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A Holistic Review of Circular Economy in Construction: Performance, Economic Viability, and Strategic Management for Structures

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***Abstract* - The global construction industry, a colossal consumer of natural resources and a significant generator of solid waste, is under immense pressure to transition from a linear "take-make-dispose" model to a Circular Economy (CE). A cornerstone of this transition is the utilization of Recycled Concrete Aggregates (RCA) derived from construction and demolition (C&D) waste in new Reinforced Cement Concrete (RCC) structures. This paper provides a comprehensive review of the performance evaluation of RCA in RCC, analysing its fresh, hardened, and durability properties. It further investigates the multifaceted economic impact, moving beyond simple cost accounting to encompass life-cycle costing, carbon pricing, and market creation. Crucially, this review integrates modern paradigms, exploring the role of Artificial Intelligence (AI) and Machine Learning (ML) in optimizing RCA mix designs and predicting performance. Finally, it bridges the gap between technical feasibility and practical implementation by discussing the financial models, risk management strategies, and business management shifts required for widespread RCA adoption. The synthesis concludes that while technical challenges persist, they are surmountable, and the true key to unlocking RCA's potential lies in a synergistic approach that combines advanced material science, data-driven decision-making, and innovative business and financial management.**

Keywords: Circular Economy, Recycled Concrete Aggregate (RCA), RCC Structures, Economic Impact, Life Cycle Assessment (LCA), Artificial Intelligence (AI) in Construction, Construction Finance, Sustainable Business Management.

I. Introduction

The construction sector is the bedrock of modern civilization, yet it is also one of the largest contributors to environmental degradation, accounting for over 35% of global solid waste generation and consuming nearly 50% of all extracted materials [1] [2] [3] [4] [5]. This linear model of consumption is unsustainable. The concept of a Circular Economy (CE) offers a transformative alternative, aiming to eliminate waste and circulate resources at their highest value for as long as possible [6] [7] [8]. Within the construction CE, the recycling of Construction and Demolition (C&D) waste into valuable resources is paramount [9] [10].

Among the various components of C&D waste, concrete rubble represents the largest fraction. Processing this rubble produces Recycled Concrete Aggregate (RCA), which can replace natural aggregates (NA) like gravel and crushed stone in new concrete production, particularly in Reinforced Cement Concrete (RCC) structures [11] [12] [13]. The potential benefits are profound: conservation of natural resources, reduction in landfill usage, and a decrease in the carbon footprint associated with quarrying and transporting virgin aggregates [14] [15].

However, the widespread adoption of RCA in structural RCC has been hesitant. This reluctance stems from three primary areas of concern:

1. **Technical Performance:** Uncertainty regarding the mechanical and durability properties of RCA-based concrete compared to conventional concrete.
2. **Economic Viability:** Perceptions of higher costs and unclear financial benefits.
3. **Management and Supply Chain:** Lack of established supply chains, quality standards, and business models.

This review paper aims to address these concerns holistically. It will first delve into a detailed performance evaluation of RAC (Recycled Aggregate Concrete). It will then conduct a nuanced economic analysis, incorporating life-

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cycle thinking and financial incentives [16] [17] [18]. Furthermore, it will explore the revolutionary role of AI and ML in overcoming technical barriers. Finally, it will discuss the essential management, business, and financial strategies needed to make RCA a mainstream, economically attractive choice for the construction industry [19] [20].

II. Performance Evaluation of RAC in RCC Structures

The performance of concrete is judged by its fresh properties, hardened mechanical properties, and long-term durability. RCA, being derived from old concrete, has different characteristics than NA, primarily due to the presence of adhered mortar on its surface.

2.1 Source and Characteristics of RCA

RCA is produced by systematically crushing and screening demolished concrete elements. Its key distinguishing feature is the porous, weaker layer of old cement mortar that remains attached to the original natural aggregate [21] [22] [34]. This leads to:

- **Lower Density:** RCA is generally lighter than NA.
- **Higher Water Absorption:** The porous mortar can absorb significantly more water (can be 3-5 times higher than NA), which impacts the mixing water requirement.
- **Reduced Strength:** The mortar-aggregate interface and the mortar itself are often the weakest links, impacting the overall concrete strength.

2.2 Fresh and Mechanical Properties

- **Workability:** For the same water content, RAC often exhibits lower workability due to the high-water absorption of RCA. This can be mitigated by pre-saturating the RCA (pre-soaking) or using additional water or superplasticizers [23] [31] [32] [33].
- **Compressive Strength:** Most studies indicate a reduction in compressive strength with an increase in RCA replacement ratio. For replacements up to 30%, the strength reduction is often minimal (5-10%). With 100% replacement, strength reductions of 15-30% are common [24] [29] [30]. However, through optimized mix design (e.g., lowering the water-to-cement ratio, using pozzolanic materials like fly ash), it is entirely feasible to produce RAC with compressive strengths matching or exceeding that of conventional concrete for structural applications.
- **Tensile Strength and Modulus of Elasticity:** The tensile strength (split tensile and flexural) is also affected, but the most significant impact is on the Modulus of Elasticity (MoE). RAC typically has a 15-30% lower MoE, indicating that it is more flexible and will exhibit larger deflections under load [25] [36]. This is a critical consideration for structural designers, requiring careful attention to serviceability limit states (deflection and crack control).

