Tunnel Lining Inspecting System

نظام فحص تبطين النفق

Attention!!

No.1

Photographing tunnel lining surfaces at the maximum speed of 100 kilometers per hour

Photos can be taken at the speed of 5 to 100 kilometers per hour without obstructing the traffic.

Attention!!

No.2

Photographing without flushing

By adopting near infrared LED, this system does not emit light usually necessary for photographing and photos can be taken without being noticed by other drivers, which helps prevent inattentive driving.

Attention!!

No.3

High-resolution image of tunnel lining surface

Cracks on lining surface can be detected to 0.2mm width.

Attention!!

No.4

Detection and mapping of defects on the lining surface

Automatic crack detecting and editing function makes it possible to extract cracks from photos automatically.

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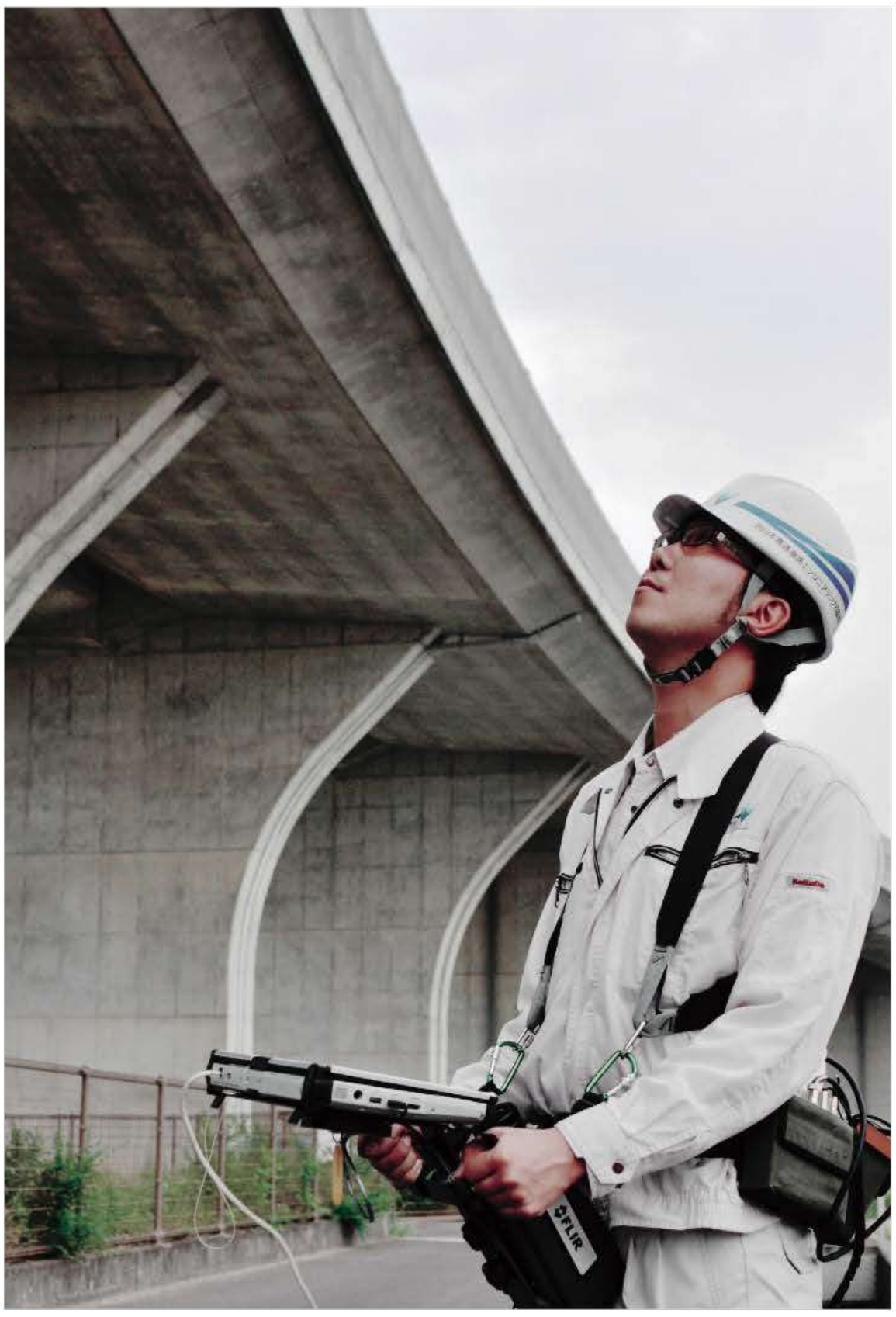
J-SYSTEM

