



## Engineering service with collective strengths of Metropolitan Expressway Group Companies

### Metropolitan Expressway Co., Ltd.

- Road development planning, route planning and design
- Inspection planning
- Repair and strengthening work planning
- Research and study of traffic control (ITS)

### Shutoko Engineering Co., Ltd.

- Inspections (periodic, daily, emergency)/Evaluation
- Expressway soundness evaluation
- Maintenance priority evaluation
- Deterioration prediction
- Design of seismic repair and strengthening work
- Development of inspection technology
- Impact examination of the proximity construction

### Highway Technology Research Center

- Establishment/operation management of asset management system
- Inspections (detailed/general)
- Soundness/deterioration evaluation
- Design
- R&D of advanced technology
- Promotional activities for new technology information (holding of lectures / training sessions)

Shutoko Maintenance West Tokyo Co.,Ltd.  
Shutoko Maintenance East Tokyo Co., Ltd.  
Shutoko Maintenance Kanagawa Co., Ltd.

Shutoko Electrical Maintenance Co., Ltd.  
Shutoko ETC Maintenance Co., Ltd.  
Shutoko Machinery Maintenance Co., Ltd.

- Planning and implementation of repair work of road structures
- Inspection and repair work of road facilities

# THE BEST SOLUTIONS FOR ROAD DEVELOPMENT AND MANAGEMENT Engineering Consulting Service

### Contacts



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<https://www.shutoko.co.jp/en/index/>



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Metropolitan Expressway Company Limited



Shutoko Engineering Company Limited



Highway Technology Research Center

# Metropolitan Expressway Group Companies support your road development and management

Metropolitan Expressway Group Comprising of Metropolitan Expressway Co., Ltd, Shutoko Engineering Co., Ltd, Highway Technology Research Center and other affiliated companies can provide various road technologies and know-how gained through our long-term experience in the high-density Tokyo metropolitan area.

● Planning & Construction P.4-5

● Maintenance P.6-9

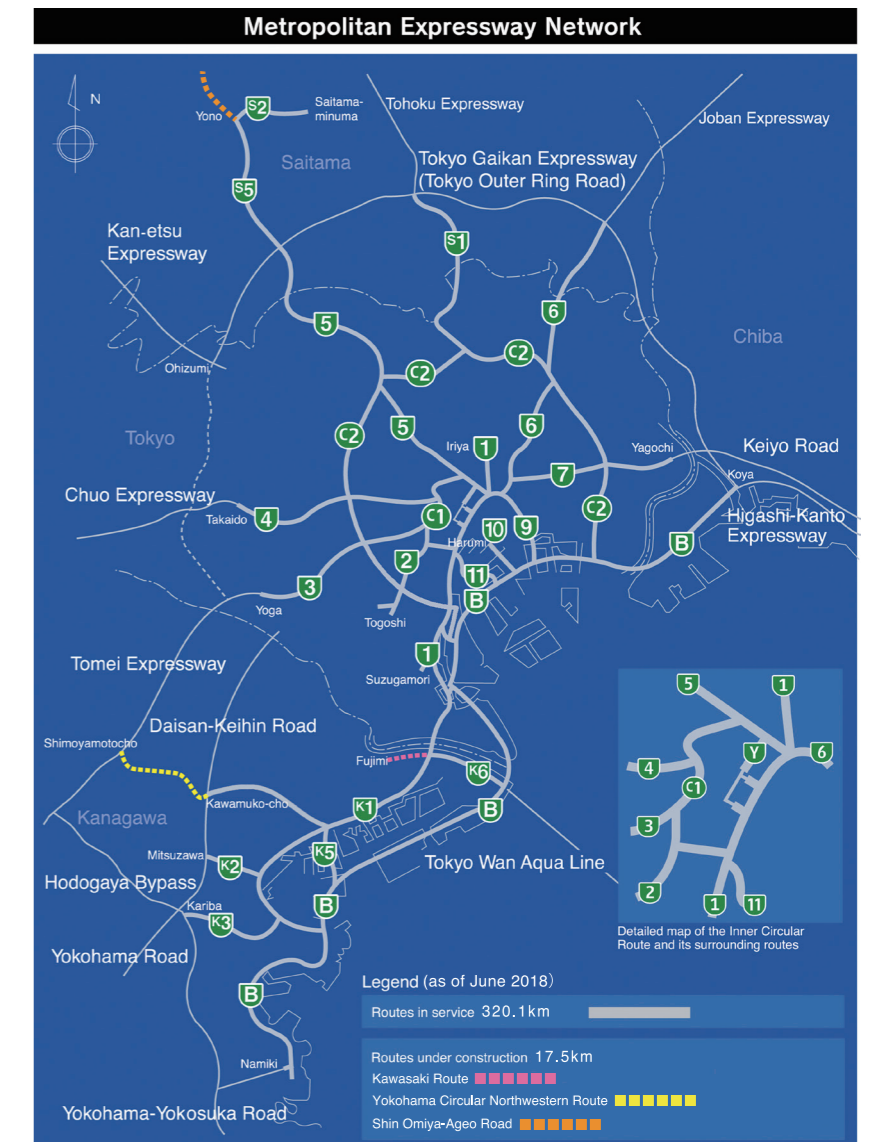
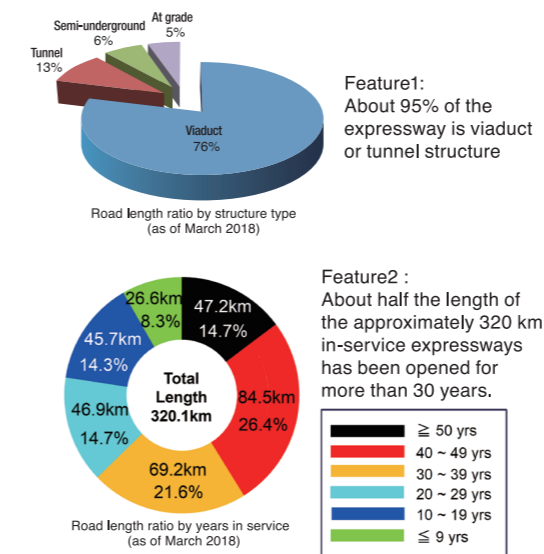
● Operation P.10-13

● Global Activities P.14-15



## Metropolitan Expressway Group Companies' strengths in road management

Metropolitan Expressway Group Companies manage the Metropolitan Expressway, which supports the socioeconomic activities in Tokyo metropolitan area. The key features of the expressways are a total length of over 320 km (about half of which are over 30 years old), approximately 90% of the road structures being viaducts and tunnels, and a road usage of approximately one million vehicles per day. Along with these features of expressway, Metropolitan Expressway Group Companies have accumulated expertise for road engineering through planning, construction, maintenance, and management of urban expressways. Utilizing our expertise, Metropolitan Expressway Group Companies aim to contribute to road development all over the world by providing safe and user-friendly roads.



