INVENTORY OF PRODUCTS AND TECHNOLOGIES DEVELOPED BY JAPANESE COMPANIES

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This Inventory of Products and Technologies developed by Japanese companies is prepared based on the new technologies of the civil engineering field mainly used for public works, registered in the New Technology Information System (NETIS) of the Ministry of Land, Infrastructure, Transport and Tourism, Japan, and the Study Team picked-up new technologies, which are considered to be applicable to countries in the Central America.

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1. New Technologies for the Road Inspection

1-1 Next-Generation Road Measurement System

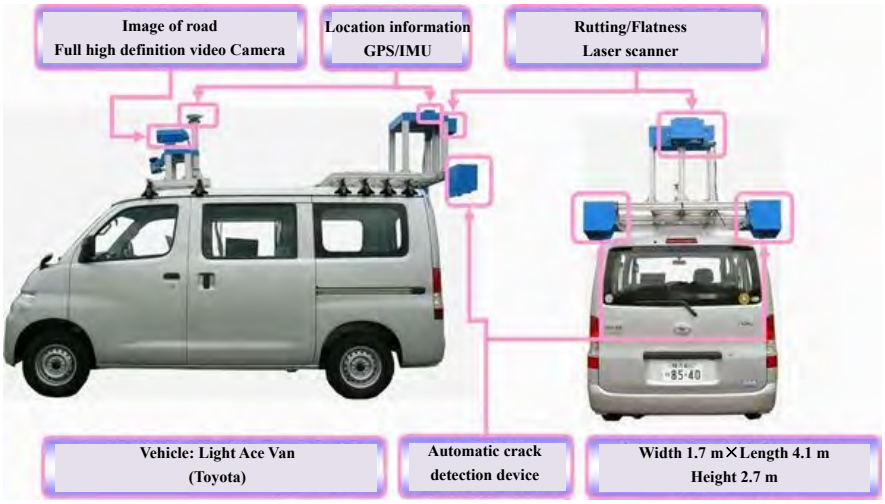
Technology: Real-mini (Next-Generation Road Measurement System)

NETIS Registration Number: KT-110060-A

Category: Pavement (roads)

<Overview>

A compact, automatic road surface measuring device that makes it possible to survey the surfaces of narrow roads. Daytime measurements, simultaneous recording of forward images and other attributes of Real-mini technology make it possible to downsize the workforce, even in places conventionally measured by automatic road surface measuring devices, which reduces labor costs and the number of working days, thereby improving economic efficiency.



<Inspection/Diagnostic Characteristics>

The Real-mini is a compact, automatic road surface measuring device that enables the effective monitoring of rutting, cracking, flatness, and IRI data required for road maintenance from the flow of general vehicle traffic.

<Expected Outcomes>

The ability to simultaneously record road surface data, forward images and geographical coordinates make it possible to shorten the construction schedule, which improves economic efficiency.

The automation of the measuring device enables two people to do the work conventionally performed by three people, which improves workability.

In addition, the compact size of the measuring vehicle makes it possible to perform measurements on narrow roads, which improves workability.

1-2 Next-Generation Road Measurement System

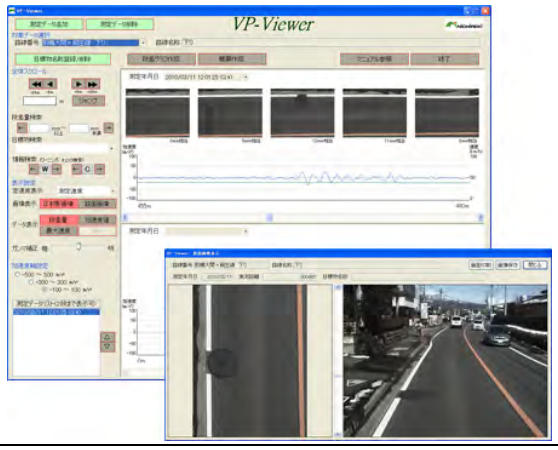
Technology: Romen Catcher VP System (Level Difference/Road Surface Image Recording System)

NETIS Registration Number: CG-100004

Categories: Bridges, pavement (roads)

<Overview>

The Romen Catcher VP System conveniently detects level differences at bridge joints, and places where insufficient flatness of the road surface causes vehicle vibrations, which result in complaints. An accelerometer coupled with the measured distance and a road surface image capturing camera are used to detect longitudinal vibrations as the vehicle passes over the road surface, and the data from the road surface images is used to detect places of insufficient flatness, and to evaluate the degree of level differences. In addition, the Romen Catcher VP System can be used to complement road patrol inspections.



<Inspection/Diagnostic Characteristics>

Compared to the conventional method of implementing traffic control to allow workers to manually measure one place at a time, the Romen Catcher VP System makes it possible to perform measurements on the move and without obstructing the flow of general traffic.

<Expected Outcomes>

The surveys carry an extremely low risk of traffic accidents, etc.

1-3 Road Scan Vehicle

Technology: Road Scan Vehicle

NETIS Registration Number: KK-130032-A

Categories: Road appendages (roads), tunnels (roads), bridges (roads), pavement (roads)

<Overview>

A technology in which electromagnetic radar is used to identify cavities beneath road surfaces and deterioration in pavement structures, and, with a single passage of an exploration rover, can acquire image data as wide as 2.1 m (29 survey lines) and fully capture underground conditions in 3D. In addition, the use of GPS and the like on the exploration rover enables the system to capture precise positional information with less than 50 cm of error.

<Inspection/Diagnostic Characteristics>

Surveys can be conducted at speeds up to 80 km/hr, which removes the need for traffic control during surveys on both general roads and expressways. Captured radar images can be used to detect cavity locations and fully understand their planar shapes.

<Expected Outcomes>

The vehicle captures 29 7.5-cm survey lines over a horizontal road survey width of 2.1 m, and data at a vertical pitch as small as 1 cm; the data comprises extremely small measurement intervals. This technology enables surveying in places where traffic control cannot be implemented. It is possible to conduct surveys in expressway traffic, which reduces the time required for surveys over wide areas and long distances.

1-4 High-Precision Three-Dimensional Road Space Imaging System

Technology: High-Precision Three-Dimensional Road Space Imaging System

NETIS Registration Number: KK-110052-A

Categories: Appendages inside tunnels (roads, ports, airports, dams), tunnels (roads, railways)

<Overview>

This system is capable of accurately superimposing laser point-cloud data and image data acquired by mobile mapping systems, and facilitates the full understanding of road conditions as well as the acquisition and plotting of positional information for topographical features through the full and accurate understanding of those features.

Existing technology: Digital stereo plotter system using aerial photo data

New technology: High-precision three-dimensional plotter system using measured data by mobile mapping system

<Inspection/Diagnostic Characteristics>

In the course of overall road stock inspection work, positional information must be recorded on report templates. This system can acquire and plot precise positional coordinates of the locations of topographical features (appendages and man-made structures) and pavement deterioration (cracking and rutting) during inspections in tunnels and on high-traffic roads, where the sites pose dangers and the inspection work is difficult.

<Expected Outcomes>

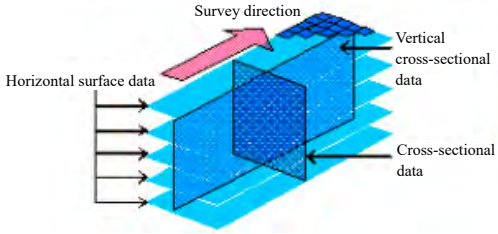
This system makes it easy to acquire positional information without relying on skilled workers, which contributes to improved workability. In addition, plotting makes it easier to integrate inspection results, which contributes to the improved quality of output. This system can be used to fully understand the condition of inspection items (photographs from the scene and photographs showing the condition of pavement deterioration, the shapes of rutting), which improves workability with respect to summarizing inspection results.

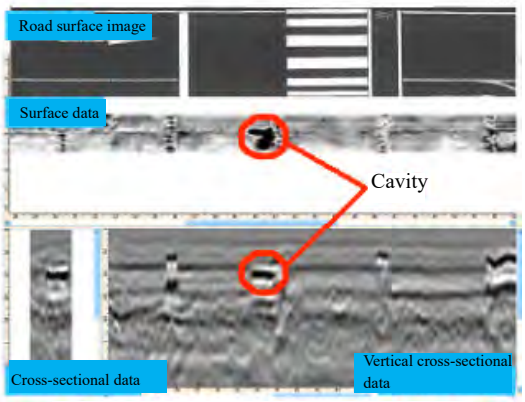
1-5 Subsurface Cavity Surveying

Technology: SKELE-CAR /Subsidence Prevention Technology (Subsurface Cavity Surveying)
NETIS Registration Number: HR-130013-A
Category: Pavement (roads)

<Overview>

Technology in which a SKELE-CAR, a probe vehicle equipped with high-resolution underground radar, is used to survey subsurface cavities on roads and in harbors, airports and the like. The technology provides high-precision, high-speed, high-resolution diagnostics for general inspections of road stock and other infrastructure facilities.





Identified location of a cavity by this system

<Inspection/Diagnostic Characteristics>

- Non-destructive surveys remove the need to cut pavement and remove cores
- The system uses high-precision microwaves to estimate the spread and depth of cavities in a single passage of the Skele-Car
- The ability to take measurements from within the flow of traffic at speeds of up to 60 km/hr removes the need to implement traffic control
- GPS, road surface videos and tri-directional images (front, left and right views) are used to identify the precise locations of cavities

<Expected Outcomes>

- High-resolution three-dimensional data evaluation improves the precision of cavity detection
- Conventional mesh surveys are not required, which improves economic efficiency and workability and reduces work processes
- Congestion is avoided because traffic control is not required
- The improvement of positional information precision enables follow-up observation of unrepaired cavities and monitoring of open-cut repair locations

1-6 Underground Probe System Using 3-D Radar

Technology: Underground Probe System Using 3-D Radar

NETIS Registration Number: HK-130010-A

Categories: Bridges, pavement (roads)

<Overview>

An underground probe system that acquires underground data by systematically and continuously transmitting electromagnetic waves of 200 MHz to 3 GHz from multiple channels and switching at extremely high speeds. The system can take measurements on both longitudinal and transverse 7.5-cm grids, and can take high-precision measurements by linking with RTK-GPS.

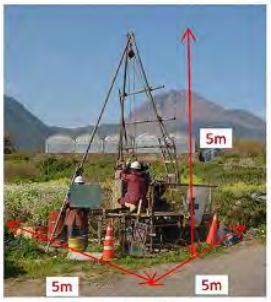
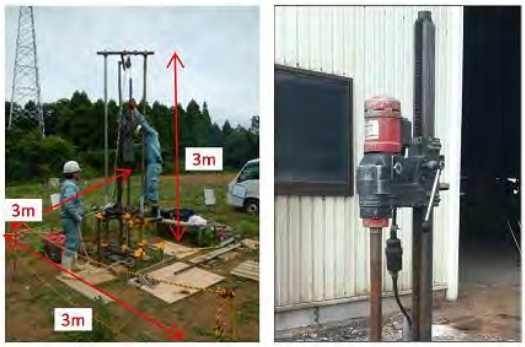
<Inspection/Diagnostic Characteristics>

The system can take measurements on both longitudinal and transverse 7.5-cm grids while in motion at 50 km/hr, which essentially eliminates the need for traffic control, and can be useful in inspections of bridges, airport pavement and other areas where measurement ranges and time are limited. In addition, the non-contact antenna makes it possible to conduct tunnel inspections that carry a high risk of target facility collapse and other secondary disasters.

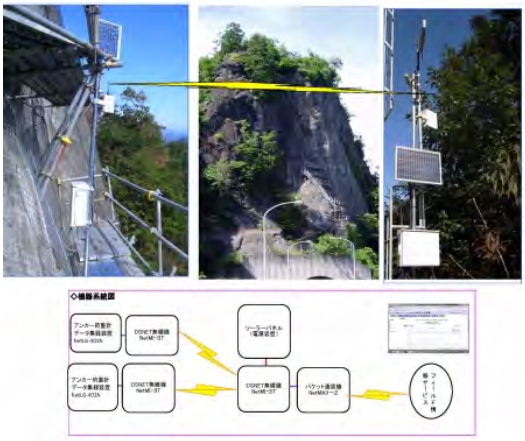
<Expected Outcomes>

This system can reduce costs as well as the number of days required for field measurements; improve safety by removing the need for traffic control, thereby reducing the number of accidents; and enable comprehensive diagnostics of public infrastructure, not only in subsurface cavity surveys of roads, but also in pavement structure surveys, bridge deck surveys and roadbed deformation surveys.

1-7 Quick Boring

Technology: Quick Boring
NETIS Registration Number: QS-130025-A
Categories: Road appendages (roads), tunnels (roads)
<Overview> A compact, lightweight, rapidly rotating core sampling device that uses a steel core drill powered by an electric motor    Existing technology    New technology
<Inspection/Diagnostic Characteristics> The device is significantly lighter and more compact than conventional boring machines, which makes it possible to carry the device by hand and work in tight spaces. The device is powered by an electric motor, which means there is no exhaust, thereby enabling surveying in narrow pits. It is possible to perforate any retaining walls or other concrete structures that exist to verify the ground behind those structures. The device has also performed horizontal boring to 3 m. <Expected Outcomes> In the course of devising inspection plans and conducting inspections, work space restrictions, cost restrictions, and sample quality targets limit the range of inspection technologies available to use. This technology facilitates consideration of the application of the best inspection technologies, and increases the likelihood of expanding the range of inspection technology development.

1-8 Rapid On-Site Automatic Observation System

Technology: Rapid On-Site Automatic Observation System
NETIS Registration Number: SK-090003
Categories: Road appendages (roads), tunnels (roads), bridges (roads)
<Overview> Battery-powered technology for detecting deformations of bridges, slopes, tunnels and the like via sensors, monitoring alerts in the field derived from thresholds, speeds and other data, and sending notifications of those alerts along with data. A monitoring technology that is useful for maintenance using an on-site network through a single communication device that enables the periodic transmission and viewing of data. Automatic observation and alarm system to observe condition of cutting and embankment slopes along a road 
<Inspection/Diagnostic Characteristics> Compared to the management of deformations through periodic inspections conducted in person, the ease of installing and monitoring enables full understanding of the progression of deformations. The ability to transmit automatic alerts during emergencies and learn about deformations and risk without delay makes it possible to prevent disasters, thereby ensuring safety. <Expected Outcomes> Quickness/safety/economic efficiency

1-9 Technology for Surveying Health of Ground Anchor Work

Technology: Licos

NETIS Registration Number: SK-100011-VE

Categories: Road appendages (roads), slopes (roads)

<Overview>

A system that can automatically control various load and unload speeds in various anchor tests (lift-off tests, basic survey tests), and can conduct tests more precisely and safely than the conventional method of visually reading instruments to determine displacement and loads.

<Inspection/Diagnostic Characteristics>

The system makes it possible to fully automate lift-off tests conducted to inspect anchor health. The use of this system makes it possible to safely and accurately obtain testing data, which enables more precise assessment of anchor health.

<Expected Outcomes>

- The ability to smoothly and automatically control the load and unload speeds of the jacks makes it possible to safely conduct lift-off tests without rapidly changing loads on existing anchors.
- Operations are fully controlled by touch-panel buttons, which makes it possible to simply and reliably operate the jacks.
- The high data acquisition frequency makes it possible to more accurately assess lift-off loads.

1-10 Technology for Surveying Health of Ground Anchor Work

Technology: LOT-006

NETIS Registration Number: SK-110021-A

Categories: Road appendages (roads), slopes (roads)

<Overview>

LOT-006 is a testing instrument that fully automates load control and displacement measurement in various anchor tests (basic survey tests, quality assurance tests and lift-off tests), whereas conventionally, loads are controlled through the manual operation of pumps to control the jacks.

<Inspection/Diagnostic Characteristics>

LOT-006 makes it possible to fully automate lift-off tests conducted to inspect anchor health. The use of this device enables the acquisition and analysis of highly precise test data, which makes it possible to assess anchor health to a high degree of certainty.

<Expected Outcomes>

- The measurement frequency can be set high, which enables highly precise measurement and data analysis.
- Data can be displayed in the form of graphs on the screen, which facilitates on-site assessments of lift-off loads.
- Anchor load speeds can be controlled precisely, and displacement is automatically controlled, which makes it possible to conduct tests safely without having to approach the jacks.

1-11 Technology for Surveying Health of Ground Anchor Work

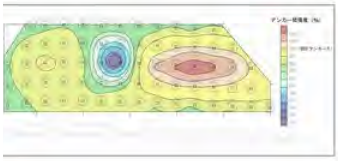
Technology: SAAM System

NETIS Registration Number: SK-070009-V

Categories: Road appendages (roads), slopes (roads)

<Overview>

A technology for surveying the health of ground anchor work used to stabilize slopes and reinforce structures. Lift-off tests using compact, lightweight jacks developed for this purpose make it possible to confirm the residual tensile force of anchors and make assessments regarding slope stability and the health of anchor materials. It is also possible to install retrofitted load meters for areal surveys and monitoring.



<Inspection/Diagnostic Characteristics>

Compared to conventional methods for inspecting anchors after they are put into service, which involve the use of cranes and other large machinery, equipment can be carried onto the site and installed manually, which can reduce the installation of scaffolding and temporary works and cut down on traffic control, thereby enabling quick, low-cost inspections of small work yards and other site conditions that could not be inspected using conventional methods. During testing, it is possible to confirm the state of anchor loads in real-time on a computer screen.

