RECOMMENDED PRACTICE FOR ACCELERATED STRENGTH TESTING AND EVALUATION OF CONCRETE

(First Revision)

Published by:

INDIAN ROADS CONGRESS

Kama Koti Marg,
Sector-6, R.K. Puram,
New Delhi-110 022

January, 2015

Price :₹ 300/-
(Plus Packing & Postage)

First Published	:	May, 1983
First Revision	:	January, 2015
Reprinted	:	November, 2018

Printed by I G Printers Pvt. Ltd., New Delhi - 110020

400 Copies

CONTENTS

PERSONNEL OF THE HIGHWAYS SPECIFICATIONS AND STANDARDS COMMITTEE

(As on 9th August, 2014)

1.	Das, S.N. (Convenor)	Director General (Road Development), Ministry of Road Transport & Highways, New Delhi.
2.	Varkeyachan, K.C. (Co-Convenor)	Addl. Director General, Ministry of Road Transport & Highways, New Delhi.
3.	Chief Engineer (R) S,R&T (Member-Secretary)	(Rep. by Shri S.K. Nirmal), Ministry of Road Transport & Highways, New Delhi

Members

4.	Basu, S.B.	Chief Engineer (Retd.), MORTH, New Delhi
5.	Bongirwar, P.L.	Advisor, L & T, Mumbai
6.	Bose, Dr. Sunil	Head, FPC Divn. CRRI (Retd.), Faridabad
7.	Duhsaka, Vanlal	Chief Engineer, PWD (Highways), Aizwal (Mizoram)
8.	Gangopadhyay, Dr. S.	Director, Central Road Research Institute, New Delhi
9.	Gupta, D.P.	DG (RD) & AS (Retd.), MORTH, New Delhi
10.	Jain, R.K.	Chief Engineer (Retd.), Haryana PWD, Sonipat
11.	Jain, N.S.	Chief Engineer (Retd.), MORTH, New Delhi
12.	Jain, Dr. S.S.	Professor & Coordinator, Centre of Transportation Engg., Dept. of Civil Engg., IIT Roorke, Roorkee
13.	Kadiyali, Dr. L.R.	Chief Executive, L.R. Kadiyali & Associates, New Delhi
14.	Kumar, Ashok	Chief Engineer (Retd.), MORTH, New Delhi
15.	Kurian, Jose	Chief Engineer, DTTDC Ltd., New Delhi
16.	Kumar, Mahesh	Engineer-in-Chief, Haryana PWD, Chandigarh
17.	Kumar, Satander	Ex-Scientist, CRRI, New Delhi
18.	Lal, Chaman	Director (Projects-III), NRRDA (Ministry of Rural Development), New Delhi
19.	Manchanda, R.K.	Consultant, Intercontinental Consultants and Technocrats Pvt. Ltd., New Delhi
20.	Marwah, S.K.	Addl. Director General (Retd.), MORTH, New Delhi
21.	Pandey, R.K.	Chief Engineer (Planning), MORTH, New Delhi
22.	Pateriya, Dr. I.K.	Director (Tech.), NRRDA, (Ministry of Rural Development), New Delhi
23.	Pradhan, B.C.	Chief Engineer, National Highways, PWD, Bhubaneshwar
24.	Prasad, D.N.	Chief Engineer (NH), RCD, Patna
25.	Rao, P.J.	Consulting Engineer, H.No. 399, Sector-19, Faridabad

26.	Raju, Dr. G.V.S.	Engineer-in-Chief (R&B), Rural Roads, Director Research and Consultancy, Hyderabad, Andhra Pradesh
27.	Representative of BRO	(Shri B.B. Lal) ADGBR, HQ DGBR, New Delhi
28.	Sarkar, Dr. P.K.	Professor, Deptt. of Transport Planning, School of Planning & Architecture, New Delhi
29.	Sharma, Arun Kumar	CEO (Highways), GMR Highways Limited, Bangalore
30.	Sharma, M.P.	Member (Technical), NHAI, New Delhi
31.	Sharma, S.C.	DG (RD) & AS (Retd.), MORTH, New Delhi
32.	Sinha, A.V.	DG (RD) & SS (Retd.), MORTH, New Delhi
33.	Singh, B.N.	Member (Projects), NHAI, New Delhi
34.	Singh, Nirmal Jit	DG (RD) & SS (Retd.), MORTH, New Delhi
35.	Vasava, S.B.	Chief Engineer & Addl. Secretary (Panchayat) Roads & Building Dept., Gandhinagar
36.	Yadav, Dr. V.K.	Addl. Director General (Retd.), DGBR, New Delhi
37.	The Chief Engineer (Mech.)	(Shri Kaushik Basu), MORTH, New Delhi

Corresponding Members

1.	Bhattacharya, C.C.	DG (RD) & AS (Retd.), MORTH, New Delhi
2.	Das, Dr. Animesh	Professor, IIT, Kanpur
3.	Justo, Dr. C.E.G.	Emeritus Fellow, 334, 14th Main, 25th Cross, Banashankari 2nd Stage, Bangalore
4.	Momin, S.S.	Former Secretary, PWD Maharashtra, Mumbai
5.	Pandey, Prof. B.B.	Advisor, IIT Kharagpur, Kharagpur

Ex-Officio Members

1.	President, Indian Roads Congress	(Bhowmik, Sunil), Engineer-in-Chief, PWD (R&B) Govt. of Tripura
2.	Honorary Treasurer, Indian Roads Congress	(Das, S.N.), Director General (Road Development), Ministry of Road Transport & Highways
3.	Secretary General, Indian Roads Congress	

RECOMMENDED PRACTICE FOR ACCELERATED STRENGTH TESTING AND EVALUATION OF CONCRETE

FOREWORD

The document was first published in May, 1983 under the recommendation about accelerated strength testing and evaluation of concrete for road and airfield constructions. The Rigid Pavement Committee (H-3) decided to revise IRC:85-1983 mainly because of cement used in 1983 was of 33 grades OPC, the correlation of 28 day compressive strength of accelerated curing and normal cured was not given. The correlation of 28 day compressive and flexural strength of concrete with PPC and PSC was also not available in the IRC:85-1983. A research project was undertaken at Central Road Research Institute (CRRI), New Delhi to develop the correlation between the accelerated cured and normal cured concrete using Ordinary Portland Cement (OPC), Portland Pozzolana Cement (PPC) and Portland Slag Cement (PSC). The team members of the R&D project were Shri J.B. Sengupta, Member advisory group Senior Principal Scientist, Shri Binod Kumar, Principal Scientist, and Shri Manoj Kumar Singh, Technical Officer, Rigid Pavement Division, CRRI, New Delhi.

