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ESTABLISHMENT OF AGE VS STRENGTH CURVE FOR SET OF MATERIALS

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ABSTRACT
This study was directed toward performance of concrete under varying water to cementitious materials ratio. The influence of constituent materials and various mix proportions on compressive strength of concretewas studied experimentally and reported. At each water/cement ratio varied from 0.25 to 0.55 at constant increment of 0.05. For all the concrete mixes, the compressive strength of concrete was determined at ages of 1, 3, 7, 28, 90 and 180 days. The experiment was carried out at the same ambient temperature and the compressive strengths of concrete mixes were found to increase with age but decrease as water-cement ratio increases. From the experimental test results, it was observed that the important parameter affecting the strength of concrete is the water/cement ratio and Abrams' generalization law is applicable to concrete in compression for our set of materials. Graphical model is proposed to predict the compressive strength of concrete using Water/Cement ratio.

KEYWORDS: Abrams' law; Water/cement ratio; Concrete mixes; Mortar; Compressive strength; Workability

INTRODUCTION

A. OBJECTIVE OF PAPER

- To gauge performance of concrete for different w/c ratio on basis of Abram's law
- To achieve optimal content of concrete.
- To gauge performance of same set of materials of different water/cement ratio and subsequently different cement content.

B.ABRAM'S LAW

Abram's water/cement ratio law states that **"the strength of concrete is only dependent upon water /cement ratio provided the mix is workable"**. In the past many theories have been propounded by many research workers. Some of them valid for some time then underwent some changes while others did not stand the test of time and hence slowly disappeared, but Abram's water/cement ratio law stood the test of time and held valid even today as a fundamental truth in concrete-making practise. No doubt some modifications have been suggested but the truth of the statement could not be challenged.

C. SCOPE OF PAPER

- With the heterogeneous nature of concrete it is very difficult to predict the performance of concrete. To make this task simpler for site engineer we have developed w/c ratio vs. strength curve, which will help site engineer or designer to predict the performance of concrete for given set of material
- We can also develop curves for different set of materials
- Thus we can design different grades of concrete for given set of materials
- Also for intermediate quality of material, we can predict the desired strength of that material on the basis of these two curves.

METHODOLOGY

A.2 Sets of Concrete:

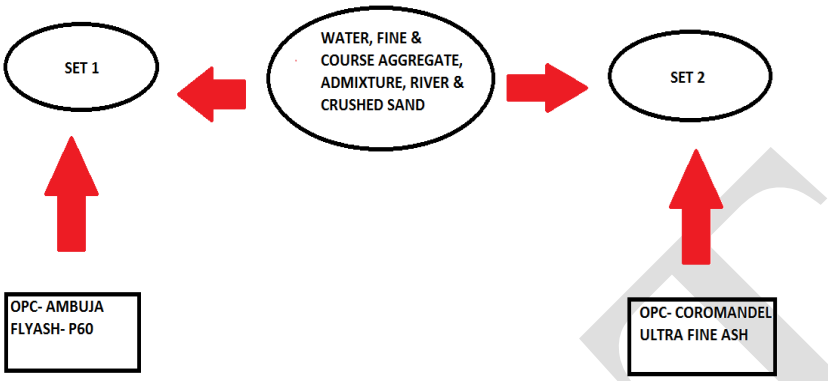


Fig.1 each set consist of materials

B. SPECIFIC GRAVITY OF MATERIALS

Table 1. Specific Gravity of Materials

Material	Specific Gravity
River Sand (R Sand)	2.62
Crushed Sand (C Sand)	2.93
10 mm Aggregate	2.97
20 mm Aggregate	2.95

C.COMBINED SIEVE ANALYSIS

Table 2. Combined Particle Size Distribution

Sieve Size	Percentage Passing			
	R.Sand	C. Sand	10 mm	20 mm
40 mm	100	100	100	100
25 mm	100	100	100	100
20 mm	100	100	100	91.74
12.5 mm	100	100	98.45	4.9
10 mm	100	100	88.92	0.49
4.75 mm	100	99.41	2.25	0
2.36 mm	84.9	88.15	0.35	0
1.18 mm	51.2	54.23	0	0
600 mcr.	27.8	27.47	0	0
300 mcr.	19.3	18.68	0	0
150 mcr.	12.9	12.04	0	0
75 mcr.	0.2	7.68	0	0
Pan	0	0	0	0

