Research Paper

Energy Efficiency for Tarachand Hospital A Case Study at Pune, Maharashtra, India.

Young Researcher's Conference, WSED, Austria, 2016

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10-9-2015

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A Case Study at Pune, India

Abstract

Hospitals may be thought of as a symbol for pain, sickness and distress, but they are also icons of healing, life, family and hope. They are important buildings for any community and "the way we design, construct and operate these buildings has a profound impact on our health and health of the environment." (Guenther and Vittori, 2008). Indian health care system is one of the fastest growing commercial sectors, providing for the health needs of the population. This scenario only projects that the energy demand for specialized sectors like these are going to increase, not only because their numbers increase, but also due to adoption of new medical technologies like radiation therapy and robotics. However, today, in the era of 21st century we still attempt to heal ourselves in buildings that use vast amounts of our dwindling resources and even impact negatively on our environmental health. This paper emphasizes on Tarachand Hospital located in Pune (Maharashtra, India) which faces main challenge in terms of high electricity consumption and tremendous water wastage. The paper focuses to achieve the balance between energy efficiency and water efficiency. An extensive study of the Hospital building was carried out in terms of 2 aspects – Planning of the building and its operation. After analyzing the ground realities on site and the requirements of the client, ECBC Compliance (Energy Conservation Building Code) was applied to the building as per Indian Standards (I.S). So the research paper adopts the method prescribed by ECBC through which issues were identified and grey areas were demarcated. The ECBC compliant building can use 40% to 60% less energy than any conventional buildings. Application of this code to the building will help reduce the energy consumption and enhance water efficiency of the hospital building. Generic recommendations & design strategies were formulated after the code was applied. This research is a snapshot of identifying the gaps in the energy efficiency of the hospital and does not go into details of the same.

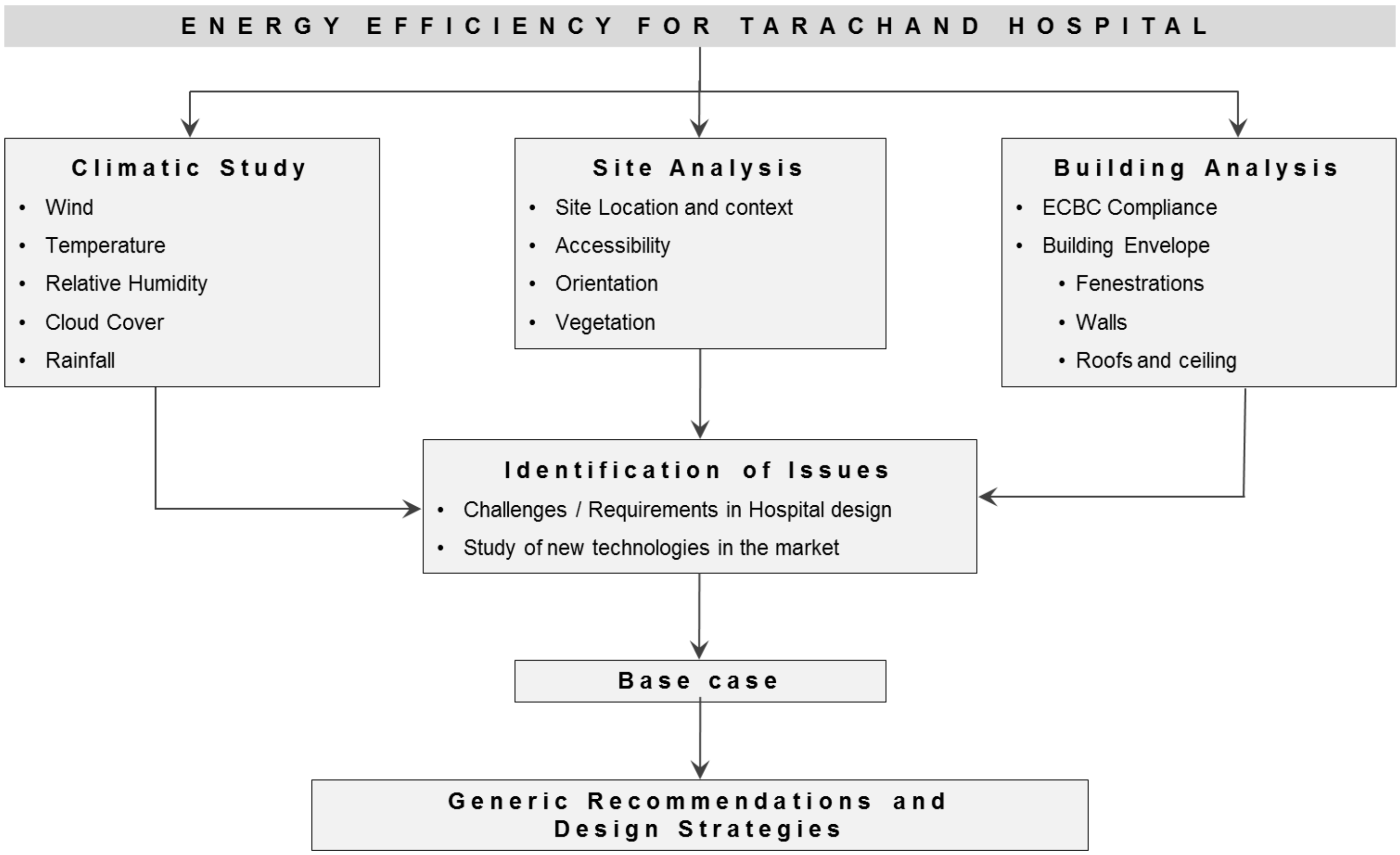
Keywords

Hospital, Energy efficiency, Water efficiency

Introduction:

Tarachand Hospital is managed by a group of trustees like developers and corporate entrepreneurs. It relies on donations and other grants for running of the hospital rather than the income of the hospital. Often, due to shortage of funds, the hospital suffers from lack of proper services and unhygienic conditions. Over a period of time, additions like toilets were constructed which further affected the internal quality space of the hospital. On account of disorganized planning of the hospital, continuous artificial lighting is required. As a result of inappropriate segregation of spaces, penetration of non-patient is observed even till the Operation theatres. Tarachand Hospital serves the poor. Due to lack of knowledge of these people, artificial lights were switched on throughout the day in few spaces which are quite well lit with daylight. There is a continuous overflow of water in the toilets leading to unhygienic conditions.

