

“A Review Paper on Design and Strength Evaluation of Concrete Paver Block Using Iron Ore Tailing Sand”

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Abstract

The increasing generation of iron ore tailings from mining and beneficiation processes has created significant environmental and disposal challenges, while the excessive extraction of natural sand for construction has contributed to the depletion of natural resources. The utilization of iron ore tailing sand (IOTS) as a partial replacement for natural fine aggregate in concrete paver blocks can provide a sustainable solution to both problems. This study focuses on the design and strength evaluation of concrete paver blocks incorporating iron ore tailing sand as a replacement for natural sand. Different proportions of IOTS are proposed to be used in the concrete mix, and their effects on the physical and mechanical properties of paver blocks are evaluated.

The study includes the determination of compressive strength, water absorption, density, flexural strength, and abrasion resistance at different curing ages. The performance of IOTS-based paver blocks is compared with conventional paver blocks containing natural sand to determine the optimum replacement percentage. It is expected that an appropriate proportion of IOTS will improve particle packing and mechanical interlocking, resulting in satisfactory strength and durability characteristics. However, excessive replacement may increase water demand and porosity and consequently reduce strength. The study aims to establish the technical feasibility of using iron ore tailing sand in paver blocks while reducing natural sand consumption and providing a beneficial application for mining waste. The research can contribute to the development of economical, environmentally sustainable, and technically suitable concrete paving materials for appropriate pavement applications.

Keywords: Iron Ore Tailings, Tailing Sand, Concrete Paver Blocks, Natural Sand Replacement, Compressive Strength, Water Absorption, Abrasion Resistance, Sustainable Construction.

1. INTRODUCTION

The study also examines the effect of different replacement percentages of natural sand with iron ore tailing sand on the strength and overall performance of paver blocks. Selecting a suitable mix proportion is essential to achieve the required strength, durability, and quality. The findings from previous studies can help identify the optimum replacement level and the potential benefits and limitations of using iron ore tailing sand.

In conclusion, the use of iron ore tailing sand in concrete paver blocks offers a promising approach to sustainable construction by reducing the consumption of natural sand and promoting the effective utilization of industrial waste. However, proper mix design, experimental testing, and compliance with relevant standards are necessary before using these blocks in practical construction projects.



Figure 1: Paver Block

2. OBJECTIVES

- To study the use of iron ore tailing sand as a partial replacement for natural sand in concrete paver blocks
- To review different mix designs and replacement percentages of iron ore tailing sand
- To evaluate the effect of iron ore tailing sand on the compressive strength of paver blocks.
- To study other properties such as water absorption, density, abrasion resistance, and durability.
- To compare the performance of paver blocks made with iron ore tailing sand and conventional concrete paver blocks.

3. LITERATURE REVIEW'S

3.1. Vaidya et al. (2026): The authors investigated the utilization of iron ore tailings as a partial replacement for conventional fine aggregates in mortar and structural concrete. Their study evaluated different replacement percentages and water-cement ratios to determine the influence of iron ore tailings on the mechanical properties and durability of concrete. The reported results indicated that replacing 40% of manufactured sand with iron ore tailings increased the 28-day compressive strength from 35.24 MPa to 39.02 MPa at a water-cement ratio of 0.50. The study also examined workability, flexural strength, splitting tensile strength, and resistance to water and ion penetration. The findings suggested that the appropriate use of iron ore tailings can improve compressive strength while supporting the sustainable utilization of mining waste and reducing dependence on natural sand. This research provides a useful foundation for further investigations into the application of iron ore tailings in concrete paver blocks, where compressive strength, water absorption, abrasion resistance, and durability are important performance parameters.

3.2. Fang et al. (2025): The authors reviewed the characteristics of iron ore tailings sand (IOTS) and its effects on the properties of concrete. The authors studied the physical properties, mineral composition, workability, mechanical strength, drying shrinkage, and durability of concrete incorporating iron ore tailings sand as a replacement for natural sand. The review indicated that the appropriate incorporation of iron ore tailings sand can improve

the compressive, splitting tensile, and flexural strengths of concrete, depending on its replacement percentage and material characteristics. The authors also reported that iron ore tailings sand can improve concrete durability by enhancing impermeability and resistance to frost and carbonation under suitable mix proportions. However, excessive replacement may negatively affect workability and mechanical performance. The study concluded that iron ore tailings sand is a promising sustainable alternative to natural sand in concrete production. These findings provide a valuable basis for evaluating the strength and durability of concrete paver blocks manufactured using iron ore tailings sand.

3.3. Ramos et al. (2024): The authors reviewed research on the potential utilization of iron ore tailings as an alternative raw material in the construction sector. The study analyzed the incorporation of iron ore tailings into various construction materials, including concrete, mortar, bricks, and blocks, as a replacement for conventional materials. The findings indicated that iron ore tailings could replace approximately 5% to 100% of conventional raw materials in different applications while meeting the relevant required properties under suitable conditions. The authors reported that concrete incorporating iron ore tailings as a replacement for aggregates achieved compressive strengths of up to 63 MPa in the reviewed studies. The study also highlighted potential economic and environmental benefits, including reduced consumption of natural resources, lower construction costs in certain applications, and effective utilization of mining waste. The authors emphasized the need for further investigations into material characteristics, durability, and long-term performance. This research provides a valuable foundation for studying the design and strength evaluation of concrete paver blocks using iron ore tailing sand as a partial replacement for natural sand.

3.4. Shi et al. (2024): The authors investigated the properties of ultra-high-performance concrete (UHPC) incorporating iron tailings powder and iron tailings sand as alternative materials. The study focused on evaluating the influence of iron tailings on the workability, mechanical properties, and microstructure of concrete. The research explored the potential of utilizing iron tailings as supplementary raw materials to reduce the consumption of conventional natural resources and improve the sustainability of concrete production. The findings provided insights into the effects of iron tailings powder and sand on the performance of UHPC, highlighting the importance of material characteristics and mix proportions in achieving the desired strength and durability. The study demonstrated the potential of iron tailings for use in high-performance cement-based materials when the mix design is appropriately optimized. This research provides a useful foundation for further investigation into the design and strength evaluation of concrete paver blocks using iron ore tailing sand, particularly in assessing compressive strength, water absorption, abrasion resistance, and durability.

