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A Comprehensive Review on the Utilization of Construction and Demolition Waste with Geotextile Reinforcement in Granular Sub-Base Layers for Sustainable Flexible Pavement Construction

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Abstract: Globally, the production of construction and demolition waste has dramatically increased due to the quick expansion of infrastructure development and urbanization. In addition to taking up valuable landfill space, improper disposal of these materials depletes natural resources and degrades the environment. In road construction, recycling of various waste materials is getting wide acceptance, leading to reduced requirements of natural aggregates. Several studies have shown that, when proper gradation, compaction, and quality control procedures are followed, recycled C&D aggregates can be effectively used in granular sub-base layers of flexible pavements. However, compared to traditional aggregates, differences in material properties often lead to greater deformation and lower strength. To overcome these restrictions, geotextiles are increasingly used as reinforcement materials to increase the strength of pavement layers, reduce rutting, and improve load distribution. This review critically examines the engineering properties of recycled C&D materials, their appropriateness for GSB applications, and the impact of geotextile reinforcement on pavement performance. In order to maximize the use of recycled materials in sustainable pavement construction, the paper discusses future opportunities, identifies research gaps, and summarizes the results of recent studies. The review emphasizes how applying geotextile reinforcement along with recycled C&D aggregates can greatly enhance pavement performance while encouraging the development of environmentally friendly infrastructure.
Keywords: Construction and Demolition Waste, Granular Sub-Base, Flexible Pavement, Geotextile, California Bearing Ratio, Sustainable Construction, Recycled Aggregates.

I. INTRODUCTION

C&D waste is produced in massive quantities by the construction industry, which is also one of the biggest consumers of natural resources. C&D waste generation has been steadily increasing in both developed and developing nations due to rapid urbanization, redevelopment of aging infrastructure, and increased construction activities (Kumar and Shukla, 2022; Khan et al., 2024). A significant amount of this waste has historically been dumped in landfills, leading to major environmental issues such as land degradation and unnecessary use of landfill space (Khan et al., 2024). Since large amounts of aggregates are needed for road construction as well as maintenance, the use of recycled C&D materials can substantially reduce the load on natural resources (Mazhar et al., 2023; Khan et al., 2024). The Sub-base and Base layers are of granular material. GSB is the bottom layer in flexible pavement and, compared to other layers, does not require very high-quality materials (MoRTH, 2013; IRC, 2018). Hence, in GSB layers, recycled C&D aggregates can partially replace natural aggregates, reducing construction costs, conserving natural resources, and mitigating environmental impacts (Mazhar et al., 2023; Khan et al., 2024). However, compared to conventional aggregates, recycled aggregates frequently show more variability in particle characteristics, water absorption, and mechanical properties, which could impact pavement performance if improperly engineered (Khan et al., 2024).

In pavement structures, geotextiles serve as components for separation, filtration, stabilization, and reinforcement (Al-Qadi, 2002; IRC, 2019; IS 16393:2015). Geotextiles have mostly been used for separating sub-grade and sub-base layers so far, or as reinforcement for weaker sub-grade layers (Al-Qadi, 2002; Sharma et al., 2014; IRC, 2019). Recently, however, its use in strengthening has been explored in the sub-base layer (Sharma et al., 2019; Ok et al., 2023; Bhat et al., 2025). Thus, it can effectively compensate for a slight reduction in strength and other properties resulting from the use of C&D materials (Sharma et al., 2019; Ok et al., 2023).

The load-carrying capacity and service life of pavements reinforced with geotextiles have been shown to have been significantly improved in several experimental studies (Sharma et al., 2019; Ok et al., 2023; Bhat et al., 2025).
While many studies have examined recycled C&D aggregates and geotextile reinforcement separately, very few studies have been made that incorporate both (Sharma et al., 2019; Ok et al., 2023; Bhat et al., 2025). Recent studies on recycled C&D aggregates, geotextile reinforcement, and their combined potential in granular sub-base layers are compiled and critically evaluated in this review (Khan et al., 2024; Bhat et al., 2025). To support the broader adoption of sustainable pavement technologies, the paper also identifies current research gaps and suggests potential directions for future research.

