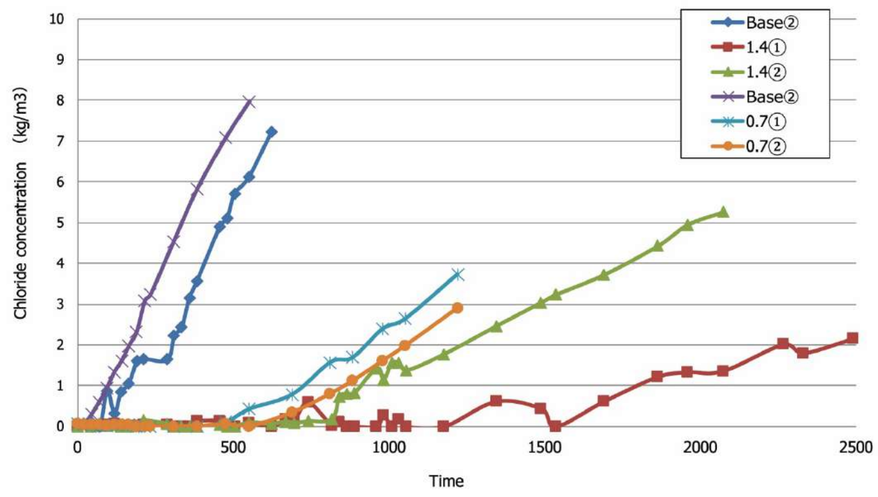
KS Bond Series
High-durability Epoxy Adhesive for Civil Engineering
لاصق إيبوكسي عالي المتانة لأعمال الهندسة المدنية
تقديم سلسلة KS Bond

For repair or renovation of aging roads and airport facilities

Adhesive-assisted concrete overlay is a maintenance/repair/reinforcement method where adhesive is applied to the surface of a steel floor base or existing concrete pavement before a new concrete layer is freshly cast on top of it. The adhesive composition is designed to maximize known adhesion characteristics between epoxy resin and a freshly cast concrete layer with improved fatigue and water resistance. In roadworks, the adhesive-assisted concrete overlay method is used for giving additional thickness to a reinforced-concrete floor base or providing SFRC paving on top of a steel floor base. In airport projects, the method is mainly used for raising the apron paving height.

Salt blocking property

The following diagram shows the result of electrophoresis tests done on our high-durability adhesives. It shows that use of our high-durability adhesive drastically improves the estimated time that chloride concentration reaches 1.2 kg/m3 at the depth of 50 mm.



(1) Diffusion co-efficient based calculation

	Actual diffusion co-efficient (cm²/year)		Number of years elapsed		Total number of years elapsed
	Initial non-constant region	Constant penetration region	Initial non-penetration region	Constant penetration region	
Base Specimen	–	0.492	–	9.0	9.0
	–	0.757	–	5.8	5.8
0.7kg/m² applied	0.061	0.197	5.1	22.4	27.5
	0.031	0.221	10.0	20.0	30.0
1.4kg/m² applied	0.012	0.107	51.5	41.2	92.7
	0.029	0.156	21.3	28.3	49.6

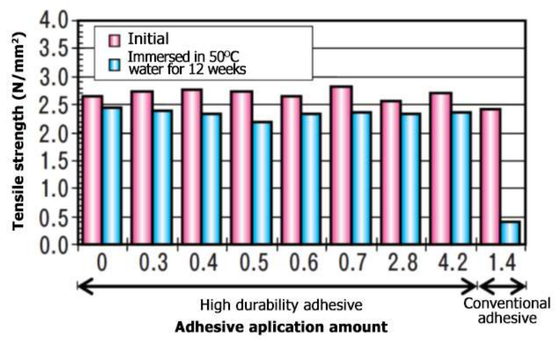
(2) Time-proportional calculation relative to the base specimen

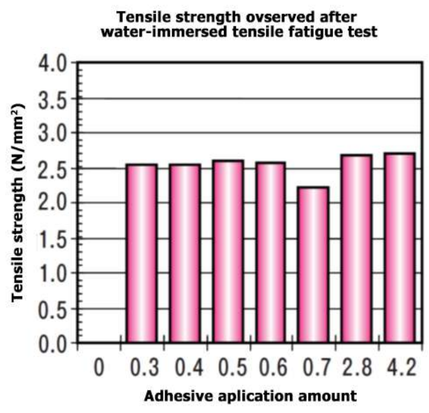
	Time to attain 1.2kg/m³		Actual diffusion co-efficient (cm²/year)	Number of years to attain 1.2kg/m³	
Base Specimen	112	141	0.492	9.0	7.4
	170		0.757	5.8	
0.7kg/m² applied	500		-	26.2	
	800		-	42.0	
1.4kg/m² applied	1863		-	97.8	
	900		-	47.2	

Durability

It is proven that application of our high-durability adhesive (0.3 to 4.2 kg/m2) prevents interfacial failure even after 2 million loading cycles in a water-immersed tensile fatigue test.

