

# Flex-Crete: Low Cost Concrete Using Old Vinyl Flex Banners as Partial Replacement of Coarse Aggregate – Solid Waste Management Perspective

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**ABSTRACT:** Concrete is the main construction material used all over the world. With the rapid growth in the industry, consumption of natural resources also increases. Consumption of natural resources will be a serious problem if exceeds the limits of mining. Though it is not possible to fully replace the conventional concrete ingredients, partial replacement becomes necessary at this moment. But the thing is we should confirm necessity of replacement without considerably affect the strength requirement. In this paper, we have proposed to investigate the effect of replacement of coarse aggregates with flex banner, being a man made solid waste which can pose very serious environmental problems on solid waste management perspective. As flex banners has all severe effects as plastics, it becomes essential to find out the solution for the disposal option for them. It is considered as one approach here as using them for replacing the coarse aggregate. With usual compressive strength testing of cubes for replacement of two different percentages (10 % and 20 %) the results reveals that, there is no big difference in strength of concrete when replacing 10% and we cannot go beyond in replacement than 10%, since 20% replacement leads to deficient strength achievement for concrete.

**Keywords** – Low Cost Concrete, Vinyl Flex Banners, Compressive Strength, Coarse Aggregate Replacement, Flex-crete.

## I INTRODUCTION

Concrete is a world's most widely used construction material. The utilization of concrete is increasing at a higher rate due to development in infrastructure and construction of concrete like the world.

- Researchers are in search of replacing coarse aggregate to make concrete less expensive and to lead sustainable development.
- Flex banner is a combination of PVC material and optical fiber mesh.
- It features flexibility, uniform light transmission, convenient transportation and by installation by being split and spliced. It is resistant to water, mildew, fire, UV and freezing weather as well.

## II NEED FOR PRESENT STUDY

- The rising cost of construction material is a matter of concern. The reason for increase in cost is high demand of concrete and scarcity of raw material.
- Almost all hoardings contain flex a material that damages environment and is a risk to health. The flex banners are made of poly-vinyl chloride. It causes a serious threat to the environment, as it is not bio-degradable.
- Flex cannot be re-used or recycled. Made of synthetic polymer, it has to be burnt. When burnt, they emit toxic fumes that have serious effects on health. It can cause cancer and infertility.

## III OBJECTIVES OF THE STUDY

- To get the effectiveness on compressive strength of concrete.
- To Comparison of result of different test with varying proportion of flex banner.
- To make sustainable concrete with more economical for constructions.

**IV METHODOLOGY**

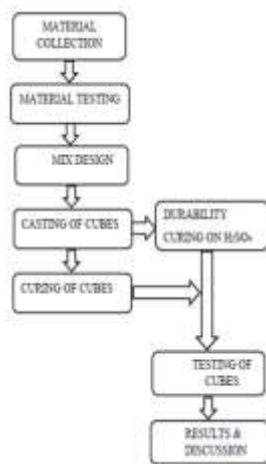


Fig 1. Methodology Flow Diagram

**A. Material Collection:**

**1) Selection of Cement:**

Type of Cement: OPC 53 Grade of Cement to IS8112

Company Name: Ultratech Cement

**2) Selection of Coarse Aggregate:**

Site Selection: Polur Quarry

Maximum Size of Aggregate: 20mm

**3) Selection of Fine Aggregate:**

Site Selection: Palar River (Karaipundi)

Confirming to Grading Zone I of Table 4 of IS383

**B. Material Testing:**

**TABLE I: Material Testing Results**

S.No	Material	Characteristics
1	Cement	Specific Gravity = 3.15
2	Fine Aggregate	Specific Gravity = 2.7 Fineness Modulus = 3.70 Bulk Density = 1.605
3	Coarse Aggregate	Specific Gravity = 2.673 Fineness Modulus = 3.56 Water Absorption = 4.3% Aggregate Impact Value = 12.096%
4	Flex Particle	1cm x 1cm to 2cm x 2cm

**C. Mix Design – M30**

**1) Strength for Mix Proportioning:**

$$f_{ck} = f_{ck} + 1.65 s$$

Where,

$f_{ck}$  = target average compressive strength at 28 days,

$f_{ck}$  = characteristic compressive strength at 28 days, and

$s$  = standard deviation.

