**Road Bureau**
**Ministry of Land, Infrastructure, Transport and Tourism**

http://www.mlit.go.jp/road/road_e/index_e.html



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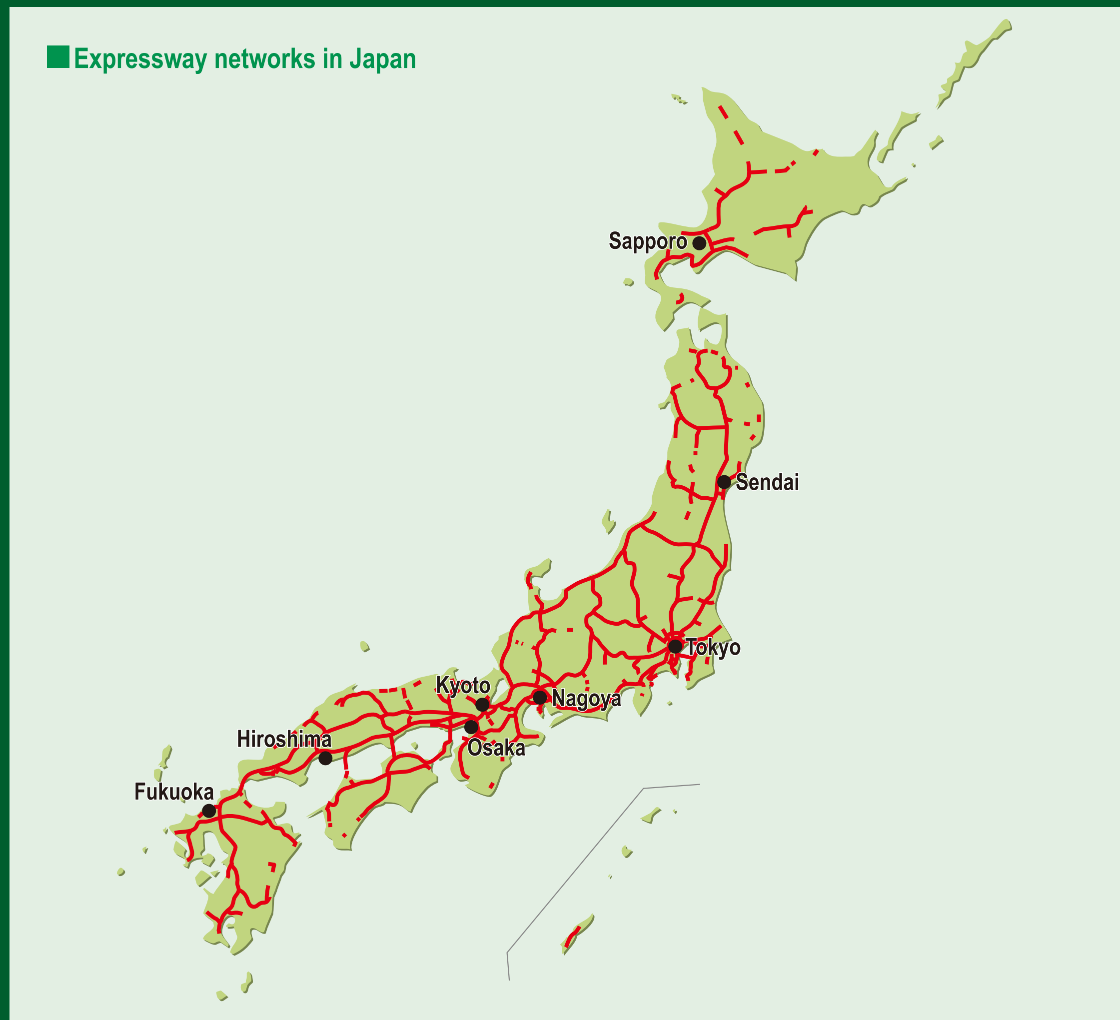
Photographs provided by:
East Nippon Expressway Co., Ltd., Metropolitan Expressway Co., Ltd., Hanshin Expressway., Ltd., and Honshu-Shikoku Bridge Expressway Co., Ltd., unless otherwise indicated.

Chapter 1

# Road Administration in Japan



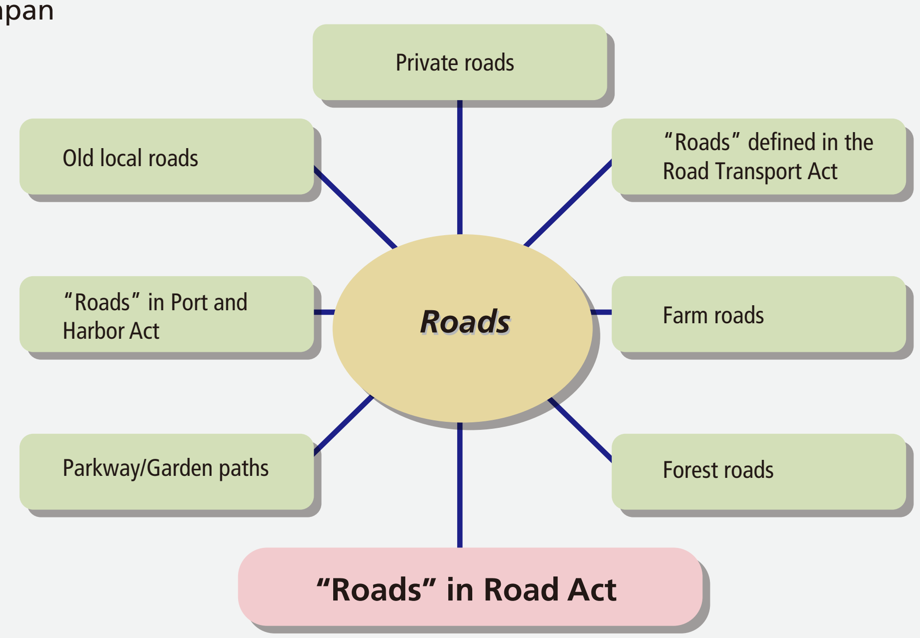
# Types of Road

**This chapter describes road types which are administrated differently by the national government, prefectural governments, municipal governments and expressway companies. It also explains how their development/improvement and maintenance/repair costs are secured along with the correlated governing acts.**

## Various types of roads in Japan

The Road Act of Japan classifies "Roads" into several categories; National Highways, National Expressways, Prefectural Roads and Municipal Roads. In addition to the roads defined by the Road Act, there are various roads such as private roads, farm roads and forest roads.

■Roads in Japan




## What is a "Road" from a legal perspective?

A "road" is defined in the Road Act.
In this Act, a "road" is defined as a thoroughfare that is open to public use and is classified into the following types, under Article 3 Road Types:

1)National Expressways*1
2)National Highways*2
3)Prefectural Roads*3
4)Municipal Roads*4

■National Highway

National Highway No 20

■National Expressway

Ichinomiya Interchange
On Meishin Expressway

Definition:
*1: National Expressways form the strategic traffic network for automobiles across the country and connect areas of political/economical/cultural importance or areas that are critical to national interest. (Article 4 of the National Expressway Act)
*2: Together with National Expressways, National Highways form the strategic road network for the nation and meet the legal requirements. (Article 5 of the Road Act)
*3: Prefectural Roads form the regional arterial road network and meet legal requirements (Article 7 of the Road Act)
*4: Municipal Roads serve as a road network within a municipal jurisdiction. (Article 8 of the Road Act)



## Cost sharing of roads

Roads in Japan are classified into National Highways, National Expressways, Prefectural Roads and Municipal Roads depending on their road administators. The burden sharing for development/improvement and maintenance/repair activities is different based on this classification.

■Burden sharing in road development projects

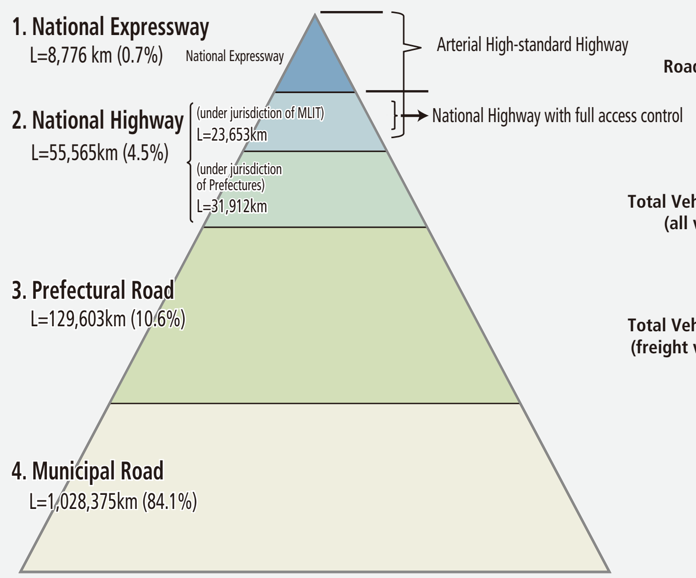
| Road Type | | Road Administrator | Burden is carried by | Burden Sharing | |
|---|---|---|---|---|---|
| | | | | Development/improvement | Maintenance/repair |
| National Expressway | Toll | Minister*1 〔Article 6 of the National Expressway Act〕 | Expressway Companies (NEXCOs) | Development, improvement and repair activities are carried out using a loan. The debt and management expense are repaid with toll revenue 〔Article 3 & 4 of the Act on Special Measures concerning Road Construction and Improvement〕 | |
| | Under jurisdiction of MLIT | | National Gov. Prefectures*2 | National Gov : 3/4 Prefectural Gov*2 : 1/4 〔Article 20 of the National Expressway Act〕 | National Gov : 10/10 〔Article 20 of the National Expressway Act〕 |
| National Highway | Under jurisdiction of MLIT | <Development/improvement> Minister*1 〔Article 12 of the Road Act〕 <Maintenance, Repair and other management> Designated section : Minister*1 Other : Prefecture*2 〔Section 13 of the Road Act〕 | National Gov. Prefectures*2 | National Gov : 2/3 Prefectural Gov*2 : 1/3 〔Article 50 of the Road Act〕 | National Gov : 10/10 〔Article 49 of the Road Act〕 |
| | Under jurisdiction of Pref.*2 | | National Gov. Prefectures*2 | National Gov : 1/2 Prefectural Gov*2 : 1/2 〔Article 50 of the Road Act〕 | Maintenance*3 : Prefectural Gov*2 〔Article 49 of the Road Act〕 Repair : Can be subsidized up to 1/2 by National Gov 〔Article 56 of the Road Act〕 |
| Prefectural Road | | Prefecture*2 〔Article 12 and 13 of the Road Act〕 | Prefectures*2 | Can be subsidized up to 1/2 by National Gov 〔Article 56 of the Road Act〕 | Maintenance*3 : Prefectural Gov*2 〔Article 49 of the Road Act〕 Repair : Can be subsidized 1/2 by National Gov 〔Article 1 of the Road Repair Act〕 |
| Municipal Road | | Municipality 〔Article 16 of the Road Act〕 | Municipalities | Can be subsidized up to 1/2 by National Gov 〔Article 56 of the Road Act〕 | Maintenance*3 : Municipalities 〔Article 49 of the Road Act〕 Repair : Can be subsidized 1/2 by National Gov 〔Article 1 of the Road Repair Act〕 |

*1 "Minister" refers to Minister of Land, Infrastructure, Transport and Tourism. *2 "Prefecture" includes ordinance-designated cities. *3 "Maintenance" includes repairs.
Note: Some national highways, prefectural roads, and municipal roads are maintained by Expressway Companies or Road Public Corporations.

## Lengths and travels by road type

Expressways account for only 0.7% of the total road length, while they account for 9% of the total vehicle kilometers traveled (VKT) and play a significant role in road traffic.

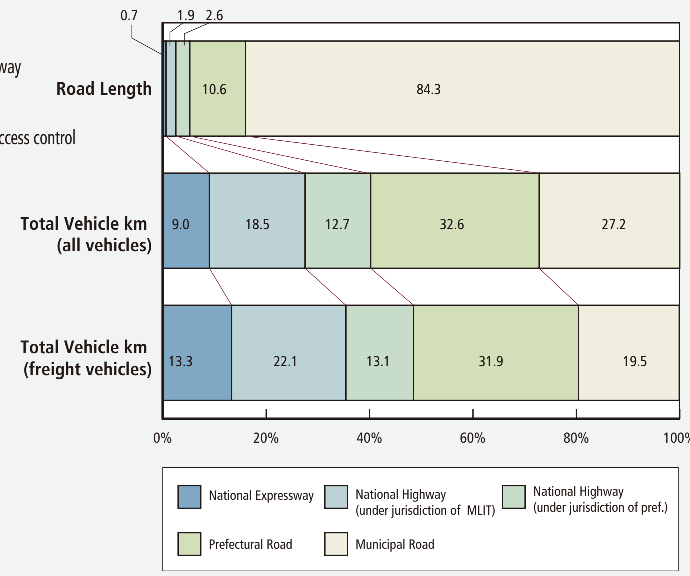
■Classification under Article 3 of the Road Act




Total Length = 1,222,319 km**

**iincludes very narrow roads. Total length of roads with enough width to pass a car coming the other way (i.e. 5.5m wide) is only about 340,000km.
As of 2016 April 1

■Road length and VKT by road type




Note:
Data about road length is from "Annual Report of Road Statistics 2013".
Data about vehicle km traveled is from "Road Traffic Census 2005" and "Annual Report of Automobile Transport 2005".
Data current as of Mar 2009 for National Expressways.
Data current as of April 1, 2007 for all other roads.

## Classification of arterial high-standard highway system

Arterial high-standard highways were created as a part of the rapid surface transport network across the country.
The total planned length is 14,000km

### ■Classification of arterial high-standard highway system

**[System]**

**Arterial High-standard Highway*** (Total length : 14,000km)

- **National Expressway** (Total length : 11,520km)
- **National Highway with full access control** (Total length : 2,480km)

**[Procedure]**

**National Expressway**

**Proposed route**

↓ Legally determined in the National Development Arterial Express Construction Act [11,520 km]

**Basic Plan**

↓ Decided by the Minister of Land, Infrastructure, Transport and Tourism after a discussion in the National Development of Arterial Automobile Roads Panel

**Development Plan**

↓ Decided by the Minister of Land, Infrastructure, Transport and Tourism after a discussion in the National Development of Arterial Automobile Roads Panel

**Section that is under direct jurisdiction of national government**

Difficult to make profitable
Financed by national and local governments
Toll-free

**Toll section**

Distant-base toll system
Throughout the nation
Use a pool system, which integrates more than one road in the redemption calculation.

**National Highway with full access control**

**Decision by Minister of Land, Infrastructure, Transport and Tourism**

↓ Master Plan [ 2,480 km]

**Basic Plan**

↓ Decided by the Minister of Land, Infrastructure, Transport and Tourism after a discussion in the Panel on Infrastructure Development (March 2009)

**Development Plan**

↓ Decided by the Minister of Land, Infrastructure, Transport and Tourism after a discussion in the Panel on Infrastructure Development (March 2009)

**Toll rate based on the individual highway profitability**
**Developed as both a public works project and a toll road project**

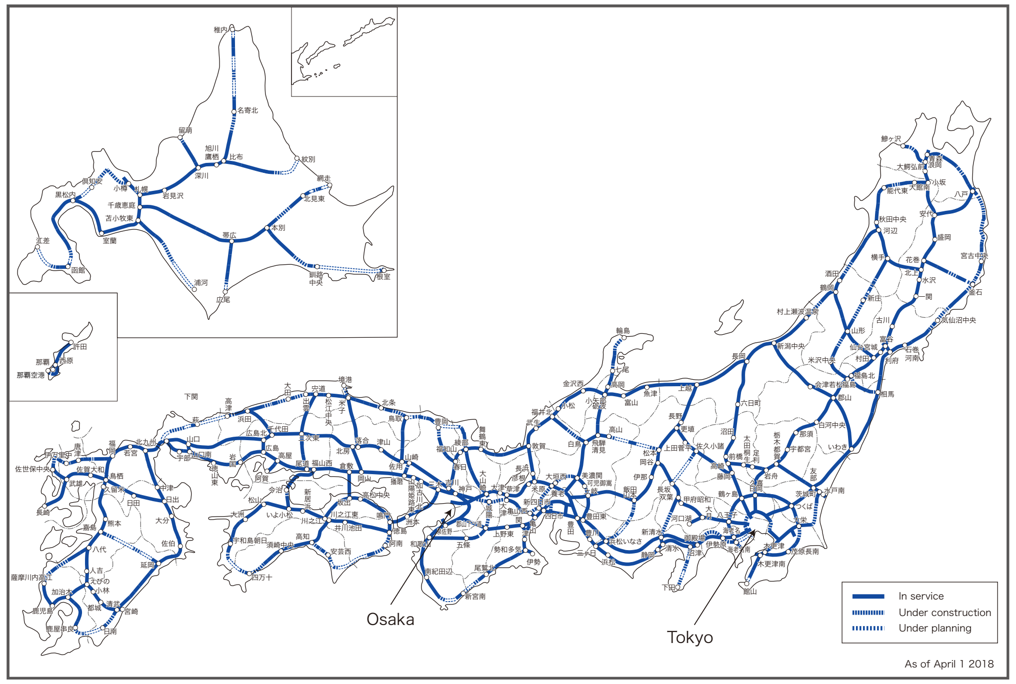
Projects mainly developed under the jurisdiction of the national government

* Planned as a strategic high-speed surface traffic network in "the Fifth Comprehensive National Development Plan" (decided by the Cabinet on June 30 1987 and "Grand Design of Japan for the 21st century" (decided by the Cabinet on Mar 31 1998).

## Arterial high-standard highway network

Arterial high-standard highways, which consist mainly of expressways, have been developed throughout the country.

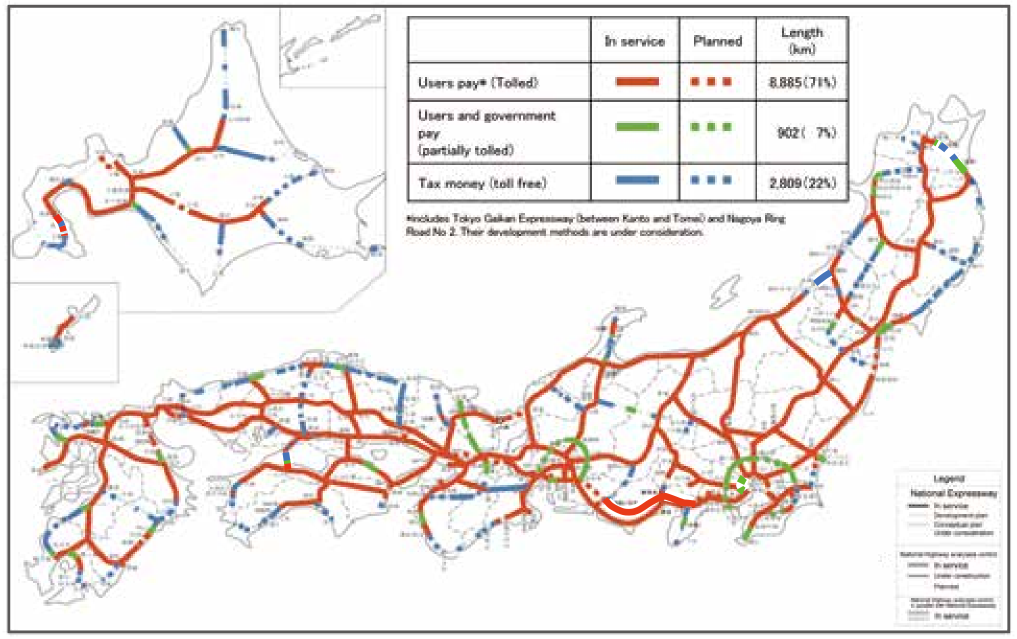
### ■Arterial high-standard highway network




## Burden sharing of arterial high-standard highways

As of April 2012, 10,000 km of arterial high-standard highways are in service. There are two types of highways in Japan: one is tolled highways and the other free highways.
Red lines indicate tolled highways, while blue and green ones indicate partly or fully financed by tax money because of insufficient profitability.

### ■Arterial high-standard highway network burden-sharing



# Toll road system in Japan

Rapid motorization accompanied by economic growth demanded networks of expressways and the government didn't have sufficient tax revenue to finance expressway development. That's why "Toll road system" was introduced. This system enables to repay the maintenance costs and construction debts of particular roads with the toll revenues that are collected from the road users.

### ■Introduction to the toll road system in Japan

**In response to the rapidly increasing traffic demand after World War II, immediate road development was necessary. However, additional financial resources were required , so a toll road system was developed.**

**A Toll Road System**

In 1952, **the Act on Special Measures concerning Road Construction and Improvement was enacted.**
The toll road system was introduced on public roads across the country.
(Project proponent: National, prefectural or municipal governments act as a road administrator.)

In order to expand the current toll road system, as part of the measure to immediately develop roads across the country, an organization needs to be established so that private funds will be widely introduced and comprehensive, efficient operations will be carried out. As such, in 1955 the Road Council recommended the creation of the Japan Highway Public Corporation (JHPC, provisional name).

In 1956, **a full-fledged revision of the Act on Special Measures concerning Road Construction and Improvement Act on Japan Highway Public Corporation was enacted.**
In 1959, the Act on the Metropolitan Expressway Public Corporation was enacted.
In 1962, the Act on the Hanshin Expressway Public Corporation was enacted.
In 1970, the Act on the Honsyu-Shikoku Bridge Authority was enacted.

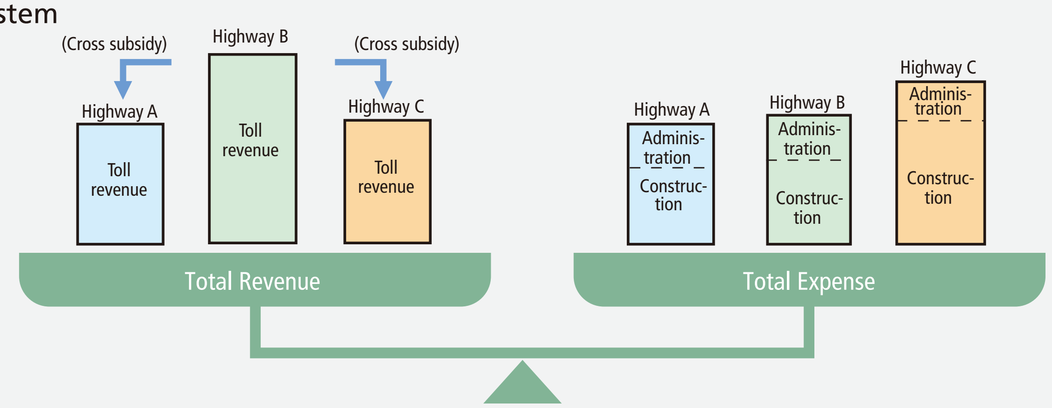
# Pool system

After the partial opening of the Meishin Expressway in 1963, a 3,400km plan, based on individual profitability, was developed and formulated by March 1972. By that time, 8 expressways, about 710km had been developed, including the Tomei Expressway and Chuou Expressway.

### 1972 Road Council Recommendation

1) Expressways should create an arterial network, wherein they connect to each other throughout the country. Each link is not necessarily considered independent and, therefore, the toll rates should remain consistent and integrated.
2) Under circumstances where development costs are affected largely by changing land costs and construction costs that depend on the length of time needed for construction, cost differentiation due to the start time of projects should be avoided. In addition, debt repayment should be smoothly carried out. Shifting from the individual profitability system to a pool system seems to be the most effective method to combat the aforementioned problems and ensure reliability.

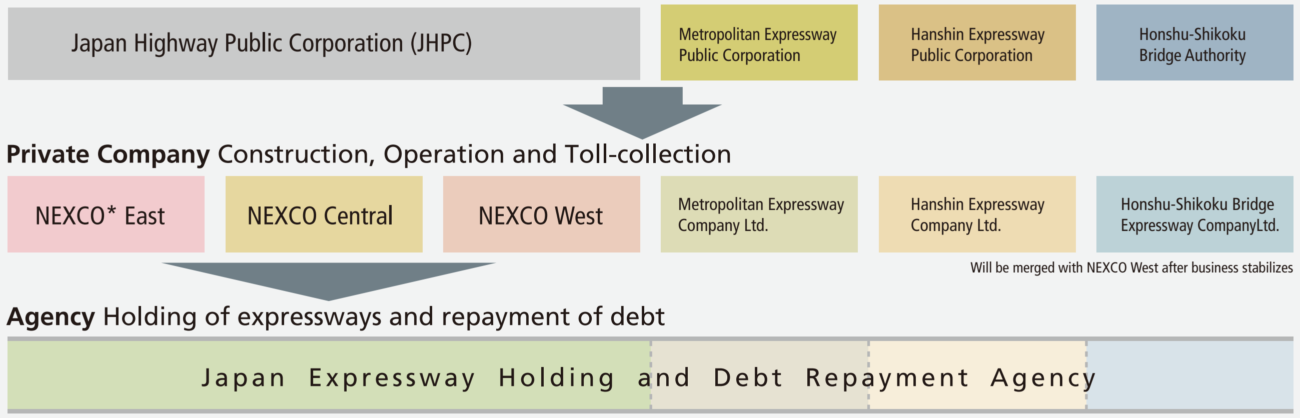
### ■Pool system




# Privatization of highway public corporation

-Secure the repayment of interest-bearing debts amounting to about 40 trillion JPY.
-Construct, without delay, genuinely needed expressways with minimum fiscal burden on the general public, while paying due respect to the autonomy of the Companies.
-Offer diverse and flexible prices and services for expressway users by utilizing the private sector's kno

### ■Organizational chart after privatization

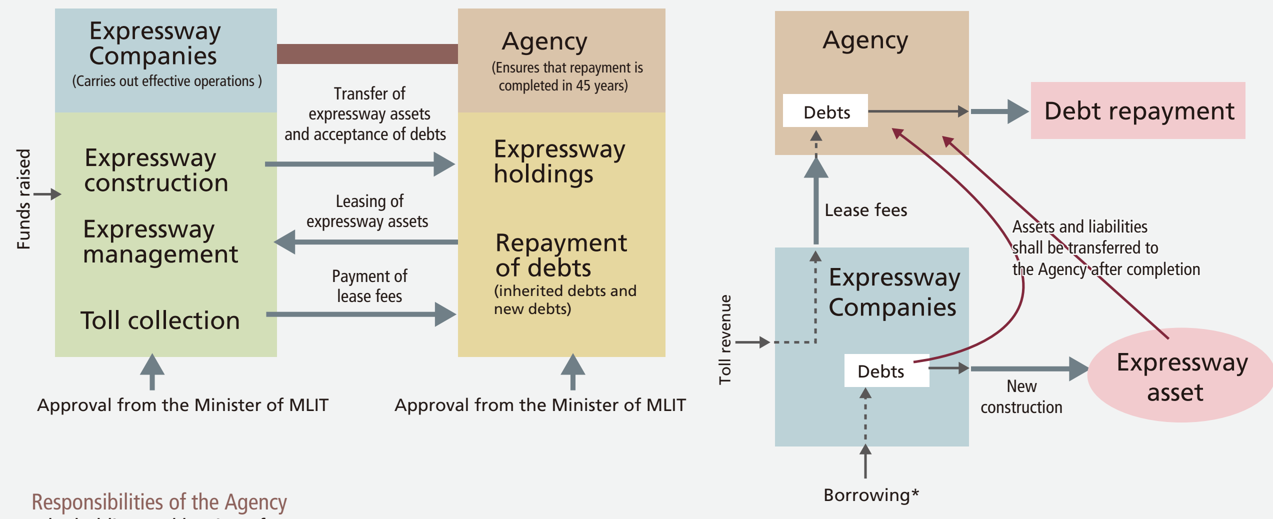



**Privatization was based on the following acts**
-Expressway Company Law
-Japan Expressway Holding and Debt Repayment Agency Law
-Law Regarding the Development of Highway-Related Laws in Connection with the Privatization of the Japan Highway Public Corporation
-Act for Enforcement of Acts Related to Privatization of the Japan Highway Public Corporation, etc.
*NEXCO: Nippon Expressway Company

# Business scheme

-Expressway Companies are responsible for the construction of new roads which are funded through loans, before transferring the expressway assets and the corresponding debts to the responsible Agency.
-The Agency is then responsible for completing the repayment of debts within 45 years, using the revenue earned from the roads.

### ■Business scheme




Responsibilities of the Agency
-The holding and leasing of expressway assets
(property tax is exempted based on the premise of free service in the future)
-To ensure early repayment of the debts and thus reduce the public's burden
-To support expressway companies in carrying out their business successfully

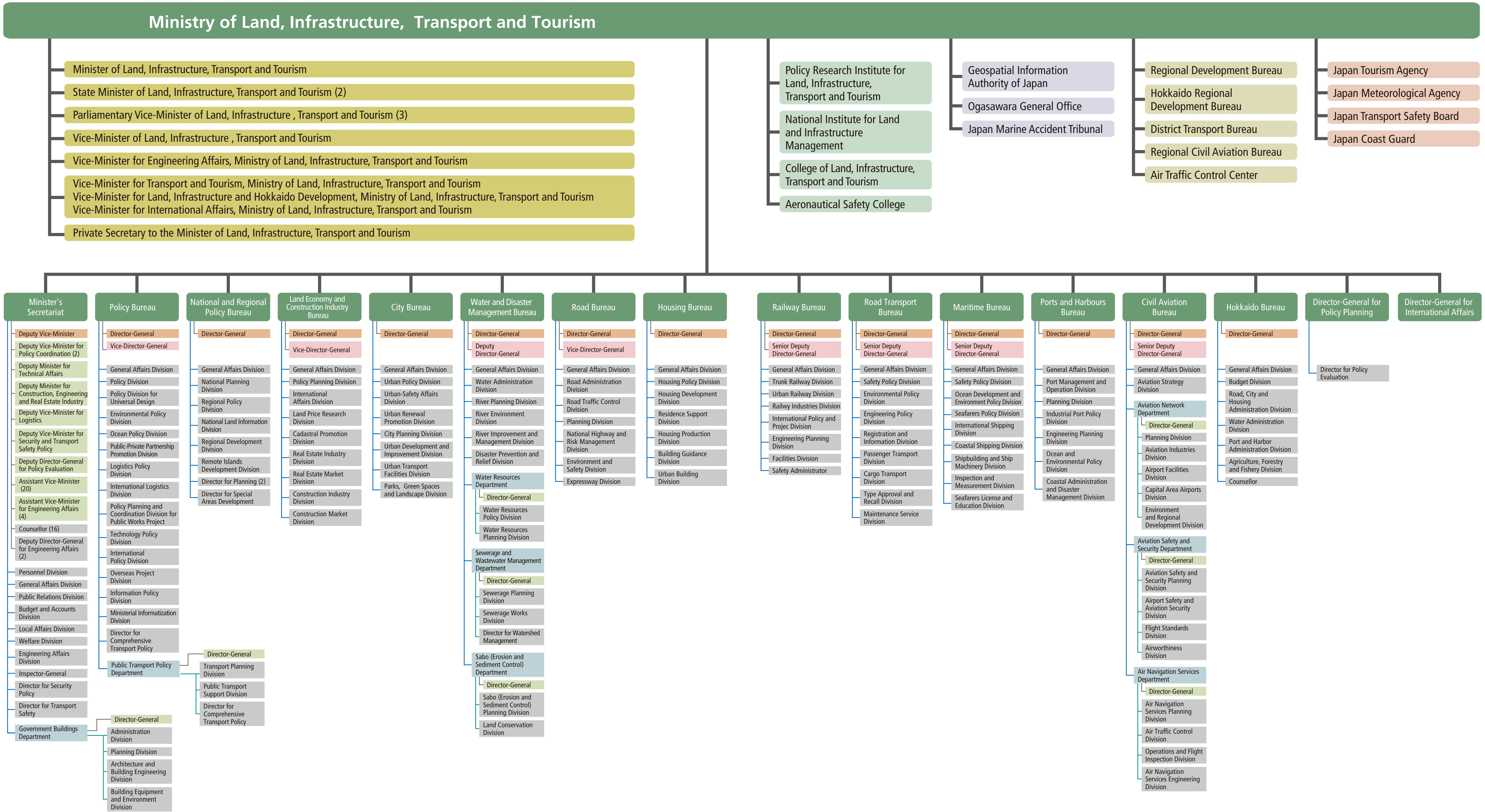
*borrowed from both national and local governments for construction (and this money is loaned to the companies at no interest)

# Administrative Organization

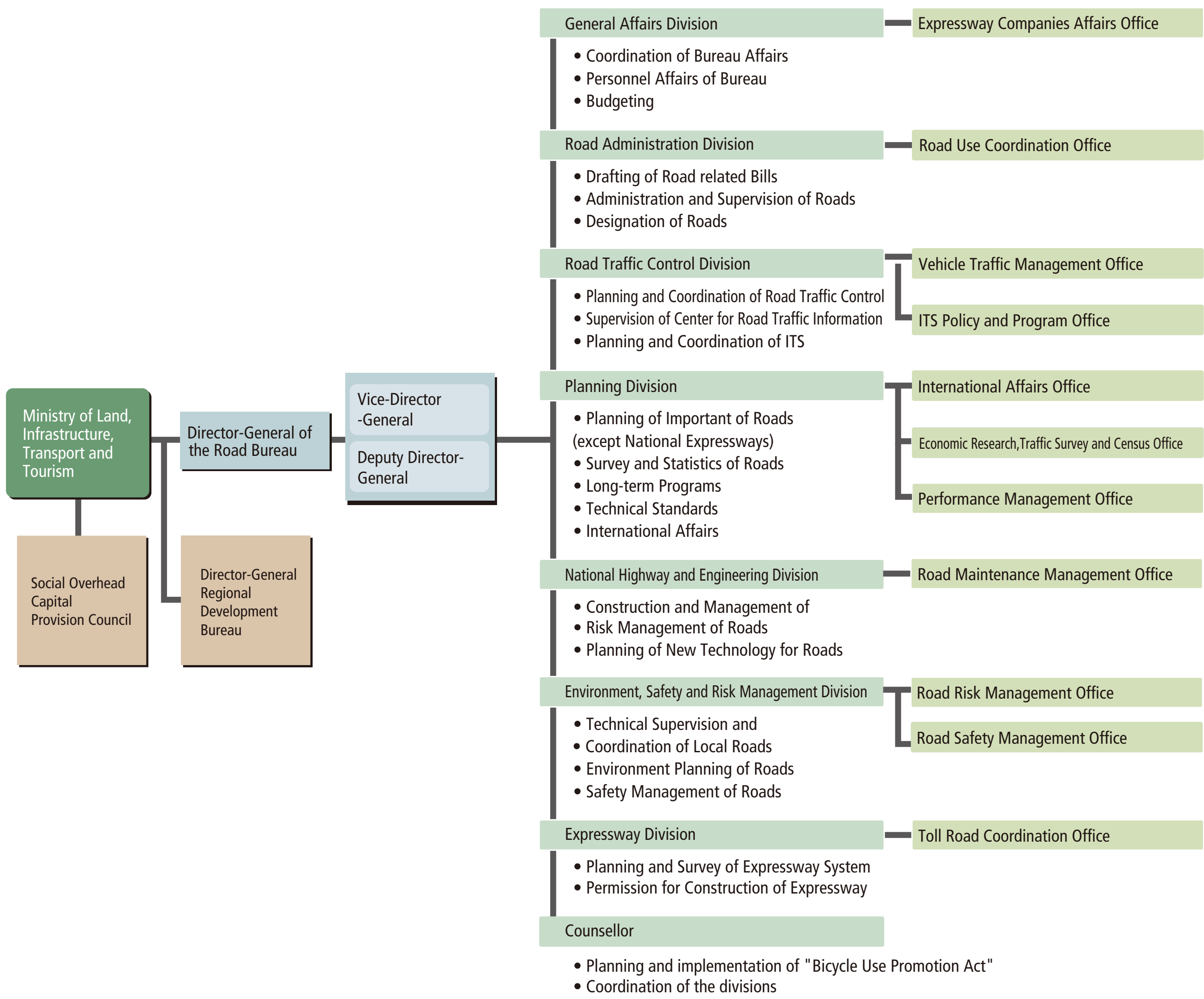
**The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) is in charge of the comprehensive and systematical use of national land, development and conservation, consistent infrastructure development, implementation of transport policies, development of meteorological service, and maritime safety and security. Below is the chart showing the organization of the MLIT.**

## ■Organization Chart of MLIT

(As of July 1, 2015)



## Organization Chart of Road Bureau




As of April 1, 2018

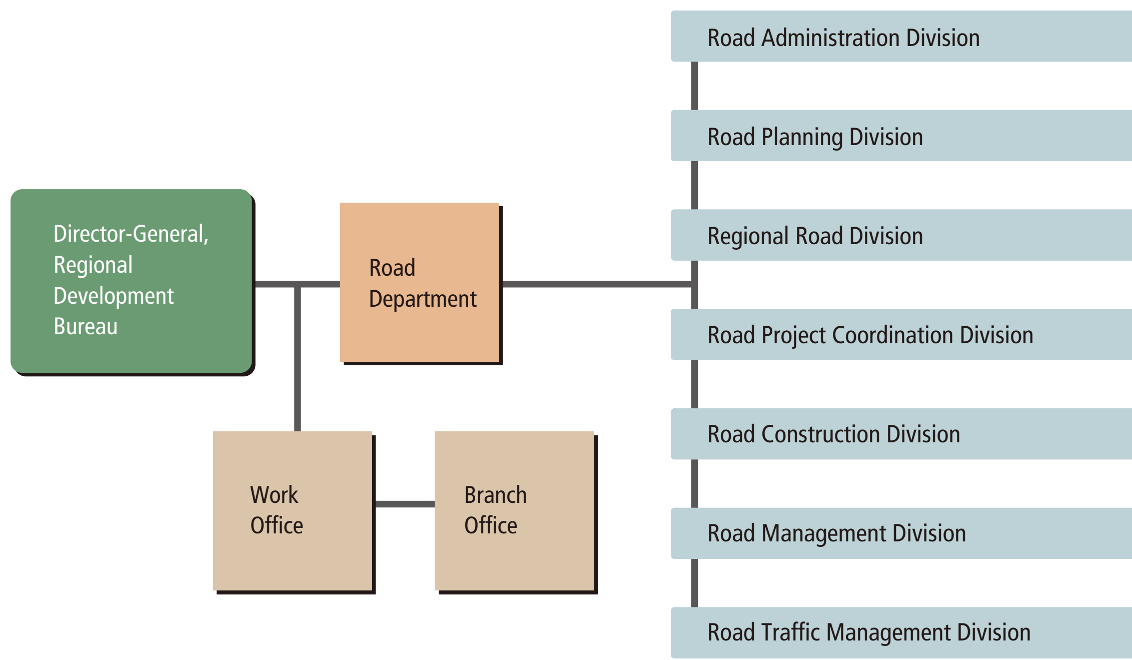
## Regional Development Bureaus

Ministry of Land, Infrastructure, Transport and Tourism Headquarters Offices

| 10 Regional Development Bureaus | 89 Offices | 272 Branches |
|---|---|---|
| Hokkaido Regional Development Bureau | 10 Offices | 33 Branches |
| Tohoku Regional Development Bureau | 13 Offices | 46 Branches |
| Kanto Regional Development Bureau | 15 Offices | 51 Branches |
| Hokuriku Regional Development Bureau | 6 Offices | 22 Branches |
| Chubu Regional Development Bureau | 13 Offices | 35 Branches |
| Kinki Regional Development Bureau | 12 Offices | 34 Branches |
| Chugoku Regional Development Bureau | 9 Offices | 26 Branches |
| Shikoku Regional Development Bureau | 7 Offices | 15 Branches |
| Kyushu Regional Development Bureau | 13 Offices | 35 Branches |
| Okinawa Regional Development Bureau | 2 Offices | 6 Branches |

As of April 1,2018

## Organization Chart of a Regional Development Bureau



# Planning and Implementation of Projects

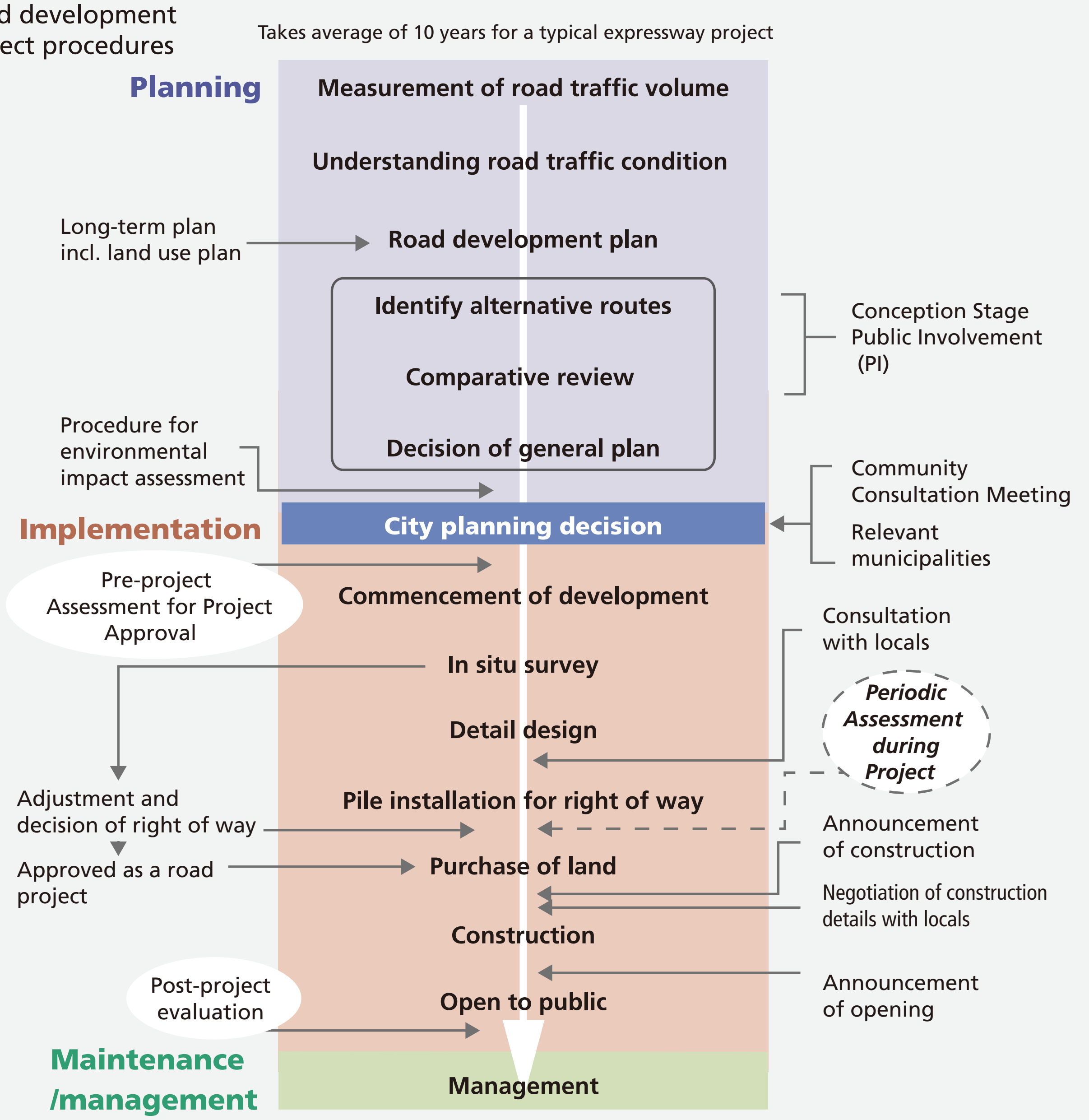
**This section describes how road projects are evaluated in order to achieve accountability**

## Implementation of an evaluation system

To improve efficiency and transparency, project evaluation is conducted throughout the entire process, from preparation to execution and servicing. The first evaluation is conducted while planning a new project and involves cost-benefit analysis. Projects that are not complete within five years of their start date are reassessed, and those that are found to be no longer necessary or no longer effective are discontinued or cancelled. Projects are also assessed when they are completed.

