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# Replacement of Fine Aggregates with Sawdust & Coarse Aggregate with Brick Ballast in Concrete

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**Abstract**

For the manufacturing of concrete, the construction industry mainly relies on standard materials like cement, sand, and gravel. River sand and gravel, which are most frequently used as fine aggregates and coarse aggregates in the creation of concrete, respectively, present the issue of acute shortage in many areas, and their continued use has started posing serious problem with respect to its availability, cost, and environmental impact. In this research, an effort is being made to manufacture lightweight, inexpensive concrete using locally accessible waste materials in place of river sand and gravels. For building concrete, river sand and gravels can partially replace sawdust and brick ballast, which are readily available and inexpensive By employing M30 grade concrete, natural sand and gravel have been partially substituted with sawdust and broken brick ballast (4% SD 8% BB, 4% SD 16% BB, 4% SD 24% BB, 8% SD 8% BB, 12% SD 16% BB, and 12% SD 24% BB, respectively). For this, thirty 150mm X 150mm X 150mm concrete cubes with a water cement ratio of 0.42 have been cast. To improve the workability, water-reducing admixture is utilised. The specimens with the aforementioned combination have had their compressive strength at (28 days), slump test, and compacting factor test results compared to control specimens.As the replacement percentages rise, the workability and compressive strength gradually deteriorate. The ideal mixture for making concrete of the M30 grade is discovered to be 16% of brick ballast and 8% of sawdust.

: Construction industry relies heavily on conventional material such as cement, sand and gravel for the production of concrete The river sand and gravels which are most commonly used as fine aggregates and coarse aggregates respectively in the production of concrete, poses the problem of acute shortage in many areas, whose continued use has started posing serious problem with respect to its availability, cost and environmental impact. Attempt is being made in this project to use the locally available waste materials to replace the river sand and gravels to produce light weight and low cost concrete. Sawdust and Brick ballast are easily affordable at low costs, which are partially replaces with river sand and gravels respectively for making concrete. Natural sand and Gravels have been partially replaced (4% SD 8% BB, 4% SD 16% BB, 4% SD 24% BB, 8% SD 8% BB, 8% SD 16% BB, 8% SD 24% BB, 12% SD 8% BB, 12% SD 16% BB and 12% SD 24% BB. by using M30 grade of concrete) with sawdust and broken brick ballast respectively. For this, thirty concrete cubes of size 150mm X 150mm X 150mm have been casted and water cement ratio of 0.42 has been used. Water reducing admixture is used to increase the workability. Slump test, Compacting factor test and compressive strength at (28 days) of specimens having above combinations have been compared with control specimens. The workability and compressive strength gradually decreases for the increasing the replacement percentages. The optimum mix found to produce M30 grade of concrete is 8% of sawdust and 16% of Brick ballasteywords: - Sawdust, lightweight concrete, waste utilization, slump cone, Vee bee, flow table, compression factor test

**Keywords**: Sawdust, brick ballast, coarse aggregates, fine aggregates, slump cone test, compaction factor test, comp. strength test, slump value.

## INTRODUCTION

As time goes on, the construction sector is expanding greatly as a result of the growth of infrastructure. Cement, fine aggregates, coarse aggregates, and water are the main ingredients of concrete. In concrete, river sand is typically utilised as a fine aggregate and stones or gravel as a coarse aggregate. On earth, there aren't many of these materials. Researchers discovered alternate aggregate-substituting materials to solve this kind of issue. These surplus lightweight components can be found at Sawdust, flyash, rice husk ash, cow manure, and over-burned bricks, among other materials, should make up the majority of the sawdust and brick ballast in light weight concrete 113. If these items are just dumped into the environment, various issues arise. In order to make concrete, these ingredients can be employed in building. The choice of these replacement materials depends on factors like cost, availability, and the physical and chemical makeup of the constituents. Waste materials that It has better heat dissipation and heat insulation property.

can be substituted for fine aggregate and coarse aggregate in concrete include sawdust and brick ballast The word "sawdust" is used to describe the loose pieces or wood chips that remain after timber has been chopped into uniformly useable proportions. About 105 million tonnes of sawdust are produced annually in India alone, where it is frequently thrown as waste. The weight of the sawdust is lower than that of river sand. There are a lot of overburnt bricks left over after making bricks in a kiln, which are a waste. Concrete can be recycled by utilising these bricks in place of coarse particles. The aggregates make up the majority of the materials in concrete, accounting for 60 to 80% of its overall volume. Due to the fact that both of these components are lightweight, the cost of the entire batch of concrete is heavily influenced by the aggregates utilised. These studies attempt to reconcile the social demand for safe and affordable garbage disposal with the aid of environmentally friendly enterprises, which require better and more affordable building materials.These are the scopes of upcoming work done with light weight concrete.

