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Use of Selfing and Crossing Theory for Strength Alteration of Blended Mix

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ABSTRACT:- A building waste is made up of materials such as concrete and mortar damaged for various masons during construction work. Observational examination has displayed that this can be as high as 5 to 10% of the ingredients that go into a structure a much greater % than the 2.5-5% ordinarily expected by quantity surveyors and the construction industry. Since, significant changeability occurs between construction places, there is more chance for decreasing this waste and by recycling the material natural resources and the environmental balance can be preserved and economy will be grown.

The study aims for identifying such a time lag after that the required target strength may be achieved even after delay in casting. To identify the meeting planes of two interface layers which has lesser effect on compressive strength. Use of bonding agent for improvement in compressive strength of partially set concrete and study of blending of different mixes by selfing and crossing concept, accordingly saving ofmaterials.

INTRODUCTION

Selfing is a word credited to the blending of 2 different individual mixes of the similar mix type but of different r and t values into a single composite mass, which henceforth be called as the selfed mass, and the corresponding strength of which be termed as selfed strength.

Crossing, on the other hand, is the generalized version of selfing, where the two mixes in blending are of different types, and the corresponding terms are crossed mass and crossed strength. Selfing is a term credited to the blending(coming together) of 2 mixes, one being relatively old and the other being relatively fresh, of known strengths, each at their corresponding time lags, in certain proportion. If the two mixes in blending are of the same mix type, they are in Selfing, Otherwise, they are in Crossing.

The blending of two different mixes of the similar mix type but of different *r* and *t* values into a single composite mass w hich is called as selfed mass and the corresponding strength of which be termed as selfed strength. When the blending, of two mixes are of different types and the corresponding terms are crossed mass and crossed strength.

Absolute Setting -It is the blending of two partially set mixes of the similar mix type, at a certain blend ratio done at a certain time lag when each of the constituters fixes in turn is blended composite mix with certain identical blend ratio.

Problem Statement:

Use of Selfing and Crossing Theory for Strength Alteration of Blended mix – If Concrete is not cast immediately after mixing, but is cast after some time is called as partially set concrete. As this concrete is cast after some duration there is loss of fresh as well as hardened properties of concrete viz. workability and strength. Therefore, to identify the blending ratio and time lag up to which concrete is workable and attains target strength.

Blending of different mixes for achieving the economy in construction to avoid the wastage in construction material as the raw material is to be saved for proper environmental balance whose extraction has greater effect on environmental and ecology.

METHODOLOGY:

The investigation is carried on the behavior of concrete when the delayed concrete is mixed with fresh concrete here we used M20, M30, M20(old) + M20(new) and M20(old) + M30(new) strength variation by use of SBR Latex in proportion (1:1) in reference with (cement : bonding agent) as the bonding agent.

METHODOLOGY

FLOW CHART OF WORK:

The entire investigation and experimental work was carried out form identification of problems up to the result and discussion for problem. The following chart gives the detail work carried out with the sequence of the activities from starting to the end of investigation.

Experimental Investigation

Initial Test on Materials:

The initial tests on the raw material used for the investigation was done firstly. The raw material selected, tested and used for the investigation was confirming as the relevant and respective IS codes and IS specifications.

MIX DESIGN: IS 10262:2009

A) M20 -

1. Following preliminary data has been considered for mix design.

2. 20N/mm^2 is the characteristics compressive strength essential in the site at 28 days

3. Maximum size of aggregate: 20mm (Angular).

4. Degree of workability: 0.80(Compacting factor).

5. Degree of quality of control: Good.

6. Types of exposure: Mild.

7. Cement used: 53 grade OPC.

8. 3.15 is the Specific gravity of cement (Sc)

9. Specific gravity:

a) Coarse aggregate: 2.61.

b) Fine aggregate: 2.67.

10. Surface moisture:

a) Coarse aggregate: Nil.

b) Fine aggregate: Nil.

11. Water absorption:

a) Coarse aggregate: 0.8%

b) Fine aggregate: 1.0%

Target mean strength:

$Ft = Fck + k \times s$ = 20+4 X1.65

=26.6 N/mm^2.

12. Selection of water cement ratio: 0.50 is the free w/c ratio for target mean strength. This is lesser than the maximum value of 0.50 for mild exposure condition.

13. Selection of sand content and water: water content /m^3 of concrete =186kg and 35 % is the sand content as per % of total aggregate by absolute volume, for sand compatible to grading zone-II and 20mm extreme dimension aggregate.

Table 4.5: Adjustment of water & sand content

Change in condition	Adjustment required	
	Water content percentage	Sand content in total aggregate
For decrease in W/C ratio	0	-2
For increasing in C.F. 0.8	-	-
For sand conforming to grading zone III table no 4 of IS:383-1970	**0**	**-1.5**
Total	0%	-3.5%

Therefore, 35- 3.5=31.5 %

This is the required sand content as percentage of total aggregate by absolute volume.