In order to evaluate the sustainability of a project, the economic, environmental and social effects of the projects should be assessed. Economic and environmental impacts are assessed through cost-benefit analyses and environmental assessments respectively.

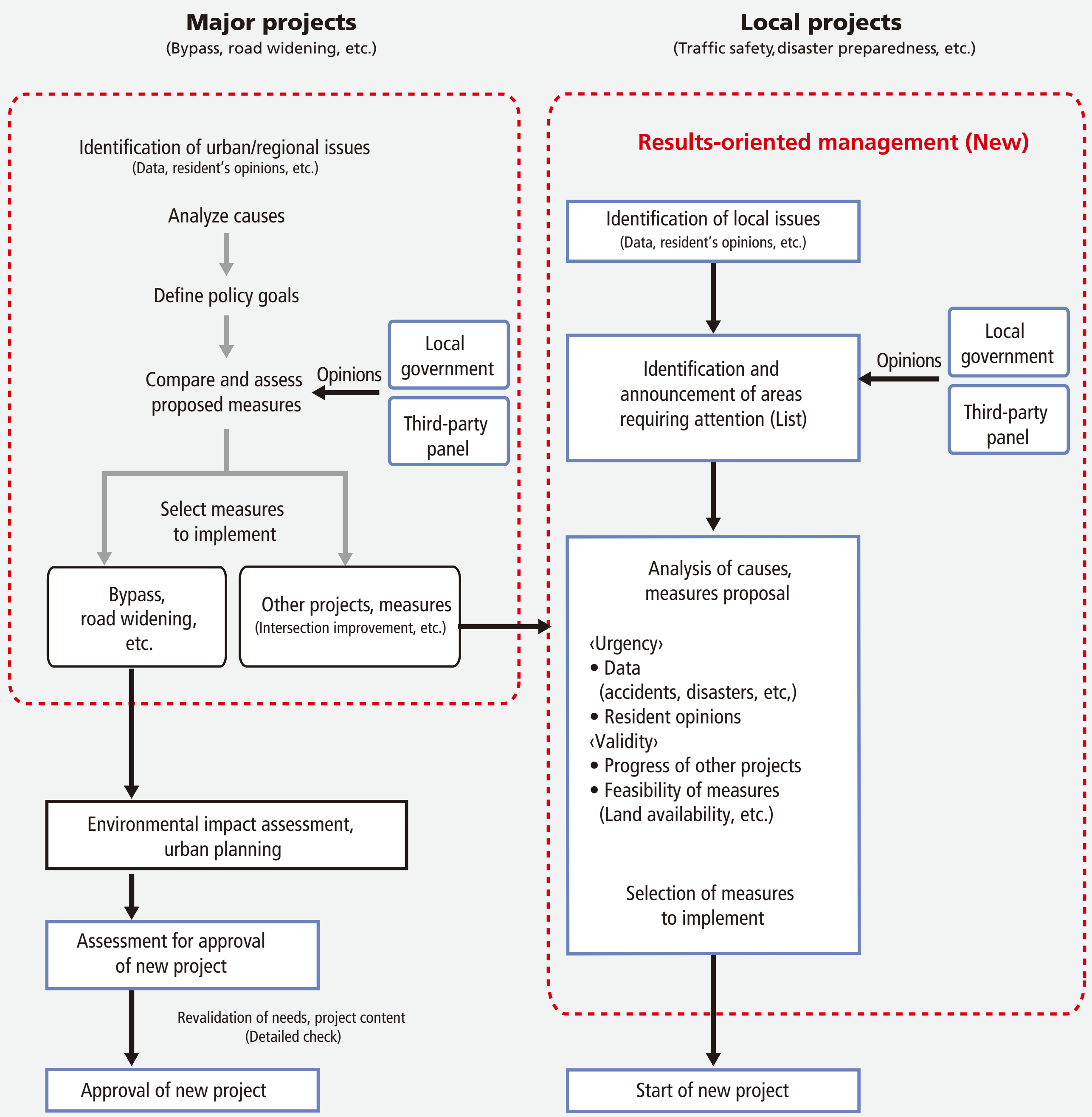
■ Road development project procedures




## Assessment of policy goals for road projects

To enhance the transparency and efficiency of road projects, reviews have been introduced into the planning stage of bypass, road widening and other projects, and "outcome-based management" practices, which are based on data, have been introduced in local projects.

■ Planning review and outcome-based management flowchart



## Road development planning

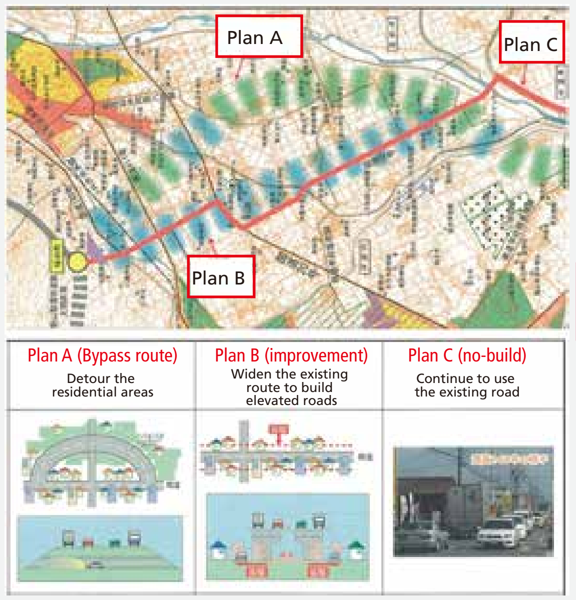
Roads in Japan are generally developed through the following procedure to make sure to choose the optimal route.

### ■Road development planning

| | |
|---|---|
| **Measurement of road traffic volume** | Covers vehicles, bicycles and pedestrians for the purposes of; (1) Traffic volume (2) Origin and destination (3) Condition of road development |
| **Assessment of road and traffic condition** | Assess the current condition such as traffic volume and traffic safety of the existing roads. |
| **Road development plan** | Determine the road type and plan the fundamental design (number of lanes and cross-section) |
| (1) **Identify alternative routes** | Identify multiple routes for comparison in the light of the plan. |
| (1) **Comparative review** | Make a comparison with other routes with respect to nature, structure, care for control-points* and economy before deciding the optimal route. |
| (2) **Decision of general plan** | |

*Control-point: a spot where a route should avoid because of its societal condition such as shrines and temples or landslide-prone areas.

(1)




(2)


## Road development process

After a city planning decision was made, roads are developed taking the following steps while making sure to build the consensus of the local residents.

### ■ Implementation of road projects

**City planning decision**

**Commencement of development**

**Community Consultation Meeting** — Explain measurement to the parties involved

(1) **In situ survey** — Install piles for center mark during the land survey

(1) **Detail design** — Designed based on the survey data (S=1/1,000)

**Consultation with locals** — Explanation of details to the parties involved using the design together with indemnity for land loss.

(2) **Pile installation for right of way** — Install piles to mark right of way

(2) **Measurement of lands** — Measurement of properties, both lands and buildings (owners are asked to be present to confirm measurements)

(2) **Land acquisition negotiation** — Negotiation with the parties involved on the indemnity for land loss

— Payment of indemnity for land loss following conclusion of agreement

**Explanation of construction plan** — Explanation of the construction methods and construction safety to the parties involved

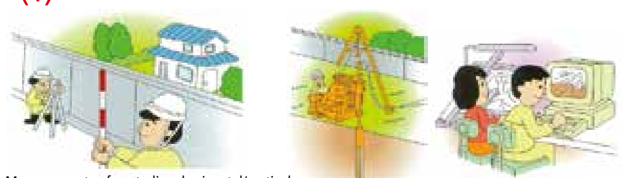
* Further survey of buried cultural properties is to be conducted as necessary

**Construction**

**Completion/open to public**

Maintenance/ management

(1)



Measurements of centerline, horizontal/vertical profiles and geological are carried out.

(2)

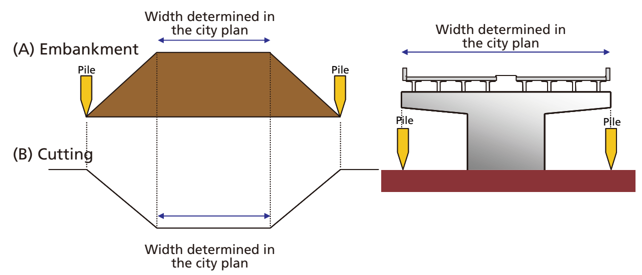
Land measurement/survey is carried out after explanation to the owners.

Negotiation of compensation is conducted.

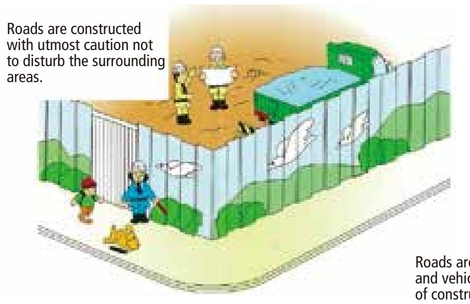
### 【Pile installation】

(1) Structures at grade

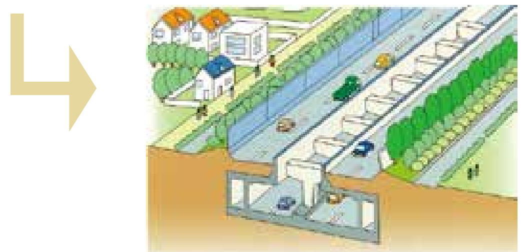
(2) Elevated structures




Roads are constructed with utmost caution not to disturb the surrounding areas.



Roads are open to pedestrians and vehicles after completion of construction.



## Environmental impact assessment (EIA)

An assessment system in which a project proponent identifies/predicts/evaluates the potential impacts of the project on the environment prior to the decision being made on the details. In order to create an improved project, this collected information is available to the public and municipalities so that they can add their input.

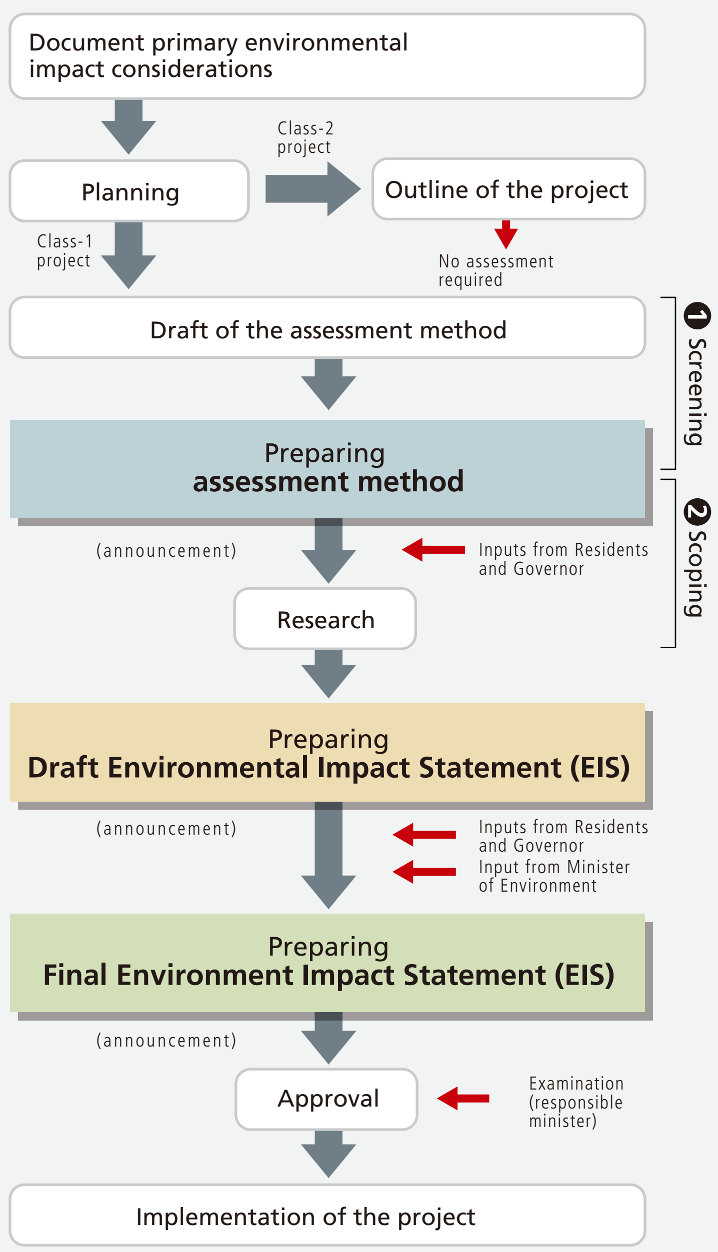
### ■Road projects that have to be assessed

| | Class 1 | Class 2 |
|---|---|---|
| National Expressway | All | ――――― |
| Tokyo Metropolitan Expressway | 4 lanes or more | ――――― |
| National Highway | 4 lanes or more,10km or longer | 2 lanes or more, 15km-20km |
| Large-scale Forest Road | 2 lanes or more, 20km or longer | 2 lanes or more, 15km-20km |

Class 1
A large-sized project with potentially significant environmental impacts.

Class 2
A large-sized project that requires an assessment to determine whether it has significant environmental impacts. A large-sized project that requires an assessment to determine whether it could have significant environmental impacts.

### ■Road projects that need to be assessed




**❶Screening**
Screening process to decide whether the project needs further EIA processing.

**❷Scoping**
Determining scope of the assessment including evaluation items, method and framework.

**Assessment method**
Document identifying method
Prepared by the project proponent identifying the evaluation items, method and other details.

**Draft EIS**
A draft summary of the assessment results for hearing opinions of residents and governor.
Prepared by the project proponent prior to implementation on the survey, prediction, evaluation and measures.

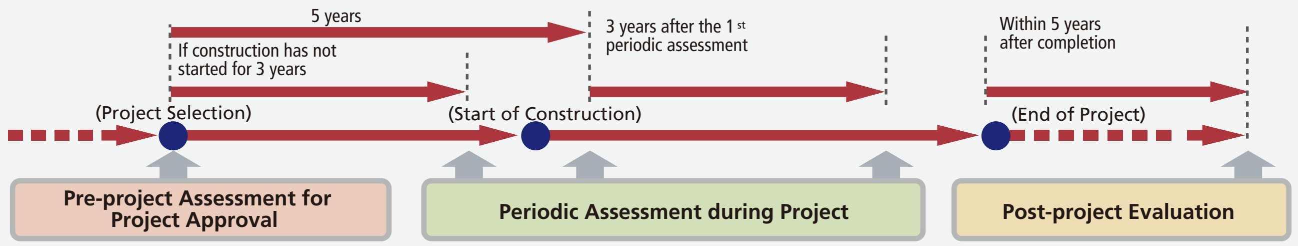
**Final EIS**
Modified form of environmental impact statement with the improvements taking into consideration the inputs of residents and governor.
Prepared by the project proponent taking local opinions into consideration.

## Road project assessment

Road project assessment is carried out at various phases of the project; assessment at planning phase, pre-project assessment phase, during project and post-project phase.

### ■Road project assessment

•Target of the project assessment : New development or improvement
•Evaluation proponent : Project proponent (MLIT, municipalities or the kind)



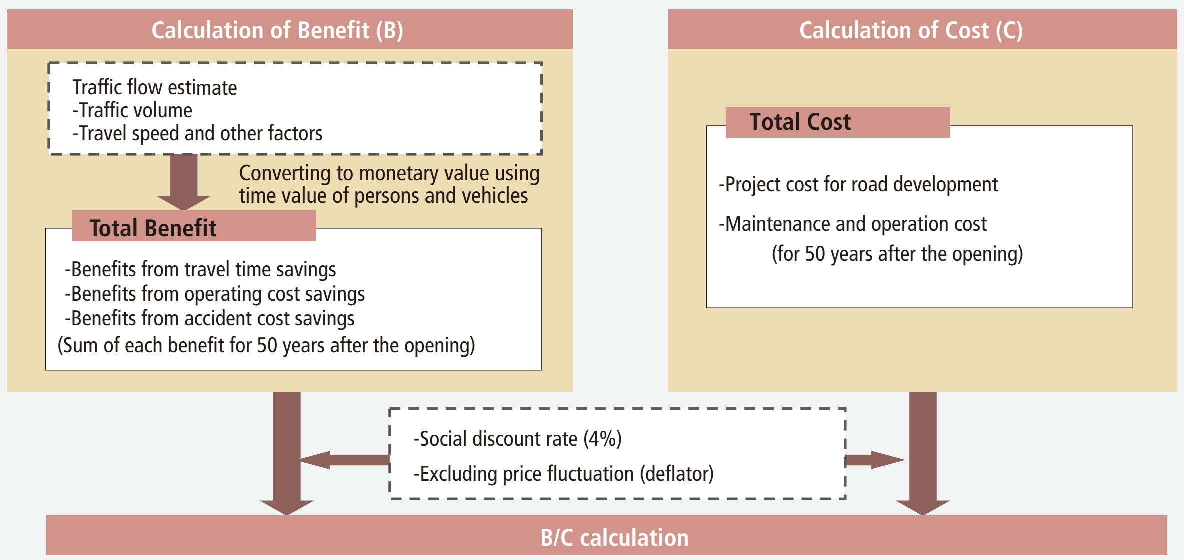

| | |
|---|---|
| **1) Pre-project assessment for project approval**<br>Project assessment including a cost-benefit analysis is conducted when approving a new project.<br>**This procedure was introduced in FY 1998.** | Total : 1,458projects<br>(no pertinent project in FY2009) |
| **2) Periodic assessment during project**<br>When a project has not started for 3 years after approval or when a project is still in progress for 5 years, another assessment will be conducted and any necessary improvements will be made. If the continuation of the project is found to be inappropriate, it will be abandoned. **This procedure was introduced in FY 1998.** | Total : 3,397projects<br>Of which reviewed projects : 72<br>terminated projects : 32<br>FY2009 : 102projects<br>Of which reviewed projects : 4<br>terminated projects : 0 |
| **3) Post-project evaluation**<br>Post-Project evaluation is carried out in order to confirm its effectiveness and environmental impacts.<br>As necessary, improvements and appropriate planning and researching for similar projects are examined.<br>**This procedure was introduced in FY 2003.** | Total : 217projects<br>(FY2009 : 29projects) |

Oversight of the third person — Independent Committee on Oversight of Project Evaluation is formed by each local office and public body for Periodic Assessment during Project and Postproject Evaluation

## Cost-benefit analysis of a road project

Cost-benefit (B/C ratio) analysis for road project is made to assess adequacy of the project from the social and economic aspects.

### ■Cost-benefit (B/C Ratio) calculation



## Benefits from travel time savings

Time values of human activities, vehicle user and freight are considered.

### Travel time savings

**Measured as a difference in the value of travel time before and after a new road is opened.**

Benefits from travel time savings = (Value of travel time Before the road is opened)-(Value of travel time After the road is opened)

**The value of travel time is a product of the time value unit multiplied by travel time and by volume.**

Value of travel time (yen) = time value unit (yen/vehicle-minutes) x travel time (min) x traffic volume (vehicles)

**What consists of the time value unit?**

**Time value unit**

The monetary value of one minute that is saved by one vehicle. (Unit: yen/vehicle-minutes)

- **Time value of *human activities***
  (Monetary) value of time savings that can be used for extra human activities such as labor and leisure.
- **Time value of *vehicle use***
  (Monetary) value of time savings that can be used for extra production activities by unused vehicle.
- **Time value of *freight***
  (Monetary) value of time savings from reduced travel time of freight

## Benefits from operating cost savings

Costs for fuel, engine oil, tire and tube, maintenance and depreciation are considered.

### Operating cost savings

**Measured as a difference in operating cost before and after a road is opened.**

Benefits from operating cost savings = (Operating costs Before the road is opened)-(Operating costs After the road is opened)

**The operating cost is calculated by multiplying the operating cost unit by length and by traffic volume.**

Operating cost (yen) = operating cost unit (yen/vehicle-km) x length (km) x traffic volume (vehicles)

**What consists of the operating cost unit?**

**Operating cost unit**

| | |
|---|---|
| **Fuel cost** | Costs for fuel |
| **Engine oil cost** | Cost for engine oil |
| **Costs for tire and tube** | Costs for tire and other |
| **Maintenance cost** | Costs for maintenance and repair |
| **Depreciation** | Reduction of vehicle value after travelling a unit distance. |

## Benefits from accident cost savings

Congestion-induced cost, physical damage and human damage are considered.

### Accident cost savings

**Measured as a difference in accident cost before and after a road is opened.**

Benefits from accident cost savings = (Accident costs Before the road is opened)-(Accident costs After the road is opened)

**The accident cost is calculated by multiplying the cost per injury/fatal accident by the number of injury/fatal accidents.**

Accident cost (yen) = number of injury/fatal accident (accidents) x cost per injury/fatal accident (yen/accident)

**Formula for cost per injury/fatal accident**

Injury/fatal accident rate x Traffic volume x Road segment length or number of major intersections

**Formula for cost per injury/fatal accident**

Per-accident cost due to congestion
+
Per-accident property damage
+
Per-accident human damage



# Administrative Management

**Together with regional public corporations, NPOs and other citizens' groups, the Japanese government is currently putting its efforts toward enhancing administrative management for roads. In order to achieve more effective, efficient and transparent road administration, Japan has promoted result-oriented administrative management for roads.**

## Establishing a well-organized evaluation system

Currently, road administrative management is conducted according to the PDCA cycle (PLAN-DO-CHECK-ACT cycle), whereby: policy goals are determined by using performance (outcome) indicators (PLAN); policy measures and projects are executed (DO); results are analyzed and achievements are evaluated (CHECK); and the results are reflected in subsequent administrative activities (ACT).

### Target and past performance measured by KEY Performance Indicators (KPIs) specified in the Priority Plan for Social Infrastructure Development

(five years, FY 2012-2016)

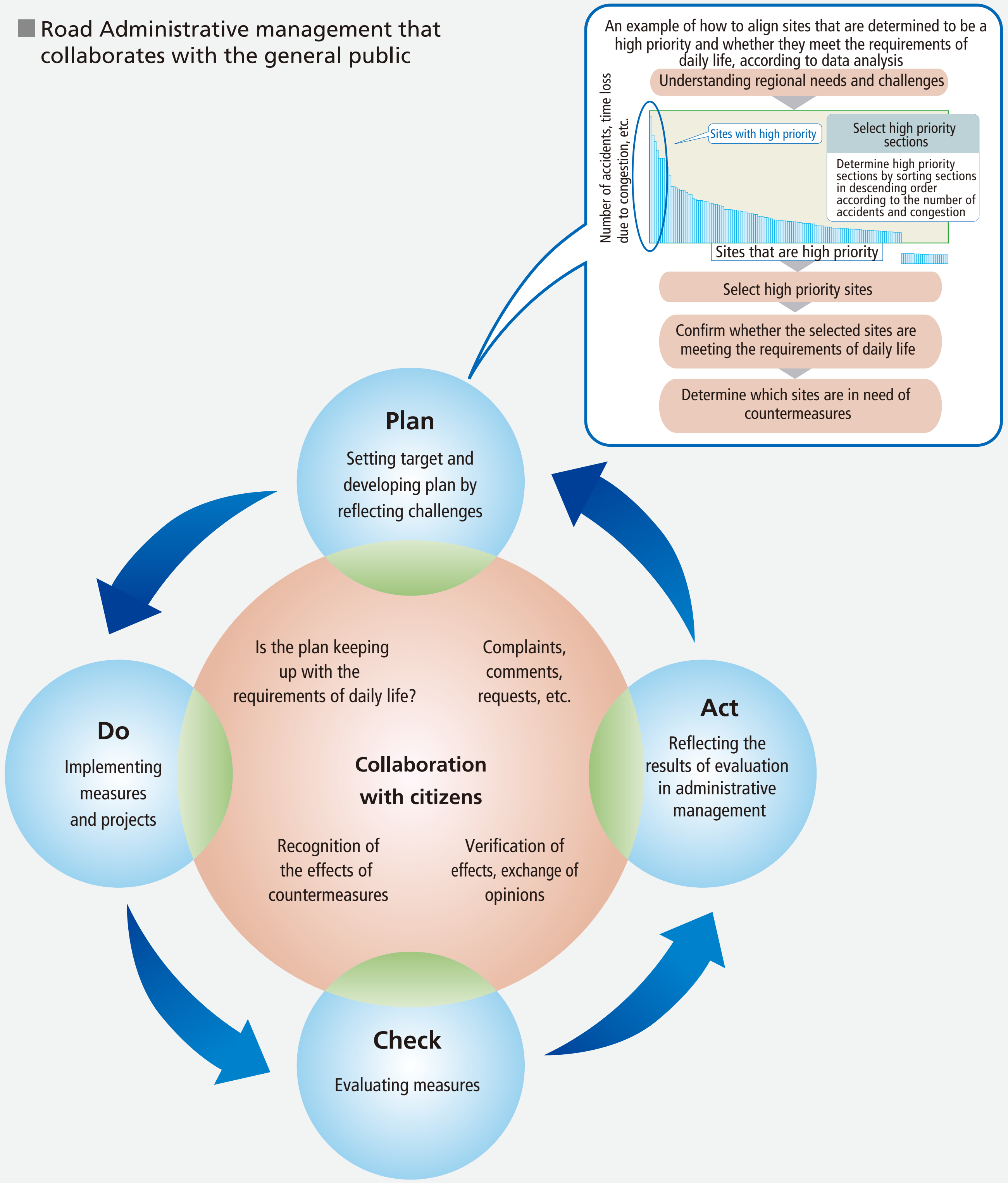
| Objective | Measure | KPI | Actual performance | | Target |
|---|---|---|---|---|---|
| | | | 2012 | 2013 | 2017 |
| 1. Reduce disaster risks on a large scale or in wide areas | 1-1 Improve earthquake-resistance strength of infrastructure and implement other non-infrastructure measures to protect against earthquakes. | Number of quake-resistant bridges on emergency routes (percentage) | 77% (as of the end of FY2010) | 78% (as of the end of FY2011) | 82% |
| | | Number of power lines on arterial roads in urban areas that are buried under ground | 15% | 15.3% | 18% |
| | | Number of road links that provide a fast connection between major cities*1 | 46% (as of the end of FY2010) | 47% (as of the end of FY2011) | About 50% |
| | 1-2 Protect massive or region-wide tsunami-prone areas and improve the protection of areas below sea level, which either have a large population or a significant number of assets, from high tide water and abrasion. | Number of power lines on arterial roads in urban areas that are buried under ground (percentage) | 15% | 15.3% | 18% |
| | 1-3 Enhance flood and large-scale landslide control measures to protect areas with a large population or a significant number of assets or areas that, in recent years, have been prone to significant damaged. | Number of improved slopes and embankments that were in need of protection (percentage) | 54% (as of the end of FY2010) | 56% (as of the end of FY2011) | 68% |
| 2. Enhance infrastructure across the country for the benefit of industry and the economy, in order to boost international competitiveness | 2-1 Expand and enhance capacity and accessibility of large cities, ports, and airports that are internationally competitive and promote overseas projects through public-private cooperation. | Length of ring roads in operation in the three largest metropolitan areas (percentage) | 56% | 58% | About 75% |
| | 2-2 Maintain and enhance progress by stressing the unique strengths and charm of each area. | Number of power lines on arterial roads in urban areas that are buried under ground (percentage) | 15% | 15.3% | 18% |
| | | Number of road links that provide fast connections between major cities (percentage)*1 | 46% (as of the end of FY2010) | 47% (as of the end of FY2011) | About 50% |
| 3. Achieve a sustainable and vibrant society and regional communities | 3-1 Create a model for a sustainable and energy-efficient life style and encourage the adoption of this lifestyle domestically and internationally. | Time lost due to railroad crossings that are closed for a long time | 1.28 million person-time/day | 1.24 million person-time/day | 1.21 million person-time/day |
| | 3-2 Promote a safe and secure society in this era of aging population, which correlates with a rate of childbirth. | Percentage of specified roads with barrier-free elements | 77% | 81% | About 100% (as of the end of FY2020) |
| | | Number of power lines on arterial roads in urban areas that are buried under ground (percentage) | 15% | 15.3% | 18% |
| | | Reduction of fatal and injury accidents at accident-prone locations (percentage) | - | - | Reduction of fatal and injury accidents by 30% |
| | | Length of sidewalks provided for school routes (percentage)*2 | 51% (as of the end of FY2010) | 52% (as of the end of FY2011) | About 60% |
| 4. Maintain, manage, and reconstruct social infrastructure in a proper manner | 4-1 Promote life extension of infrastructure, where applicable. | Number of plans for extending road bridge life across the country (percentage) | 76% | 89% | 100% |

*1 Number of road links that provide fast connection between major cities: "fast connection" is defined as 60km/h or higher when the length of the shortest route between cities is divided by the shortest travel time.
*2 "School route": specified in the Article 3 of the Act on Advancement of Traffic Safety Facilities Improvement Program.
Excerpt from "Chapter 3 Outline of Priority Objectives and Projects during the Target Period" in "the Priority Social Infrastructure Development Plan" (decided by the Cabinet on August 31, 2013)

## Effective implementation of projects by selection and concentration

To effectively implement each project, data analysis is conducted on each policy issue. This allows for the clear identification of sites and sections that are in particular need of substantial countermeasures. Road administration becomes more effective, efficient and transparent when the general public is consulted at each stage of the PDCA cycle.  For example, regional needs and challenges can be better understood and confirmed when input from the public is solicited about which sites to select.

■ Road Administrative management that collaborates with the general public






# Chapter 2

# Safety and Security

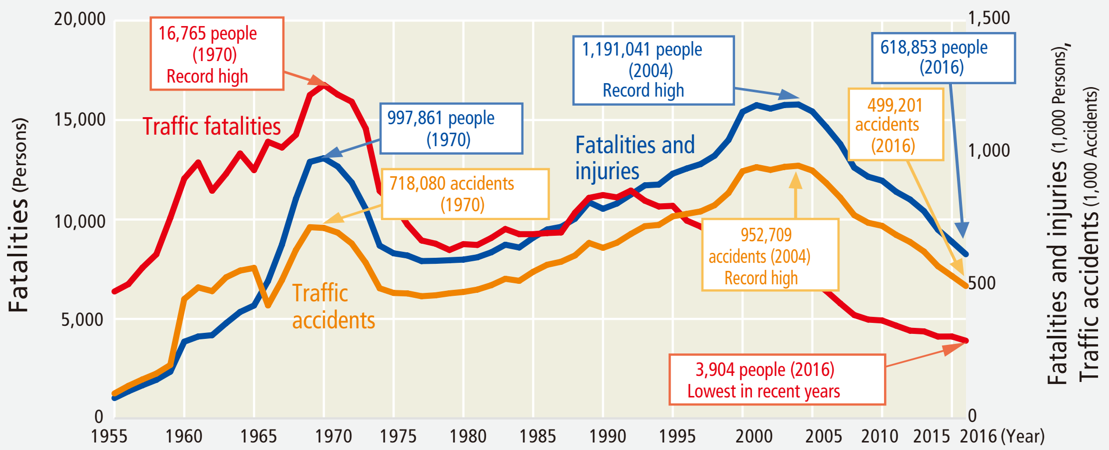
Japan is a country with beautiful natural scenery, which changes from season to season, but also has steep land formations, weak geological features and is prone to earthquakes, storms, heavy snowfall and other natural disasters. Traffic accident fatalities and casualties are also rising with traffic-related deaths of about 4,500 and traffic-related casualties reaching 800,000, signifying that one out of every 140 people is injured or dies in a traffic accident a year.

Diverse measures are being implemented to prevent disasters and accidents; mitigate damages; enable quick restoration; improve the safety and security of road traffic; and create comfortable living environments.

# Road Safety

**Since the 1990s, the number of road fatalities has steadily declined, falling below 4,500 in 2012. However, the annual number of road fatalities and injuries remains over 800,000. Pedestrians, particularly the elderly, account for a larger proportion of fatalities in Japan.**
**Therefore, authorities have been implementing various safety actions on both arterial and local roads.**

### ■Trends in the number of road traffic accidents, fatalities and injuries



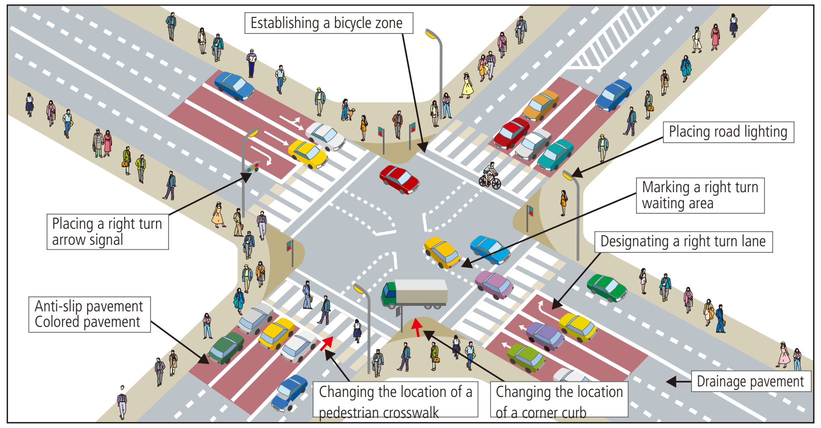

＊1 Up until 1959, accidents causing minor injuries (injuries treat able in less than eight days and property damage less than 20,000 yen) were not included.
＊2 In and after 1966, the number of accidents does not include property damage.
＊3 In and before 1971, Okinawa Prefecture is not included in the numbers of accidents, fatalities and injuries.

Source: Data from the National Police Agency

## Actions for reducing accidents on arterial roads

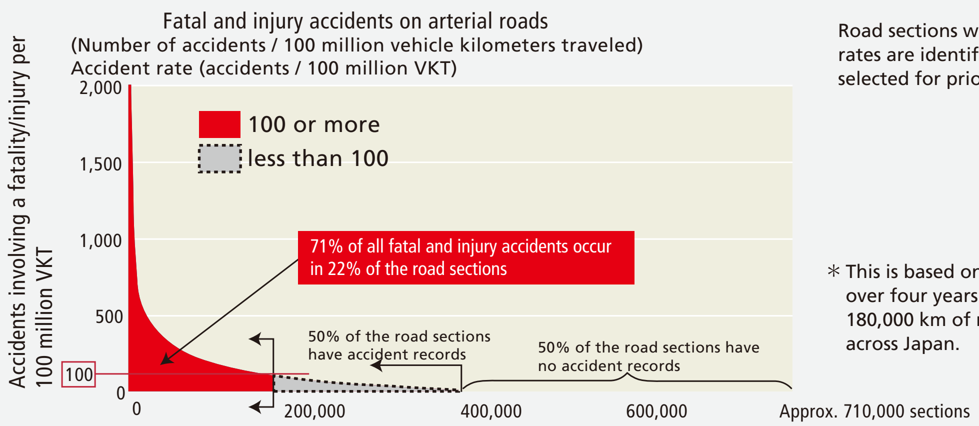
The government identified 3,396 arterial road sections across the country where fatal or injury accident rates (accidents per VKT) were particularly high.
Prefectural public safety commissions and road administrators gave higher priority for actions to be taken on these segments.

### ■An example of safety actions for arterial roads




### ■Identifying accident black spots

● Accident occurrence on arterial roads




Road sections with higher fatal and injury accident rates are identified as accident black spots and selected for priority actions.

＊This is based on the average accident occurrence over four years (2003-2006) for approximately 180,000 km of national and prefectural highways across Japan.



## Safety actions for local roads

Meticulous safety actions are implemented on local roads, in partnership with residents and related organizations, by applying a problem solving cycle, which starts with problem identification and sorting and ends with post evaluation of its benefits.