Methodology



1. ECBC (Energy Conservation and Building Code)

Energy Conservation and Building Code (ECBC) was launched by Ministry of Power in 2007 and developed as a first step towards promoting energy efficiency in building sector. ECBC was set by Bureau of Energy Efficiency (BEE) with the guidance from United States Agency for International Development (USAID). Key features are as follows:

1. Sets minimum energy efficiency standards for design and construction
2. Encourages energy efficient design or retrofit of buildings
3. Ensures that the building design does not constrain the building function, comfort, health, or the productivity of the occupants
4. It has appropriate regard for economic considerations

The ECBC code is applicable to building or building complexes that have a connected load of 500 kW or greater or a contract demand of 600 kVA or greater. Generally, buildings or building complexes having conditioned area of 1000 sq.m.or greater will fall under this category.

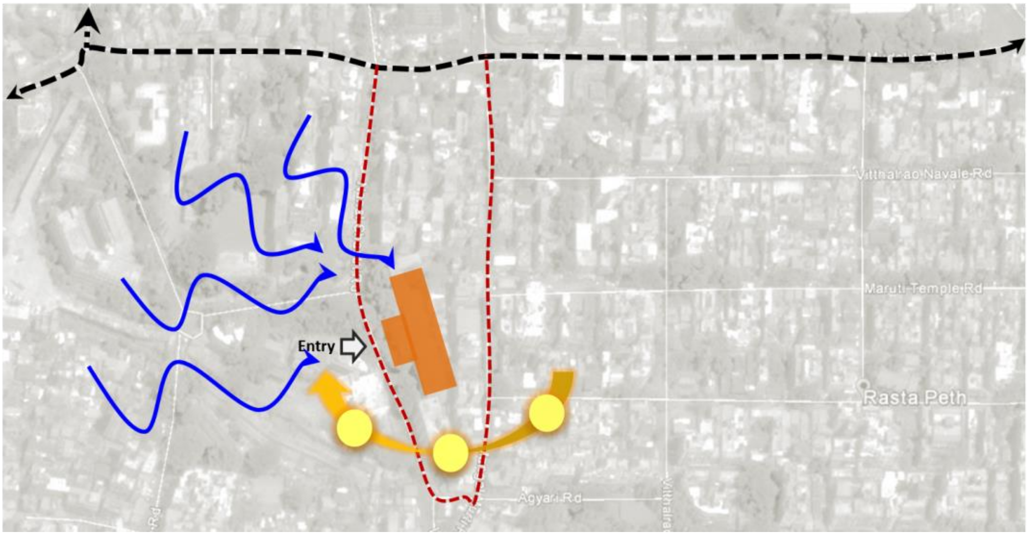
2. Site Location and Accessibility

Tarachand hospital, a G+2 structure is located in Rasta Peth of Pune city, Maharashtra, India. The main access to the site is from the west. More vegetation is observed towards its western side. The hospital building is located in dense area surrounded by buildings on all sides, which becomes a challenge in terms of daylight and ventilation aspects.

Source: Google earth dated 01.10.2015

3. Macro-climate analysis for Pune City

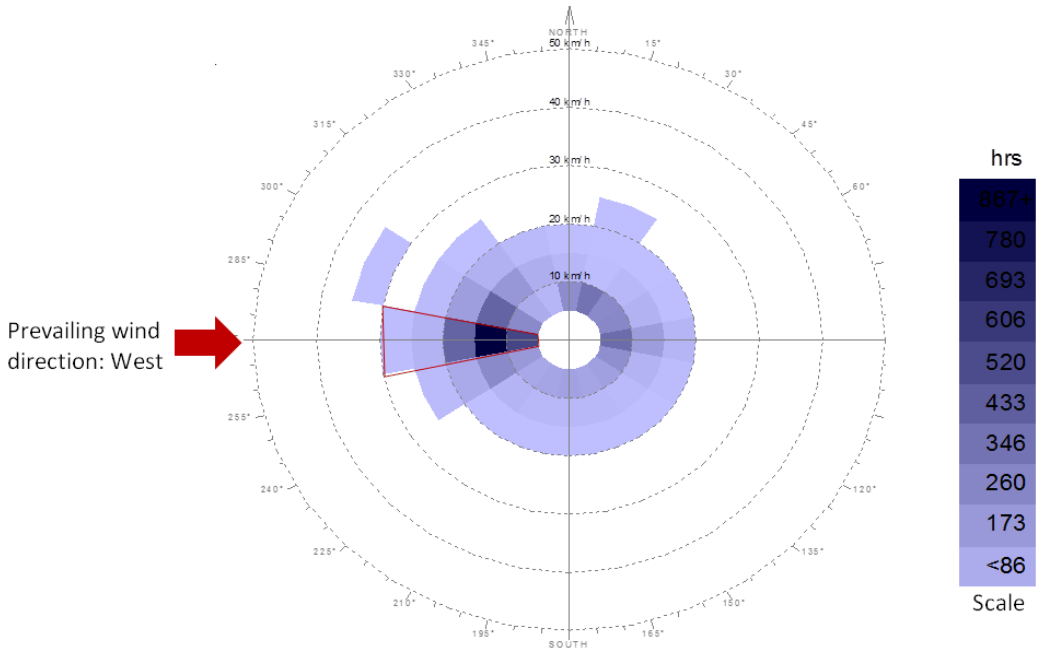
The climate of Pune falls under warm and humid category of five climatic zones of India. The parameters like wind, temperature, relative humidity, cloud cover, rainfall were considered for climatic analysis.

