AN EXPERIMENTAL STUDY ON LIGHT WEIGHT CONCRETE BY PARTIAL REPLACEMENT OF COARSE AGGREGATE WITH STEEL SLAG

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ABSTRACT

The study has been conducted explore the possibility of utilization of steel slag in concrete as coarse aggregate. After collection of steel slag aggregate from the steel manufacturing company, a steel slag aggregate was separated in to light weight slag aggregate. The aggregate were tested for different physical properties as well as mechanical properties by preparing cube specimen, cylinder specimen with different coarse aggregate proportion are 0%, 10%, 20%, 30%, 40%, 50%. The concrete specimen were tested at 7, 14 and 28 days. The strength will increased by 30% replacement of steel slag in cube and cylinder specimen and reduced the strength in above 30% replacement of steel slag.

INTRODUCTION

1.1 GENERAL

Concrete is a manmade material that looks like stone. Combining cement with aggregate and sufficient water makes concrete. water allows it to set and bind the materials together. Different mixtures are added to meet specific requirements. Concrete is normally reinforced with the use of rods or steel mesh before it is poured into moulds. The pyramids of Shaanxi in china, build thousands of years ago, contain a mixture of lime and volcanic ash or clay.

The Assyrians and Babylonians used clay as cement in their concrete. The Egyptians used lime and gypsum cement. It is said that the romans used a primal mix for their concrete it consisted of small gravel and coarse sand mixed with hot lime and water and sometimes even animals blood To trim down shrinkage they are know to have used horse chair. Historical evidence state that the Assyrians and Babylonians used clay as the bonding materials. Even ancient Egyptians are believed to have used time and gypsum cement for concrete.

Lime mortars and gypsum were also used in the world acclaimed pyramids. However, romans are know to have made wide usage of concrete for building road. It is interesting to learn that they build some 5300 miles of roads using concrete. Concrete is a very strong building material.

1.2 CONVENTIONAL REINFORCED CONERETE

Johnston (1994) found that tensile strength of concrete is typically 8% to 15% of its compressive strength. This weakness has been dealt with over many decades by using system of reinforcing bars (re bars) to create reinforced concrete; so that concrete primarily resists compressive stress and re bar tensile and shear stresses. The longitudinal re bars in a beam resist flexural (tensile stress) whereas the stirrups, wrapped around the longitudinal bar. Use of reinforced concrete makes for good composite mater with extensive applications.

Steel bar, however, reinforced concrete against tension only locally. Cracks in reinforced concrete members extent freely until encountering are bars. Thus need for multidirectional and closely spaced steel reinforced arises. That can't be practically possible. Steel fiber reinforced gives the solution for this problems.

1.3 CEMENT

In the most general sense of the word, cement is a binder, a substance that sets and hardens independently, and can blind other materials together. The word cement traces to the romans, who used the term opus cementesium to describe masonry resembling modern concrete that was made from crushed rock with burnt lime as binder. The volcanic ash and pulverized brick additives that were added to the burnt lime to obtain a hydraulic binder were later referred to as cemented, momentum, and cement.

Cement is used in construction is characterized as hydraulic or non-hydraulic cements (e.g., Portland cement) harden because of hydration chemical reactions that occur independently of the mixture's water content; they can harden even under water or when constantly exposed to wet weather. The most important use of cement is the production of mortar and concrete, the bonding of nature or artificial aggregates to form a strong building material that durable in the face of normal environmental effect. Concrete should not be material used to bind the aggregate materials of concrete. Concrete is a combination of a cement and aggregate.

1.4 AGGREGATE

Construction aggregate, or simply "aggregate", is a broad category of coarse particulate material used in construction, including sand, gravel, crushed stone, slag, recycled concrete and geosynthetic aggregate. Aggregate are a component of composite material such as concrete and asphalt concrete; the aggregate serves as reinforced to add strength to the overall composite materials. Due to the relatively high hydraulic conductivity values as compared to most soils, aggregate are widely used in drainage applications such as foundations and French drains, septic drains fields, retaining wall drains, and road side edge drains. Aggregate are as bases as material under foundation, roads, and rail roads

To put it another ways, aggregate as used as stable foundation or road/rail bases with predictable, uniform properties (e.g. to help prevent differential settling under the road or building), or as alow cost extender that binds with more expensive cement or asphalt to form concrete. The American society for testing and material publishes an exhaustive listing of specifications for various constructions aggregate products which, by their individual design, are suitable for specific construction purposes.

This products include specific types of coarse and fine aggregate designed for such uses as additives to asphalt and concrete mixes, as well as other construction uses. State transportation departments further refine aggregate material specification in order to tailor aggregate used to the needs and available supply in their particular locations. Sources for the basic materials can be grouped in to three main areas; mining of mineral aggregate deposits, including sand, gravel, and stone; used of waste slag from the manufacturing of iron and steel; and recycling of concrete, which it's chiefly manufactured from mineral aggregates.

1.5 STEEL SLAG

Steel slag is an industrial by product obtained from the steel manufacturing industry. It is produced in large quantities during the steelmaking operations which utilize Electric Arc Furnance (EAF). Steel slag can be used in the constructions industry as aggregates in concrete by replacing natural aggregates . Natural aggregate are becoming increasingly scarce and their production and shipment is becoming more difficult .Steel slag is currently used as aggregate in hot mix asphalt surface applications ,but there is a need for some experimental investigation on partial replacement of steel slag as coarse aggregate.

Steel slag can be used as aggregate in granular based applications. It is considered by many specifying agencies to be a conventional aggregate requirement for granular aggregate base. The high bearing capacity of steel slag aggregates can be used advantageously on week subgrades and in heavy trafic applications. Good interlock between steel slag aggregate practicals provides good load transfer to weaker subgrades. Because of their similar particle shape and angle of internal friction blast furnance slag aggregates have at times been blended with steel slag aggregates to improve yield, without substantial reduction in stability

1.6 OBJECTIVES OF THE STUDY

- To study the possibility of using steel slag as coarse aggregate replacement in concrete.

