ISSN1346-7328
Technical Note of
NILIM No.599

THE 18TH CONFERENCE ON PUBLIC WORKS RESEARCH AND DEVELOPMENT IN ASIA

Proceedings

December 2009

National Institute for Land and Infrastructure Management
Ministry of Land, Infrastructure and Transport
Government of Japan

Technical Note of NILIM
No.599 , June 2010

The 18th Conference on Public Works Research and Development in Asia

Proceedings

December 2009

Synopsis:
This proceedings summarizes the reports of the session on subject of common interest, lecture notes, etc. on the 18th Conference on Public Works Research and Development in Asia held mainly at the National Institute for Land and Infrastructure Management (NILIM) in Tsukuba from November 9, 2009 to December 18, 2009.

Keywords:
Unique Road-policy Applied to The Regional Condition and Issues in Asia
Conference on Public Works Research and Development in Asia
National Institute for Land and Infrastructure Management

FOREWORD

The 18th Conference on Public Works Research and Development in Asia was held at the National Institute for Land and Infrastructure Management (NILIM), Ministry of Land, Infrastructure, Transport and Tourism(MLIT) in Tsukuba, Ibaraki Prefecture from Tuesday, November 10 to Tuesday, November 17, 2009.

The conference has been held every year since 1993 aiming to encourage government officials responsible for research and development of civil engineering technology in Asian countries to meet together to exchange their views and to develop their research network.

Representatives of 3(three) countries : Indonesia, Myanmar and Japan attended the 18th conference. In line with the subjects of "Unique Road-policy Applied to The Regional Condition and Issues.", they presented their papers and discussed the related problems.

This report summarized the participants' presentation papers, documents provided for discussion, records of lectures and related information. In conclusion, we would like to extend our deepest gratitude to people and organizations concerned, especially, the Japan International Cooperation Agency (JICA), the Public Works Research Institute (PWRI) and MLIT for the support of and cooperation with the conference.

NILIM Conference Secretariat

CONTENTS

I PROGRAM

November 9 (Mon.) **Arrival in Japan**

Accommodation: JICA Tsukuba International Center
3-6 Koyadai, Tsukuba, Ibaraki 305-0074, Japan
TEL. +81-29-838-1111, FAX +81-29-838-1119

November 10 (Tue.) **Venue: NILIM**

Morning Orientation by JICA（at JICA Tsukuba International Center）

13:30-14:00 Opening Ceremony of “The 18th Conference on Public Works Research and Development in Asia”
（8th floor, International Conference Room）

14:00-14:30 Orientation by NILIM

14:30-15:00 Break

15:00-17:00 Keynote Lecture

Dr.Eng. Takashi OGUCHI
Professor at Infrastructure Planning & Traffic Eng. Lab.,
Division of Civil and Environmental Eng.,
Graduate school of Urban Environmental Sciences
Tokyo Metropolitan University

18:00-19:30 Welcome Party
(Venue: Keyaki Room, 4F, Okura Frontier Hotel Tsukuba）
Host Director General of NILIM
Guests Chief Executive of PWRI

Accommodation: JICA Tsukuba International Center
3-6 Koyadai, Tsukuba, Ibaraki 305-0074, Japan
TEL. +81-29-838-1111, FAX +81-29-838-1119

November 11 (Wed.) Venue: 8thF International Conference Room, NILIM

09:30-10:00 Preparation for the next presentation

(Chair: Mr. Hiroshi SATO, Director, Road Department, NILIM)

10:00-10:15 Conference Report
Mr. Masaaki NAKAYASU,
Director, Planning and Research Administration Department, NILIM

This is to show the outline and history of the Conference on Public Works Research and Development in Asia.

10:15-17:00 Session on Subject of Common Interest
"Unique Road-policy Applied to The Regional Condition and Issues"

10:15-10:45 Japan
Dr. Kazuhiro NISHIKAWA
Director General, NILIM

10:45-11:15
Indonesia
Mr. Agus Bari Sailendra
Director, Reserch and Development Center for Road and Bridges
Reseach and Development Agency, Ministry of Public Works

11:15-11:45 Indonesia
Mr. Nurdin Samaila SIKKI
Head, National Road Implementation Body(Balai Besar Pelaksanaan Jalan National Ⅳ Makassar),
Directorate General of Highways, Ministry of Public Works

12:00-13:00 Lunch

13:00-13:30 Myanmar
Mr. Tint WIN
Chief Engineer, Road and Building Departmet,
Public Works, Ministry of Construction

13:30-14:35 Discution

14:35-15:00 Break

15:00-17:00 Observation Tour

Accommodation: JICA Tsukuba International Center
3-6 Koyadai, Tsukuba, Ibaraki 305-0074, Japan
TEL. +81-29-838-1111, FAX +81-29-838-1119

November 12 (Thu.) **Venue: 8th International Conference Room, NILIM**

09:00-09:40	Lecture "Efficient development and operation of road net works" Mr. Katsumi UESAKA Head, Traffic Engineering Division, Road Department, NILIM
09:40-10:20	Lecture "Measures to secure road traffic safety" Mr. Masahiro KANEKO Head, Advanced Road Design and Safety Division, Road Department, NILIM
10:20-10:30	Break
10:30-11:10	Lecture "Improvement of road environment" Mr. Shinri SONE Head, Road environment Division, Environment Department, NILIM
11:10-12:15	Lecture "Toward realization of smartway in Japan" Mr. Hideto HATAKENAKA Head, Intelligent Transport System Division, Research Center for Advanced Information Technology, NILIM
12:15-13:15	Lunch
13:15-13:55	Lecture "Earthquake disaster management for Road" Mr. Susumu TAKAMIYA Head, Earthquake Disaster Prevention Division, Research Center for Disaster Risk Management, NILIM
13:55-14:35	Lecture "Strategy for maintenance of Road structures" Mr. Takashi TAMAKOSHI Head, Bridge and Structures Division, Road Department, NILIM
14:35-14:45	Break
14:45-15:25	Lecture "Techniques for inspection and reinforcement of bridges" Mr. Jun MURAKOSHI Senior Researcher, Bridge and structural Technology Research group, Center for Advanced Engineering Structural Assessment and Research, PWRI
15:25-16:25	Lecture "Efficient maintenance of pavements and tunnels" Mr. Kazuyuki KUBO Senior Researcher, Pavement Research Team, Road Technology Research group, PWRI Mr. Katsunori KADOYU Senior Researcher, Tunnel Research Team, Road Technology Research Group, PWRI

16:25-16:35 Break

16:35-17:15 Lecture “Risk Management Strategy in Privatizagion of Expressway Public Corporations in Japan”
Mr. Tsutomu MORIMOTO
Director, Planning Division, Japan Expressway Holding and Dept Repayment Agency

Accommodation: JICA Tsukuba International Center
3-6 Koyadai, Tsukuba, Ibaraki 305-0074, Japan
TEL. +81-29-838-1111, FAX +81-29-838-1119

November 13 (Fri.) Venue: MLIT and Tokyo Area observation sites

07:55-10:00 Move (From Tsukuba to Tokyo)

10:00-10:20 Courtesy Call to Vice-Minister of Land,Infrastructure Transport and Tourism (at MLIT)

10:20-18:00 Site visit to Tokyo

10:20 Leave MLIT

10:20-11:20 Move

11:20-12:00 Tokyo bay Aqua Line highway

12:00-13:00 Lunch

13:00-13:50 Move

13:50-15:20 Oohashi Junction (Tokyo outer Ring Road)

15:20-16:00 Move

16:00-16:50 Hakozaki Operation Bureau,
Metropolitan Expressway Company

16:50-18:00 Move

18:00 Arrive at Hotel

Accommodation: JICA Tokyo International Center
2-49-5,Nishihara, Shibuya-ku, Tokyo 151-0066, Japan
TEL. +81-3-3485-7051, FAX +81-3-3485-7904

November 14 (Sat.)	**Day Off**

Accommodation: JICA Tokyo International Center
2-49-5,Nishihara, Shibuya-ku, Tokyo 151-0066, Japan
TEL. +81-3-3485-7051, FAX +81-3-3485-7904

November 15 (Sun.)	**Takamatsu**

Move (From Tokyo to Kochi)

Accommodations: Hotel Sunroute Kochi
1-1-28 Kitahon-machi, Kochi City, Kochi, 780-0056, Japan
TEL. +81-888-1311, FAX +81-888-1383

November 16 (Mon.)	**Venue: Kochi**

09:00	Leave Hotel
09:00-10:00	Move
10:00-16:00	Lecture・Discussion(Kochi University of Technology) and Tour of Regional ITS in Kochi
16:00-18:00	Move
18:00	Arrive at Hotel(Takamatsu)

Accommodations: Takamatsu Tokyu Inn
9-9 Hyogomachi, Takamatsu-City, Kagawa, 760-0024, Japan
TEL. +81-821-0109, FAX +81-821-0291

November 17 (Tue.)	**Venue: Kagawa**

08:30	Leave Hotel
08:30-09:20	Move
09:20-11:20	Kita Bisan-Seto Bridge
11:20-12:10	Move
12:10-13:00	Lunch
13:00-15:00	Move
15:00-15:30	Akashi-Kaikyo Bridge
15:30-17:30	Move
17:30	Arrive at Hotel

Accommodations: Hotel Nikko Kansai Ariport
1 Senshu-Kuko Kita, Izumisano, Osaka, 549-0001, Japan
TEL. +81-72-455-1111, FAX +81-72-455-1155

November 18 (Wed.)	**Return to Home Country**

Ⅱ　18th CONFERENCE PARTICIPANTS

The 18Conference on Public Works Reserch and Development in Asia

No.	Country	Title	Name	Office/posion	Address
1	Indonesia	Mr.	Agus Bari SAILENDRA	Director, Research and Development Center for Road and Bridges Research and Development Agency, Ministry of Public Works	JI. AH Nasution 264, Ujung Berung -Bandung 42094
2	Indonesia	Mr.	Nurdin Samaila SIKKI	Head, Balai Besar Pelaksanaan Jalan National, Public Works of Department, Directorat General of Highway	JL. MASJID RAYA NO. 72
3	Myanmar	Mr.	Tint WIN	Chief Engineer, Road and Building Department, Public Works, Ministry of Construction	BUILDING DEPARTMENT, MINISTRY OF CONSTRUCTION, NAY PYI TAN, MYANMAR
4	Japan	Mr.	Kazuhiro NISHIKAWA	Director-General National Institute for Land and Infrastructure Management, Ministry of Land, Infrastructure and Transport	Asahi 1, Tsukuba-Shi, Ibaraki-Ken 305-0804 JAPAN

Ⅲ MINUTES

The 18th Conference on Public Works Research and Development in Asia

Session on Subject of Common Interest "Unique Road-Policy Applied to the Regional Condition and Issues"

Minutes

1. Date and venue: 10:00-15:00 Wednesday, 11th November 2009
   International Conference Room of NILIM

2. Participants

Indonesia	Mr. Agus Bari SAILENDRA
	Mr. Nurdin Samaila SIKKI
Myanmar	Mr. Tint WIN
Japan	Mr. Kazuhiro NISHIKAWA
	Mr. Masaaki NAKAYASU
	Mr. Hiroshi SATO
	Mr. Hiroaki TERAMOTO
	Mr. Katsumi UESAKA
	Mr. Hirotaka SEKIYA
	Mr. Toshiaki MABUCHI
	Mr. Masaru TERADA

The 18th Conference on Public Works Research and Development in Asia

"Keynote Lecture"

Minutes

1. Date and venue: 15:00-17:00 Tuesday, 10th November 2009
   International Conference Room of NILIM

2. Participants

Indonesia	Mr. Agus Bari SAILENDRA
	Mr. Nurdin Samaila SIKKI
Myanmar	Mr. Tint WIN
Japan	Dr.Eng.Takashi OGUCHI Professor, Infrastructure Planning & Traffic Eng.Lab., Division of Civil and Environmental Sciences, Graduate school of Urban Environmental Sciences, Tokyo Metropolitan University

Keynote Lecture: “Highway Capacity, Operation and Congestion in Japan”
Lecturer: Prof. Takashi OGUCHI ,
Infrastructure Planning & Traffic Eng. Lab.,
Division of Civil and Environmental Eng.,
Graduate school of Urban Environmental Sciences,
Tokyo Metropolitan University

(Keynote introduction by Mr. Teramoto)
Prof. Oguchi is a famous professor in the field of transport science. In 1988 he graduated from Tokyo University in civil engineering. He earned his doctorate in 1993 and started to work for Nissan. He moved to academia in 1995 at Metropolitan University of Tokyo as a civil engineering lecturer. In 2008 he was invited in the Swiss Federal Institute of Engineering. In 2007 he started as a professor at Tokyo Metropolitan University. Prof. Oguchi has many books, publications and works as a special member of many committees at local and national level.

Prof. Oguchi.: Welcome to Japan in the beautiful autumn season.
I prepared 3 topics:

1. brief overview of capacity and service studies in Japan
2. effects of auxiliary lanes upstream of bottleneck sag sections on expressways
3. emission modeling for highway traffic

All these topics were presented at other international conferences (see ppt).
I had my sheet of reference distributed to you. Please see the references for details.

Electronic toll collection (ETC) history shown with monthly data
Almost 80% of vehicles passing tollbooths have ETC.
This impacts traffic congestion on intercity expressways.
Topic 1: The first 4 parts of my talk are about intercity expressway congestion, the 5th part on the urban expressway. And 6 and 7 are urban arterial road network and 8 is on the quality of service.
In our Japanese experience, maximum traffic volume is 2130 pc/h/ln (passenger cars/hour/lane) for multilane highways.
This pie chart shows a summary for 2003 when ETC penetration was less than 20%. Therefore this chart includes tollbooth congestion, which has been further reduced recently.
Sags and upgrade sections were the most frequent locations of observed jams on intercity expressways in 2003.
In sections without merges or diversions, bottlenecks have flow rates of 1800–2000 veh/h/lane in the median lane and max flow was achieved before congestion occurred.
Breakdown flow rates are very probabilistic phemonena.
Breakdown flow rates range widely. The probabilities for each of these levels vary and are stochastic.
Slide 10: Not 'shoulder lane widths', but 'shoulder widths'
Slide 11: two way two lane 'highways' TWTL
Slide 12: This is a curious bottleneck phenomenon. This is a graphic signboard that shows travel time to some point. I'll skip the toll booth congestion part because this is no longer an important problem in Japan.
I'll skip slide 13 because I'll cover it in more detail in part 2 of this talk.
Slide 15: From now on, I'll talk about arterial road capacity phenomena

Slide 16: perhaps No is too strong a word, but there are almost no studies on unsignalized intersection capacity in Japan.
I am one of the members of the committee finalizing the Japanese manual of roundabout design.
Slide 18: In Japan there are many variable signboards.
Slide 19: sample display of the VICS system
Slide 22: That was the overview. Now moving on to second topic: effects of auxiliary lanes upstream bottleneck sag…
Slide 23: You can see many red colors showing bottlenecks in the national and Tokyo area maps
Lets focus on 1 point on the Chuo Expressway and another on the Tomei Expressway
Slide 27: mechanism of bottleneck activation.
Slide 29: slow rate to 1300 veh/2lanes/hour
Slide 31: this diagram shows our air surveillance with video pictures. We drew vehicle trajectories in time space. Each trajectory shows a vehicle's movement. To the right you can see a shockwave with very low speed, which means that traffic congestion occurs. There is no reason other than the sag vertical curve.
Slide 32: Now I'd like to show you about auxiliary lane distribution
Slide 33: This slide shows typical lane use nature. In the case of higher traffic flow, the median lane usage rate is a little bit higher than in the outer lane.
Slide 35: Installation of an auxiliary lane upstream of bottleneck section can equalize lane use.
Slide 38: I considered several types of auxiliary lanes
Slide 39: We can consider the advantages and shortcomings of these 4 auxilliary lane types. An additional outer lane offers only indirect control (a). … (d) looks best. Inside addition at beginning and outside closure at end.
Slide 41: I found some examples of road layout similar to (d) and we monitored lane use
Slide 43: Based on these results, I think this configuration would be useful to control lane use.
Slide 44: We applied my idea at a famous bottleneck. The existing configuration does not work well. I think we can expect almost equal lane usage. This idea will be tested from next January.
Slide 46: Now lets move onto the 3rd topic: emission modeling.
Slide 47: I think emissions can be explained from the fuel consumption. There are many factors involved. One type is from the vehicle side and another from the transport side. I'll concentrate on the highway traffic factors. We need such an emission model or fuel consumption model.
Slide 48: We made a test vehicle to measure speed, acceleration, and instantaneous fuel consumption.
Slide 49: This is an example of the output we measured.
Slide 50: From this measured data, we raised the concept of a short trip: the duration between start of motion, slowdown or stop, and the start of the next start of motion.
Slide 51: Travel speed means the height for a uniform speed; running speed excludes the stop time.
Slide 52: Here are the variables I'd like to use. If we use these kinds of variables, they can be additive, which makes them easy to model. In Japan we know this curve for speed versus fuel consumption: it is nonlinear. But if you convert both variables to reciprocals, then you get an almost linear relationship.
Slide 53: I added a new independent variable A: the speed fluctuation index
Slide 54: This function is only for the running condition and this one only for the idling condition. The total fuel use for one short trip is the sum of these two functions. We found this kind of formula and the values are quite reasonable. Tau means the time ratio for one trip: reciprocal of travel speed. This formula gives you fuel per unit length (per short trip)
Slide 55: This is the empirical model I found.

Slide 56: I'll skip the theoretical version because it is confusing.
Slide 59: I found that the theoretical model can be written like this. We can derive some numerical results from the theoretical consideration.
Slide 60: We can see convergence when we compare the theoretical and empirical models. This 3rd term comes from aerodynamic resistance, but it is negligible.
Slide 61: After simplifying, the empirical and theoretical formulas become rather similar. I found a model to explain emissions from travel time, travel speed and fluctuation factors.
Slide 62: My model is quite different than the unit emission factor model, which uses speed and speed fluctuation indices.
Slide 63: The speed fluctuation indices have significant meaning. We must consider V and A independently.
Slide 64: This figure shows the contribution of those 3 factors. At higher speed with higher speed fluctuations, the speed fluctuation has a contribution more than half.
Slide 65: Last I will show you some examples of using this kind of environmental impact modeling. This is to make a kind of system using a traffic simulator combined with a 3D city model. With it, we can produce pollution and noise predictions.
Slide 67: We developed a network traffic simulator.
Slide 68: demo movie
Slide 69: This simulation is combined with a CO or NOx model.
Slide 70: Emission intensity is shown here.
Slide 71: and combined with a diffusion model here.
Slide 72: They made some visual output like this 3D urban model. This demo shows this kind of concentration of emissions
Slide 73: We extended the model to noise impact. This considers not only noise intensity, but also building attenuation and so on. This is all I prepared for this presentation.

Thank you Prof. Oguchi. This meeting is open to questions. Any questions are ok.

Q(Sailendra): Interesting topic. In general I would like more information. In the future I think we will have more collaboration and an MOU. I want to invite you to collaborate on these topics. For highway capacity, in Indonesia we have an Indonesian highway capacity manual. As far as I know, the basic study looks at traffic flow. In Indonesia we have different traffic behavior and many motorcycles. I want to know what's your opinion. We want to develop the manual development capacity in Indonesia. We have very rapid growth of motorcycles. More than 50% of vehicles in urban areas are motorcycles. In rural areas, about 30%. The motorcycle drivers are not disciplined. We want to have special lanes for motorcycles to develop the highway capacity manual for Indonesia. Our priority is to develop the highway capacity manual especially with the motorcycle lane.
Second, about the sag lane bottleneck, I don't know if there have been studies about auxiliary lanes in Indonesia. What were the criteria for your study?
For the emission model, I agree with your assumptions. I didn't see about the driver behavior. What about driver behavior? In Indonesia, driver behavior is caused by spirits. When they stop, they always keep the vehicle in 1st or second gear and rev their engines. How would this fit in the model?
I want to know about the type of vehicles in your model because we have different types, different fuels, etc.

A(Oguchi): I know that South and Southeast Asian countries have many motorcycles. The highway traffic conditions there are very different from developed countries. Highway capacity problems are different from developed countries. Some Japanese researchers are trying to survey traffic conditions in South and Southeast Asian countries. I know of some studies in Thailand and the Philippines. The problem is to understand the conditions. The analytical methodology should be newly developed for this kind of traffic condition. This is a very challenging kind of research.

Q(Teramoto): What scenario do you have in the central government? In the future, people will have more income. Will people have intention to buy larger vehicles?

C(Sailendra): People tend to buy the motorcycles. Accidents are very common. We are concerned about the motorcycles. We want to study more about how to create the special lane for motorcycles.

Q(Oguchi): So your government is thinking of a permanent system for motorcycles?

A(Sailendra): not yet.

Q(Oguchi): But a motorcycle lane would be a permanent feature, right?

A(Sailendra): Yes. The motorcycle is very dangerous. 70% of accidents involve motorcycles. How about the rules to reduce accidents or increase capacity for motorcycles?

C(Oguchi): The behavior at the close corner of the road, red-green signal change, all motorcycles go and then cars go afterwards. This is the normal behavior for your country.

C(Sailendra): We need to develop capacity. The motorcycles accelerate very fast from green lights.

QOguchi): Before Japan had an advanced stop line for motorcycles, but Japanese police do not want them anymore.

Is it the normal case in your country that vehicles are condensed in the passing lane compared to the outside lane?

A(Sailendra): We have no passing lane. On freeways, we have an additional lane for the trucks for crawling up 7% grades or steeper.

A(Win): In Myanmar, we control traffic by police. All our roads are 2 lanes. Same lane for cars and motorcycles. In Yangon, 2 lanes in each direction. Outside, 2 lanes for both directions.

A(Sailendra): About the traffic noise, I have read some papers from Japan about traffic noise and about noise abatement barriers. Do you have some info about the material used to build such barriers. If you come in my office, we need a traffic noise barrier.

C(Oguchi): I don't know about the cancelation system for noise, but one of the systems that impressed me was a column above roads that reduces noise.

C(Teramoto): Japanese people are very sensitive to noise. There are not so many noise barriers in the US or Europe. We have higher population density here. I don't know how flat your country is. In Japan we have developed some kinds of barriers with an absorptive body above roads that cuts 2 or 3 dB. This equals to about 2 m of height of barriers. The length of barrier can be shorter with such absorptive bodies.

C(Sailendra): I heard about more than 70 dB from arterial roads, so we want to reduce to less than 55 dB, the standard for hospitals. The people don't care about the noise and air pollution, but in the future they will, so we want to develop this capacity.

C(Teramoto): We will be able to discuss this topic the day after tomorrow.

C(Oguchi): I'm afraid that many of our materials are written in Japanese. But a few can be provided.

C(Teramoto): We have abstracts in English for almost all documents. Read them and when you have interest, I will prepare as many documents as possible.

Q(Sikki): We cannot compare Japan and Indonesia because of differences in industrial and physical environments. Drivers in Indonesia are not disciplined. We are capacity limited. In Sulawesi, we have bejat (3 wheels with no motor). We don't plan for lanes. Land acquisition is very difficult. How about total vehicles in Japan compared to lengths of various types of roads? Why don't you make cars with devices to reduce emissions?

C(Teramoto): Total road length is about 10,000 km for toll roads, about 60,000 km for highways. About 20,000 km of this is under central government control; the other 40,000 is under local governments. Improvements to local government controlled roads is paid half and half by the national/local governments.

C(Oguchi): roughly there are about 80 million Japanese vehicles. Total road length is about 1 million km. Not sure if this includes motorcycles.

C(Teramoto): Use of motorcycles is for young men or normally it has very large engine (very expensive). Ordinary people have small ones with engines like 50 cc. We have two types of users. But I understand that your country has many middle size engines with 150 cc and the whole family rides, sometimes perhaps 4 people.

C(Oguchi): Many companies try to invent devices to reduce emissions and the government has policy measures to reduce emissions.

C(Teramoto): At this stage in Japan, 20% of CO_2 emissions come out from the transport sector. But Prime Minister Hatoyama has declared a commitment to a 20% reduction compared to 1990, or 30% from today. Top priority of vehicle companies has come to environmental issues, especially CO_2 emissions. Many are in hybrids now, but full electric cars in the future. Toyota focuses now on hybrids, but Nissan focuses now on fully electric cars.

Q&A in Nihongo about the equations used in the simulation modeling of pollutants.

C(SATO): One additional comment on preventing air pollution. 40 years ago we had very bad air pollution. As a result we have regulations on exhaust gases like NO_2, SO_2 and suspended particulate matter (SPM). I think that exhaust gas regulations are the most effective measures to reduce air pollution. Alternative technological systems to treat the free air are less effective than emission regulations because the concentration of pollutants in air is much lower than that at the tailpipe.
In the late 1970s, we had the first regulations. At that time, the regulations were very loose. After a few years, the regulations were progressively tightened. The most severe regulations were promulgated in 2007. In this year, we implemented the newest regulations. The conditions of the air pollution are getting better, but in the areas of most severe pollution, air does not meet the quality standards. SPM meets the quality standards but NO_2 and NOx, standards are not met in some places. emissions other than those from vehicles contribute to the problem. If we want further improvement, we have to total regulate all combustion systems in city areas. Recently, some pollution was emitted from the continental areas and blown to Japan. In western Japan in some places even in uncongested areas, we find some high air pollutant concentrations. A few years ago we considered that NO_2 or SPM are local problems, but now we are aware that they are international problems.

C(Sailendra): Thanks. I want to know about the traffic and highway capacity and noise and air pollution, because we want to know and have important references. We have a study to reduce urban air pollution with a plantation along the roadside. It would be better for us if you help us with this study.

C(Teramoto): Thanks to all members of today's meeting. Especially to Prof. Oguchi who gave us advance information about traffic configuration. If possible we want to use this information.

3. Conference Report by Mr. Masaaki Nakayasu

About 18 years ago the Construction Ministry convened a forum among directors or senior researchers of Asian Public Works ministries and institutes for the following purposes:

1.exchange information 2.discuss common technology issues 3.establish a network

Objective 1, information exchange. Here is a list of the issues covered in the past and a list of topics of discussion on common technological issues.

Through these meetings, we had discussions on the matter of Environmental issues and natural disasters which we Asian countries face with. For example, two years ago we had discussions on “Management of integrated water applied to the climate change” . We had discussion on “Prevention and Minigation of Natural Disasters” in last year. And we have discussion on “Unique Road-policy Applied to The Regional Condition and Issues” in this year.

Through these discussions we hoped to identify the common issues of importance for the future. The establishment of human network. The history of our conference and the main topics at each conference. Up to 19 countries have participated in the past. The total number of participants from each country is over the years. There have been a total of 148 participants. Myanmar is the first time to participate in this meeting . The achievements and research cooperation in Asia: conference participation and information exchange and promotion/cooperation with JICA. Researcher and engineer exchange to support public works projects in cooperation with Asia. 909 people have gone from NILIM to Asia and 1674 have come from Asia to NILIM. I believe that our cooperation has been instrumental in supporting development. The left picture shows a JICA training course on rivers and dams.

I'd like to continue to seek cooperation and we hope you can make this most of your visit. Please enjoy your stay.

Q (Sailendra): I want to know more about the future project especially on capacity building and research exchange. I want to know the program for researcher and engineer exchange. In my country, engineers are not always engineers in practice in the field.

A (Sato): The answer to your question is item 2 on the agenda. Future projects can be discussed in that time frame starting at 13:50. As a first step, we'd like to begin by discussing that topic this afternoon.

Q (Sikki): Talking about natural disasters. In my island Sulawesi, the land is unstable. Every rainy season, many locations experience landslides. From JICA or NILIM, can you give me advice on how to arrange development to minimize landslides and protect people?

Second, you spoke about Sabo. In my country, we have a big dam constructed with a loan from JICA . There was a landslide into this dam. My irrigation friend

asked if Japan can come to the dam to see what is the matter. Perhaps you can help with how to deal with this problem.
A (Nishikawa): I n Indonesia, concerning natural disasters, I believe that they have various teams of cooperation. This is a good opportunity for feedback. We value your feedback and with exchange of views we can devise better and more schemes.
C (Sikki): For Sulawesi, I have responsibility for questions. I can help with identification of places.
C (Nishikawa): This is not directly related to the topic of this meeting, but what you raise is an important issue and we want to exchange views about it.
Q (Win): How many people are in Myanmar from NILIM?
A (Sato): None from NILIM, but there is an attaché at the Japanese embassy in Myanmar and the staff of MMIT is now serving there. If you have questions or requests, please go to him.
We have 4 speakers with presentations. First, Mr. Nishikawa, followed by Mr. Agus from Indonesia and then Mr. Sikki from Indonesia. Mr. Win will present after lunch.

4. Country Reports

Presentation from Japan: Mr.Kazuhiro Nishikawa

Road planning and design in Japan. I'll discuss how Japan has developed its roads and the problems we have faced. Japan is slightly smaller than Indonesia and we are very mountainous. To go between cities we have to cross mountains. The map shows transport more than 150 years ago. We had roads, but these road were for pedestrians. The freight was carried mostly by boat. Transport policy changed in the mid 19^{th} century with modernization by railways. There were very meticulous lines of railways. The total length of railways is more than 27000 km. After WWII, we realized that we lacked roads for autos. About 1955 we recognized the lack of expressways. We started building them around the 1960s. Our population has already peaked and started to decline. The expressway development timeline and the highway network. The green or yellow areas are missing links of the road and expressway network. Regular highways compensate for missing links in the expressway system.
Around 1950 railways played a dominant role. In the past, railway and sea transport dominated. Now the roadways play a more dominant role for freight transport due to increased convenience. The transport policymakers in the 1950's recognized 2 options. A: An optimal road network that could cope best with future road traffic demand. B: develop roads quickly without altering the existing network structure. Japan selected B and paved the existing roads. We could quickly catch up with western countries. The graph shows the pavement ratio
We also had to quickly produce standards for road design. Traffic volume estimation serves as a basis for road design. Here are drawings for bridges. Having them on paper facilitated quicker road development. We outsourced the

work to private sector companies. The superstructure elements were subdivided in this way. The number of bridges has expanded very rapidly in Japan. Speed of development was prioritized, which facilitated rapid economic growth, the miracle of Asia. However, some issues remained. We must make endless improvements. The old network system gives rise to congestion. There is a mismatch of design standards. Old important roads were built to lower standards. New construction of low priority roads is to high standard. Planning was not done by engineers in a comprehensive manner.
From now on, we have to spend time responding to the problems and needs. For the future, we must consider a longer timeframe. Since strategic infrastructure maintenance is my specialty, I'd like to spend time on this. In the future, many existing bridges will rapidly become older and require replacement. We have to extend the lifespan of existing bridges. We have to maintain road functionality in a sustainable manner. This must be our strategic target. Preventative maintenance is a tactic to extend service life. I will show you some different types of maintenance. The first one is no-maintenance. You never make any amendments. The second one is what we do today. Some maintenance work is done before deterioration becomes serious. Doing this is believed to extend the service life and reduce the total cost. When the intervals between the small maintenance works get smaller, the service life can be the longest and the cost be the minimum. It is ultimate ideal maintenance, but we have not yet achieved this.
We have made several vital decisions, resulting in our quick catch up with the top-runner countries, leaving some issues as I introduced today. I hope my presentation can be a good hint that triggers you to speculate as to which way your countries should take. Thank you.

Q (Sailendra): Good presentation. More information has been given to us. I think the Indonesian condition today is likely the be similar to that 60 years ago in Japan. We also chose option B: rapidly developing roads by paving old roads. We have a lack of standards or specifications, particularly for local materials. On different islands, we have different quarry material standards. We should make a national standard for the rock materials. We want to know about information for developing standards and specifications for local materials. Second, for local engineering, we want to increase local engineering capabilities. We also want to increase local management capability. We want to know about Japan's experience with these. We call the maintenance road preservation. We have road maintenance including extending bridge service life. In Indonesia, bridges were built 30 years ago. Under Indonesian conditions, all the roads and bridges are being degraded by overloading. We need to change the design by conventional and analytical design methods. Maybe you have information about that.
A (Nishikawa): It would take time to answer all of your questions so some of your questions will be handled in the afternoon general discussion session. The government has to have a strong commitment to educate the local engineers so

that they can develop your standard specifications for your local conditions. NILIM has a short history, but the PWRI was established 80 years ago. Around 90 years ago we had a big earthquake around Tokyo. To rebuild the city, we had to do many things including material testing, etc. This became the core of technological development. It lead to road construction and river development. Japanese engineers went to local areas to supervise this development. We started training in the public sector and had to transfer technology to the private sector. We provide instruction to engineers of the private sector. As a result, we could develop very good private sector companies. At the beginning you have to make a firm commitment to train your engineers and your private sector. Then everything starts to move. Next, how to train engineers, I have already answered. You have to identify some center or government research institute. This is what we did in Japan. But in the US and Europe, it was the private sector that had the technology first and then they had to transfer technology to the national government. These patterns are different and you must choose which pattern to use. Either way, you have to make a commitment to train your local engineers.

At the beginning we had many foreign engineers coming to Japan and we had to pay them high salaries so that they would teach us. Regarding maintenance, it is like maintaining our health. We have to identify the diseases, the risks of injuries; knowledge is first. Without knowledge, you cannot move ahead. You have to identify the problems and troubles of roads and bridges. Then you have to identify the ways to solve the problems. What are the medicines that can cure the ailments? Japan has not conducted systematic inspections in the past, and we have just started systematic inspections in recent years. We would like to share our knowledge with you.

C (Win): Good presentation. Our country is trying to build roads and railways with new construction. We are building a new city, using technology transfer from Japan to Myanmar. We are building so many roads, trying to let our country modernize. I have no questions.

Q (Sikki): Comparing Japan and Indonesia is very difficult. Indonesia is a big country, with maybe 10 highlands. The road map is from the central government. The second problem is about human resources. Thanks to JICA for helping with this. My question is first, what is the status of roads in Japan? In Indonesia we have many different types of roads and the responsibility for financing also varies.

Also, we have a problem with use of roads by very heavy vehicles. Some trucks carry 15 or 20 tons. How is enforcement in Japan?

A (Nishikawa): About overloading, this issue has not been solved yet. We'll prepare some information about this to share in the afternoon.

Presentation from Indonesia: Mr. Agus Bari SAILENDRA

Strengthening the role of the research an development center for road building and highway engineering under the Director General of Highways budget. The

Dutch began to colonize Indonesia in the 17th century. Indonesia is the world's biggest archipelago. Biggest muslim population. Many current issues. We have 30 provinces, 3 with special status. We have 440 districts. Road network classification. Primary is national roads intercity. Secondary is only in the city. The road status affects financing. According to dimension of vehicles and maximum loads, we classify roads. Class I roads max vehicle length is 2.5 m, max load 10 ton. Class II also up to 10 tons. Class III up to 8 tons. The Research and Development Centre for Roads and Bridges (RDCRB) is in Bandung. The campus is about 30 ha in area.
RDCRB is under the Ministry of Public Works, on same level with water resources and other R&D organizations. The Institute of Road Engineering has 4 main laboratories, each with equipment and engineers. TRMS should be BRMS, bridge management system. Cakar Ayam is for subsoil. One of the problems in Indonesia is the assignment of contracts. We want to develop performance based contracts. Hot mixed asphalt (HMA), etc. From this point are my observations. This is an example of developing tools for pavement design. We have no APT (acceleration pavement test) and no road test so we skip these and jump to road tests.
We have achieved cost reductions for road design and construction.
Q (Teramoto): What is a transroad? Do you mean a road with a special bus system?
A (Sailendra): A transroad is a main road.
Q (Teramoto): It seems that a transroad has a special system for buses.
A (Sailendra): Not yet. The weight load is more than 10 t/axel. Main road is same as primary arterial road to connect the cities of a province.
Q (Uesaka): What is the main purpose of that automatic traffic monitoring system and what kinds of devices do you use?
A (Sailendra): In the past we collected traffic data manually: by men recording. This data is not accurate and takes much time. So we changed to automatic traffic data collection. The devices come from Japan. The automatic counter records number and types of passing vehicles: Truck, car, motorcycle. We want to record data also about vehicle speed.
We also develop equipment in Indonesia based on new technology. If we import the equipment from other countries, it is very expensive; so, we develop ATC ourselves. We put this on the main transroads. Composition, speed, and we hope load/axel.
Q (Uesaka): You are collecting all kinds of data with the system. What will you use this data for? To build new roads? To cite overloaded vehicles? To develop motorcycle lanes?
A (Sailendra): If we want to design a road, we have to have a feasibility study. We have no existing accurate data. We want to develop a database on the traffic.

C (Sato): I understand that local materials are important, especially for pavement. Tomorrow we have a session on pavement and I hope you will pick up this issue then. Do you have any comments about this?
C (Terada): We have some local materials in Japan and we try to use them in constructing roads. But we also have standard specifications. Sometimes we use standards and local materials. Depending on local conditions, sometimes we select suitable materials for local conditions. The way we apply the standards varies. We have to look at the volume of traffic. We try to satisfy local needs with local materials.
C (Sato): Tomorrow I hope you will deliver an informative lecture to the participants.
Q (Sailendra): In Indonesia we have a standard, but not for local materials. We call local materials substandard, but it is difficult to establish a cost price based on local materials. So we try to create local material standards to correct this problem. We want to know more about local materials and standards in Japan.
A (Sato): We would like to answer these questions at the lecture tomorrow. We are far behind schedule. Let's change the schedule. Let's move the Sikki presentation to 12:45. So we will close the morning session. If you have any informal questions, you can ask our staff during the lunch break.

Lunch Break

Presentation from Indoenesia: Mr. Nurdin Samaila SIKKI
Mr.Sikki read his presentation from the powerpoint slides. 24% of the roads is maintained in good condition. 92% of the roads is asphalt pavement and the rest is gravel.
Q (Sato): This is the 1st time we heard about buton asphalt. Can you explain?
A (Sikki): We have tried since 1980 to use it. It is difficult to spread. But we keep working with it.
A (Sailendra): Buton asphalt is not the usual asphalt. The problem is the processing of this product. We process to make it like oil asphalt. Softening from 1995 to 1999.
Q (Japanese side): What is buton?
A (Sailendra): It is a stone in the land. It is an aggregrate bitumen.
A (Sikki): We take it out with excavators. More than 30% asphalt. It is made from soil or gravel.
A (Sailendra): Buton means rock asphalt. There is bitumen content in the rock. It is difficult to process because the bitumen content is variable. We use it with a hot mix.
A (Sikki): The deposit is more than 100 million tons on the small island Buton in SE Sulawesi. We export to China.
A (Sailendra): We want full extraction of buton asphalt.

Q (Nishikawa): You mentioned Sulawesi. And you have Java, which is a big island. Do you have exchange of engineers between Java and Sulawesi.
A (Sikki) : We employ engineers from any place. We have a great need for human resources, especially engineers. In my place perhaps 50% of the engineers are from Java.
Q (Teramoto): Do you have universities in Sulawesi?

A (Sikki): We have 3.
Q (Nishikawa): I have a question about human resource exchange. We are interested in how technologies can be disseminated throughout the country. In Japan, the government hires civil servants and they rotate throughout the country. But those hired by municipalities have to work only in that municipality. Does Indonesia have a system for circulating engineers throughout the country?
A (Sikki): We are always facilitating training, seminars, and hosting visitors from overseas and from Java.

Presentation from: Mr. Tint WIN
Naypyidaw is newly built capital and Yangon is the old capital and the biggest city. Myanmar has 16 states. My organization, Public Works under the Ministry of Constuction is an organization which is responsible for Construction and Maintenance of roads, airfields, bridges and buildings all over the country. We think "Better roads create better environment". It brings that we have more important role on roads than railways and air. Myanmar is surrounded by high snow capped mountains and river runs from north to south. Roads have emerged across the nation from the east to the west and from the north to the south. 19,313 miles roads were constructed and other 44,296 miles are now under construction. Ministry of Construction has Public works and Housing departments.
I am chief Engineer from Public Works and have to submit progress report on road network to Minister of MOC. There were hard damages by the attack of Cyclone in 2008. Now 8 roads are under construction for the road networking. We are working enthusiastically to uphold our motto "Speed, Quality,Economy". We are also endeavoring to improve Myanmar's technical ability by maintaining standards and quality controls.
In 1985 we started to build Yongon International Airport and at first Japan had been supported but it stopped until now. Extension of Runway is under construction at the airport.

Q (Sato): In Myanmar highways, do you frequently use concrete construction? We use it mostly in tunnels and in snow country?
A (Win): We use concreate.
Q (Sato): Why did you choose concrete? Is concrete more durable?
A (Win): Myanmar produces a lot of cement. All of our road construction is with concrete. Myanmar is largely limestone, the raw ingredient for cement.

Q (Teramoto): How many engineers are in your organization, the Ministry of Public Works?
A (Win): 1500. Now all state and divisions have Institutes of Technology.
Q (Sikki): How would you compare the cost between concrete and asphalt?
A (Win): In Myanmar asphalt (bitumen) is imported only. One ton of bitumen is $500 in Myanmar. We are trying to use local materials.
Q (Sikki): What are the costs /m2?
A (Win): Asphalt is more expensive. We use it over the bridges. There is only one asphalt road in Myanmar, funded by an ADB program.
Q (Sato): Japan uses asphalt mainly. Asphalt is a byproduct of refining oil, so it is not very expensive in Japan. We import crude oil for gasoline and the asphalt is an intermediate product. If you import crude oil to make gasoline, then you can get asphalt inexpensively.
A (Win): In Myanmar, we import asphalt, so it is expensive.
Q (Teramoto): Do you import crude oil and refine it or do you import petrol.
A (Win): We import diesel.
C (Sato): You have submitted to us your inception report. Later on we will introduce you to Japanese efforts. What efforts are you taking to counter the problem of overload?
C (Win): We start to control the overload.
Q (Sato): What measures do you use?
A (Win): The police weigh vehicles. Previously we were overloading and all roads were damaged. Now we are trying to control the overload.

C (Sato): Now we want to show you about the Japanese efforts to control overload. About 5 years ago we increased the allowable load by 5 tons/vehicle, but increased enforcement. The person in charge will explain in detail.

Presentation from Japan : Mr.Mabuchi
I want to explain how Japan deals with this issue. From H6 until 2004. Please open page 4 of the powerpoint. This shows frequency distributions of various vehicle weights. We increased the allowed vehicle weight from 20 to 25 tons from 1994 to 1995, together with stricter enforcement and punishment. This successfully helped to reduce the number of heavy vehicles that must have caused damage to the road. Please open page 26: companies were held liable for violations of vehicle load regulations. They could have lost their licenses to do business. Drivers could lose their driver licenses or pay fines. Penalties also against shippers.
In 2008, automatic measurement devices were installed in about 30 locations and the results of the monitoring were put online. In 2009, the period of licenses was extended to 2 years from 1 for load regulation compliant companies.
Slide 27 please: from Oct. 2008 to July 2009, compliance increased from 39 to 43%.

Q (Sailendra): It was very impressive story. What kind of equipment did you use to measure weights in the field? This approach is interesting. What was the cost?
A (Mabuchi): Sometimes we have to call in another truck to haul off excessive loads. We are working with the police on this. Of course money must be paid by the violators. Page 31 please: Here is a road weight measurement device embedded in the road. Each car can be stopped by roadside for physical measurements. This is a bridge gauge that monitors weight as vehicles pass.
C (Sato): Currently we have to physically stop vehicles and weigh them before we can issue a fine. But if the technology becomes more advanced, then we can take action against violators based on automatic measurements (now we just issue warnings). Now actual citation rather than just a warning requires stopping them with help from the police. Of course the automatic devices can be used together with later physical stops by police.
C (Sailendra): We need load per axel width, not total gross weight. So is the bridge sensor for total weight or per axel weight? We want to know the per axel weight.
C (Win): In Myanmar, vehicles carry more load. We need more agents to monitor loads. We have 24 wheel trucks.
C (Nishikawa): I have been studying the durability and service life of bridges. Overloads affect both pavement and bridge service life. We measure wheel load to calculate total load. We also measure how bridges are affected by various loads. Early in the morning we sometimes see 60 kinds of trucks running over bridges. We have to collaborate with police to check trucks. But once we pull one truck over, the other truckers are informed by mobile phone. Weighing in motion is not to enforce laws, but to have understanding of the trend. We have to show the data to the public so we can educate them. We can justify enforcement by showing the trend. There are some political reasons. If we just control loads, we would be stopped from somewhere. This photo shows fatigue damage of an RC slab on the abutment of a bridge. You will visit the lab and see the devices used to measure such damage. This photo shows a machine designed by me 10 years ago to test fatigue of highway bridge slabs. We'll give you a printout of this.
C (Sato): Overload is not in tomorrow's program, which is why we made a short presentation now.
C (Win): In Myanmar we are trying to control loads. Many people carry overloading. The government is controlling overloading to prevent damage to bridges and roads. We are trying to purchase a weighing machine. Trucks in Myanmar carry 40–50 tons. We are trying to control the load. Now studying.
C (Sato): In Japan enforcement should be done or we cannot get the real benefit of the law. In the past, drivers were advising each other by radio so they would know where enforcement was being done. Now they use mobile phones to avoid weighing stations. You will have similar problems when more drivers use

mobile phones to avoid enforcement. We'll discuss it in the general discussion, which begins now.

5.General Discussion

C (Sailendra): We are happy to receive more information and experiences from Japan about our problems. I want more details about that. I hope to transfer technology and know-how for the specification of standards, which would be good for us. Indonesia's situation today is like Japan's 60 years ago. We want to improve the accessability of the country and connect cities.
C (Sikki): I hope to be given more details about the topics of this seminar.
C (Win): In Japan, I am very happy. I study for knowledge. Thank you very much.
C (Sato): There are some moves taking place about standardization. The government made a standard that makes it difficult to adapt to local resources and needs. If you are too rigid, then you cannot incorporate creativity and take advantage of new advances. You have to give weight to the merits of implementing standards in a flexible manner.
C (Nishikawa): Human resources and engineers. How can we develop and nurture the next generation of engineers. This is a very difficult issue to deal with. Japan has a deceleration of the rate of public works. Please encourage the engineers of your country. Give them a lofty goal. You should challenge them to develop their own standards as a way of educating them.
C (Sato): We would like to conclude the general discussion. We are right back on the second theme of continuing cooperation among our countries.
C (Teramoto): I want to explain the background of the enhancement in and improvement of the relationships between our countries. Yesterday Mr. Sato mentioned that this meeting has been held for 17 years with many achievements. But we believe that these achievements are not enough for Asian countries. So we analyzed how to proceed on a systemic level. The person to person style of moving ahead is sometimes stopped by transfer of individuals. On a visit to Bandung last June, my counterpart suggested a close relationship such as with an MOU. We prepared such a document and it has been approved by our Ministry of Foreign Affairs. If Indonesia also agrees, shall we have a ceremony for the signing of this MOU after this meeting.
C (Sailendra): Yes. I approve and have already signed.
C (Teramoto): For Myanmar and NILIM, we would like to continue talks to improve cooperation for mutual understanding. From our understanding, since you are the first participant from Myanmar, for now we want to continue talks. After mutual understanding is achieved, we hope to proceed to enhanced cooperation.
C (Win): Thanks for inviting me. Please invite us next year too.

C (Sato): Thanks very much. The conference session is over. Thanks for your cooperation. At 3 pm we are planning to visit experimental facilities.

End of the meeting

The 18th Conference on Public Works Research and Development in Asia

(Subject：Efficient development and operation of road net works)

Minutes

1. Date and venue: 09:00-09:40 Thursday November 12th 2009
   International Conference Room of NILIM
2. Participants

Indonesia	Mr. Agus Bari SAILENDRA
	Mr. Nurdin Samaila SIKKI
Myanmar	Mr. Tint WIN
Japan	Dr. Katsumi UESAKA
	Head, Traffic Engineering Division
	Mr.Hirotaka SEKIYA

3. The summary of the discussions, etc.

In Japanese road maps, roads are classified into four different categories according to road management jurisdiction (highways, national roads, major local roads and prefectural roads) with each road indicated using a different color. However, national roads are not always of a high standard, with some sections so narrow that cars traveling in opposite directions cannot pass easily, and so this method of categorizing roads is not necessarily an easy way for travelers who are unfamiliar with the area to understand. With this in mind, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) first created a paper map where roads are classified according to their drivability. Since then, MLIT has been looking at providing this information over the Internet so that it can be included in car navigation systems. This lecture provided information on the current status and issues of these initiatives. It was also proposed that Indonesia and Myanmar create their own drivability maps, and the possibility of doing so was discussed.

Q: (Indonesia) Does this initiative cover the whole country?

A: (Japan) Yes, that's right.

Q: (Indonesia) Does this initiative cover all roads?

A: (Japan) It covers highways, national roads, major local roads and prefectural roads.

Q: (Japan) Road maps are the easiest way of providing simple but useful information. However, we don't expect that Japan's drivability map can be applied to Indonesia and Myanmar without any changes. For example, in yesterday's presentation we were shown photographs of places where the roads had become impassable as a result of natural disasters. So one type of drivability map would be to create a map showing blocked roads and unsealed roads. Are you doing anything like this in Indonesia?

A: (Indonesia) In Indonesia we provide information about blocked roads in the newspaper, but we don't create maps listing that kind of information.

Q: (Japan) Perhaps you could create something like that in future?

A: (Indonesia) That's something we'd like to consider. In tourist areas like Bali in particular, we can expect that a map like that would be useful for tourists. This lecture has given us a good idea.

A: (Myanmar) In Myanmar, pamphlets for tourists include road maps. We agree that road maps are very important.

The 18th Conference on Public Works Research and Development in Asia

(Subject: Measures to secure road traffic safety)

Minutes

1. Date and venue: 09:40-10:20 Thursday November 12th 2009
   International Conference Room of NILIM
2. Participants

Indonesia	Mr. Agus Bari SAILENDRA
	Mr. Nurdin Samaila SIKKI
Myanmar	Mr. Tint WIN
Japan	Mr. Masahiro KANEKO, Head
	Mr. Keiichi IKEHARA, Senior Researcher
	Mr. Keita NAKASU, Senior Researcher
	Mr. Katsuhiro ITO, Guest Research Engineer
	Mr. Kouki HASHIMOTO, Guest Research Engineer
	Advanced Road Design and Safety Division, Road Department

3. The summary of the discussions, etc.

Kaneko from the Advanced Road Design and Safety Division gave a presentation on the current situation of traffic accidents in Japan, and on the measures to prevent traffic accidents. Regarding the current situation of traffic accidents, he presented such as the number of traffic accidents fatalities in Japan, and compared the situation of traffic accidents in Japan with those in other countries. Regarding the measures to prevent traffic accidents, he explained that measures are roughly divided into arterial roads and residential roads, and introduced “Selected and focused” measures for arterial roads and the measures in two-dimensional spaces and zones for residential roads.

After the presentation, there was time for questions and answers and discussion.

Q: In Japan, how do you identify hazardous spots?

A: We identify hazardous spots based on accident rates, calculated as the number of accidents divided by VK (vehicle - kilometers).

Q: Please tell us which measures are most effective at reducing accidents.

A: We are currently in the process of taking the results from accident reduction measures around Japan and organizing the information about accident reduction benefits. We plan to announce these results in the future.

The 18th Conference on Public Works Research and Development in Asia

(Subject： Environmental issues of Roads in Japan)

Minutes

1. Date and venue: 10:30-11:10 Thursday November 12th 2009
   International Conference Room of NILIM
2. Participants

Indonesia	Mr. Agus Bari SAILENDRA
	Mr. Nurdin Samaila SIKKI
Myanmar	Mr. Tint WIN
Japan	Mr. Shinri SONE
	Head, Road Environment Division

3. The summary of the discussions, etc.

The lectures have been taken place in the following current situation of environmental problem in road.

・Environmental Assessment system
・Air pollution and the pollution-control measures
・Noise pollution in road and the noise-control measures
・Current situation and the counter measures toward greenhouse gas

The 18th Conference on Public Works Research and Development in Asia

(Subject: Toward realization of Smartway in Japan)

Minutes

1. Date and venue: 11:10-12:00 Thursday November 12th 2009
   International Conference Room of NILIM
2. Participants

Indonesia	Mr. Agus Bari SAILENDRA
	Mr. Nurdin Samaila SIKKI
Myanmar	Mr. Tint WIN
Japan	Mr.Hideto HATAKENAKA
	Head, Intelligent Transport System Division
	Mr.Koichi SAKAI

3. The summary of the discussions, etc.

Mr. Hatakenaka explained the spread of the Electronic Toll Collection System (ETC) and the Vehicle Information and Communication System (VICS) that are currently deployed in Japan, and the concept and services of Smartway using the 5.8 GHz dedicated short-range communication (DSRC) which is now used by ETC.

A DVD was shown to explain an overview of the field operational tests (FOTs) conducted on the Metropolitan Expressway in 2007, and some of the services such as providing information on obstacles ahead and merging assistance. Mr. Hatakenaka introduced the results of these FOTs, and presented overviews of the FOTs of Smartway conducted all over Japan in 2008, and the large-scale FOTs jointly conducted by the four relevant government agencies.

Mr. Hatakenaka also introduced deployment strategies of Smartway in the future.

Q: How much is the benefit of introducing ETC or Smartway? It would be helpful to understand if there was some concrete data…

A: This is an extremely difficult question to answer. The question of how much the benefit for installation is an important one for road administrators when it comes to introducing these systems, but we haven't been able to express this benefit well so far.

For examples, one of the effects of introducing ETC has been that the traffic congestion at the main lane toll gates has been reduced by more than 80% as the usage rate has reached about 80%. Another example is that the experimental service which provides information on obstacles ahead at the Sangubashi curve (a curve is one of the rear-end collision accident-prone area) has reduced traffic accidents by about 70%, although other traffic accident countermeasures such as installing variable message sign (VMS) were also taken at the same time. In another experiment which was conducted last year at the Rinkai-Fukutoshin off-ramp of the Bay Shore Route of the Metropolitan Expressway, a service which provided information on obstacles ahead reduced the average speed by 3 km/h.

However there are very few examples where the effects can be quantified in this way. For example, we believe that systems which assist safe driving not only reduce the number of traffic accidents, they also give drivers a sense of security. We are conducting questionnaire surveys of test subjects as a way of trying to grasp these kinds of effects.

We believe that the eventual goal of quantifying the effects is to convert these effects into monetary terms and perform a cost-benefit analysis. We are conducting further research towards this eventual goal.

Q: In the other presentation of environmental measures for road improvement, he said that he was implementing measures to increase the speed of vehicles, because the environmental impact (such as CO_2 emissions) increased when vehicles were traveling slowly. But just now you said that you are trying to lower the speed of vehicles. What is the relationship between these two goals?

A: It is important to slow the speed of vehicles traveling too fast down to a safe speed in order to prevent traffic accidents. That's why measures to make vehicles travel slowly to prevent accidents are important at accident-prone areas.

Moreover, although CO_2 emissions increase substantially as vehicle speed decreases, the minimum emissions occur at 60 to 80 km/h, and emissions are more or less the same in this interval. In the example of the Rinkai-Fukutosin off-ramp mentioned before, the vehicle speed was around 60 km/h and lowering the speed would not so significantly affect CO_2 emissions.

The 18th Conference on Public Works Research and Development in Asia

(Subjects： Earthquake disaster management for Roads)

Minutes

1. Date and venue: 13:15-13:55 Thursday November 12th 2009
   No.204 Meeting Room of NILIM
2. Participants

Indonesia	Mr. Agus Bari SAILENDRA
	Mr. Nurdin Samaila SIKKI
Myanmar	Mr. Tint WIN
Japan	Dr. Susumu TAKAMIYA
	Head, Earthquake Disaster Prevention Division

3. The summary of the discussions, etc.

Regarding earthquake disaster management for roads in Japan, the framework of the management, road damages due to earthquakes in Japan in the past, risk management pertaining to earthquakes and crisis management to be taken right after being struck by earthquakes were introduced and discussed. Regarding risk management, the technical policies to be taken for newly constructed road facilities and existing road facilities were introduced. And regarding crisis management, various support systems for checking the damages to the road facilities, and communicating and sharing that information were introduced.

Q: Will it be effective to introduce the SATURN system into Indonesia?

A: The SATURN system is a system that will estimate damages incurred upon the road facilities, right after being struck by earthquakes, in an effort to improve efficiency in the subsequent inspection activities. Introducing this system into Indonesia will be effective. However, it will be necessary to obtain ground motion data right after being struck by earthquakes, and also necessary to have data such as “ground” data prepared and maintained in advance, in order to estimate the damages incurred upon the road facilities using this system. These points should be taken into consideration.

Q: Will it be possible to inquire furthermore about the details of the SATURN system?
A: Yes, it is.　If you have any questions, etc., you can make those inquiries to the National Institute for Land and Infrastructure Management.

Q: Today's lecture was about earthquake disaster management, and I would like to know whether it is also the subject of researches to be conducted here, to predict ground motions or inform the citizens of them.
A: No, they are not.　The subject of researches to be conducted here is the way to conduct management of reinforcement of social infrastructure facilities such as roads, against earthquakes.

Q: I want to know about the specific earthquake-proof reinforcement measures to be taken, such as for road bridges.
A: The Public Works Research Institute is in charge of the specific earthquake-proof reinforcement measures to be taken.　Since there will be a lecture by a bridge specialist from the Public Works Research Institute, later on, please inquire about the details at the lecture.

The 18th Conference on Public Works Research and Development in Asia

(Subject： Strategy for maintenance of Road structures)

Minutes

1. Date and venue: 13:55-14:35 Thursday November 12th 2009
   International Conference Room of NILIM
2. Participants

Indonesia	Mr. Agus Bari SAILENDRA
	Mr. Nurdin Samaila SIKKI
Myanmar	Mr. Tint WIN
Japan	Mr. Toshiaki MABUCHI
	Senior Researcher,
	Bridge and Structures Division,
	Road Department,NILIM

3. The summary of the discussions, etc.

I introduced the current state of aging and damage for Japanese bridges, and explained how performing efficient maintenance had become a challenge, and about the maintenance efforts underway in Japan.

It is necessary to establish a mechanism to carry out systematic management comprising inspection, prediction, assessment and countermeasures, as well as periodic inspections to collect data on which to base those actions. The inspection of areas that cannot be covered in periodic inspections (internal parts, underwater parts, etc.) poses a problem. I introduced efforts at maintenance, which were discussed.

Q: Is any equipment used in periodic inspections?
A: Inspections mainly involve getting close and performing inspections visually, and vehicles for conducting testing are sometimes used.

Q: What is the timing for performing each type of work (preventative maintenance, repairs and replacements) and who performs the work?

A: The road administrator determines what type of action to take. Preventative maintenance is at an advanced level in Japan. Replacements are carried out when no effective countermeasures are available.

In the area of preventative maintenance and repairs, these differ greatly depending on the circumstances at the bridge location, and the road administrator determines what to undertake based on the volume of traffic, nearby conditions, and so on.

Q: If severe damage is discovered after performing an inspection, what is done in the lead up to funds being secured and the commencement of repair work?

A: At that point we take whatever emergency measures are possible. For example, we may consider closing the road to traffic or restricting the passage of large vehicles.

The 18th Conference on Public Works Research and Development in Asia

(Subject： Techniques for inspection and reinforcement of bridge)

Minutes

1. Date and venue: 14:45-15:25 Thursday November 12th 2009
   No.204 Meeting Room of NILIM
2. Participants

Indonesia	Mr. Agus Bari SAILENDRA
	Mr. Nurdin Samaila SIKKI
Myanmar	Mr. Tint WIN
Japan	Mr.Taku HANAI,
	Mr.Naoki YANADORI
	Bridge and structural Technology Research group, Center for Advanced Engineering Structural Assessment and Research, PWRI

3. The summary of the discussions, etc.

We described the defects of concrete and steel bridges and ways to maintain, repair and reinforce them.

With respect to concrete bridges, we presented the results of a defects survey on concrete structures across Japan, and described the deterioration tendencies of concrete structures in Japan.

For steel bridges, we explained about the corrosion of steel components and fatigue on concrete decks as the typical forms of deterioration, as well as ways to maintain, repair and reinforce such structures.

Q: I would like to know about earthquake reinforcement work for bridge piers.

A: We explained about RC-jacketing reinforcement methods and steel jacketing reinforcement methods while referring to diagrams.

Other: The Indonesian attendees introduced case examples of concrete decks in Indonesia having developed many cracks.

The 18th Conference on Public Works Research and Development in Asia

(Subject：Efficient maintenance of the pavements and tunnels)

Minutes

1. Date and venue: 15:25-16:25 Thursday November 12th 2009
   International Conference Room of NILIM
2. Participants

Indonesia	Mr. Agus Bari SAILENDRA
	Mr. Nurdin Samaila SIKKI
Myanmar	Mr. Tint WIN
Japan	Mr.Kazuyuki KUBO
	Team Leader, Pavement Research Team,
	Mr.Nobuharu ISAGO
	Senior Researcher, Tunnel Research Team,
	Road Technology Research Group, PWRI

3. The summary of the discussions, etc.

We will introduce the current state of maintenance and management of the pavements and tunnels in our country, centering on directly-controlled national highways, and also explain about the investigations and researches aimed at achieving efficient maintenance and management in the future.

In regard to pavements, I will report about the current state of the pavements in our country, and also introduce the pavement management support system that has already been applied to directly-controlled national highways, etc. Furthermore, I will explain about the preventive-repair, which is currently under investigation and research at the Public Works Research Institute.

Furthermore, in regard to tunnels, I will explain about the current state of maintenance and management of the road tunnels in our country, the workflow in tunnel inspection, and representative repair and reinforcement methods, and I will also introduce the maintenance and management of tunnels in Japan in the future.

○ About effective utilization of locally produced (low quality) materials

Q: In Indonesia, the quality of aggregate is not so good in some regions. Isn't there a similar problem in Japan?

A: We have similar problems. In Okinawa, for example, only limestone can be mined. In Japan, the state does not publish the manuals directly, but the Japan Road Association publishes them, and the administrators of the roads will draft their original specification sheets by referring to those manuals. In most cases, they conform to such books published by the association, but when the aggregate situation is different from the nationwide standard situation, as is the case in Okinawa, they will draft their original specification sheets, by working on it independently, or starting up a third party committee. It may turn out that I visit Indonesia next March, so I might have a chance to discuss the details in the field.

○ About crack sealants

Q: Is there any means to select a good crack sealant?

A: We are in the process of investigating and researching a quality criteria for crack sealants. Repeated bending tests may be effective. At the present moment, we have no choice but trust big manufacturers, such as NICHIREKI Co., Ltd.

○ About nondestructive examination of pavements

Q: Do you use the Benkelman beam or the like, for detailed examinations of the road surface?

A: We usually use the FWD (Falling weight Defrectmeter), but it is still in the research level, not in the practical application stage yet.

○ Other comments

- With the decrease in maintenance and repair budgets, it is necessary to clarify the management level of the pavements, for a rational maintenance and management of the roads, but it is difficult to make that clarification, with the issue of defect in the management.

- Overloaded vehicles can be blamed as one of the causes of extremely deep ruts being dug up, but the number of deep ruts has dropped drastically in Japan, because, with the amendment of the Road Traffic Law, not only the drivers, but also their companies and the customers giving them orders became punishable.

- There are few concrete pavements in Japan. I think one of the reasons for this is that it is difficult to repair them when they are damaged.

- In Indonesia, we are currently in the process of proceeding the investigations about construction of road tunnels, with the support of JICA.
- Past examples of tunnels in Myanmar is limited to waterway tunnels and railway tunnels, and there is currently no road tunnel.

The 18th Conference on Public Works Research and Development in Asia

(Subject：Risk Management Strategy in Privatization of Expressway Public Corporations in Japan))

Minutes

1. Date and venue: 16:35-17:15 Thursday November 12th 2009
   International Conference Room of NILIM
2. Participants
   Indonesia Mr. Agus Bari SAILENDRA
   Mr. Nurdin Samaila SIKKI
   Myanmar Mr. Tint WIN
   Japan Mr. Katsuhiko NAKAMURA
   Planning Division, Japan Expressway Holding and Debt Repayment Agency

3. The summary of the discussions, etc.

In Japan, four expressway public corporations were privatized in 2005, and at the same time the Japan Expressway Holding and Debt Repayment Agency was launched.

The agency's role is to ensure that its debts are paid off within 45 years, as well as to provide support to ensure that companies construct necessary roads and steadily maintain them.

The biggest risk factors in repaying the debt are traffic volume and interest rates. The risk management of these factors is very important.

With respect to force majeure risk, financial support is available from the government in case of major disasters.

Out of consideration for the recent economic and social conditions, tolls were drastically reduced through government-funded investment.

Q: What is the state of pricing for large vehicle, which have a significant impact on damage to the expressways?

A: Expressway tolls are divided into five levels. Standard-sized cars are regarded as 1.0, and based on the size of the car, the levels go in sequence of 0.8, 1.0, 1.2, 1.65 and 2.75. The per-kilometer toll for a standard-sized car is 24.5 yen.

Q: What is the basis for the unit toll for the base standard-sized car and for the proportions paid by each of the other classes of car?

A: The tolls take everything into account, including construction costs, administrative expenses and the benefit to users. I don't have a detailed basis for the tolls on hand.

Q: In Indonesia, efforts are made to raise tolls every three years due to inflation. Are the tolls ever changed in Japan?

A: The tolls take everything into account, including construction costs, administrative expenses and the benefit to users. I don't have a detailed basis for the tolls on hand. Due to recent economic conditions, in Japan tolls have not risen for the past decade or so, and raising them in the future is not feasible. In addition, as I explained before, with the change in government discussions have just begun over making expressways toll-free.

Ⅳ　SESSION REPORTS

1. Japan

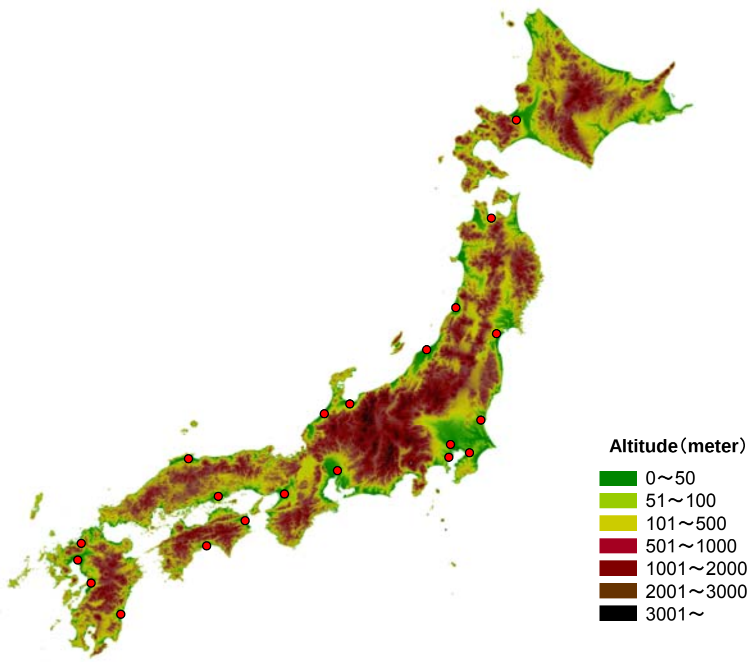
Mr. Kazuhiro NISHIKAWA

Road Planning and Design in Japan

Past decisions and Current challenges

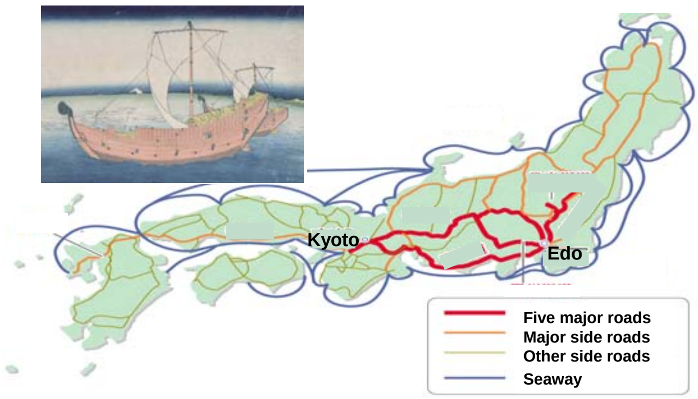
Kazuhiro Nishikawa
Director General
NILIM, MLIT
11 November 2009

Introduction (1)



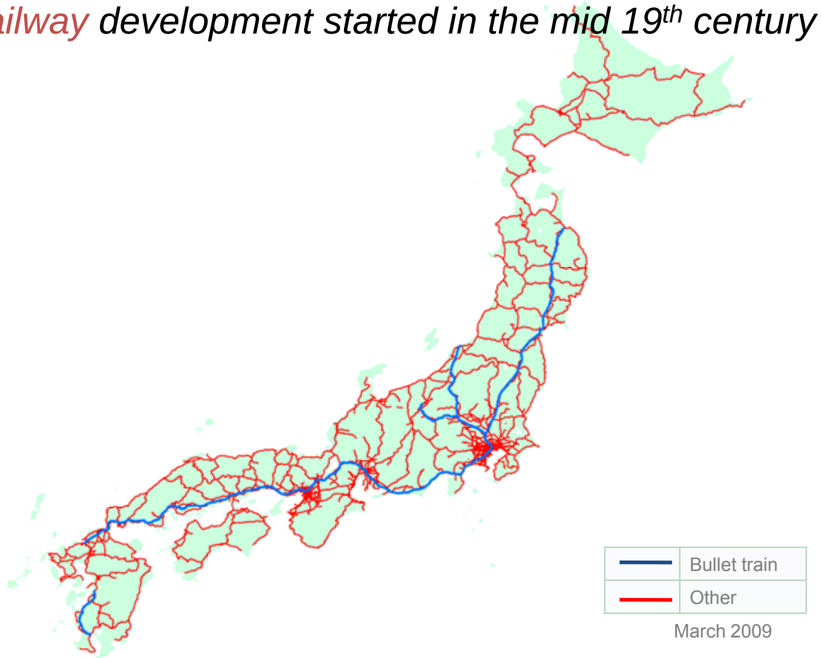
Introduction (2)

Seaways were mainly used before the mid 19th century

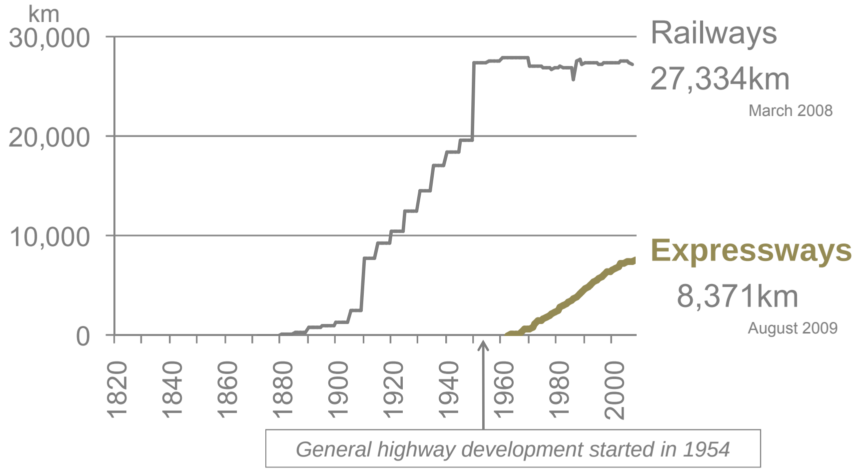


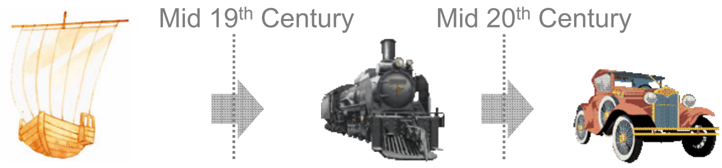
Introduction (3)

Railway development started in the mid 19th century

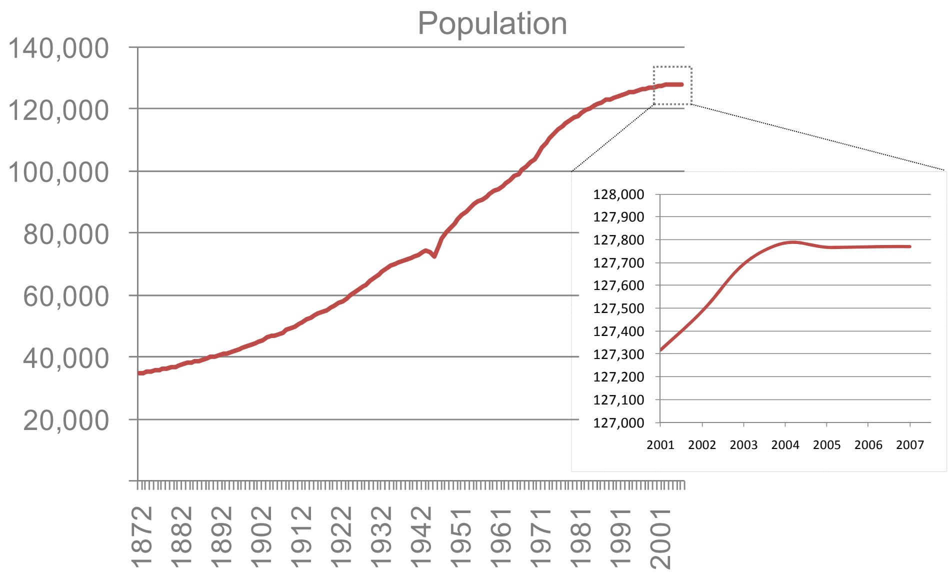


Introduction (4)



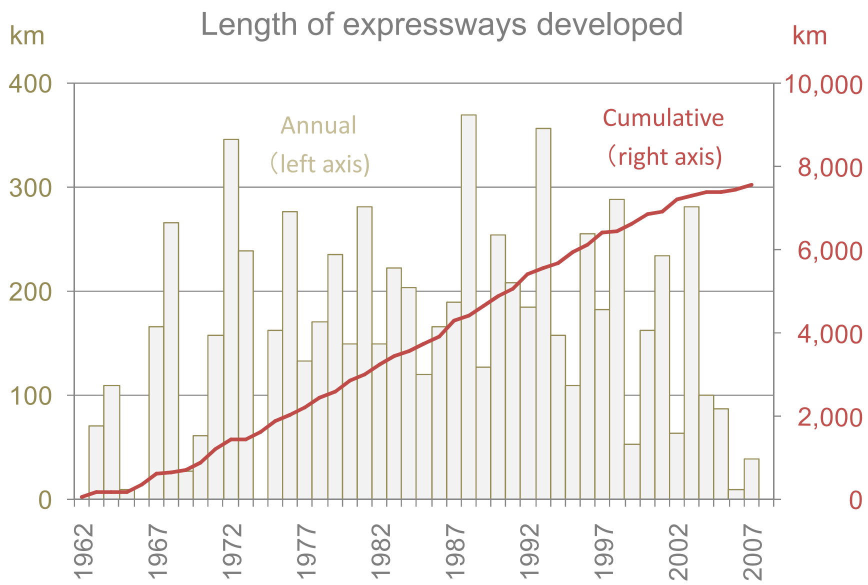


Introduction (5)

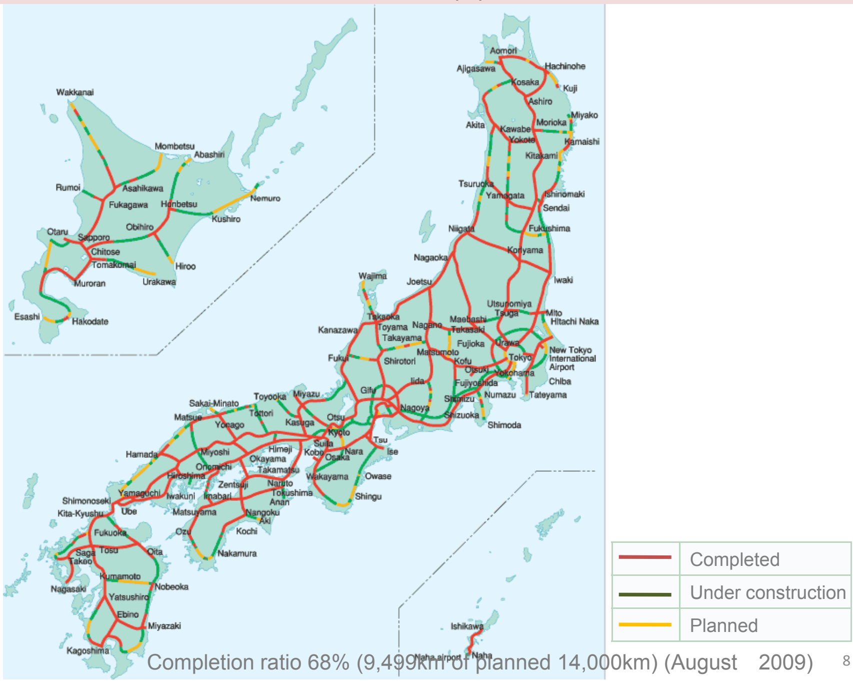


2002	2003	2004	2005	2006	2007
127,486	127,694	127,787	127,768	127,770	127,771

Introduction (6)

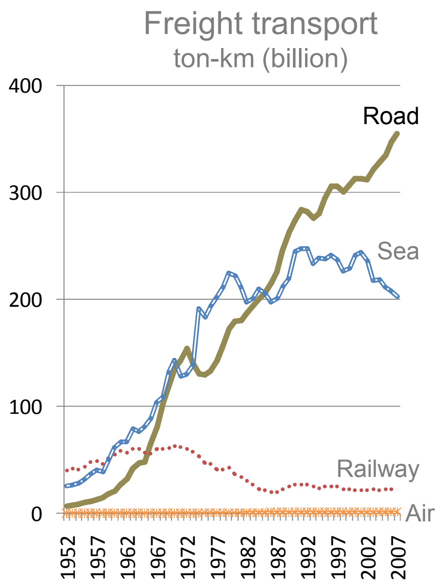


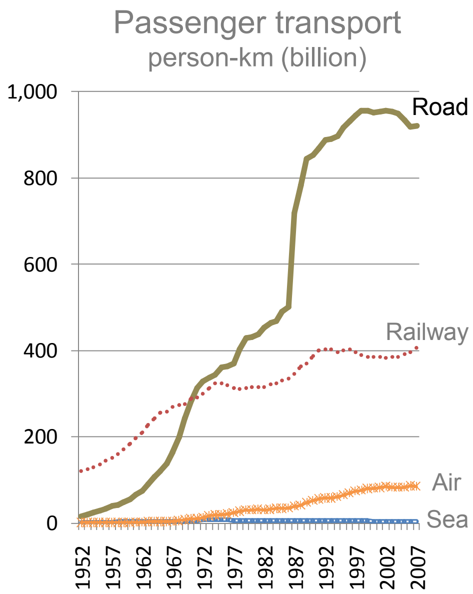
Introduction (7)



Completion ratio 68% (9,499km of planned 14,000km) (August 2009)

Introduction (8)





Past Road Plans and Designs (1)

Decisions made in the 1950's

Option A

Study a desirable road network and build a strategic road network that can cope with future road traffic demand.