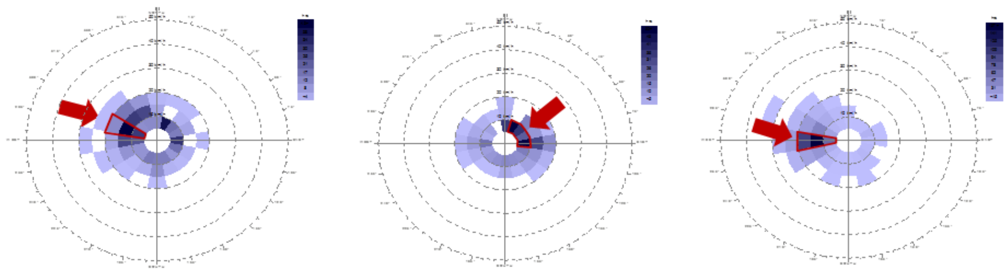


Source: Google earth dated 01.10.2015

3.1. Wind analysis

The prevailing wind direction for Pune city is from West and North-West direction.

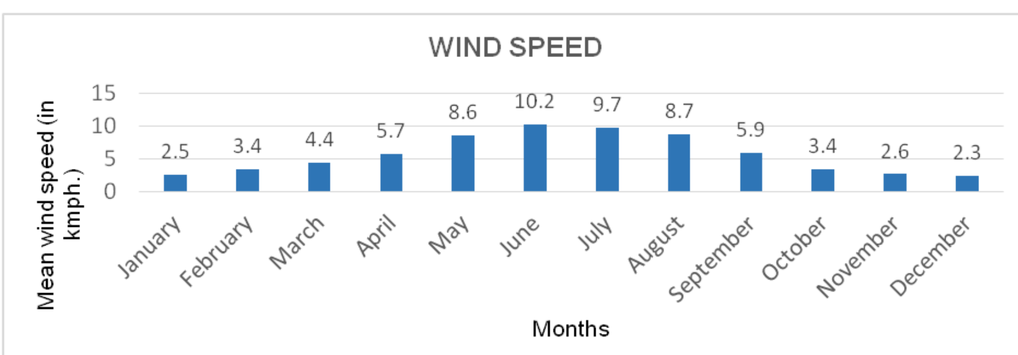




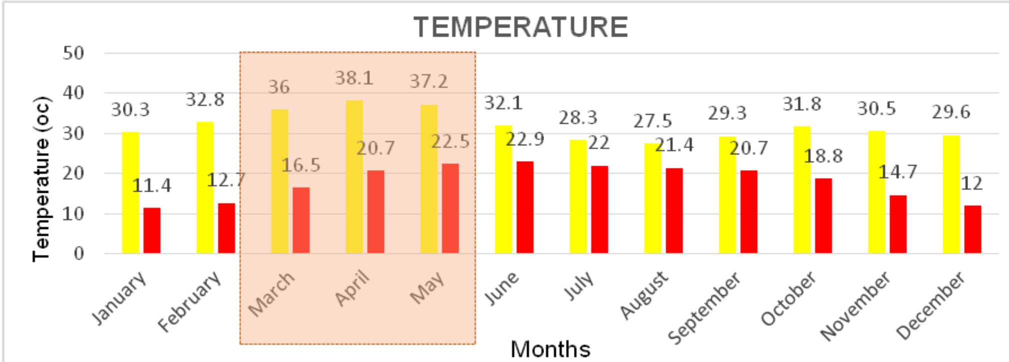
APRIL
Direction: North West

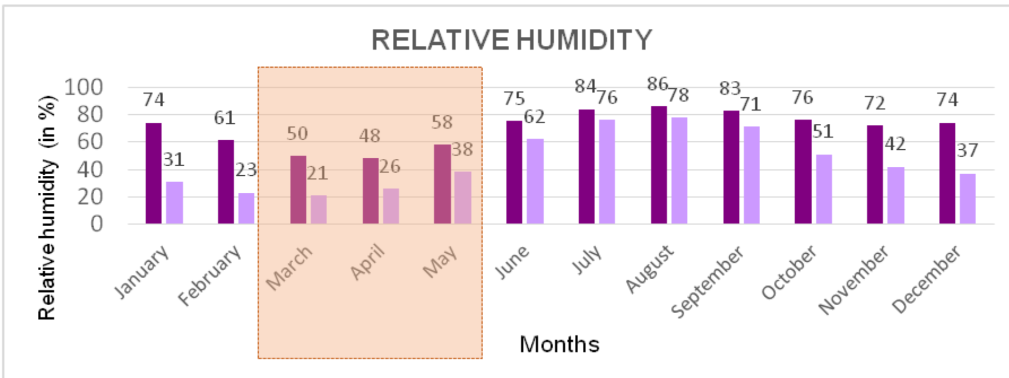
JUNE
Direction: North East

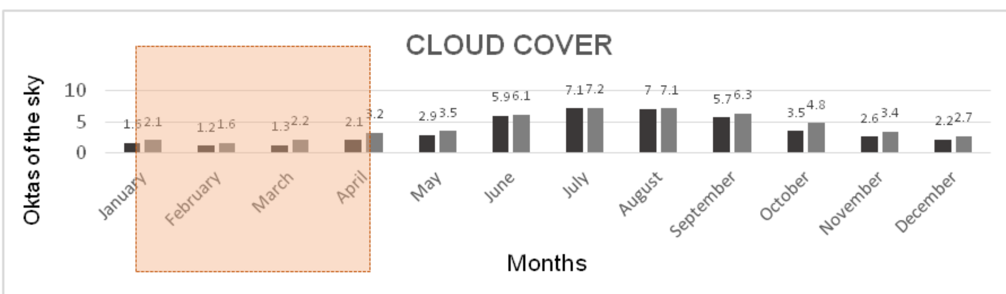
DECEMBER
Direction: West

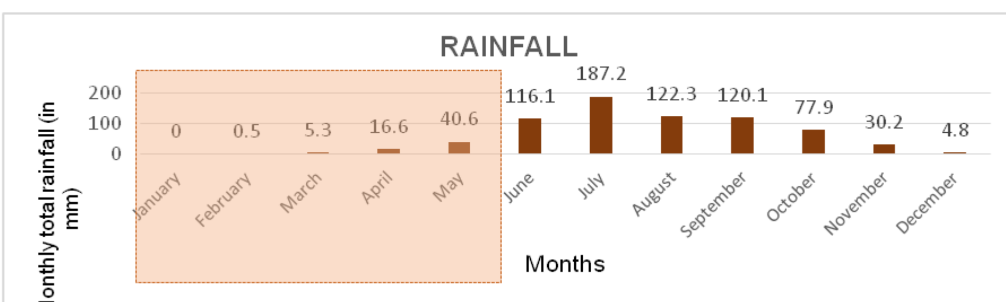


