VIT®

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

"Design of a Hospital Building"

A PROJECT REPORT

Submitted in partial fulfillment for the award of the degree of

Bachelor of Technology

in

CIVIL ENGINEERING

by

CHANDAN YADAV

School of Civil Engineering

November 2022

DECLARATION BY THE CANDIDATE

We hereby declare that the project report entitled "Design of a Hospital Building" submitted by us to Vellore Institute of Technology University, Vellore in partial fulfillment of the requirement for the award of the degree of Bachelor of Technology in Civil Engineering is a record of bonafide project work carried out by us under the guidance of Prof. Suganya Om. We further declare that the work reported in this project has not been submitted and will not be submitted, either in part or in full, for the award of any other degree or diploma in this institute or any other institute or university.

Signature of the Candidates

Chandan Yadav

Place: Vellore

Date: 15 November 2022

VIT®
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

School of Civil Engineering

CERTIFICATE

This is to certify that the project report entitled "Design of a Hospital Building" submitted by Chandan Yadav (20BCL0133), Arjun Kumar Thakur (20BCL0139), Ashish Timilsina (20BCL0141), Nishu Kumari Yadav (20BCL0143), Ambikesh Kumar Sah (20BCL0144) and Nikita Sah (20BCL0145), to Vellore Institute of Technology University, Vellore, in partial fulfillment of the requirement for the award of the degree of Bachelor of Technology in Civil Engineering is a record of bona fide work carried out by them under my guidance. The project fulfills the requirements as per the regulations of this Institute and in my opinion meets the necessary standards for submission. The contents of this report have not been submitted and will not be submitted either in part or in full, for the award of any other degree or diploma and the same is certified.

Prof. Suganya Om
Project Guide

Dr. Shravana Kumar M P
HOD-SCE

ACKNOWLEDGEMENT

We find immense pleasure in expressing our profound gratitude and thanks to our guide Prof. Suganya Om for his invaluable guidance, constant encouragement and keen interest in the progress and completion of this work. She has always been most willing to spend his valuable time for discussion. The discussions were always enjoyable as well as his comments have been extremely valuable. We learned a lot from the discussion. She has associated with us as a friend, philosopher and advisor. We would like to thank our HODs and Dean for providing all the infrastructure facilities to carry out our project successfully.

Chandan Yadav

CONTENTS

Introduction

A hospital is a health care institution providing patient treatment with specialized medical and nursing staff and medical equipment. Each hospital is comprised of a wide range of services and functional units. These include diagnostic and treatment functions, such as clinical laboratories, imaging, emergency rooms, and surgery; hospitality functions, such as food service and housekeeping; and the fundamental inpatient care or bed-related function. A hospital is a health care institution providing patient treatment with specialized medical and nursing staff and medical equipment. Each hospital is comprised of a wide range of services and functional units. These include diagnostic and treatment functions, such as clinical laboratories, imaging, emergency rooms, and surgery; hospitality functions, such as food service and housekeeping; and the fundamental inpatient care or bed-related function.

Hospitals are usually funded by the public sector, health organisations (for profit or nonprofit), health insurance companies, or charities, including direct charitable donations. Historically, hospitals were often founded and funded by religious orders, or by charitable individuals and leaders.

REASON BEHIND HOSPITAL BUILDING

- Hospitals are medical treatment centers. They are one of the most important pillars of any society. They are the physical execution of one of the pillars that form the infrastructure of a nation: healthcare.
- Hospitals are important to treat minor and serious diseases, illnesses and disorders of the body function. Hospitals work to address health issues of citizens and tries to achieve well-being of society.
- Hospitals matter to people and often mark central points in their lives. They also matter to health systems by being instrumental for care coordination and integration. They often provide a setting for education of doctors, nurses and other health-care professionals and are a critical base for clinical research.
- Hospitals offer a variable range of acute, convalescent and terminal care using diagnostic, preventive and curative services in response to acute and chronic conditions arising from diseases as well as injuries and genetic abnormalities.

Objective

- ♦ To study the facilities, present in the hospital building.
- ♦ To prepare the layout and detailed plan of hospital building as per National Building Code.

Types of hospital

Hospitals are typically subsidized by the government, for-profit or nonprofit health agencies, health insurance providers, or charities, such as direct charitable donations. Depending on the funding, hospitals can be classified into one of three groups.

