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Construction and Demolition Waste Utilisation as Recycled Concrete Aggregate in Concrete: A State of Art

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Abstract: Construction and demolition waste (CDW) is a serious environmental problem since it causes greenhouse gas emissions and the loss of natural resources. However, CDW may be efficiently utilized again in concrete as RCA (recycled concrete aggregates). Concrete may use RCA in lieu of natural aggregates to lessen the environmental effect of CDW disposal and the need for natural resources. This article gives a general review of RCA's possible use in concrete, including its physical, mechanical, and durability characteristics as well as the advantages it offers in terms of both the environment and the economy. It also emphasizes the difficulties and possibilities related to the use of RCA in concrete. Construction and demolition waste (CDW), which is estimated to have been produced across the globe in excess of 2.01 billion tonnes in 2016, is a major environmental hazard. Recycling CDW for use in building may reduce the quantity of waste dumped in landfills and lessen the negative environmental effects of the construction sector. The usage of CDW as recycled concrete aggregate (RCA) in the creation of concrete is examined in this book. The characteristics of RCA, their impact on the performance of concrete, and the difficulties and advantages of using RCA in concrete are all covered in the article.

Keywords: Construction and demolition waste, Concrete, Sustainability, Recycled concrete aggregates (RCA)

1. Introduction

Construction and demolition debris (CDW), which includes concrete, bricks, tiles, wood, plastics, and metals, is produced during building, restoration, and demolition operations [1]. Degradation of the environment, including the use up of natural resources and the release of greenhouse gases, is considerably exacerbated by the disposal of CDW [2], [3]. These negative effects on the environment may be lessened by CDW recycling. Recycled concrete aggregates (RCA) in particular may be used to make concrete instead of natural aggregates. RCA may be utilized in a variety of concrete applications and is created by crushing and screening CDW. Utilizing RCA in concrete may lessen the negative effects of disposing of CDW on the environment, minimize the need for natural resources, and increase the sustainability of concrete manufacturing [4], [5]. During building and demolition projects, the construction sector produces a substantial quantity of garbage. Concrete, bricks, wood, metals, plastics, and glass are just a few examples of the elements that make up this garbage, sometimes referred to as construction and demolition waste (CDW). As CDW contributes to landfills and uses a lot of energy to transport and dispose of, managing it presents a huge environmental problem [6], [7]. Utilizing CDW as recycled concrete aggregate (RCA) is a successful method of reducing CDW's negative environmental effects while producing a sustainable building material [8], [9].

2. Properties of RCA

To produce a coarse aggregate appropriate for use in the manufacturing of concrete, CDW components, such as concrete, bricks, and tiles, are crushed and processed to produce RCA. The kind and quality of the CDW materials utilized, the crushing procedure, and the processing technique may all have a major impact on the RCA qualities [10], [11]. Natural aggregate and RCA often vary in terms of density and absorption, as well as the form and texture of the RCA particles. The characteristics and effectiveness of the RCA in concrete may be impacted by the presence of pollutants including paint, plaster, and wood [12]. The mechanical and physical characteristics of concrete may be impacted by the application of RCA. Natural aggregates are stronger and more porous than RCA, which might change the characteristics of the concrete that results [13]–[15]. However, using RCA may also make concrete easier to work with because of its rough surface roughness, which strengthens the connection between cement paste and aggregate. Additionally, RCA may make concrete denser, which will boost its longevity and damage resistance [16], [17]. The kind of CDW utilized and the processing methods used to make the RCA affect the RCA's characteristics. To assure the quality of the resultant RCA and the performance of the resulting concrete, rigorous CDW selection and processing procedure selection are essential [2], [8], [10].

3. Effects of RCA on Concrete Performance

Reducing the need for natural aggregates, minimizing the negative environmental effects of CDW disposal, and producing a more environmentally friendly building material are just a few advantages of using RCA in concrete. However, the mechanical and durability characteristics of concrete may also be impacted by RCA usage [18]. Studies have revealed that when the amount of RCA in the mix rises, the compressive and flexural strengths of concrete decrease [19]–[23]. The use of RCA may also make concrete more porous, which can make it less durable and more vulnerable to freeze-thaw damage [1]. These detrimental impacts may be minimized with good concrete mix design that takes the qualities of the RCA into account. Concrete's durability characteristics, such as its resistance to abrasion, freeze-thaw cycles, and chemical assault, may also be impacted by the usage of RCA in concrete. Since RCA often has a larger porosity than natural aggregates, exposure to the weather may make it more susceptible to degradation [7]. Due to its rough surface roughness, which may strengthen the binding between the aggregate and cement paste, and its capacity to absorb and release moisture, which can strengthen the concrete's resistance to freeze-thaw cycles, the use of RCA can, however, also increase the durability of concrete. Due of the reactive minerals included in CDW, RCA may also increase concrete's resistance to chemical assault [24].

4. Challenges and Opportunities

The use of RCA in the manufacturing of concrete confronts a number of obstacles and possibilities. The absence of standardization and quality control in RCA manufacture and processing is a major problem. Contaminants in CDW may have an impact on the performance and quality of the RCA in concrete, necessitating rigorous processing and testing to guarantee that the RCA satisfies the necessary criteria. The lack of high-quality CDW materials suited for RCA manufacture is another difficulty [24]. However, there are chances to address these issues via the creation of RCA production and processing standards and guidelines as well as the use of tactics to enhance CDW collecting and sorting [25]. Significant environmental advantages of using RCA in concrete include a decrease in the amount of CDW disposed in landfills, the preservation of natural resources, and a decrease in greenhouse gas emissions related to the manufacturing of natural aggregates [26]–[29]. Because RCA requires less energy to generate than natural aggregates, using it in concrete may help cut the energy needed to make concrete. Additionally, the use of RCA in concrete may lessen the need for new aggregates, which will lessen the requirement for natural aggregate quarrying, shipping, and processing [30].

Economic advantages from the use of RCA in concrete include decreased expenses for CDW disposal, decreased costs for the acquisition of natural aggregates, and decreased transportation costs for the transportation of natural aggregates [31]–[36]. Additionally, by using RCA in concrete, CDW may be able to expand into other markets, opening up new business potential and employment chances in the recycling sector [24].

5. Conclusion

A viable method for minimizing the negative environmental effects of the building sector is the use of CDW as recycled concrete aggregate in the manufacturing of concrete. RCA may reduce the need for natural aggregates, lessen the environmental effect of CDW disposal, and provide a more environmentally friendly building material, among other advantages. To make sure that the RCA does not negatively affect the performance and longevity of the concrete, adequate mix design and quality control are crucial. To address the issues with RCA usage in concrete production and to realize the full potential of this sustainable building material, further research and development is required.

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