IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 7, March 2024

An Analytical Research on Innovation in Construction Material Management for Enhanced Project Performance

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Abstract: *Reviewing the many kinds of cutting-edge building materials that are now on the market was the goal of this study. Developments in nanotechnology, the use of mineral admixtures, glass and plastic, biological materials, wood, and other building materials have all been proven to have a major impact on the rise in the discovery and manufacture of novel building materials. Innovative construction materials can be used to meet a variety of requirements, including those for environmental friendliness, simplicity of assembly, durability, dependability, safety, cost reduction, and improved mechanical and physical characteristics. About 40% of the project's total cost in the construction industry was attributed to the materials utilised to complete the project. Success stories on converting agricultural and industrial trash into money were documented*

Keywords: Nanotechnology, Converting Agricultural, Industrial Trash, Construction Material, Concrete, Sustainability, Economy

I. INTRODUCTION

One could characterise construction materials as the foundation of civil engineering. In order to improve safety, reduce pollution, make buildings more user-friendly, aesthetically pleasing, and promote a healthy atmosphere, construction materials are used in the development of streets, railway tracks, aeroplane terminals, viaducts, burrows, spans, dams, seaward structures, television towers, water reservoirs, and nearly every other aspect of the planet Earth. In construction projects, the cost of construction materials could account for up to 40% of the total project cost. The adage "Necessity is the mother of invention" is frequently used. Man's quest for a better life has compelled him to build safer and more comfortable living environments that are functional, dependable, and contain some harmony and beauty. A few of these criteria, including sustainability, durability, dependability, safety, cost savings, improved quality, superior mechanical and physical properties, extreme condition flexibility, ease of assembly, and environmental friendliness, should be met before innovative construction materials are deemed acceptable. Plaited microbial cellulose, aluminium, foam, and bamboo reinforced concrete, bio-receptive concrete, bricks created from pollutants, 3D printed sandstone, and super plasticisers are a few examples of novel building materials. Another example of converting trash into income is producing concrete using fly ash or pond ash in place of cement and sand. As a result, costs are reduced and the problem of the transmission of flaming debris from power plants is resolved. Any construction project's material selection should be determined by the project's needs and suitability. The environment has also been contaminated by some man-made building materials, including concrete, metals, brick, ceramics, and plastics. Both the end user and the construction sector should broadly accept construction materials. When choosing and approving any building material, the financial viability is crucial. It is crucial to make sure that the new building materials save labour on construction sites and contribute to even further project construction cost savings. Environmentally friendly and sustainable materials should be used in modern construction. The lack of availability and local manufacture of new materials is one of the primary factors influencing acceptance of new building materials.

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II. LITERATURE REVIEW

The contribution of small and medium-sized contractors (SMEs) to economic development in South Africa is noteworthy. A call for sustainability initiatives to help SMEs gain a competitive edge and enhance project delivery has been made (Trufil & Hunter, 2006). According to a review by Vatsal and Pitroda (2017), effective material management techniques are important for SMEs since they reduce material waste during construction and allow contractors to keep their potential revenues. According to Sogaxa, Simpeh, and Fapohunda (2021), a zero-waste culture is essential to empowering SME contractors to support the growth and sustainability of emerging contractors.

According to Kulkarni et al. (2017), the following are the main advantages of successful material management practices: increased inventory turnover, efficient use of working capital, and departmental cooperation. Therefore, effective material management techniques guarantee that the necessary amount and quality of material is acquired, delivered to the right place, and treated appropriately when it arrives (Edike, 2021).

Isnin, Ahmad, and Yahya (2012) pointed out that SME contractors are currently using insufficient material management systems. The majority of SME contractors' performance is impeded by decision-making abilities, problem-solving abilities, opportunity recognition, and change management, which are critical personal traits impacting project success (Hwang & Ng, 2013). While the general issue with SMEs' material management practices is related to improper handling of materials on the construction site, ineffective planning for material procurement, and strained relationships with suppliers, all of these factors lead to poor quality, delays in construction projects, and ultimately, the failure of the contractor's project (Alabi & Sapohunda, 2021). Vilasini et al. (2012) agreed that inadequate planning, a lack of materials, financial difficulties for SMEs, client payment delays, and other factors all have an impact on SMEs' material management procedures.

