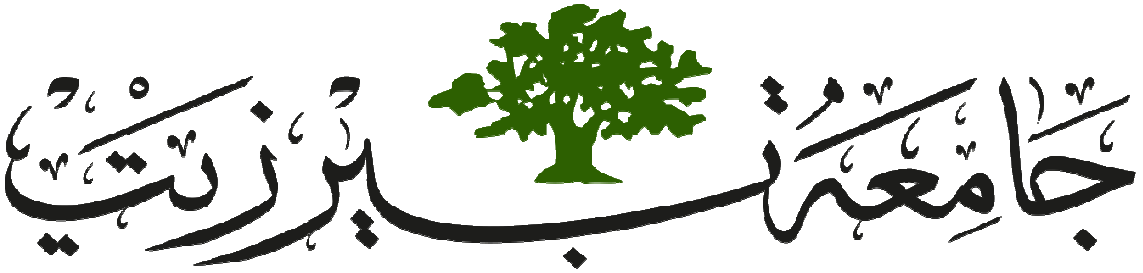

Faulty of Engineering and Technology

Civil Engineering Department

Construction Materials Laboratory

ENCE215

Experiment :

" Crushing "

Instructors :

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Eng. Nasser

Done by Group D :

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Date of performing the experiment : 17/6/2020

Date of submitting the experiment : 12/8/2020

Contents :

Introduction :

Crushing tests are universally used for determining the strength of concrete and the standard test measures the crushing strength at an age of 28 days after mixing .

Because of the time delay in obtaining the test results for concrete crushing strength ,it is often very difficult or expensive to take remedial action if the test results are unsatisfactory. It is, therefore, essential to continuously control all aspects of concrete production so that the concrete very rarely fails in crushing strength tests .

Crushing strength tests may be carried out on either cylinders or cubes made in standard moulds, cured under standard conditions and crushed in a standard manner. Any variations in the methods of manufacture, curing or testing may affect the final results and all these aspects require careful control .

For Crushing operations , We smashed three kinds of pieces :

1- Small Cubes

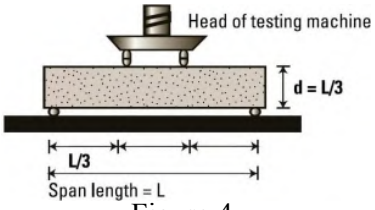
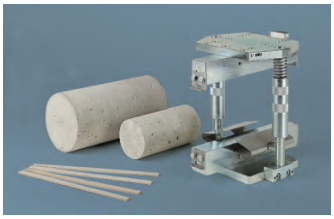
2- Prism

3 – Cylinders

Purpose :

1- Determining the strength of concrete and the standard test measures the crushing strength at an age of 28 days after mixing **.**
2- Essential to continuously control all aspects of concrete production so that the concrete very rarely fails in crushing strength tests .

Materials and Equipment's :

Equipment	The name of it :	Equipment	The name of it :
 Figure 1	**Small concrete cube**	 Figure 2	**Prism**
 Figure 3	**Concrete cylinders**	 Figure 4	**Point loading apparatus capable**
 Figure 5	**Apparatus for aligning the specimen**	 Figure 6	**Testing machine capable of applying load continuously**

" Table 1 "

Procedure :

A – Procedure for small and large cubes " Prism " :

- Remove the specimen from the curing facility just prior to testing. Specimens shall be tested while still in a moist condition.
- Measure the dimensions for all cubes.
- Record the weight of all of the specimens as SSD and soaked in water.
- Center the specimens in the testing machine and load at the prescribed rate of 0.14 to 0.34 MPa/s (20 to 50 psi/s).
- Load to failure .
- Record the ultimate load, the angle of fracture, and any other pertinent aspects of failure such as voids.

