AN EXPREMENTAL STUDY ON THE ENGINEERING BEHAVIOUR OF GROUTED LOOSE SOILS

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ABSTRACT

The constructional activities in the coastal belt of our country often demand deep foundations because of the poor engineering properties and the related problems arising from weak soil at shallow depths. The soil profile in coastal area often consists of very loose sandy soils extending to a depth of 3 to 4 m from the ground level underlain by clayey soils of medium consistency. The present investigation was aimed at obtaining solutions for problems like this. The improvement in relative density and thereby the load carrying capacity of loose sandy soils of different gradations through different methods such as vibration technique was studied. Grouting is quite a familiar term in foundation engineering, the primary purpose of which is to fill the voids of the formation material by replacing the existing fluids/air with the grout and thereby improving the engineering properties of the medium. The most commonly used grout material i.e. - ordinary Portland cement - has many advantages such as high strength, high durability, environmentally free and of low cost. A grouting setup was developed in the laboratory for grouting the sand beds prepared in steel tanks. The lateral flow of the grout and thereby the efficiency of grouting was assessed by three methods (i) from the cross section area of the grouted mass measured at different depths. The effectiveness of grouting in reducing the permeability of granular medium was also studied. Constant head permeability tests were carried out on the sand medium treated with different materials such as cement, bentonite, lime, locally available clay and different combinations of the above materials. The results of the various investigations conclusively proved that grouting.

Key Words : Loose soil , Stabilization, Grouting .

INTRODUCTION

GENERAL

Concrete has an extensive role to play in the construction and improvement of our civil engineering and infrastructure development. Its great strength, durability and veracity are the properties that are utilized in construction of Roads, Bridges, Airports, Railways, and Tunnels, Port, Harbours, and many other infrastructural project.

Use of admixtures to concrete has long been practised since 1900. In the early 1900s, asbestos fibres were used in concrete. There was a need to find replacement for the asbestos used in concrete. By the 1960s, steel, glass (GFRC) and synthetic fibres such as polypropylene fibres were used in concrete.

Concrete in general weak in tensile strength and strong in compressive strength. The main object of this project is to improve the tensile strength of concrete. To overcome this serious defect partial incorporation of fibres is practised. Great quantities of steel waste fibers are generated

from industries related to lathes, empty beverage metal cans and soft drink bottle caps. This is an environmental issue as steel waste fibres are difficult to biodegrade and involves processes either to recycle or reuse.

The resulting compressive strength, split tensile strength and flexural strength of the mixture depends on the type of cement, size and type of aggregate, period and type of curing adopted.

ADMIXTURES

Admixtures is defined as a material, other than cement, water and aggregate, that is used as an ingredient of concrete and is added to the batch immediately before or during mixing. Additive is a material which is added at the time of grinding cement clinker at the cement factory.

These days concrete is being used for which varieties of purposes to make it suitable in different conditions. In these condition ordinary concrete
may fail to exhibit the required quality performance or durability. In such cases, admixture is used to modify the properties of ordinary concrete so as to make it more suitable for any situation.

Chemical admixture
Mineral admixture.

CHEMICAL ADMIXTURE

Super plasticizers constitute a relatively new category and improved version of plasticizer, the use of which was developed in Japan and Germany during 1960 and 1970 respectively. They are chemically different from normal plasticizers. Use Super plasticizers permit the reduction of water to the extent upto 30 percent without reducing workability in contrast to the possible reduction upto 15 percent in case of plasticizers.

The use of super plasticizers is practiced for production of flowing, self compacting and for the production of high strength and high performance concrete. In our project tecmix550 used as chemical admixture.

BENEFITS AND FEATURES OF TECMIX550

Enhanced water reduction properties resulting in improved workability and greatly reduced porosity of concrete.

Significantly reduces segregation and bleeding of concrete mix.

Helps produce concrete of high early strength and also increase the ultimate compressive strength.

An extremely useful admixture for pre-cast concrete.

Improves final texture of concrete.

Does not contain chloride. It is safe for use pre-stressed concrete.

USES OF TECMIX550

Ideal as an admixture for high volume concreting for floors, walls or foundations.