Material management, according to Kasim et al. (2005), entails precise planning techniques, material quantification, subcontractor or supplier adjudication and selection, material purchasing, expenses, transportation, material receiving, storing and recording, and material distribution. According to Fapohunda (2014) and Blaževska-Stoilkovska, Hanák, and Žileska-Pančovska (2015), poor material management techniques used throughout the project's construction phase raise project material costs and have an impact on projected profit. But according to Gulghane and Khandve (2015), SMEs must have efficient ordering, scheduling, and planning processes in place for their procurement.

However, Fapohunda (2014) noted that precise material scheduling and monitoring must be given top priority if construction SMEs are to manage materials at the project level. Consequently, extra expenses incurred while Delays in the building stage might be attributed to unavoidable circumstances when an inadequate material procurement strategy is implemented. SMEs must give material management at the project level top priority in order to facilitate efficient project flow and administration and improve the sustainable delivery of construction projects.

Sr no.	Author Name	Year	Results
1	Yap and Lock	2017	SMEs are confronted by a lack of working knowledge, inadequate management techniques adopted by SME contractors and ineffective human resource management
2	Bouazza, Ardjouman, and Abada	2015	stated that the success of SME contractors' construction projects is hampered by a lack of consideration from financial institutions, low enterprise capacities, a lack of managerial capabilities to effectively manage production initiatives, and a lack of leadership abilities in the construction industry
3	Ogbu & Olatunde	2019	Because of their labour-intensive nature, SMEs are crucial to the global growth of construction activities and a suitable source of employment
4	Sogaxa, Simpeh, & Ndihokubwayo	2021	Because of their labour-intensive nature, SMEs are crucial to the global growth of construction activities and a suitable source of employment
5	Offei, Kissi, and Nani	2019	reveal that in developing countries like Ghana, SME contractors are the backbone of the economic development
6	Prasanna et al.,	2019	Empirical data also revealed that SMEs are confronted by the challenges of sustainability, globalization, and technology

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7	Bhorat et al.	2018	posited that for SME contractors to enhance sustainable business, they significantly require certain skills that is achievable through effective education and training programmes
8	Matt, Modrák, and Zsifkovits	2020	share different sentiments by noting that SMEs are more proactive in improving their business operations, which gives them an edge over well established firms in terms of business innovation
9	Musa and Chinniah	2016	also revealed that in other developing countries like Malaysian, SME contractors are challenged by lack of attention regarding workforce skills and knowledge training, and hesitant to take advantage of training programmes sponsored by the government
10	Kasim, Anumba, & Dainty, 2005; Kasim & Ern,	2010	Notwithstanding, SMEs' inadequate material management practices result in high waste, inadequate logistics, poor material handling on site, misuse of the materials, lack of activity planning, wrong materials delivery and excessive paperwork all adversely affect materials management

III. USE OF MINERAL ADMIXTURE

Concrete composition has changed as a result of recent developments that have demonstrated the value of long-lasting concrete constructions. Cement, aggregate sand and water were the three or four ingredients used to make concrete until recently, but durable concretes today contain six or more building components. Numerous studies on mineral admixtures have been conducted. Concrete can be mixed with mineral admixtures in the bonding or batching plant to minimise microcracks. This approach extends the service life of concrete structures while being reasonably priced. Studies on mineral mixtures include the following.

(i) Fly Ash- When coal is burned in a power plant, an undesired fine solid residue byproduct results. Large amounts of these are manufactured. Power plant resources may incur expenses associated with the disposal of unused fly ash. The amount of fly ash produced annually is currently around 120 million tonnes, and not all of it can be used straight away without processing. SiO 2, Fe 2 O3, Al 2 O3, and CaO are among the many components that fly ash may have. The vacancy content of concrete can be reduced by using fly ash as a filler additive; it has been demonstrated that fly ash can take on amorphous or other forms.

