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Research Paper

Modern Green Building Rating Systems Prioritize Traditional Architecture And Passive Energy Efficiency Approaches.

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ABSTRACT:
This paper delves into the lack of emphasis on passive approaches to sustainability within the current construction industry in India, specifically focusing on the city of Jhansi. This paper aims to provide a practical tool for the general public to assess the energy efficiency of residential units in the city.
An in-depth examination of the IGBC rating systems reveals a strong inclination towards active techniques that consume energy, rather than passive solutions. The paper highlights the need to shift towards passive-right techniques by exploring traditional structures in the region through field studies and reviewing ancient texts like the Mayamata.
By analyzing the factors that promote passive-right techniques, the paper seeks to offer a comprehensive list of sustainable elements that can potentially replace active methods. These sustainable factors are rooted in the ever-evolving context of the region, providing affordable and effective solutions for enhancing the sustainability of buildings. In conclusion, the paper underscores the importance of incorporating passive techniques derived from the region's vernacular to achieve a more sustainable built environment.
Keywords: VernacularHistory, Passive-rightapproach, Sustainability, Energy-Efficiency

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I. INTRODUCTION

Vernacular architecture is a unique form of architecture that is deeply rooted in the local culture and built to meet the specific needs of its users. It can be compared to a local dialect, serving as a common language in the built environment. This type of architecture encompasses a wide range of building traditions that reflect the linguistic diversity of society.

According to Oliver (1997), vernacular architecture is a product of the people in a region and evolves as a result of a complex interplay between social, economic, material, and environmental factors. It is a manifestation of the culture, traditions, climate, social life, and technology of the region.

Lawrence (2006) further emphasizes the importance of vernacular architecture in reflecting the unique characteristics of a region. He highlights how the design of vernacular architecture is influenced by human needs and the relationship between various factors such as social dynamics, economic conditions, material availability, and ecological considerations.

The author focuses on the visual and abstract elements of vernacular architecture that respond to climatic conditions and tangible parameters. The research aims to provide passive guidelines for designing energy-efficient solutions that create comfortable living spaces for residents in Jhansi City. By understanding and incorporating the principles of vernacular architecture, designers can create sustainable and culturally relevant structures that enhance the quality of life for the people in the region.

Cityof Jhansi

Jhansi, a bustling city located in the Northen region of India, is situated in a temperate climatic zone known for its High climate. This region is considered to have the most favorable conditions for living, with temperatures typically ranging from a comfortable 1 to 45 degrees Celsius. One of the key features of Jhansi's climate is its non-humid atmosphere for 9 Months in a year, which is characterized by pleasant and cooling

breezes that provide natural ventilation. This unique aspect has influenced the design and architecture of structures in the city, making it an essential spatial characteristic.

Despite the overall balance of hot and cold temperatures, as well as dry and wet periods, Jhansi has witnessed a shift in its climate patterns over the past few decades. This change can be attributed to factors such as globalization and climate change, leading to a short period of extreme climates with rising temperatures. As a result, the city has had to adapt to these new challenges in order to maintain its reputation as a comfortable and livable urban environment.Thegraphbelowshowsvaryingtemperaturesinjhansioverayearanditsimpactwhen compared annually.

Jhansi, renowned for its dense foliage consisting of deciduous trees, is experiencing a decline in its natural essence due to rapid deforestation to make way for urban infrastructure to accommodate the expanding population. Land reclamation through the filling of existing water bodies and extensive deforestation of indigenous vegetation are the primary factors contributing to significant challenges faced by the city, including severe water scarcity, rising urban temperatures, loss of native flora and fauna, and deteriorating air quality. In order to address these adverse conditions, a substantial amount of energy is being consumed, placing strain on limited resources in turn - creating a cycle of generating a new issue to solve the previous one.

A typical housing typology is carefully crafted, through a process of refinement and experimentation, to suit the needs of the community that inhabits it. The design of spaces within a housing unit and the larger residential complex is a reflection of the residents' habits, lifestyle, work requirements, and cultural values. The spatial layout is a result of a careful balance between climatic conditions and the intended use of the space, aimed at ensuring the comfort of the occupants. According to the Battelle Environmental Evaluation System (BEES), which assesses biological, physical, and socio-economic factors of a city, jhansi falls significantly below the average index in terms of air quality and socio-economic indicators. The socio-economic aspect of a region encompasses aspects such as quality of life, traffic conditions, and the availability of urban infrastructure (Anon., n.d.).