### ■Safe areas for pedestrians

**Arterial roads**

■ **Intersections**
- Providing right-turn lanes and geometrical improvements

■ **Parking enforcement**

■ **Traffic signals**
- Signal optimization based on traffic volume
- LED traffic signals
- Barrier-free traffic signals for the elderly and the visually impaired

**Route measures**

■ **Non-motorized users**
- Development and improvement of sidewalks, bicycle routes and shared spaces
- Removal of electric poles by Underground installation of electric cables

**Residential zones**

Introducing zones where pedestrians and bicycles take priority over vehicles

Speed regulation within the zone (Public Safety Commissions)

Chicane

Speed bump

## Improvements at railroad crossings

A survey on road traffic in 2006, which evaluated approximately 36,000 railroad crossings across the country, revealed that about 1,800 crossings urgently needed actions to ease traffic congestion. Comprehensive and intensive schemes have been carried out at these crossings by using both minor actions, such as widening pedestrian paths, and major improvements, such as grade separation.

**Grade separation projects**

Before improvement

After improvement

The program helped safety improvements to expedite the movement of vehicles by eliminating railroad crossing at grade with a grade separation, a structure that separates the vehicle roadway from the railroad tracks by a bridge.

## Road space for cycling

There is a guideline that provides a planning process, including goal-setting, selection of roads for bicycle network and selection of type of space for cycling.

### ■Planning process for bicycle road networks

Commencement of planning

- Public Involvement (PI) for sharing the plan's basic policies and targets ⟷ 1) Setting basic policy and targets

**Planning of bicycle network**

- PI for building a consensus on the bicycle network plan and the types of space for cycling in both the present and future ⟷ 2) Selecting roads for bicycle networks
- 3) Selecting types of space for cycling

**Planning of bicycle network**

- PI for building a consensus on detailed design of individual cycling spaces ⟷ 4) Consideration on detailed design of individual cycling spaces
- 5) Selecting types of space for cycling
- Evaluation and review of the plan

The guideline provides idea and criteria of space for cyclists to choose in addition to the basic shared carriageway, taking into consideration of automobile speeds and traffic volume.

### ■Selecting types of space for cycling

| Selecting types of space for cycling taking into consideration of the current traffic. | A: Roads with automobiles travelling at over 50km/h | B: Other roads that do not fit either A or C. | C: Roads with less traffic and automobiles travelling at slow speed. (below 40km/h or 4,000 vehicles/day) |
|---|---|---|---|
| **Separation between bicycles and automobiles** | **Physical separation** | **Visual separation** | **Not separated (shared)** |
| **Classification** | **Bicycle road** | **Bicycle lane** | **Carriageway** (Bicycle tracks, with colorized shoulder markings or pictograms at the left side, within the carriageway) |

Consideration of the rearrangement of road space and road widening

Consideration for speed limits changes and/or the rearrangement of road space for bicycle lanes or on carriageways.

where the rearrangement or road widening is difficult

Consideration of practical developments for the time being → Selection of alternative routes

**Utilize the existing sidewalks shared by cyclists and pedestrians.**

**Carriageway**
(Bicycle tracks, with colorized shoulder markings or pictograms at the left side, within the carriageway or bus lane)


Bicycle road


Bicycle lane


Shared sidewalk by cyclists and pedestrians



## Development of better cyclist environment

In December 2016, "Bicycle Use Promotion Act" was adopted. Bicycle Use Promotion Headquarters are established within the MLIT.

### ■Summary of Bicycle Use Promotion Act

**Fundamental Principle**

- Utilization of bicycle should contribute to public welfare, through the emission reduction of CO2, while providing mobility in a time of disaster.
- Utilization of bicycle should contribute to improving health and reducing traffic congestion, and other economic and social benefits, through the reduction of automobile dependency.
- It should be aimed to to increase the role of bicycle in the transportation system.
- Bicycle should be utilized in consideration with securing safety.

➡ **considerate and implement the following measures intensively**

**Responsibilities**

- National Government: promotes bicycle use in an integrated and systematic manner
- Municipal governments: implement realistic measures through a proper role-sharing with the National Government
- Public transportation operators: aim for a good relationship between bicycle and public transportation
- Citizen: supports various bicycle use measures by the National Government and municipal governments

**Bicycle Use Promotion Plan**

- National Government: approves the plan at the Cabinet meeting based on the fundamental principal and reports to the Diet.
- Prefectural / municipal governments: plans based on the realities of the local communities

**Bicycle Day & Bicycle Month**

- May 5th is set as "Bicycle Day" and the month of May as "Bicycle Month".

### ■Bicycle Use Promotion Headquarters and Secretariat

○ "Bicycle Use Promotion Headquarters" (Administrative Chief; Minister of Land, Infrastructure, Transport and Tourism) has been established within the MLIT.
○ "Bicycle Use Promotion Headquarters Secretariat" has been established within Road Bureau, MLIT, involving staff from various agencies.
○ Liaison meeting among relevant agencies has been established to bring agencies together as one to promote use of bicycle

**Bicycle Use Promotion Headquarters**

**[Administrative Chief]**
Minister of Land, Infrastructure, Transport and Tourism

**[Administrative Members]**
Minister for Internal Affairs and Communications Minister of Education, Culture, Sports, Science and Technology, Minister of Health, Labour and Welfare Minister of Economy, Trade and Industry, Minister of the Environment, Minister of State, Chief Cabinet Secretary, Chairman of National Public Safety Commission (Prime Minister may add more members as necessary)

**Bicycle Use Promotion Headquarters Secretariat**

**[Secretary General]** Director-General, Road Bureau, MLIT

**[Acting Director-General]** Assistant Vice-Minister for Road Bureau, MLIT

**[Sub-director]** Counsellor, Minister's Secretariat for MLIT, Director-level officials for Cabinet Office, National Police Agency, Ministry of Internal Affairs and Communications, Ministry of Education, Culture, Sports, Science and Technology, Ministry of Health, Labour and Welfare, Ministry of Economy, Trade and Industry, and Ministry of the Environment.

**Liaison meeting among relevant agencies**

**[Chairperson]**
**Director-General, Road Bureau, MLIT**
**(also serving as Administrative Chief in Headquarters)**

[Members]
- Councillor, Cabinet Secretariat
- Director General for Policy Coordination, Cabinet Secretariat
- Deputy Director General for Policies on Cohesive Society, Cabinet Office
- Director-General of Traffic Bureau, National Police Agency
- Director-General of Supervisory Bureau, Financial Services Agency
- Vice-Commissioner, Consumer Affairs Agency
- Director-General for Policy Coordination, Minister's Secretariat, Ministry Of Internal Affairs And Communications
- Deputy Commissioner, Japan Sports Agency, Ministry Of Education, Culture, Sports, Science And Technology
- Director-General of Health Service Bureau, Ministry of Health, Labour and Welfare
- Director-General, Manufacturing Industries Bureau, Ministry of Economy, Trade and Industry
- Director-General for Global Environment Bureau, Ministry of the Environment

Note: Members include staff from ministries that are not part of Headquarters
A subordinate organization may be established as necessary.

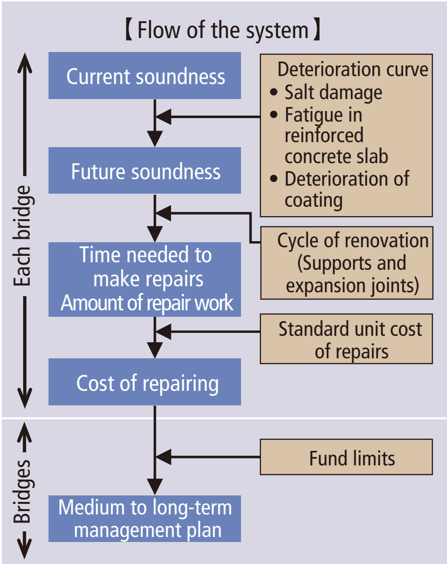
# Asset Management

**A great deal of Japan's infrastructure was constructed during the postwar reconstruction period, which was also a rapid economic growth period from the 1950s to the 1970s. As the Japanese society and its economy have matured, concerns have shifted to extending the use of accumulated capital stock in order to cope with a decreasing birthrate, aging population and the need to protect the global environment. Infrastructure management in Japan is in the process of switching its focus from construction to maintenance.**

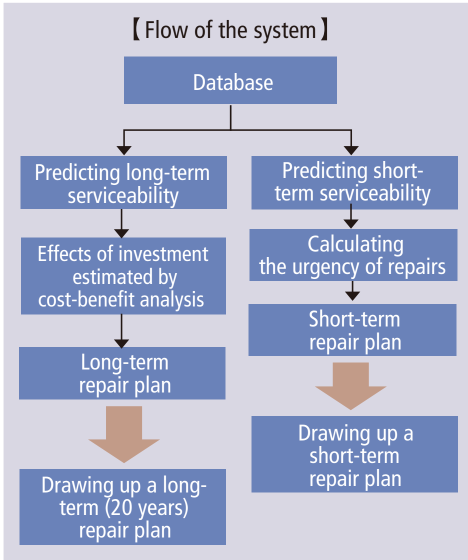
## Development of road asset management

The Bridge Management System (BMS) and the Pavement Management System (PMS) are being developed to predict future deterioration of structures and to ultimately extend their lifetime by extending the time until renovations are needed and reducing the total costs of maintenance and renovation.

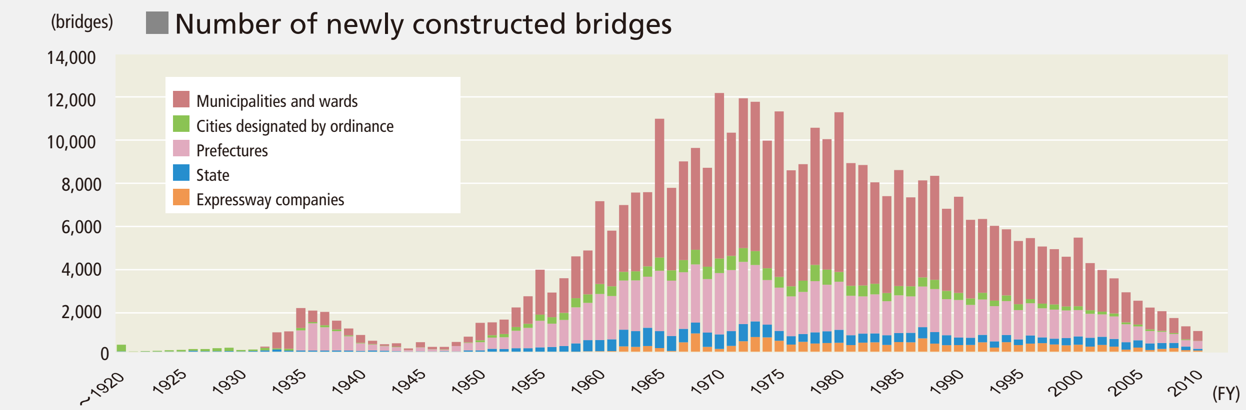
■ Overview of a Bridge Management System




■ Overview of Pavement Management System

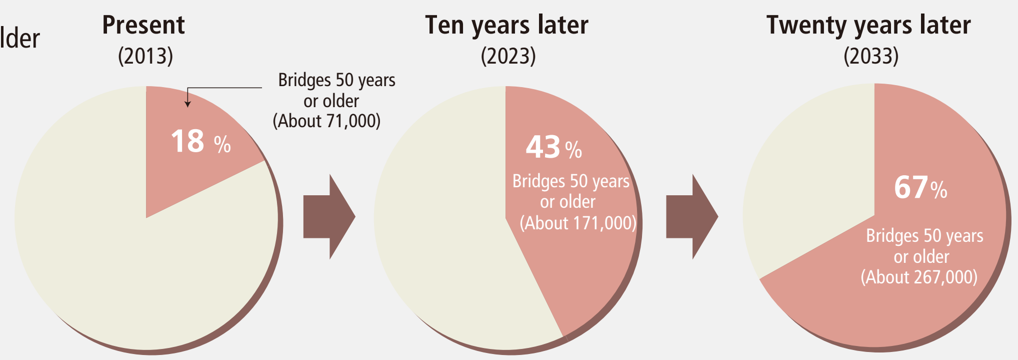



■ Number of newly constructed bridges




■ Percentage of bridges older than 50 years

In 2023, the number of bridges that are 50 years or older will account for 43% of all bridges and in 2033 they will account for 67% of all bridges.




Source: Survey of current road infrastructure conditions (data as of April 2013)

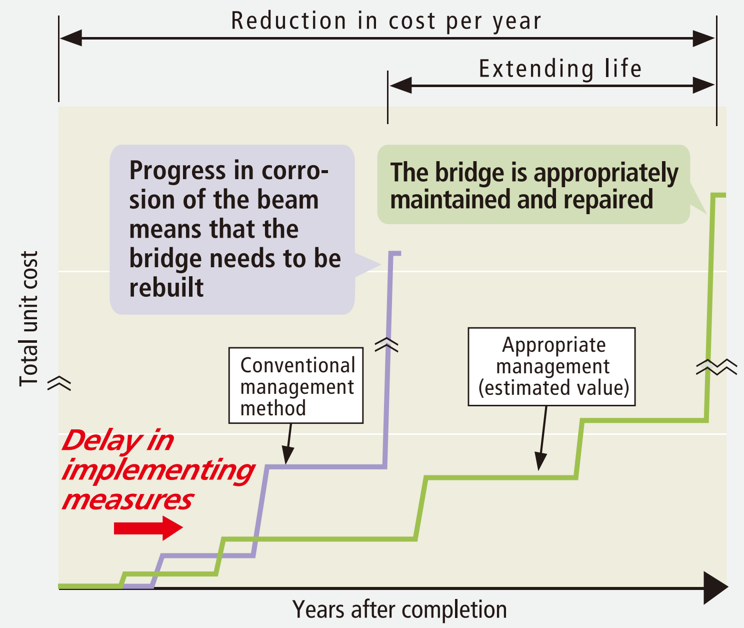
## Efficient management of road assets

Preventive maintenance involves taking appropriate measures before roads are seriously damaged. This is vitally important for ensuring the safety of roads and minimizing the overall cost of repairs and renovation.

Efforts will be made to ensure long-term safety and security of road traffic by extending the service life of bridges that connect expressways with municipal roads. This will be completed, based on the periodic inspection of the bridges, using the planned implementation of "preventive maintenance, or early detection and early maintenance".

Cost-saving and other measures will be carried out through efficient maintenance and through responsive management based on regional characteristics.

■ Schematic diagram of the effects of preventive repairing (Comparison of total unit cost)




Bridge inspection example

Collapsed slab due to fatigue

Deterioration due to salt damage

Deterioration due to an alkali aggregate reaction

## History of activities for aging road

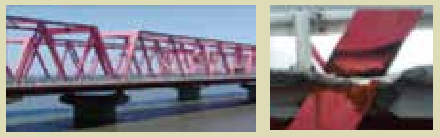
In the wake of Sanyo Shinkansen Tunnel Lining Concrete Collapse in 1999, the National Government established an inspection guideline along with various activities by road administrators. After Sasago Tunnel Ceiling Collapse in December 2012, the government amended the Road Act in 2013, prompting the 2014 Ministerial Ordinance which obligates road administrators to conduct close visual inspection once every 5 years.

### ■History of the road asset management

**2003**: Recommendations for management and renewal of road structures "Early preventive maintenance can reduce total cost"

**2004**: Notice of National Guideline for Periodic Bridge Inspection (for national road bridges) Prescribes specific inspection procedures

**2007**: Break of diagonal truss of Kisogawa Ohashi Bridge over National Highway Not 23



Note: embeded part of diagonal truss in concrete

**2013**: Called "The First Year of Infrastructure Maintenance Era"

**December 2, 2012**: Sasago Tunnel Ceiling Collapse

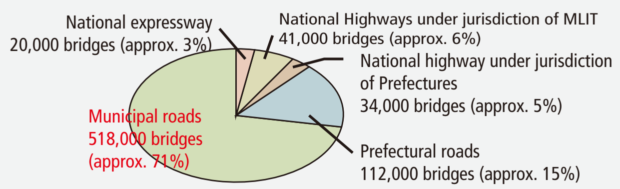
**2013**: Amendment of the Road Act Inspection standards were legislated with clear perspectives of preventive maintenance

**December 7, 2012**: Order of urgent inspection of road tunnel facilities Jet fans, lighting and other

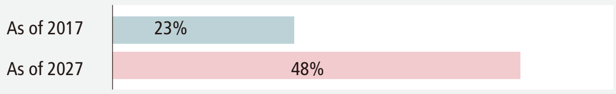
## Current activities for aging roads

Of the 730,000 road bridges across Japan, 520,000 bridges, which account for 70% of all bridges, are situated on municipal roads. 10 years later, 48% of all bridges are expected to be 50 years or older.
Deterioration is evident, especially in an infrastructure that was constructed in the short term, and other infrastructure that is in severe environments, such as under-water. Municipalities have increased traffic restrictions on their bridges in recent years.

### ■Number of bridges by road type

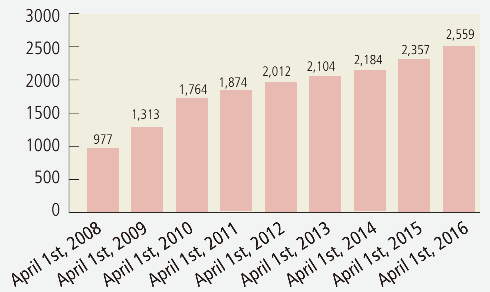



### ■Percentage of bridges with the age of 50 or higher




Note: There are another 230 thousand bridges that are unknown of ages.
Source: Road Bureau (as of March 2017)

### ■Increasing number of traffic restrictions on municipal bridges (over 2m long)




Source: Road Bureau (as of April 2015)
Note: the figure does not include some damaged areas from the Great East Japan Earthquake.

### ■Serious damages on a bridge

37-year old Miharashi Bridge (on Shinyamashita 8th municipal road) was found damaged.

## Standards for statutory inspection

1. The ministerial ordinance and notice prescribes once-a-five-year close visual inspection and defines 4 categories of the soundness results (applied to tunnel, bridge and other structures).
2. Periodic Inspection Standard is established to provide specific procedures (by structure (e.g. tunnel, bridge))
3. The MLIT has developed a periodic inspection guideline containing bridge deformation to be looked for and case examples to technically assist municipalities to implement their inspections (by structure (e.g. tunnel, bridge)).

### ■Legal system of the inspections

**Road Act**

Enforced on September 2, 2013

-Prescribe implementation of maintenance, inspection and necessary actions

**Cabinet order**

Enforced on September 2, 2013

-Prescribe implementation of a periodic inspection for tunnels, bridges, and other structures that may pose a serious problem with road structures and traffic when damage, corrosion and other deterioration or deformation occurs.

**Ministerial ordinance and notice**

-Implementation of a once-a-five-year close visual inspection
-4 categories of soundness results

(Tunnels, bridges and other structures)
This applies to tunnels, bridges and other structures

Enforced on July 1, 2014

**National Guideline for Periodic Inspection**

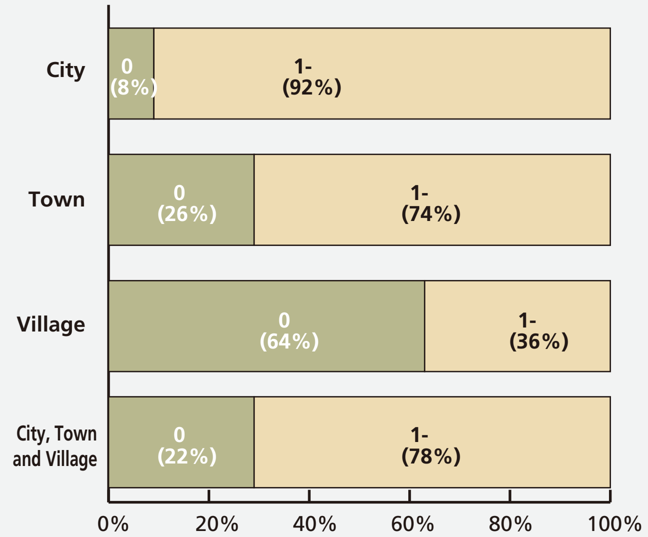
-Specific inspection method based on structure's characteristics in conformity with the ordinance and announcement
-deformation to be looked for, and case examples with photos

(Tunnels, bridges and other structures)
Provided for each of structures

## Maintenance by Municipalities (Technician and Inspection Method)

30% of towns and 60% of villages in the country have no civil engineering technicians for bridge maintenance in their workforce. In addition, most (80%) of municipalities use a bridge inspection guideline that instructs distant visual inspection, which is insufficient.

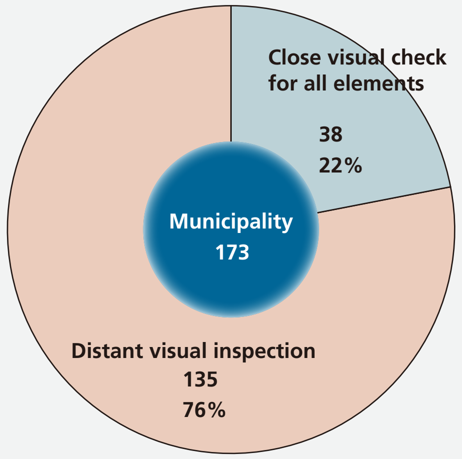
### ■Number of bridge maintenance engineers in the workforce by types of municipal governments




Source: Road Bureau (as of November 2016)

### ■Inspection method for bridges in municipal guideline

80% requires only "distant visual inspection"




Source: Road Bureau (as of October 2013)

## Road Maintenance Panel

Through the Road Maintenance Panels, the National Government provides various technical supports to complement a shortage of human/technology resources of municipal governments. Road Maintenance Panels were launched in all prefectures in 2014 to facilitate cooperation with interested parties, to grasp and share the current issues, and to assist with promoting effective measures for aging roads.

Through "Road Maintenance Panel" the following activities are supported:

-Introduce an efficient procurement including area-wide lump sum ordering and multi-year contract for maintenance projects.

-Establish technical assistance system such as sending a "road maintenance specialist team", comprised of national government officials, to evaluate bridges of social importance or with complicated structure and record the results. This includes financial support from the national government.

-Utilize a new system that allows national government to immediately carry out technically-difficult maintenance work on behalf of a municipality.

-Combine or remove unnecessary bridges according to changing demands. For important bridges (e.g. bridges on expressways and other arterial road network and overpass of bullet train and other arterial railway network) or bridges in need of immediate repair, national government and expressway companies should carry out periodical inspections and repairs on behalf of municipalities.

-Provide a series of extensive training courses for municipal government officials and private business employees for better maintenance framework.

### ■Composition of the Panel

**Institutional framework**

-Regional Development Bureau (under MLIT)
-Municipalities (prefectures, cities, towns and villages)
-Expressway Companies (NEXCOs, Tokyo Metropolitan Expressway, Hanshin Expressway, Honshu-Shikoku Bridge Road, designated urban expressways)
-Road Public Corporation

**Roles**

1. Facilitate training and presentation meetings for standards.
2. Facilitate training and presentation meetings for standards.
3. Organization, evaluation and publication of current inspection and repair work.
4. Assistance for area-wide lump sum ordering of inspection work
5. Technical assistance and other

**Photo of the Panel** (Nara Road Maintenance Panel on February 3, 2016)

## New technologies and "InfraDoctor" (Infrastructure Doctor)
## Shutoko Engineering Company's Activities

*InfraDoctor, our service is provided in the cloud, in other words, in comfortable environment, accessible anytime, anywhere.

InfraDoctor is an innovative system, providing support to road structure maintenance through GIS (Geographical Information System) and 3D point cloud data. This can help achieve labor savings and advancing/streamlining inspection, repair and design work in the infrastructure maintenance. InfraDoctor has 3 main features:

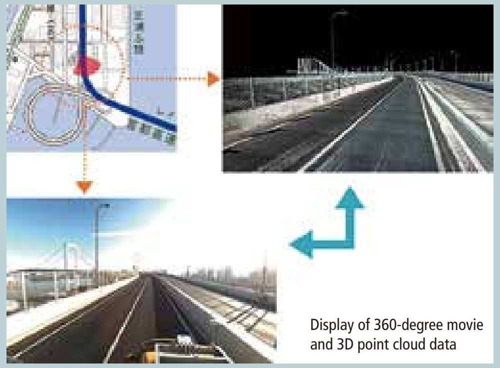
### I. Basic features for GIS and 3D point cloud data

#### Advancing of road space examination feature and labor savings through use of 3D point cloud data

InfraDoctor provides an integrated management of 3D point cloud data and movies from laser scanner. With a replaying feature 360-degree movie and 3D dimension measurement feature, this allows operators to quickly understand the situation on site, realizing labor savings in infrastructure management.

#### Upgrading of road space examination feature and labor savings through use of 3D point cloud data

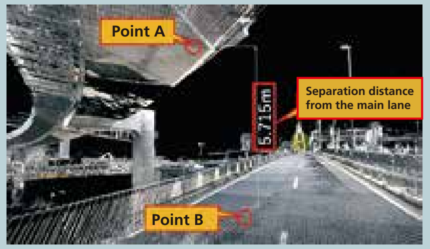
InfraDoctor displays 3D point cloud data and 360-degree movie in synchronization. Easy switching between these data enables to quickly understand the situation on site.



Display of 360-degree movie and 3D point cloud data

#### 3D measurement

3D point cloud data has accurate 3D coordinate (X, Y, Z) for all points, allowing a distance measurement between any 2 points at your fingertips. This eliminates the need for traffic restriction at intersection which was previously necessary for measurement, a separation distance from railway facility and track closure which was necessary for checking clearance.




Dimension measurement between 2 points by point cloud data

#### Measurement of 3D point cloud data

3D point cloud data is obtained by Mobile Mapping System (MMS) equipped with laser scanner and cameras. For underneath the elevated road/track and side strips where MMS is not accessible, a fixed-type laser scanner is used for measurement.

Measurement by MMS

### II. Management and search features for GIS records

#### Easy-to-use search system for management/inspection result records that meets needs of administrator]

InfraDoctor provides a customizable search system for management/inspection result records depending on the need of infrastructure administrator. This solution helps realize rational and efficient management.

#### Search system for various records for management

Maintenance and management work involves record data for structures, accessories, and underground utilities. InfraDoctor provides efficient management by associating record data with 3D point cloud data.

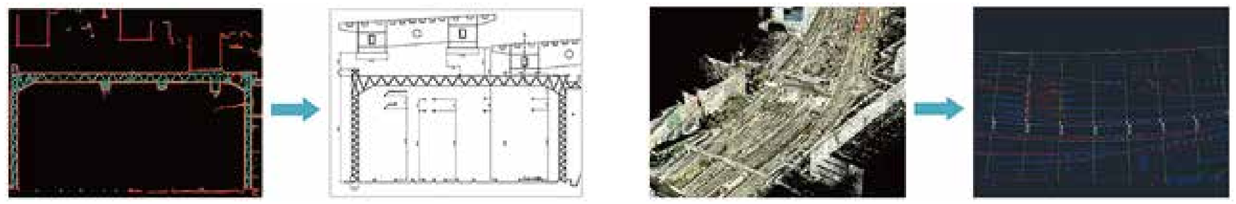
### III. Further sophisticated management and advanced features

#### Further sophisticated infrastructure management through expanded features using GIS and 3D point cloud data

InfraDoctor provides various features, including drawing, deformation detection on pavement and walls, creation of traffic control plan drawing and 3D simulation, streamlining maintenance work through a good use of GIS and 3D point cloud data.

#### 2D CAD drawing feature

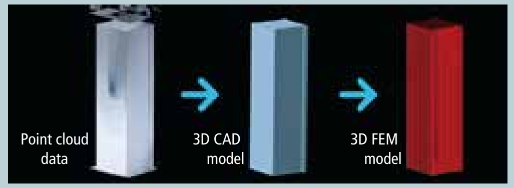
InfraDoctor provides a semi-automatic feature of drawing floor plan/cross section from 3D point cloud data. InfraDoctor also provides a high measurement resolution with mm for cross section and sufficient resolution for a 500:1 scale floor plan.



Automatic contour extraction of 3D point cloud data | 2D CAD drawing (cross section) | 3D point cloud data | 2D CAD drawing (floor plan)

#### 3D CAD model drawing feature

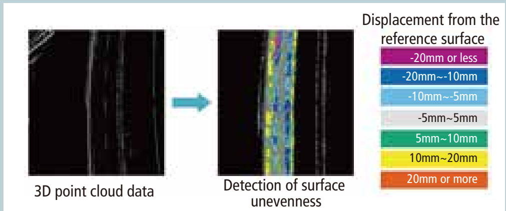
InfraDoctor provides a semi-automatic feature of creating a 3D CAD model from 3D point cloud data that reflects the current condition of structure.




Creation of an FEM model from 3D point cloud data

#### Deformations detection feature

InfraDoctor creates a reference surface from 3D point cloud data of surface and structures, displaying a difference from the 3D point cloud data with gradient tints. This feature enables an early detection of ruttings, potholes, concrete jacking and damage from delamination, serving as a preliminary investigation before detailed inspection (close investigation).

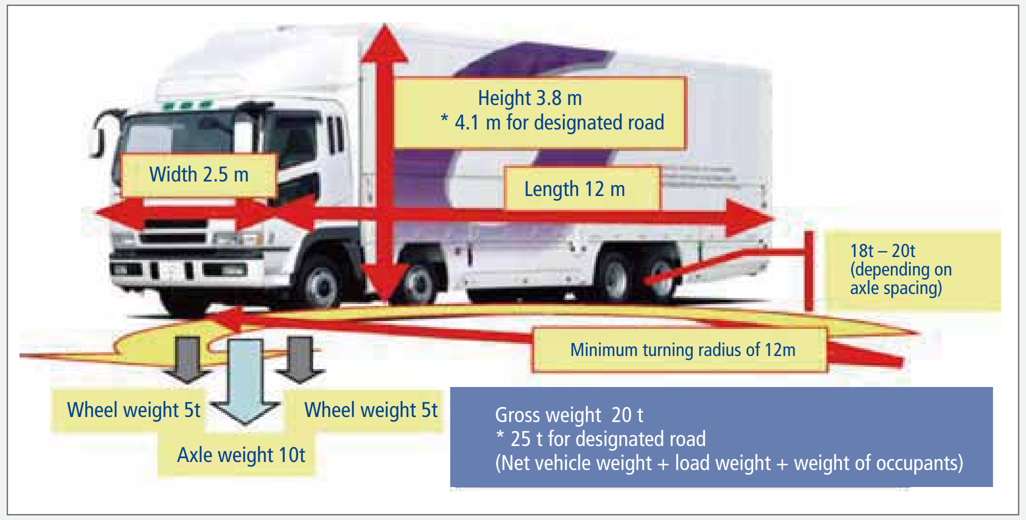


# Road-related systems in Japan

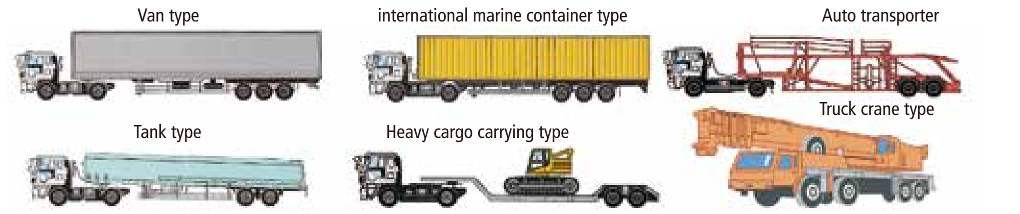
Roads are designed to ensure safe and smooth traffic for vehicles with certain specifications. In principle, vehicles that do not meet size and weight requirements are not allowed to be on the road because they can potentially damage the roads and disrupt traffic.
However, road administrators are empowered to give permission to vehicles that exceed the size or weight regulation to use the road, only if the road administrator acknowledges that there are no alternatives after examining the vehicle's structural characteristics and the cargo. In these cases, the road administrator will require that the vehicle meets certain conditions in order to protect the road structure and prevent potential danger to other road users.

## ■On general roads

General limit (upper limit) of vehicles according to Article 3.1, Vehicle Size and Weight Restrictions




● Typical overweight or oversize vehicle types




## ■On expressways

Dimension and weight limits for specified vehicles on expressways are more lenient than the limits on general roads

| combination vehicles | Length |
|---|---|
| Semi-trailer | 16.5m |
| Full-trailer | 18.0m |

| Distance from the foremost axle to the rearmost axle | 8m or more | 9m or more | 10m or more | 11m or more | 12m or more | 13m or more | 14m or more | 15m or more | 15.5m or more |
|---|---|---|---|---|---|---|---|---|---|
| Gross weight | 25t | 26t | 27t | 29t | 30t | 32t | 33t | 35t | 36t |

● Specified vehicle types




# Approval system for transporting abnormal loads

Road administrators are authorized to permit the drivers of vehicles that exceed the size or weight limits to use the road, but only after the road administrator examines the vehicle's structure and cargo and determines that there are no alternatives. In these cases, the road administrator will put certain conditions in place to protect the roads and to prevent any potential danger to other road users. Road fatigue, which is caused by oversize or overweight vehicles, can have a significant impact on roads and pavement. In order to utilize our road stock effectively in the future, it is important to ensure the road structures are properly maintained.

## ■Enforcing regulations

Instructive enforcement

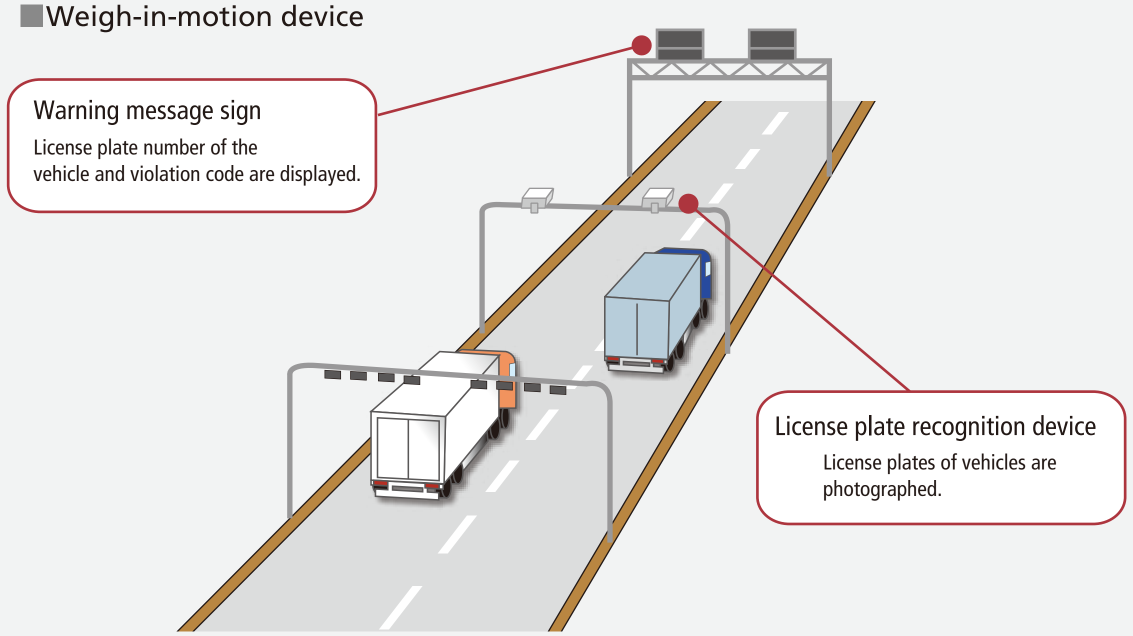
# Stopping unauthorized vehicles

1.Instructive enforcement
Drivers are told to pull over at "instruction stations", where vehicle weights and sizes are measured. If the vehicle exceeds the size or weight limits, the drivers are ordered or warned to reduce the weight and size of the vehicle by splitting the cargo.

2. Weigh-in-motion (WIM)
A WIM device automatically measures a vehicle's gross weight. If the vehicle is over the weight limits, the WIM system then determines if the overweight vehicle has a permit by accessing the database. Based on the results, repeated violators will be given an instructive warning.

License plate recognition device

## ■Weigh-in-motion device



# Disaster Prevention

**In order to secure safe and reliable road networks, construction of arterial high-standard highways, urban ring roads and other disaster-resistant roads has begun. Since roads are an important part of disaster relief, measures to respond to and reduce the damages of earthquakes, storms and heavy snows on roads are also being implemented.**

## Earthquake

The land area of Japan comprises only 0.25% of the world's total, but Japan experiences a large percentage of earthquakes. The probability of a large-scale earthquake, with a magnitude of 6.0 or more, is about 23%.

On March 11, 2011 a massive earthquake and the following giant tsunami caused an enormous amount of damage to the roads in Japan
(National Highway 6, Hirono-machi, Fukushima Prefecture)
(Photo: Tohoku Regional Development Bureau)

## Heavy rain

Japan receives twice as much precipitation as the mean amount of precipitation in the rest of the world, especially during the heavy rain and typhoon seasons. Throughout the last decade, heavy rains have increased sharply, thereby increasing the risk of floods. The soft soil easily collapses during storms and is prone to sediment run-off, landslides and other sediment-related disasters.

In July 2009 there were a mudslides caused by heavy rain in Chugoku and Northern Kyushu regions.
(National Highway 262, Hofu City, Yamaguchi Prefecture)

## Heavy snow

Since the Sea of Japan lies between Japan and the Asian continent, Japan receives heavy snows brought by prevailing winds from the continent in the winter, especially in areas closest to the sea. About 60% of the land is snowy and cold in the winter season, and approximately one-fifth of the population of Japan lives in this area. The population density in these snowy and cold areas is as high as 105 people per km$^2$, which far exceeds the density in other snowy countries.

In February 2014 there was a record-breaking heavy snow in the Kanto region.
(Japan Self-Defense Force clearing the snow on Route 20)
(Photo: Mainichi Shimbun)

## Measures against Earthquakes

In addition to bridge collapse prevention measures, the MLIT accelerates other anti-seismic measures for expressways and national highways under the jurisdiction of MLIT to prevent a large surface gap, including reinforcement and replacement of supports, based on the probability of large earthquake. In specific, the ministry reinforces support of bridges for immediate recovery from damages and takes other measures where the reinforcement is not possible. Earthquake preparedness is scheduled as below:

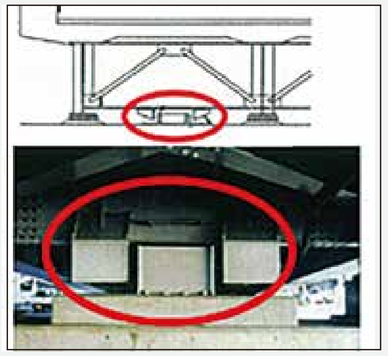
-By the end of FY 2021: seismic reinforcement in areas with a probability of 26% or more is expected to complete (see the black areas in the map below)

-By the end of FY 2026: seismic reinforcement for all areas across the nation is completed.

### ■Measures for immediate recovery

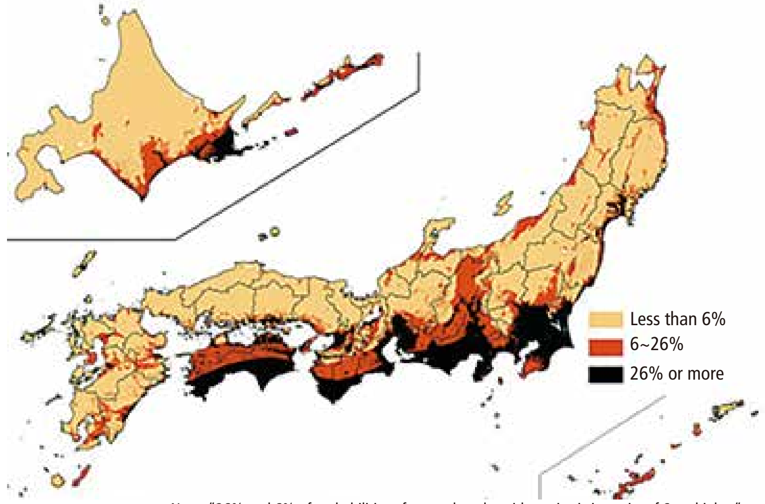
Bridge collapse prevention measures
+
Reinforcement/replacement of supports

Example of a support reinforcement



Structure to diverge horizontal force

### ■Probability of an earthquake with a seismic intensity of 6- or higher in 30 years




Note: "26% and 6% of probabilities of an earthquake with a seismic intensity of 6- or higher" is equal to roughly once a 100 years and once a 500 years of event, respectively.

