SPECIAL ADMIXTURE FOR CONCRETE PROPERTIES AND EXPECTED USES OF SILICA WHITE

Silica Japan Inc.
Kanazawa Institute of Technology/Japan

CONTENTS

WHAT IS SILICA WHITE?

- Natural pozzolan based powder admixture derived from domestic production volcanic ashes.
- Silica White can be mixed to dramatically improvement the finish and durability of concrete.

- ✓ It produces a glossy white finish and no happen uneven color. And this material is best used in public building, apartment house and individual house.
- ✓ Concrete workability and grouting are improved, and even complex shapes are less likely to cause casting inferiority, resulting in significantly improved workability.

WHAT IS SILICA WHITE?

- ✓ Improves permeation resistance moisture and salt, crack resistance, and impregnation resistance. Therefore, it is ideal for harbor structures, tunnels and shield segments, bridges in snowy areas, roadside structures, etc.

WHAT IS SILICA WHITE?

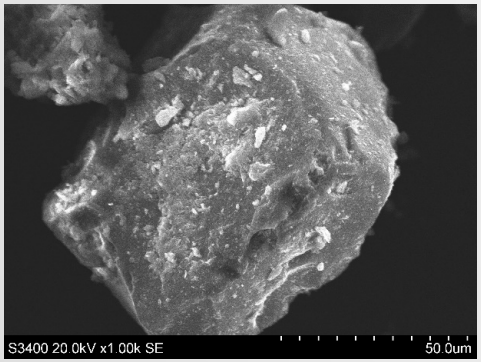
- Natural pozzolanic powder admixture derived from Japan (Fukushima Prefecture) volcanic ash.
- Effective in increasing strength, suppressing cracks, improving finish, reducing water permeability and salt permeability, and reducing wear and tear loss.
- Due to the well-formed white fine powder, the glossy bright white concrete surface finish.
- JIS A 6209 “Volcanic glass fine powder for concrete” applying pending.
- High strength concrete certification by the Ministry of land, infrastructure, transport and tourism ”Certification number MCON-4014, MLIT Notification No.1489」.
- NETIS HK-060017「Concrete special admixture Silica White」 : Registration is no longer posted

WHAT IS SILICA WHITE?

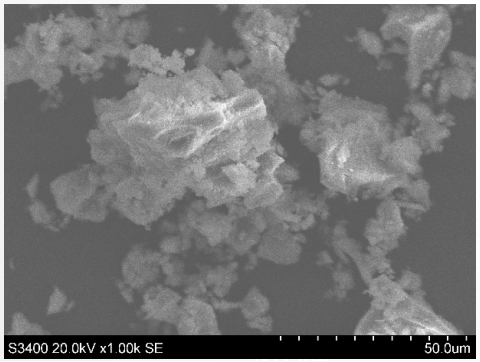
- Volcanic glass fine powder produced from volcanic ash from Fukushima Prefecture (fixed origin).
- Pulverized using a roll crusher and classified by a cyclone.

Volcanic glass fine powder

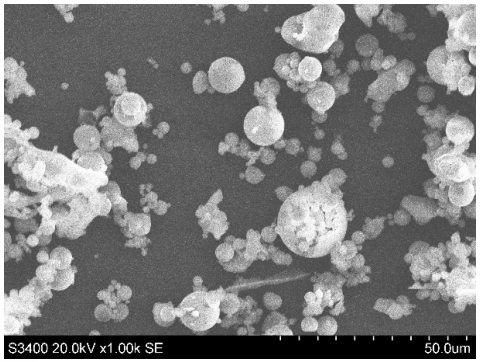
	Component(%)								Density (g/m³)	Specific surface area		Activity index	
Item	Silicon dioxide	Aluminum oxide	Magnesium oxide	Sulfur trioxide	Free calcium oxide	Chloride ion	Ignition loss	Moisture		BET method (cm²/g)	Blaine value (cm²/g)	7 days age	28 days age
Category Ⅰ (JIS)	70.0 or more	15.0 or less	5.0 or less	3.0 or less	1.0 or less	0.10 or less	4.0 or less	3.0 or less	2.25~2.40	80000 or more	-	100 ore more	105 or more
Category Ⅱ (JIS)										40000 or more		95 or more	100 or more
Category Ⅲ (JIS)										10000 or more		90 or more	95 or more
Fine powder A	71.2	12	0.4	0.11	0.1 or less	0.002	1.2	0.1	2.36	186020	6000	97	103
Fine powder B	70.5	12	0.4	0.26	0.1 or less	0.002	1.3	0.3	2.32	430310	14000	98	104



Volcanic glass fine powder A



Volcanic glass fine powder B



Classifying fly ash
(Brain value 4400)

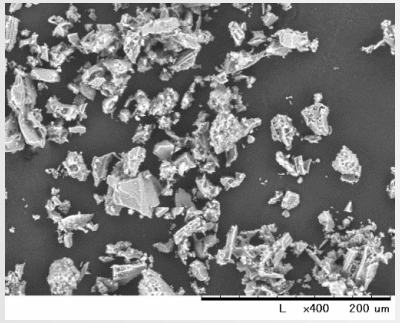
SEM image(1000times)

CONTENTS

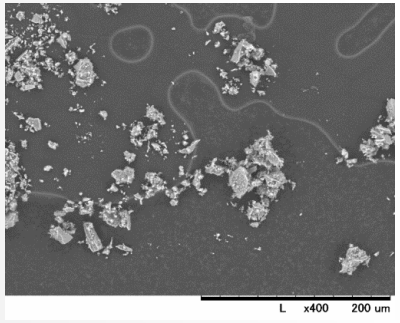
CHARACTERISTIC OF SILICA WHITE

- It is a natural pozzolanic powder admixture derived from volcanic ash produced in Japan, and since it is manufactured at a dedicated factory, the quality such as mesh size is stable, and the supply is stable and can be delivered immediately.
- Cement replacement is possible by the pozzolanic reaction, and in the case of fine aggregate replacement, an increase in compressive strength can be expected even without additives.
- Since the pozzolanic reaction product fills the coarse voids, the tissue becomes denser over time, and the water permeability is physically reduced (improvement of water tightness) compared to the absence of additives, leading to crack suppression and improvement of wear resistance.
- Concrete placement quality can be improved by reducing the amount of bleeding and improving material separation resistance.
- Stable white color tone improves uneven color of launch concrete and realizes a stable white finish for each lot.

CHARACTERISTIC OF SILICA WHITE(PARTICULATE)

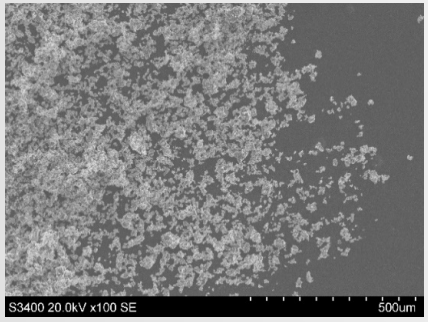


#6000

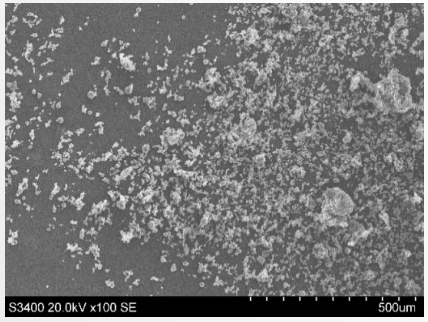


#14000

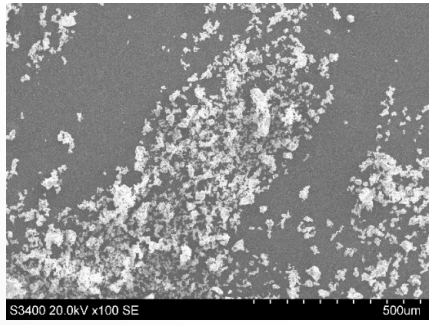
SEM image generation：Kanazawa Institute of Technology, College of Engineering, Civil and Environmental Engineering, Hanaoka Laboratory



Cement



Fly ash

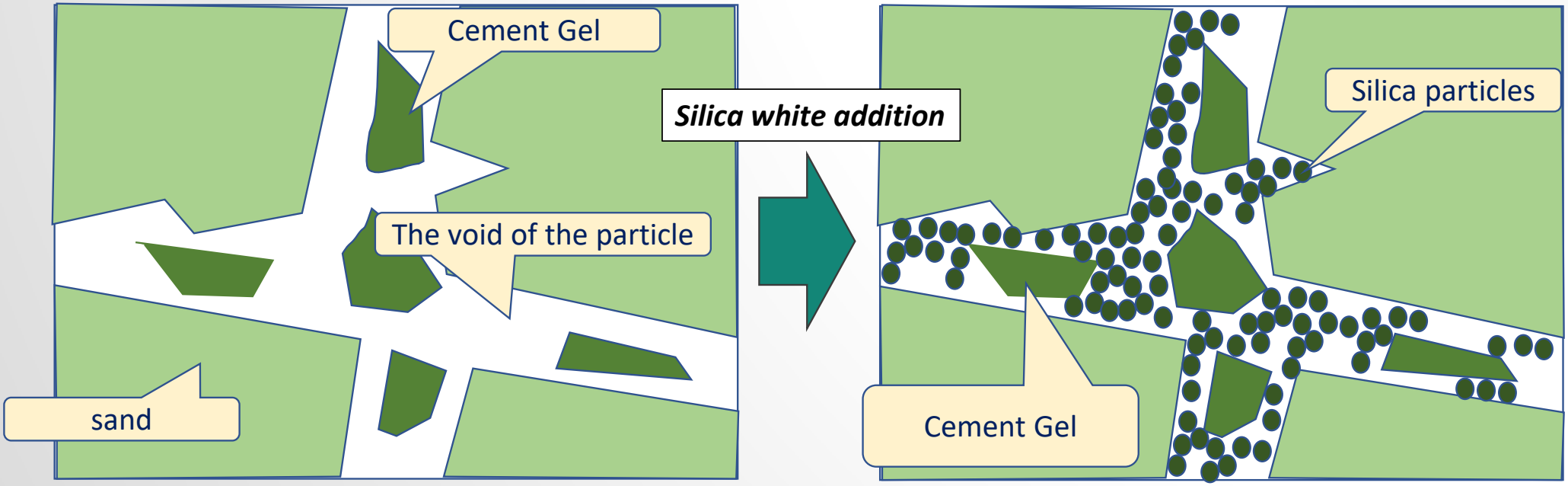


Blast furnace slag

- ✓ Bridges the particle size gap between cement, fly ash, blast furnace slag and fine aggregates to improve crack resistance and flowability.