Option B

Rapidly construct roads without changing the existing fundamental network structure.

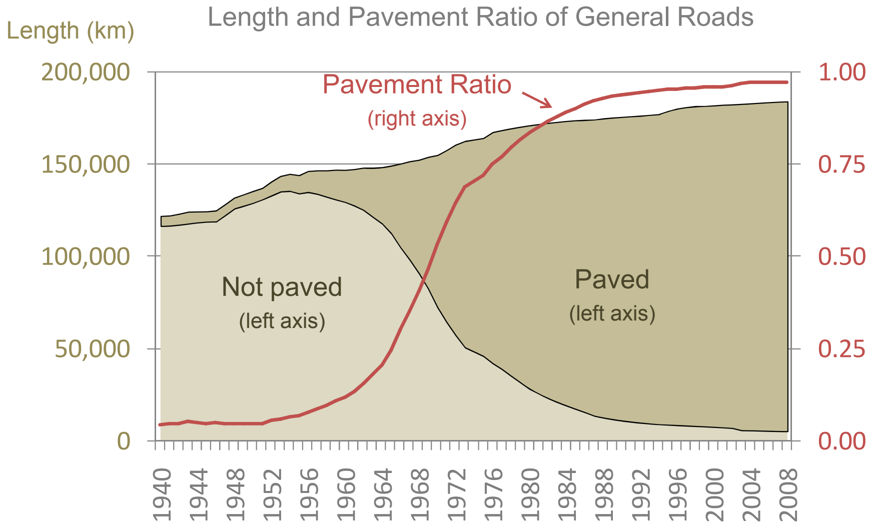
- paving the existing roads -

Option B was adopted in favor of the quick realization of the advanced road network so as to quickly catch up with top-runner countries.

Past Road Plans and Designs (2)

1. Rapid Road Development by Paving Existing Roads

In the past, road development meant paving existing roads.



Past Road Plans and Designs (3)

2. Standard Specifications

Standards and systems that allow everyone to draw the same designs were established to make up for the lack of engineers.

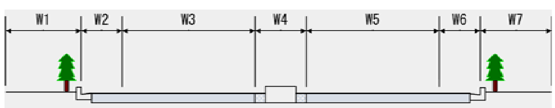
✓ Standard Specification for Road Design

Area
- Urban area
- Rural area
- Flat area
- Mountainous area

Traffic volume

Road type
- Expressway
- National Highway
- Prefectural road
- Municipal road

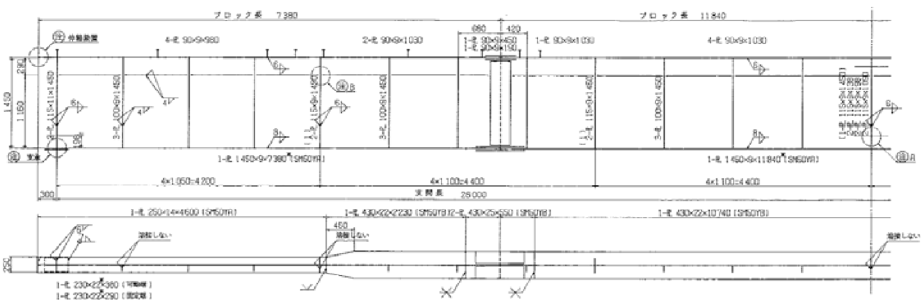
Alignment, Number of lanes, Width, Super elevation, etc.



Past Road Plans and Designs (4)

(for bridges)
•Standard Specifications for Highway Bridges
•Drawings prepared for every possible span

Concept: Providing the drawings enables everyone to construct bridges

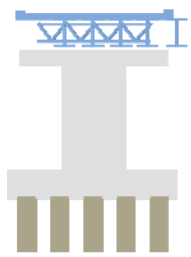


Example: Steel members

Past Road Plans and Designs (5)

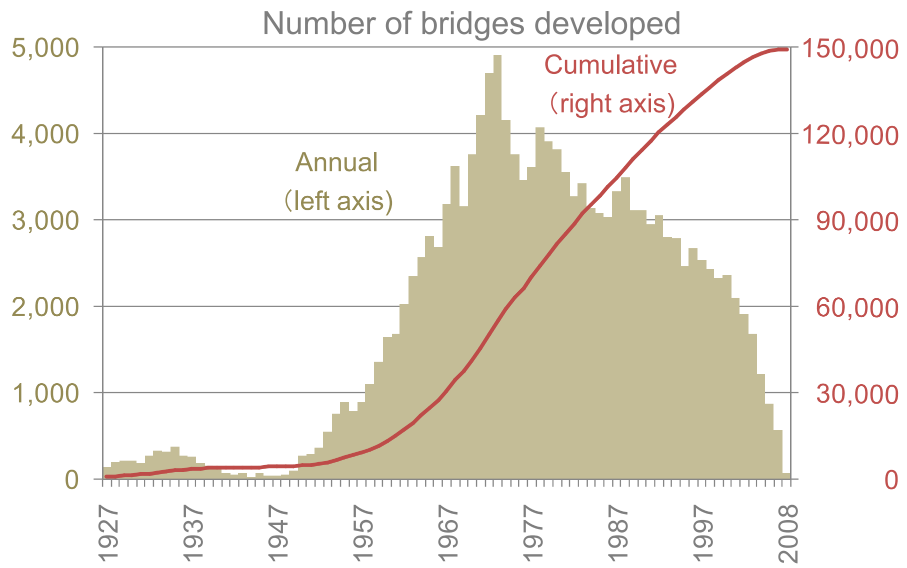
3. Outsourcing and Subdivision of Specialty Fields

✓ Outsourcing to private companies
✓ Technique transfer to private companies
✓ Subdivision of specialty fields
- ◆Investigation
- ◆Design
- ◆Implementation
  - ➢Superstructures
    - • Steel bridges
    - • Concrete bridges
  - ➢Piers, Abutments
  - ➢Foundations



Past Road Plans and Designs (6)

Rapid Bridge Development



Total number of bridges developed: 149,000 (March 2009)

Looking back on the Road Plans and Designs in the past 60 years (1)

Consequences of Rapid Road Development

- Road network development occurred very rapidly.
  - Bolstered high economic growth. *(Miracle of the East)*
  - Helped Japan quickly catch up with top-runner countries.

- However, various issues were left unresolved.

Looking back on the Road Plans and Designs in the past 60 years (2)

Issues

(1. Rapid Road Development by Paving Existing Roads)

✓ Endless improvement

Lack of capacity, poor alignment, and congestion associated with urbanization
→ Development of new standard roads such as bypasses

(2. Designs Based on Standard Specifications)

✓ Mismatch of standard designs

- High priority roads → Old, poor standards
- Low priority roads → New, high standards

Neither of these situations is rational.

✓ Education of engineers for creativity and imagination

(3. Outsourcing and Subdivision of Specialty Fields)

✓ Education of engineers in comprehensive design management capability

A policy shift may have been necessary sometime in the 1980s.

Looking back on the Road Plans and Designs in the past 60 years (3)

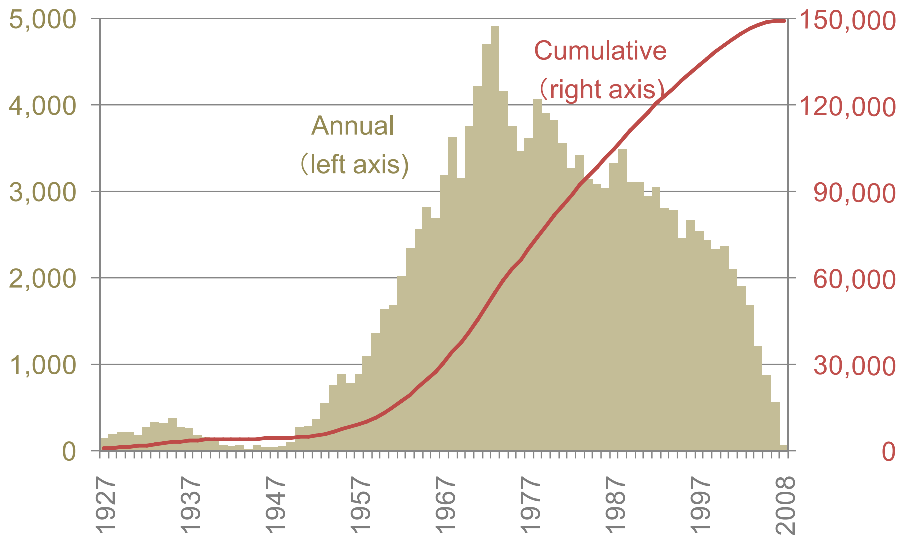
Future Direction

1. Shifting from a speed-centered approach to a mindset conscious of performance and quality
   - Fine-tuned responses to the problems, needs and requirements of each region

2. Perspective for the future
   - Social change after network completion
   - Strategic infrastructure maintenance

Strategic Infrastructure Maintenance（1）

Number of bridges developed



Strategic Infrastructure Maintenance（2）

Strategic Maintenance

Road Bridge Life Extension Plan of Road Bridges

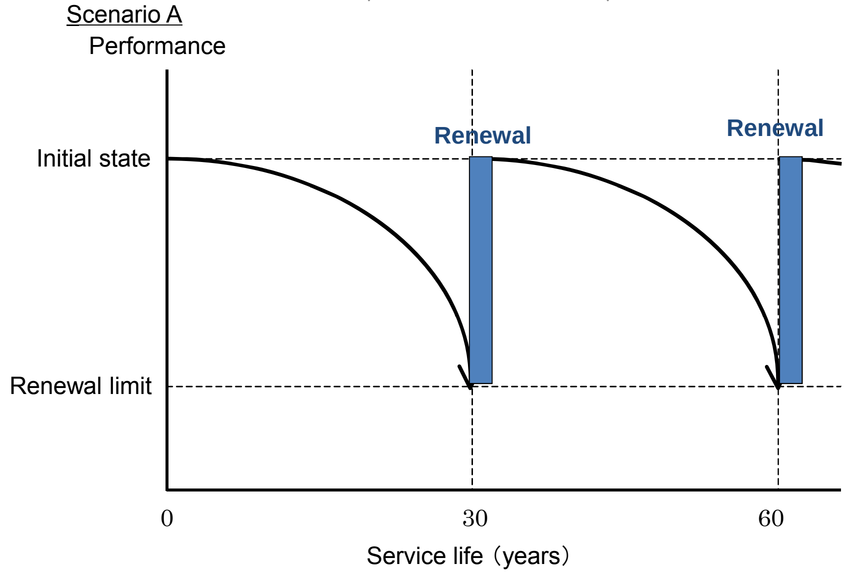
What is strategy?

- The "Strategic Target" is as follows: Road functionality shall be maintained sustainably for many years without loss due to aging.
  - ✓ Roads are meant to serve. They must meet "the unspoken expectation of eternal service"
  - ✓ Characteristics of infrastructure management
- Service life extension of bridges is "Strategy"
  - ✓ Service life extension allows a sustainable maintenance of functionality.
- Preventive maintenance is "Tactics" to extend service life
  - ✓ Preventive maintenance is an effective method for extending service life.

Strategic Infrastructure Maintenance (3)

No maintenance

(Let the roads be)

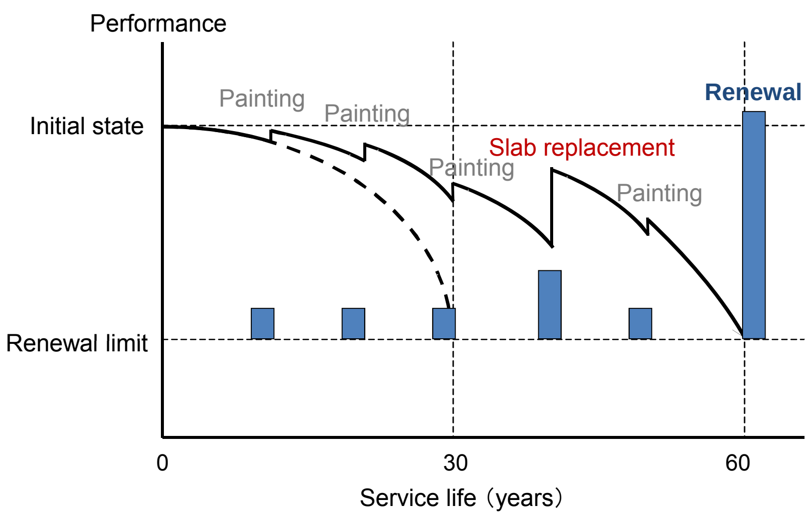


Strategic Infrastructure Maintenance (4)

Traditional maintenance

(Repair after problems occur)

Scenario B

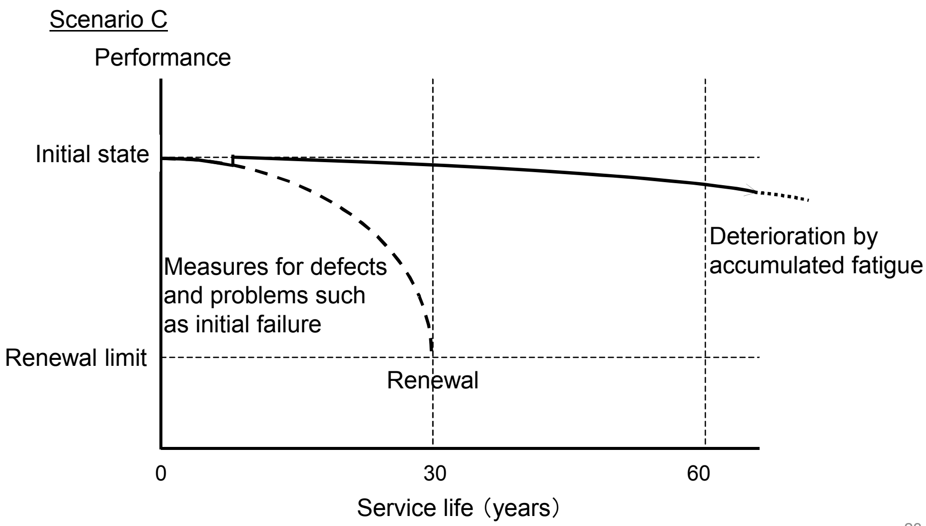


Early treatment: easier and cheaper

Strategic Infrastructure Maintenance (5)

Ultimate ideal maintenance

(Based on US Navy Risk Management)



Thank you for your attention

2. The Republic of Indonesia

Mr. Agus Bari SAILENDRA

JICA GROUP TRAINING COURSE ON INFRASTRUCTURE DEVELOPMENT AND MANAGEMENT (JFY 2009)

INCEPTION REPORTS

Name	Agus Bari Syailendra, Ir.,M. Sc.
Country	Indonesia
Organisation	Research and Development Agency, Ministry of Public Works
Position	Director of Research and Development Center for Roads and Bridges

Summary

Roles of the Research and Development Center for Roads and Bridges-Indonesia, formerly known as the Institute of Road Engineering (IRE), in road development and traffic operation in Indonesia is ensuring the use of appropriate technology to achieve best construction quality, efficient construction and traffic operation. As a director of RDCRB, I am responsible to lead the Institute to achieve a common dream that has been set, that is, becoming a leading institution in providing road technology for better future of Indonesia. We have identified urgent and strategic needs and challenges of Indonesia to enable the provision of sufficient infrastructure in relation to geographical condition, environmental constraints, and traffic characteristics of Indonesia. From these challenges, we set our goals to provide the best road construction and traffic operation technology that can be in-harmony with the nature of Indonesia on the basis of local materials and capacity.

1. Organisation data:

(1) Name of Organisation : The Research and Development Center for Road and Bridges (RDCRB), formerly known as The Institute of Road Engineering (IRE)

(2) Summary of Organisation:

The RDCRB is a government owned research institute works primarily in providing technology for road and bridges construction in Indonesia. The institute belongs to the Agency for Research Development of the Ministry of Public Works and works side by side with the Directorate General of Highways (Bina Marga) in ensuring infrastructure quality that meets the necessity of each region in Indonesia.

The establishment of the institute was initiated by the Government of Deutsch-Indische in 1925 functioning as an investigation station for soils and roads. This function had continued and the institute had been part of the Directorate

General of Highways of the Ministry of Public Works until the establishment of the ARD within the Ministry in 1985.

Since 1985, the institute has gradually developed its capacity and management in carrying out R and D in roads and bridges, including tackling problematic-soil, traffic problem and developing safety measures for Indonesian highways network. Today, main tasks of the institute are defined as the following mission statement:

1. Conducting Research and Development in roads and bridges technology to support the provision of strong road networks in Indonesia.
2. Developing standard specifications and guidelines for roads construction; and
3. Improving knowledge and engineering bases of Indonesian engineers in road and bridges technology.

The operation of RDCRB is mainly funded by Indonesian Government from the Ministry's budget. Small portion of funding for consultancy and advisory works is funded by private companies. Within the last three year, the RDCRB managed around 12.5 to 16.3 Mill USD per year research budget. It was between 0.85 to 1.85% of the Directorate General of Highways budget.

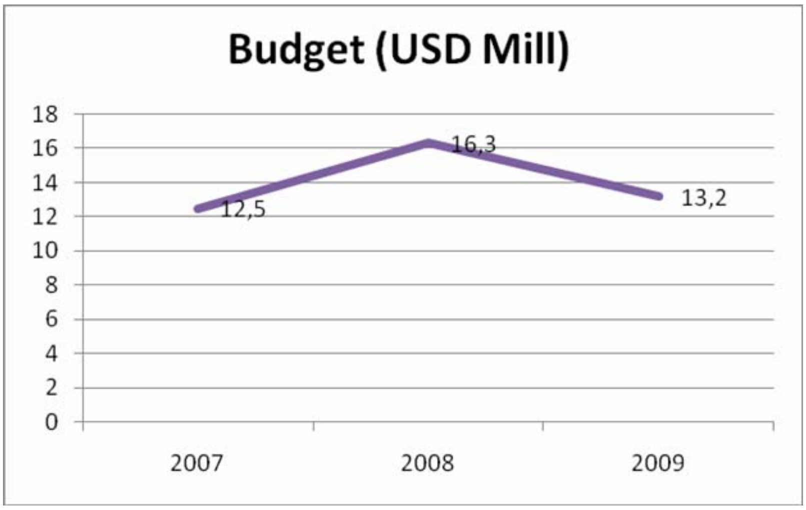


Figure 1 RDCRB budget 2007-2009

Referring to the national program of the Government of Indonesia, the budget of RDCRB was supported from 3 national programs, namely Good-Governance, Science and Technology, and Road and Bridges Program. The budget allocated for good governance program aimed at providing research facilities and routine expenditures including salary and wages. The fund provided from Science and Technology Program aiming at funding research and development activities, while the Road and Bridges programs funded field trials and pilot projects of technology application. The following figure provides proportion of each activity in relation to the national program.

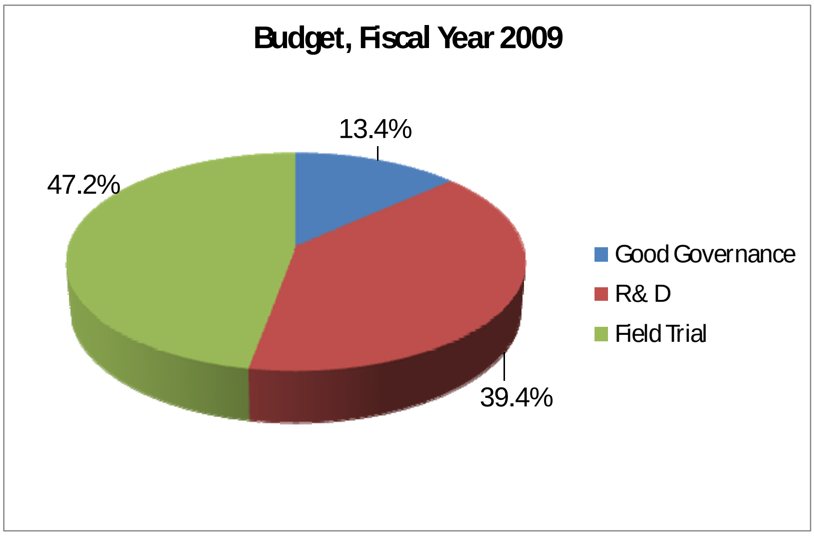


Figure 2 Composition of RDCRB Budget in 2009 by Program

For an institutional budget there are two schemes of Expenditures, namely Material Expenditures and Capital Expenditures. Materials Expenditures includes funding allocated for in-house facility improvement and expenditures for moving items, while the Capital Expenditures associates with expenses which are used for Infrastructures and buildings development.

In each projects budget, the proposed project cost consists of 5 major items, including:

1. Labor Costs and Incentives
2. Transportation and Out off Station Allowances
3. Materials
4. Outsourcing Personnel
5. Others

In accordance with the above categories, the institute's budget in 2009 can be figured as the following chart.

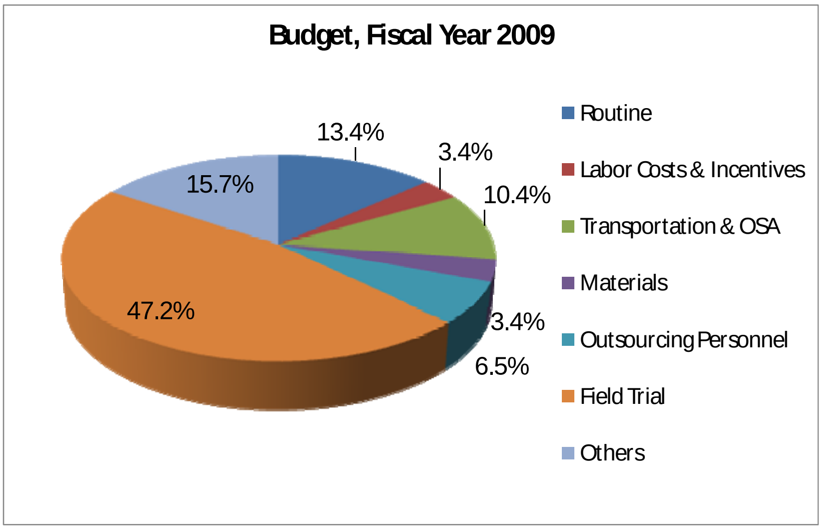


Figure 3 Expenses Category of RDCRB Budget in 2009

(3) Organisation Chart

The Institute runs 4 laboratories consisting of Pavement and material, Geotechnical, Traffic and Environment, and Bridges and Structures laboratory.

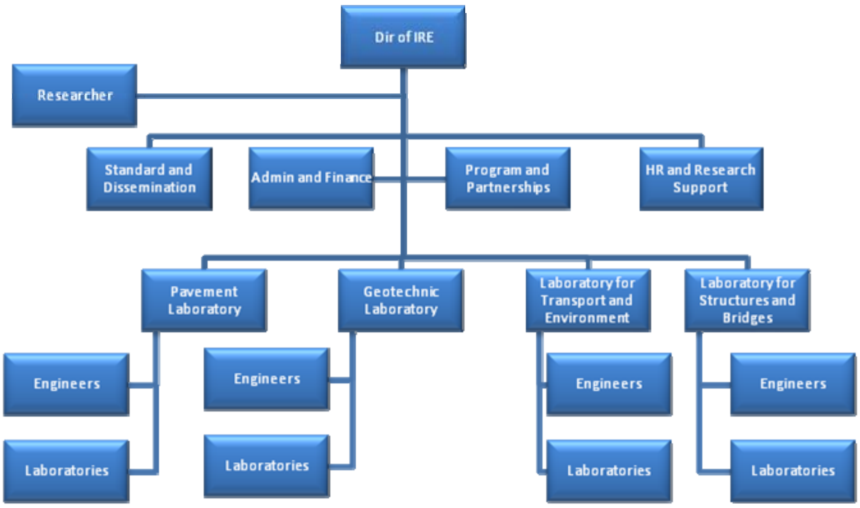


Figure 4 Organisation Chart of RDCRB

As a director of the institute, I am responsible in managing the whole operation of the institute, which consists of research and development (R and D), technical advisory (TA) and Technology Transfer and Dissemination (TTD). For these works, the institute is manned by 373 staffs from various educational background. They comprise 73 specialists (20 %) in pavement, soil and slopes, traffic and environment, and bridges and road structures. About 40% of the whole staffs are administration and supporting personnel, including guards and cleaning service personnel. The rest are surveyors, laboratory personnel, and technicians.

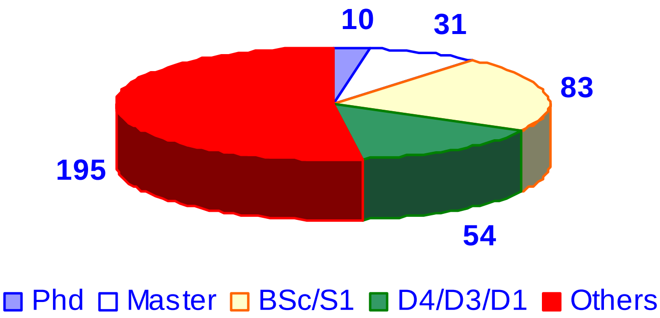


Figure 5 Human Resources of RDCRB by Education Level

(4) Organisation's Position in Government

The Institute has been well known to be a referent institute for road specification and standard in Indonesia. It is designated to support the Ministry of Public Works in managing roads and bridges in Indonesia, especially in relation to capacity development, construction, and supervision tasks. The institute ensures the application of technology which suits the need of each regions and assists the Directorate General of Highways through providing standard procedures for the technology as well as assisting the DGH to solve any practical problems which requires research based problem solving. In addition, the Institute has also provided assistance to the Inspector General of the Ministry in technological audit. Accordingly, the Ministry requires maintaining the position of the Institute being independent and free from any unnecessary pressure.

The Research and Development Center for Roads and Bridges (RDCRB), as well as other Research and Development Center within the Ministry of Public Works, namely Research and Development Center for Water Resources (RDCWS), Research and Development Center for Human Settlement (RDCHS), and Research and Development Center for Socio Economic, Cultural, and Community Participation (RDCSECCP), is administered and supervised by the Agency for Research and Development (ARD) of the Ministry. The head of ARD ranks in the similar level with other Director General in the Ministry. As a research administrating agency, the ARD coordinates with three government agencies namely the Agency for Technological Review and Application (BPPT), The Agency for Standardisation, and Indonesia Institute of Science (LIPI).

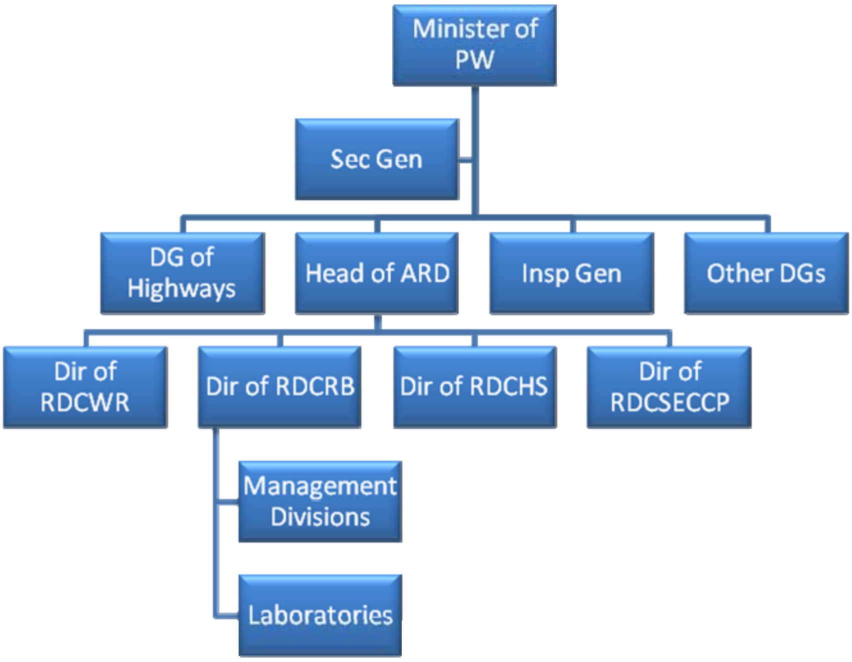


Figure 6 Organisation Chart of the Ministry of Public Works and Positioning of RDCRB

2. Personal Data

(1) Recent Work

I have been joining the Ministry of Public Works for over 30 years when I completed my bachelor degree in Engineering in Bandung. I started my carrier as a field surveyor at the institute, responsible in collecting traffic and road geometry data for road design verification in Mid 1970's. Since then I have gradually improved my education to a full engineer and then took my master degree in Engineering in Surabaya in 1984. My carrier had also been gradually improved being traffic engineer, head of traffic engineer laboratory (2000-2005), head of programming (2005-2007), before I was promoted to be a Director of the institute in 2007.

In the last three years I have focused my work in improving the performance of the RDCRB in providing technology transfer and disseminating research products of RDCRB throughout Indonesia. It was aimed at improving the capacity of Indonesian road engineers to be able to handle more complicated tasks in road and bridges constructions. Also, it is becoming an effective media to introduce new method in road construction and traffic management technology to enable efficient road construction and traffic operation. I took the action in accordance with the new vision of the

RDCRB becoming a leading institute in providing roads and bridges technology for the future of Indonesia.

(2) Contact Address:

Office Address: Jalan Raya timur no. 264 Ujungberung Bandung-Indonesia

Office Phone Number: +62 22 7802251

Fax: +62 22 7802726

Email Address: abnsyail@yahoo.com

3. Road Policies Implemented According to the Unique Environment and Challenges of Various Region

(1) Issues and Challenges in implementing policies for road development and traffic operation

Effective implementation of policies in road development and traffic operation in Indonesia faces a number of issues in relation to variation on geographical condition of Indonesia, environmental situations, traffic characteristics, and disaster areas. Indonesia is an archipelagic countries consisting over 13,600 islands, wherein the population are unevenly distributed. The distribution of movements is significantly different from one island to another. The availability of road network is following accordingly. Jawa and Sumatra, two of 5 major Islands in Indonesia, are considered beeing more developed than others. In these islands road transports is considered to be a domintant mode that contributes to 70% of freight movements and around 61% of passengers movement. Road network in these two islands are quite well connected. Major issues in these two islands include premature damage of road pavement, traffic congestion in major cities, high accident rates, and sudden road closure due to flood and slope failures.

In three other main islands, Sulawesi, Kalimantan, and Papua, the availability of road network are still quite limited. Except Sulawesi that enjoys the connection of Trans National at Western Coast, most part of these islands have only provided with limited local connection to facilitate movements within province. Other than Sulawesi, in Kalimantan and papua, the Trans National are being constructed. Major issues in these areas include the availability of standard road materials, environmental destructions in association with the presence of wide conservation areas, which brings in high-costs road construction. The challenge in this area is to find out the most appropriate specification for traffic situation and optimalising the use of local materials available in the area.

In smaller islands, except Bali and Lombok, road connections are relatively limited. Road development policy in these islands encounters high-costs and inefficiency problems due to the availability of materials, personnel, and equipments in the areas. Due to the priority of development budget, road developments in these islands are likely abandoned. Bali and Lombok are two islands which have been becoming international destination for tourisms, road developments in these islands are well supported by the development of tourisms and strong demands to connect tourism spots within the island. The efficiency of road development in these islands has been well proven even though the availability of road materials in these islands cannot sufficiently support the construction.

The general issue related to road development and traffic operation in Indonesia is significant gap between the provision of road infrastructure and increases in vehicle ownerships. Data issued by the Directorate General of Highways and Directorate General of Land Transportation (DGLC, Ministry of Transportation) showed that road length in Indonesia has increased by 4.79 % per year while vehicle ownerships increased by 36.94 % annually since 2001. Also, by category, increases in vehicle ownerships is mostly contributed by motorcycle ownerships which grows by 38.6 % on average per year in the last 5 years. This has caused great problem to safety level of road network.

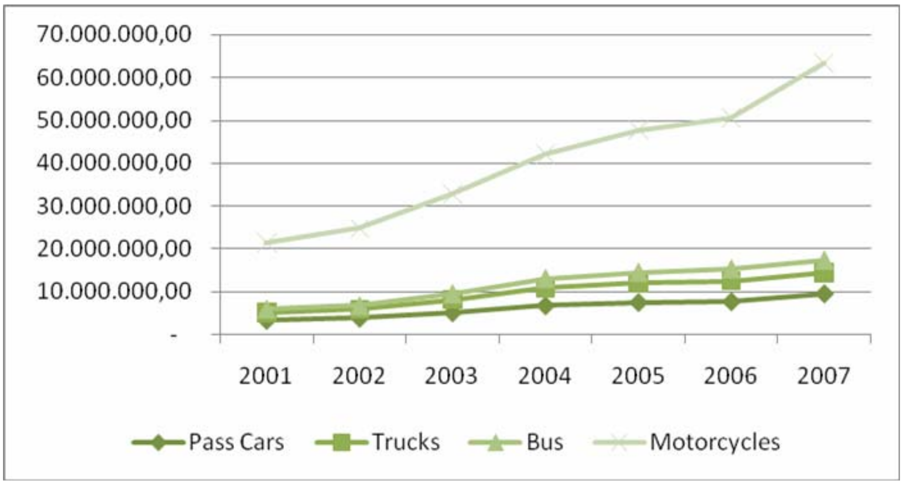


Figure 7 Changes in Vehicle Ownerships in Indonesia 2001-2007

In addition, Indonesia locates at the Pacific Ring of Fire, which is characterised by the chain of active volcanos between Asia and Australia plates. This makes Indonesia suffering from consistent earthquake, volcanic eruptions and landslides. The intensity of earthquake has been increasing in the last 4 years, which has also raised greater concern to the strength of bridges and other structures in Indonesia.

(2) Efforts and Innovation

Anticipating such conditions, the Institute has intensified research on a number of issues as tyhe following:

1) Roads for Sustainable Development
   i) Environmentally friendly roads
   ii) Reformulation Concept of Municipal Roads
   iii) Disaster Mitigation and Prevention
   iv) Safer Roads
   v) Tunnel
2) Technology for better Road Network to support the competitiveness of the nation
   i) Strategic Pavement Research
   ii) Buton Asphalt Pavement
   iii) Long Span Bridges
   iv) Intelligent Transport System
3) Low costs and Low Volume Roads
   i) Unpaved roads technology
   ii) Low-cost bridges
4) Reducing technological gaps by providing local based roads and bridges technology
   i) Road Material Inventory
   ii) Manual Development for the application of local materials and technology

A number of trials for new method and road specification has been undertaken. A number of new pavement specification using Buton Granular Asphalt (BGA) have been published, more environmentally friendly road construction using recycling and mining waste (tailing and slag) materials have been introduced as well as the use of rubber mixed asphalt and concrete. The institute has also introduce dedicated stopping space for motorcycle at the signalised intersection to allow for better accommodation of motorcycles at the intersection. In addition, the use of local materials as substitute of standard aggregates has been on trial in Central Kalimantan since 2007. Through such field trials, the institute could help the acceleration of road development in Indonesia.

For near future, the institute has set up a number of research roadmaps to enable greater support in answering actual global problem, such as climate changes, road safety, MDGs in infrastructure development. A number of technology innovations in road construction and operation are expected delivered from these plans.

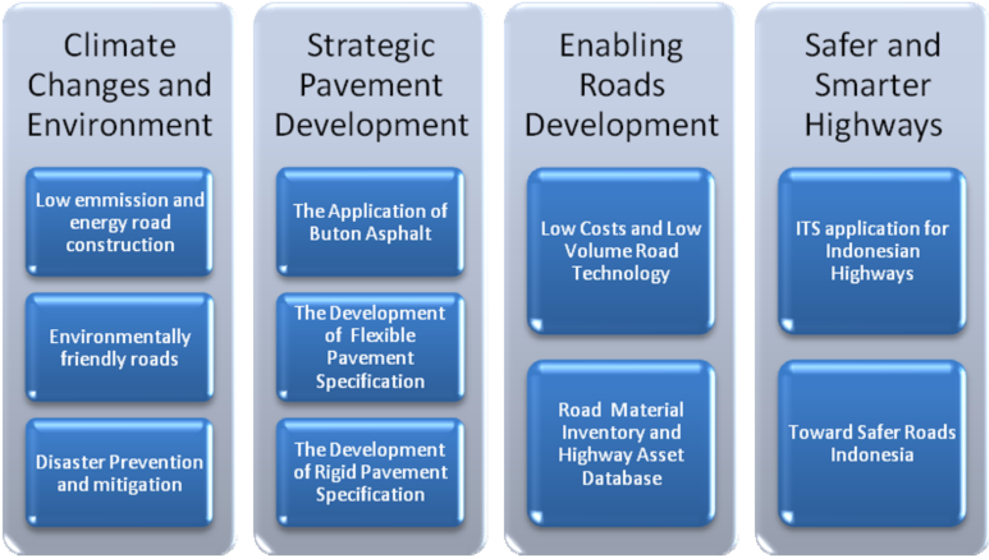


Figure 8 Research Focus of RDCRB 2010-2014

3. The Republic of Indonesia

Mr. Nudin Samaila SIKKI

JICA GROUP TRAINING COURSE ON INFRASTRUCTURE DEVELOPMENT AND MANAGEMENT (JFY 2009)

INCEPTION REPORTS

Name	**NURDIN SAMAILA, IR., MSi.**
Country	Indonesia
Organisation	Directorate General of Highways, Ministry of Public Works
Position	Head of National Road Implementation Body (Balai Besar Pelaksanaan Jalan Nasional VI Makassar)

Summary

The role of National Road Implementation Body (Balai Besar Pelaksanaan Jalan Nasional – BBPJN) in road development is ensuring the implementation of road construction in a proper manner inline with the Indonesian government rule and provisions of the technical specification of the Directorate General of Highways. As the Head of the National Road Implementation Body VI of Makassar (BBPJN VI Makassar), I am responsible to lead the Body in achieving a good quality and performance of national road in six (6) provinces in Sulawesi Island. In achieving goals of the body the main task covering design and supervision, implementation and controlling, and quality tests in the development and maintenance of roads. In addition to that task the body also provide services in the supply of road and bridge material and road equipment.

There are ten (10) National Road Implementation Body throughout the country, consiting of seven (8) large bodies (BBPJN) and three (2) small bodies (BPJN). Under BBPJN VI Makassar there are six (6) Provinces consisting of North Sulawesi, Gorontalo, South Sulawesi, Centre Sulawesi, South East Sulawesi and West Sulawesi province. covering of 7.091 Kms of national road laying throughout Sulawesi. The body has responsibility to preserve and maintain the road length of national road every year in order to serve goods transportation and people movement from one place to an other.

1. Organisation of BBPJN :

   (1) Name of Organisation : National Road Implementation Body (Balai Besar Pelaksanaan Jalan nasional VI Makassar, BBPJN VI Makassar)

(2) Summary of Organisation:

Balai Besar Pelaksanaan Jalan Nasional is a Unit of Technical Implementation of national road under Directorat General of Highway. There are 10 Units throughout the country, eight units of type A and two units of type B. These are regional bodies of national road established to ensure that the implementation of road infrastructure fulfill technical specification and meets the necessity of each region in Indonesia.

The BBPJN is a young body owned by the Directorate General of Highway Ministry of Public Works of Indonesia for the effective and efficient implementation of national road. The Units started in early 2007 with the limitation of resources, up to now the requirement of the resources especially human resources including office fasility is still set up, good coordination and cooperation with local government is also need to be build. Main tasks of the BBPJN namely :

1. Provide data and information for planning and programming of national road under its jurisdiction.
2. Conducting design, supervision and implementation on the development of national road and bridges construction, and maintenance/preservation throughout the year.
3. Implementation of quality management system for the implementation of roads and bridges.
4. Provision, utilization, storing and maintenance of road and bridge material and equipment, and carrying out quality testing of construction.
5. Administration of personnel, organization and job description, finance, state asset and carrying out coordination with local public works and related institution.
6. BBPJN VI Makassar covering national road in six (6) Provinces in the island of Sulawesi, covering North Sulawesi, Gorontalo, South Sulawesi, Centre Sulawesi, South East Sulawesi and West Sulawesi. Length of national roads under BBPJN VI responsibility are 7,091.50 Kms of road laying throughout Sulawesi.

The areas, length of national roads and the amount of population of each province in the island of Sulawesi under the BBPJN VI Makassar is summarized as follows :

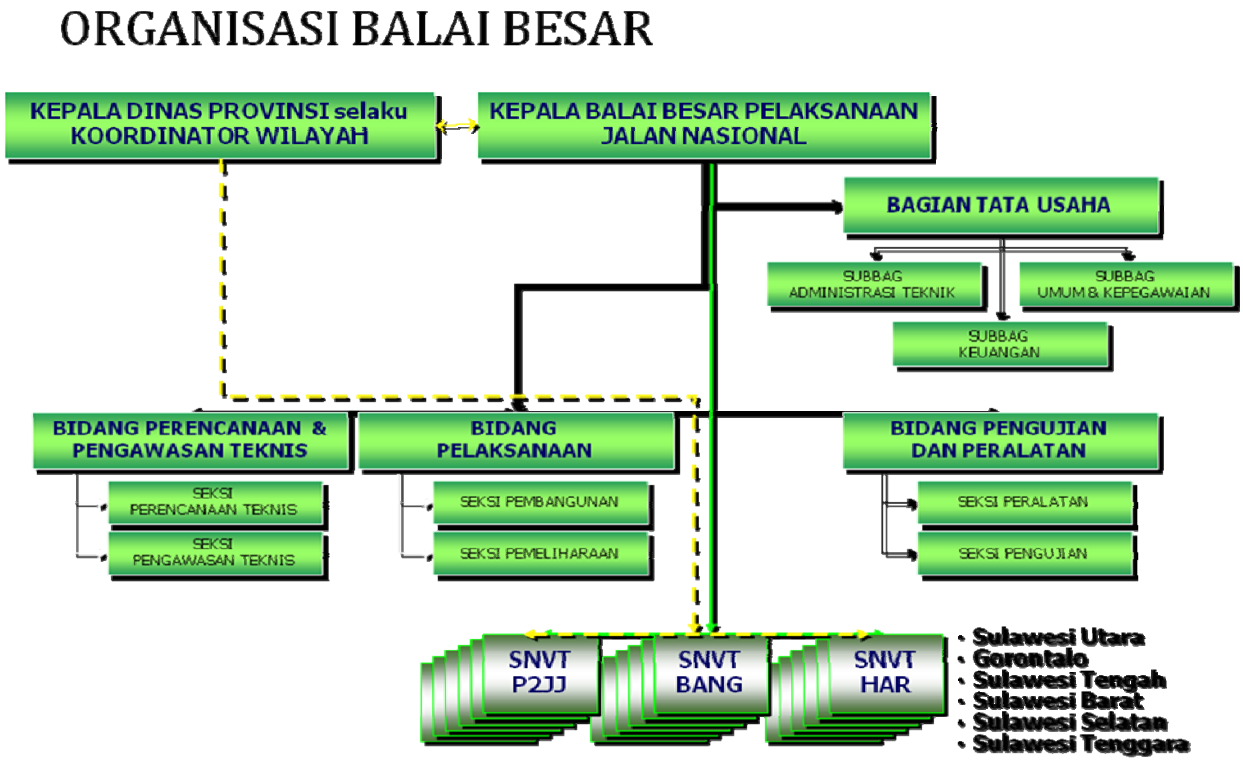
1.	North Sulawesi	: 13.930.73 Km2	/ 1.267,39 Km	/ 12.333.974 People
2.	Gorontalo	: 12.165,44 Km2	/ 616,24 Km	/ 916.488 People
3.	South Sulawesi	: 6.116,45 Km2	/ 1.556,13 Km	/ 7.475.882 People
4.	Central Sulawesi	: 68.089,83 Km2	/ 1.806,46 Km	/ 2.324.025 People
5.	South East Sulawesi	: 36.757,45 Km2	/ 1.293,87 Km	/ 1.965.958 People
6.	West Sulawesi	: 42.224,65 Km2	/ 551,41 Km	/ 966.535 People
	Total Sulawesi	**: 19.284,55 Km2**	**/ 7.091,50 Km**	**/ 25.982.862 People**

In each province there are three units of project, ie :
1. Design and Supervision Project Unit
2. Road Development Project Unit
3. Preservation/Maintenance Project Unit

The operation of BBPJN is mainly funded by Indonesian Government from the Ministry's budget (APBN). In Fiscal Year 2009 BBPJN VI Makassar managed 2.007 Billion IDR budget. The budget were allocated for three national road programs, namely design & supervision, road development and preservation/maintenance of road. The following figure provides proportion of each activity for Fiscal Year 2009 program.

1.	Design & Supervision	: Rp. 81,420,371,000
2.	Road Development	: Rp. 1,433,882,540,000
3.	Preservation/Maintenance	: Rp. 4,852,188,995,000
4.	SKPD	: Rp. 68,280,628,000
	Amount of Budget FY 2009	: Rp. 2,077,370,114,000

(4) Organisation Structure of the BBPJN VI Makassar :



The BBPJN also runs laboratory of material and construction testing consisting of asphalt, concrete and soil material for road and bridges.

National Road Implementation Body is designated to support the Ministry of Public Works in managing roads and bridges in Indonesia, especially in relation to design, supervision, construction and preservation tasks.

2. Personal Data

(1) Recent Work

I have been joining the Ministry of Public Works for over 29 years when I completed my bachelor degree in Civil Engineering in Makassar. I started my carrier as a field Staff of the project, responsible in construction supervision in Mid 1982's. Since then I have gradually improved my education to a full engineer and then took my master degree in Engineering Science in Makassar in 2002 My carrier had also been gradually improved being civil engineer, chief of engineering Section (1993 - 2001), vice of head of provincial Public Works (2005 - 2006), before I was promoted to be a Head of the National Road Implementation Body VI in Makassar (Balai Besar Pelaksanaan Jalan Nasional - BBPJN VI Makassar) in 2007.

In the last three years I have focused my work in improving the performance of the BBPJN VI Makassar in providing national road management and disseminating relevant provisions relating to the development of road and bridge. It was aimed at improving the quality and performance of road and bridges constructions.

(2) Contact Address:

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Office Phone Number: +62 411 442673

Fax: +62 411 431877

Email Address: balaibesarmakassar@yahoo.co.id

3. Road Policies Implemented According to the Unique Environment and Challenges in Sulawesi Region

(1) Issues and Challenges in implementing policies for road development and traffic operation

Effective implementation of policies in road development and traffic operation in Indonesia faces a number of issues in relation to variation on geographical condition of Indonesia, environmental situations, traffic characteristics, and disaster areas. Indonesia is an archipelagic countries consisting over 13,600 islands, wherein the population are unevenly distributed. The distribution of movements is significantly different from one island to another. The availability of road network is following accordingly. Major issues include premature damage of road pavement, traffic congestion in major cities, high accident rates, and sudden road closure due to flood and slope failures.

In the islands of Sulawesi the availability of road network are still quite limited. Sulawesi enjoys the connection of Trans National at Western Coast, most part of these islands have only provided with limited local connection to facilitate movements within province. In smaller islands road connections are relatively limited. Road development policy in these islands encounters high-costs and inefficiency problems due to the availability of materials, personnel, and equipments in the areas. Due to the priority of development budget, road developments in these islands are likely abandoned.

(2) Efforts and Innovation

Anticipating such conditions, the BBPJN VI Makassar has initiated a number of activities as the followings:

1) Conducting of Training Staff :
   i) Laboratory Training
   ii) Pavement Material
   iii) Buton Asphalt Pavement
   iv) Utilization of Heavy Equipment
   v) Asphalt Mixing Plan
2) Decimination and Socialization :
   i) Road Safety
   ii) Bridge Inspection
   iii) Quality Management System

3) Participation in Seminar and Workshop :
   i) Road Maintenance Management
   ii) Bridge Material
   iii) Quality Management System

4. The Union of Myanmar

Mr. Tint WIN

SEMINAR ON
INFRASTRUCTURE DEVELOPMENT AND MANAGEMENT

COURSE NO J-09-00920

INCEPTION REPORT

Submitted by

WIN TINT

CHIEF ENGINEER (CIVIL)

ROAD AND BUILDING DEPARTMENT

PUBLIC WORKS

MINISTRY OF CONSTRUCTION

MYANMAR.

DATE: 1.10.2009

INCEPTION REPORT ON

INFRASTRUCTURE DEVELOPMENT AND MANAGEMENT

INCEPTION REPORT ON

INFRASTRUCTURE DEVELOPMENT AND MANAGEMENT

1. Introduction

1.1. Map of Myanmar

1.2. Geography of Myanmar

Myanmar in geographically located at the cross roads between East and West, North and South of Asia continent, serving a natural link between in Asian countries. With the total land area of 676577 square kilometers, Myanmar stands as the longest Country in the Indochina Peninsual, Sharing borders with Bangladesh, India, China, Lao and Thailand and possessing coastal lines by Andaman Sea and Bay of Bengal in the South.

The climate in divided into two main climatic zones, a dry tropical zone in upper Myanmar and a humid tropical zone in lower Myanmar. Rain fall intensities are lower in upper Myanmar (less than 40") in contrast to 80 to 172 inches in lower Myanmar. Monthly mean temperature ranges from 13°C to 33°C. Myanmar has three seasons, summer, rainy and winter. Summer season starts from middle of January to middle of May, rainy seasons from middle of May to middle of September and from middle of September to middle of January is winter season.

1.3. Curriculum Vitae of Participant

(a)	Name	Mr. Win Tint
(b)	Date of Birth	15.6.1960
(c)	Ethnic Race	Myanmar
(d)	Qualification Status	A.G.T.I (Civil) Diploma B.E (Civil)
(e)	Position (Rank)	Chief Engineer (Civil)
(f)	Department	Public Works
(g)	Organization	Ministry of Construction
(h)	Country	Union of Myanmar

1.4. Contact Address

(a)	Office address	Building Department Ministry of Construction Nay Pyi Taw, Myanmar.
(b)	Phone Number	95-67-407424 95-01-534710
(c)	Fax Number	95-67-407065
(d)	Email	wintint2000@gmail.com

2. Development and Administration of Roads in Myanmar

Smooth transportation plays a key role in development of a region. Better transportation will contribute to trade promotion and improvement of socio-economic standard of the local people.

In transportation sector, road transport is more important than other means of transport such as rail, air and water transport.

As such, the State Peace and Development Council has laid down plans for construction of roads and bridges.

Myanmar is surrounded by high snow-capped mountains and offshore seas in addition to rivers such as Ayeyawady, Chindwin, Thanlwin and Sittoung which runs from north to south. Moreover, there are also mountain ranges situated along north-south.

At present, the road and bridge networks have emerged across the nation from the east to the west and from the north to the south.

According to 2008 Record, the followings are miles of road built by the ministries concerned.

No	Subjects	M / F
1.	Public Works, Ministry of Construction	19313 / 7
2.	Ministry for Progress of Border Areas and National Races and Development Affairs.	51843 / 4
3.	Yangon City Development Committee	1951 / 6
4.	Mandalay City Development Committee	605 / 4
5.	Nay Pyi Taw Development Committee	334 / 2
6.	Directorate of Military Engineers of the Ministry of Defence	4296 / 3
	Total	**78345 / 2**

3. My Organization

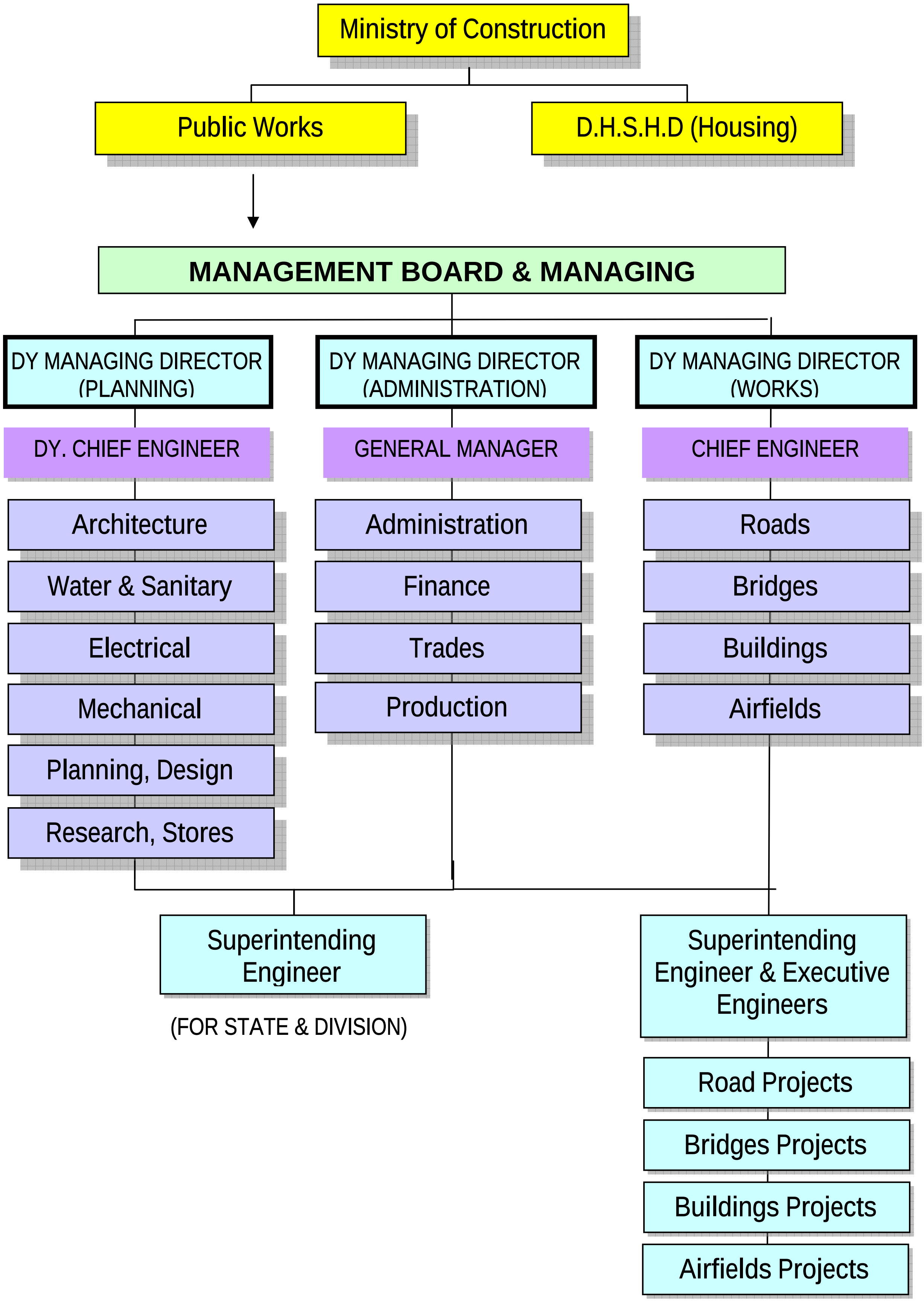
My organization, Public Works under the Ministry of Construction is an organization which is responsible for Construction and Maintenance of roads, airfields, bridges and buildings all over the country.

Overall management responsibilities are vested in Managing Director who reports directly to Deputy Ministers and Minister and is advised by Management Board. Managing Director is assisted by three Deputy Managing Directors, Administration, Planning and Works.

There are Chief Engineers, Deputy Chief Engineers and Superintending Engineers to assist Deputy Managing Director (Works). At the Main Office, sections concerned with pre-engineering works, design and budget are working under Deputy Managing Director (Works). I am one of the Chief Engineers.

Road department (group of road sections) is under Deputy Managing Director (Works). There are five road sections which are responsible for Planning, Finance, Statistics, Road Design and Road Research Laboratory, each section is headed by an Executive Engineer. Public Works' Organization Chart is presented in the Appendix.

4. Organization Chart



5. Duty and Responsibility

- I am chief Engineer from Public Works, Ministry of Construction. I am undertaking and supervising the construction and maintenance of Roads, Bridges and Buildings all over the country.

- I am now supervising the projects implemented in states and Division for completion in time and specification with the field engineers and project engineers.

- I have to submit progress report on road network of Delta region in Ayeyarwady Division to MD, Deputy Minister and Minister of MOC.

- I have to recommend for allotment made by site engineers, project engineers and command engineers of State an Division.

- I am responsible for directing and controlling, both technically and financially, the project engineers who are executing road maintenance rehabilitation and construction works all over the country.

6. Organization Position in Government and The Role of Public Work

Public Works Corporation was established in 1965 after the merger of Highway Department set up in 1952 and 21 Civil Engineering Departments under other ministries. It was recognized as Construction Corporation (CC) in 1972 and Public Works emerged on 1 April, 1988.

The Ministry of Construction has expedited building new roads and upgrading existing ones year after year. Although there were 13635 miles of road in 1988, there were 19999 miles and one furlong in 2009. A total 984 miles of mule tracks are being maintained.

In the past, the Ministry of Construction took responsibility for maintenance of 11 highways stretching 2452 miles in total length.

With a view to undertaking improvement of economic, social, administration and national unity and development, a total of 36 highways from the north to the south of the nation and 45 highways from the east to the west, totalling 81 roads stretching 15344 miles long have been constructed throughout the nation. All these facilities become Union Highways.

A total of 1411 miles of strategic roads are also constructed by Public Works.

With a view to enabling the Ministry of Construction to effectively carry out the secure and smooth transportation assigned by the State Peace and Development Council, Public Works and Private Entrepreneurs are implementing the rehabilitation of the 19 roads through the Build, Operate & Transfer System.

In the last year, the budget allotment for construction of new roads and bridges is (88363.509) K in Million and for rehabilitation works the allotment was (26596.8) K in Million.

7. Present and Past Experiences

At present, I am responsible for directing and controlling, both technically and financially, the project engineers who are executing road maintenance, rehabilitation and construction works all over the country.

In the past three years, I was Executive Engineer of Special Road Construction Unit (15). I was responsible for management of rehabilitation works along two highways, Yangon-Phya Road and Yangon-Pegu road.

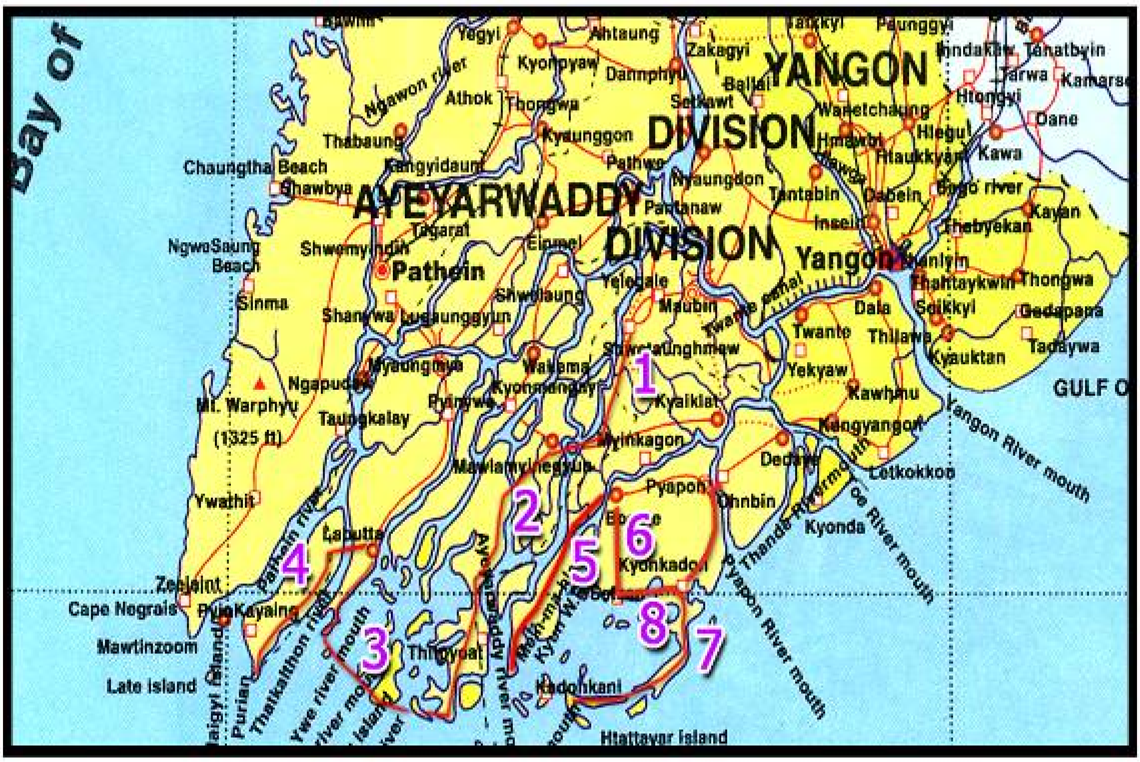
Yangon-Phya road is 175 miles long. It is two lanes asphalt concrete road. Yangon-Pegu road is six lanes road and it is about 60 miles long. I have to maintain and rehabilitate these roads so that traffic can flow smoothly.

Our budget year starts at 1st April. To get budget allotment for maintenance and rehabilitation works, estimates were made based on road inventory and condition of the roads. Traffic survey, axle load survey and road condition survey were made before the starts of the new budget year. In our organization, there is Road Research Laboratory which is responsible for road testing and road structure design. After investigation of roads, Road research Laboratory submitted design for rehabilitation works. Estimates with traffic survey and axle load survey data, road condition chart, work program together with rehabilitation design, are submitted to Head Quarter through Command Engineer of State or Division. This estimate is for routine maintenance and rehabilitation works.

Funds are also available for special maintenance which is required for slope failures in mountainous areas or failure of roads due to heavy rain or overloading of trucks which crossed the road.

8. Delta Region Road Network Development Project in Ayeyawady Division

In accord with the guidance given by the Head of State on his tour of Ayeyawady Division on 21.5.2008, Public Works of the Ministry of Construction commenced implementation of the Road Network Development Project by building five roads. At present, the region has eight roads in the road network including three routes.



(1)	Maubin - Yaylegale - Shwetaunghmaw - Kyaikpi - Mawlamyinegyun Road	43 M 5 F
(2)	Mawlamyinegyun - Hlinephone - Thitpok - Kwinkauk - Pyinsalu Road	69 M 3 F
(3)	Labutta - Thingangyi - Pyinsalu Road	35 M 2 F
(4)	Labutta - Thongwa - Ottwin - Hteiksun Road	39 M 0 F
(5)	Bogale - Kyeinchaung - Kadonkani Road	41 M 2 F
(6)	Bogale - Setsan - Htawpaing - Amar Road	38 M 5 F
(7)	Pyapon - Kyonkadun - Daw Nyein Amar Road	51 M 5 F
(8)	Kyonkadun - Setsan Road	19 M 1 F
	Total	337 M 7 F

9. Road Policies to be Implemented

Geometric Designs are made based on annual average daily traffic and specification of road class adopted from the specified Geometric Design Standards. That is geometry requirement of roads for safety and smooth flow of the traffic.

Road Structure Design is made based on subgrade strength, layer strength and traffic loading expected during the design life.

During the past 4 or 5 years, for some reasons, most of the constructed or rehabilitated roads failed prematurely. The maintenance cost is very high. Some of the roads have to be reconstructed. We are trying to find the causes.

As mentioned in section (5), roads are important in developing the country. Smooth transport and transportation of goods to destinations in a short time are relied on the following points:-

- building roads according to the designs and the standard set,
- driving vehicles in compliance with the directives of automobile producing organizations, and with that of road designing bodies.

There has been a remarkable increase in vehicles in Myanmar. The expense on maintenance of roads is estimated to be 25% of road construction cost if the roads are built in line with the standard set. Otherwise, the expense of maintenance will be higher. The cost of using vehicles forms major part of transporting charges. So, if this can be reduced, transportation charges, commodity prices and fares will fall down. The cost in use of vehicles will decrease if roads are fine, and goods can be transported to the destinations in a short time.

In every country, road engineers have to honour the set designs and standards in building roads to minimize the damage of roads. In addition, they have to enforce traffic rules for vehicles in coordination with the organization concerned (for example in our country, the Directorate of Road Administration, the Traffic Police Force and Local Authorities) in order that the pressure put by vehicles is in the limit of road withstanding.

It is required to transport more goods with fewer vehicles for ensuring swift flow of commodities. On the other hand, that can cause adverse effect on the roads, so new designs are to be sought to reduce the pressure of the vehicles to minimize road damage.

New designs were also introduced to avert unnecessary damage to vehicles (bodies and lower structures) and overturning of vehicles due to overweight. Therefore, if the vehicle is overloaded,

- the road will be damaged,
- the vehicle's body and its lower structure will be deteriorate and
- the vehicle will overturn resulting from loss of proper control.

Now, owners, seeking own interests, have come to load trucks with excessive goods from 60 tons to 100 tons by strengthening leaf springs and frames, expanding bodies, widening side frames and using different tyres.

In a short run, they can make greater profit, but in the long run, they will face a variety of unnecessary consequences: the treads of wheels become worn and cracked easily; frames and leaf springs are broken; it takes longer than due time; there may be damage to goods, it poses dangers to the driver, people near the roads and surrounding areas and passengers; and the engines can be damaged easily due to overloads, and damage to roads.

Through AASHTO Road Test conducted in 1962, interrelation between total weight, number of axles and road damage was discovered. In the past, in road structure design, the number of trucks with wheel weighing 5000 lbs and subgrade strength during the design life were considered.

However, now roads are designed using Standard Axle Load (18000 lbs) owing to sharp increase in the number of types and vehicles. In this process, Damaging Factor found out in AASHTO Road Test (US) is standardized.

The damaging factor shows how many more times a vehicle can damage to the road than caused by Standard Axle Load.

$$\text{Damaging Factor} = (\text{Axle Load of Vehicle / Standard Axle Load})^{4 \text{ to } 4.55}$$

According to damaging factor, if the load of the front axle of a 13 tons TE-11 is 7722 lbs. and that of the rear axle, 20878 lbs the damaging factor of the front axle is 0.023 and the damaging factor of the rear axle, 1.964 in accord with the relationship formula to the damaging factor. The total damaging factor is 1.985.

If approximately the factor is 2.0, it can be defined that damage caused by 13 tons truck is equivalent to twice the damage caused by a standard axle.

If the load of the front axle of 60 tons truck with three axles is 34320 lbs and the middle axle, 55440 lbs and that of the rear axle, 42240 lbs, the total damaging factor is 234.399.

Compared with a 13 tons truck and 60 ton truck, it can be concluded that by running a 60 tons truck is equivalent to damage caused by running 118 numbers of 13 tons truck. (234.399/1.985=118)

Now, in other countries, there are limitations on vehicles with high damaging factor in order not to increase the damaging factor. The following ways are used in prescribing limits:

(1) Prescribing limits on type of vehicles, number of axles and axle load.
(2) Prescribing legal axle load limit.

Today's trucks running on motorways in Myanmar -

It is seen that a two axle fixed truck carries from 13 to 20 tons of load, a 3 axle fixed truck from 20 to 60 tons of load and four axle fixed truck from 30 to 80 tons of load and five axle fixed truck from 40 to 100 tons of load approximately.

To reduce the damages caused by vehicles on the roads and to reduce transportation cost, at present, the Government is trying to educate the road users by publishing literatures concerning road design and factors affecting the performance of roads, in a very simplified way, in news paper (See Appendix I, II, III and IV).

With the consultation of the Road Engineers, the government will implement policies in the near future, to control axle load of the vehicles and to enforce laws so that vehicles are used following the manufacturer's requirements.

We have also tried to reduce the construction cost by adopting stage construction method. Not really successful, because, due to shortage of funds, construction could not be executed as planned.

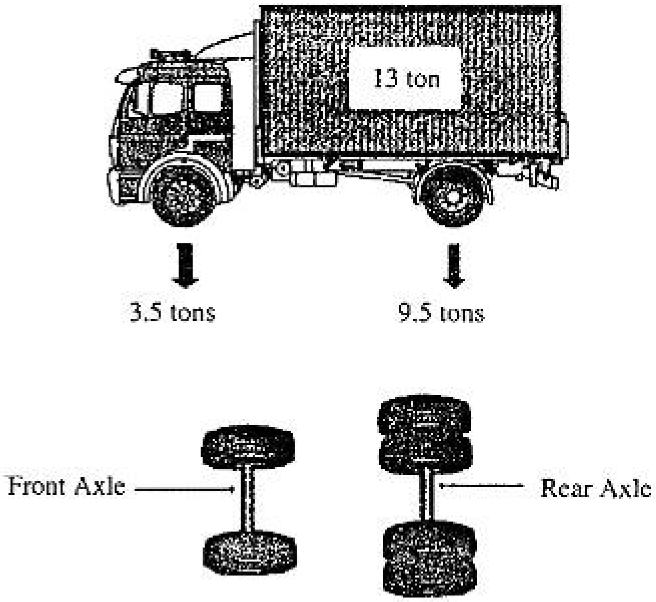
We also have tried to reduce the traffic loading. One way of reducing the traffic loading is to widen the road. If fund is not available for widening, the hard shoulder is constructed as temporary widening.

It is felt that, from this training, road policies for road development and traffic operation exercised in other countries will be learnt. Pavement Management System and Maintenance Management System are also essential for our country.

Annexes - I

Two – axle – fixed vehicle (vehicle + load = 13 tons)

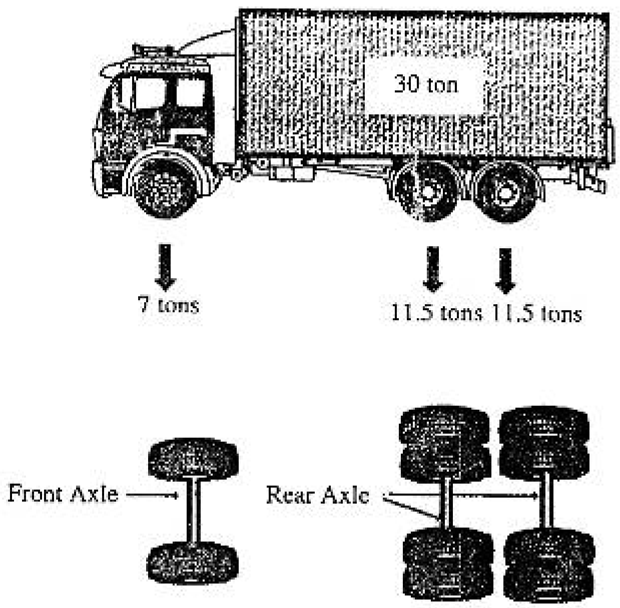
(Six – wheel vehicle in non – technical term)



(Figure-1)

Three – axle – fixed vehicle (vehicle + load = 30 tons)

(10 – wheel vehicle in non – technical term)

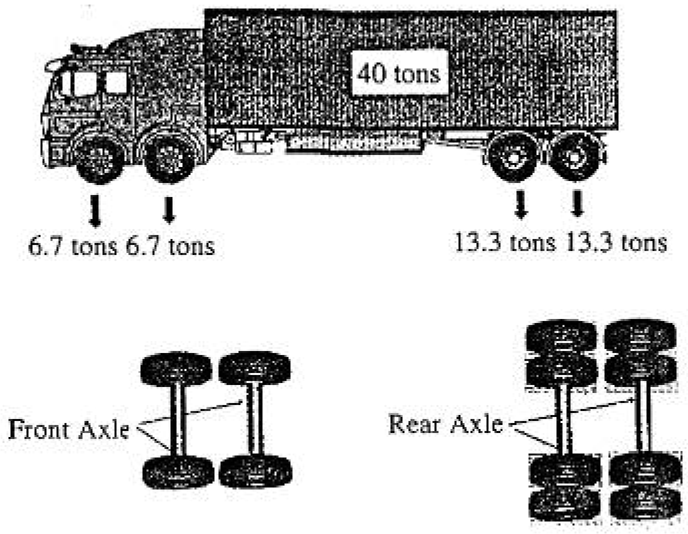


(Figure-2)

Annexes - II

Four – axle – fixed fabricated vehicle (vehicle + load = 40 tons)

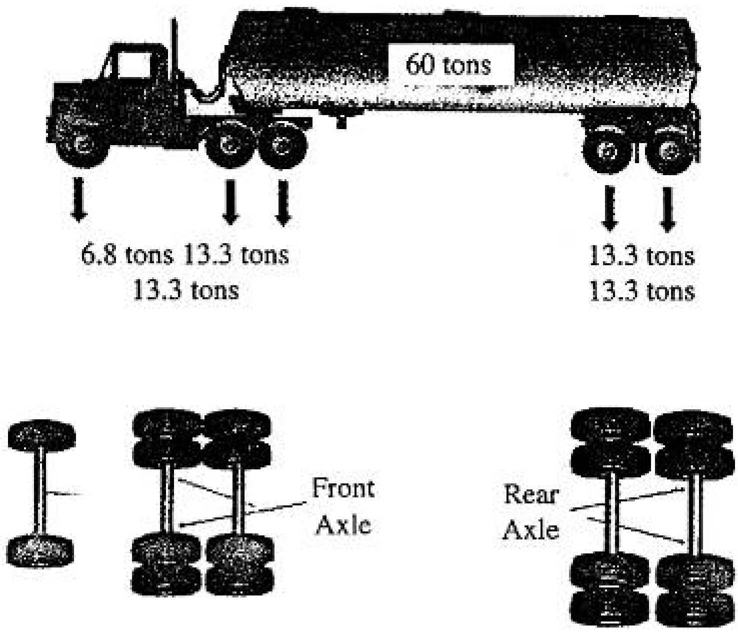
(12 – wheel vehicle in non – technical term)



(Figure-3)

Five – axle – fixed fabricated vehicle (vehicle + load = 60 tons)

(18 – wheel vehicle in non – technical term)



(Figure-4)

Annexes – III

A truck with overload of goods seen on a road

A vehicle overloaded with sawn timber seen on the road

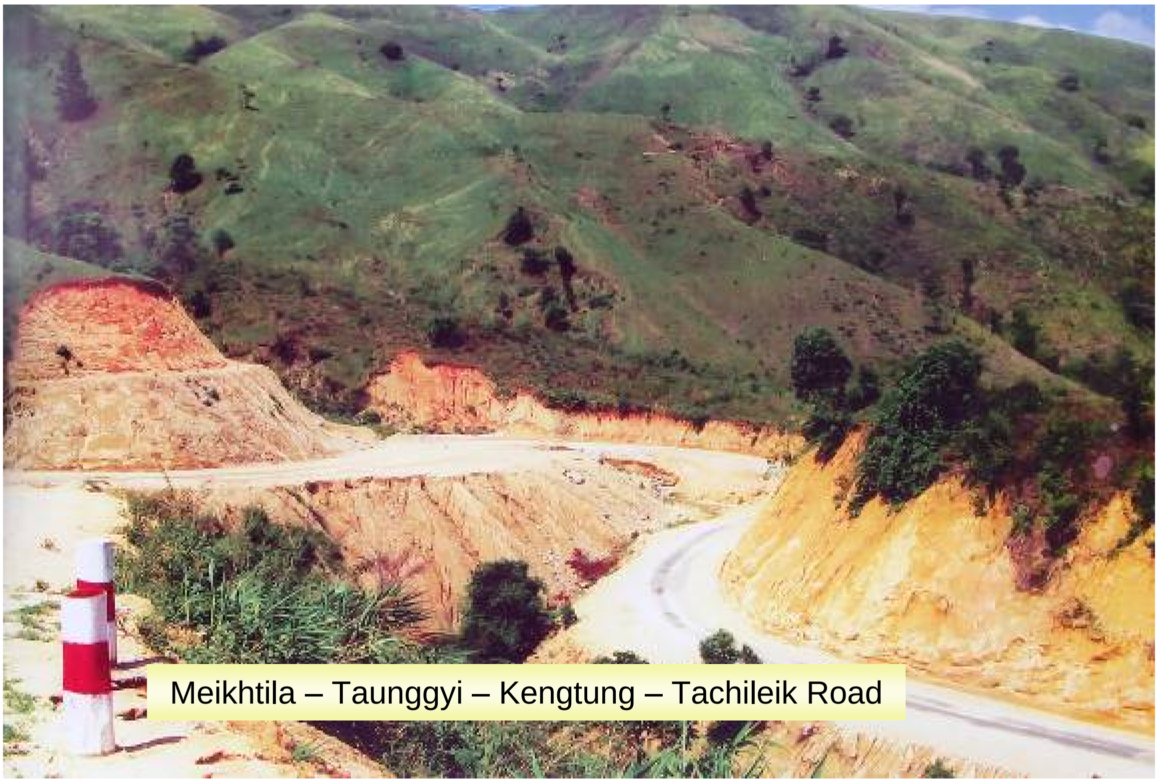
Annexes – IV

Photo shows trucks overloaded with timber logs.

