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A Project Report on Partial Replacement of Coarse Aggregate by Overburnt Bricks in Concrete

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Abstract: *The use of concrete as a building material is widespread throughout the globe. Water, sand, cement, and rock aggregates are the standard ingredients in concrete. The coarse aggregate used in this project describes larger pieces of concrete. The coarse aggregate of rock normally used in concrete will be swapped out for the other ingredient. Overcooked bricks are included in this category. Because of its accessibility, this item was selected. The brick factory is where you can get your hands on some burned bricks. Many bricks are also rejected throughout the brickmaking process because they do not meet the necessary standards. The inconsistent temperature regulation in the kiln results in distorted brick form, a major non-conformity. These discarded bricks can be used as coarse aggregate as well. This would not only put the material to good use, but it would also help solve disposal issues. Partial replacement of the burnt brick bat with coarse aggregate was employed to test the concrete's mechanical qualities.*

Keywords: *Partial Replacement, Coarse Aggregate, Overburnt Bricks, Concrete*

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Concrete is the workhorse of the building industry. Compression is where it shines, but tension is where it falters. Cement, sand, coarse aggregate, and water combine to form concrete, which may

then be shaped into practically any desired form. Nearly 60% of the volume of concrete was made up of coarse material [4]. As demand rises and supply decreases, the price and supply of coarse aggregate skyrocket. Brick factories often have access to overfired bricks [5]. The burned brickbats were swapped out for concrete ones. The Overburned Bricks help keep the concrete's strength and performance while reducing the concrete's overall mass. In the bulk concrete infill area, charred brick can be replaced with concrete. In an effort to reduce pollution and conserve energy, they are using recycled bricks instead of fire [6-11]. Where natural aggregates can't be found, brickbats are used as a substitute. Over-burned bricks are used as coarse aggregate in brickbats because they are dense and absorb little water. The scarcity of aggregate can be remedied by using aggregate made from over-burned bricks. Binders are employed in construction because they set, harden, and stick to other materials, securing the structure. It is unusual to see cement used alone [12]. Instead, it is used to hold aggregates like sand and gravel together. Mortar for pulverised bricks can be made with cement and fine aggregate to create a hydraulic binder, also known as cementum, cementum: cement, and cement. Cement made from organic polymers is a viable option in the present era [13-17].

Cement used in building is typically an inorganic material. Cement is classified as hydraulic or non-hydraulic based on whether or not it requires water to set [18]. Cement is often made from lime or calcium silicate (see hydraulic and non-hydraulic lime plaster) [19]. Non-hydraulic materials don't harden when wet or submerged; rather, they harden as they dry and react with CO2 in the air. After it hardens, it can withstand chemical assaults [20]. The chemical reaction between the dry materials and water causes hydraulic cement (such as Portland cement) to set and become sticky [21]. The resulting mineral hydrates are stable in water, resistant to chemical assault, and somewhat insoluble in water. Setting in water is possible, and the chemical resistance of the hardened substance is increased. The ancient Romans discovered the chemical procedure for making hydraulic cement out of volcanic (puzolona) and adding lime (calcium oxide)[22-29].

Sand used in industry typically comes from riverbeds or sand dunes. Initially, it was the wind's motion. Quartz and other siliceous minerals make up the bulk of fine aggregates [30]. Mortar consists mostly of sand. Polishing and blasting concrete. Water purification by using clear sand [31]. This experimental scheme made use of river bed fine aggregates. The aggregate utilised was fine enough to pass a 4.75 mm sieve. We used river sand from the area that met the requirements of zone-Ill in the Indian Standard (IS) grading system of 1970. Fine aggregate consists of particles that pass the 9.5mm sieve, almost all of which pass the 4.75mm sieve, and which are primarily retained on the 75m sieve. To save money by reducing cement usage, the fine aggregate should have a spherical form. Fine aggregate is used to compact the coarse aggregate and improve the mix's workability [32-38]. Used as fill material and foundation aggregate. Concrete and mortar require a binding agent, such as white cement, bitumen, lime, gypsum, or another adhesive [39]. The volume, stability, resistance to wear or erosion, and other desirable physical attributes of the final product are all contributed by the aggregate. Sand and boiler ashes (clinkers) are two types of often utilised aggregates [40-45]. Coarse aggregates include gravel (pebbles), shattered stone fragments, and other coarse material, while fine aggregates often consist of sand, crushed stone, or crushed slag screens [46-49]. When creating thin concrete slabs or other structural components, fine aggregate is employed, while coarse aggregate is used when a smooth surface is required for a larger, heavier

member. Concrete can't exist without aggregate [50]. Aggregates provide these functions in concrete:

