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The Light Houses of Kashmir

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Abstract: ***Home is a basic necessity for everyone and becomes one the critical challenges faced by the developing countries. India is currently facing a shortage of about 17.6 million houses and the situation is no different in Kashmir if not more prominent owing to the geographical and climatic conditions of the valley. Presently in Kashmir, We witness that the Middle income groups, low income groups and economically weaker sections of the society, which are growing in size, are struggling to have their own houses. Concrete and steel housing cost a fortune so low cost and sustainable buildings are much needed in Kashmir. Low Cost Housing' refers to those housing units which are affordable by that section of society where income is below MHI (Median Housing Income). It includes the use of construction methods that are cost effective, innovative and environment friendly and allow for a speedy construction. The paper deals with the present and the future trends about low cost housing materials and technologies in Kashmir. These technologies & materials, if implemented, can reduce the present housing problems up to some extent.***

Keywords: AAC, GFRG, filler slabs, SPW, CEB

I. INTRODUCTION

Low Cost Housing refers to the concept which deals with the construction of buildings with locally available materials and improvised skills by the means of effective budgeting and sophisticated techniques to ensure that the performance, lifetime and structural stability of the structure is not compromised. Alternative building construction materials and technologies can be used while constructing low cost housing units to minimize the cost up to some extent and to ensure that the construction is comparatively fast.

This includes the use of natural materials (*e.g.,* Bamboo, Jute, Straw, etc) in low cost housing as they can potentially reduce the building cost to an extent as these are locally available and have easy workability. Naturally locally available materials have comparatively less transportation charges; thereby reducing the overall cost of the building. The use of industrial waste, such as fly ash, can act as an excellent material in low cost housing which proves to be environment friendly as well.

A. Need for Low Cost Housing

Constructing thermally efficient, sustainable and cost efficient houses is very critical to housing infrastructure of Kashmir. Owing to the geographical location of Kashmir, it experiences chilling cold for most part of the year. Therefore necessitating housing for all. 11% of total population falls under BPL group (according to economic survey of 2011-12) in Kashmir and many more which can't afford construction costs become victims of cold because of inefficient housing. So this low cost housing, which promises reducing cost of construction through use of available techniques without altering power, performance and life of structure, can prove profitable for them.

Moreover most housing financing schemes initiated by government and banks often end up benefiting the high/middle income segment owing to the administrative procedures, terms and conditions set up by the government and banking institutions that exclude the less privileged due to their low affordability levels. As of now, affordable housing is a matter of concern as most of times the access to subsidized financing is not easy and discourages the target segment. In addition to this, Kashmir is a fast urbanising place undergoing a lot of developmental changes.

Such projects demand labour and place. Because of which lots of people are moving in to the UT for work. However the migrated lot struggles finding an accommodation. Most of the migrating population belong to the economically weaker sections (EWS), low income group (LIG) and middle income group (MIG). These segments of the society don't have the financial strength or resources to afford a house or dwelling of their own. They are forced to live in rented accommodation or take shelter in informal settlements. This creates a situation that overall creates a rift in the poverty reduction effort. These issues if left unheard and unaddressed shall hamper the overall economic growth of the UT. This calls for the need of a Low Cost Housing in the valley proves to be environment friendly as well.

II. MATERIALS EMPLOYED IN LOW COST HOUSING SOLUTIONS

A. AAC Blocks

AAC *(Autoclaved Aerated Concrete)* Blocks are lightweight, precast, foam concrete building materials composed of the below mentioned ingredients cured under heat and pressure in an autoclave. These can be listed as one of the major developments happening in the field of construction in the 20th century. It is an advanced material that offers a perfect combination of high durability and strength, in addition to it's low weight and superior eco friendly features.