<Expected Outcomes>

This technology makes it possible to confirm anchor loads even while on-site, which is difficult to do using conventional methods, and also to quickly detect and take action in response to changes in slope stability and the health of the underground parts (the parts that are not visible) of anchor work, which are difficult to assess via visual inspections using load control. It is also possible to install retrofitted load meters for monitoring anchor loads.

1-12 Non-destructively Survey in the Ground

Technology: FDEM Exploration

NETIS Registration Number: KK-050083

Categories: Road appendages (roads), tunnels (roads), pavement (roads)

<Overview>

An exploration method for measuring specific resistance distribution of the ground and underground structures non-destructively and from the position of the ground surface. The full understanding of the relative specific resistance distribution at various points and depths makes it possible to estimate roadbed thickness, moisture content, cavities and other elements of the state of the ground beneath structures.

<Inspection/Diagnostic Characteristics>

(1) It is possible to non-destructively survey the ground from the position of the ground surface.

(2) The exploration instruments are compact, which means they can be used in a wide variety of locations.

(3) There are 16 frequency settings, which makes it possible to explore up to 30 m below the ground surface at a higher resolution than conventional electronic exploration.

<Expected Outcomes>

There is no need to install electrodes or do other large-scale preparation, which can reduce the time required for surveys and improve economic efficiency. It is also relatively easy to explore cavities in the tight spaces behind tunnel lining.

1-13 Underground Object Length Measuring Device

Technology: Underground Object Length Measuring Device
NETIS Registration Number: CB-110028-VR
Categories: Road appendages (roads), tunnels (roads), bridges (roads), pavement (roads)
<Overview> A non-destructive technology for confirming the embedded length of underground and underwater steel structures as well as cracks, corrosion and other deformations of supports, steel sheet piles and other members of road appendages by attaching sensors to the exposed above-ground parts of the steel structures and transmitting ultrasonic waves from the measuring device. 
<Inspection/Diagnostic Characteristics> The ability to conduct non-destructive inspections of underground steel structures removes the need for excavation. The device can be carried by a single person. The screen shows wave profiles and numerical values, which means that measurement lengths and crack locations can be understood at a glance. The device is equipped with corrosion analysis software that displays the degree of corrosion in four levels and also as a percentage via images of wave profiles. Measurement positional information can be managed via GPS. These attributes result in good workability. <Expected Outcomes> The ability to conduct non-destructive inspections of underground steel structures removes the need for destruction and excavation of structures, and enables confirmation of crack locations and corrosion via ultrasonic waves. The device has been used to measure the lengths of elongated buried steel structures as long as 16 m. Construction schedules can be shortened/recovery materials are not necessary, which can reduce costs; work does not result in noise or dust; work can be done with around three engineers and in small spaces, which makes it possible to eliminate traffic control

1-14 Monitor Disaster Risk Reduction on Slopes and Health of Structures

Technology: T-FOpSS (FBG Optical Fiber Sensing System)

NETIS Registration Number: KT-070110

Categories: Road appendages (roads), tunnels (roads), slopes (roads)

<Overview>

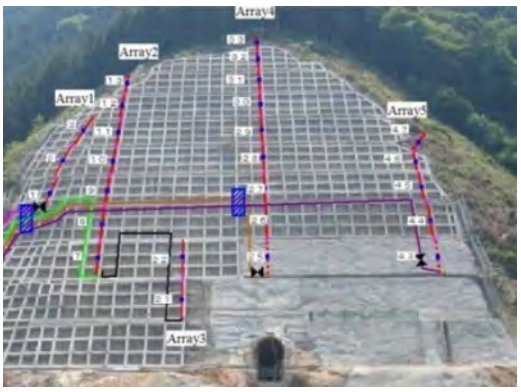
A measurement technology that uses TDM FBG optical fiber sensors to monitor disaster risk reduction on slopes and the health of structures made of soil, concrete, steel and other materials for the purpose of maintenance

■Scope of application

・Monitoring of disaster risk reduction on slopes

・Monitoring of health for the purpose of maintaining in-service structures made of soil, concrete, steel and other materials.

・Monitoring of the impact of construction work in the vicinity of structures, etc.



<Inspection/Diagnostic Characteristics>

・Highly durable sensors enable long-term monitoring

・It is possible to control up to 100 sensors (up to 400 sensors using four channels) using a single system

・Manage and measure various characteristics of structures with a single system

・It is possible to measure special environments such as large-scale structures, explosion protection requirements, and non-inductive requirements

<Expected Outcomes>

Simplification of monitoring system maintenance

2. New Technologies for the Bridge Inspection

2-1 Crack Measurement System

Technology: Crack Measurement System
NETIS Registration Number: KK-080019-V
Categories: Appendages inside tunnels (roads), tunnels (roads), bridges (roads), pavement (roads)
<Overview> This crack measurement system uses electro-optical surveying instruments to remotely measure and plot the width, shape and three-dimensional positional coordinates of cracks. In addition, measurements of appendages and the shapes of structures make it possible to create planar views of clearances and the like, elevation views of buildings and the like, and development views of arched structures. 
<Inspection/Diagnostic Characteristics> The use of this technology removes the need for scaffolding, vehicles with elevating work platforms and the like, which enables safe, economically efficient crack measurement. In addition, the combination of proprietary applications and commercial AutoCAD software makes it possible to automatically plot measurement data in two- or three-dimensional drawings. <Expected Outcomes> This technology improves economic efficiency and safety in taking measurements without relying on scaffolding, vehicles with elevating work platforms minimizing the risk of traffic accident during the survey. In addition, the ability to provide three-dimensional positional information regarding crack variation and to store that information as digital data can improve the reproduction quality of measurement data and be useful for annual variation surveys.

2-2 On-Site Analysis of Concrete Salt Damage

Technology: On-Site Analysis of Concrete Salt Damage with a Portable Fluorescent X-Ray Analysis Device

NETIS Registration Number: KK-100109-VR

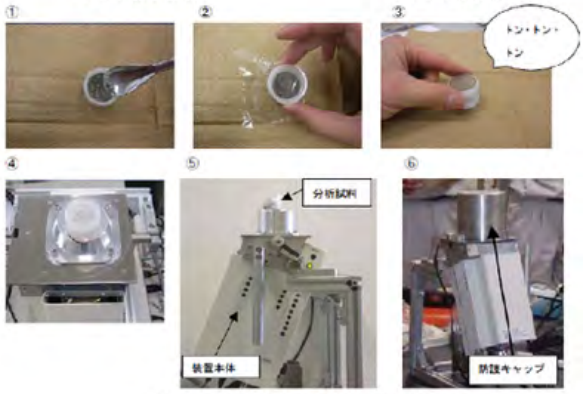
Categories: Appendages inside tunnels (roads), tunnels (roads), bridges (roads), pavement (roads)

<Overview>

Presently, concrete salt damage surveys are carried out by collecting concrete cores, transporting them to an analysis center, implementing complex preprocessing, and then conducting potentiometric titration analysis. In this technology, a portable fluorescent X-ray analysis device is used on-site, which simplifies and expedites analysis and surveys, thereby streamlining salt damage surveys and reducing costs.

Gathering cut powder by drill

Analysis of cut powder



Process to analyze cut powder of drill by X-ray fluorescence analyzer

<Inspection/Diagnostic Characteristics>

The use of this technology enables simple, quick on-site measurements and analysis without transferring samples, which shortens construction schedules and reduces costs. In addition, this technology does not use acids or the like, and therefore does not pollute the environment.

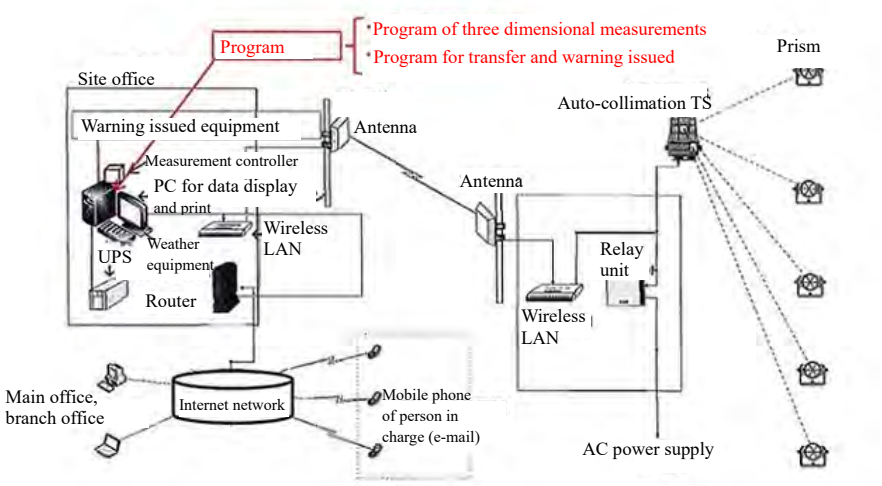
<Expected Outcomes>

Benefits to using this technology in concrete structure salt damage surveys include (1) A substantial reduction in time, (2) Reduced costs, (3) The removal of the need for special skills or expertise compared to conventional methods, (4) No use of acids, reagents or the like, which makes work easy and does not pollute the environment, (5) Analytical precision verified by public agencies.

2-3 Portable Concrete Checkup Device

Technology: Portable Concrete Checkup Device
NETIS Registration Number: KT-100062
Categories: Appendages inside tunnels (roads), tunnels (roads), bridges (roads), pavement (roads)
<Overview> A technology in which the hammering method (a technique of analyzing sounds generated by the impact of hammering recorded by a microphone to evaluate structural health) is used to survey surface defects (spalling, peeling, cavities, etc.) in tunnel lining concrete, RC slabs and the like, and peeling of steel plates and concrete in composite deck slabs, submerged tunnels and the like.     Installation status of the system  Measurement situation
<Inspection/Diagnostic Characteristics> This alternative technology to hammering inspections provides the following benefits when used in inspections: (1) Accurate, objective results can be obtained regardless of inspector experience. (2) Inspection results can be compared in terms of time because the results can be saved as numerical data. (3) Excellent investigation performance (deep peeling, etc.). <Expected Outcomes> (1) Improved investigation performance and precision, (2) Results can be applied to subsequent inspections because they can be saved as numerical data. (3) Results are not dependent on inspectors' experience.

2-4 Three-Dimensional Displacement Measurement System

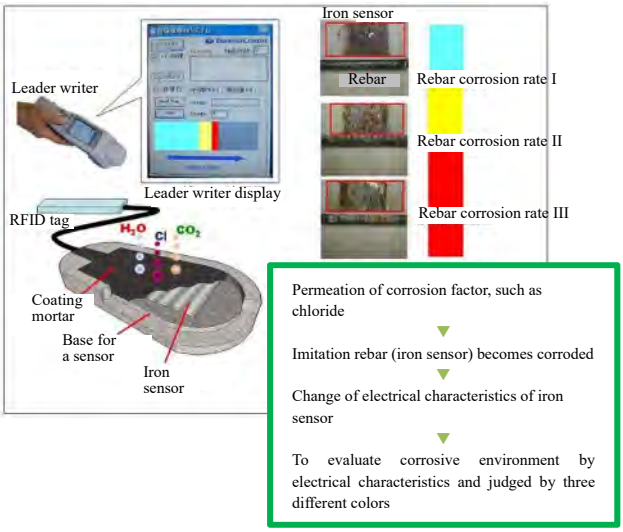
Technology: DAMSYS (Three-Dimensional Displacement Measurement System)
NETIS Registration Number: KT-130095-VE
Categories: Appendages inside tunnels (roads), tunnels (roads), bridges (roads), pavement (roads)
<Overview> A system that quickly measures three-dimensional displacement of structures using a program that controls automatic collimation TS and the like, whereas the conventional method is to measure structures with manual TS and calculate displacement. The application of this system enables inspectors to quickly identify structural deformations, thereby contributing to improved safety. 
<Inspection/Diagnostic Characteristics> In the past, it was not possible to quickly identify changes because calculations were done by hand after measuring structural displacement using manual TS; this system measures three-dimensional displacement of structures using a program that controls automatic collimation TS and the like, which enables inspectors to identify hazardous structural conditions more quickly, thereby contributing to the improvement of safety. <Expected Outcomes> · The change from commercial automatic collimation TS and GNSS to measurement by an automatic control program makes it possible to quickly verify the measurement results of three-dimensional displacement and identify deformations in abnormal situations, thereby contributing to the improvement of safety. In addition, this system reduces labor costs by eliminating manual measurement work, thereby contributing to improved economic efficiency. · The elimination of manual calculations contributes to improved workability.

2-5 Corrosion Environment Detection System

Technology: RFID Corrosion Environment Detection System
NETIS Registration Number: KT-110059-A
Categories: Appendages inside tunnels (roads), tunnels (roads), bridges (roads), pavement (roads)

<Overview>

A system that uses radio waves and transmitter/receivers (RFID tags) and sensors embedded around rebar in concrete structures to measure and diagnose corrosion around the rebar caused by factors such as neutralization (namely salt damage) and chemical corrosion.



<Inspection/Diagnostic Characteristics>

· Embedding sensors and transmitters/receivers in structures and using readers/writers for wireless communication enables completely non-destructive measurements

· The sensors do not require a power source (batteries), which enables long-term monitoring

· The ability to store measurement results and histories in the built-in memories of embedded RFID tags provides for optimal maintenance and management

<Expected Outcomes>

· The conventional technology (the self-potential method) required chipping prior to measurement and backfill work after measurement; with this technology, those processes can be eliminated, which can streamline measurement work while maintaining structural health

· The measurements are taken wirelessly, which eliminates wiring work, thereby improving workability and operability.

· Multiple locations can be measured simultaneously from a single location, which can reduce measurement processes.

2-6 Aerial Still Image Creation/Editing Technology

Technology: Mofix Continuous Image Viewer, Real-Time Imaging System (Aerial Still Image Creation/Editing Technology)

NETIS Registration Number: TH-010024

Categories: Appendages inside tunnels (roads), tunnels (roads), bridges (roads), pavement (roads)

<Overview>

A system that automatically creates high-definition, long continuous images from Full Hi-Vision video, and can create straight-on continuous images from any image position with no distortion.

This system provides seamless, distortion-free continuous images of entire structures and wide ranges that serve as visual records of inspections as well as findings and diagnostics derived from images in the course of maintaining structures.

Cavity inspection inside a tunnel

<Inspection/Diagnostic Characteristics>

This system captures images while moving parallel to the structure surface at a set speed with the camera directly facing the structure. To photograph wide continuous images, the view angle is changed and the structure is captured repeatedly with a single camera, or multiple video cameras set to different view angles are used.

<Expected Outcomes>

· Enables the recording of straight-on, distortion-free, continuous images, even for very long structures.
· High-definition continuous images enable the full understanding and diagnosis of conditions throughout entire structures through video.
· Continuous imaging facilitates the full understanding of positional relationships of deformations throughout entire structures.
· This technology helps reduce work processes and reduce costs compared to conventional continuous imaging production.

2-7 Distortion Measurement System

Technology: RFID Distortion Measurement System

NETIS Registration Number: KT-100044

Categories: Appendages inside tunnels (roads), tunnels (roads), bridges (roads), pavement (roads)

<Overview>

A system that uses radio waves and transmitter/receivers (RFID tags) and sensors embedded in concrete structures to measure concrete and rebar distortion caused by external forces, deterioration and the like.

<Inspection/Diagnostic Characteristics>

· Embedding sensors and transmitters/receivers in structures and using readers/writers for wireless communication enables completely non-destructive measurements

· The sensors do not require a power source (batteries), which enables long-term monitoring

· The ability to store measurement results and histories in the built-in memories of embedded RFID tags provides for optimal maintenance and management

<Expected Outcomes>

· The measurements are taken wirelessly, which eliminates wiring work, thereby improving workability.

· Multiple locations can be measured simultaneously from a single location, which can reduce measurement processes.

· The availability of the six-time data recording function makes it possible to avoid losing past measurement data and fully understand distortion history in the field, which improves computerization.

2-8 Mobile Bridge Inspection Catwalk

Technology: BRIDGE HANGER (Mobile Bridge Inspection Catwalk)

NETIS Registration Number: QS-160032-A

Category: Bridges (roads)

<Overview>

A mobile bridge inspection catwalk that can be installed and removed quickly

・Bridge inspection vehicles are commonly used to conduct surveys, inspections and repairs underneath bridges, but this mobile inspection catwalk can be installed and removed quickly, and enables roads to remain open to traffic while it is being used.

<Inspection/Diagnostic Characteristics>

・This sectional, mobile bridge inspection catwalk is an alternative to bridge inspection vehicles.

・The Bridge Hanger removes the need to restrict traffic, as is required when bridge inspection vehicles are used.

・The Bridge Hanger can be moved manually.

・Only one person can board bridge inspection vehicles; multiple people can board the Bridge Hanger.