II. CONSTRUCTION AND DEMOLITION (C&D) WASTE

C&D aggregates possess engineering characteristics that make them suitable for road construction when processed properly through crushing, screening, contaminant removal, and grading (Khan et al., 2024; Mazhar et al., 2023; Kumar & Shukla, 2022). However, their properties vary depending on the source material, processing technique, and percentage of adhered cement mortar (Khan et al., 2024; Mazhar et al., 2023). Consequently, understanding the composition and characteristics of C&D waste is essential before its utilization in pavement construction (Khan et al., 2024; Kumar and Shukla, 2022).

A. Classification of Construction and Demolition Waste

Construction and Demolition waste consists of various recyclable and non-recyclable materials generated from different construction activities. Based on their origin and engineering properties, C&D waste can be classified.

1) Concrete Waste: Concrete waste is the largest component of C&D waste, generated from demolished buildings, pavements, and bridges. After crushing, it is widely used as recycled aggregate in pavement base and sub-base layers.
2) Brick Waste: Brick waste is obtained from demolished masonry structures. Owing to its porous nature, it has higher water absorption and lower density, but it can partially replace natural aggregates in GSB.
3) Asphalt Waste: Asphalt waste, mainly obtained from pavement milling, is recycled as Reclaimed Asphalt Pavement (RAP), helping conserve natural resources and reduce construction costs.
4) Masonry Waste: Masonry waste consists of mortar, concrete blocks, and stones. After processing, it can be used as granular material in pavement layers.
5) Ceramic Waste: Ceramic waste includes broken tiles and sanitary ware. Its high hardness makes it a suitable partial replacement for natural aggregates.
6) Metal Waste: Metal waste, such as steel and aluminium, is usually recovered and recycled separately because of its high economic value.
7) Wood Waste: Wood waste includes timber and plywood. It is generally recycled into wood products or used for energy recovery rather than as aggregate.
8) Glass Waste: Glass waste from windows and other glass products can be crushed and used as a partial replacement for fine aggregates.
9) Plastic Waste: Plastic waste, including PVC, Polyethylene, and similar packaging materials, is being used in hot bitumen mixes as a partial replacement for bitumen.
10) Soil and Excavated Materials: Excavated soil can be reused for embankments, backfilling, or subgrade improvement, depending on its engineering properties.

B. Processing of Construction and Demolition Waste

Before C&D waste can be utilized in pavement construction, it undergoes several processing stages to ensure uniform quality and compliance with engineering specifications (Khan et al., 2024; Kumar and Shukla, 2022). The general processing sequence includes collection, segregation, contaminant removal, crushing, screening, grading, and quality testing (Khan et al., 2024). Contaminants such as wood, plastics, gypsum, metals, and organic matter are removed to improve the quality of recycled aggregates (Khan et al., 2024). The processed material is then classified into different size fractions suitable for many applications, e.g., production of concrete and pavement applications (Mazhar et al., 2023; Khan et al., 2024). Proper processing significantly improves particle shape, gradation, and engineering performance while reducing variability among recycled aggregates (Mazhar et al., 2023; Khan et al., 2024).

C. Physical and Mechanical Properties of Recycled C&D Aggregates

The suitability of recycled C&D aggregates for GSB applications depends on their physical and mechanical properties. Compared with natural aggregates, they generally exhibit lower specific gravity, higher water absorption, and slightly lower strength due to the presence of adhered mortar. Key physical properties include particle shape, surface texture, gradation, and compaction characteristics, while important engineering properties include Aggregate Impact Value (AIV), Los Angeles Abrasion Value, California Bearing Ratio (CBR), Maximum Dry Density (MDD), and Optimum Moisture Content (OMC). Studies have shown that properly processed recycled aggregates can satisfy GSB requirements to a large extent and is suitable for blending with virgin materials.

Table 2.1: Physical Properties of Recycled C&D Aggregates

Property	Natural Aggregate	Recycled C&D Aggregate
Specific Gravity	2.60–2.75	2.20–2.55
Water Absorption (%)	0.5–2.0	3.0–8.0
Bulk Density (kg/m³)	1600–1800	1450–1700
Particle Shape	Angular	Angular to Irregular
Surface Texture	Smooth to Rough	Rough
Porosity	Low	Moderate to High

D. Advantages and Challenges w.r.t. use of C&D Waste in Granular Sub-Base.

The utilization of recycled C&D waste in Granular Sub-Base offers several technical, economic, and environmental benefits:

- Conserves natural aggregates and non-renewable resources.
- Reduces landfill waste, greenhouse gas emissions, and the overall environmental impact.
- Provides a cost-effective alternative for road construction.
- Supports waste management and circular economy practices. Challenges in Utilizing C&D Waste.

