GREEN HOSPITAL DESIGN & INFRASTRACTURE

Abstract

A green hospital is one that uses renewable resources, strives to be environmentally friendly, uses green methods to reduce waste, and improves patient care. Providing healthcare without endangering the environment or the healthcare provider is the foundation of the "Green Hospital" idea. In order to enhance biodiversity and provide a variety of ecosystem services, green infrastructure is described as "a strategically planned network of natural and semi-natural areas with other environmental features." Green hospitals reduce their carbon footprint from the very beginning of their design process by implementing environmentally friendly practices. It was discovered that, as resource-intensive organizations, healthcare facilities use enormous amounts of water, electricity, and building materials in order to deliver high-quality care.

Keywords: creating green hospital design, Hospital interior design, Tips for batter hospital building, Planning hospital layout, Advantages of garden and landscape, Future strategy, Guideline successful hospital, Conclusion.

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I. INTRODUCTION

A green hospital is one that uses renewable resources, strives to be environmentally friendly, uses green methods to reduce waste, and improves patient care. The green hospital concept based on three principle R's—Reduce, Reuse, and Recycle—are the foundation of the green hospital idea. These hospitals are highly inventive and significantly lower carbon emissions. Providing healthcare without endangering the environment or the healthcare provider is the foundation of the "Green Hospital" idea. Because protecting the environment is just as important as protecting patient safety and wellbeing, green hospitals are becoming increasingly important. In order to enhance biodiversity and provide a variety of ecosystem services, green infrastructure is described as "a strategically planned network of natural and semi-natural areas with other environmental features." Water purification, better air quality, recreational space provision, and assistance with climate adaptation and mitigation are a few examples of these services. The world is teetering on the brink of catastrophe. Environmental crises such as global warming, pollution, ozone layer depletion, climate change, and others can have a serious effect on people's health and lives. All industries must address these issues and implement environmental protection measures. A notable shift towards eco-friendliness and energy efficiency in design, operation, and practices has also been seen by the hospital building industry. A hospital that is built with an emphasis on sustainability is referred to as a "green hospital." A hospital that saves lives and protects the environment is referred to as a "green hospital." A "green hospital" is a medical facility that is planned, built, and maintained with the least amount of adverse environmental effects possible from its development, construction, and operation. Massive amounts of energy, raw materials, and resources are used in the construction of hospitals. Building a green hospital entails taking steps to reduce resource consumption and waste by utilizing design and architectural concepts and aspects. Green hospitals reduce their carbon footprint from the very beginning of their design process by implementing environmentally friendly practices. Healthcare architects and designers strive to "go green," but they also concentrate on ways to limit energy use and lessen the impact on the environment.

The already-existing shortage of high-quality healthcare infrastructure is made worse by the rapid growth of the Indian population and consequent morbidity. Current hospitals are overworked and do not provide the high-quality care that patients are entitled to. According to him, this is the point at which green infrastructure makes environmentally sustainable areas possible, promoting greater ecological harmony and healthier urban environments.

Green healthcare infrastructure is increasingly the focus of Indian hospitals, which aim to enhance patient rehabilitation while using natural resources in an environmentally responsible and effective way. Low VOC (volatile organic compound) content is a feature of green building materials, which include the use of recyclable and biodegradable materials like rubber and composite woods, as well as locally sourced finishing materials. These are also very cleanable and create no emissions, which is why they are increasingly being used in green hospital design. Due to their high level of electro-mechanical and plumbing requirements, hospitals are among the building categories with the highest energy consumption. Generally speaking, green healthcare infrastructure ranges from extremely effective passive designs that reduce the need for mechanical heating and cooling systems to spaces that are integrated to promote healing.

II. CREATING A GREEN HOSPITAL DESIGN

Energy-Saving Lighting Fixtures: A hospital needs to use a ton of electricity.to power machinery, control temperature, supply light...The list is not enable. The following tactics are used in a green hospital design to reduce the amount of fossil fuels used:

1. **Utilizing Sunlight:** The best clean power source is the sun. In a bright country like ours, solar energy is readily available and pollution-free (fig. 1). To take advantage of this, a Green Hospital design incorporates skylights, glass curtain walls, huge French windows, domes, and glazing facades into its layout to use natural sunshine to illuminate the spaces. This can reduce your carbon footprint and electricity costs, as well as the requirement for artificial lighting in the morning.