CHARACTERISTIC OF SILICA WHITE(PARTICULATE)

- ✓ Microfiller effect : When fine powder fills between cement particles, it functions as a nucleus of hydrate and densifies the pore structure.



CHARACTERISTIC OF SILICA WHITE (CONTRIBUTION TO THE SDGS)

- ✓ Concrete with silica white added reduces the permeability of moisture, salt, and chemical substances that cause deterioration due to the densification effect, delaying the occurrence of deterioration damage. This will contribute to the maintenance of resilient infrastructure
- ✓ Natural silica materials, including silica white, are cementitious materials that do not generate much CO2 during the manufacturing process. By using this material in cement replacement, it is possible to suppress the generation of CO2 generated during cement production, contributing to specific measures against climate change

CONSIDERATION BASED ON THE CHARACTERISTICS OF SILICA WHITE, EXPECTED APPLICATIONS

- ✓ Filling with coarse voids in concrete, and further progressing of the pozzolanic reaction promotes densification, and is expected to suppress moisture penetration and the penetration of salt and chemical substances induced by moisture.
- ✓ By promoting densification, it is expected to be effective in reducing the occurrence of cracks and the occurrence of peeling on the concrete surface due to driving quality.
- ✓ Similarly, it is expected to be effective in reducing deterioration and wear of concrete surfaces.
- ✓ The quality of the concrete is high, and it is unified with a white glossy bright finish without water pockmarks.

CONSIDERATION BASED ON THE CHARACTERISTICS OF SILICA WHITE, EXPECTED APPLICATIONS(ARCHITECTURE)

Expected effect	Expected applications
Filling with coarse voids in concrete, and further progressing of the pozzolanic reaction promotes densification, and is expected to suppress moisture penetration and the penetration of salt and chemical substances induced by moisture.	• Public buildings such as schools, Public hospitals, Libraries, and Halls that require longer life • Buildings under the water table, such as basements, underground parking lots, subway stations, and underground shopping malls • Factory
It is expected to achieve the same or better durability improvement without increasing the rebar cover, and reduces beam and column reinforcement due to the increase in member weight.	• Major structural components of large-scale buildings • Tower
By promoting densification, it is expected to be effective in reducing the occurrence of cracks and the occurrence of peeling on the concrete surface due to driving quality.	• Pools, Water tanks • Public building • Buildings under the water table, such as basements, underground parking lots, subway stations, and underground shopping malls
Expected to reduce wear and tear due to densification of the concrete surface.	• Concrete pavement
The stable white color tone improves the uneven color of the launch concrete and realizes a stable white finish for each lot.	• Expected concrete finish in public buildings, apartment buildings, and private residences (exterior and interior)

CONSIDERATION BASED ON THE CHARACTERISTICS OF SILICA WHITE, EXPECTED APPLICATIONS(CIVIL ENGINEERING)

Expected effect	Expected applications
Filling with coarse voids in concrete, and further progressing of the pozzolanic reaction promotes densification, and is expected to suppress moisture penetration and the penetration of salt and chemical substances induced by moisture.	• Precast roadside structures (secondary products) • Coastal/Port structures • Shield tunnel segment, secondary lining • Foundation piles (Ready-made piles, Cast-in-place piles) • Concrete pavement
It is expected to achieve the same or better durability improvement without increasing the rebar cover, and reduces the reinforcement of legs and pillars due to the increase in the weight of the member.	• Precast floor slabs, Slabs, Updated girders • Ground anchor pressure resistant plate (secondary product) • Reinforced earth wall front block (secondary product)
By promoting densification, it is expected to be effective in reducing the occurrence of cracks and the occurrence of peeling on the concrete surface due to driving quality.	• Mountain tunnel lining • Shielded tunnel segment • Precast floor slabs, Slabs, Updated girders, Precast retaining walls
Expected to reduce wear and tear due to densification of the concrete surface.	• Concrete pavement • Precast concrete plate pavement
The stable white color tone improves the uneven color of the launch concrete and realizes a stable white finish for each lot.	• Precast structures • Ground anchor pressure plate • Reinforced earthen wall front block

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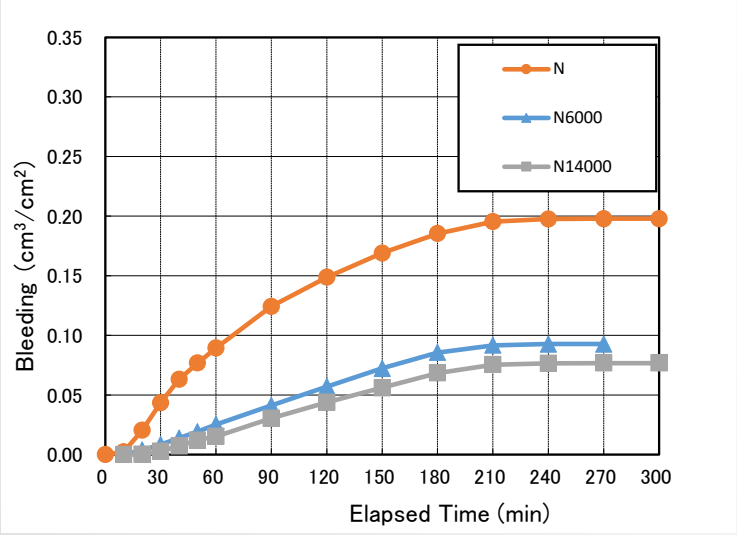
SILICA WHITE TEST AND EXPERIMENTAL DATA FRESH PERFORMANCE : BLEEDING TEST

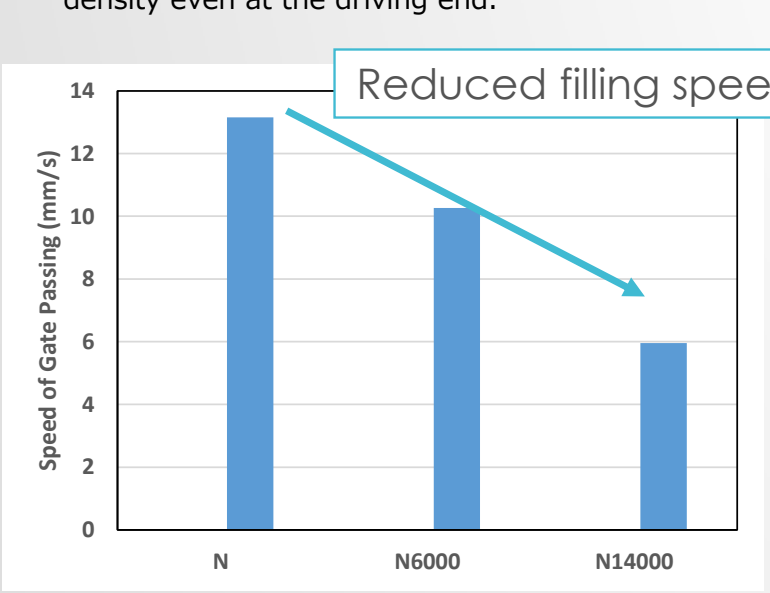
- ✓ Conducted a bleeding test (JIS A 1123) on concrete in which 10% of the cement amount was replaced with Silica White, and confirmed that bleeding of fresh concrete was reduced.
- ✓ Excessive bleeding can cause poor water tightness, loss of strength, and cracking, which must be removed or prevented.

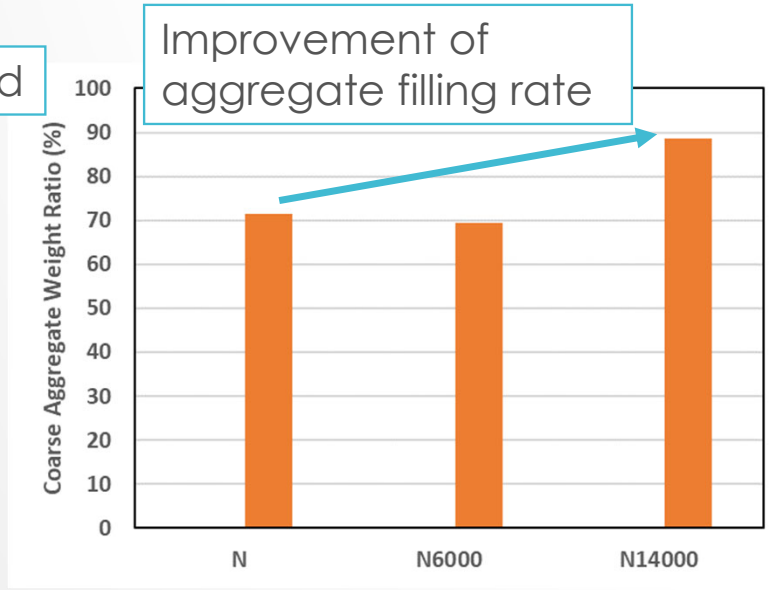


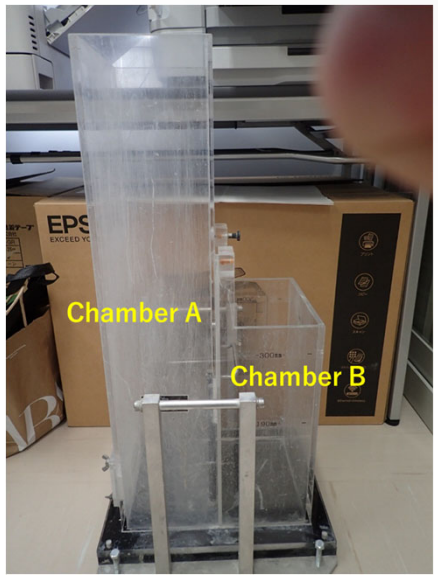
- The experiment was conducted using ordinary Portland cement and replacing 10% of the cement amount of 290kg/m³ with Silica White.
- Where N6000 refers to #6000 and N14000 refers to #14000 product mesh size.
- All experiments were conducted at Kanazawa Institute of Technology (Hanaoka Lab.) based on joint research between Silica Japan inc and Kanazawa Institute of Technology.