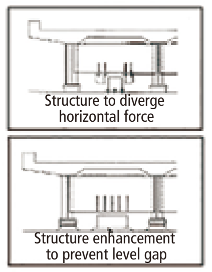
Source: 2016 National Earthquake Prediction Map (Headquarters for Earthquake Research Promotion)

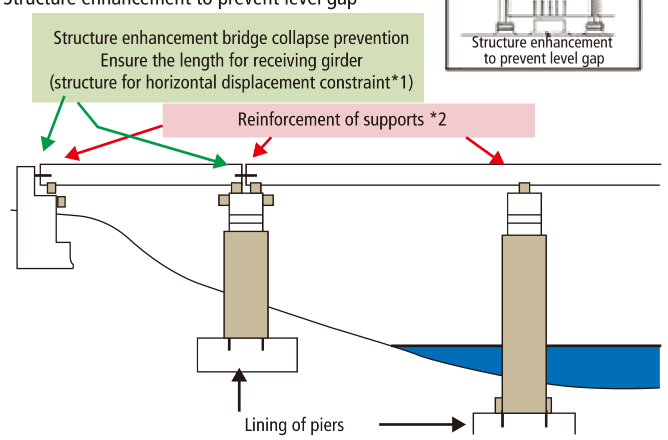
### ■Example of earthquake preparedness

Implement bridge collapse prevention measures that add an ability of immediate recovery of functions.

Bridge collapse prevention measures towards immediate recovery of functions
(Level 2 in the Seismic resistance performance)

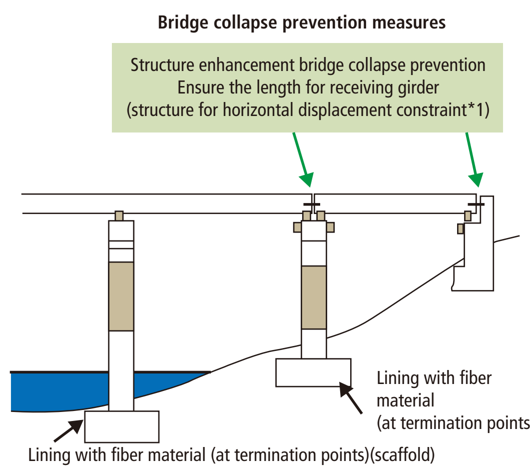
**[Measures]**
• Structure enhancement for bridge collapse prevention
• Reinforcement of piers
• Reinforcement of supports
-Replacement of supports
-Structure enhancement to divert horizontal force
-Structure enhancement to prevent level gap




Bridge collapse prevention measures
(Level 3 in the Seismic resistance performance)

**[Measures]**
• Structure enhancement for bridge collapse prevention
• Reinforcement of termination points of pier

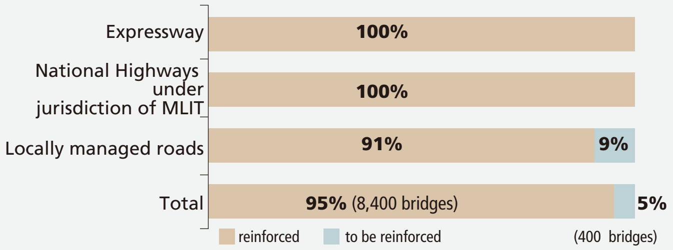



Note *1: only for curved and skew bridges
*2: Reinforcement of support (replacement of support and structure to diverge horizontal force and/or prevent difference in level)

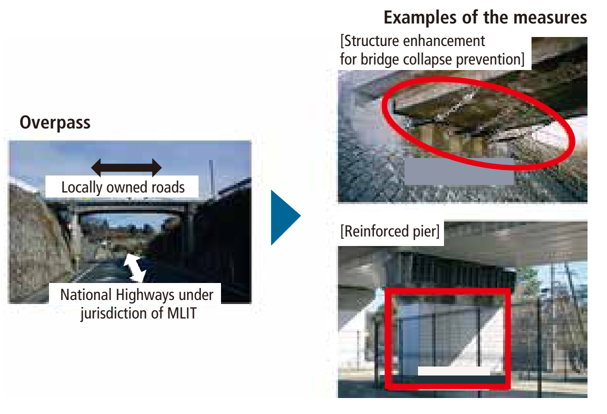
## ■A seismic retrofitting of overpass

-Overpasses over expressways and national highways under jurisdiction of MLIT are given priority on the collapse prevention measures in the next 5 years (400 bridges are owned by local governments as of November 2016).

**Progress of overpass collapse prevention measures for expressways and national highways under jurisdiction of MLIT**




Note: expressways and national highways under jurisdiction of MLIT have already been reinforced for collapse prevention




## ■Seismic strengthening for bridges with rocking piers

Seismic strengthening is conducted by the end of FY 2019 for bridges with rocking piers over expressways, national highways under jurisdiction of MLIT (450 bridges).



Example of seismic reinforcement

## Challenges of seismic retrofitting identified after Kumamoto Earthquake (April 14, 2016)

1. A bridge with rocking piers was collapsed by Kumamoto Earthquake. There remains the possibility that measures in the past were insufficient to avoid collapse, considering peculiarities of Kumamoto Earthquake (consisting of 2 strong quakes) and structure itself.
2. Several overpasses over expressways and national highways under jurisdiction of MLIT have not been reinforced for collapse prevention (completion rate is 91% as of November 2016 for those owned by local governments).
3. Although collapse prevention measures have been completed for all the emergency transportation routes (consisting of expressways and national highways under jurisdiction of MLIT), the seismic reinforcement (including reinforcement of bridge shoes) that promptly enables emergency transport vehicles to pass the routes has not been completed (completion rate is 77% as of March 2017).

(1) Collapsed a rocking pier over Kyusyu Expressway (Prefectural road Ogawa-Kashima Line, Furyo Daiichi Bridge)

(2) Locally owned overpasses (have not been reinforced)

(3) Damages on supports and main girders of a bridge (Heiryu Bridge, Oita Expressway)



# Countermeasures for heavy rains

The MLIT undertakes various initiatives to minimize the impact of heavy rainfall.

## ■Protection of road slopes

Following works are used for slope protection from a heavy rain.
-Rock fall prevention fence work: installation of fence to protect from rock falls. Fence is installed along the road to catch falling rocks.
-Pocket-type rock fall prevention net work: installation of a net to catch falling rocks where they start falling.
-Wire rope that tie a rock: the rope will fix some rocks that may fall in the future.
-Concrete crib work: covers and fixes a slope that may collapse in the future.
-Concrete crib + anchoring: in some cases, concrete structure is supported by additional anchors.

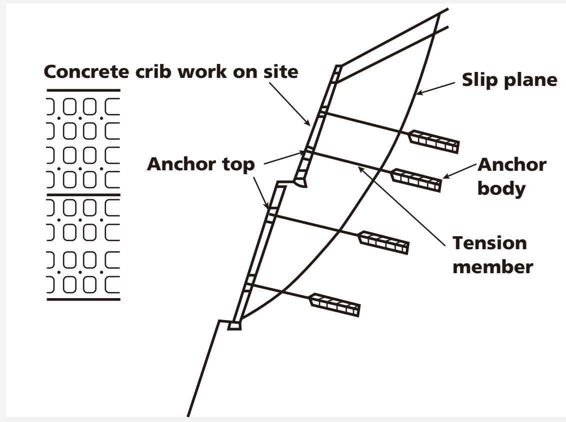
Rock falling protection fence

Pocket-type rock falling protection net

Wire rope work

Concrete crib work

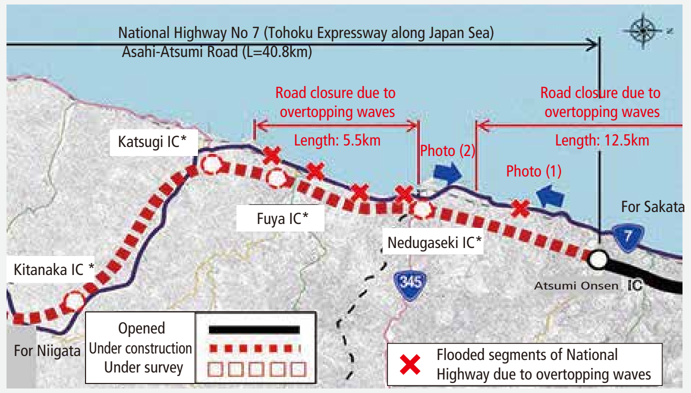
Crib work + anchoring




Illustrative description of anchoring

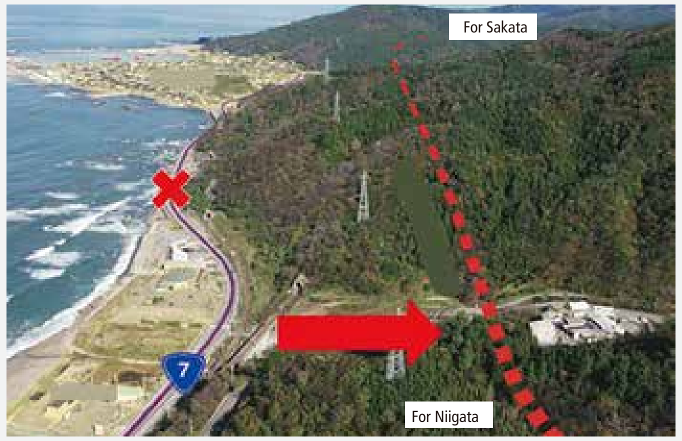
## ■Enhancement of road network for redundancy

In the areas with frequent heavy rain, development of arterial high-standard roads is promoted to provide redundancy, rather than individual spot improvements. Given that overtopping waves frequently force to close National Highway No 7 around the border between Niigata and Yamagata, the Asahi-Atsumi Road is going to be developed as a high-standard road at a distant from the sea shore to ensure redundancy at the event of disaster and reliable transport between regions.




*provisional name

(1) Wracks from overtopping waves
(On April 4, 2012 in Wasada, Tsuruoka)




(2) Congestion due to traffic restrictions
(On April 4, 2012 in Nezugaseki, Tsuruoka)

High-standard Arterial Highway is developed to ensure alternative route in the event of disaster (example of Asahi-Atsumi Road)

## ■Protection of road from flooding

In urban areas, there are about 3,500 underpasses across the country as of April 1, 2015. A heavy rain exceeding the capacity of a drain pump under the underpass will make a pool on the underpass. In the event of such a heavy rain, we will close the road and provide information for road users.

Example of road information provision


Example of drain pump



# Countermeasures for snowfall

Heavy snowfall hampers every year the improvement of living standards and industrial development of the residents. Sustainable support is required to minimize the impact of the snowfall.

## ■Purpose of countermeasures for snowfall

About 60% of the country is in cold and snowy area where a quarter of the population lives.

-Although snowy areas in Japan are located at lower latitudes than many large cities in Europe and North America, they have a significant amount of snowfall with the similar snow depth*.
-A heavy snowfall causes avalanche and ice roads, resulting in slipping and congestion.
-To prevent these disasters, road administrators are responsible for ensuring stable road traffic during winter using antifreezing agent and other snow protection work.
-When heavy snowfall or blizzard may make vehicles stuck on the road, which block the emergency vehicles and constitutes a serious obstacle of emergency relief operation, road administrators will be entitled to remove those obstacles based on the Basic Act on Disaster Control Measures (amended in November 2014).
*Snow depth in Japan which is reported by MET may be measured differently from city snow depth data published on websites in other countries.

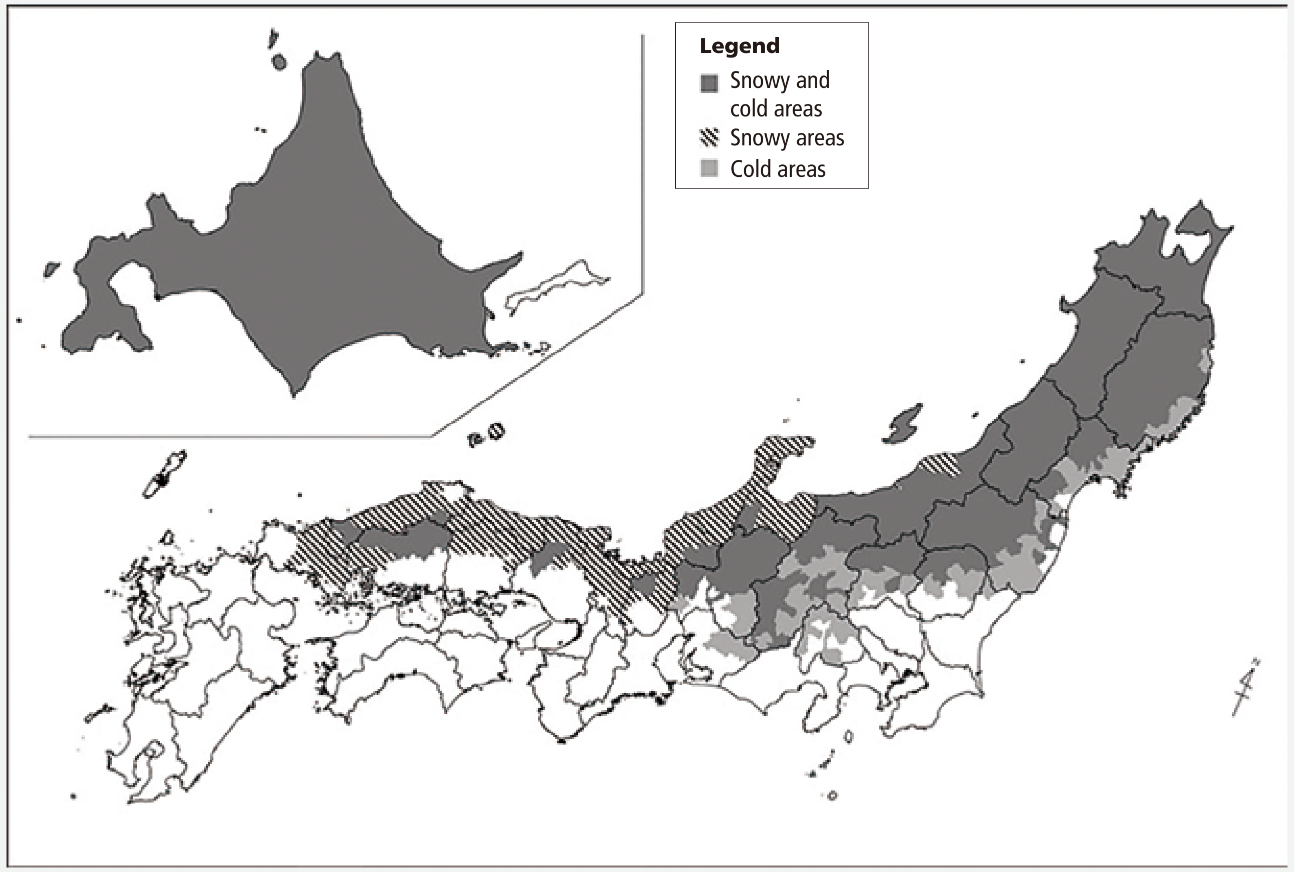



Figure: Snowy and Cold Areas

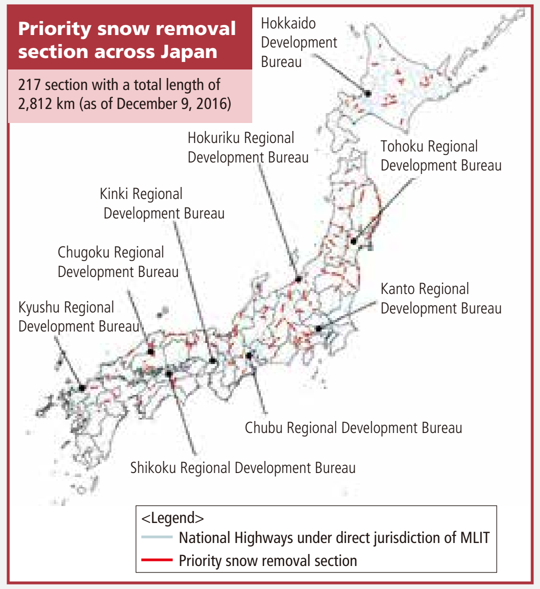
Vehicles stuck on road due to heavy snow
(Sanin Region, 2016)

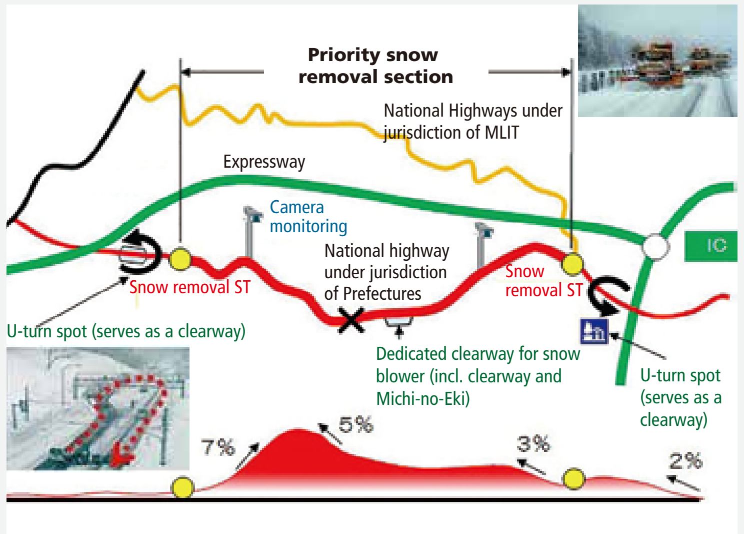
Snow protection work
(Hokuriku Regional Development Bureau)

Removal of vehicles at a standstill on road
(Shikoku Regional Development Bureau)

## ■Priority snow removal section

This refers to a section identified as a standstill-prone location in the event of heavy snow especially for heavy vehicles on a steep slope. This section receives intensive and efficient snow removal preferentially. 217 road sections were identified as priority snow removal section across Japan in FY 2016.




Illustrative description of "Priority snow removal section"

## Ensuring smooth freight transport at normal time and during disaster

After the Kumamoto Earthquake in 2016, 50 locations were closed on the emergency transportation routes which extends to about 2,000 km in Kumamoto Prefecture. To ensure smooth freight transport whether it is a normal time or at the event of disaster, the MLIT is committed to improving accessibility to key locations as well as enhancing functions of arterial network to support stable economy and everyday life by supporting and investing on a priority basis.

-About 100,000 km of roads were designated as Emergency transportation routes which should ensure smooth emergency transportation

-As a countermeasure of aging roads, about 35,000 km of roads were designated as "recommended roads for trucks" which should guide heavy trucks to desirable routes and promote proper road usage

-Improve accessibility of last-mile roads to airports, ports, freight rail stations and other key logistics hubs by reviewing the rural high-standard highways.

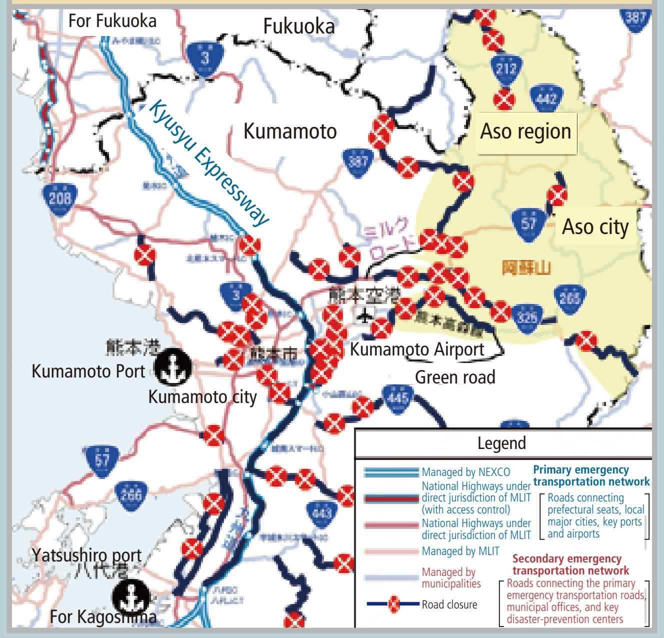
-Establish an arterial network (including planned roads) by selecting from various and complicated current network and key locations

For the arterial network,

-reinforce road structures for quicker road reopening and recovery of alternative routes at the event of disaster and for extra large trucks

-more control over roadside usage by large-scale facilities through intensive support and investment

**Closure of emergency transportation routes after Kumamoto Earthquake**
(As of April 17, 2016, which is 24 hours after the event)






Chapter 3

# Efficiency and Comfort


Consistent road construction programs in post-World War II Japan have created a certain stock of roads. In a more mature society, it will be important to shift to road administration that focuses on the outcomes of roadservices and satisfies road users. The project management approach has been used to ensure accountability to the public, as well as effective and efficient road administration.

# ITS (Intelligent Transport Systems)

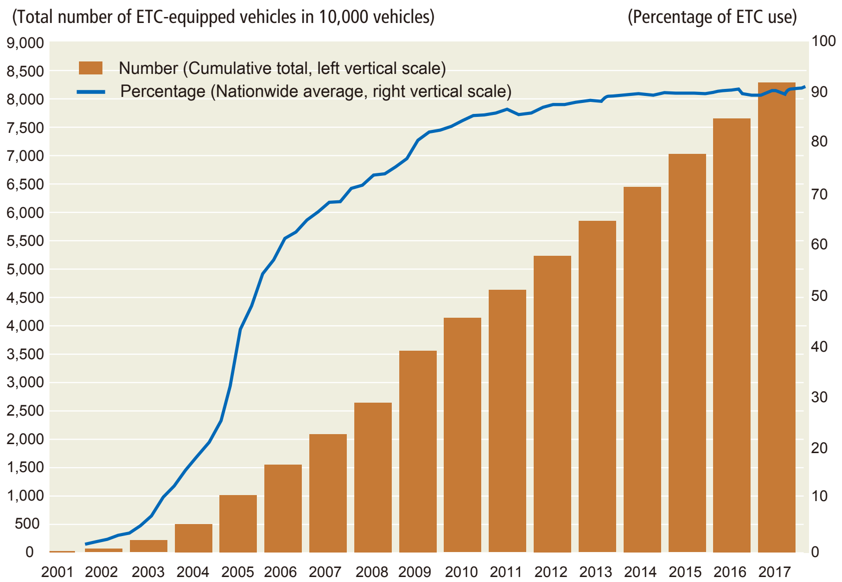
**In Japan, ITS (Intelligent Transport Systems) are steadily expanding with the popularization of ETC (Electronic Toll Collection) systems and VICS (Vehicle Information and Communications System). They have been effective in allowing for better traffic flow by providing real-time information, eliminating congestion at toll gates and mitigating environmental impacts by offering differential toll discounts. ITS have entered the second stage and are now being promoted to solve social issues.**

**The installation of systems for collecting and providing information, which is the basis of ITS, is being promoted and other systems are being developed so drivers can enjoy a diverse set of services via a single on-board ITS unit.**

## ETC (Electronic Toll Collection)

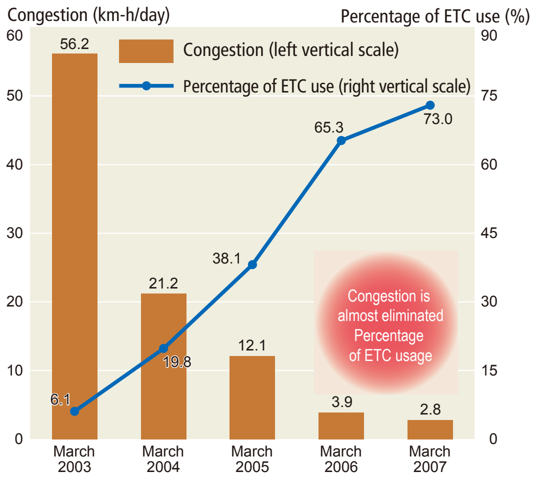
Since ETC went into service in March 2001, the number of ETC users has been rapidly increasing with the popularization of on-board ETC units. At the end of March 2011, ten years after its introduction, there were approximately 34.24 million vehicles equipped with ETC and ETC users now account for 86.2% of all vehicles on expressways in Japan. By utilizing this system, congestion at toll gates has been eliminated. Since drivers can use ETC to pass through toll gates without having to stop, the processing capabilities of toll gates have improved, effectively eliminating congestion that would otherwise occur. ETC communication technology is also used by private operators for non-stop passage through parking gates, ferry boarding and other similar uses.

### ■Changes in the number of vehicles equipped with on-board ETC units and the percentage of ETC usage




Source: Survey by the Organization for Road System Enhancement

### ■The congestion reduction effect of increased ETC usage on the Metropolitan Expressway




Relationship between ETC usage rate and congestion. Average congestion of weekdays in March at a toll booth was measured.

Source: Metropolitan Expressway data

ETC for non-stop toll collection has been installed at almost all expressway toll gates throughout Japan, which directly contributes to the mitigation of congestion at toll booths.

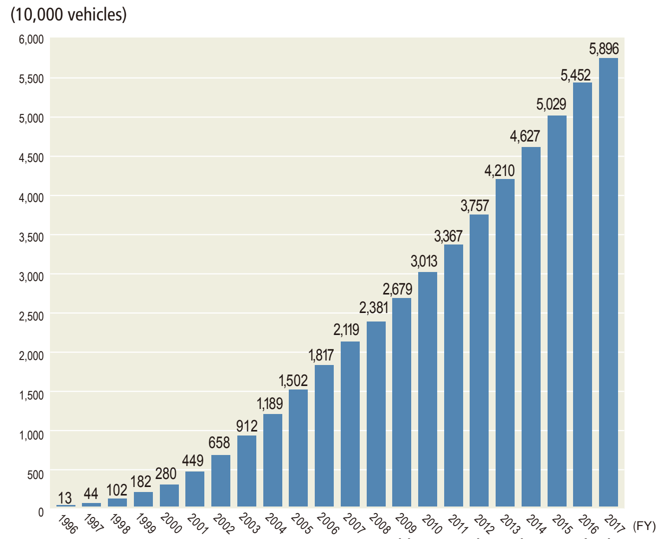
Automated parking lot payment

Simplified ferry boarding procedure

## VICS (Vehicle Information and Communication System)

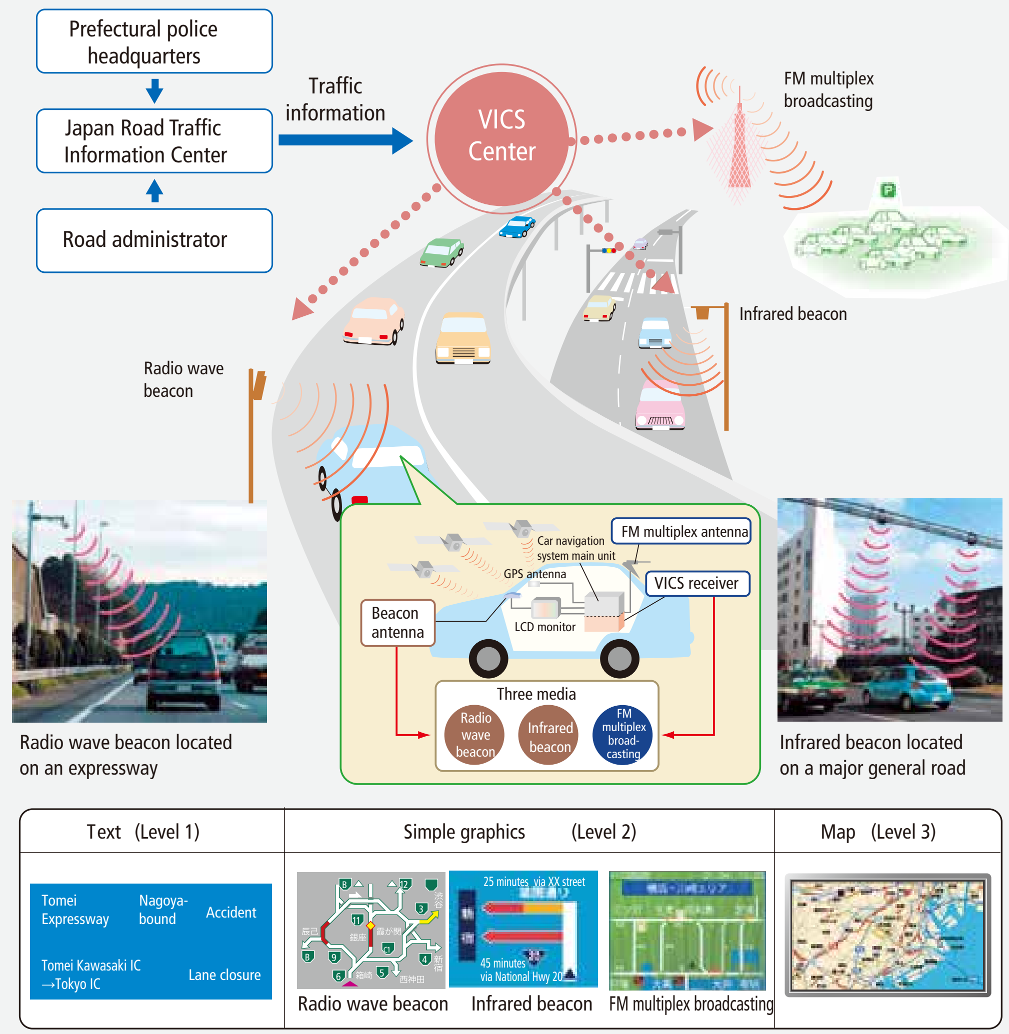
VICS transmits real-time road traffic data, such as congestion and traffic restrictions, to on-board vehicle navigation units and displays data in the form of text, simple graphics and maps. The service started in Japan in April 1996, earlier than anywhere else in the world. VICS delivers information using three types of media: FM multiplex broadcasting, a radio wave beacon and an infrared beacon. At the end of March 2011, over 30.13 million vehicles were equipped with VICS compatible on-board units. VICS's best route guidance capability adjusts traffic flow and improves fuel efficiency, which in turn reduces CO2 emissions and environmental impacts.

### ■Number of VICS-compatible on-board units in use




Prepared by MLIT based on VIC's data

### ■VICS information mechanism




Source: Vehicle Information and Communication System Center

## Collecting information

Vehicle detectors, CCTV cameras, meteorological observation apparatus and other sensors are installed along roads to quickly collect precise information on traffic congestion, broken-down vehicles, accidents and weather conditions. During disasters, patrol cars and vehicles equipped with satellite communication systems rush to sites and are able to collect traffic information. Today, efficient methods are used to identify congestion-prone points instead of the conventional method of conducting field surveys at major intersections. Efficient methods include the use of GPS equipped probe cars, VICS data and other ITS technologies, all with the cooperation of police departments.

### Devices that collect traffic information

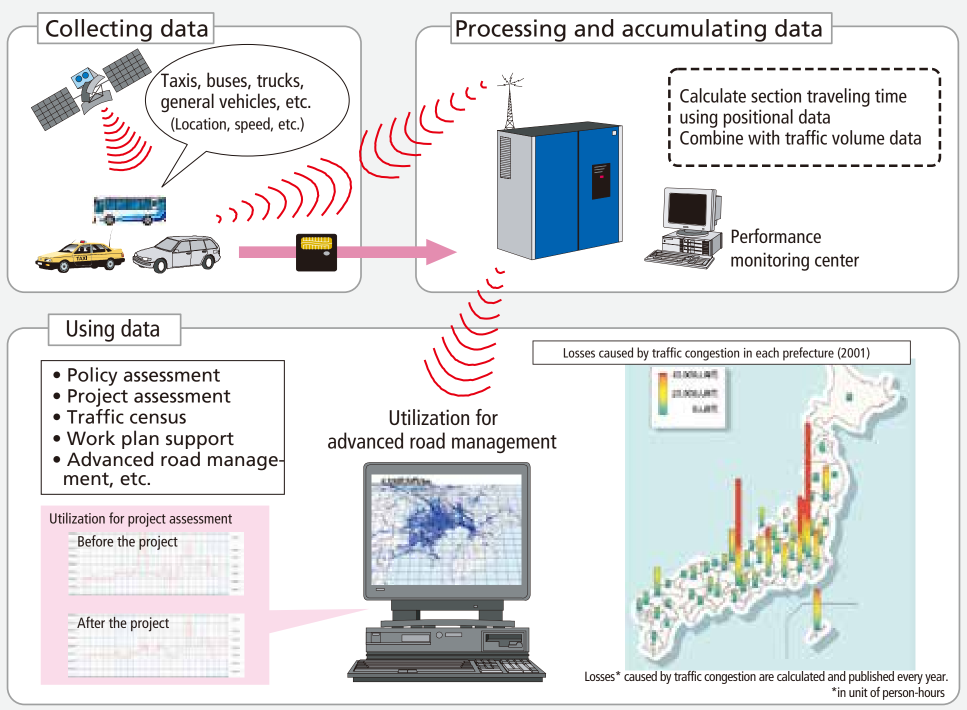
Vehicle detector

CCTV camera

Meteorological observation apparatus

Vehicle equipped with satellite communication system

### Data collecting, processing and utilization




## Collect, analyze and provide information

Information collected by on-road sensors is transmitted to traffic control centers and analyzed. Information on traffic congestion, accidents and traffic regulations is quickly and properly transmitted to road users via roadside variable information boards, VICS and the Internet.

### Traffic control center

### Providing road information

Displaying congested road sections on an information board


Warning of tunnel congestion, using an information board

Displaying congested sections and the time required to traverse them

Car radio


Providing information to VICS-compatible car navigation units


Displaying traffic congestion information on large displays at Service Areas and Parking Areas

Providing information via the Internet

## System architecture

This system uses 5.8 GHz DSRC (Dedicated Short Range Communication), an international standard adopted by ISO (International Organization for Standardization) and ITU (International Telecommunication Union) that enables high-speed, high-volume, two-way communication. DSRC will make various services available by using roadside equipment, "ITS spots" and "compatible in-vehicle car navigation systems."


## Expanding ITS spots throughout Japan

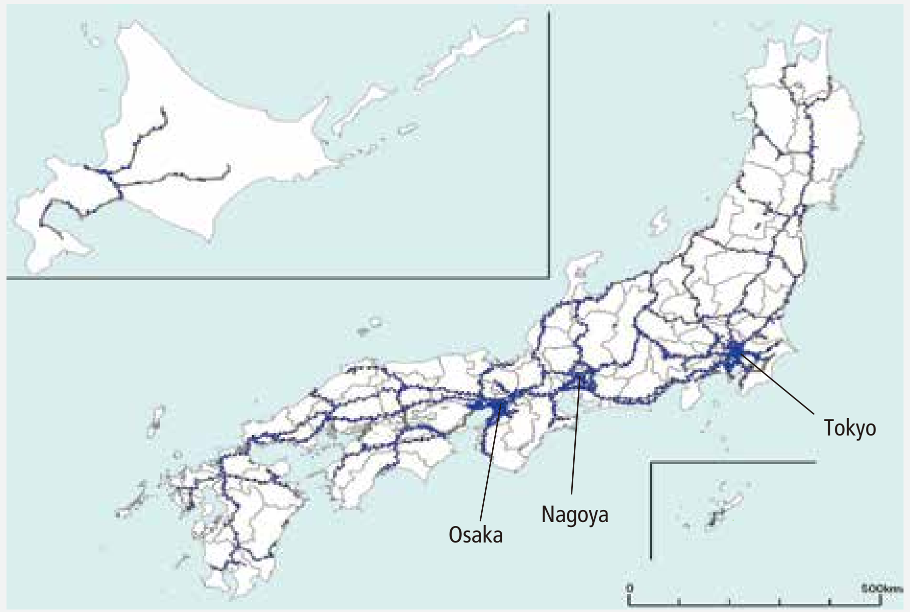
As of August 2011, ITS spots are installed in about 1,600 locations positioned on expressways throughout Japan. On inter-city expressways, an ITS spots is installed about every 10 to 15 km, including 90 locations immediately in front of junctions, while on urban expressways there is a spots installed about every 4 km.

■Locations of ITS spots

ITS spots have been installed at approximately 1,600 locations on the expressways across the country. It is intended that they will be installed on newly opened expressways and tolled roads.

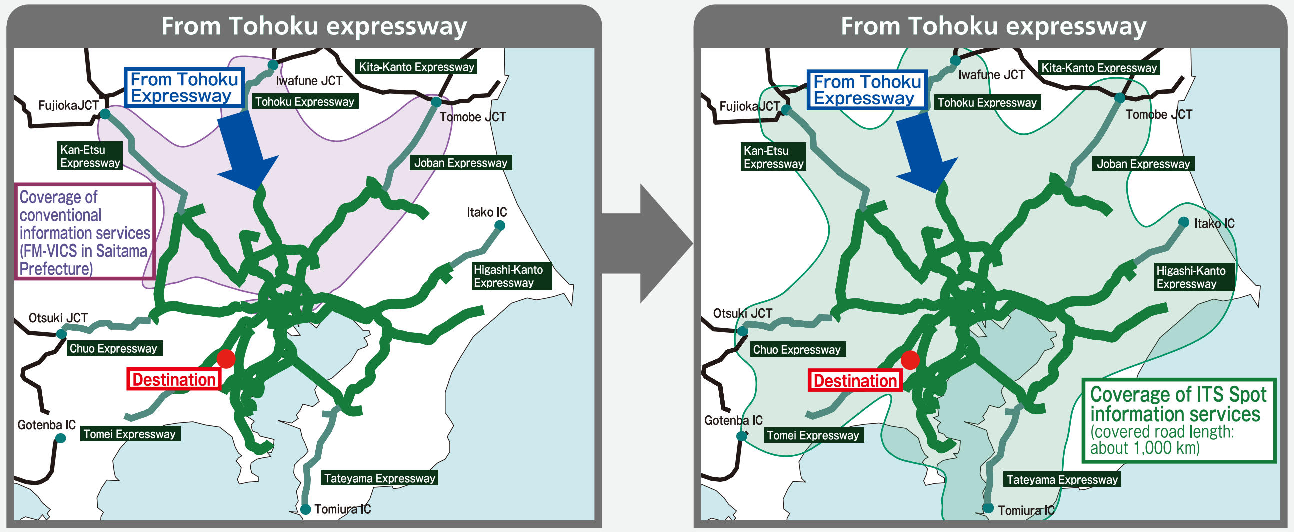
*1,600 locations across the country*

● Locations where ITS spots have been installed




## ETC2.0 service

■Comparison of the scope of information that is provided by existing FM-VICS and ITS spots (Urban areas)




Since October 2014, a new service called "ETC2.0" has been provided. ETC2.0 provides advanced driver assistance on expressways using the communication between ITS spots and onboard units, in addition to the existing automatic toll payment feature.

ETC2.0 provides the following assistance services:

① Detouring assist : provides precise information about wide-area traffic congestion on a real-time basis with actual pictures of the road ahead of the driver.

②Assistance in the event of disaster: provides safety precautions, such as identification of obstacles on roads, a slow-running automobile at the end of congestion and pictures of the weather condition ahead of the driver.

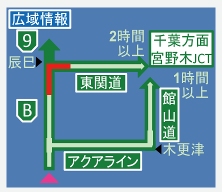
③Safe driving assist: provides useful information for drivers in the event of road closures.

