Healing the Effects of Industrial Waste

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Abstract

This research focuses on addressing the health issues in Faisalabad, a city known for its textile industries, which ironically contribute to a health crisis. The unregulated discharge of waste has resulted in water and air pollution leading to an increase in waterborne and airborne diseases.

Faisalabad is known for a high number of Acute Respiratory Infections in Pakistan and unfortunately, specialized medical facilities that cater to these health challenges are lacking in Faisalabad. The main goal of this study is to design a facility specifically tailored to treat and control the spread of diseases primarily caused by pollution.

The proposed medical complex incorporates design principles with functionality creating a welcoming and healing environment for patients. It integrates healthcare technology and sustainable features that seamlessly blend with the landscape of Faisalabad. Demonstrating an integrated approach to healthcare and environmental responsibility. The aim is to reduce the prevalence of Acute Respiratory Infections, provide healthcare solutions and raise awareness about the health risks associated with waste. The approach encompasses a strategy that combines treatment, prevention, public health education and improvements in sanitation infrastructure. All aimed at reducing the burden of diseases while fostering a healthier and more resilient community.

Keywords: *Healthcare Architecture, Acute Respiratory Infections, Healing, Pollution, Technology*

Contents

List of Tables

List of Figures

CHAPTER 1: Introduction

1.1 **Introduction**

Faisalabad is famous for its textile industries but at the same time these industries prove fatal for the residents of the city. These industries produce water and air pollution, which leads to air borne and water diseases. Currently, most of the people living in the city are sick with gastro disease and respiratory lungs infections due to air pollution. Faisalabad tops in the Acute Respiratory Infections (ARI) in Pakistan. According to the Punjab Health Ministry, from 2015 to 2019 only Faisalabad has 20,00,000+ cases of ARI and the other 4 diseases in the top 5 diseases of the district are gastro diseases like scabies, diarrhea, dysentery. These are caused by the heavy water in the city. Both air and water pollution are caused by industrial wastes that are directly dumped into the air and water respectively without any treatment. Smoke from chimneys of floor and textile industries and waste chemical water into the canal and streams of the city are the main causes of infectious diseases (Directorate General Health Services, Punjab). Textile waste has salts and organic compounds such as dyes, pigments, colorants, surfactants (red water).

Faisalabad has a total of 1000+ industries including 350+ textile industry, 500+ floor industries but only 22 of them have a treatment plant. According to SDGs 18 beds are needed for a population of 10,000 while this city lacks this digit by the factor of 10.

According to Faisalabad Development Authority FDA, 5 hospitals are proposed by 2030 with the capacity of more than 200 beds within the city and in the sub-urban areas. Currently, there is no dedicated facility is working for the treatment of these infectious disease patients, hence it becomes imperative that the medical facility with the specialized purpose of dealing with such diseases be provided to the people of Faisalabad (Faisalabad Development Authority (FDA)).

Thesis Background

Only 22 industries out of 1000+ have incorporated water and air treatment mechanism in Faisalabad resulting in high infection rates. When mixed into drinking water the industrial waste leads top gastric problems and hepatitis A&E.

1.2 Rationale

In the past decade, Faisalabad has witnessed a concerning surge of acute respiratory infections, with a reported numbers exceeding 200,000 cases (Directorate General Health Services, Punjab). Unfortunately, the city currently grapples with an absence of dedicated medical facilities equipped to address these specific health needs. Moreover, research has indicated that the origins of these respiratory and water diseases can be attributed to untreated industrial waste, for which comprehensive mitigation measures are lacking.

1.3 Thesis Statement

Designing a medical facility in metropolitan city of Faisalabad that treats and mitigates to control spread of water and air borne diseases spread mostly through civic works.

1.4 Aims & Objectives

Aims

- Reducing ARI's in Faisalabad.
- Healing patients with ARI and increasing on the health risks of industrial waste on the general population.

Objectives

- Designing a hospital with specialized areas for treating respiratory infections.
- Creating a facility that uses water as not only an element of landscape but also cleans and purifies contaminated water in the process.

1.5 Research Methodology

Unfortunately, the city of Faisalabad currently grapples with an absence of dedicated medical facilities equipped to address these specific health needs. Moreover, research has indicated that the origins of these respiratory and water diseases can be attributed to untreated industrial waste, for which comprehensive mitigation measures are lacking.

The research approach uses both quantitative and qualitative methods to gather data-based knowledge on demographics and design guidelines for a healthcare facility, respectively. Secondary research has been undertaken to understand the current situation of rising infectious diseases and demographics of the city through reports, documentations, and articles. Research on architecture for health care institutes has also been explored to aid the design process. Understanding of infectious diseases in general and their treatment is a part of the research as well.

1.6 **Scope**

To treat the infectious diseases and cater to the cause of these diseases in the metropolitan city of Faisalabad. In addressing the challenge of infectious diseases within the bustling city of Faisalabad, a multifaceted approach is essential to both treatment and prevention. The densely populated city demands a comprehensive strategy that not only focuses on the cure of such diseases but also catches the root causes behind their prevalence. By prioritizing accessible healthcare, public health education, and sanitation infrastructure improvements, we can strive to alleviate the burden of infectious diseases on the city's residents. By doing this, we not only provide immediate relief to those affected but also work toward a healthier, more resilient community by addressing the underlying factors contributing to the spread of these illnesses.

1.7 **Strategic Plan**

Month	Week one	Week two	Week three	Week four
September	**Thesis Conceptualization** -Finalizing thesis topic -Finalizing thesis rationale	**Defining Thesis aims & Objectives.**	**Conceptual Development.** -Reviewing precedent studies on the base of topic -Modifying topic on the base of further research. -Thesis Statement.	**Site Analysis** - Preparation of Site Selection Criteria -Detailed documentation of Site - Messo Analysis
October	**Site Analysis** -Micro -Macro -Swot Analysis -Legal & Historic -Cultural Analysis	**Quarter Jury** -Thesis Introduction -Primary and Secondary Research -Site Analysis	**Iterating on Jury Feedback**	**User and Programmatic analysis**
November	**Conceptual Development** -Parti Diagrams -Sketches -Iterations -Case Studies -Site Analysis	**Mid Jury** -Graphics Development -Sheets Development -Architectural Translation	**Iterating on Jury Feedback**	**Initial Planning and schematics** -Zoning -Schematic planning -Iterations
December	**Finalization of Planning**	**Pre-Final Jury** -Graphics Development -Sheets -Finalizing the layouts	**Iterating on Jury Feedback**	**Finalization of Design** -Planning -Master and layout plans finalization -Digital Modelling -Physical Modelling
January	**Preparation for Final Jury**	**Final Jury**		

Table 1 Strategic Plan

CHAPTER 2

2.1 Introduction

This chapter focuses upon the first step towards solving a problem i.e. thoroughly researching the problem and understanding the extents of it. This involves going through existing research papers that focus on this issue and any solutions that they may have presented, any existing architectural design that may help to alleviate the problem and the current situation in Pakistan regarding this issue. This involves an in-depth literature review understanding of the site through a critical site analysis and the use of architectural precedents that can help guide the design process and help to understand the workings of this health care typology in a more practical sense.

2.2 Literature Review

2.2.1 Architecture of the Pandemic- Jysper Nygard

The guideline looks at several factors concerning anti-infection, flexibility, and adaptability to the new standards and challenges from the pandemic environment.
Here's a breakdown and explanation of some of the mentioned concepts:

2.2.1.1 Reconfiguring Interiors:

Adaptation of interiors to meet new needs –social distance, improved hygiene standard and flexibility in use of rooms.

2.2.1.2 Infection Control by Design:

Spatial design, mainly through alteration in their configuration, choice of a surface material or the air flow system

2.2.1.3 Activity-Based Design:

Creating places by activities: that every place is maximally designed for its functionality while being safe.

2.2.1.4 Rooms for Hybrid Meetings:

Space design for effective hybrid (in-person & virtual) meetings.

2.2.1.5 Assistance from Sensors:

Sensor-oriented technologies that can be used to keep track of and control diverse areas in spaces like occupancy, air quality, or toilets.

2.2.1.6 Natural Ventilation for All:

Including natural airflows and ventilation designs into space creation procedures and adapting modified spaces to facilitate improved air movement and freshness.

These ideas and approaches represent how architects and designers are now looking at space design considering public health issues and changing demands due to the pandemic situation. (Nygård)

2.2.2 Negative and Positive pressure rooms-Air Innovations

A positive pressure room is a type of specialized space that has been engineered to control airflow to limit the spread of infections.

2.2.2.1 Positive Pressure Rooms:

- **Purpose:** The rooms are built with an arrangement that makes them have an elevated air pressure within them than in the external zone. This kind of airflow pushes the air within the room towards the exterior.
- **Function:** The positive pressure rooms are widely used for protecting vulnerable patients like those whose immunity is compromised or recovery patients from environmental contaminations or infection which may exist beyond a room.
- **Benefits:** It prevents the entry of polluted air into the room and protects the patients inside the room from catching infections by maintaining a high-pressure environment within the room.

2.2.2.2 Negative Pressure Rooms:

- **Purpose:** The rooms are created in such a way that it will create less air pressure in the room and its surroundings. They ensure that the air flows inwards from the external locations in the room.
- **Function:** The negative pressure rooms basically facilitate the confinement of various airborne contaminants within the rooms, thereby preventing them from spreading outside the localized environment. These isolate rooms are mainly meant for patients suffering from highly infectious diseases like tuberculosis, covid19, etc., to minimize healthcare worker exposure.
- **Benefits:** Specialized ventilation systems within the room trap and expel airborne pathogenic agents and contaminants that may be inhaled by individuals other than the person inside the room.

2.2.2.3 Negative Pressure Rooms:

Infection control is also provided by either positive or negative pressure rooms available within health care systems. The positive and negative pressure rooms protect susceptible patients in a clean and safe environment on one hand and contain and keep in the room contaminated air that may not reach outside on the other hand (Air Innovations).

2.2.3 Infectious Disease Control and Architectural Design-Akira Ito

It is important to consider some key issues raised by Akira Ito in relation to infection control and architectural design specifically, AIIR in maintaining a safe environment and prevention of the spread of airborne infections. Here's an explanation of each point:

- Create a constant flow of air and maintain negative pressure.
- The regular exchange and ventilation of the air in a room to minimize the presence of airborne pathogens and keep the atmosphere clean.
- Construction materials and designs that are airtight for prevention of leakage through the walls, ceiling, floor, etc.
- Releasing of any air containing pollutants directly outwards towards unpopulated places to avoid possible contacts with people.

- Ventilation and circulation of air within buildings using advanced air filtration systems like HEPA filters that catch and eliminate a very large number of airborne particulates including pathogens.
- Controlling negative pressure in the room to maintain its required levels for containing airborne contaminants.
- The design of hospital rooms should consider an anterior space which is probably an extra space that comes towards the entrance door to the room for better management of negative pressure in the air.

The basic steps are vital in ensuring safety and safe provision of care for patients with airborne communicable illnesses. Well-constructed AIIRs are crucial to prevent the infection of other patients as well as healthcare workers consequently leading to proper infection control (Ito).