SILICA WHITE TEST AND EXPERIMENTAL DATA　FRESH PERFORMANCE　: FILLABILITY TEST（JSCE-F 701）

- ✓ A test that measures the time it takes for kneaded concrete to be packed in room A and filled into room B after the partition is remove.
- ✓ Concrete with a high rate of fine power contamination, a decrease in concrete filling speed, an improvement in coarse aggregate filling rate, and an improvement in workability were confirmed.
- ✓ It is possible to improve concrete construction where material separation is an issue, such as tunnel lining, and to obtain high coarse aggregate density even at the driving end.







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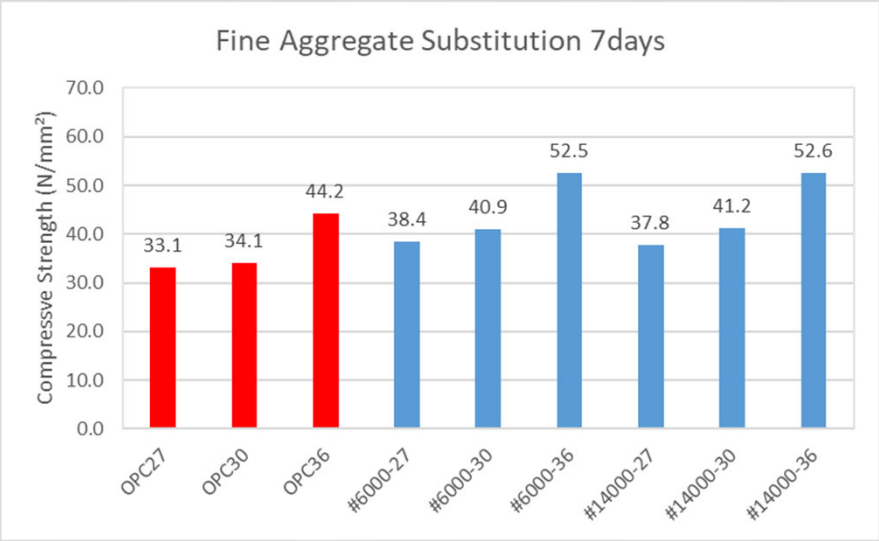
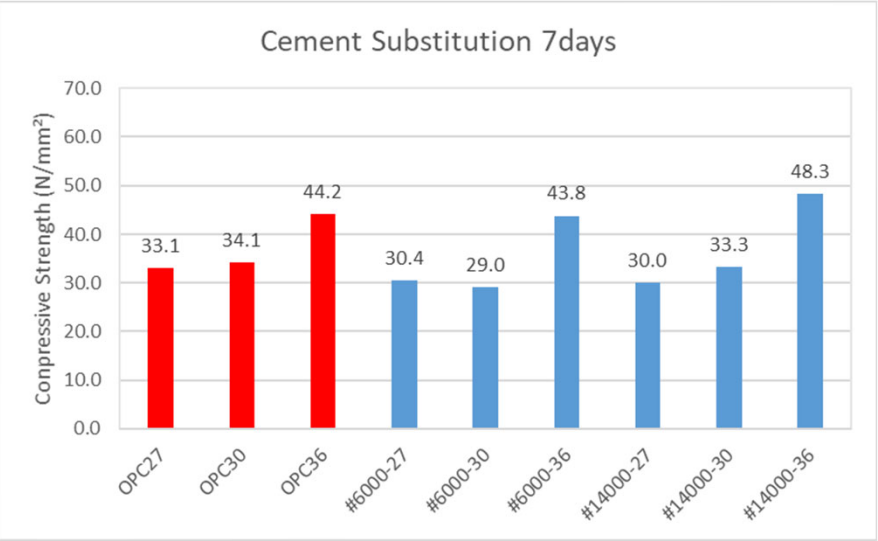
SILICA WHITE TEST AND EXPERIMENTAL DATA

PERFORMANCE AFTER CURING : COMPRESSIVE STRENGTH TEST (7 DAYS STRENGTH)

- ✓ Silica White is a pozzolanic reactive material and can be used in both cement and fine aggregate replacement.
- ✓ Fine aggregate replacement improves the 7days strength of standard concrete by about 10%, and cement replacement provides strength comparable to that of non-replacement even if it is mixed with about 27N and 30N.



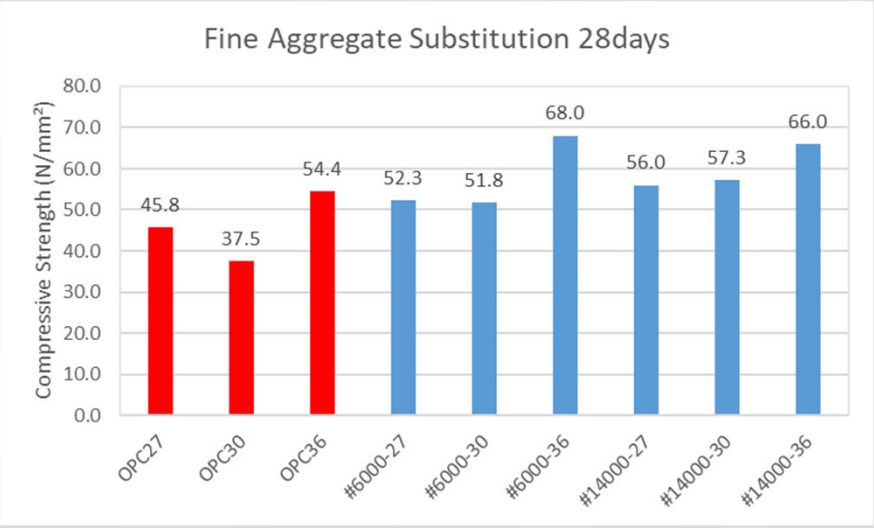


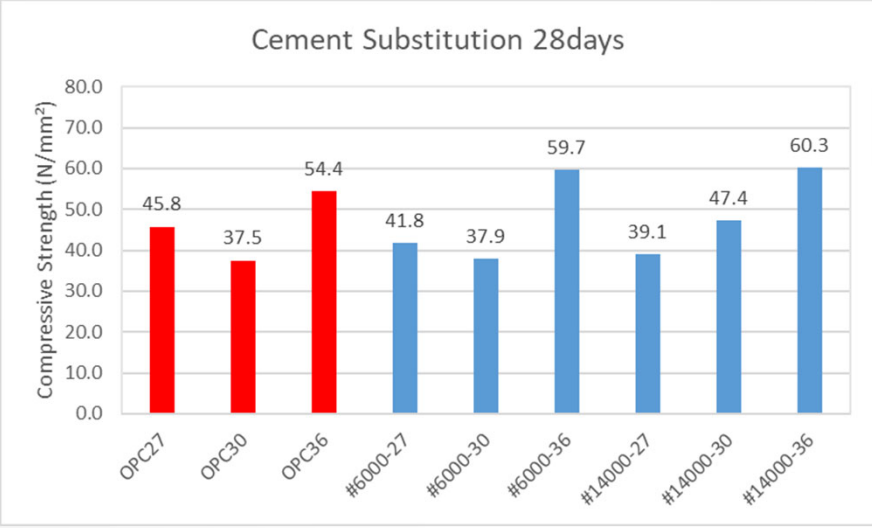
- In cement replacement, experiments were conducted using Ordinary Portland Cement, with nominal strengths of 27, 30, and 36, replacing 10% of the unit cement amount with Silica White.
- OPC here refers to formulations using Ordinary Portland Cement and #6000 and #14000 refer to Silica White product mesh sizes.
- All experiments were conducted at Kanazawa Institute of Technology (Hanaoka Lab.) based on joint research between Silica Japan inc and Kanazawa Institute of Technology.

SILICA WHITE TEST AND EXPERIMENTAL DATA

PERFORMANCE AFTER CURING : COMPRESSIVE STRENGTH TEST (28 DAYS STRENGTH)

- ✓ Silica White is a pozzolanic reactive material and can be used in both cement and fine aggregate replacement.
- ✓ Fine aggregate replacement improves the 28days strength of standard concrete by about 20%, cement replacement provides strength comparable to non-replacement compounding, and high-strength concrete with a large amount of cement per unit increases strength.





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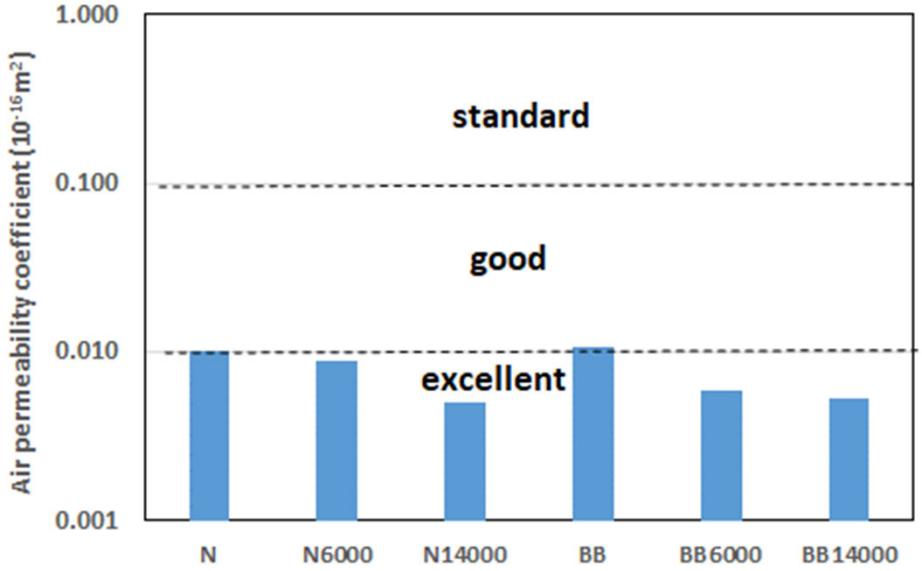
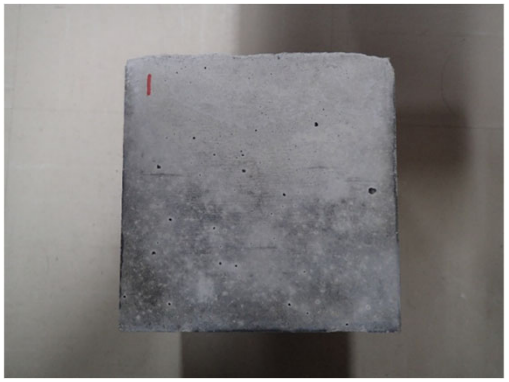
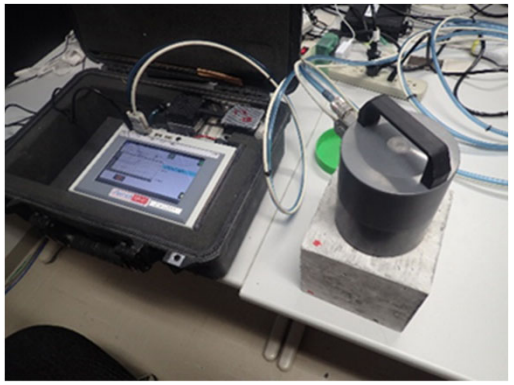
SILICA WHITE TEST AND EXPERIMENTAL DATA

