

# Behavior of HVFA Concrete in Presence of Recycled Aggregate

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**ABSTRACT** - The issue of waste transfer has turned into a noteworthy issue in the created nations and in addition creating nations like India. This is because of the colossal increment in the amount of dispensable materials, the proceeding with capacity of dumping destinations, increment in the expense of transportation and its transfer. Along these lines the idea of reusing the waste material and utilizing it again as a part of some structure has assembled energy. Likewise, reusing takes care of the issue of waste transfer as well as decreases the expense and monitors the non-renewable normal sources.

Devastation waste produced in numerous nations is no special case to the above issue. Also, thus, reusing innovation is making impressive progress in the reusing of crushed cement. The amount of cement disposed of consistently has achieved figures of around 60 million tons in the U.S., 50 million tons in the European Economic Community, 10 to 12 million tons in Japan, 11 million tons in U.K., and 13 million tons in France. It is assessed that these figures will increments ceaselessly by the year. The exhaustion of the common coarse total, particularly in the region of the development locales and the constantly expanding interest for total by the development business further empower the appropriation of this idea of reusing innovation.

**KEYWORDS**- Dispensable materials, Waste material, Devastation waste, Common coarse total, reusing innovation.

## I. INTRODUCTION

In India as well, the same exchange of consumption of the total stores, increment in the expense of annihilation and transportation, and lack of dumping locales because of the quick urbanization are unmistakably perceivable. The circumstance in India is not as genuine like that of in the west, yet there are a few sections of Northern India, particularly in the Gangetic bowl, where pounded stone total are not accessible inside a few kilometers of the sweep. In any case, the gravity circumstance later on requests genuine reexamining with respect to the Indian people group, particularly when the volume of solid development is relied upon to expand complex in coming decades.

Improvement of Recycled Aggregate Concrete: from the most recent two decades the rate of development of development industry, urbanization gets to be fast which devours heaps of characteristic material assets. As sources are restricted, in alarm of constrained source and the reusing is better arrangement on it. Reused total these days utilized as a part of development segment is picking up interest.

### Sources of waste cement:

- a) Demolition of solid structures because of different reasons is the fundamental source from which the waste cement is produced. Private structures which are for the most part intended for an existence range of over 50 years are some of the time halfway or completely crushed at an early age because of different reasons like high cost of repair and upkeep, development issues and redevelopment of local locations for different employments.
- b) Commercial and Industrial structures which have lower life range and private structures are frequently subjected to remodel and recreation because of changes in possession or interest for extra offices.

- c) Civil designing structures, for example, airplane terminals, runways, asphalts, spans, flyover, ports and so forth are by and large subjected to extensive weakening because of their uses and additionally introduction.
- d) In prepared blended and site blended solid plants, ordinarily a generous amount of undesirable cement is created from abundance generation or dismissal.
- e) Precast solid industry where significant wastage may emerge from the breakage of precast solid component amid throwing, lifting and transportation.
- f) Central and site research facilities, where a critical amount of control examples are tried for consistence.

#### **Quality and Quantity of waste cement:**

Rejected undesirable material in our development industry and in all affable building works, development and decimation. Materials for the most part thought to be not water-dissolvable and nonhazardous in nature, including, but rather not constrained to, steel, glass, block, black-top roofing material, channel, gypsum wallboard and so forth from the development or decimation of a structure as a major aspect of a development or destruction venture or from the redesign of a structure, and including rocks, soils, tree remains, trees, and other vegetative matter that typically comes about because of area clearing or land improvement operations.

#### **Production of reuse total:**

The C&D flotsam and jetsam waste stream is involved real sub-classifications are: area clearing garbage, transportation related trash, building development, annihilation trash and catastrophe trash. Land clearing flotsam and jetsam is included root dividers, non-merchantable timber, brush, rocks, waste and different soils. Transportation determined flotsam and jetsam incorporates Portland bond cement and black-top solid clearing for roadways, checks, walkways, spans and other fundamentally solid garbage, normally with imbedded pipe or steel. Building related C&D garbage incorporates: wood, solid, block and other brick work, material, drywall, and random paper, plastics and metals. It can originate from development, remodel or decimation of private and non-private or business structures and differs generally relying upon the sort of building and movement. As indicated by the United States Environmental Protection Agency (USEPA), remodel and decimation represents 88% of all C&D garbage from private and business structures.

