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STUDY OF RECYCLED CONCRETE AGGREGATE (RCA)

(Construction and Demolition Waste)

Mrs.Sneha Sawant[a], Mr.Prasad Otari[b], Mr Yash Chavan[b], Mr. Vaibhav Kamble[b], Mr Jayant Pansare[b]

Department Of Civil Engineering

Dr. D.Y. Patil Collage of Engineering, Akurdi, Pune.

[a] Asst Professor In Department Of Civil Engineering , D Y Patil College Of Engineering, Akurdi.
[b] Student In Department Of Civil Engineering , D Y Patil College Of Engineering, Akurdi.

Abstract: Construction industry produces large amount of waste throughout the year. Most of the time construction and demolition waste ends up in landfills disturbing environmental, economical and social life cycle. Construction and demolition waste is the waste materials that are produced in the process of construction, renovation or demolition of residential or nonresidential structures. Components of construction and demolition waste typically include concrete, asphalt, wood, metals, gypsum wallboard, roofing, paper, plastic, drywall and glass. Sustainable development in construction will help a lot to reduce the problems related to environment and natural resources as construction industry is a major user of world's resources. Sustainable design, proper use and reuse of the construction materials will make construction industry more economical and green. So this paper is expected to reuse the demolished construction material like concrete, glass, roofing material, aggregate, metal etc. so the objective of this paper is to recycling the demolished concrete as aggregate, called recycled demolition aggregate (RDA). It is chip and general way to minimize environmental impact of demolition waste. This paper focus on the recycling of the aggregate for its reutilization in the construction activities, so that by using the Recycled aggregate the cost of the project also gets down. By taking the sample tests in the Pune region the recycling of the aggregate is done and which can be used for the pavement designs and other construction purposes.

Keywords: Aggregate, Recycle, Reuse, Construction & Demolition Waste.

INTRODUCTION

India is the world's second-largest consumer of natural aggregates. In 2020, India's demand for crushed stone aggregates was estimated to be 5 billion tonnes. In the absence of official statistics, India's current estimated market size is 3.2 billion tonnes per year. In India there is a significant increase in the use of natural aggregates due to infrastructure and construction development. The use of recycled aggregate in construction can be useful for environmental protection and economical terms; Recycled Concrete Aggregate (RCA) is an innovative construction material derived from the recycling of demolished concrete structures such as buildings, roads, and bridges. This process involves crushing and processing old concrete to create an aggregate that can replace natural aggregates in various construction applications. RCA offers a range of environmental and economic benefits, making it an increasingly popular choice in the construction industry. The production of RCA begins with the demolition of existing concrete structures, followed by the collection and transportation of the rubble to a recycling facility. Here, the concrete is crushed into smaller pieces, screened to remove contaminants, and sorted by size. Often, the material is also washed to ensure it meets

quality standards. RCA is utilized in numerous applications including road base and sub-base layers, new concrete production, landscaping, and as fill material. It is particularly valued for its lower cost compared to natural aggregates and its contribution to sustainability by reducing landfill waste and conserving natural resources. Despite challenges such as ensuring consistent quality and removing contaminants, RCA's benefits make it a viable and eco-friendly alternative in construction projects. Its use supports sustainable building practices and helps in reducing the environmental impact of construction activities.

AIM & OBJECTIVE

The construction and demolition waste management is one of the broad aspects of the construction industry, Recycling aggregate from construction and demolition waste can help with environmental sustainabillitynby reducing the consumption of natural resources and amout of land needed for waste disposal. It can also help the circular economy by minimizing landfill disposals.

- Aim to reduce the amount of waste sent to landfills by maximizing recycling and reuse.
- Reduce environmental impact: Recycled aggregate can reduce the impact of waste on the environment.
- Reduce costs: Recycled aggregate can reduce costs because it doesn't need to be mined and there's less transportation and manufacturing required.
- Increase protection from seepage: Recycled concrete aggregate can provide increased protection from seepage.
- Contribute to a more sustainable construction industry: Recycling reduces waste and energy consumption, which contributes to a more sustainable construction industry

METHODOLOGY

The research will gather information through surveys, group discussions, individual interviews, and questionnaires. The answers from the interviews and questionnaires will be the main source of information for the study (called primary data). Before analyzing this data, it will be carefully organized and put together.

