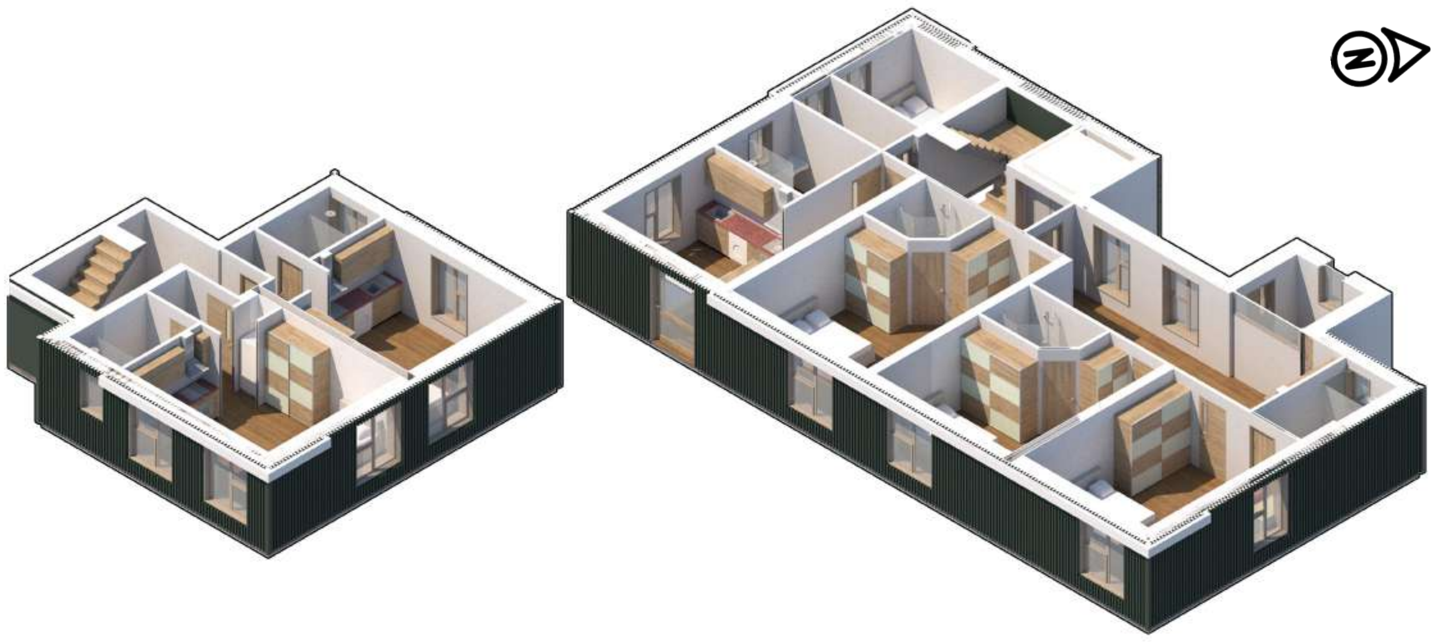
En- Suite Room

Studio Room



5.5 | Internal Layout

Proposed Lower Ground Floor



Existing Ground Floor

Proposed Ground Floor

Existing Ground Floor

The existing building internal layout is altered to accomodate more spaces and improve the quality of the experience of the customers, and encourage interaction and common activity. Every floor has a social space for activities such as reading, craft and social entertainment. The WWR on the southern facade is increased to improve daylighting and solar gain in winter. The use of timber allows for a lightweight structure and an externl exoskeleton to support the upper new structure

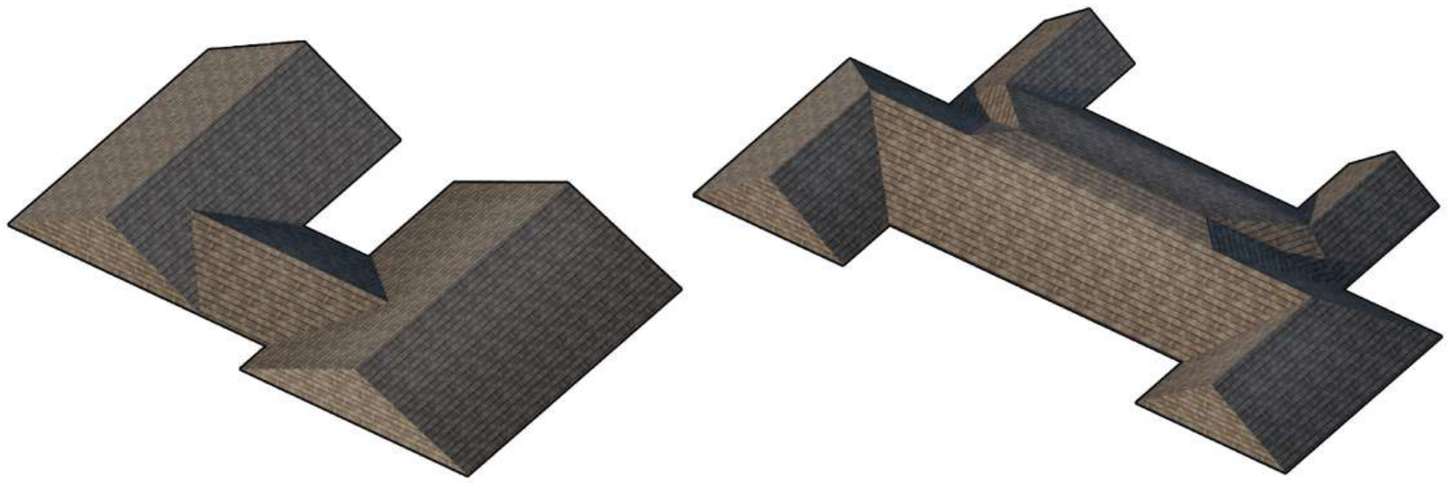
5.5 | Internal Layout

Proposed First Floor

Existing First Floor

Proposed Second Floor

Existing Roof

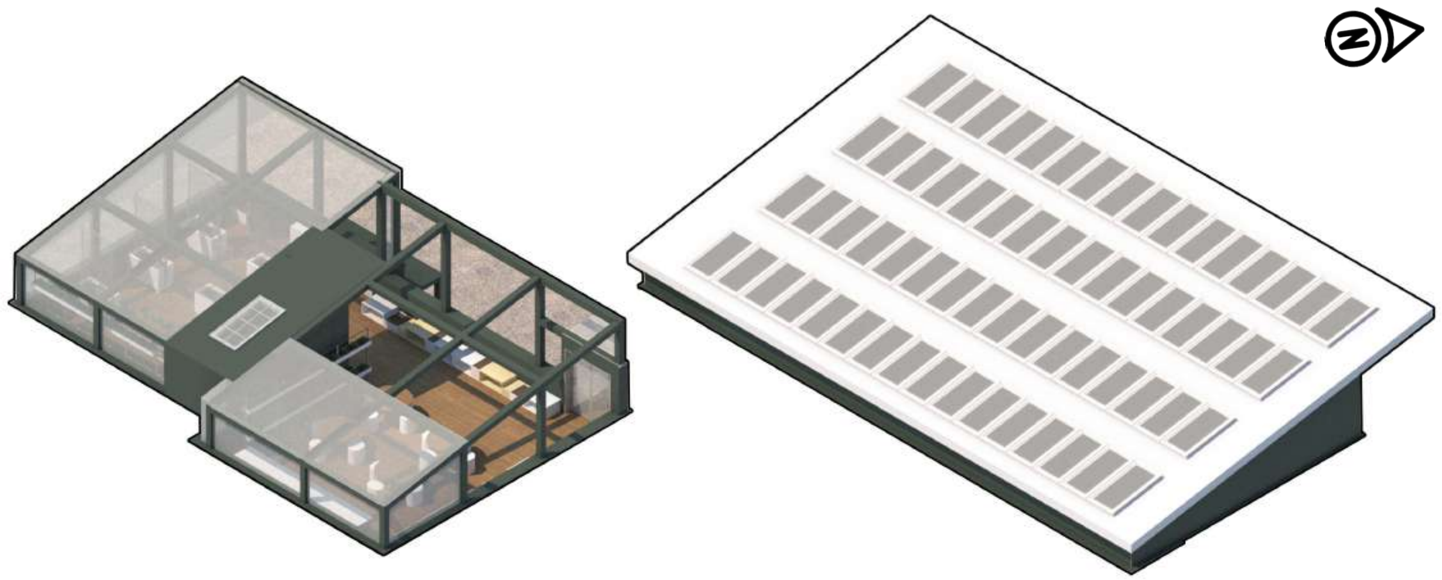


The upper floors have balconies on private rooms and common areas for semi outdoor activities such as crafts, basking, private gardening and reading. To connect the two buildings, there exists a bridge on the ground floor, second and third floors. The existing roof tiles are carefully deconstructed to be reused in this building and future SYHA projects, reducing theembodied carbon of the retrofit.

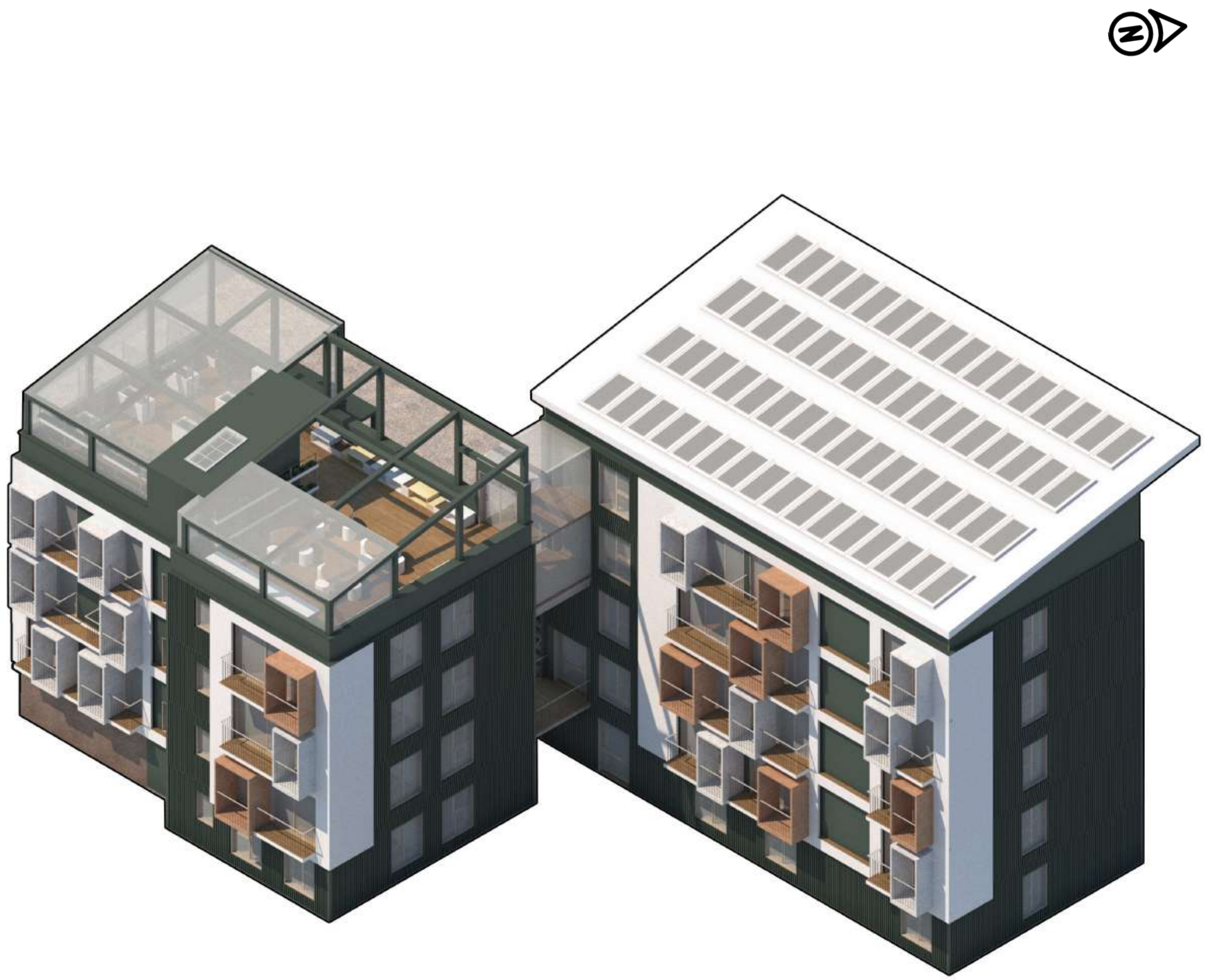
5.5 | Internal Layout

Proposed Forth Floor

Proposed Roof



Final Proposed Design



The upper floors are constructed with a combination of CLT and engineered timber ijoists for the structure. The ensures a lightweight structure, reducing the dead load on the existing building. The roof of the building includes succient surface for placing and orienting PV thermal panels and a semi open space for communal activity such as meet-ups and gardening. The connecting bridges are in glass to reduce the overshadowing effect on the south-east facade windows.

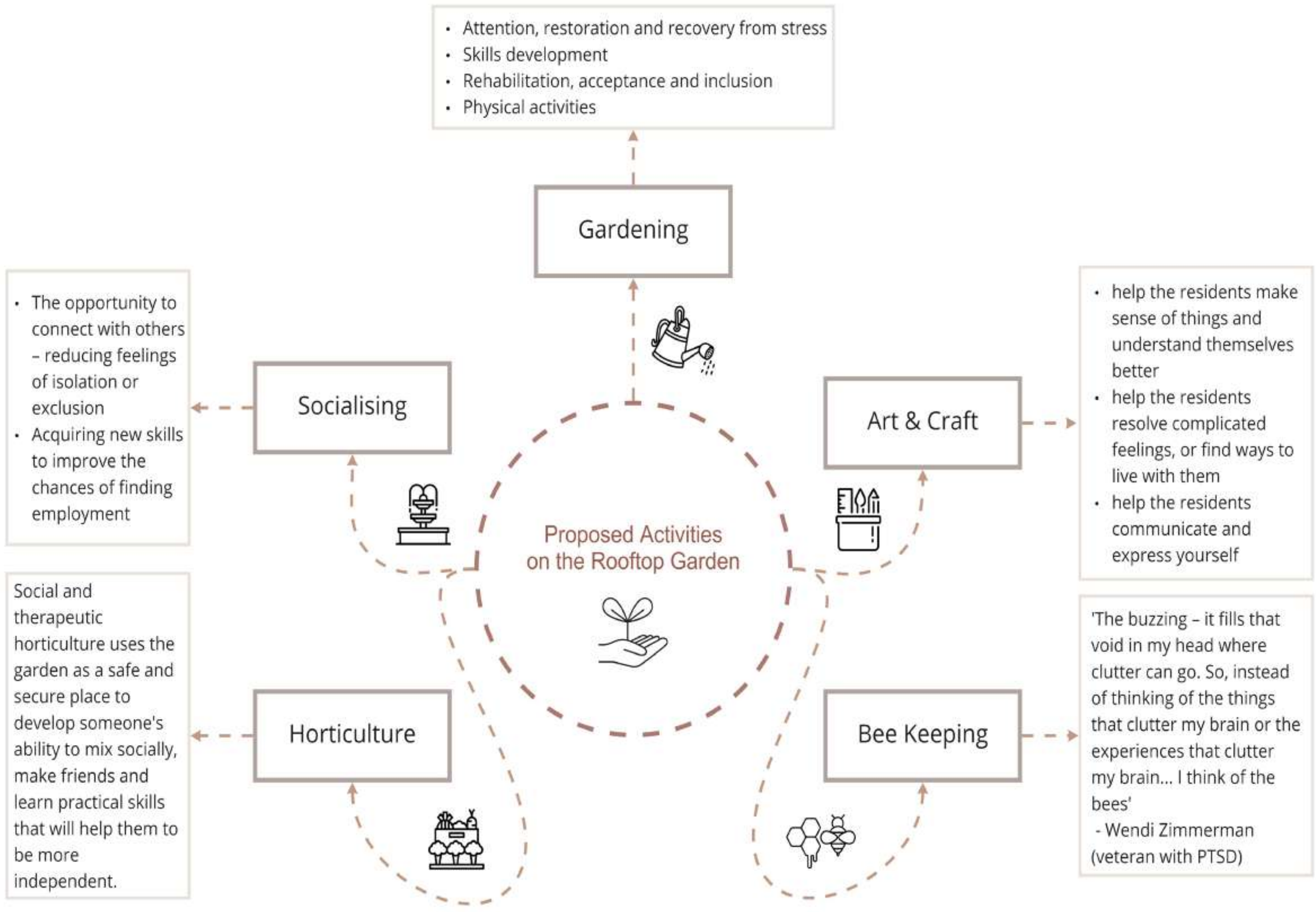
5.6 | Bedroom Interior Design

5.7 | Common Space Interior Design

5.8 | Semi-Common Space Interior Design

5.9 | Rooftop Garden Activities

Proposed Program of Outdoor Activities



1. Artistic therapies are considered helpful because they provide ways of addressing painful feelings and difficult experiences without talking about them.
2. Researches demonstrated that the act of beekeeping may help people with mental health problems such as stress, anxiety and depression. It is called “beekeeping therapy.”
3. Therapeutic horticulture is “a process that uses plants and plant-related activities through which participants strive to improve their well-being through active or passive involvement” ((AHTA, 2012).
The other activities are used in order to facilitate at best the reconciliation of the residents with the society by introducing activities that will encourage them to socialise within themselves.

Source of Inspiration

Bee Keeping

Greenhouse

Greenhouse

Oslo Urban Development, Nord Architects

Site

Approaches emphasizing active participationsuggest that working in a garden can be particularly rewardingbecause:
1. Human existence is based on and dependent on plants
2. Observing the beauty of plants and animals distracts us from ourproblems
3. By cultivating we develop attachment
4. Horticultural activities facilitate integration into society

Summary
‘Socialising and talking can be one of the first things to be lost in mental illness, then your job, friends, family and your sense of self. The expert care here helps people to recover in a meaningful way, and these projects are all part of that' - Kathleen Lynch, Minister of State for Disability, Equality and Mental Health
Spending time in nature has been found to be extremelly helpfull for people dealing with anxiety and depressions. The production of mental health benefits from nature experience may occur through multiple psychological causal mechanisms and pathways, including reduction of stress, increases in social cohesion or physical activity, or replenishment of cognitive capacities.