PERFORMANCE AFTER CURING : SURFACE AIR PERMEABILITY COEFFICIENT

- ✓ The low surface air permeability coefficient of concrete after hardening means that the finish of the concrete surface is dense and there are few voids.
- ✓ If the surface finish is dense, the penetration of water from the concrete surface and the accompanying penetration of chlorides and chemical substances will be suppressed, and the inside of the concrete will be kept fresh for a long time, which is thought to lead to suppression of deterioration of concrete and suppression of peeling.







Torrent method

Evaluation of grading by air permeability test coefficient

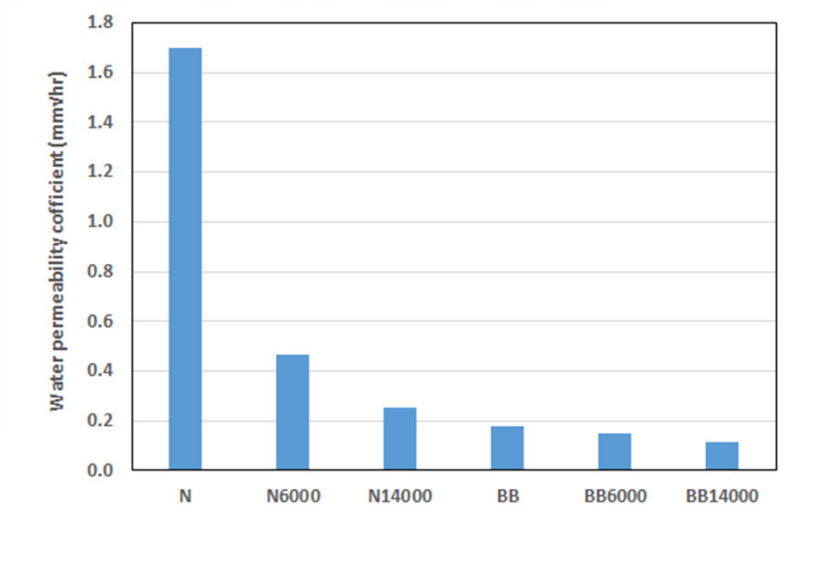
Air permeability coefficient ($10^{-16}m^2$)				
Excellent	Good	Standard	Inferior	Extremely Inferior
0.001~0.01	0.01~0.1	0.1~1	1~10	10~100

- Silica White is mixed with concrete (W/C=55%) using Ordinary Portland Cement and Blast Furnace Cement by fine aggregate replacement, and tested after curing in air.
- Where N6000 refers to #6000 and N14000 refers to #14000 product mesh size.
- All experiments were conducted at Kanazawa Institute of Technology (Hanaoka Lab.) based on joint research between Silica Japan inc and Kanazawa Institute of Technology.

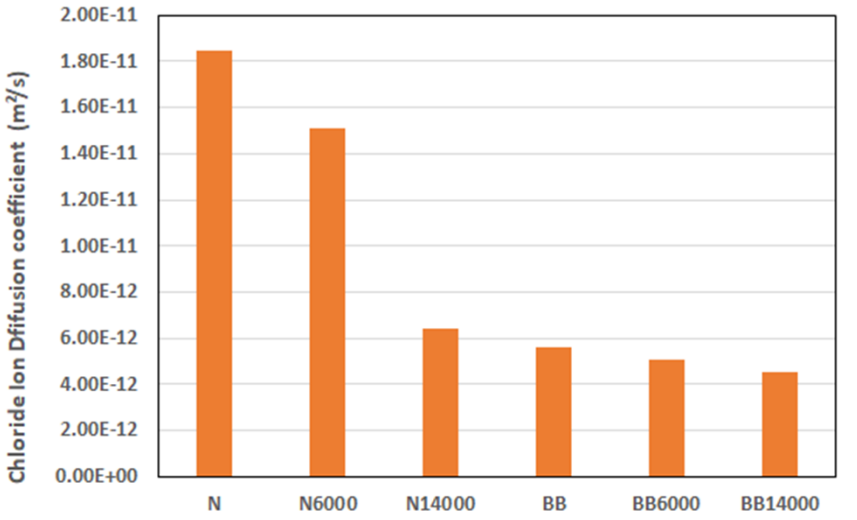
SILICA WHITE TEST AND EXPERIMENTAL DATA

PERFORMANCE AFTER CURING ：WATER PERMEABILITY COEFFICIENT AND NON-STEADY-STATE MIGRATION TEST

- ✓ The low moisture penetration rate coefficient of concrete after hardening means that the finish of the concrete surface is dense and there are few voids.
- ✓ The low chloride ion diffusion coefficient means that is highly salt- shielding, and similar results have been confirmed by the total chloride ion concentration by the immersion method.



Water penetration rate coefficient of concrete
(Water permeability coefficient)

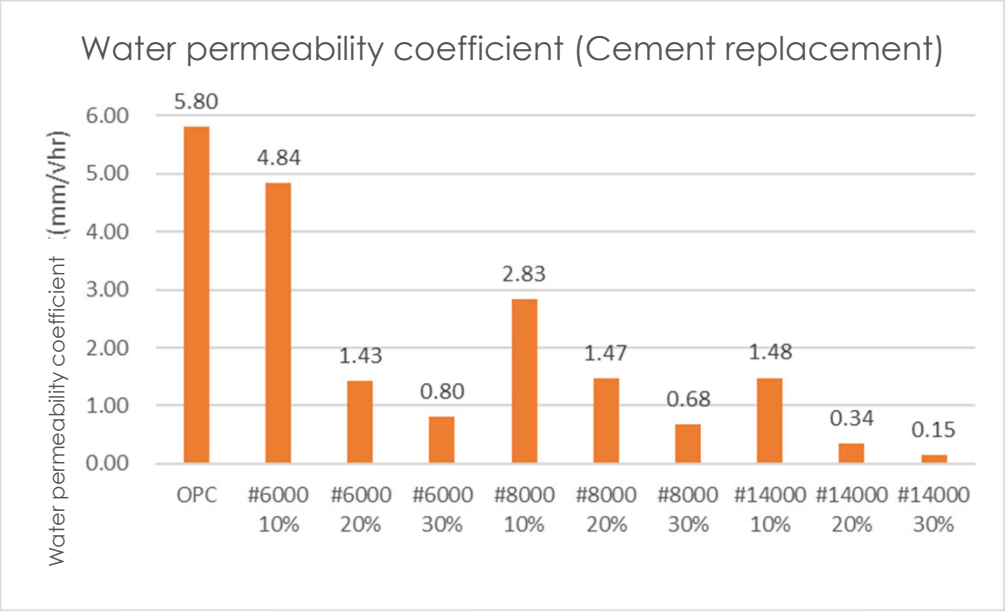


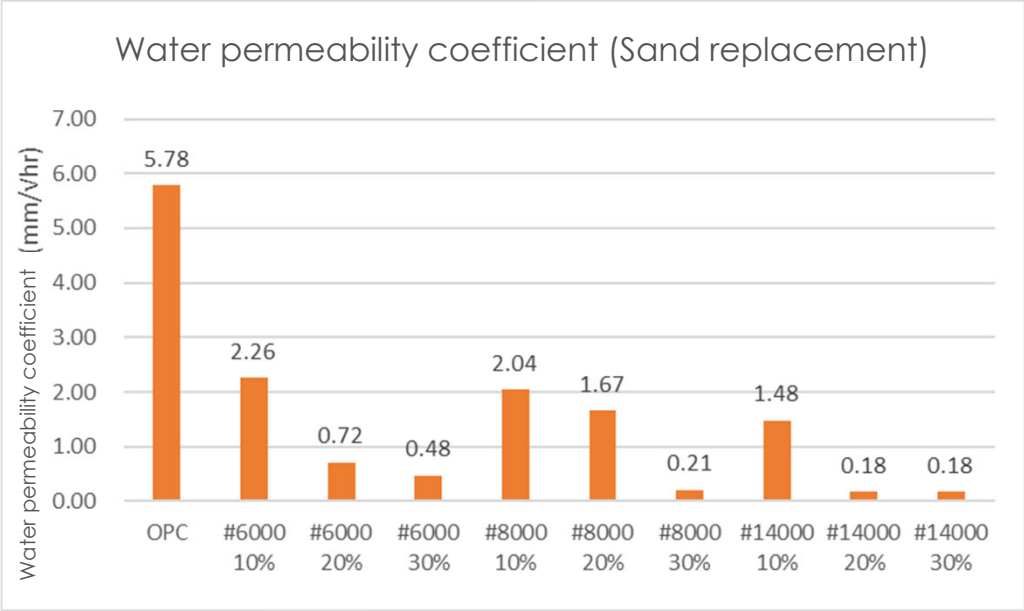
Non-steady-state migration test
(Chloride ion diffusion coefficient)

- Non-steady-state migration test performed by NT BUILD 492.
- Where N6000 refers to #6000 and N14000 refers to #14000 product mesh size.
- All experiments were conducted at Kanazawa Institute of Technology (Hanaoka Lab.) based on joint research between Silica Japan inc and Kanazawa Institute of Technology.