(ii) Ground Granulated Blast-Furnace Slag (GGBS)- The GGBS is a concrete additive made from slag, a liquid cooling waste product that is created in the blast furnace during the smelting of iron ore. In the growth of construction, the mineral additive in concrete is affordable, dependable, and sustainable. GGBS is employed in many nations, including the United States, Japan, Singapore, and European countries, to build concrete structures with better lifespans and durability. Notable examples of these structures include the Burj Khalifa. The used GGBS improves the workability of the concrete, lowers the risk of cracking from low early age temperature rises, reduces corrosion in the reinforcement due to its strong resistance to chloride intrusion, has sustainable benefits, is resistant to sulphate attack, and can also be used in precast soil stabilisation in-situ and concrete. Additional studies on GGBS have been conducted, including experimental investigations and applications.

(iii) Concentrated Silica Fume (CSF) as Admixture- the (CSF) that is obtained by Ferro-Silicon Industries has small particles that are substantially smaller than cement. These particles fill the space between cement particles in a concrete mix, reducing the amount of water needed and adding excellent resilience to a closely compacted concrete. CSF can replace five to ten percent of the cement in concrete to produce durable results. The use of CSF for lower grades merely results in an increase in project expenses without a matching improvement in technology. Research on the use of condensed silica fume as an additive comprises

(iv) Ternary Blended Cement (TBC)- TBC was utilised by nations to produce concrete. Fly cinder slag, fly fiery debris, fly silica fume, or slag-silica smoulder are all involved. There are 27 different types of cement mixtures listed in the European Standard EN 197 for cements. Mineral additive generally has a complementary influence on cement hydration. Furthermore, limestone fillers improve the cement test results. Ternary concretes that have a small amount of

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limestone filler between 12% and 30% GGBS perform well in environments with low sulphate levels and offer good resistance to chloride infiltration. Numerous investigators have studied ternary mixed cement.

(v) Carbon Dioxide- Carbon dioxide is utilised for pre-cast concrete and companies employ it to reduce vitality utilisation because it has an edge over other atmospheric gases. Traditional steam use requires a lot of energy. Its curing produces less strength development than steam curing, but when the structure is adequately pre-conditioned, it performs better. Additionally, compared to carbon dioxide-cured blocks, steam-cured structures absorb more water.

IV. BIOLOGICAL MATERIALS

Because microcracks can arise in concrete structures and constitute a significant risk, particularly in damp environments, it is essential to design long-lasting concrete structures free from cracks. This has inspired scientists to explore on several approaches to creating eco-friendly methods. Before this time, fracture repair was typically accomplished by routinely using synthetic polymers, which are not environmentally friendly. As of right now, it is advised to use bacterially induced carbonate mineralisation as an environmentally benign technique for crack rehabilitation. Autogenous healing is the term for this method. Numerous physical, chemical, and mechanical mechanisms are necessary for the fundamental autogenous healing mechanism to function. In this mechanism, calcium carbonate plays a crucial role. Certain bacteria, which are present in soil, sand, and certain other natural minerals, have the ability to mend microcracks. A product called "bio concrete" is made using a formula to seal concrete fractures and improve its appearance. It guards against water seeping in and corroding the steel reinforcement in the building. Metakoline combined with concentrated NaOH is used to make hydro-ceramics. Materials made of hydro-ceramics are a novel development in the building sector. These materials are a viable alternative to air conditioning in buildings. When compared to their amount of water, the hydrogel bubbles in hydro-ceramics have the capacity to store more water. When it's hot outside, bubbles dissipate, yet the temperature in the designated area drops. The homeowner will save a significant amount of money by using material on walls and other building components, which can significantly cut energy consumption. Permeations and moisture are prevalent issues in all types of concrete constructions. Well-considered water is the main hazard to buildings. Many extremely hydrophobic coatings have been developed and tested recently. These include carbon nanotube (CNT) structured coatings, manganese oxide, polystyrene nanocomposites, zinc oxide, precipitated calcium carbonate, and nano silica. Waterproof constructions are produced using a lot of typical methods. These entail the application and inclusion of paints, polymeric coatings, membranes, and admixtures. Alkanes, greasy materials, oils, and fats are examples of hydrophobic materials. To create different polymer binders and hydrophobic agents for surface structures, silica nanoparticles are employed.