Despite its advantages, the use of recycled C&D waste presents several challenges.

Variations in material quality, higher water absorption, and lower density than natural aggregates limit the use of C&D waste. Proper processing and quality control are essential to remove contaminants and ensure consistent performance. In addition, long-term field data for high replacement levels remain limited. These challenges can be mitigated through appropriate material processing, optimized gradation, and reinforcement techniques such as geotextiles.

III. GRANULAR SUB-BASE IN FLEXIBLE PAVEMENTS

The Ministry of Road Transport and Highways (MoRTH) classifies GSB materials into different gradings based on aggregate size distribution. Selection of a suitable grading depends on pavement type, layer thickness, and traffic conditions. GSB Grading-II is widely adopted for highway construction because it provides an optimum balance between strength, drainage, and compaction characteristics.

A. Material Requirements for Granular Sub-Base

According to MoRTH Specifications, Table 3.1: Typical Engineering Requirements for GSB materials, the materials should satisfy the following engineering requirements.

Table 3.1: Typical Engineering Requirements for GSB Materials

Property	Requirement
California Bearing Ratio (CBR)	≥ 30%
Aggregate Impact Value	≤ 40%
Plasticity Index	Non-Plastic
Liquid Limit	≤ 25%
Organic Matter	Nil
Gradation	As per MoRTH

B. Utilization of C&D Waste in Granular Sub-Base

Recent studies indicate that properly processed C&D waste can effectively replace natural aggregates in GSB layers partially. Replacement levels of 20–50% have shown satisfactory compaction and durability. Although higher replacement levels may increase water absorption and reduce density due to adhered mortar, these effects can be minimized through proper gradation and geotextile reinforcement. Overall, recycled C&D aggregates provide a sustainable and practical alternative for pavement construction.

C. Scope of Geotextile Reinforcement in GSB

Geotextile reinforcement has gained considerable attention for enhancing the performance of Granular Sub-Base layers in flexible pavements. Numerous studies have reported that geotextiles improve aggregate confinement, promote more uniform stress distribution, increase the California Bearing Ratio, and reduce permanent deformation under repeated traffic loading. They also improve the overall stability and durability of GSB layers, particularly when C&D aggregates are used. Geotextile reinforcement can further improve their load-bearing performance where minor strength reductions occur. These benefits enable higher utilization of recycled materials while maintaining the required engineering performance.

IV. GEOTEXTILE REINFORCEMENT IN FLEXIBLE PAVEMENTS

A. Geotextile Reinforcement in Flexible Pavements

Geotextiles are permeable geosynthetic materials manufactured from synthetic polymers such as polypropylene (PP), polyester (PET), polyethylene (PE), and polyamide (PA) (Al-Qadi, 2002; IRC, 2019; IS 16393:2015). Owing to their high tensile strength, durability, and resistance to chemical degradation, they have been widely used in highway engineering since the 1970s (Al-Qadi, 2002; Raja et al., 2019). The reviewed literature shows that geotextiles perform multiple functions, including reinforcement, separation, filtration, drainage, and protection, making them suitable for flexible pavement applications (Al-Qadi, 2002; Sharma et al., 2014; IRC, 2019; IS 16393:2015). Their use has increased with the growing adoption of recycled C&D materials, as several studies have reported improvements in the engineering performance of Granular Sub-Base layers reinforced with geotextiles (Sharma et al., 2019; Ok et al., 2023; Bhat et al., 2025).

B. Classification of Geotextiles

Based on the manufacturing process, geotextiles are classified into three main categories:

1) Woven Geotextiles: Woven geotextiles are produced by interlacing synthetic yarns at right angles. They possess high tensile strength, low elongation, and good dimensional stability, making them suitable for reinforcement in roads, embankments, retaining structures, and other soil stabilization applications.
2) Non-Woven Geotextiles: Non-woven geotextiles are manufactured by bonding synthetic fibres through needle punching, thermal bonding, or chemical processes. Their high permeability, filtration efficiency, drainage capacity, and puncture resistance make them the most commonly used geotextiles in pavement engineering.
3) Knitted Geotextiles: Knitted geotextiles are produced by interlocking synthetic yarns. Although they provide good flexibility, they are used less frequently in pavement applications than woven and non-woven geotextiles.