- It ought to be applied to partition walls and other non-structural components of buildings like PCC works because its construction cost is low.
- It has better heat dissipation and heat insulation property.
- Because sawdust reacts poorly with these liquids, testing for acid resistance and water absorption must be analysed before being conducted.
- Lower pollution from the disposal of sawdust & brick ballast due to its environmental friendly nature in all way from everyday use.

1) To compare the strength characteristics of normal concrete and concrete with Quarry dust and
2) Saw dust.

Scope:

1)To provide an alternate light weight material
2)To compare the compressive strength of thesaw dust with the conventional mix.

METHODOLOGY
The methodology clearly shows the process which have been carried out in this work. The step by step process of this project is explained in the flow chart.
Work Methodology

1) Properties
2) Coarse
3) aggregate
4) Fine
5) aggregate
6) Saw dust
7) Max size mm
8) 20
9) 4.75
10) 4.75
11) Specific gravity
12) 2.69
13) 2.62
14) 0.27
15) absorption
16) 0.5
17) 1
18) 2
19)

Physical properties of materials
Literature Collections
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## METHODOLOGY

The test specimens have been casted using cement (PPC), Sand, Sawdust (having moisture content 9.8%), Gravel, Brick Ballast (having moisture Optimum Percentage of Sawdust and Brick Ballast in Light Weight Concrete 115 content 13.5%) and water. The materials, in general, confirming to the specifications laid down in the relevant Indian Standard Codes of Practice, wherever applicable. Super plasticizer (ROFF 820 super Plast) based on high molecular weight polymers and sulphonated melamine formaldehyde has been used throughout the investigation. The nominal dose of the super plasticizer has been kept at 1.0% of the weight of cement. Sawdust and Brick Ballast are partially replaces with sand

and gravels and different percentage. The proportion by weight of the ingredients constituting the concrete mix is 1:1.23:2.53 with a water-cement ratio of 0.42 by weight. A total of 30 no. of cubes have been casted and tested after 28 days. Detail of test specimens is given in table 1.The standard size of cube 150 mm x 150 mm x 150 mm is used. The casting of the various specimens has been done under laboratory conditions using standard equipments. Each casting batch consists of at least three cubes determining the concrete cube compressive strength. The compressive test was conducted using a 2000 KN capacity compression testing machine.

Table – 1 Detail of Test Specimens

| **Sr.No.** | **Designation of Specimen** | **% Replacement of Sand with Sawdust** | **% Replacement of Gravels with Brickballast** |
|---|---|---|---|
| 1 | S0 | - | - |
| 2 | S1 | 4 | 8 |
| 3 | S2 | 4 | 16 |
| 4 | S3 | 4 | 24 |
| 5 | S4 | 8 | 8 |
| 6 | S5 | 8 | 16 |
| 7 | S6 | 8 | 24 |
| 8 | S7 | 12 | 8 |
| 9 | S8 | 12 | 16 |
| 10 | S9 | 12 | 24 |

## MATERIALS

**1) Cement-**

Portland Pozzolona Cement (PPC), often known as "ACC Cement," is the cement that wasemployed in this investigation. The cement was free of any hard lumps and had a consistentgrey colour with a mild greenish tint. IS: 1489 (Part 1) 1991 is being confirmed by PortlandPozzolona Cement.

**2) FineAggregates**

1) **Coarse Sand**:

The crucial component of concrete is aggregate. They give concrete body, lessen shrinkage,and have an economic impact. Naturalsand, crushed stone sand, and crushed gravel stonedustarealltypesofcoarsesand.Locallyaccessiblecleananddrysandwillbeused.Allofthespecimenswillbe castusingsandthatpassesthrougha4.75mmscreenbutisretainedbya 1.18mmsieve.

**2) Sawdust:**

The minuscule pieces of wood that result from cutting wood are known as sawdust. In variedamounts, sand substitutes some of the sawdust in concrete. Sawdust is a mixture of soft andhard wood that is acquired from nearby mills. Due to its small weight, it will lessen the concrete's overall density.

The self-weight andtotaldeadloadofthestructureare reducedwhenconcretedensitydecreases.Sun-dried sawdust isutilisedfor cubecasting.A 4.75mmsieveis usedforsawdust.

