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Affordable Housing Solutions: Reducing Spending with PMAY and Gharkul Yojana

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Abstract: India's vision for inclusive growth focuses on the importance of meeting affordable housing needs, especially in rural and semi-urban regions. The present study discusses cost-effective construction techniques using locally available sustainable materials and in conjunction with government programs like the Pradhan Mantri Awas Yojana (PMAY) and the Gharkul Yojana. Based on a 600 sq.ft. home in Rahuri village, Maharashtra, the study discusses the use of alternative materials such as fly ash bricks, bamboo, recycled steel, and ferrocement. The use of these locally available materials not only ensures environmental sustainability but also reduces the cost by as much as 35% over conventional construction techniques. The study involves comparative analysis of conventional and sustainable materials, accurate cost calculation, environmental assessment, and strategies towards the inclusion of necessary infrastructure. Synergizing with national housing policy and focusing on a strategy of community participation, the paper develops a replicable model that can be implemented in different regions, with a call for a paradigm shift in built practices towards sustainable built practices in order to achieve the vision of 'Housing for All' in India.
Keyword: 1.Affordable Housing 2.Sustainable Construction 3.Cost Optimization 4.Low-Cost Housing 5.Construction Cost Analysis

I. INTRODUCTION

Affordable housing is a priority issue in developing countries due to rising land price, urbanization, and increasing demand. This project explores viable, low-cost, and eco- friendly housing solutions for economically weaker sections with special emphasis on a 600 sq.ft. dwelling in Rahuri village. The focus is on low-cost design, cost-effective construction materials, and government scheme assistance to make housing affordable for low-income groups. Affordable housing is one of the greatest challenges of India today, particularly in rural and semi-urban areas. Rural-urban migration, population growth, and economic disparity have caused humongous housing shortage. Millions of families continue to live in substandard and hazardous housing, which has negative impacts on their health, education, and overall wellbeing. This project tackles the long-standing challenge of affordable, sustainable, and durable housing by exploring new building techniques, green materials, and cost-reduction strategies. The goal is to create housing solutions that are not only economically sustainable but also environmentally sustainable and socially inclusive. At the core of this strategy is the use of readily available local materials such as fly ash bricks, bamboo, recycled steel, and ferrocement, which reduce transportation costs and environmental impact while boosting regional economic activity. Moreover, taking advantage of government schemes such as the Gharkul Yojna and Pradhan Mantri Awas Yojna (PMAY) offers financial assistance and affordability for lower-income groups, bringing demand and supply equilibrium to affordable housing. This project will also focus on practical design features, building practices, and case studies to demonstrate practical implementation of affordable housing models that can be replicated in similar conditions all over the country. By incorporating green building materials and supportive policy conditions, this project will be significantly contributing to India's "Housing for All" vision by the year 2025, moving towards improved living standards and inclusive growth.

II. LITERATURE REVIEW

1) *Adeyemi, A. B., & Ohakawa, T. C. (2024)*

Title: Affordable Housing Solutions: Real Estate Strategies for Managing Urban Population Growth

Description: This assessment addresses the core role of urban design in creating affordable housing. It centers on the creation of sustainable, livable, and inclusive neighborhoods through the exploration of urban design elements including site planning, density maximization, and community integration. The study highlights the need for the integration of social, economic, and environmental sustainability in the construction of affordable housing.

2) Singh, D., Yadav, A., & Deb, A. (2024)

Title: A Review on Sustainable Affordable Housing in India

Description: The study requires the integration of economic, environmental, and social considerations into housing regulations and practices to reduce the housing crisis in India. It advocates for sustainable affordable housing to improve the economy, the environment, and overall wellness. People's awareness and education are emphasized by the authors in enabling sustainable housing practices.

3) Lall, A. B., Sethi, G., & Subrahmanyam, N. (2023)

Title: Healthy Affordable Housing in India

Description: The authors refer to the convergence of affordable housing and health and stress the importance of planning housing for well-being. They advocate for the incorporation of health factors in affordable housing design and policy, and for natural ventilation, daylighting, and thermal comfort as essential factors in enhancing residents' health.

