Construction of the Shin-Saiwaibashi Tenant Building

Debrief Report of Mixing Test

Construction name: Concrete construction
(Water-proof material: Silica White)

Design supervisor
First Class Authorized Architect Office, Mitsubishi Estate Co. Ltd.
Tokyo Electric Power Services, Co. Ltd.

Construction supervisor
Joint Body of Construction Supervision

Contractor
Joint Venture of the Construction of the Shin-Saiwaibashi Tenant Building

■Shin-Saiwaibashi Tenant Building (Waterproof in underground structure, 5F)

Contractors: Taisei, Shimizu, Takenaka, JV

SILICA JAPAN LABORATORY

1 . Objectives

Although mixing tests had already been conducted by selecting typical mixtures from those classified in terms of cement and planed slump in order to confirm whether the materials and mixture, etc. of concrete used for underground structure would meet the requirement, mixing tests were additionally conducted because it was newly decided to use the Silica White as a water-proof material.

2 . Dates and Plant of the Tests

Date	**Plant (number of batches)**
March 27, 1995 (Monday)	Keihin Ryoko Concrete Kogyo, Inc. Shinagawa Plant (FB cement, 10 batches)
1W compressive strength test April 3 (Monday) 4W compressive strength test April 24 (Monday) 5W compressive strength test May 22 (Monday)	
May 22, 1995 (Monday)	Keihin Ryoko Concrete Kogyo, Inc. Shinagawa Plant (FB cement, 2 batches) blending in summer season
1W compressive strength test May 29 (Monday) 4W compressive strength test June 14 (Monday) 5W compressive strength test July 17 (Monday)	

3. Table of materials used and results of blend of mixing tests

Shinagawa Plant, Keihin Ryoko Concrete Kogyo, Inc.

(Materials used)

Cement : Fly Ash B cement (made by Mitsubishi Materials Corporation)
water : tap water
Fine aggregate : Kimitsu (Chiba)
Coarse aggregate : Torigatayama (Kochi)
Additive : RHEOBUILD SP-9N, POZZOLITH 70 (made by NMB, Inc.)
Water-proof materiall : Silica White

Table of blend for mixing tests

Blending No.		Cement	Water	Fine aggregate	Coarse aggregate	Additive	Additive name	Water-proof material
		Water-cement ratio %		Sand-aggregate ratio %				
1 (K-37)	FB-W/C 53.0 -15-20	299	158	796	1050	0.748	Pozzolith 70	15.0 Silica White
		53.0		44.5				
2 (K-39)	FB-W/C 51.0 -15-20	312	159	780	1053	0.780	Pozzolith 70	16.0 Silica White
		51.0		43.3				
3 (K-40)	FB-W/C 49.5 -15-20	324	160	764	1056	0.810	Pozzolith 70	16.0 Silica White
		49.5		43.4				
4 (K-41)	FB-W/C 48.0 -15-20	336	161	749	1056	0.840	Pozzolith 70	17.0 Silica White
		48.0		43.0				
5 (K-42)	FB-W/C 46.5 -15-20	349	162	731	1058	0.872	Pozzolith 70	17.0 Silica White
		46.5		42.4				
6 (K-43)	FB-W/C 53.0 -21-20	310	164	827	994	5.580	Rheobuild SP-9N	16.0 Silica White
		53.0		46.8				
7 (K-45)	FB-W/C 51.0 -21-20	324	165	811	994	5.832	Rheobuild SP-9N	16.0 Silica White
		51.0		46.4				
8 (K-46)	FB-W/C 49.5 -21-20	336	166	793	996	6.048	Rheobuild SP-9N	17.0 Silica White
		49.5		45.8				
9 (K-47)	FB-W/C 48.0 -21-20	348	167	777	999	6.264	Rheobuild SP-9N	17.0 Silica White
		48.0		45.3				
10 (K-48)	FB-W/C 46.5 -21-20	362	168	762	999	6.516	Rheobuild SP-9N	18.0 Silica White
		46.5		44.8				

４．　Test Results

Mixing tests were conducted in the following procedures:

1) Based on the blending plans (refer to the exhibits), each material was measured and photographed.