From Table I, IS 456, standard deviation,

$$s = 5 \text{ N/mm}^2.$$

$$\text{Target strength} = 30 + 1.65 \times 5 = 38.25 \text{ N/mm}^2.$$

**2) Water-Cement Ratio:**

From Table 5 of IS456, maximum water-cement ratio = 0.45.

Based on experience, adopt water-cement ratio as 0.40.

$$0.40 < 0.45, \text{ hence O.K.}$$

**3) Calculation of Water Content:**

From Table 2, maximum water content = 186 litres (for 25 to 50mm)

$$\text{For 100 mm slump} = 186 + (186 \times 6 / 100) = 197.16 \text{ litres}$$

**4) Calculation of Cement Content:**

$$\text{Water-cement ratio} = 0.4$$

$$\begin{aligned} \text{Cement content} &= 197.16 / 0.45 \\ &= 438.13 \text{ kg/m}^3. \end{aligned}$$

<450, hence o.k.

**5) Mix Proportion**

$$\text{Cement} = 438.13 \text{ kg/m}^3$$

$$\text{Fine aggregate} = 739.454 \text{ kg/m}^3$$

$$\text{Coarse aggregate} = 1083.30 \text{ kg/m}^3$$

$$\text{Water-cement ratio} = 0.45$$

**6) Final Mix Design Ratio: M30**

Mix Design Ratio M30: 1:1.68:2.47

$$C : F.A : C.A$$

$$1.478 \text{ kg} : 2.478 \text{ kg} : 4.1496 \text{ kg}$$

**TABLE II: Mix Proportion for Casting**

% Repla ceme nt	Cement (Kg)	Fine Aggregate (Kg)	Coarse Aggregate (Kg)
0	1.478	2.483	4.1496
10	1.478	2.483	3.7346
20	1.478	2.483	3.3260

**D. Preparation of Specimen:**

**1) Concrete Mix Design:**

M30 grade of concrete was designed by IS 10262-2009 method. The natural coarse aggregate were replaced as 0%, 10%, 20% with flex banner particles. The test results are analyzed and compared with conventional concrete.

**2) Batching and Mixing:**

Weight Batching was practiced with the help of electronic weighing balance. Batching was done as per mix proportions. Mixing was done manually.

**3) Placing and Compaction:**

Cubes are cleaned and oiled to prevent the formation of bond between concrete and moulds. Place the fresh concrete in cubes in three layers, tamping each layer 25 times. The entrapped air in concrete is removed by table vibrator.

**4) Demoulding:**

After placing fresh concrete in moulds, it was allowed to set for 24 hours. It was marked with some permanent identification mark. Concrete cubes are then kept in curing tank for 28 days. After 28 days, concrete cubes were taken from curing tank to conduct tests on hardened concrete.



Fig 2. Cube (Flex particles added) Testing



Fig 3. Crack Formation during Cube Testing

**E. Schedule of Cube Casting & Testing:**

**TABLE III: Schedule of Cube Casting & Testing**

S.No		Moulding Date	Testing Date		
Mix Proportion		-	Normal Concrete	10% Replacing	20% Replacing
Curing Dates	7 Days	21/3/15	27/3/15	27/3/15	27/3/15
	14 Days	13/3/15	27/3/15	27/3/15	27/3/15
	21 Days	6/2/15	27/2/15	27/2/15	27/2/15
	28 Days	15/3/15	12/4/15	12/4/15	12/4/15