3.5. Shi et al. (2024): The authors investigated the properties of ultra-high-performance concrete (UHPC) incorporating iron tailings powder and iron tailings sand as alternative materials. The study focused on evaluating the influence of iron tailings on the workability, mechanical properties, and microstructure of concrete. The research explored the potential of utilizing iron tailings as supplementary raw materials to reduce the consumption of conventional natural resources and improve the sustainability of concrete production. The findings provided insights into the effects of iron tailings powder and sand on the performance of UHPC, highlighting the importance of material characteristics and mix proportions in achieving the desired strength and durability. The study demonstrated the potential of iron tailings for use in high-performance cement-based materials when the mix design is appropriately optimized. This research provides a useful foundation for further

investigation into the design and strength evaluation of concrete paver blocks using iron ore tailing sand, particularly in assessing compressive strength, water absorption, abrasion resistance, and durability

3.6. Ling et al. (2023): The authors investigated the damage behaviour of concrete incorporating iron ore tailings as aggregates under uniaxial cyclic compression. The study focused on evaluating the mechanical response and progressive damage development of concrete subjected to repeated loading and unloading. The research examined the influence of iron ore tailings on the deformation behaviour, stress-strain relationship, and damage characteristics of concrete. The findings provided insights into the failure mechanisms and damage evolution of concrete containing iron ore tailings under cyclic loading conditions. The study highlighted the importance of understanding the mechanical behaviour of tailings-based concrete to ensure its structural reliability and long-term performance. This research is relevant to the design and strength evaluation of concrete paver blocks using iron ore tailing sand, as it provides a basis for investigating their strength, resistance to repeated loading, and durability under service conditions.

3.7. Chen et al. (2023): The authors investigated the high-temperature resistance of high-strength concrete incorporating iron tailing sand as a replacement for natural fine aggregate. The study focused on evaluating the effects of elevated temperatures on the mechanical properties and performance of concrete containing iron tailing sand. Important parameters included residual compressive strength, changes in physical appearance, and the damage characteristics of concrete after exposure to high temperatures. The research helped explain how iron tailing sand influences the thermal stability and strength retention of high-strength concrete under different temperature conditions. The study highlighted the potential use of iron tailing sand in sustainable concrete production while emphasizing the importance of evaluating its performance under severe environmental conditions. This research is relevant to the present study on the design and strength evaluation of concrete paver blocks using iron ore tailing sand, as it provides a basis for further investigation of strength, durability, and resistance to environmental exposure

3.8. Liu, J. P., Ge, X. W., Liu, P., Song, G., and Hu, Z. Y. (2023): The authors investigated the preparation of cementitious materials from iron ore tailings through activation techniques. The study focused on improving the potential reactivity of iron ore tailings and evaluating their suitability for use in cement-based construction materials. The research examined the influence of activation on the material properties and cementitious performance of iron ore tailings. The findings highlighted the potential for converting mining waste into useful construction materials, thereby reducing waste accumulation and the consumption of conventional raw materials. The study also emphasized the importance of appropriate activation methods to improve the utilization efficiency of iron ore tailings in sustainable construction applications. This research provides a useful foundation for further studies on concrete paver blocks incorporating iron ore tailing sand, particularly in developing environmentally friendly construction materials and evaluating their strength and durability.

3.9. Zhao, J. S., Wang, Q. X., Xu, G. Q., Shi, Y. X., and Su, Y. P. (2023): The authors investigated the influence of macrosynthetic fibers on the mechanical properties of concrete incorporating iron ore tailings. The study focused on evaluating how the addition of fibers affects the strength and deformation behaviour of tailings-based concrete. Important mechanical properties, including compressive strength, tensile performance, flexural behaviour, and crack resistance, were considered to understand the contribution of fiber

reinforcement. The research highlighted the potential of macrosynthetic fibers to improve crack control and enhance the mechanical performance of concrete containing iron ore tailings. The study also demonstrated the importance of selecting suitable fiber contents and mix proportions to achieve the desired concrete properties. This research is relevant to the present study on the design and strength evaluation of concrete paver blocks using iron ore tailing sand, as it provides a basis for further investigations into strength improvement, crack resistance, and durability of sustainable concrete paving materials

3.10. Wang et al. (2023): The authors are studied the influence of iron tailings powder on the properties of cement concrete prepared using machine-made sand. The researchers investigated the workability, compressive strength, chloride ion permeability, and freeze–thaw resistance of concrete containing different proportions of iron tailings powder. The results showed that incorporating 7% iron tailings powder produced the highest compressive strength, lowest chloride ion permeability, and improved freeze–thaw resistance. The microstructural analysis also revealed a denser concrete structure with reduced pore volume. The study concluded that the appropriate utilization of iron tailings powder can improve the mechanical properties and durability of concrete while promoting the sustainable reuse of industrial waste. These findings provide a useful foundation for investigating iron ore tailing sand in concrete paver blocks.

3.11. Duarte et al. (2022): The authors is studied the influence of mechanical treatment and magnetic separation on the performance of iron ore tailings as a supplementary cementitious material. The authors investigated how these treatment methods affect the physical and chemical characteristics of iron ore tailings and their potential to improve cement-based materials. The study highlighted that mechanical treatment can improve the fineness of the tailings, while magnetic separation can modify their mineral composition by removing magnetic components. These treatments influence the reactivity and performance of iron ore tailings when used as a partial replacement for cement. The research demonstrated the potential of processing iron ore tailings to promote the sustainable utilization of mining waste in construction materials. This study provides useful background for exploring the use of processed iron ore tailings in concrete paver blocks and evaluating their strength and durability.