2.3 Durability Aspects

Durability is the major long-term concern for RCC structures. The porous nature of RCA raises questions about its resistance to environmental attacks [39] [40].

- **Permeability and Sorptivity:** RAC generally has higher permeability and water sorptivity, making it more susceptible to the ingress of harmful agents like chlorides and sulfate.
- **Carbonation Resistance:** The increased porosity can lead to a faster rate of carbonationthe process where carbon dioxide penetrates the concrete and lowers its alkalinity, potentially corroding the steel reinforcement. Several studies confirm a higher carbonation depth in RAC compared to NAC [26] [35].
- **Chloride Ion Penetration:** Similarly, the resistance to chloride ion penetration is often lower, increasing the risk of reinforcement corrosion in marine environments or where de-icing salts are used [27] [37].
- **Mitigation Strategies:** These durability challenges are not insurmountable. The use of supplementary cementitious materials (SCMs) such as fly ash, slag, or silica fume can densify the concrete matrix, significantly improving its impermeability and durability performance. Furthermore, limiting the RCA replacement ratio in aggressive environments is a prudent design choice [28] [38].

2.4 The Role of AI and ML in Performance Prediction and Optimization

The variability in RCA quality (source-dependent) makes creating a universal mix design formula challenging. This is where **Artificial Intelligence (AI)** and **Machine Learning (ML)** are game-changers [40] [41] [42].

- **Predictive Modeling:** ML algorithms, such as Artificial Neural Networks (ANNs), Support Vector Machines (SVM), and Random Forests, can be trained on vast datasets of experimental results. These models can learn the complex, non-linear relationships between input variables (e.g., RCA replacement ratio, water-cement ratio, cement content, SCM type) and output properties (e.g., compressive strength, MoE, chloride permeability)

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[43] [44]. An engineer can input the locally available RCA properties and desired concrete performance, and the ML model can predict the optimal mix proportions, saving time and resources on extensive lab trials [45] [46] [52].

- **Quality Control and Classification:** Computer vision systems, powered by AI, can be used at recycling plants to automatically sort and classify C&D waste, ensuring a more consistent and higher-quality RCA feed [47]. AI can also analyze real-time data from sensors in mixing plants to adjust water addition dynamically based on the moisture content of the RCA, ensuring consistent workability [48] [51].
- **Generative Design:** AI systems can explore thousands of potential mix design combinations to meet multiple, often conflicting, objectives (e.g., maximize strength, minimize cost, and minimize carbon footprint), presenting engineers with a set of Pareto-optimal solutions [49] [50].

III. Economic Impact and Financial Appraisal

The economic discussion around RCA must evolve from a simplistic comparison of "aggregate price per ton" to a comprehensive financial appraisal that captures its true value in a circular economy [53] .

3.1 Traditional Cost Analysis: The Surface View

At first glance, the production cost of RCA can be higher than that of NA. This is due to the costs associated with collection, transportation, processing (crushing, screening, contaminant removal), and quality control of C&D waste. In many regions, the low disposal fees for landfilling C&D waste make recycling economically unattractive. Therefore, from a narrow, initial-cost perspective, NAC often wins [54].

3.2 Life Cycle Costing (LCC): The Bigger Picture

A Life Cycle Costing (LCC) analysis, which considers all costs from cradle to grave, often reveals a different story. LCC for an RCC structure using RCA includes:

- **Initial Costs:** Material, transportation, and construction.
- **Operational Costs:** Maintenance and repairs.
- **End-of-Life Costs:** Demolition, disposal, or future recycling.

While initial costs for RAC might be slightly higher, the LCC can be lower due to:

- **Avoided Disposal Costs:** The generator of C&D waste saves on landfill tipping fees by diverting it to a recycling center.
- **Reduced Virgin Material Procurement:** Savings on the cost of quarrying and transporting new aggregates.
- **Future Liability:** As carbon taxes and strict landfill regulations become more prevalent, the cost of linear disposal will rise, making circular options financially prudent.

3.3 Carbon Pricing and Green Financing

The integration of environmental externalities is a powerful economic driver for RCA [55] [56].

- **Carbon Credits and Taxes:** The use of RCA has a significantly lower carbon footprint than quarrying virgin aggregates. In jurisdictions with carbon pricing mechanisms, this reduction can be monetized through carbon credits or by avoiding carbon taxes, directly improving the project's bottom line.
- **Green Bonds and Loans:** Projects demonstrating a clear commitment to sustainability, such as using a high percentage of RCA, are increasingly eligible for "green financing." This can come in the form of green bonds or loans with lower interest rates, improving the project's financial viability [7].
- **Green Building Certifications:** Using RCA contributes to points in rating systems like LEED (Leadership in Energy and Environmental Design) or BREEAM, which can enhance the asset's market value, attract tenants, and lead to higher rental yields.