<Expected Outcomes>

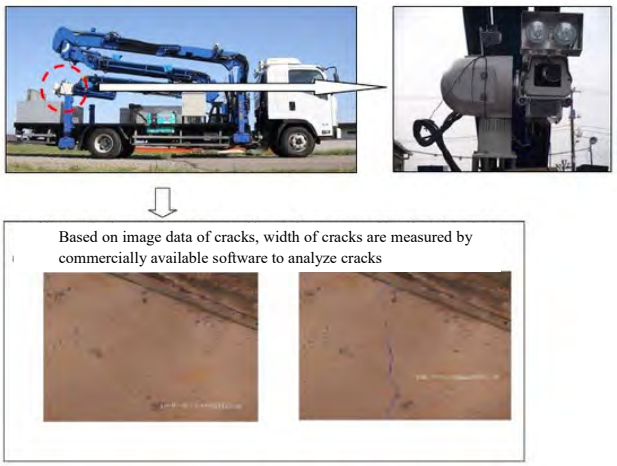
・Installation and removal are simple, which can improve workability.

・The removal of the need to restrict traffic can improve surrounding environments.

・The ability to move the Bridge Hanger manually can reduce construction schedules and the number of people required for the work.

・The capacity for multiple people to board the Bridge Hanger enables highly effective inspections and repairs.

2-9 Bridge Inspection Robot System

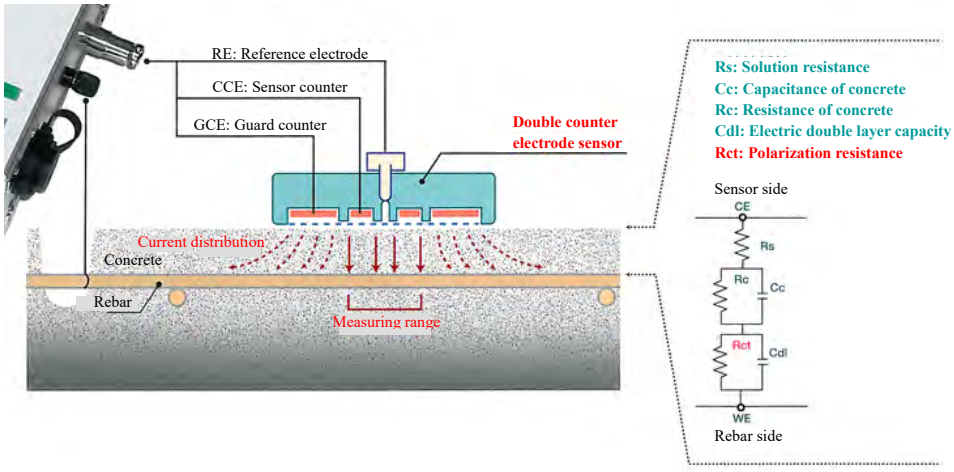
Technology: Bridge Inspection Robot System
NETIS Registration Number: HK-090007
Category: Bridges (roads)
<Overview> This system makes it possible to safely and easily conduct visual inspections of surfaces beneath truss bridges, arch bridges and other structurally complex bridges as well as bridges over large rivers and valleys that are difficult for inspectors to directly access, from the upper surfaces of those bridges using 3DCG. In addition, it is possible to save and store the locations of inspection photographs, and to use that data to create images of damaged locations and photograph albums.    
<Inspection/Diagnostic Characteristics> (1) Safety: Inspectors do not ride on the edge of the arm of the inspection car, which decreases the likelihood of accidents. (2) Ease: Only a general license is required to drive the inspection car, and the ability to take inspection photographs using a joystick while viewing 3DCG and high-definition monitors facilitates the comparison of year-to-year information (3) Reliability: Locations of inspection photographs are automatically saved and stored on the spot. <Expected Outcomes> Compared to conventional technology, bridge inspection work can be done safely and easily, data can be consolidated with a high degree of reliability, and the administrative work of creating images of damage and photograph albums can be done semi-automatically. In addition, the establishment of connections to existing bridge administrators' databases enables the effective use of inspection data.

2-10 Mobile Rebar Corrosion Diagnostic Instrument

Technology: Mobile Rebar Corrosion Diagnostic Instrument
NETIS Registration Number: SK-090004
Categories: Road appendages (roads), tunnels (roads), bridges (roads)

<Overview>

A technology for obtaining information about rebar corrosion by attaching one end of a lead wire to at least one place on embedded rebar exposed by chipping, and placing the sensor at the other end of the wire at the concrete surface directly above the rebar to measure self-potential, and then applying a weak, dual-frequency alternating current to achieve impedance values for measuring the electrical resistance and polarization resistance of the concrete.



<Inspection/Diagnostic Characteristics>

The defining characteristic of this diagnostic instrument is the ability to obtain information about the speed of rebar corrosion despite the need to expose embedded rebar (minor destruction) through chipping in at least one location. The instrument is equipped with a battery and is compact and lightweight (2.5 kg), which enables on-site measurement. Note also that measurement at each point requires roughly three minutes (not including the time it takes to move and install the sensor).

<Expected Outcomes>

This technology is used to estimate the corrosion speed of embedded rebar by measuring the polarization resistance of locations in structures and areas under survey that are susceptible to rebar corrosion as selected from the distribution of self-potential and concrete electrical resistance. The ability to consider information about the temperatures and infiltration status of chloride ions makes it possible to estimate the degree of corrosion.

2-11 Structural Health Evaluation Method Using Impact Vibration Testing

Technology: Structural Health Evaluation Method Using Impact Vibration Testing

NETIS Registration Number: CB-090013

Categories: Road appendages (roads), tunnels (roads), bridges (roads)

<Overview>

This method is used to obtain visible numerical assessment results in the assessment of bridge structural health; the natural frequencies of superstructures as well as foundations that are not visible because they are underground or underwater are measured and compared to reference values for structural health. In recent years, this method is being implemented for tunnel lining and expressway facilities and structures.

<Inspection/Diagnostic Characteristics>

(1) Use natural frequencies, which all structures have, to assess bridge health; (2) Testing can be conducted simply and precisely; (3) Accurately measure natural frequencies; (4) It is possible to accurately assess the health of foundations that are not visible; (5) Reference values, which are important in health assessment, are based on expansive measurement data and design values; (6) This method is highly efficient; thus, it can be implemented cheaply.

<Expected Outcomes>

(1) This method is effective for structures such as foundations that are not visible because they are underground or underwater

(2) Natural frequency is the only assessment indicator; this method is compatible with a wide range of structures and types of materials

(3) This method has been put into practice many times; thus, it is highly reliable

(4) It is possible to obtain high cost-performance and highly precise assessment results.

(5) It is possible to eliminate traffic control and scaffolding, and to reduce the time spent on inspections.

2-12 Grout Filling Detection System

Technology: Grout Filling Detection System
NETIS Registration Number: CB-080019
Category: Bridges (roads)
<Overview> The Grout Filling Detection System is a non-destructive grout filling detection method that uses electromagnetic wave radar and broadband ultrasonic waves to survey grout filling in prestressed concrete bridges. 
<Inspection/Diagnostic Characteristics> This system can be applied to non-destructive grout filling surveys of post-tensioned prestressed concrete bridges at which PC grout work is being performed. <Expected Outcomes> Compared to conventional technology, the application of this system expands the scope of measurement and improves work efficiency, safety and economic efficiency. It is also possible to immediately confirm survey results on-site.

2-13 Automatic Concrete Structure Crack Identification System

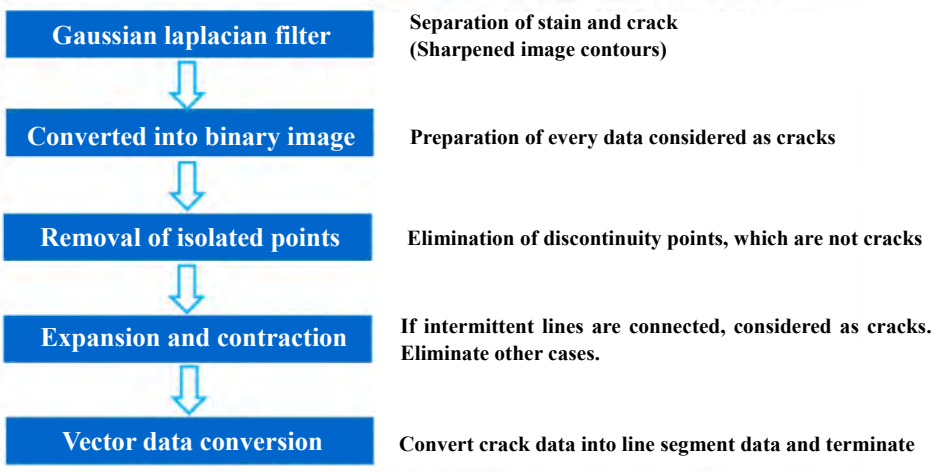
Technology: Automatic Concrete Structure Crack Identification System

NETIS Registration Number: KT-130046-V

Categories: Road appendages (roads), tunnels (roads), bridges (roads), pavement (roads)

<Overview>

A technology in which digital cameras take high-definition photographs from as far away as 50 m, and proprietary software automatically identifies cracks. The ability to simultaneously obtain image data removes the need to conduct visual inspections.



<Inspection/Diagnostic Characteristics>

(1) No need for scaffolding or vehicles with elevating work platforms.

(2) No dependence on worker skill.

(3) It is possible to substantially reduce the time required for on-site work.

(4) It is possible to obtain precise crack data (widths and lengths) in 0.2-mm units.

(5) It is possible to conduct inspections from remote locations.

<Expected Outcomes>

(1) Contributes to reduced costs.

(2) Contributes to the reduction of time required for work and traffic control.

(3) It is possible to obtain precise data.

(4) Optimal for fully understanding changes due to aging.

(5) It is possible to conduct inspections of structures that are difficult to get close to.

2-14 Structure Monitoring System Using Wireless Sensors

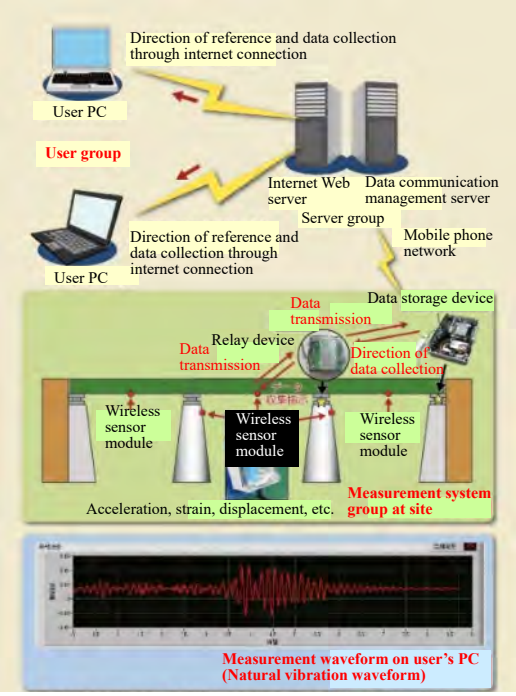
Technology: Structure Monitoring System Using Wireless Sensors

NETIS Registration Number: QS-130011-A

Categories: Road appendages (roads), tunnels (roads), bridges (roads)

<Overview>

A system for monitoring the characteristics of structural behavior and vibrations in which many accelerometer sensors are installed throughout structures to enable the remote, real-time understanding of those characteristics via mobile communication networks.



Within degradation process of structure, to grasp decrease of load bearing capacity and seismic performance in accelerated phase and deterioration period, as decrease of natural vibration waveform and increase of strain/displacement.

<Inspection/Diagnostic Characteristics>

A system for remotely monitoring the condition of damage (the progression of deterioration due to structure aging, structural damage due to earthquakes and floods) from the characteristics of structural behavior and vibrations via mobile communication networks, in which many wireless accelerometer sensors are installed throughout structures to enable the real-time measurement of structural vibrations.

<Expected Outcomes>

This technology requires no cables; on-site, only wireless sensors, data recording devices and relay devices are needed, which contributes to more efficient preparation for measurement compared to conventional methods. In addition, the ability to use a networked computer to obtain on-site measurement data in real time from anywhere makes it possible to safely monitor structures after they suffer damage without having to visit the sites.

2-15 Concrete Tester

Technology: Concrete Tester (CTS-02)

NETIS Registration Number: HK-060013

Categories: Road appendages (roads), tunnels (roads), bridges (roads)

<Overview>

A non-destructive inspection device that quickly and rapidly estimates concrete compression strength and detects spalling, peeling and the degree of deterioration near surfaces using measurement and analysis of wave profiles generated by the impact of hammers on the concrete. This compact, lightweight measuring device comprises a main unit (440 g) and a hammer unit (Head weight: 380 g).

<Inspection/Diagnostic Characteristics>

The only action required is to strike concrete with the hammer of this lightweight, compact measuring device, which makes it simple to fully understand the condition of the concrete. In addition, the device is a non-destructive inspection device; it does not cause damage to structures. Therefore, it is possible to establish points of measurement and continuously obtain data from those points.

<Expected Outcomes>

- No special techniques are required for measurement; anyone can take measurements
- Measurement surface treatment is not required, which makes it possible to reduce the amount of time required for measurements and to reduce the time spent on surveys
- All data is recorded digitally, which improves the speed of consolidation and compilation
- The ability to reduce the time spent on surveys, streamline data consolidation, and narrow down detailed survey locations and repair locations makes it possible to reduce overall expenses

2-16 Concrete Tester

Technology: Concrete Tester
NETIS Registration Number: HK-060013-V
Categories: Bridges (roads)
<Overview> A non-destructive inspection device that quickly and rapidly estimates concrete compression strength and detects spalling, peeling and the degree of deterioration (plasticized) near surfaces (about 50 mm from the surface) using measurement and analysis of wave profiles generated by the impact of hammers on the concrete. No surface treatment is required on the measurement surface, and it is possible to quickly measure by one measurement staff. 
<Inspection/Diagnostic Characteristics> No surface treatment is required on the measurement surface, and it is possible to quickly measure by one measurement staff by this device. It takes about 2 seconds to measure one point, and it is possible to significantly decrease inspection duration. This device can also be used for inspection of the whole area of a structure, and it is possible to grasp the condition of not only partial structure but also the entire structure. <Expected Outcomes> All data is recorded digitally, and results of analyses can be output by MS-Excel file, which improves the speed of consolidation and compilation. Also, as results of inspection can be displayed by contour plots, it is possible to refine locations for a detailed inspection and repair.

2-17 Inspection and Diagnostic System for Concrete structures

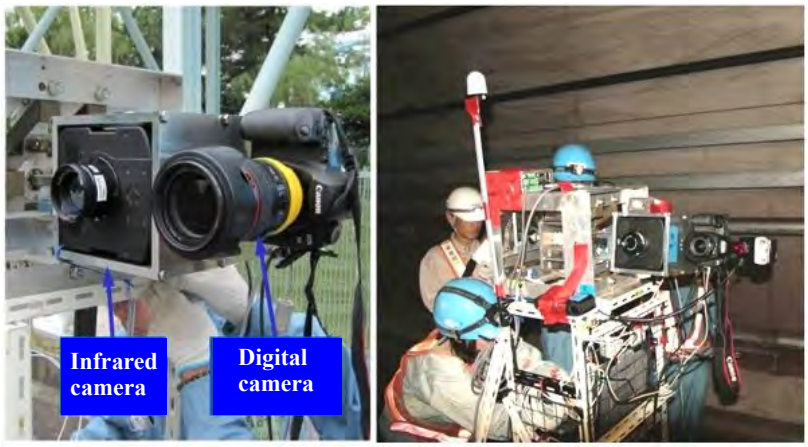
Technology: HIVIDAS

NETIS Registration Number: KT-130041-V

Categories: Road appendages (roads), tunnels (roads), pavement (roads)

<Overview>

An inspection and diagnostic system for concrete structures that serves as an alternative to conventional visual inspections and hammering tests. A supersensitive infrared camera and digital camera are secured to a frame, and simultaneously capture infrared heat images and visible images from the same view angle. Cracks, spalling, peeling and other structural deformations are identified through image analysis performed by superimposing these images.



<Inspection/Diagnostic Characteristics>

The frame and photography equipment used for this technology are compact; equipment can be transported manually and assembled quickly, which is helpful for completing work within the amount of time train service is suspended in railway tunnels at night, and toward reducing the time required for traffic control in road tunnels. In addition, deformations are identified by imaging and analysis software, which contributes to more consistent assessments and a fuller understanding of changes due to aging as a result of multiple inspections.

<Expected Outcomes>

Improved repeatability, reduction of human error, reduction of time required for on-site inspections, elimination of scaffolding installation, limiting of negative effects to surrounding environments

2-18 Structure Monitoring System Using Optical Fibers

Technology: Structure Monitoring System Using Optical Fibers

NETIS Registration Number: KT-000059

Categories: Road appendages (roads), tunnels (roads), bridges (roads), pavement (roads)

<Overview>

This system uses optical fiber sensors to measure and monitor the relative displacement of structures. It is possible to obtain important information for monitoring and management, confirmation of repair effects and other elements of various structures that are in service or under construction. It is also possible to measure vibrations and other dynamic displacement with consistent precision. There is no concern over noise, and the excellent durability makes the system suitable for monitoring under severe outdoor conditions.

<Inspection/Diagnostic Characteristics>

It is possible to take measurements and conduct long-term monitoring in line with objectives to efficiently obtain important information regarding measures to counter obsolescence, diagnosis of structural health, monitoring of nearby construction work, confirmation of repair effects and other elements of managing various structures that are in service or under construction.

