JAPAN TESTING CENTER FOR CONSTRUCTION MATERIALS

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Date: September 7th, 2016

NOTE: This is an English version report translated from the original test report.

TEST REPORT

No. 15A4686

Client

Address : 4-3-15 5F TAMAGAWA, SETAGAYA-KU, TOKYO, JAPAN

Firm Name : EIKEN CO., LTD.

Designation of Test

Soil solidification performance test (Freezing and thawing test)

This is to certify that the entitled test result is true and correct as written in this test report.

JAPAN TESTING CENTER FOR
CONSTRUCTION MATERIALS
CENTRAL TEST LABORATORY

O. Kawakami

Osamu Kawakami
Senior Managing Director

[Designation of test]

Soil solidification performance test (Freezing and thawing test)

[Contents]

1. Description of test

The freezing and thawing test was performed for the hardened mortar submitted by EIKEN CO., LTD.

2. Test specimens

The test specimens were prepared by the client, and were carried in the Central Test Laboratory. The outline of the test specimens is described in Table 1, and the test specimens at carrying in are shown in Photos 1 and 2.

Table 1 Test specimens (based on the data submitted by the client)

Common name	Hardened mortar
Material	Cement, inorganic system Kurikara soil, silica system mineral additive
Product name	FlatPlugResin 3000 (ECO5000)
Symbol	50-1, 50-2, 50-3, 50-4, 50-5
Dimensions	200 mm × 100 mm × 60 mm
Quantity	5
Date of carrying in	March 2, 2016

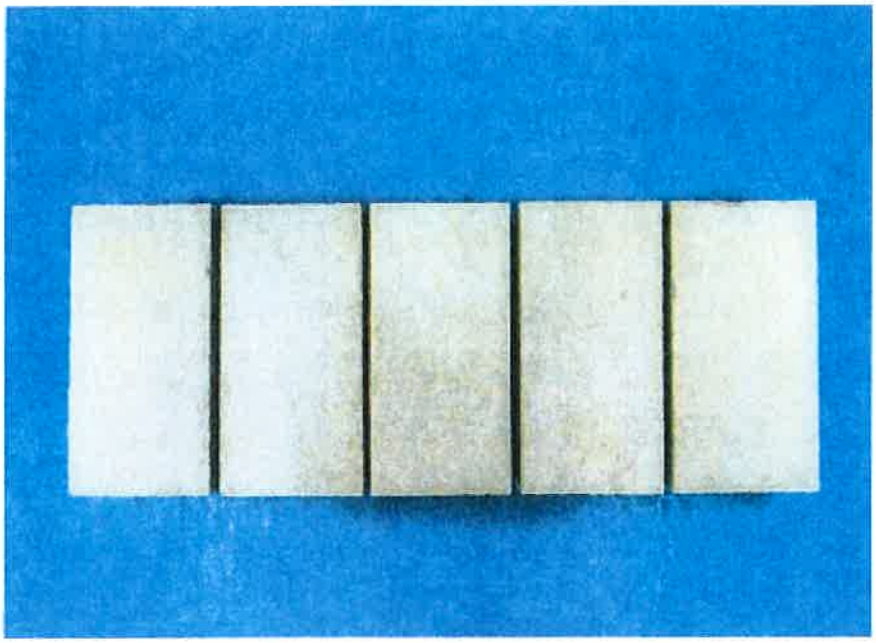

Photo 1 Appearance of test specimens at carrying in [front side]