Mayamata - A written Treatise on Housing (translated SanskritTreatiseon IndianArchitecture)

Voluminous Sanskrit literature on architecture and iconography in India, with Mayamata being a key text specifically for housing in the southern part of the country. Covers construction techniques, site selection, soil preparation, measuring system, and temple architecture iconography. Principles from Mayamata can be adapted for present and future issues.

ParametersConsideredfromMayamata

Assessment of Site Conditions and Optimal Building Orientation.

The selection of a location for construction involves a comprehensive evaluation of various factors including color, smell, taste, shape, size, direction, sound, and texture, ultimately determining its classification as a residential site. These residential sites are further divided into primary sites, such as the Earth itself, and secondary sites like villages, towns, and cities. The structures built on these sites, such as houses, halls, and pavilions, are collectively known as 'buildings,' while different modes of transportation are labeled as 'conveyances.' This categorization establishes a clear hierarchy, with the Earth holding the highest significance and moving vehicles ranking at the lowest level.

The importance of the Earth and its distinctive qualities, as reflected in its surroundings, is emphasized in this context. The evaluation process for a site follows a systematic approach, involving techniques like soil testing to assess its density for ensuring a strong foundation, avoiding proximity to sacred structures to maintain their sanctity and promote community engagement, and steering clear of irregularly shaped or vegetation-laden areas that may indicate a lack of groundwater. Additionally, it is recommended to avoid selecting sites surrounded by roads or pathways on all sides to shield residents from pollution and noise, while also providing them with a sense of privacy and tranquility. This comprehensive literature offers valuable guidance on site selection for construction projects, prioritizing the well-being and comfort of the future occupants. After accurately marking the center of the dwelling site, it is important to take note of the four main directions and the significant characters associated with each. In the east direction, we find trisutra, which represents the connection between the mind, body, and soul. Moving towards the west, we encounter dhana, which symbolizes wealth and prosperity, often linked to the workplace or study room within the house. Heading south leads us to dhanya, representing food and nourishment, typically associated with the kitchen and pantry areas. Finally, in the north direction, we discover sukha, which embodies joy and peace, commonly found in spaces like the living room, bedroom, and dining area. By understanding the symbolism behind each direction, we can create a harmonious and balanced living environment that promotes overall well-being and positive energy flow.

SYSTEM OF MEASUREMENTS

A 'hasta' is a common measurement unit in construction, typically ranging from 1.5 to 1.7 meters. Architects and builders use multiples of a 'hasta' for various structures, from small objects to entire villages. Measurements were sometimes based on body parts. Today, an average can be derived to humanize building dimensions. Houses are often rectangular, with lengths 1.5 times the width. Buildings in a cluster are spaced 3 meters apart. They feature verandas, galleries, and central courtyards. Roof styles vary based on the number of buildings in the cluster.

MATERIAL AVAILABILITY AND SELECTION

No specific section has been designated to dictate the suitable materials in this discourse. However, the pervasive theme and emphasis on the Earth as a nurturing entity unmistakably reveal a keen awareness of material selection. Furthermore, the ideal material is elucidated in all pertinent sections. Indigenous materials such as diverse species of hardwood are denoted by their Sanskrit monikers, as well as locally sourced fiber threads, grass, mud, sand, and silt. An extensive array of these materials is referenced throughout the text, and beyond mere nomenclature, the central message underscores the significance of utilizing local materials in response to the environmental context of a habitation site.

ExternalEnvelope

The external facades of the buildings were designed with a focus on public spaces, such as verandas. These verandas were located either on the front side of the building or on both the front and back sides in larger houses. The upper floors featured small openings, with windows specifically planned for these levels. The lower floors, on the other hand, were designed to be ventilated through the use of verandas and courtyards. Additionally, the gabled roofs of the buildings had overhangs that provided extra protection from the elements. To further enhance security and safety, thorny hedges were strategically planted around the perimeter of the buildings to deter wild animals. Overall, the architectural design of the buildings took into account both functionality and aesthetics, creating a harmonious blend of form and function.

CURRENT SUSTAINABILITY TRENDS IN INDIA - INDIAN GREEN BUILDING COUNCIL (IGBC) RATING SYSTEM.

The rating system implemented by the Indian Green Building Council primarily aims to mitigate the adverse impacts of the construction industry on the surrounding environment. Given India's vast diversity in terms of climate, lifestyle, and topography, these comprehensive guidelines claim to have encompassed the various natural regions of the country. They promote green strategies that address national concerns such as water scarcity, energy conservation, reduced reliance on fossil fuels, preservation of depleting natural resources, and effective waste management. While the overall goal of sustainability is universal, the specific methods and strategies to achieve it are heavily influenced by the environmental and economic context. Despite the emphasis on green buildings, the current rating systems lean towards active techniques that may not align with the goal of natural resource preservation. Therefore, this study aims to revamp the rating systems by prioritizing passive techniques. This research delves into the realm of energy efficiency, providing an in-depth analysis of the various factors that impact it.