## **II. LITERATURE SURVEY**

### **2.1 General**

The idea of reusing material is practically speaking for recent decades. More often than not, the obliterate rubble was utilized as area fill material, despite the fact that there are few examples of using these materials as totals for making concrete. Notwithstanding, in last one and half decade, impressive exploration work has been done on different parts of reused total and reused total cement.

### **2.2 Mix Proportions**

Compressive quality diminished with increment in a/c proportion and is specifically relative to quality of the mixed total (Poon and Lam 2008).[17] The degree to which the properties of cement are influenced by the utilization of reused total relies on upon the water retention, pulverizing worth and soundness of the reused totals (Kikuchi et al 1998).

### **2.3 Stress-Strain Behavior**

Solid quality diminished when reused cement was utilized (Barra de Oliveira and Vasquez 1996)[18]; and the quality lessening could be as low as 40% (katz 2003; Chen et al 2003). No diminishing in quality for cement containing up to 20% fine or 30% coarse reused totals, however past which there was a precise reduction in quality as the substance of reused totals expanded (Dhir

et al 1999). Nature of reused total did not influence quality at high water/bond (w/c) proportion yet at low w/c proportion (Ryu 2002; Padmini et al 2002)[19].

#### **2.4 Durability**

Reused total cement has preferred imperviousness to carbonation over characteristic total cement (Dhir and Paine 2007) on the grounds that reused total cements have higher concrete substance to accomplish a given quality. Scraped area resistance of reused total cement has been evaluated utilizing a quickened scraped area technique (Dhir et al 1999). Up to 30% by mass of reused total as coarse total, there is just a little contrast in scraped area resistance (around 0.2mm), and which is inside content repeatability however underneath 30%, the distinction is as much as 1mm. With the substitution of fine normal and fine reused solid total, the scraped area resistance appears to increment.

#### **2.5 European Practice**

European standard, BS EN 12620, characterizes characteristic fabricated and reused total as:

- (i) Natural totals, being from mineral sources and subject to simply mechanical handling.
- (ii) Mechanical totals being of mineral root coming about because of modern procedure including warm or other alteration and
- (iii) Recycled total, result from the handling of inorganic material already utilized as a part of development.

#### **2.6 Japanese Practice**

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Japanese models (JIS A 5021) perceiving that creation of reused total does not as a matter of course reflect execution capacity, are presenting determinations for three gauges of reused total for cement. (i) low quality reused total for inlaying, filling and leveling concrete. (ii) Use of RCA with mixed bonds as a measure against antacid silica reactivity (iii) Provision of prerequisites for "typical" reused totals. [21].

### **III. OBJECTIVES**

Reused coarse total found a spot as option coarse total for making concrete for all reasons. As needs be, the broad examination work has been completed by different agents in various parts of the world. Reused total cement has been effectively used for development and restoration of asphalts and runways. The designers and analysts have reservations about its appropriateness as basic cement for assortment of reasons expressed in the accompanying sections. However these reservations can be expelled by guaranteeing that,

- a) This reusing innovation is produced on the premise of sound comprehension of the properties of reused total and
- b) A objective blend configuration is advanced taking into account the particular properties of reused total for determining ideal execution of reused total cement both in crisp and solidified state. In this manner, there is a solid requirement for an efficient, thorough and co-ordinate research work.

#### **Necessity of utilization of RCA:**

Numerous old structures and other solid structures have conquer their farthest point of utilization should be obliterated. Structures even sufficient to utilize are under devastation in light of the fact that there are new prerequisites and necessities in different applications.

Totals regularly speak to an extensive extent of a district's C&D waste stream because of their weight and prevalence in cutting edge development procedures. The reused total coming about because of C&D waste reusing procedure can be utilized as:

- 1. Foundation material for street development.**
- 2. Hardcore for any establishment work.**

3. **Base or fill for seepage and**
4. **Aggregate for solid assembling.**

**Objectives of the examination:**

The through investigation of a writing accessible on the reused totals lead to taking after targets of the present examination.