<Expected Outcomes>

It is possible to fully understand the overall state of structural deformations/It is possible to monitor abnormalities/It is possible to conduct long-term, maintenance-free monitoring/It is possible to use this technology in various environments, including buried concrete, underground, underwater, etc./No impact of voltage, noise or lightning/Low dependence on temperature, no need for temperature calibration

2-19 Bridge Inspection Camera System

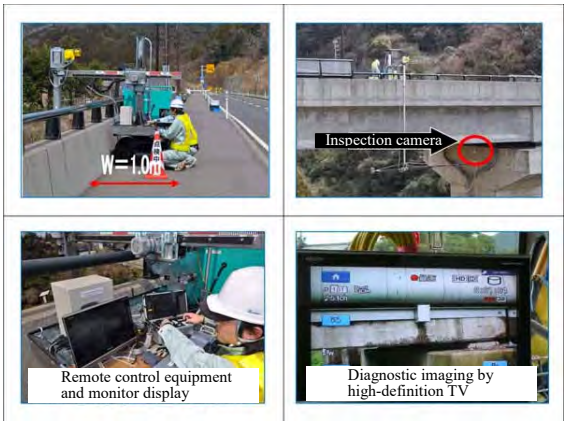
Technology: MIRU MIRU (Bridge Inspection Camera System)

NETIS Registration Number: KK-110063-A

Category: Bridges (roads)

<Overview>

MIRU MIRU is an alternative technology for close visual inspections of bridges. Inspections are conducted through clear photographic images from video cameras controlled remotely from the upper surfaces of bridges. This system is particularly useful on bridges where conventional bridge inspection vehicles cannot be used, bridges that require suspended scaffolding, and the like. This inspection technology enables inspectors to measure cracks and fully exhibit their talents in difficult inspections of tight locations.



<Inspection/Diagnostic Characteristics>

(1) Safe inspections: A compact system that is just 1.0 m wide and 2.7 m long. There is no need to implement traffic control if there is a pedestrian walkway, and the surfaces beneath bridges can be inspected from the upper surfaces of bridges with the system installed on the road shoulder. (2) Consistent inspection precision: Diagnosis from clear video imaging makes it possible for many people to confirm and assess images without reliance on individual eyesight, thereby improving inspection precision. (3) Bridge inspection vehicles and suspended scaffolding are not required.

<Expected Outcomes>

- Economic efficiency: This system is inexpensive compared to conventional bridge inspection vehicles.
- Quality: The ability to conduct close visual inspections of tight spaces that cannot be entered by inspectors reduces oversights and improves inspection precision.
- Safety: It is possible to avoid work in high places and to conduct inspections from safe locations on upper bridge surfaces.
- Workability: The reduction of work space (2.7 m^2) makes it possible to avoid traffic control.

2-20 Deck Slab Concrete, etc. Health Measurement System Using Hammering

Technology: Deck Slab Concrete, etc. Health Measurement System Using Hammering

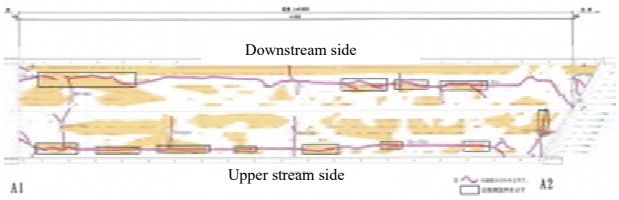
NETIS Registration Number: CB-120029-A

Category: Bridges (roads)

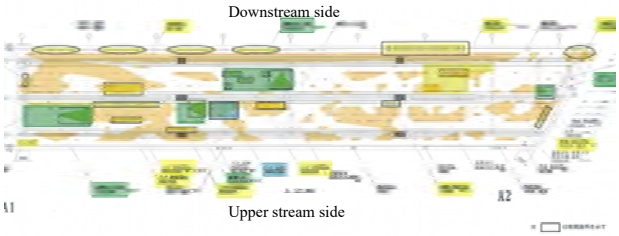
<Overview>

This system involves manually pushing measuring instruments over paved surfaces of bridges as a recorder records the sounds of impact obtained by the rotating parts. An analysis program analyzes the data and displays healthy parts and parts that generate abnormal sounds on a map. The map enables two-dimensional visualization of the presence or absence of internal deformations in pavement, deck slabs and the like, which makes it possible to record observations.

Correlation diagram of cracks on pavement and allophones



Correlation diagram of condition of under slab and allophones



<Inspection/Diagnostic Characteristics>

This system involves hammering inspections conducted to measure the health of bridge decks, and hammering inspections conducted as preliminary studies for deck slab repair and improvement work. Two workers can measure over 2,000 m^2 per day. It is possible to measure abnormal sounds as deep as 40 cm below the surface. The single criterion makes conditions easier to understand, increases reliability, and enables two-dimensional visualization via maps.

<Expected Outcomes>

Improved accuracy: It is possible to assess with a single criterion. Two-dimensional visualization via maps is possible.

Comparison of changes due to aging: Maps make it easier to compare changes due to aging.

Reduced measurement time: The ability to take measurements from paved surfaces removes the need to cut and repair pavement.

2-21 Bridge Management System

Technology: I-BIMS (Bridge Management System)
NETIS Registration Number: HR-130003-A
Categories: Bridges (roads), road appendages (roads)
<Overview> I-BIMS is a system accessible via online application service provider (ASP) that assists in the development of repair plans for prolonging service life through forecasting of the deterioration of bridges and other structures and conducting life cycle cost analysis and other analysis.
<Inspection/Diagnostic Characteristics> ・Systematization of analysis work ・ASP enables the sharing of inspection results and the centralization of data management <Expected Outcomes> ・The automation of analysis work for repair plans for prolonging service life reduces work, thereby improving economic efficiency and work processes. ・The sharing of data between I-BIMS users improves the precision of statistical deterioration forecasting, thereby improving the quality of analysis.

2-22 Diagnostic Technology for Bridge Deck Slab Interiors

Technology: G-Cube (Diagnostic Technology for Bridge Deck Slab Interiors)

NETIS Registration Number: CG-090019

Category: Bridges (roads)

<Overview>

A technology for detecting and diagnosing various deterioration damage and conditions of RC deck slab interiors in 3D via non-destructive inspections conducted from paved road surfaces. The G-Cube's diagnosis makes it possible to appropriately assess partial repairs, repavement, additional pavement and other deck plate repairs prior to cutting pavement, and the knowledge of the condition of the damage is helpful toward designing plans to counter obsolescence.

<Inspection/Diagnostic Characteristics>

- The use of a probe vehicle (Skele-Car) equipped with high-resolution underground radar makes it possible to quickly inspect a wide array of bridges
- Measurements can be taken from within the flow of traffic at speeds of up to 60 km/hr, which removes the need to implement traffic control
- Road surface photographs are used to identify damaged locations
- Handy equipment associated with traffic control is used for diagnosis in order to fully understand the condition of deterioration in more detail

<Expected Outcomes>

- The ability to appropriately assess damaged locations on deck plates without cutting pavement reduces both overlooking and overestimation of damage
- It is possible to implement designing and construction based on detailed conditions of deck plate interiors
- High-quality data is used to forecast the progression of deterioration (comparative analysis of changes due to aging)
- Substantial shortening of inspection schedules, optimal for on-site use, where survey time is limited
- Quick, simple on-site work

2-23 Non-destructive Inspection Technology to Detect Fatigue Cracks on Steel Deck Plate U-ribs

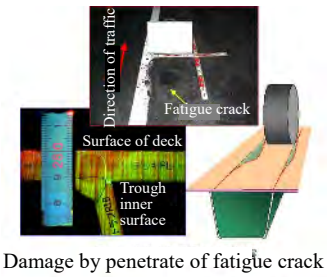
Technology: SAUT (Steel Deck Plate)

NETIS Registration Number: KT-110050-VR

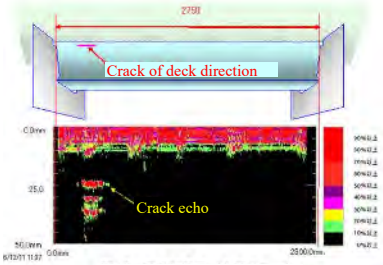
Category: Bridges (roads)

<Overview>

Non-destructive inspection technology that uses semi-automatic ultrasonic testing from the undersides of deck plates to efficiently detect fatigue cracks on steel deck plate U-ribs (trough ribs) that carry a high risk of spreading in the direction of the deck plates.

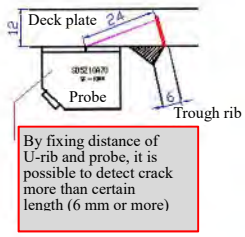


Damage by penetrate of fatigue crack



Example of result of checking flaw (crack echo)

Checking flaw of steel deck plate



Condition of checking flaw

<Inspection/Diagnostic Characteristics>:

This technology enables flaw detection from the undersides of deck plates, which removes the need to implement traffic control. It is possible to detect fatigue cracks that threaten to penetrate deck plates because they have extended more than 6 mm in the direction of the plates. The use of semi-automatic flaw detection (manual operation + automated recording) using a specially designed probe holder for U-ribs makes it possible to conduct inspections efficiently.

<Expected Outcomes>

Compared to the conventional manual flaw detection method, work efficiency is higher, which contributes to reduced survey time. In addition, the ability to record and store total wave profiles throughout the scope of flaw detection makes it possible to take action in response to changes due to aging (crack occurrence, expansion surveys).

2-24 Support System for Devising Repair Plans for Prolonging the Service Lives of Road Bridges

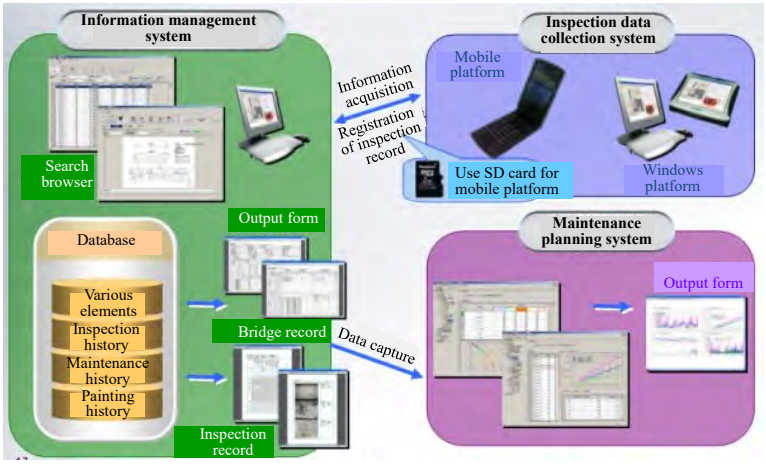
Technology: Chojuro/BG (Support System for Devising Repair Plans for Prolonging the Service Lives of Road Bridges)

NETIS Registration Number: KT-110013-A

Category: Bridges (roads)

<Overview>

A system for efficiently preparing inspection data, consolidating bridge ledgers and devising bridge repair plans required for repair plans for prolonging the service lives of road bridges. The system makes it possible to inspect road bridges and devise repair plans for prolonging their service lives, consolidate and amass road bridge inspection results (images and photographs of damage, etc.), and consolidate and amass bridge ledgers (into a database) based on the draft of Guidelines for the Collection of Basic Data Regarding Road Bridges.



<Inspection/Diagnostic Characteristics>

- Intuitive operation makes it possible to create images of damage
- Photograph management functions (reordering photograph batch numbers, automatically entering comments, etc.) streamline inspection ledger creation
- The interface corresponds to the draft of Guidelines for the Collection of Basic Data Regarding Road Bridges

<Expected Outcomes>

The use of the system makes it possible to centrally operate and manage inspection data collection, bridge ledger consolidation and repair plans, which makes it possible to centrally operate and manage the development of plans, thereby contributing to saved labor and improved economic efficiency.

2-25 Safety Assessment Method after Major Earthquakes

Technology: SBBR Maximum Displacement Gauge
(Safety Assessment Method After Major Earthquakes)

NETIS Registration Number: SK-130015-A

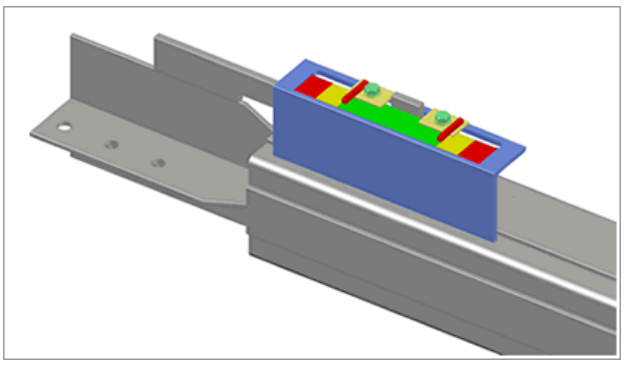
Category: Bridges (roads)

<Overview>

Technology for instantaneously assessing the safety of bridges after major earthquakes, which can significantly reduce survey and inspection times.

Using buckling restriction braces to mount the SBBR Maximum Displacement Gauge, which has excellent visibility, makes it possible to conduct visual inspections from a distance from above the ground to check whether the displacement of the braces is within allowable levels.

It is also possible to make an initial assessment of whether the amount of displacement allows for the passage of traffic. Assessments can be made based on maximum displacement as indicated by the position of SBBR Maximum Displacement Gauges: green, yellow or red



<Inspection/Diagnostic Characteristics>

Checking maximum displacement after major earthquakes remotely and visually makes it possible to assess bridge safety. Simple inspections can be conducted to make decisions regarding road closures.

<Expected Outcomes>

- Reduced inspection time
- Reduced time to initial decisions
- Elimination of scaffolding installation and vehicles with elevating work platforms for initial inspection
- Simplified inspections
- Visual inspections can be conducted remotely

2-26 Technology for Non-destructive Inspections of Steel Embedded in Concrete Structures

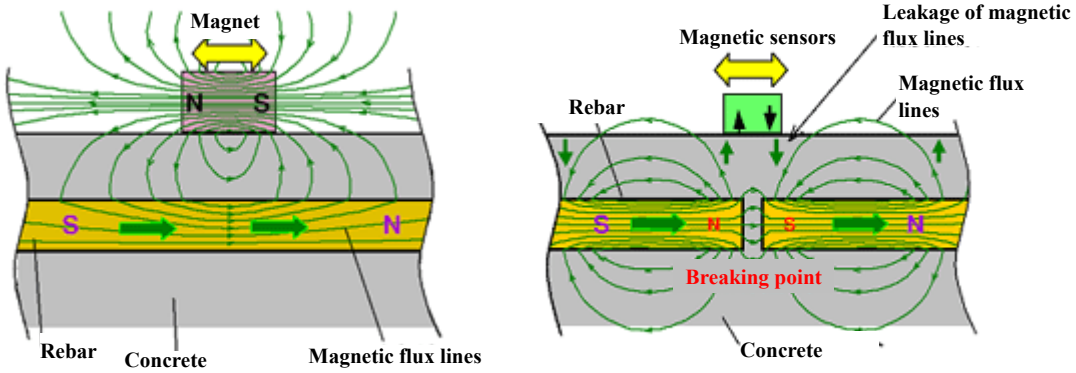
Technology: M.EYE Checker

NETIS Registration Number: SK-080018

Category: Bridges (roads)

<Overview>

Technology for non-destructive inspections of steel embedded in concrete structures. To date, this technology has been used for ruptures of stirrups, hoop lateral ties and other curved manufactured parts of bridges and other RC structures that have deteriorated mainly due to ASR, and ruptures of main reinforcements (pressure welding failure); recently, this technology is also being applied in surveys of the health of PC steel within sheaths in post-tensioned girders.



<Inspection/Diagnostic Characteristics>

In light of the ferromagnetic properties of steel, a permanent magnet is moved across concrete surfaces to magnetize the embedded steel to be inspected. Then, the magnetic flux density of the concrete surface is measured in a completely non-destructive manner. In the magnetic flux leakage method, measured wave profiles are used to determine the presence or absence of magnetic flux leakage occurring near the locations of steel ruptures under survey.

<Expected Outcomes>

It is possible to non-destructively survey the health of steel embedded in concrete structures, whereas conventionally, it is confirmed visually after chipping. It is also possible to detect damaged areas, which can facilitate prompt action against the progression of deterioration.

2-27 Bridge Inspection System that Uses Infrared Method

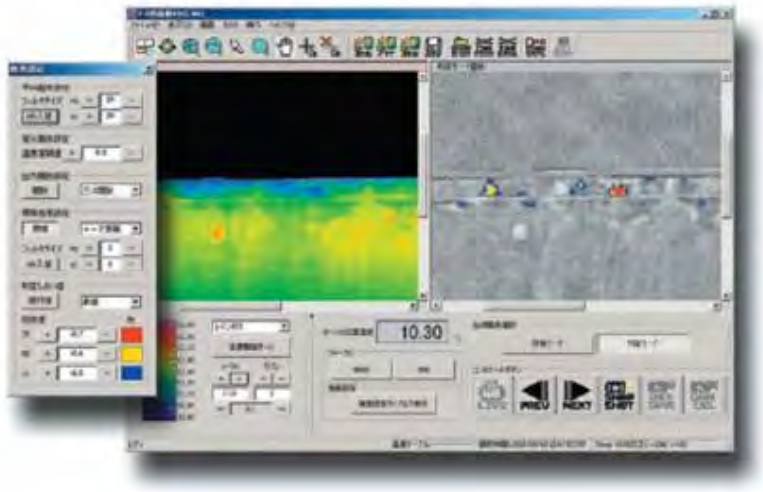
Technology: J System (Total Support System for Infrared Surveys)

NETIS Registration Number: SK-110019-VE

Category: Bridges (roads)

<Overview>

A bridge inspection system that uses the infrared method to accurately and quantitatively identify the locations of spalling, cavities and other deformations of bridges and other concrete structures. The use of this system in primary screenings prior to hammering tests makes it possible to conduct highly precise, highly efficient and highly safe bridge inspections.



