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Research article

Predicting Heterogeneity of Gravel Influences on Concrete Tensile Strength Partially Replaced Cement with Metakaolin Content

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Abstract

Heterogeneity of aggregate in concrete has been monitored in different developed mixed design concrete by experts applying different curing techniques. Their findings have always reflected the variation of aggregate size as one of the major influential property that determined various rates of tensile, based on its compressive strength. The behaviour are basically on the effect from aggregate shapes that reflect on the generated results on the model concrete, but other parameters that express impact on the variation rate of tensile strength are not always determined, because of the limitation of experimental techniques including the concept of ignoring these other parameters on concrete properties , these are other major significant areas that will determine various rate of tensile partially replaced cement with Metakaolin substance, the study applied modeling and simulation using derived analytical solution, the developed model generated simulation values that produced various rates of tensile strength parameters at the optimum values recorded at ninety days of curing, decrease of the tensile were observed based on the reflection of aggregate heterogeneity, compaction rate mixed time and curing techniques were experienced in the study, the impact of heterogeneous aggregate on tensile strength including variation of water cement ratios were observed, the predictive and experimental values were monitored and both parameters developed best fits. The study is imperative because the application of simulation techniques has expressed the impact of various parameters that there impact were not observed in the experimental development of concrete generating tensile strength.

Keywords: Predicting; Heterogeneity; Gravel Cement and Metakaolin

Introduction

Several studies have been carried out in various dimensions, this was carried out to monitor the application of the localized materials, and these are iron slag waste tyre and Rice husk Ash as partial replacement of cement. other materials are fine and coarse aggregates that develop strength, these type of techniques are now available in the literature [1-7], the techniques has produced high required result, the method of applying waste tyre were observed and it has generated tremendous feasibility using gargantuan amounts from waste tyre on concrete products. Experts has also applied other materials such as plastic waste, this concept become a better option because it has solved some environmental issues around the globe Choi et al. [8] current studies that familiar has examined the effect of waste PET bottles as aggregate on properties of concrete. It has been definitely yielding tremendous results because this technique of applying waste tyre and bottles has reduced by 2-6% of normal weight concrete. Marzouk et al. [9], while other studies carried out on the applications of consumed plastic bottle as waste material for partial sand replacement; the study from its thorough examinations monitored that density was lowered when the PET aggregate exceeding 50% by volume of sand. Meanwhile Suganthy et al. [10] examined the reduction in weight of concrete compared to plastic content and it experienced an increase Ode and Eluozo [11]. Marzouk [9] other research was carried out to examine the reduction of compressive strength from plastic concrete; other experts in the same vein applied techniques of partial replacement of sand with plastic. Al-Manasser and Dalal (1997) this investigation was carried out by monitoring the influence of plastic on concrete mix. It was observed that the splitting tensile strength experienced decreased as the plastic content increased. Batayneh et al. [12] express splitting tensile and flexural strength of concrete mix slump on the replacement and observed that the plastic content an increase in both materials. Numerous researchers have also investigated the strengths of plastic concrete, Batayneh et al. [12] mentioned that the integration of ground plastic in concrete and it was observed to have an effect on its compressive strength [13-15] investigated the effect of post-consumer waste plastic in concrete as a soft filer [16-20].

Theoretical Background

Nomenclature

C = Tensile Strength

D = Cementious materials

K= Concrete porosity and void ratios

2n =Water Cement Ratios

X = Curing Age

$$\frac{d}{dX} + A_{(X)}C_{(d)} = K_{(X)}C_d{}^n ; n \geq 2 \quad (1)$$

Let β = $C_d{}^{1-n}$

$$\frac{d\beta}{dX} = (1-n)C_d{}^{-n}\frac{d}{dX} \quad (2)$$

$$C_d{}^{-n}\frac{d}{yd} = \left(\frac{1}{1-n}\right)\frac{d\beta}{dX} \quad (3)$$

But $\beta = C_d{}^{1-n}$

$$C_d{}^{1-n} = 2D\exp\left[(2n-2)\int K_{(x)}dt\right] \quad (4)$$

$$C_d{}^{1-n} = D\exp[(2n-2)K_{(x)}X] \quad (5)$$

Materials and Method

Apparatus required tensile strength

1. Weights and weighing device.
2. Tools, containers and pans for carrying materials & mixing.
3. A circular cross-sectional rod (φl6mm & 600mm length).
4. Testing machine.5.
5. Three cylinders (φ150mm & 300mm in height).
6. A jig for aligning concrete cylinder and bearing strips.

Prepare three cylindrical concrete specimens following same steps as test No.32:

1. After moulding and curing the specimens for seven days in water, they can be tested.
2. Two bearings strips of nominal (1/8 in i.e 3.175mm) thick plywood, free of imperfections, approximately (25mm) wide, and of length equal to or slightly longer than that of the specimen should be provided for each specimen.
3. The bearing strips are placed between the specimen and both upper and lower bearing blocks of the testing machine or between the specimen and the supplemental bars or plates.
4. Draw diametric lines each end of the specimen using a suitable device that will ensure that they are in the same axial plane. Centre one of the plywood strips along the Centre of the lower bearing block.
5. Place the specimen on the plywood strip and align so that the lines marked on the ends of the specimen are vertical and centered over the plywood strip.
6. Place a second plywood strip lengthwise on the cylinder, centered on the lines marked on the ends of the cylinder.
7. Apply the load continuously and without shock, at a constant rate within, the range of 689 to 1380, kPa/min splitting tensile stress until failure of the specimen.
8. Record the maximum applied load indicated by the testing machine at failure. Note the type of failure and appearance of fracture.

Observations and calculations

Calculate the splitting tensile strength of the specimen as follows:

T = 2P/Ld

Where: T: splitting tensile strength, N/mm^{2}P: maximum applied load indicated by testing machine, NL: Length of the specimen, mmd: diameter of the specimen, mm

Results and Discussion

Table 1-6 and Figure 1-6.

