Experimental Study of Cost Impact by use of Fly Ash Based Concrete & Conventional Concrete with Balanced Score Card Technique for construction Infrastructure

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Abstract **- Concrete is the most important universal construction material. Due to changing construction techniques, materials & global warming impact due to manufacturing of cement, so there is need to use some other materials which may change the properties of concrete. Fly ash the most widely used supplementary cementitious mineral which is a by product of the combustion of pulverized coal in electric power generating plants are also known as mineral admixtures have been used with cements for many years. In India the production of fly ash is crosses more than 300 million in the year 2017. Fly ash is classified as class F & class C. Fly ash &Silica fume now viewed as cement replacement material and in some area it is usually replaced by much smaller quantity of cement weight for making bricks, in road pavement, light weight aggregate. It reduces heat of hydration, water demand &improves workability & compressive strength.This paper aims at studying the availability and use of fly ash in various proportions, which can be used in many residential & commercial buildings. The research paper indicates that fly ash based PCC of grade M10 & RCC of grade M20 can be used to reduce the cost of construction and has the potential to minimize the overall cost of construction. Balance score card technique can also be applied for improving the performance, customer satisfaction, quality for high performance concrete in major construction. In this experimental study Concrete mix of grade M20 & M10 which are designed as per the Indian standard code IS-10262-1982 by adding fly ash 10%, 15%, 20%, 30%, 40%, 50% by wt of cement in concrete.. Concrete cubes of size 150mm X 150mm X 150 mm are casted and tested for having compressive strength at 7 days,14 days & 28 days. Also fly ash based cement mortor are prepared of grade M10 of size 70.7mmx70.7 mmx 70.7 mm. Compressive strength of all specimen is taken at 7 days, 14 days,28 days & the results are compared with that of conventional concrete.**

Keywords**— Balanced Score Card, Construction Cost, Compressive Strength , Fly ash**,

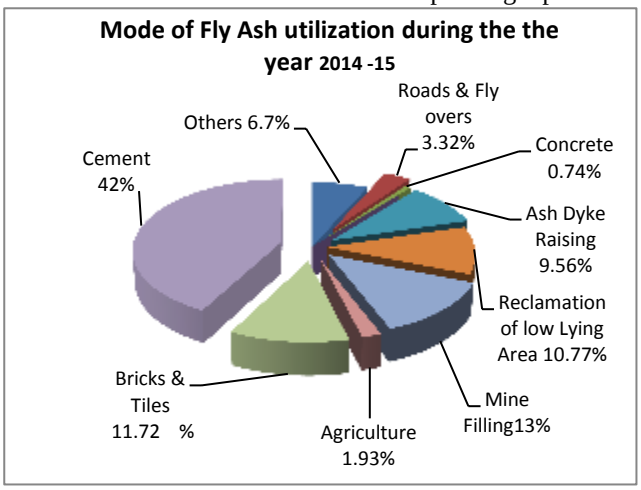
1. INTRODUCTION

1.1General

Concrete is most widely used and versatile construction material possessing several advantages over other constructions materials. It is difficult to point out another material of constructions which is as versatile as concrete. Concrete is a mixture of cement, sand, coarse aggregate and water. It can be used for construction of multistorey buildings, dams, road pavement, tanks, offshore structures, canal lining.

1.2 Fly ash & its need to use:

Fly ash is the waste residue of thermal power plant. It can be seen from the chemical properties fly ash is same as that of Ordinary Portland Cement (OPC). Fly ash offers environmental advantages & improves the various properties of concrete. The classification & selection of it depends upon properties so that can be used efficiently. It is classified as class F & class C depending upon the



chemical properties of fly ash.

Class F fly ash having lime less than 15%.In case of class C fly ash percentage of lime is greater than 15%. Fly ash increase strength, decreases permeability, reduces water demand, segregation & bleeding. Reduces corrosion of steel reinforcement. Fly ash has been incorporated in manufacturing bricks, slabs, wall panels, pavements. Previous study generally recommends the 30 % use of fly ash by the weight of cement. It has content same as the content of cement.As per IS 3812:2003.When water is added in cement hydration occurs from two products,

$OPC + H_2O$ = Calcium silicate hydrate + (Free Lime)
(CSH) $Ca(oH)_2$

OPC + Fly ash+ H_2O = Calcium silicate hydrate (CSH)

Table 1 The Basic Components of cement

SiO2	**17-25 %**
Al2O3	**4-8%**
Fe2O3	**0.5-0.6 %**
CaO	**61-63 %**
MgO	**0.1-4.0 %**
SO3	**1.3-3.0 %**
Na2 + K2O	**0.4-1.3 %**
Cl	**0.01-0.1%**
IR	**0.6-1.75 %**

The fly ash used for the experimental purpose is taken from Thermal Power Plant at Parali, Maharashtra. The quality of fly ash is based on the physical & chemical parameters like pozzolanic activity,material retained on 45 micron sieve.