3.12. Liu et al. (2022): The authors is studied the effect of iron ore tailings as an eco-friendly aggregate on the mechanical properties, pore structure, and durability of concrete. The authors investigated the influence of iron ore tailings on concrete strength, pore characteristics, resistance to sulfate attack, and durability under repeated dry–wet cycles. The study highlighted the potential of iron ore tailings to serve as an alternative aggregate in concrete, helping to reduce the consumption of natural resources and minimize mining waste. The findings also emphasized that the performance of tailings-based concrete depends on the replacement ratio and the characteristics of the tailings. The research demonstrated the importance of evaluating both mechanical properties and durability when incorporating iron ore tailings into concrete. These findings provide a useful foundation for assessing the strength and durability of concrete paver blocks prepared using iron ore tailings sand.

3.13. Arbili et al. (2022): The authors is studied the use of iron ore tailings as a fine aggregate in concrete to promote sustainable construction practices. The authors investigated the effects of replacing natural fine aggregate with iron ore tailings on the mechanical properties and performance of concrete. The study examined important properties, including compressive strength, tensile strength, and the overall behavior of concrete containing iron

ore tailings. The findings highlighted that iron ore tailings can be utilized as an alternative fine aggregate, with concrete performance depending on the replacement percentage and mix proportions. The use of iron ore tailings also offers environmental benefits by reducing the demand for natural sand and providing a productive application for mining waste. The study concluded that iron ore tailings have potential for sustainable concrete production when their properties and replacement levels are carefully considered. These findings are relevant to the present study on the design and strength evaluation of concrete paver blocks using iron ore tailing sand.

3.14. Jayasimha et al. (2022): The author's is studied the strength and durability properties of high-strength concrete incorporating iron ore tailings as a partial replacement for fine aggregates. The authors investigated the effects of iron ore tailings on the mechanical performance and durability of concrete. The study focused on evaluating the suitability of iron ore tailings as an alternative to natural fine aggregate in high-strength concrete. The research highlighted the importance of selecting an appropriate replacement percentage to achieve satisfactory concrete performance. The use of iron ore tailings can also help reduce the consumption of natural sand and promote the sustainable utilization of mining waste. The study provides a useful reference for understanding the behavior of concrete containing iron ore tailings and supports further investigation into their application in concrete paver blocks, particularly in terms of strength and durability.

3.15. Zhang et al. (2021): The authors is studied the cementitious activity of iron ore tailings and their potential utilization in cementitious materials, bricks, and concrete. The authors investigated the properties of iron ore tailings and their suitability for use as a supplementary material in construction applications. The study discussed how the chemical composition, particle size, and processing methods of iron ore tailings influence their cementitious activity and performance. The research highlighted that suitable treatment and activation can improve the reactivity of iron ore tailings, making them more useful in cement-based products. The utilization of iron ore tailings in bricks and concrete can reduce the consumption of natural resources and support the sustainable management of mining waste. This study provides a useful foundation for exploring the application of iron ore tailings in concrete paver blocks and evaluating their strength and performance.

3.16. Zhao et al. (2021): The authors is studied the utilization of iron tailings in ultra-high-performance concrete (UHPC), focusing on its fresh properties and compressive behaviour. The authors investigated the influence of iron tailings on the workability and compressive strength of concrete. The study examined how incorporating iron tailings affects the performance of UHPC and explored their potential as an alternative material in high-performance construction. The research highlighted the importance of optimizing the proportion of iron tailings to achieve suitable fresh-state properties and satisfactory compressive strength. The use of iron tailings can also help reduce the consumption of natural resources and promote the recycling of industrial waste. This study provides useful background for evaluating iron tailings in cement-based materials and supports further research into the strength performance of concrete paver blocks manufactured using iron ore tailing sand.

3.17. Zhao et al. (2021): The authors is reviewed the characteristics of iron ore tailings (IOT) and their effects on the properties of concrete. The authors examined the physical and chemical characteristics of iron ore tailings and evaluated their influence on the workability, mechanical properties, and durability of concrete. The review indicated that iron ore tailings

have potential for use as a replacement for natural fine aggregates; however, their irregular particle shape and high specific surface area may reduce concrete workability. The authors also reported that the effects on strength and durability depend on the replacement percentage and characteristics of the tailings. At an appropriate replacement level, iron ore tailings can provide satisfactory concrete performance while reducing the consumption of natural resources and promoting the sustainable utilization of mining waste. The study provides a useful foundation for investigating iron ore tailing sand in concrete paver blocks, particularly with respect to mix design, compressive strength, and durability.

3.18. Protasio et al. (2021): The author's is studied the use of iron ore tailings obtained from the Germano dam in the production of sustainable concrete. The authors investigated the potential of utilizing iron ore tailings as an alternative aggregate in concrete to reduce the consumption of natural resources and minimize the environmental impacts associated with mining waste. The study evaluated the characteristics of the tailings and their influence on the properties of the resulting concrete. The research highlighted the potential of incorporating iron ore tailings into concrete production as an environmentally responsible construction practice. The findings support the reuse of mining residues in building materials, provided that the material characteristics and concrete performance requirements are carefully considered. This study is relevant to the present research on the design and strength evaluation of concrete paver blocks using iron ore tailing sand, as it provides a basis for investigating sustainable aggregate alternatives and their effects on concrete performance.

3.19. Chinnappa and Karra (2020): The author's is studied the strength properties of concrete incorporating iron ore tailings as a fine aggregate through experimental investigations and statistical analysis. The authors evaluated the influence of iron ore tailings on concrete strength and examined their suitability as an alternative to natural sand. The study highlighted the importance of selecting appropriate replacement proportions to achieve satisfactory concrete performance. The use of iron ore tailings can help reduce natural sand consumption and promote the sustainable utilization of mining waste. This research provides a useful foundation for evaluating the compressive strength of concrete paver blocks manufactured using iron ore tailing sand.