2.3 Precedent Studies

Name	Location	Architect	Reason for Selection
PIMS	G-8 Islamabad		Non centralized design/Flexibility for future growth
Allied Hospital	Faisalabad		To understand the hospital typology in Faisalabad

Table 2 Precedent Studies

2.3.1 Pakistan Institute of Medical Sciences (PIMS)

2.3.1.1 Project Description

Pakistan Institute of medical Sciences was built in established in 1985 to provide clinical services, conduct applied research and develop linkages with academic institutions, national and international agencies including WHO, UNICEF, JICA. It is in G-8/3, Islamabad and its primary access is through Ibn-e-Sina Road. The hospital has a capacity of 592 beds and specializes in almost all forms of medical sciences. The site area for this project is 140 acres

which is mostly flat. The layout for this hospital is spread horizontally in a decentralized passion each department having its own separate building which means the vertical growth of PIMs is mostly limited to ground plus one floor (Pakistan Institute of Medical Sciences).

2.3.1.2 Analysis

Due to the decentralization of the departments the circulation become very straight forward without overlapping which allows for more streamline traffic. However, that also means that there are long distances that patients have to travel between Out-Patient and related departments such as radiology and pathology. One commendable thing about this design is that each department has been divided into three zones which are mostly color-coded through green, orange, and red based on the level of danger. Each zone has its own waiting area which divides the users more efficiently. However, it is very alarming to find that since the circulation was concentrated within this central portion of this design which meant that the windows were allocated mostly to the room sand the spaces within the depth of the floor plan received almost no natural light, making the spaces seems depressing and increases the sense of confusion for the average user. Talking about the circulation of the exterior there is a stark contrast between the circulation defined for different social hierarchies. Such as within the reception the public must take a much tighter and poorly build corridor to reach the Emergency and OPD department even if they brought by ambulance in emergency, while for special guests there is proper road access which led directly into the premises of the spaces.

2.3.1.3 Conclusion

While the analysis brings about a couple of short comings within the design PIMS is a standing testament to the constant change that a hospital goes through for which the feasibility for retro fitting and adaptability was catered to from the very beginning.

2.3.2 Allied Hospital, Faisalabad

2.3.2.1 Project Description

Allied Hospital was built in established in 1978. It was the leading government run hospital in the district of Faisalabad. Allied Hospital serves as the teaching hospital of Faisalabad Medical University, Faisalabad (Punjab Medical college) and its primary access is through Jail Road. The hospital has a capacity of 1450 beds and specializes in almost all forms of

medical sciences. The site area for this project is 140 acres which is mostly flat. The general layout of Allied Hospital is a composition of intersecting buildings connected through large corridors which creates a seamless flow for the user throughout the facility (Allied Hospital).

2.3.2.2 Analysis

While the circulation brings about seamless flow there is an emerging problem of lack of demarcation of circulation for different user such as doctor's patients and attendants because of which there has been intermixing which causes serious health and infection risks. According to Dr. Umair, a medical officer at the hospital, this can be accredited to the increasing number of patients which has exceeded the current capacity and resources of Allied Hospital. Consequently, there is an increase in long waiting lines for patients especially in front of admission counters and outside clinics which is not being catered to by the defined waiting areas and make management more difficult to handle. Similar to the previous case study, an absence of natural light is a prevailing problem in this hospital. However, one of the major benefits of this hospital is its increased surgical units and ward facilities because of which most medical hospitals in Faisalabad district refer to Allied Hospital for further exam and treatment.

2.3.2.3 Conclusion

While Allied Hospital serves as an important learning experience for anyone wishing to design a hospital in Faisalabad, it also defines the rationale for this thesis project as it shows an inadequacy of healthcare resources in the district.

2.3.3 Conclusion

After analysing the different architectural works in healthcare facilities outlined above and the different views and techniques presented by different entities in the literature reviews, the scope for this thesis has been further solidified and developed. The site analysis presents more concerns and factors that need to be taken into consideration in the design process. The inadequacy of Allied Hospital in Faisalabad further establishes the need for a hospital that not only provides basic treatment facilities but also acts as a specialized institution for diseases related to the industrial waste.

Chapter 3

3.1 Introduction

The research combines thorough evaluation of the site approaches with the design of a strong programmatic framework to address the growing need for specialised healthcare infrastructure to fight infectious diseases in this populated city. This study aims to aid policymakers, urban planners, and healthcare professionals in strategically identifying a suitable location for the needed healthcare services, units, and infrastructure by synthesising real data and innovative concepts. Finally, the thesis seeks to contribute to Faisalabad's healthcare system by setting up a dedicated institution that is in accordance with global standards for successfully managing infectious disease outbreaks.

3.2 Site Analysis

The chosen site is located on Jhang Road near Faisalabad Airport. It is a vast farmland spanning a total of 1,20,000 square feet. The site is accessible through Jhang Road. A black water channel passes through the site producing toxic industrial waste.

3.2.1 Proximity to Nearby Towns

The site was then analyzed to determine and understand its advantages and disadvantages and how the design would be directed by the features of the site.

Town	Distance from Site	Time from site
Jhang	64 km	1 hr. 20 min
Toba tek singh	77 km	1 hr. 10 min
Bhawana	60 km	1 hr.
Gojra	51 km	52 min
Painsra	17 km	25 min
Dijkot	27 km	43 min
Chinot	41 km	1 hr.
Samundari	45 KM	52 min
Jaranwala	48 KM	1 hr. 10 min

Table 3 Proximity Table

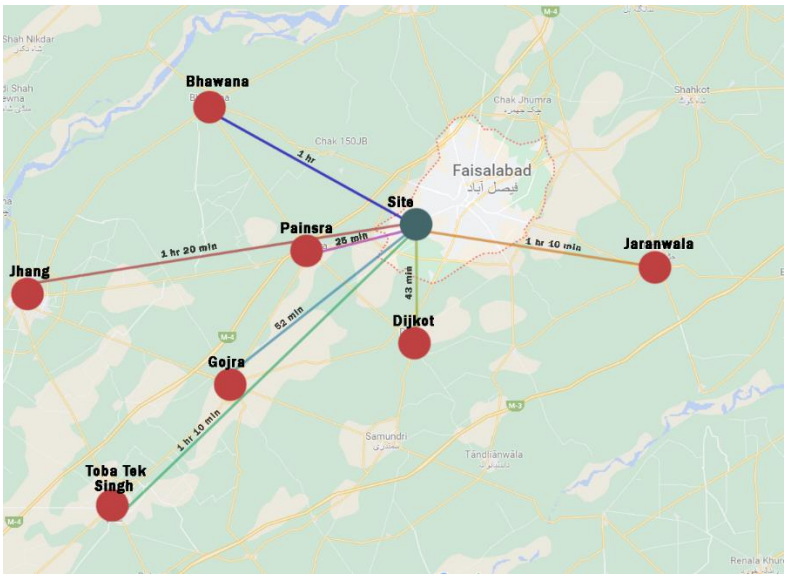


Figure 1 (Distance from Vicinity Source: Author)

3.2.2 Proximity to Nearby Hospitals

To understand the site better its proximity to other hospitals has also been mapped out.

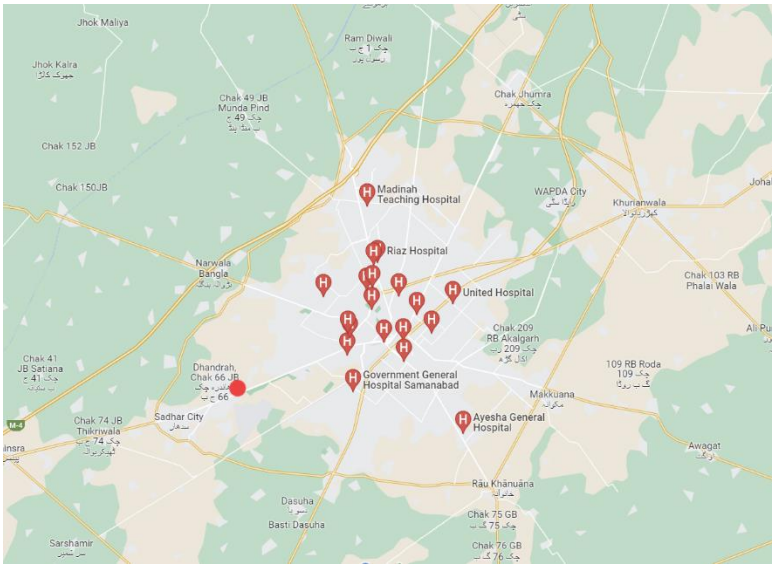


Figure 2 (Distance from nearby hospitals Source: Author)

3.2.2 Proximity to Industrial water and waste

Since the project deals with diseases related to industrial waste and aims to reduce it through methods like water purification, it was particularly important that the site intersects a channel

of industrial wastewater and may also serve as a dump for a nearby industry. (“Situational Analysis of Water Resources of Faisalabad City”)

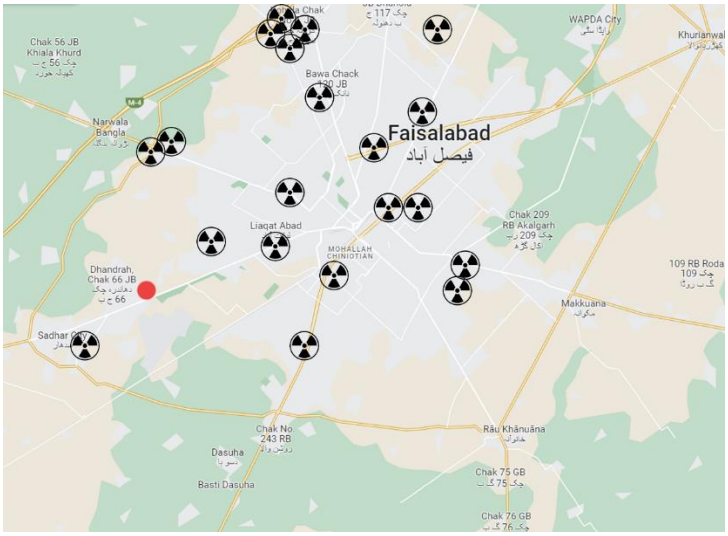


Figure 3 (Distance from nearby industries Source: Author)

3.2.3 Meso Analysis

There are a multitude of institutions in the vicinity of the site, the most important one of which is the Faisalabad Airport which serves as a landmark for the entire area. Educational institutes including the Agriculture University Paras Campus are also located near the site. Furthermore, there lies an extensive large population of residential units i.e., Saddar, thus highlighting the need for a hospital in the area.

3.2.4 Macro Analysis

The macro level shows the proximity of the site to key infrastructure of Faisalabad city such as Bypass Road, Samundari Road, Jhang Road and New Mandi Road, Government institutions such as NIAB, NIBGE and AARI Research Centre and more educational institutes such as GCU.

3.2.5 Climatic Analysis

The site, common to the rest of Faisalabad, enjoys wind from North to South direction. The sun path is parallel to the entrance to the south I.e. Jhang Road. These factors can prove to be crucial in deciding the building form and orientation for improved passive energy saving strategies (Meteoblue).

3.2.6 Conclusion

The site was analysed, and its features were sorted into a swot analysis which is as follows.

Strength

- Flat land.
- Located on main access route.
- Large expanse of land.

Weakness

- Heavy traffic on Jhang road.
- 2 lane road.

Opportunity

- Job opportunities for locals.
- Rich vegetation to be used as horticulture therapy.
- Airport/educational institute.

Threats/Limitations

- Security.
- Site area.

