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Self-Compacting Concrete using Flyash and Recycled Asphalt Pavement

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Abstract - *The decline in the availability of skilled in the construction industry led to a need for a concrete that could overcome the problems of poor workmanship. This led to the development of self-compacting concrete. Self-compacting concrete (SCC) can be considered as an advance type of concrete that can flow under its own mass with different geometric configurations even in the presence of dense reinforcement without the need of vibration while maintaining the homogeneity. SCC generally possesses high powder content which keeps the concrete cohesive with high flow ability. A substantial part of the powder could contain fillers like fly ash.*

Key Words: **Self-compacting concrete (SCC), Recycled Asphalt Pavement (RAP), Recycled Asphalt Aggregates (RAA), Fly ash, Concrete**

1. INTRODUCTION

Concrete is one of the most widely used construction materials. It is usually associated with Portland cement as the main component for making concrete. The demand for concrete as a construction material is on an increase. Often, additives and reinforcements are included in the mixture to achieve the desired physical properties of the finished material. When these ingredients are mixed together, they form a fluid mass that is easily moulded into shape. Over time, the cement forms a hard matrix which binds the rest of ingredients together into a durable stone-like material with many uses. With time there has been many developments in the field of concrete technology out of which Self-Compacting Concrete is one. Today's concrete research and practice have shown that material selection and mix design of concrete can be tailored to provide a good compaction without the need for vibration. This approach is based on the principles of self-compacting concrete (SCC) widely used in precast and cast-in-place construction. SCC has generated tremendous industrial interest since its initial introduction in Japan in 1990.

In most third world countries where technological development is still growing some regions especially large urban areas already have a problem in obtaining adequate aggregate supplies at reasonable cost. At the same time, increasing quantities of demolished asphalt pavement materials from road reconstruction projects are generated as a waste material close to these areas. These waste asphalt pavement materials are usually used as sub base material during reconstruction process or as embankment's filler material which does not represent the most suitable use for the Recycled Asphalt Pavements (RAP). In recent developments it has been observed that partial replacement of coarse aggregate can be done using RAP.

2. MATERIAL USED

The materials used in SCC are cement, fly ash, fine aggregate, coarse aggregate, RAP, sikament and water.

RAP consists of high-quality, well-graded aggregates coated by asphalt cement.

3. EXPERIMENTAL STUDIES

In this experiment, 4 different samples of SCC were prepared at different percentage by volume of coarse aggregates. The concrete was designed for M30 mix design as per the IS 10262: 2009. The cube specimen of size 15x15x15 cm were prepared at 0%, 15%, 30%, 50% of RAP (by volume of coarse aggregates). After 7, 14 and 28 days of curing, they were tested for compressive strength in CTM machine. The following are the proportions of the material used for M30 concrete design:

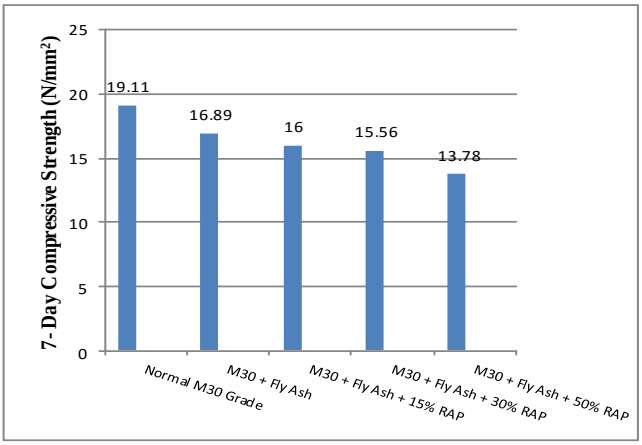
Table -1: Quantity of material for 3 cubes

S.No	Materials	Units	0%	15%	30%	50%
1	Cement	Kg	2.145			
2	Fly Ash	Kg	2.145			
3	Fine Agg	Kg	7.641			
4	Coarse Agg	Kg	9.684			
	20mm		5.811	4.939	4.068	2.906
	10mm		3.873	3.292	2.711	1.936
5	RAP	Kg	---			
	20mm		0	0.872	1.743	2.906
	10mm		0	0.581	1.162	1.936
6	Water	L	1.931			
7	Sikament	g	51.435			