The draft IRC:85 "Recommended Practice for Accelerated Strength Testing and Evaluation of Concrete" (*First Revision*) was prepared by the Sub-group comprising Dr. S.C. Maiti, Shri J.B. Sengupta, Shri R.K. Jain, Shri Satander Kumar and Shri Binod Kumar. The Committee deliberated on the draft document in a series of meetings. The H-3 Committee finally approved the draft document in its meeting held on 19th June, 2014 and authorized the Convenor, H-3 Committee to send the final draft for placing before the HSS Committee.

The composition of the Rigid Pavement Committee (H-3) is given below:

Jain, R.K.	--------	Convenor
Kumar, Satander	--------	Co-Convenor
Kumar, Raman	--------	Member Secretary

Members

Bongirwar, P.L.	Pandey, Dr. B.B.
Ganju, Col. V.K.	Prasad, Bageshwar
Gautam, Ashutosh	Sachdeva, Dr. S.N.
Gupta, K.K.	Seehra, Dr. S.S.
Jain, A.K.	Sengupta, J.B.
Jain, L.K.	Sharma, R.N.
Joseph, Isaac V.	Singla, B.S.
Kadiyali, Dr. L.R.	Sitaramanjaneyulu, K.
Krishna, Prabhat	Tipnis, Col. Manoj

The Highways Specifications & Standards Committee (HSS) approved the draft document in its meeting held on 9th August, 2014. The Executive Committee in its meeting held on 18th August, 2014 approved the same document for placing it before the Council. The IRC Council in its 203rd meeting held at New Delhi on 19th and 20th August, 2014 approved the draft IRC:85 “Recommended Practice for Accelerated Strength Testing and Evaluation of Concrete” (*First Revision*) for publishing.

1 INTRODUCTION

1.1 The quality acceptance criteria of most cement concrete works including paving concrete works for roads and airfields are based on the strength of specimens tested at the age of 28 days after curing under standard curing conditions. An estimate of 28-day strength of concrete is sometimes done from the corresponding 7-day strength results for purpose of early quality control. In case of many constructions, the time lapse of even 7 days is too long for the strength results to serve any useful purpose from the point of either quality control or predicting the 28-day strength.

1.2 With a view to overcoming this problem, accelerated strength testing of concrete has been recommended in this document that would provide early information, say in about a day, on the concrete strength likely to be developed at 28 days. Such information may enable taking decision on removal of any defective concrete very early while it has still not hardened much, or before it is covered by subsequent layer. With the estimate of 28 days strength, the accelerated test also helps in taking early corrective steps for concrete mixes as being produced and which may not perform satisfactorily. It will thus help achieve better control of concrete quality economically with greatly reduced chances of rejection, and take corrective actions early.

1.3 For predicting the compressive and flexural strengths of concrete at 28 days, it will be desirable to obtain in advance, in the laboratory, along with the mix design of concrete, the correlations between the accelerated strength results and standard cured strength results at 28 days, using the material to be actually used in construction. The present Recommended Practice relates particularly to 28-day compressive and flexural strength estimation of concrete through accelerated curing. Since compressive and flexural strength of concrete is of great importance to the paving engineers, this document will have particular significance in road and airfield constructions.

2 SCOPE

This Recommended Practice covers procedure for accelerated curing, details of accelerated strength test under compression/flexure and estimation there of from strength under standard curing for 28 days, and is recommended to be used when estimation of 28-day compressive strength or flexural strength is required from the accelerated one day strength tests.

3 WORKING PRINCIPLE OF ACCELERATED CURING

The concrete specimens (cubes or beams), after 23 hours ± 15 minutes of their preparation, are cured in boiling water for 3.5 hours ± 5 min. The specimens are then taken out of boiling water and allow cooling in air under wet gunny bags for 2 hours and then tested. The total period elapsed between castings and testing is 28.5 hours.

4 APPARATUS FOR ACCELERATED CURING

4.1 Water Bath

4.1.1 When it is desired to conduct accelerated strength test for both compressive and flexural strength, the water bath which is to provide the accelerated curing conditions shall consist of a galvanized steel tank of appropriate capacity and dimensions and shall have a detachable top cover. The tank should accommodate at a time minimum 3 cubes and 3 beams encased in moulds. The plan of placement of moulds in the tank is shown in **Fig. 1**. The dimensions of the tank may be varied depending on the number, size and type of specimens to be accommodated in the tank.

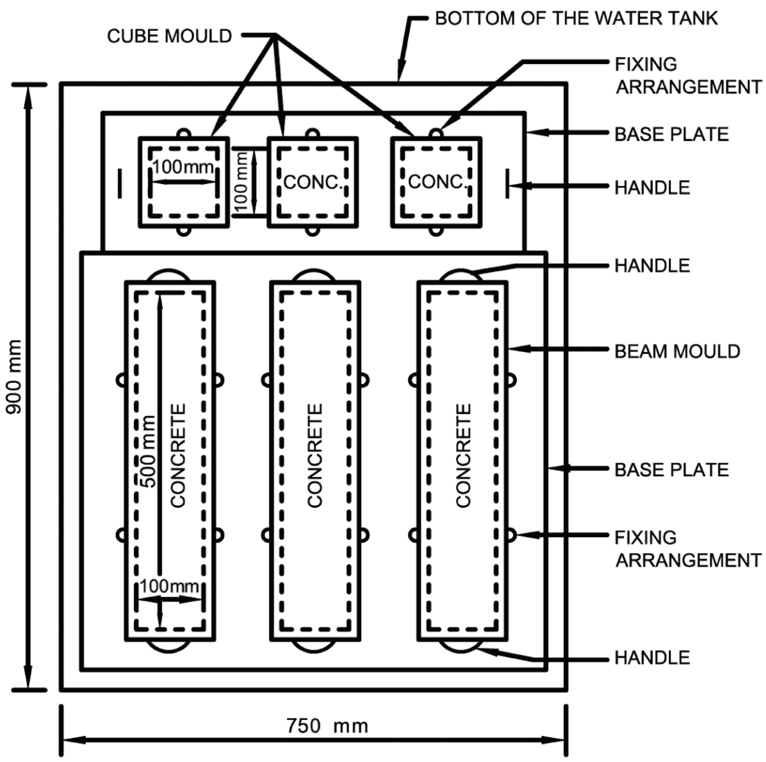


Fig. 1 Layout Plan for 3 Beams and 3 Cubes Inside the Water Tank

For 900 mm x 750 mm x 400 mm deep tank shown in **Fig. 1**, six immersion type heating elements (220V, 1500W each) having a combined load of 9 kilo-watts are fitted horizontally at the side of the tank. These elements are distributed on the sides of the tank and located about 70 mm above the bottom of the tank. The tank is provided with a mild steel grid platform resting on 4 angles iron supports welded to the sides of the tank. The grid is placed about 100 mm above the bottom of the tank, **Fig. 2**. The cube and beam or only beam specimens together with their moulds are placed on the grid. The tank shall have an outlet at the bottom for emptying it, when required.