Source: India Meteorological Department (IMD)



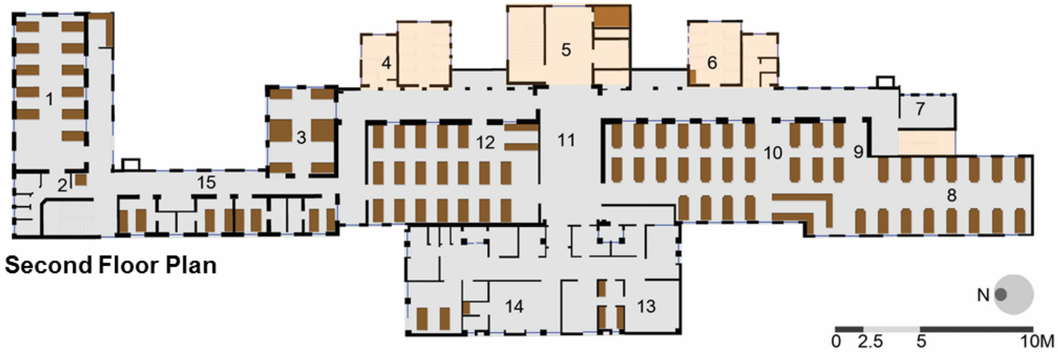




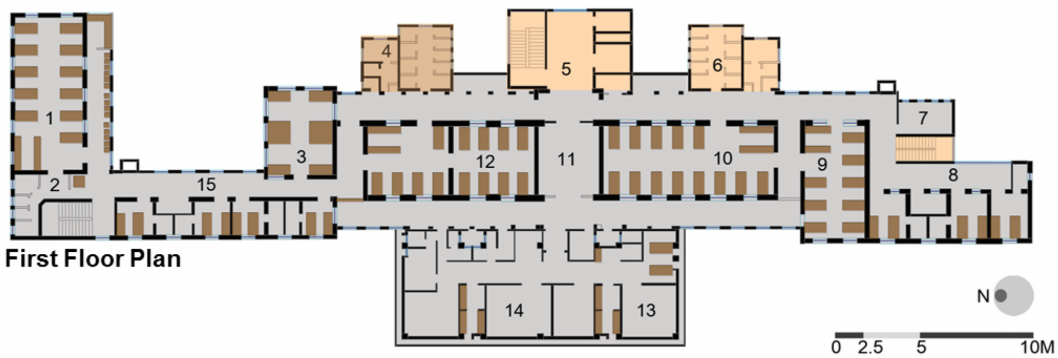


Source: India Meteorological Department (IMD

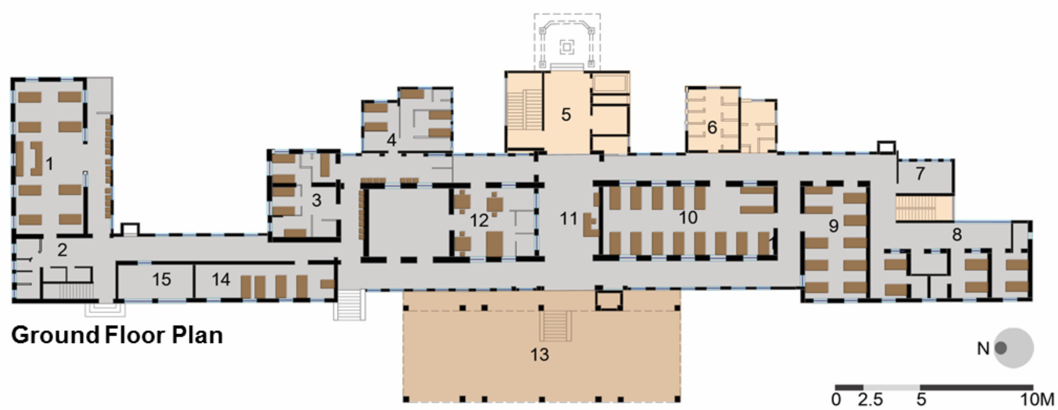
4. Hospital Floor Plans



1. General Ward
2. Toilet Block
3. Semi-Special Room
4. Toilet Block
5. Core
6. Toilet Block
7. Store
8. Gynecology Wards
9. Nurse Station
10. Gynecology Ward(with cradle)
11. Lobby
12. General ward
13. Labour Room
14. Operation Theatre
15. Special Rooms