Ideal for production of high strength concrete with reduced permeability by reducing the water content.

Improved workability makes Tec mix550 suited for concreting in areas with congested reinforcement.

Ideal for sloped roof concreting in areas and roof with complicated geometry like domes, shells and folded plate.

TECHNICAL DATA FOR TECMIX550

Physical data	Dark brown medium viscous liquid
Base	Sulphonated naphthalene polymers
Specific gravity	1.20 ± 0.02 @ 30^0 c
PH Value	7-9
Air entrainment	<1% compared to control concrete mix
Chloride content	Nil as per IS 456
Compatibility	Compatible with all types of cement with the exception of high alumina cement
Dosage	250-350ml/ 50kg bag of cement

MINERAL ADMIXTURE

The metallic waste obtained from varies sources such as mild steel lathe waste, empty beverage tins, soft drink bottle caps are deformed into the rectangular from with an approximate size of 3mm wide and 10mm long as in the form of fibers. These fibers are added in the concrete with 1.5%, 2.5%, and 3.5% by weight of concrete.

ECMIX550 SAMPLE

MATERIAL INVESTIGATION

GENERAL

Ordinary Portland Cement (OPC) 43 grade, locally available river sand as a fine aggregate, and locally available fibre material like bottle cabs such as a coarse aggregate, and water are used.

SAMPLE OF FIBER

MATERIALS

CEMENT

OPC of 43 grades is used in the investigation. It should satisfy the requirement of IS12262. The properties of cement are determined as per IS4031:1968 & results are tabulated.

PROPERTIES OF CEMENT

S.No.	Properties	Values
1	Fineness	10%
2	Initial setting time	28min
3	Final setting time	2-3hours
4	Standard consistency	29%
5	Specific gravity	3.15

FINE AGGREGATE

The fine aggregate with less amount of clay and silt (3% by weight). The fine aggregate used for casting was pure from silt, clay, salts and organic materials and The river sand taken from Coimbatore and it was clean and dry. The sand size is pass through 1.19mm sieve and retained on 900micron sieve.

COARSE AGGREGATE

The coarse aggregate is strongest and porous component of concrete. Presence of coarse aggregate reduces the drying shrinkage and other dimensional changes occurring on account of movement of moisture. The coarse aggregate used in 20mm & 12.5mm size. It is well graded (should of different particle size and maximum dry packing density and minimum voids).

WATER

Bore water available in the construction laboratory was used for casting all specimens of this investigation. Water helps is dispersing the cement even, so that every partial of the aggregate is coated with it and brought into ultimate contact with the ingredients. It reads chemically with cement and brings about setting and hardening of cement.

It lubricates the mix and compact property. Potable water, free from impurities such as oil, alkalies, acids, salts, sugar, and organic materials were used. The quality of water was found to satisfy the requirement of IS 456 – 2000.

TEST CARRIED OUT FOR THE PROJECT

COMPACTION FACTOR TEST

Description of work	Values in kg
Weight of cylinder W1	7.21
Weight of cylinder + partially compacted concrete W2	20.11
Weight of partially compacted concrete W2-W1	12.9
Weight of cylinder + fully compacted concrete W3	23.21
Weight of fully compacted concrete W3-W1	16
Compaction factor	0.8

SPECFIC GRAVITY OF FINE AGGREGATE

Description of work	Values in kg
Weight of empty Bottle W1	0.391
Weight of Bottle and sand W2	0.886
Weight of Bottle, sand and water W3	1.400
Weight of Bottle and water W4	1.092
Specific gravity of sand	2.64

SPECFIC GRAVITY OF COARSE AGGREGATE

Description of work	Values in kg
Weight of empty Bottle W1	0.391
Weight of Bottle and CA W2	0.870
Weight of Bottle, CA and water W3	1.400
Weight of Bottle and water W4	1.092
Specific gravity of coarse aggregate	2.80

CASTING AND CURING

INTRODUCTION

The mould specification, preparation of mould the method of casting and curing are discussed in following

CASTING

MOULD PREPARATION

The cube mould was placed in position on an even surface. All the interior faces and sides were coated with mud oil to prevent the sticking of concrete to the mould.