C. Functions of Geotextiles in Flexible Pavements

Geotextiles perform several engineering functions simultaneously within pavement systems:

1) Separation: Prevents the intermixing of subgrade soil and granular layers, preserving the designed gradation of the GSB.
2) Reinforcement: Improves aggregate confinement and stress distribution, thereby increasing pavement stability and bearing capacity.
3) Filtration: Allows water to pass while retaining fine soil particles, thereby minimizing erosion and particle migration.
4) Drainage: Facilitates lateral movement of water within the pavement structure, reducing excess pore-water pressure.

D. Mechanism of Geotextile Reinforcement

The reinforcement effect of geotextiles is achieved by mobilizing tensile forces under traffic loading. The geotextile restricts the lateral movement of aggregates, improves confinement, and distributes applied stresses over a larger area of the subgrade. The effectiveness of reinforcement depends on factors such as geotextile properties, subgrade strength, aggregate characteristics, and loading conditions.

E. Placement of Geotextiles within Pavement Layers

The effectiveness of geotextile reinforcement depends not only on its material properties but also on its placement location within the pavement system. Experimental investigations have shown that the optimum placement location depends on subgrade strength, layer thickness, traffic loading, and geotextile characteristics. In laboratory CBR studies, placing the geotextile near the zone of maximum tensile stress generally produces the greatest improvement in bearing capacity.

F. Advantages of Geotextile Reinforcement

The reviewed literature indicates that geotextile reinforcement enhances the engineering performance of flexible pavements by improving the California Bearing Ratio (CBR) and structural stability. It maintains separation between pavement layers, improves drainage, and extends pavement service life. These advantages support the effective utilization of recycled C&D aggregates in GSB layers and promote more sustainable pavement construction.

G. Geotextile Reinforcement with Construction and Demolition Waste

The combined application of recycled C&D waste and geotextile reinforcement has emerged as an effective strategy for developing sustainable pavement systems (Sharma et al., 2019; Ok et al., 2023; Bhat et al., 2025). Although recycled aggregates generally exhibit higher water absorption and lower strength than natural aggregates, geotextile reinforcement compensates for these limitations by improving confinement and stress distribution (Khan et al., 2024; Sharma et al., 2019; Ok et al., 2023). Recent laboratory investigations have demonstrated that geotextile-reinforced recycled aggregate layers exhibit higher CBR values, improved compaction behaviour, reduced settlement, and enhanced resistance to repeated traffic loading compared with unreinforced recycled aggregate layers (Sharma et al., 2019; Ok et al., 2023; Bhat et al., 2025). Consequently, geotextile reinforcement enables higher percentages of recycled C&D waste to be incorporated into Granular Sub-Base layers without compromising structural performance (Sharma et al., 2019; Ok et al., 2023; Bhat et al., 2025).

V. LITERATURE REVIEW

Table 5.1: Literature Review

Ref.	Author(s)	Material / Reinforcement	Key Parameters	Major Findings
1	Bhat et al. (2025)	Geotextile	CBR, Rutting, Placement Depth	Geotextile placement depth significantly influences load distribution, rutting resistance, and fatigue performance. Optimum placement improves pavement service life.
2	Khan et al. (2024)	Recycled C&D Aggregates	CBR, Shear Strength, Durability	Recycled C&D aggregates satisfy engineering requirements for pavement base and sub-base layers when properly processed and graded.
3	Mazhar et al. (2023)	Demolished Concrete Waste	CBR, Density	50% recycled aggregate replacement was found suitable for road sub-base applications, satisfying IRC and MoRTH requirements while promoting sustainable use of C&D waste.
4	Ok et al. (2023)	C&D Waste + Geosynthetics	Bearing Capacity, Settlement	Geosynthetic reinforcement substantially improves the bearing capacity and mechanical performance of recycled C&D materials.
5	Mazupadhyaya & Jaysawal (2023)	Geotextile	Reinforcement, Separation, Drainage	Geotextiles perform multiple engineering functions, improve pavement durability, and reduce maintenance requirements.
6	Verma (2023)	Geotextile	CBR, Load Distribution	Geotextiles increase bearing capacity, reduce deformation, and improve pavement stability under traffic loading.