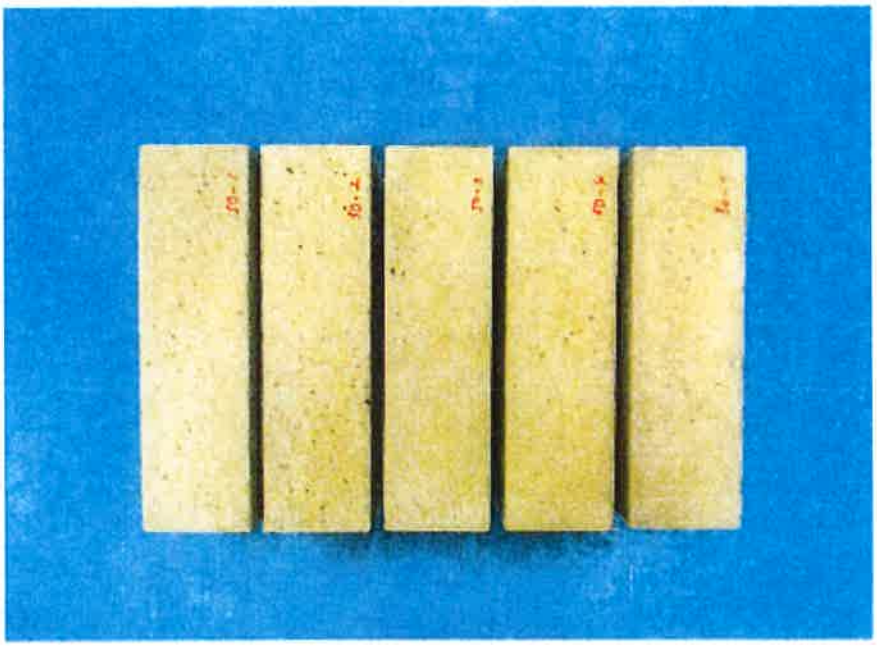

Photo 2 Appearance of test specimens at carrying in [side face]

3. Test method

The test was performed in accordance with "5.5 Frost damage test" in JIS A 5208 (Clay rooftiles). The details of the test are shown below.

(1) Water absorption process

The test specimens were immersed in fresh water at 20 ± 2°C for 24 hours, and after being wiped with a wet cloth, the mass was measured to the digit of 0.1 g.

(2) Conditions for freezing and thawing test

After being left at rest in a thermo-hygrostat at - 20 ± 3°C for 18 hours, the test specimens were immersed in water at 20 ± 2°C for six hours. After that, they were wiped with a wet cloth, the mass was measured to the digit of 0.1 g, and the appearance observation (check for crack, separation, and fracture) was performed. This operation was performed once.

(3) Frequency of freezing and thawing

The frequency of freezing and thawing was 30 times.

(4) Calculation of mass change

The mass change was calculated by the following formula, and was rounded to one digit after the decimal point.

$$\Delta M = \frac{M_n - M_0}{M_0} \times 100$$

Where, ΔM: Mass change (%)

M_o: Mass of test specimen after completion of water absorption (g)

M_n: Mass of test specimen just after completion of predetermined number of times (g)

4. Test results

The freezing and thawing test results are shown in Table 2 to 7, and the appearance of the test specimens are shown in Photo 3 to 7.

The results of 0 to 15 times are transcribed from the results in No. 15A4430.

Table 2 Freezing and thawing test results [mass]

Frequency of freezing and thawing	Mass (g)				
	50-1	50-2	50-3	50-4	50-5
0	2395.5	2377.0	2348.9	2361.1	2357.0
1	2398.9	2381.1	2350.7	2365.3	2360.1
2	2400.8	2383.1	2351.7	2367.3	2361.9
3	2402.1	2384.1	2352.5	2368.6	2363.1
4	2403.1	2385.2	2353.0	2369.6	2364.3
5	2403.7	2386.0	2353.5	2370.2	2364.9
6	2404.8	2387.0	2354.3	2371.1	2365.5
7	2404.5	2386.9	2354.1	2371.0	2365.7
8	2405.4	2387.7	2355.0	2372.0	2366.7
9	2406.0	2388.0	2355.5	2372.0	2367.2
10	2406.9	2388.9	2356.2	2373.2	2367.9
11	2407.4	2389.3	2356.7	2373.6	2368.5
12	2407.4	2389.3	2356.6	2373.6	2368.5
13	2408.3	2390.0	2357.4	2374.4	2369.4
14	2408.6	2390.5	2357.6	2374.7	2369.8
15	2408.5	2390.1	2357.5	2374.3	2369.4
16	2411.0	2393.0	2360.2	2377.4	2372.3
17	2410.6	2392.5	2359.9	2377.0	2372.3
18	2409.7	2391.1	2358.8	2375.3	2370.9
19	2410.6	2392.3	2358.9	2376.2	2371.5
20	2411.3	2392.8	2359.7	2376.8	2372.0
21	2411.4	2393.0	2360.1	2377.6	2372.8
22	2411.6	2393.0	2360.3	2377.2	2372.7
23	2412.1	2393.1	2360.5	2377.4	2373.1
24	2413.0	2394.2	2361.2	2378.2	2374.0
25	2413.3	2394.6	2361.3	2378.7	2374.1
26	2414.1	2395.5	2362.8	2379.4	2375.2
27	2413.9	2395.0	2363.0	2379.5	2375.2
28	2414.6	2395.6	2363.5	2379.7	2375.8
29	2415.1	2396.3	2364.1	2380.2	2376.2
30	2415.3	2396.6	2364.6	2380.8	2376.9