The growth rate of the tensile strength were also linked with the behaviour the aggregate size in the various mixed proportions, the heterogeneity of the aggregates in size reflected the maximum tensile strength in different water cement ratios, based on these factors, the growth rate were affected, these are based on these influential material in the model concrete grades, this implies that the heterogeneity that reflected the surfaced area for developments of gel bond become responsible for the variations of the developed strength at various mixed proportions, these factors in the model concrete study implies that bigger aggregate size causes a more heterogeneity in the concrete which will prevent the uniform distribution of load when stressed. The shape and texture of aggregate affects the properties of fresh concrete more than hardened concrete. This implies that there would have been rapid in tensile strength if the aggregate shape has the require quality texture, because it affect the properties of fresh concrete more than harden concrete. Aggregate particles that are cubicle or spherical in shape with correct mineral composition are ideal for maximizing concrete strength. The trend observed the effect from these behaviour of aggregate heterogeneity based on these stated factors, these expressed the graphical representation on linear growth rate, but the results observed decrease in different mixed proportion based on the variation of aggregate size, the results even on exponential trend explained the decrease in strength that will definitely prevent uniformity distribution of load, other factors from the trend that decrease the tensile strength are reflection from the variation of different mixed proportion on the developed model concrete, while other are from the rate of degree of compaction, mixed time, different techniques in curing, including the variation size of the aggregate. The results from these presented figures were monitor based these expressed factors. The figures show the results on linear phase that observed the variation in all the designed parameters to determine the effect it has on tensile strength.

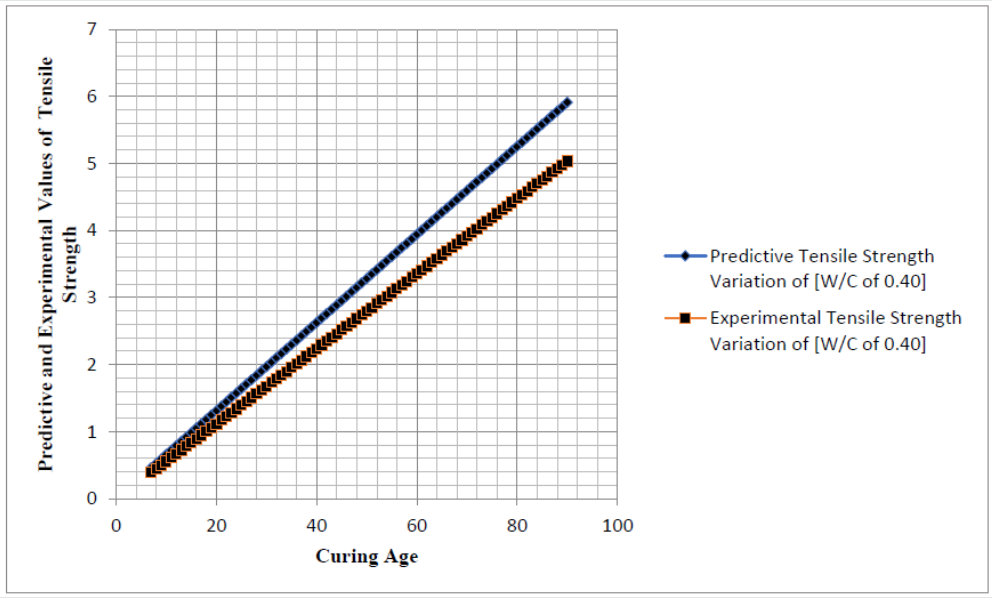

Figure 1: Predictive and Experimental Value of Split Tensile Techniques at Different Curing Age.

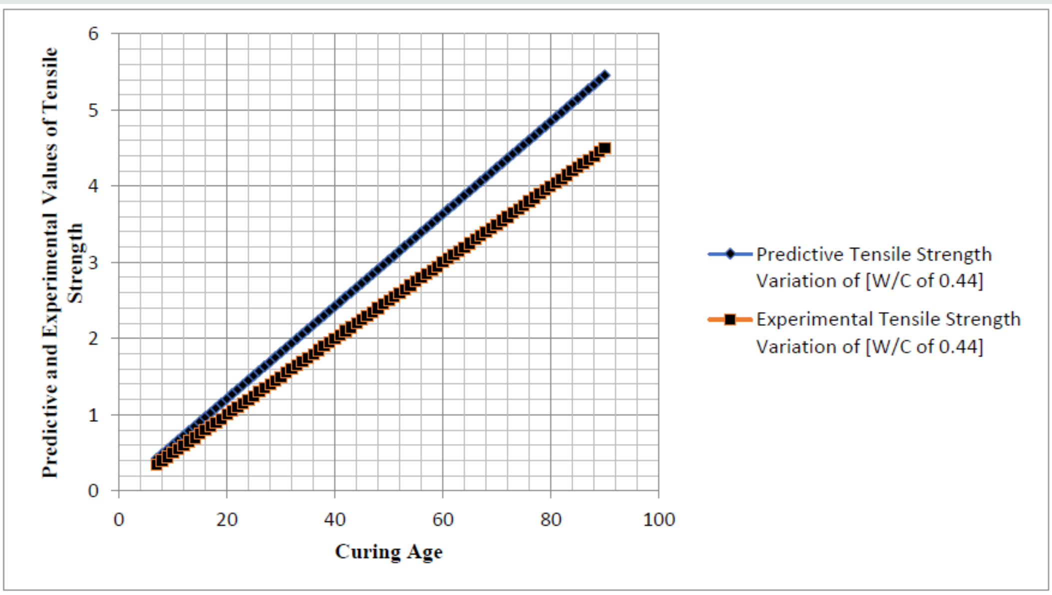

Figure 2: Predictive and Experimental Value of Split Tensile Techniques at Different Curing Age.

