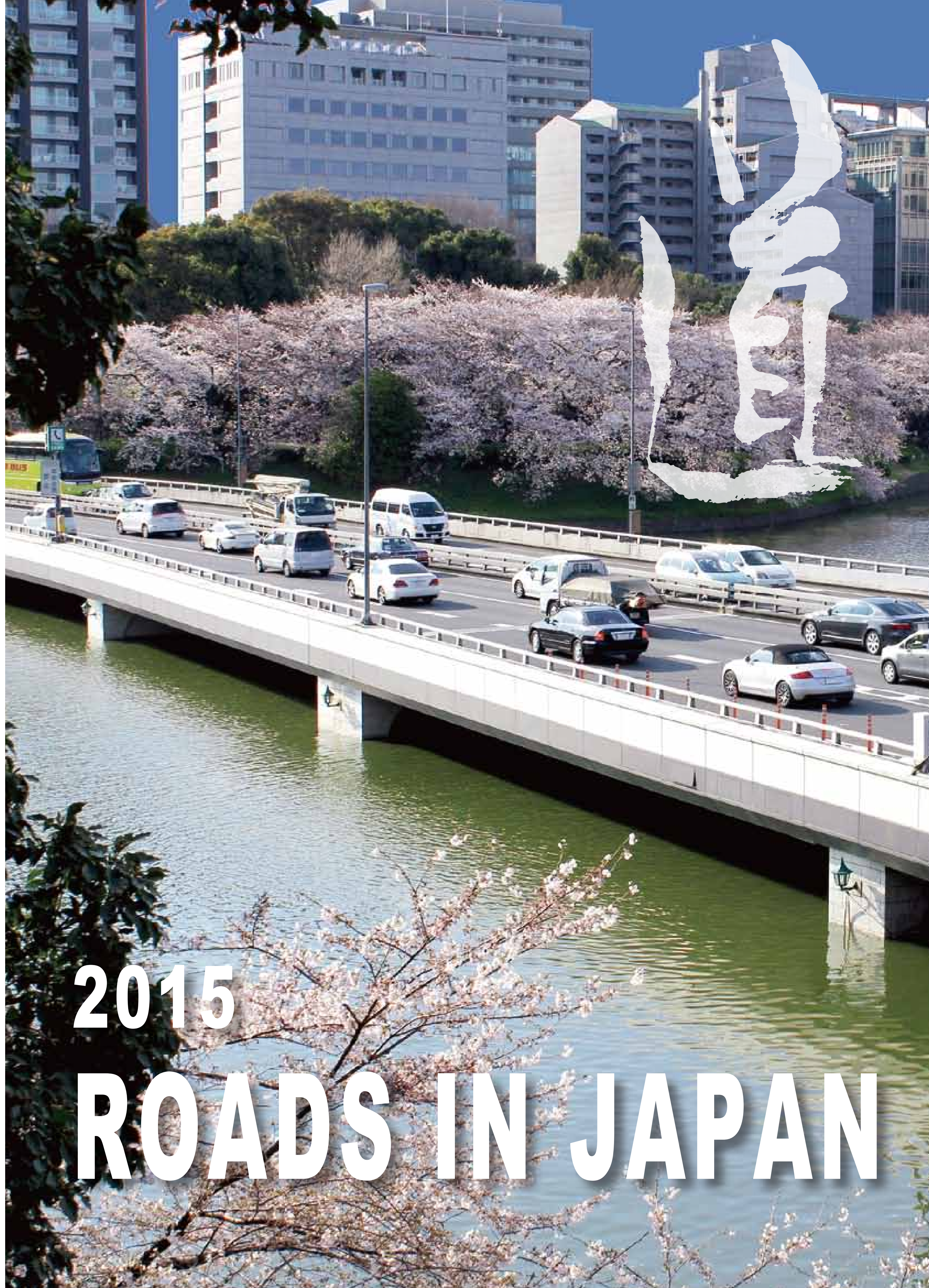
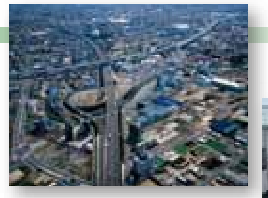
Road Bureau
Ministry of Land, Infrastructure, Transport and Tourism

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

2015



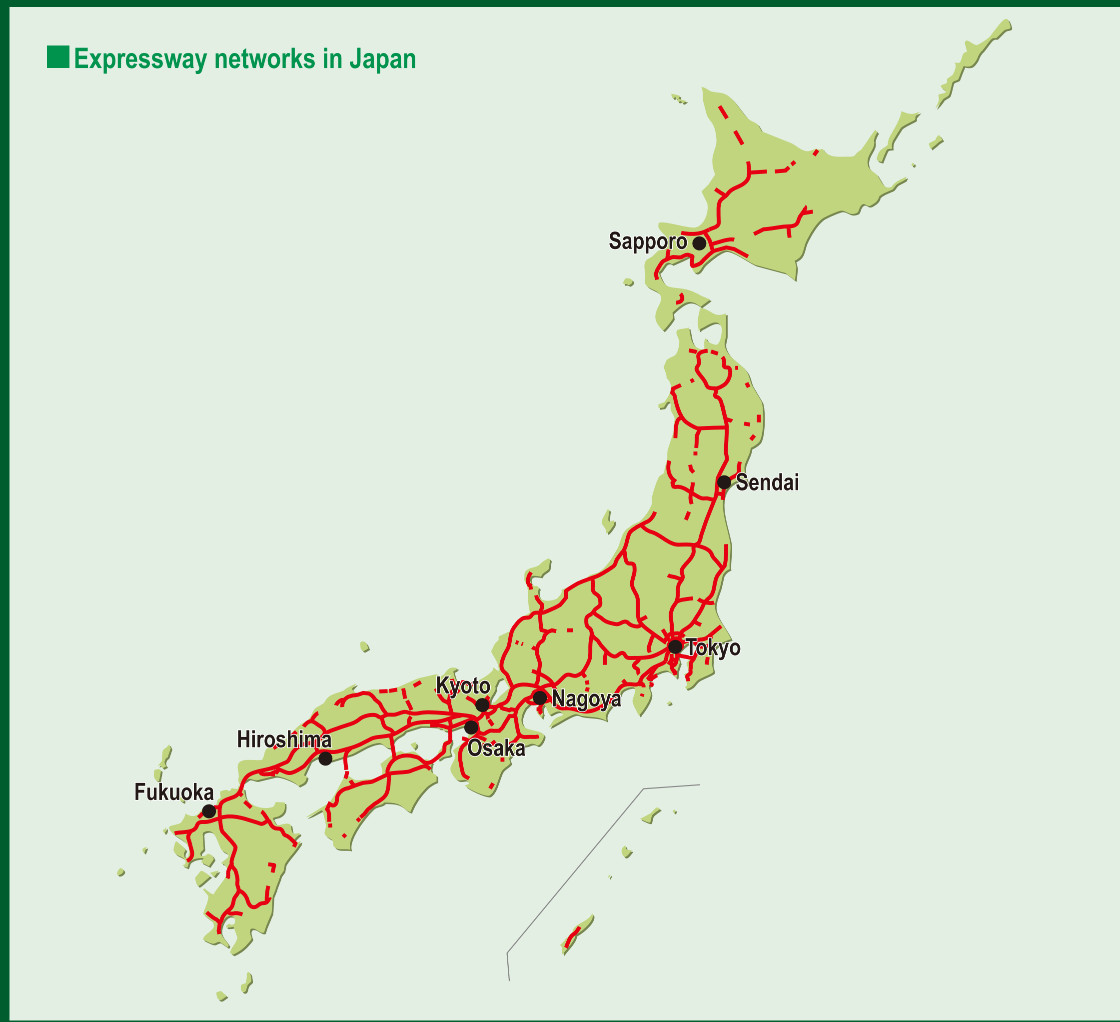
C O N T E N T S



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



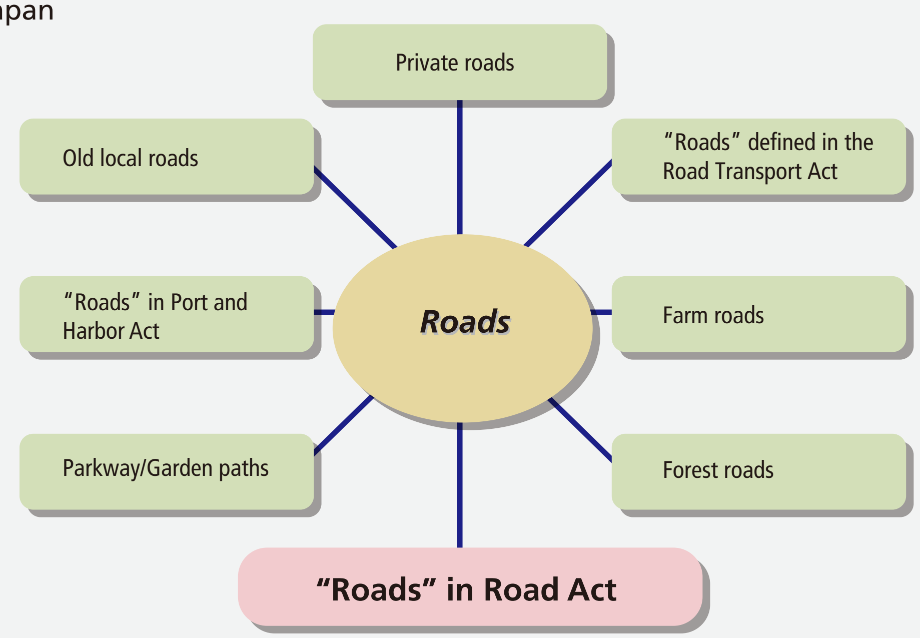
Types of Road

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 corre-lated 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

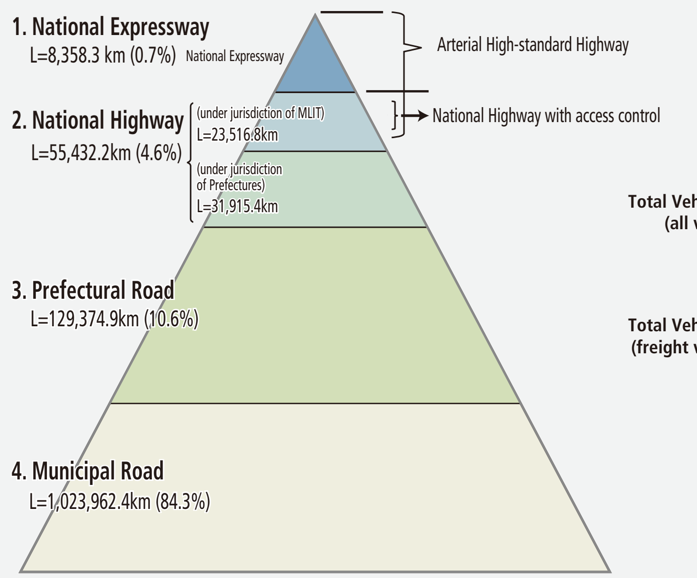
Road Type		Road Administrator	Burden is carried by	Burden Sharing	
				Development/improvement	Maintenance/repair
National Expressway	Toll	Minister*1 〔Article 6 of the National Expressway Act〕	Expressway Companies (NEXCOs)	Development, improvement and repair activities are carried out using a loan. The debt and management expense are repaid with toll revenue 〔Article 3 & 4 of the Act on Special Measures concerning Road Construction and Improvement〕	
National Expressway	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〕
National Highway	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 subsided 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 subsided 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 travel in vehicle kilometers and play a significant role in road traffic.

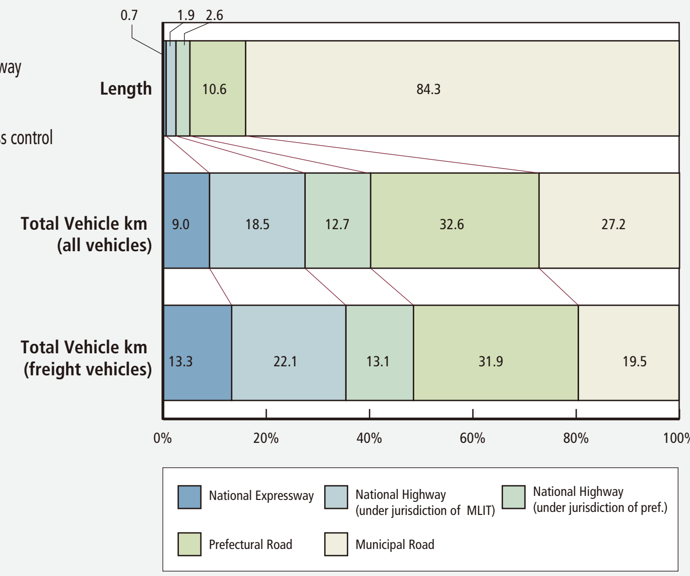
■Classification under Article 3 of the Road Act



Total Length = 1,217,127 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 2013 April 1

■Length traveled classified 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 : about 14,000km)

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

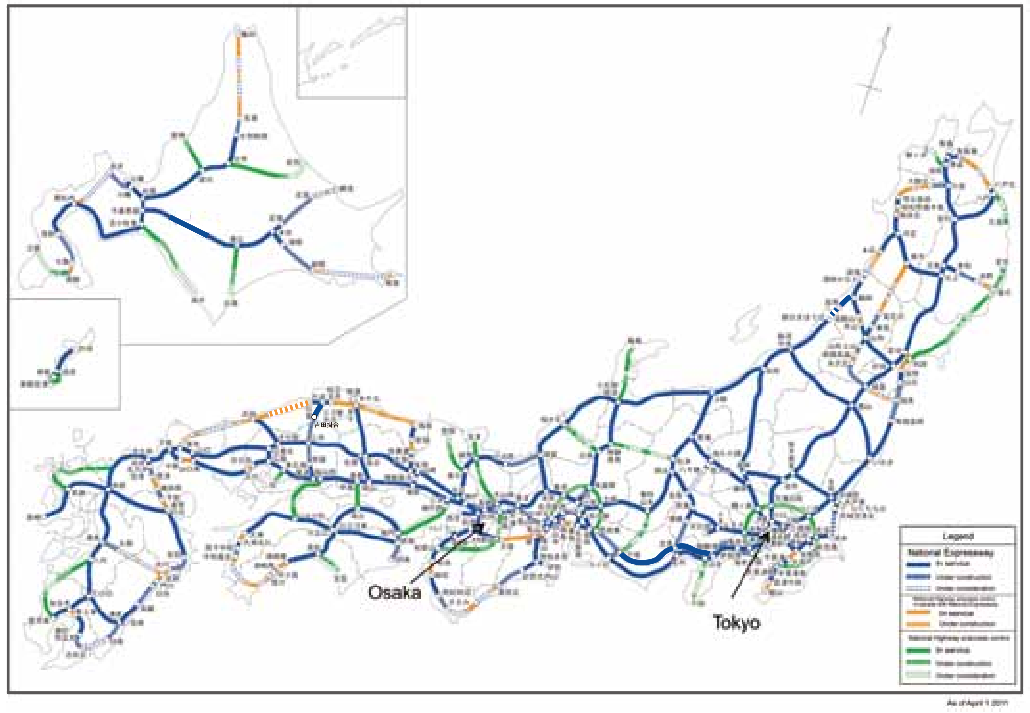
Projects mainly developed under the jurisdiction of the national government

* 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.

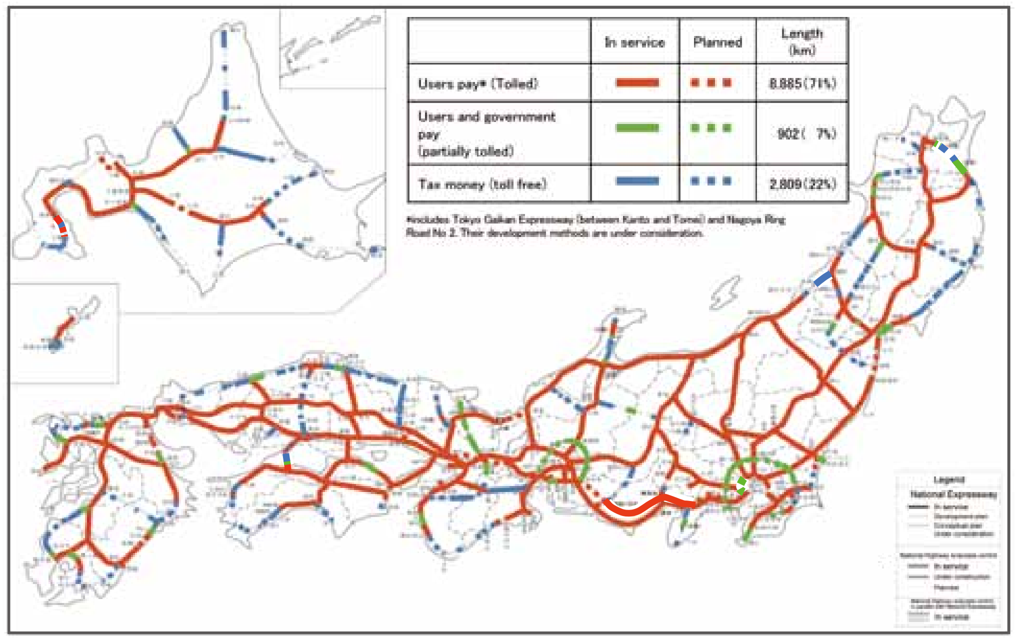
■Arterial high-standard highway network



Burden sharing of arterial high-standard highways

As of April 2012, about 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 in service or under contemplation, 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 two systems were developed

① Earmarking gasoline taxes for road development

② 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.