- To impose a firm framework.
- So that shrinking and cracking are minimised.
- Aggregate concrete is utilised in a wide variety of architectural components, bridges, and foundations.
- The more surface area an aggregate has, the more binding material (cement) is needed to keep it together. The cost rises as a direct consequence.
- The higher the aggregate size, the more binding material is lost to voids (cement).
- Therefore, these issues can be avoided by using a combination of coarse and fine aggregate in concrete

Burnt bricks can be seen in abundance at brick factories. This charred brick is collected and crushed down to 20 mm fragments [51-52]. The dust and small particles are taken out of the crushed brick by sieving it. Lighter than coarse aggregate, these burned bricks are still usable. Loose or muddy particles are screened out after crushing. Crushing can be done manually or mechanically, if necessary [53-59]. The results of the water absorption and special gravity tests conducted on the crushed particles were 12% and 2.19, respectively [60]. The addition of steel fibre strengthens the concrete and helps prevent cracking between the wet and hardened phases. Steel fibres are added to concrete to make it last longer. Steel fibre content in concrete is typically reported as a fraction of the total cement volume [61-64]. The percentage of steel fibre remains unchanged at 2%. When the aspect ratio exceeds a certain threshold, or when more steel fibre is added, the material becomes difficult to work with [65-71].

- After adding steel fibres and charred brickbats to concrete, test its workability.
- Find out if bricks that have been burned too much can be used to partially substitute coarse aggregate in concrete.
- Explore available options for traditional building materials.
- Investigate what happens to the concrete's fresh and hardened qualities when over-burnt brick is used to substitute some of the coarse material.
- To evaluate the difference in price between regular concrete and those constructed from recycled materials.

Literature Review

Concrete containing over-burned bricks as a partial replacement for coarse aggregate has been the subject of experimental research by Dwivedi [1]. Compressive strength and split tensile strength tests were conducted on 24 cubes of 150 mm in size when conventional coarse aggregate was substituted with 10–15 percent of over-burned bricks. To obtain the desired workability, steel fibres were mixed into the cement at a weighted percentage of 0.5% to 5%. According to the results of the tests, using up to 25 percent over-burnt brick in concrete is acceptable (i.e., comparable to the qualities of M20 excellent concrete). Up to 25% of coarse aggregate can be substituted with over-burned brick without

significantly altering the concrete's characteristics, and doing so results in a 10% savings in cost [72-79].

Bidve Ganesh [2] conducted an experimental investigation into the characteristics of concrete. After 7, 14, and 28 days of curing, a 150mm cube was subjected to a fresh stage slump test for 20, 40, and 60% replacement in harden stage compressive strength test. Compressive strength is improved with up to 20% replacement. If you replace 20% of the aggregates with something else, you'll get a 3% boost. Replacement up to 20 percent increases tensile strength by 5.29 percent. Flexural strength: - When up to 20% is replaced, flexural strength increases by 7.1% [80-86].

Experimental studies on concrete have been conducted by Kumar Gautam et al. [3]. 25-50%-75%-100% granite mixture is used to replace the burned brick. Specimens in the shape of cubes and tubes have been cast. After a curing time of 28 days, the samples are examined for quality. They've poured an M20 concrete mixture. After 28 days of curing, concrete's compressive strength has decreased by anywhere from 11 to 87 percent, according to tests. Testing for things like specific gravity, fineness modulus, and crushing value have also been done on both granite aggregate and over-burned brick [87-94].

Interferences from Literature Review

The literature review suggests that the disposal problem can be solved and that the economic value of reinforced cement can be increased by using waste materials in place of Fine and Coarse aggregates.

Test of Materials

Normal Portland cement is the most widely used type of cement (OPC). Normal Portland cement is utilised, with grades that are in line with IS: 8112-1989. Indian regulations mandate testing for specific gravity, uniformity, setting time, and fineness modulus. For the purpose of measuring the fineness of a cement sample. The fraction of cement with grains larger than the required mesh size is established by this approach. Instrumentation: arc I.S., sieve no (90 um). A nylon brush for cleaning the sieve and a weighing scale. If the cement sample has any air set lumps, they are broken up by hand [95-101]. Accurately weighing (WI) around 100 g of cement. It is shaken in a sieve continuously for 15 minutes at 90 microns (1.S) sieve size. The underside of the sieve is brushed gently with a bristle brush after every five minutes of sieving. After 15 minutes of sieving, the remaining debris is measured (W2).

