



Eco- Configuration and Plan of Green Academic Library Utilizing GRIHA Specification and Rating Norms

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ABSTRACT

The concept of a Green Academic Library emphasizes sustainability through passive design and the application of green building norms, such as GRIHA and IGBC certifications. This manuscript discusses the crucial role of interior design in enhancing resource efficiency, occupant comfort, and minimizing environmental impact. Focusing on factors like natural light, ventilation, and thermal comfort, it outlines how libraries can provide practical, adaptable, and comfortable spaces for learning and research. Sustainable materials, energy-efficient systems, and optimum water usage contribute to the ecological footprint of green libraries. Moreover, the manuscript highlights the importance of visual tasks like reading, writing, and information browsing, which require well-planned lighting, furniture design, and colour schemes. It also emphasizes the psychological impact of colours and lighting on students, ensuring a conducive atmosphere for concentration. By integrating sustainable principles and optimizing interior elements, a green library not only supports academic activities but also serves as a model for environmental awareness and sustainable living.

Keywords: Green Academic Library, GRIHA, IGBC, Sustainable Design

Guidelines for indoor library design and decision-making; The concept for a Green Library

The university library is a place for learning and contemplation. Green libraries employ passive design principles and are therefore sustainable. Planning the library indoors is crucial to ensure that the area is practical, adaptable, accessible, well-lit naturally, ambiently, efficiently, economical, well ventilated, and has comfortable lighting conditions. Natural airflow and light improve the quality of the area. A library, which is a centre of learning, transforms into a structure that imparts knowledge about environmental issues and sustainable building.

The goal of a green library is to reduce negative environmental effects, maximize resource efficiency, and create the most comfortable indoor atmosphere possible. The amount of sunlight accessible outside, the sky's condition, the thermal qualities of the materials, the occupancy, the design of the apertures, and the ventilation systems are all taken into consideration when designing indoor lighting and ventilation.

IGBC, GRIHA, LEED, and other standards are used to certify green buildings. Although buildings are developed in accordance with green rating standards and receive certification, the interior design is an important component that requires the most attention. The most important considerations in a library are the lighting layout, the materials, the thermal comfort, and the indoor air quality. If a user is at convenience, he uses the library space. However, a building is not considered to be green if it is not comfortable while maximizing water and energy use. Like a temple of knowledge, an academic library is a place for learning and concentration. The layout of the area should encourage visitors to stay longer.

Parameters of a green library for rating norms:

- Recycled/ Sustainable Materials
- Natural ventilation & light
- Optimum use and collection of Water
- Optimum use and renewable Energy
- Site and locality
- Indoor occupant comfort

Indoor quality improvement of a green library:

- Interior materials

- Interior colours
- Natural ventilation and light
- Comfortable conditions: temperature, humidity, thermal.
- Spacing and furniture design
- Size and location of Apertures
- Artificial lighting design

Activities and related Library Space design considerations

Space Attributes

- Entrance and lobby
- Reading area
- Staff work place
- Meeting space
- Digital space
- Storage and services

Visual tasks, interior and lighting design:

Writing and reading are both medium-difficult tasks, but reading needs enough light to generate a decent contrast ratio. All day long, there shouldn't be any shadows on the reading table. Designing tables perpendicular to the window or positioned diagonally can accomplish this. Balanced lighting atmosphere and softly coloured materials. A student's psychological state is impacted by the colour and decorations. Colours that are visually harmonized provide a relaxing environment. The most harmonious colour on the eye is green; natural colours promote harmony and balance. The ability of readers to read, write, and absorb knowledge is ensured by improving light, colour, and serenity in the interiors. In a library, subtle hues should be used because bright ones might cause eye strain. Natural materials work best with tints and tones.

Information browsing is a medium-difficult task that requires the use of self-illuminating PCs and laptops. It is advised to use balanced ambient lighting free of glare. It is ideal to use reflected light and reduce window glare. Frost glass windows, light shelves, and the appropriate artificial lighting can all help to spread light evenly. The inside of a computer lab or digital zone shouldn't utilize many colours; instead, grey, white, and cream tones are preferable. The environment should be balanced so that it is neither too dark (which causes strain on the eyes) nor too bright (which creates reflection on the screen), while using computers enables attention on just one device.

Searching and viewing books: To view the books, you must employ the highlight effect. A person views a large number of books at once, thus there should be less distractions. Darker furniture should be used to highlight the books. Warm-toned track lighting is appropriate for highlighting the books. The walking area is permitted to have shadows. Another wonderful choice is furniture that illuminates itself. Interior design and colour schemes should be restrained and modern. By including carpet on the floor and sound-absorbing materials, silence is to be preserved. Reflectivity must be present in the ceiling.

Drawing/painting: High difficult task of work which requires well-lit place with high illuminance. No shadows and uniformly distributed place with reduced glare and reflectance. Direct sunlight may cause glare and reflectance which may damage the paint and quality of work. Dark ceiling makes a cave effect minimizing reflectance and the drawing becomes the focus view. Skylights and light wells are best suitable for this activity. Walking/waiting/ at public zones: the task involves only viewing and not concentration. The space can be designed as much attractive as possible. Vivid colours attract people to enter the space and spend time. Natural light and ventilation should be high enough to cater the occupancy.