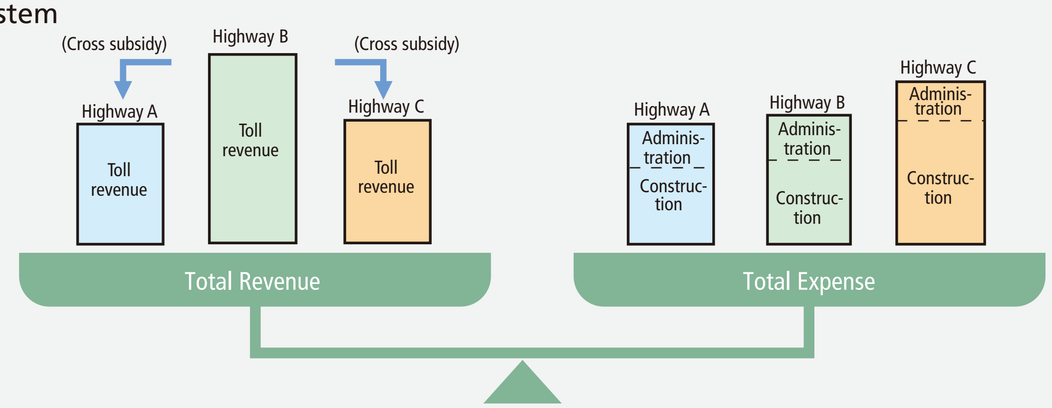
Pool system

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 traffic 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.

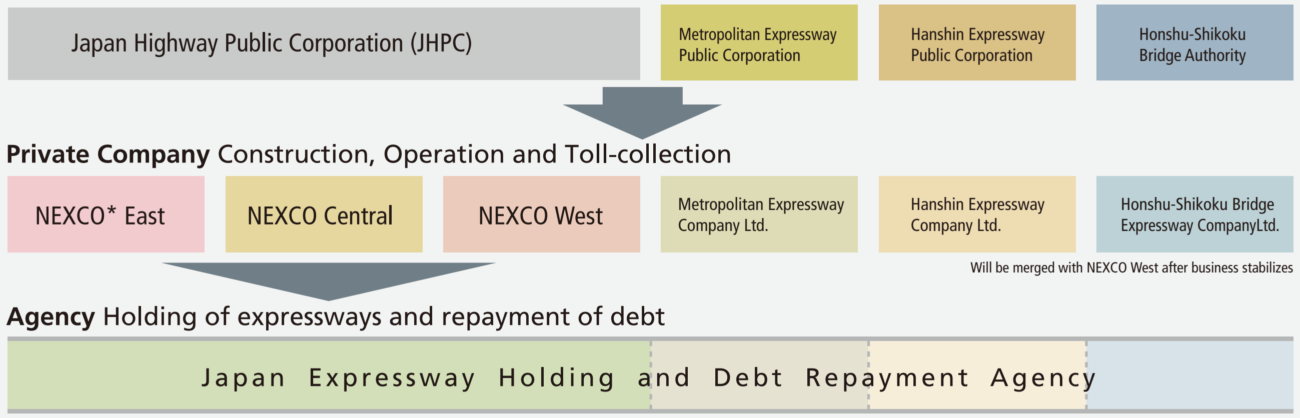
■Pool system



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 know-how.

■Organizational chart after privatization

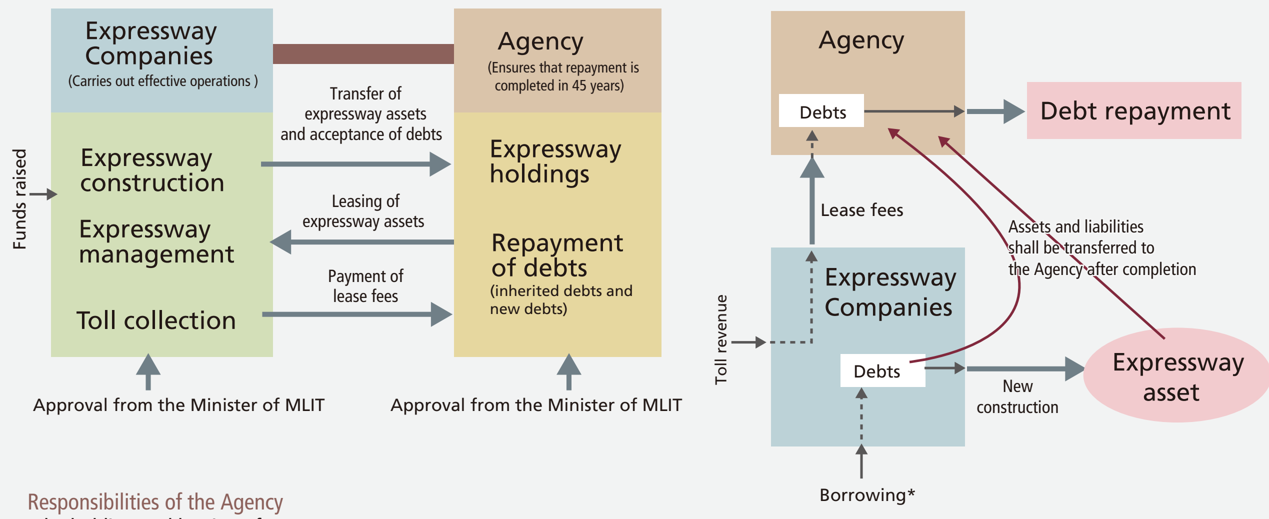


Privatization was based on the following acts
-Expressway Company Law
-Japan Expressway Holding and Debt Repayment Agency Law
-Law Regarding the Development of Highway-Related Laws in Connection with the Privatization of the Japan Highway Public Corporation
-Act for Enforcement of Acts Related to Privatization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

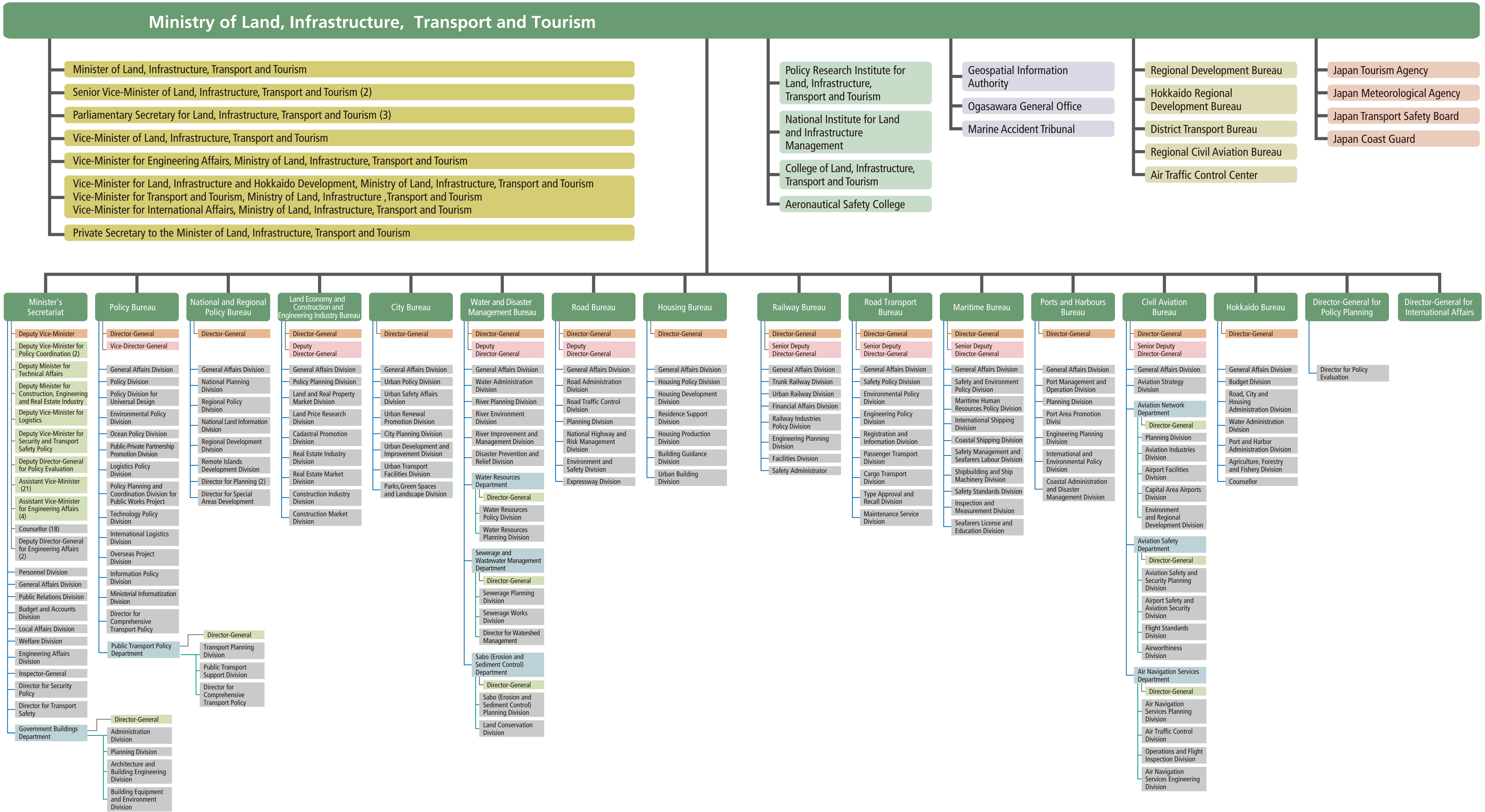
*borrowed from both national and local governments for construction (and this money is loaned to the companies at no interest)

Administrative Organization

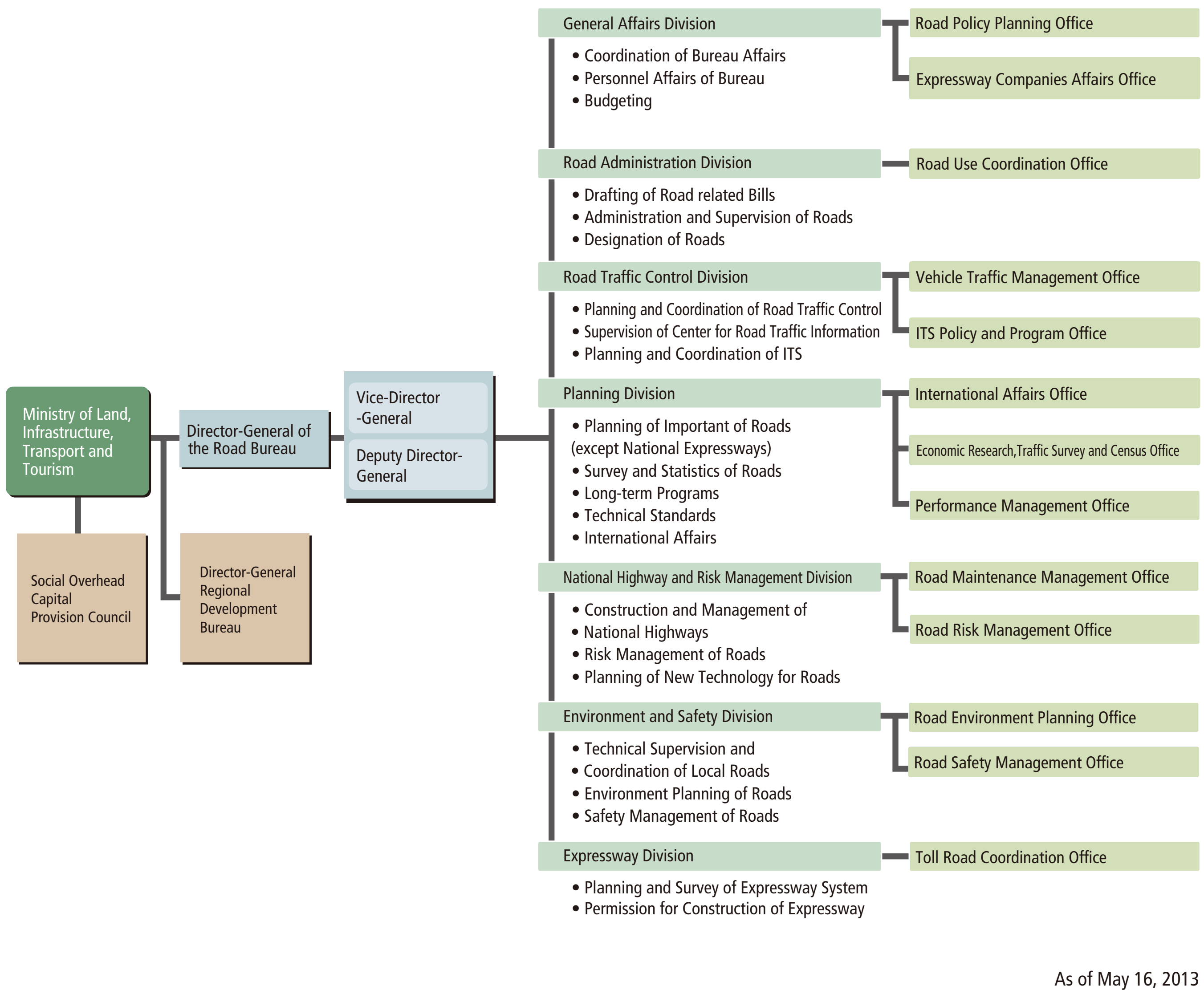
The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) is in charge of the comprehensive and systematical use of national land, development and conservation, consistent infrastructure development, implementation of traffic policies, development of meteorological service, and maritime safety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

■Organization Chart of MLIT

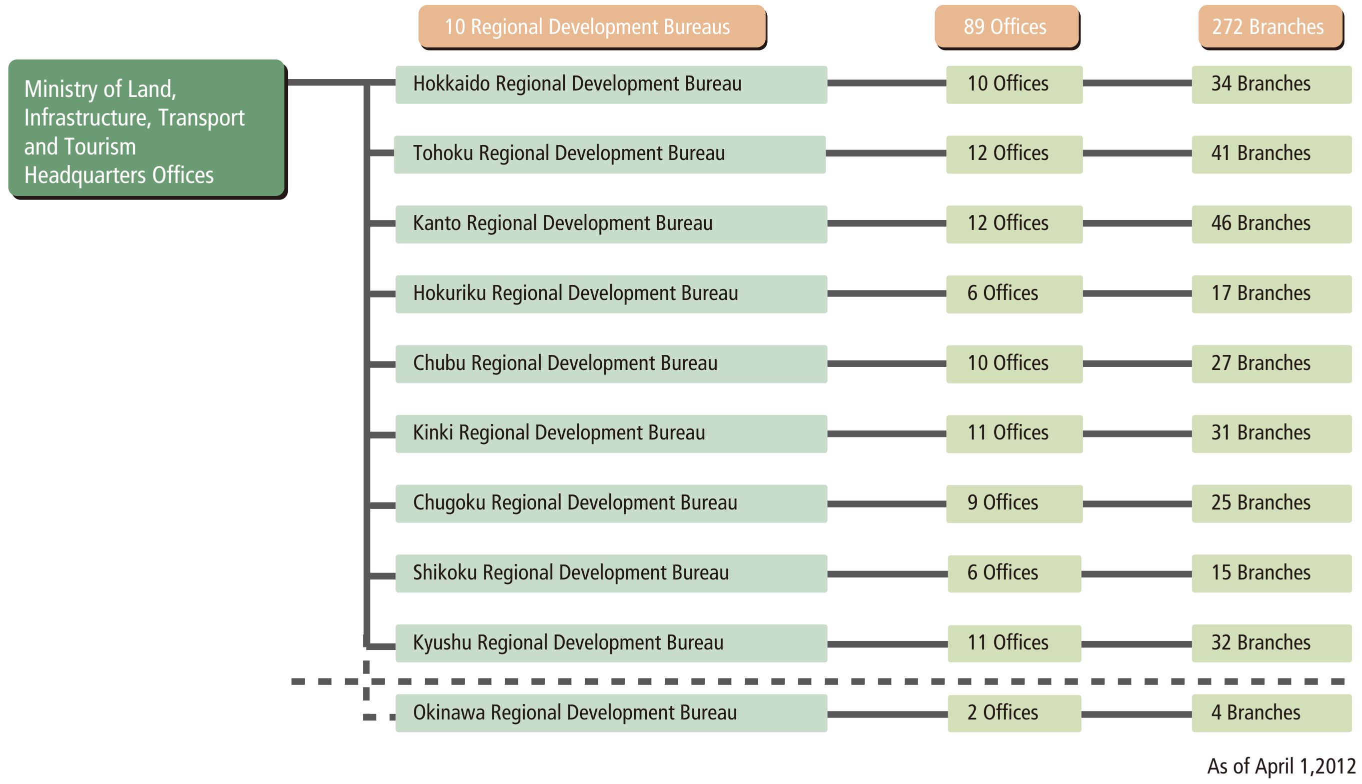
(As of July 1, 2013)