2) Each material was charged into a mixer in the following process.

(Shinagawa Plant, Keihin Ryoko) ・・・fine aggregate → cement → coarse aggregate→ water (additive included)

3) After charging all the materials, they were mixed. Mixing time is shown below.

(Shinagawa Plant, Keihin Ryoko) ・・・120 seconds

4) After the completion of mixing, the mixture was put on the mixing plate and turned over twice, and then we conducted following measurements.

Slump measurement (JIS A 1101)

Air volume measurement (JIS A 1128)

Flow value measurement

Concrete temperature measurement (thermometer bar)

Salinity measurement (Shinagawa Plant, Keihin Ryoko) ・・・(using SALMATE-100)

5) The criteria of the measurement results were as follows.

Slump measurement (Shinagawa Plant, Keihin Ryoko) ・・・15cm:16.5±1.5 (transportation loss, 1.5cm)
21cm:22.5±1.5 (transportation loss, 1.5cm)

Air volume measurement (Shinagawa Plant, Keihin Ryoko) ・・・4.0%:4.5%±1.0 (transportation loss, 0.5%)

Salinity measurement not more than 0.3kg／m^3

6) Since the measurement results of all the batches that had gone through the mixing test satisfied the criteria, the blending plan was determined to be appropriate, and three specimens for the compressive strength test per material age were taken. Standard care was taken during curing, and the material ages for compressive strength tests were as follows.

FB concrete・・・ 7 days, 28 days, 56 days

7) Criteria for the compressive strength tests were as follows. (strength = kg／cm^2)

* Note that all the specimens were assumed to satisfy the criteria.

FB concrete

Silica White	Shinagawa Plant, Keihin Ryoko	Plan	Slump	Result	Slump	Result
m^3／15 k	W／C＝53.0・・・56 days	Strength≧300 k	15C	380 k	21C	371 k
m^3／16 k	W／C＝51.0・・・56 days	Strength≧315 k	15C	391 k	21C	377 k
m^3／16 k	W／C＝49.5・・・56 days	Strength≧330 k	15C	412 k	21C	393 k
m^3／17 k	W／C＝48.0・・・56 days	Strength≧345 k	15C	424 k	21C	415 k
m^3／17 k	W／C＝46.5・・・56 days	Strength≧360 k	15C	435 k	21C	423 k

8) Regarding the results of the compressive strength tests, the measurement results on all the batches satisfied the criteria as shown in the exhibits.

9) Considering the results described above, this blending plan was judged to be appropriate, and so we determined to employ it for this construction together with the temperature corrections that were not used in the mixing tests (as shown in the blending tables in the exhibits).

Table of Blending Plan – 7/K (basement structure)

Plant name	Shinagawa Plant, Keihin Ryoko Concrete Kogyo, Inc.		
Common Items	・Design strength: 270kg／cm^2 (Material age of strength management = 56 days) ・Concrete type: High-strength concrete ・Cement type: Fly Ash Cement B Type (cement classification code = FB) ・20mm Maximum size of coarse aggregate: 20mm ・Air volume =4.0%		
JASS5 Temperature correction	Value of temperature correction	Applicable period of time	Remarks
	0	3／9 ～7／15 , 9／4 ～10／20	
	0	7／16 ～9／3	Blending in summer season
	15	1／23 ～3／8 , 10／21 ～12／4	
	30	12／5 ～1／22	

	Water-cement ratio	Applicable period of time No.	Applicable period of time	Remarks
Water-cement ratio Applicable period of time	53.0	1	5／25 ～7／15	
	51.0	2	7／16 ～9／3	Blending in summer season
	51.0	3	4／1 ～5／24 , 9／4 ～9／29	
	49.5	4	9／30～10/24 , 3/10～9／31	
	48.0	5	2／15～3/9 , 10/25～11／14	
	46.5	6	11／15 ～2／14	