Pinpoint potential delamination area in bridges by 3 steps (pre-inspection, inspection, post-inspection)

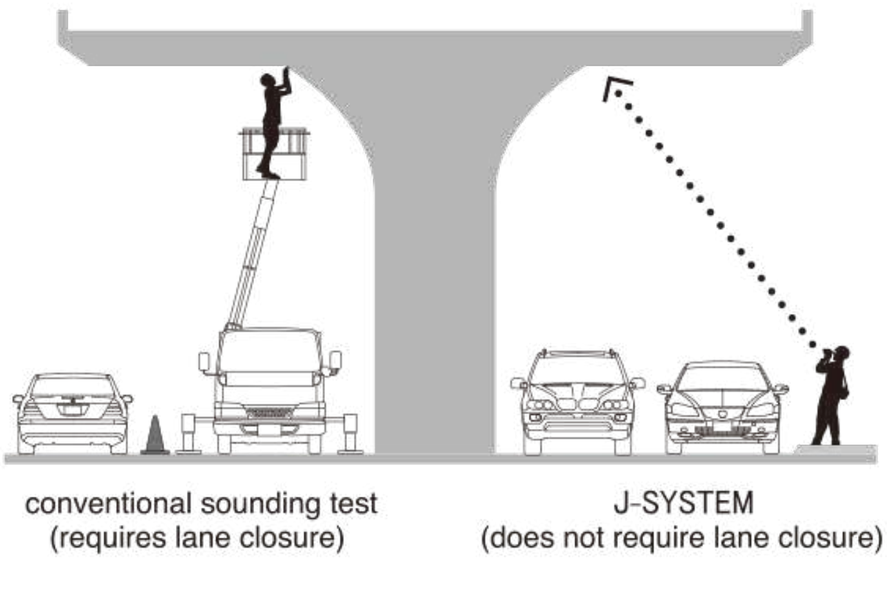


J-SYSTEM
Computer Aided Judgement of Infrared Thermography

- J-SYSTEM Specimen
- J-SYSTEM Monitor
- J-SYSTEM Software

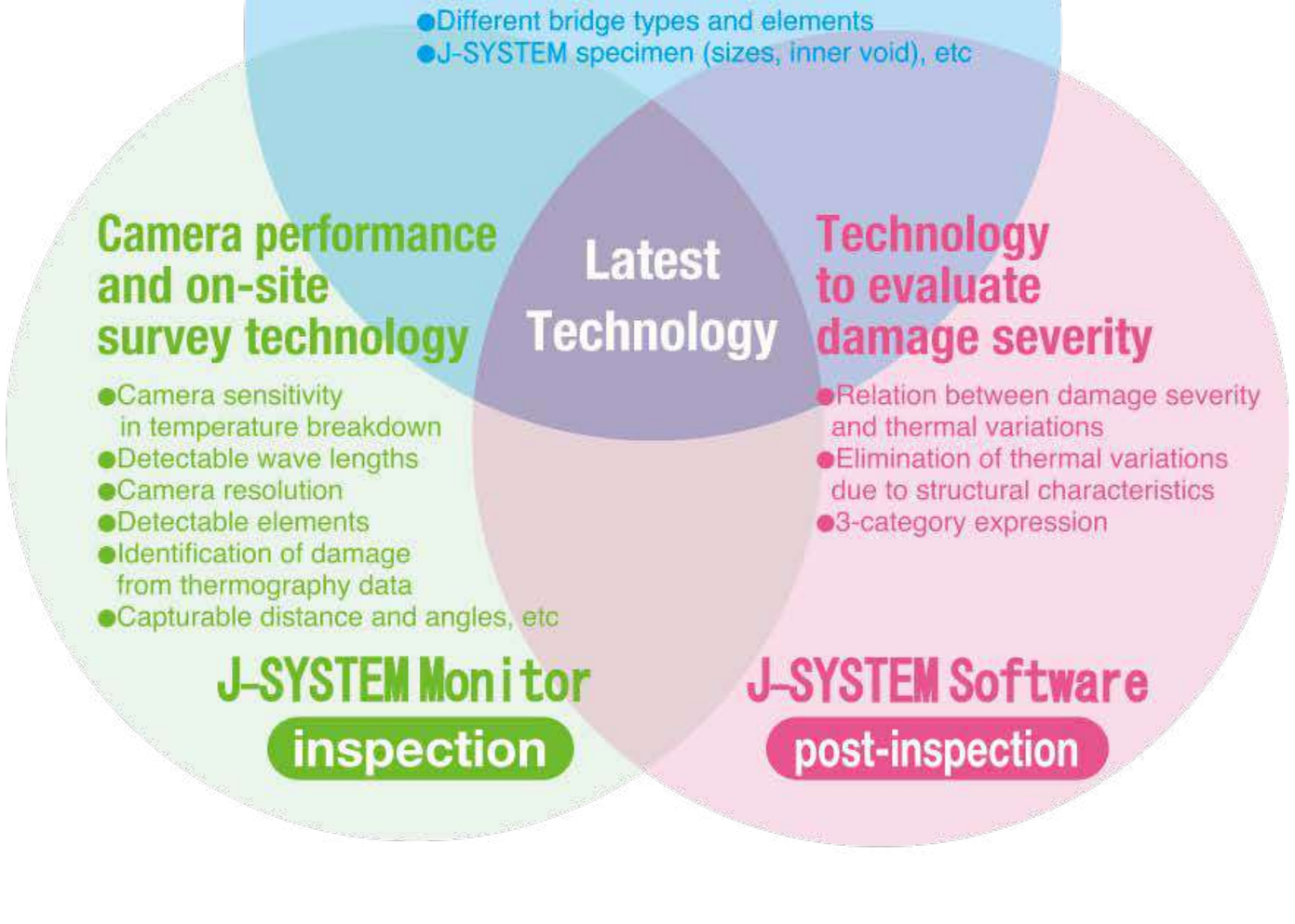
J-SYSTEM covers all phases of inspection (pre-inspection, inspection, and post-inspection) to identify potential concrete delamination efficiently and accurately.

J-SYSTEM can:
(1) collect thermal environment information for concrete structures and identify appropriate time period to perform inspection with J-SYSTEM Specimen.
(2) show damage severity on the monitor (J-SYSTEM Monitor).
(3) evaluate and indicate damage severity in three categories based on collected thermography data (J-SYSTEM Software).
With our J-SYSTEM, bridge inspectors can identify potential delamination accurately and implement post-inspection examination and recommend more economical and efficient repair plans



conventional sounding test (requires lane closure)

J-SYSTEM (does not require lane closure)



J-SYSTEM

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Smart-EAGLE

Road Surface Inspection

فحص أسطح الطرق

Proposal for road surface inspection using a compact car equipped with simple system device.

Smart-EAGLE

Road Surface Inspection

- Road surface conditions can be easily inspected by mounting the simple measurement device on a customer's compact car.
- Road surface conditions such as road profile, cracks, rutting and evenness can be automatically analyzed with high-accuracy 3-D road profile measurements using light section method.
- Network level management can be conducted based on daily monitoring of road surface conditions by applying these systems to road patrol cars.

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Road Surface Management using the IRI and the Road Management Images
[Visual Road Management]

إدارة أسطح الطرق باستخدام تقنية IRI وصور إدارة الطرق
[إدارة الطرق البصرية]