Decisions on the placement of windows, furniture, lighting, interior materials, and colours, among other things, can be made with more accuracy by using 3D models and simulation of lighting design. The following list of elements influencing light design includes;

Thermal design considerations and occupant comfort

The thermal design of a building is an essential aspect of green building design that promotes comfortable indoor environment. Maintaining a temperature between 20 and 25 degrees Celsius, natural ventilation at a rate of 2 to 3 m/s, heat-resistant materials, a green roof and green walls, shading devices, and passive cooling and heating techniques can all contribute to thermal comfort.

It is not always the same for each person to be comfortable in their space. Thus, comfort conditions are created by combining the design of a building's systems with adaptations to the local environment. According to NBC and ECBC, India has five climate zones: Composite, Warm and Humid, Cold, Hot and Dry, and Temperature. It is necessary to design pleasant settings based on the climate's features. The building's design, orientation, construction materials, wind direction, and window placement are all taken into account.

Depending on the outside temperature, the indoor library may need to be heated or cooled. To prevent direct heat and sunshine, the shorter sides of buildings should face east and west. The most cosy, glare-free, and ideal for reading settings are rooms with a north orientation. In a library, the spaces will be divided into directions-based zones. It is possible for services and support areas to be situated in disadvantageous places. High heat and light are received in the south; however, this can be mitigated by having enough overhangs.

Every substance has the ability to withstand heat; those that do best are stone, high density burned brick, lime, sand, and insulation. When designing cross ventilation in a building, wind direction and direction are essential. Cross ventilation that is effective keeps the surroundings comfortable by removing interior heat. Too much or too little wind speed is not advised because it is useless and undesired.

Advanced passive technologies:

Evaporative cooling:

Fine water droplets are used in an enclosed space as part of an evaporative cooling system to cool the air that passes through it. The temperature of the incoming air is lowered by the evaporation of cool water. Through the process of this, air is precooled before entering the interior space. Air is drawn in by a motor-driven fan and forced to pass through water droplets. The energy used by the air conditioning system is decreased by this system. Reusing treated water at the residential level can be done using water used for evaporative cooling. This system's only flaw is that it increases humidity levels by adding moisture to the air.

Solar Tubes – skylights:

Solar tubes, sometimes referred to as light tubes, are roof-mounted apparatuses that collect daylight from all angles and direct it into the area below. It is made out of a cylindrical structure with internally reflective surfaces and a dome over the top to let sunlight inside. The most amount of daylight is directed. Solar tubes are used to reflect sunlight, which can be used to control heat. It is possible to achieve uniform lighting that is appropriate for hallways, living rooms, and public spaces. Only a sloping roof or a sloping direction can be used to install it.

Dynamic shading devices:

Shading devices cut down direct glare from sun. In climates having all season extreme weather conditions, the operable shading devices are effective. Depending on the season, solar path, and time, operable shade devices can be positioned at various angles. Modern, demand-adaptive technology is used in dynamic shading systems. The devices can be programmed to operate automatically to maximise daylight and save electricity. Outstanding aesthetics and solar heat control are made possible by the development of various patterns, shapes, and parametric designs in fenestration design.

Wind catchers and wind tunnel:

Access to natural wind is especially challenging in densely populated places. As a result, wind catchers are erected at higher elevations with their openings facing the direction of the wind in order to capture the wind and send it downward into the room. Wind tunnels are underground tunnels which help in cooling the air received from inlet.

Green roof and wall:

Green roof and green wall are external vegetative coverings that absorb heat and reduce urban heat island effect. Certain creeper plant varieties are appropriate for green covering. This is a long-lasting method of preventing strong heat from entering inside spaces, as well as absorbing heat and lowering heat reflection in the outdoors. It regulates the temperature without using any energy. Such installation and frequent plant watering require maintenance.

Rating norms

Comparison of various green rating norms: GRIHA, IGBC and LEED

Parameter	GRIHA for Existing school rating	IGBC Green Schools rating	LEED Rating for New Schools
Total points/credits	50 points	100 points	118 credits
Site selection & planning	-	13	10
Occupant health & comfort	8	15	12
Air quality	6	25	

Energy management	12	15	10
Water management	8	16	7
Solid Waste Management	7	-	
Well-being & social aspects	9	-	4
Eco friendly material	-	11	6
Green Education	-	10	
Integrative process			1
Location & Transportation	-	-	8
Innovative Practices	Bonus 2 points	5	2

Analysis

According to the comparison in the above table, LEED prioritises occupant health and comfort, IGBC grading prioritises air quality, and GRIHA prioritises energy management the most. The improvement of indoor comfort encourages users to spend more time in the library, which helps students' academic abilities. The rating systems take into account the building's total systems for waste reduction, optimisation, reuse, and recycling. The building qualifies as a green building due to its overall performance.

Conclusion

Thermal design considerations are crucial for ensuring occupant comfort in green buildings, particularly in academic libraries where concentration and extended use are essential. By incorporating natural ventilation, appropriate orientation, and passive heating and cooling techniques, libraries can maintain optimal temperature and airflow conditions, tailored to local climate zones as per NBC and ECBC standards. The selection of heat-resistant materials, proper window placement, shading devices, and technologies like evaporative cooling, solar tubes, and dynamic shading systems further enhance thermal comfort while minimizing energy consumption. Green roofs and walls provide additional thermal insulation, contributing to a sustainable and comfortable indoor environment. Ultimately, a well-designed thermal system in green libraries promotes an inviting, comfortable, and eco-friendly space that supports both user well-being and environmental sustainability.

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