UnderstandingIGBCRating Systemfor Energy-Efficiency

The rating systems mentioned in the text are believed to have their roots in the five elements of nature and are applicable to all different climatic regions in our country. While these systems cover a range of eco-friendly features for different types of buildings, the main focus of this study is on the increasing need for housing units and the depletion of fossil fuels at a fast pace. Therefore, the features that enhance energy efficiency, classified into active and passive approaches, are highlighted in the table provided below. These features play a crucial role in addressing the current environmental challenges and promoting sustainable development in the construction industry.

Natural Topography: Active approach involves implementing proper measures for soil erosion before and after construction. It also mandates retaining 15-25% of natural topography/vegetation on the ground, with the option to add additional greenery on built structures to achieve a total of 30-40% vegetation cover.

Building Design - Heat Island Effect:To mitigate the heat island effect and maintain microclimate and local biodiversity, the active approach requires covering 50-75% of non-roof impervious areas with trees, open-grid pavers, or low SRI pavers. Additionally, at least 75% of roof areas should feature high albedo materials or vegetation cover. The passive approach emphasizes adopting design measures like incorporating passive heating/cooling techniques and ensuring adequate natural daylighting.

*Green Procurement Policy:*This approach entails committing to purchasing products with minimal environmental impacts, prioritizing those with high recycled content, energy efficiency, reduced water consumption, and emissions of fewer toxic substances.
Green Products:A percentage (5-25%) of materials used must be certified as green products, promoting sustainability in construction projects.
Local Materials:To support local economies and reduce environmental impact, 50-75% of construction materials, by cost, should be procured within a 400 km radius. Additionally, renewable or recycled wood should replace 50-75% of new wood.
Alternative Construction Material:An active approach involves replacing 5-10% of typical construction materials, by cost, with alternatives such as slag sand or artificial sand, reducing reliance on finite resources.
Green Parking System:To encourage sustainable transportation, facilities should provide electrical charging for vehicles and ventilation for basements.
Energy Efficiency:Active measures include using HCFC-free equipment and achieving minimum/enhanced energy performance standards for building envelope and lighting systems. Passive measures involve integrating energy monitoring systems and promoting the use of renewable energy sources.
Alternate Water Heating System:Utilizing natural gas/LPG-based systems, heat pumps, or solar water heating can significantly reduce energy consumption for water heating.
On-site Renewable Energy:A minimum of 25% of total annual common lighting energy should come from renewable sources, contributing to overall sustainability.
*Daylighting:*Active measures ensure that 50-75% of regularly occupied spaces receive sufficient daylight, enhancing both energy efficiency and occupant well-being.
Occupants Wellbeing - Ventilation:Regularly occupied spaces should have exterior openings to facilitate natural ventilation, promoting a healthier indoor environment.
Occupants Wellbeing - Cross Ventilation:Providing cross ventilation in 25-95% of regularly occupied spaces enhances indoor air quality and comfort.
Occupants Wellbeing - Connectivity to Exteriors:Ensuring 50-75% of regularly occupied spaces have access to the sky, flora, fauna, or a combination thereof fosters a connection with nature, benefiting occupants' well-being.
Low VOC Finishes:Using eco-friendly labeled or green-certified materials reduces harmful emissions into the local environment, contributing to better indoor air quality.