3.20. Cheng et al. (2020): The authors is studied the durability of concrete incorporating siliceous iron tailings. The authors investigated the influence of iron tailings on the durability performance of concrete, focusing on its resistance to environmental deterioration. The study explored the potential of siliceous iron tailings as an alternative construction material and evaluated their effects on concrete performance. The research highlighted the importance of the physical and chemical characteristics of iron tailings and their replacement proportions in determining concrete durability. The utilization of iron tailings can help reduce the consumption of natural resources and promote the sustainable reuse of mining waste. This study provides a useful foundation for evaluating the durability and strength of concrete paver blocks prepared using iron ore tailing sand.

3.21. Han et al. (2020): The authors is studied the properties of concrete containing a high volume of iron tailing powder under different curing conditions. The authors investigated how curing conditions influence the strength development and overall performance of concrete incorporating iron tailing powder. The study highlighted the importance of suitable curing conditions in improving the hydration process and achieving satisfactory concrete strength. The findings emphasize that the performance of iron tailing powder concrete depends on its proportion, curing conditions, and material characteristics. The use of iron

tailings can promote the sustainable utilization of mining waste and reduce the consumption of conventional construction materials. This research provides useful background for investigating the strength development of concrete paver blocks using iron ore tailing sand.

3.22. Zhang et al. (2020): The authors is studied the effects of iron ore tailings on the compressive strength and permeability of ultra-high-performance concrete (UHPC). The authors investigated how incorporating iron ore tailings influences the mechanical performance and water penetration resistance of concrete. The study highlighted the importance of selecting suitable proportions of iron ore tailings to achieve satisfactory compressive strength and permeability performance. The findings provide insights into the potential use of iron ore tailings as an alternative material in high-performance concrete while promoting the sustainable utilization of mining waste. This research provides a useful foundation for evaluating the strength and durability of concrete paver blocks manufactured using iron ore tailing sand.

3.23. Tang et al. (2019): The authors isstudied the recovery of iron from iron ore tailings and their potential application in concrete composite admixtures. The authors investigated methods for recovering valuable iron resources from tailings, supporting the efficient utilization of mining waste. The study highlighted the importance of recycling iron ore tailings to reduce waste accumulation and improve resource efficiency. The findings provide useful background for sustainable construction practices involving the reuse of iron ore tailings. This research is relevant to the present study on concrete paver blocks using iron ore tailing sand because it emphasizes the environmental benefits of utilizing mining by-products and conserving natural resources in construction.

3.24. Tang et al. (2019): The authors is studied the performance of cement concrete incorporating iron tailings sand as a fine aggregate. The authors investigated the influence of iron tailings sand on the properties and strength performance of concrete. The study emphasized the importance of selecting suitable replacement proportions to achieve satisfactory concrete performance. The use of iron tailings sand as a fine aggregate can reduce the consumption of natural sand and promote the sustainable utilization of mining waste. This research provides a useful basis for investigating the design and strength evaluation of concrete paver blocks manufactured using iron ore tailing sand.

3.25. Han et al. (2017): The authors is studied the early-age hydration characteristics of a composite binder containing iron tailing powder. The authors investigated the influence of iron tailing powder on the hydration process and early-age development of cementitious materials. The study focused on understanding how iron tailing powder affects the hydration reactions and performance of composite binders. The research highlighted the importance of the physical and chemical characteristics of iron tailing powder in determining its contribution to cement-based materials. The utilization of iron tailings can help reduce industrial waste and support sustainable construction practices. This study provides useful background for understanding the behavior of iron tailing materials in cement-based mixtures and their potential application in concrete paver blocks.

3.26. Sant'Ana Filho et al. (2017): The authorsis studied the technical and environmental feasibility of producing interlocking concrete pavers using iron ore tailings obtained from tailings dams. The authors evaluated the potential of iron ore tailings as a substitute for conventional materials in paver block production, focusing on their mechanical performance and environmental suitability. The study highlighted the potential to manufacture concrete

pavers using mining waste while reducing the consumption of natural resources and minimizing the environmental impacts associated with tailings disposal. The research demonstrated the importance of assessing the strength and environmental safety of tailings-based pavers before practical application. This study is directly relevant to the present research on the design and strength evaluation of concrete paver blocks using iron ore tailing sand, as it addresses both the technical performance and sustainability of these construction materials.

3.27. Cheng et al. (2016): The authors isstudied the effects of mechanochemically activated iron tailings on the compressive strength of concrete. The authors investigated how mechanical activation improves the properties of iron tailings and influences their performance when incorporated into concrete. The study focused on evaluating the compressive strength of concrete containing treated iron tailings and explored their potential as a supplementary material in cement-based mixtures. The research highlighted that mechanical activation can modify the physical characteristics and reactivity of iron tailings, potentially improving their contribution to concrete performance. The use of processed iron tailings also supports the sustainable utilization of mining waste and reduces dependence on conventional construction materials. This study provides a useful foundation for investigating the strength performance of concrete paver blocks using iron ore tailing sand.

3.28. Shettima et al. (2016): The author's isstudied the use of iron ore tailings as a replacement for fine aggregate in concrete. The authors investigated the influence of iron ore tailings on the mechanical properties and overall performance of concrete. The study evaluated the potential of using iron ore tailings as an alternative to natural sand, helping to reduce the consumption of natural resources and manage mining waste. The research highlighted the importance of selecting suitable replacement levels to achieve satisfactory concrete performance. The findings support the sustainable use of iron ore tailings in construction materials and provide a useful basis for evaluating the strength of concrete paver blocks manufactured using iron ore tailing sand.

