A REVIEW ON THE ANALYSIS AND TESTING OF IMPROVED MECHANICAL PROPERTIES OF WASTE REINFORCED CONCRETE

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***Abstract*— concrete is known as the most commonly used building material. However, properties such as flexibility, toughness, and energy absorption and impact resistance make concrete unusable for some structural needs. Static loads experienced by structures are permanent and slow-moving, and most dynamic loads are sudden. The purpose of this study was to investigate the effect of volumetric displacement due to fine crumb rubber on the impact loading performance of fine-aggregate concrete of his PCC samples and to compare the results with those of regular his PCC samples. . To determine the strength properties, tests should be carried out on concrete beams designed with a concrete mix of class M20. Applications for rubber concrete are also being explored in the areas of damping and noise transmission reduction, anti-cracking concrete, lightweight concrete, and seismic energy absorbing structures. We are also considering the use of rubber scrap products, which have a high proportion of solid waste. Here we focus on the use of rubber concrete in rigid road construction. As a result, buildings can be designed in an economical and environmentally friendly way. We can also find a solution to a major waste management problem, the uncontrolled dumping of rubber waste.**

***Index Terms*— flexibility, damping, crack-resistant concrete, lightweight concrete, earthquake energy absorption structures**

I. INTRODUCTION:

Concrete is generally characterized by brittle behavior that limits its ability to withstand dynamic activities such as impact loads. Typical examples of impact loads are vehicles hitting traffic barriers, icebergs or ships hitting offshore structures, and projectile explosions on protective equipment. Localized patterns of impact loads can cause severe damage to concrete elements, compromising structural stability and integrity. Therefore, improvements in the durability, energy absorption and impact resistance of concrete are highly desired in order to withstand high impact loads well. Therefore, there is a need for materials that efficiently and economically improve the impact strength of concrete.

II. OBJECTIVES AND MOTIVATION [1]:

Development of appropriate mixing design using rubber granules as a partial substitute for coarse aggregate. For the production of concrete mixtures for M20 concrete with different content of rubber grains. Study the hardening properties of concrete made with different amounts of rubber waste. Finding effective solutions to uncontrolled dumping of rubber waste [1]. Realize environmentally friendly construction. The use of rubber products worldwide is increasing year by year. India is also one of the largest countries with population over 100 Cr. As a result, the use of vehicles has increased, so vehicle tires are used more frequently, increasing the amount of rubber crumbs. This causes great problems for the planet and its life. For this problem, the easiest and cheapest way to break down the rubber is to burn it. This leads to smoke pollution, other toxic emissions and global warming. Currently, 75-80% of waste rubber ends up in landfills. Less than 25% is used as a fuel substitute or raw material for various rubber products. Landfilling waste rubber in landfills is not only wasteful, it is also expensive. Due to the size of the fire and its tendency to surface over time, most landfill operations prohibit the disposal of all rubber. As a result, rubber must be shredded before it can be accepted in most landfills. In this way, rubber undergoes many recycling processes as needed.

III.I. MATERIALS & MATERIAL TESTS [2]:

The various materials selected are

III.I.I CEMENT:

All work uses OPC (Ordinary Portland Cement) Class 53 according to IS 12269:1987. Cement is a binder used in concrete mixtures. It binds the mixture together and fills the voids between the fine aggregates. Portland cement is the most widely used material of this kind. Portland cement is a carefully controlled combination of lime, silica, alumina and iron oxides. This is a change in the chemical composition of the ingredients from which various complex silicate crystals are formed, the mass hardens and hardens.

III.I.II FINE AGGREGATES:

Fine aggregate used in concrete has the function of a filler that fills the voids in concrete created by coarse aggregate. Natural river sand is used for filling. It has a cubic or rounded shape with a smooth surface texture. It has a three-dimensionally rounded and smooth surface structure and is excellent in workability.

