Experiment

#7

Compressive Strength of Drilled Concrete Core

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Compressive Strength of Drilled Concrete Cores

Introduction:

The examination and compression testing of core cut from hardened concrete is a well-established method, enabling visual inspection of the interior regions of a member to be coupled with strength estimation. Concrete cores are cut by means of a rotary cutting tool with diamond bits. The equipment must be firmly supported and braced against the concrete to prevent relative movement, which will result in a distorted or broken core. Usually, in concrete coring, water supply is used to lubricate the cutter and uniformity of pressure is important, so it is essential that a skilled operator perform drilling.

Objective:

This test method covers obtaining, preparing, and testing cores drilled from concrete for compressive strength determination

Apparatus:

- Core Drill
- Saw

Procedure:

1. The diameter of core specimens for the determination of compressive strength should preferably be at least three times the nominal maximum size of the coarse aggregate used in the concrete, and must be at least twice the maximum nominal size of the coarse aggregate in the core sample.
2. The length of the specimen, when capped, should be as nearly as practicable twice its diameter. A core having a maximum height of less than 95% of its diameter before capping or a height less its diameter after capping shall not be tested.
3. Saw or tool the ends of the specimens until their ends are smooth and perpendicular to the longitudinal axis of the core.

4. Submerge the test specimens in lime-saturated water at (73.4+3.0F) (23.0+1.7C) for at least 40h immediately prior to making the compression test.
5. Cap the ends of the specimens before conducting the compression test.
6. Prior to testing measure the length of the capped specimen to the nearest 2.5mm and use this length to compute the length –to diameter ration.
7. Determine the average diameter by averaging two measurement taken at right angles to each other about the mid-height of the specimen.
8. Test the specimens under compression load till the failure.

Calculation:

1. Calculate the compressive strength of each specimen using the computed cross-sectional area based on the average diameter of the specimen.
2. Apply correction factor shown in the following tables in order to estimate the equivalent standard cylinder compressive strength $\sigma_{cylinder}$. This factor depends on the H/D:

If H/D exceed 2.10 it shall be reduced by cutting the H	$\frac{H}{D} \geq 2.10$
If H/D within the ratio 1.94 -2.10 no correction required	$2.10 > \frac{H}{D} \geq 1.94$
If H/D less than 1.94 use the Core strength Correction Factor ASTM C42	$\frac{H}{D} < 1.94$

Example :

Core diameter = D = 102.56mm

H_b= Height before capping = 112.24mm

H_a = Height after capping = 115.38mm

P = Crushing Load = 309.8 KN

Calculation:

$$\sigma_{core} = \frac{P}{A} = \frac{P}{\pi * D^2/4}$$

$$= \frac{309.8*1000}{\pi*(102.56)^2/4} = 37.5 \text{ MPa}$$

$\sigma_{Cylinder} = \sigma_{core}$ * Correction factor

The correction factor for $= \frac{Ha}{D} = \frac{115.38}{102.56} = 1.13$

From this table insert H/D = 1.13 ⇨ Factor = 0.90

H/D	Factor	H/D	Factor	H/D	Factor	H/D	Factor
1.00	0.87						
1.01	0.87	1.26	0.93	1.51	0.96	1.76	0.98
1.02	0.87	1.27	0.93	1.52	0.96	1.77	0.98
1.03	0.88	1.28	0.93	1.53	0.96	1.78	0.98
1.04	0.88	1.29	0.93	1.54	0.96	1.79	0.98
1.05	0.88	1.30	0.94	1.55	0.96	1.80	0.98
1.06	0.88	1.31	0.94	1.56	0.96	1.81	0.98
1.07	0.89	1.32	0.94	1.57	0.96	1.82	0.99
1.08	0.89	1.33	0.94	1.58	0.96	1.83	0.99
1.09	0.89	1.34	0.94	1.59	0.96	1.84	0.99
1.10	0.89	1.35	0.94	1.60	0.97	1.85	0.99
1.11	0.90	1.36	0.94	1.61	0.97	1.86	0.99
1.12	0.90	1.37	0.94	1.62	0.97	1.87	0.99
1.13	0.90	1.38	0.95	1.63	0.97	1.88	0.99
1.14	0.90	1.39	0.95	1.64	0.97	1.89	0.99
1.15	0.91	1.40	0.95	1.65	0.97	1.90	0.99
1.16	0.91	1.41	0.95	1.66	0.97	1.91	0.99

1.17	0.91	1.42	0.95	1.67	0.97	1.92	0.99
1.18	0.91	1.43	0.95	1.68	0.97	1.93	0.99
1.19	0.92	1.44	0.95	1.69	0.98	1.94	1.00
1.20	0.92	1.45	0.95	1.70	0.98	1.95	1.00
1.21	0.92	1.46	0.96	1.71	0.98	1.96	1.00
1.22	0.92	1.47	0.96	1.72	0.98	1.97	1.00
1.23	0.93	1.48	0.96	1.73	0.98	1.98	1.00
1.24	0.93	1.49	0.96	1.74	0.98	1.99	1.00
1.25	0.93	1.50	0.96	1.75	0.98	2.00	1.00

$\sigma_{Cylinder}$ = 37.5 * 0.90 = 33.75 MPa

Estimate σ_{cube} = 1.25 * $\sigma_{Cylinder}$ = 1.25*33.75 = 42.19MPa

Acceptance Criteria (ACI 318)

Concrete in area represented by a core test will be considered acceptable if average strength of cores is equal to at least 85 percent of, and if no single core is less than 75 percent of, specified strength (f'_c).

Example :

Diameter	98.8 mm	Average = 98.7
	98.6 mm	
	98.7 mm	
Height	186.1	Average = 186.3
	186.5	
	186.4	
Weight	3246 gm	

Hb= Height before capping = 186·3mm

(Capping: a layer is placed on each end (approximate 1·5 top+ 1·5 bottom)

Ha = Height after capping = 186·3 + 3 = 189·3 mm

P = Crushing Load = 168 KN

Calculation:

σ *core* $= \frac{P}{A} = \frac{P}{\pi * D^2/4}$

$= \frac{168*1000}{\pi*(98.7)^2/4} = 21.96$ *MPa*

The Cylinder specimen of concrete (150mm diameter and 300mm height)

*The Cube specimen of concrete (150mm *150mm *150mm)*

σ *Cylinder* = σ *core* * *Correction factor*

The correction factor for $\frac{Ha}{D} = \frac{189.3}{98.7} = 1{\cdot}92$

From this table insert H/D = 1·92 ⇨ *Factor = 0·99*

$\sigma_{Cylinder}$ = 21.96 * 0.99 = 21.74 MPa

Estimate $\sigma_{cube} = 1.25 * \sigma_{Cylinder} = 1.25*21.74 = 27.18$MPa

$\sigma_{cube} > \sigma_{Cylinder}$

To perform tow checks we should take 3 cores, if design plans state a K300 kg/cm²

σ *cube (1) = 27·30*

σ *cube (2) = 27·28*

σ *cube (3) = 27·26* *average = 27·28*

(f'c)· = 300/10 = 30 MPa

Check #1

σ *cube (average)* ≥ σ *strength of concrete (required in plan) * 0·85*

σ *cube (average)* ≥ *30 * 0·85 = 25·2MPa*

27·28 ≥ *25·5 MPa* **ok**

Check #2

σ *cube (minimum of all 3)* ≥ σ *strength of concrete (required in plan) * 0·75*

27·26 ≥ *30 * 0·75 = 22·5 5 MPa* **ok**