Metropolitan expressway opened (Kyobashi - Shibaura)



Near Hamazakibashi Junction (At the time of the Previous Tokyo Olympics)



Rainbow Bridge opened



Ohashi Junction opened



New traffic control system AISS'2013 operated



Yamate Tunnel (total 18.2km) opened

# Planning & Construction

## Route Planning

We provide engineering advice on efficient and cost-effective route plans, considering the selection of optimal structures and the preservation of roadside environments.

### Engineering advice on planning, design and construction of roads in high-density areas.

The Metropolitan Expressway has been planned and constructed in densely populated areas.



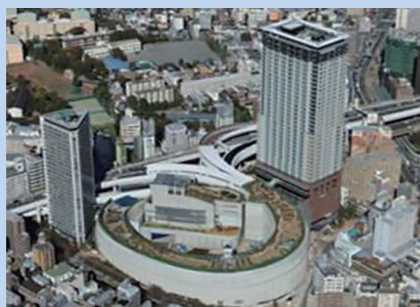
Junction constructed above a river (Edobashi Junction)



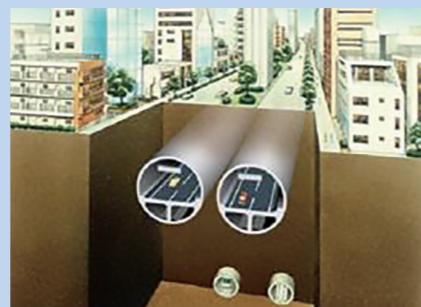
Multilayered structure (Hakozaki Junction)

### Engineering advice on planning and constructing road structures considering land constraints for construction and the reduction of the impact on the existing traffic due to construction work.

Many road structures are selected by considering land limitations for construction and the impact on the existing traffic flow.



Compact Junction in a residential area (Ohashi Green Junction)



Long urban tunnel under an existing surface road (Yamate Tunnel)

## Large-Scale Bridges

### Suspension Bridge



**Rainbow Bridge**  
Structure type : suspension bridge  
Length of bridge : 798m  
Center span : 570m  
Main tower height (above sea level) : 126m  
Bridge inauguration : August 26, 1993

### Cable-Stayed Bridge



**Yokohama Bay Bridge**  
Structure type : cable-stayed bridge  
Length of bridge : 860m  
Center span : 460m  
Main tower height (above sea level) : 175m  
Bridge inauguration : September 27, 1989

### Arch Bridge



**Goshikizakura-Ohashi Bridge**  
Structure type : arch bridge  
Length of bridge : 142m  
Main tower height (above sea level) : 53m  
Bridge inauguration : December 25, 2002



**Tsurumi Tsubasa Bridge**  
Structure type : cable-stayed bridge  
Length of bridge : 1020m  
Center span : 510m  
Main tower height (above sea level) : 183m  
Bridge inauguration : December 21, 1994

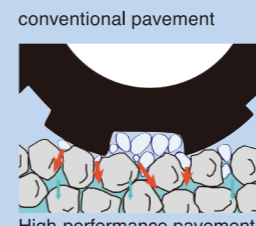
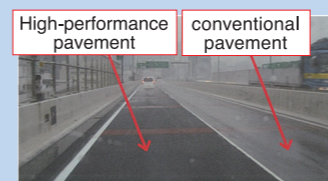
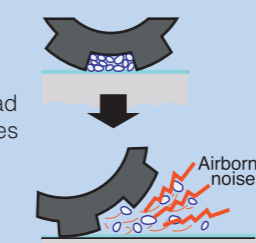
## Initiatives to Improve Roadside Environment

We provide engineering advice on environmental friendly "Eco Road" that conserves the environment and alleviates traffic, noise, and air pollution.

### Countermeasures for Noise and Vibration

#### High-Performance Pavement (Porous Asphalt Pavement)

This high-performance pavement has more pores than conventional pavements. It reduces air pumping noise because the air between the road surface and tires can escape into pores on the surface. In addition, rainwater quickly penetrates into the pavement. Therefore, running safety is improved owing to greater visibility of lane markings on rainy days.



#### Noise Barrier, Viaduct Undersurface Acoustic Board

Noise from expressways can be suppressed by installing the noise barrier which has higher sound insulation performance along with undersurface acoustic board for viaducts.



The noise barrier



Viaduct undersurface acoustic board

### Joint Elimination

Eliminating road joints enables smooth driving without shocks, noise and vibration. After the work, joint replacement becomes unnecessary, so traffic congestion due to repair work is reduced.



### Ventilation System

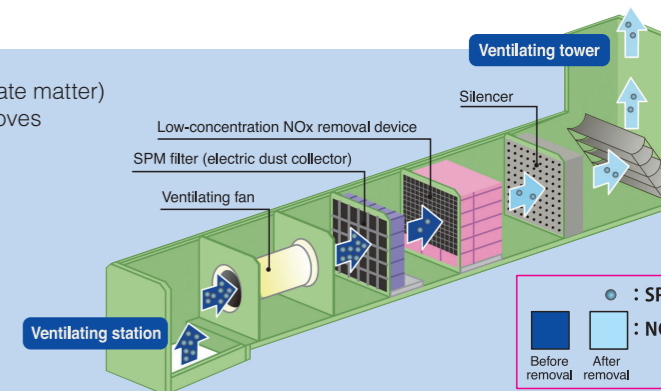
We propose an advanced NO<sub>2</sub> and SPM (suspended particulate matter) removal system in tunnel ventilation facilities. This system removes most of the NO<sub>2</sub> gas and SPM emitted by vehicles.