1.3 Cement

The cement use for the experimental purpose is ordinary Portland cement (OPC) of grade 53 ultratech. Many tests are conducted in the lab , some are fineness,standard consistency, setting time, compressive strength.

1.4 Fine Aggregates

The river sand is used with coarse aggregate. Aggregates are the main constituent which take 60 to 80 percentage of volume of total concrete. The river sand is washed & screened, to eliminate deleterious impurities. It decrease the shrinkage, gives shape. Some tests are conducted on fine aggregate in the lab some are fineness modulus, specific gravity.

1.5 Coarse aggregates

Coarse aggregates from Locally available from basalt rock, confirming to the requirement of IS:383 are used. The well graded of normal size greater than 4.75 mm & less than 20 mm are used for the experimental study. Some tests are conducted on coarse aggregate in the lab, are aggregate impact value, sieve analysis.

1.6 water

Water is most important constituent for making concrete & which take part in hydration process. A potable water is safe & pure is used for the concrete mixing & curing purpose. A constant water cement ratio of 0.5 is used for design purpose.

II. OBJECTIVES

The following are the Objectives of this study,

1. To study the concept, physical & chemical properties of fly ash
2. To study the physical properties of fly ash based mortar.
3. To make the mix design for fly ash concrete.
4. To compare the most economical concrete & mortar for reducing construction cost.
5. Applying balanced score card technique for improving construction quality, customer satisfaction & reducing overall construction cost & time in useful manner for various construction.
6. To study the cost comparison for production of conventional concrete & fly ash concrete.

III. METHODOLOGY

1.1 Mix design :

Fly ash is mixed with cement as 30% & 40% in different proportions to prepare PCC of grade M10 (1:3;6) for plastering work & brick masonry. Also preparing RCC of grade M20(1:1.5:3) with fly ash 0%,10%,20%,25%,30%,35%,40%,50%.Replacing the fly ash in PCC & RCC for studying the impact on overall cost of construction. Water cement ratio is kept constant as 0.5 for both PCC & RCC.

1.2 Determination of Compressive Strength of Cube

Concrete moulds of size 150mm X 150mm X 150 mm are casted in different proportion by replacing fly ash 0%, 10%,20%,25%,30%,35%,40%,50% by weigh of cement. Also fly ash based cement mortar are prepared of grade M10 of size 70.7mmx70.7 mm x 70.7 mm mm.

For each mix three specimens are prepared. The cubes are kept for curing in curing tank. The load is applied smoothly & gradually. The crushing strength for three specimen is determined . Compressive strength of all specimen is taken at 7days, 14 days,28 days & the results are compared with that of conventional concrete.

IV. BALANCE SCORE CARD TECHNIQUE

1.1Balance score card (BSC):

Balanced Scorecard is a concept which is used to measure a company's activities in terms of its vision and strategies, by applying concept of performance management. This new approach to strategic management was developed in the early 1990s by Dr Robert Kaplan (Harvard Business School) and Dr David Norton .Performance management is systematic way to improve the goals through an ongoing process of establishing objectives. In the construction industry BSC based performance management is currently introduced with need of balanced performance evaluation. With the developing performance process in construction ,the companies can detect the deficiencies of the current performance management. Construction company conducts a number of projects at a time. In addition to that it is co related with several other construction group to participate the project completion. Knowing the lack of balanced evaluation many companies started to use BSC to check their strength & weakness.