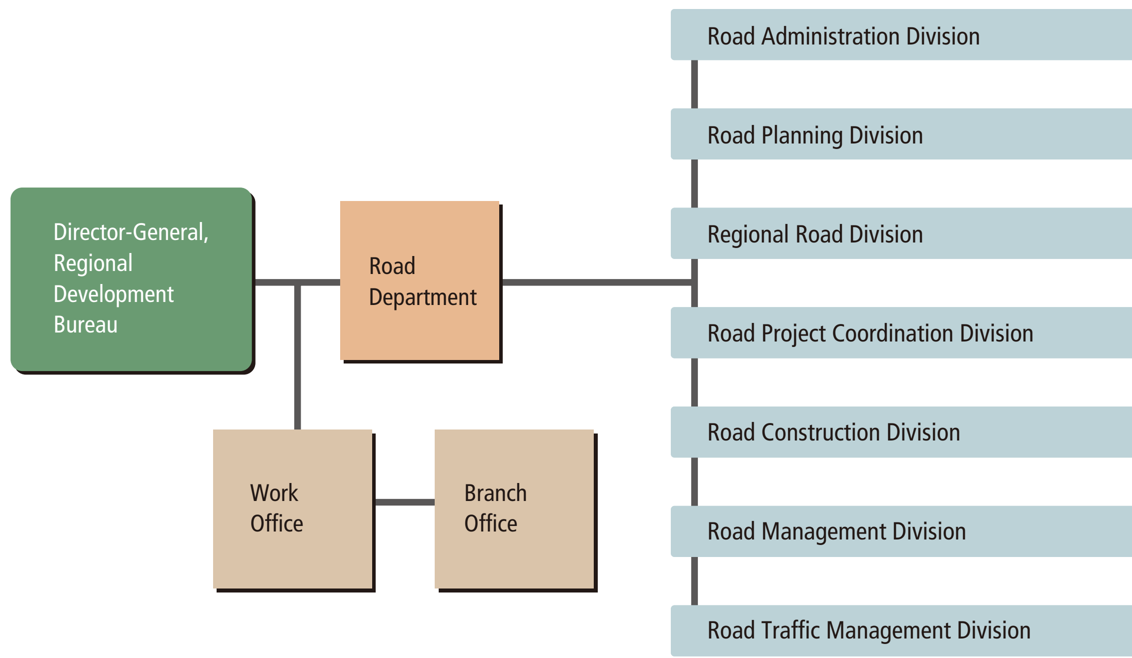
■Organization Chart of Road Bureau



■Regional Development Bureaus



■Organization Chart of a Regional Development Bureau



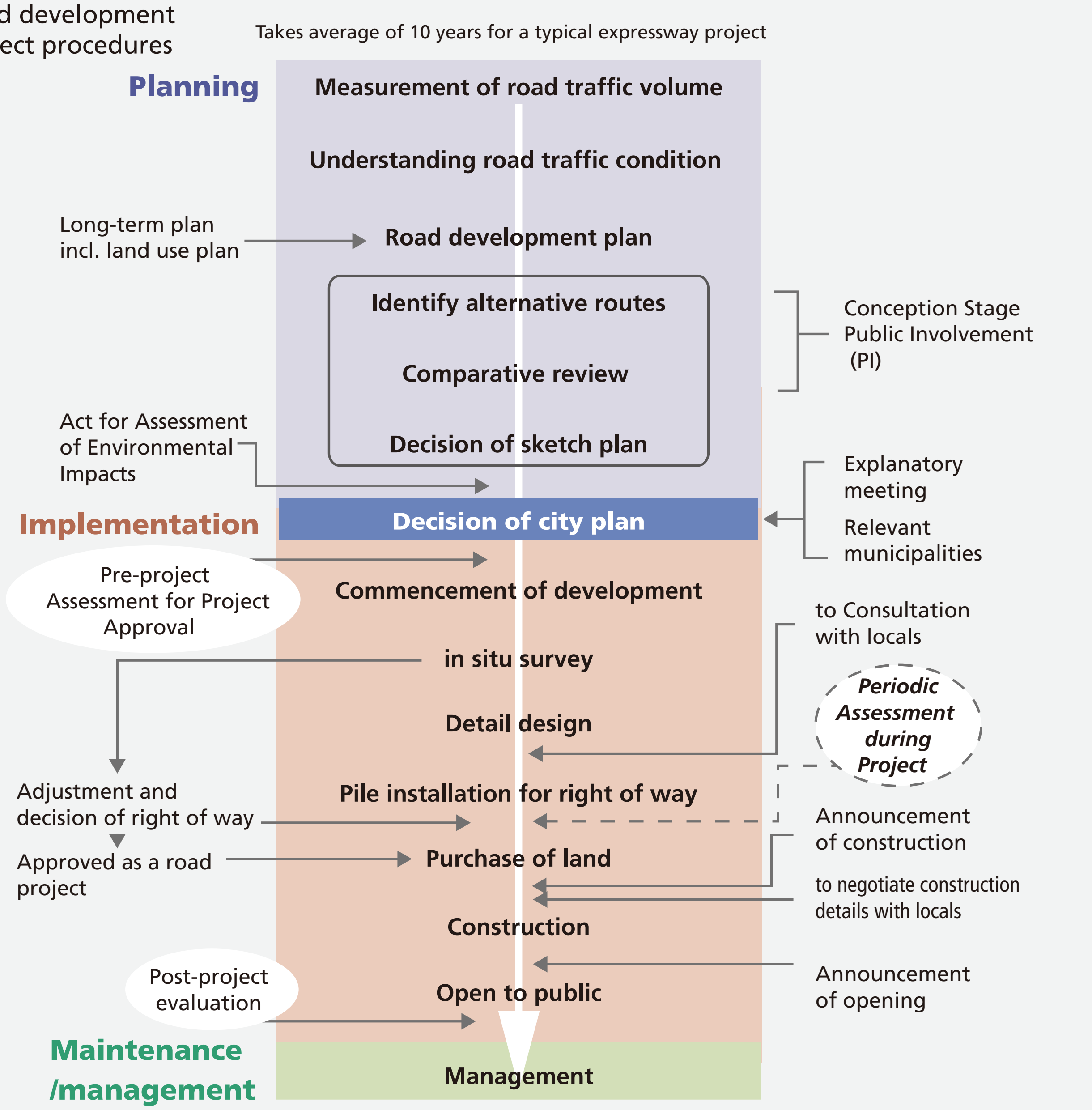
Planning and Implementation of Projects

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.

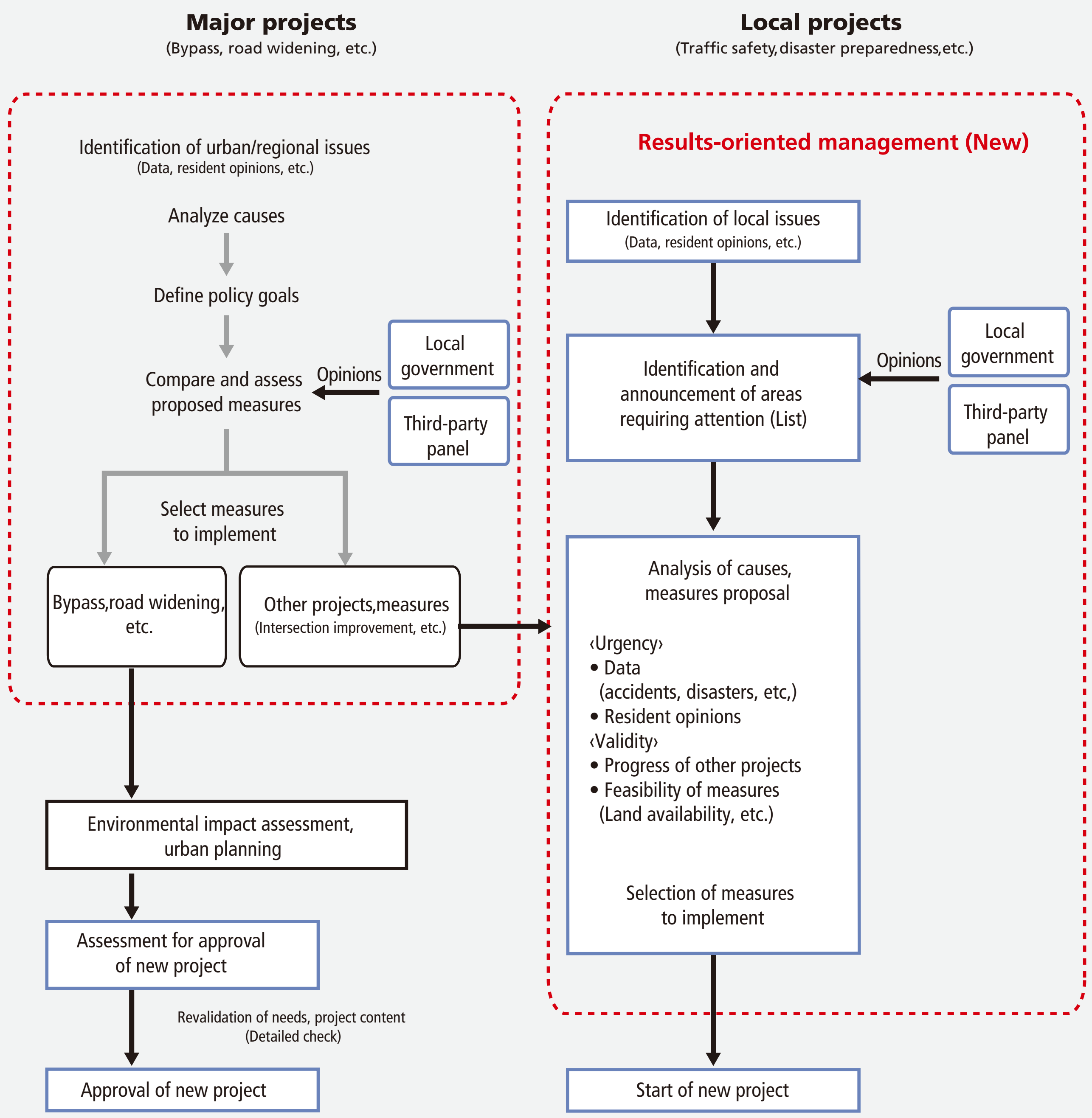
■ Road development project procedures



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 structure (number of lanes and cross-section)

↓

(1) **Identify alternative routes** — Identify multiple routes for comparison in the light of the plan.

↓

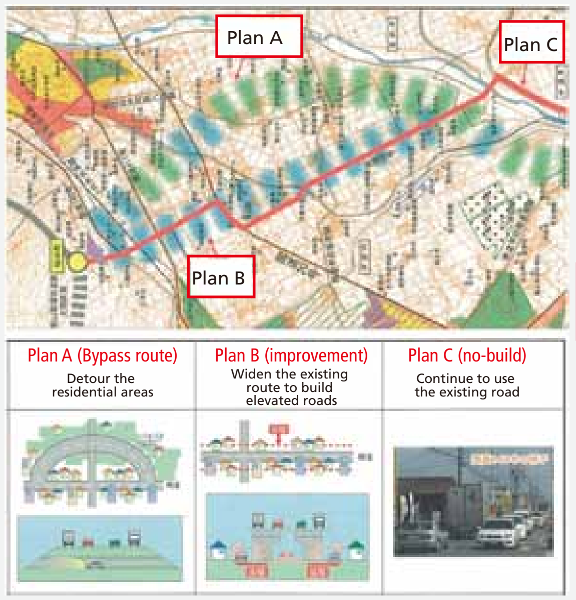
(1) **Comparative review** — Make a comparison with other routes with respect to nature, structure, care for control-points* and economy before deciding the optimal route.

↓

(2) **Decision of sketch 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)



Comparison

(2)

Road development process

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

■ Implementation of road projects

Decision of City Plan

Commencement of development

Explanatory 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

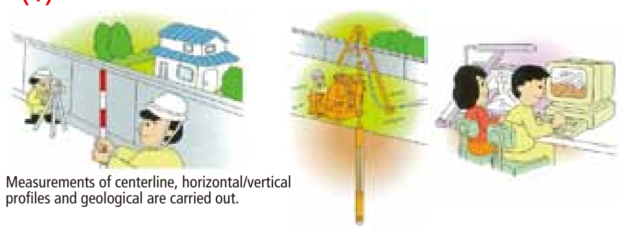
* Further survey of buried cultural properties is to be conducted as necessary

Construction

Completion/open to public

Maintenance/ management

(1)



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

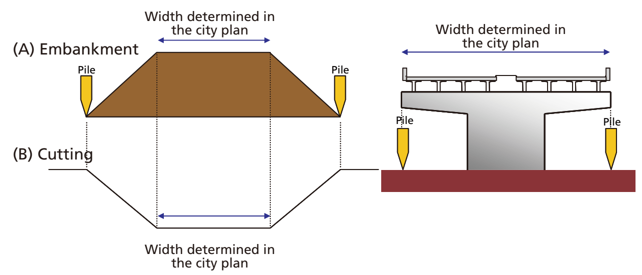
(2)

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

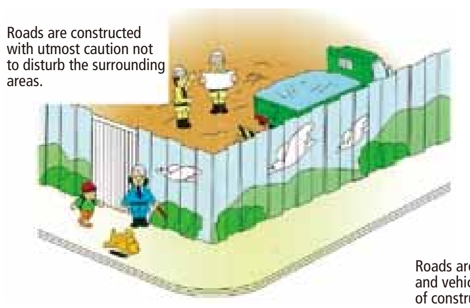
Negotiation of compensation is conducted.

【Pile installation】

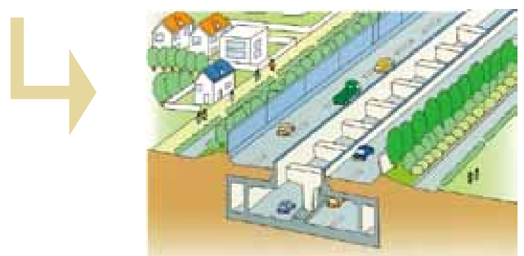
(1) Structures at grade　　(2) Elevated structures



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.