3.3 Programs

3.3.1 Introduction

The intricate web of healthcare services demands an exhaustive and precisely orchestrated architectural program for the proposed medical facility in Faisalabad. The design of a hospital goes beyond the conventional; it is a testament to the commitment to healing and preventive care for the community plagued by respiratory and waterborne diseases. The comprehensive program that underpins the architectural blueprint, encompasses the Outpatient Department (OPD), Inpatient Department (IPD), Surgery, Diagnostics, Intensive Care Unit (ICU), and other essential departments intrinsic to a healthcare institution. Each service zone is meticulously defined, detailing the requisite rooms, their functions, the necessary numerical

capacity, and the corresponding spatial allocations. The program not only outlines the physical infrastructure but also symbolizes a commitment to sustainable, patient-centric, and efficient healthcare delivery. The confluence of medical expertise, technological advancements, and empathetic design principles converge in the program, setting the stage for a transformative healthcare environment tailored to meet the unique needs of Faisalabad's population.

3.3.2 Programmatic Breakdown

a. Out-Patient department

S.No.	Name	Zone Service	Number	Area Required	Total Area	Recommmendations
1	General Medicine	waiting area	1	50	50	
		consultation/examination room	6	12	72	
		treatment room	2	20	40	
		minor ot	1	25	25	
2	General Surgery	waiting area	1	50	50	
		consultation/examination room	4	12	48	
		minor ot	1	25	25	
3	Pediatric Department	waiting area	1	50	50	
		consultation/examination room	6	12	72	
		treatment room	1	20	20	
		vaccination	2	12	24	
4	Orthpaedic Department	waiting area	1	50	50	
		consultation/examination room	4	12	48	
		treatment room	1	20	20	
		plaster room	1	25	25	
		psychiotherapy hall	2	60	120	
5	ENT	waiting area	1	50	50	
		consultation/examination room	4	12	48	
		speech therapy	1	12	12	
		audiotherapy	1	12	12	
6	Gynecology	waiting area	1	50	50	
		consultation/examination room	6	12	72	
		family welfare	1	20	20	
		cancer detection	1	25	25	
7	Ophthmalogy	waiting area	1	40	40	
		consultation/examination room	4	12	48	
		treatment room	1	20	20	
8	Liver	waiting area	1	40	40	
		consultation/examination room	3	12	36	
		treatment room	1	20	20	
9	Respiratory	waiting area	1	40	40	
		consultation/examination room	4	12	48	
		treatment room	1	20	20	
10	Dermatology	waiting area	1	50	50	
		consultation/examination room	4	12	48	
		treatment room	1	20	20	
		proccdure room	1	25	25	
11	Neurology	waiting area	1	30	30	
		consultation/examination room	2	12	24	
		treatment room	1	20	20	

Table 4 (Outpatient Department breakdown Source: Author)

b. Operation Theatre

S.No.	Name	Zone Service	Number	Area Required	Total Area	Recommmendations
1	Zone A	OT reception bay	1	50	50	
		relatives waiting area	1	80	80	
		official ot incharge	2	20	40	
		changing room doc	2	30	60	
		changing room nurse	2	30	60	
		changing room other staff	2	40	80	
		staff lounge	1	40	40	
		sterile storage	1	25	25	
		instrument and linen storage	1	30	30	
		troley bay	1	25	25	
		gas cylinder storage	1	25	25	
		switch room	1	15	15	
2	Zone B	minor OT	1	35	35	
		prep room with toilet	2	50	100	
		post operative room	2	100	200	
		nurse duty room	2	20	40	
		theatre preparation room	1	25	25	
		pantry	1	20	20	
3	Zone C	operation theatre	8	50	400	
		instrument sterilization	8	20	160	
		anaesthetic room	8	25	200	
		doctors work room	8	25	200	
		nusre work room	8	25	200	
4	Zone D	dirty utility	8	15	120	
		janitor closet	8	10	80	
		scrub up	8	15	120	

Table 5 (Operation Theatre breakdown Source: Author)

c. In-Patient Department Wards

S.No.	Name	Zone Service	Number	No. of beds	Total beds	Area Required	Total Area	Recommmendations
1	general medicine	general ward	3	15	45	150	450	
2	general surgery	surgery ward	2	10	20	100	200	
3	paediatric department	paediatric general ward	1	10	10	100	100	
4	IPD wards	triple room with toilet	15	3	45	40	600	
		double room with toilet	25	2	50	30	750	
		single room with toilet	20	1	20	20	400	
		isolation wards	10	1	10	25	250	

Table 6 (Inpatient Department breakdown Source: Author)

d. diagnostics

S.No.	Name	Zone Service	Number	Area Required	Total Area	Recommmendations
1	Diagnostics	reception	1	50	50	
		collection pt	2	15	30	
		waiting area	1	150	150	
		Xray rooms	2	25	50	
		TMT room	1	20	20	
		PFT room	1	20	20	
		MRI	1	40	40	
		Film development	1	9	9	
		processing area	1	9	9	
		film drying area	1	20	20	
		contrast studio and prep room	1	20	20	
		Xray record room	1	20	20	
		radiologists office	2	9	18	
		technicians room	1	9	9	
		nurse room	2	30	60	
		ultrasound (toilet)	1	30	30	
		contril room	4	12	48	
		consultant room	1	12	12	
		troley bay	1	9	9	
		switch room	3	9	27	
		stores	1	9	9	
		contrast therapy	1	9	9	
		superticial therapy	1	9	9	
		intermediatary therapy	1	50	50	
		physicist room	1	40	40	
		CT scan	1	30	30	
		ECHO	1	25	25	
2	Toilets	ladies	1	25	25	
		gents	1	4	4	
		accesible	1	4	4	
		janitors closet	1	4	4	
		changing room	2	25	50	

Table 7(Diagnostics Department breakdown Source: Author)

3.4 Conclusion

The site is on a main road that is accessed maximally by the public. A health care facility along a main artery of Faisalabad is meant for it to be accessible with ease. The site area offers an opportunity for future growth as it is a vast piece of land that is located on fertile land which can be used for therapeutic purposes as well. Since the site is on a main road, the locals from nearby rural areas can also access it, creating job opportunities as well.

The programmatic breakdown of the hospital is based on standards studied in the research process for an infectious disease institute. The area breakdown has been extracted from international and local standards for health institutes. The detailed program brief is discussed in the following chapter.

Chapter 4

4.1 Introduction

The detailed research conducted, and the site analysis create a complex set of design considerations that are associated with the hospital typology. Every user in the hospital be it the patient, their attendee, physicians, nurses, or any other staff follow unique circulation/pathway while catering to their functional needs throughout the day. These needs thus require a complex set of programs and spaces that then form the heart and body of the complex itself.

4.2 Site entrance

The Site entrance location will have an impact on circulation and connections within the hospital. Generally, the entrance of the hospital site is designed after considering number of criteria:

- Hospital layout plan.
- Relationship to site functions.
- Relationship to public transport facilities; relationship to available parking areas to minimize.
- Walking distances.
- Existing site landscape features; localized climate.
- Site circulation.
- Future development proposals, characteristics of adjacent sites.
- The main entrance would be in relation to several other services as part of an overall plan for the hospital's internal layout. Connections to the hospital street and specific services like outpatient clinics, emergency care, and rehabilitation should be scheduled with the primary goal of minimizing internal circulation distances.

The point of entry to the site should always be viewed as a portal to the hospital. The planning, detail, and maintenance of this area must exercise subtle but clear control over the site entrance and main entrance, providing a suitable approach route and allowing effective site circulation.

A clear visual objective and a landmark for orientation while approaching the building are provided by a direct view of the main entrance canopy from the point of arrival onto the site. Aligning the approach road with the entrance canopy before directing cars away to the visitors' car parking.

The main entrance design should consider these factors:

- ensure a moderate local climate.
- avoid strong winds.
- give shelter from the prevailing weather.
- provide sunlight areas to the associated external and internal spaces.

For the incoming visitor or patient, the entrance gate canopy and external entrance area serve as the initial focus and objective. The layout should provide weather protection while also allowing for the numerous activities associated with people arriving and departing.

4.2.1 Parking

The availability, location, and design of car parking should be considered early in the site planning process to avoid obstructing the foreground and approach to the hospital with unnatural looking parking areas. Visitors should not have to walk long distances from the parking lot to the main entrance. Parking for patients and visitors, staff, disabled users, and temporary parking for medical transport and service vehicles is all part of a comprehensive site strategy.

Some of the main factors are given below:

- Location of adequate parking as close as possible the main entrance, including designated areas or disabled users; easy wayfinding, clear signing.
- Retention of existing landscape features and extensive landscaping of parking areas; designated areas for bicycles and motorcycles.
- Separate parking for staff.
- Control of unauthorized parking.
- Security against vandalism and theft.
- Suitable night lighting.

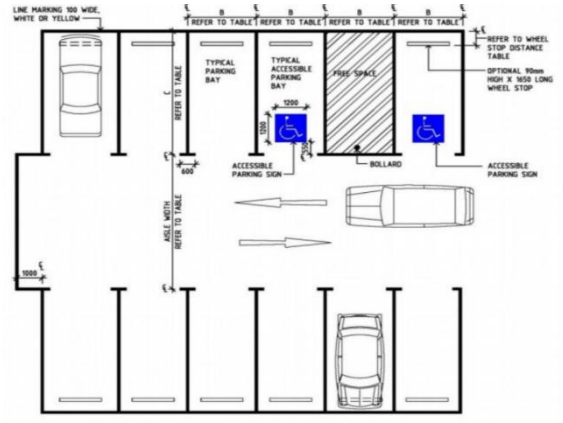


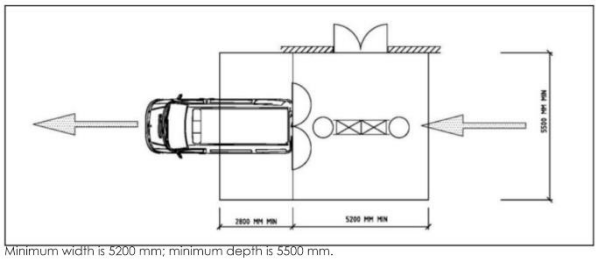
Figure 4 (Ambulance Bay diagram Source: ((IHFG))

4.2.1.1 Parallel Parking Bays: with Obstructions

Parallel spaces shall be located at least 300 mm clear of obstructions higher than 150 mm such as walls, fences, and columns. If the opposite side of the aisle is bounded by obstructions higher than 150 mm then the aisle width (W) should be increased by at least 300 mm.
If a single space is obstructed at both ends the dimensions of the space shall be increased by 300 mm.

4.2.1.2 Parking Aisles

- Aisles for 90° bays need to allow for two-way traffic. Aisles for 30°, 45° or 60° angled bays shall be.
- Parallel parking bay aisles may be either one way or two-way traffic.
- Aisles for angled parking bays will vary according to the width of the parking bays, wider bays require less aisle width.
- Where there are blind aisles, the aisle shall extend one meter beyond the last parking bay. If the last
- Parking bay is bounded by a wall or a fence, it should be widened by 300 mm.



Minimum width is 5200 mm; minimum depth is 5500 mm.

Figure 5 (Ambulance Bay diagram Source: ((IHFG))

4.2 Corridors

Hospital floors have traditionally been built as "corridors." As the length of the corridors grows longer, a hospital may become more "detached" and monotonous. Because of the old way of building hospitals, some of the older hospitals have very long halls.