Table 3 Freezing and thawing test results [mass change]

Frequency of freezing and thawing	Mass change (%)				
	50-1	50-2	50-3	50-4	50-5
1	0.1	0.2	0.1	0.2	0.1
2	0.2	0.3	0.1	0.3	0.2
3	0.3	0.3	0.2	0.3	0.3
4	0.3	0.3	0.2	0.4	0.3
5	0.3	0.4	0.2	0.4	0.3
6	0.4	0.4	0.2	0.4	0.4
7	0.4	0.4	0.2	0.4	0.4
8	0.4	0.5	0.3	0.5	0.4
9	0.4	0.5	0.3	0.5	0.4
10	0.5	0.5	0.3	0.5	0.5
11	0.5	0.5	0.3	0.5	0.5
12	0.5	0.5	0.3	0.5	0.5
13	0.5	0.5	0.4	0.6	0.5
14	0.5	0.6	0.4	0.6	0.5
15	0.5	0.6	0.4	0.6	0.5
16	0.6	0.7	0.5	0.7	0.6
17	0.6	0.7	0.5	0.7	0.6
18	0.6	0.6	0.4	0.6	0.6
19	0.6	0.6	0.4	0.6	0.6
20	0.7	0.7	0.5	0.7	0.6
21	0.7	0.7	0.5	0.7	0.7
22	0.7	0.7	0.5	0.7	0.7
23	0.7	0.7	0.5	0.7	0.7
24	0.7	0.7	0.5	0.7	0.7
25	0.7	0.7	0.5	0.7	0.7
26	0.8	0.8	0.6	0.8	0.8
27	0.8	0.8	0.6	0.8	0.8
28	0.8	0.8	0.6	0.8	0.8
29	0.8	0.8	0.6	0.8	0.8
30	0.8	0.8	0.7	0.8	0.8

Table 4 Freezing and thawing test results [appearance observation]

Frequency of freezing and thawing	Symbol	Appearance observation	Observed state
1	50-1	There were no crack, separation, and fracture in the test specimen.	-
	50-2	There were no crack, separation, and fracture in the test specimen.	-
	50-3	There were no crack, separation, and fracture in the test specimen.	-
	50-4	There were no crack, separation, and fracture in the test specimen.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-
2	50-1	There were no crack, separation, and fracture in the test specimen.	-
	50-2	There were no crack, separation, and fracture in the test specimen.	-
	50-3	There were no crack, separation, and fracture in the test specimen.	-
	50-4	There were no crack, separation, and fracture in the test specimen.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-
3	50-1	There were no crack, separation, and fracture in the test specimen.	-
	50-2	There were no crack, separation, and fracture in the test specimen.	-
	50-3	There were no crack, separation, and fracture in the test specimen.	-
	50-4	There were no crack, separation, and fracture in the test specimen.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-
4	50-1	There were no crack, separation, and fracture in the test specimen.	-
	50-2	There were no crack, separation, and fracture in the test specimen.	-
	50-3	There were no crack, separation, and fracture in the test specimen.	-
	50-4	There were no crack, separation, and fracture in the test specimen.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-
5	50-1	There were no crack, separation, and fracture in the test specimen.	-
	50-2	There were no crack, separation, and fracture in the test specimen.	-
	50-3	There were no crack, separation, and fracture in the test specimen.	-
	50-4	There were no crack, separation, and fracture in the test specimen.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-
6	50-1	There were no crack, separation, and fracture in the test specimen.	-
	50-2	There were no crack, separation, and fracture in the test specimen.	-
	50-3	There were no crack, separation, and fracture in the test specimen.	-
	50-4	There were no crack, separation, and fracture in the test specimen.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-
7	50-1	There were no crack, separation, and fracture in the test specimen.	-
	50-2	There were no crack, separation, and fracture in the test specimen.	-
	50-3	There were no crack, separation, and fracture in the test specimen.	-
	50-4	There were no crack, separation, and fracture in the test specimen.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-
8	50-1	There were no crack, separation, and fracture in the test specimen.	-
	50-2	There were no crack, separation, and fracture in the test specimen.	-
	50-3	There were no crack, separation, and fracture in the test specimen.	-
	50-4	There were no crack, separation, and fracture in the test specimen.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-

