STUDY ON PROPERTIES OF CONCRETE USING OVERBURENT BRICK CHIPS AND DEMOLISHED CONCRETE WASTE AS PARTIAL REPLACEMENT OF COARSE AGGREGATE

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Abstract

Concrete is a mixture of cement fine aggregate coarse aggregate and water. Concrete plays a vital role in the development of infrastructure Viz., building, industrial structures, bridges and highways etc. leading to utilization of large quantity of concrete. So the rapid increase in consideration activities has led to a dramatic increase in the price of conventional construction materials. Additionally various government agencies have put restrictions on sand and stone quarrying to conserve this diminishing natural resource.

Keywords: Cement, aggregate, over burnt bricks, pozzolana materials

1. INTRODUCTION:

Concrete is the second largest material consumed by human beings after food and water As per WHO. It is obtained by mixing cement, fine aggregate, coarse aggregate and Water in required proportions. The mixture when placed in forms and allowed to cure becomes hard like stone. The hardening is caused by chemical action between water and the cement due to which concrete grows stronger with age.

Today, the rate at which concrete is used is much higher than it was 40 years ago. It is estimated that the present consumption of concrete in the word is of the order of 11 billion metric tones every year. There are at least three primary reasons. First, concrete possesses excellent resistance to water. Unlike wood and ordinary steel, the ability of concrete to withstand the action of water without serious deterioration makes it an ideal material for building structures to control, store, and transport water. In fact, some of the earliest known applications of the material consisted of aqueduct and waterfront retaining walls constructed by the Romans. The use of plain concrete for dams, canal linings, and pavements is now a common sight almost everywhere in the world structural element to moisture, such as piles, foundation, footings, beams, columns, roofs, exterior, wall, and pipes, are frequently built with reinforced and pressurised concrete. Reinforced concrete is concrete usually containing steel bars, which on designed in the assumption that two materials act together in resisting tensile force. With pressurised concrete by tensioning the steel tendons, as per compression is introduced such the tensile stresses during service are counteracted to prevent cracking. Large amounts of concrete find their way into reinforced or pre stressed structural elements. The durability to aggressive waters is responsible for the fact its use extended to service).

2. METHODOLOGY:

There are many types of Concrete available, created by varying the proportions of the main ingredients below. By varying the proportions of materials or by substitution for the cement and aggregate phases, the finished product can be tailored to its application with varying strength, density, or chemical and thermal resistance properties.

The mix design depends on the type of structure being built, how the Concrete will be mixed and delivered, and how it will be placed to firm this structure

2.1. CEMENT:

The Combination of brick powder and volcanic tuff with burned lime used as hydraulic binder was called Cementation and Cement.

2.2. Portland Cement:

Portland cement is the most common type of cement in general usage. It is a basic ingredient of concrete, mortar and plaster. It consists of a mixture of oxide of calcium, silicon and aluminum. Portland cement and similar materials are made by heating limestone are made by heating limestone(a source of calcium) with clay, and grinding this product (called clinker) with a source of sulphate (most commonly gypsum). The manufacture of Portland cement creates about 5 percent of human CO_2 emission.

2.3. Water:

Hydration process gradually bond together the individual sand and gravel particles, and other components of the concrete to form as solid mass.

Reactions:

Cement chemist notation: $C_3S+H \rightarrow C\text{-}S\text{-}H+CH$

Standard notation: $Ca_2SiO5+H_2O \rightarrow (Cao).(SiO_2).(H_2O)+CA(OH)_2$

Balanced: $2Ca_2Sio_5+7h_2O \rightarrow 3(Ca_2).2(SiO_2)\,4(H_2O\,(gel)+3\,Ca(OH)_2$

2.4. Aggregates:

Decorative stone such as quartzite, small river stone or crushed glass are sometimes added to the surface of concrete for a decorative “exposed aggregate” finish popular among landscape designers.

2.5. Over Burnt Bricks:

In brick making a large number of brick are rejected, due to nonconformity with required specifications. One such major nonconformity is the distorted form of brick produced due to the uneven temperature control in the kiln.

2.6. Demolished concrete waste:

Demolition waste includes material from complete building removal as well as partial removals when aspects of the buildings are retained. Waste include bricks, concrete, masonry, soil, lumber, paving materials glass, plastic, aluminium, steel drywall(gypsum), plywood(formwork), plumbing fixtures electrical, and roofing materials.

2.6.1. Admixtures:

The compressive strength of concrete is a vital parameter like tension, flexure etc. The effect of polypropylene fibre, glass fibre and steel fibre on the compressive strength of concrete has been discussed in many literatures and observed that these fibres either decreases or increases the compressive strength of concrete, but overall effect is negligible in many cases. Compressive strength test of concrete is measured on 150 mm*150mm*150mm cubes of standard size. As shown in Figure 3.10, a compressive testing machine (CTM) with capacity of 3000 KN at loading rate 5.25 KN per second is used. The average compressive strength of three cubes is taken for each test, and the test were conducted at age of 7 days and 28 days.

2.6.2. Pozzolana:

- Fly
- Silica Fume
- Rice Husk Ash
- Metakaolin

2.6.3. Chemical admixtures:

Chemical admixtures are materials in the form of powder or fluids that are added to the concrete to give it certain characteristic not obtainable with plain concrete mix. In normal use, admixture dosages are less than 5 % by cement, and are to the concrete at the time of batching/ mixing.

