ISSN No:-2456-2165

Partial Replacement of Fine Aggregate with Waste Glass and Coarse Aggregate with Demolished Aggregate

Shivankar Kumar*, Er. Vikas Sheoran*
* Student, Department of Civil Engineering, (M. Tech), IEC University Baddi, H.P India
* Assistant Professor, Department of Civil Engineering, (M. Tech), IEC University Baddi, H.P India

Abstract:- In today's scenario, concrete is the most commonly used material for infrastructure expansion in the world. Concrete is made up of components that occur naturally in the environment, so the availability of these resources is gradually depleted. To deal with this scarcity, much research has been done and various waste materials have been introduced as a partial replacement for cement, fine aggregate, and coarse aggregate. These waste materials if utilized in the production of concrete, will lead to save the environment by reducing the junk deposition in landfills. This article is intended to provide a brief overview of the replacement of fine aggregates with waste glass and coarse aggregates with demolished aggregates in order to analyze the properties of new and hardened concrete.

Keywords:- *Waste Glass, Demolished Aggregate (Recycled Concrete Aggregate), Properties of Fresh and Hardened Concrete, Environmental Issue, Replacement of Fine Aggregate, Replacement Coarse Aggregate.*

I. INTRODUCTION

Concrete is now the most frequently utilized composite material on the planet. Concrete is blend of cement, fine aggregate, coarse aggregate, and water. Since fine aggregates and coarse aggregates are inert minerals and decompose over time, we need to develop alternative materials that do not depend on natural resources. Glass, e-waste, rubber, demolition waste, ceramics, plastic, and other materials can be used instead. In this study, glass and demolition waste are used as substitutes for fine and coarse aggregates, respectively.

➢ *About Glass*

Since glass is an inert material containing silica, it can be used as an alternative to fine aggregate. Glass makes up about 0.7 percent of India's urban garbage. Glass waste is generated from liquor stores, broken utensils, electrical and electronic equipment, mirror stores, laboratories, etc. This glass waste can be recycled, but because the recycling rate is so low, most of it will end up in landfills. However, because glass is a non-biodegradable substance that takes millions of years to decompose, the deposition of glass waste poses a danger to the environment.

➢ *About Demolition*

Waste Coarse aggregates, like fine aggregates, are formed from rocks, a natural resource, and are therefore finite. This means that aggregates obtained from construction and demolition waste can easily replace coarse materials. Every year, 150 million tons of C&D waste is generated in India, of which only about 1% is recycled. Old and dilapidated structures, new investment replacements, structural renovations, road excavations, and substandard structures are some of the sources of C&D waste. The properties of chip aggregates are determined by the quality and quality of concrete used in the structures.

II. LITERATURE REVIEW

This literature is based on replacing fine aggregate and coarse aggregate with crushed waste glass and demolished aggregate.

➢ *Replacement with waste glass*

Aman Roy Patil (2019) In this study, M25 grade of concrete is produced with 0%, 5%, 10%, 12%, and 20% fine aggregate percentage replaced by waste glass. The mix was prepared using two water-cement ratios, 0.45 and 0.5. A water-cement ratio of 0.5 shows better results for M25-grade concrete. The workability of concrete decreased with an increase in glass percentage. The compressive strength was found to increase up to 10% replacement at 7 and 28 days. The increase in compressive strength for 0.45 W/C was 7.18% and 13.19% for 0.5 W/C. Hence, the optimum replacement percentage was considered as 10%.

Prajakta N. Haramkar (2018) In their study part, the fine aggregate was replaced with waste glass by 0%, 10%, 20%, and 30%. The concrete specimens with a water-cement ratio of 0.55 were prepared and the compressive strength was observed at 7, 14, and 28 days. The maximum strength gain was found to be 11.29%, when replacing the fine aggregate by

10% and is therefore considered to be the optimum substitution ratio. The slump was found to increase with the increase in glass percentage.