IRI Profiler

STAMPER Type

Installation / Attachment Example

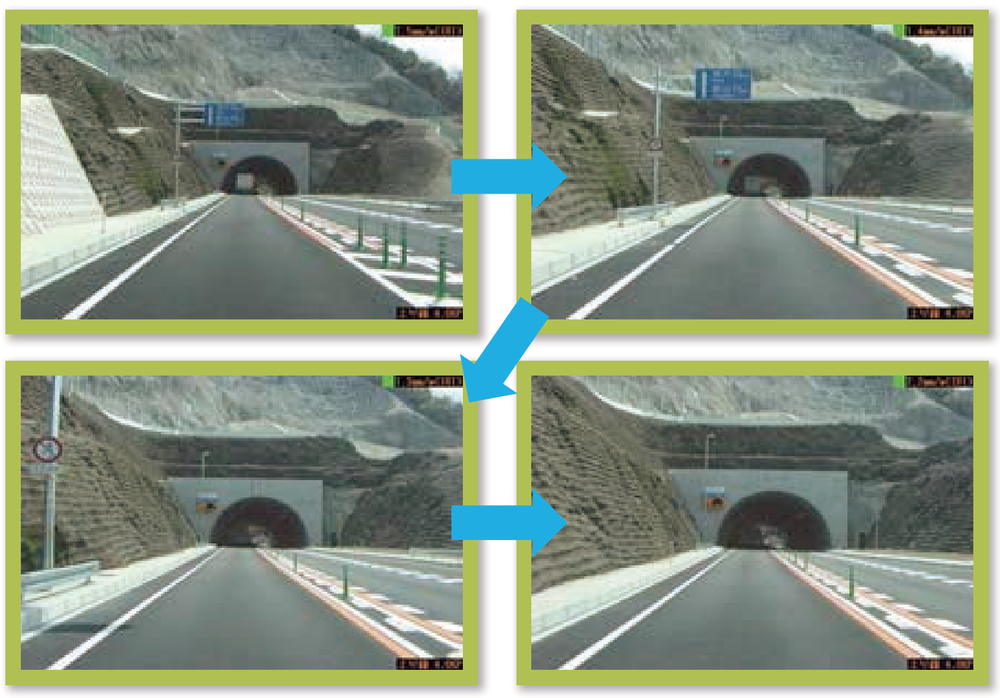
IRI Profiler	STAMPER Type
Method of Measurement	Vibration Type
Measurement Speed	20-120km/hr
Measurement Vehicle	Can be attached to a standard sized car.
Applicable Road Surface	Road surface on which a car can be driven on.

Road Management Images
(Consecutive Still Photographs)

Images for managing the pavements, joints, and incidental facilities.

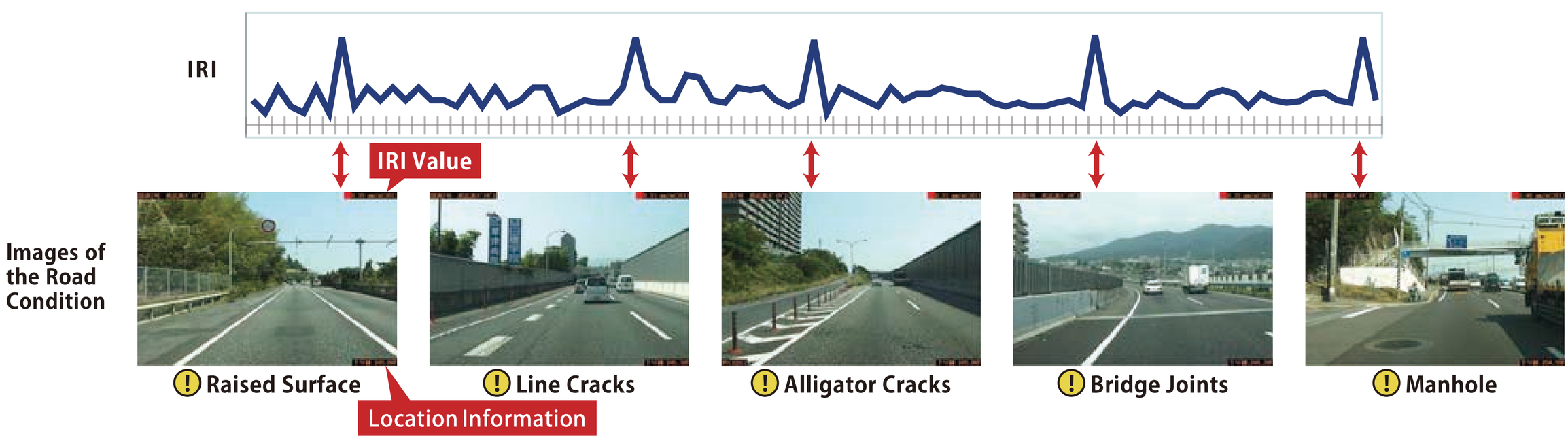
Characteristics

- Photos taken at 10m intervals.
- Indicates the km, TN, bridge names, etc.
- Records the latitude and longitude.
- Portable using image archives.



The optimum system for road management. The ride quality can be visualized using the Road Management Images.

What the Road Management Images will show:



Future road management using the ride quality images.

