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Social Tiny Housing for Educational and Medical Sector

A design project thesis submitted to the Faculty of Architecture, as a partial fulfillment for the degree of Bachelor of Science in Architecture

Project Theme:

The Tiny Housing Movement

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Dedication

To all people in my life, who have been always a source of inspiration and encouragement.

To all Sudanese citizens, We will build Sudan now.

Hopefully this humble project will contribute to build Sudan.

BUILD SUDAN NOW FOUNDATION

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1. CHAPTER ONE : INTRODUCTION

1.1. Title of thesis

social tiny housing for educational and medical sector.

Figure 01: tiny house (view)

Figure 02: tiny house (view)

1.2. The projects theme

The Tiny Housing Movement.

1.2.1. Definition

Tiny houses are primary **full-fledged dwelling** units on **small scale**. **Tiny house is find freedom in simplicity**. (Gabriella and Andrew Morrison)

Figure 03: tiny house (view)

Figure 04: benefits

1.2.2. History of tiny housing

The tiny house movement it originated in the **United States**, as an answer to a series of events that **shook the housing market**. A **collapsing economy** and disasters like **hurricane Katrina** caused people to lose their homes.(Gabriella and Andrew Morrison)

Figure 05: tiny house (1989)

Figure 06: tiny house (1989)

In **1000 bc**, **Yurt or Gers** were established in **Mongolia** as practical **small mobile homes**.(Brent Heavener)

Figure 08: tiny house (1964)

Figure 07: tiny house (1000 bc)

Figure 09: tiny house (1989)

1.3. Social housing in Sudan

Most Sudanese live in **simple houses** of their **own or rent** for **landlords** or **agricultural-scheme authorities**.

A **national housing** authority provides **low-cost** housing to **government employees**, **rural school teachers**, and person in low-income groups. A town-planning ordinance provides for **slum clearance** and **re planning of towns**.(S Ismail Ahmed Ali and Z Szalay)

Figure 10: social housing

The **KSHDF** finances the construction of housing for **high, middle and low-income** segments. The three housing categories have the following general characteristics:(S Ismail Ahmed Ali and Z Szalay)

1. **Popular housing**: **core units** for **working** and **low-income** households with **eligibility requirements**, **90,000 units built**.
2. **Economic housing**: **core units** for **middle-income** households without **eligibility requirements**, **41,000 units built**.

Figure 11: economic housing

Figure 12:3d economic housing

3. **Investment housing**: **villas and flats** with **two rooms or more** for **upper-income** households without eligibility requirements, **5,000 units built**.

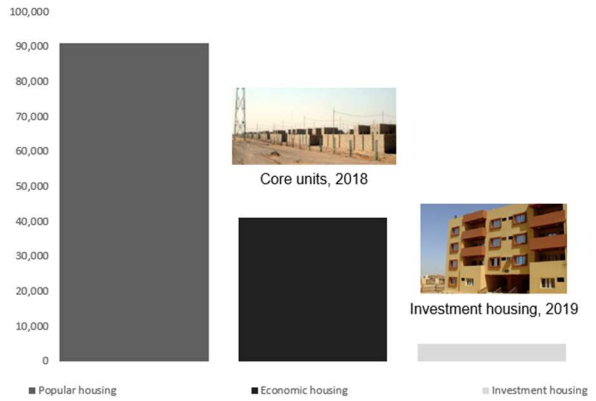

Chart 1: types of housing by author

1.3.1.Housing characteristics

Different **shapes of houses** like **square**, **rectangular and circular houses**. There is also a **special functional space** called **Al-Hosh**, which is found almost in most **Sudanese homes**, and is usually used **after sunset** for **family gathering**, **talking and drinking tea**. And using **shading elements** called **veranda**.

Figure 14: qatiyah

Figure 13: veranda

Figure 15: house

1.3.2. Housing materials

The housing materials in Sudan and classified into three types:(S Ismail Ahmed Ali and Z Szalay)

I. **Modern materials**: i.e., **concrete**, **red brick with cement mortar**, **cement bricks** and **corrugated iron sheets**.
II. **Traditional permanent materials**: **red bricks combined with mud bricks** for wall construction, **mud construction** for walls and **roofing made from sticks**, **thatch** and **mud**.
III. **Traditional materials**: i.e., **thatch** used for **roofing** and for **walls**.

In **first class areas** (classification according to the residential area level), residential buildings are made of **red bricks** with **clay** or **cement mortar**, **reinforced cement ceiling**, and roofs or **corrugated iron sheets** for **roofing**.(S Ismail Ahmed Ali and Z Szalay)

Construction Time	Temporary	Single Family Dwelling Detached			Multi-family Dwelling
		Climate Zone I (warm desert climate)	Climate Zone II (warm semi – arid climate)	Climate Zone III (tropical savanna climate)	
(1900- 1950)1,2		House of One Floor Mud (Adapted)		Tukul/Gottiya Mud	
(1956- 2000)3	Tukul /Gottiya Sticks	Tukul/ Gottiya Mud	House of One Floor Brick/ Concrete	Dwelling of Straw Mats Wooden Dwelling	Flat or Apartment
(2000- till now)4	Tent Tukul /Gottiya Sticks	House of One Floor Mud	Villa		Multi Storey House

1 Early Colonial Architecture (1900–1920) 2 Late Colonial Architecture (1921–1956) 3 The Post-Independence Era (1956–2000) 4 Architecture from 2000 onwards

Table 1: housing typology table by author

1.4. Project purpose

The **immense increase of population in Khartoum** is the **main reason** for the houses demands increase because it is the **center of cervices**. And due to the declivity economy and the shortage of available, **affordable housing**, the **continued escalation in housing costs**, **long-term residents** are threatened with displacement, which encourages thein **formal settlements**.

1.5. Project aims

The **main aim** is **not only** to **provide housing**, but to **provide the services** that **individuals need** to be **close to their work place** to **motivate them to meet higher needs to reach self-actualization**, **inspired from Maslows hierarchy of needs** (needs lower down in the hierarchy must be satisfied before individuals can attend to needs higher up).

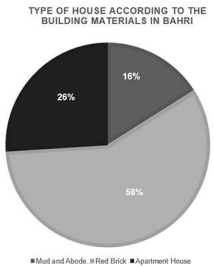

Chart 2: materials by author

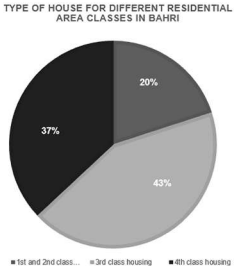

Chart 3: types of housing by author

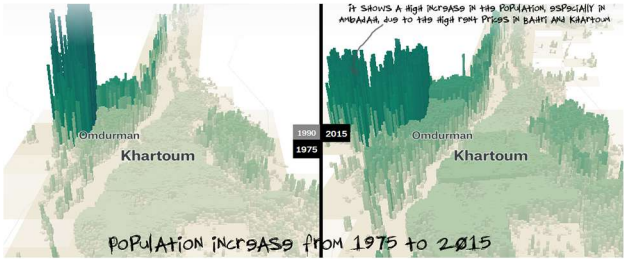

Figure 16: population increase in khartoum by author

Figure 17: Maslow's pyramid

Figure 18: Maslow's pyramid

1.6. Project approach

Taking in consideration all **interaction** that would **take place in this one project**, by **variety of people**, by studying all **aspects (social-physical-economic-cultural)** that affect making the **design usable** by all to the **greatest extent possible**.

1.7. Project objective

1. **Accessibility** and **affordability**.
2. Use the space as a **most efficiency**.
3. Using **low cost materials** and **finishes**.
4. **Hierarchy of spaces**.
5. **Safety**.
6. **Stable** and **comfortable expansion**.
7. **Minimize horizontal expansion**.
8. Achieve **environmental needs** to make the place more **lively and healthy**.
9. Reside the **maximum numbers of families** in the **selected site**.

1.8. Project challenges

1. **Planning small spaces** efficiently with **providing** what **Sudanese family needs**.
2. **Balance** between **building and open areas**.
3. **Sociological comfort** with **good interior design**.
4. Providing an integrated residential **eniveronment at affordable prices**.
5. Suitable **environmental solutions** design.
6. Suitable the **social order of Sudanese culture** and customs like **privacy** in building.

