

Environmental



To Sustain Rich Global Environment

■ Basic approach

In recent years, with the increasing momentum of ESG, SDGs and carbon neutrality, companies are required to make a higher level of effort than ever before to address global climate change. The Nichireki Group aims to both solve environmental issues, which include realizing a decarbonized and recycling-oriented society and conserving biodiversity, and achieve a high level of sustainable development of its business. To these ends, the Nichireki Group has set up the Environmental Management Committee that deliberates on and examines group-wide initiatives to address general environmental issues including climate change and the evaluation and review of such initiatives. The Nichireki Group also manages environmental measures and ensures the implementation thereof from a sustainability perspective.

■ Environmental policy and our environmental management system

The Nichireki Group acquired the certification for integrated management system including environmental management system (ISO 14001) in February 2012, in addition to the certification for quality management system (ISO 9001) that has been implemented. Five efforts are specified in our environmental policies that form the backbone of our environmental management system. Under those policies, we promote the development and provision of eco-friendly products and construction methods, with reducing wastes, saving natural resources and energy, and recycling, while of course complying with laws and regulations, in mind.

Environmental Policies

As a corporate group that is indispensable for creating “roads,” we will strive to preserve the global environment, improve the local living environment and contribute to the realization of a sustainable society.

To these ends, we will promote environmental management and make the following efforts.

April 1, 2024

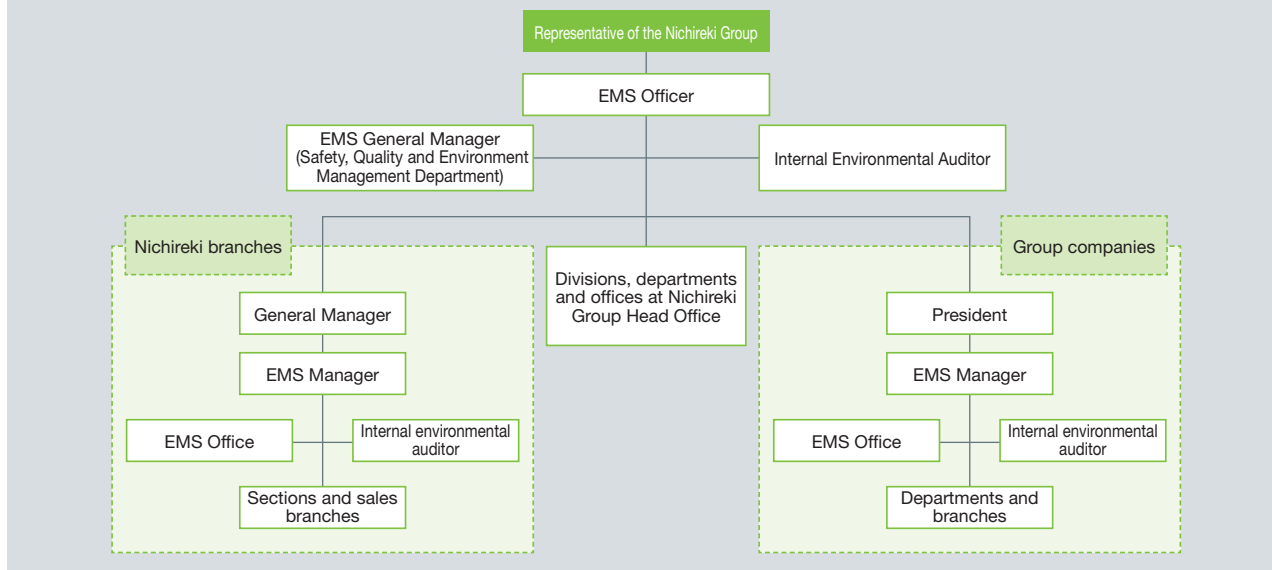
Manabu Obata, Representative of the Nichireki Group

1. We comply with environmental laws and regulations, and promote an environmental management system.
2. We promote the reduction of waste products, saving of natural resources, energy conservation, and recycling activities.
3. We develop eco-friendly products and construction methods, and provide them to society.
4. We promote environmental protection activities and strive to prevent pollution.
5. We strive to further improve environmental awareness through education and business activities to reduce the impact on our environment.

ISO Certificate of Registration (Union of Japanese Scientists and Engineers ISO Registration Center)



Environmental Management System (EMS)



Realization of a decarbonized and recycling-oriented society

The Nichireki Group has always worked to create eco-friendly roads by developing cold paving using asphalt emulsion. In addition to our conventional efforts, in recent years, we have been working to reduce CO₂ emissions further to contribute to the realization of a decarbonized society. Such efforts include reducing the temperature of mixture production using modified asphalt for warm mix, extending the lifespan of pavements, and developing and supplying *Tastainability*[®] products and construction methods ▶ P.29 that contribute to the effective use of resources through recycling. As a milestone in our efforts, by FY2043, the 100th anniversary of our founding, we aim to achieve a consolidated sales ratio of eco-friendly products and construction methods exceeding 80%.

In our day-to-day business activities, we are focusing on initiatives to reduce environmental impact. For example, we promote resource reuse by thoroughly sorting waste within the office and switching to green power. We will further accelerate our efforts toward the realization of carbon neutrality (eliminating net emissions of greenhouse gases including CO₂) by 2050.

Medium- to long-term targets

Item	FY2021 results	FY2022 results	FY2023 results	FY2025	FY2043	SDGs mapping
Sales ratio of eco-friendly products and construction methods*	21.2%	23.9%	22.2%	30% or more	80% or more	<div>7 AFFORDABLE AND CLEAN ENERGY</div> <div>9 INDUSTRY, INNOVATION AND INFRASTRUCTURE</div> <div>11 SUSTAINABLE CITIES AND COMMUNITIES</div> <div>12 RESPONSIBLE CONSUMPTION AND PRODUCTION</div> <div>13 CLIMATE ACTION</div> <div>15 LIFE ON LAND</div>

* Eco-friendly products and construction methods refer to those more conscious of environment than existing ones. Sales ratio refers to a ratio to consolidated net sales.

Conservation of biodiversity

Forest thinning is an effort that contributes to the conservation of biodiversity. Felling trees at appropriate intervals in a dense forest allows enough sunlight to reach the trees to form a healthy forest, which enables to protect the habitats of diverse living organisms living in the forest. Timber from forest thinning is used in various ways; however, there are also cases where unused forest-thinning materials are combusted for disposal. Nichireki uses such forest-thinning materials for the pavement of promenades in parks as ASWOOD paving ▶ P.35 by crushing the materials and mixing them with asphalt emulsion, thereby promoting the recycling of forest-thinning materials and protecting ecosystems.

Promoting construction methods such as heat-blocking paving ▶ P.42, which contributes to mitigating the urban heat island effect, and soil-based paving, which has excellent water retention properties, also helps conserve the living environment for animals and plants.

Moreover, we have also been contributing to the conservation of ecosystems from a perspective of community contribution activities by, for example, proactively participating in various activities, including cleaning and greening of roads and rivers in the communities where our offices are located.



ASWOOD paving

Responding to Climate Change

Information disclosure based on TCFD recommendations

The Nichireki Group considers addressing the impact of climate change on its business to be one of its key managerial challenges. Accordingly, we support the Task Force on Climate-related Financial Disclosures (TCFD) and proactively take measures against climate change.