The road is constantly monitored by the users. For optimum road management, up-to-date road data is crucial.
This system allows such needs to be met in real-time.

Application of the System

- Make appropriate road repair plans by identifying the cause of the road damage.
- Improved budget management by simulating the management standards.
- Utilization of the data for asset management.
- Soundness evaluation of the road accessories.

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Safety and peace of mind

Moving-vehicle weighing instrument

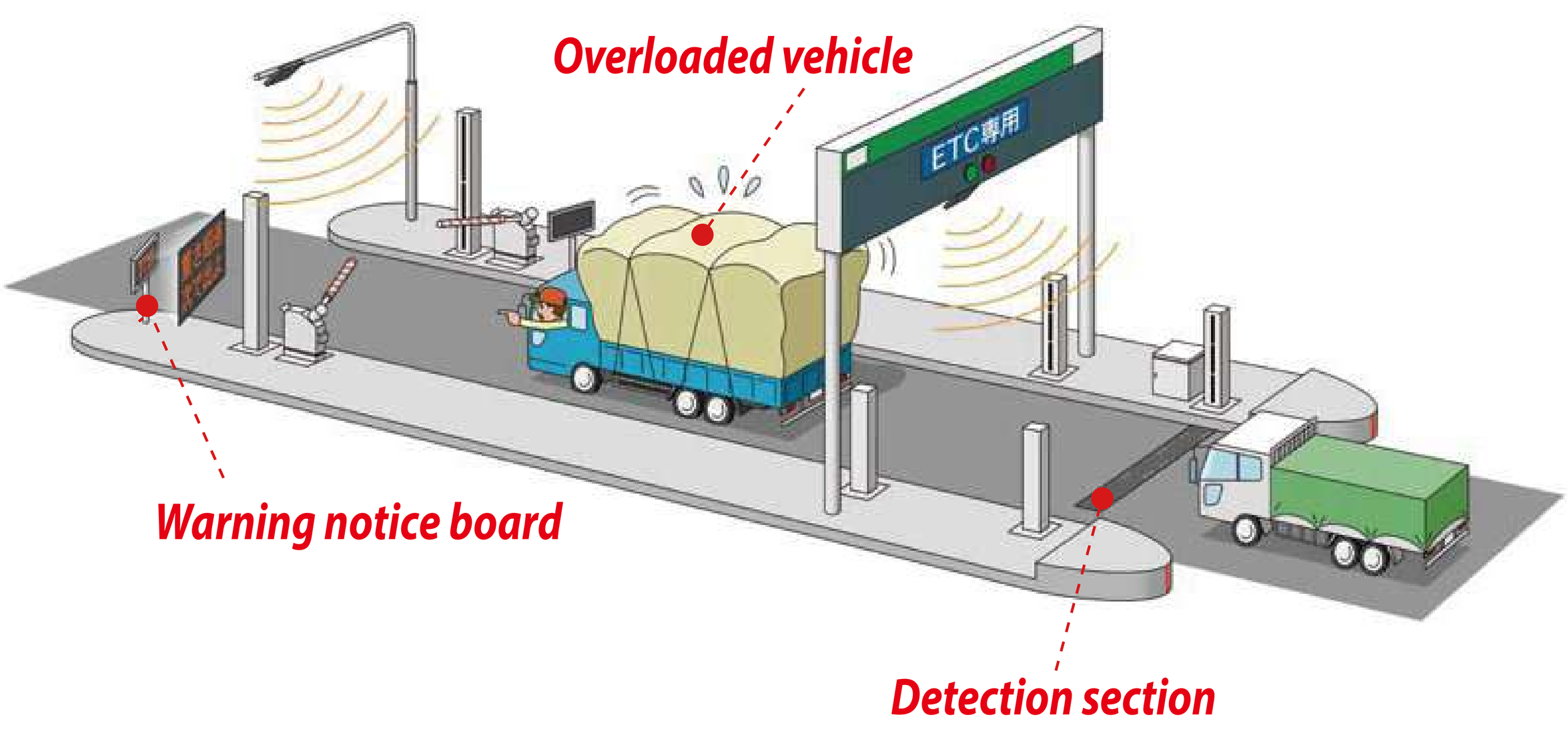
الأمان وراحة البال

جهاز وزن الآليات المتحركة

Warns drivers who are driving overloaded vehicles

- *Overloading is a cause of major accidents.*
- *Overloading negatively affects road surfaces and bridges.*

Patent pending



Features of the moving-vehicle weighing instrument

- The number of axles can be detected at high speeds.
- Vehicle weights (gross weights) can be measured more accurately at high speeds.
- The meter distinguishes the forward and backward movement of vehicles.
- The new meter is more durable than the previous models.