NO<sub>2</sub> Removal System



Electrostatic Precipitator



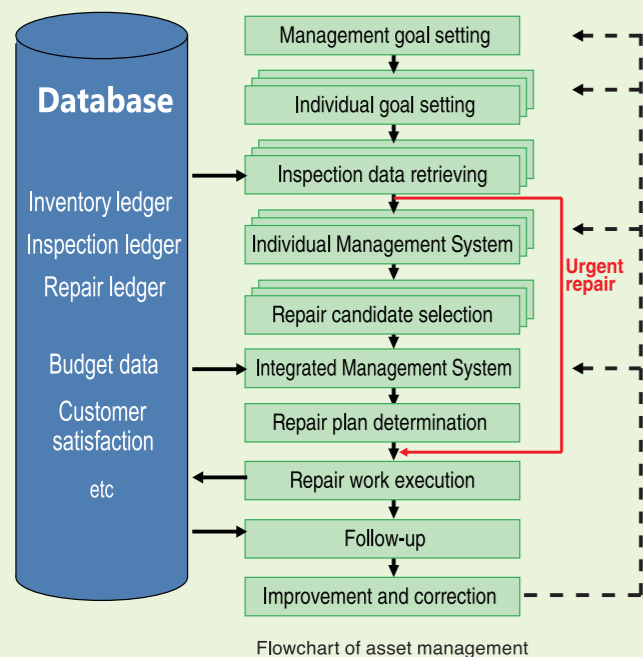
# Maintenance

## Maintenance System

We provide engineering advice on road maintenance system, e.g. for inspection, evaluation and repair work, based on our technologies and practical experience of more than 50 years.

### Maintenance Planning

We provide engineering advice on the development of an optimal maintenance plan, e.g. for inspection work, repair work and asset management, according to the type and scale of road structures.



### Inspection / Evaluation

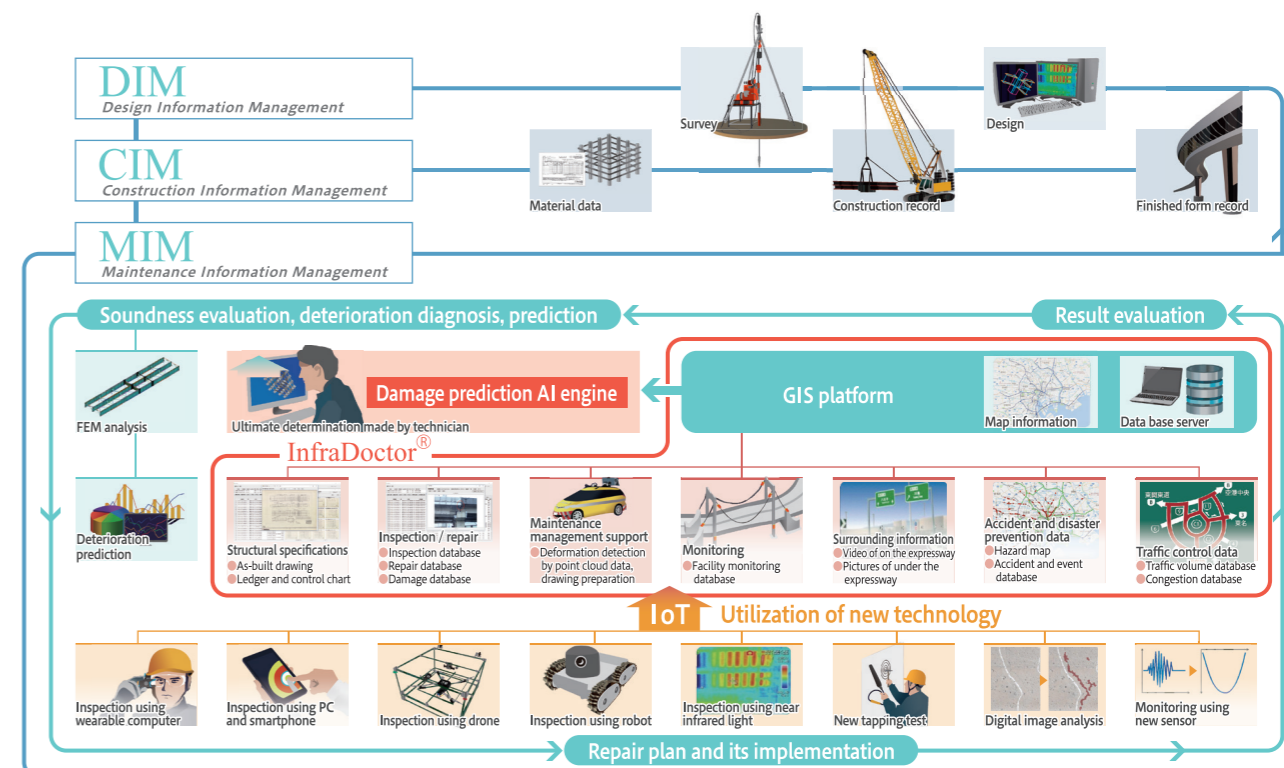
We provide engineering advice on inspection work and evaluation methods for damage for each type of structures. This also includes a detailed examination for evaluating the cause of damage and planning for repair or strengthening work.



Inspection work

## i-DREAMs® intelligence-Dynamic Revolution for Asset Management systems

i-DREAMs® is a smart infrastructure management system. It coordinates the information that is needed to manage maintenance with a geographical information system (GIS) \*1, platform\*2, and manages that maintenance efficiently by putting to use a combination of 3D point cloud data\*3 obtained from the MMS\*4, information and communication technology (ICT) and artificial intelligence (AI) \*5



\*1 GIS: A system that makes it possible to perform sophisticated analyses and make speedy decisions through the visual tracking of geographical information plotted on maps  
\*2 Platform: A computing environment in which information is generated, collected, stored, distributed, shared, and used  
\*3 3D point cloud data: A cluster of data collected by scanning an area with lasers and recording the 3D positioning data based on the signals bounced back from objects

\*4 Mobile Mapping System: A mobile, high-precision 3-dimensional measurement system that can taken around on a moving vehicle to efficiently obtain highly precise 3-dimensional positioning information about buildings and roads  
\*5 Artificial intelligence: Software and systems modeled so that they can carry out such human intellectual functions as memorization, reasoning, and learning

### Construction Management / Quality Control

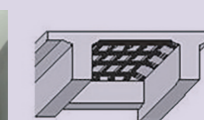
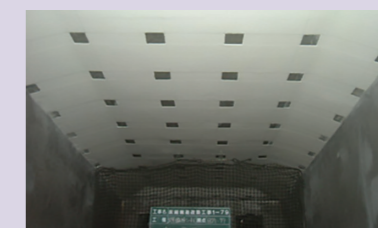
We provide engineering services for construction management and quality control in order to ensure high-quality, safe construction work.



Check of rebar arrangement

### Design and Construction of Repair Work

We provide the most suitable approach for the design and construction of repair or strengthening work according to the type of damage.

