EXPERIMENTAL STUDY OF PERMEABILITY OF RECYCLED AGGREGATE CONCRETE BY VARYING DOSAGE OF FLY ASH

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ABSTRACT:

Use of recycled aggregate in concrete can be useful for environmental protection. Recycled aggregates are the materials for the future. The application of recycled aggregate has been started in a large number of construction projects of many European, American, Russian and Asian countries. Work arising from construction and demolition constitutes one of largest waste streams within the developing nations of this a large portion of potentially useful material is disposed as landfill. The environment and economic implementation of this area no longer considered sustainable and as a result construction industry is expressing more pressure than even before to overcome this practice.

In order to overcome this problem, the idea of using debris came into existence. This gave a raise to inception of recycled aggregate. Recycled aggregate are basically comprised of crushed, graded inorganic particles produced from the concrete, which has been previously used in construction.

The objective of present study is to determine sustainability of recycled aggregate an alternate material to coarse aggregate material to normal coarse aggregate and to compare the permeability using fly ash of recycled aggregate concrete with that of natural aggregate concrete.

The investigations were carried out in fresh and hardened state property concrete. The compressive strength of recycled aggregate for each grade increases till 20% fly ash and decrease for 30% addition of fly ash. The permeability of recycled aggregate concrete using different proportion of fly ash and natural aggregate concrete were tested. There were total 4 batches of concrete mixes of grade M20 M25 M30 M35 with 100% replacement of conventional aggregate with recycled aggregate. The result observed is permeability of recycled concrete is more compared to natural aggregate but addition of fly ash can improve the permeability characteristic of recycled aggregate concrete.

INTRODUCTION:

Any construction activity requires basic materials such as concrete, steel, brick, stone, glass, clay, mud, wood, and so on. However, the cement concrete remains the main construction material used in construction industries. For its suitability and adaptability with respect to the changing environment, the concrete must be such that it can conserve resources, protect the environment, economize and lead to proper utilization of energy. To achieve this, major emphasis must be laid on the use of wastes and by products in cement and concrete used for new constructions. The utilization of recycled aggregate is particularly very promising as 75 per cent of concrete is made of aggregates. In that case, the aggregates considered are slag, power plant wastes, recycled concrete, mining and quarrying wastes, waste glass, incinerator residue, red mud, burnt clay, sawdust, combustor ash and foundry sand. The enormous quantities of demolished concrete are available at various construction sites, which are now posing a serious problem of disposal in urban areas. This can easily be recycled as aggregate and used in concrete. Recycled aggregate is the result of processing appropriate construction and demolition waste. Thereby it is to distinguish between concrete rubble and mineral building material rubble. The processing leads to crushed sand, crushed stone and crushed gravel, derived from concrete rubble and mineral building material rubble respectively.

It is also known that the relationship between the aggregate porosity and water permeability of concrete is of great importance for concrete durability because in most cases this relationship is the starting point for concrete deterioration. For this investigation, Recycled Concrete containing RCA was tested on order to determine its water permeability. To accomplish these four grades of RC with different fly ash proportion are considered.

NEED FOR THE PRESENT WORK:

As more than 50% construction and demolition (C&D) wastes are compound of concrete debris, recycling this debris into Recycled Aggregate (RA) for production of Recycled Aggregate concrete (RAC) is an efficient way to alleviate the burden on landfill areas.

Since RA is generated from concrete debris which has undergone years of services, the resulting Recycled Aggregate Concrete bears the weaknesses of lower density, higher water absorption, and higher porosity that limit them to lower-grade applications.

Permeability of cement mortar or concrete is of particular significance in structures which are intended to retain water or which come into contact with water. Besides functional considerations, permeability is also intimately related to the durability of concrete, specially its resistance against progressive deterioration under exposure to severe climate, and leaching due to prolonged seepage of water, particularly when it contains aggressive gases or minerals in solution. The determination of the permeability characteristics of mortar and concrete, therefore, assume considerable importance.