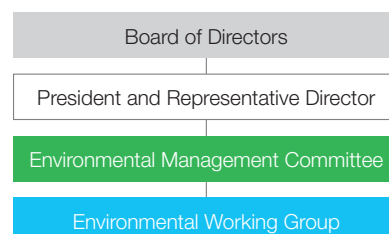
We clarify the impact on our business of the risks and opportunities brought about by climate change and take measures, thereby enhancing social sustainability and our corporate value while improving our business continuity.



Governance

In the Nichireki Group, the Board of Directors deliberates on and resolves key matters such as a basic policy for addressing general environmental issues including climate change. Particularly, the Environmental Management Committee, chaired by the President and Representative Director and comprised of General Managers of Corporate Planning, Administration, Business, and Technology Development Divisions, deliberates on and examines how to address group-wide environmental issues. Such deliberated and examined issues are ultimately presented to the Board of Directors. The Board of Directors is reported and reviews each year the progress of environmental management as well as business risks and growth opportunities related to environmental issues.

Governance system diagram



Risk management

In the Nichireki Group, the above-mentioned Environmental Management Committee has a group-wide risk management system that regularly monitors climate change-related risks. In addition, we will seek to advance our approach of appropriately identifying and examining material risks that could significantly impact our business management by, for example, improving our scenario analysis and assessment so as to sufficiently hedge tail risk (the risk of an event with a small probability of happening but could cause enormous losses if once happened).

Strategy

The Nichireki Group identifies climate change-related risks and opportunities from both short-term and medium- to long-term perspectives. The Nichireki Group also performs two types of scenario analysis—the 2°C scenario with the assumption that the goals of the Paris Agreement will be achieved and the 4°C scenario with the assumption that no additional policy responses will be provided—, assesses the level of impact of such risks and opportunities on its business, and considers countermeasures. We will assess the resilience of the countermeasures on an ongoing basis and consider new countermeasures as necessary.



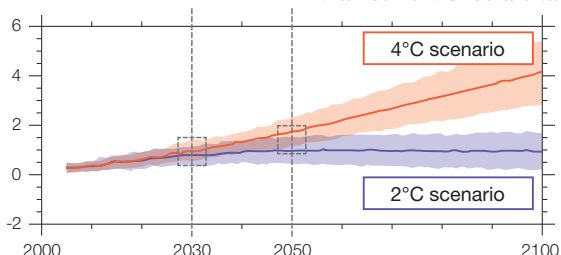
2°C scenario

A scenario assuming that countries around the world will have stricter regulations and policies toward decarbonization and accordingly take stricter measures against climate change, and that the increase in the global average temperature will be limited to below 2°C above pre-industrial levels.

4°C scenario

A scenario assuming that countries around the world will neither introduce any additional regulations or policies nor take sufficient measures against climate change and that the increase in the global average temperature will be 4°C above pre-industrial levels.

Projected global average surface temperature change (relative to the average of 1986 to 2005 period)



Temperature will rise by 2.6°C to 4.8°C above pre-industrial levels unless measures more rigorous than current ones are taken

While 2°C and 4°C scenarios show a nearly identical change in temperature up until 2030, the gap between the two scenarios widens after 2030

Temperature will rise by 0.3°C to 1.7°C above pre-industrial levels if strict measures are taken

Sources: AR5 SYR Figure SPM.6; IEA, "ETP 2017"; UNEP, "The Emission Gap Report 2015"; Website of the Ministry of Foreign Affairs of Japan; Website of the Ministry of the Environment

The Nichireki Group's risks and opportunities expected, financial and business impact levels assessed, and countermeasures based on the scenarios are as shown in the table below.

Classification	Type	Risks and opportunities expected	Financial and business impact		Countermeasures
			2°C	4°C	
Transition risks	Policies, laws and regulations	<ul style="list-style-type: none"> Limitation of our business activities due to greenhouse gas emissions regulations Increase in facility costs due to greenhouse gas emissions regulations Cost increase due to the introduction of carbon tax 	High	Medium	<ul style="list-style-type: none"> Purchase low-carbon fuel and green power, and install solar panels Develop low-carbon manufacturing methods and construction methods as well as construction technology, etc. (e.g., cold paving materials, robotic construction) Promote the innovation of manufacturing processes (at the Tsukuba Big Ship and other sites) Reduce CO₂ emissions by using low-carbon vehicles and equipment
		<ul style="list-style-type: none"> Mandatory use of alternative materials and recycled materials 	High	Medium	<ul style="list-style-type: none"> Develop products and construction methods using sustainable materials
	Technology	<ul style="list-style-type: none"> Intensifying competition in technology development toward the creation of a decarbonized society 	High	Medium	<ul style="list-style-type: none"> Put more effort into developing low-carbon products and construction methods
	Market	<ul style="list-style-type: none"> Increase in procurement costs due to soaring petroleum based raw materials Increase in waste disposal cost 	High	Medium	<ul style="list-style-type: none"> Consider increasing raw materials suppliers or narrowing down the current raw materials suppliers Examine and develop alternative materials Promote recycling
	Reputation	<ul style="list-style-type: none"> Changes in reputation of our efforts to address climate change among investors and consumers 	High	Medium	<ul style="list-style-type: none"> Put more effort into making propositions of low-carbon products and construction methods and developing them
Physical risks	Acute	<ul style="list-style-type: none"> Increase in the costs of restoring our production facilities and logistics infrastructure if being severely damaged during extreme weather events Suspension of production and shipment due to the difficulty of obtaining raw materials resulting from extreme weather events 	Medium	High	<ul style="list-style-type: none"> Take stronger business continuity measures in our manufacturing sites and supply chain
	Chronic	<ul style="list-style-type: none"> Decrease in productivity with increasing temperature during summer 	Medium	High	<ul style="list-style-type: none"> Improve a work environment by using air-conditioning clothing, power assist suits, etc. Promote labor-saving practices by using IoT, AI, robots, and other solutions
Opportunities	Products and services	<ul style="list-style-type: none"> Increases in needs adapted to climate change and opportunities for receiving orders 	High	Medium	<ul style="list-style-type: none"> Put more effort into making propositions of low-carbon products and construction methods and developing them in response to changes in consumer preferences
	Resilience	<ul style="list-style-type: none"> Increase in infrastructure resilience needs 	High	Medium	<ul style="list-style-type: none"> Expedite the development of products and construction methods that help prevent and mitigate disasters Promote our one-stop solutions business that comprises all the processes from design and proposal based on survey, diagnosis and prediction with the use of IoT and AI to manufacture and sales followed by construction and management
	Resource efficiency	<ul style="list-style-type: none"> Reduction in operating costs with increase in productivity through the innovation of manufacturing processes 	High	Medium	<ul style="list-style-type: none"> Install more productive manufacturing equipment that uses IoT and AI (at the Tsukuba Big Ship and other sites)

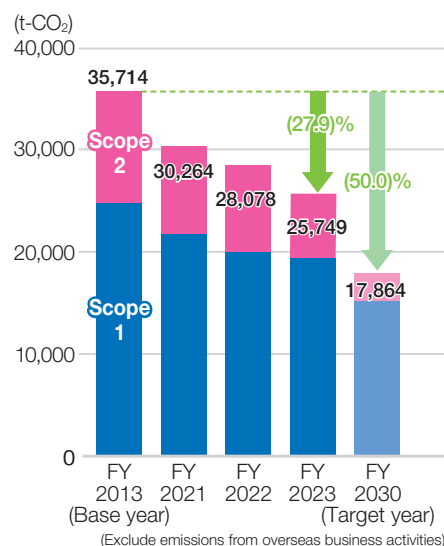
Metrics and targets

The Nichireki Group has set the long-term target of achieving net-zero greenhouse gas emissions across its value chain by 2050. Taking fully into account the goal set by the government of "aiming to reduce greenhouse gas emissions by 46% (from FY2013) by 2030," the Nichireki Group has also set the medium-term target of "reducing Scope 1 and 2* greenhouse gas emissions by 50% (from FY2013) by FY2030."