- To study and compare the performance of conventional concrete and steel slag ratio of concrete.

- To understand the effectiveness of steel slag in strength enhancement of concrete.

- To arrive a mix design summery for concrete using IS Code method

- To study the various strengthen of concrete such as compressive strength of concrete cube at 7 days,14days and 28 days, split tensile strength of cylinder at 7days,14days and 28 days.

1.7 SCOPE OF THE STUDY

Experimental investigation has been carried out study the strengthening of concrete cube and cylinder is done using steel slag at different percentage of 10%,20%,30%,40%,50%.

LITERATURE REVIEW

2.1 GENERAL

In this chapter, some of the technical papers related to steel slag concrete published in journals and conference proceedings have been discussed.

2.2 LITERATURE COLLECTION

Samdish Abrol (2016), normal aggregates are gradually more limited plus theirmanufacture and delivery is extra rigid. Steel slag at present utilized as aggregate in hot mix asphalt plane applications, except there is a necessity for some supplementary job to resolve the probability of utilizing this engineering by-product extra intelligently as a substitution for similarly fine plus coarse aggregates in a conservative concrete mixture. The most important aim of this study was to estimate the toughness of concrete completed with steel slag aggregates. This study presents effect of investigational study conceded out to assess effects of replacing aggregate (fine) by means of that of slag on a variety of concrete assets. Within the currentstudy M25 grade of concrete by means of steel slag assorted in place of fine aggregates in set proportions was used plus the compressive strength, flexural strength in addition to tensile strength were determined adopting conventional examination process. The present work aims at developing a material that can replace the conventional aggregate in concrete work using the waste product of steel industry like steel slag, ground granulated blast furnace slag, and fly ash. Quality assessment of ecofriendly concrete that is made out of cement, steel slag as coarse aggregate, steel slag as fine aggregate and some quantity of fly ash. This will solve the problem of waste disposal side by side preserving our natural resources. The objective of the experiment is to investigate the properties such as compressive strength, flexural strength, split tensile strength of concrete of the M-25 grade of concrete having mix proportion 1:1:2 with water cement ratio 0.50 and replacing sand with steel Slag in ratio of 10%, 15%, and 20% by weight of sand. The result data obtained will be analyzed and compared with a control specimen of 0% steel Slag or plain M-25 concrete for effective study of variation of compressive strength, Flexural Strength and split tensile strength of Concrete with respect to the change in steel Slag content.

U.Mohammed (2016), study has been conducted to explore the possibility ofutilization of steel slag in concrete as a coarse aggregate. After collection the steel slag aggregate from a local steel manufacturing company, the steel slag aggregate was separated in to light weight, heavy weight, and mixed slag aggregate. The aggregate were tested for different physical properties as well as mechanical properties by preparing cylindrical concrete specimen (100 mm by 200mm) were different water cement ratio, cement content, and sand to aggregate volume ratios. Total eleven cases for steel aggregate and five cases of brick aggregate were investigated. The concrete specimen were tested at 7, 28, 60 and 90 days. Also, ultrasonic pulse velocity (UPV) test was conducted prior to crushing of the specimen for evaluation of compressive and tensile strength. For compression, similar investigation were also carried out on brick aggregate commonly used in Bangladesh.

Experimental result show that slag aggregate absorb less water compared to the brick aggregate. The compressive strength of concrete made with mixed slag aggregate is similar or better than that of concrete made with brick aggregate. concrete made with heavy weight slag aggregate gives more compressive strength than other aggregate. Relationships between compressive and tensile strength of concrete are proposed for different slag aggregate.

Y. Anandh babu (2016), concrete is the 2ndhighest using material in the world.Continuous utilization of coarse and fine aggregates for concrete we are facing different problems like lack of availabilities of these aggregates with good quality. To over come this problem replaced the aggregate with eco-sand and steel slag. The primary objective of the project is to increase the strength of the concrete by replacing coarse aggregate by steel slag and also 30% replacement of eco sand as fine aggregate. As of from literature steel slag is replaced for 0, 15, 30, 45, 60, 75, 90% which indeed gives us 7 mixes (M2, M2, M3, M4, M5, M6, M7) totally. After conducting various testes we are arrive to conclusions of mix M1, M2, M3, M4 are relatively good strength then conventional mix. Particularly the mix M3, M4 which consist of 30 & 45 % of slag has high strength in all test. It is evident that 50% are more is not feasible as the strength found is very low compared to conventional mix.

Sandip.S.Patil, S.S.Bachhav,. D.Y.Kshirsagar (2016), The large amount ofIndustrial wastes as increased year by year and disposal becomes a very serious problem. It is necessary to utilize the steel slag waste affectively with technical development in each field. Commonly murrum soil has been used for construction of all categories of roads in our country. Although murrum is a good construction material, due to scarcity they increase the construction cost at some parts of the country, several types of murrum soils are found to be unsuitable for road construction in view of higher finer fraction and excessive plasticity properties. Such as used industrial material like steel slag in construction of road pavement. Its disposal causing severe health and environmental hazards in road construction industries is gradually gaining significant importance in India considering the disposal, environmental problems and gradual depletion of natural resources like soil and aggregates. Steel slag is a waste material generated as a by-product during the manufacturing of steel from steel industries. The quantity of generation is around 24 lacs MT per year from (Ref.Report.CRRI-2010) different steel industries in the India. Presently, it has no applications and dumped haphazardly on the costly land available near the plants. In this study, a typical steel slag was collected from an M/s Jindal Steel Iindustry Pvt.Ltd Sinnar MIDC, (M.S) in India and its feasibility for use in different layers of road construction was investigated. To improve its Geotechnical engineering properties, the Steel Slag material was mechanically stabilized with locally available soil in the range of 5 – 25%. Geotechnical parameters of these stabilized mixes were evaluated to investigate their suitability in the construction of different layers of road Technical specification of steel slag is developed for utilization in the construction of embankment, sub grade and sub base layer of Flexible pavement.