AIM AND OBJECTIVES:

- To obtain the compressive strength of natural and recycled aggregate concrete.
- To determine the permeability of recycled aggregate using varying dosage of fly ash.
- To asses and compare the permeability of both natural and recycled aggregate.

SCOPE FOR THE PRESENT WORK:

In this present investigation four grades of concrete viz.M20, M25, M30, M35 have been considered for both natural and recycled aggregate. A total of 48 standard cubes and cylinders have been considered. Different proportions of fly ash such as 0%, 10%, 20%, and 30% were mixed in each mix of recycled aggregate.

LITERATURE:

Tam etal from Spain (2005) [1] developed the Two-Stage Mixing Approach (TSMA) for improving the strength of RAC, leading to the possibility in applying RAC for higher-grade applications. MORGAN (permeability and water absorption) [2] had done a permeability test for standard cube specimen of size 150mm X150mm X150 mm was installed in the apparatus. Water pressure of 0.1 MPa was applied for48hours, and then pressure of 0.3 MPa

and 0.7 MPa, each for 24 hours, was applied. After this, the specimen was split vertically in the middle applying compressive forces. José Manuel Gómez-Soberón, Spain [3] has done an experimental analysis of recycled concrete (RC) in which the natural aggregates are replaced by recycled concrete aggregates (RCA). This experimental program covers the specifications of the aggregates employed, together with that of the concrete that is manufactured with them. Ujike, Isao. (2000). "Air and water permeability of concrete with recycled aggregate" [4]. Recycled concrete aggregate has been used for dense graded aggregate base course since the mid-80. Recent research conducted by Rutgers University has indicated that although RCA exhibits superior structural properties, the permeability is very low. Hansen and Boegh [5] tells that Concrete permeability plays a significant role in most deterioration mechanisms because they are caused by penetration of the aggressive agent. K A Paine, R.K Dhir[6] had studied the relative proportions of the three main constituents within recycled aggregates (unbound stone, crushed concrete and crushed brick) can vary widely and it is generally assumed that, as a result, the performance of concrete containing recycled aggregates can vary significantly. Wainwrigh P.J., A. Trevorrow, Y.Yu and Y.Wang (1993)[7] explained the guidelines for Construction, demolition and excavation waste (CDEW) makes up more than half of the national total waste in most countries of the world.

EXPERIMENTAL STUDY:

Ordinary Portland cement (ultratech cement) of 53 grade confining to IS: 12269 were used. It was tested for its physical properties as per IS: 4031(part-II)-1988. Fine aggregate obtained from local market was used. The physical properties of fine aggregate such as specific gravity, fineness modulus was determined in accordance with IS: 2386-1963. Coarse aggregate fractions of max size 20mm and 10mm were used. Recycled aggregate chips of max 20mm and 10mm were used. Specific gravity and fineness modulus were found to be 2.84 and 2.76. The water absorption capacity of recycled aggregate in the mixture represents one of the main differences

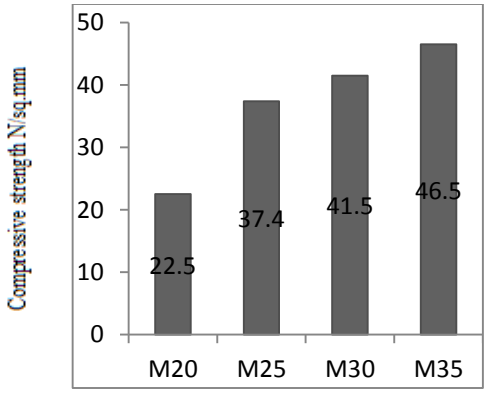
between recycled and raw aggregate. The value of water absorption is 4.5%. The silica content of the fly ash was estimated to about 96%. The fly ash passing from 90P sieve was used throughout the experiment. The fly ash used in this study was basically to improve workability and cohesiveness of concrete.

