

# TRAUMA CARE CENTRE

A Space for Healing and Recovery

By

FARDEEN MEMON

A REPORT

Submitted in partial fulfilment of the requirements for the degree of  
Bachelor of Architecture



University of Mumbai

2023

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AIKTC   
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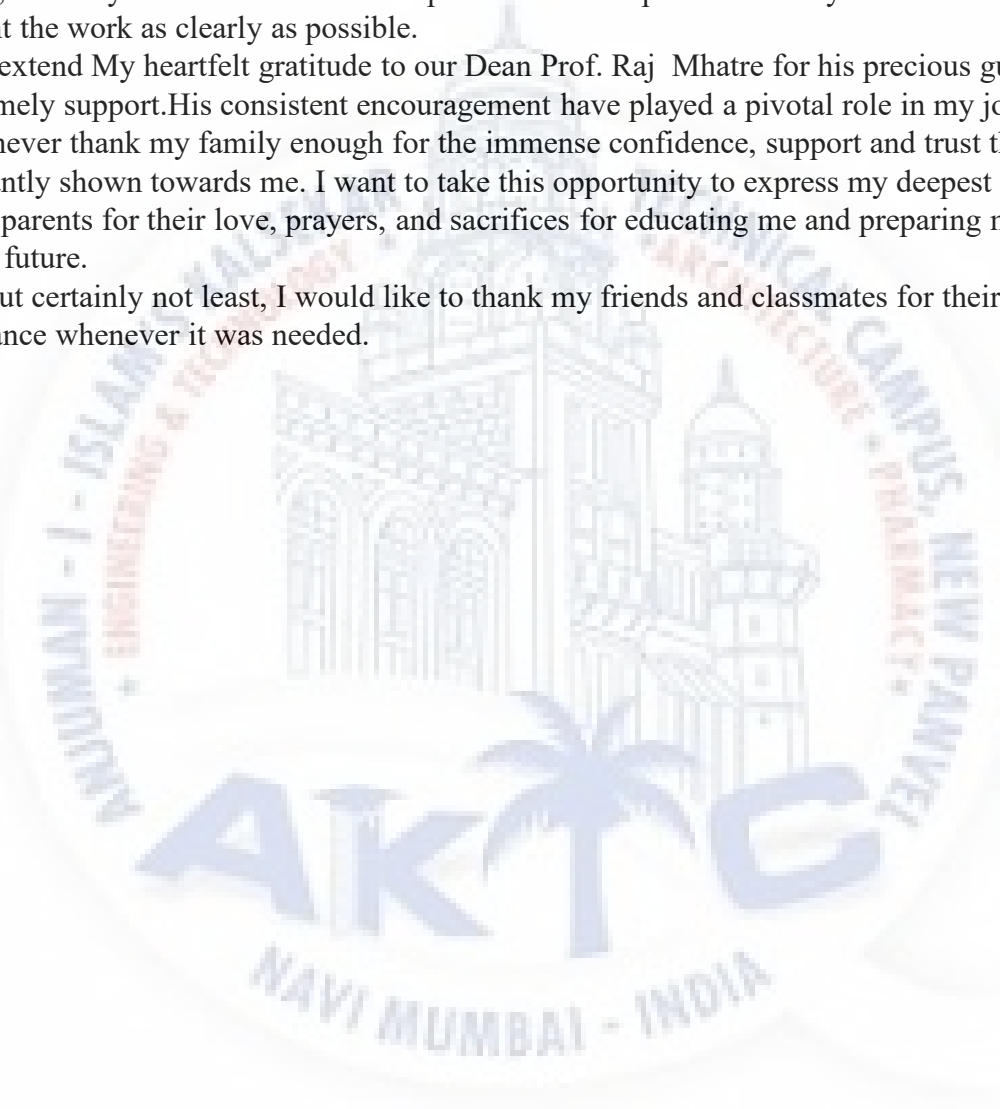
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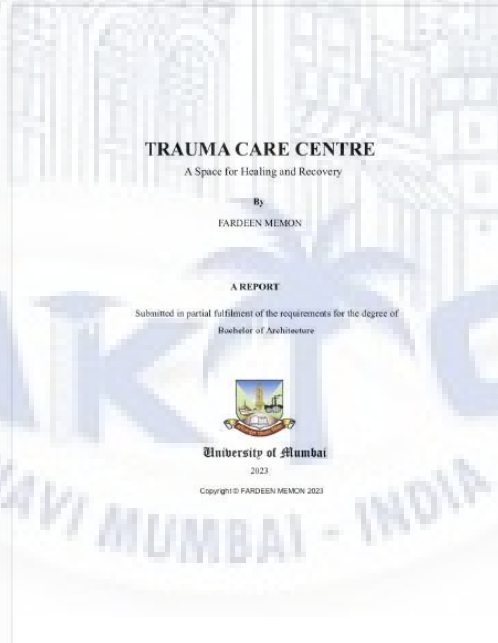


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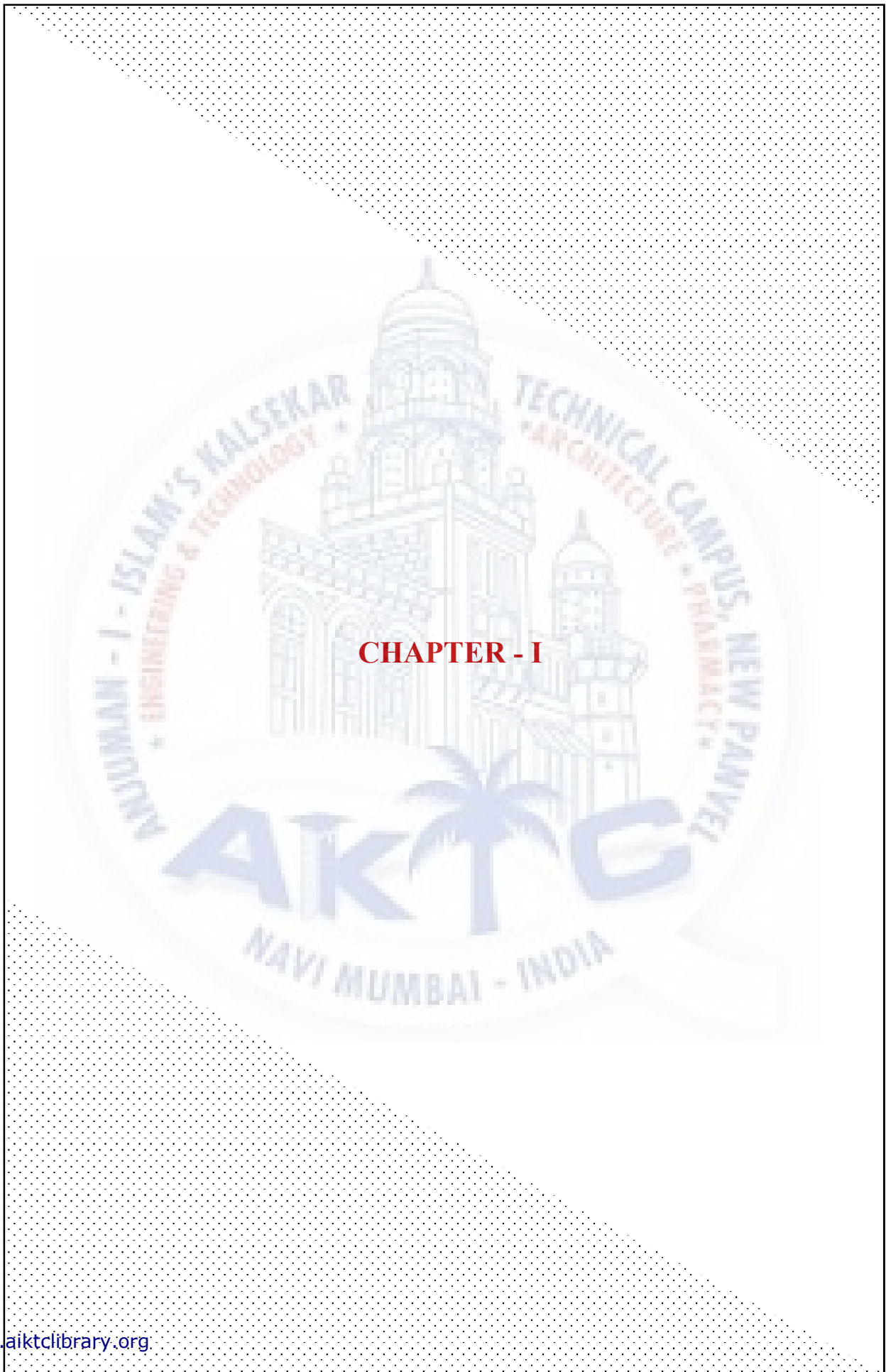
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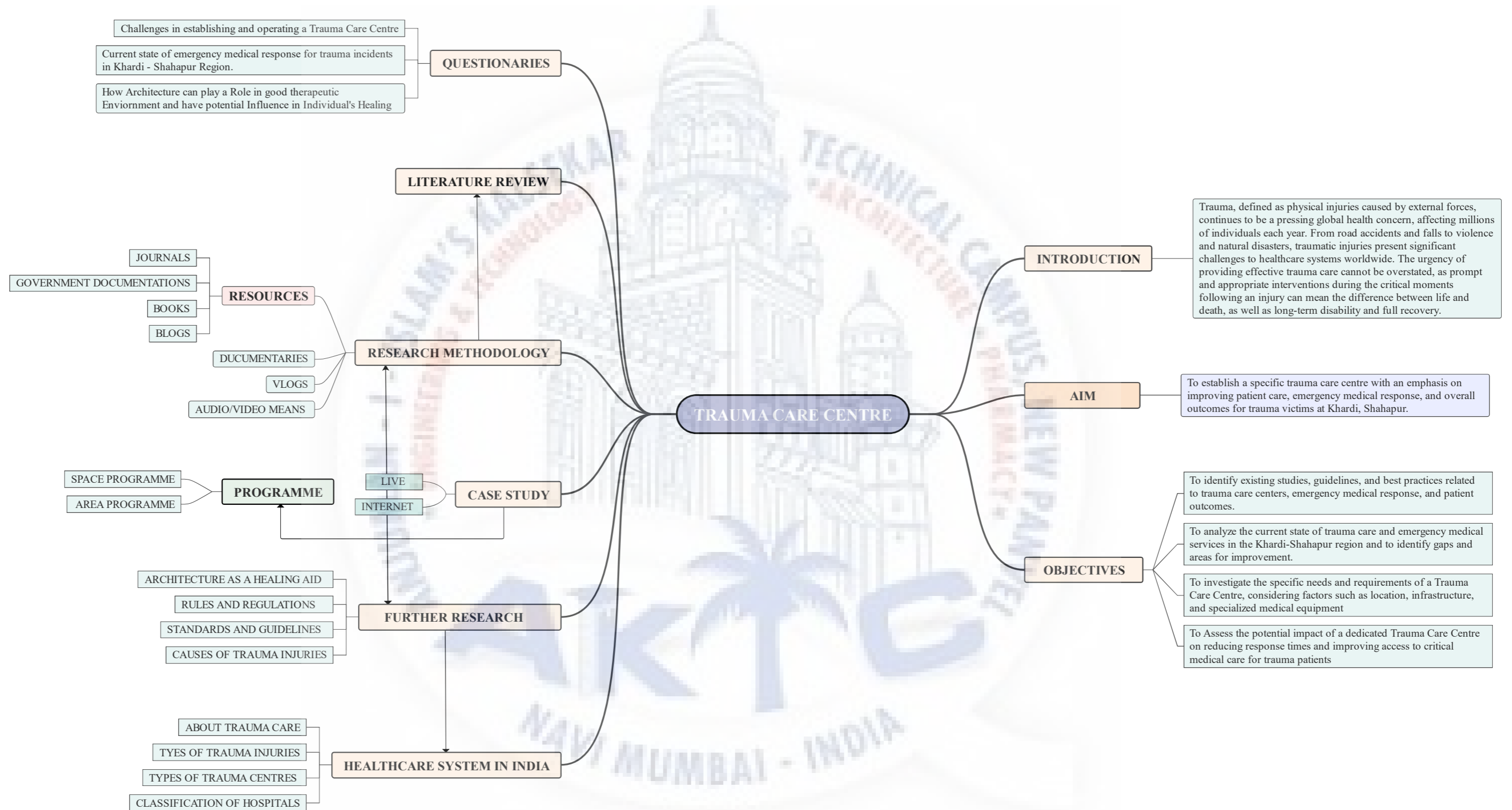
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**CHAPTER - I**





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## List of Abbreviations -

1. **ATLS:** Advanced Trauma Life Support
2. **BLS:** Basic Life Support
3. **CPR:** Cardiopulmonary Resuscitation
4. **ED:** Emergency Department
5. **EMS:** Emergency Medical Services
6. **FAST:** Focused Assessment with Sonography for Trauma
7. **GCS:** Glasgow Coma Scale
8. **IV:** Intravenous
9. **LOC:** Level of Consciousness
10. **MVC:** Motor Vehicle Collision
11. **OR:** Operating Room
12. **PPE:** Personal Protective Equipment
13. **TBI:** Traumatic Brain Injury
14. **TPA:** Tissue Plasminogen Activator
15. **ICU:** Intensive Care Unit
16. **BMI:** Body Mass Index
17. **B.P:** Blood Pressure
18. **CT:** Computed Tomography
19. **XR:** X-ray
20. **MRI:** Magnetic Resonance Imaging
21. **EMR:** Electronic Medical Record
22. **Hb:** Haemoglobin
23. **OPD:** Out Patient's Dept.
24. **IPD:** Inpatient's Dept.
25. **O.T:** Operation Theatre
26. **ABG:** Arterial Blood Gas
27. **ACLS:** Advanced Cardiac Life Support
28. **PALS:** Paediatric Advanced Life Support
29. **RBC:** Red Blood Cell
30. **WBC:** White Blood Cell

## List of Abbreviations

31. **H&P:** History and Physical Examination
32. **H.R:** Heart Rate
33. **TET:** Tube Thoracostomy (Chest Tube)
34. **ROS:** Review of Systems
35. **LOC:** Loss of Consciousness
36. **AVPU:** Alert, Verbal, Painful stimuli, Unresponsive
37. **MOI:** Mechanism of Injury
38. **ECG/EKG:** Electrocardiogram
39. **NSAID:** Nonsteroidal Anti-Inflammatory Drug
40. **V/Q:** Ventilation/Perfusion
41. **PE:** Pulmonary Embolism
42. **DVT:** Deep Vein Thrombosis
43. **O<sub>2</sub>:** Oxygen
44. **SOB:** Shortness of Breath
45. **RR:** Respiratory Rate
46. **HR:** Heart Rate
47. **BMI :** Body mass index
48. **BP:** Blood pressure
49. **BRCA:** Breast Cancer Gene
50. **BUN:** Blood urea nitrogen
51. **CA:** Cancer OR Calcium
52. **CABG:** Coronary artery bypass graft
53. **CAD:** Coronary artery disease
54. **CAT:** Computerized axial tomography
55. **CBC:** Complete blood count
56. **CHD:** Congenital heart disease
57. **CHF:** Congestive heart failure
58. **CMV:** Cytomegalovirus
59. **CNS :** Central nervous system
60. **COPD:** Chronic obstructive pulmonary disease

## Definitions of Terms -

**Trauma** - Physical injury or wound caused by an external force, often resulting from accidents, falls, violence, or other events.

**Resuscitate** - refers to revive a person who has lost consciousness 3. **Surgery** - refers to treatment of injuries or disorders of the body by incision or manipulation, especially with instruments.

**Intensive care** - refers to a special medical treatment of a dangerously ill patient, with constant monitoring

**Pre hospital care** - refers to a generic term for healthcare provided on-scene at a medical emergency or major incident, and during transfer of casualties to definitive care facilities

**Health facility** - refers to any location where healthcare is provided 7. **Rehabilitation** - refers to the act of restoring something to its original state

**Critical care services** - refers as a physician's direct delivery of medical care for a critically ill or critically injured patient.

**Surgery** - refers to treatment of injuries or disorders of the body by incision or manipulation, especially with instruments. definitive care facilities .

**Trauma: Mechanism of Injury (MOI):** The specific circumstances or forces that caused a traumatic injury, providing insights into the potential severity of the injury and guiding treatment decisions.

**Injury Severity Score (ISS):** A numerical score that quantifies the overall severity of multiple injuries sustained by a patient, aiding in prognosis and treatment planning.

**Secondary Survey:** A more comprehensive assessment conducted after the primary survey, focusing on gathering a detailed patient history, performing a physical examination, and ordering appropriate diagnostic tests.

**Focused Assessment with Sonography for Trauma (FAST):** A rapid ultrasound examination used to identify the presence of free fluid (blood, bile, urine) within body cavities, often performed in trauma cases.

**Triage:** The process of categorizing and prioritizing patients based on the severity of their injuries and the resources available, ensuring that those in critical condition receive timely care.

**Hemorrhage:** Excessive bleeding, often a critical concern in trauma cases that can lead to shock and organ damage.

**Hypovolemic Shock:** A state of shock caused by severe blood loss or fluid depletion, resulting in inadequate tissue perfusion and oxygen delivery.

**Hemothorax:** Accumulation of blood in the pleural cavity (space around the lungs) due to injury, causing impaired lung function and potentially leading to shock.

## Definitions of Terms -

**Glasgow Coma Scale (GCS):** A scoring system used to assess a patient's level of consciousness based on eye, verbal, and motor responses. It provides an objective measure of neurological function.

**Pneumothorax:** Presence of air in the pleural cavity, leading to lung collapse and impaired breathing.

**Tamponade:** A condition where blood accumulates within the pericardial sac, compressing the heart and impairing its ability to pump effectively.

**Crash Cart:** A portable cart equipped with emergency medical equipment and supplies for use during resuscitation efforts.

**Cervical Collar:** A device used to immobilize the neck and stabilize the cervical spine in trauma patients with suspected spinal injuries.

**Hypothermia:** Abnormally low body temperature, which can occur in trauma patients due to exposure or shock and can lead to further complications.

**Tracheostomy:** A surgical procedure to create an opening in the neck to provide an alternative airway for breathing, often performed in cases of upper airway obstruction.

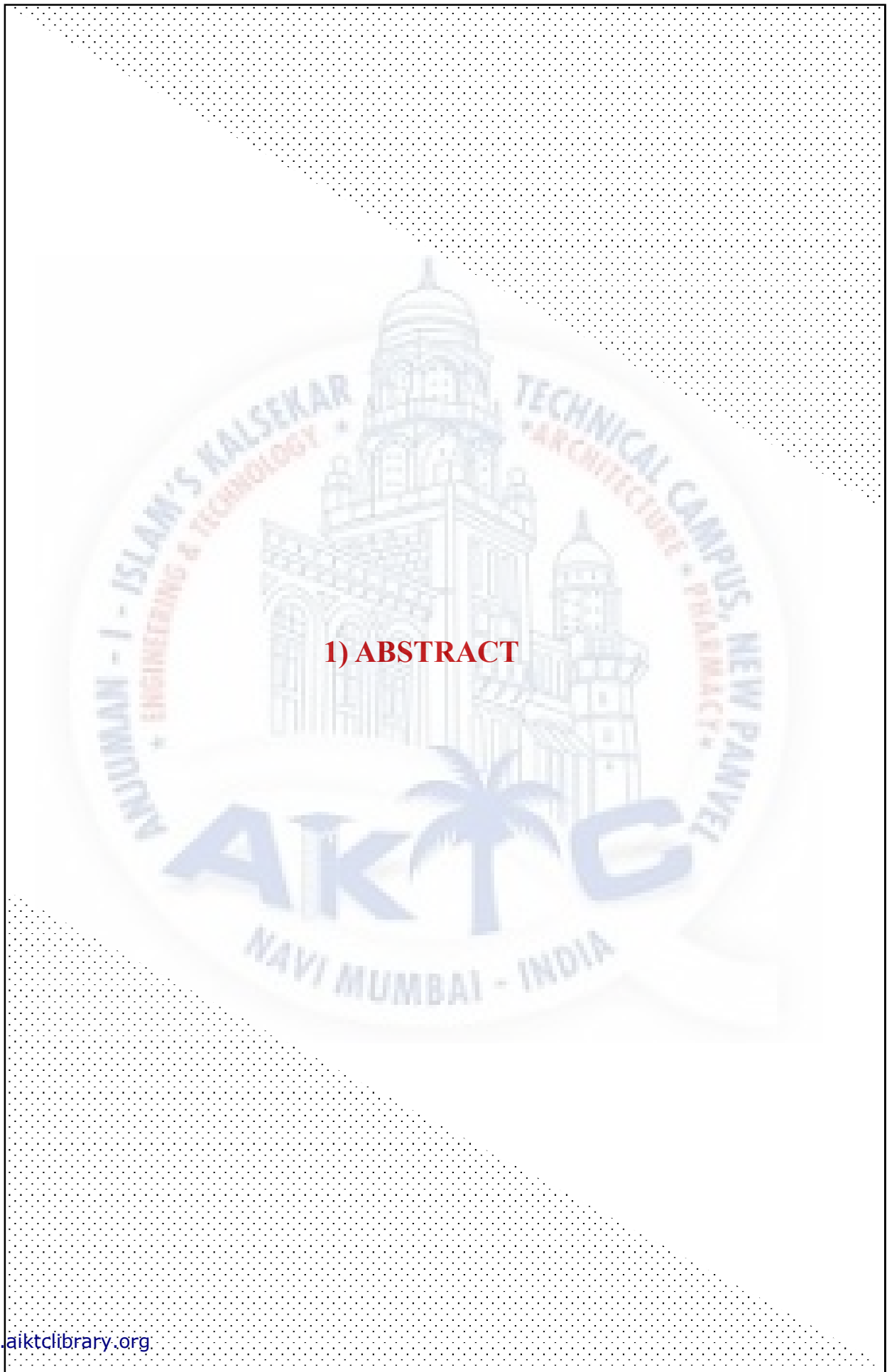
**Venous Thromboembolism (VTE):** A condition characterized by the formation of blood clots (thrombi) within veins, which can lead to deep vein thrombosis (DVT) or pulmonary embolism (PE).

**Debridement:** The surgical removal of dead or contaminated tissue from a wound to prevent infection and promote healing.

**Hemostasis:** The process of stopping bleeding, often achieved through various methods such as pressure, sutures, or hemostatic agents.

**Rehabilitation** - refers to the act of restoring something to its original state.





**1) ABSTRACT**

**Abstract -**

A **trauma center**, is a specialized hospital equipped and staffed to treat patients suffering from major traumatic injuries such as falls, motor vehicle collisions, or gunshot wounds.

Trauma continues to be a major global cause of death and morbidity, which poses a serious threat to public health. This thesis explores the various facets of trauma care with the goal of putting forth an integrated strategy that improves trauma patients outcomes by means of better methods for assessment, treatment, and rehabilitation.

This thesis concludes with an integrated trauma care framework that covers all stages of care, from the injury to rehabilitation and beyond, through a multidisciplinary examination of the infrastructure, Planning , functioning , future plans, and vision of the established trauma centers.

In order to enhance outcomes and save lives in the field of trauma care, the study intends to provide insightful information and improve the efficiency of trauma care facilities and their critical role in public health as we negotiate the intricate and unexpected terrain of severe injuries.

**Keywords** – Trauma, Emergency, Accidents, Injuries, Sufferings, Stress, Rural Access, Health, Life.

## Introduction -

A **trauma center**, is a hospital equipped and staffed to treat patients suffering from major traumatic injuries such as falls, motor vehicle collisions, or gunshot wounds

Trauma continues to be a pressing health concern, affecting millions of individuals each year globally. From road accidents and falls to violence and natural disasters, traumatic injuries present significant challenges to healthcare systems worldwide.

Over the years, advancements in medical technology, improvements in emergency response systems, and a deeper understanding of trauma physiology have led to notable progress in trauma care. However, despite these strides, trauma-related mortality and morbidity rates persist, particularly in resource-constrained regions where access to adequate healthcare services remains limited. Moreover, the burden of trauma extends far beyond the initial injury, often resulting in long-term physical, emotional, and socioeconomic consequences for both patients and their communities.

This thesis highlights the importance of addressing trauma as a public health priority and emphasizes the potential for reducing trauma-related mortality and disability through well-coordinated and evidence-based interventions.

Ultimately, this thesis aspires to contribute to the broader discourse surrounding trauma care as advancements in medical knowledge and technology continue to evolve, a unified approach to trauma care has the potential to transform the trajectory of countless lives impacted by traumatic injuries, forging a future where trauma no longer claims unnecessary loss and suffering..

## Hypothesis:

- The establishment of a dedicated Trauma Care Centre will significantly improve emergency medical response times for trauma incidents in Khardi-Shahapur region.
- Patients treated at the Trauma Care Centre will experience better outcomes and higher rates of recovery compared to those treated at non-specialized medical facilities.
- The presence of a Comprehensive Trauma Care Centre will lead to a reduction in trauma-related morbidity and mortality rates in the community

## Aim:

To establish a specific trauma care centre with an emphasis on improving patient care, emergency medical response, and overall outcomes for trauma victims at Khardi, Shahapur.

## Objectives:

1. To identify existing studies, guidelines, and best practices related to trauma care centers, emergency medical response, and patient outcomes.
2. To analyze the current state of trauma care and emergency medical services in the Khardi-Shahapur region and to identify gaps and areas for improvement.
3. To investigate the specific needs and requirements of a Trauma Care Centre, considering factors such as location, infrastructure, and specialized medical equipment.
4. To Assess the potential impact of a dedicated Trauma Care Centre on reducing response times and improving access to critical medical care for trauma patients

## Scope:

Healthcare in India is in a developing stage and it needs a radical policy shift at government level to face the challenges of the future. Health care provision in India is different in rural and semi urban settings .The sector suffers from long years of neglect by the government in terms of priority funding despite being a basic need of the community.According to the Health Ministry India accounts for almost 10% of total road accident fatalities in the world due to the large number of vehicles on Indian roads and the lack of any pre-hospital trauma care infrastructure, which is especially important when every minute affects the patient's chances of survival. At least 40% deaths occur on the roadside due to delay in treatment.

India's trauma care services are inadequate compared to the western countries. In terms of infrastructure and equipment most of the physical resources for in-hospital care are already available at most of secondary and tertiary care hospitals and need moderate upgrades.

The Government of India has set up the Jai Prakash Narayan Apex Trauma Center (JPNATC) at the All India Institute of Medical Sciences (AIIMS) in New Delhi a step forward in providing an apex institution for quality trauma patient care facilities, which act as a role model for other institutions and centers providing trauma care in the country.

In addition to offering the best patient care facilities, this trauma center's role has been envisioned as an advanced research and training facility that aids in the formulation of national rules governing the structure of trauma care institutions across the nation.

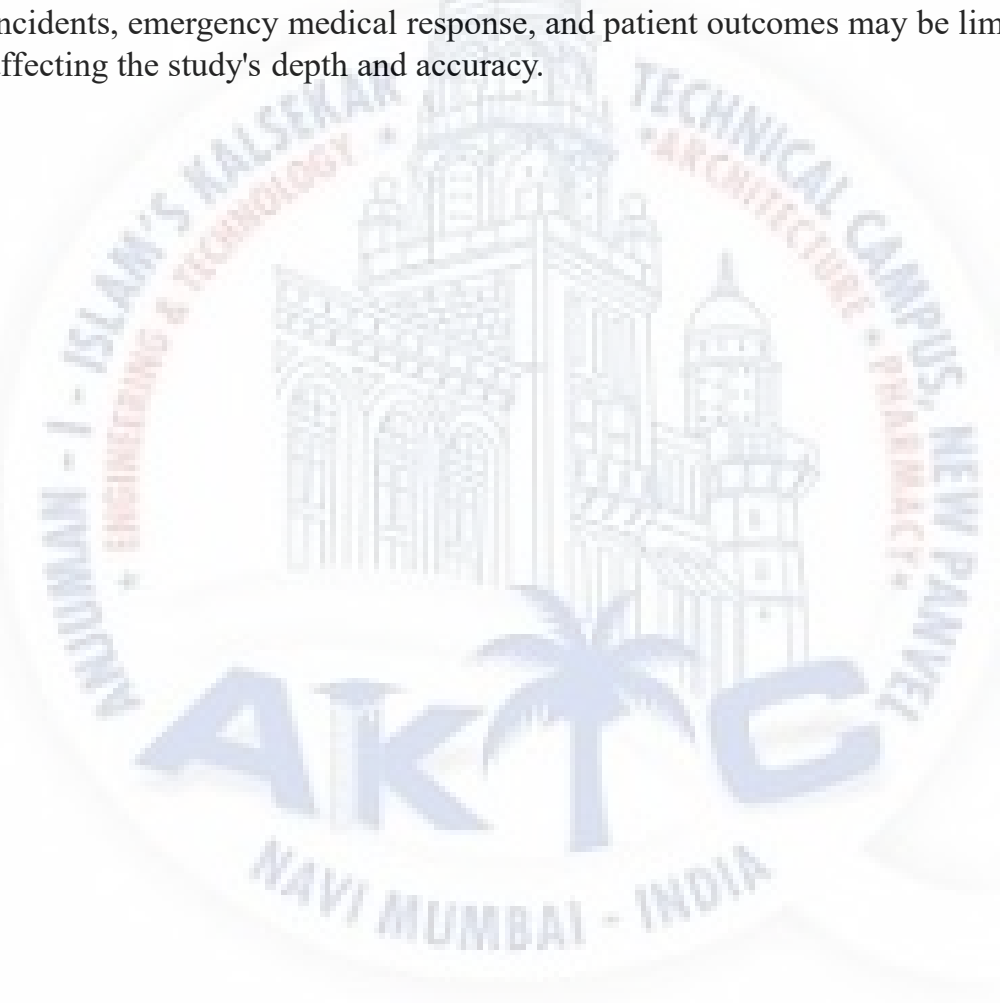
## Thrust Areas –

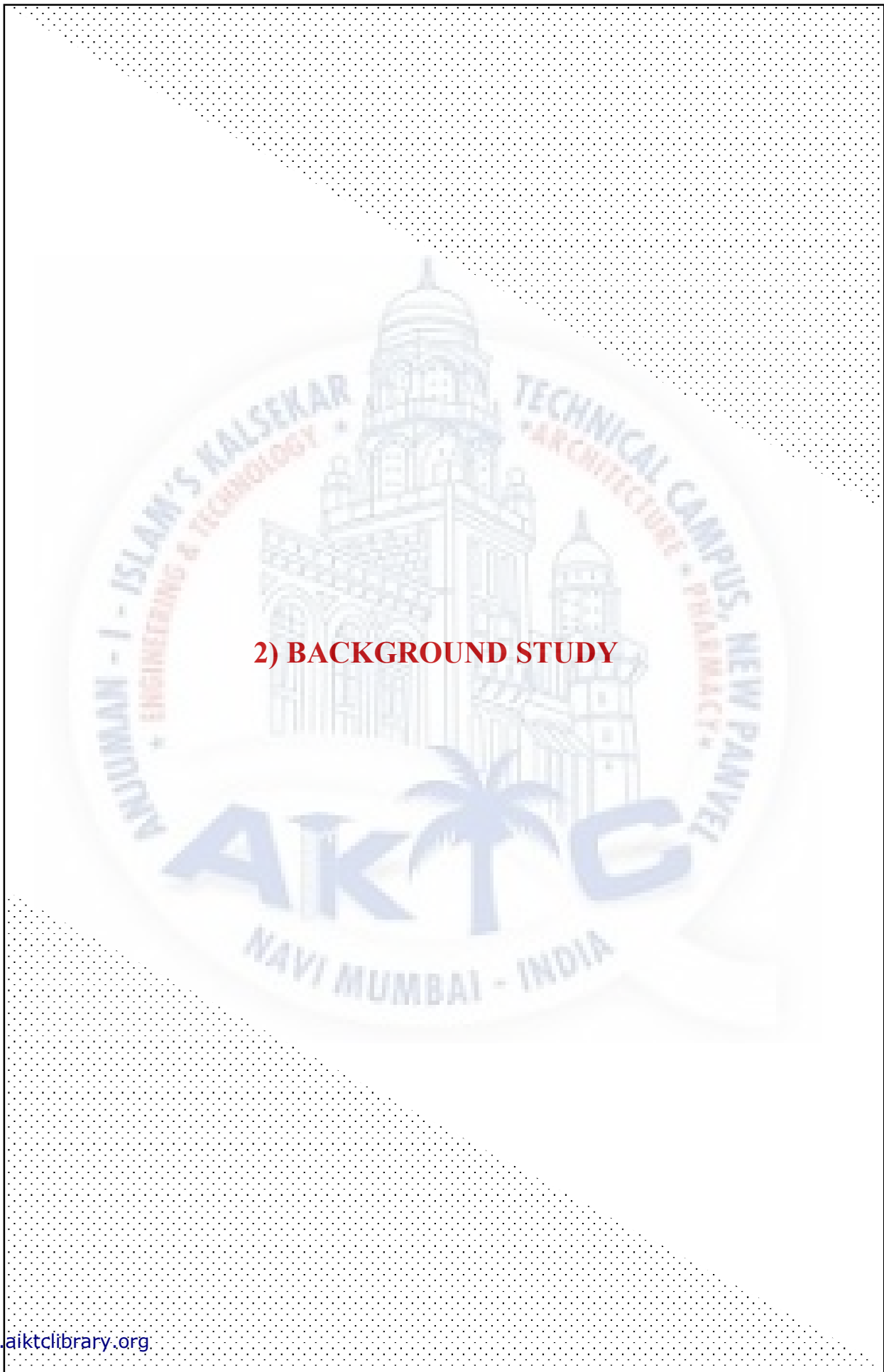
The Thrust areas in the field of trauma services are as follows -

- Provide physical resources/services with definitive care facilities for hospital care .
- Architecture as a Healing Aid: The study will look into the important role that architecture may play in enhancing healthcare environment for trauma patients.

## Limitations:

- Among all requirement of Hospital,Multi -specialty would be detailed and designed including various activities
- Geographic Specificity: The study's scope will be limited to a specific geographical area, and the findings may not be directly applicable to other regions with different healthcare infrastructures or demographic characteristics.
- Time Constraints: Depending on the timeframe for data collection and analysis, the study may not be able to capture long-term trends or developments related to trauma care services in the Khardi-Shahapur area.
- Data Availability: The availability of accurate and comprehensive data on trauma incidents, emergency medical response, and patient outcomes may be limited, affecting the study's depth and accuracy.





## 2) BACKGROUND STUDY

## 2.1) About Khardi :

Khardi is a town Located in the Shahapur taluka ,Thane district, of Maharashtra. It is also a station on the Mumbai Suburban Railway system on the Central line route between Kalyan and Kasara.

It is 1000 ft. above sea - level and is a tourist destination for people from Mumbai.

Khardi is located on National Highway No.3 one of the 4-lane highways which connect India's states. Khardi is surrounded by the Sahyadris, and places like Mahuli and Aaja are common spots for trekking.

The Maharashtra Government has declared Shahapur a center for tourism. Shahapur had an average literacy rate of 87%, higher than the national average of 59.5%.

District Shahapur supplies the drinking water to Mumbai for which the government of Maharashtra has declared this town to be a "No Chemical Zone"; no one can start a chemical industry here.

Three large water fresh bodies surrounding Khardi help keep temperatures down.

(Approx. Distance from Thane City is about 60 km)

Dwellers from Mumbai and surrounding towns have made Khardi their second home while few have migrated to Khardi. Khardi is accessible by rail or road and is surrounded by three lakes (Bhatsa, Tansa, and Vaitarna), which are a major source of drinking water for Mumbai And Thane city.

This Town is also the location for the Tansa reserved forest.

### Location

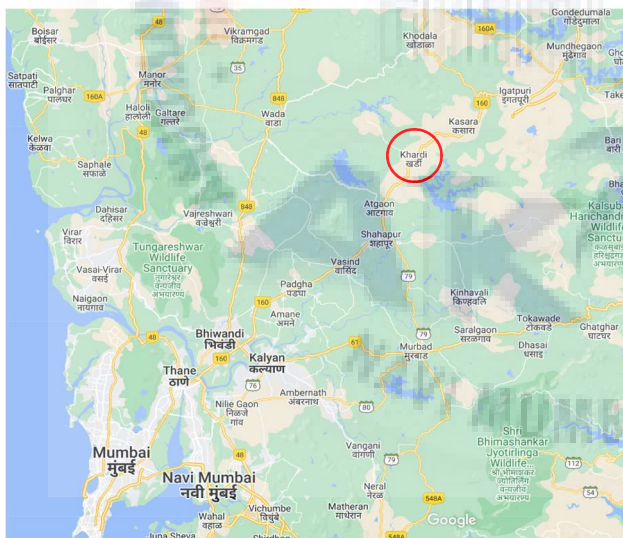


Image - 01  
Macro level map

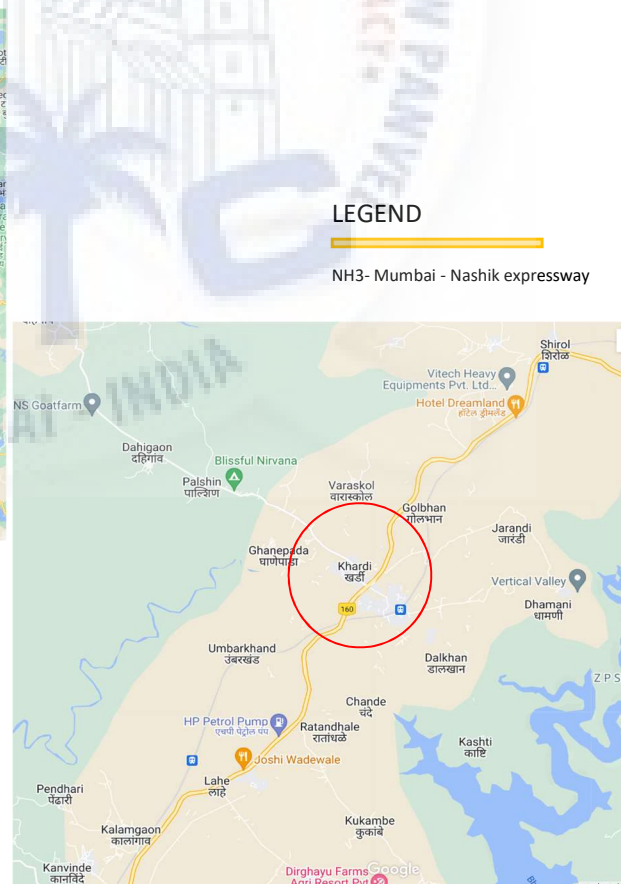


Image - 02  
Micro level map



### 2.1.1) Educational Facilities :

Khardi as a town has about 10 gov primary schools up to level 8<sup>th</sup>, 2 Gov & 3 private schools up to level 10<sup>th</sup> and 2 junior colleges up to level 12<sup>th</sup>. KHARDI VIBHAG EDUCATION SOCIETY'S HIGHSCHOOL & JUNIOR COLLEGE KHARDI is the oldest school and Jr.college in Khardi and was established in the year 1963 This school consists of Grades from 5 to 12. Other Educational facilities include -

#### Primary School

- Z.P. School, kumbhyachapada
- Z.P. School, pimpalpada
- Z.P. School, bendekon
- Z.P. School, dalkhan no.2
- Z.P. School, talekhan
- Z.P. School, jarandi
- Z.P. School, ghanepada
- Z.P. School, Khardi
- Bhakti sangam vidyalay sec.
- Z.P. School, vaytagwadi

#### Junior Colleges

- Sonubhau Baswant College Of Arts And Commerce
- Bhimrao Pradhan College
- G.V Khade Vidyalay
- Jeevandeep Shaishanik Sansthas Arts, Commerce And Science.

#### Technical Institutes

- Shivajirao S Jondhle Institute Of Management Science and Research.
- Alamuri Ratnamala Institute Of Engineering And Technology.
- Atma Malik Institute of Technology & Research.

#### Healthcare Facilities :

Khardi has some basic healthcare facilities in the main town area ,which includes 1 Government hospital and number of private clinics.

However higher medical treatments is not available in the region and the nearest hospital for it is around 25 km away .

There are private emergency hospital being built recently and under construction stage currently.

#### Government Hospital

Primary Health Centre ,Khardi

#### Private Clinics

Around 10 small clinics in the main town and major hospital at Shahapur (25 km away from the town)

### 2.1.2)Infrastructure:

NH3 – MUMBAI – NASHIK EXPRESSWAY



Now Renamed as (NH60) Image - 03  
Mumbai - Agra Expressway

KHARDI RAILWAY STATION



(Station Between Central Rly Image - 04  
Mumbai-Kasara line)



BHATSA DAM Image - 05



VAITARNA DAM Image - 06



TANSA DAM Image - 07



AJMERA HERITAGE CITY Image - 08

An advertisement for 'Our Town The Villa Township'. It features a house and a lake. The text includes 'OUR TOWN', 'THE VILLA TOWNSHIP', 'Parsi owned Project', 'Low Investment..High Returns', 'Pay Rs 30,000 into 36 interest-free monthly installments for freehold Villa Plot', and contact information: 'Call : +91 9821015865, 9833353628 ourtown9@gmail.com'. The website 'www.ourtownindia.com' is also mentioned.

OUR TOWN Image - 09



CHANDAN PARK Image - 10

## 2.2) About Trauma Centre -

A trauma center is a specialized hospital that treats victims of physical trauma. Physical trauma is characterized as a blunt, piercing, or burn damage that necessitates rapid medical attention in order for the victim to survive. These injuries are most frequently caused by falls, car accidents, gunshots, stabbings, and/or burns. A trauma surgery team that is highly trained to handle severe injuries is on duty 24 hours a day, 7 days a week in a trauma center. The trauma center team must maintain the patient's treatment after stabilization until the patient is discharged from the trauma center.

### Year Wise Road Accidents in India

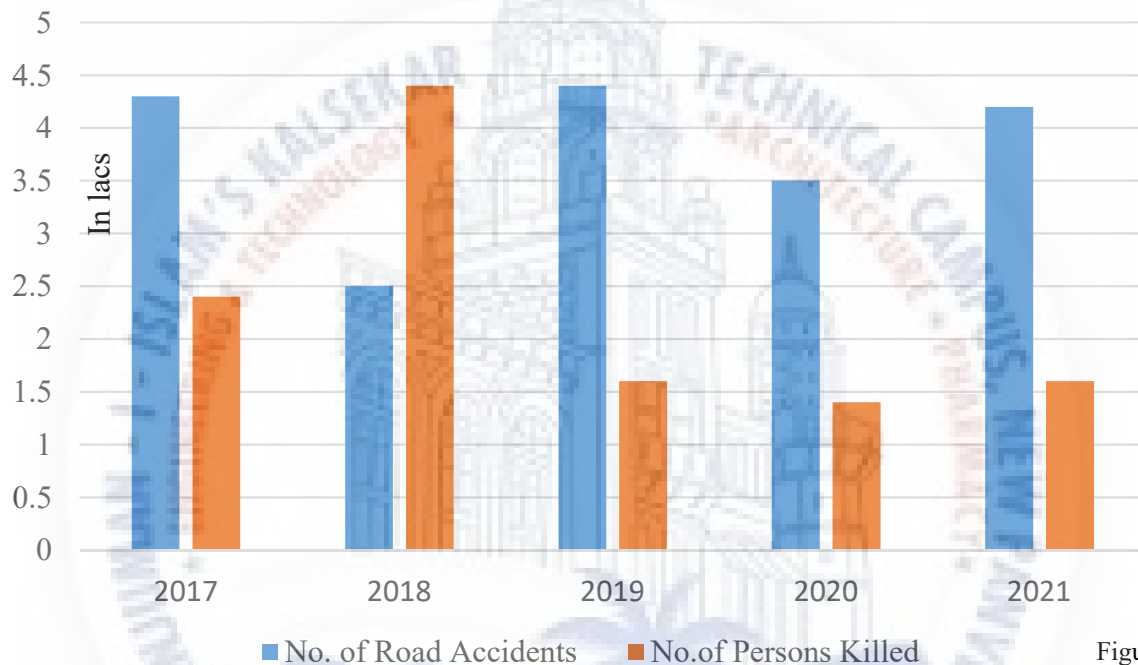


Figure - 01

As per the Ministry's annual report on road accidents based on the data reported by Police authorities throughout India, road safety continues to be a cause for concern:

Parameter	2019	2020	2021
Number of road accidents	4,49,002	3,66,138	4,12,432
No. of persons killed	1,51,113	1,31,714	1,59,972

Source –[app.powerbi.com/MoRTH](http://app.powerbi.com/MoRTH)

Table - 01

### 2.2.1)What causes the trauma?

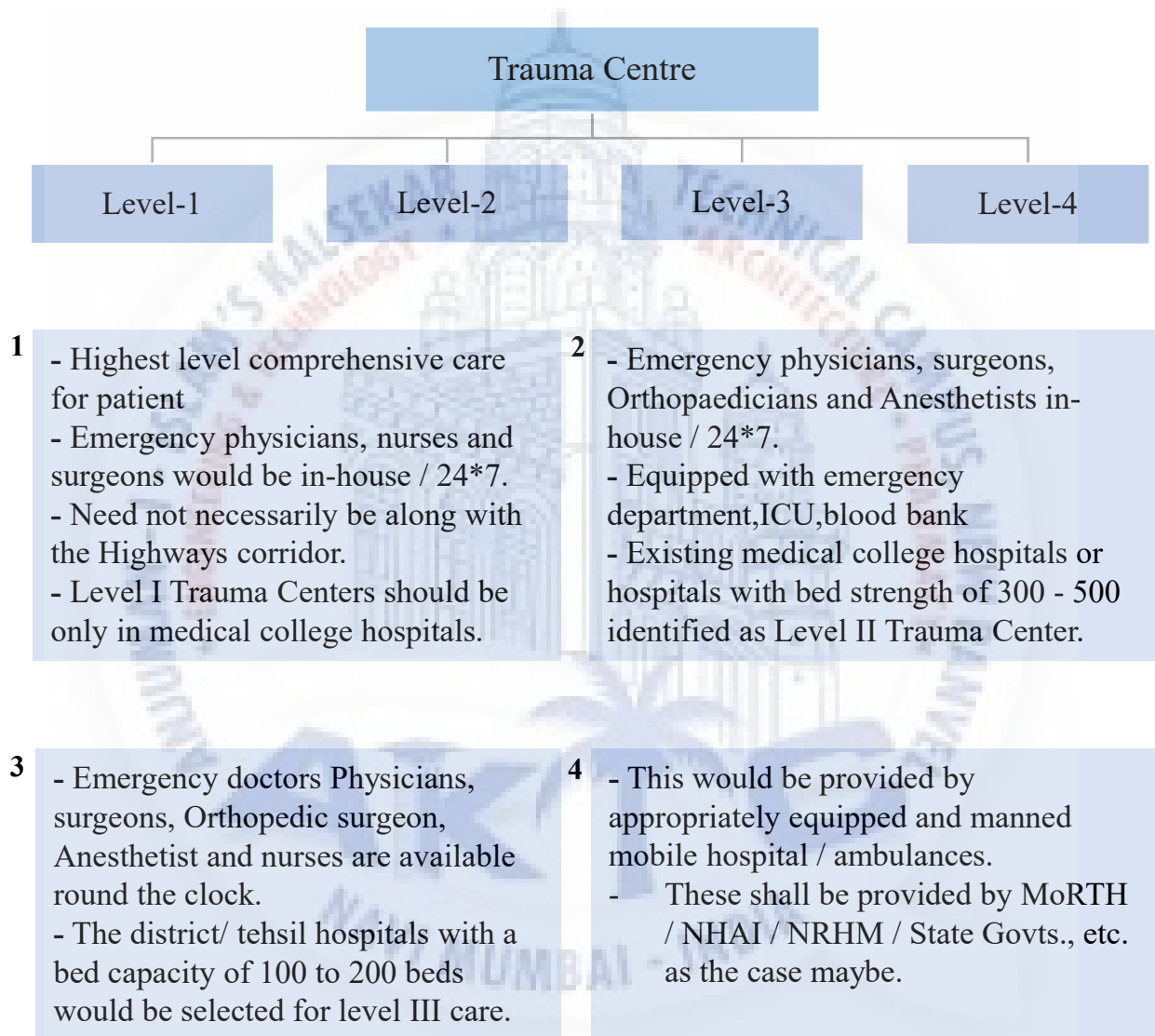
- Serious accidents
- Natural disasters
- Robbery
- Construction site Accidents
- Rape
- Major surgeries
- Chronic or repetitive experiences (e.g. Child abuse, cheating, lying, and neglect.)
- War, combat and concentration camps
- Hostile environment
- Oppression arguments
- Break-ups
- Major life changes
- Become part of negative spiral from previous trauma

### 2.2.2)Trauma System design –

The trauma care network has been so envisaged that no trauma victim has to be transported for more than 50 kilometers and a designated trauma care facility is available at every 100 Km. A Trauma Care Facility often referred to as ‘Trauma Centre’ is a healthcare institution that has the resources and capabilities necessary to provide trauma services at a particular level to injured patients. Trauma center designation criteria set strict requirements for staffing, specialist availability, response times, training, quality improvement and community education. This facility verification and designation is an important foundation for the success of an inclusive trauma system. Instead of an area-centric approach, trauma care is confined to specialized care in hospitals. Reaching the right hospital at the right time is .

