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DURABILITY PROPERTIES OF EXCAVATED SOIL CONCRETE

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Abstract - *River sand is the most common material used as a fine aggregate in concrete. Due to the sand crisis, all building projects have affected. So it is a need to find some alternative material to replace the river sand in concrete. In this study, the fine aggregate is fully replaced by excavated soil and the durability properties of the excavated soil concrete are investigated. Initially, the particle size of the excavated soil is analyzed by the sieve test. The mix proportion 1:1.3:2.8 was evaluated for excavated soil concrete by using IS 10262: 2009. Standard test specimens were cast separately for conventional concrete and excavated soil concrete. The acid test, alkaline test, water absorption test and thermal test were conducted to evaluate the durability properties of concrete. The results of the both conventional concrete and excavated soil concrete were compared. The conclusion shows that the excavated soil gives good durability properties in concrete.*

Key words: Concrete, Fine aggregate, Excavated soil, Testing, Physical properties

1. INTRODUCTION

Concrete is the important and basic construction material in construction industry. In the production of concrete, generally the river sand is used as fine aggregate. River sand plays the important role in construction industry. Nowadays the good sand is not readily available and the cost of the river sand is high. So, the idea of the investigation is to use the excavated soil as a fine aggregate. The excavated soil is easily and adequately available. It will protect the natural resources and ecological balance on environment. Excavated soil is collected from the Anna University Regional Campus, Tirunelveli, Tamilnadu. The mix proportioning is carried out for M25 grade concrete. The mix proportions were calculated for conventional concrete and excavated soil concrete by using IS method. The mix proportion of 1:1.3:2.58 and water cement ratio of 0.4 was adopted for the excavated soil used concrete. Cubes of size 150 mm x 150mm x 150 mm were cast for conventional concrete and excavated soil concrete. Then the cubes were immersed in water for proper curing. After 28 days of water curing, the specimens were tested to evaluate the durability properties. Durability is the important property of concrete. Durability is the ability to resist weathering action, chemical attack, abrasion etc. The durability of concrete plays a vital role in structure's lifespan. So, the main objective of the study is to investigate the durability properties of the excavated soil concrete.

2. EXPERIMENTAL PROGRAMME

At first the ordinary Portland cement of grade 43, 20 mm size of coarse aggregate, river sand and excavated soil were collected and used. Specific gravity test and Sieve analysis test were carried out for river sand and excavated soil. The specific gravity of the river sand and excavated soil is 2.68 and 2.52. The sieve analysis test was conducted to determine the particle size distribution as per IS 383 (1970). The results show that the gradation curve of excavated soil is similar to the curve of river sand. The fineness modulus of the excavated soil is 3.43 and classified in zone II grading. The fineness modulus of the river sand is 2.984. The mix design was evaluated as per IS 10262 (2009). The conventional concrete mix and excavated soil concrete mix was prepared. The river sand was fully replaced by the excavated soil in excavated soil concrete mix. The various concrete specimens based on the test and trial basis were cast for the cube of size 150 mm ×150 mm × 150 mm. The casted specimens are immersed in water for 28 days. After curing the testing was conducted for various concrete specimens.

Fig 1: River sand and Excavated soil

3. RESULTS AND DISCUSSION

The following results will show the durability properties of the excavated soil concrete.

3.1 Acid test

After 28 days of water curing, the specimens were weighed and immersed in 5% of HCL solution for 30 days. Then the weight of the specimens was taken. From these weights, the weight loss in concrete was calculated. The results are shown in the table 1. From the results the mass loss of excavated soil is lower than conventional concrete. The chart 1 represents the mass loss percentage in excavated soil concrete and conventional concrete.

Table –1: Acid test results on concrete

S.No	Type of concrete	Initial weight (kg)	Weight after immersed in acid solution (kg)	Weight loss (kg)	Weight loss (%)
1	Conventional concrete	8.631	8.442	0.123	1.43
		8.622	8.493	0.129	1.49
2	Excavated soil concrete	8.70	8.596	0.104	1.19
		8.72	8.621	0.099	1.14