The objective is to settle on a universal cement consistency criterion. Vicats apparatus, including a plunger and mould, scale, mixing bowl, measuring jar, and trowel, is employed. There is a thorough cleaning and drying of the mould and the nonporous plate [102-106]. On the non-porous plate, you'll find 400g of the provided cement sample. To make a smooth cement paste, 30 percent water by weight of cement is slowly and carefully added to the dry cement while continuing to mix completely. Within 3–5 minutes of adding water, the mixing is done. The cement paste is then poured into the visit mould, which has been put on a non-porous plate. Utilizing a trowel. Until it is flush with the mould, the surface is smoothed [107-111]. Any air in the sample can be released by gently shaking the mould. Under the plunger, you'll find the non-porous plate and the mould. After adjusting the indicator to read zero, the plunger is slowly lowered until it touches the paste's surface. Quickly releasing the plunger allows it to break through the paste. The index reading is

taken when the plunger stops moving. Several test pastes with different amounts of water are made, and the test is repeated until the needle reaches a depth of 5 millimetres to 7 millimetres above the base of the mould [112-116].

The objective is to calculate the cement's specific gravity. A density bottle, a measuring jar, and a scale are the instruments employed [117]. The bottle cap serves as a weight, and it is on a dry, clean bottle. After securing the cap on the density container, measure one-third of the cement's weight. Fill the density bottle with kerosene, then secure the brass top. Pour kerosene into the density bottle until it is completely full. After closing the screw top with one finger, shake to expel any leftover air and wipe off the exterior [118-121]. The density of the bottle was used to calculate its mass. Remove the contents and properly clean the density bottle. Put kerosene up to the top of the density bottle. The kerosene fills the whole space under the lid. First, get the density bottle weighed [122].

Initial And Final Setting Time Test

Following the guidelines of IS: 4031 (Part 5)- 1988, we can determine how long it will take for the cement to fully set. The use of Vicats equipment that meets the standards of IS: 5513 - 1976 is required. Make a cement paste by adding 0.85 times as much water as is called for in a conventional cement paste recipe. As soon as the water is introduced to the cement, the clock should start ticking. Cement paste, measured as described above, should fill the Vicats mould. The mould sits flush with the top of the paste because it is supported by a nonporous plate [123-126]. Start by positioning the test block beneath the needle-carrying rod. Slowly lower the needle until it touches the cement paste's surface, then swiftly lift it to see if it can pierce the test block. You should feel guilty until your needle can't pierce the test block at a depth of 5.0 + 0.5 mm, as measured from the bottom of the mould. It takes time for the cement to set after water is applied to it. At an initial setting time of 5.0 + 0.5mm from the bottom of the mould, the needle is unable to puncture the test block [127-131]

Time for the final setting: switch to the needle with the ring. When the needle can be inserted into the surface of the test block without resistance, the cement is deemed fully set. The needle leaves a mark inside of it. Simultaneously, the attachment falls short of the mark. In the final setting time, the attachment still doesn't leave an impression on the test block's surface, although that time has passed since water was introduced to the cement [132]. A fine aggregate's specific gravity is what we're after. Equipment includes a pycnometer, sieve with a 10 mm opening, measuring jug, and scale. Remove the cover from a fresh, dry Pycnometer and weigh it. (W1g). Fill the pycnometer with dry sand (about 200g) and measure its weight. (W2g). Shake the pycnometer to expel any trapped air before filling it with distilled water up to the opening in the conical top. Add sand and water to the pycnometer and record the resulting weight [133-137]. (W3g). The pycnometer has to be emptied and cleaned. Fill it with distilled water until the weight reaches the apex of the conical top. (W4g). The specific gravity of sand can be determined using the aforementioned mass values.

