

Parameters for Combination of Contemporary and Traditional Roof Design for Residential Buildings in Hot and Dry Climatic Region in India

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Abstract:- The thermal comfort requirements of historic and contemporary buildings are different. Despite the fact that passive thermal performance is excellent for current building designs, old levels of thermal enjoyment do not match today's requirements for passive thermal performance in traditional structures. An architectural viewpoint on thermal comfort is examined in this study, which examines the viability of comparing old and modern building construction methods. Is it possible to use vernacular architecture ideas to design passive buildings? Before addressing the efficiency of mechanical systems to satisfy the demand, it is considered a highly successful technique for decreasing energy consumption in buildings. Architecture in India is known for its ability to respond to the local climate and cultural, social, and environmental contexts by employing passive design principles that have evolved over time. Constructing structures that are sensitive to their environment is difficult because it requires knowledge of not only the physics of buildings, but also the cultural context in which they are designed, built, and used as well. This study examines the various elements that should be taken into account while designing a roof at three different stages: pre-design, building, and post-construction.

Keywords: Contemporary, Traditional, Thermal comfort, passive design, parameters.

INTRODUCTION:

In hot, dry regions, about half of the urban peak load of energy consumption is expected to be used to meet air-conditioning cooling demands throughout the summer. Because the rate of urbanization in emerging countries is fast increasing, the pressure on energy resources to meet residents' indoor comfort needs is also rapidly increasing. (1) Buildings are supposed to provide healthy and comfortable inside environments regardless of the weather outside. Keeping a building comfortable necessitates a significant amount of energy, which accounts for 20–40 percent of overall energy consumption, in addition to the excellent energy performance provided by building envelopes. (2) In comparison to walls of any orientation, the roof is the surface of the building that is highly exposed to solar radiation for the majority of the day. Despite the fact that the diurnal variation of solar intensity over the roof surface varies dramatically, the overall radiation intensity received

on the roof is the highest due to constant daytime exposure to the sun. The energy consumption of buildings is directly influenced by the building envelope design, particularly the HVAC component of the energy consumption. The building envelope is thought to be the most important factor influencing energy use. (3)

Each type of roofing has its own set of characteristics, such as look and application range; as a result, it's hard to say which roofing is the best and most universal solution to market need. In the case of roofing, it's crucial to specify the type of object for which the examined parameters are compared. (4) The qualities of the roof's surface have been studied in order to limit radiative and conductive heat gain through the roof component in a number of studies. To promote energy efficiency in buildings, building energy rules address roof reflectivity and roof insulation. Architects, on the other hand, use a variety of additional roof design solutions that have an impact on building energy use without explicitly quantifying the impact. This research will look into roof design ideas that help buildings perform better in terms of energy efficiency. Roofs have long been a major source of heat gain in buildings, necessitating passive cooling/heating solutions in roof design. Because the roof, unlike the walls, is exposed to solar radiation throughout the day, heat transfer from the roof has a significant impact on user comfort. In hot climates, the effect is particularly strong in small size buildings such as individual dwellings, apartments, and low-rise buildings, accounting for over 70% of total heat gain. (5)

DIFFERENT PARAMETERS FOR ROOF DESIGN:

Definitely, the selection of roofing materials is influenced by the expectations of the customers, as well as the requirements of the architects and designers. In order to make an informed choice on the best roofing material, a thorough roof study must consider a wide range of criteria. When constructing a detached house, it is important to examine both the aesthetic and technical features of the structure, as well as the cost of various roofing options. In apartment buildings, the ornamental purpose is pushed aside in favour of technical and cost considerations, which is even

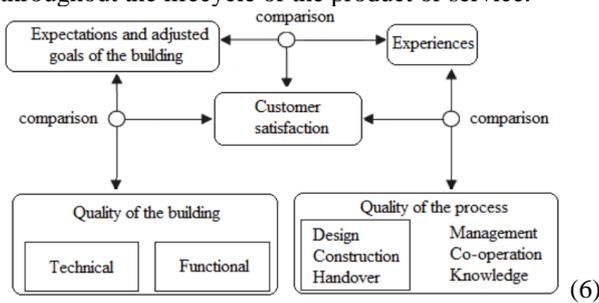
more pronounced in industrial structures. The weight of the roofing has an impact on the price. Larger loads are generated by heavier roofing, which the roof framework must support. The roof angle has an impact on the spectrum of roofing applications. (4)