1. General Ward
2. Toilet Block
3. Semi-Special Room
4. Toilet Block
5. Core
6. Toilet Block
7. Store
8. Special Rooms
9. Male General Ward
10. Male General Ward
11. Female General Ward
12. Office
13. Recovery Room
14. Operation Theatre
15. Special Rooms



1. ICU
2. Toilet Block
3. Panchakarma - Females
4. Panchakarma –Males
5. Core
6. Toilet Block
7. Store
8. Special Rooms
9. Male General Ward
10. Female General Ward
11. Lobby
12. Office
13. Porch
14. Casualty
15. Pharmacy

Source: Tarachand Hospital Trust

5. Site Images Imaginary

More use of artificial lighting in wards

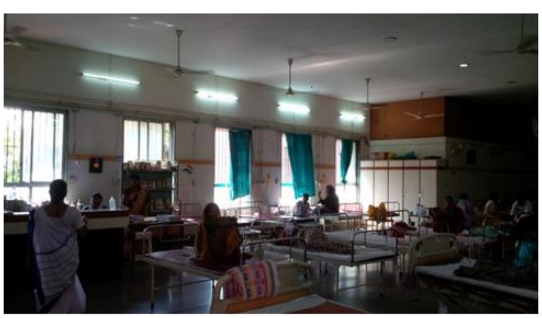
Corridors along wards on the western side, reducing the light intensity in the wards.

Glare from windows facing west

Toilets

No much natural light from west side

Main Lobby areas with less natural light



More use of artificial lights in wards due to corridors on the periphery

Corridors with no light and ventilation

6. Issues Identification

Note: The red color marked areas are the highlighted problem areas.

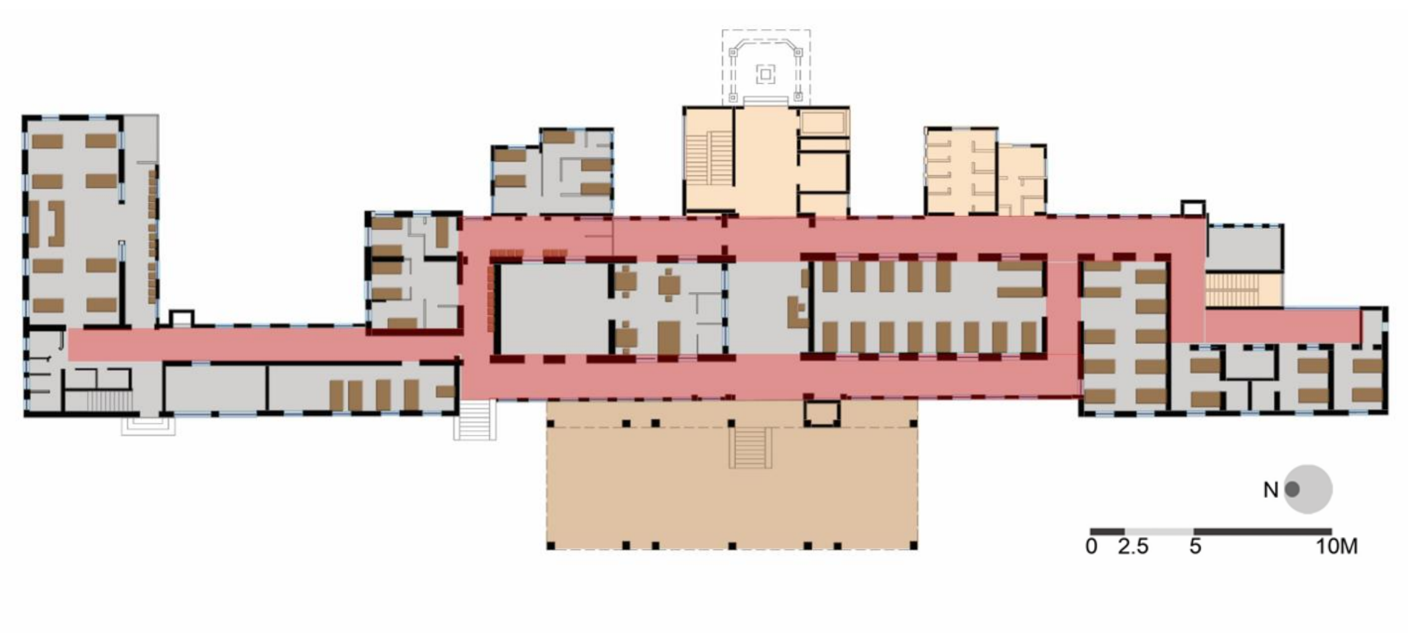
The issues are identified on basis of building analysis in terms of planning and design aspects at first stage. The second stage involves study of different environmental performances of the building which are addressed as follows:

1. Corridors,
2. Daylight and ventilation,
3. Lobby and waiting areas and
4. Location of toilets.

The main challenge faced was inappropriate orientation of building. Other challenges observed were inefficient daylight and ventilation at significant locations which resulted into inhabitable spaces. Later on a market study regarding new energy efficient technologies was carried out to make the building energy efficient.