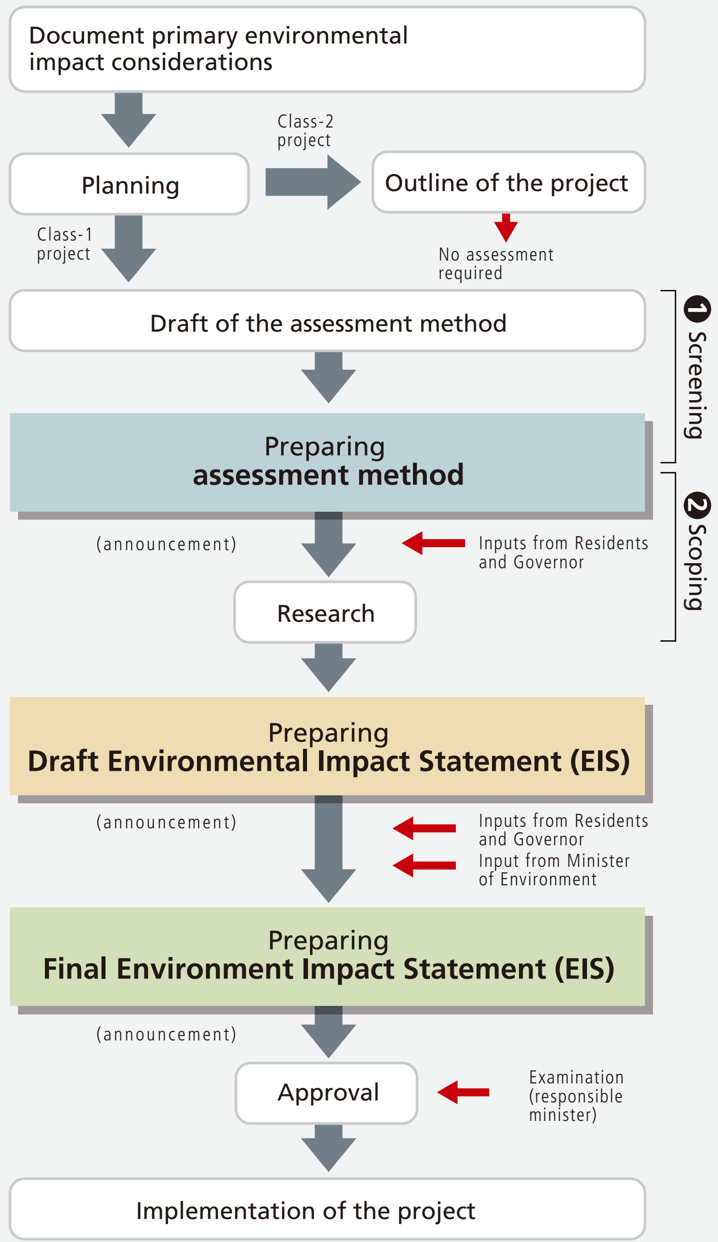
■Road projects that have to be assessed

	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 anassessment 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
creening 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.

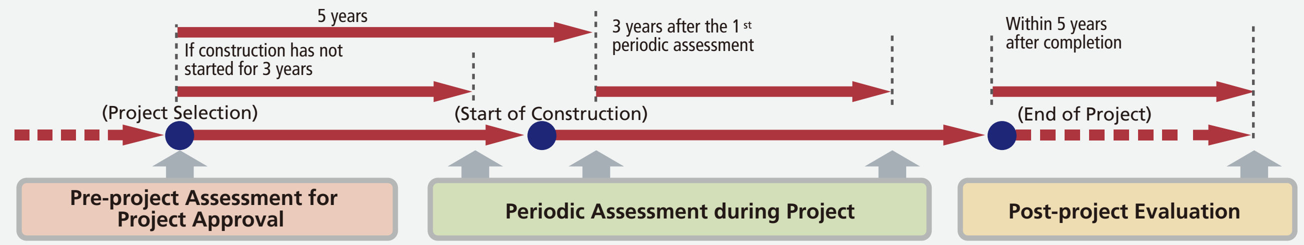
Final EIS
Modified form of environmental impact statement with the improvements taking into consideration the inputs of residents and governor.
Prepared by the project proponent taking local opinions into consideration.

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)



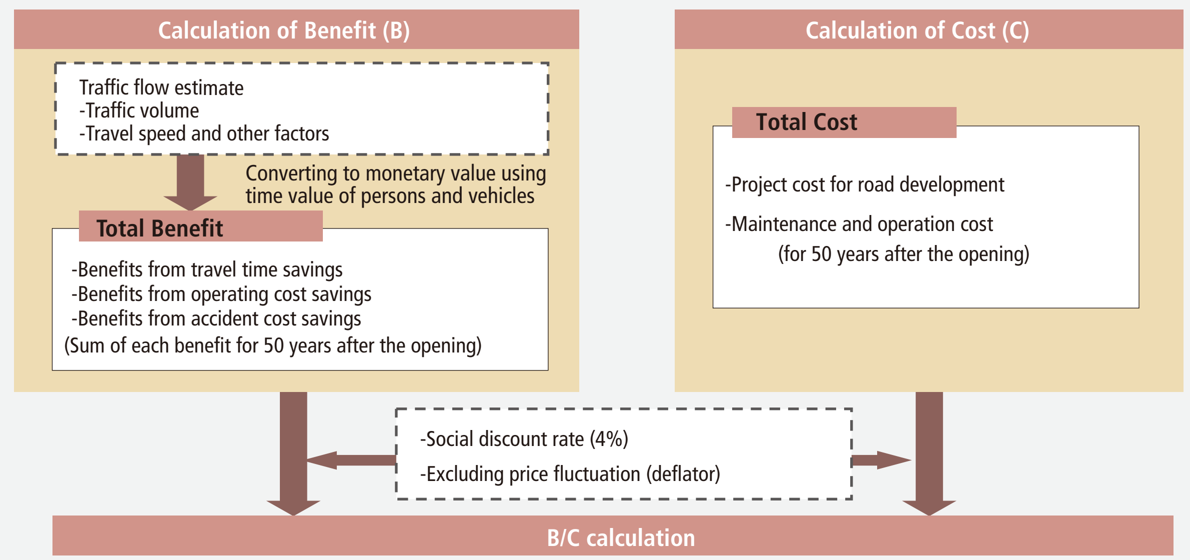
1) Pre-project assessment for project approval Project assessment including a cost-benefit analysis is conducted when approving a new project. **This procedure was introduced in FY 1998.**	Total : 1,458projects (no pertinent project in FY2009)
2) Periodic assessment during project When a project has 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 Of which reviewed projects : 72 terminated projects : 32 [FY2009 : 102projects Of which reviewed projects : 4 terminated projects : 0]
3) Post-project evaluation Post-Project evaluation is carried out in order to confirm its effectiveness and environmental impacts. As necessary, improvements and appropriate planning and researching for similar projects are examined. **This procedure was introduced in FY 2003.**	Total : 217projects (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 and diesel oil
- **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 administration 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 Social Infrastructure Development Plan

(five years, from FY 2012-2016)

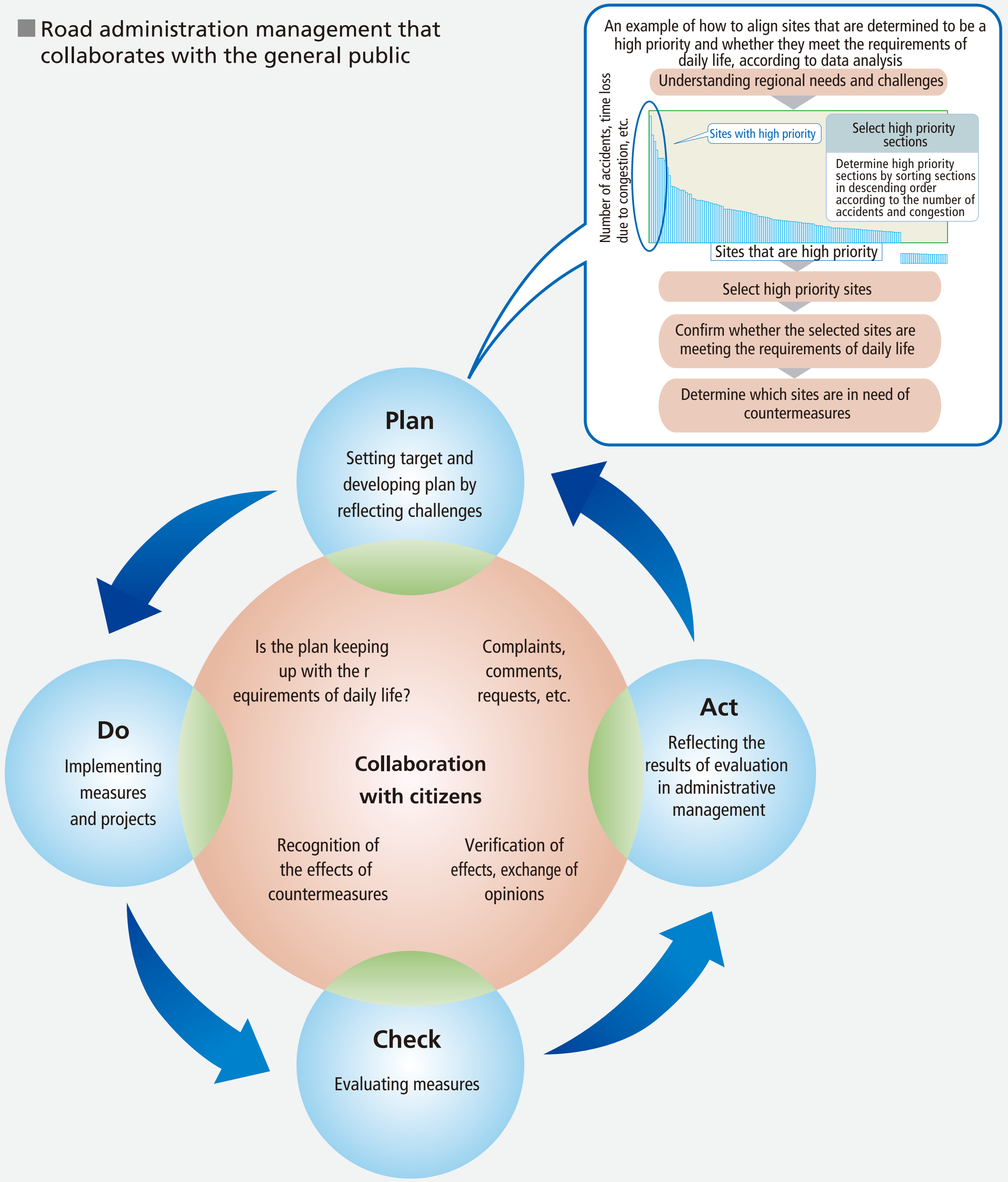
Objective	Measure	KPI	Actual performance 2012	Actual performance 2013	Target 2017
1. Reduce disaster risks on a large scale or in wide areas	1-1 Improve earthquake-resistance strength of infrastructure and implement other non-infrastructure measures to protect against earthquakes.	Number of quake-resistant 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 administration management that collaborates with the general public



Chapter 2

Safety and Security

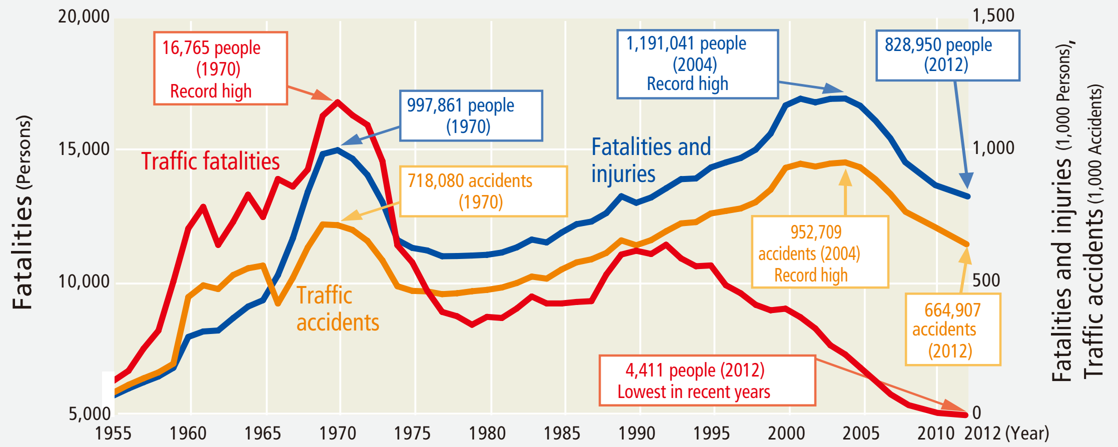
Japan is a country with beautiful natural scenery, which changes from season to season, but also has steep land formations, weak geological features and is prone to earthquakes, storms, heavy snowfall and other natural disasters. Traffic accident fatalities and casualties are also rising with traffic-related 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.

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 than in European countries and the United States. 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.

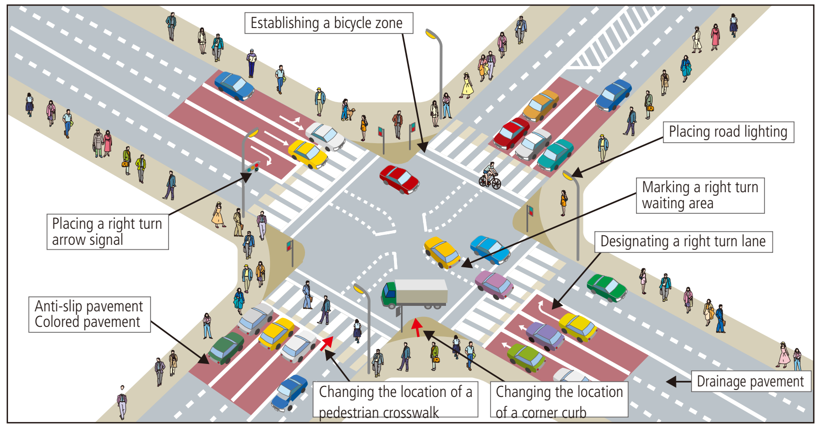
Source: Data from the National Police Agency

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.

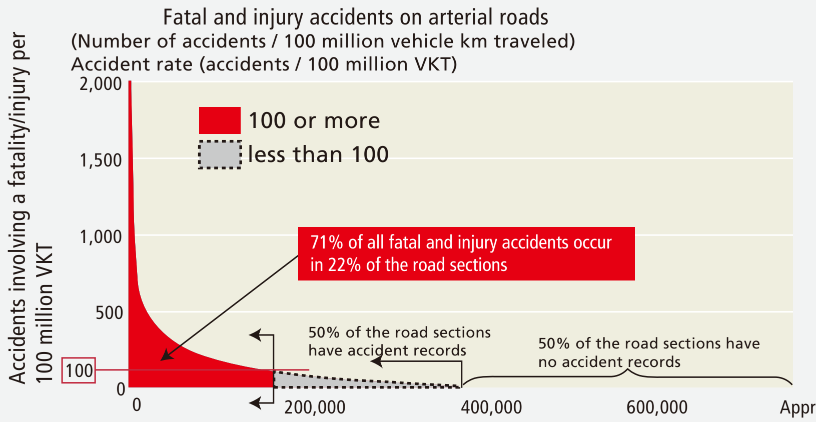
Prefectural public safety commissions and road administrators gave higher priority for actions to be taken on these segments.