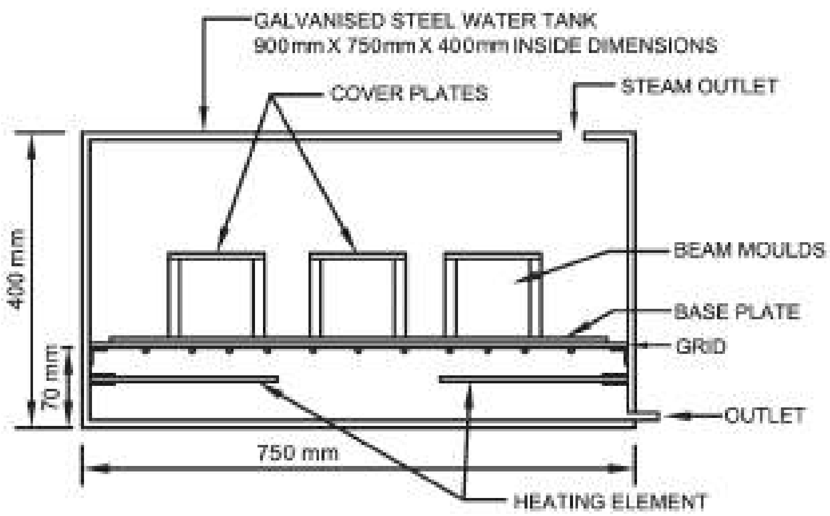


Fig. 2 Water Tank Showing Position of Heating Elements, Grid, Base Plate, Mould, Cover Plate, etc.

4.1.2 The tank is to be filled with water to a depth of 250 mm for 900 mm x 750 mm x 400 mm deep tank so that when the specimens are placed in it, the water level rises to about 70 mm above the top of the moulds. This level of water is to be maintained during the heating period by adding small amount of water (as required) into the tank from time to time in order to maintain constant heat capacity of the curing medium. Depending on the ambient temperatures prevalent at the time of experimentation, about 60-75 minutes are required to raise the temperature of water in the tank to its boiling point near 100ºC. The steam formed during heating is allowed to escape through an outlet provided in the tank cover, **Fig. 2**.

4.2 Water Bath in the Field

At construction sites in the field, where electrical power may not be available, water may be brought to boiling temperature by means of heating through coal or firewood. The dimensions and other arrangements of the water bath should remain the same as described in Para 4.1.

4.3 Mould for Concrete Specimens

The moulds for concrete specimens (cube or beams) shall be as per IS:516-1959. In addition, 6 mm thick mild steel plate (with machined surface in contact with concrete) of size corresponding to that of the moulds is required to cover the specimens during the period of curing in boiling water. The moulds shall have suitable handles for easy removal.

5 PROCEDURE

5.1 Concrete cube and beam shall be prepared in accordance with IS:516-1959. The mould flanges are wiped clean after the concrete is trowelled level with the top of the mould. The specimens are cured for 23 ± ½ hours under wet gunny bags at standard temperature of 27 ± 2ºC. After such curing, the specimens still in moulds shall be covered with cover plates (with machined surface in contact with concrete) and placed in boiling water in the tank. The temperature of water will drop slightly due to immersion of moulds but will regain the boiling temperature within 15 minutes.

5.2 The specimens shall be kept in the boiling water for 3.5 hours ± 5 min. After this period, these should be removed from the tank with hooks having wooden handles, demoulded and left to cool in air for two hours under wet gunny bags. Immediately after 2 hours of cooling of the specimens, these shall be tested for compressive/flexural strength as per IS: 516-1959.

6 ESTIMATION OF 28-DAY STRENGTH

6.1 Ordinarily, the correlation between the accelerated strength results as per procedure described in Para 5 and standard cured strength results at 28 days shall be obtained in the laboratory along with the mix design of concrete, using the materials to be actually used in the construction. These correlations should be supplied to the site engineer along with the mix design.

6.2 Where such correlations are not made available from the laboratory, general guidance may be had from the correlations given in **Figs. 3, 4 and 5** which have been drawn on the basis of laboratory test results given in **Annexure I**. While **Fig. 3** gives the statistical correlations between accelerated and 28-day standard cured compressive and flexural strength using OPC, **Fig. 4** shows the same between accelerated and 28-day standard cured compressive and flexural strength using PPC and **Fig. 5** shows the same between accelerated and 28-day standard cured compressive and flexural strength using PSC. The correlations shown in **Fig. 3** relate to concrete mixes using ordinary Portland cements having widely different physical and chemical properties i.e., 3 day compressive strength varying between 23 to 26 N/mm^2, 7-day compressive strength varying between 33 to 38 N/mm^2 and 28-day compressive strength varying between 43 to 49 N/mm^2, minimum specific surface area 2250 cm^2 per gm (Blaine's), C_3S content varying between 45 percent and 55 percent and C_2S content varying between 30 percent and 20 percent. In **Fig. 4** the pozzolana content in PPC varying from 25 percent to 35 percent. Whereas in **Fig. 5** slag content in PSC varying from 30 percent to 50 percent. The statistical relationship between one day accelerated and 28 day normal cured specimen's compressive and flexural strength using OPC, PPC and PSC are given in **Table 1**.

Table 1 The Statistical Relationship Between One Day (x) Accelerated and 28 Day (y) Normal Cured Specimen's Compressive and Flexural Strength Using OPC, PPC and PSC

Type of Cement	Correlation of Compressive Strength (N/mm^2)	R^2	Correlation of Flexural Strength (N/mm^2)	R^2
OPC	y = 1.69x + 1.15	0.95	y = 2.09x + 1.35	0.88
PPC	y = 1.76x + 2.08	0.83	y = 2.01x + 0.77	0.88
PSC	y = 1.78x + 1.29	0.95	y = 2.08x + 1.09	0.90

