

Properties of Clay as Building Material and its Potentials Benefits for Restoration of Built Environmental

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Abstract:- This research work looks at the properties and potentials of clay for its utilization as building development material. It upgrades ecological restoration of built environment. The reasoning for this assessment began from the perspectives held by researchers that clay earth blocks are more liked as economical structure materials than regular sand concrete structures; notwithstanding, there is restricted investigation, whether the decision of clay building materials is impacted simply by its possible advantages. The investigation attempted a methodical writing audit and embraced a quantitative analysis strategy including the review of chosen building and common development firms in Katsina, Kano and Kaduna provinces of Nigeria. The data information gathered on the monetary, social and environmental properties of clay and its possibilities in ecological reclamation. The information was examined utilizing clear factual methods. The investigation tracked down that the financial parts of clay make it more appealing as a structure material that is helpful in ecological assurance. The discoveries suggest further investigation into the improve usage of clay as building material that tends to manage the main concern of monetary aspects, social and environmental prerequisites.

Keywords:- Potentials, Clay Blocks, Restoration, Monetary, Social, Built Environment.

I. INRODUCTION

Clay is a structure material that has been utilized by people's creatures on the planet for a long time in the over a significant time span. It is not difficult to excavate from the beginning little preparing is required, which implies that energy and tedious cycles is eliminated. Clay earth goes about as clay bricks, blocks, rooftop slates, floor tiles kitchen appliances and lab sterile apparatuses are made of the common assets of clay and water in close by manufacturing plants utilized locally, keeps away from long vehicle transporting. It is flexible, energy proficient, strong, tasteful and financial worth (Wiesenberger, 2019). Furthermore, it is utilized for protection to get a good deal on numerous customary structure strategies. Saving expense of manufacture and energy utilization is likewise conceivable; given that structures with clay materials will save more energy use. Wiesenberger (2019), satisfied that structures don't utilize more power than required, this will permit homes

to keep up their warmth throughout the cold weather months and keep up the agreeable temperatures throughout the late spring months. Earth is perceived as an economical structure material.

Clay is perceived as monetary structure material since it gives the accompanying advantages to inhabitants: Warm prevalence, less water use, solidness, prevalent acoustics it additionally gives better indoor air quality, sustainable, re-usable and great primary components. Despite the fact that clay has every one of these possible potentials, there is restricted exploration that researches decision of clay as a structure material is just impacted by its ecological advantages. Subsequently, this research looks at the potential and advantages of clay as a structure material and its reception on development of projects is affected exclusively by its monetary and natural advantages.

II. OUTLINE OF THE PARTS OF CLAY AS BUILDING MATERIAL

The actual properties of clay as structure materials incorporates: pliancy, shrinkage under terminating and air-drying, fineness of grain, shading in the wake of terminating, hardness, attachment, and limit of the surface to take adornment. Legget (2011) states that clay earth is a solid breathing structure material that really improves the air around it, retaining and delivering stickiness moderately quick. This outcome in a normally controlled degree of mugginess and with a solid room environment accomplished. When the general stickiness ascends from half to 80%, non-consumed blocks can ingest multiple times more dampness than customary consumed blocks inside a two-day duration. Abdurrahman (2010) states that clay structures additionally store heat in the colder time of the year and coolness in the late spring. In light of that planning and working with clay building materials will contribute extensively to energy saving funds. At the point when the factor of low energy is needed for the readiness, handling and utilization of clay, working with clay earth is harmless to the ecosystem. According to Abidin (2010) it takes just about 1% of the energy required for making clay blocks / bricks. As worldwide populaces increased, so likewise the requirement for housing convenience increases. Notwithstanding, current standard structure techniques are unreasonable in light of the fact that it, produce a lot of fossil fuel by-product underway and during development and all through a structure's life.

Glass and Steel have their limitations when contrasted with clay. They are inclined to warm, climate components, rust, expanded energy utilization, non-fireproof properties, low composite strength and significant maintenance costs.