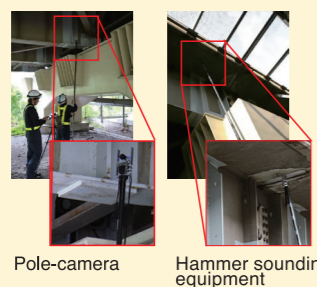


Strengthening of concrete slab

## OUR ADVANCED INSPECTION TECHNOLOGIES

### Pole-camera and hammer sounding equipment for inspection at high elevated places

Inspections are carried out by pole-camera and hammer sounding equipment in locations where close visual inspection is difficult.

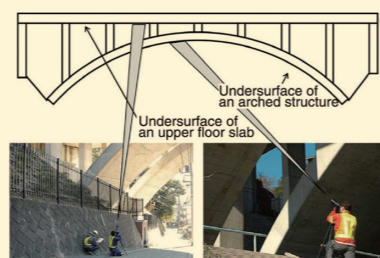


Pole-camera

Hammer sounding equipment

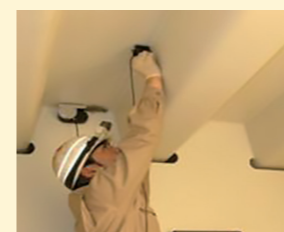
### Inspection and assessment method using digital image processing

The condition of structures is accurately recorded, checked and analyzed using the captured digital images and processing technology.



### Semi-automatic ultrasonic testing (SAUT) for steel plate deck

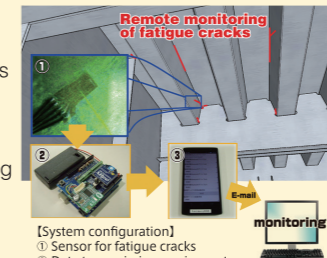
Through-deck-type fatigue cracks in orthotropic steel decks are detected and the inspection results are recorded by the sliding operation of the SAUT probe.



Semi-automatic ultrasonic testing (SAUT)

### Remote monitoring technology for fatigue cracks

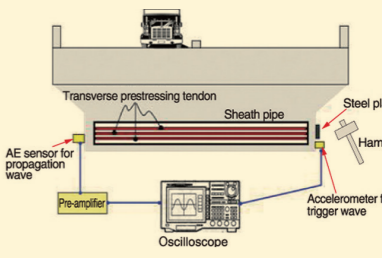
The propagation of fatigue cracks in steel structures can be remotely monitored for a long term by the remote monitoring technology.



Remote monitoring of fatigue cracks

### Inspection of filling condition of grout in transverse prestressing tendons

The filling condition of grout in transverse prestressing tendons of prestressed concrete bridges is evaluated by the impact elastic wave generated by the hammer.



Impact elastic wave method

# Maintenance

## InfraDoctor®

A cutting-edge system for supporting infrastructure maintenance utilizing GIS and 3D point cloud data

### Super Efficient System for Maintenance Management Works

The system is super efficient, allowing the inspections, maintenance management, road repair and design works to be more precisely targeted.

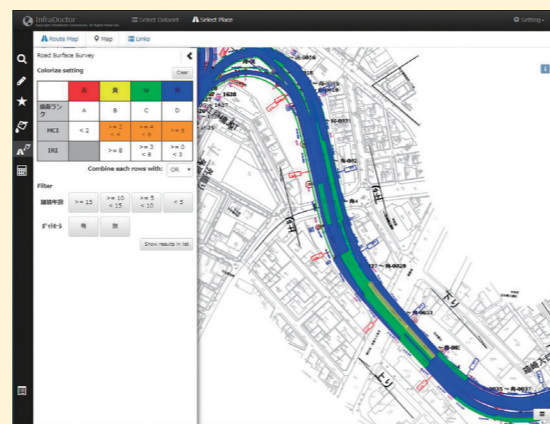


#### Feature

- Automatic detection pavement conditions
- Detection by spatial frequency analysis of 3D point cloud data. Our method builds the system to output results automatically by loading road surface condition surveys data on GIS.
- It shows replacement targets by visible coloring and calculate replacement cost.



3D dimension measurement



Result of road pavement condition on GIS

For more information <https://www.infradoctor.jp/en/>

## Wave Doctor®

High accuracy measurement of illuminance, electric field intensity, and tunnel environment without traffic regulation.

#### Feature

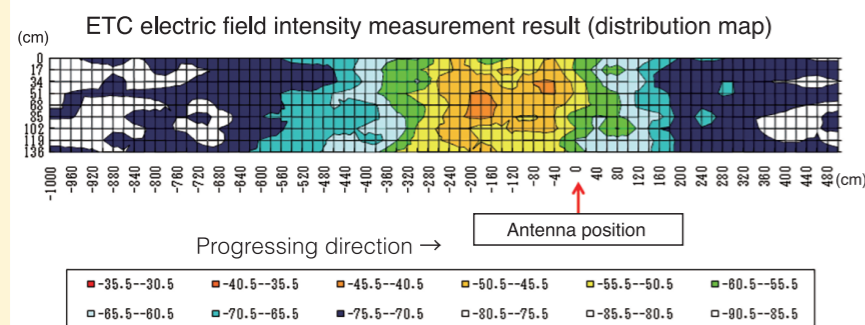
- Diagnosing deterioration based on quantitative measured data, without visual or auditory sensation.
- Utilizing for maintenance work such as "prevention of lowering of functional level" and "setting of cleaning / inspection cycle".



Overall view of measured vehicle



Illuminance meter : above ground clearance 15 cm



Electric field intensity measurement result (ETC)