The roof has different parameters while designing the roofing parameters are categorized under three types namely, 'Parameters during design', 'Parameters During construction' and 'Parameters post construction'

PARAMETERS DURING DESIGNING A ROOF

1.1 CUSTOMERS SATISFACTION

As a result of perceived quality and unmet expectations, customer satisfaction is a measure of the level of quality and expectation inequalities. The consumer evaluates the expected product or service by comparing it to predetermined specifications and benchmarks. While he or she is satisfied when expectations are exceeded, dissatisfied when expectations are not met, he or she is not satisfied (KRN 2004). A customer's enjoyment or unhappiness with the product or service received can be defined as a result of differences between what was delivered and what was expected (KOSKELA 2002). Another way to look at it is that customer satisfaction is a situation in which all of a customer's needs, wishes, and expectations are met throughout the lifecycle of the product or service.



Customers' expectations and experiences must be compared to the building's aims and goals, as well as the building's construction process and experience gathered during the process, in order to evaluate how customer satisfaction and product/service quality are related. (6)

1.2 : DECISION ABOUT SELECTION OF ROOFING TYPE

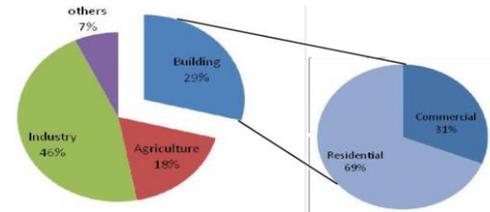
It is essential to have a working knowledge of a variety of roofing materials and systems, as well as a thorough awareness of roof design concerns, in order to select, detail, and specify the best roof system for a particular project.. To help you design high-performance roofing systems, we've put together a section focusing on low and steep-slope roofs. (7)

The type of roof you want and your decision on which type to go with are influenced by a variety of factors, including the architectural style of your house or building, the roofing application, who owns the property, state building codes, local ordinances, and residential community covenants. (8)

1.3 : ENERGY EFFICIENCY

The energy consumption of buildings is increasing at an alarming rate, necessitating no other proof to establish that

climate change is occurring as a result of human activity. According to a research conducted by the Bureau of Energy, electrical energy accounts for more than 30% of overall energy consumption in a structure in the United States, with the percentage increasing at an annual rate of 8%. 69 percent of the total building area falls under the category of residential structures, while the remaining 31 percent is occupied by commercial buildings, as depicted in the pie diagram.



1.4 : AESTHETICS AND TECHNICAL ASPECTS

When choosing a roofing material, this is an extremely important factor to consider. The quality of a home's roof has a direct impact on the satisfaction of its owner as well as the visual appeal of the residence to passersby. Providing it is made of high-quality, reputable, and long-lasting materials and is painted in a colour that complements the surrounding area, this is attainable. Nowadays, the roofing material is used to cover a house's roof is determined by the owner's sense of aesthetics and attractiveness, as well as his or her financial means. (4)

1.5 : COST OF THE ROOFING TYPE

The cost of a roof's roof is a major factor in the decision to buy one. One should not cut corners when it comes to purchasing materials for the roof because it is the most vulnerable portion of the building to the weather. Buying a cheap roof means you'll have to pay more in the long run for repairs, maintenance, and, eventually, replacement. (4)

1.6 ASSEMBLY

A roof's cost and completion time must be taken into consideration when selecting a particular type of roofing material. It takes a lot of time and effort to install some types of roofing, such as shingles or tiles (particularly plain tiles). The rising expense of roof construction and other roofing jobs is due in part to a lack of sufficient expertise. Substantially. In the case of ceramic tile roofs, a lot of time is consumed. Installation of finishes, especially when dealing with a very large area, multi-layered roof (e.g. dormer windows, eyebrow windows). depending on the sort of roof you have . Laths and/or wooden boards are nailed to the roof. A wide range of options are available. Bituminous sheet and insulating film are used to reduce the time it takes to install a new roof. Cost of building and the time required to complete it. (4)

DURING CONTRUCTION

2.1 : WEIGHT OF THE ROOF

Heavy roofing necessitates a sufficiently thick roof truss and proper construction, but also provides greater roof slope stability and better wind resistance, which has become increasingly important in recent years due to frequent storms. (4)

2.2 : ROOF ANGLE

The angle of the roof is determined by the weather conditions. When building a roof, it is vital to consider the climate, which includes factors such as rainfall, humidity, and temperature. The slope angle should be greater in the location that receives the most rainfall.