Hospitals may be planned with clearly designated staff-only and patient corridors; the requirements for patient corridors will not apply to staff only accessed corridors.

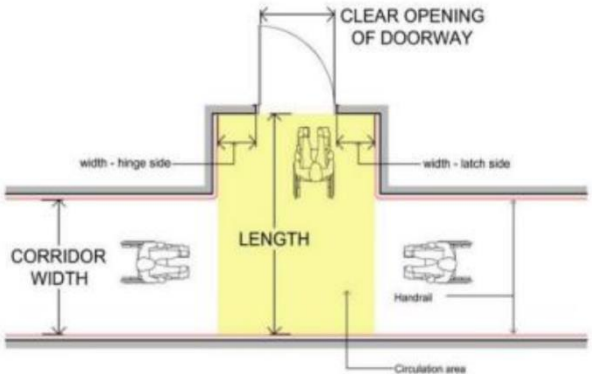


Figure 6(Corridor diagram Source: ((IHFG))

4.3 Emergency

The emergency department's responsibility is to accept, triage, stabilize and treat patients who need immediate medical attention. Patients that need resuscitation as well as those with emergent, critical, semi-urgent, and less urgent conditions are included. An emergency department must also be capable of dealing with mass casualties and disasters. In the emergency department, there are some patient groups that may have unique psychosocial and treatment needs.

There are some of them:

- Major trauma patients
- Elderly patients
- Children and adolescents
- Patients with physical and mental disabilities
- Victims of child abuse, domestic violence, or sexual assault:
- Patients with mental health issues

- Patients with infectious diseases or who are immunocompromised sustodial patients; and patients affected by chemical, biological or radiological contaminants.

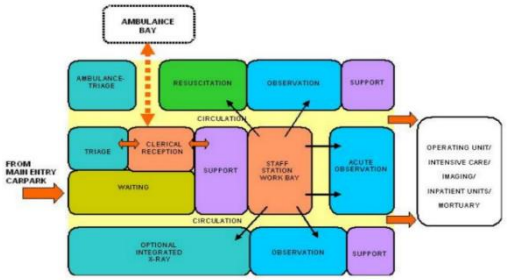


Figure 7 (Emergency diagram Source: ((IHFG))

4.3 Outpatient Department

Outpatient care, also known as ambulatory care, is delivered in hospital-based outpatient or stand-alone facilities, physician offices, ambulatory surgical centers, and a variety of other specialized settings where patients undergo treatment but do not stay overnight.

The Outpatient Unit may perform the following functions:

- Consultation with medical specialists, examination, and treatments on a same day basis
- Minor procedures.
- Follow up review consultation and ongoing case management.
- Patient screening prior to surgery-perioperative services.
- Health education or counselling sessions for patients and families.
- Referral of patients to other units or disciplines for ongoing care and treatment
- Referral for admission to a hospital for inpatient services.

To meet demand and operational policies, however, patient care standards and flexible work schedules can necessitate extending operating hours to evenings and weekends. During the planning process, consider the availability of assistance, cleaning, and repair facilities.

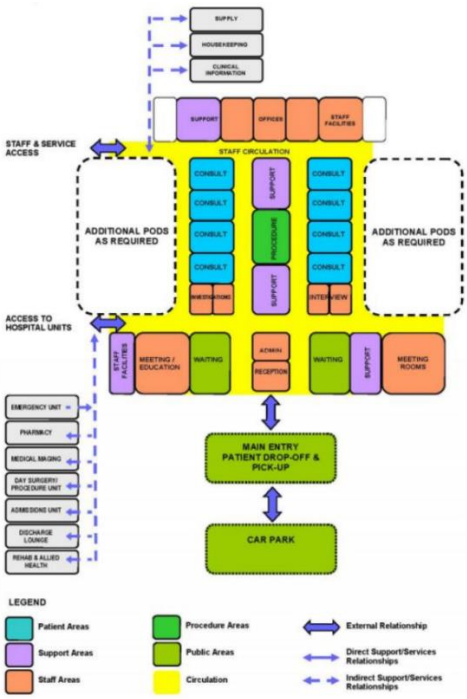


Figure 8 (Outpatient Department diagram Source: ((IHFG))

4.4 Operation Theatre & Intensive Care Unit

The Operating Room offers a safe and controlled atmosphere for patients undergoing diagnostic/surgical procedures under anesthesia, as well as peri-operative treatment and post-operative recovery.

Critically ill patients who need invasive life support, high levels of medical and nursing care, and complex treatment are admitted to Intensive Care. The intensive care unit brings together clinical experience, technical advancements, and therapeutic tools to provide care for critically ill patients.

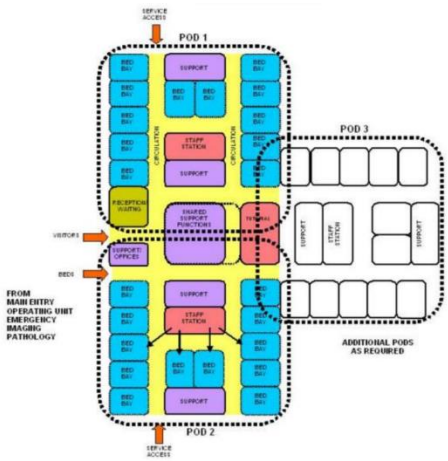


Figure 9 (Operation theatre diagram Source: ((IHFG))

4.4 Delivery Suite & NICU

The Birthing Unit is a private facility that offers secure prenatal, childbirth, and immediate postnatal treatment for mothers and their newborn babies. The number of birth rooms and the scale of the corresponding service areas will be determined by the Service Plan's planned obstetrical workload.

The Birthing Unit will form a component of the Maternity Unit or Obstetric Unit which consists of the following areas:

- Inpatient unit for mothers suffering from antenatal complications Inpatient unit for postnatal care, normal or complicated.
- General Care (Well Baby) Nursery for newborn babies requiring minimal care.
- Special Care Nursery for newborn babies requiring care for complications arising from
- medium risk factors.
- Neonatal Intensive Care Unit may be incorporated into Maternity Unit or with Critical Care
- Units according to the Operational Policy of the facility.

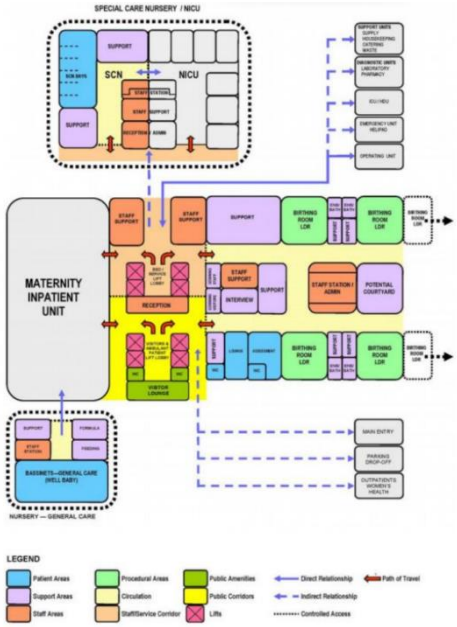


Figure 10 (Delivery Suite diagram Source: ((IHFG))

4.4.1 Infection Control

The placenta is known as contaminated/clinical waste and should be disposed of according to hospital waste disposal policies. The use of placental macerators for disposal is not

recommended and should be avoided. For cultural reasons, freezer storage should be provided inside the unit to allow family collection. It should also be possible to dispose of the placenta using cultural methods.

4.5 Inpatient Ward

The Inpatient Unit's primary role is to provide adequate accommodations for the delivery of health care services to inpatients, Including diagnosis, care, and treatment. In addition, the unit must have services and conditions to meet the needs of patients and visitors, as well as staff workplace standards.

The models of care that could be implemented include:

- patient allocation
- task assignment
- team nursing
- case management primary care

The Inpatient Unit should be built to reduce ambient noise levels inside the unit as well as sound propagation between patients, staff, and public areas. The location of noisy areas or operation away from quiet areas, such as patient bedrooms, should be considered, as should the selection of sound absorbing materials and finishes.
Acoustic treatment will be required to the following:

- patient bedrooms.
- interview and meeting rooms
- consult rooms.

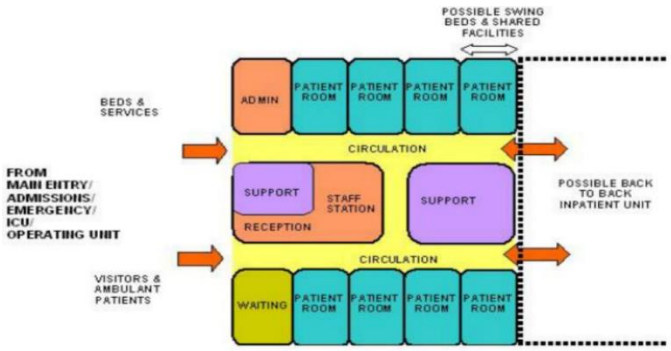


Figure 11 (inpatient wards diagram Source: ((IHFG))

4.6 Laboratory

A Hospital Laboratory is a place where clinical pathology experiments are performed on clinical specimens to collect information about a patient's health to assist in disease detection, care, and prevention.

- One centralized laboratory which should have different sections.
- Collection counters at different places, both in wards & outpatient area.
- Have separate section for emergency investigation to prevent delay in reporting.

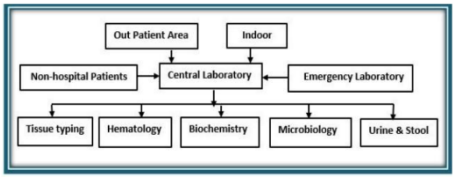


Figure 12 (Laboratory diagram Source: ((IHFG))

4.7 Pharmacy

Pharmacy services, including dispensing, non-sterile and sterile commodity preparation as required, clinical trial conducted, adverse drug reaction reporting, and drug information and education.

4.8 Waste Management

A Waste Management Unit is required in every hospital to store waste and used linen. The following features must be included in the Waste Management Unit:

- Located close to all functional areas.
- Accessible from within the unit and externally fitted with a deadlock.
- Located away from food and clean storage areas.
- Not accessible to the public.

The unit should be designed to keep materials safe, minimize organic decomposition, contain odors, and allow for sanitary cleaning of storage areas and carts. The construction of a mechanized bin washing facility could be advantageous to larger institutions. Waste that is liquid disinfection procedures can need to be stabilized before being disposed of. systems of sewage disposal (Frankel).

