IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684, p-ISSN: 2320-334X
PP 01-07
www.iosrjournals.org

DEVELOPMENT OF INNOVATIVE BUILDING BLOCKS (TNSCST- SPONSORED RESEARCH PROJECT)

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ABSTRACT : *The compressive and tensile strengths of lightweight concrete (LWC) of density 1700 kg/m^3 to 1800 kg/m^3 with different aluminium powder content were investigated using cube and cylinder specimens. Based on an earlier investigation of the first two authors, cement to combined aggregate ratios of 1:6, 1:8, and 1:10 have been selected. Both sand and quarry dust have been tried as fine aggregate. Aluminium powder was added at 0.2% to 0.8% by weight of cement. For that the ultimate strength of LWC is of the range between 3N/mm^2 – 10.5N/mm^2 for different aluminium powder content. Addition of more than 0.2% of aluminium powder reduces the compressive strength drastically.*

Keywords - *Aluminium powder, Fly ash, Lightweight concrete, water/cement ratio.*

I. INTRODUCTION

1.1 Light weight concrete:

Lightweight concrete can be defined as a type of concrete which includes an expanding agent in it that increases the volume of the mixture while reducing the dead weight. It is lighter than the conventional concrete with a dry density of 300 kg/m^3 to 1840 kg/m^3.The main specialties of lightweight concrete are its low density and low thermal conductivity. There are many types of lightweight concrete which can be produced either by using lightweight aggregate or by using an air entraining agent. In this project, aluminium powder has been used as an air entraining agent of concrete. The fine powder of Aluminium to the slurry reacts with the calcium hydroxide producing hydrogen gas. This hydrogen gas in the slurry mix gives the cellular structure and makes the concrete lighter than the conventional concrete.

1.2 Objective and Scope:

The objective of this investigation is to develop the most economical light weight concrete building blocks with satisfactory amount of compressive strength.

II. MATERIALS

All the materials used in this research work were tested as per relevant Indian standards.

2.1 Cement:

Cement is the most important ingredient of concrete which acts as a binding agent between the aggregates and enhances the strength. In this investigation Ordinary Portland Cement (OPC) is used.

2.2 Fine Aggregate:

In this investigation two types of fine aggregates, namely river sand and quarry dust were used.

2.3 Coarse Aggregate:

The coarse aggregate is the strongest and least porous component of concrete. As per requirements of IS 383- 1970, angular coarse aggregate of maximum size 6mm was used in this investigation.

2.4 Aluminium Powder:

The aluminium powder of grade con-85 was used in this project. It had a density of 0.55 g/cc. The aluminium powder confirmed to IS: 438 – 2006 and ASTM B 212 – 99.

2.5 Fly ash:

In this investigation Class C fly ash was used. Class C fly ash normally comes from coals which may produce an ash with higher lime content – generally more than 15 % often as high as 30%.

III. OBSERVATIONS

3.1 Mix proportions adopted:

The economical mixes found by an earlier investigation by the authors Dr.N.Arunachalam and Mr.V.Mahesh, are given below and adopted in this research work.

Table 3.1 Mix Proportions

S.NO.	MIX PROPORTIONS	WATER/CEMENT RATIO
1	Mix 1:6, 55%QD* + 45% CA*	0.65
2	Mix 1:8, 60 %QD* + 40% CA*	0.45
3	Mix 1:10, 55%QD* + 45% CA*	0.55
4	Mix 1:6, 55% FA* + 45% CA* (20% fly ash)	0.50
5	Mix 1:8, 50% FA* + 50% CA*	0.50
6	Mix 1:10, 50%FA* + 50% CA*	0.50

**QD-Quarry dust, *CA-Coarse aggregate, *FA-Fine aggregate (river sand).*

3.2 Casting of Specimens:

The cubes of size 150mm X 150mm X 150 mm and cylinders of 150 mm diameter were cast. The concrete was compacted in three layers by using vibrator on each layer. The use of aluminium powder caused the expansion of concrete which led to irregular shapes and dimensions. The expanded layers were cut to form the required shape and size.

Fig 3.1 Expansion of concrete.

IV. RESULTS AND DISCUSSIONS

In this investigation, **t**he strength related tests were carried out on hardened cement concrete at the age of 7 days and 28 days. These results are tabulated and compared.