1.9. Project methodology

1. **Selection** and **analysis** the appropriate of **site**.
2. **Study and analysis** the **international projects**.
3. Study about **users** and the **number** of them.
4. **Calculation** and **analyzing components** and requirements.
5. **Calculating** the **suitable area** for the project.

2. CHAPTER TWO : CASE STUDIES

2.1. La Borda / Lacol (Clara Ott)

Apartments . Barcelona, Spain.

Architects: **Lacol**.
Area: **3000 m²**.
Year: **2018**.
Photographs: Lluc Miralles, Lacol.

Manufacturers: Placo, Steico, 9INTEX, Egoin, Fermacel, Guntamatic, Ininsa, Orona Pecres, Siber, Zinco.

Figure 19: view

Figure 20: elevation

2.1.1. Introduction and location

La Borda housing cooperative is a development self-organized by its users to access decent, non-speculative housing that places its use value in the center, through a collective structure. The idea of a housing cooperative was born in **2012 as a project of Can Batlló driven by the community in the process of recovery of the industrial premises**, and the neighborhood and cooperative fabric of the Sants neighborhood of Barcelona. The project is located on **a public land of social housing**, with a leasehold of **75 years**. Located in **Constitució Street**, in a bordering position of the **industrial area of Can Batlló with a facade to the existing neighborhood of La Bordeta**.

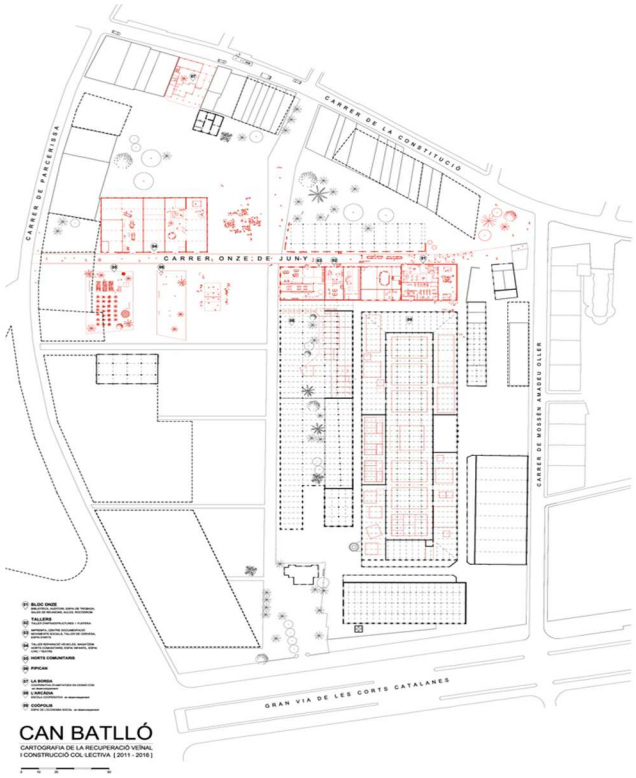

Figure 21: plan

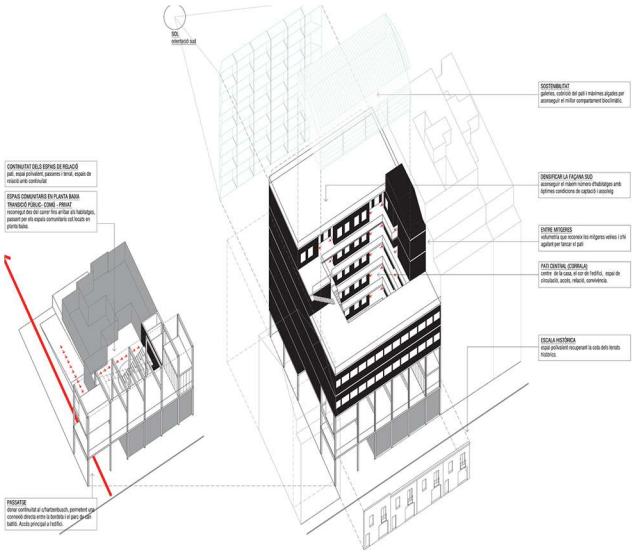

Figure 22: diagram

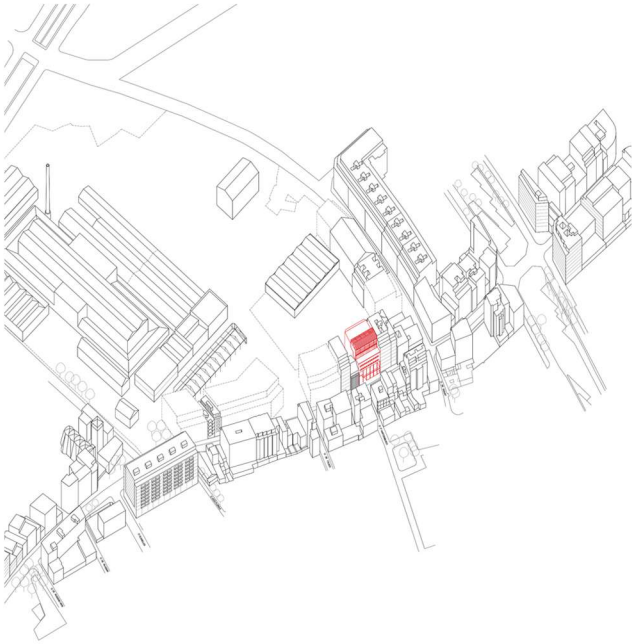

Figure 23: urban context

2.1.2. Space distribution

There are three fundamental and cross-sectional principles of the project, (1) redefine the collective housing program. **The building program proposes 28 units (40, 60 and 75m²) and community spaces that allow stretching the fact of living**, from the **private space to the public space to enhance the community life**. These spaces are: **kitchen-dining room, laundry, multipurpose space, space for guests, health and care space, storage in each plant, and exterior and semi-exterior spaces such as the patio and roofs.** All of them articulated around a **central courtyard**, a large **relationship space reminiscent of the "corralas"**, a typology of popular housing in central and southern parts of Spain.

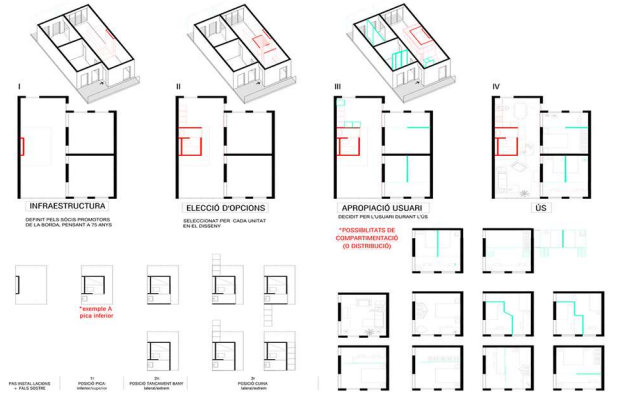

Figure 24: diagram

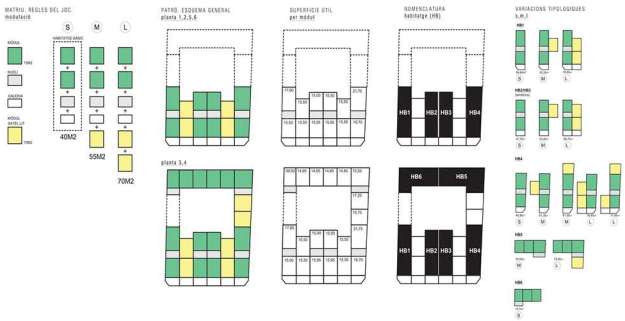

Figure 25: diagram

Figure 26: plan

2.1.3. Sustainability and environmental

The objective is to build with the **lowest environmental impact possible**, both in the **construction work and during its life** and, above all, **achieve comfort in homes with minimum consumption**, to reduce the overall costs of access to housing and eliminate the possibility of energy poverty among users. We started from the conviction that the best strategy is to reduce the initial demand of all the **environmental vectors of the building (energy, water, materials and waste)**, especially at the **energy level**, where we prioritized passive strategies to achieve maximum use of existing resources.

Figure 28: section

Figure 27: view

Figure 29: view indoor

2.1.4. Lesson learned

• **Natural day light**, **ventilation** & **shading** importance.
• **Articulating spaces** around the **courtyard** ,give the project a feel of **domesticity**, and enhance the **social life**.
• The **facades** of the building **reflect** the **culture** of the region.
• **Social interactions** in every part of the building.
• Use many **solutions** to make **housing affordable**. For example, use **passive solutions**, make spaces **narrower** but **comfortable**.
• use **environment** in building to make building more **vital** and **healthy**.