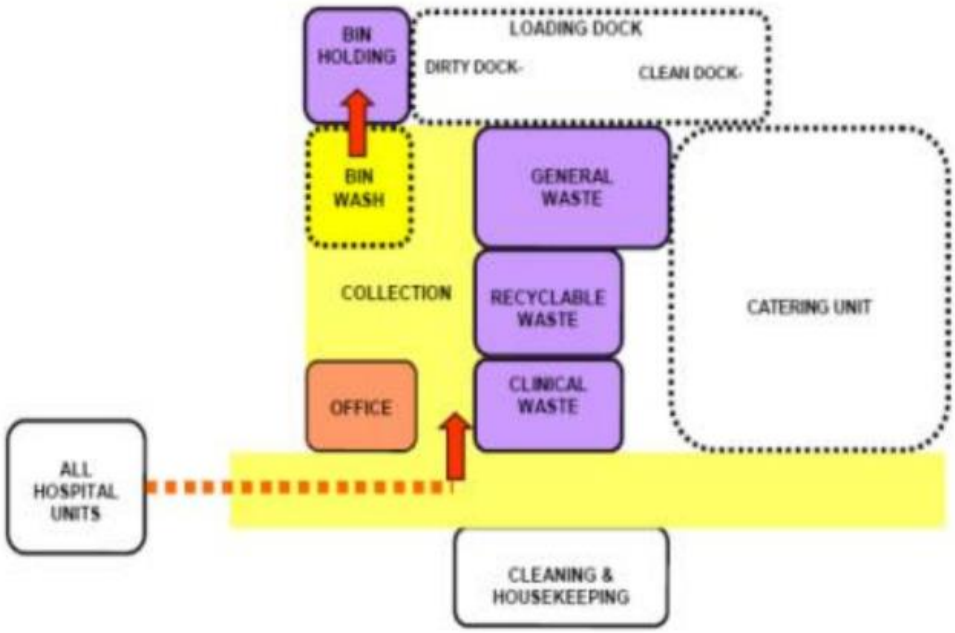


Figure 13 (Waste Management diagram Source: ((IHFG))

4.9 Conclusion

The meticulously crafted program for the proposed medical facility in Faisalabad reflects a holistic approach to healthcare. Strategic considerations for the site entrance, parking infrastructure, emergency department, and various hospital sections showcase a commitment to efficiency and patient well-being.

From outpatient care to critical units like the emergency department, birthing unit, rehabilitation center, and support services, each component aligns with operational needs. The program not only delineates physical spaces but symbolizes a dedication to a healing environment beyond conventional boundaries.

In conclusion, the synthesis of medical expertise, technology, and empathetic design principles sets the stage for a transformative healthcare facility. Every detail contributes to providing high-quality, accessible, and sustainable healthcare for the residents of Faisalabad.

CHAPTER 5-DESIGN PROCESS

5.1 Introduction

The design process serves as the foundation for the creation of an architectural solution specific to Faisalabad's healthcare needs. This chapter is built on a careful technique that combines research, analysis, and creative synthesis to describe the evolution of an architectural concept designed specifically for a medical facility.

The methodology described herein promotes public health improvement through principles of high quality, innovation, and social responsibility. During these conversations, a thorough examination of strategic master planning, conceptual frameworks, zoning policies, and architectural development procedures is conducted, establishing the foundation of the architectural endeavour.

The advocacy for biophilic design principles is central to the ideology, which harnesses the intrinsic human need to connect with nature to support healing, well-being, and resilience in the built environment. The goal is to create a design that promotes holistic wellness by strategically using biophilic elements, materials, and landscaping practices.

Furthermore, the zoning strategy used is based on extensive research into functional needs, operational efficiency principles, and patient-centered care concepts. The goal is to create spatial hierarchies that promote smooth flow, so improving healthcare delivery while prioritizing patient comfort, privacy, and safety.

The last section of the chapter discusses the modelling process, which involves architecture engaging with its environment on both expressive and cognitive levels. Drawing inspiration from Faisalabad's urban fabric and its specific problems, the proposed design is a dynamic fusion of beauty, utility, and sustainability.

As the intricate parts of the design are studied, readers are led on a journey, discovering the beauty and power of visual design. A call to cooperation is issued, pushing joint research efforts to reinvent healthcare through architecture, thereby stimulating the success of Faisalabad's residents.

5.2 Design Strategies

Designing a hospital is a complex, multifaceted process that requires a deep understanding of medical needs, patient care, staff workflow, and environmental impact. The following strategies are critical in creating a facility that is functional, sustainable, and conducive to healing:

5.2.1 Patient-Centered Design

Patient-Centered Design is a fundamental principle in the creation of healthcare environments, emphasizing the paramount importance of tailoring spaces to meet the needs and preferences of patients. At its core, this approach seeks to cultivate a healing environment that not only addresses medical needs but also promotes holistic well-being, comfort, and dignity throughout the patient's journey.

Central to Patient-Centered Design is the prioritization of patient comfort, recognizing that a serene and welcoming atmosphere can positively impact the healing process. This entails meticulous attention to detail in every aspect of the built environment, from the layout and arrangement of spaces to the selection of materials and finishes. By creating spaces that evoke feelings of warmth, tranquillity, and familiarity, patients are afforded a sense of ease and reassurance during their stay.

Privacy emerges as a cornerstone of Patient-Centered Design, acknowledging the sensitive and personal nature of healthcare interactions. Design interventions aimed at preserving patient privacy encompass the provision of private rooms, consultation areas, and discreet circulation routes. This not only safeguards patient confidentiality but also fosters an environment where individuals feel respected, valued, and empowered to engage in open and honest dialogue with healthcare providers.

Safety is another paramount consideration in Patient-Centered Design, encompassing both physical and psychological aspects of well-being. From the implementation of infection control measures to the mitigation of environmental hazards, the design of healthcare facilities must prioritize the prevention of harm and the promotion of patient security. Thoughtful consideration of ergonomics, wayfinding, and accessibility further enhances safety by minimizing the risk of accidents and promoting ease of movement for patients of all abilities.

In striving to create healing environments, Patient-Centered Design recognizes the therapeutic potential of natural elements and biophilic interventions. Integrating abundant natural light, soothing colors, and tactile materials fosters a connection to the outdoors, instilling a sense of vitality and rejuvenation within the built environment. Additionally, the incorporation of nature-inspired motifs, indoor greenery, and access to outdoor spaces imbues healthcare settings with a sense of tranquillity and serenity, offering patients moments of respite and renewal amidst the rigors of medical treatment.

Ultimately, Patient-Centered Design embodies a comprehensive approach to healthcare architecture, wherein the physical environment becomes a catalyst for healing, comfort, and hope. By prioritizing patient needs and preferences, designers can create spaces that not only facilitate medical treatment but also nurture the human spirit, fostering resilience, empowerment, and well-being for all who enter.

5.2.2 Flexibility and Scalability

Flexibility and Scalability are pivotal principles in the design of hospitals, recognizing the dynamic nature of healthcare and the need for facilities to adapt and evolve over time. Hospitals, as complex ecosystems, must be equipped to accommodate shifting demographics, emerging medical technologies, and evolving best practices without the need for extensive and costly renovations.

At the heart of Flexibility and Scalability lies the concept of futureproofing, wherein design decisions are made with an eye toward the long-term viability and adaptability of the facility. Modular design elements serve as building blocks that can be reconfigured, expanded, or repurposed to meet changing needs and accommodate growth. By adopting a modular approach, hospitals can readily adapt to fluctuations in patient volume, service demands, and technological advancements without the disruption and expense associated with traditional construction methods.

Adaptable spaces represent another key component of Flexibility and Scalability, offering multifunctional environments that can be easily reconfigured to accommodate diverse clinical activities and care models. Flexible room layouts, movable partitions, and adjustable furniture enable spaces to be tailored to specific patient populations, treatment modalities, or interdisciplinary collaborations. This versatility empowers healthcare providers to optimize

workflow efficiencies, enhance patient experiences, and respond swiftly to emerging healthcare trends and challenges.

Furthermore, infrastructure plays a crucial role in supporting the future growth and evolution of hospitals. Robust and scalable building systems, such as mechanical, electrical, and plumbing (MEP) systems, are designed with excess capacity and redundancy to accommodate the integration of new equipment, technologies, and services. Additionally, advanced IT infrastructure and connectivity enable seamless communication and data exchange, facilitating the implementation of digital health solutions and telemedicine initiatives.

By embracing Flexibility and Scalability, hospitals can navigate the complexities of healthcare delivery with agility and resilience. Rather than being constrained by rigid design parameters, they are empowered to adapt and innovate in response to evolving patient needs, regulatory requirements, and industry trends. In doing so, hospitals become dynamic and forward-thinking institutions that are well-positioned to thrive in an ever-changing healthcare landscape, providing exceptional care and service to their communities for generations to come.

5.2.3 Efficiency in Workflow:

Efficiency in Workflow is a critical aspect of hospital design, aiming to streamline operations and optimize the delivery of care by maximizing the effectiveness of staff, resources, and infrastructure. At its core, Efficiency in Workflow revolves around creating an environment that promotes seamless coordination, communication, and movement throughout the healthcare facility.

Central to this principle is the strategic placement of departments and functional areas within the hospital layout. By carefully orchestrating the spatial arrangement of clinical, administrative, and support services, designers can minimize the distance travelled by patients, staff, and supplies, thereby reducing inefficiencies and delays in care delivery. For instance, locating diagnostic imaging departments near emergency departments or operating rooms can accelerate the diagnostic process for critically ill patients, leading to more timely interventions and improved outcomes.

Furthermore, Efficiency in Workflow entails the design of intuitive pathways and circulation routes that guide patients, visitors, and staff through the facility with ease and clarity. Clear signage, wayfinding cues, and visual landmarks help orient individuals within the space and

facilitate navigation between different areas and departments. Additionally, the use of color-coded floor plans or digital wayfinding systems can further enhance wayfinding efficiency, particularly in large and complex healthcare environments.

In addition to optimizing physical layouts, Efficiency in Workflow encompasses the implementation of innovative technologies and systems that support streamlined processes and enhance productivity. Automated scheduling and patient tracking systems, for example, can minimize wait times and improve appointment scheduling, while digital communication tools facilitate real-time collaboration and information sharing among healthcare teams. Similarly, the integration of point-of-care technologies, such as mobile devices and electronic health records, enables clinicians to access patient information and documentation at the bedside, reducing the need for redundant data entry and enhancing clinical decision-making.

By prioritizing Efficiency in Workflow, hospitals can achieve significant improvements in patient outcomes, staff satisfaction, and operational efficiency. A well-designed healthcare environment that optimizes workflow processes not only enhances the overall patient experience but also enables healthcare providers to deliver high-quality care in a timely and cost-effective manner. Ultimately, Efficiency in Workflow is essential for ensuring that hospitals remain responsive, adaptable, and resilient in the face of evolving healthcare challenges and demands.

5.2.4 Sustainability:

Sustainability is a fundamental consideration in contemporary hospital design, reflecting a commitment to environmental management, resource conservation, and durability. By integrating sustainable design principles into the built environment, hospitals can minimize their environmental footprint, reduce operational costs, and create healthier, more resilient spaces for patients and staff alike.

At its core, Sustainability in hospital design encompasses a comprehensive approach that considers environmental, social, and economic factors. This involves selecting building materials and construction methods that minimize embodied energy and carbon emissions while maximizing durability, recyclability, and local sourcing. Additionally, sustainable design strategies aim to optimize energy efficiency through the incorporation of passive design strategies, high-performance building envelopes, and energy-efficient HVAC systems. By

reducing energy consumption and greenhouse gas emissions, hospitals can mitigate their environmental impact and contribute to global efforts to combat climate change.

Furthermore, Sustainability extends to water conservation efforts, including the implementation of water-saving fixtures, rainwater harvesting systems, and greywater recycling technologies. By minimizing water consumption and reducing strain on local water resources, hospitals can enhance their resilience to droughts and water scarcity while lowering utility costs and promoting environmental sustainability.

Green roofs and vegetated landscapes represent another key element of Sustainability in hospital design, offering a range of environmental, social, and health benefits. Green roofs help mitigate urban heat island effects, improve air quality, and reduce stormwater runoff, while also providing therapeutic outdoor spaces for patients, staff, and visitors. Additionally, green spaces enhance biodiversity, support wildlife habitat, and contribute to a sense of well-being and connection to nature within the built environment.