Farag Khodary (2015), Using aggregate in the field of construction increase rapidlyand looking for alternative source of aggregate assumed to be more important. The objective of this research at first is to study the effect of using steel slag aggregates in the properties of asphalt concrete mixtures. Secondly make comparative study of using steel slag aggregate and crushed limestone in asphalt concrete mixtures. Slag from industrial waste for the production of iron, which causes serious environmental problem. The use of steel slag aggregates is means of preserving the environment as well as reduces the energy needed to search for natural aggregates and prepared for use in mixtures. In this research have been the adoption percentages of bitumen 4.0% 4.5% 5.0% 5.5% 6.0% to find the optimal ratio of bitumen for asphalt concrete mixtures. The results have been obtained with the optimum bitumen content (5.02%) for asphalt concrete mixtures using crushed limestone and optimum bitumen content (5.60%) for asphalt concrete mixtures using steel slag aggregate. The Marshall stability of asphalt concrete mixtures using steel slag aggregate is 1.50 higher than mixtures with Crushed limestone aggregate. From the result it can be seen that using steel slag aggregate is useful for resist rutting and suitable for pavement in hot climate area.

Krishna Prasanna P and Venkata Kiranmayi K (2014), Waste management isone of the most common and challenging problems in the world. The steel makingindustry has generated substantial solid waste. Steel slag is a residue obtained in steelmaking operation. This paper deals with the implementation of Steel slag as an effective replacement for sand. Steel slag, which is considered as the solid waste pollutant, can be used for road construction, clinker raw materials, filling materials, etc. In this work, Steel slag is used as replacement for sand, which is also a major component in concrete mixture. This method can be implemented for producing hollow blocks, solid blocks, paver blocks, concrete structures, etc. Accordingly, advantages can be achieved by using Steel slag instead of natural aggregates. Thiswill also encourage other researchers to find another field of using Steel slag.

METHODOLOGY

3.1 GENERAL

In this chapter explains the methodology to be followed in this project work.

3.2 METHODOLOGY

The methodology of the project is shown in figure 3.1

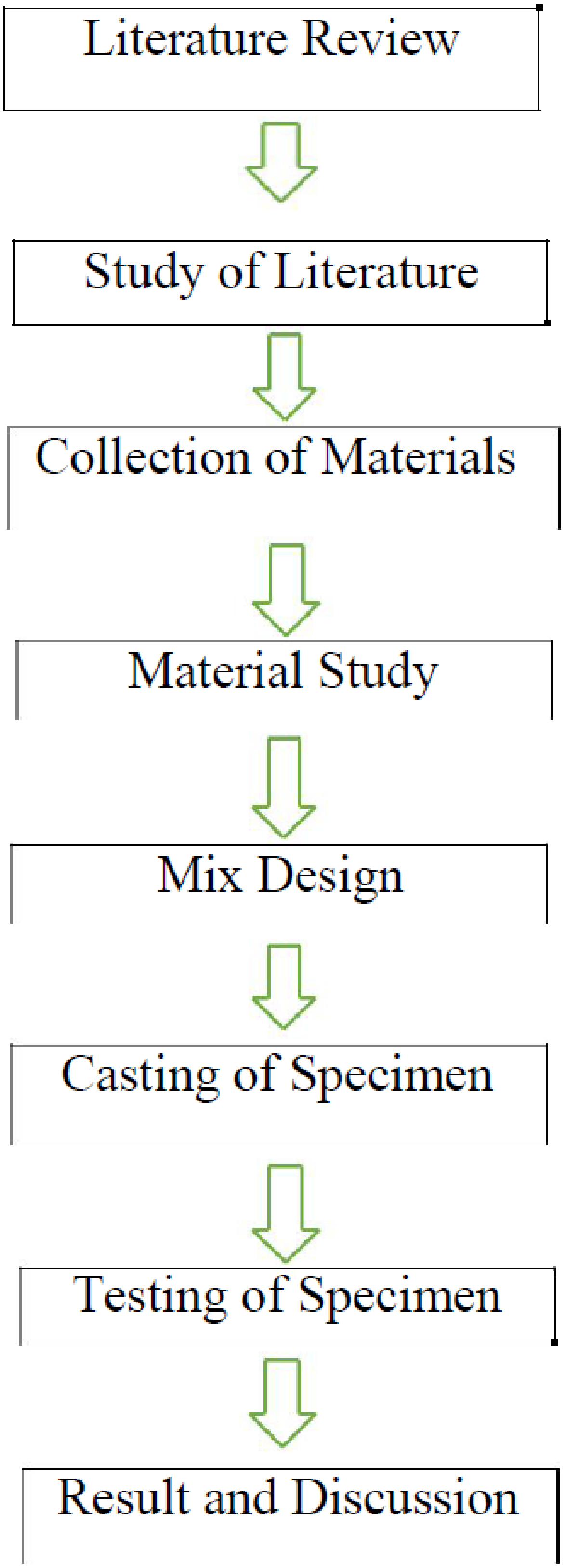

Figure 3.1 Flow Chart For Methodology Description

PROPERTIES OF MATERIALS AND CONCRETE MIX DESIGN

4.1 GENERAL

Cement is an artificial which is made up of cement, fine aggregate, coarse aggregate and water. In the project an attempt have been made with addition to concrete respectively.

4.2 CEMENT

Cement can be defined as the bonding material having cohesive & adhesive properties which makes it capable to unite the different construction materials and form the compacted assembly. Ordinary/normal Portland cement is one of the most widely used type of Portland cement. It is used in general construction purposes were special properties are not required. It is normally used for the reinforcement concrete buildings, bridges, pavements, and were soil conditions are normal. It as greater resistance to cracking and shrinkage but has less resistance to chemical attacks. In this project work, dalmia brand 53 grade OPC cement is used for experimental study.

The specific gravity of all grades of OPC is 3.15.