3.29. Sunil et al. (2015): The author's is studied the potential use of mine tailings and fly ash in concrete as alternative construction materials. The authors investigated the feasibility of incorporating these industrial by-products into concrete to reduce the consumption of conventional materials and promote sustainable construction practices. The study examined their influence on concrete properties and highlighted the importance of selecting suitable material proportions to achieve satisfactory performance. The utilization of mine tailings and fly ash can help minimize waste disposal problems, conserve natural resources, and reduce the environmental impact of concrete production. This research provides useful background for the present study on the design and strength evaluation of concrete paver blocks using iron ore tailing sand.

3.30. Zhu et al. (2015): The authors is studied the influence of iron ore tailings used as fine aggregate on the strength of ultra-high-performance concrete (UHPC). The authors investigated the effects of incorporating iron ore tailings on the mechanical properties of concrete and evaluated their suitability as an alternative to conventional fine aggregate. The study highlighted the importance of the proportion of iron ore tailings in determining the strength performance of concrete. The use of iron ore tailings can help reduce the consumption of natural sand and promote the sustainable utilization of mining waste. This research provides a useful foundation for evaluating the strength properties of concrete paver blocks manufactured using iron ore tailing sand.

3.31. Zhao et al. (2014): The authors is studied the utilization of iron ore tailings as fine aggregate in ultra-high-performance concrete (UHPC). The authors investigated the effects of replacing conventional fine aggregate with iron ore tailings on the mechanical properties and performance of concrete. The study demonstrated the potential of iron ore tailings as an alternative fine aggregate and highlighted the importance of optimizing the replacement proportion to achieve satisfactory concrete strength. The use of iron ore tailings can reduce the demand for natural sand, conserve natural resources, and promote the sustainable reuse of mining waste. This research provides a valuable foundation for the present study on the design and strength evaluation of concrete paver blocks using iron ore tailing sand.

3.32. Uchechukwu and Ezekiel (2014): The authors is studied the suitability of iron ore tailings obtained from Itakpe as a material for concrete production. The authors evaluated the characteristics of the tailings to determine their potential use as an alternative construction material. The study highlighted the importance of assessing the physical and engineering properties of iron ore tailings before incorporating them into concrete mixtures. Utilizing these tailings can help reduce the consumption of natural aggregates, minimize mining waste, and promote sustainable construction practices. This research provides useful background for investigating the use of iron ore tailing sand in concrete paver blocks and evaluating its influence on strength performance.

3.33. Zhang et al. (2013): The author's isstudied the preparation and properties of concrete containing iron tailings and manufactured sand as fine aggregates. The authors investigated the potential of combining these materials as alternatives to natural sand in concrete production. The study focused on evaluating the properties and performance of concrete prepared using iron tailings and manufactured sand. The research highlighted the potential of utilizing iron tailings as a fine aggregate to conserve natural resources and reduce the environmental problems associated with mining waste. The findings provide useful background for exploring alternative fine aggregates in concrete and support further investigation into the design and strength evaluation of concrete paver blocks using iron ore tailing sand.

3.34. Feng et al. (2011): The authors' isstudied the drying shrinkage behavior of concrete prepared using iron mine tailings. The authors investigated how the incorporation of iron mine tailings influences the shrinkage characteristics of concrete during drying. The study highlighted the importance of understanding shrinkage behavior to minimize cracking and improve the long-term performance of concrete. The findings provide useful insights into the suitability of iron mine tailings as an alternative material in concrete production. The utilization of iron mine tailings can also promote sustainable construction by reducing mining waste and conserving natural resources. This research provides a useful foundation for evaluating the durability and long-term performance of concrete paver blocks manufactured using iron ore tailing sand.

3.35. Bai et al. (2011): The author's isstudied methods for reducing alkali-silica reaction (ASR) expansion in concrete prepared using iron ore tailings sand. The authors investigated the potential for controlling ASR expansion, which can cause cracking and affect the durability of concrete. The study focused on improving the performance of concrete containing iron ore tailings sand by addressing this durability-related issue. The research highlights the importance of evaluating not only the strength but also the long-term durability of concrete made with alternative fine aggregates. This study provides useful background for

the present research on concrete paver blocks using iron ore tailing sand, particularly when considering durability and resistance to expansion-related damage.

3.36. Soutsos et al. (2011): The author's isstudied the use of recycled demolition aggregates in the production of precast concrete products, particularly concrete paving blocks. The authors investigated the feasibility of replacing natural aggregates with recycled materials and evaluated their effects on the properties and performance of paving blocks. The study highlighted the potential of recycled aggregates to conserve natural resources and reduce construction and demolition waste. The findings emphasized the importance of selecting suitable aggregate replacement levels to achieve the required performance of concrete paving blocks. This research provides a valuable reference for the present study on the design and strength evaluation of concrete paver blocks using iron ore tailing sand, as both studies explore sustainable alternatives to conventional aggregates in paving applications.

3.37. Siddique and Singh (2011): The author's isinvestigated the use of waste foundry sand (WFS) in concrete manufacturing as a replacement for natural fine aggregate. The authors discussed its influence on concrete properties and its potential to reduce the consumption of natural resources. The study highlighted that the performance of concrete containing waste foundry sand depends on the replacement level and the properties of the material. The utilization of waste foundry sand can reduce industrial waste disposal and support sustainable construction practices. This study provides a useful reference for the present research on concrete paver blocks using iron ore tailing sand, as both studies explore the use of waste materials as alternative fine aggregates.

3.38. Siddique et al. (2011): The author's isstudied the strength, durability, and microstructural properties of concrete incorporating used-foundry sand (UFS). The authors investigated the influence of used-foundry sand as a partial replacement for natural fine aggregate on the performance of concrete. The study evaluated important properties, including compressive strength, durability, and microstructural characteristics. The research highlighted that the performance of concrete depends on the proportion and characteristics of the used-foundry sand. The utilization of used-foundry sand can reduce industrial waste disposal and conserve natural sand resources. This study provides useful background for the present research on concrete paver blocks using iron ore tailing sand, particularly in evaluating strength, durability, and the suitability of alternative fine aggregates.