In addition to environmental benefits, hospitals designed with Sustainability in mind can also yield significant economic advantages. By reducing energy and water consumption, minimizing waste generation, and optimizing operational efficiencies, sustainable hospitals can lower operating costs and improve long-term financial viability. Furthermore, sustainable design features can enhance the marketability and reputation of healthcare facilities, attracting patients, staff, and investors who value environmental responsibility and social impact.

5.2.5 Infection Control:

Infection control is a paramount consideration in the design of healthcare facilities, particularly in areas dedicated to treating infectious diseases such as acute respiratory infections (ARIs). By implementing rigorous infection control measures, hospitals can minimize the risk of healthcare-associated infections (HAIs), protect patients, and staff, and maintain a safe and hygienic environment for care delivery.

Central to infection control design is the selection of materials and surfaces that are durable, non-porous, and easy to clean and disinfect. Smooth and impermeable surfaces, such as stainless steel, glass, and high-quality plastics, are preferred as they inhibit microbial growth and allow for thorough cleaning and decontamination. Additionally, antimicrobial coatings and

surface treatments may be applied to high-touch surfaces to further reduce the transmission of pathogens.

Well-planned air circulation systems play a crucial role in preventing the spread of airborne infections within healthcare facilities. HVAC (heating, ventilation, and air conditioning) systems are designed to provide adequate ventilation, filtration, and air exchange rates to remove contaminants from indoor air and maintain optimal air quality. In areas specializing in infectious diseases, such as isolation wards or airborne infection isolation rooms (AIIRs), specialized ventilation systems with negative pressure and high-efficiency particulate air (HEPA) filtration are employed to prevent the spread of airborne pathogens to other parts of the facility.

Spatial layouts are carefully designed to minimize cross-contamination between different departments and patient populations. This involves segregating high-risk areas, such as intensive care units (ICUs) or emergency departments, from low-risk areas to prevent the transmission of infections. Additionally, clear signage, color-coding, and physical barriers may be used to delineate zones and guide the flow of patients, staff, and visitors through the facility in a manner that minimizes the risk of cross-contamination.

In areas dedicated to treating ARIs and other infectious diseases, additional infection control measures may be implemented, such as hand hygiene stations, personal protective equipment (PPE) donning and doffing areas, and dedicated equipment and supplies for patient care. Staff training and adherence to infection control protocols are also critical in preventing the spread of infections within healthcare settings.

Ultimately, designing for infection control requires a multidisciplinary approach that considers architectural, engineering, and operational factors to create a safe and hygienic environment for patient care. By integrating infection control principles into the design of healthcare facilities, hospitals can mitigate the risk of HAIs and enhance patient safety and well-being.

5.2.6 Technology Integration:

Technology integration is a pivotal aspect of modern hospital design, ensuring that healthcare facilities are equipped to harness the power of advanced medical technologies to enhance patient care, improve clinical outcomes, and optimize operational efficiencies. By planning for the seamless integration of both current and future medical technologies, hospitals can position

themselves at the forefront of innovation and provide patients with access to state-of-the-art healthcare services.

At the heart of technology integration is the physical infrastructure necessary to support heavy and complex medical machinery. This includes considerations for the layout and configuration of clinical spaces to accommodate diagnostic imaging equipment, surgical suites, and specialized treatment modalities. Flexible room designs, reinforced floors, and ample space for equipment installation and maintenance are essential components of the physical infrastructure, ensuring that hospitals can adapt to evolving technology requirements without the need for costly retrofitting or expansion.

In addition to physical infrastructure, hospitals must also invest in robust digital infrastructure to support the implementation of digital health tools and technologies. This includes the development of secure and interoperable electronic health record (EHR) systems that enable seamless sharing of patient information across different departments and healthcare settings. By centralizing patient data and facilitating real-time access to clinical information, EHR systems enhance care coordination, reduce medical errors, and improve patient safety.

Furthermore, technology integration encompasses the deployment of telemedicine platforms and remote monitoring systems to extend the reach of healthcare services beyond the confines of the hospital walls. Telemedicine enables patients to access virtual consultations with healthcare providers, receive remote monitoring and management of chronic conditions, and access educational resources and support services from the comfort of their own homes. By leveraging telemedicine technologies, hospitals can enhance patient access to care, improve healthcare outcomes, and reduce unnecessary hospital visits and readmissions.

Moreover, technology integration extends to the adoption of innovative medical devices and wearable technologies that empower patients to actively participate in their own care. From wearable fitness trackers and smart watches to implantable medical devices and remote monitoring sensors, these technologies enable continuous monitoring of vital signs, medication adherence, and lifestyle behaviours, empowering patients to make informed decisions about their health and well-being.

5.2.7 Accessibility:

Accessibility is a fundamental principle in hospital design, ensuring that healthcare facilities are welcoming, inclusive, and accommodating for individuals of all abilities. By prioritizing accessibility, hospitals can create environments that are easy to navigate, safe, and dignified for patients with disabilities, the elderly, and those with mobility challenges.

Central to accessibility in hospital design is compliance with established accessibility standards and regulations, such as the Americans with Disabilities Act (ADA) in the United States or similar regulations in other countries. These standards dictate requirements for the design of physical spaces, amenities, and facilities to ensure equal access and participation for individuals with disabilities.

One of the key considerations in designing accessible hospitals is the layout and configuration of spaces to accommodate individuals with mobility impairments. Wide corridors, spacious waiting areas, and clear pathways ensure ease of movement for patients using mobility aids such as wheelchairs, walkers, or mobility scooters. Additionally, ramps and elevators are strategically placed throughout the facility to provide barrier-free access to different levels and departments.

Accessible bathrooms are another essential component of hospital design, featuring features such as grab bars, lowered sinks, and accessible toilets to accommodate individuals with mobility challenges or assistive devices. These bathrooms are designed to be spacious and easy to maneuver, ensuring privacy, safety, and independence for all patients.

Furthermore, accessibility extends beyond physical infrastructure to encompass the design of signage, wayfinding systems, and communication materials. Clear signage with large fonts, high contrast colours, and tactile elements help individuals with visual impairments navigate the hospital environment independently. Additionally, the use of universal symbols and multilingual signage ensures that information is accessible to patients from diverse cultural and linguistic backgrounds.

In addition to physical accessibility, hospitals must also consider the needs of patients with sensory impairments, cognitive disabilities, or other disabilities that may impact their ability to navigate or understand the healthcare environment. This may involve providing alternative communication methods, such as sign language interpreters or written materials in accessible formats, to ensure effective communication and information access for all patients.

Overall, accessibility in hospital design is a multifaceted endeavour that requires careful consideration of the diverse needs and abilities of patients. By prioritizing accessibility in the design process, hospitals can create environments that are inclusive, equitable, and empowering for individuals of all backgrounds and abilities, ultimately promoting better health outcomes and enhancing the overall patient experience.

5.2.8 Community Integration:

Community integration is a crucial aspect of hospital design, emphasizing the interconnectedness between healthcare facilities and the broader social, economic, and environmental context in which they exist. By fostering meaningful connections with the surrounding community, hospitals can serve as catalysts for positive change, promoting health and well-being beyond their walls and contributing to the overall vitality and resilience of the community.

At the heart of community integration is the creation of spaces that are open and accessible to the public, providing engagement, interaction, and collaboration among community members. This may involve the development of public parks, green spaces, or recreational areas within the hospital campus, providing opportunities for relaxation, exercise, and socialization for patients, visitors, and residents alike. Additionally, hospitals may host community events, health fairs, or educational workshops to promote health awareness and preventive care within the community.

Furthermore, community integration extends to considerations of the hospital's impact on local infrastructure and transportation networks. Hospitals are often major drivers of traffic and activity within their surrounding neighbourhoods, necessitating careful planning and coordination to minimize congestion, mitigate environmental impacts, and ensure equitable access to healthcare services for all members of the community. This may involve implementing traffic management strategies, such as designated drop-off zones, public transit incentives, or alternative transportation options, to reduce reliance on private vehicles and alleviate pressure on local roadways.

In addition to physical infrastructure, community integration encompasses efforts to address social determinants of health and promote equity and involvement within the community. This may involve partnering with local organizations, government agencies, and community

stakeholders to address social disparities, improve access to healthcare services, and enhance health outcomes for underserved populations. Hospitals may also collaborate with educational institutions, vocational training programs, and workforce development initiatives to create pathways to employment and economic opportunity for community members.

5.2.9 Healing Environments:

Healing environments represent a paradigm shift in hospital design, acknowledging the profound impact of physical surroundings on mental and emotional well-being and recognizing the integral role of holistic healing in healthcare delivery. Beyond the technical and functional aspects of hospital design, healing environments prioritize the integration of elements that facilitate comfort, peace, and connection, creating spaces that support the physical, emotional, and spiritual needs of patients, families, and healthcare providers alike.

At the core of healing environments is the incorporation of art and aesthetics as therapeutic styles. Art has the power to evoke emotions, stimulate the senses, and provide moments of respite and reflection amidst the clinical setting. Hospitals may feature curated art collections, rotating exhibitions, or interactive installations that engage and uplift patients and visitors, promoting a sense of beauty, inspiration, and hope. Additionally, music therapy programs, live performances, and healing soundscapes may be integrated into hospital environments to provide comfort, reduce anxiety, and enhance the healing experience for patients and caregivers.

Therapeutic gardens represent another key component of healing environments, offering sanctuary amidst the hustle and bustle of the hospital environment. These outdoor spaces are designed to provide opportunities for relaxation, contemplation, and connection with nature, promoting physical activity, stress reduction, and emotional well-being. Features such as lush vegetation, flowing water features, and sensory gardens engage the senses and create a tranquil oasis for patients, families, and staff to recharge and rejuvenate.

In addition to art and nature, healing environments may incorporate amenities and design elements that provide comfort, distraction, and a sense of normalcy for patients undergoing medical treatment. This may include cozy seating areas with soft furnishings, natural light-filled spaces that blur the boundaries between indoors and outdoors, and private rooms equipped with personal amenities and technology to enhance the patient experience. By prioritizing patient-centered design principles, hospitals can create environments that empower patients to take an active role in their healing journey, encouraging a sense of autonomy, dignity, and control.

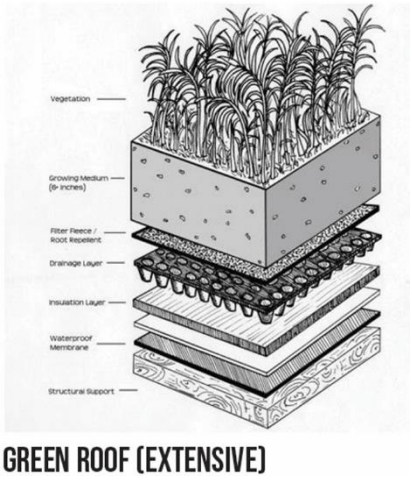


Figure 14 (Green roof details)

5.2.10 Security and Safety:

Security and safety are paramount considerations in hospital design, ensuring the protection of patients, staff, and hospital assets against potential threats and hazards. By implementing comprehensive security measures and design features, hospitals can create environments that promote a sense of safety, deter security breaches, and facilitate effective emergency response.