Table 5 Freezing and thawing test results [appearance observation]

Frequency of freezing and thawing	Symbol	Appearance observation	Observed state
9	50-1	There were no crack, separation, and fracture in the test specimen.	-
	50-2	There were no crack, separation, and fracture in the test specimen.	-
	50-3	There were no crack, separation, and fracture in the test specimen.	-
	50-4	There were no crack, separation, and fracture in the test specimen.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-
10	50-1	There were no crack, separation, and fracture in the test specimen.	-
	50-2	There were no crack, separation, and fracture in the test specimen.	-
	50-3	There were no crack, separation, and fracture in the test specimen.	-
	50-4	There were no crack, separation, and fracture in the test specimen.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-
11	50-1	There were no crack, separation, and fracture in the test specimen.	-
	50-2	There were no crack, separation, and fracture in the test specimen.	-
	50-3	There were no crack, separation, and fracture in the test specimen.	-
	50-4	There were no crack, separation, and fracture in the test specimen.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-
12	50-1	There were no crack, separation, and fracture in the test specimen.	-
	50-2	There were no crack, separation, and fracture in the test specimen.	-
	50-3	There were no crack, separation, and fracture in the test specimen.	-
	50-4	There were no crack, separation, and fracture in the test specimen.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-
13	50-1	There were no crack, separation, and fracture in the test specimen.	-
	50-2	There were no crack, separation, and fracture in the test specimen.	-
	50-3	There were no crack, separation, and fracture in the test specimen.	-
	50-4	There were no crack, separation, and fracture in the test specimen.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-
14	50-1	There were no crack, separation, and fracture in the test specimen.	-
	50-2	There were no crack, separation, and fracture in the test specimen.	-
	50-3	There were no crack, separation, and fracture in the test specimen.	-
	50-4	There were no crack, separation, and fracture in the test specimen.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-
15	50-1	There were no crack, separation, and fracture in the test specimen.	-
	50-2	There was a fracture in the surface corner.	See Photo 3
	50-3	There were no crack, separation, and fracture in the test specimen.	-
	50-4	There was a fracture in the surface corner.	See Photo 3
	50-5	There were no crack, separation, and fracture in the test specimen.	-

Table 6 Freezing and thawing test results [appearance observation]

Frequency of freezing and thawing	Symbol	Appearance observation	Observed state
16	50-1	There were no crack, separation, and fracture in the test specimen.	-
	50-2	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-3	There were no crack, separation, and fracture in the test specimen.	-
	50-4	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-
17	50-1	There were no crack, separation, and fracture in the test specimen.	-
	50-2	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-3	There were no crack, separation, and fracture in the test specimen.	-
	50-4	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-
18	50-1	There were no crack, separation, and fracture in the test specimen.	-
	50-2	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-3	There were no crack, separation, and fracture in the test specimen.	-
	50-4	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-
19	50-1	There were no crack, separation, and fracture in the test specimen.	-
	50-2	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-3	There were no crack, separation, and fracture in the test specimen.	-
	50-4	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-
20	50-1	There were no crack, separation, and fracture in the test specimen.	-
	50-2	There was a progress of fracture in the test specimen corner from the completion of the previous time.	See Photo 4
	50-3	There were no crack, separation, and fracture in the test specimen.	-
	50-4	There was a progress of fracture in the test specimen corner from the completion of the previous time.	See Photo 4
	50-5	There were no crack, separation, and fracture in the test specimen.	-
21	50-1	There were no crack, separation, and fracture in the test specimen.	-
	50-2	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-3	There were no crack, separation, and fracture in the test specimen.	-
	50-4	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-
22	50-1	There were no crack, separation, and fracture in the test specimen.	-
	50-2	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-3	There were no crack, separation, and fracture in the test specimen.	-
	50-4	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-
23	50-1	There were no crack, separation, and fracture in the test specimen.	-
	50-2	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-3	There were no crack, separation, and fracture in the test specimen.	-
	50-4	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-