Jostin. P. Jose (2014) 0%, 10%, 20%, and 30% of the fine aggregate were replaced with waste glass to prepare M50 grade concrete. The samples are tested for compressive strength, split tensile strength and flexural strength. The optimum replacement rate is 10%, as the increases in compressive strength, split tensile strength and flexural strength after 28 days of curing are 9%, 23% and 74% respectively.

J. Premalatha (2019) The Five mixtures prepared in this study are M20, M30, M40, M50 and M60. The percentage of sand replacement with waste glass powder was 0%, 10%, 20%, 30%, 40% and 50%. The result shows that the value of the slump increases with the percentage of glass up to 40%. The 28 day compressive strength, split tensile strength and flexural strength were found to increase up to 30% replacement and were comparable for 40% and 50% replacement percentages as compared to the controlled mix. Up to 50% substitution percentage, the chloride penetration rate and permeability showed a strong decline and therefore the optimum percentage substitution was taken as 50%, as it also maintained the strength properties.

Jagriti Gupta (2018) They used waste glass bottles as replacements for some of the sand. The percentage replacements were 0%, 2%, 5%, 7%, and 10%. M30 grade concrete mixes were prepared using the above alternating formulations and were tested for compressive strength after 7 and 28 days. The water absorption and density of concrete decrease with an increase in the percentage of glass. The workability of concrete increases up to 20% replacement and compressive strength increases up to 10% replacement of glass with fine aggregate. The increase in compressive strength at the optimum rate is 23.75%.

- *Replacement with demolished aggregate*

Abdulsamee M. Halahla (2019) An M-25 mix was prepared with the substitution of 100% natural coarse aggregate (NCA) with recycled concrete aggregate (RCA) and tried for 3, 7, 14, and 28 days. RCA collected from an old building in Tabuk, Saudi Arabia has a specific gravity of 2.695 and a smoothness factor of 7.88. After testing, it was found that compressive strength and split tensile strength decreased with increasing RCA, but the difference did not exceed 5%. When compared to natural aggregate concrete, the initial tangent elasticity modulus was determined to be 10% lower. The elongation at break was higher in RCA than in NCA.

Reema (2020) Makes M-25 mix with a coarse aggregate replacement rate of 0%, 10%, 15%, and 20%. The aggregate utilized had a nominal size of 20mm. RCA encompasses a specific gravity of 2.45 and a water absorption rate of 5.62%. After 7 and 28 days, different tests were performed with a water-cement ratio of 0.5 and additive Auramix 200. The results showed that as the percentage of RCA increased, the deflection increased, but the nominal durability is reduced. The highest reduction in compressive and split tensile strength was 8.825% and 13.22%, respectively. Since it does not affect the functional requirements of the structure, the optimal replacement rate is 20%.

Mohd Monish (2013) Retrieved the RCA from IIT building, Allahabad. They roll out 1:1.67:3.33 mixtures with alternative percentages of 0%, 10%, 20%, and 30%. Workability and compressive strength were assessed on these specimens after 7, 14, and 28 days. It was concluded that the slump was reduced compared to the control mixture and the amount of water required to achieve the same workability is significant. With RCA, the compressive strength was found to be comparable up to 30% replacement.

Rao (2018) As part of his research, he extracted recycled concrete aggregates from grades M20, M25, M30 and M40 waste concrete. He called it RCA20, RCA25, RCA30 and RCA40. Using RCA20 and RCA25 he prepared mix M20 and using RCA30 and RCA40, he prepared concrete M30 grade. Prepared samples were cured and tested for compressive strength after 3, 7 and 28 days. The split tensile strength, flexural strength, and ultrasonic pulse velocity test were carried out at 28 days. The results show that for high-grade RCA bulk density decreases whereas, water absorption increases. It was also observed that the concrete made with the same grade of RCA gives lower strength as compared to the sample made with a higher grade of RCA which gives the equivalent result as that of the conventional mix. A similar trend was observed for split tensile and flexural strength. For concrete with a higher RCA grade, a 6% reduction in strength was observed when tested with an ultrasonic pulse tachometer compared to the original mix.