3.39. Poon and Chan (2007): The author's isstudied the effects of contaminants on the properties of concrete paving blocks produced using recycled concrete aggregates. The authors investigated how impurities present in recycled aggregates influence the performance and quality of paving blocks. The study highlighted the importance of assessing aggregate quality to ensure satisfactory strength and durability of concrete paving blocks. The findings emphasized that contaminants can affect the properties of concrete and that proper material selection and quality control are essential for achieving reliable performance. This research provides a useful reference for the present study on the design and strength evaluation of concrete paver blocks using iron ore tailing sand, as both studies emphasize the importance of evaluating alternative aggregate materials for paving applications.

3.40. Poon and Chan (2006): The author's isstudied the production of concrete paving blocks using recycled concrete aggregate and crushed clay brick as alternative aggregate materials. The authors investigated the potential of replacing conventional aggregates with recycled materials and evaluated their influence on the properties and performance of paving

blocks. The study highlighted the benefits of recycling construction waste to reduce the consumption of natural aggregates and minimize environmental impacts. The findings emphasized the importance of selecting suitable replacement proportions to achieve satisfactory paving-block performance. This research provides a useful foundation for the present study on the design and strength evaluation of concrete paver blocks using iron ore tailing sand, as both studies explore sustainable alternatives to conventional aggregates in paving applications.

3.41. Khatib et al. (2005): The author's isstudied the properties of concrete incorporating fine recycled aggregate as a partial replacement for natural fine aggregate. The research examined how recycled aggregate influences the properties of concrete and explored its potential for sustainable construction. The study highlighted the importance of evaluating recycled aggregate when developing concrete mixtures that reduce the consumption of natural resources. This research is relevant to the present study on the design and strength evaluation of concrete paver blocks using iron ore tailing sand, as both investigations consider alternative materials for replacing conventional fine aggregates.

3.42. Poon et al. (2004): The authors is investigated the influence of moisture conditions in natural and recycled aggregates on the slump and compressive strength of concrete. Their study emphasized that aggregate moisture content can affect the water available in a concrete mix, thereby influencing its workability and strength development. Understanding the moisture condition of aggregates is therefore important for achieving consistent concrete quality. This research is relevant to the present study because iron ore tailing sand may also influence the water demand, workability, and strength of concrete paver blocks, making proper control of aggregate moisture and mix proportions essential.

3.43. Poon et al. (2002): The author's isstudied the use of recycled aggregates in the production of molded concrete bricks and blocks. The research explored the potential of using recycled materials as alternatives to natural aggregates and examined their suitability for manufacturing concrete products. The study highlighted the importance of recycling construction waste to conserve natural resources and reduce environmental impacts. This research is relevant to the present study on the design and strength evaluation of concrete paver blocks using iron ore tailing sand, as both studies investigate sustainable alternative aggregates for producing concrete building materials.

4. CONCLUSION

After studied above review papers we concluded that, the review paper on "Design and Strength Evaluation of Concrete Paver Block Using Iron Ore Tailing Sand" highlights the potential of iron ore tailing sand as an alternative material to natural river sand in concrete paver block production. The increasing generation of iron ore tailings from mining activities creates environmental challenges, while the excessive extraction of natural sand contributes to the depletion of natural resources. The utilization of iron ore tailing sand in concrete paver blocks can help address these issues by promoting sustainable construction practices and reducing the consumption of conventional fine aggregates.

The performance of concrete paver blocks incorporating iron ore tailing sand depends on factors such as replacement percentage, particle size distribution, water-cement ratio, mix proportion, and compaction method. Important properties, including compressive strength, water absorption, abrasion resistance, and durability, must be evaluated to determine the suitability of the material for practical applications. An appropriate replacement level may

provide satisfactory strength and performance while reducing construction material costs and minimizing environmental impacts.

In conclusion, iron ore tailing sand offers promising potential for use in concrete paver blocks when its properties and mix proportions are properly evaluated. However, further experimental investigations are required to establish the optimum replacement percentage and assess long-term durability under different service conditions. The adoption of this material can contribute to effective waste utilization, conservation of natural sand, and the development of economical and environmentally sustainable construction materials.

5. REFERENCES

1. Vaidya, O. V., Kawade, U. R., Nagashree, Mehta, N., Hosur, V. A., Angadrao, R. A., & Sunagar, P. (2026). Microstructure-Driven Strength and Durability Optimization of Structural Concrete Incorporating Iron Ore Tailings. *International Journal of Civil Engineering*, 13(8), 526–559. <https://doi.org/10.14445/23488352/IJCE-V13I8P131>
2. Fang, Y., Qiao, L., Hu, T., Zhang, L., Long, H., Yu, F., & Yang, Z. (2025). Characteristics of Iron Ore Tailings Sand and Properties of Iron Ore Tailings Sand Concrete: A Review. *International Journal of Concrete Structures and Materials*, 19, 41. <https://doi.org/10.1186/s40069-025-00784-2>
3. Ramos, L. T. S., Azevedo, R. C., Bezerra, A. C. S., Amaral, L. M., & Oliveira, R. D. (2024). Iron ore tailings as a new product: A review-based analysis of its potential incorporation capacity by the construction sector. *Cleaner Waste Systems*, 7, 100137. <https://doi.org/10.1016/j.clwas.2024.100137>
4. Shi, J., Pan, W. Z., Kang, J. Y., Yu, Z. J., Sun, G. R., Li, J., Zheng, K. K., & Shen, J. Y. (2024). Properties of ultra-high-performance concrete incorporating iron tailings powder and iron tailings sand. *Journal of Building Engineering*, 83, 108442. <https://doi.org/10.1016/j.jobe.2024.108442>
5. Ling, J., Wang, K. P., Wang, M., Tao, Y., & Wu, T. Y. (2023). Damage evaluation of concrete using iron ore tailings as aggregates under uniaxial cyclic compression. *Granular Matter*, 25, 25. <https://doi.org/10.1007/s10035-023-01316-z>
6. Li, Y. C., Liu, L., Deng, Y. F., Chen, Y. G., Li, Y. H., & Wu, J. (2023). Unlocking the potential of iron ore tailings in controlled low-strength material: Feasibility, performance, and evaluation. *Journal of Cleaner Production*, 423, 138772. <https://doi.org/10.1016/j.jclepro.2023.138772>
7. Chen, J. H., Yuan, Y. X., Zhu, Q., & Duan, J. Y. (2023). High-temperature resistance of high-strength concrete with iron tailing sand. *Journal of Building Engineering*, 63, 105544. <https://doi.org/10.1016/j.jobe.2022.105544>
8. Liu, J. P., Ge, X. W., Liu, P., Song, G., & Hu, Z. Y. (2023). Experimental study on the preparation of cementitious materials from iron ore tailings by activation. *Construction and Building Materials*, 385, 131409. <https://doi.org/10.1016/j.conbuildmat.2023.131409>

