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Experimental Investigation of the Properties of Concrete by Partially Replacing Fine Aggregates with Sea Shell Powder and Mersey Silt

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ABSTRACT- The Concrete industry in particular is one of the major global consumers of natural resources. In order to minimize this impact, experts have considered the manufacture of concrete as a possible destination for construction and demolition waste (CDW) and also a source for recycled aggregates to be used in new concrete life cycles. Concrete is utilized generally all through. This consequently provokes a huge demand for elements of concrete (Fine aggregates, Coarse aggregates and Cement). Sea shells and Mersey silt are some of these waste materials that are rapidly accumulating on sea shores and landfills causing an environment problem of their own. In the present work, study has been made to focus on the utilization of various types of sea shell waste materials in concrete and various amounts of Mersey silt in the preparation of concrete as a partial replacement of fine aggregates. For this reason, the use of recycled construction and demolition waste (CDW) as concrete aggregate has been studied in the recent years. The most explanation of this can be because of its high strength and functionality.

KEYWORDS- Concrete, Sea shells, Mersey Silt, Fine aggregates.

I. INTRODUCTION

Concrete's production, use, and environmental impact are complicated, influenced in part by the infrastructure and building industry's direct effects as well as carbon dioxide emissions. Cement production constitutes one of the main producers of atmospheric carbon dioxide, a powerful greenhouse gas. Concrete harms the topmost soil, which is the greatest productive layer that covers the ground. Concrete-made pavements encourage runoff from the surface, that can cause loss of soil, contamination of water, and flooding. On the contrary hand, because it's able to dampen, redirect, and intercept water from floods and debris flows, concrete is one among the most powerful tools for successful flood control. Concrete recycling is gaining popularity as a method of eliminating concrete buildings. Recovery of concrete trash is becoming more popular as a consequence of growing environmental awareness, governmental laws, and financial incentives. Previously, concrete debris was frequently taken to trash for burial. A durable concrete performs adequately in the working environment under the expected exposure circumstances throughout service. The materials and mix proportions specified and used should be such that its integrity is maintained and, if appropriate, embedded metal is protected against corrosion. The permeability of concrete to the intrusion of water, oxygen, carbon dioxide, chlorides, sulphate, and other elements is one of the key factors impacting its durability. The developing worry of the world's normal asset exhaustion and worldwide contamination has constrained the development business to investigate utilizing by - products and waste materials. Sea shell materials gathering on waterfront regions can be utilized as one of the substantial fixings. They can be reused and handled to be utilized as fine total, coarse total or as a concrete substitution. The point of this work was to examine the appropriateness of Stream sediment dug from the Mersey as development total. From this emerged, further means to research the groundwork of principles for substantial materials with specific reference to natural contaminations and fine particles in totals. Mersey residue was broadly tested and portrayed genuinely and artificially. It was utilized as fine totals in a progression of substantial preliminaries. The sediment contains no minerals liable to block its utilization as a substantial total, however is extremely fine and has a wide variety in molecule size reviewing with up to 6% by weight of natural matter.

II. BACKGROUND

A. Sea shell powder

Sea shell materials gathering on waterfront regions can be utilized as one of the substantial fixings. They can be reused and handled to be utilized as fine total, coarse total or as a concrete substitution. The compound creation of shells differs as indicated by the kind of shelled, spot for assortment and chemical synthesis of the liquid particles. Regardless of the slight contrast in substance organization. obviously crude shells are exceptionally wealthy in calcium carbonate (CACO3-95-97%) with little amounts of minerals and natural materials. The shell powder created in the wake of consuming the shells during elevated heats, which contains lot of calcium oxide (52-57%) contingent upon the sort or structure of CACO3 content of the crude shell. This powder which is depicted below in Figure 1, will be utilized to supplant fine totals in substantial blends somewhat. Execution of substantial blends ready with shell would be assessed for leading expected trails that incorporate compressive strength, parting elasticity or solidness test. The chemical composition of sea shells is explained in Table 1.