M. Chakradhara Rao (2010) The study was done considering the coarse aggregate replacement percentages of 0%, 25%, 50% and 100% with recycled concrete aggregate. The mix was prepared considering the water-cement ratio to be 0.43 with 50mm to 60mm slump. The super-plasticizer used was Sika Viscocrete R550. The results show that up to 50% replacement percentage the compressive strength was comparable to the conventional mix, while the modulus of elasticity and split tensile strength shows a significant difference. The observation shows that the concrete with partial wet and air curing shows better result than constant wet curing. The penetration depth of chloride increases as the proportion of substitution increases. It can also be used as lightweight concrete since, the density of concrete decreases.

ISSN No:-2456-2165

III. CONCLUSIONS

From the above papers, the following conclusions can be made:

- Waste glass can be used as a substitute for fine aggregate in concrete mixes.
- The initial and final setting times of concrete decrease as the proportion of glass increases. This indicates that crushed glass also acts as a retarder in the mixture.
- The water absorption of a concrete mix decreases as the glass percentage increases.
- No exact trend in workability is observed, it depends on the grade of the concrete and the Percentage of glass replacement.
- The use of glass has been found to improve compressive strength, tensile strength and Bending strength from angular particles.
- Using demolished aggregates as a partial replacement for coarse aggregate can be Beneficial.
- The coarse aggregates can 100% be replaced by the demolished aggregates but the good Strength is achieved when the replacement percentage is between 25% to 50%.
- The water absorption of concrete mixes with demolished aggregate as the coarse aggregate Is high compared to mixtures with virgin aggregates. It's because of the old mortar Attached on the surface of demolished aggregates.
- Concrete mix is made of demolished aggregate to partially replace of coarse Aggregate requires more water to maintain the workability same as the original mix.
- The compressive, tensile and flexural strength of concrete decreases as the replacement Percentage of demolished aggregate increases. Strength largely depends on the grade Of Concrete of the demolished aggregate.
- The use of waste glass and demolished aggregate at place of fine aggregate and coarse aggregate makes the concrete economical and eco-friendly.
- However, using water glass as a fine material is somehow better, but using dismantling material as coarse aggregate is still questionable, because of its excessive use i.e., more than 50% of "dismantled" aggregate leads to "efflorescence". Such as excessive use of water for curing as well as a water-cement ratio.

REFERENCES

[1]. **Abdulsamee M. Halahla, M. A.:** Utilization of Demolished Waste as Coarse Aggregate in Concrete. Civil Engineering, Journal 5, 2019.

[2]. **Aman Roy Patil, T. s.:** Recycling of Waste Glass as Partial Replacement of Sand in Concrete- Effects on Compressive Strength. International Journal of Engineering and Technology, 2019.

[3]. **J. Premalatha R.:** Properties of Concrete with Waste Glass Powder (Gp) as Fine Aggregate Replacement. International Journal of Research Technology and Engineering, 8 (2S11), 2019.

[4]. **Jagriti Gupta, N. L.:** Strength of Concrete Partially Replacing Fine Aggregates by Glass Powder, RTCEC.6, IJERT, 2018.

[5]. **Jostin. P. Jose, S. B.:** Use of Glass Powder as Fine Aggregate in High Strength Concrete. International Journal of Science and Engineering Research, 2014.

[6]. **M. Chakradhara Rao, S. K.:** Impact of field recycled coarse aggregate on Properties of Concrete. Materials and Structures, 205-220, 2010.

[7]. **Mohd Monish, V. S.:** Demolished waste as coarse aggregate in concrete. Youth Education and Research Trust, 1(9), 2013.

[8]. **Prajakta N. Haramkar, S. M.:** Partial substitution of Fine Aggregate by using Glass dust, IJET, 2018.

[9]. **Rao, M. C.:** Properties of recycled aggregate and recycled aggregate concrete: Effect of Parent Concrete. Asian Journal of Civil Engineering, 2018.

[10]. **Reema, C.:** Partial Replacement of Coarse Aggregates with Demolition Waste in Construction. Mukt Shabd Journal, 9 (6), 2020.