Below mentioned are the types of the hospital:

- Publicly owned hospital
- Nonprofit hospitals
- For-profit-hospitals

Hospitals may be further graded depending on the type of care they provide (indicative) or the services they provide, such as:

- Specialty Hospitals
- General Medical & Surgical Hospitals
- Clinics
- Teaching Hospitals
- Psychiatric Hospitals
- Clinics for Family Planning and Abortion
- Hospices & Palliative Care Centers
- Centers for Emergency and Other Outpatient Care
- Clinics for Sleep Disorders
- Blood & Organ Banks
- Dental Laboratories

1) Academic Medical Centers:

   Academic medical centers often serve specific medical schools or universities. Facilities like this offer a variety of services to treat the general healthcare needs of their communities as well as specialized services while simultaneously offering educational opportunities to students in the healthcare field.

2) Acute Hospitals Acute hospitals focus solely on the treatment and care of people with short-term needs like the following:

- Illnesses
- Diseases

- Injuries
- Surgeries
- Surgery recoveries
- Obstetric care Postnatal care

They are not equipped to handle chronic or long-term care for patients. According to EOSCU, approximately 91 percent of hospitals are acute care facilities. Most people who are treated in acute care hospitals stay for 10 days or fewer.

3) Children's Hospitals

Children's hospitals specialize in the care and treatment of children and the conditions that affect younger patients. It is a type of specialty hospital, which means the staff has received additional training to aid in the treatment of children for a variety of acute and long-term medical needs. In addition to offering medical treatment to children, children's hospitals are widely praised for the level of psychosocial support they offer the children in their care and their families — especially in the case of children who require long stays in the hospital.

4) Community Hospitals

Non-teaching hospitals serving local communities without federal funding are known as community hospitals. They can be found in rural or urban settings and provide vital 8 services to their local populations. The American Hospital Association reports that there are 4,840 community hospitals operating in the U.S. today.

5) District Hospitals:

District hospitals serve as healthcare hubs for their geographic regions. They have more extensive intensive care facilities and long-term care programs in addition to providing necessary treatments in fields like obstetrics, general surgery, plastic surgery and more.

6) Federal hospitals:

Sometimes referred to as government hospitals, federal hospitals receive funding from the federal government. In the United States, federally funded hospitals typically handle the healthcare and medical needs of select populations such as Native Americans and Veterans.

7) Free Hospitals:

Free hospitals do not charge patients for the services they provide. They are generally located in areas that reach out to patients of poor socio-economic classes and frequently operate at a loss. As a result, they often struggle to provide the amenities and level of services many physicians strive to offer.

8) General Services Hospitals:

General service hospitals focus on general and necessary services for the community, like:

- Surgery
- OB/GYN services
- Pediatric services
- General medical care

They offer little in the way of specialty services and may not be equipped to provide long-term care to patients. Most hospitals today are general services hospitals.

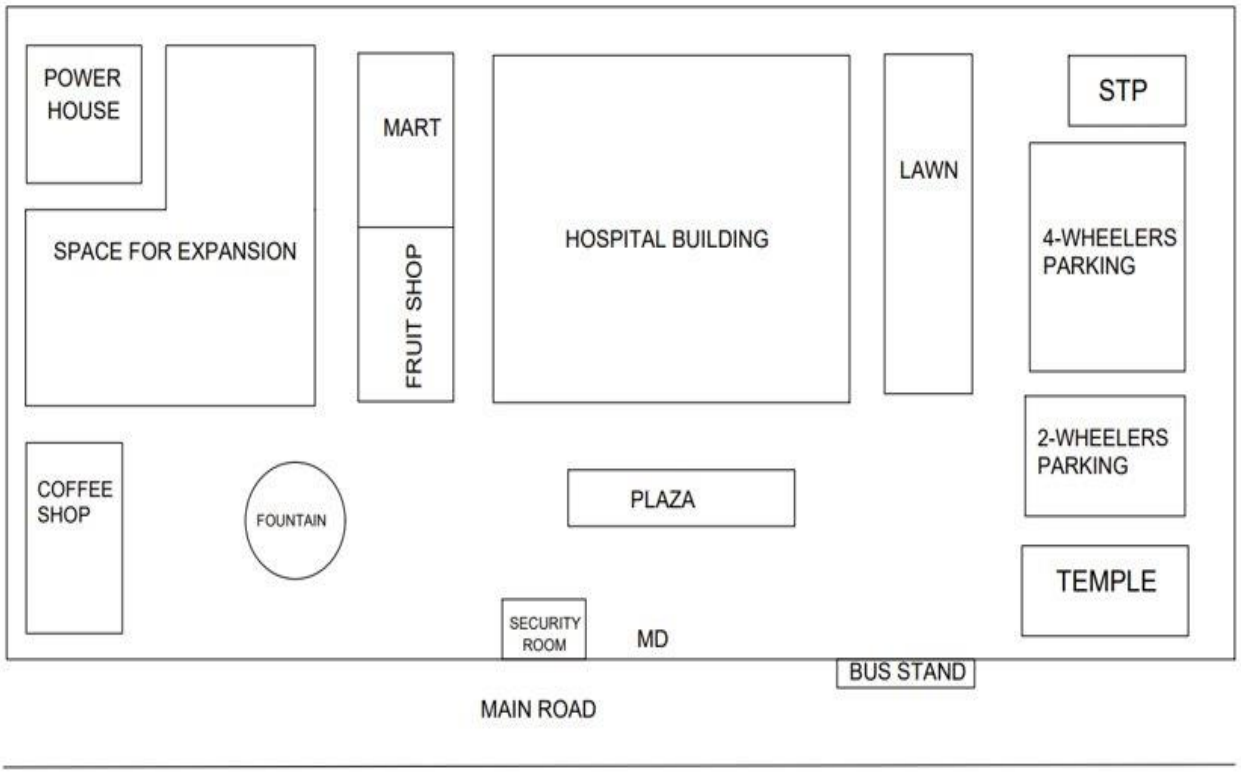
9) Government-Funded Hospitals:

State or federal governments provide grants or public funding to government funded hospitals to operate. Veterans hospitals are perhaps the most famous of these kinds of hospitals.

Layout of hospital

The layout of hospital has the following components

- Hospital building
- Fruit shop, coffee shop, mart
- Fountain Area, Lawn and plaza
- Parking areas
- Temples
- Sewage treatment plant
- Power house
- Space for expansion
- Security room



Components of hospital

Different Departments in Hospital (Various Departments in Hospital)

Outpatient department (OPD), Surgical department, Inpatient service (IP), Nursing department, Physical medicine, Paramedical department, and Rehabilitation department, Dietary department, Pharmacy department, Operation theater complex (OT), Radiology department (X-ray), and Non-professional services are some of the departments located in hospitals.

A nursing department, led by a director of nursing or a chief nursing officer, might exist in a hospital. Such a department has the responsibility of overseeing the hospital's clinical nursing practice, research, and regulation.

Numerous units also have nursing as well as a medical director who also acts as a supervisor for their subject areas. A medical director, for instance, is in charge of doctors and medical treatment in an intensive care nursery, whereas the nursing manager is in charge of both nurses and nursing healthcare.

Health records, technical support, disclosure of information, facilities management, clinical engineering, dining services, and plant operations, are examples of support units.

- Reception
- General Ward
- Examination/Consultation
- Operation Theatre
- Intensive Care Unit (ICU)
- Surgery Room
- Doctor's Cabin
- Nurse Room
- Laboratory
- Pharmacy
- Labor room
- Emergency Ward
- Blood Bank
- Waiting Room
- Storeroom
- Canteen
- X-ray

- MRI
- General administration
- Children Room

NBC STANDARDS REGARDING HOSPITAL BUILDING

All the Standard taken here are from NBC, this Indian Standard was adopted by the Bureau of Indian Standards on 20 July 1988, after the draft finalized by the Hospital Planning Sectional Committee had been approved by the Consumer Products and Medical Instruments Division Council.

The Government of India is the signatory to the Alma Ata declaration to achieve the objective of health lor all by the year 2000 A D The country at present has nearly 7 000 hospitals with over 500 000 beds with a bed population ratio of 0 7 bed per 1 000 population This bed complement is inadequate and inequitably distributed and even inefficient National Health Policy (1983) has laid guidelines towards comprehensive and integrated approach to development.

Safety:

Minimum of two (2) exits, remote from each other, shall be provided for each floor of the building.

Security:

A hospital and other health facilities shall ensure the security of person and property within the facility.

Patient Movement

Spaces shall be wide enough for free movement of patients, whether they are on beds, stretchers, or wheelchairs. Circulation routes for transferring patients from one area to another shall be available and free at all times. Corridors for access by patient and equipment shall have a minimum width of 2.44 meters. Corridors in areas not commonly used for bed, stretcher and equipment transport may be reduced in width to 1.83 meters. A ramp or elevator shall be provided for ancillary, clinical and 18 nursing areas located on the upper floor. A ramp shall be provided as access to the entrance of the hospital not on the same level of the site.