   Advantage of Natural Sunlight

   - The recuperation process can be accelerated by natural lighting. It can lessen seasonal depression.
   - Can help patients and employees feel less stressed and anxious.
   - Has the potential to improve behaviour and mood.
   - Can save artificial lighting costs and increase efficiency.

   Artificial lighting is essential in delicate spaces such as operating rooms, consultation rooms, etc. But if you combine this with natural lighting, you can lower your hospital's daily running expenses.

Figure 1: Sunlight

Appropriate Lighting Levels for Medical Facilities

Types of Room	Light Power Density (LPD)
Emergency	**2.7**
Recovery	**0.8**
Nurse Station	**1.0**
Examination/ Treatment	**1.5**

Pharmacy	**1.2**
Patient Room	**0.7**
Operating Room	**2.2**
Nursery	**0.6**
Medical Supply	**1.4**
Physical Therapy	**0.9**
Radiology	**0.4**
Laundry Washing	**0.6**

2. **Automation of Mechanism:** AI has the potential to transform hospital operations, increase sustainability, and lower power usage. To reduce waste, an automated system that senses motion and the time of day can regulate the lights inside the structure.

3. **Solar Panel Installation on the Roof:** Using solar panels, a green hospital design aims to maximize solar energy's potential. Non-medical devices (fig.2) like geysers and hallway lights can be powered by the energy from this.

Figure 2: Solar panel installation of Roof

4. **Devices that Save Electricity:** Every green hospital design incorporates equipment with five-star energy efficiency. It is recommended that movement-sensor lights and dimming lights (Fig. 3) be included. Energy technologies that are rechargeable and renewable ought to be selected.

Figure 3: Save electricity

Strategies for Conserving Water: In actuality, water is the drop of life. For a variety (Fig. 4) of uses, a hospital requires hundreds of liter of water. Numerous steps are taken in a green hospital to guarantee water conservation on all fronts.

1. **Utilizing Rainwater Harvesting Systems:** Rainwater harvesting systems are integrated into green hospital designs to collect, store, and responsibly recycle rainfall. To ease the strain on your city's drinking water supply, you can use the collected water for gardening and cleaning.

2. **Recycling Water:** There are numerous uses for recyclable water in a green hospital design. Drainage water, for instance, can be utilized for gardening, coolant, and cleaning after being cleansed by the sewage treatment facility. Pipes to reroute this water for best use should be included in your design.

3. **Technical Modifications to Plumbing and Supply Systems:** Numerous minor and substantial technical changes to plumbing, water supply, and sanitation fixtures and systems are planned for in a green hospital design. Low-flow plumbing systems and sensor taps can prevent liters of drinkable water from being wasted.

Sustainable and Environmentally Friendly Raw Resources: Raw materials that don't affect the environment are used in green hospital designs. A few modifications that support the usage of environmentally friendly building materials.

- Substitute biodegradable materials like bamboo, wood, cane, etc. for acrylic and polymers.
- Making use of paints devoid of lead and cadmium.
- Staying away from asbestos coatings.
- Staying away from harmful materials that bio-accumulate, such as PVC and halogenated flame retardants.
- Taking advantage of recycled resources, such as wood and steel.
- Reducing fuel and energy waste from transportation by using indigenous and local materials.
- Utilizing construction materials with high insulation ratings.

The goal of designing and building sustainable healthcare facilities is to lower hospital carbon dioxide levels while maintaining patient and staff safety. More harmful waste is emitted into the environment when a hospital uses more energy, which could endanger humans and other biological life forms. Hospitals are only one of the many locations where sustainable design is popular for all the right reasons. An environmentally friendly, energy-efficient, green hospital serves as an example of how to save lives while preserving the environment.