III.I.III COARSE AGGREGATES:

They become materials when mixed with other substances such as sand or cement, adding strength to structures. They are responsible for the stability of concrete. Here we used aggregates with sizes less than 20 mm.

III.I.IV WATER:

Potable water is generally considered as being acceptable. Hence clean drinking water available in the college water supply system is used for casting as well as curing of the test specimens.

III.I.V SCRAP RUBBER:

Crumb Rubber is reclaimed rubber made from scrap car and truck tires. During the recycling process, steel and tire cords (fuzz) are removed and tire rubber is granulated. Further processing in a granulator or cracker mill, possibly using cryogenic or mechanical means, further reduces the particle size. Particles are sorted and classified according to various criteria, including color (black only or black and white). The 10 granules are sized by passing them through a sieve, sized based on dimension (1/4 inch) or mesh size (holes per inch: 10, 20, etc.). Crumb rubber is often used as a cushion for artificial grass.

III.II TEST FOR CEMENT [2],[1]:

III.II.I Specific gravity of cement - Test procedure:

An empty dry bottle was weighed and designated as W1. He then filled the bottle with distilled water and weighed it, which he called W2. The bottle was dried, filled with kerosene and weighed to W3. Then I discarded the kerosene in the bottle, took out the cement, filled it with water and weighed it as W4. The bottle was gently tilted to remove air bubbles.

III.II.II Fineness of cement:

Cement fineness has a significant effect on the rate of hydration and thus the rate of strength increase and heat release. Fine cement provides a large surface area for hydration, resulting in faster strength development. Prepare 100g of cement. Cement fineness is tested in two ways. Through a sieving and aeration process

By sieving Test procedure:

Take 100 gm of cement on a standard IS Sieve No.9 (90 microns). Break down the air-set lumps in the sample with fingers. Continuously sieve the sample for 15 minutes. Weigh the residue rest on the sieve.

III.II.III Standard consistency of cement:

It is defined as that consistency which will permit a Vicat plunger having 10mm diameter and 50mm length to penetrate to a depth to a depth of 33-35mm from the top of the mould. The apparatus is called Vicat apparatus.

Test procedure:

Take approximately 400g of cement and prepare a paste with a weighed amount of water (24% cement by weight). Then pour the paste into the mold within 3-5 minutes. Once the mold is completely filled, shake the mold to remove air. Install a standard plunger with a diameter of 10 mm and a length of 50 mm and lower it under its own weight until it touches the surface of the paste. Note and measure the penetration depth of the plunger. If you run the test at a higher water content, record the penetration value until the plunger penetrates from the top to a depth of 33-35 mm.

III.II.IV Setting time:

The initial setting time and the final setting time of the setting time are divided arbitrarily. Initial hardening time is the time interval during which the cement product retains its plastic state. Final setting time is the time from the moment water is added to the cement until the paste has completely lost its plasticity and gained sufficient strength to withstand the initial setting time of a given pressure. Carefully lower to bring the 1 mm diameter needle attached to the Vicat device into contact with the surface of the block and quickly release. Penetrate the test block. The first time the needle penetrates completely. Note when the paste begins to lose its plasticity. The needle can only penetrate to a depth of 33-35 mm from the top. Note the point at which the central needle leaves a mark on the specimen, i.e. when the paste reaches a hardness such that the central needle does not penetrate the paste beyond 0.5 mm.

III.III TESTS FOR FINE AGGREGATE [1]:

III.III.I Specific gravity of fine aggregate - Test procedure:

A pycnometer test was used to determine the specific gravity of fine aggregate. Let W1 be the weight of the pycnometer including the brass cap and washer. Place approximately 200 g of oven-dried fine aggregate into the pycnometer. The pycnometer and sample are weighed and labeled as W2. Fill the remainder of the pycnometer with distilled water, mix thoroughly and weigh as W3. Empty the pycnometer, clean it thoroughly, fill the conical cap opening with distilled water, and weigh W4. [3]