Reference

https://advances.sciencemag.org/content/5/7/eaax0903

5.10 | Rooftop Garden Proposal Design

Exploded Diagram

Green House

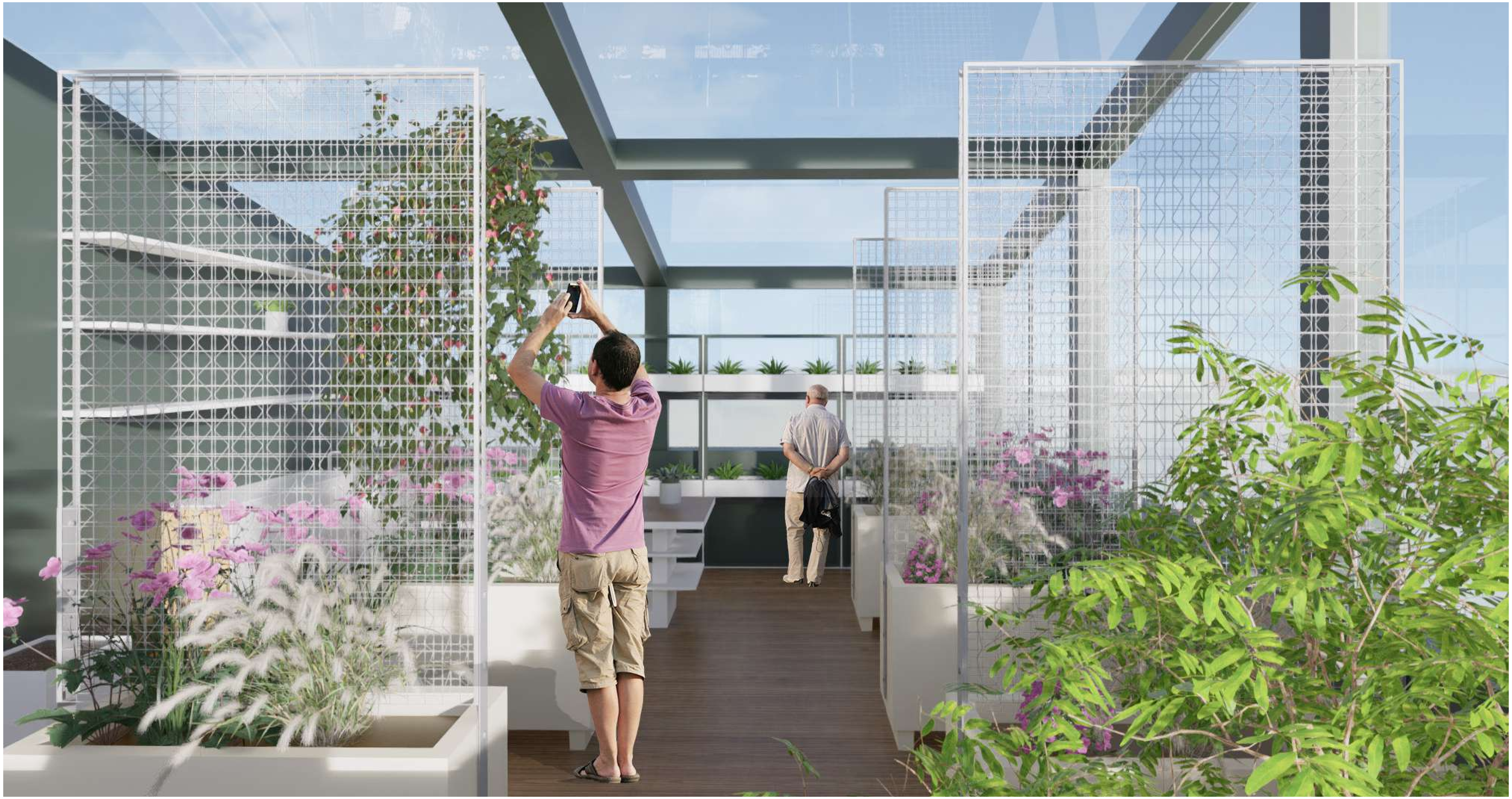
Social Space

Summary

After the research of possible additional activities to add to the Beaufort therapeutic program, the design of the rooftop was drafted. The design is divided into two main areas: the first one is reserved for horticulture, gardening and bee-keeping, while the second area represents a more flexible space where the residents can socialise while carrying out different activities (example: artistic activities, eating, playing).

5.11 | Rooftop Garden

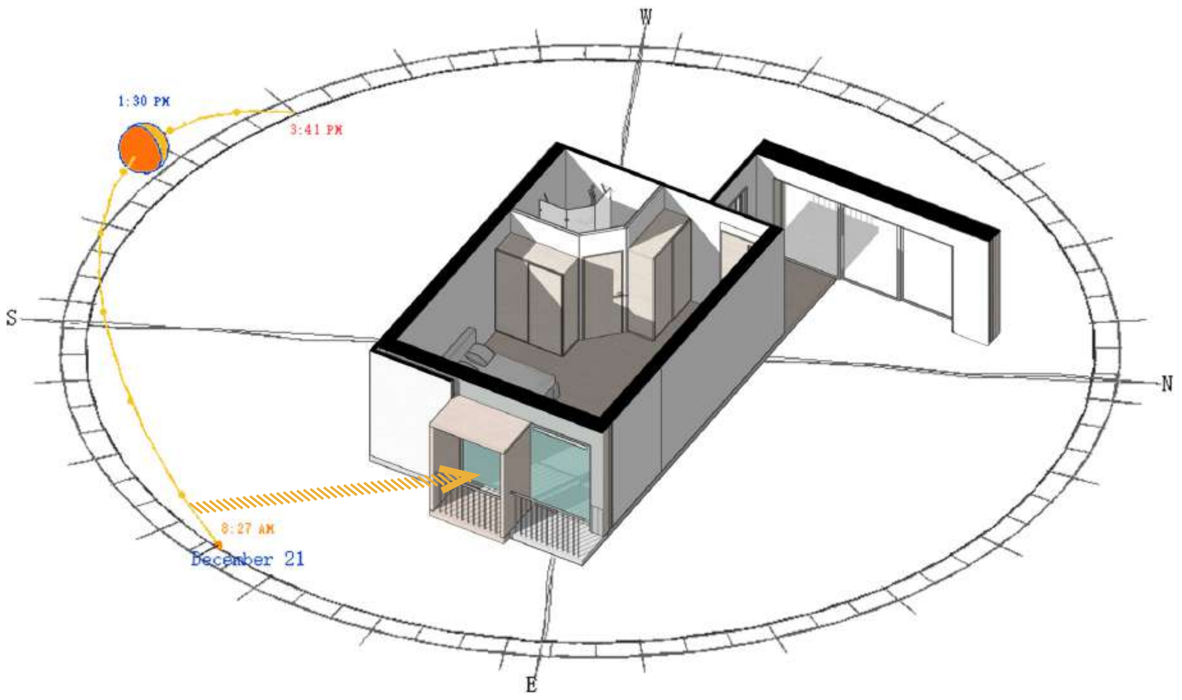
5.11 | Rooftop Garden



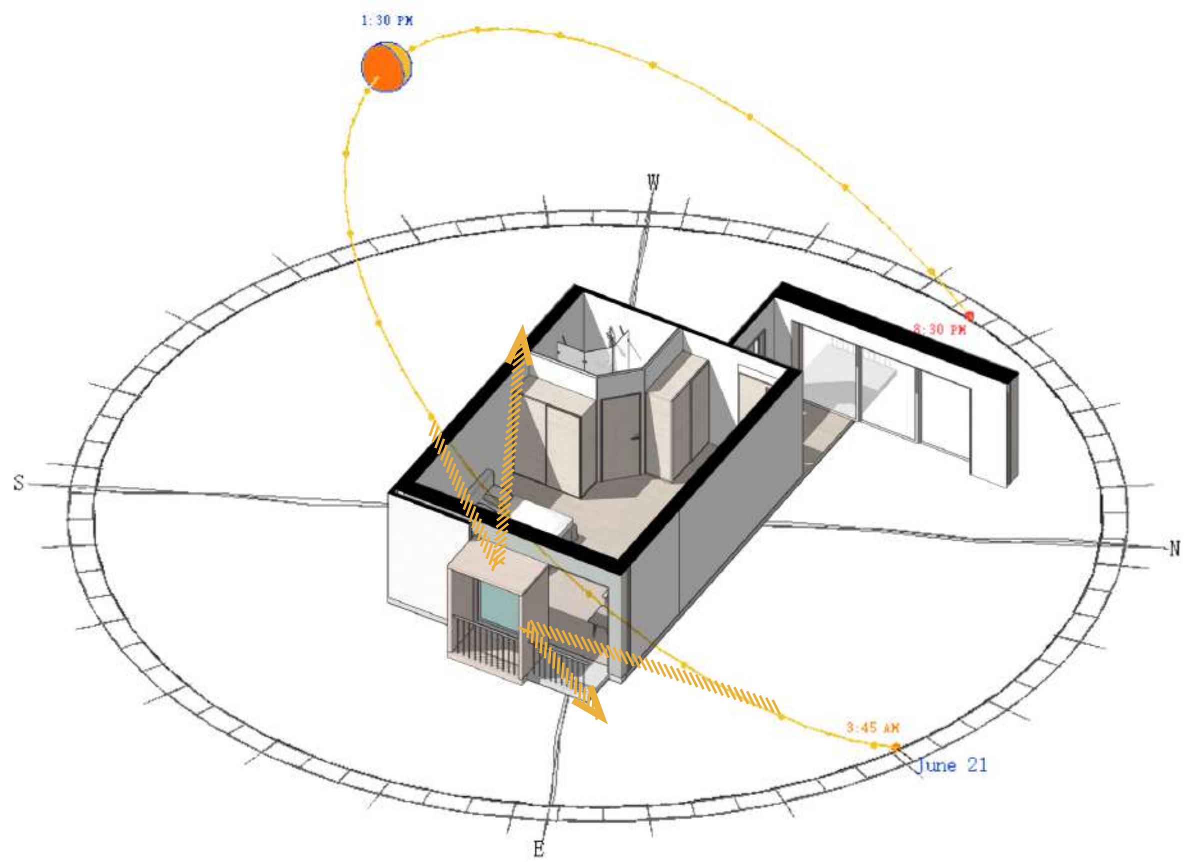
5.12 | Balcony Design

Illuminance

Winter solstice

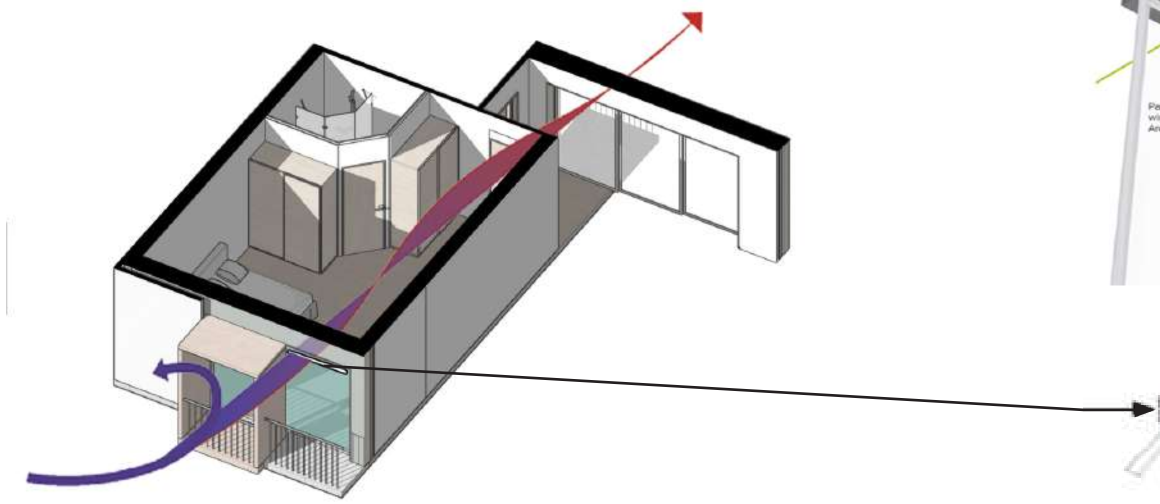


Summer solstice

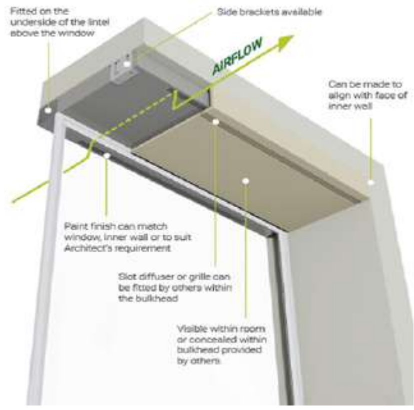


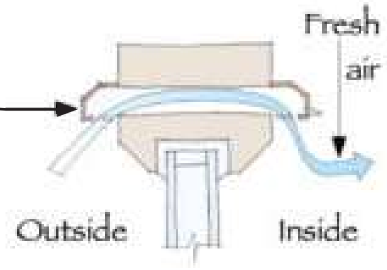
Ventilation

Winter solstice

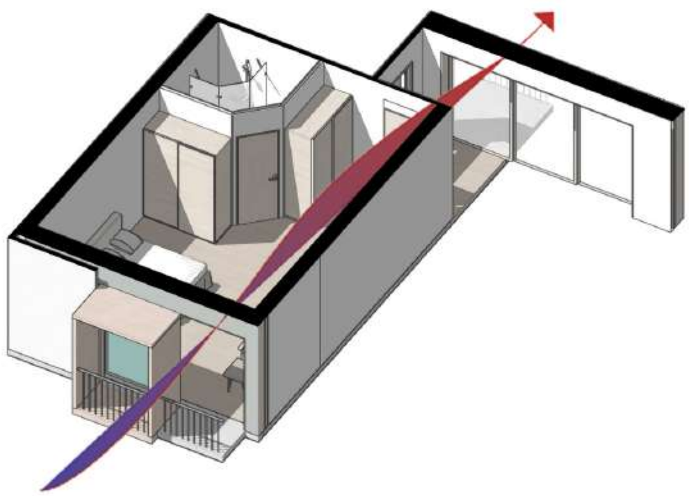


Trickle vents





Summer solstice

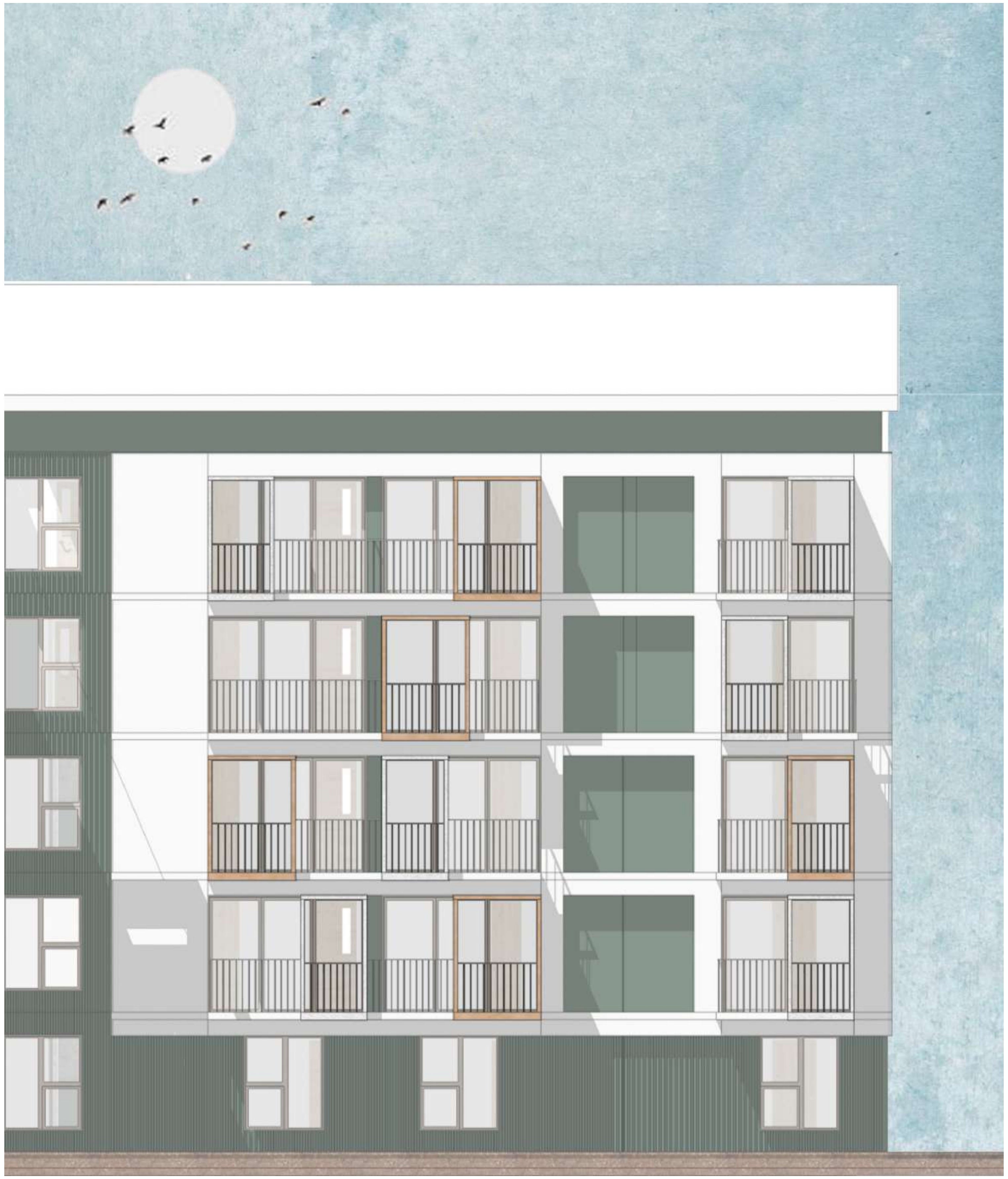


Summary

-During winter time, the balcony with larger opening than before can help introduce more daylight. At the same time, The sliding door can be closed to block cool air to get into the room. With the help of the trickle vents, ventilation still can be improve.

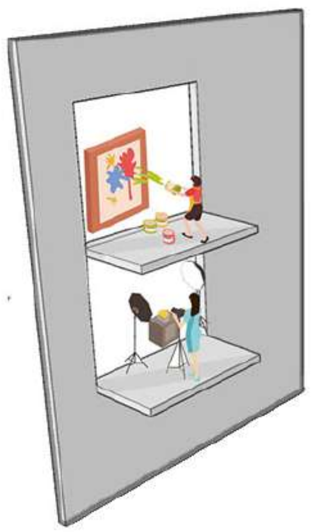
-During summer time, the box with combination of horizontal and vertical shading block direct sunlight, which alleviate glare problems. And the door can be openentroduce cross ventilation and reduce overheating.