■Information provided by car navigation systems

**Detouring assist**

Real-time region-wide traffic information and pictures of congested roads are provided.

<Simple diagram> <Picture>





**Assistance in the event of disaster**

Upon occurrence of a disaster, useful information will be provided.

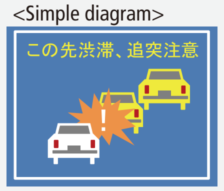
<Simple diagram>


An earthquake has occurred. Turn on your hazard lights and park on the shoulder.

**Safe driving assist**

Locations of obstacles, the location of the last car in the back up, and danger warnings are provided.

<Simple diagram> <Picture>




Backup ahead. Careful of rear-end collision.

Careful there is snow on the road.

Automatic payment system at a parking lot.

## Enhanced services at ITS spots

In the future, new ETC2.0 services are scheduled to begin. Drivers will soon be given preferential treatment if they take a detour around congested routes. In the future we are also going to support commercial fleet control through ETC2.0.

Furthermore, private services such as automatic payment systems at private parking lots and drive-through booths are under consideration.

# New toll rates for Tokyo Metropolitan Expressway

## Expressway toll rates in the Greater Tokyo Area

### Background

Tokyo Metropolitan Expressway, which had been developed since 1960s, connects not only to the surrounding areas but also to Tomei Expressway (bound for Osaka), Tohoku Expressway and other major national expressways to form a wider road network.

The following challenges were identified before the revision.

・Toll rates and vehicle categories were varied according to the route and section
・Toll rate via Metropolitan Expressway was lower than that via the Metropolitan Intercity Expressway to drive through the center of Tokyo.
・Higher toll rate and a terminal charge that was imposed for every routes of different operators.

With these challenges, a more reasonable concept for toll rate setting "Three smart principles of expressway toll rates in the Greater Tokyo Area" was created. All expressways in the area surrounded by the Metropolitan Intercity Expressway were subject to the concept.

1. Fair toll rate depending on usage: A distance-based, fair toll rate system on the beneficiary-pays principle.
2. Seamless toll rates regardless of difference in operators: Integrated toll rate system among expressway operators.
3. Strategic toll rate to optimize traffic flow: Toll rate system to induce traffic from congested routes in the urban area to less-congested routes.

### Details of the revise

Outline of new toll rate system which was introduced on April 1 2016.

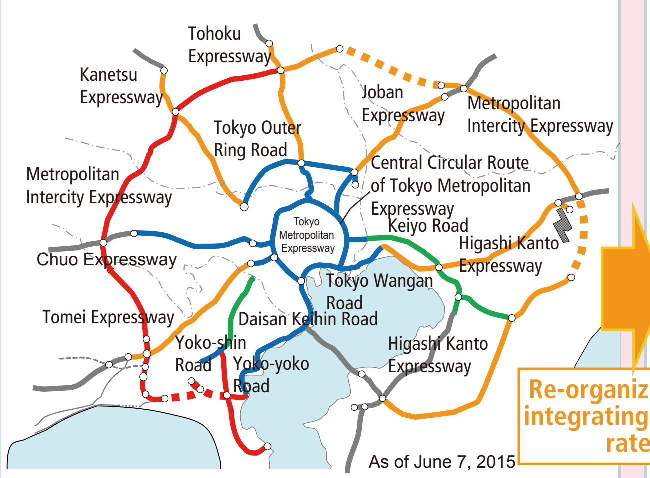
1. The toll rates for Metropolitan Intercity Expressway are lowered (same toll for the same origin/destination).
2. ETC2.0 equipped vehicles are subject to further discount
3. Tolls for Tokyo Outer Ring Road will be discounted if a driver uses it to the central Tokyo
4. Drivers going through the central Tokyo will be charged depending on the traveled distance

### Effects of the toll revision

The following effects have been experienced
1. Through-traffic was shifted to outer ring roads, reducing congestion on Tokyo Metropolitan Expressway
-10% reduction of through-traffic in the central Tokyo, with 50% through-traffic reduction between Tomei and Tohoku Expressways
-1% reduction of traffic on Tokyo Metropolitan Expressway
2. Smoother traffic on general roads due to increase of short-distance use of Tokyo Metropolitan Expressway
-Short-distance users of the Tokyo Metropolitan Expressway increased by 1 to 4% due to the lowered toll and reduced congestion with less through-traffic.
-Traffic volume on the Tokyo Metropolitan Expressway (Shibuya Line) increased by 2% while the parallel national highway No. 246 decreased by 7% around Minato-ku Aoyama.

3. Network development and toll discount promote use of Metropolitan Intercity Expressway
-Traffic on Metropolitan Intercity Expressway increased by 30% (additional 5~8% increase after it was connected to Tohoku Expressway)
-A significant increase of distribution centers that are newly constructed in the areas along Metropolitan Intercity Expressway by 4.6 times (or by 2.7 times in the Greater Tokyo Area)

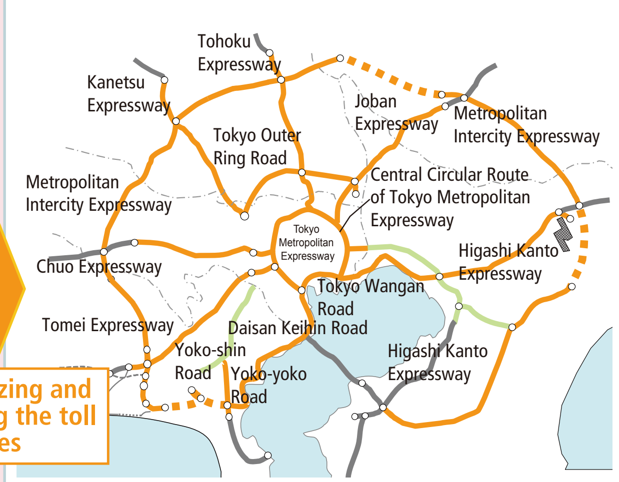
<Before >




Re-organizing and integrating the toll rates

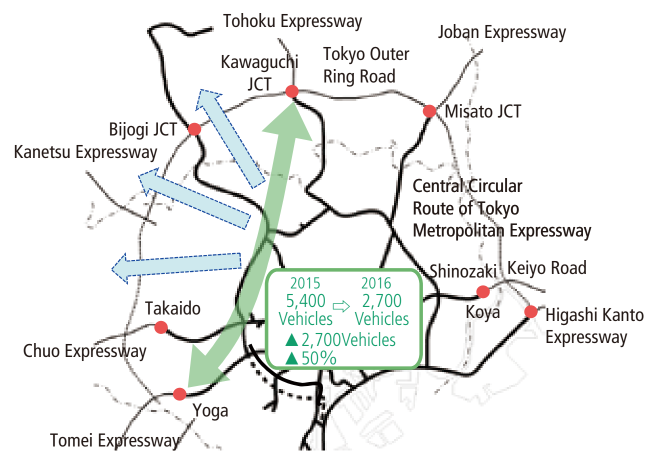
■: Higher toll rate than the national expressway toll rate for major city area
■: Almost the same toll rate as the national expressway toll rate for major city area
■: Lower toll rate than the national expressway toll rate for major city area
■: Distance-based toll rate
■: National expressways out of the major city areas
Note: dotted line represents sections under construction

<After >



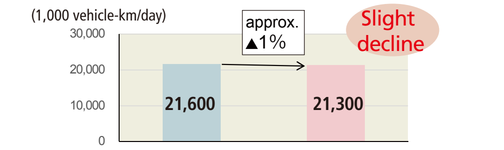

■: Almost the same toll rate as the national expressway toll rate for major city area
■: Almost the same toll rate as the national expressway toll rate for major city area (to avoid radical change)
■: National expressways out of the major city areas (standard section)
Note: dotted line represents sections under construction
Note *: Upper limit is set to avoid radical change

Through-traffic in the central Tokyo

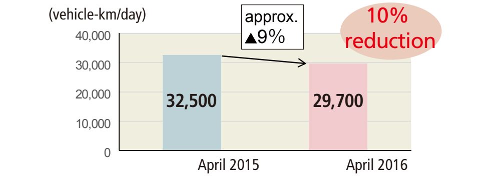



Total through-traffic* reduced by 11%
(43,100 vehicles/day to 38,200 vehicles/day)

Total vehicle kilometers traveled on Tokyo Metropolitan Expressway

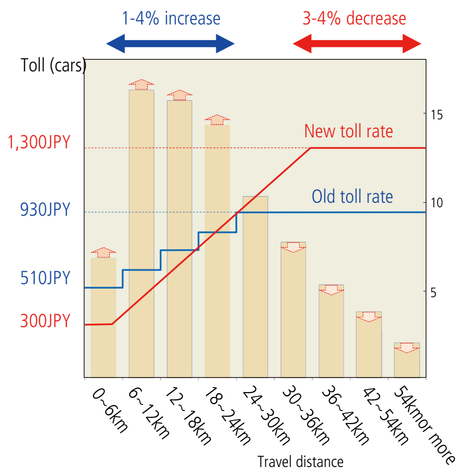


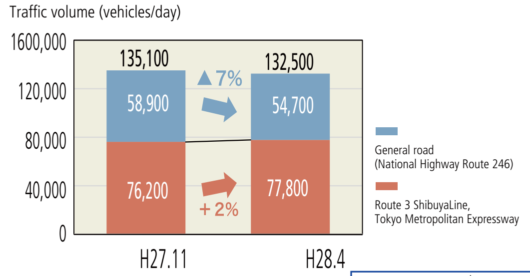

Travel delay on the Tokyo Metropolitan Expressway

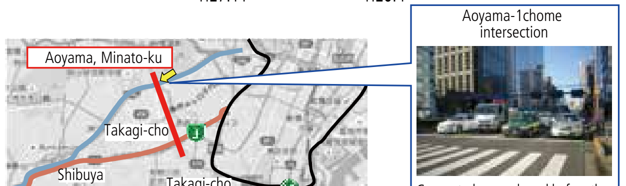



Note: Average in April 2015 compared with the average in April 2016 (excluding holidays and other abnormal days)

Traffic volume change by travel distance on Tokyo Metropolitan Expressway




Congested general road before the revised toll rate was introduced (at Aoyama 1 chome intersection)

Note: Based on ETC data
Note: Average in April 2015 compared with the average in April 2016 (excluding holidays and other abnormal days)

# Livability Enhancement

**Road projects will focus on enhancing the living environment, so that everyone can benefit from improvements such as safe and accessible pedestrian areas, pleasant living environments with road-side greenery, and safer pedestrian spaces and better townscapes by removing utility poles.**

## Promoting universal designs in pedestrian spaces

By 2020, all designated roads will have barrier-free sidewalks.
The Minister of Land, Infrastructure, Transport and Tourism has identified roads with a high volume of pedestrian traffic, especially areas where many elderly and disabled people travel along the roads that connect railway stations, government facilities, hospitals and other important public facilities, and has designated them as in need of upgrades.

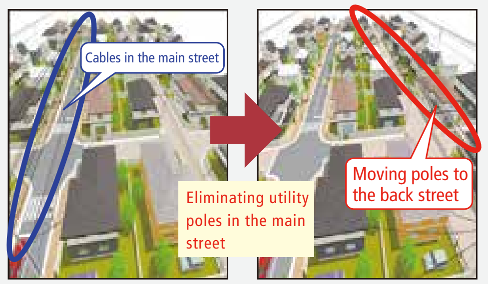
■An example of universal design in pedestrian spaces

## Removing utility poles

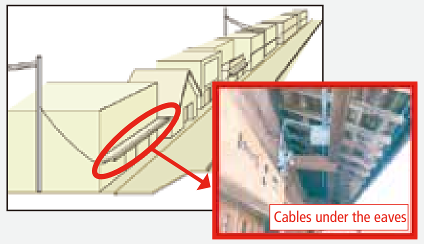
Utility poles are often considered unsightly and obstructive, so MLIT promotes the removal of them in order to secure safe and comfortable pedestrian spaces, improve the landscape and living environment, enhance the reliability of telecommunication networks and preserve historical townscapes. This visual preservation of historical sites and towns promotes tourism, restores local culture and revitalizes local communities.
MLIT will continue promoting the removal of utility poles using methods that accommodate local situations, such as widening roads in conjunction with burying utility cables underground and installing cables under or behind eaves. MLIT will also seek the most cost effective methods for pursuing these activities.

■Methods for Removing Utility Poles


Installation of underground utility ducts as a part of road construction projects.




Relocation of cables to side streets in order to remove utility poles along the main streets.




Installation of cables under/along the eaves of houses along the street.

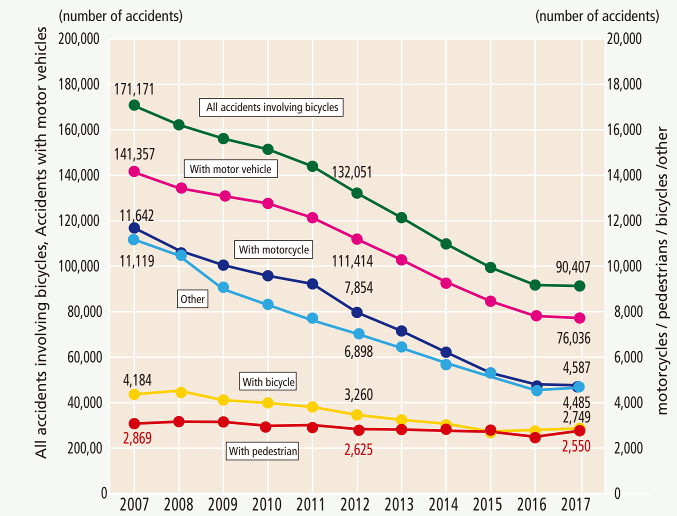
■An example of Removing Utility Poles



## Safer and pleasant environments for cyclists

While bicycles play an important role in urban transportation as a convenient transportation mode, infrastructure for cyclists is still insufficient and has resulted in slower reduction rate of bicycle accidents compared to that of all accidents.
To lower the accident rate, MLIT and the National Police Agency (NPA) have launched the "Committee for Creating a Safe & Comfortable Environment for Bicycles" in 2011. The Committee submitted the following recommendation to MLIT and the NPA: "A Bicycle Environment that is Friendly for Everybody: Proposal for a Safe & Comfortable Environment for Bicyclists."
In response to the recommendation, in November 2012, MLIT and the NPA jointly created "Guidelines on Creating a Safe and Comfortable Environment for Bicyclists."

■Changes in the Number of Accidents by Category




Note: "Accidents involving bicycles" means that at least one victim involved in the accident is a bicyclist and accidents between two or more bicyclists are counted as one accident.

(Source: Information from National Police Agency)

■Actions to Advance Urban Settings for Bicycle Usage

Development of bicycle route networks

Construction of bicycle parking facilities

Education for cyclists on riding rules

Collaboration with public transportation systems

Development and promotion of community bicycle programs

*Conceptual images of the initiative

# Environmental Measures

**Projects are being executed to quickly improve roadside environments and roadside areas. In order to prevent global warming, the transport industry must urgently deploy measures to reduce CO2 emissions from vehicles, which account for a large percentage of total emissions.**

## Protecting and creating roadside environments

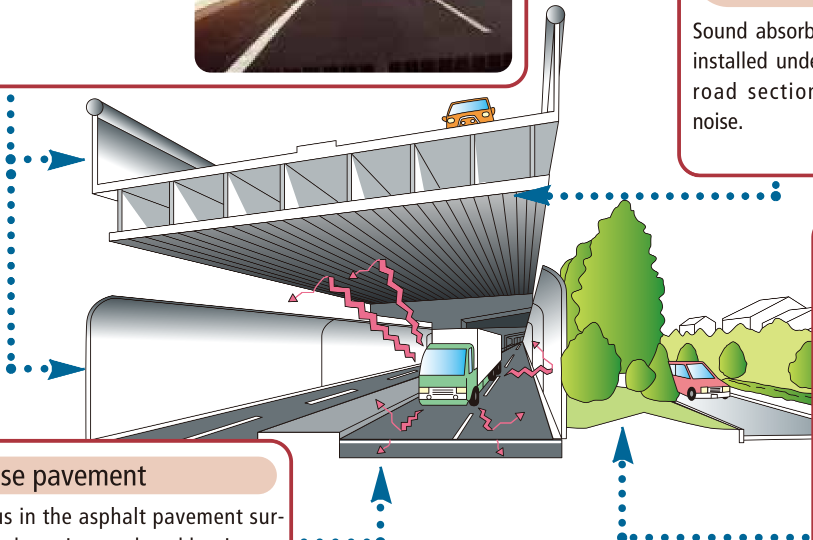
Roadside environmental measures are being deployed to achieve environmental quality standards for noise and air pollution. Measures to control the heat-island phenomenon in cities are also being actively researched and developed.

### Noise barriers

Noise barriers lower noise level in roadside residential and other districts.

### Sound absorbing panels installed under bridges

Sound absorbing panels installed under elevated road sections reduce noise.



### Green belts

Trees are planted between highways and residential districts to create green spaces and reduce noise and gas concentration.

### Low noise pavement

Small porous in the asphalt pavement surface absorb the noise produced by tires.

## MLIT's climate change mitigation

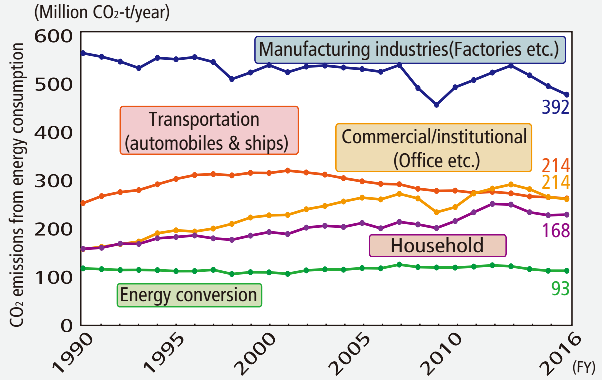
After a continual increase during the period between 1990 and 1996, the level of $CO_2$ emissions from the transportation sector became relatively steady in 1997. Emissions reached their peak in 2001 when a level of 263 million $CO_2$-t was recorded. Since then, emissions have decreased to the level of 224 million $CO_2$-t, the level which was recorded in 2013.

This means that the transportation sector's target, 240-243 million $CO_2$-t, for Japan's proclaimed commitment under the Kyoto Protocol during the first commitment period (2008 to 2012) was achieved, taking into consideration the average level of emissions during these 5 years.

In March 2014, the MLIT created a plan called "National Environmental Action Plan (2014-2020)". In the Plan, the Ministry claims that it will implement its mitigation strategy, with a series of measures including smarter use of existing road networks to optimize traffic flows and introduction of low-carbon road facilities. Currently, the road sector of the Ministry promotes improvement of traffic flows (e.g. development of ring roads), roadside greenery, and a shift to low-carbon road facilities such as LED road lighting.

Although Japan will not renew its commitment for the second commitment period (2013-2020), the country will continuously dedicate its efforts to $CO_2$ reduction.

### ■$CO_2$ emissions by sectors




Source: Greenhouse Gas Inventory Office of Japan (GIO, April 23, 2018)

### ■Climate change mitigation measures in road sector

**Traffic optimization**
- Development of arterial and ring road networks
- Revision of toll policy for expressways
- Development of cycling roads
- Promotion of ITS
- Minimization of road work periods
- Grade separation of railroad crossings
- Promotion of transit use
- Designation of routes for heavy trucks

**Greener roads**
- Promotion of roadside greenery

**Low-carbon road facilities**
- LED lighting
- Life extension of road bridges
- Renewable energy use



# Enhancement of Modal Connect

**Modal connect aims to enhance the connection of road network and other transport modes to improve user environment.**

## Background

The level of buses services in Japan is poor and far from user-oriented. It is necessary to improve convenience of bus and other public transport based on the current situations of expressways, railways/shinkansen networks in regions.

This includes a pilot project and practical application of "Busta Project" (Bus terminal project), which improves accessibility of bus stops through a cooperative role sharing between public and private sectors by fully using ITS and PPP.

## Strategic development of integrated transport terminal

Under the cooperation with city planning and local public transport policy, the MLIT aim to strengthen connection between various traffic modes, to revitalize the area and strengthen disaster response.

### ■Busta (Bus Terminal) Shinjuku (opened in April 2016)

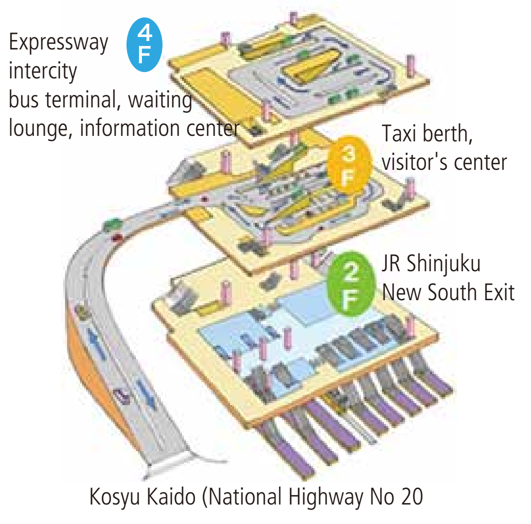
-Developed in coordination of public (road administrator of National Highway No 20) and private (terminal business) sectors

-19 scattered expressway bus stops are now aggregated in the terminal that is integrated with the railway station.

-Frequency of expressway bus services: up to 1,720 services/day

-Number of expressway bus operators: 117 operators

-Number of passengers: 40,000 passengers/day on the busiest day




### ■Strategic development of integrated transport terminal

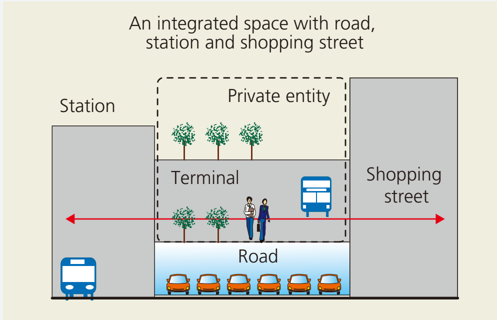
-We are committed to developing a public transport terminal directly connected to a railway station, considering impacts on surrounding road traffic.

-With a basic idea of the development outside of main road, a PPP project will promote efficient development and operation of a terminal while making use of profits in private sector.

-Functions are shared between terminals to avoid congestion due to concentration of passengers and to provide redundancy in the event of disaster.

#### Example of a terminal development in urban area

With a limited space around station, a terminal project will make use of space over the road to create an integrated space with road, station and shopping street.




#### Example of a terminal development in rural area (Anamizu town)

This project created an integrated traffic terminal in cooperation with local governments and railway operator to enhance usability of expressway networks and mobility of buses.

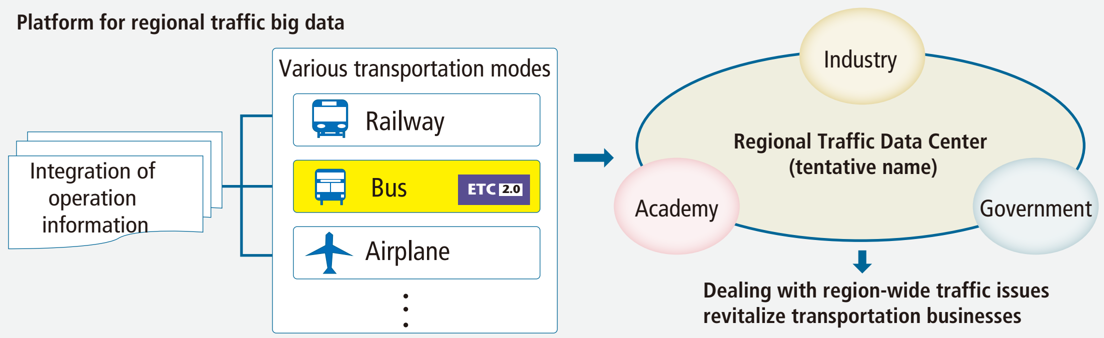

Michi-no-Eki "Anamizu" (Ishikawa)

## Establishment of smart transit system

The establishment of a smart transit system that enables efficient transit according to traffic conditions is proceeding.

### Establishment of a platform and center

-To integrate operation information of various modes, platform of regional traffic big data and "Regional Traffic Data Center" will be set up in each region, which plays a central role in dealing with regional traffic issues through industry-government-academia cooperation.
-Consider a system that will deal with practical issues including handling of competing companies' data and personal information.
-Examine disclose data including operation information.




### Efficient connections between modes according to traffic conditions

**[Extended information provision for users and businesses]**

Provision of delay information and connection information

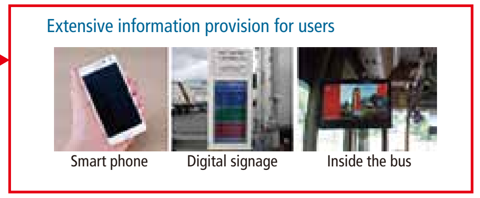
Niigata → Lake Kawaguchi

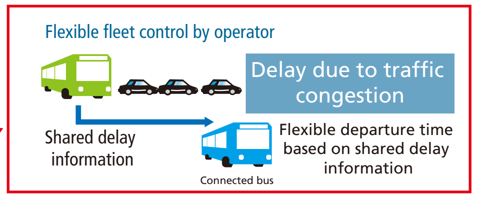
| Origin | Estimated time of departure | Destination | Estimated time of arrival | Status |
|---|---|---|---|---|
| Scheduled | | | | |
| Niigata | 12:00 | Busta Shinjuku | 17:30 | 15 minutes of delay |
| Connection information | | | | |
| Busta Shinjuku | 15:30 | Lake Kawaguchi | 19:15 | On schedule |
| JR Shinjuku Station | 15:50 | Lake Kawaguchi Station | 20:35 | 5 minutes of delay |
| Busta Shinjuku | 18:00 | Lake Kawaguchi | 19:45 | On schedule |

Displayed along with available services

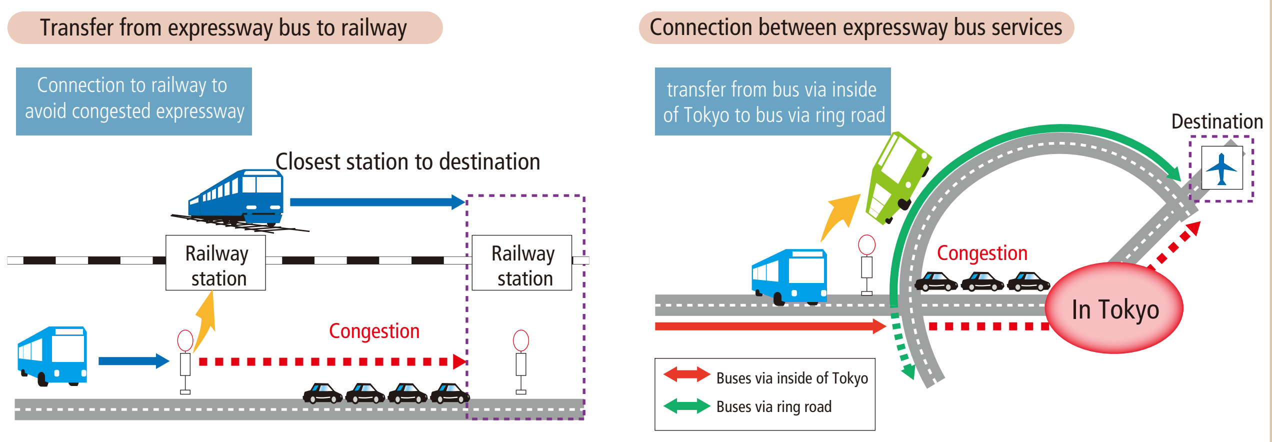
Originally scheduled connection

Alternative connection




**[Coordination between operators]**






# Multi-level Road System

**Making a good use of the multi-level road system, the MLIT continually improves function, convenience and value of road space. Through reorganization of the road space, the ministry addresses problems and needs of the area along the road.**

## Background

Multi-level road system was established in 1989 to allow an integral development of road and building in a designated area for multi-level road. The background of the introduction of this system included:
-Increase of land price was inhibiting acquisition of right of way, resulting in slow progress in arterial road development
-It was increasingly necessary to develop arterial roads and the surrounding areas in an integrated manner to promote appropriate and reasonable land use.
At the beginning, the multi-level road system applied to new or reconstructed roads only. After the Road Act was amended in 2014, however, the multi-level road system expanded its coverage to include existing roads.

## Case Study (Station square in front of the west exit of the Shinagawa Station adjoining National Highway No. 15)

Shinagawa Station in Tokyo serves as a starting point to access Haneda Airport. Since a new terminal station "Shinagawa New Station" (provisional name) of the maglev Chuo Shinkansen (scheduled to be open in 2027) is going to start operation (in a provisional manner) in 2020, there is an increasing development need involving private entity.

### Current Status and Issues

The current station square and pedestrian space in front of the west exit is already busy with a number of vehicles, pedestrians and public transportation everyday in a small area compared to the east exit (port south exit) where urban redevelopment has been progressing, which poses a problem of comfort and safety for users.

**Traffic Disorder in front of the Station**

A significant number of pedestrians cross the National Highway No. 15 near Shinagawa Station. The current pedestrian crossing in front of Shinagawa Station, which does not have a sufficient waiting space for pedestrians, cannot accommodate 8,000 pedestrians in the peak hour of 6 p.m. This space is filled with pedestrians, cyclists and bus users who are all walking toward different directions, creating an unpleasant and even dangerous situation.

**Loading/unloading Vehicles**

A number of vehicles (over 350 vehicles a day) use this station square for loading and unloading goods to deliver to stores in the station. As a result, this space no longer offers a good traffic hub function.

**Non-barrier-free Overpass**

The overpass crossing National Highway No. 15 is narrow and does not have an elevator. It is hard for wheelchair users and the elderly to use.

**Taxi Stand**

The current taxi stand accommodates only 10 taxis, which are always too few to meet the demand.

**Community Bus**

Because the current station square is too small to offer a bus stop area, it has been installed along National Highway No. 15, which causes confusion among bus users and other pedestrians.

### Development Policy

Shinagawa Station and the surrounding area have a strong potential as a regional transportation hub or an international exchange hub especially after Haneda Airport started serving intentional flights and maglev Chuo Shinkansen is developed. Making a good use of a limited space near the station, the urban infrastructure should be developed in an integrated manner among roads, station and other elements in the town.
-Apply the multi-level road system to National Highway No. 15 to make good use of the space over the road.
- Offer a safe traffic line for pedestrians
-Improve accessibility to walk around the station and the town
-Enhance a modal connect function of the station square by separating vehicles and pedestrians and integrating bus stop and taxi stand.

# Michi-no-Eki

**As a longer driving and female/elderly drivers become common, there is an increasing demand for resting areas along general roads where they can drop in and rest at ease so that they go back to safe driving which ultimately support smooth traffic flow.**
**With diverse values, people desire for unique and interesting places. These resting areas would provide various and unique services based on the local culture, history, tourist destinations and local specialities. Resting areas are expected to attract a lot of tourists, which means it will help surrounding areas to become more vibrant and facilitate a synergistic relationship with other local areas through the road.**
**Aiming for these effects, the Rest Areas network called "Michi-no-Eki" were introduced. Michi-no-Eki plays 3 different roles; "a place for resting" for road users, "a place to provide information" for both road users and locals, and "a place to facilitate local communications".**

## Locations

-Rest Areas are located at appropriate intervals to best serve as a resting place for road users

## Services

-Parking space, washrooms and telephone booths available 24 hours a day
-Attentive information service provided at the information desk

## Facilities

-Free parking space large enough for road users to rest
-Clean washrooms
-Information center for road users and locals
-Various service facilities
-Barrier-free designed walking paths

## Eligible local proponents

-Municipalities or the equivalent public bodies

## Remarks

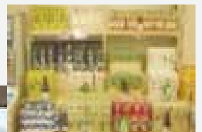
-Facilities are designed so that children, elderly and physically challenged people can easily use them
-Michi-no-Eki is designed to suit local beautiful sceneries

## Disaster-prevention features in the event of natural disaster

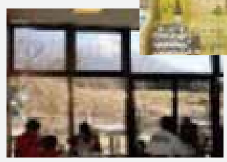
-With a power generation facility, a storage for reserve stock and a heliport, Michi-no-Eki serves as a local disaster-prevention center
-Michi-no-Eki actually played an important role in providing a place for life-saving activities, distribution of relief goods, evacuation center and food distribution

### ■Overview of Michi-no-Eki

**● Michi-no-Eki “Asagiri Kogen” (Shizuoka Pref.)**

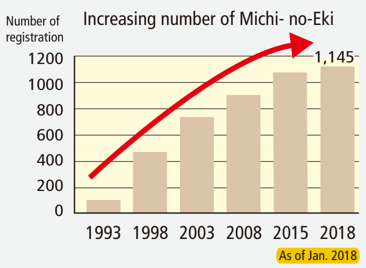


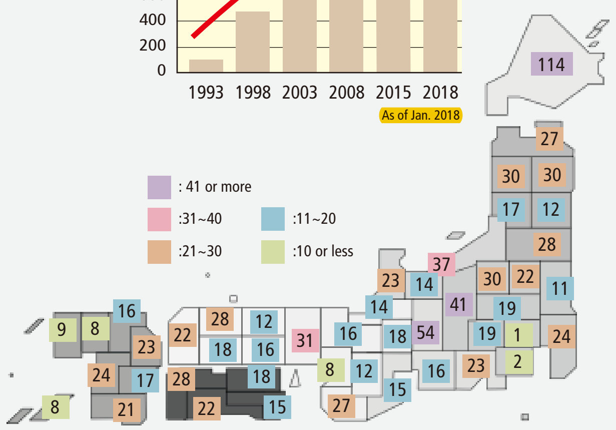
Local Sake



Restaurant overlooking Mt. Fuji

**● Number of Michi-no-Eki**




**● Rest area**

24-hour free toilet / parking lot

**● Information provision**

Tourist center
(Kawaba Denen plaza in Gunma)

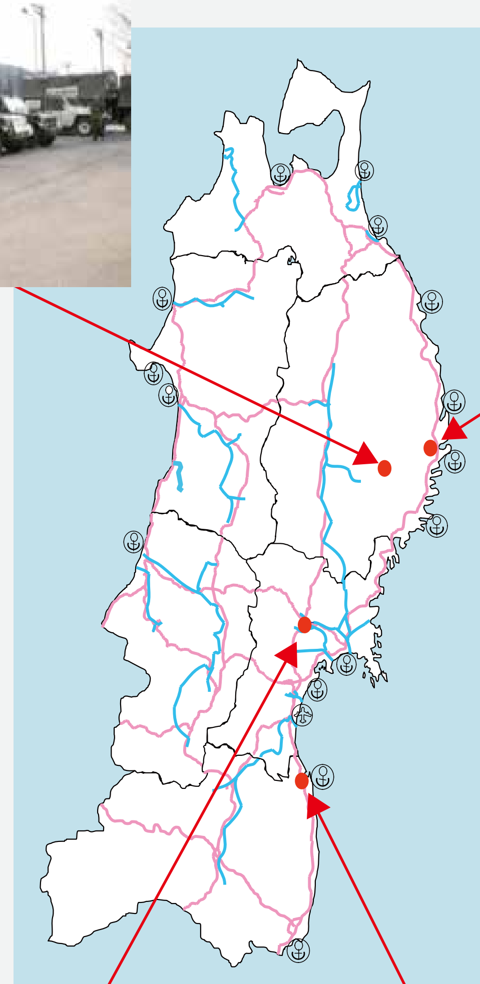
**● Cultural exchange**

Store jointly invested by local residents
(Miyama Fureai-hiroba, Kyoto)

### ■ Disaster prevention features that were found to be useful after the Great East Japan Earthquake

**Logistics support by Self Defence Forces (SDF)**

Tono Kazeno-oka
(Tono city, Iwate)



**Food/daily necessities supply for affected residents**

Re-opened as the only store just 1 week after the earthquake and provided local vegetables and daily necessities.

Yamada (Yamada town, Iwate)

**Emergency shelter**

With an in-house power generation, it opened 24 hours a day and provided rice balls and snacks for evacuees.

Sanbon-gi (Osaki city, Miyagi)

**Distribution center for relief goods**

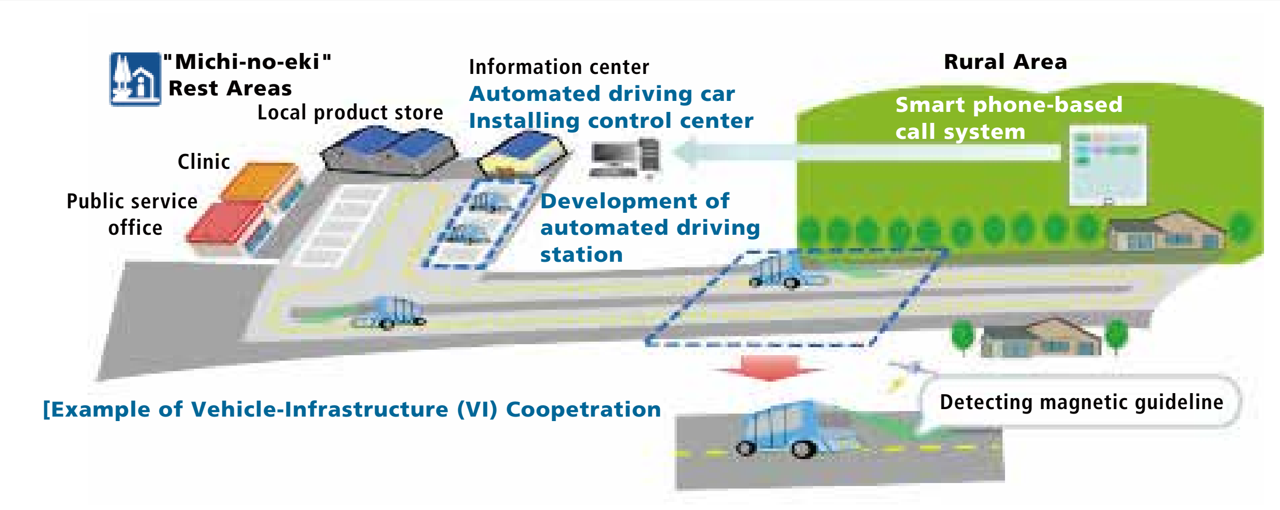
Serves as a relaying point of relief-goods transport from all over the country.

Soma (Soma city, Fukushima)

# Automated driving services in rural area

In 2017, the MLIT started pilot projects to demonstrate a VI-based automated driving service around Michi-no-Eki which is expected to assure smooth transportation of people and goods in rural area where many elderly people reside.