B – Procedure for Cylinders :

- Remove the specimen from the curing facility just prior to testing. Specimens shall be tested while still in a moist condition.
- Measure the diameter of the specimen, determined at right angles to each other about mid-height of the specimen. Average the two values to the nearest 0.25 mm (0.01 in.).
- Center the capped specimens in the testing machine and load at the prescribed rate of 0.14 to 0.34 MPa/s (20 to 50 psi/s).
- Load to failure.
- Record the ultimate load, the angle of fracture, and any other pertinent aspects of failure such as voids.

Data and Calculations :

Data Sheet for Prism Flexural strength			
W/c	**age at Testing**	**Type**	**F (Kg/m)**
0.5	28	Prism	2500
0.55	28	Prism	2000
0.6	28	Prism	940
0.65	28	Prism	600

Let the area of the prism = (10 * 10) cm^2

Data Sheet for Crushing of Concrete cylinder-d				
W/c	age at Testing	Type	F (KN)	□ (Mpa)
0.5	28	small cylinder	513	51.3
0.5	28	large cylinder	469	46.9
0.55	28	small cylinder	417	41.7
0.55	28	large cylinder	408	40.8
0.6	28	small cylinder	321	32.1
0.6	28	large cylinder	316	31.6
0.65	28	small cylinder	261	26.1
0.65	28	large cylinder	214	21.4

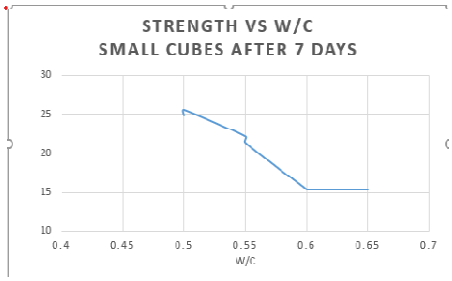
Data Sheet for Crushing of Concrete cubes-D									
W/c	age at Testing	Type	Dimension	W in air	W in water	Vol. (cm^3)	D (gr/cm^3)	F (KN)	□ (MPa)
0.5	7	small cube	10 * 10 * 10	2.402	1.339	1063	2.260	248	24.8
0.5	7	small cube	10 * 10 * 10	2.403	1.338	1065	2.256	255	25.5
0.5	14	small cube	10 * 10 * 10	2.425	1.347	1078	2.250	303	30.3
0.5	14	small cube	10 * 10 * 10	2.322	1.29	1032	2.250	304	30.4
0.5	21	small cube	10 * 10 * 10	2.26	1.302	958	2.359	316	31.6
0.5	28	small cube	10 * 10 * 10	2.453	1.37	1083	2.265	369	36.9
0.55	7	small cube	10 * 10 * 10	2.408	1.339	1069	2.253	221	22.1
0.55	7	small cube	10 * 10 * 10	2.435	1.353	1082	2.250	213	21.3
0.55	14	small cube	10 * 10 * 10	2.455	1.421	1034	2.374	233	23.3
0.55	14	small cube	10 * 10 * 10	2.448	1.44	1008	2.429	225	22.5
0.55	21	small cube	10 * 10 * 10	2.31	1.39	920	2.511	305	30.5
0.55	28	small cube	10 * 10 * 10	2.424	1.335	1089	2.226	357	35.7
0.6	7	small cube	10 * 10 * 10	2.32	1.253	1067	2.174	153	15.3
0.6	7	small cube	10 * 10 * 10	2.283	1.235	1048	2.178	153	15.3
0.6	14	small cube	10 * 10 * 10	2.318	1.26	1058	2.191	209	20.9
0.6	14	small cube	10 * 10 * 10	2.347	1.28	1067	2.200	198	19.8
0.6	21	small cube	10 * 10 * 10	2.35	1.39	960	2.448	276	27.6
0.6	28	small cube	10 * 10 * 10	2.433	1.369	1064	2.287	291	29.1
0.65	7	small cube	10 * 10 * 10	2.257	1.371	886	2.547	153	15.3
0.65	7	small cube	10 * 10 * 10	2.348	1.281	1067	2.201	153	15.3
0.65	14	small cube	10 * 10 * 10	2.356	1.4	956	2.464	177	17.7
0.65	14	small cube	10 * 10 * 10	2.354	1.396	958	2.457	179	17.9
0.65	21	small cube	10 * 10 * 10	2.4	1.49	910	2.637	197	19.7