Method of Approach for Achieving the Objective

- Collection of data from internet and journal papers
- Conduct a detailed assessment of the demolition site to identify types and quantities of materials.
- Segregate materials at the source into categories such as concrete, bricks, metals, wood, and hazardous materials.
- Process concrete and masonry waste into aggregates using crushers and screen
- Study of various tests done on aggregate

The following aspects are going to be studied

Studying the construction and demolition (C&D) aggregate recycling process involves examining several key aspects to ensure effective, efficient, and sustainable recycling practices. Here are the main aspects to consider:

1. Material Characteristics
   - Composition Analysis: Determine the types and proportions of materials present in the C&D waste, such as concrete, asphalt, bricks, metals, and wood.
   - Quality Assessment Evaluate the quality and condition of the materials to determine their suitability for recycling and reuse.
2. Recycling Technologies
   - Crushing and Screening: Study the methods and machinery used for crushing and screening C&D waste into usable aggregates.
   - Advanced Recycling Techniques: Explore innovative technologies such as advanced sorting systems, magnetic separation and sensor-based sorting..

3. Quality Control

- Material Testing: Conduct regular testing of recycled aggregates to ensure they meet required specifications and standards for construction use.
- Process Monitoring: Implement quality control measures throughout the recycling process to maintain consistency and reliability.

4. Resource Conservation:

- Evaluate how recycling C&D waste contributes to resource conservation and reduces the need for virgin materials.

RECYCLING CONSTRUCTION AND DEMOLITION WASTES

Introduction

- Recycling construction and demolition (C&D) waste offers numerous benefits that make it a critical practice in sustainable construction and waste management.
- Recycling construction and demolition (C&D) waste involves processing various materials that can be reclaimed and reused in new construction projects or other applications. The most commonly recycled materials from demolition and construction waste is concrete
- Using demolished concrete as aggregate, known as recycled concrete aggregate (RCA), is a sustainable practice that can significantly benefit the construction industry and the environment. Here's a detailed overview of the process, benefits, applications, and considerations for using demolished concrete as aggregate.

Recycling of Aggregate C and D Waste

The main goal of our project was to conduct research and development (R&D) on construction and demolition (C&D) waste by closely examining its properties at various construction sites in Pune. We noticed significant amounts of C&D waste at these sites. During our initial survey, we discovered that waste are dumped at construction and Demolition waste treatment plant Wagholi, Pune with an additional 250 metric tons collected daily. Following Pune Municipal Corporation's policy of Reduce, Reuse, Recycle, we developed a methodology to recycle C&D waste into useful products. We collected samples of concrete, bricks, tiles, wood, metals, plastics, and other C&D materials from different sites, totaling about 25 kilograms. After thorough testing of these samples, we designed a recycling process based on the results.

The Procedure for the Sample Separation of C and D waste:

The process of aggregate separation from construction waste at a construction and demolition (C&D) waste plant in Wagholi, Pune, would typically follow a standard procedure similar to the one outlined in the previous response. However, specific details may vary based on the equipment, technology, and practices employed at the facility. Here's a generalized overview of how aggregate separation from construction waste could take place at a C&D waste plant in Wagholi, Pune:

1. Collection and Transportation

- C&D waste, including concrete, bricks, masonry, wood, metals, plastics, and other materials, is collected from demolition sites, construction projects, and waste collection centers in Wagholi and surrounding areas.
- The collected waste is transported to the C&D waste plant in Wagholi using trucks or other suitable transportation methods.

2. Initial Sorting and Pre-processing

- Upon arrival at the C&D waste plant, the waste undergoes an initial sorting process to remove large contaminants such as wood, metal, and plastics. Manual laborers may perform this initial sorting.
- Machinery such as conveyors and loaders may be used to facilitate the movement and sorting of materials

3. Mechanical and Automated Sorting
   - The sorted waste is then fed into mechanical sorting equipment, such as trommels, screens, crushers, and magnetic separators, to further separate materials based on size, density, and magnetic properties.
   - Automated sorting technologies, including optical sorters and eddy current separators, may be employed to separate materials based on their optical and electromagnetic properties.

4. Aggregate Separation
   - Concrete and masonry waste are specifically targeted for aggregate separation. These materials are crushed and screened to produce recycled aggregate of various sizes.
   - Crushing equipment, such as jaw crushers, impact crushers, and cone crushers, may be used to break down concrete and masonry into smaller pieces.
   - Screens and classifiers are utilized to separate the crushed aggregate into different size fractions, ranging from coarse to fin.

5. Quality Control and Testing
   - Samples of the separated aggregate are collected for quality control testing to ensure they meet specified standards and requirements.
   - Tests may include sieve analysis to determine particle size distribution, as well as tests for contaminants and impurities.