### 2.2.3)Types of Trauma centers -

The Ministry of Health & FW started a pilot project (1999) during the Ninth five year plan to augment and upgrade the accidents and emergency services in selected State Govt. The scheme envisaged providing financial assistance for upgrading emergency services of selected Government hospitals. Under this scheme, Trauma Care Facilities have been categorized into four levels:



Source –Mohfw.gov.in

Figure- 02

## 2.3) Types of Trauma Injuries

### Bone fracture

A bone fracture is the medical definition for a broken bone. A bone fracture is a crack or break in a bone. Bone fractures usually result from a high force impact or stress. But, people with osteoporosis or bone cancer may experience a fracture with very little impact.

### Spinal Cord Injury

A spinal cord injury (SCI) is damage to the tight bundle of cells and nerves that sends and receives signals from the brain to and from the rest of the body. The spinal cord extends from the lower part of the brain down through the lower back

### Traumatic Brain Injury

A traumatic brain injury (TBI) can be caused by a forceful bump, blow, or jolt to the head or body, or from an object that pierces the skull and enters the brain. Not all blows or jolts to the head result in a TBI. Some types of TBI can cause temporary or short-term problems with normal brain function, including problems with how the person thinks, understands, moves, communicates, and acts. More serious TBI can lead to severe and permanent disability, and even death.

### Concussion

A concussion is a mild traumatic brain injury (TBI) that can occur after an impact to your head .

Concussions can also happen during a whiplash-type injury that causes your head and brain to shake quickly back and forth.

Not every bump to the head will cause a TBI. But concussions can cause noticeable symptoms that shouldn't be ignored. These include headaches an altered mental state and even loss of consciousness

### Burns

Damage to the skin or deeper tissues caused by sun, hot liquids, fire, electricity or chemicals.

There are three primary types of burns: first-, second-, and third-degree. Each degree is based on the severity of damage to the skin, with first-degree being the most minor and third-degree being the most severe.

## 2.3) Types of Trauma Injuries

### Facial Trauma

Facial injuries are most commonly caused by motor vehicle accidents and assault.

Facial trauma can involve facial bleeding, swelling, bruising, lacerations, cuts, burns and deformity.

### Pneumothorax

A pneumothorax is a collection of air outside the lung but within the pleural cavity. It occurs when air accumulates between the parietal and visceral pleura inside the chest. The air accumulation can apply pressure on the lung and make it collapse.

### Crush Injury

Crush injury: Injury caused as a result of direct physical crushing of the muscles due to something heavy. It is recorded that upto 80% of crush injury patients die due to severe head injuries

### Ballistic Trauma

Ballistic trauma is also referred to as projectile trauma, is trauma sustained from any type of firearms or munitions

### Skull Fracture

A skull fracture is any break in the cranial bone (skull). There are various type of skull fracture depending upon force of blow & location

Source – ninds.nih.gov  
 Medical news today.com  
 Healthline.com  
 Ncbi.com  
 Sciencedirect.com

Figure- 03

## 2.4) Consequences of Trauma-

- The consequences of trauma widely varies depending on the individual and the nature of the traumatic experience.

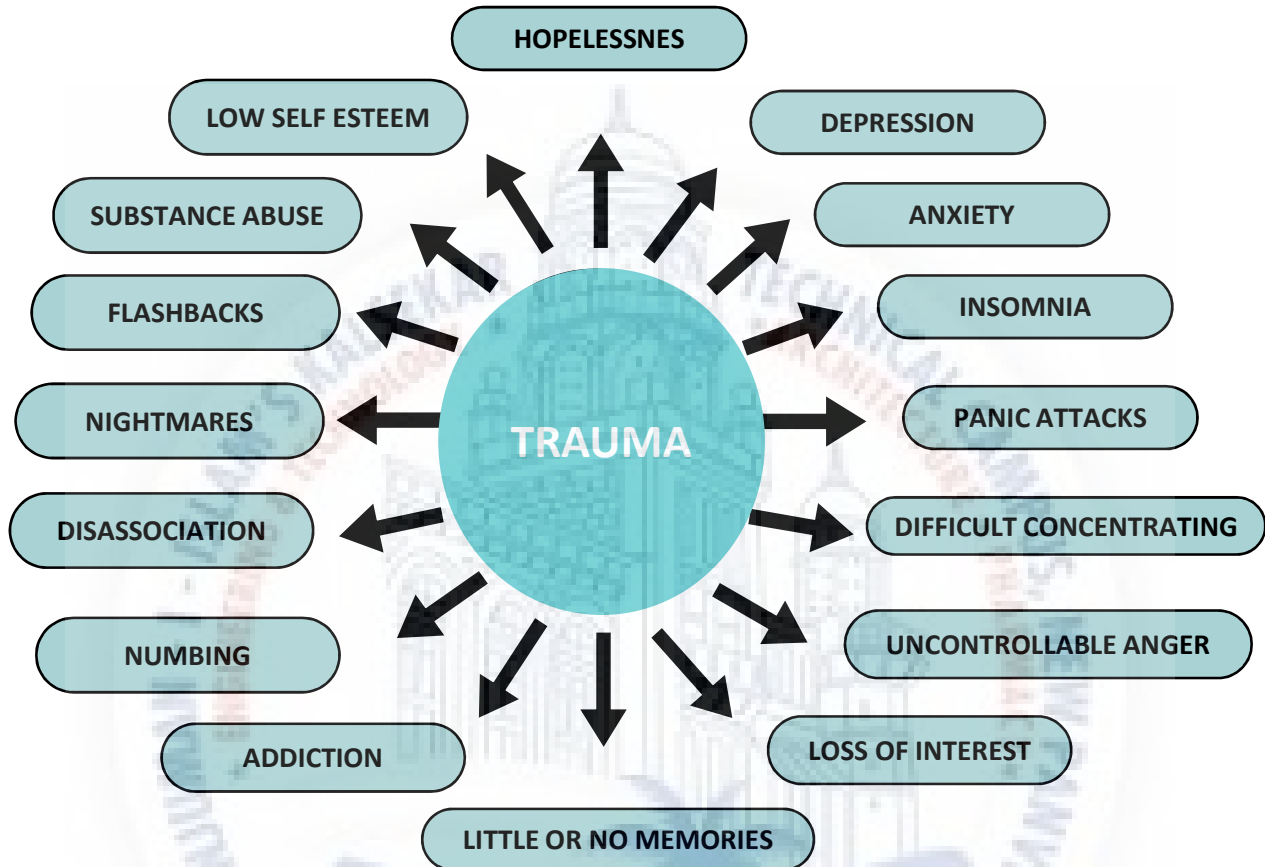


Figure- 04



## 2.5)History of Trauma Centre's

- Systems of care for injured service members were first implemented during the Civil War from 1861-1865. Triage, aid stations, and rapid transport to field hospitals or general hospitals would be rudimentary by today's standards, but this system was a significant achievement of the time and set the stage for injury management during World Wars I and II.
- Trauma Centre's grew into existence out of the realization that traumatic injury is a disease process unto itself requiring specialized and experienced multidisciplinary treatment and specialized resources. The world's first trauma centre, the first hospital to be established specifically to treat injured rather than ill patients, was the Birmingham Accident Hospital, which opened in Birmingham, England in 1941.

### 2.5.1)Evolution of Trauma Centre's in India

The evolution of trauma centers in India has been a significant development in the country's healthcare system. The growth of trauma centers in India can be traced through several key phases:

#### Early Stages:

- Historically, trauma care in India was often provided in general hospitals and emergency departments.
- Limited facilities and expertise were available for the comprehensive management of trauma patients.
- Trauma care was mainly the responsibility of general surgeons and emergency physicians.

#### Formation of the National Trauma Management Committee:

- In 2005, the Ministry of Health and Family Welfare in India constituted the National Trauma Management Committee.
- This committee played a significant role in developing guidelines and standards for trauma care in India.

#### Trauma Care Systems:

- The concept of trauma care systems was introduced, emphasizing a network of care that includes pre-hospital care, trauma centers, and rehabilitation services.
- The development of emergency medical services (EMS) became an essential component of this system.

#### Introduction of Trauma Centers:

- Over the years, many hospitals and medical institutions across India have developed specialized trauma centers.
- These centers are equipped with advance facilities, including trauma bays, operating rooms, intensive care units, and specialized staff trained in trauma care.
- Trauma care systems in India are still in their early stages of development. Across the country, there's a significant disparity in the availability of trauma services. Rural areas, often constrained by finances and a lack of proper healthcare infrastructure, face inefficiencies in trauma care. India lacks a centralized coordinating agency for trauma systems and has no accreditation mechanism for trauma centers and professionals. Although injuries are a major public health concern, they have yet to be fully recognized as a significant public health challenge by the government, medical community, and society.

## 2.5.2) Government Trauma Care Hospitals Scenario in India

- In India, there is a scarcity of dedicated government trauma care hospitals.
- Most government healthcare institutions, including sub-district and district hospitals, have emergency departments that attend to trauma patients. Unfortunately, many of these facilities lack comprehensive infrastructure and treatments, necessitating patient transfers to other hospitals for further care. This can be particularly challenging during emergencies, such as accidents or falls.
- In light of this critical situation, the Government of India has initiated a strategic plan to establish a network of trauma care centers along national highways.
- The primary objective of this endeavor is to significantly reduce preventable fatalities resulting from traffic accidents. The urgent need for this initiative arises from the fact that swift and effective medical attention is often the difference between life and death in such scenarios.
- Beyond the primary focus on traffic accidents, these trauma care centers will also play a pivotal role in providing essential treatment to patients afflicted by other traumatic diseases or injuries. This broader mission underscores the importance of these facilities in addressing a wide spectrum of healthcare needs.
- In essence, the establishment of trauma care centers along national highways is a laudable step toward enhancing public health and safety in India. It represents a vital contribution to reducing preventable fatalities on the road and addressing the medical needs of individuals suffering from various forms of trauma.

## 2.6) Healthcare system In India -

### Classification of hospitals based on Ownership/Management -

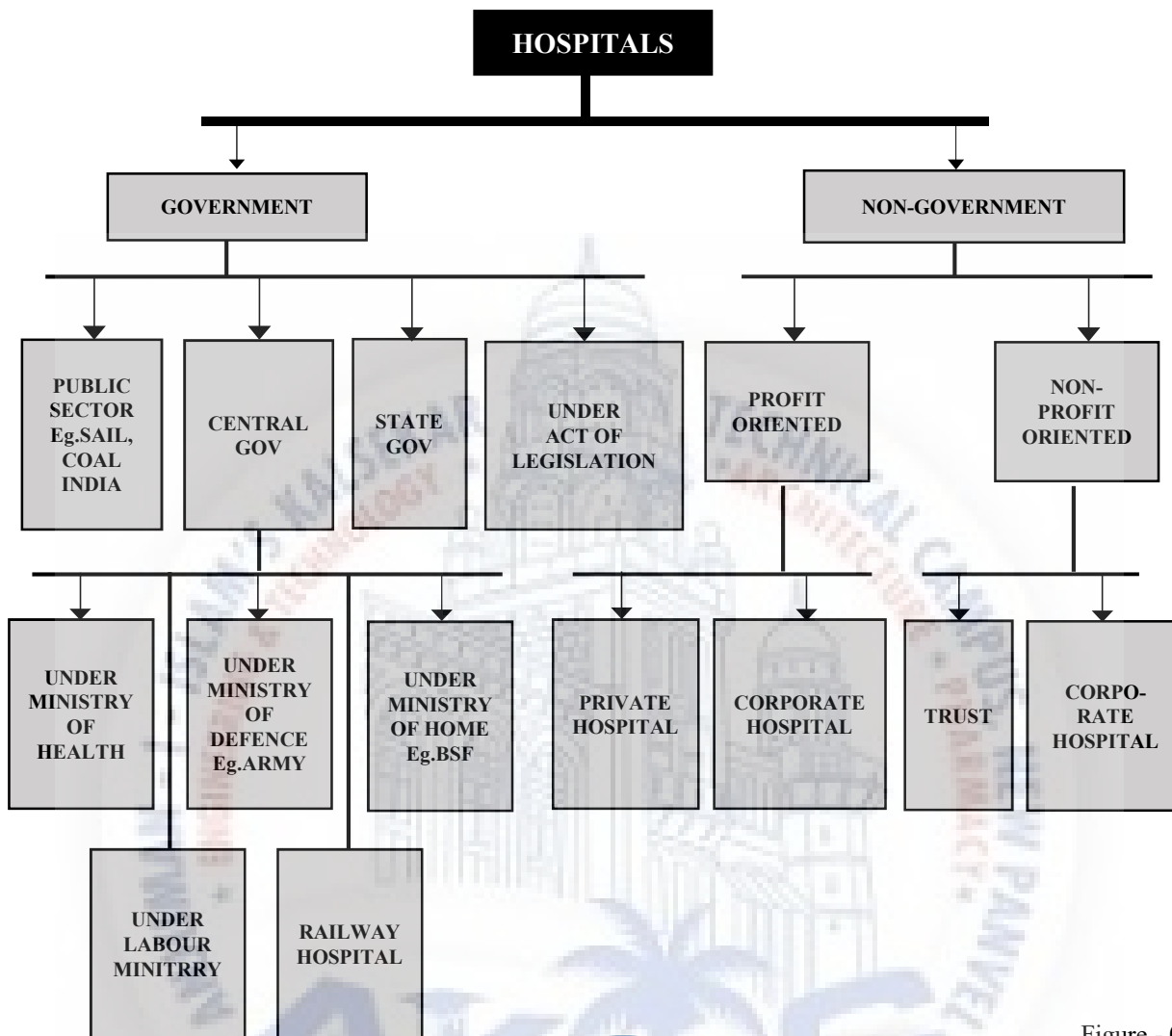


Figure - 05

### Types of hospitals based on objectives -

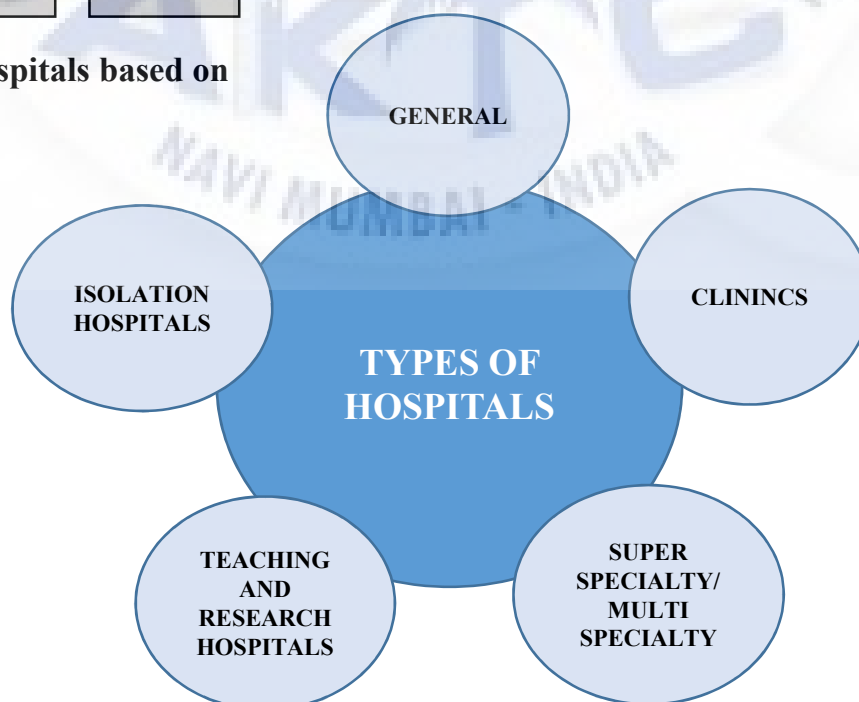


Figure - 06

## 2.7) About : National highway's (NH)

Approximately 25% of all road accidents in India occur on national highways, leading to a significant increase in the mortality rate. In response to this concerning trend, the Ministry of Health & Family Welfare has initiated the "Capacity Building for Developing Trauma Care Facilities in Government Hospitals on National Highways" program. This program's primary objective is to establish 140 trauma centers along the Golden Quadrilateral & North-South, East-West Corridors at a total cost of 732.25 crores. Given that the proposed trauma centers will primarily cater to victims of accidents on national highways, it is imperative to conduct a comprehensive study of these highways in India. This study should encompass aspects such as the number of national highways, their total length, and their connectivity to various regions across the country

### What is a National highway (NH)

National highways are the roads that connects state capital and industrial cities with harbors. The speed limit of national highway is 80 to 100 kmph These highways are constructed and maintained by the central government. The milestones in these highways are painted particular with yellow & white with NH number Example: NH44. It is the longest highway, which runs between Srinagar in Jammu and Kashmir and Kanyakumari in Tamil Nadu.



Image - 11

Representative Image  
Source-Economic times

### History

In 1956, the National Highways Act was passed. However the backbone of the Indian road network was set up under the Parliament Act in 1988.

To connect India's four largest cities, the National Highways Development Project (NH DP) was started.

The national roads in Delhi, Chennai, Kolkata, and Mumbai have been paved with four lanes.

A new numbering system based on the geographic location of the roads was later introduced in 2010 by the Ministry of Road Transport and Highways.

This method was chosen so that new roadways built in more recent years would be consistent. From NH2, the routes' even numbers were assigned.

### National highways of India

The road system in India is ranked as the second largest in the world. Expressways, freeways, state highways, and national highways are all included. The road network links towns, cities, ports, and capitals. Among these trunk roads, the National Highway Authority of India (NHAI) has built a vast national highway network. The Ministry of Road Transport & Highways, Government of India, is the legal owner of both the National Highways and Infrastructure Development Corporation Limited (NHIDCL) and the NHAI. All of India's national highways are promoted and surveyed by these nodal organizations. They are also in charge of planning and building National Highways and Strategic Roads. Roads in the nation have international borders with nearby nations on a few of them. Consequently, the national highway promotes and protects cross-border trade in commodities and safeguards India's international borders.

## Examples of some Major National highways In India :

NH -1 connects Delhi to Amritsar (via Ambala and Jalandhar).

NH-3 Connects Mumbai to Agra NH-7 connects Varanasi to Kanyakumari (via Nagpur, Bangalore and Madurai).

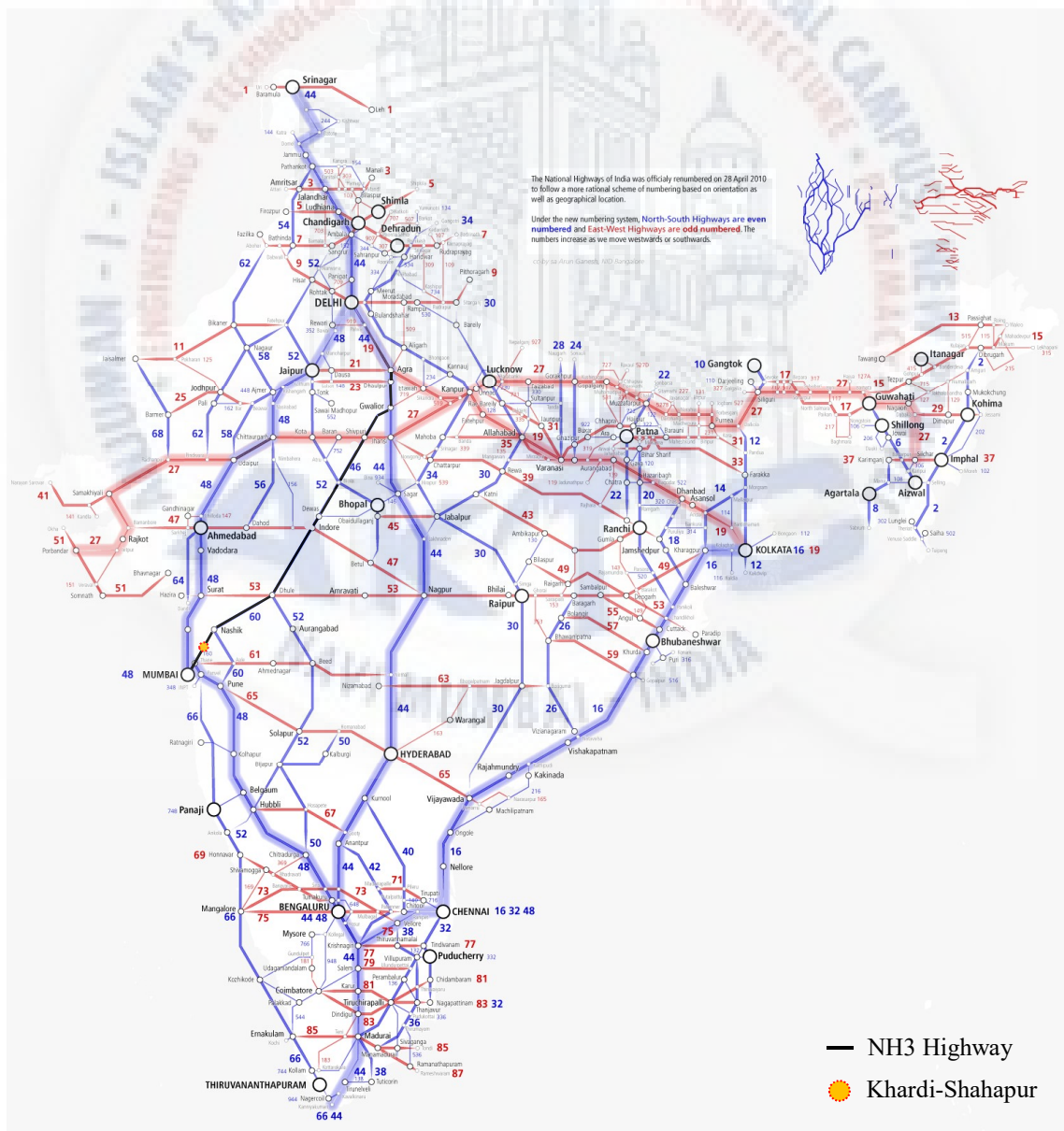
NH-24 connects Delhi to Lucknow.

•NH 27 connects Porbandar in Gujarat to Silchar in Assam.

•NH 34 connects Gangotri Dham in Uttarakhand to Lakhnadon in Madhya Pradesh.

## Numbering system of National highways

On April 28, a numbering system was initiated by the Ministry of Road Transport and Highways to give specific names to the highways. All of the major highways have single or double digit numbers according to the new numbering scheme. Highways running north to south have even numerals, whereas those running east to west have odd digits. Additionally, these networks' secondary branches have three-digit numbers.



## 2.7.1) List of National Highways in India.

Sr.No	New Name	Old Name	Description
1	NH1	NH1A and NH1D	One of the Oldest Highways in India (connects Delhi & Amritsar)
2	NH4	NH223	Connects Mumbai & Chennai via Pune
3	NH5	NH21, NH22 and NH95	
4	NH16	NH5, NH6 & NH60	Part of Golden Quadrilateral (connects Chennai and Kolkata via Bhubaneshwar)
5	NH19	NH2	Connects Palanpur in Gujarat & Panvel In Maharashtra
6	NH21	NH11	Connects Ambala in Haryana with Chandigarh
7	NH40	NH18 & NH4	Connects Hyderabad with Bangalore
8	NH41	NH8-A	Connects Ahmedabad with Kandhla in Gujarat
9	NH44	NH7	Connects Srinagar in Jammu with Kanyakumari in T.N
10	NH45	NH7	Connects Dandigul in T.N with Bangalore
11	NH48	NH8	Connects Delhi & Mumbai via Jaipur, Ahmedabad and Vadodara (part of Golden Quadrilateral)
12	<b><u>NH60</u></b>	<b><u>NH3 &amp; NH50</u></b>	<b><u>Connects Kolkata &amp; Mumbai Via Khragpur, Bhubaneshwar &amp; Vishakhapatnam</u></b>
13	NH65	NH9	Connects Pune in Maharashtra with Machilipatnam in Andhra Pradesh
14	NH110	NH55	Connects Salem with Karur in T.N
15	NH112	NH35	Connects Kolkata with Dawki in Meghalaya
16	NH114	NH2B	Connects Cities of Moradabad and Saharanpur in U.P
17	NH129	NH39	Connects Numaligarh in Assam with dimapur in Nagaland
18	NH138	NH7-A	Connects Hyderabad with Machilipatnam in Andhra Pradesh
19	NH147	NH8-C	Connects Ahmedabad with Dholera in Gujarat
20	NH148	NH11-A	Connects Dehradun with Chamba in Himachal Pradesh
21	NH151	NH8-D	Connects Godhra with Bamanbore in Rajasthan
22	NH156	NH79	Connects Anand in Gujarat with Udaipur in Rajasthan
23	NH244	NH1B	Connects Delhi & Kolkata (part of Golden Quadrilateral)
24	NH319	NH30	Connects Ahmedabad with Dholka in Gujarat
25	NH320	NH23	Connects Barhi with Hazaribagh in Jharkhand
26	NH348	NH4-B	Connects Hospet in Karnataka with Hubli
27	NH519	NH2A	Connects Gwalior in M.P with U.P
28	NH530	NH24	Connects Delhi with Lucknow
29	NH544	NH47	Connects Salem in T.N with Kanyakumari
30	NH731	NH56	Connects Varanasi in U.P with Ranchi
31	NH748	NH4-A	Connects Belgaum in Karnataka with Goa
32	NH966-A	NH47-C	Connects Kundanoor with Vytilla hub in Kochi ,Kerala
33	NH966-B	NH47-A	Connects Kundanoor with Willingdon Island in Kochi, Kerala

Source-Studyyiq.com

Table - 02

After renumbering of all national highways by National Highway Authority of India in 2010, the former NH 3 has been broken into several new national highway numbers and the old NH 3 number has ceased to exist.

## 2.7.2) Total length of highways In Maharashtra (in kms)

Year	2005-2007	2007-2009	2009-2011	2011-2013	2013-2015	2015-2017	2017-2019	2019-2021
<b>Length</b>	<b>4176</b>	<b>4176</b>	<b>4191</b>	<b>4498</b>	<b>7048</b>	<b>16239</b>	<b>17757</b>	<b>17931</b>

Source: Ministry of Road Transport and Highways, Government of India.

Table - 03

## Total Length of National Highways in India in (KM)

Year	Total Length in (KM)	Year	Total Length in (KM)
2009 - 2010	70,934	2022-2023	145,240
2008 - 2009	70,548	2021 - 2022	140,995
2007 - 2008	66,754	2020 - 2021	136,440
2006 - 2007	66,590	2019 - 2020	132,995
2005 - 2006	66,590	2018 - 2019	132,500
2004 - 2005	65,569	2017 - 2018	126,500
2003 - 2004	65,569	2016 - 2017	114,158
2002 - 2003	58,112	2015 - 2016	101,011
2001 - 2002	58,112	2014 - 2015	97,991
1991 - 2001	57,737	2013 - 2014	91,287
1981 - 1991	33,650	2012 - 2013	79,116
1971 - 1981	31,671	2011 - 2012	76,818
1961 - 1971	23,838	2010 - 2011	70,934
1950 - 1961	23,798		

Source: MoRTH.nic.in

Figure - 07

The data presented underscores the steady year-on-year development of India's road network, an essential component of the country's infrastructure. However, it's imperative to acknowledge that this growth in road infrastructure has led to a commensurate increase in road traffic.

The heightened traffic on these roadways has its merits, but it also brings forth a concerning issue - the surge in road accidents. Unfortunately, a consequence of increased road traffic is a higher incidence of accidents, which, in turn, results in a rise in fatalities and injuries on Indian roads.

In conclusion, the expansion of India's road network, while contributing to economic growth, has also led to an increase in road traffic and, regrettably, a surge in road accidents. To effectively counteract the rising fatalities and injuries resulting from these accidents, the establishment of a well-structured network of trauma hospitals is not just a necessity but a crucial element in promoting road safety and safeguarding the well-being of the nation's citizens

### 3.1) RESEARCH METHODOLOGY –

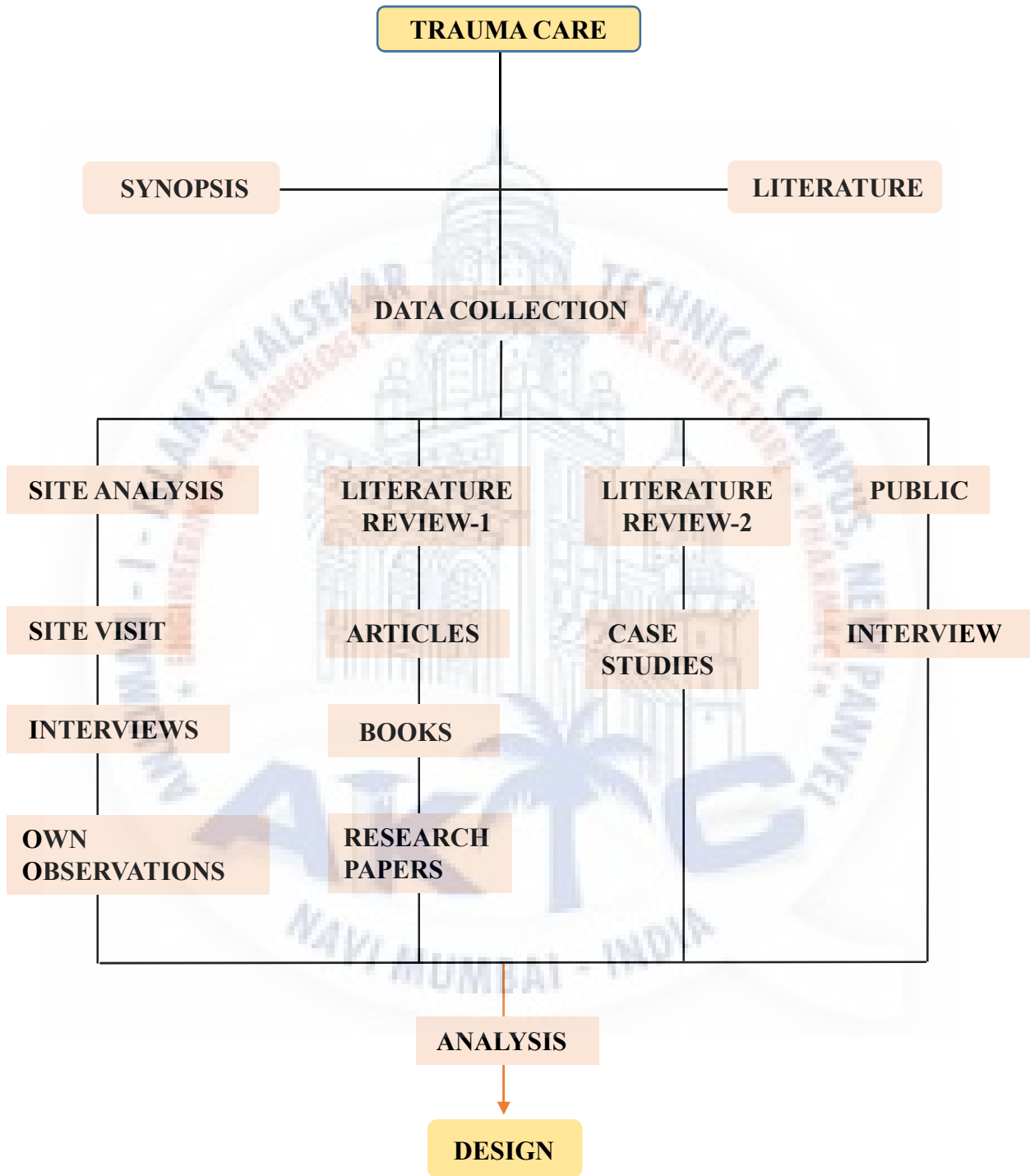
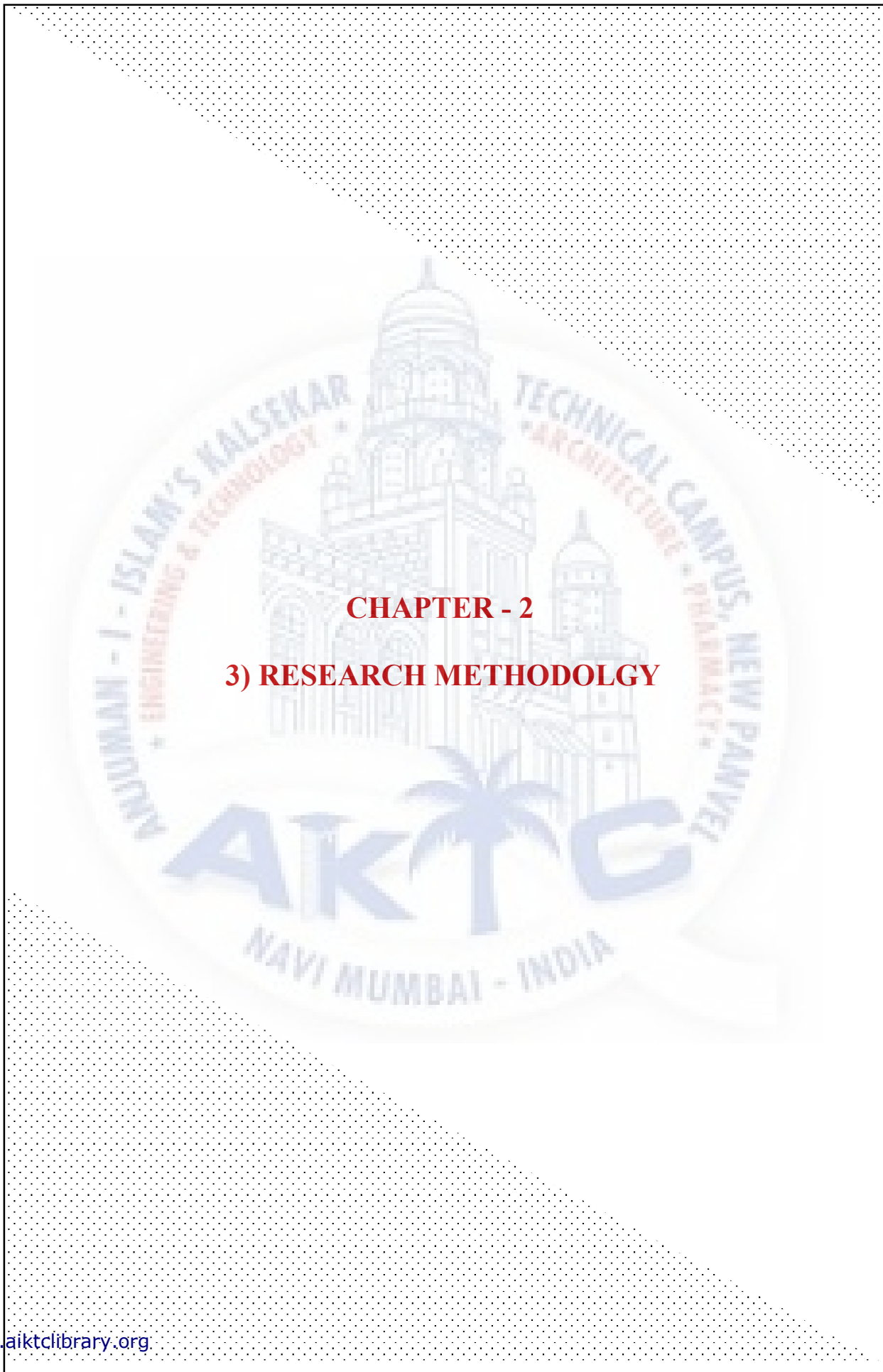


Figure - 08





## CHAPTER - 2

### 3) RESEARCH METHODOLOGY

## 4.1) LITERATURE REVIEW -1

### News Article

# Need for emergency medical services in rural India : Manish Sacheti

Providing quality healthcare to rural populations is a vital, but highly overlooked issue in the developing world.

ETHealthWorld

Published On Feb 22, 2018 at 08:30 AM IST

Read by:

1191 Industry Professionals



Image - 14

By **Manish Sacheti**

CFO, Ziqitza Healthcare Limited,  
Mumbai

Healthcare is a foremost requirement for the citizenry of every nation, unfortunately, when it comes to medical services,

particularly in rural areas, several countries including India lag considerably. Providing quality healthcare to rural populations is a vital, but highly overlooked issue in the developing world.

India, the world's most populous democracy, has struggled with establishing Emergency Medical Service (EMS) for all sections of society. Fortunately, in recent years, the emergency medical service scenario in urban India has undergone a major transformation and there are now innumerable hospitals, responsive ambulance services, and improved medical facilities available in metropolitan India.

Source – Economic Times

Image - 13

### Inference –

- This Article talks about the challenges in healthcare that Rural Society of India Currently faces which is lack of emergency medical service .
- It Also speaks about how medical system is crucial in saving lives during a emergency.
- And lastly how a coordinated participation of EMS agencies, government, police and fire departments, hospitals, and the community is essential to ensuring maximum efficiency.

## News Article - Road Accidents in India

### AP India's stretched health care fails millions in rural areas

BY ANIRUDDHA GHOSAL  
Published 9:51 AM GMT+5:30, April 14, 2023

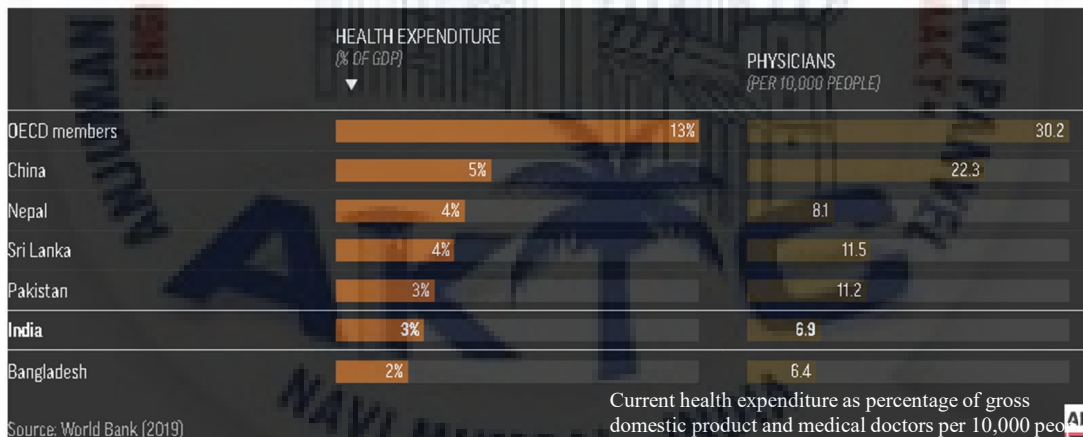
Hundreds of millions of rural Indians struggle to access care for a simple reason: The country just doesn't have enough medical facilities.

India's population has quadrupled since its independence in 1947, and an [already fragile medical system](#) has been stretched too thin: In the country's vast countryside, health centers are rare, understaffed and sometimes run out of essential medicines. For hundreds of millions of people, basic health care means a daunting journey to a distant government-run hospital.

Such inequities aren't unique to India, but the sheer scale of its population — it will soon overtake China, making it the [world's largest country](#) — widens these gaps. Factors ranging from identity to income have cascading effects on health care, but [distance](#) is often how inequities manifest.

What that means for people with chronic problems like sickle cell disease is that small differences in luck can be life-changing.

Image - 14



India's Healthcare compare with neighboring countries

Image - 15

Source – AP news.com

### Inference –

- The article sheds light on the state of India's rural health system, which has suffered due to years of neglect.
- Despite the critical importance of healthcare, the country allocated a mere 3.01% of its gross domestic product (GDP) to health in 2019. much lower than China's 5.3% and Nepal's 4.45%.as reported by the World Bank.
- This underscores the challenges faced by rural Indians in accessing medical services and emphasizes the need for increased investment in the healthcare sector.

## News Article - Road Accidents in India

Home / Latest Reports

### Road Accidents Killed 17 Indians Every Hour, Even As Trauma Care Remains Ill-Equipped

By Prachi Salve | 4 Feb, 2020



Source – Indiaspend.com

Image - 16

#### Inference –

- In 2018, **National Highways**, comprising only 1.94% of India's road network, saw 30.2% of accidents and 35.7% of deaths. State highways, at 2.97% of road length, accounted for 25.2% of accidents and 26.8% of deaths.
- From 2014 to 2018, **rural area accidents rose 5%**, with a **20.5% increase in deaths** and 2.3% in injuries.
- India, which has the highest populated globally, reported the most road-accident deaths among 199 countries, according to the World Road Statistics 2018 report

## News Article - Road Accidents in India

### Outlook

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# Number Of Road Accident Deaths In Maharashtra Up By More Than 2,000 In 3 Years: Official Data

Maharashtra had witnessed a dip in road accidents and fatalities in 2020 when there was Covid-19 pandemic outbreak and the vehicular movement was restricted due to the lockdown, but the numbers went up in 2021 and the trend continued in 2022.

 Friday, Jul 28, 2023



Source – OutlookIndia.com

Image - 17

#### Inference –

- There was a significant increase in the number of road accident fatalities in Maharashtra from 2019 to the year under consideration.
- In 2022, there were 14,883 fatalities, which is an increase of 2,095 fatalities (or approximately 16.38%) compared to 2019 when there were 12,788 fatalities. This suggests a worrisome trend of a rising number of people losing their lives in road accidents over this period.

## News Article - Road Accidents in India

### India Records 1,55,622 Road Accident Deaths In 2022

62 per cent of these accidents were recorded on just 5 per cent stretch of the highways, hinting that preventive measures need to be taken to reduce accidents on these stretches.



By Shubham Parashar · 1 mins read · 14-Dec-22 02:46 AM IST

In 2022, there were 1,55,622 deaths due to road accidents were registered in India and 59.7 per cent of fatalities occurred due to over-speeding. In fact, 62 per cent of these accidents were recorded on just 5 per cent stretch of the highways, hinting that preventive measures need to be taken to reduce accidents on these stretches. The authorities need to identify more such stretches across the country and take preventive measures like revising speed limits, fixing blind spots and even out extreme undulations on these roads which are few of the major reasons of road accidents.

Source – Carandbike.com

Image - 18

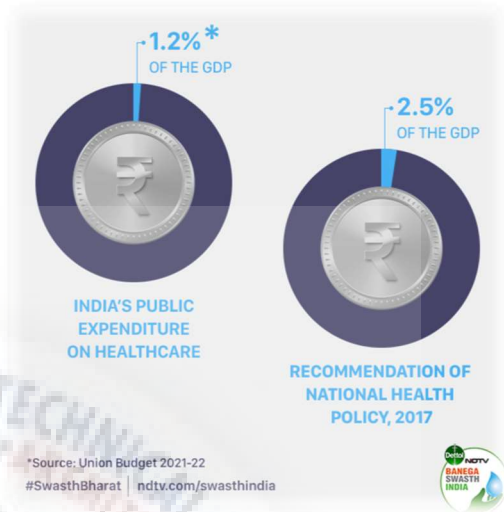
#### Inference –

- In the article published by Car and Bike, the subject under discussion pertains to the fatalities resulting from road accidents in the year 2022.
- The road accident data from 2022 in India reveals **alarming** trends that warrant immediate **attention**.
- There has been **increase** in number Road of accidents leading to increase in the **fatality** and **injury** rates .
- This gives the scope for a Trauma Hospital which will help in addressing this situation.

## Research Article - Healthcare Scenario in India

### High Out-Of-Pocket Medical Expenditure And Unequal Access To Healthcare

- According to the Union Budget 2021-22, the public health expenditure in the country is **just 1.2 per cent of the GDP** (Gross Domestic Product) and is among the lowest in the world, lower even than that of other South Asian countries like Sri Lanka (1.6 per cent) and Bhutan (3.5) per cent. The Economic Survey has strongly recommended **increasing the public health spending to 2.5-3 per cent of GDP as recommended in the National Health Policy 2017** and said that increased public spending can decrease the out-of-pocket expenditure to 30 per cent.



Source – NDTV

Image - 19

- According to the Economic Survey 2020-21, in India, **65 per cent** of the overall health expenditure is **out-of-pocket which is very high** as compared to the **world average of 18.2 per cent**. It observed that bulk of the **healthcare in India is provided by the private sector** which is **more expensive than the government facilities**.
- NITI Ayog has highlighted that because of **high out-of-pocket expenditure, 6.3 crore people fall into poverty every year**.

#### Inference -

- In the above article recently published by NDTV, India's healthcare system has been extensively scrutinized through surveys and research. One pressing issue highlighted is the allocation of government expenditure for public health in relation to the country's GDP.
- The article also sheds light on the average medical expenses incurred by individuals in India and how these figures compare with the global average.
- A significant revelation from this research is the prevailing trend where individuals, despite recognizing the higher costs, tend to opt for private healthcare facilities over government-run ones. This preference for private healthcare institutions underscores the need for improvements in the quality and accessibility of government healthcare service.
- Lastly, the article draws attention to a disconcerting statistic provided by NITI Ayog, revealing that approximately 6.3 crore people in India are pushed into poverty every year due to the excessive out-of-pocket medical expenses they incur. This alarming statistic underscores the urgency of implementing comprehensive healthcare reforms to ensure that healthcare services are affordable and accessible to all segments of society.