5.12 | Balcony Design



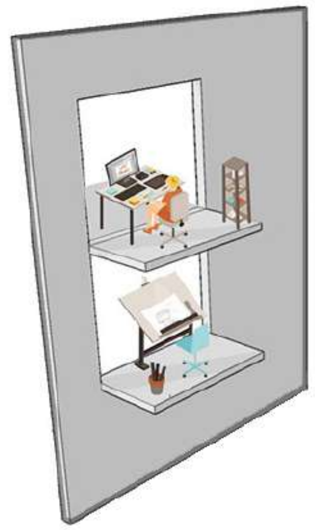
Suggested activities on balcony

Develop personal hobbies



Hobbies help users to develop tastes and passion in their life and make them feel a sense of belong.

Working and producing



They can set up their work office next to the windows. Productive activities help them develop the ability of independence.

Planting and gardening

Related research showed that gardening as being able to reduce stress and improve mood, with a reduction in symptoms of depression and anxiety.

Summary

The balconies are provided for users to design by themselves. Spending time on an activity that hey enjoy can improve mental health and wellbeing.
Different activities can help people suffering from low mood, and depression to reduce stress and more relaxed.
At the same time, the ability of independence can be built.vvvc

5.13 | Modern Methods of Construction

'Smart Construction'

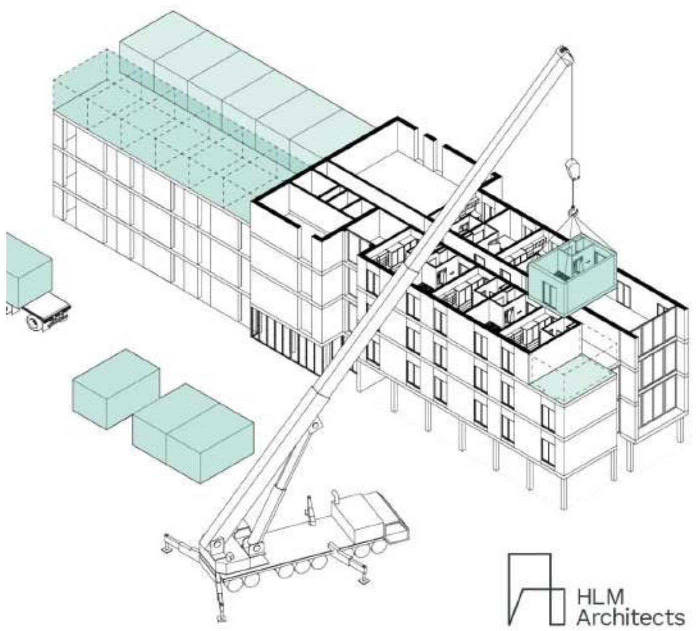
Advantages	Disadvantages
• Phased construction and design for disassembly. • Reduce waste and damage of materials (sustainable waste). • Minimum labour staff required on site for instalation and better supervision. • Allows for teting to find best fit for project before production. • Quality control ensuring projectd enegy use is close to actual.	• May be costly on average. • Progressive collapse must be addressed by the structural design. • Little or no thermal mass capacity of lightweight components. • In the case of retrofit, prefabricated components could mismatch with on-site in-situ work.

Modern Method's of Construction (MMC) or smart construction refer to the use of techniques that can be maximized by controlled factory conditions and mass production techniques. These majorly include offsite construction, prefabrication or modular construction. As confirmed, they are ways to work more effectively to achieve more without using more, within a short span of time. By their application, business efficiency is improved, construction quality, more satisfied customers, better environmental performance, and more predictable delivery timescales.

There are different approaches to MMC according to Sofie (2015) which include:

- 'Volumetric' or 3D prefabrication, e.g. plant rooms, bathroom/kitchen pods, student housing and hotel bedrooms and services, as well as apartments and retail units. They are entirely fitted out in a factory-controlled environment, transported to site and craned into place.
- Panelised prefabrication: roof, wall and floor panel systems which, when put together, form rooms and buildings. This is more suitable where there is a larger variety of layouts.
- Pre-assembly: modular components, such as solar shading, balconies, decking and partitions, are made and preassembled in the factory for rapid placement or connection on site.

Design for deconstruction



Offsite construction will enable our project to cut down on the construction time as well offer flexibility in accomodating the current building users and ensuring minimal distruptions of ongoing SYHA wellbeing programs. This will also allow offering spatial flexibility and ensuring the buildings carbon footprint is minimised by using low impact materials such as timber that can be reused at the end of the building life.

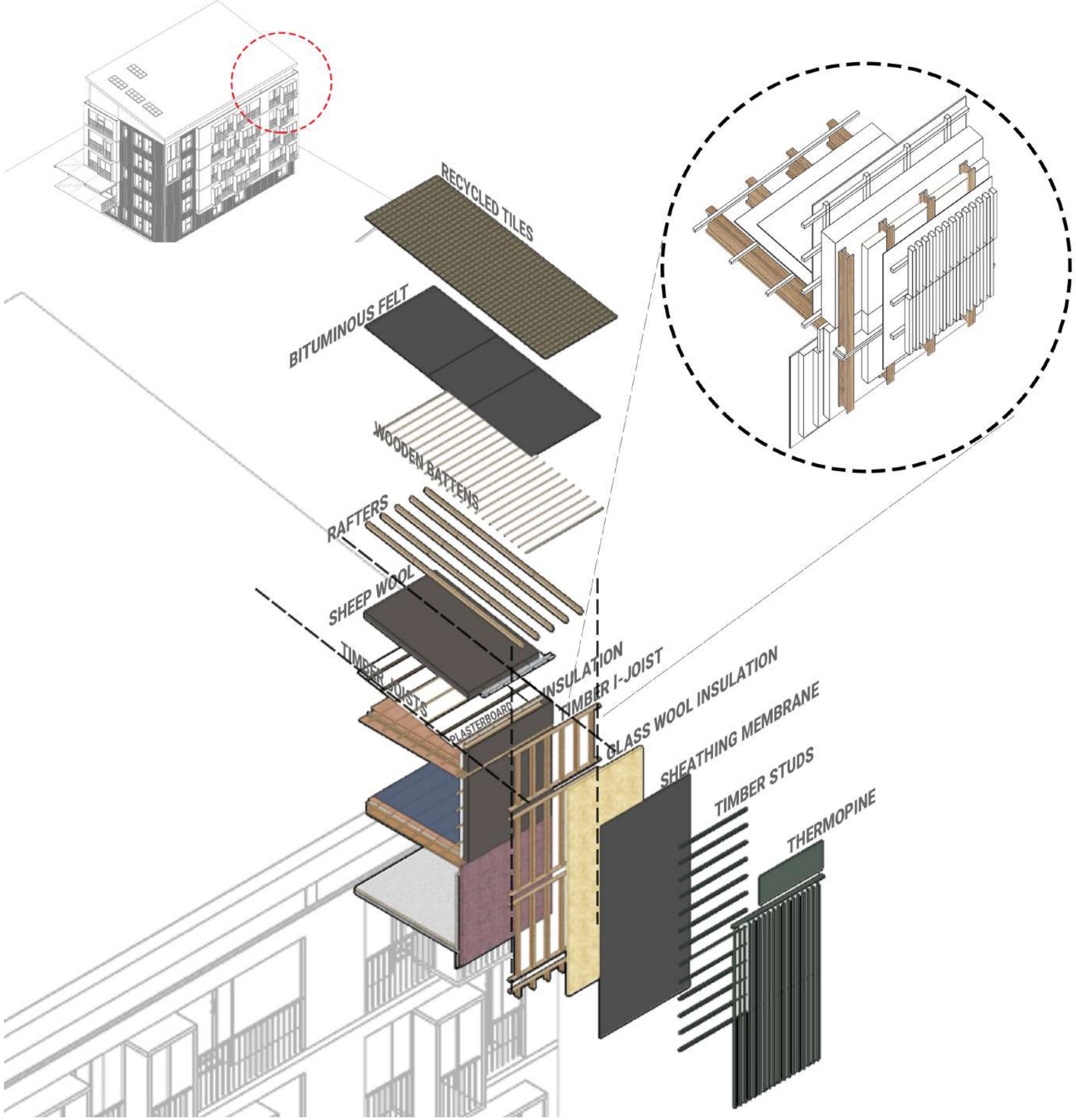
However, it is important to ensure close coordination between the designers, service and structural engineers, as well as manufacturer and contractor required.

Reference

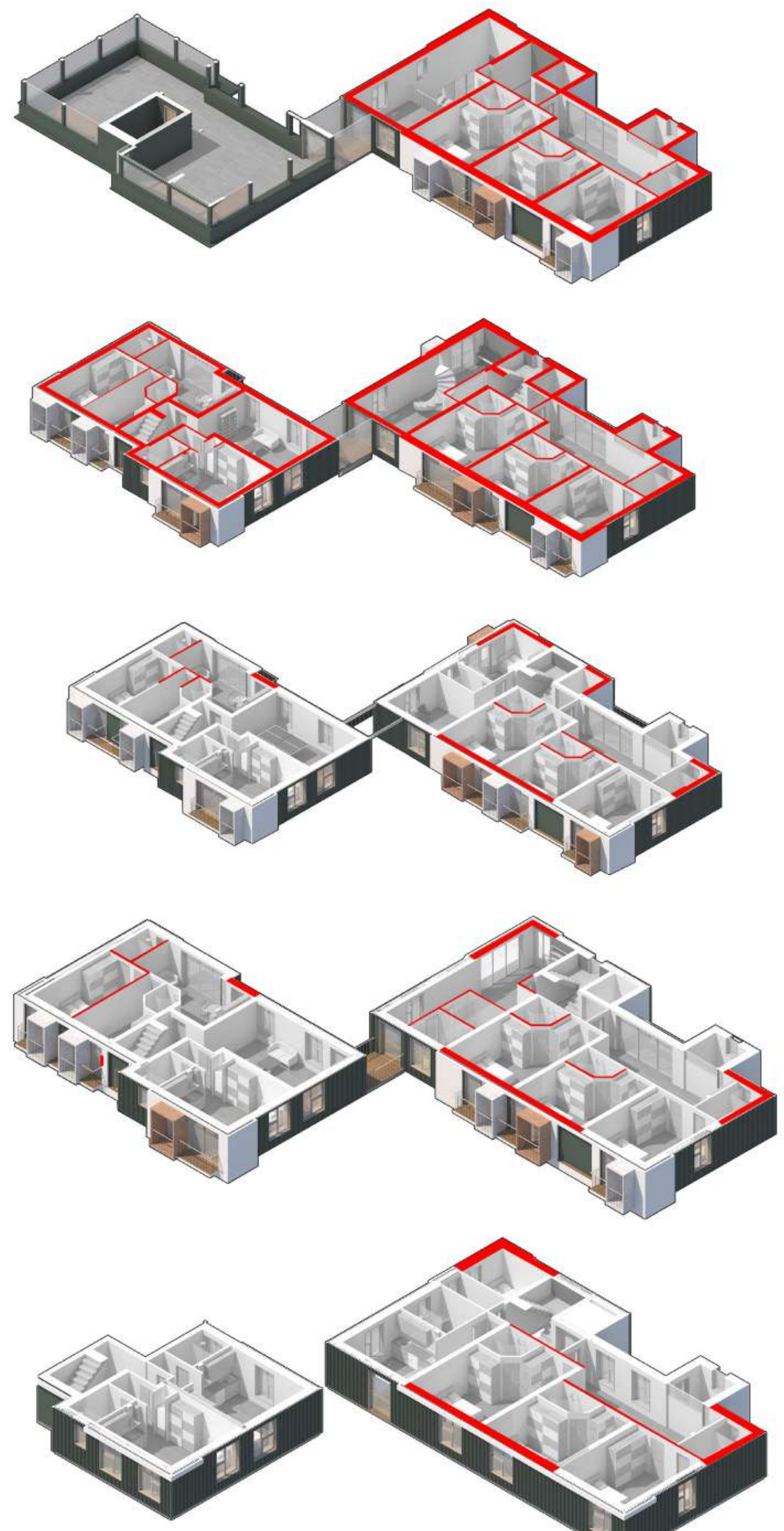
Pelsmakers, S. (2015) The environmental design pocketbook. Second edition. London: RIBA Publishing.
https://www.designingbuildings.co.uk/wiki/Modern_methods_of_construction
https://www.ukconstructionmedia.co.uk/wp-content/uploads/Stewart-Milne-min.jpg

5.14 | Structure of Proposed Building

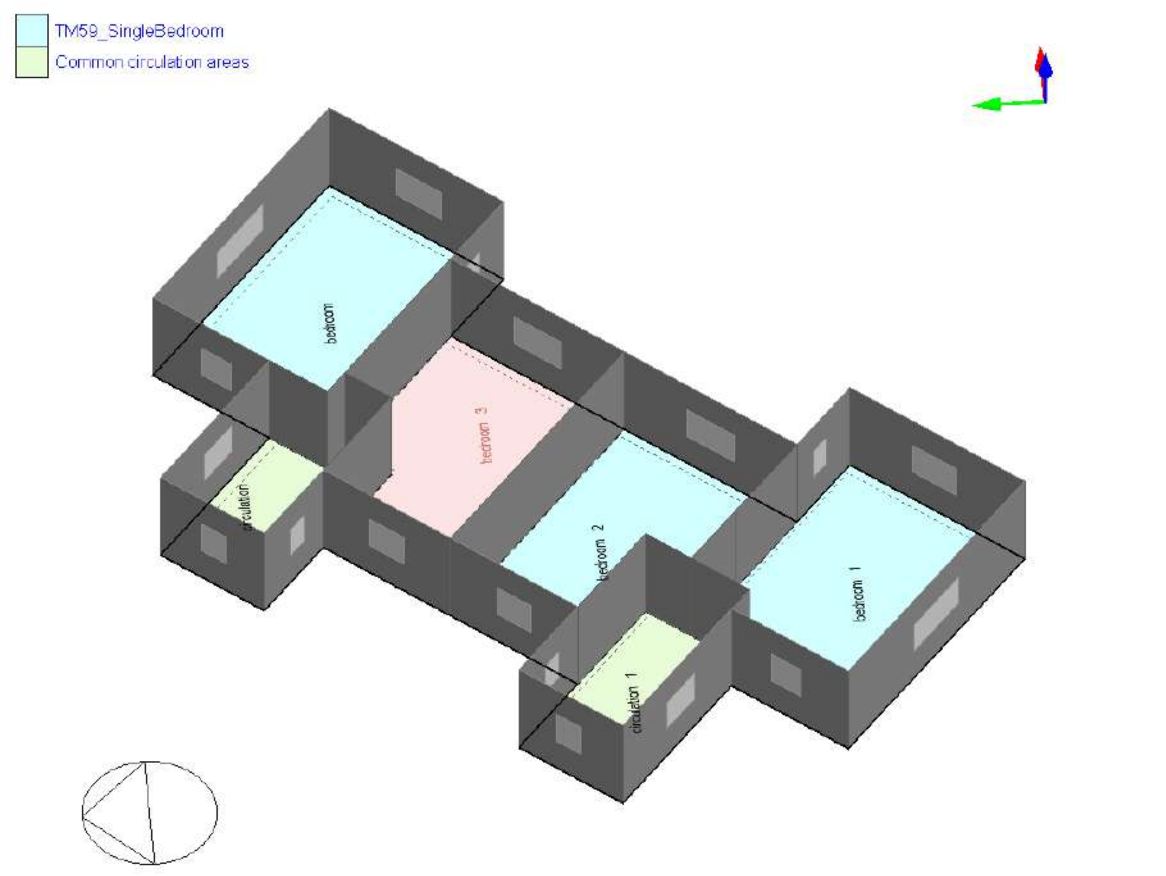
Proposed Exploded Structure Layout

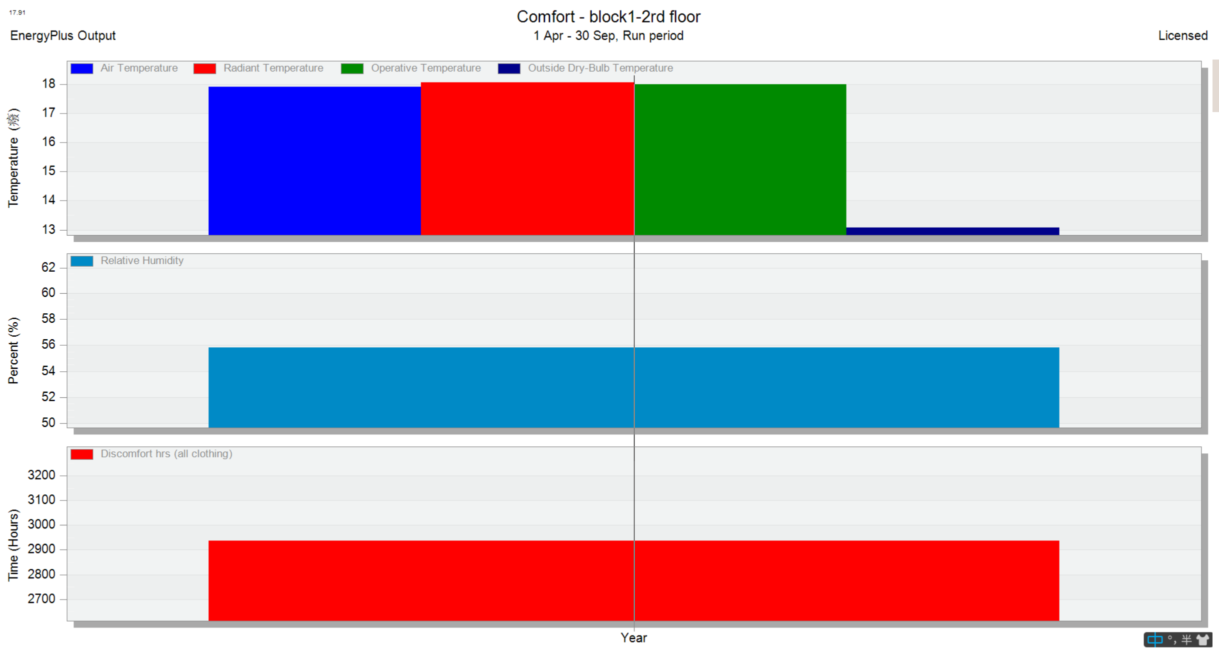


Internal Wall Layout Changes



5.15 | Thermal Comfort



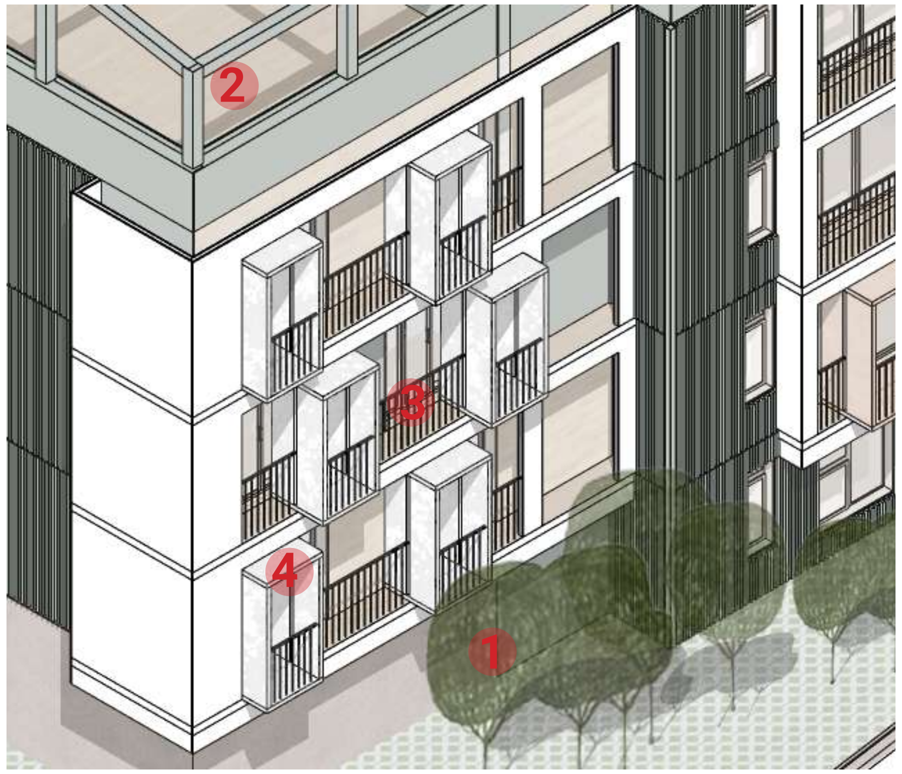


Summary:

Summer Months reach beyond 18 °C, risking the overheating. therefore passive cooling strategies has to be adopted to maintain thermal comfort in the bedroom.