## Pilot projects of automated driving service in rural area




**Ensure freight transport** (delivery service and collecting/ shipping agricultural products)

Consolidated transport (passenger and goods)

**Means of mobility in everyday life** (shopping, hospital and public services)

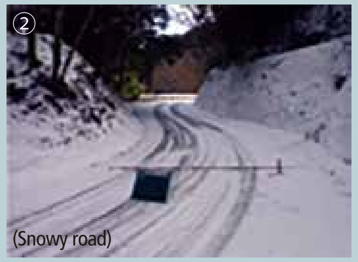
**Local revitalization** (tourism, creation of a work place)

## Examined items at the pilot projects

①**Road / transport**
②**Regional environment**
③**Cost**
④**Social acceptance**
⑤**Impacts on the local community**


(Road in rural area)

(1) Road structure (alignment, gradient etc.)
(2) Road administration (lane markings,vegetation etc.)
(3) Support for mixed traffic
(4) Space needed for road transport centers


(Snowy road)

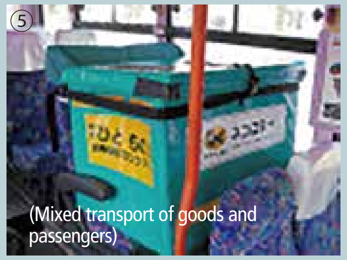
(1) Weather conditions (rain, snow etc.)
(2) Communication conditions (GPS receiver sensitivity)


(Placement of electromagnetic guidelines in pavement)

(1) Vehicle introduction / maintenance costs
(2) Non-vehicle costs needed


(Passenger vehicle)

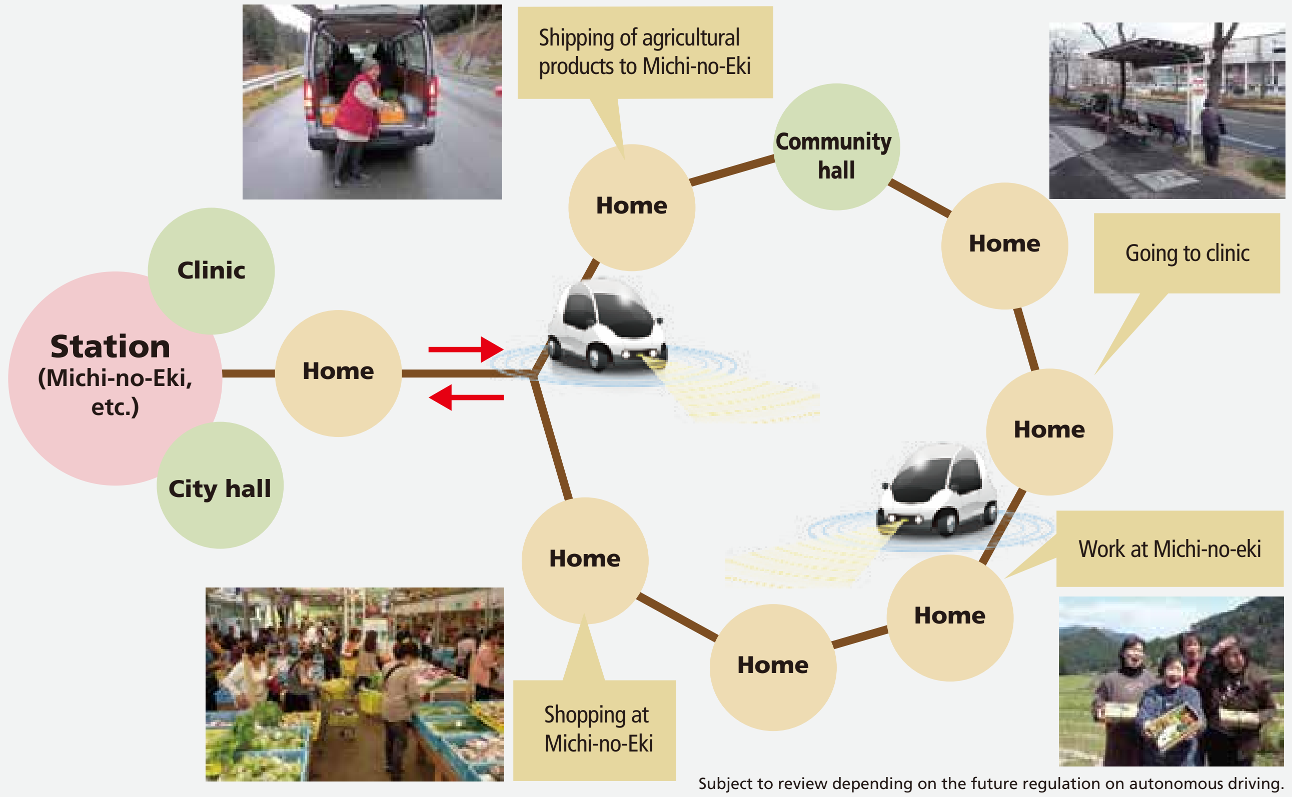
(1) Comfort (speed, psychological impact etc.)
(2) Convenience (route, frequency of travel etc.)


(Mixed transport of goods and passengers)

(1) Increase in senior citizens venturing out into society
(2) Expanded collection and shipment of agricultural products, etc.

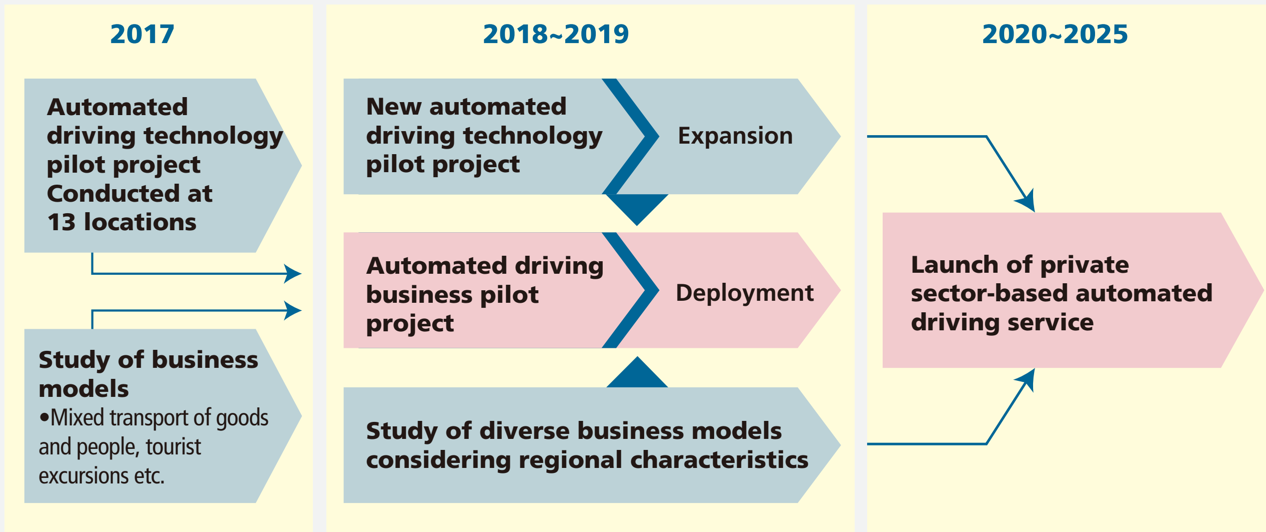
## Driving route in the experiment

| | |
|---|---|
| **Test route** | Go the rounds of customer house and facilities (clinic and city hall, starting from Michi-no-Eki.) |
| **Travel distance** | About 4~5 km |
| **Driving space** | ①Driving on the dedicated space by traffic restriction (autonomous driving level 4) (an officer is on board for emergency stop)<br>②Driving on dedicated space + mixed traffic (public road) (autonomous driving level 4 + 2) (a driver is on board) |
| **Schedule and routes** | ①scheduled service ②request using a smart phone |




Subject to review depending on the future regulation on autonomous driving.

## Road map



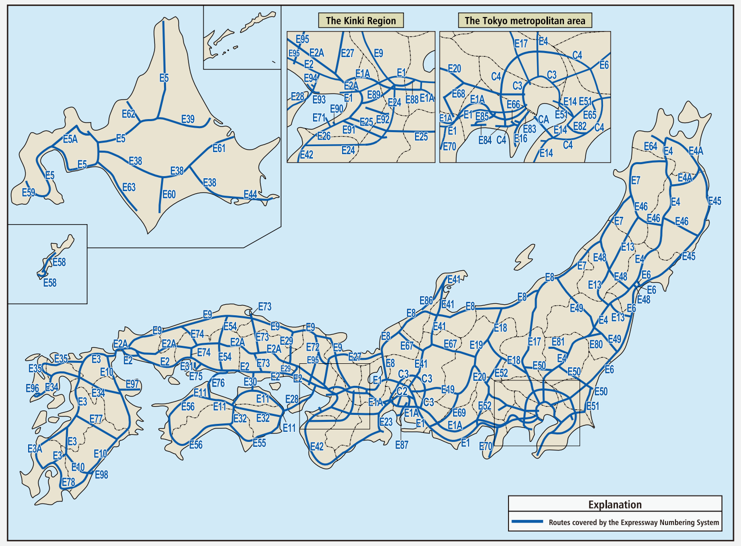
# Japan's Expressway Numbering System

**In 2017, the MIIT introduced a new numbering system, a scheme that combines route numbers with route names to Japan's growing expressway network in order to make it easier to understand for all expressway users, including foreign visitors in Japan.**

## Basic features of the Expressway Numbering System

Road types and functions are indicated with alphabetic letters.
- The letter "E" indicates an expressway
- The letter "C" indicates a circular route
- The letter "A" at the end of a route number indicates grouped route.

### ■Expressway Numbering System



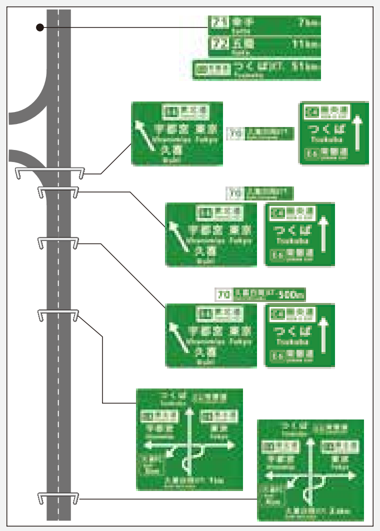

| Route number | Route name |
|---|---|
| E 1 | TOMEI EXPWY, MEISHIN EXPWY |
| E 1 A | SHIN-TOMEI EXPWY, SHIN-MEISHIN EXPWY, ISEWANGAN EXPWY |
| E 2 | SANYO EXPWY |
| E 2 A | CHUGOKU EXPWY, KANMON EXPWY |
| E 3 | KYUSHU EXPWY |
| E 3 A | MINAMI-KYUSHU EXPWY |
| E 4 | TOHOKU EXPWY |
| E 4 A | HACHINOHE EXPWY, AOMORI EXPWY, etc. |
| E 5 | HOKKAIDO EXPWY, etc. |
| E 5 A | SASSON EXPWY, etc. |
| E 6 | JOBAN EXPWY, SENDAI-TOBU ROAD, SANRIKU COAST EXPWY (Sendaiko-kita — Rifu), SENDAI-HOKUBU ROAD |
| E 7 | NIHONKAI TOHOKU EXPWY, AKITA EXPWY (Kawabe — Kosaka) |
| E 8 | HOKURIKU EXPWY |
| E 9 | KYOTO-JUKAN EXPWY, SAN-IN KINKI EXPWY, SAN-IN EXPWY |
| E 10 | HIGASHI-KYUSHU EXPWY (Kitakyusyu — Kiyotake), MIYAZAKI EXPWY |
| E 11 | TOKUSHIMA EXPWY (Tokushima — Naruto), TAKAMATSU EXPWY, MATSUYAMA EXPWY (Kawanoe — Matsuyama) |
| E 13 | TOHOKU-CHUO EXPWY (Soma — Fukushima-kita), TOHOKU EXPWY (Fukushima-kita — Fukushima), TOHOKU-CHUO EXPWY (Fukushima — Yokote) |
| E 14 | KEIYO ROAD, TATEYAMA EXPWY, FUTTSU-TATEYAMA ROAD |
| E 16 | YOKOHAMA SHINDO (Shin-hodogaya — Kariba), YOKOHAMA-YOKOSUKA ROAD |
| E 17 | KAN-ETSU EXPWY |
| E 18 | JOSHIN-ETSU EXPWY |
| E 19 | CHUO EXPWY (Komaki — Okaya), NAGANO EXPWY |
| E 20 | CHUO EXPWY (Takaido — Okaya) |
| E 23 | HIGASHI-MEIHAN EXPWY, ISE EXPWY |
| E 24 | KEINAWA EXPWY |
| E 25 | MEIHAN EXPWY, NISHI-MEIHAN EXPWY |
| E 26 | KINKI EXPWY, HANWA EXPWY (Matsubara — Wakayama) |
| E 27 | MAIZURU-WAKASA EXPWY |
| E 28 | KOBE-AWAJI-NARUTO EXPWY |
| E 29 | HARIMA EXPWY, CHUGOKU EXPWY (Yamasaki — Sayo), TOTTORI EXPWY |
| E 30 | SETO CHUO EXPWY |
| E 31 | HIROSHIMA-KURE ROAD |
| E 32 | TOKUSHIMA EXPWY (Tokushima — Kawanoe-higashi), KOCHI EXPWY (Kawanoe — Kochi) |
| E 34 | OITA EXPWY (Hiji — Tosu), NAGASAKI EXPWY, NAGASAKI-DEJIMA ROAD |
| E 35 | NISHI-KYUSHU EXPWY |
| E 38 | DOTO EXPWY (Chitose-Eniwa – Akan), etc. |
| E 39 | ASAHIKAWA-MONBETSU EXPWY |
| E 41 | TOKAI-HOKURIKU EXPWY, NOETSU EXPWY |
| E 42 | KISEI EXPWY, HANWA EXPWY (Nanki-Tanabe — Wakayama), etc. |
| E 44 | KUSHIRO-SOTOKAN ROAD (Kushiro-higashi — Kushiro-Beppo), etc. |
| E 45 | SANRIKU COAST EXPWY (Rifu — Hachinohe) |
| E 46 | KAMAISHI EXPWY, TOHOKU EXPWY (Hanamaki — Kitakami), AKITA EXPWY (Kitakami — Kawabe) |
| E 48 | SENDAI-NANBU ROAD, TOHOKU EXPWY (Sendai-minami — Murata), YAMAGATA EXPWY |
| E 49 | BAN-ETSU EXPWY |
| E 50 | KITA-KANTO EXPWY, HIGASHI-MITO ROAD, HITACHINAKA TOLL ROAD |
| E 51 | HIGASHI-KANTO EXPWY |
| E 52 | SHIN-TOMEI EXPWY (Shimizu — Shin-Shimizu), CHUBU-ODAN EXPWY (Shin-shimizu — Futaba), CHUO EXPWY (Futaba — Nagasaka), CHUBU-ODAN EXPWY (Nagasaka — Sakukomoro) |
| E 54 | ONOMICHI EXPWY, MATSUE EXPWY |
| E 55 | HIWASA ROAD, KITAGAWA-NAHARI ROAD, KOCHI-TOBU EXPWY, etc. |
| E 56 | KOCHI EXPWY (Kochi — Shimantocho-chuo), MATSUYAMA EXPWY (Ozu — Matsuyama), etc. |
| E 58 | OKINAWA EXPWY, NAHA AIRPORT EXPWY |
| E 59 | HAKODATE-ESASHI EXPWY |
| E 60 | OBIHIRO-HIROO EXPWY |
| E 61 | DOTO EXPWY (Honbetsu — Ashoro), TOKACHI-OKHOTSK EXPWY, etc. |
| E 62 | FUKAGAWA-RUMOI EXPWY |
| E 63 | HIDAKA EXPWY |
| E 64 | TSUGARU EXPWY |
| E 65 | SHIN-KUKO EXPWY |
| E 66 | KEN-O EXPWY (Sakae — Totsuka) |
| E 67 | CHUBU-JUKAN EXPWY |
| E 68 | CHUO EXPWY (Otsuki — Kawaguchiko), HIGASHI-FUJIGOKO ROAD |
| E 69 | SHIN-TOMEI EXPWY (Mikkabi — Hamamatsu-Inasa), SAN-ENNANSHIN EXPWY |
| E 70 | IZU JUKAN EXPWY |
| E 71 | KANSAI-KUKO EXPWY, KANSAI INTERNATIONAL AIRPORT ACCESS BRIDGE |
| E 72 | KITAKINKI TOYO-OKA EXPWY |
| E 73 | OKAYAMA EXPWY, CHUGOKU EXPWY (Hokubo — Ochiai), YONAGO EXPWY |
| E 74 | HIROSHIMA EXPWY, CHUGOKU EXPWY (Hiroshima-kita — Chiyoda), HAMADA EXPWY |
| E 75 | HIGASHIHIROSHIMA KURE EXPWY |
| E 76 | ONOMICHI-FUKUYAMA EXPWY, SHIMANAMI EXPWY, IMABARI-KOMATSU EXPWY |
| E 77 | KYUSHU-CHUO EXPWY |
| E 78 | HIGASHI-KYUSHU EXPWY (Kiyotake — Kajiki) |
| E 80 | ABUKUMA KOGEN ROAD |
| E 81 | NIKKO-UTSUNOMIYA ROAD |
| E 82 | CHIBA-TOGANE ROAD |
| E 83 | DAISAN-KEIHIN , YOKOHAMA SHINDO (Hodogaya — Totsuka) |
| E 84 | SHIN-SHONAN BY-PASS (Chigasaki — Chigasakikaigan), SEISHO BY-PASS |
| E 85 | ODAWARA-ATSUGI ROAD |
| E 86 | NOTO SATOYAMA KAIDO (Chidoridai — Tokudaotsu) |
| E 87 | CHITAHANTO ROAD (Odaka — Handa-chuo), CENTRAIR LINE |
| E 88 | KEIJI BY-PASS |
| E 89 | DAINI-KEIHAN ROAD |
| E 90 | SAKAISENBOKU TOLL ROAD |
| E 91 | MINAMI-HANNA TOLL ROAD, MINAMI-HANNA ROAD, YAMATOTAKADA BY-PASS (Bennosho — Shijo) |
| E 92 | DAINI HANNA TOLL ROAD |
| E 93 | DAINI SHINMEI ROAD |
| E 94 | DAINI SHINMEI KITASEN ROAD |
| E 95 | BANTAN ROAD |
| E 96 | NAGASAKI BY-PASS |
| E 97 | HIJI BY-PASS, OITA AIRPORT ROAD |
| E 98 | HITOTSUBA TOLL ROAD (SOUTH ROUTE) |
| C 3 | (TOKYO-)GAIKAN EXPWY |
| C 4 | KEN-O EXPWY (Kamariya — Kisarazu) |
| C A | TOKYO-WAN-AQUA-LINE EXPWY, AQUA RENRAKU EXPWY |
| C 2 | MEI-NIKAN EXPWY |
| C 3 | TOKAI-KANJO EXPWY |

### ■Road sign guidance

signs show both route numbers and route names.

Examples of signs at expressway entrances

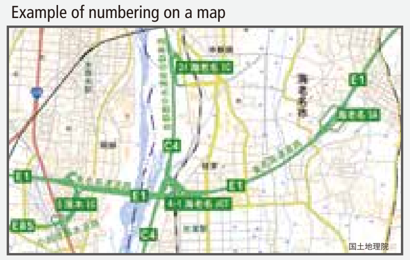

Examples of signs at junctions



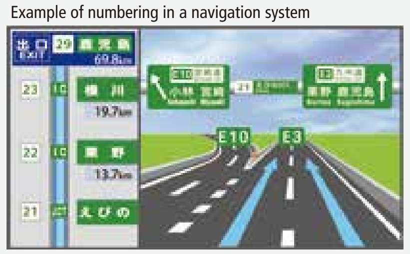
### ■Application of expressway numbering

The Expressway Numbering System is being applied to maps, car navigation systems, and various other tools and media.

Example of numbering on a map



Example of numbering in a navigation system



Current as of February 2017



Chapter 4

# Advanced Road Technologies

Work within a shield tunneling machine, which is constructing the Tokyo Bay Aqua-line Expressway.

Of Japan's total land area of 378,000km$^2$, only one-third is suitable for living. Due to its topographical, geological, meteorological and other natural conditions, Japan is prone to numerous natural disasters such as storms, heavy snowfall, floods, landslides, earthquakes and tsunamis. Consequently, various road construction technologies have been developed to overcome the resulting severe conditions and difficulties posed by these natural disasters.

# Tunnels

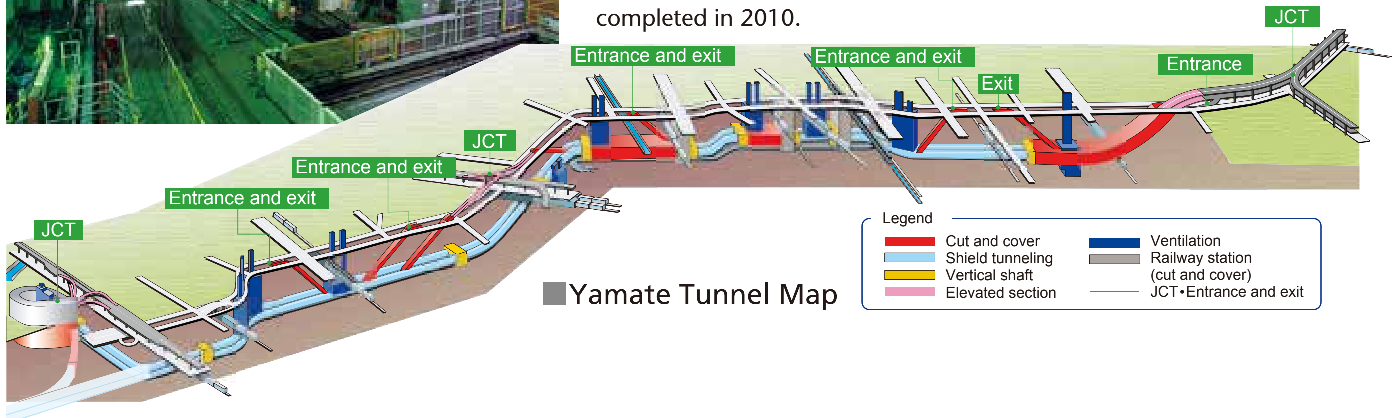
**The long, thin chain of islands that compose Japan has a spine of steep mountains running north to south down the island chain. The elevations reach 2,000m to 3,000m above sea level and about 70% of the land is mountainous. Therefore, roads must be constructed on the narrow strips of land between steep slopes and the sea, alongside rivers winding between mountains, and sometimes through mountains. Tunnels are increasingly used when constructing roads in highly populated areas due to the shortage of land and to protect the environment.**

## Kan-etsu tunnel (Kan-etsu Expressway)

The Kan-etsu Tunnel is 11km long and is the longest highway tunnel in Japan and the fifth-longest in the world. At its lowest depth the tunnel passes 1,100m below the mountain's peak. Of its four lanes, the outbound lanes were opened in 1985 and the inbound lanes were completed in 1991.

## Yamate tunnel
**(Central Circular Shinjuku Route of the Metropolitan Expressway)**

The Central Circular Shinjuku Route of the Metropolitan Expressway connects Shibuya, Shinjuku and Ikebukuro, which are major sub-centers of Tokyo. Two tunnels account for most of its 11km length, one for the inbound lanes and the other for the outbound lanes. The tunnels were completed in 2010.




■Yamate Tunnel Map

## Tunnel boring machine

The tunnel boring machine consists of both a tunnel shield and a front rotating cutting wheel. As the front cuts into the ground, it assembles concrete segments inside the machine, and as it advances it constructs the tunnel behind it. Advanced robotic technologies are used, with a computer controlling a series of activities required for the tunneling work.

World's largest tunnel boring machine (diameter: 14.14m) used to construct the Tokyo Bay Aqua-line Expressway



# Bridges

**Japan consists of four major islands, Hokkaido, Honshu, Kyushu, along with Shikoku, and a number of smaller islands. Straits and inland seas hinder traffic between the islands. For well-balanced development, transportation access is required, so bridges connecting islands have been constructed. Also, since Japan is highly prone to earthquakes, typhoons and strong winds, cutting-edge technologies are used to construct and maintain long-span bridges that can withstand severe weather and natural disasters**

## Honshu-Shikoku expressway

The Honshu-Shikoku Expressway was completed in 1999 and connects the main island of Honshu with the island of Shikoku. It has three routes, including: the Kobe-Naruto route (the Kobe Naruto Expressway), the Kojima-Sakaide route (the Seto-Chuo Expressway and the JR Seto-Ohashi line), the Onomichi-Imabari route (the Nishi-Seto Expressway). The total length of these roads is approximately 173km. The center span of the Akashi Kaikyo Bridge is 1,991m, making it the longest in the world. Additionally, the height of the main tower is approximately 300m above sea level.

Akashi Kaikyo Bridge

Tatara Bridge

Seto Bridge

## Tokyo bay aqua-line expressway

The Tokyo Bay Aqua-line Expressway, which allows a motorist to transverse the Tokyo Bay, was completed in 1997. About 10km, out of its total 15.1km, are under the Bay and the remaining 5km are configured as the Aqua Bridge. A ventilation tower ("Kaze-no-to") was constructed in the middle of the tunnel, and a manmade island ("Umihotaru") was constructed where the tunnel and the bridge meet.

The manmade island "Umihotaru" and the Aqua-line Bridge

## Reinforcement and management of long bridges

Long bridges are inspected daily using advanced technologies in order to prolong their service life. For instance nondestructive methods are used to inspect hangers on suspended bridges.

Implementation of damage control earthquake-resistant designs to retrofit existing long bridges has reduced the cost of constructing long bridges to 65%.

Non-destructive inspection of hangers

Use of a damage control earthquake-resistant design on the Minato-ohashi Bridge helped reduce the construction cost (Hanshin Expressway).

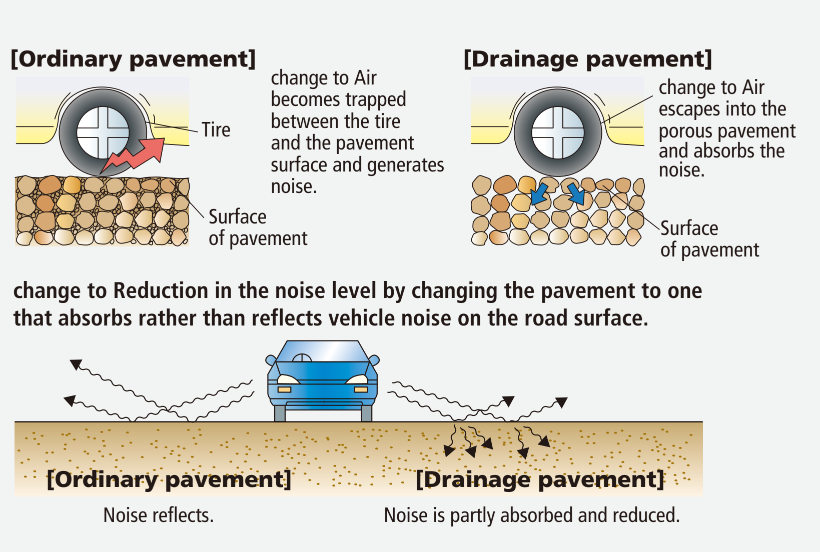
A model experiment using a 1/6-scale model of buckling restraint braces.

# Pavement

**In 1955, the percentage of paved national highways in Japan was less than 14% of the total road network. The percentage increased sharply thereafter as motorization rapidly progressed, reaching 57% in 1965, 79% in 1975, and over 90% today. Various paving technologies have been researched and developed since roads in Japan are subject to large seasonal temperature differences and heavy rainfall. New technologies are being developed to address an aging society and environmental issues.**

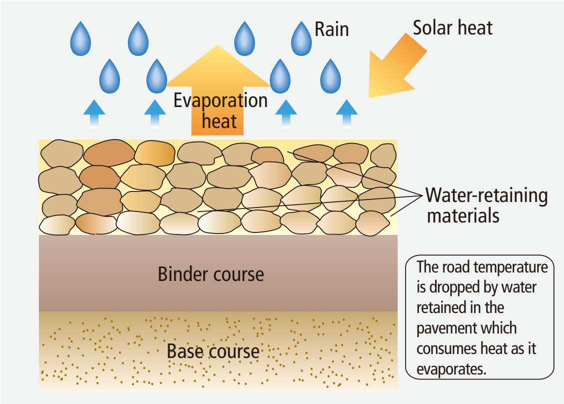
## Drainage and low-noise pavement

The surface of a newly developed pavement is more porous than ordinary pavement and allows water to seep into and pass through the pavement. It flows along an inclined, impermeable course and is then discharged out the side gutters. The pavement drains the rain water and allows the road surface to remain non-slippery, controls spray and ensures good visibility. The porousness of the pavement also suppresses the noise generated by tires and traffic.



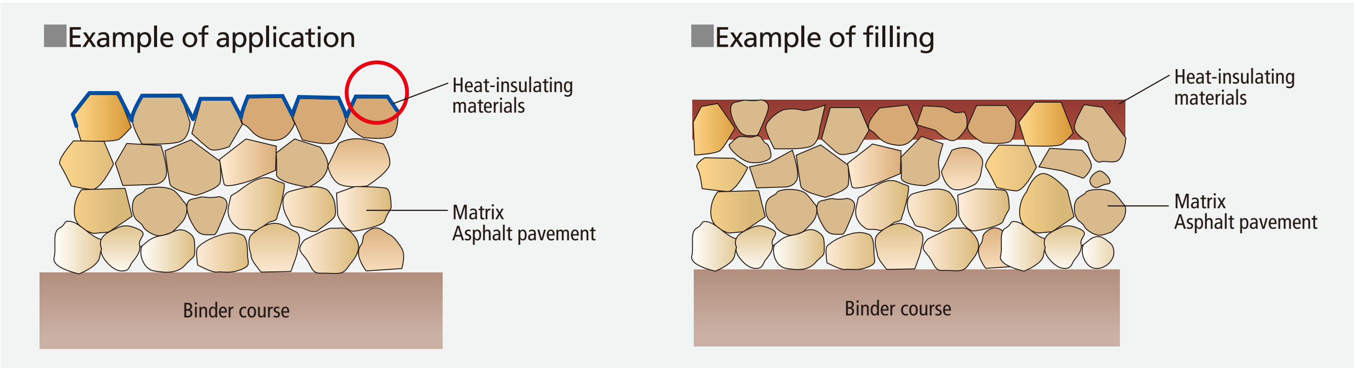

## Water-retaining pavement

The pavement retains water and thus lowers the road temperature through water evaporation. Diverse techniques, from which rain water and underground water slowly evaporate, have been proposed. For example, injecting water-retaining materials like polymers into the voids of asphalt mixtures is one such option.




## Heat-insulating pavement

Special paint is applied on the pavement surface to reflect infrared rays from the sun and thus reduce the amount of heat that is absorbed and accumulated in the pavement. The paint controls the rise in the surface temperature of the pavement and improves the thermal environment for pedestrians and road-side users, helping to mitigate the heat-island phenomenon.






# *Appendix*

## -History of Roads in Japan
## -Technical Standards
## -Statistics

# History of Roads in Japan

**Japan is a country comprised of four major islands and numerous minor islands. It is configured as a crescent shape and situated to the east of the Asian continent in the Northwestern Pacific Ocean. Of its 378,000 square km of land, about 70% is comprised of mountainous terrain. It is inhabited by more than 120 million people.**

**It is a country that has achieved harmony between its traditional culture from ancient eras and its modern society with advanced technology. Yet, Japan's fascinating natural environment is one that changes from season to season.**

**The history of land transport in Japan began over two thousand years ago and can roughly be categorized into the following four eras: 1) Age of People and Nature (ancient times until the Meiji Restoration in 1867), 2) Age of Modernization (from the Meiji Restoration until the 1950s), 3) Age of High Efficiency Networks (from the 1950s to the present day) and 4) Age of Optimal Maintenance and Management for Maximum Utilization of Existing Roads.**

## I. Age of People and Nature (ancient times until the Meiji Restoration in 1867)

### I) The Ancient Foundations of Modern Japan

The oldest written record of roads in Japan appeared in a Chinese history book from the 3rd Century called Gishi-wajinden. At that point in time, Japan was in the process of unifying the country under the Yamato Dynasty. People travelled on foot or horseback for hundreds of years until the Meiji Restoration, when Japan opened its doors to the modern nations of the West late in the 19th century, which resulted in modern conveniences becoming available and then prominent in Japan.

Unlike in China and the European countries, horse-drawn carriages never fully evolved in Japan. The historical lack of use of horse-drawn carriages could be due, in part, to the country's terrain which is mostly mountainous and criss-crossed by numerous creeks and inlets.

After the Reformation of the Taika Era (645 C.E.), an elaborate central government system, characterized by emerging administrative and judicial institutions, was established. A new road network was developed at this time that connected Honshu (the largest island) to Shikoku (the smallest of the four main islands) and then continued all the way down to Kyushu (the southernmost and third largest island).

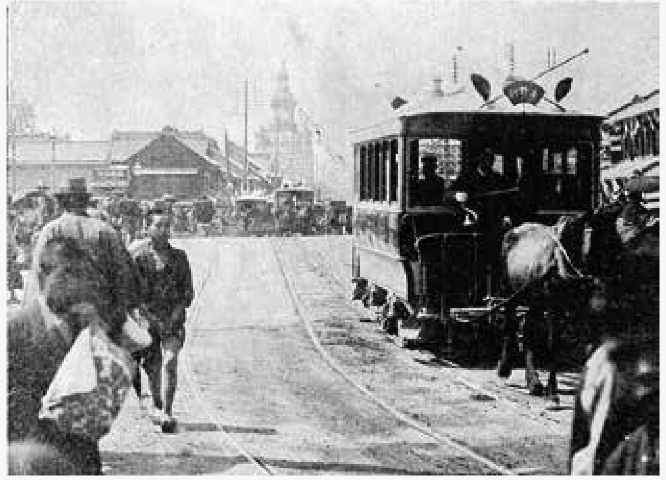
This nationwide public road network was called "Seven Roads" and was composed of Tokaido, Tosando, Hokurikudo, San-indo, San-yodo, Nankaido and Saikaido ('-do' in Japanese means 'road'). After bitter struggles with the rough terrain of the country, the Seven Roads were completed and in later years were used as the prototype for highways and roads. Almost all of the Seven Roads routes were used as arterial railways during the Meiji Era (1868-1921 C.E.) and then expressways that opened after 1964. In short, ever since the Seven Roads were first established during this age, they have continued to serve as the backbone for transport routes in Japan.

### 2) User-friendly Roads Can Be Traced Back to Early Times

Along with the establishment of the Seven Roads came another system called "Ekiba, Tenma" (Post Horse System), which eventually became the modern international word "Ekiden" (a relay road race). In this Chinese-originated system, an "Eki" (meaning station) was located at each interval of 16km along a road and would provide necessary services for the officials and people of high rank who travelled that road on their journeys. Approximately 400 "Eki" were developed across the country. In the mid-8th century, a number of fruit trees were systematically planted along the Seven Roads, which eventually led to the tree lined roads of today.

Later, in the 16th century, a road signage system called "Ichirizuka" was established by referencing a similar practice from ancient China. This system can be viewed as the Asian version of the Roman milestone-system. After the Edo Shogunate was established in 1603 C.E., the ichirizuka system was transformed when ample facilities were created and the 5 Major Highway System, radiating from Edo (the old name for Tokyo), was formed. The Shogunate specified that the five major highways should be about 11m wide and

Numazu-juku as depicted by Hiroshige
Source: National Diet Library



Nihombashi in the Meiji Era
Source: National Diet Library

secondary roads should be 5.5m wide. The roads were to be filled with gravel and cobbles to a depth of 3cm and topped with sand after treading them down.

Sir Rutherford Alcock, the first British Minister to visit Japan, wrote about his visit at the end of the Shogunate era, saying, "Their highways, the Tokaido, the imperial roads throughout the kingdom, may challenge comparison with the finest in Europe. Broad, level, carefully kept and well macadamized, with magnificent avenues of timber to give shade from the scorching heat of the sun, it is difficult to exaggerate their merit."

### 3) Road Construction with Consideration for People and Scenery

Japanese people frequently traveled, to such a degree that foreigners were astounded by how far and how often they traveled in comparison to themselves. The Japanese did not hesitate to travel because there were such excellent road facilities and services even back then.

In the middle of the Edo Era (1690 C.E.), Englebert Kaempfer, a German doctor who came to Japan to work for a Dutch trading house, wrote: "An unbelievable number of people travel the highways of this country every day. The reason for this is the high population of this country, but another reason is that, unlike inhabitants of other nations, the Japanese travel extremely often."[1]

The Hakone Road was already paved by 1680 C.E. Sir Ernest Satow, a British diplomat who came to Japan at the end of the Edo Shogunate (mid-19th century), wrote in his book, "A Diplomat in Japan," about his astonishment at the pavement there: "Next morning, we started at half-past six to ascend the pass which climbs the range of mountains by an excellent road paved with huge stones after the manner of the Via Appia where it leaves Rome at the Forum, and lined with huge pine trees and cryptomerias."

Unlike the Via Appia, Japanese surface transport routes were developed primarily for people and horses, because horse-drawn carriages were not common prior to the Meiji Era (~1868 C.E.) For this reason, roads were usually in good condition since damage caused by traffic was not severe and maintenance was relatively easy to complete. Road cleaning and other regular maintenance was not performed by the Shogunate or the government of feudal clans, but by roadside residents on a voluntary basis. This implies that there was a general understanding that roads were not the exclusive property of the overlords, but considered to be "public property".

[1] "Geschichte und Beschreibung von Japan"

The state of roads in the mid-1950s was as "incredibly bad" as Watkins wrote in his report.

## 2. Age of Modernization
### (from Meiji Restoration to the 1950s)

After ending two hundred years of isolation, the revolutionary government of the Meiji Era (1868-1912 C.E.) quickly started modernizing the surface transport system by importing new technologies from Europe. Unlike China and Europe, Japan did not have a history of horse-drawn carriages as a method of transport. It was thus impossible to transform the ancient roads, designed strictly for the passage of people and horses, into modern roads in a single step.

The beautifully maintained pre-modern roads of the Edo Era began to deteriorate under the burden of modern horse-drawn carriages and human-powered vehicles (or rickshaws). Arthur Crow, who visited Japan in 1881 C.E., recorded this observation in "Highways and Byways in Japan": "The Tokaido is in a dreadfully bad state, with ruts and holes large enough almost to swallow a cart, and yet traffic is very heavy, both for horse and man-power vehicles".

The slow improvement of roads can be partially attributed to the decision by the Meiji Government to give rail and sea transport higher priority over roads. This decision was intended to allow Japan to catch up with the advanced nations of the West as quickly as possible. The backwardness of the road system in Japan continued until 1945 when the World War II ended and the entire national landscape was devastated by bombings and other catastrophes of war. During the reconstruction process in Japan, the modernization of roads in Japan was fully accelerated along with the development of railways.

April 1968
Vehicles driving from Okazaki IC to Komaki IC after the opening ceremony of the Tomei Expressway
(Photo: Mainichi Shimbun)



## 3. Age of High Efficiency Networks
### (from the 1950s ~ today)

### 1) Arrival of the Motorization Age

Automobiles proliferated quickly as the Japanese economy recovered from hardship after the war and the standard of living improved. Only 130,000 vehicles were registered at the end of World War II, but the number increased rapidly, reaching 500,000 vehicles by 1951, then doubling to one million in 1953, and doubling again to two million in 1957. The Age of Motorization had finally arrived in Japan.

However, the road system in Japan remained insufficient to support the ongoing rapid motorization. Ralph J. Watkins, an economist invited by the Japanese Government to conduct research on the Meishin Expressway, wrote in his 1956 report, "The roads of Japan are incredibly bad. No other industrial nation has so completely neglected its highway system."

Indeed, Japan's road system in those days was truly terrible. Only 23% of the first-class arterial national highway system was paved. Only two-thirds of national Highway Route 1, supposedly the major arterial highway connecting Tokyo with Osaka, was paved. The Japanese Government at that time accepted Mr. Watkins' proposals and immediately put them into practice. Thus, road improvement in Japan moved into high gear, propelling the nation into the high economic growth era of later years.

### 2) The Five-Year Road Development Program, Toll Road System and Tax Revenue System with Earmarks for Roads

Without a long history of horse-drawn carriages, the roads in Japan were severely underdeveloped. What was worse, road development was inevitably slow because the development of railways was given priority over the development of roads. Under these circumstances, the Five-Year Road Development Program was launched so that road development could be fully accelerated.