**Fig. 1 SawDust**

**3) CoarseAggregates-**

Additionally crucial to the composition of concrete are coarse particles. They offer concretestructure,lessenshrinkage,andhaveanimpactontheeconomy.Thevolumeoftheaggregates in the concrete ranges from 70 to 80 percent. The aggregates underwent crushingstrength and impact value testing in accordance with IS: 2386-1936. All specimens will becast using coarse materials that pass through a 20 mm screen but are retained on a 10 mmsieve.

**Fig. 2 CoarseAggregate(Gravels)**

1) **BrickBallast-**These are pieces of smashed brick that were removed from properlyburned bricks. Before use, it is made dust-free. Gravels in concrete are used to partiallyreplace brick ballast in various ratios. Due to its small weight, it will lessen the concrete'soverall density. Its own weight and total dead

weight of the structure are cut down whenconcretedensitydecreases. Sun-dried sawdust isutilised forcube casting.

**Fig 3 BrickBallast**

2) **Water-**Forcastingandcuring specimens,potablewaterfromthesiteswasused.

3) **Admixture-** A super plasticizer made of high molecular weight polymers and sulphonatedmelamine formaldehyde was used throughout the experiment. The nominal dose of the superplasticizerwas retained at1.0% of theweightof thecement.

**TEST PERFORMED**

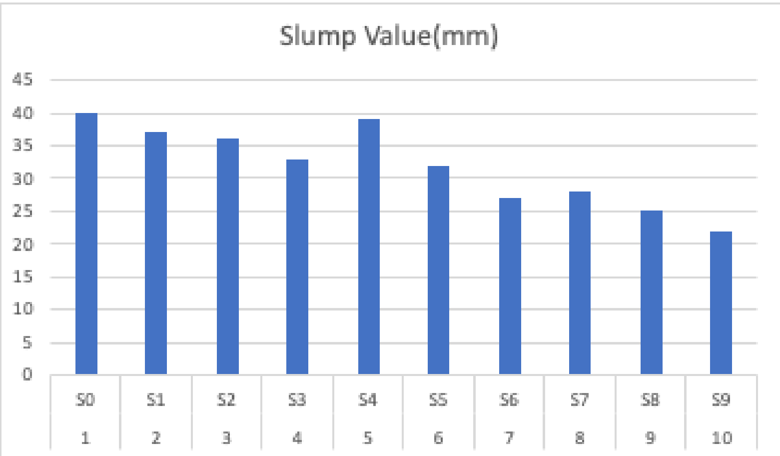
**Slump cone test**: - The Slump Cone Test is performed to determine if concrete is workable.Throughout the research, a constant water-to-cement ratio of 0.42 is used. Increased waterreducingadditive is addedto theconcrete to make it more workable.

**Fig. 4 – SlumpConeTestPerformance**

**Table 2 ObservationTableonSlumpvalues**

| Sr.No. | DesignationofSpecimen | SlumpValue(mm) |
|---|---|---|
| 1 | S0 | 40 |
| 2 | S1 | 37 |
| 3 | S2 | 36 |
| 4 | S3 | 33 |
| 5 | S4 | 39 |
| 6 | S5 | 32 |
| 7 | S6 | 27 |
| 8 | S7 | 28 |
| 9 | S8 | 25 |
| 10 | S9 | 22 |

**DegreeofWorkability:-**Low




**Graph1SlumpValueVsSpecimenName**

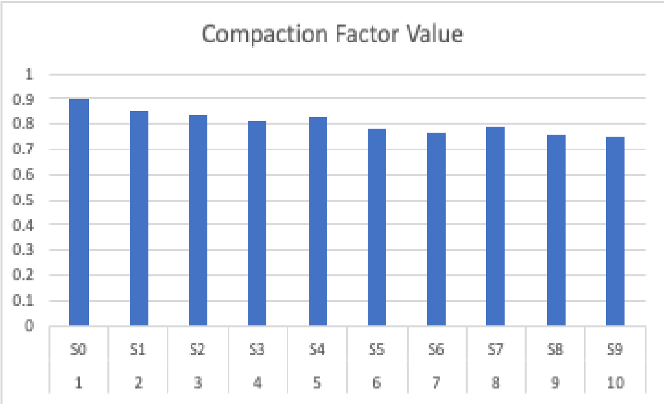
**CompactingFactorTest: -**

The compacting factor test is performed to determine if concrete is workable.According to the findings of this study, the compacting factor value falls as an alternativefraction of sawdust and brick ballast in concrete increases. means that the workability ofconcretedecreasesas thereplacementfraction ofsawdustandbrickballastincreases.