2.2. Centre Village (Clara Ott)

Housing, Social Housing . Winnipeg, Canada.

Architects: **5468796 Architecture, Cohlmeyer Architecture Limited**.
Year: **2010**.
Landscape Design: **Cynthia Cohlmeyer Landscape Architect**.
Builder: **Capstone Construction**.
Project Manager: **Hold Zone Inc**.

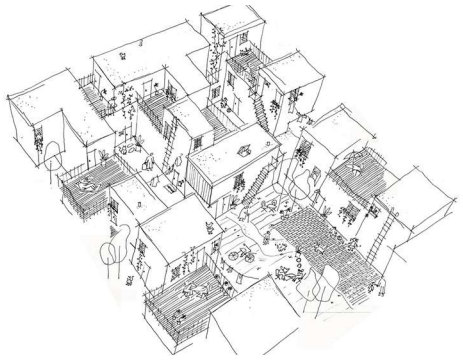

Figure 30: 3d sketch

2.2.1. Introduction

The site was an abandoned **L-shaped lot zoned for six single-family houses**. Instead, the project established a micro village of **25-dwellings within six, three-storey blocks** that would be easy to build and maintain. The blocks' arrangement both defines and animates two public spaces – **a through-street and a shared courtyard – that weave the city through the project and provide amenities for residents and the surrounding neighbourhood**. **The landscaped courtyard offers a calm and protected place for children to play**, and the new street is an informal meeting place. Each dwelling has its own entrance, either at grade or up an exterior staircase, thus reducing internal circulation and the size of the overall building, and also prompting residents to connect and get to know one another.

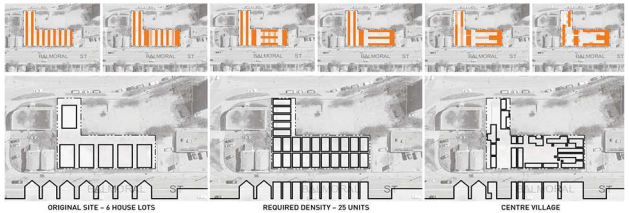

Figure 31: site plan

Figure 32: plan

Figure 33: elevation

Figure 34: view

2.2.2. Design of spaces

Designed to make the most of space, **material and daylight,** the units have rich and playful compositions made from **compact 8'x12' modules and cantilevered 14 x 12 modules for larger living areas that offer broader views**. The modules are stacked and interlocked to create diverse unit configurations that vary from **375 square feet for a one-bedroom unit**, to **875 square feet for four-bedroom units**. Since the rooms of each unit are **distributed over several floors, even small apartments have plenty of privacy,** which was an important factor since a number of the tenants are multi-generational families.

Figure 35: indoor design

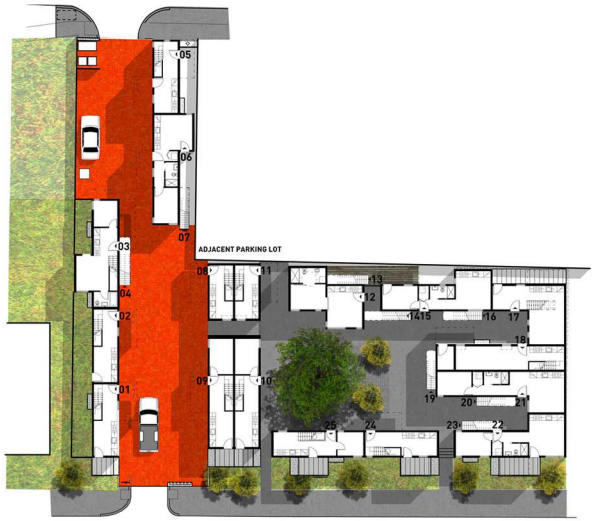

Figure 36: plan

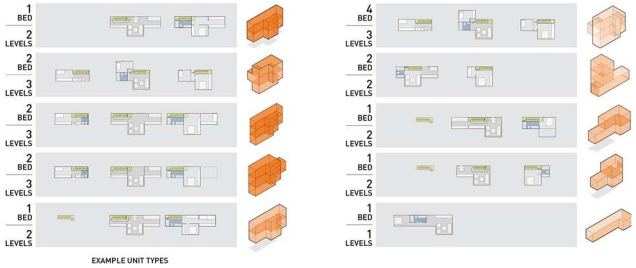

Figure 37: diagram

2.2.3. Entries and windows design

With **entries and windows positioned on all sides of the blocks**, there is no rear side to this project, thus **improving the street quality and safety and security** in all directions. Further, **a typical residence has eight or more windows** on at least two sides of the building, providing ample and varied access to **views, daylight and cross-ventilation**. Deeply set, vibrant orange cowlings around the windows modulate **privacy and views into the units**, granting Centre Village a distinct identity in the city. With time the project is demonstrating how inventive architecture can influence **urbanism and positively impact social relationships**.

Figure 38: view (windows)

Figure 39: view (windows)

Figure 40: view (windows)

2.2.4. Sustainability and environmental

The primary sustainable initiative of **Centre Village is the density of units achieved** within a three storey townhouse typology on the given site. Density on its own, however, **is not innovative if the solution is not livable or compromises on the quality of space**. What was originally six single family house lots were amalgamated to create the site for **25 homes**, the number of units required by the client. Quadrupling the density had the potential to fill the entire lot, leaving no shared **community space, breathing room for the units**, or even enough wall area for windows which would have rendered both the **interior and exterior spaces uninhabitable**.

Figure 41: view (environmental)

Figure 42: view (environmental)

2.2.5. Lesson learned

- **Natural day light**, **ventilation** & **shading** importance.
- Using of **land efficiently**, that the land was zoned for **6 dwelling** became for **25** by going vertically and designing **small units**, and also design could make **courtyard**.
- The **courtyard** created by clusters provided a perfect **environment** for **social interactions**.
- use **environment** in building to make building more **vital** and **healthy**.
- When we living smaller we use **less energy**, **generate less waste** and become more intelligent and **international consumers**.
- Providing the necessary **privacy** in building.
- **Flexibility** in houses.

3. CHAPTER THREE : PROGRAM

3.1. Users

Users can be divided to two sector:

Educational and medical sector	(2) person (family)	(3-4) person (family)	(5-6) person (single)	Numbers of family	Numbers of apartments	Numbers of persons	Numbers of cars
Bahri basic school for boys	3%	1%	6%	5	11	52	8
Bahri secondary school for boys	4%	3%	5%	8	13	49	6
Bahri secondary school for girls	3%	5%	3%	18	14	38	13
Omar Abdul-Aziz school for boys	5%	7%	7%	9	12	67	5
Bahri hospital	8%	9%	9%	15	17	87	10
Ahmed Gassem hospital- cardiac surgery and kidney transplant center	7%	3%	12%	6	39	157	21
Totals	30%	28%	42%	61	106	450	63

Table 2: data about users by author

3.2. Land use

Total area = **7,950 m^2.**

Built up area **(housing units+comunal services)= 32% = 2,544m^2.**

Open areas **(landscaping, parking, sitting outdoor, open spaces and play grounds) = 68% = 5,460m^2.**