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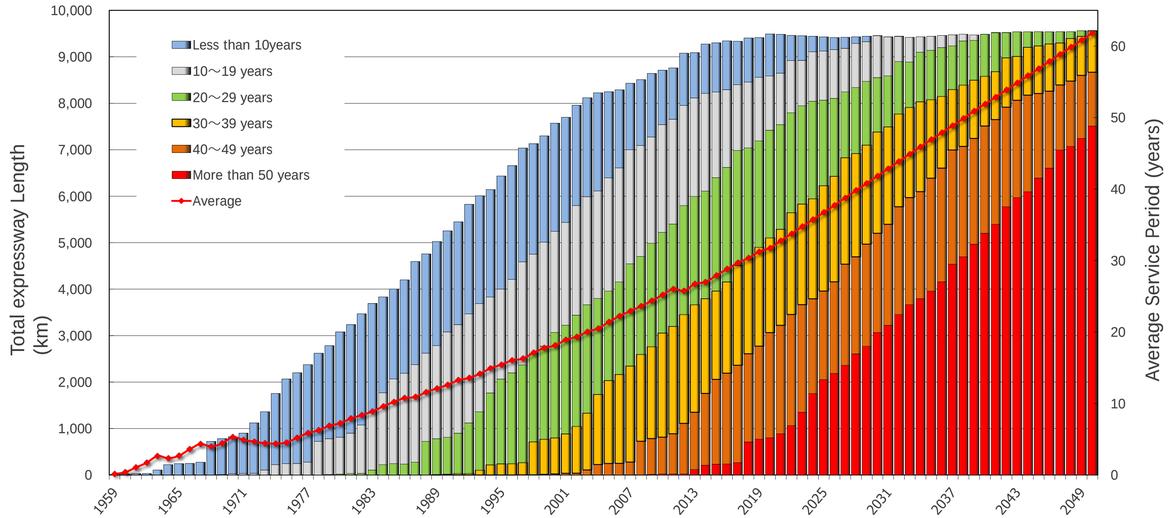
Ageing Road Assets

متقادم

Current situation and problem of expressways

- At least 40% of the total expressways-length has been operated for more than 30 years and because of this, the expressways are seriously deteriorated.
- At least 40% of the total bridge-length and 20% of total tunnel-length were also constructed more than 30 years ago and they are facing increased risk by the aged deterioration.
- The total vehicle weight is increasing with the increase in the number of large-scale vehicle on the expressways. The expressways are under severe conditions such as increasing in the usage of anti-freezing agent (NaCl) and the increase in the amount of extreme rainfall for a short time.



Elapsed years of the expressway transition

Severe environment in snow region

Concrete cracks and float

Concrete free lime

Damaged Condition

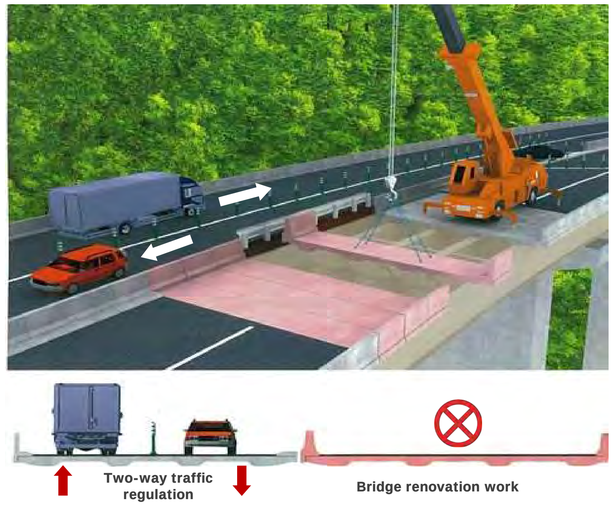
Expressway Renewal Project

التجديد

Severe deterioration on slab lower surface

Large-scale renovation for bridges

e.g. Replacement of RC concrete slab with PC precast slab



Open to Traffic (1963)

Deteriorated Structure (2014)

Undergoing Renewal Works (2019)

Renewed Segment (planed in 2026)

Expressway Inspection & Diagnosis

التفتيش والتشخيص

Road Surface

One of unique road surface inspection vhiecles, not only can measure rutting, cracking, and flatness (σ10ft, IRI) but also longitudinal and transverse pavement measurements without making contact with the pavement.
It can smoothly and safely perform all 6 functions at 100km/h without impacting the flow of other traffic.