Ramp:

Corridors in areas not commonly used for bed, stretcher and equipment transport may be reduced in width to 1.83 meters.

A ramp or elevator shall be provided for ancillary, clinical and nursing areas located on the upper floor.

Lighting & Ventilation:

Adequate ventilation shall be provided to ensure comfort of patients, personnel and public.

Sanitation:

Utilities for the maintenance of sanitary system, including approved water supply and sewerage system, shall be provided through the buildings and premises to ensure a clean and healthy environment.

Fire Protection:

There shall be measures for detecting fire such as fire alarms in walls, Peepholes in doors or smoke detectors in ceilings. There shall be devices for quenching fire such as fire extinguishers or fire hoses that are easily visible and accessible in strategic areas.

Material Specification:

Floors, walls and ceilings shall be of sturdy materials that shall allow durability, ease of cleaning and fire resistance.

Zoning:

The different areas of a hospital shall be grouped according to zones as follows:

Outer Zone – areas that are immediately accessible to the public: emergency service, outpatient service, and administrative service. They shall be located near the entrance of the hospital.

Second Zone – areas that receive workload from the outer zone: laboratory, pharmacy, and radiology. They shall be located near the outer zone.

Inner Zone – areas that provide nursing care and management of patients: nursing service. They shall be located in private areas but accessible to guests.

Deep Zone – areas that require asepsis to perform the prescribed services: surgical service, delivery service, nursery, and intensive care. They shall be segregated from the public areas but accessible to the outer, second and inner zones

Service Zone – areas that provide support to hospital activities: dietary service, housekeeping service, maintenance and motor pool service, and mortuary. They shall be located in areas away from normal traffic.