Table 4.1 Details of Oxide Composition

OXIDE	PERCENT CONTENT
Cao	60-67
SiO_2	17-25
Al_2O_3	3-8
Fe_2O_3	0.5-6
MgO	0.1-4
Alkali's(K_2o,Na_2O)	0.4-1.3

Table 4.2 Properties of Cement

Specific gravity	3.15
fineness	97.80

Initial setting time	28 min
Final setting time	10 hrs
Standard consistency	30.00%

4.3 FINE AGGREGATE

A concrete with better quality can be made with sand consisting of rounding grains rather than angular grains. River or pit sand must be used and not sea sand as it contains salt and other impurities.

In this project cauvery river sand has been used as fine aggregate. The specific gravity of sand using pycnometer test is found to be 2.65 By conducting sieve analysis, it is found that sand confirms to grading zone –III as per table 4 of IS 383 -1970.

Table 4.3 Sieve Analysis Sand

Sieve size in mm	**% 0f passing**
10	100
4.75	100
2.36	98
1.18	92
600	63.50
300	14.40
150	3.20

4.4 COARSE AGGREGATE

Aggregate must be clean and fresh impurities. The coarse aggregate obtained from a quarry in salem has been used for the project study.

The specific gravity of the coarse aggregate is found 2.70

The sieve analysis result shows that the coarse aggregate confirm to single a normal size of 20mm as per IS 383-1970.

Table 4.4 Sieve Analysis of Coarse Aggregate

Sieve size in mm	80	40	20	16	12.5	10	4.75	2.36
% passing	100	100	93.10	91.40	91.40	15.30	0.04	-

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4.5 Steel Slag

Steel slag Aretha waste materials which are collected from local steel industry

Fig 4.1 Steel slag

4.5.1 Advantages of Steel Slag

Blast furnance slag and steel slag are the aggregates of choice in many industries.

A lower unit weight than most natural aggregate make blast furnance slag economically efficient. Durability, strong, and light weight, blast furnance slag offers high resistance to sulfate attack and alkali and alkali-silica reaction.

Construction of ports and harbors and other large civil engineering projects.

4.6 Water

The water is used for the concrete mix should be free from salts such as sulphate, chloride. Portable water used for the drinking purpose in the college permises was used for casting as well as curing in the concrete cubes.

Specific gravity of water is 1.0

EXPREMENTAL WORK AND ITS RESULT

5.1 TESTES ON HARDERN CONCRETE

As the hardening concrete takes time, one will not come to know, the actual strength of concrete for some times. This is an inherent dis advantage in conventional test. But mostly when correct materials are used and careful steps are taken at every stage of the work, concrete namely give the required strength. The result of the test on hardened concrete, even if they are know late, helps to reveal the quality of concrete and enable adjustments to be made in the protection of feature concretes. Testes are made by casting cubes, cylinder from the respective concrete.

The properties of concrete only can be determine by testing and testing itself introduce error. It is important to release this and to understand what is mean by precession of testing concrete. Precision expresses the closeness of agreement between independent test results, obtained under stipulated conditions, in terms of repeatability and reproducibility.

The precision under condition were independent test result are obtained with the same method on identical test specimen in the same laboratory

by the same operator using the same equipment with in short intrevals of time. On the other hand reproducibility is defined as the precision under conditions.
Various strength of concrete

The following testes of concrete are generally determined
a) Cube Compressive strength of concrete.
b) Cylinder Compressive strength of concrete.

5.1.1 Cube Compressive strength test

The compressive strength test, the specimen are cast cubical in shapes, of size 15 cm x 15 cm x 15 cm. compressive test are made at recognized ages of the test specimens, the most usual being7, 14 and 28 days. At least three specimens, preferably from different batches shall be made from testing at each selected age. Specimen stored in water are tested immediately on removal from water and wile they are still in wet condition. The cubes are placed in the compressive testing machine in such a manner that the loads applied to opposite sides of the cube as cast. The load is applied without shock and continuously at the rate approximately 140 kg/ cm2/min until failure of the specimen. Ultimate compressive strength is the ratio between ultimate load and the area of specimen. The compressive strength of concrete gives an idea about the over all quality of concrete.

Fig 5.1 Cube Compressive strength test

5.1.2 CYLINDER COMPRESSIVE STRENGTH TEST

Direct tensile strength of concrete cannot be determined owing to deficulty in preparation of the test specimen and in applying truly axial tensile load. Split tensile strength test is an indirect method of finding out the tensile strength of concrete. The specimen shall be cylindrical in shape 15 cm diameter, 30 cm long. The test is made at ages, most usual being 7, 14 and 28 days. One of the fly wood strips is cantered along the center of the lower pattern. The wet specimen is placed on the strip horizontally with it axis perpendicular to the loading direction. The second ply wood is then placed length wise on the cylinder centrally. The load is then applied without shock and increase continuously at a rate to produce approximately a splitting tensile stress pf 14 to 21 kg/cm/min until failure. The maximum load applied to the specimen is noted. The splitting strength is given by 2P/LD, were p is max load, l is length and D is diameter of the specimen.

5.2 cylinder compressive strength test

5.2 TEST RESULT

It is taken, the test result obtained by conducting compressive strength and split tensile strength on concrete specimen casting for M30 grade are presented. In discussion topic, the detailed explanation on the result and variation in results such as compressive strength, split tensile strength and water absorption, were studied.

The following testes are conducted for M25 grade concrete specimens.