Composition of Autoclaved Aerated Concrete (AAC) blocks:

1) Fly Ash or Sand - *(key ingredient)*
2) Lime Powder
3) 53 Grade OPC
4) Gypsum
5) Aluminium Powder/Paste

Comparing the cost of constructing a wall of 10'-6" x 8' and 9" thickness by AAC Blocks and Red Clay Bricks , we see

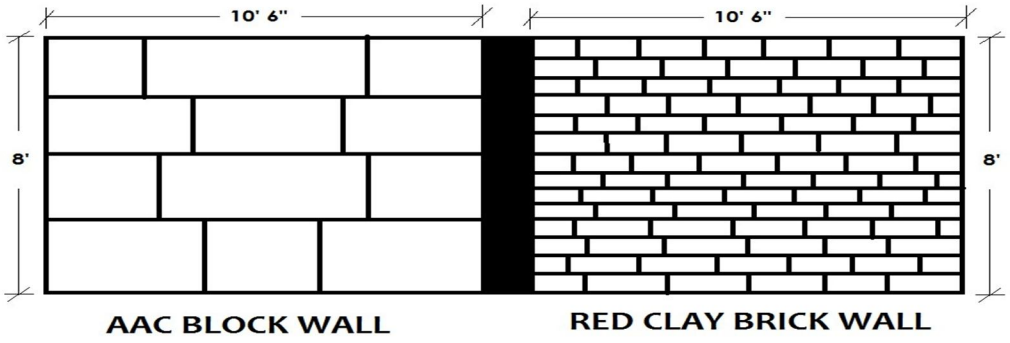

Fig-1: Comparison Of AAC Block Wall and brick wall

Table- 1: Red Clay Brick Wall VS AAC Block wall

PARAMETER	RED CLAY BRICKWALL	AAC BLOCK WALL
No. Of Bricks/Blocks	585 bricks	50 blocks
Joints	1656	162
Bonding Material	Cement: 2 bags Sand: 20 ft^3	Cement: 1 Bag
Labour	6 men	3 men
Time	6 hours 30 minutes	3 hours
Water Usage	Requires more water	Requires less water
Plastering	Always Required	Not Necessarily
Wastage	10 – 30 %	Minimal wastage
COST of Bricks/Blocks	Around Rs. 4,000	Around Rs. 4000
COST of Bonding Material	Rs. 1350	Rs 650
COST of Labour	Rs. 1500	Rs 400

Table- 2: Savings

Cement	40 – 50 %
Mortar	70 – 80 %
Plaster	60 – 70 %
Labour	50 – 60 %
Constt. Time	40 – 50 %

III. COMPARISON BETWEEN AAC BLOCKS & RED CLAY BRICKS

A. General

A *Red brick* is a block, or a single unit of a ceramic material used in masonry construction, usually stacked together or laid using various kinds of mortar to hold the bricks together and make a permanent structure.
AAC Blocks are lightweight building materials cut into masonry blocks or formed larger planks and panels. AAC Block is relatively uniform when compared to other wall unit and does not contain coarse aggregate phase.

B. Raw Material

Natural soil is used for production of *Red Clay Bricks*.
AAC Blocks are made from the mixture of fly ash, cement, lime and gypsum. Cement is used in very little Quantity. The Problem of fly ash utilisation is solved by the use of fly-ash in AAC Block. This was a major problem till day

C. Size

Red Clay *Bricks*: 190 mm x 90 mm x 90 mm
AAC Blocks: 600 mm x 200 – 250 mm x 100 – 300 mm
One AAC Block is equal to about 8 Red Clay Bricks in volume.

D. Weight

Red Clay Brick: Around 3 kg (of size 190 mm x 90 mm x 90 mm)
AAC Block: Around 14 kg (of size 600 mm x 250 mm x 150 mm)

E. Compressive Strength

Clay Brick: 2.5 – 3.5 N/mm^2
AAC Blocks: 3 – 4.5 N/mm^2

F. Fire Resistance

Clay Bricks: 100 mm thick wall can resist fire up to *2 hours.*
AAC Block: 100 mm thick wall can resist fire for up to 4 *hours.*

G. Thermal Conductivity

Clay Bricks: The thermal conductivity of brick is high and hence heat transfer from brick is more than AAC block.
AAC Block: The thermal conductivity of block is less which keeps interior cool in summer and warm in winter.