Road surface thermometer illuminance meter

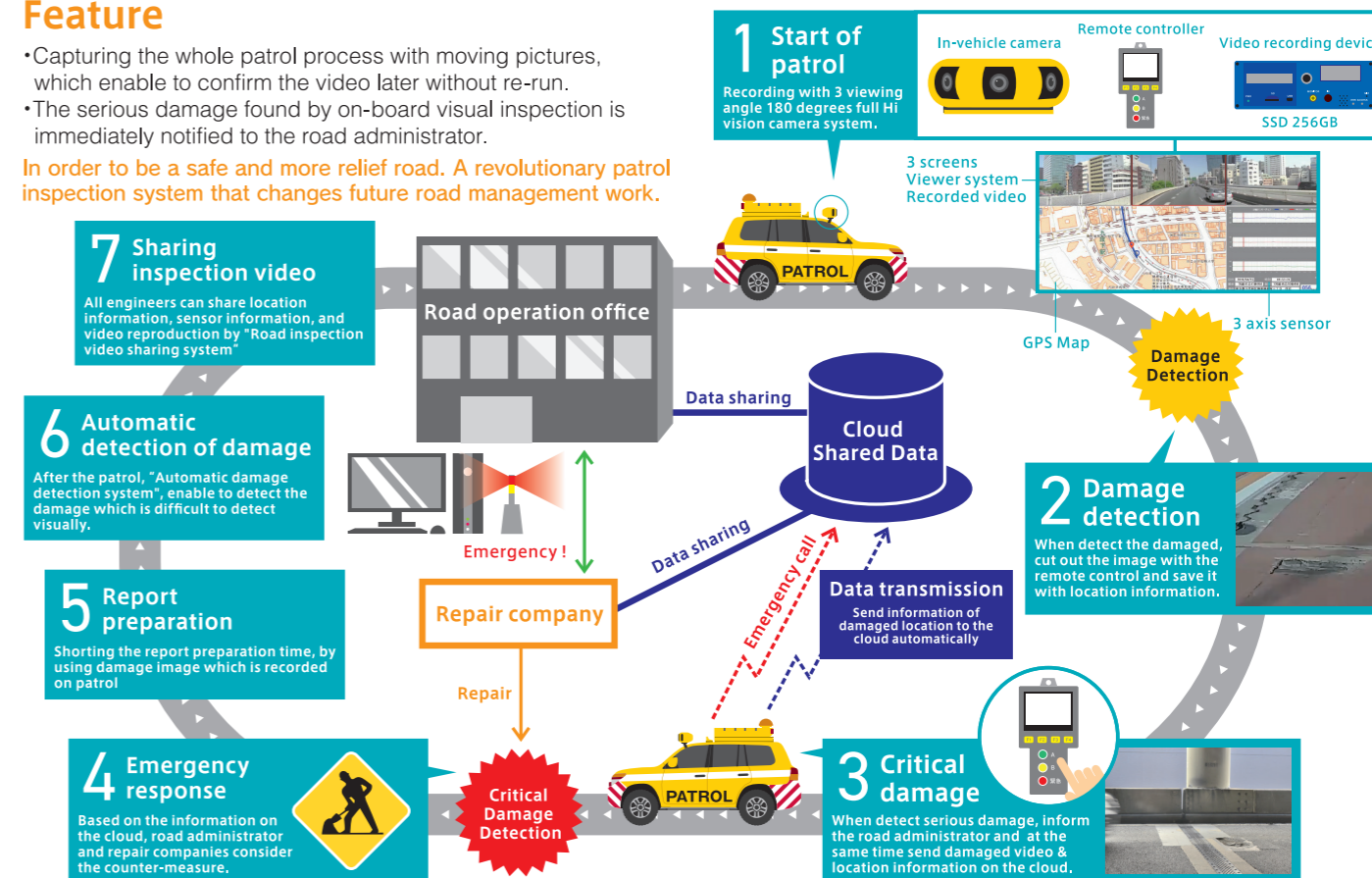
## InfraPatrol®

A system checking the daily road inspection work more efficiently and promptly, then confirming a damage on the road surface automatically

#### Feature

- Capturing the whole patrol process with moving pictures, which enable to confirm the video later without re-run.
- The serious damage found by on-board visual inspection is immediately notified to the road administrator.

In order to be a safe and more relief road. A revolutionary patrol inspection system that changes future road management work.

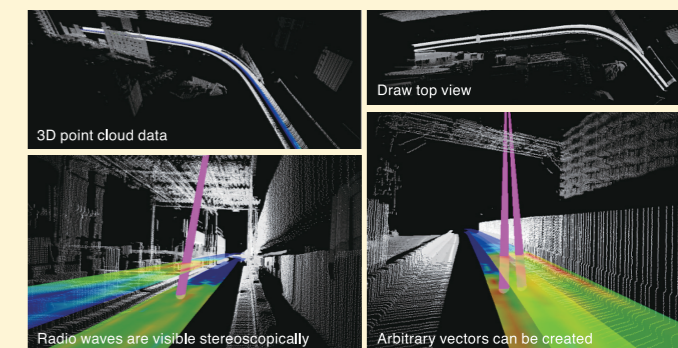
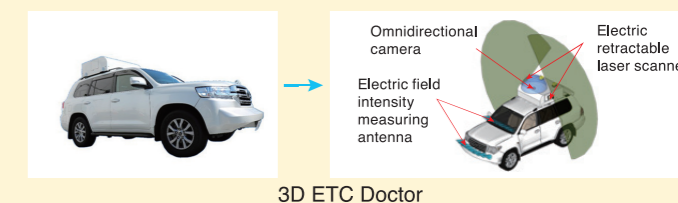


## 3D ETC Doctor™

Confirm 3D point cloud data of surrounding structure and electric field intensity measurement result by using 3D image

#### Feature

- Stereoscopic analysis is possible by absolute coordinates obtained from the GPS and posture sensor.
- Through 3D analysis, Investigating the cause of reflection wave / radio wave leakage, and optimizing the installation area of radio wave absorber
- Measuring the distance from structure with the wave without traffic regulation
- Measuring two-wave of ETC / ITS spot simultaneously.
- It is possible to link multiple routes data and build a database of various electric field intensity measurements.