Test result (immersed in 50°C water for 12 weeks)





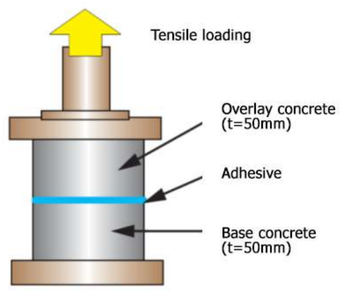
Water-immersed tensile fatigue test condition

Loading frequency (Hz)	10
Loading curve	Sine wave
Loading stress	1.1~1.3N/mm² (Determined by FEM analysis)
Number of loading cycles	Max 2,000,000 times
Test temperature	Room temperature

Water-immersed tensile fatigue result

Application amount (kg/m²)	Stress (N/m²)	Number of loading cycles	Type of destruction
0.0	1.1	20,855	Interfacial
	1.3	566	Interfacial
0.3	1.3	2,000,000	No destruction
0.4	1.3	2,000,000	No destruction
0.5	1.3	2,000,000	No destruction
0.6	1.3	2,000,000	No destruction
0.7	1.3	2,000,000	No destruction
2.8	1.3	2,000,000	No destruction
4.2	1.3	2,000,000	No destruction

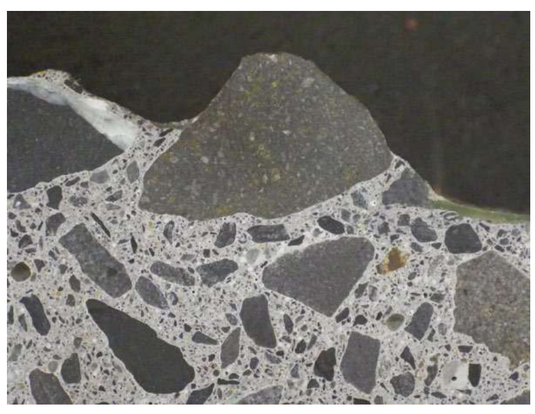
Direct tensile test setup

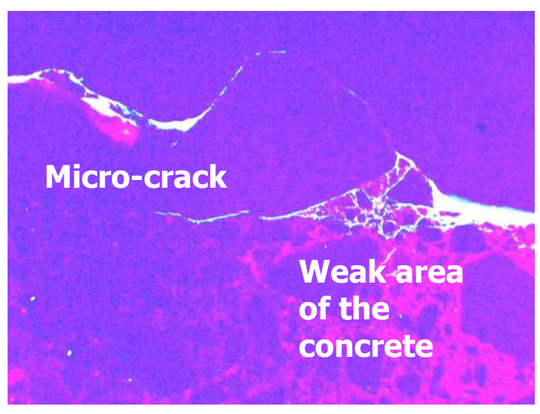


Penetrative KS Bond

Penetrative KS Primer is a highly durable epoxy primer to be applied before adhesive application. It soaks into micro-cracks in the concrete to repair the damaged road base or strengthen other weak areas of roadwork, contributing to greater fatigue resistance of partial road repair projects. Penetrative KS Bond is the general term for our adhesive assisted concrete overlay technology where a Penetrative KS Primer is applied in the amount of 0.5 kg/m2 or greater (the primer soaks deep into the structure as part of capillary action) before KS Bond is applied in the amount of 0.9 kg/m2 or greater. It provides dependable adhesion between the existing base and the concrete overlay even when the base concrete has micro-cracks or other internal weakness. The Penetrative KS Bond method assures both strong penetration and reliable adhesion, hand-chipped section, partial repairs, correction of micro-cracks and fissures.

Potential application: Finishing a separated paving.





