



ROLLER COMPACTED CONCRETE PAVEMENT

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Abstract: The aim of this research is to check the suitability of roller compacted pavement in India. In order to check suitability, samples of M40 grade concrete with 0, 10, 20, 30% replacement of cement by fly ash is tested in the laboratory for compressive and tensile Strength for different time periods (i.e. 3days, 7days, 14days, and 28days). It is cured for 28 days

Keywords- roller compacted concrete, Road, Pavement, compressive strength, grade of concrete, water cement ratio, curing, admixture.

I. INTRODUCTION

Roller compacted concrete or RCC is a special concrete has essentially the same ingredients as conventional concrete, but at different ratios with or without adding admixtures such as fly ash and plasticizer. It is no slump concrete that is compacted by the vibratory roller. It should be dry enough to be able to resist sinking of the roller and Wet enough to the extent that the mortar can be distributed within concrete during vibration. It does not require any formwork and reinforcement still and finishing. It has high production rate. Because it has a small amount of water, it cannot be placed by the same methods used for conventional concrete. Also, the method of compaction is different from conventional concrete and it is compacted by vibration and pneumatic roller. The objective of mix design is to produce a mix that has a sufficient cote volume to cote the aggregates in the mix and to fill voids between them. Any basic method of concrete proportioning like soil compaction method, concrete engineering approach, optimum past volume method

II. METHODOLOGY

In order to check suitability, testing program was aimed to find the possibility of implementing destructive and non-destructive testing to evaluate strength and other effective factors such as durability and density. Testing program consists of construction of RCC slab and blocks using two types of cement (i.e. Ordinary portland cement and portland pozzolona cement). It is cured for 28 days and then samples are obtained for testing. Beam and cube are tested for tensile and compressive strength. As properties of materials also affect characteristic of concrete, testing of materials also evaluated.

III. MATERIALS

3.1 Aggregates

Aggregates consists about 70 to 80% volume in RCC. It should be hard, durable, and tough. In fresh stage they affect the workability, potential to segregation and also affect the speed and effectiveness of the roller. Normally RCC mix is not cohesive as conventional concrete so segregation and thus, aggregate segregation may be consideration. Large size aggregates reduce voids and thus reduce cement demand. On the other hand large aggregate can't give bonding. Thus the nominal size of aggregates is 20mm. The table shows aggregate gradations and sieve analysis of aggregate use in RCC.

3.2 Chemical Admixtures

Sieve designation(mm)	26.50	19.00	9.50	4.75	0.006	0.00075
Percentage passing the sieve by weight	100	80-100	55-75	35-60	10-35	0-5

Effectiveness of chemical admixture is related to cement properties. Retarders are used for delay setting time, which give time for transportation, placing, and compaction and prevent cold joint formation between the layers. Air entraining admixtures are used to improve workability of concrete. It reduces water and cement content and helps in improving the durability in freezing and thawing. But at the consistency of the RCC mixes, the real effectiveness is limited.

3.3 Cementations material

Any cement can be used but for heat of hydration consideration, low heat cement is recommended for RCC. As W/C ratio is low Portland pozzolona cement is suitable for RCC and it also reduces heat of hydration and gives better workability. Other materials such as hydraulic cement, ground granulated blast furnace slag or fly ash may also use after appropriate test.

3.4 Water

Water used in RCC was tap water obtained from Dharmaj area. It is also used for curing.

3.5 Fly ash

Fly ash used in RCC was class-f fly ash obtained from thermal power plant.

IV. MIX DESIGN AND PROCEDURE

Special design mix is prepared for M40 grade concrete as per maximum dry density – optimum moisture content method.

Mix Design	
Name	Quantity
Cement	440
Water	185
Fine AGG.	804
Coarse AGG.	1097
Admixture	4.20
W/C ratio	0.30

Table 4.1 Mix design

V. TESTING METHODOLOGY

5.1 mixing

Mixing of concrete was done in mechanical mixer. Before mixing surface of mixer was washed by water. Concrete was mixed for fifteen minutes.