3. EXPERIMENTAL RESULTS

3.1. Properties of Constituents of Concrete:

The determination of the properties of the constituents of concrete is necessary to ensure that they do not contain any deleterious element which may affect the behaviour of the composite or they may not conform to the specified requirements necessary to achieve a standard of performance. The subsection under this head give the detail of the work test carried out and the specification as mentioned in IS codes.

3.2. Test on Cement:

Portland pozzolana Cement of 43 grade was use throughout the experimental investigation the recommendation stated in IS (1999) [31] have been strictly adhered to during the investigation

3.2Consistency of Cement:

The basic aim is to find out the water content required to produce a cement paste of standard consistency as specified by the IS: 4031 (Part 4) -1988. The principal is that standard consistency of cement is that which the Vicat plunger penetrates tp a point 5-7 mm from the bottom of Vacate mould.

3.3Initial Setting Time:

It's the time from which cement starts the setting process after water is added. Usually it is 30 mm. It can be delayed or advanced using chemicals.

Vicat Apparatus conforming to IS: 5513*1976[32] balance, whose permissible variation at a load of 1000g should be + 1.0g

Gauging trowel conforming to IS: 10086-1982 [33].

Characteristics	Observed values
Fineness modules	0.92
Specific gravity of conventional aggregate	2.64
Specific gravity over brunt brick aggregate	2.40
Specific gravity of demolished concrete waste	2.62

aggregate	

3.4. Water:
As per recommendation of IS : 456 (2000) [36] the water to be used for mixing curing of concrete should be free from deleterious material . Potable water was used in the present study in all operations control over water quality.

3.5. Super Plasticizer:
In the present study CICO SUPER PLAST HS used as a super plasticizer to meet the required workability. CICO SUPER PLAST HS is a concrete admixture based on specially selected high molecular weight organic polymers. This has a high plasticizing effect which is retained over a longer period and act as a high range water reducer for concrete and mortar.

3.6. Mix Design Procedure:
To design a concrete mix for s desired strength, first we need to decide the constituents of concrete mix such as cement, fine aggregate. Course aggregate, admixture etc. and their optimum quantity that will results in achievement of the requisite performance. In general the acceptance criteria of a concrete mix are its workability in fresh state and compressive strength at the age of 28 days.

3.7. Calculation of cement content:
Water cement ratio = 0.43

Cement content c= 191.58/0.43= 445.53Kg/m^3

So water content = 162.843 Kg/m^3

From table 5 IS 456, minimum cement content for mild exposure condition = 300 Kg/m^3

445.54 Kg/$m^{3>}$ 300 Kg/m^3

3.8. Proportion of volume of coarse and fine aggregate:

From table 4, for 20 mm avg. Nominal size aggregate and sand for forming to to zone 1 sand content as % age of aggregate by absolute volume = 35

Correction required in sand content

For the zone 1 conforming IS 383 = +1.5%

True% age of fine content = 100-33.5=66.5

3.9. Prepartion of Specimen:

The quantities of the constituents of the concrete were obtained from the Indian standard mix design procedure. The variation in strength of hardened concrete using over burnt brick chips and demolished concrete waste as a partial replacement of coarse aggregate is studied by casting cube and cylinders. The concrete was prepared in the laboratory using concrete mixer .The cement, fine aggregate and course aggregate were mixed in dry state and calculated of water is mixed to achieve required workability super plasticizer was added and the whole concrete was mixed .

3.10. Casting Mixing and Curing: After the preliminary tests on the constituents of concrete confirmed the suitability of ingredients and the design mix was found to be satisfactory, the task of casting cube and cylinder was taken up. The available laboratory equipment's were utilized in the accomplishment of the experimental program. The guidelines in the IS 10262:

(1982) [40] ,were strictly adhered to in the process of mixing concrete . Firstly, the coarse aggregate was washed a day before casting in order to make it silt free and was laid to dry. On the following day, the coarse aggregate was found to be satisfactorily moisture. This was necessary to prevent absorption of moisture by the aggregate from the water being added

mix i.e the design water cement ratio had to be carefully regulated. Next silica fume in case of high strength concrete mixes with silica fume in case of high strength concrete mixes.

CONCLUSION

- The compressive and split tensile strength of concrete up to 25% replacement of coarse aggregate by over burnt brick chips and that of up 35% replacement of demolished concrete waste reveals approximately same strength as compared to concrete made by conventional coarse aggregate.
- Although it is found that the compressive and tensile strength of conventional concrete is always higher for both the case (i.e. in case of over burnt brick chips and demolished concrete waste.) but up to 255 and 35% replacement of conventional coarse aggregate by over burnt brick chips and demolished concrete waste respectively the variation in these properties are very less split tensile strength of glass fiber is very low as compare to normal mix.
- It should be seen that the compressive strength of steel, glass, and polyamide fiber is almost same.
- Higher percentages of fibres from 1.5 percentages affect the workability of concrete, and decrease the strength of concrete matrix.
- All the mixes of over burnt brick chips shows better performance in splitting tensile strength test as compared to demolished concrete waste mixes.
- Over burnt bricks and demolished concrete waste have a potential to provide alternative to conventional coarse aggregate and helps in maintaining the environment as well as economical balance.
- There is a 10% saving of money if conventional aggregate is replacement by over brunt brick chip and about 25% of saving of money if conventional aggregate is replacement by demolished concrete waste.
- The maximum size of course aggregate in concrete should not be more than 10mm to 20mmfor better result.

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