MIXING

The concrete using grade M35 (1:1.43:2.825) with water cement ratio 0.45 were used. Concrete is mixed in roller type of mixing machine.

PLACING

Concrete is properly placed beneath and along the sides of the mould with help of trowel.

COMPACTION

Hand compaction was done for all the cubes used in the test. The damping mild steel rods having point ends were used to poke the concrete and it is placed in vibrating table to make compaction complete.

MIXING OF MATERIALS

CURING

The mould is striped after 24 hours. The test cubes were cured for duration of 7, 14 and 28 days in a curing tank. After the wet curing the specimens were air cured for minimum period 2 Hours under laboratory conditions.

TESTING OF SPECIMENS AND RESULT ANALYSIS

INTRODUCTION

Testing of concrete plays an important role in controlling and confirming the quality of cement concrete. Cube, beam and cylinder are tested for its strength characteristics.

TESTING OF SPECIMEN

COMPRESSION TEST

The cubes of size 150x150x150mm are placed in the machine such that load is applied on the opposite side of the cubes as casted. Align carefully and load is applied, till the

specimen breaks. The formula used for calculation

Compressive Strength= Total Failure Load / Area of the Cube

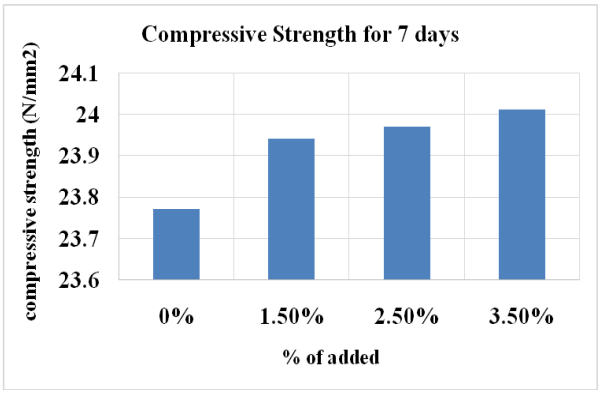
COMPRESSION TEST

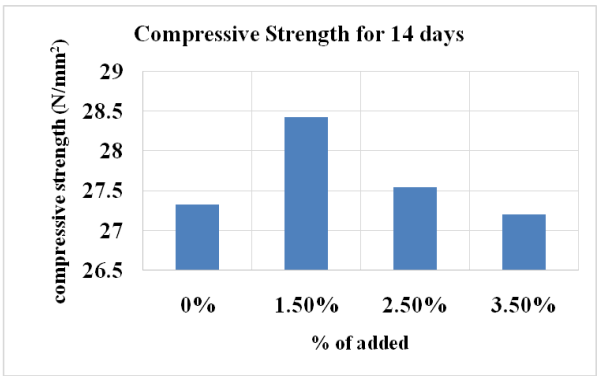
COMPRESSIVE STRENGTH RESULTS

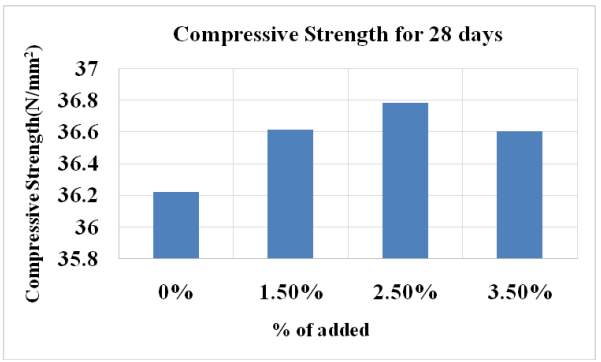
It has been observed that the concrete produced from 0%, 1.5%, 2.5%, & 3.5% added of coarse aggregate by bottle caps, shows maximum compressive strength.