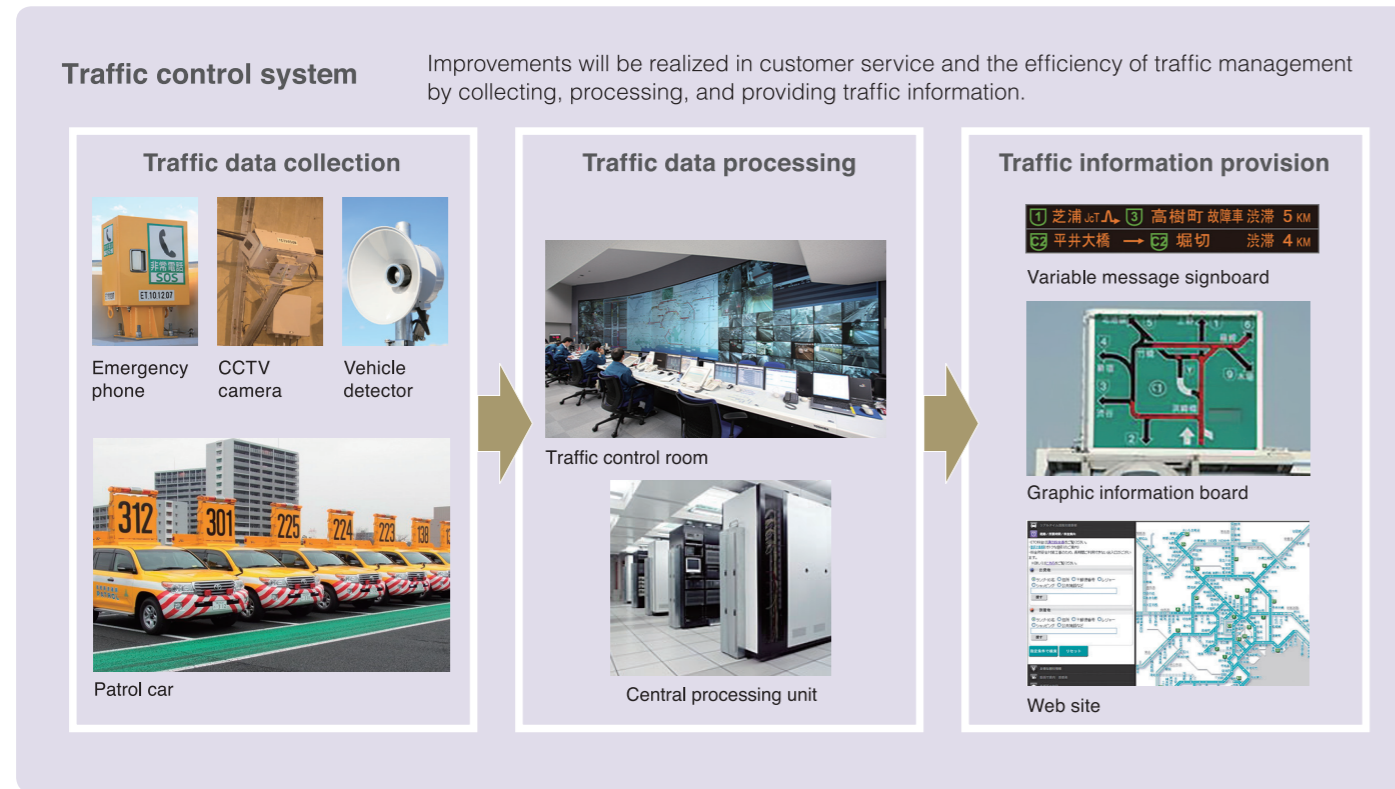


3D ETC Doctor's abundant analysis ability

# Operation

## Traffic Management

A leading-edge traffic control system is utilized to quickly process the incoming data and provide drivers with useful traffic information (traffic condition, route, travel time) in real time and every minute in order to ensure safe, smooth and comfortable use of the expressways 24 hours a day..



## Road Patrol

We strive to secure safe and comfortable passage by 24 hours a day, 365 days a year.

### Automatic detection system for unexpected events

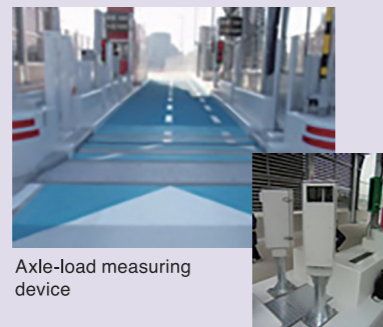
This system can automatically detect unexpected events, including low-speed vehicles, stopped vehicles and reverse running vehicles, by processing images from CCTV cameras, and inform traffic controllers of such events.



Example of image processing (stopped vehicle)

### Automatic axle-load weighing system

This system is installed at the toll gate to check overloaded vehicles, which can cause damage to road structures.



Axle-load measuring device

Camera

### Motorcycle patrol group / message signboard vehicle

A motorcycle patrol group can reach a site quickly even in congestion. Vehicles with a message signboard can warn following vehicles of any danger.