Passive Cooling Strategies in the Proposed Building

Summer months have high **risk of overheating**, due to future climate change. Some passive strategies are adopted to reduce the direct summer solar gain



1. Vegetation for solar shading

Decidiuous Plants are designed that surrounds the building, that will provide shading in summer months. However, In winter, the tress leaves will shed, allowing the winter sun to illminate the building.

2. Roof Garden

The roof garden will reduce the solar impact on roof in summer months and will reflect the light

2. Balconies for Natural Ventilation

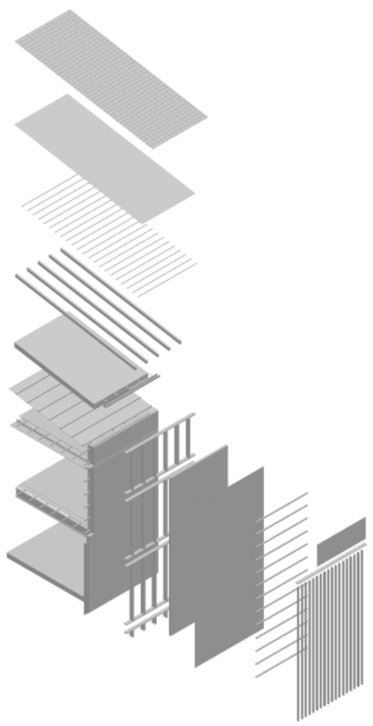
Radical Architectural changes allowed to introduce the balconies that allows natural ventilation throughout the year. In summer, the windows can be fully opened to provide cool air inside.

3. Horizontal and Vertical Shading

The building is SE facing, Sophie Pelmaker's book suggest to have vertical and horizontal shading for cutting the summer and winter sun.

Passive Heating Strategies in the Proposed Building

Passive Heating Strategies to reduce the annual energy demand of the building.



1. Increase the size of Wall Window Ratio:

The building is facing SW direction, allowing winter sun. Increasing the window size improved the illuminane performance of the rooms. Reducing dependency on Artificial lighting, especially during summer months.

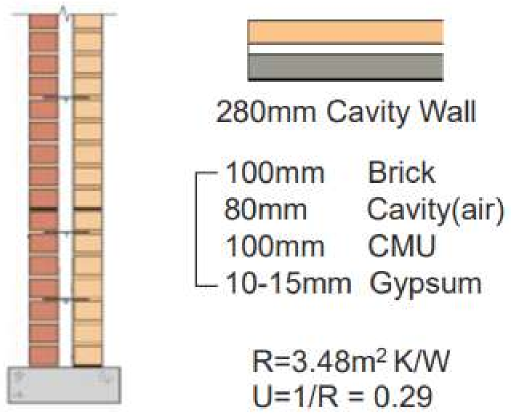
2. Improving the Building Fabric of the building

The building has cavity wall insulation, with poor air tightness and thermal bridging, leading to high depenedency on mechanical system. Improving the performance, by adding extra insulation will reduce the dependency.

3. New Methods of Construction

The new techniques of using prefabricated materials to speed up the process of construction, without disturbing the residents. The process also allows to design for deconstructionism, so that the material can be reused.

5.16 | Building Fabric Design



Typical retrofit thermal insulation measures include cavity wall insulation (CWI), the external (EWI) and internal (IWI) insulation of walls, the insulation of the ground floor (FI) or the ground beneath it (GI), the insulation of roofs (RI) and the application of insulated glazing (double and triple glazing).
The Existing building is 280mm Cavity Wall, with 80 mm cavity inside. Considering the lack of space inside, **insulation inside the cavity and the exterior surfaces** are provided to improve the fabic performance.

Building Regulation U-Values	
Building Element	U-Values
External Walls	0.18
Windows	1.4
Floors	0.13
Doors	1.0-1.2
Roof	0.13

Passivehaus Regulation U-Values	
Building Elemanet	U-Values
External Walls	0.15
Windows	0.8
Floors	0.15
Doors	0.8
Rood	0.15

Cavity Wall Insulation

This research project focuses on CWI, which refers to the process of filling the hollow space (the cavity) between the inside leaf and outside leaf of an exterior brick wall. Contrary to EWI and IWI, CWI hardly affects the aesthetics of the facades, nor does it affect the interior building volume.
Furthermore, CWI is both quicker and cheaper than EWI or IWI, although a drawback is that the thickness of the insulation package is limited to the cavity width.
Cavity wall insulation causes the internal layer to act as a heat storage device.
100 mm cavity insulation resulted in a 56% reduction in heat loss through the wall

Thermal Bead EPS Insulation

The polystyrene used for CWI is in the form of virgin pre-formed bead which is usually combined with a binding agent or adhesive at the time of injection. Polystyrene beads are produced to a specified size and density which remains unaltered during the installation process.

Properties:
Thermal Conductivity: The k value of can reach upto 0.038 W/m C - 0.040 W/m C
Density: A typical installed density is 12kgm3 +/- 2kgm3
Water: The material is resistant to water penetration and will not transmit water across the cavity by capillary action or from below dpc level.

Exterior Wall Insulation

Glass Wool

It is porous material that traps the air. The porous and elastic structure of the wool also absorb noise. Mineral Wool is incombustible and doesnot fuel fire or propogate flames.
3 types of mineral wool- Glass, Stone and ultimate. The one that is most suitale for the project is glass mineral wool. According to ISOVER, Saint Gobain- one roll of glass wool contains the equivalent of at least 10 recycled bottles.

Benefits of Glass Wool:
1. High Fire Resistance
2. Sound Proofing Properties
3. Reduces the risk of Overheating beacuase it has high heat storage.

Properties:
Density (kg/m^2) -12
Approximately embodied Carbon (kgCO_2) - 1.35
Approx Embodied Carbon kgCO_2 per m^{2}of surface area - 3.8
k- Value - 0.04 W/mK
Price: ISOVER company - 2.29 pounds/ m^2

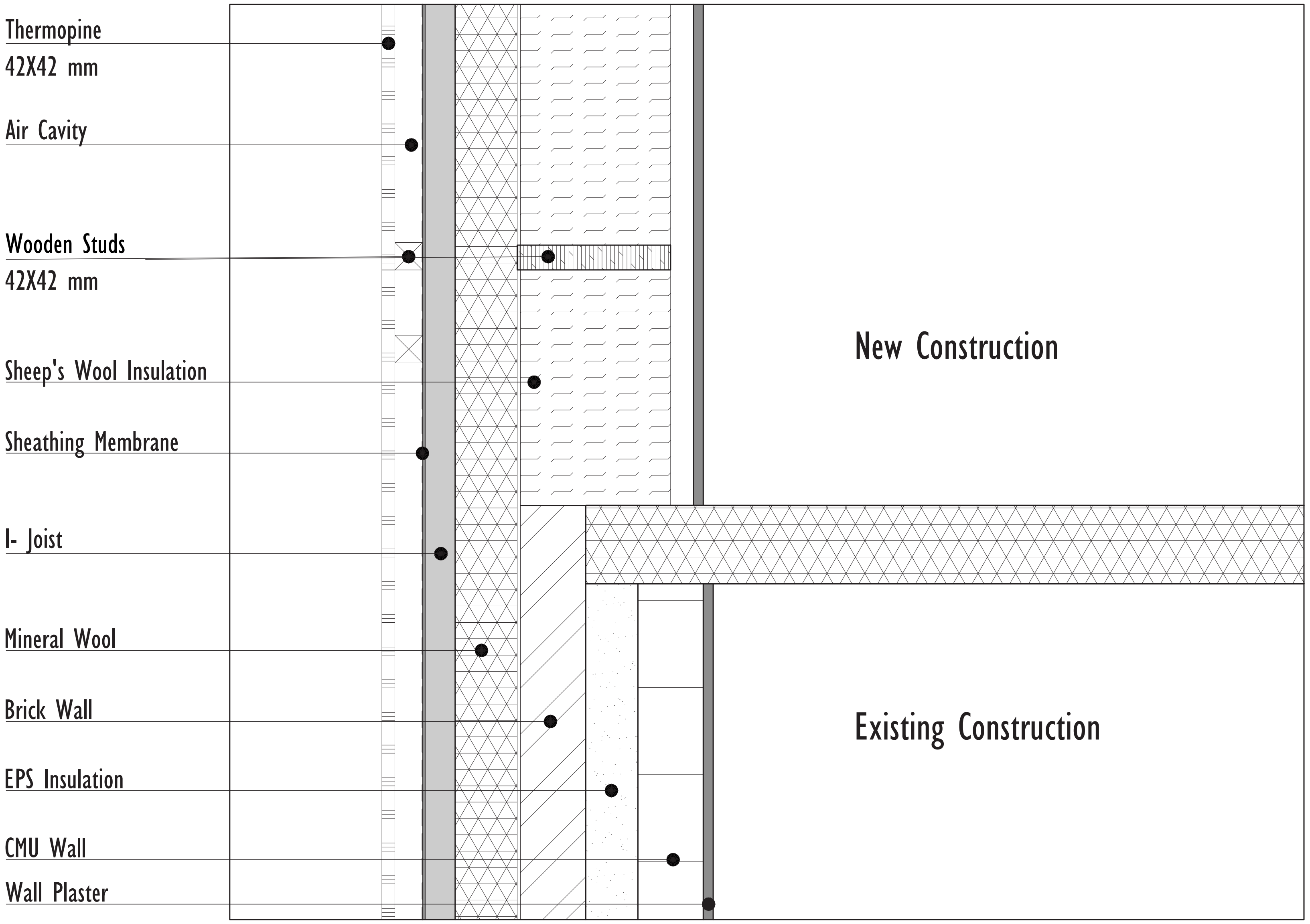

Section of Building showing Bead Insulation

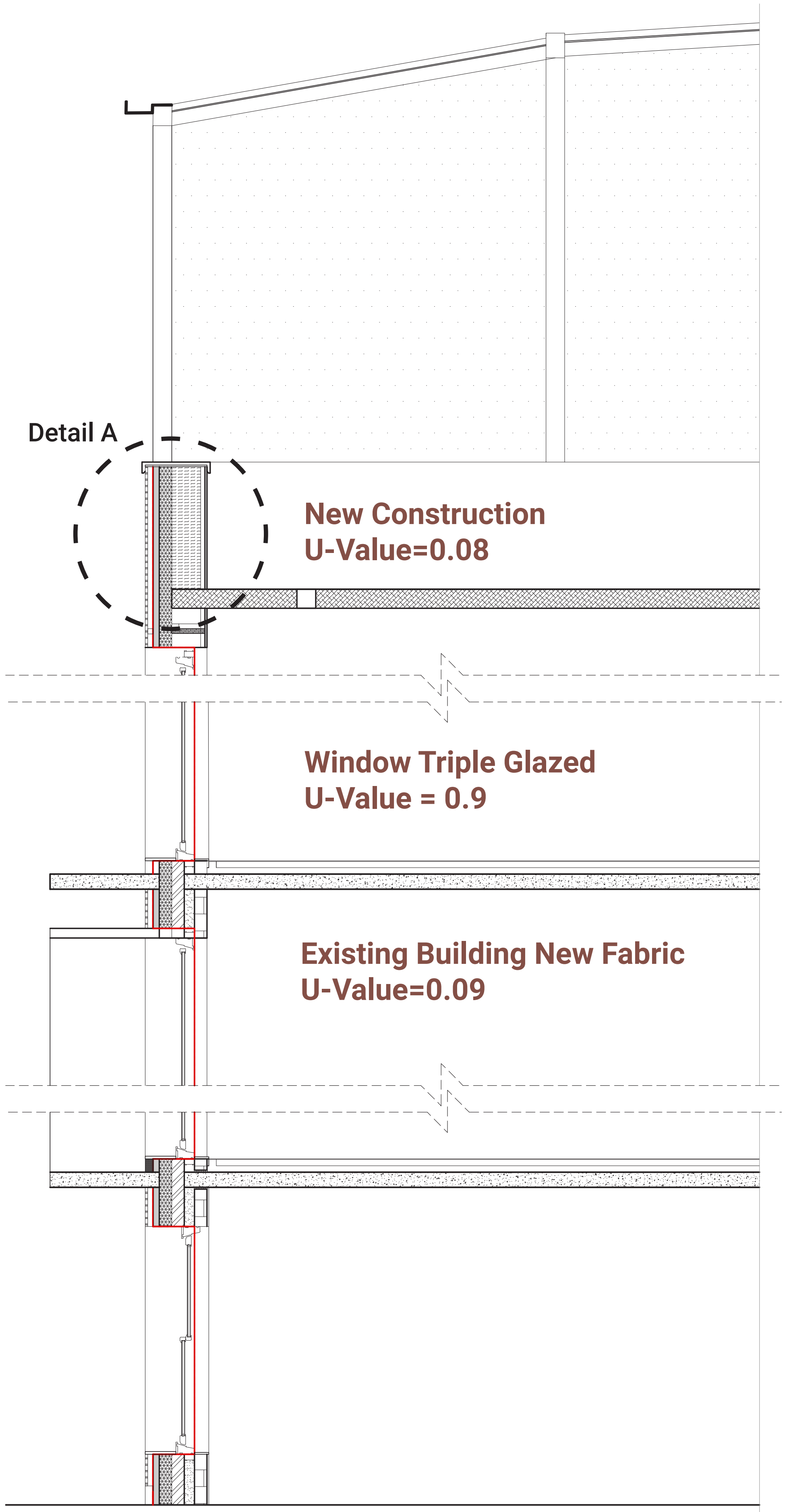

Picture of the Beads

Source: https://www.nia-uk.org/understanding-insulation/cavity-wall-insulation/with-eps-beads/
https://www.diasen.com/sp/en/p/diathonite-evolution.3sp

5.17 | Building Fabric Detail

Wall Detail of Exisitng and New Construction, Detail A





Material Properties used in Wall Construction

Exisiting Building Wall

S.No.	Material	K-Value	Thickness	R-Value
1	Plaster	0.79	0.01	0.012658
2	CMU	1.63	0.1	0.06135
3	EPS Bead Insulation	0.038	0.08	2.105263
4	Brick	0.5	0.1	0.2
5	Mineral Wool	0.036	0.18	5
6	Sheathing Membrane	0.13	0.009	0.069231
7	Air Cavity	0.14	0.42	3
8	Thermopine	0.13	0.02	0.153846
	Total		0.919	10.60235
	Total R Value Including Inner and external Themal			10.77235
	Total U-Value of exsiting wall			0.09283

New Building Design Wall

1	Sheep Wool Insulation	0.038	0.23	6.052632
2	Mineral Wool	0.036	0.18	5
3	Air Cavity	0.14	0.02	0.142857
4	Sheahing Membrane	0.13	0.009	0.069231
5	ThermoPine	0.13	0.02	0.153846
	Total		0.459	11.41857
	Total R Value Including Inner and external Themal			11.58857
	Total U-Value of new Building Design Wall			0.086292