6.1. Corridors

*Co*rridors on all the sides of the general ward, leads to compromise in natural light, ventilation and waste of space. Area under passage is 27% of floor area, which is above recommended standards (STD.15% maximum.). More of artificial lighting is thus used which results in more energy consumption. Due to the Operation theatre block on the west side, corridors experience lack of air movement and less natural light.

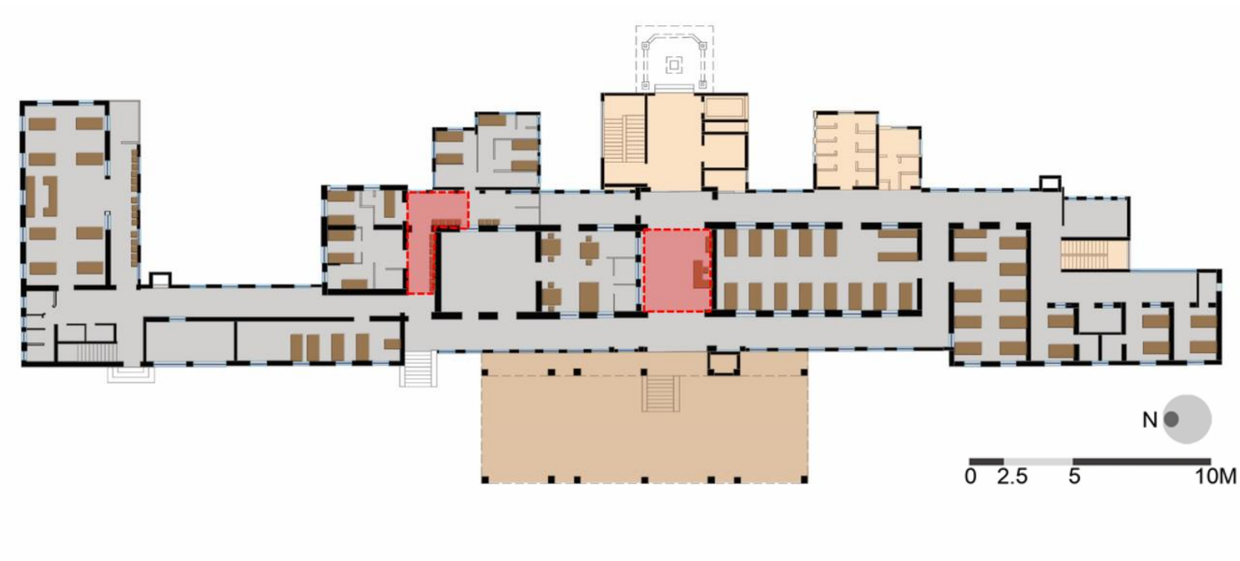


6.2. Daylight and Ventilation

As corridors are surrounding the wards from all sides, the external walls of wards are not exposed directly to natural daylight. Less daylight and ventilation in common wards is thus observed which results in dependency on artificial lighting, increasing in energy consumption.

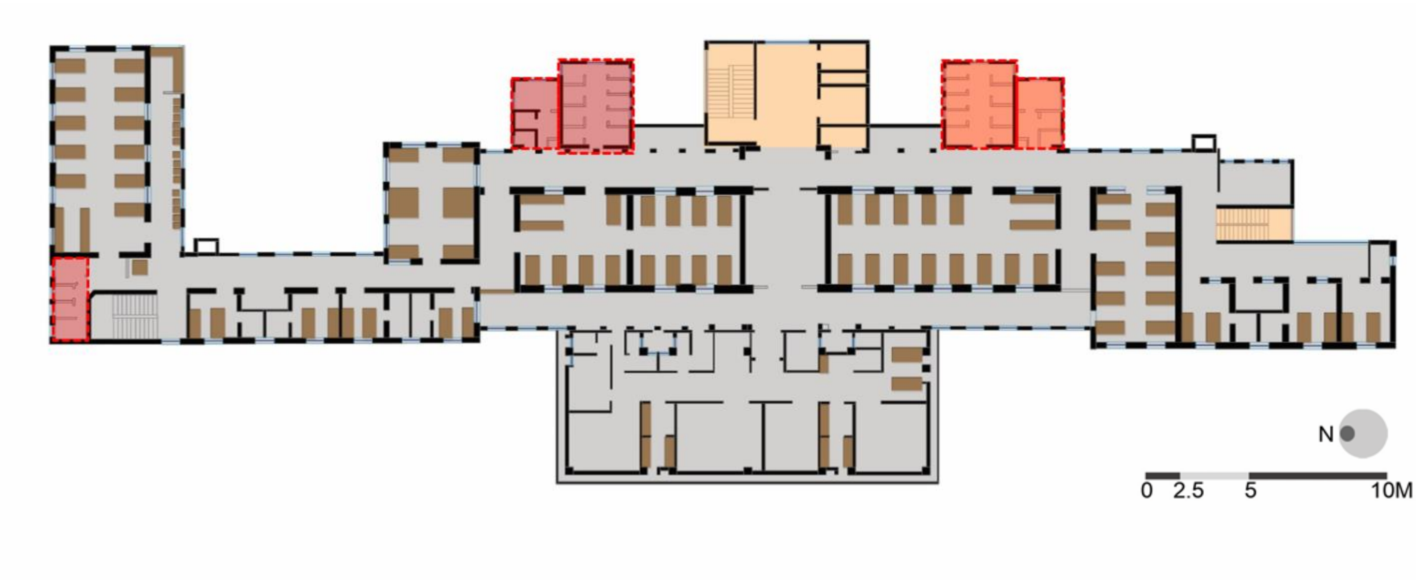
6.3 Lobby and Waiting areas

Due to increase in number of patients, new functional spaces were added in hospital building on later stage which resulted into transformation of lobby areas into waiting areas on all the floors. So the hospital lacks in proper designated waiting areas.



