



STRUCTURAL AND MATERIAL TESTING LABORATORY
CIVIL ENGINEERING DEPARTMENT, KMUTT

CERTIFICATE OF TESTING

Client : Hilti (Thailand) Ltd.
Address : 1858/107-108 Interlink Tower, 24th Fl., Bangna-Trad Road Bangna Bangkok 10260
Place of testing : King Mongkut's University of Technology Thonburi (KMUTT)
Subject : Pull-out Test of Adhesive Anchors (RE100)
Code or standard : ASTM E488
Date of testing : 1/2/2017 – 21/3/2017

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Tested By : 
(Dr. Raktipong Sahamitmongkol)

Checked By : 
(Associate Prof. Dr. Sutata Leelataviwat)



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TEST REPORT

PULL-OUT STRENGTH OF ADHESIVE ANCHOR (ASTM E488)

Test Arrangement & Procedures :

1. The concrete specimens with size of 2400×1200×300 mm were produced and holes were drilled by using rotary hammer on the top surface (see Figure 1)
 2. The adhesive anchors (see Figure 2) were installed into the drilled holes by inject adhesive from the bottom of the bore hole and insert anchor/bar according to Table 2.
 3. The testing device as described in ASTM E488 was then installed to perform pull-out test (see Figure 3).
- The test configuration for each size of anchor is summarized in Table 1 and Table 2.



Figure 1: Preparing concrete specimens for testing



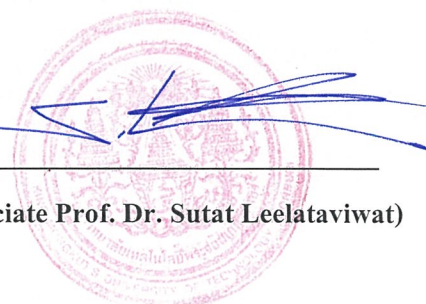
Figure 2: Adhesive Anchors (RE100)

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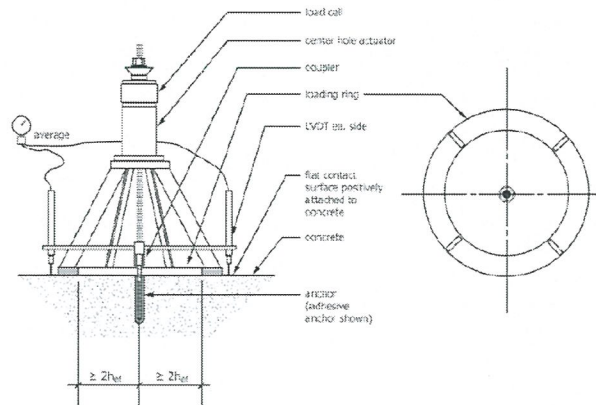
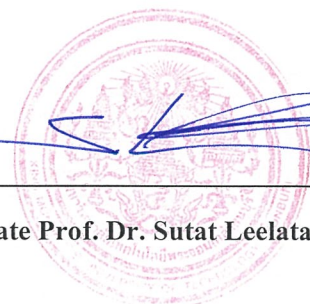


Figure 3: Unconfined pull-out test arrangement according to ASTM E488

4. Start the test by loading and recording until the measured load reaches the maximum value.
5. During the loading, the loads were recorded at the rate of 2 Hz.

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Table 1: Test Configuration for Adhesive Anchor

Type of Anchor	Type of Rod	Drill Bit (mm)	Bolt Diameter (mm)	Embedment Length (mm)	Total Length (mm)
Adhesive Anchor (RE100)	Thread rod	10	8	80	160
		12	10	90	160
		14	12	100	160
		18	16	100	160
		22	20	100	160
		28	24	100	160
		30	27	130	200
		35	30	130	200
	Deformed bar	16	12	100	160
		20	16	100	160
		25	20	100	160
		32	25	100	160
		35	28	130	200
		40	32	130	200

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Pull-out Strength of Adhesive Anchors (RE100) :

Table 2: Pull-out Strength of Adhesive Anchors (RE100)

No.	Type of Rod	Embedment Length (mm)	Peak Load (kN)	Average Peak Load (kN)	Failure Mode
1	M8	80	30.74	31.14	SF
2			32.32		SF
3			30.35		SF
1	M10	90	48.93	49.33	SF
2			48.93		SF
3			50.12		SF
1	M12	100	60.89	62.51	CB
2			66.63		CB
3			60.00		CB
1	M16	100	69.49	68.24	CB
2			68.90		CB
3			66.33		CB
1	M20	100	91.93	87.42	CB
2			84.81		CB
3			85.51		CB
1	M24	100	85.11	90.75	CB
2			94.60		CB
3			92.52		CB

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Table 2: Pull-out Strength of Adhesive Anchors (RE100) (continued)

No.	Type of Rod	Embedment Length (mm)	Peak Load (kN)	Average Peak Load (kN)	Failure Mode
1	M27	130	129.49	126.79	CB+SP
2			126.33		CB+SP
3			124.55		CB+SP
1	M30	130	168.94	147.42	CB+BF
2			131.87		CB+SP
3			141.46		CB+SP
1	DB12	100	48.14	52.03	SF
2			57.53		SF
3			50.41		SF
1	DB16	100	75.52	66.49	CB+BF
2			64.15		CB
3			59.80		CB
1	DB20	100	85.60	83.56	CB
2			88.27		CB
3			76.81		CB
1	DB25	100	82.44	86.07	CB+SP
2			85.51		CB+SP
3			90.25		CB+SP

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Table 2: Pull-out Strength of Adhesive Anchors (RE100) (continued)

No.	Type of Rod	Embedment Length (mm)	Peak Load (kN)	Average Peak Load (kN)	Failure Mode
1	DB28	130	124.95	134.47	CB
2			141.46		CB+SP
3			137.01		CB+SP
1	DB32	130	159.94	162.45	CB
2			160.73		CB+SP
3			166.66		CB+SP

Note : CB = Concrete Breakout , SF = Steel Failure , BF = Bond Failure , SP = Splitting of Concrete

Properties of Concrete :

Table.3 Mix Proportion of Concrete Used in the Pullout Test (Ready-Mixed Concrete).