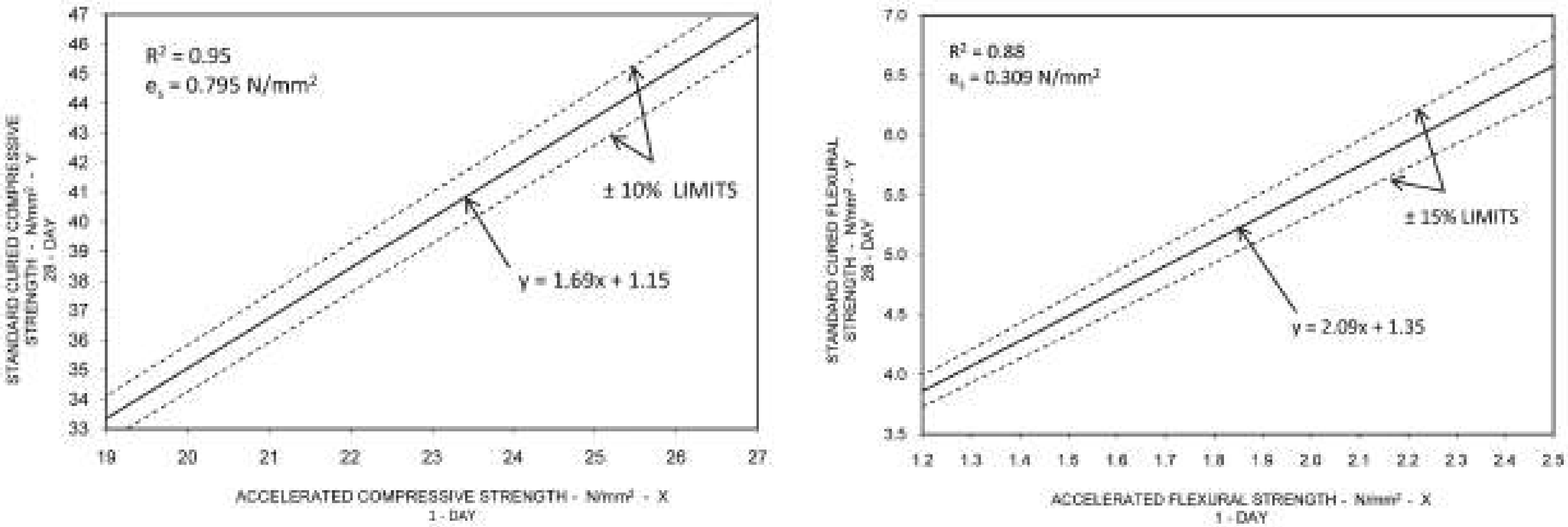


Fig. 3 Statistical Relationship Between Accelerated and Standard Cured Compressive and Flexural Strength Using OPC

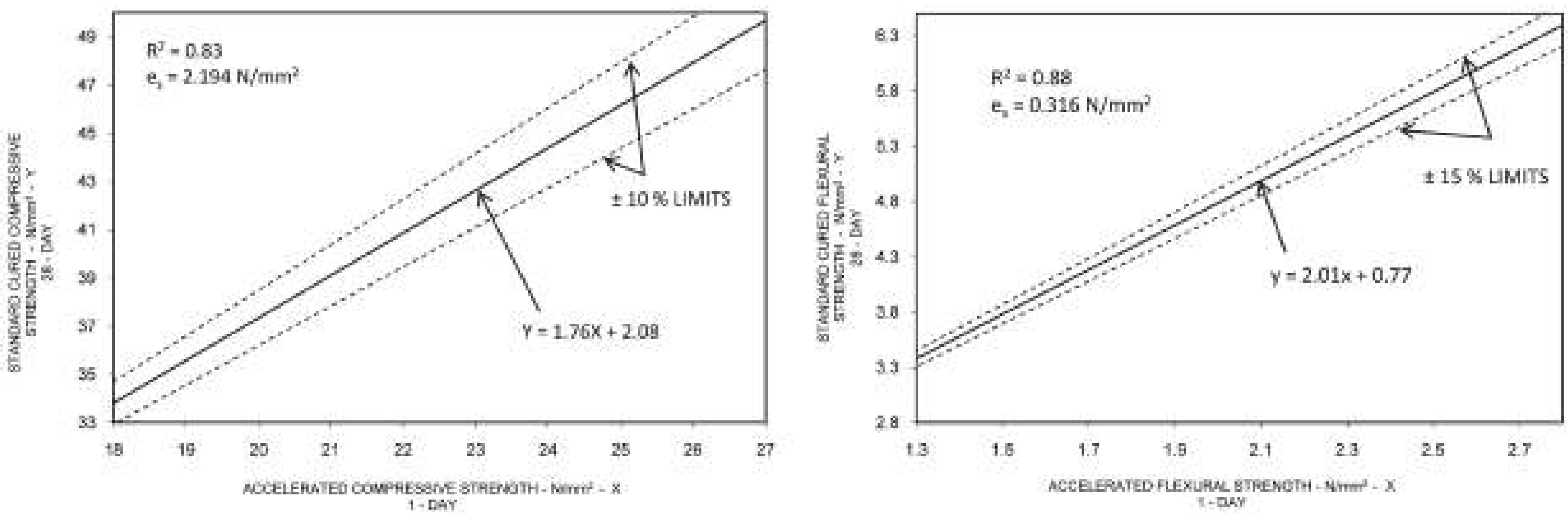
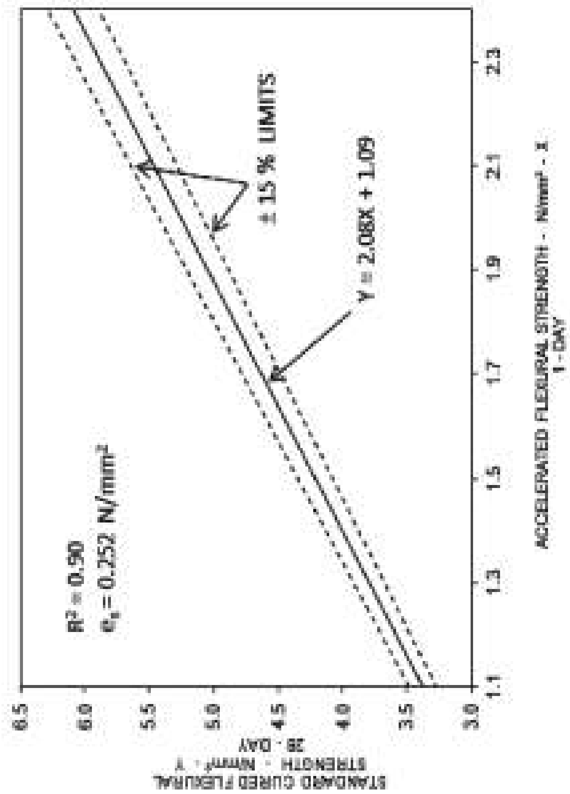


Fig. 4 Statistical Relationship Between Accelerated and Standard Cured Compressive and Flexural Strength Using PPC