**V RESULTS & DISCUSSIONS**

**A. Results:**

**TABLE IV: Results on Compressive Strength**

S.No	% Replacement of Flex	Compressive Strength (N/mm <sup>2</sup> )			
		7 Days	14 Days	21 Days	28 Days
1	0%	16.88	20	38.22	40
2	10%	16	18.66	32	35
3	20%	7.55	12.44	20.44	21

**TABLE V: Results on Durability Testing**

% \ Days	0 <sup>th</sup> Day (N/mm <sup>2</sup> )	3 <sup>rd</sup> Day (N/mm <sup>2</sup> )	7 <sup>th</sup> Day (N/mm <sup>2</sup> )
0	8.388	8.385	8.378
10	8.130	8.140	8.150

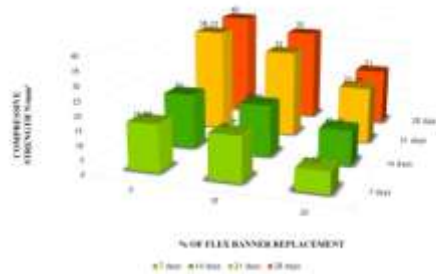


Fig 4. Graphical Representation of Compressive Strength Results based on % of Coarse Aggregate Replacement with Flex

**B. Discussions:**

From the test results given above, we can infer that:

- The compressive strength of concrete replaced with flex banners is nearly same as that of the normal concrete. And this implies that we can use the replaced concrete for minor structural constructions.
- Also it is obvious that, by using the replaced concrete we can reduce the cost of the concrete very much.
- The consumption of natural resources can be minimized.
- A meaningful solid waste management method can be achieved by this process, thus the problem of disposal of wastages like flex banners in metropolitan cities can very much be handled more economically and effectively.

**VI SCOPE FOR FUTURE WORK**

- Flex banners waste can be effectively replaced (Partially) with fine aggregates which would give an economical and as well as environmental health benefits.

- If Fine aggregate replacement gives a positive results, the research would become more significant. Because, river sand exploitation is a threatening issue in current scenario.
- Minor Prefabricated structural components can be prepared with those flex-crete.

**VII SUMMARY & CONCLUSION**

Flex banners are the unavoidable canvassing tool of today’s modern technology. They cannot be totally altered with any kind of similar tool. But, same time they can be effectively reused and recycled as discussed in this paper. And many more untold possibilities of reuse and recycle of such flex are there. Those have to be explored by consecutive research efforts. By doing so, we can minimize the growing threat of plastic pollution on sustainability and environmental health.

**REFERENCE**

[1] IS 10262 – 1982: Recommended guide lines for concrete mix design, Indian standard institution, New Delhi.  
 [2] Gunasekaran. K et al, “Mechanical and bond properties of coconut shell concrete” (2011), construction and building materials 25 92-98. 9.  
 [3] K.Gunasekaran, P.S.Kumar, - “Lightweight concrete mix design using coconut shell aggregate” Proceedings of International Conference on Advances in Concrete and Construction, ICACC- 2008 ,7-9 February, 2008, Hyderabad, India pp. 450-459.  
 [4] Saravanan J, Sridhar M, Vinitha Judith J, “Effective Utilization Used Vinyl Flex Banners – A Solid Waste Management Perspective” International Journal of Applied Engineering Research, ISSN 0973-4562 Vol 10.No 38 (2015)  
 [5] Saravanan J, Sridhar M “Construction Technology, Challenges and Possibilities of Low-Carbon Buildings in India”. SSRG International Journal of Civil Engineering (SSRG-IJCE), 6-11 November 2015. ISSN: 2348-8352. www.internationaljournalssrg.org/IJCE/index.html Published by Seventh Sense Research Group  
 [6] Effective Utilization of Waste Plastic in construction of Flexible Pavements for improving their performance. IOSR International Journal of Civil and Mechanical Engineering.2005  
 [7] Municipal Solid Waste Management in Chennai City, India. Eleventh International Waste Management and Landfill Symposium. 2007.