**Fig.5- CompactingFactorTestperformance**

**Table3 -ObservationTableof CompactionFactorValue**

| S.NO. | DesignationofSpecimen | CompactionFactorValue |
|---|---|---|
| 1. | S0 | 0.903 |
| 2. | S1 | 0.85 |
| 3. | S2 | 0.838 |
| 4. | S3 | 0.816 |
| 5. | S4 | 0.83 |
| 6. | S5 | 0.785 |
| 7. | S6 | 0.77 |
| 8. | S7 | 0.79 |
| 9. | S8 | 0.76 |
| 10. | S9 | 0.75 |




**Graph 2 - CompactionFactorVsSpecimen Name**

**Compressivestrength:-**

Compressivestrengthgraduallydecreasesasthereplacementproportionofsawdust and brick ballast materials increases.CompressivestrengthformixM0(NormalMix)is43.80N/sqmmforM30gradeofconcreteafter28days.Withanexpansionofreplacementfractionofsawdustandbrickballast aggregates, it continuouslyfalls.


**Fig. 6 - CompressiveStrength Test**

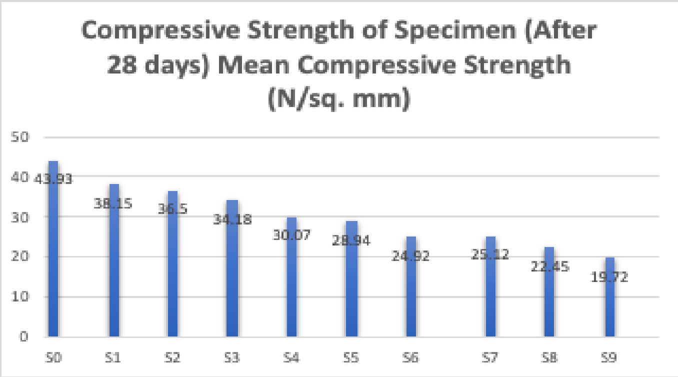

**Fig.7 - STEELCUBE150MM**

**Fig 8 – CubeSpecimen**

**Table4 - Compressivestrengthofvarious Mixproportion at 28days**

| S.NO. | DesignationofMix | SpecimenName | CompressiveStrengthofSpecimen (After28 days) | | |
|---|---|---|---|---|---|
| | | | Load(KN) | CompressiveStrength(N/sq.mm) | MeanCompressiveStrength (N/sq.mm) |
| 1. | S0 | 1 | 990 | 44.00 | 43.93 |
| | | 2 | 998 | 44.52 | |
| | | 3 | 972 | 43.22 | |
| 2. | S1 | 1 | 868 | 38.56 | 38.15 |
| | | 2 | 858 | 38.15 | |
| | | 3 | 851 | 37.82 | |
| 3. | S2 | 1 | 840 | 36.93 | 36.50 |
| | | 2 | 800 | 35.58 | |
| | | 3 | 825 | 36.65 | |
| | | 1 | 790 | 35.13 | |
| | | 2 | 748 | 33.22 | |

| | | | | | |
|---|---|---|---|---|---|
| 4. | S3 | 3 | 768 | 34.15 | 34.18 |
| 5. | S4 | 1 | 720 | 32.05 | 30.07 |
| | | 2 | 680 | 30.20 | |
| | | 3 | 698 | 31.05 | |
| 6. | S5 | 1 | 635 | 28.20 | 28.94 |
| | | 2 | 672 | 29.85 | |
| | | 3 | 647 | 28.76 | |
| 7. | S6 | 1 | 550 | 24.45 | 24.92 |
| | | 2 | 570 | 25.32 | |
| | | 3 | 563 | 25.04 | |
| | | 3 | 551 | 24.46 | |
| 8. | S7 | 1. | 598 | 26.59 | 25.12 |
| | | 2 | 548 | 24.36 | |
| | | 3 | 551 | 24.49 | |
| 9. | S8 | 1 | 490 | 21.76 | 22.45 |
| | | 2 | 520 | 23.12 | |
| | | 3 | 505 | 22.43 | |
| 10 | S9 | 1 | 468 | 20.78 | 19.72 |
| | | 2 | 455 | 20.24 | |
| | | 3 | 408 | 18.15 | |