0.65	28	small cube	10 * 10 * 10	2.551	1.495	1056	2.416	198	19.8
0.5	28	large cubes	15 * 15 * 15	3.145	2.081	1064	2.956	703	31.24
0.55	28	large cubes	15 * 15 * 15	3.151	2.179	972	3.242	609	27.067
0.6	28	large cubes	15 * 15 * 15	3.246	2.171	1075	3.020	513	22.8
0.65	28	large cubes	15 * 15 * 15	3.345	2.266	1079	3.100	546	24.267

$$\text{Stress} = \frac{\text{Force} * 10^3 \text{ (N)}}{\text{Area} * 10^2 \text{ (mm}^2\text{)}} = \text{MPa}$$

Drawings of required curves:

(1 – 4) : □ VS W/C (Small Cubes) after (7 , 14 , 21 , 28) days
(5) : □ VS W/C (Large Cubes) after 28 days
(6-9) : □ VS D (Small Cubes **)**
(10-13) : □ VS T (Small Cubes **)**
(14) : □ VS W/C (Large Cylinders)
(15) : Small Cylinders load VS Large Cylinders load
(16) : Force " Load " VS W/C (Splitting Test)
(17) : □ VS T (Flexure Prism **)**



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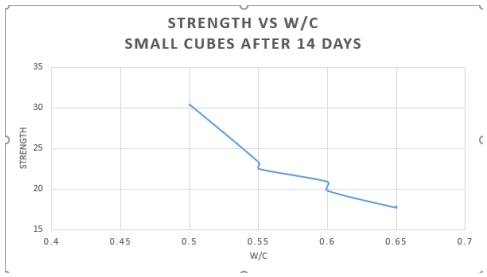

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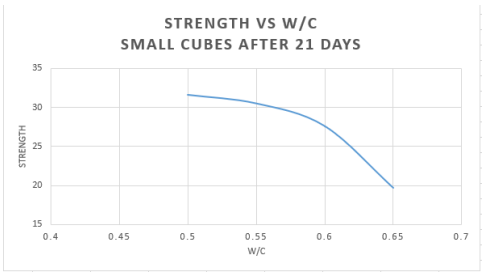

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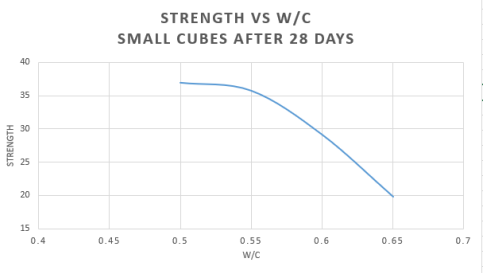

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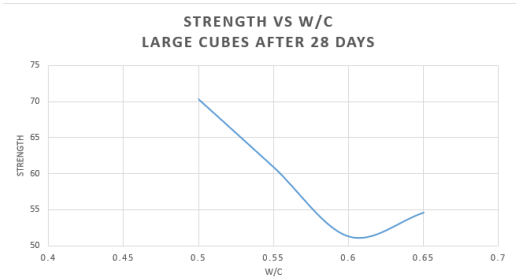
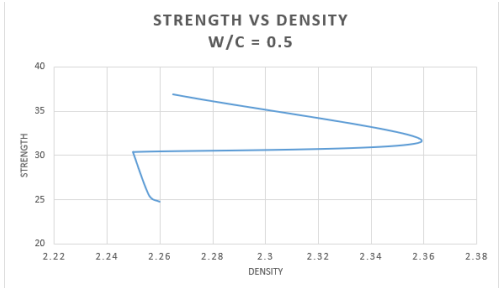
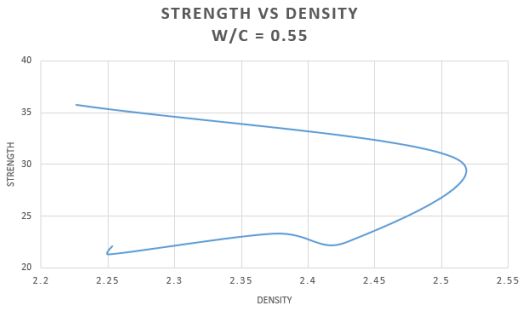