SILICA WHITE TEST AND EXPERIMENTAL DATA　PERFORMANCE AFTER CURING ：MORTAR SPECIMEN WATER PENETRATION RATE COEFFICIENT

- For additive-free, the effect of suppressing moisture penetration was confirmed with any substitution method.
- It was confirmed that the finer the mesh size of Silica White, the higher the moisture penetration suppression effect.





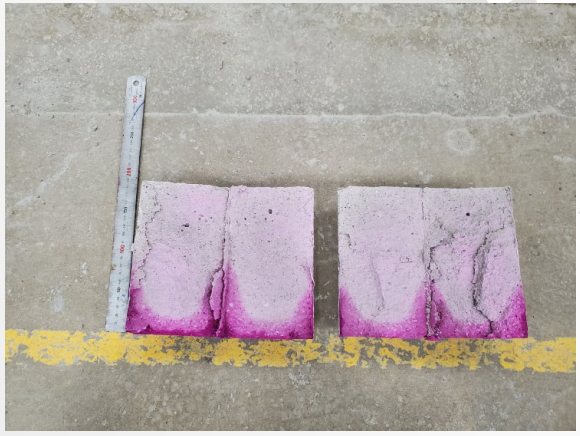
- The water penetration rate coefficient of concrete test was conducted by JSCE-G 582-2018 on a mortar specimen that was cured in water for 28 days and then cured in air at 20 degrees Celsius for 91 days.
- Where N6000 refers to #6000 and N14000 refers to #14000 product mesh size. #8000 is the mesh size prepared for the experiment.
- All experiments were conducted at Kanazawa Institute of Technology (Hanaoka Lab.) based on joint research between Silica Japan inc and Kanazawa Institute of Technology.

SILICA WHITE TEST AND EXPERIMENTAL DATA POST-CURING PERFORMANCE : MORTAR SPECIMEN MOISTURE PENETRATION TEST

48hours

OPC

#6000-10

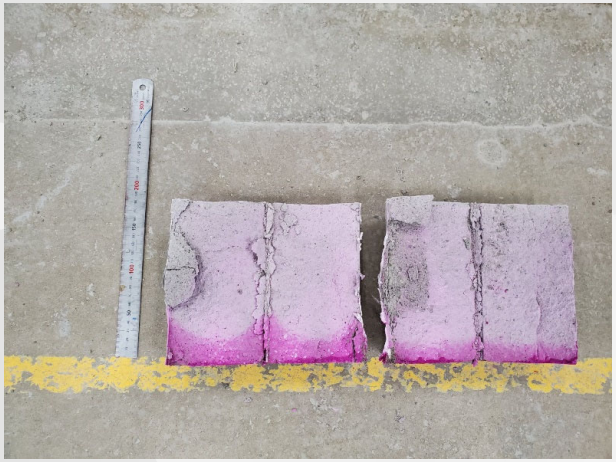


#6000-20

#6000-30

Moisture penetration test

48hours



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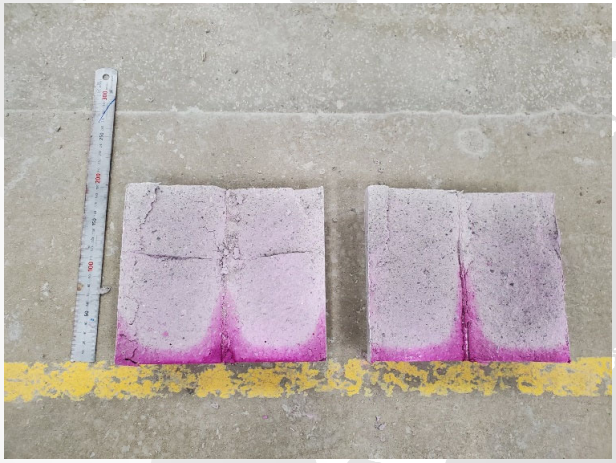

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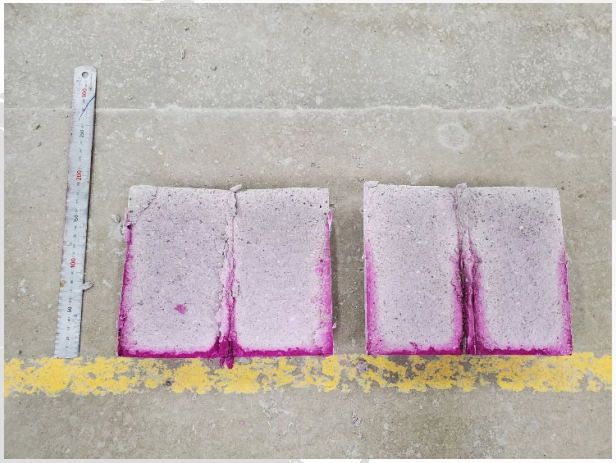

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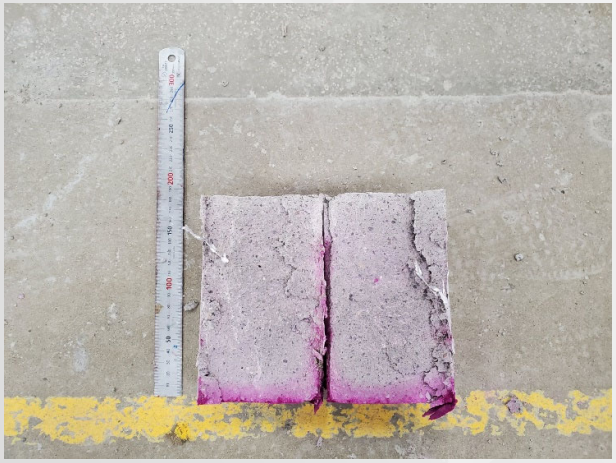

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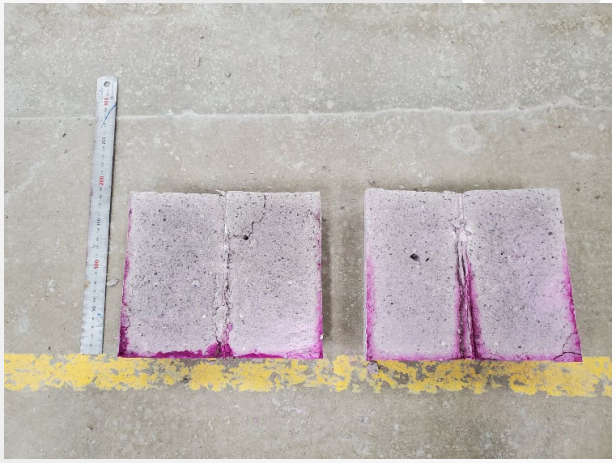
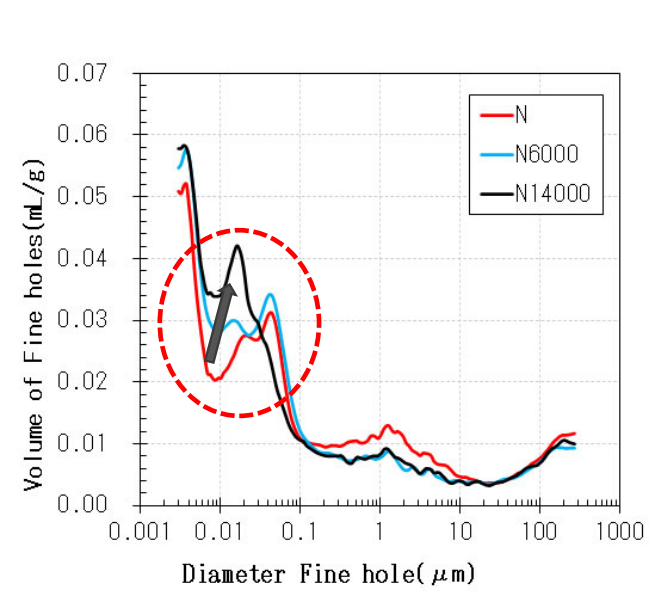


#14000-20

#14000-30

SILICA WHITE TEST AND EXPERIMENTAL DATA
PERFORMANCE AFTER CURING : MERCURY INTRUSION METHOD

- ✓ Pore size distribution is confirmed by mercury intrusion method on cured concrete specimens.
- ✓ In the unadded specimen (N), the pore volume of 0.1~10μm is large, but the pore volume of 0.1μm or less is increased by mixing Silica White, and it was confirmed that the surface is dense.

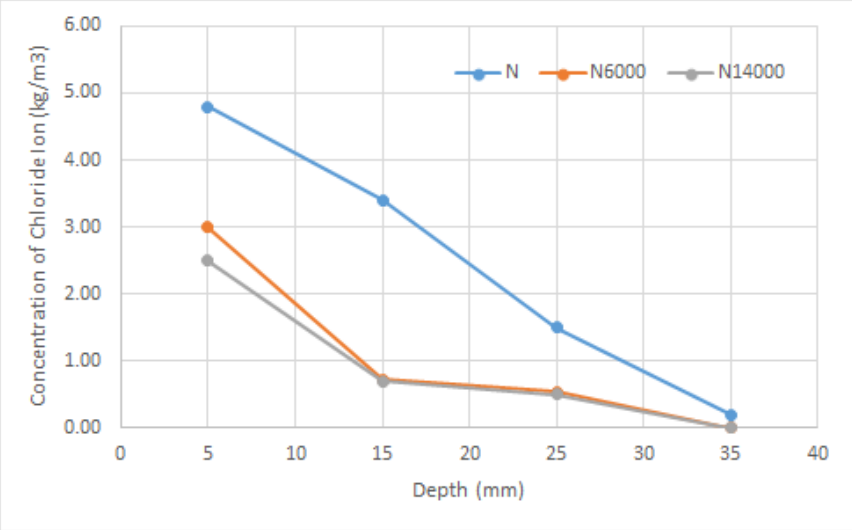


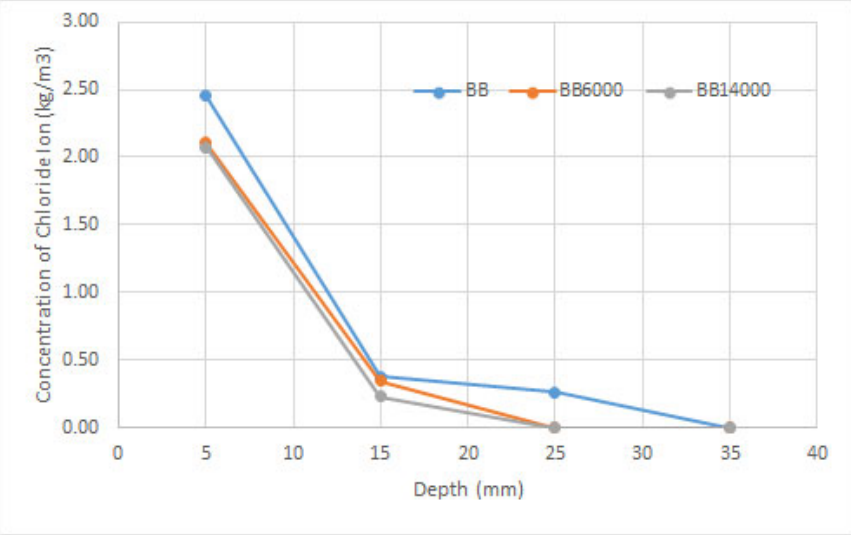
Reference : Mercury injection porosimeter