Essential water content =186 lit/ m^3

14. Determination of cement:
Water-cement ratio= 0.5

Water= 186 liters= 186 kg

Cement= 186/0.5= 372 kg/m^3

For mild exposure condition this cement is bearable.

15. Determination of coarse & fine aggregate content: For the stated maximum dimension of aggregate of 20mm, the quantity of entrapped air in the damp concrete is 2% & Concrete volume =1.00-0.02=0.98 m^3

V= fw + c/Sc + (1/p) x (Fa/ Sfa)J x 1/100

0.98= [186+ (372/3.15)+ (1/0.325) x (Fa/2.67)] x1/1000

Fa=570 kg/m^3

Ca= [w+ (c/Sc) + (I/1-p) x (Ca/ Sca)J x1/1000

0.98= [186+ (372/3.15)+ (1/1-0.325) x (Ca/2.67)] x1/1000 , Ca=1212kg/m^3.

16. Mix proportion of concrete:

IS method of mix design is used for mix design of M20 grade of concrete. As per design mix proportion and the quantity of materials is as follows:

Table 4.6: Mix proportion

Material	Proportion by weight	Weight in kg/m^3
Cement	1	372
F.A.	1.53	570
C.A.	3.3	1212
Water	0.5	186

17. Trial mix for compressive strength for concrete:

i. Mix proportion: 1:1.53:3.3.

ii. W/C ratio: 0.5.

iii. Size of cube: 150mm x 150mm x 150mm.

iv. Maximum size of coarse aggregate used: 20mm.

v. Weight of cement Wl: 3.76 kg.

vi. Weight of F.A. (sand) W2: 5.76 kg.

vii. Weight of C.A.:20mm size W3: 12.42 kg.

viii. Weight of water W5: 1.88 kg.

ix. Date of casting: 12/09/2015.

x. Date of testing: 16/10/2015.

Sr. No.	Identification mark	Date of casting	Age in days	Comp. Strength N/mm^2	Remark
1	C1	12/09/2015	28	30.45	30.52 N/mm^2
2	C2			29.56	
3	C3			31.55	

30.52 N/mm2 is the compressive strength of concrete at 7 days. As per the first consideration of M20 grade; the above mix proportion exceeds the target strength of M20 concrete

B) M30 -

1. Following preliminary data has been considered for mix design.

2. Characteristics compressive strength required in the field at 28 days: 30 N/mm^2.

3. Maximum size of aggregate: 20mm (Angular).

4. Degree of workability: 0.80(Compacting factor).

5. Degree of quality of control: Good.

6. Types of exposure: Moderate.

7. Cement used: 53 OPC.

8. Specific gravity of cement (Sc): 3.15.

9. Specific gravity: c) Coarse aggregate: 2.61.

d) Fine aggregate: 2.67.

10. Surface moisture: c) Coarse aggregate: Nil

d)Fine aggregate: Nil

11. Water absorption : c)Coarse aggregate:' 0.8%
d)Fine aggregate: 1.0%
Target Mean Strength :

Ft= Fck + k x s = 30+4 X1.65

=36.6 N/mm^2.

12. Selection of water cement ratio: 0.40 is the free w/c ratio for target mean strength. This is lesser than the maximum value of 0.50 for mild exposure.

13. Selection of sand content an water : water content per m^3 of concrete =186 kg and 35% is the sand content as per percentage of total aggregate by absolute volume, for sand compatible to grading zone-III and 20mm nominal maximum dimension aggregate.

14. **Adjustment of water & sand content**

Change in condition	Adjustment required	
	Water content percentage	Sand content in total aggregate
For decrease in W/C ratio	0	-1
For increasing in C.F. 0.8	-	-
For sand conforming to grading zone III of table no 4 of IS:383-1970	0	-1.5
Total	0%	-2.5%

Therefore, 35- 2.5 = 32.5%

This is the essential sand content as percentage of total aggregate by means of absolute volume

Essential water content =186 lit/ m^3

16. Determination of cement content:

Water-cement ratio= 0.4

Water= 186 liters = 186 kg

Cement= 186/0.4 = 465 kg/m^3

For mild exposure condition this cement content is suitable.

17. Determination of coarse & fine aggregate content: for the stated maximum size of aggregate of 20mm, the magnitude of entrapped air in the damp concrete is 2% Concrete volume =1.00-0.02=0.98 m^3

V= fw + *c/Sc + (1/p) x (Fa/ Sfa)J x 1/100*

0.98= [186+ (465/3.15)+ (1/0.325) x (Fa/2.67)] x1/1000

Fa=560.89kg/m^3

Ca= [w+ (c/Sc) + (I/1-p) x (Ca/ Sca)J x1/1000

0.98= [186+ (465/3.15)+ (1/1-0.325) x (Ca/2.67)] x1/1000

Ca=1139 kg/m^3.

