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"REVIEW PAPER ON REINFORCED CONCRETE ROOF WITH DIFFERENT COVER SIZE BLOCKS"

Deepak Kumar [1], Dharmendra Singh [2]

[1] M. Tech Scholar, Department of Civil Engineering Rabindranath Tagore University, Raisen, Madhya Pradesh, India
[2]Assistant Professor, Department of Civil Engineering Rabindranath Tagore University, Raisen, Madhya Pradesh, India

ABSTRACT

Reinforced Concrete (RC) roofs are integral components of modern structural systems, combining the tensile strength of steel with the compressive resistance of concrete. The performance of RC roofs largely depends on design parameters such as concrete cover thickness, block geometry, and material composition. Variations in cover size influence both structural durability and thermal efficiency. This review summarizes recent research focused on RC roofs constructed with different cover size blocks, highlighting their impact on structural integrity, service life, thermal insulation, and cost-effectiveness. The paper further identifies research gaps and suggests directions for optimizing cover thickness and block configurations for enhanced performance in various climatic and load conditions.

Key Words: *RC, concrete, thermal, tensile.*

I. INTRODUCTION

Reinforced concrete has been the most widely used structural material in building construction due to its strength, versatility, and adaptability.[1] The roof, as a major horizontal structural element, must resist dead loads, live loads, temperature stresses, and environmental degradation. The cover size—the layer of concrete protecting embedded steel reinforcement—plays a crucial role in ensuring durability, fire resistance, and corrosion protection.[2]
Recently, experimental and analytical studies have examined the effect of varying cover thicknesses and block dimensions on mechanical behavior, crack propagation, deflection, and energy efficiency of concrete roof systems.[3] Different block configurations, such as solid, hollow, cellular, and filler-block types, have been employed to improve insulation and reduce self-weight without compromising strength.[4]

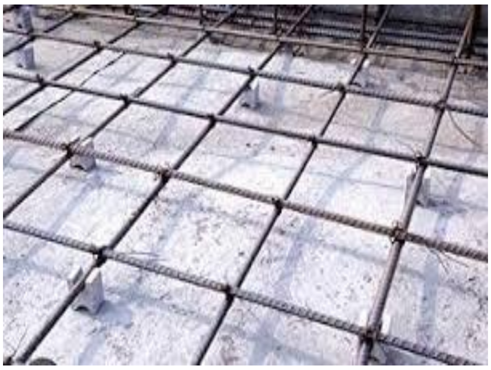

Fig.1 cover block

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II. LITERATURE REVIEW

Omar, A.I et al (2017) In the Sub-Saharan African countries like Djibouti, the energy situation, the high rate of urban areas growth and the inadequate techniques of construction offer an exciting potential for the bioclimatic approach and sustainable construction. However, this poorly explored potential requires an investigation of different construction types in Djibouti and a good knowledge of the behavior of buildings components. Further a low energy building can be obtained because of the good realization of all its components.[7]

He B-J et al (2018) Many uncontrollable risks and uncertainties emerge during transitions pathways. Previous studies have examined the "formula" of successful sustainable initiatives (SIs), while there have been few attempts to explore the reciprocities amongst them. Therefore, this study is to investigate the linkages among and mutual benefits among SIs at different urban scales for tackling their risks and uncertainties. The low-carbon eco-city, green university and green building in China are selected as the representatives at city, community and building scales for elaborating their linkages. In the city-community-building system, the GB implementation builds up the internal momentum that can lead to the changes of sustainable interests, rules and beliefs at the community scale, which then results in the changes on city structures, according to the theory of multi-level perspective.[8]

Peerzada Jaffar Abass et al (2025) Direct sunlight on concrete roofs raises interior heat flow and cooling demands. Latent heat storage with phase change materials (PCMs) offers passive cooling, but nanomaterials are needed to improve their low thermal conductivity. In this study, a two-way hollow concrete roof (HCR) integrated with macroencapsulated nano-enhanced PCM (NePCM) is developed for passive cooling and tested under ambient conditions. Characterization of selected organic PCM (OM35) is conducted individually and in combination with 2 % and 4 % mass fractions of multi-walled carbon nanotubes (MWCNT) and graphene nanoplatelets (GNP). Following unit cell approach, a conventional concrete roof (CCR) without PCM and three HCR specimens are cast: OM35–SU, 2%GNP–NePCM, and 4%GNP–NePCM. Thermal performance of the four specimens is assessed by analyzing temperature variations, heat flow, thermal load, decrement factor, and time lag. It is observed that thermal conductivity enhances 36.4 % and 45.5 % in 2 % and 4%GNP–NePCMs over OM35. During sunny hours, OM35–SU, 2 %, and 4%GNP–NePCMs reduce indoor surface temperatures by an average of 8.1, 8.7, and 9.6 °C, respectively. Cooling loads in 2 % and 4 % GNP–NePCMs are 68 % lower than CCR. Further, 2 % and 4 % GNP–NePCMs have 33 % and 36 % less mean time lag than OM35–SU. The findings offer valuable insights into the macroencapsulation of NePCM in roof slabs, enabling effective thermal energy management for indoor environments in hot climates.[9]