**Graph 3 - CompressiveStrengthVsSpecimenName**

**WeightReduction:-**

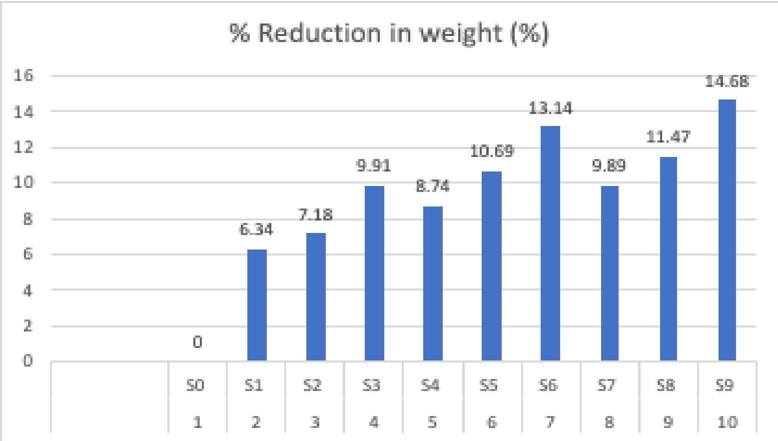
For the purpose of estimating the weight-reduction capabilities of sawdust and brick ballastaggregates in concrete, the weight of concrete cubes is kept on file. Table displays theweight decrease in percentage terms for various mixtures. By substituting sawdust andbrickballast for sandandcoarse stones inM1mix, weightis reduced by6.34%.

Weight reduction is obtained for M2 mix at 7.18%, M3 mix at 9.91%, M4 mix at 8.74%, M5mix at 10.69%, M6 mix at 13.14%, M7 mix at 9.89%, M8 mix at 11.47%, and M9 mix at14.48%.

**Table 5 - Weightreductionof ConcreteofVariousmixproportions**

| Sr.No. | Mixdesignation | Weightofspecimen (After28daysinKg) | | | MeanValue(Kg) | % Reductioninweight (%) |
|---|---|---|---|---|---|---|
| | | I | II | III | | |
| 1. | S0 | 8.2 | 8.3 | 8.3 | 8.35 | 0 |
| 2. | S1 | 7.7 | 7.8 | 7.7 | 7.84 | 6.34 |
| 3. | S2 | 7.6 | 7.8 | 7.6 | 7.75 | 7.18 |
| 4. | S3 | 7.4 | 7.6 | 7.5 | 7.52 | 9.91 |
| 5. | S4 | 7.5 | 7.7 | 7.6 | 7.62 | 8.74 |
| 6. | S5 | 7.3 | 7.5 | 7.6 | 7.45 | 10.69 |
| 7. | S6 | 7.2 | 7.2 | 7.3 | 7.24 | 13.14 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 8. | S7 | 7.6 | 7.4 | 7.5 | 7.54 | 9.89 |
| 9. | S8 | 7.3 | 7.4 | 7.6 | 7.48 | 11.47 |
| 10. | S9 | 7.0 | 7.2 | 7.3 | 7.14 | 14.68 |




**Graph 4 - WeightreductionofConcreteofVariousmixproportions**

## CONCLUSIONS

1) The primary goal of this study was to examine how sawdust and brick ballast aggregatesaffectedthecharacteristicsofconcrete.Theanalysisfoundthatconcrete'sworkability,compressivestrength, weightperunitvolume, andcost were alldeclining.

2) Themixes'valueisdeclinesteadilydeclinesandworkabilityalsodiminishesasanalternative fraction of sawdust and brick ballast increases in concrete. The slump value dropsfrom 40 mm (for nominal concrete) to 32 mm at the ideal replacement proportion, i.e. M5 (8SD 16 BB).

3) The compacting factor value of the mixes gradually declines as an alternative fraction ofsawdustandbrickballastinconcreteincreases,andworkabilityalsodiminishes.Thecompactingfactorvaluedropsfrom0.93(fornominalconcrete)to0.785attheidealreplacementpercentage, M5 (8 SD16 BB).

4) Forincreasingreplacementpercentages,theconcrete's28-daycompressivestrengthgradually falls. The compressive strength of M 30 grade concrete reduces from 43.93 N/sqmm(for regularmix)to 28.94 N/sq mmfortheidealmixM5 (8 SD 16 BB).

5) Theweightreductionshould beup to10.69% fortheidealblend.

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