High-Speed Road Surface Measuring Vehicle (Road Tiger)

Tunnel Liner

Inspection vehicle

Filming in a tunnel

Crack analysis (minimum 0.2mm in width)

Tunnel liner inspection vehicle:

It is now possible to obtain a clearer image at a speed of 100km/h by adopting the line sensor camera instead of the conventional video camera. In addition, because the photographing illumination using LED infrared illumination is not visible to the naked eye, it no longer influences on the passing vehicles on the opposite direction. Moreover, this vehicle automatically identifies the cracks by the captured image.

Bridge

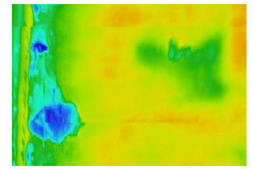
Digital camera/video camera system - Crack inspection:

High definition images taken by digital camera or video camera makes it possible to inspect the surface of a structure in the same way as the close visual inspection. Through a computer analysis of the images, the clacks are automatically detected.

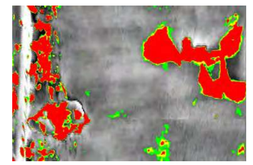
Infrared Camera System – Delaminations /spill inspection:

The infrared camera system takes images which is analyzed automatically and displays the damage level in three stages. Because damages are objectively analyzed by software, bias or oversight in measuring caused by skill difference can be prevented. In addition, this system helps to create a research report since the detected results are easily captured on spreadsheets or word processing software. This system has gotten track records in the U.S.

Bridge inspection using Infrared Camera System

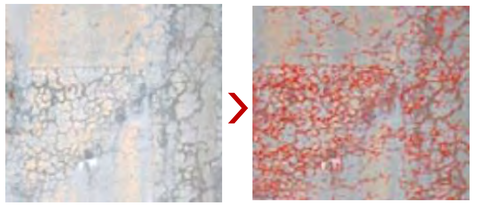


Infrared thermal image



Damage is detected by computer analysis

Bridge inspection using Digital Camera System



Automatic crack-analysis by computer

Video Camera System

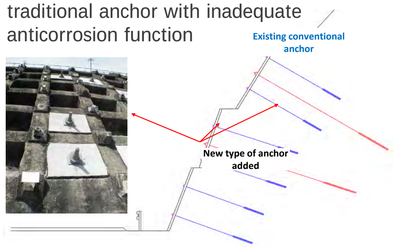
Disaster Management
الوقاية من الكوارث

Disaster Prevention

Disaster caused by extreme rainfall for a short time

◆ Ground anchor

New type of anchor installation filling up traditional anchor with inadequate anticorrosion function



◆ Slope Protection Work

Measures against land slide

The recovery of the Tomei expressway in Makinohara area

Immediately after the Surugawan earthquake, NEXCO-Central started emergency checkup and stopgap recovery, and 4 days later, finished temporary recovery for general traffic.

Aug. 11th 2009

Aug. 15th 2009 (4 days later)

Earthquake Museum for educational assistance on disaster prevention

Great Hanshin-Awaji Earthquake occurred in January 1995, took precious lives and destroyed cherished livings of local communities. Earthquake Museum conveys how Hanshin Expressway responded in the 623 days to complete the restoration of the expressway system. It displays damaged structures and introduces new technologies and various activities which put into practice based on the lessons including disaster management support and educational assistance for disaster prevention.

Use of rest areas as disaster-management bases

In the Great East Japan Earthquake, the Self-Defense Forces and firefighters heading to stricken areas used expressway rest areas as relay and support bases. Based on this experience and various issues, authorities are bolstering their disaster-response capabilities across Japan to respond effectively and efficiently to emergencies, using Moriya SA on the Joban Expressway as their model.