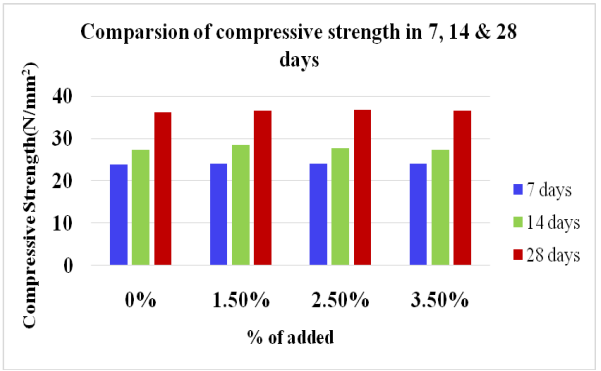
COMPRESSIVE TEST FOR 7, 14 & 28 DAYS

% of Added	No. of Specimen	7 days compressive strength N/mm^2	14 days compressive strength N/mm^2	28 days compressive strength N/mm^2
0% Added	1	23.51	27.22	36.32
	2	24.02	27.33	37.12
	3	23.78	27.42	35.23
	Avg.	23.77	27.32	36.22
1.5% Added	1	23.32	28.32	36.33
	2	24.32	28.44	37.25
	3	24.20	28.50	36.25
	Avg.	23.94	28.42	36.61
2.5% Added	1	23.60	28.51	36.40
	2	24.10	27.50	36.45
	3	24.22	27.52	37.50
	Avg.	23.97	27.54	36.78
3.5% Added	1	28.51	26.22	37.10
	2	24.22	27.24	36.90
	3	24.32	28.12	35.80
	Avg.	24.01	27.19	36.60









SPLIT TENSILE TEST

The test is carried out by placing cylinder specimen of dimension 150mm diameter and 300mm length, horizontally between the loading surface of compression testing machine and the load is applied until failure of the cylinder along the vertical diameter. The failure load of the specimen is noted.

The failure load of tensile strength of cylinder is calculated by using the formula

Tensile strength = 2P / 3.14 DL

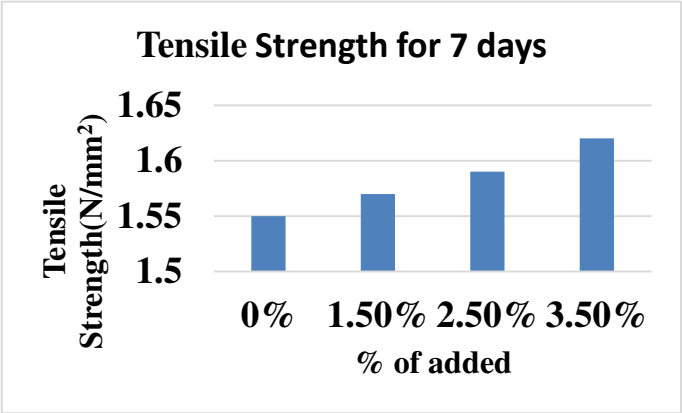
Where,

P - Failure of the specimen .