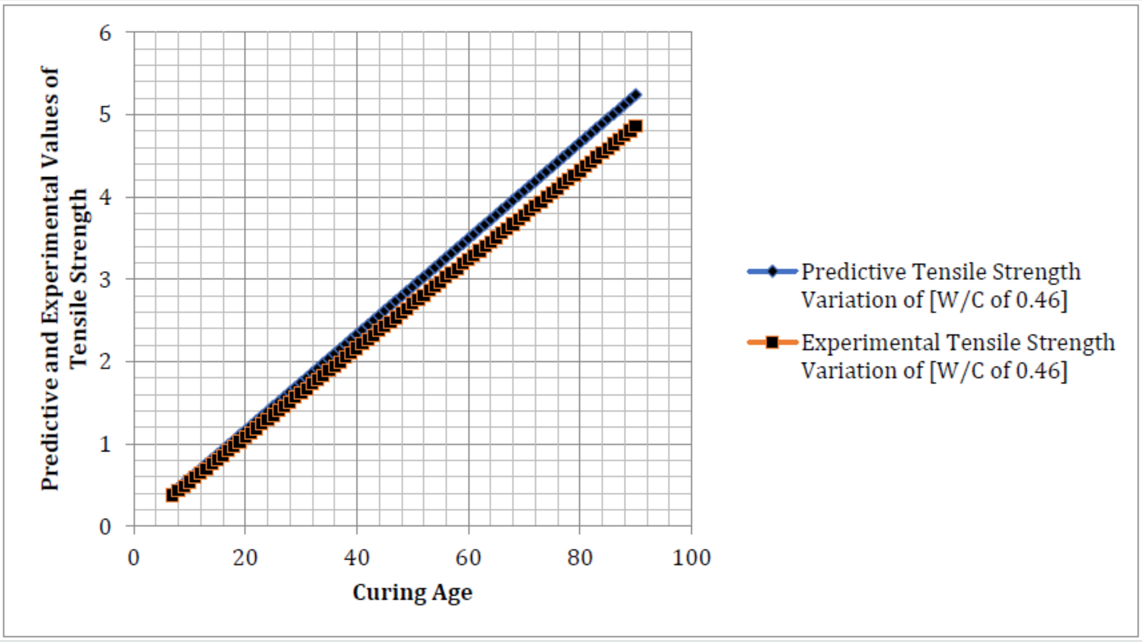

Figure 3: Predictive and Experimental Value of Split Tensile Techniques at Different Curing Age.

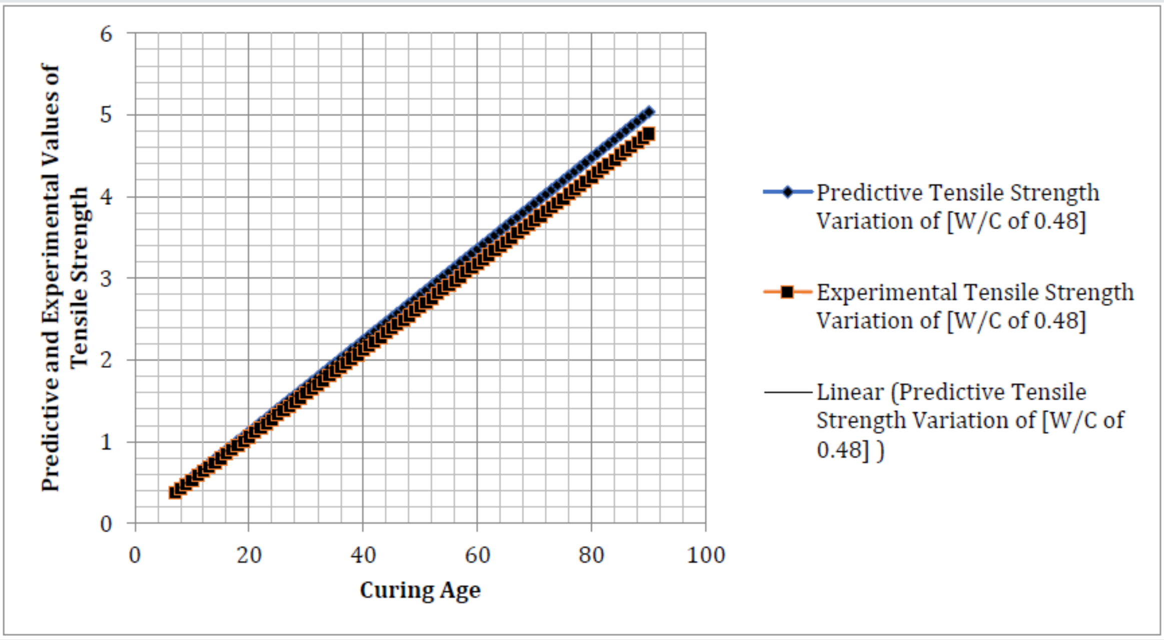

Figure 4: Predictive and Experimental Value of Split Tensile Techniques at Different Curing Age.