2.3 : PRICE

In many cases, the cost of a roof is a crucial issue. It's a bad idea to skimp on roofing materials because that's the part of the building that gets hit the hardest by weather. As a result of purchasing low-quality roofing, you may end yourself paying for costly repairs and replacements in the future. (4)

POST CONTRUCTION

3.1 : FINISH

Finishing work on roofs might include things like installing soffit and roofing details, installing roof windows, installing gutters, and installing chimney flashing. The number and type of finishes will differ depending on the complexity and variety of the roof. The expense of the finish and its installation is important in the case of the former. (4)

3.2 : LEAK TIGHTNESS

Leak-tightness is a basic element that prevents moisture from entering the roof truss, which is crucial for living comfort and durability. The higher the roofing's leak-tightness, the more confident you may be that individual pieces will not become separated during a powerful wind, causing the entire roof to collapse. (4)

3.3 : GUARANTEE

Roofing products, like any other product on the market, have warranty periods during which customers can file product complaints. (4)

3.4 : DURABILITY

The durability of different types of roofing materials differs. Roofing with a short lifespan has a low cost, but it must be changed after several decades, which frequently necessitates the replacement of the entire wooden structure. The roofing that is nailed or screwed to the frame corrodes or rots at the connecting places, reducing its strength. (4)

3.5 : MAINTENANCE

Painting, washing, impregnation, moss, and rust removal are all included in this category. Furthermore, expenditures for possible replacement of damaged single roofing

components, such as roof tiles or shingles, are factored in. (4)

PARAMETERS OF DESIGN

The design of the building envelope has a direct impact on the amount of energy consumed by the building, particularly the amount of energy consumed by the HVAC system in the building. Okba (2005) and Sadineni, Madala, and Boehm (2011) believe that the building envelope is the most important component in a building's energy usage because it is the most visible. While conventional architecture used to place a strong emphasis on the design parameters of the building envelope to address human comfort, today's structures are becoming increasingly reliant on mechanical systems to provide that comfort. Additionally, due to the rapid pace of building design and construction these days, very little time is spent researching design alternatives to improve the user's overall comfort. As a result, the design aspects of the building exterior have been given the least amount of attention throughout the whole design process. The technique of reducing the energy demand of buildings first, before addressing the efficiency of mechanical systems that must be used to meet the demand, is believed to be highly effective. While the entire globe is working toward net zero or nearly zero energy buildings, sometimes known as NZEBs, the majority of the work is focused on building heating and cooling. Kapoor, Deshmukh, and Lal (2011) published a paper on NZEB aims for India, which emphasises the urgent need to reduce energy demand while increasing renewable energy supply in order to reach the NZEB targets in India by 2030.

reducing the energy demand of buildings through building design and passive techniques for cooling and heating is essential. (5)

Parameters during design	Parameters During construction	Parameters for post construction
1. Customers satisfaction	1. Weight of the roof	1. Finish
2. Decision about selection of roofing type	2. Roof angle	2. Leak tightness
3. Functionality, energy efficiency	3. Price	3. Guarantee
4. Aesthetics and technical aspects		4. Durability
5. Cost of the roofing type		5. Maintenance
6. Assembly		

CONCLUSION

Roofing is now being replaced on new construction as well as on existing structures that have had their roofs repaired, because of the importance people place on aesthetics, long-term use, and the influence on the environment. In other words, we should take it into account as early in the design process as possible.

Customers satisfaction , Decision about selection of roofing type , Functionality, energy efficiency , Aesthetics and technical aspects , Cost of the roofing type, Assembly should consider at design stage , Weight of the roof , Roof angle , Price should consider at construction stage and Finish, Le ,

ak tightness , Guarantee , Durability and Maintenance are the parameters after construction

Traditional materials have their unique characteristics for each of the aspects listed above, which should be taken into consideration when combining them with current materials. Therefore, there is the need to conduct further studies in order to improve the indoor thermal conditions for better performance and healthy well-being.

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