As per NBC-

Floor height of hospital building should not be less than 3.5m

In our project,

Height of ground floor- 4000mm

Height of first floor- 3600mm

Height of second floor- 3600mm

Height of basement- 800mm

Total height of building- 12.8 m

SPECIFICATIONS FOR FOOTING

FOOTING - STEPPED FOOTING

FOOTING DISTANCE, 3000MM

LINTEL 100MM THICK

FLOOR FINISHING WITH C.M 1:5, 30MM THICK

FLOORING CONCRETE 1:4:8, 150MM THICK

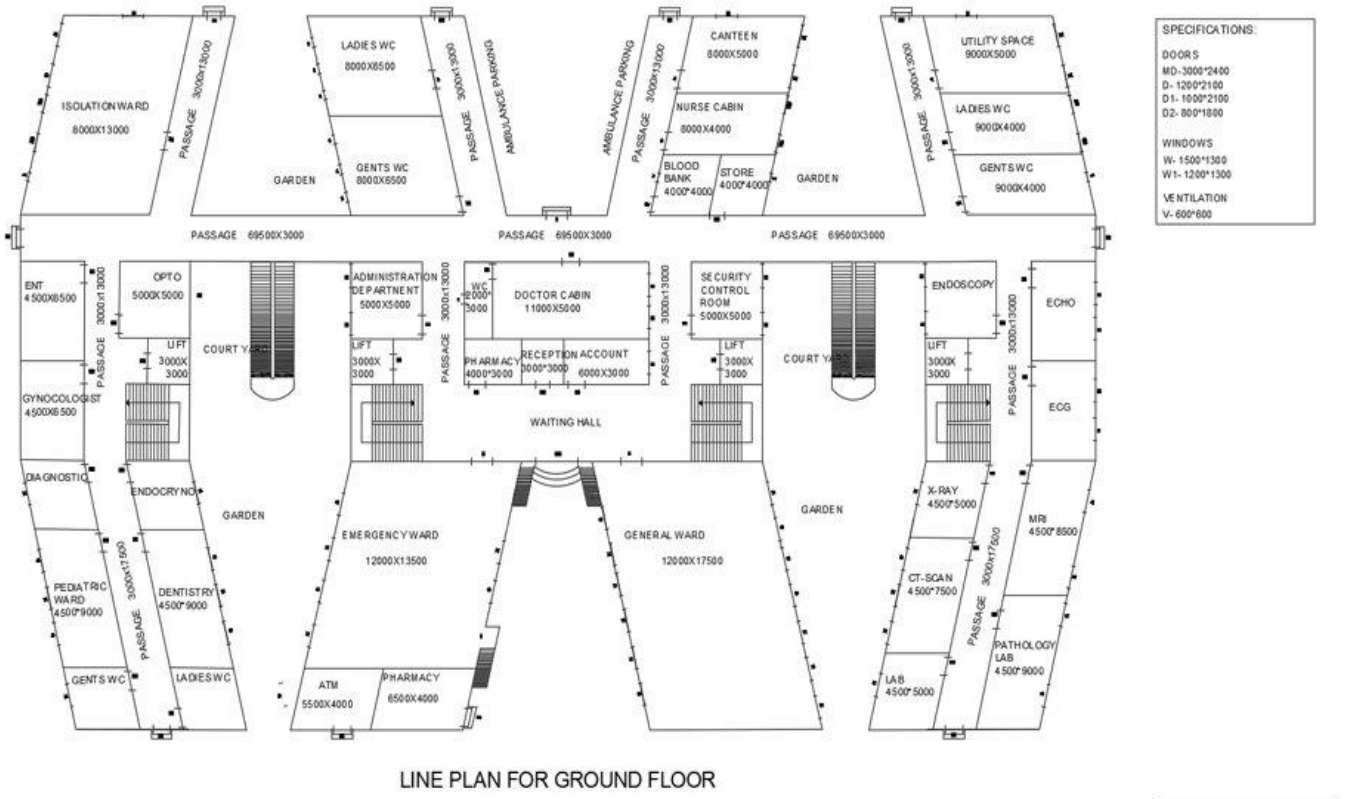
SAND FILLING FOR BASEMENT 600MM THICK

BRICKWORK FOR FOOTING, 600MM THICK

P.C.C. FOR FOOTING, 1:4:8, 150MM THICK

SAND FILLING FOR FOOTING, 150MM THICK

Line plan of hospital building

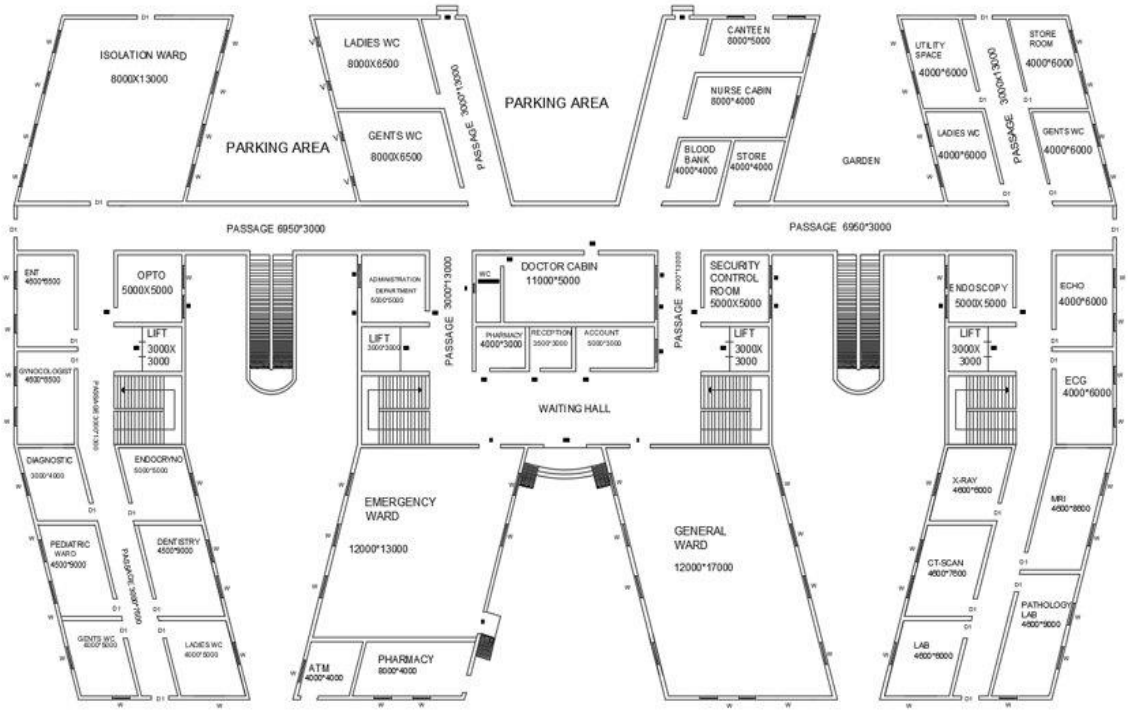


LINE PLAN FOR GROUND FLOOR

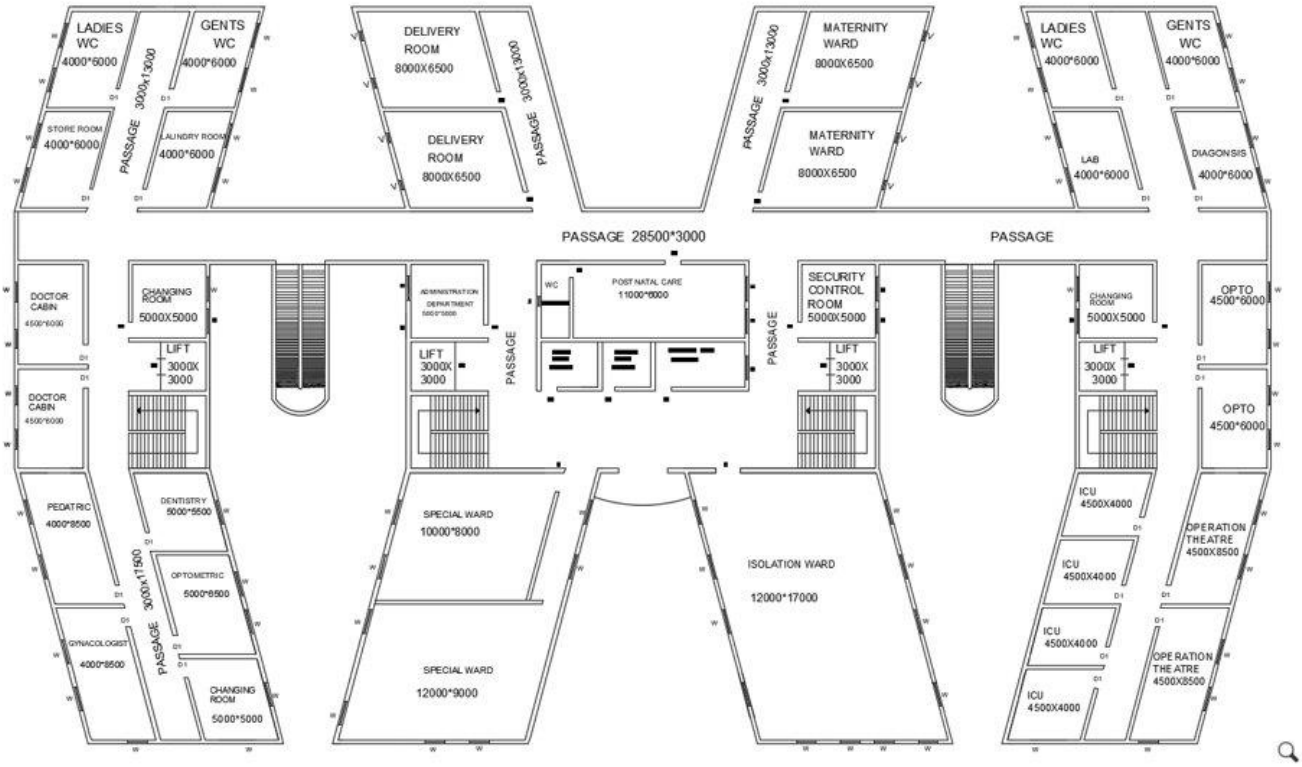
ALL DIMENSIONS ARE IN mm

GROUND FLOOR PLAN
HOSPITAL BUILDING
GROUP III

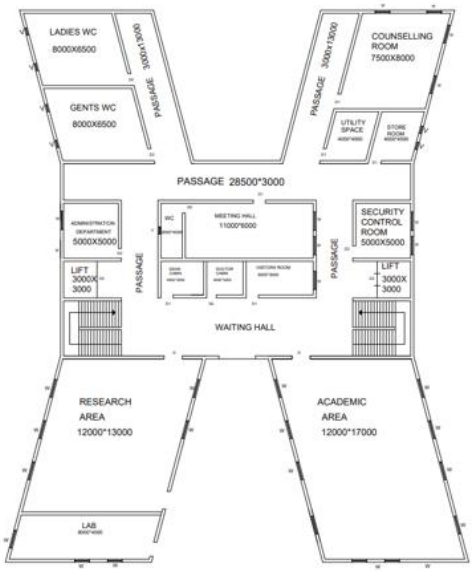
Detailed plan



GROUND FLOOR

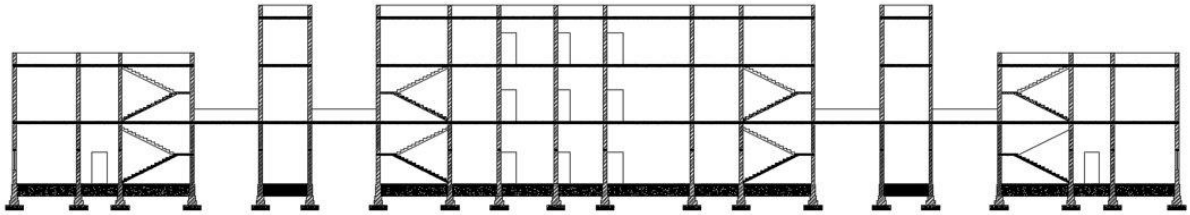


FIRST FLOOR



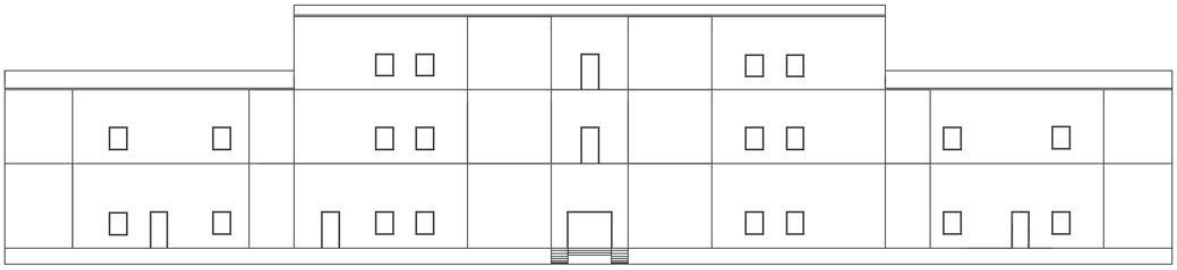
SECOND FLOOR

Cross sectional view



CROSS SECTION ON A-A

Front Elevation



ELEVATION

AREA CALCULATION

Area of central block=1142.36 sq. m

Area of lateral blocks= 543 sq. m

Area of bridge joining central block with lateral blocks= 72.6 sq. m

So, Total built up area = 1142.36 + 2*543 + 2* 72.6

= 2373.8 sq. m

Total floor area = 2*2373.8 + 1142.36

= 5889.96 sq. M

Area for parking= 1200 sq. m

Area for lawn = 400 sq. M

Area for power station= 100 sq. m

Area for coffee shop, fruit shop and mini mart= 200 sq. M

Area for expansion = 2000 sq. M

Open space area= 1/3* built-up area

= 800 sq. M

Plot area = 2373.8 +1200+ 400+ 100+ 200 + 2000+ 800