7	Kumar & Shukla (2022)	Construction Waste	Sustainability, CBR	Waste materials can effectively replace natural aggregates while promoting sustainable pavement construction.
8	Thakur et al. (2022)	C&D Waste	Strength Characteristics	Properly processed C&D waste is suitable for flexible pavement applications and contributes to resource conservation.
9	Kumar et al. (2020)	Geosynthetics	Reinforcement	Geosynthetics enhance pavement performance through reinforcement, separation, and stress redistribution.
10	Raja et al. (2019)	Geotextile	Pavement Design	Geotextile reinforcement improves structural capacity and reduces pavement distress.
11	Sharma et al. (2019)	Crushed Concrete + Geotextile	Load Carrying Capacity	Geotextile-reinforced crushed concrete significantly improves load-bearing capacity and pavement performance.
12	Yeole et al. (2018)	Geotextile	Flexible Pavement Behaviour	Geotextiles reduce deformation and improve the engineering behaviour of pavement layers.
13	Elakya & Bharath Kumar (2017)	Geotextile	CBR	The inclusion of geotextile increases CBR and enhances subgrade stability.
14	Bindu (2015)	Waste Materials	Subgrade Improvement	Construction waste materials improve subgrade strength and reduce the consumption of natural aggregates.
15	Sharma et al. (2014)	Non-woven Geotextile	Drainage	Non-woven geotextiles provide effective filtration and drainage while preventing migration of fine particles.
16	Al-Qadi (2002)	Geosynthetics	Reinforcement, Separation	Geosynthetics improve pavement performance by increasing load distribution, controlling moisture, and reducing deformation.

Table 5.2: Comparative Performance of Recycled C&D Aggregates

Property	Natural Aggregate	Recycled C&D Aggregate	Overall Observation
Specific Gravity	Higher	Slightly Lower	Due to adhered mortar
Water Absorption	Lower	Higher	Increased porosity
Maximum Dry Density	Higher	Slightly Lower	Depends on the recycled material composition
Optimum Moisture Content	Lower	Higher	Additional moisture is required for compaction
Aggregate Impact Value	Lower	Slightly Higher	Generally, within permissible limits
California Bearing Ratio	Higher	Comparable	Suitable for GSB after proper gradation
Durability	Excellent	Good	Adequate after processing
Permeability	Moderate	Moderate–High	Better drainage characteristics

Table 5.3: Effect of Geotextile Reinforcement on Flexible Pavement Performance

Parameter	Without Geotextile	With Geotextile	Improvement
California Bearing Ratio	Moderate	High	Significant increase
Load Distribution	Fair	Excellent	Better stress dispersion
Rutting	Higher	Lower	Reduced permanent deformation
Aggregate Confinement	Moderate	Excellent	Improved interlocking
Settlement	Higher	Lower	Reduced vertical deformation
Pavement Service Life	Normal	Extended	Increased durability
Drainage	Moderate	Improved	Better moisture control

VI. RESEARCH GAPS

A. *Research Trends and Knowledge Gaps*

The reviewed literature demonstrates that the use of Construction and Demolition (C&D) waste in Granular Sub-Base (GSB) layers has emerged as a sustainable alternative to natural aggregates. Most studies have reported satisfactory engineering performance at replacement levels of up to approximately 30%, provided that proper processing and gradation are maintained.

Despite these advancements, several research gaps remain. Most published studies have investigated recycled C&D aggregates and geotextile reinforcement separately, with relatively few studies examining their combined application in GSB layers. Furthermore, no standardized recommendations are available regarding the optimal placement depth or position of geotextiles within the GSB layer. Research on the performance of 200 GSM non-woven geotextiles with recycled C&D aggregates is also limited. In addition, most investigations are laboratory-based, while long-term field performance under varying traffic and climatic conditions has received comparatively little attention. Studies evaluating higher replacement levels of recycled aggregates, the long-term durability of reinforced GSB layers, and comprehensive Life Cycle Assessment (LCA) and Life Cycle Cost Analysis (LCCA) are also limited. Moreover, research conducted under Indian traffic conditions, in accordance with MoRTH and IRC specifications, remains insufficient. Addressing these research gaps will contribute to the development of standardized design guidelines and to the wider adoption of sustainable, durable, flexible pavement systems incorporating recycled C&D materials and geotextile reinforcement.