## Research Article - Healthcare Scenario in India

- The government has also recognised the rising costs of healthcare and has been running a few schemes to deal with this –
- Ayushman Bharat- Pradhan Mantri Jan Arogya Yojna (PMJAY) that aims at providing a health cover of Rs. 5 lakhs per family per year for hospitalization to the poor
- Janani-Shishu Suraksha Karyakram (JSSK) under the National Health Mission (NHM) aims to make maternal services more accessible and affordable by providing free institutional deliveries, free medicines, free diagnosis at Government health facilities
- Surakshit Matritva Aashwasan is committed to provide assured, dignified, respectful and quality healthcare, at no cost to women and newborn at public healthcare facility.
- National Health Mission Free Drugs Service Initiative which provides essential drugs free of cost in public health facilities
- Out-of-pocket healthcare expenses are a major cause of poverty, creating a harmful cycle of poor health and financial instability. Despite government pledges to allocate 2-3 percent of GDP to healthcare, this often doesn't materialize. In fact, the 2021-22 budget for the Ministry of Health and Family Welfare was lower than the previous year, suggesting a lack of learning from past experiences.
- The COVID-19 pandemic has exposed flaws in the public health system, particularly in the case of Ayushman Bharat, which hasn't effectively addressed out-of-pocket expenses, notably for diagnostics and medicines. Moreover, only 65 percent of claims under the scheme were honored, leaving 35 percent of patients without the financial support they needed.

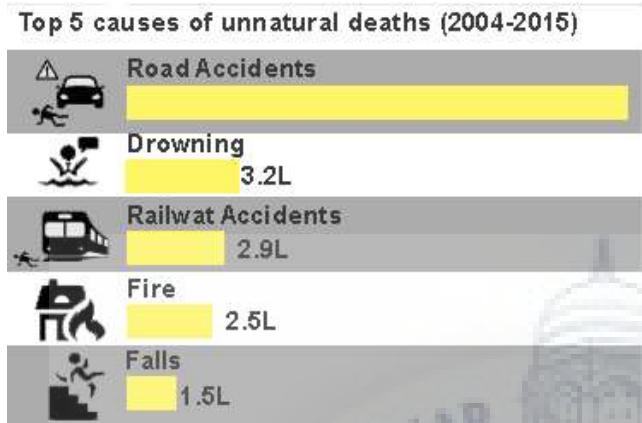
### Inference -

- In the above article recently published by NDTV, India's healthcare system has been extensively scrutinized through surveys and research. One pressing issue highlighted is the allocation of government expenditure for public health in relation to the country's GDP.
- The government has launched various healthcare schemes to tackle rising costs, such as Ayushman Bharat, Janani-Shishu Suraksha Karyakram, Surakshit Matritva Aashwasan, and the National Health Mission Free Drugs Service Initiative. However, out-of-pocket healthcare expenses remain a significant issue, often pushing people into poverty.
- Despite promises to allocate 2-3 percent of GDP to healthcare, budget allocations have not always reflected this commitment.
- In conclusion, there is a pressing need for more comprehensive and equitable healthcare financing and delivery system to ensure that people can access affordable and quality healthcare without the risk of impoverishment.



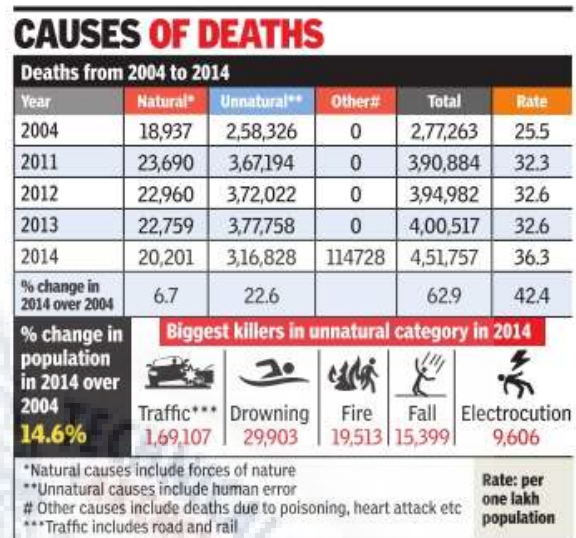
## Research Article

### Rate/Percentage of Trauma Injuries -



Source-Times of India/Indpaedia.com

Image - 20

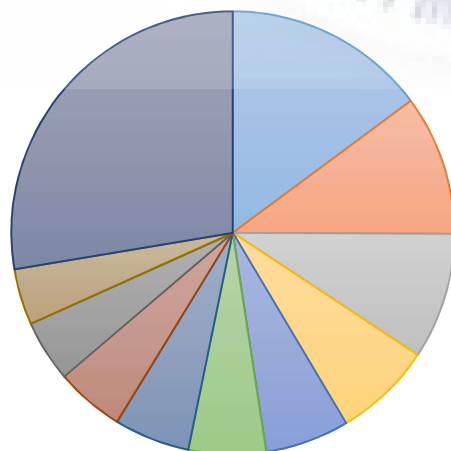


Source-Times of India/Indpaedia.com

Image - 21

### Inference –

- In an article published by Indpaedia, an extensive study was conducted on the causes of mortality in India spanning the years from 2004 to 2014. The research findings reveal that road accidents constitute the leading cause of fatalities in India, and this statistic has shown a consistent upward trend.
- Drowning and railway accidents emerge as significant contributors to mortality, following closely behind road accidents in terms of the number of lives affected. Furthermore, fire-related incidents and falls also rank prominently among the major contributors to mortality.
- In the year 2014 specifically, the data indicates a stark picture: 169,107 individuals lost their lives in road accidents, while 29,903 succumbed to drowning. Additionally, 19,513 fatalities were attributed to fire-related incidents, and 15,399 individuals tragically lost their lives due to falls. Lastly, 9,606 individuals met their demise as a result of electrocution.
- These statistics underscore the critical need for enhanced safety measures and awareness campaigns to address these public health concerns in India.



Percentage Share Of Major States In Accidental Death in 2021

- Maharashtra
- Madhya Pradesh
- Uttar Pradesh
- Tamil Nadu
- Karnataka
- Rajasthan
- Gujarat
- Odisha
- Chhattisgarh
- Andhra Pradesh
- Others

Source-TheFederal.com

ir.aiklibrary.org

## Research Article

### Rate/Percentage of Trauma Injuries -

- As per the records of the surveys taken by the Indian Journal of Critical Care Medicine, there has been a tremendous scale of increase in the trauma rates.
- Their reports state that the death rates are also alarmingly increasing every year for the past ten years, due to the nascent stage of development in the Trauma Care industry.
- Their charts compare three major aspects; Number of injured versus the Number of Accidents and the Mortality rate due to improper care.
- Further, a more detailed study was conducted, by the Indian Society for Trauma and Acute Care.
- According to the ISTAC, there is a 1.4 ratio of road accident to all trauma incidents, and a death every 1.9 minutes due to trauma; making road Accidents 22.8% responsible for overall trauma Incidents in India.

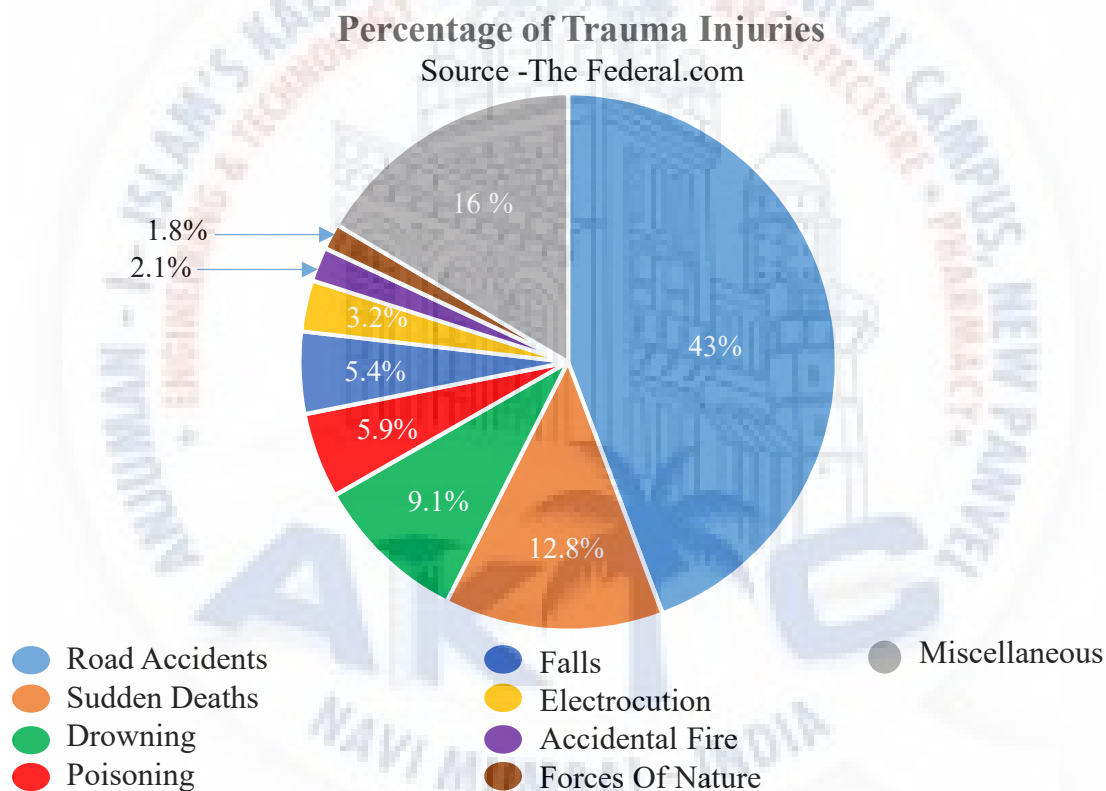


Figure - 10

### Inference -

- The data from both the Indian Journal of Critical Care Medicine and the Indian Society for Trauma and Acute Care (ISTAC) strongly underscore the pressing need for the establishment and improvement of trauma care centers in India.
- The increasing trauma rates, rising mortality rates and the significant contribution of road accidents to trauma incidents, make a compelling case -for the establishment and enhancement of trauma care centers in India.
- These centers can play a vital role in reducing fatalities, providing specialized care, and improving the overall quality of trauma healthcare in the country.

## Research Paper

### Rate/Percentage of Trauma Injuries in India -

Article | [Open Access](#) | [Published: 12 October 2022](#)

## Measuring the burden of accidental injuries in India: a cross-sectional analysis of the National Sample Survey (2017–18)

[Bhed Ram](#) & [Ramna Thakur](#) 

*Humanities and Social Sciences Communications* 9, Article number: 363 (2022) | [Cite this article](#)

2057 Accesses | 1 Citations | 1 Altmetric | [Metrics](#)

Image - 22

- Globally, injuries are the leading cause of premature deaths and disability and account for nearly 9 per cent of total deaths worldwide. Like other countries, India also faces a very high burden of injuries, with the second most common cause of death and disability. Annually, 0.15 million people lose their lives due to accidental injuries/road traffic accidents in India, which is 11 per cent of the accident-related death worldwide. This study aims to analyze the socio-economic and demographic differentials in the magnitude of economic burden and coping strategies associated with accidental injuries in India
- Among all injuries, road traffic injuries are the leading cause of mortality and disability in India (Gururaj, 2005, 2008; Gururaj et al., 2016). The severity of these road traffic injuries is measured by the individuals killed or disabled in such accidents (Ravikumar, 2013). Every minute registers a road traffic accident, and in it, one dies every 3.6 min from such accidental injuries in the country. According to WHO, road traffic accidents are India's sixth-leading cause of death, contributing to 16.6 per cent of all deaths (WHO, 2018). Annually, 1.5 lakh (0.15 million) people lose their lives due to road traffic injuries in India. Interestingly, with only one per cent of the world's vehicles, India accounts for nearly 11 per cent of accidental-related death worldwide (GOI, 2019).

### Inference –

- In their article titled "Measuring the burden of accidental injuries in India" Bhed Ram and Ramna Thakur have extensively examined the issue of accidental injuries within India.
- Their comprehensive study has yielded the following findings: In India, injuries pose a significant health burden, with road traffic accidents being the leading cause of both mortality and disability.
- These accidents result in one death every 3.6 minutes, contributing to 16.6% of all deaths in the country and annually causing 150,000 fatalities.
- India's high accident-related death rate is noteworthy, considering it has only 1% of the world's vehicles but accounts for nearly 11% of global accident-related deaths.

## Research Paper

[VOLUME 5 | ISSUE 3 | JULY - SEPT 2018]  
<http://ijrar.com/>

e ISSN 2348 -1269, Print ISSN 2349-5138  
 Cosmos Impact Factor 4.236

### Trauma care system in India: Where are we?

**Dr.Samir Misra\* & Dr.Sandeep Tiwari\*\***

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 U.P, Lucknow.

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Accepted: July 07, 2018

#### ABSTRACT

*Trauma-care systems in India are at a nascent stage of development. Metropolitan cities, industrialized cities, rural towns and villages coexist, with variety of health care facilities and almost complete lack of organized trauma care. There is gross disparity between trauma services available in various parts of the country. While rural areas are deficient because of varied reasons. Metropolitan cities, have very good infrastructure of health care. There is no co-ordination of various a government agencies in regard to trauma prevention, management & rehabilitation. A nationwide survey encompassing various facilities has demonstrated significant deficiencies in current trauma systems. Although injury is a major public health problem, the government, medical fraternity and the society are yet to recognize it as a growing challenge.*

**Keywords:** Trauma System, Developing Country, Health System, Trauma Care.

Image - 23

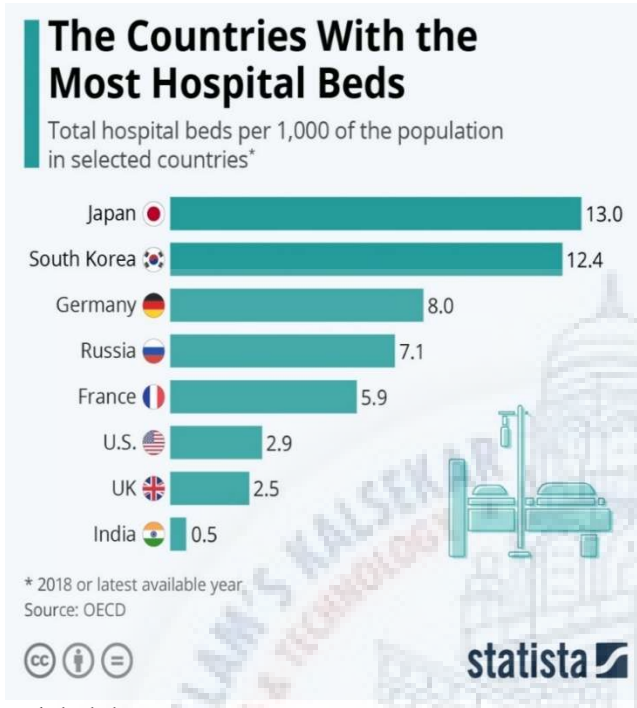
[Source- http://ijrar.com/](http://ijrar.com/)

[VOLUME 5 | ISSUE 3 | JULY - SEPT 2018]

#### Inference –

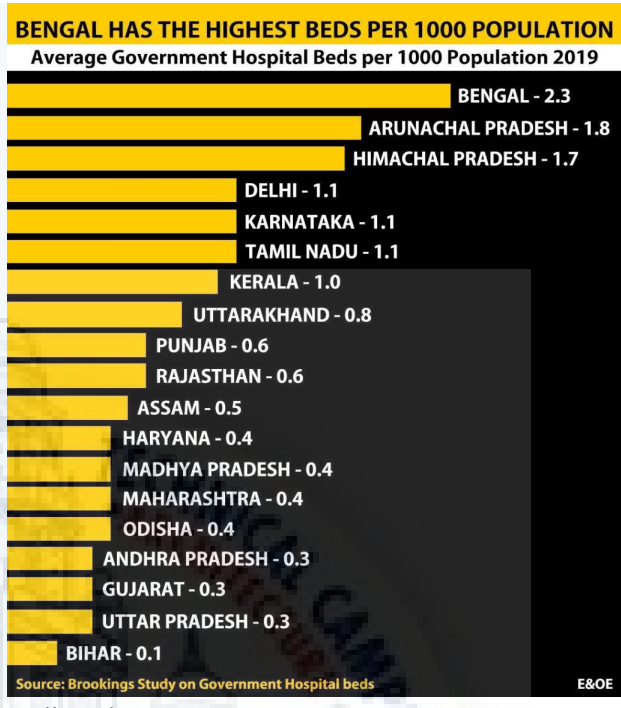
- In this Research Paper Dr. Samira Misra and Dr. Sandeep Tiwari conducted an extensive study on the trauma care system in India. Their research paper highlighted various critical issues, including administrative challenges, deficiencies in education and training, the absence of prehospital care in rural areas, and communication problems within the system.
- One significant concern addressed in the article is the question of financial responsibility for traumatic accidents. Given that over 70% of India's population resides in rural areas.

## Research Paper Beds Per Population Ration



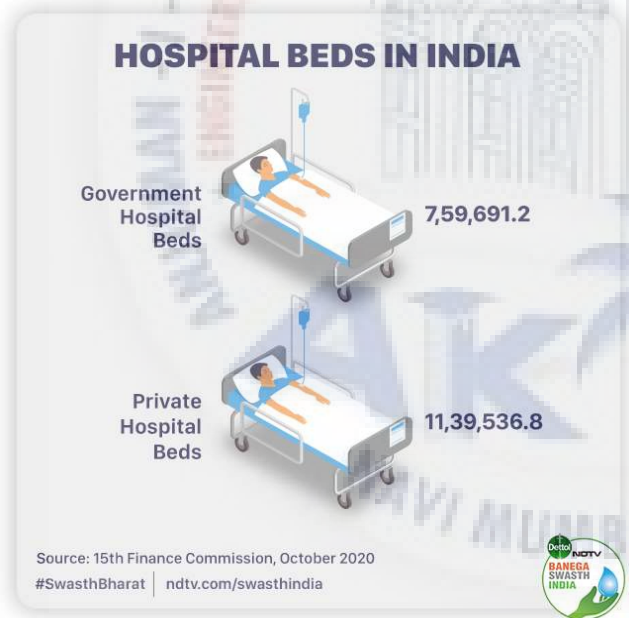
Global data

Image - 24



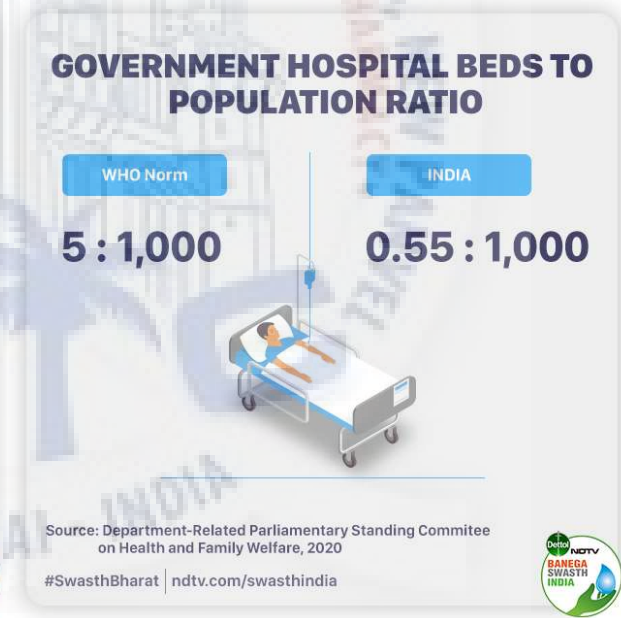
India's data

Image - 25



Source-NDTV

Image - 26



Source-NDTV

Image - 27

### Inference -

- Based on the above data, one can easily conclude that -
- India has the lowest number of hospital beds per 1000 population compared to other countries like Japan, South Korea, Germany, Russia, France, United States and the United Kingdom.
- This implies a substantial disparity in healthcare infrastructure and capacity, highlighting the need for India to invest in expanding its healthcare facilities to better serve its population's medical needs.

## Inference –

- Some of the critical issues Identified in India's trauma care system are as -
- **Injury as a Neglected Problem:** Trauma is a significant public health concern in India, & yet not received adequate attention within the healthcare system.
- **Administrative Gaps:** The Ministry of Health lacks a dedicated unit to address trauma-related issues, despite its high morbidity and mortality rates.
- **Education and Training Deficiencies:** Mandatory education and specialty training in fields like emergency medicine, trauma surgery, and critical care are lacking for healthcare personnel involved in trauma care.
- **Lack of Prehospital Care:** Rural and semi-urban areas often lack prehospital care, and the timely "golden hour" concept remains unattainable for many patients.
- **Communication and Transfer Challenges:** Despite technological advancements, communication within trauma care systems in India is outdated and inefficient.
- **Limited Definitive Trauma-Care Facilities:** The availability of trauma care facilities varies, with government hospitals, corporate hospitals, and small clinics providing care. Many of these facilities report a significant portion of their beds occupied by trauma victims, primarily from road accidents.
- The additional outcomes and suggestions from the research article were –
- The question of who bears the cost of trauma care is a significant concern, as it strains healthcare budgets. The government, both at the state and central levels, needs to allocate a dedicated budget for trauma patient care. Currently, it's unclear who shoulders this financial burden. While many government hospitals offer free care, the quality varies between centers.
- Improving trauma care in India necessitates a systematic and organized approach. It requires close coordination among different stakeholders and sectors. Integrated emergency care programs that cover various emergencies, including trauma, should be developed. Basic first aid training should be provided to individuals like drivers, police, teachers, and others, enabling them to assist victims, call for help, ensure safety, and provide immediate assistance.
- Advanced pre-hospital and trauma care facilities should be available in hospitals with more than 100 beds. All public sector hospitals must be well-equipped and staffed to provide appropriate trauma care without delays.

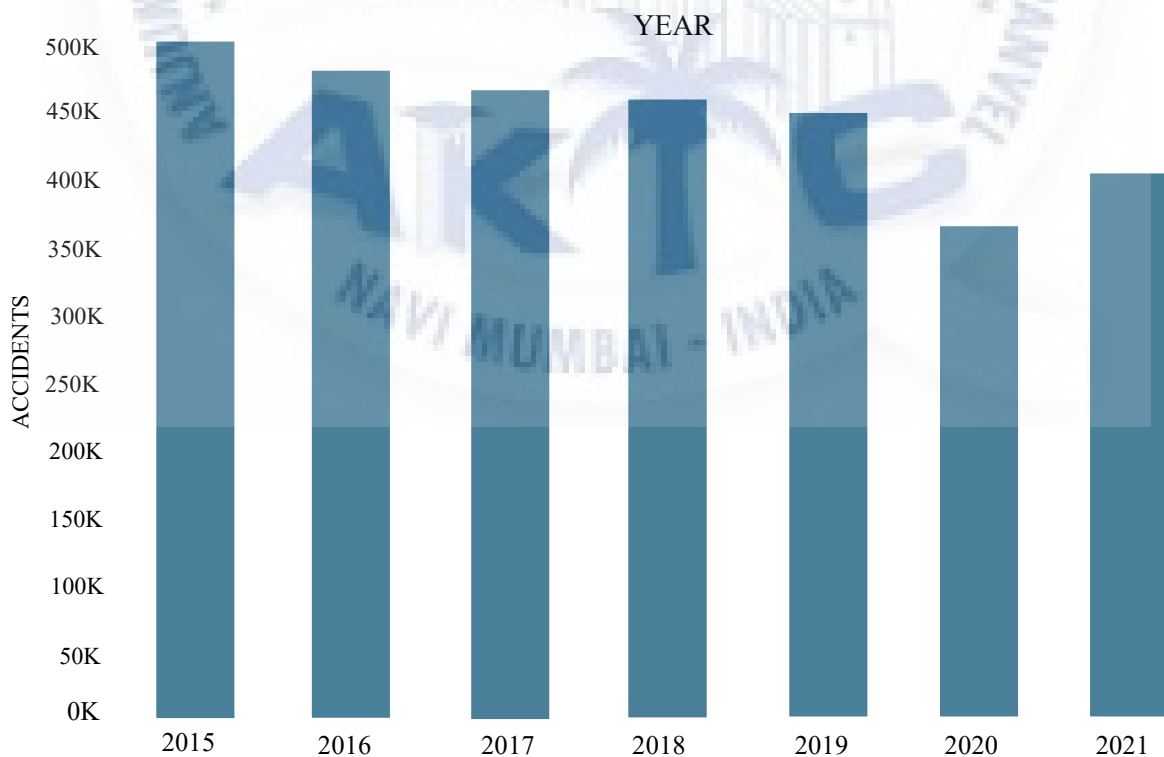
## Road Accidents in India

**Traffic collisions** in India are a major source of deaths, injuries and property damage every year. The National Crime Records Bureau (NCRB) 2021 report states that there were 155,622 fatalities, highest since 2014, out of which 69,240 deaths were due to two-wheelers. In India, national highways make up only 2% of the entire length of the country's roads, but they are responsible for 30.3% of all traffic fatalities and accidents, according to a study by IIT Delhi..

Year	Total No of Road Accidents (In Numbers)	Total No Of Person Killed (in Numbers)	Total No Of Person Injured in Numbers)
2015	501,423	146,133	500,279
2016	480,652	150,785	494,624
2017	469,910	147,913	470,975
2018	467,044	151,417	469,418
2019	449,002	151,113	451,361
2020	366,138	131,714	348,279
2021	412,432	173,972	384,448

Source –Ministry of Road Transport and Highways, India / morth.nic.in

Table - 04



Road Accidents in India Year 2015-2021

Figure -11

## Road Accidents In Maharashtra -

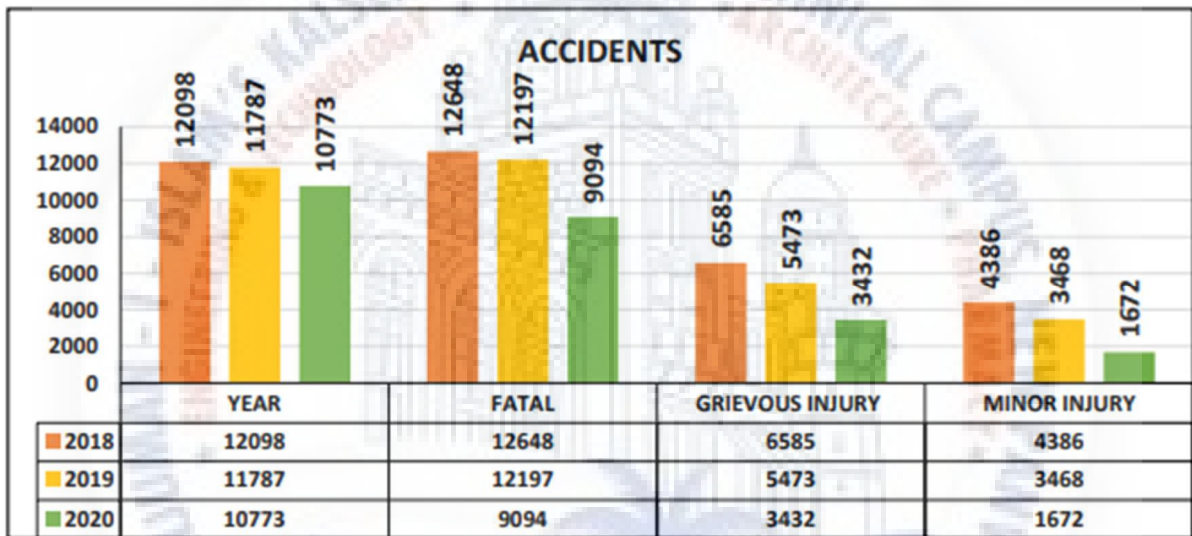
### ALL MAHARASHTRA YEAR-WISE ACCIDENTS

Last 3 years Statistics of Road Accidents in Maharashtra

ROAD ACCIDENTS IN MAHARASHTRA								
YEAR	FATAL		GRIEVOUS INJURY		MINOR INJURY		WITHOUT INJURY	TOTAL ACCIDENTS
	Accident	Killed	Accident	Injured	Accident	Injured		
2018	12,098	13,261	12,648	20,335	6,585	11,030	4,386	35,717
2019	11,787	12,788	12,197	19,152	5,473	9,476	3,468	32,925
2020	10,773	11,569	9,094	13,971	3,432	5,943	1,672	24,971
Difference (2019-20) %	-9	-10	-25	-27	-37	-37	-53	-24

Source - Accident Research Cell Report \_2020 ,Maharashtra

Table - 05



Source - Accident Research Cell Report \_2020 ,Maharashtra

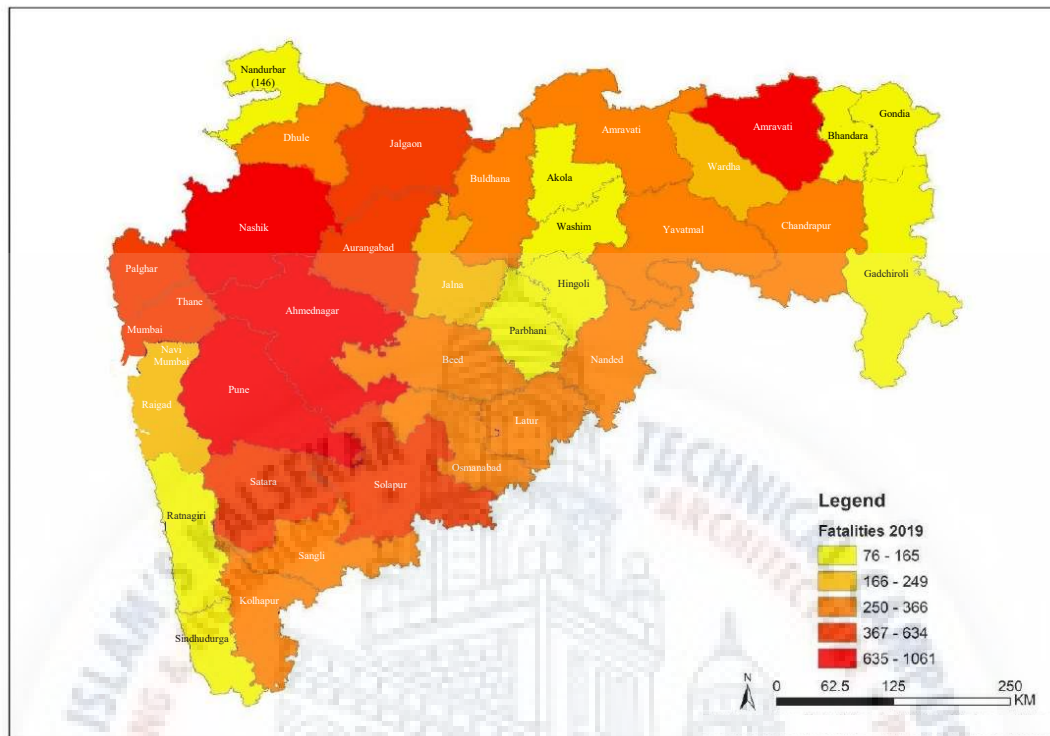
Figure - 12

### Inference –

- The data above pertains to road accidents in Maharashtra over a three-year period. It indicates a rise in accident rates in 2019 compared to 2018, followed by a decline in 2020. Notably, the decrease in 2020 can be attributed, in part, to the impact of the COVID-19 outbreak.



## District Wise -Road accidents In Maharashtra -



District Wise Road Accident Fatalities in 2020 in Maharashtra

Image - 28

### Inference -

- The aforementioned map provides a detailed breakdown of road fatalities in various districts of Maharashtra, categorized into five distinct zones, each assigned a specific color code corresponding to the death rates in that particular region.
- The first zone, depicted in red, signifies the highest number of fatalities, ranging from 635 to 1001 per 100,000 population. The second zone is represented by a reddish-orange hue, indicating a range of 367 to 634 fatalities per 100,000 population. Moving on, the third zone is characterized by an orange shade, encompassing a range of 250 to 366 fatalities per 100,000 population. Following that, the fourth zone is denoted by a yellowish-orange color, reflecting fatalities ranging from 166 to 249 per 100,000 population. Lastly, the fifth zone is portrayed in yellow, indicating fatalities in the range of 76 to 165 per 100,000 population.
- One prominent observation from the map is that the majority of accidents occur in western Maharashtra in comparison to other regions. The districts with the highest incidence of road accidents are Nashik, Ahmednagar, Pune, and Amravati, followed closely by Thane, Mumbai, Palghar, Jalgaon, Aurangabad, Satara, and Solapur, where the accident rate falls within the range of 367 to 634 per 100,000 population.

Source - Accident Research Cell Report \_2020 ,Maharashtra

## District Wise -Road accidents In Maharashtra -

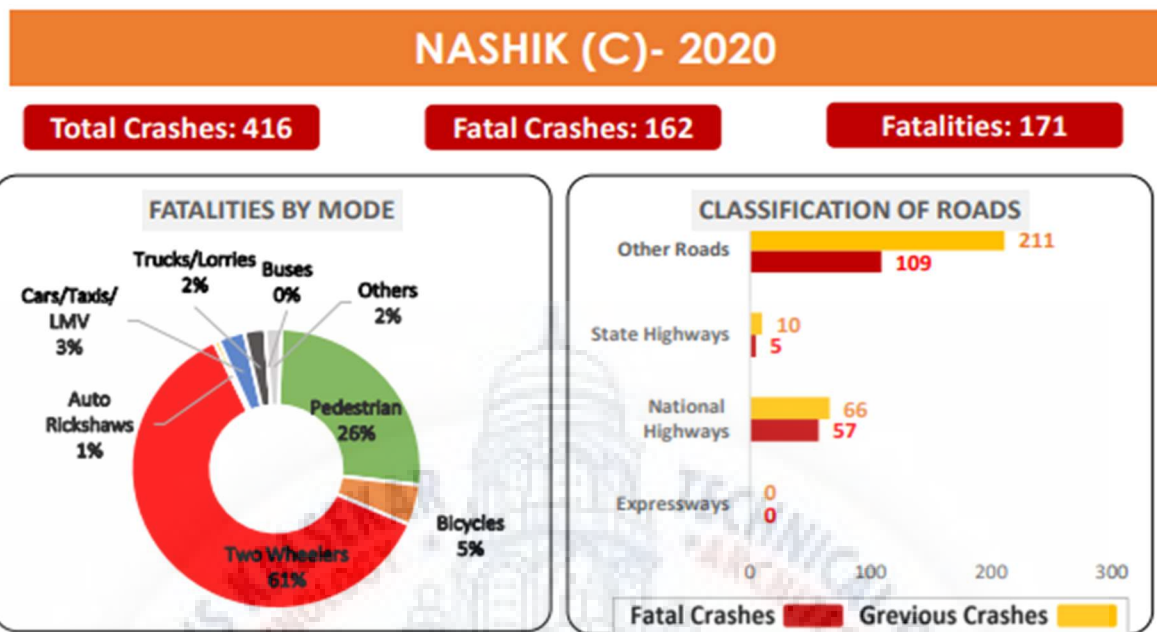


Figure - 13

Figure - 14

### Inference -

- The above data pertains to road accidents within Nashik district in year 2020..
- It is evident from the data ‘fatalities by mode’ that two-wheeler riders constitute the highest number of fatalities in these accidents.
- Furthermore, the data indicates that national highways are a significant hotspot for accidents, contributing to a substantial number of incidents, Whereas other types of roads within the district also play a substantial role as contributors to road accidents.

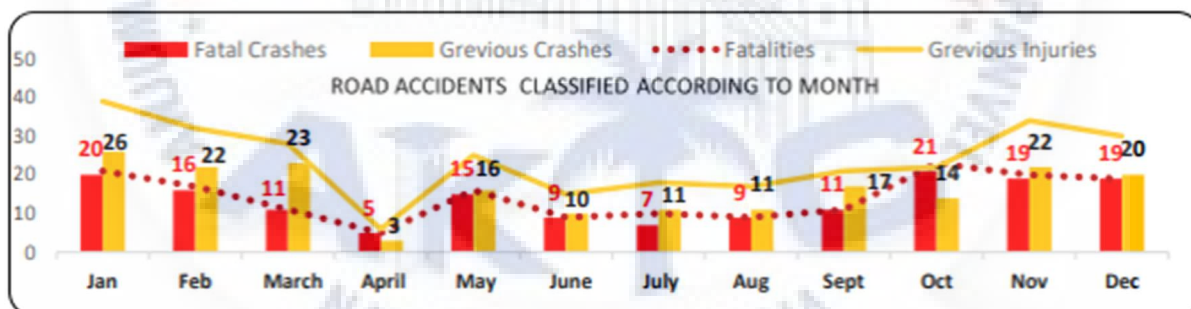


Figure - 15

### Inference –

- In the above statistics, which categorize road accidents by month in Nashik district in year 2020, a discernible pattern emerges.
- From the months of April to August, there is a noticeable decrease in the number of accidents, followed by a gradual increase starting in September.
- The peak of accidents in Nashik district occurs during the period from December to February. This trend aligns with research findings suggesting that winter conditions, characterized by fog and associated factors, contribute to a higher incidence of accidents compared to the warmer months of summer.

Source - Accident Research Cell Report \_2020 ,Maharashtra

## District Wise -Road accidents In Maharashtra -

### THANE RURAL- 2020

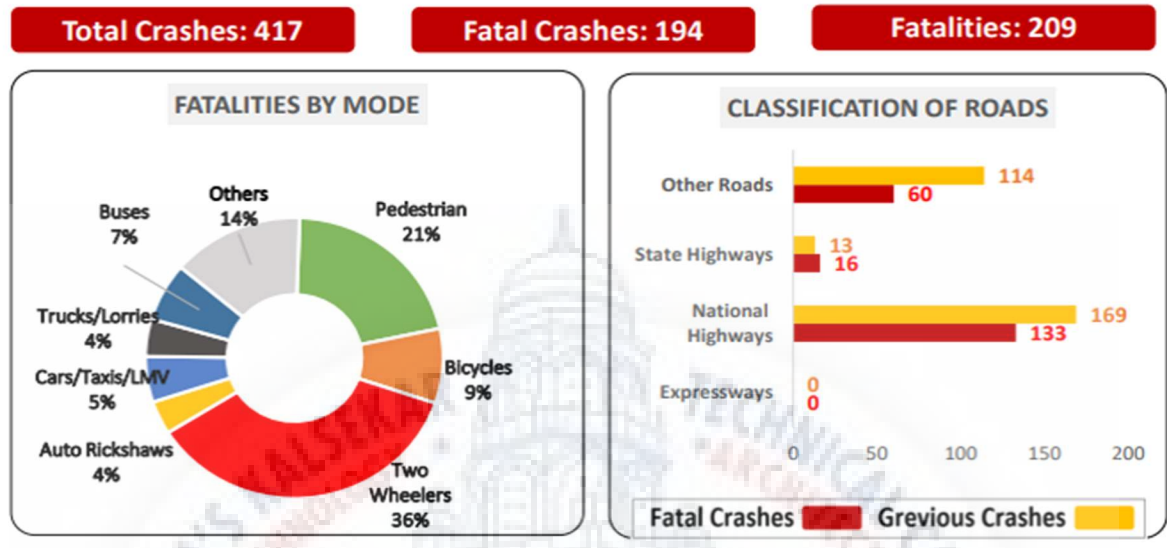


Figure - 16

Figure - 17

#### Inference -

- The above data pertains to road accidents within Thane district in year 2020.
- It is evident from the data ‘fatalities by mode’ that two-wheeler riders constitute the highest number of fatalities follow by pedestrian fatalities and bicycles fatalities in these accidents.
- Furthermore, the data indicates that national highways are a significant hotspot for accidents, contributing to a substantial number of incidents, Whereas other types of roads within the district also play a substantial role as contributors to road accidents.

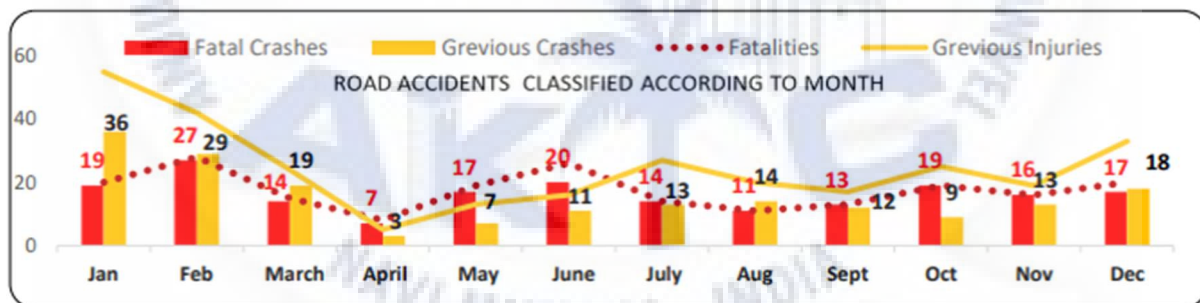


Figure - 18

#### Inference –

- In the above statistics, which categorize road accidents by month in Thane district in year 2020, a discernible pattern emerges.
- From the months of April to September, there is a noticeable decrease in the number of accidents, followed by a gradual increase starting from october.
- The peak of accidents occurs during the period from December to February. This trend aligns with research findings suggesting that winter conditions, characterized by fog and associated factors, contribute to a higher incidence of accidents compared to the warmer months of summer.

Source - Accident Research Cell Report \_2020 ,Maharashtra

## Road accidents In Maharashtra according to Classification of Roads -

### ACCIDENTS CLASSIFIED ACCORDING TO CLASSIFICATION OF ROAD

Sr. No.	Classification of Road	NUMBER OF ACCIDENTS					NUMBER OF PERSONS INVOLVED			
		Fatal	Grievous Injury	Minor Injury	Non Injury	Total	Killed	Grievous Injured	Minor Injured	Total
1	Expressways	62	38	12	49	161	66	79	13	158
2	National Highways	3170	2048	672	450	6340	3462	3656	1505	8623
3	State Highways	2729	1818	661	310	5518	2971	3030	1306	7307
4	Other Roads	4812	5190	2087	863	12952	5070	7206	3119	15395
<b>Total</b>		<b>10773</b>	<b>9094</b>	<b>3432</b>	<b>1672</b>	<b>24971</b>	<b>11569</b>	<b>13971</b>	<b>5943</b>	<b>31483</b>

Table - 06

#### Inference –

- In the above statistics, which classify accidents according to road types in Maharashtra for the year 2020, there were a total of 24,971 accidents reported, involving 31,483 individuals.
- The data highlights that a substantial portion of these accidents occurred on national highways, with a total of 6,340 incidents, involving 8,623 individuals.
- Interestingly, other roads, distinct from national highways, contributed significantly more to the overall accident count, with a total of 12,592 accidents recorded and 15,395 individuals involved.
- State highways also registered a noteworthy number of accidents, totaling 5,518, and these incidents involved 7,307 individuals.

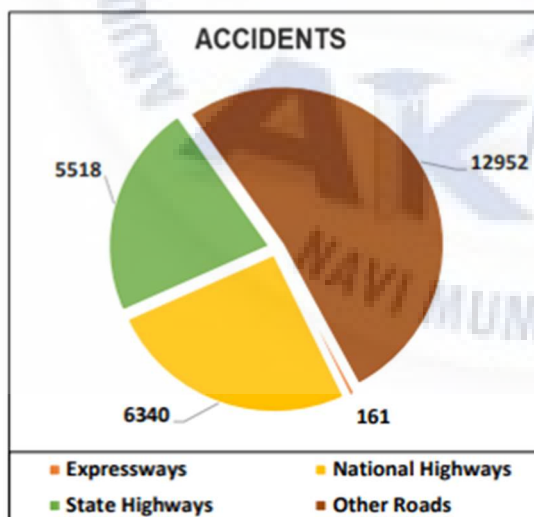


Figure - 19

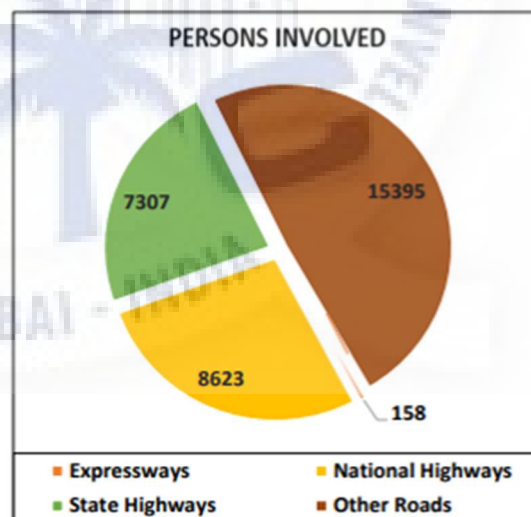


Figure - 20

Source - Accident Research Cell Report \_2020 ,Maharashtra

## Road accidents In Maharashtra according to type of impacting vehicle

### ACCIDENTS CLASSIFIED ACCORDING TO TYPE OF IMPACTING VEHICLE

Sr. No.	Type of Vehicle	NUMBER OF ACCIDENTS					NUMBER OF PERSONS INVOLVED			
		Fatal	Grievous Injured	Minor Injury	Non Injury	Total	Killed	Grievous Injured	Minor Injured	Total
1	Pedestrian	2177	2312	631	36	5156	2214	2621	709	5544
2	Bicycles	169	233	89	10	501	172	253	98	523
3	Two Wheelers	5484	4378	1541	581	11984	5868	6488	2543	14899
4	Auto Rickshaws	244	345	155	120	864	271	700	340	1311
5	Cars, Taxis, Vans & LMV	1363	937	476	497	3273	1576	2049	985	4610
6	Trucks/Lorries	524	327	209	248	1308	561	578	400	1539
7	Buses	84	148	55	67	354	106	425	326	857
8	Other Non-motorized vehicle (E-rickshaw etc.)	19	19	2	6	46	25	29	10	64
9	Others	709	395	274	107	1485	776	828	532	2136
Total		10773	9094	3432	1672	24971	11569	13971	5943	31483

Table - 07

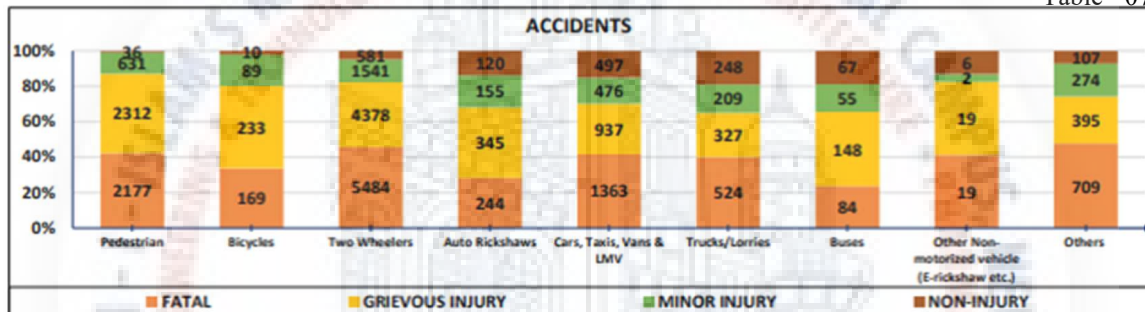


Figure - 21

#### Inference –

- In the above statistics, which classify Road accidents according to types of Impacting Vehicle in Maharashtra for the year 2020, there were a total of 24,971 accidents reported, involving 31,483 individuals.
- It is evident from the data that two-wheeler riders constitute the highest number of fatalities follow by pedestrian fatalities and Cars/Taxis fatalities in these accidents.
- Two Wheelers are high-risk motor vehicles and are more likely to be involved in accidents than cars. According to a study Bike crashes are 28 times as likely to be fatal as passenger car accidents.