Photo shows trucks overloaded with R.S.J

Road Construction

Ministry of Construction
Public Work



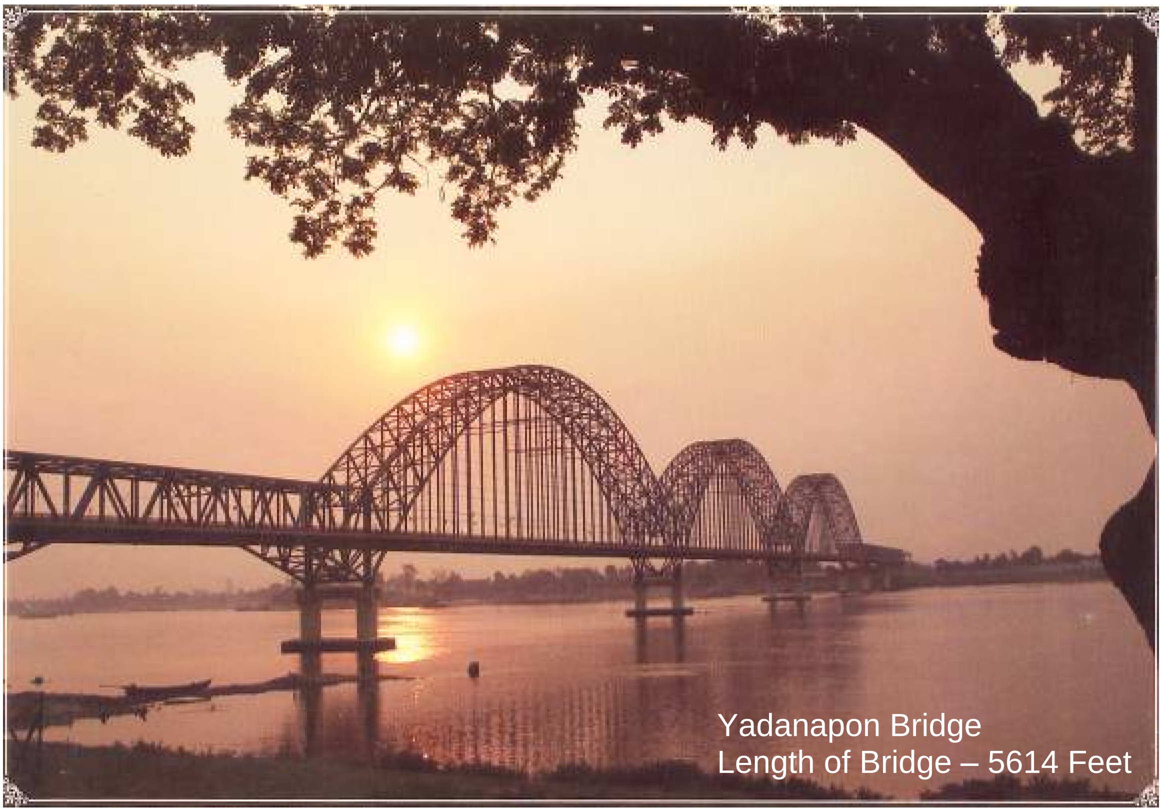
Meikhtila – Taunggyi – Kengtung – Tachileik Road

Yangon – Mandalay Express Road

Bridges Construction

Ministry of Construction
Public Work

Thanlwin Bridge (Mawlamyaing)
Length of Bridge – 11575 Feet



Yadanapon Bridge
Length of Bridge – 5614 Feet

Buildings Construction

Ministry of Construction
Public Work

Maw Tin Tower

Junction Center - Naypyitaw

Airfields Construction

Ministry of Construction
Public Work

Extension of Runway at Kauthoung Airport

Yangon International Airfields Runway Construction Works

V LECTURE NOTES

1. Keynote Lecture
“Highway Capacity, Operation and Congestion in Japan“

Dr. Eng. Takashi OGUCHI

Highway Capacity, Operation and Congestion in Japan

in The 18th Conference
on Public Works Research and Development in Asia

by **OGUCHI, Takashi**

Professor at
Department of Civil and Environmental Engineering,
Tokyo Metropolitan University

WEB site http://www.comp.tmu.ac.jp/ceeipogc/

Contents

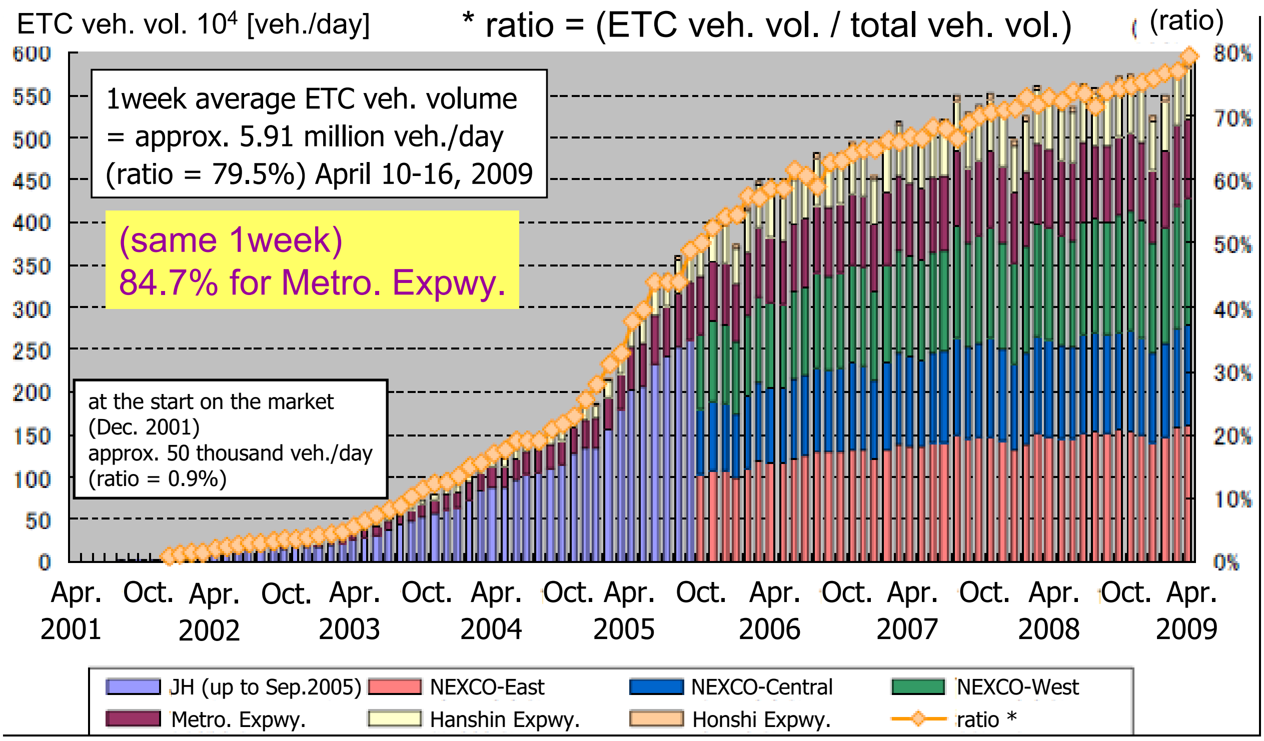
I. An overview on capacity and quality of service studies in Japan
- ✓ country report in ISHC2006 (Yokohama)

II. Effects of auxiliary lanes upstream bottleneck sag sections on expressways
- ✓ Typical JPN's bottleneck phenomena on Expressways
  - ✓ presented in ISFO2009 (Honolulu)

III. Emission model in actual vehicular traffic conditions
- ✓ CO_2 estimation method considering traffic condition
  - ✓ presented at EPFL (Lausanne, Suisse)

ETC (Electronic Toll Collection system) History in JPN

April 16, 2009 report: http://www.mlit.go.jp/road/yuryo/riyou.pdf



I. An overview on capacity and quality of service studies in Japan

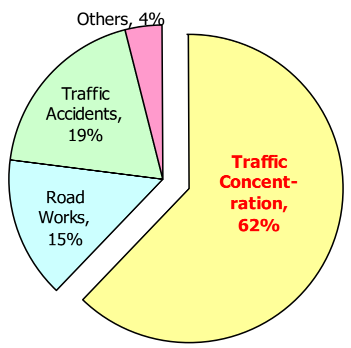
Contents

1. Actual Conditions of “Observed” Capacity
2. Bottleneck Phenomena in Basic Sections of Intercity Expressways
3. Empirical Studies on Bottleneck Phenomena
4. Mechanisms of the Bottleneck Phenomena and Its Corresponding Countermeasures
5. Merging Capacity at the Tokyo Metropolitan Expressway
6. Research in the Capacity of Signalized Intersections
7. Research on Unsignalized Intersections
8. Research and Practice on Quality of Service

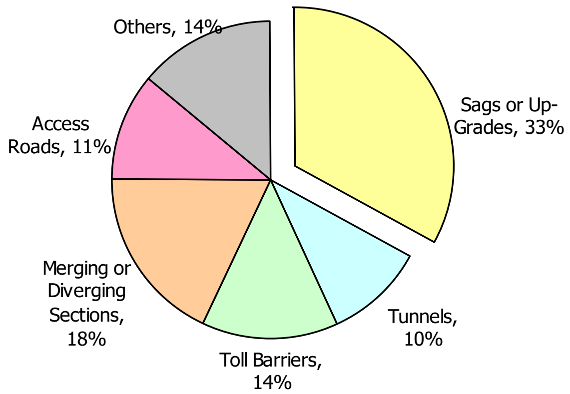
1. Actual Conditions of "Observed" Capacity - Ordinary Highways (JSTE 2006)

- ✓ The average of observed maximum hourly traffic volume by detectors
  - ✓ Multilane highways (4- or 6-lane)
    - ✓ 2,130 pc/h/ln
  - ✓ Two-way, two-lane (TWTL) highways
    - ✓ Directional: 1,650pc/h
    - ✓ Two-way: 2,900pc/h
- ✓ Just the “observed maximum”, the actual capacity of these sections might be higher
  - ✓ Observed by individually placed detectors of limited numbers

1. Actual Conditions of "Observed" Capacity - Intercity Expressways



Ratio of number of traffic congestion occurrences on intercity expressways by cause in 2003 (JH 2004)



Ratio of number of bottleneck points on expressways by factor in 2003 (JSTE 2006)

- ✓ Remarkable features of congestion on Japanese intercity expressways
  - ✓ Due to “traffic concentration”: congestion caused by the convergence of traffic demand to a bottleneck section
  - ✓ Frequent congestion occurrences at sag and up-grade bottlenecks of basic segments

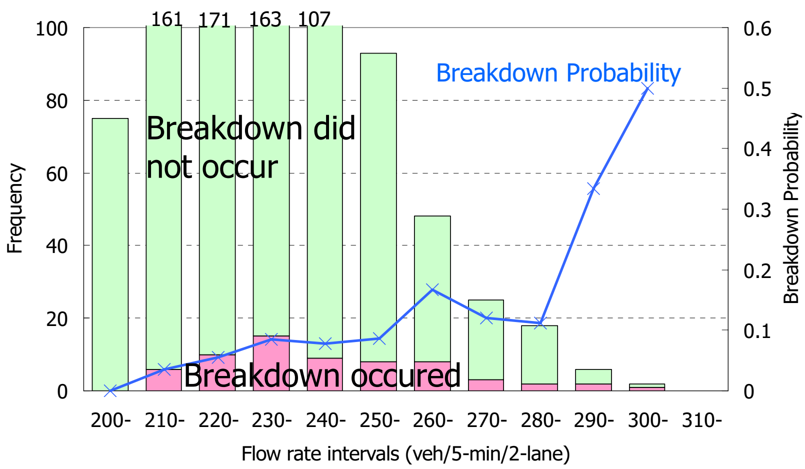
2. Bottleneck Phenomena in Basic Sections of Intercity Expressways

- ✓ Traffic flow characteristics in basic segments with sags (KOSHI 1985; 1986, KOSHI et al. 1992)
  - ✓ Bottleneck flow rate before congestion occurs
    - ✓ Median lane flow rate ≈ 1,800 to 2,000 veh/h/lane
    - ✓ While the maximum flow rate ≈ 3,000 to 3,500 veh/h/2-lane
      → median lane flow > shoulder lane flow
  - ✓ After breakdown
    - ✓ The flow rates for both lanes become almost equal
    - ✓ The capacity flow rate is reduced to 2,200 to 2,700 veh/h/2-lane

3. Empirical Studies on Bottleneck Phenomena

- ✓ Breakdown probability at bottlenecks of intercity expressway basic sections (OGUCHI 2004)

- Breakdown flow rates widely range from 210 to 300 veh/5-min/2-lane
- The breakdown probability of 300 veh/5-min/2-lane (the highest attained traffic flow rate) is only 50%



↗ **Frequency distribution and breakdown probability**

3. Empirical Studies on Bottleneck Phenomena

- ✓ Analysis on the general characteristics of breakdown probability (OKAMURA H. et al. 2001)
  - ✓ A stochastic procedure for estimating capacity by a cumulative percentile value of the probability, approximated by a quadric curve
  - ✓ The more number of lanes a basic expressway section has, the higher its lane capacity becomes
    - ✓ Lane capacity ratios

      1-lane : 2-lane : 3-lane sections ≈ 0.4 : 1.0 : 1.7
  - ✓ Shoulder lane widths ranging from 0.3 to 2.5m do not affect the bottleneck capacity

3. Empirical Studies on Bottleneck Phenomena

- ✓ Bottlenecks in "divided TWTL expressway" basic sections
  - ✓ Sections with low forecasted traffic demands are provisionally operated as TWTL facilities on single carriageways
  - ✓ Capacity analysis of TWTL expressway sections (YOSHIKAWA et al. 2004)
    - ✓ Flow rates before a breakdown: 1,100 to 1,180 vphpl
    - ✓ Discharge flow rates from front end of queues: 950 to 1,050 vphpl

    →lower than those of multilane sections

TWTL Expressway Sections

3. Empirical Studies on Bottleneck Phenomena

- ✓ Variable message signs
  - ✓ Likely to pay extra attention to these signs than usual
    - ✓ Driver behavior could result in speed reductions and increases in vehicle spacings (NAKASHIBA et al. 1997, WATANABE and NAKAMURA, 2004)

↗ **Variable graphic signboard**

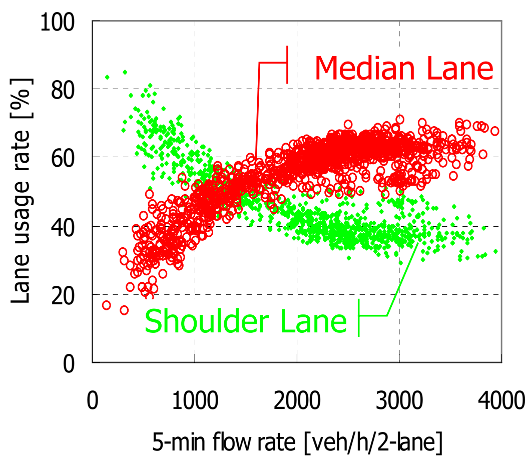
- ✓ Capacity of toll plaza
  - ✓ Most expressways in Japan are toll roads
  - ✓ ETC (Electronic Toll Collection)
    - ✓ The ETC usage rate is over 60% in April 2006, although only 6% in April 2003
    - ✓ Queues due to toll booths have been drastically decreasing
  - ✓ 3 booth types: ETC only, non-ETC only and a mixture of both
    - ✓ A study on the optimum combination of the toll booth types (HORIGUCHI and KUWAHARA, 2000)

↗ **Toll booths at an exit**

4. Mechanisms of the Bottleneck Phenomena and ITS Corresponding Countermeasures

- ✓ Mechanisms of bottleneck phenomena in basic sections
  - ✓ KOSHI(1985; 1986), KOSHI et al.(1992)

- ✓ Mechanisms of bottleneck phenomena in basic sections
  - ✓ KOSHI(1985; 1986), KOSHI et al.(1992)
- ✓ Car-following behavior analysis
  - ✓ KOSHI et al.(1986), OZAKI(1993; 1995), XING and KOSHI(1995), OGUCHI(1995), KOTANI et al. (1999; 2003)
- ✓ Auxiliary lane controlling platoon formation
  - ✓ OGUCHI(1995), KURIHARA et al. (1995; 1999), WATANABE et al. (2001), OGUCHI et al.(2001)
- ✓ Improvement of tunnels
  - ✓ KURIHARA et al.(1997)



↗**Example of lane usage rate of an expressway with two lane for one direction (OGUCHI et al., 2001)**

5. Merging Capacity at the Tokyo Metropolitan Expressway ("SHUTOKO")

- ✓ The majority of bottlenecks on urban expressways
- ✓ Various empirical studies related to capacities or lane operations on the SHUTOKO
  - ✓ HARA et al.(2004), WARITA et al.(2005), YOSHIKAWA et al.(2005), YAMADA et al.(2005), TANAKA et al.(2005), JSTE(2006)
  - ✓ Merging capacity on the SHUTOKO
    - ≈ Capacity of the basic segments downstream of the merging sections
    - ➔ Reduction in the total number of lanes after merging is a substantial reason for the capacity shortage
    - ✓ Breakdown probability analysis (SHAWKY and NAKAMURA 2006)

6. Research in the Capacity of Signalized Intersections

- ✓ Recent advancements for the enhancement of traffic signal controls
  - ✓ Fixed-time → traffic adaptive control
  - ✓ Area expansions of a central traffic adaptive control
  - ✓ Program selection by a central control → program formation control
- ✓ Few researches on the capacity increase effects as a result of these measures
- ✓ Impact studies of signal change (intergreen) intervals
  - ✓ Few studies on capacities
  - ✓ On lost time (SHIKATA et al. 2003) and driver behavior (SUZUKI et al. 2004)
- ✓ Saturation flow rate studies have been actively pursued, but are mostly case studies
  - ✓ SHIKATA et al.(1997, 2000, 2001), KATAOKA et al.(2004), AKIYAMA et al.(1998), YAMADA et al.(2001), NODA et al.(2002), KAWAI et al.(2000; 2002; 2005)

7. Research on Unsignalized Intersections

✓ Unsignalized intersection capacity < Signalized intersection capacity

- ✓ Intersections where traffic demand is relatively high and capacity is likely to be critical, have generally been signalized
- ✓ A predominant way of thinking of putting higher preference on signalization, primarily due to safety considerations
- ➔ No studies on unsignalized intersection capacity

✓ Roundabouts

- ✓ Only a limited number of similar type intersections exist mainly in rural areas
- ✓ Rarely been considered as an option during intersection planning

✓ Some researches investigating the performance of roundabouts have been recently initiated

- ✓ Aiming to reduce the number of traffic signals and relieve traffic accidents at intersections
  - ✓ MANAGE et al.(2003), MABUCHI and NAKAMURA (2005; 2006)
  - ✓ A research group on roundabout design in the JSTE (2006-2008) is now finalizing Japanese manual of roundabout design.

8. Research and Practice on Quality of Service

✓ QOS Consideration in Highway Planning and Design Practice

- ✓ "Traffic Capacity of Roads"(Japan Road Association 1984): a manual on highway capacity in Japan
- ✓ Basic sections
  - ✓ Design capacity = Potential capacity*(v/c)
    - ✓ v/c = a preset value for the "planning level" of the concerned section
  - ✓ Compared with the 30th highest hourly volume (as a DHV)
  - ✓ Unclear relationship between the designed configuration and the projected operational condition
- ✓ Signalized intersections
  - ✓ Cycle length is suggested as a service measure (JSTE 1988; 2004)
  - ✓ However, not used in practice at all

8. Research and Practice on Quality of Service

- ✓ Evaluation of Traffic Flow and Information Provision to Road Users
  - ✓ Suffering shortages in capacity and experiencing severe traffic congestions
  - ✓ Information regarding queue lengths and travel times are being provided on:
    - ✓ Intercity expressways, urban expressways and ordinary highways/arterial streets
  - ✓ The identification of traffic congestion is generally based on a combination of:
    - ✓ Estimated queue lengths, speeds and status durations, by using detector data
- ✓ Researches regarding users' perception on congestions
  - ✓ MATSUI et al.(1994), MIZOKAMI and KAKIMOTO(1996)

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8. Research and Practice on Quality of Service

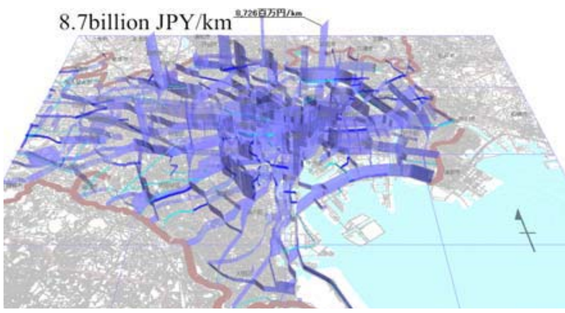
Speed thresholds of congestion levels used in the VICS

Congestion level (displayed color)	Ordinary Highways and Streets	Urban Expressways	Intercity Expressways
Jam (red)	<10km/h	<20km/h	<40km/h
Congested (orange)	<20km/h	<40km/h	<60km/h
Fine (green)	≥20km/h	≥40km/h	≥60km/h

Source: http://www.vics.or.jp/english/

An example of the car navigation display with the VICS

- ✓ VICS (Vehicle Information and Communication System)
  - ✓ Real-time traffic conditions indicated on a digital road map of car navigation systems
    - ✓ Three speed levels by color
    - ✓ Updated every five minutes
- ✓ Travel time measurements by using probe vehicles to monitor traffic conditions
  - ✓ Used for such policy evaluations as bottleneck identification and lost time due to congestions (MLIT)



Annual losses due to traffic congestion in the Tokyo road network, Source: MLIT, http://www.mlit.go.jp/

8. Research and Practice on Quality of Service

- ✓ Quality of Service research
  - ✓ Scarce compared to capacity studies and the insufficient knowledge
  - ✓ OKAMURA (2002): classifying operating speeds into five levels in intercity expressway basic sections
  - ✓ FUJITA (2004): practical issues to be considered when the LOS concepts being applied to expressway planning and design

- ✓ Recent QOS research activities
  - ✓ Necessary for a "performance-oriented" road planning/design and traffic operation to attain a specified operational condition
    - ✓ NAKAMURA (2003), OGUCHI (2003)
  - ✓ Impacts of road geometry and other factors on operating conditions
    - ✓ HONG and OGUCHI(2006), INANO et al.(2006)
  - ✓ Measure of Effectiveness (MOE)
    - ✓ TWTL Expressways (CATBAGAN and NAKAMURA 2006)
    - ✓ Platoon parameters in six-lane expressway sections (SURAZAK et al. 2004)
    - ✓ Relationship between traffic flow conditions and traffic accident rates (HIKOSAKA and NAKAMURA 2001)

8. Research and Practice on Quality of Service

- ✓ User Perception Studies
  - ✓ Subjective evaluation studies in intercity expressway sections
    - ✓ NAKAMURA et al.(2000), ISHIBASHI et al.(2006)
  - ✓ Measurement of instantaneous driver perception through values of a utility function of a driver behavior model
    - ✓ KITA(2000), KITA and MAEDA(2004), NAKAMURA et al.(2001)

- ✓ All of these QOS studies are limited to expressways mainly because of data availability

- ✓ Needs of investigation on the impacts of road geometry, roadside friction and signal control conditions on QOS in ordinary <u>TWTL highways</u> and <u>arterial streets</u>
  - ✓ with many flow interruptions due to traffic signals and roadside access

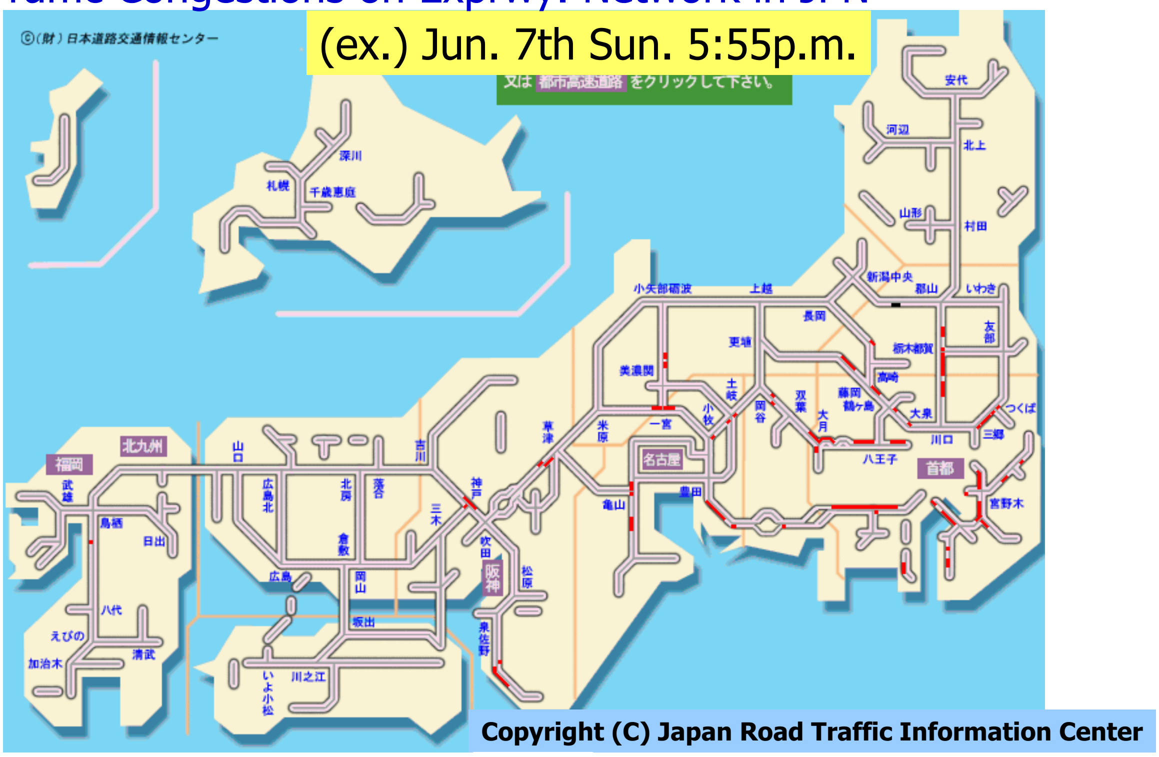
II. Effects of auxiliary lanes upstream bottleneck sag sections on expressways

Contents

- Bottleneck Phenomena on Expressway in Japan
- Mechanism of bottleneck activation at sag
- Major countermeasures for the bottlenecks
- Auxiliary lane effects
- Empirical Study
- Conclusions

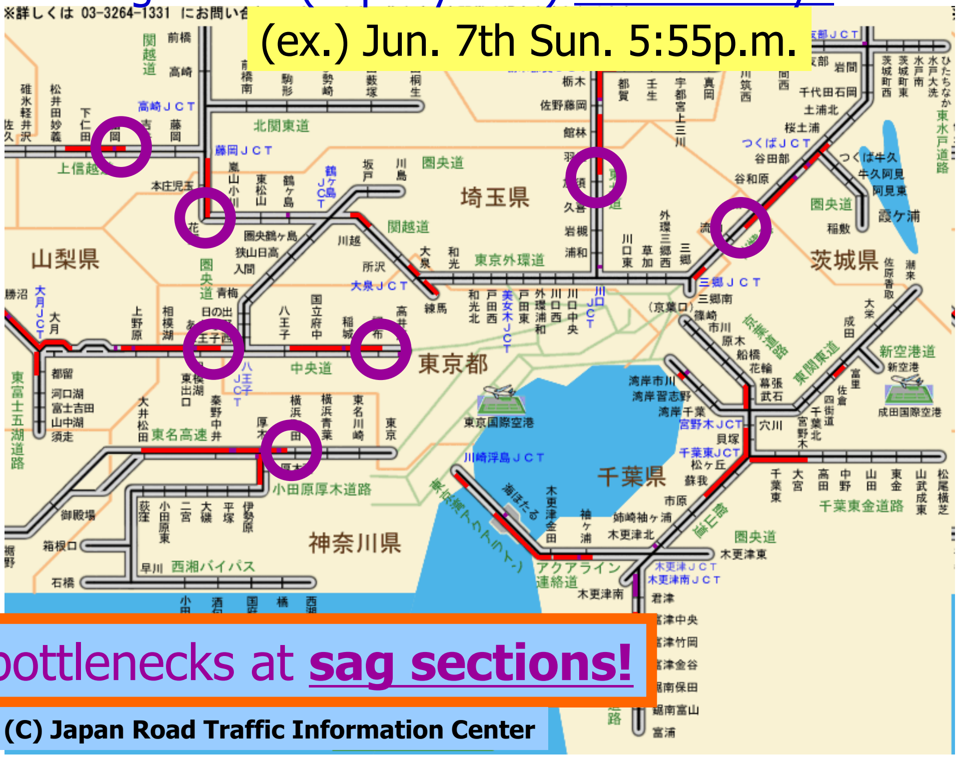
1. Bottleneck phenomena on Expressway in Japan

✓ Traffic Congestions on Exprwy. Network in JPN



1. Bottleneck phenomena on Expressway in Japan

✓ Traffic Congestions (Exprwy. Net) around Tokyo

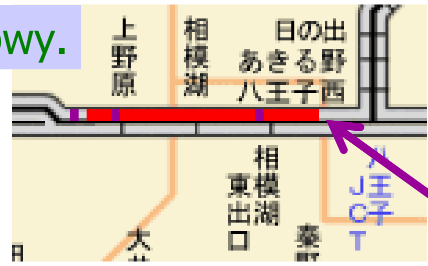


Many bottlenecks at **sag sections!**

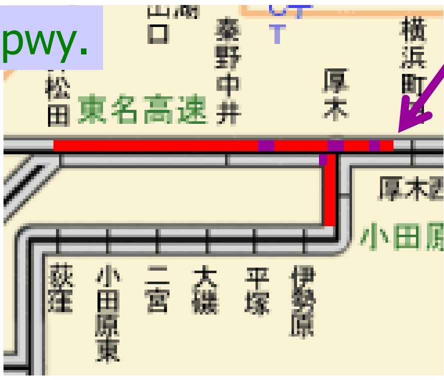
1. Bottleneck phenomena on Expressway in Japan

✓ example bottlenecks at **sag sections!**

Chuo-expwy.



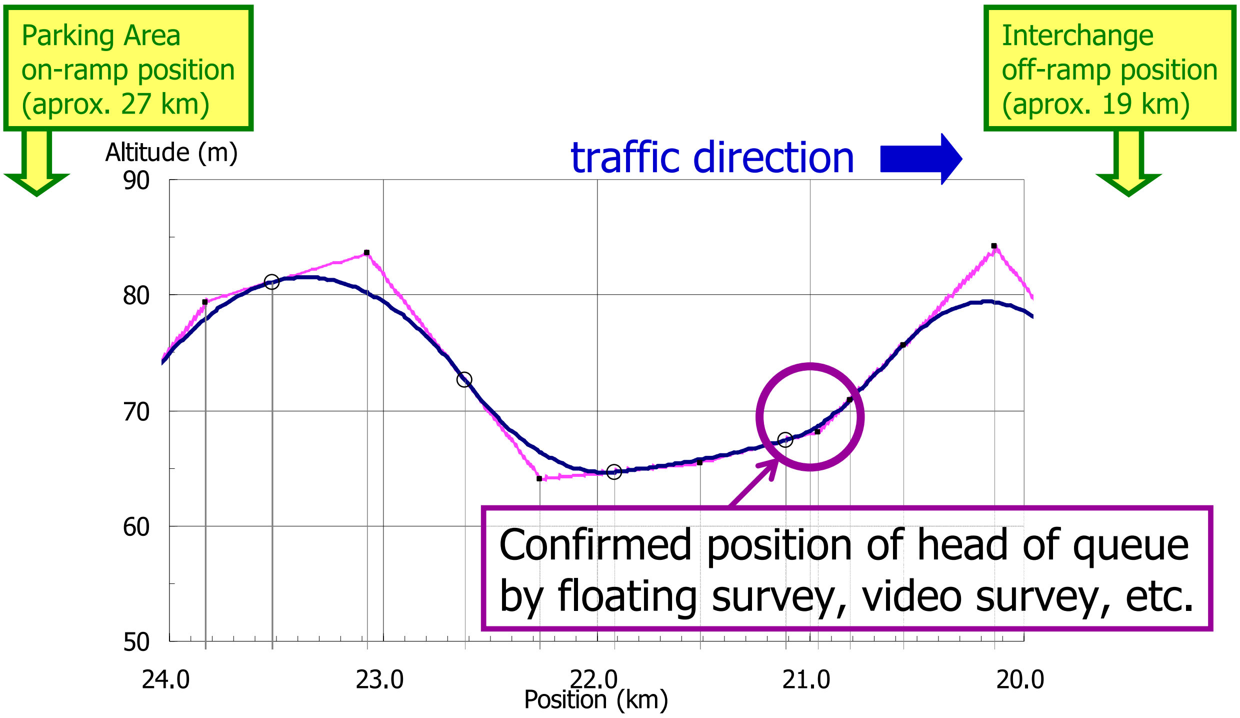
Tomei-expwy.



Head of queues are located on ordinary sections

1. Bottleneck phenomena on Expressway in Japan

✓ Many bottlenecks at **sag sections!**



2. Mechanism of bottleneck activation at sag

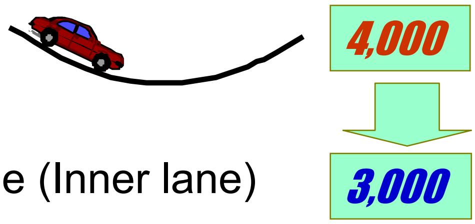
much **DEMAND**

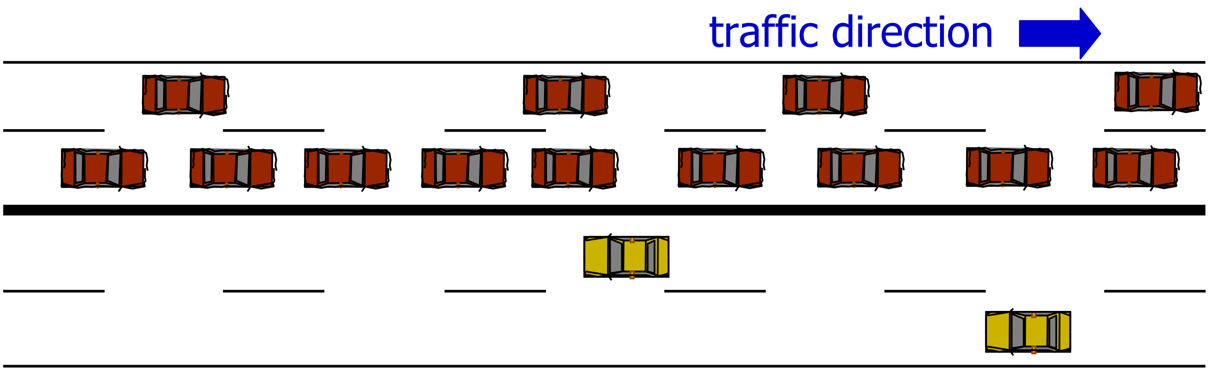
↓

Lane use concentration on Median-lane (Inner lane)

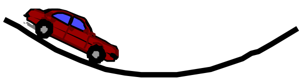
↓

Dense platoon with many cars





2. Mechanism of bottleneck activation at sag



4,000

3,000

much **DEMAND**

↓

Lane use concentration on Median-lane (Inner lane)

↓

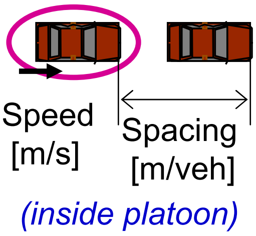
Dense platoon with many cars

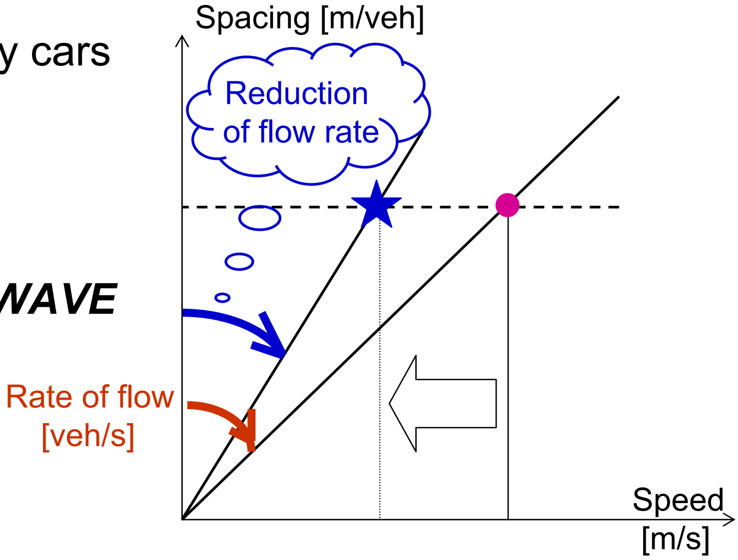
↓

Deceleration & maintenance of Spacing

↓

Deceleration SHOCK- WAVE





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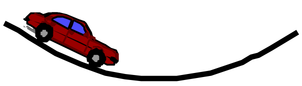


4,000

3,000

much **DEMAND**

↓

Lane use concentration on Median-lane (Inner lane)

↓

Dense platoon with many cars

↓

Deceleration & maintenance of spacing

↓

Deceleration SHOCK- WAVE

↓

Slow Speed at the end of platoon

↓

Queuing (congestion)

Mechanism of bottleneck activation at sag section

2. Mechanism of bottleneck activation at sag

- Drivers in the queue are *tired*.
- The point of bottleneck is *not clear*.

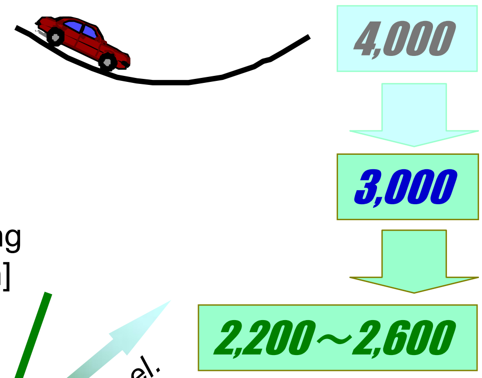
↓

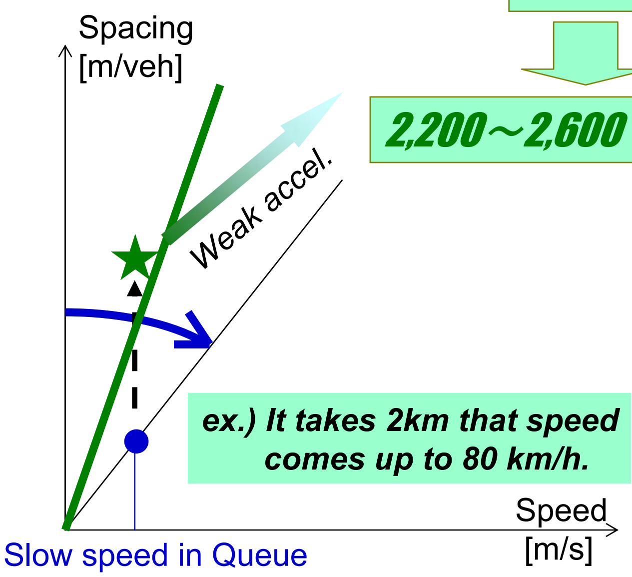
- Large spacing makes drivers accelerate.
- Weak acceleration from the head of queue

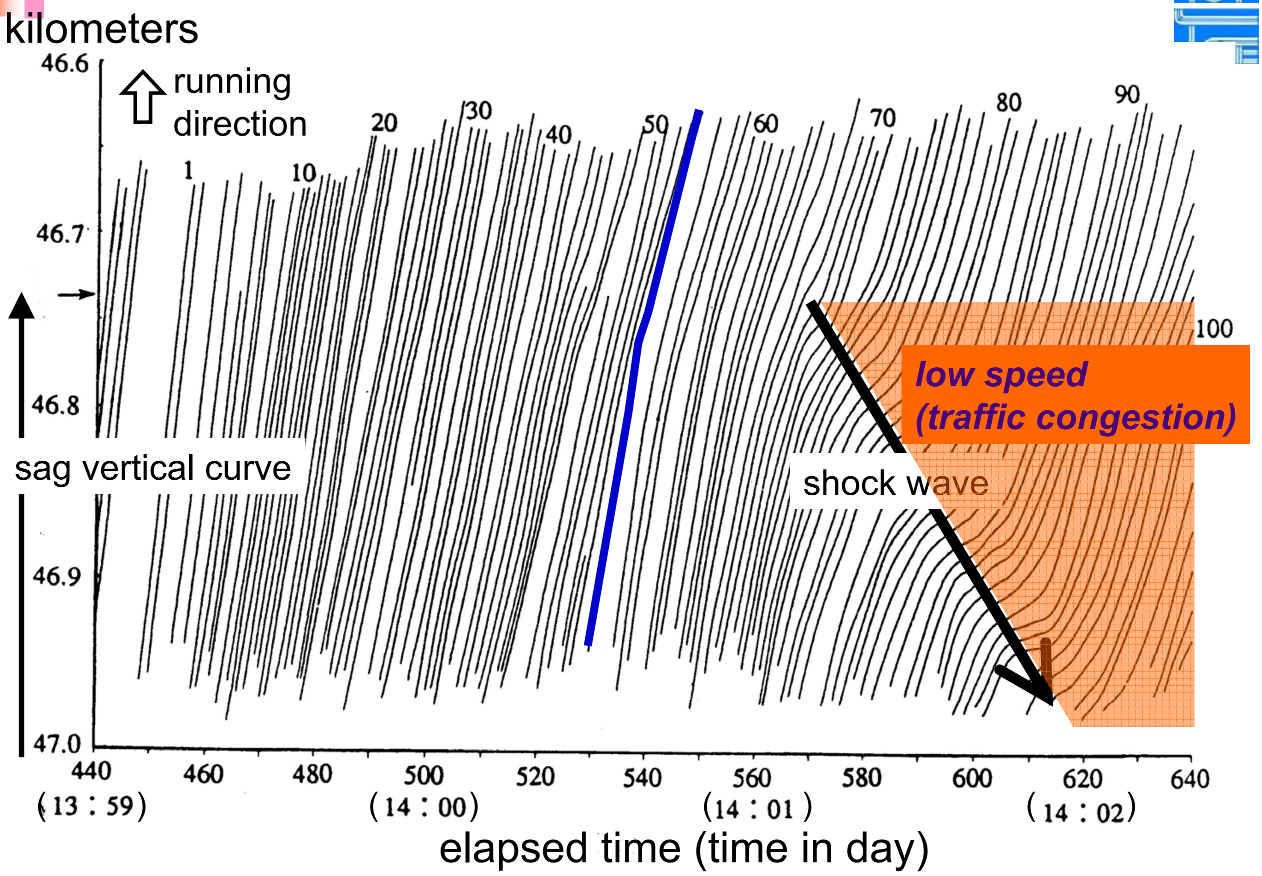
↓

- Capacity is reduced to *Lower Level*.

Mechanism of more capacity reduction after congestion occurred







3. Major countermeasures for the bottlenecks

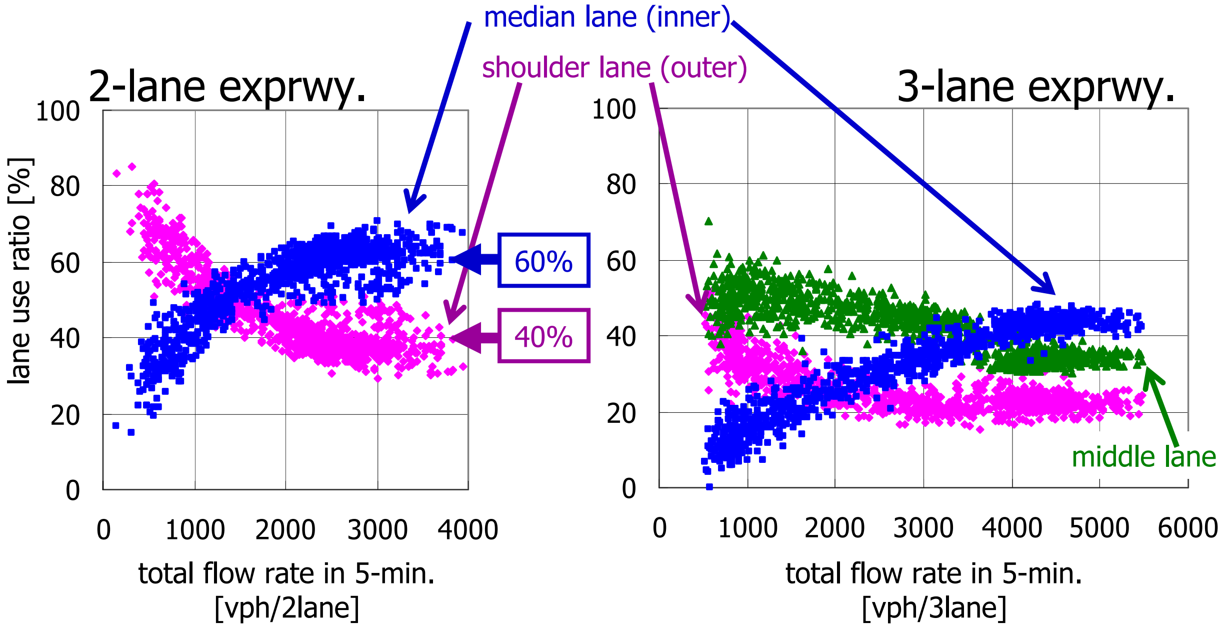
- ✓ **DEMAND & CAPACITY**
  - ✓ TDM, traffic prediction & information
  - ✓ Capacity Increase (increase of number of lanes, etc.)
- ✓ Lane use concentration
  - ✓ Control the traffic lane distribution

Auxiliary lane installation upstream of the bottleneck

- ✓ ***Car-following behavior***
  (deceleration, maintenance of spacing, large spacing, weak acceleration)
  - ✓ ITS (AHS-i, AHS-c; intelligent cruise control)

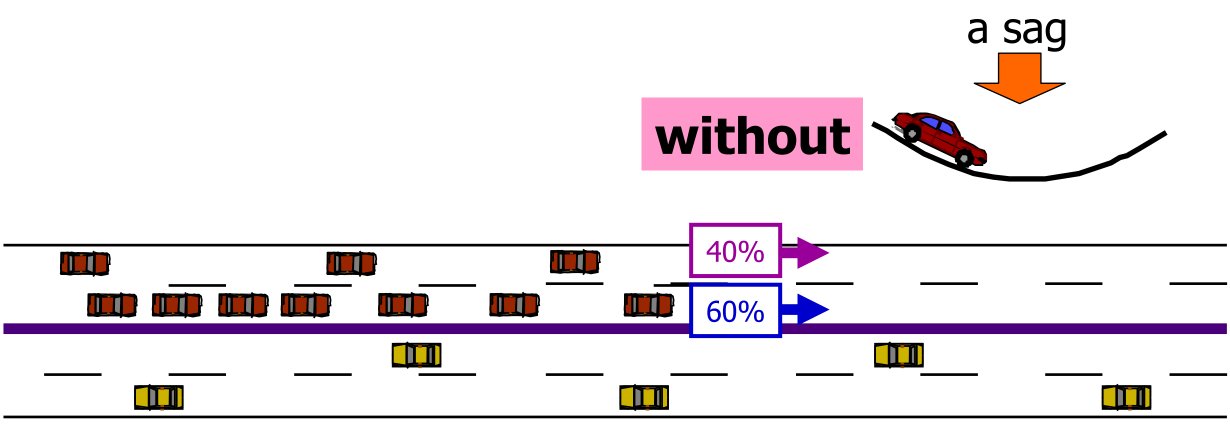
3. Major countermeasures for the bottlenecks

- ✓ Lane use concentration : typical example in JPN



3. Major countermeasures for the bottlenecks

✓ Auxiliary lane installation upstream of the bottleneck



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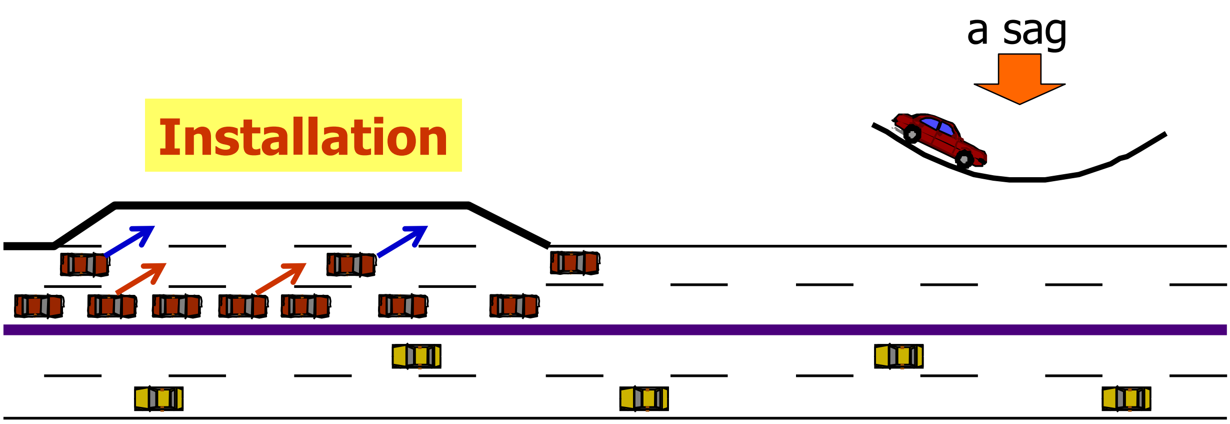
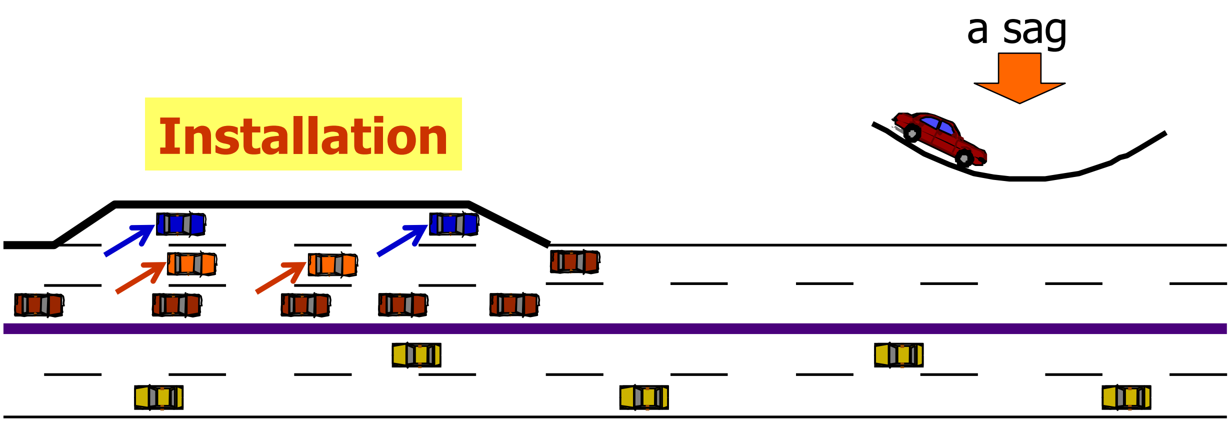
3. Major countermeasures for the bottlenecks

✓ Auxiliary lane installation upstream of the bottleneck



3. Major countermeasures for the bottlenecks

✓ Auxiliary lane installation upstream of the bottleneck



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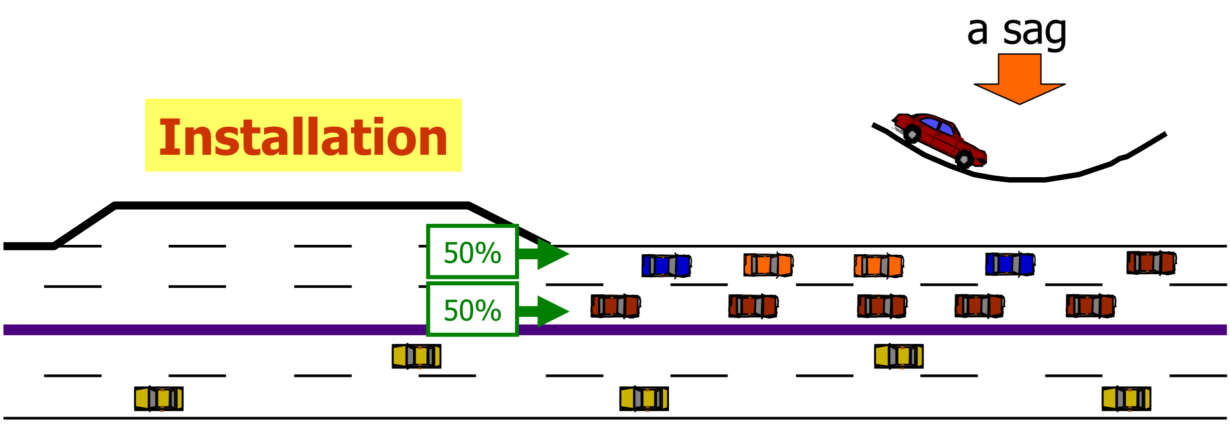
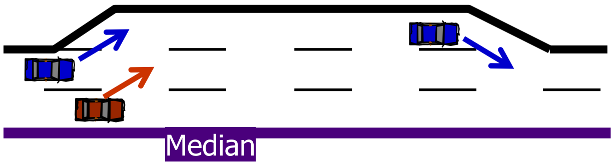
3. Major countermeasures for the bottlenecks

✓ Auxiliary lane installation upstream of the bottleneck

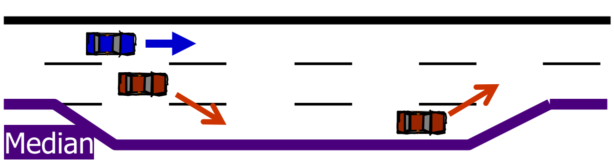


4. Auxiliary lane effects

✓ Types of auxiliary lane installation

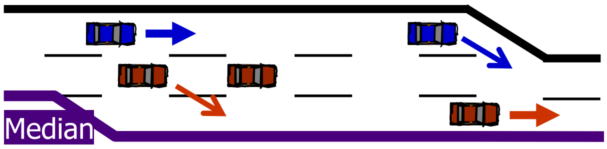


a) additional outer-lane
[typical in JPN] "**crawling lane**"



b) additional inner-lane
"**passing lane**"

c) outside addition at the beginning, inside closure at the end

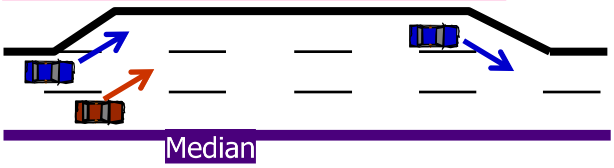


d) inside addition at the beginning, outside closure at the end

4. Auxiliary lane effects: comparisons

Ad. : advantages
Sc. : shortcomings

Ad. only crawlers need lane change
Sc. indirect control of lane use



a) additional outer-lane
[typical in JPN] "**crawling lane**"

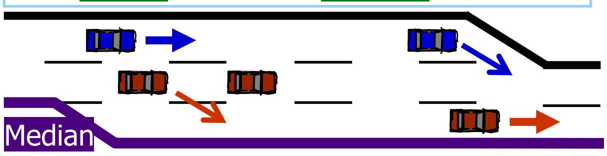
Ad. passing-veh. need lane change; which has higher mobility
Sc. safety at the end in heavy traffic

b) additional inner-lane
"**passing lane**"

Sc. indirect control of lane use
safety at the end in heavy traffic

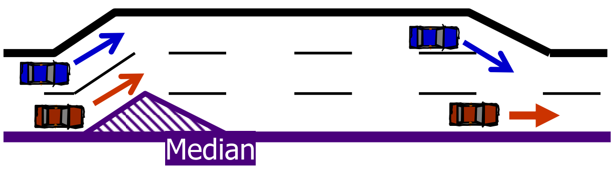
c) outside addition at the beginning, inside closure at the end

Ad. passing-veh. need lane change; which has higher mobility
direct lane use control



d) inside addition at the beginning, outside closure at the end

4. Auxiliary lane effects: practical installation



Ad. passing-veh. need lane change;
which has higher mobility
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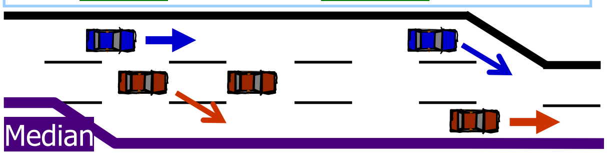
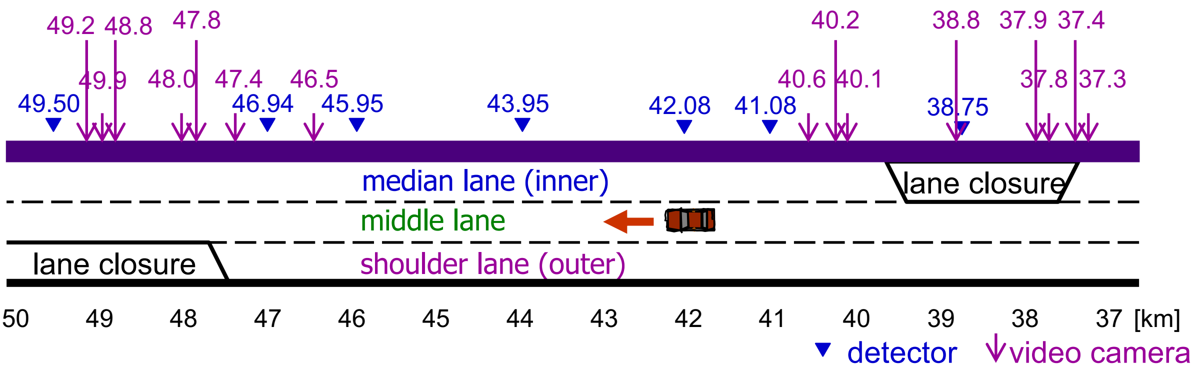
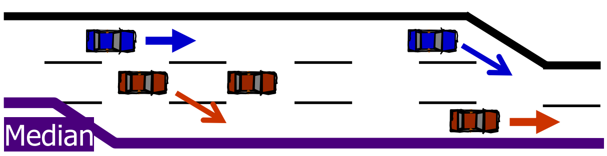


d) inside addition at the beginning, outside closure at the end

5. Empirical Study

✓ observations: road works with lane closure



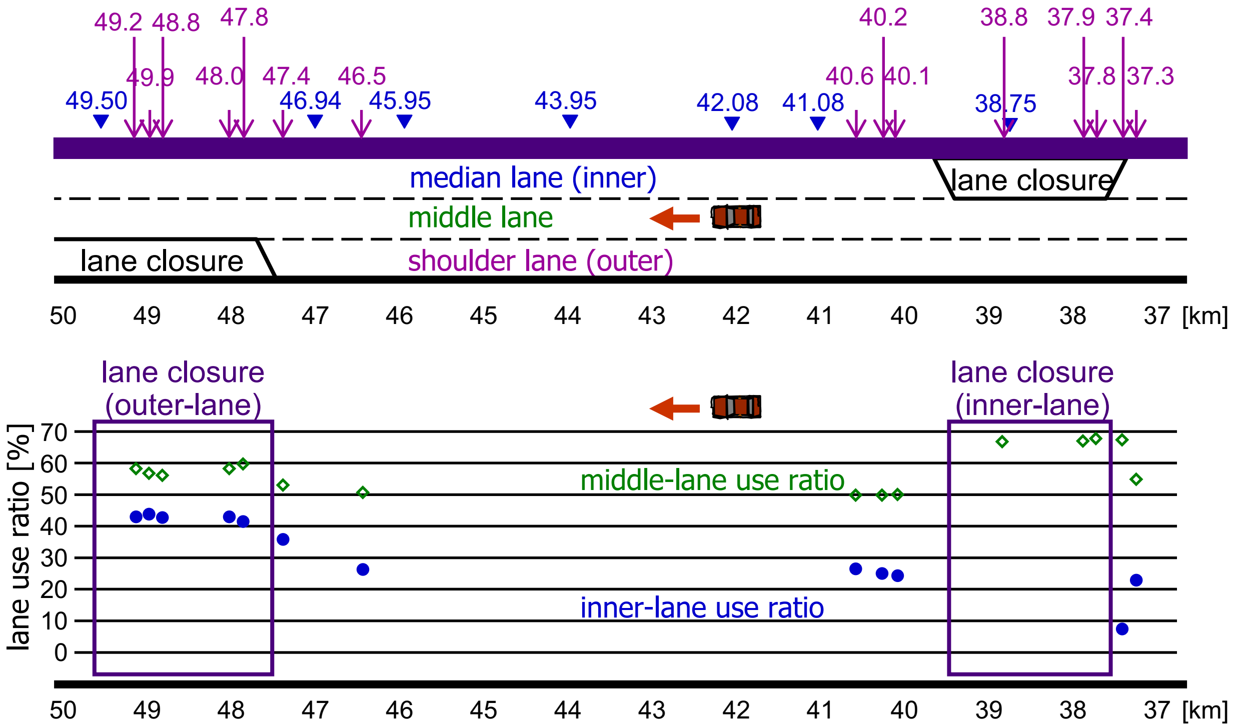


d) inside addition at the beginning, outside closure at the end

5. Empirical Study

- total volume (approx.) 2,200 [vph]
- 7a.m.-8a.m.

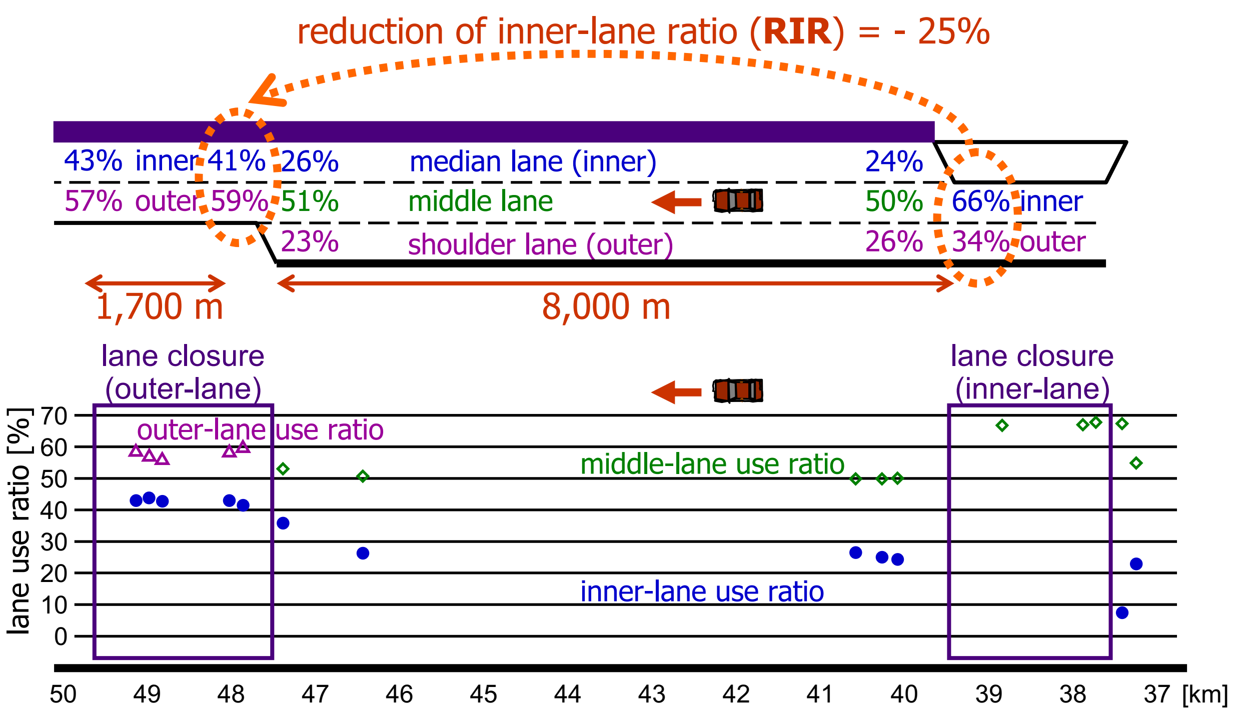
✓ observations: road works with lane closure



5. Empirical Study

- total volume (approx.) 2,200 [vph]
- 7a.m.-8a.m.

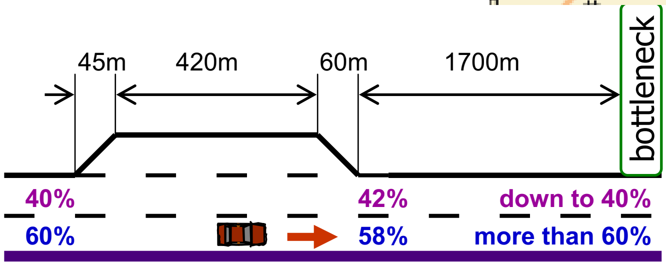
✓ observations: road works with lane closure



6. Conclusion

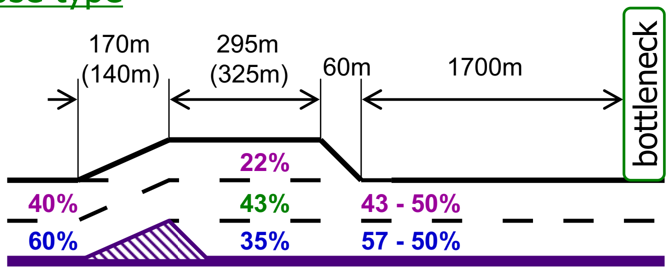
✓ Comparative study (at a famous bottleneck)

a) crawling lane type



v.s.

d) inner-add/outer-close type



with traffic demand condition of 3,000[vph/2lane]

6. Conclusion

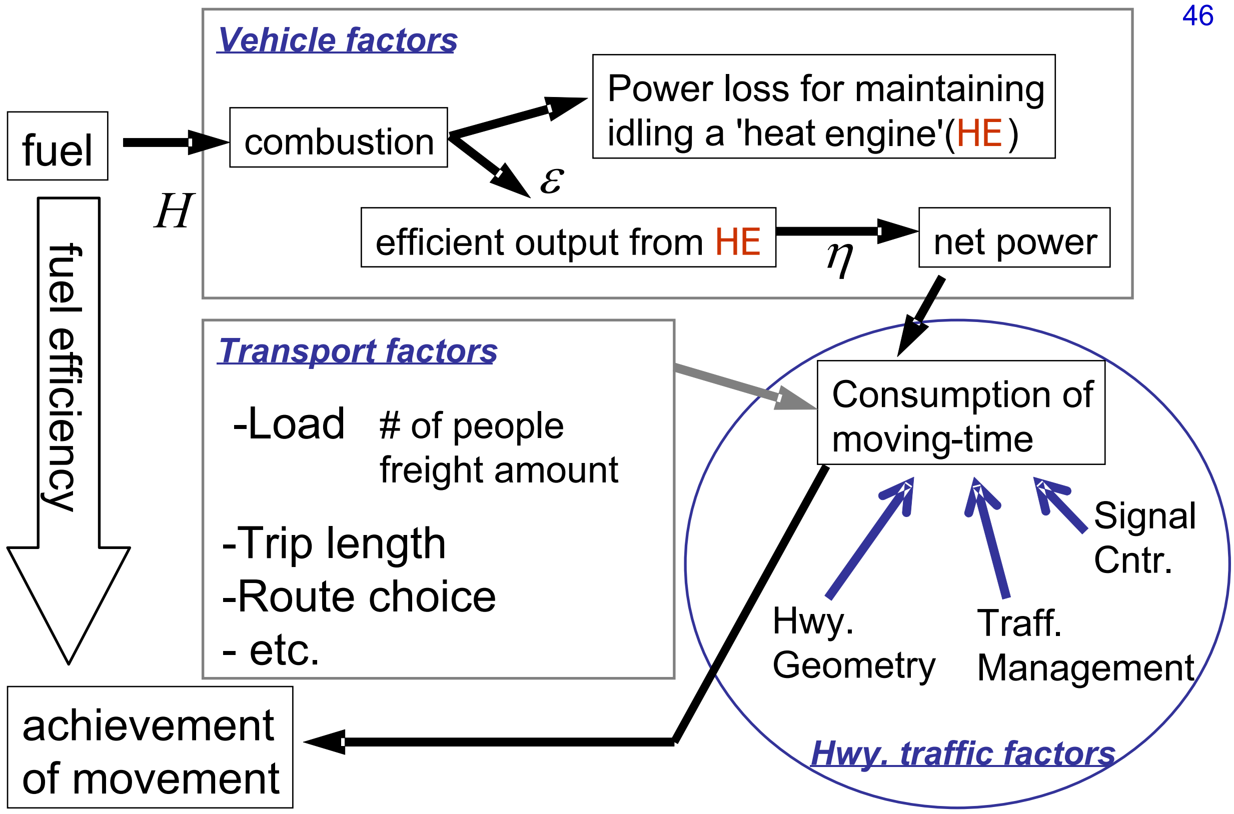
- ✓ Bottleneck activations at sag sections are more focused these days in Japan
  - ✓ because of high ETC penetration rate
  - ✓ well-known in Japan, caused by drivers' bahavior (car-following behavior, lane use ratio) and grade change
- ✓ Major countermeasures in Japanese practices
  - ✓ capacity increase at sag bottlenecks
    - ✓ deconcentration of lane use on median lane (inner lane)
  - ✓ traffic demand management
- ✓ Auxiliary Lane installation is one of the effective measures
  - ✓ change of lane use ratio
  - ✓ auxiliary lane, adding inside at beginning and closing outside at end, is the most effective measure to control the lane use ratio

III. Emission model in actual vehicular traffic conditions

Contents

1. Concept of the study
2. Empirical study
3. Theoretical consideration
4. Discussion of the model
5. Example applications

1. Concept of the study

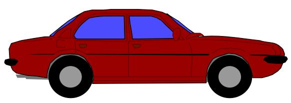


2. Empirical study

➢ test runs

59 journeys on *three* kinds of facilities
(each journey distance : 5 - 10 km)

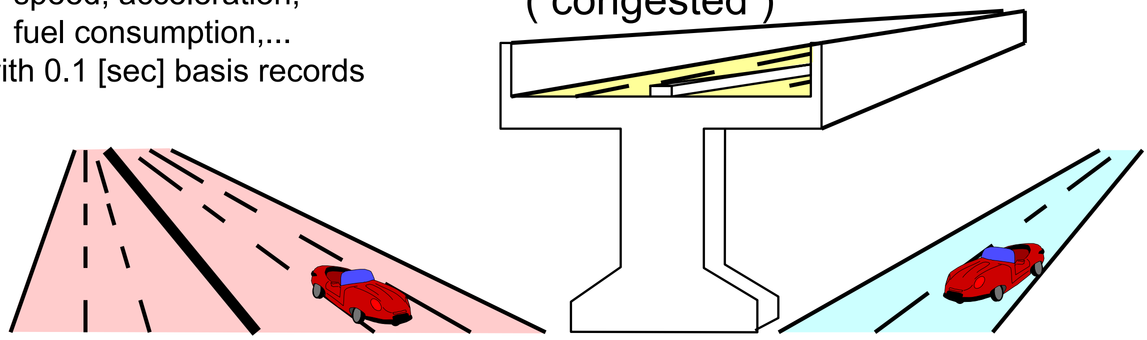
on normal daytime weekdays, inside Tokyo



test vehicle

2.0 liter gasoline engine
[measurement items]
speed, acceleration,
fuel consumption,...
with 0.1 [sec] basis records

Urban Expressway (MEX)
(congested)



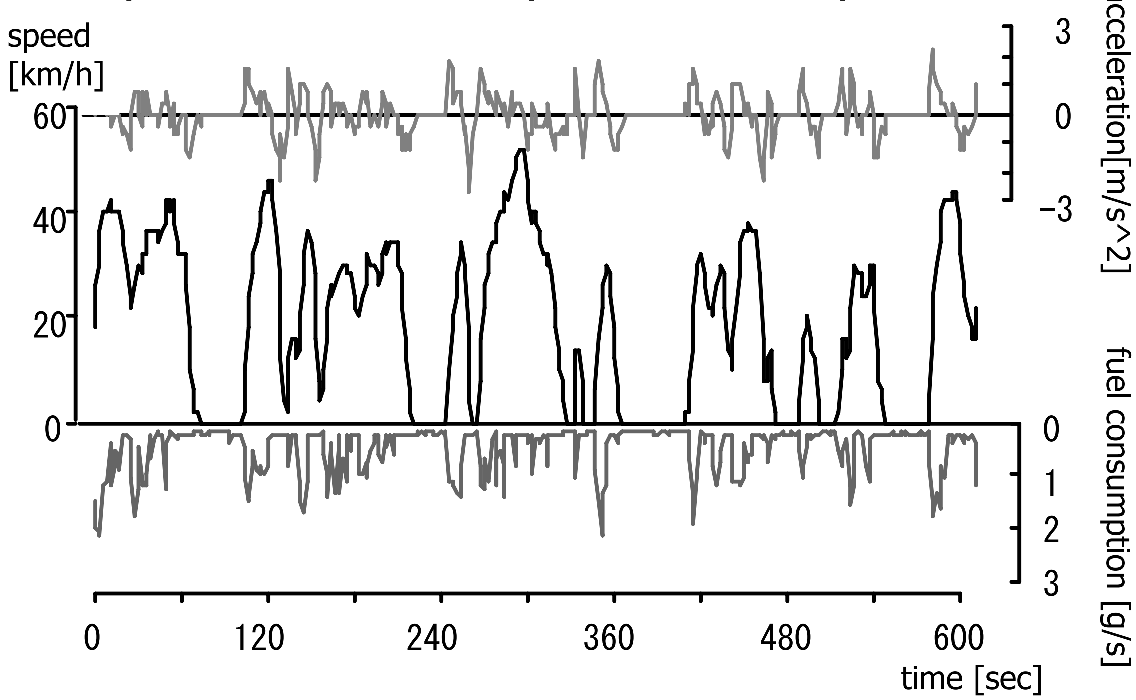
six-lane surface streets

two-way two-lane surface streets

2. Empirical study

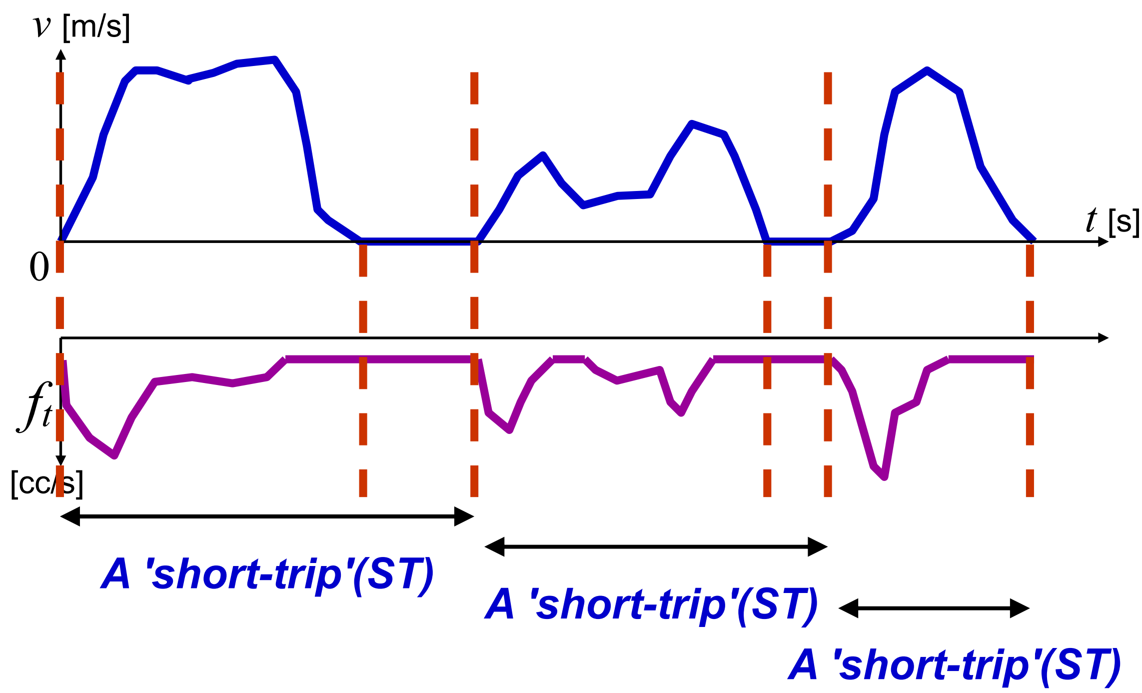
➢ test runs

ex.) result of a test run (on a surf. street)