1. To research altogether, all the physical and mechanical properties of reused total got from cement of assortment in evaluation and age.
2. To study the properties of HVFA cement in new and solidified state.
3. To watch conduct of the reused total cement in its new state and solidified state for the extensive variety of blend cases.
4. To supplant the common coarse totals by RCA and study its conduct.
5. To explore the properties of the new reused total concrete and transient properties of the solidified reused total cements.
6. To develop the relationship between different properties of reused total cement.

**Scope of work:**

The extent of the work has been restricted to the accompanying:

- Maximum size of all around reviewed reused totals confined to 20mm.
- For parametric study parameters like particular gravity, water request, water ingestion, compressive quality, flexural quality, split elasticity have been considered to built up sought relationship between different parameters.
- For compressive study concrete with changing % of reused total with altered water-bond proportion have been chosen
- Percentage supplanting of bond with fly fiery debris is confined to 20% to 30%.

**IV. METHODOLOGY**

**Natural Aggregate:**

**Table 1: Properties of natural aggregate**

Test	Result
Aggregate crushing value	11.26%
Aggregate impact value	11.11%
Specific gravity	2.77
Water absorption value	2.65%
Fineness modulus	3.92

**Recycled Aggregate:**

**Table 2: Properties no of recycled aggregate**

Test	Result
Aggregate crushing value	15.45%
Aggregate impact value	15.16%
Specific gravity	2.23%
Water absorption value	6.995%

Fineness modulus	2.62
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**Table 3: Different mix proportions**

Mix Designation	Description
M1	Mix prepared with 0% replacement RCA
M2	Mix prepared with 20% replacement RCA
M3	Mix prepared with 40% replacement RCA
M4	Mix prepared with 60% replacement RCA
M5	Mix prepared with 80% replacement RCA
M6	Mix prepared with 100% replacement RCA

**Generation of recycled aggregate-**

In the present work source of aggregate of concrete selected for production of recycled aggregate is collected from demolished structure from an old site of construction which is 30 years old .These concrete specimens are of different grade.

**Processing of Aggregate:** Production of recycled aggregate involves crushing of concrete, removal of fine particles and sieving them into different size fractions. The detailed procedure for production of recycled aggregate is described below.

The concrete specimen filled into container and transported to crusher plant. Jaw crusher is used for crushing concrete. Before feeding and operation of crusher, the jaws of the jaw crusher were set to require size. The concrete blocks are fed continuously in the hopper of the crusher. The crusher product is collected below in the heap. The jaw crusher setting is frequently checked for its correctness as it may get disturbed due to vibrations and impact of the feed of the concrete blocks.

After a batch of crushing, the whole crusher product is well mixed, and sieve analysis is carried out. Subsequently, aggregate fraction more than and less than the required size are removed by sieving. Sieve analysis is carried out, as per the standard sieve analysis procedure. The recycled aggregate the store into the overhead hopper through conveyer system. The hopper have opening arrangement at its bottom container is stand below the opening of hopper. The crushed material then transported to the laboratory to carry laboratory test on it.

**Preliminary investigation of natural and recycled aggregate-**

The fine aggregate and coarse aggregate are tested for their important properties before utilizing them for making concrete.

**Fine aggregate (sand):** Locally available fine aggregate i.e. sand from the nearby river at Nashik is used.

The following necessary and important tests are carried out for sand.

- a) Specific gravity;
- b) Water absorptions;
- c) Sieve analysis and fineness modulus.

These test are carried out as per the relevant IS code of practice. The test result are presented in table no. 3.1

The test result indicates that, the sand is satisfying the requirement according IS code, the silt content and clay lumps are within the limits. Same sand were used throughout all concrete mix.

**Coarse aggregate:** Coarse aggregate (natural aggregate) used is a crushed volcanic Basalt rock. The following test are carried out for coarse aggregate, as per the procedure given in relevant IS code of practice.

- a) Sieve analysis and fineness modulus,
- b) Specific gravity,
- c) Water absorption,
- d) Mechanical properties.



Fig. 1 Aggregate Testing Apparatus



Fig.2 Concrete Mix

## V. RESULT AND DISCUSSION

In this stage the properties of RAC blend cases with shifting rate of reused total have been tried and their outcome ordered efficiently in an unthinkable structure. Their outcomes are exhibited graphically for better understanding and to set up conceivable connections.