5.2 slump test

Apparatus of slump test is first cleaned and then oil is applied on surface of it. Concrete is filled in slump cone in three equal layers. After placing of layers 25 blows of tamping rod is applied to distribute concrete in cone. After placing all layers top surface is leveled. Then cone was slowly lifted without disturbing concrete. Height of concrete slump is then measured. This height gives slump value in mm.

5.3 Casting:

Cube mold size of 150*150*150 cm were casted in conventional method to know compressive strength of concrete. Beam were casted to know tensile strength of concrete. Moulds were cleaned and inside surface was oiled. Now moulds were placed on vibrator machine and filled with concrete in five layers by giving vibration to each layer for period of 2 minutes. After that compression is applied on concrete with help of hammer blows. Level the top surface and smoothen it with a trowel.

5.4 Curing:

The mold filled with concrete are stored in moist air for 24 hours and let them settle. After this period the it is de-molded and kept submerged in clear fresh water until taken out prior to test.

5.5 Compressive Strength Testing and Tensile Strength

M40 grade of concrete cubes of 15cm were used to determine the compressive strength. In total 16 cubes were casted. With 0, 10, 20, 30% of fly ash replacement. The compressive strength was tested after 3,7,28 days. These cubes were tested under compression testing machine. Results shown in below table.

Replacement by fly	3 day strength	7 day strength	14 day strength	28 day strength
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ash	N/MM ²	N/MM ²	N/MM ²	N/MM ²
0%	29.63	53.11	64.69	71.11
10%	27.72	43.56	54.80	65.32
20%	26.46	39.48	53.06	60.89
30%	24.52	32.69	52.36	56.96