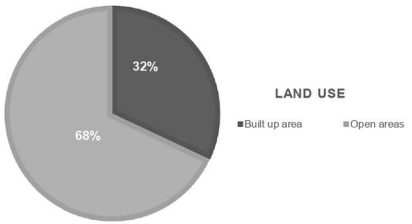

Chart 4: land use by author

3.3. Components

3.3.1. Services

***For children**

Day care = 521.30 m^2

***For males**

Game hall = 57.80 m^2

***For females**

Boutique = 43.20 m^2

Beauty center = 83.40 m^2

***For all**

Super market = 387.60 m^2

Restaurant = 521.30 m^2

Dry clean = 87.80 m^2

Bakery = 44.50 m^2

Health club = 298.10 m^2

3.3.2. Housing units

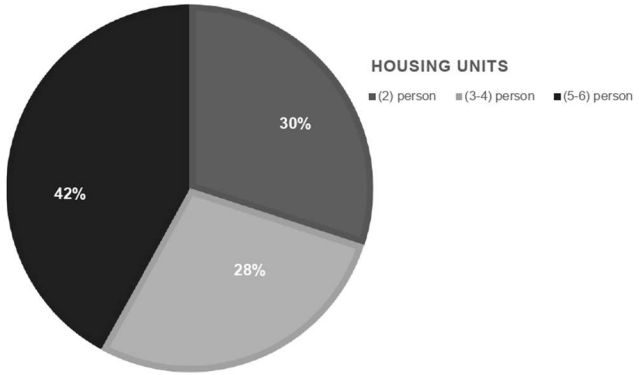

Chart 5: types housing units by author

3.3.3. Housing units components

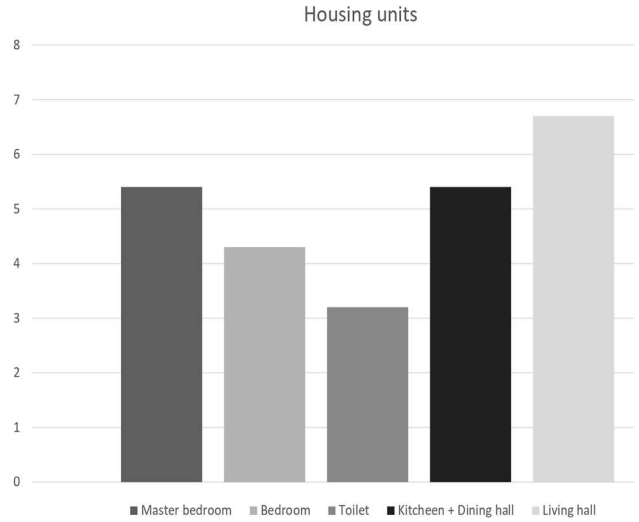

Chart 6: housing unit components by author

3.4. Site selection

Suggested two sites for the project:

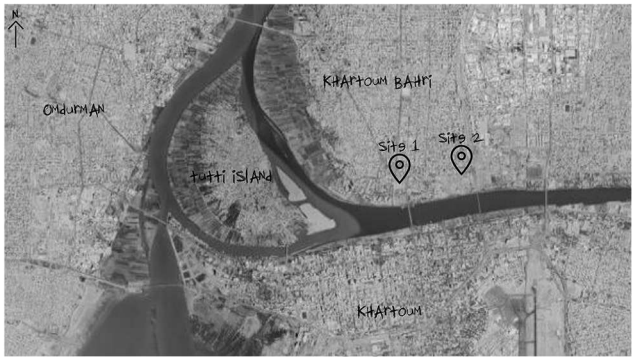

Figure 43: site selection by author

3.4.1. Near Al-Mauna St.

The land is owned by **the government**, the site is located at **Al-Waburat**, there is **one main road: Al-Mauna Street**. The site near **central station- Bahri**.

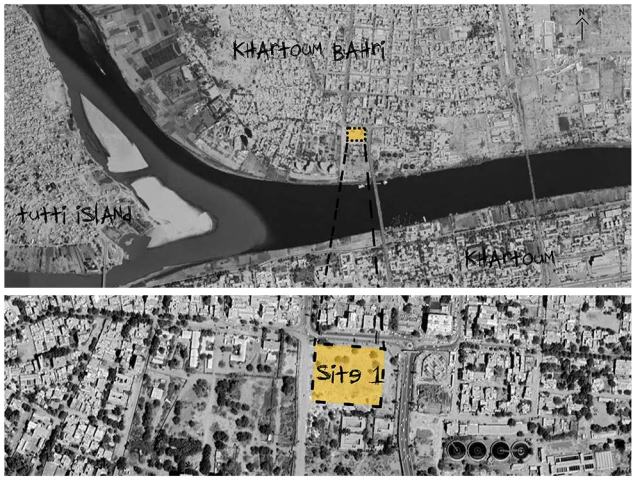

Figure 44: site 1 location by author

3.4.2. Near blue nile bridge

The land is **private property**, the site is located at **Al-Waburat**, there is one **sub road**. The site near **military museum- Bahri**.

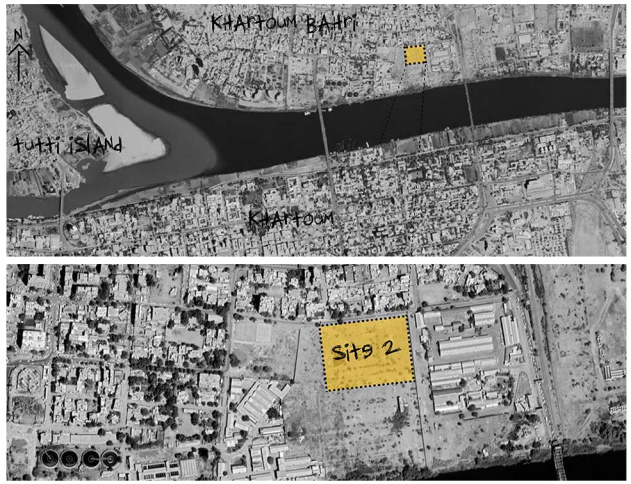

Figure 45: site 2 location by author

3.4.3. The differences between the two sites

Site 1 – near Al-Mauna St.	Site 2 – near Blue Nile bridge
1.close to public transportation	1.relatively far to public transportation
2.the land is owned by government	2.the land is is private property
3.its surrounded by one main street: Al-Mauna St.	3.its surrounded by one sub street.
4.close to services like supermarket	4.far from services like supermarket
5.Close to users' workplaces	5.far from users' workplaces
6.far from Khartoum north train station	6.Close to Khartoum north train station
7.The area of the site is suitable for the number of people to be accommodated	7.The area of the site is suitable for the number of people to be accommodated

Table 3: difference between sites by author

3.5. The selected site

There is **one main road: Al-Mauna Street**.

Site area is **7,950 m²**.

Ease of access to the site The site can be accessed via **4 bridges (blue nile bridge, El Mak Nemer bridge, Armed Forces Bridge and shambat bridge)** between Bahri, Khartoum and Omdurman.

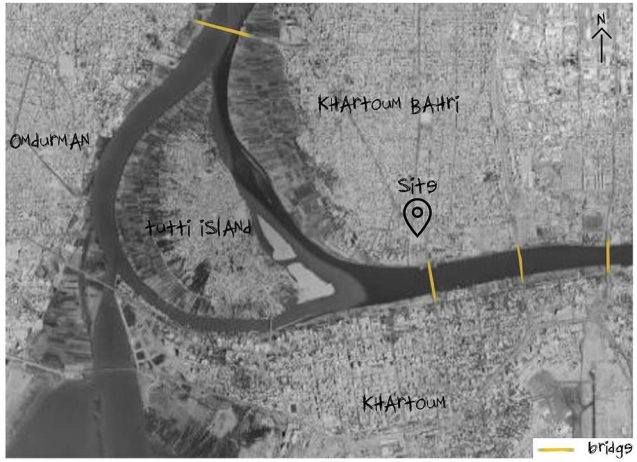

Figure 46: bridges by author

3.5.1. Site positioning and connectivity

The site strategically located in close to the **Khartoum international airport**, **Khartoum north train station** and **public transportation**.

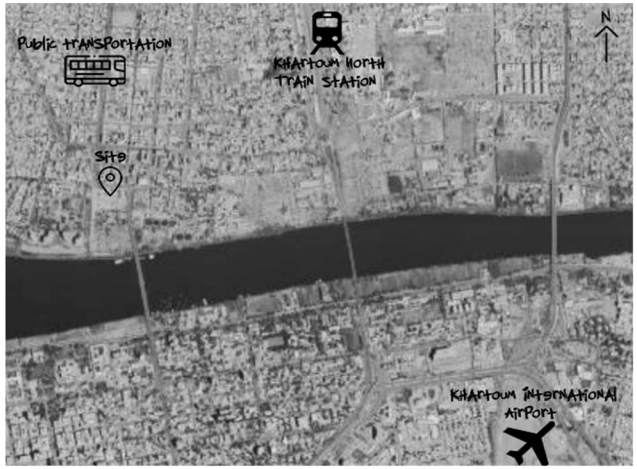

Figure 47: site position by author

3.5.2. Transportation Accessibility

Minimum driving time to **international airport is (18 min.)**, to **Khartoum north train station is (17 min.)** and to **public transportation is (4 min.)**.