3.4 Financial De-risking and Investment

The perceived risk of using a "non-standard" material like RCA often deters investors and contractors. To overcome this, the financial sector can play a role:

- **Insurance Products:** Development of specialized insurance products that cover performance risks associated with green building materials could provide comfort to project owners.
- **Performance Bonds:** Surety companies could offer bonds specifically tailored for projects using RCA, guaranteeing their performance.
- **Securitization of C&D Waste Streams:** Financial instruments could be created based on the predictable revenue from processing C&D waste, attracting investment into the recycling infrastructure.

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IV. Management, Business, and Strategic Implications

Technical feasibility and economic models alone are insufficient. Widespread adoption requires strategic shifts in management and business operations across the construction value chain.

4.1 Supply Chain Management and Reverse Logistics

The linear aggregate supply chain is well-established. For RCA, a new, reverse logistics chain must be created and managed effectively.

- **Creating a "Waste-as-a-Resource" Mindset:** C&D waste must be re-framed not as garbage, but as a valuable feedstock. This requires on-site segregation practices to prevent contamination.
- **Strategic Location of Recycling Plants:** To minimize transportation costs (both financial and environmental), recycling plants should be located near urban centers, the primary sources of C&D waste and the primary demand for new construction.
- **Quality Assurance and Standards:** Management must implement rigorous quality control protocols at recycling plants to ensure consistent RCA properties. The development and enforcement of national and international standards for RCA (e.g., EN 206 in Europe, IS 383 in India) are crucial for building confidence among engineers and specifiers.

4.2 Business Model Innovation

Companies can build competitive advantages around CE principles.

- **Vertical Integration:** Large construction firms can integrate backwards by acquiring or partnering with C&D waste recycling companies. This secures their supply of green materials, controls costs, and creates a new revenue stream.
- **Product-Service Systems (PSS):** Instead of just selling concrete, a company could offer a "structural performance service," where they retain ownership of the material and are responsible for its eventual deconstruction and reuse, creating a long-term customer relationship and ensuring the return of valuable materials.
- **Digital Marketplaces:** Tech startups can create B2B online platforms that connect C&D waste generators with recycling facilities and construction projects seeking RCA, optimizing logistics and creating market transparency.

4.3 Risk Management and Contractual Frameworks

Traditional construction contracts often allocate risk in ways that discourage innovation.

- **Collaborative Contracting:** Models like Partnering, Alliancing, or Integrated Project Delivery (IPD) foster collaboration between the client, designer, contractor, and supplier. This shared risk/reward environment is more conducive to implementing new solutions like RCA.
- **Clear Specification and Liability:** Contracts must clearly specify the required quality of RCA, the mix design protocols, and the testing regimes. They should also clearly define liabilities, perhaps with a shared-risk approach during the initial pilot projects.

4.4 Leadership and Change Management

The transition to a circular model is a cultural shift. It requires:

- **Top-Down Commitment:** Senior management must champion sustainability and circularity as core business values, not just a marketing slogan.
- **Training and Upskilling:** Engineers, architects, and site supervisors need training on the properties, specification, and handling of RAC.
- **Stakeholder Engagement:** Early and continuous engagement with regulators, clients, and the community is essential to build trust and acceptance for using "recycled" materials in structures.

V. Discussion and Synthesis of Findings

The review reveals a complex but promising landscape. The technical challenges of using RCA in RCC are well-understood and can be effectively managed through prudent mix design, the use of SCMs, and sensible limits on replacement ratios in harsh environments. The perceived performance gap is closing rapidly with advanced material science and, more recently, with the powerful tools of AI and ML for optimization and prediction.

The economic argument, while not straightforward, is compelling when viewed through the lens of Life Cycle Costing, carbon economics, and green finance. The initial cost premium is often a myth when avoided disposal costs and transportation savings are factored in, and it becomes a clear advantage when future-facing financial instruments are applied.

Ultimately, the final and most significant barrier is not technical or purely economic, but managerial and strategic. The success of RCA hinges on the construction industry's ability to transform its business models, manage

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reverse supply chains, adopt collaborative contracts, and lead a cultural shift towards valuing resources differently. The integration of AI and data analytics provides the tools to de-risk the technical side, while innovative financial models can de-risk the economic side, allowing management to focus on the strategic opportunity.

VI. Conclusion and Future Directions

The integration of Recycled Concrete Aggregates into structural RCC is a viable and essential step for the construction industry's transition to a Circular Economy. This review concludes that:

1. **Technically,** RAC is a competent material for many structural applications. Future research should focus on advanced treatment methods to remove adhered mortar and enhance RCA quality, and on the long-term (50+ years) in-situ performance monitoring of RCC structures built with RCA.
2. **Economically,** the full value proposition of RCA is realized through holistic financial models that internalize environmental costs and benefits. Future efforts should be directed at standardizing the accounting of "circularity benefits" and developing more sophisticated green financial products.
3. **Managerially,** the industry must embrace new business models, collaborative contracts, and digital tools to build robust RCA supply chains. A major future direction is the development of AI-powered "Circular Construction Platforms" that integrate material passports, digital twins of buildings, and marketplaces for secondary materials.

The path forward is one of convergence. Material scientists, data analysts, economists, financial experts, and business leaders must collaborate. By fusing technical innovation with economic intelligence and strategic management, the vision of a circular construction sector, where buildings are not merely structures but future material banks, can become a reality.