D - Diameter of the specimen

L - Length of the specimen

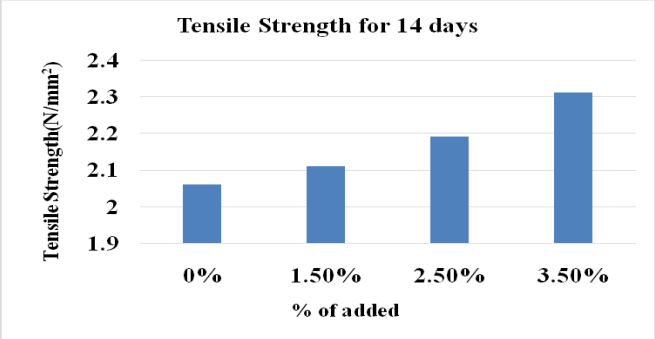
SPLIT TENSILE STRENGTH RESULTS

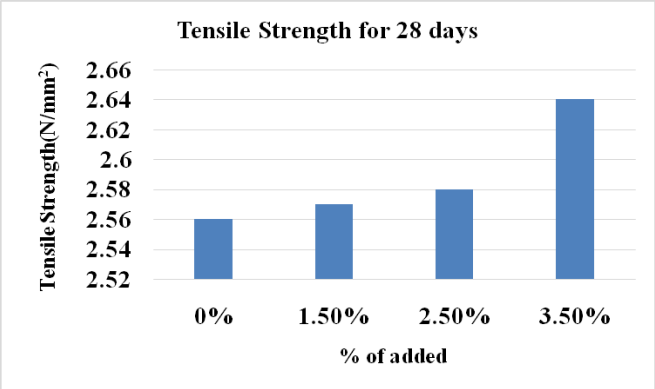


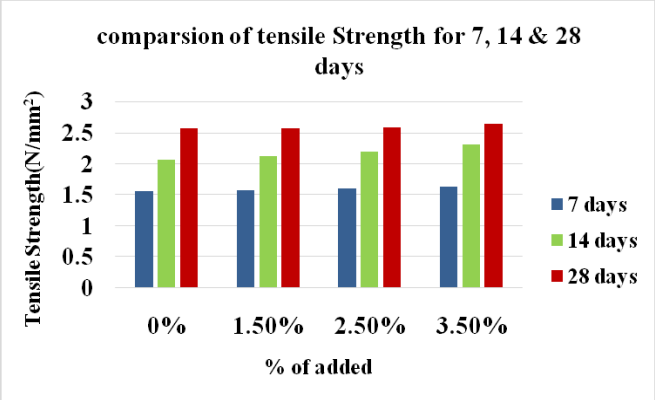
It has been observed that the concrete produced from 0%, 1.5%, 2.5%, & 3.5% added of coarse aggregate by bottle caps, shows maximum tensile strength.

TENSILE STRENGTH FOR 7, 14 & 28 DAYS

% of Added	No. of Specimen	7 days tensile strength N/mm²	14 days tensile strength N/mm²	28 day tensile strength N/mm²
0% Added	1	1.40	1.96	2.48
	2	1.57	2.01	2.57
	3	1.68	2.22	2.65
	Avg.	1.55	2.06	2.56
1.5% Added	1	1.48	1.92	2.51
	2	1.55	2.09	2.56
	3	1.69	2.32	2.64
	Avg.	1.57	2.11	2.57
2.5% Added	1	1.49	2.01	2.54
	2	1.60	2.20	2.57
	3	1.68	2.38	2.63
	Avg.	1.59	2.19	2.58
3.5% Added	1	1.52	2.17	2.58
	2	1.64	2.29	2.67
	3	1.70	2.47	2.69
	Avg.	1.62	2.31	2.64







FLEXURAL TEST:

The test is carried out to find the flexural strength of the prism of dimension 100 x 100 x 500 mm. The beam is then placed in the machine in such manner that the load is applied to the uppermost surface as cast in the mould. Two points loading adopted on an effective span of 400 mm while testing the prism .The load is applied until the failure of the prism. By using the failure load of prism