Windows

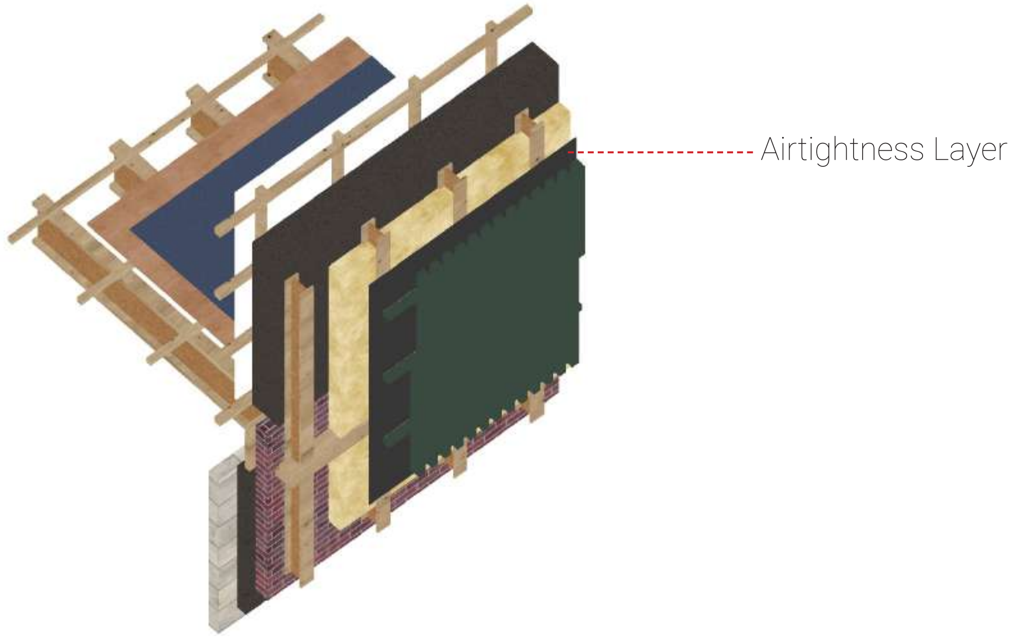
1	Triple Glazing Windows	0.9

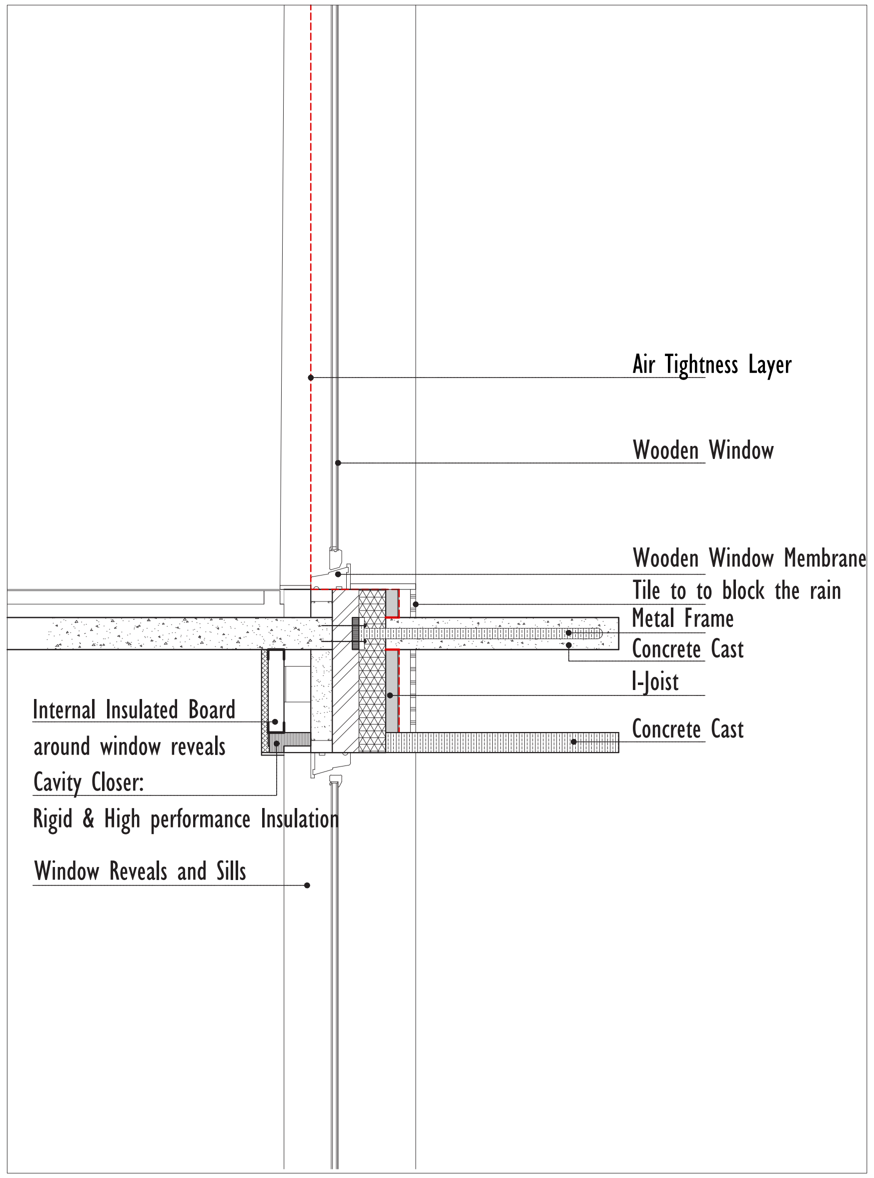
5.18 | Air Tightness of the Building

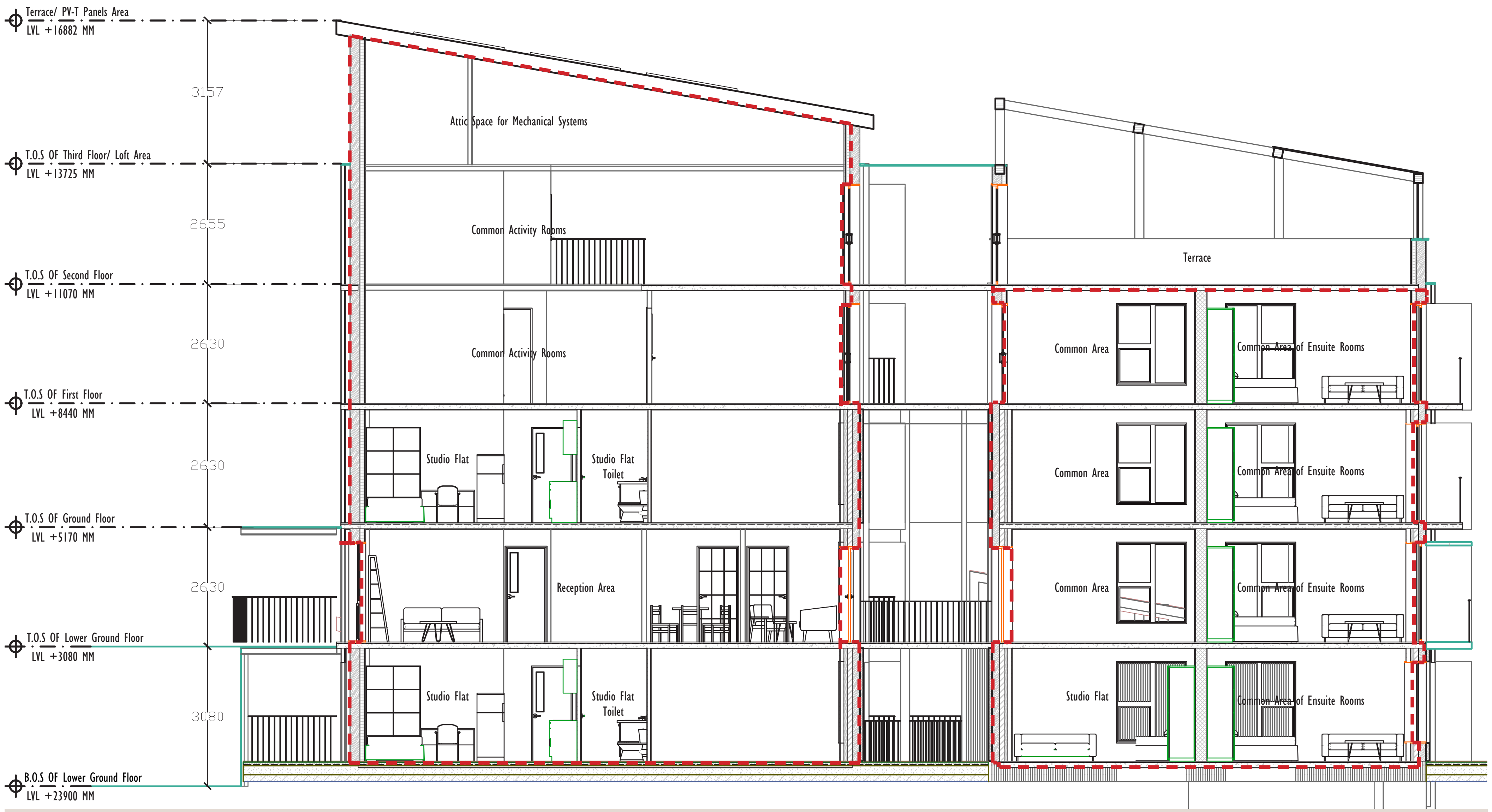
Introduction

Air Tightness of the building is very critical point as it prevents the building from heat loss and affects thermal comfort. As the project is retrofit with new built floors, due consideration is given to achieve the same airtighness zone in the building.
Some of the strategies adopted for airtightness are:
1. **Monolithic construction** of airtight material like in-situ plaster and taped membranes
2. Adopting the **whole buillding airtightness** approach
3. Reduce the air gaps by working on the **balconies and window Detail.**
4. Designed the **clear airtightness drawings** for cler understanding of sperating the internal finishes to airtightness layer to avod any leakage.

Isometric of Building Envelope

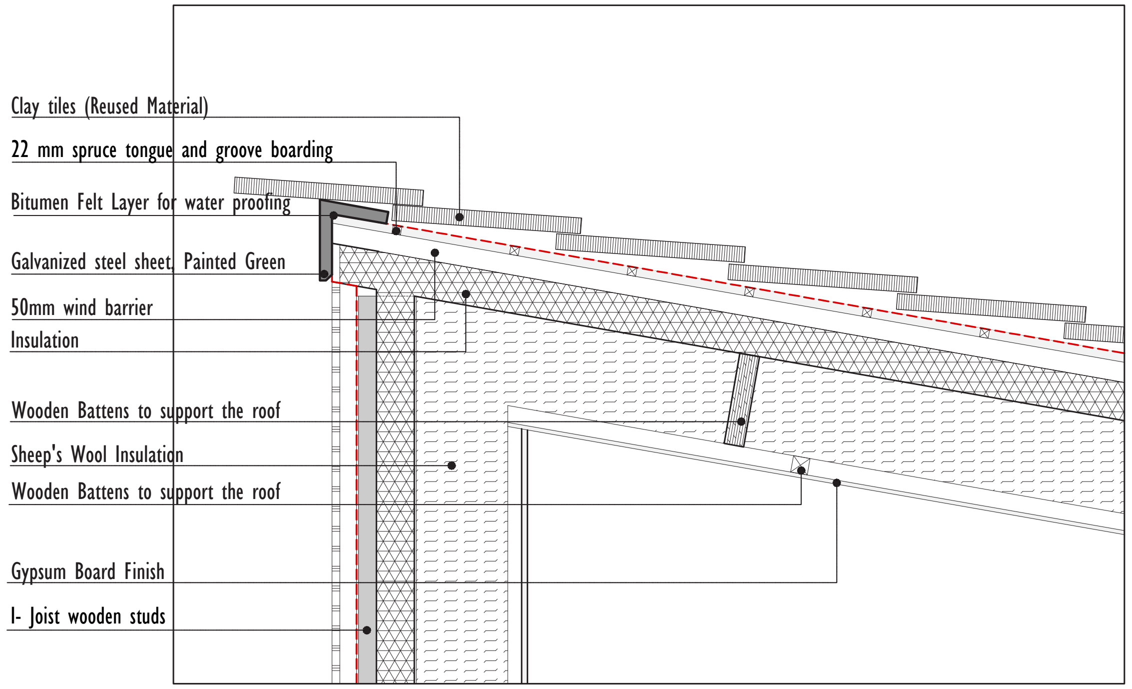




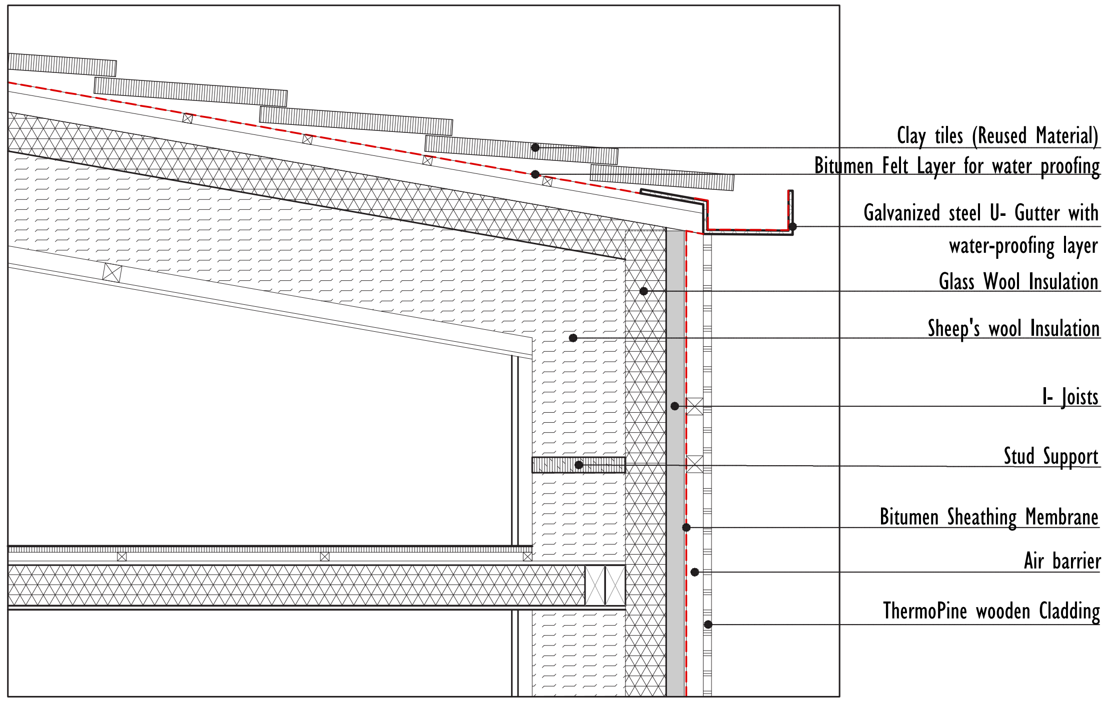


Air Tightness Layer surrounding the building

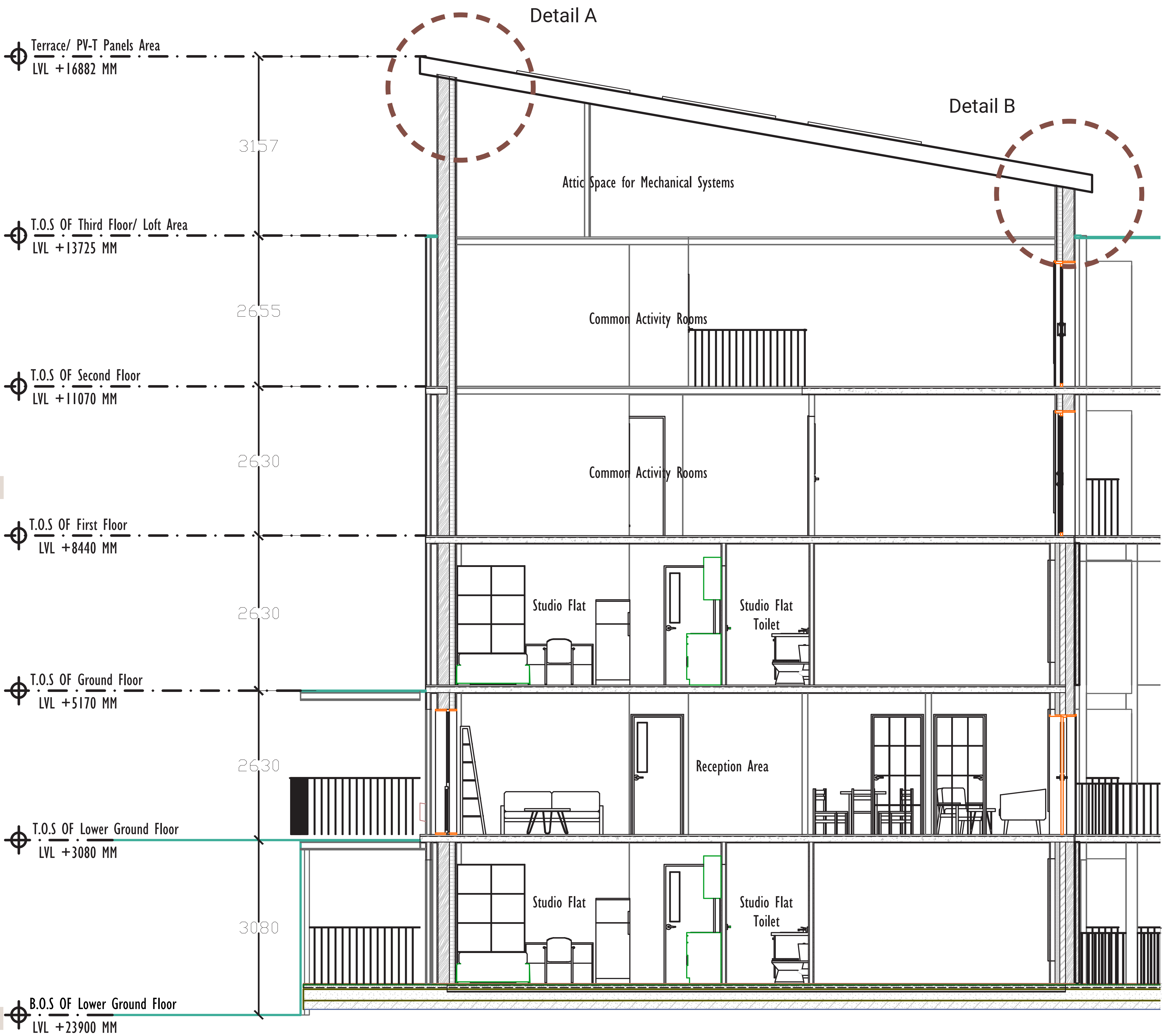
5.19 | Construction Details of Pitched Roof