■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

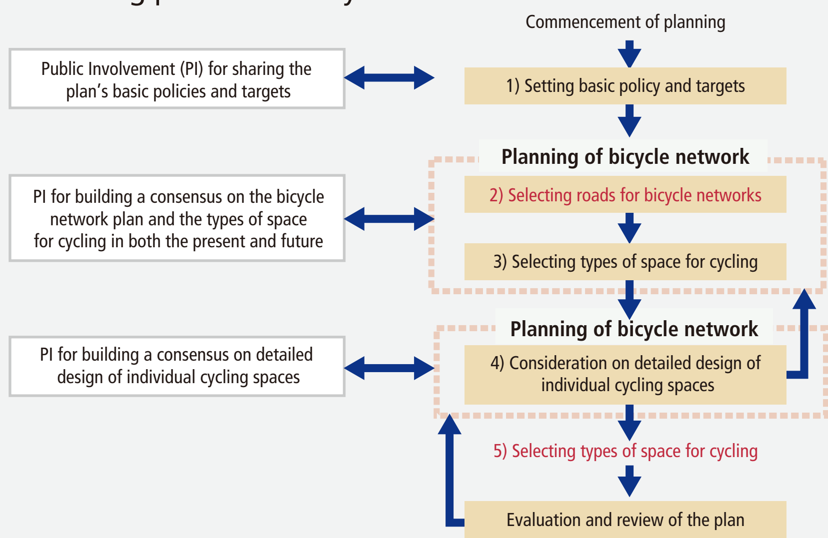
After improvement

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

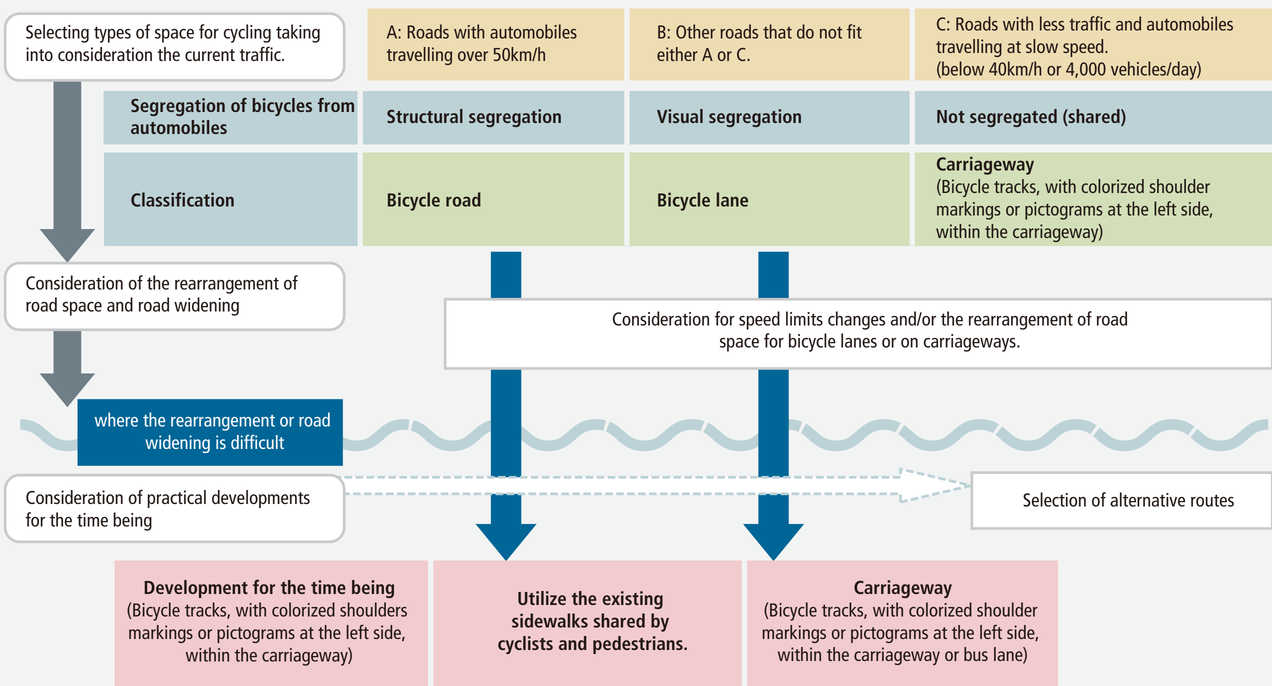
There is a guideline that provides a planning process, including goal-setting, selection of roads for bicycle network and selection of type of space for cycling.

Planning process for bicycle road networks



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




Bicycle road


Bicycle lane


Shared sidewalk by cyclists and pedestrians

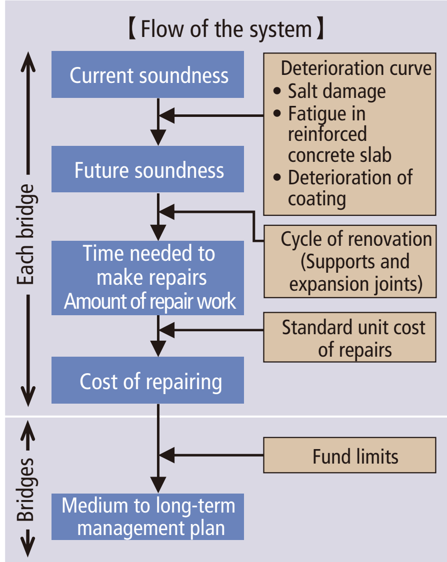
Asset Management

A great deal of Japan's infrastructure was constructed during the postwar rehabilitation period of rapid economic growth 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.

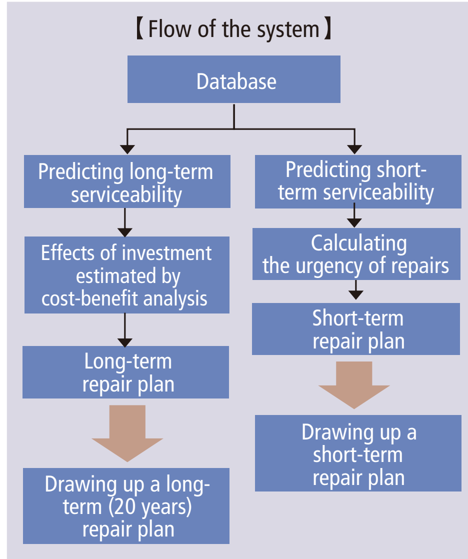
Development of road asset management

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

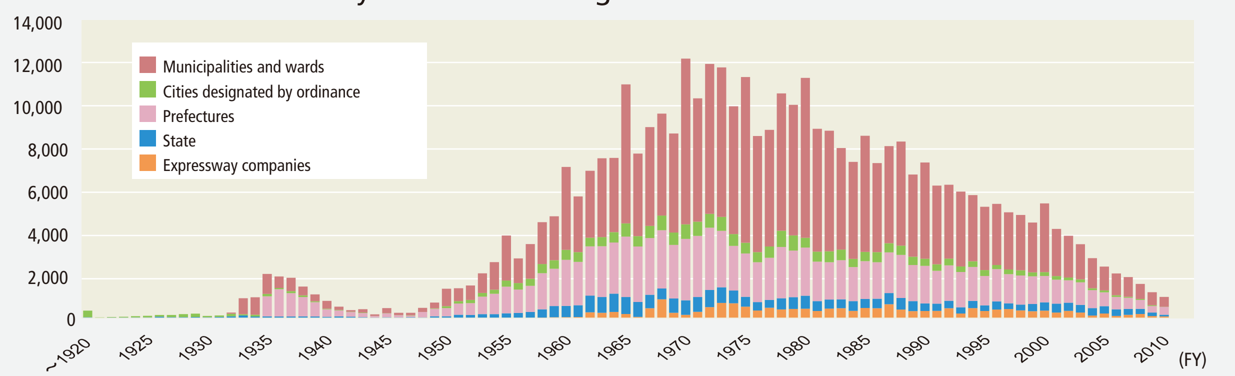
Overview of a Bridge Management System



Overview of Pavement Management System

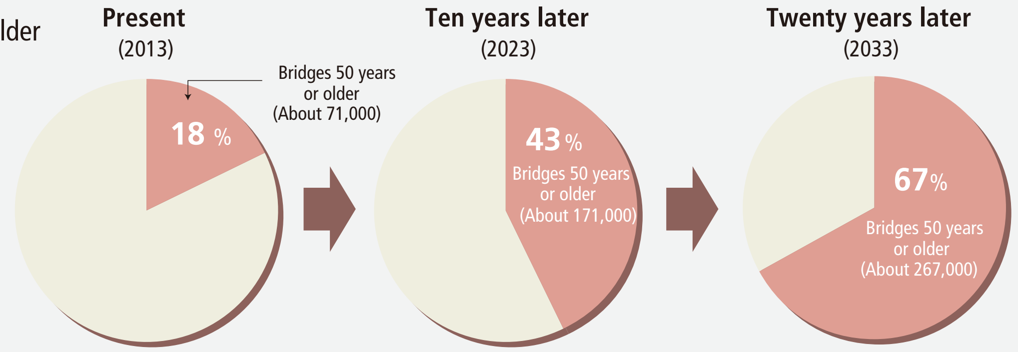


Number of newly constructed bridges



Percentage of bridges older than 50 years

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

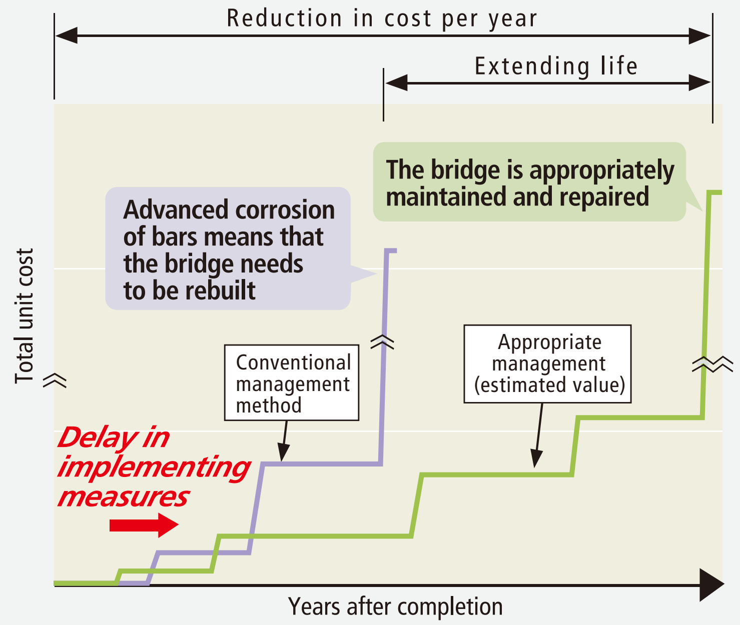


Source: Survey of current road infrastructure conditions (data as of April 2013)
All road bridges nationwide: about 700,000 (those which are 2m or longer)

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

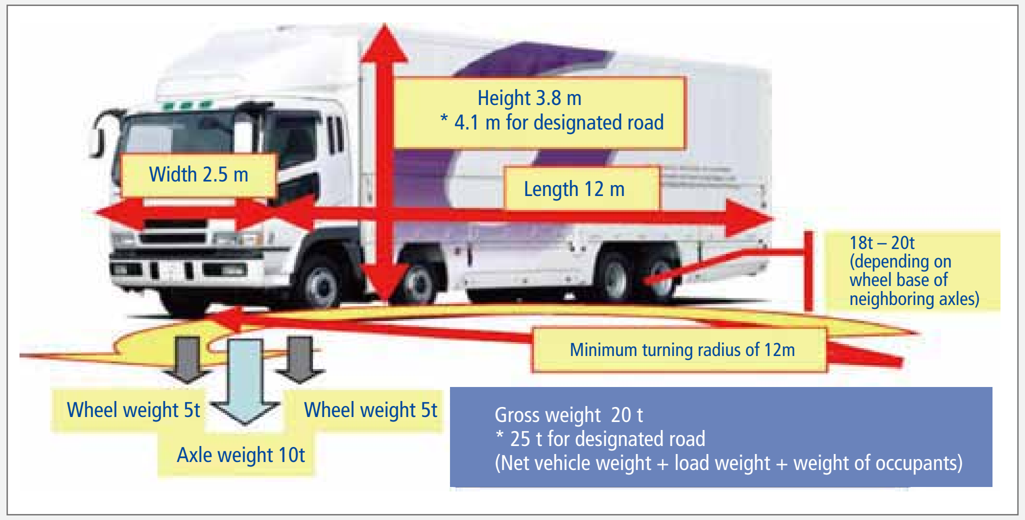

Deterioration due to an alkali aggregate reaction

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 road users.

■On general roads

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



●Typical overweight or oversized vehicle types

■On expressways

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

	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 vehicle traffic that is over the weight or size limits, 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

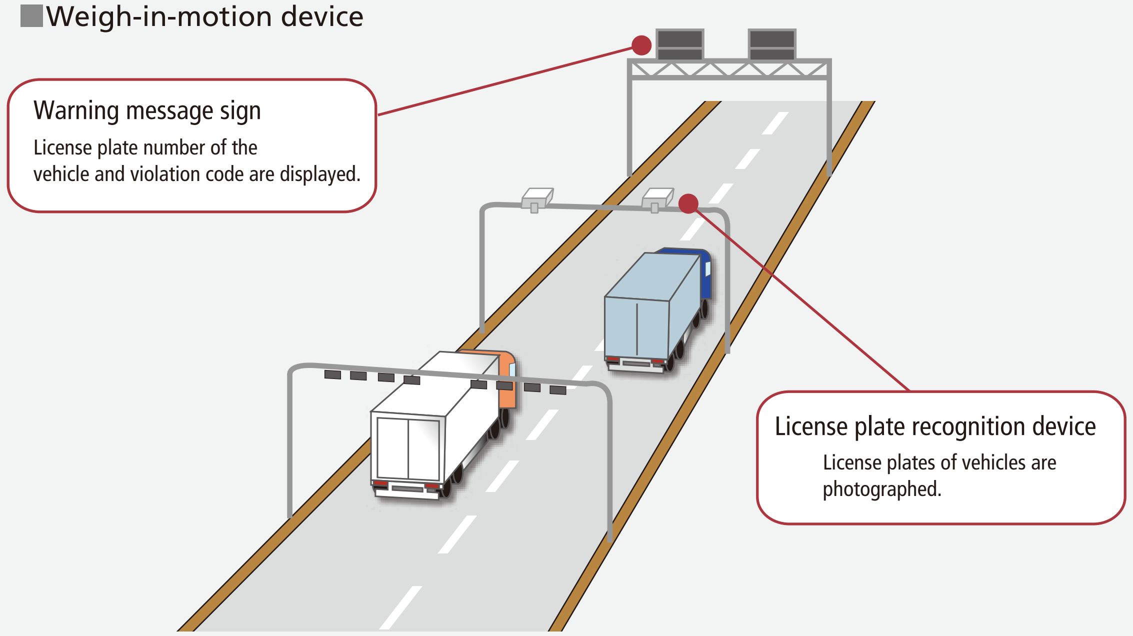
change to License plate recognition device

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.

■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)

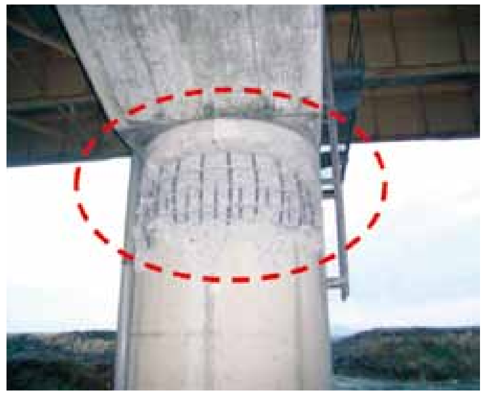
Heavy snow

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)

Earthquake protection

To ensure highly reliable road networks, which allow for fast and safe emergency response activities just after an earthquake, bridges are being retrofitted with earthquake protection.


Non-seismically reinforced bridge pier that was damaged during an earthquake.


A bridge pier seismically reinforced by concrete jacketing.

Disaster prevention on roadside slopes

A number of measures are implemented to protect road users from heavy rain and snow, including disaster prevention work on roadside slopes, construction of roads that bypass disaster-prone areas and other disaster prevention methods.


A road with a rock fall shelter.


Protective concrete that prevents a roadside slope from collapsing.

Protection of road transportation during the winter

During the wintertime, road transportation in the snowy, cold regions is protected by the efficient removal of snow, as well as the proactive installation of snowslide and other facilities protecting against snow disasters.


A snow shed that provides snowslide protection.


Snow removal operation

Chapter 3

Efficiency and Comfort


A night scene in Tokyo

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)

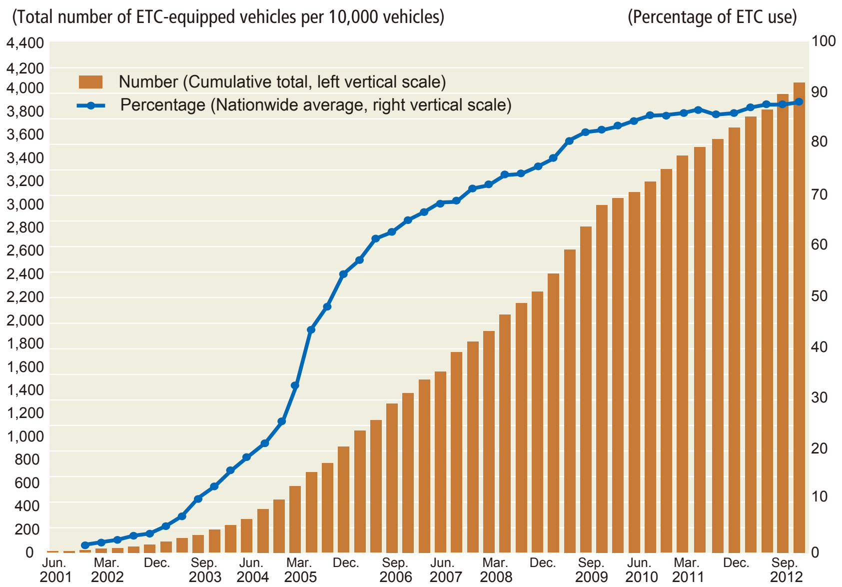
In Japan, ITS (Intelligent Transport Systems) are steadily expanding with the popularization of ETC (Electronic Toll Collection) systems and VICS (Vehicle Information and Communications System). They have been effective in allowing for better traffic flow by providing real-time information, eliminating 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 System)

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 in Japan, 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

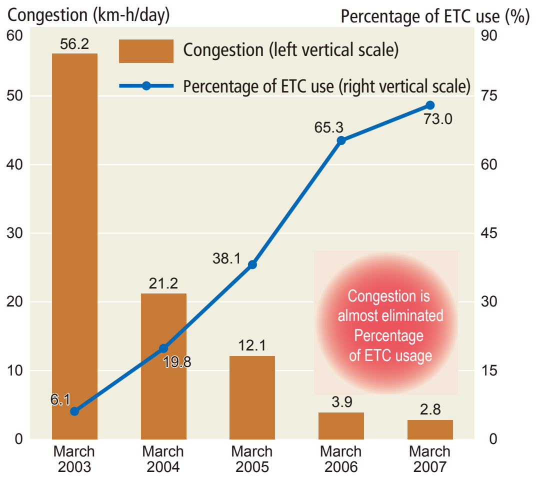


Source: Survey by the Organization for Road System Enhancement

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

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.