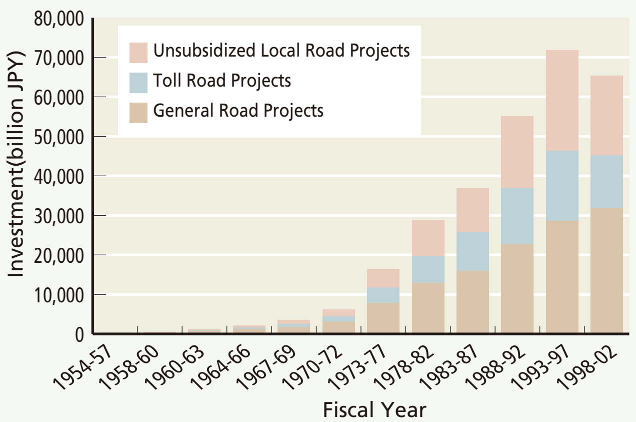
Since the public works budget, under the general revenue scheme, was insufficient in meeting the ever-increasing road traffic demand, two new financing systems were introduced: the toll road system and the tax revenue system with earmarks for roads. These systems allowed for a significant number of road projects to be undertaken in a short period of time.

The former "Act on Special Measures concerning Road Construction and Improvement", which was enacted in 1952, introduced the toll road system and enabled the national and municipal governments to borrow sufficient funds to develop roads. After the new roads were complete, the borrowed money would be repaid using the toll revenue from the roads.

The toll road system was used primarily for national expressway projects. In 1956, the Japan Highway Public Corporation was founded, so that expressways would be efficiently managed and financial resources from the private sector could be widely utilized.

With its founding, toll road development was now led by JH instead of the National Government. Although the mechanisms of the toll road system are similar to that of current PPP projects, the former included an ingenious system that enabled them to carry out unprofitable road projects if the road was recognized as necessary from a point of social benefit. The National Government reduced the business risk of unprofitable road projects by guaranteeing the loan and by paying a fixed rate of interest. In addition, the Government utilized the pool system, in which revenues and expenditures were balanced throughout the toll expressway network. This system enabled them to develop not only profitable expressways in urban areas but also unprofitable expressways in rural areas across the country.

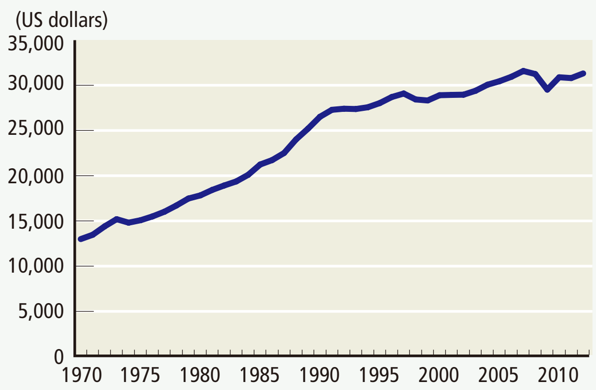
■Investment change in the Five-Year Road Development Program




Note:
1) Reserve fund (150 billion) is included.
2) Reserve fund (100 billion) is included.
3) Reserve fund (500 billion) is included.
4) Reserve fund (700 billion) is included.
5) Adjustment cost (1,300 billion) is included.
6) Adjustment cost (1,300 billion) is included.
7) Adjustment cost (1,400 billion) is included.
8) Adjustment cost (5,000 billion) is included.
9) Reserve fund (11.2 billion for Okinawa) is included in the total of the 6th plan.

In 1953, the "Act on State's Tentative Financial Measures for Road Construction Projects" was enacted and thus ushered in a new tax revenue system with earmarks for roads. This system, based on the "beneficiary-pays" principle, earmarked the revenue from fuel tax and other automobile-related taxes for road projects. This measure secured stable financial resources for the long-term development of roads, including the 1st Five-Year Road Development Program and the subsequent 11 programs that followed.
The toll road system and the tax revenue system with earmarks for roads supported the development of the nationwide road network for more than 50 years. During those years, all major roads were paved and more than 10,000km of expressways were developed across the country.
However, there were increasing calls for a change in both of the financial revenue systems since the road network in Japan had reached an almost adequate level of development. There were various critiques and opinions about road development, including the belief that roads were developed wastefully and sometimes redundantly, spending a large amount of both borrowed money and the national budget. At the same time, the repayment and management costs were not being sufficiently preserved due to the high-cost structure of JH's toll road system. As a result, JH was privatized and reorganized into the Japan Expressway and Debt Repayment Agency (JEDRA) and 6 regional Expressway Companies. The main purposes of this change were to ensure the repayment of the massive road debt that had reached 40 trillion yen, to streamline the administrative authority and to provide various services for road users by utilizing experience from the private sector.
There was also increasing criticism of the tax revenue system with earmarks for roads. Critics argued that fixed expenditures from the abundant financial resources resulted in unnecessary road development. In 2009, the tax revenue system with earmarks for roads was abandoned and the Government decided to pay for road expenditures using funds from the general revenue.

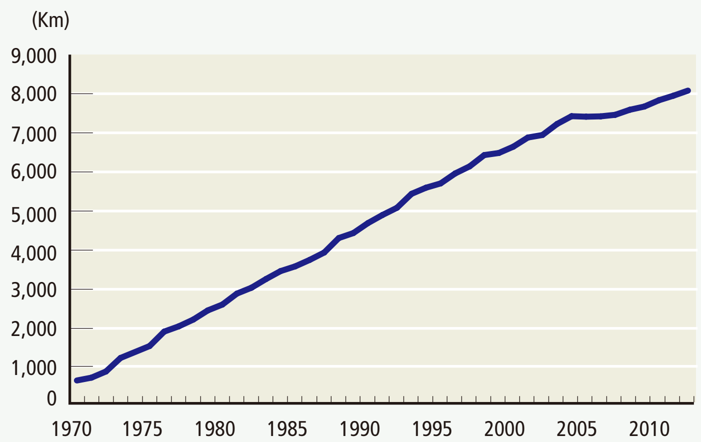
■Change in real GDP per capita




## 4. Age of Optimal Maintenance and Management for Maximum Utilization of Existing Roads

By the beginning of the 21st century, the total length of expressways had reached more than 8,000 km and the public opinion was that Japan had almost sufficient road networks, especially in urban areas. At the same time, Japan entered an age of declining birthrates and an aging population (the national population has been declining since it peaked in 2008).
In addition to these social changes, ever-increasing social security costs and the fragile national financial condition brought about the wide-spread belief that public investments should be economized. As discussed in the previous section, this led to the abolition of the tax system with earmarks for roads and the reorganization and privatization of JH. While road development is slowing down, utilization of existing road networks and improvement of asset management is becoming the focus of current programs.
The first task of asset management is to map out strategies for the aging road infrastructure, which was largely developed during the high-growth period of the Japanese economy (from the late 1950s to the 1960s).
The second task is to continually provide road transport services and to support the lives and economies of the people who live in a country that is prone to natural disasters such as earthquakes and typhoons.
The third task is to provide road services that are safe, accessible and environmentally friendly by utilizing evolving ITS technologies and by improving the quality of roads.

■Change in total length of expressways




### 1)Strategies for Aging Road Infrastructure

The majority of roads and bridges were constructed in the high-growth period of the Japanese economy and will be 50 years old in the next 10 years. To maintain the safety of this aging infrastructure, periodic investigation and database management, as well as systematic repair work, are required. It is a new technical challenge to efficiently investigate and repair 5.2 million bridges and 10,000 tunnels. At the same time, this is also a significant challenge in terms of the financial and human resources that are needed to meet road demands.

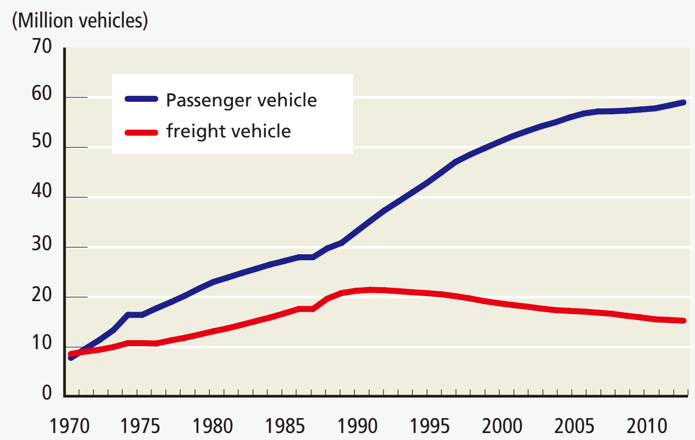
### 2)Preparing for Natural Disasters

The Great East Japan Earthquake in March 2011 forced the reevaluation of the importance of road networks in the face of large-scale natural disasters. 20% of world-wide earthquakes with a magnitude of 6 or higher occur in Japan. As an earthquake-prone country, disaster prevention measures, including improvement of bridges' quake resistance, have been deemed necessary after the repeated experience with these disasters. In addition, it is necessary to enhance road networks to guarantee alternative routes in the event of road closures after a large-scale disaster and in order to add disaster prevention functions to existing roadside service facilities. As climate change is increasingly occurring on a global scale, Japan has been experiencing more frequent heavy rains and snows. Overcoming landslides on slopes and snowbound traffic are always serious challenges in a country with precipitous terrain. Japan road administration has been implementing countermeasures that include: constructing slope protection, establishing a snow removal system, installing road monitoring systems and improving operations.

### 3)Improvement of Road Service Provisions using Intelligent Transport Systems (ITS)

Ring roads are being developed in the Tokyo Metropolitan Area, where traffic congestion is a serious problem. Once complete, ring roads are expected to provide more route options and smoother traffic flow.
Since they were introduced in the 1990s, ITS technologies have provided various services, including car navigation systems and Electronic Toll Collection (ETC). Even now, the technologies are evolving to meet the demands of road infrastructure and the automobile sectors. Newly introduced automobiles with crash-avoidance systems offer the potential for fully automatic driving systems sometime in the near future. In the road infrastructure sector, dynamic traffic guidance, warning messaging and vehicular controlling technologies are being studied as part of road-to-vehicle and/or vehicle-to-vehicle communication systems.
The advancement of technology is going to integrate road infrastructure and automobiles into a new synthetic transport system and will provide a breakthrough solution for traffic congestion, traffic accidents and environmental pollution, all of which have been major issues since the modernization of the road system began.

■Change in number of registered vehicles

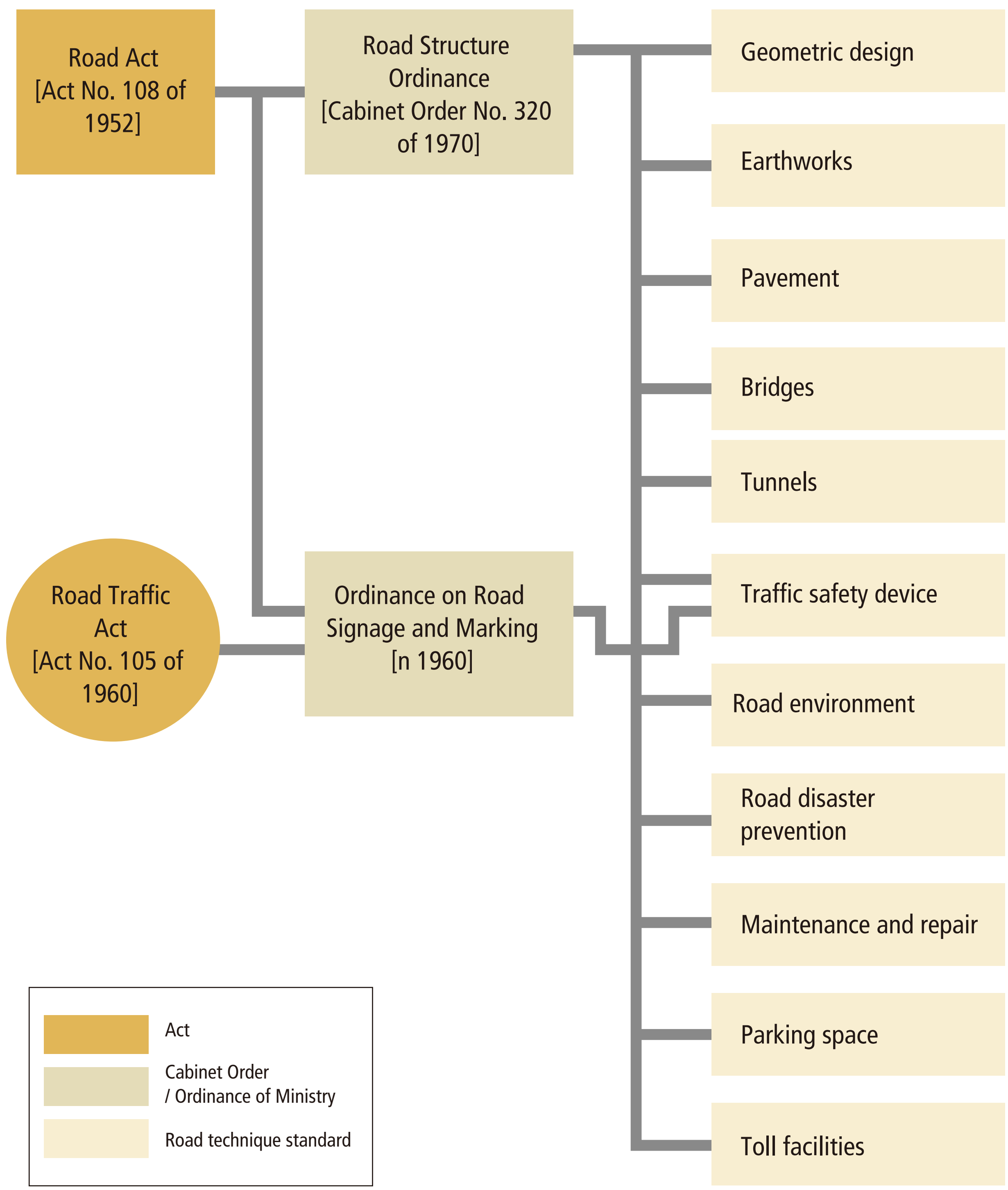


# Technical Standards

## (Government Ordinance No.320 of 29th October, 1970)

[Provisional translation]

Structure of Road Technical Standards




### (Purpose of This Ordinance)

#### Article 1

This Ordinance specifies general technical standards (limited to the provisions of the Road Act (hereinafter "Act") Article 30.1.1, 30.1.3 and 30.1.12 for general technical standards of the structure of prefectural roads and municipal roads) for the structure of national expressways and national highways when these roads will be newly constructed or reconstructed and also specifies general technical standards that should be taken into account when technical standards (except for the provisions in Article 30.1.1, 30.1.3 and 30.1.12) for the construction of prefectural roads and municipal roads are required under the ordinances of prefectural or municipal governments, who also serve as a road administrator.

### (Definition)

#### Article 2

The following terminology definitions shall apply to the corresponding terms in this Ordinance:

1. Sidewalk: A road section provided for dedicated pedestrian traffic, which is separated by curb lines or fences or other similar structures.
2. Bicycle track: A road section provided for dedicated bicycle traffic, which is separated by curb lines or fences or other similar structures.
3. Bicycle/pedestrian track: A road section provided for dedicated bicycle/pedestrian traffic, which is separated by curb lines or fences or other similar structures.
4. Carriageway: A road section used by dedicated vehicular traffic, except for bicycles.
5. Lane: A strip section of the carriageway (except for the service road) provided for safe and smooth traffic by directional separation of vehicles traveling in a single direction.
6. Additional overtaking lane: An additional lane (except for climbing, turning and speed change lanes) provided specifically for vehicles to overtake other vehicles.
7. Climbing lane: A lane for slower vehicles to be separated from other vehicles on uphill roads.
8. Turning lane: A lane for vehicles to turn right or left.
9. Speed change lane: A lane for vehicles to accelerate or decelerate.
10. Median: A strip road section provided to separate a lane from the traffic in the opposite direction and ensure lateral clearances.
11. Service road: A strip of carriageway provided to applicable sections, parallel to the carriageway, to ensure access of vehicles to roadsides where access is prevented by embankment and/or cut, or other means.
12. Shoulder: A strip of road section connected with carriageway sidewalks, bicycle tracks or bicycle/pedestrian tracks to protect major road structure sections and to maintain carriageway functions.
13. Marginal strip: A strip section of the median or shoulder connected with the carriageway to provide optical guidance for drivers and ensure lateral clearance.
14. Stopping lane: A strip of carriageway section principally used to park vehicles.
15. Track bed: A road section dedicated for use by streetcar traffic (streetcars as specified in Article 2.1.13 of the Road Traffic Act [Act No.105 of 1960]; this definition of streetcars shall apply hereinafter).
16. Island: An area facility provided at intersections, carriageway separation points, bus bays, streetcars stops, or other areas to ensure safe and smooth vehicular traffic or the safety of pedestrians crossing streets or bus and streetcar passengers boarding or alighting.
17. Planted strip: A strip of road section provided for tree planting in order to improve road traffic environment and ensure a better living environment along roadsides, which is separated by using curb lines or fences or other similar structures.
18. On-street facility: A road accessory facility on sidewalks, bicycle tracks, bicycle/pedestrian tracks, median, shoulders, bicycle paths and bicycle/pedestrian paths, except for common ducts and common cable ducts.
19. Urban area: An area forming or expected to form a city or town.
20. Rural area: Other areas than urban areas.
21. Design traffic volume: Daily vehicular traffic volume determined by planners for road construction or reconstruction planners designated by the Land, Infrastructure and Transport Ministry's ordinance according to requirements in the same ordinance for the basis of road design, in consideration of trends of development in the area and vehicular traffic conditions in the future.
22. Design speed: Vehicle speed that is used as a basis for road design.
23. Sight distance: The distance measured along the lane (or carriageway in the case of a road without a lane and the same is applied hereinafter) centerline at which an apex of a 10cm high object on the lane centerline is visible from 1.2m on the lane centerline.

## (Road Classification)

### Article 3

1. Roads shall be classified into Types 1 through 4 as listed in the following table.

| Area where road is located / National expressways and access-controlled highways or other roads. | Rural Area | Urban Area |
|---|---|---|
| National expressways and access-controlled highways | Type1 | Type2 |
| Other Roads | Type3 | Type4 |

2. Type 1 roads shall be classified into classes 1 through 4 as listed in Table 1, Type 2 roads shall be classified into Class 1 or 2 as listed in Table 2, Type 3 roads shall be classified into classes 1 through 5 as listed in Table 3, and Type 4 roads shall be classified into classes 1 through 4 except where topographic conditions or other circumstances do not permit such provision. Roads can be classified into one class lower than the original class unless roads are otherwise applicable to Type 1 Class 4, Type 2 Class 3, Type 3 Class 5, or Type 4 Class 4.

**Table 1 Type 1 Roads**

| Road type | Type of Terrain | Designed traffic volume (vehicles/day) | | | |
|---|---|---|---|---|---|
| | | More than 30,000 | 20,000~ 30,000 | 10,000~ 20,000 | Less than 10,000 |
| National Expressway | Level | Class 1 | Class 2 | | Class 3 |
| | Mountainous | Class 2 | Class 3 | | Class 4 |
| Roads other than National Expressway | Level | Class 2 | | Class 3 | |
| | Mountainous | Class 3 | | Class 4 | |

**Table 2 Type 2 Roads**

| Area where road is located / Road type | Areas other than Central Business District in Large Metropolitan areas | Central Business District in Large Metropolitan areas |
|---|---|---|
| National Expressway | Class 1 | |
| Roads other than National Expressway | Class 1 | Class 2 |

**Table 3 Type 3 Roads**

| Road type | Type of Terrain | Designed traffic volume (vehicles/day) | | | | |
|---|---|---|---|---|---|---|
| | | More than 20,000 | 4,000~ 20,000 | 1,500~ 4,000 | 500~ 1,500 | Less than 500 |
| National Highway | Level | Class 1 | Class 2 | Class 3 | | |
| | Mountainous | Class 2 | Class 3 | Class 4 | | |
| Prefectural Roads | Level | Class 2 | | Class 3 | | |
| | Mountainous | Class 3 | | Class 4 | | |
| Municipal Roads | Level | Class 2 | | Class 3 | Class 4 | Class 5 |
| | Mountainous | Class 3 | | Class 4 | | Class 5 |

**Table 4 Type 4 Roads**

| Designed traffic volume (vehicles/day) / Road type | More than 10,000 | 4,000~ 10,000 | 500~ 4,000 | Less than 500 |
|---|---|---|---|---|
| National Highway | Class 1 | | Class 2 | |
| Prefectural Roads | Class 1 | Class 2 | Class 3 | |
| Municipal Roads | Class 1 | Class 2 | Class 3 | Class 4 |



3. Roads shall be classified as specified in the previous paragraph 2 based on traffic conditions.
4. Type 1, 2 and 3 Class 1 through 4 roads or Type 4 Class 1 through 3 roads (limited to elevated roads and other structures from which vehicles cannot access roadsides for Type 3 Class 1 through 4 roads and Type 4 Class 1 through 3 roads) can be specified as the roads exclusively for the traffic of smaller motor vehicles (hereinafter indicating small-sized vehicles and other similar small vehicles; and pedestrians and bicycles in the case of Type 3 Class 1 through 4 and Type 4 Class 1 through 3 roads), in an unavoidable case such as for a topographical reason and due to conditions of urbanization, there shall be a neighboring detour road for other types of vehicles, other than smaller motor vehicles.
5. A lane specifically for the traffic of smaller motor vehicles can be provided, by separating other lanes on Type 1, 2 and 3 Class1 through 4 roads or Type 4 Class 1 through 3 roads, in unavoidable cases such as for a topographical reason and due to conditions of urbanization. In the case of Type 3 Class 1 through 4 roads and Type 4 Class 1 through 3 roads, the lane specifically for the traffic of smaller motor vehicles shall be limited to elevated roads or other structures from which vehicles cannot access roadsides.
6. Roads shall be classified into smaller motor vehicle roads (hereinafter indicating the roads provided specifically for the traffic of smaller motor vehicles specified in the paragraph 4 and smaller motor vehicles and pedestrians and bicycles in Type 3 Class 1 through 4 and Type 4 Class 1 through 3 roads and vehicles specified in the previous paragraph) and regular motor vehicle roads (hereinafter indicating roads and road sections other than smaller motor vehicle roads).

## (General Technical Standards for Construction of National Expressways and National Highways Structures)

### Article 3-2

The next Article through Article 40 specify general technical standards for the construction of national expressways and national highways structures, when these roads will be newly constructed or reconstructed.

## (Design Vehicles)

### Article 4

1. Roads shall be so designed for the smooth and safe passage of small-sized motor vehicles and semitrailers (hereinafter indicating combined body consisting of trailing motor vehicle and trailed vehicle without front axle, in which a part of the trailed vehicle rests on the motor vehicle and substantial weight of the trailed vehicle and its load are supported by the motor vehicle) on Type 1, Type 2, Type 3 Class 1 or Type 4 Class1 regular motor vehicle roads, small-sized motor vehicles and regular-sized motor vehicles on other regular motor vehicle roads and smaller motor vehicles on smaller motor vehicle roads).
2. Specifications for the vehicle that is a basis of road design (hereinafter referred to as “design vehicle”) by Type shall be listed below.

| | Length | Width | Height | Front-edge overhang | Wheelbase | Rear-edge overhang | Minimum turning radius |
|---|---|---|---|---|---|---|---|
| Small-sized motor vehicle | 4.7 | 1.7 | 2.0 | 0.8 | 2.7 | 1.2 | 6.0 |
| Smaller motor vehicles | 6.0 | 2.0 | 2.8 | 1.0 | 3.7 | 1.3 | 7.0 |
| Regular-sized motor vehicle | 12.0 | 2.5 | 3.8 | 1.5 | 6.5 | 4.0 | 12.0 |
| Semi-trailer | 16.5 | 2.5 | 3.8 | 1.3 | Front section wheelbase: 4.0<br>Rear section wheelbase: 9.0 | 2.2 | 12.0 |

For this table, the following terminology definitions shall apply to the corresponding terms.
1. Front-edge overhang: Distance from the front face of the vehicle body to the center of the front-wheel axle of a vehicle.
2. Wheelbase: Distance from the center of front-wheel axle of a vehicle to the center of the rear-wheel axle.
3. Rear-edge overhang: Distance from the rear face of the vehicle body to the center of the rear-wheel axle of a vehicle.

## (Lane)

### Article 5

1. The carriageway (except for the service road, stopping lane and other sections specified by the ordinances of Ministry of Land, Infrastructure, Transport and Tourism) shall consist of the below-specified lanes, except for those classified as Type 3 Class 5.
2. The number of lanes shall be 2 (except for additional overtaking, climbing, turning and speed change lanes and the same is applied in the following paragraph) in accordance with the road classification and on rural roads where design daily traffic volume is no more than values of standard design volume (hereinafter indicating maximum allowable traffic volume) as listed in the following table, while taking into account topographic conditions.

| Classification | | Type of Terrain | Standard Design Volume (vehicles/day) |
|---|---|---|---|
| Type1 | Class 2 | Level | 14,000 |
| | Class 3 | Level | 14,000 |
| | | Mountainous | 10,000 |
| | Class 4 | Level | 13,000 |
| | | Mountainous | 9,000 |
| Type3 | Class 2 | Level | 9,000 |
| | Class 3 | Level | 8,000 |
| | | Mountainous | 6,000 |
| | Class 4 | Level | 8,000 |
| | | Mountainous | 6,000 |
| Type4 | Class 1 | | 12,000 |
| | Class 2 | | 10,000 |
| | Class 3 | | 9,000 |

As for Type 4 roads with many intersections, standard design traffic volume shall be calculated by multiplying standard design traffic volume herein by 0.8.

3. The number of lanes on roads, other than those specified in the provision above, (except for Type 2 one-way roads and Type 3 Class 5) shall be more than 4 (a multiple of 2 unless otherwise required depending on traffic conditions) on Type 2 roads and one-way roads shall be more than 2 on roads that meet the road classification and are located in rural areas, and shall be determined by the rate of design daily traffic volume on the road according to standard design daily traffic volume per lane as listed in the following table, taking into consideration topographic conditions.

| Classification | | Type of Terrain | Standard Design daily Traffic Volume per Lane (vehicles/lane/day) |
|---|---|---|---|
| Type1 | Class 1 | Level | 12,000 |
| | Class 2 | Level | 12,000 |
| | | Mountainous | 9,000 |
| | Class 3 | Level | 11,000 |
| | | Mountainous | 8,000 |
| | Class 4 | Level | 11,000 |
| | | Mountainous | 8,000 |
| Type2 | Class 1 | | 18,000 |
| | Class 2 | | 17,000 |
| Type3 | Class 1 | Level | 11,000 |
| | Class 2 | Level | 9,000 |
| | Class 3 | Mountainous | 7,000 |
| | | Level | 8,000 |
| | Class 4 | Mountainous | 6,000 |
| | | Mountainous | 5,000 |
| Type4 | Class 1 | | 12,000 |
| | Class 2 | | 10,000 |
| | Class 3 | | 10,000 |

In the case of Type 4 roads with many intersections, standard design traffic volume per lane shall be calculated by multiplying standard design traffic volume per lane herein by 0.6.

4. Lane width (except for climbing, turning, and speed change lanes,) shall be the values as listed in the columns for lane width, in the following table, in accordance with road classification. However, the lane width on Type 1 Class 1 and 2 or Type 3 Class 2 or Type 4 Class 1 regular motor vehicle roads may add 0.25m to the values as listed in the columns depending on the traffic situation. Lane width on Type 1 Class 2 or 3 smaller motor vehicle roads or Type2 Class 1 roads may be reduced 0.25m from the values as listed in the columns in unavoidable cases, such as for topographical and other reasons.



| Classification | | | Lane Width (m) |
|---|---|---|---|
| Type1 | Class 1 | | 3.5 |
| | Class 2 | | |
| | Class 3 | Regular motor vehicle roads | 3.5 |
| | | Smaller motor vehicle roads | 3.25 |
| | Class 4 | Regular motor vehicle roads | 3.25 |
| | | Smaller motor vehicle roads | 3.0 |
| Type2 | Class 1 | Regular motor vehicle roads | 3.5 |
| | | Smaller motor vehicle roads | 3.25 |
| | Class 2 | Regular motor vehicle roads | 3.25 |
| | | Smaller motor vehicle roads | 3.0 |
| Type3 | Class 1 | Regular motor vehicle roads | 3.5 |
| | | Smaller motor vehicle roads | 3.0 |
| | Class 2 | Regular motor vehicle roads | 3.25 |
| | | Smaller motor vehicle roads | 2.75 |
| | Class 3 | Regular motor vehicle roads | 3.0 |
| | | Smaller motor vehicle roads | 2.75 |
| | Class 4 | | 2.75 |
| Type4 | Class 1 | Regular motor vehicle roads | 3.25 |
| | | Smaller motor vehicle roads | 2.75 |
| | Class 2 and 3 | Regular motor vehicle roads | 3.0 |
| | | Smaller motor vehicle roads | 2.75 |

5. Carriageway width on Type 3 Class 5 regular motor vehicle roads shall be 4m. However, the width could be reduced to 3m where design daily traffic volume is extremely low and topographic conditions or special reasons do not permit such provisions or where bulb-out is created on regular motor vehicle roads pursuant to the provisions of Article 31.2.

## (Lane Division)

## Article 6

1. The lanes (hereinafter this applies for all except one-way roads) on Type 1, Type 2 or Type 3 Class 1 roads shall be directionally divided. It is also applied to other roads with four or more lanes if necessary for safe and smooth traffic.
2. Notwithstanding the provisions of the first sentence of the preceding paragraph, Type 1 roads with three or less lanes (hereinafter, this applies for all except for climbing, turning and speed change lanes) may be left directionally undivided in unavoidable cases, such as for topographical conditions or any other reasons.
3. A median shall be provided, when required, for directional lane division.
4. Median width shall be no less than the values indicated in the left columns in the following table. However, the median width can be reduced to values listed in the right columns, in the same table, where tunnels longer than 100m, bridges longer than 50m, elevated roads, topographic conditions or other special conditions do not permit.

| Classification | | Median Width(m) | |
|---|---|---|---|
| Type1 | Class 1 | 4.5 | 2.0 |
| | Class 2 | | |
| | Class 3 | 3.0 | 1.5 |
| | Class 4 | | |
| Type2 | Class 1 | 2.25 | 1.5 |
| | Class 2 | 1.75 | 1.25 |
| Type3 | Class 1 | 1.75 | 1.0 |
| | Class 2 | | |
| | Class 3 | | |
| | Class 4 | | |
| Type4 | Class 1 | 1.0 | |
| | Class 2 | | |
| | Class 3 | | |

5. A marginal strip shall be provided to the median.
6. The width of the marginal strips shall be the values listed in the left column of the following table in accordance with road classification. However, the median width can be reduced to the values listed in the right columns of the same table when the median width of the road or road section is reduced in accordance with paragraph 4.

| Classification | | Width of Marginal Strip Provided to Median(m) | |
|---|---|---|---|
| Type1 | Class 1 | 0.75 | 0.25 |
| | Class 2 | | |
| | Class 3 | 0.5 | |
| | Class 4 | | |
| Type2 | | 0.5 | 0.25 |
| Type3 | Class 1 | 0.25 | |
| | Class 2 | | |
| | Class 3 | | |
| | Class 4 | | |
| Type4 | Class 1 | 0.25 | |
| | Class 2 | | |
| | Class 3 | | |

7. Fences, or other similar structures, or curb lines connected to the marginal strip shall be provided to sections other than the marginal strip of the median (hereinafter referred to as the "median").
8. When on-street facilities are provided on the median, the median width shall be determined considering clearances as specified in Article 12.
9. If necessary, additional overtaking lanes shall be provided to the carriageway of Type 1 roads with single lanes in each direction.

## (Service Roads)

### Article 7

1. The service roads shall be provided to Type 3 or 4 roads with more than four lanes (except for climbing, turning and speed change lanes) if necessary.
2. Service road width shall be a standard 4m.

## (Shoulders)

### Article 8

1. Shoulders shall be provided to roads connected to carriageways, except where a median or stopping lane is provided.
2. Shoulder width on the left side of the carriageway shall be, in accordance with road classification, no less than the values listed in the left column of the following table. However, road width may be reduced to the values listed in the right columns in the same table where additional overtaking lanes, climbing lanes or speed change lanes are provided, or on road sections of bridges 50m or longer or elevated roads or other road sections in unavoidable cases such as for a topographical or other special reasons.

| Classification | | | Width of Shoulder Provided on Left of Carriageway(m) | |
|---|---|---|---|---|
| Type1 | Class 1 and 2 | Regular motor vehicle roads | 2.5 | 1.75 |
| | | Smaller motor vehicle roads | 1.25 | |
| | Class 3 and 4 | Regular motor vehicle roads | 1.75 | 1.25 |
| | | Smaller motor vehicle roads | 1.0 | |
| Type2 | | Regular motor vehicle roads | 1.25 | |
| | | Smaller motor vehicle roads | 1.0 | |
| Type3 | Class 1 | Regular motor vehicle roads | 1.25 | 0.75 |
| | | Smaller motor vehicle roads | 0.75 | |
| | Class 2 through 4 | Regular motor vehicle roads | 0.75 | 0.5 |
| | | Smaller motor vehicle roads | 0.5 | |
| | Class 5 | | 0.5 | |
| Type4 | | | 0.5 | |

3. Notwithstanding the provisions of the preceding paragraph, shoulder width on the left side of carriageways on Type 1 roads with directionally divided lanes shall be, in accordance with road classification, no less than the values listed in the left column of the following table. However, shoulder width on the left side of the carriageway may be reduced to the values listed in the right columns in the same table where the road section is in a tunnel of no shorter than 100m, on bridges of no shorter than 50m, on elevated roads with low traffic volume of larger vehicles, or in unavoidable conditions such as for topographic or other reasons.

| Classification | | Width of Shoulder Provided on Left of Carriageway(m) | |
|---|---|---|---|
| Class 2 and 3 | Regular motor vehicle roads | 2.5 | 1.75 |
| | Smaller motor vehicle roads | 1.25 | |
| Class 4 | Regular motor vehicle roads | 2.5 | 2.0 |
| | Smaller motor vehicle roads | 1.25 | |

4. Width of the shoulders provided on the right of carriageway shall be, in accordance with road classification, no less than the values listed in the right column of the following table.

| Classification | | | Width of Shoulder Provided on Right of Carriageway(m) |
|---|---|---|---|
| Type 1 | Class 1 and 2 | Regular motor vehicle roads | 1.25 |
| | | Smaller motor vehicle roads | 0.75 |
| | Class 3 and 4 | Regular motor vehicle roads | 0.75 |
| | | Smaller motor vehicle roads | 0.5 |
| Type 2 | | Regular motor vehicle roads | 0.75 |
| | | Smaller motor vehicle roads | 0.5 |
| Type 3 | | | 0.5 |
| Type 4 | | | 0.5 |



5. Shoulder widths of the regular motor vehicle roads in tunnels (except for shoulders specified in the paragraph 3) or shoulder widths on the left side of smaller motor vehicle roads (except for shoulders specified in the paragraph 3) may be reduced to 1m on Type 1 Class 1 or 2 roads, 0.75m on Type 1 Class 3 or 4 roads and 0.5m on Type 3 (except for Class 5) regular motor vehicle roads or Type 3 Class 1 smaller motor vehicle roads.
6. As for the shoulder connecting to the service road, values of "1.25" and "0.75" in the left column of Type 3 carriageway as tabulated in Section 2 shall be regarded as "0.5" and provisory requirements in Section 2 shall not be applied.
7. On roads where sidewalks, bicycle tracks or bicycle/pedestrian tracks are provided, major road structures shall be protected. If smooth carriageway traffic can be maintained, the shoulder connecting width can be omitted or the width can be reduced.
8. A marginal strip shall be provided to the shoulder connecting with the carriageway on Type 1 or 2 roads.
9. The width of the marginal strips for regular motor vehicle roads shall be the values listed in the left column of the following table in accordance with road classification. The width of the marginal strips on smaller motor vehicle roads shall be 0.25m. However, shoulder widths for the regular motor vehicle roads in tunnels may be the values listed in the right columns in the same table.

| Classification | | Width of Marginal Strip Provided to Shoulder (m) | |
|---|---|---|---|
| Type1 | Class 1 | 0.75 | 0.5 |
| | Class 2 | | |
| | Class 3 | 0.5 | 0.25 |
| | Class 4 | | |
| Type2 | Class 1 | 0.5 | |
| | Class 2 | | |

10. Where it is necessary to protect major road structures, the shoulder shall be provided on road ends so as to be connected to the sidewalk, bicycle track or bicycle/pedestrian track.
11. Where on-street facilities are provided on the shoulder connected to the carriageway, shoulder width shall be the values of shoulder width provided for the left side of the carriageway listed in paragraph 2 or the values of shoulder width provided for the right side of the carriageway listed in paragraph 4, plus the values required for the on-street facilities.

## (Stopping Lane)

### Article 9

1. A stopping lane shall be provided on the left carriageway end on Type 4 roads to prevent stopping vehicles from impeding safe and smooth traffic.
2. The stopping lane width shall be 2.5m. However, the width may be reduced to 1.5m where the traffic volume of larger vehicles is low.

## (Track Bed)

### Article 9.2

The track bed width shall be, in accordance with single or double track, wider than the values listed in the bottom columns of the following table.

| Single or Double Track | Track Bed Width(m) |
|---|---|
| Single Track | 3 |
| Double Track | 6 |

## (Bicycle Track)

### Article 10

1. Bicycle tracks shall be provided on both sides of roads on Type 3 or 4 roads with higher vehicle and bicycle traffic volume, except where topographic conditions or other special reasons do not permit such provision.
2. Bicycle tracks shall be provided on both sides of the roads to ensure safe and smooth traffic on Type 3 or 4 roads with higher bicycle traffic volume or on Type 3 or 4 roads with higher vehicle and pedestrian traffic volume (except for roads specified in the preceding paragraph), if separation of bicycle traffic is considered necessary, except where topographic conditions or other special reasons do not permit such provision.
3. Bicycle tracks shall be wider than 2m, except where topographic conditions or other special reasons do not permit such provision, in such cases the width can be reduced to 1.5m.
4. Where on-street facilities are provided on the bicycle tracks, the road width shall be determined in consideration of clearances as specified in Article 12.
5. Bicycle track width shall be determined in consideration of bicycle traffic conditions on roads.

## (Bicycle/Pedestrian Track)

### Article 10.2

1. Bicycle/pedestrian tracks shall be provided on both sides of Type 3 or 4 roads with large traffic volume (except for roads where the bicycle tracks would already be provided) except where topographic conditions or other special reasons do not permit such provisions.
2. Bicycle/pedestrian track width shall be wider than 4m for roads with higher pedestrian traffic volume and wider than 3m for other roads.
3. Where pedestrian bridges or pedestrian underpasses (hereinafter referred to as "pedestrian bridges etc." ) or on-street facilities

are provided, the bicycle/pedestrian track width shall be increased by 3m where pedestrian bridges etc. are to be constructed, 2m where a roofed bench is to be installed, 1.5m where a row of trees is to be planted, 1m where a bench is installed or 0.5m in other cases, respectively to the values given in the preceding paragraph.The requirements as specified above shall be applied except for Type 3 Class 5 roads where topographic conditions or other special reasons do not permit such provisions.
4. The bicycle/pedestrian track width shall be determined in consideration of bicycle and pedestrian traffic conditions on the road.

## (Sidewalk)

### Article 11

1. A sidewalk shall be provided on both sides of Type 4 roads (excluding those roads provided with bicycle/pedestrian tracks), Type 3 roads (except for Class 5 and excluding those roads provided with bicycle/pedestrian tracks) with higher pedestrian traffic volume or Type 3 roads already provided with bicycle tracks, except where topographical conditions or any other reasons prevent such provision.
2. Sidewalks shall be provided on Type 3 roads (excluding those roads already provided with bicycle/pedestrian tracks and those roads stipulated in the preceding paragraph) where it is required for safe and smooth traffic, except where topographic conditions or any other reasons do not permit such provision.
3. The sidewalk width shall be wider than 3.5m for roads with higher pedestrian traffic volume and wider than 2m for other roads.
4. Where pedestrian bridges etc. or on-street facilities are provided, bicycle/pedestrian track width shall be increased by 3m where pedestrian bridges etc. are to be constructed, 2m where a roofed bench is to be installed, 1.5m where a row of trees is to be planted, 1m where a bench is installed or 0.5m in other cases, respectively to the values given in the preceding paragraph, and requirements as specified above shall be applied, except for Type 3 Class 5 roads where topographic conditions or other special reasons do not permit such provisions.
5. The sidewalk width shall be determined in consideration of pedestrian traffic conditions on the roads.