Figure 49: public transportation

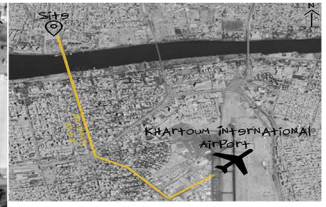

Figure 48: airport by author

Figure 50: train station by author

3.5.3. Infra-structure

Figure 51: electricity power supply

Figure 52: water supply by author

Figure 53: sanitary system

3.5.4. Land use

Figure 54: land use by author

3.5.5. Site study

Figure 57: site study by author

3.5.6. Photos from site

Figure 55: parking area (near site)

Figure 56: night activities

Figure 58:Existing trees (in site)

Figure 59: electrical poles and lamps

Figure 60: north profile elevation by author

Figure 61: south profile elevation by author

3.5.7. Climatic analysis

Location: **Khartoum Bahri.**

Latitude & longitude: **15°37'08.8"N 32°31'53.1"E.**

Climate: **hot arid.**

Temperature: **high difference in temperature between day and night.**

Provability wind: **northeast.**

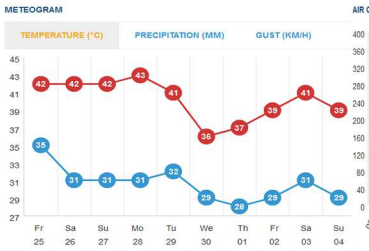

Chart 7: temperature analysis (site)

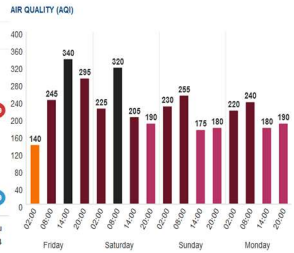

Chart 8: air analysis (site)

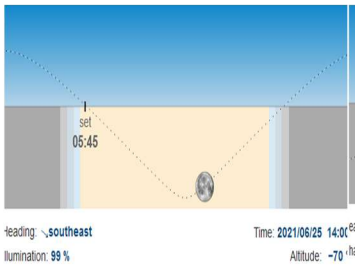

Figure 62: moon analysis (site)

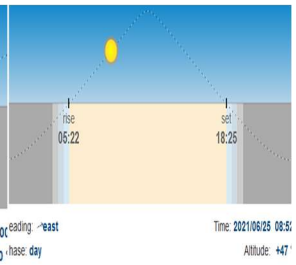

Figure 63: sun analysis (site)

3.5.8. Sun path diagrams

Khartoum Bahri (15°37'08.8"N 32°31'53.1"E).

Summer solar study.

21/6/2021 - 12 o'clock.

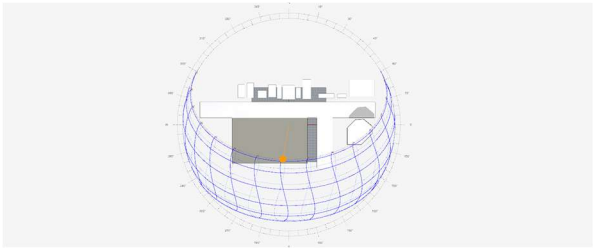

Figure 64: plan by author

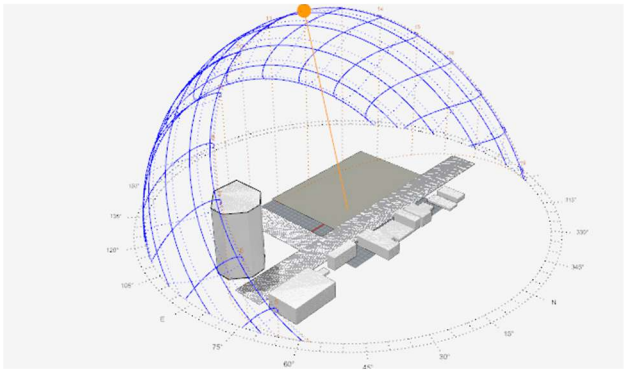

Figure 65: 3d by author

Khartoum Bahri (15°37'08.8"N 32°31'53.1"E).

Winter solar study.

21/3/2021 - 12 o'clock.

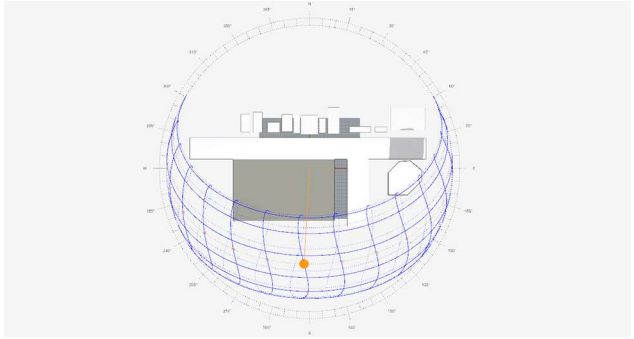

Figure 66: plan by author

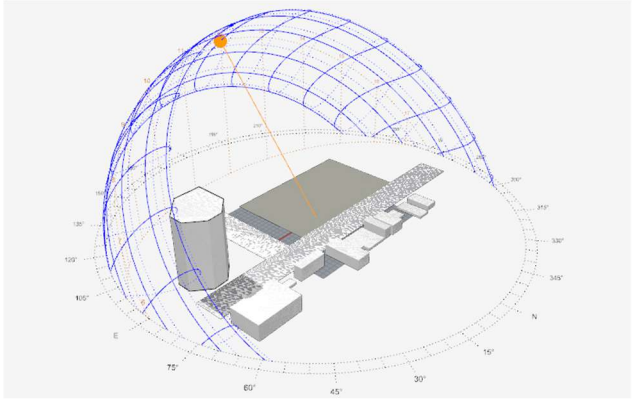

Figure 67: 3d by author

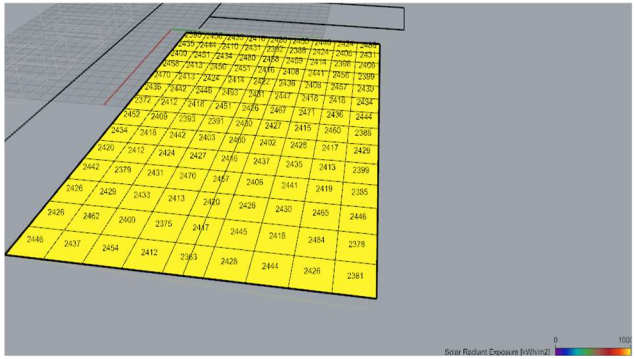

Figure 68:site objection to solar radiation through the year by author

4. CHAPTER FOUR : CONCEPT AND DESIGN STRATEGIES

Identify ideas, that allows the designer to overcome the circumstances of each project and to accomplish what is really important to accomplish.(Snyder and Catanese,230)

According to the project, there are issues to the think about and attempt to solve:

Figure 69: plan by author

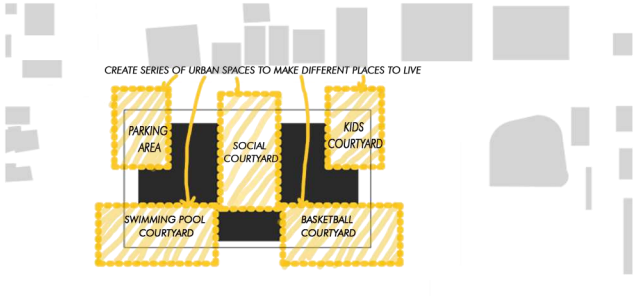

Figure 70: plan analysis by author

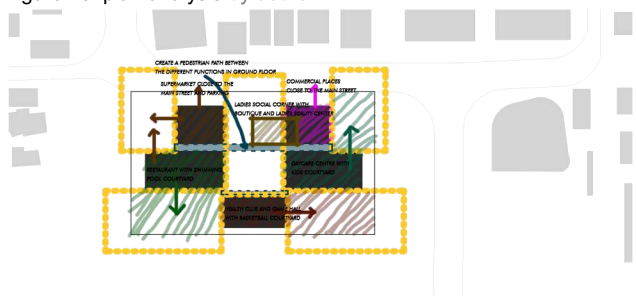

Figure 71: plan analysis by author

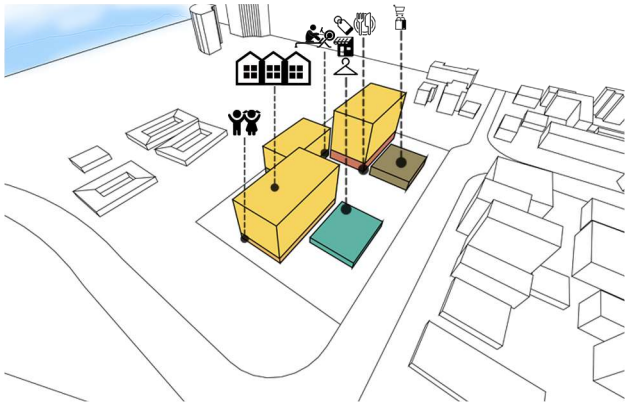

Figure 72: diagram by author

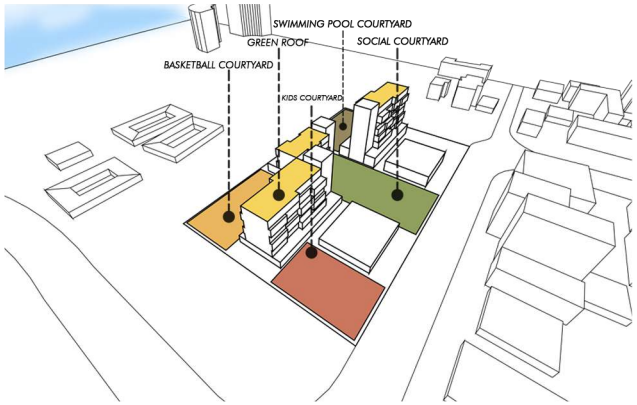

Figure 73: diagram by author

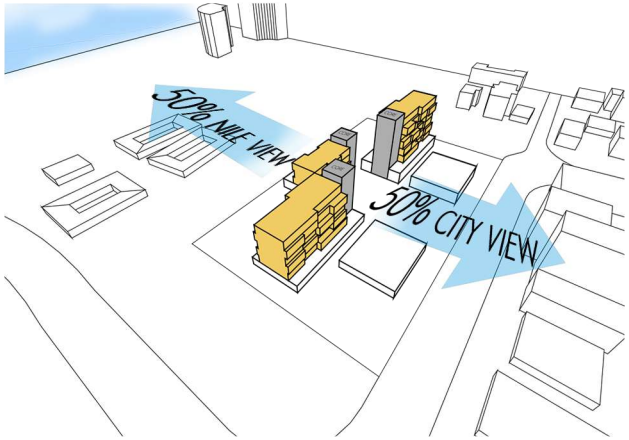

Figure 74: diagram by author

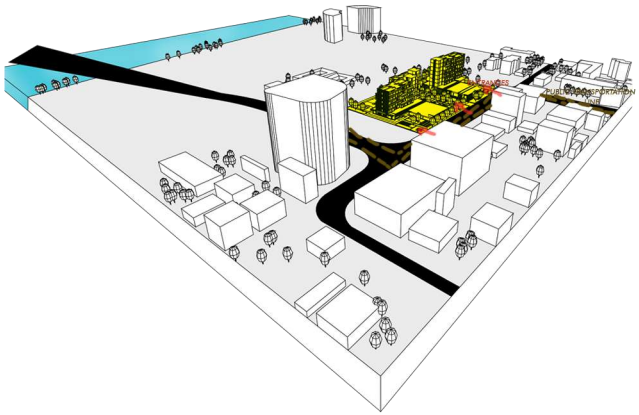

Figure 75: diagram by author

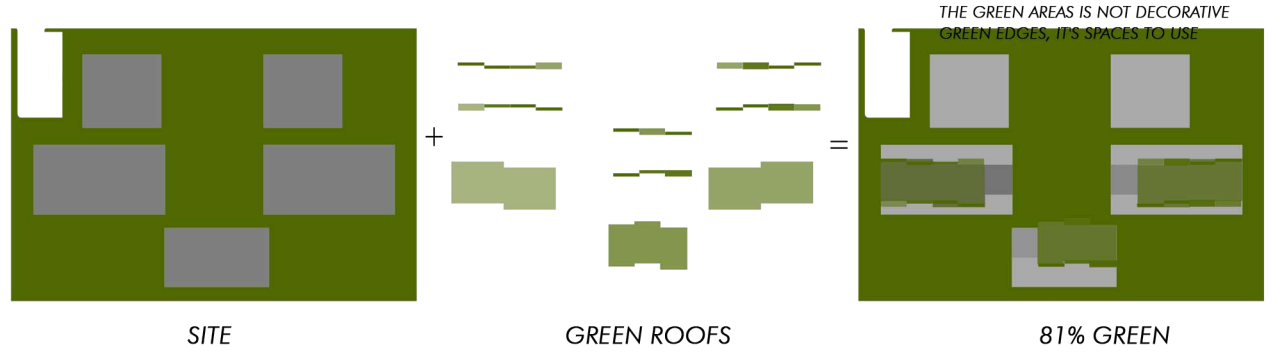

Figure 76: plan of green areas by author

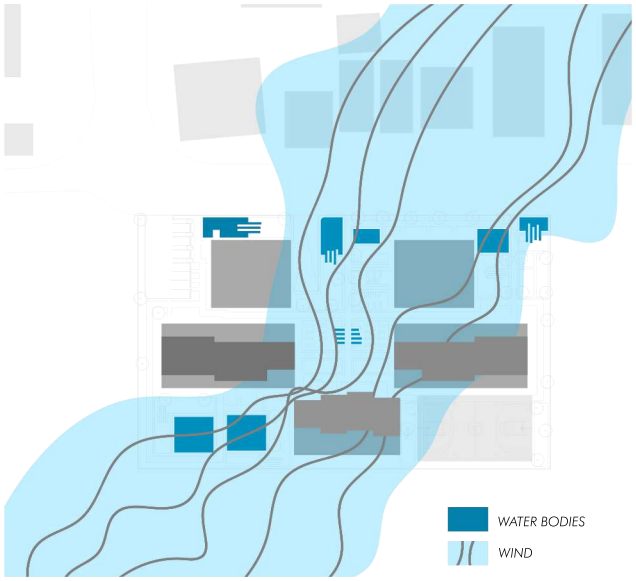

Figure 77: water bodies by author

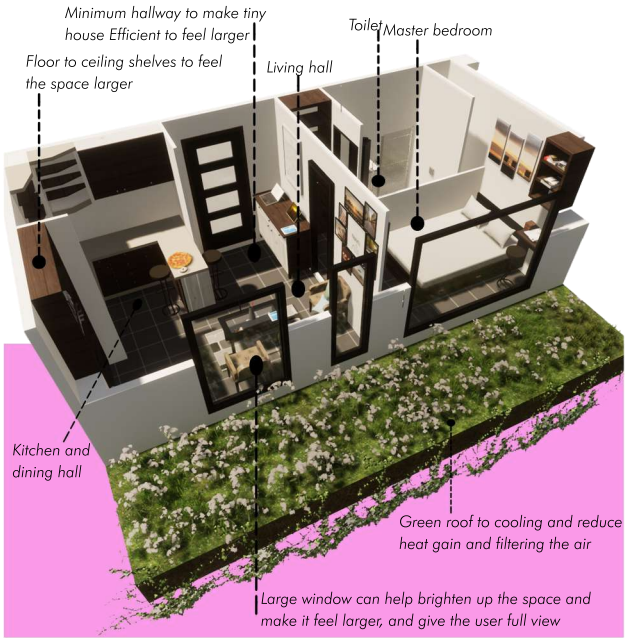

Figure 79: (2 person) apartment diagram by author