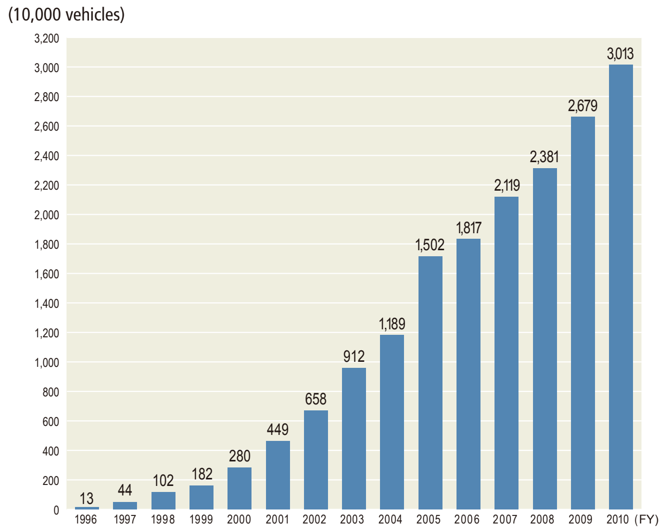
Source: Metropolitan Expressway data

Simplified ferry boarding procedure

VICS (Vehicle Information and Communication System)

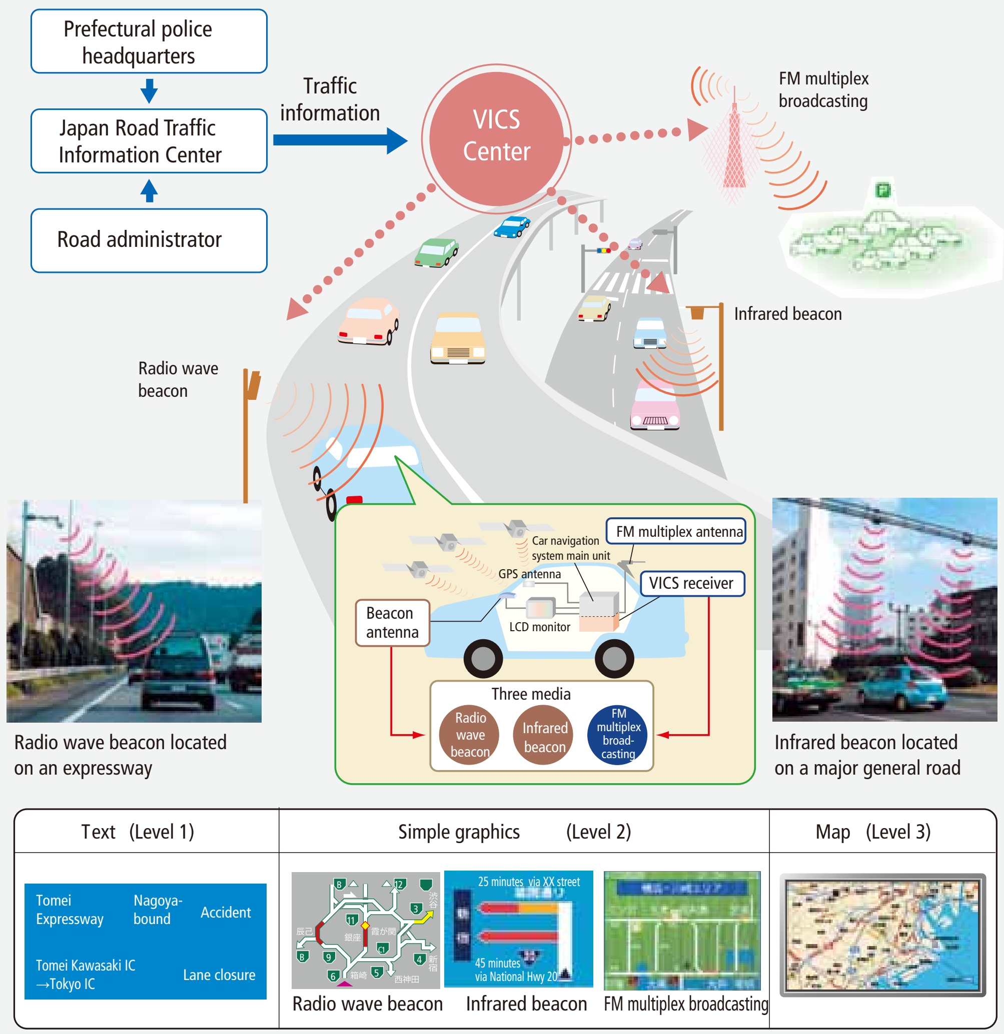
VICS transmits real-time road traffic data, such as congestion and traffic restrictions, to on-board vehicle navigation units and displays data in the form of text, simple graphics and maps. The service started in Japan in April 1996, earlier than anywhere else in the world. VICS delivers information 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 CO_2 emissions and environmental impacts. Protocol Goal Achievement Palin is to reduce CO_2 emissions by approximately 2.5 million tons (approximately 30% of all road related policy measures) by FY 2012.

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

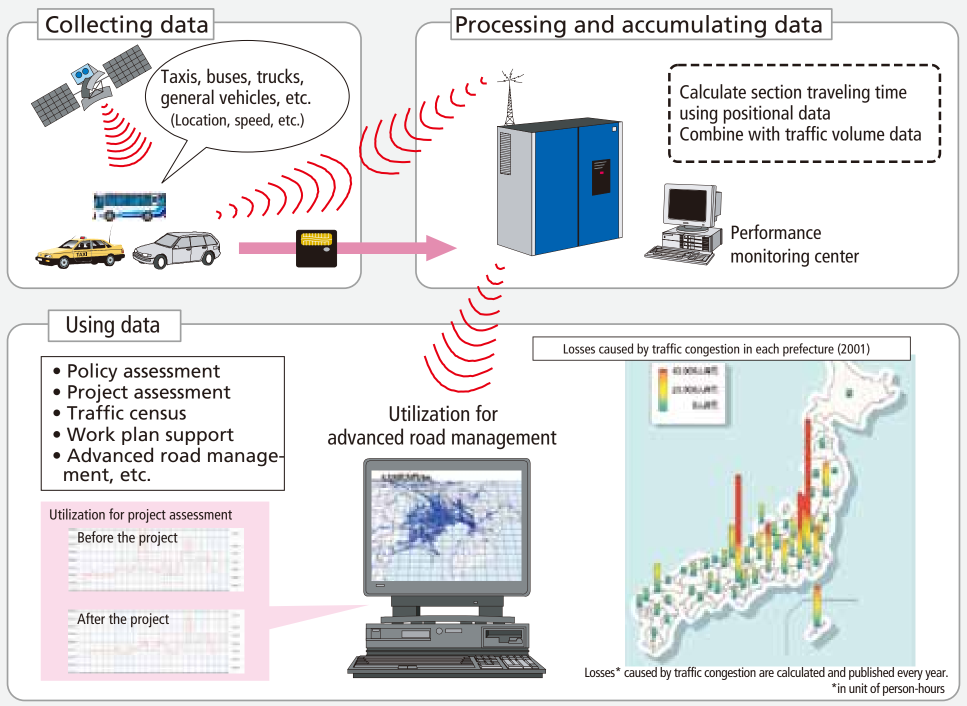
Vehicle detector

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

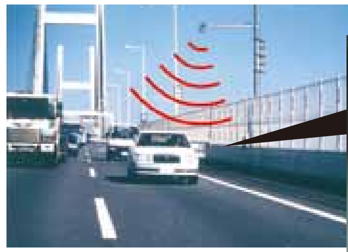
Providing road information

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



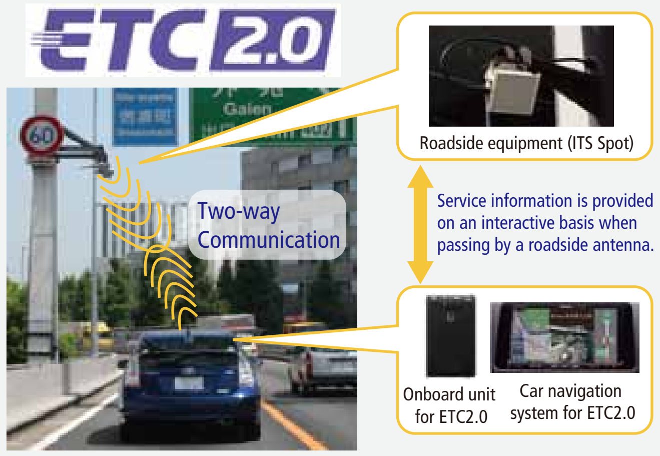
Providing information to VICS-compatible car navigation units

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

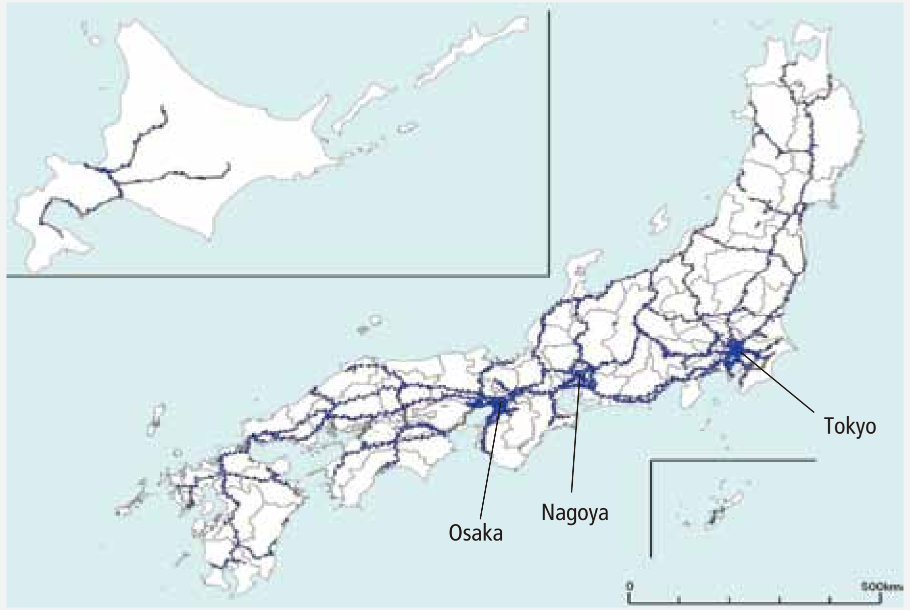
As of August 2011, ITS spots are installed in about 1,600 locations positioned on expressways throughout Japan. On inter-city expressways, an ITS spots is installed about every 10 to 15 km, including 90 locations immediately in front of junctions, while on urban expressways there is a spots installed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

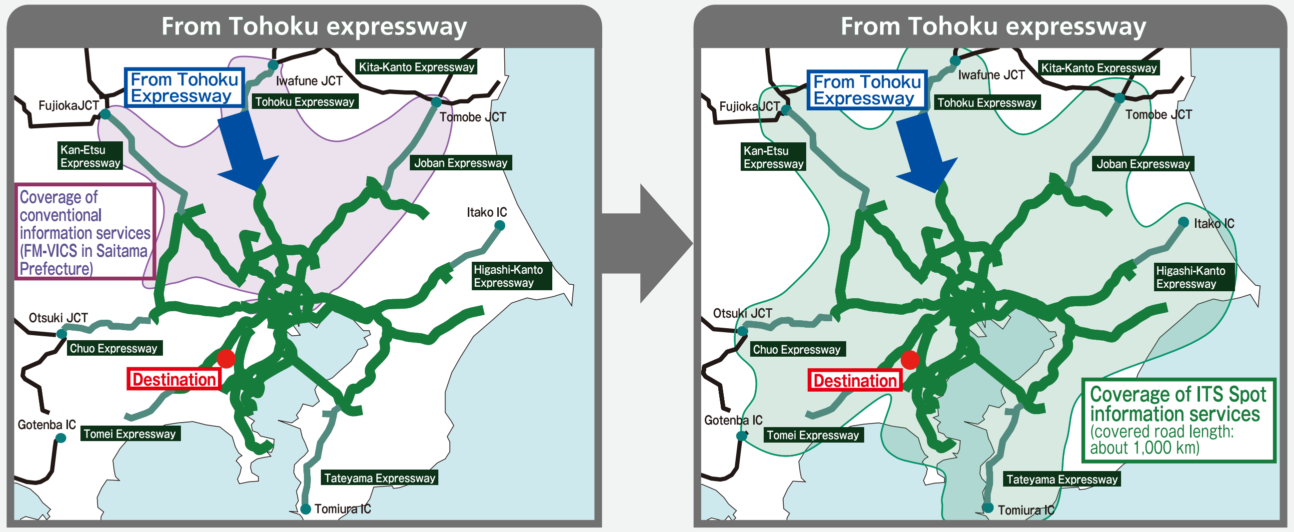
1,600 locations across the country

● 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, and adds to the existing automatic toll payment feature.

ETC2.0 provides the following assistance services:

①Detouring 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 disaste: 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.

Assistance in the event of disaster
Upon occurrence of a disaster, useful information will be provided. .

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

<Simple diagram> <Picture> <Simple diagram> <Simple diagram> <Picture>

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.

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 roadside 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.

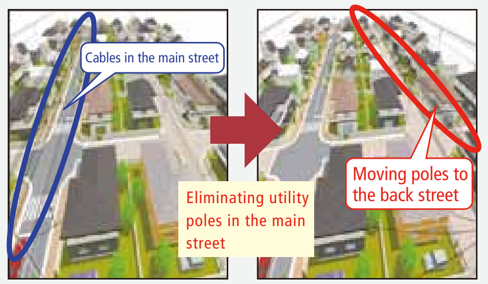
■An example of universal design in pedestrian spaces

Removing utility poles

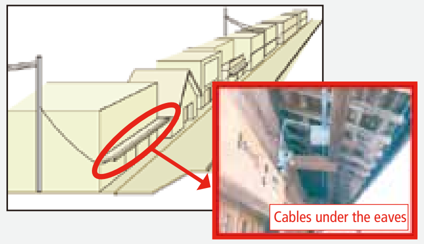
Utility poles are often considered unsightly and obstructive, so MLIT promotes the removal of them in order to secure safe and comfortable pedestrian spaces, improve the landscape and living environment, enhance the reliability of telecommunications networks and preserve historical townscapes. This visual 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.



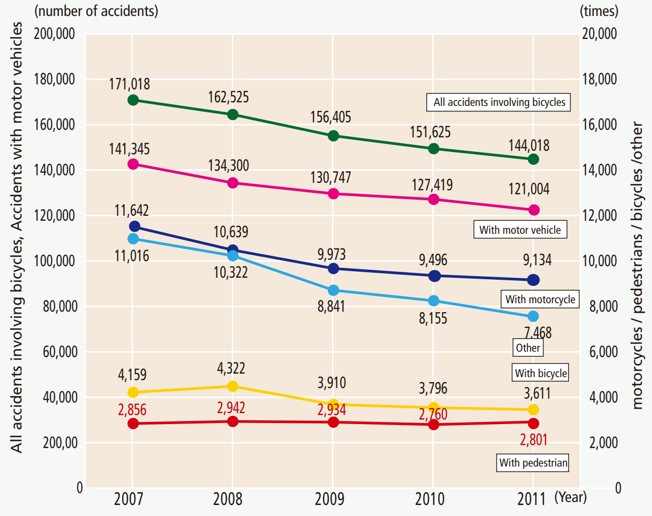
Installation of cables under/along the eaves of houses along the street.