- The mercury intrusion method is an experiment in which mercury is injected into a sample while pressurizing it, and the pore size is estimated from the relationship between injection pressure and injection amount.
- Where N6000 refers to #6000 and N14000 refers to #14000 product mesh size.
- All experiments were conducted at Kanazawa Institute of Technology (Hanaoka Lab.) based on joint research between Silica Japan inc and Kanazawa Institute of Technology.

SILICA WHITE TEST AND EXPERIMENTAL DATA
DURABILITY PERFORMANCE : SALT IMMERSION TEST

- ✓ After curing, concrete is immersed in NaCl solution with a salt concrete of 3% for 91 days, and the total chloride ion concentration is measured by surface depth.
- ✓ In Ordinary Portland Cement, the addition of Silica White confirmed a decrease in the total chloride ion concentration in the depth direction, and the effect of improving salt shielding properties was confirmed.
- ✓ It was confirmed that the affinity of adding Silica White to Blast Furnace Cement (BB) was good, and that it cooperatively improved salt shielding properties.

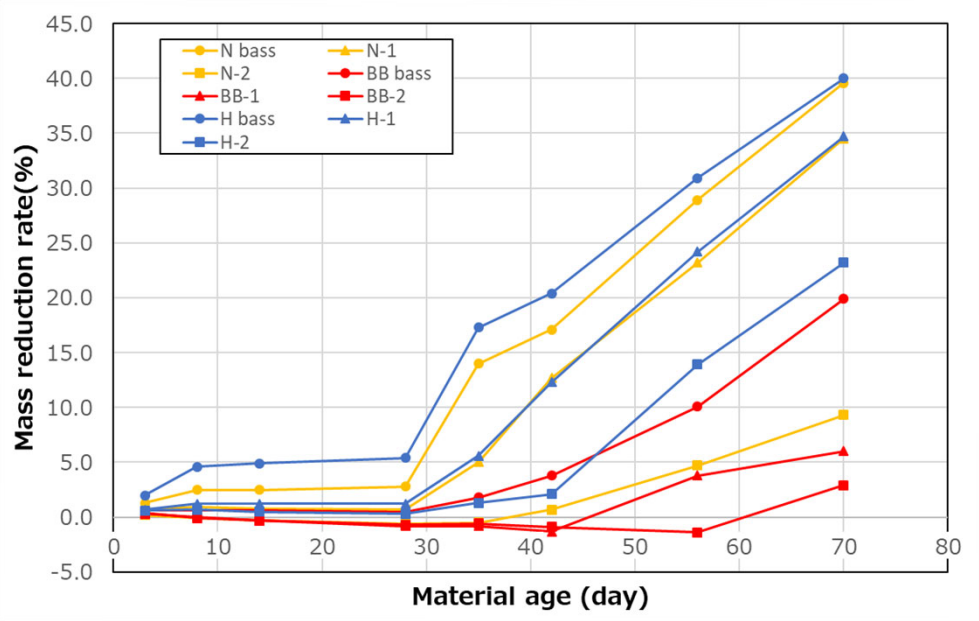




- The mercury intrusion method is an experiment in which mercury is injected into a sample while pressurizing it, and the pore size is estimated from the relationship between injection pressure and injection amount.
- Where N6000 refers to #6000 and N14000 refers to #14000 product mesh size.
- All experiments were conducted at Kanazawa Institute of Technology (Hanaoka Lab.) based on joint research between Silica Japan inc and Kanazawa Institute of Technology.

SILICA WHITE TEST AND EXPERIMENTAL DATA
DURABILITY PERFORMANCE : ACID RESISTANCE TEST

- ✓ After curing, the mortar specimen is immersed in a 5% solution of sulfuric acid to measure mass loss.
- ✓ By mixing Silica White, long-term acid resistance was improved, and it was confirmed that the affinity with blast furnace cement was well coordinated to improve the effect.



	N bass (Portland Cement)	BB bass (Blast Furnace Cement)	H bass (Fast-strong Cement)
No mixed	N bass	BB bass	H bass
SW-10%	N-1	BB-1	H-1
SW-20%	N-2	BB-2	H-2

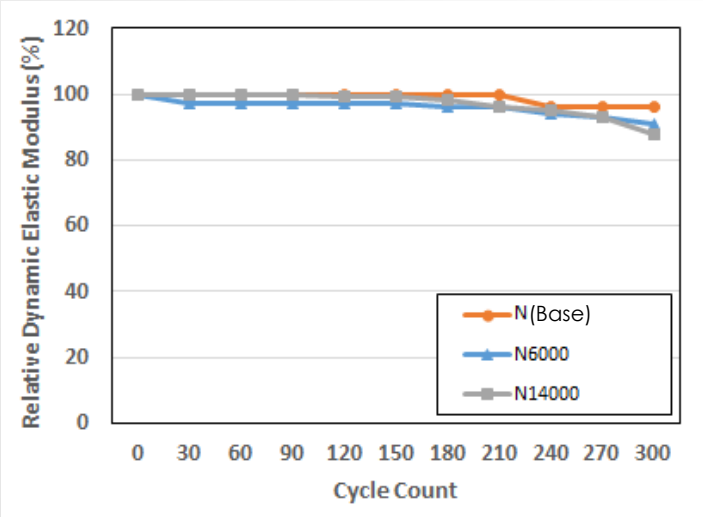
SW=Silica White

- Here, N refers to Ordinary Portland Cement, BB refers to Blast Furnace Cement, H refers to Fast Strong Cement, and SW-10% and SW-20% refer to specimens mixed with 10% and 20% Silica White, respectively.
- All experiments were conducted Silica Japan inc.

SILICA WHITE TEST AND EXPERIMENTAL DATA

DURABILITY PERFORMANCE : RESISTANCE OF CONCRETE TO FREEZING AND THAWING TEST

- ✓ Freezing and thawing concrete after hardening and measuring the decrease in relative modulus (JIS A 1148)
- ✓ The improvement effect od adding Silica White is not remarkable, but since the durability index is 60 or higher, it was confirmed that it has frost resistance.



Durability Index DF

$$DF = \frac{PN}{M}$$

DF : Durability Index
P : Relative modulus of elasticity during N cycles
N : Number of cycle with a relative modulus of
elasticity of 60%, or 30% cycles.
Whichever is small.
M : 300cycle

- Where N6000 refers to #6000 and N14000 refers to #14000 product mesh size.
- All experiments were conducted at Kanazawa Institute of Technology (Hanaoka Lab.) based on joint research between Silica Japan inc and Kanazawa Institute of Technology.

SILICA WHITE TEST AND EXPERIMENTAL DATA
DURABILITY PERFORMANCE : ABRASION RESISTANCE TEST

- ✓ Measurement test of wear and loss by running wear wheels on cured mortar specimens (JIS K 7204)
- ✓ A mortar mixed with 1:2 mortar and 1:2 Silica White was prepared and the amount of wear was measured, and it was confirmed that the amount of wear and tear was reduced by about 45% by mixing Silica White.

Test machine photo

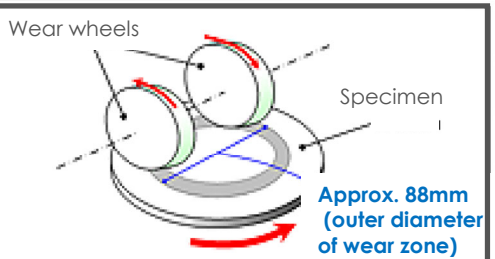
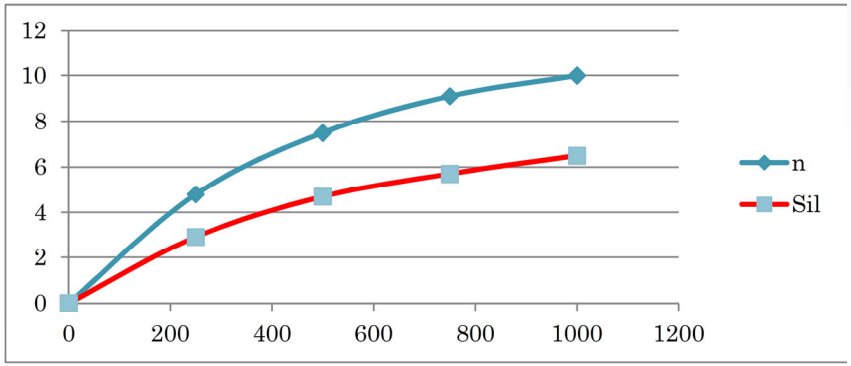


Figure 1. Movement of wear wheels

Test overview figure



Test results (wear amount) **Wear amount (g)**

W/C=40%	250 rotation	500 rotation	750 rotation	1000 rotation
1:2 mortar	4.8g	7.5g	9.1g	10g
1:2mortar Sil W(C*10%)	2.9g	4.7g	5.7g	6.5g

- Here, n refers to Ordinary Portland Cement, and Sil refers to a specimen in which Silica White is added to 10% of the cement amount.
- All experiments were conducted at Silica Japan inc.