KS Bond Type M

KS Bond Type M is an adhesive series designed for large-area projects such as airport concrete paving. KS Bond Type M takes longer time to cure than standard KS Bond so that it allows 6 hours (at 20°C), instead of 2 hours that KS bond does (at the same temperature), before a fresh concrete layer is cast on top of it. With smartly controlled viscosity of the main and the curing agents, they can be mechanically mixed and sprayed with the specially designed bond spray machine.

Potential application: Airport paving, seaport yards, other large-area concrete paving projects

KS Primer II

KS Primer II is a series of rust-proofing primer that is applied to the steel base before KS Bond as a preparation for fresh concrete overlay casting. KS Primer II keeps the steel base from rusting, both before KS Bond application and also after concrete casting.

Potential application: Steel floor base, reinforcement bars; the Primer satisfies the requirements for a rust-proof steel reinforcement specified in NEXCO Structure Management Procedure "Evaluation of Steel Reinforcement Performance").

KS Bond

KS Bond is a series of high-durability epoxy adhesive products designed to assure that a freshly cast concrete layer bonds well with the steel or concrete base.

Potential application: SFRC on steel floor base, adding thickness to a concrete floor base

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Reinforcement by SFRC Bond

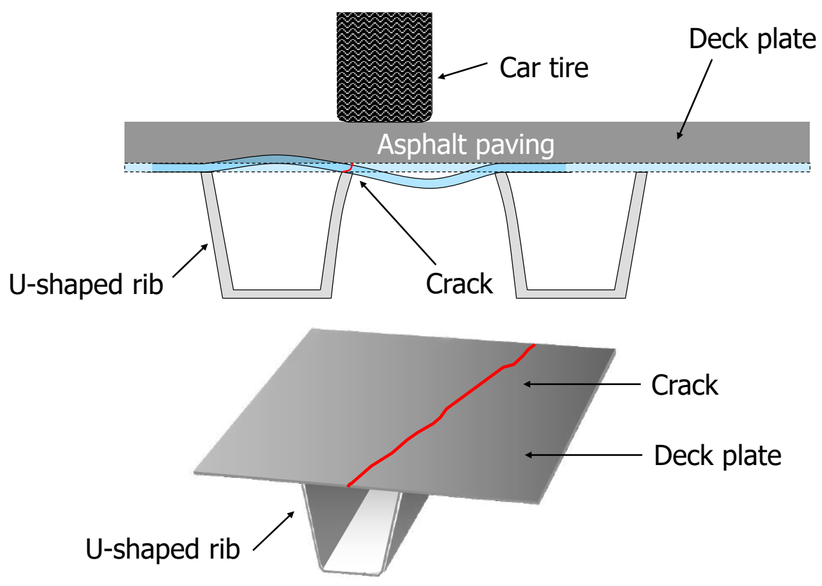
Use of adhesive for permanently reinforcing bridge components (steel and concrete floor base)

أسلوب التقوية الدائمة عبر توصيل الجسور
أسلوب التقوية "SFRC Bond"

Overview

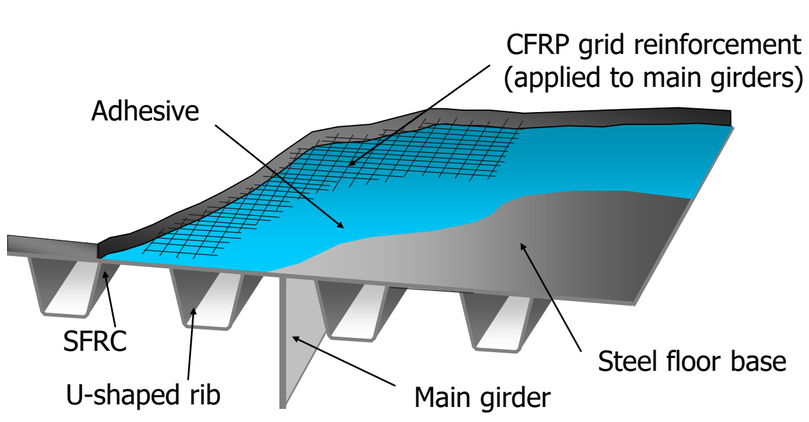
NETIS registration: KT-090029-A

Crack occurrence mechanism



Recently, fatigue cracks have been observed in bridges with steel floor base, many of which have been unexpectedly high levels of traffic loading, especially in the weld areas between the steel floor deck plate and the U-shaped ribs. The main contributors to such fatigue cracking are the increased axis loading and higher number of wheels of large vehicles, and the insufficient rigidity of the steel floor base to support such loading. "SFRC Paving on Steel Floor Base" is a method to permanently reinforce a steel floor base under concrete paving. A "Steel Fiber Reinforced Concrete" (SFRC) composition, which is produced by mixing steel fiber into the base concrete mix before concrete is cast and compacted. Use of a special epoxy resin adhesive assures that the concrete layer dependably bonds with the steel floor base, improving the overall base rigidity and also reducing distortion concentration in the weld areas. The method is also useful for adding thickness to an existing concrete paving.