III.III.II Fineness modulus of fine aggregates - Test procedure:

Samples were air dried by drying at room temperature. The required amount of sample was taken (1000 g). The screens were placed in a mechanical screen shaker in order of size, with the larger screen facing up. Sieving was carried out for 10 minutes. The material remaining on each sieve after shaking represents the percentage of aggregate that is coarser than the sieve under consideration and finer than the sieve above. The weight of aggregate retained on each sieve was measured and converted to bulk samples. Powder modulus was determined as the cumulative ratio of the cumulative weight percent (F) retained to 100. Screening of fine aggregate.

III.IV TEST FOR COARSE AGGREGATE:

III.IV.I Specific gravity of coarse aggregate - Test procedure:

Collect 3 kg of aggregate and wash it thoroughly to remove fine particles and dust. Then place it in a wire basket and soak it in distilled water. After 24 hours in water, shake and weigh the baskets and aggregates. Then remove the baskets and aggregates from the water and let them drain for a while. Then remove the aggregate from the basket and carefully dry the surface with a dry cloth. The container is re-immersed in water and weighed. Record the weight of surface dry aggregate. The surface-dried aggregate was placed in an oven maintained at a temperature of 100-110 degrees Celsius for 24 hours. Then cool and weigh.

III.IV.II Impact strength of coarse aggregate - Test procedure [1]:

The sample consists of aggregates of sizes 11.0 mm to 13.5 mm. Aggregate can be dried and cooled by heating at 100-111°C for 4 hours. Sieve the material through 12.5 mm and 10.0 mm IS sieves. Agglomerates that pass through a 12.5 mm sieve and are retained by a 10.0 mm sieve constitute the test material. Pour aggregate to fill only about 1/3 of the depth of the graduated cylinder. Compact the material with 25 taps with the rounded end of the ramrod. Similarly, he adds two more layers so that the cylinder is full. Wipe off excess clumps. Determine the net weight of the aggregate to the nearest gram (W). Secure the hammer to a flat plate, block, or floor without chocking or packing so that the tie bars of the hammer are vertical. The cup is fixed firmly to the base of the machine, the entire test sample is placed in it and compressed with 25 light strokes of the tamping rod. Raise the hammer until the bottom of the hammer is 380 mm above the surface of the aggregate sample in the bucket and let it fall freely onto the aggregate sample. He delivers 15 such blows, with at least 1 second between consecutive falls. The crushed aggregate is removed from the beaker and sieved through a 2.36 mm IS sieve until he has no more than that in 1 minute. Weigh the portion that passes through the sieve to an accuracy of 1 g. Also, weigh the portion remaining on the sieve. Calculate the total effect value. The average of the two observations rounded to the nearest integer is reported as the total effect value.

III.IV.III Abrasion resistance of coarse aggregate - Test procedure [1]:

Test samples consisted of clean aggregate that was oven dried at 100° to 111°C. Take a 5 kg sample for grit A, B, C, D and a 12 kg sample for grit E, F, G. Select the grinding charge according to Table 2, depending on the grit of the aggregate. Place the aggregate and grinding charge into the cylinder and tighten the cover. Spin the machine at a speed of 30-35 revolutions per minute. The speed is 500 for grades A, B, C, and D and 1000 for grades E, F, and G. Machines must be balanced and driven to achieve a constant peripheral speed. The machine stops at the desired speed and the material is discharged into a tray. All stone dust is sieved through a 1.80 mm IS sieve. Materials coarser than 1.7 mm are weighed to the nearest gram.

III.IV.IV Crushing strength of coarse aggregate - Test procedure [1]:

Place the cylinder on the base and weigh (W). Place the sample in 3 layers and use a tamping rod to stroke each layer 25 times. For weaker materials, weigh carefully so as not to break the particles (W1). Carefully level the surface of the aggregate and insert the ram flush with the surface. It is important to keep the piston from getting stuck in the cylinder. Place the cylinder with piston on the bed of the compression tester. Apply the load evenly for a total load of 40T in 10 minutes. Load is released and is removed from the cylinder. Sieve the material using a 2.36 mm IS sieve, being careful not to lose fines. Weigh the portion that passes through the IS sieve (W2).