III. ROLE OF CONCRETE COVER IN RC ROOFS

The concrete cover acts as a **protective barrier** between the reinforcement and the environment. Adequate cover thickness ensures:

- **Protection against corrosion** from moisture and chloride ingress.
- **Thermal insulation** reducing the transmission of heat into interior spaces.
- **Fire resistance**, improving occupant safety.
- **Bond strength** between concrete and steel.

However, excessive cover thickness can lead to higher shrinkage stresses and increased self-weight, while insufficient cover accelerates corrosion and reduces service life. Studies (e.g., IS 456:2000 and Eurocode 2) recommend 20–40 mm for slabs and roofs depending on exposure conditions.[5]

IV. EFFECT OF BLOCK SIZE AND GEOMETRY ON ROOF PERFORMANCE

The integration of different **block types** within the RC roof system affects both mechanical and thermal performance:

- **Solid blocks** offer higher load-carrying capacity but increase dead load.
- **Hollow blocks** (clay, concrete, or lightweight aggregates) reduce self-weight and provide improved thermal insulation.
- **Aerated concrete blocks** enhance energy efficiency and reduce heat transfer through the roof.

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- **Polystyrene or filler-block systems** reduce material consumption and improve sustainability.

Research findings indicate that roofs with hollow or filler blocks achieve 20–30% weight reduction, leading to lower bending moments and increased economic efficiency.[6]

V. Influence of Different Cover Sizes

Experimental investigations have shown that:

- Increasing cover thickness from 20 mm to 40 mm enhances corrosion resistance and service life, particularly in marine or humid climates.
- Optimal cover provides a balance between durability and crack control.
- Too thin a cover results in early cracking and loss of reinforcement bond, while excessive cover may reduce effective depth and flexural strength.

Finite element simulations have validated that differential cover thickness alters stress distribution within the roof slab. An optimized design often considers 25–30 mm cover for mild exposure and 40–50 mm for severe environments.

VI. Thermal and Energy Efficiency Aspects

Thermal performance is an emerging focus in RC roof design. Roofs with thicker covers or integrated hollow blocks show significant reductions in indoor heat gain and cooling energy demand. Using lightweight aggregate concrete, insulating blocks, or reflective surface coatings improves thermal resistance (R-value). Studies comparing conventional solid RC roofs with hollow block roofs report temperature reductions of 3–6°C in indoor spaces under similar conditions.

VII. Durability and Sustainability Considerations

Concrete cover deterioration due to carbonation, chloride attack, or thermal cycling directly affects reinforcement corrosion and roof life. Adopting sustainable practices—such as fly ash, GGBS, or silica fume additions—improves the impermeability of cover concrete. Replacing traditional blocks with eco-friendly filler materials (recycled plastic, coconut shell, EPS) reduces embodied energy and enhances sustainability.

VIII. Summary of Key Research Findings

Study Focus	**Findings**	**Recommended Cover (mm)**
Corrosion Resistance	Increased with thicker cover	40–50
Flexural Strength	Optimum at moderate cover	25–35
Thermal Insulation	Improved with hollow blocks	30–40
Weight Reduction	20–30% lower with filler blocks	25–30
Economic Feasibility	Improved with reduced mateal usage	25–35

IX. Research Gaps and Future Scope

- Lack of standardized guidelines for combined evaluation of structural and thermal effects of varying cover thicknesses.
- Need for long-term durability studies under real environmental exposure.
- Integration of finite element modeling with experimental validation to predict performance under service

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loads.

- Exploration of sustainable filler materials to reduce embodied carbon without compromising strength.

X. Conclusion

The design of reinforced concrete roofs with different cover size blocks significantly influences both structural and thermal performance. While increased cover thickness enhances durability, optimized cover provides a balance between strength, protection, and economy. Incorporating hollow or filler blocks reduces self-weight, improves insulation, and supports sustainable construction practices. Future research should emphasize hybrid materials, smart monitoring for corrosion, and life-cycle optimization to ensure long-term resilience of RC roof systems.

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