Structure



Since 1970s, U-shaped ribs have been the most commonly used longitudinal rib design in roadwork for their superior torsional rigidity.
FEM (finite-element method) based stress comparison in projected areas of box-girder steel floor base bridge construction before and after SFRC paving revealed that an approximately 80% stress reduction can be obtained in the weld areas between the steel floor base and U-shape ribs under a 10-ton loading.

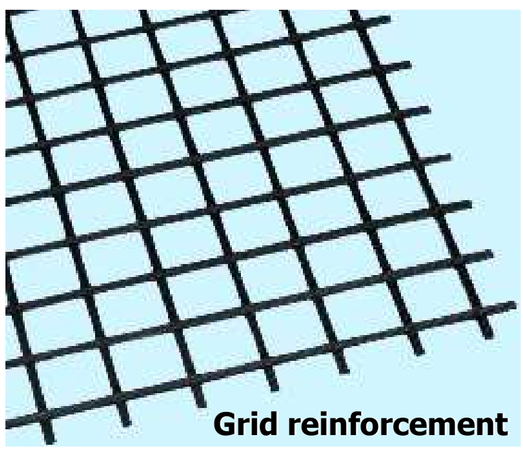
Material

Steel fiber-reinforced concrete

Steel fiber-reinforced concrete (hereinafter "SFRC") is a composite material with steel fiber mixed into the base concrete. It has a number of improved post-cure characteristics compared to those of conventional concrete composition. Conventional concrete is resistant under compression stress but is relatively weak to tensile, bending and shear stresses. SFRC has an equivalent compression strength to conventional concrete but also offers greater tensile, bending and shear resistance. SFRC is useful for maintaining road rigidity even with cracks in the concrete.

Special adhesive "KS Bond"

Our special adhesive series "KS Bond" is a high-durability adhesive designed for civil engineering applications. It exhibits very little strength reduction in hot water spray tests (JIS K6857, Condition E) and resists interfacial failures. KS Bond offers dependable long-term adhesion and rustproofing effects even with cracks or rainwater ingress.



CFRP grid reinforcement

According to FEM (finite element method)-based distortion analysis on the SFRC surface, CFRP (carbon fiber-reinforced plastic) grids are installed when necessary.

CFRP grid reinforcement helps maintain rigidity and load bearing of the road even with cracked concrete base.

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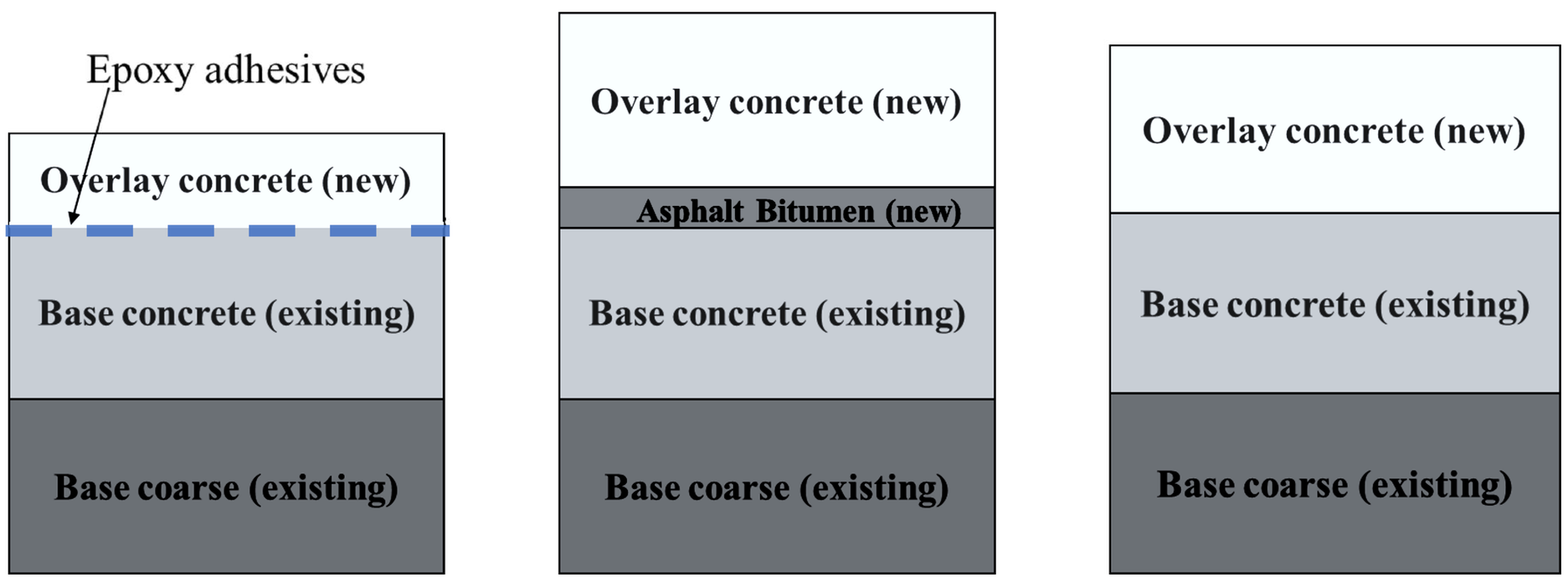
Concrete Overlay Construction Method
to adjust inclination of concrete apron pavement in airports