Detail A



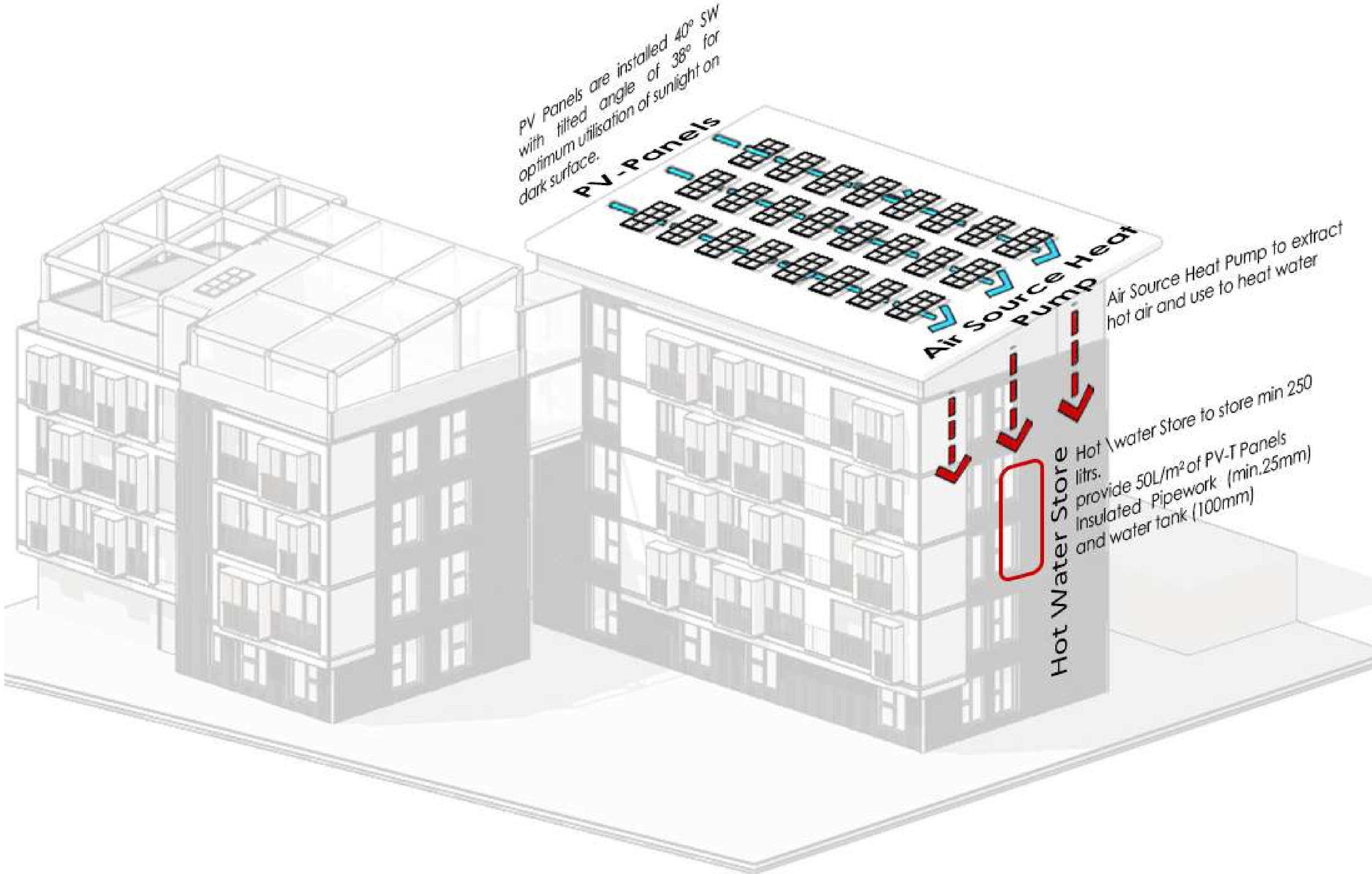
Detail B



5.20 | Photovoltaic - Thermal Panels

Section of Panel

Installation Picture



End User Energy Utilisation

	Electricity [kWh]	Natural Gas [kWh]	Additional Fuel [kWh]	District Cooling [kWh]	District Heating [kWh]	Water [m3]
Heating	0.00	0.00	0.00	0.00	73627.60	0.00
Cooling	0.00	0.00	0.00	101.18	0.00	0.00
Interior Lighting	8758.64	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	3977.17	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00
Fans	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	0.00	0.00	0.00	0.00	0.00	0.00
Heat Recovery	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	0.00	0.00	0.00	0.00	5116.40	80.12
Refrigeration	0.00	0.00	0.00	0.00	0.00	0.00
Generators	0.00	0.00	0.00	0.00	0.00	0.00
Total End Uses	12735.81	0.00	0.00	101.18	78744.00	80.12

Note: District heat appears to be the principal heating source based on energy usage.

Description:
PV-T panels are hybrid solutions that collect electricity and heat both mounted together.PV-T Panels are efficient moncrystallite PV Collectors with a heat pump to collect the waste heat. The system has high conversion rate, thus works better than plain photovoltaics.
Estimated Embodied Energy- 242 KgCO_2

Requirement of PV-T Panels:
Total Area of building= 645.14 m^2
Total Site Energy Demand (from Design Builder)= 91580 kWh
District Heating Requirement (Heating)= 35 kWh
Electricity (interior lighting+ Equipments)= 20231 kWh

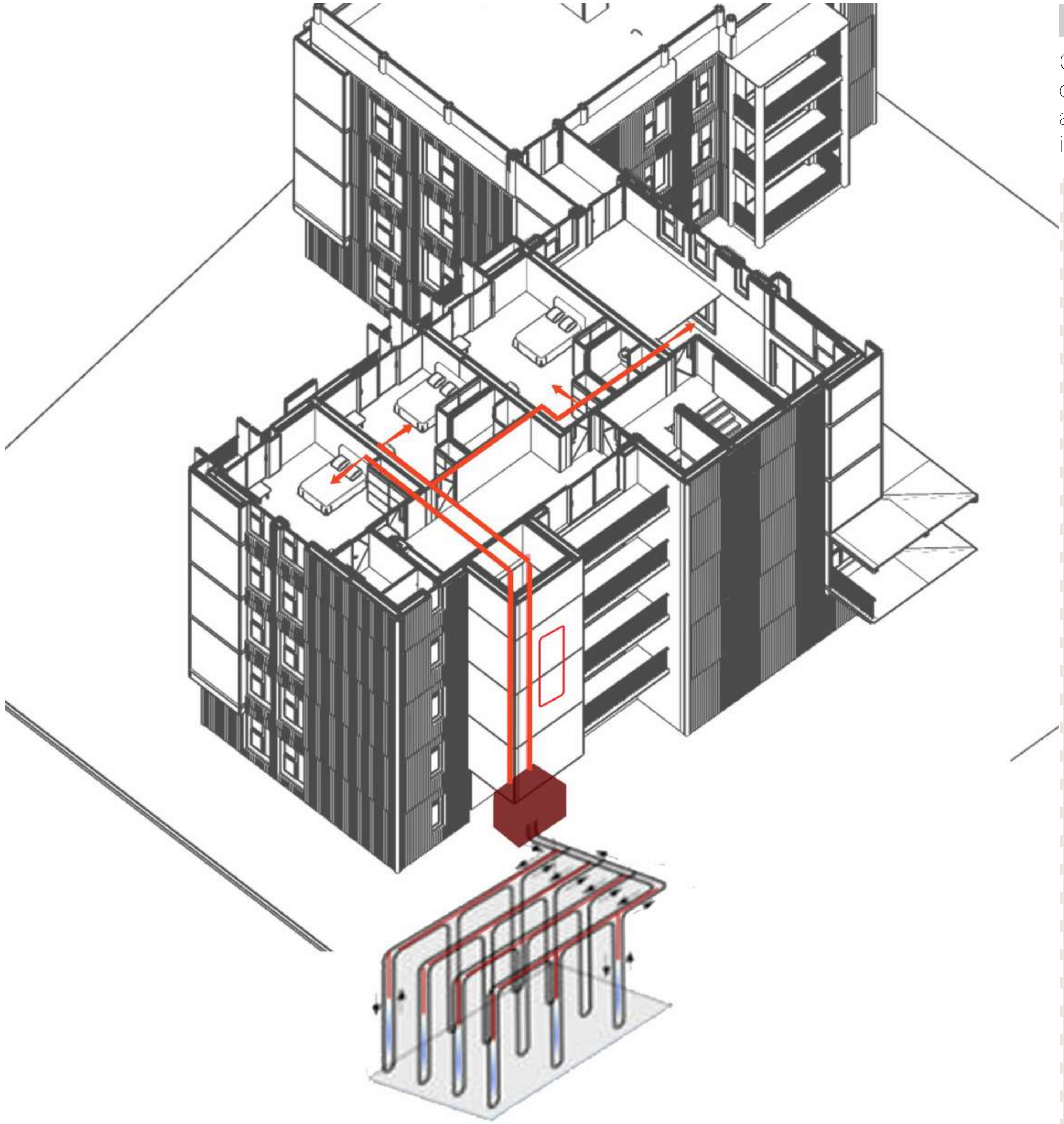
1 m^2 of PV-T panels produces around 120kWh of electricity per year and around 250 kWh of usefule heat, Source: Sophie Pelsmaker's Book

Total roof area available (excluding circulation area)- 188m^2
Total heat produced each year - 140x250 - 47kWh
Total electricity produced each year - 188X120 - 22560 kWh

Cost - 1000-1500/sq.m.
Total Cost- 188 X 1500- 282,000

1.https://www.solarguide.co.uk/solar-pvt#/
2.https://www.thegreenage.co.uk/solar-pvt-hybrid-panels/

5.21 | Ground Source Heat Pump



Closed Loop Vertical Ground Source Heat Pump

Ground Source Heat Pump will extract the heat from the ground and pass it to the building using the pipes. Lack of enough space, Vertical Pipes are most suitable for the project. The temperature gained from the source is not as high. The solution is low carbon intensive, yet still depend on electricty to work. Therefore, the pump can be integrated with PV Solar Panels.

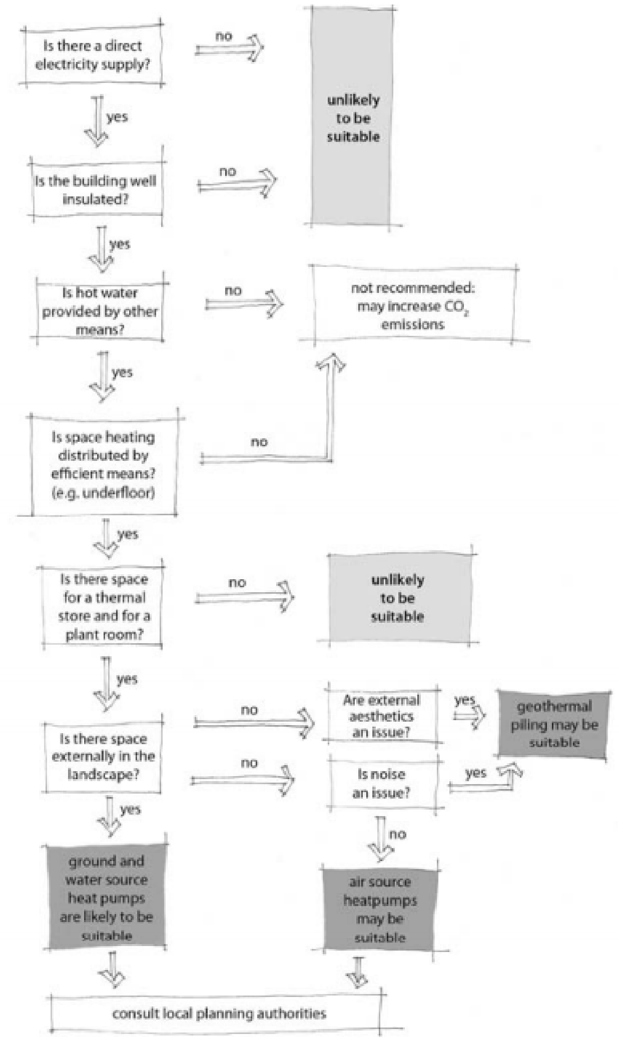
Design Considerations

Throught the year, the soil temperature 10m deep remains constant i.e. 10-14°C. This base heat can be harested by GHSP. Pipework can be installed vertically deep.

Benefits to use GHSP:
1. The night ventilation can be secured because the system provides heating and cooling system both.
2. Overcome the Problem of Overheating.
3. It is low Carbon but not renewable.
4. Approximately Heat energy can be produced 3900 kWh per year.
5. Carbon reduced per dwelling -90-220 kgCO_2
6. The system can cater to 100% heating demand.

Design Considerations:
1. Around 35m of pipe per kW installed in the capacty i.e. 175m pipework run at depth of 15-20m
2. Typical house will take no more than one or two bore holes, making the installation easier.
3. Pipework is usually liquid based.
4. Can be part of building foundation in the form geothermal Pilling.

Design Matrix



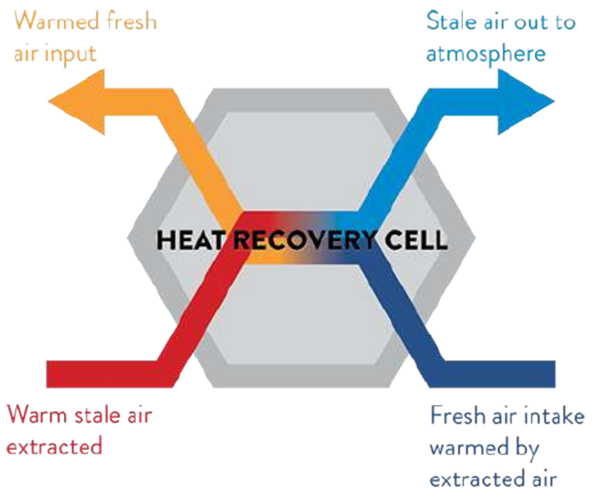
Source: Pelsmaker,2015, The environmental Design Pocket Book, pg-443-445

5.22 | MVHR

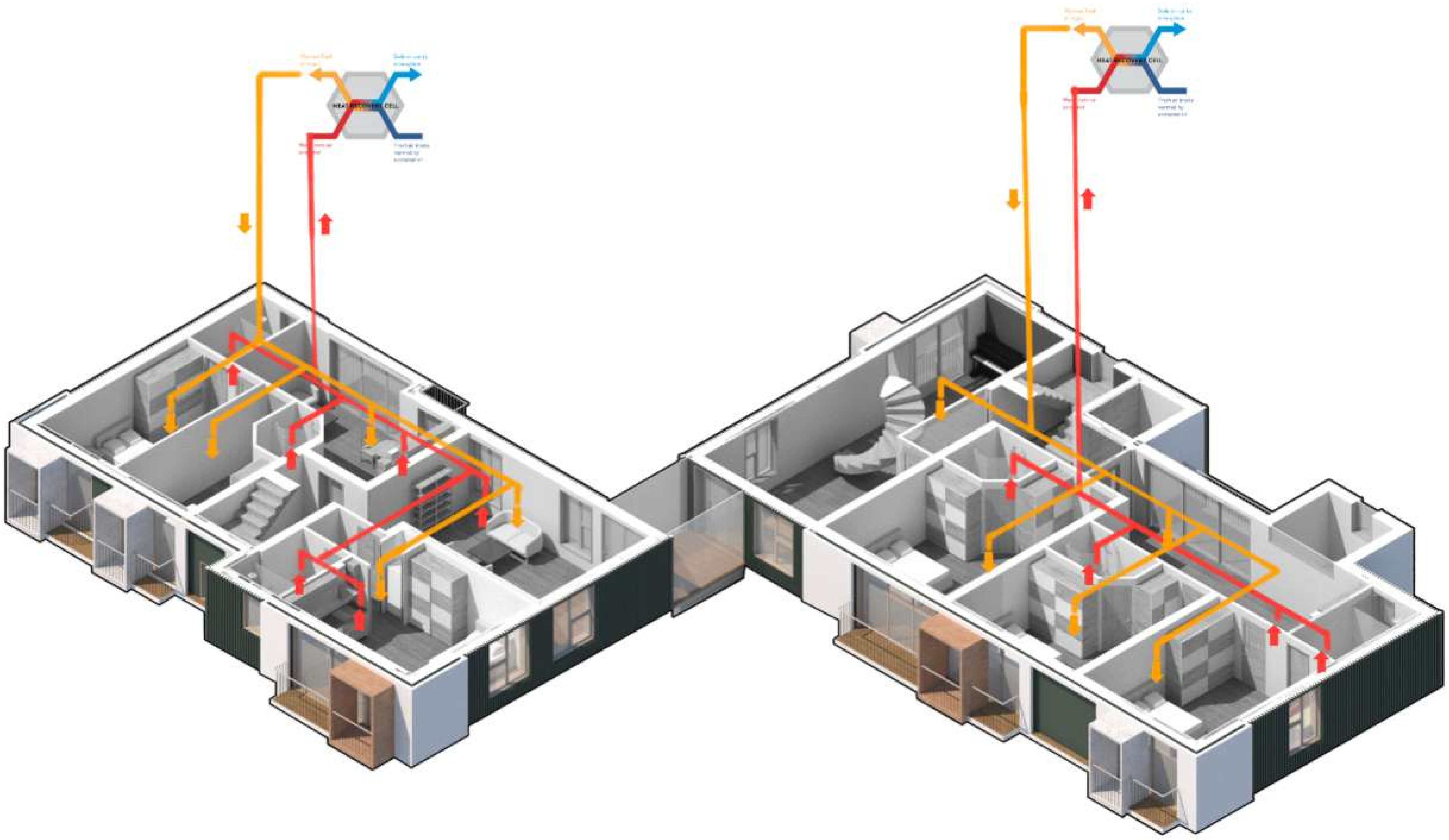
The MVHR air-to-air heat exchanger system works by simply extracting stale air and using it to preheat fresh air supply. The heat exchanger facilitates the volumes of air passing over each other but never mixing. This is important because the air infiltration through window trickle vents and/or the occassion-al loss through the fabric gaps and cracks is not dependable to provide good indoor air quality year round (Pelsmakers, 2015).

The proposed Beaurfort design achieves an infiltra-tion rate of **3.73 ACH**, thereby well appropriate for the 'whole house heat recovery' system.

The system is more beneficial in terms of thermal comfort and energy use in more airtight buildings as the heat recovered is likely to offset the additional electrical energy use.
It is also useful to remove contaminants, smells and CO_2, while providing oxygen and recovering heat that would normally be lost.



https://www.xpelair.co.uk/what-is-mvhr



Summary

A building that achieves outstanding fabric efficiency is well suitable for a heat recovery system. Whole house heat recovery is recommended in this case. This is suitable to provide the winter background ventilation and space heating requirements.