H. Moisture Resistance

Clay Bricks: Moisture Resistance of Red Brick is Average.
AAC Block: Moisture resistance of AAC block is better than the Red Brick.

I. Termite Resistance

Clay Bricks: Red bricks are not termite resistant as they are made from clay which is an organic material.
AAC Blocks: AAC blocks are insect resistant as they are made from inorganic material. AAC block does not allow spread of termites and pests and hence increase the life of wall.

J. Labour Output

Red Clay Bricks: Comparatively Slow
AAC Blocks: Speed of work is almost double than that of Red Clay Bricks.

K. Carpet Area

Red Clay Bricks: Less carpet area available compared to block work.
AAC Blocks: More carpet area available due to less thickness of the block.

L. Mortar Consumption

Red Clay Bricks: Requires more mortar due to irregular surface & more number of joints.
AAC Blocks: Requires less mortar due to flat and even surface & less number of joints.

M. Speed of Construction

Red Clay Bricks: The speed of construction of the brick wall is slower than the block construction.

AAC Blocks: Speedy construction of wall due to the bigger block size, light in weight and less number of joint.

N. Breakage & Utilisation

Red Clay Bricks: Average 10 to 12 % breakage happens on the construction site, so 100% utilisation is not possible. Even at some place, due to the poor quality of bricks, wastage goes up to 33%.

AAC Bricks: Negligible breakage. Almost 100 % utilisation is possible.

IV. GFRG PANELS/FAST WALLS

GFRG is a revolutionary material that stands for glass fiber reinforced gypsum. Common dimension of the GFRG panel is generally 12 m long, 3 m wide, and 0.124 m deep. These panels are composed mainly of Gypsum, glass fiber, concrete slurry, and chemicals, such as water-repellent emulsion.

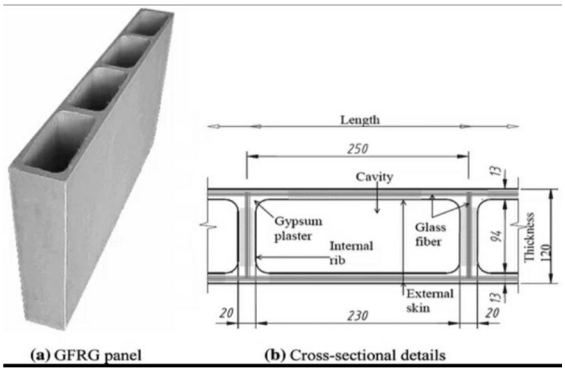

Fig-2: Diagrammatic and pictorial representation of GFRG panel

The main application of these panels is seen as load bearing structures in buildings. When the cavities inside the GFRG panels are filled with concrete, the compressive strength of the panels increases. Moreover when reinforcement bars are introduced, the ability to withstand lateral loads also gets enhanced. Preferentially filling is done with M20 concrete and reinforced with an 8 mm reinforcement bar. These panels can also be used as partition walls with appropriate fillings and can be can also be used as an intermediate floor or slab in combination with reinforced concrete structures.

Manufacturing of GRPF with 90% purity implies less energy compared to conventional construction materials that consume a lot of energy such as bricks concrete etc. The air cavities in the GFRG panels reduce the solar heat penetration through it. In addition, the low thermal conductivity of GFRG reduces the heat transfer from outdoor to indoor. Thus, reduction in cooling load and therefore enhancement in energy saving can be realized.

Table 3: Comparison of GFRG Wall Building VS Conventional Building (for 1500 sq. ft.)

	CONVENTIONAL BUILDING	GFRG WALL BUILDING	SAVING %
Cement	32.55 tons	16 tons	50.8
Steel	2779 kg	1800 kg	35.2
Sand	83.37 cum	20 cum	76
Water	20,00,000 l	50,000 l	75
Labour	1200 man days	389 man days	67.59
Built Area	154.45 sqm	143 sqm	8
TIME	4 months	21 days	82 %
COST	Rs. 18.27 lakhs	Rs. 13.25 lakhs	27.47 %

GFRG panels are fire resistant, earthquake resistant, water resistant, have high insulation value, eco-friendly, reduce cement usage, construction time, labor cost and prove to be very economical.