REFERENCES

[1] Chagger, Jeevanjot & chedda, Er & Wuntah, Er. (2025). Review study: Waste glass powder (WGP) with replacement of cement. *International Journal of Structural Design and Engineering*. 6. 01-06. 10.22271/27078280.2025.v6.i2a.43. https://www.researchgate.net/publication/394245448_Review_study_Waste_glass_powder_WGP_with_replacement_of_cement

[2] Sharma, H., Singh, J., Kumar, A., Bala, M., & Kumar, S. (2025, June). Review on the utilization of the Geogrids in road construction. *In AIP Conference Proceedings* (Vol. 3261, No. 1, p. 120002). *AIP Publishing LLC.* https://www.researchgate.net/publication/392428380_Review_on_the_utilization_of_the_Geogrids_in_road_construction

[3] Singh, Mehir & Thakur, Dr. (2024). Optimizing Tourism and Traffic with ITS in Nepal and India. *International Journal of Applied Science and Engineering Review.* 5. 2582-6948. Vol. 5 Issue 7, July 2024, https://www.researchgate.net/publication/387540549_Optimizing_Tourism_and_Traffic_with_ITS_in_Nepal_and_India

[4] Ashraf, Aadil & Thakur, Dr. (2023). Use of Waste Polythene in Bituminous Concrete Mixes for Highways. *International Journal for Research in Applied Science and Engineering Technology.* 11. 1709-1712. 10.22214/ijraset.2023.56293. https://www.researchgate.net/publication/375113951_Use_of_Waste_Polythene_in_Bituminous_Concrete_Mixes_for_Highways

[5] Chagger, Jeevanjot & Anil, Er. (2025). A REVIEW STUDY: ELECTRICAL WORK ON CONSTRUCTION SITE. *Industrial Engineering Journal, ISSN: 0970-2555*, Volume: 53, Issue 6, No.5, June: 2024. https://www.researchgate.net/publication/396053644_A_REVIEW_STUDY_ELECTRICAL_WORK_ON_CONSTRUCTION_SITE

[6] Chagger, Jeevanjot & chedda, Er & Wuntah, Er. (2025). Review study: Waste glass powder (WGP) with replacement of cement. *International Journal of Structural Design and Engineering.* 6. 01-06. 10.22271/27078280.2025.v6.i2a.43. https://www.researchgate.net/publication/394245448_Review_study_Waste_glass_powder_WGP_with_replacement_of_cement

[7] Sharma, H., Singh, J., Kumar, A., Bala, M., & Kumar, S. (2025, June). Review on the utilization of the Geogrids in road construction. *In AIP Conference Proceedings* (Vol. 3261, No. 1, p. 120002). *AIP Publishing LLC.* https://www.researchgate.net/publication/392428380_Review_on_the_utilization_of_the_Geogrids_in_road_construction

[8] Suri, Navleen & Chagger, Jeevanjot & Sharma, Er. Harish & Chandel, Dr. (2025). INVESTIGATION ON THE TENSILE STRENGTH WITH USE OF ScBA AND WPSA WITH PARTIAL REPLACEMENT OF CEMENT IN CONCRETE. *Industrial Engineering Journal.* 54. 678-704. https://www.researchgate.net/publication/391643779_I

ISSN (online): 2581-3048
Volume 9, Issue 10, pp 245-254, October-2025
https://doi.org/10.47001/IRJIET/2025.910031

NVESTIGATION_ON_THE_TENSILE_STRENGTH_WITH_USE_OF_ScBA_AND_WPSA_WITH_PARTIAL_REPLACEMENT_OF_CEMENT_IN_CONCRETE

[9] Jeevanjot Singh, Simran, Pema Chheda, Prince Wuni Wuntah. A review study on machine learning to investigate the issue of plastic pollution in oceans. *Int J Hydropower Civ Eng* 2025; 6(1):48-51. DOI: 10.22271/27078302.2025.v6.i1a.62. https://www.researchgate.net/publication/396213967_A_review_study_on_machine_learning_to_investigate_the_issue_of_plastic_pollution_in_oceans

[10] Chagger, Jeevanjot & Sharma, Er. Harish & Bala, Er. (2024). PARTIAL REPLACEMENT OF CEMENT WITH RICE HUSK ASH & SUGARCANE BAGASSE ASH: REVIEW PAPER. *Industrial Engineering Journal ISSN: 0970-2555* Volume: 53, Issue 6, June: 2024. https://www.researchgate.net/publication/387567151_PARTIAL_REPLACEMENT_OF_CEMENT_WITH_RICE_HUSK_ASH_SUGARCANE_BAGASSE_ASH_REVIEW_PAPER

[11] Suri, Navleen & Chagger, Jeevanjot & Sharma, Er. Harish & Chandel, Dr. (2025). INVESTIGATION ON THE COMPRESSIVE STRENGTH WITH USE OF ScBA AND WPSA WITH PARTIAL REPLACEMENT OF CEMENT IN CONCRETE. *Industrial Engineering Journal. Industrial Engineering Journal ISSN: 0970-2555* Volume: 54, Issue 4, April: 2025. https://www.researchgate.net/publication/391643772_INVESTIGATION_ON_THE_COMPRESSIVE_STRENGTH_WITH_USE_OF_ScBA_AND_WPSA_WITH_PARTIAL_REPLACEMENT_OF_CEMENT_IN_CONCRETE