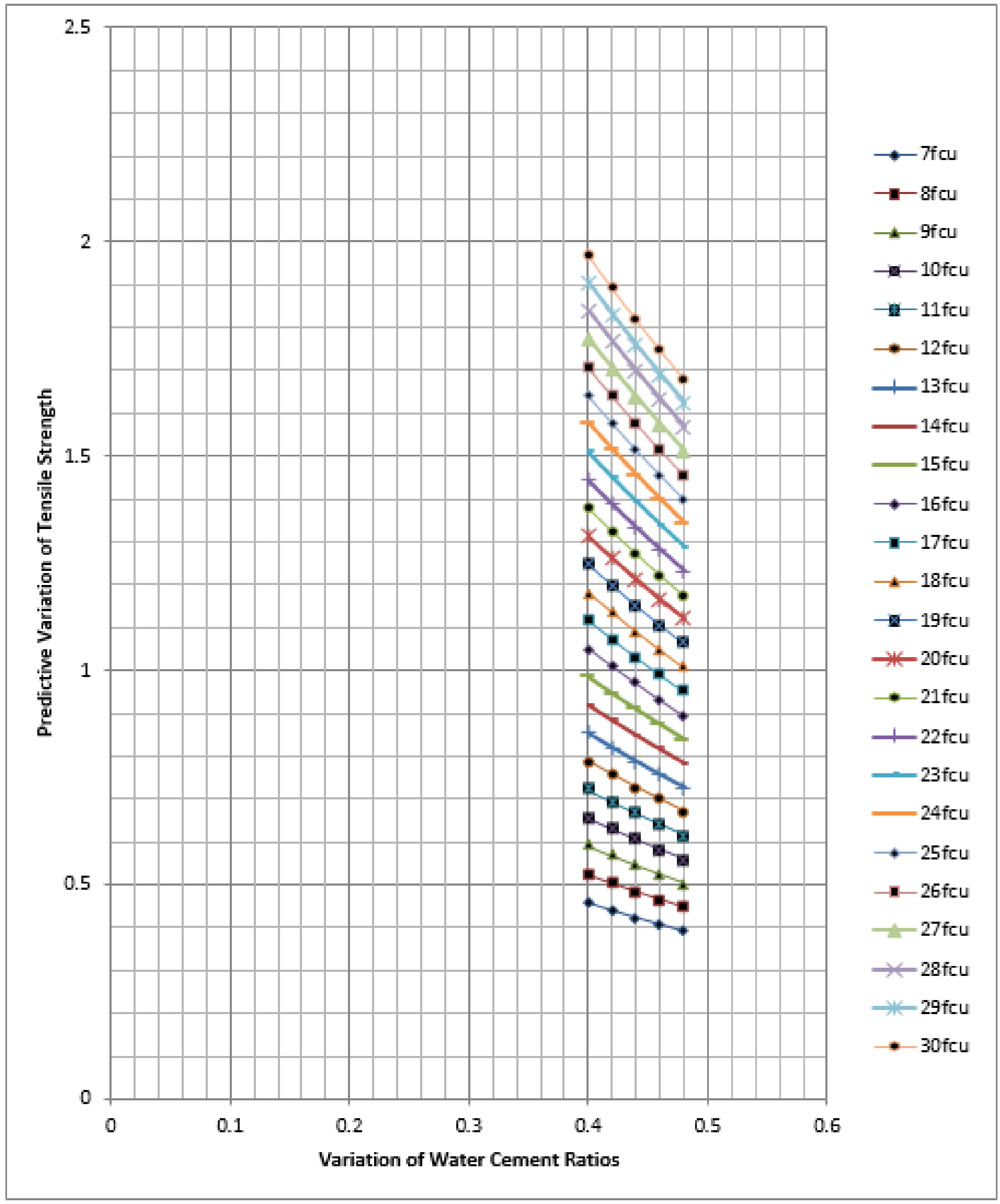

Figure 6a: Variation of Predictive Values of Split Tensile Techniques at Different Water cement Ratios Curing Age.

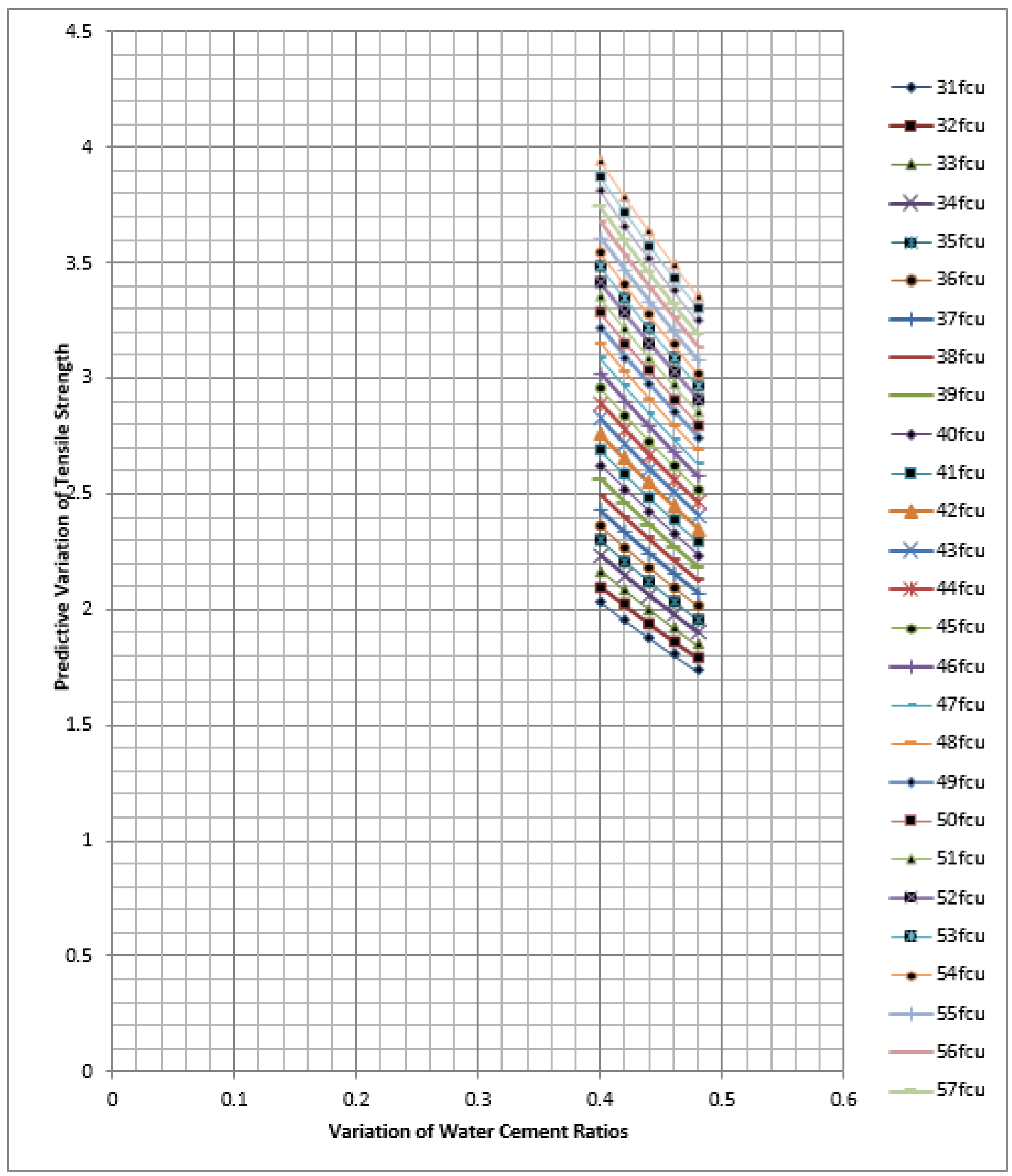

Figure 6b: Variation of Predictive Values of Split Tensile Techniques at Different Water cement Ratios Curing Age