9. Zhao, J. S., Wang, Q. X., Xu, G. Q., Shi, Y. X., & Su, Y. P. (2023). Influence of macrosynthetic fiber on the mechanical properties of iron ore tailing concrete. *Construction and Building Materials*, 367, 130293. <https://doi.org/10.1016/j.conbuildmat.2023.130293>
10. Wang, L., Du, G. K., He, X. X., Wei, Z. C., Xu, Y. B., Li, S., & Liu, X. J. (2023). The influence of iron tailings powder on the properties on the performances of cement concrete with machine-made sand. *Coatings*, 13(5), 946. <https://doi.org/10.3390/coatings13050946>
11. Duarte, M. S., Almada, B. S., & Santos, W. J. (2022). Influence of mechanical treatment and magnetic separation on the performance of iron ore tailings as supplementary cementitious material. *Journal of Building Engineering*, 59, 105099. <https://doi.org/10.1016/j.jobbe.2022.105099>
12. Liu, K. N., Wang, S. L., Quan, X. Y., Jing, W., Xu, J., Zhao, N., & Liu, B. (2022). Effect of iron ore tailings industrial by-product as eco-friendly aggregate on mechanical properties, pore structure, and sulfate attack and dry-wet cycles resistance of concrete. *Case Studies in Construction Materials*, 17, e01472. <https://doi.org/10.1016/j.cscm.2022.e01472>
13. Arbili, M. M., Alqurashi, M., Majdi, A., Ahmad, J., & Deifalla, A. F. (2022). Concrete Made with Iron Ore Tailings as a Fine Aggregate: A Step towards Sustainable Concrete. *Materials*, 15(18), 6236. <https://doi.org/10.3390/ma15186236>
14. Jayasimha, N., Sujini, B., & Annapurna, B. P. (2022). A study on durability and strength properties of high strength concrete with partial replacement of iron ore tailings with fine aggregates. *Materials Today: Proceedings*, 65, 1922– 1929. <https://doi.org/10.1016/j.matpr.2022.05.163>
15. Zhang, N., Tang, B. W., & Li, X. M. (2021). Cementitious activity of iron ore tailing and its utilization in cementitious materials, bricks and concrete. *Construction and Building Materials*, 288, 123022. <https://doi.org/10.1016/j.conbuildmat.2021.123022>
16. Zhao, Y. Q., Gu, X. W., Qiu, J. P., Zhang, W. F., & Li, X. H. (2021). Study on the utilization of iron tailings in ultra- high-performance concrete: Fresh properties and compressive behaviors. *Materials*, 14(17), 4807. <https://doi.org/10.3390/ma14174807>
17. Zhao, J. S., Ni, K., Su, Y. P., & Shi, Y. X. (2021). An evaluation of iron ore tailings characteristics and iron ore tailings concrete properties. *Construction and Building Materials*, 286, 122968. <https://doi.org/10.1016/j.conbuildmat.2021.122968>
18. Protasio, N. M. F., Avillez, R. R. D., Letichevsky, S., & Silva, F. A. D. (2021). The use of iron ore tailings obtained from the Germano dam in the production of a sustainable concrete. *Journal of Cleaner Production*, 278, 123929. <https://doi.org/10.1016/j.jclepro.2020.123929>