Figure 1: Sea Shell powder

Table 1: Chemical composition of sea shells

Component	Quantity %)
Calcium (Cao)	4.49
Total carbon	43.87
Sodium (Na2O)	1.119
Magnesium (Mg)	0.617
Sculpture(SO2)	0.403
Strontium (So)	0.020
Moisture (H2O)	0.8045
Others	5.662
Total	100%

B. Mersey Silt

Inside the setting of extending interest for development totals and developing strain to moderate assets and climate, squander materials are elective supplies. The point of this work was to examine the appropriateness of Stream sediment dug from the Mersey as development total. From this emerged, further means to research the groundwork of principles for substantial materials with specific reference to natural contaminations and fine particles in totals. Mersey residue was broadly tested and portrayed genuinely and artificially. It was utilized as fine totals in a progression of substantial preliminaries which is depicted below in Figure 2 . The sediment contains no minerals liable to block its utilization as a substantial total , however is extremely fine and has a wide variety in molecule size reviewing with up to 6% by weight of natural matter .

Figure 2: Mersey Silt

III. NEED OF PROJECT

- Numerous research has been carried out on usage of materials that are both environmental friendly and highly effective
- The combined use of sea shell and Mersey silt showed the improvement in the compressive strength.
- Utilizing such a material not only benefits the environment and energy efficiency, but also lowers the cost of construction of concrete structures.

IV. OBJECTIVES OF STUDY

The study's specific goals are listed below:

- To design M30 grade concrete and to review its compressive strength after the prescribed 7 days and 28 days.
- To examine the impact on concrete and determine the ideal proportion of seashells and Mersey silt as a replacement for some of the fine aggregates.
- To prepare the high performance concrete without compromising the strength parameter.
- To check the mechanical behavior of various mixes prepared during the work.

V. LITERATURE REVIEW

Concentrate on creating assets helps us with tracking down openings in the associated region and subsequently allows us an astonishing opportunity to fulfil those openings. The overview of related composing also engages the investigator to describe the limitations of the field. It helps the researcher with delimiting and describes the issue. The data on related composing invites the examiner ground breaking on the works which others have done and thus to communicate the objectives clearly and minimalistic ally. By looking over the associated composition, the expert can avoid unfruitful and vain regions. He can pick those places where the positive revelations are most likely going to result and attempts would presumably add to the data in a huge way. At last, we can say that investigation work can never be embraced in repression of the work that has proactively been done on the issues related straight forwardly or indirectly to a survey proposed by a trained professional. Subsequently, a wary overview of the investigation journals, books, compositions, proposition and various wellsprings of information on the issue to be inspected is perhaps of the primary push toward the field of assessment. The study shapes a huge segment in a paper where its inspiration is to give the establishment and legitimization to the researcher review. A piece of the different past assessments done in a comparable field incorporate:

Sea shell powder was used in a trial to partially replace cement in concrete in order to increase strength under compression. On the seven, fourteen & 28-day curing times, five percent, ten percent, fifteen percent, or twenty percent per quantity of cement, respectively, of the cement is substituted with marine shelled dust. Ultimately, investigators got to the view that the material gets harder the longer it cures, and its greatest compressive strength can be achieved once marine shells dust replaces twenty percent of the total cemented [1].

Performed a trial to determine the characteristics of masonry using marine shells dust for an interim substitute of cement and comparing it to regular Portland cement. The researchers 2, 4, 6, or eight percent of the total volume of cement are composed of up of marine shells dust. Both traditional and substituted material's compressive strengths begin to rise after seven, 28 and 91 days of use; however traditional solid's compressive capacity is greater than that of replacement material. [2]

Complete an undertaking affecting "That impact of oyster shells when swapped with fine gravel upon masonry qualities." Under consideration are alternative use options regarding small stones and oyster shells, which are major industrial byproduct that is thrown away within large pits within coastline oysters executive areas. The chemical structure for shellfish shells including their compatibility using concrete paste was investigated to be a consequence. Notably, the structural characteristics of newly poured concrete along with established building material had been evaluated in terms for their fineness modulus while swapping percentage of smashed shellfish. The findings for tests indicate the overall practicality for building materials dropped as one increased quality its modulus along with swapping pace for oyster shell. likewise, research turned out because incorporating shellfish into pavement failed to decrease the breaking strength for it with aged twenty-eight days while the speed when the mollusc shells was removed influenced how quickly its crushing force grew. While the amount at which replacement occurs rises, the elasticity modulus of material swapped using broken shells of oyster's falls. Ten percent less was due for a twenty percent reduction in the replacement charge [3]