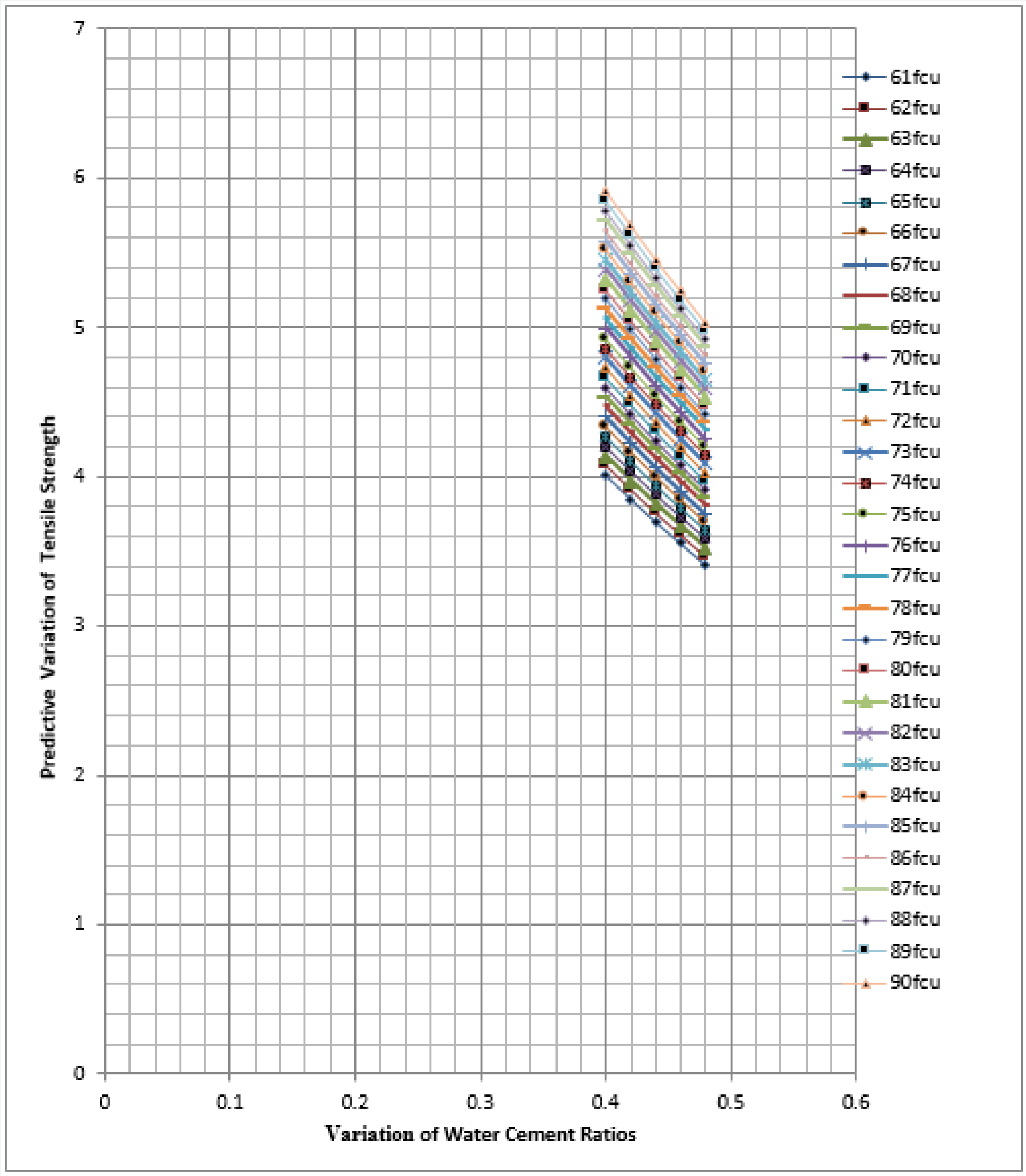

Figure 6C: Variation of Predictive Values of Split Tensile Techniques at Different Water cement Ratios Curing Age

Table 1: Predictive and Experimental Value of Split Tensile Techniques at Different Curing Age.

Curing Age	Predictive Tensile Strength Variation of [W/C of 0.40]	Experimental Tensile Strength Variation of [W/C of 0.40]
7	0.459653	0.387
8	0.525318	0.443
9	0.590982	0.499
10	0.656647	0.555
11	0.722312	0.611
12	0.787976	0.667
13	0.853641	0.723
14	0.919306	0.779
15	0.98497	0.835

16	1.050635	0.891
17	1.1163	0.947
18	1.181964	1.003
19	1.247629	1.059
20	1.313294	1.115
21	1.378958	1.171
22	1.444623	1.227
23	1.510288	1.283
24	1.575953	1.339
25	1.641617	1.395
26	1.707282	1.451
27	1.772947	1.507
28	1.838611	1.563
29	1.904276	1.619
30	1.969941	1.675
31	2.035605	1.731
32	2.10127	1.787
33	2.166935	1.843
34	2.232599	1.899
35	2.298264	1.955
36	2.363929	2.011
37	2.429593	2.067
38	2.495258	2.123
39	2.560923	2.179
40	2.626588	2.235
41	2.692252	2.291
42	2.757917	2.347
43	2.823582	2.403
44	2.889246	2.459
45	2.954911	2.515
46	3.020576	2.571
47	3.08624	2.627
48	3.151905	2.683
49	3.21757	2.739
50	3.283234	2.795
51	3.348899	2.851
52	3.414564	2.907
53	3.480228	2.963
54	3.545893	3.019
55	3.611558	3.075
56	3.677223	3.131
57	3.742887	3.187
58	3.808552	3.243
59	3.874217	3.299
60	3.939881	3.355
61	4.005546	3.411
62	4.071211	3.467
63	4.136875	3.523

64	4.20254	3.579
65	4.268205	3.635
66	4.333869	3.691
67	4.399534	3.747
68	4.465199	3.803
69	4.530863	3.859
70	4.596528	3.915
71	4.662193	3.971
72	4.727858	4.027
73	4.793522	4.083
74	4.859187	4.139
75	4.924852	4.195
76	4.990516	4.251
77	5.056181	4.307
78	5.121846	4.363
79	5.18751	4.419
80	5.253175	4.475
81	5.31884	4.531
82	5.384504	4.587
83	5.450169	4.643
84	5.515834	4.699
85	5.581498	4.755
86	5.647163	4.811
87	5.712828	4.867
88	5.778493	4.923
89	5.844157	4.979
90	5.909822	5.035

Table 2: Predictive and Experimental Value of Split Tensile Techniques at Different Curing Age.