What are some of the green initiatives adopted for hospitals?

Constructing green hospitals necessitates the implementation of specific tools and processes for an eco-friendly and sustainable space, enabled by accurate mechanical 3D modelling services, thermal load calculation, duct design for HVAC (Heating, Ventilation, Air condition) systems and HVAC heat load calculations.

HVAC System in Hospital (Heating, Ventilation, Air Condition) Function

1. **Control of Infections:** HVAC systems aid in stopping the spread of contamination and cross-contamination. They are capable of filtering out fungi, germs, viruses, and dust.

2. **Comfort:** By regulating the ideal temperature, humidity, and air quality, HVAC systems contribute to the comfort of patients, employees, and guests.

3. **Healing:** By enhancing patient comfort, HVAC systems aid in the healing process.

- To maintain the temperature, heat is added or removed.
- In order to keep the air's moisture content constant, water vapour is added or removed.
- **Filtering:** Eliminating biological pollutants and dust particles.
- Ventilation is the process of transferring air from the interior to the exterior.
- Controlling the air's velocity, flow pattern, direction, and distribution.

Healthcare Facilities Must be Ventilated with Fresher Outdoor Air

Application	Estimated Occupancy/100 Sq. m	Outdoor Air Requirement	
		CFM/Person	CFM/Sq. Ft
Patient Rooms	10	25	
Medical Procedures	20	15	
Recovery & ICU	20	30	
Autopsy Rooms	20	15	0.5
Physical Therapy	20	15	Air cannot be recycled in to other location

Tips for Better Hospital Building

Hospitals are important community resources that offer families and individuals critical healthcare services. It takes meticulous planning and serious thought to build a hospital that is effective, patient-centered, and flexible enough to meet changing demands. serve as a guide for hospital development project:

1. **Create with Patient Comfort and Efficiency in Mind**

- **Flowing Well:** Separate the inpatient and outpatient spaces to reduce confusion and increase efficiency, and make sure that personnel and patients follow a logical flow.
- **Outpatient Services:** Boost income and maximize space usage by incorporating outpatient services to satisfy the rising need for non-emergency treatment.

2. Prioritize Patient Privacy

- **Private Areas:** Plan treatment rooms and patient rooms to ensure comfort (Fig. 7) and seclusion, fostering trust and well-being.
- **Patient Compliance:** Put the needs of your patients first by fostering a friendly, courteous environment that motivates them to actively engage in their care.

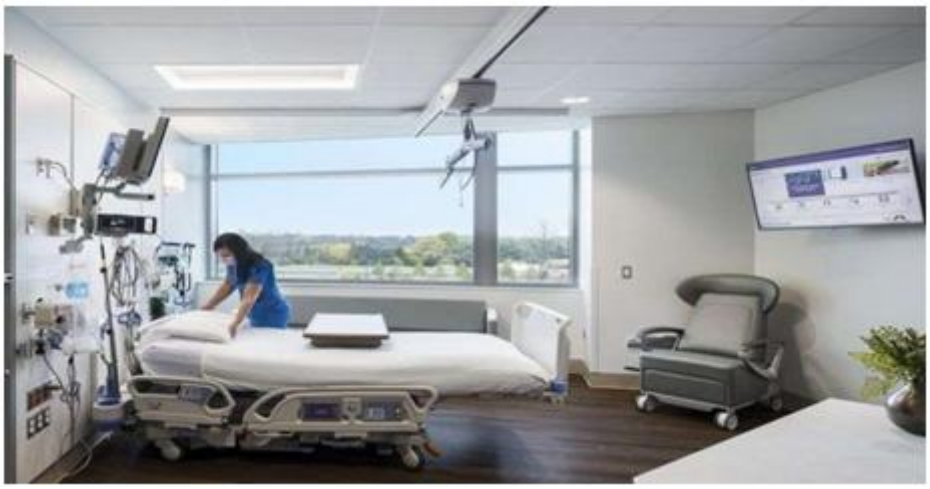

Figure 4: Patient privacy

3. Make User Needs a Priority

- **Get Input:** Interview employees, supervisors, and patients to learn about their particular requirements and difficulties.
- **Seasoned Group:** Employ skilled hospital builders with expertise in healthcare facility design, such as engineers and architects.
- **Communicating Openly:** Encourage open communication between builders, engineers, and owners at every stage of the project to guarantee coordination and quickly resolve problems.