<Inspection/Diagnostic Characteristics>

- The infrared method is a remote, non-contact, non-destructive inspection; there is no need for scaffolding or traffic control.
- Proprietary survey support software prevents the overlooking of deformation locations, which enables high quality surveys.
- Proprietary damage assessment support software enables quantitative damage assessment that is difficult to achieve with the conventional infrared method.

<Expected Outcomes>

- The reduction of risky work on scaffolding or in other high places improves the safety of the work.
- The reduction of the area of hammering tests improves the overall economic efficiency of bridge inspections.
- The reduction of traffic control beneath bridges makes it possible to alleviate traffic congestion.
- It is possible to understand from a distance the condition of damage at JR crossings and other locations where it is difficult to implement traffic control.

2-28 Structure High Spatial Resolution Distortion/Temperature Measurement System

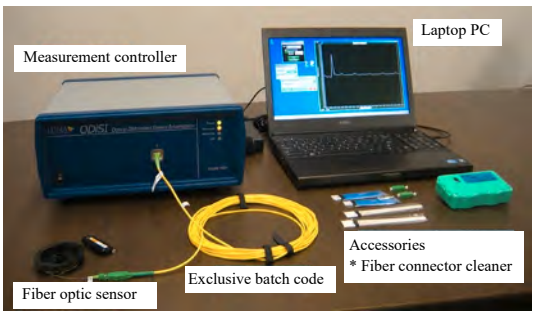
Technology: FBI-Gauge (Structure High Spatial Resolution Distortion/Temperature Measurement System Using Optical Fiber Sensors)

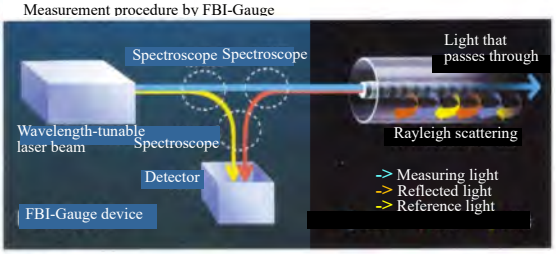
NETIS Registration Number: KT-130083-A

Category: Bridges (roads)

<Overview>

Technology that measures structural distortion in a continuous distribution along the entire length of optical fibers, with high spatial resolution that contributes to the identification of localized stress concentration points.





<Inspection/Diagnostic Characteristics>

Periodically measuring structural distortion along the entire length of optical fibers and compiling and comparing measurement data makes it possible to identify where changes due to aging are occurring along the optical lines, which enables efficient inspection plans focused on the positions of changes due to aging.

<Expected Outcomes>

Distortions can be measured in a continuous distribution over the entire length of optical fibers, which makes it possible to identify localized stress concentration points. It is also possible to use a single batch code to connect optical fiber sensors to measuring instruments, which improves workability.

2-29 Technology for Surveying Damage to Steel, etc. Using the Ultrasonic Guided Wave Method

Technology: Technology for Surveying Damage to Steel, etc. Using the Ultrasonic Guided Wave Method
NETIS Registration Number: KT-130058-V
Categories: Road appendages (roads), bridges (roads)
<Overview> A non-destructive method of surveying damage to steel and other materials embedded in concrete and the like, whereas conventionally, surveys are conducted by excavation, visual inspection and reconstruction. The application of this technology can reduce the expense per support, thereby contributing to improved economic efficiency.
<Inspection/Diagnostic Characteristics> ・The use of guided waves, which are a type of ultrasonic wave, makes it possible to detect damage on front and back surfaces. ・Although it is possible to detect damage on front and back surfaces, it is difficult to identify which surface is damaged. ・Although it is possible to confirm the condition (size, etc.) of corrosion and other damage detected, it is difficult to measure the remaining sheet thickness. <Expected Outcomes> ・It is possible to reduce expenses and shorten construction schedules, which contributes to improved economic efficiency. ・It is possible to detect damage to inner surfaces that could be overlooked using conventional methods, which contributes to improved quality. ・The materials are compact and lightweight, which contributes to improved workability. ・The work generates no noise or dust, which helps limit negative effects to surrounding environments.

2-30 Detailed Crack Width Measuring Instrument

Technology: Detailed Crack Width Measuring Instrument
NETIS Registration Number: KT-090030-A
Category: Bridges (roads)
<Overview> Technology that enables users to measure the widths of cracks in concrete by aligning a camera connected to their computer with the measurement area and looking at the screen. 
<Inspection/Diagnostic Characteristics> With simple one-touch operations, the same results can be obtained no matter who takes measurements; this technology can be used for initial inspections, maintenance, selection of repair methods and more. Measurement of widths of cracks in concrete. (1) Crack detection precision is 0.05 mm (display is 0.01 mm), detection precision is ±0.02 mm; (2) Calculates all measurement data and displays the average width, maximum width, and standard deviation; (3) Displays crack width profiles and histograms; (4) Equipped with save functions for measurement data images and crack width data. <Expected Outcomes> The change from visual to mechanical measurement and from single-point to multi-point measurement eliminates human error and mitigates measurement error, thereby improving precision.

2-31 Concrete Structure Crack Detection Coating System

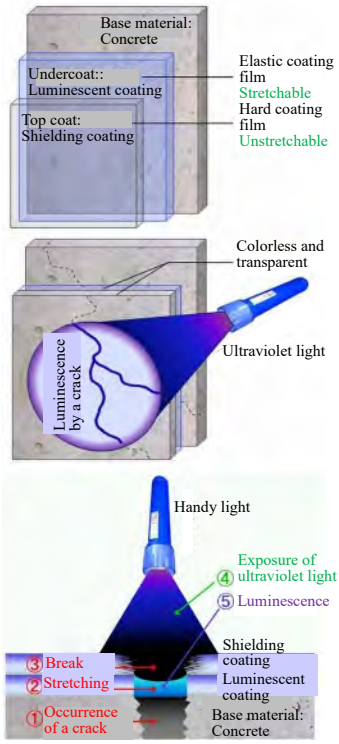
Technology: Concrete Structure Crack Detection Coating System

NETIS Registration Number: CB-120002-A

Category: Bridges (roads)

<Overview>

A detection coating system in which a special light source is used to illuminate and expose crack locations to enable visual inspections and image capturing in inspections of concrete structures (whereas conventionally, cracks are detected via visual inspections), thereby improving inspection precision and speed.



<Inspection/Diagnostic Characteristics>

During inspections, a special light source is used to illuminate and expose crack locations, which minimizes the overlooking of cracks, even by inexperienced workers. Inspections can be conducted visually from a distance the further the light source illuminates, which reduces the need to close lanes of traffic, etc. Illuminating cracks, capturing digital images and binarizing them makes it possible to quantify cracks.

<Expected Outcomes>

- Reduction of work by skilled inspectors
- Reduction of overlooking of cracks
- Simple, inexpensive inspections increase inspection frequency, thereby contributing to improved safety
- Inspections are conducted with handheld flashlights even in emergencies and disasters, and it is easy to conduct inspections in the field
- The ability to photograph cracks with digital cameras makes it possible to obtain objective data

2-32 Simple Attach/Remove Strong Magnetic Scaffolding/Temporary Rail Method

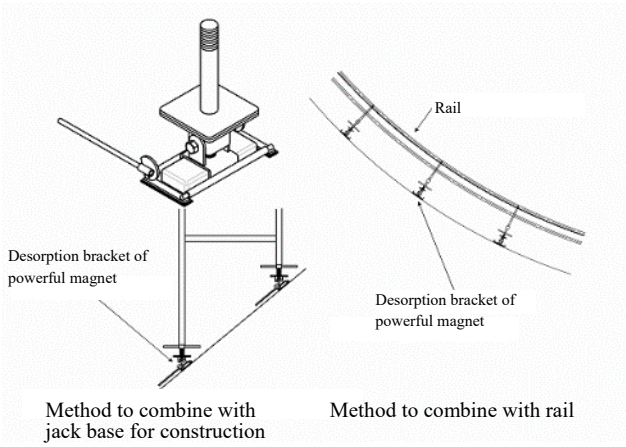
Technology: Simple Attach/Remove Strong Magnetic Scaffolding/Temporary Rail Method

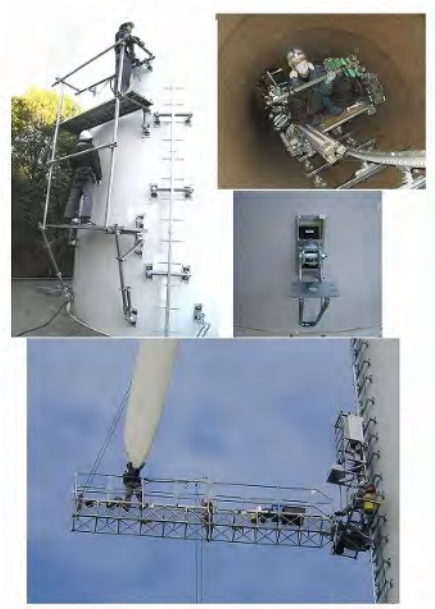
NETIS Registration Number: CB-110048-A

Category: Bridges (roads)

<Overview>

Magnetic scaffolding comprises strong permanent magnets that are extremely easy to attach and remove from steel structures, and is easy to install as scaffolding for inspections and repairs.





<Inspection/Diagnostic Characteristics>

Facilitates scaffolding installation on steel structures.

<Expected Outcomes>

Magnetic scaffolding can be easily attached and removed, which can shorten construction schedules and contribute to lower costs.

2-33 Measurement/Alert System Using LEC Optical Device

Technology: Measurement/Alert System Using LEC Optical Device

NETIS Registration Number: KK-130017-A

Category: Bridges (roads)

<Overview>

Technology that uses color changes of light-emitting diodes (LED) to visualize and display measurement points obtained from various instruments. This technology can visually disseminate information about measurement results in the field in real time.

<Inspection/Diagnostic Characteristics>

The ability to disseminate visual information about changes and conditions of structures and environments as well as numerical information makes it possible to assess inspection results at a glance. Everything about slopes and a wide array of other structures can be seen at a glance, which makes it possible to streamline inspections in the course of maintenance, cut costs and take action sooner.

<Expected Outcomes>

The ability to assess the condition of structures at a glance contributes to the streamlining of inspections. In addition, the color coding (Green = Safe; Yellow = Caution; Red = Danger) is intuitive not only for administrators but also for users of the structure and residents in the vicinity, which makes it easier to avoid emergency situations.

3. New Technologies for the Road Maintenance

3-1 Asphalt Mixture that Solidifies by Reacting with Water,

Technology: MILD MIX
NETIS Registration Number: KT-100046-V
Category: Pavement (roads)
<Overview> An asphalt mixture that solidifies by reacting with water, and can ensure sufficient workability and compaction characteristics even at normal temperatures. Thus, it is possible to manufacture asphalt pavement of equal quality to conventional asphalt pavement, even in areas where there are no asphalt plants in the vicinity, such as on remote islands, in mountainous areas, etc. 
<Inspection/Diagnostic Characteristics> Conventional hot mix asphalt must be placed within one to two hours after it is mixed because it is necessary to maintain a temperature of around 150°C during placement. Thus, whether for new pavement or for repairs, it is difficult to place asphalt pavement on areas far removed from asphalt plants such as remote islands and mountainous areas. The addition of special lubricants and auxiliary reactive agents to Mild Mix substantially improves workability at normal temperatures, which enables placement as late as the day after it is mixed (spreading at roughly 20°C). <Expected Outcomes> · The addition of special lubricants and auxiliary reactive agents to Mild Mix lowers the manufacturing temperature roughly 50°C, which reduces CO_2 emissions roughly 30% and helps combat global warming. · Mild Mix can be used on general roadways because the addition of additives that react with water makes it a cold mix asphalt that also solidifies to the requisite strength quickly.

3-2 All-weather Cold Mix Asphalt

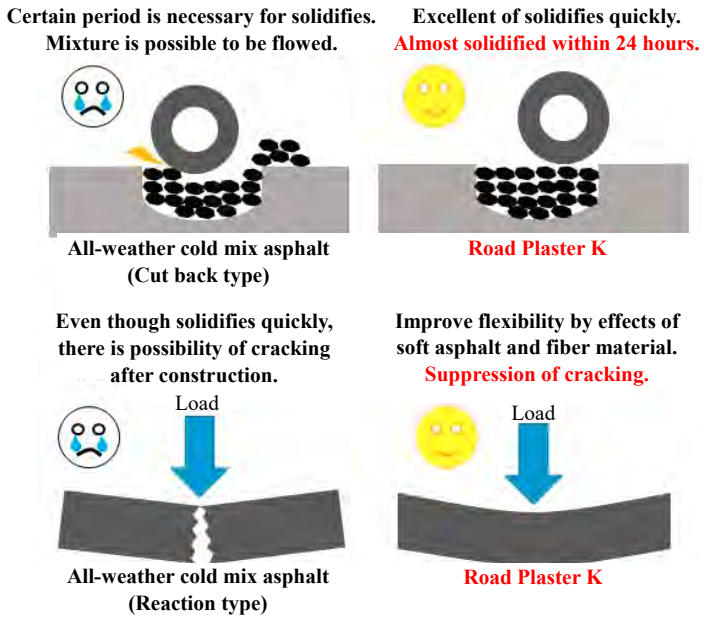
Technology: Road Plaster K

NETIS Registration Number: KT-170005-A

Category: Pavement (roads)

<Overview>

An all-weather cold mix asphalt that solidifies quickly when water is sprinkled before compaction.



<Inspection/Diagnostic Characteristics>

·Road Plaster K can be used to repair damaged asphalt pavement on general roads and high-standard highways.

·Maximum aggregate particle size: 5.0 mm

<Expected Outcomes>

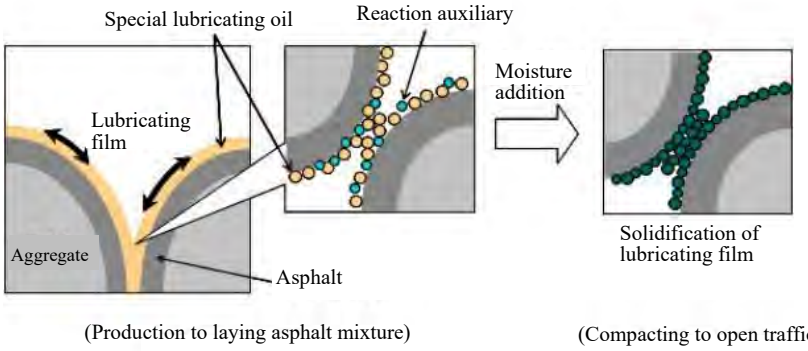
·The addition of fiber materials to Road Plaster K makes it solid and hard, which improves fluidity resistance, thereby contributing to improved durability.

·The change to soft asphalt provides appropriate flexibility and improves resistance to aggregate flaking, thereby contributing to improved durability.

·The addition of alkaline additives and special vegetable oils that react with water dramatically reduces the time required to achieve final strength (final strength achieved in 24 hours), which offers quicker solidification, thereby contributing to improved quality.

·The change to special vegetable oils eliminates the development of volatile organic compounds (VOCs), which helps limit negative effects to surrounding environments.

3-3 Cold Mix Asphalt Packed in Bags

Technology: Mild Patch
NETIS Registration Number: HR-110020-VR
Category: Pavement (roads)
<Overview> A cold mix asphalt packed in bags for use in emergency repairs of potholes and other damage to roads 
<Inspection/Diagnostic Characteristics> ·Special lubricants and auxiliary reactive agents added to the materials of the asphalt mixture. ·Additives that react to water added to the materials of the asphalt mixture. ·Highly airtight material used for the bags that contain the asphalt mixture. <Expected Outcomes> ·Eco-friendly pavement material ·Highly durable ·Excellent solidification ·Consistent storage quality

3-4 Crack Repair Sheet

Technology: PRO PATCH SHEET

NETIS Registration Number: CG-150005-A

Category: Pavement (roads)

<Overview>

Technology in which a special primer is applied before affixing the sheets to seal cracks (whereas conventionally, linear cracks and pavement joints are filled with hot sealants developed specifically to prepare pavement cracks), thereby enabling roads to open to traffic shortly after repairs.

<Inspection/Diagnostic Characteristics>

A crack repair sheet based on modified asphalt is used as substitute for the conventional hot sealant developed specifically for cracks.

<Expected Outcomes>

·Optimal for emergency repairs because small-scale pavement cracks can be repaired easily and quickly.

·The repair work is manual; construction machinery is not used.

·The weight of passing motor vehicles presses the sheets into the pavement cracks, and the sheets bond with the cracks.