IV. EXPERIMENTAL INVESTIGATION:

M 20 cement mix
R denotes quantity of crumbed rubber in percentage

Table.1. Quantity of Materials.

Components	M20RO Control mix	M20R5	M20R10
Cement (Kg)	13.2	13.2	13.2
Fine Aggregate (Kg)	15.3	15.3	15.3
Coarse Aggregate (Kg)	33.56	30.41	27.75
Water (L)	5.76	5.76	5.76
Rubber (Kg)	0	1.93	3.706

Geometric effects were analyzed by varying the number of coil turns. The effects of velocity, temperature, and geometrical changes are shown to indicate changes in the local Nusselt number. Several cases were considered to correctly evaluate the geometric effect. Four different nanofluids were then implemented in selected heat exchangers, introducing internal flow through circular tubes.

IV.I Casting of Specimens [5]:

Particular care should be taken when administering ingredients. Weight dosing is the most preferred method. The effect of aggregate water content also affects aggregate weight when mixing concrete. It's a small amount, so I'm going to mix it with my hands. The cement and fine aggregate were dry mixed until the moisture formed a uniform color. Next, coarse aggregate was added and uniformly mixed. The amount of water required for the mixture was poured into the dry mixture. The mass was mixed to achieve a homogeneous mass. The mass is mixed into 3 layers and 25 stocks with concrete cubes and cylinders and beams.

IV.II Specimen Details [2]

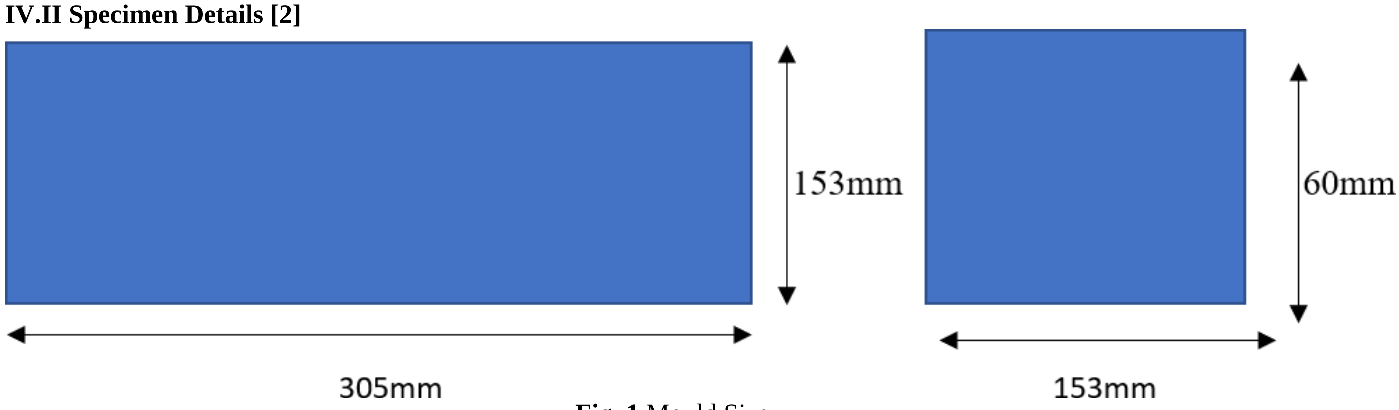

Fig. 1 Mould Size

IV.III Test on Concrete – Compression Test:

Of the many tests applied to concrete, this one is the most important and gives you an idea of all the properties of concrete. This single test can determine if the concrete has been installed correctly. For the cube test, two types of his samples of 15 cm x 15 cm x 15 cm or 10 cm x 10 cm x 10 cm are used, depending on the size of the aggregate.