To achieve these target levels, we will promote the reform of manufacturing methods and others, the purchase of green power and the installation of solar panels. In the medium and long run, we will also proactively use vehicles and construction equipment that use low-carbon fuel, decarbonized fuel, hydrogen and electricity. Furthermore, we will work at increasing sales of eco-friendly products such as longer-life and warm mix modified asphalt and other paving materials, and encouraging the development of low-carbon cold-laid paving materials and construction technology.

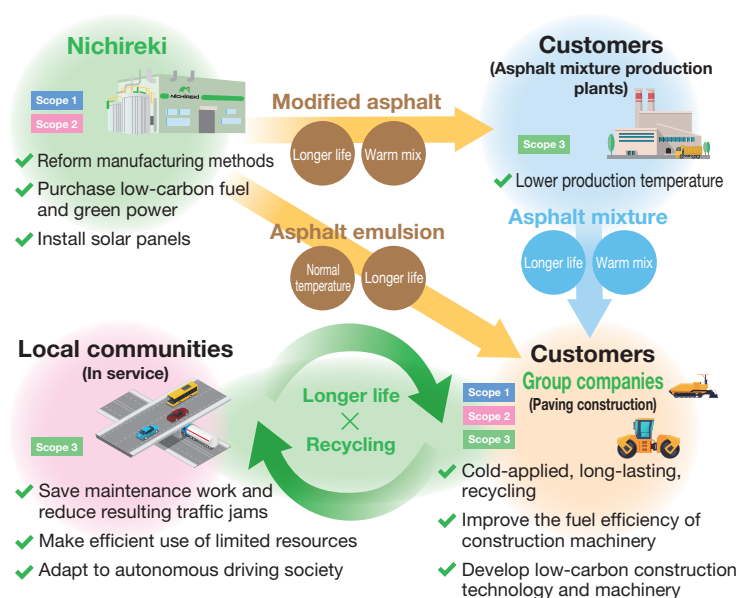
As for Scope 3, we are currently working to quantify the amount of CO₂ emissions for each category and will continue to consider specific reduction measures together with those for Scope 1 and 2.

Nichireki Group's CO₂ emissions



- Scope 1** Direct greenhouse gas emissions from the reporting company (fuel combustion and industrial processes)
- Scope 2** Indirect greenhouse gas emissions from consumption of electricity, heat, or steam supplied by other companies
- Scope 3** Other indirect emissions not covered in Scope 1 or 2 (that occur in other companies related to the reporting company's activities)

Image diagram of CO₂ reduction in our business model



Eco-friendly Products and Construction Methods

The Nichireki Group contributes to conserving the living environment, the local environment, and even the global environment through the provision of environmentally friendly products and construction methods. We have always worked to create eco-friendly roads using asphalt emulsion and other products and construction methods that can be handled at normal temperatures. In addition, we contribute to environmental conservation at a higher level, including further reduction of

Global Environment

Building recycling-oriented society

- Wood chip paving (ASWOOD paving ▶ P.35) *for sidewalks Low carbon Recycling Normal temperature Safety and security
- On-site base course recycling construction method (STABI-CEMENT RC construction method ▶ P.33) Low carbon Longer life Recycling Normal temperature
- Recycled modified asphalt for warm mix (CLEANPHALT AF/AFH, CLEANPHALT SAR/SAH) Low carbon Recycling Warm mix
- Modified asphalt for recycled mixture (AF PHALT/H, TOUGHPHALT SUPER RV) Low carbon Recycling

Ecosystem conservation measures

- Heat-blocking paving (THERMOTEC construction method) Low carbon Normal temperature Safety and security
- Soil-based pavement (Polycamic construction method) *for sidewalks Low carbon Normal temperature Safety and security
- Water-retentive paving (AQUASPAVE construction method) Safety and security

Groundwater recharging

- Permeable pavement (ASWOOD paving) Low carbon Recycling Normal temperature Safety and security
- Permeable pavement (COLORPHALT TO) *for sidewalks Low carbon Normal temperature Safety and security

Curbing global warming

Reducing the number of constructions

- On-site base course recycling construction method (STABI-CEMENT RC construction method) Low carbon Longer life Recycling Normal temperature
- Rapid-breaking asphalt emulsion (SUPER TACKZOL) Low carbon Longer life Normal temperature
- Asphalt emulsion surface treatment construction method (SUPER SURFTREAT construction method ▶ P.36) Low carbon Longer life Normal temperature
- Crack prevention cushion layer construction method (EMULTEC SAMI construction method) Low carbon Longer life Normal temperature
- Molded water cut-off material (L-seal tape ▶ P.40) Low carbon Longer life Normal temperature
- Crack sealant (COALCUT K) Low carbon Longer life Normal temperature
- Modified asphalt for warm mix (SUPER SHINAYAKAPHALT ▶ P.34 ; SUPER CONTAINERPHALT) Low carbon Longer life Warm mix
- Modified asphalt for warm mix and longer life + On-site base course recycling construction method (SUPER SHINAYAKAPHALT; SUPER CONTAINERPHALT + STABI-CEMENT RC construction method) Low carbon Longer life Recycling Warm mix
- Modified asphalt for longer life (Noncrackphalt; CONTAINERPHALT S; REKIPHALT SUPER ▶ P.40) Low carbon Longer life
- Modified asphalt for long-life porous paving (Chemiphalt MX) Low carbon Longer life Safety and security
- Modified asphalt for longer life + On-site base course recycling construction method (Noncrackphalt; CONTAINERPHALT S; STABI-CEMENT RC construction method) Low carbon Longer life Recycling
- Modified guss asphalt for bridge leveling layer (MG PHALT) Low carbon Longer life
- Highly durable bridge deck waterproofing methods (HQ PAVERANE construction method ▶ P.39 ; HQ HIBRANE AU construction method ▶ P.39 ; MULTI FRESH construction method ▶ P.40) Low carbon Longer life
- Hot-applied crack sealant (CRACKSEAL NX) Low carbon Longer life

CO2 emissions through the supply of “*Tastainability*®” products and construction methods that add new performance and functionality, such as longer life, recyclability and warm mix. We will also work to improve the living environment of roadside residents, including reducing vibration and noise, ensuring traffic safety, and mitigating odors, thus contributing to creating sustainable roads. The chart below shows Nichireki’s leading eco-friendly product and construction method groups.