4) Agarwal, S., Mandal, S. N., Bajaj, D., & Singh, T. P. (2021)

Title: Affordable Housing and sustainability – A review of Critical Success Factors (CSFs)

Description: The research finds 13 critical success factors that are most essential to the sustainability of affordable housing schemes. The writers, by means of expert surveys and relative importance analysis, point to stakeholders' involvement, cost- effective materials, and efficient project management as essential features of the success of such schemes.

5) Gopalan, K., & Venkataraman, M. (2015)

Title: Affordable Housing: An Academic Perspective of Policy and Practice in India

Description: The authors have provided an academic synopsis of affordable housing policy and practice in India. The authors have specified affordable housing definitions, issues, and institutional frameworks for affordable housing, and provided insights on policy formulation and implementation. The paper has highlighted the necessity of having a standard definition of affordable housing to harmonize policy initiatives.

6) Sengupta, U. (2006)

Title: New Challenges and Frontiers for Affordable Housing Supply in India

Description: This paper applies an empirical assessment of a trailblazing model of low-cost housing in Kolkata to highlight conceptual contradictions in the conceptualization and marketability of low-cost housing. It examines the shift from state to market provision of low-cost housing, highlighting the implications of the shift for housing affordability and quality.

III. PROBLEM STATEMENT

India faces a huge housing shortage estimated at more than 19 million units, primarily impacting Economically Weaker Sections (EWS) and Low-Income Groups (LIG) of rural and semi-urban populations. Further, high population growth, urban drift, and uncontrolled growth lead to the proliferation of informal settlements with unhygienic and unsafe living conditions. Traditional construction methods based on expensive materials such as cement, steel, and fired clay bricks drive up the cost of housing beyond reach for the masses. Furthermore, extensive use of non-sustainable materials leads to environmental degradation through wasteful energy utilization and generation of waste. Despite government-led initiatives such as the Pradhan Mantri Awas Yojana (PMAY) and Gharkul Yojana to offer affordable housing, many prospective beneficiaries remain unaware or unable to access these schemes due to procedural complexities and inadequate information. Finally, there is a lack of integration of sustainable construction philosophy and affordability objectives. This research seeks to overcome these inseparable issues by designing cost-saving housing models that do not compromise quality through locally available materials such as fly ash bricks, bamboo, recycled steel, and ferrocement, successfully scaling government housing schemes, creating housing that is culturally and climatically responsive, and introducing scalable models to realize India's "Housing for All" dream.

A. Objective

This project aims to provide sustainable and affordable housing to low-income semi- urban and rural Indian families. Through the utilization of locally available natural materials such as fly ash bricks, bamboo, recycled steel, and ferrocement, the project aims to reduce construction cost while maintaining quality and safety. The project further aims to utilize government housing programs such as Pradhan Mantri Awas Yojana (PMAY) and Gharkul Yojana to enhance affordability and accessibility.

Through the utilization of community engagement and integrated sustainable construction practices, the initiative anticipates its full potential to maximize India's "Housing for All" vision, promoting socio-economic development and environmental sustainability.

1) Create Affordable and Sustainable Housing Models: Design a housing model that is affordable using environmental materials like fly ash bricks, bamboo, recycled steel, and ferrocement in a way that keeps construction costs and the environment low, while providing structural strength and durability.
2) Tap Government Housing Schemes: Make use of schemes like the Pradhan Mantri Awas Yojana (PMAY) and Gharkul Yojana to procure maximum financial benefits and subsidies for the beneficiaries, enhance affordability, and maintain policy guideline compliance.
3) Provide Climate-Relevant and Culturally Responsive Designs: Design homes that are specific to the socio-economic, cultural, and climatic requirements of village and semi-urban townspeople to ensure safety, comfort, and responsiveness to local living needs.
4) Enhance Community Involvement and Employment: Engage local communities and stakeholders during planning and construction phases to ensure social acceptance, ownership, and create employment within the affordable housing sector.
5) Make it Replicable and Scalable: Create replicable housing models that are scalable in different locations, in accordance with the overall aim of developing sustainable and affordable housing models in India.