[12] Chagger, Jeevanjot & Bala, Er & Sharma, Er. Harish. (2024). INVESTIGATE THE COMPRESSIVE STRENGTH OF CONCRETE USING FLY ASH ON M30 CONCRETE GRADE. *Industrial Engineering Journal ISSN: 0970-2555* Volume: 53, Issue 6, No.5, June: 2024 https://www.researchgate.net/publication/387566115_INVESTIGATE_THE_COMPRESSIVE_STRENGTH_OF_CONCRETE_USING_FLY_ASH_ON_M30_CONCRETE_GRADE

[13] Singh, Er & Chagger, Jeevanjot. (2024). Review Study: Robotics and Automation in Construction, *IRJIET*, Volume 8, Issue 11, November 2024 pp. 260-264. 10.47001/IRJIET/2024.811033. https://www.researchgate.net/publication/396051331_Review_Study_Robotics_and_Automation_in_Construction

[14] Chagger, Jeevanjot & Sharma, Er. Harish. (2024). Review Study on Partial Replacement of Cement with Sugarcane Bagasse Ash (SCBA), *National Conference on "Empowering Sustainability: Bridging Science, Technology and Climate Resilience" (ESBSTCR-2024),* 17-19 Jan 2024; SBBS University, Jalandhar, Punjab. https://www.researchgate.net/publication/396270286_Review_Study_on_Partial_Replacement_of_Cement_with_Sugarcane_Bagasse_Ash_SCBA

[15] Chagger, Jeevanjot & Sharma, Er. Harish. (2024). A Review: ScBA& WPSA Used in Concrete as Partial Replacement of Cement, *National Conference on "Empowering Sustainability: Bridging Science, Technology and Climate Resilience" (ESBSTCR-2024),* 17-19 Jan 2024; SBBS University, Jalandhar, Punjab. https://www.researchgate.net/publication/396270282_A_Review_ScBA_WPSA_Used_in_Concrete_as_Partial_Replacement_of_Cement

[16] Chagger, Jeevanjot & Sharma, Er. Harish. (2024). A Review on Improving Asphalt Mixtures Through the Use of Geosynthetics and Waste Fibers, *National Conference on "Empowering Sustainability: Bridging Science, Technology and Climate Resilience" (ESBSTCR-2024),* 17-19 Jan 2024; SBBS University, Jalandhar, Punjab. https://www.researchgate.net/publication/387573908_A_Review_on_Improving_Asphalt_Mixtures_Through_the_Use_of_Geosynthetics_and_Waste_Fibers

[17] Mahi, Vishal & Chagger, Jeevanjot & Sharma, Er. Harish & Bala, Er. (2024). Performance Evaluation of Adhession in Recycled & Reused Construction Material in RCC, *International Research Journal of Innovations in Engineering and Technology (IRJIET),* ISSN (online): 2581-3048, Volume 8, Issue 1, pp 19-37, January-2024. https://doi.org/10.47001/IRJIET/2024.801004,https://www.researchgate.net/publication/387570170_Performance_Evaluation_of_Adhession_in_Recycled_Reused_Construction_Material_in_RCC

[18] Anmol, & Sharma, Er. Harish & Bala, Er & Chagger, Jeevanjot. (2023). An Examination the Use of Waste Glass Powder as Cement Partial Replacement in Concrete. *International Research Journal of Innovations in Engineering and Technology (IRJIET)* ISSN (online): 2581-3048 Volume 7, Issue 11, pp 343-355, November-2023. https://doi.org/10.47001/IRJIET/2023.711047,https://www.researchgate.net/publication/375826197_An_Examination_the_Use_of_Waste_Glass_Powder_as_Cement_Partial_Replacement_in_Concrete

[19] Chagger, Jeevanjot & Singh, Gurpreet & Mohit, (2023). A Review Study on The Use of Geosynthetics

ISSN (online): 2581-3048
Volume 9, Issue 10, pp 245-254, October-2025
https://doi.org/10.47001/IRJIET/2025.910031

in Road Constructions. *International Journal of Research Publication and Reviews*, Vol 4, no 7, pp 518-522 July 2023. https://ijrpr.com/uploads/V4ISSUE7/IJRPR15273.pdf,https://www.researchgate.net/publication/396052553_A_Review_Study_on_The_Use_of_Geosynthetics_in_Road_Constructions

[20] Chagger, Jeevanjot. (2023). ASSESSING THE EFFECTIVENESS OF BAMBOO IN ENHANCING THE STRENGTH OF CONCRETE STRUCTURES: A REVIEW STUDY, *International Journal of Engineering Technology Research & Management*, Vol-07 Issue 07, 68-76, July-2023. https://www.researchgate.net/publication/396052546_ASSESSING_THE_EFFECTIVENESS_OF_BAMBOO_IN_ENHANCING_THE_STRENGTH_OF_CONCRETE_STRUCTURES_A_REVIEW_STUDY