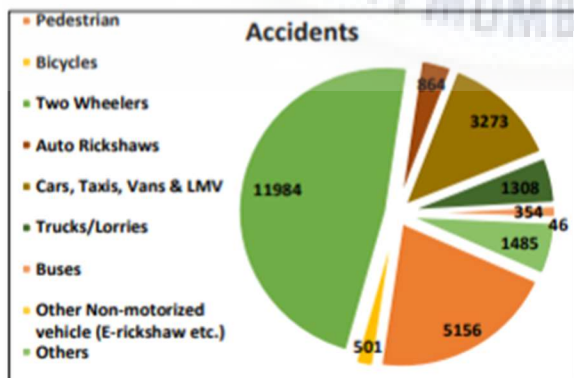


Figure - 22

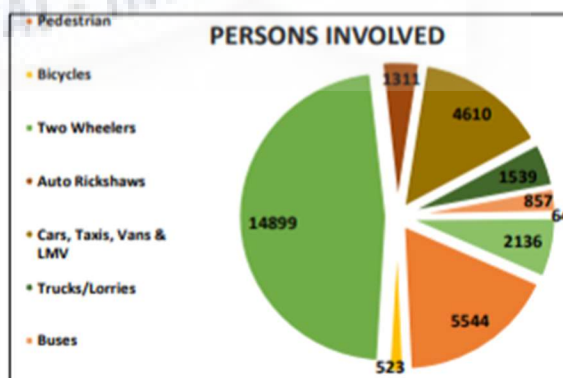


Figure - 23

Source - Accident Research Cell Report \_2020 ,Maharashtra

## Causes of Road accidents In Maharashtra -

- Almost 30% of road accidents in Maharashtra occur in Pune, Solapur, Ahmednagar and Nashik districts.
- Road accidents are the most unexpected events to happen to any road user, though their frequency is quite often.
- Unfortunately, we don't learn from our mistakes on the road.
- The lack of concern/strictness on part of road users causes accidents and crashes.
- Listed below are the most common mistakes or human errors committed by road users in Maharashtra, which lead to accidents:
  - Over-Speeding –
  - Drunken Driving
  - Red Light Jumping
  - Avoiding Safety Gears like Seat belts and Helmets
  - Non-adherence to lane driving and overtaking from the right side or without giving an indication
  - Wrong-side driving
  - Environmental factors
  - Vehicular Factors
  - Condition of Roads

## Road Accident at Kasara /NH3-Mumbai Nashik Expressway



Image - 29

Source – prokerala.com



Image - 30

Source – Marathi.abp.com



Image - 31

Source – lokmat.com

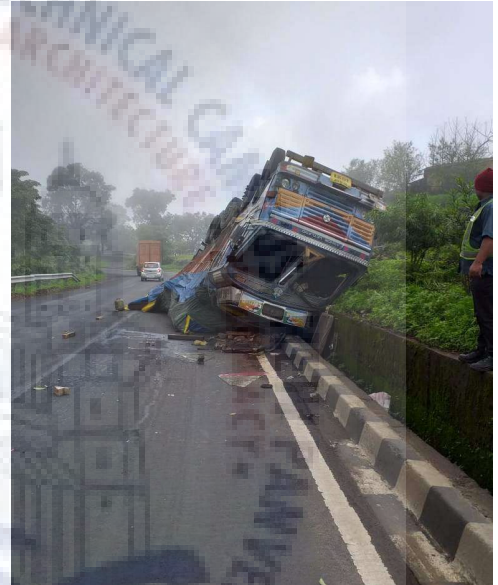


Image - 32

Source – lokmat.com



Image - 33

Source – sakal.com



Image - 34

Source – lokmat.com

## News Article

### Safety Measures -

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Published on End Poverty in South Asia

## Road safety: How a state in India is leading the way to lower road crash deaths

JAMES MARKLAND, DIPAN BOSE & DOMINIC S. HAAZEN | JANUARY 18, 2021

This page in: English

*Road safety is a critical development priority for South Asia, impacting health, wellbeing and economic growth. Countries in the region must work together if they are to achieve the goal of halving road crash deaths by 2030. This blog is part of our [Together for Road Safety](#) campaign.*

“Every life lost on the road is one too many” resonates viscerally in Tamil Nadu, which until recently, was one of the worst-ranked states in India for road crashes and fatalities 🐦.

In 2014, more than 15,000 people were dying every year from road crashes in Tamil Nadu. But decision-makers have turned the situation around through strategic vision and leadership.

In 2019, road deaths in Tamil Nadu fell to 10,000, a reduction of over 25 percent. 🐦 What's notable is that improving road safety did not come at the expense of [economic development](#) but rather supported it.

What important lessons can other Indian states learn from Tamil Nadu's successful experience in improving road safety? 🐦

Source – World Bank Blogs

Image - 35

### Inference -

- The article highlights Tamil Nadu's transformation from being the state in India with the highest number of accident fatalities to achieving a remarkable 25% reduction in fatalities within a relatively short timeframe.
- Tamil Nadu's successful experience in improving road safety offers several important lessons for other Indian states:
- **Focus on Post-Crash Response** - Prioritizing a quick and effective post-crash response is crucial. They Established Emergency Care Centers and Accident Relief Centers on high-risk road stretches which significantly reduce fatalities.
- **Data-Driven Approach** - Embracing data-driven, scientific methods for road safety management. Tamil Nadu's RADMS is a prime example of how technology and data can help identify problem areas and implement solutions.
- **Collaboration with International Organizations** - Collaborating with organizations like the World Bank which provided valuable support and resources for implementing multi-sectoral road safety initiatives.
- **Balancing Road Safety with Economic Development** - Tamil Nadu's success demonstrates that improving road safety doesn't have to hinder economic development. In fact, it can complement it, making it a win-win situation for the state.
- **Reducing Emergency Response Time** - Tamil Nadu's achievement in reducing emergency response time to 14 minutes is a critical factor in saving lives. Incorporating these lessons into their own road safety strategies, other Indian states too can work towards reducing road crashes and fatalities, ultimately saving countless lives.



## Safety Measures -

In addition to furnishing essential physical resources to aid accident victims, it is imperative to explore the myriad of other initiatives, rules, and regulations instituted by the government to safeguard the lives of trauma victims. Given the prevailing lack of public awareness surrounding this critical matter, there is a pressing need to disseminate information regarding how trauma outcomes can be improved.

The government has implemented a range of measures and regulatory frameworks to mitigate the impact of traumatic incidents and enhance the prospects of survival and recovery. These initiatives encompass a spectrum of activities -

### Highway initiative

The Ministry has devised a comprehensive strategy to enhance road safety, focusing on Education, Engineering, Enforcement, and Emergency Care:

#### Education:

- - Awareness campaigns through media and NGOs.
- - Annual National Road Safety Month/Week observance.

#### Engineering (Roads and Vehicles):

- - Identification and rectification of accident-prone black spots on national highways.
- - Road safety incorporated into road design.
- - Delegated powers for black spot rectification approval.
- - Guidelines for pedestrian facilities for persons with disabilities.
- - Enhanced safety standards for vehicles, including airbags, ABS, tires, crash tests, and speed-limiting devices.
- - Model Inspection & Certification Centers in each State/UT for vehicle fitness testing.

#### Enforcement:

- - Strict enforcement using technology with penalties for traffic rule violations.
- - Guidelines for protecting Good Samaritans.

#### Emergency Care:

- - Cashless treatment scheme for accident victims during the "golden hour" under the Motor Vehicles (Amendment) Act, 2019.
- - Ambulances at toll plazas on national highways, with some upgraded to Basic Life Support as per AIS125.

These measures collectively aim to improve road safety and emergency care across India.

## Government Initiatives (Policies) -

### 1) Ministry of Health and Family Welfare

**Press Information Bureau  
Government of India  
Ministry of Health and Family Welfare**

22/07/2014, 15:36 PM

Ministry of Health & Family Welfare provides assistance to State Governments under the scheme "Capacity Building for Developing Trauma Care Facilities in Govt. Hospitals on National Highways", to augment and upgrade the accident & emergency services in Govt. Hospitals along the National / State Highways with an aim that no trauma victim has to be transported for more than 50 Km and a designated trauma care facility is available at every 100Km.

The scheme was started in the 11th Plan during which it was decided to cover the Golden Quadrilateral Corridor (5846Kms) S, E-W corridor-(7716 Kms) by establishing 140 trauma care facilities.

Under the 12th Plan, 85 more Trauma Care Facilities are to be established in government hospitals in or around national highways, preferably in accident prone areas on those highways and states not covered earlier.

Priority shall be accorded to those existing Govt. hospitals in the State, which are within 100km radius of the identified black spot and the mortality due to Trauma has been consistently high there despite all possible road safety interventions.

These new Trauma Care Facilities would be identified on the following national / state highways:

- Connecting two capital cities
- Connecting major cities other than capital cities
- Connecting ports to major cities
- Connecting industrial townships with capital city

In Jharkhand, District Hospital, Hazaribagh (NH-2) was taken up for upgradation of Trauma Care Facilities under the pilot scheme in the year 2006 and funds to the tune of 1.5cr were released to the said hospital for the same.

Under the 11th Five Year plan, Patilputra Medical College Hospital, Dhanbad (NH-2) along with District Hospital, Hazaribagh (NH 2) were identified for further upgradation of trauma care facilities and funds for construction have been released to the said Hospital. No timeline for completion of various activities has been intimated by the respective hospitals. The Health Minister stated this in a written reply in the Rajya Sabha here today.

Image - 36

### 2) Ministry of Road Transport and Highways

**Press Information Bureau  
Government of India  
Ministry of Road Transport & Highways**

22 JUL 2019 6:19PM by PIB Delhi

**Trauma Care Centres for Road Accident Victims**

The Govt. of India has taken initiatives towards setting up of Trauma Care Facilities along National Highways, under the scheme "Capacity Building for Developing Trauma Care Facilities on National Highways". The overall objective of the scheme is to bring down preventable deaths due to road accidents by developing a pan-India trauma care network. The scheme provides for setting up a designated trauma center at every 100 km on NHs. During the 11th and 12th Five Year Plans, about 200 Trauma Care Facilities (TCFs) were identified and financial support provided under the Programme.

Considering the shortage of medical and paramedical personnel in trauma care facilities, the scheme, implemented during the 11th & 12th FYP, provided for financial support for manpower component to these facilities for a period of 3 years. Further, as per MoU signed with the states, the state governments are required to create permanent posts to undertake the liability of the contractual manpower recruited under the program, to ensure unhindered functioning of the trauma care facilities. In addition to this, various training courses are being provided for capacity building of the existing manpower in these trauma care facilities so that they can provide better healthcare services. These include Advanced Trauma Life Support (ATLS) for doctors and Basic Life Support (BLS) for nurses. In addition, a Pre-Hospital Trauma Technician (PTT) course curriculum has also been developed under the Trauma scheme for paramedics to be posted in ambulances.

As per the information received from police departments of State/UTs, number of road accidents on Highways in India for during the calendar year 2015 to 2017 is given below:-

## Government Initiatives (Policies) -

### Inference –

- There are several initiatives by State and Central government in strengthening emergency healthcare by upgrading the existing Hospitals to establishing dedicated trauma centers.
- A plan was devised to establish a network of trauma care centers covering the Golden Quadrilateral and North-South-East-West Corridors.
- The primary objective was to reduce preventable deaths in traffic accidents to around 10%.
- To achieve this, the plan involved upgrading existing hospitals, providing rapid transportation for trauma victims to reach hospitals within the "golden hour," and focusing on state-of-the-art communication systems instead of solely building new infrastructure.
- The Ministry of Health & Family Welfare introduced the "Capacity Building for Developing Trauma Care Facilities in Govt. Hospitals on National Highways" program, aiming to construct 140 trauma centers along the Golden Quadrilateral and N-S, E-W Corridors at a cost of 732.25 crores under the 11th Plan.

## Government Initiatives -

mint

rkets Premium Money Mutual Fund Industry Companies Tec

### Rs554-crore national trauma care policy awaits cabinet approval

2 min read • 14 Nov 2017, 12:53 AM IST

**Neetu Chandra Sharma**

*J.P. Nadda says the trauma care policy for establishing 30 new trauma care facilities has been approved by the expenditure finance committee, now waits cabinet nod*



In India, accidental injury is one of the leading causes of mortality and morbidity. In India, 4 50,898 road accidents caused 141,526 deaths during 2014. Photo: HT

Source – Mint

Image - 38

### Inference -

- The Union Health Ministry had proposed to establish a national program for trauma care with an allocation of Rs554.41 crore.
- This program aims to reduce death and disability resulting from road injuries.
- The plan includes setting up 30 new trauma care facilities, which have received approval from the Expenditure Finance Committee (EFC) and are awaiting approval from the Cabinet Committee on Economic Affairs (CCEA).
- Additionally, the government plans to develop 85 new trauma care facilities, primarily on National Highways, as part of the 'capacity building for developing Trauma Care Facilities in government hospitals' initiative.
- This initiative underscores the government's commitment to enhancing trauma care services and improving road safety.

## Government Initiatives -

# City to get its first trauma-care hospital

Clara Lewis / TNN / Nov 5, 2009, 03:05 IST

32 PTS



From January 2005 to September 2009, around 3,040 Mumbaikars have been victims of fatal road accidents. The only civic hospital along the Western Express Highway - V N Desai in Santa Cruz East - does not have a fully functional trauma unit, and often, timely help to victims does not arrive in time. Now, Mumbai will get its first-ever trauma-care hospital along the WEH, in Jogeshwari East - a much-needed move that has been welcomed by the medical community. The Brihanmumbai Municipal Corporation (BMC) has already started work on the 17-storey trauma care centre on a 50,840 sq ft plot of land.

According to officials, a majority of these are pedestrian accidents that take place on the WEH after midnight and in the early hours of the morning when vehicles tend to break the speed limit and visibility is poor. "Wider roads, faster cars, and the growing population between Andheri and Borivli are resulting in an increasing number of accidents on the Western Express Highway. We have virtually nothing in this area to provide immediate and expert aid to victims. This hospital will enable us to give early treatment," said Dr Sanjay Oak, director, Health Service, BMC. The closest hospital is Bhagwati Hospital, which is in Borivli West.

Source – Times Of India

Image - 39

### Inference -

- The city i.e (Mumbai) had received its first trauma centre in the year 2009.
- The Trauma Centre is operable since 2011.
- The area had lacked even a single specialty hospital earlier .
- The hospital had been constructed at a cost of Rs 79 crore and was ready by October 2011.
- It has all departments, including casualty, neurology, surgery, orthopedic, dental, ophthalmology, burns, etc., associated with emergency & trauma care.
- The specialty center had also had a mortuary and a post-mortem center to ensure that relatives did not have to move to different hospitals in case the accident was fatal.
- According to BMC officials, approximately 150 patients are admitted every day.

## The Proposal

### 3 महानगर परिसर

# खर्डीमध्ये आघात केंद्राला दोन हेक्टर जागा मंजूर

#### ■ प्रतिनिधी | खर्डी

शहापूर तालुक्यामध्ये मोठा विभाग म्हणून खर्डी विभागाकडे पाहिले जाते. खर्डी विभागाची अतिदुर्गमभाग आणि आदिवासीपट्टा म्हणून ओळख

विभागाने ग्रामीण रुग्णालय खर्डीच्या मागील नवीन गावठाणापैकी /अ/०१/०१ संपूर्ण क्षेत्र २६-०४-४८ हे.आर. यापैकी-२-००-०० हे.आर. म्हणजेच (०५ एकर) सदर

**6** ट्रामा केअर सेंटर झाल्याने मुंबई-नाशिक महामार्गावरील होणाऱ्या अपघातामधील रुग्णांना वेळच्यावेळी उपचार होतील.

जागेची मोजणी झालेली असून आघात केंद्रासाठी मान्यता देण्यात आली आहे.

#### ■ हेमंत अधिकारी,

माजी ग्रामपंचायत सदस्य

खर्डीमध्ये आघात केंद्र सुरु झाल्याने मुंबई-आग्रा आंतरराष्ट्रीय महामार्गावरील होणाऱ्या

आहे. असे असून वाढती लोकसंख्या, नागरी सुव्यवस्था लक्षात घेता रेल्वे स्थानक आणि मुंबई-आग्रा आंतरराष्ट्रीय महामार्ग नजीक असल्याने वाढते अपघात लक्षात घेता खर्डीगाव विभागाच्या मध्यंतरी असल्याने शासनाने येथे आघात केंद्र (ट्रामा केअर सेंटर) मंजूर केले आहे. त्यासाठी लागणारी जमीन शहापूर महसूल

अपघातामुळे रुग्णाला योग्य उपचार मिळत नसल्याने मृत्यूचे प्रमाण वाढले होते. उपचारासाठी शहापूर कल्याण ठाणे तेथे रुग्णाला घेऊन जावे लागत असे.

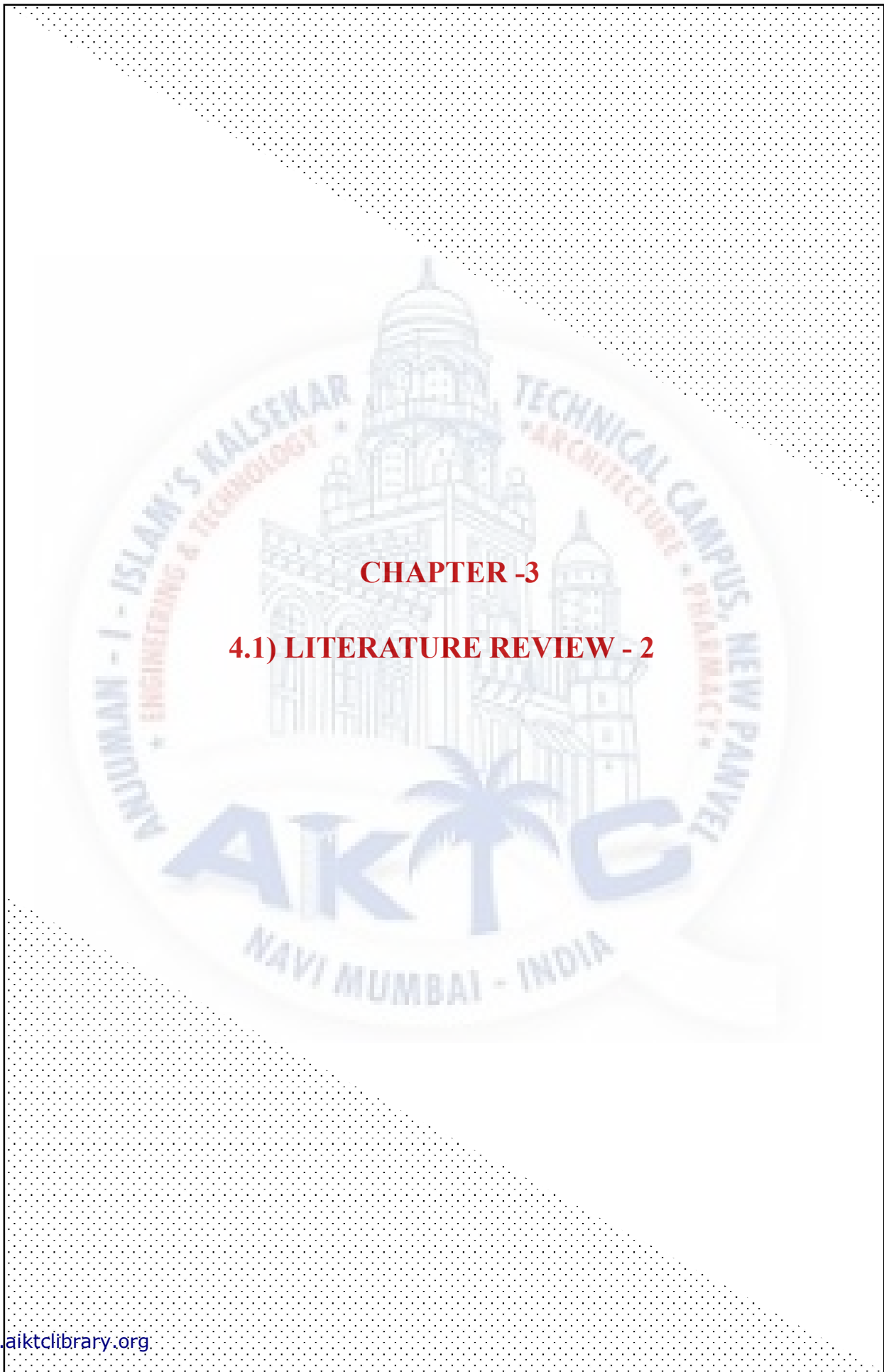
खर्डी येथे आघात केंद्र सुरु झाल्याने नागरिकांना त्याचा मोठ्या प्रमाणात उपयोग होईल व अपघातामुळे होणारे मृत्यूचे प्रमाण कमी होईल.

Source – fb/Mahanagri Times

Image - 40

- Khardi, located within Shahapur taluka, has exhibited notable population growth and a promising trend in development.
- Additionally, it enjoys excellent connectivity due to its proximity to the Mumbai-Agra national highway and the central railway network. Recognizing these factors, the government has put forth a proposal to establish a trauma care center in this region.
- The required land for this significant project has been approved by the Shahapur revenue department. Subsequently, a parcel of approximately 2 hectares has been designated for this purpose, which is adjacent to the existing government Primary Hospital.
- Once the trauma care center becomes operational, it is poised to make a substantial impact on the community. It will enable timely and appropriate medical treatment, which has been unavailable, particularly for accident victims on the national highway. Consequently, this initiative is expected to contribute to saving lives and

ir.aiktclimproving healthcare services in the region



## **CHAPTER -3**

### **4.1) LITERATURE REVIEW - 2**

## 4.1) LITERATURE REVIEW - 2

### CASE STUDY-LIVE

1. D.Y.PATIL HOSPITAL – NERUL,NEW MUMBAI
2. BALASAHEB THAKRE TRAUMA CENTRE – JOGESHWARI,MUMBAI
3. SUASTH MULTISPECIALITY HOSPITAL – KALAMBOLI,NEW MUMBAI

### CASE STUDY INTERNET BASED (INDIAN)

1. FORTIS ,GURGAON

### CASE STUDY INTERNET BASED (INTERNATIONAL)

1. PARS HOSPITAL – RASHT,IRAN
2. HEFEI BOW HOSPITAL – HEFEI,CHINA
3. HARA HOSPITAL – ISESAKI,JAPAN





## CASE STUDY (Live) -

### 2) Dr D.Y Patil Hospital –Nerul, Navi Mumbai

**Location:** Nerul, Navi Mumbai

**Built - up area :** 2,25,000 Sq.ft

**Architect :** Ar. Shirish Beri

**NO. of BEDS :** 750

**General care beds :**

**ICU beds :**

**OPD chamber :**



#### About –

- D Y Patil Hospital or D.Y.P.H.R.C. (D. Y. Patil Hospital and Research centre - Navi Mumbai) is a charitable hospital in Navi Mumbai, India.
- It was founded in 2004 by Shri Dnyandeo Yashwantrao Patil (Ex Governor of Tripura, West Bengal and Bihar).
- It has 750 beds dedicated to charity as well as private, a 300-bed ICU facility (the largest in Navi Mumbai), 15 operation theatres, a 24x7 charitable casualty and trauma centre.
- DY Patil Hospital, Navi Mumbai, stands tall by offering quality healthcare for all strata of the community with its excellent infrastructure.

#### DEPARTMENTS

Trauma and Emergency services | Neurosurgery | Anaesthesiology | Orthopaedics | Cardiac Anaesthesia | Cardiology | Cosmetology | Urology | Dermatology | Paediatrics | Psychiatric | Obstetrics | Surgery | Urology | Oncology | Obstetrics and Gynaecology | Stroke (Paralysis) | Physiotherapy | Ayurveda | Skin | E.N.T | Nephrology | Neurology | Ophthalmic | Paediatric Dental | Dental | MICU | SICU | PICU | NICU |

#### About –

- Born in November 1950 at Pune, Shirish Beri graduated in architecture from the School of Architecture (CEPT), Ahmedabad in Jan 1974
- Shirsh Beri's Works have been bearing a distinct mark on modern Indian architecture since 1975 initially as Director (Design) with "Beri architects and engineers pvt. Ltd." And later through his "Shirish Beri and Associates".
- His work is free, spontaneous, as it is not bound by conditioning and constrains of a particular style or ism. It is intensely responsive to the site, the social cultural behavior-values and Life as a whole.
- His design concepts evolve from the understanding of life and are also highly responsive to the site and the socio-cultural behavior-values.
- The designs address his users' lives, these designs have won him National-International awards and coverage.

## Location and Connectivity -



### Approaches to The Hospital

#### Road Connectivity –

On Mumbai – Satara Highway .  
Internal Road - On Ayyapa Temple Road ,Sector 5.

#### Airport Connectivity –

Chhatrapati Shivaji Maharaj International  
Airport : (29 km)

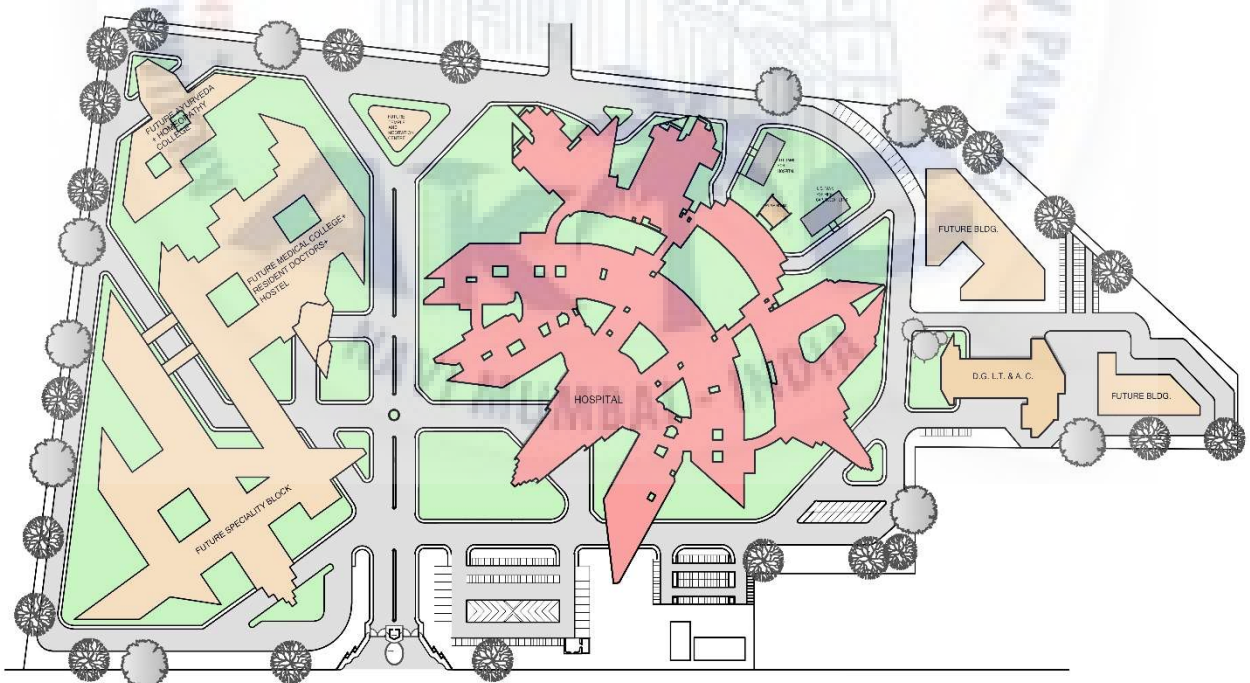
#### Nearest Metro Station –

Taloja Metro Station(400 M )

#### Nearest Railway Station –


Nerul Railway Station : (1.2 km)

### Site Plan




#### Legend

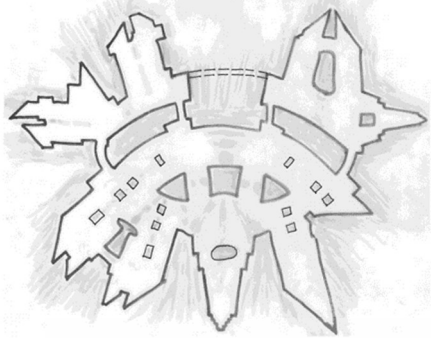
 Hospital

 Existing Built Mass

ir.aiktclibrary.org Building's

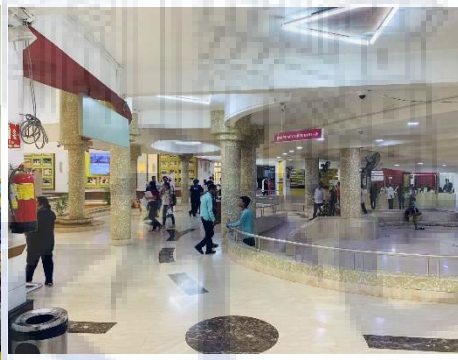
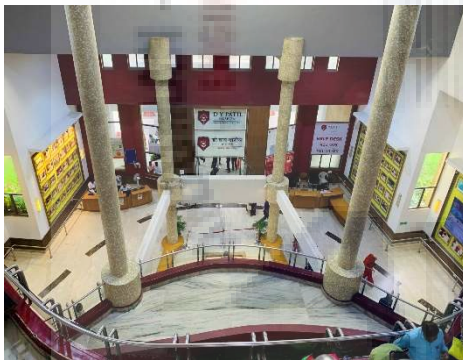
 Open/Green space

## Design Concept -



- The governing design parameters for the hospital were thought out as below.
- The design of the hospital should contribute to the healing process by - having a healthy atmosphere with lots of natural light, ventilation and nature (plants, landscaped courtyards) - having good, direct, short circulation linkages between various easy to locate functions.
- Efficient planning of the various services like medical gases, CCTV, computer networking, A.C, electricity, water, drainage etc.
- Designing for high level of sterility in certain critical areas. Using materials that would stay clean and require minimum maintenance over the years. (especially for the Mumbai climate).
- Breaking away from the typical hospital image externally by making it more nature friendly & green as well as internally by avoiding long, dark, smelly passages of a similar hospital. Viewers outside.

## Interior Spaces -

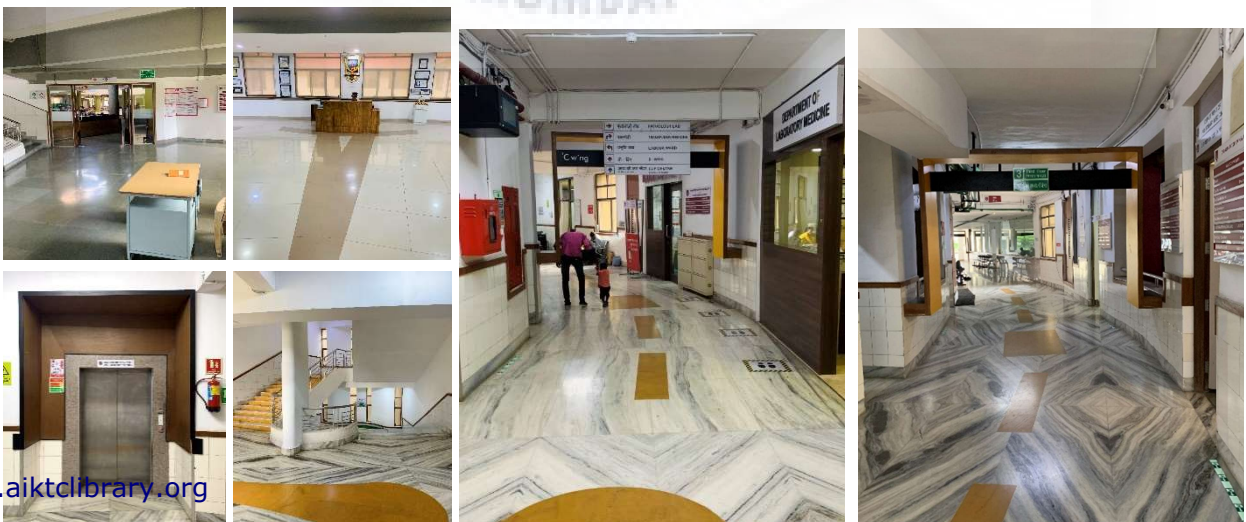
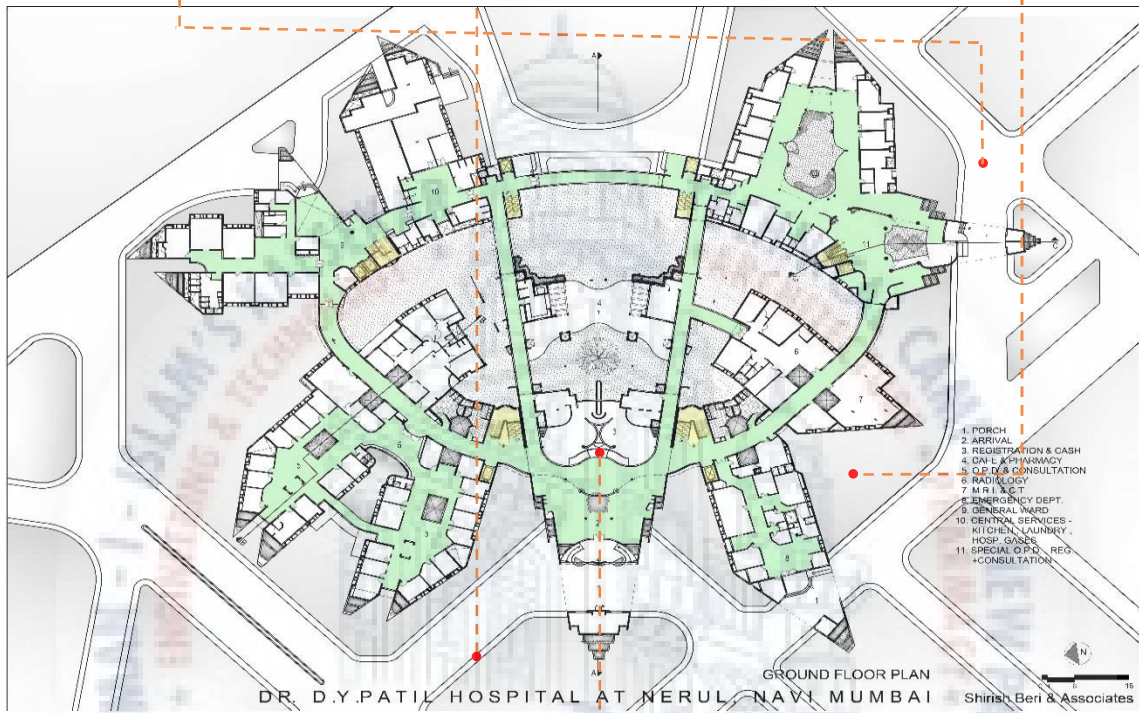


## Exterior Spaces -

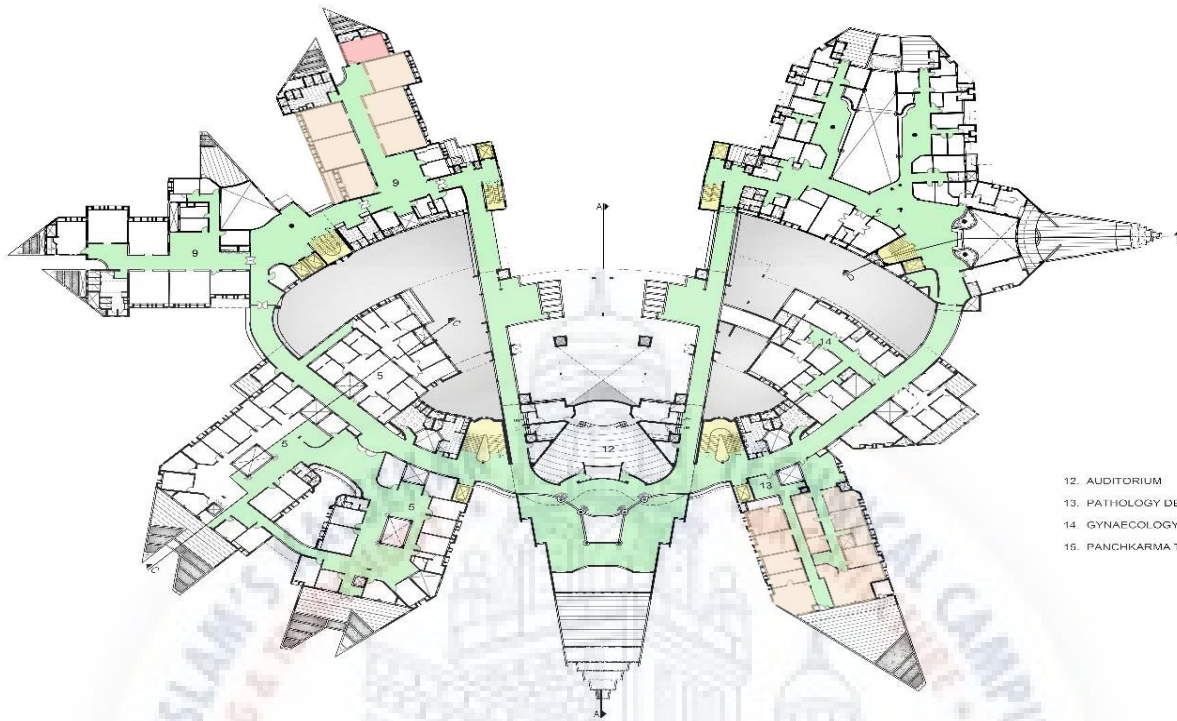


- To reduce maintenance costs and ugly stains (due to Mumbai rains) on the outside, the entire building has glass mosaic tiles on walls and full length glass in the window bays.
- The typical box type image of the hospital from outside is broken by creating light, airy terraces and a shading pergola that would soon be covered with green flowering creepers, making the building look more healthy and eco friendly.

# Ground Floor Layout and Pictures -



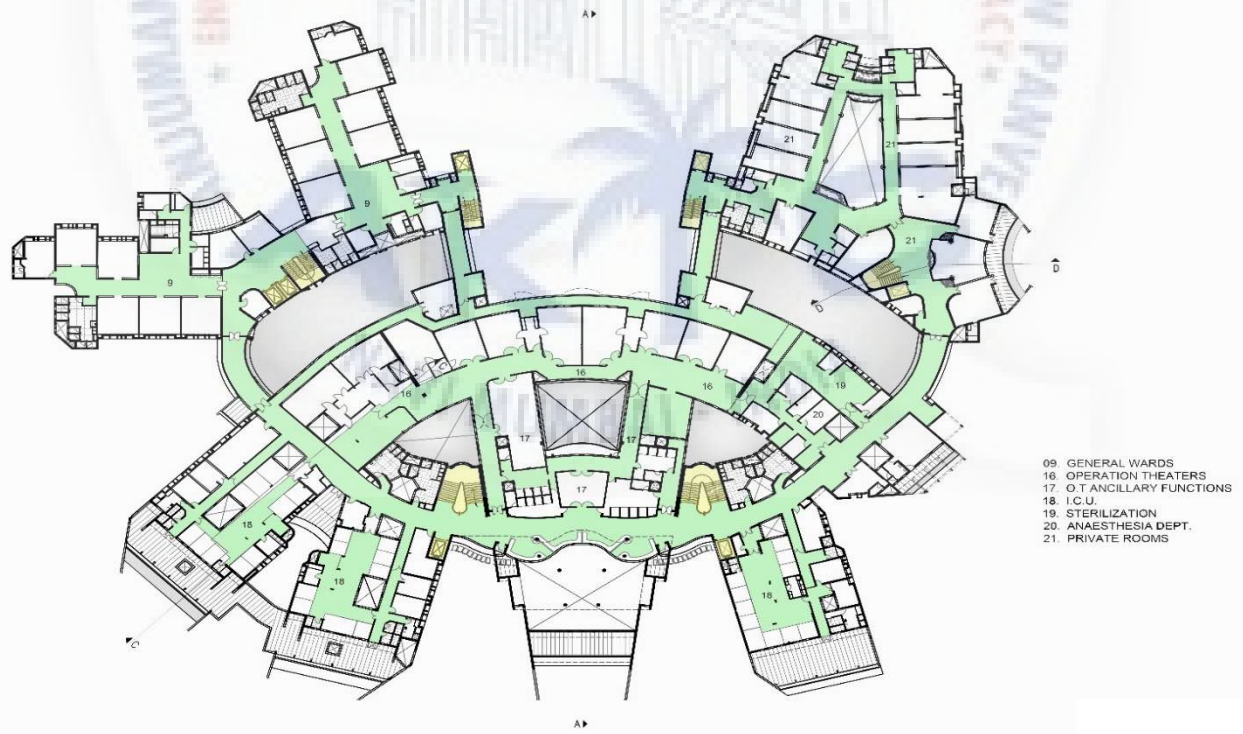
## Architectural plans -



- 12. AUDITORIUM
- 13. PATHOLOGY DEPT
- 14. GYNAECOLOGY
- 15. PANCHKARMA THERAPY

### First Floor Plan

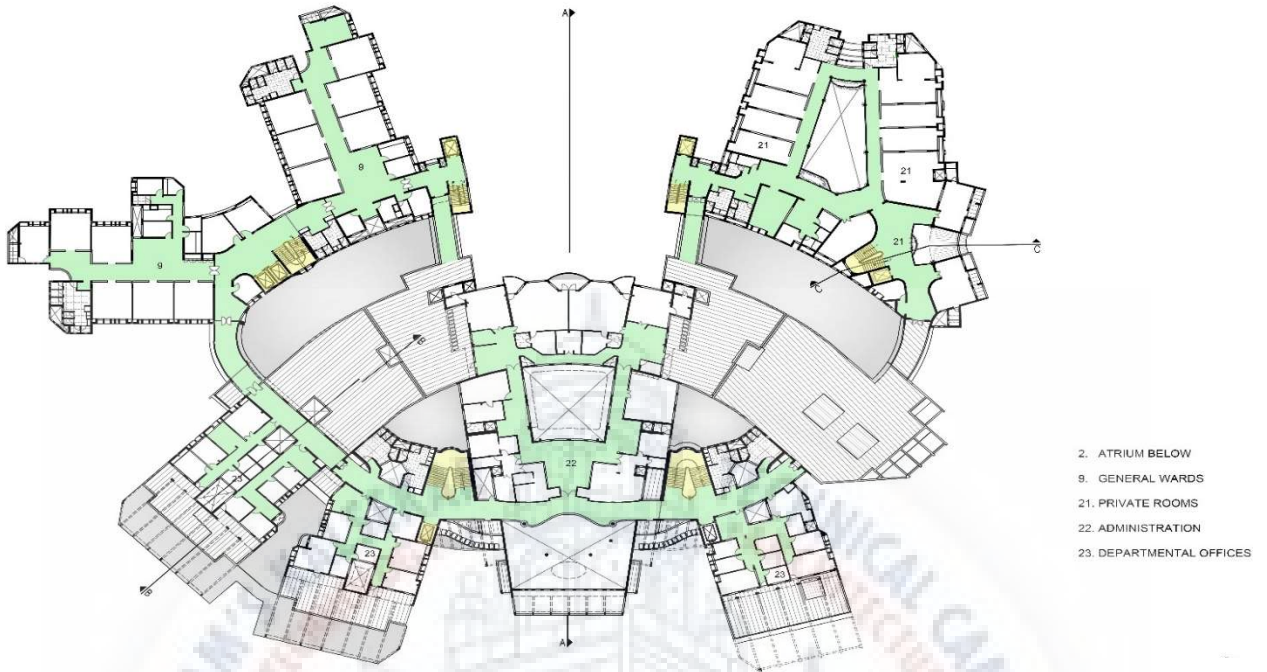
● Services    ● Vertical Access    ● Circulation



- 09. GENERAL WARDS
- 16. OPERATION THEATERS
- 17. O.T. ANCILLARY FUNCTIONS
- 18. I.C.U.
- 19. STERILIZATION
- 20. ANAESTHESIA DEPT.
- 21. PRIVATE ROOMS

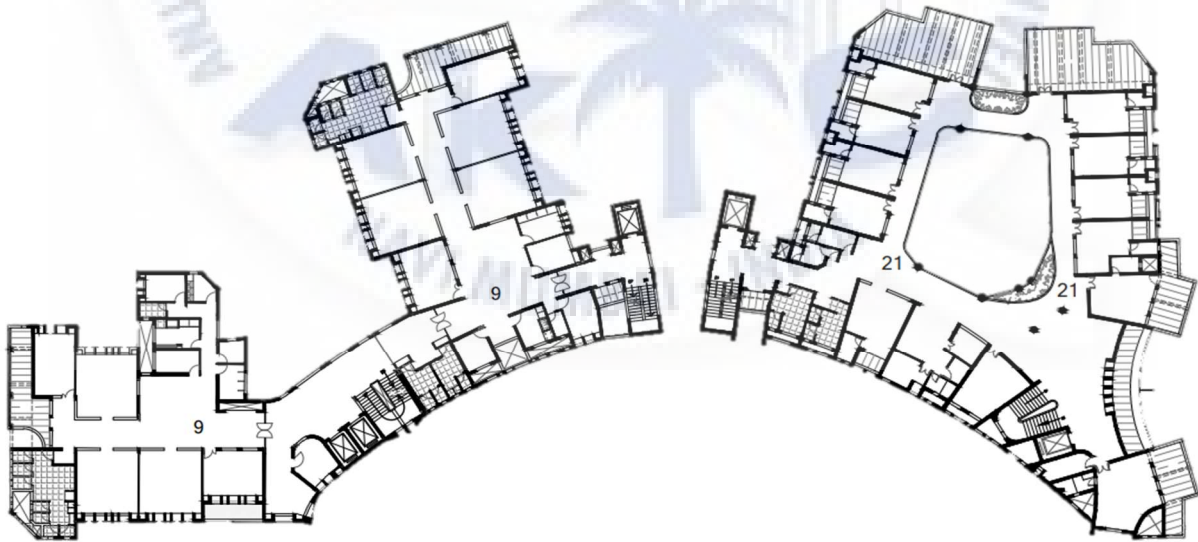
### Second Floor Plan

## Architectural plans -



**Third Floor Plan**

● Services    ● Vertical Access    ● Circulation



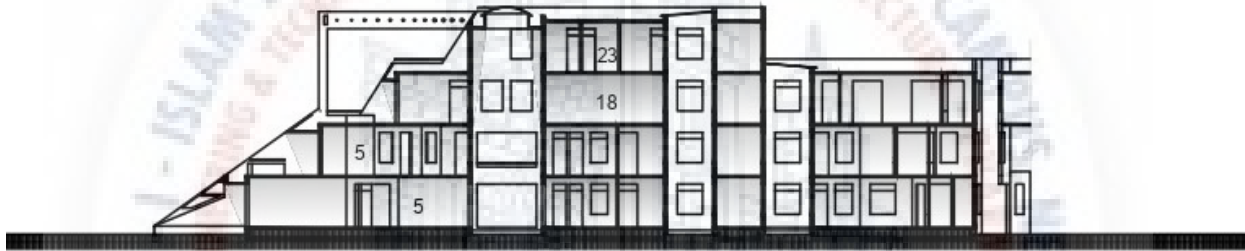
**Fourth Floor Plan**

**Fifth Floor Plan**

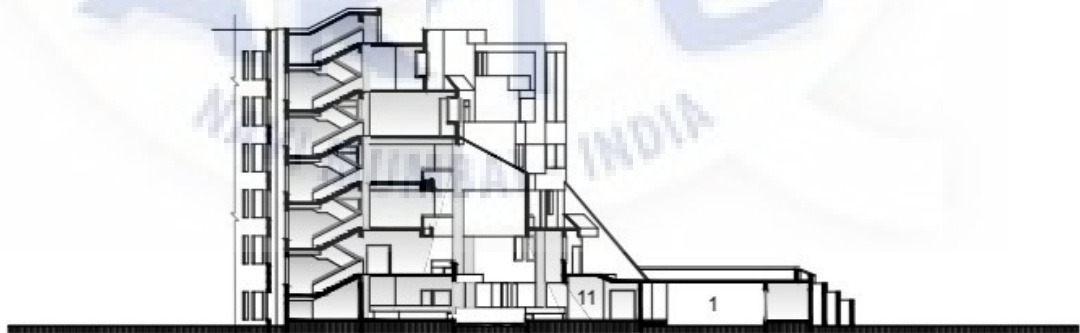
## Architectural Sections -



Section At A-A'



Section At B-B'



Section At C-C'

## CASE STUDY (Live) -

### 2) Balasaheb Thakare Trauma Care Municipal Hospital – Jogeshwari, Mumbai.

**Location:** Jogeshwari, Mumbai

**Site area :** 8000 sq. m.

(2 acres)

**Built - up area :** ~ 20,500 sq.m

**Architect :**

**NO. of BEDS :** 320

**ICU beds :** 60

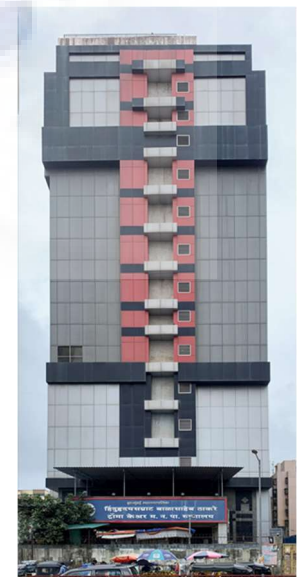


#### About –

- The Hindufriday samrat Balasheb thakare Trauma care municipal hospital, established In 2013 in the vibrant city of Mumbai, stands as a beacon of excellence in trauma care and multi-speciality healthcare with a Capacity of 320 beds.
- The hospital has multiple facilities with road Front entrances, exits. It also has all safety features designed with respect To standards and by laws along with proper circulation and vertical transportation.
- The hospital has very good location and connectivity as its accessible easily by road. It can also be reached easily by using metro and railway.
- The hospital comprises a total of 13 floors, including a basement. From the 1st to the 10th floor, the facility houses various medical facilities, offering a wide range of healthcare services. Notably, the 6th floor serves as a dedicated service floor, supporting the smooth operation of the hospital's medical services.
- On the 11th floor, another service floor is situated. The 12th floor is designated for the accommodation of doctors and staff.
- The 13th floor, in contrast, is left unoccupied.