Central to security and safety in hospital design is the establishment of secure entry points and access control measures. Controlled access points, such as entrance lobbies or reception areas, are equipped with security personnel, access control systems, or electronic key card readers to monitor and regulate entry into the facility. Additionally, perimeter fencing, gates, or barriers may be installed to prevent unauthorized access and deter trespassers.

Surveillance systems play a crucial role in enhancing security and monitoring activities within the hospital environment. Closed-circuit television (CCTV) cameras are strategically positioned throughout the facility to monitor high-traffic areas, critical infrastructure, and sensitive locations, providing real-time surveillance, and recording of events. Advanced video analytics and monitoring software may also be employed to detect suspicious behaviour, unauthorized access, or security breaches, enabling security personnel to respond swiftly and effectively to potential threats.

Emergency response planning is another key component of security and safety in hospital design. Hospitals develop comprehensive emergency response plans and protocols to address a wide range of potential threats, including natural disasters, medical emergencies, and security incidents. These plans outline procedures for evacuations, lockdowns, and sheltering in place, as well as coordination with local law enforcement, emergency services, and community partners. Additionally, hospitals conduct regular training drills and exercises to test the effectiveness of their emergency response plans and ensure staff readiness in the event of a crisis.

In addition to physical security measures, hospitals may also employ technology-enabled solutions to enhance security and safety. Panic buttons, duress alarms, and mobile communication devices provide staff with quick and discreet means of summoning assistance in emergency situations. Mass notification systems and emergency communication platforms enable rapid dissemination of critical information to staff, patients, and visitors during emergencies, ensuring timely and coordinated response efforts.

Incorporating these strategies requires a collaborative effort among architects, healthcare professionals, patients, and the community to ensure the hospital meets current needs while being adaptable for future challenges.

5.3 Zoning

In the design process of the hospital, zoning plays a pivotal role in organizing and optimizing the layout of various departments and services to facilitate efficient workflow, enhance patient care, and ensure operational effectiveness. Zoning requires the strategic allocation of spaces and functions within the hospital to create logical and intuitive spatial relationships that support the delivery of healthcare services while promoting safety, accessibility, and convenience for patients, staff, and visitors.

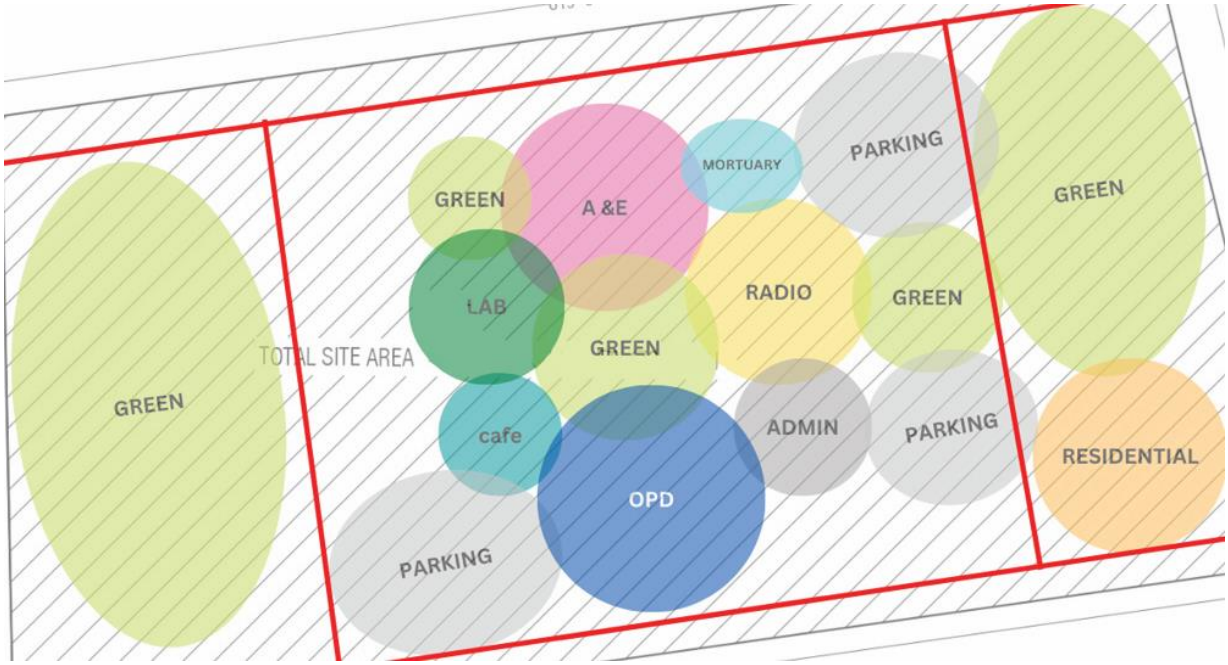


Figure 15 (Zoning)

At the forefront of the hospital's zoning plan is the emergency department, strategically located at the entrance for quick and easy access. This placement ensures that patients requiring urgent medical attention can receive timely care upon arrival, minimizing wait times and facilitating rapid triage and assessment by medical personnel. The emergency department is designed with dedicated treatment areas, trauma bays, and support spaces to accommodate a wide range of medical emergencies and ensure efficient patient flow and throughput.

Adjacent to the emergency department, a central hub comprising laboratories and diagnostic imaging facilities is situated to provide seamless access to essential diagnostic services. This proximity allows for prompt diagnostic testing and imaging studies to support clinical decision-making and treatment planning for patients presenting to the emergency department or outpatient clinics.

Near the Out-Patient Department (OPD), a pharmacy is strategically located to provide convenient access to prescription medications and pharmaceutical services for patients following their clinic appointments. This adjacency facilitates the timely dispensing of medications and promotes medication adherence and continuity of care for patients transitioning from consultation to treatment.

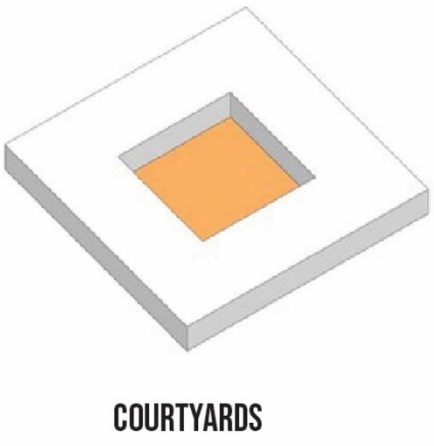


Figure 16 (Building form)

Courtyards are integrated between departments to provide therapeutic outdoor spaces for patients, staff, and visitors, fostering a connection to nature and promoting healing and well-being. These courtyards serve as peaceful retreats where individuals can relax, recharge, and find respite from the clinical environment, enhancing the overall patient experience and contributing to a healing environment.

Vertically, the hospital's zoning plan extends across multiple floors, with specialized departments and services strategically organized to optimize patient care delivery and operational efficiency. Gynaecology, Paediatrics, Operating Theatres (OTs), and Intensive Care Units (ICUs) are situated on the first floor, providing immediate access to critical care services and surgical interventions. This arrangement ensures proximity between related services and facilitates efficient patient transfer and coordination of care.

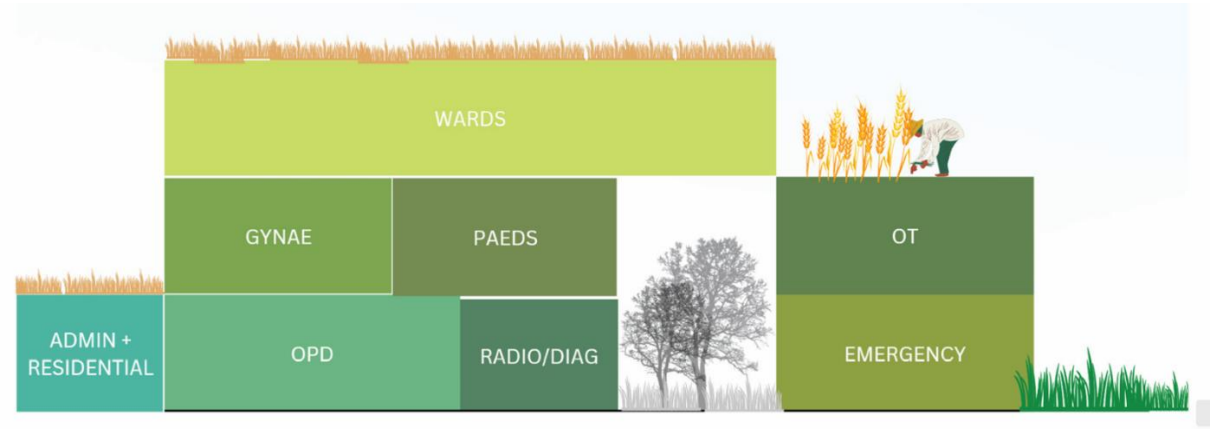


Figure 17 (Vertical zoning)

On the second floor, inpatient wards are located to provide dedicated spaces for the ongoing management and rehabilitation of patients requiring hospitalization. These wards are designed to optimize patient comfort, privacy, and safety while supporting multidisciplinary care teams in delivering high-quality patient-centered care.

At the rear of the hospital, residential units are situated to provide on-site accommodations for medical staff, ensuring round-the-clock availability and access to care while minimizing commute times and enhancing staff retention and satisfaction.

Overall, the zoning plan of the hospital is carefully designed to optimize spatial organization, workflow efficiency, and patient-centered care delivery while promoting safety, accessibility, and comfort for all stakeholders. By thoughtfully organizing departments and services within the hospital, the zoning plan contributes to the creation of a functional, efficient, and patient-friendly healthcare environment that meets the diverse needs of the community it serves.

5.4 Conclusion

In conclusion, this chapter encapsulates a comprehensive exploration of the design process for the hospital, discussing precise design strategies and zoning considerations aimed at optimizing the layout and functionality of the healthcare facility. Through a methodical examination of key design principles and spatial organization, the chapter elucidates the critical role of deliberate planning and integration in crafting a hospital environment that prioritizes patient care, safety, and well-being.

These design strategies underscore a comprehensive approach to healthcare architecture, incorporating elements such as patient-centered design, sustainability, technology integration, and community engagement. By adeptly integrating these strategies into the design process, hospitals can fashion environments that not only address the immediate needs of patients and staff but also uphold enduring resilience, innovation, and excellence in healthcare delivery.

Central to the design process is the concept of zoning, which entails the strategic allocation of spaces and functions within the hospital to optimize workflow efficiency, enhance patient care, and ensure operational effectiveness. From the strategic placement of emergency departments and diagnostic facilities to facilitate swift access to critical services, to the vertical organization of specialized departments and services to facilitate coordinated care delivery, zoning emerges

as a pivotal tool in shaping the spatial organization and functionality of the hospital environment.

Throughout the design process, attention has been directed towards discerning the diverse needs and preferences of patients, staff, and the surrounding community, underscored by a concerted effort to create healing environments that promote comfort, safety, and dignity for all stakeholders. By embracing innovative design solutions, integrating advanced technologies, and cultivating meaningful connections with the community, hospitals can emerge as paragons of excellence and compassion within the healthcare milieu, furnishing exemplary care and support to those under them.

As we transition into the implementation phase of the hospital project, the insights gleaned from this chapter will serve as an indispensable guiding framework for translating design concepts into tangible, real-world solutions that elevate the quality of care and enhance the overall patient experience. Through collaborative endeavour, artistic ingenuity, and an unwavering commitment to excellence, we stand poised to fashion a hospital environment that not only fulfils the requirements of the present but also envisages and navigates the challenges and opportunities that lie ahead with sagacity and efficacy.