Table 6.1: Identified Research Gaps from the Reviewed Literature

Research Area	Current Research Trend	Identified Knowledge Gap
C&D Waste Utilization	Increasing use as a sustainable alternative to natural aggregates	Limited studies on higher replacement levels under field conditions
Geotextile Reinforcement	Improves CBR, bearing capacity, and pavement performance	Limited combined studies with recycled C&D aggregates in GSB
Non-woven Geotextiles	Widely used due to reinforcement, separation, filtration, and drainage functions.	Limited research on 200 GSM non-woven geotextiles
Long-term Performance	Most studies are laboratory-based	Lack of field validation under traffic and environmental conditions
Durability	Short-term performance has been widely evaluated	Limited studies on wetting–drying cycles, repeated loading, and aging
Sustainability	Environmental benefits have been recognized	Limited Life Cycle Assessment (LCA) and Life Cycle Cost Analysis (LCCA)

The above research gaps highlight the need for further investigation into the combined use of recycled C&D and geotextile reinforcement in GSB layers.

VII. FUTURE SCOPE

The use of C&D waste in GSB layers offers significant opportunities to develop sustainable, resource-efficient pavement systems. Future research should focus on full-scale field validation to evaluate the long-term performance of recycled C&D aggregates under varying traffic and environmental conditions. Further studies are also required to determine the optimum replacement level of recycled aggregates and to compare the performance of different types and GSM values of geotextiles. Investigations on the optimum placement depth of geotextiles within GSB layers will help establish standardized design recommendations. Additionally, comprehensive Life Cycle Assessment (LCA) and Life Cycle Cost Analysis (LCCA) should be conducted to quantify the environmental and economic benefits of using recycled materials. The application of advanced techniques such as Artificial Intelligence and Machine Learning to optimize material proportions and predict pavement performance also offers promising research opportunities.

Future studies aligned with MoRTH, IRC, and BIS specifications will facilitate the wider adoption of recycled C&D waste and geotextile reinforcement in sustainable flexible pavement construction.

Table 7.1: Future Research Directions

S. No.	Research Area	Future Scope
1	Field Implementation	Conduct full-scale pavement trials using recycled C&D aggregates in GSB layers.
2	Replacement Percentage	Investigate replacement levels above 30% with suitable reinforcement techniques.
3	Geotextile Type	Compare woven, non-woven, and composite geotextiles with different GSM values.
4	Placement Depth	Develop standardized guidelines for optimum geotextile placement within GSB layers.
5	Long-Term Durability	Assess pavement performance under repeated loading and environmental exposure.
6	Artificial Intelligence	Apply AI and ML to predict engineering properties and optimize mix design.
7	Sustainability Assessment	Perform Life Cycle Assessment (LCA) and Life Cycle Cost Analysis (LCCA).
8	Standardization	Develop comprehensive guidelines for recycled C&D aggregates in accordance with MoRTH, IRC, and BIS specifications.
9	Climatic Performance	Evaluate reinforced GSB performance under different climatic and subgrade conditions.
10	Circular Economy	Promote recycling practices that reduce landfill disposal and conserve natural resources.

VIII. CONCLUSIONS

The growing demand for sustainable infrastructure and the depletion of natural aggregate resources have increased interest in using C&D waste in pavement construction. This review highlights the significant potential of recycled C&D aggregates as an alternative to natural aggregates for GSB layers in flexible pavements. When properly processed and graded, recycled materials exhibit satisfactory engineering properties, including adequate compaction, bearing capacity, and durability, making them suitable for sub-base applications. The reviewed literature indicates that the performance of recycled C&D aggregates largely depends on the replacement level and material quality. Most studies report that replacement levels of up to 30% provide an effective balance among engineering performance, economic viability, and environmental sustainability. Although recycled aggregates generally have higher water absorption and slightly lower density than virgin aggregates, these limitations can be minimized through proper material selection, gradation, and quality control. Geotextile reinforcement significantly enhances the performance of flexible pavements by improving load distribution, aggregate confinement, drainage, and separation, while increasing the California Bearing Ratio (CBR) and reducing pavement deformation. The combined use of recycled C&D waste and geotextile reinforcement, therefore, offers a practical solution for developing durable, sustainable pavement systems while reducing dependence on natural resources and minimizing construction waste disposal. Despite the encouraging findings, several challenges remain. Limited information is available on long-term field performance, the optimal placement depth for geotextiles, higher replacement rates, and the durability of reinforced recycled pavement systems under varying traffic and environmental conditions. Addressing these aspects through future research will support the development of standardized design guidelines and wider implementation in road construction. Overall, this review's findings demonstrate that integrating recycled C&D waste with geotextile reinforcement is a technically feasible, economically beneficial, and environmentally sustainable approach to improving the performance of GSB layers in flexible pavements. Continued research, supported by appropriate quality control and adherence to MoRTH, IRC, and BIS specifications, will further promote the adoption of recycled materials and contribute to sustainable transportation infrastructure.

