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REVIEW ON AN EXPERIMENT STUDY ON PARTIAL REPLACEMENT OF FINE AGGREGATE WITH WASTE MARBLE AND GRANITE CRUSH

Rajdeep Bhaveshbhai Shah M.tech. Student, Department of Civil Engineering, Parul University, Gujrat, Vadodara Email Id 2303032090008@paruluniversity.ac.in,
Dr. Vrajesh M Patel Assistant Professor, Department of Civil Engineering, Parul University, Gujrat, Vadodara Email Id vrajesh.patel29510@paruluniversity.ac.in

ABSTRACT
This study explores the potential of using waste marble and granite crush as partial replacements for fine aggregate in concrete, aiming to enhance sustainability and reduce environmental impacts associated with construction materials. Traditionally, natural sand is used as a fine aggregate in concrete, but the extraction of sand leads to environmental degradation, such as habitat destruction and soil erosion. By incorporating marble and granite waste, which are by-products of the stone-cutting and processing industries, this approach not only diverts waste from landfills but also reduces the reliance on natural sand.
In this research, various proportions of marble and granite dust were substituted for natural sand in concrete mixtures to evaluate their impact on compressive strength, tensile strength, and durability. The findings indicate that a 15% replacement ratio offers the best balance between performance and sustainability. This optimal percentage was shown to enhance the compressive and tensile strengths of concrete while maintaining durability. Additionally, the use of waste materials contributed to a more environmentally friendly concrete production process by lowering the demand for natural resources and minimizing the carbon footprint associated with material extraction.
Overall, the incorporation of marble and granite crush in concrete presents a promising solution to mitigate the environmental impact of construction while maintaining or even improving the material's mechanical properties.

Keywords:
Waste marble , Granite cruse , Fine aggregate replacement, Sustainable construction, materials, Recycled materials ,Compressive strength, Self-compacting concrete (SCC) ,Marble and granite waste

Introduction
The increasing demand for sustainable construction practices has led to extensive research into the use of recycled materials in concrete production. In particular, **marble and granite waste**, which are by-products of the stone-cutting industry, present a significant environmental challenge due to the large volumes generated annually. In India alone, an estimated **6 million tons** of waste marble and granite are produced each year. This waste, if not properly managed, contributes to environmental degradation, with the potential to cause air pollution, groundwater contamination, and soil erosion.
The construction industry, as a major consumer of natural resources, is exploring innovative ways to reduce its environmental footprint. One approach that has gained attention is the use of industrial by-products as partial replacements for traditional concrete materials. Marble and granite waste, which are typically discarded, can be repurposed as a replacement for natural sand in concrete production. This not only provides a solution for waste disposal but also reduces the reliance on river sand, which is becoming an increasingly scarce resource.
This study investigates the potential of using marble and granite dust as partial replacements for natural sand in **M40 grade** concrete. The primary goal is to determine the optimal replacement percentage that enhances the mechanical properties of concrete, particularly its compressive and tensile strengths. The research evaluates various replacement ratios, ranging from 0% to 20%, to assess the performance of the concrete under different conditions.

Additionally, the study incorporates steel fibers into the concrete mix to improve its impact resistance. Steel fibers are known to enhance the toughness and ductility of concrete, making it more resistant to dynamic loads. The concept of fiber bridging, where fibers prevent the propagation of cracks under load, is also explored in this research. This reinforcement technique has the potential to improve the overall durability and strength of the concrete.

The study's findings contribute to the growing body of knowledge on sustainable concrete production. By incorporating waste materials into the concrete mix, the research offers an eco-friendly alternative to conventional construction practices. This approach not only reduces the demand for natural resources but also mitigates the environmental impact of waste disposal. Moreover, the use of recycled marble and granite in self-compacting concrete (SCC) has the potential to improve the workability and performance of concrete, making it a viable option for large-scale construction projects.