Blending table （kg／m^3）

Blending No.	56 d Strength	Slump	Applicable period of time №	Cement	Water	Fine aggregate	Coarse aggregate	Additive	Additive name	Water-proof material
				Water-cement ratio %		Sand-aggregate ratio %				
K-37	300	15	1	299	158	796	1050	0.748	Pozzolith №70 (AE water reducing agent)	15.0 Silica White
				53.0		44.5				
K-38	300	15	2 Blending in summer season							
K-39	315	15	3	312	159	780	1053	0.780	Pozzolith №70 (AE water reducing agent)	16.0 Silica White
				51.0		43.3				
K-40	330	15	4	324	160	764	1056	0.810	Pozzolith №70 (AE water reducing agent)	16.0 Silica White
				49.5		43.4				
K-41	345	15	5	336	161	749	1056	0.840	Pozzolith №70 (AE water reducing agent)	17.0 Silica White
				48.0		43.0				
K-42	360	15	6	349	162	731	1058	0.872	Pozzolith №70 (AE water reducing agent)	17.0 Silica White
				46.5		42.4				

Management Table for Concrete Strength Test (Test 7)

Date placed on	Place (remarks)	Strength test results					Blending		
		Material age (curing)	Tested on	№-1	Strength (kg/cm^2)	Average strength (σ)	TYPe	Blending s (Measured slump) a (Measured air volume)	Cement classification code / Water-proof material name
				-2	〃				
				-3	〃				
95 3 / 27	Mixing test (Ryoko Shinagawa)	7d (standard)	4／3	1-1	222	223		W / C 53.0-15-20 s(16.5) a(4.4)	FB
				-2	228				
				-3	219				
		28d 〃	4／24	1-4	336	332			
				-5	334				
				-6	327				
		56d 〃	5／22	1-7	385	380			Silica White 15.0 (K-37)
				-8	379				
				-9	376				
		7d 〃	4／3	2-1	238	241		W / C 51.0-15-20 s(16.0) a(4.4)	FB
				-2	245				
				-3	239				
		28d 〃	4／24	2-4	332	344			
				-5	353				
				-6	346				
		56d 〃	5／22	2-7	393	391			Silica White 16.0 (K-39)
				-8	393				
				-9	387				
		7d 〃	4／3	3-1	258	259		W / C 49.5-15-20 s(16.5) a(4.4)	FB
				-2	256				
				-3	262				
		28d 〃	4／24	3-4	365	362			
				-5	359				
				-6	360				
		56d 〃	5／22	3-7	405	412			Silica White 16.0 (K-40)
				-8	417				
				-9	414				
		7d 〃	4／3	4-1	274	272		W / C 48.0-15-20 s(17.0) a(4.6)	FB
				-2	276				
				-3	266				
		28d 〃	4／24	4-4	379	378			
				-5	386				
				-6	370				
		56d 〃	5／22	4-7	434	424			Silica White 17.0 (K-41)
				-8	412				
				-9	424				
		7d 〃	4／3	5-1	280	282		W / C 46.5-15-20 s(16.5) a(4.2)	FB
				-2	282				
				-3	283				
		28d 〃	4／24	5-4	398	385			
				-5	381				
				-6	376				
		56d 〃	5／22	5-7	427	435			Silica White 17.0 (K-42)
				-8	432				
				-9	446				

Water-proof material: Silica White

Table of Blending Plan – 8/K (basement structure)

Plant name	Shinagawa Plant, Keihin Ryoko Concrete Kogyo, Inc.		
Common Items	・Design strength: 270kg／cm^2 (Material age of strength management = 56 days) ・Concrete type: High-strength concrete ・Cement type: Fly Ash Cement B Type (cement classification code = FB) ・20mm Maximum size of coarse aggregate: 20mm ・Air volume =4.0%		
JASS5 Temperature correction	Value of temperature correction	Applicable period of time	Remarks
	0	3／9 ～7／15 , 9／4 ～10／20	
	0	7／16 ～9／3	Blending in summer season
	15	1／23 ～3／8 , 10／21 ～12／4	
	30	12／5 ～1／22	