Sieve Analysis

The particle size distribution of the coarse and fine aggregates can be calculated with the aid of sieve analysis. The aggregates are sieved in accordance with IS: 2386 (Part 1) - 1963. Here, we employ sieves of varying sizes, as specified by the IS code, to separate aggregates into particles of varying sizes. The sample is oven-dried to 110 degrees plus 5 degrees Celsius before being

weighed. When done, the sample is sieved through an IS Sieve set. Each sieve has its contents measured [138]. The proportion of the entire sample weight that goes through each filter is determined. When compared to "Grading limits for fine aggregate in IS 383- 1970," the aforementioned table values are considered acceptable. Aggregate, by way of contrast, has a grading zone of ZONE -1 [139].

Coarse Aggregate

Coarse aggregate consists of particles larger than 20 mm but smaller than 4.75 mm. Crushed basalt rock, meeting the specifications of IS: 383- 1970, is used to make the coarse aggregates. A sample of not less than 2000 g is required for this test to measure the water absorption of coarse aggregates in accordance with IS: 2386 (Part III) - 1963. Before placing the sample in the wire basket and submerging it in distilled water between 22 and 32 °C, it should be cleaned to eliminate smaller particles and dust. After being submerged, the basket needs to be lifted and dropped 25 times within 25 seconds to release the trapped air. For the next 24 hours and 15 minutes, keep the sample and basket submerged. The next step is to drain the water from the basket and aggregates. After letting the aggregates drain for a few minutes, they should be transferred carefully from the basket to one of the dry clothing and patted dry to remove excess moisture. Since further moisture removal from the first cloth is impossible, they are switching to a second dry one. The aggregates should be spread out on the second cloth and left out of the sun to air dry at the surface until dry to the touch. Weigh the sum total (Weight "A*"). After that, bake the aggregates for 24 hours at 100 to 110 degrees Celsius. After then, take it out of the oven. Weight (B) after cooling and measuring.

Specific Gravity Test

Coarse aggregate specific gravity is the target. A Pycnometer, a 10 mm sieve, a measuring jar, and a weighing balance are all needed to weigh a sealed Pycnometer after it has been cleaned and dried. (W1g). Find the weight of the pycnometer when filled with roughly 200g of coarse material that has passed a 10mm sieve (W2g). Shake the pycnometer to expel any trapped air before filling it with distilled water up to the opening in the conical top. Then, fill the Pycometer with coarse aggregate and water, and record the resulting weight (W3g). The pycnometer has to be emptied and cleaned. Then, fill it with distilled water until the opening in the conical top is reached, and measure its weight (W4g). Compute the specific gravity of coarse aggregate using the given weights.

Aggregate Impact Value Test

Coarse aggregates are evaluated in terms of their impact strength in accordance with IS: 2386 (Part IV) - 1963. Impact testing machines that meet the standards of IS: 2386 (Part IV)- 1963, IS: 2386 (Part V)- 1993 are used to calculate the aggregate impact value of coarse aggregates. Different sized sieves (12.5mm, 10mm, 2.36mm), A metal cylinder, 75 mm in diameter and 50 mm in depth, A tamping rod with a rounded end with a 230mm length and a 10mm circular cross section.

Preparation of Sample

Twenty-five thump blows were delivered. At long last, the jug should be bursting at the seams. Excess aggregates were removed with a tamping rod after being tamped 25 times. The sample to be tested should meet the following standards: All the samples passed the 12.5 mm IS sieve test. One

hundred percent retention on a 10 mm IS sieve. For 4 hours, dry the sample in the oven. 100-110 degrees Celsius, then chilled. The prepared aggregates should fill about a third of the measure, and it should be tamped with the tamping rod 25 times. A straight edge and an equal amount of aggregates are required. To the closest gramme (Weight 'A'), calculate the net weight of the aggregates used in the measurement. After securing the cup of the impact testing machine to the machine's base, the entire test sample is placed within the cup and crushed using the tamping rod 25 times. To get the best results, raise the hammer to a height of 380mm over the top of the aggregates in the cup, then let it drop freely. The test sample needs to take 15 of these strikes, spaced out by at least one second each. A 2.36mm IS sieve should be used to remove the sample. The portion that makes it should be measured ('B' Weight). The portion that remains on the sieve must also be weighed (Weight 'C'), and if the combined B+C weight is less than the initial A weight by more than 1 gramme, the result must be thrown out and a new test must be performed. The proportion of fines should be calculated as the ratio of the fines weight to the entire sample weight.