Local Environment

Eliminating traffic congestion caused by construction

- On-site base course recycling construction method (STABI-CEMENT RC construction method) Low carbon Longer life Recycling Normal temperature
- Rapid-breaking asphalt emulsion (SUPER TACKZOL) Low carbon Longer life Normal temperature
- Recycled modified asphalt for warm mix (CLEANPHALT AF/AFH, CLEANPHALT SAR/SAH) Low carbon Recycling Warm mix
- Modified asphalt for warm mix (SUPERCLEAN 50; CLEANPHALT SA/Type II/Type H/HDS) Low carbon Warm mix

Mitigating the rise in surface temperature of roads

- Heat-blocking paving (THERMOTEC construction method ▶ P.42) Low carbon Normal temperature Safety and security
- Soil-based pavement (Policamic construction method) *for sidewalks Low carbon Normal temperature Safety and security
- Water-retentive paving (AQUASPAVE construction method) Safety and security

Reducing road vibration and noise

- Bump repairing material (SUPER ROMENPATCH ▶ P.41) Safety and security Low carbon Normal temperature
- Patching material (RESCUEPATCH ▶ P.41) Safety and security Low carbon Normal temperature
- Manhole top repairing method (MR² method ▶ P.41) Safety and security Low carbon Longer life Normal temperature
- Embedded-type expansion joint (Seamless joint ▶ P.41) Safety and security Low carbon Longer life

Reducing road surface noise

- Porous paving (Chemiphalt MX ▶ P.42) Safety and security Low carbon Longer life
- Porous paving (TOUGHPHALT SUPER) Safety and security

Reducing water splash

- Permeable pavement (ASWOOD paving) Safety and security Low carbon Recycling Normal temperature
- Permeable pavement (COLORPHALT TO) *for sidewalks Safety and security Low carbon Normal temperature
- Porous paving (Chemiphalt MX) Safety and security Low carbon Longer life
- Porous paving (TOUGHPHALT SUPER) Safety and security

Living Environment

Ensuring traffic safety

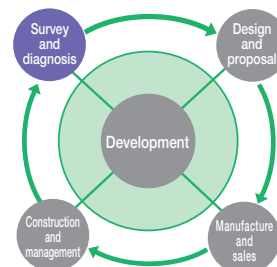
- Anti-skid paving (COALCUT R construction method) Safety and security Low carbon Normal temperature
- Resin mortar-based color paving (COLORPHALT KT method) *for sidewalks and cycling paths Safety and security Low carbon Normal temperature
- Road marking (Lining) ▶ P.42 Safety and security

Improving landscape

- Wood chip paving (ASWOOD paving) *for sidewalks Safety and security Low carbon Recycling Normal temperature
- Resin mortar-based color paving (COLORPHALT KT method ▶ P.42) *for sidewalks and cycling paths Safety and security Low carbon Normal temperature
- Weed control construction method (FC weed-control method) Safety and security

Reducing odor emissions

- Modified asphalt for improving odor control and warm mix Safety and security Low carbon Warm mix
- Modified asphalt for improving odor control Safety and security



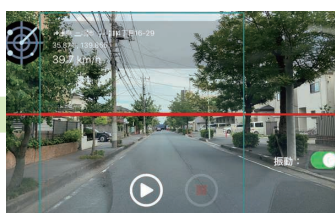
GLOCAL-EYEZ enables anyone anywhere to easily inspect the road surface conditions, such as cracks and rutting, by shooting the paved road with a smartphone mounted on an ordinary car such as a patrol car. This system allows you to instantly check inspection results online using AI to automatically analyze images extracted from videos taken with a dedicated app and uploaded to the cloud.

Sample images of inspection using GLOCAL-EYEZ

- 1** Start the app and mount the smartphone in the vehicle



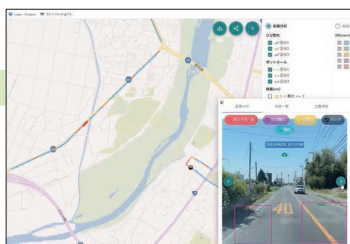
- 2** Film road conditions while driving



- 3** Upload image data → AI analysis



- #### 4 Check inspection results online

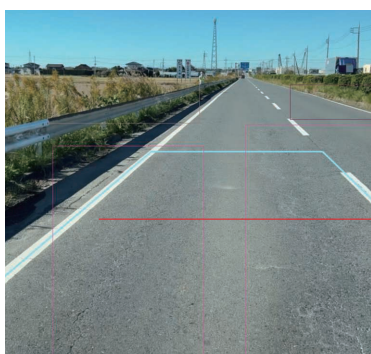


- 5** Utilize inspection results (sample image)

[illegible]

Sample images of AI analysis

Sample image of patrol analysis



Sample image of road inspection analysis



Red: severe crack areas Yellow: moderate crack areas



GLOCAL-EYEZ has passed the performance verification test for road surface condition automatic measuring device (vehicle-mounted type) in FY2023 (hereafter, the “Performance Verification Test^{*1}”) conducted by the Public Works Research Center^{*2}. It was the first simplified in-vehicle technology that uses a smartphone without the need for a dedicated vehicle to pass the Performance Verification Test for measurement accuracy in “cracks,” “rutting,” and “flatness” categories.

^{*1}: The Performance Verification Test confirms that the measurement values of road surface conditions obtained from an automatic road surface condition measuring device during actual driving are sufficiently accurate when compared to the standard values measured manually and verifies that the device has the necessary performance to process these measurements.

^{*2}: Report on performance verification test for road surface condition measuring device in FY2023 (PWRC Road Properties No. 2383), Public Works Research Center, September 2023 (Valid until October 1, 2023).

Cracks



Rutting



Flatness



In February 2024, we received the 2023 Infrastructure Maintenance Challenge Award from the Japan Society of Civil Engineers in recognition of our efforts to shift from conventional breakdown maintenance to planned preventive maintenance based on predictive results, including the addition of a unique function to predict pothole locations in collaboration with Aomori Prefecture using GLOCAL-EYEZ.

▶ P.53

SMART ROMEN CATCHER FWD

ROMEN CATCHER FWD applies an impact load by dropping a weight to the road surface identified as needing repair based on road surface inspections by GLOCAL-EYEZ and other methods and measures the deflection amount that occurs as a result. This enables non-destructive diagnosis of the structural soundness of the road pavement by identifying which layer is damaged as well as proposal of an appropriate repair method depending on the damage state.

SMART ROMEN CATCHER FWD



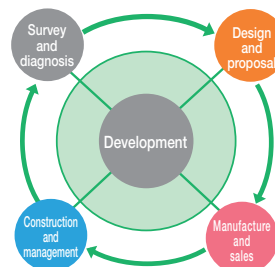
Measurement of deflection amount



Technology overview ▶



Designing and Proposing *Tastainability*® Products and Construction Methods



By reusing existing pavement

**20% reduction in
CO₂ emissions**



STABI-CEMENT RC construction method



- STABI-CEMENT RC construction method involves crushing the existing pavement at the exact location where it has been damaged and then mixing it with asphalt emulsion and cement to construct new pavement.