6.4. Toilet Locations

The toilets were constructed later on which create an obstruction to natural daylight. Location of toilet towards east side resulted into blocking of morning sunlight, reducing daylight in wards. Location of toilet towards north-west side is in wind direction which causes foul smell.



7. Generic Recommendations

Reaaranging of functions

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Segregation of electrical network based on functional areas
Use of energy efficient devices
Use of occupancy sensors to reduce enrgy consumption

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Facade treatments to avoid glare on west side of building

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Use of renewable technologies

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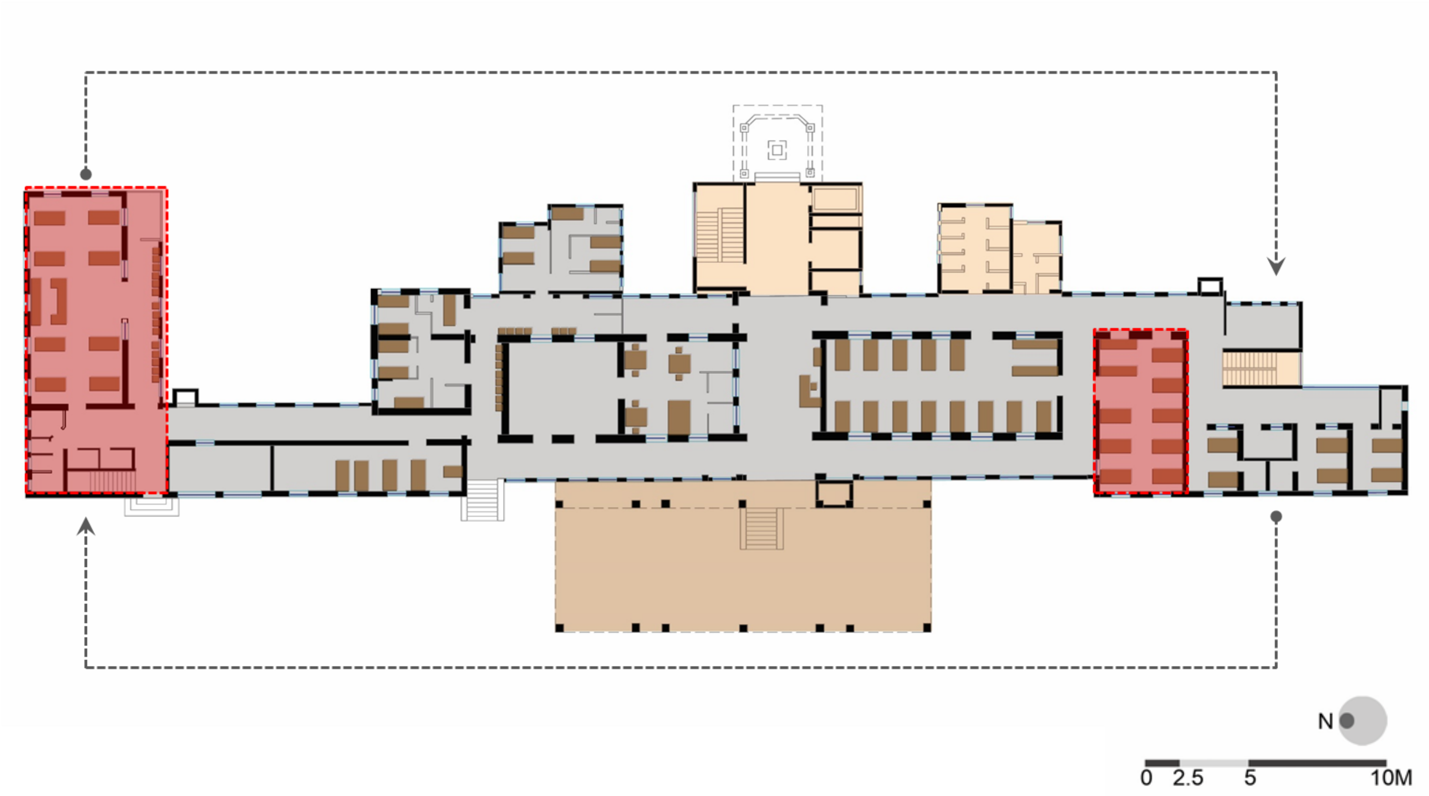
Water conservation through water efficient taps and water recycling

7.1. Rearranging of functions

Ventilation and daylight in functional areas plays a crucial role. As there is heat gain from southern side and I.C.U. block is an air conditioned space, shift of I.C.U. block to South side will function in more proper manner. Likewise general wards are unconditioned spaces and need more ventilation, therefore shift of general wards to the north side will help in positive way.