East Elevation



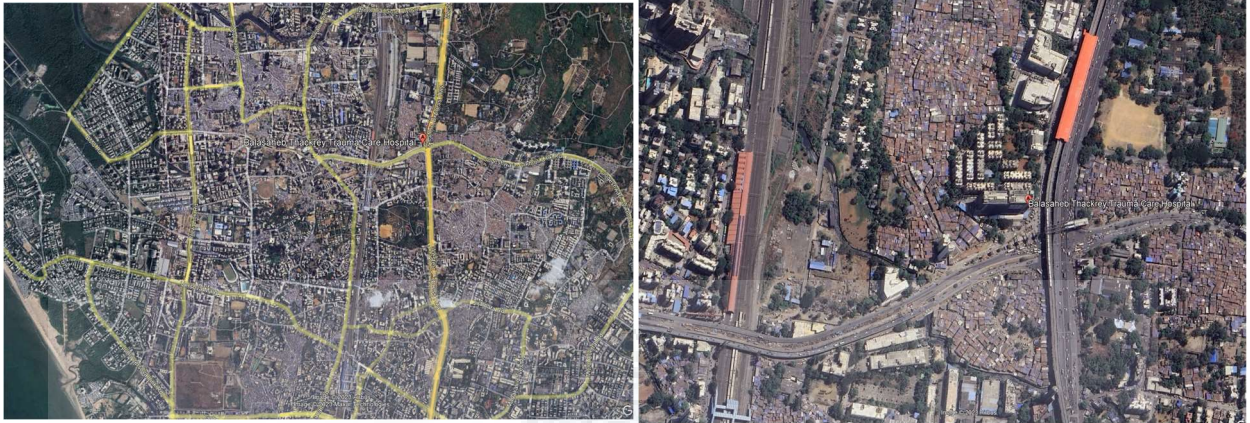
North/Front Elevation

#### DEPARTMENTS

Trauma | Neurosurgery | Orthopaedics | Psychiatric | Obstetrics | Surgery | Urology | Oncology | Obstetrics and Gynaecology | Stroke (Paralysis) | Physiotherapy | Ayurved | Skin | E.N.T | Ophthalmic | Paediatric Dental | Dental



## Location and Connectivity -



### Approaches to The Hospital

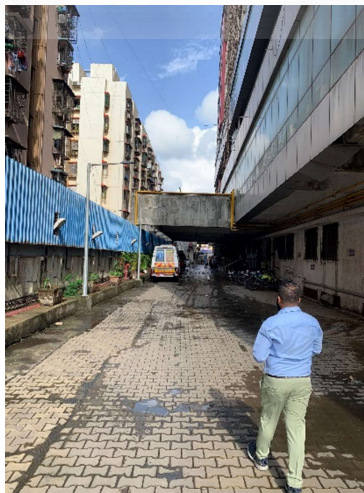
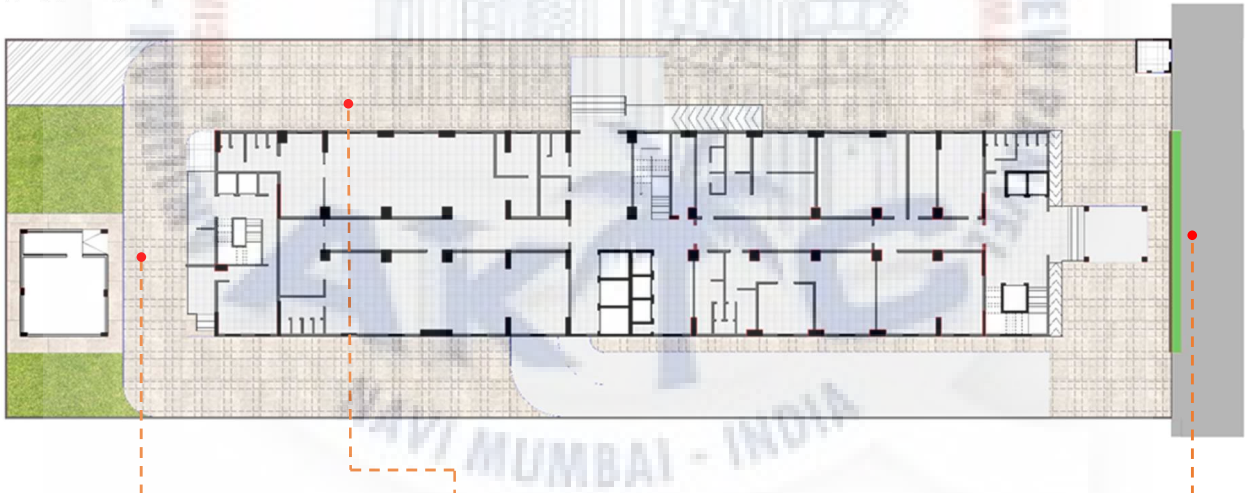
**Road Connectivity –**  
On Western Express Highway

**Airport Connectivity –**  
Chhatrapati Shivaji Maharaj International  
Airport : (6.5 km)

**Nearest Metro Station –**  
Jogeshwari East Metro station (300 M )

**Nearest Railway Station –**  
Jogeshwari Rly Station (1.0 km)  
Jogeshwari harbour line Rly Station (0.95 km)

### Site Plan



## Ground Floor Layout and Pictures -



Site Plan



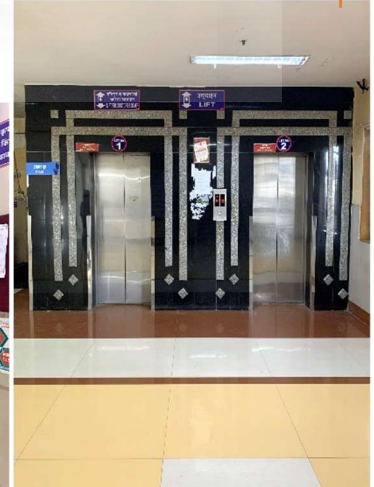
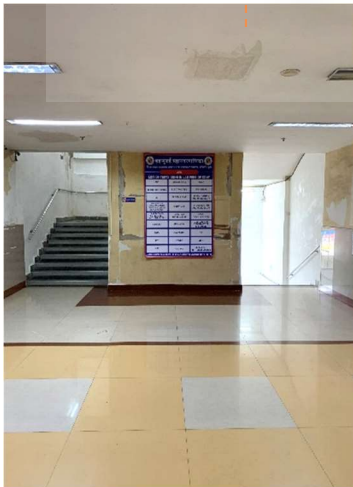
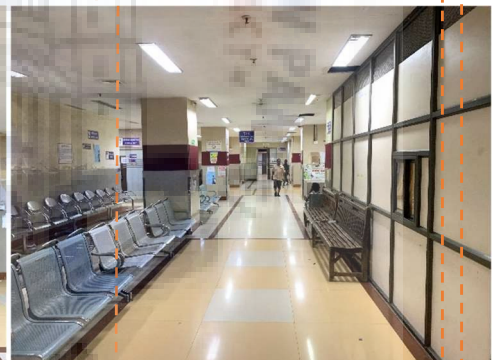
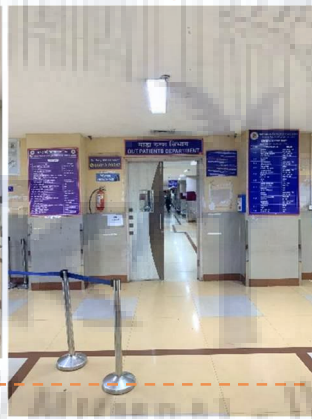
# First Floor Layout and Interior Pictures -



● Public Spaces   ● Private spaces   ● Services   ● Vertical Access   ● Circulation



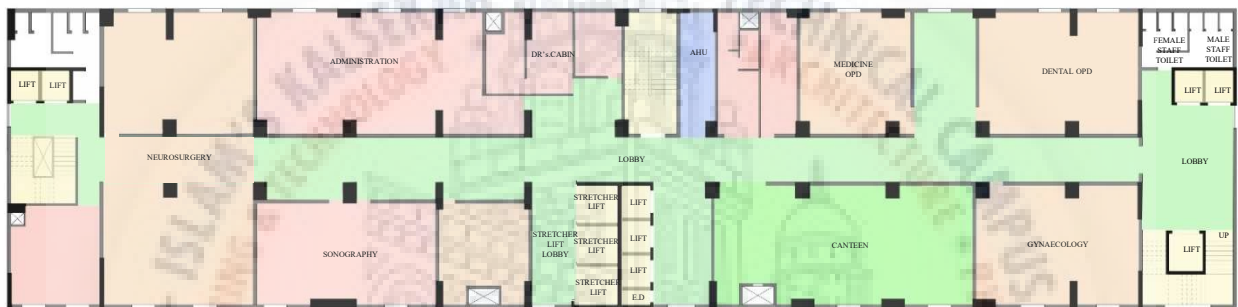
First Floor Plan



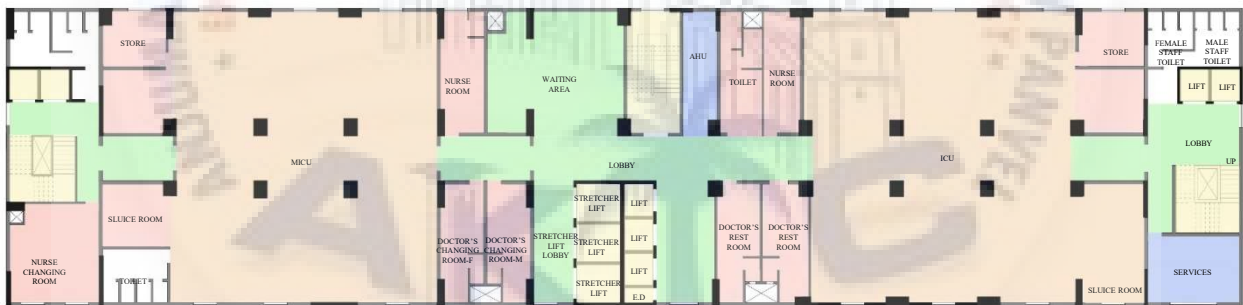
## Architectural plans -



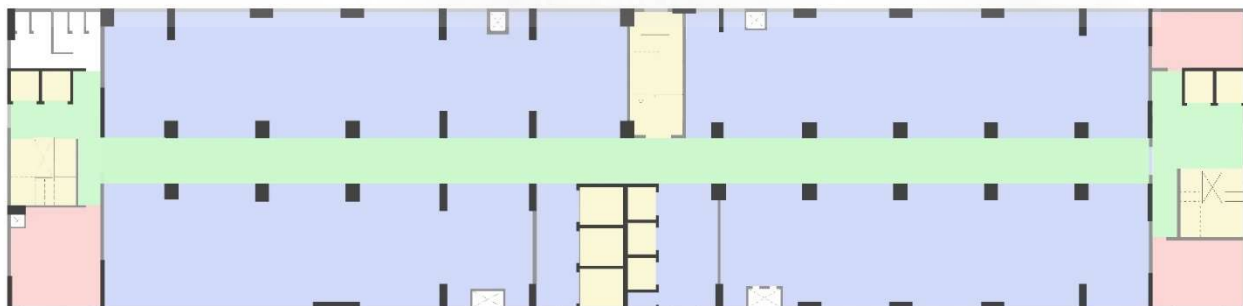
**Ground Floor Plan**



**Second Floor Plan**

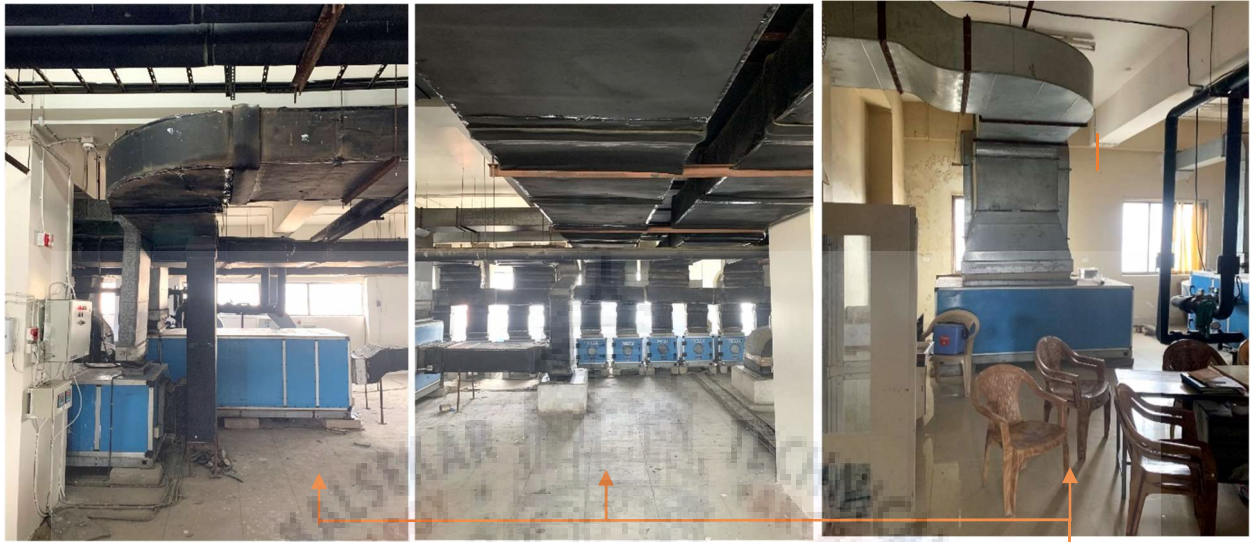


**Third/Typical Floor Plan till 9<sup>th</sup> Floor**

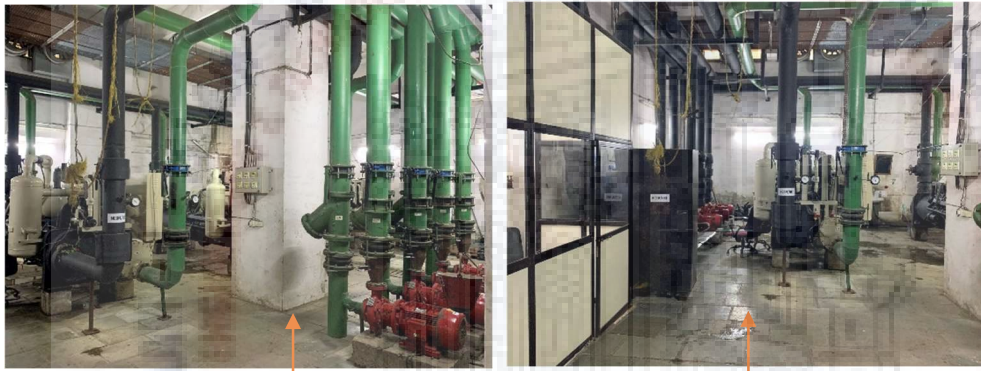


**Service Floor Plan**

## Building Services - Ventilation System

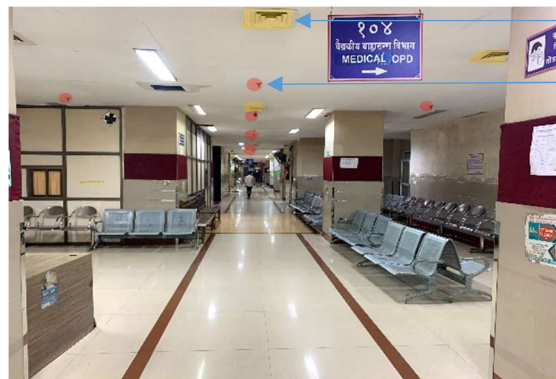
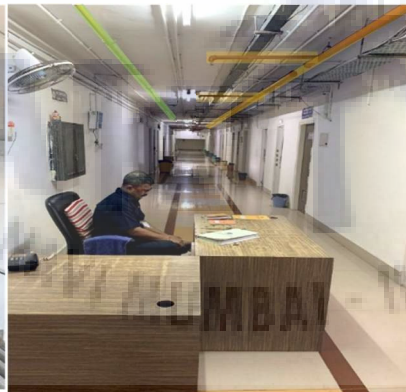


AHU Layout  
On service  
(6th floor)



AHU in  
basement

## Fire Fighting



Smoke Detectors

Sprinklers

Sprinklers

- Sprinklers
- Stand Pipe
- Gas Pipe

## CASE STUDY (Live) -

### 3) Suasth Multispecialty Hospital- Kalamboli, New Mumbai

**Location:** New Mumbai

**Site area :** 20,000 sq. m.

(5 acres)

**Built - up area :** 48,300 sq.m

**Architect :**

**NO. of BEDS-** 400

**General care beds:** 250

**ICU beds :** 65

**Neonatal ICU :** 10



#### About –

- Suasth Hospital, a multi-specialty hospital and Institute of Advanced Healthcare with 350 beds, recently became operational and has opened its doors to residents across Navi Mumbai.
- The 500,000 sq. foot facility with multiple entrances, exits and safety features has been designed to international standards by Dr. Sanjeev Kanoria [FRCS, MBA, Ph.D.] along with optimized ‘patient flow and journey’.
- He is a well-known healthcare entrepreneur and liver transplant surgeon from the UK with book chapters and numerous original scientific publications

#### DEPARTMENTS

Trauma | Plastic Surgery | Neurosurgery | Oncology | Organ Transplant |Liver Transplant| Biliary Surgery |Cardiology |Urology |Oncology |Obstetrics and Gynaecology |Mental Health & Behavioural Science | Physiotherapy |Radiation | Radiology |Maternity and IVF |

### Location and Connectivity -



#### Approaches to The Hospital

##### Road Connectivity –

Main Highway ,NH48 – 2.1 km

##### Airport Connectivity –

Chhatrapati Shivaji Maharaj International Airport : (36 km)

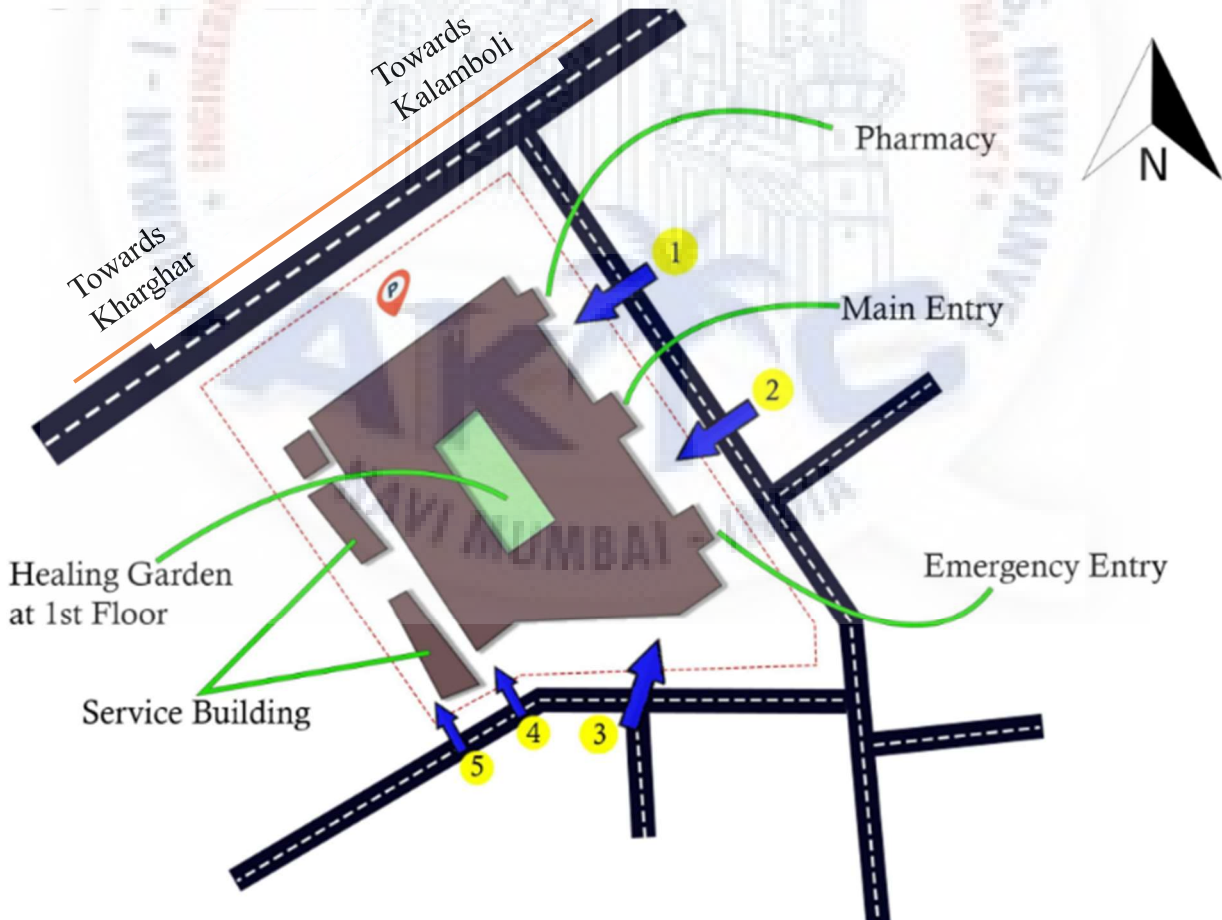
##### Nearest Metro Station –

Taloja Metro Station –(5.8 km)

##### Nearest Railway Station –

Kalamboli –3.5 km  
Panvel –8.1 km

#### Site Plan -



## Pictures



MAIN ENTRANCE



VIEW FROM ADJACENT ROAD



VIEW FROM ADJACENT ROAD



VIEW FROM ADJACENT ROAD



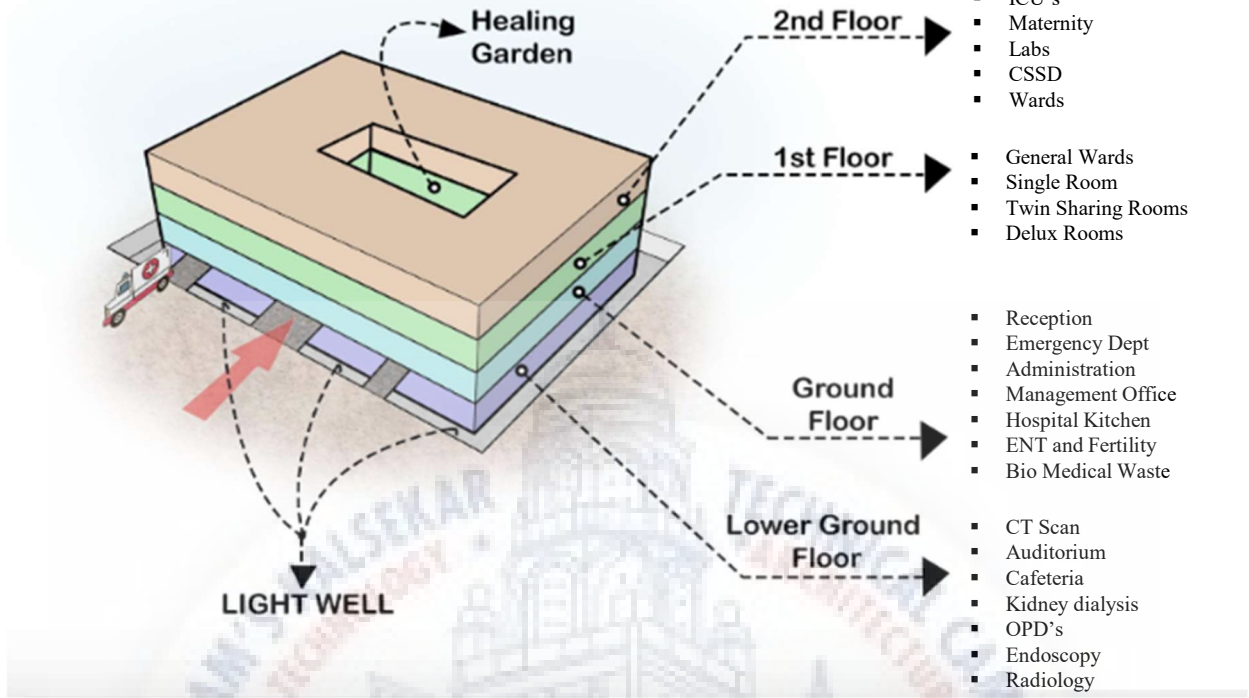
MAIN ENTRANCE



CENTRAL COURTYARD



### Zoning



### Interior Rendered pictures



### Interior Pictures



ICU Wards

ICU Ward

Lift Lobby



Delux Ward

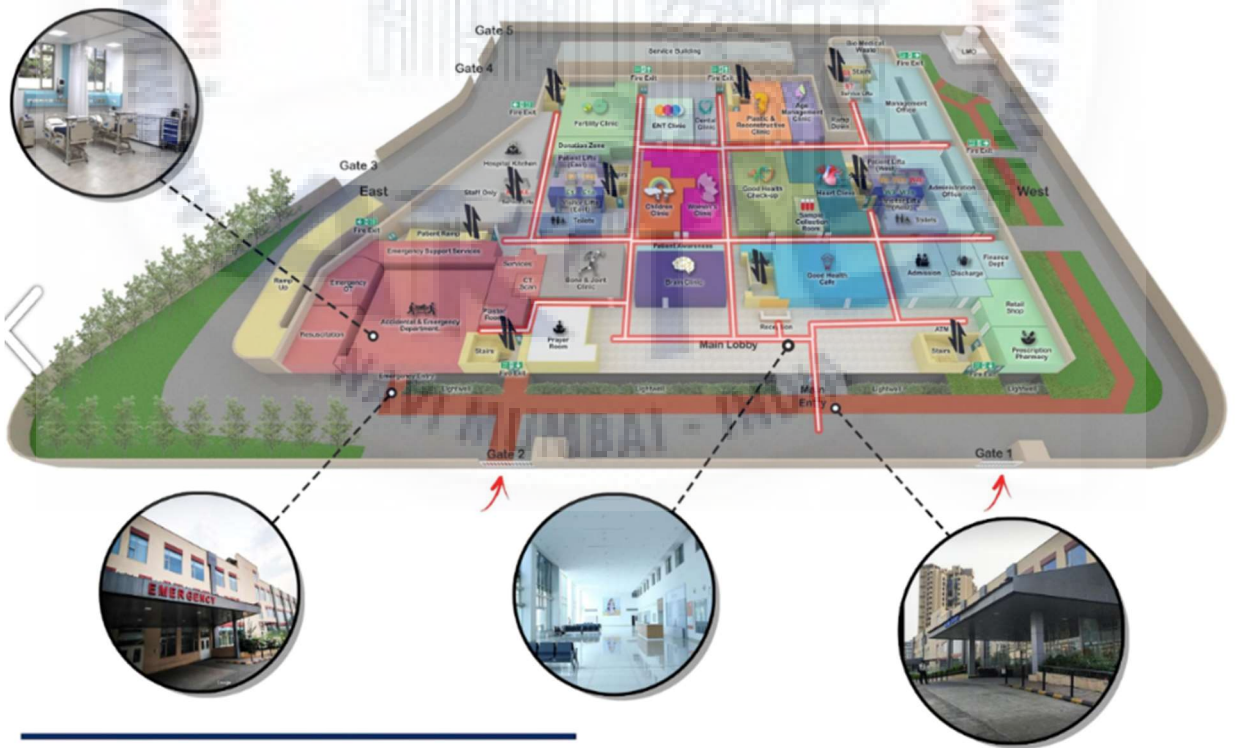
General Ward

Lobby

## Architectural plans -

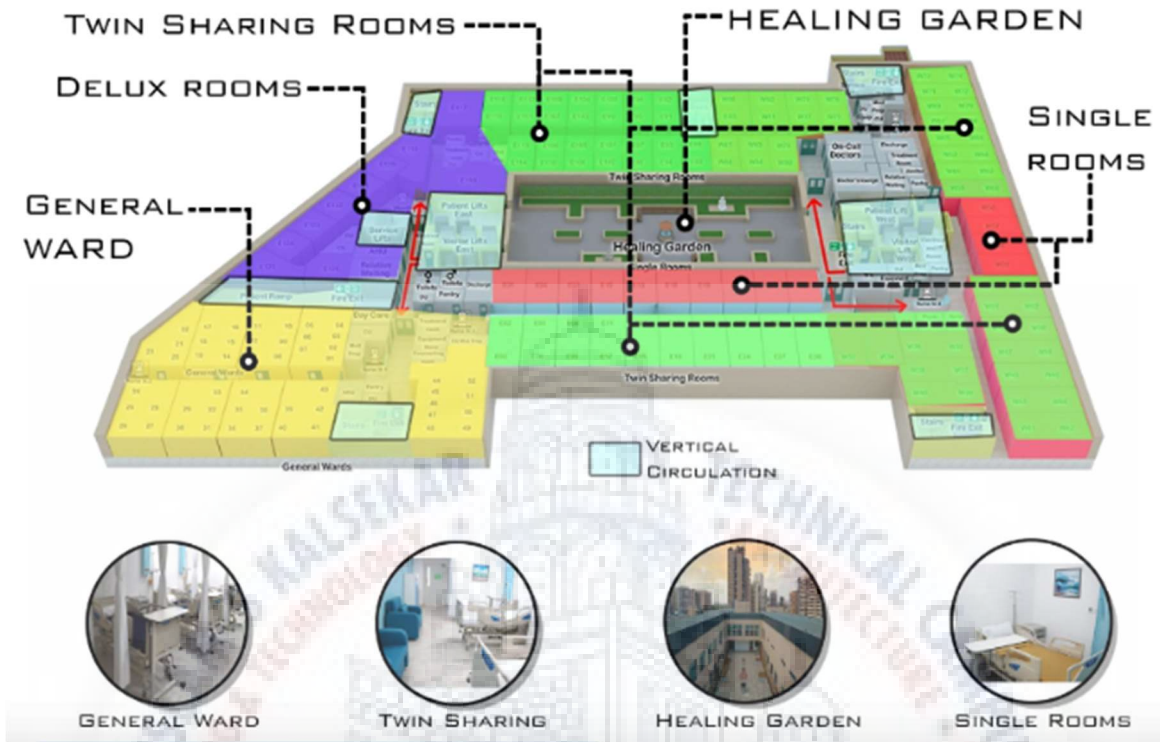


Lower Ground Floor Plan

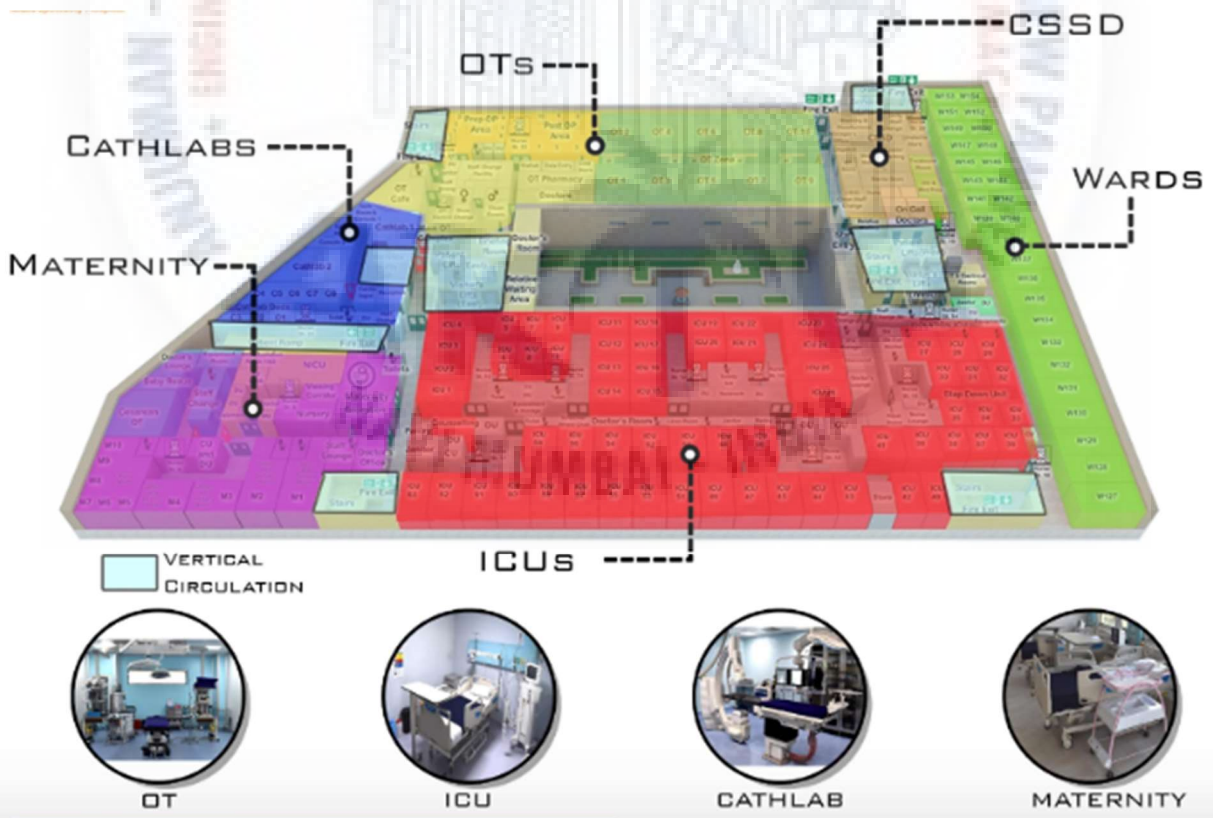


Ground Floor Plan

### Architectural plans -



### First Floor Plan



### Second Floor Plan

## CASE STUDY (Internet Based/Indian)

### 1) Fortis Hospital - Gurgaon

**Location:** Sector 44, Gurgaon

**Site area :** 43,303 sq. m.  
(10.70 acres)

**Built - up area :** 65,961 sq.m

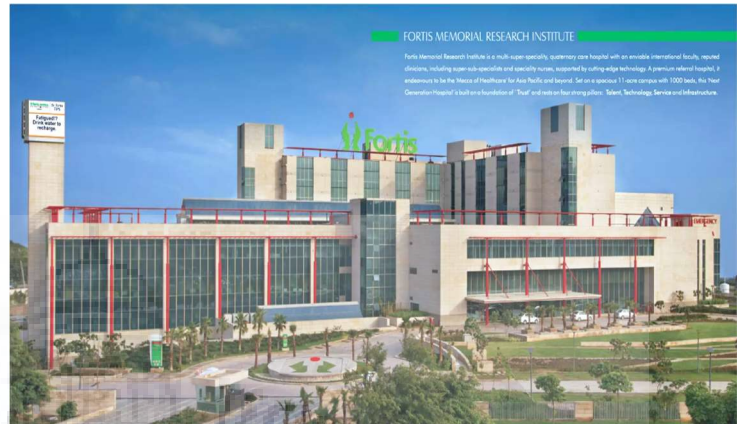
**Architect :** Ar Rajinder Kumar Associates (RKA), New Delhi

**NO. of BEDS-** 430

**General care beds:** 250

**ICU beds :** 100

**OPD chamber :** 80



- Fortis Memorial Research Institute, Gurgaon (FMRI) is a flagship multi super-specialty, hospital of the Fortis Healthcare Limited.
- It has 430 functional beds, with a further planned increase in beds to 1000.
- FMRI is accessible easily by road, It can also be reached using Delhi Metro, as the hospital is located opposite to the HUDA city metro station

### DEPARTMENTS

Trauma | Plastic Surgery | Ophthalmology | Pulmonology | Dental Sciences | Cosmetology | Invasive Cardiology | Paediatrics | Minimal Assess Surgery (Gynae) | Neonatology | IVF | Liver Transplant, GI & Hepato Pancreato | Biliary Surgery | Mental Health & Behavioural Science | Radiation | Radiology | Rheumatology | Gastroenterology & Hepatobiliary Sciences.

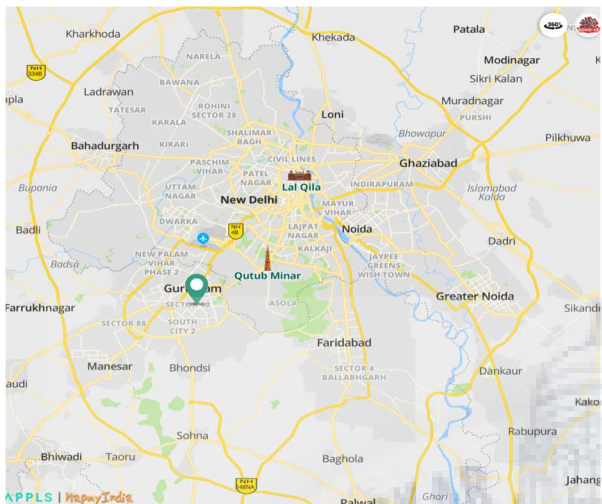
### About Architect -

Rajinder Kumar Associates (RKA) is a multidisciplinary firm specializing Architecture, Planning, & Interior Design.

RKA is the pioneering architectural firm in India for Green Buildings, having designed one of the first Platinum rated Green Corporate Office Buildings in India for ITC at Gurgaon and one of the largest 'platinum' rated green hotel at the ITC Royal Gardenia at Bengaluru.

RKA's nationwide achievements are amplified by its association with buildings such as The Imperial Hotel, The Grand (Hyatt), Crown Plaza, Vivanta (by Taj), Ibis, Radisson and ITC Maurya Sheraton Hotel in New Delhi; Crown Plaza & Taj Vivanta at Gurgaon; The Ritz Carlton, ITC Royal Gardenia, Holiday Inn & Radisson at Bangalore, the new Pepsico headquarters, Motorola Headquarters in India, Microsoft and Ericsson offices at Gurgaon, the Perot System Software Parks in both Bangalore & Noida, and the Microsoft & Ericsson Corporate Offices at Gurgaon to name merely a few!

## Location and Connectivity-



### Approaches to The Hospital

#### Road Connectivity –

On Sector 44 Road Touch .

#### Airport Connectivity –

Indira Gandhi International Airport (120 km)

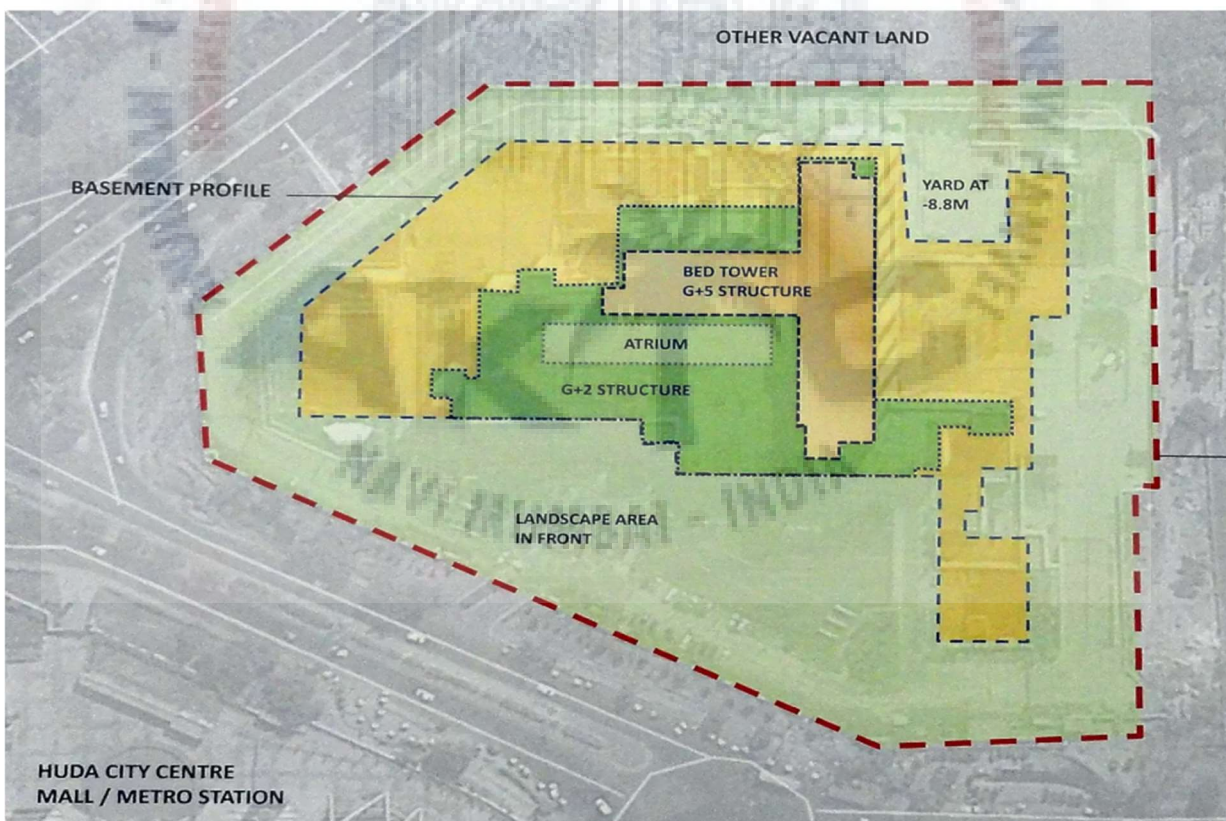
#### Nearest Metro Station –

Huad City Centre (400 M )

#### Nearest Railway Station –

Gurgaon Railway Station (9.7km)