Table 5.1 Compressive strength

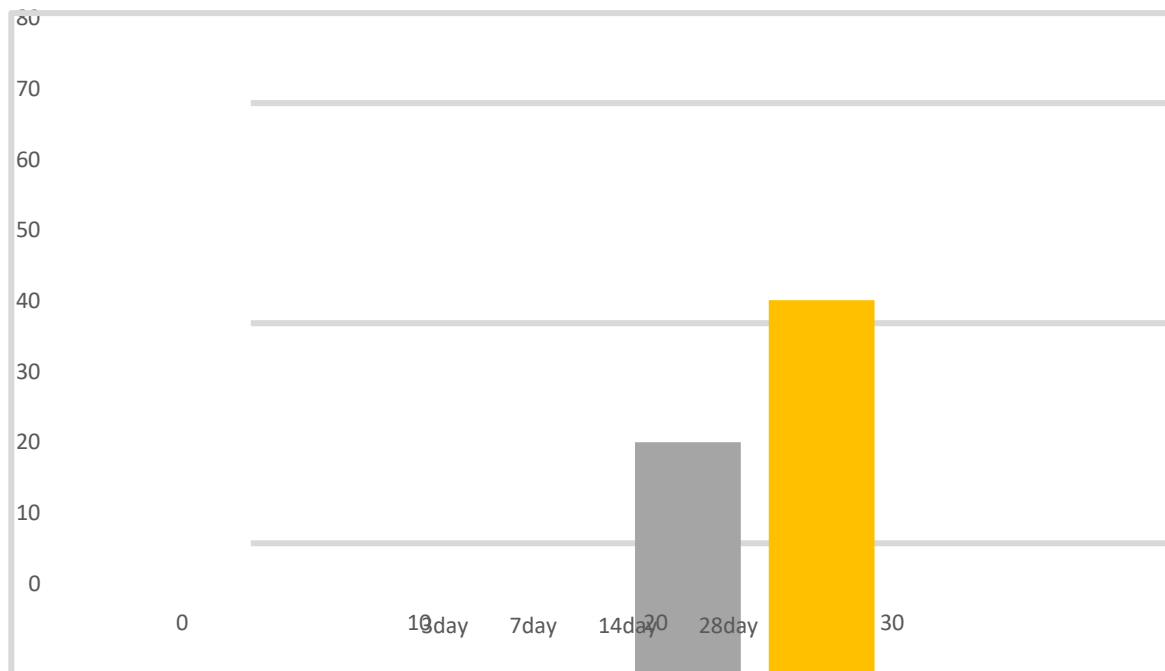


Chart 5.1 compressive strength

Replacement by fly ash	Tensile strength
0%	4.5
10%	3.98
20%	2.90
30%	2.89

Table 5.2 Tensile strength

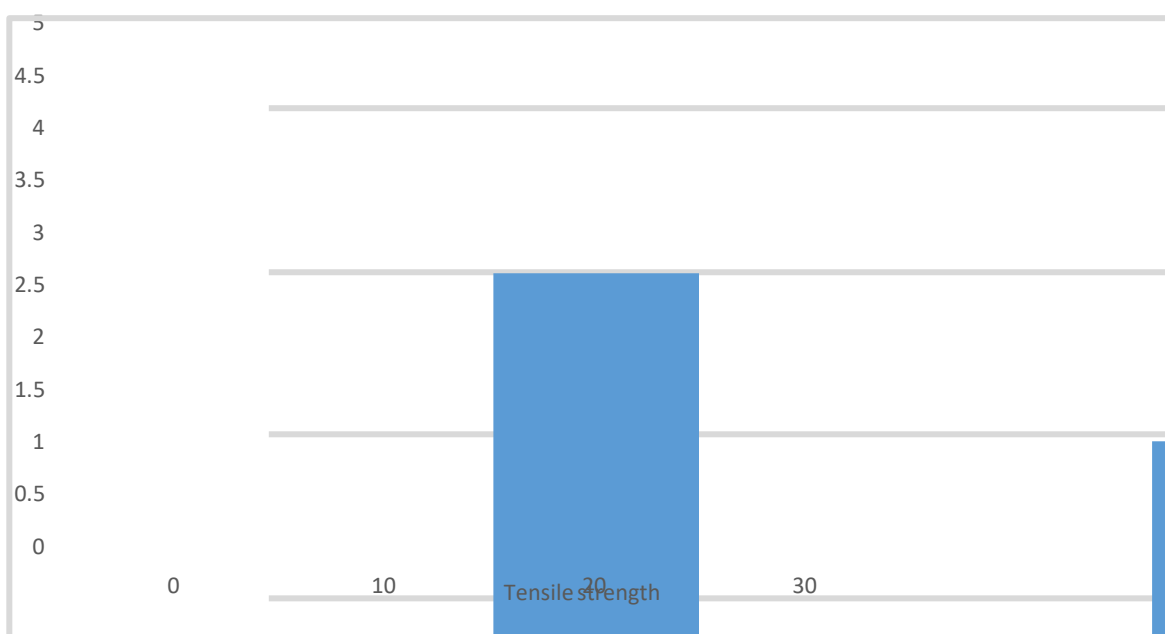


Chart 5.2 Tensile strength

VI. COST

Cost of concrete depends on cost of cement hence reduction in use of cement will reduce overall cost of concrete.

Table 6.1 Cost of materials

No	% Fly Ash	Cement	F.A	C.A	Admixture	Fly ash	Total
1	0	2464	402	658	134	0	3658
2	10	2217	402	658	134	44	3455
3	20	1971	402	658	134	88	3253
4	30	1724	402	658	134	132	3050

Price of material

Cement 280 per Rs bag(50 kg)

Fine agg. 500 Rs per ton

Coarse agg. 600 Rs per tone

Fly ash 1000 Rs per tone

Chemical admixture 32 RS per liter (1 lit = 1kg)

VII. CONCLUSION

- Replacing cement by fly ash will reduce cost of concrete
- It reduces heat of hydration
- Addition of proper admixture achieve early strength and reduce water requirement
- We have observed that addition of fly ash reduces cost by 30%
- We have observed that cement content in trial mix get completely hydrate to achieve M40 design strength.
- We have observed that compressive and tensile strength of Roller compacted concrete replaced by fly ash is nearly same as concrete without fly ash

REFERENCES

- [1] Mohamed I. Abu Khashba , I. Adam, A. El-Ashaal,16 June 2013,Alexandar Engineering Journal, "Investigating the possibility of constructing low cost roller compacted concrete dam"
- [2] Martin Wieland and R. Peter Brenner, 1st Aguast, 2004"Earthquake Aspect of Roller Compacted Concrete and Concrete – Face Rockfill Dams"