= 7073.8 sq. M

= 1.75 acres

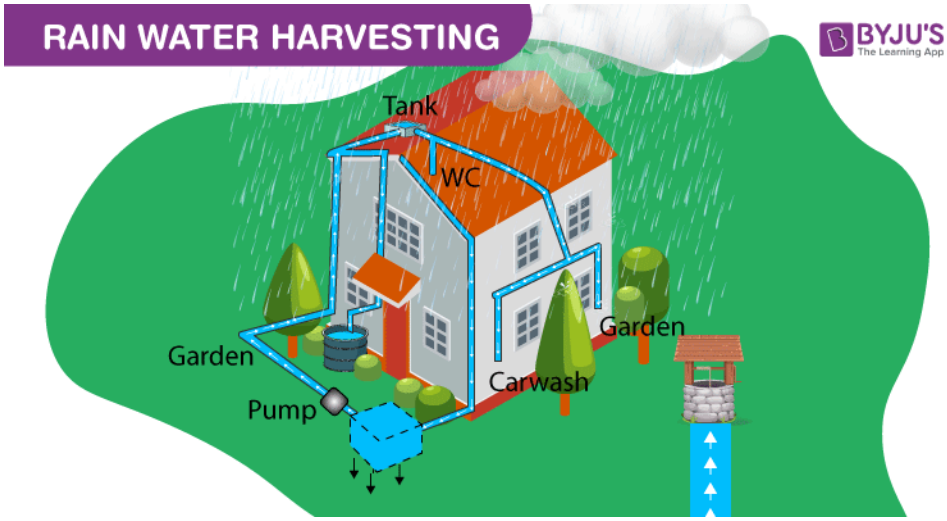
= 0.7 hectares

Total capacity of patients = 160

Innovative ideas

Rain water harvesting

Rainwater harvesting (RWH) is the collection and storage of rain, rather than allowing it to run off. Rainwater is collected from a roof-like surface and redirected to a tank, cistern, deep pit (well, shaft, or borehole), aquifer, or a reservoir with percolation, so that it seeps down and restores the ground water. Dew and fog can also be collected with nets or other tools. Rainwater harvesting differs from stormwater harvesting as the runoff is typically collected from roofs and other surfaces for storage and subsequent reuse. Its uses include watering gardens, livestock, irrigation, domestic use with proper treatment, and domestic heating. The harvested water can also be committed to longer-term storage or groundwater recharge.



Power-generating glass

A major development in creating environmentally friendly construction materials has been the innovation of photovoltaic glass. Building integrated photovoltaic (BIPV) glazing can help buildings generate their own electricity by essentially turning an entire building into one big solar panel.

Several types of photovoltaic glass, the two main ones being amorphous silicon glass and crystalline silicon glass.

Both types of photovoltaic glass generate clean energy but have are suitable for different conditions and placements on buildings. Amorphous silicon glass is the most similar to architectural glass, with some tinting and visible wiring. Approximately 30% of light is let in and it works best in diffuse light conditions or overcast lighting.