B. *Advantages*

1) Increased Disposable Income: Less spent on shelter, leaving money available for food, healthcare, education, and discretionary spending to energize local economies.
2) Economic Stability: Exempts financial stress and risk of financial crises for low and moderate-income households.
3) Lower Homelessness Expenses: Avoids homelessness, which represents substantial public expense (e.g., emergency services, healthcare).
4) Lower Poverty: Establishes a stable environment in which families can escape poverty.
5) Better Health Outcomes: Quality, stable homes diminish contact with health threats (stress, poor ventilation, pests) and enable more resources for medicine and healthy food.
6) Improved Education: Stable housing allows children to achieve better school performance and better overall health.
7) Better Financial Security: Offers a secure asset and eliminates the stress of housing instability.
8) Better Quality of Life: Provides a safe and stable home environment, which decreases stress and enhances mental well-being.
9) Long-term Wealth Generation: To recipients who acquire ownership, it may result in long-term wealth generation.

IV. METHODOLOGY

1) *Policy and Scheme Analysis:*
- Evaluated the government housing schemes, i.e., the Pradhan Mantri Awas Yojana – Gramin (PMAY-G) and the Gharkul Yojana, to understand the eligibility, financial models, and implementation.

2) *Data Collection and Site Assessment:*
- Conducted literature reviews and site visits to gather information on site practices, availability of materials, labor rates, ground conditions, and climatic conditions peculiar to Rahuri village.

3) *Cost Estimation and Material Selection*
- Developed a detailed cost estimate of a 600 sq.ft. prototype building constructed using green materials such as fly ash bricks, bamboo fill, recycled steel, ferrocement roof, and stabilized mud blocks (SMBs).

4) *Comparative and Sensitivity Analysis*
- Carried out comparative evaluation of the traditional and proposed sustainable building plans, highlighting the potential cost reduction in the range of 35–40%.
- Completed sensitivity analysis to determine the effect of changing material and labor prices on the project feasibility.

5) *Structural planning and design*
- Finished material procurement according to cost-effectiveness, environmental performance, availability locally, and structural stability.
- Integrated labor-friendly and resource-efficient building methods suitable for self-help housing.
- Integrated passive design elements like natural ventilation and thermal comfort, and space for minimal infrastructure such as sanitation and water storage.

6) Financial Analysis

- Estimated total cost of construction with and without subsidies from the government to determine affordability of target income levels.
- Assessed return on investment in social terms and long-term savings.

7) Documentation and Reporting:

- Compiled the findings into a technical report that included AutoCAD drawings, cost comparison charts, and sustainability evaluation to ensure the economic viability, replicability, and India's "Housing for All" program compatibility of the envisioned housing model.