Chapter 6: Final Design

In this last chapter of thesis, the planning and innovative design approaches is presented in the final design of the respiratory disease's hospital. This chapter encapsulates the architectural vision, functional organization, and materiality that define the essence of this vital healthcare facility.

6.1. Introduction

In this chapter, the conclusion of research, planning, and innovation converges to unveil the final design of the hospital. As stated, this project's foundation is the desire to solve Faisalabad's acute healthcare requirements through a purpose-driven architectural solution. Guided by the ethos of medical excellence and social accountability, the final design incorporates a blend of creative concepts and pragmatic concerns, positioned to change the region's healthcare delivery environment. The complexities of the final design are detailed in the following sections, revealing a piece of artwork, function, and purpose that has been deliberately weaved to overcome conventional paradigms and create a paradigm shift in healthcare architecture.

6.2 Design Description

This chapter discusses thoroughly the final design of the hospital, combining architectural concepts, contextual considerations, and innovative solutions to create a transformative healthcare environment. Drawing on established principles and site-specific characteristics, this chapter provides a thorough exploration of the proposed hospital's overarching design philosophy and distinguishing features.

6.2.1 Site Integration and Therapeutic Landscape

Situated on a corner site adjacent to Jhang Road and bordered by a meandering water body, the hospital capitalizes on its unique surroundings to create a therapeutic landscape. The integration of the water body not only fosters a serene atmosphere but also serves as a focal point for healing and meditation, fostering a connection to nature. Complementing this, lush jungle gardens enveloping the hospital further enhance the healing environment, providing tranquil green spaces amidst the urban setting.

6.2.2 Strategic Zoning and Accessibility

The design prioritizes accessibility and efficiency from the moment one enters from Jhang Road, with the emergency department and burn unit strategically positioned at the forefront of the site. This deliberate placement ensures swift access to critical care services, emphasizing the hospital's dedication to patient safety. Moving through the site, the main outpatient department (OPD) emerges as a central hub, facilitated by interspersed courtyards that brings natural light and greenery, promoting comfort and peacefulness.

6.2.3 Functional Integration and Departmental Layout

Adjacent to the OPD, seamless integration of the pharmacy facilitates convenient access to medications post-consultation. The central positioning of labs and diagnostics ensures expedited testing and imaging studies, vital for clinical decision-making. On the first floor, specialized departments including gynecology, pediatrics, operating theatres, and intensive care units are strategically located for efficient care delivery. Meanwhile, the second-floor houses inpatient wards, prioritizing patient comfort and privacy to aid healing and recovery.

6.2.4 Sustainability and Operational Resilience

At the periphery, a water treatment plant ensures operational sustainability, reflecting the hospital's commitment to environmental sustainability. Residential units at the rear provide on-site accommodation for medical staff, creating a sense of community and collaboration.

6.3 Thesis Statement Justified

The thesis statement,

"Designing a medical facility in the metropolitan city of Faisalabad that treats and mitigates to control the spread of water and airborne diseases spread mostly through civic works,"

serves as the cornerstone of the architectural endeavor. It summarizes the core objectives, challenges, and aspirations that drive the project forward. Rooted in a deep understanding of the pressing healthcare needs and challenges facing the community of Faisalabad, this thesis statement sets the overarching direction for the design and development of the medical facility.

6.3.1 Contextual Rationale

The justification for this thesis statement is multi-faceted and grounded in the specific context of Faisalabad. As a metropolitan city grappling with rapid urbanization, inadequate infrastructure, and environmental degradation, Faisalabad faces significant health risks associated with water and airborne diseases spread through civic works. These diseases pose a pervasive threat to public health, particularly impacting the most vulnerable segments of the population. Therefore, the design of a medical facility dedicated to treating and mitigating the spread of these diseases is imperative to address the pressing healthcare needs of the community.

6.3.2 Public Health Imperatives

The thesis statement underscores the dual mandate of the medical facility: to provide treatment for individuals afflicted by water and airborne diseases and to serve as a proactive hub for preventive measures and community outreach initiatives. By situating the facility within the heart of Faisalabad, accessible healthcare services can be provided to the local population, thereby addressing immediate healthcare needs while also implementing proactive measures to curb the spread of infectious diseases. Through public health education, community engagement, and preventive interventions, the facility aims to empower individuals and communities to adopt healthier behaviors and mitigate the risk factors contributing to disease transmission.

6.3.3 Innovation and Sustainability

Moreover, the thesis statement reflects a commitment to innovation and sustainability in healthcare design. It advocates for architectural solutions that not only respond to immediate healthcare needs but also encourage flexibility and adaptation in the face of evolving environmental and public health challenges. By incorporating principles of biophilic design, green infrastructure, and sustainable practices, the medical facility aims to create a healing environment that promotes wellness, restoration, and harmony with the natural world.

6.4 Elements of Intervention

In this section, we will discuss the more detailed features of intervention in hospital design, exhibiting the different approaches and solutions used to solve healthcare concerns while also

improving the facility's general functionality and sustainability. These measures, based on a thorough awareness of Faisalabad's healthcare requirements and influenced by new ways, offer a proactive reaction to current concerns as well as a commitment to establishing a resilient and impactful healthcare environment.

6.4.1 Integrated Water Treatment Plant

The integrated water treatment plant is a key component of the hospital's infrastructure, ideally located to meet the hospital's needs while also benefiting the adjacent residential areas. This facility serves a dual role by purifying water for both the hospital's landscape and the residential neighborhoods along the adjacent water canal path. This initiative supports public health while also demonstrating the hospital's dedication to community well-being and environmental sustainability.

6.4.2 Biophilic Design Elements

Another significant approach is the use of biophilic design, which features throughout the hospital's landscape and architecture. These components, which include green roofs and living walls as well as natural light and ventilation systems, are intended to create a healing atmosphere that promotes physical, mental, and emotional health. By reconnecting patients, staff, and visitors with nature, these approaches encourage relaxation, stress reduction, and faster recovery, improving the entire patient experience and outcomes.

6.4.3 Innovative Technological Solutions

Innovative technological solutions are critical to improving the efficiency, safety, and efficacy of healthcare delivery in the hospital. From advanced medical supplies and telemedicine platforms to smart building systems and digital health records, these interventions enable healthcare practitioners to provide high-quality care while optimizing resource utilization and operational workflows. Furthermore, these technological interventions enable seamless communication and collaboration among diverse care teams, improving the quality and coordination of patient care.

6.4.4 Community Engagement Initiatives

In addition to physical infrastructure and technical developments, community participation programs play an important role in the hospital's design. The hospital actively engages with the local community through educational programs, campaigns for health promotion, and outreach activities to raise awareness about preventative healthcare measures, encourage healthy lifestyles, and empower people to take control of their health. These initiatives establish relationships and collaboration with community stakeholders, resulting in a supporting environment that extends beyond the hospital walls, improving overall health and well-being at the community level.

In conclusion, the Elements of Intervention section emphasizes the varied tactics and solutions built into the hospital's architecture to solve healthcare concerns, improve patient care, and create sustainability and resilience. By embracing innovative approaches and engaging with the community, these interventions underscore the hospital's commitment to excellence in healthcare delivery and its role as a catalyst for positive change within the Faisalabad community and beyond.

6.5 Final Design

In this chapter, a complete overview of the architectural design is provided, which reflects the combination of research, creativity, and community-centered ideas. Each component of the final design reflects our dedication to providing an innovative healthcare environment that is customized to the specific needs of Faisalabad.

Figure 18 (Masterplan)

6.5.1 Main Access and Entrance

The main access and entrance serve as the hospital's doorway, symbolizing a welcoming and accessible approach. The entrance, which is prominently located along Jhang Road, is designed to allow for seamless patient and visitor movement while simultaneously prioritizing safety and efficiency. Architectural components and landscaping are interconnected to generate a sense of arrival and build the hospital's distinctive visual character within the urban environment of Faisalabad.

Figure 19 (Ground Floor Plan)

6.5.2 Department Layouts

The department layouts are carefully planned to improve patient care and operational efficiency. Each department is deliberately positioned to reduce travel distances and encourage multidisciplinary collaboration. The layout of clinical facilities is guided by patient-centric design principles, ensuring accessibility, privacy, and comfort for all individuals who use hospital healthcare services.

6.5.3 Vertical Planning

Vertical planning is an important component of our design approach since it maximises the utility of limited space while also allowing for natural navigation and circulation. Vertical zoning enables the effective stacking of departments and services, with critical care units located on upper floors for quick access to specialized treatment. This vertical integration

improves operational efficiency and allows for the seamless delivery of healthcare services across multiple levels of the institution.

6.5.4 Residential Units

In addition to medical facilities, our final design includes residential units to meet the demands of medical and support personnel. These units have been placed towards the hospital's backside, giving workers easy access to clinical areas while also providing a calm getaway during off-duty hours. Thoughtful design features create a comfortable living environment that encourages rest and relaxation, increasing employee satisfaction and productivity.

6.5.5 Water Treatment Plant

The integrated water treatment plant is a key component of our final design since it ensures the sustainability and robustness of hospital operations. The plant is designed to purify water not only for hospital usage but also for nearby residential areas, demonstrating our commitment to environmental preservation and community health. Sustainable water management strategies are integrated throughout the design to reduce water wastage and promote conservation.

6.5.6 Courtyards

Courtyards are incorporated into the architecture to offer therapeutic outdoor spaces that promote well-being and healthy living. These green oases provide calm getaways for patients, visitors, and staff, allowing for rest, self-awareness, and connection with nature. Courtyards, which are thoughtfully manicured and include lounging places, provide respite from the clinical atmosphere while also contributing to the hospital's overall environment.

6.5.7 Biophilic Design

Our final design incorporates biophilic design concepts, which harness the healing power of nature to improve the patient experience and promote holistic wellness. Biophilic elements such as natural light, indoor greenery, and organic materials are used throughout the hospital to develop a connection to the natural world and promote relaxation and renewal. This biophilic approach demonstrates our dedication to creating therapeutic settings that nourish both the body and spirit.

In conclusion, our Final Design chapter outlines a comprehensive and integrated approach to healthcare architecture based on accessibility, sustainability, and patient-centered care. We hope to establish a hospital that not only fulfils Faisalabad's immediate healthcare requirements, but also nurtures a culture of health.

6.6 Conclusion

In the Final Design chapter, a journey to redefine healthcare architecture in Faisalabad was started. Through proper planning and inventive design, our planned hospital emerges as a beacon of hope and healing, ready to meet the community's urgent healthcare needs.
The Thesis Statement Justified emphasizes the critical need for a dedicated medical institution to tackle water and airborne infections, establishing our hospital as a proactive change agent. Our design narrative, based on biophilic principles and intelligent zoning, creates a healing environment that encourages well-being and adaptability.

Our Elements of Intervention demonstrate our dedication to excellence, sustainability, and engagement with the community. From integrated water treatment plants to innovative technological solutions, our design takes a comprehensive approach to healthcare delivery.
Thus, our Final Design is a team effort to create a positive and healthy future for Faisalabad. With compassion, innovation, and collaboration at its foundation, our hospital is poised to have a significant effect on the lives of individuals and communities for decades to come.

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