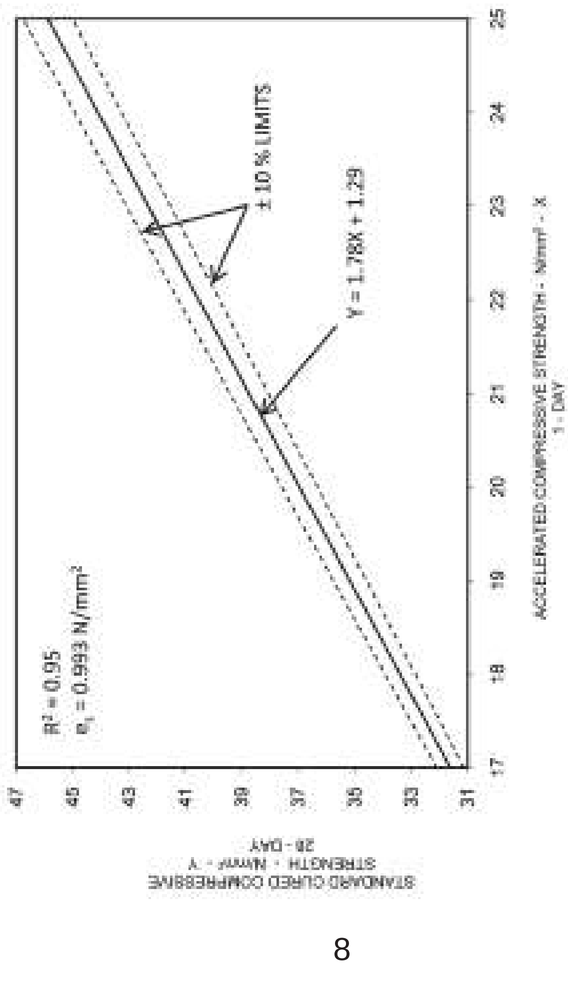


Fig. 5 Statistical Relationship Between Accelerated and Standard Cured Compressive and Flexural Strength Using PSC

ANNEXURE-I

(Refer Para 6.2)

Test Results

Statistical data of OPC for accelerated and standard cured compressive strength

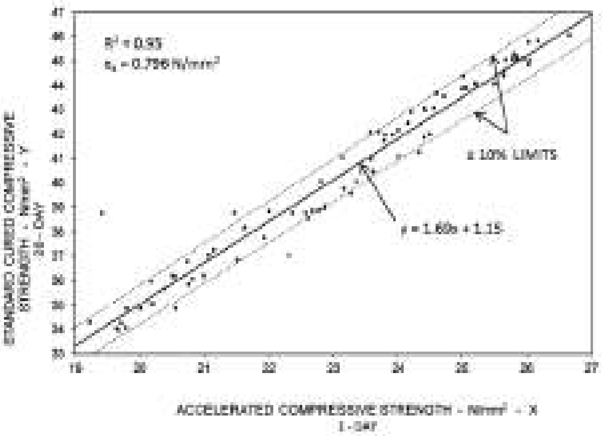
S.No	C/S of OPC		S.No	C/S of OPC	
	1 Day	28 Day		1 Day	28 Day
1	19.4	38.8	41	24.4	41.9
2	19.2	34.3	42	23.6	41.0
3	20.7	36.8	43	23.6	40.4
4	21.0	36.2	44	23.8	42.0
5	19.7	34.3	45	24.0	42.2
6	20.2	35.1	46	24.7	43.6
7	20.5	36.2	47	25.0	44.4
8	20.6	34.9	48	23.7	42.1
9	20.2	35.0	49	24.0	41.1
10	20.2	36.0	50	24.2	42.5
11	20.4	35.7	51	24.2	42.9
12	19.8	34.1	52	23.4	40.1
13	20.5	36.2	53	23.6	42.1
14	19.6	34.1	54	24.4	43.0
15	19.7	34.0	55	24.4	43.1
16	20.8	36.1	56	24.5	42.0
17	20.8	35.9	57	24.6	43.7
18	19.8	34.9	58	24.6	43.1
19	20.0	34.9	59	23.9	42.0
20	21.1	37.0	60	23.8	41.7
21	22.3	37.0	61	25.2	44.1
22	22.7	38.9	62	25.1	43.9
23	21.5	36.8	63	25.7	45.1
24	21.6	38.2	64	25.8	45.2
25	23.3	39.6	65	25.2	44.1
26	23.2	39.8	66	25.0	43.9
27	21.6	38.2	67	26.0	44.8
28	22.6	38.8	68	26.7	46.1
29	22.9	39.1	69	25.9	45.2
30	23.1	41.0	70	25.8	45.1
31	21.9	37.8	71	25.5	44.1
32	22.6	38.5	72	25.6	44.4
33	22.8	38.9	73	26.0	45.6
34	22.8	40.1	74	26.2	45.8
35	22.4	38.8	75	25.0	43.9
36	22.0	38.8	76	26.0	45.0
37	22.9	39.0	77	26.0	45.1
38	21.2	37.3	78	25.9	45.0
39	21.5	38.8	79	25.6	44.6
40	24.3	41.3	80	25.8	45.3

Calculation of confidence interval for Regression Line

Value	Confidence Interval	Upper Limit	Lower Limit
x	CI	y+CI	y-CI
5	1.3	10.9	8.3
10	0.9	19.0	17.2
15	0.6	27.2	26.0
20	0.3	35.3	34.8
25	0.2	43.7	43.3
30	0.5	52.5	51.5
35	0.8	61.3	59.6
40	1.2	70.1	67.7
45	1.5	79.0	75.9
50	1.9	87.8	84.0
55	2.2	96.6	92.1

Derrived value form regression analysis

Slope, m	m	1.69	SLOPE(y,x)
Intercept, b	b	1.15	INTERCEPT(y,x)
Observations, n	n	80.00	COUNT(x)
Std error in estimate, Syx	SYX	0.80	STEYX(y,x)
Average x	XAVG	23.12	AVERAGE(x)
SSX	SSX	355.45	DEVSQ(x)
t(a,df)	t	1.66	TINV(0.1,n-2)



Statistical relationship between accelerated and standard cured compressive strength