A. Steel Plate Wall System

It is a revolutionary structural steel lateral load building system which can be fabricated at low cost and quickly erected and is expected to have a superior performance. A steel plate shear wall system element mainly consists of a column and beam frame augmented by a steel in-fill panel between the boundary wide flange members. When these in-fill plates occupy each level within a frame bay of a structure. An SPW system, when designed and detailed properly, has relatively large energy dissipation capability with stable hysteretic behaviour, thus being very attractive for high risk earthquake zones.

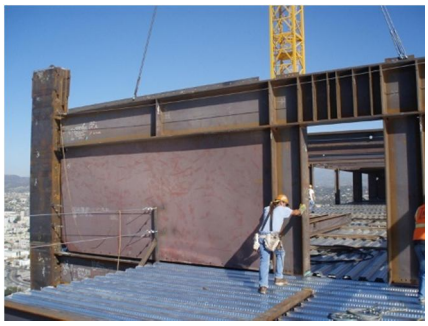

Fig-3: Pictorial representation of SPW

In comparison to reinforced concrete shear walls, SPWs are much lighter, which ultimately reduces the demand on columns and foundations, and reduces the seismic load, which is proportional to the mass of the structure.
In comparison to reinforced concrete construction, the erection process of an all-steel building is significantly faster, thus reducing the construction duration, which is an important factor affecting the overall cost of a projects.
All-steel construction with SPWs is a practical and efficient solution for cold regions where concrete construction may not be feasible, as very low temperatures complicate construction and freeze-thaw cycles can result in durability problems.
In seismic retrofit applications, SPWs are typically much easier and faster to install than reinforced concrete shear walls, which is a critical issue when building occupancy needs to be maintained throughout the construction time.

Some other low cost building materials include:

B. Hollow Concrete Blocks

Hollow concrete blocks are blocks composed of concrete that have hollow spaces between their walls. These are used in construction of different types of walls like retaining walls, decorative walls, classic walls, etc.. Gravel, sand, Portland cement, water are used as ingredients. At times fly ash, a waste product from industrial combustion, maybe used instead of heavier ingredients like sand and aggregate which makes the hollow concrete block light weight, easier to handle, and more economical. The standard size of a hollow concrete block is 20cm*20cm*40cm. There are other sizes of hollow blocks like 15cm*20cm*40cm and 10cm*20cm*40cm but these are not considered and the main size. Load bearing walls composed of hollow concrete blocks are generally used for for Low Cost Housing Construction

Fig-4: Hollow concrete block

Use of hollow concrete blocks for load bearing walls has many advantages such as:

1) They are way cheaper than stone bricks we conventionally use.
2) Because they are light in weight, they are very easy to handle and to work on.
3) There is a special advantage of insulation to space air void.
4) A very less amount of mortar is consumed.
5) The most important fact is that, these are environment friendly.

C. Compressed Earth Bricks

CEBs or Compressed Earth Bricks/ Compressed Earth Blocks refer to blocks made out of soil and reinforced with a mixture of lime and cement. Sometimes also called adobe bricks, they are lightweight, harmless and fire proof. Compacted earth bricks are thick and for the most part utilized for outside plaster work and are viewed as most cost efficient and eco-friendly building material of all.

Fig-5: Compressed Earth Bricks

CEBs have the following advantages:

1) Limited or no need for mortar, thus reducing both the labour and materials costs.
2) Transport costs are reduced as suitable soils are often available at or near the construction site.
3) Strengths might exceed the ASTM standard for concrete blocks (1900 psi) in some instances. In India, the observed compressive strength and flexural strength of CSEB at 28 days of aging with 9% cement stabilization has been observed to be 3.2 MPa and 1 MPa respectively.
4) These are non-toxic made up of materials that are completely natural, non-toxic, and do not out-gas
5) These have sound resistant properties that come in handy for high-density neighbourhoods or residential areas adjacent to industrial zones
6) CEBs are fire resistant
7) CEBs are Insect resistant. Birds and insects are curbed as the walls are solid and very dense, and have no food value.