1.2 Components of a Balanced Scorecard:

There are four main components of a Balanced Scorecard Discussed below,

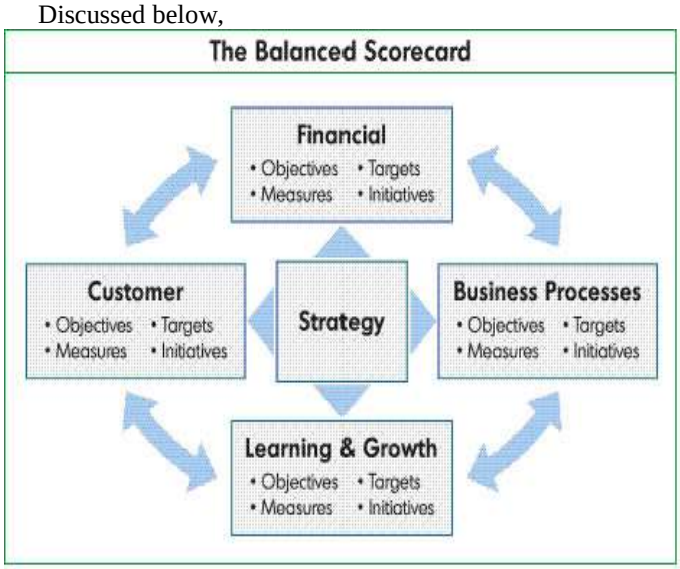


Fig.1 Components of balanced score card

a) Financial Perspective: The importance of financial considerations is highly effective in most situations. For any strategic choice, therefore, the timely and accurately presented funding data is critical and the sources of funding and budgeting must be done. Another key consideration is the prospects of sustainability of funding for the initiative required to implement the strategy.

b) Customer Perspective: This area focuses on what must be done and what's most important, from the customer's perspective, to achieve the mission. The importance of customer focus and customer satisfaction has done.

c) Internal Process Perspective: This component focuses on what an organisation must be doing well to meet the customer defined in the Customer Perspective. It also know how well their business is running and how well the internal processes are designed to meet the objectives.

d) Learning & Growth Perspective: This perspective focuses on how an organisation is improving its ability to innovate, improving techniques, organising training to employs.

V. RESULT AND DISCUSSION

Compressive strength of fly ash used PCC is checked by preparing mix 1:3 proportion cement & sand. In that replacing 0%,30% & 40% of fly ash by cement weight. Cubes of size 70.7mmx70.7 mm x 70.7 mm & three in numbers are prepared for test .

In this experimental study various properties of fresh concrete ,fly ash are determined. Here only result are discussed. 4.1 Due to addition of fly ash the Initial & Final setting Time of concrete decreases & varies between 85 minutes to 592 minutes for addition of fly ash 0% to 50%.Workability of concrete increases as the percentage of fly ash increases with constant water cement ratio. So by maintaining required slump water cement ratio can be reduced. Slump varies 155 mm to 257 mm for 0% to 50% fly ash.Compressive strength is maximum 25% fly ash which is nearly 31N/mm2 in 28 days. Brief results are discussed shown in table3.Fineness of fly ash on 45micron sieve is 17.4% & loss on ignition is 1.4% which are within limit of 34% & 5% as per IS 3812-2003 specification.

Specimen No	Setting Time (Minutes)		Slump (mm)	Compressive Strength (N/mm^2)		
	Initial	Final		7 Days	14 Days	28 Days
1	70	440	9	21.1	25.3	27.32
2	85	476	15.5	21	24.7	26
3	90	470	18.3	21.5	24.27	26.8
4	104	472	19.5	21.3	25.2	28.2
5	117	475	21	19.6	24.13	27
6	239	487	22.7	18.5	21.37	25
7	322	530	23.3	18	21.14	23.8
8	400	592	25.7	17.57	20.4	22.5

Cost analysis comparison for G+4 Building :

Sr. No	Particulars	Amount Without Fly-Ash	Amount With Fly-Ash	Saving in %	Remark
1	Total civil Work	48794003.3	46129091.7	5.462	
2	Concrete Work	17424691.65	15551335	10.751	
3	Brick Work	3576615	2785060	22.131	
4	Concrete Work+Brick Work	21001306.65	18336395	12.689	

VII. CONCLUSION

The fly ash generation is in millions of tons per year but its utilization & disposal is a big task . The percentage of use of fly ash in various ways in construction should be increased..The effective utilization of this waste product would not only minimize the disposal problem but reduce green house gas emission. It can be more effectively used in other potential areas like manufacturing of brick, pavement construction, light weight aggregates.

The fly ash improves the workability & compressive strength of concrete. The rate of strength development is depends on the water cement ratio & percentage of fly ash in concrete mix.

This experimental study concludes that by applying the BSC technique for construction ,not only the total cost of construction reduces upto 10% but there is proper utilization

of waste product. Use of fly ash in concrete is not so aware in small contractors & associated fear of safety. By replacing the fly ash in various percentage to get the required strength it is necessary to use extensive laboratory, field work.

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