4. Assure Superior Construction

- **Thorough Planning:** Carefully consider every stage of construction, (Fig. 8) from choosing a site to acquiring supplies.
- **Strict Quality Control:** procedures should be followed to guarantee the use of premium materials and compliance with building codes.
- **Knowledgeable Group:** Collaborate with a respectable construction firm that has experience working on healthcare projects.

Figure 5: Construction building

5. Make a Future Strategy

- **Phased Construction:** To control expenses and adapt to evolving healthcare demands, take into account phased development.
- **Expandability:** Take future growth and technology developments into consideration while designing the facility.
- **Research Facilities:** To promote innovation and enhance patient care, set aside space for research labs.

Planning a Hospital Layout: Making the Most of Spaces to Provide Better Care

Planning a hospital's layout entails placing buildings, services, and departments in a systematic manner. Establishing a flow that encourages effectiveness, security, and comfort for both patients and employees is the aim. A carefully planned arrangement guarantees that care is provided quickly and efficiently, minimizes needless movement, and cuts down on wait times.

Figure 6: Hospital layout

III. IMPORTANT GUIDELINES FOR A SUCCESSFUL HOSPITAL LAYOUT

1. **Technology Integration:** A lot of technology is used in modern healthcare. By incorporating technological solutions like electronic health record systems, telemedicine capabilities, and advanced imaging technologies into the design, patient care can be improved and operations can be streamlined.

2. **Patient-Centric Design:** The needs of the patient should come first in the arrangement. This includes welcoming waiting spaces, convenient service access, and unambiguous signage to direct patients through the building. Creating environments where patients feel appreciated and cared for is our main goal at Hospertz India Pvt Ltd.

3. **Effective Workflow:** Healthcare workers should be able to work efficiently thanks to the departmental layout. This involves putting inpatient and emergency rooms next to high- -demand services like imaging and labs. Workflows that are efficient cut down on delays and improve the standard of care.

4. **Scalability and Flexibility:** Hospitals need to be able to change to meet the evolving needs of healthcare. It is simple to adapt areas to new technology, services, or patient volumes when the layout is flexible. Hospertz India Pvt Ltd ensures lifespan and adaptability by designing hospitals with future growth in mind.

5. **Safety and Compliance:** When designing a hospital, safety must come first. The safety of patients and employees depends on layout planning that complies with health legislation and standards. Clear evacuation routes, infection control procedures, and sufficient equipment spacing are all included in this.

Figure 7: Hospital settings

Conclusion: Planning a hospital's layout well is crucial to providing high-quality medical care. Hospertz India Pvt Ltd is dedicated to creating healthcare spaces that improve patient care and operational effectiveness by placing a high value on technology integration, flexible design, safe operations, and patient-centric design.

Hospital Interior Design: Creative Designs

1. **Adaptable Layouts for Flexibility:** Hospitals are able to adjust to changing needs by designing flexible areas. Efficient use of space is ensured by movable partitions and multipurpose rooms that convert spaces for various uses, such as waiting areas, group therapy, or consultations.

2. **Carefully Choosing Furniture:** Selecting mobile and modular furniture can significantly improve the use of available space. we fervently support comfortable and useful ergonomic designs. Patients and employees can walk around the room freely and securely.

Figure 8: Furniture selection

3. **Efficient Use of Natural Light:** Including open floor plans and huge windows enhances light levels and promotes patient health. Hospital design must incorporate natural light since it has been demonstrated to elevate mood and lower stress levels.

4. **Colour and Appearance:** Clinical settings can be made more hospitable by using soothing hues and captivating artwork. Carefully selected colour schemes can aid in the healing process and make the environment more comfortable for patients, guests, and medical personnel.