Curing Age	Predictive Tensile Strength Variation of [W/C of 0.42]	Experimental Tensile Strength Variation of [W/C of 0.42]
7	0.44163	0.371
8	0.50472	0.424
9	0.567809	0.477
10	0.630899	0.53
11	0.693989	0.583
12	0.757079	0.636
13	0.820169	0.689
14	0.883259	0.742
15	0.946349	0.795
16	1.009439	0.848
17	1.072529	0.901
18	1.135619	0.954
19	1.198709	1.007
20	1.261799	1.06
21	1.324889	1.113
22	1.387979	1.166
23	1.451069	1.219

24	1.514159	1.272
25	1.577248	1.325
26	1.640338	1.378
27	1.703428	1.431
28	1.766518	1.484
29	1.829608	1.537
30	1.892698	1.59
31	1.955788	1.643
32	2.018878	1.696
33	2.081968	1.749
34	2.145058	1.802
35	2.208148	1.855
36	2.271238	1.908
37	2.334328	1.961
38	2.397418	2.014
39	2.460508	2.067
40	2.523598	2.12
41	2.586687	2.173
42	2.649777	2.226
43	2.712867	2.279
44	2.775957	2.332
45	2.839047	2.385
46	2.902137	2.438
47	2.965227	2.491
48	3.028317	2.544
49	3.091407	2.597
50	3.154497	2.65
51	3.217587	2.703
52	3.280677	2.756
53	3.343767	2.809
54	3.406857	2.862
55	3.469947	2.915
56	3.533037	2.968
57	3.596127	3.021
58	3.659216	3.074
59	3.722306	3.127
60	3.785396	3.18
61	3.848486	3.233
62	3.911576	3.286
63	3.974666	3.339
64	4.037756	3.392
65	4.100846	3.445
66	4.163936	3.498
67	4.227026	3.551
68	4.290116	3.604
69	4.353206	3.657
70	4.416296	3.71

71	4.479386	3.763
72	4.542476	3.816
73	4.605566	3.869
74	4.668655	3.922
75	4.731745	3.975
76	4.794835	4.028
77	4.857925	4.081
78	4.921015	4.134
79	4.984105	4.187
80	5.047195	4.24
81	5.110285	4.293
82	5.173375	4.346
83	5.236465	4.399
84	5.299555	4.452
85	5.362645	4.505
86	5.425735	4.558
87	5.488825	4.611
88	5.551915	4.664
89	5.615005	4.717
90	5.678094	4.77

Table 3: Predictive and Experimental Value of Split Tensile Techniques at Different Curing Age.

Curing Age	Predictive Tensile Strength Variation of [W/C of 0.44]	Experimental Tensile Strength Variation of [W/C of 0.44]
7	0.424313	0.35
8	0.484929	0.4
9	0.545545	0.45
10	0.606161	0.5
11	0.666778	0.55
12	0.727394	0.6
13	0.78801	0.65
14	0.848626	0.7
15	0.909242	0.75
16	0.969858	0.8
17	1.030474	0.85
18	1.091091	0.9
19	1.151707	0.95
20	1.212323	1
21	1.272939	1.05
22	1.333555	1.1
23	1.394171	1.15
24	1.454788	1.2
25	1.515404	1.25
26	1.57602	1.3
27	1.636636	1.35
28	1.697252	1.4
29	1.757868	1.45
30	1.818484	1.5

31	1.879101	1.55
32	1.939717	1.6
33	2.000333	1.65
34	2.060949	1.7
35	2.121565	1.75
36	2.182181	1.8
37	2.242797	1.85
38	2.303414	1.9
39	2.36403	1.95
40	2.424646	2
41	2.485262	2.05
42	2.545878	2.1
43	2.606494	2.15
44	2.66711	2.2
45	2.727727	2.25
46	2.788343	2.3
47	2.848959	2.35
48	2.909575	2.4
49	2.970191	2.45
50	3.030807	2.5
51	3.091423	2.55
52	3.15204	2.6
53	3.212656	2.65
54	3.273272	2.7
55	3.333888	2.75
56	3.394504	2.8
57	3.45512	2.85
58	3.515737	2.9
59	3.576353	2.95
60	3.636969	3
61	3.697585	3.05
62	3.758201	3.1
63	3.818817	3.15
64	3.879433	3.2
65	3.94005	3.25
66	4.000666	3.3
67	4.061282	3.35
68	4.121898	3.4
69	4.182514	3.45
70	4.24313	3.5
71	4.303746	3.55
72	4.364363	3.6
73	4.424979	3.65
74	4.485595	3.7
75	4.546211	3.75
76	4.606827	3.8
77	4.667443	3.85

78	4.728059	3.9
79	4.788676	3.95
80	4.849292	4
81	4.909908	4.05
82	4.970524	4.1
83	5.03114	4.15
84	5.091756	4.2
85	5.152372	4.25
86	5.212989	4.3
87	5.273605	4.35
88	5.334221	4.4
89	5.394837	4.45
90	5.455453	4.5

Table 4: Predictive and Experimental Value of Split Tensile Techniques at Different Curing Age.