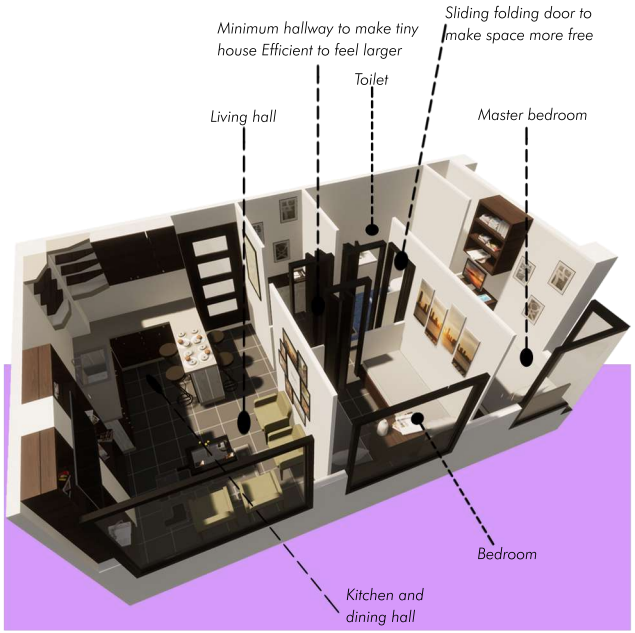

Figure 80: (3-4 person) apartment diagram by author

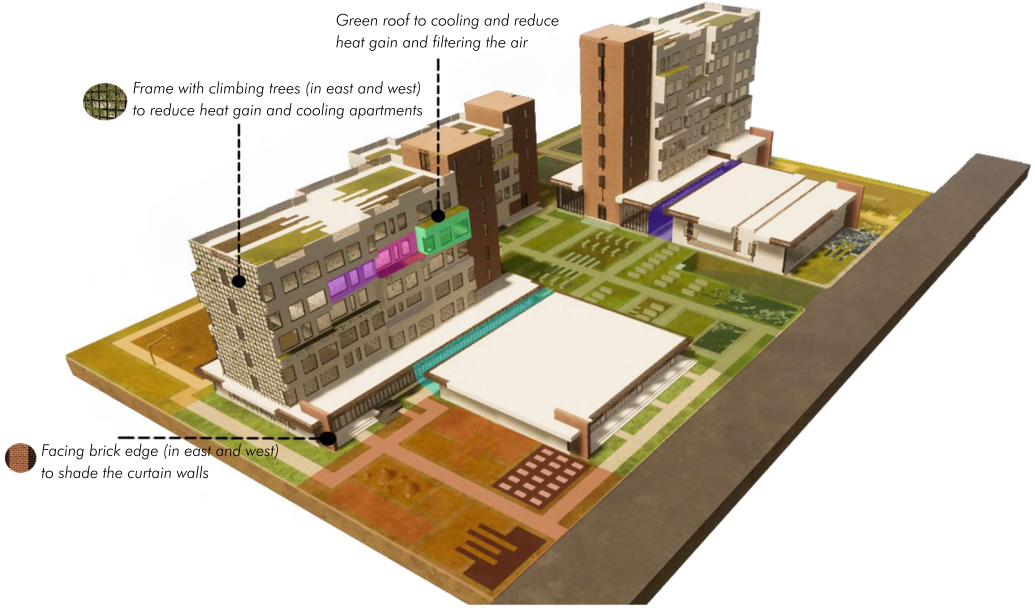

Figure 78: 3d diagram by author

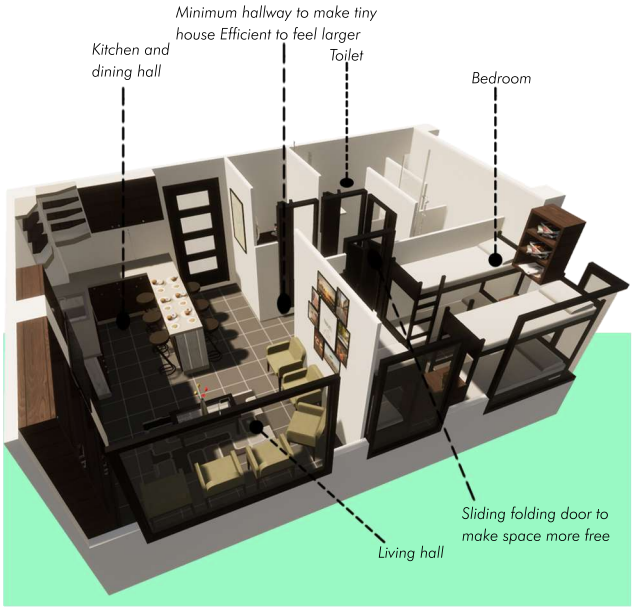

Figure 81: (5-6 person) apartment diagram by author

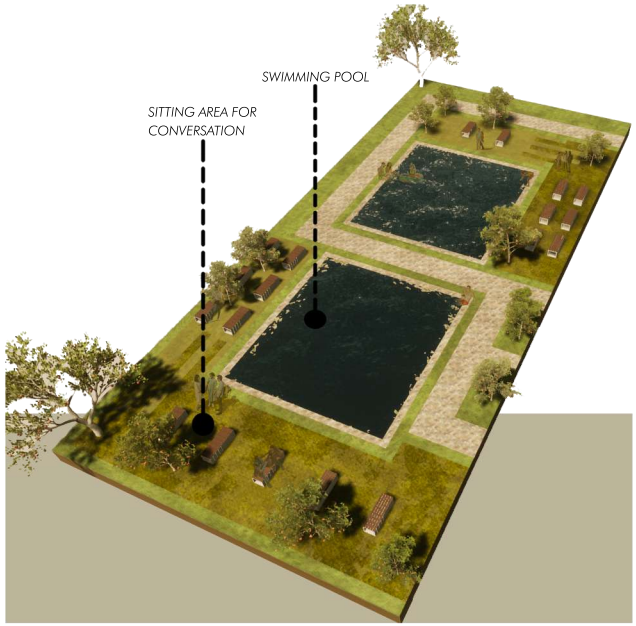

Figure 82: swimming pool courtyard by author

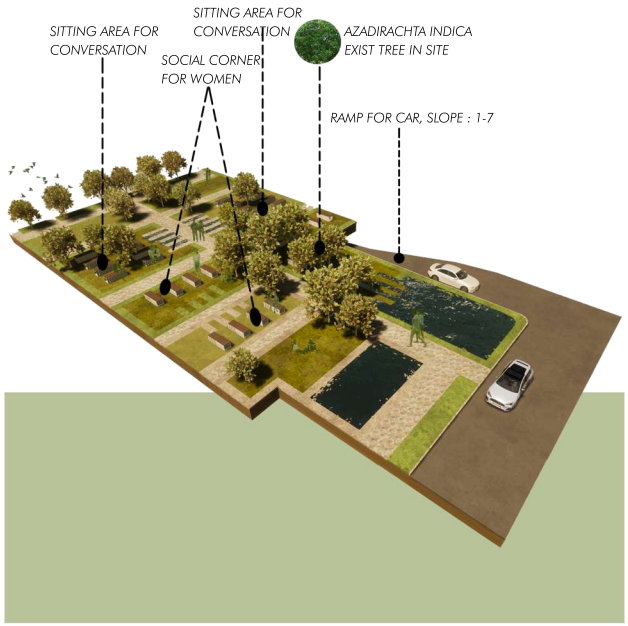

Figure 84: social courtyard by author

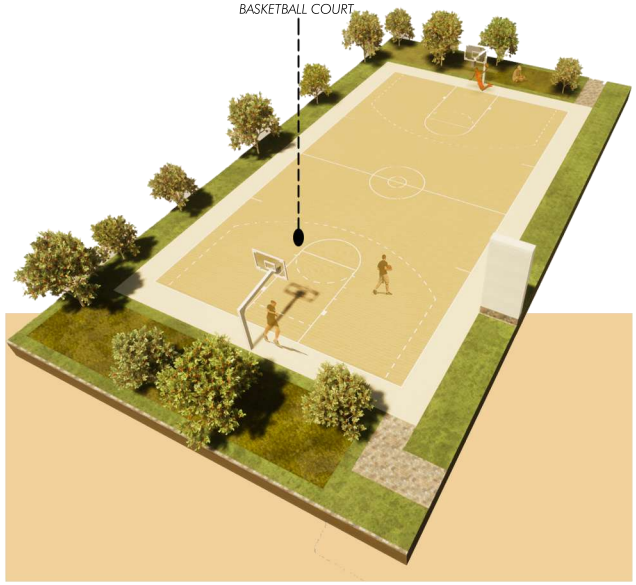

Figure 83: basketball courtyard by author

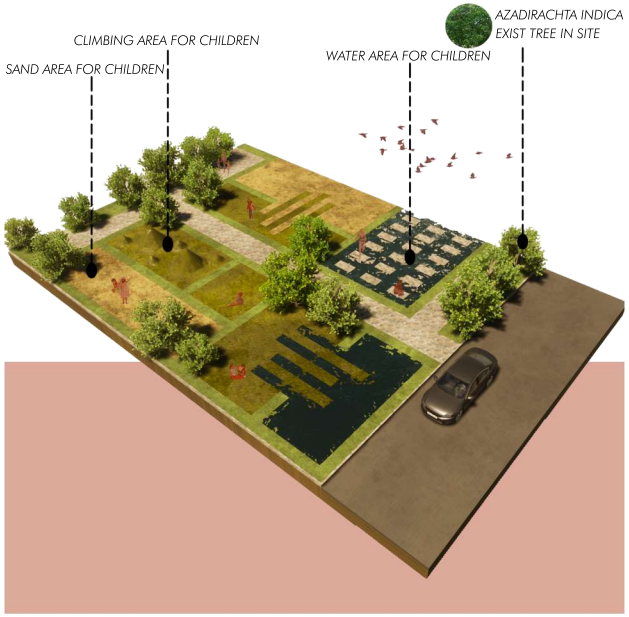

Figure 85: kids courtyard by author

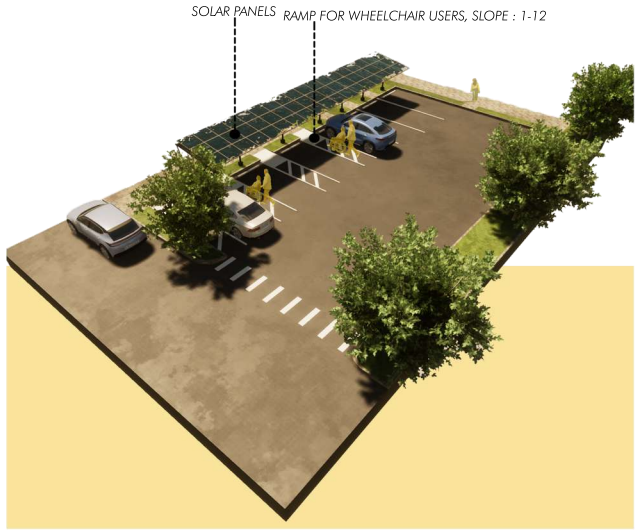

Figure 86: parking by author

Figure 87: pathway design by author