## (Waiting Area for Pedestrians)

### Article 11.2

Waiting space for pedestrians shall be provided on sidewalks, bicycle-and pedestrian tracks, bicycle-and pedestrian paths or exclusive pedestrian roads, in the case that it is necessary to ensure that the safe and smooth passage of pedestrians or bicycle riders will not be impeded due to the accumulation of pedestrians at the pedestrian crossings or at bus stops.

## (Median Width in Snowy Areas)

### Article 11.3

Center strip, shoulder, bicycle/pedestrian track and side walk width in snowy areas shall be determined in consideration of snow removal.

## (Planted Strip)

### Article 11.4

1. The planted strip shall be provided to Type 4 Class 1 and Class 2 roads and if necessary to other roads, except where topographic conditions or other special reasons do not permit such provisions.
2. The planted strip width standard shall be 1.5m.
3. The planted strips provided between road sections as described below shall have proper width values, exceeding values specified in the section above when required for conditions in comprehensive consideration of road structure, traffic condition, and land use of adjoining areas and other measures taken to improve road traffic environment or to ensure a better living environments along adjoining areas irrespective of the requirements above:
1) Sections of arterial roads and central business districts in large cities running through scenic spots.
2) Sections of arterial roads running through residential areas or areas that are expected to become residential.
4. For planted strips, the selection of plant species and arrangement of trees shall take into account with the ecological characteristics of the area.

## (Clearances)

### Article 12

Clearances on roads shall be shown in Fig.1 for carriageways and in Fig.2 for sidewalks and bicycle tracks or bicycle/pedestrian tracks (hereinafter referred to as "bicycle tracks").



**Fig.1**

| (1) | | (2) | (3) |
|---|---|---|---|
| Carriageway of roads where the shoulder is provided by connecting with the carriageway [except for the road sections specified in (3)] | | Carriageway of roads where the shoulder is not provided by connecting with the carriageway[except for the road sections specified in (3) ] | Of carriageway, sections related to Separator or Island |
| Carriageway of roads other than tunnels without sidewalk or bicycle track, bridge longer than 50m or elevated road | Carriageway in tunnels without sidewalk or bicycle track, on bridges longer than 50m or elevated road | | |

Figure (omitted)

In this figure, H, A, b, c, d and e indicate the following values.

H: 4.5m for regular motor vehicle roads and 3m for smaller motor vehicle roads except for Type 3 Class 5 regular motor vehicle roads where the value may be reduced to 4m in unavoidable cases such as for a topographical reason (or 3m when traffic volume of large-sized motor vehicles is extremely small and these may access neighboring bypass roads).

a: The width of the shoulder connected with the carriageway on regular motor vehicle roads (for shoulders where on-street facilities are provided, shoulder width minus value required for on-street facilities), provided that the value exceeds 1m shall be 1m. The width of the shoulder connected with the carriageway on smaller motor vehicle roads shall be 0.5m.

b: Value subtracting 3.8m from H (regarded as 3.8m where H is less than 3.8m) for regular motor vehicle roads and this value shall be 0.2m for smaller motor vehicle roads.

c and d: Concerning the separator, values listed in columns c and d in accordance with road classification and concerning the island, the value of c shall be 0.25m and the value of d shall be 0.5m.

| Classification | | | c (Unit: m) | d (Unit: m) |
|---|---|---|---|---|
| Type 1 | Class 1 | Regular motor vehicle roads | 0.5 | 1.0 |
| | | Smaller motor vehicle roads | | 0.5 |
| | Class 2 | Regular motor vehicle roads | 0.25 | 1.0 |
| | | Smaller motor vehicle roads | | 0.5 |
| | Class 3 and 4 | Regular motor vehicle roads | 0.25 | 0.75 |
| | | Smaller motor vehicle roads | | 0.5 |
| Type 2 | Regular motor vehicle roads | | 0.25 | 0.75 |
| | Smaller motor vehicle roads | | | 0.5 |
| Type 3 | | | 0.25 | 0.5 |
| Type 4 | | | 0.25 | 0.5 |

e: Width of the shoulder connected with the carriageway (for shoulders where on-street facilities are provided, shoulder width minus value required for on-street facilities).

**Fig. 2 (omitted)**

## (Design Speed)

### Article 13

1. Design speed on roads, except for service roads, shall be the values listed in the left column of the following table, in accordance with road classification, except where topographical conditions or any other reasons do not permit such provisions. Design speed on roads may be the values listed in the right column of the same table when dealing with these exceptions, however this does not apply to Type 1 Class 4 roads that are national expressways.
2. Design speed on the service roads shall be 40km, 30km, or 20km per hour.

| Classification | | Design Speed (km/h) | |
|---|---|---|---|
| Type1 | Class 1 | 120 | 100 |
| | Class 2 | 100 | 80 |
| | Class 3 | 80 | 60 |
| | Class 4 | 60 | 50 |
| Type2 | Class 1 | 80 | 60 |
| | Class 2 | 60 | 50 or 40 |
| Type3 | Class 1 | 80 | 60 |
| | Class 2 | 60 | 50 or 40 |
| | Class 3 | 60,50 or 40 | 30 |
| | Class 4 | 50,40 or 30 | 20 |
| | Class 5 | 40,30 or 20 | |
| Type4 | Class 1 | 60 | 50 or 40 |
| | Class 2 | 60,50 or 40 | 30 |
| | Class 3 | 50,40 or 30 | 20 |

## (Carriageway Bend Section)

### Article 14

Carriageway bend sections shall be curved in shape, except for transition sections, (hereinafter indicating certain sections, provided at the carriageway bend sections, that allow for smooth vehicle traffic) or bend sections provided pursuant to the provision of Article 31.2.

## (Radius of Curve)

### Article 15

Radii of curve at the centerline of the carriageway (hereinafter referred to as "radius of curve"), except for transition sections, (hereinafter referred to as "carriageway curve section") shall not be less than the values as listed in the left column of the following table according to design speed, except when unavoidable due to, for example, topographical reasons, in which case the radii of curve may be reduced to the values as listed in the right column of the same table.

| Design Speed (km/h) | Radius of Curve (m) | |
|---|---|---|
| 120 | 710 | 570 |
| 100 | 460 | 380 |
| 80 | 280 | 230 |
| 60 | 150 | 120 |
| 50 | 100 | 80 |
| 40 | 60 | 50 |
| 30 | 30 | |
| 20 | 15 | |

## (Superelevation at Curve Section)

### Article 16

Appropriate Superelevation with no more than the values as listed in the right column of the following table (6% for Type 3 roads without bicycle track) shall be provided on curves of the carriageway, the median (except for divider), and the shoulder connected with the carriageway, according to road classification and degree of snow fall or cold climate in the areas where the roads are located, in consideration of design speed, radii of curve, and topographical conditions, unless the radius of the curve is too large, except for Type 4 roads which can be omitted in such unavoidable cases as topographical conditions or any other reasons.

| Classification | Area Where Road is Located | | Maximum Super-elevation (%) |
|---|---|---|---|
| Type 1,2 and 3 | Snowy or Cold Area | Severely Snowy or Cold Area | 6 |
| | | Other Areas | 8 |
| | Other Areas | | 10 |
| Type4 | | | 6 |

## (Widening Lane at Curve Section)

### Article 17

The lane width on carriageway curve sections (or carriageway width in the case of roads without lanes) shall be appropriately widened except for Type 2 and 4 roads, where topographical conditions or any other reasons do not permit such provisions.

## (Transition Section)

### Article 18

1. Transition sections shall be provided on carriageway bend sections for Type 4 roads where topographical conditions or any other reasons do not permit such provisions.
2. When a curved section is widened and/or provided with Superelevation, a runoff for this widening and/or Superelevation shall be completed in the transition section.
3. The transition curve length shall not be less than the right side value as listed in the following table according to design speed (or length required for runoff when length required for runoff as specified in Section above exceeds values as listed in the same column).

| Design Speed (km/h) | Transition Section Length (m) |
|---|---|
| 120 | 100 |
| 100 | 85 |
| 80 | 70 |
| 60 | 50 |
| 50 | 40 |
| 40 | 35 |
| 30 | 25 |
| 20 | 20 |



## (Sight Distance)

### Article 19

1. Sight distance shall not be less than the values below, as listed in the following table according to design speed.
2. For roads with two lanes (except for one-way roads), sufficient sections of oncoming highway visible to the driver shall be provided for overtaking.

| Design Speed (km/h) | Transition Section Length (m) |
|---|---|
| 120 | 210 |
| 100 | 160 |
| 80 | 110 |
| 60 | 75 |
| 50 | 55 |
| 40 | 40 |
| 30 | 30 |
| 20 | 20 |

## (Grade)

### Article 20

Carriageway grades shall be no more than the values listed in the left grade column of the following table according to road classification and design speed, except where topographical conditions or any other reasons do not permit such provisions; in such cases the values of the grade may be reduced to the values listed in the right grade column of the same table.

| Classification | | Design Speed (km/h) | Grade (%) | |
|---|---|---|---|---|
| Type 1, Type 2 & Type3 | Regular motor vehicle roads | 120 | 2 | 5 |
| | | 100 | 3 | 6 |
| | | 80 | 4 | 7 |
| | | 60 | 5 | 8 |
| | | 50 | 6 | 9 |
| | | 40 | 7 | 10 |
| | | 30 | 8 | 11 |
| | | 20 | 9 | 12 |
| | Smaller motor vehicle roads | 120 | 4 | 5 |
| | | 100 | | 6 |
| | | 80 | 7 | |
| | | 60 | 8 | |
| | | 50 | 9 | |
| | | 40 | 10 | |
| | | 30 | 11 | |
| | | 20 | 12 | |
| Type 4 | Regular motor vehicle roads | 60 | 5 | 7 |
| | | 50 | 6 | 8 |
| | | 40 | 7 | 9 |
| | | 30 | 8 | 10 |
| | | 20 | 9 | 11 |
| | Smaller motor vehicle roads | 60 | 8 | |
| | | 50 | 9 | |
| | | 40 | 10 | |
| | | 30 | 11 | |
| | | 20 | 12 | |

## (Climbing Lane)

### Article 21

1. A climbing lane, if necessary, shall be provided to the carriageway of the regular motor vehicle roads where grades exceed 5% (or 3% when the design speed is no less than 100 km per hour on other regular motor vehicle roads than national expressways and national highways).
2. The climbing lane width shall be 3m.

## (Vertical Curve)

### Article 22

1. Vertical curves shall be provided where grades change on the carriageway.
2. Radii of vertical curves shall be more than the values listed in the radius of vertical curve column of the following table according to design speed and Types of vertical curves, except when the radii of crest vertical curves on Type 4 Class 1 roads, when design speed is 60km per hour, the radii shall be reduced to 1,000m, where topographical conditions or any other reasons do not permit such provisions.
3. Vertical curve lengths shall be more than the values listed in the below right column of the following table according to design speed.

| Design Speed (km/h) | Type of Vertical Curve | Radius of Vertical Curve(m) |
|---|---|---|
| 120 | Crest | 11,000 |
| | Sag | 4,000 |
| 100 | Crest | 65,00 |
| | Sag | 3,000 |
| 80 | Crest | 3,000 |
| | Sag | 2,000 |
| 60 | Crest | 1,400 |
| | Sag | 1,000 |
| 50 | Crest | 65,00 |
| | Sag | 800 |
| 40 | Crest | 700 |
| | Sag | 450 |
| 30 | Crest | 250 |
| | Sag | 250 |
| 20 | Crest | 100 |
| | Sag | 100 |

| Design Speed (km/h) | Vertical Curve Length(m) |
|---|---|
| 120 | 100 |
| 100 | 85 |
| 80 | 70 |
| 60 | 50 |
| 50 | 40 |
| 40 | 35 |
| 30 | 25 |
| 20 | 20 |

## (Pavement)

### Article 23

1. Carriageways, median (except for divider), shoulders connected with carriageways, bicycle tracks and sidewalks shall be paved except in unavoidable cases, such as extremely small traffic volume.
2. The pavement of carriageways and marginal strips shall be constructed so that safe and smooth vehicular traffic can be ensured on the basis of the design wheel load of 49 kN, in consideration of designed traffic volume, vehicle weight, subgrade conditions, and meteorological conditions and that shall meet the standards laid down in the Ordinance of Ministry of Land, Infrastructure, Transport and Tourism, except in the case of traffic volume of small vehicles or any other unavoidable conditions.
3. Type 4 roads (except for tunnels) shall be constructed so that it shall be capable of causing storm water to permeate smoothly under the road surfaces and reducing the traffic noise level, in consideration of the land uses and vehicle traffic conditions in the area where the roads are located or along them, except where road structure, meteorological conditions or other special reasons do not permit such provisions.

## (Cross Slope)

### Article 24

1. Cross slopes shall be provided to the carriageway, median(except for divider) and shoulder connected with the carriageway according to road surface Type and the right side values as listed in the following table unless Superelevation is provided.
2. 2% of cross slope as a standard shall be provided to sidewalks and bicycle tracks.
3. The paved road of the structure specified in paragraph 3 of the previous Article may dispense with or reduce cross slope, if proper road surface drainage can be ensured in consideration of meteorological conditions.

| Road Surface Type | Cross Slope (%) |
|---|---|
| Paved Road Complying with Standards Specified in Article 23.2 | 1.5-2 |
| Others | 3-5 |



## (Compound Grade)

### Article 25

1. Compound Grades (hereinafter indicating combination of vertical grade and Superelevation or cross slope) shall be no more than the right side values as listed in the following table according to design speed, except for roads with design speed of 30km/h or 20km/h where compound grades may be 12.5% in unavoidable cases, such as topographical conditions or any other reasons.
2. Compound grades shall be not more than 8% on those roads located in severely snowy or cold areas.

| Design Speed (km/h) | Compound Grade (%) |
|---|---|
| 120 | 10 |
| 100 | |
| 80 | 10.5 |
| 60 | |
| 50 | 11.5 |
| 40 | |
| 30 | |
| 20 | |

## (Drainage Facility)

### Article 26

Gutter, gully, or other drainage facilities shall be provided to roads if necessary.

## (At-grade Intersection or Connection)

### Article 27

1. An intersection shall be designed so as to contain no more than five intersecting legs, except when it is located in a special place such as in front of a station.
2. At an intersection where two or more roads join or intersect at grade, if necessary, a turning lane, speed change lane, or island shall be provided, and corners of intersection shall be cut, and unobstructed sight shall be ensured.
3. Where the turning lane or speed change lane is provided, lane width (except for the turning lane or speed change lane) of the related section may be reduced to 3m for Type 4 Class 1 regular motor vehicle roads or to 2.75m for Type 4 Class 2 or 3 regular motor vehicle roads or to 2.5m for Type 4 smaller motor vehicle roads.
4. The standard width of turning and speed change lanes shall be 3m for regular motor vehicle roads and 2.5m for smaller motor vehicle roads.
5. Where a turning or speed change lane is provided, proper runoff shall be provided according to design speed.

## (Grade Separation)

### Article 28

1. When two regular motor vehicle roads having four or more lanes intersecting mutually, excluding climbing lanes, turning lanes and speed change lanes, the intersection shall be separated by grades as a rule, except when the grade separation is unsuitable due to traffic conditions or in an unavoidable case such as a topographical reason.
2. When a smaller motor vehicle road with four or more lanes (except for turning lanes and speed change lanes) crosses another smaller motor or a regular motor vehicle road, the intersection shall be separated by grades.
3. Where the grade separation is provided, a road linking intersecting roads mutually (hereinafter referred to as a "ramp" ) shall be provided if necessary.
4. Provisions of Articles 5 through 8, Article 12, Article 13, Article 15, Article 16, Articles 18 through 20, Articles 22 and 25 shall not be applied to the ramp.

## (At-grade Intersection with Railway)

### Article 29

When a road intersects at a grade with a railway or street railway newly constructed in accordance with the Street Railway Act (Act No.76 1921) (hereinafter referred to as a "railway" ), the road shall be so constructed as specified below.

1. Intersection angles shall be not less than 45 degrees.
2. Sections 30m from both ends of railroad crossing and the railroad crossing section shall be straight and vertical carriageways, grades for these sections shall be less than 2.5%, except where there is extremely small vehicular traffic volume or topographical conditions or any other reasons do not permit such provisions.
3. A visible distance, distance from the intersection point of the railway end track centerline and the carriageway centerline to the point on the track centerline visible at the height of 1.2m at point 5m on the carriageway centerline from the track, shall not be less than the values listed in the following table, except for where a crossing gate or other security facilities are provided or with smaller vehicular traffic volume and fewer passing trains.

| Maximum Train Speed at Railroad Crossing (km/h) | Visible Distance (m) |
|---|---|
| Less than 50 | 110 |
| 50-70 | 160 |
| 70-80 | 200 |
| 80-90 | 230 |
| 90-100 | 260 |
| 100-110 | 300 |
| More than 110 | 350 |

## (Turnout)

### Article 30

Turnout shall be provided on Type 3 Class 5 roads as specified below, except for on roads where smooth traffic can be ensured.

1. Distance between two turnouts shall be within 300m.
2. Roads between two turnouts shall be visible from one of these turnouts.
3. The length shall be more than 20m and the total width of the carriageway shall be more than 5m.

## (Traffic Safety Device)

### Article 31

When it is necessary for traffic accident prevention, the pedestrian bridge, fence, lighting, safety post, emergency notification facility, and other similar facilities, as specified by the Land, Infrastructure and Transport Ministry's Ordinances, shall be provided.

## (Speed Hump, Builb-out, etc.)

### Article 31.2

When it is necessary for slowing down vehicles, to ensure safe pedestrian or bicycle traffic, speedhump shall be provided on the surface of the carriageway or on the shoulders connecting to the carriageway, or builb-out or bend sections shall be provided on the carriageway, on Type 3 Class 5 roads intended primarily for use by nearby residents.

## (Islands at Bus/Tram stops)

### Article 31.3

Islands shall be provided as necessary at bus bays or streetcar stops that do not connect to bicycle tracks, bicycle/pedestrian tracks or sidewalks.

## (Automobile Parking Lot, etc.)

### Article 32

Automobile parking lots, bicycle parking lots, bus bays, emergency parking basis or other similar facilities specified by the Land, Infrastructure and Transport Ministry's Ordinances shall be provided, if necessary, to ensure safe and smooth traffic or to contribute to public convenience.

## (Snow Protection Facility and Other Protector)

### Article 33

1. Where an avalanche, blizzard, snowfall or other meteorological events could prevent smooth traffic, snow shed, drain for snow removal, snow melting facilities or other facilities shall be provided as specified by the Land, Infrastructure and Transport Ministry' s Ordinances.
2. Unless specified above, a fence, retaining wall, and other proper protectors shall be installed where falling stone, slope failure, billow, etc. could prevent traffic or damage road structure.

## (Tunnel)

### Article 34

1. To ensure safe and smooth traffic, proper ventilation facilities shall be provided in the tunnel when required in consideration of design traffic volume and tunnel length on the road.
2. When required for safe and smooth traffic, proper lighting shall be provided in the tunnel in consideration of design speed.
3. When a vehicle fire or other accidents in the tunnel could cause risks to traffic, the communication facilities, warning facilities, firefighting facilities and other emergency facilities shall be provided in the tunnel if necessary.

## (Bridge and Elevated Road)

### Article 35

1. Bridges, elevated roadss, or other similar roads shall be steel or concrete structure or the equivalent.
2. Design vehicle load for bridges, elevated roads, and other similar regular motor vehicle roads shall be 245kN. The structures of said bridges, elevated roads, and other similar regular motor vehicle roads shall secure safe traffic in view of large-sized vehicle traffic conditions for these roads.
3. Design vehicle load for bridges, elevated roads, and other similar smaller motor vehicle roads shall be 30kN. The structures of said bridges, elevated roads, and other similar smaller motor vehicle roads shall secure safe traffic in view of smaller vehicular traffic conditions for these roads.
4. In addition to the requirements in the three previous paragraphs, necessary matters regarding construction standards for bridges, elevated roads, or other similar roads shall be specified by the Ordinances of the Ministry of Land, Infrastructure, Transport and Tourism.

## (Exception to Incidental Work)

### Article 36

After a case is identified in which road work executed on others roads or work other than road work is executed and determined to be influencing roads, provisions from Articles 4 to 35 (except for Article 8, Article 13, Article 14, Article 24, Article 26, Article 31 and Article 33) may be exempted from application after it is approved that the case is not subject to these requirements.

## (Exception to Change of Road Classification)

### Article 37

When classification, as specified in Article 3.2, is changed by plans as to change a part of national highways to prefectural or municipal roads, classification following the change shall result in applying requirements of Article 3.4, Article 3.5, Article 4, Article 5, Article 6.1, Article 6.4, Article 6.6, Article 8.2 through 8.6, Article 8.9, Article 8.11, Article 9.1, Article 10.2.3, Article 11.1, Article 11.2, Article 11.4, Article 11.4.1, Article 12, Article 13.1, Article 16, Article 17, Article 18.1, Article 20,Article 22.2, Article 23.3, Article 27.3, Article 30 and Article 31.2. In this case, "Type 3 Class 5 roads" in proviso of Article 5.1, Article 5.5, proviso of Article 10.2.3, proviso of Article 11.4 and Article 12 shall be read as "Type 3 Class 5 or Type 4 Class 4 roads". "Type 3 Class 5 roads" in Article 5.3 shall be read as "Type 3 Class 5 and Type 4 Class 4 roads". "Type 4 roads" in Article 9.1 and Article 11.1 shall be read as "Type 4 (except for Class 4)". "Type 3" in these paragraphs shall be read as "Type 3 or Type 4 Class 4". "Type 3" in Article 11.2 shall be read as "Type 3 or Type 4 Class 4". "Values listed in the top column" in Article 13.1 shall be read as "Values listed in the top column (for Type 4 Class 4 roads, 40km/h, 30km/h or 20km/h)". "Mainly" in Article 31.2 shall be read as "Type 4 Class 4 roads or mainly".

## (Exception to Reconstruction of Short Section)

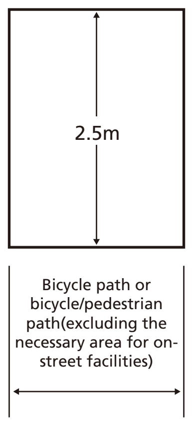
### Article 38

1. When a short section on roads that severely prevents traffic is reconstructed as an emergency measure, except for reconstruction as listed in the following requirements, this section may be exempted from application of Article 5, Article 6.4 through Article 6.6, Article 7, Article 9, Article 9.2, Article 10.3, Article 10.2.2, Article 10.2.3, Article 11.3, Article 11.4, Article 11.4.2, Article 11.4.3, Article 15 through Article 22, Article 23.3, and Article 25, if it is approved that the road structure of sections adjacent to this section do not satisfy these requirements.
2. When a short section of roads that severely impact safety is reconstructed as an emergency measure, this section shall be exempt from application of Article 5, Article 6.4 through Article 6.6, Article 7, Article 8.2, Article 9, Article 9.2, Article 10.3, Article 10.2.2, Article 10.2.3, Article 11.3, Article 11.4, Article ll.4.2, Article 11.4.3, Article 19.1, Article 21.2, Article 23.3, Article 39.1, Article 39.2, and Article 40.1, if it is determined in consideration of road conditions that it is not proper to apply these requirements.

## (Bicycle Path and Bicycle/Pedestrian Path)

### Article 39

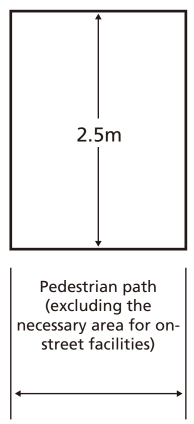
1. Bicycle path width shall be not less than 3m, while bicycle/pedestrian path width shall be no less than 4m. However, where topographical conditions or any other reasons do not permit such provisions, bicycle path width can be reduced to 2.5m.
2. Lateral clearances wider than 0.5m shall be provided to both sides of bicycle paths or bicycle/pedestrian paths as a part of the roads.
3. Where on-street facilities are provided on bicycle tracks or bicycle/pedestrian tracks, width of these tracks shall be determined in consideration of clearances as specified in the following provision.
4. Bicycle path and bicycle/pedestrian path clearances shall be in accordance with the following figure.
5. Alignment, grade, and other features of bicycle paths and bicycle/pedestrian paths shall be determined so as to ensure safe and smooth bicycle and pedestrian traffic.
6. Requirements of Article 3 through 37 and Section 1 of the preceding Article (excluding Article 1 1.2 for bicycle/pedestrian path) shall not be applied to bicycle paths and bicycle/pedestrian paths.




## (Pedestrian Path)

### Article 40

1. Pedestrian path width shall be not less than 2m in consideration of pedestrian traffic conditions and areas where the track is located, except where topographical conditions or other reasons do not permit such provisions, in which case the width can be reduced to 1m.
2. Where on-street facilities are provided on pedestrian paths, width shall be determined in consideration of clearances as specified in the following provision.
3. Pedestrian path clearances shall be in accordance with the following figure.
4. Alignment, grade and other features of pedestrian paths shall be determined so as to ensure safe and smooth pedestrian traffic.
5. Requirements of Articles 3 through 11, Article 11.3 through 37 and Section 1 of Article 38 shall not be applied to pedestrian paths.

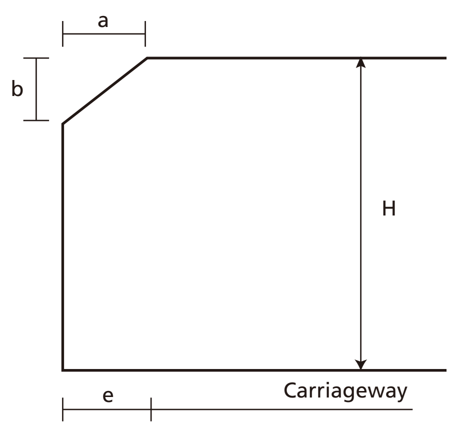


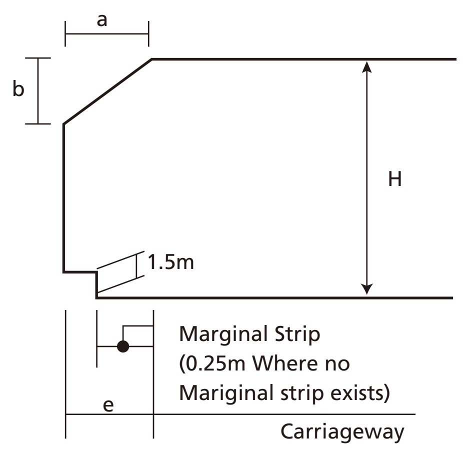

## (General technical standards for structure of prefectural and municipal roads)

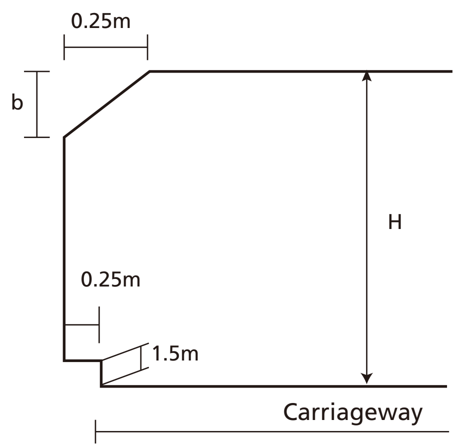
### Article 41

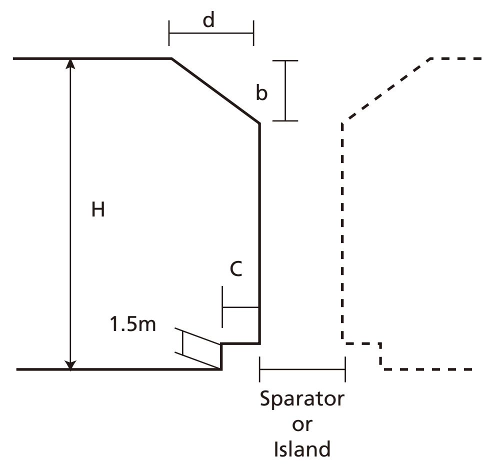
1. The provisions of Article 4, 12, 35.2, 35.3, 35.4 (limited to the matters listed in Article 30.1.12), 39.4, and 40.3 shall apply mutatis mutandis to general technical standards for the structure of prefectural or municipal roads when these roads are newly constructed or reconstructed. In this case, "Type 3 Class 5" in Article 12 shall be read as "Type 3 Class 5 or Type 4 Class 4".
2. The provisions of Article 5 through Article 11.4, Article 13 through 34, Article 35.1 and 35.4 (except for the provisions listed in Article 30.1.12), Article 36 through 38, Article 39.1 through 39.3, Article 39.5 and 39.6, Article 40.1, 40.2, 40.4, and 40.5 shall apply mutatis mutandis to the standard specified in Article 30.3. In this case, "Type 3 Class 5 roads" in proviso of Article 5.1, Article 5.5, proviso of Article 10.2.3, and proviso of Article 11.4 shall be read as "Type 3 Class 5 or Type 4 Class 4 roads". "Type 3 Class 5 roads" in Article 5.3 shall be read as "Type 3 Class 5 and Type 4 Class 4 roads". "Type 4 roads" in Article 9.1 and Article 11.1 shall be read as "Type 4 (except for Class 4)". "Type 3" in these paragraphs shall be read as "Type 3 or Type 4 Class 4". "Type 3" in Article 11.2 shall be read as "Type 3 or Type 4 Class 4". "Values listed in the left column" in Article 13.1 shall be read as "Values listed in the left column (for Type 4 Class 4 roads 40km/h, 30km/h or 20km/h)". "Primarily for use" in Article 31.2 shall be read as "Primarily for Type 4 Class 4 roads or use". In Article 37 "National highways" shall be read as "prefectural roads", "prefectural roads or municipal roads" and "other roads" shall be read as "municipal roads", "subject part" shall be read as "subject prefectural roads".

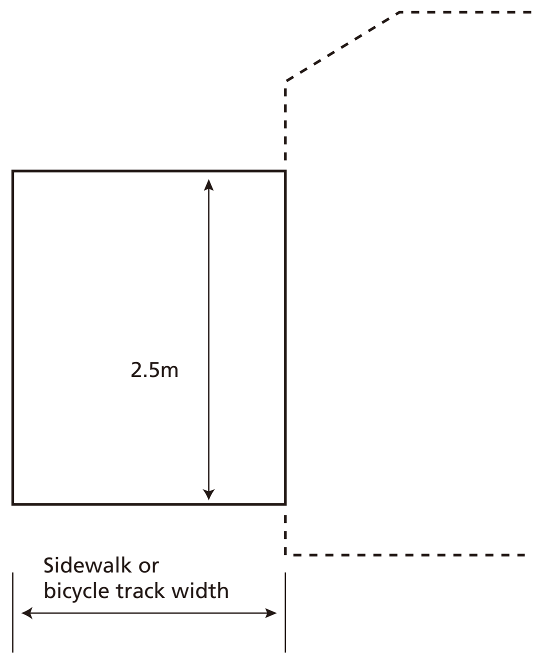


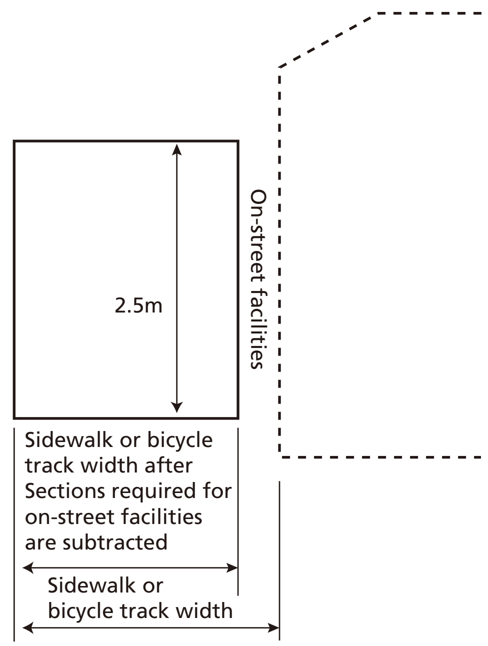


# Statistics

## Road Statistics of Japan

### Road Length by Category (April 1, 2016)

| Category | Unit : km |
|---|---|
| Motorways (National expressways) | 8,776 |
| Highways, Main or National Roads (National highways) | 51,796 |
| Secondary or Regional Roads (Prefectural roads) | 96,040 |
| Other Roads (Municipal roads) | 196,216 |
| Total | 349,828 |

・Roads less than 5.5m in width have been excluded from the statistics.
(Source: Road Statistics Annual Report [Douro Toukei Nenpo] 2017, Road Bureau, MLIT)

### Vehicular Traffic Volume (2016)

| Vehicle type | Unit: Million vehicle kilometers/year |
|---|---|
| Passenger cars | 525,470 |
| Buses & Motor coaches | 5,916 |
| Vans, pick-ups, lorries, road tractors | 198,381 |
| Total | 729,768 |

Source: Transport-related Statistics Data [Kotsu Kanren Toukei Shiryoshu], Policy Bureau, MLIT

### Freight Transport (2016)

| Modes | Unit: million ton-km/year |
|---|---|
| Road | 212,034 |
| Rail | 21,654 |
| Waterway | 180,381 |
| Total | 413,680 |

### Passengers Transport (2016)

| Modes | Unit: million passenger-km/year |
|---|---|
| Road, public transport | 63,737 |
| Road, private transport | 821,360 |
| Rail | 431,799 |
| Total | 1,316,896 |

Source: Transport-related Statistics Data [Kotsu Kanren Toukei Shiryoshu], Policy Bureau, MLIT

### Vehicles in Use (Mar. 31, 2016)

| Vehicle type | Unit: vehicles |
|---|---|
| Passenger cars | 61,253,300 |
| Buses & Motor coaches | 232,793 |
| Vans, pick-ups, lorries, road tractors | 16,004,870 |
| Total | 77,490,963 |
| (Reference) Motorcycles & Mopeds | 3,602,689 |

(Source: Automobile Inspection & Registration Information Association website)

### Road Accidents (2016)

| | Unit: accidents, or persons |
|---|---|
| Number of Injury Accidents | 499,201 |
| Number of Persons Injured | 618,853 |
| Number of Persons Killed | 3,904 |

(Source: Traffic Accidents Situation, and Number of Fatalities within 30 days from the Time of Accident, National Police Agency)

### Road Expenditure (2015)

| | Unit: million yen |
|---|---|
| Gross investment | 3,677,549 |
| Maintenance expenditures | 1,820,704 |
| Total | 5,498,253 |

・Expenditures for toll roads are excluded.
(Source: Road Statistics Annual Report [Douro Toukei Nenpo] 2017, Road Bureau, MLIT)

## Change in Investment in the Five-Year Road Development Program

| The Five-Year Road Development Plans | General Road Projects | | Toll Road Projects | | Unsubsidized Local Road Projects | | Total ¥billions |
|---|---|---|---|---|---|---|---|
| | Investment ¥billions | Ratio % | Investment ¥billions | Ratio % | Investment ¥billions | Ratio % | |
| 1st Plan | 260.0 | 100.0 | - | - | - | - | 260.0 |
| FY1954-57 | 182.1 | 59.0 | 146.0 | 4.7 | 111.9 | 36.3 | 308.6 |
| a/A (%) | 70.0 | - | - | - | - | - | - |
| 2nd Plan | 610.0 | 61.0 | 200.0 | 20.0 | 190.0 | 19.0 | 1,000.0 |
| FY1958-60 | 322.2 | 61.3 | 51.0 | 9.7 | 152.1 | 29.0 | 525.2 |
| b/B (%) | 52.8 | - | 25.5 | - | 80.0 | - | 52.5 |
| 3rd Plan | 1,300.0 | 61.9 | 450.0 | 21.4 | 350.0 | 16.7 | 2,100.0 |
| FY1960-63 | 722.2 | 57.7 | 225.5 | 18.0 | 304.5 | 24.3 | 1,252.2 |
| c/C (%) | 55.6 | - | 50.1 | - | 87.0 | - | 59.6 |
| 4th Plan | 2,200.0 | 53.7 | 1,100.0 | 26.8 | 800.0 | 19.5 | 4,100.0 |
| FY1964-66 | 1,244.1 | 56.8 | 443.2 | 20.2 | 502.3 | 23.0 | 2,189.6 |
| d/D (%) | 56.6 | - | 40.3 | - | 62.8 | - | 53.4 |
| 5th Plan | 3,550.0 | 53.8 | 1,800.0 | 27.3 | 1,100.0 | 16.6 | 1) 6600 |
| FY1967-69 | 1,795.6 | 51.9 | 753.5 | 21.7 | 912.7 | 26.4 | 3,461.8 |
| e/E (%) | 50.6 | - | 41.9 | - | 83.0 | - | 52.5 |
| 6th Plan | 5,200.0 | 50.2 | 2,500.0 | 24.2 | 2,550.0 | 24.6 | 2) 10300 |
| FY1970-72 | 3,108.0 | 49.9 | 1,317.9 | 21.2 | 1,786.3 | 28.8 | 9) 6223.5 |
| f/F (%) | 59.8 | - | 52.7 | - | 70.1 | - | 60.1 |
| 7th Plan | 9,340.0 | 47.9 | 4,960.0 | 25.4 | 4,700.0 | 24.1 | 3) 19500 |
| FY1973-77 | 7,757.8 | 47.3 | 3,960.8 | 24.1 | 4,693.9 | 28.6 | 16,412.5 |
| g/G (%) | 83.1 | - | 79.9 | - | 99.9 | - | 84.2 |
| 8th Plan | 13,500.0 | 47.4 | 6,800.0 | 23.9 | 7,500.0 | 26.3 | 4) 28500 |
| FY1978-82 | 12,947.9 | 45.0 | 6,614.5 | 23.0 | 9,231.4 | 32.0 | 28,793.8 |
| h/H (%) | 95.9 | - | 97.3 | - | 123.1 | - | 101.0 |
| 9th Plan | 16,000.0 | 41.9 | 9,200.0 | 24.1 | 11,700.0 | 30.6 | 5) 38200 |
| FY1983-87 | 15,926.5 | 43.1 | 9,740.3 | 26.4 | 11,252.7 | 30.5 | 36,919.4 |
| i/I (%) | 99.5 | - | 105.9 | - | 96.2 | - | 96.6 |
| 10th Plan | 23,800.0 | 44.9 | 14,000.0 | 26.4 | 13,900.0 | 26.2 | 6) 53000 |
| FY1988-92 | 22,637.6 | 41.1 | 14,238.7 | 25.9 | 18,164.3 | 33.0 | 55,040.6 |
| j/J (%) | 9.1 | - | 101.7 | - | 130.7 | - | 103.9 |
| 11th Plan | 28,800.0 | 37.9 | 20,600.0 | 27.1 | 25,200.0 | 33.2 | 7) 76000 |
| FY1993-97 | 28,627.4 | 39.9 | 17,703.6 | 24.7 | 25,476.2 | 35.5 | 71,807.2 |
| k/K (%) | 99.4 | - | 85.9 | - | 101.1 | - | 94.5 |
| 12th Plan | 29,200.0 | 37.4 | 17,000.0 | 21.8 | 26,800.0 | 34.4 | 8) 78000 |
| FY1998-02 | 31,729.0 | 48.6 | 13,431.2 | 20.6 | 20,155.4 | 30.9 | 65,315.6 |
| l/L (%) | 108.7 | - | 79.0 | - | 75.2 | - | 83.7 |