Graduation of Coarse Aggregate

The particle size distribution of the coarse and fine aggregates can be calculated with the aid of sieve analysis. To do this, the aggregates are sieved in accordance with is: 2386 (part I - 1963. Here, aggregates are sieved using a variety of mesh sizes specified by the code, with the oversize particles collected. A collection of IS Sieves are used to sort through the sample. When done, the contents of each sieve are brought together and weighed. The proportion of the entire sample weight that goes through each filter is determined. We compare the aforementioned cable readings to the "Grading restrictions for fine aggregate in IS 383 - 1970*." ZONE - I is the comparative grading zone for aggregate.

Over Burnt Bricks

Burnt bricks can be seen in abundance at brick factories. This charred brick is collected and crushed down to 20 mm fragments. The dust and small particles are taken out of the crushed brick by sieving it. Lighter than coarse aggregate, these burned bricks are still usable. Loose or muddy particles are screened out after crushing. A hammer or crushing machine can accomplish the crushing. The results of the water absorption and special gravity tests conducted on the crushed particles were 12% and 2.19, respectively.

Sieve Analysis Test

The particle size distribution of over-burned bricks can be analysed with a sieve. To achieve this, we use a sieve calibrated to IS: 2386 (Part 1) - 1963 to sort the bricks. Here, we run bricks through a series of sieves standardised by the IS code, collecting the debris of varying sizes that each sieve misses. The sample is oven-dried to 110 degrees plus 5 degrees Celsius before being weighed. A collection of IS Sieves are used to sort through the sample. When done, the contents of each sieve are brought together and weighed. The proportion of the entire sample weight that goes through each filter is determined.

Steel Fibres

The addition of steel fibre strengthens the concrete and helps prevent cracking between the wet and hardened phases. Steel fibres are added to concrete to make it last longer. Steel fibre content in concrete is typically reported as a fraction of the total cement volume. The percentage of steel fibre remains unchanged at 2%. When the aspect ratio exceeds a certain threshold, or when more steel fibre is added, the material becomes difficult to work with.

Water

Water that is potable can also be used to make concrete. Because of its role in the chemical reaction with cement that produces the strength-giving cement gel, water is a crucial component of concrete. There needs to be careful consideration given to water availability and quality.

Slump Cone Test

The ease with which new concrete may be shaped is measured by what's called a "slump test." The apparatus used for the slump test is carried out in accordance with the standards set forth in Indian Standard IS: 1199: 1959. Wash and grease the mold's inside surface. Set the mould on a level, nonporous, horizontal base plate. Pour the concrete mixture into the mould in four roughly equal thicknesses. Apply 24 even strokes with the rounded end of the tamping rod across the mold's cross section between layers. The tamping needs to go through to the base layer. Get rid of the surplus cement and smooth it out with a trowel. Remove the mortar from between the mould and the base plate to prevent water leakage. Quickly and carefully lift the mould up and away from the concrete. Concrete slump is measured by subtracting the height of the mould from the highest point of the test specimen.

Mix Design
Stipulation for Proportioning

The mixture proportioning was done according to the Indian standard recommended methods IS 10262-2009.

Mix Design for M20 Grade

Grade designation = M20 Maximum nominal size of aggregate = 20mm

Workability = 75mm – 90mm Slump

Types of aggregate = Crushed Angular Aggregates

Exposure condition = Mild

Minimum cement content = 300 kg/m^3

Maximum cement content = 450 kg/m^3 Maximum water-cement ratio = 0.55

Test Data For Materials

Cement = OPC 53 grade conformed to IS 12269

Specific gravity,

Cement = 3.15
Fine aggregate = 2.56
Coarse aggregate = 2.62
Water absorption,

Fine aggregate = 2.34%
Coarse aggregate = 0.55%
Sieve analysis,
Coarse aggregate = conforming grade as per IS 383:1970
Coarse aggregate = conforming grade as per IS 383:1970
Requirement 20mm downsizes

Fine aggregate = Zone - Il of table 4 of IS 383:1970

Target Mean Strength Of Concrete

For a tolerance of 1.65 and using Table I from 10262-2000. the standard deviation S = 5 N/mm^2.

So, Target mean strength for the specified Characteristic cure strength = 25 + (5 x 1.65) = 33.25 N/mm^2.

Selection Of Water Cement Ratio

Table 5 from IS-456-2000. maximum w/c ratio = 0.55. Based on experience, adopt the water-cement ratio as 0.54.

0.54 < 0.55

Hence ok.