17. Mix proportion of concrete:

IS method of mix design is used for mix design of M30 grade of conc

quantity of ingredient and mix proportions

as per design is as under:

Mix Proportion [

Material	Proportion by weight	Weight in kg/m^3
Cement	1	465
F.A.	1.2	561
C.A.	2.45	1139
Water	0.4	186

18 .Trial mix for compressive strength of concrete:

xi. Mix proportion: 1:1.2:2.45.

xii. W/C ratio: 0.4.

xiii. Size of cube: 150mm x 150mm x 150mm.

xiv. Maximum size of coarse aggregate used: 20mm.

xv. Weight of cement Wl: 4.69 kg.

xvi. Weight of F.A. (sand) W2: 5.63 kg.

xvii. Weight of C.A.:20mm size W3:11.5 kg.

xviii. Weight of water W5:1.87 kg.

xix. Date of casting: 18/12/2015.

xx. Date of testing: 24/01/2016.

Sr. No.	Identification mark	Date of casting	Age in days	Comp. Strength N/mm^2	Remark
1	C1	18/12/2015	28	39.40	42.08 N/mm^2
2	C2			42.30	
3	C3			44.55	

42.08 N/mm^2 is the compressive strength of the concrete at 7 days. As per the first consideration of M30 grade; the

above mix proportion exceeds the target strength of M30 concrete.

TEST RESULTS AND DISCUSSIONS:

The following observation was made for different parameters namely Type-1, 2, 3 and 4 of stained concrete, for compressive strength and graphs are plotted for compressive strength against time lag in minutes.

Partially set concrete of grade M20:

Type-1 Results in N/mm² Compressive strength test of Concrete

PARAMETER NAME		20	20	20	20
TIME LAG					
PLANE	SPCM. NO.	50	120	180	240
	1	41.21	50.65	19.82	12.43
	2	39.99	22.14	26.20	14.84
	3	39.35	24.09	20.80	16.89
	AVG	40.18	32.56	22.27	14.72

Selfed concrete consisting M20(old)+M20 (fresh) grade concrete:

Type 2- Results in N/mm² Compressive strength test of Concrete

PARAMETER NAME		20+20	20+20	20+20	20+20
TIME LAG					
PLANE	SPCM. NO.	50	120	180	240
	1	43.58	35.96	27.28	8.31
	2	45.37	38.33	28.97	15.65
	3	40.22	34.24	29.48	17.23
	AVG	43.06	36.18	28.76	13.69

Type-3 Results in N/mm² Compressive strength test of Concrete

PARAMETER NAME		20+30	20+30	20+30	20+30
TIME LAG					
PLANE	SPCM. NO.	50	120	180	240
	1	44.48	35.16	30.81	14.33
	2	45.17	37.42	32.33	14.36
	3	45.80	39.97	31.88	16.32
	AVG	45.15	38.07	31.67	15.00

Type-4 Results in N/mm² Compressive strength test of Concrete

TIME LAG(HRS)		12	16
PLANE	SPECIMEN NO.		
HORIZONTAL	1	20.70	21.30
	2	21.65	22.10
	3	20.15	20.15
	AVERAGE	20.83	21.18
VERTICAL	1	18.20	19.21
	2	19.30	20.15
	3	19.65	20.50
	AVERAGE	19.05	19.95
DIAGONAL	1	24.65	26.02
	2	24.10	25.10
	3	25.65	26.10
	AVERAGE	24.8	25.8

Splitting tensile strength for selected time lag in N/mm²

Name/Time lag	50	120	180	240
Parameter	A	B	C	D
Standard specimen(M-20)	09.330	08.420	11.940	10.640
Parameter	E	F	G	H
Selfing (M-20+M-20)	11.190	10.780	10.340	13.330
Parameter	I	J	K	L
Crossing (M-20+M-30)	13.390	13.230	13.126	11.324

CONCLUSIONS:

1. Strength of partially set concrete reduced with time lag towards end result.
2. The result of reduced compressive strength of partial set concrete can be overcome by blending with same grade or high grade of, i.e self it.
3. 10.60% increment in the strength improvement in selfing of old mix with fresh mix.
4. For crossing fresh M30 concrete with old mix it improves strength by 23%(Partial Set Concrete) & 13% increment in strength with respect to self-concrete.
5. Improvement in fresh properties of blended concrete i.e. compaction & workability with improvement in compressive strength of selfed and crossed concrete
6. Waste material like delayed concrete is by crossing in which target strength of concrete as per design is achieved by crossing with higher grade of concrete.

7. Concrete is to be attained upto delay of 180 minutes by blending with same or different grade of concrete.

8. Using bonding agent SBR latex should strength increment upto delay of 12hrs-16hrs.

9. Because of wedge action theory in comparison with other planes, out of the planes adopted for casting of interface layers, diagonal plane should maximum compressive strength of 26Mpa.

10. Target compressive strength can be obtained by using proper bonding agent in proportion with cement i.e. 1:1 (kg : liters).

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