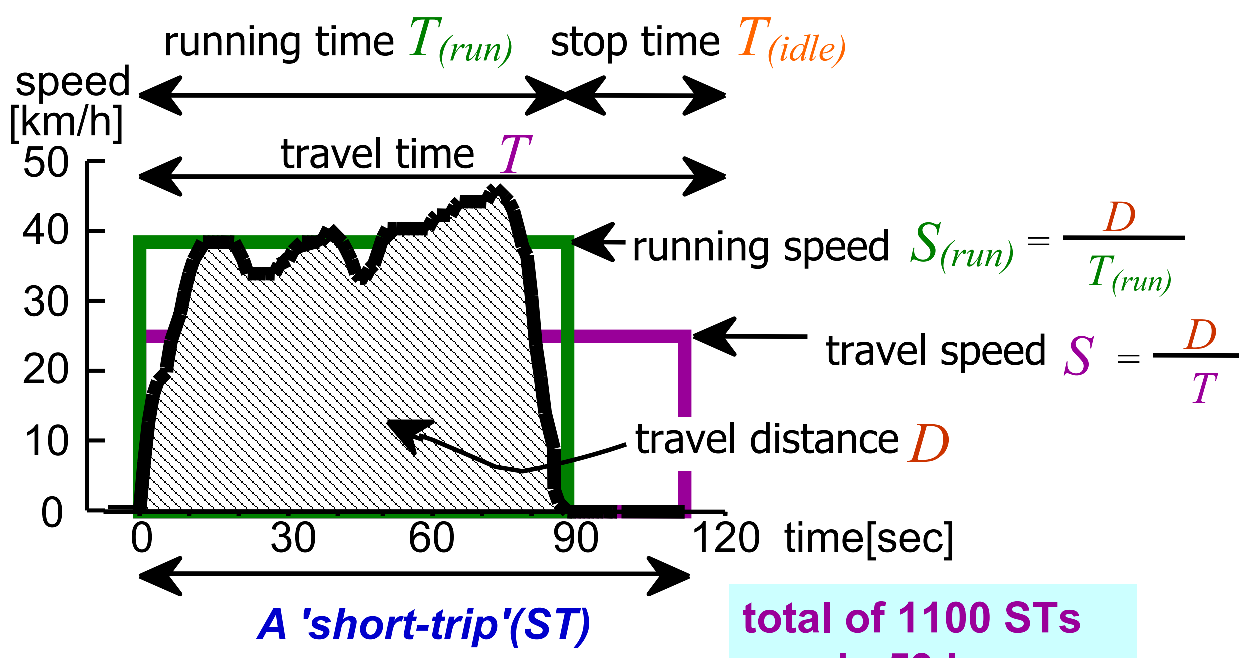
2. Empirical study

- concept of 'short-trip'(ST)



2. Empirical study

- concept of 'short-trip'(ST)



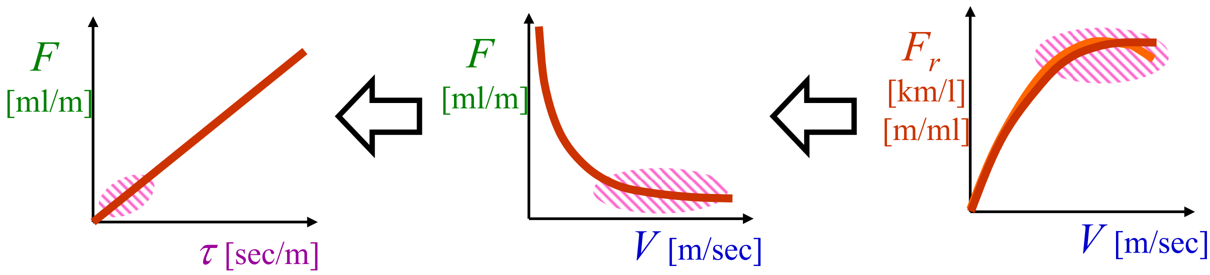
total of 1100 STs in 59 journeys

2. Empirical study

- additivity of variables

fuel consumption rather than the rate of consm.
[ml/m]=[l/km] [m/ml]=[km/l]

time rate rather than speed
[sec/m] [m/sec]=1/3.6[km/h]

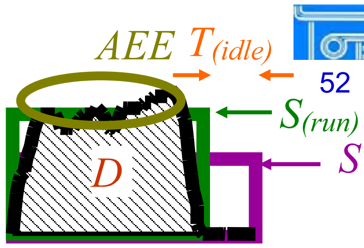


The 18th Conference on Public Works Research and Development in Asia 10 Nov. 2009 T. Oguchi (TMU)

2. Empirical study

- fuel consm. in running cond.

result of regression analysis



$$\boxed{F_{(run)} = 0.028 + 0.31\ \tau_{(run)} + 0.056\ A}$$

$$(t = 160.1) \qquad (t = 16.3)$$

n=1100, R=0.981, RMSE=0.032 [ml/m]

$$\boxed{F_{(run)} = a + b\,\tau_{(run)} + cA}$$

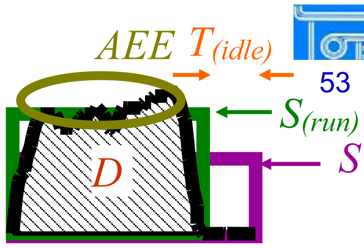
where

$F_{(run)}$ [ml/m]

$\tau_{(run)}$ [sec/m]

A [m/sec²]

2. Empirical study



- fuel consumption in **ST**s
= (running) + (idling)

$$\boxed{F_{(run)} = 0.028 + 0.31\ \tau_{(run)} + 0.056\ A}$$

$$F = F_{(run)} + F_{(idle)} \qquad \boxed{F_{(idle)} = f_{t(idle)} \times \tau_{(idle)}}$$

$$F = 0.3\ \tau_{(idle)} + 0.028 + 0.31\ \tau_{(run)} + 0.056\ A$$

$$\approx\ 0.3(\tau_{(idle)} + \tau_{(run)}) + 0.028 + 0.056\ A$$

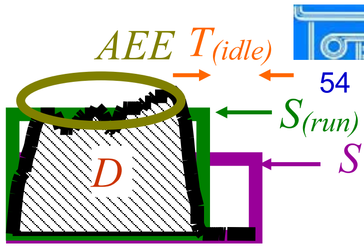
$$\boxed{F = 0.3\ \tau + 0.028 + 0.056\ A}$$

[ml/m] [sec/m] [m/sec^2]

where
$\tau = \tau_{(idle)} + \tau_{(run)} = 1/S$
[sec/m]

convert into Q [ml] for a **ST**

2. Empirical study



- fuel consumption in STs
total amount of consumption

$$Q = F \times D = 0.3\ T + 0.028\ D + 0.056\ AAE$$

$$Q = f_{t(idle)}\ T + c_1\ D + c_2\ AAE$$

empirical model

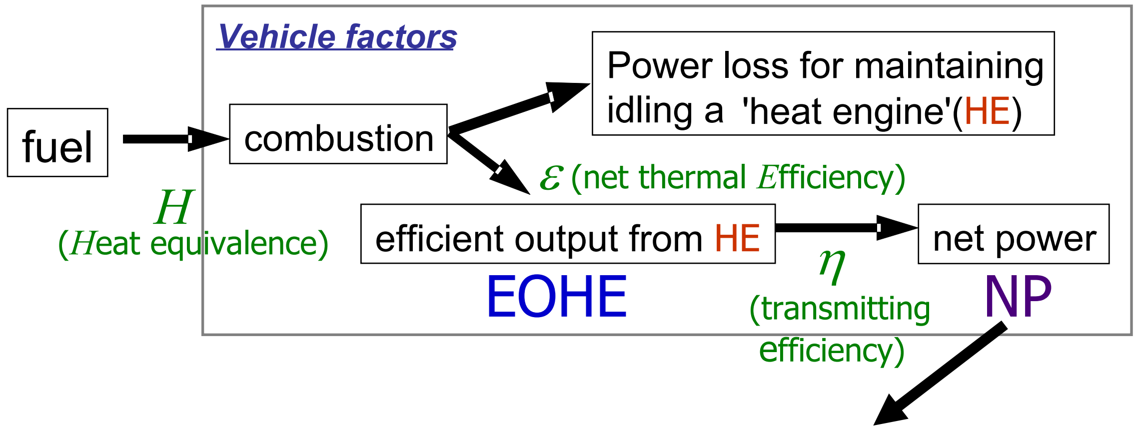
$$\boxed{F = 0.3\ \tau + 0.028 + 0.056\ A}$$

[ml/m] [sec/m] [m/sec^2]

convert into Q [ml] for a ST

3. Theoretical consideration

- From 'thermal engine model' and 'kinetics', instantaneous fuel consumption rate: f_t [ml/sec]



'driving force'

= total resistance

3. Theoretical consideration

- From 'thermal engine model' and 'kinetics', instantaneous fuel consumption rate: f_t [ml/sec]

$$f_t = f_{(idle)} + \frac{(\mu + \sin\theta)\,M g}{\varepsilon\,\eta\,H}\,v + \frac{\kappa}{\varepsilon\,\eta\,H}\,v^3 + \frac{M + M'}{\varepsilon\,\eta\,H}\,\alpha\,v$$

speed term (rolling resistance + grade resistance)

cubic speed term (aero-resistance)

product of acc. & speed term (acc. resistance) only when with acc. ($\neq 0$)

> 0 (positive NP, even in *decelerating condition*) then the HE produces mechanical work

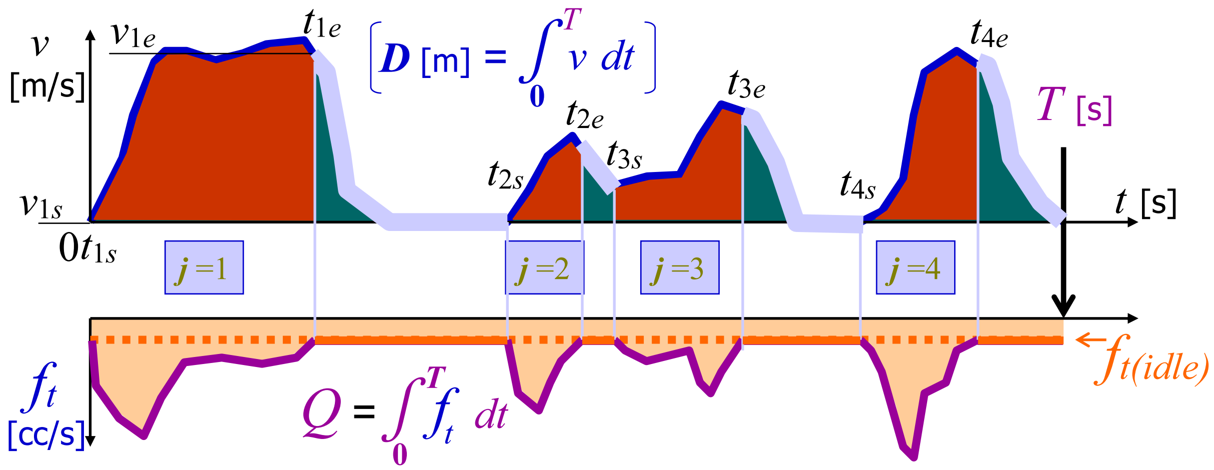
EOHE (efficient output from the HE) > 0

$=< 0$ then EOHE $= 0$

$$\boxed{f_t = f_{(idle)}}$$

3. Theoretical consideration

- amount of fuel consm. in a trip: Q [ml]



$$Q = f_{t(idle)}\,T + C_3 \boxed{\sum_j \int_{t_{js}}^{t_{je}} v\,dt} \equiv \Delta \text{ [m]}$$

$$+\; C_4 \sum_j \int_{t_{js}}^{t_{je}} v^3\,dt \;+\; C_5 \sum_j \{(v_{je})^2 - (v_{js})^2\}$$

4. Discussion of the model

- numerical check

$$Q = f_{t(idle)}\,T + C_1\,D + C_2\,AAE$$

empirical

$$Q = 0.3\,T + 0.0245\,\Delta + 0.00016 \sum_j \int_{t_{js}}^{t_{je}} v^3\,dt + 0.18 \sum_j \left(\frac{1}{2} v_{js}^2 - \frac{1}{2} v_{je}^2\right)$$

M : vehicle gross weight=1,500[kg]	κ : aero-resistance coef.=0.5[kg/m]
M' : weight equiv. of moment inertia=0.1M	ε : net thermal efficiency=0.3
g : gravity acceleration=10[m/sec^2]	μ : rolling resistance coef.=0.015
H : heat equivalence=3.4 10^4[J/cc]	η : transmitting efficiency coef.=0.9

theoretical

assumptions

$f_{t(idle)} = 0.3$

$$Q = f_{t(idle)}\,T + C_3\,\Delta$$

$$+\; C_4 \sum \int_{t_{js}}^{t_{je}} v^3\,dt \;+\; C_5 \sum \{(v_{je})^2 - (v_{js})^2\}$$

4. Discussion of the model

- numerical check

$$Q = 0.3\,T + 0.028\,D + 0.056\sum\{(v_{ie})^2 - (v_{is})^2\}$$

empirical

$$Q = 0.3\,T + 0.0245\,\Delta + 0.00016\sum_j \int_{t_{js}}^{t_{je}} v^3 dt + 0.18\sum_j\left(\frac{1}{2}v_{js}^2 - \frac{1}{2}v_{je}^2\right)$$

say,
$\Delta = 0.9\,D$

trial calc. w/ const. speed;
= 0.0014 D (if v = 18 [km/h])
= 0.0054 D (if v = 36 [km/h])
= 0.049 D (if v = 108 [km/h])

this term can be negligible
when the speed is low enough

$$\boxed{Q = 0.3\,T + 0.022\,D + 0.09\sum_j (v_{js}^2 - v_{je}^2)}$$

4. Discussion of the model

- validated model

$$Q = 0.3\,T + 0.028\,D + 0.056\sum\{(v_{ie})^2 - (v_{is})^2\}$$

empirical

well-known relationship between CO_2 emission E [gram-Carbon] and fuel consumption Q [cc] $E = k\,Q$

emission E = factor × T (travel time) [s]
[g-c] + factor × D (travel distance) [m]
+ factor × AEE (speed fluctuation indices) [m^2/s^2]

theoretical

difficulty of defining the duration of NP>0

$$\boxed{Q = 0.3\,T + 0.022\,D + 0.09\sum_j (v_{js}^2 - v_{je}^2)}$$

4. Discussion of the model

➢ structure of the estimated emission estimation

emission E = factor × T (travel time) [s]
[g-c] + factor × D (travel distance) [m]
+ factor × AEE (speed fluctuation indices) [m²/s²]

to compare with unit emission factor E_{dist} [g-c/m]

$$\underset{[\text{g-c}]}{E} = \underset{[\text{g-c/m}]}{E_{dist}} \times \underset{[\text{m}]}{D}$$

$$\underset{[\text{g-c/m}]}{E_{dist}} = \frac{E\ [\text{g-c}]}{D\ [\text{m}]} = \frac{func'\{T, D, AEE\}}{D\ [\text{m}]}$$

$$= func.\{T/D, A\}$$

then $E_{dist} = func.\{1/V, A\}$

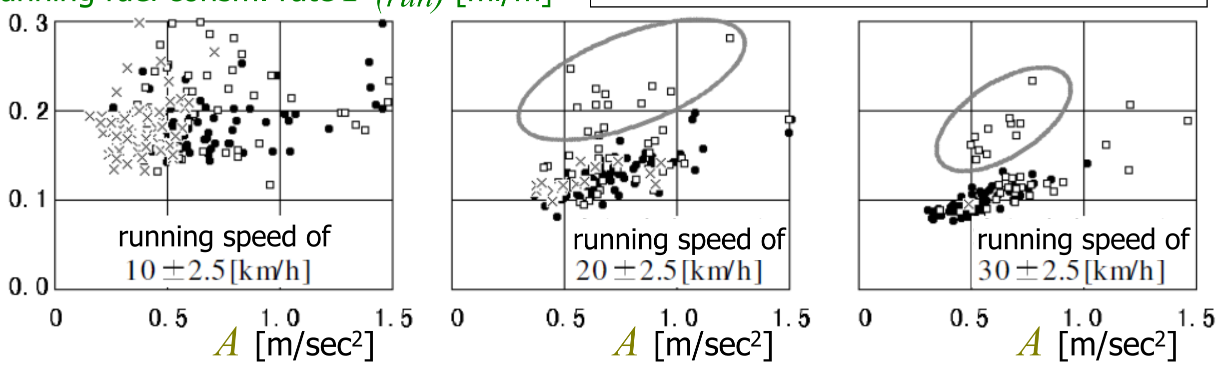
$$\underset{[\text{g-c/m}]}{E_{dist}} \neq func.\{V\}$$

4. Discussion of the model

➢ variation of A (AEE)

running fuel consm. rate $F_{(run)}$ [ml/m]

• 2 lane hwy. ▫ 6 lane hwy. × MEX



Variation of 0.2 < A < 1.5 can be observed in any of speed ranks.

⇨ individuality

$E_{dist} = func.\{1/V, A\}$

$$\underset{[\text{g-c/m}]}{E_{dist}} \neq func.\{V\}$$

4. Discussion of the model

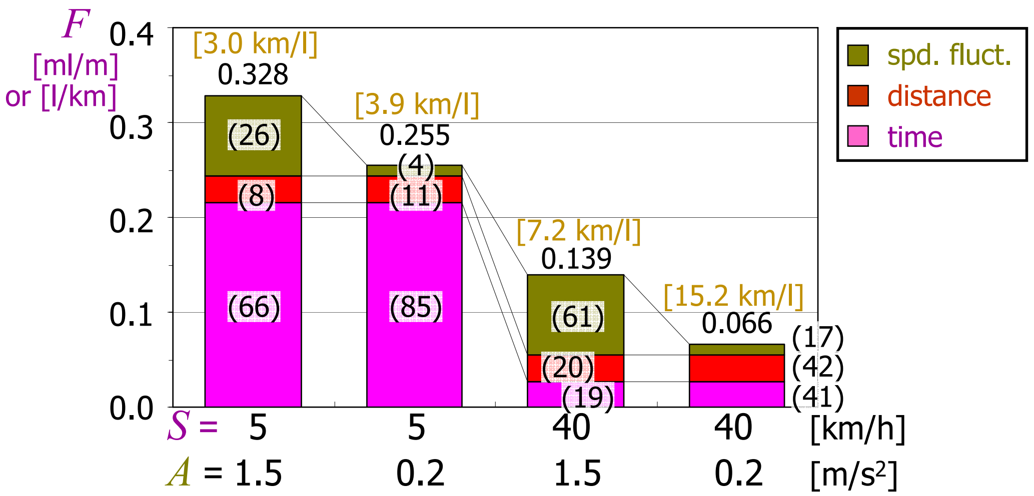
- contribution of each factor

$S = D/T$

$A = AEE/D$

fuel consm. Q = factor × T (travel time) [s]
[ml] + factor × D (travel distance) [m]
+ factor × AEE (speed fluctuation indices) [m^2/s^2]

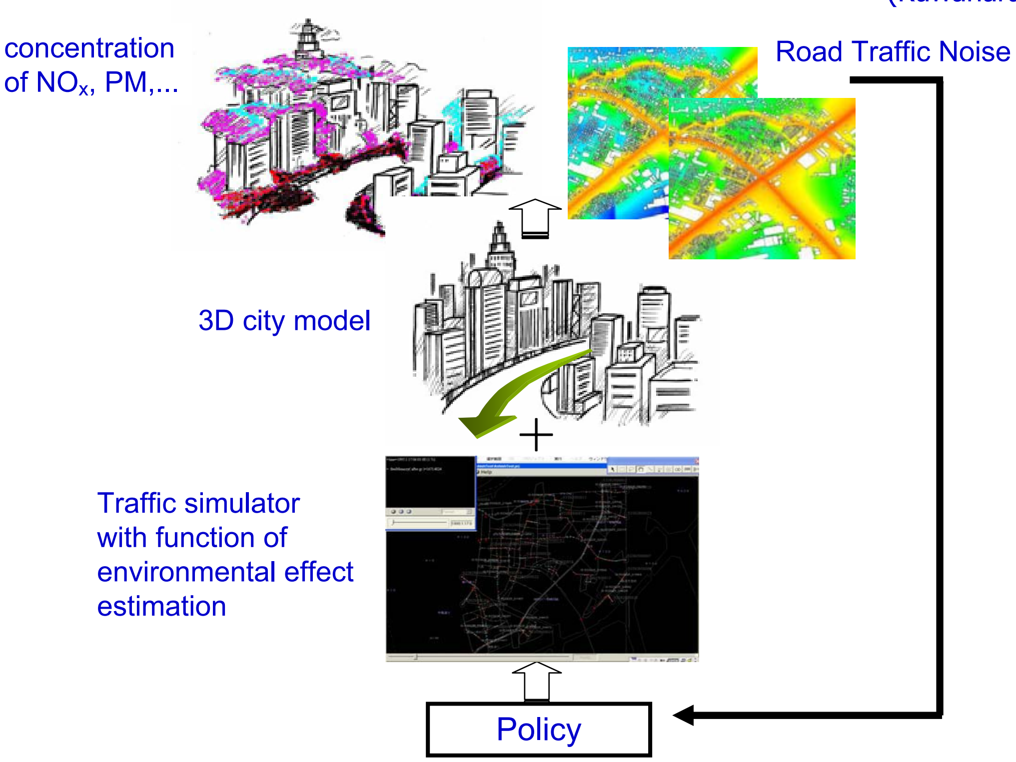
$F = Q/D$



5. Example applications

[2] "Transport + City + Environment" integrated model

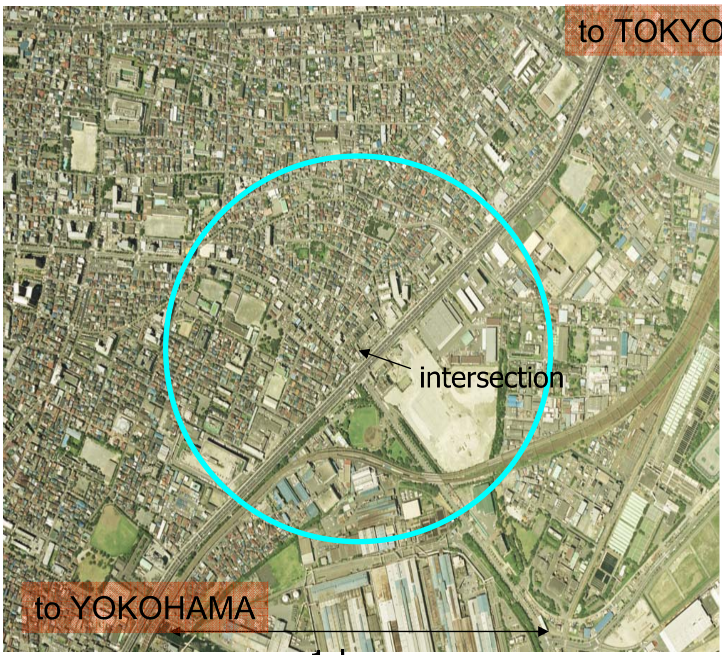
(Kuwahara, 2004[JP])



5. Example applications
[2] "Transport + City + Environment" integrated model

(Kuwahara, 2004[JP])

Target Area: R=500 [m] around a intersection (Ikegami-Shinmachi)



located in Kawasaki city of Kanagawa prefecture
[**SW** part of Metropolitan Area]

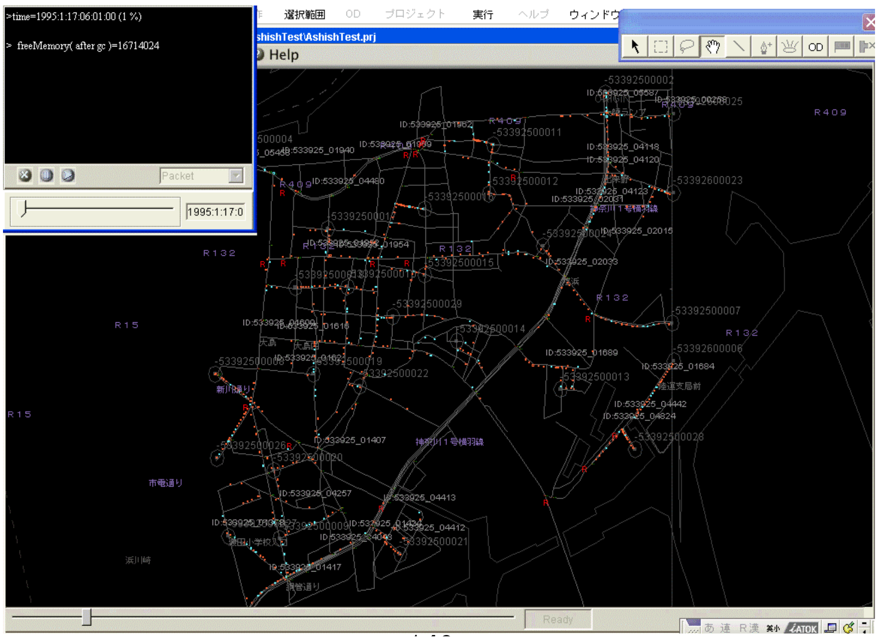
famous point for bad air quality

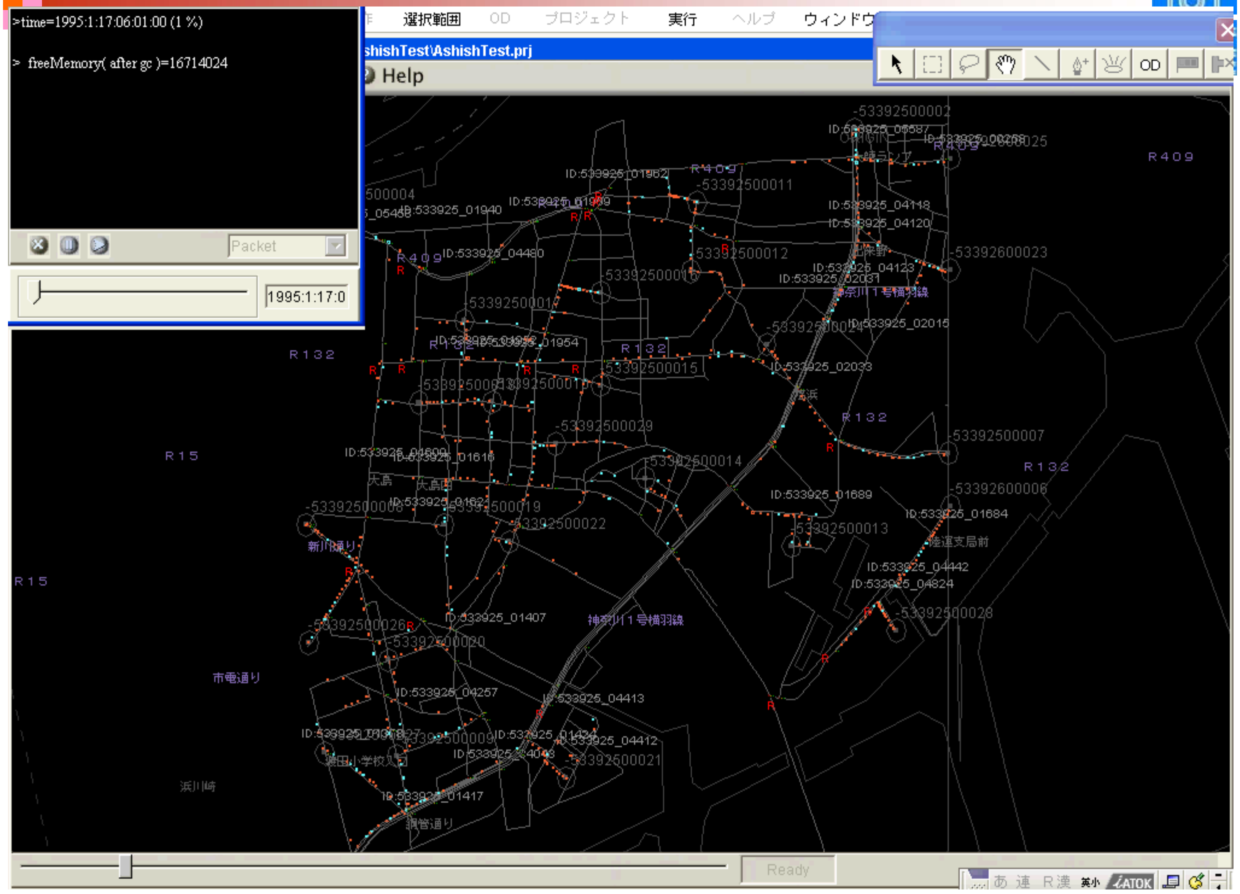
Traffic Survey
on a weekday (Sep., 2003)
morning/evening peak periods
(three hrs. for each period)
at 14 intersections

5. Example applications
[2] "Transport + City + Environment" integrated model

(Kuwahara, 2004[JP])

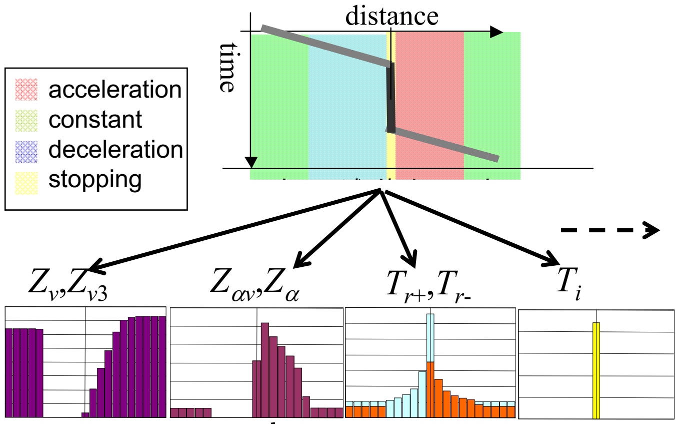
Network traffic simulator: **SOUND4U** (developed in IIS, U-Tokyo, JP)





5. Example applications
[2] "Transport + City + Environment" integrated model

(Kuwahara, 2004[JP])



using the output of PLT
piece-wise-linearized trajectory

MCIE Model to Calculate Indicators for estimation of Emissions

apply the given **SD** (spatial distribution) for each **AGI** (aggregate indicators)

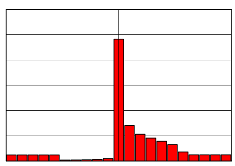
to fit the amount of emission

AGI model
(aggregate indicators)

NOx/CO

$$\text{emission} = c_1 \cdot Z_v + c_2 \cdot Z_{v3} + c_{3a} \cdot Z_{\alpha v} + c_{3b} \cdot Z_{\alpha} + c_{4r+} T_{r+} + c_{4r-} T_{r-} + c_{4i} T_i$$

SD of emission
(spatial distribution)

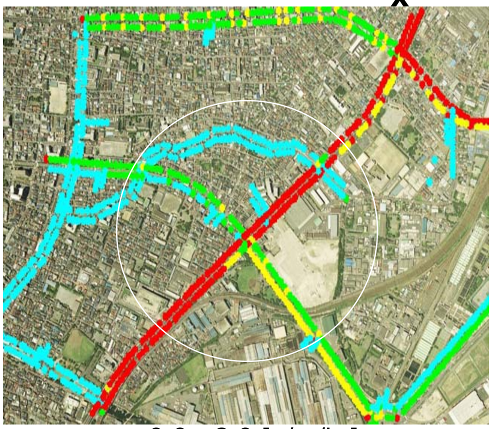


5. Example applications

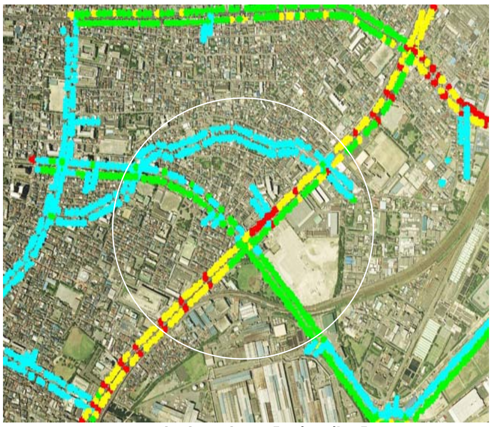
[2] "Transport + City + Environment" integrated model

(Kuwahara, 2004[JP])

emission of NO_x | emission of CO



0.0 - 2.0 [g/m/hr]
2.0 - 4.0 [g/m/hr]
4.0 - 6.0 [g/m/hr]
6.0 - [g/m/hr]



0.0 - 0.5 [g/m/hr]
0.5 - 1.0 [g/m/hr]
1.0 - 1.5 [g/m/hr]
1.5 - [g/m/hr]

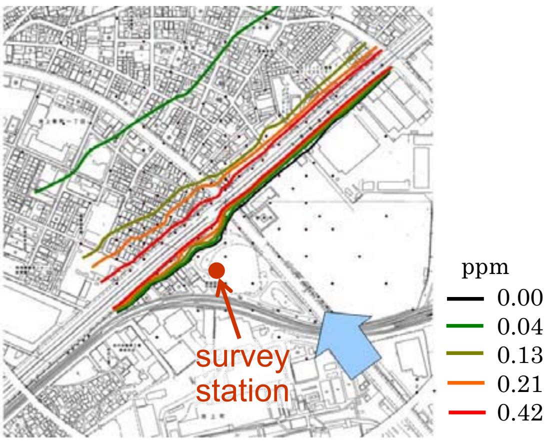
New regulation (2005) personal car (petrol) =0.05[g/km], diesel car = 2.0[g/kWh]＝0.1[g/km/ton]
0.05[g/km]*3000[veh/hr]/1000[m]=0.15[g/m/hr] if all personal-cars
0.15*50%+0.15*10*20%+0.15*40*30%= 2.2[g/m/hr] if mixed

5. Example applications

[2] "Transport + City + Environment" integrated model

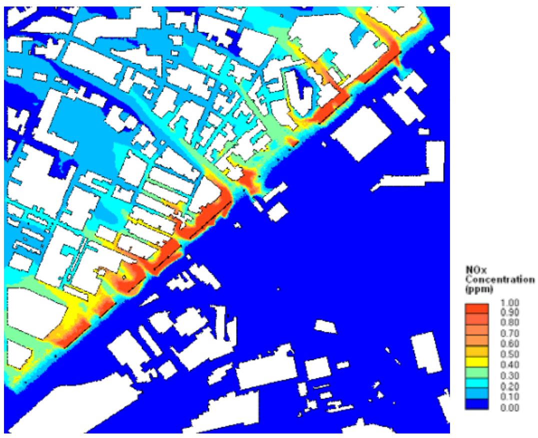
(Kuwahara, 2004[JP])

results for emission of NO_x



NOx emission estimation with Gaussian diffusion (height=1.8m, wind: SE)

area-wide concentration estimated with an approximation model created by Gaussian diffusion applied to model output



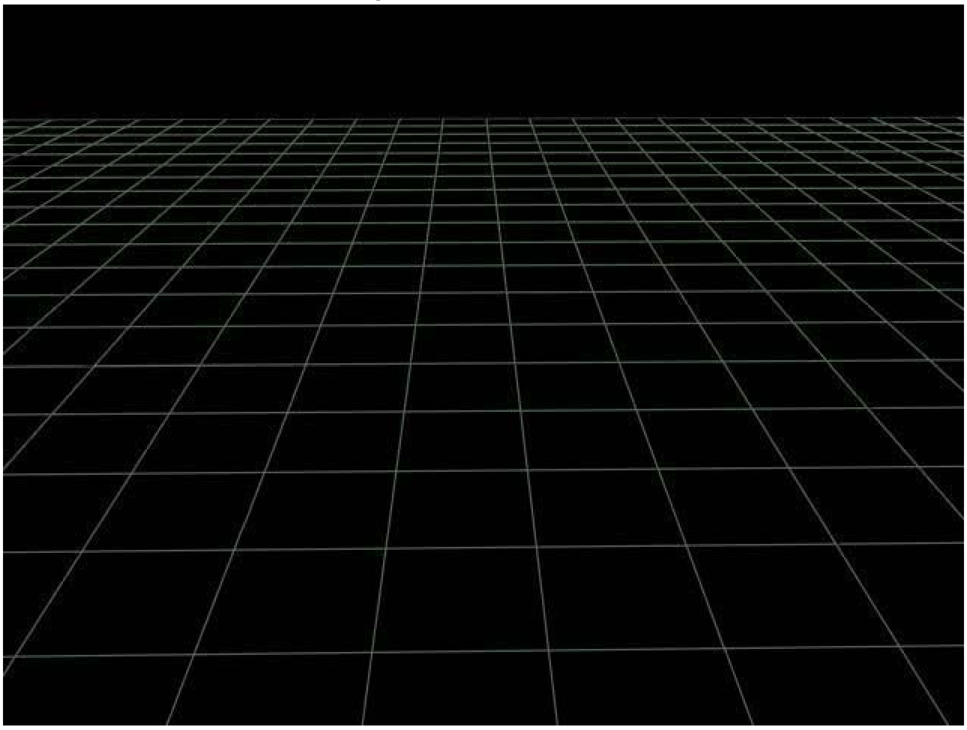
NOx emission estimation with CFD (Computational Fluid Dynamics) (height=1.8m, wind: SE)

pilot study for validating CFD
Results are consistent with Gaussian diffusion in the area with certain distance from source.

5. Example applications
[2] "Transport + City + Environment" integrated model

(Kuwahara, 2004[JP])

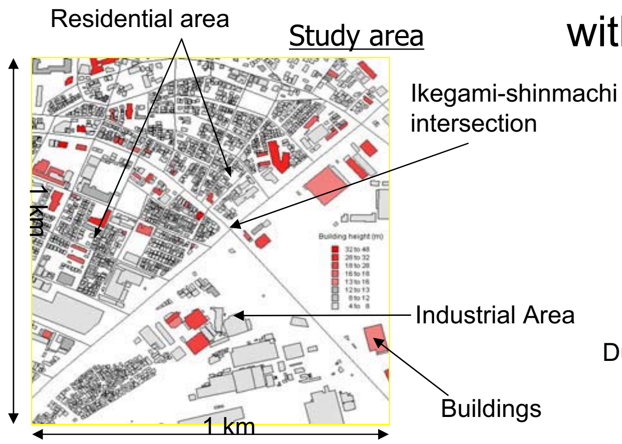
Visualization demo of air pollution

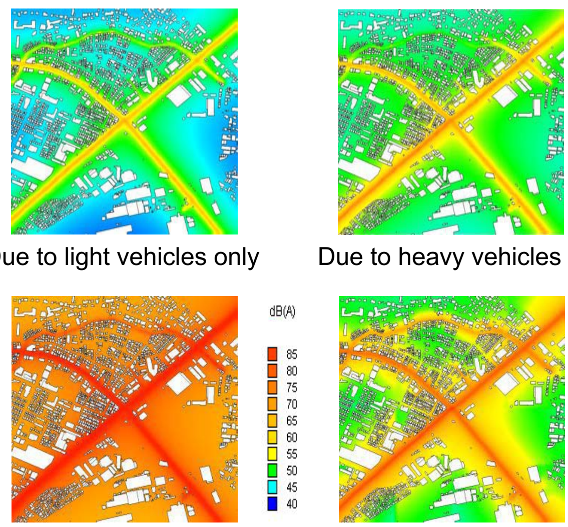


5. Example applications
[2] "Transport + City + Environment" integrated model

(Bhaskar, 2004)

contour-map of road traffic noise with ASJ-model (Acoustical Society of Japan)





Due to light vehicles only

Due to heavy vehicles only

Without considering building attenuation

With considering building attenuation

2. Lecture
"Efficient development and operation of road net works"

Mr. Katsumi UESAKA

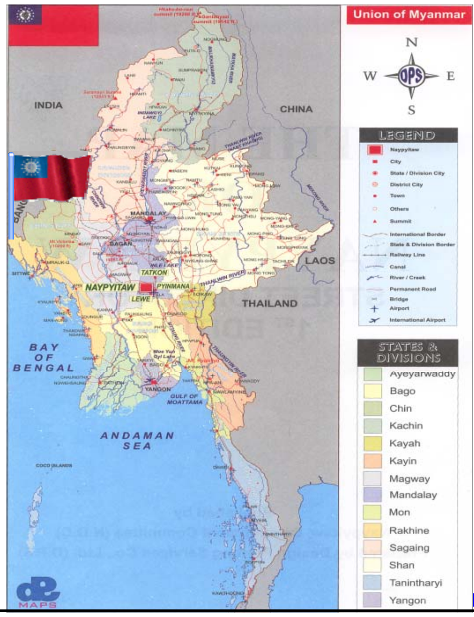
Drivability Map as one Means to Use Existing Road Networks Effectively

Katsumi UESAKA
Traffic Engineering Division, NILIM, MLIT
November 12, 2009

Background

- In Japan, it is more and more important to use existing roads effectively.
- Therefore, it is indispensable to give drivers some useful information on road traffic.
- A roadmap is one of the most basic means for providing the information. However, it has some problems.

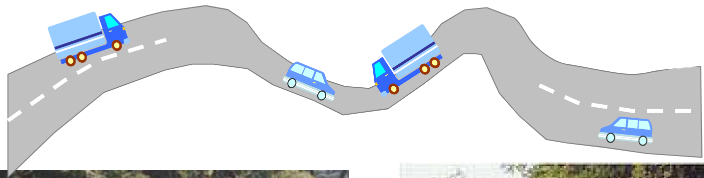
Roadmaps of Our Friendly Countries

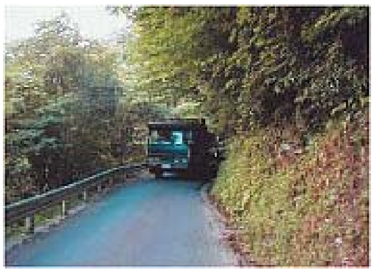


What is the Problem with Japanese Roadmaps?

国道(kokudo) as 酷道(kokudo)

国道 National Highway　酷道 Severe Highway





Proposal of Drivability Map

- “**Drivability**” means
  the ease with which a car can be driven along a particular road.

Example of Drivability Map

A drivability map gives three pieces of information to drivers, especially tourists.

- **Road Structure Ranking**: M, S, A, B, C, D ●
- **Congested Points** ☆
- **Hazardous Spots** with high accident rates

Road Structure Ranking (M and S)

- Trunk roads are divided into sections about 500 m in length.
- Each section is categorized by road structure: number of lanes; curve radius; shoulders; and sidewalk conditions.

M: Motorway

S:

1) Roads with two or more lanes with gentle curves or inclinations over more than 5 km.

2) Wide shoulders with few pedestrians or sidewalks and roadways divided by fences.

3) One or fewer intersections per kilometer.

Road Structure Ranking (Suburban and Mountain Areas)

A: 1) Two or more lanes, gentle curves or slopes.
2) Sidewalks or wide shoulders.

B: 1) Two or more lanes, some not gentle curves or slopes.
2) Some parts with narrow shoulders.

C: 1) One lane with sharp curves. Two or more lanes, with sharp curves and steep slopes.
2) Some parts with narrow shoulders.

D: 1) One lane with continuous sharp curves.
2) Narrow shoulders.

Road Structure Ranking (Urban Areas)

A: 1) Road with two or more lanes and gentle curves.
2) Sidewalks usable by cyclists on both sides, and wide shoulders.

B: 1) Road with two or more lanes.
2) Sidewalks on both sides.

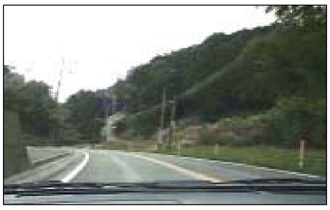
C: 1) Road with two or more lanes.
2) Sidewalk on one side or no sidewalk.

D: 1) Road with one lane.
2) No sidewalk.

Acquisition of Basic Data for Road Structure Ranking

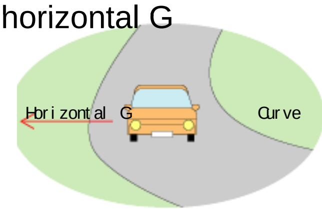
When there was no sufficient data existing for the ranking, a field survey was conducted using a car equipped with a video camera and probe system.

Sample video image



Calculating the radius of curvature from horizontal G

Plane curve radius (m) = $\dfrac{V^2}{gG}$



For whom is a drivability map the most useful?

Tourism is one of the most important tasks of our ministry.

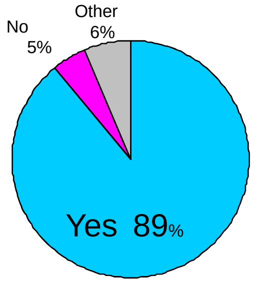
THE MINISTER OF LAND, INFRASTRUCTURE, TRANSPORT AND TOURISM

Evaluation of a Paper Drivability Map

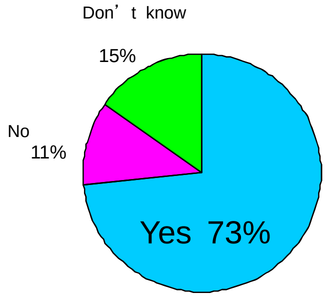
• Nearly 90% of respondents felt that the Drivability map was a good idea.

• Over 70% respondents were keen to use the map in the future.

Do you think it's a good idea?

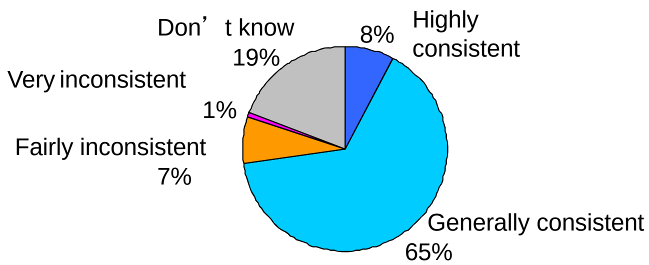


Would you like to use it?



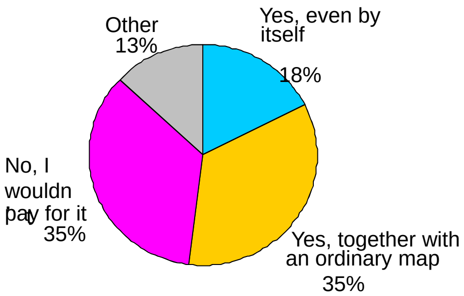
Consistency with Actual Feelings

How consistent were the indicated classification with actual feelings ?

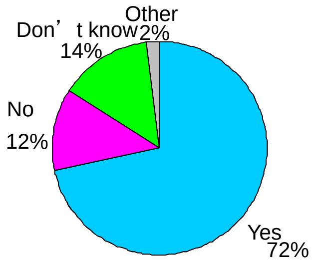


Need for Drivability Maps for Car Navigation Systems

Would you buy a drivability map, if it were sold?



Should drivability maps be incorporated into car navigation systems?



Development of Drivability Map for Practical Use

Step 1 Paper map (2004)

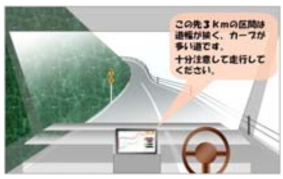
Step 2 Digital map on website (2007)

Step 3 Integration into car navigation system (2010?)

Step 1

Step 2

Step 3



Route Search Service on Internet Using Digital Drivability Maps

Integration of Drivability Maps into Car Navigation Systems

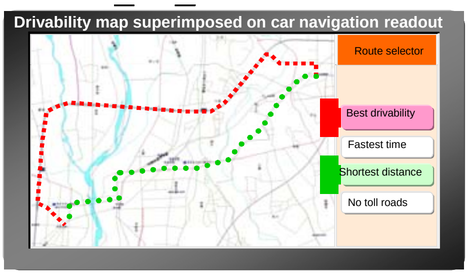
NILIM is executing a joint study with six industry groups on the feasibility of integrating drivability maps into car navigation systems.

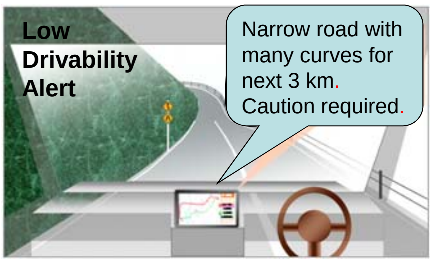
Period

December 2006 - February 2009

Participating companies

- Aisin AW, Denso, Toyota Mapmaster
- Alpine
- Increment P Corp, Pasco
- Kenwood, Zenrin
- Sumitomo Electric System Solutions
- Panasonic





Problems Clarified by the Joint Research

- Usefulness of data for car navigation companies
- Check system for accuracy of data
- Reduction in update cost of data

Summary in Japan

Step 1 (paper map) and Step 2 (digital map on website) seems to be successful.

Step 3 (integration into car navigation system) has a lot of problems to be solved.

The success depends on cooperation between governments and private car navigation companies.

I hope that you will have your own drivability map.

A Kind of Drivability Map !?

Thank you very much for listening.

3. Lecture
“Measures to secure road traffic safety”

Mr. Masahiro KANEKO

Road Safety Measures in Japan

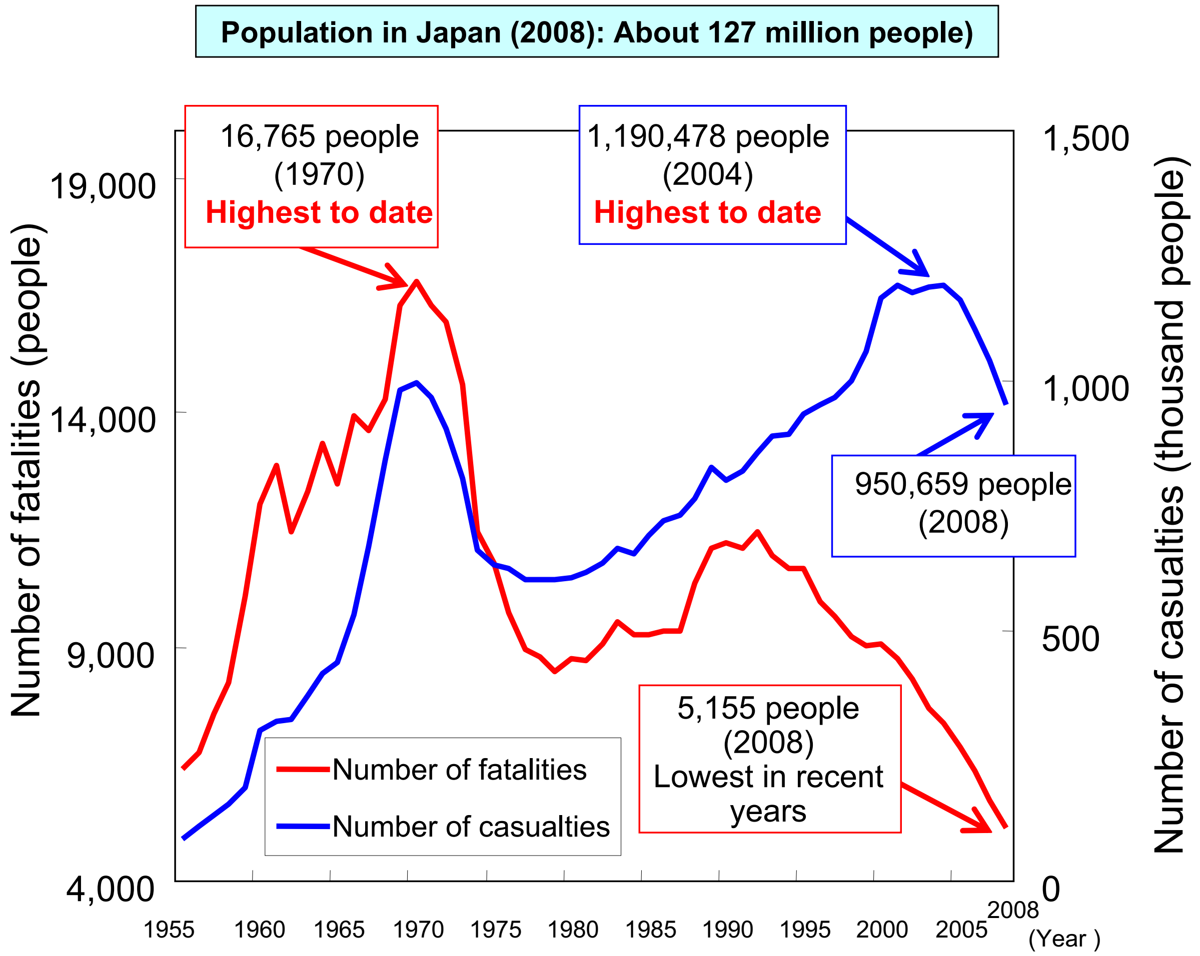
November 12, 2009
The 18th Conference
on Public Works Research and Development
in Asia

Advanced Road Design and Safety Division
National Institute for Land and Infrastructure Management
Ministry of Land, Infrastructure, Transport and Tourism

Road Safety Measures in Japan

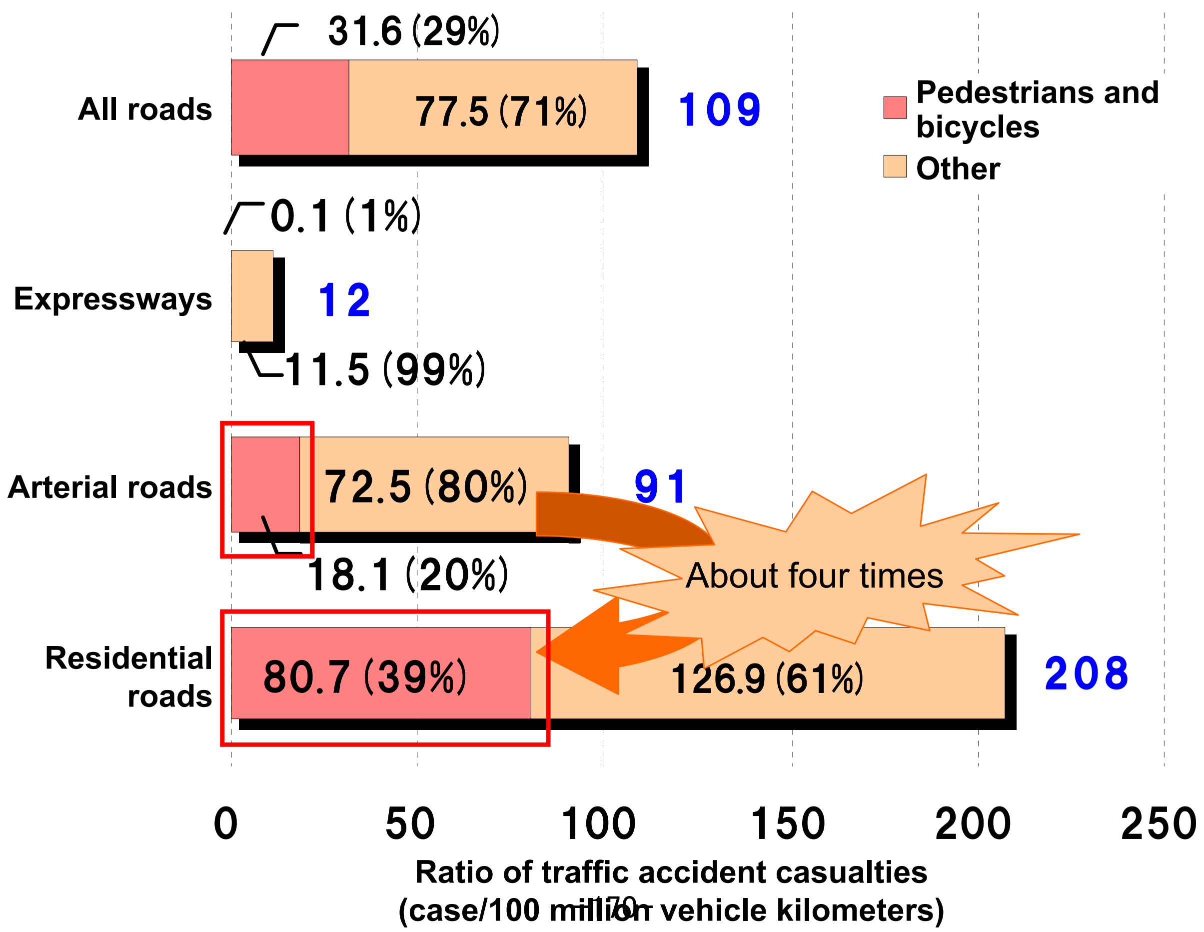
- **Current situation of traffic accidents**
- **Efforts to prevent traffic accidents**
  - Preventive measures for arterial roads
  - Preventive measures for residential roads

Current situation of traffic accidents: Number of traffic accident fatalities and casualties



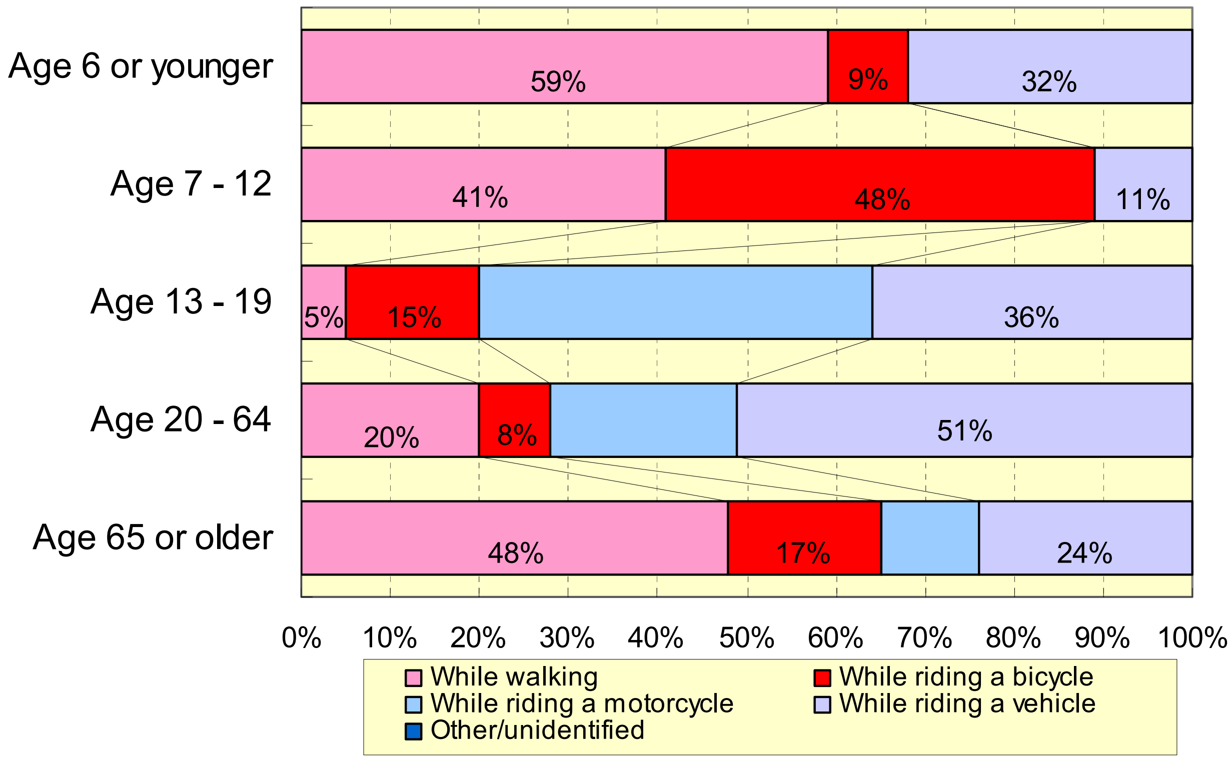
2

Current situation of traffic accidents:
Comparison of ratios of traffic accident casualties by type of road (2007)



3

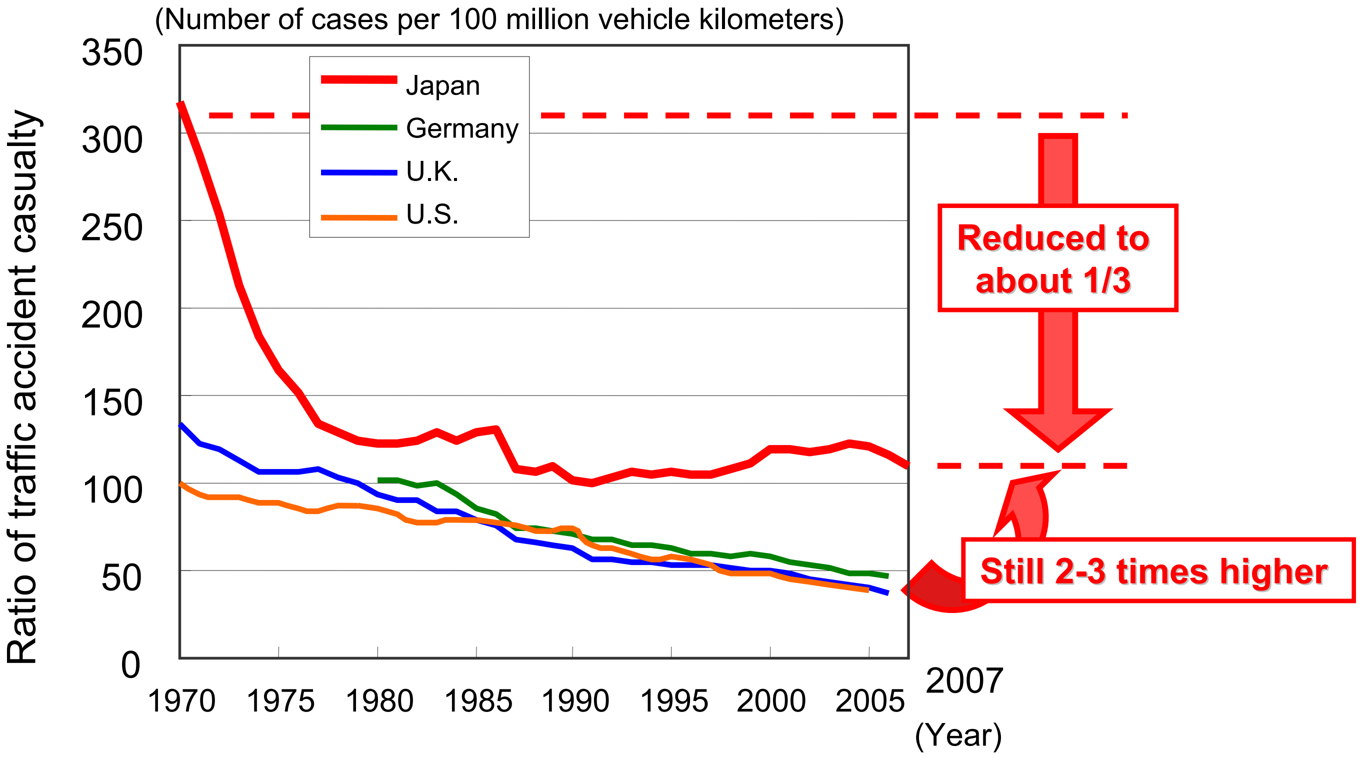
Current situation of traffic accidents: Number of fatalities by age and situation (2006)



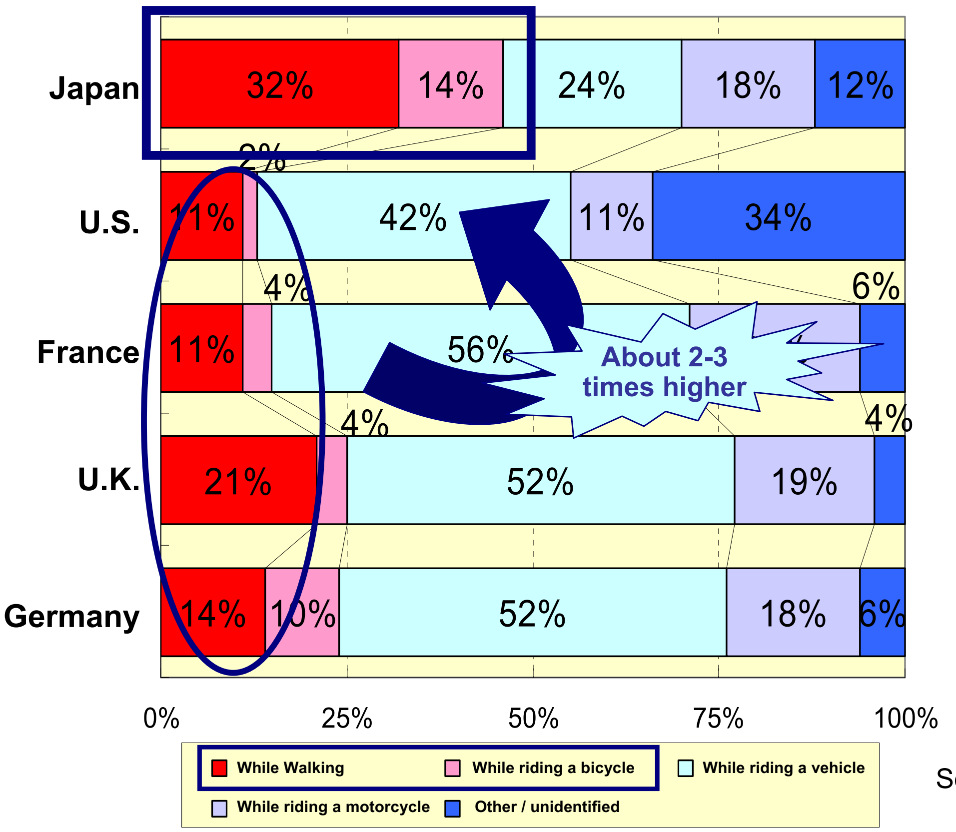
Source: Annual Report on Traffic Accident Statistics

Current situation of traffic accidents: Changes in traffic accident casualties

Country	Japan	Germany	U.K.	U.S.
Ratio of traffic accident casualty	**109** (2007)	47.6 (2006)	37 (2006)	38.6 (2005)



Current situation of traffic accidents:
International comparison of the number of fatalities by situation (2006)

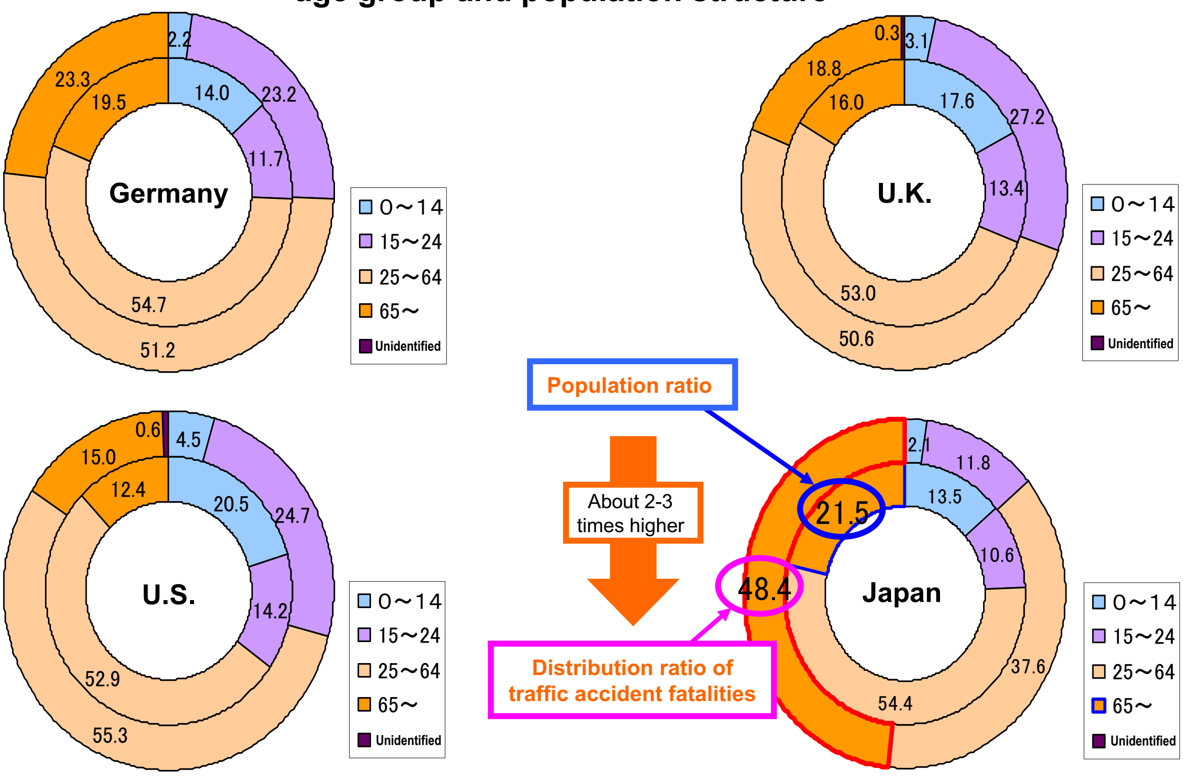


Source: Data by IRTAD/OECD

6

Current situation of traffic accidents:
Ratios of traffic accident fatalities by age group

International comparison of traffic fatality ratios by age group and population structure



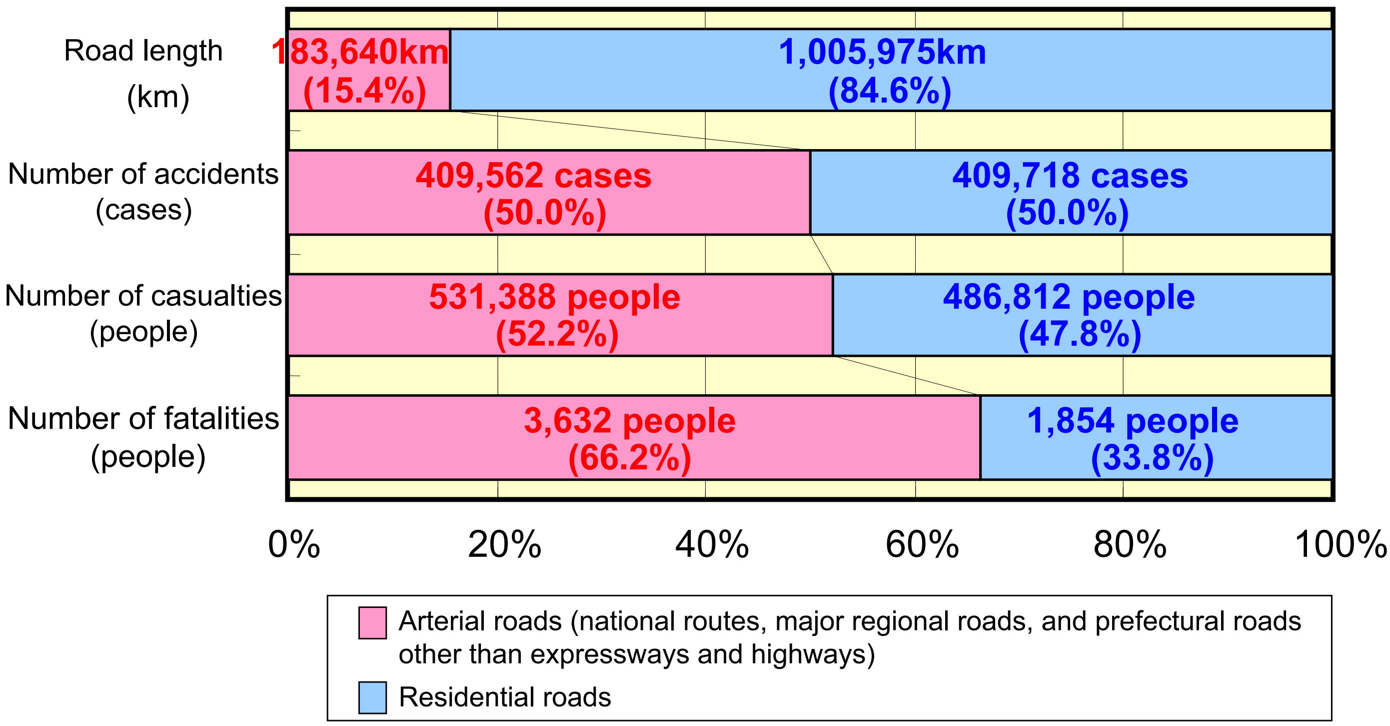
Note 1: IRTAD data 2: Values indicate distribution ratios (%) 3: The inner circle indicates population, and the outer circle the number of traffic accident fatalities 4: Data is based on 2007 (2005 for the U.S. only)

7

Road Safety Measures in Japan

- Current situation of traffic accidents
- **Efforts to prevent traffic accidents**
  - **Preventive measures for arterial roads**
  - Preventive measures for residential roads

Current situation of traffic accidents on arterial roads and residential roads

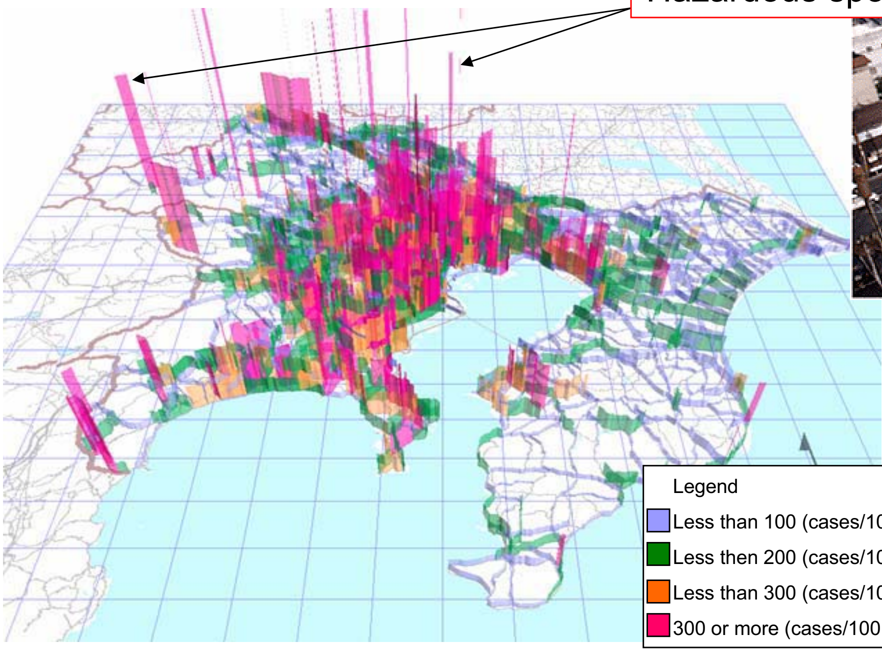


* Road length is based on the Annual Report on Road Statistics (2006)
* Number of accident is based on the Annual Report on Traffic Accident Statistics (2007)

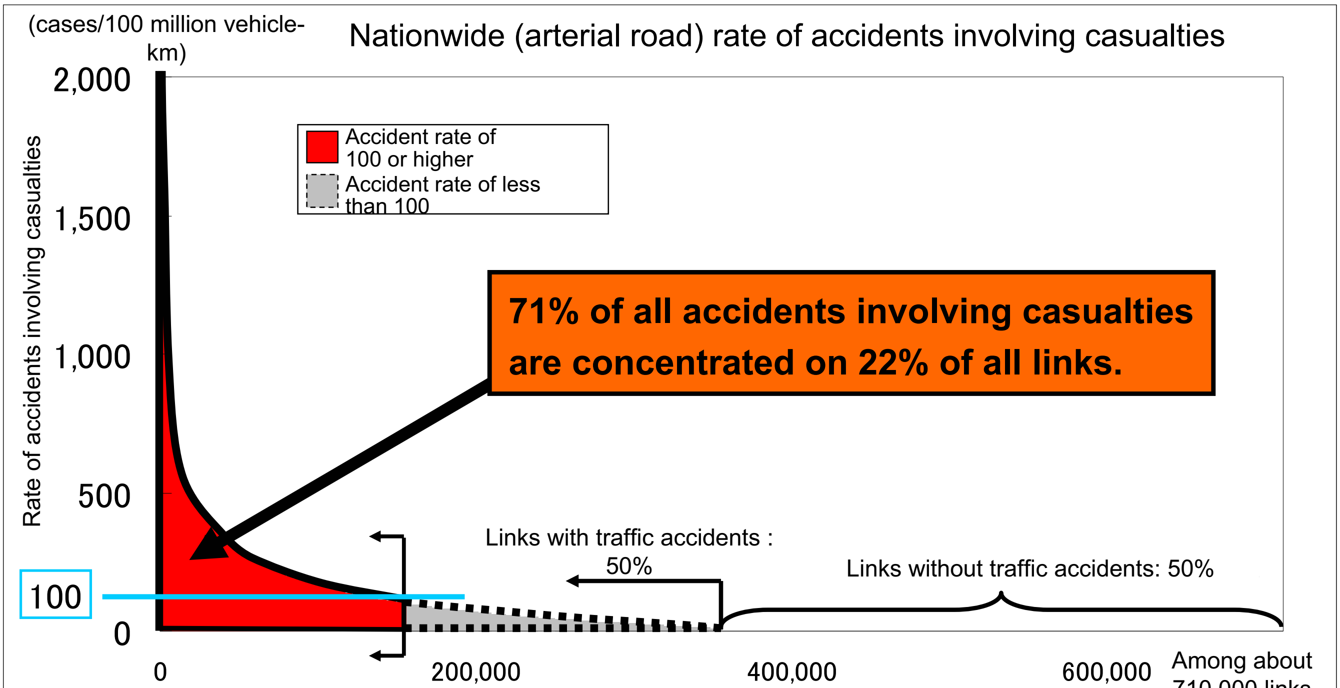
■Occurrence of Traffic Accidents

- Arterial Roads: Accidents are concentrated at specific locations.