	Water-cement ratio	Applicable period of time No.	Applicable period of time	Remarks
Water-cement ratio Applicable period of time	53.0	1	5／25 ～7／15	
	51.0	2	7／16 ～9／3	Blending in summer season
	51.0	3	4／1 ～5／24 , 9／4 ～9／29	
	49.5	4	9／30～10/24 , 3/10～9／31	
	48.0	5	2／15～3/9 , 10/25～11／14	
	46.5	6	11／15 ～2／14	

Blending table （kg／m^3）

Blending No.	56 d Strength	Slump	Applicable period of time №	Cement	Water	Fine aggregate	Coarse aggregate	Additive	Additive name	Water-proof material
				Water-cement ratio %		Sand-aggregate ratio %				
K-43	300	21	1	310	164	827	994	5.580	Rheobuild SP (air entraining and high-range water reducing agent)	16.0 Silica White
				53.0		46.8				
K-44	300	21	2 Blending in summer season							
K-45	315	21	3	324	165	811	994	5.832	Rheobuild SP (air entraining and high-range water reducing agent)	16.0 Silica White
				51.0		46.4				
K-46	330	21	4	336	166	793	996	6.048	Rheobuild SP (air entraining and high-range water reducing agent)	17.0 Silica White
				49.5		45.8				
K-47	345	21	5	348	167	777	999	6.264	Rheobuild SP (air entraining and high-range water reducing agent)	17.0 Silica White
				48.0		45.3				
K-48	360	21	6	362	168	762	999	6.516	Rheobuild SP (air entraining and high-range water reducing agent)	18.0 Silica White
				46.5		44.8				

Management Table for Concrete Strength Test (Test 8)

Date placed on	Place (remarks)	Strength test results					Blending		
		Material age (curing)	Tested on	№-1	Strength (kg/cm²)	Average strength (σ)	TYPe	Blending s (Measured slump) a (Measured air volume)	Cement classification code / Water-proof material name
				-2	〃				
				-3	〃				
95 3 / 27	Mixing test (Ryoko Shinagawa)	7d (standard)	4／3	6-1	217	218		W / C 53.0-21-20 s(22.0) a(5.2)	FB B.T Silica White 16.0 (K-43)
				-2	216				
				-3	222				
		28d 〃	4／24	6-4	334	331			
				-5	334				
				-6	326				
		56d 〃	5／22	6-7	381	371			
				-8	370				
				-9	362				
		7d 〃	4／3	7-1	238	241		W / C 51.0-21-20 s(22.0) a(4.9)	FB B.T Silica White 16.0 (K-45)
				-2	241				
				-3	244				
		28d 〃	4／24	7-4	344	345			
				-5	340				
				-6	350				
		56d 〃	5／22	7-7	380	377			
				-8	384				
				-9	367				
		7d 〃	4／3	8-1	243	249		W / C 49.5-21-20 s(22.0) a(5.0)	FB B.T Silica White 17.0 (K-46)
				-2	250				
				-3	253				
		28d 〃	4／24	8-4	354	355			
				-5	355				
				-6	356				
		56d 〃	5／22	8-7	389	393			
				-8	393				
				-9	397				
		7d 〃	4／3	9-1	271	265		W / C 48.0-21-20 s(22.0) a(4.9)	FB B.T Silica White 17.0 (K-47)
				-2	259				
				-3	264				
		28d 〃	4／24	9-4	377	370			
				-5	366				
				-6	366				
		56d 〃	5／22	9-7	425	415			
				-8	414				
				-9	407				
		7d 〃	4／3	10-1	276	279		W / C 46.5-21-20 s(22.0) a(5.0)	FB B.T Silica White 18.0 (K-48)
				-2	278				
				-3	283				
		28d 〃	4／24	10-4	388	385			
				-5	383				
				-6	384				
		56d 〃	5／22	10-7	422	423			
				-8	422				
				-9	424				

Water-proof material: Silica White