RESISTANCE TO CHLORIDE ION PENETRATION AND ASR SUPPRESSION EFFECT OF CONCRETE MIXED WITH VOLCANIC GLASS POWDER

KANAZAWA INSTITUTE OF TECHNOLOGY GRADUATE SCHOOL FROM THE RESEARCH RESULTS OF TAISEI ARAKI ETC.

combinaton	W/B(%)	s/a(%)	Unit quantity(kg/m^3)											slump (cm) 12±2.5	Air volume (%) 4.5±1.5
			W	C		FA	VGP	S-1	S-2	G-1	G-2	SP	AE-1	AE-2	
				OPC	BB										
N	50	45	160	320	-	-	-	802	-	984		1.70	0.48	-	12.5	4.5
N-A				288			32	798		979		4.32	0.64		14.0	4.5
N-B												5.76	1.28		14.5	4.9
BB				-	320		-					1.12	0.96		13.5	3.5
N'	50	45	160	320	-	-	-	-	845	-	996	1.57	0.96	-	14.5	5.7
N-A'				288			32		841		990	2.08	1.92		14.0	5.9
N-B'												3.84			14.0	5.8
FA						32	-					0.48	-	1.60	12.5	4.0

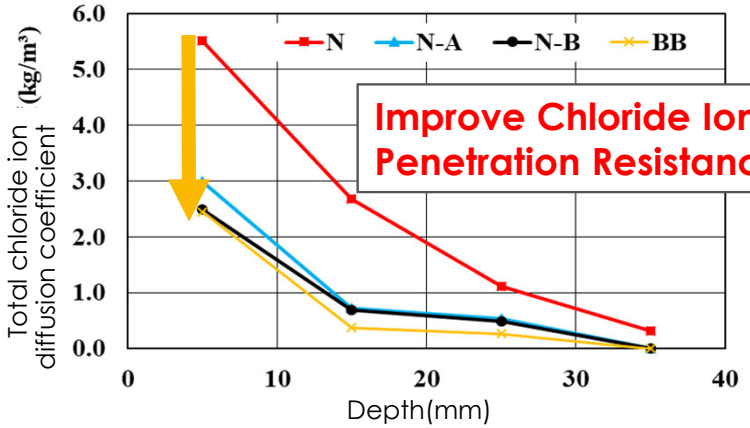
C：Ordinary Portland Cement（Density 3.16g/cm³, Brane specific surface area 3340cm²/g），BB：Blast Furnace Cement Type B（Density 3.08g/cm³），FA：Fly Ash Ⅱ Seed Ash（Density 2.30g/cm³, Brane Specific Surface Area 4440cm³/g），VGP：Volcanic Glass Fine Powder A（Density 2.36g/cm³,BET Specific Surface Area 186020cm²/g），B（Density 2.32g/㎤,BET Specific Surface Area430310cm²/g），S-1：Fine Aggregate（Density 2.57g/cm³），S-2：Reactive Fine Aggregate（Density 2.708g/cm³），G-1：Coarse Aggregate（Density 2.58g/cm³），G-2：Reactive Fine Aggregate（Density 2.61g/cm³），SP：High Performance AE Water Reducer（SF500S），AE-1:AE Entraining （AE-4），AE-2：AE Entraining（AE-9B）

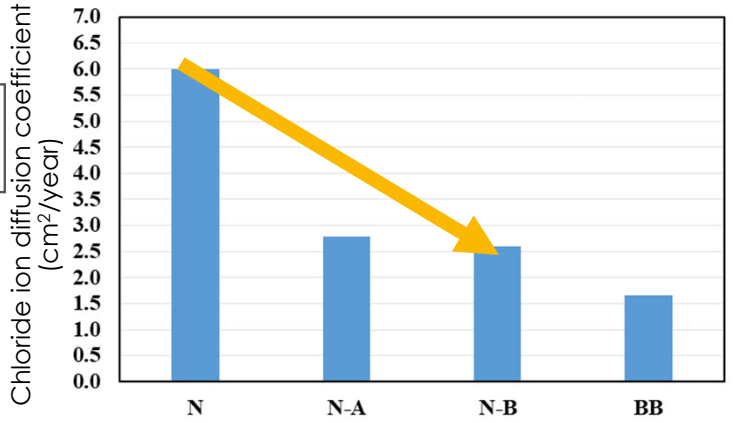
The mixing ratio of volcanic glass fine powder and fly ash was 10% of the mass of cement.

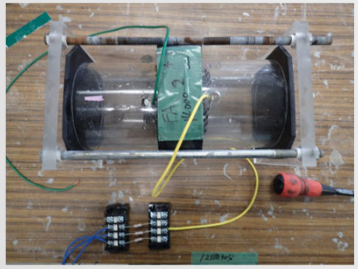
Chloride Ion Penetration Resistance Test

・Immersion method：After 28 days of curing in water, immersion in NaCl solution at a concentration of 3.0% for 91 days.
・Non-steady-state migration test：Experiment after 28 days of underwater curing (NT BUILD 492)

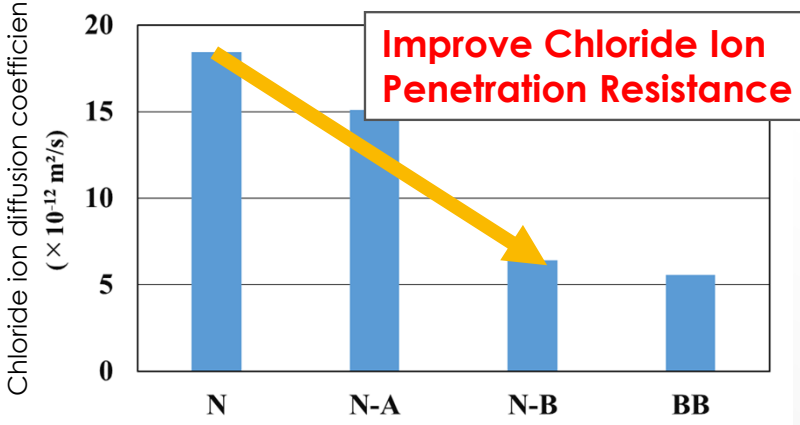
Immersion method test

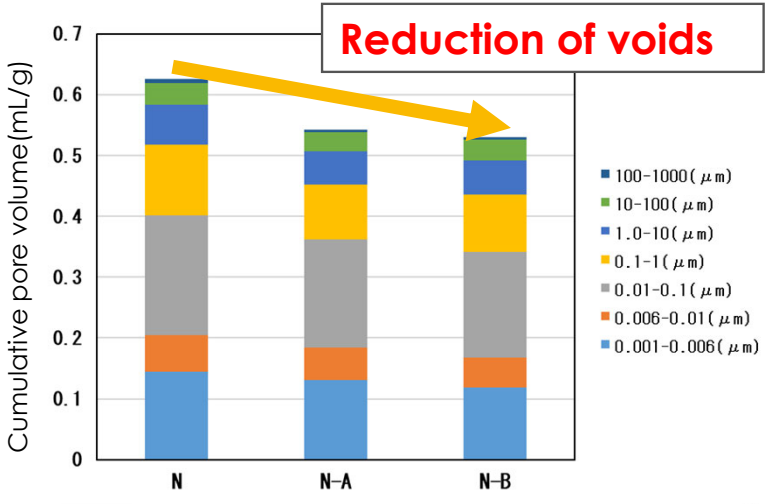






Non-steady-state migration test



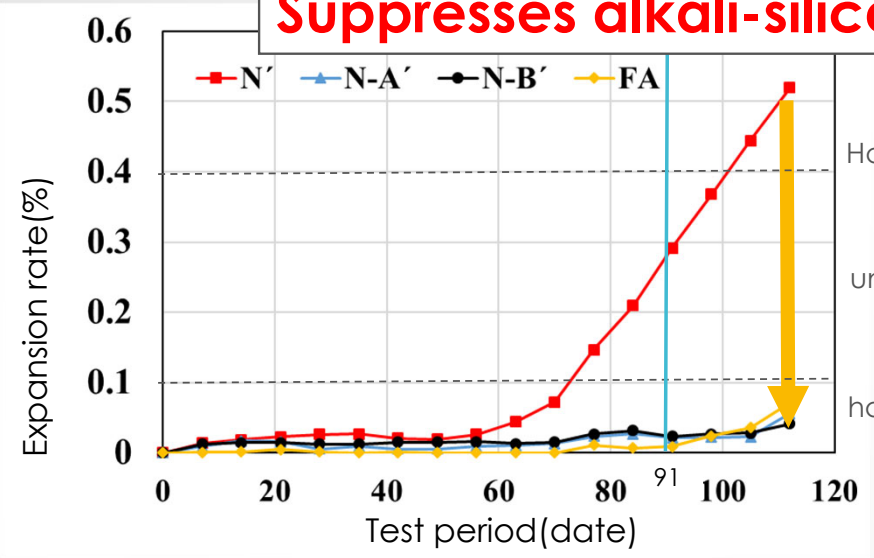


ASR TEST

Volcanic glass powder
N-A' : BET specific surface area 186020cm²/g
N-B' : BET specific surface area 430310cm²/g

・Danish method, 7days after wet curing, immersion in saturated NaCl solution.

Suppresses alkali-silica reaction



N-A',N-B',FA has a 100days expansion rate of 0.1% or less.

