Fracture Mechanics of Concrete using Recycled Concrete Aggregate

Supekar Mohini G[1] Gerange Smita T[2] Gulam Hazaque A[3] Sayed Faisal S[4] Prof.B.D Kanawade[5]
[5]Project Guide
[5]Department of Civil Engineering
[1,2,3,4,5]Dr. Vithal Rao Vikhe Patil College of Engineering, Ahmednagar, India

Abstract— Worldwide, cities generate about 1.3 billion Tonnes of solid waste per year. Building materials account for about half of all materials used and about half the solid waste generated worldwide. The waste, generated in the construction, maintenance, repair and disposal phases of a building, is called Construction and Demolition (C&D) Waste. Management of C&D waste is a problem faced not only in India but by the global community and quantum of waste produced occupies a huge fraction of the total solid waste generation by mass. Furthermore, a continued environmental awareness instigates the pressure for reuse of construction materials instead of classifying them as waste materials. Using construction waste material as an aggregate for developing new concrete product is technically viable and may, in some circumstances, be environmentally beneficial. The recent government initiative to stop sand mining insists the need to recycle, reuse and substitute natural aggregates in order to ensure environmental sustainability. This research work aims at making one such experiment where recycled aggregates are produced from C&D waste thus paves a way, for the effective management of concrete debris.

Key words: Concrete, Natural Coarse Aggregate, Recycled Concrete Aggregate, Fresh Properties, 34 Hardened Properties, Durability

I. INTRODUCTION

- Concrete is a construction material having the ingredients like cement, fine aggregate, coarse aggregate with water and some admixtures if any, will gave strength and durability properties.
- Concrete is very useful construction material since 20th century because of it is molding into any shape before setting. About 70% to 75 % of volume is filled by coarse aggregate.
- We need to take care about naturally occurring coarse aggregate because of lack of availability of coarse aggregate in some countries.
- Aggregate separated from construction and demolition waste will contain hardened mortar around its surface is called it as Recycled aggregate.
- The use of recycled aggregate will reduce the environmental losses and this type of re-usage will become an Ecofriendly construction material.
- To reduce large quantity of waste material it is a better step to introduce recycled aggregate.
- The cost of recycled aggregate concrete may be 20% to 30% less than natural aggregate concrete in some regions.
- Recently Delhi Metro Rail Corporation (DMRC) takes a step to initiate towards environmental conservation and recycling of construction waste scientifically.
- Delhi Metro Rail Corporation commissioned at Rohini for Recycling C & DW from construction works.
- This project report will try to use Recycled aggregate for constructions. And how the strength variations are obtained will be studied.

II. RESEARCH AND METHODOLOGY

For concrete mix design based on the percentage replacement of RA in CA, design mixes are prepared for M30 grade of concrete.

- Mix proportions were prepared as per IS-10262-2009. For this experimental program OPC 53 grade cement, Natural fine aggregate, Coarse aggregate of size not more than 20mm, Recycled Aggregate from

III. LITERATURE REVIEW

A. Revathi Purushothaman et al (2014)

Strength characteristics and the performance of Recycled Aggregate Concrete

Author taken six series of concrete mixes and are prepared using Natural Aggregate, RA, RA treated with H2SO4 solution and RA treated with HCL solution. Sample of Recycled aggregate is obtained after Scrubbing treatment, heating and Scrubbing treatment. The six series of concrete mixes are prepared for determining its physical properties and mechanical properties of concrete

B. Saravanakumar et al(2013)

Strength properties of High- Volume Fly Ash

The replacement of Natural Aggregate (NA) with RA is performed in different percentages like 25%, 50% and 100% to study the effect of RAC on compressive strength and tensile strength characteristics. Also Author replaced the amount of cement with Fly Ash in different proportions like 40%, 50% and 60% to study the effect of Fly ash on compressive strength and tensile strength of concrete at an age of 28days.

IV. OBJECTIVES

- To replace natural coarse aggregate by the recycled coarse aggregate in various percentages (0%, 30%, 60% and 100%)
- To study and compare the mechanical properties - compressive strength, split tensile strength, flexural strength of hardened concrete specimens with and without recycled aggregates

V. TESTS ON RAC

A. Compressive strength

The compressive strength of RCA concrete is usually lower than that of NCA concrete as shown in Fig. 1. Most commonly, the compressive strength of RCA concrete is 5 to 10% lower than that of NCA concrete (ACPA 2009). But it can also be decreased up to 25% depending upon the quality