  → Implementation of focused road traffic environment countermeasures for hazardous spots



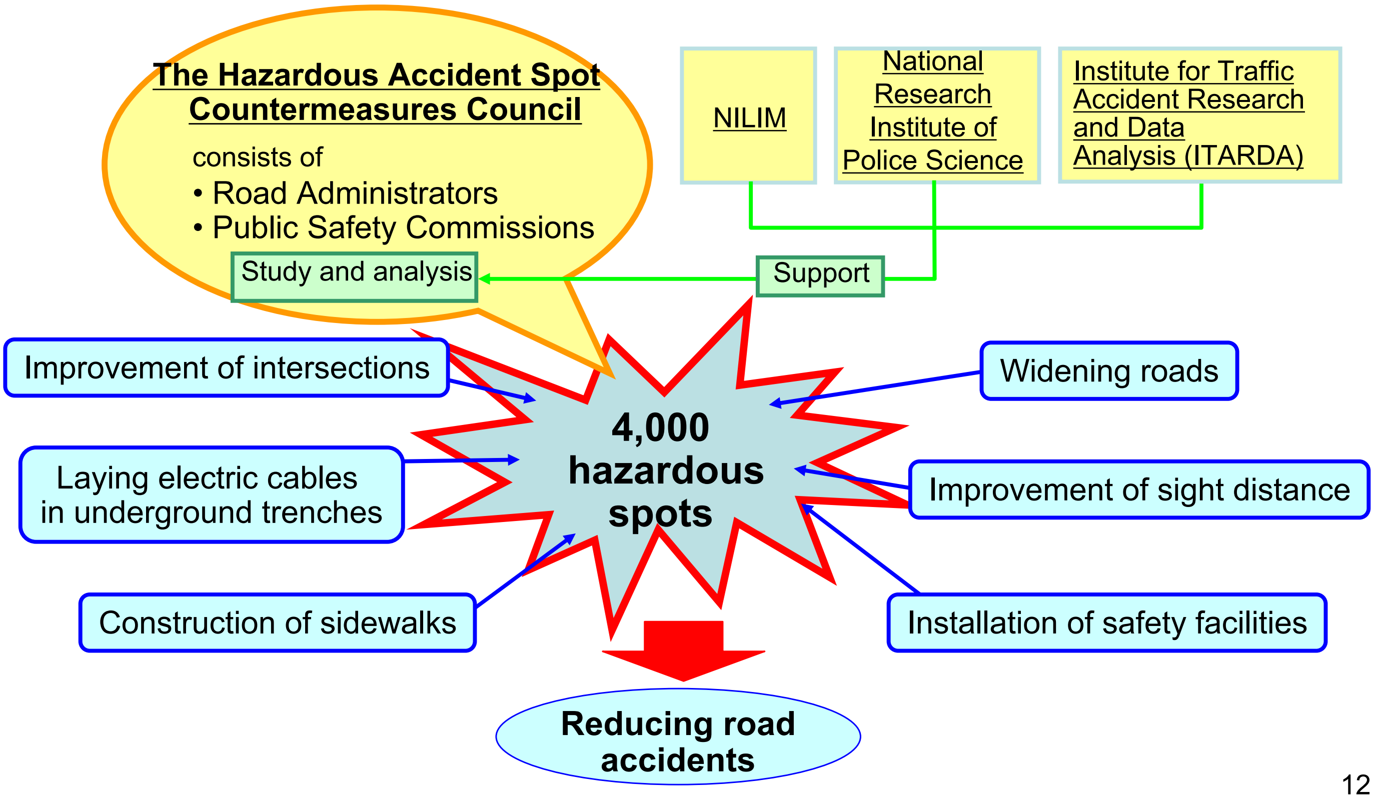
Traffic accidents on arterial roads: Selected and focused measures



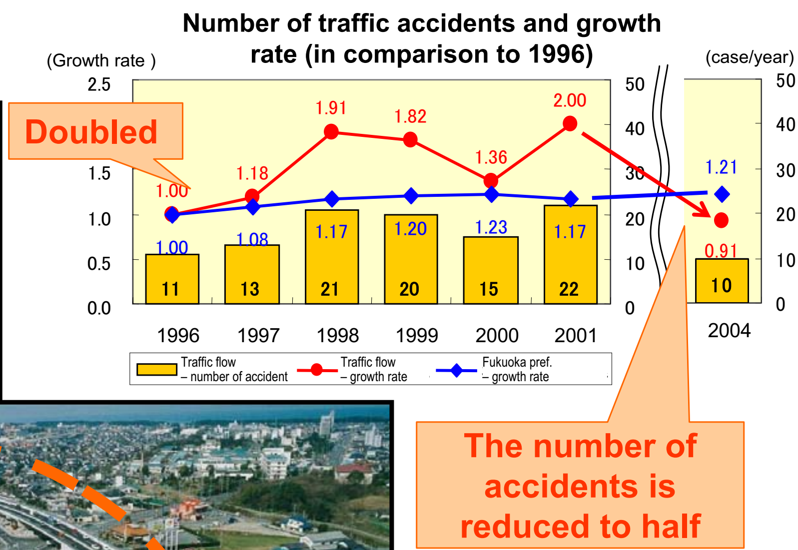
* The graph is created based on the average accident data over four years (2003 to 2006) on approximately 180,000 km of national routes and prefectural roads in Japan.

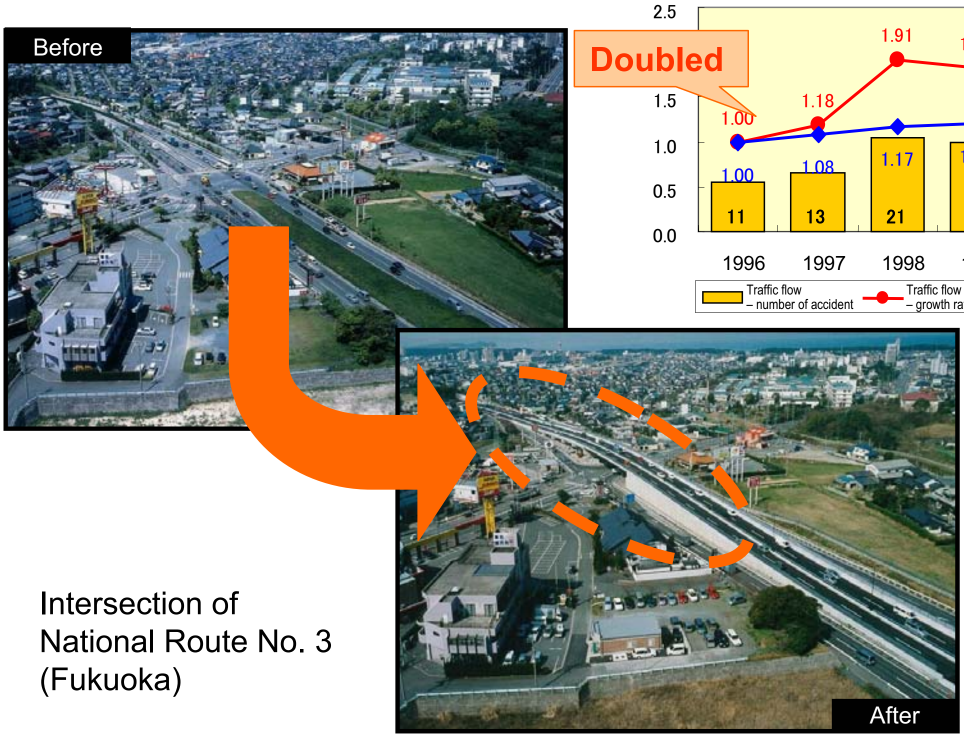
■Urgent Measures for Hazardous Accident Spots

●Overview



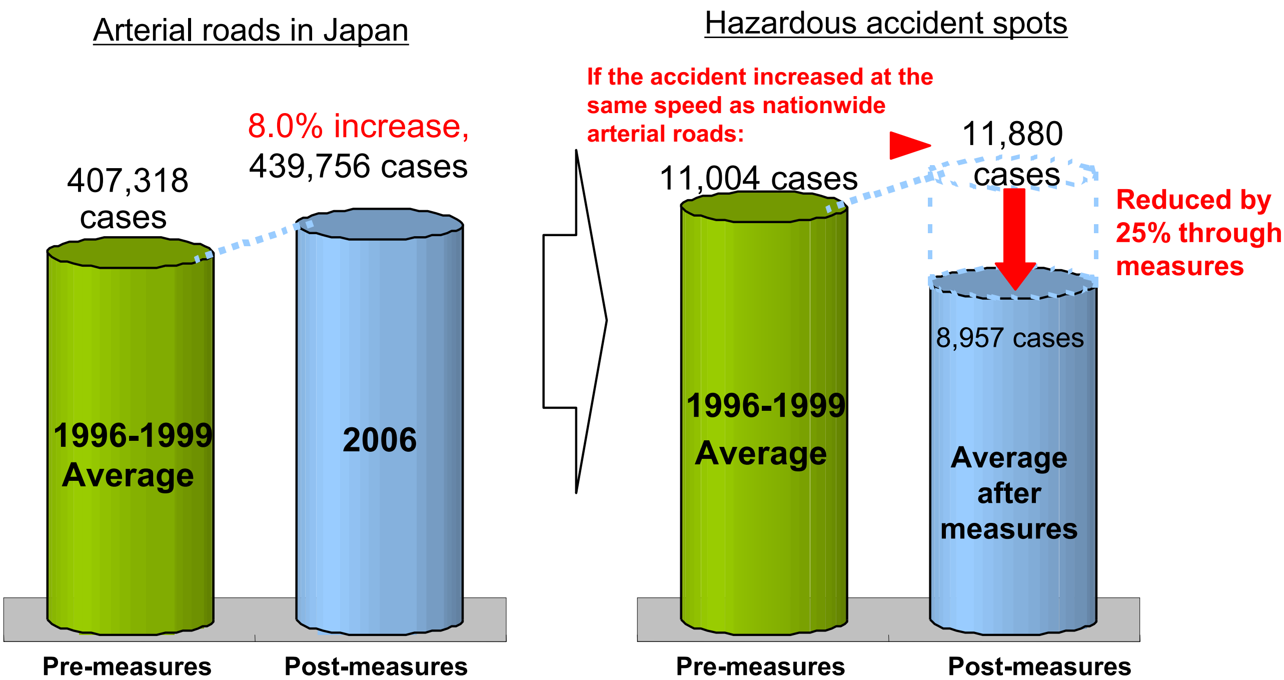
Example of preventive measures against traffic accidents on an arterial roads (Intersection of National Route No. 3)





Intersection of National Route No. 3 (Fukuoka)

Effect of reducing accidents through measures implemented at hazardous accident spots



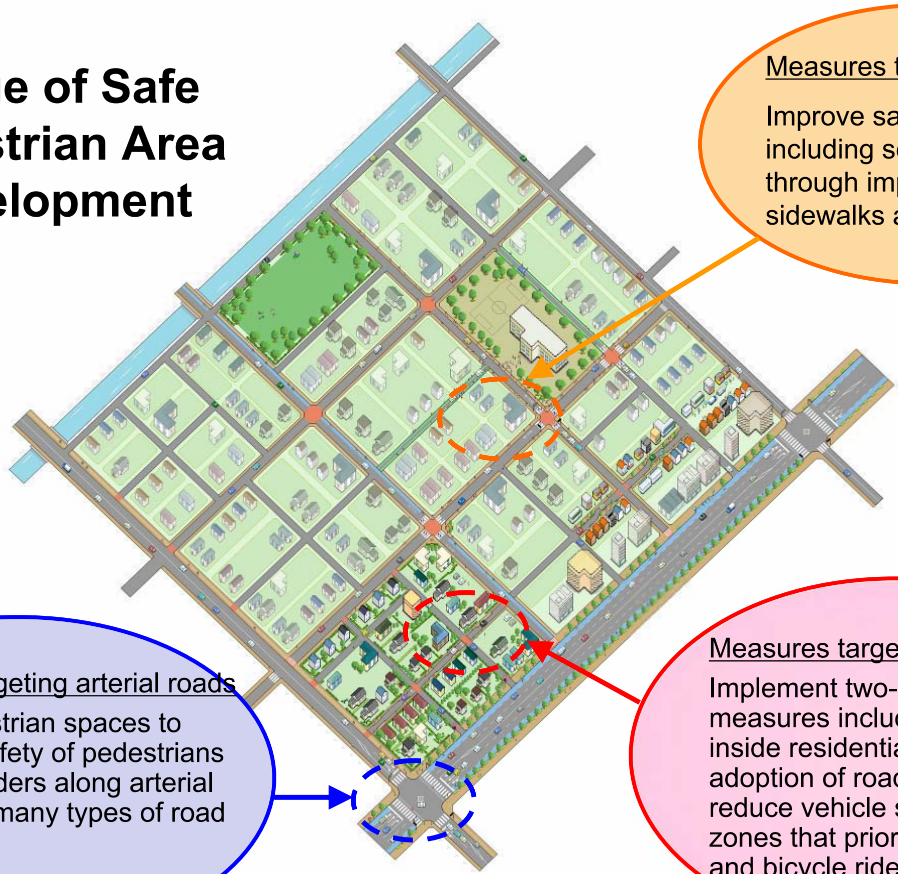
* This data covers 2,261 locations where measures administered by road administrators and public safety commissions were completed or partially completed by 2005.
* Pre-measure data is the four-year average from 1996 to 1999.
* Post-measure data is the three-year average from 2004 to 2006 for locations where measures were completed or partially completed in 2003, the two-year average from 2005 to 2006 for locations where measures were completed or partially completed in 2004, and the 2006 data for locations where measures were completed or partially completed in 2005.

Road Safety Measures in Japan

- Current situation of traffic accidents
- **Efforts to prevent traffic accidents**
  - Preventive measures for arterial roads
  - **Preventive measures for residential roads**

Promotion of measures on residential roads under pedestrian-friendly area projects

Image of Safe Pedestrian Area development



Measures targeting routes

Improve safety of routes including school roads through improvement of sidewalks and traffic lights.

Measures targeting zones

Implement two-dimensional measures including speed limits inside residential areas and adoption of road structures to reduce vehicle speed to develop zones that prioritize pedestrians and bicycle riders.

Measures targeting arterial roads

Secure pedestrian spaces to ensure the safety of pedestrians and bicycle riders along arterial roads where many types of road users gather.

Promotion of measures on residential roads under pedestrian -friendly area projects

Examples of measures implemented in Safe Pedestrian Areas

Measures targeting arterial roads	Measures targeting routes	Measures targeting zones
Construction of intersection overpasses	Development of sidewalks	Installation of speed bumps

Construction of intersection overpasses

Development of sidewalks

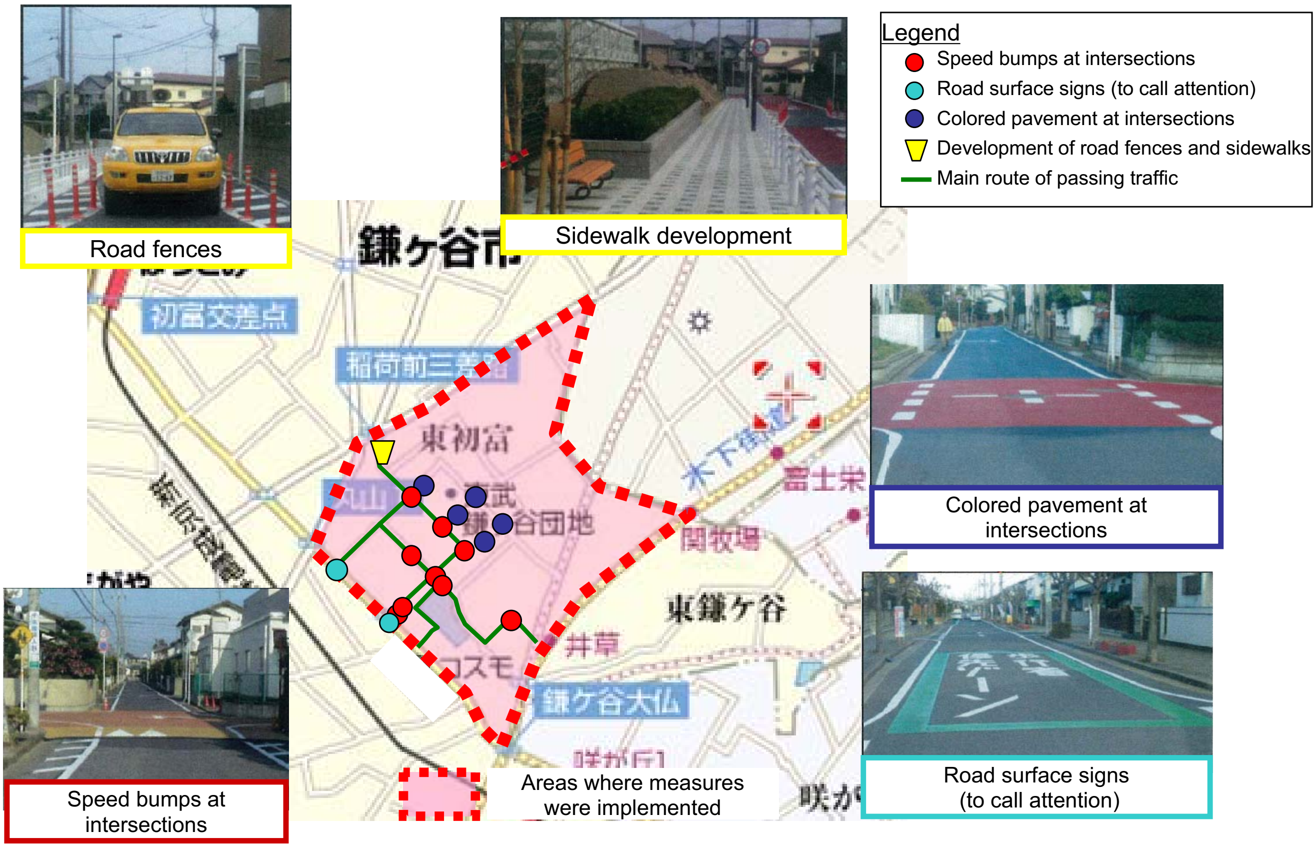
Installation of speed bumps

Separate traffic lights for pedestrians and vehicles

Push-button traffic lights

Regulation of maximum speed

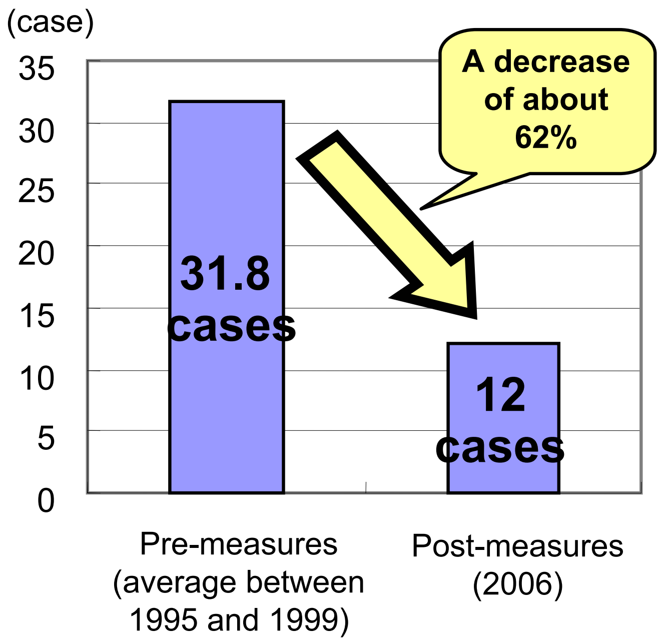
Example of two-dimensional development in a Safe Pedestrian Area (Kamagaya, Chiba)



Example of two-dimensional development in a Safe Pedestrian Area (Kamagaya, Chiba)

Workshop

Effectiveness of the measures



*Circumferential arterial roads are not included.

4. Lecture
“Environmental Issues of Roads in Japan”

Mr. Sinri SONE

Environmental Issues of Roads in Japan

Shinri　SONE、
Head of Road　Environment　Division
National Institute for Land and Infrastructure Management
Ministry of Land, Infrastructure and Transport

Outline

1.Grobal Warming

2.Environmental Impact Assessment

3.Air pollution

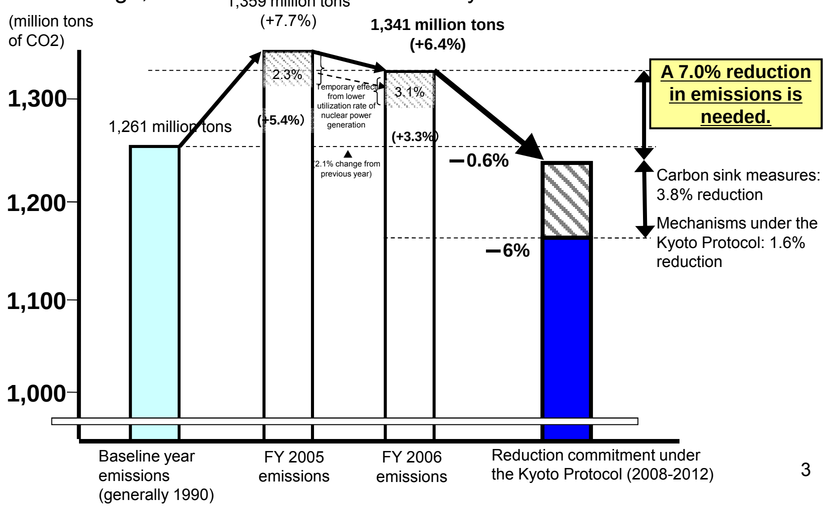
4.Traffic Noise

5.Eco-system

6.History of Engineering

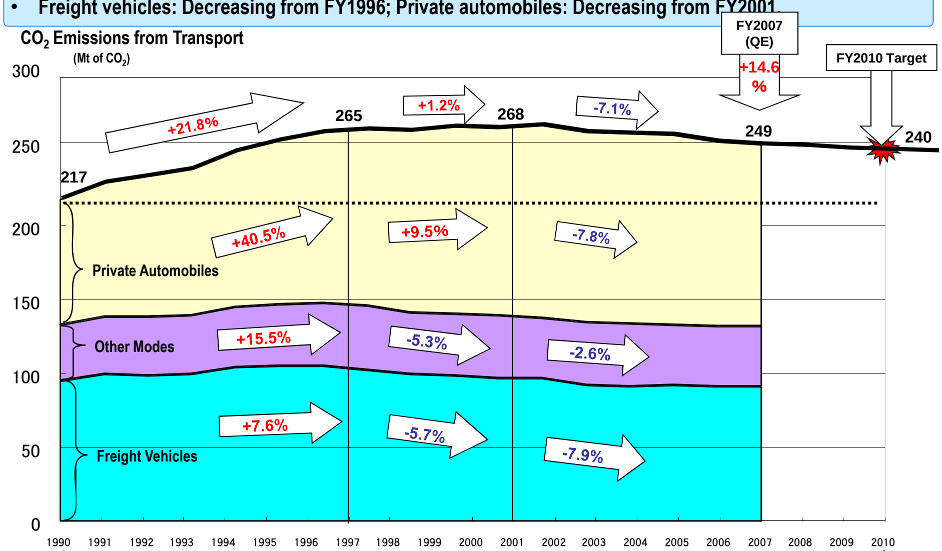
1.1.Target of Greenhouse gas emissions

- In FY 2006, Japan's greenhouse gas emissions were 6.4% higher than their baseline 1990 levels.
- To achieve Japan's commitment to a 6% reduction under the Kyoto Protocol on climate change, emissions must be reduced by 7.0%.



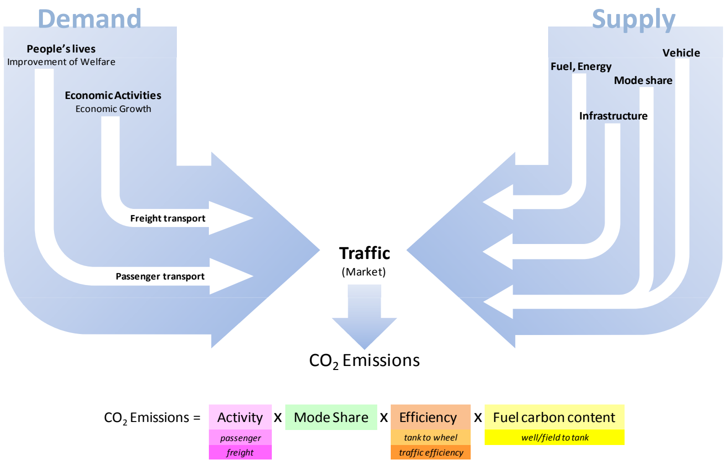
1.2. CO_2 Emissions from Transport Sector in Japan

- CO_2 emissions from transport have been decreasing after peaking in FY2001.
- Freight vehicles: Decreasing from FY1996; Private automobiles: Decreasing from FY2001.



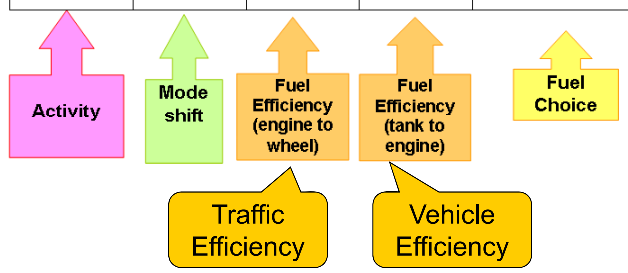
* “Other Modes” includes emissions from buses, taxies, railways, ships and aircraft.

1.3.Evaluation and Monitoring Framework for Addressing Transport CO2 Emissions

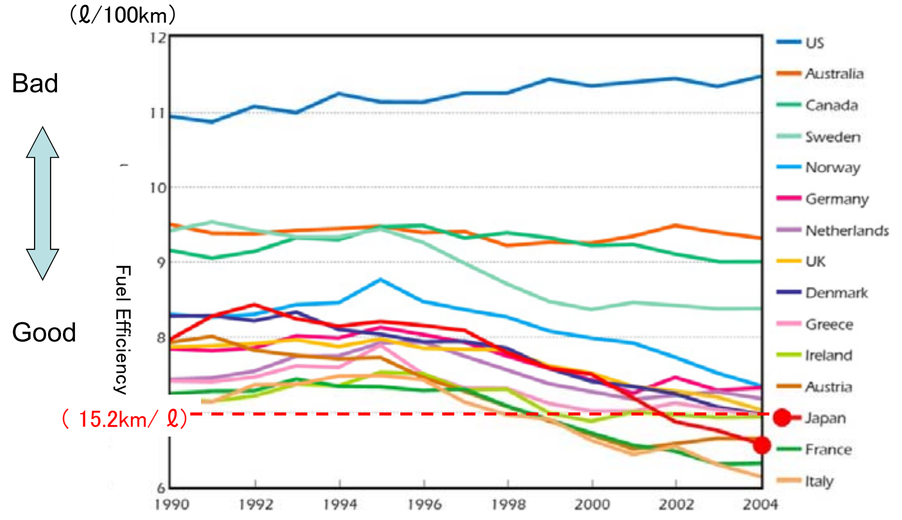


1.4.Evaluation Model of Transport CO2 Emissions

$$CO_2 = \frac{Trip}{Economy} \cdot \frac{Wheel}{Trip} \cdot \frac{Engine}{Wheel} \cdot \frac{Tank}{Engine} \cdot \frac{Well}{Tank} \cdot \frac{CO_2}{Well} \cdot Economy$$

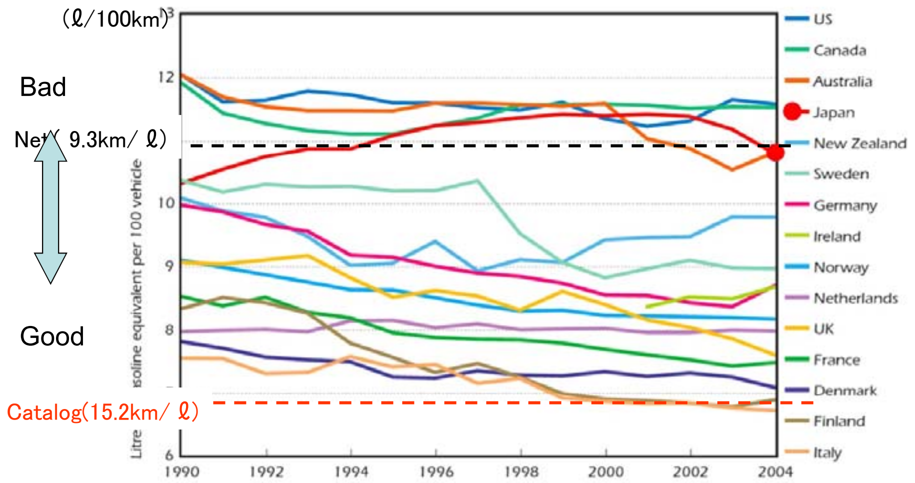


1.5.Fuel Efficiency (catalog) in the world

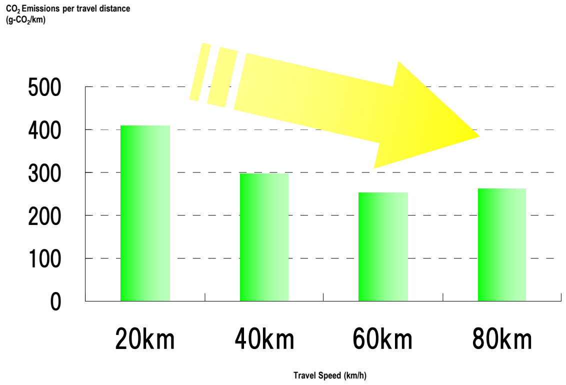


Source: IEA Mobility Modelling Database.

1.5.Fuel Efficiency net) in the world



1.6.CO2 and Traffic condition



9

1.7.Development of Bypass Roads and Ring Roads

$$\frac{CO_2}{Economy} = \frac{Trip}{Economy} \cdot \frac{Traffic}{Trip} \cdot \frac{Wheel}{Traffic} \cdot \boxed{\frac{Engine}{Wheel}} \cdot \frac{Tank}{Engine} \cdot \frac{Well}{Tank} \cdot \frac{CO_2}{Well}$$

Traffic Condition

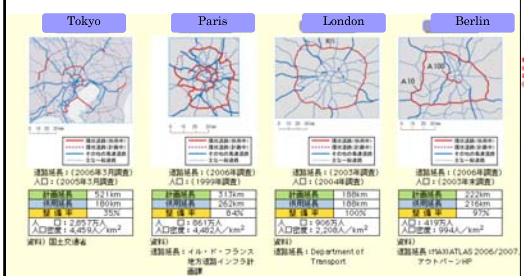


Figure-10 Comparison of Ring Road Networks in Metropolitan Areas in some Countries

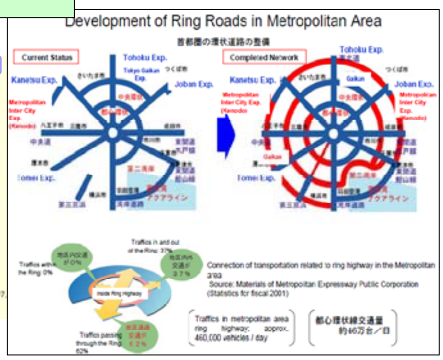
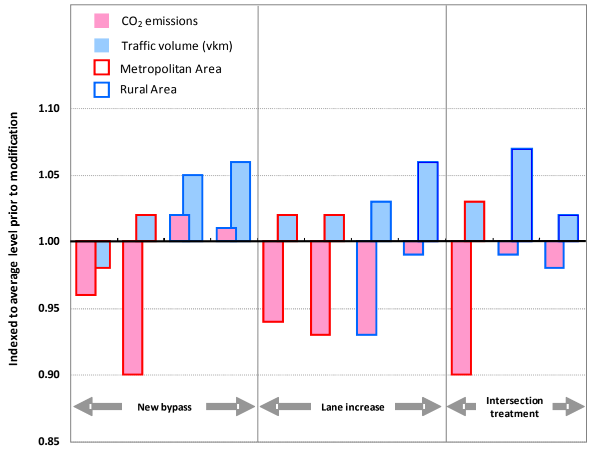


Figure-11 Image of Metropolitan Ring Road Networks in Japan

10

1.8.CO2 and VKT Impacts of Selected Road Infrastructure Modifications in Japan

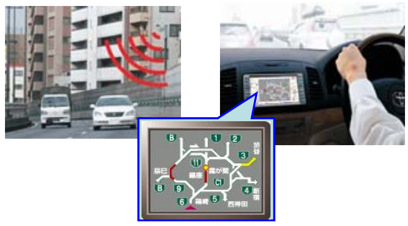


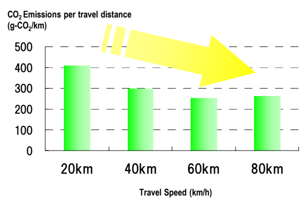
1.9.Promotion of Intelligent Transport Systems (VICS)

■VICS: Provides road traffic information in real time, realizing smooth traffic & higher travel speed, resulting in the improvement of actual fuel efficiency:

→ Reduce CO_2 emissions by 2.4 Mt in 2010.

VICS
(Vehicle Information and Communication System)





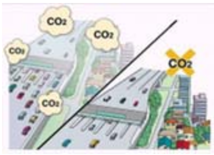
In 2010
Reduction of 2.4Mt-CO_2

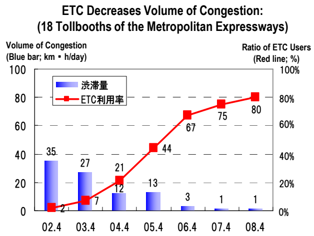
1.10.Promotion of Intelligent Transport Systems (ETC)

■ETC: Enables non-stop, cashless toll collection at expressway tollbooths, whose capacity shortage causes about a third of traffic jams on expressways:

→ Reduce CO_2 emissions by 0.2 Mt in 2010.

ETC
(Electronic Toll Collection System)





In 2010
Reduction of 0.2Mt-CO_2

2. Outline of Environmental Impact Assessment System

Environmental Impact Assessment Law
Article 1:
Taking into account that it is extremely important for entrepreneurs who conduct projects, such as alterations to the configurations of land and the new construction of structures, to assess the environmental impacts in advance of the implementation of the projects in order to conserve the environment, this law ensures that proper consideration will be given to the conservation of the environment related to the projects, and contributes to the maintenance of people's healthy and cultural lives now and in the future by clarifying the national government's and others' responsibilities for environmental impact assessments, by deciding on procedures for proper, efficient environmental impact assessment, and other required matters for large-scale projects that are likely to have a significant environmental impact, and by taking measures for the conservation of the environment related to the projects so the results of environmental impact assessments that are made under the above procedures can be reflected in decisions concerning the details of the projects.

2.1. Projects applicable for the Environmental Impact Assessment Law

	Class 1 Project	Class 2 Project
1. Roads (* Large scale forest roads were newly added.)		
National Expressway	All	———
Metropolitan Expressway, etc.	Four lanes or more	———
National Highway	Four lanes or more, 10 km or more	Four lanes or more, 7.5 km or more Less than 10 km
Large scale forest road	Two lanes or more, 20 km or more	Two lanes or more, 15 km or more Less than 20 km
2. Rivers (* Dams related to second class rivers, and weirs (weirs for water supply, weirs for industrial use, and weirs for irrigation) outside the jurisdiction of the Ministry of Construction were newly added. A requirement for the size of dams was reduced from 200 ha, which was decided upon by the Cabinet, to 100 ha.)		
Dam	Water surface area of 100 ha or more	Water surface area of 75 ha or more, less than 100 ha
Weir	Water surface area of 100 ha or more	Water surface area of 75 ha or more, less than 100 ha
Lake water level adjusting facilities	Altered area of 100 ha or more	Altered area of 75 ha or more, less than 100 ha
Flood-way	Altered area of 100 ha or more	Altered area of 75 ha or more, less than 100 ha
3. Railroads (* Ordinary railroads and tracks (for ordinary railroads, or equivalent) were newly added.)		
Shinkansen railroad (including new railroads constructed in compliance with standards for Shinkansen railroads)	All	———
Ordinary railroad	10 km or more	7.5 km or more, less than 10 km
Tracks (for ordinary railroads, or equivalent)	10 km or more	7.5 km or more, less than 10 km
4. Airports	Runway of 2,500 m or more	Runway of 1,875 m or more, less than 2,500 m

(* Major changes from matters decided upon by the Cabinet)

	Class 1 Project	Class 2 Project
5. Power plants (* newly added)		
Hydroelectric power plant	Output power of 30,000 kW or more	Output power of 22,500 kW or more, less than 30,000 kW
Thermoelectric power plant (except for geothermal power)	Output power of 150,000 kW or more	Output power of 112,500 kW or more, less than 150,000 kW
Thermoelectric power plant (geothermal power)	Output power of 10,000 kW or more	Output power of 7,500 kW or more, less than 10,000 kW
Nuclear power plant	All	———
6. Final waste-disposal sites	30 ha or more	25 ha or more, less than 30 ha
7. Filling-up and reclamation of state-owned water resources	More than 50 ha	40 ha or more, less than 50 ha
8. Land readjustment projects	100 ha or more	75 ha or more, less than 100 ha
9. New residential city area development projects	100 ha or more	75 ha or more, less than 100 ha
10. Industrial park development projects	100 ha or more	75 ha or more, less than 100 ha
11. New urban development projects	100 ha or more	75 ha or more, less than 100 ha
12. Distribution estate development projects	100 ha or more	75 ha or more, less than 100 ha
13. Building land development projects (Building land includes residential and industrial land.)		
Japan Environment Corporation	100 ha or more	75 ha or more, less than 100 ha
Housing and Urban Development Corporation	100 ha or more	75 ha or more, less than 100 ha
Japan Regional Development Corporation	100 ha or more	75 ha or more, less than 100 ha

○ Port and harbor plan	Reclaimed land area and excavated area of 300 ha or more

2.2. Applicable items (road work)

I Maintenance of natural components of the environment in a good condition

- ❄ Atmospheric environment
  - ○ Air quality
  - ○ Noise
  - ○ Vibration
  - ○ Offensive odor
  - ○ Other
- ❄ Water environment
  - ○ Water quality
  - ○ Deposits
  - ○ Groundwater
  - ○ Other
- ❄ Soil and other environments
  - ○ Topography and geology
  - ○ Ground
  - ○ Soil
  - ○ Other

II Ensured diversity of living things, and systematic conservation of the natural environment

- ❄ Plants
- ❄ Animals
- ❄ Ecosystems

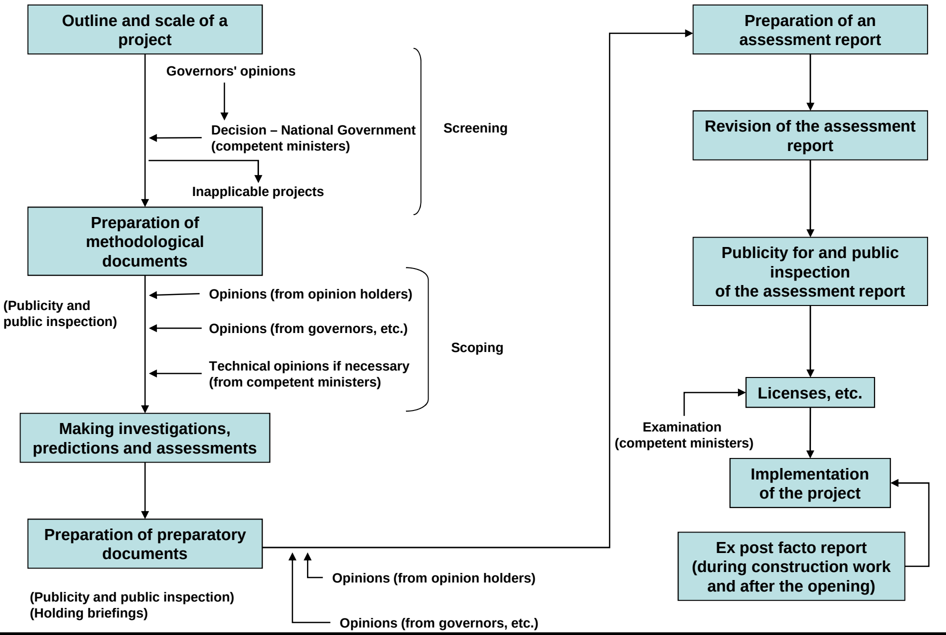
III Affluent exchanges with people and nature

- ❄ Landscape
- ❄ Place for exchanging activities

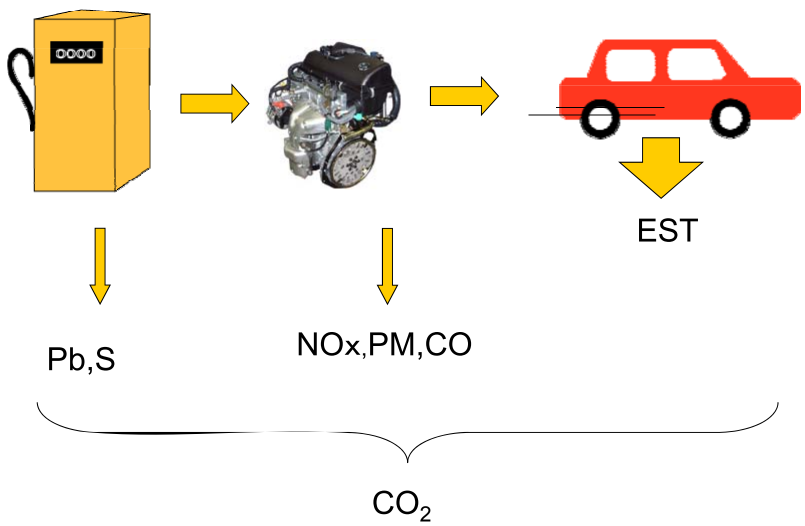
IV Environmental burdens

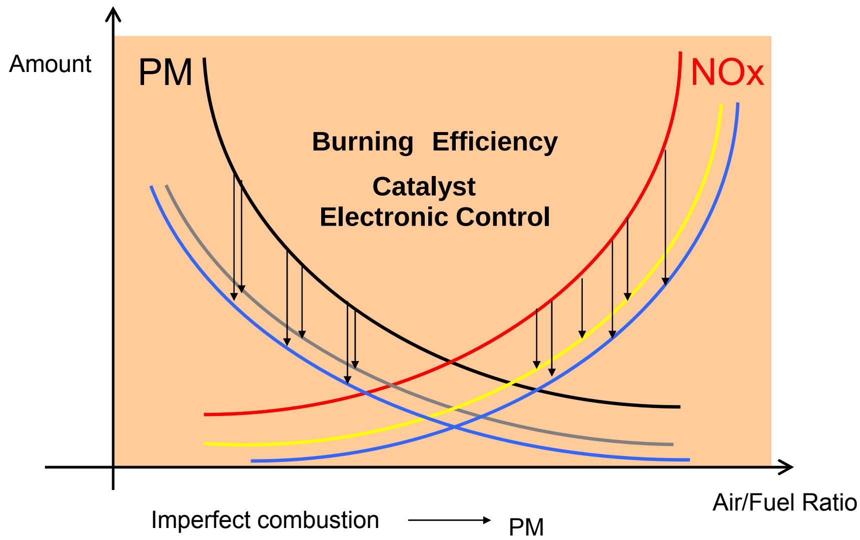
- ❄ Waste, etc.
- ❄ Greenhouse effect gas, etc.

2.3. Flow of environmental impact assessment



3.Air Pollution (**Ground Policy)**

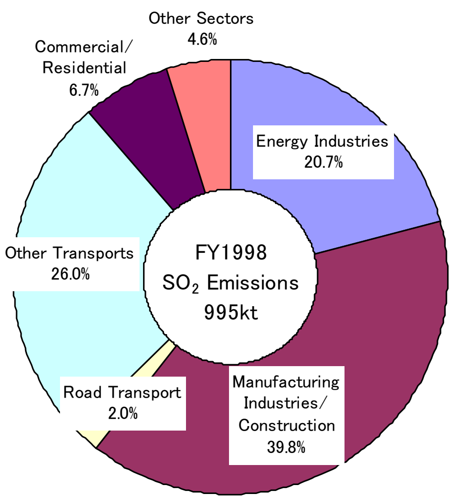




Imperfect combustion → PM

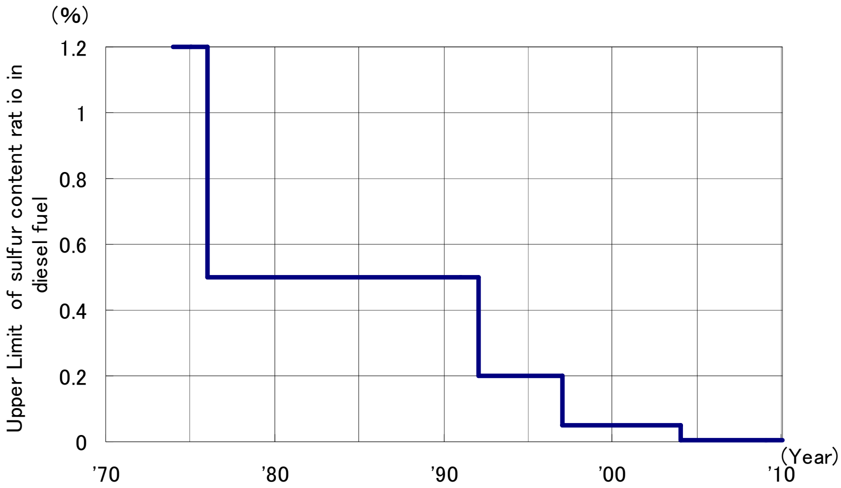
High temperature → NOx

3. 1. Air Pollutant Emissions (SO_2)



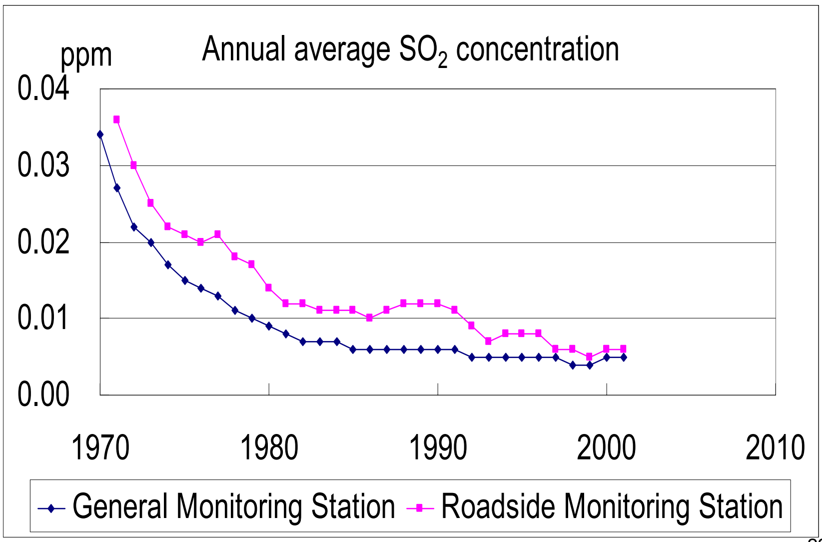
SO_2 emission shares by sources
(FY1998,in Japan)

3.1.1 Fuel Quality Regulation（S）



21

3.1.2 State of Air Pollution (SO_2)



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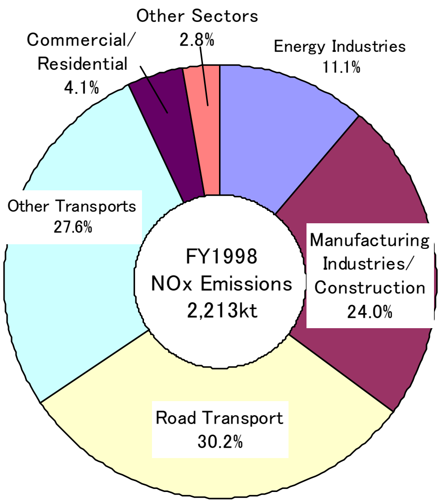
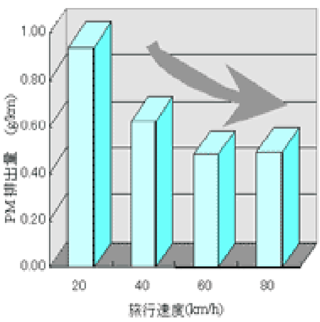
3.2. Air Pollutant Emissions (NO_x)



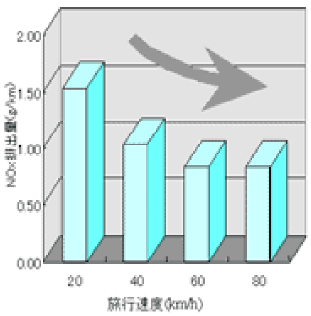
NOx emission shares by sources
(FY1998,in Japan)

3.2.1.Relationship between average speed and environmental load

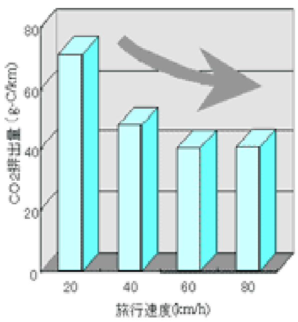
PM



NO_2

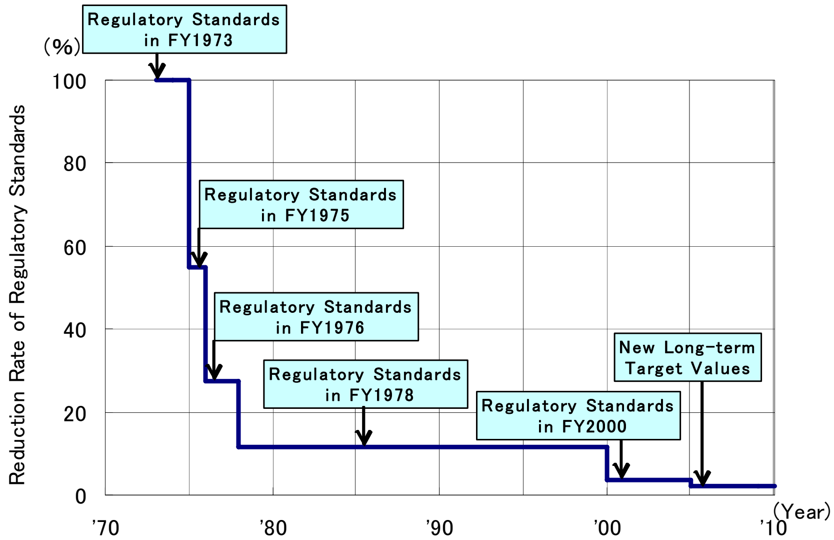


CO_2

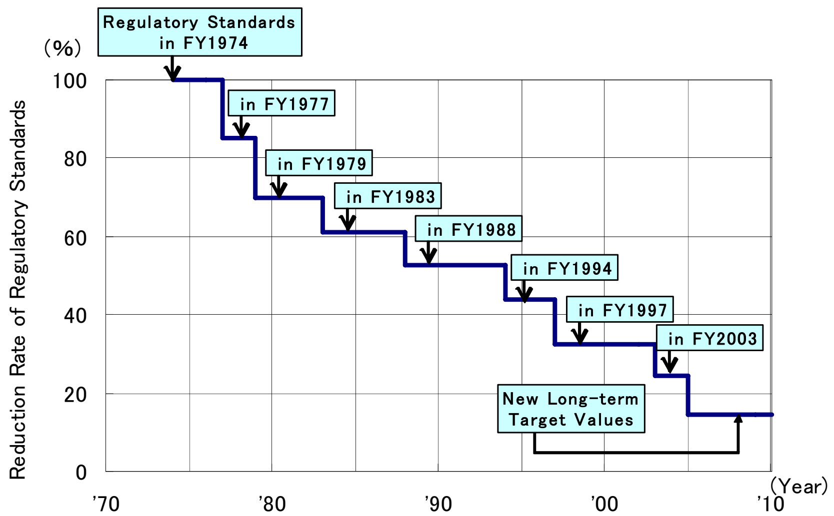


3. 3. 1 Regulation on individual Vehicle（NOx）

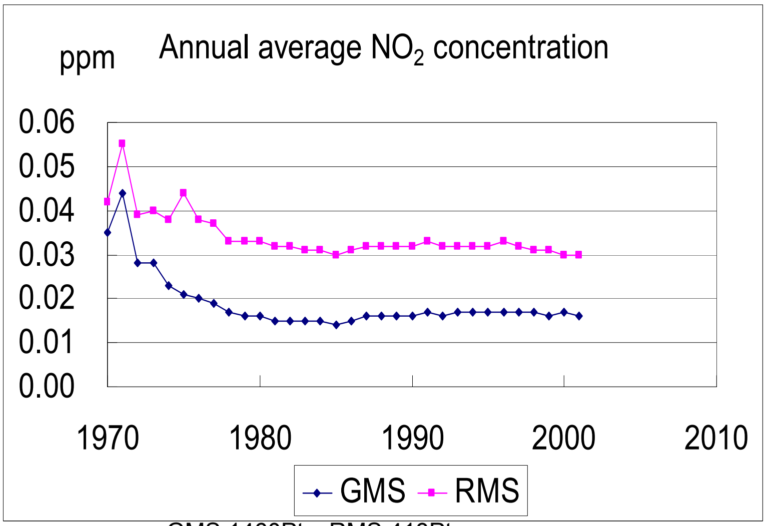
① Gasoline passenger cars



3. 3. 2. Diesel-powered heavy trucks（NOx）

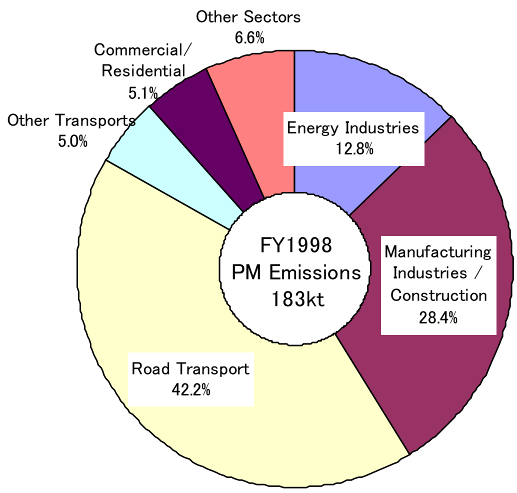


3. 3. 3. State of Air Pollution (NO_2)



GMS:1460Pts. RMS:413Pts.

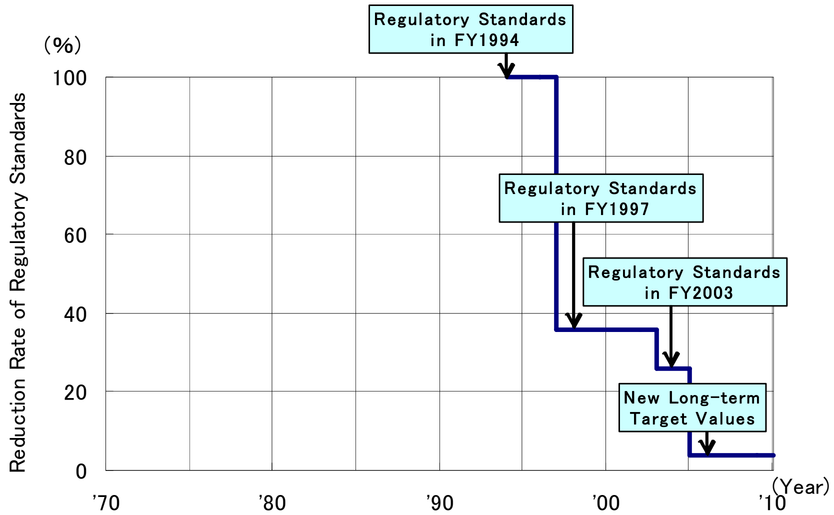
3. 4. Air Pollutant Emissions (PM)



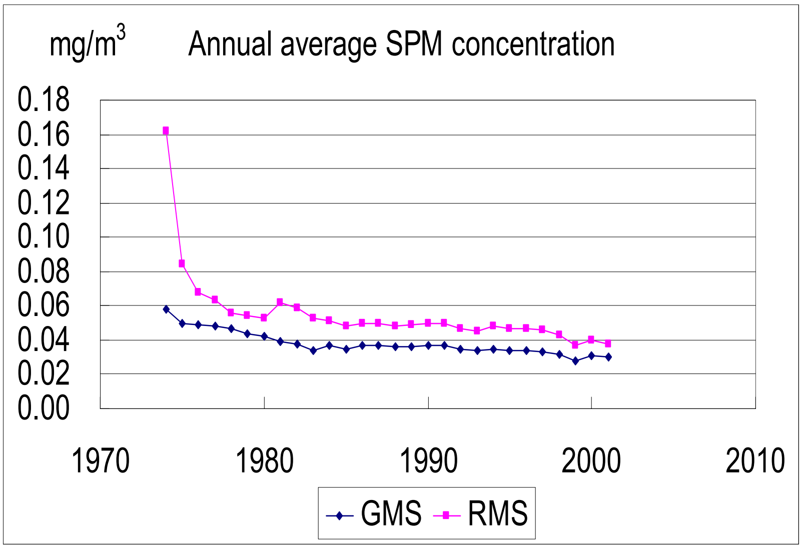
PM emission shares by sources
(FY1998,in Japan)

3．4．1．Regulation on individual Vehicle（PM）

① Diesel-powered heavy trucks



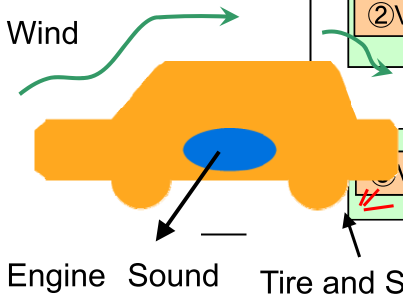
3．4．2．State of Air Pollution(PM)



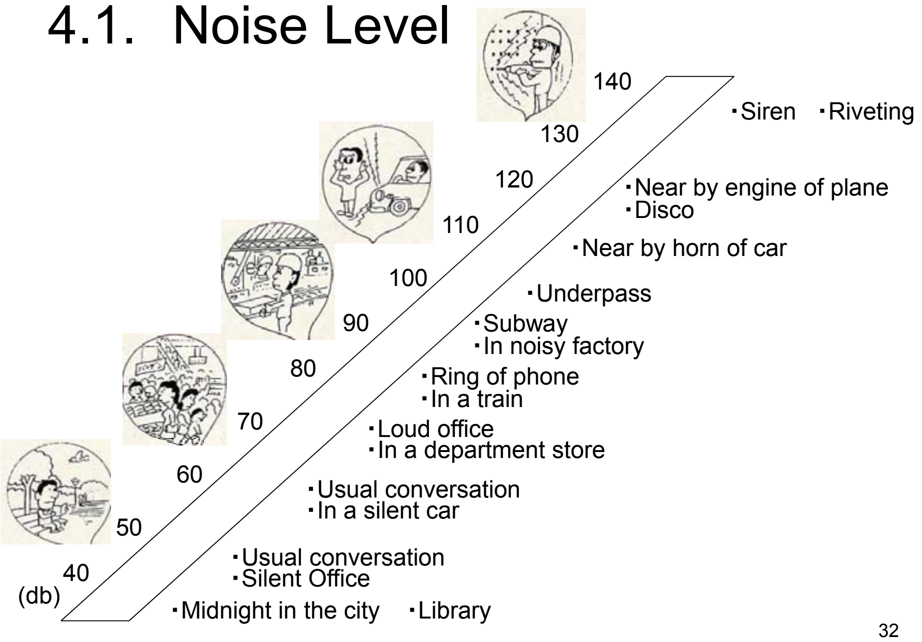
GMS:731Pts. RMS:359Pts.

4.Traffic Noise

- Road traffic noise
  - ①Vehicle
    - Engine
    - Intake/exhaust system etc.
  - ②Vehicle and road
    - Tire vibration etc.
  - ③Vehicle and atmosphere
    - Wind roar etc.



4.1. Noise Level



4.2. Environmental Quality Standards

(1) General Zone

Zone Types	Time Division	
	Daytime(6:00~22:00)	Nighttime(22:00~6:00)
AA	50dB or under	40dB or under
A or B	55dB or under	45dB or under
C	60dB or under	50dB or under

AA: The zone where needs silence in particular

A: The zone where is used mostly for residence

B: The zone where is used mainly for residence

C: The zone where is used for residence, business and industry

4.3. Zone fronting on the road

Division of Zone	Time Division	
	Daytime (6:00~22:00)	Nighttime (22:00~6:00)
The zone fronting on the road with lane 2 and over of the zone A	60dB or under	55dB or under
The zone fronting on the road with 2 and over of the zone B and the zone fronting on the road with lane of the zone C	65dB or under	60dB or under

A: The zone where is used mostly for residence

B: The zone where is used mainly for residence

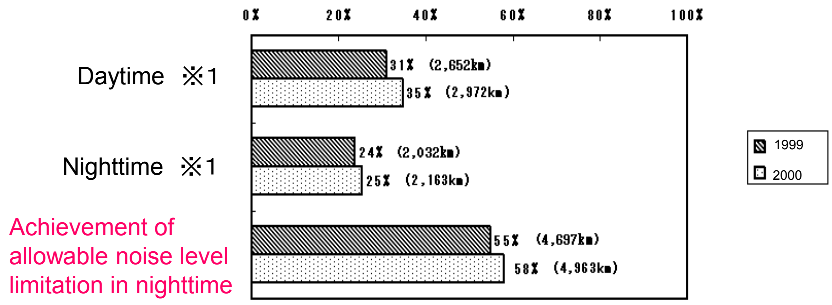
C: The zone where is used for substantial residence and business, industry, and so on

4.3. State of Accomplishment of Environmental Quality Standards(1)

（1999,2000）

The ratio of achievement and accomplished length of environmental quality standards

(The whole country)

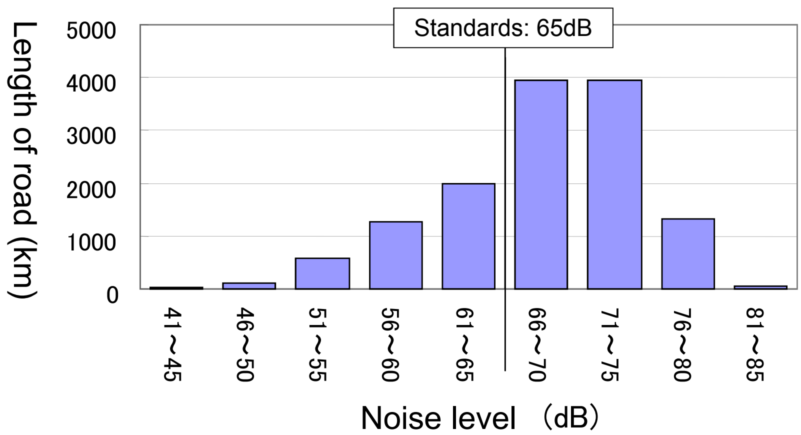


※1 Daytime: 6am～10pm Nighttime: 10pm～6am

4.4. State of Accomplishment of Environmental Quality Standards(2)

（Road environmental census on 1998）

The rate of achievement of the environmental quality standard of nighttime in National Highway is 30%.



4.5. Measures for Road Traffic Noise

(1) Organized Cooperation

- Road traffic noise arrives at the ear with the three phase
  :Generation
  :Propagation
  :Reception
- To reduce the traffic noise
  ①Measure at source
  ②Measure during propagation
  ③Measure at receiver

(2) Measures for Road Traffic Noise

Measure at receiver

Soundproofing of buildings

Measure during propagation

Noise barrier,Absorption panel at backside of bridge

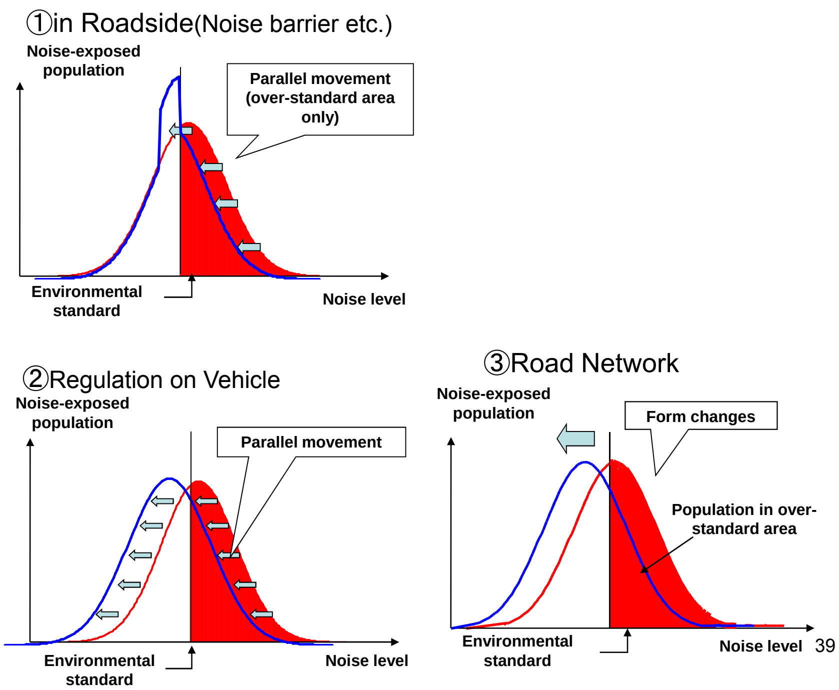
Adoption of underground road structure

Buffer zone,Buffer buildings

Measure at source

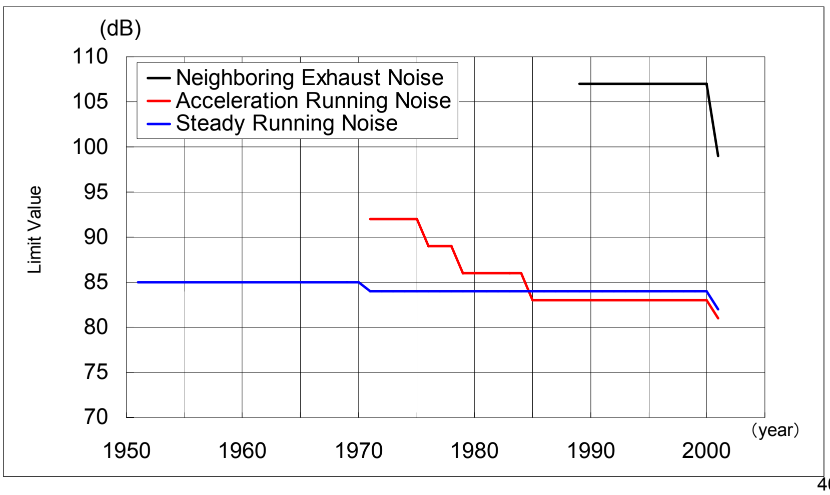
Low noise pavements

Regulation on speed (case beyond 60km/h)

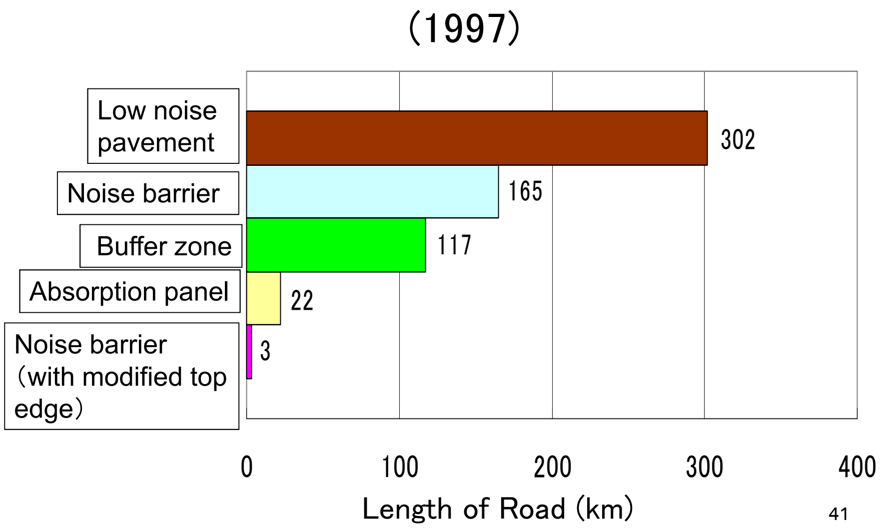


(3) Regulation on Vehicle Noise Emission

Large truck

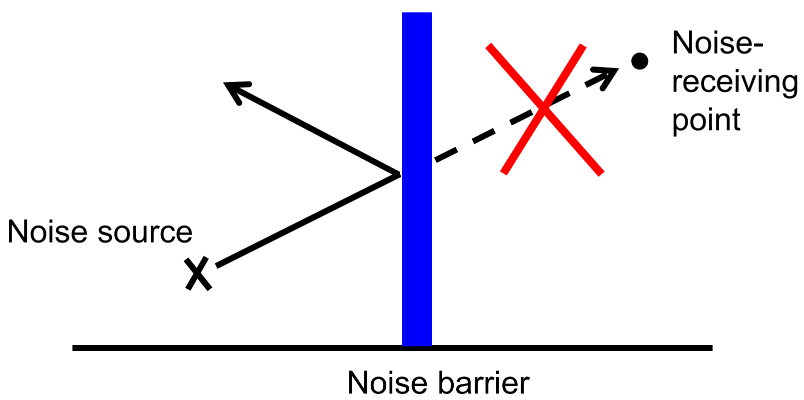


(4) Past Construction Record



10-7 Noise-Reducing Mechanism by Noise Barrier

(1) Reflection

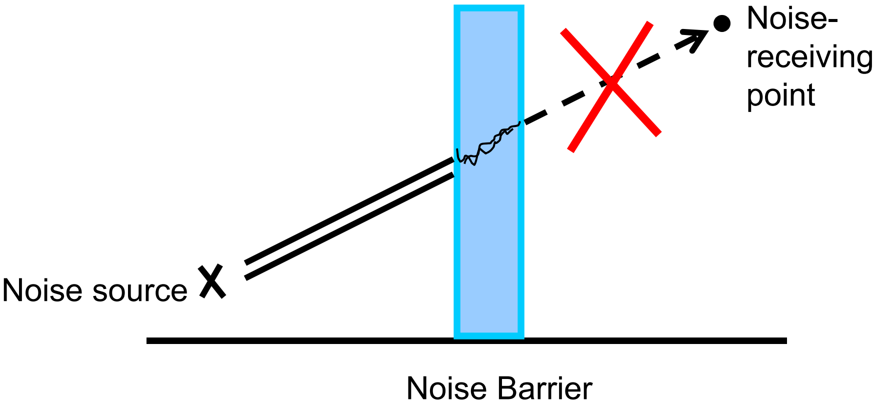


Note) The sound by the side of opposite may become large.

Reflection Noise Barrier
（Concrete type）

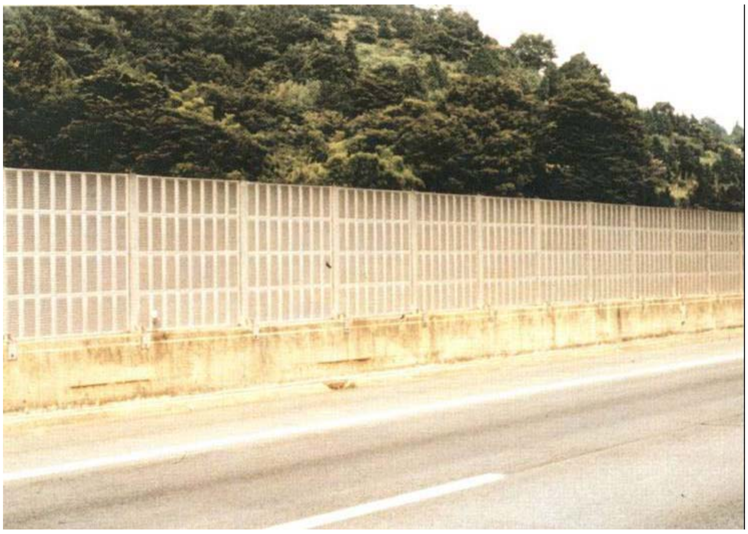
Meishin Expressway 1963

(2) Absorption



Note） The sound which is not able to be absorbed is penetrated.

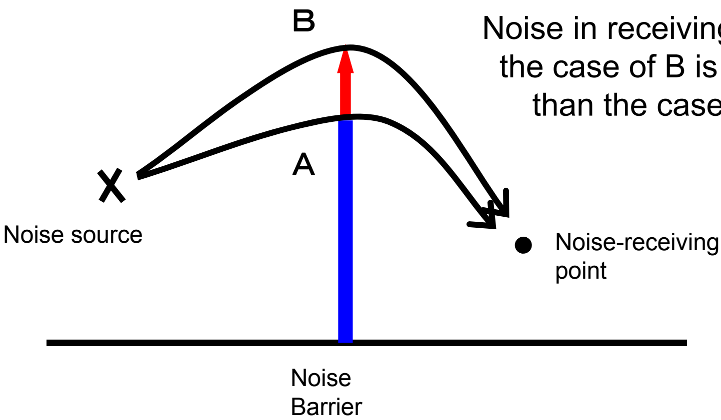
Absorption Noise Barrier



Installed from 1976

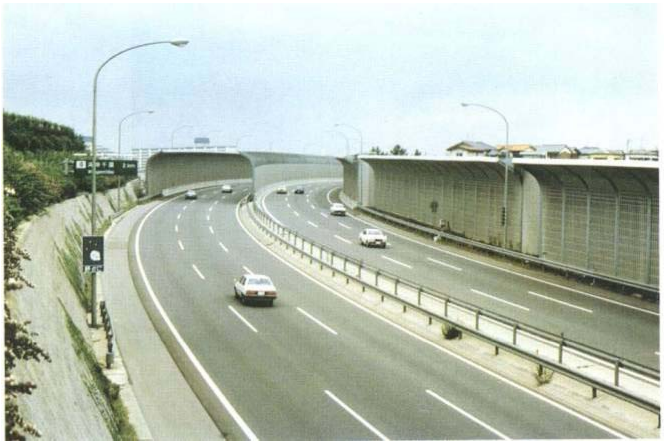
(3) Measures for Improving Noise-Reducing Effect

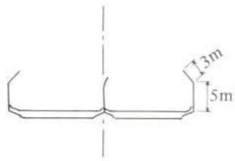
①Heightening the wall



Noise in receiving point in the case of B is smaller than the case of A.

Tall Noise Barrier



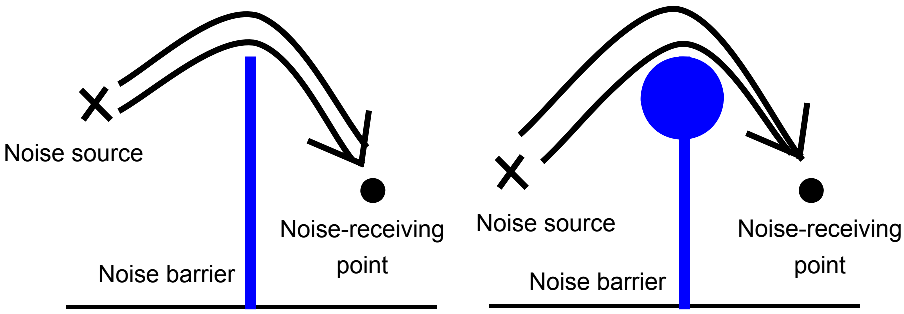


Higashikanto Expressway
Between Wanganchiba IC and MIyanoki JCT

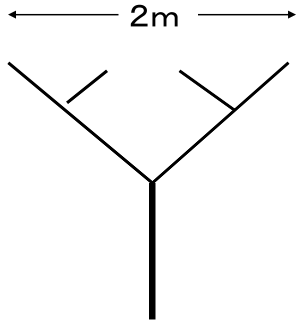
(3) Measures for Improving Noise-Reducing Effect

②Reshaping the top edge

By reshaping the top edge, noise in receiving point becomes small.