[21] Singh, J.; Chandel, S.K.; Mohit; Singh, G. The Article Explores Improving the Performance of Asphalt Mixtures through the Utilization of Added Fibers. *Int. Res. J. Innov. Eng. Technol.* 2023, 7, 59–65. https://www.researchgate.net/publication/389533862_The_Article_Explores_Improving_the_Performance_of_Asphalt_Mixtures_through_the_Utilization_of_Added_Fibers

[22] Singh J, Mohit, Gurpreet Singh. Case study on partial replacement of cement with RHA. Int J Res Anal Rev (IJRAR). 2023; 10(3):5-10. Available from: http://www.ijrar.org/IJRAR23C1002.pdf,https://www.researchgate.net/publication/389533760_Case_Study_on_Partial_Replacement_of_Cement_with_RHA

[23] J. Singh, D. S. Chandel, "An Examination and Investigation Compressive Strength the Use of Waste Paper Sludge Ash and Rice Husk Ash as Cement Substitutes in Concrete", *International Journal of Innovative Research in Engineering and Management (IJIREM)*, Vol-10, Issue-3, Page No-60-66, 2023. Available from: https://doi.org/10.55524/ijirem.2023.10.3.11,https://www.researchgate.net/publication/372098556_An_Examination_and_Investigation_Compressive_Strength_the_Use_of_Waste_Paper_Sludge_Ash_and_Rice_Husk_Ash_as_Cement_Substitutes_in_Concrete

[24] Jeevanjot Singh, Mohit, Gurpreet Singh (July2023), "THE EXAMINATION STUDY TO INVESTIGATE THE EFFECTS OF USING A REDUCED AMOUNT OF CEMENT WITH WPSA, '*International Research Journal of Modernization in Engineering Technology and Science*, Volume:05/Issue:07/July-2023 Impact Factor- 7.868 www.irjmets.com, e-ISSN: 2582-5208. https://www.researchgate.net/publication/396052546_ASSESSING_THE_EFFECTIVENESS_OF_BAMBOO_IN_ENHANCING_THE_STRENGTH_OF_CONCRETE_STRUCTURES_A_REVIEW_STUDY

[25] Jeevanjot Singh, Dr. Sandeep Kumar Chandel, Mohit, Gurpreet Singh (2023), "A Study: How Using Waste Paper Sludge Ash and Rice Husk Ash Instead of Cement in Concrete, '*Quest Journals Journal of Architecture and Civil Engineering*, Volume 8 ~ Issue 7, pp: 20-29, ISSN (Online): 2321-8193, www.questjournals.org, https://www.researchgate.net/publication/396052558_A_Study_How_Using_Waste_Paper_Sludge_Ash_and_Rice_Husk_Ash_Instead_of_Cement_in_Concrete

[26] Sah, Nandkishor& Thakur, Dr. (2025). Evaluation of Innovative Construction Techniques for Rapid MSE Wall Installation. 10.1007/978-981-96-7779-5_12. https://www.researchgate.net/publication/396546906_Evaluation_of_Innovative_Construction_Techniques_for_Rapid_MSE_Wall_Installation

[27] Singh, Mehir & Thakur, Dr. (2025). USING INTELLIGENT TRANSPORTATION SYSTEMS FOR TOURISM AND TRAFFIC CONTROL IN NEPAL AND INDIA. 2024. https://www.researchgate.net/publication/396143907_USING_INTELLIGENT_TRANSPORTATION_SYSTEMS_FOR_TOURISM_AND_TRAFFIC_CONTROL_IN_NEPAL_AND_INDIA

[28] Thakur, Dr. (2025). View of Thermal Properties of Concrete Prepared with Water Absorbing Beads, *International Conference on Multidisciplinary Approaches for Sustainable Development*, Volume: 32. https://www.researchgate.net/publication/394873033_View_of_Thermal_Properties_of_Concrete_Prepared_with_Water_Absorbing_Beads

[29] Sah, N., Thakur, A., Sah, S.K. (2025). Evaluation of Innovative Construction Techniques for Rapid MSE Wall Installation. In: Dixit, M.S., Jaiswal, S.S., Shermale, Y., Satyam, N., Singh, A.P. (eds) *Proceedings of the Indian Geotechnical Conference (IGC 2024)*, Volume 6. IGC 2024. *Lecture Notes in Civil Engineering, vol 702. Springer, Singapore*. https://doi.org/10.1007/978-981-96-7779-5_12

[30] Thakur, Dr. (2024). Comparative Simulation of Advanced Oxidation Process and Electrocoagulation for Wastewater Treatment: A Two-Dimensional Diffusion–Reaction Study, *Conference: International Conference on Multidisciplinary Approaches for Sustainable Development,* Volume: 31. https://www.researchgate.net/publication/394872905_Comparative_Simulation_of_Advanced_Oxidation_Process_and_Electrocoagulation_for_Wastewater_Treatment_A_Two-Dimensional_Diffusion-Reaction_Study

ISSN (online): 2581-3048
Volume 9, Issue 10, pp 245-254, October-2025
https://doi.org/10.47001/IRJIET/2025.910031

[31] Thakur, Dr. (2024). Development of Sustainable and Cost-Effective Framework for Rain Water Treatment, *Conference: International Conference on Multidisciplinary Approaches for Sustainable Development*, Volume: 32, https://www.researchgate.net/publication/394872689_Development_of_Sustainable_and_Cost-Effective_Framework_for_Rain_Water_Treatment