Statistical data of OPC for accelerated and standard cured flexural strength

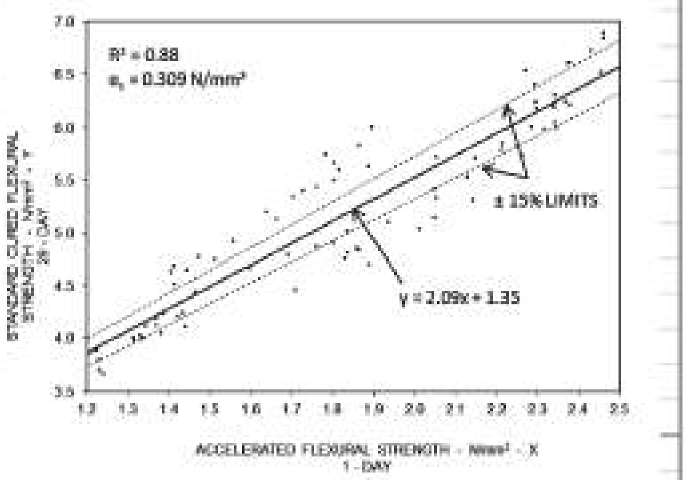
S.No	F/S of OPC		S.No	F/S of OPC	
	1 Day	28 Day		1 Day	28 Day
1	1.34	4.00	41	1.87	5.83
2	1.44	4.64	42	1.90	6.00
3	1.37	4.12	43	1.93	5.10
4	1.43	4.24	44	1.87	4.84
5	1.51	4.75	45	1.80	4.90
6	1.37	4.19	46	1.84	5.01
7	1.31	4.01	47	1.86	4.85
8	1.47	4.43	48	1.83	4.76
9	1.33	4.02	49	1.84	4.81
10	1.31	3.97	50	2.01	5.03
11	1.41	4.68	51	2.05	5.34
12	1.34	4.11	52	2.05	5.14
13	1.22	3.89	53	2.14	5.31
14	1.23	3.70	54	2.21	5.79
15	1.24	3.67	55	2.26	5.73
16	1.41	4.62	56	2.32	5.98
17	1.41	4.51	57	2.15	5.71
18	1.39	4.23	58	2.13	5.53
19	1.23	3.80	59	2.05	5.72
20	1.17	3.61	60	2.05	5.41
21	1.42	4.20	61	2.25	5.83
22	1.44	4.10	62	2.34	6.00
23	1.38	4.05	63	2.21	5.84
24	1.47	4.77	64	2.38	6.60
25	1.56	4.92	65	2.34	6.30
26	1.60	4.66	66	2.34	6.20
27	1.76	4.87	67	2.38	6.21
28	1.76	5.43	68	2.34	6.05
29	1.71	4.45	69	2.34	6.19
30	1.66	5.12	70	2.28	6.00
31	1.70	5.34	71	2.30	6.18
32	1.64	5.20	72	2.30	6.24
33	1.73	5.40	73	2.43	6.73
34	1.81	5.67	74	2.46	6.84
35	1.80	5.50	75	2.46	6.52
36	1.89	5.63	76	2.37	6.24
37	1.78	5.74	77	2.29	6.40
38	1.69	4.80	78	2.27	6.54
39	1.89	4.70	79	2.46	6.89
40	1.82	5.60	80	2.37	6.60

Calculation of confidence interval for Regression Line

Value	Confidence Interval	Upper Limit	Lower Limit
x	CI	y+CI	y-CI
0.00	0.24	1.60	1.11
0.50	0.18	2.58	2.22
1.50	0.07	4.55	4.42
2.00	0.05	5.59	5.48
3.50	0.22	8.88	8.45
4.50	0.34	11.10	10.41
5.50	0.47	13.32	12.37
6.50	0.60	15.53	14.33
7.50	0.73	17.75	16.29
8.50	0.86	19.97	18.25
9.50	0.98	22.18	20.21

Derrived value form regression analysis

Slope, m	m	2.088	SLOPE(y,x)
Intercept, b	b	1.354	INTERCEPT(y,x)
Observations, n	n	80.000	COUNT(x)
Std error in estimate, Syx	SYX	0.309	STEYX(y,x)
Average x	XAVG	1.844	AVERAGE(x)
SSX	SSX	12.251	DEVSQ(x)
t(a,df)	t	1.453	TINV(0.1,n-2)



Statistical relationship between accelerated and standard cured flexural strength

Statistical data of PPC for accelerated and standard cured compressive strength

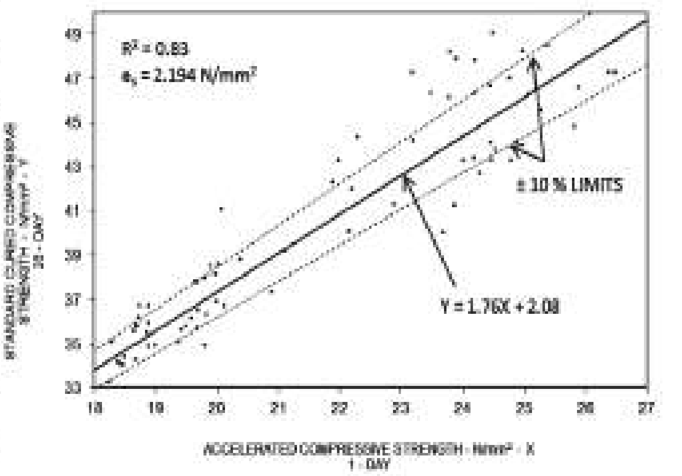
S.No	C/S of PPC		S.No	C/S of PPC	
	1 Day	28 Day		1 Day	28 Day
1	18.4	34.1	41	20.9	37.3
2	18.2	33.2	42	21.2	27.8
3	17.9	31.3	43	22.3	44.3
4	18.9	35.5	44	23.8	46.1
5	17.8	32.2	45	24.8	43.3
6	18.7	36.2	46	24.5	44.1
7	18.0	34.3	47	24.5	43.8
8	18.7	35.6	48	23.5	46.3
9	18.3	35.1	49	24.3	42.7
10	18.9	34.9	50	23.2	47.3
11	18.7	34.2	51	22.9	41.3
12	17.8	32.9	52	22.1	40.1
13	17.7	32.2	53	21.1	39.2
14	17.9	34.6	54	22.0	43.3
15	19.0	34.9	55	21.9	42.3
16	18.5	34.4	56	20.1	41.1
17	18.7	35.8	57	22.2	42.0
18	18.9	35.9	58	23.2	44.2
19	18.4	34.2	59	24.5	46.7
20	18.0	35.7	60	24.2	46.3
21	19.6	37.8	61	25.9	46.6
22	19.8	38.0	62	26.4	47.3
23	19.8	36.3	63	25.0	48.2
24	19.5	35.8	64	26.5	47.3
25	19.8	34.9	65	25.4	48.5
26	19.7	37.8	66	24.5	49.0
27	19.7	36.5	67	23.9	47.9
28	19.9	38.5	68	23.8	48.2
29	20.4	38.8	69	24.2	47.8
30	20.0	38.6	70	25.1	46.3
31	20.0	36.9	71	25.3	45.6
32	20.1	36.7	72	24.5	43.3
33	19.4	35.1	73	24.2	43.4
34	19.7	35.7	74	23.9	41.2
35	18.9	36.7	75	24.0	43.3
36	20.0	38.1	76	24.8	47.0
37	18.7	36.7	77	24.9	44.1
38	18.5	34.0	78	23.7	40.0
39	19.4	35.6	79	24.0	44.3
40	19.6	36.1	80	25.8	44.8

Calculation of confidence interval for Regression Line

Value	Confidence Interval	Upper Limit	Lower Limit
x	CI	y+CI	y-CI
10	1.8	21.5	17.9
15	1.1	29.6	27.5
25	0.7	46.8	45.5
35	2.1	65.9	61.7
45	3.6	85.0	77.8
55	5.1	104.2	93.9
65	6.6	123.3	110.0
75	8.2	142.4	126.1
85	9.7	161.6	142.2
95	11.2	180.7	158.4
105	12.7	199.9	174.5