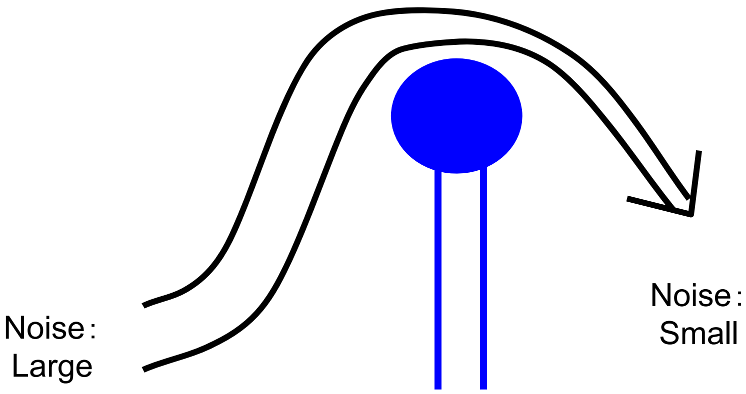
Reindeer-type Noise Barrier



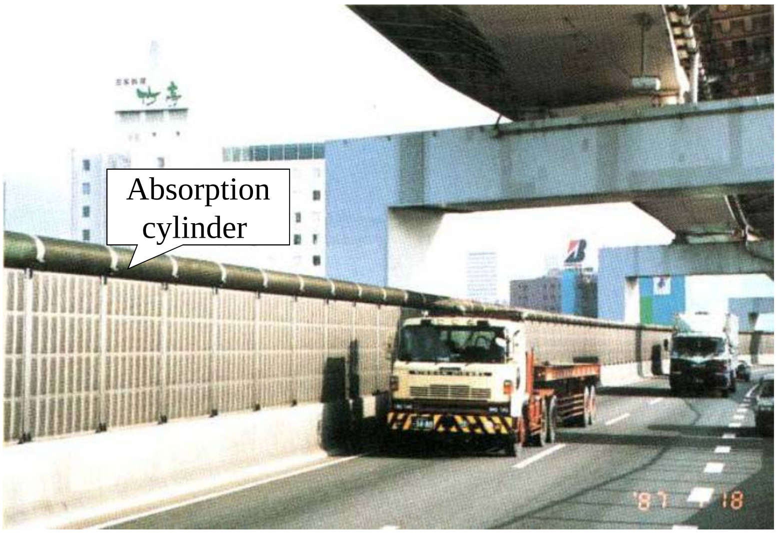
(3) Measures for Improving Noise-Reducing Effect

③ Absorption／Friction

Noise becomes small by Absorption/Friction



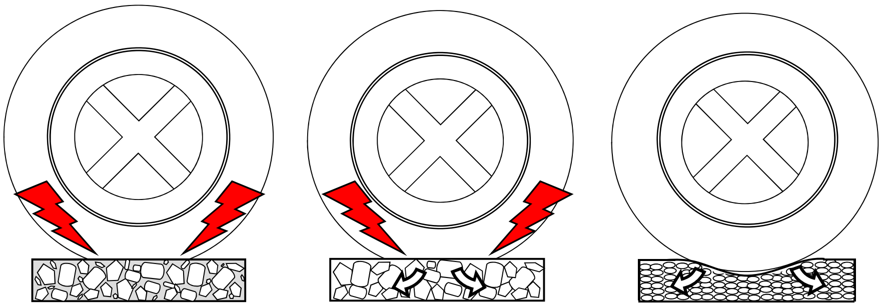
Noise Barrier with Absorption Cylinder



National Highway 2 Hamanote Bypass

9-8 Low Noise Pavement

(1) Noise-Reducing Mechanism by Low Noise Pavement



Dense-graded pavement	Single-layer・Double-layer Drainage pavement	Poroelastic Road Surface（Rubber pavement）

Drainage Pavement (single-layer)

Dense-graded pavement

Drainage pavement (single-layer)

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Double-layer Drainage Pavement

upper layer

lower layer

Drainage pavement

Double-layer drainage pavement

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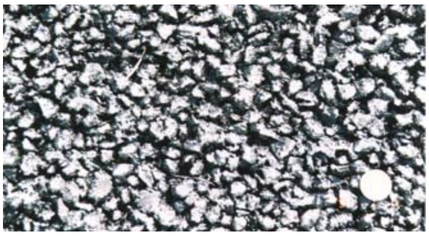
Poroelastic Road Surface

Dense-graded pavement



Drainage pavement

Poroelastic road surface

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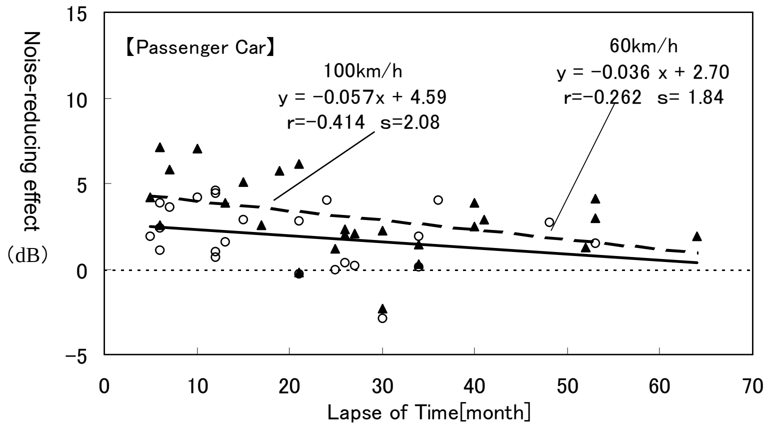
(2) Noise-Reducing Effect by Drainage Pavement

＜Passenger Car＞



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Road-Cleaning by Sweeper

(3) Noise-Reducing Mechanism of Low Noise Pavement

1) the same as the single-layer

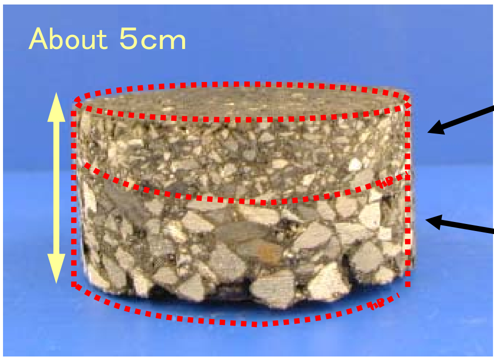
2) and、

① Reduced air-pumping noise by the frequency of pores increased from 20% to 23%

② Smoothened surface and reduced wheel vibration noise by upper layer containing finger-grained aggregate

③ Improved stability by lower layer containing coarse-grained aggregate

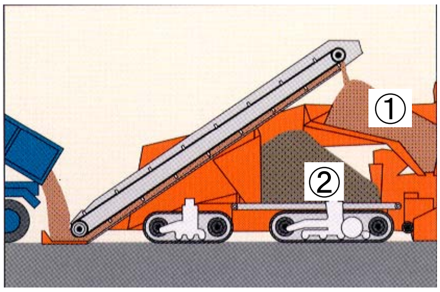
② Smoothening surface
③ Improving stability

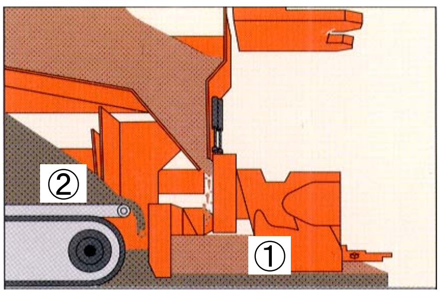


② Smoothened surface and reduced wheel vibration noise by upper layer containing finger-grained aggregate

③ Improved stability by lower layer containing coarse-grained aggregate

Pavement by MAP





① Finer-grained aggregate 2.5–5mm

②Coarse-grained aggregate 5-13mm

5. Roads and Ecosystem Conservation

How can we coexist with ecosystems?

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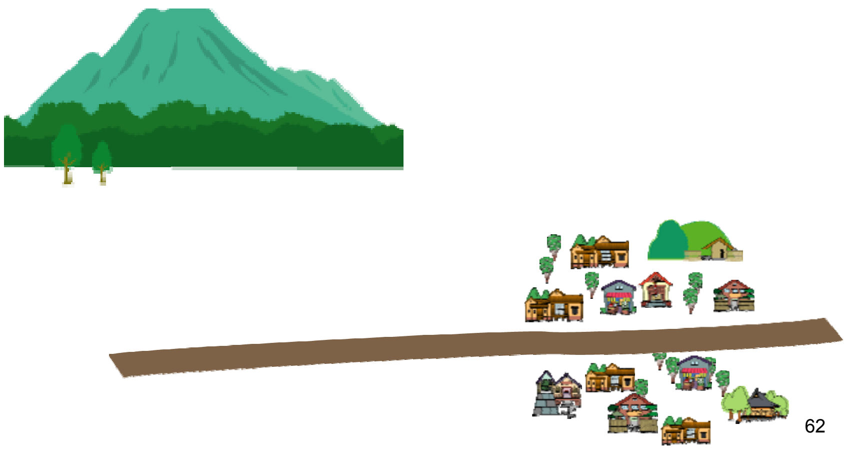
5.1. Old highways

- Old highways were built through villages.



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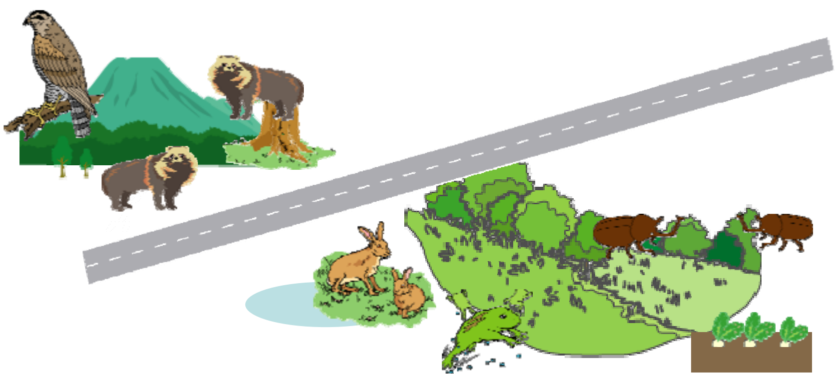
5.2. Present bypass roads

- Present bypass roads are constructed outside cities.

5.3. From the viewpoint of animals …

- From the viewpoint of people, bypass roads are located in the suburbs.
- From the viewpoint of animals, bypass roads are located between their habitats and feeding places.

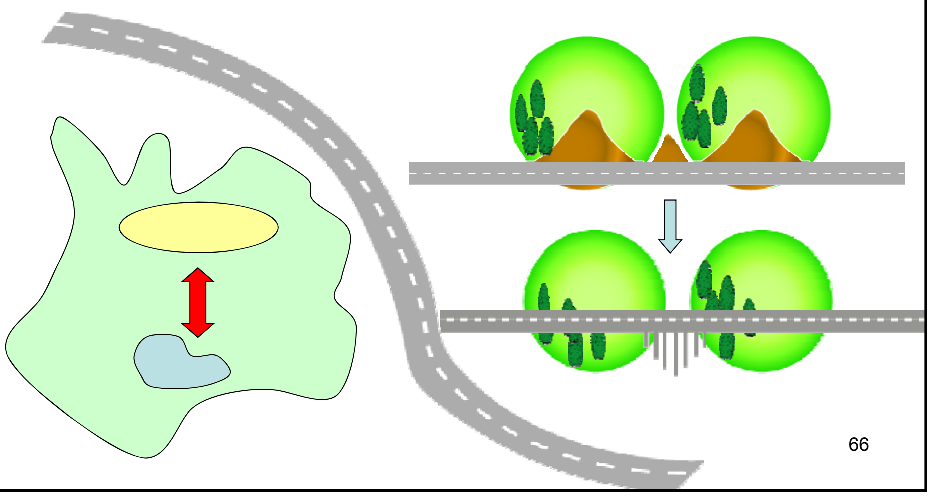


5.4. For ecosystems, it would be best to …

- For ecosystems, it would be best to not build anything.
- However, roads are necessary.

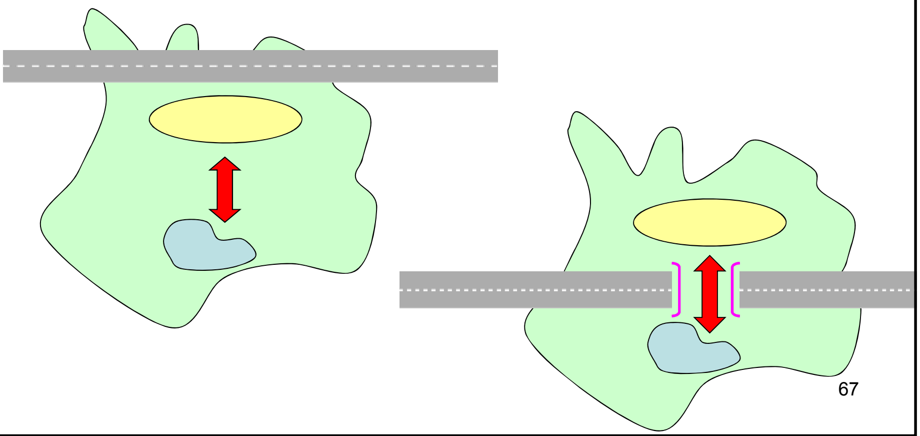
5.5. Bypass

- Roads should be planned to be built away from ecological habitats.



5.6. Minimization

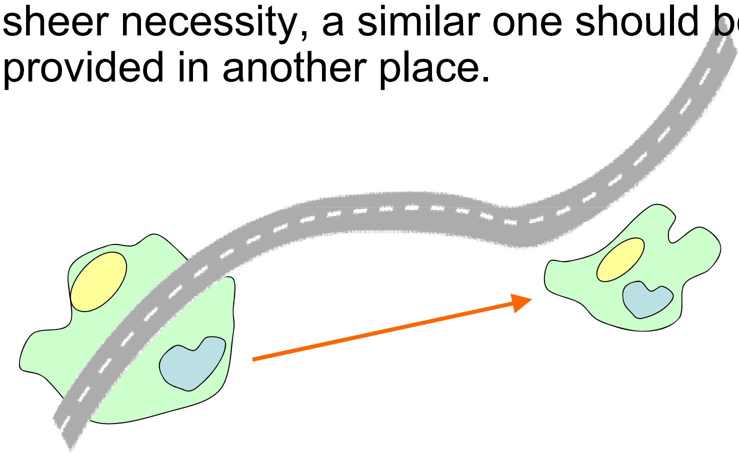
- Plans should be made to bypass the important areas of habitats such as nesting places and spawning grounds, and the movements of animals should not be cut off.



5.7. Replacement

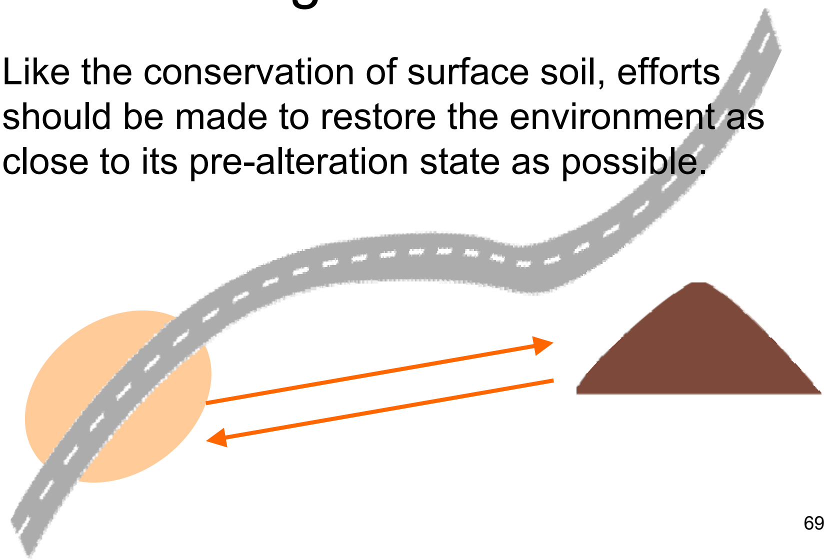
Replacement:

- When a habitat needs to be altered out of sheer necessity, a similar one should be provided in another place.



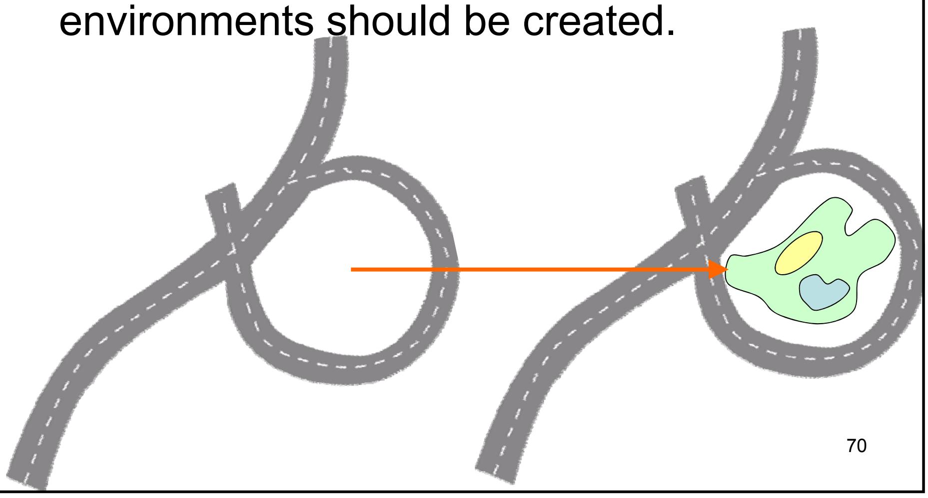
5.8. Restoration and regeneration

- Like the conservation of surface soil, efforts should be made to restore the environment as close to its pre-alteration state as possible.



5.9. Creation

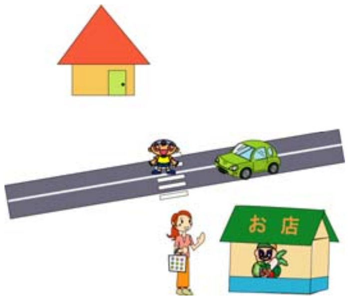
- New environments such as water environments should be created.



5.10. Same for both people and raccoon dogs

- The concept is the same for both people and raccoon dogs.

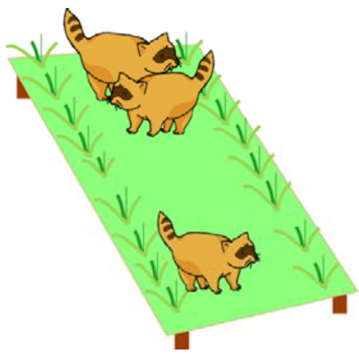
Houses, workplaces, schools, stores, sidewalk, etc.
Habitats, feeding places, animal runways, etc.



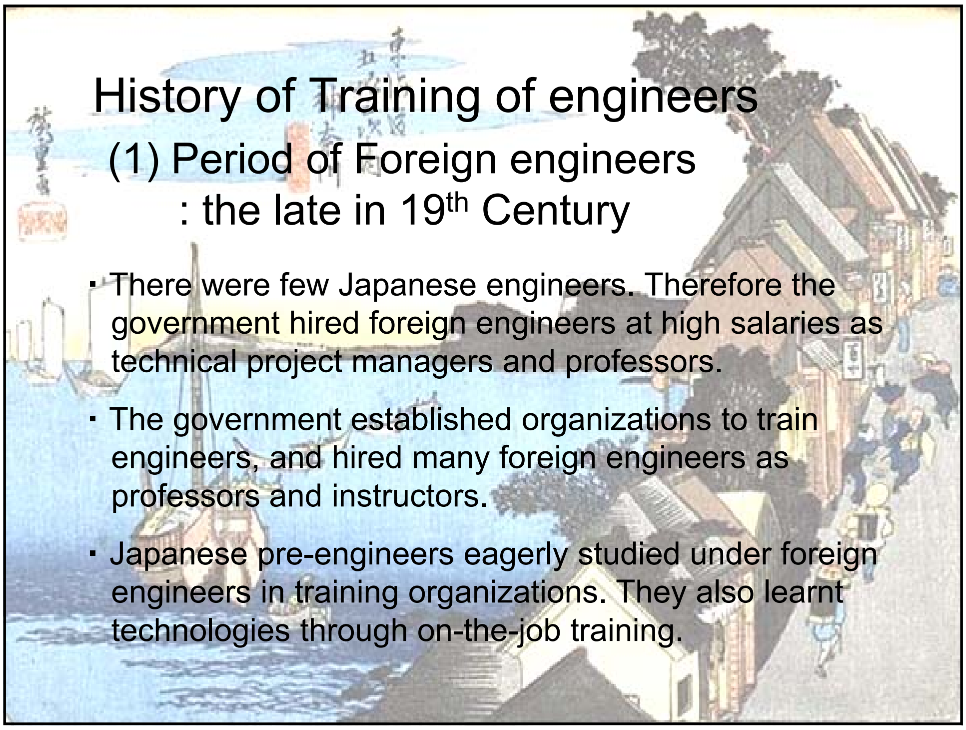
5.11. Traffic safety facilities for raccoon dogs

- The concept is the same for both people and raccoon dogs.

Fences for the prevention of disorderly crossing, pedestrian bridges, underpasses, etc.
Fences for the prevention of intrusion, crossing facilities for animals, etc.



6. Engineering



History of Training of engineers

(1) Period of Foreign engineers : the late in 19th Century

- There were few Japanese engineers. Therefore the government hired foreign engineers at high salaries as technical project managers and professors.
- The government established organizations to train engineers, and hired many foreign engineers as professors and instructors.
- Japanese pre-engineers eagerly studied under foreign engineers in training organizations. They also learnt technologies through on-the-job training.

(2) Period of 1st generation engineers : the Early in 20th Century

- To acquire modern engineering, the government sent talented persons abroad to study.
- The government employed engineers, having studied abroad, as in-house engineers at high salaries and responsible posts and assigned these people as site managers.
- The government also employed engineers having studied in Japan as in-house engineers.

(3) Period of force account method : the Mid-20th Century

- Government owned modern technology in-house.
- Public works used plentiful local resources and contributed to economic progress via the force account method.
- Many engineers were produced and were assigned to sites of public works. Engineers gradually became experts and specialists.

(4) Period of contracting out method : the late in 20th Century

- Semi-public sectors published detailed engineering standards that were widely used.
- To maintain engineering and technical levels, the licensing of engineering and techniques is initiated mainly by the government.
- Competition within the private sectors has become severe, therefore the private sector struggled to develop engineering and technologies.
- Engineers have become more experts and specialized.

(5) Contemporary Period

In-house engineer:

→From policy making to social science

→Arrangement of engineering

→From hardware technology to communication with people

Use of Various types of engineers

→outsourcing

→from design standard to service quality control

World wide activities

→international engineers

5. Lecture
"Toward realization of smartway in Japan"

Mr. Hideto HATAKENAKA

Toward Realization of Smartway in Japan

November 11, 2009

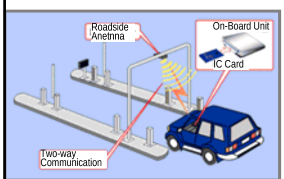
Hideto Hatakenaka
Head,
Intelligent Transport Systems (ITS) Division,
Research Center for Advanced Information Technology,
National Institute for Land and Infrastructure Management (NILIM)

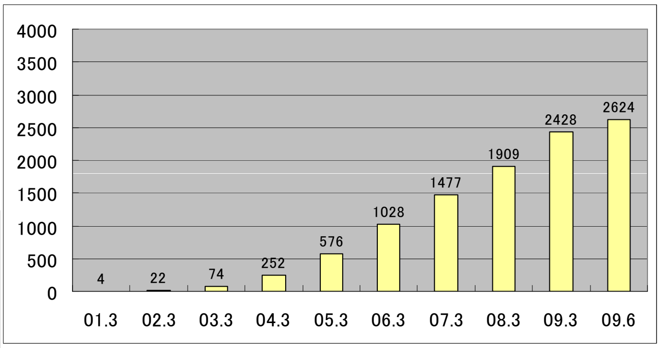
1. Background (Penetration of ITS Technology for Car Users in Japan)
- Electronic Toll Collection System (ETC)

- Approx. 80% of vehicles travelling expressways use ETC (As of August 2009)
- Approx. 26million ETC on-board units are penetrated (As of June 2009)

ETC-OBU

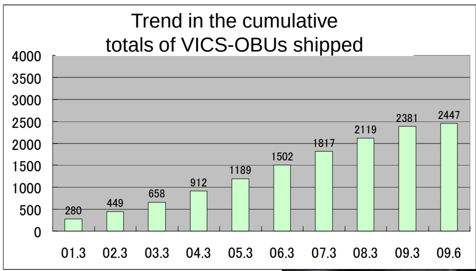
Source: Mitsubishi Electric

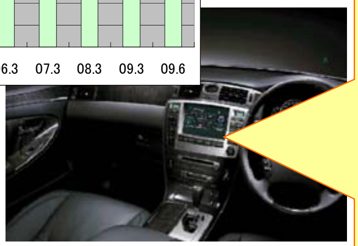




1. Background (Penetration of ITS Technology for Car Users in Japan)
- Vehicle Information Communication System (VICS)

- Provide real-time road traffic congestion information on car navigation system which started in 1996
- Over 24 million VICS-OBUs have been shipped (as of June 2009)





Example of Display

Level 2 : Simple diagrams

Level 3 : Map Display

2. Feature of Smartway
- Purpose

Definition of Smartway

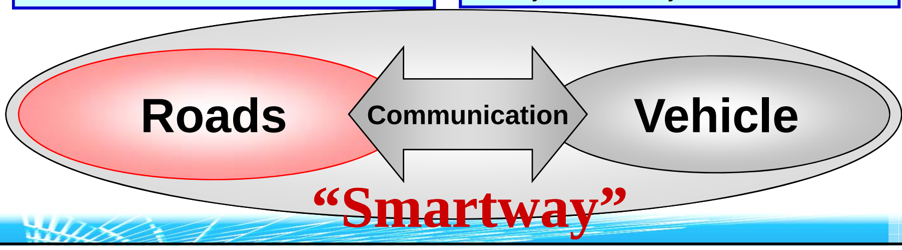
Smartway: a road system which can exchange various types of information among cars, drivers, pedestrians, and other roadway users.

Foundation for the deployment of various ITS services

- Realize integrated ITS to provide safe, smooth road transportation and positive environment.

Foundation for affluence and comfort in life and society

- Realize efficient mobility for people, goods, and information
- Realize comfortable living spaces
- Build infrastructure that provides safety and security



2. Feature of Smartway
- Road-Vehicle Cooperation System

- Develop new “Road-Vehicle Cooperation Systems” using 5.8 GHz DSRC and ITS On-board Units (OBUs) for Smartway

<Road-Vehicle Cooperation Systems>

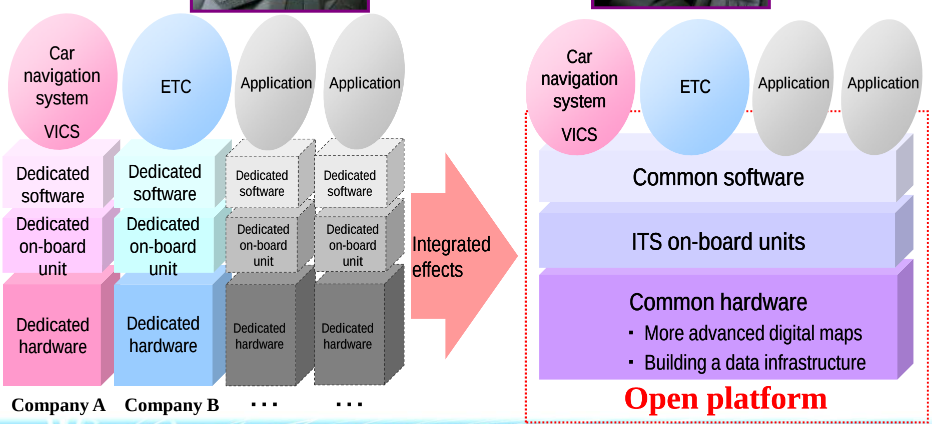
DSRC Antenna

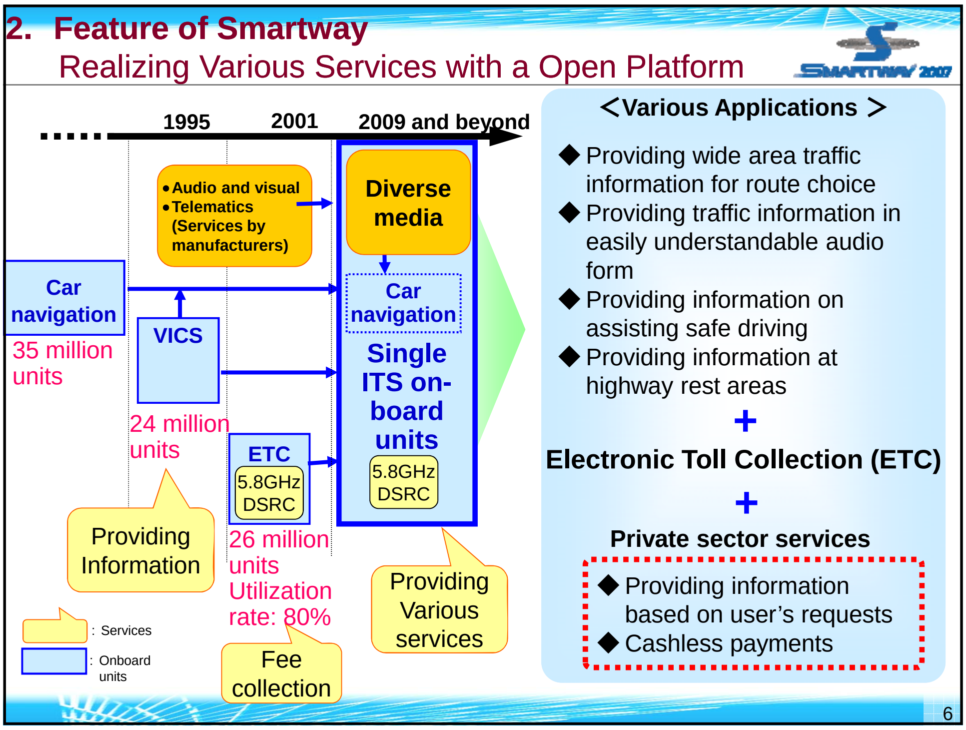
ITS OBU

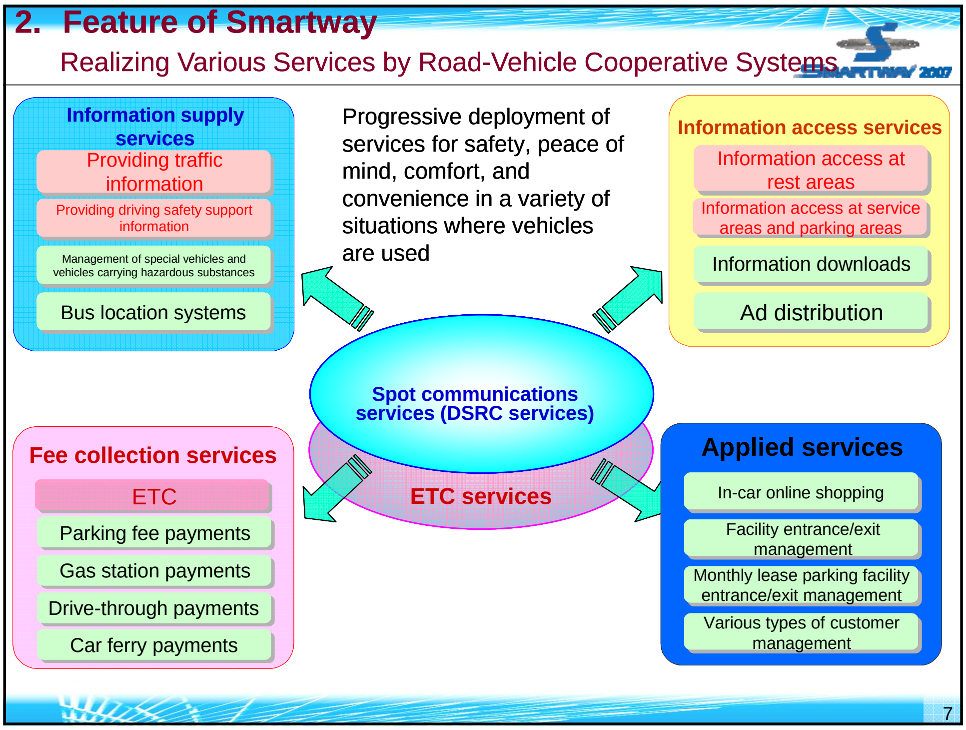
5.8GHz DSRC (Dedicated Short Range Communication)

2. Feature of Smartway
Establishing a Open Platform of OBU

- Open platform of OBU was developed by Public-Private Joint Research




2. Feature of Smartway
Realizing Various Services with a Open Platform
SMARTWAY 2007
1995
2001
2009 and beyond
•Audio and visual
•Telematics
(Services by manufacturers)
Diverse media
Car navigation
35 million units
VICS
24 million units
Car navigation
Single ITS on-board units
5.8GHz DSRC
ETC
5.8GHz DSRC
26 million units
Utilization rate: 80%
Providing Information
Fee collection
Providing Various services
: Services
: Onboard units
＜Various Applications＞
◆ Providing wide area traffic information for route choice
◆ Providing traffic information in easily understandable audio form
◆ Providing information on assisting safe driving
◆ Providing information at highway rest areas
+
Electronic Toll Collection (ETC)
+
Private sector services
◆ Providing information based on user's requests
◆ Cashless payments
6


2. Feature of Smartway
Realizing Various Services by Road-Vehicle Cooperative Systems
SMARTWAY 2007
Information supply services
Providing traffic information
Providing driving safety support information
Management of special vehicles and vehicles carrying hazardous substances
Bus location systems
Progressive deployment of services for safety, peace of mind, comfort, and convenience in a variety of situations where vehicles are used
Information access services
Information access at rest areas
Information access at service areas and parking areas
Information downloads
Ad distribution
Spot communications services (DSRC services)
ETC services
Fee collection services
ETC
Parking fee payments
Gas station payments
Drive-through payments
Car ferry payments
Applied services
In-car online shopping
Facility entrance/exit management
Monthly lease parking facility entrance/exit management
Various types of customer management
7

3. Smartway 2007 – Field Operational Tests on the MEX

ITS On-Board Units (OBUs) and Roadside Equipment (RSE)

Providing Information by **image and audio** linked with car navigation

Providing Information by **audio only**

3. Smartway 2007 – Field Operational Tests on the MEX

Lineup of Services (1/2)

Providing Information on Obstacles Ahead

Audio + Visual

Providing information on stopped vehicles or congestion tail beyond a curve with poor visibility by visual and audio

Providing Information on Conditions Ahead

Audio + Visual

Providing information on road condition ahead by visual and audio

Merging Assistance

Audio + Visual

Providing information on existence of merging vehicles by visual and audio just before the merging section

3. Smartway 2007 – Field Operational Tests on the MEX

Lineup of Services (2/2)

Map-linked Services to call attention or provide information

Audio＋Visual

Warning based on digital map data stored in car navigation units according to vehicle speed

Smart Parking

Parking fee payment services using ETC . ITS OBU allows to use credit card

Internet Connection

Internet connection for parked vehicles at Parking Area

3. Smartway 2007 – Field Operational Tests on the MEX

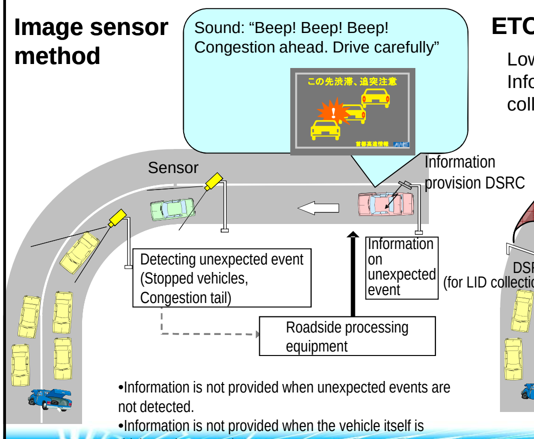
Providing Information on Obstacles Ahead

◆ **System Details**

・When roadside sensor detects stopped vehicles or congestion tail on curves with poor visibility, this information is provided to the following vehicle by visual and audio

・For detecting stopped vehicles or congestion tail, image sensor or ETC-ID are used

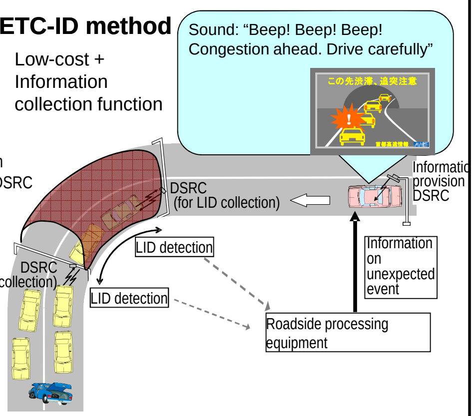
Image sensor method



•Information is not provided when unexpected events are not detected.
•Information is not provided when the vehicle itself is driving at low speed.

ETC-ID method

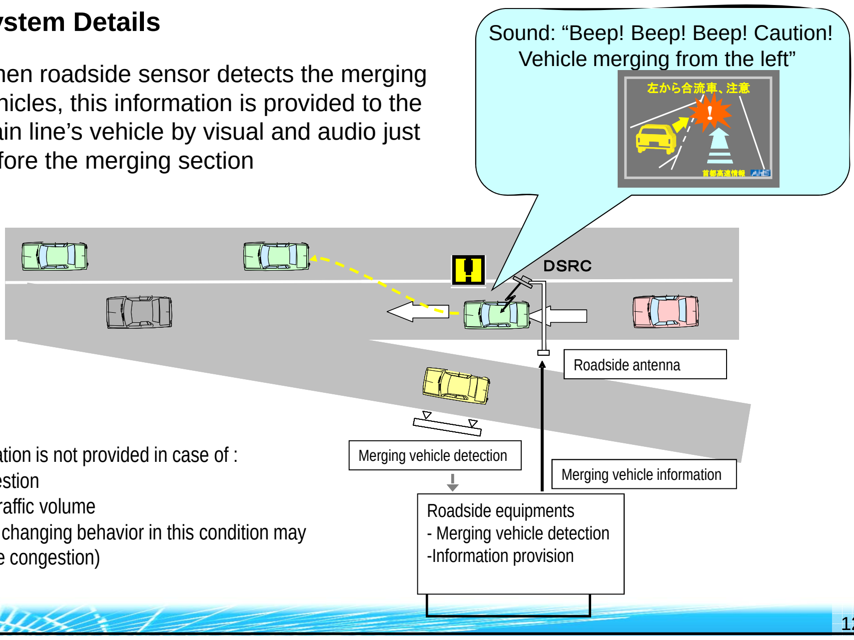
Low-cost + Information collection function



3. Smartway 2007 – Field Operational Tests on the MEX
Merging Assistance

◆ System Details

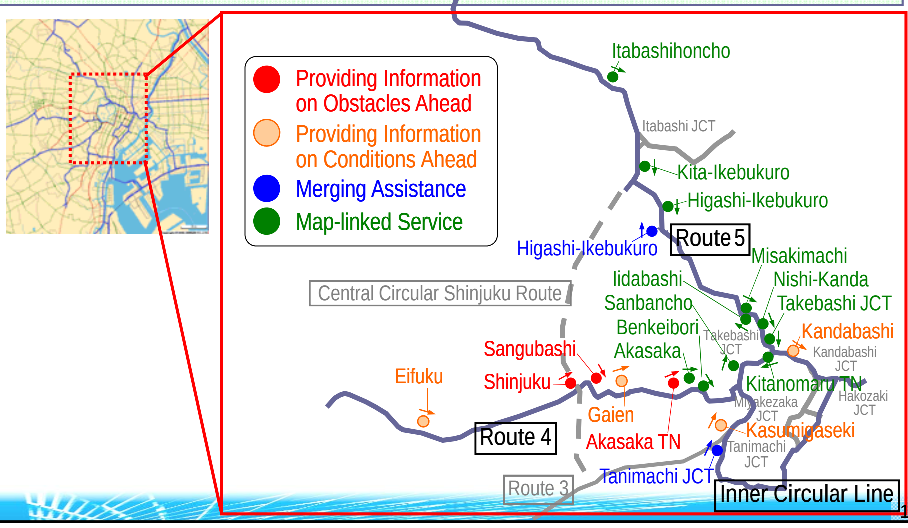
When roadside sensor detects the merging vehicles, this information is provided to the main line's vehicle by visual and audio just before the merging section



Information is not provided in case of :
- congestion
- high traffic volume
  (lane changing behavior in this condition may cause congestion)

3. Smartway 2007 – Field Operational Tests on the MEX
Location of Field Operational Tests

- Field operational tests (FOTs) are conducted on the Inner Circular Route, Route 4, and Route 5 of the Tokyo Metropolitan Expressway (MEX)



3. Smartway 2007 – Field Operational Tests on the MEX
Scale of Field Operational Tests (FOTs)

(1) Advance proving tests

- Number of experimental vehicles: 14
- Test period: from January to May and September, 2007
- Test subjects: 219 people
- Total trips: 1,167

(2) On-road trials

- Participating companies:
  11 automakers
  18 OBU and electronic manufacturers
  6 academic experts
- Number of experimental vehicles: 40
- Test period: from May 14, 2007
- Total trips: 2,522 (as of December 10, 2007)

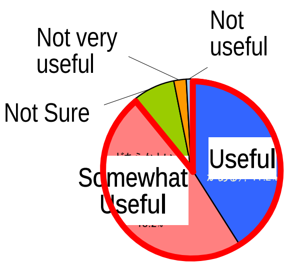
(3) Trial runs of "Smartway Demo 2007"

- Trial run participants: 666 people
  (including 54 from overseas)
- Questionnaire responses: 511

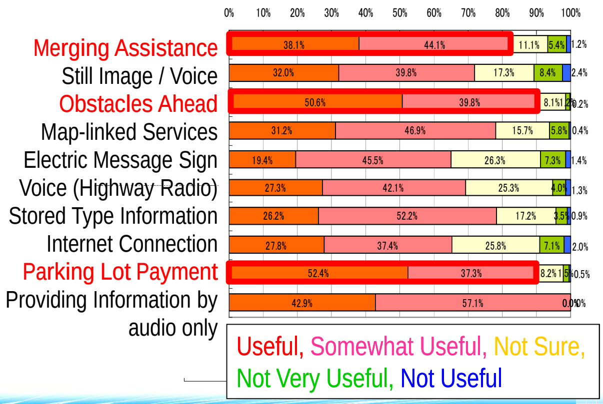
4. Results of Smartway 2007
Results of Questionnaire Survey of FOT Demonstration on MEX

- 89 % of participants answered positively.
- "Merging Assistance", "Providing Information on Obstacles Ahead" and "Parking Lot Payment" got high evaluations.

Overall Evaluation of Test Ride

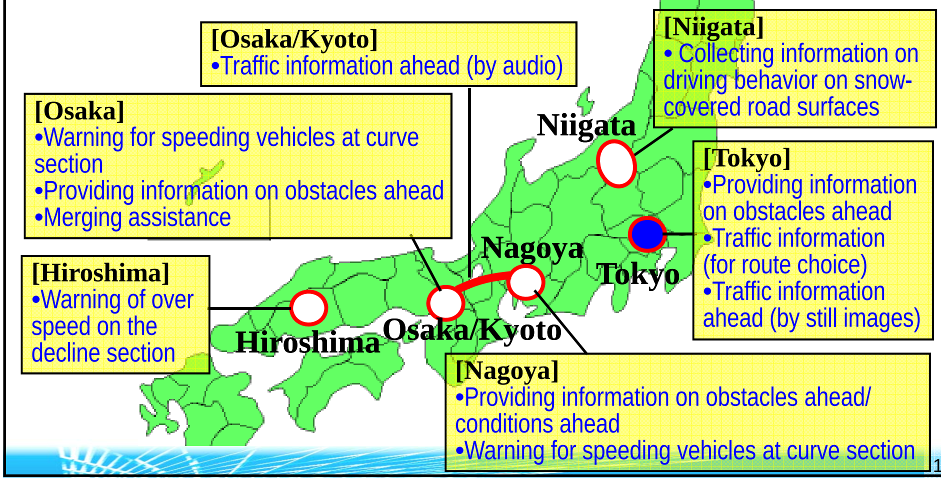


Evaluation of each Service



5. Regional FOT of Smartway in 2008

- Field operational tests (FOTs) will be conducted at three (3) major metropolitan areas and other areas in FY 2008
- Based on the results of FOTs in FY 2008, nationwide deployment of Smartway services will start in FY 2009



6. ITS-Safety 2010 Large-Scale FOT

Summary of Open Demonstration

1. Period: Feb. 25-28, 2009
2. Place: Kagaku-Miraikan, Odaiba, Tokyo
3. Relevant parties

Organizer: ITS promotion counsel (Cabinet Secretariat, NPA, MIC, METI, MLIT, Japan Business Federation, ITS Japan)

Co-organizer: Tokyo Metropolitan Government

Co-sponsor: JAMA, JAPIA, JAF, VICS Center, JAIA, JEITA, JTMTA, JTSA, JSDC

Cooperative association: ITS Info-communications Forum, AHSRA, Metropolitan Expressway, UTMS Japan, Smartway Project Advisory Committee, Smartway liaison meeting, ASV promotion committee, ARIB, HIDO, JARI, Hanshin Expressway

Cooperative companies: IHI, Alpine Electronics, Isuzu Motors, Oki Electric Industry, OMRON, Calsonic Kansei Corporation, Kawasaki Heavy Industries, Kyosan Electric Mfg., Clarion, Koito Industries, Xanavi Informatics, JVC KENWOOD Holdings, Suzuki Motor Corporation, Sumitomo Electric Industries, Daihatsu Motor, DENSO, Toshiba, Toyota InfoTechnology Center, Toyota Motor, Toyota Central R&D Labs., Nissan Motor, Nissan Diesel Motor, THE NIPPON SIGNAL, NEC, Japan Radio, PIONEER, Panasonic, BMW Japan, Hitachi Kokusai Electric Inc., Hitachi, Hino Motors, Fuji Heavy Industries, Fujitsu, FUJITSU TEN, Volkswagen Group Japan, Honda Motor Company, MAZDA Motor Corporation, MITSUBISHI MOTORS, Mitsubishi Heavy Industries, Mitsubishi Electric, Mitsubishi Fuso Truck and Bus Corporation, Mitsubishi Precision, Mercedes Benz Japan, YAZAKI CORPORATION, Yamaha Motor

4. Main activities: trial ride for the public on ITS (safety support systems etc.), Symposium, Indoor and outdoor exhibition
5. Number of participants: approx. 5,000

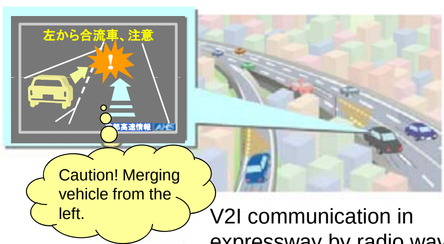
6. ITS-Safety 2010 Large-Scale FOT
Test Ride on the Fields

Test ride

Test ride for the public was conducted. Participants experienced safety support systems by Smartway, DSSS and ASV. Ms. Noda, Minister of State for Science and Technology Policy, also tried and commented: “Even beginner drivers can feel safe to drive with this system.”

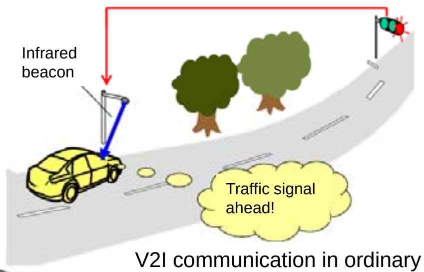
6. ITS-Safety 2010 Large-Scale FOT
Systems in the Test Ride

Road Bureau, MLIT: Smartway



V2I communication in expressway by radio wave (DSRC)

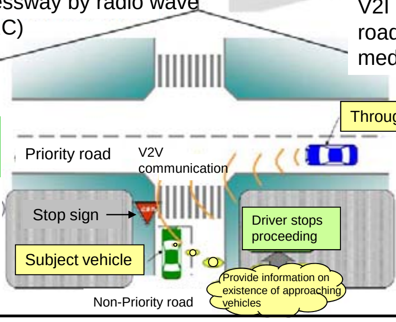
National Police Agency (NPA): DSSS



V2I communication in ordinary road by radio communication media, such as infrared beacons

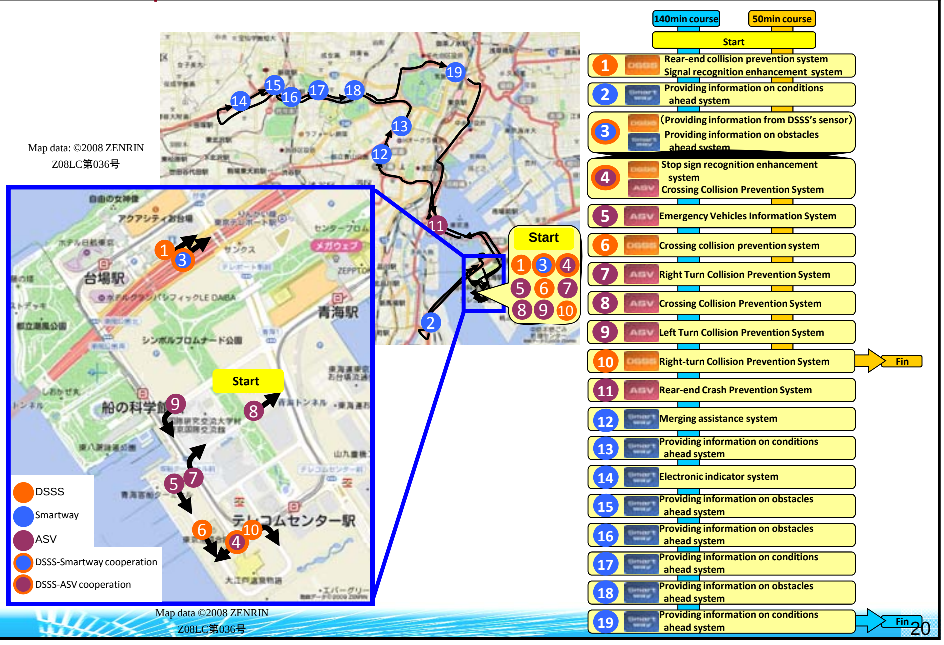
Road Transport Bureau, MLIT: ASV

V2V communication by radio wave (5.8GHz, 700MHz)



6. ITS-Safety 2010 Large-Scale FOT

Course Map of Test Ride

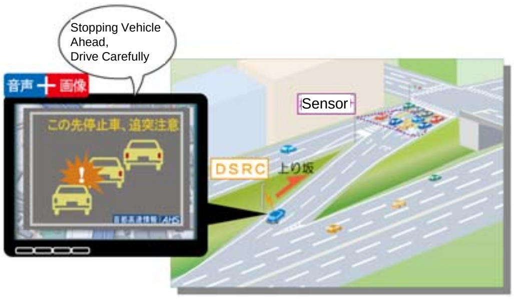


7. FOT in Tokyo Metropolitan Expressway 2009

(Providing Information on Obstacles Ahead)

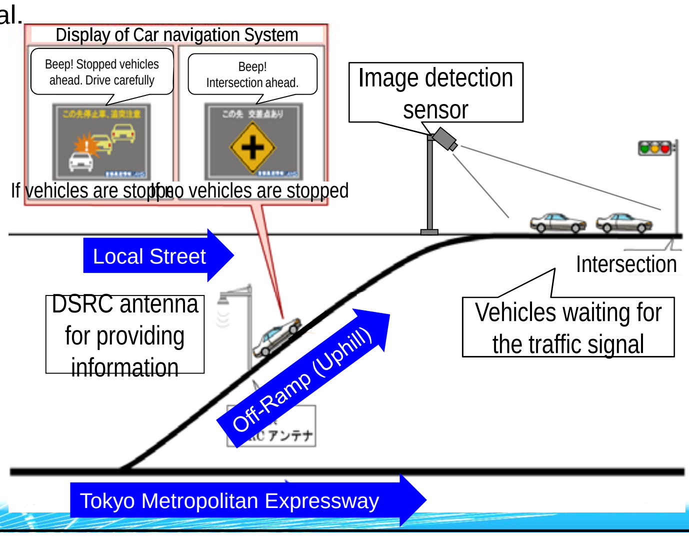
(1) Overview

- Test Period: Feb. 18 – 21, 2009 (w/o service), Mar. 1 – 11, 2009 (w/ service)
- Number of experimental vehicles: 3
- Number of subjects: 60
- Location: Rinkai Fukutoshin Exit (Exit to Tokyo Waterfront City)



7. FOT in Tokyo Metropolitan Expressway 2009
(Providing Information on Obstacles Ahead)

➢As the shape of the Rinkai Fukutoshin off-ramp is crest of a hill, it is difficult for driver to see the intersection beyond it.
➢This system is to prevent rear-end collisions with vehicles waiting for the traffic signal.

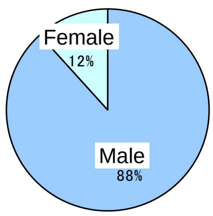


7. FOT in Tokyo Metropolitan Expressway 2009
(Providing Information on Obstacles Ahead)

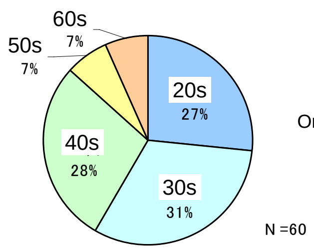
(2) Category of Subjects

- Sex: Male: 53, Female: 7
- Age: 30% of Subjects are 20s, 30s and 40s each, and 10% of subjects are 50s, and 60s each
- Frequency of driving: Once a week

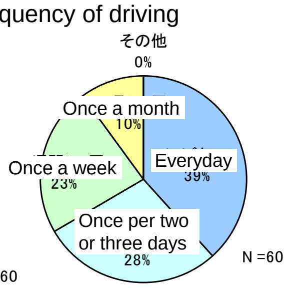
■ Sex



■ Age



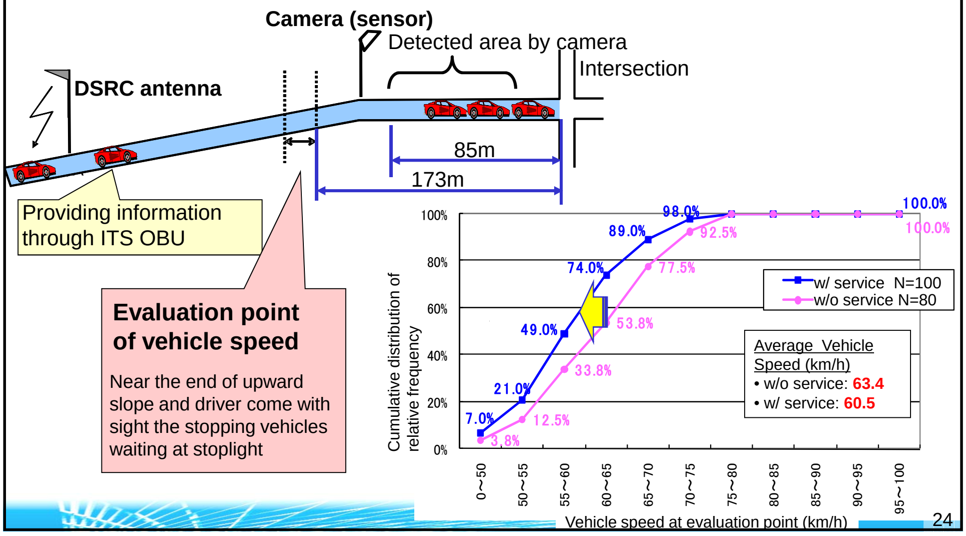
■ Frequency of driving



7. FOT in Tokyo Metropolitan Expressway 2009
(Providing Information on Obstacles Ahead)

(3) Results of FOT (Behavior survey; effect of speed reduction)

- Number of subjects entering the evaluation point (near the end of upward slope) at low speed increase by providing information

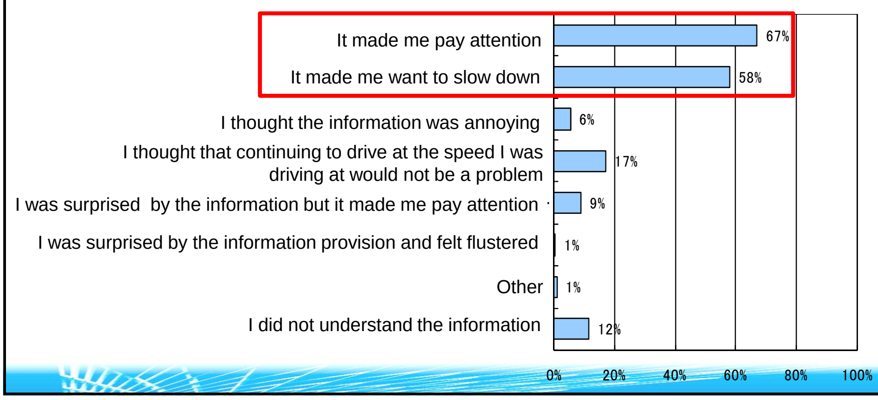


7. FOT in Tokyo Metropolitan Expressway 2009
(Providing Information on Obstacles Ahead)

(3) Results of FOT (Questionnaire survey)

- Many subjects answered positively, “It made me pay attention” or ”It made me want to slow down”.

Q. How did you feel when you received the information?
(Multiple responses possible)



8. FOT in Tokyo Metropolitan Expressway 2009
(Providing Information on Condition Ahead; Still Image)

SMARTWAY 2007

(1) Overview

- Test period: Feb.– March 2009
- Number of Subjects: 32
- Number of experimental vehicles: 3
- Location: Oi

1st Contents

(Audio)
1km ahead,
current status
in the Tokyo
Port Tunnel.

2nd Contents

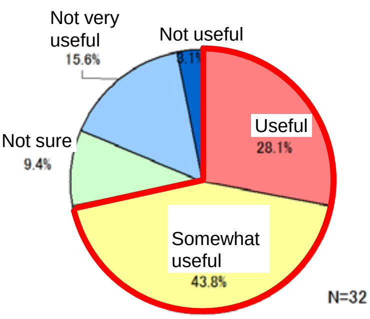
8. FOT in Tokyo Metropolitan Expressway 2009
(Providing Information on Condition Ahead; Still Image)

SMARTWAY 2007

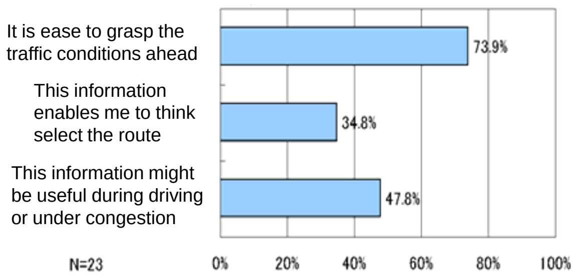
(2) Results of FOT (Questionnaire survey)

- 70% of subjects answered positively, “Useful” of “Somewhat useful”

Evaluation of this service



Q. What is the reason of answer “useful”, or “somewhat useful”? (Multiple responses possible)



9. Evaluation of Smartway Services
by General Drivers

- To evaluate and improve Smartway services, questionnaire survey by general drivers have been conducted.
- In this survey, approx. 500 general drivers (frequent users of Tokyo Metropolitan Expressway) have participated.
- ITS OBUs (Stand-alone type) are lent to the drivers.
- This survey have started since February 2009

Poster for Notification

10. Future Plans
- Deployment Plan of RSE and ITS OBU for Smartway Services

• Operation of Smartway services will begin from FY 2009 on Tokyo Metropolitan Expressway and Hanshin Expressway

		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010 and on
		Demo 2006	Smartway 2007	ITS-Safety 2010		
Deployment of RSE for Smartway services	Tokyo Metropolitan Expressway (MEX)		FOTs on MEX	Trial operation on MEX	Operation (MEX, Hanshin Exprssway)	Nationwide deployment
	Three major metropolitan areas (Mainly Expressways)			FOTs on three major metropolitan areas		
	Other Areas: Expressways					
	Other Areas: National Highways					
ITS OBU for Smartway services		Public-Private Joint Research			Available to the market	Available to the market

6. Lecture
“Earthquake Disaster management for Roads”

Mr. Susumu TAKAMIYA

The 18th Conference on Public Works Research and Development in Asia

Earthquake Disaster Management for Roads

November 12th, 2009

Susumu TAKAMIYA
Head, Earthquake Disaster Prevention Division
National Institute for Land and Infrastructure Management

Contents

- Overview
- Earthquake Disaster in Japan
- Risk Management
- Crisis Management

Earthquake Disaster Management

Damage Estimation

- ✓ Damage Estimation of Road Facilities such as Bridges and Embankments

Risk Management

- ✓ Disaster Mitigation Project
  - Prioritization of Alternative Plans
- ✓ Seismic Design
- ✓ Seismic Retrofitting

Crisis Management

- ✓ Urgent Response
  - Post-Earthquake Inspection
  - Gathering and Sharing of Damage Information
  - Emergency Operation
  - Temporary Restoration of Road Facilities
- ✓ Complete Restoration
- ✓ Training for Post-Earthquake Urgent Response

Major Earthquake Disaster in Japan

	M	death toll	damaged houses	features
1891 Nobi	8.0	7,273	220,000	Largest inland earthquake in Japan
1923 Kanto	7.9	105,000	373,000	60% of houses were lost by fire
1964 Niigata	7.5	26	8,600	Liquefaction
1993 Hokkaido	7.8	230	3,600	Tsunami
1995 Kobe	7.3	6,435	513,000	Viaducts collapsed Struck mega-city
2004 Niigata	6.8	39	1,422	Landslide (natural dam) Isolated villages

Long-term Prediction for Earthquakes around Japan

The Headquarters for Earthquake Research Promotion

Major Subduction Zone Earthquakes

Major Active Faults

Probability of Earthquake Occurrence during 30 years from 2009

Major Loss in the 1995 Kobe Earthquake

Date and Time	AM5:46, January 17th, 1995
Magnitude	7.3
Damaged Buildings	About 513,000 houses
Fire Outbreak	285 locations
Casualties	About 50,200 (Fatalities 6,435)
Damage to Road Facilities	9,900 locations (including 30 fallen girders of expressway viaducts)
Damage to River Embankment	2,600 locations
Damage to Sewage Pipe	1,000 locations
Disrupted Water Supply	About 1.3 million houses
Electric Power Outage	About 2.6 million houses
Total Amount of Loss	About 10 trillion yen (100 billion US dollar)

(After Fire Defense Agency)

Collapsed Viaduct, Kobe Line of Hanshin Expressway

Damage to the Reinforced Concrete Piers Designed in Accordance with the 1980 Specifications

- Seismic performance of the RC pier was verified in terms of ductility.
- The RC pier did not suffer complete collapse, though cracks penetrated entirely through the cross section.

Lessons Learned from the Kobe Earthquake

- Seismic Performance of Road Facilities
  - Necessity to consider extremely strong ground motions
    => Revising seismic design specifications for newly constructed facilities
    => Seismic retrofitting of existing facilities
  - Securing seismic performance based on structural importance
- Crisis Management

9

The Mid Niigata Prefecture Earthquake
- Damage to Expressways

- Complete closure of Hokuriku- and Kanetsu Expressways

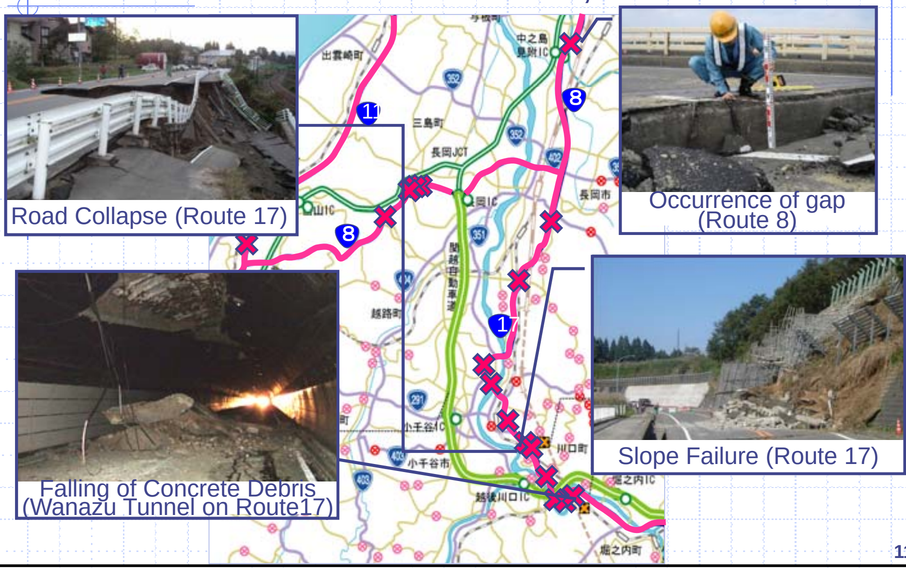

Kanetsu expressway immediately after the event
(Photos from former Japan Highway Public Corporation)

10

The Mid Niigata Prefecture Earthquake

- Damage to Nationally Administrated Roads

- 17 closed sections on routes 8, 17 and 116



Lessons Learned from the Mid Niigata Prefecture Earthquake

- Seismic Performance of Road Facilities
  - Necessity to investigation on the cause of damage
  - Necessity to implement seismic retrofitting of highway bridges
  - Necessity to intensify safety of tunnels
- Crisis Management

Proposals on Earthquake Resistance for Civil Engineering Structures

- initially proposed in 1995 and updated in 1996 and 2000 -
(Japan Society of Civil Engineering)

- Two levels of design ground motions for seismic designs
  - *Level 1 earthquake ground motion: highly probable to strike a facility during the service period*

    => No damage should be caused to the facility.
  - *Level 2 earthquake ground motion: unlikely to strike a facility during the service period but extremely strong enough to cause critical damage*

    => Facility damage should be limited within allowable range.
- Seismic performance for a civil engineering structure should be determined based on the structural importance, which is comprehensively evaluated from various perspectives such as how much impact would be placed on human lives and socio-economic activities by the structural failure.
- Seismic safety inspection should be implemented for existing facilities. Seismic retrofitting needs to be promoted by prioritizing the existing facilities based on the seismic hazard at the sites.

Seismic Design Specifications for Highway Bridges

Design Ground Motions and Seismic Performance of Bridges

Earthquake Ground Motions		Seismic Performance of Bridges: Bridges other than Class B bridges (Class A Bridges)	Seismic Performance of Bridges: Bridges of High Importance (Class B Bridges)
Level 1 Earthquake Ground Motion: Highly probable to occur during the bridge service life		Keeping sound functions of bridges	
Level 2 Earthquake Ground Motions: Earthquake ground motion with Low probability of occurrence during the bridge service life	Type I Earthquake Ground Motion (an plate boundary type earthquake with a large magnitude)	No critical damages	Limited seismic damages and possible to recover bridge functions within a short period
	Type II Earthquake Ground Motion (an Inland direct strike type earthquake like the Kobe Earthquake)		

Earthquake Disaster Prevention Strategy for Roads

3 Year Seismic Retrofitting Program for Bridges on Emergency Transportation Roads (2005-2007)

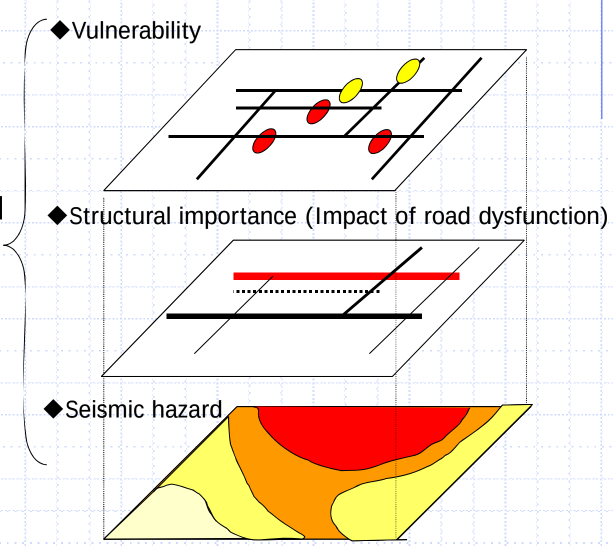
The 3 Year Program(2005-2007) was planned under the collaboration of national government and regional authorities.

- Based on the lessons learned from the Kobe Earthquake, seismic retrofitting was implemented for the bridges that should be given priority among those designed in accordance with the specifications earlier than 1980 Road Bridge Guidelines.
- Seismic retrofitting for expressways and nationally administrated roads was mostly completed.
- Regarding the roads administrated by prefectures, the targets were exclusively limited to the bridges on the Priority Routes*1. Seismic retrofitting for the targets was mostly completed.
- Regarding long span bridges, technical analyses were implemented considering their structural characteristics and the ground conditions. Based on the analyses, the targets were retrofitted, if necessary.

*1 Priority Routes:
- access roads to especially critical facilities such as ports, harbors and airports
- routes in high seismicity areas such as the designated areas for the Tokai-, Tonankai- and Nankai- Earthquakes

Conceptual Diagram for Disaster Prevention Program

Prioritization of road facilities for seismic retrofitting



Major Assessment Factors in Prioritization

Disaster Prevention Planning : Damage Estimation

Practical Earthquake Damage Estimation Procedure for Highway Bridges (PWRI)

Comprehensive Assessment

Check sheet for simple-span bridge
1.Bearing support at the edge of girder, unseating prevention system
2.Abutments, foundations

Damage assessment for bearing support

Check sheet for multi-span bridge
1.RC piers
2.Steel piers
3.Bearing support, unseating prevention systems
4.Abutments, foundations
5.Pile foundation under lateral flow caused by liquefaction

Damage assessment for
-RC pier (table1-4)
-Steel pier (table1-3)
-Bearing support

Check sheet for rigid frame bridge
1.RC piers
2.Steel piers
3.Bearing support, unseating prevention systems
4.Abutments, foundations

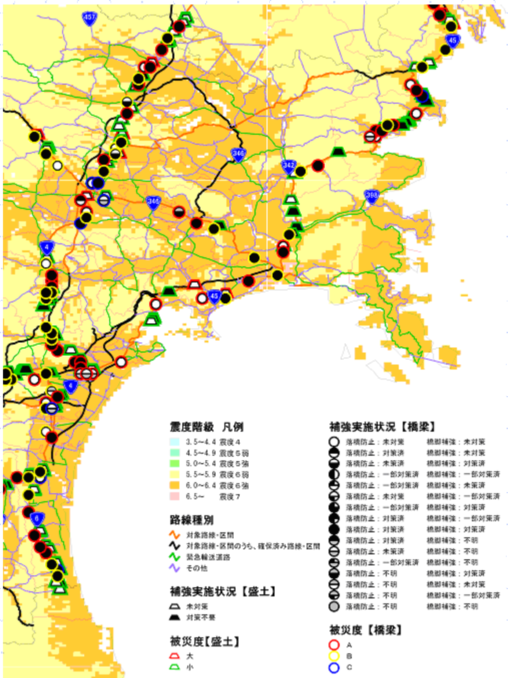
Damage assessment for
-RC pier (table1-2)
-Steel pier (table1-3)
-Bearing support

Availability Assessment for Automobile Traffics

Check sheet for embankment behind abutment

Check sheet for impacts of bearing support damage on automobile traffics

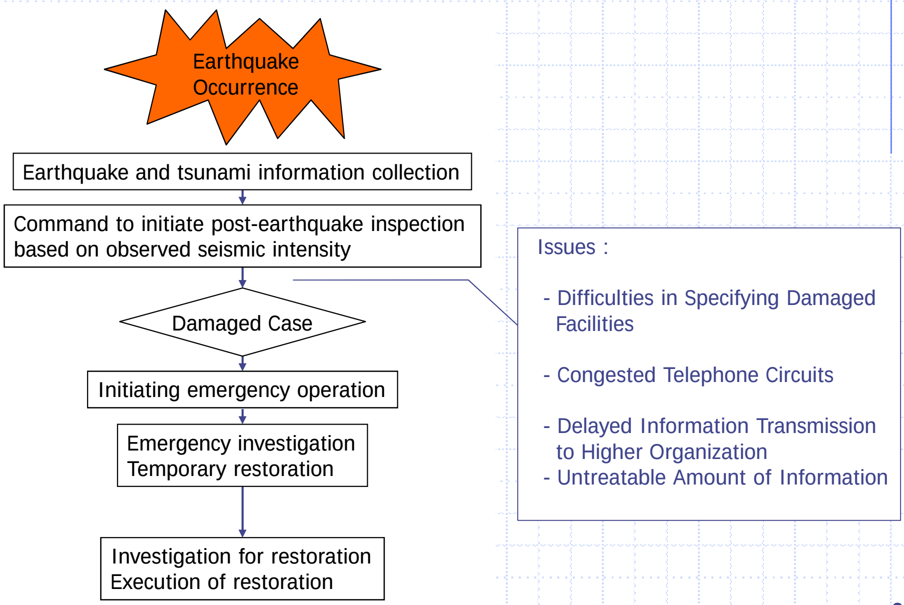
Disaster Prevention Planning : Mapping



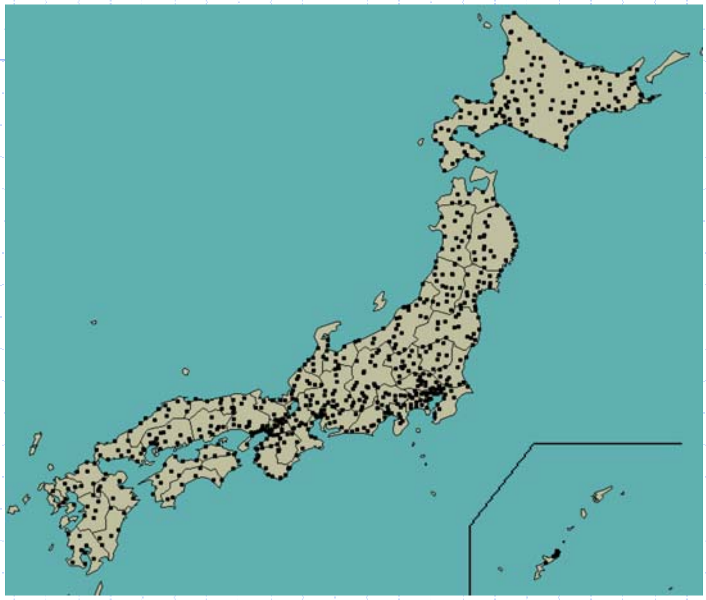
Disaster Prevention Planning : Prioritization of Road Facilities for Seismic Retrofitting

- Collaboration of Road administrators
  - Choice of the routes to be secured
  - Prioritizing road facilities for seismic retrofitting based on estimated damage, likelihood of secondary disaster and so forth

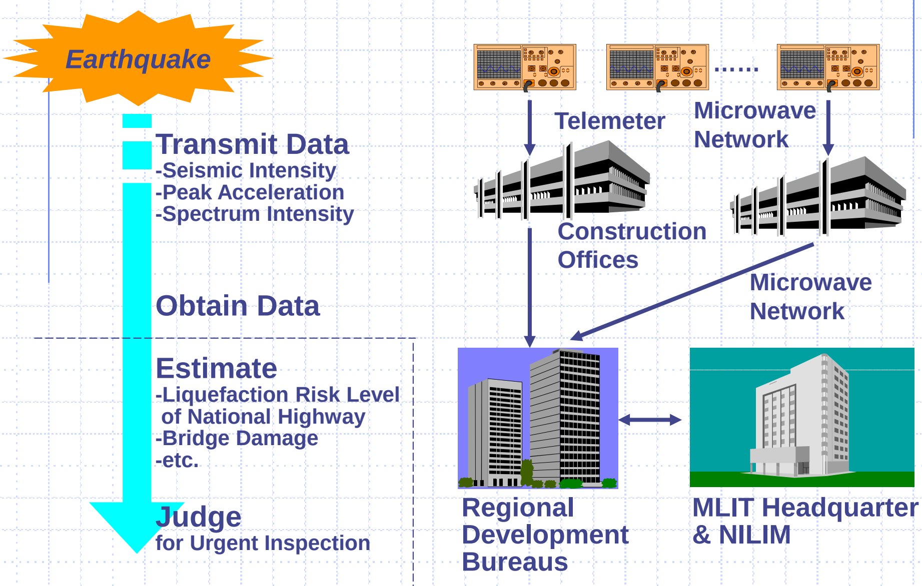
Flow of Crisis Management



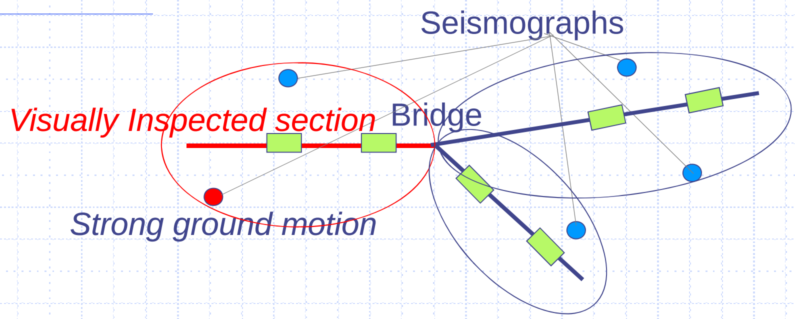
Location of Seismograph



Flow of Seismograph Data



Traditional Post-earthquake Visual Inspection



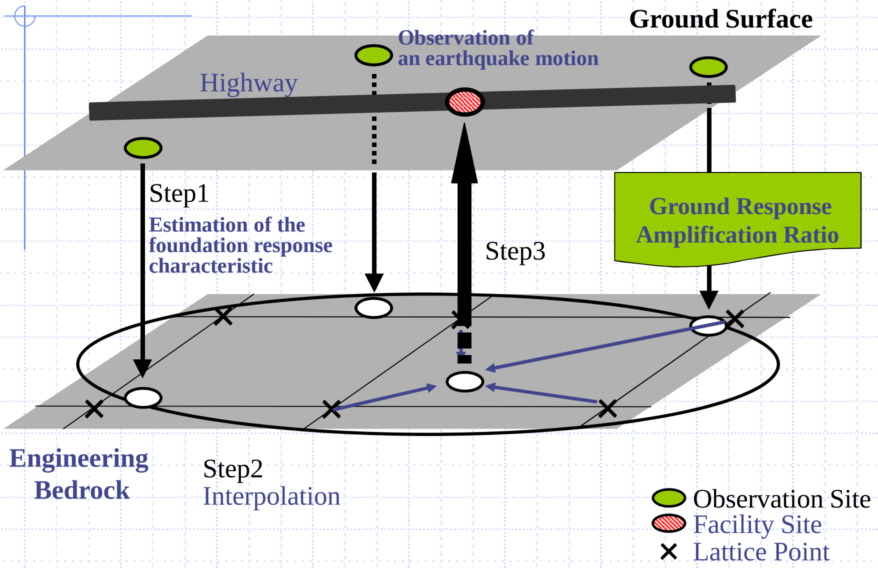
In the case ground motion observed by the seismographs in the neighborhood of a road section exceeds predetermined intensity, damage state of bridges on the road section must be assessed by visual inspection tour.

"SATURN" helps instant use of data

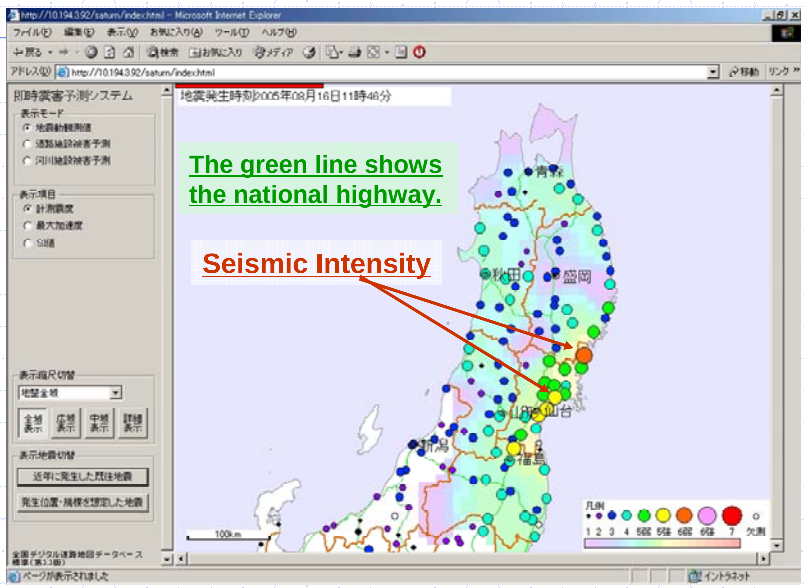
A computer system "SATURN" (Seismic Assessment Tool for Urgent Response and Notification) has been developed.