Table 7 Freezing and thawing test results [appearance observation]

Frequency of freezing and thawing	Symbol	Appearance observation	Observed state
24	50-1	There were no crack, separation, and fracture in the test specimen.	-
	50-2	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-3	There were no crack, separation, and fracture in the test specimen.	-
	50-4	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-
25	50-1	There was a fracture in the test specimen corner.	See Photo 5
	50-2	There was a progress of fracture in the test specimen corner from the completion of the previous time.	See Photo 5
		There was a new fracture in the test specimen corner.	See Photo 5
	50-3	There was a fracture in the test specimen corner.	See Photo 5
	50-4	There was a progress of fracture in the test specimen corner from the completion of the previous time.	See Photo 5
	50-5	There were no crack, separation, and fracture in the test specimen.	-
26	50-1	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-2	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-3	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-4	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-
27	50-1	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-2	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-3	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-4	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-
28	50-1	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-2	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-3	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-4	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-
29	50-1	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-2	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-3	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-4	There was no progress of fracture in the test specimen corner from the completion of the previous time.	-
	50-5	There were no crack, separation, and fracture in the test specimen.	-
30	50-1	There was a progress of fracture in the test specimen corner from the completion of the previous time.	See Photo 6
	50-2	There was a progress of fracture in the test specimen corner from the completion of the previous time.	See Photo 6
	50-3	There was a progress of fracture in the test specimen corner from the completion of the previous time.	See Photo 6
	50-4	There was a progress of fracture in the test specimen corner from the completion of the previous time.	See Photo 6
	50-5	There was a fracture in the test specimen corner.	See Photo 6

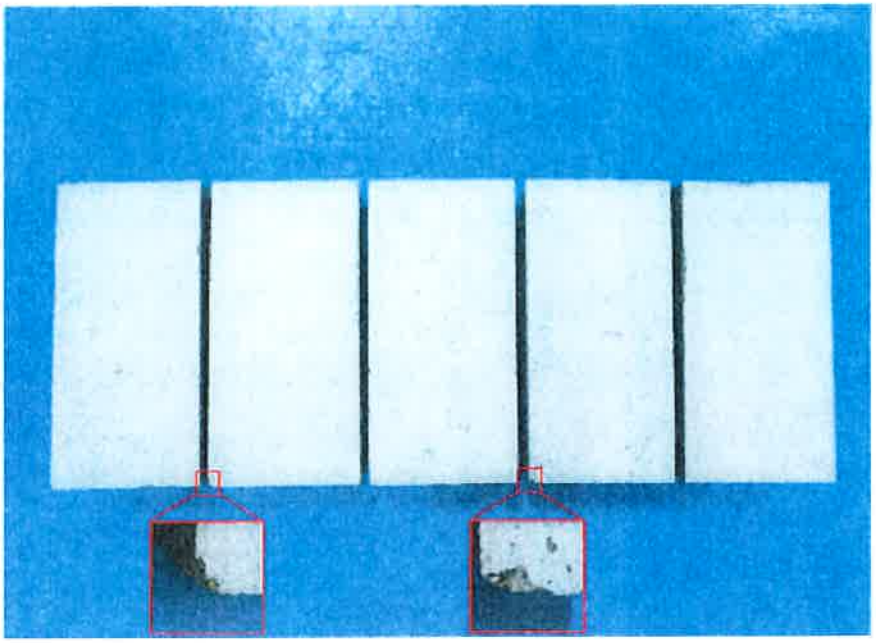

Photo 3 Appearance of test specimens at completion of freezing and thawing 15 times [front side]