Methodology Chart

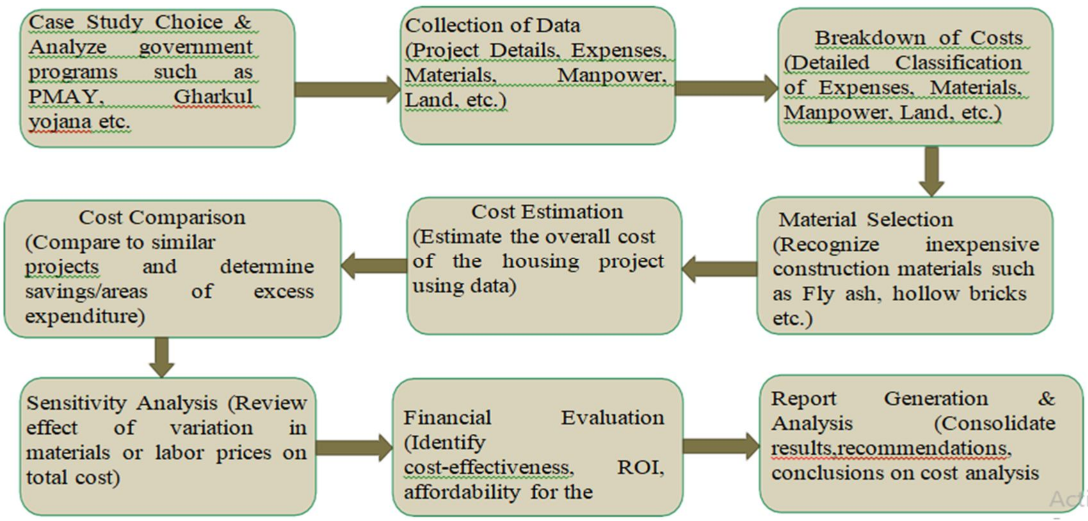

Fig (1): Methodology Chart

V. LAYOUT PLAN

The proposed 600 sq.ft. residential unit in Rahuri village is efficient in space and all intelligently designed to provide natural ventilation and daylight. Sustainable materials like fly ash bricks, bamboo, recycled steel, and ferrocement are used in the design, aligning with green construction practices. The design also provides provisions for water storage and sanitation so that the unit has minimal infrastructure needs. It is a model to be replicated on a large scale for low-cost housing for rural and semi-urban areas.

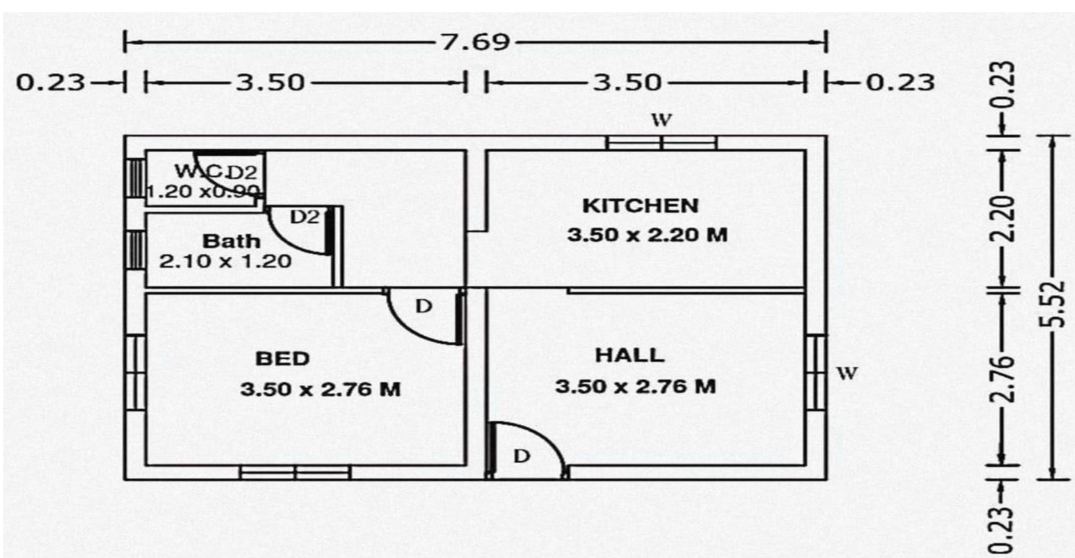

Fig (2): Layout Plan

VI. COST COMPARISON

A. Traditional Construction Model

Component	Material Used	Rate (₹/sq.ft.)	Quantity (sq.ft.)	Total Cost (₹)	Remarks
Foundation	Cement concrete + RCC footing	300	600	1,80,000	Higher costs due to cement, steel, and shuttering
Plinth and Filling	Brick soling + sand filling	25	600	15,000	Increased material and water usage
Walling	Burnt clay bricks	65	550	35,750	High embodied energy and pollution due to kiln use
Roofing	RCC slab	160	600	96,000	Expensive and heavier, increasing foundation cost
Flooring	Vitrified tiles or cement concrete	65	600	39,000	High carbon footprint and prone to breakage
Doors and Windows	Teakwood or iron with enamel paint	—	—	30,000	Expensive due to hardwood scarcity
Toilet	RCC base + ceramic fittings	—	—	35,000	May include flush system and septic tank
Plumbing + Electrical	Multiple fittings	—	—	30,000	Includes switchboards and concealed wiring
Plastering	Cement mortar 1:4	45	550	24,750	Prone to cracking if not properly cured
Painting	Emulsion paint	15	550	8,250	Costlier and requires frequent repainting
Miscellaneous	Tools, tiles waste, contractor margin	—	—	52,775	Accounts for average variations
Total Traditional				5,46,525	₹911/sq.ft.