Figure 9: Hospital colour appearance

5. **Green and Clean Materials for Interior Construction:** Healthcare facilities may unintentionally spread disease by exposing staff and patients to a variety of harmful bacteria and toxins that enter the hospital through a high patient infection rate. Decluttering areas and creating concealed compartments and built-in storage makes them feel more open and well-organized. Maintaining functioning and cleanliness in hectic medical settings requires effective storage solutions.

   It is recommended that interior copper-based materials be used for countertops, light switches, faucets, and door knobs. Copper provides a microbially resistant surface when used as a building material, according to research.

6. **Gardening and Landscaping:** Hospital gardens and landscapes enhance patients' well-being and are aesthetically pleasing (fig. 12) Compared to negative emotions like fear and rage, people who are around plants experience more positive emotions like calmness and pleasantness. shown that patients who are exposed to the natural environment recover from stress more quickly and completely than those who are exposed to any other type of artificial setting.

Figure 10: Landscaping and gardening

IV. THE ADVANTAGES OF GARDENS AND OTHER LANDSCAPING ARE NUMEROUS

1. **Psychological:** Studies indicate that exposing patients to natural settings helps lower stress-induced elevated blood pressure and cardiac activity because they interest them, divert their attention from distressing ideas, and aid in their recuperation.

2. **Social:** Health care facilities' natural settings foster social integration by offering spaces for support and social engagement.

In addition to providing a choice between communal and isolated spaces, the garden should offer chances for exercise and mobility, as well as direct or indirect engagement with nature and constructive distraction.

3. **Physical:** Patients who interact with a natural setting report feeling more well-adjusted, which benefits their physical health. The benefits of spending time in nature on blood pressure, cholesterol, and stress reduction have been demonstrated in theoretical and empirical research in addition to anecdotal evidence.

In contrast to patients in similar rooms facing brick walls, Robert Ulrich's study found that patients recovering from surgeries who had windows overlooking nature were discharged earlier, took fewer analgesics, and were evaluated less negatively by nurses. A study of the home environment also found that windows overlooking a natural scene produced "micro-restorative experiences" that improved a sense of well-being, as opposed to a context with views of built elements.

Thorny or dangerous plants, however, are to be avoided, particularly in gardens intended for kids or mental health patients. Near walkways, low shrubs and dense, dark vegetated "walls" that block the view should not be planted; rather, year-round screens that are softened by a variety of deciduous plants and open spaces should be placed.

For reasons of both physical and therapeutic safety, the landscaping site's design should make maintenance simple. Despite their higher maintenance requirements, flowers, trees, and shrubs offer the greatest therapeutic advantages. Hand weeding, mulching, companion planting, and appropriate plant spacing will reduce the use of chemical fertilizers. Other key elements that contribute to the garden features that users prefer include appropriate fertilization, selective thinning rather than shearing, and the use of seasonal colour. To put it briefly, a poorly kept environment diminishes patients' dignity and lowers their morale.

V. CONCLUSION

In order to optimize the use of natural light instead of artificial light, healthcare planning firms should develop and construct healthcare facilities. It is crucial to improve the quality of the air by utilizing air sterilizers and specific plant species that absorb contaminants. It is crucial to recycle waste products whenever feasible, put in place an appropriate waste disposal system, utilize sustainable building materials, and refrain from using things that are dangerous. Parks and gardens improve patient satisfaction, improve their well-being, and give aesthetic appeal, all of which hasten the healing process. Waste reduction could be achieved by putting different strategies like six sigma and lean management into practice. Hospitals favour buying safe and environmentally friendly items. Therefore, when constructing a green hospital, hospital planning companies should take the aforementioned aspects into account and attempt to apply them wherever feasible. Even though there are many benefits to designing hospital buildings and structures according to green standards, not many healthcare organizations have adopted this idea. These important projects suffer from a lack of infrastructure, expertise, awareness, and adequate recycling facilities. Therefore, governments, healthcare designers, and other stakeholders should place greater emphasis on developing and constructing green healthcare structures and determining how best to use them to improve patient outcomes and the environment.

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