DISCUSSION ON THE TEST RESULTS:

Slump and compaction factor values decreased with increase in grades from M20 to M35 grades of concrete. The permeability of natural aggregate is less than the recycled aggregate with the addition of fly ash. Because fly ash provides a dramatic lubricating effect which greatly reduces water demand (2% to 10%). This water reduction reduces internal voids and bleed channels and keeps harmful compounds out of the concrete. The slump for M20 grade is reducing form 0% fly ash to 30% and same in case for M25, M30, M35 grade concrete for recycled aggregate concrete. The slump is between 25mm to 75mm for all grades it indicates the slump is true slump. It has a good workability. The compaction factor recycled aggregate concrete in M20 is decreasing from 0.94 to .89 for 0% fly ash to 30% fly ash. In M25 grade aggregate from 0% fly ash to 30% fly ash it decreases from 0.93 to 0.85. The value of compaction factor in M39 grade aggregate decreases from 0.92 to .85 and in M35 it decreases from 0.9 to 0.8. it shows that the as the grade and percentage of fly ash increases the compaction factor represents high to medium workability it indicates that the aggregate is of good workability.

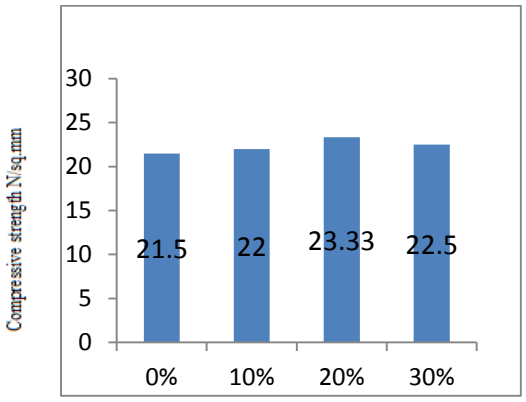
GRAPHS:

1.In these graph relation between compressive strength of concrete and different grade of natural aggregate concrete is shown**.**



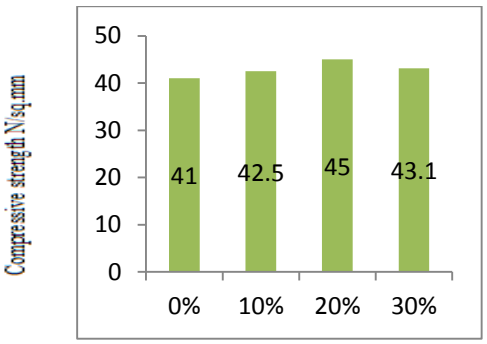
Grade of concrete

2. In these graph relation between percentage of fly ash and compressive strength of different grade of recycled concrete is shown.



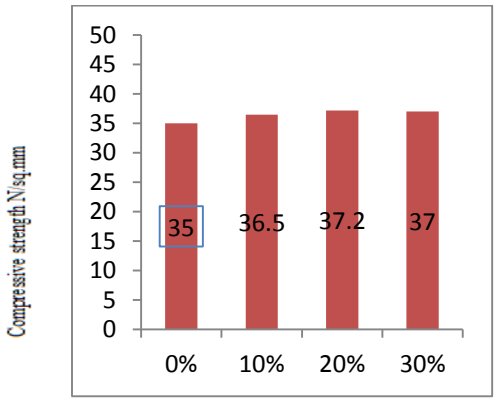
% of fly ash

Fig: Relationship between % of fly ash and compressive strength of M20 grade concrete (RAC)

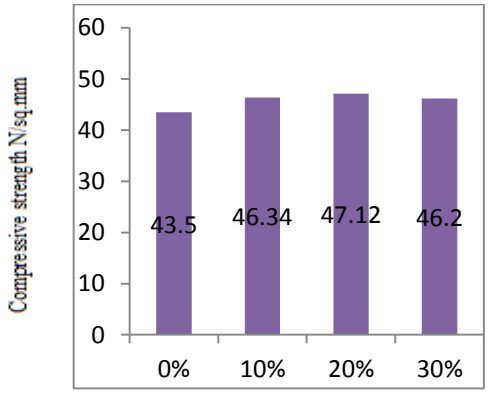


% of fly ash

Fig: Relationship between % of fly ash and compressive strength of M25 grade concrete (RAC)