Table (1): Traditional Construction Model

B. Sustainable Construction Model:

Component	Material Used	Rate (₹/sq.ft.)	Quantity (sq.ft.)	Total Cost (₹)	Remarks
Foundation	Stone with lime- cement + compacted earth	250	600	1,50,000	Low cement use; suitable strength for single-storey homes
Plinth and Filling	Earth filling + stabilized mud	15	600	9,000	Reduces cement cost and avoids over-excavation
Walling	Stabilized Mud Blocks (SMBs) or Fly Ash Bricks	35	550	19,250	Excellent insulation; no high-temperature firing required
Roofing	Ferrocement slab or GI sheet on bamboo truss	85	600	51,000	Lightweight, earthquake- resistant and cost-effective
Flooring	Oxide finish or local stone tiles	40	600	24,000	Breathable and low maintenance
Doors and Windows	Bamboo/recycled steel	—	—	15,000	Durable if treated properly; cost-effective compared to hardwood
Toilet	Leach pit or twin- pit system (brick- lined)	—	—	25,000	As per Swachh Bharat guidelines; effective in low water use areas
Plumbing + Electrical	Single point wiring + simple CP fittings	—	—	20,000	Basic lighting and water line
Plastering	Mud-lime mix (internal), lime-cement (external)	20	550	11,000	Breathable and cost-effective
Painting	Lime wash or natural paint	5	550	2,750	Healthy and non- toxic
Miscellaneous	Water tank, solar light, tools, contingency	—	—	31,600	Accounts for variations during construction
Total Sustainable				3,58,600	₹598/sq.ft.

Table(2): Sustainable Construction Model

C. Comparative Analysis

Category	Sustainable Build	Traditional Build	Savings (%)	Remarks
Total Cost	₹3,58,600	₹5,46,525	~34%	Significant cost saving with sustainable materials.
Embodied Energy	Very Low	High	—	Sustainable methods reduce carbon footprint.
Maintenance Cost	Low	Medium	—	Mud-lime plaster lasts longer with touch-ups.
Water Consumption	Low	High	—	Cement and flush systems need more water.
Temperature Regulation	High (natural)	Low	—	SMBs and bamboo offer better insulation.
Construction Time	Faster (4–6 weeks)	Slower (8–12 weeks)	—	Dry techniques like ferrocement reduce time.