### Site Plan -

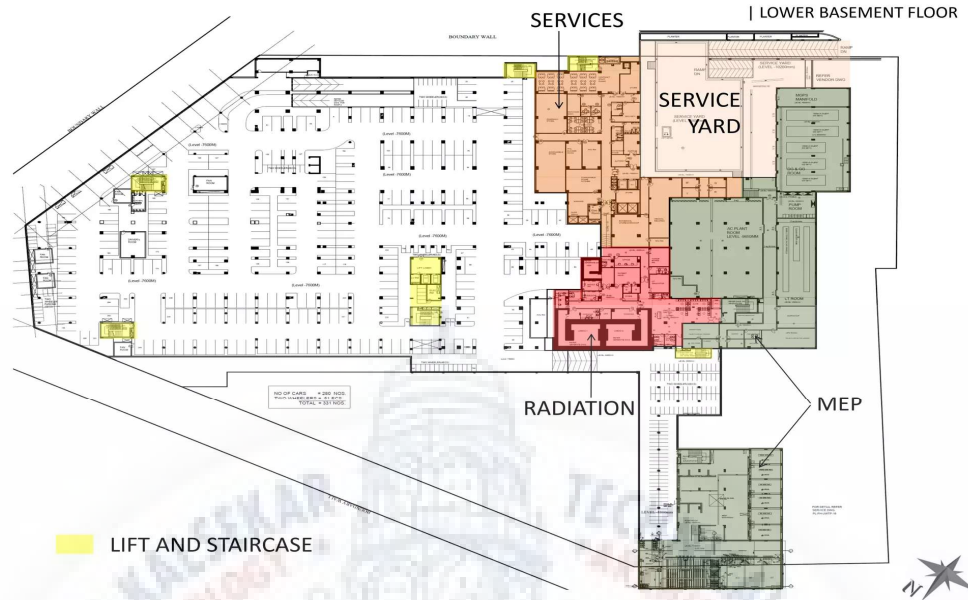


### Legend

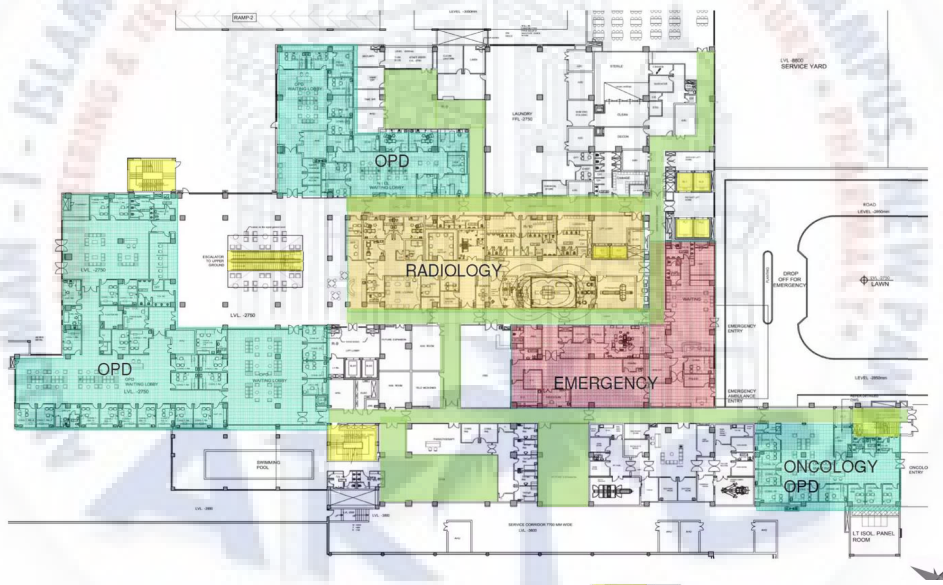
- Plot Boundary
- Basement Profile

- Structure
- Bed Tower

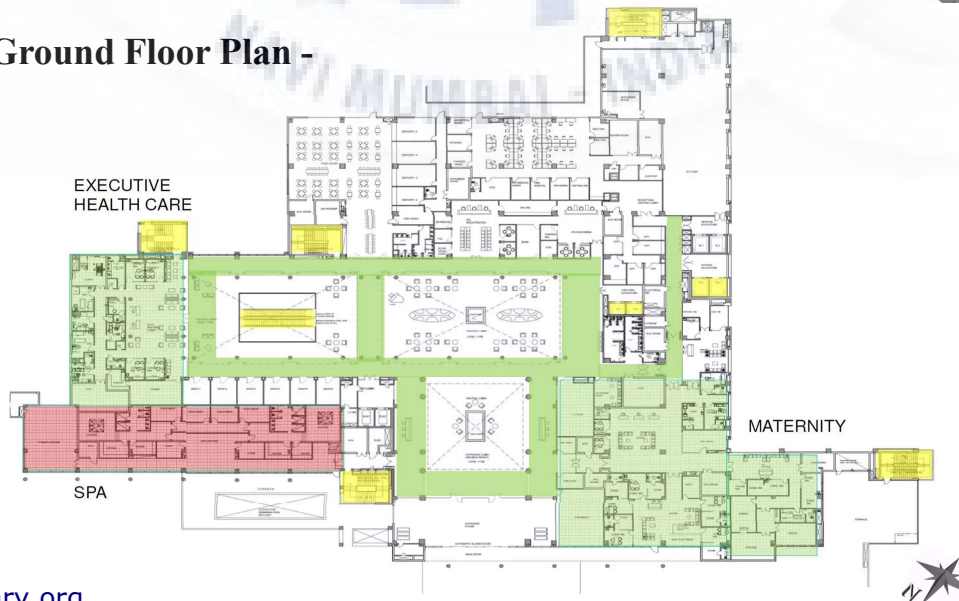
### Basement Plan -



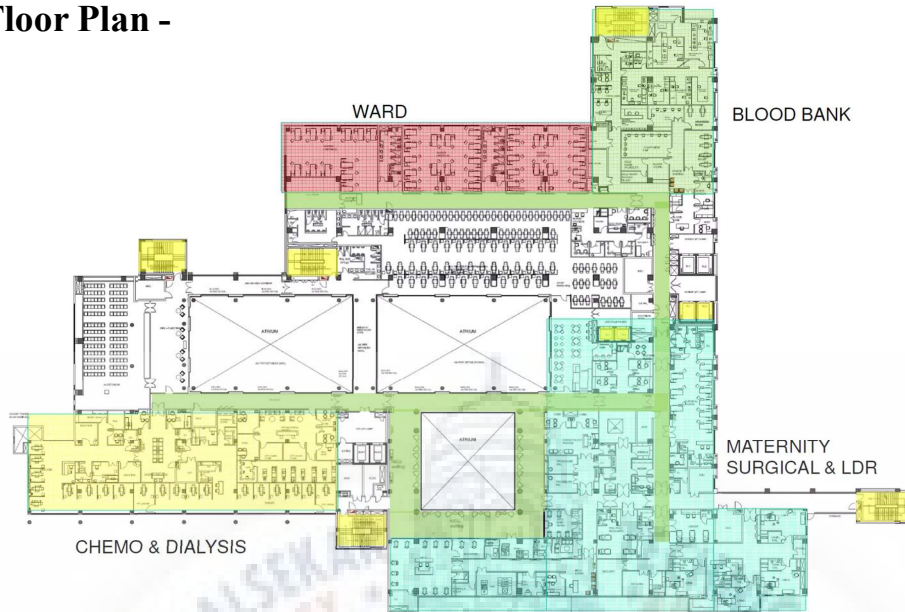
### Lower Ground Floor Plan -



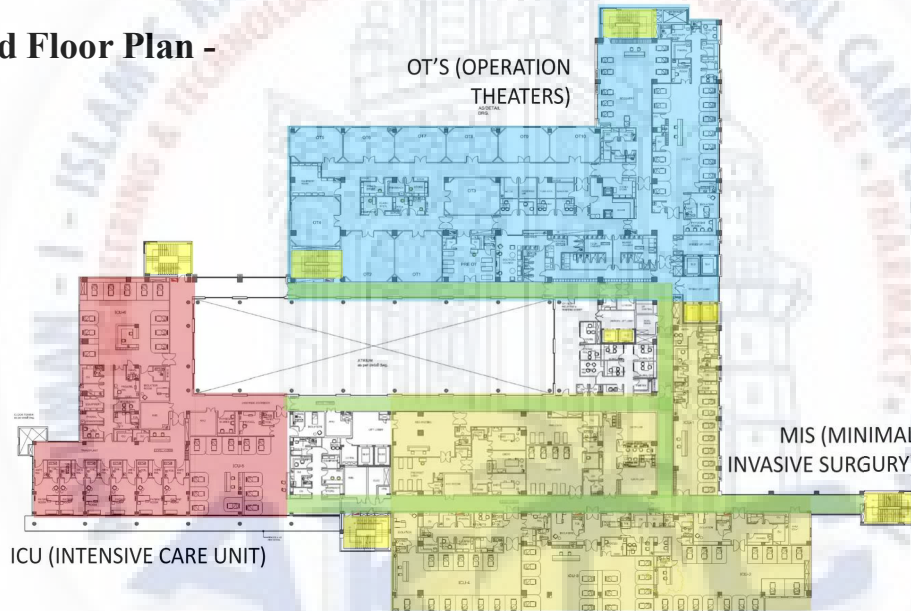
### Upper Ground Floor Plan -



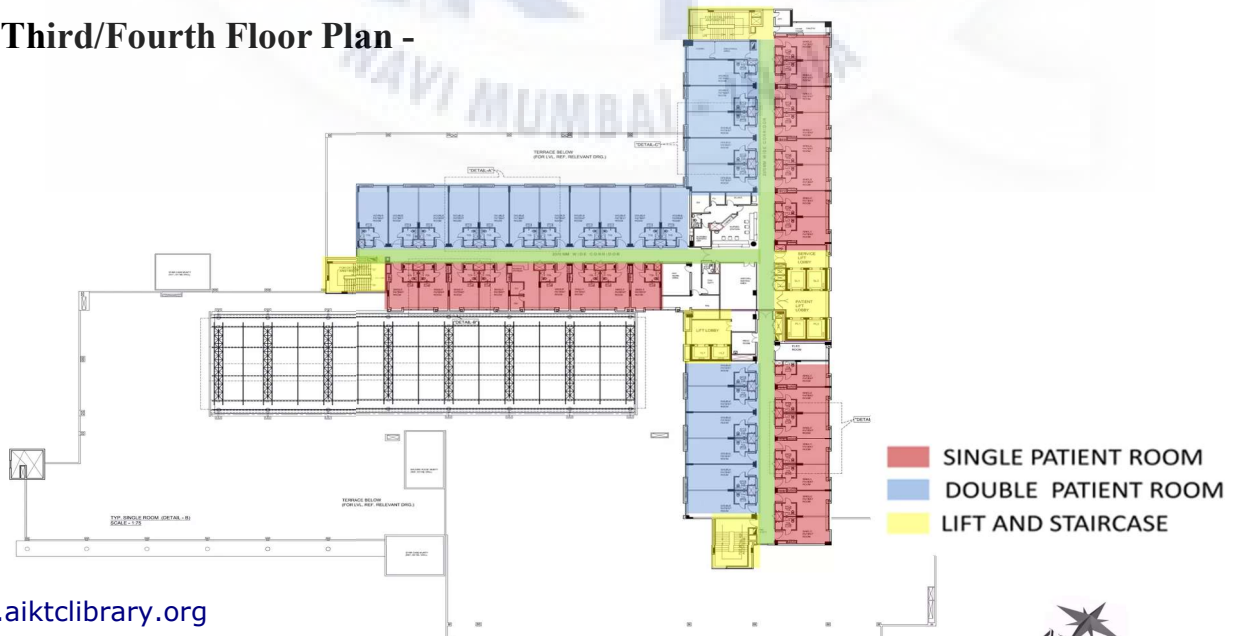
### First Floor Plan -



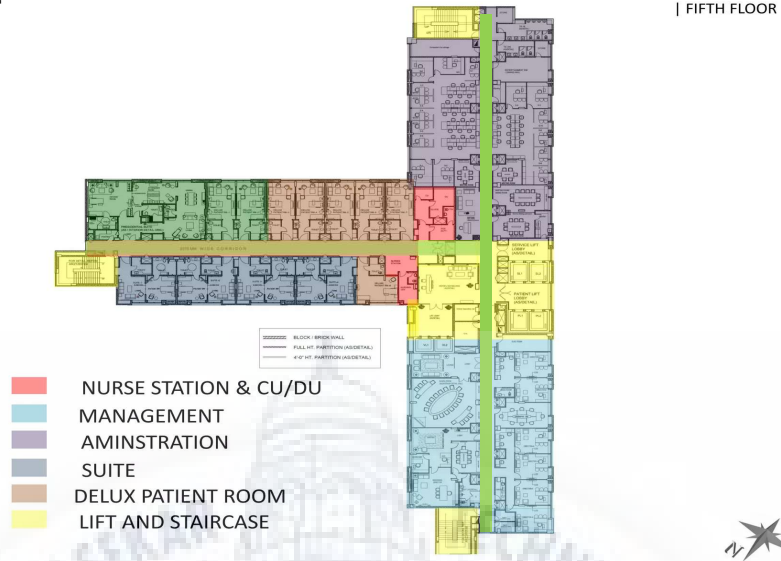
### Second Floor Plan -



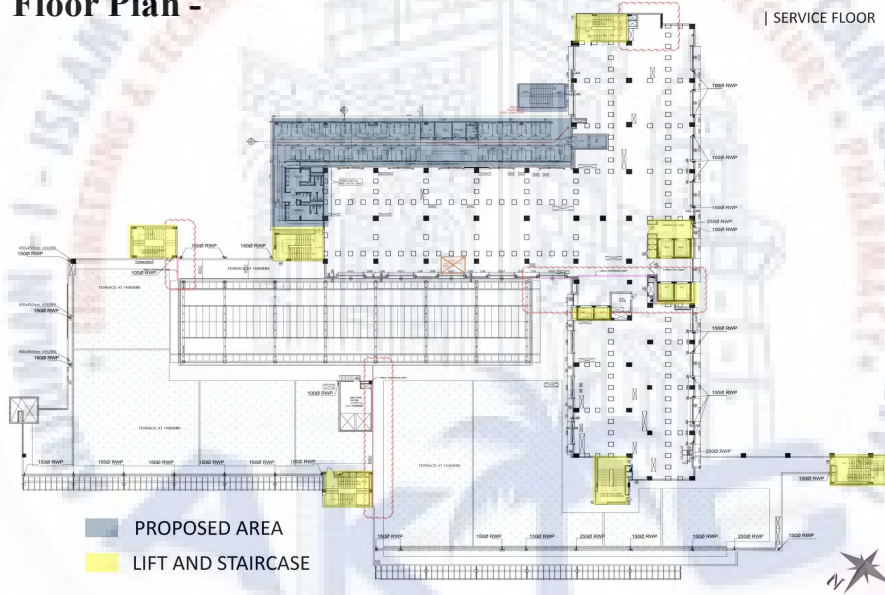
### Third/Fourth Floor Plan -



## First Floor Plan -

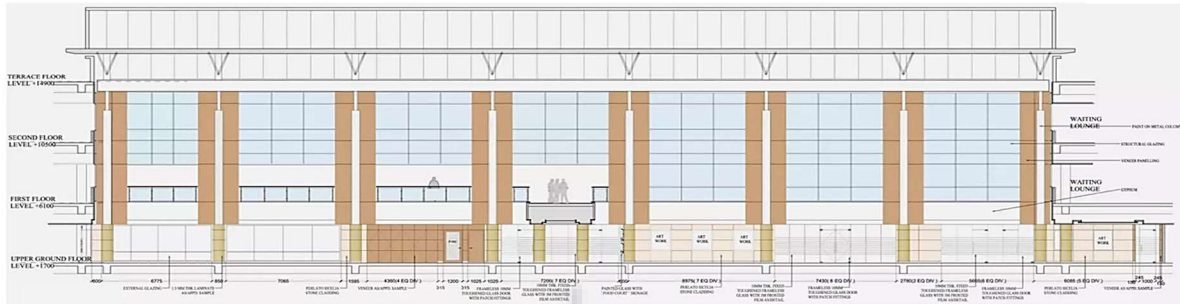


## Service Floor Plan -

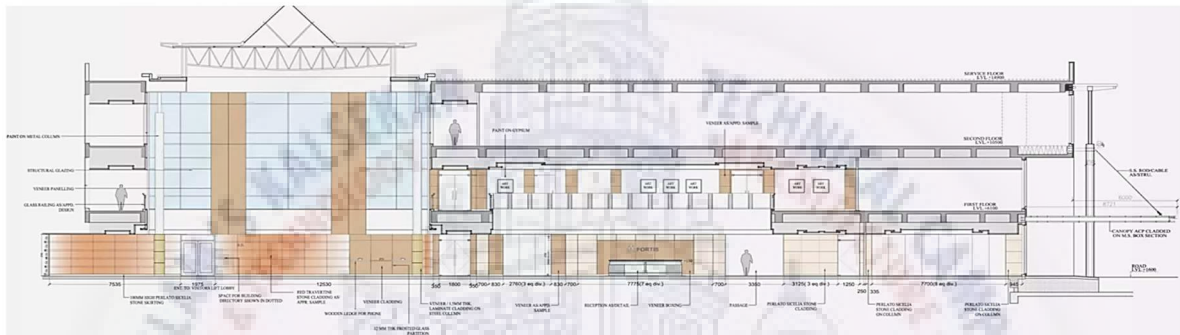




# Elevational Section

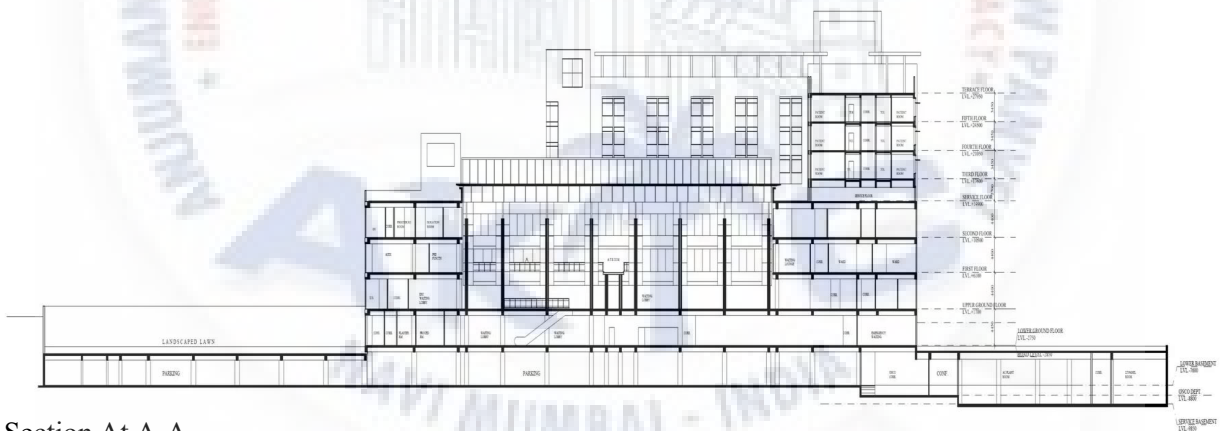


OPTION 1

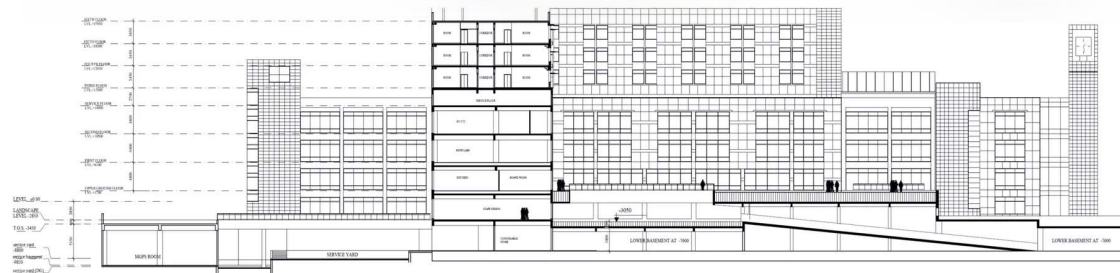


OPTION 2

## Sections -



Section At A-A



Section At B-B

## Interior pictures



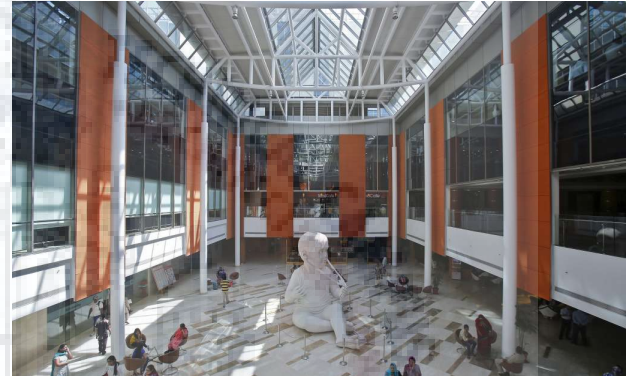
Entrance Atrium



Entrance Atrium



Reception



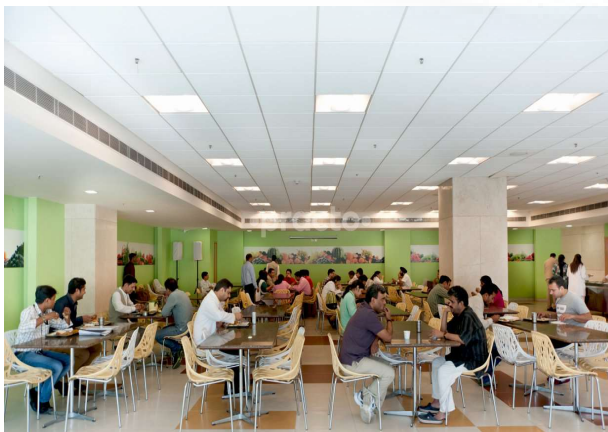
Atrium



Deluxe Ward



ICU Ward



ir.aiktclibrary.org Canteen



General Ward

## CASE STUDY (Internet Based/International) -

### 1) Pars Hospital - Iran

**Location:** Rasht, Iran  
**Built - up area :** 30,000 sq.m  
**Architect :** Lida Almassian,  
 Shahin Heidari (New Wave Architects)  
**No. of BEDS :** 160  
**Year :** 2016

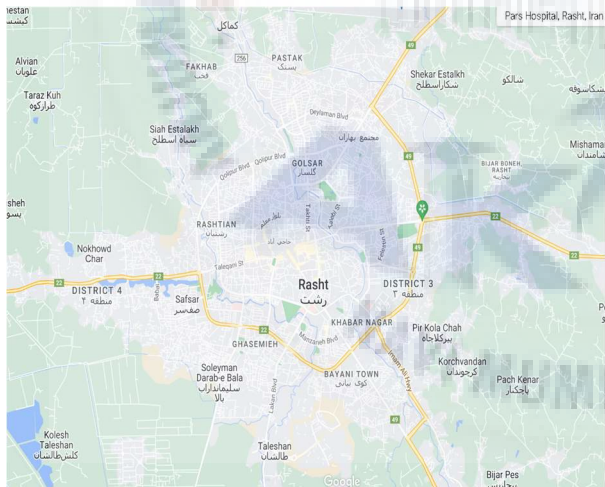


#### About –

- The Pars Hospital of Rasht is
- Multispecialty Hospital built
- in overall 30,000 sq m area having capacity of around 160 beds.
- It is located adjacent to one of most crowded roads of Rasht city with high possibility of rising in noise pollution in future.

**Departments;** laboratories |accident and emergency(A&E) | Acute care services| obstetrics and gynecology theater & IVF |ICU | CCU |specialized clinics | Pediatric & E.N.T wards | operating theater |

#### Location and Connectivity-



#### Approaches to The Hospital

##### Road Connectivity –

On Qolipur Blvd Road

##### Airport Connectivity –

Sardar Jangal Rasht International Airport :  
 (7.0 km)

##### Nearest Metro Station –

---

##### Nearest Railway Station –

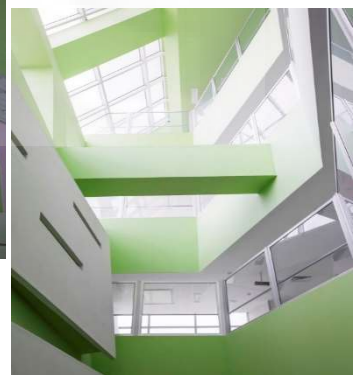
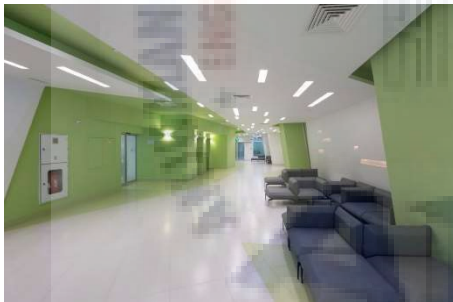
Rasht Rly Station (13.4 km)

## Design Concept -



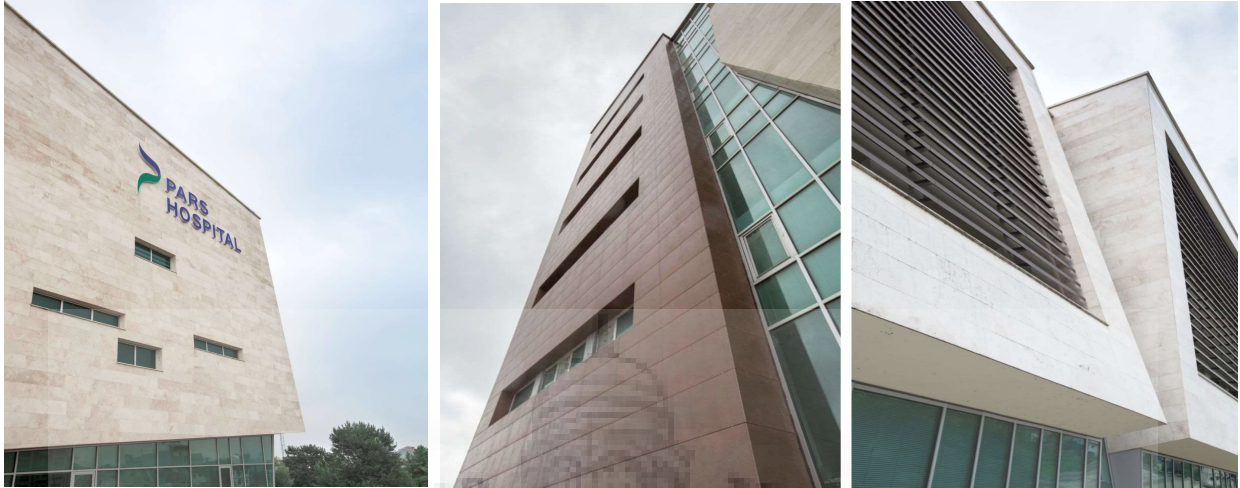
- In accordance with Context of the city Rasht, designer tries to consider sloppy volumes so in this way apparently continuity of sightseeing preserved beyond remedial section in all parts of building is afforded in a way that wouldn't makes any interruption between protected and unprotected areas.
- The whole volume and form of the facades have vital influence in inviting the users and support their feeling of trust to these places as its specific design criteria tries to prepare a place of calm for patience and their attendances.
- Days and nights in this building give them sense of liveliness, as in the days bright spaces with controlled penetration amount of natural light inside with nice colors in walls and floors makes their stresses less and in night, the bright atrium in the hearth of the building shine like star that shows path of health and improve sense of hope to life for users and viewers outside.

## Interior Spaces -



- The spaces are very bright spaces which increases efficiency of daylight usage in interiors.
- Perfect distribution of areas, shape of volume, view to outside, green spaces, furnishing, materials, color and light values, etc. have considered, as they help persuade comfort feelings and reduce stress and pain in patients.

## Material

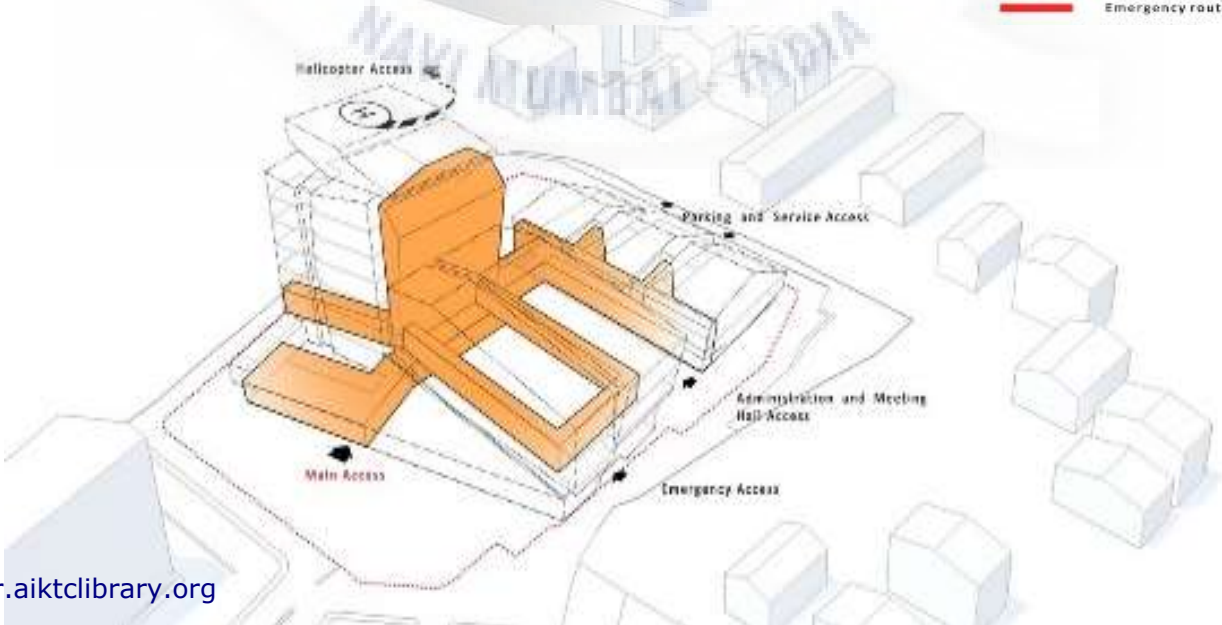
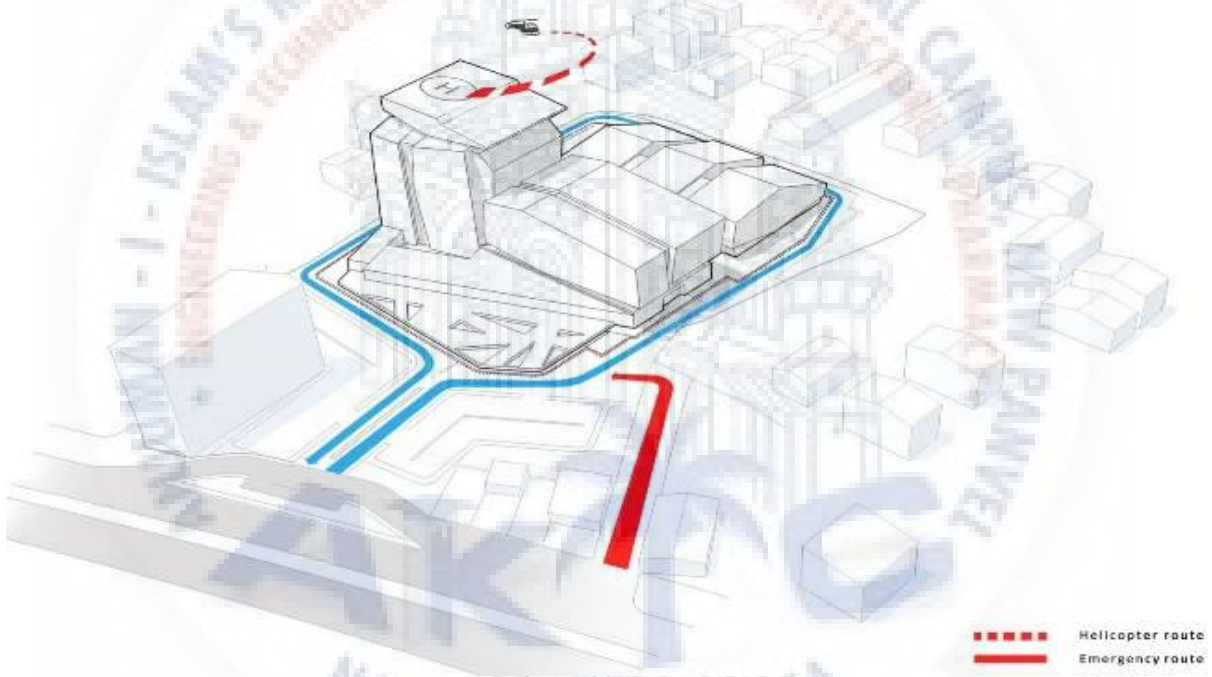
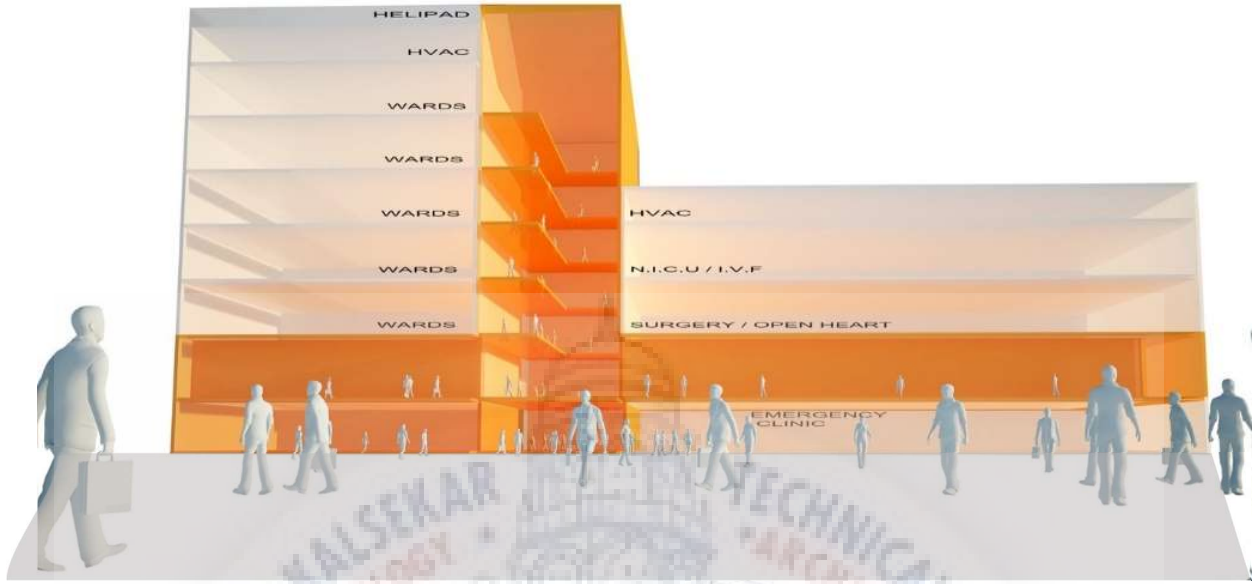


- White Travertine stone and glass as the main material are applied in combination of wooden texture panels on the exterior walls as a sort of emblematic of vernacular architecture .
- Interior surfaces of departments covered by anti-bacterial homogeneous floor-covering, exclusively designed for health care facilities.

## Interior Spaces -



# Internal Departments



### Site Plan -



### Ground Floor Plan -



ir.aiktc.org Public Spaces

Private spaces

Services

Vertical Access

Circulation

### First Floor Plan -



### Second Floor Plan -

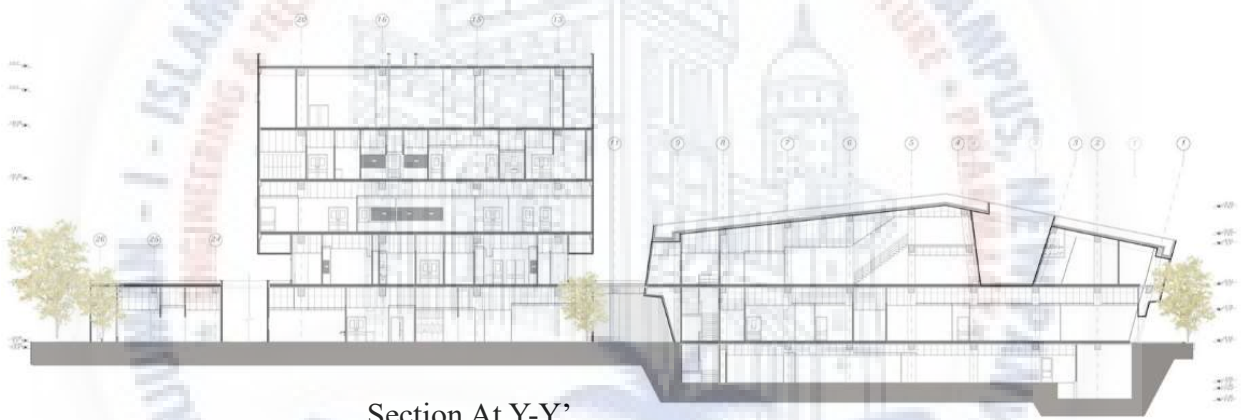




## Sections



Section At X-X'



Section At Y-Y'



Key Plan

## CASE STUDY (Internet Based/International) -

### 2) Hefei Boi Hospital - China

**Location:** Hefei, China

**Built - up area :** 1,80,000 sq.m

**Architect :** HKS Architects

(Ar.Alex Wang)

**No. of BEDS :** 1000

**Year :** 2019

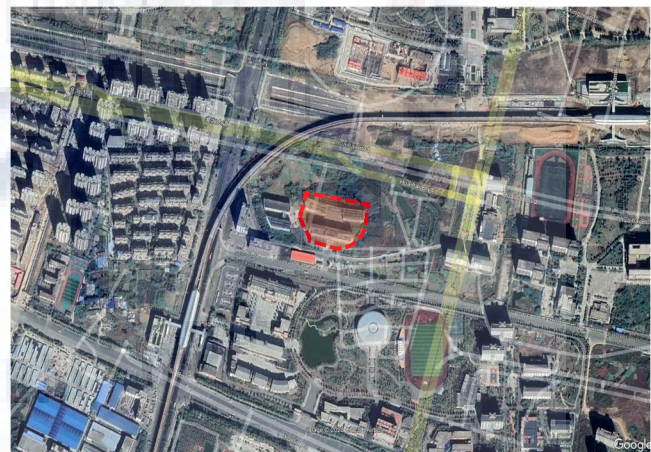
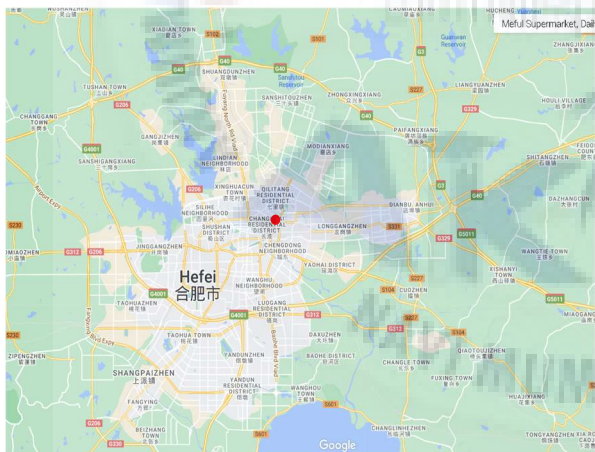


#### About –

- BOE Hefei Digital Hospital is one of China’s first truly ‘smart’ hospitals.
- It has been developed by BOE, a leading Chinese LED screen manufacturer, partnered with American medical group, Dignity Health.
- They wanted to create a world-class hospital incorporating the latest digital technologies and services to deliver the highest quality medical care, patient safety, and user experience.

**Departments :** laboratories | accident and emergency(A&E) | Cardiology| orthopedics|ICU | CCU |specialized clinics |Neurology| Oncology |Infusion Centre | Rehab | Pharmacy | Medical mall | imaging | Peds Clinic

#### Location and Connectivity-



#### Approaches to The Hospital

##### Road Connectivity –

On N.Yihuan Road.

##### Airport Connectivity –

Hefei Xinqiao International Airport (55 km)

##### Nearest Metro Station –

---

##### Nearest Railway Station –

Hefei South Railway Station (15 km)

## Design Concept -



- The design concept of simple, high-tech, healing garden design with a focus on patient experience.
- In an effort to create the best healing experience, Hefei BOE Hospital incorporates a number of gardens from the roof to the ground to connect indoor and outdoor spaces with a sustainable environment.
- The natural and comfortable spaces take into account the experience of patients, families and medical staff.
- The architects used evidence-based design to integrate and isolate spatial functions and organizational flow lines.
- The team has provided a high-quality, safe and effective medical environment for patients and visitors, while also providing a good working environment for medical staff.

## Material -



Stone Wall

Stone Pier



Tile Cladding

Glass

Steel Canopies

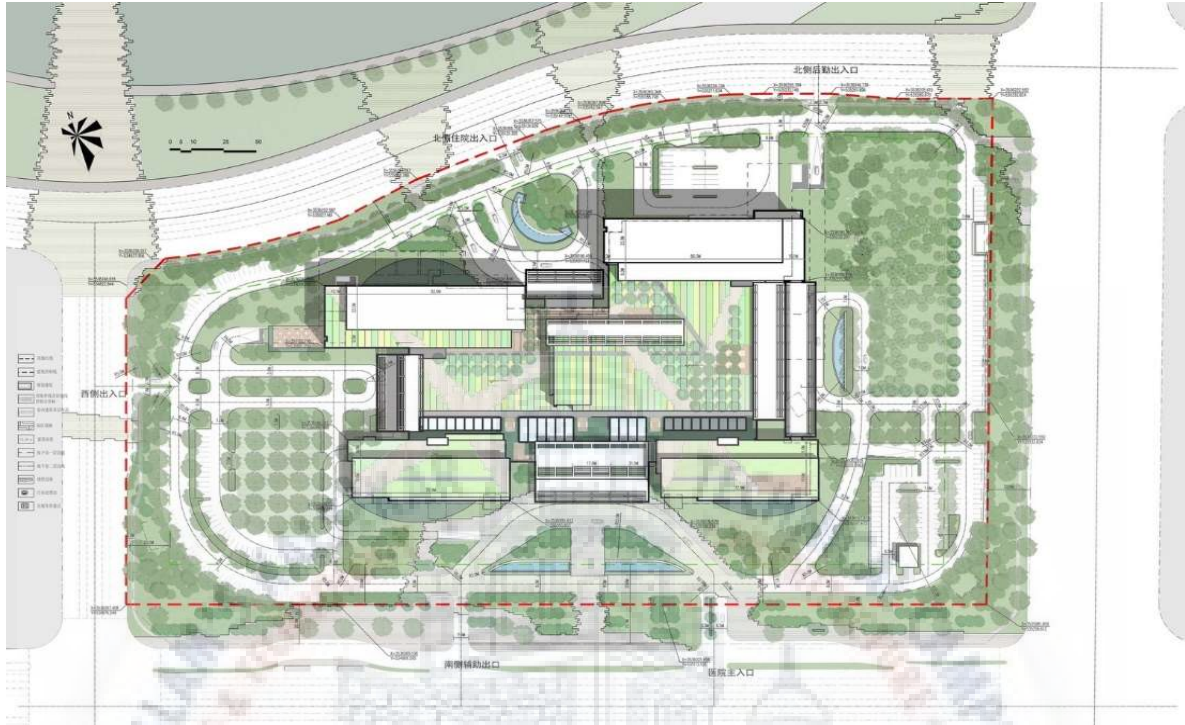


ir.aiktclibrary.org  
Stone Pier

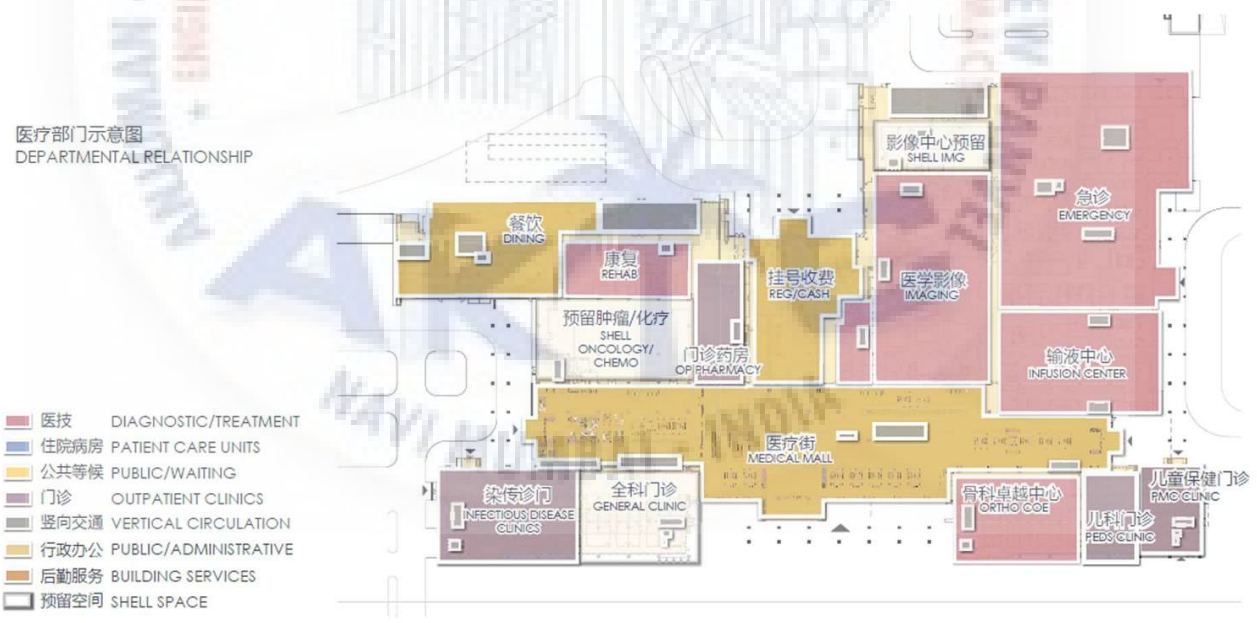
Tile Cladding

- The natural stone walls provide warmth through color and texture at the lower levels and grounds the hospital in Hefei.
- Natural light, views and gardens everywhere are accessed through the large expanses of glass to take advantage of some of the important design elements of evidence based design principles.

# Site Plan -



医疗部门示意图  
DEPARTMENTAL RELATIONSHIP



## Zoning and Layout -

- Major hospital functions such as Emergency, Radiology and Perioperative Services are located within the diagnostics and treatment podium.
- The patient unit towers are designed to sit on top of the diagnostics and treatment podium to optimize their connectivity to each other.
- The towers were pushed to the north edge of the podium to take advantage of the lake views to the north as well as provide a large green roof garden for the south facing patient rooms.



Administration  
General Clinic  
Oncology/Chemo  
Ortho  
Emergency



Emergency    Ortho    General Clinic  
Oncology/Chemo    Administration

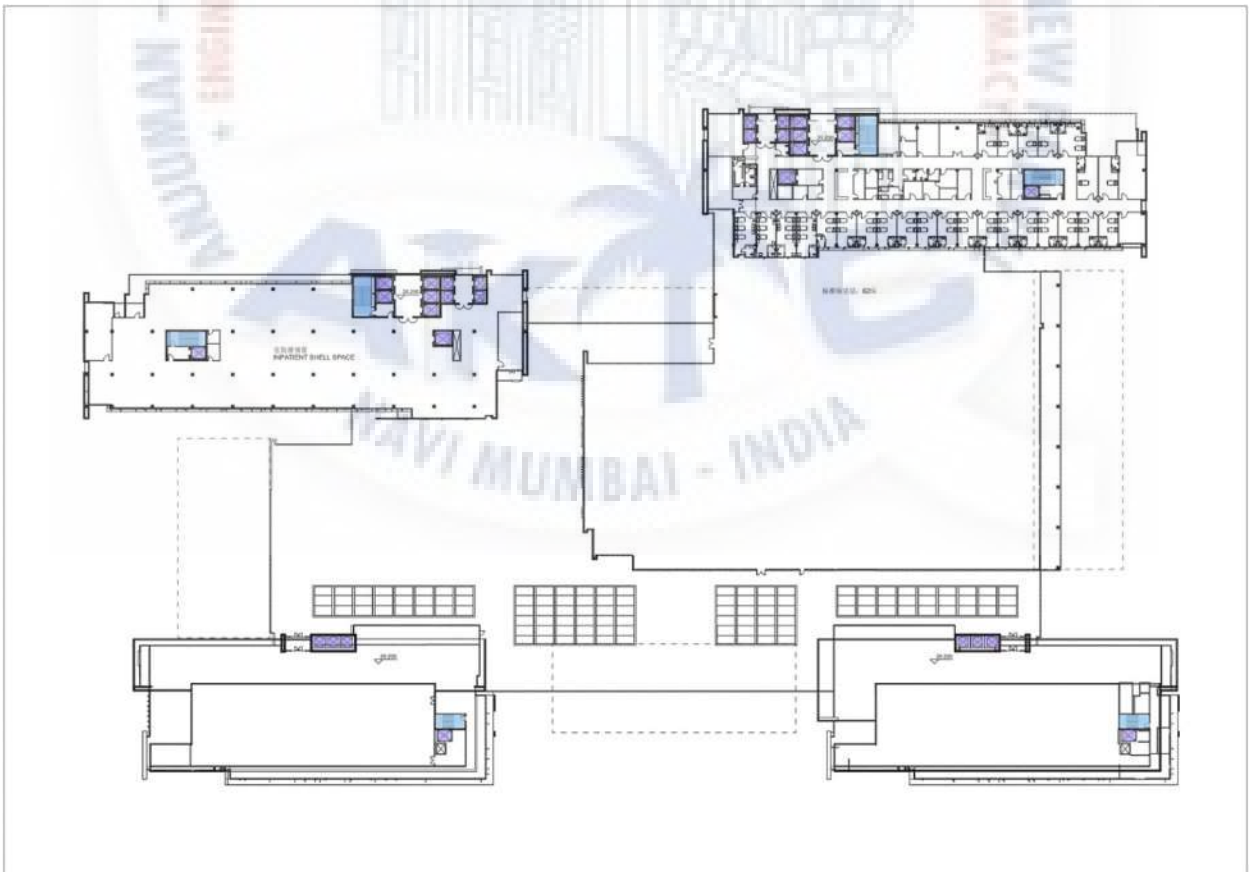


- Large metal bent planes used as canopies and walls cradle and protect and hold these areas of glass, giving the architecture a sense of lightness and compositional terminus.
- The glazed areas are also protected by layers of brise-soleil designed to function as shading elements as well as aesthetic devices with mullion integrated LED lighting.
- The interior architecture continues this design language into the medical mall and beyond. The high tech – high touch design is also influenced by nature's efficiency and beauty.