Patrol Motorcycle

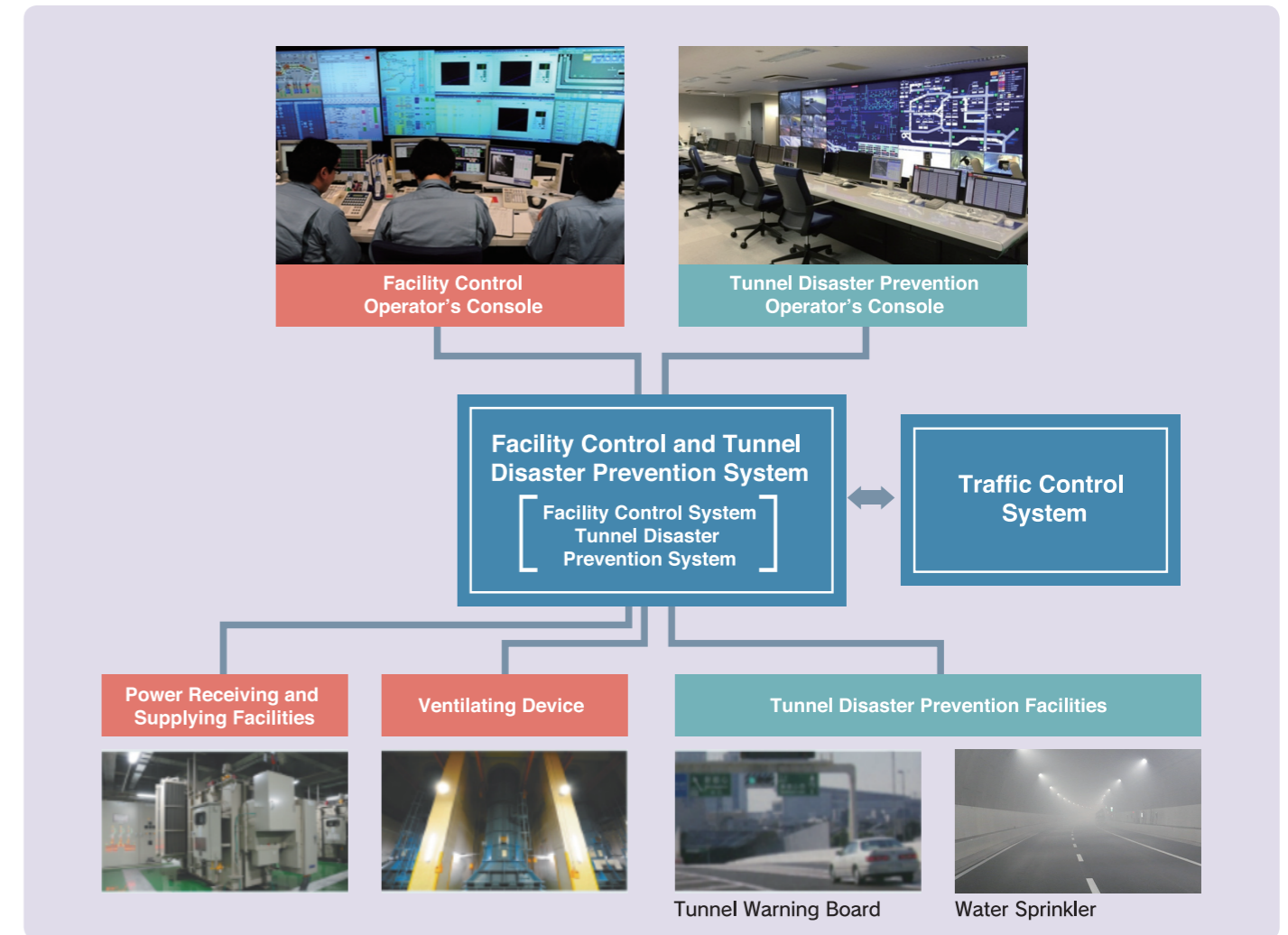


Message signboard vehicle

## Facility Control & Tunnel Disaster Prevention System

The Facility Control System controls power receiving and supplying facilities, ventilating device and other facilities, while the Tunnel Disaster Prevention System controls tunnel disaster prevention facilities. These two systems combined ensure comfort and safety for drivers.

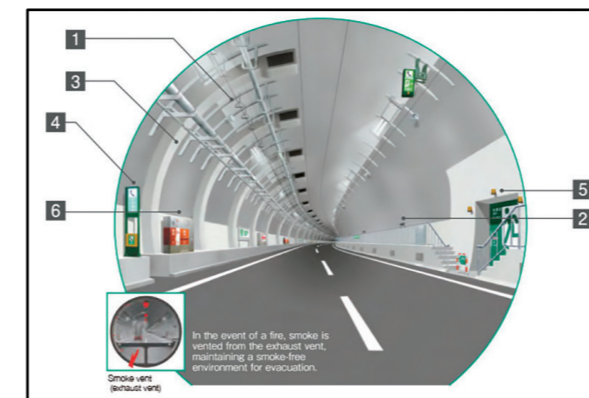
### — Facility Control and Tunnel Disaster Prevention System



### — "Eyes" to watch over drivers around the clock (1.2.3)



### — "Emergency equipment" that drivers can easily use (4.5.6)



# Operation

## Traffic Safety Measures

In order to prevent traffic accidents, we have been implementing traffic safety measures from both the hardware and software aspects by installing traffic safety equipment and initiating safe driving awareness activities.

### Facilities for Ensuring Traffic Safety

Measures that instinctively encourage careful driving are installed.

- "caution-evoking painted pavements" and "curve warning zebra plates" at the common accident area.
- "large alert boards" to notice curves, branches, and mergers
- "narrow dotted markings" to control speed
- "branching impact mitigation devices" to prevent serious accidents at branching sections
- "congestion trail information boards" before congestion prone spots to alert drivers about rear-end accidents.



Congestion tail information board



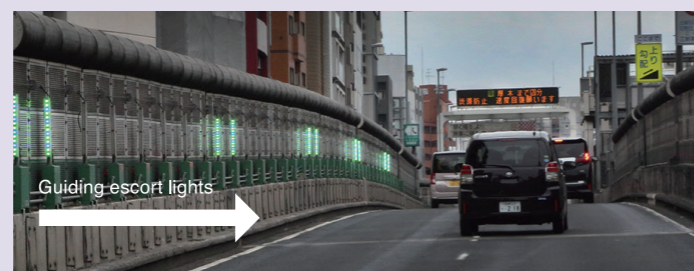
## Traffic Safety Campaign

JAPAN SMART DRIVER (project) is an approach launched by users of the Metropolitan Expressway targeting a reduction of traffic accidents through mutual consideration while driving.



## Escort Lights

We installed traffic control devices called "escort lights" on the roadside which blink in the direction of travel thereby preventing drops in speed. Drivers are encouraged to return to their original speed on while driving uphill to alleviate traffic congestion.



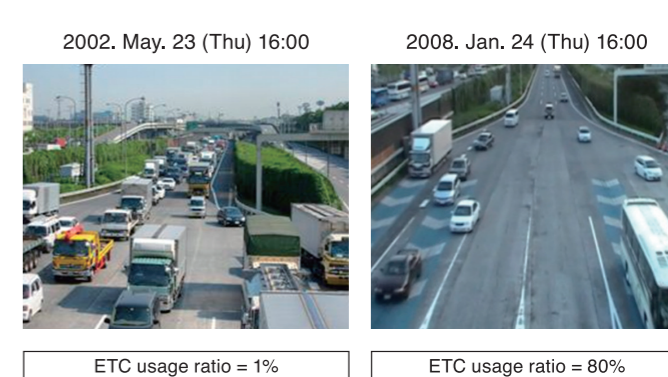
Guiding-escort lights

## Electronic Toll Collection System (ETC)

The Electronic Toll Collection (ETC) is a system that enables the customer to pay the toll automatically without stopping when passing the toll gate.

The spread use of ETC system can effectively reduce the traffic congestion at the toll gate.

As of FY2018, the ETC usage ratio in the Metropolitan Expressway is approximately 95%.



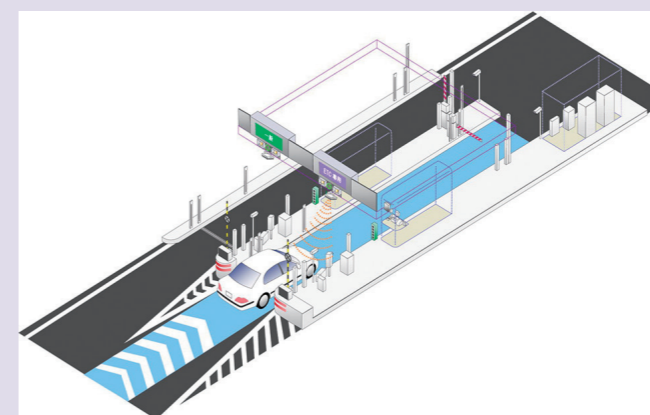
ETC usage ratio = 1%

ETC usage ratio = 80%

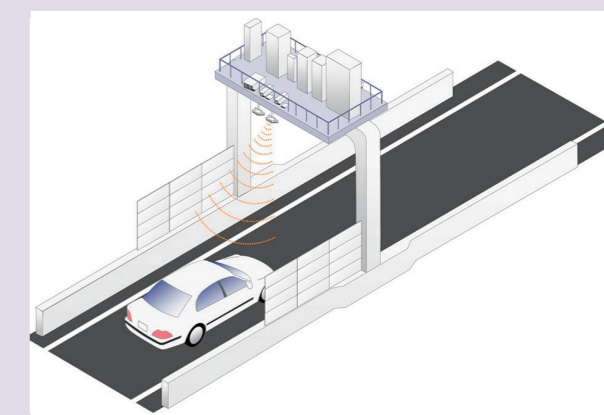
## ETC Installation

We can support the installation of ETC, including proposals on the construction of Toll Gate with ETC and Free Flow ETC systems.