Table (3): Comparative Analysis

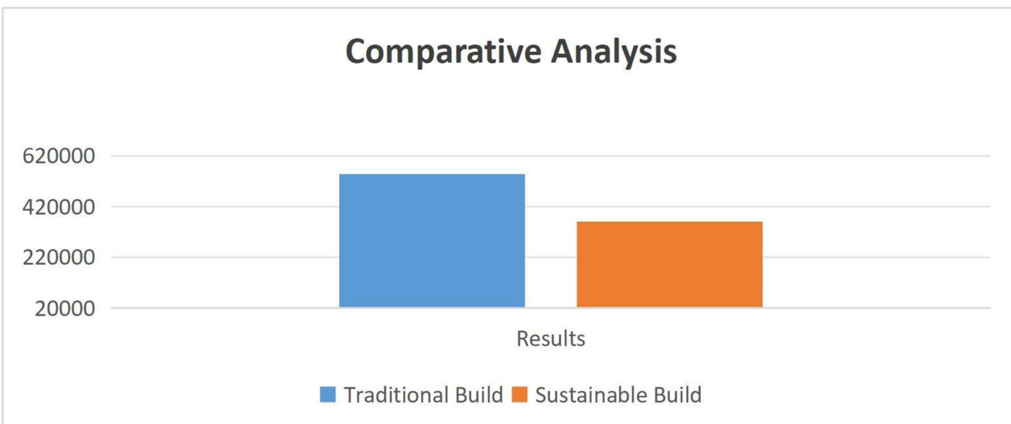

Fig (3): Comparative Analysis

VII. RESULTS

The cost study of building a 600 sq.ft. house with sustainable materials and conventional materials shows strong economic and environmental advantages. The cost of the entire project with a sustainable building process is around ₹3.58 lakh, while conventional building processes cost around ₹5.46 lakh, a saving of around 34%. This enormous saving is primarily due to the utilization of locally available and eco-friendly building materials like stabilized mud blocks, bamboo, and fly ash bricks, reducing not only the cost of materials but also transportation charges. Moreover, sustainable building processes possess better thermal insulation characteristics, resulting in better energy efficiency and lower long-term utility bills. Addition of necessary infrastructure systems—stable water supply, efficient sanitation, renewable energy sources, and digital connectivity—also enhances living conditions in these low-cost housing structures. The results substantiate the efficacy of sustainable building as a cost-effective and green alternative to conventional building processes, as per national programs like Pradhan Mantri Awas Yojana (PMAY) and Gharkul Yojna for promoting resilient and inclusive community development.

A. *Case Studies*

1) Awas Par Samvad – Rural Maharashtra (2022):

Focusing on SC/ST families of Beed, Nanded, and Nashik, this scheme under PMAY- Gharkul made use of fly ash bricks and RCC roofing for building 600 sq.ft. homes at
₹3.8 lakh per unit. The project was successful in timely fund disbursement and high community engagement despite the monsoon delay in material supply.

2) Kerala Eco-Village Pilot (2020):

In Kerala's Alappuzha, the local panchayats and NGOs built 580–600 sq.ft. green houses using bamboo, recycled plastic roof tiles, and compressed earth blocks at ₹3.6 lakh per unit. The incorporation of rainwater harvesting and raised plinths enhanced flood resistance, though protection from termites was a concern and moisture protection was a minor issue.

3) Odisha Cyclone Relief Housing (2020):

After cyclone hits at Puri and Kendrapara, the Odisha State Disaster Management Authority, in association with the World Bank, constructed 600 sq.ft. ferrocement slab cyclone-resistant houses and GI roofs at ₹3.7 lakh per dwelling. The quick implementation ensured low-maintenance units, albeit with transport and access issues in affected regions.

4) Latur Affordable Housing Scheme (2017):

MHADA launched Latur's inaugural modular housing blocks for EWS and LIG families, building 600 sq.ft. apartments using concrete hollow blocks and prefab steel doors in ₹4.1 lakh per apartment. The scheme was integrated with city planning and generated local employment in construction, but lagged behind in clearing financial tranche sanction.

5) Indore Slum Redevelopment Project (2019):

Indore Municipal Corporation under PMAY-Urban rehabilitated slums using precast panel and steel framing to build 580–620 sq.ft. G+2 row houses with central courtyards at a cost of ₹5.1 lakh per unit. The scheme provided institutional property rights to over 1,500 families, although there was reluctance to shift at first and inadequate access to basic services during transition.

6) Tamil Nadu Green Housing Pilot (2018):

In Villupuram and Thiruvannamalai districts, the government of Tamil Nadu, in partnership with NGOs such as Auroville Earth Institute, promoted green houses made of stabilized mud blocks and bamboo reinforcements. The natural ventilation and thermal comfort of the 600 sq.ft. cost ₹3.4 lakh houses improved climate resilience. An initial resistance to mud blocks based on concerns about durability posed a significant challenge.

VIII. CONCLUSION

The Rahuri village, Maharashtra, affordable housing project proves that sustainable construction techniques can reduce cost and environmental footprint by half and raise the standard of living of low-income families. Using locally available, green materials like stabilized mud blocks (SMBs), fly ash bricks, bamboo, and ferrocement, the cost of building a 600 sq.ft. house was lowered by about 34% against traditional construction—₹3.58 lakh versus ₹5.46 lakh. Not only do these materials reduce embodied energy and greenhouse gas emissions, but they also increase thermal comfort, resulting in healthier living conditions. Integration with government initiatives like Pradhan Mantri Awas Yojana (PMAY) and Gharkul Yojna makes it even more cost-effective and affordable to economically weaker sections. The success of the project proves the applicability of sustainable materials, low-cost design, and policy intervention in solving India's housing shortage, providing a replicable model for rural and semi-urban towns across the country.