Curing Age	Predictive Tensile Strength Variation of [W/C of 0.46]	Experimental Tensile Strength Variation of [W/C of 0.46]
7	0.407675	0.378
8	0.465915	0.432
9	0.524154	0.486
10	0.582394	0.54
11	0.640633	0.594
12	0.698872	0.648
13	0.757112	0.702
14	0.815351	0.756
15	0.87359	0.81
16	0.93183	0.864
17	0.990069	0.918
18	1.048308	0.972
19	1.106548	1.026
20	1.164787	1.08
21	1.223026	1.134
22	1.281266	1.188
23	1.339505	1.242
24	1.397744	1.296
25	1.455984	1.35
26	1.514223	1.404
27	1.572463	1.458
28	1.630702	1.512
29	1.688941	1.566
30	1.747181	1.62
31	1.80542	1.674
32	1.863659	1.728
33	1.921899	1.782
34	1.980138	1.836
35	2.038377	1.89
36	2.096617	1.944
37	2.154856	1.998

38	2.213095	2.052
39	2.271335	2.106
40	2.329574	2.16
41	2.387814	2.214
42	2.446053	2.268
43	2.504292	2.322
44	2.562532	2.376
45	2.620771	2.43
46	2.67901	2.484
47	2.73725	2.538
48	2.795489	2.592
49	2.853728	2.646
50	2.911968	2.7
51	2.970207	2.754
52	3.028446	2.808
53	3.086686	2.862
54	3.144925	2.916
55	3.203164	2.97
56	3.261404	3.024
57	3.319643	3.078
58	3.377883	3.132
59	3.436122	3.186
60	3.494361	3.24
61	3.552601	3.294
62	3.61084	3.348
63	3.669079	3.402
64	3.727319	3.456
65	3.785558	3.51
66	3.843797	3.564
67	3.902037	3.618
68	3.960276	3.672
69	4.018515	3.726
70	4.076755	3.78
71	4.134994	3.834
72	4.193233	3.888
73	4.251473	3.942
74	4.309712	3.996
75	4.367952	4.05
76	4.426191	4.104
77	4.48443	4.158
78	4.54267	4.212
79	4.600909	4.266
80	4.659148	4.32
81	4.717388	4.374
82	4.775627	4.428
83	4.833866	4.482
84	4.892106	4.536
85	4.950345	4.59

86	5.008584	4.644
87	5.066824	4.698
88	5.125063	4.752
89	5.183302	4.806
90	5.241542	4.86

Table 5: Predictive and Experimental Value of Split Tensile Techniques at Different Curing Age.

Curing Age	Predictive Tensile Strength Variation of [W/C of 0.48]	Experimental Tensile Strength Variation of [W/C of 0.48]
7	0.39169	0.371
8	0.447646	0.424
9	0.503602	0.477
10	0.559558	0.53
11	0.615513	0.583
12	0.671469	0.636
13	0.727425	0.689
14	0.783381	0.742
15	0.839336	0.795
16	0.895292	0.848
17	0.951248	0.901
18	1.007204	0.954
19	1.063159	1.007
20	1.119115	1.06
21	1.175071	1.113
22	1.231027	1.166
23	1.286982	1.219
24	1.342938	1.272
25	1.398894	1.325
26	1.45485	1.378
27	1.510805	1.431
28	1.566761	1.484
29	1.622717	1.537
30	1.678673	1.59
31	1.734628	1.643
32	1.790584	1.696
33	1.84654	1.749
34	1.902496	1.802
35	1.958451	1.855
36	2.014407	1.908
37	2.070363	1.961
38	2.126319	2.014
39	2.182274	2.067
40	2.23823	2.12
41	2.294186	2.173
42	2.350142	2.226
43	2.406098	2.279
44	2.462053	2.332
45	2.518009	2.385

46	2.573965	2.438
47	2.629921	2.491
48	2.685876	2.544
49	2.741832	2.597
50	2.797788	2.65
51	2.853744	2.703
52	2.909699	2.756
53	2.965655	2.809
54	3.021611	2.862
55	3.077567	2.915
56	3.133522	2.968
57	3.189478	3.021
58	3.245434	3.074
59	3.30139	3.127
60	3.357345	3.18
61	3.413301	3.233
62	3.469257	3.286
63	3.525213	3.339
64	3.581168	3.392
65	3.637124	3.445
66	3.69308	3.498
67	3.749036	3.551
68	3.804991	3.604
69	3.860947	3.657
70	3.916903	3.71
71	3.972859	3.763
72	4.028814	3.816
73	4.08477	3.869
74	4.140726	3.922
75	4.196682	3.975
76	4.252637	4.028
77	4.308593	4.081
78	4.364549	4.134
79	4.420505	4.187
80	4.47646	4.24
81	4.532416	4.293
82	4.588372	4.346
83	4.644328	4.399
84	4.700284	4.452
85	4.756239	4.505
86	4.812195	4.558
87	4.868151	4.611
88	4.924107	4.664
89	4.980062	4.717
90	5.036018	4.77

Table 6a: Variation of Predictive Values of Split Tensile Techniques at Different Water cement Ratios Curing Age.

Variation of [W/C] on Tensile strength	0.4	0.42	0.44	0.46	0.48
7fcu	0.459653	0.44163	0.424313	0.407675	0.39169
8fcu	0.525318	0.50472	0.484929	0.465915	0.447646
9fcu	0.590982	0.567809	0.545545	0.524154	0.503602
10fcu	0.656647	0.630899	0.606161	0.582394	0.559558
11fcu	0.722312	0.693989	0.666778	0.640633	0.615513
12fcu	0.787976	0.757079	0.727394	0.698872	0.671469
13fcu	0.853641	0.820169	0.78801	0.757112	0.727425
14fcu	0.919306	0.883259	0.848626	0.815351	0.783381
15fcu	0.98497	0.946349	0.909242	0.87359	0.839336
16fcu	1.050635	1.009439	0.969858	0.93183	0.895292
17fcu	1.1163	1.072529	1.030474	0.990069	0.951248
18fcu	1.181964	1.135619	1.091091	1.048308	1.007204
19fcu	1.247629	1.198709	1.151707	1.106548	1.063159
20fcu	1.313294	1.261799	1.212323	1.164787	1.119115
21fcu	1.378958	1.324889	1.272939	1.223026	1.175071
22fcu	1.444623	1.387979	1.333555	1.281266	1.231027
23fcu	1.510288	1.451069	1.394171	1.339505	1.286982
24fcu	1.575953	1.514159	1.454788	1.397744	1.342938
25fcu	1.641617	1.577248	1.515404	1.455984	1.398894
26fcu	1.707282	1.640338	1.57602	1.514223	1.45485
27fcu	1.772947	1.703428	1.636636	1.572463	1.510805
28fcu	1.838611	1.766518	1.697252	1.630702	1.566761
29fcu	1.904276	1.829608	1.757868	1.688941	1.622717
30fcu	1.969941	1.892698	1.818484	1.747181	1.678673

Table 6b: Variation of Predictive Values of Split Tensile Techniques at Different Water cement Ratios Curing Age.