1. Displays ground motion intensity map obtained by the seismograph network immediately after an earthquake.
2. Displays damage estimation for various facilities (bridge, embankments).

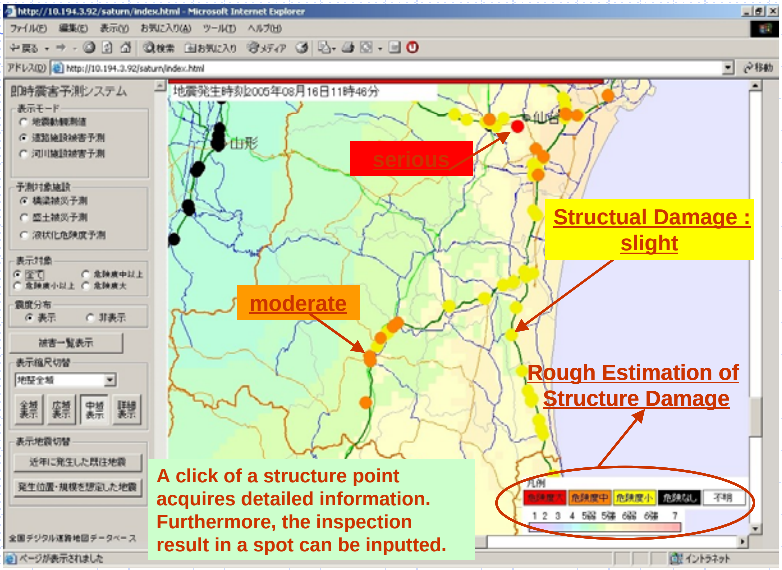
Estimation Steps of Ground Motion Characteristics



SATURN displays seismic intensity

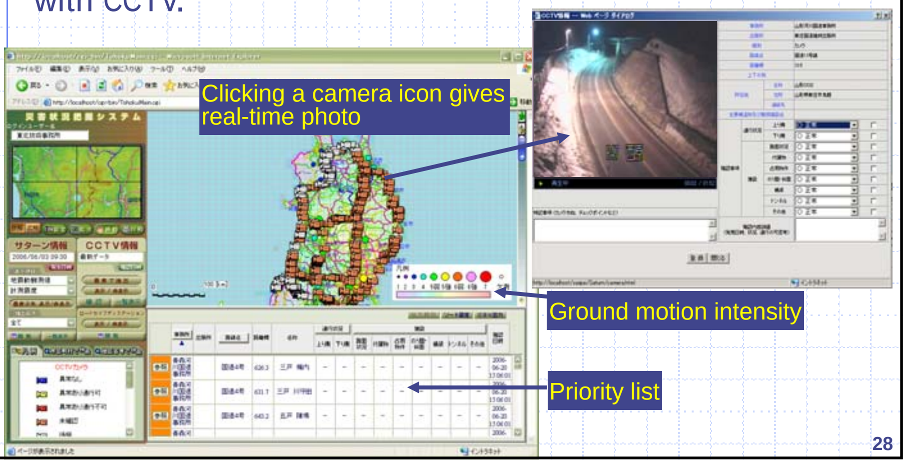


SATURN displays damage estimation



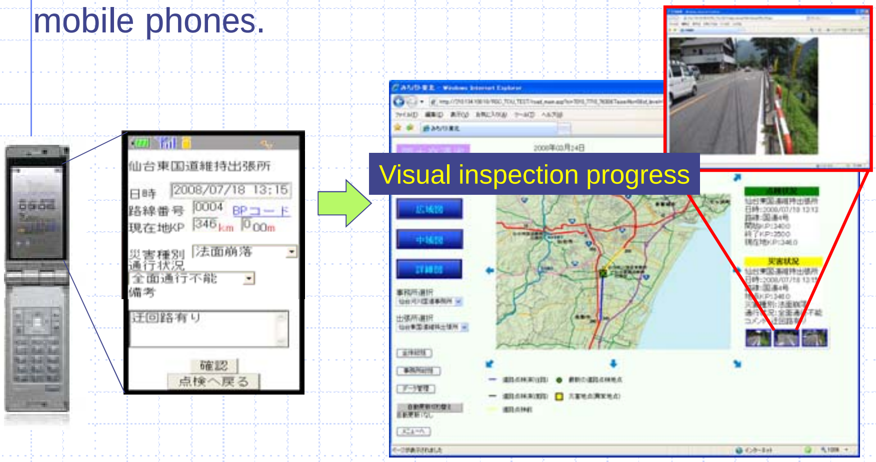
Remote Patrol System for Highways

- Road damage states can be visually assessed remotely with Closed Circuit Televisions (CCTV)
- Shaking map gives priority to road sections to be checked with CCTV.

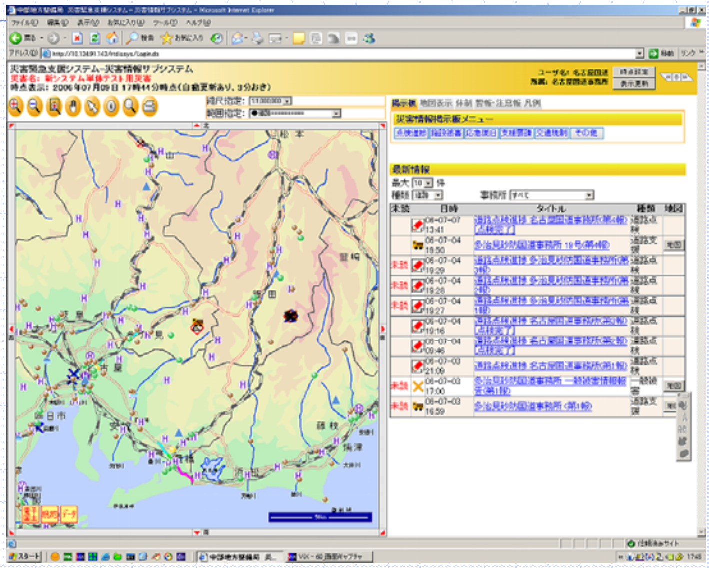


Road Patrol System for Post-earthquake Damage Inspection Patrol

- ✓ Road damage states and inspection progress are shared.
- ✓ Inspection patrollers transmit damage information with mobile phones.



Disaster Information Sharing System



7. Lecture
“Strategy for maintenance of Road structures”

Mr. Takashi TAMAKOSHI

Strategy for Maintenance of Road Structures in Japan

2009. 11. 12

Toshiaki Mabuchi

Bridge and Structures Division,
National Institute for Land and Infrastructure Management

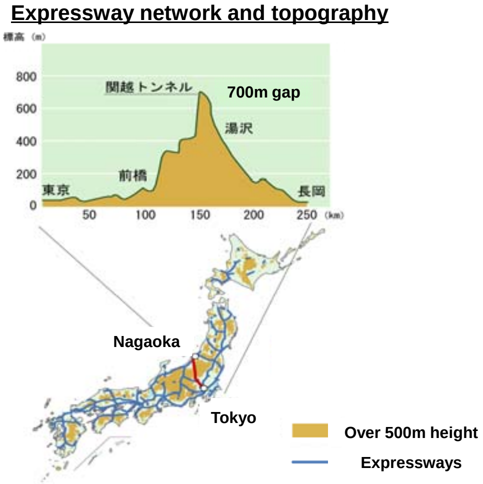
- Current situation of bridge stock in Japan
- Policies and activities for better bridge management
- Summary

■ Current situation of bridge stock in Japan

Severe environmental condition (Nature, Terrain)

There are little plains in Japan and the road network has been developed under severe terrain, therefore ratio of structures such as bridges and tunnels along the road network is relatively high. Coastal areas, where population and infrastructure are dense, are affected by severe salt environment.

Expressway network and topography



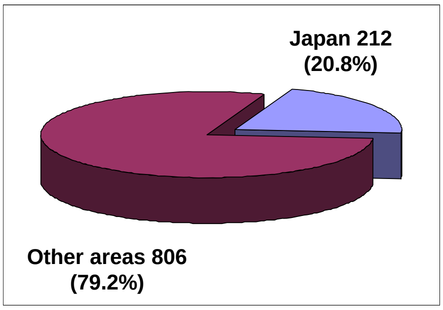
Severe salt environment

Damage of concrete by salt attack

Severe environmental condition (Earthquake)

Japan is famous for frequency of earthquakes in the world, and many bridges have been damaged by earthquakes.

Frequency of earthquakes over M6
(yr1999-2008)



Reference;
White Paper on Disaster Management

Earthquakes caused fatalities in recent years

Mo/Yr	Name	M
Sept 2003	2003 Tokachi-Oki	M8.0
Oct 2004	2004 Niigataken-Chuetsu	M6.8
Mar 2005	Hukuokaken-Seihouoki	M7.0
Mar 2007	2007 Notohanto	M6.9
July 2007	2007 Niigataken-Chuetsuoki	M6.8
June 2008	2008 Iwate-Miyagi Nairiku	M7.2

Source;
Japan Meteorological Agency *www.jma.go.jp/*

Severe environmental condition (Earthquake)

Japan is famous for frequency of earthquakes in the world, and many bridges have been damaged by earthquakes.

Collapse of bridge by earthquake
(Hyogoken-Nanbu, Jan 1995)

Collapse of bridge by earthquake
(Iwate-Miyagi Nairiku, Jun 2008)

Severe environmental condition (Typhoon)

There are many typhoons which causes damage of bridges such as scouring.

Number of Typhoons
(yr2003-2008)

	Approach	Landing
2003	12	2
2004	19	10
2005	12	3
2006	10	2
2007	12	3
2008	9	0

Passes of typhoons in 2004
10 typhoons landed

Damage of bridge by scouring
(Typhoon No9, Sept 2007)

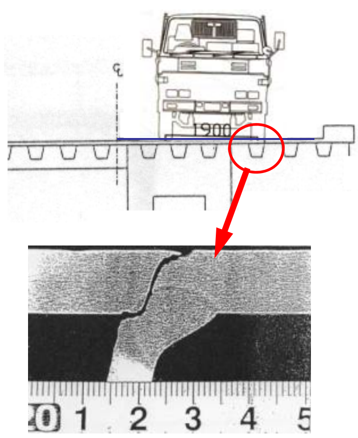
Source;
http://www.nikkei.co.jp/news/main/im20070907SSXKF007807092007.html

Severe environmental condition (Traffic)

In some urban roads where heavy vehicles passing, fatigue cracks of steel members become obvious.

Roads in the urban area covered by heavy traffic

Penetrating crack through steel deck slab

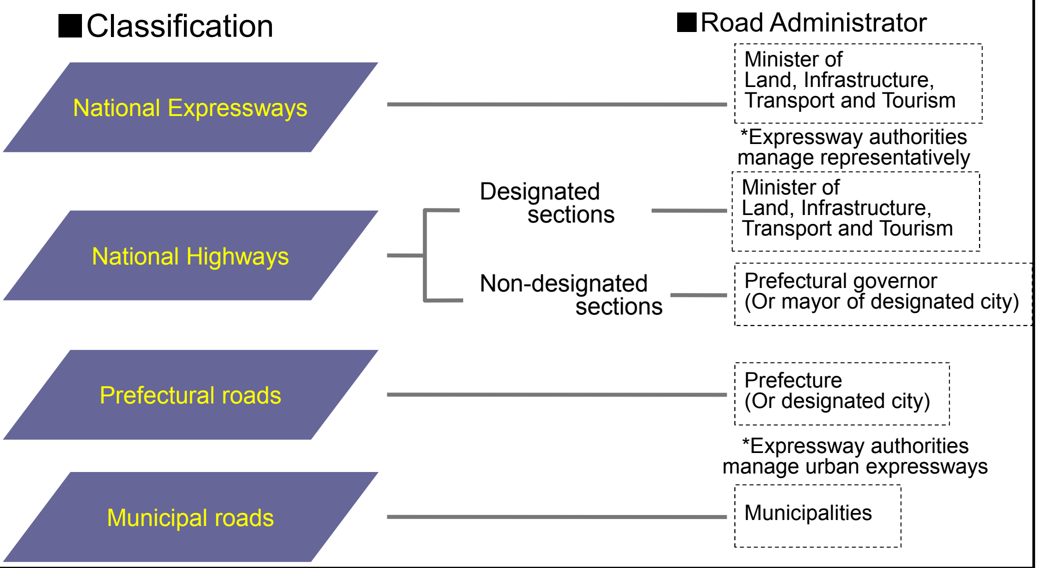


Crack occurred at the girder end

Crack occurred at the steel box girder

Road classification and Administrators

In Japan, road is classified into 4 kinds based on law.
National expressways which were privatized few years ago are controlled access from local road with toll system.



Road length & Bridges by classification

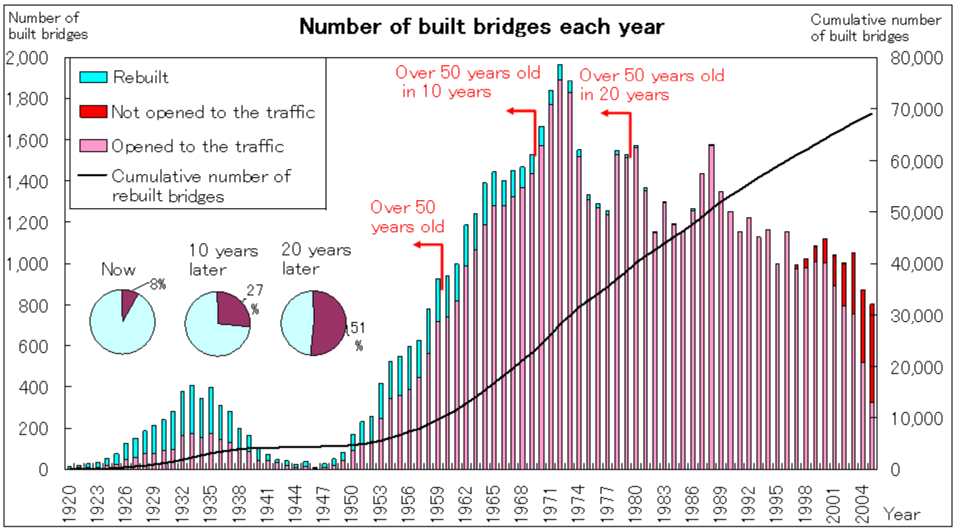
The main arteries, that are the backbone of the national infrastructure, are managed by the national government or the expressway authorities, but the majority of roads and bridges are managed by local governments.

	Length (km)	Bridges (over 15m)
National Expressways	7,431 (0.6%)	6,614 (4.4%)
National Highways *Designated sections*	22,592 (1.9%)	11,368 (7.5%)
National Highways *Non-Designated sections*	31,939 (2.7%)	12,899 (8.5%)
Prefectural roads	129,329 (10.8%)	32,981 (21.7%)
Municipal roads	1,009,599 (84.1%)	88,098 (58.0%)
total	1,200,890 (100%)	151,960 (100%)

Source: 2008 Annual Report of Road Statistics

Number of Bridges by Age

At present, Japan has a stock of nearly 150 thousand road bridges. Approximately 40% were built during the high economic growth period (1955-1973). This large number of road bridges will age in the near future.

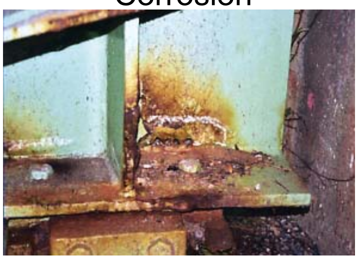


National highway bridges and prefectural road bridges, over 15m 【Source: Technical note of NILIM】

Degradation and Damage (Steel Structures)

Recently, most of deteriorations and damages has already confirmed by inspection.

Corrosion

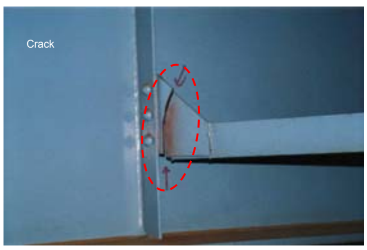


Local corrosion on girder edge

Broken girder edge caused by corrosion

Fatigue

Crack by fatigue extending from lower flange to the web



Crack by fatigue occurring in sway brace

Degradation and Damage (Concrete Structures)

Recently, most of deteriorations and damages has already confirmed by inspection.

Salt Damage

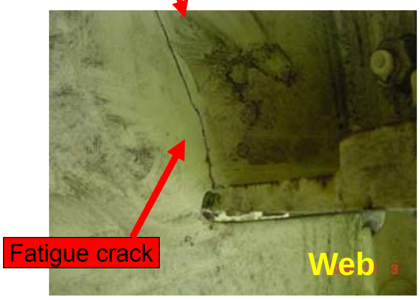
Crack

Corrosion and breaking of prestressing steel

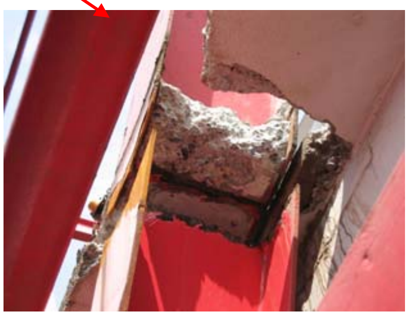
Fatigue

Recent examples of damages

Recently, there have been incidents where the damage was so severe that the bridge had to be closed to traffic.



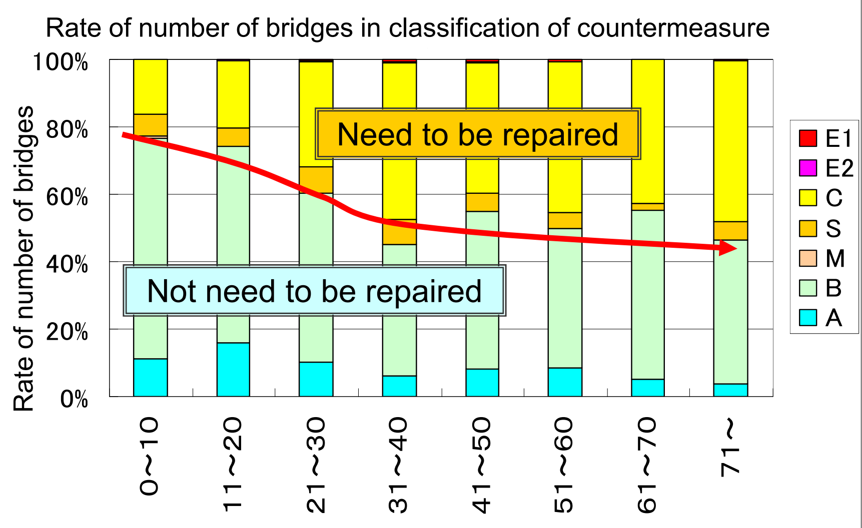
Fatigue crack of steel main girder



Fracture of diagonal truss member

Soundness of bridges as to age

The results of national bridge inspections show that soundness of bridges tends to deteriorate as bridges get older.

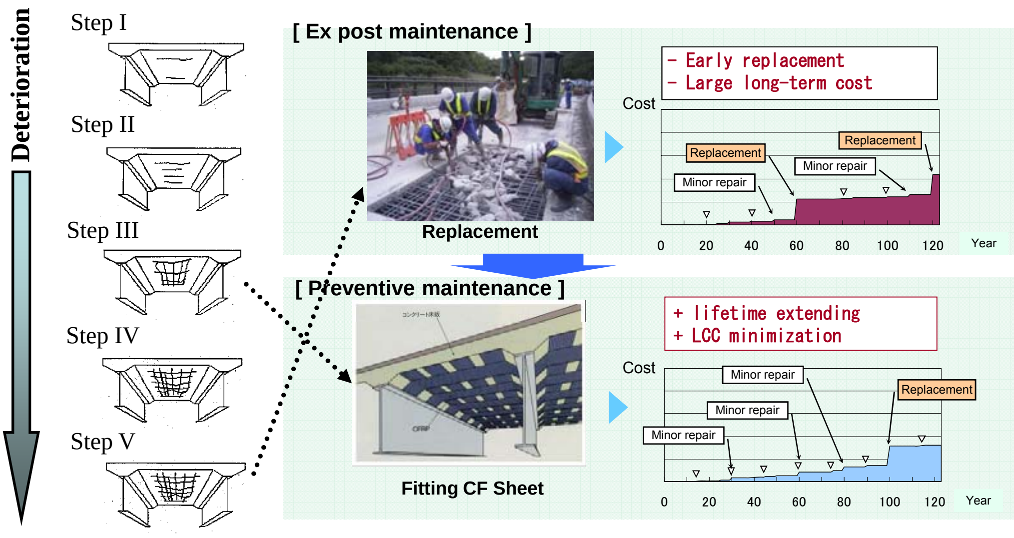


Source: Technical note of NILIM No.488

■ Policies and activities
for better bridge management

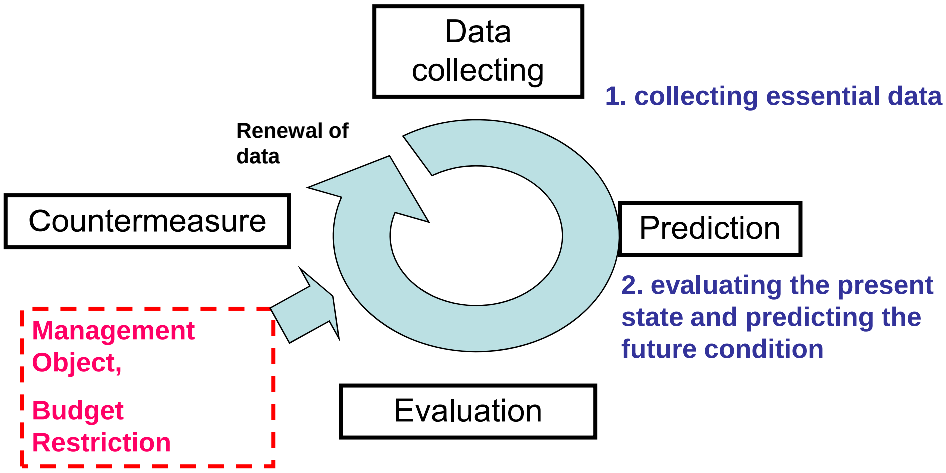
Conversion to preventive maintenance

By applying preventive maintenance rather than ex post maintenance after damaged, secure soundness and aim for extending lifetime and reducing life-cycle cost.



Planned Management

Planned management cycle is in dispensable to realization of preventive maintenance that proper repair is done at proper time.



3. Deciding the concrete contents of the maintenance work for each structures

Collecting essential data

Enhancement of Inspection System for Introduction of LCC and Substantiation of AMS

Inspection Data Collection System in Japan

Bridge inspection	Role of inspection
Regular inspection	Daily check
Routine major inspection	To have a regular grasp of the damage
Detailed survey	To have a grasp of what caused the damage
Follow-up survey	To check progress of damage
Middle inspection	To supplement the periodic inspection (mid-year)
Specific inspection	For specific incidents such as salt damage
Disaster inspection	For disasters such as earthquakes and typhoons

Collecting essential data

Contents and Character of Routine Major Inspection

1988 Version

remarks about damage & bridge

Evaluation division	General situation
I	Damage is remarkable. Traffic safety may be compromised.
II	Damage is big. Execute detailed investigation and provide repairs.
III	
IV	Damage is confirmed. Follow-up investigation is necessary.
V	Damage is confirmed and the extent is recorded.
O.K	Free from damage.

Data Quality was improved

2004 Revision

progress of damage

・Continuous and objective damage data
・Evaluation level per damage type

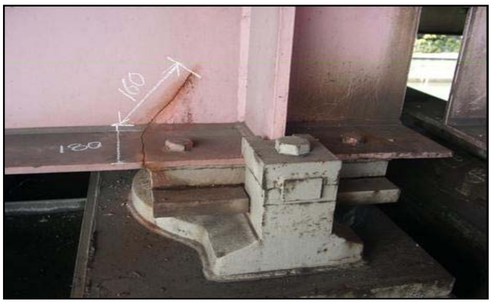
Evaluation level	a	b	c	d	e
Extent of damage	Small				large

recommendation of countermeasure

Evaluation division	Content of evaluation
A	There is negligible or no damage. Repairs are not needed.
B	Repairs are necessary according to the situation.
C	Immediate repairs are necessary.
E1	Structural safety and emergency response are necessary.
E2	Other emergency response is necessary.
M	Response through maintenance construction work is necessary.
S	Detailed investigation is necessary.

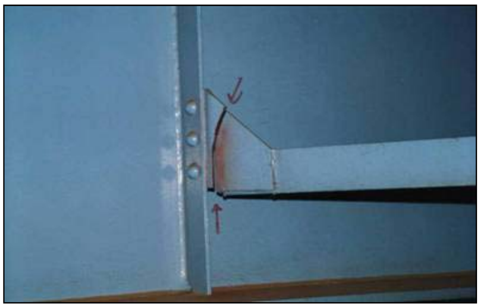
Collecting essential data

In a complex structure like bridge, the relation between damage degree and structural safety is various and complicated.



The crack progresses from sole plate of main girder to web

the crack is so severe damage from the viewpoint of structural safety



Fracture of cross frame

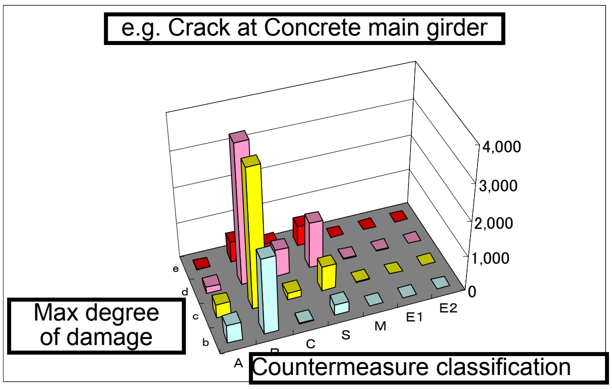
the influence is much smaller than left from the viewpoint of structural safety.

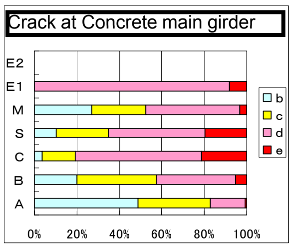
Collecting essential data

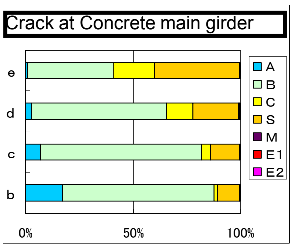
＜Judgment of countermeasure classification＞

Judgment of countermeasure ≠ Degree of damage

Based on <u>a performance</u> required to each individual bridge







Collecting essential data

Collected Data Level

Classification of damage types for data collection

Damage to steel members

1	Corrosion
2	Cracking
3	Looseness/falling
4	Rupture
5	Deterioration of corrosion-proofing function

Damage to concrete parts

6	Cracking
7	Peeling and exposure of reinforcing bars
8	Leakage and free lime
9	Falling out of place
10	Damaged concrete reinforcement
11	Deck slab cracking
12	Lifting

Other damage

13	Problems
14	Unevenness of road surface
15	Paving problems
16	Deteriorated bearing function
17	Others

Common damage

18	Anchor problem
19	Discoloration/deterioration
20	Leaking or collecting water
21	Abnormal noise/vibration
22	Abnormal deflection
23	Deformation/missing material
24	Sediment blockage
25	Settlement, displacement, inclination
26	Scouring

Collecting essential data

Collected Data Level

Classification of member types for data collection

Superstructure

main girder
Cross beam
Stringer
Deck slab
Cross frame
Lateral

Substructure

Pier	Wall
	Beam
Abutment	Parapet wall
	Body wall
	Wing wall
Footing	

Shoe, bearing

Bearing
Anchor bolt
Mortar
Concrete
Structure for prevention of bridge collapse

Drain

Drainage inlet
Drainpipe

On-street

Railing
Guard fence
Felloe guard
Median
Expansion joint
Sound insulation
Curb
Pavement

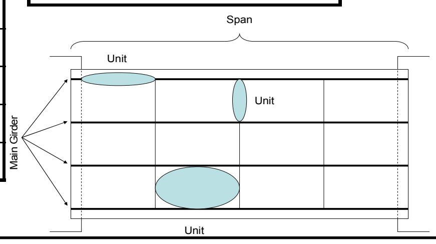


Plate girder steel bridge
Span : 30 m

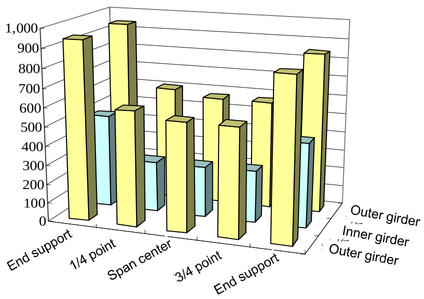
Number of inspection data :
Over 1000

Collecting essential data

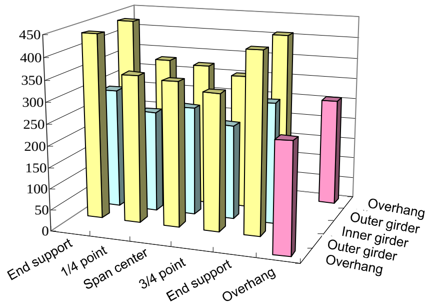
Degree of damage···Use for consideration to rationalize inspection in the future.
By unit of element ramified according to bridge part or member.

＜Application example of Degree of damage＞

e.g. 1 ： Corrosion of Steel Bridges



e.g. 2 ： Crack of deck slab



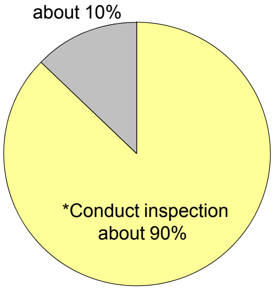
Collecting essential data

Local government and other authorities which manage 90% of all roads on their responsibility. In fact, however, it becomes clear that most of them cannot conduct bridge inspection properly.

[Survey on bridge management by local governments]

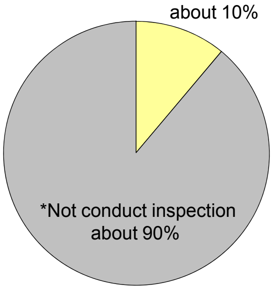
●Prefectures
(total 47)

*Not conduct inspection
about 10%



●Municipalities
(total 1,768 including designated cities)

*Conduct inspection
about 10%



* Excluding daily patrols.

[Survey by MLIT]

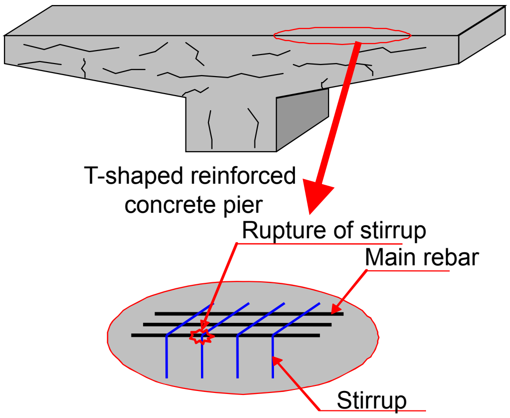
Rusting by Salt Damage

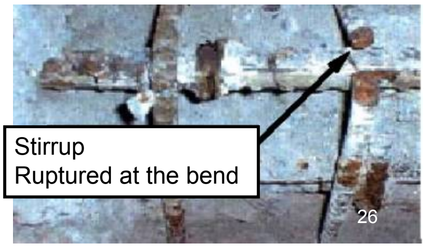
Weight Limitation by Aging

Collecting essential data

Routine major inspection depends on close visual method to grasp damage, but the method has limitation. The first reason is that it is not possible to grasp the condition of re-bar inside of concrete.

Alkali silica reaction at concrete member

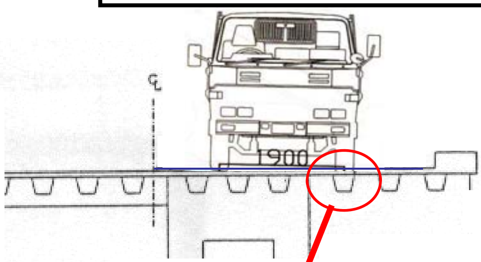


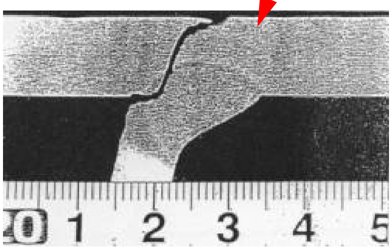


Collecting essential data

Fatigue crack which progresses from the inside of U-rib to the surface of steel deck plate cannot be confirmed even if the pavement is torn off until it reaches to the surface.

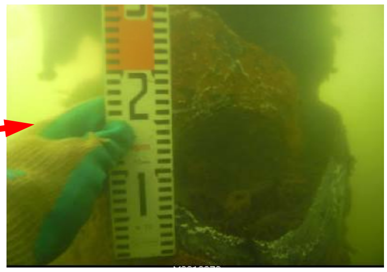
Crack's development trough steel deck

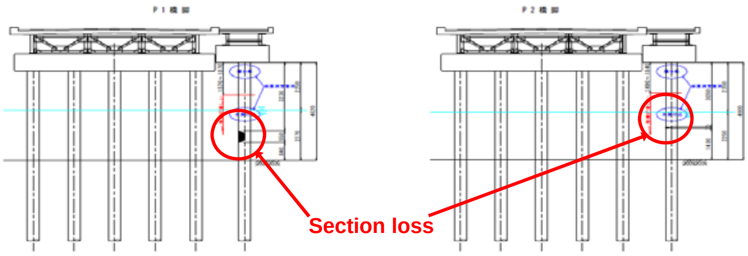




Collecting essential data

Bridge parts in ground or water cannot be confirmed by visual inspection.
The section loss at underwater part of steel pile bents pier was discovered by accident when worker dived for repair.





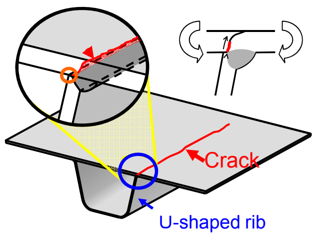
28

Collecting essential data

Effective method to solve the limitation of close visual inspection is development and introduction of Non Destructive Inspection (NDT).

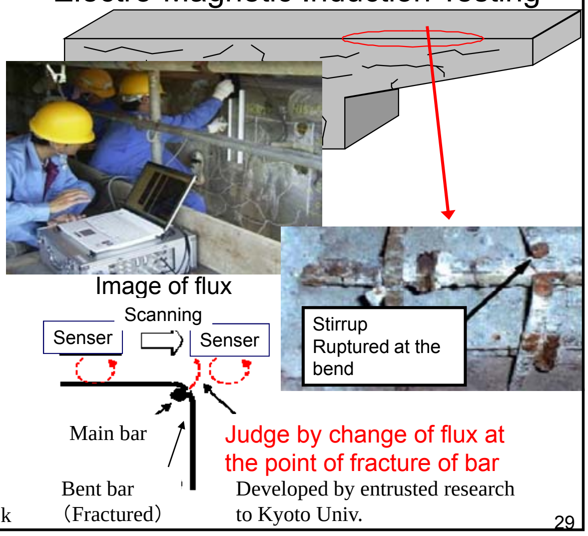
・**Necessary technical development：To watch inside of steel and concrete members**

Ultrasonic Testing



PWRI developed the method to apply to steel deck

Electro-Magnetic Induction Testing



Developed by entrusted research to Kyoto Univ.

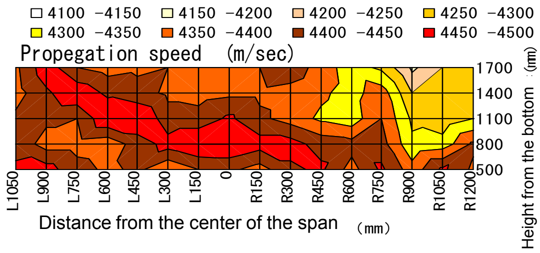
Collecting essential data

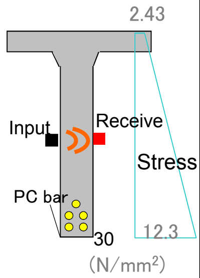
Effective method to solve the limitation of close visual inspection is development and introduction of Non Destructive Inspection (NDT).

・Necessary technical development：To watch stress condition at structural member

Propagation characteristics at surface

Propagation characteristics of transmission





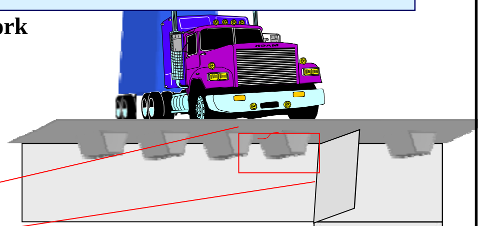
Collecting essential data

Effective method to solve the limitation of close visual inspection is development and introduction of Non Destructive Inspection (NDT).

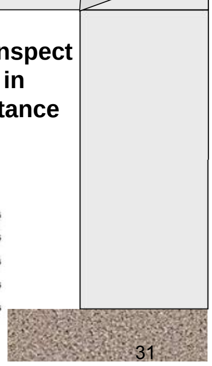
Necessary technical development（Improvement of work environment , increase efficiency, and upgrade）:

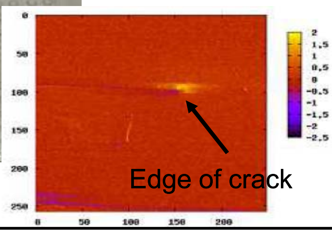
Watch widely from distance

【NDT for crack at steel deck】
・Detecting technology from distance
・Quantitative evaluation with machine



The technology to inspect many welded joints in dimension from distance



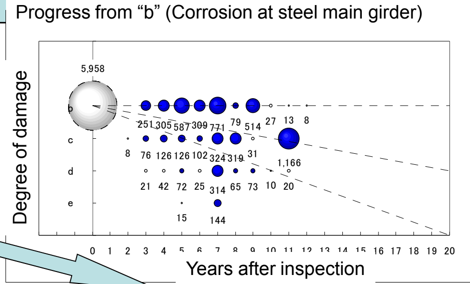


Developing by entrusted research to an University

Prediction

At present, NILIM tries to sophisticate the formula for deterioration prediction with inspection result of existing bridges.
However, there are dispersion between prediction and actual progress according to bridge types or parts of a bridge.

【Progress of corrosion】



Degree of damage：c

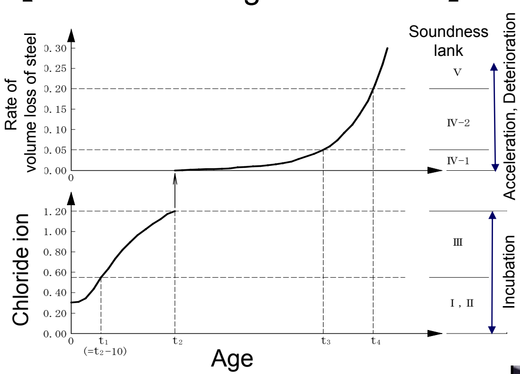
Degree of damage：d

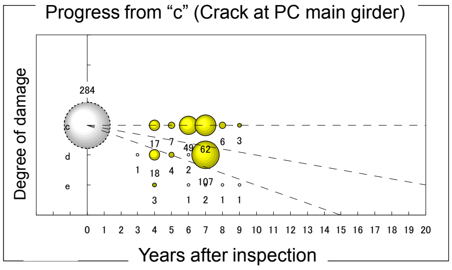
Degree of damage：e

Prediction

There are dispersion between prediction and actual progress.
It is difficult to control the condition of each individual bridge and external force, so there is limitation to predict the deterioration of bridge at present.

【Chloride damage at concrete】





Evaluating the present state and predicting the future to be able to correctly prioritize them

Relation of BMS and other maintenance management works

- To support experts who exam and decide the countermeasure
- To pick out bridges which have deteriorated or will soon become serious condition

Basic data	Clarification of present situation	Evaluation of present situation	Prediction/trial calculation

Structure specification data → BMS

Repair etc. history data → BMS

BMS
① Prediction of deterio-ration of each member
② Evaluation of future soundness of bridge and calculation of the most appropriate method

Clarification of degree of damage → **Countermeasure classification judgment data**

Detailed survey of the state of specific damage such as salt damage, ASR, fatigue etc.

Other inspections

Quantitative and objective evaluation based mainly on data

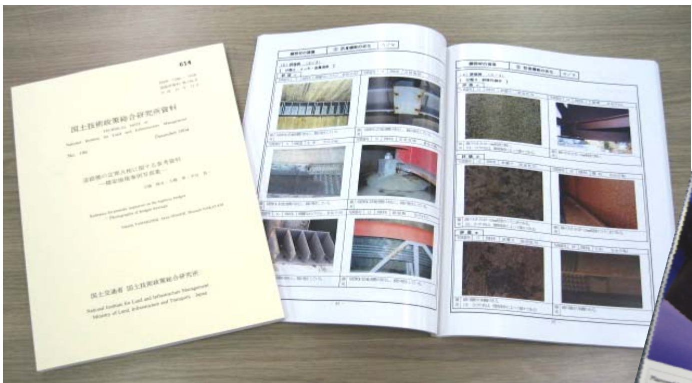
Qualitative and comprehensive evaluations based on the views of experts etc.

Management plan

Obtaining engineers able to operate, diagnose and treat them appropriately

Preparation of Manual and Sample collection

Continuation the Training Courses



Preparation of "damage sample photo collection" to complement the experience of engineers

A DVD intended for awareness raising of engineers

Obtaining engineers able to operate, diagnose and treat them appropriately

In order for local governments to apply preventive maintenance rather than ex post maintenance smoothly, support them financially and technically, and facilitate asset management as unified network among road authorities related.

Technical Support
- Organizing training courses for local staff
- Providing a manual to grasp condition of bridges roughly

Mutual Cooperation
- Organizing committee; studying road management standards in view of road management & disaster prevention

Financial Support
- Introducing subsidies for planning maintenance program
- Subsidies for repair & replacement works

[Organizing seminars for local staff]

[Guideline to grasp condition of bridges roughly]

Summary

・In Japan, it is necessary to gain 2 different types of data;
1) data of objective damage degree
2) data of judgment of countermeasure by professional engineer

・Inspection data is gained at every element of bridge member which is subdivided for evaluation of deterioration tendency and soundness of bridges according to structural characteristic and environmental condition based on data analysis

・BMS is used effectively within limited range such as deterioration prediction and future evaluation of bridges.

・Development and introduction of Non Destructive Inspection (NDT) are needed to solve the limitation of close visual inspection.

Challenge

・Inspection has place of improvement and sophistication is necessary

・Bridge maintenance system has limit, and it needs consideration how to use.

・Engineers are indispensable, and improvement of technology is important.

Convert to preventive maintenance from ex post maintenance
Achieve continuous management of safe highway bridge reducing life cycle cost

Thanks for your attention.

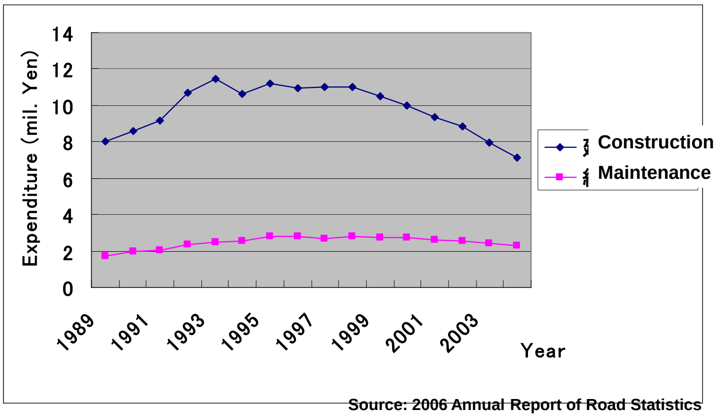
N I L I M

Appendix

Budget constraints

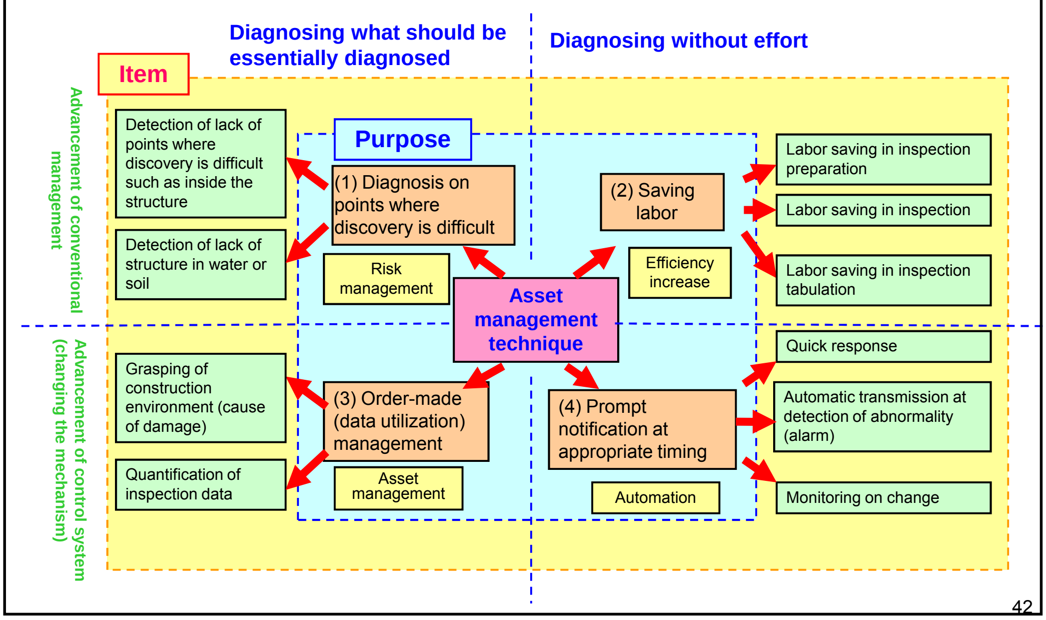
Budget for construction is decreasing by severe national financial condition.
Budget for maintenance is also decreasing slightly in spite of stock increase and aging.

History of construction expenditure and maintenance expenditure



Source: 2006 Annual Report of Road Statistics

Technology required in inspection and management



The regulation by the Road Law

The proper management of roads is regulated by the Road Law. But there is a lack of governmental order and standards for management based on that law. At present, the fact that the budgets and organization of administering bodies are different makes it is difficult to establish standardized regulations.

Article 42 of *the Road Law*

1 The Road Administrator shall endeavor to maintain and repair the roads in good condition so that the traffic on them is not obstructed.

2 <u>Technical standards</u> and other necessary matters <u>for the maintenance and/or repair</u> of roads <u>shall be provided in a national government ordinance.</u>

↑

Problem:
Each body administering roads is so different in their budget and organization that it is difficult to establish regulations in regard to technical standards.

Examples of bridge inspections in Japan

The national government, each expressway company and some local governments conduct routine inspections based on their regulations. But, many local governments have no such regulations and can't conduct routine inspections.

Governing Authority	Frequency of Inspection	Remarks
National Gov't	once in 5 yrs	・Inspections are conducted based on "the Regulations for Periodic inspections (tentative)". ・Inspections are basically close observations. ・The first inspection should be conducted within two years after opening the road.
Expressway Company	once a year	・Inspections are conducted based on their own regulations. ・Inspections are conducted as frequently as budgetary concerns allow. ・Actual situation: once every 5 - 8 years

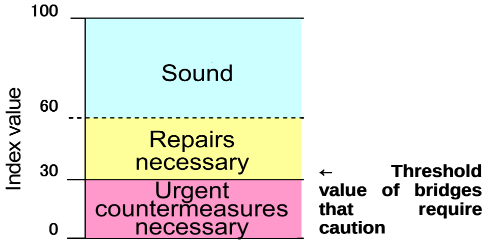
Problem:
Many local governments do not have regulations and they can't conduct routine inspections.

Evaluation and Measurement of Effect

<Development of Performance Indicators>

- It is needed for the people to understand the necessity and effect of maintenance and management activities such as reinforcement and repair works
- It is needed for the manager to grasp the condition of road network all the time

Performance indicators
(1)Reliability to maintain the performance to traffic load
(2)Reliability to keep the performance at earthquake
(3)Level to guarantee the driving safety



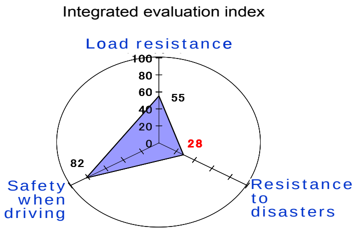


Image of Indicators

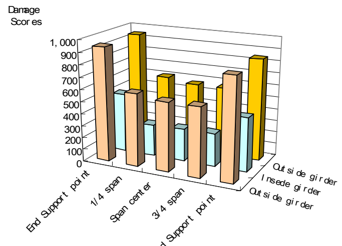
Performance required for Indicators

- Each indicator does not explain more than one function

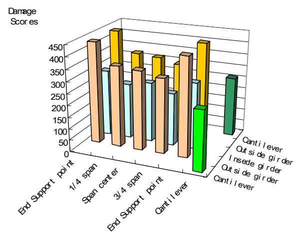
  (By composing the performances ,indicator will be ambiguous)

- Tendencies of damage progress which founded by analyzing inspection data are considered

  → Indicator can be calculated with small number of data.

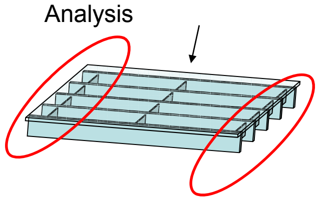


Damage score by corrosion



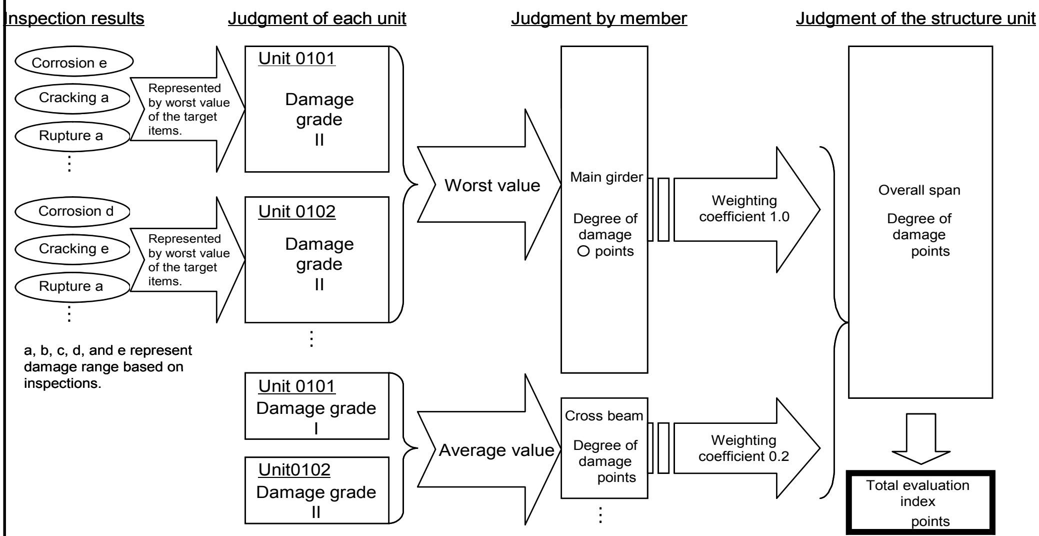
Damage score by crack of RC slab

Utilization of Tendency Analysis



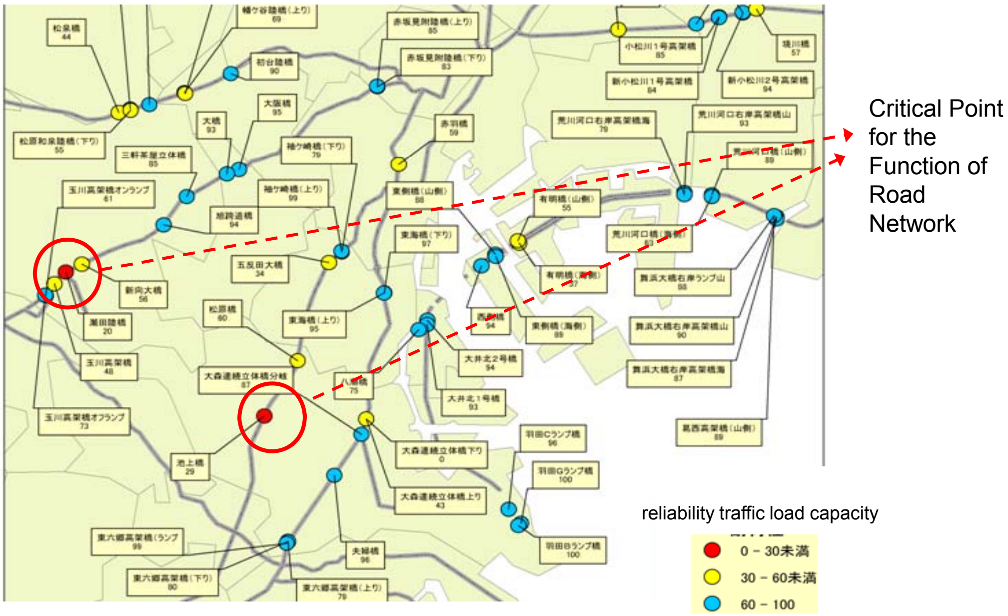
Distribution of Damages Frequency

Calculation Flow of Condition evaluation indicator

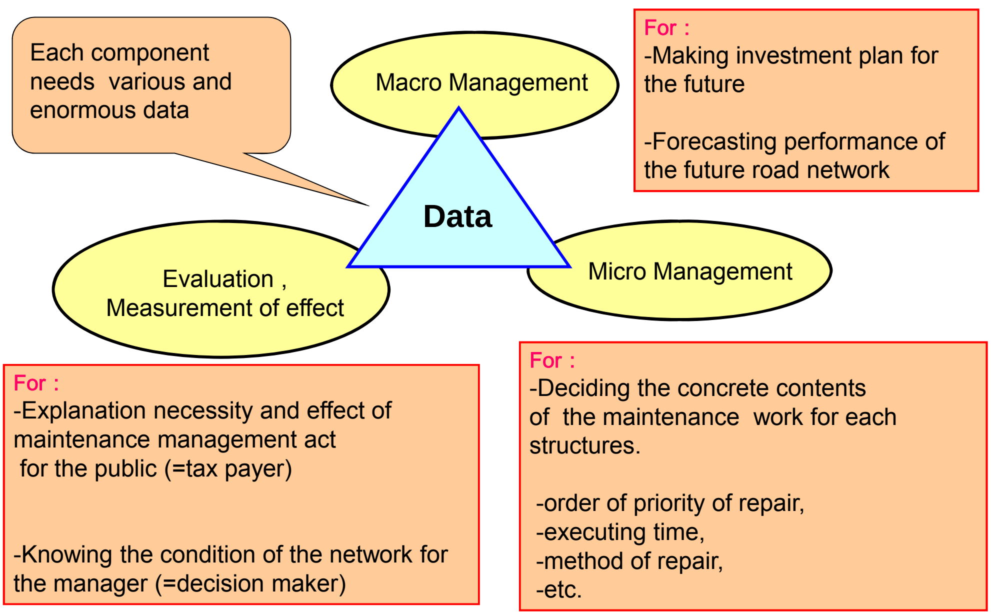


Inspection data are combined with weighting factor

Images of evaluation result of road network conditions



Components and relations of maintenance management



Summary

- Macro Management by BMS
  is using only for picking out of the bridges which are already deteriorated or have high possibility of serious condition in near future.

- Micro Management
  must be improved by developing inspection technology and management system (ex. non-destructive inspection, Application the experts and their knowledge, optimizing of each bridge maintenance using the GIS)

- For Evaluation and Measurement of effect
  performance indicators are developed which can explain the necessity and effect of maintenance and management activities, and the network performance in same time.

Management System is inadequate at all points.
Harmony and a balance of component is important and to be improved.

8. Lecture
"Maintenance of Bridges"

Mr. Jun MURAKOSHI

Maintenance of Bridges

Taku Hanai, Naoki Yanadori
CAESAR: Center for Advanced Engineering Structural Assessment and Research

Maintenance of Concrete Bridges

Taku Hanai

Outline

- Deterioration Mechanism of Concrete Structures
- Repair Methods for Concrete Bridges
- Strengthening Methods for Concrete Bridges

Deterioration Mechanism of Concrete Structures

- Corrosion of Steel Bars in Concrete
  – Chloride Induced Corrosion
  – Carbonation
- Deterioration of Concrete
  – Alkali-Aggregate Reaction
  – Freezing and Thawing
  – Chemical Attack

Deterioration of Concrete can facilitate Corrosion in Concrete.

Defect of Concrete Structures

- Poor Construction Work
  - Cracking (Thermal stress, Drying shrinkage)
  - Cold joint
  - Honeycomb
  - Shortage of cover concrete

A defect of concrete structures can be affected by more than one mechanism.

Chloride Induced Corrosion

- Mechanism
  - Chloride ions facilitate the corrosion of re-bar in concrete
  - Chloride ions can be brought by sea wind
  - Chloride ions can be brought as deicing salt
- Countermeasures in Latest Construction
  - Thick cover concrete
  - Epoxy coated Re-bar
  - Surface coating (epoxy)

Carbonation

- Mechanism
  - Carbonation of concrete facilitate the corrosion of re-bar in concrete
  - Often shortage of cover concrete cause corrosion by carbonation
- Countermeasures in Latest Construction
  - Minimum cover thickness
  - Maximum W/C of concrete

Alkali-Aggregate Reaction

- Mechanism
  - Chemical reaction between some types of aggregate and alkali compounds in concrete cause the swelling of concrete
- Countermeasures in Latest Construction
  - Maximum alkali compounds in concrete
  - Use of blast furnace slag and fly-ash
  - Use on non-reactive aggregate

Freezing and Thawing

- Mechanism
  - Freezing of water in concrete cause the cracking and scaling of concrete
- Countermeasures in Latest Construction
  - Use of chemical admixture (AE water reducing agent)

Poor Construction

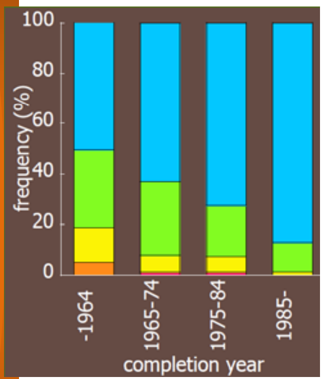
Nationwide Survey on Soundness of Concrete Structures in Japan

- The Survey was carried out in 1999 by Ministry of Construction
- Visual Inspection was carried out in 2099 Structures.
  - Bridge Superstructures: 371
  - Bridge Pier and Abutment: 390
  - Other Structures: 1338
- Deterioration Mechanism was estimated from the Record of Visual Inspection

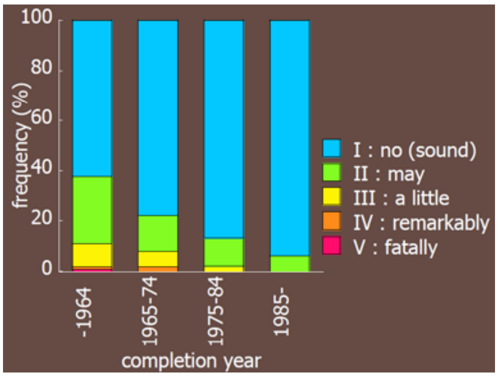
Nationwide Survey on Soundness of Concrete Structures in Japan

- Deterioration of Investigated Concrete Structures were Classified into Five Categories
  - I: No Deterioration
  - II: May be Deteriorated, but low possibility (There are some defects)
  - III: Deteriorated a little
  - IV: Deteriorated remarkably
  - V: Deteriorated fatally (Need some action)

Bridge Superstructures



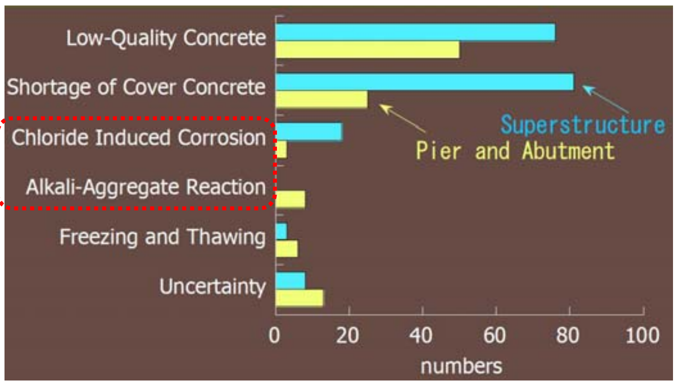
Bridge Pier and Abutment



- Most concrete structures were in sound condition
- Deterioration was observed more frequently in older concrete structures

Deterioration Mechanism in Actual Concrete Structures

The effect of deterioration is considerable



Chloride induced corrosion

Chloride induced corrosion (PC girder)
PC tendon was broken

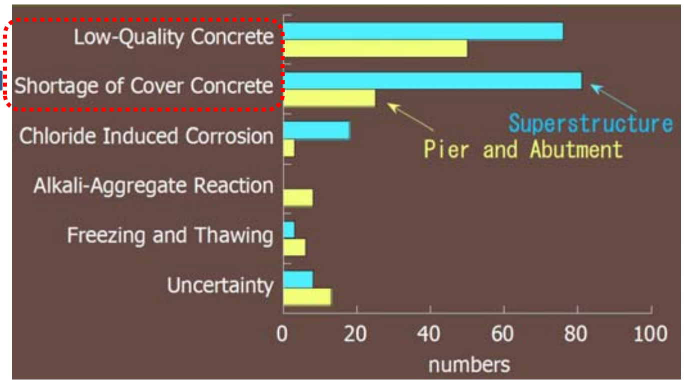
Alkali-Aggregate Reaction

Alkali-Aggregate Reaction
(Abutment)

Broken Re-bar

Deterioration Mechanism in Actual Concrete Structures

Poor Construction Work



Poor Construction Work

Shortage of cover concrete (bridge girder)

Poor Construction Work

Honeycomb (bridge pier)

Repair Methods for Concrete Bridges

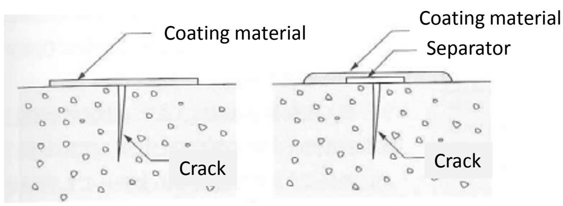
- Crack Repair
- Sectional Repair
- Impregnation Method
- Surface Coating
- Falling-off Prevention
- Electric Protection
- Electrochemical Repair

Crack Repair

- Crack Covering (width of 0.2mm or less)
- Injection Method
- Infilling Method (crack width of 0.5mm or more)

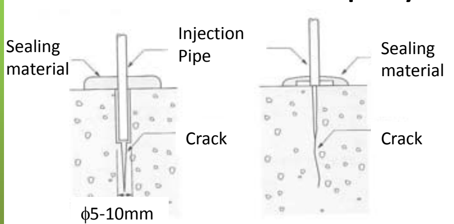
Crack Covering

- Crack width of 0.2mm or less
- Materials that resist crack width variation is used
- Materials are the same as Surface Coating



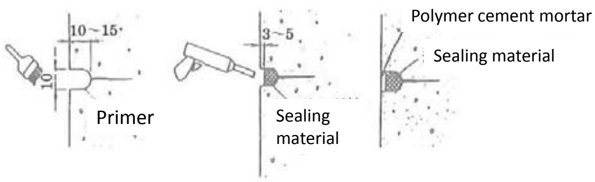
Injection Method

- Resin-based or Cement-based materials are injected into crack
- Injected materials are organic materials, such as epoxy or acrylic, or inorganic materials, such as cement or polymer cement



Infilling Method

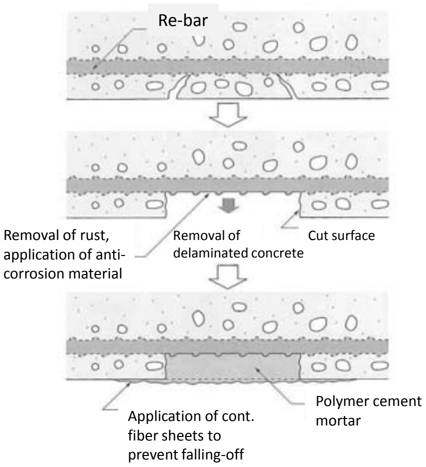
- Crack width of 0.5mm or more
- Repair material is infilled in U- or V-shaped cutting along crack with 10mm width
- Material: Urethane, Silicon, or flexible epoxy



Sectional Repair(1)

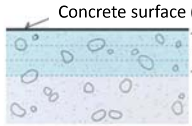
- Repair method for sectional loss
- Repair method when cover concrete which suffered carbonation or chloride penetration is removed
- It consists of (1)Primer coating of re-bars, (2)infilling to sectional loss

Sectional Repair(2)



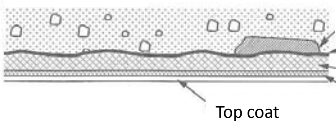
Impregnation Method

- Impregnation material applied on concrete surface prevents intrusion of deterioration factor or diminish corrosion induction
- Function of each material
  - Increase of alkalinity
  - Corrosion prevention
  - Water impermeability
  - Solidification



Surface Coating

- Coating applied on concrete surface with resin-based or polymer-cement materials prevent intrusion of water, carbon dioxide, oxygen, and chloride ion



Falling-off Prevention

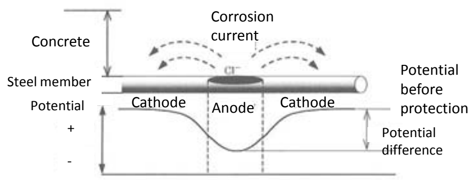
- Strengthening surface layer by sheets or nets to prevent falling-off of concrete

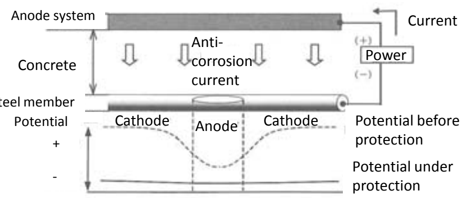
Attachment of Sheets

Applying adhesive on the sheets

Electric Protection(1)

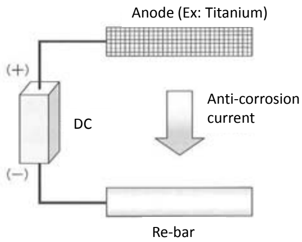
- Mechanism of Corrosion
  - At steel member, with which passive film is destroyed, potential difference on steel surface causes corrosion current and facilitate corrosion
- Mechanism of Electric Protection
  - Application of electric current from anode reduce potential difference and thus suppress corrosion



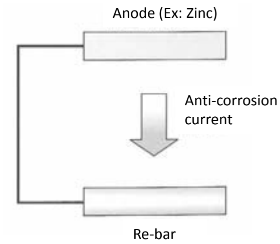


Electric Protection(2)

- Categorization by Anode System
  - External Power Method
    - By external power source, electric current is applied
  - Galvanic Anode System
    - By connecting Metal material such as Zinc to steel members, protection current is induced

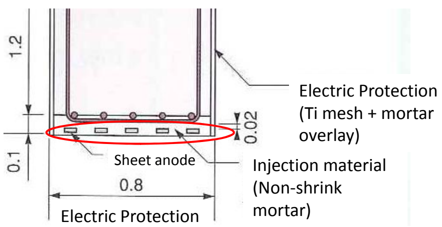


External Power Method



Galvanic Anode System

Electric Protection (Example of Galvanic Anode System)



Titanium anode is set to re-bars

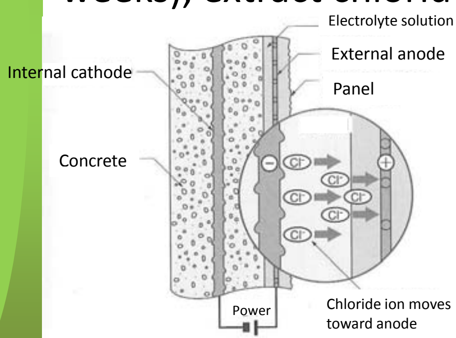
Anodes for steel pipe piles（Gray members）

Electrochemical Repair

- Desalination Method
  – To extract chloride contents inside concrete
- Re-Alkalization Method
  – Re-alkalization of carbonized concrete

Desalination Method

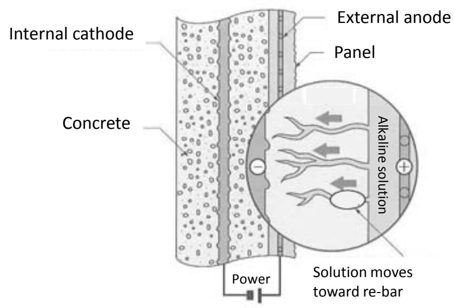
- Applying direct current between external electrode and steel members in concrete (8 weeks), extract chloride contents



Electrolyte solution is filled between panel and concrete. Direct current is being applied.

Re-Alkalization Method

- Applying direct current between external electrode and steel members in concrete (1 week), impregnate alkaline solution

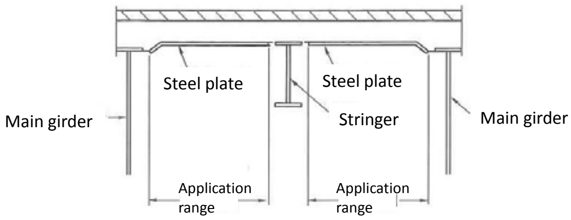


Strengthening Methods for Concrete Bridges

- Steel Plate Bonding Method
- Continuous Fiber Sheet Bonding Method
- Outer Cable

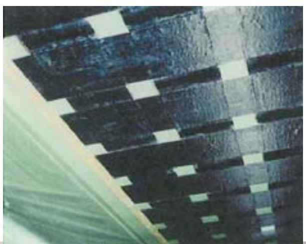
Steel Plate Bonding Method

- Steel plate is set along tension side of concrete member. Adhesion is secured by injecting adhesive between plate and concrete
- Strengthening for bending and shear



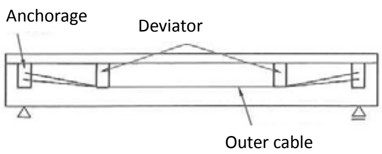
Continuous Fiber Sheet Bonding Method

- Attaching continuous fiber sheets on the surface where tension or diagonal tension stress is working
- Light weight, and anti-corrosive
- Increase of stiffness cannot be expected



Outer Cable

- By installing tension members outside of concrete and introducing pre-stress, bending and shear capacities are improved



Maintenance of Steel Bridges

Naoki Yanadori

Contents of presentation

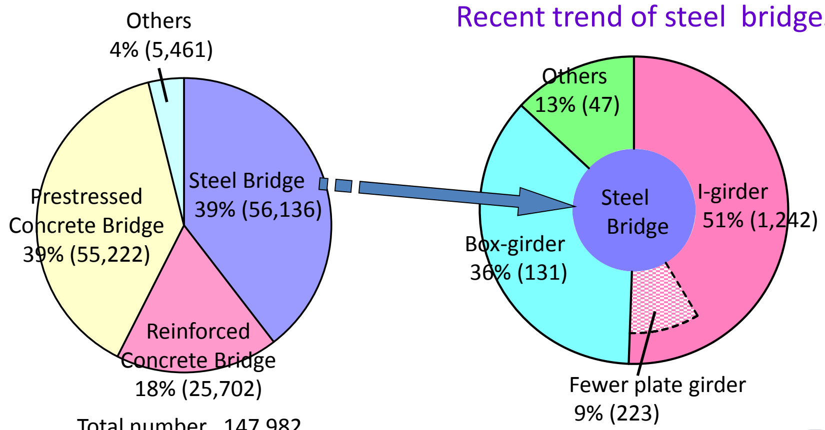
■ Current status of steel bridge stock

■ Major damage of steel bridges and countermeasures

- Corrosion of Steel member
- Fatigue of RC deck
- Fatigue crack of steel member

Bridge type

Recent trend of steel bridges



Total number 147,982

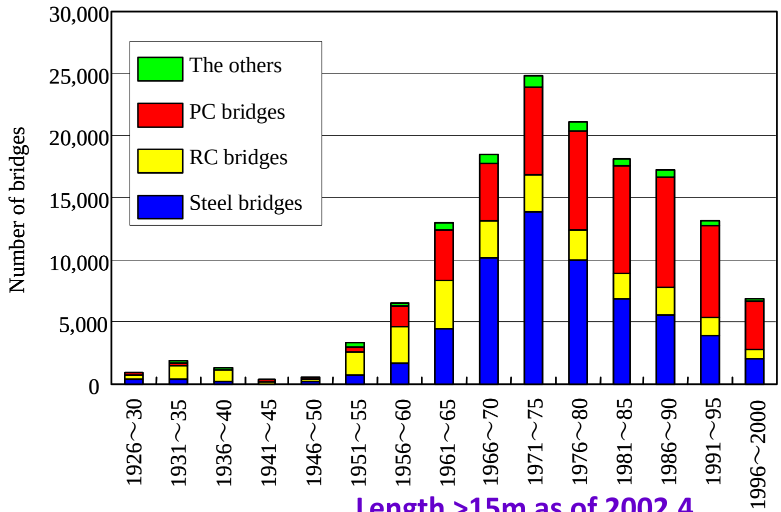
Bridge number by bridge type

（Length >15m as of 2002.4）

（Length >30m as in 2000 ～ 2003）

http://www.jasbc.or.jp/kyoryodb/index.cgi

Number of bridge by year of construction



Length >15m as of 2002.4

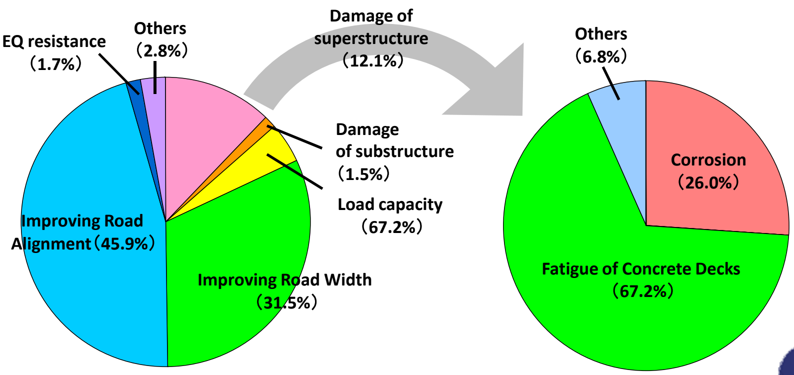
Major causes of replacement of steel bridges (1986-1995)

・Most are functional problem so far.

・About 12% is Deterioration of superstructure.

⇒ Deterioration of concrete deck, Corrosion of steel members

(Importance of preventive maintenance)



603 bridges

73 bridges

Deterioration factor
-Corrosive environment-

Severe geographical feature
- Long & slender country, coastal area, mountainous area
- Much rain, Seasonal wind in winter, Typhoon
- About 60% area is snowy and cold

etc.

Deterioration factor
-Traffic Conditions-

Heavy traffic in urban area

Heavy truck

Corrosion prevention method

Measures	Mechanism	In case of deterioration
Painting	Protection by paint	Repainting
Weathering steel	Protective rust layer	Repair with painting
Hot dip galvanizing	Protective layers by zinc and alloys, and Sacrificial protection	Repair with painting
Metal spray	Spray deposit and Sacrificial protection by zinc-aluminum pseudo-alloys	Repair with painting

Prevention of corrosion

Manual for painting and corrosion protections for steel highway bridges

- Revised in 2005
  to reduce LCC for prevention of corrosion

- Contents of the revised manual
  - Part 1: General
  - Part 2: Painting
  - Part 3: Weathering steels
  - Part 4: Hot dip galvanizing
  - Part 5: Metal spray

Corrosion of girder end

Corroded area was cut and replaced with new steel members.

Corrosion of inside of box girder

Corrosion by stagnant water

Accumulation of dropping of birds

Current research theme

■Repair method for prevention system of corrosion (New material Team)

・Repair methods for
-corroded weathering steel bridges,
-hot dip galvanized bridges,
-metal sprayed bridges

■Retrofit method of severe corrosion at girder ends of steel bridge (Bridge Team)

・Selection of repair methods
・Effectiveness of repair method by bolted connection plate for corrosion members

Damage of reinforced concrete deck

Transverse direction crack

Cracks in a grid pattern

Falling of concrete portions

Damage of road surface

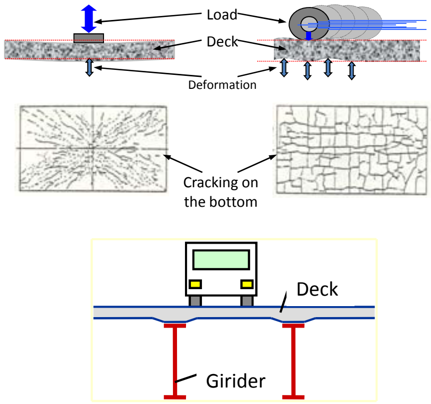
Fatigue of concrete deck

- Concrete deck is subjected to traffic load
  - ⇒Cracks, Dropping of concrete portion

・Improvement of durability
(Revision of design code several times)
・Increase of thickness
・Increase of design moment
・Increase of amount of rebars
・Waterproofing of deck surface,　etc.