Figure 88: pathway design by author

4.1. Technical solutions

4.1.1 Structure system

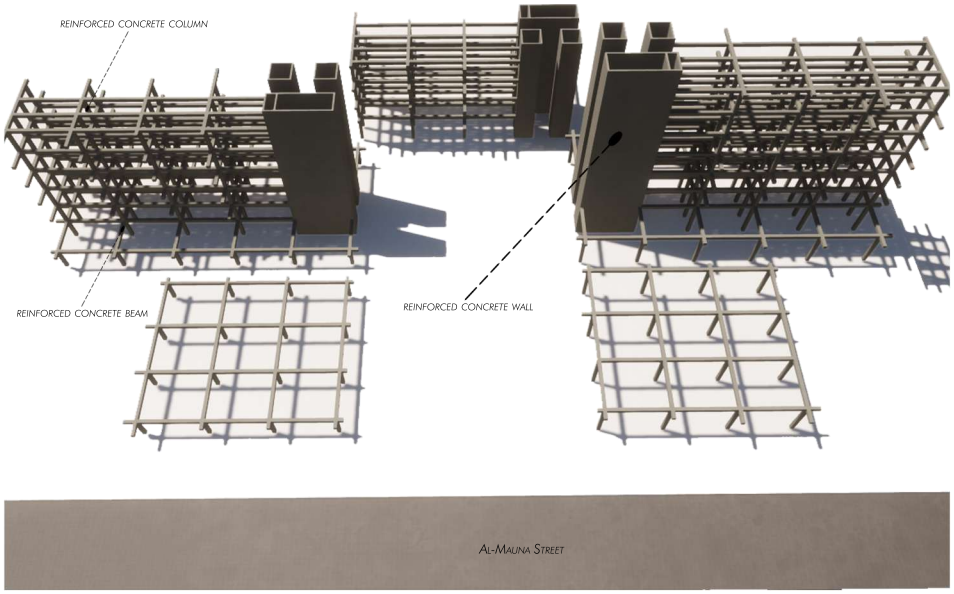

Figure 89: 3d structure by author

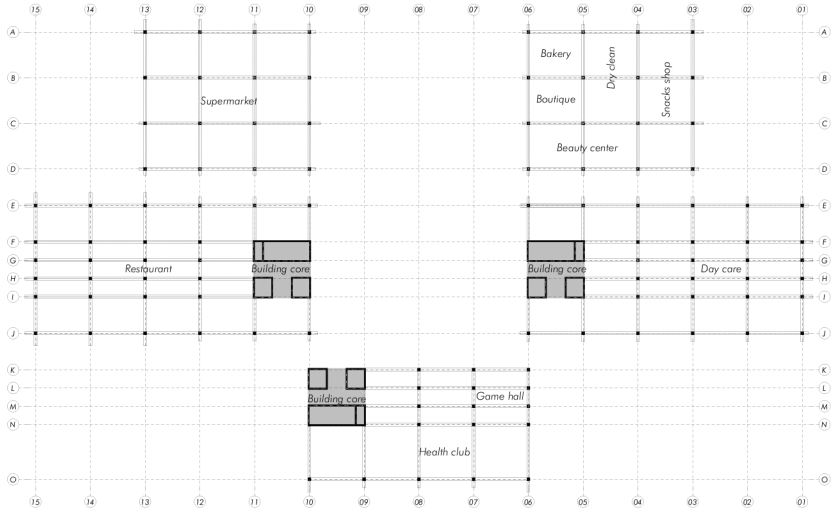

Figure 90: structure plan by author

4.1.2 Air conditioning system

A package unit is the all in one heating and cooling system, contain all of their parts in one outdoor unit that sits on the roof.

The advantages of package unit:

1. Efficiency.
2. Easy installation.
3. Quite.
4. Easy to control.

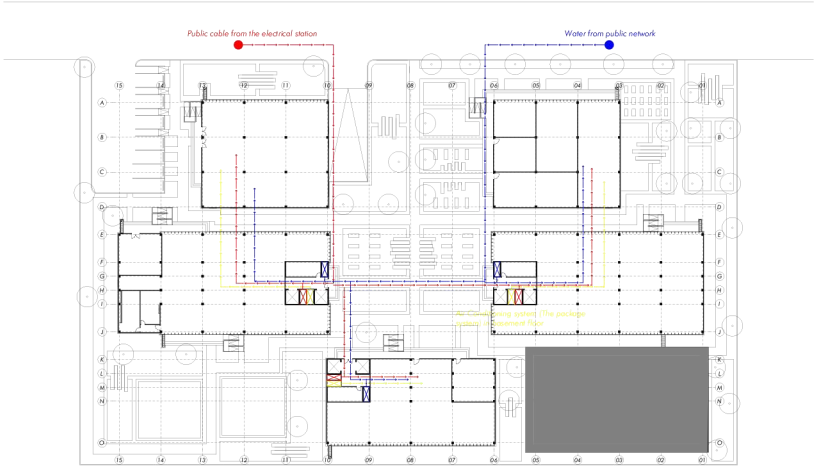

Figure 91: technical plan by author

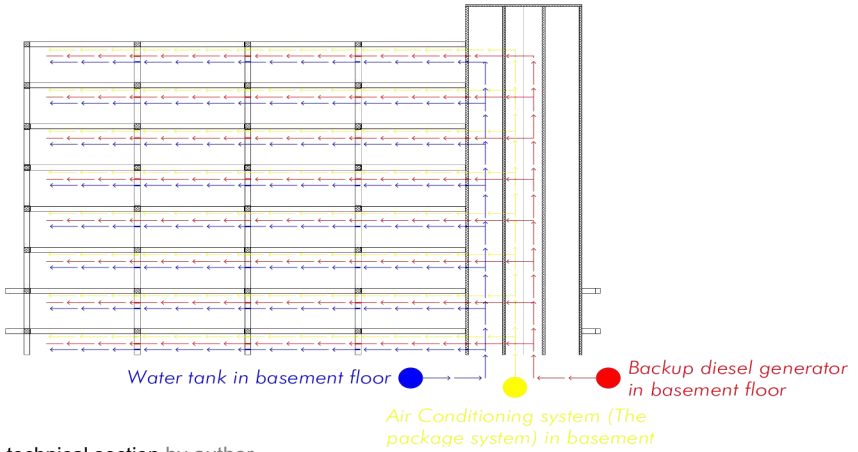

Figure 92: technical section by author

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