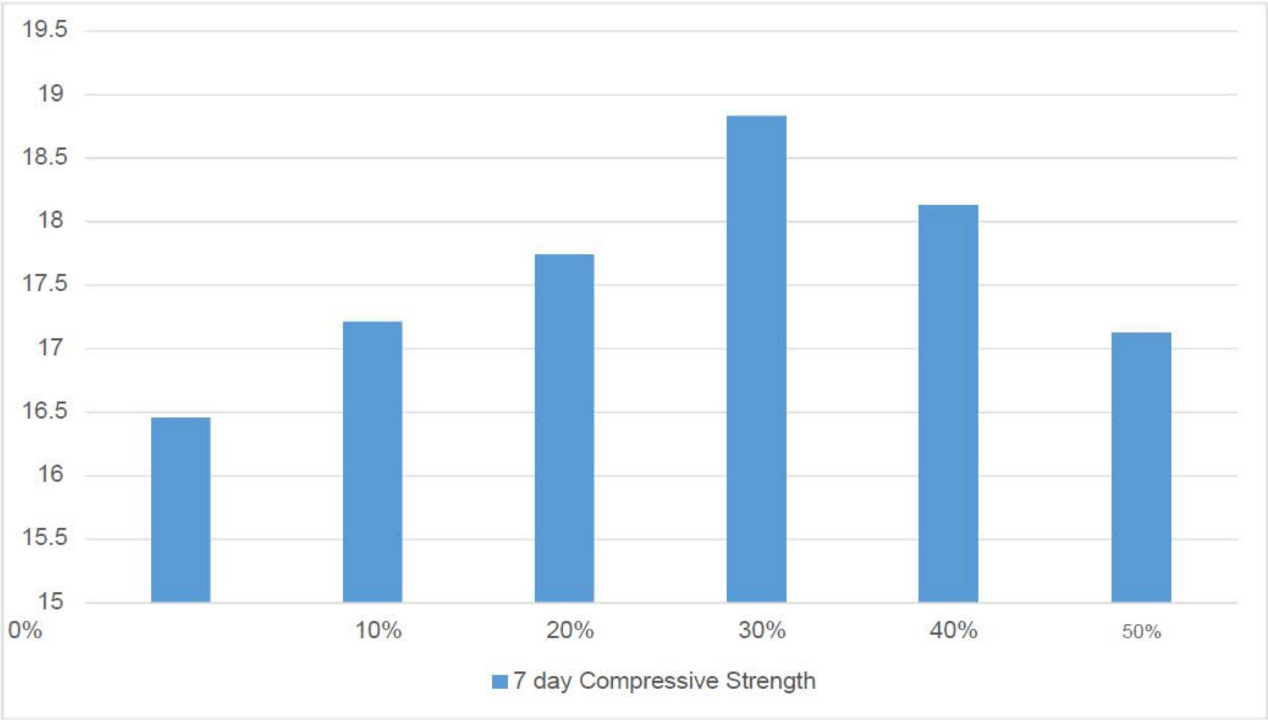
a) Cube Compressive strength.
b) cylinder Compressive strength.