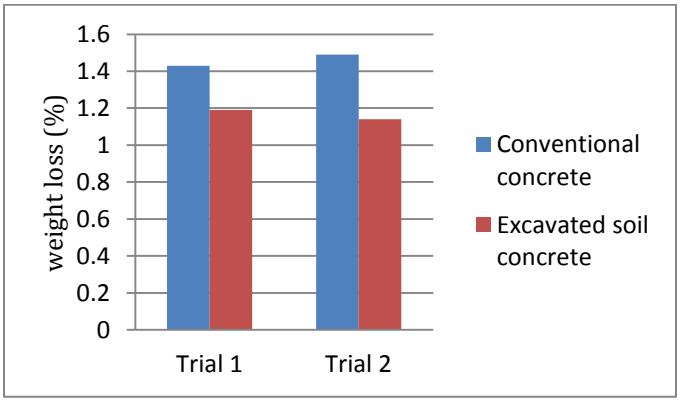

Chart – 1: Weight loss in concrete due to acid

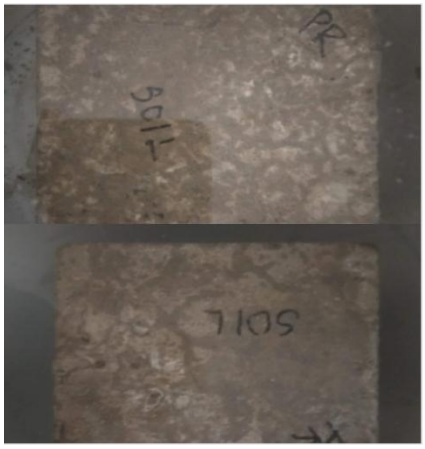

Fig 2: Acid test on concrete

3.2 Alkaline test

The excavated soil and sand cubes were weighed after 28 days of water curing. Then the concrete cubes are immersed in 5% of NaOH solution for 30 days. The weight of the cubes was taken after 30 days. The test results are given in the table 2. The chart 2 shows the weight loss in various concrete. From these results, the mass loss in excavated soil concrete does not give greater difference compared to conventional concrete.

Table –2: Alkaline test results on concrete

S.No	Type of concrete	Initial weight (kg)	Weight after immersed in alkaline solution (kg)	Weight loss (kg)	Weight loss (%)
1	Conventional concrete	8.62	8.584	0.036	0.42
		8.61	8.578	0.032	0.37
2	Excavated soil concrete	8.72	8.69	0.03	0.34
		8.7	8.671	0.029	0.33

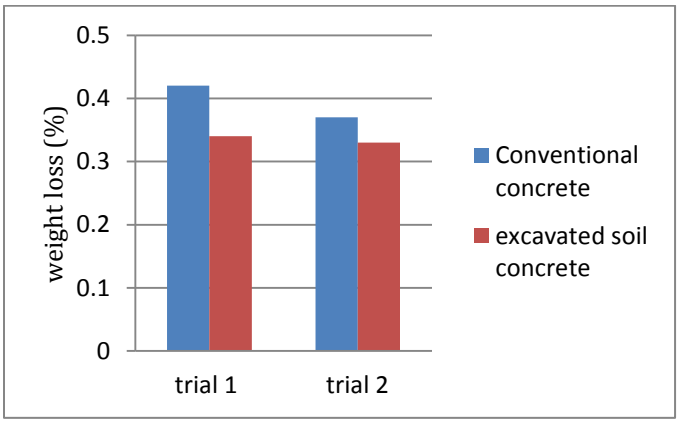

Chart – 2: Weight loss in concrete due to alkaline

3.3 Water absorption and porosity test

After 28 days of water curing the excavated soil and conventional concrete cubes were taken out. The cubes were dried in oven for 24 hours at 100˚c. The dry weight of the cubes was taken. Then the cubes were immersed in water for 24 hours. The weight of the wet cubes was taken. From this two weights the water absorption and porosity of the concrete was calculated. The porosity has influence on the properties of concrete in many aspects. The water weight is divided by its density is considered as a porosity of concrete. The results are shown in the table 3. The water absorption in excavated soil concrete is higher than the conventional concrete. And porosity is also increased in excavated soil concrete.