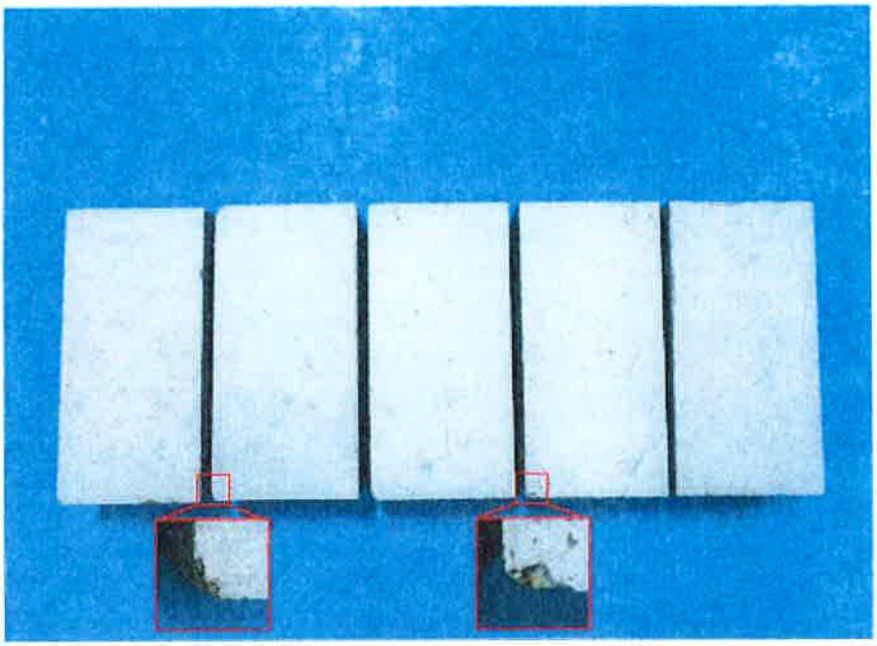

Photo 4 Appearance of test specimens at completion of freezing and thawing 20 times [front side]

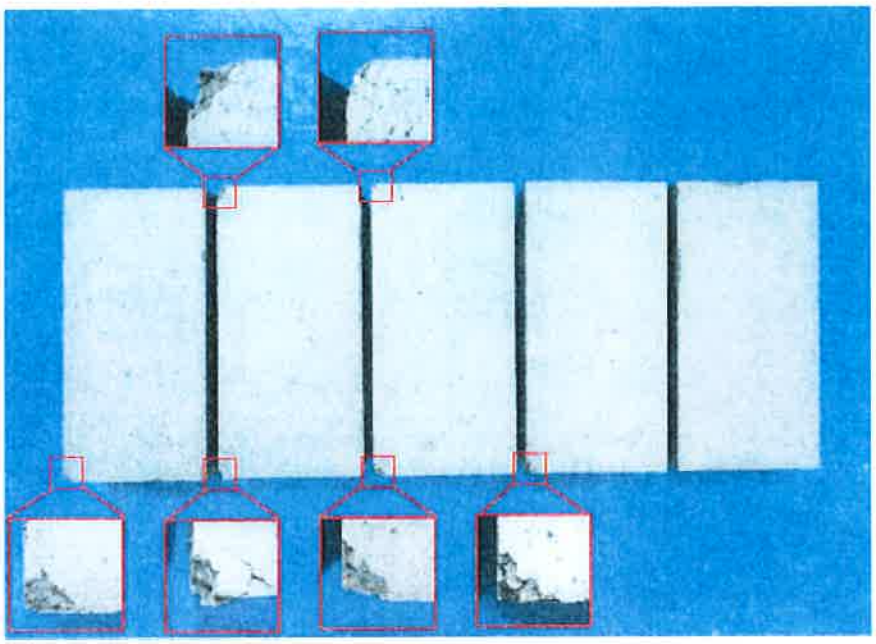

Photo 5 Appearance of test specimens at completion of freezing and thawing 25 times [front side]