V. METHODOLOGIES OF LOW COST HOUSING

Low cost housing can be accomplished by ensuring efficient planning and project management, making use of low cost materials and economical construction technologies. Some of the approaches to achieve Low Cost Housing are discussed below

Reducing the Building Cost

1) The building construction cost mainly comprises of two parts viz
Building material cost : 65 to 70 %
Labour cost : 65 to 70 %
In low cost housing, building material cost is reduced as locally available materials are used and the labour cost is consequently minimized by properly making the time schedule of our work.
2) Reduction of cost can also be achieved by selection of more efficient material or by an improved design**.** The best way of reducing construction costs is choosing a more straightforward geometric design. Introduction of unwanted complexity in design, leads to increase in construction materials and requires more labour for execution.
3) Reduction of cost for individual building components:
a) *Plinth:* Plinth area can be reduced by using thinner wall concept. The plinth slab of 4 to 6″ which is normally adopted can be replaced by brick on edge which consequently reduces the cost by about 35 to 50%.
b) *Walls:* For walls rat trap bond can be used which is a cavity wall construction with additional benefit of thermal comfort and reduces the quantity of bricks required for masonry work. This method of bonding of brick masonry compared to traditional English or Flemish bond masonry reduces the material cost of bricks by 25% and the masonry cost by about 10 to 15%.
c) *Doors and windows:* Use of wood for doors and windows need to be discouraged and subsequently replaced by concrete or steel section frames which ends up savings in cost up to 30 to 40%. For shutters, commercially available block boards, fibre or wooden practical boards etc., can be used which reduces the cost by about 25%.
d) *Lintels and Chajjas:* The commonly occurring R.C.C. lintels are very costly and can be replaced by brick arches for small spans which saves construction cost up to 30 to 40% over the traditional method of construction.

e) *Roofing:* Conventionally 5″ thick R.C.C. slabs is used for roofing of residential buildings. Adoption of rationally designed in situ construction practices like filler slab and precast elements can potentially decrease construction cost of roofing by about 20 to 25%.

f) *Filler Slabs:* These are RCC slabs where bottom half (tension zone) concrete portions are replaced by filler materials such as bricks, tiles, cellular concrete blocks, etc. These filler materials ensure that the structural strength isn't compromised, and also the unwanted and non functional tension concrete is replaced, which results in economy.

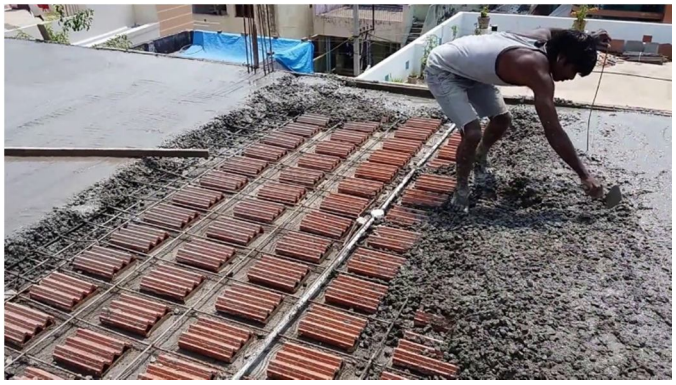

Fig-6: Filler slab

g) *Staircase:* Normally the cast-in-situ stair construction is used which is comparatively more expensive. It can be replaced by an effective and efficient method known as Precast Staircase System.

Precast staircase system has several advantages such as:

- Its construction is inexpensive and less time consuming.
- No laborious form of work is required to construct it.
- It can be simply supported or can be supported with a cantilever.

h) *Electricals:* Recurring cost for repairing can be minimized by selecting the branded wires for House wiring. Moreover costs can be further saved by choosing native build switches and sockets. Additionally, fittings which are economical and demand less maintenance should be opted for.