أسلوب إنشاء تراكب الأسمنت
لضبط ميل طرق مواقف الطائرات الأسمنتية في المطارات

Concrete overlay construction method with adhesives is a repair industrial method that spreads epoxide resin adhesives after the surface of the existing concrete is processed in the blast, places thin concrete (from 50 to 300mm in thickness) to adjust inclination of concrete apron pavement.

1. Structure (Three types of concrete overlay manner)

Bonded overlay type's merits are thickness, speed of construction, less waste of materials and environmental friendliness.

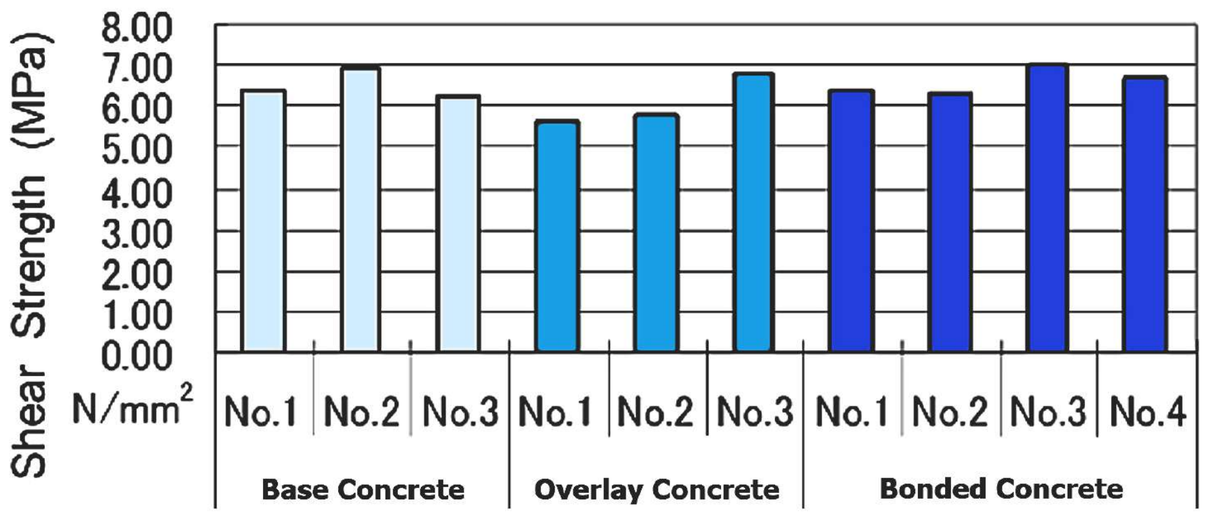


1. Bonded overlay type **2. Separate type** **3. Directly placing type**

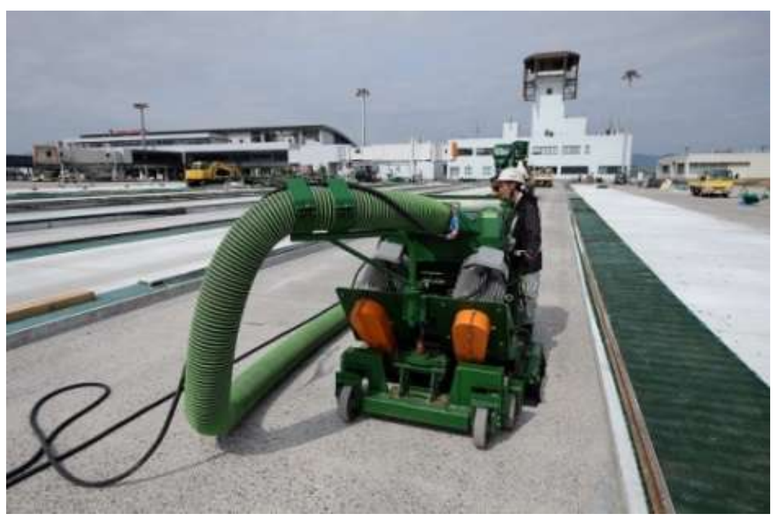
2. Material (The special epoxy adhesives for fresh concrete)

The KS bond-type M is epoxide resin adhesives of the high endurance type to bond fresh concrete to the existing concrete.

It is possible to spray by using the specialized machine with an automatic mixture of the base resin and the curing agent.



3. Construction



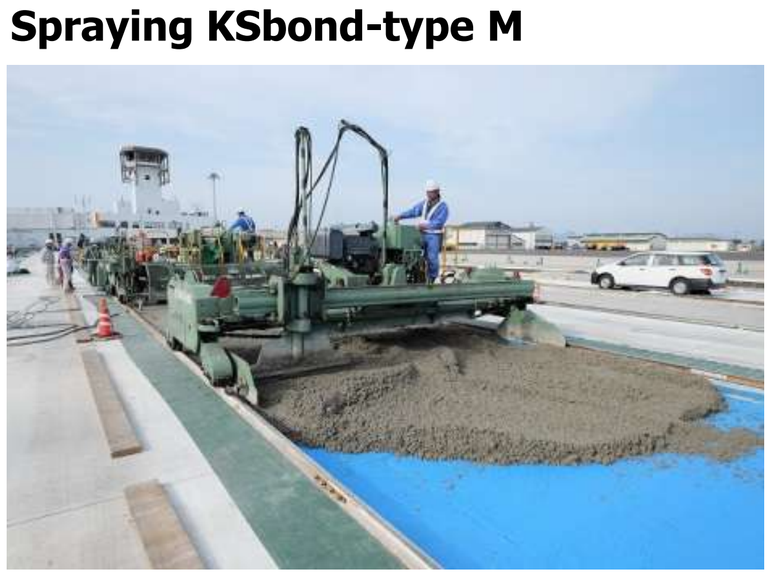
Blasting

Spray machine

Spraying KSbond-type M

KS bond-type M

Placing concrete



Spreading concrete