■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

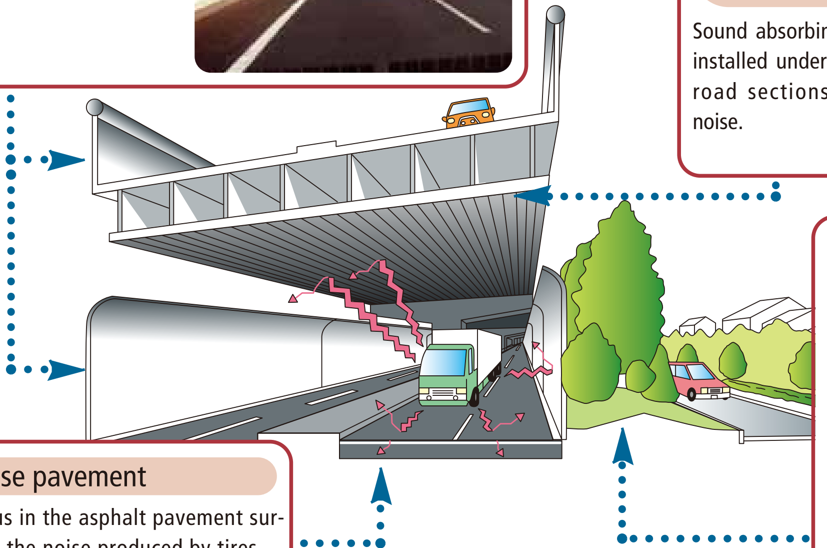
Roadside environmental measures are being deployed to achieve environmental quality standards for noise and air pollution. Measures to control the heat-island phenomenon in cities are also being actively researched and developed.

Noise barriers

Noise barriers prevent noise from reaching 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 emissions.

Low noise pavement

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

MLIT's climate change mitigation

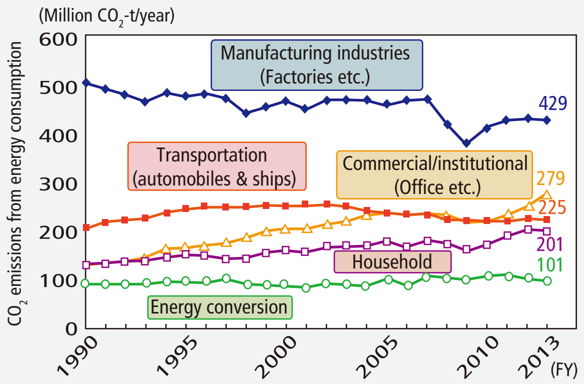
After a continual increase during the period between 1990 and 1996, the level of CO_2 emissions from the transportation sector became relatively steady in 1997. Emissions reached their peak in 2001 when a level of 259 million CO_2-t was recorded. Since then, emissions have decreased to the level of 225 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, 2015)

■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

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 specialties. 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

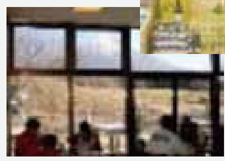
-With a power generation facility, a storage for reserve stock and a heliport, Michi-no-Eki serves as a local disaster-prevention center

-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

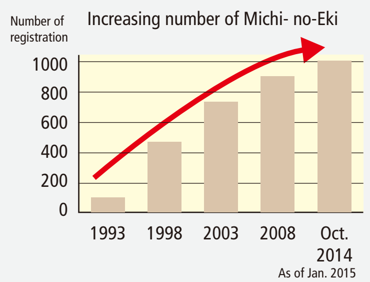
● Michi-no-Eki "Asagiri Kogen" (Shizuoka Pref.)

Local Sake

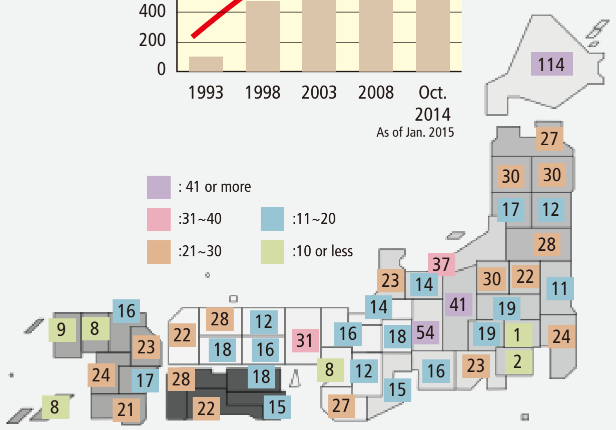


Restaurant overlooking Mt. Fuji

● Number of Michi-no-Eki



As of Jan. 2015



● Rest area

24-hour free toilet / parking lot

● Information provision

Tourist center
(Kawaba Denen plaza in Gunma)

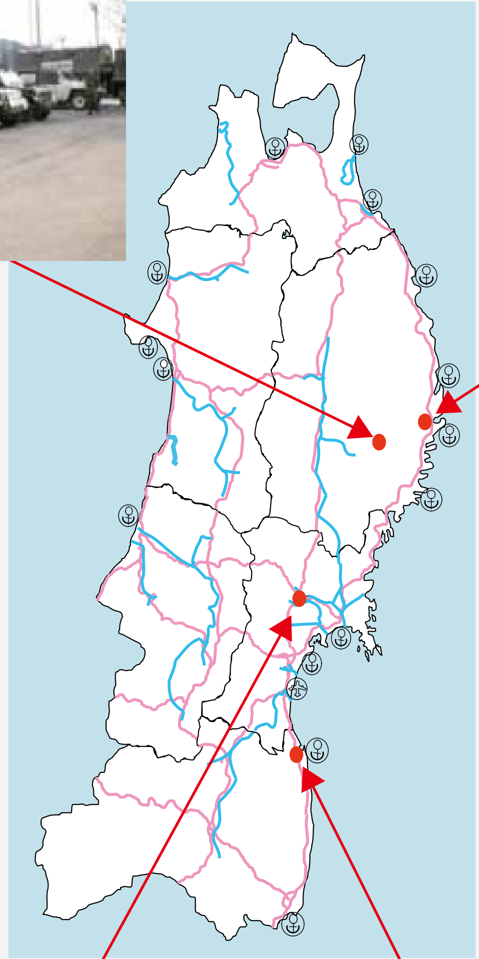
● Cultural exchange

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)

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 about 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 arable land and to protect the environment.

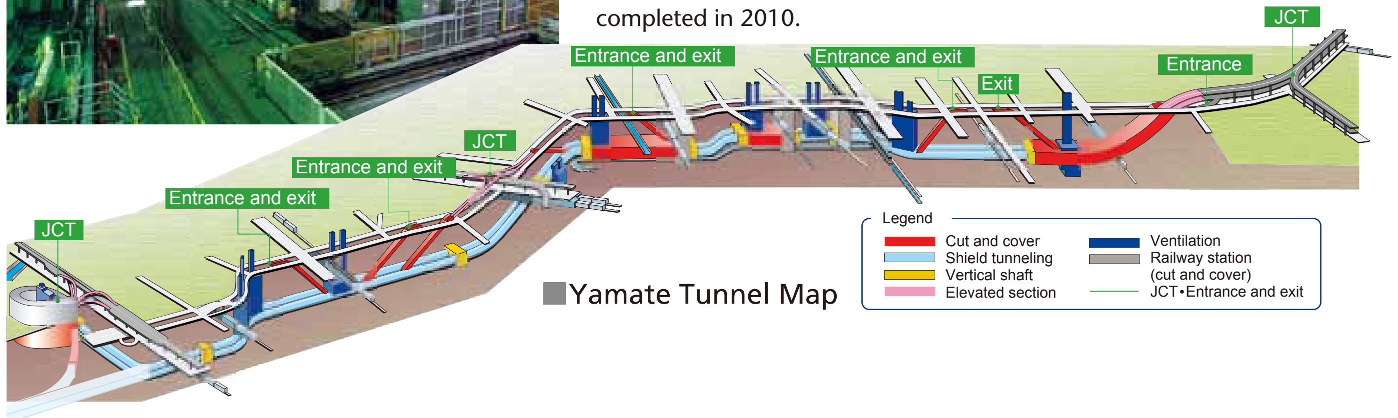
Kan-etsu tunnel (Kan-etsu Expressway)

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).

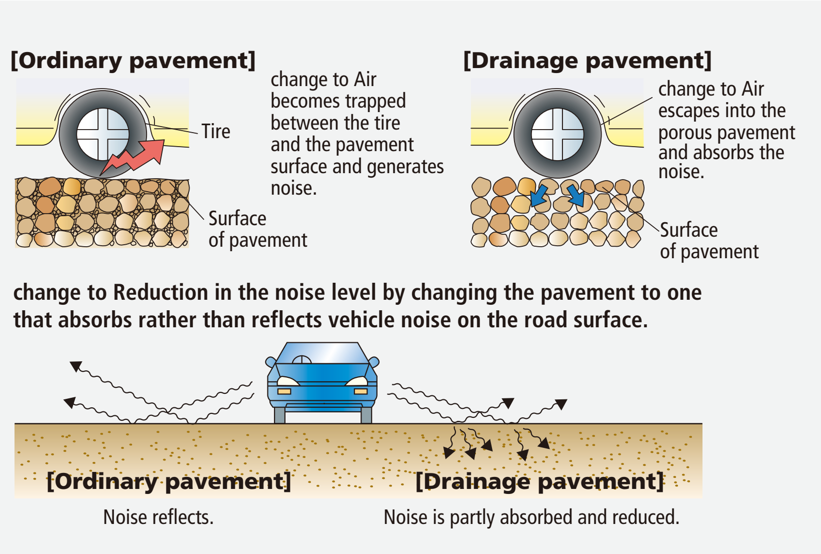
A model experiment using a 1/6-scale model of buckling restraint braces.

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.

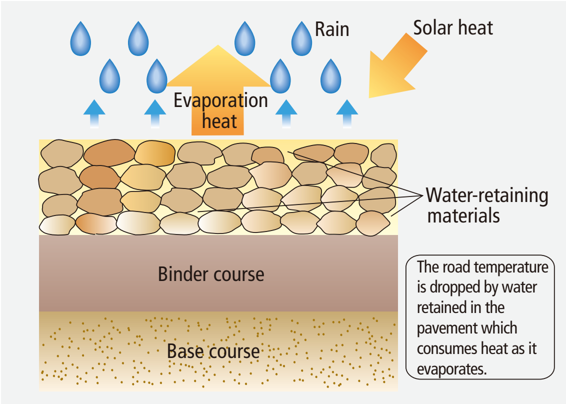
Drainage and low-noise pavement

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

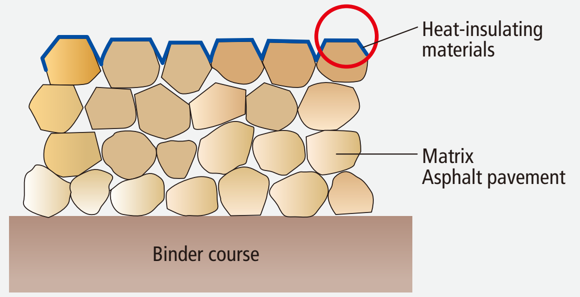
The pavement retains water and thus lowers the road temperature through water evaporation. Diverse techniques, from which rain water and underground water slowly evaporate, have been proposed. For example, injecting water-retaining materials like polymers into the voids of asphalt mixtures is one such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



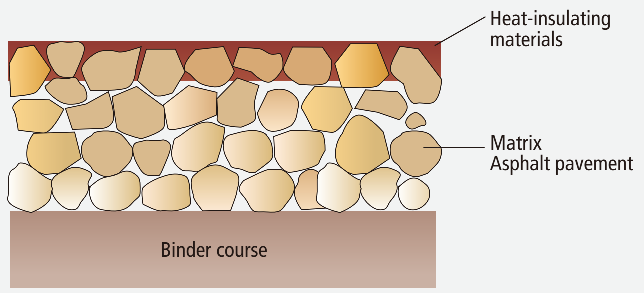
Heat-insulating pavement

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.

■Example of application



■Example of filling



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)

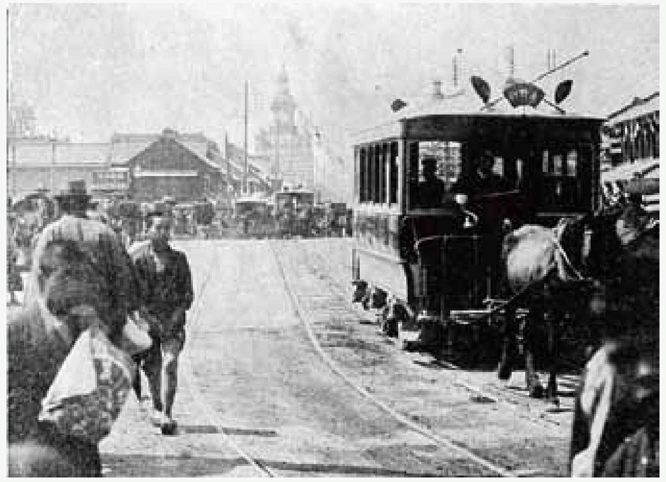
I) The Ancient Foundations of Modern Japan

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, Hokuri-kudo, 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 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."

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



Nihombashi in the Meiji Era
Source: National Diet Library

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 1950's)

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 1950's ~ 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.

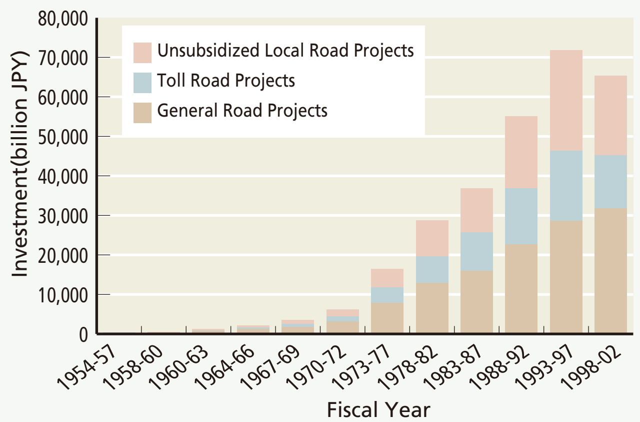
Since the public works budget, under the general revenue scheme, was insufficient in meeting the ever-increasing road traffic demand, two new financing systems were introduced: the toll road system and the tax revenue system with earmarks for roads. These systems allowed for a significant number of road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

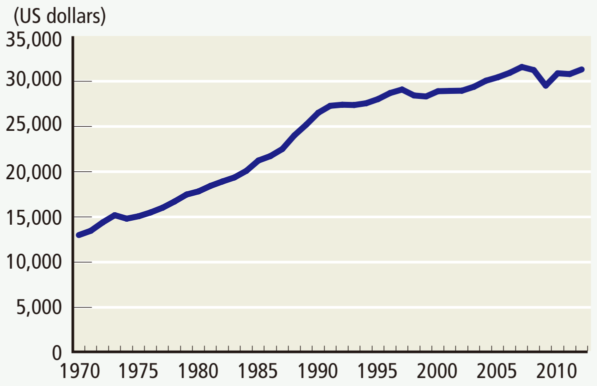
In 1953, the “Act on State’s Tentative Financial Measures for Road Construction Projects” was enacted and thus ushered in a new tax revenue system with earmarks for roads. This system, based on the “beneficiary-pays” principle, earmarked the revenue from gasoline tax and other automobile-related taxes 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.

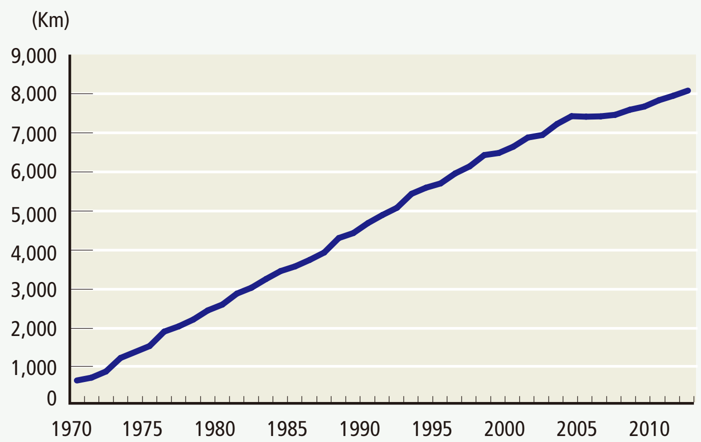
However, there were increasing calls for a change in both of the financial revenue systems since the road network in Japan had reached an almost adequate level of development. There were various critiques and opinions about road development, including the belief that roads were developed wastefully and 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



■Change in total length of expressways



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.

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.