Reference

Pelsmakers, S. (2015) The environmental design pocketbook. Second edition. London: RIBA Publishing.
https://www.xpelair.co.uk/what-is-mvhr

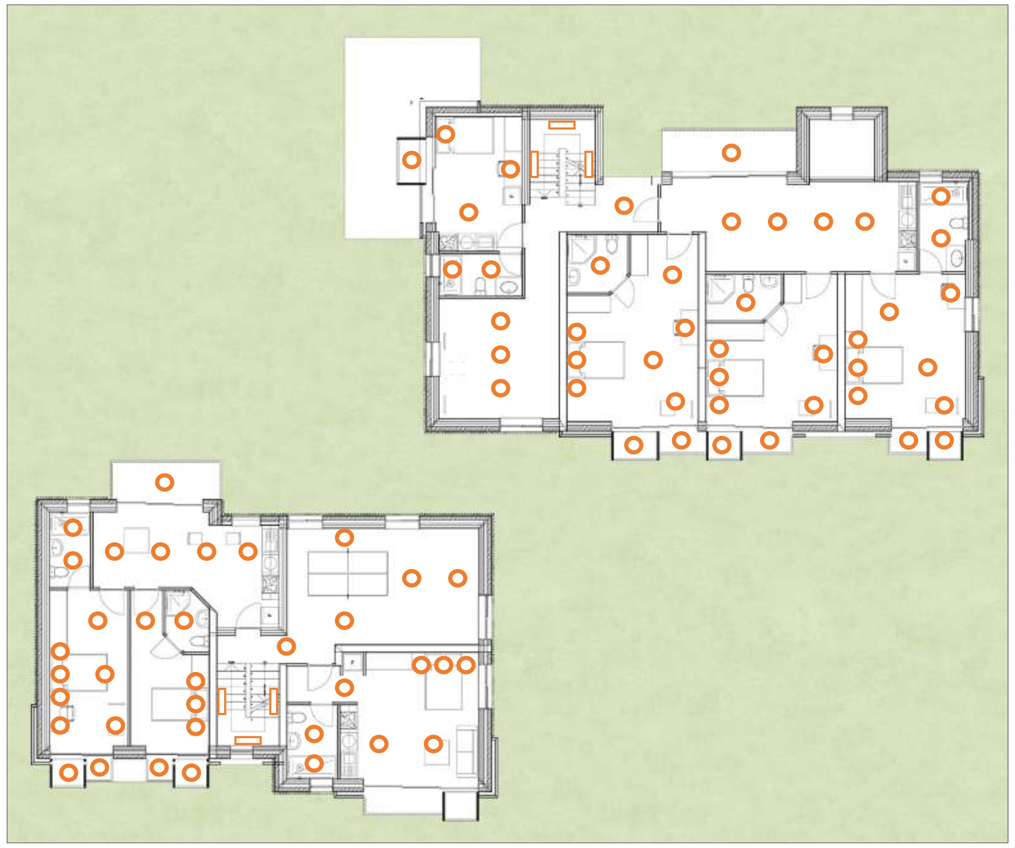
5.23 | Artificial Lighting Design

Lower Ground Floor

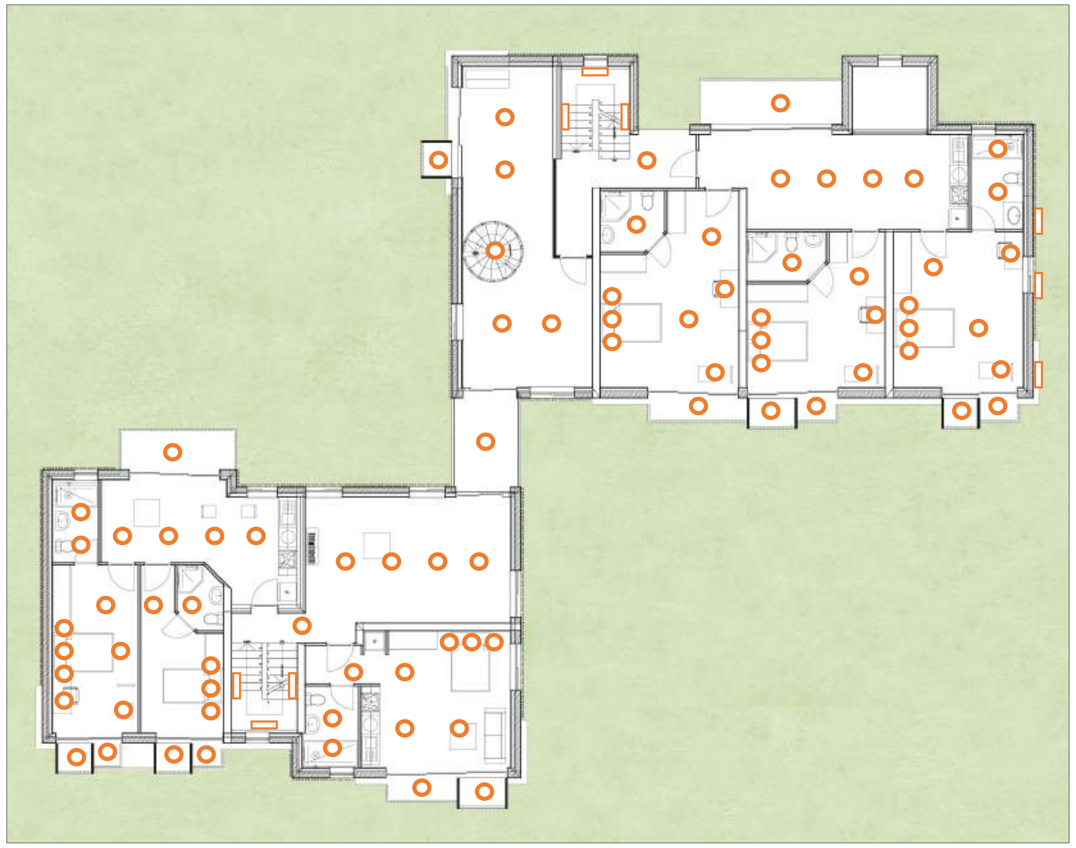
Ground Floor

3rd Floor

First Floor



2nd Floor



Recommended light levels in domestic spaces:

Type of Space	Illuminance (lux)
Bedroom	200-300
Study room / home office	500- 800
Living room	300-500
Dining room	200
kitchen	300-500
bathroom	300
Laundry / utility room	200
Mechanical room	200
Landing / stairs	100

Summary

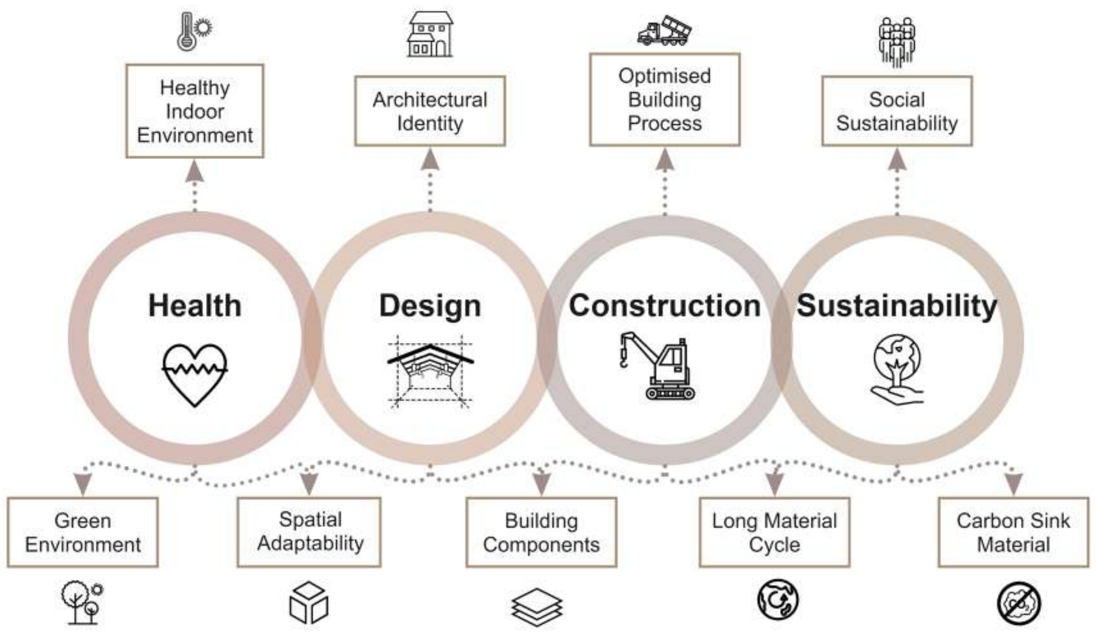
Reasonable artificial light design can effectively meet the lighting needs. At the same time, the selection of energy-saving artificial lamps can effectively improve the energy efficiency.

In the outdoor areas of the building, emphasis is placed on the addition of lights, such as the space under the corridor, to increase the sense of security of residents when they walk at night.

5.24 | Local Availability

Pine

Pine is considered a very sustainable because, when compared with other woods, it grows fast and consequentely forests can be replenished in less time.
The material is also readily available throught England and it can be used in different sectors of the architectural field. In fact, it can be used for both furniture and structural purposes.
Pine wood is medium-weight and relatively soft. Its strength and elasticity are good. Due to its light weight, pine results to be cheaper than other materials regarding shipping and construction costs.
As every timber material, pine has excellent thermal propertiens and the material also acts as a carbon sink.
Pine can also be painted in a solid colour or in a translucent stain to emphasise the distinctive grain without altering the physical properties of the material.

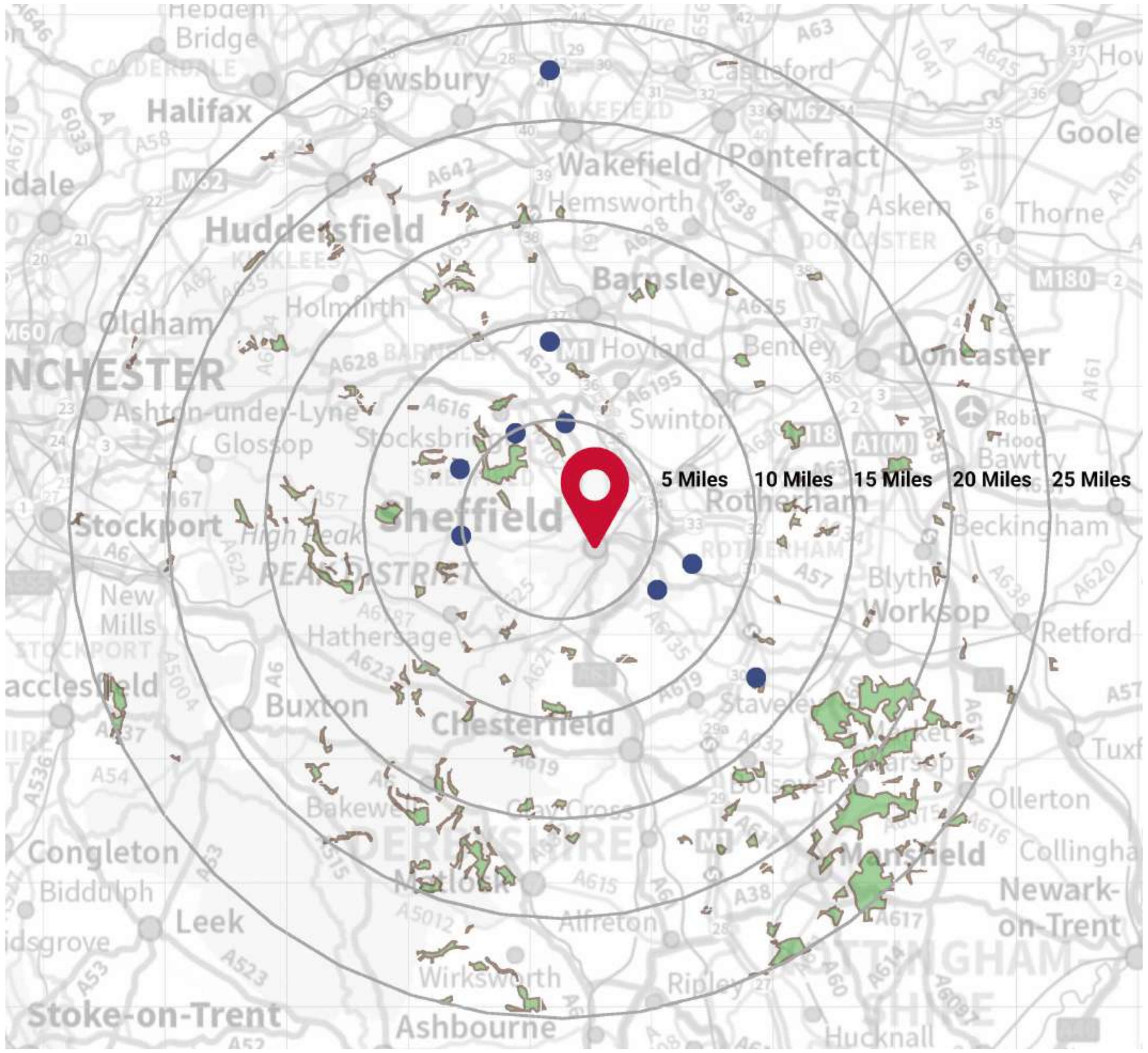


Advantages	Disadvantages
- Because it is a softwood, it is easier to work with compared to other woods - Durable and shock resistent for residential construction - Easily coloured - It is more eco-friendly and more renewable than other materials	- Its light weight makes it easier to get damaged - Usually it doesn't last as long as hardwood - It can get scratched or dented more easily than hardwood - It needs to be correctly and carefully treated with strong preservatives in order to prevent rot

Reference

https://www.pinetimberproducts.com.au/environment/
https://www.moelven.com/uk/products/pine--spruce---our-raw-material/
https://www.sheffield.gov.uk/treesandwoodlands
http://www.musterkiste.com/en/holz/pro/1029_Pine.html

Local Availability



Albion Timber
Upper Hurst Farm, Hirst Common Lane,
Birley Carr, Sheffield, S6 1EX

SAWMILL TIMBER
Ward Lane, Wakefield, West Yorkshire, WF3 4LU

Holyland Dismantling Co.
Tinker Lane, Hoyland Common, Barnsley, South Yorkshire, S74 0PR

Workshop Wood Mill
Unit 10, Craggs Industrial Park, Morven Street, Creswell, Nottinghamshire, S80 4AJ

Arnold Laver Sheffield Mosborough Depot,
Oxclose Park Road North, Sheffield, South Yorkshire, S20 8GN

Timber Specialists Ltd
Harried Roard South, Sheffield, S6 1QS

Greenwood Forest Products
Mansfield Road, Sheffield, Wales Bar, S26 5RL

Sheffield Timber Co Ltd
Site D, Ecclesfield 35 Industrial Estate, Sheffield, South Yorkshire

Hillsborough Fencing Company
20 Livesey Street, Sheffield, South Yorkshire, S6 2BL

5.25 | Life Cycle Analysis: Thermo Pine

1. Extraction of the raw material

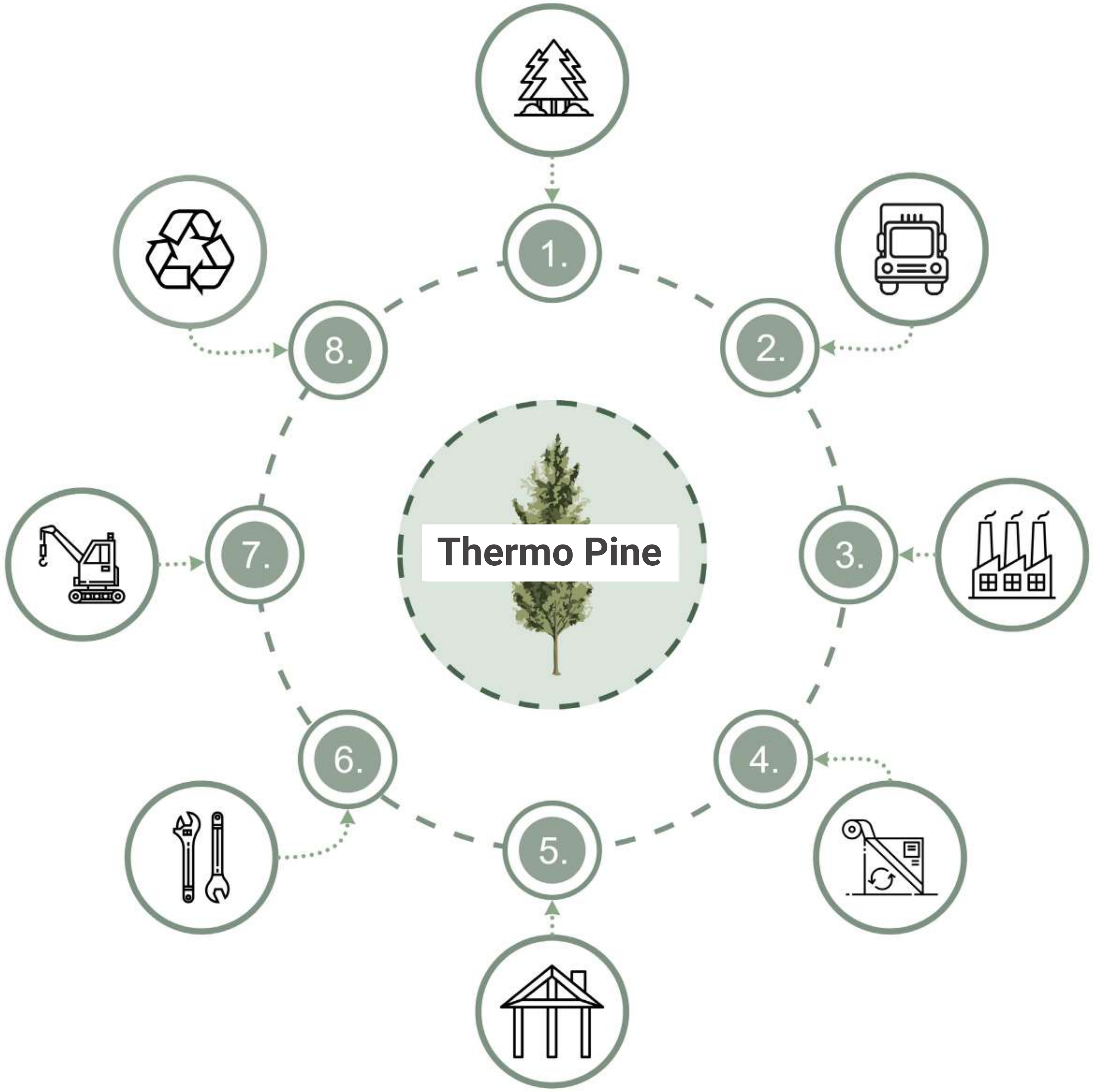
The trees will be harvested from sustainable and local forests. The fast-growing process of the material makes pinewood very sustainable when talking about the problem of deforestation. In this case, the material will be extracted from the woodlands indicated in the previous map.

2. Transportation to the fabric

The wood will be transported to the fabric in order to be processed.

3. Processing and Manufacturig

Thermopine is produced by thermally modifying pinewood with the use of heat, steam and pressure. The result will present a material with improved stability and durability.
The manufacturing process penetrates the whole sheet modifying every cellule of the material in order to make achieve pine a Durability Class 2 Timber as per BS EN 350-2.
The process takes in total 96 hours and it can be divided in three main stages.
1. Drying stage: the water contained in the wood is evaporated by altering regularly the temperature up to 140°C.
2. Heath treatment stage: the temperature rises within 150°C and 210°C for more than 6 hours. In this way water and hydroxyl are extracted from the material.
3. Cooling stage: the wood is gradually cooled and stabilised with water vapour to room temperature for about 18 hours.



4. Distribution

The light weight property will make the distribution of the thermopine wood easy and cost efficient. The source used in this project is located at 7.25 km away from the site.

5. Construction

When the material arrives to the site, there won't be any need for special machinery in order to assemble the boards. Therefore the construction will require both limited amount of money and time.