[32] Thakur, Dr. (2025). Development of Sustainable and Cost-Effective Framework for Rain Water Treatment. *International Conference on Multidisciplinary Approaches for Sustainable Development*, Volume: 32, https://www.researchgate.net/publication/394872496_Identification_of_Contaminants_Present_in_Rainwater_Collected_from_Ground_Pit_and_its_Removal

[33] N. Sah and A. Thakur, "Innovative Techniques for Rapid MSE Wall Installation", *J. Sci. Techn.*, vol. 4, no. 2, pp. 90–93, May 2025. https://www.researchgate.net/publication/396733403_Innovative_Techniques_for_Rapid_MSE_Wall_Installation

[34] Singh, Mehir & Thakur, Dr. (2024). Optimizing Tourism and Traffic with ITS in Nepal and India. *International Journal of Applied Science and Engineering Review*. 5. 2582-6948. Vol. 5 Issue 7, July 2024, https://www.researchgate.net/publication/387540549_Optimizing_Tourism_and_Traffic_with_ITS_in_Nepal_and_India

[35] Ashraf, Aadil & Thakur, Dr. (2023). Use of Waste Polythene in Bituminous Concrete Mixes for Highways. *International Journal for Research in Applied Science and Engineering Technology*. 11. 1709-1712. 10.22214/ijraset.2023.56293. https://www.researchgate.net/publication/375113951_Use_of_Waste_Polythene_in_Bituminous_Concrete_Mixes_for_Highways

[36] Themisana, Rajkumari & Thakur, Dr &Thaguna, Parwati& Thounaojam, Anuradha & Senagah, Amenjor. (2023). TO DETERMINE THE STRENGTH OF CONCRETE WITH PARTIAL REPLACEMENT OF SAND WITH MARBLE DUST POWDER. 10.17605/OSF.IO/QD68N. https://www.researchgate.net/publication/372724255_TO_DETERMINE_THE_STRENGTH_OF_CONCRETE_WITH_PARTIAL_REPLACEMENT_OF_SAND_WITH_MARBLE_DUST_POWDER

[37] Thagunna, Parwati& Thakur, Dr & Devi, Rajkumari & Thounaojam, Anuradha & Senagah, Amenjor. (2023). EXPERIMENTAL STUDY FOR STABILIZING PROPERTIES OF BLACK COTTON SOIL BY USE OF GEOGRID AND ADMIXTURE. *Journal of Biomechanical Science and Engineering*. APRIL 2023. 725-728. 10.17605/OSF.IO/A4E39. https://www.researchgate.net/publication/372724185_EXPERIMENTAL_STUDY_FOR_STABILIZING_PROPERTIES_OF_BLACK_COTTON_SOIL_BY_USE_OF_GEOGRID_AND_ADMIXTURE

[38] Thakur, Dr. (2023). ASSESSMENT OF INITIATION OF SOIL LIQUEFACTION INDUCED BY EARTHQUAKES: A RESEARCH. *European Chemical Bulletin.* (Special Issue 7). 2240-2259. https://www.researchgate.net/publication/372102614_ASSESSMENT_OF_INITIATION_OF_SOIL_LIQUEFACTION_INDUCED_BY_EARTHQUAKES_A_RESEARCH

[39] Yousuf, Saleem & Thakur, Dr. (2023). A Review Intelligent Transport System. *Zeitschrift fur celtische Philologie*. volume 10. 2017-2045. https://www.researchgate.net/publication/371131269_A_Review_Intelligent_Transport_System

[40] Thakur, Dr. (2023). Enhancing the soils geotechnical properties by using plastic waste: A Review. Yingyong JichuyuGongcheng Kexue Xuebao/*Journal of Basic Science and Engineering*. 23. 168-186. 10.37896/JBSV23.5/2096. https://www.researchgate.net/publication/370528028_Enhancing_the_soils_geotechnical_properties_by_using_plastic_waste_A_Review

[41] Er. Abhilash Thakur, NaveenKumar, Sangharsh Kaith, Sanchit Rana, Pranshu Goyal, D. K. Tiwary, D. R. K. Thakur, "A Critical Review On Fiber Reinforced Polymer Composites In Strengthening Reinforced Concrete Structure", *International Journal of Innovative Research in Engineering and Management (IJIREM)*, Vol-9, Issue-2, Page No-562-567, 2022. Available from: https://doi.org/10.55524/ijirem.2022.9.2.88.