Clay bricks, blocks, rooftop tiles and pavers are sturdy, moderate and give agreeable, protected and sound housings to a large number of individuals. Moreover, they consolidate customary structural legacy with inventive and future arranged development techniques. Lastly, clay building materials offer important answers for energy saving, lessen ozone layer harming and global warming substance emanations in the structure area (T&B Europe 2015). Ball clay is especially esteemed for their liquid and projecting properties which are significant for assembling of sterile and kitchen apparatuses (UNCHS 2013). Different properties of clay blocks are that it can ingest and store sun based warmth, empowering a reasonable environment atmosphere in the late spring. This is rather than lightweight structures that regularly experience the severe effects of summer overheating; They are fire resistance, give fantastic imperviousness to heat penetration and don't emanate any dangerous substances or gases; The block facades likewise withstand immersion from rising water and burst pipes without being antagonistically influenced fundamentally;

Properties of clay blocks are that it, withstands flat loads, like those from tremors, yet should be built up in regions subject to high seismic unsettling influences and furthermore give undeniable degrees of safety from interlopers. Clay material tiles are dormant materials they are non-combustible and there is no discharge of poisonous gases in the event of fire, water overflow can be gathered and put away for use. The blocks structures are entirely adaptable. Changes are conceivable both during the development cycle and all through the structure's life, when social changes may direct changes in the design. (Sharma, 2015).

III. EMPLOYMENTS OF CLAY IN BUILDINGS STRUCTURES

Utilization of clay as reasonable structure material is turning into a need for building designers in the fabricated conditions, for tending to worldwide convenience in workplaces, private and different frameworks, clay earth blocks, confronting blocks and clay rooftop tiles just as pavers are especially economical and normal structure materials since they comprise of the regular crude materials clay and water. Blocks and tiles are totally liberated from poisons and allergens and along these lines particularly viable with people and nature (Clay wienerberger.com).

Abdurrahman (2010) clay has been utilized since the actual beginnings of antiquated civilization, for building, cooking pots making, water pots, blocks, sterile apparatus, divider claddings, and furthermore seepage pipes. Both clay blocks and different bricks are utilized for different purposes, for example, the assembling of mud pipes, and for floor and divider tiles. Fire clays utilized for more headstrong purposes, example, heat-safe tiles material framework and building blocks. China clay, dominantly kaolinite is utilized as filler,

bonding and in drug production. Extended clays are utilized as a lightweight total in the production of extended clay blocks utilized for protection. Clay has been utilized in the production of the accompanying structural segments.

i. Clay material and floor tiles: Consolidate customary structural legacy with inventive and future situated techniques. Clay tiles offer important answers for energy saving funds and decrease ozone harming substance outflows in the structure area. Earth floor tiles are frequently called fired or porcelain tiles, produced using blends that incorporate clay as a typical fixing, terminated in oven and solidified. Clay floor tiles are coated, giving them assortment of tones and water-safe surface.

ii. Heat Sinks and Smokestacks: Warmth sinks are intended to draw heat away from explicit regions to abstain from overheating. Since clay is heat safe and can likewise move heat away, clay floors are in some cases worked to go about as warmth sinks, drawing heat away from furnaces, boilers or different gadgets to forestall harm. Most chimney stacks are worked of clay blocks up to the rooftop level and afterward the stack polished off with red burnt bricks; it was more normal for the whole fireplace stack to have been worked of clay blocks in view of their solidarity, virtue and capacity to withstand incredible heat. Ball clay is completely utilized as crude materials for clean products, emergency clinic and latrine tiles in view of its versatility, usefulness and strength in fire state.

iii. Plasters and Rendering: Clay mortars have been utilized broadly for bonding wall structures in the assembled realm and undoubtedly everywhere on the world for millennia. Despite the fact that it isn't generally known, there are presumably more than 1,000,000 structures with clay materials in their design in the unified realm, and a large number of these have clay mortars. Frequently clay mortars are not perceived on the grounds that they are painted or have a flimsy lime clay skim coat over them, both inside and remotely. Numerous clay mortars are performing great after numerous hundreds of years, both in vernacular structures and in higher status properties remembering their utilization for mouldings, decorative safeguards, clay mortars have.