·Pressing the sheets into the pavement prevents aggregate from scattering.

3-5 Mat-type Crack Repair Material

Technology: Mat Pave

NETIS Registration Number: KK-100092-A

Category: Pavement (roads)

<Overview>

A technology for repairing cracks and other defects in asphalt pavement.

· A mat-type crack repair material made of highly viscous modified asphalt, specially mixed aggregate, and crushed rock for reinforcement.

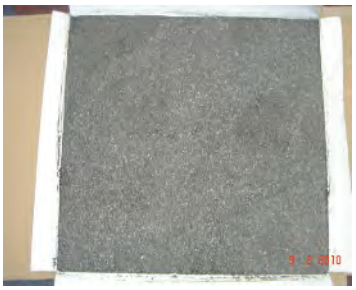
· Highly adhesive tensile strength and durability against repetitive wheel load.

· To repair damage, simply apply the special asphalt primary adhesive to the adhesive surface of Mat Pave, and affix Mat Pave to the damaged area.

· Repairs can be performed more quickly than with hot mixtures.

· A repair material for preventive pavement maintenance through repairs at the stage of cracking.

· 1 sheet: 50 cm x 50 cm x 5 mm; 2.6 kg



<Inspection/Diagnostic Characteristics>

A crack repair sheet based on modified asphalt is used as substitute for the conventional hot sealant developed specifically for cracks.

<Expected Outcomes>

· Optimal for emergency repairs because small-scale pavement cracks can be repaired easily and quickly.

· The repair work is manual; construction machinery is not used.

· The weight of passing motor vehicles presses the sheets into the pavement cracks, and the sheets bond with the cracks.

· Pressing the sheets into the pavement prevents aggregate from scattering.

3-6 Pavement Crack Grouting Method

Technology: Pavement Crack Grouting Method
NETIS Registration Number: CB-160027-A
Category: Pavement (roads)
<Overview> Pavement crack grouting is a method of directly melting and injecting sealant into linear cracks interspersed throughout pavement over small areas using an asphalt joint grouting machine, which is compact, lightweight and highly maneuverable. It is possible to repair cracks over a wider area by using a large melting kettle together with the asphalt joint grouting machine, but the grouting machine is optimal for repairing the initial stage of deterioration interspersed throughout pavement (linear cracks) because it can melt small amounts of sealant.  
<Inspection/Diagnostic Characteristics> Pavement crack grouting is performed using a highly maneuverable asphalt joint grouting machine that is compact (Length: 1,271 mm; Width: 650 mm: Height: 1,152 mm) and lightweight (Weight: 160 kg; Melting kettle capacity: 50 L); the equipment required for the work can be transported by a small truck. <Expected Outcomes> · Repairing linear cracks prevents the development of map cracking and reduces road life cycle costs. · A major advantage of pavement crack grouting is the ability to ensure the quality of the work during the injection of sealant because the asphalt joint grouting machine has a melting temperature control function and a sealant warming function.

3-7 Heat Stick Method

Technology: Heat Stick Method
NETIS Registration Number: HK-110003-A
Category: Pavement (roads)
<Overview> Under the heat stick method, a road heater is used to heat, scrape and loosen existing pavement without damaging it (see photograph), and the new asphalt mixture is poured immediately thereafter, which improves the bond between the new and existing asphalt mixtures. Then, a thin layer (2-3 cm) of overlay is spread without applying a tack coat. 
<Inspection/Diagnostic Characteristics> Conventionally, minor cracking (crack rate around 20% or less) and rutting (around 30 mm or less) of asphalt-paved roads was repaired by spraying asphalt emulsion onto the road surface and then applying the new layer of asphalt, but now the method of heating, scraping and loosening the existing surface without cutting is used. <Expected Outcomes> · Heating, scraping and loosening the existing surface, laying and leveling a thin (t = around 2 cm) layer of new asphalt, and simultaneously compacting the new and old layers improves durability by increasing the strength of the bond between the two layers.

3-8 Concrete Pavement for the Soonest Possible Opening of Roads to Traffic

Technology: 1 Day Pave (Concrete Pavement for the Soonest Possible Opening of Roads to Traffic)

NETIS Registration Number: KT-130044-VE

Category: Pavement (roads)

<Overview>

A concrete pavement method that makes it possible to open roads to traffic within a one-day curing period through the use of a mixture with a lower water-cement ratio than conventional pavement concrete.

In the standard application (placement) environment, the required curing period is as short as 15 hours, and as long as 24 hours.

<Inspection/Diagnostic Characteristics>

· The water-cement ratio for pavement concrete has been decreased from roughly 42% to 35%.

· The consistency of pavement concrete has increased from slump of 2.5 cm or 6.5 cm to slump flow of 40 cm.

· The maximum dimensions of coarse aggregate have decreased from 40 mm to 20 mm.

<Expected Outcomes>

· The shortening of the 14-day curing period to a single day contributes to a shorter construction schedule.

· The shortening of the curing period reduces the expense of traffic signalers, thereby improving economic efficiency.

· The increased strength compared to conventional pavement concrete contributes to improved durability.

· The change to slump flow of 40 cm improves workability and makes fresh concrete easier to deal with, which facilitates the manual labor of laying and leveling, thereby improving work efficiency.

3-9 Cloud Logger

Technology: Cloud Logger

NETIS Registration Number: HK-100029-V

Categories: Appendages inside tunnels (roads), tunnels (roads), bridges (roads), pavement (roads)

<Overview>

Connecting various measuring instruments installed on construction sites and elsewhere in the field makes it possible to collect measurement data and use mobile communication networks to record and save the data on dedicated cloud servers, which makes the data available for confirmation online any time. If alarm trigger levels are set in advance, e-mail notifications can be sent to key people and alarm devices can be activated when measurement data is abnormal.

Example of combination with measuring instrument (water gauge)

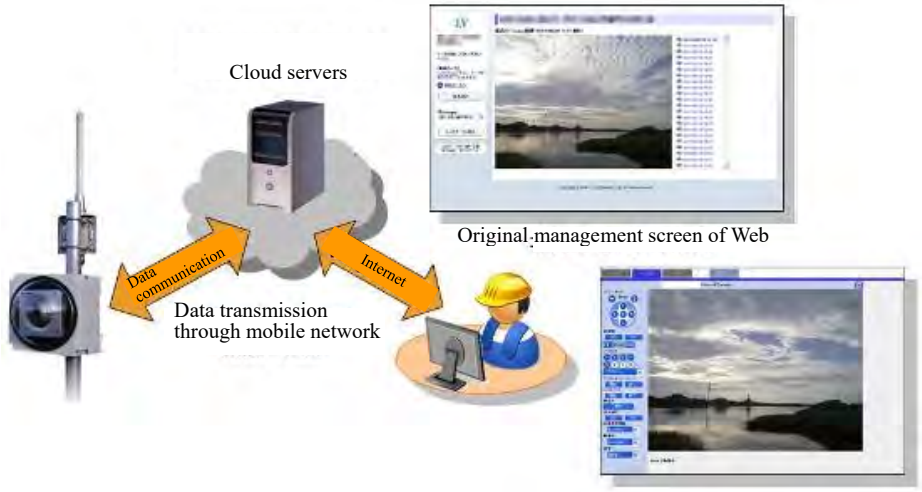
<Inspection/Diagnostic Characteristics>

The connection to strain gauges, extensometers, clinometers and other instruments that can measure minute changes and displacement in structures enables inspectors at remote locations to confirm measurement data from multiple locations any time from their connected terminals.

<Expected Outcomes>

The ability to automatically record structural displacement data at set intervals enables inspectors to quantitatively observe changes, displacement and other attributes of structures subject to inspection. In addition, the ability to monitor remotely can reduce the cost and time loss of sending inspectors into the field. Even when accidents such as collapse occur at structures subject to inspection, inspectors will not be involved in the accidents.

3-10 Mobile Live Camera

Technology: GEOSCOPE (Mobile Live Camera)
NETIS Registration Number: HK-110026-VE
Categories: Appendages inside tunnels (roads), tunnels (roads), bridges (roads), pavement (roads)
<Overview> On-site conditions can be monitored remotely using live videos streamed over mobile communication networks (mobile phone communication networks). It is also possible to record and save photographs taken at set intervals on dedicated cloud servers. Computers, smartphones, mobile phones and other terminals can be used to confirm on-site conditions any time. 
<Inspection/Diagnostic Characteristics> A remote monitoring camera system that can be used for inspections of all types of structures provided that communication can be maintained and there is space for the installation of cameras. Photographs are automatically saved to dedicated cloud servers so that inspectors can compare structural deterioration and other attributes to past images in the course of their assessments.
<Expected Outcomes> Once cameras are installed, inspectors can use a single connected terminal to visually inspect conditions at multiple sites without visiting them, which can reduce the cost and time loss of sending inspectors to structures subject to inspection. In addition, because the visual inspections are conducted remotely, inspectors will not be involved in the accidents even when structures collapse or other accidents occur.

3-11 Eco-Mobile Fixed-Point Camera Information Service

Technology: MIRUMOTT (Eco-Mobile Fixed-Point Camera Information Service)
NETIS Registration Number: HK-090002-VE
Categories: Appendages inside tunnels (roads), tunnels (roads), bridges (roads), pavement (roads)
<Overview> Mirumott is a camera that uses mobile communication networks and solar panels to enable inspectors to remotely monitor on-site conditions and operate connected instruments. Installation is simple because Mirumott requires no wiring work for a power source or communication, and computers, smartphones, mobile phones and other terminals can be used to confirm on-site conditions at any time. 
<Inspection/Diagnostic Characteristics> A remote monitoring camera system that can be used for inspections of all types of structures provided that communication can be maintained and there is space for the installation of cameras. Photographs are automatically saved to dedicated cloud servers so that inspectors can compare structural deterioration and other attributes to past images in the course of their assessments. <Expected Outcomes> Once cameras are installed, inspectors can use a single connected terminal to visually inspect conditions at multiple sites without visiting them, which can reduce the cost and time loss of sending inspectors to structures subject to inspection. In addition, because the visual inspections are conducted remotely, inspectors will not be involved in the accidents even when structures collapse or other accidents occur.

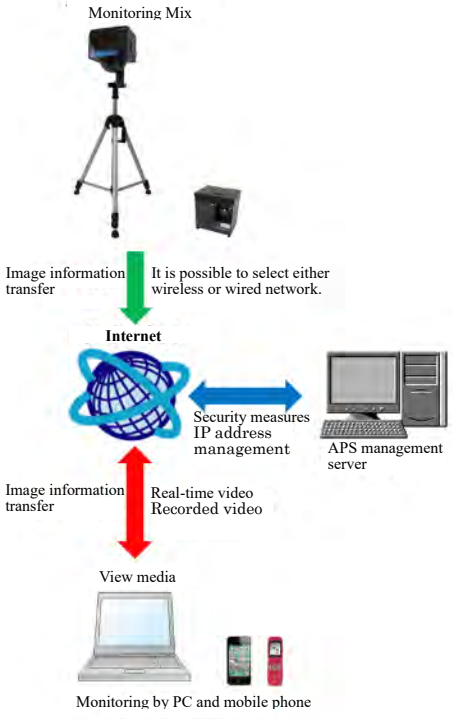
3-12 Mobile Network Camera

Technology: Monitoring Mix (Mobile Network Camera)
NETIS Registration Number: QS-110023-V
Categories: Appendages inside tunnels (roads), tunnels (roads), bridges (roads), pavement (roads)

<Overview>

The Monitoring Mix is a mobile network camera.

The removal of the need for wiring work facilitates online video and image viewing and camera operation. The Monitoring Mix is helpful technology not only for managing construction sites but also for preventing crime, monitoring disaster damage and illegal dumping, outdoor events and tourism publicity.



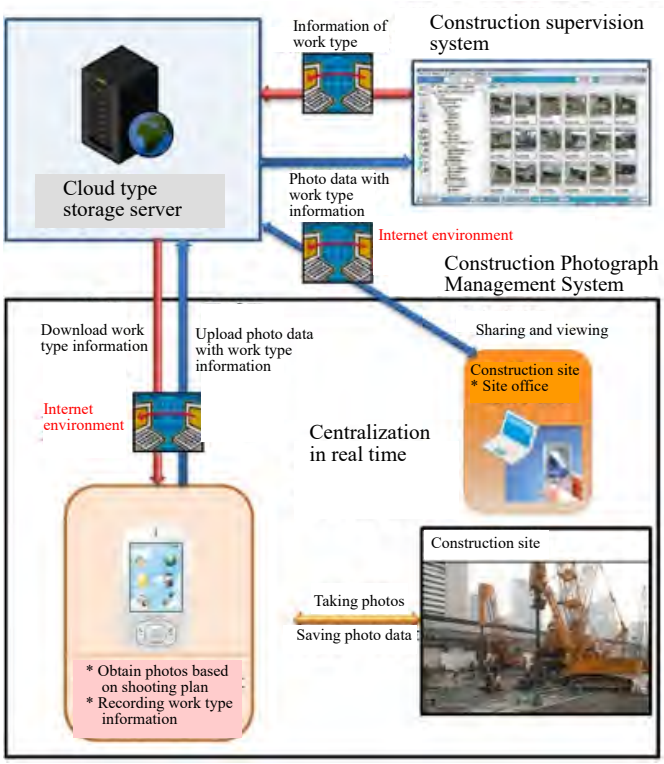
<Inspection/Diagnostic Characteristics>

The pan/tilt function (horizontal rotation 360°, vertical rotation 128°) and 42X zoom make it possible to check any part of sites.

<Expected Outcomes>

Unlike conventional network cameras, the Monitoring Mix requires no construction work to set up, which can shorten construction schedules. The Monitoring Mix makes it possible to prevent and record theft and other problems on construction sites. The ability to remotely operate cameras and view live videos of sites saves the trouble of traveling to sites.

3-13 Construction Photograph Management System

Technology: Construction Photograph Management System
NETIS Registration Number: KK-130023-A
Categories: Appendages inside tunnels (roads), tunnels (roads), bridges (roads), pavement (roads)
<Overview> This system provides a cloud storage service for inspection and construction photograph data taken by smartphone and other devices to enable central management and sharing in real time. 
<Inspection/Diagnostic Characteristics> This system automatically filters photographs by the name of the construction process specified when the photographs were saved, which makes it possible to effectively sort photographs during emergencies. Photographs are stored to the cloud immediately after being taken, which enables central management and sharing in real time via smartphone and other devices. In addition, this eliminates the need to reacquire data if it is corrupted or lost. <Expected Outcomes> Photograph data is saved to cloud storage directly from smartphones, which makes it possible to instantaneously share inspection and construction information in both emergencies and ordinary situations. This facilitates the full understanding of emergency situations and makes it possible to effectively prepare for and implement actions in subsequent stages.

3-14 Quick-hardening Repair Material for Repairing Concrete Deterioration and Cracks

Technology: MK CRETE 45

NETIS Registration Number: KT-160116-A

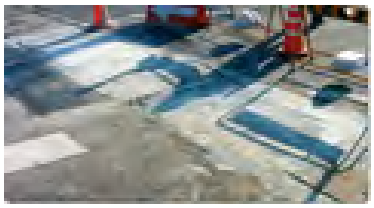
Categories: Pavement (roads), bridges (roads)

<Overview>

A quick-hardening repair material for repairing concrete deterioration and cracks:

・A concrete repair material used to repair deteriorated concrete, concrete cracks, bridge concrete and other concrete conventionally repaired by pouring repair mortar.



<Inspection/Diagnostic Characteristics>

・Quick-hardening, high-strength concrete repair material that includes silica sand in the aggregate. Since it is a premixed polymer cement mortar, simply add water and mix to use. Safe and highly workable, the work can be performed by anybody. In addition, there is no need for primers, sealers or other undercoat materials. There are no flames, foul odors or the like because no solvents are used, which provides a quality working environment.

<Expected Outcomes>

・The addition of silica sand to the aggregate makes it harden quickly and gives it an affinity with poured concrete, which can contribute to shortened construction schedules due to the prompt opening of roads to traffic, the elimination of construction work, and improved economic efficiency.

3-15 Using Box Culverts to Reinforce Small and Medium-Sized Bridges

Technology: Using Box Culverts to Reinforce Small and Medium-Sized Bridges

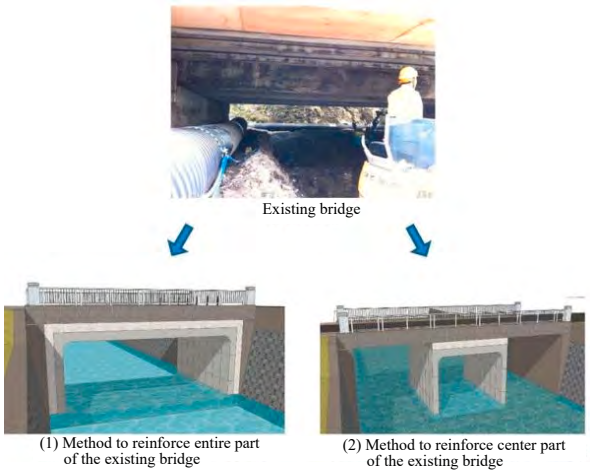
NETIS Registration Number: KT-160067-A

Category: Bridges (roads)

<Overview>

A reinforcement method that strives to extend the service lives of aging small and medium-sized bridges by inserting precast PC box culverts beneath their girders and integrating them into their structures:

・A reinforcement method in which precast PC box culverts are integrated into the structures of aging small and medium-sized bridges (length of around 15 m) that would normally be replaced with new bridges.