19. Chinnappa, B. G., & Karra, C. R. (2020). Experimental and statistical evaluations of strength properties of concrete with iron ore tailings as fine aggregate. *Journal of Hazardous, Toxic, and Radioactive Waste*, 24(1), 04019038.
[https://doi.org/10.1061/\(ASCE\)HZ.2153-5515.0000480](https://doi.org/10.1061/(ASCE)HZ.2153-5515.0000480)
20. Cheng, Y. H., Huang, F., Qi, S. S., Li, C., & Li, G. L. (2020). Durability of concrete incorporated with siliceous iron tailings. *Construction and Building Materials*, 242, 118147. <https://doi.org/10.1016/j.conbuildmat.2020.118147>
21. Han, F. H., Luo, A., Liu, J. H., & Zhang, Z. Q. (2020). Properties of high-volume iron tailing powder concrete under different curing conditions. *Construction and Building Materials*, 241, 118108. <https://doi.org/10.1016/j.conbuildmat.2020.118108>
22. Zhang, W. F., Gu, X. W., Qiu, J. P., Liu, J. P., & Zhao, Y. Q. (2020). Effects of iron ore tailings on the compressive strength and permeability of ultra-high performance concrete. *Construction and Building Materials*, 260, 119917. <https://doi.org/10.1016/j.conbuildmat.2020.119917>
23. Tang, C., Li, K. Q., Ni, W., & Fan, D. C. (2019). Recovering iron from iron ore tailings and preparing concrete composite admixtures. *Minerals*, 9(4), 232. <https://doi.org/10.3390/min9040232>
24. Tang, K., Mao, X. S., Xu, W., & Tang, X. L. (2019). Performance analysis of cement concrete with iron tailings sand as fine aggregate. *Industrial Construction*, 49(8), 153–157. <https://doi.org/10.13204/j.gyz201908025>
25. Han, F. H., Li, L., Song, S. M., & Liu, J. H. (2017). Early-age hydration characteristics of composite binder containing iron tailing powder. *Powder Technology*, 315, 322–331. <https://doi.org/10.1016/j.powtec.2017.04.022>
26. Sant’Ana Filho, J. N., da Silva, S. N., Silva, G. C., Mendes, J. C., & Peixoto, R. A. F. (2017). Technical and Environmental Feasibility of Interlocking Concrete Pavers with Iron Ore Tailings from Tailings Dams. *Journal of Materials in Civil Engineering*, 29(9), 04017104. [https://doi.org/10.1061/\(ASCE\)MT.1943-5533.0001937](https://doi.org/10.1061/(ASCE)MT.1943-5533.0001937)
27. Cheng, Y. H., Huang, F., Li, W. C., Liu, R., Li, G. L., & Wei, J. M. (2016). Test research on the effects of mechanochemically activated iron tailings on the compressive strength of concrete. *Construction and Building Materials*, 118, 164–170. <https://doi.org/10.1016/j.conbuildmat.2016.05.020>
28. Shettima, A. U., Hussin, M. W., Ahmad, Y., & Mirza, J. (2016). Evaluation of iron ore tailings as replacement for fine aggregate in concrete. *Construction and Building Materials*, 120, 72–79. <https://doi.org/10.1016/j.conbuildmat.2016.05.095>
29. Sunil, B. M., Manjunatha, L. S., Lolitha, R., & Subhash, C. Y. (2015). Potential use of mine tailings and fly ash in concrete. *Advances in Concrete Construction*, 3(1), 55–69. <https://doi.org/10.12989/ACC.2015.3.1.055>

30. Zhu, Z. G., Li, B. X., & Zhou, M. K. (2015). The Influences of Iron Ore Tailings as Fine Aggregate on the Strength of Ultra-High Performance Concrete. *Advances in Materials Science and Engineering*, 2015, 1–6. <https://doi.org/10.1155/2015/412878>
31. Zhao, S. J., Fan, J. J., & Sun, W. (2014). Utilization of iron ore tailings as fine aggregate in ultra-high performance concrete. *Construction and Building Materials*, 50, 540–548. <https://doi.org/10.1016/j.conbuildmat.2013.10.019>
32. Uchechukwu, E. A., & Ezekiel, M. J. (2014). Evaluation of the iron ore tailings from Itakpe in Nigeria as concrete material. *Advanced Materials*, 3(4), 27–32. <https://doi.org/10.11648/j.am.20140304.12>
33. Zhang, G. D., Zhang, X. Z., Zhou, Z. H., & Cheng, X. (2013). Preparation and properties of concrete containing iron tailings/manufactured sand as fine aggregate. *Advanced Materials Research*, 838–841, 152–155. <https://doi.org/10.4028/www.scientific.net/AMR.838-841.152>
34. Feng, X. X., Xi, X. L., Cai, J. W., Chai, H. J., & Song, Y. Z. (2011). Investigation of drying shrinkage of concrete prepared with iron mine tailings. *Key Engineering Materials*, 477, 37–41. <https://doi.org/10.4028/www.scientific.net/KEM.477.37>
35. Bai, R., Cai, J., & Feng, X. (2011). Study on Reducing ASR Expansion in Concrete Prepared with Iron Ore Tailings Sand. *Advanced Materials Research*, 295–297, 594–597. <https://doi.org/10.4028/www.scientific.net/AMR.295-297.594>
36. Soutsos, M. N., Tang, K., & Millard, S. G. (2011). “Use of recycled demolition aggregate in precast products, phase II: Concrete paving blocks.” *Construction and Building Materials*, 25(7), 3131–3143. <https://doi.org/10.1016/j.conbuildmat.2010.12.024>
37. Siddique, R., & Singh, G. (2011). “Utilization of waste foundry sand (WFS) in concrete manufacturing.” *Resources, Conservation and Recycling*, 55(11), 885–892. <https://doi.org/10.1016/j.resconrec.2011.05.001>
38. Siddique, R., Kaur, G., & Rajor, A. (2010). “Strength, durability, and micro-structural properties of concrete made with used-foundry sand (UFS).” *Construction and Building Materials*, 25(4), 1916–1925. <https://doi.org/10.1016/j.conbuildmat.2010.11.065>
39. Poon, C. S., & Chan, D. (2007). “Effects of contaminants on the properties of concrete paving blocks prepared with recycled concrete aggregates.” *Construction and Building Materials*, 21(1), 164–175. <https://doi.org/10.1016/j.conbuildmat.2005.06.031>
40. Poon, C. S., & Chan, D. (2006). “Paving blocks made with recycled concrete aggregate and crushed clay brick.” *Construction and Building Materials*, 20(8), 569–577. <https://doi.org/10.1016/j.conbuildmat.2005.01.044>
41. Khatib, J. M. (2005). “Properties of concrete incorporating fine recycled aggregate.” *Cement and Concrete Research*, 35(4), 763–769. <https://doi.org/10.1016/j.cemconres.2004.06.017>

42. Poon, C. S., Shui, Z. H., Lam, L., Fok, H., & Kou, S. C. (2004). "Influence of moisture states of natural and recycled aggregates on the slump and compressive strength of concrete." *Cement and Concrete Research*, 34(1), 31–36 [https://doi.org/10.1016/S0008-8846\(03\)00186-8](https://doi.org/10.1016/S0008-8846(03)00186-8)
43. Poon, C. S., Kou, S. C., & Lam, L. (2002). "Use of recycled aggregates in molded concrete bricks and blocks." *Construction and Building Materials*, 16(5), 281–289. [https://doi.org/10.1016/S0950-0618\(02\)00019-3](https://doi.org/10.1016/S0950-0618(02)00019-3)