Damaged road pavement



Construction with a road stabilizer

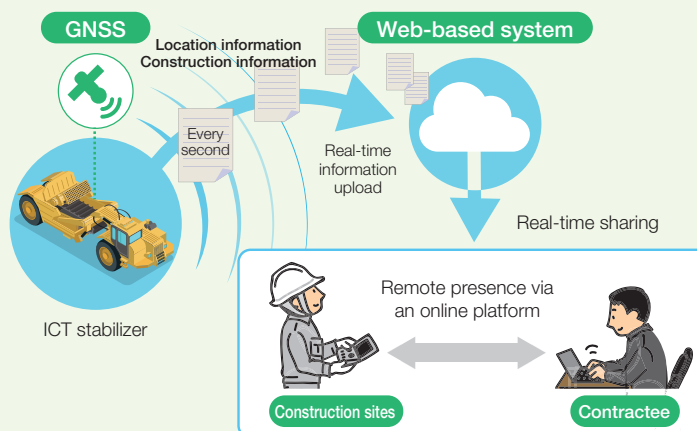


- This construction method constructs a strong base course with asphalt flexibility and cement stiffness, contributing to the pavement's longevity. This is also effective in preventing liquefaction phenomena caused by earthquakes.

We utilize the Smart Stabilizer Monitoring System as part of our efforts to introduce ICT in this construction method. With this system, sensors are attached to the road stabilizer to measure various data in real time during construction. This method enhances construction accuracy and allows for the construction of a higher-quality base course, further extending the pavement life.

In addition, by combining the streaming of on-site images from wearable cameras with web conferencing, the contractee and other construction managers can check measurement data and on-site conditions from anywhere, which also contributes to improving productivity at construction sites.

Smart Stabilizer Monitoring System (image diagram)



During construction ▶



Liquefaction resistance test ▶



The Smart Stabilizer Monitoring System won the Jury's Special Prize in the Infrastructure DX Competition, which was held to discover advanced technologies that contribute to DX in the infrastructure field, as part of the Construction Technology Expo 2023 Kinki, organized by the Ministry of Land, Infrastructure, Transport and Tourism Kinki Regional Development Bureau in Osaka Prefecture in November 2023.

System overview ▶



■ STABI-CEMENT RC construction method uses most of the existing pavement as it is on-site, reducing materials being carried in and out, which also contributes to energy conservation and effective use of resources. In particular, the amount of pavement waste removed from the site per construction project is reduced by around 80% compared to the replacement method, and **CO₂ emissions can be reduced by approximately 20%.**



SUPER SHINAYAKAPHALT

In asphalt mixture production

22% reduction in CO₂ emissions



■ SUPER SHINAYAKAPHALT is a special modified asphalt that is flexible enough to be bent by hands and tough enough to withstand traffic loads. SUPER SHINAYAKAPHALT with 1.7 times greater performance than conventional asphalt mixture helps extend the life of pavement.



■ In addition, the temperature of mixture production can be lowered by 50°C from 180°C to 130°C compared to our conventional SHINAYAKAPHALT. This enables a reduction in fuel consumption during mixture production, cutting **CO₂ emissions by approximately 22%.**

After construction

SUPER SHINAYAKAPHALT



Conventional asphalt mixture



Bending Comparison: SUPER SHINAYAKAPHALT vs. conventional mixture ▶



STABI-CEMENT RC construction method

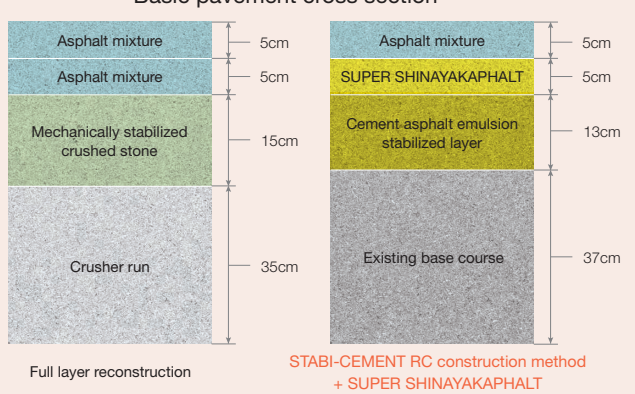


SUPER SHINAYAKAPHALT

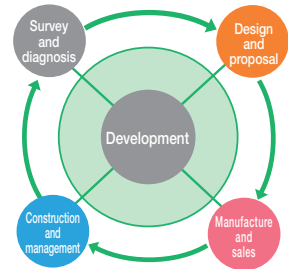
This hybrid method achieves unprecedentedly long-lasting pavement by paving a long-lasting asphalt mixture (SUPER SHINAYAKAPHALT) on the base constructed by reusing existing pavement at the exact location where it has been damaged (STABI-CEMENT RC construction method).

It enables longer-life paving than ever, reducing **CO₂ emissions by approximately 49%** in a 50-year pavement life cycle.

Basic pavement cross section



Designing and Proposing *Tastainability*[®] Products and Construction Methods



Compared to the typical pavement using hot mix

34% reduction in CO₂ emissions



ASWOOD paving



- ASWOOD paving is wood-based (wood chip) paving made by mixing a rubber-modified asphalt emulsion ASWOOD Emulsion, which has outstanding flexibility, and wood chips produced by finely crushing forest-thinning materials and other materials. As it is possible to carry out the entire process from mixture production to construction at normal temperature, this method is extremely friendly to the environment. It reduces CO₂ emissions by approximately 34%, compared to the typical pavement using hot mix.

ASWOOD paving



Basic pavement cross section



- Using forest-thinning materials and other resources without combusting prevents CO₂ from being emitted into the atmosphere and contains CO₂ as it is within the materials and resources (CO₂ fixation). For example, when we construct 1,000 m² of pavement with 4 cm in thickness using the ASWOOD paving method, we can fix approximately 18 t of CO₂, which is equivalent to the amount absorbed by 1,300 Japanese cedar trees per year.

This method also enables the utilization of trees damaged by Japanese oak wilt disease*, which has been spreading across the country in recent years, or by pine weevils as well as bamboos from an abandoned bamboo forest.

* A contagious disease that causes trees to die of necrosis and water-blockage, as a result of Japanese oak wilt pathogen are spread throughout the tree when platypus quercivorus (oak ambrosia beetle) burrow into the trunks of oak, chinquapin, and chestnut trees. New adults that have grown and emerged within the tree body carry Japanese oak wilt pathogen on their bodies. When they move to and invade other healthy oak trees, they spread the damage to the surrounding area.

Source: Edited portions of the Forestry Agency website (https://www.rinya.maff.go.jp/j/hogo/higai/naragare_R3.html)

ASWOOD paving using trees damaged by Japanese oak wilt disease



Self-propelled conveyable wood timber crusher



Nichireki supports the purpose of "Wood Change" promoted by the Forestry Agency as activities to change to a sustainable society through the use of wood and is actively driving efforts to promote wood utilization.



- ASWOOD paving has outstanding water permeability and cushioning properties, making it easy on the feet of walkers and runners and preventing the formation of puddles, thereby reducing water splash. Further, its gentle texture that blends in with the surrounding natural scenery brings comfort and relaxation to people. It also helps recharge groundwater by facilitating the infiltration of rainwater and other water into the soil, thereby increasing the supply of water to the underground aquifer.