Exploratory perception: Table no. 6, 7, 8, 9, 10 introduce the compressive quality, flexure quality, part elasticity, and so on for differing rate of reused total and tried at 7 days, 28 days of curing. Relationship between quality of cement for different rates of reused total of 7 days and 28 days of curing.

### Discussion -

Reused totals have displayed low imperviousness to mechanical activity like, smashing, effect and scraped spot. Total smashing worth, total effect esteem and los-Angles total scraped spot esteem increments with the period of wellspring of cement.

An expanding interest for characteristic total coming about because of huge extension in urbanization is exacerbated by impressive decrease in the accessibility of good quality normal total in the region of development locales, and stringent antipollution and ecological controls for preservation of regular assets. All the while, there has been huge increment in the amount of wrecked cement, the transfer of which postured major issue because of the lack of dumping destinations and steep ascent in dumping cost. While reused total cement has been utilized effectively for asphalts and runways, it has not been utilized for general development reason. Albeit, broad examination work has been completed in different parts of the world, the greater part of it remained a divided one. Accordingly, designers and analysts have still some reservation on its utility for general development reason.

**Compressive quality results:**

**Compressive quality of cement:** Out of numerous test connected to the solid, this is the most extreme vital which gives a thought regarding every one of the attributes of cement. By this single test one judge that whether Concreting has been done appropriately or not. For 3D shape test two sorts of examples either solid shapes of 15 cm X 15 cm X 15 cm or 10cm X 10 cm x 10 cm relying on the measure of total are utilized. For a large portion of the works cubical molds of size 15 cm x 15cm x 15 cm are normally utilized.

**CALCULATIONS**

Size of the shape =15cm x15cm

Range of the example (computed from the mean size of the example )=225cm<sup>2</sup>

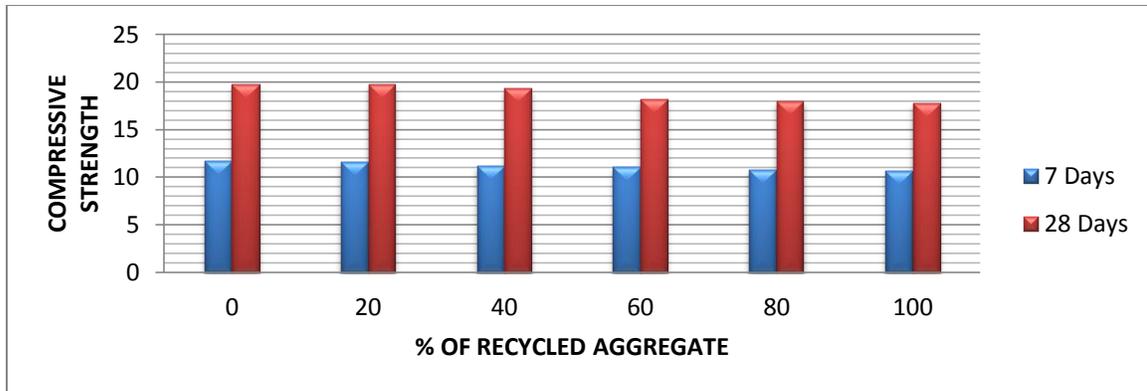
Greatest burden connected =... .. tones = ... ..N