CONCEPT OF MIX DESIGN

Mix design can be defined as the process of selecting ingredients of concrete and determining their relative proportions with the object of producing concrete of certain minimum strength and durability as economically as possible. Cost wise all concretes depends primarily on two factors; namely cost of materials and cost of labour; labour cost is nearly same for good concrete and poor concrete. Therefore, attention is mainly directed to the cost of materials. Since the cost of cement is many times more than the cost of other ingredients, thus attention is mainly directed to the use of as less amount of cement, provided that strength and durability do not get affected.

A. MIX DESIGN- DOE METHOD

The DOE method was first published in 1975 and revised in 1988. The method uses the relationship between water cement ratio and compressive strength of concrete depending on the type of cement and the type of aggregate used. The water contents required to give various levels of workability, namely, very low, low, medium and high are determined

B. MIX PROPORTIONS:(ALL QUANTITIES IN KG)

Table 3. SET 1 Mix Proportion

Sr No	W/C	Water	Admixture	Slump (mm)	Ambuja OPC (53 grade)	P60 Fly Ash	R.Sand	C.Sand	20 mm Aggregate	10 mm Aggregate
1	0.55	150	3.5	140	206	69	534	534	694	463
2	0.50	150	3.6	150	225	75	528	528	686	458
3	0.45	150	3.99	155	250	83	520	520	676	451
4	0.40	150	4.5	155	281	94	510	510	663	442
5	0.35	150	5.16	170	323	107	497	497	646	430
6	0.30	150	3	70	375	125	480	480	624	416
7	0.25	150	3.6	160	450	150	456	456	593	395

Table 4. SET 2 Mix Proportion

Sr No	W/C	Water	Admixture	Slump (mm)	OPC Coromandel King (53 grade)	Ultra fine Fly Ash	R.Sand	C.Sand	20mm Aggregate	10mm Aggregate
1	0.5	150	3.6	100	225	75	528	528	686	458
2	0.4	150	4.5	160	281	94	510	510	663	442
3	0.3	150	3	160	375	125	480	480	624	416
4	0.25	150	3.6	200	450	150	456	456	593	395