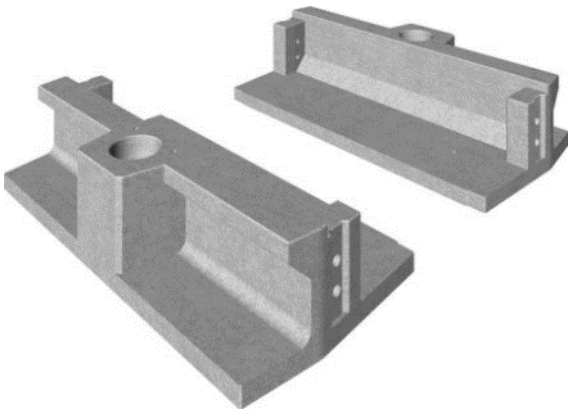
<Inspection/Diagnostic Characteristics>

・Precast PC box girders are installed beneath the girders of aging small and medium-sized bridges and integrated into the existing bridge structures to repair the bridges rather than replacing them with new bridges.

<Expected Outcomes>

・The use of existing roads on existing bridges for traffic removes the need to build detour roads and remove existing bridges as required in conventional methods, which reduces costs
・The removal of the need to build detour roads and remove existing bridges streamlines work processes
・Striving to prolong the service lives of aging small and medium-sized bridges by integrating precast PC box culverts into their structures improves the durability of the bridges after the work is complete, thereby ensuring the same quality as conventional technology
・The removal of the need to detour traffic to temporary roads and remove existing bridges reduces the danger associated with accidents and demolition
・The streamlining of the number of work processes and the use of precast PC box culverts improves workability
・The removal of the need to build temporary roads (detours) minimizes the space required for work

3-16 Precast, Flexible Safety Barrier Foundation Blocks

Technology: SS BASE
NETIS Registration Number: SK-160015-A
Category: Road appendages (roads)
<Overview> Precast, flexible safety barrier foundation blocks: ・Precast foundation blocks for installation as flexible safety barriers (guardrails, guard pipes) atop retaining wall structures, reinforced earth retaining walls and the like for motor vehicle safety.    
<Inspection/Diagnostic Characteristics> Precast products are used for vehicle safety barrier foundation work rather than the conventional cast-in-place concrete. <Expected Outcomes> The use of precast products reduces concrete work (form assembly, pouring, curing, form removal) and other work, and shop production facilitates quality assurance, which contributes to improved quality and reduction of work processes.

4. New Technologies for the Bridge Maintenance

4-1 Panel-Type System Suspended Scaffolding

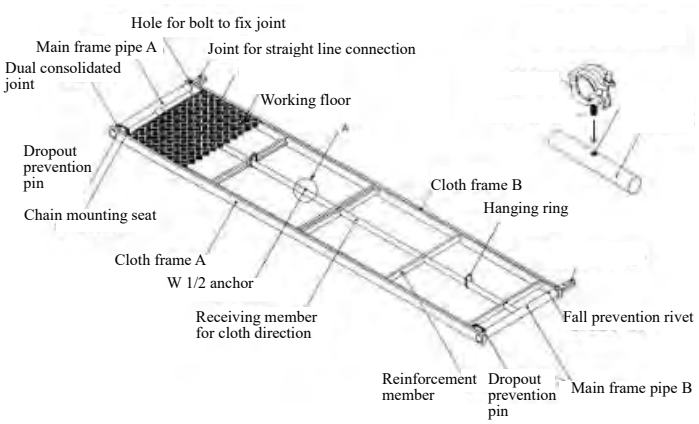
Technology: Safety SK Panel (Panel-Type System Suspended Scaffolding)

NETIS Registration Number: KT-100070-VE

Category: Bridges (roads)

<Overview>

The Safety SK Panel comprises a panel-type unit that provides the scaffolding and protection work beneath bridge girders conventionally provided by suspended pipe scaffolding. This technology enables the application of construction methods that conventionally require support from vehicles with elevating work platforms and lifting by machines, but are impossible to apply at girders above rivers and oceans and high above the ground.



<Inspection/Diagnostic Characteristics>

An integrated panel unit that comprises pipes, clamps, scaffolding panels, wires and the like.

<Expected Outcomes>

· The repetition of simple tasks enables highly efficient installation and removal, which improves economic efficiency.

· Reduced installation and removal processes and shortened traffic control periods on existing roads helps limit negative effects to surrounding environments.

· Delivery can occur from panels, which greatly reduces the risk of falls and collisions, thereby improving safety.

· The structure doubles as the main scaffolding and panel protection, and provides a seamless structure, which ensures the flatness of the entire working surface, thereby improving the working environment.

4-2 Crack Repair Set

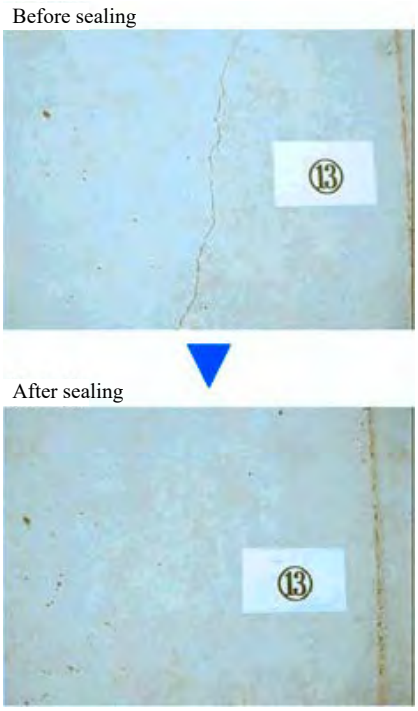
Technology: CS-21 Crack Repair Set

NETIS Registration Number: CG-110003-VE

Categories: Road appendages (roads), bridges (roads)

<Overview>

The CS-21 Crack Repair Set smooths cracks that occur in hardened concrete to make frames uniform and prevent the infiltration of factors of deterioration. CS-21 Clear (a concrete improving agent) is applied and allowed to seep into the concrete, which promotes the densification of fine cracks and has the effect of sealing them, and CS Putty (a dry-hardening putty) is applied to fill in the cracks.



<Inspection/Diagnostic Characteristics>

·The conventional technique of surface coating involves applying a coating over the width of cracks (less than 0.2 mm) and over cracks included in a set area for cosmetic appeal. This concrete protection technique requires a lot of time; intervals are required between the concrete surface preparation process, the application of primer, the treatment of unevenness, and the application of second and final coats. With the CS-21 Crack Repair Set, CS-21 Clear is applied and allowed to seep into the finest cracks, and CS Putty is applied to fill in the cracks; only the cracks are repaired, and repairs can be completed more quickly than in the conventional technique.

<Expected Outcomes>

· The removal of the need to work on healthy parts and the streamlining of repair processes can substantially reduce the time required for work and cut costs. In addition, the filling in of cracks prevents the infiltration of factors of concrete deterioration and improves the durability of concrete structures.

· Scenery can be maintained because the color can be made to match the color of the concrete on-site, repairs can be focused on more detailed parts rather than the overall structure, and evidence of repairs is subtle.

4-3 Repair/Reinforcement Technology that Involves Adhesion of Carbon Fiber Sheets

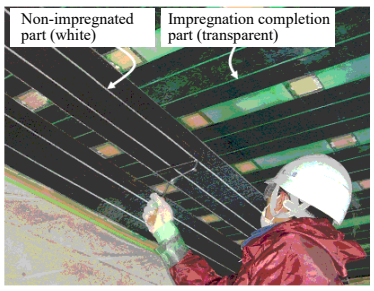
Technology: Toreyka Cloth G Method

NETIS Registration Number: KT-090053-VE

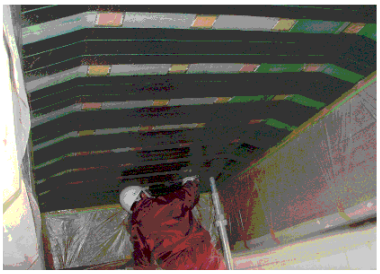
Categories: Road appendages (roads), bridges (roads), tunnels (roads)

<Overview>

Repair/reinforcement technology that involves the adhesion of carbon fiber sheets to concrete structures conventionally repaired using the steel plate adhesion method.



Situation of resin-impregnated



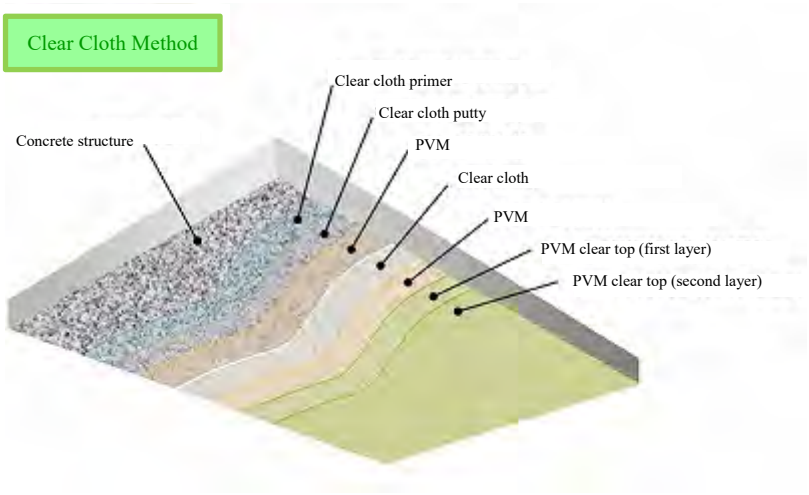
<Inspection/Diagnostic Characteristics>

- In contrast to the conventional steel plate adhesion method, this method uses lightweight carbon fiber sheets.
- This method uses carbon fiber sheets, which are more corrosion-resistant then steel plates.
- Resin impregnation check lines are weaved into the sheets to clearly show the impregnation of resin.

<Expected Outcomes>

- Heavy machinery is unnecessary, which facilitates work atop scaffolding and in narrow places, thereby substantially improving workability. In addition, there is no need to consider increasing dead loads during reinforcement designs, which avoids the vicious circle of further increasing reinforcement weight due to increasing dead loads.
- The use of highly corrosion-resistant carbon fiber sheets contributes to the reduction of the running costs of maintenance.
- Conventionally, individual workers judge the degree of resin impregnation; this technology enables objective judgments, which contributes to the assurance of consistent work quality and the reduction of more working hours than are necessary.

4-4 Bridge Repair Method that Prevents Peeling of Concrete Fragments

Technology: Clear Cloth Method
NETIS Registration Number: KT-110052-VR
Categories: Road appendages (roads), bridges (roads), tunnels (roads)
<Overview> A bridge repair (peeling prevention in piers, PC/RC girders, deck plates, parapets, etc.) method that prevents the peeling of concrete fragments and improves the visibility of concrete surfaces through the application of a special vinylon cloth that turns clear upon material impregnation, compared to the conventional method by which surfaces are chipped and repaired with mortar. 
<Inspection/Diagnostic Characteristics> This method ensures the visibility of concrete surfaces after treatment, which enables the visual confirmation of concrete surface deformations (peeling, cracks), thereby facilitating inspections and other maintenance. <Expected Outcomes> ・The use of a special vinylon sheet that turns clear upon material impregnation removes the need for chipping, which reduces industrial waste and eliminates noise, thereby improving economic efficiency and limiting negative effects to surrounding environments. ・This method ensures the visibility of concrete surfaces after treatment, which enables the visual confirmation of concrete surface deformations (peeling, cracks), thereby improving workability. ・The ability to use materials with short curing periods enables the earliest possible (as little as two hours) application of the final coat as the second layer, which can reduce work processes.

4-5 Bridge Deck Slab Underside Thickness Increasing Method

Technology: Super Hozen Method

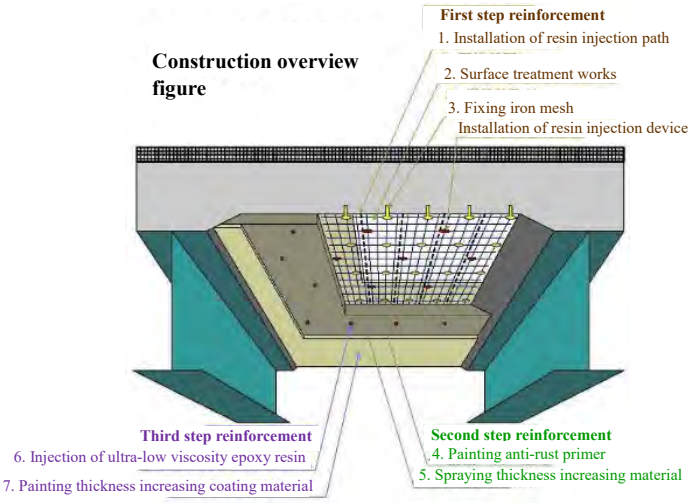
NETIS Registration Number: CG-110038-A

Category: Bridges (roads)

<Overview>

A bridge deck slab underside thickness increasing method coupled with epoxy resin injection:

・A technology in which reinforced concrete deck slabs of road bridges where cracking has occurred due to deteriorated (insufficient) durability and load-bearing capacity due to aging and other factors are simultaneously repaired with epoxy resin injections and underside thickness increasing reinforcement.



<Inspection/Diagnostic Characteristics>

・The establishment of epoxy introduction paths and the injection of ultra-low-viscosity epoxy resin repairs gaps and fine cracks and achieves complete integration with existing deck slabs

・Rust control primer that includes lithium nitrite, which serves as a primer and to control rust, is used

・Improved Hozen material (polymer cement mortar) application using a sprayer or roller rather than a trowel

<Expected Outcomes>

・Reducing the weight of materials and improving workability enables reduced construction costs and processes

・The injection of ultra-low-viscosity epoxy resin to fill in gaps and fine cracks can deliver the benefits of complete integration and reinforcement without defects

・The use of a primer with rust control properties can improve corrosion resistance

・Improved Hozen material (polymer cement mortar) application using a sprayer or roller rather than a trowel can improve the consistency of workability and quality

4-6 Chipping Hammer Support Device

Technology: Chipping Pole
NETIS Registration Number: QS-170004-A
Categories: Road appendages (roads), bridges (roads)
<Overview> A chipping hammer support device for concrete structure chipping work: ・A device for supporting chipping tools when facing upward to chip concrete, which requires workers to hold the tools in their hands while pushing upward       
<Inspection/Diagnostic Characteristics> ・Chipping tools are supported with a pole rather than workers' hands. ・The inner structure is equipped with a spring mechanism. ・The pole is equipped with a height adjustment function.
<Expected Outcomes> ・Supporting chipping tools with a pole with a spring mechanism reduces the physical strength required to hold the tools and push them upward, which increases the volume of work per unit of time, thereby improving economic efficiency and workability. ・Supporting chipping tools with a pole with a spring mechanism reduces the physical strength required to hold the tools and push them upward, which reduces the physical load on workers, thereby improving working environments and safety. ・The height adjustment function makes it possible to accommodate a variety of chipping heights.

4-7 Concrete Surface Protection Material

Technology: Permeate HS-300 (Concrete Surface Protection Material)

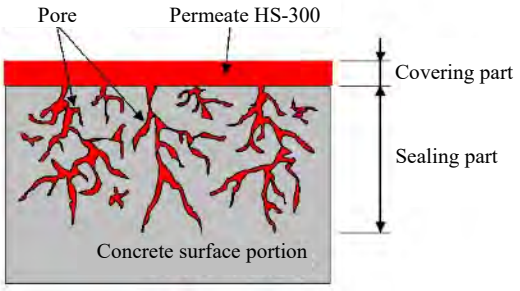
NETIS Registration Number: CB-090033-V

Categories: Road appendages (roads), bridges (roads)

<Overview>

A solventless, inorganic impregnation/covering material with permeation/sealing functions, used to improve concrete durability

・When applied to concrete surfaces, Permeate HS-300 replaces air as it seeps into micropores, and reacts with moisture in the atmosphere to form an inorganic polymer that prevents ultraviolet deterioration. A single layer of Permeate HS-300 can limit deterioration due to salt damage, frost damage, neutralization, alkali-aggregate reaction and other factors, and makes it possible to improve the durability of concrete structures.



<Inspection/Diagnostic Characteristics>

・Eliminated the use of organic solvents.
・Made the base color clear.
・Optimized viscosity and hardening time to enable simultaneous surface covering and sealing treatment.
・Eliminated the use of primers.
・Used an inorganic polymer as the base to prevent ultraviolet deterioration.
・When applying multiple coats, there is a two-hour coating interval (23°C, 50% RH).

<Expected Outcomes>

・It is possible to limit the generation of volatile organic compounds (VOCs).
・It is possible to confirm the condition of concrete after work is complete.
・The coating bonds with the concrete as if setting down roots, and bubbling and peeling do not occur.
・Permeate HS-300 can deliver long-lasting durability and weather resistance.
・Permeate HS-300 can shorten work schedules, and can also contribute to improving economic efficiency.
・The ability to apply multiple coats in two-hour intervals means that work can be completed in a single day. (Construction schedule: Shortened 50%)
・It is possible to limit concrete surface roughness.