Table 4.1 Compressive Strength for Specimens Made Of Quarry Dust

S.NO	MIX PROPORTIONS	WATER/CEMENT RATIO	ALUMINIUM POWDER %	ULTIMATE STRENGTH N/mm^2	
				7-DAYS	28-DAYS
1	1:6	0.65	0	19.69	28.48
			0.2	6.23	6.72
			0.4	4.45	4.96
			0.6	3.38	4.62
			0.8	2.61	3.32
2	1:8	0.45	0	16.86	20.24
			0.2	5.56	5.94
			0.4	4.36	4.36
			0.6	2.90	4.08
			0.8	2.05	3.28
3	1:10	0.55	0	15.40	19.21
			0.2	5.12	5.53
			0.4	3.77	4.04
			0.6	2.62	4.07
			0.8	2.03	3.09

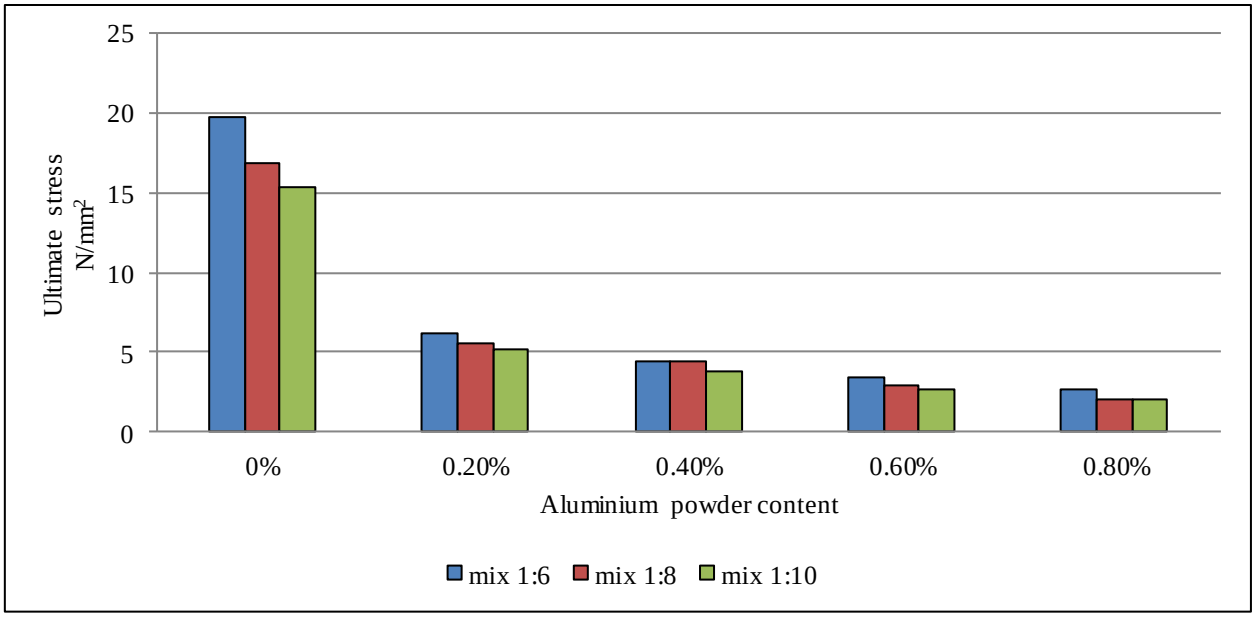

Fig 4.1 Strength Comparison of Specimens for 7-Days (Quarry Dust)