Construction examples ▶





SUPER SURFTREAT S construction method

Compared to hot mix thin-layer pavement

61% reduction in CO₂ emissions



■ SUPER SURFTREAT S construction method is an ultra-thin pavement construction method that is highly resistant to wear and tear and protects the pavement surface before damage progresses. By applying a surface treatment, the road surface is made to look like new, and the functions of the road surface, such as its non-slip properties and noise reduction, are restored, leading to a longer lifespan for the pavement (prolongation) and, in turn, a reduction in medium- to long-term repair costs.



■ As it is a cold construction method that uses a special asphalt emulsion, it does not generate CO₂ during heating, meaning it is also an environmentally friendly construction method. For example, compared to heated thin-layer paving, it can reduce CO₂ emissions by approximately 61%. Another feature of this method is that it can be applied to various surfaces other than carriageways.

A specialized vehicle that can complete the work by itself



Leveling with a specialized vehicle



Manual construction

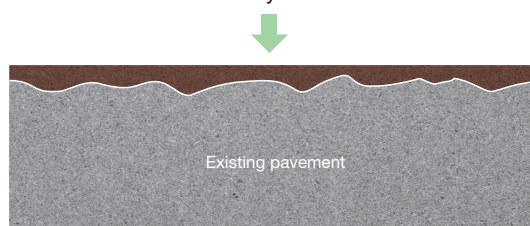


After construction



Basic pavement cross section

Average construction layer thickness $t=1.0\text{mm}$
Maximum construction layer thickness $t=2\text{--}3\text{mm}$

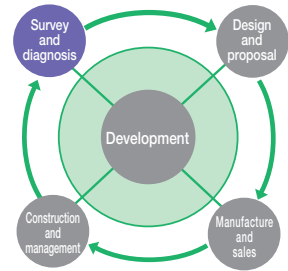


Manual construction is also possible.

Applicable areas

- ① Carriageways
- ② Airport pavement, including runways, taxiways, and shoulders
- ③ Residential roads and roads within housing complexes
- ④ Sidewalks and cycling paths
- ⑤ Parking lot
- ⑥ Station platforms

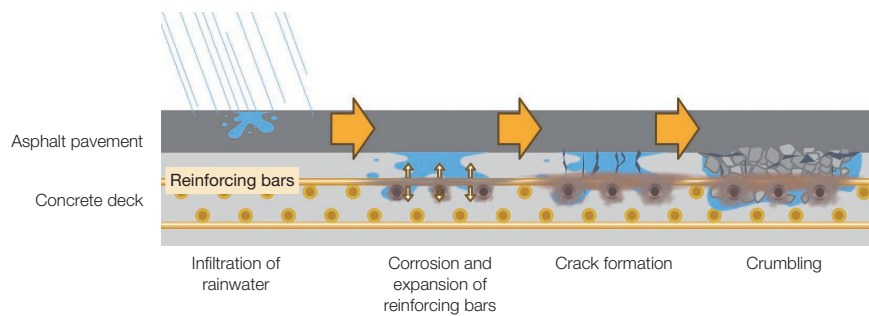
Survey and Diagnostic Technologies for Designing and Proposing *Tastainability*® Products and Construction Methods (bridges)



SMART SHOBAN CATCHER

When water seeps into a concrete deck, which supports the pavement of the bridge, reinforcing bars inside the deck corrode and expand, resulting in cracks on the deck. The propagation of cracks results in crumbling of concrete, deck potholes, and other severe damage; therefore, it is necessary to construct a highly durable bridge deck waterproofing layer.

Progress in deterioration of bridge deck



Deck pothole



SMART SHOBAN CATCHER is a measuring vehicle that uses electromagnetic wave technology to investigate the damage to the upper surface of a concrete deck on a road bridge (from the underside of the pavement to the upper reinforcing bars) without having to remove the asphalt pavement (non-destructive). The method analyzes the damage by comparing the reflections of the sound and damaged concrete decks, taking advantage of the property that electromagnetic waves are reflected at the interface between asphalt pavement and concrete deck.

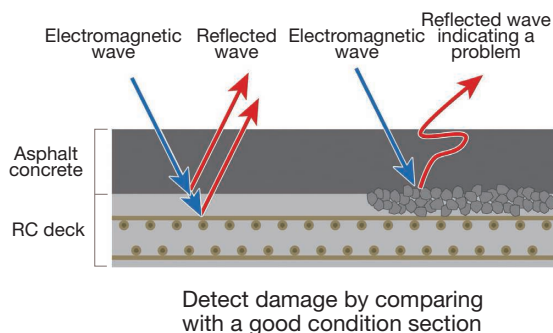
SMART SHOBAN CATCHER



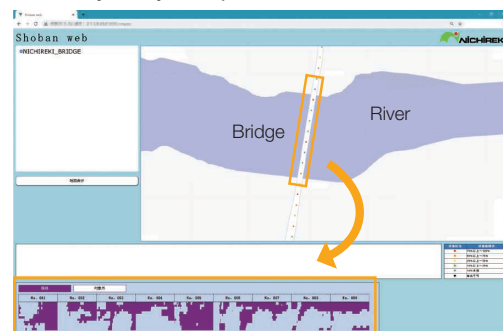
Electromagnetic wave antenna at the tail of the vehicle

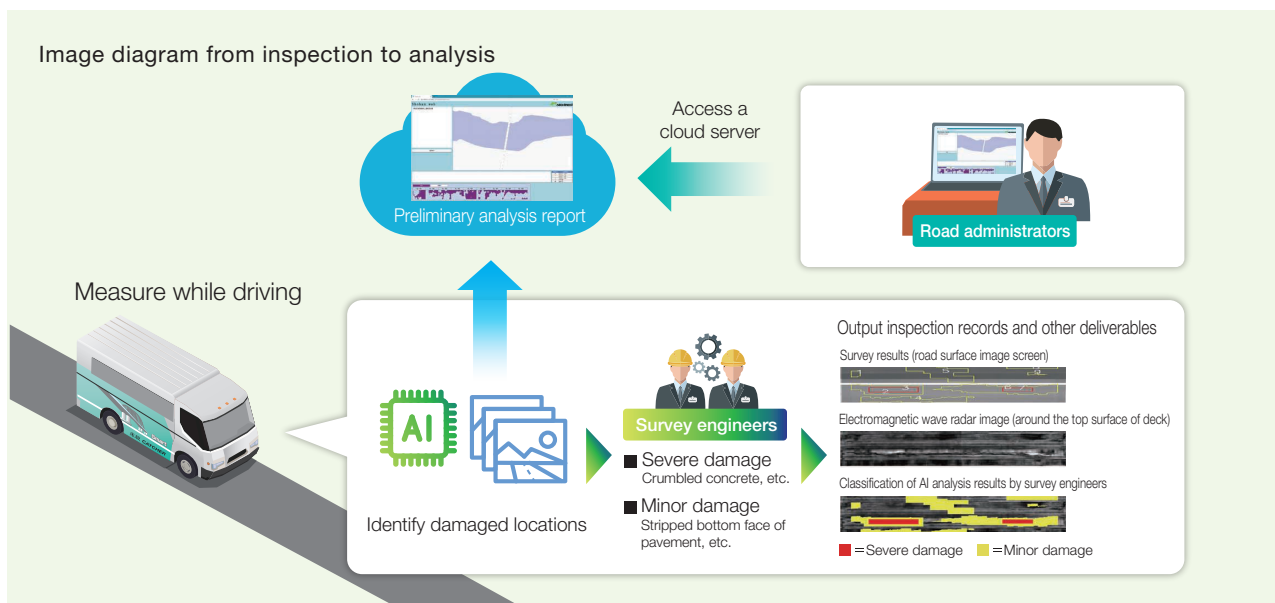


Differences in reflection of electromagnetic waves depending on the condition of the deck