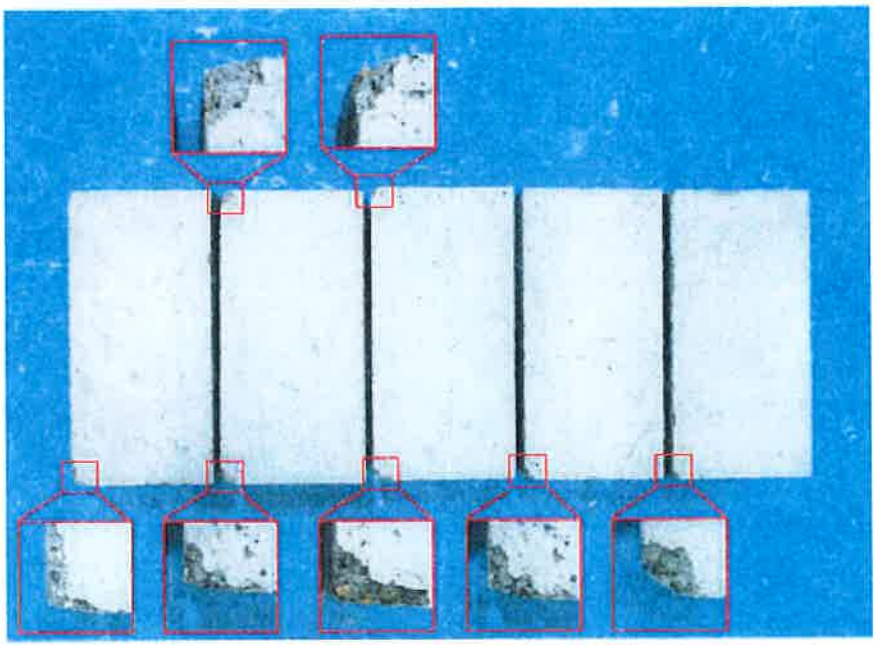

Photo 6 Appearance of test specimens at completion of freezing and thawing 30 times [front side]

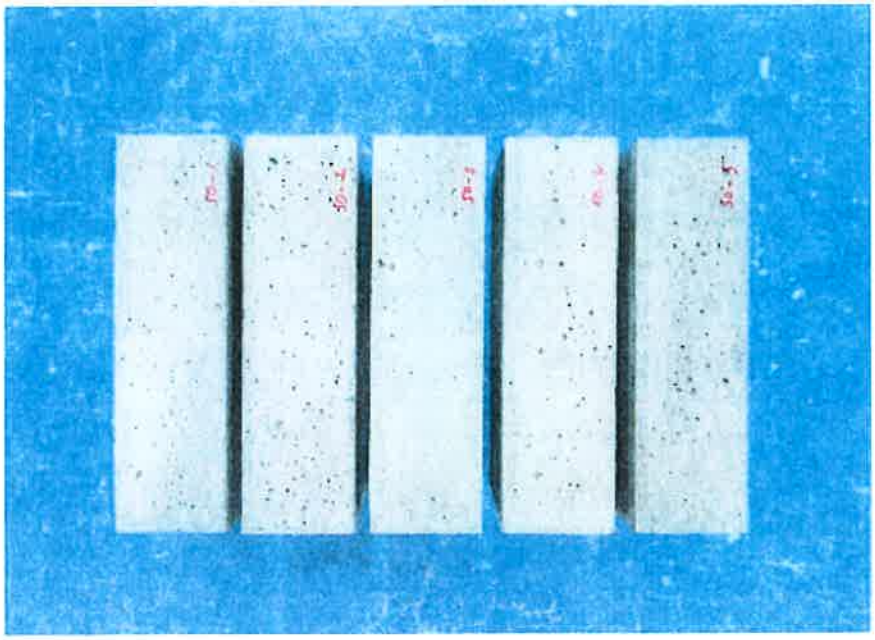

Photo 7 Appearance of test specimens at completion of freezing and thawing 30 times [side face]

5. Period of test, person in charge and place

Test period: March 2, 2016 to May 20, 2016

Person in charge: Materials Testing Group
Administrative Manager: Toshio Suzuki
Deputy Administrative Manager: Norikiyo Nakamura
Yusuke Okada (main person in charge)

Test place: Central Test Laboratory

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