4. RESULTS

Table No. 2: 7 – Day Compressive Strength

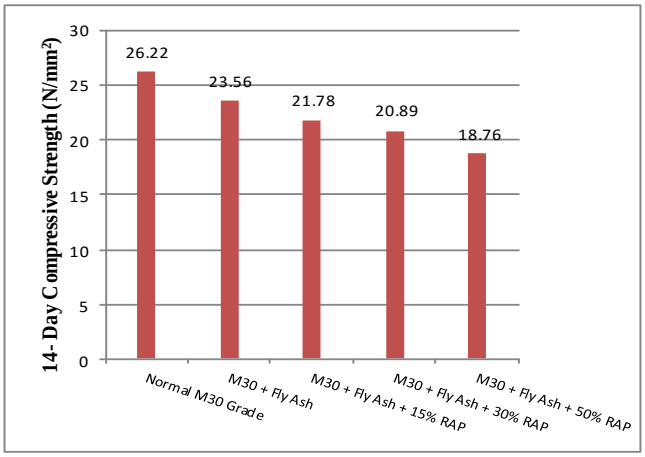
S.No.	Description	Load At Failure (KN)	Compressive Strength (N/mm²)
1	Normal M30 Grade	430	19.11
2	M30 + Fly Ash	380	16.89
3	M30 + Fly Ash + 15% RAP	360	16
4	M30 + Fly Ash + 30% RAP	350	15.56
5	M30 + Fly Ash + 50% RAP	310	13.78



Graph 1: 7-Day Compressive Strength

Table No. 3: 14 – Day Compressive Strength

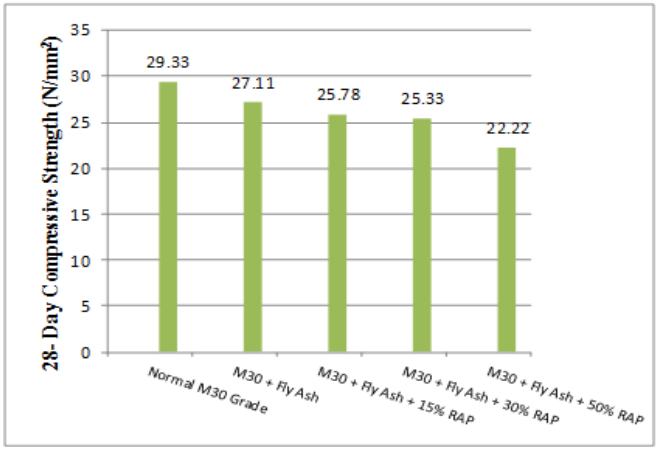
S.No.	Description	Load At Failure (KN)	Compressive Strength (N/mm²)
1	Normal M30 Grade	590	26.22
2	M30 + Fly Ash	530	23.56
3	M30 + Fly Ash + 15% RAP	490	21.78
4	M30 + Fly Ash + 30% RAP	470	20.89
5	M30 + Fly Ash + 50% RAP	420	18.67



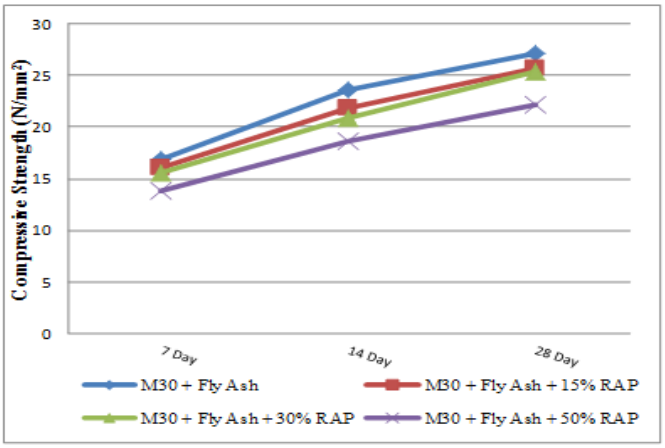
Graph 2: 14-Day Compressive Strength

Table No. 4: 28 – Day Compressive Strength

S. No.	Description	Load At Failure (KN)	Compressive Strength (N/mm²)
1	Normal M30 Grade	660	29.33
2	M30 + Fly Ash	610	27.11
3	M30 + Fly Ash + 15% RAP	580	25.78
4	M30 + Fly Ash + 30% RAP	570	25.33
5	M30 + Fly Ash + 50% RAP	500	22.22



Graph 3: 28-Day Compressive Strength



Graph 4: Compressive Strength of the samples

5. CONCLUSIONS

- It was observed that the compressive strength of the samples decreased with the increase in the percentage of the recycled asphalt pavement aggregates and maximum amount that can be replaced was found out to be 30% for obtaining an adequate strength.
- Addition of fly ash resulted in the decrease of the strength of concrete but helped in providing added workability to the concrete mix. This further helped in the formation of self-compacting concrete.
- After replacing various percentages of virgin aggregates by RAP it was observed that the 28 day strength of the concrete remained above 25MPa for up to 30% replacement.
- Replacing virgin aggregates with RAP as well as partial replacement of cement with a cementitious material i.e. fly ash provided an eco-friendly method of their disposal thus reducing the load on the landfills. It also reduces the demand for virgin aggregates thus saving the environment and some money.

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