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High endurance epoxide resin adhesives for fresh concretes

KS bond-type M

مواد لاصقة عالية المقاومة من راتنج الإيبوكسي للأسمنت المصبوب حديثاً
KS bond - النوع M

4. Features of KS bond-type M

Performance of adhesion:
Interfacial tensile strength is more excellent than existing concretes because there is little influence on stiffening of fresh concrete with epoxy resin.

Temperature range:
It is possible to construct within the range from 5 to 50℃.

Durability:
It has excellent durability for water, temperature, and cyclic loads.

Workability:
It is suitable for constructions of large areas like the airport pavement.

5. Specification

		Properties	Remarks
Appearance	Base resin	White paste	–
	Curing agent	Blue liquid	–
Ratio of mixtures (Base : Curing)		100 : 75	Weight ratio
Specific gravity		1.40±0.20	JIS K 7112
Compressive strength		50N/mm2	JIS K 7181
Stiffness coefficient		1000N/mm2	JIS K 7181
Shear strength		10N/mm2	JIS K 6850
Bond strength		1.6N/mm2	JIS K 6909
Spread amount	Machine	Flat : 0.88kg / m² Ruggedness : 1.11kg / m²	Loss rate 10%
	By hand	Flat : 1.47kg / m² Ruggedness : 1.91kg / m²	Loss rate 5%

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