% of fly ash

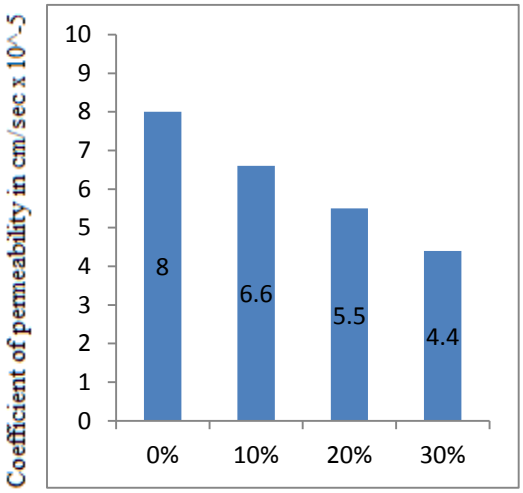


% of fly ash

Fig: Relationship between % of fly ash and compressive strength of M30 grade concrete (RAC)

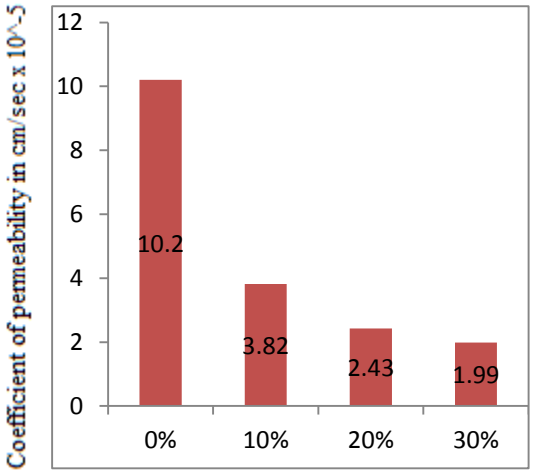
Fig: Relationship between % of fly ash and compressive strength of M35 grade concrete (RAC)

3. In these graph relationship between percentage of fly ash and coefficient of permeability of different grade of recycled aggregate concrete is shown.



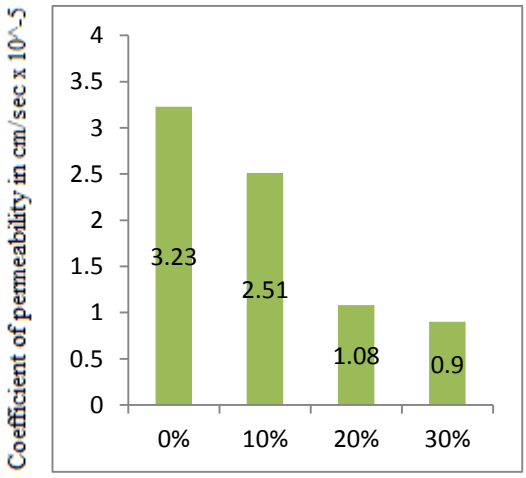
% of fly ash

Fig: Relationship between % of fly ash and coefficient of permeability M20 grade concrete (RAC)



% of fly ash

Fig: Relationship between % of fly ash and coefficient of permeability M25 grade concrete (RAC)



% of fly ash

Fig: Relationship between % of fly ash and coefficient of permeability M30 grade concrete (RAC)