Table –3: Water absorption and porosity test results

S.No	Type of concrete	Dry weight (kg)	Wet weight (kg)	Water absorption (%)	Porosity $(10)^{-4}$ m^3
1	Normal concrete	8.516	8.674	1.86	1.58
		8.512	8.67	1.85	1.58
2	Excavated soil concrete	8.529	8.75	2.59	2.21
		8.523	8.79	3.13	2.67

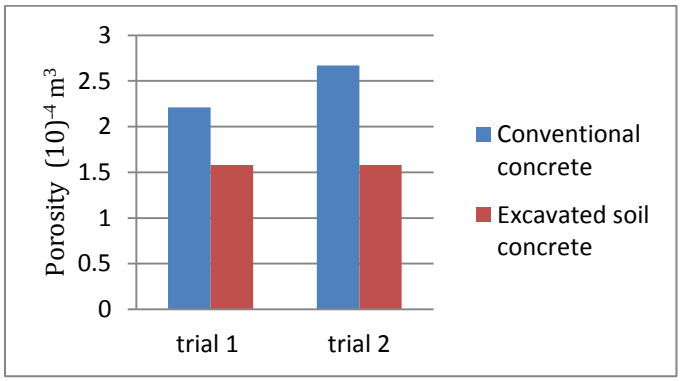

Chart – 3: Porosity test result on concrete

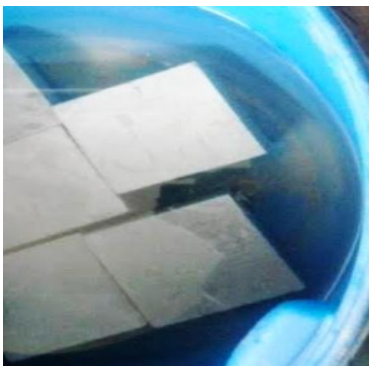

Fig 2: Water absorption test on concrete

3.4 Thermal test

After 28 days of water curing, the weight of the cubes was taken. The cubes were dried in oven for 6 hours at 300˚c. And then the cubes were weighed and subjected to compressive strength test. It is used to find the fire resistance of concrete. The results are given in the table 4.

Table –4: Thermal test results on concrete

S.No	Type of concrete	Initial weight (kg)	Final weight (kg)	Weight loss (%)	Compressive strength (MPa)
1	Normal concrete	8.61	8.5	1.27	30
		8.631	8.512	1.38	29
2	Excavated soil concrete	8.7	8.532	1.93	36.76
		8.72	8.521	2.28	37

Fig 3: Thermal test on concrete

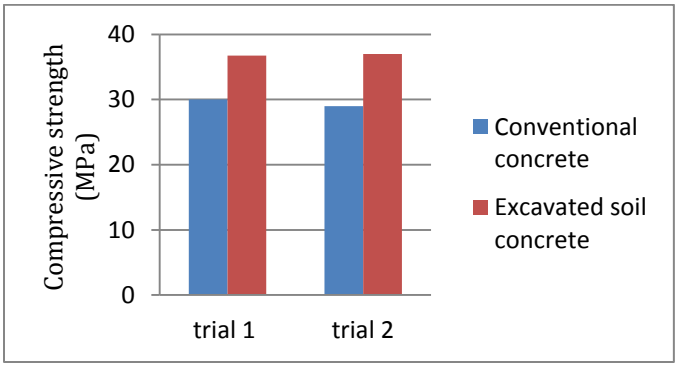

Chart – 4: Compressive strength on concrete after elevated temperature

4. CONCLUSION

In this experimental investigation, the durability properties of the excavated soil concrete and conventional concrete were determined. From the results the following conclusions can be made.

1. The Acid test result shows that the percentage of weight loss in both excavated soil concrete and conventional concrete was much lower. The average weight loss in excavated soil and conventional concrete is 1.165 % and 1.46 %.
2. The percentage of weight loss in both excavated soil concrete and conventional concrete is similar and much lower. The average weight loss in excavated soil concrete is 0.335 %.
3. The average porosity of the excavated soil concrete is 2.44 x 10^{-4} m^3. The average porosity of the sand concrete is 1.58 x 10^{-4} m^3. The porosity of the excavated soil concrete is higher than the conventional concrete. The water absorption of the excavated soil concrete is 1.54 times higher than the conventional concrete.
4. The average compressive strength of the excavated soil concrete and conventional concrete is 36.88 MPa and 29.5 MPa. The weight loss in excavated soil is 1.59 times higher than the conventional concrete.
5. From this investigation, the behavior of the excavated soil concrete is similar to the conventional concrete. Hence excavated soil is a suitable material to use as a fine aggregate in concrete.

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