In contrast, crystalline silicon glass is capable of generating twice the amount of power and is better positioned in direct sunlight. This makes it an ideal choice for sun-facing structures as its dark photovoltaic squares prevent much light coming through.

Permeable flooring

Permeable pavement is a pavement type with a porous surface that is composed of concrete, open pore pavers or asphalt with an underlying stone reservoir. Also considered as green pavement, it allows water to run through it rather than accumulate on it or run off of it. The precipitation and water get stored in the reservoir from where it slowly infiltrates the soil below or is drained via a drain tile. The stone or gravel acts as a natural filter and clears the water of pollutants. It is commonly used in parking lots, sidewalks, low-traffic areas and driveways. This eco-friendly pavement is suitable for different conditions that include hot climates and high-speed traffic areas.

Sprinkler irrigation

Sprinkler irrigation system allows application of water under high pressure with the help of a pump. It releases water similar to rainfall through a small diameter nozzle placed in the pipes. Water is distributed through a system of pipes, sprayed into air and irrigates in most of the soil type due to wide range of discharge capacity.

Advantages

Eliminates water conveyance channels, thereby reducing conveyance loss.

Suitable in all types of soil except heavy clay.

Water saving up to 30% - 50 %.

Suitable for irrigation where the plant population per unit area is very high.

Helps to increase yield.

Reduces soil compaction.

Mobility of system helps system operation easy.