[42] Er. Manpreet Singh, Dr. Vijay Dhir, & Er. Simran. (2025). A Multi-Method AI Framework for the Sustainable Optimization of Concrete Mix Designs Using Industrial and Agricultural Waste: A Comprehensive Review. *International Research Journal of Innovations in Engineering and Technology - IRJIET*, 9(9), 82-87. Article DOI https://doi.org/10.47001/IRJIET/2025.909012

[43] Er. Manpreet Singh, Dr. Vijay Dhir, & Er. Simran. (2025). A Geospatial and AI-Based Decision Support System for Planning Sustainable Infrastructure Corridors: Integrating Material Science and Modern Construction Techniques. *International Research Journal of Innovations in Engineering and Technology - IRJIET*, 9(9), 88-94. Article DOI https://doi.org/10.47001/IRJIET/2025.909013

ISSN (online): 2581-3048
Volume 9, Issue 10, pp 245-254, October-2025
https://doi.org/10.47001/IRJIET/2025.910031

[44] Er. Manpreet Singh, Dr. Vijay Dhir, & Er. Simran. (2025). Life-Cycle Assessment and Digital Twin Modeling for Resilient and Eco-Friendly Construction Practices: A Comprehensive Review. *International Research Journal of Innovations in Engineering and Technology - IRJIET*, 9(9), 95-102. Article DOI https://doi.org/10.47001/IRJIET/2025.909014

[45] Er. Manpreet Singh, Dr. Vijay Dhir, & Er. Simran. (2025). An Integrated Review: Harnessing Industry 4.0 Technologies for a Circular Economy in the Construction Sector. *International Research Journal of Innovations in Engineering and Technology - IRJIET*, 9(9), 103-111. Article DOI https://doi.org/10.47001/IRJIET/2025.909015

[46] Er. Manpreet Singh, Dr. Vijay Dhir, & Er. Simran. (2025). Predicting the Mechanical and Durability Properties of Hybrid Green Concrete using Artificial Neural Networks and Weight of Evidence: A Comprehensive Review. *International Research Journal of Innovations in Engineering and Technology - IRJIET*, 9(9), 112-120. Article DOI https://doi.org/10.47001/IRJIET/2025.909016

[47] Er. Manpreet Singh, Dr. Jagdeep Kaur, & Er. Simran. (2025). Investigation into the Valorization of Agro-Industrial Waste for Sustainable Construction: From Material Characterization to Field Application. *International Research Journal of Innovations in Engineering and Technology - IRJIET*, 9(9), 121-127. Article DOI https://doi.org/10.47001/IRJIET/2025.909017

[48] Er. Manpreet Singh, Dr. Jagdeep Kaur, Er. Simran. (2025). Resilient Infrastructure Development in Mountainous Regions: A Synergy of Natural waste Materials, Geosynthetics, and Intelligent Systems. *International Research Journal of Innovations in Engineering and Technology - IRJIET*, 9(9), 128-134. Article DOI https://doi.org/10.47001/IRJIET/2025.909018

[49] Er. Manpreet Singh, Dr. Jagdeep Kaur, & Simran. (2025). Meta-Analysis and Knowledge Synthesis in Sustainable Construction Materials Using Machine Learning and Information Value Models. *International Research Journal of Innovations in Engineering and Technology - IRJIET*, 9(9), 135-141. Article DOI https://doi.org/10.47001/IRJIET/2025.909019

[50] Er. Manpreet Singh, Dr. Jagdeep Kaur, & Er. Simran. (2025). Automation and Robotics for the Precision Manufacturing of Precast Elements using Sustainable Concrete Mixes. *International Research Journal of Innovations in Engineering and Technology - IRJIET*, 9(9), 142-148. Article DOI https://doi.org/10.47001/IRJIET/2025.909020

[51] Er. Manpreet Singh, Dr. Jagdeep Kaur, & Er. Simran. (2025). A Unified Performance-Based Specification Framework for Green Concrete Incorporating Waste Materials and Advanced Monitoring. *International Research Journal of Innovations in Engineering and Technology - IRJIET*, 9(9), 149-154. Article DOI https://doi.org/10.47001/IRJIET/2025.909021

[52] Chagger, Jeevanjot. (2025). GEOGRAPHIC INFORMATION SYSTEM FOR CIVIL ENGINEERS. 10.5281/zenodo.10636618. https://www.researchgate.net/publication/396525537_GEOGRAPHIC_INFORMATION_SYSTEM_FOR_CIVIL_ENGINEERS

[53] Vanadi, Vinay & Kumar, A & Chagger, Jeevanjot. (2025). NUMERICAL METHODS IN CIVIL ENGINEERING: PRACTICAL APPLICATIONS AND TECHNIQUES. 10.5281/zenodo.15227277. https://www.researchgate.net/publication/396525095_NUMERICAL_METHODS_IN_CIVIL_ENGINEERING_PRACTICAL_APPLICATIONS_AND_TECHNIQUES

[54] Singh, V., Taneja, S., Singh, V., Singh, A., & Paul, H. L. (2021). Online advertising strategies in Indian and Australian e-commerce companies: A comparative study. In Big data analytics for improved accuracy, efficiency, and decision making in digital marketing (pp. 124-138). *IGI Global.*

[55] Sardana, S., Singh, V., & Adhikari, D. (2025). Sustainable Product Design: Materials, Processes, and Longevity. *In Sustainability, Innovation, and Consumer Preference* (pp. 65-90). *IGI Global Scientific Publishing*.

[56] Lalit, N., & Singh, V. (2025). Neuro Green: Case Studies on the Power of Neuromarketing in Promoting Eco-Investments. *In Neuromarketing's Role in Sustainable Finance* (pp. 231-244). *IGI Global*.

ISSN (online): 2581-3048
Volume 9, Issue 10, pp 245-254, October-2025
https://doi.org/10.47001/IRJIET/2025.910031

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