# Architectural Plans - Ground Floor Plan



First /Typical Floor Plan



## Interior Pictures-



Entrance Atrium



Entrance Atrium



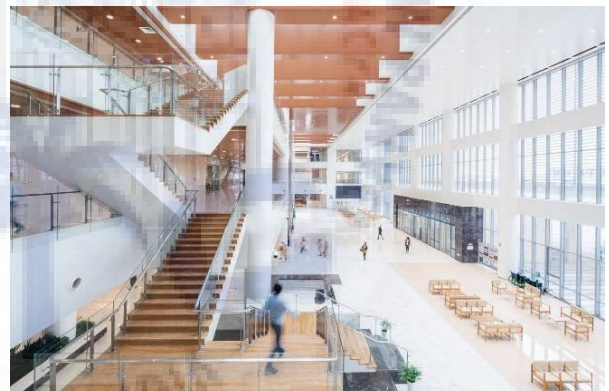
Deluxe Ward



Atrium



Deluxe Ward



Entrance Atrium



Special Ward



Administration

## CASE STUDY (Internet Based/International) -

### 3) Hara Hospital - Japan

**Location:** Isesaki, Japan

**Built - up area :** 7,559 sq.m

**Architect :** Aya Sato, K+S

Architects, Nobuya Kashima

**No. of BEDS :** 344

**Year :** 2020

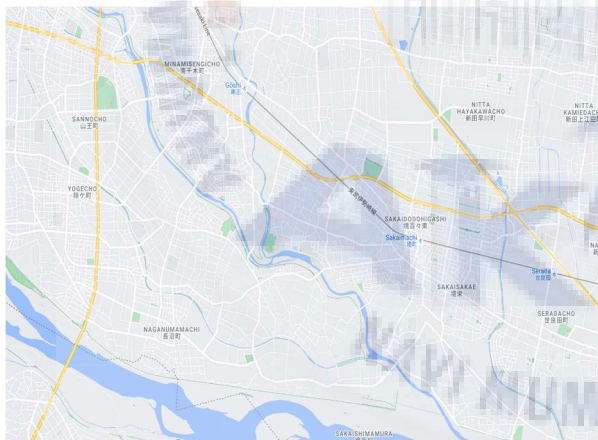


#### About –

- BOE Hefei Digital Hospital is one of China's first truly 'smart' hospitals.
- It has been developed by BOE, a leading Chinese LED screen manufacturer, partnered with American medical group, Dignity Health.
- They wanted to create a world-class hospital incorporating the latest digital technologies and services to deliver the highest quality medical care, patient safety, and user experience.

**Departments;** laboratories |accident and emergency(A&E) |Cardiology| orthopedics|ICU | CCU |specialized clinics |Neurology| Oncology |Psychiatric

#### Location and Connectivity-



#### Approaches to The Hospital

##### Road Connectivity –

1.1 km from Nat 1 Rte Road

##### Airport Connectivity –

Tokyo Haneda International Airport (130 km)

##### Nearest Metro Station –

---

##### Nearest Railway Station –

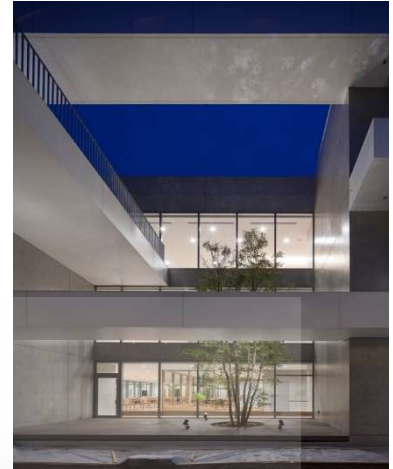
Goshi Station (2.3 km)



## Design Concept -

### Structural concept -

- The structure material is mainly reinforced concrete, and partially steel. The Rahmen structure of the hospital rooms in the perimeter of this building resists earthquake forces. The slender steel columns inside carry only vertical loads. A wider view spreads out by a few slender columns in dayrooms, so the dayrooms and two courtyards make a deep connection. This structural design makes planning flexibility.



### Environment with hospitality -

- This building has three courtyards and two small yards with trees. The courtyards give us peacefulness, comfortableness of the sunlight and breeze, and pleasure of changes in the four seasons. The voids of the courtyard make the visual connection with the upper floors and down floors. We use the natural wood inside to make living space homely and warm. The architects used evidence-based design to integrate and isolate spatial functions and organizational flow lines.
- The team has provided a high-quality, safe and effective medical environment for patients and visitors, while also providing a good working environment for medical staff.



### Open for the community -

- To open for the community, we remove the fence at the edge of the site, and plant.
- We connect the garden, the courtyards, and the small yards to the living space softly.
- Patients can enjoy to see a view of the mountains and the gardens from their rooms.

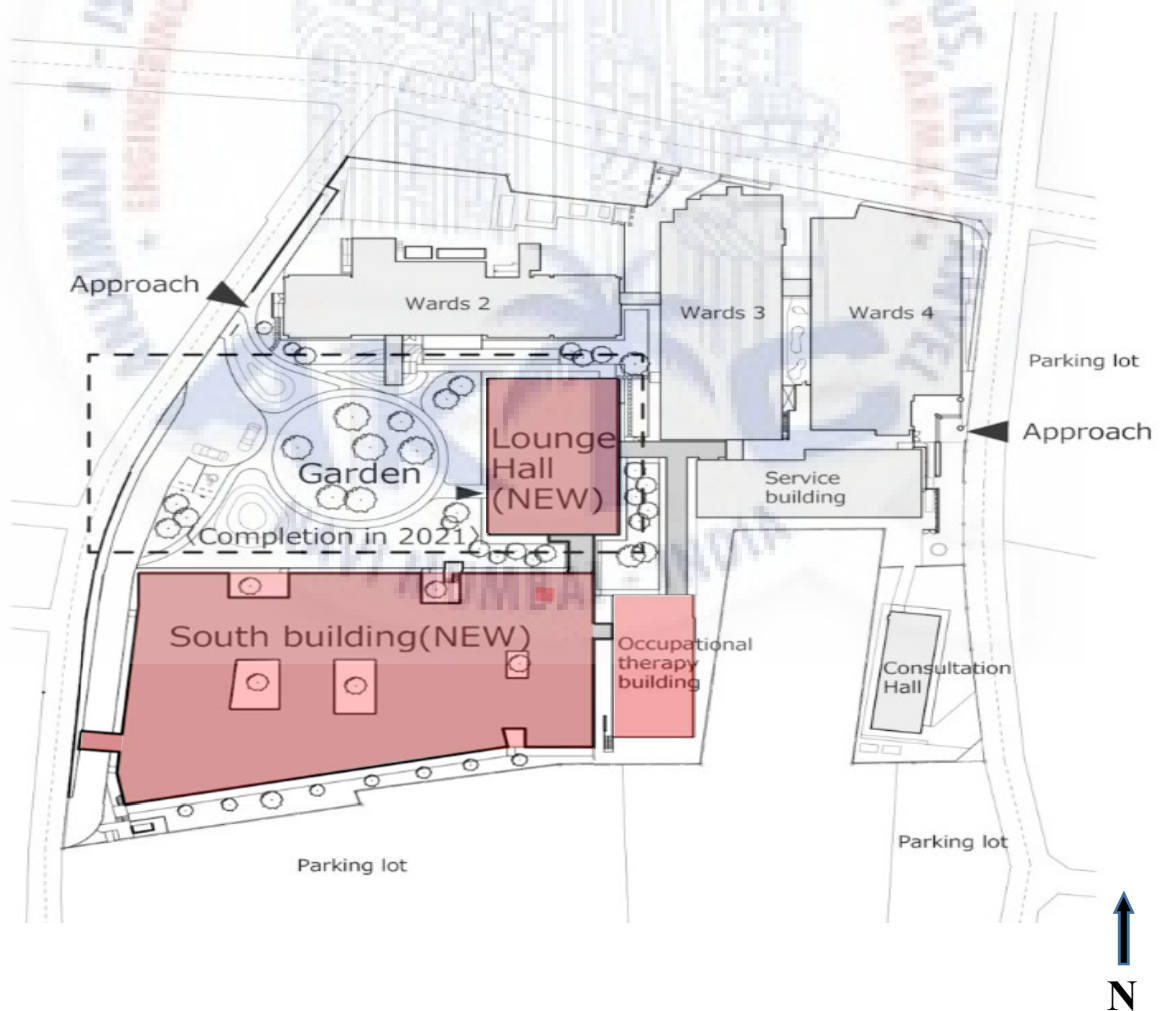


**Material -**



The natural stone walls provide warmth through color and texture at the lower levels and grounds the hospital in Hefei. Natural light, views and gardens everywhere are accessed through the large expanses of glass to take advantage of some of the important design elements of evidence based design principles.

**Site Plan -**



● New Hospital Building

# Architectural Plans -



First Floor Plan

- Public Spaces
- Private spaces
- Services
- Vertical Access
- Circulation



Psychiatric ward of the hospital  
2nd Floor Plan

Second Floor Plan

- Public Spaces
- Private spaces
- Services
- Vertical Access
- Circulation

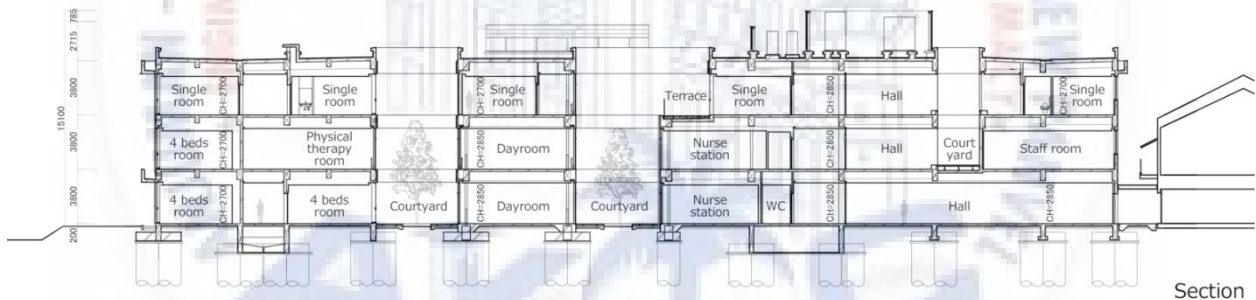
# Architectural Plans/Section -



**Third Floor Plan**

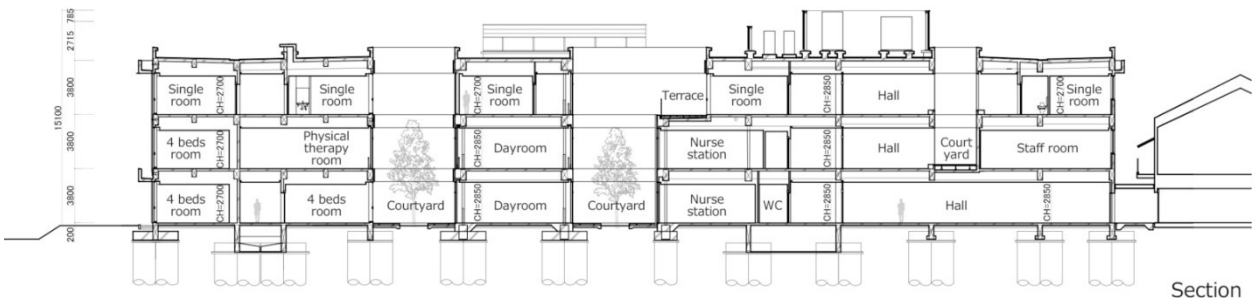
Nursing home  
3rd Floor Plan

- Public Spaces
- Private spaces
- Services
- Vertical Access
- Circulation



**Section At X-X'**

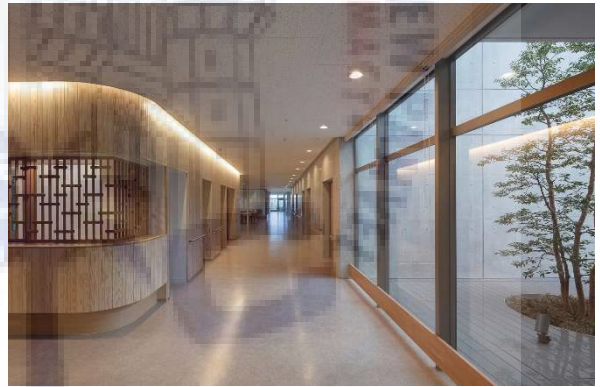
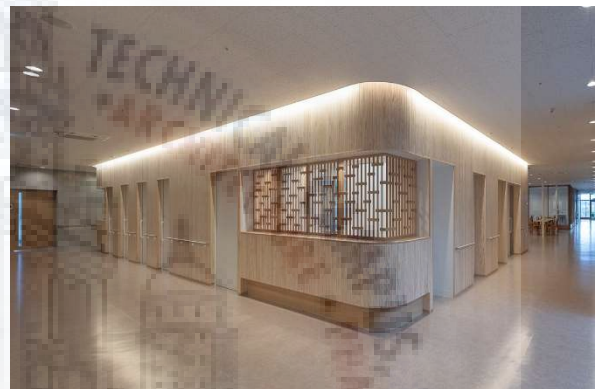
Section



**Section At Y-Y'**

Section





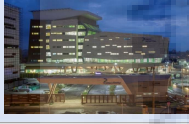


## Interior Pictures-

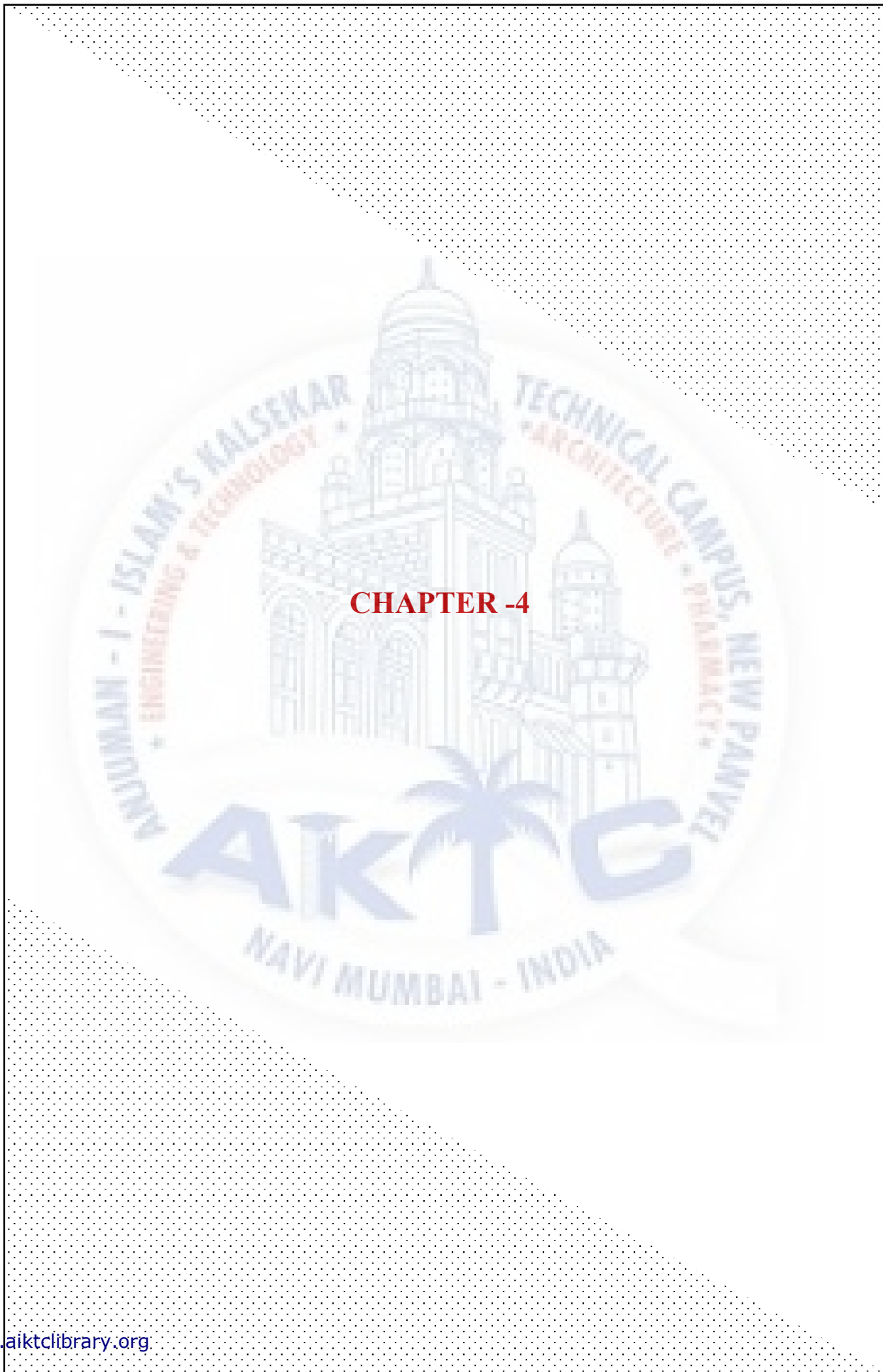


## Software based Model -



COMPARATIVE ANALYSIS	DR.D.Y PATIL HOSPITAL	HINDUHRIDAY SAMRAT BALASAHEB THAKARE TRAUMA CARE CENTRE	SUASTH EMERGENCY AND MULTISPECIALTITY HOSPITAL	FORTIS HOSPITAL	PARS HOSPITAL	HEFEI BOW HOSPITAL	HARA HOSPITAL
LOCATION	Nerul, Navi Mumbai	Jogeshwari, Mumbai	Kalamboli, Navi Mumbai	Gurgaon	Rasht, Iran	Hefei, China	Isesaki, Japan
OWNERSHIP TYPE	Private	Government	Private	Private	Private	Government	Private
BUILT-UP AREA (Sq.ft)	30,000	21,000	18,000	48,000	65,960	1,80,000	10,000
NO OF BEDS	500	320	400	250	160	10000	345
ARCHITECT	Ar.Shirish Beri	---	---	Ar Rajinder Kumar Associates (RKA),	Ar.Lida Almassian, Ar.Shahin Heidari (New Wave Architects)	HKS Architects (Ar.Alex Wang)	Aya Sato,K+S Architects, Nobuya Kashima
PROGRAM	Trauma,Neuro,Orhto,Psychiatric, Obstetrics,Surgery,Phsiotherapy, Nephrology,Neurology,Heart, Gynaecology,Ayurved,Dental, ICU,MICU,NICU	Trauma,Neuro,Orhto,Psychiatric, Obstetrics,Surgery,Phsiotherapy, Nephrology,Neurology, Gynaecology,Dental,ICU,MICU, NICU	Trauma,Neuro,Orhto,Psychiatric, Obstetrics,Surgery,Phsiotherapy, Nephrology,Neurology, Gynaecology,Dental,ICU, Mental Health and Behavioural Science, Radiation	Trauma,Neuro,Orhto,Psychiatri, Obstetrics,Ophthalmology,Pulmology,Surgery,Phsiotherapy, Cosmetology,IVF, Nephrology,Neurology, Gynaecology,Dental,ICU, Mental Health and Behavioural Science, Radiation	Trauma,Neuro,Orhto,Psychiatri, Obstetrics,Ophthalmology, ,Surgery, Neurology, Gynaecology,Dental,ICU,	Trauma,Neuro,Orhto,Psychiatri, Obstetrics,Ophthalmology,Pulmology,Surgery,Phsiotherapy, Rehab,Nephrology,Neurology, Gynaecology,Dental,ICU	Trauma,Neuro,Orhto,Psychiatri, Obstetrics,Ophthalmology, Surgery,Neurology,ICU,
CATEGORY	Emergency and Multi Specialty Hospital	Trauma Care Centre	Emergency and Multi Specialty Hospital	Multi Specialty Hospital	Multi Specialty Hospital	Emergency and Multi Specialty Hospital	Multi Specialty Hospital
CLIMATE	Wet And Dry	Warm And Humid	Warm And Humid	Composite	Hot and Dry	Composite	Warm And Humid
MATERIAL	RCC	RCC	RCC, Steel	RCC	RCC	RCC,Steel	RCC, concrete,
PROVISION FOR HEALING SPACES LIKE – LANDSCAPING,COURTYARD	Yes Courtyards and Gardens	No	Yes Courtyards and Gardens	Yes Courtyards and Gardens	Yes Courtyards and Gardens	Yes Courtyards and Gardens	Yes Courtyards and Gardens
FIRE SAFETY MEASURES	Good Enough	Good Enough	Good Enough	Good Enough	Good Enough	Good Enough	Good Enough
MAJOR STRENGTHS	Proper Spatial Arrangement and Smooth circulation.	Smooth circulation and Easy Access	Proper Spatial Arrangement and Smooth circulation	Proper Spatial Arrangement and Smooth circulation	Proper Spatial Arrangement and Smooth circulation	Proper Spatial Arrangement and Smooth circulation	Material Used and form of structure .
MAJOR WEAKNESS	---	Lack of Future Planning No Landscaping /Interaction spaces	Poor Circulation	---	---	---	---

No	Project name	Project image	Intent	Analysis
1	DR.D.Y PATIL HOSPITAL		The reasoning behind choosing this case study was to understand the spatial arrangement, Fire Safety Measures, Medical Gas Supply System, Interactive spaces and the circulation required for the functioning of Hospital .	This hospital is adeptly managed, possesses a comprehensive array of essential facilities, and maintains ample bed capacity across all departments. Notably, patients treated within its confines consistently exhibit positive recovery outcomes. Moreover, the hospital has diligently attended to design elements that foster a healing environment, contributing to a patient-centric approach to care.
2	HINDUHRIDAY SAMRAT BALASAHEB THAKARE TRAUMA CARE CENTRE		The reasoning behind choosing this case study was to understand the spatial arrangement, Fire Safety Measures, Medical Gas Supply System, and the circulation required for the functioning of Hospital .	As a government-operated medical institution, the trauma care hospital has been meticulously managed, ensuring the provision of essential facilities. It encompasses a comprehensive array of departments specifically dedicated to trauma care. Abundant openings for daylight and ventilation have been thoughtfully integrated into the hospital's architectural design, enhancing the well-being of patients and staff. The spatial arrangement within the facility is methodically organized to optimize operational efficiency and patient care.
3	SUASTH EMERGENCY AND MULTISPECIALITY HOSPITAL		To study the Spatial arrangements and to understand how Healing environment like Courtyard and Landscaping plays an important role in Trauma Hospitals.	The structure showcases a well-planned design with exceptionally organized spaces and elements. It houses a wide range of departments exclusively dedicated to trauma care. Thoughtful incorporation of ample windows for natural light and ventilation has been an integral part of the hospital's architectural concept, contributing to the overall well-being of patients and staff. The layout within the facility is systematically structured to maximize operational efficiency and the quality of patient care
4	FORTIS HOSPITAL		To understand the Spatial arrangements ,structural system, design Aspects , and Material used in the structure.	The building exhibits thoughtful layout and incredibly well-structured spaces and elements. Notably, sustainable materials have been judiciously employed in its construction. The hospital stands out for its extensive expanses of lush green spaces, further enhancing its architectural appeal and commitment to sustainability.
5	PARS HOSPITAL		To understand the design aspects majorly the facade as well as interior spaces of the structure while maintaining the parameters of Multi speciality Hospital.	The hospital is skillfully administered, equipped with a wide range of essential amenities, and maintains substantial bed capacity in all its departments. It's worth mentioning that patients treated at this facility consistently achieve favorable recovery results. Additionally, the hospital has conscientiously addressed design aspects that promote a healing atmosphere, emphasizing its patient-focused approach to healthcare.
6	HEFEI BOW HOSPITAL		To study the Spatial arrangements ,design aspects ,and functioning.	The structure features a well-planned design with meticulously organized areas and elements. It's worth mentioning that sustainable materials have been thoughtfully utilized in the building's construction. The hospital distinguishes itself with its abundant green areas, which not only enhance its architectural attractiveness but also underscore its dedication to sustainability.
7	HARA HOSPITAL		To study the Spatial arrangements ,design aspects arrangements and to understand how Courtyard and Landscaping plays an important role in Trauma Hospitals.	The building's design is well thought out, with dedicated trauma care departments, plenty of natural light through large windows, and a layout that maximizes efficiency and patient well-being. There are also several green spaces, promoting a patient-centered approach to care..



**CHAPTER -4**



## 5.1) ARCHITECTURE AS A HEALING AID

- The World Health Organization defines health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. What’s remarkable about this definition is that it does not include “curing” disease but encompasses well-being in body, mind and spirit.
- While healthcare has primarily focused on fixing the body, there is growing recognition that our healthcare system could do more by promoting overall wellness, which requires expanding the focus. Evidence-based design research (EBD) has demonstrated the power of environmental design to support improved patient, family and staff outcomes and to avoid harm in healthcare settings
- A healing environment is one that has a nurturing and therapeutic effect. Studies show that, through EBD, well designed healing environments make hospitals less stressful and promote faster healing for patients and improve well-being for their families, as well as create a pleasant, comfortable and safe work environment for staff..
- Healing is the process of re-establishing harmony within the organism. Illness implies a loss of this balance and the need for reintegration with the body's natural ability to heal and regenerate. The human body has ability to heal when put in healthy and positive environment.



Figure - 24

Source- Samueli Institute

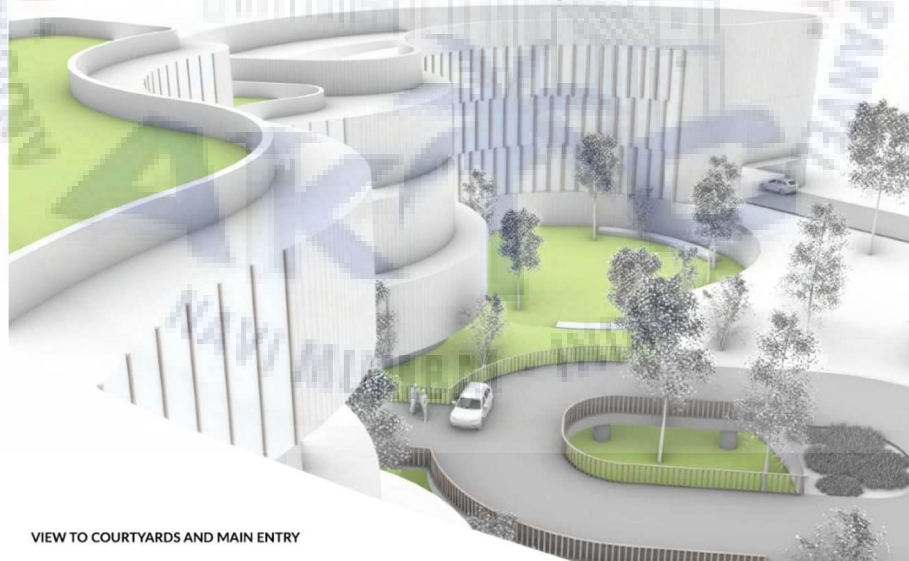
### Healing Environment Framework

## What is Healing Environment or Healing Architecture?

- Healing architecture for healthcare facilities describes a physical setting that supports patients and families through the stresses that develop as a result of illness, hospitalization, medical visits and the healing process. The concept implies that the physical healthcare environment can make a difference in how quickly patients recover or adapt to specific conditions.
- Architecture and the built environment have the potential to influence the individual's well-being. Few architects such as, Architects Christopher Day (Day, 2004) and Carol Venolia (Venolia, 1988) identified and analyzed healing elements and how some elements can be altered in order to bring mental and physical therapy into the built form. These elements include light, color, material, texture and vegetation.

### Goal of Healing Architecture -

- Healing spaces design in such a way that they eliminate noise, poor air quality, lack of privacy, lack of sunlight.
- Introduce natural elements like outdoor views, interior gardens, water elements and natural sunlight.
- Giving the patient right to choice what they want, such as to get socialize or not, control brightness of the light, what type of music they want to listen, get privacy.



VIEW TO COURTYARDS AND MAIN ENTRY

Source- Pentoday.upenn.edu

Image - 42

## History of healing architecture

- Healing environments historically have often been places where nature itself was deemed to have a great impact on healing and recovery. These ideas have been expressed in a variety of ways throughout history. Buildings for healthcare and rehabilitation have often been located in peaceful, beautiful places with dramatic views of landscapes and bodies of water. Nurturing the land and working in fresh air has been a model for many mental hospitals. After the First World War it started to become clear that providing returning soldiers with activity in gardens and natural areas could help them deal with posttraumatic stress disorders resulting from harrowing war experiences, and since then the therapeutic potential of the natural world has been a topic of research.

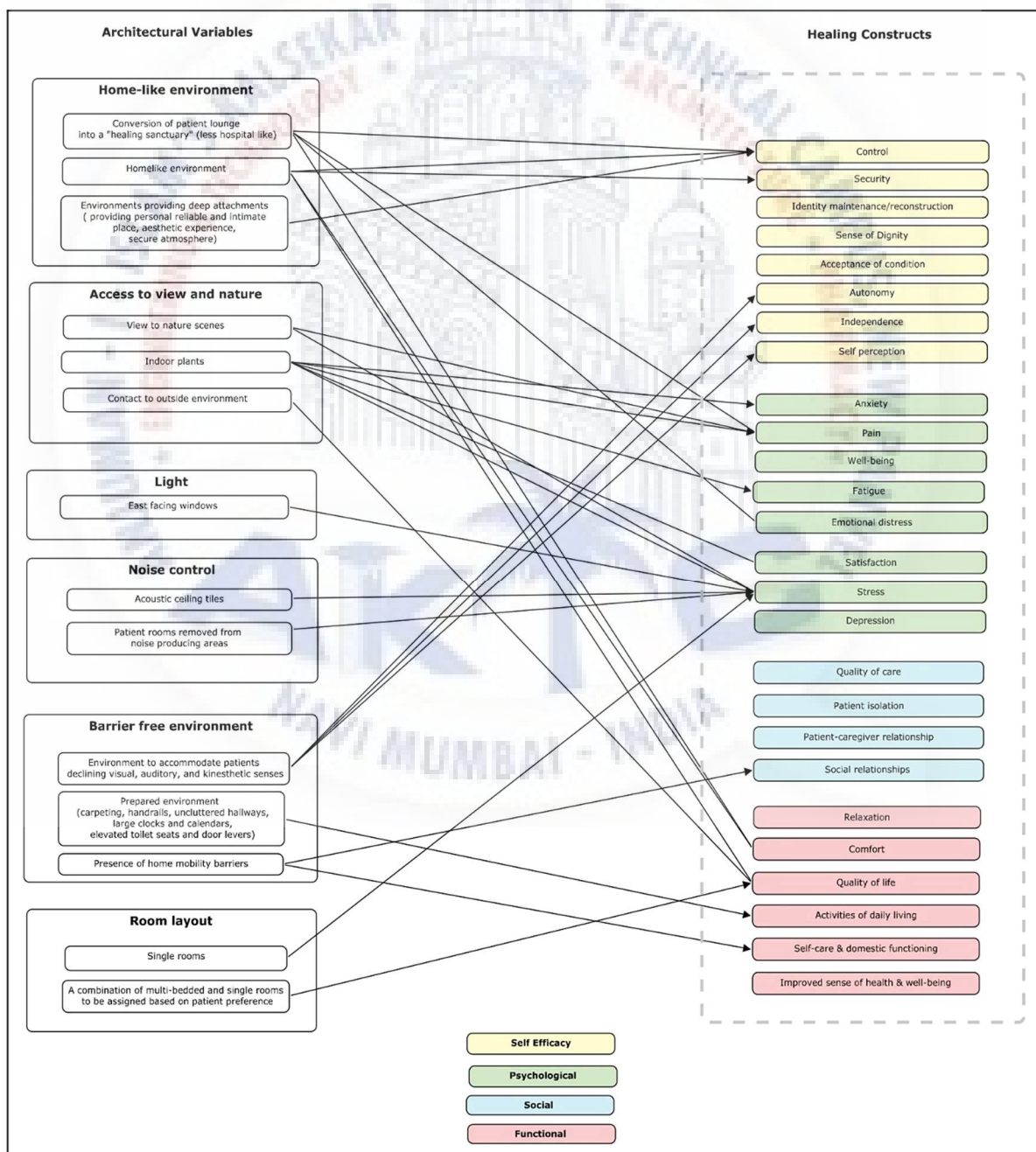


Figure - 25

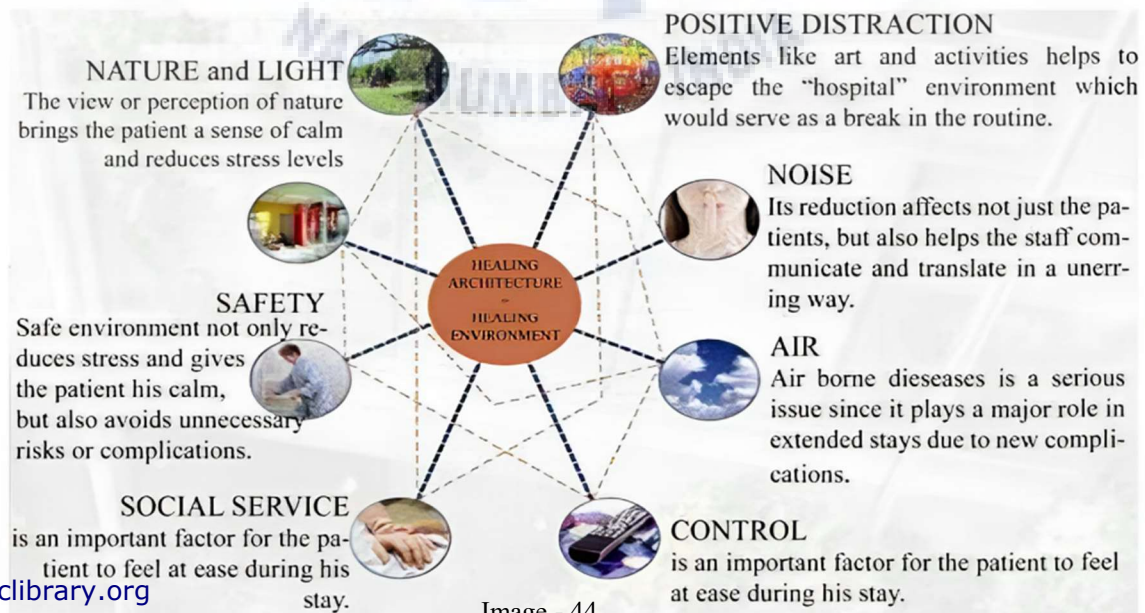
Source- SemanticScholar.org

## Design Recommendation For Healing Environment :

- Welcoming entrance
- Qualitative daylighting
- Privacy
- Open space
- Biophillic approach
- Space for interaction
- Creating positive distraction
- Waterbody
- Calm and quiet environment
- Colour
- Sense of freedom
- Building orientation
- Space for family and relatives

### Specific healing design elements include:

- Exposure to nature such as views to the outside, interior or exterior gardens, aquariums, and art with a nature theme
- Soothing colors, natural light, pleasant sounds, cleanliness, visual stimuli such as artwork
- Reducing environmental stressors such as noise, glare from lights, and poor air quality
- Comfortable rooms with seating that can be arranged for visits from family and friends
- Encouraging patients to personalize their room with special personal items that provide them comfort.
- These and other elements create surroundings that help calm patients and strengthen their ability to cope and recover.
- Gardens and parks offer natural appeal, improve the joy of patients and increase their wellbeing, thereby allowing them to feel better quicker.



## Some important aspects of creating good therapeutic interior are:

- Use familiar and culturally relevant materials wherever consistent with sanitation and other functional needs
- Use cheerful and varied colours and textures
- Use natural light and ventilation wherever feasible
- Wherever possible, provide the outdoor view from every patient bed
- Use photo murals of nature scenes
- Repeat similar objects and patterns to establish continuity
- Design a "way-finding" process by using signage, graphics and artwork to facilitate movement of Patients, visitors, and staff

## Psychology behind spaces In Healing Environment –

### Windows

- Windows provide access to daylight with its associated health benefits
- Windows can provide access to a view, which has been associated with reduced length of stay and reduced need for analgesic medication
- The presence of windows has been associated with better orientation and less delirium, plus positive outcomes.
- Patients report preferences for windows with views, and highly value connections to the outside world.

**WELLNESS**  
Achieving balance and wholeness  
in body, mind, and spirit

**EFFICIENCY**  
Providing  
quick, accessible care

**SUSTAINABILITY**  
Environmentally friendly  
architecture

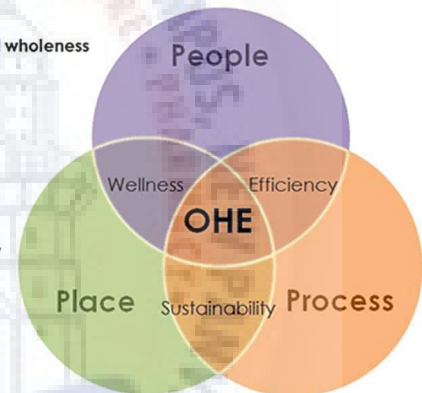


Figure - 26

OHE-Optimal Healing Architecture

Source- Terri Zborowsky

## Psychology behind spaces In Healing Environment –

### Physical plan of ward/unit-

- The layout of the ward/unit is associated with the amount of walking staff undertake, the access to windows and natural lighting, and the opportunity for "corridor conversations".
- The layout may have the unintended consequence of making it more difficult for nurses to observe patients
- The provision of family areas is valued by patients and staff, and is especially important when families need to take on care's role on discharge (e.g. NICU, pediatric areas).
- Decentralization of supply areas and nurses' stations may free up more time for direct patient care, and may improve safety.
- Provide family areas including sleeping facilities.
- Avoid hallways that finish in dead ends.

### Access to nature and gardens

- There is an association between nature
- and positive health outcomes
- Provision of natural features are also of benefit to staff
- Provide contact with nature where possible - views from windows, indoor features or access to outside gardens.

### Color and lighting as a design feature -

- There is tentative evidence that color may affect mood and behavior. Color and lighting can be used as a signal to alert people to hazards or supportive features, and to add visual interest
- and distraction.
- Consider using cool colors to promote relaxation, warm colors to energies and neutral colors to minimize attention.
- Use contrasting colors as an alert for potential hazards and to attract to other features.
- Newer hospital designs now try to reestablish design that takes the patient's psychological needs into account, such as providing for more air, better views, and more pleasant color schemes. These ideas hearken back to the late eighteenth century, when the concept of providing fresh air and access to the "healing powers of nature' were first employed by hospital architects in improving their buildings.
- Another major change which is still ongoing in many parts of the world is the change from a ward-based system (where patients are treated and accommodated in communal rooms, separated at best by movable partitions) to a room-based environment, where patients are accommodated in private rooms.
- The ward-based system has been described as very especially for the medical staff, but is considered to be more stressful for patient.

## Case Study Healing Environment -

KarunaShraya Home for ill patients, Bangalore Mukhtangan Rehab Centre,Pune



Source- cmepedia.com



Source- Pentoday.upenn.edu

The Centre is design with Healing as the central concept.

It is a place with lush greenery, bird's songs and peace, in the middle of metropolitan city. It was an attempt to create a serene environment with quality care, irrespective of caste creed or Colour, for terminally ill cancer patients.

The word "serene" acquires a new meaning here, that every corner is designed to stimulate calmness and peace in one's inner self.

This was achieved through introducing water bodies, greenery which enhance the feeling of close to the nature. Outside wall cladding done by granite stone. There is a proper ventilation and penetration of natural light into the buildings.

The patients get relax from the view of greenery in one side and water on another side of their wards. There is a courtyard between the wards which act as a transition space.

The all- around ambiance is kept simple and green without any loud Colour. Settle Colour combination are used throughout the building which provide psychological comfort to the patients.

A building which having therapeutic values and it helps in process of healing for Drug Addiction.

This design having the transparency by which it express the freedom and increase physical and visual interaction. Visual connection with nature is established from the cut-outs, the terraced balconies and the sitting encourage the patient to interact and connect with nature.

Building is surrounded by large trees and outdoor sitting for patients, their relatives and staff.

Landscaping is done by providing raised planters and flower beds.

There is a small arranged open air theatre of 150 seating, inhales light and ventilation in structure, it ties the different functions together, making a feeling of space. It is utilized as cooperation space and act as a Centre point. Passageway have abundant measure of light and ventilation and visual availability with open area theatre. General ward balconies open into amphitheater, giving visual connection. Clearstory windows in the meditation hall give light inside from top opening.

## Developing a healing environment:

### Light

- No glare lighting in patient Room.
- Ability to control intensity of Light
- Good reading light
- Window should be low enough for patient to see outdoors while lying in bed
- Patient room lighting should be full spectrum

### Colour

- Careful use of color to create mood, lift spirit, and-make rooms cheerful
- Use in bed linens, bedspreads, gowns, personal hygiene kits, accessories, food trays
- Views of nature
- Views of nature from patient's room
- Indoor Landscaping

### Texture

- Introduce textural variety in wall surfaces, floors, ceilings, furniture, fabrics & artwork

### Noise control

- Sound of footsteps in corridor
- Slamming doors, clanking latches
- Loudspeaker paging system
- Other patients' televisions and radios
- Clanking of dishes on food carts

### Air quality

- Need for fresh air, solarium, or roof garden
- Avoidance of odiferous cleaning agents
- Adequate number of air changes.

### Thermal comfort

- Ability to control room
- temperature, humidity, and air circulation to suit personal needs.

### Accommodation for families

- Provide place for family members to make them feel welcome, rather than intrusive
- Provide visitor lounges and access to vending machines, telephones and cafeteria



## 6.1) DESIGN OBJECTIVES

### Hospital Departments and Facilities

#### Emergency Department (ED)

- Triage area
- Treatment rooms
- Isolation rooms
- Radiology suite (for immediate imaging needs)

#### Operating Rooms (OR)

- Multiple operating rooms equipped with surgical lights and equipment
- Pre-operative preparation area

#### Intensive Care Unit (ICU)

- Individual patient rooms with monitoring capabilities
- Equipment storage

#### Imaging and Diagnostics

- Radiology suite with CT, MRI, X-ray, and ultrasound capabilities
- Pathology department

#### Rehabilitation Department

- Physical therapy and occupational therapy rooms
- Consultation rooms

#### Patient Rooms

- Inpatient rooms with different levels of care (e.g., private rooms, semi-private rooms)
- Isolation rooms with negative pressure for infectious case

#### Administrative and Support Spaces

- Administrative offices
- Conference and meeting rooms
- Pharmacy

#### Ancillary Services

- Security and reception desk
- Public restrooms

#### Infrastructure and Support Systems:

- Utility rooms (for HVAC, electrical, plumbing)
- Emergency power and backup systems
- Information technology (IT) infrastructure

#### Outdoor Spaces:

- Ambulance bays and parking
- Outdoor waiting areas
- Landscaped green areas for relaxation and reflection

## Accident and Emergency

Emergency has been defined by the WHO as a condition determined clinically or considered by the patient or his/her relatives as requiring urgent medical services. Emergency department is considered as the "Front Door" of the hospital. It is vital for functioning of a hospital, especially in cases of disasters or any uncalled for events. It screens the patients for first aid, minor operations, major operations or admissions. It provides the first step of treatment in a trauma case or any emergency.

### Functions

Provides fast and effective relief and management during disaster situations.  
Initiate interaction with police in medico-legal cases.  
Provision of ambulance services.  
Provision for life saving and immediate treatment at all the times.  
Works throughout the day, can be accessible anytime in case of emergency.

### Design and Planning Parameters

It should be easily accessible by patients, ambulances and the general public.  
It should have distinct and visible entrance.  
The movement of staff, patients and equipment should not impede each other.  
The treatment areas should provide privacy to each patients.  
Further Treatment in plaster room, burn room, OT, ICU or Ward  
OPD/referral to other hospital/ discharge

## Outpatient Department

An OPD provides primary and well as comprehensive healthcare for patient who come for diagnosis, treatment or follow-up care. It is the point of first contact between a hospital and a patient. Importance of OPD is that it reduces the number of terminally ill patients traffic, as its helps in early detection or timely care of any disease.

### Functions

control diseases by early diagnosis and timely treatment •Facilitates treatment and further investigation without admission into the hospital, thus reducing the in-patient load.  
Provides follow up care to discharged patients.  
Screens cases and investigates if the hospitalization is required.  
Facilitates training of paramedical staff, nurses and doctors.

### Design and Planning Parameters

An OPD should be a separate complex within a hospital and location should be such that it shares diagnostics, laboratory etc. hospital services.  
The Traffic of OPD should be totally separated from rest of the hospital, especially from the IPD and Accident and Emergency Department. should be readily accessible from main entrance.  
OPD should have easy accessibility to medical imaging, laboratory and Pharmacy.  
In a general hospital it all the polyclinics should be accommodated in a single OPD. However, in specialty hospitals, there may be separate OPD's for varying specialties.

## **Impatient Department**

The inpatient department is the place where patients are admitted for longer duration or may be even for a day in case a day care facility is not available in a hospital. It is most important for this part of the hospital to be designed holistically keeping in mind the psychology of the patients. As it is also a home away from home, the environment of this unit must be warm, flexible and allow of freedom of use of space according to one's need and suitability, while keeping health safety in mind. Its is also called as nursing unit or surgical care unit

### **Design and Planning Parameters**

Ensure privacy and safety for patients

The nursing fatigue factor is a major design issue while planning for an IPD. Thus, nursing stations must be visible and at an optimum distance from each room.

Its should provide a humanized environment for faster healing and a comfortable stay.

It is vital to provide view of the outdoors and natural elements.

The facility may have wards, or multiple bed rooms , private rooms.

It should also provide for appropriate waiting/ accommodation space for at least one attendant, along with a pantry and other value added services easily accessible.

### **Operation Theatres**

Operation Theatre is a specialized facility in a hospital where life saving or life improving procedures are carried out on human body by invasive methods under strict sterile environment maintained mechanically to provide for safe and infection free results. All operation theatres have be compulsorily be septic and restricted for outside people or even the attendants to maintain its sterile environment.

### **Design and Planning Parameters**

Avoidance of unrelated hospital traffic flow in the O.T area.

Convenient linkages with surgical ward, ICU, CSSD, Blood Bank, radiology department, Laboratory, accident and emergency department.

Avoidance of out door source of noise.

It does not require daylight or natural ventilation, as the air has to be mechanically ventilated and kept sterile to have a controlled environment.

Corridors should not be less than 2.85 m in width to facilitate the movement of trolley and stretchers.

In operating rooms, anesthesia room, holding area, the Colour of walls and ceiling should not alter the skin Colour of the patient.

## Intensive Care Unit (ICU)

ICU is a dedicated facility to critically ill patients who require invasive life support, high level of medical and nursing care and complex treatment. It is a unit equipped to treat critical sick patients promptly and efficiently. Depending on the Size of a hospital there may be separate ICU for each specialty such as: Cardiac, Neonatal, Pediatrics, Neurology, Neurosurgery, Burn care Centre, organ transplant.

### Design and Planning Parameters

**Location:** Should be in close proximity to operation theatres, emergency department, imaging unit.

**Size of Unit:** Each cubicle/ bed space should have an area of 4 m x 4m. Usually 20 sq.m. of area is taken in account for multiple bed unit. and 22 sq.m. for single bedded unit.

**Lighting:** The patient area should have 300 lux of light, and should be anti glare. Thus, daylight should be maximized. Windows should constitute 15% of the floor area and should provide visual connect to the outside environment, preferably a natural setting.

**Environment Controls:** The air inside is mechanically controlled to have a sterile environment.

**Isolation Rooms:** There should be at least one isolation room per ICU.

**Nursing Station :** U shape or a semi-circular ICU plan minimizes the movement required by the nurses and also provides maximum visibility of the patients.