The lowest 28-day a cube durability reading of 21N/mm2 when 15N/mm2 predicted over mixes containing concrete 1:2:4 along with 1:3:6 accordingly are still achievable by concrete alongside thirty-five percent while 42 percent periwinkle shell participation, according to the finding which the resilience of periwinkle the outer shell building materials has been established within regard to the physical characteristics during its shells when various rate replacements [4]

Periwinkle is shells potential for an intermediate aggregate over masonry was investigated. Studies revealed the contrary, after a duration of 28 days for treatment, the cement provided containing proportional (1:1:2, 1:2:3, and 1:2:4) mixture displayed compressive strength values for 25.67N/mm2, 19.5N/mm2, along with 19.83N/mm2, separately. Those ratings of strength were above matching the minimum capacity recommended by ASTM-77 to construction low-weight mortar, which is 17N/mm2. However, mixtures featuring compressive values at 14N/mm2 as well as 1.6N/mm2, correspondingly, fell short of their recommended requirements [5]

Examined the way thin-walled masonry contained shells made of periwinkle behaved as elevated temperatures as well as discovered revealed the strength at compression decreases increasing an upsurge both warmth plus water/cement concentration [6]

M30 its effectiveness was improved while coconut plus shellfish were substituted fractionally. The swelling for ten per cent (5%) about coconuts mixed shellfish was shown to have an uninterrupted negative impact overall the compressible strength for the slabs of concrete. When compared to regular concrete, the compressive power of coconut husks with snails improved by ten per cent (five percent plus five percent) [7]

The hollow fish marine shells served for a midway replacement for mortar during this trial. A cockle was burned, ground up, crushed, and finally filtered to create a solid marine shell. In addition, the split strength, flexural strength, and elastic modulus from marine shells masonry have been taken into consideration. All of these features were compared to characteristics in an OPC concrete sample comparison. The blend featuring four percent fewer blocks of cement has been demonstrated to provide a superior strength for compression through tests utilising shell fragments within lieu half two, four, six, then eight percent of the necessary mortar. In comparison to OPC mortar, marine shells asphalt produced reduced the compressive strength along with modulus of elasticity. These tensile and flexural strengths were greater than that found in OPC concrete, which is favourable to boost the compression characteristics of the material being tested. The impact of substituting mortar with powdered marine shells for the mechanical properties for masonry was examined in this article. The compressive value for marine shells material decreased when powdered shells from the ocean were used on top of concrete to be contrasted with OPC building materials, which served as the control. The underwater shells material has greater tension as well as flexibility over the test materials. The ocean's shells the material's modulus of elasticity rose alongside time. It might be said that cement incorporating powdered marine shells produced comparatively higher tensions characteristics that control concrete, however had a lesser compressive strength along with modulus of elastic [8].

The goal of this literature review is to develop an environmentally friendly planet and lessen the effects of climate change. This focuses on a variety of sea shell ash, including cockle, clam, oyster, mollusk, periwinkle, snail, and green mussel shell ash. The present work incorporates prior research on the mechanical and chemical features of masonry made by partially substituting cement with seashell ash, including as specific gravity, chemical composition, compressive strength, tensile strength, and flexural strength. The best amount of seashells to replace cement, according to the findings, is between 4 and 5%. The investigation of sea shell ash as an alternative to cement might result in a cement-like substance with the same or finer particle size, according to this review. Seashells can be used in instead of cement to generate concrete that is stronger in terms of tensile strength, compressive strength, and flexural strength. That has been looked at employing various kinds of seashells to lessen environmental concerns. Obviously, this project will produce superior outcomes in terms of potential financial benefit for the community's economy and industry, as well as better tangible technical solutions. In order to include every participant in an environmentally friendly scenario, values that focus on improving the prospects of concrete manufacturing ought to be expended by superior research among industry actors and institutions of higher learning. Additionally, collaborating with local authorities through rules and regulations would provide stakeholders better chances to develop programmes for waste utilisation and reduction. Consequently, recycling waste products [9]

VI. METHODOLOGY AND MATERIALS

A. General

The materials to be utilized in the creation of concrete are cement, fine and coarse aggregates, sea shell powder as well as Mersey silt as supplanted substitution of fine particles. In this section, we have made step wise procedure to perform experiment and details on these ingredients and casting procedure are discussed.