Suitable for undulating land.

Saves land as no bunds required.

Soluble fertilizers and chemicals use are possible.

Provides frost protection & helps in alteration of micro climate.

Sensor taps

Sensor taps are now some of the most popular options when it comes to water flow, particularly in light of coronavirus.

Sensor tap is a device that automatically lets out water after detecting movement.

It also cuts down water wastage by up to 70%.

Water Purification using Solar Energy

There are different water sources available for drinking water in the world, but the available water in many areas is not pure, brackish, and saline. In the coastal areas like Gujarat, Kutch, the major problem is Salinity. So for water purification, there are different methods that are available in the market namely, sand filters, removal of fluoride, overturn osmosis plants, etc.

To overcome this problem, here is a system namely solar energy-based water purification system which works on the principle of reverse osmosis. This project uses renewable energy like solar energy. The main reason to use this energy is cheap, abundant, pollution less, etc.

In the power failure case, the water purifier system continuously works by using solar energy. This project uses 8051 microcontrollers to stop the overflow of water and this water purifier is applicable.

References

National Building Code

https://www.re-thinkingthefuture.com/rtf-fresh-perspectives/a1072-10-innovative-construction-materials-used-around-the-world/

https://proest.com/construction/tips/innovative-materials/

https://www.linkedin.com/pulse/hospital-design-considerations-dr-salil-choudhary