Clay as Cover and Mortar: has been the most generally utilized covers on the planet, for building purposes as well as for palaces, public, strict structures, and landmarks, example, the 35-meter-high minaret of Tarim in Yemen and the long incredible mass wall of China. Utilized as covers on dividers in the structure and are comprised of little mineral particles under two microns. In spite of the fact that they have the constraint that they mellow when wetted, they are likewise without a doubt the least expensive covers. Clay mortar is a combination of materials for jointing brick, block work units. It has various undertakings. It adheres the blocks together to give strength and robustness while holding them separated to spread loads uniformly. Just as satisfying its hole filling glue work it is needed to have solidness and solidarity to suit the application. Working with reused clay block could lessen CO₂ emanation, improve preservation of common assets, and

diminishing the expense of garbage removal at locales (Barker, 2007).

IV. PROTECTION ASPECTS FROM CLAY SEGMENTS IN STRUCTURES

The latest things in engineering and inside plan are seeing a recovery in the utilization of natural materials, similar to clay blocks. Clay is end route to happen to most durable, natural and favoured structural materials for a wide range of green structures whether business, government or private. Clay building materials are feasible and agree with various government rating and green structures guidelines (Wiesenberger, 2017). Clay has additionally amazing protecting properties as a result of its high heat resistance. It retains stores and deliver heat adequately, making the structure inside cooler in summer and hotter in winter. This makes the inside climate more agreeable and furthermore decreases energy interest and related fossil fuel by-products (Blemish, 2017).

i. Social Viewpoints

The attributes of clay that empowers ecological insurance in the constructed climate are that it is re-usable, effectively recyclable, gives low outflow, contamination and guarantees manageability. It additionally has critical medical advantages over different materials since it is totally common, non-poisonous and latent, with no VOCs or synthetic compounds off-gassing from the material. Just as directing temperature, clay is likewise a mugginess controller. It does not just make more agreeable climate, it forestalls form and contagious development in the home. This makes an unrivalled inside air quality which is significant for wellbeing, particularly when you consider that individuals in Europe and America invest around 90% of their energy inside their apartments (<http://koruprojesi.org/>). Clay additionally has critical medical advantages over different materials since it is totally common, and controlling temperature, it is likewise a moistness controller, it forestalls form and parasitic development in the home. This makes an unrivalled interior air quality which is significant for wellbeing, particularly when you consider that individuals in Europe and America invest around 90% of their energy inside. The qualities of clay empower ecological security in the constructed climate, that it is re-usable, effectively recyclable, gives low discharge and contamination and guarantees supportability (<https://ewh.org.uk/project/koru>).

ii. Economic Perspectives

The existence cycle cost of clay is a more significant proportion of thought underway of clay building materials. Nonetheless, inhabitants are keen on the running expenses of any building warming, cooling and support. The financial assessment of any building considers the entire lifecycle, costs caused for the venture, cooling and warming, just as for dismantling and affidavit individually reusing of materials. Lifecycle costs are firmly connected to the heating of a buildings so the lifecycle costs will likewise be impacted by the kind of energy utilized, regardless of whether power, oil, flammable gas, environmentally friendly power or local heating (Berger and Vocalist, 2011). General financial

pointers are that: Cavity block walls has an extremely long life expectancy up to 100 years without bringing about much maintenance costs; Venture costs in clay material tiles have 100 years life expectancy; Upkeep costs for clay block building structures are low in contrasted with customary structure materials since they require little maintenance inside their life expectancy, the solitary ordinary support needed for delivered dividers is painting, contingent upon the area of the building structural Components considered in the appropriation of clay as a structure material are that:

- (i) The colder the environment, the more energy required for warming, however this can be limited by the sun oriented warmth gains during the year.
- (ii) The more modest the building, the higher the particular warming energy required.
- (iii) Building guidelines contrast from one country to another; the necessary qualities will rely upon the nearby environments.
- (iv) Thicker clay block walls can store sun powered warmth gains and emanate the energy out when it is required.
- (v) Ventilation frameworks can decrease the warming energy prerequisite by a normal 20 kWh/m²a.