- Collection of materials.
- Testing of materials (physical and chemical).
- Mix Design
- Batching of material
- Mixing
- Casting of concrete cube, cylinder, beam
- Testing
- Compilation of result of testing
- Conclusion

B. Cement

In this test OPC of grade 43 is utilized, produced by JK cement factory, Anantnag (J&K), and its technical specifications are in complete accordance with "the General Portland Cement. The quantity per bag is 50kg. The cement is created by crushing cement clinker with gypsum, water or performance improvers such as fly ash etc. The cement's physical characteristics are depicted in Table 2 below:

Table 2: Cement's physical characteristics

S.NO	Properties	Observations
1	Bulk Density	1440 kg/m3
2	Specific Gravity	3.14
3	Initial Setting Time	30 min
4	Final Setting Time	260 min
5	Standard Consistency	32%
6	Fineness	6.95%

C. Fine aggregates

River sand with an average fineness modulus of 2.70, which is that conforming per grade level II, is used in the fine aggregate form. Having a surface density for 1.692 g/cm3, this is medium-grade sands. The gravel had previously been crushed using an aperture of 4.75 mm to remove larger particulates, which followed by washing so remove impurities. The sieve Analysis of fine aggregates are described in Table 3 below:

Table 3: Sieve Analysis of Fine aggregates

Sieve size	Weight of sample retained	Cumulative weight retained(g)	Cumulative % retained	Percentage passing
4.75	70.6	70.6	3.53	96.47
3.35	151.2	221.8	11.09	88.91
2.36	207.9	429.7	21.48	78.52
1.18	112.5	542.2	27.11	72.89
0.60	380.2	922.4	46.12	53.88
0.30	450.5	1372.9	68.64	31.36
0.15	473.7	1846.6	92.33	7.67
pan	34.2	2000	100	0

D. Coarse aggregates

Coarse aggregate is a fundamental part of concrete that gives strength and solidness to the design. It works in blend with cement and fine aggregates to produce a concrete mixture that is robust and long-lasting that can endure various environmental and physical stresses. Properties of aggregates greatly influence the qualities of fresh and hardened concrete, such as workability and strength durability, surface tension etc. Bigger the size of coarse aggregates lesser the surface area and hence lesser is the quantity of fine aggregates required. Rough texture of aggregates increases 75% strong connection between cement and aggregates that raises the concrete's compressive strength by 20%. That research investigation's coarse gravel has twenty millimeters overall number, smashed, also pointy form style. The grained material has a particular density for 2.87 with water intake of a 0.50 percent.

E. Water

Water is used in the mix tap water free from all types of harmful chemicals and Organic material, confirming to IS 456-2000. The PH of water used is 6.

These basic qualities for merging fluid:

1) Combining fluid's pH ought to range from six to eight.

2) Aroma on the fluid used for stirring shouldn't seem salty.

3) You can utilize naturally occurring, somewhat acidic fluid or water to mix. Waters with humus and acidic compounds needs to be eliminated since they impact the capacity for concrete to solidify.

F. M-30 grade concrete Mix Design

Design requirement:

- *Target strength for mix proportioning*
- $\mathbf{f'ck = fck + 1.65\,s}$

Where, f ′ ck = Target Average compressive strength of 28 Days,

fck = compressive strength of 28 Days,

Tolerance factor = 1.65

S = Standard deviation, S =5 N/mm2, from IS 456; 2013, table no 8 Standard deviation can increase by +1 if your site management is not good. Therefore, target strength = 30 + 1.65 x 5 =38.25 N/mm2.

- *Selection of water - cement ratio*

Water cement ratio depends on exposure condition, from table 5, IS 456: 2000, Maximum water-cement ratio = 0.45 (Page no 20)

- *Selection of water -content*

Selection of water content

From table 2, as per IS10262:2009

Maximum water content =186 liters, for 20mm aggregate and 25-50 slump range as per IS 10262-2009, clause 4.2 We can increase 3% for every additional 25 slump. Estimated water content for 100-125 mm slump as per IS10262:2009 = 186+ (186 X 6%) =197 Lt

- *Calculation of cement content*

Water cement ratio = 0.45 and Water content = 197ltr.