Selection Of Water Cement Content

Table 2 of IS 10262-2009. maximum water content is 186 litre (75-100mm), slump range of 200mm aggregate. Estimate water content for (75-100mm) slump = 186 kg/m^3

Calculation of cement content

Water cement ratio = 0.54
Water = 186 Kg/m^3
Cement = [186/0.54]
Cement content = 344 Kg/cum or 345 Kg/cum

From Table 5 of IS 456, minimum cement Content for 'Mild' exposure condition = 300 Kg/m^3 300 Kg/m^3 < 345 Kg/m^3. Hence ok.

Proportion Of Volume of Coarse Aggregate and Fine Aggregate

From Table 3 of IS 10262-2009, the volume of coarse aggregate corresponding to 20mm size aggregate for zone- I (from sieve analysis) is 0.60m^3 per unit volume of total aggregates.

Therefore, the volume of fine aggregate = 1-0.60m^3 = 0.40m^3 per unit volume of total aggregates.

Mix Calculation

The calculations per unit volume of concrete shall be as follows.

Volume of concrete = 1m^3

The volume of cement= (mass of cement / specific gravity of cement) × (1/1000)

= (345/3.15) × (1/1000)

=0.1095 m^3

Volume of water = (mass of water/specific gravity of water) × (1/1000)

= (186/1000)

= 0.186 m^3

The volume of all aggregate

= [a - (b + c + d)]

= 1 - 0.1095 + 0.186]

= 0.7045 m^3

Volume of coarse aggregate = 0.7045 x 0.60 × 2.71 × 1000

= 1158 Kg/m^3

Mass of fine aggregate = 0.7045 x 0.40 x 2.71 × 1000

= 764 Kg/m^3

Experimental Procedure Mixing

Both mechanical and human mixing processes are used. The concrete's functionality is affected by the mixing process. Fresh concrete's quality is affected by the consistency of the materials used to

make it. Good concrete strength and strong cement-to-aggregate bonding are the results of a well-mixed batch of concrete (fig.1).

Figure 1: Mixing

Compacting

Machine and human mixing are both used. The quality of the concrete's performance depends on how well it's mixed. The consistency of the raw materials used to make new concrete has a direct impact on the finished product's quality. Good concrete strength and cement-aggregate bonding can be attained by using the correct concrete mix (fig.2).

Figure 2: Compacting

Casting

After the concrete was mixed, cube and cylinder test specimens were prepared by packing the concrete into moulds to achieve full compaction without any segregation or undue laitance. To guarantee a uniform distribution of concrete within the mould, the scoop must be rotated around the upper edge of the mould as it is filled (fig.3).

Figure 3: Casting

Curing

For 24 hours + 0.5 hours after the water is added to the dry components, the test samples are kept in a vibration-free location with moist air of at least 90% relative humidity and at a temperature of 27°+ two °C. After this time has elapsed, the specimens are labelled and removed from the moulds before being stored in clean, fresh water or a saturated lime solution until right before the test. Both 7 and 28 days were spent submerged with the specimens. The temperature of the water or solution in which the specimens are kept is 27°+ 2°C, and it is refreshed every seven days. The samples were removed from the curing tank and allowed to air dry before testing.

Compressive Strength Test

Compression tests, which measure the concrete's resistance to compression, are the most frequently used. This is due to the fact that concrete's compressive strength is vitally important in building. The concrete's compressive strength is the standard by which it is graded. The procedure follows International Standard 516-1959. Unless they are needed for the test within 24 hours, the test

specimens are submerged in clean, fresh water and stored there until right before the test is performed (fig.4). The specimen is sandwiched between two CTM steel plates, and a force of 140kg/cm2/min is applied from above. The CTM's load indicator can be used to determine the load at failure.

- Measure the dimensions of the cube specimen.
- Place the cube specimen in the compression testing machine.
- Apply the load to the specimen uniformly.
- Apply further load until the specimen fails.
- Note down the load at failure.
- This load is the ultimate compressive load.
- Repeat the procedure for the remaining specimen.