- Reduction of unit cement volume
- Adsorption of alkaline components
- Densification

CONTENTS

HAKODATE JOMON CULTURE CENTER（HAKODATE, HOKKAIDO ROAD STATION JOMON ROMAN MINAMI KAYABE）

- ✓ Silica White is added to use exposed concrete with a wooden board texture for the exterior and interior
- ✓ Silica White has a neat finish of white color, so it is ideal for construction of exposed concrete that makes the most of the texture of the material

- Design： Atelier BNK Co.Ltd

AWASE CATHOLIC CHURCH（OKINAWA CITY, OKINAWA）

- ✓ In order to create a sacred space, unpoured concrete is used, and silica white is added
- ✓ Silica White has a neat finish of white color, so it is ideal for construction of exposed concrete that makes the most of the texture of the material

HIMEJI CITY MUSEUM OF LITERATURE（HIMEJI, HYOGO）

- ✓ In order to create a modern atmosphere that matches the nearby Himeji Castle, exposed concrete is used and Silica White is added
- ✓ Silica White is highly fillable for exposed concrete with complex shapes

- Design： Tadao Ando Architect&Associates

MIYAGI PREFECTURE ISHINOMAKI TECHNICAL HIGH SCHOOL (MIYAGI)

- ✓ In order to create a high-technology atmosphere, exposed concrete is used and Silica White is added
- ✓ Silica White is highly fillable for exposed concrete with complex shapes

- Design： MHS Planners, Architects & Engineers

NAGANO UNIVERSITY LIBRARY（UEDA CITY, NAGANO）

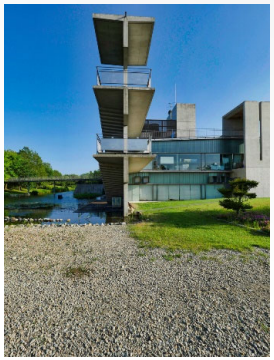
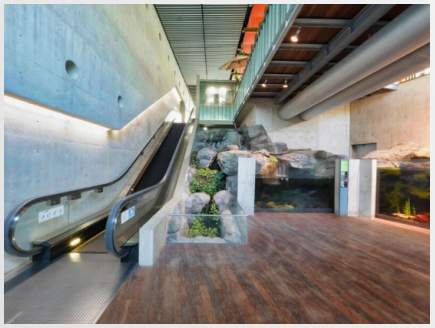
- ✓ In order to create an academic and modern atmosphere on the new campus, expressed concrete was adopted and Silica White was added
- ✓ Silica White is highly fillable for exposed concrete with complex shapes

- Design： Yamashita Sekkei Inc.

TOCHIGI NAKAGAWA AQUATIC PARK（OTAWARA CITY, TOCHIGI）

✓ Silica White has a beautiful finish and high fillability for exposed concrete with complex shapes




- Design： Tetsuo Furuichi Urban Building Research Institute・Sato Comprehensive Plan Specific Design JV / 2005 Japan Architectural Institute Award

WATER TANK, POOL FRAME STRUCTURE

- ✓ Silica White has been adopted in many aquariums, public swimming pools, etc. Where dense, low-cracked concrete with low water permeability is required

NONNOCO warm pool & public bath

(Isahaya city, Nagasaki)

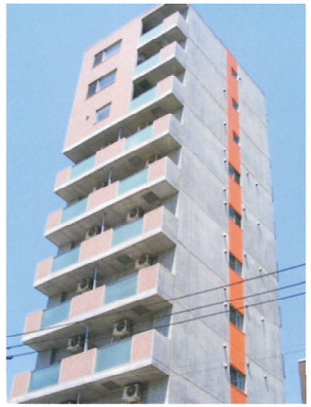
Private regulating pond（Okayama)

Salmon, hatching, and fish breeding ponds（Hokkaido)

PRIVATE, MULTIFAMILY AND TENANT BUILDINGS

- ✓ In order to create a design atmosphere with a sense of material, we a sense of material, there adopted exposed concrete and added Silica White
- ✓ Silica White has a beautiful and dense surface finish and is highly fillable for exposed concrete with complex shapes





CONTENTS

HIGHLY DURABLE STRUCTURES, DURABLE FLOOR SLABS (CONCRETE PAVEMENT)

- ✓ Silica White is used in tsunami evacuation towers that require robust, dense, low water permeability and high salt shielding concrete.
- ✓ Applications are increasing in underground passage pavements and parking lot top slabs, which require high wear resistance.

Underground pedestrian space in front of Sapporo Station(Hokkaido)

Nahari Tsunami Evacuation Tower（Kochi）

Tano Tsunami Evacuation Tower(Kochi)

Hirosaki University Hospital Underground Parking Lot（Aomori）

Rausu fishing port sanitation management type wharf pavement（Hokkaido）

BRIDGE（SUPERSTRUCTURE, HIGH BALUSTRADE, WELL BALUSTRADE, JOINT）

- ✓ Silica White is used for bridges in snowy and cold regions that require robust, dense, low water permeability and high salt shielding concrete.
- ✓ High crack resistance is expected to have an inhibitory effect on deterioration and performance degradation caused by cracking of RC structures.



Kashino Bridge（Komatsu, Ishikawa）



Hokuriku area expressway（Ishikawa, Toyama）

BRIDGE（SUBSTRUCTURE）

- ✓ Silica White is used for bridge substructure in snowy and cold regions where robust, dense, and highly resistant concrete is required to resist freezing and thawing.
- ✓ High crack resistance is expected to have a suppressive effect on deterioration and performance degradation caused by cracks in RC structures, and is considered to be effective for bridge repair and reinforcement work that is a small-scale construction.

Matsuhama bridge upstream bridge（Niigata）

Application examples of bridge repair and reinforcement work

ROAD STRUCTURES(CULVERTS), PRECAST STRUCTURES

- ✓ Robust, dense, and high crack resistance is expected to have a suppressive effect on the performance degradation of RC structures, and stable color tones are suitable for precast structures.
- ✓ Silica White is used to improve durability and strength of fine-walled precast structures.

Central Hokkaido connecting road（Hokkaido)

Application examples to precast structures

TUNNELS, SHIELD SEGMENTS

- ✓ The addition of Silica White improves the worker-like performance and formwork filling performance before curing, which improves the pouring performance of mountain tunnel lining, and can be expected to be effective in suppressing potential cracks and peeling.
- ✓ Robust, dense, and high crack resistance is expected to have a suppressive effect on the deterioration of the structural performance of the RC segment, and since it improves water resistance and salt resistance, it contributes to the thinning of the RC segment for shields and the reduction of cracks caused by the mutual influence of the attached tunnel.

Abashiri park line improvement work

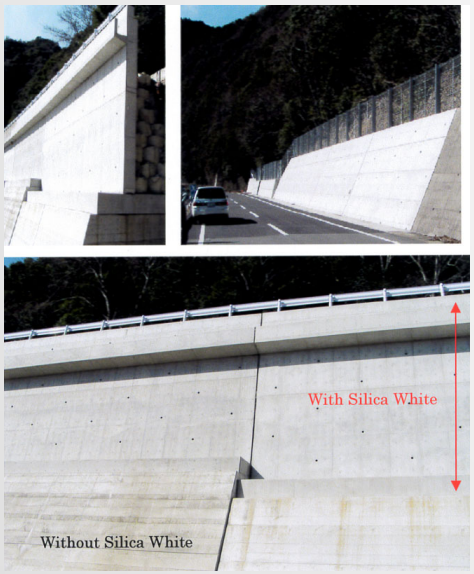
(Abashiri, Hokkaido)

National highway No.1 Seisen bypass Shizuhata tunnel construction

This segment is for Yokohama shonan road shield construction

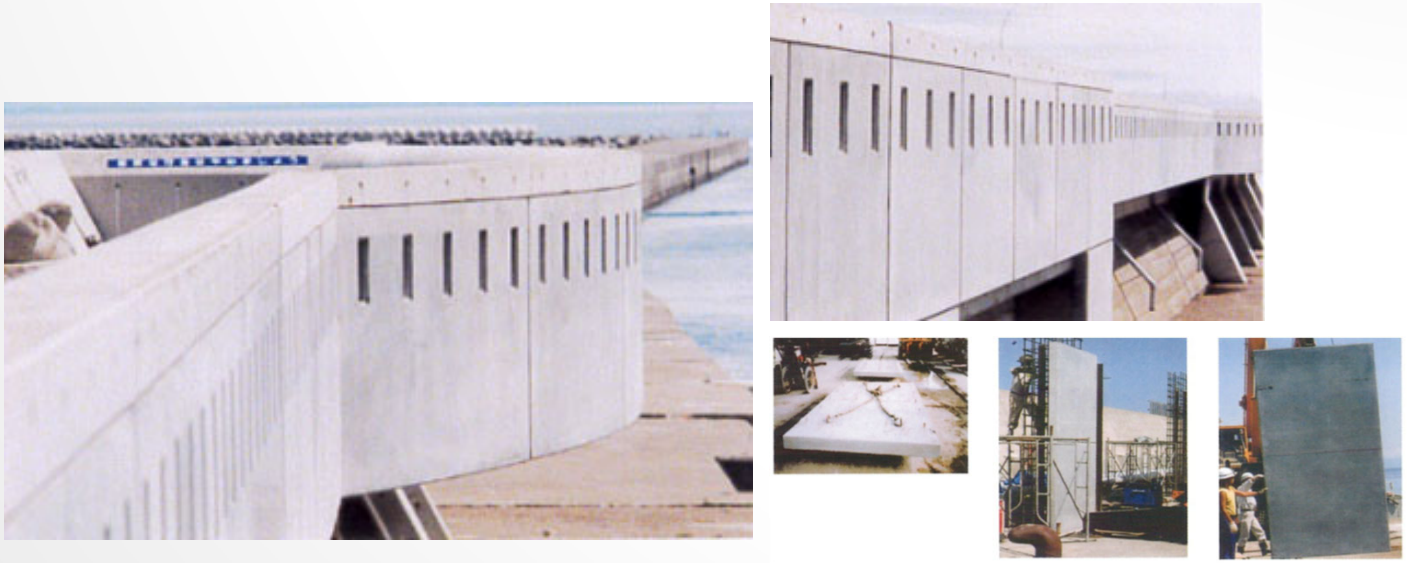
PORTS AND COASTAL STRUCTURES

- ✓ The addition of Silica White improves water and salt shielding properties, which is expected to be effective in improving the durability of port and coastal structures.
- ✓ Robust, dense, and high crack resistance suppresses salt penetration caused by cracking, and is expected to be effective in suppressing corrosion of reinforcing bars and the resulting deterioration of RC structures.
- ✓ Silica White has a good affinity with the durability improvement of blast furnace cement used in port structures, and the addition of silica white is expected to further improve durability.



Anan washiki line improvement work

(Anan, Tokushima)



Popo 260 hydrophilic breakwater（Abashiri, Hokkaido)

THANK YOU FOR YOUR ATTENTION!