5.2.1 CUBE COMPRESSIVE STRENGTH

CUBE AT 7 DAYS

Table 5.1 cube compressive strength at 7 days

SI.NO	% OF REPLACEMENT	CUBE COMPRESSIVE STRENGTH
1	0	16.45
2	10	17.21
3	20	17.74
4	30	18.83
5	40	18.13
6	50	17.12



CUBE AT 14 DAYS

Table 5.2 cube compressive strength at 14 days

SI.NO	% OF REPLACEMENT	CUBE COMPRESSIVE STRENGTH
1	0	22.78
2	10	23.83
3	20	24.62
4	30	26.07
5	40	25.11
6	50	23.70

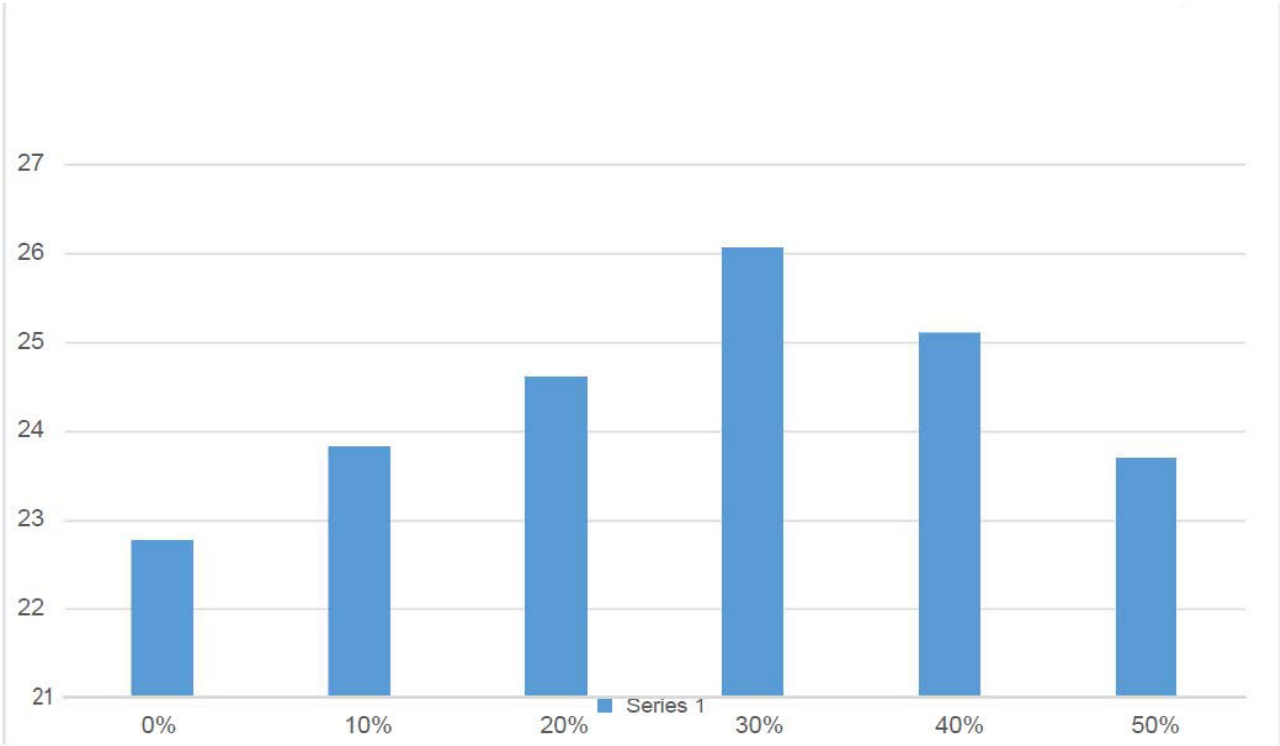


Fig 5.4 14 days cube compressive strength

CUBE AT 28 DAYS

Table 5.3 cube compressive strength at 28 days

SI.NO	% OF REPLACEMENT	CUBE COMPRESSIVE STRENGTH
1	0	25.32
2	10	26.48
3	20	27.36
4	30	28.97
5	40	27.90
6	50	26.34

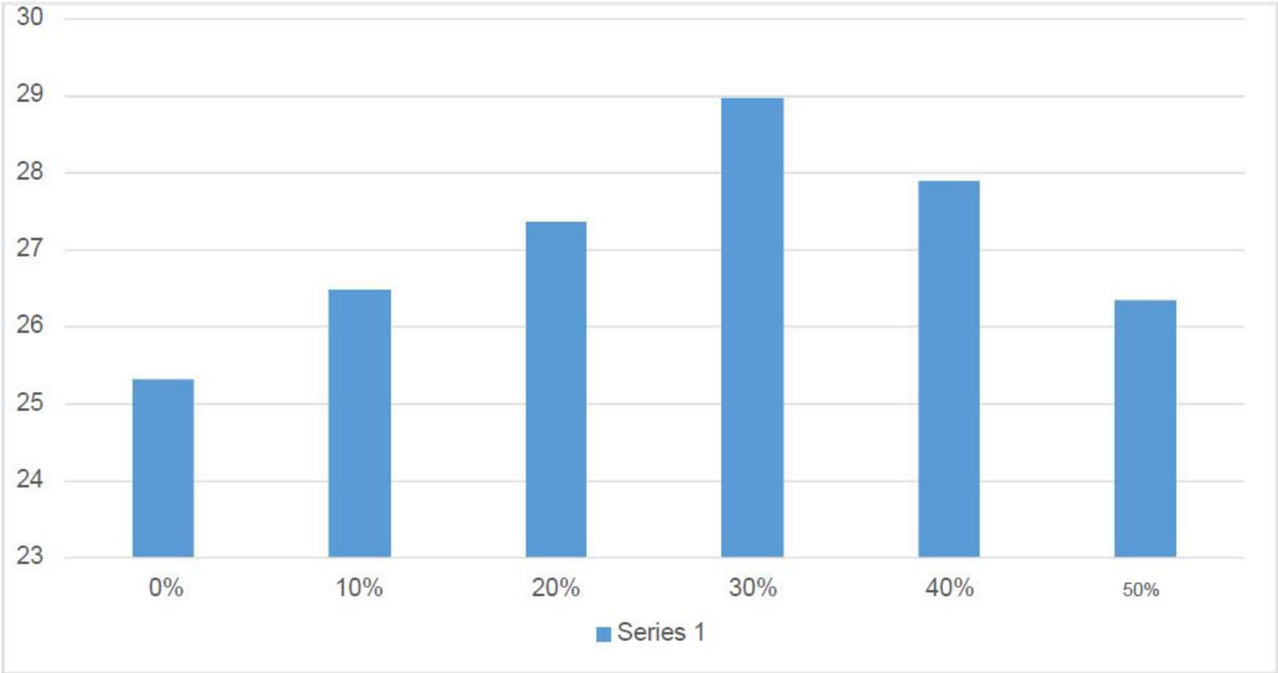


Fig 5.5 28 days cube compressive strength

5.2.2 CYLINDER COMPRESSIVE STRENGTH

CYLINDER AT 7 DAYS

Table 5.4 cylinder compressive strength at 14 days

SI.NO	% OF REPLACEMENT	CYLINDER COMPRESSIVE STRENGTH
1	0	13.16
2	10	13.76
3	20	14.19
4	30	15.06
5	40	14.50
6	50	13.69

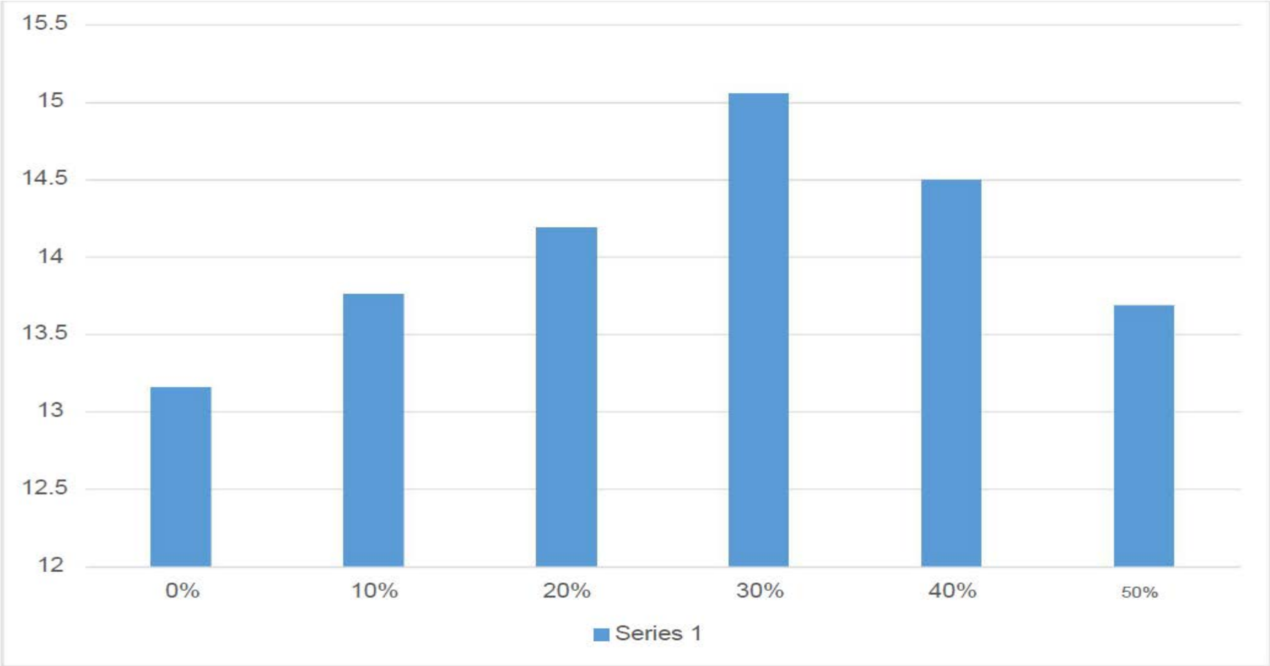


Fig 5.6 7 days cylinder compressive strength

CYLINDER AT 14 DAYS

Table 5.5 cylinder compressive strength at 14 days

SI.NO	% OF REPLACEMENT	CYLINDER COMPRESSIVE STRENGTH
1	0	18.22
2	10	19.06
3	20	19.69
4	30	20.85
5	40	20.08
6	50	18.96

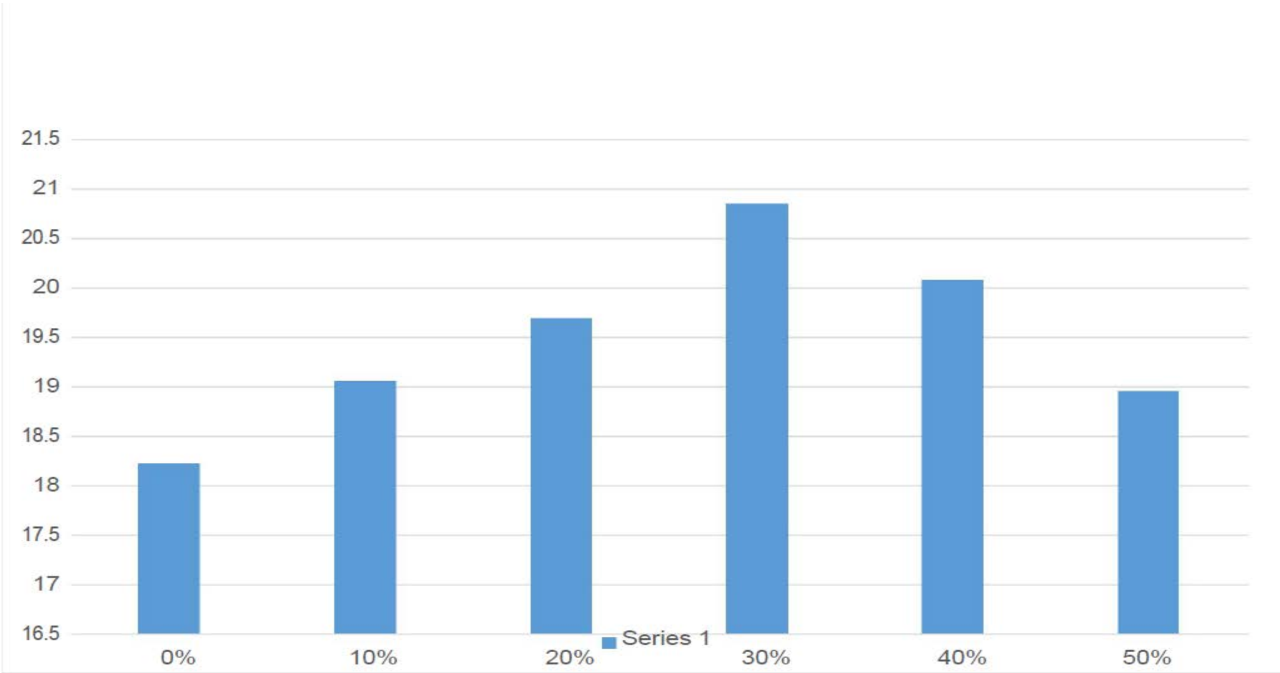


Fig 5.7 14 days cylinder compressive strength

CYLINDER AT 28 DAYS

Table 5.6 cylinder compressive strength at 28 days

SI.NO	% OF REPLACEMENT	CYLINDER COMPRESSIVE STRENGTH
1	0	20.26
2	10	21.18
3	20	21.88
4	30	23.17
5	40	22.32
6	50	21.07

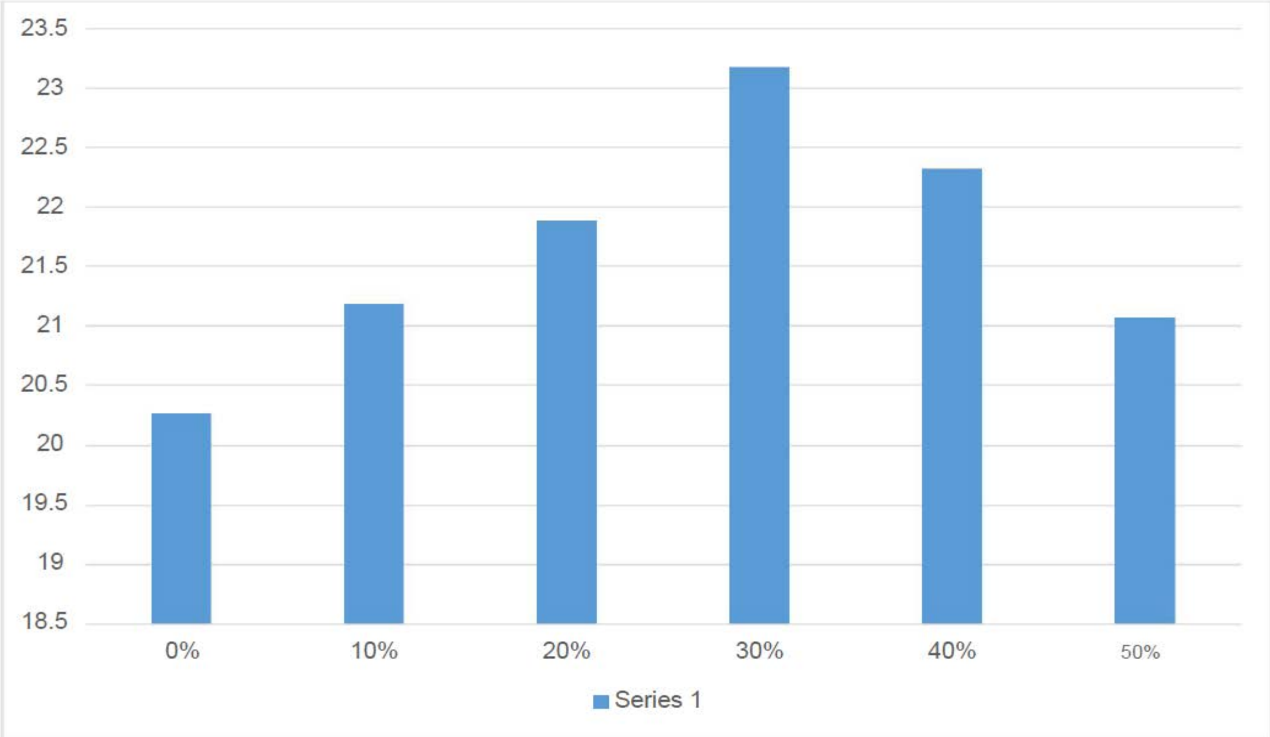


Fig 5.8 28 days cylinder compressive strength

CONCLUSION

Based on the test results the following conclusions are drawn.

- In this work replacement of 30%of steel slag give higher strength then the conventional concrete at 28 days.