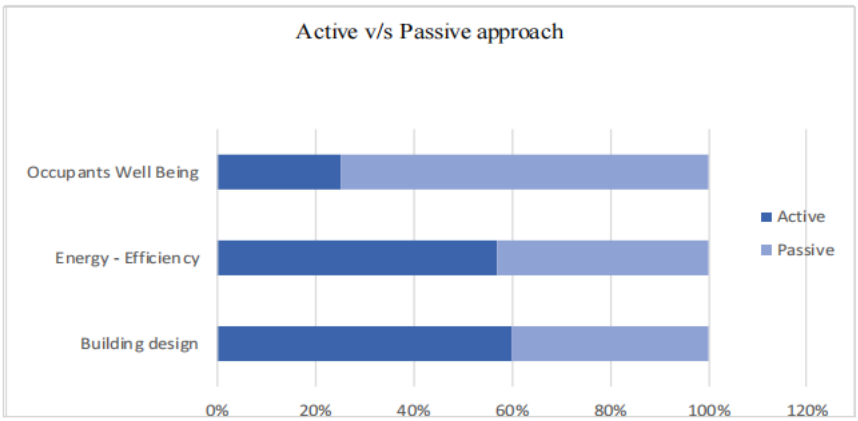

Fig 1 Active vs passive approach in current IGBC rating systems

The graph presented above illustrates how each parameter in the rating systems contributes to a comparative analysis of passive and active approaches. Figure 1 clearly shows that there is a lack of emphasis on passive approaches in the rating system being discussed, even though in reality, passive techniques are not widely implemented in actual buildings. This discrepancy highlights the necessity for a new and improved approach to sustainability. Furthermore, this study points out the insufficient information and exploration of passive techniques available for designers to utilize in their projects. This calls for a shift towards a more comprehensive understanding and application of passive strategies in the field of sustainable design.

RelevanceofparametersfromIGBCRatingSystemtowardsaPassive-Rightapproach.

The IGBC rating system is widely used throughout the country for sustainability, surpassing its competitors in popularity. However, it has been noted that the system does not fully delve into passive techniques (as shown in Figure 1). Despite their potential benefits, passive techniques only contribute minimally to the final scorecard, leading users to overlook their importance.

One reason for this oversight may be the variability of passive techniques based on different regions and climates. This makes them context-specific and time-sensitive, posing a challenge for widespread implementation. Nevertheless, there is a growing consensus that passive techniques and contextually responsive architecture hold the key to addressing issues such as affordability, housing shortages, resource depletion, and climate change resulting from high energy consumption.

Therefore, a comprehensive approach is needed, incorporating traditional (Mayamata) and vernacular construction practices into the IGBC rating system. By blending these elements, a diverse range of construction techniques, principles, and materials can be offered to address the complex challenges of sustainable construction in India.

II. CONCLUSION

The fundamental factors that determine sustainability for the three green building processes discussed in this paper are the five expected elements: Earth (geographical features), Water (water requirements), Fire (energy requirements), Wind (ventilation requirements), and Space (indoor ambience). This paper presents a comparative framework that incorporates knowledge from ancient scholars of the science of Vaastu Shastra (Mayamata), the necessity of making buildings for humans transitioning from nomads to farmers (Vernacular Architecture), and a consulting handbook for modern times (IGBC Rating System). The data gathered is summarized in the table below.

When utilized together, these characteristics with similar or related properties in several construction categories will result in a more noticeable as well as effective achievement of sustainability.

Table No. 1 Analysing framestructure

IGBC Rating System	Vernacular Architecture	Mayamata
Earth*(geographicalfeaturesandmaterial)*		
NaturalTopography	Topographical Features	Site Evaluation
	Climatic Conditions	
	Orientation and planning	Building Orientation
	Surrounding context	Building context
Retaining vegetation	Local flora andfauna	
Green certified products	Nature ofmaterial	
Local materials (within 400km)	Local material (within 50km)	Available material
Alternative construction material	Innovative replacements by available material	
Eco-friendly material	Reuse ofmaterial	
Fire *(energy-efficiency)*		
EfficientBuildingEnvelope		
% ofopenings	Numberofandtypesofopenings	
Heatgaincapacityofmaterial used for openings	Materialofopenings	
Projectionfactoroffenestrations	Recessed windows and shading devices	
Heatgaincapacityofmaterial used for walls	Material ofwalls	
Heatgaincapacityofmaterials usedforroofassembly	Roofing material	
Slopeanglesforroof	Type ofroof	
Heating, coolingandventilationsystems		
Alternate water heating system	Water heating system	
HVAC [7] system	Naturalcoolingandheating techniques	
Cross Ventilation	NaturalVentilationtechniques	
Others		
Useofdaylightingtoreduce artificial lighting	Efficientuseofdaylight	
Lighting system used		
On-site renewable energy	Renewable energy resources	
Integrated energy monitoring system		
	Local construction skills	

Wind *(Ventilation)*		
Ventilation		
Cross ventilation	Cross ventilation	Cross ventilation
Space*(indoor ambience)*		
Daylighting	Day Light Analysis	
Ventilation	Ventilation	Ventilation
Connectivity to exterior	Built to un-built ratio	
	Thermal Comfort	
Non-toxicfinishes	Naturalfinishes	NaturalFinishes
Facility for wellbeing	Community Lifestyle	Lifestyle dominated by caste system
Heat Islandeffect		
	Micro-climate and local ecology	

source: author

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