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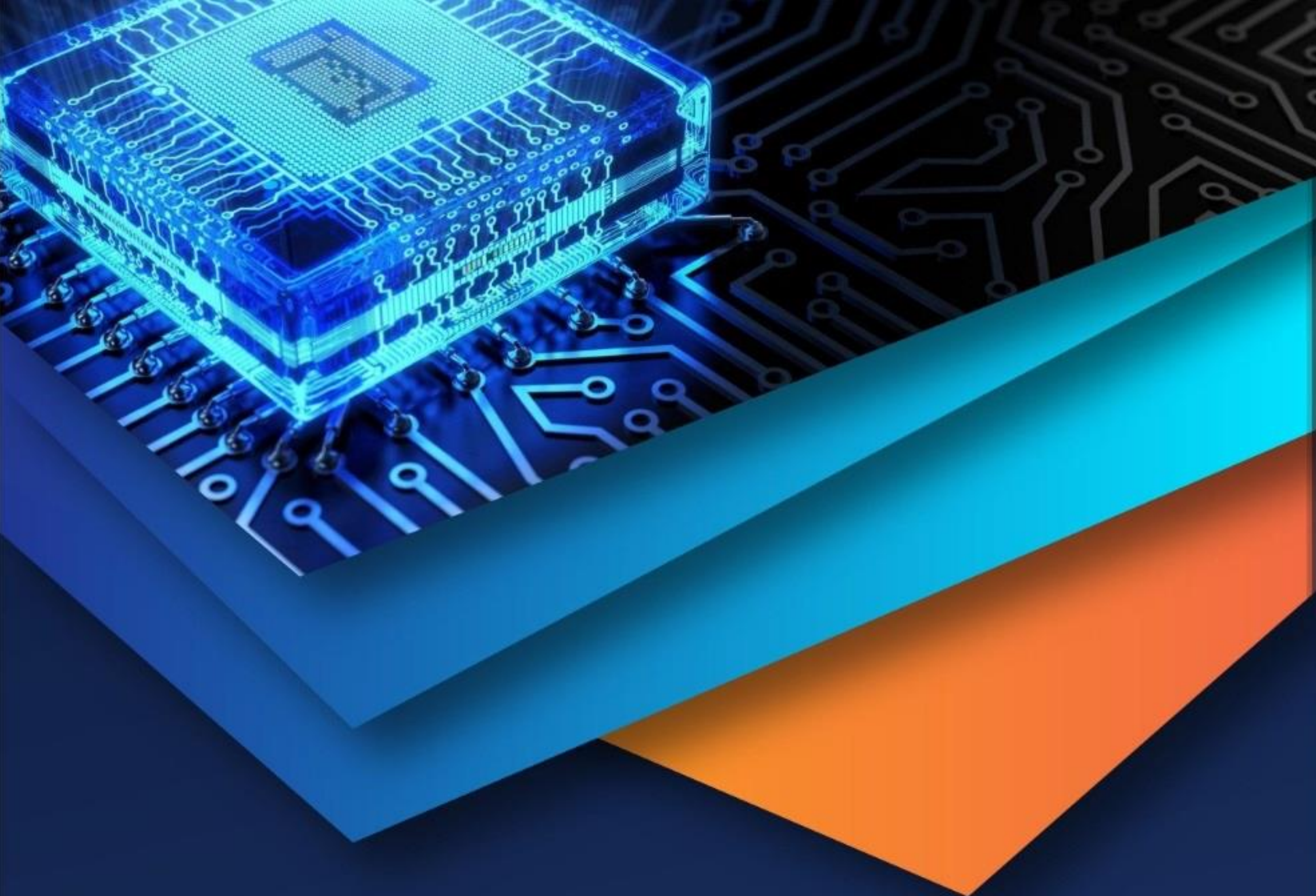

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