TEST RESULTS AND GRAPH

A.TEST RESULTS

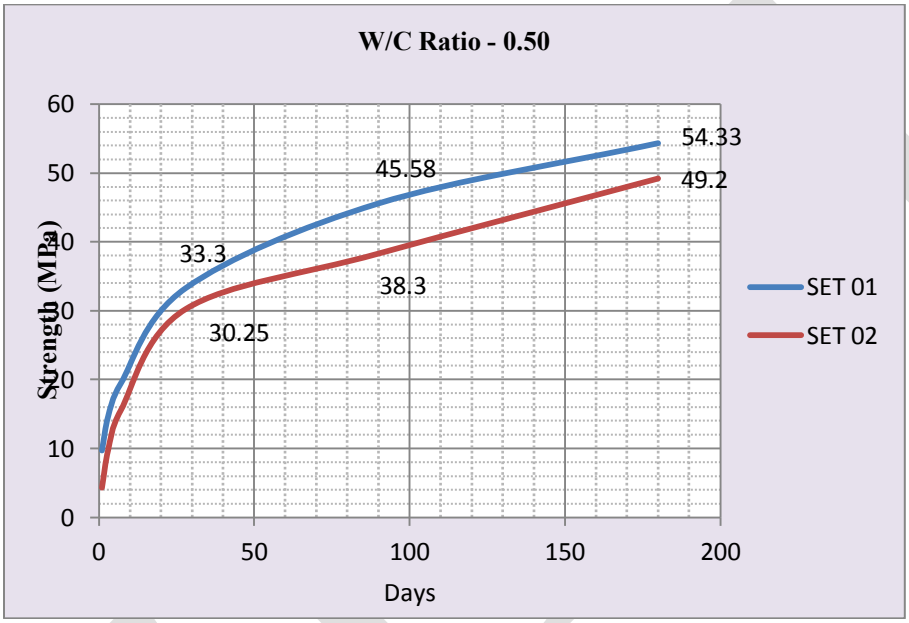
Table 5. Set 1 Strength (MPa) at day

W/C	Day 01	Days 03	Days 07	Days 28	Days 90	Days 180
0.25	33.5	62.75	75.2	99.8	118.2	118
0.30	27	45.39	60.36	79.25	102.8	109
0.35	15.4	32.29	37.03	62.33	83.74	87.6
0.40	10.9	20.8	29.7	47.59	64.37	73.5
0.45	9.3	16.4	21.53	37.2	55.95	60
0.50	9.7	14.68	19.39	33.3	45.58	54.3
0.55	8.8	12.9	17	28.9	40.12	46.4

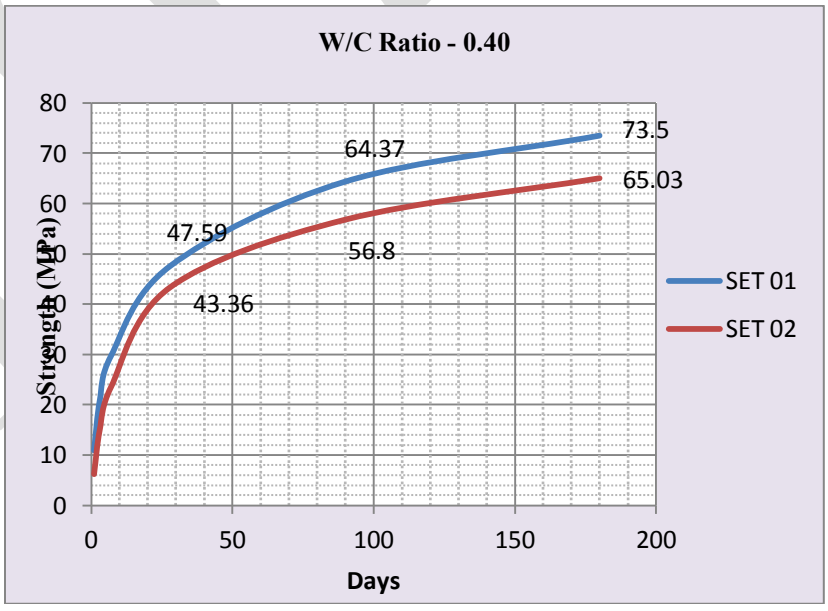
Table 6. Set 2 Strength (MPa) at day

W/C	Day 01	Days 03	Days 07	Days 28	Days 90	Days 180
0.25	13.5	41.88	61.4	94.25	102.1	102
0.3	13.1	35.59	53.49	76.56	89.09	102
0.4	6.2	14.96	23.5	43.36	56.8	65
0.5	4.3	9.79	15.48	30.25	38.3	49.2

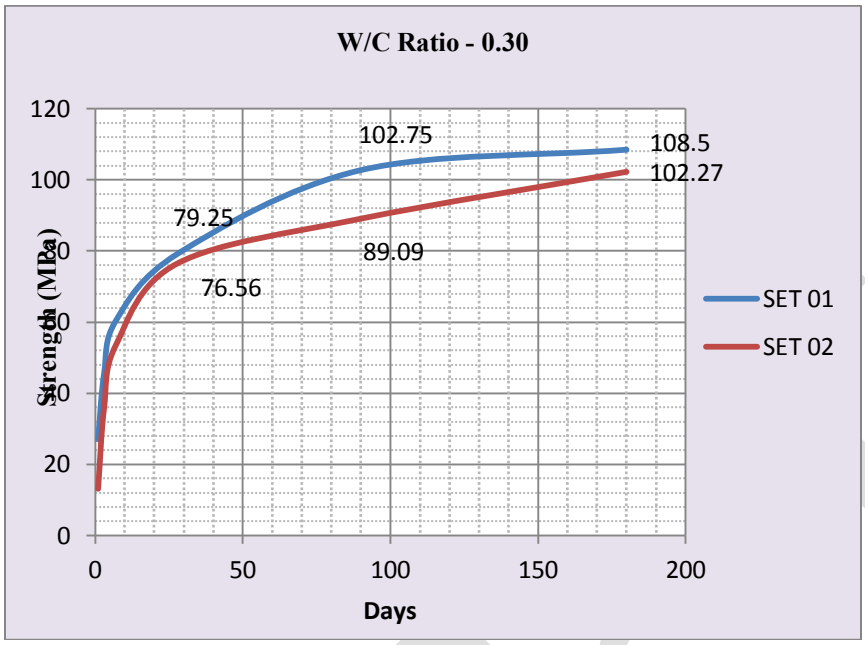
B.AGE VS STRENGTH CURVES AS FOLLOWS:



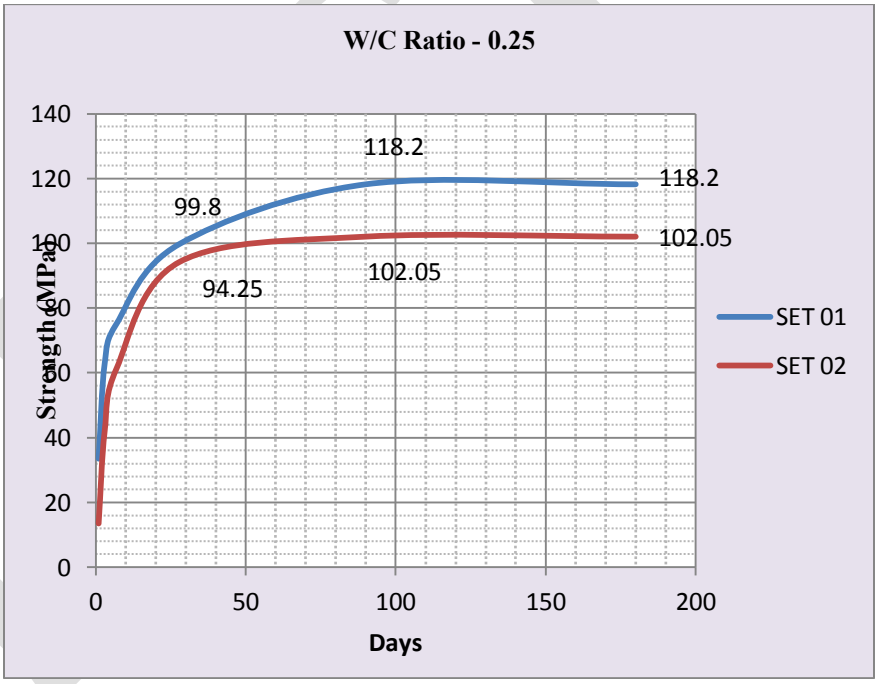
Graph 1 – Age VS Strength for W/C Ratio = 0.50



Graph 2 – Age VS Strength for W/C Ratio = 0.40



Graph 3 – Age VS Strength for W/C Ratio = 0.30



Graph 4 – Age VS Strength for W/C Ratio = 0.25

C.AGE V/S STRENGTH CURVE DISCUSSION

- Initially, there is exponential increase in strength up to 28 days and then, there is stable increment of strength.
- For an intermediate quality of materials, we can compare with our standard curve and can estimate the desired strength of concrete mix.

CONCLUSION

From the above results and graphs, we can conclude that;

- We conclude that water/cement ratio plays very important role in concrete.
- As the water in cement paste reduces, Strength increases, as result we can get higher strength of concrete for low water content.
- If the desired strength of any concrete is below to our lower curve then, we can design it as per lower curve quality material so that, it can give strength more than our requirement.
- If the desired strength of concrete mix is in between to our curves, then we can also design it for upper curve.
- Abram's law holds well for given set of material.
- Optimization of concrete can be done by these standard curves.
- Presence of fly ash increases strength after 28 days.

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