We can support detailed design, construction management and quality control of the ETC system.



Toll Gate with ETC

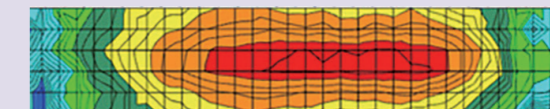


Free Flow ETC

## ETC Reliability Improvement

Proposals can be offered to decrease radio communication errors. (measurement of electromagnetic intensity, measures against electromagnetic wave leakage, etc.)

Proposals can be offered to secure toll collection in terms of both the system and the operation.



Measurement of electromagnetic field intensity



Measurement of electromagnetic field intensity



Tentative installation of electromagnetic wave absorbers

# Global Activities

## Technical Visit / Training Program

We accept technical visits from road organizations and road administrators of foreign countries to our expressways that are in service or under construction. Training programs on our technologies are also provided.

### Major subjects of the training / technical visit

- Route planning
- Construction technology for bridges / tunnels
- Inspection of structures
- Maintenance and management techniques
- Traffic control system
- ETC system
- Traffic safety measures



Training program



Technical visit



Technical visit

### Inspection training at a training facility

The training facility for structural damage inspection skills has been established for developing inspection skills. The trainees can obtain technical knowledge which is essential for damage detection and evaluation.



## Specialists Dispatch / Seminars

We can support road development in foreign countries in various ways through dispatching specialists and holding seminars on road infrastructure.



Seminar in Indonesia



Seminar in Thailand

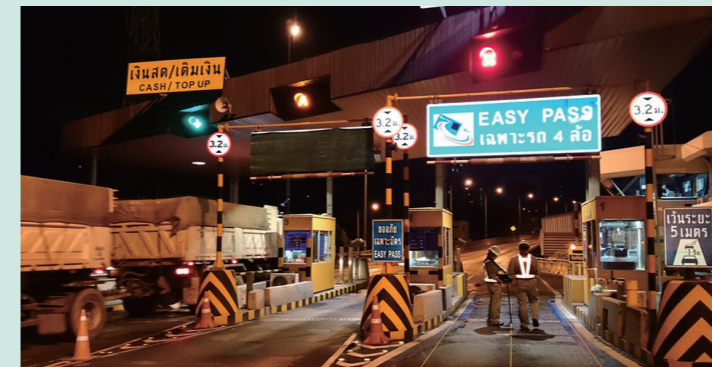


Inspection demonstration during a seminar

## Overseas Technical Consulting Business

### Expanding Our Technical Consulting Business Overseas

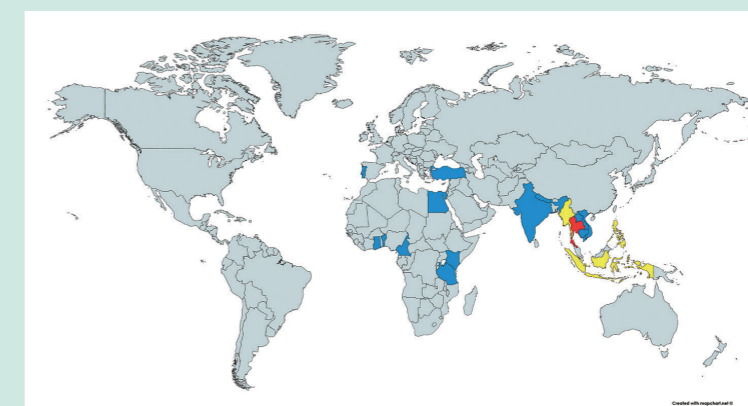
Kicking off with an order received from JICA in February 2010, we have been promoting our technical consulting operations abroad. We received an order for consulting work directly from Don Muang Tollway Public Company Limited (Thailand) in January 2013. We will continue to expand overseas, using the various skills and expertise we have accumulated while planning, building, operating and managing the Metropolitan Expressway. In addition, we continue to seek further development to overseas.



Measuring ETC wireless transmissions at a Thai toll plaza



Explanation for Lapu-Lapu City in Philippines



- 1 - 4 projects
- 5 - 9 projects
- More than 10 projects

## MOU on Technical Cooperation

No.	Country	Date	Organization
1	Cambodia	Aug. 2009	Ministry of Public Works and Transport
2	Thailand	Apr. 2010	Expressway Authority of Thailand (EXAT)
3	Indonesia	Jun. 2010	Pt. Jasa Marga (Persero) Tbk. and Pt. Astratel Nusantara
4	Thailand	Jul. 2012	Bangkok Expressway Public Company Limited (BECL)
5	Thailand	Aug. 2012	Don Muang Tollway Public Company Limited (DMT)
6	France	Dec. 2012	COFIROUTE
7	Myanmar	Apr. 2014	Public Works, Ministry of Construction
8	Thailand	Jul. 2015	Thammasat University
9	Malaysia	Dec. 2015	Projek Lintasan Kota Holding Sdn Bhd (PROLINTAS)
10	Thailand	Sep. 2016	Department of Highways (DOH), Ministry of Transport
11	Philippines	Sep. 2018	Department of Public Works and Highways (DPWH)
12	Philippines	Apr. 2019	METRO PACIFIC TOLLWAYS CORPORATION (MPTC)

We have signed Memorandum of Understanding (MOU) on technical cooperation with overseas expressway agencies and other entities. In this context, we exchange technical assistance conformed to our particular issues and needs through training program, seminars, etc.



Signing ceremony of MOU with Department of Highways, Ministry of Transport (DOH) in Thailand



Signing ceremony of MOU with Department of Public Works and Highways (DPWH) in Philippines