Derrived value form regression analysis

Slope, m	m	1.76	SLOPE(y,x)
Intercept, b	b	2.08	INTERCEPT(y,x)
Observations, n	n	80.00	COUNT(x)
Std error in estimate, Syx	SYX	2.19	STEYX(y,x)
Average x	XAVG	21.40	AVERAGE(x)
SSX	SSX	577.15	DEVSQ(x)
t(a,df)	t	1.66	TINV(0.1,n-2)



Statistical relationship between accelerated and standard cured compressive strength

Statistical data of PPC for accelerated and standard cured flexural strength

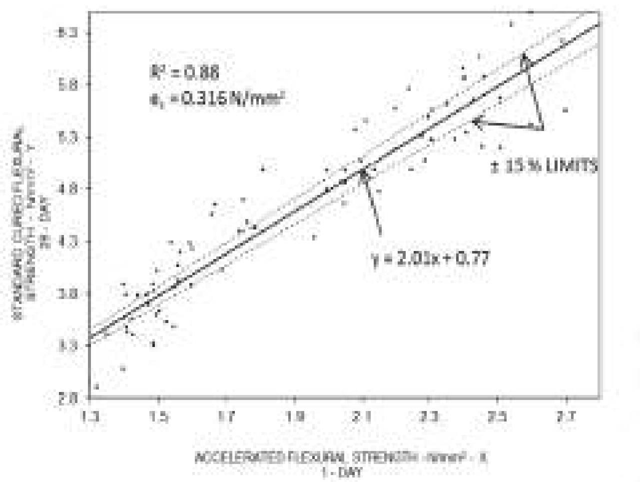
S.No	F/S of PPC		S.No	F/S of PPC	
	1 Day	28 Day		1 Day	28 Day
1	1.32	2.90	41	1.96	4.33
2	1.49	3.59	42	2.04	4.87
3	1.35	3.41	43	2.05	4.97
4	1.74	4.39	44	1.99	4.79
5	1.56	4.19	45	2.14	4.98
6	1.54	4.29	46	2.30	5.28
7	1.75	4.69	47	2.20	5.19
8	1.60	4.22	48	2.30	5.49
9	1.52	3.52	49	2.25	4.98
10	1.48	3.32	50	2.10	5.07
11	1.51	3.63	51	2.05	4.86
12	1.34	2.80	52	2.05	4.66
13	1.48	3.88	53	2.31	5.27
14	1.40	3.57	54	2.29	5.08
15	1.40	3.07	55	2.08	5.37
16	1.60	3.87	56	2.00	4.97
17	1.55	3.48	57	2.15	4.78
18	1.49	3.30	58	2.11	5.46
19	1.43	3.40	59	2.31	5.56
20	1.40	3.88	60	2.28	5.31
21	1.42	3.55	61	2.20	5.57
22	1.44	3.78	62	2.24	5.76
23	1.56	3.92	63	2.40	5.96
24	1.47	3.69	64	2.41	5.87
25	1.56	4.07	65	2.69	6.22
26	1.78	4.42	66	2.35	5.62
27	1.81	4.98	67	2.54	6.38
28	1.49	3.82	68	2.45	6.07
29	1.69	4.02	69	2.40	5.86
30	1.55	3.87	70	2.60	6.49
31	1.41	3.42	71	2.70	5.55
32	1.59	4.28	72	2.62	5.38
33	1.67	4.65	73	2.43	5.66
34	1.47	3.79	74	2.60	5.42
35	1.41	3.47	75	2.46	5.22
36	1.79	4.43	76	2.51	5.20
37	1.66	4.55	77	2.41	5.34
38	1.76	4.48	78	2.51	5.68
39	1.50	4.01	79	2.46	5.88
40	1.41	3.79	80	2.37	5.28

Claculation of confidence interval for Regression Line

Value	Confidence Interval	Upper Limit	Lower Limit
x	CI	y+CI	y-CI
0.50	0.18	1.95	1.59
1.50	0.07	3.85	3.71
2.00	0.05	4.84	4.73
2.50	0.09	5.88	5.70
3.00	0.14	6.94	6.66
3.50	0.20	8.00	7.60
4.00	0.26	9.06	8.55
4.50	0.32	10.13	9.49
5.00	0.38	11.19	10.44
5.50	0.44	12.26	11.38
6.00	0.50	13.33	12.33

Derrived value form regression analysis

Slope, m	m	2.010	SLOPE(y,x)
Intercept, b	b	0.767	INTERCEPT(y,x)
Observations, n	n	80.000	COUNT(x)
Std error in estimate, Syx	SYX	0.316	STEYX(y,x)
Average x	XAVG	1.921	AVERAGE(x)
SSX	SSX	14.265	DEVSQ(x)
t(a,df)	1	1.454	TINV(0.1,n-2)



Statistical relationship between accelerated and standard cured flexural strength

Statistical data of PSC for accelerated and standard cured compressive strength

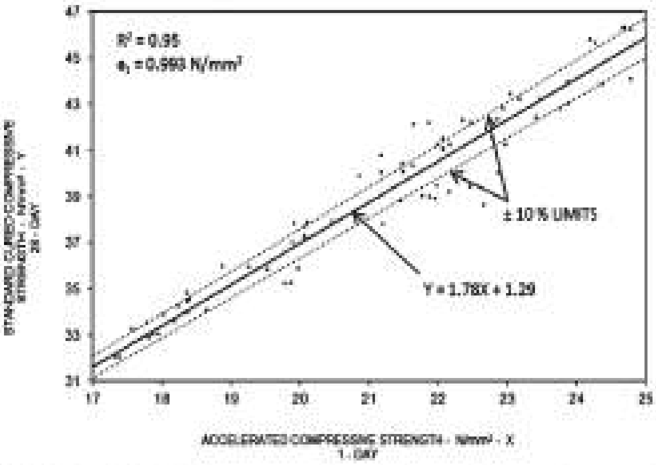
S.No	C/S of PSC 1 Day	C/S of PSC 28 Day	S.No	C/S of PSC 1 Day	C/S of PSC 28 Day
1	19.5	35.8	41	22.2	41.2
2	17.3	32.0	42	22.9	42.3
3	18.0	33.9	43	22.9	42.8
4	17.4	32.0	44	23.2	43.2
5	17.8	32.9	45	22.0	38.9
6	18.4	34.8	46	21.5	38.8
7	18.2	34.2	47	21.2	37.8
8	17.9	33.0	48	22.0	39.4
9	20.1	37.9	49	22.1	41.5
10	20.1	37.2	50	22.4	42.3
11	18.6	34.1	51	22.5	42.2
12	18.0	33.0	52	21.6	42.1
13	17.0	30.1	53	22.8	41.5
14	18.4	34.0	54	22.1	41.1
15	18.2	33.6	55	21.9	42.2
16	17.9	33.1	56	23.1	43.4
17	16.9	31.0	57	22.0	41.2
18	18.4	34.5	58	22.2	39.2
19	18.4	34.4	59	22.7	38.6
20	17.6	33.2	60	22.5	39.4
21	17.8	33.5	61	23.5	43.2
22	20.1	37.3	62	25.2	45.6
23	21.5	40.1	63	22.9	40.0
24	21.6	40.3	64	23.0	41.2
25	19.8	35.2	65	23.4	42.4
26	20.1	37.7	66	24.3	45.6
27	19.9	37.0	67	24.2	45.8
28	18.9	36.0	68	23.9	44.0
29	21.5	40.4	69	24.7	46.3
30	21.2	40.8	70	25.0	47.1
31	21.9	39.0	71	25.2	45.2
32	20.0	35.9	72	24.4	43.9
33	19.9	35.2	73	24.8	44.1
34	20.5	37.9	74	23.8	42.8
35	20.9	39.9	75	23.9	43.0
36	21.2	40.0	76	24.7	46.3
37	22.1	41.0	77	25.2	46.4
38	21.8	39.0	78	25.1	45.9
39	19.9	37.8	79	25.5	47.2
40	19.3	35.9	80	24.8	46.2