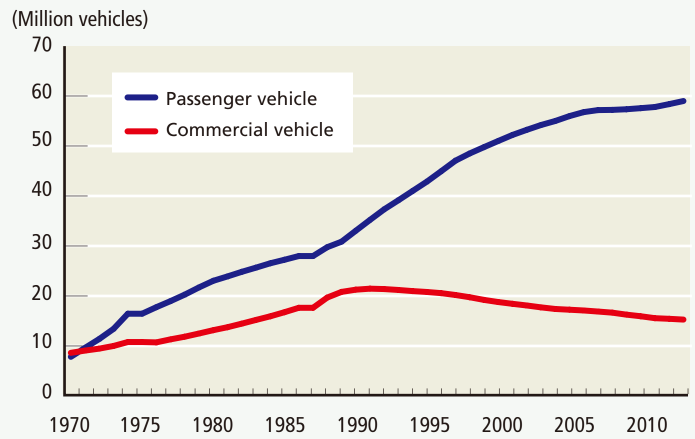
3)Improvement of Road Service Provisions using Intelligent Transport Systems (ITS)

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

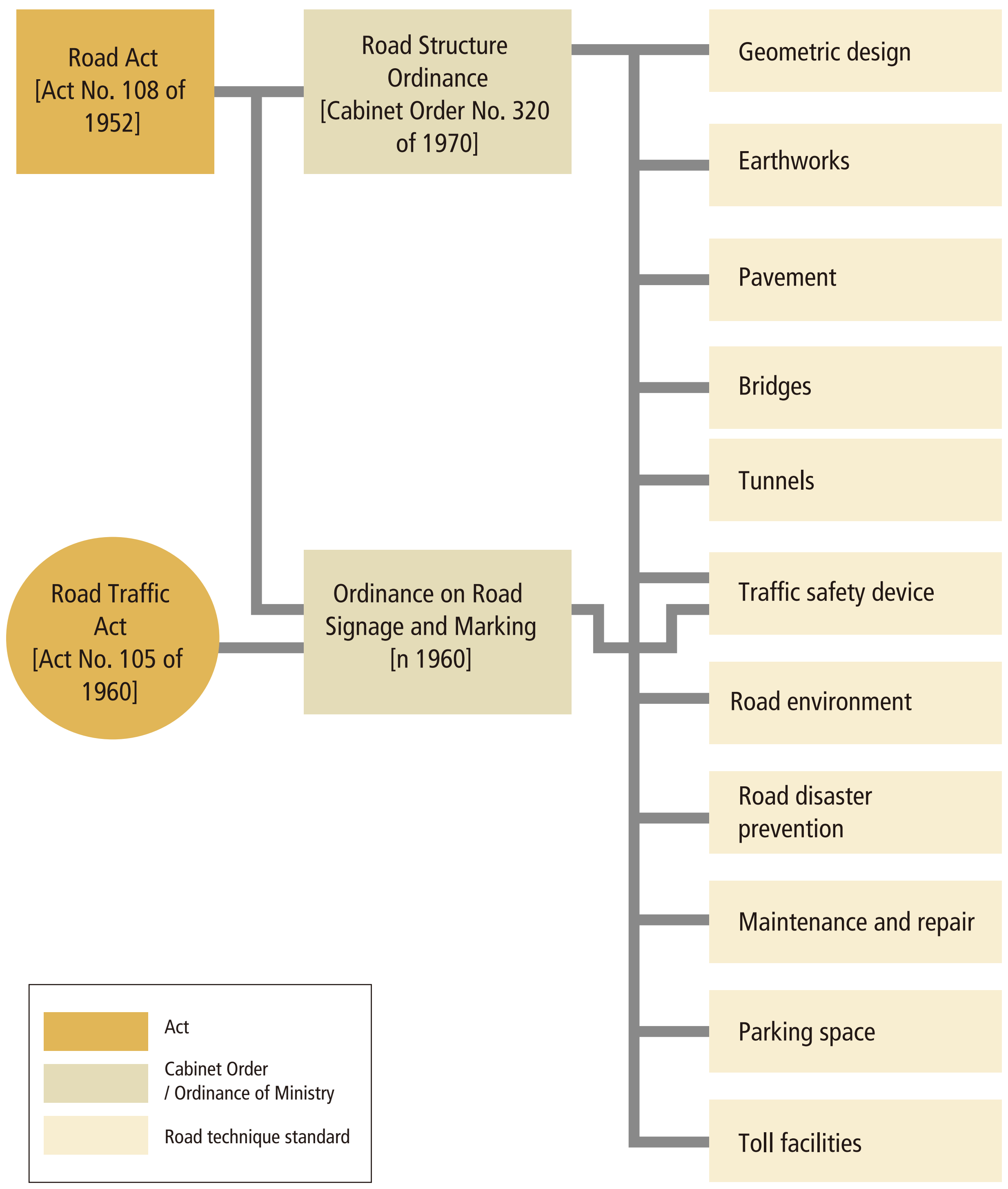


Technical Standards

(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 vehicle 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 vehicle 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. Designed traffic volume: Daily vehicle 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 vehicle 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.

National expressways and access-controlled highways or other roads. \ Area where road is located	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

Road type \ Area where road is located	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

Road type \ Designed traffic volume (vehicles/day)	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 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 designed 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 designed daily volume on the road according to standard designed traffic volume per lane as listed in the following table, taking into consideration topographic conditions.

Classification		Type of Terrain	Standard Design Traffic Volume per Lane(vehicles/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 designed 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 Left 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 a sidewalk is crossing a bridge or underpass (hereinafter referred to as "pedestrian crossing bridge") or on-street facilities

are provided, the bicycle/pedestrian track width shall be increased by 3m where a pedestrian crossing bridge is 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 a sidewalk is crossing a bridge or underpass (hereinafter referred to as "pedestrian crossing bridge") or on-street facilities are provided, bicycle/pedestrian track width shall be increased by 3m where a pedestrian crossing bridge is 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	

(Super-elevation at Curve Section)

Article 16

Appropriate super-elevation 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 median), 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 super-elevation, a runoff for this widening and/or super-elevation 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 median), 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 vehicle 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 Infrastructure, Transport and Tourism, except in the case of small vehicle traffic volume 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 median) and shoulder connected with the carriageway according to road surface Type and the right side values as listed in the following table unless super-elevation 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 super-elevation 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 vehicle 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 vehicle 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 crossing 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 designed 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 vehicle 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)

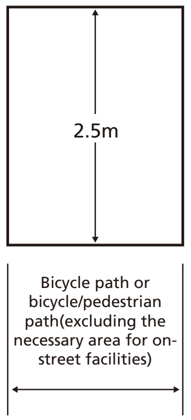
Article 38

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

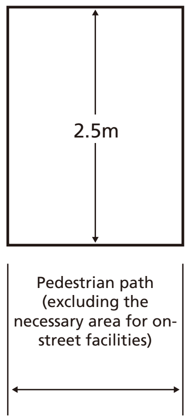
1. Bicycle path width shall be not less than 3m, while bicycle/pedestrian path width shall be no less than 4m. However, where topographical conditions or any other reasons do not permit such provisions, bicycle path width can be reduced to 2.5m.
2. Lateral clearances wider than 0.5m shall be provided 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

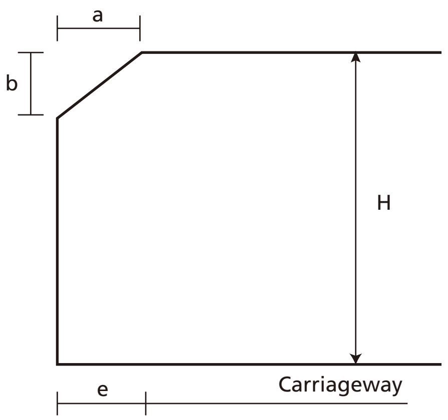
1. Pedestrian path width shall be not less than 2m in consideration of pedestrian traffic conditions and areas where the track is located, except where topographical conditions or other reasons do not permit such provisions, in which case the width can be reduced to 1m.
2. Where on-street facilities 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.

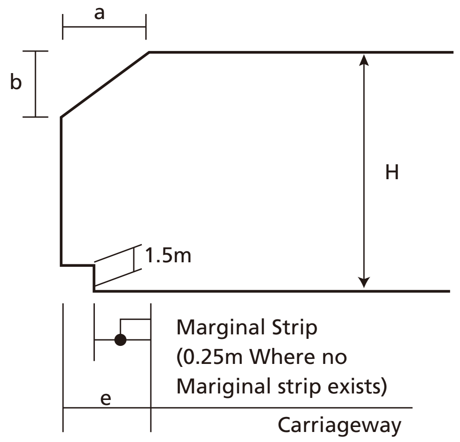


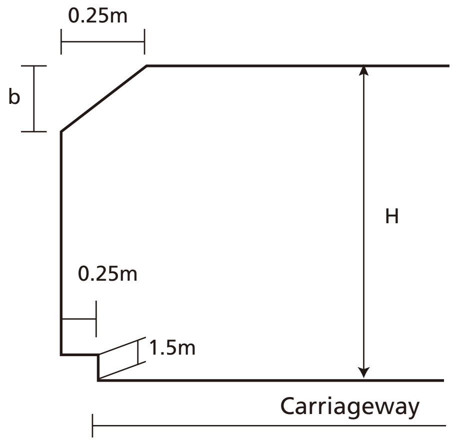
(General technical standards for structure of prefectural and municipal roads)

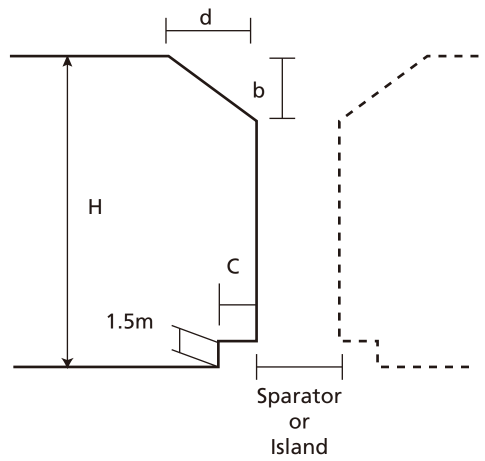
Article 41

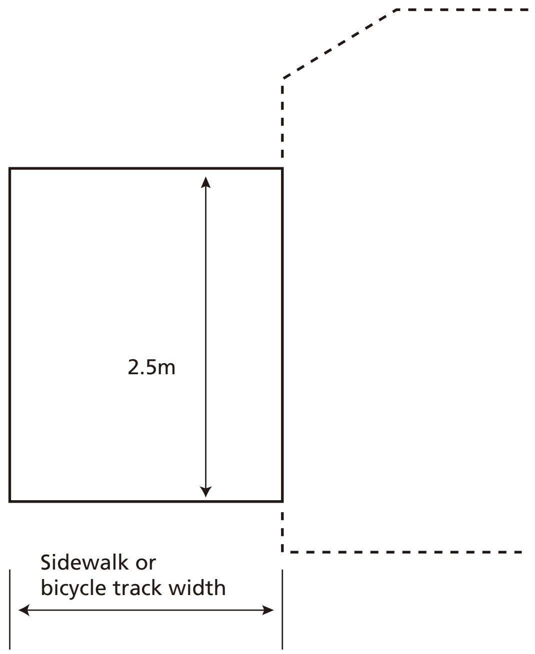
1. The provisions of Article 4, 12, 35.2, 35.3, 35.4 (limited to the matters listed in Article 30.1.12), 39.4, and 40.3 shall apply mutatis mutandis to general technical standards for the structure of prefectural or municipal roads when these roads are newly constructed or reconstructed. In this case, "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".

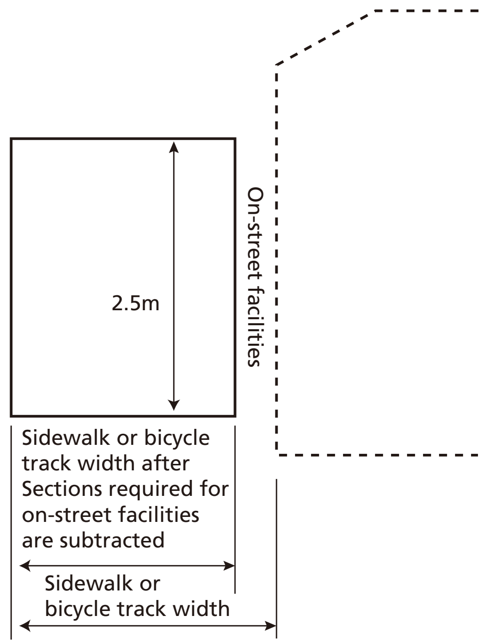












Statistics

Road Statistics of Japan

Road Length by Category (April 1, 2013)

Category	Unit : km
Motorways (National expressways)	8,358
Highways, Main or National Roads (National highways)	51,489
Secondary or Regional Roads (Prefectural roads)	91,844
Other Roads (Municipal roads)	192,049
Total	343,740

・Roads less than 5.5m in width have been excluded from the statistics.
(Source: Road Statistics Annual Report [Douro Toukei Nenpo] 2014, Road Bureau, MLIT)

Vehicle Traffic Volume (2013)

Vehicle type	Unit: Million vehicle km/year
Passenger cars	543,415
Buses & Motor coaches	6,091
Vans, pick-ups, lorries, road tractors	196,703
Total	746,210

・Since 2010, survey and calculation methods for road traffic have been changed, so the data do not match the previous data.
・Due to Great East Japan Earthquake, traffic for March of FY2010 (2010.4-2011.3) in Hokkaido and Tohoku Regions are not included in 2010 figures.
(Source: Transport-related Statistics Data [Kotsu Kanren Toukei Shiryoshu], Policy Bureau, MLIT)

Freight Transport (2013)

Modes	Unit: million ton-km/year
Road	214,091
Rail	21,071
Waterway	184,860
Total	420,022

Passengers Transport (2009)

Modes	Unit: million passenger-km/year
Road, public transport	81,360
Road, private transport	817,361
Rail	393,765
Total	1,292,486

・Since 2010, survey and calculation methods for road traffic have been changed, so the data do not match the previous data.
Private passenger car and private truck were excluded from the survey.
・Due to Great East Japan Earthquake, traffic for March of FY2010 (2010.4-2011.3) in Hokkaido and Tohoku Regions are not included in 2010 figures.
(Source: Transport-related Statistics Data [Kotsu Kanren Toukei Shiryoshu], Policy Bureau, MLIT)

Vehicles in Use (Mar. 31, 2014)

Vehicle type	Unit: vehicles
Passenger cars	60,668,070
Buses & Motor coaches	226,944
Vans, pick-ups, lorries, road tractors	16,469,691
Total	77,364,705
(Reference) Motorcycles & Mopeds	3,644,849

(Source: Automobile Inspection & Registration Information Association website)

Road Accidents (2014)

	Unit: accidents, or persons
Number of Injury Accidents	573,842
Number of Persons Injured	711,374
Number of Persons Killed	4,838

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

Road Expenditure (2012)

	Unit: million yen
Gross investment	3,840,076
Maintenance expenditures	1,862,616
Total	5,702,692

・Expenditures for toll roads are excluded.
(Source: Road Statistics Annual Report [Douro Toukei Nenpo] 2014, 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 (A)	260.0	100.0	-	-	-	-	260.0
FY1954-57 (a)	182.1	59.0	146.0	4.7	111.9	36.3	308.6
a/A (%)	70.0	-	-	-	-	-	-
2nd Plan (B)	610.0	61.0	200.0	20.0	190.0	19.0	1,000.0
FY1958-60 (b)	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 (C)	1,300.0	61.9	450.0	21.4	350.0	16.7	2,100.0
FY1960-63 (c)	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 (D)	2,200.0	53.7	1,100.0	26.8	800.0	19.5	4,100.0
FY1964-66 (d)	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 (E)	3,550.0	53.8	1,800.0	27.3	1,100.0	16.6	1) 6600
FY1967-69 (e)	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 (F)	5,200.0	50.2	2,500.0	24.2	2,550.0	24.6	2) 10300
FY1970-72 (f)	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 (G)	9,340.0	47.9	4,960.0	25.4	4,700.0	24.1	3) 19500
FY1973-77 (g)	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 (H)	13,500.0	47.4	6,800.0	23.9	7,500.0	26.3	4) 28500
FY1978-82 (h)	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 (I)	16,000.0	41.9	9,200.0	24.1	11,700.0	30.6	5) 38200
FY1983-87 (i)	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 (J)	23,800.0	44.9	14,000.0	26.4	13,900.0	26.2	6) 53000
FY1988-92 (j)	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 (K)	28,800.0	37.9	20,600.0	27.1	25,200.0	33.2	7) 76000
FY1993-97 (k)	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 (L)	29,200.0	37.4	17,000.0	21.8	26,800.0	34.4	8) 78000
FY1998-02 (l)	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