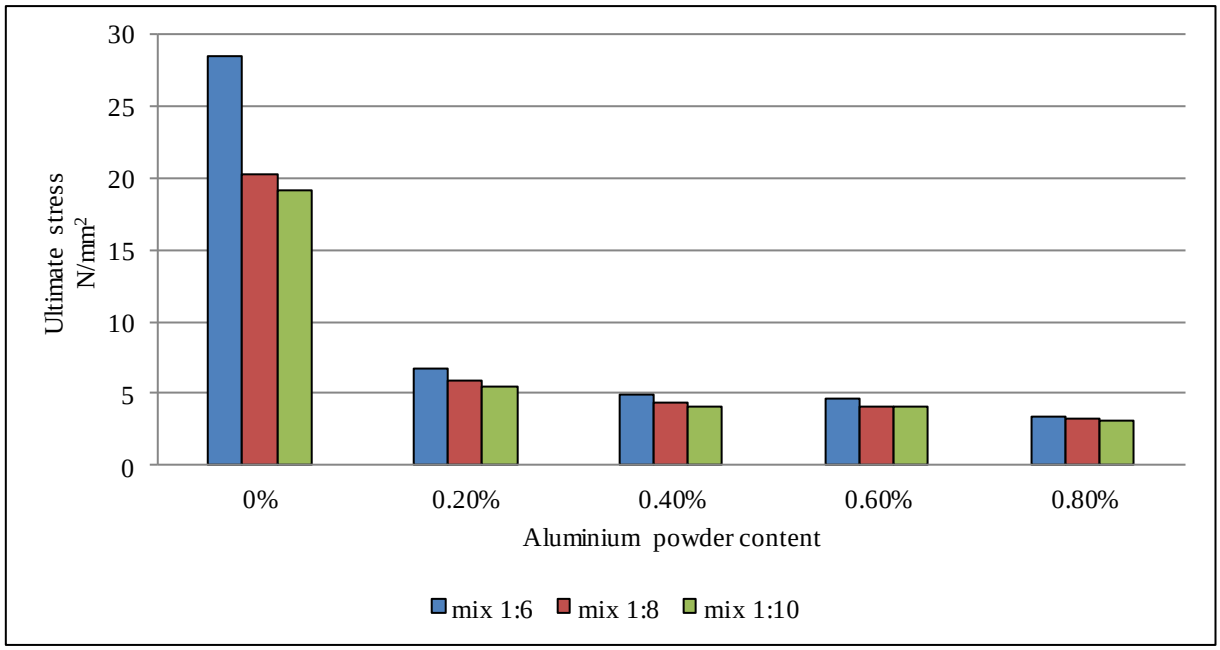

Fig 4.2 Strength Comparison of Specimens for 28-Days (Quarry Dust)

Table 4.2 Compressive Strength for Specimens Made Of Sand

S.NO	MIX PROPORTIONS	WATER/CEMENT RATIO	ALUMINIUM POWDER %	ULTIMATE STRENGTH N/mm^2	
				7-DAYS	28-DAYS
1	1:6	0.50	0	21.02	24.05
			0.2	8.72	10.92
			0.4	4.07	4.54
			0.6	3.49	3.51
			0.8	3.04	3.22
2	1:8	0.50	0	20.93	21.41
			0.2	6.67	9.27
			0.4	3.93	3.27
			0.6	3.31	3.55
			0.8	2.88	3.19
3	1:10	0.50	0	18.45	19.02
			0.2	6.20	8.72
			0.4	4.10	3.36
			0.6	3.58	3.33
			0.8	3.09	3.32