Calculation of confidence interval for Regression Line

Value	Confidence Interval	Upper Limit	Lower Limit
x	CI	y+CI	y-CI
8	1.0	16.6	14.5
15	0.5	28.6	27.5
20	0.2	37.2	36.8
25	0.3	46.2	45.5
30	0.7	55.5	54.1
35	1.1	64.8	62.7
40	1.4	74.1	71.2
45	1.8	83.4	79.7
50	2.2	92.7	88.3
55	2.6	102.0	96.8
60	3.0	111.3	105.3

Derrived value form regression analysis

Slope, m	m	1.783	SLOPE(y,x)
Intercept, b	b	1.296	INTERCEPT(y,x)
Observations, n	n	80.000	COUNT(x)
Std error in estimate, Syx	SYX	0.993	STEYX(y,x)
Average x	XAVG	21.328	AVERAGE(x)
SSX	SSX	466.955	DEVSQ(x)
t(a,df)	t	1.665	TINV(0.1,n-2)



Statistical relationship between accelerated and standard cured compressive strength

Statistical data of PSC for accelerated and standard cured flexural strength

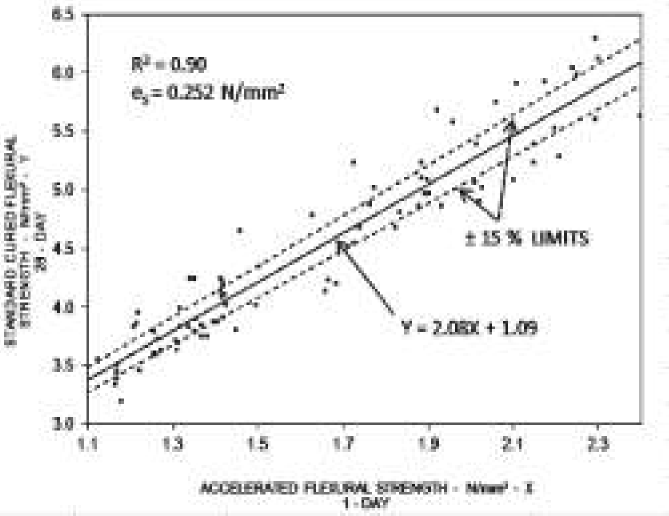
S.No	F/S of PSC 1 Day	F/S of PSC 28 Day	S.No	F/S of PSC 1 Day	F/S of PSC 28 Day
1	1.33	3.84	41	2.01	5.07
2	1.37	3.75	42	1.73	4.55
3	1.42	3.91	43	1.88	5.24
4	1.41	4.25	44	1.41	4.08
5	1.38	3.75	45	1.66	4.23
6	1.43	4.02	46	1.46	4.65
7	1.41	4.14	47	1.74	4.69
8	1.37	3.85	48	1.83	4.82
9	1.34	4.24	49	1.90	5.10
10	1.42	4.11	50	1.88	4.86
11	1.32	4.00	51	1.63	4.79
12	1.42	4.19	52	1.76	4.88
13	1.32	3.83	53	1.89	4.97
14	1.50	4.35	54	1.66	4.14
15	1.22	3.46	55	1.77	5.02
16	1.31	3.71	56	1.90	4.98
17	1.17	3.50	57	1.82	4.68
18	1.12	3.55	58	1.72	5.24
19	1.26	3.73	59	1.68	4.21
20	1.21	3.83	60	1.88	5.10
21	1.26	3.60	61	2.24	6.05
22	1.35	3.79	62	2.15	5.40
23	1.17	3.40	63	2.01	5.40
24	1.31	3.70	64	2.30	6.12
25	1.45	3.81	65	2.18	5.93
26	1.50	4.02	66	2.06	5.76
27	1.31	3.63	67	2.25	5.99
28	1.17	3.45	68	2.29	6.29
29	1.26	3.61	69	2.20	5.53
30	1.21	3.86	70	2.29	5.81
31	1.35	3.90	71	2.21	5.29
32	1.26	3.80	72	2.40	5.63
33	1.35	4.25	73	1.96	5.58
34	1.22	3.95	74	1.92	5.69
35	1.16	3.35	75	2.10	5.09
36	1.40	3.87	76	1.93	4.87
37	1.41	4.23	77	2.11	5.91
38	1.27	3.64	78	2.02	4.91
39	1.39	3.87	79	2.15	5.24
40	1.18	3.20	80	2.03	5.03

Calculation of confidence interval for Regression Line

Value	Confidence Interval	Upper Limit	Lower Limit
x	CI	y+CI	y-CI
0.00	0.19	1.28	0.90
1.00	0.08	3.26	3.09
2.00	0.06	5.32	5.20
3.00	0.16	7.50	7.18
4.00	0.27	9.70	9.16
5.00	0.38	11.89	11.13
6.00	0.49	14.09	13.10
7.00	0.60	16.29	15.08

Derrived value form regression analysis

Slope, m	m	2.084	SLOPE(y,x)
Intercept, b	b	1.088	INTERCEPT(y,x)
Observations, n	n	80.000	COUNT(x)
Std error in estimate, Syx	SYX	0.251	STEYX(y,x)
Average x	XAVG	1.633	AVERAGE(x)
SSX	SSX	10.608	DEVSQ(x)
t(a,df)	t	1.454	TINV(0.1,n-2)



Statistical relationship between accelerated and standard cured flexural strength