Preliminary analysis report screen





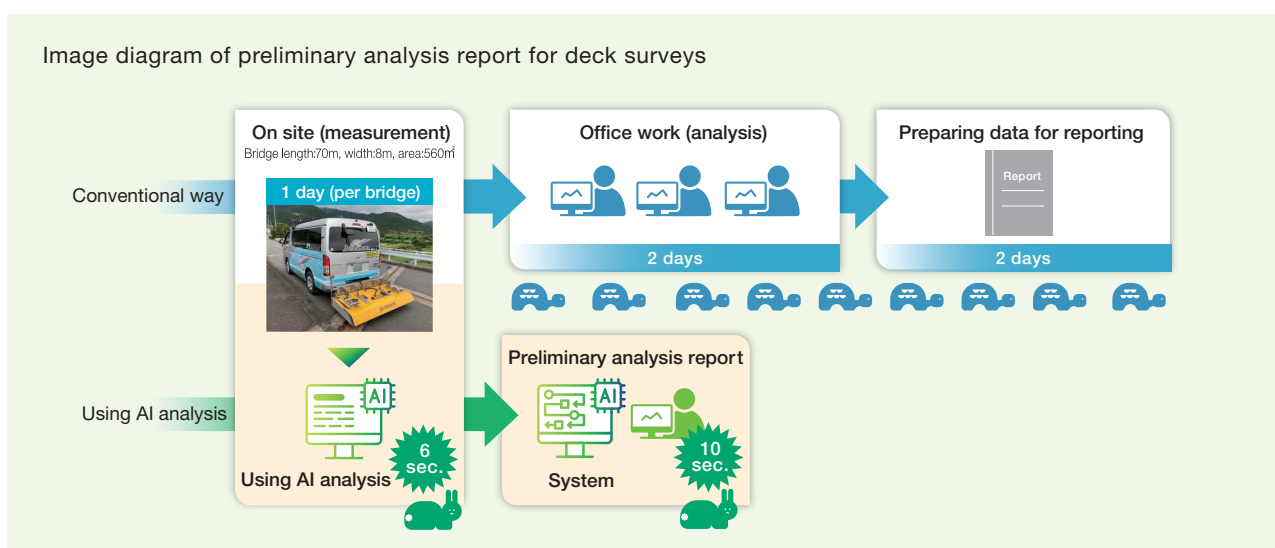
Technology overview ▶



A trained AI, developed based on training data from skilled survey engineers, performs the analysis of damage. In addition, by uploading the results of AI analysis from the site to a cloud server, road administrators can quickly be notified of the preliminary analysis report. This is a function that allows us to perform AI analysis of the electromagnetic wave data obtained on site immediately after measurement, and provide the inspection results (preliminary reports) to road administrators. We are also introducing AI into conventional analysis work, not just preliminary reports, to improve the efficiency of analysis work.

This is how the use of AI and the internet can shorten the time needed for analysis work. For example, analysis work on electromagnetic wave reflection waveforms, which previously took even skilled engineers at least five days from measurement to report preparation, can now be completed in one day.

In addition, it is possible to create a more accurate repair design by combining open-cut inspection as appropriate according to the damage situation analyzed by the SMART SHOBAN CATCHER.

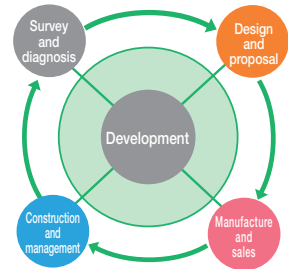


The SMART SHOBAN CATCHER has been evaluated by external organizations, such as being registered in the NETIS^{*1} as a “non-destructive inspection system for bridge surface pavement and the upper sections of decks” and being listed in the Ministry of Land, Infrastructure, Transport and Tourism’s Inspection Support Technology Performance Catalog^{*2} as a “system for determining damaged areas on the top surface of decks.”

^{*1}: An acronym for the New Technology Information System, a database for promoting the use of new technology operated by the Ministry of Land, Infrastructure, Transport and Tourism

^{*2}: A catalogue-style compilation of performance values for standard items set by the government, requested from developers and submitted by them

Designing and Proposing *Tastainability*[®] Products and Construction Methods (bridges)



A bridge is an important lifeline that connects people, goods, transportation, and economy. Therefore, it must be durable enough not to disrupt daily lives. Nichireki offers a wide range of options for bridge deck waterproofing, which is essential for extending the service life of bridges to meet the needs of road administrators. Increasing the durability of the deck waterproofing layer enables a reduction in repair frequency of pavement, which in turn leads to reducing **CO₂ emissions** by approximately 50% to 75% in a 50-year pavement life cycle.

Compared to conventional waterproofing
in a 50-year pavement life cycle



HQ PAVERANE construction method

**75% reduction in
CO₂ emissions**

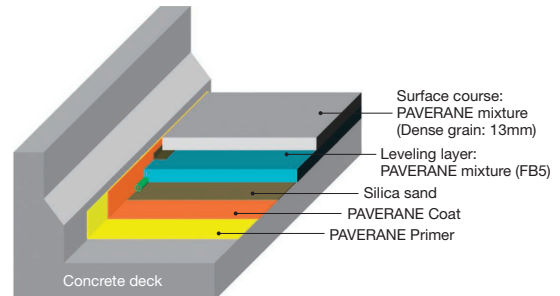


■ HQ PAVERANE construction method is a waterproofing method with excellent shear fatigue resistance that has passed a crack opening and closing load test equivalent to 30 years of service. As this is a high-performance pavement waterproofing method that demonstrates durability by combining the pavement and waterproofing layers, it protects the deck from de-icing agents and airborne salts and contributes to extending the pavement life.

During construction



Construction cross section example



Compared to conventional waterproofing
in a 50-year pavement life cycle



HQ HIBRANE AU construction method

**75% reduction in
CO₂ emissions**

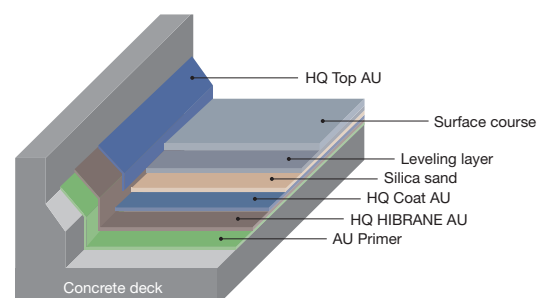


■ HQ HIBRANE AU construction method is a highly durable asphalt-urethane membrane-type waterproofing method for bridge decks, which has passed the performance standards that apply a load equivalent to 30 years of service. This method allows seamless construction from the deck to the edge of the rise, and it also features excellent adhesion between the waterproof layer and the pavement. It is a long-life waterproofing construction method that is also registered with NETIS (the Ministry of Land, Infrastructure, Transport and Tourism's new technology information system).