Flexural strength = Pl/bd^2

Where,

P - Failure load of the prism

l - Length of the prism

b - Breadth of the prism

d - Depth of the prism

FLEXURAL TEST

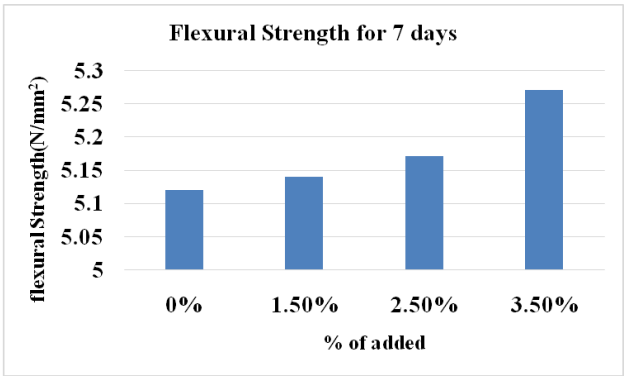
FLEXURAL STRENGTH RESULTS

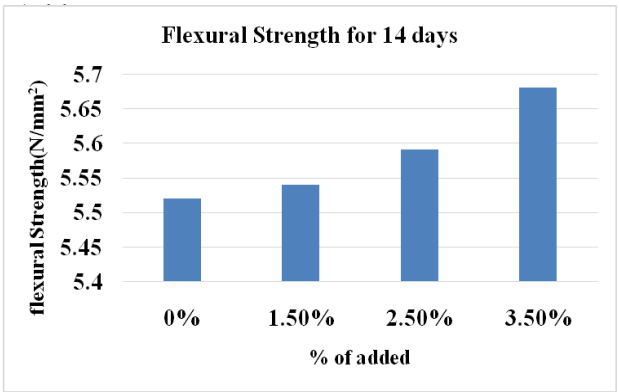
It has been observed that the concrete produced from 0%, 1.5%, 2.5%, & 3.5% added of coarse aggregate by bottle caps, shows maximum flexural strength.

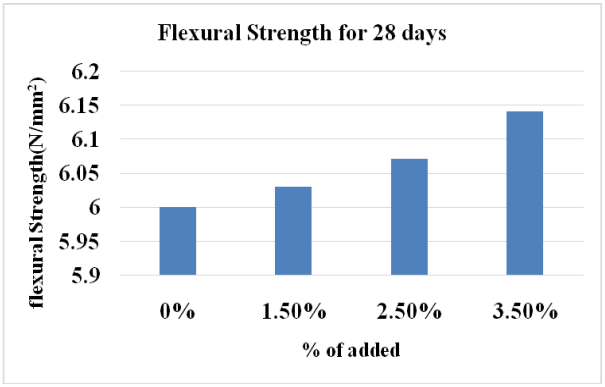
FLEXURAL STRENGTH FOR 7, 14 & 28 DAYS

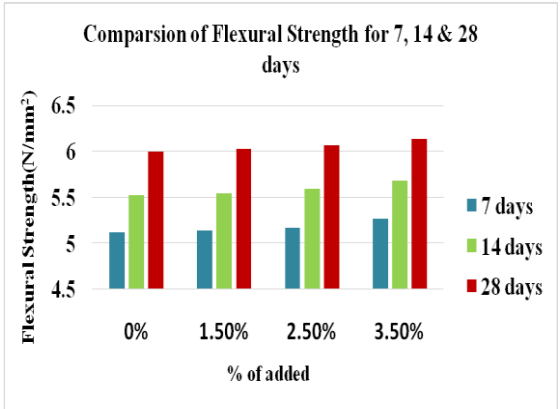
% of Added	No. of Specimen	7 days flexural strength N/mm²	14 days flexural strength N/mm²	28 days flexural strength N/mm²
0% Added	1	4.92	5.32	5.82
	2	5.18	5.56	5.98
	3	5.26	5.68	6.20
	Avg.	5.12	5.52	6.00
	1	4.96	5.35	5.78
	2	5.02	5.58	5.97

1.5 % Added	3	5.28	5.71	6.26
	Avg.	5.14	5.54	6.03
2.5 %	1	5.08	5.42	5.84
	2	5.18	5.62	5.99
	3	5.27	5.75	6.40
	Avg.	5.17	5.59	6.07
3.5 % Added	1	5.18	5.46	5.87
	2	5.26	5.65	6.07
	3	5.37	5.78	6.48
	Avg.	5.27	5.68	6.14









RESULT AND DISCUSSION

The test results of compressive strength , split tensile strength and flexural strength shows the consistent increase upto 1.50% and 3.50% added respectively by bottle caps. Super plasticizer techmix550 has used about 250ml per bag of cement which increase the strength of concrete.

CONCLUSION

Based on this experimental investigation, the behavior of bottle caps in concrete is concluded below

The specimen with tecmix550 was found to be good in compression which had the compressive strength more than the conventional concrete.

Better split tensile strength was achieved with the addition of the bottle cap waste in concrete.

The strength has increased when compared to that of the conventional concrete specimen.

In flexure the specimen with soft drink bottle caps as waste material was found to be good. While adding the soft drink bottle caps the flexural strength increased than the conventional concrete.

Hence this concept of mixing is good for strength and workability of concrete.

SUGGESTION FOR FUTURE WORK

There is scope for doing further investigation to increase the strength by analyzing durability properties.
Further this experiment can be extended to the field conditions, real time condition also.

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