4-8 Core Drill with Rebar Sensor

Technology: Core Drill with Rebar Sensor

NETIS Registration Number: CG-080007-V

Categories: Road appendages (roads), bridges (roads)

<Overview>

A device for boring without cutting the rebar in reinforced concrete:

・Technology for reinforced concrete boring that automatically stops core drills when the tips of their blades touch rebar, whereas conventionally, drill operators must manually feel and determine when rebar is touched and stop their drills.

<Inspection/Diagnostic Characteristics>

・Core drills boring into reinforced concrete are automatically stopped when the tips of their blades touch rebar.

・Applicable locations: Reinforced concrete structures (Rebar diameter: 9 mm or higher), boreholes (Diameter: 25-77 mm), locations with no pipes or other embedded objects other than rebar

<Expected Outcomes>

・It is possible to avoid cutting rebar.

4-9 Vacuum Suction Adjustable Pressure Injection Method

Technology: Vacuum Suction Adjustable Pressure Injection Method

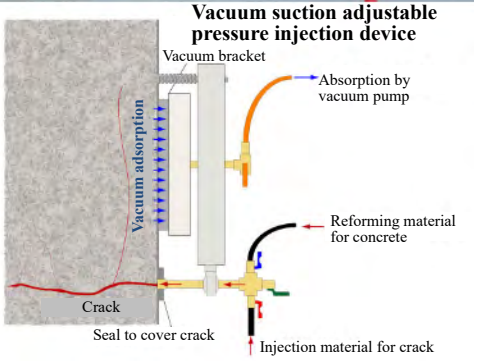
NETIS Registration Number: TH-110002–A

Categories: Road appendages (roads), tunnels (roads), bridges (roads)

<Overview>

A crack repair method in which an injector with a vacuum suction function is used to inject concrete repair material from the position of the crack surface. Defining characteristics include the ease of attachment and removal to concrete structures, the ability to adjust injection pressure from low to high, compatibility with repair materials (inorganic and organic), and the ability to inject multiple repair materials in succession.

Vacuum suction adjustable pressure injection device



<Inspection/Diagnostic Characteristics>

In addition to inspections of outward appearances of cracks, non-destructive inspection instruments (ultrasonic measuring instruments, diagnostic infrared cameras, etc.) are used to investigate the depth of cracks and the state of peeling. After cracks are repaired via injection, non-destructive inspection instruments are used to verify how well the cracks were sealed.

<Expected Outcomes>

It is possible to inject multiple repair materials in a single injection to achieve quality repair effects by injecting repair materials to seal cracks while also injecting concrete improving agents to improve the health of the concrete.

4-10 Nozzle Adjustable Pressure Injection Method

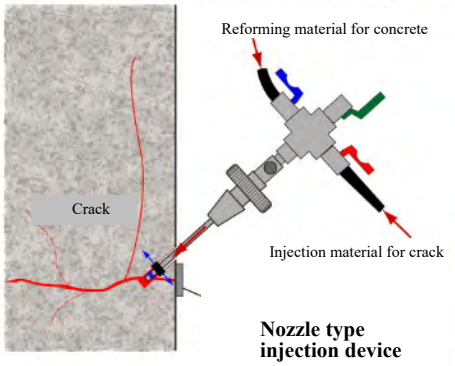
Technology: Nozzle Adjustable Pressure Injection Method

NETIS Registration Number: TH-110003-A

Categories: Road appendages (roads), tunnels (roads), bridges (roads), pavement (roads)

<Overview>

A crack repair method in which a nozzle injector is inserted into an injection hole perforated into a concrete frame surface, secured in place, and made to inject concrete repair material from its position inside the frame. Defining characteristics of this technology for repairing cracks and spalling and for stopping leaks include the ease of injector attachment and removal, the ability to adjust injection pressure, and compatibility with repair materials.



Nozzle type injection device

<Inspection/Diagnostic Characteristics>

In addition to inspections of outward appearances of cracks, non-destructive inspection instruments (ultrasonic measuring instruments, diagnostic infrared cameras, etc.) are used to investigate the depth of cracks and the state of peeling. After cracks are repaired via injection, non-destructive inspection instruments are used to verify how well the cracks were sealed.

<Expected Outcomes>

It is possible to inject multiple repair materials in a single injection. This makes it possible to achieve quality repair effects by injecting repair materials to seal cracks while also injecting concrete improving agents to improve the health of the concrete.

4-11 Seismic Reinforcement of Existing RC Bridge Piers

Technology: SRS Method

NETIS Registration Number: QS-070007-V

Category: Bridges (roads)

<Overview>

A construction method in which a special polymer cement mortar is sprayed for the seismic reinforcement of existing RC bridge piers:

The common seismic reinforcement method of RC lining for existing RC bridge piers requires a lining thickness of at least 250 mm, and there are cases where applying the method is difficult due to problems resulting from minimum clearance outlines, river cross-section blockage ratio and other structural dimension restrictions, and the increase of loads on bridge foundations. The SRS Method involves installing rebar flush with existing bridge surfaces and spraying them with a special polymer cement mortar until they are covered to the requisite thickness (which is roughly 1/5 of the thickness of RC lining) in order to integrate and improve the seismic performance of the bridges.

<Inspection/Diagnostic Characteristics>

- Under the RC lining method, there are cases where bridge foundations must be reinforced due to the increase of dead loads because of the increase of cross-sections; the SRS Method makes it possible to reduce loads on bridge foundations.
- When compared with the conventional trowel application, spraying rather than lining substantially improves the speed of the work.

<Expected Outcomes>

The application of a thin layer of mortar as the lining makes it possible to apply this method to problematic bridges in terms of minimum clearance outlines, river cross-section blockage ratios and foundation loads.

In addition, the action of spraying on a mortar lining can deliver the following benefits:

- The range of work that can be performed in a single batch is large; work can be performed consistently, quickly and over wide areas.
- The work can be performed quickly, which shortens the construction schedule and is highly economically efficient.
- Excellent filling performance of the special polymer cement mortar on the rear surfaces of the rebar.
- The spray pressure is high, which improves the effects of compaction and delivers excellent adhesiveness with base materials.

4-12 Concrete Structure Repair/Reinforcement Method

Technology: FORCA Strand Sheet Method

NETIS Registration Number: QS-080011-V

Category: Bridges (roads)

<Overview>

A concrete structure repair/reinforcement method using specially fabricated continuous fiber sheets:

The FORCA Strand Sheet Method is a highly workable method of repairing/reinforcing concrete structures by using epoxy resin and other adhesives that harden in ambient temperatures to apply Strand Sheets (reinforcement fiber sheets that comprise carbon fibers and the like hardened into cylindrical shapes using epoxy resin, lined up in a row facing the same direction, and bound together in a bamboo screen shape) to target surfaces.

<Inspection/Diagnostic Characteristics>

- The materials for this method are lighter and thinner than the conventional reinforcement material (steel plates), and can be affixed by hand, which makes it possible to repair/reinforce easily and quickly.
- This method is easier to employ than the carbon fiber sheet adhesion method because the proprietary adhesive doubles as a primer and an unevenness treatment material, which eliminates the need for dry sheet resin impregnation.

<Expected Outcomes>

- Thin and lightweight
- Workability
- Durability
- Design method

4-13 Concrete Structure Cross-Section Restoration Material

Technology: GOMLATE Series (Concrete Structure Cross-Section Restoration Material)

NETIS Registration Number: QS-150017-A

Categories: Road appendages (roads), bridges (roads)

<Overview>

Premixed ultra-quick-hardening polymer cement mortar/concrete:

・A technology that uses ultra-quick-hardening polymer cement mortar or concrete to restore the cross-sections of deteriorated and damaged concrete structures in upper surface repair construction of road bridge deck concrete (emergency work), bridge joint concrete construction, general repair construction of concrete structures (cross-section restoration) and the like.

<Inspection/Diagnostic Characteristics>

・Ultra-quick-hardening polymer cement mortar and ultra-quick-hardening polymer cement concrete are used in place of the conventional ultra-quick-hardening concrete.

<Expected Outcomes>

・Material can be selected on-site in response to the extent of the damage.

・There is little drying shrinkage, which inhibits the formation of cracks.

・Excellent adhesive performance makes it possible to form robust, seamless bonds with existing deck plates.

・This technology can deliver durability against neutralization, salt damage and other factors of deterioration.

・Conventionally, it is best to chip concrete down to 5 cm beneath rebar, even when damage is minor; however, with this technology, it is possible to limit chipping to the damaged part only when using mortar, and to 2 cm beneath rebar when using concrete.

4-14 Method of Stripping Paint Using Water-based Paint Stripping Agent

Technology: Eco Paint Peeling (EPP) Method

NETIS Registration Number: KT-150081-A

Category: Bridges (roads)

<Overview>

A method of stripping paint using a water-based paint stripping agent

・A technology used in the repainting of steel structures such as bridges from which existing paint has been removed by the conventional blast method or power tools, in which a water-based paint stripping agent is used to cause existing deteriorated paint to flake so that it can be peeled off and removed.

<Inspection/Diagnostic Characteristics>

・A method of removing paint using the chemical reactions of a water-based stripping agent instead of mechanical paint removal methods.

<Expected Outcomes>

・Paint removal generates no dust, which eliminates worry over damage to the health of workers, thereby improving safety.

・Paint removal work is mainly done by hand, which reduces noise from the work, thereby limiting negative effects to surrounding environments.

・The paint has the consistency of clay when it is stripped, which makes it easy to collect. In addition, used stripping agent and peeled paint are the only industrial waste materials generated, which improves economic efficiency.

4-15 Buckling Restriction Braces

Technology: SUB (Buckling Restriction Braces)
NETIS Registration Number: TH-110015-A
Category: Bridges (roads)

<Overview>

SUB (buckling restriction braces) are installed as measures to improve the seismic performance of structures.

When major earthquakes (L2 or greater) strike, SUB core materials force members to capitulate, preemptively absorbing the seismic energy and maintaining the health of main structural members.

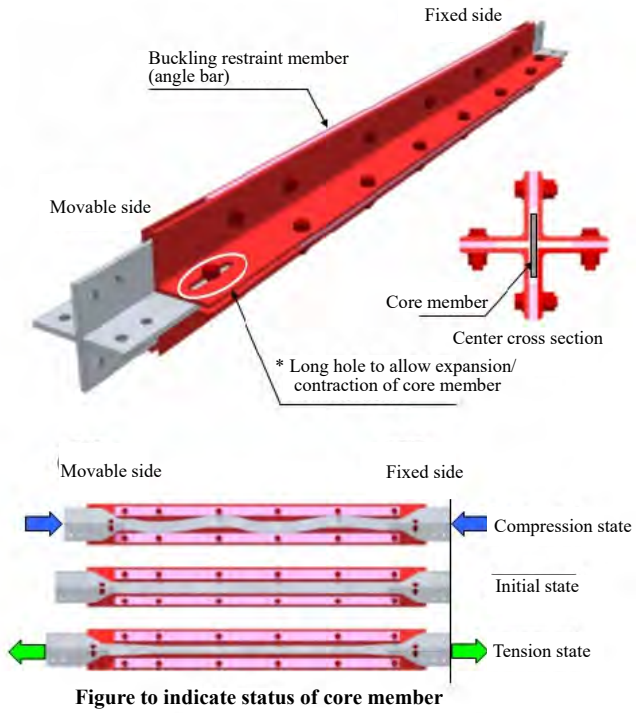


Figure to indicate status of core member

<Inspection/Diagnostic Characteristics>

The movable parts at the edges of SUB (buckling restriction braces) were designed to move within the range of expansion and contraction of core materials, and the ability to visually confirm the range of motion through long holes makes it possible to quickly determine whether seismic vibrations were within the envisioned range and whether to put the structures into service.

<Expected Outcomes>

- It is possible to reduce expenses and shorten construction schedules, which contributes to improved economic efficiency.
- It is possible to detect damage to inner surfaces that could be overlooked using conventional methods, which contributes to improved quality.
- The materials are compact and lightweight, which contributes to improved workability.
- The work generates no noise or dust, which helps limit negative effects to surrounding environments.

4-16 Bearing Support Corrosion Control Method

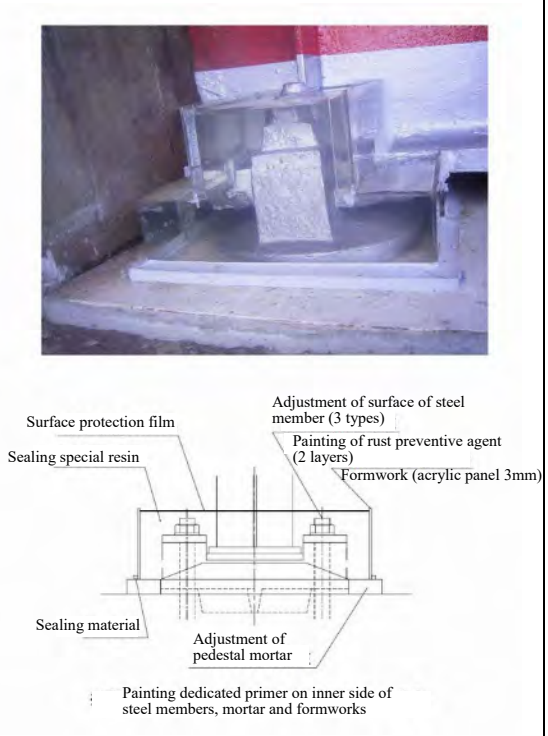
Technology: Bearing Support Corrosion Control Method (Transparent Shoes)

NETIS Registration Number: TH-120011-A

Category: Bridges (roads)

<Overview>

A long-term corrosion control method in which a special resin is used to seal steel bearing supports against factors of corrosion. Conventionally, steel bearing supports in tight places are supported with a heavy corrosion control coding (Rc-I coating system). The application of this technology contributes to improved working environments, and the special resin is transparent, which facilitates visual confirmation.



<Inspection/Diagnostic Characteristics>

- The infiltration of factors of corrosion is prevented through the complete covering of bearing supports, which can produce a uniform corrosion control effect in cities, rural areas, mountainous areas and other general environments as well as coastlines, areas where anti-freeze agents are spread and other saline environments.
- The use of highly weather-resistant, transparent formwork prevents the deterioration of the special resin, which ensures transparency over the long term.

<Expected Outcomes>

- The sealing of supports with special resin enables long-term corrosion control.
- The transparency of the special resin can be maintained over the long term, which facilitates visual confirmation during inspections and surveys.
- The application of this technology makes it possible to achieve Type 3 surface preparation; workability is improved even in cases where Type 1 blast cleaning is required.

4-17 Rust/Corrosion Control Technology

Technology: Cold Galvanizing Roval Method

NETIS Registration Number: KK-090014-VR

Category: Bridges (roads)

<Overview>

Rust/corrosion control technology for steel and hot dip galvanized steel:

- An alternative to hot galvanized HDZ-55 (galvanization adhesion of at least 550 g/m^2) that protects steel from corrosion for the same period as conventional technology.
- Work can be performed at ambient temperatures, which eliminates restrictions regarding steel dimensions, shapes, work locations and the like, thereby substantially increasing design/work freedom.
- A defining characteristic is the quality of workability provided by the ability to perform on-site rust control measures for existing steel and galvanized structures and appendages.

<Inspection/Diagnostic Characteristics>

- After surface preparation, work can be performed directly on steel and galvanized surfaces.
- This technology can provide the same rust/corrosion control capacity as hot galvanized HDZ-55 (galvanization adhesion of at least 550 g/m^2).
- The coating provides the same rust/corrosion protection effects as hot dip galvanizing.
- Maintenance cycles can be extended.
- Primers, recoating and other painting work is not required.

<Expected Outcomes>

- Work is possible at ambient temperatures, which makes this technology an alternative to hot dip galvanizing.
- The protection provided by this technology can last as long as galvanizing.
- This technology can contribute to the reduction of overall construction costs.
- Work can be performed with the general painting techniques using brushes and airless sprayers. (Work can be performed on-site)
- Recoating is done by simply applying the material over existing coats. (*Except areas with red rust)

Advantage: The need to carry members to the galvanizing tub is eliminated.

4-18 Strong Rust Control Cross-section Repair Method

Technology: N-SSI Method
NETIS Registration Number: KK-100009-V
Categories: Road appendages (roads), bridges (roads)
<Overview> A strong rust control cross-section repair method using saline matter adsorbent: ・This technology enables quality improvement in concrete rebar by turning corrosive environments into rust control environments. ・This concrete quality-improving cross-section restoration technology uses saline matter adsorbents to adsorb and solidify residual rust in rebar and harmful chloride ions in concrete, and release nitrate ions to create in concrete strong rust control environments that are stable and long-lasting.
<Inspection/Diagnostic Characteristics> ・This technology can adsorb chloride ions to a certain depth in concrete, which can reduce the depth of chipping. <Expected Outcomes> ・The ion-exchange function of the saline matter adsorbent adsorbs and neutralizes residual rust in rebar and chloride ions in concrete and releases nitrate ions, which delivers strong rust control effects. ・This technology delivers strong rust control effects even when the chloride ion content of concrete is higher than 2 kg/m^3, and past data shows that it can even turn corrosive environments with chloride ion content exceeding 10 kg/m^3 into rust control environments in time. ・When chloride ions infiltrate from outside structures, salt-blocking mortar traps them at the surface; the material doubles as a surface protection agent.