**Doctors Room:** Room for duty doctors along with provision for overnight stay.

**Staff Room:** facility for locker and change for the staff, might include a pantry of its own.

### Diagnostics

Diagnostic Department consists of medical imaging services and also sample collection for blood, urine tests. It basically deals with any kind of tests required for diagnosis of disease. Depending on the type and size of the healthcare facility, the medical imaging unit may provide for X-ray, C.T scan, diagnostic investigations, fluoroscopy, ultrasound, ultrasonography, mammography, radiation procedures, MRI, etc.

### Design and Planning Parameters

Flexibility in Design must ensure future expansion as technology keeps changing. Thus, room sizes should be flexible to allow for upgrading of machines and equipment.

The imaging unit may consist of the following functional areas.

Reception | X-ray and screening room | Film processing areas | Film storage areas |

Support areas like preparation areas, storage, disposal and utility room | Administrative area | Staff amenities |

## Laboratories

Modern medicine is becoming increasingly dependent on laboratory services for prevention, diagnosis and control of disease. It generates patient-related information that enhances the delivery of healthcare. The hospital laboratory conducts tests for the diagnosis, progress and response to therapy.

## Design and Planning Parameters

There should be scope for future expansion. Modular structural systems ensure ease in future flexibility.

Special plumbing, electrical and anti-vibration measures should be incorporated.

Daylight should be utilized maximally.

It should be located close to acute patient care and ambulatory care.

The processing areas need not be accessible to the patients/public but the collection point should be.

The main determinants of space in a laboratory are the extent of automation and type of technology used in it. A standing human body requires 4 square feet space, whereas a sitting posture requires 6 square feet space.

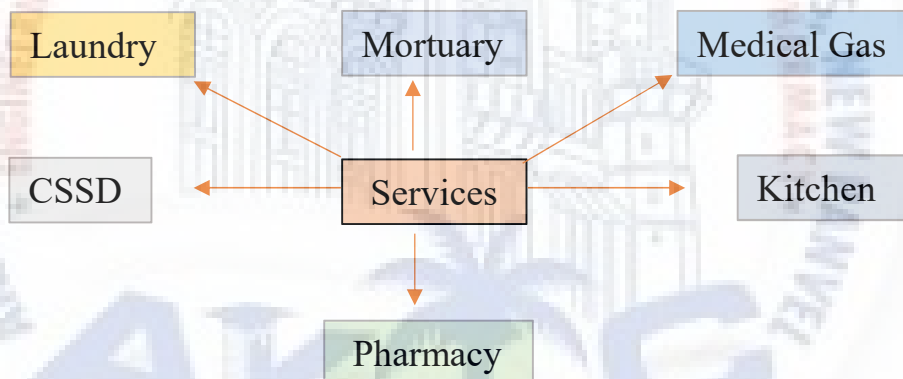


Figure - 27

Services Flow Diagram

## Laundry

The main functions of the laundry service are as follows:

Collection and receipt of soiled and infected linen.

Sorting, sluicing, disinfecting, washing and ironing of the linen.

Repair of damaged linen •Assembling and packaging specialty items and linen packs for sterilization.

Distribution of linen to the user departments

## Medical gases

A medical gas system involves a highly sophisticated life support network, which supplies medical air and oxygen for patient breathing, nitrous oxide for anesthesia, medical air for driving orthopedic tools and vacuum for suction.

## Planning and Design Parameters

Designated Area should have proper ventilation.

Location - must permit delivery vehicles to load, dock and also clear passage for cylinders.

Areas involved - Critical patient areas.

Anesthizing locations

Locations storing flammables

Rooms containing open transformers or electrical points

DH sets

Kitchen

In the outdoor facility, an enclosure wall must be constructed of noncombustible materials.

## CSSD

A Central Sterile Supply Department (CSSD) is a hospital support service, which is entrusted with processing and issue of supplies including sterile instruments and equipment used in various departments of a hospital.

## Planning and Design Parameters

There should be no Back tracking of sterile goods

The clean, sterile and dirty areas should be separated by physical barriers.

Space requirement depends on the total number of beds. It varies from 0.7 to square meter per bed

## Mortuary

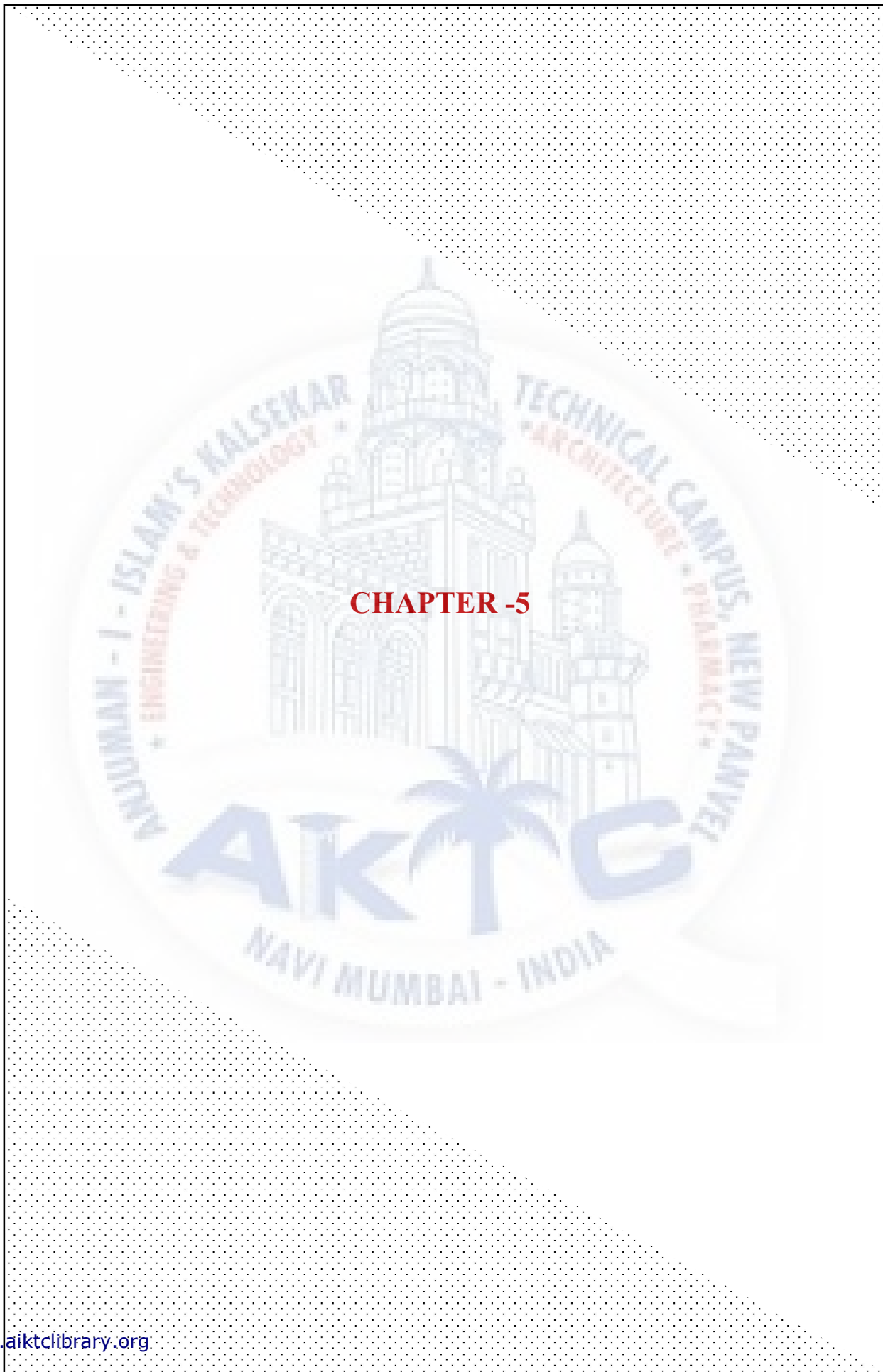
The main objective of this facility is to provide for a suitable place for temporary holding of a dead body.

Location - the need for adequate vehicular access from the service road;

where the facility is located on a hospital site, the functional layout of the hospital and the need for the mortuary to be discreetly sited away from clinical, kitchen and dining areas, with no direct entry to public and staff thoroughfares;

the desirability for the mortuary to be located at ground level;

the need for convenience of access by the various users (staff, visitors and undertakers);



**CHAPTER -5**

## 7.1) DESIGN BRIEF

### Introduction:

The Trauma Care Center Design involves 300 bedded Multi specialty hospital focusing on the architectural and functional aspects of a trauma care center. The objective is to create a space that promotes efficient medical care, comfort, and the well-being of patients and healthcare providers.

**1.Project Overview:** The Trauma Care Center will be located in Khardi, Shahapur , with an estimated capacity to serve 300 patients. It should be equipped to handle a wide range of medical emergencies, including accidents, injuries, and sudden illnesses.

**2.Purpose of the Thesis:** The thesis aims to explore architectural and functional considerations in the design of trauma care facilities and to propose innovative solutions for improving patient outcomes and the working environment for medical staff.

### 3.Design Objectives:

#### a. Patient-Centered Design:

Creating an environment that prioritizes patient well-being, privacy, and comfort.  
Fostering a calming and supportive atmosphere to reduce stress and anxiety.

#### b. Efficiency and Functionality:

Optimizing the layout for streamlined workflows, minimizing patient wait times and improving staff efficiency.  
Ensuring the facility is equipped with cutting-edge medical technology and infrastructure..

#### c. Sustainability:

Integrating sustainable design principles to minimize environmental impact.  
Promoting energy efficiency, waste reduction, and resource conservation.

#### d. Flexibility and Expansion:

Design for flexibility to accommodate future expansion and adapt to changing healthcare needs.  
Plan for modularity and scalability of the facility.

#### e. Integration with Technology:

Exploring how technology can enhance patient care, communication, and data management.  
Consider telemedicine and telehealth integration.

### 4.Site Selection:

1. To Determine the location for the trauma care center, considering accessibility, proximity to major roads, and available utilities.
2. To Evaluate the site for its suitability, topography, and environmental impact.



## 7.2) DESIGN PROGRAMME

Sr.No	MAIN SPACE	SUB SPACE
1	RECEPTION AND WAITING AREA	RECEPTION LOUNGE WAITING AREA
2	EMERGENCY DEPT.	TRIAGE AREA TREATMENT ROOMS ISOLATION ROOMS PROCEDURE ROOMS NURSE STATIONS PATIENTS WAITING ROOM
3	OPERATING THEATRES	MAJOR OT DOCTOR'S LOUNGE EQUIPMENT ROOM DISPOSAL ROOM
4	ICU	
5	MICU	
6	NICU	
7	IMAGING AND DIGNOSTICS	C.T SCAN MRI X-RAY DIAGNOSTIC STORE/REPORT DISPATCH
8	LAB	PATHOLOGY LAB SAMPLE COLLECTION WASHING AREA CLINICAL PATHOLOGY STORE ROOM
9	REHABILITATION DEPT	PHYSICAL & OCCUPATIONAL THERAPY ROOMS CONSULTATION ROOMS
10	OPD	PADEATRICS ORTHO CARDIOLOGY UROLOGY NEUROLOGY SKIN GYNAC DENTAL

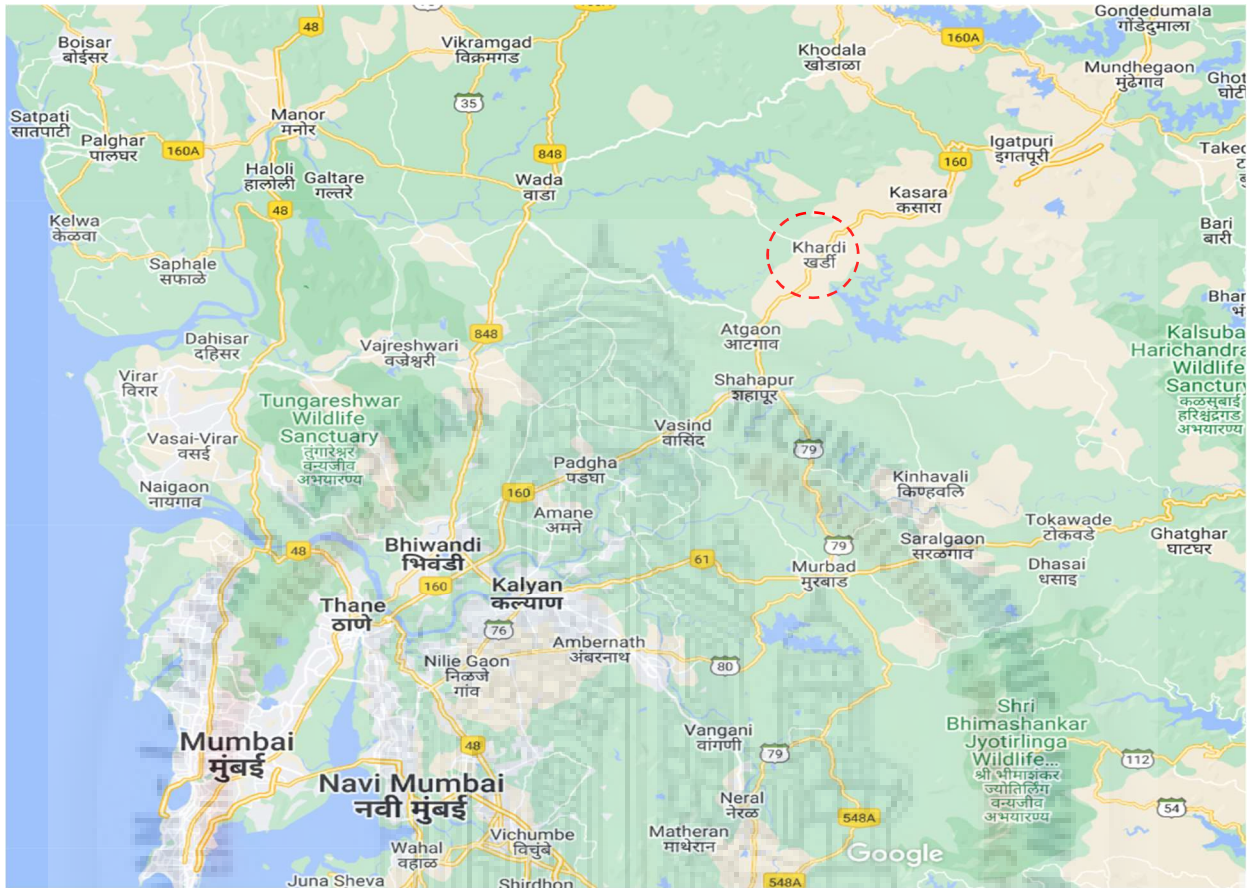
## 7.2) DESIGN PROGRAMME

Sr.No	MAIN SPACE	SUB SPACE
10	OPD	PADDETRICS
		ORTHO
		CARDIOLOGY
		UROLOGY
		NEUROLOGY
		SKIN
		GYNAC
		DENTAL
11	WARDS (PRIVATE,SEMI PRIVATE,DELUXE)	ORTHO
		PEDIATRICS
12	ADMINISTRATION	RECEPTION
		ADMIN OFFICES
		CONFERENCE ROOMS
		SEMINAR ROOM
		MEDICAL RECORDS AND BILLING OFFICE
		STORAGE ROOM
13	BLOOD BANK	
14	PHARMACY + SUPPLY STORAGE AND DISTRIBUTION AREAS	
15	ANCILLARY SPACES	RESTROOMS
		NURSE STATIONS
		CANTEEN
		SECURTIY ROOMS
		MECHANICAL +CIVIL DEPT ROOMS
16	INFRASTRUCTURE AND SUPPORT SYSTEM/SERVICES	UTILITY ROOMS FOR PLUMBING,ELECTRICAL,HVAC
		EMERGENCY POWER AND BACKUP SYSTEM ROOM
		CCTV ROOM
		INFORMATION TECHNOLOGY ROOM
17	OUTDOOR SPACES	LANDSCAPING
		AMBULANCE DROP OFF POINT
		AMBULANCE PARKING
		OUTDOOR WAITING AREA
18	PARKING	DOCTOR'S PARKING
		STAFF PARKING
		VISITOR'S PARKING
19	MORTUARY	

### 7.3) SITE SELECTION & LOCATION

Location – Khardi, At Shahapur Taluka, Thane, Maharashtra.

Area of Site – 6 Acres | Noise level – Moderate | Climate – Warm And Humid |



Google Map Image – Macro level



Google Earth Image – Micro level

■ Nh3- Mumbai - Nashik expressway    
 ■ Railway station    
 ■ Primary road    
 ■ Existing rural hospital  
■ Proposed Site

### 7.3.1) BACKGROUND STUDY :

Khardi is a town Located in the Shahapur taluka ,Thane district, of Maharashtra. It is also a station on the Mumbai Suburban Railway system on the Central line route between Kalyan and Kasara.

It is 1000 ft. above sea - level and is a tourist destination for people from Mumbai. Khardi is located on National Highway No.3 one of the 4-lane highways which connect India's states. Khardi is surrounded by the Sahyadris, and places like Mahuli and Aaja are common spots for trekking.

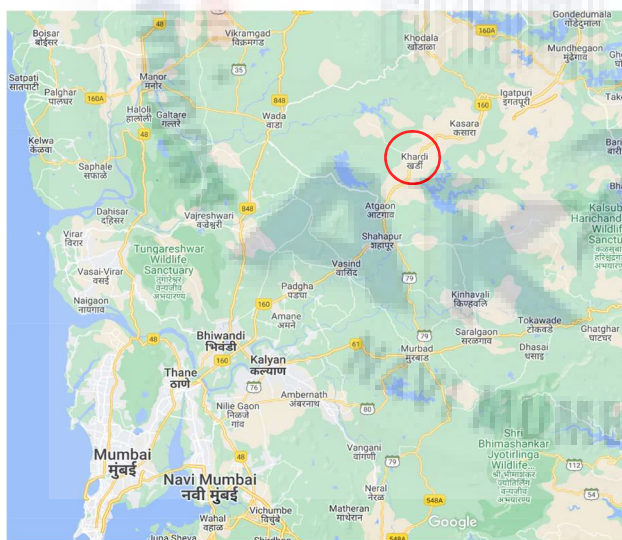
The Maharashtra Government has declared Shahapur a center for tourism. Shahapur had an average literacy rate of 87%, higher than the national average of 59.5%. District Shahapur supplies the drinking water to Mumbai for which the government of Maharashtra has declared this town to be a "No Chemical Zone"; no one can start a chemical industry here.

Three large water fresh bodies surrounding Khardi help keep temperatures down. (Approx. Distance from Thane City is about 60 km)

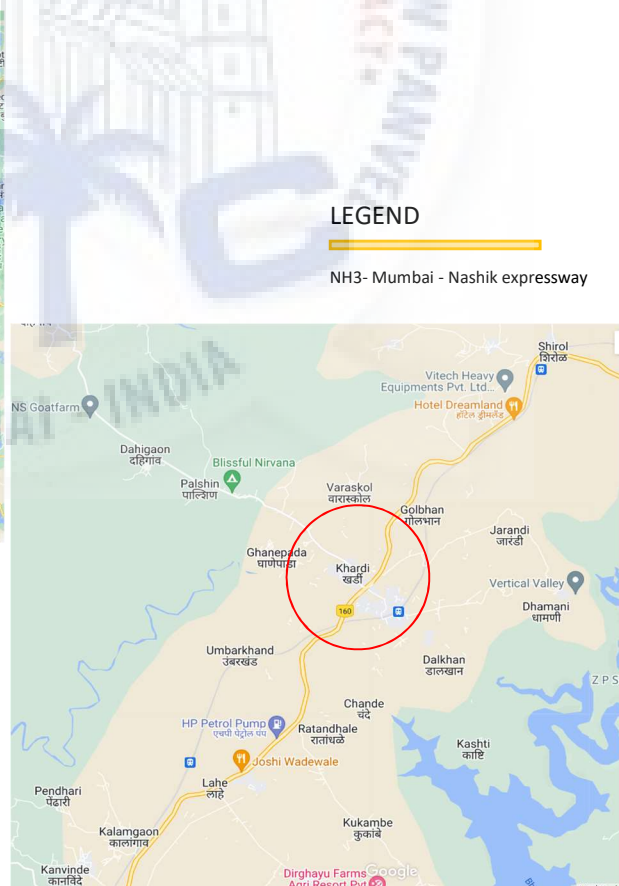
Dwellers from Mumbai and surrounding towns have made Khardi their second home while few have migrated to Khardi. Khardi is accessible by rail or road and is surrounded by three lakes (Bhatsa, Tansa, and Vaitarna), which are a major source of drinking water for Mumbai And Thane city.

This Town is also the location for the Tansa reserved forest.

#### LOCATION



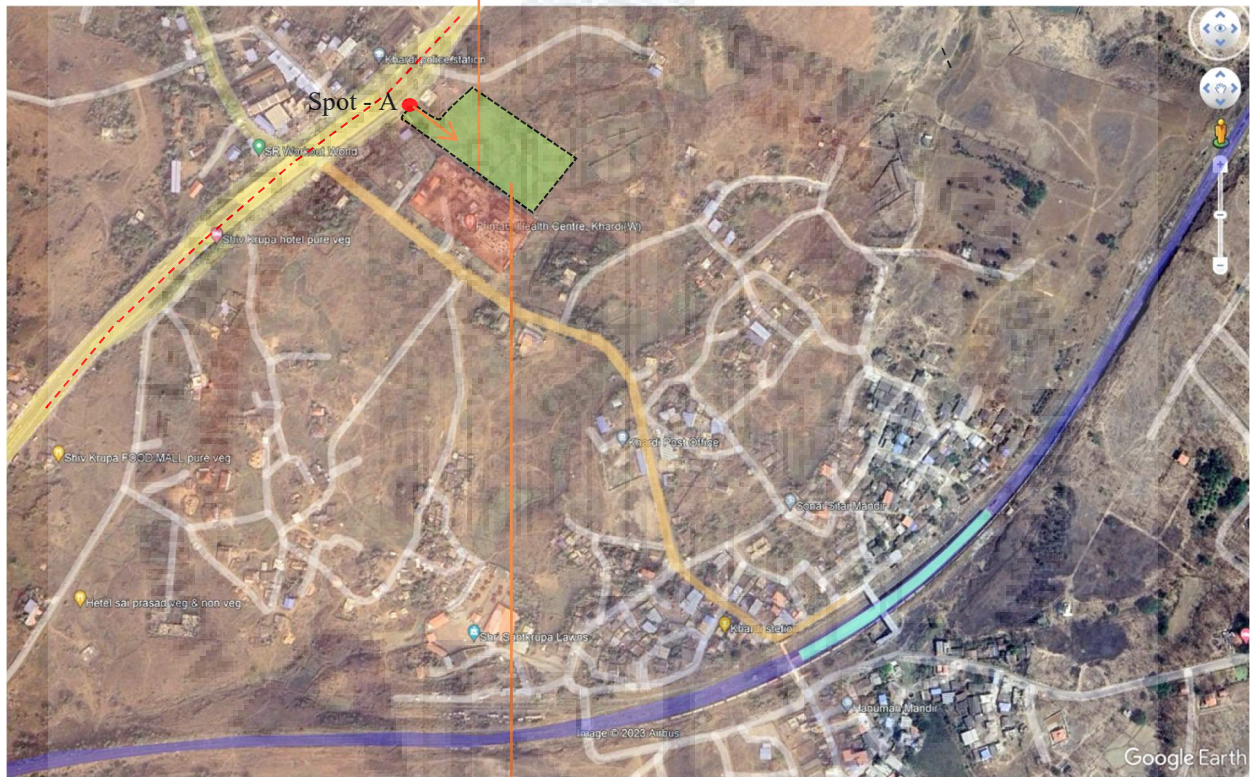
Macro level map



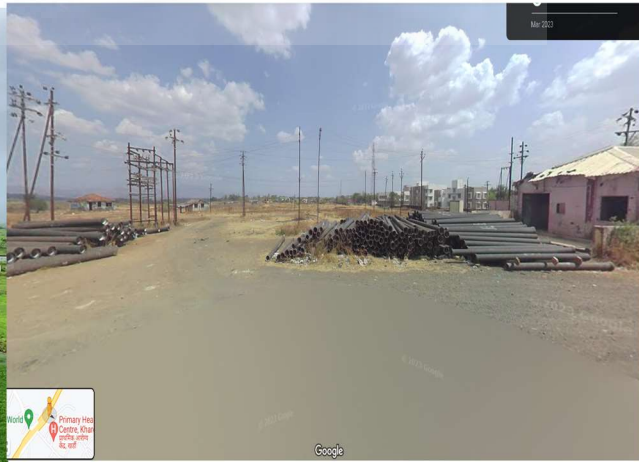
#### LEGEND

NH-3- Mumbai - Nashik expressway

Micro level map



- Nh3- Mumbai - Nashik expressway
- Railway station
- Primary road
- Existing rural hospital
- Proposed Site



### 7.3.2)Infrastructure and Amenities

#### Educational Facilities :

Khardi as a town has about 10 gov primary schools up to level 8<sup>th</sup>, 2 Gov & 3 private schools up to level 10<sup>th</sup> and 2 junior colleges up to level 12<sup>th</sup>. KHARDI VIBHAG EDUCATION SOCIETY'S HIGHSCHOOL & JUNIOR COLLEGE KHARDI is the oldest school and Jr.college in Khardi and was established in the year 1963 This school consists of Grades from 5 to 12. Other Educational facilities include -

#### Primary School

- Z.P. School, kumbhyachapada
- Z.P. School, pimpalpada
- Z.P. School, bendekon
- Z.P. School, dalkhan no.2
- Z.P. School, talekhan
- Z.P. School, jarandi
- Z.P. School, ghanepada
- Z.P. School, Khardi
- Bhakti sangam vidyalay sec.
- Z.P. School, vaytagwadi

#### Junior Colleges

- Sonubhau Baswant College Of Arts And Commerce
- Bhimrao Pradhan College
- G.V Khade Vidyalay
- Jeevandeep Shaishanik Sansthas Arts, Commerce And Science.

#### Technical Institutes

- Shivajirao S Jondhle Institute Of Management Science and Research.
- Alamuri Ratnamala Institute Of Engineering And Technology.
- Atma Malik Institute of Technology & Research.

#### Healthcare Facilities :

Khardi has some basic healthcare facilities in the main town area ,which includes 1 Government hospital and number of private clinics. However higher medical treatments is not available in the region and the nearest hospital for it is around 25 km away . There are private emergency hospital being built recently and under construction stage currently.

#### Government Hospital

Primary Health Centre ,Khardi

#### Private Clinics

Around 10 small clinics in the main town and major hospital at Shahapur (25 km away from the town)

### 7.3.2)Infrastructure:

NH3 – MUMBAI – NASHIK EXPRESSWAY



Now Renamed as (NH60)  
Mumbai - Agra Expressway

KHARDI RAILWAY STATION



(Station Between Central Rly  
Mumbai-Kasara line)



BHATSA DAM



VAITARNA DAM



TANSA DAM



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CHANDAN PARK

## NH3 Highway



**Khardi/NH3-Mumbai Nashik Expressway**

Image Source-Google/Kushal Chaudhari



**Kasara Ghat /NH3-Mumbai Nashik Expressway**

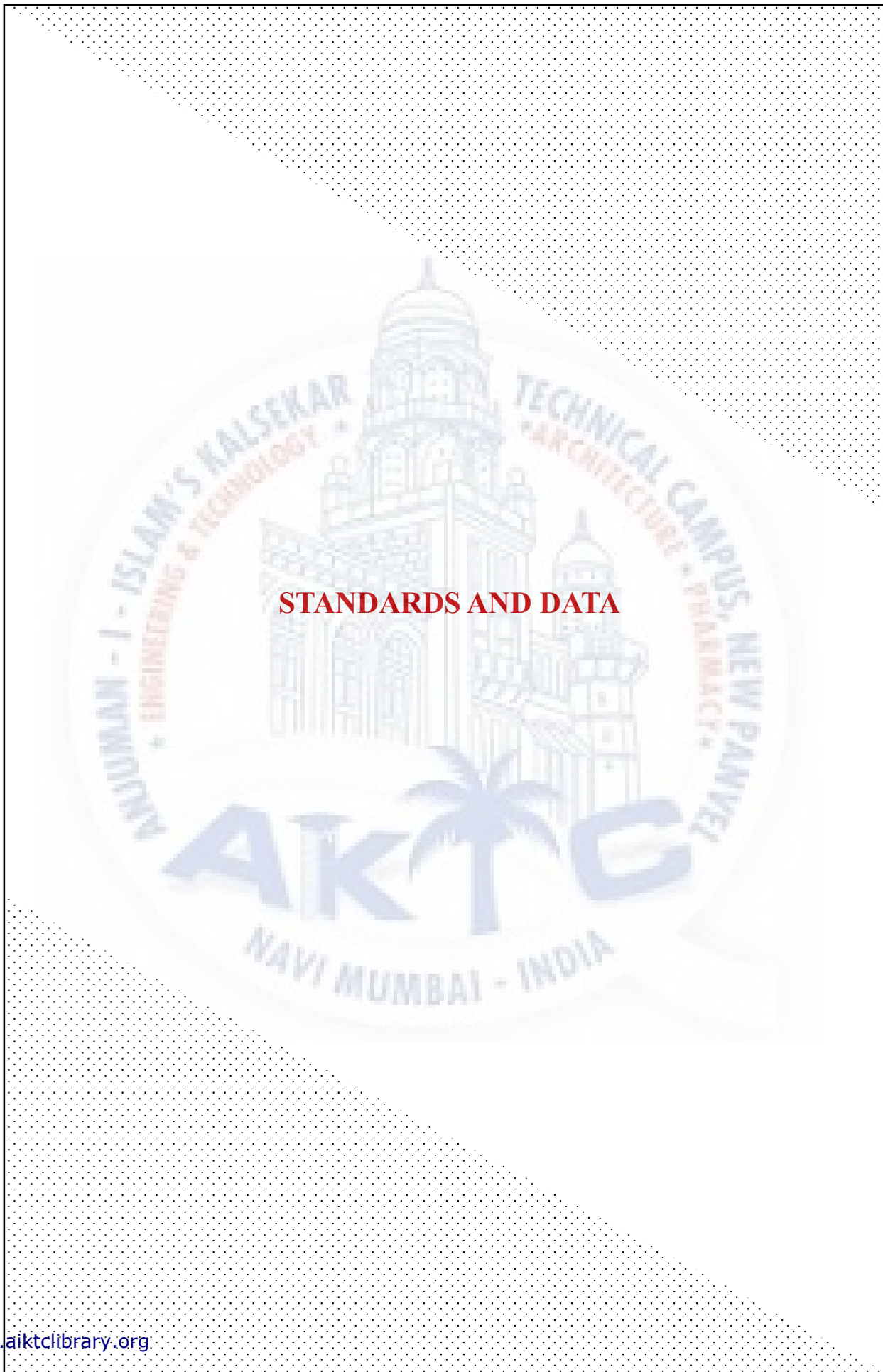
Image Source-Peak Infra



**Kasara Ghat /NH3-Mumbai Nashik Expressway**

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**STANDARDS AND DATA**

## 8.1) STANDARDS AND DATA

### General Requirements

As the topic of Trauma/Multispeciality hospital there are mainly services are which are to be taken care of. Also the spaces in hospital have to meet the requirements and the standards. The data collection in this section will helps in forming standards for various spaces for Trauma/multispeciality hospital.

#### Space requirement an access

Barrier Free Environment is one which enables people with disabilities to move about safely and freely and to use the facilities within the built environment. The goal of barrier free design is to provide an environment that supports the independent functioning of individuals so that they can get to, and participate without assistance, in every day activities such as procurement of goods and services, community living, employment, and leisure. The fundamental principles which have been followed in developing standards / norms for various facilities to meet disabled people's standards for safety, convenience and usability. Barrier free design standards should satisfy anyone who is hampered in his mobility or functioning (as compared with a nondisabled person) as a result of obstacles put in his way by the design of a building, the choice of hardware and equipment, and the arrangement of outside space.

#### Walks and paths:

Walks should be smooth, hard level surface suitable for walking and wheeling. Irregular surfaces as cobble stones, coarsely exposed aggregate concrete, bricks etc. often cause bumpy rides. The minimum walk way width would be 1200 mm and for moderate two way traffic it should be 1650 .mm - 1800 mm. Longitudinal walk gradient should be 3 to 5% (30 mm - 50 mm in 1 meter) When walks exceed 60 Meter in length it is desirable to provide rest area adjacent to the walk at convenient intervals with space for bench seats. For comfort the seat should be between 350 mm - 425 mm high but not over 450 mm. Texture change in walk ways adjacent to seating will be desirable for blind persons.

#### Approach to plinth level

Approach to plinth level : Every building should have at least one entrance accessible to the handicapped and shall be indicated by proper signage. This entrance shall be approached through a ramp together with the stepped entry. Ramped Approach : Ramp shall be finished with non slip material to enter the building. Minimum width or ramp shall be 1800 mm. with maximum gradient 1:12, length of ramp shall not exceed 9.0 M having double handrail at a height of 800 and 900 mm on both sides extending 300 mm. beyond top and bottom of the ramp. Minimum gap from the adjacent wall to the hand rail shall be 50 mm.

#### Entrance Landing :-

Entrance landing shall be provided adjacent to ramp with the minimum dimension 1800 x 2000 mm. The entrance landing that adjoin the top end of a slope shall be provided with floor materials to attract the attention of visually impaired persons (limited to coloured floor material whose color and brightness is conspicuously different from that of the surrounding floor material or the material that emit different sound to guide visually impaired persons hereinafter referred to as "guiding floor material" (Annexure - I). Finishes shall have a non slip surface with a texture traversable

## Provisions for Passageway/Corridors

The following minimum width provisions shall be made for each passage way/corridor.

- a) Residential buildings, dwelling unit type. 1.00 m.
- b) Residential buildings, e.g., hostels, etc. 1.25 m.
- c) Assembly buildings like auditorium theatres and cinemas. 2.00 m.
- d) All other buildings including hotels. 1.50 m.
- e) Hospital, Nursing Homes, etc. 2.40 m.

## Ramps

- a. The ramp to basement and parking floors shall not be less than 7.2m wide for two way traffic and 4 m wide for one way traffic, provided with Gradient of 1:10 for cars and 1:15 for heavy vehicles. At curved portions of the ramp or for circular ramps the slope should not be more than 1:12.
- b. Ramp may also be provided in setback area which can be sloped considering unhindered movement of fire Engine and in no case the gradient shall be less than 1: 10.
- c. All structural design/safety aspects as per latest BIS Codes & NBC, 2005 shall be complied along with consideration of weight of Fire Engine & its maneuverings.
- d. The minimum width of the ramps in hospitals shall be 2.4 m for stretcher and not for vehicular movement
- e. In this case Handrails shall be provided on both sides of the ramp.
- f. Ramps shall lead directly to outside open space at ground level or courtyards or safe place.

## Staircase

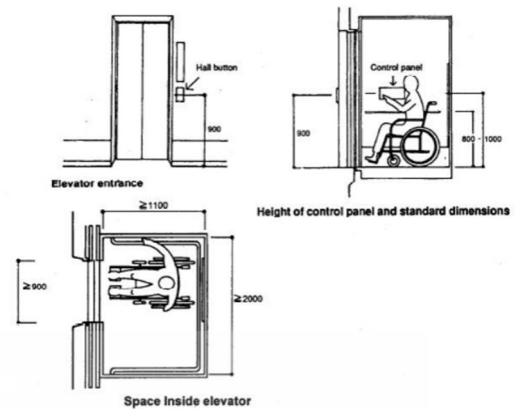
**Table 5.1 Minimum width of staircase for different types of buildings**

Types of Building	Width
Residential buildings (dwellings)	1.0m
Residential hotel buildings	1.5m
Assembly buildings like auditorium, theatres and cinemas	2.0m
Educational buildings up to 30 m in height	1.5m
Institutional buildings like hospitals	2.0m
All other buildings	1.5m

Source-Modern Building By laws

**Lifts :-**

Wherever lift is required as per bye-laws, provision of at least one lift shall be made for the wheel chair user with the following cage dimensions of lift recommended for passenger lift of 13 persons capacity by Bureau of Indian Standards. Clear internal depth : 1100mm. Clear internal width : 2000 mm. Entrance door width : 900 mm



**Signages :**

The main purpose of signs should be to provide a clear designation of places, warnings and routing information. A person in a wheel chair is less than 1200 mm high. A person who is partially sighted needs contrasting texture along side walkways and audible signs for dangerous areas,. Signs should be useful to everyone, easily seen from eye level, readable by moving the fingers and well lighted for night time identification.

Signs shall indicate the direction and name of the accessible facility and incorporate the symbol of access.

The size, type and layout of lettering on signs shall be clear and legible.



**Table 5.2 Travel Distance for Occupancy and Type of Construction**

Sl. No	Group of Occupancy	Maximum Travel Distance Construction	
		Type 1 &2	Type 3 & 4
i.	Residential(A)	30.0	22.5
ii.	Educational(B)	30.0	22.5
iii.	Institutional	30.0	22.5
iv	Assembly(D)	30.0	30.0
v	Business(E)	30.0	30.0
vi	Mercantile(F)	30.0	30.0
vii	Industrial(G)	45.0	Construction type 3 and 4 not permitted.
viii	Storage(H)	30.0	Construction type 3 and 4 not permitted.
ix	Hazardous(J)	22.5	Construction type 3 and 4 not permitted.

**Notes:**

1. For fully sprinkled building, the travel distance may be increased by 50% of the values specified above
2. Ramps shall be counted as one of the means of escape wherever permitted in National Building Code 2005.

Source-Modern Building By laws

## Fire Safety Measures

Sl. No.	Types of Fire Protection (Active Defense)	Requirements
1.	Fire Extinguishers	Minimum 2 per floor, depending upon the area and travel distance.
2.	Hose Reel Assembly	Provided at all floors (Per 1000 m2)
3.	Wet-riser	Provided at all floors (Per 1000 m2)
4.	Yard Hydrant	All around the building at 30mts interval
5.	Automatic Sprinkler System	To be provided in suitable places In consultation with Fire and Rescue Services Department
6.	Manually operated fire alarm (MCP) Call points	To provided in each floor near exit door
7.	Automatic Detection and Alarm system	For entire building
8.	Underground water tank	100,000 liters
9.	Terrace level over head tank	20,000 liters
10.	Fire Pumps at ground level	1 electric and 1 diesel pump of capacity 2280 LPM and 1 electric pump 180 LPM (Jockey Pump)
<b>Life Safety (Passive measure)</b>		
11.	Staircase (2 meters width)	Minimum of 2 nos. at remote distance
12.	Ramp	1 no. for easy evacuation of stretcher patients.
13.	Compartmentalization	Area more than 500 m2 on individual floor shall be segregated by fire resistance wall to contain the spread of fire, smoke and heat.
14.	Fire lift	1 no. with a provision to evacuate the stretcher patients.
15.	Smoke Ventilation System	Automatic system should be provided for visibility during emergency.
16.	Fire resistance compartment	At suitable floors for intermediate evacuation of intensive care patients.
17.	Side Set Back Area	7 meters all round the building
18.	"Exit" signage	With alternate source of power supply or battery back-up with glow type
19.	Lightning arrester	Should be provided

Source-Modern Building By laws

## Fire Safety Measures

Category Applicable – Group ‘C’ Zone III

### Fire Protection Requirements for Buildings in Zone-I Category

Sl. No.	Measures	Group-A: Residential A1, A2, A3, A4				Group-B: Educational			Group-C: Institutional		
		O	I	II	III	I	II	III	I	II	III
1	Access	P	P	P	P	P	P	P	P	P	P
2	Means of Escape	P	P	P	P	P	P	P	P	P	P
3	Compartmentation	P	P	P	P	P	P	P	P	P	P
4	Refuge Area	X	X	X	X	X	X	X	X	X	X
5	Emergency Lights	X	X	P	P	P	P	P	P	P	P
6	Exit Signs	P	P	P	P	P	P	P	P	P	P
7	PA System with Talk Back Facility	X	X	X	X	X	P	P	P	P	P
8	Moefa	X	X	X	P	X	P	P	P2	P	P
9	Extinguishers	P	P	P	P	P	P	P	P	P	P
10	Hose Reel	P3	P	P	P	P3	P	P	P	P	P
11	Yard Hydrant	X	X	X	P	X	P	P	X	P	P
12	Down Comer	X	X	X	P	X	P	X	P4	X	X
13	Wet Riser	X	X	P	X	X	X	P	X	P	P
14	Fire Detection System	X	X	X	X	X	P6	X	P2	P	P
15	Automatic Sprinkler System	S	S	S	S	S	S	FS	S	S	FS
16	Under Ground Tank	X	X	X	X	X	X	P	P2	P	P
17	Over Head Tank	P13	P	P	P	P	P	P	P	P	P
18	Fire Pumps	X	X	X	X	X	X	P	X	P	P
19	Booster Pumps	P3	P	P	P	P	P3	P	P	X	P
20	Auto D.G. Set	P3	X	P	P	P3	P	P	P	P	P
21	MCB/ELCB	P	P	P	P	P	P	P	P	P	P
22	Hose Boxes	X	X	X	P	X	P	P	P4	P	P
23	Fireman's Grounding Switch	P	P	P	P	P	P	P	P	P	P

Source-Modern Building By laws

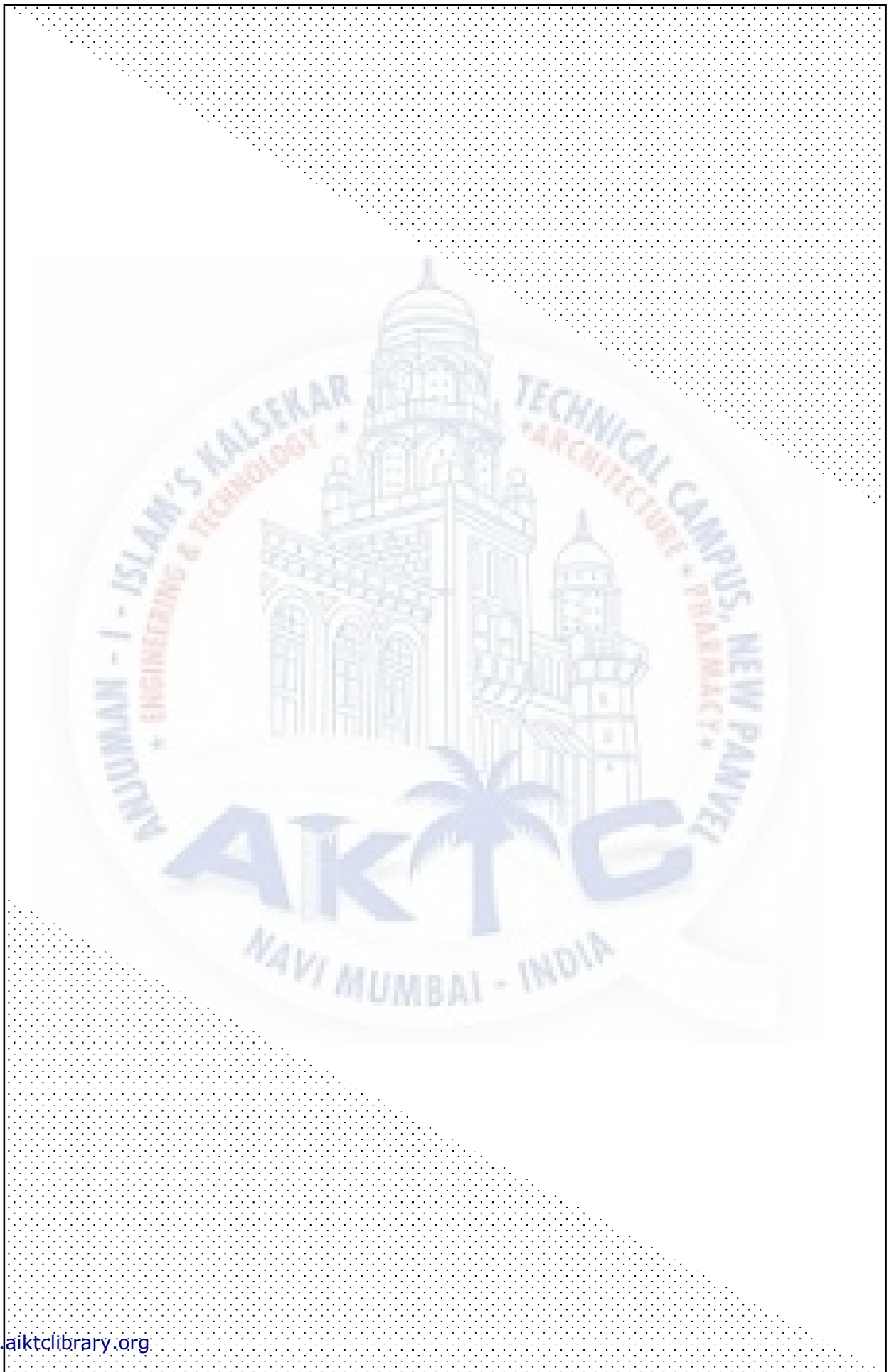
## Water Requirements

Source-Modern Building By laws

Sl. No.	Type of Occupancy	Consumption per head per day (in Lt.)
1.	Residential a) In living units b) Hostels c) Hotels with lodging accommodation (per bed) d) Hotels (5 star and above)	135 135 180 340
2.	Educational a) Day schools b) Boarding Schools	45 135
3.	Institutional (Medical Hospitals) a) No. of beds not exceeding 100 b) No. of beds exceeding 100 c) Medical quarters and hostels	340 450 135
4.	Assembly- Cinema theatres, auditoria, etc. (per seat accommodation)	15
5.	Government or Semi public business	45
6.	Segregated toilet facilities for Visitors in Public Buildings a) Each use of toilet (including washing hands and floors) b) Flushing urinals	7 0.20
7.	Mercantile (Commercial) a) Restaurants (per seat) b) Other business building	70 45
8.	Industrial a) Factories where bath-rooms are to be provided b) Factories where bath-rooms are not to be provided	45 30
9.	Storage ( including Warehouses )	30
10.	Hazardous	30
11.	Intermediate Stations (excluding mail and express stops).	45 (25)*
12.	Junction Station	70 (45)*
13.	Terminal Stations	45
14.	International and Domestic Airports	70

**Table 4.12 Sanitation Requirements for Institutional (Medical) Occupancy- Hospital**

Sl. No.	Sanitary Unit	Hospitals With indoor Patient Ward For Males & females	Hospitals With outdoor Patient Wards	
			For Males	For Females
1.	Toilet Suite (1WC+1Washbasin+ 1shower)	Private room upto 4 persons	For upto 4 patients	
2.	Water Closet (W.C.)	One for every 8 beds or part thereof	One for every 100 persons or part thereof	One for every 25 persons or part thereof
3.	Ablution taps	One in each W.C.	One in each W.C.	One in each W.C.
4.	Wash Basins	Two upto 30 bed; add one for every additional 30 beds; or part thereof	One for every 100 persons or part thereof	One for every 25 persons or part thereof.
5.	Baths with Shower	One bath with shower for every 8 beds or part thereof.	--	--
6.	Bed pan washing sink	One for each ward	--	--
7.	Cleaner' Sinks	One for each ward	One per floor minimum	One per floor minimum
8.	Kitchen sinks & dish Washers (where Kitchen is provided)	One for each ward	--	--
9.	Urinals	One for 30 beds (male wards)	One for every 50 persons or part thereof	--
10.	Drinking water fountain	One for each ward	One for 500 persons or part thereof	







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