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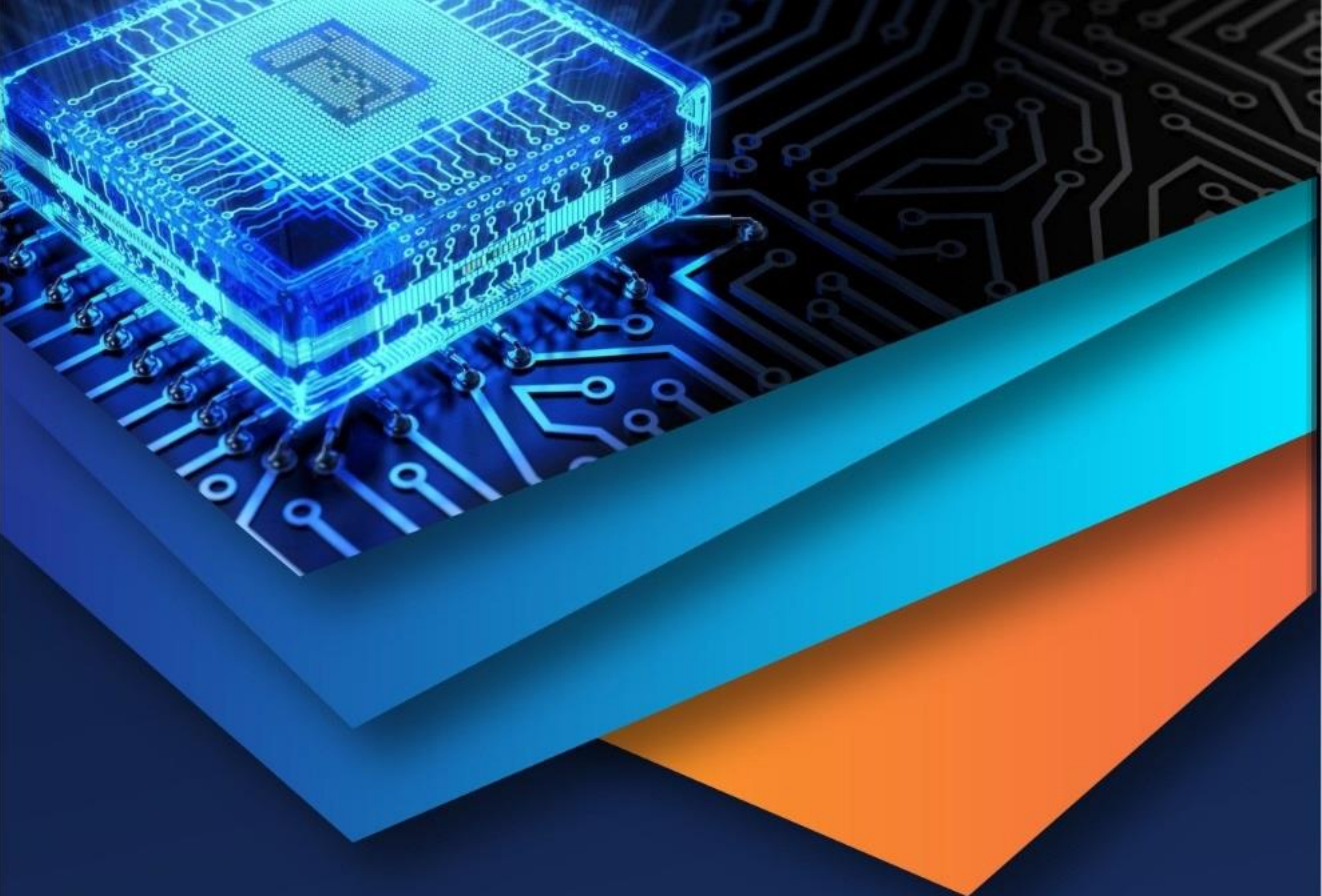

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