Procedure:

After the specified curing time, remove water from the sample and excess water is wiped off the surface. He keeps sample dimensions within 0.2 m. Clean the supporting surface of the testing machine. Place the sample in the machine so that the load is applied to the opposite side of the cube cast. Place the sample in the center of the machine's base plate. The gently moving part is rotated by hand to bring it into contact with the surface. Gradually apply a non-shocking load and then continuously apply the load at a rate of 140 kg/cm2/min until the specimen fails. Record the maximum load and note any unusual features of the failure mode.

IV.III Test on Concrete – Compression Test:

A drop weight test uses a tube or rail to drop a heavy mass vertically during free fall. Given the height and weight of the mass, we can calculate the impact resistance. When a weight falls on a structure, it creates a shock wave on the element, causing a momentary change in velocity. Moments are thus absorbed and the structure acquires kinetic energy, which is converted into strain energy that causes structural deformation. The most important characteristic of impact resistant structures is their ability to absorb impact energy without damaging the structure. Different materials behave differently under impact loads. Therefore, it is necessary to calculate the impact strength of each element. The way kinetic energy is distributed across the section is also important in determining response. The energy emitted by the drop hammer is: E = Nmgh where E is energy in joules, N is the number of hits required to miss, m is the mass of the drop weight club in kilograms, g is the acceleration of gravity in meters per second, and h is the height (Units are meters) Meters. Thus, loading or dropping the weight determines the maximum energy that the specimen can absorb. The advantage of the drop weight test over other standard tests is that, depending on the test setup, the specimen does not need to be fixed and can mimic the conditions under which real components are subjected to impact loading. Can be used for mold patterns, structural elements, raw parts, etc. Our test setup consists of a drop weight impact tester with a drop height of 40 cm and a drop weight of 10 kg.

V RESULTS AND DISCUSSIONS [5]:

Expected result by the reference of journals**;**

V.I Compression Test:

Table.2. Compression Test Results

Concrete mix	**Compressive strength (N/mm^2) (approximate value)**
Control mix	35
5% Crumbed Rubber	18.77
10% Crumbed Rubber	16.56
15% crumbed rubber	16.98

V.II Split Tensile Strength Test:

Table.3. Split Tensile Test Results

Concrete mix	**Split Tensile Strength(N/mm^2) (approximate value)**
Control mix	4.475
5% Crumbed Rubber	5.10
10% Crumbed Rubber	5.17
15% crumbed rubber	5.25

V.III Impact Load Strength Test:

Table.4. Impact Load Strength Test Results

Concrete mix	**Impact Strength E = Nmgh (J)**
Control mix	74.48
5% Crumbed Rubber	114.72
10% Crumbed Rubber	194.2
15% crumbed rubber	198.1

A soft material, rubber acts as a barrier to crack propagation in concrete. Therefore, the tensile strength of rubber-containing concrete should be higher than the control mixture. The reason for this behaviour may be due to the following variables: The interfacial zone between rubber and cement can act as microcracks due to the weak bond between the two materials. A weak boundary layer accelerates the deterioration of concrete. As the crack propagates and contacts the rubber particles, the applied stress causes a surface separation between the rubber and the cement paste.

VI CONCLUSIONS:

From the above studies and journal references, we can draw the following conclusions: The impact strength of concrete increases with increasing rubber grain content. Rubber substitute concrete can be used in lightweight concrete as it reduces the density of the concrete. Adding rubber granules to concrete is a better solution for its disposal. Environmentally friendly hard paving construction method. The compressive strength of concrete decreases with increased rubber waste exchange. The tensile strength of concrete increases with increasing rubber content. Literature review and experimental studies conclude that the demand for concrete, which can be used as a partial replacement, is very high despite the decline in strength of concrete. Lightweight rubber concrete can be used for architectural purposes.

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