Materials	Content
Cementitious Materials (kg/m ³)	326
Fine Aggregate (kg/m ³)	860
Coarse Aggregate (kg/m ³)	1070
Water (kg/m ³)	180
Admixture (cc)	875
Slump (cm)	10

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Table.4 Density and Compressive Strength of Concrete. (Cylinder)

Specimen	Age (days)	Diameter (cm)	Height (cm)	Weight (g)	Density (kg/m ³)	Avg. Density (kg/m ³)	Compressive Strength (MPa)	Avg. Compressive Strength (MPa)
CC-1	17	10.1	19.95	3670	2297.26		22.72	
CC-2	17	9.99	19.83	3620	2330.16		23.22	
CC-3	17	10.03	19.46	3610	2349.05	2326.34	25.34	24.02
CC-4	17	9.98	19.60	3560	2323.07		24.34	
CC-5	17	9.99	19.43	3550	2332.14		24.47	
CC-6	19	9.92	19.73	3628	2380.99		25.58	
CC-7	19	10.01	19.69	3649	2354.91		28.36	
CC-8	19	10.90	19.85	3724	2011.53	2293.49	25.22	24.97
CC-9	19	9.98	19.71	3651	2371.54		21.33	
CC-10	19	10.01	19.96	3689	2348.52		24.36	

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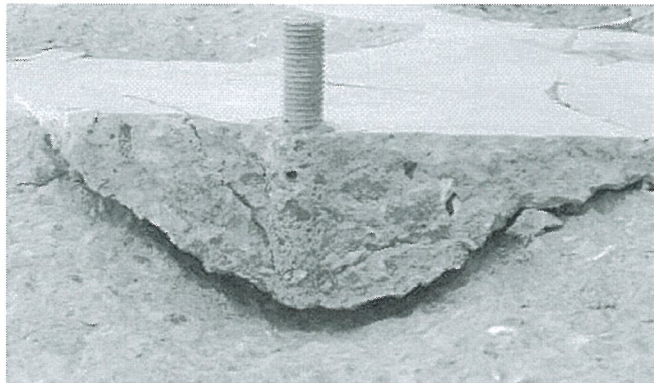
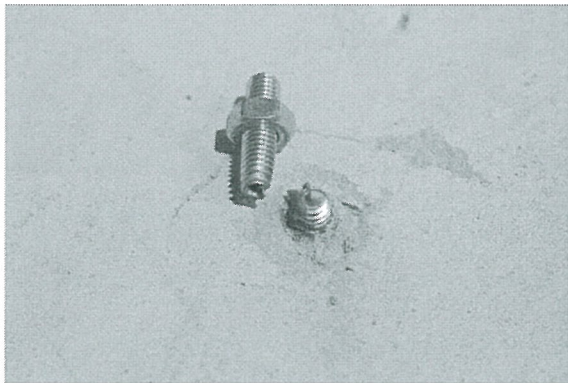
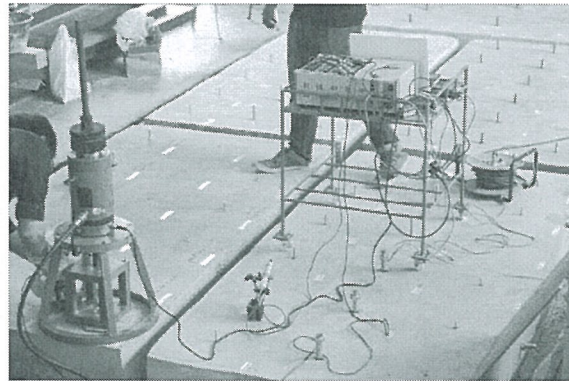
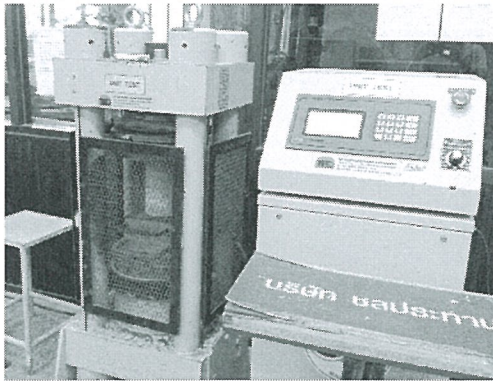
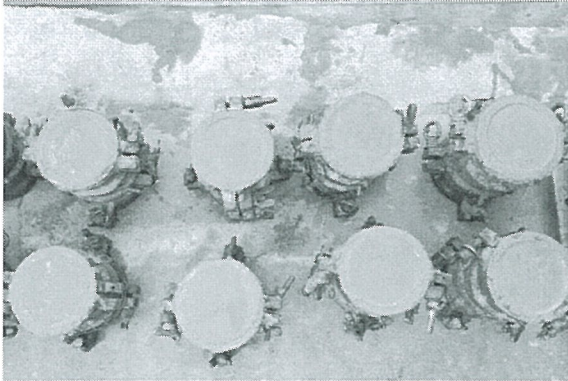
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Photos of the Specimens and Testing :



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