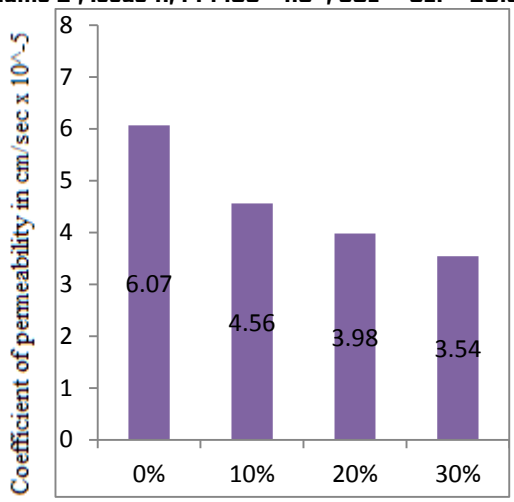
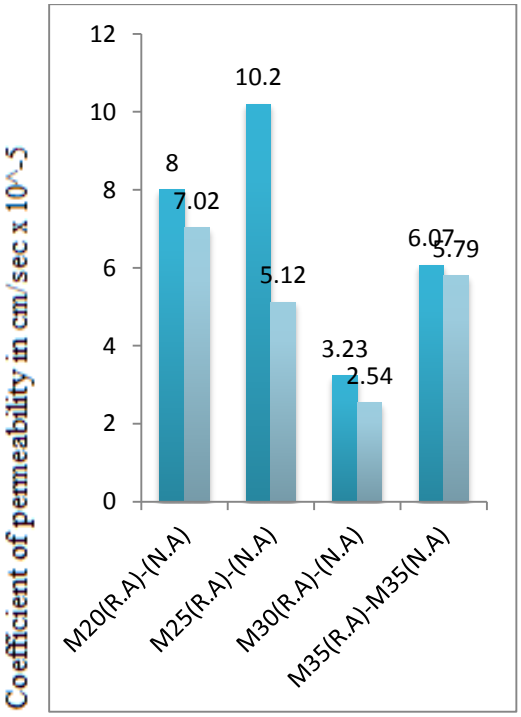


Fig: Relationship between % of fly ash and coefficient of permeability M35 grade concrete (RAC)



% of fly ash

Fig: Relationship of coefficient of permeability for natural and recycled aggregate concrete for all grades of concrete

Conclusions:

1. The workability of the fresh concrete mix was measured for natural aggregate concrete and recycled aggregate concrete. The test result of slump and compaction factors of natural aggregate concrete is more than the recycled aggregate concrete.

2. The slump for M20 grade is reducing form 0% fly ash to 30% and same in case for M25, M30, M35 grade concrete for recycled aggregate concrete. The slump is between 25mm to 75mm for all grades it indicates the slump is true slump. It has a good workability.

3. The compaction factor recycled aggregate concrete in M20 is decreasing from 0.94 to .89 for 0% fly ash to 30% fly ash. In M25 grade aggregate from 0% fly ash to 30% fly ash it decreases from 0.93 to 0.85. The value of compaction factor in M39 grade aggregate decreases from 0.92 to .85 and in M35 it decreases from 0.9 to 0.8. it shows that the as the grade and percentage of fly ash increases the compaction factor represents high to medium workability it indicates that the aggregate is of good workability.

4. The compression strength of each grade concrete (recycled aggregate) i.e., M20, M25, M30 and M35 the is increasing with addition of fly ash from 0% to 30% fly ash and for 30% fly ash compression strength decreases because of the mixes addition of fly ash it becomes sticky and the honey combs are formed in the concrete cube. This reduces the compressive strength of concrete.

5. The permeability of natural aggregate is less than the recycled aggregate with the addition of fly ash. Because fly ash provides a dramatic lubricating effect which greatly reduces water demand (2% to 10%). This water reduction reduces internal voids and bleed channels and keeps harmful compounds out of the concrete.

6. From figure it known that in each grade M20, M25, M30 and M35 grade concrete for recycled aggregates the coefficient of permeability for 0% fly ash is more than 10%

and 10% has more permeability than 20% and 20% has more than 30%. It shows that as percentage of fly ash increases the permeability is decreasing.

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