6. Storage and Stockpiling
   - The separated and processed aggregate is stockpiled in designated areas within the C&D waste plant.
   - Stockpiles are organized based on aggregate type, size, and quality, and measures are taken to prevent contamination and ensure material integrity.

AGGREGATE RECYCLING TESTS

Introduction

Recycling tests provides an overview of the importance of testing recycled aggregates, the objectives of the tests, and the significance of the results. The recycling of construction and demolition (C&D) waste into usable aggregates offers numerous environmental and economic benefits, including resource conservation, waste reduction, and cost savings. However, the quality and suitability of recycled aggregates must be rigorously assessed to ensure their successful integration into construction applications. This necessitates the implementation of standardized testing procedures to evaluate the properties and performance of recycled aggregates.

A. Sampling

Sampling of recycled aggregate is a critical step in the quality control process to ensure that the recycled material meets specified standards and requirements. Proper sampling techniques help obtain representative samples that accurately reflect the characteristics of the entire aggregate batch.

B. Sampling Sites

1. Dr. D. Y. Patil Girls Hostel, Akurdi, Pune
2. Construction and Demolition waste plant, Wagholi

Tests Conducted

Crushing Value Test

The crushing value test on recycled aggregate is a crucial test to assess the strength and durability of the aggregate, particularly its resistance to crushing under a compressive load. This test helps determine the suitability of recycled aggregate for various construction applications, such as road base, concrete production, and pavement construction. By conducting the crushing value test on recycled aggregate, we can assess its strength and durability characteristics, ensuring its suitability for various construction applications and contributing to sustainable construction practices.

Abrasion value Test (Los Angeles Machine)

The abrasion test on recycled aggregate is conducted to assess its resistance to abrasion, which is important for determining the durability and suitability of the aggregate for use in construction applications, especially in pavement and road construction. One commonly used test method is the Los Angeles Abrasion Test. By conducting the Los Angeles abrasion test on recycled aggregate, we can assess its durability characteristics and ensure its suitability for use in various construction applications, contributing to sustainable construction practices.

Water Abrasion Test

The water absorption test on recycled aggregate is crucial for assessing its ability to absorb water, which impacts its durability and performance in various construction applications. Here's how the water absorption test is typically conducted for recycled aggregate. By conducting the water absorption test on recycled aggregate, we can assess its durability characteristics and suitability for use in concrete mixtures, asphalt mixtures, and other construction applications, contributing to sustainable construction practices.

Impact Value Test

The impact value test on recycled aggregate is conducted to assess its resistance to sudden impact or shock loads, which is important for evaluating its suitability for use in construction applications such as road base, pavement, and concrete. One commonly used test method is the Aggregate Impact Value (AIV) test. By conducting the Aggregate Impact Value (AIV) test on recycled aggregate, we can assess its resistance to impact loading and ensure its suitability for various construction applications, contributing to sustainable construction practices.

CONCLUSION

The construction and demolition (C&D) recycle aggregate successfully demonstrates the feasibility and benefits of utilizing recycled materials in the construction industry. the use of recycled aggregates significantly reduces the need for virgin materials, thereby conserving natural resources and minimizing the environmental footprint of construction activities. This also contributes to a decrease in the volume of waste sent to landfills. incorporating recycled aggregates can be cost-effective. By reducing the expenses associated with waste disposal and the procurement of new materials, construction projects can achieve considerable cost savings. through rigorous testing and evaluation, it has been established that recycled aggregates can meet the required performance standards for various construction applications. When processed and used correctly, they offer comparable strength, durability, and reliability to traditional materials. the project has shown that with proper guidelines and standards, recycled aggregates can gain acceptance within the construction industry. Encouragingly, regulatory bodies are increasingly recognizing the importance of sustainable practices and are supporting the use of recycled materials through favorable policies and incentives. while the benefits are clear, the project also highlights some challenges in implementation, including the need for improved processing technologies, better quality control measures, and overcoming industry skepticism. Addressing these challenges requires ongoing research, education, and collaboration among stakeholders. The success of this project paves the way for broader adoption of recycled aggregates in the construction industry. It underscores the potential for innovative recycling technologies and the development of new markets for recycled materials. As the industry continues to evolve, the integration of sustainable practices will be crucial in building a more resilient and eco-friendly infrastructure. the C&D recycle aggregate not only underscores the practical benefits of using recycled materials but also sets a precedent for future sustainable practices in the construction industry. By embracing these methods, we can move towards a more sustainable and resource-efficient future.

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