◆ Moriya Service Area (Southbound) on Joban Expressway, as a disaster management base

Disaster-response warehouse
Inflatable tents for outdoor use, emergency food and rations, relief supplies, traffic regulation equipment and other suppliers are store at this Disaster-response warehouse

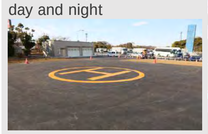
Emergency vehicle entrance/exit
Used by emergency vehicles to enter and exit outside of expressway in times of disaster

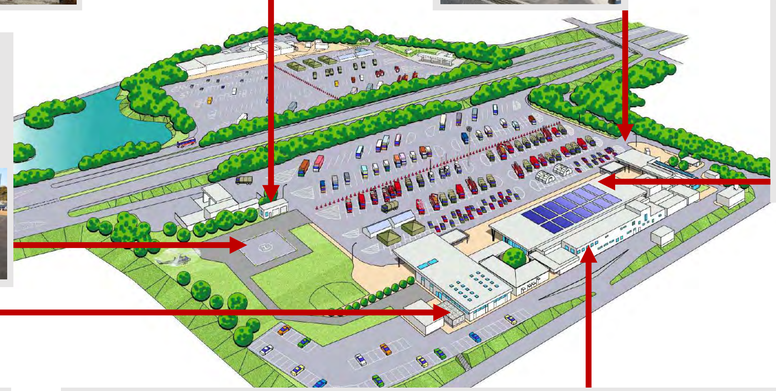
Generators and rooftop solar-power generation facilities

Solar-power generation panels on the roofs of commercial facilities

Generators enable continuous use for 72 hours

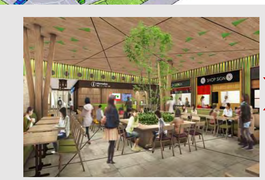
Heliport for mid-size Helicopters
Nighttime illumination and a helicopter office have been installed, enabling safe landing and take-off day and night



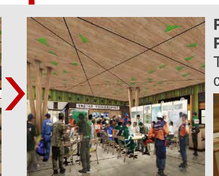


Well
A well has been dug in case of interruption of water supply

The food court is used as a disaster management office (1st Floor)
The food court layout can be rearrange for use as a disaster management office, under disaster situations
- Electrical power outlets and TV antenna terminals are installed
- Large monitors and whiteboards are installed



General situation



Emergency situation

First-aid space (2nd Floor)
The employee break lounge can be used as a first-aid

Expressway Network in Japan

شبكة الطرق السريعة في اليابان

Japan's Expressways are built and operated by six companies.
The total length in operation is 10,351km, and 331 km is under construction.

NEXCO WEST

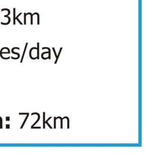
Company Name:
West Nippon Expressway Company Limited
Head Office: Osaka
Expressways in Operation: 3,533km
Traffic Volume: 2.95million vehicles/day
Toll Revenue: US$ 7.1billion
Expressway under construction: 72km

Hanshin Expressway

Company Name:
Hanshin Expressway Company Limited
Head Office: Osaka
Expressway in Operation: 250.4km
Traffic Volume: 0.72million vehicles/day
Toll Revenue: US$ 1.7billion
Expressway under Construction: 34.2km

Honshu-Shikoku Bridge Expressway

Company Name:
Honshu-shikoku Bridge Expressway Company Limited
Head Office: Kobe
Expressway in Operation: 172.9km
Traffic Volume: 0.12million vehicles/day
Toll Revenue: US$ 0.6billion



NEXCO EAST

Company Name:
East Nippon Expressway Company Limited
Head Office: Tokyo
Expressway in Operation: 3,943km
Traffic Volume: 2.95million vehicles/day
Toll Revenue: US$ 7.82billion
Expressway under Construction: 75km

NEXCO CENTRAL

Company Name:
Central Nippon Expressway Company Limited
Head Office: Nagoya
Expressway in Operation: 2,132km
Traffic Volume: 1.98million vehicles/day
Toll Revenue: US$ 6.30billion
Expressway under Construction: 132km

shutoko

Company Name:
Metropolitan Expressway Company Limited
Head Office: Tokyo
Expressway in Operation: 320.1km
Traffic Volume: 1.02million vehicles/day
Toll Revenue: US$ 2.4billion
Expressway under Construction: 17.5km

In operation
Under construction

As of JULY 1st, 2019
Note: Revenue is for year ended March 31, 2019 and calculated by the exchange rate of 110 JPY for 1 US$