Cement content = 197 ÷ 0.45 = 437.78 Kg/m3

Adopted cement content is 437.78 Kg/m3 (450 < 437.78 > 300) Kg/m3, hence safe.

So, final water cement ratio = 197/437.78 = 0.45

- *Proportion of volume of coarse aggregate and fine aggregate content*

From table No 3of IS code 10262-2009, volume of coarse aggregate consequent to 20 mm size aggregate and fine aggregate zone II for water cement ratio of 0.45 = 0.63. Actual water cement ratio = 0.45 volume of coarse aggregate = 0.63 The Volume of fine aggregate content = 1 − 0.63 = 0.37

- *The mix calculations per unit volume of concrete shall be as follows*

The mix calculations per unit volume of concrete shall be as follows:

I.) Volume of concrete = 1m3

(A) Volume of cement = Mass of cement specific/ gravity of cement X 1/1000 = 438/3.15 X 1/1000 = 0.139m3

(B) Volume of water = Mass of Water/ specific gravity of water X 1/1000 = 197/1 X 1/1000 = 0.197m3

(C) Volume of all aggregate = [1-(A+B)] = [1-(0.139+0.197)] = 0.664 m3

(E) Mass of coarse aggregate (CA) = E x volume of coarse aggregate x Specific gravity of coarse Aggregate x 1000 = 0.664 x 0.37 x 2.61 x 1000 = 1179.66 Kg

(F) Mass of natural fine aggregate = E x volume of fine aggregate x Specific gravity of fine Aggregate x 1000 = 0.664 x 0.37 x 2.61 x 1000 = 641.22 Kg

- *Materials reuired for each casting of M30 grade concrete*

Volume calculations:

Volume of 1 cube = 3.375 × 10−3 m3,

Volume of 1 beam=0.0156 m3 And

Volume of 1 cylinder = 1.6 x 10-3 m3

Total volume to be filled with concrete = (3.375 × 10−3 x numbers of cube + 0.0156 x no. of beam casting + 1.6 x 10-3 m3 x Numbers of cylinders)

G. Source of material:

- Cement: JK Cement (OPC Grade 43)
- Coarse Aggregate: Larkipora
- Fine Aggregate: Local river
- Water: plant site
- Sea shell powder: India Mart
- Mersey silt: Local Brengi

H. Physical attributes of Coarse & Fine Aggregate

- A type of coarse aggregate measuring twenty
- 0.50% intake of water
- 2.6 Specific gravity
- Water Uptake for Small Aggregates (%).
- 2.6 Particular gravity
- Modulus of fineness: 2.70
- The cement spectral gravity: 3.15

I. Coarse aggregate 20.0 MM

Water uptake (%): 0.50

Spectral gravity: 2.6

J. Fine Aggregate

Water up takes (%): 2.5

Spectral gravity: 2.6

Fineness modulus: 2.70

The fine gravel completion percentage is depicted below in Table 4.

Table 4: Fine gravel Completion percentage:

IS filter size in mm	% satisfying	Specific level that corresponds with IS
4.75	96.47	90-100
3.35	88.91	75-100
2.36	78.52	65-90
1.18	72.89	55-90
0.60	53.88	35-59
0.30	31.36	8-30
0.15	7.67	0-10

K. Methodology: Tests conducted

Fresh concrete Properties (Plastic stage):

Plastic stage means the state in concrete within the starting set-up; it is also known as green concrete. Those properties that come under plastic stage are as:

- Functioning
- Absence of discrimination
- Absence of weeping

Slump flow test

It is considered quite straight forward yet frequently utilized during building sites (IS 7320-1974). This was initially created within the United States that is utilized to assess the suitability for a media. The rule is only applicable to concrete made with particles smaller than 38 mm.