During construction



Construction cross section example



Compared to conventional waterproofing
in a 50-year pavement life cycle



MULTI FRESH construction method

50% reduction in
CO₂ emissions

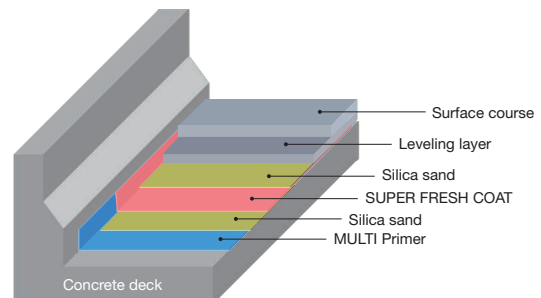


■ MULTI FRESH construction method is a composite waterproofing construction method that applies a highly durable hot-applied asphalt membrane-type waterproofing material with excellent adhesion to asphalt pavement on top of a primer that penetrates even the finest cracks in the concrete deck surface. This method would improve the stiffness and fatigue resistance of deck, contributing to extending the life of pavement.

During construction



Construction cross section example



Comparison of highly durable bridge deck waterproofing methods

	Durability (approximate useful lives*)	Workability	Lifecycle cost
HQ PAVERANE construction method	◎ (20 to 30 years)	◎	◎
HQ HIBRANE AU construction method	◎ (20 to 30 years)	○	◎
MULTI FRESH construction method	○ (10 to 20 years)	○	○
Conventional waterproofing	△ (5 to 10 years)	○	△

* This may vary depending on the on-site conditions.

With either the HQ HIBRANE AU construction method or MULTI FRESH construction method, a further extension of pavement life can be expected by laying a long-lasting asphalt mixture (REKIPHALT SUPER) on the waterproofing layer.

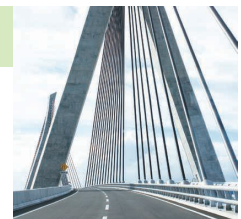
Introduction to the three construction methods ►



REKIPHALT SUPER



■ REKIPHALT SUPER is a polymer-modified asphalt with outstanding workability and resistance to stripping. It enables to obtain mixtures with a high degree of compaction, regardless of the timing of construction, resulting in longer life pavement.



L-seal tape



■ L-seal tape is a molded water-stop tape with adhesive properties at room temperature that prevents water from entering at the boundary between the edge of a bridge and the newly paved asphalt mixture.

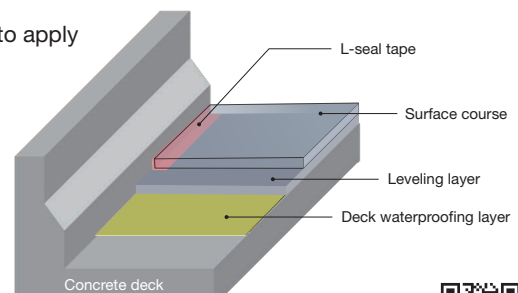


■ Its L-shaped design prevents it from peeling off and falling in during construction. It is highly effective in preventing water from entering the top surface of the deck, leading to longer pavement life.

After construction

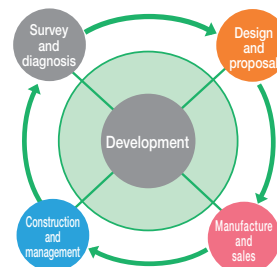


Where to apply



During construction ►





Designing and Proposing *Tastainability*[®] Products and Construction Methods (safety and security)

Reducing road vibration and noise

SUPER ROMENPATCH



■ SUPER ROMENPATCH is a cold-applied asphalt emulsion mixture with outstanding wear resistance used for repair of bumps on roads.



■ This is an eco-friendly material as it enables construction at normal temperature. As construction does not require machinery, the work can be easily done.

SUPER ROMENPATCH



After construction



RESCUEPATCH



■ RESCUEPATCH is a cold-applied mixture (patching material) with outstanding durability used for repair of potholes on roads.



■ This is an eco-friendly material as it enables construction at normal temperature. This also enables construction even when the construction surface is wet by rain or snow.

RESCUEPATCH



After construction



MR² method



■ MR² method is a construction method to repair bumps between manholes and pavement with less vibration and noise. The material cures quickly, enabling construction in a short time.



■ It does not cause lack of compaction due to a decrease in temperature, contributing to extending the pavement life.



■ As a cold-applied mixture is used for construction around manholes, this construction method is friendly to the environment.

During construction
(removal of a manhole)



After construction



Seamless joint

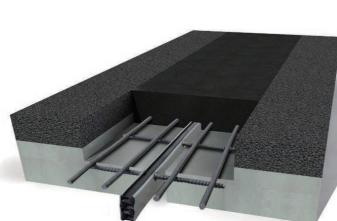


■ Seamless joint is an embedded-type expansion joint used to embed bridge joints. As steel and rubber parts are not exposed on the road surface, this enables smooth driving of vehicles.



■ Seamless joint has outstanding water shut-off performance and quality stability, which allow it to be used over a long period, contributing to extending the life of bridges.

Seamless joint



After construction



Reducing road surface noise / Reducing water splash

Chemiphalt MX



■ Chemiphalt MX is porous paving that prevents water from accumulating on the road surface in rainy weather. This paving prevents slipping, water splash, and deterioration of visibility during driving, reducing traffic accidents. This also reduces noise from the road surface caused by driving.

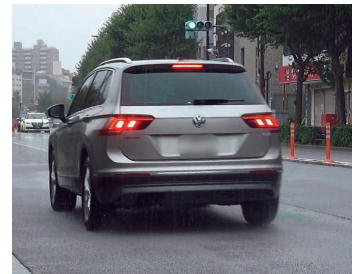


■ Chemiphalt MX has outstanding aggregate scattering resistance and demonstrates high durability, contributing to extending the life of pavement.

Conventional paving



Porous paving



Lowering road surface temperatures

THERMOTEC construction method

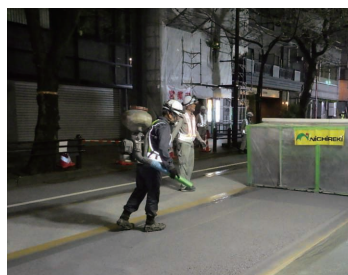


■ This heat-blocking paving limits the rise in temperature of paved surfaces during the day by reflecting near-infrared rays, which account for about half of the solar radiation energy. During summer months with clear weather, it is expected to reduce road surface temperatures by around 10°C, which will also help to alleviate the heat island effect.



■ This is an eco-friendly construction method as it allows construction at normal temperature.

During construction



After construction



Ensuring traffic safety

Road marking



■ Using road markings that appear to be three-dimensional and color paving visually alerts drivers to reduce driving speed and prevents them from accidentally entering the wrong lane, thereby contributing to ensuring traffic safety.

Road markings that appear to be three-dimensional



Dedicated ETC lane marking on the Metropolitan Expressway



Improving landscape

COLORPHALT KT method



■ This is a resin mortar pavement made from epoxy resin and various aggregates. It has excellent flexibility and is ideal for use in pedestrian bridges. It also has excellent slip resistance, ensuring safe walking even in the rain.



■ This is an eco-friendly method as it allows construction at normal temperature.

After construction