6. Maintenance

One of the main advantages of the use of Themopine consists of the redution of any substrate movement. In other words, the paint coating lasts almost three times longer than with other timbers. This reduces the needs of maintenance requirement and the lifetime cost of the product.

7. Demolition

Generally, thermopine is easy to install, dismantle and reuse.

8. Reuse and Recycle

At the end of life of the building, wood can be recycled and reused in different ways. WRA (Wood Recyclers Association) has classified wood waste into four main grades: clean recycled wood, industrial feedstock grade, fuel grade and hazardous waste.

Summary
The use of Thermopine will bring several advantages to our structure. The costs of maintenance throughout the life of the building are limited when comparing them with other timber structures. The heat treatment reduces the density by approximately 10% to 450kg/m3, making it relatively light in weight and easy to work. Also the final material has a carbon footprint equal to 3 kg CO2/m2.

Reference

https://www.russwood.co.uk/about/visit-russwood/
https://www.felixwood.com/wood-cladding/thermopine-enduro-cladding/

6

Validation

Energy Demand

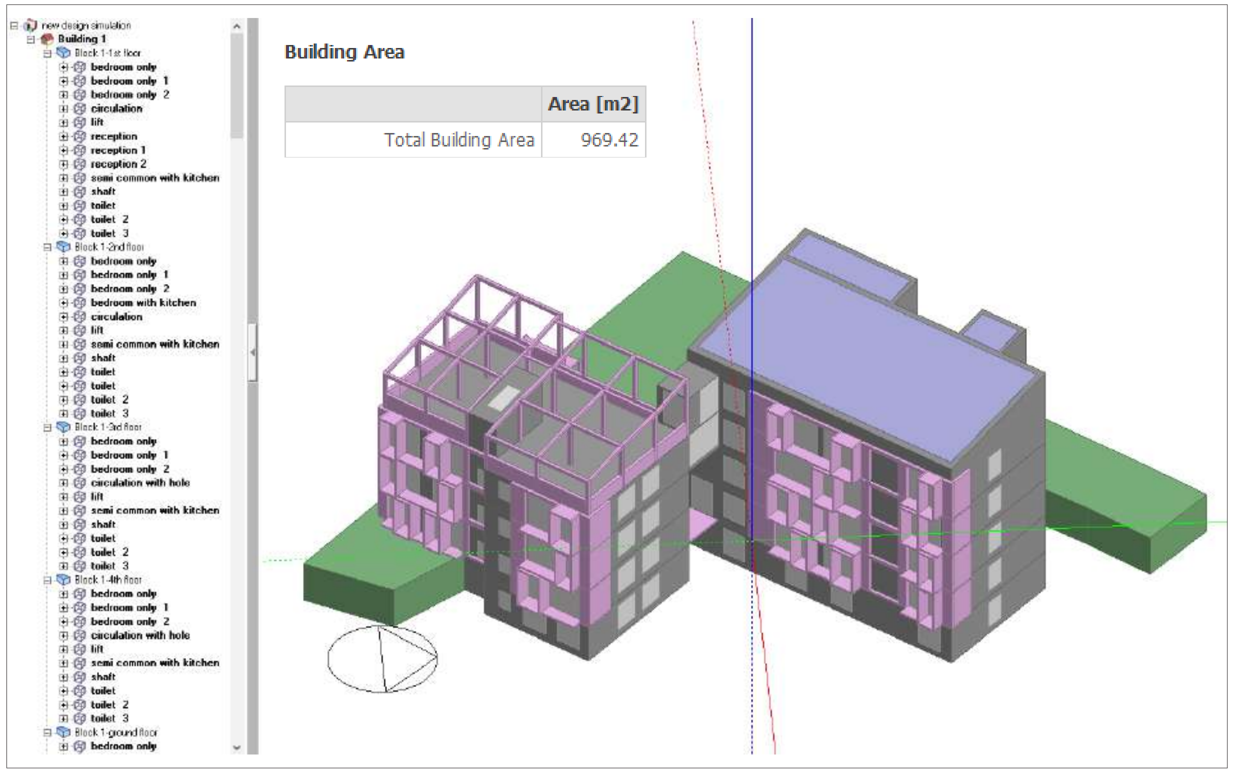
Lighting

Budget

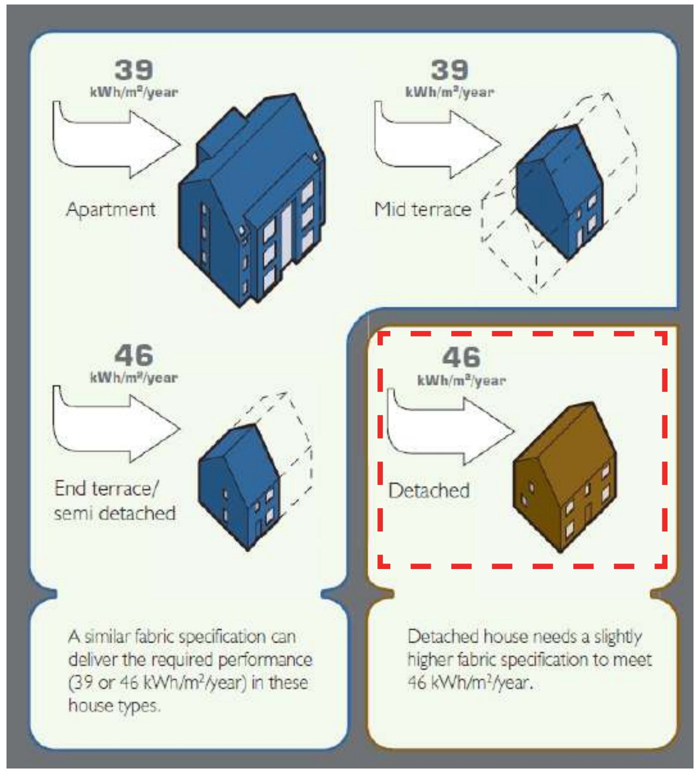
Phasing

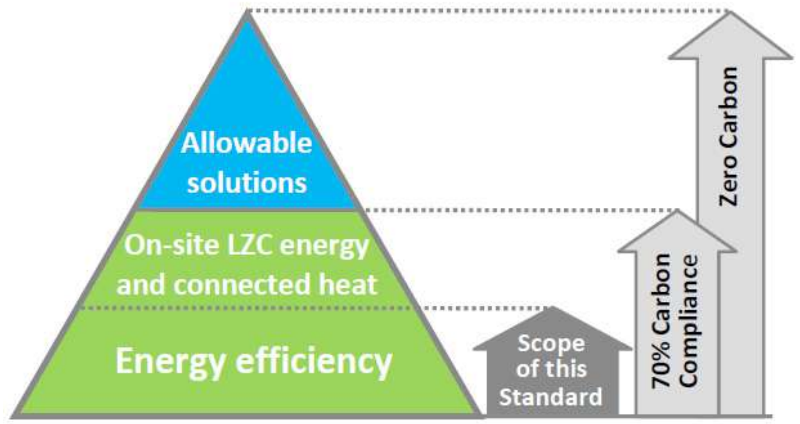
6.1 | Fabric Energy Efficiency and Total Energy Demand

Energy Model



Fabric Energy Efficiency for Zero Carbon Homes





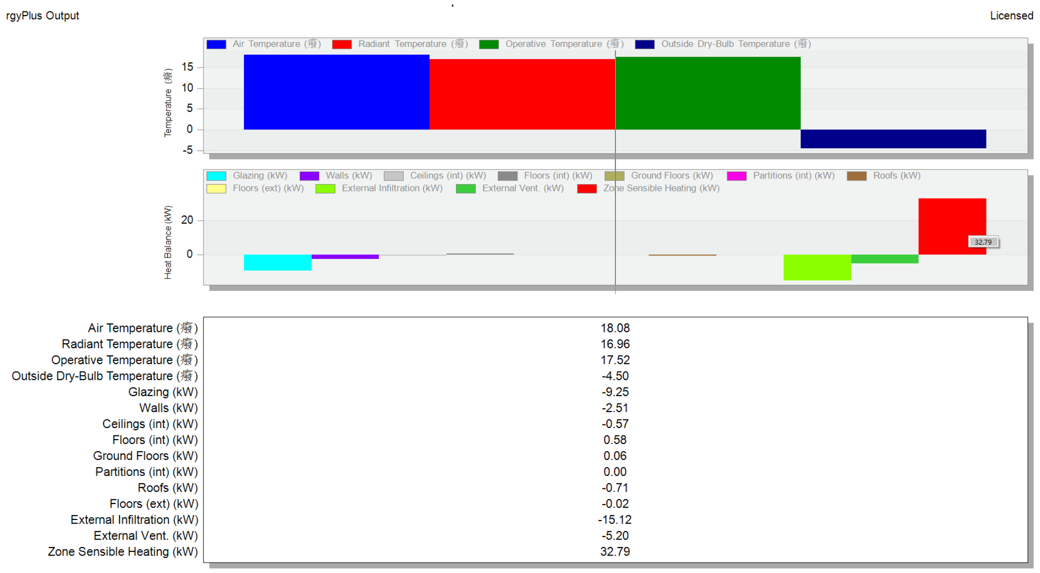
Source: Zero Carbon Hub

	Electricity [kWh]	Natural Gas [kWh]	Additional Fuel [kWh]	District Cooling [kWh]	District Heating [kWh]	Water [m3]
Heating	0.00	0.00	0.00	0.00	35784.07	0.00
Cooling	0.00	0.00	0.00	0.00	0.00	0.00
Interior Lighting	8730.67	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00

35784.07 kwh/969.42 m^2= 36.91kWh/m^2/yr < 46 kWh/m^2/yr

Zero Carbon ✓

Simulation Results



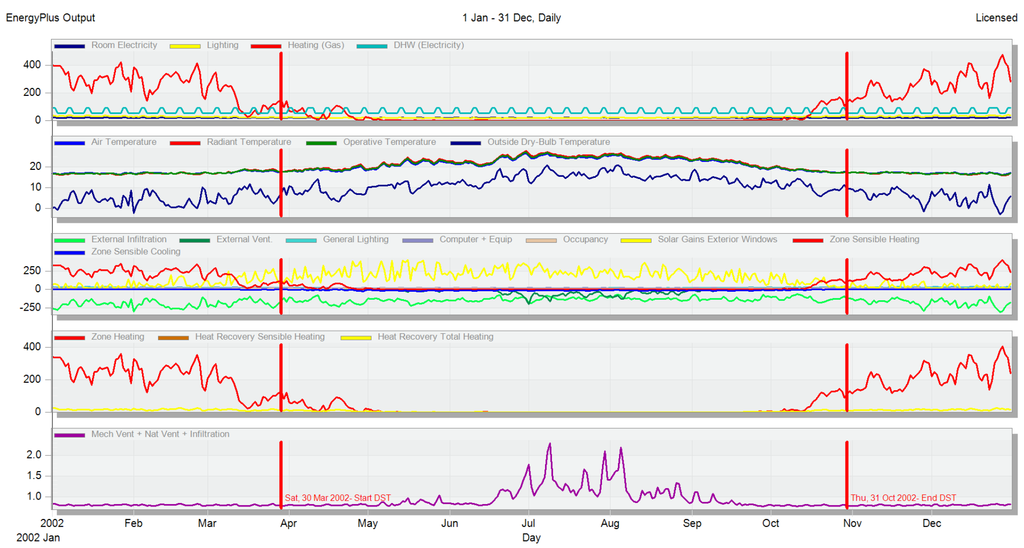


Fig. 10.1.2 Approximate building energy demand benchmarks³

Building Typology	Regulated energy kWh/m2 per year			Unregulated energy kWh/m² per year		Total energy demand kWh/m² per year
	space heating	hot water	lighting, fans, pumps, cooling	appliances, equipment	cooking, catering	
dwelling, Building Regulations	60	55	10	25	15	165
zero carbon dwelling	39–46	55	10	25	15	144–151
dwelling, Passivhaus (PH) standard	15	55	10	25	15	120

Source: Environmental Pocket Book

	Total Energy [kWh]	Energy Per Total Building Area [kWh/m2]	Energy Per Conditioned Building Area [kWh/m2]
Total Site Energy	70638.54	72.87	72.87
Net Site Energy	70638.54	72.87	72.87
Total Source Energy	248361.69	256.20	256.20
Net Source Energy	248361.69	256.20	256.20

Total Energy Demond per year= 72.87 kWh/m^2/yr < 120 kWh/m^2/yr

Passivhaus Energy Demond Standard ✓

Summary

The new design was implemented in the DesignBuilder for space heating simulation and total energy consumption simulation, achieving the values required by the standards.

6.2 | Illuminance Analysis

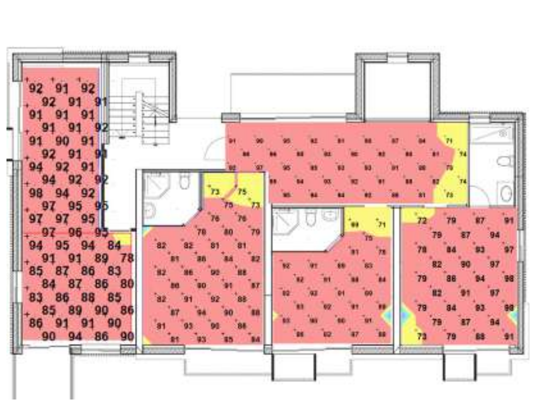
[UDI] % < 100 Lux for Occupancy

Building A - Lower Ground Floor

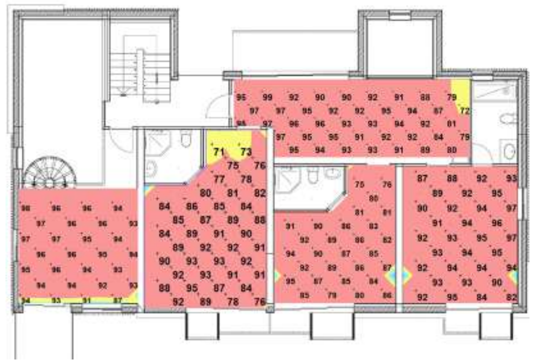
Building A - Ground Floor

Building A - First Floor

Building A - Second Floor



Building A - Third Floor

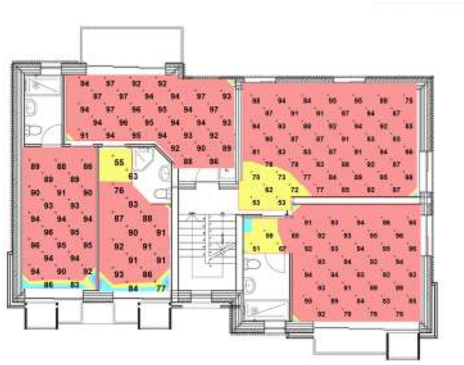


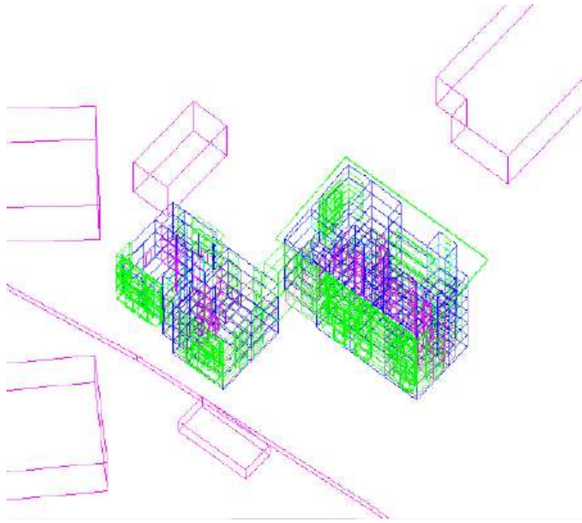
Building B - Lower Ground Floor

Building B - Ground Floor

Building B - First Floor

Building B - Second Floor





Summary

Through illuminance simulations based on climate conditions carried out in IESVE software, over 90% of bedroom area have good UDI, which greatly reduced the demand of artificial lighting.

6.3 | Total Cost Analysis

paul testa architecture

Cost Calculator

This cost calculator is designed to give you a clear idea on what to budget for as you start your dream build journey. It's a rough tool but can be used throughout the early stages of your project to keep your ideas on budget.

1. Take a look at our costs blog and choose your specification level and steepness of slope from the drop down orange cells. This gives you the rates that apply to the build.
2. Then fill in the area of building or number of bathrooms/kitchens in the blue cells to apply these rates to the size of your project.
3. Please don't edit any of the other cells as the spreadsheet may not work.

Construction Costs Blog

Element	Specification	Rate	Slope	Slope Adjustment Factor	Adjusted rate	Area/Number	Cost
New build/extension	Medium	£1900.00	Major	1.2	£2,280.00	616	£1,404,480.00
Garage	High	£1550.00	Minor	1.1	£1,705.00	0	£0.00
Retrofit/remodel	Medium	£900.00	NA		£900.00	103	£92,700.00
Kitchen	Low	£10000.00	NA		£10000.00	8	£80,000.00
Bathrooms	Low	£5000.00	NA		£5000.00	12	£60,000.00
External hard landscape	Low	£125.00	Minor	1.1	£137.50	0	£0.00

Total construction cost	**£1,637,180.00**

Contingency	5%	£81,859.00
Approx. professional Fees	0%	£0.00
Total Cost inc. contingency & Fees		£0.00

Grand Total inc. VAT	20.0%	**£2,062,846.80**

Source: Paul Testa Architecture Practice

6.4 | Project Phasing

Priority	Client wellbeing	Reduce Energy Demand	Capacity	Budget	Decarbonise
Challenge	Disruption of service	Budget	Disruption of service		Budget
Requirement	Space quality Space reconfiguration Indoor Air Quality Thermal Comfort Activity Area	Deep Retrofit	New Build	Overall architectural quality	Wall insulation Windows, Ventilation with HR
Action	Deep Retrofit Capacity Windows, Ventilation with HR	Fabric Insulation Renewable Energy	New structure	Biodiversity Facade design Function	Material choice

Summary
Prioritising the different needs of the client enables to identify the best approach too phasing the solutions of the project. The well being of the current and future customers of Beaurfort is a priority hence this will determine the immediate items for expenditure. However, the parameters of the client's vision of reducing the carbon footprint of their projects by 2023 an the budget of £4,000,000 regulate the approach to be considered. Therefore, giving priority to developing the new structure before improving the building fabric of the existing structure is recommended. This will then allow for retrofiting of the internal layout of the existing building, before the landscaping.

Reference

Pelsmakers, S. (2015) The environmental design pocketbook. Second edition. London: RIBA Publishing, p.279.

7

Visualisation

Exterior View

Facade

Garden

7.1 | East View

7.2 | Main Entrance

7.3 | South East Facade

7.4 | South East Facade

7.5 | Outdoor Garden

Thank you