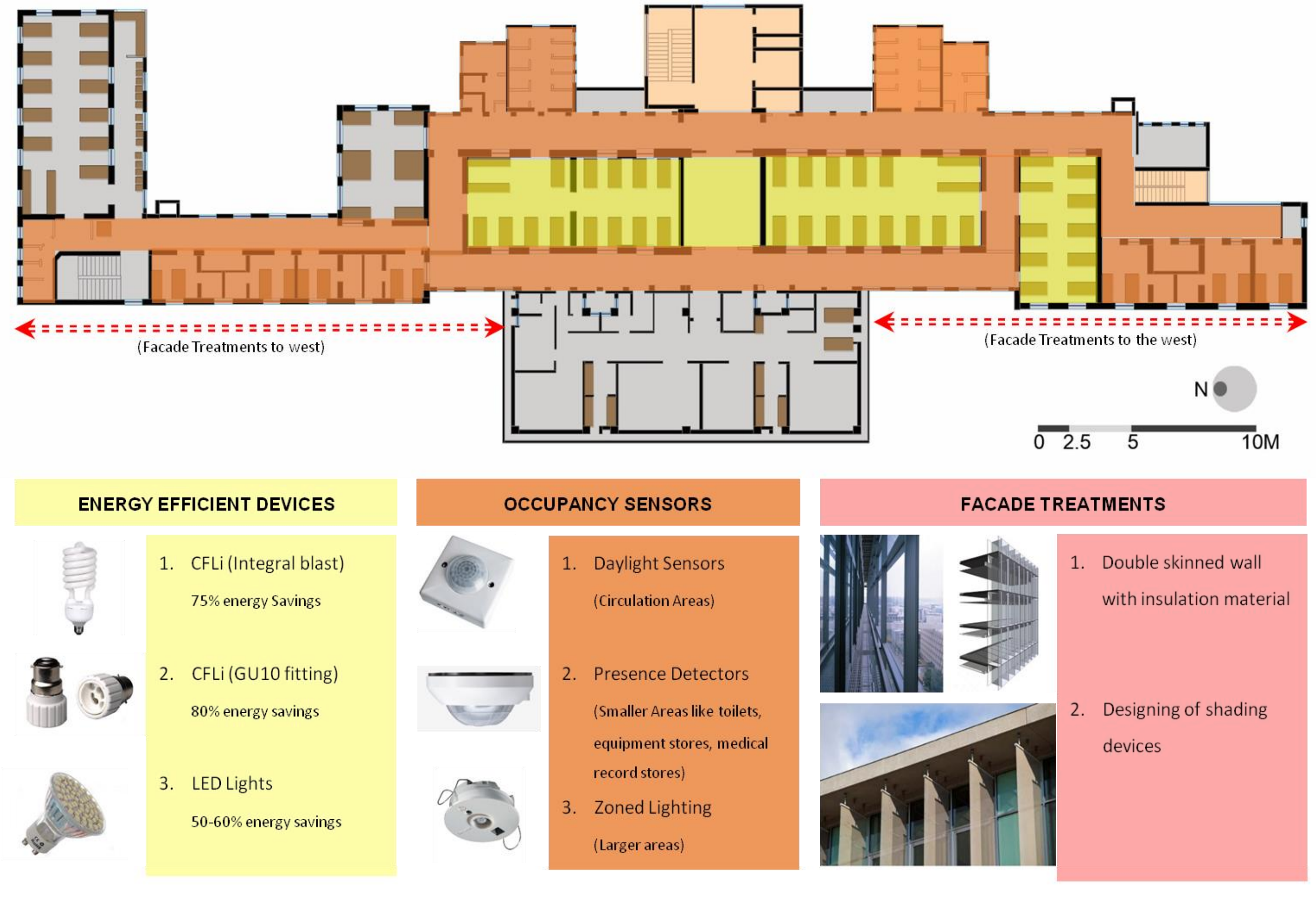


7.2. Segregation of electrical network based on functional areas

The central area of hospital comprising of mainly general wards, lobby areas gets less daylight. Hence modern energy efficient devices like CFL, LED's are recommended which save 50%-80% energy even if it comes under artificial lighting. Occupancy sensors save 50% energy savings. Daylight sensors are recommended to turn lights on and off and also dim lights when sufficient daylight is available in circulation areas like corridors. Presence detectors are recommended wherever variable occupancy occurs such as smaller areas like toilets, equipment stores, medical record stores etc. Zoned daylighting is recommended where lighting can be adjusted according to daylight availability by switching to 'off' for larger areas like special rooms etc.

7.3. Facade Treatments

The windows of the west side of building experiences glare which disturbs the wards. To avoid this glare, double skin wall with insulation and shading of devices are recommended which will help to bring good quality of light in wards and thereby also maintaining indoor air quality.



7.4. Use of renewable energy technologies

Use of renewable energy technologies like solar PV panels, Biogas plant and Heat pumps help to save 30% to 50% energy which also benefits in total energy consumption of building.

- Each panel capacity 250 watts
- 53% electrical load is catered by Solar PV Panels

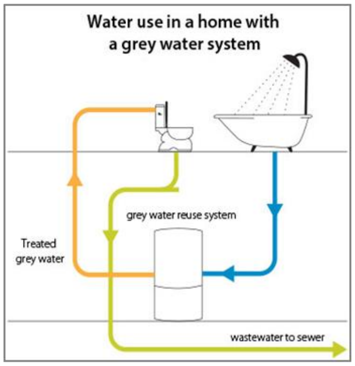
- Waste produced each person: 1kg
- Plant capacity - 20 cubic meters plant having capacity of 500 kg per day segregated waste food and landscape waste.
- Biogas generation - Alternative to approx. 2 cylinders per day.
- Organic manure generated- approx. 3.3 tones annually.

- Energy savings are upto 30% to 40%
- Require less space

7.5. Water Harvesting and Conservation

Use of water efficient taps and water recycling by using bating and basin water for flushing will help in water conservation. Water harvesting through rain water harvesting system maintains underground water table.

Rain Water Harvesting by storing Water



Use of bathing and wash basin water for flushing

Duel Flush W.C.

Low flow Aerator

Conclusion

For the optimum energy efficiency in hospitals, it should be taken care from the initial stages of planning and design. The efficiency of hospitals can be attained in three levels as follows:

1. Planning and utility aspects
2. Ultimate utilization of spaces at design stage
3. Appropriate use of fixtures and appliances to reduce energy and water consumption.

Way Forward

This research will further address simulation based methodology and would include calculations for LPD and EPI. It will also include comparison of base case and design case which will result in alternatives with block estimate.

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