All rights reserved by www.ijsrd.com

of RCA (Rahal 2007; Ajdukiewicz and Kliszczewicz 2002;
Hansen 1992; Evangelista and de Brito 2007; Juan and Gutierrez 2004; Anderson et al. 2009). The higher air content normally found in the concrete mixes containing RCA may also lead to Lower strength values (Anderson et al. 2009). However, RCA concrete may have the similar and sometimes higher compressive strength than NCA concrete if the RCA is derived from a source of old concrete, which was originally produced with a lower water to cement ratio than the new concrete (Padmini et al. 2009).
Mandal et al. (2002) and Limbachiya et al. (2000) found that RCA produced no effect on the compressive strength of concrete up to the replacement level of 30% by weight; but the compressive strength decreased for the RCA content more than 30%. Poon et al. (2004) found that the compressive strength of concrete was much lower when RCA was used in the oven-dry state. In the case of high-performance concrete, 20 to 30% reduction in compressive strength was found due to the use of RCA (Hwang et al. 1996; Chern et al. 1995; Li and Hwang 2002). A similar result was observed by other researchers (Sagoe-Crentsil et al. 2001; Ajdukiewicz and Kliszczewicz 2002). Grdic et al. (2010) investigated the properties of self-compacting concrete prepared with RCA and compared with those of NCA concrete; they observed that the difference in compressive strength at the same age was not significant.
The fine RCA can also affect the compressive strength of concrete. According to Tavakoli and Soroushian (1996), the compressive strength of RCA concrete is influenced by the coarse aggregate to fine aggregate ratio of the source concrete of RCA. The lower coarse to fine aggregate ratio leads to a higher quantity of mortar attached to coarse RCA particles, and thus results in a reduction in the strength of RCA concrete. This reduction is even greater local destructive structures are used.The experimental program is to observe the mechanical properties of concrete such as Compressive strength, Split tensile strength and Flexural strength and also Durability of concrete using Recycled aggregate.

B. Splitting tensile strength:

Limited literature is available concerning the effect of RCA on the splitting tensile strength ofconcrete. Nelson (2004) reported that the splitting tensile strength of RCA concrete is lower than that of NCA concrete, as shown in Fig. 2. Several researchers observed that the splitting tensile strength of RCA concrete is 0 to 10% lower than that of NCA concrete, but no statistically significant reduction in the tensile strength occurred during the period of 91 to 365 days (Ajdukiewicz and Kliszczewicz 2002; Hansen 1992; Anderson et al. 2009). On the other hand, Tovakoli and Sorushian (1996) reported that RCA concrete produced highe splitting tensile strength than NCA concrete. Hence, more research is required to investigate the effect of RCA on the splitting tensile strength of concrete.

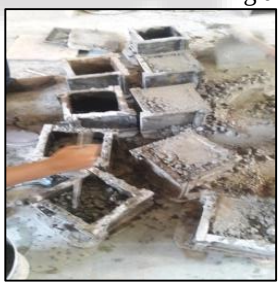
C. Flexural strength:

The flexural strength of RCA concrete is generally lower than that of NCA concrete, as shown in Fig. 3. The flexural strength of RCA concrete is typically 0 to 10% lower than that of NCA concrete (Hansen 1992; Ajdukiewicz and Kliszczewicz 2002; Yang et al. 2008).
According to Yong and Teo (2009), the 3-day flexural strength of RCA concrete was higher than that of NCA concrete; but the strength was lower at the age of 28 days. In their study, the NCA concrete gained strength gradually and had a higher flexural strength than RCA concrete at later age. Safiuddin et al. (2011a) reported that RCA did not produce any significant negative impact on the flexural strength of concrete. Nevertheless, the RCA concrete with adequate flexural strength can be produced for different applications, sometimes even with 100% replacement of NCA (ACI 555R 2001; Yrjanson 1989).

VI. PROCEDURE


Tested Conc.Waste Recycle Aggregate


Mixing and Proportioning




Compaction and Moulding

VII. CONCLUDING REMARKS:

There is a significant potential for recycling demolished concrete for use in value added applications to maximize economic and environmental benefits. Significant savings can be achieved through converting RCA into useful resources in the production of new concrete

REFERENCE

[1] Tomas U. Ganiron Jr, (2015), “Recycling Concrete Debris from Construction and Demolition Waste”, International Journal of Advanced Science and Technology Vol.77, pp.7-24.
[2] Roz-Ud-Din Nassar and Parviz Soroushian, (2012), “Strength and durability of recycled aggregate concrete containing milled glass as partial replacement for

All rights reserved by *www.ijsrd.com*

cement", Construction and Building Materials, Vol. 29. pp. 368–377
[3] Markandeya Raju Ponnada1 and Kameswari P, (2015), "Construction and Demolition Waste Management – A Review", International Journal of Advanced Science and Technology, Vol. 84, pp.19-46.
[4] Hardik Gandhi et al, (2011), "Study on Use of Recycled Coarse Aggregate In Concrete", National Conference on Recent Trends in Engineering & Technology, 13-14 May, pp. 1-4.
[5] IS 10262-2009, Recommended Guidelines for Concrete Mix Design (Bureau of Indian Standards, 2009).
[6] IS 2386 (Part III) – 1963, Methods of test for aggregates for concrete, Part 3: Specific gravity, density, voids, absorption and bulking (Bureau of Indian Standards, 1963).
[7] Jitender Sharma and Sandeep Singla, (2014), "Study of Recycled Concrete Aggregates"`, International Journal of Engineering Trends and Technology (IJETT), Vol. 13, No. 3, pp. 123 – 125.

All rights reserved by *www.ijsrd.com*