Formula

Ultimate compressive strength of concrete = (Ultimate load / Area ofcross section) Area of a cross section of mortar cube = 75 x 75 = 5625 mm^2

Area of cross section of concrete cube = 150 x 150 = 22500 mm^2

Figure 4: Compressive Strength Test

Tensile Strength Test

One of the most fundamental and crucial characteristics of concrete is its tensile strength. The tensile strength of concrete can be measured by splitting a concrete cylinder. Due to its fragile composition, concrete is unable to withstand stress and should not be subjected to it. When tension is applied to concrete, cracks appear. Therefore, the load at which the concrete member splits can only be estimated by measuring its tensile strength. The tensile strength of the concrete should be used to determine the concrete's grade. According to IS: 5816-1999, a cylinder measuring 150 mm by 300 mm is used for the test. Unless they are needed for the test within 24 hours, the test specimens are submerged in clean, fresh water and stored there until right before the test is performed. CTM failure load is determined by placing a specimen between two steel plates and applying a load at a rate of 14 to 21kg/cm2/min, with the use of the M load indicator.

- Measure the dimensions of the cylinder specimen.
- Draw diametrical lines on the two ends of the specimen to ensure that they are on the same axial plane.
- Keep the plywood strip on the lower plate and place the specimen.
- Align the specimen so the lines marked on the ends are vertical and centred over the bottom plate.
- Place the other plywood strip above the specimen.
- Bring down the upper plate to touch the plywood strip.
- Apply the load to the specimen uniformly.
- Apply further load until the specimen fails.
- Note down the load at failure.
- Repeat the procedure for the remaining specimen.

Formula:

Splitting tensile strength of concrete = (2P/ 22.7 x D x Z)

Where, P = Applied load

D = Diameter of the specimen = 150 mm. L = Length of the specimen = 300 mm.

Flexural Strength Test

According to IS: 516 [Method of test for the strength of concrete], beams measuring 100 mm x 100 mm x 500 mm were subjected to a standard beam test (Modulus of rupture) on the assumption that the material is homogeneous. Two equal loads were applied at third places to test the beams over a 400 mm span for a 100 mm specimen. A beam resting on steel rollers at the third point has been subjected to a central point load in order to generate these forces. The flexural tensile strength of the sample was evaluated based on the type of failure, the appearance of fracture, and the fracture load; the loading rate was 1.8 KN/minute for 100 mm specimens, and the load was raised until the beam filed. One way to evaluate the tensile strength of concrete is by testing its flexural strength. It is the load at which a beam or slab of unreinforced concrete fails under bending. 100mm x 100mm x 500mm concrete beam is loaded to determine the strength. As was previously mentioned, the flexural strength test was performed on M20 grade or SCC concretes at 14 and 28 days on various sizes of coarse aggregate. If the distance 'a' separates the crack and the nearest support, then the crack can propagate. Finally, the rupture modulus must be calculated. These are all valid considerations. The flexural strength, or modulus of rupture, is given by Fb= pl/bd2 (FB). (where an is greater than 20.0cm for a 15.0cm specimen, or greater than 13.0cm for a 10cm specimen).

Conclusion

The compressive strength of concrete at fixed 2% of Steel fibres with 0,5,10, 15, 20and 30% replacement with over-burnt brick is 27.11, 24.44, 21.77, 20.88, 19.55 and 17.77, respectively, at 28

days of curing period. The split tensile strength of concrete at 2% of Steel fibres with different proportions of 0, 5, 10, 15, 20 and 30% are 3.55, 3.67, 3.82, 3.96, 4.10and 3.82, respectively, at 28 days of curing. The flexural strength of concrete with the same mixed concrete at 0, 5, 10, 15, 20 and 30% replacement are 4.84, 4.87, 4.92, 4.98, 5.02 and 5.08, respectively, at 28 days curing period. With 2% fixed Steel fibres and 20% replacement of coarse aggregate with over-burnt brick, the compressive strength is enhanced at 20% replacement at 7, 14 and 28 days curing period; beyond 20% replacement, the compressive strength decreases. The percentage increases in compressive strength are 13.78, 16, and 19.55, respectively. The test result of split tensile strength at 20% replacement with over burn brick is near to target strength beyond which the values decrease at 7, 14 and 28 days curing period; the percentage increase in split tensile strength at different curing periods is 2.97, 3.68, and 4.10. The flexural strength of concrete at 20% replacement increases at various curing periods; the percentage increase in flexural strength at different curing periods is 3.41, 4.32, and 5.02, respectively. Utilizing waste and non-degradable waste materials like burnt brick in construction is useful in developing eco-friendly concrete by reducing and depleting natural resources and another advantage is a reduction in construction cost.

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