Compressive quality = (Load in N/Area in mm<sup>2</sup>)=... .. N/mm<sup>2</sup>

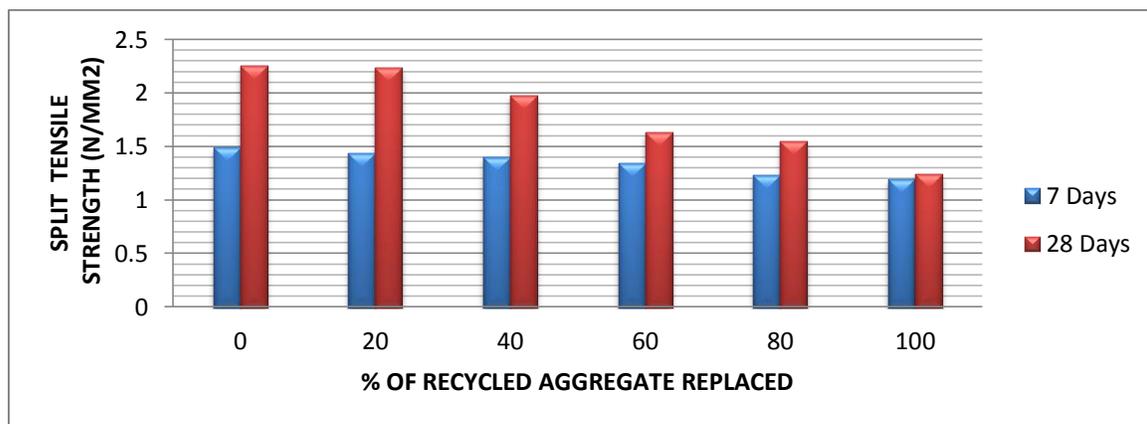
**Table 5: Compressive strength after age of 7 days & 28 days.**

Cube size: 150mmX150mmX150mm

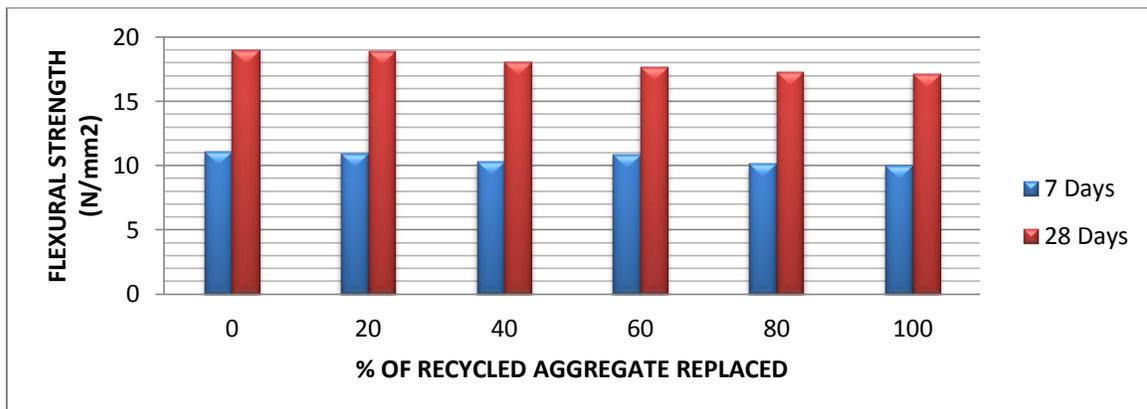
Designation	Percentage of Recycled aggregate	Compressive Strength	
		7 Days	28 Days
M1	0	11.70	19.75
M2	20	11.61	19.73
M3	40	11.23	19.35
M4	60	11.10	18.23
M5	80	10.83	17.98
M6	100	10.64	17.79



Graph 1: Variation in compressive strength due to replacement of recycled aggregate



Graph 2: Variation in splitting tensile strength due to % replacement of recycled aggregate



Graph 3: Variation in flexural strength due to % replacement of recycled aggregate

## VI. CONCLUSION

The accompanying conclusion can be drawn in light of test results and the separate talk of study:

- 1) As mortar is joined to the surface of RCA it shows low particular gravity and high water ingestion than routine total.
- 2) Recycled total have shown low imperviousness to mechanical activity like squashing, effect and scraped area than routine total. The above properties diminish with expanding the time of wellspring of reused total.
- 3) The workability of reused total cement is more than the normal total cement in view of the additional water is added by of water assimilation of RCA.

- 4) Proportions' (M1 to M6) has been observed to be 60% to 75% of the compressive quality of comparing traditional cements composed by same strategy.
- 5) About 5% to 18% diminishment in part rigidity has been seen for reused total cements than that of ordinary cements.
- 6) The blend extent arranged with HVFA cement is under sand because of RCA and has brutal blend.
- 7) It is found that the flexure quality of reused total cement blends decreased by 10% to 15% than the customary cement.
- 8) By utilizing flyash as a part of solid we can supplant normal coarse total upto 40% by Recycled coarse total without influencing the properties of cement in plastic too in solidified stage.
- 9) HVFA solid increases quality gradually as contrast with ordinary cement..

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