More, individuals are finding the advantages of building structures with clay in agricultural nations particularly in tropical countries, the advantages are from warming rooms during cold and cooling in hot seasons, accessibility in many countries, low in cost of extraction, preparing and manufacturing of building items like blocks, blocks, tiles, pipes and clean machines. Another advantages are better properties and magnificence that can be obtain by adding shading colours added substances the materials.

v. Environment Angles

UNCHS (2011) expressed that, the decision of clay as building materials was frequently affected by single natural angles. However, more all-encompassing methodology is supported when the clay is surveyed. The clay block and building industry was first in the building sector to give proportionality as building materials. Components considered in the selection of clay as structural material are that: the colder the environment, the more noteworthy the energy required for warming, though this can be limited by sun powered warmth gains by the clay material during the year; the more modest the building, the higher the particular warming energy utilization for the building structure ; Building guidelines vary from one country to another; the necessary qualities will rely upon the nearby environment; thicker clay block walls can store sun based warmth gains and transmit the energy out when it is required; Ventilation frameworks can diminish the warming energy prerequisite by a normal 20 kWh/m²a. Masonry wall development has inalienable high warm mass, this empowers building to store warm and stay cooler for more than lightweight constructions. It managed limits of temperature in both summer and winter so that, paying little mind to how blistering it gets outside in the daytime or how much cooler it gets inside the house around evening time, the inside stays agreeable. This prompts lower life cycle working expenses as well as being energy productive, asset proficient and naturally is dependable (Shangase, 2017).

V. BENEFITS AND POTENTIALS ADVANTAGES OF CLAY

Great number individuals are understanding the advantages and potentials of working with clay building items in non-industrial nations particularly in tropical countries, the advantages range from warming rooms during cold and cooling in hot seasons, accessibility of the clay material in many countries in the world, low in cost of extraction, preparing and construction of building items like bricks, blocks, tiles, pipes and sterile machines. Another advantage is better properties and excellence can be gain by adding shading couloirs substances materials. Common magnificence accessible in an assortment of rich tones, surfaces and shapes of corobrik colourfast clay face blocks permits you to establish the fabricated climate you want. Dirt face blocks and mud pavers are adaptable in plan and can consummately supplement each other (Corobrik clay, SA). Clay workmanship materials fundamentally help to save energy and time cost. Uniquely planned mud blocks for outer dividers have incredible warm protection properties. Accordingly, mud blocks/blocks help to keep the energy utilization of a structure low and decrease a dangerous atmospheric deviation (TBE, 2005). Different kinds of clay are reasonable for use in building and structural designing works. Figures 1, 2, 3 and 4 presents notable structures made of clay materials in Katsina State northern Nigeria.



Figure. 3: The Katsina Royal Palace worked in 1348 by Muhammad Korau, the main Muslim Emir of Katsina. Source: (Nigeria Galleria ©2017).

The Katsina Imperial Royal residence or the Emir's Castle, which is famously alluded to as Gidan Korau by local people, is a magnum opus of Hausa design, representing the way of life, history and custom of Katsina. The monumental complex situated at the focal point of the city is accepted to have been worked in 1348 by Muhammad Korau mud earthen materials, the principal Muslim Emir of Katsina. It is additionally accepted to be one of the most seasoned and among the original castles in Hausa land, the others are that of Daura, Kano and Zazzau. (Nigeria Galleria, ©2017). In the times past the royal residence was circled with a defences (ganuwar Gidan Sarki) yet that is presently terminated. The blend additionally fills in as defensive mortar.