VI. CONCLUSION

To conclude, adoption of good planning and design methods in the valley by availing the assistance of an experienced engineer for supervision is the need of the hour. This will consequently lead to overall cost effectiveness. Thus a low cost housing system shall provide all basic facilities with quality and lasting construction at affordable cost and shall prove beneficial to the lesser privileged section of the society.

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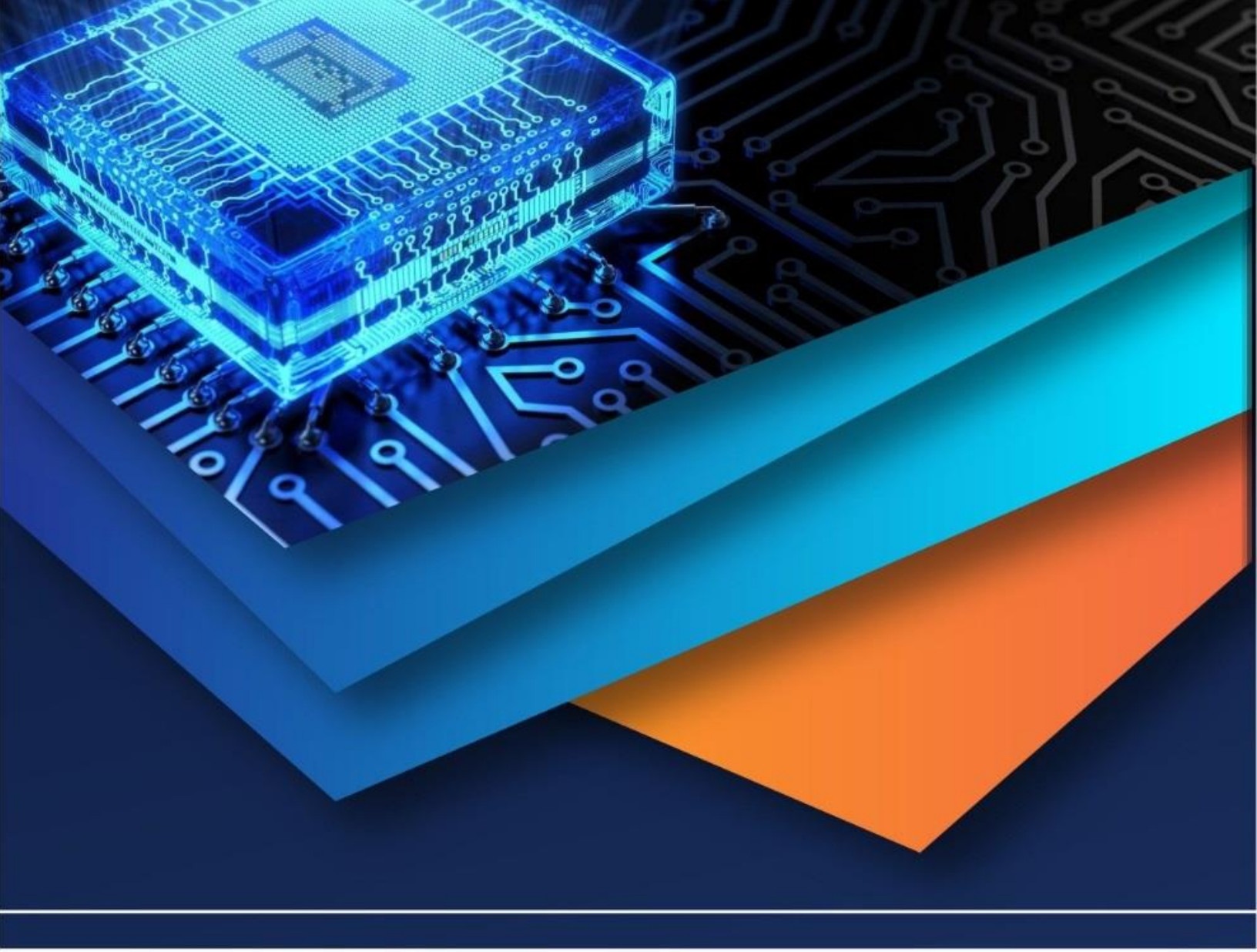

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