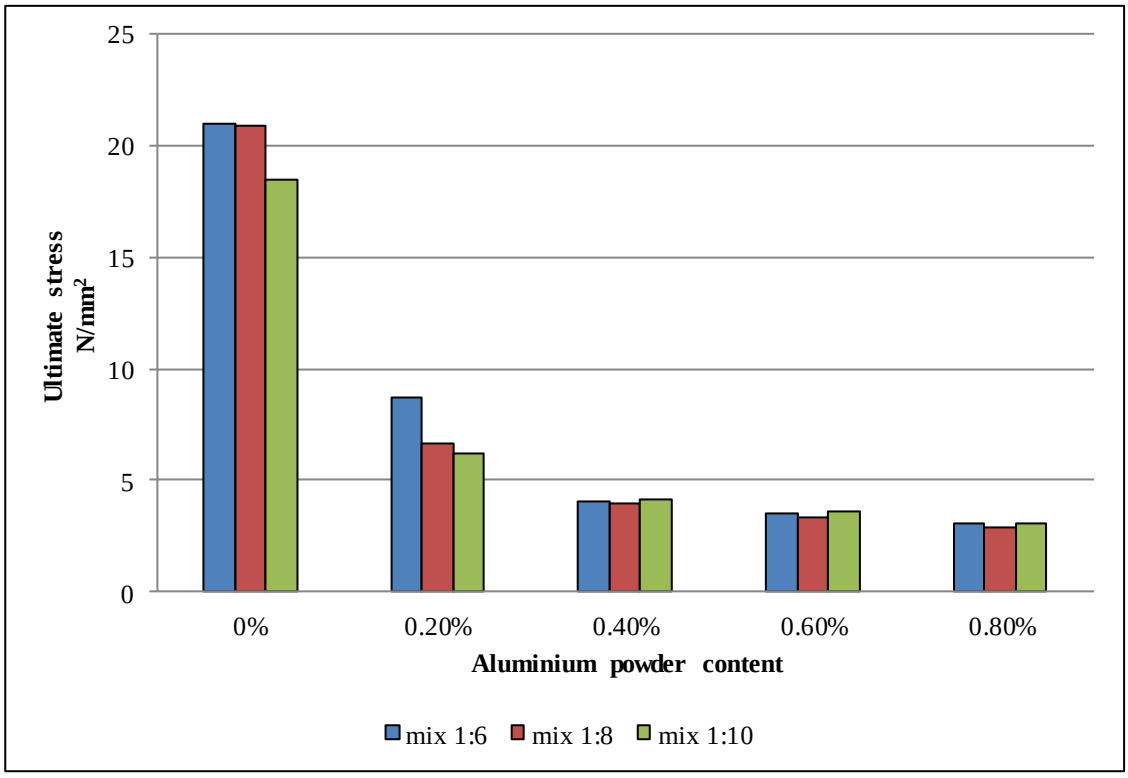

Fig 4.3Strength Comparison of Specimens for 7-Days (Sand)

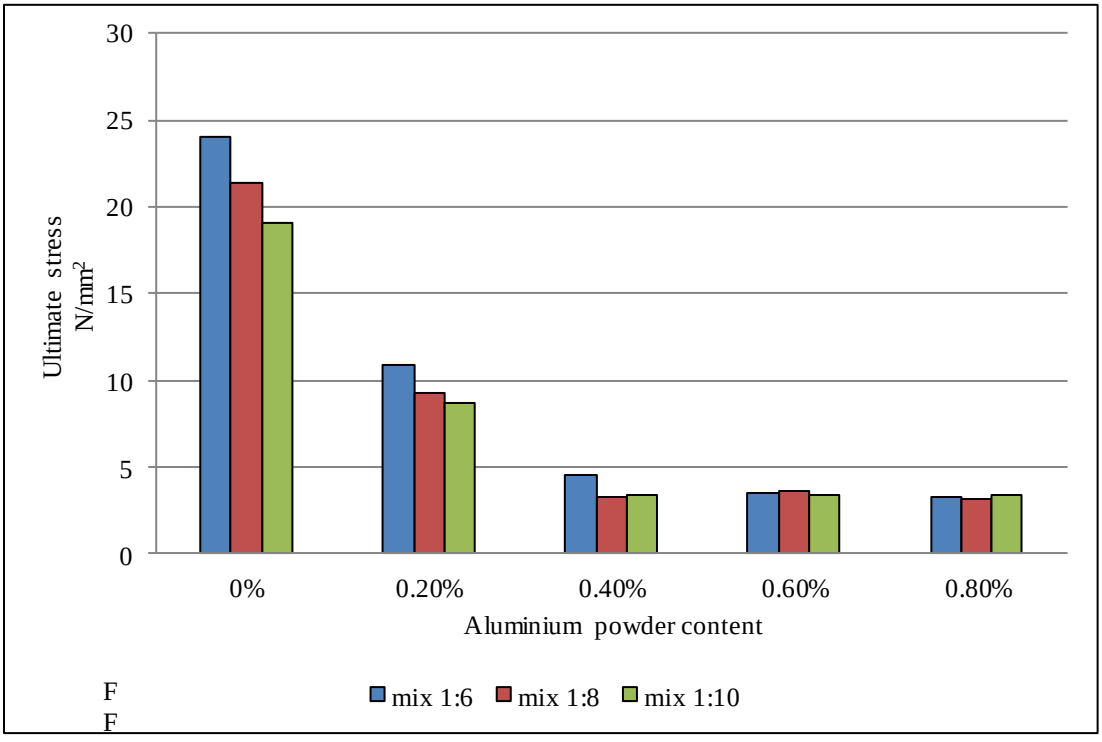

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Fig 4.4 Strength Comparison of Specimens for 28-Days (Sand)

V. CONCLUSION

The following could be concluded from the test results obtained in this investigation.

- 1:6 mix proportions gives more compressive strength than the other two mix proportions in both the cases with quarry dust and sand.
- Compressive strength decreases as aluminium powder is increased.
- The use of aluminium powder decreases the dead weight and the strength of the concrete as compared to normal concrete.
- The ultimate strength of LWC is of the range between $3N/mm^2 – 10.5N/mm^2$ for sand mixes and $3N/mm^2 – 7N/mm^2$ for quarry dust mixes with different aluminium content.
- Compared with quarry dust mixes, sand mixes gives more strength.

4.1 Critical Observations:

Even 3 days after curing of specimens was stopped, large amount of moisture was present inside the specimens as revealed by the broken pieces after the test.

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