Apparatus used:

- Steel molds having shape of a frustum whose top diameter is 10cm or 100mm, bottom 20cm or 200mm and height is 30cm or 300mm. Top and bottom ends are open, thickness of mould ought not to be any smaller than 1.6mm. Steel tamping rod is used for tamping purpose whose diameter is 16mm and height is 60cm.
- A firm, non-absorbing foundation plate that is not less than 700 millimeters squared or has been engraved having a circular shape designating exact Centre under the cone that slumps as a second concentric circular has an outside diameter of 500 millimeters
- Trowel
- Sweep
- Divider
- Keep an eye on the time.

Concrete Sample

Filled in 4 layers (equal), 75 cm each and each one is 25 times tamped. The slump test is described in Figure 3 below. It is suitable for high and medium workability i-e; 25-125mm. It cannot be used to measure workability for aggregate size more than 40mm. The slump mix for different conditions are described in Table 5:

Table 5: Slump mix for different conditions:

Condition	Slump mix
For road construction	20-40mm
Beams and slabs	40-45mm
Mass concreting	25-50mm
Regular RCC construction	80-150mm
Vibrating concrete	10-25mm
Impermeable work	75-120mm

As the slump value increases, workability also increases.

Figure 3: Slump test for fresh concrete

The material's characteristics on compressive strength, split tensile and flexural strength of cured concrete had been investigated.

1) Compressive strength test:

The building material cubes assessment's strength at compression gives an overview of every one of the attributes for material. Specific may determine if the construction is being performed successfully through this specific assessment. Within residential or commercial constructions, its strength at compression can vary from 15MPa (2200 psi) through 30MPa (4400 psi) even beyond. The compressible strength of concrete is influenced by an assortment of variables, including the percentage of water to cement, mortar value, production-stage inspections of quality, and more.

According to the dimension of those aggregates, both 15 cm x 15 cm x 15 cm or 10 cm x 10 cm cubes have been utilized as samples to carry out the cubed experiment. The compressive strength test machine is showed in Figure 4.

Apparatus: device to evaluate compressing

Cubes are measuring 150mmx150mmx150mm are utilized to this experiment.

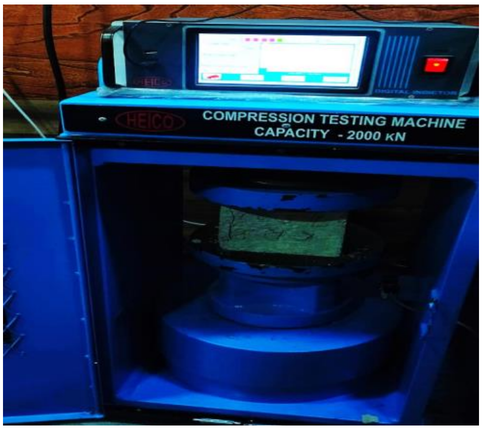

Figure 4: Compressive strength test

L. Split tensile strength

The capability for concrete for withstanding tension and stress is recognized as its strength of tensile. Among the most important characteristics of mortar, particularly when utilized to build highways as runways for landings was its ability to withstand stress, which can be determined using the divided cylindrical testing in the mortar technique. The measurement units for force / sectional area (N/Sq.mm or Mpa) are employed for determining the tension strength of masonry. The material's tension strength typically ranges between 10 and 12 percent above the material's compressive strength. The majority of the time, cylinder sample remolded for tension tests.

Testing for tension strength requirements: Specimens - This cylinder sample is 300 millimeters and measures 150mm in diameter.

Load spectrum: The lifting mechanism is able to applying a steady pressure.

Life in testing: The examination ought to be administered around seven and twenty-eight days of existence.

Number of samples: It is suggested to examine a minimum of three instances to more accurate outcomes

M. Flexural strength test

This tension strength on masonry is informally assessed through the flexion testing. This evaluates a concrete slabs as well as beam's resistance to collapse through twisting. The findings for the flexion test upon masonry are represented by the breaking elasticity (MR), that is stated as Mpa or PS. Whether each of the three-point load examination (ASTM C78) and the center of gravity loading analysis (ASTM C293) can be used to carry out the flexural assessment upon masonry. The testing procedure within this paper adheres with ASTM C78 as showed in Figure 5.

In accordance with ASTM, the sample needs to be 150 millimetres wide, 1150 mm deep, & the total length cannot exceed greater than three times the depth of the specimen. Indian standards stipulated that the concrete sample should be 150 millimetres wide, 150-millimetre-deep, and 150-millimetre-long and span of 700millimeters.