STRENGTH VS W/C
LARGE CUBES AFTER 28 DAYS
STRENGTH
W/C

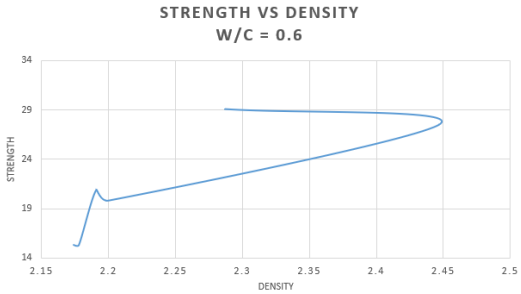
(5)


STRENGTH VS DENSITY
W/C = 0.5
STRENGTH
DENSITY

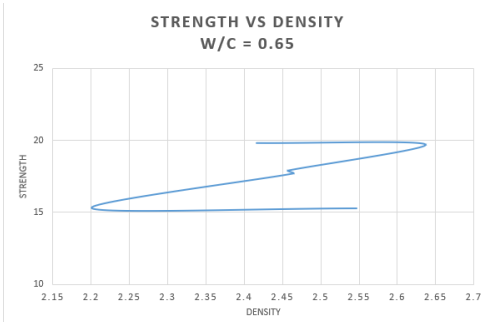
(6)


STRENGTH VS DENSITY
W/C = 0.55
STRENGTH
DENSITY

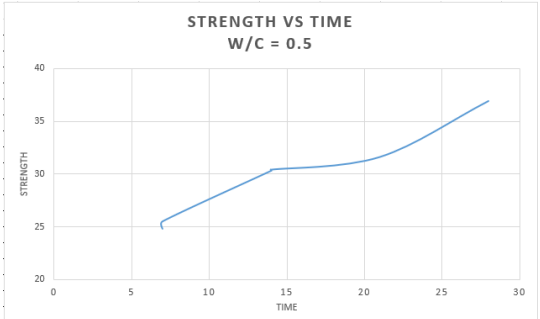
(7)


STRENGTH VS DENSITY
W/C = 0.6
STRENGTH
DENSITY

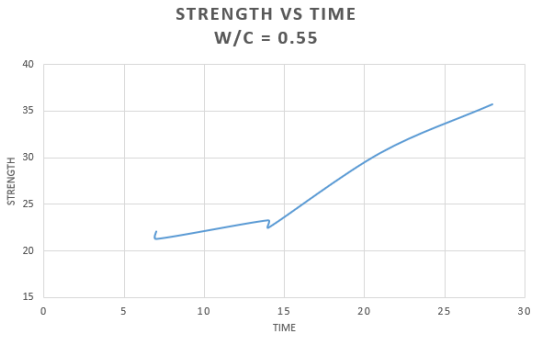
(8)


STRENGTH VS DENSITY
W/C = 0.65
STRENGTH
DENSITY

(9)


STRENGTH VS TIME
W/C = 0.5
STRENGTH
TIME

(10)



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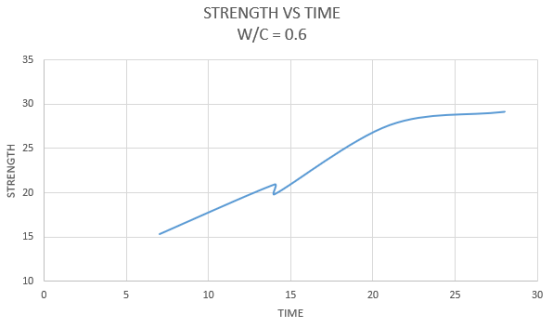