  - 30% replacement gives 28.97 higher than the conventional concrete 25.32 in cube compressive strength.
  - 30% replacement gives 23.17 higher than the conventional concrete 20.26 in cylinder compressive strength.
- Also 40% and 50% of steel slag replaced concrete given decrement of strength than the conventional concrete.
- It is concluded that the steel slag replacement with concrete gives more strength than we needed steel slag may be subjected to corrosion. In future work, the corrosion of steel slag should be arrested to enhance the performance of concrete.

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ANNEXTURE
MIX DESIGN

1. Specific gravity of cement =3.15
2. Compressive strength of cement
   in a. 7 days = satisfied
   (as per the requirements of IS: 12269- 1989)
3. Specific gravity of aggregate
   a.Coarse aggregate = 2.70
   b.fine aggregate = 2.65
4. water absorption
   a.Coarse aggregate = 0.50%
   b.fine aggregate = 1.00%
5. fine (surface moisture)
   a.Coarse aggregate = Nill
   b.fine aggregate = 2.60
6. sieve analysis is shown below:

FINE AGGREGATE

Sieve size (mm)	**Fine aggregate (% passing)**	**Remarks**
5.60	98.0	
4.75	97.5	
2.00	94.5	Conforming to
1.00	78.5	Grading zone III OF
0.60	57.5	Table 4 IS 385- 1970
0.30	19.0	
0.075	0.0	
pan	0.0	

COARSE AGGREGATE

Sieve size (mm)	**Coarse aggregate (% passing)**	**remarks**
20.0	98.0	
12.5	97.5	Conforming to
10.0	94.5	Grade zone III of
6.3	78.5	Table 2 IS 385 - 1970
4.75	57.5	
pan	0.0	

CONCRETE MIX DESIGN OF M25 GRADE
DESIGN SPECIFICATION:

Compressive strength required in 28 days = 25 Mpa
Maximum size of aggregate = 20mm

Degree of workability C.F = 0.90

Degree of quality control = good

Type of exposure = Mild

Specific gravity of cement = 3.15

Specific gravity of coarse aggregate = 2.70