Variation of [W/C] on Tensile strength	0.4	0.42	0.44	0.46	0.48
31fcu	2.035605	1.955788	1.879101	1.80542	1.734628
32fcu	2.10127	2.018878	1.939717	1.863659	1.790584
33fcu	2.166935	2.081968	2.000333	1.921899	1.84654
34fcu	2.232599	2.145058	2.060949	1.980138	1.902496
35fcu	2.298264	2.208148	2.121565	2.038377	1.958451
36fcu	2.363929	2.271238	2.182181	2.096617	2.014407
37fcu	2.429593	2.334328	2.242797	2.154856	2.070363
38fcu	2.495258	2.397418	2.303414	2.213095	2.126319
39fcu	2.560923	2.460508	2.36403	2.271335	2.182274
40fcu	2.626588	2.523598	2.424646	2.329574	2.23823
41fcu	2.692252	2.586687	2.485262	2.387814	2.294186
42fcu	2.757917	2.649777	2.545878	2.446053	2.350142
43fcu	2.823582	2.712867	2.606494	2.504292	2.406098
44fcu	2.889246	2.775957	2.66711	2.562532	2.462053
45fcu	2.954911	2.839047	2.727727	2.620771	2.518009
46fcu	3.020576	2.902137	2.788343	2.67901	2.573965
47fcu	3.08624	2.965227	2.848959	2.73725	2.629921

48fcu	3.151905	3.028317	2.909575	2.795489	2.685876
49fcu	3.21757	3.091407	2.970191	2.853728	2.741832
50fcu	3.283234	3.154497	3.030807	2.911968	2.797788
51fcu	3.348899	3.217587	3.091423	2.970207	2.853744
52fcu	3.414564	3.280677	3.15204	3.028446	2.909699
53fcu	3.480228	3.343767	3.212656	3.086686	2.965655
54fcu	3.545893	3.406857	3.273272	3.144925	3.021611
55fcu	3.611558	3.469947	3.333888	3.203164	3.077567
56fcu	3.677223	3.533037	3.394504	3.261404	3.133522
57fcu	3.742887	3.596127	3.45512	3.319643	3.189478
58fcu	3.808552	3.659216	3.515737	3.377883	3.245434
59fcu	3.874217	3.722306	3.576353	3.436122	3.30139
60fcu	3.939881	3.785396	3.636969	3.494361	3.357345

Table 6C: Variation of Predictive Values of Split Tensile Techniques at Different Water cement Ratios Curing Age.

Predictive Variation of [W/C] on Tensile strength	0.4	0.42	0.44	0.46	0.48
61fcu	4.005546	3.848486	3.697585	3.552601	3.413301
62fcu	4.071211	3.911576	3.758201	3.61084	3.469257
63fcu	4.136875	3.974666	3.818817	3.669079	3.525213
64fcu	4.20254	4.037756	3.879433	3.727319	3.581168
65fcu	4.268205	4.100846	3.94005	3.785558	3.637124
66fcu	4.333869	4.163936	4.000666	3.843797	3.69308
67fcu	4.399534	4.227026	4.061282	3.902037	3.749036
68fcu	4.465199	4.290116	4.121898	3.960276	3.804991
69fcu	4.530863	4.353206	4.182514	4.018515	3.860947
70fcu	4.596528	4.416296	4.24313	4.076755	3.916903
71fcu	4.662193	4.479386	4.303746	4.134994	3.972859
72fcu	4.727858	4.542476	4.364363	4.193233	4.028814
73fcu	4.793522	4.605566	4.424979	4.251473	4.08477
74fcu	4.859187	4.668655	4.485595	4.309712	4.140726
75fcu	4.924852	4.731745	4.546211	4.367952	4.196682
76fcu	4.990516	4.794835	4.606827	4.426191	4.252637
77fcu	5.056181	4.857925	4.667443	4.48443	4.308593
78fcu	5.121846	4.921015	4.728059	4.54267	4.364549
79fcu	5.18751	4.984105	4.788676	4.600909	4.420505
80fcu	5.253175	5.047195	4.849292	4.659148	4.47646
81fcu	5.31884	5.110285	4.909908	4.717388	4.532416
82fcu	5.384504	5.173375	4.970524	4.775627	4.588372
83fcu	5.450169	5.236465	5.03114	4.833866	4.644328
84fcu	5.515834	5.299555	5.091756	4.892106	4.700284
85fcu	5.581498	5.362645	5.152372	4.950345	4.756239
86fcu	5.647163	5.425735	5.212989	5.008584	4.812195
87fcu	5.712828	5.488825	5.273605	5.066824	4.868151
88fcu	5.778493	5.551915	5.334221	5.125063	4.924107
89fcu	5.844157	5.615005	5.394837	5.183302	4.980062
90fcu	5.909822	5.678094	5.455453	5.241542	5.036018

Conclusion

The aggregate size were observed in this study to monitor the rate of effect it has on the tensile strength of concrete, this was applied using Metakaolin as partial replacement of cement, aggregate sized applied on the study were heterogeneous in size, the results were generated from applied modeling and simulation through analytical solutions, the results generated linear trend were the optimum values were observed at ninety days of curing, the results at various mixed design experienced heterogeneity in tensile strength, this condition were based on the reflection of concrete property from aggregate variations in size, the compaction and this type of curing application based these condition including environmental factors. The simulation considered these parameters in the system to ensure that the influential reflections of these parameters are observed in the system. The study has expressed the variation impact on the aggregate heterogeneity based on the water cement ratios, the study observed the trend experiencing decrease in tensile as the water cement ratios increase, this implies that the behaviour of aggregate heterogeneity reflection stand out on its own, these are based on its major impact on the bond that is established on concrete materials as a property. The simulation monitored the behaviour of other concrete properties, but established precise reflection of impacts from the variation of aggregate size in the designed model concrete, the study is imperative because the rate of aggregate heterogeneity has been determined on various water cement ratios reflection through aggregate heterogeneous state in model concrete.

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