Informal testing is used to gauge the breaking point of concrete. This evaluates the concrete structure or slab's resistance to fracture due to twisting. Flexural test findings for concrete are represented by a fracture modulus, abbreviated as (MR) in MPa or PS. Either the three-point load test (ASTM C78) or the centre point load test (ASTM C293) can be used to perform the flexural examination on concrete. The study's testing methodology adheres to ASTM C78.

This ASTM specifies that the sample's dimensions be 150 mm wide by 1150 mm deep, with the length not exceeding three times the depth of the sample. The concrete specimen's dimensions were established by Indian standard to be 150 mm in width, 150 mm in depth, and 700 mm in span.

Figure 5: Flexural strength test

VII. RESULTS AND DISCUSSIONS

The section comprises of results of the tests and examinations completed towards the goal of the undertaking. It comprises of the outcomes from the slump test, compressive strength, tensile test and flexural strength test. The outcomes and Results are joined by charts and tables to have a definite examination of the trials. The outcomes are better clarified by these charts and tables for meet the fundamental and definite goal of the task. The slump flow test results are described in Table 6 below and is described in graph as Figure 6:

Table 6: Slump flow test results

Mix Designation	Slump flow in mm
M1	102
M2	100
M3	97
M4	93
M5	89
M6	86
M7	80

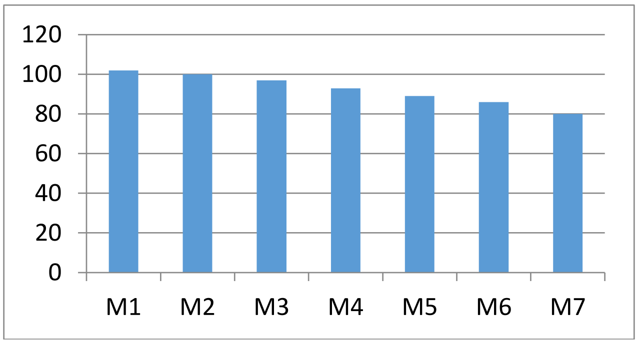

Figure 6: Workability of concrete

A. *Compressive strength (in Mpa) at different curing age*

The goal for such testing procedures is to ascertain the trial specimen's greatest load bearing capability. By letting every cube dried in sunlight, all of the wetness was taken off before testing. Three crystals from every combination were studied utilizing compressor testing device with a 2000KN capability after ages in seven days and twenty-eight days of hardening. The strength of compression at both seven and twenty-eight days is displayed in the following Table 7 and graphically is described in Figure 7.

Table 7: Compressive strength at 7 and 28 days

Mix Identity	Sea Shell Powder (%)	Mersey Silt (%)	Compressive strength 7 Days	28 Days
M1	0	0	25.15	38.7
M2	10	5	25.48	39.2
M3	10	10	25.87	39.8
M4	10	15	26.19	40.3
M5	10	20	26.58	40.9
M6	10	25	26.91	41.4
M7	10	30	27.10	41.7

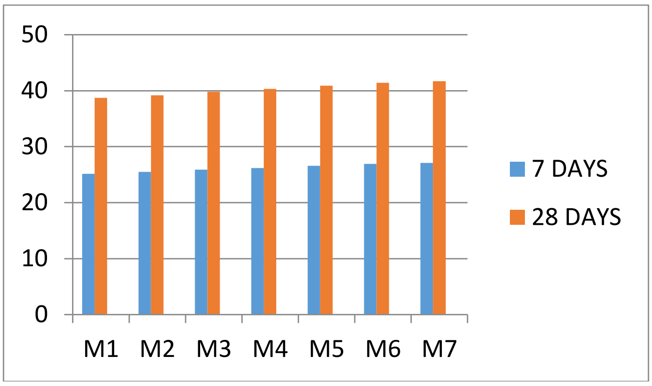

Figure 7: 7 and 28 days' compressive strength

B. *Outcomes of tensile test*

The material's function under tension is their most significant characteristic. Concrete's splitting tension strength first declines to be contrasted with standard concrete, however suddenly increases by 20%. Then gradually declines. The 7 and 28 days' tensile strength is explained in Table 8 and graphically is described in Figure 8 below:

Table 8: Tensile strength at 7 and 28 days

Mix Identity	Sea Shell Powder (%)	Mersey Silt (%)	Tensile strength 7 Days	28 Days
M1	0	0	2.51	3.87
M2	10	5	2.54 3.92	
M3	10	10	2.58	3.98
M4	10	15	2.61	4.03
M5	10	20	2.65	4.09
M6	10	25	2.69	4.14
M7	10	30	2.71	4.17

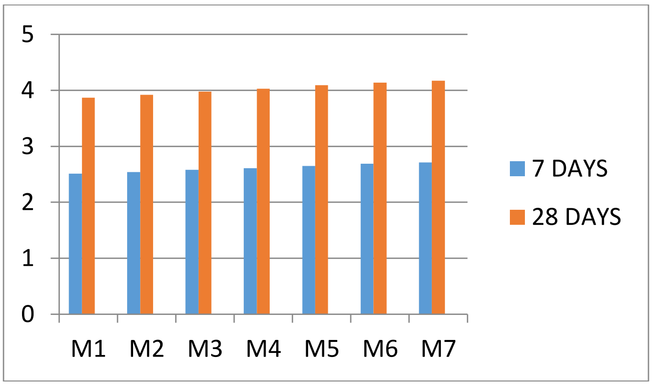

Figure 8: 7 and 28 days' Tensile strength

C. *Outcomes of flexibility test*

Flexural strength of concrete increases gradually up to 20% replacement then slowly decreases. The 7 and 28 days' flexural strength is explained in Table 9 and graphically is described in below Figure 9.

Table 9: Flexural strength at 7 and 28 days

Mix Identity	Sea Shell Powder (%)	Mersey Silt (%)	Flexural strength 7 Days	28 Days
M1	0	0	3.76	5.80
M2	10	5	3.81	5.88
M3	10	10	3.87	5.97
M4	10	15	3.91	6.04
M5	10	20	3.97	6.13
M6	10	25	4.03	6.21
M7	10	30	4.06	6.25

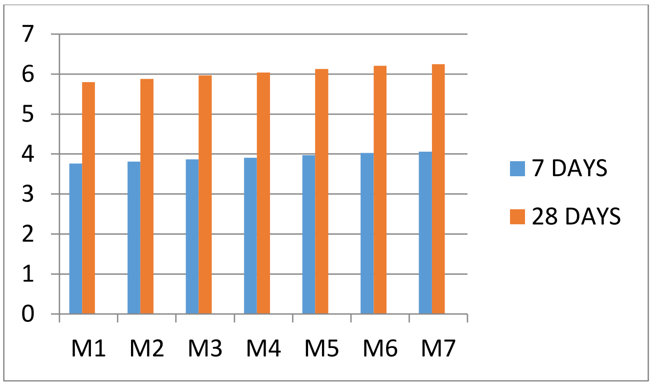

Figure 9: 7 and 28 days' Flexural strength

VIII. CONCLUSIONS

The study examined the compressive strength, flexural strength, and tensile strength of cement concrete that had been conducted using different environmental friendly materials such as sea shell powder and Mersey silt etc. . . . Based on the control mix, variations were made by replacing fine aggregates with sea shell powder and Mersey silt. Mechanical behaviors were measured on the number of mixes prepared and conclusions are drawn. The various mix proportions are as follows:

Cement, fluid, small particles, or coarse gravel make up M1.
M2: Coarse gravel, Small particles- eighty-five percent (Sea shell, ten percent; Mersey silt, 5%); Waters; Cement
M3 – coarse gravel + fine particles – eighty percent (sea shells – ten percent; Mersey silt – ten percent) + Waters + Cement
M4: Coarse gravel, Small particles, 75 percent (sea shell, ten percent; Mersey silt, 15%); liquid; cement.
M5: coarse gravel + fine particles seventy per cent (sea shells ten percent + Mersey silt twenty percent), fluid, and cement.
M6: coarse gravel + fine particles – sixty-five percent (sea shells – ten percent + Mersey silt – twenty-five percent) + Waters + Cement.
M7: coarse gravel + fine particles – sixty percent (sea shells – ten percent + Mersey silt – thirty percent) + Waters + Cement.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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