Specific gravity of fine aggregate = 2.65

WATER ABSORBTION:

1. Coarse aggregate = 0.50%
2. Fine aggregate = 1.0%

FREE MOISTURE:

1. Coarse aggregate = Nill
2. Fine aggregate =2.0%

TARGET MEAN STRENGTH OF CONCRETE

Target mean strength, f_{ck} = f_{ck} + t x s

= 25 + 1.65 x 4.6

=31.6 N/mm^2

32

SELECTION OF WATER CEMENT RATIO FROM TABLE 5 OF IS 456

Maximum w/c ratio of mild exposure condition = 0.55

Based on experience adopt w/c ratio = 0.5

0.5 < 0.55 hence ok.

SELECTION OF WATER CONTENT FROM TABLE 2 OF IS 10262 – 2009

Maximum water content = 186 kg.

Maximum size of aggregate = 20 mm.

Estimate water content = 186 + (3/100)

= 191.6 kg/m^3.

SELECTION OF CEMENT CONTENT

w/c ratio = 0.5

corrected water content = 191.6 kg/$m^{3.}$

From table 5 of IS 456

Minimum cement content for mild exposure condition = 300 kg/m^3

w/c = 0.5

191.6/c = 383.2 kg/m^3.

Cement = 383.2 kg/m^3.

383.2 > 300

Hence ok

Maximum cement content is= 450mm

ESTIMATION OF COARSE AGGREGATE

a)volume of concrete = m^3

b) volume of cement= (383.2/3.15) x (1/1000) = 0.1916 m^3

c). volume of water= (383.2/3.15) x (1/1000) = 0.1916 m^3

d). volume of total aggregate = a – (b + c) = 1 – (0.122 + 0.191) = 0.6864 m^3

e). mass of coarse aggregate= 0.6864 x 0.558 x 2.84 x 100

= 1087 75 kg/m^3

f). mass of fine aggregate = 0.6864 x 0.442 x 2.64 x 1000

= 800.94 kg/m^3

CONCRETE MIX PROPTION

Cement	=383.2 kg/m^3
Water	=191.6 kg/m^3
Fine aggregate	=800.9 kg/m^3
Coarse aggregate	=1087.75 kg/m^3
w/c	= 0.5

volume of concrete required for one cube

(0.15^3 x 1.25)	= 0.0042187 m^3
Cement	= 3383 2 x 0.0042187
	= 1.16 kg.
Water	= 191. 6 x 0.0042187
	= 0.808 kg.
Coarse aggregate	= 1087.75 x 0.0042187
	= 4.58 kg.
Fine aggregate	= 800.94 x 0.0042187
	= 3.37 kg.

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