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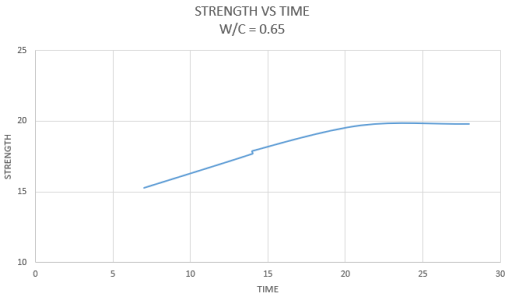

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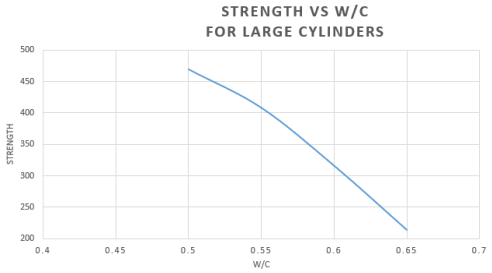

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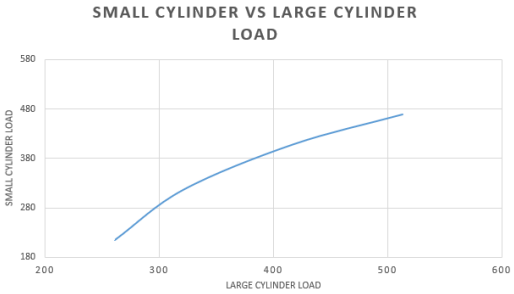

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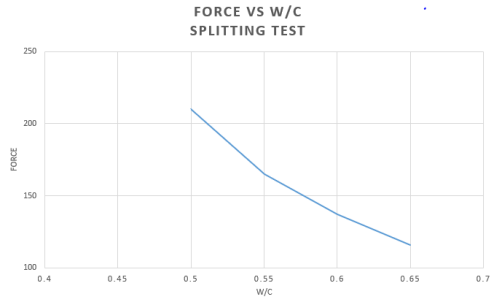

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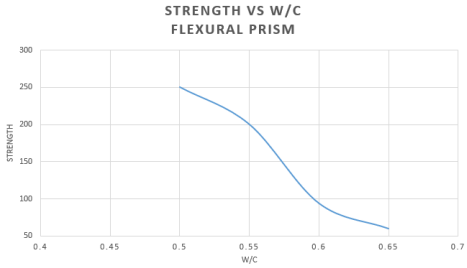

(17)

Result and Conclusion :

The relationship for all types of specimens between the strength and w/c ratio is inversely proportional because of increasing in porosity and voids in concrete specimens that decreases the cohesion between molecules and decreasing the strength with some errors in some data when testing or designing .

The relationship for small cubes between strength and average density is linearly proportional since increasing the density increases the cement paste /volume and that increases the adhesion between molecules and strength .

Average strength of the whole small cubes increases when the time increases since the increasing in the age raise the hydration process of concrete and gaining some strength to concrete and rigidity increasing also .

The relationship between large and large cylinders strength and large cubes is linearly proportional. The relationship between large and large cylinders strength and small cylinders is linearly proportional .

There are some errors in the experiment including the following:

1- some moisture remains on the surface of specimen

2- the rapid change in the load rating when crushing the specimens

3- errors in the job mix design calculations

4- insufficient curing of the specimens

5- improper readings of the measurements during the crushing

6- inaccurate weighting of material

7- improper vibrating of concrete in handling process

References:

- Lab Manual ENCE215
- Bungey, J.H., Millard , S.G. and Grantham, M.G.(2006). Testing of Concrete in Structures. 4 th ed. Taylor & Francis: London.
- Mustafa abedmosa (2017) . Construction Materials Laboratory.
- Concrete, S. Mindess, J. Young. Prentice-Hall, New Jersey.