V. CONCLUSION

The current standards for concrete construction are strength, durability, dependability, affordability, and environmental and human safety. Using the proper binders and admixture in the batching plant helps minimise microcracks in concrete and improve its structure more effectively. In construction projects, the cost of materials could account for as much as 40% of the total project cost. Innovative building materials include bamboo reinforced concrete, bio-receptive concrete, laminated timber, aluminium foam, 3D printing, 3D printed ceramics, pollution-absorbing concrete, bricks created from pollutants, plaited microbial cellulose, super plasticisers, etc. One of the developments in the field of building materials is the creation of Super Ductile Rebars, which are utilised in earthquake situations. There were documented success stories in the field of converting wastes into riches.

REFERENCES

[1] Ahmadi, B., & Al-Khaja, W. (2001). Utilization of paper waste sludge in the building construction industry. Resources, conservation and recycling, 32(2), 105-113.

[2] Alabi, B., & Fapohunda, J. (2021). Effects of increase in the cost of building materials on the delivery of affordable housing in South Africa. Sustainability, 13(4), 1772.

[3] Alumbugu, P., Shakantu, W., & Tsado, A. (2020). Assessment of transportation efficiency for the delivery of construction material in North-Central Nigeria. Acta Structilia, 27(2), 30-56.

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[4] Arbulu, R., & Ballard, G. (2004). Lean supply systems in construction. International Group for Lean Construction. Conpenhague, Dinamarcapp, 1-13.
[5] Ashby, M. F., & Johnson, K. (2013). Materials and Design: The Art and Science of Material Selection in Product Design. Elsevier Science.
[6] Bhorat, H., Asmal, Z., Lilenstein, K., & Van der Zee, K. (2018). SMMEs in South Africa: Understanding the constraints on growth and performance. Development policy research unit, University of Cape Town.
[7] Blaževska-Stoilkovska, B., Hanák, T., & Žileska-Pančovska, V. (2015). Materials supply management in construction projects and satisfaction with the quality of structures. Tehnički vjesnik, 22(3),721-727.
[8] Khandve P 2014 Nanotechnology for building material Inter. J. Basic Appl. Res. 4, 146151
[9] Mu L and Sprando R L 2010 Application of nanotechnology in cosmetics. Pharma. Res. 27 17461749
[10] You J, Mills-Beale J M, Folev S, Roy G M, Odegard O, Dai and Goh S W 2011 Nanoclay- modified asphalt materials: Preparation characteristics. Const. Build. Mater. 25 10721080
[11] Konsta-Gdoutos M S, Metaxa Z S and Shah S P 2010 Multi-scale mechanical and fracture Characteristics and early-age strain capacity of high performance carbon/nanotube/cement nanocomposites. Cem. Conc. Comp. 32 110115
[12] Kapliński O, Košeleva N and Ropaitė G 2016 Big data in civil engineering: A state-of-the-Art survey.Eng. Struct. Tech. 8 165175.
[13] Kapliński O, Werner W, Kosecki A, Biernacki J and Kuczmarski F 2002 Current State and perspectives of research on construction management and mechanization in Poland J. Civil Eng. Managt. 8221230
[14] Passuello A, Moriconi G and Shah S P 2009 Cracking behavior of concrete with shrinkage reducing admixtures and PVA fibers Cem. Conc. Comp. 31 699704
[15] Subalakshmi P, Saraswathy V and Sivasankaran S K 2012 Hydraulicity of mineral admixtures in cement blends Constr. Build. Mater. 36 648653
[16] Altwair N M and Kabir S 2010 Green concrete structures by replacing cement with pozzolanic materials to reduce greenhouse gas emissions for sustainable environment Proc. 6th Int. Eng. Constr. Conf. (IECC'6) (Cairo: Egypt) p 269279
[17] Gajzler M 2016 Usefulness of mining methods in knowledge source analysis in the construction industry Arch. Civil Eng. 62 127142
[18] Dziadosz A and Kończak A 2016 Review of selected methods of supporting decision-making process in the construction industry Arch. Civil Eng. 62 111126
[19] Zhuang X Y et al 2016 Fly ash-based geopolymer: Clean production, properties and applications. J. Clean. Prod. 125 253267.

ISSN 2581-9429 IJARSCT