In conclusion, the use of waste marble and granite as partial replacements for natural sand in concrete production presents a promising solution to both waste management and resource conservation. The study highlights the potential benefits of this approach, including improved mechanical properties, enhanced durability, and reduced environmental impact. As the construction industry continues to seek sustainable alternatives, the repurposing of industrial by-products such as marble and granite waste could play a crucial role in promoting eco-friendly construction practices

MATERIAL SELECTION

1. Cement: Ordinary Portland Cement (OPC) was used as the binding material.
2. Fine Aggregate: Natural river sand was partially replaced with marble and granite dust in varying percentages (5%, 10%, 15%, and 20%).
3. Coarse Aggregate: Crushed stone aggregates of 20 mm were used as coarse aggregates.
4. Water: Portable water that meets IS specifications was used for the preparation of concrete.
5. Admixtures: A plasticizer was used to improve the workability of the concrete mix.

CEMENT:-A cement is a binder, a chemical substance used for construction that sets, hardens, and adheres to other materials to bind them together. Cement is seldom used on its own, but rather to bind sand and gravel (aggregate) together. Cement mixed with fine aggregate produces mortar for masonry, or with sand and gravel, produces concrete. Concrete is the most widely used material in existence and is behind only water as the planet's most-consumed resource.

MARBLE CRUSH:-Marble Crush are metamorphic rocks formed by the alteration of limestone by heat and pressure. In its pure form, marble is a white stone with a crystalline and sugary appearance, consisting of calcium carbonate CaCO3. Usually, marble contains other minerals, including quartz, graphite, pyrite, and iron oxides. It is used for its chemical properties in pharmaceuticals and agriculture. It is used for its optical properties in cosmetics, paint, and paper. They are used as Industrial Raw Materials.

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COARSE AGGREGATE: Coarse aggregates are any particles greater than 0.19 inch, but generally range between 3/8 and1.5 inches in diameter. Gravels constitute the majority of coarse aggregate used in concrete withcrushed stone making up most of the remainder.

FINE AGGREGATE: Fine aggregates are essentially any natural sand particles won from the land through the mining process. Fine aggregates consist of natural sand or any crushed stone particles that are ¼" or smaller. This product is often referred to as 1/4"' minus as it refers to the size, or grading, of this particular aggregate.

LITRATURE REVIEW

The use of marble and granite waste as alternative aggregates in concrete has shown significant improvements in both mechanical properties and durability. Replacing fine aggregate with marble waste, in proportions ranging from 20% to 40%, enhances the compressive and tensile strength of concrete. Additionally, incorporating granite dust into the concrete mixture reduces water absorption by 32-38% and water penetration by 60-70%. Waste granite, when used up to 300 kg/m^3, further reduces water penetration in concrete samples from 67 mm to 18 mm and from 81 mm to 31 mm, significantly improving impermeability. Furthermore, using granite dust as a partial replacement (20% to 30%) in concrete mixes increases the compressive strength across all curing periods, including early age (28 days) and extended periods of 90 and 180 days. These findings suggest that marble and granite waste can be effectively utilized as sustainable alternative aggregates, offering enhanced strength and durability in concrete while promoting environmental sustainability by recycling industrial by-products.

CONCLUSIONS

This compilation of studies on concrete mixtures replacing fine natural aggregates with recycled materials like marble and granite waste, alongside steel fibers, highlights several key benefits. Substituting fine aggregates with marble and granite improves compressive, tensile, and flexural

strength, particularly at lower replacement levels (up to 20%). Steel fibers enhance ductility and impact resistance, while reducing porosity and water absorption. However, workability tends to decline with increased waste content. Granite powder is especially effective at boosting compressive strength up to 15-20% replacement. Additionally, combining both steel fibers and waste aggregates enhances the overall mechanical properties and durability of the concrete, while promoting environmental sustainability by conserving natural resources and minimizing industrial waste disposal issues. Optimal replacement percentages differ slightly across studies, but overall, these substitutions are shown to be viable alternatives to traditional aggregates, contributing to stronger, more durable, and eco-friendly concrete mixtures.

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