Figure. 3: The Katsina Royal Palace worked in 1348 by Muhammad Korau, the main Muslim Emir of Katsina. Source: (Nigeria Galleria ©2017).

These royal residences are vacation spots on account of their exceptional compositional constructions. The castles which were developed with conventional clay building materials portray northern Nigeria's customary engineering plans dated as far back as the mid nineteenth Century. The blend likewise fills in as defensive mortar. This clarifies why the structures have withstood the impacts of cruel climate for a long time," the book clarified. The imperial compound is isolated into three segments; the living quarters of the Emir and his family which is called Soros and barga, the yard where the Emir's steady is found, where his workers and slaves additionally live. Likewise, there is the Gideon ganye, where the illustrious nursery and the Emir's visitor house are found.



Figure. 4: The Katsina Royal Palace worked in 1348 by Muhammad Korau, the main Muslim Emir of Katsina. (Source Nigeria Galleria ©2017)

TABLE 1 RESPONDENTS PERCEPTIO FOR CLAY UTILIZATION.

1	Familiar with characteristics of clay	Respondents
	Very familiar	4
	Familiar	2
	Non familiar	1
2	Used in the past and present projects	Respondents
	Very familiar	2
	Just familiar	4
	Non familiar	1
3	Percentage of incorporating clay in projects	Respondents
	60% - 90%	2
	25% - 80%	1
	20% - 30%	2
	3% - 8%	1
4	Percentage of clay products used in most projects	Respondents
	70% - 90%	2
	60% - 80%	3
	25% - 70%	1
	20% - 30%	1

TABLE 2 RESTROTION ASPECTS OF CLAY

Categories of Clay Aspects as Restoration Materials in the Built Environment	Categorical Mean (x)
Economic Aspects	4.25
Environmental Aspects	4.24
Social Aspects	4.01
Mean average	4.17

VI. ASSURANCE ASPECTS OF CLAY COMPONENTS

The discoveries from the examinations of the assurance viewpoints by clay building components is introduced in Table 2. the classes parts of clay as a security material in the assembled climate. The outcomes presented that the economic aspects of clay are acknowledged by majority of respondents, the more altogether upgrade the economic aspect of building development than the environmental and social viewpoint in built environment. The Classes of Clay Aspects as Restoration Materials in the Built Environment are presented in Categorical Mean (x)

VII. CONCLUSION AND RECOMMENDATIONS

The exploration analyses the properties and possibilities advantages of clay and whether its utilization as a development material is seen by development partners to improve Environmental Restoration. The examination found that clay is utilized as a building structural material in the development of notable structures and those respondents saw that the economic angles are altogether agreed by respondents improved the utilization of clay when contrasted with the environmental and social aspects of maintainability. In view of these discoveries, the research found that monetary aspects of clay gave more importance and likely potentials advantages to clients for the built environment in the future development

- The concentrate subsequently suggests Governments, Stakeholders, Non-Governmental Organizations and analysts to plan a program that will improve viable use of dirt items especially in country and metropolitan regions and public structures in non-industrial nations since it empowers the three primary concern of maintainability monetary, environmental and social.
- The concentrate additionally prescribes further exploration that will add to social, financial and environmental maintainability aspects of assembled climate, and distinguish the enhancements that can be utilized clay as a building material in the built environment, further advantages that can be acquired from the use of clay in the incorporated climate and more examination into the environmental security characteristics that clay has over other building materials.
- The concentrate additionally prescribes further exploration that will add to social, monetary and environmental supportability aspects of assembled environment, recognize the enhancements that can be utilized clay as a structure material in the built environment, further advantages that can be acquired from the use of clay in the incorporated environment and more investigation into the characteristics that clay has over other building materials.

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