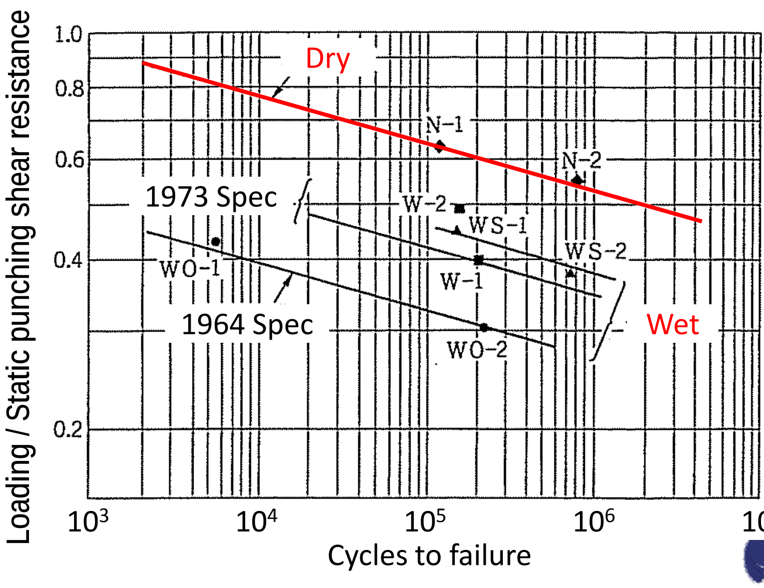
・Fatigue Evaluation by wheel running test

Wheel Running Machine



Major Research Issues:
- To establish evaluation method for durability of concrete decks
- To evaluate effectiveness of repair methods for concrete decks
- To evaluate durability of newly developed bridge decks

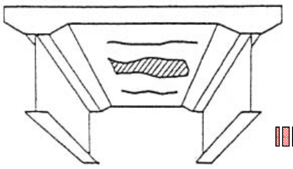
S-N curve by wheel running test



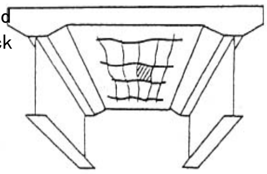
Provided by Prof S. Matsui et al., Osaka

Deterioration process of RC deck

①Initial cracks due to shrinkage causes tranvese cracks



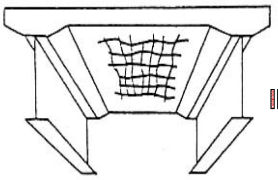
②Formation of grid cracks due to truck wheel loading



⇒Improvement of flexure
CFRP Sheet bonding,
Steel plate bonding, etc.

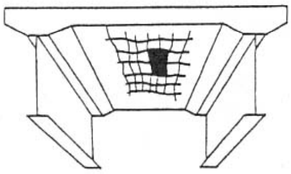
③Increase of grid crack density. Occurrence of penetrating cracks (Water leak and free lime)

④Decrease of punching shear strength



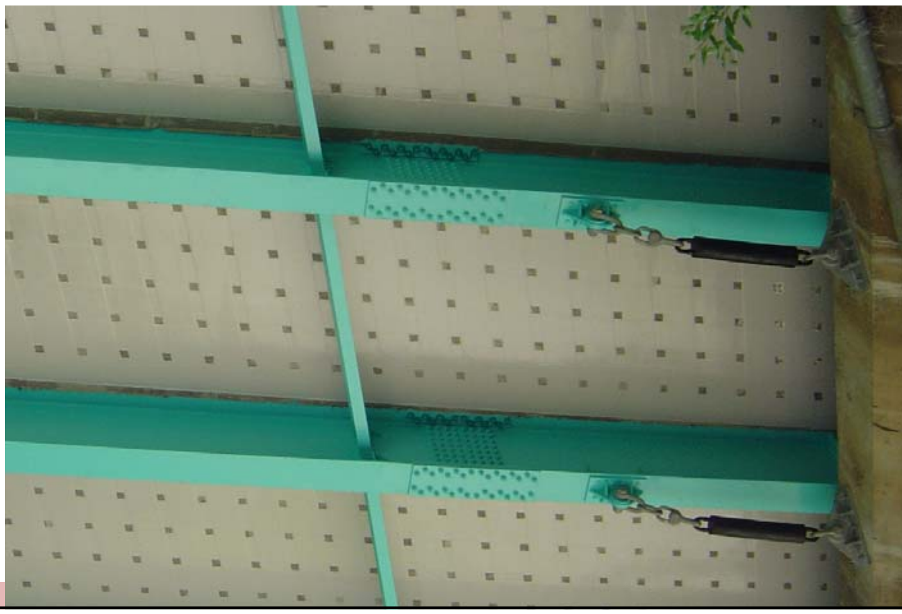
⇒Improvement of shear resistance
Increase of thickness of deck from upper and/or lower side, etc.

⑤Punching shear failure (concrete dropping)



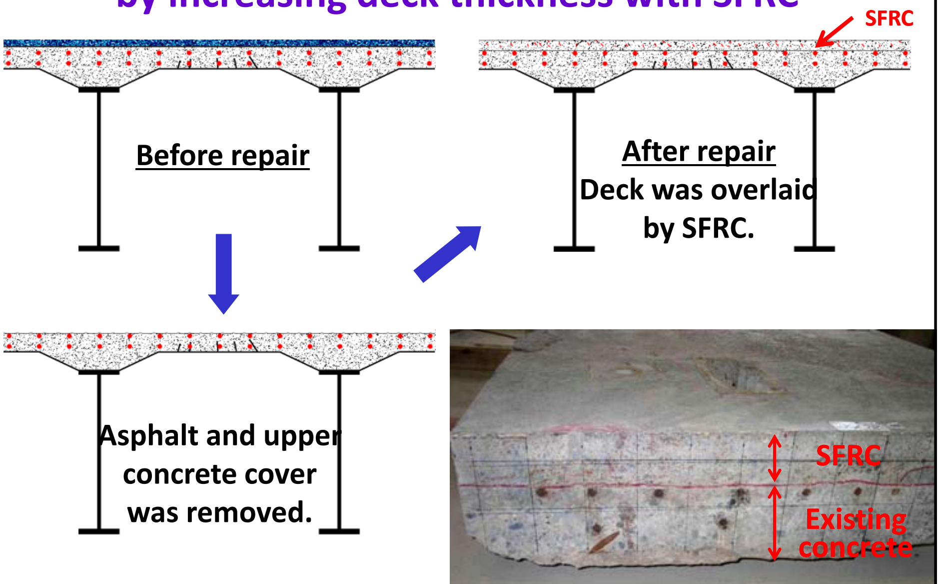
⇒Reconstruction

Bridge deck strengthened by CF sheets



Bridge deck strengthened by increasing deck thickness with SFRC

Bridge deck strengthened by increasing deck thickness with SFRC



Replacing concrete deck by using steel forms

Fatigue of steel bridge

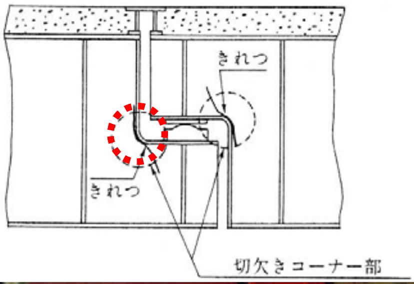
<u>Major factors of fatigue damage</u>

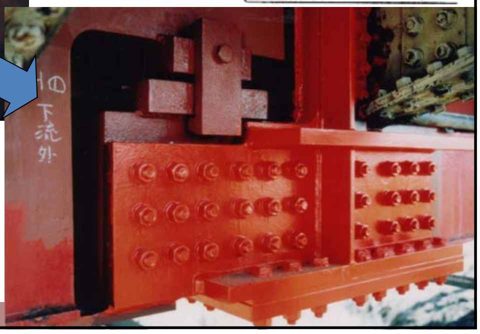
- Heavy truck traffic

- Design
  - -Improper structural detail (Low fatigue resistance)
  - -Secondary stress (Analytical model vs. Actual bridge)

- Fabrication
  - -Welding quality, welding defects

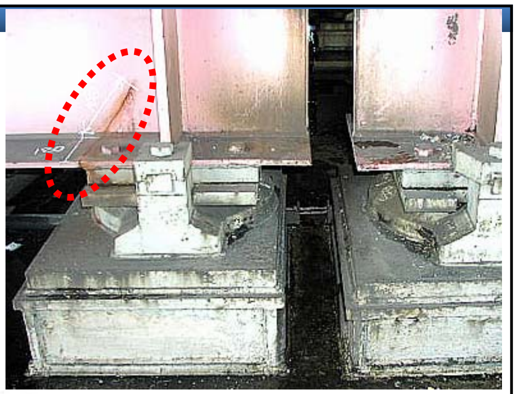
Fatigue crack at hinges of cantilever through truss

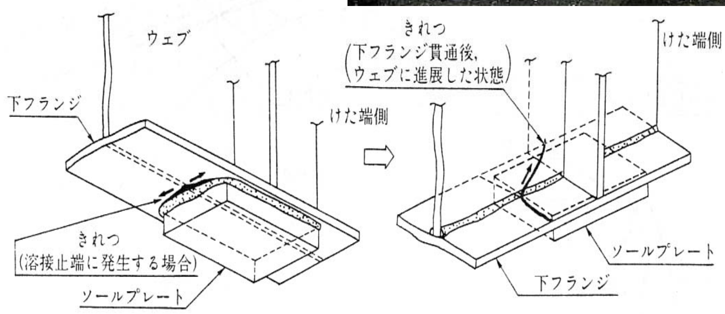




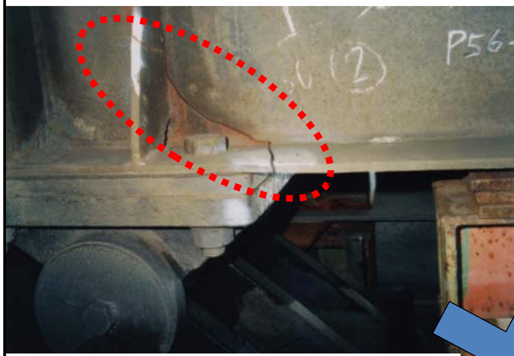
Strengthened by bolted stiffened steel member

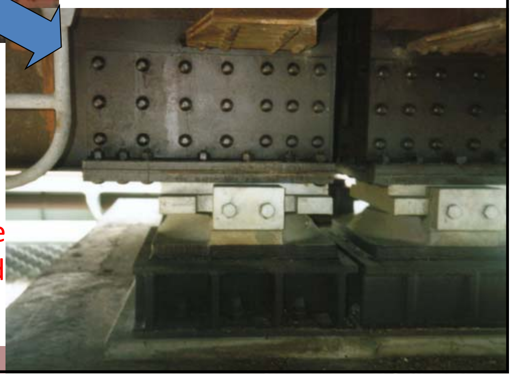
Fatigue crack at weld of sole plate





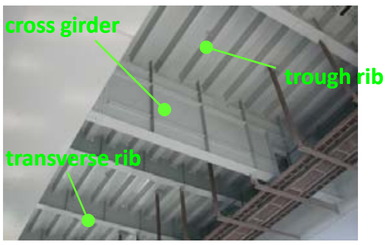
Fatigue crack at weld of sole plate





- Replace bearing
- Replace with extended sole plate
- Strengthened by bolted stiffened steel member

Fatigue cracks of orthotropic steel deck



Welded thin(12mm) deck plate

Direct wheel load

↓

Complicated plate bending
Stress concentration

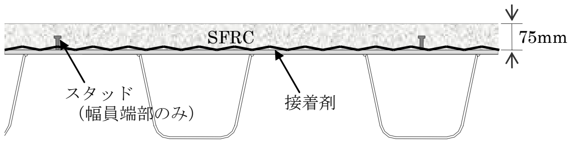
↓

Fatigue damage

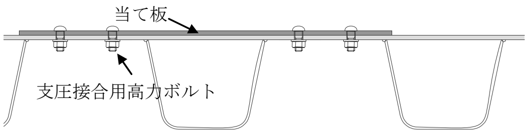
Current Research Theme

- **Retrofit method for fatigue damage of existing orthotropic steel deck**

Replacement of asphalt pavement with SFRC



Reinforcement by bolted splice plate



9. Lecture
"Efficient maintenance of pavements and tunnels"

Mr. Kazuyuki KUBO
Mr. Katsunori KADOYU

Efficient maintenance of pavements and tunnels

Kazuyuki Kubo

Senior Researcher, Pavement Research Team, PWRI

Nobuharu Isago

Senior Researcher, Tunnel Research Team, PWRI

PART I :Pavement Maintenance and Management in Japan

Kazuyuki Kubo

Topics

1. Present Status of Roads in Japan

2. Pavement Management Practices in Japan

   1) Outline of Pavement Management

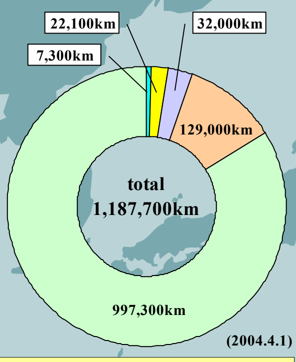
   2) Pavement Monitoring

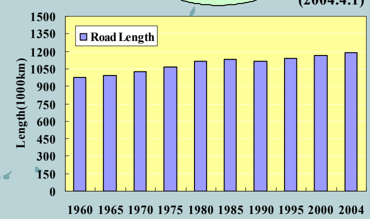
   3) Pavement Management System (MLIT)

   4) Guideline for Pavement Repair (MLIT)

1. Present Status of Roads in Japan

Road Networks





Motorway ①

National Roads ②
(Managed by MLIT)

National Roads ③
(Managed by Pref. etc)

Prefectural Roads ④

Municipal Roads ⑤

① (②)

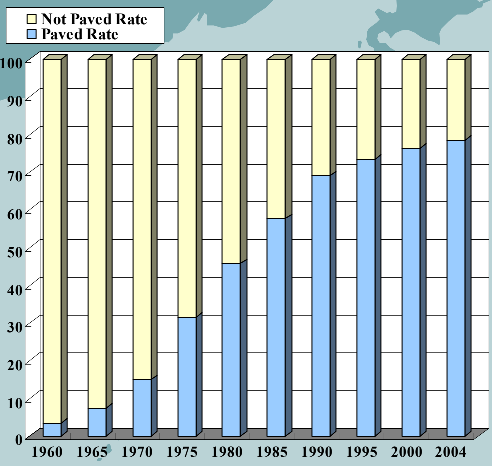
② ③ ④ (⑤)

② ③ ④ ⑤

(③) ④ ⑤

1. Present Status of Roads in Japan

Paved Rate



Paved Rate

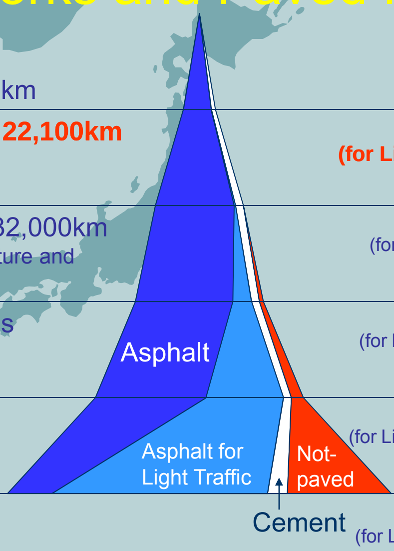
Not Paved Rate

1. Present Status of Roads in Japan

Road Networks and Paved Roads

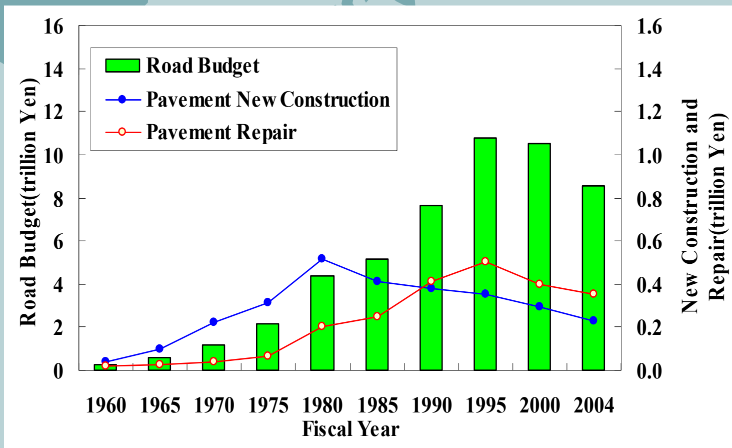
(2004.4.1)

Motorway 7,300km	Asphalt 6,800km Cement 500km
National Roads 22,100km (Managed by MLIT)	**Asphalt 21,000km** **(for Light Traffic 400km)** **Cement 1,100km**
National Roads 32,000km （Managed by Prefecture and Metropolitan Cities）	Asphalt 30,600km (for Light Traffic 4,700km) Cement 1,000km Not-paved 400km
Prefectural Roads 129,000km	Asphalt 122,200km (for Light Traffic 47,600km) Cement 1,700km Not-paved 5,100km
Municipal Roads 997,300km	Asphalt 698,000km (for Light Traffic 573,500km) Cement 50,800km Not-paved 248,500km
Total 1,187,700km	Asphalt 878,600km (for Light Traffic 626,200km) Cement 55,100km Not-paved 254,000km



1. Present Status of Roads in Japan

Road and Pavement Budget



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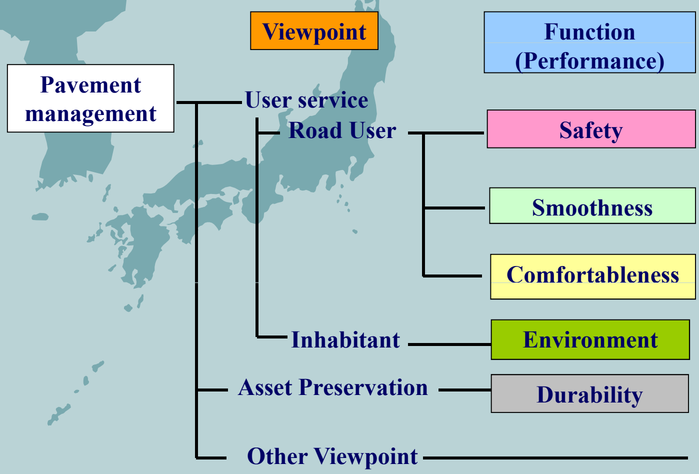
2. 1) Outline of Pavement Management

Pavement Management for expected Pavement Performance (1)



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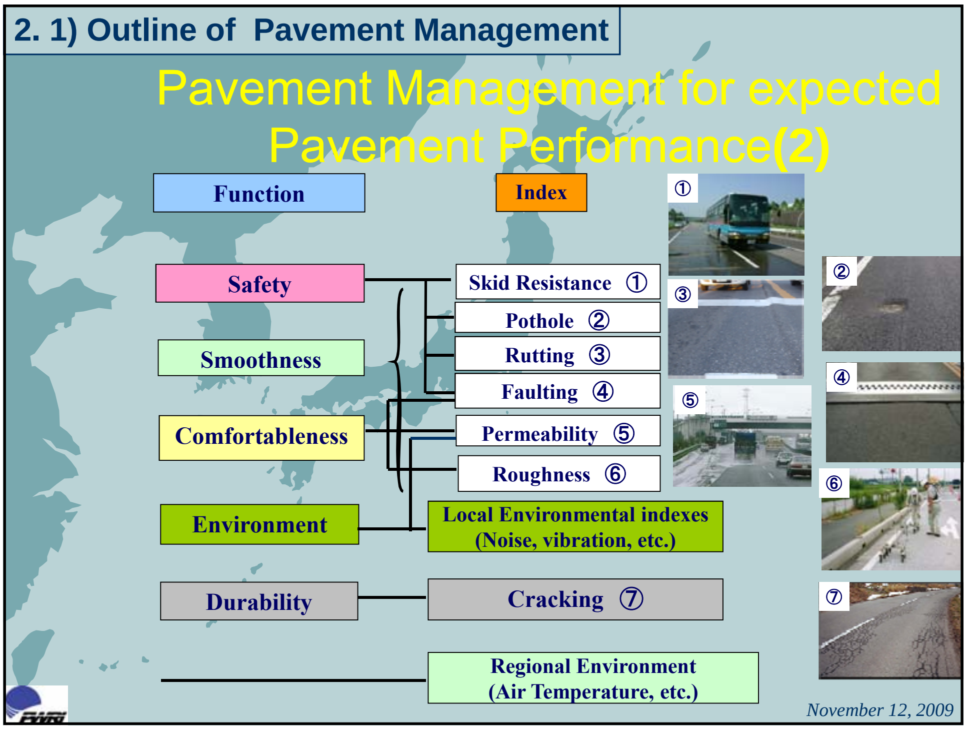
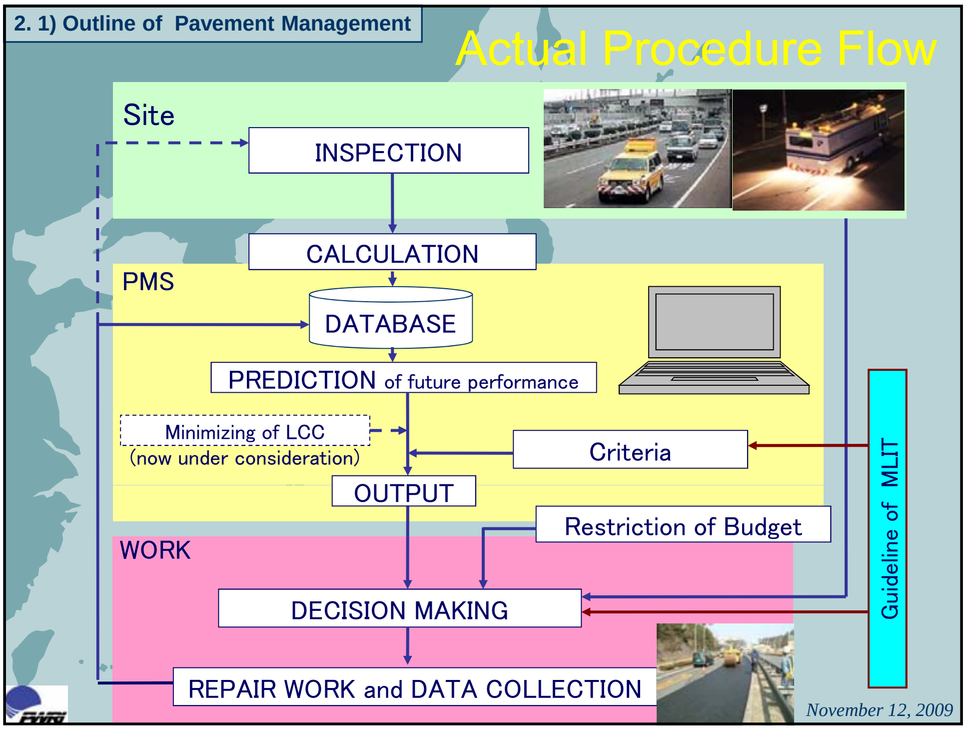

2. 1) Outline of Pavement Management
Pavement Management for expected
Pavement Performance(2)
Function
Index
Safety
Smoothness
Comfortableness
Environment
Durability
Skid Resistance ①
Pothole ②
Rutting ③
Faulting ④
Permeability ⑤
Roughness ⑥
Local Environmental indexes
(Noise, vibration, etc.)
Cracking ⑦
Regional Environment
(Air Temperature, etc.)
①
②
③
④
⑤
⑥
⑦
November 12, 2009

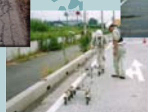

2. 1) Outline of Pavement Management
Actual Procedure Flow
Site
INSPECTION
CALCULATION
PMS
DATABASE
PREDICTION of future performance
Minimizing of LCC
(now under consideration)
Criteria
OUTPUT
Restriction of Budget
WORK
DECISION MAKING
REPAIR WORK and DATA COLLECTION
Guideline of MLIT
November 12, 2009

2. 2) Pavement Monitoring

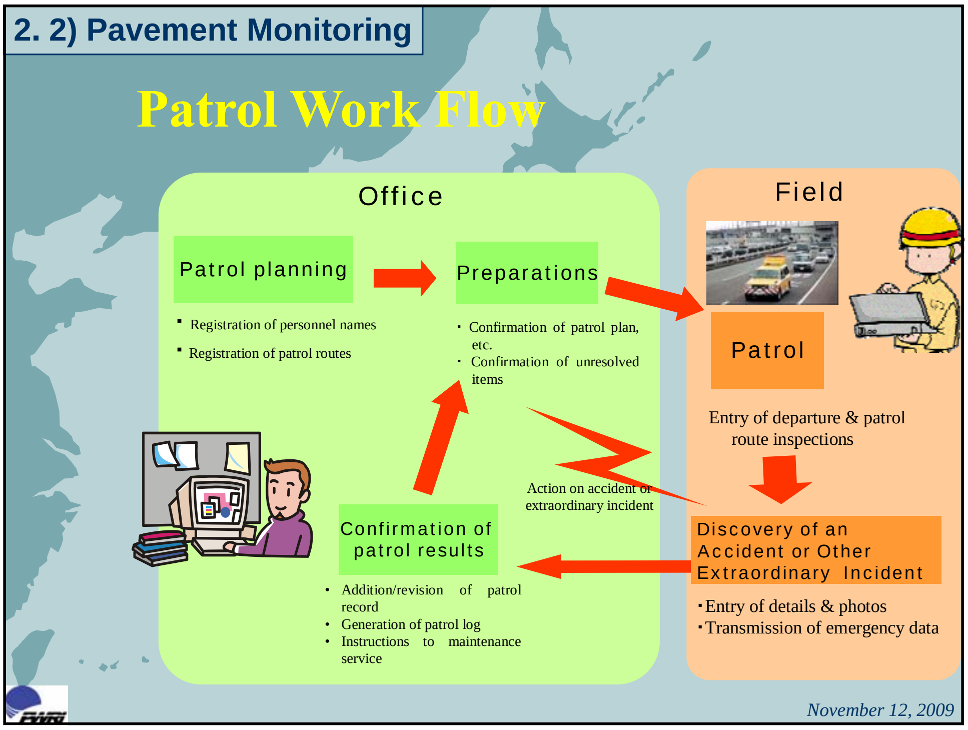
- **Daily** → Patrol (generally using patrol car)
- **Annual** → Measuring of Road Surface Condition (by road surface measuring vehicle)
- **Detail** → Detailed measuring of road surface condition, Core test etc

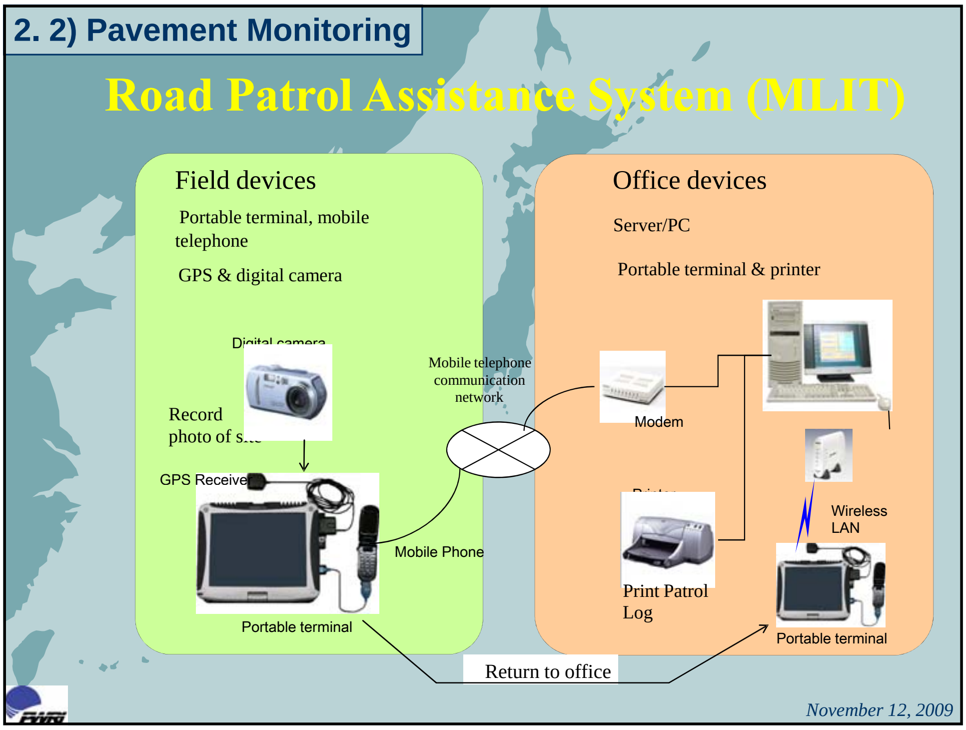
2. 2) Pavement Monitoring

Implementation for monitoring



INDEX	Rutting	Cracking	Roughness	Skid Resistance	Faulting	Pothole Diameter
In case of National Highways (MILT)	Annual Measurement			Daily Patrol		


2. 2) Pavement Monitoring
Patrol Work Flow
Office
Patrol planning
Registration of personnel names
Registration of patrol routes
Preparations
Confirmation of patrol plan, etc.
Confirmation of unresolved items
Confirmation of patrol results
Addition/revision of patrol record
Generation of patrol log
Instructions to maintenance service
Action on accident or extraordinary incident
Field
Patrol
Entry of departure & patrol route inspections
Discovery of an Accident or Other Extraordinary Incident
・Entry of details & photos
・Transmission of emergency data
November 12, 2009


2. 2) Pavement Monitoring
Road Patrol Assistance System (MLIT)
Field devices
Portable terminal, mobile telephone
GPS & digital camera
Digital camera
Record
photo of
GPS Receive
Mobile Phone
Portable terminal
Mobile telephone communication network
Office devices
Server/PC
Portable terminal & printer
Modem
Wireless LAN
Print Patrol Log
Portable terminal
Return to office
November 12, 2009

2. 2) Pavement Monitoring

< Annual Measurement >

- Total length (managed by MLIT)
  about 22,000km

- Monitoring length (Annually Implemented)
  about 7,300km/ a year
  → whole network is measured every 3 year

- Road Surface Measuring Devices
  Items Measured
  *Cracking Ratio
  *Rutting Depth
  *Roughness

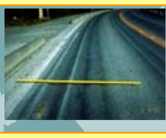
2. 2) Pavement Monitoring

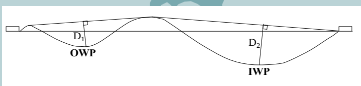
■ Road Surface Measuring Device (1)

2. 2) Pavement Monitoring

Measured Data

Rutting ⇒ Rutting Depth (D)





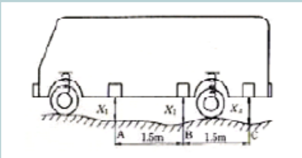
$D=\max(D_1 , D_2)$

Cracking ⇒ Cracking Ratio (C)

$$C = \frac{\text{Cracking area } (m^2)}{\text{Section area } (m^2)} \times 100$$

Calculation method of cracking area is defined by Manual for Pavement Testing Method (Japan Road Association)

Roughness ⇒ σ



$\sigma = \sqrt{\{\Sigma d^2 - (\Sigma d)^2/n\}/(n-1)}$

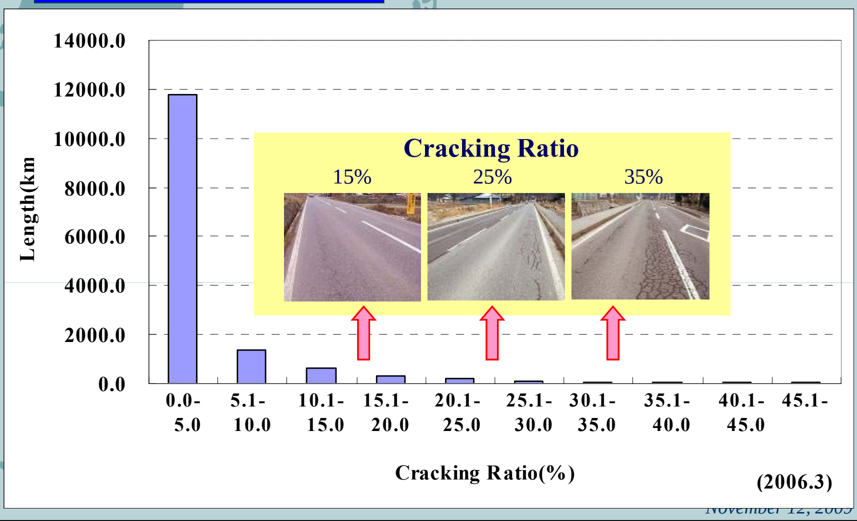
$d = (X_1 + X_3)/2 - X_2$

n = number of data

2. 2) Pavement Monitoring

Pavement Condition in National Roads

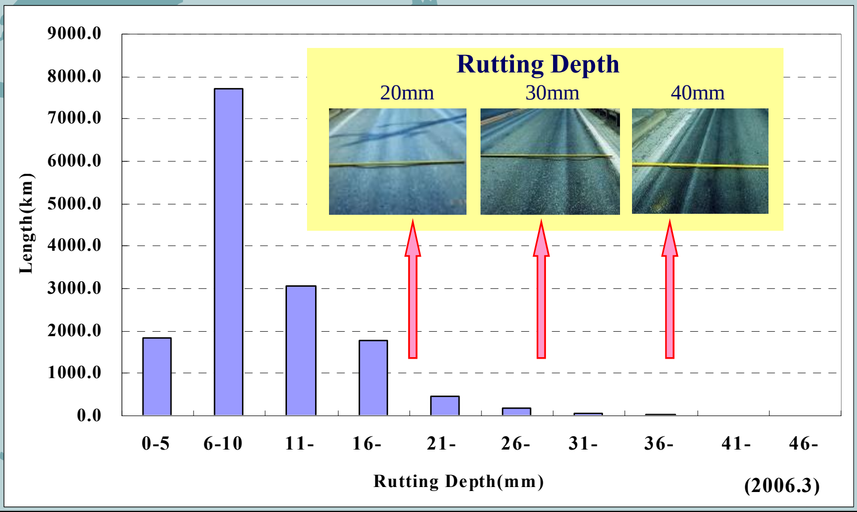
1. Cracking Ratio



2. 2) Pavement Monitoring

Pavement Condition in National Roads

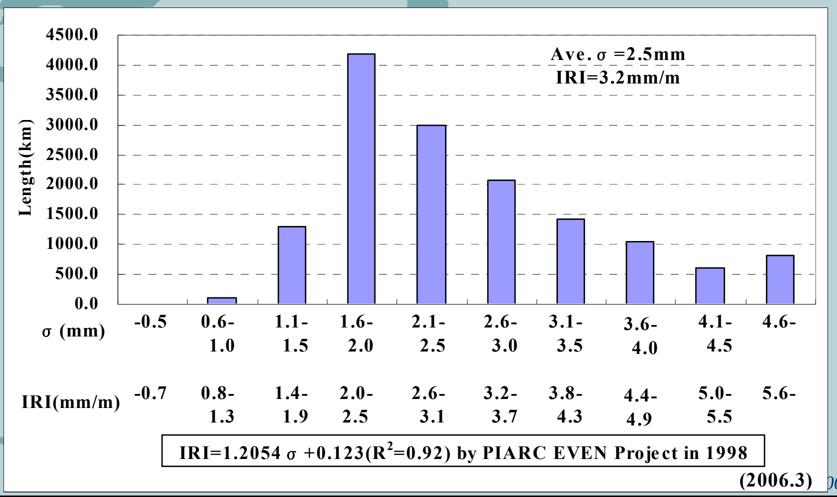
2. Rutting Depth



2. 2) Pavement Monitoring

Pavement Condition in National Roads

3. Roughness



2. 3) Pavement Management System (PMS)

Brief History of Development

I. INTRODUCTION(1979-83)
- Started feasibility study on implementing the PMS
- Established and Operated Pavement Database System

II. DEVELOPMENT(1985-87)
- Established PMS
- Development monitoring devices

III. ENHANCEMENT(1995-)

Main System(1995)
- operated by host-computer at each regional bureau

PC System(1998)
- to operate easily at national highway offices

WEB System(2002)
- to unify with other road management system

2. 3) Pavement Management System (PMS)

Flow of MLIT-PMS

Monitored data
(by road surface
Measuring Device)
Surface Condition

Data Base

Road Inventory
Construction History
etc.

Short-Term Strategic
Planning System

Prioritization
Project Selection
Construction Method Selection

Long-Term Strategic
Planning System

Prediction for long-term performance
Effect of investigation

2. 3) Pavement Management System (PMS)

Input Data(1)

1. Road Management

   Local Office, Branch Office, Kilo post, etc.

2. Road Structure

   Traffic Lane, Width, Cross Point, Median, Sidewalk, etc.

3. Roadside Condition

   Climate (freeze/non-freeze), District Classification (DID, city, flat land, mountain)

4. Traffic Condition

2. 3) Pavement Management System (PMS)

Input Data(2)

5. Pavement Condition

   Surface conditions (C, D, s), Shape of Rutting

   (Skid Resistance, Permeability, Road Noise, Deflection)

6. Pavement Design

   Load classification by heavy traffic volume, Design CBR

7. Pavement Construction

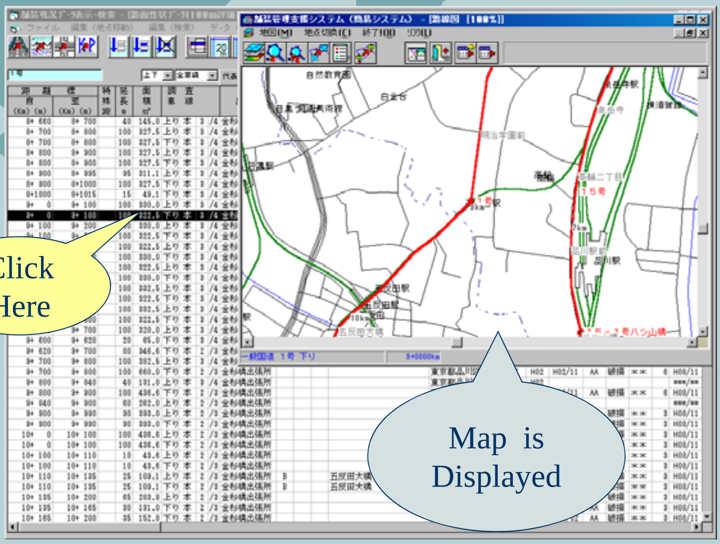
   Year and month conducted in,

   Type of pavement, Material, Thickness, etc.

2. 3) Pavement Management System (PMS)

Map Display

data unit : ～100m



Click Here

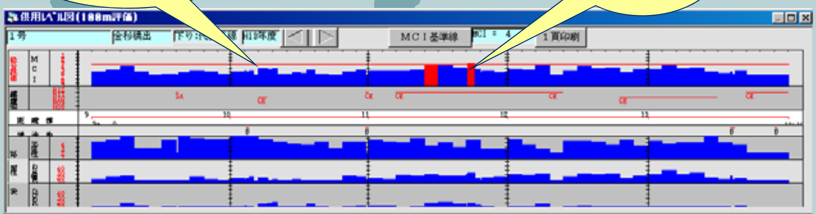
Map is Displayed

2. 3) Pavement Management System (PMS)

Service Level

Criteria

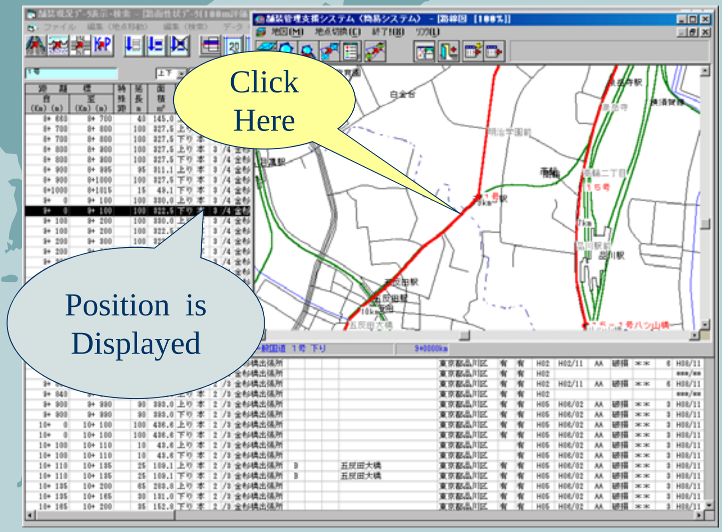
Alert



Display MCI(=distress level of each pavement), Cracking Ratio, Rutting Depth, and Roughness

2. 3) Pavement Management System (PMS)

Map Display



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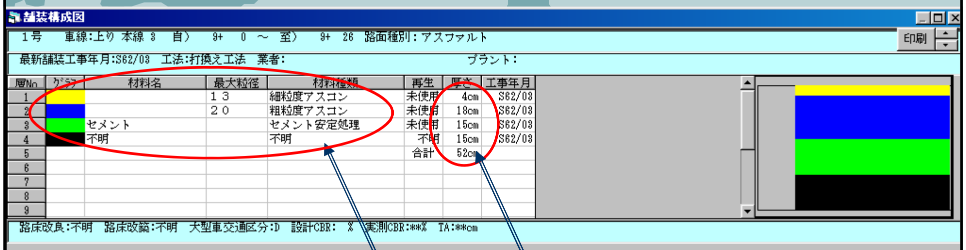
2. 3) Pavement Management System (PMS)

Detailed data for repair work
-Present Pavement Structure-



Materials, Thickness,
(at construction/repair work)

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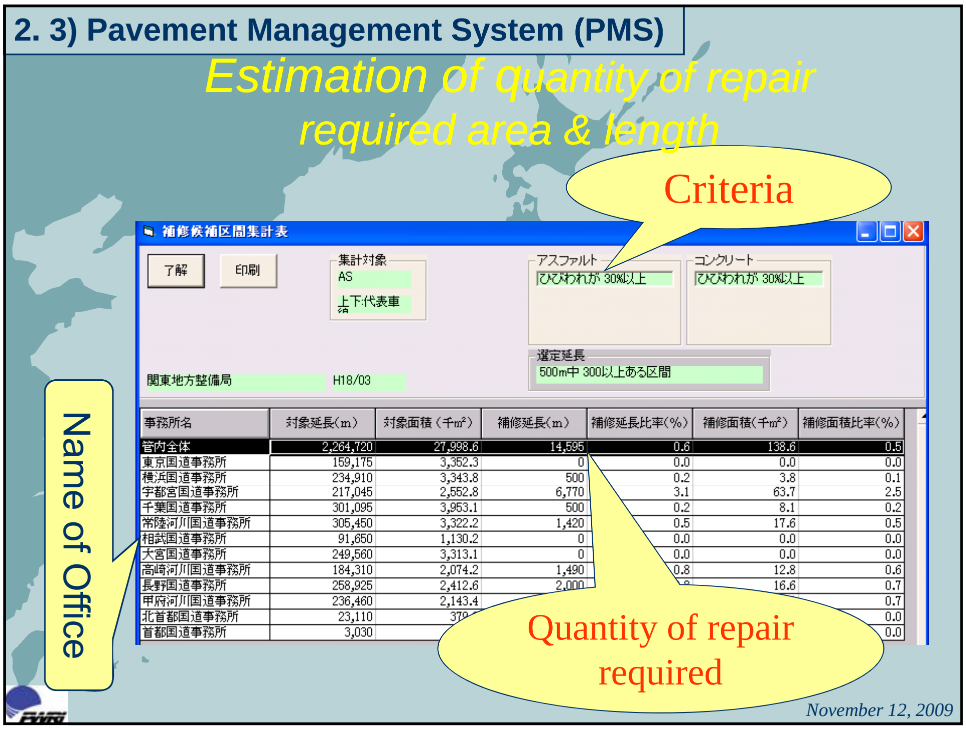
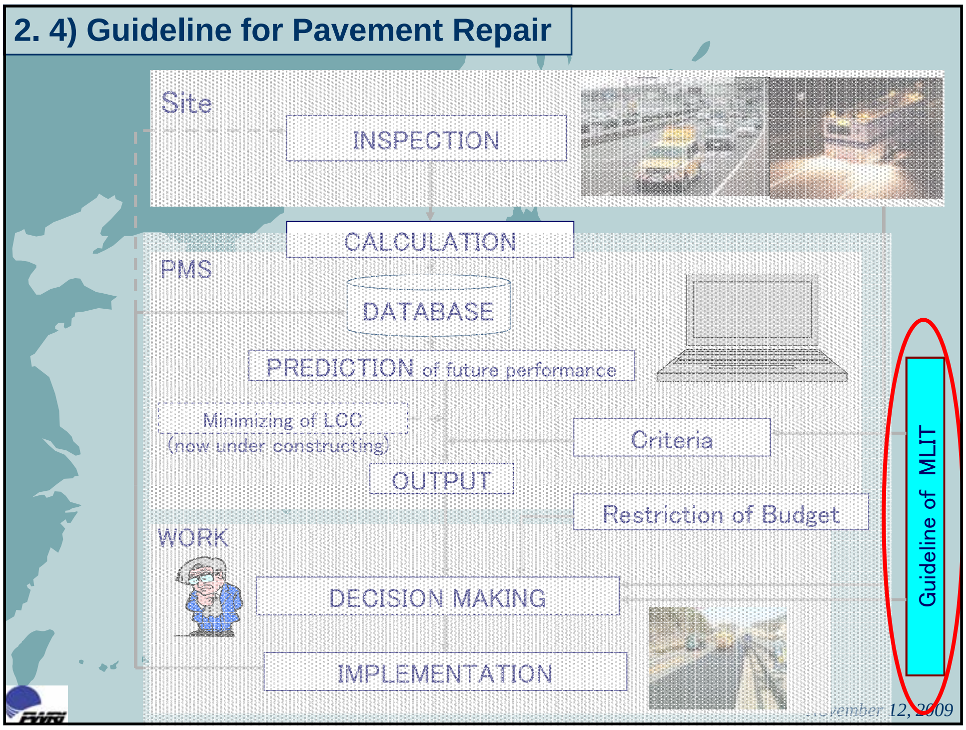
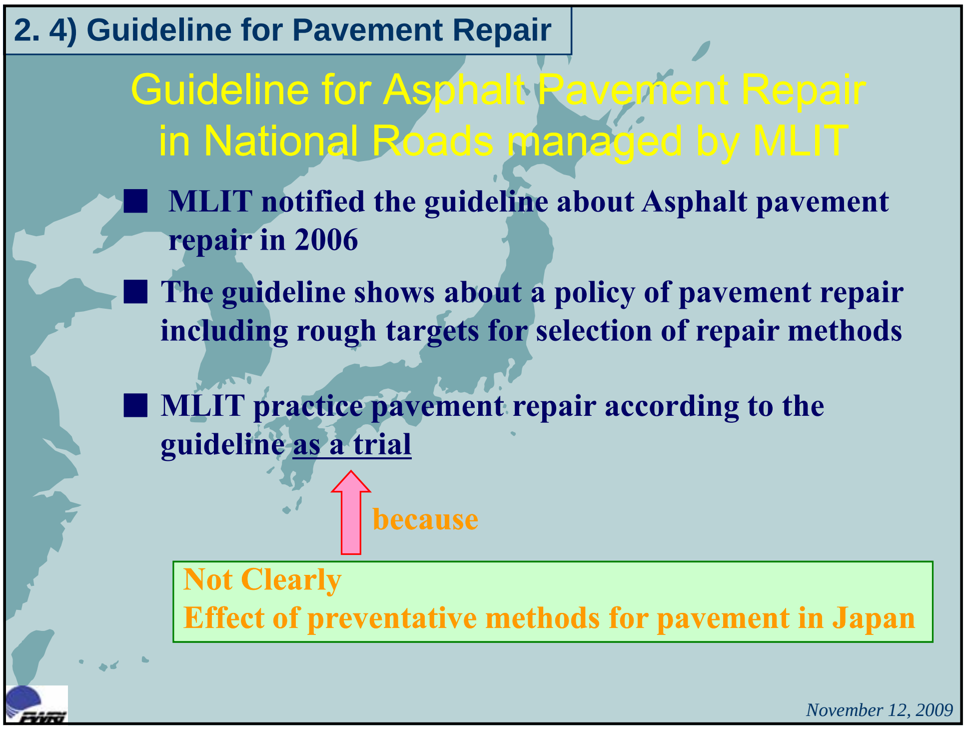
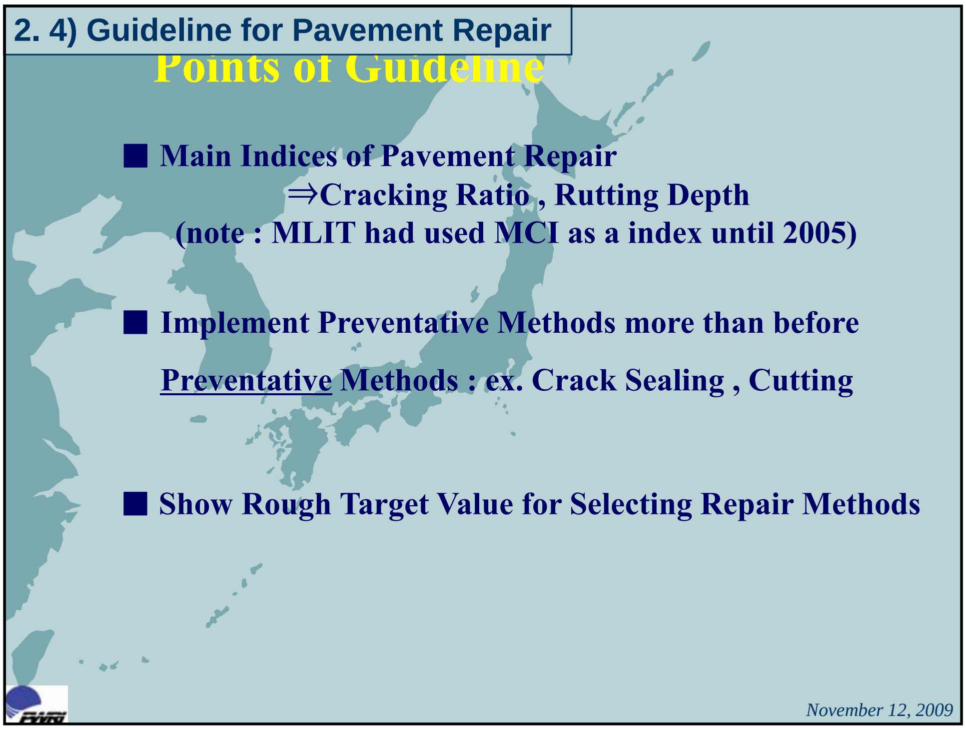


事務所名	対象延長(m)	対象面積(千m²)	補修延長(m)	補修延長比率(%)	補修面積(千m²)	補修面積比率(%)
管内全体	2,264,720	27,998.6	14,595	0.6	138.6	0.5
東京国道事務所	159,175	3,352.3	0	0.0	0.0	0.0
横浜国道事務所	234,910	3,343.8	500	0.2	3.8	0.1
宇都宮国道事務所	217,045	2,552.8	6,770	3.1	63.7	2.5
千葉国道事務所	301,095	3,953.1	500	0.2	8.1	0.2
常陸河川国道事務所	305,450	3,322.2	1,420	0.5	17.6	0.5
相武国道事務所	91,650	1,130.2	0	0.0	0.0	0.0
大宮国道事務所	249,560	3,313.1	0	0.0	0.0	0.0
高崎河川国道事務所	184,310	2,074.2	1,490	0.8	12.8	0.6
長野国道事務所	258,925	2,412.6	2,000	[illegible]	16.6	0.7
甲府河川国道事務所	236,460	2,143.4	[illegible]	[illegible]	[illegible]	0.7
北首都国道事務所	23,110	[illegible]	[illegible]	[illegible]	[illegible]	0.0
首都国道事務所	3,030	[illegible]	[illegible]	[illegible]	[illegible]	0.0




2. 4) Guideline for Pavement Repair
Guideline for Asphalt Pavement Repair
in National Roads managed by MLIT
■ MLIT notified the guideline about Asphalt pavement repair in 2006
■ The guideline shows about a policy of pavement repair including rough targets for selection of repair methods
■ MLIT practice pavement repair according to the guideline as a trial
because
Not Clearly
Effect of preventative methods for pavement in Japan
November 12, 2009


2. 4) Guideline for Pavement Repair
Points of Guideline
■ Main Indices of Pavement Repair
⇒Cracking Ratio , Rutting Depth
(note : MLIT had used MCI as a index until 2005)
■ Implement Preventative Methods more than before
Preventative Methods : ex. Crack Sealing , Cutting
■ Show Rough Target Value for Selecting Repair Methods
November 12, 2009

2. 4) Guideline for Pavement Repair

< Reference >

Concept is very close to PSI in USA

MCI (Maintenance Control Index)

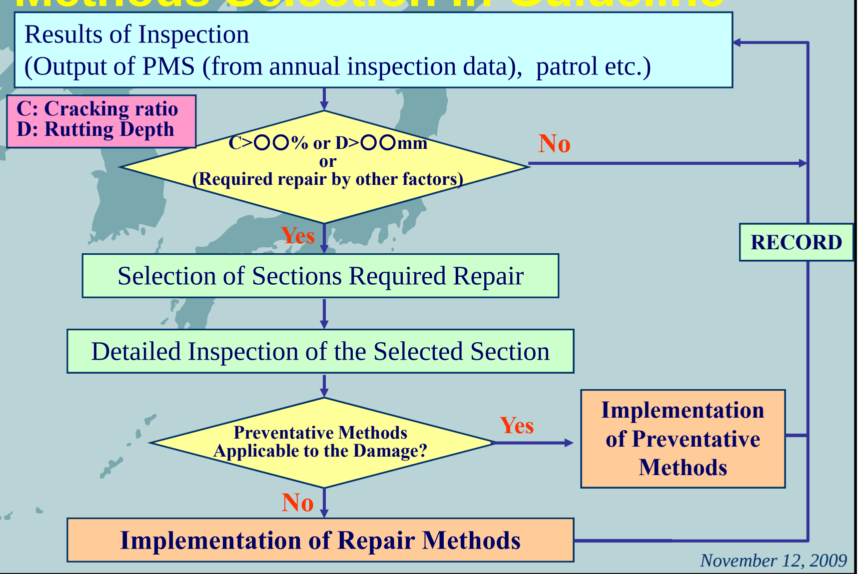
$$MCI=10 - 1.48C^{0.3} - 0.29D^{0.7} - 0.47\sigma^{0.2}$$

C: Cracking Ratio (%)
D: Rutting Depth (mm)
σ: Roughness (mm)

- Fullmark=10points
- MCI had been used by MLIT as a Index of the pavement management until 2005.
- At present , MLIT uses Cracking Ratio and Rutting Depth as the important Indices for judgment of repair pavement.

2. 4) Guideline for Pavement Repair

Basic Flow of Pavement Repair Methods Selection in Guideline



2. 4) Guideline for Pavement Repair

Preventative methods
(ex. Crack Sealing)

Repair methods
(ex. Cut and Overlay)

2. 4) Guideline for Pavement Repair

Rough Target (Selection of Method)

Rutting Depth / Craking Ratio	0mm-10mm	10mm-20mm	20mm-30mm	30mm-40mm	35mm-40mm	40mm-
0%-10%				cutting		
10%-20%						
20%-30%						
30%-35%	Crack sealing		Crack sealing + cutting			
35%-40%						
40%-				repair method(cut and overlay,etc)		

Preventative methods

Notice : The guideline shows these rough targets

but the guideline also says “technical judgment of engineer is important for selecting repair method properly”.

2. 4) Guideline for Pavement Repair

Example picture of Rutting

Repair Method Applicable section

Preventative Method Applicable section

2. 4) Guideline for Pavement Repair

Example picture of Cracking

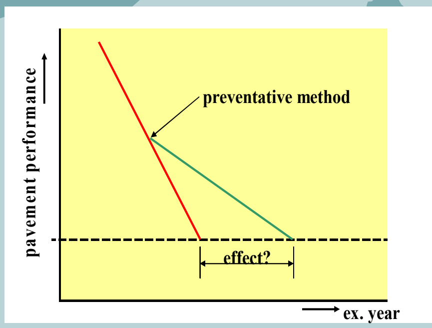
Repair Method Applicable section

Preventative Method Applicable section (after implementation)

2. 4) Guideline for Pavement Repair

Review of Guideline

- MLIT and PWRI will analysis trial results according to the guideline



duration of material performance?

- In future , MLIT will review the guideline if necessary

Thank you for your attention !

PART II :Efficient maintenance for tunnel in Japan

Nobuharu Isago

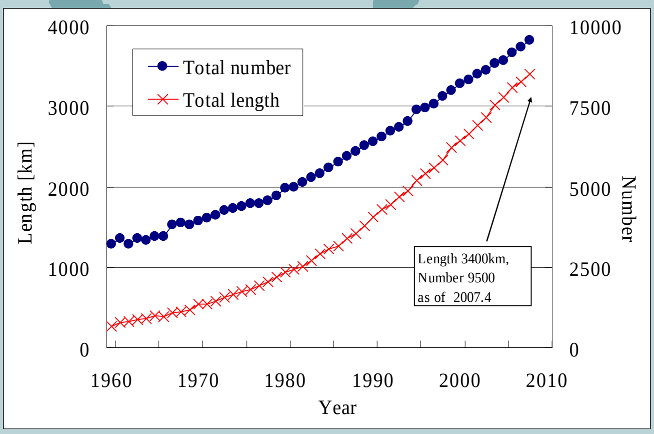
Today's Agenda

- Tunnel in Japan
- Defect of tunnel
- Inspection and survey
- Countermeasure for tunnel defects
- Future prospects

1. Tunnel in Japan

1.1 Number and length of road tunnel in Japan

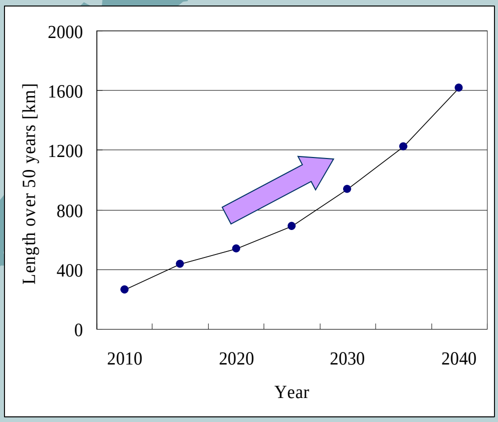
- Road tunnels in Japan have increased every year
- Some of them were completed more than 50 years ago



1.2 Aged tunnel will increase

- **Tunnels with defects due to material deterioration etc. have increased**

Efficient maintenance is required



Prediction of tunnel length over 50 years

2. Defect of tunnel

2.1 Example of tunnel defects

Crack on lining

Crack on portal

Heaving of road surface

Deformed ditch in roadside

Bump on sidewall

Leakage

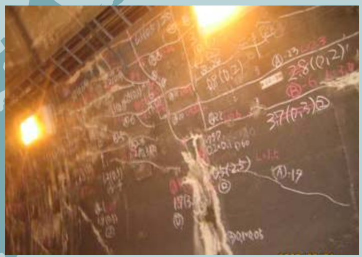
2.2 Cause of tunnel defects

- **By external load**
  - **Loosened earth pressure**
  - **Swelling and squeezing**
  - **Partial earth pressure**
  - **Landslide**
  - **Shortage of bearing capacity**
  - **Water pressure**
  - **Frost heaving**
  - **Earthquake**
- **By material, construction condition**
  - **Aged deterioration**
  - **Shrinkage by temperature or moisture**
  - **Cold joint**
  - **Honeycomb**
  - **Poor workmanship with bad formwork, shortage of concrete curing**
  - **Rebar corrosion**

Overall collapse of structure may be induced by the deformation through external load

2.3 Tunnel defects by external load

Earth pressure by swelling rock



Partial earth pressure

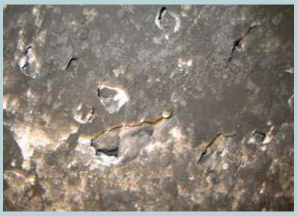
Landslide

Earthquake

2.4 Tunnel defects by material and construction condition

Shrinkage by temperature or moisture

Cold joint



Honeycomb

Crack by poor workmanship in setting form

Shortage of concrete casting

Alkali-aggregate reaction

3. Inspection and survey

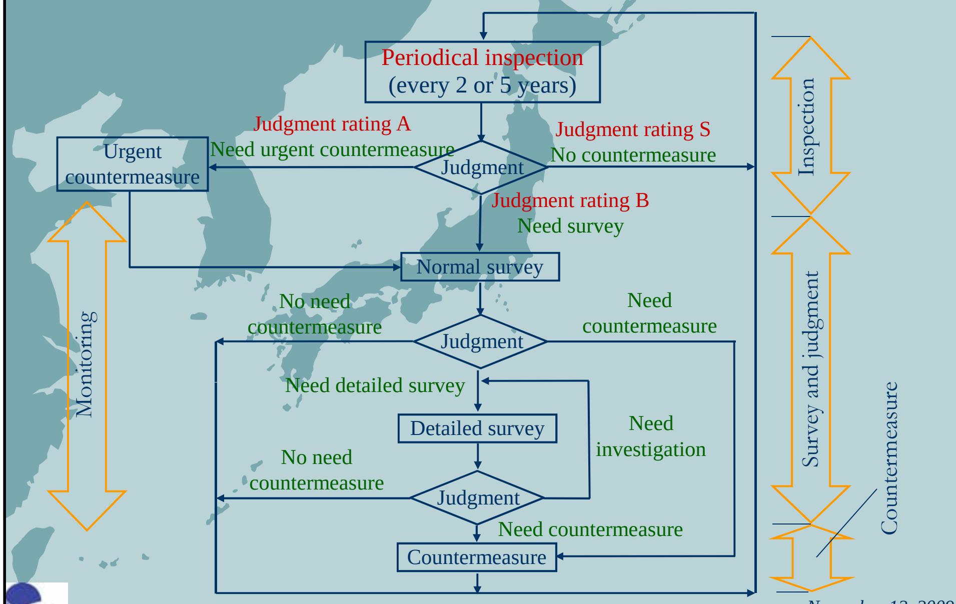
3.1 Execution of inspection and survey

Item checked	Method	Problems
Cracks	Visual check by walking or using a boom lift	A lane to be closed Time-consuming Difficulty to easily detect cracks high up such as on arches Suffering from subjectivity in recording the crack
Spalling of concrete lining	Hammer strike by workmen on boom lift	(Same as above)
Voids behind the lining and the thickness of the concrete	Vehicles equipped with electromagnetic-wave probes	Requiring sophisticated and specialized knowledge to interpret the results Not applicable when there are rebars and sections of high water content in the lining

3.2 Useful information to judge defects

- Cracks
  - Characteristics from such as compressive, shear or tensile
  - Location
  - Direction such as transverse, longitudinal, horizontal, vertical, diagonal
  - Development speed and degree of penetration
- Condition of tunnel
  - Construction method (eg. NATM or other method)
  - Geological and geographical condition
  - Shape, dimension and structure (eg. with/without invert)
  - Behavior during construction (eg. large deformation)
  - With/without structure near tunnel
  - Underground water

3.3 Flow of inspection and survey for road tunnels



3.4 Condition codes for soundness

Rating of tunnel soundness for inspection

Rating	Description
A	Seriously deformed. Urgent countermeasures are needed since users are at risk.
B	Deformed. Further inspection or survey is needed to examine the need of repair and rehabilitation.
S	Not deformed or slightly deformed.

Rating of tunnel soundness for normal/ detailed survey

Rating	Description
3A	Seriously deformed. Urgent countermeasures are needed since users are at risk.
2A	Deformed. Urgent countermeasures are needed since the defects may progress and endanger users.
A	Deformed. Close monitoring and systematic countermeasures are needed since the defects may endanger users in future.
B	Not deformed or slightly deformed. The deformation has no effect on users, but the tunnel needs to be monitored.

3.5 Problem for proper inspection and survey

- At the stage of inspection execution,
  - To collect the data of tunnel defects, rapidly and quantitatively
- At the stage of results evaluation from inspection,
  - To predict the cause of defects, whether by external load or by material.
  - To judge the current state and need of countermeasure
- At the stage of countermeasure decision,
  - To select proper countermeasure method in accordance with the cause
  - To ensure the safety of construction under traffic

4. Countermeasure ~ repair/rehabilitation ~ for tunnel defects

4.1 Example of countermeasure –minor degree-

Chipping

Section repair

Crack/joint injection

4.2 Example of countermeasure –moderate degree-


Wired mesh


Net


Steel panel


Fiber sheet panel

4.3 Example of countermeasure –severe degree-


Internal reinforcement
(Precast lining)


Internal reinforcement
(Steel arch support)

✓ **Effect, characteristics and adoption of each countermeasure method needs to be clarified.**

5. Future prospects

November 12, 2009

5. Future prospects

- Tunnels should be designed so as to reduce the life cycle cost.
- Tunnels should be constructed by strictly controlling the quality in order to prevent defects in future.
- Tunnels should be inspected, surveyed and evaluated, taking objective records of quantitative data and using consistent evaluation criteria.

In advance, attention should be paid that…..

- Technologies need to be developed
- Experts should be trained
- Various maintenance is needed not only for structure but also for facilities in tunnel

November 12, 2009

10. Lecture
“Risk Management Strategy in Privatization of Expressway Public Corporations in Japan”

Mr. Tsutomu MORIMOTO

RISK MANAGEMENT STRATEGY in PRIVATIZATION of EXPRESSWAY PUBLIC CORPORATIONS in JAPAN

November 12, 2009

MORIMOTO, Tsutomu
Japan Expressway Holding and Debt Repayment Agency

OVERVIEW

1. Privatization of Four Expressway Public Corporations
2. Risk Management Strategy
3. Recent Toll Discount Schemes

1. Privatization of Expressway Public Corporations

1-1 Background of Privatization

The debts piled up to over ¥40 trillion

The Repayment date had become later and later, finally drifted beyond 2050

Strong concern for the burden on the future generations

Demand to utilize wisdom and financial funds of private sector

Privatization of 4 Expwy Corporations in October 2005

1-2. Overview of the Privatization

3 Purposes

- To ensure repaying the interest-bearing debts of ¥40trillion
- To expedite construction of necessary roads with minimum cost while respecting companies' own decisions
- To provide various and flexible toll rates and services utilizing know-how of private companies

[Outline of Privatization]

Japan Highway Public Corporation | Metropolitan Expressway Public Corporation | Hanshin Expressway Public Corporation | Honshu-Shikoku Bridge Authority

Companies: Construction and management of expressways and collection of tolls

(To merge with West Nippon Expressway Co.,Ltd when business stabilizes)

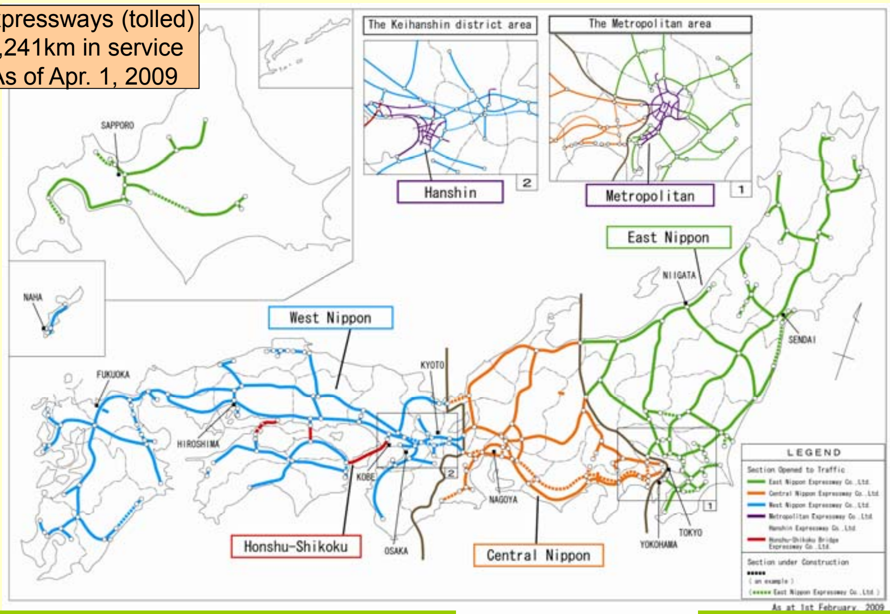
East Nippon Expressway Co., Ltd. | Central Nippon Expressway Co., Ltd | West Nippon Expressway Co., Ltd | Metropolitan Expressway Co., Ltd | Hanshin Expressway Co., Ltd | Honshu-Shikoku Bridge Expressway Co., Ltd

The Agency: Holding of expressways, repayment of debts

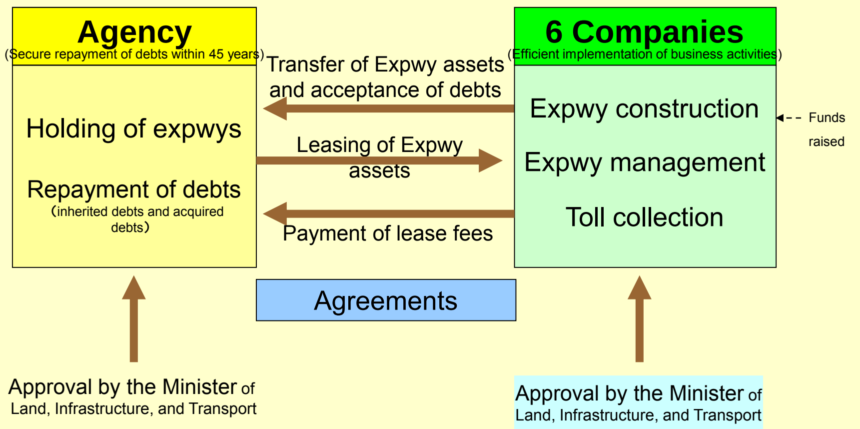
Japan Expressway Holding and Debt Repayment Agency (JEHDRA)

1-3 Expressway Network and 6 New Companies

Expressways (tolled)
9,241km in service
As of Apr. 1, 2009



1-4. Framework of Privatization



1-5. All Incomes and Expenditures

All Incomes and Expenditures
During the Agreement Term (2005 – 2050, 45yrs)

Incomes

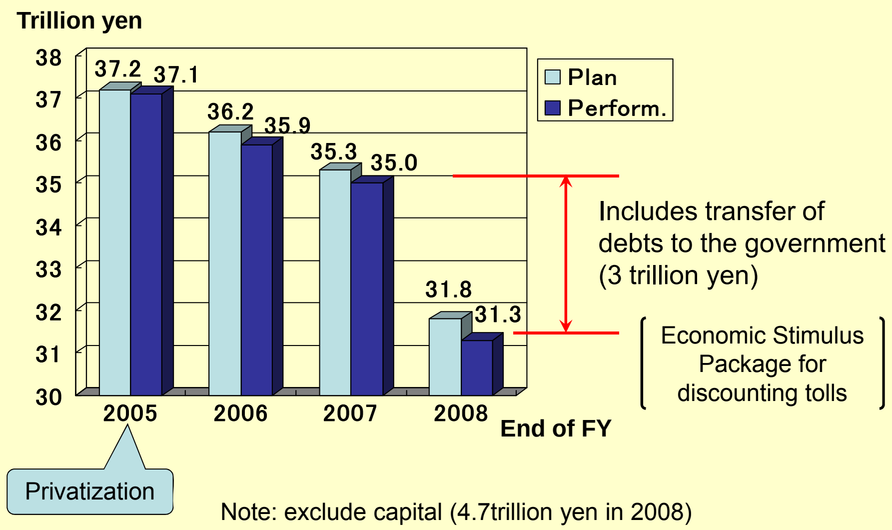
Total Revenue:	**128**

Expenditures

Construction and Renovation :	**13**
Repair Investment :	**8**
Maintenance :	**28**
Repayment of Debt :	**38**
Interest Payment :	**36**
Consumption Tax :	**4**
Total :	**128**

Unit: ¥ trillion

1-6. Trend of Debts, Plan & Performance



Note: exclude capital (4.7trillion yen in 2008)

1-7. Repayment of Debts in FY 2008

	Amount (tr. yen)
Debts, beginning of FY2008	**35.0**
Lease fee received	-1.9
Interest paid	+0.5
New debts received	+0.5
Subtotal	**34.3**
Transfer of Debts to the Gov't (Economic Stimulus Package)	-3.0
Debts, end of FY 2008	**31.3**

2. Risk Management Strategy

2-1 Existing Risks

OUR TASK

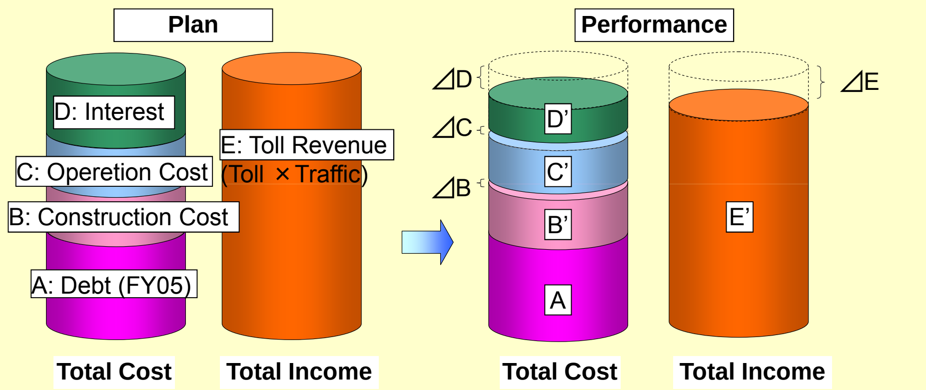
- The debt of 31 trillion yen (Beg. of FY2009) needs to be repaid by 2050
- The repayment plan is formulated in the agreements between JEHDRA & Expwy Companies, regarding toll rate, revenue, traffic, management cost, maintenance cost, construction cost, and interest

RISKS

Risks	Major Factors
Traffic Risk	Economic Situations
Interest Rate Risk	Economic Situations
Force Majeure Risks	Natural Disasters ---Earthquake

2-2 Against Traffic Risk

- Both the traffic volume (E) and the interest rates (D) are correlated with the economy, so the relations work like a risk mitigation function.
- When the agreements are revised because of the smaller volume of actual traffic (E'), the operation cost (C) and the construction cost (B) may have to be reviewed, if necessary.

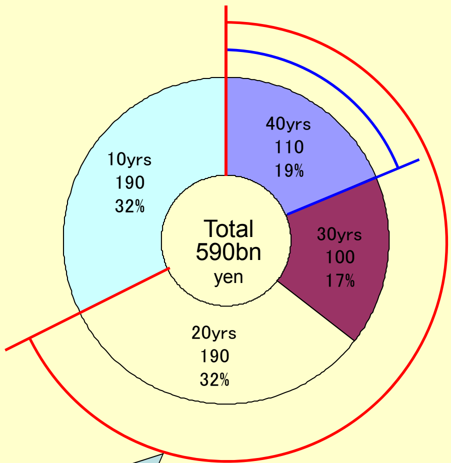


2-3 Against Interest Risk

To reduce the interest risk,

- JEHDRA issued 40-year fixed interest bonds in 2005, first in Japan.
- JEHDRA has been issuing long-term fixed interest bonds. (20-40 years)

In FY 2008, around 70% of all bonds are long-term bonds.



Total amount of bonds of no less than 20 years is 400 billion yen, or about 70% of FLIP Agency bonds.

2-4 Against Force Majeure Risk

〇Japan has many unexpected disasters such as earthquake.
⇒The Government supplies the funds to repair the damage.

・(Ex.) The Chuetsu Offshore Earthquake in July, 2007
Hokuriku Expressway was damaged in 330 locations along 95 km of the expressway
⇒JEHDRA and the East Nippon Expwy Co. received ¥8.5 billion to repair the damage.

3. Recent Toll Discounts Schemes

3-1 Background

- A criticism is increasing that higher toll rates compared with those in other countries causes higher freight costs.
- While some sections of toll-free highways are congested, parallel sections of tolled expressways provide free traffic flow, even during the same peak hours.

⇒ In May 2008, The government enacted a bill to use the national budget for **discounting tolls**.

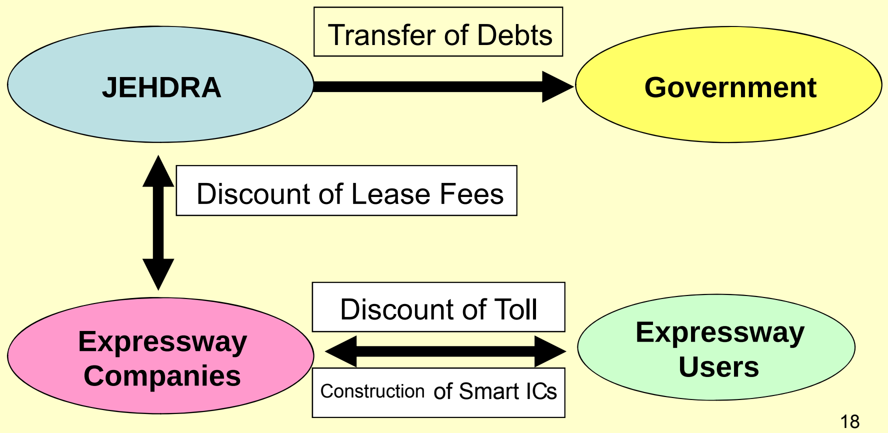
⇒ In October 2008, after the increase in oil prices and the world economic crisis, the government decided to introduce, as a part of the **economic stimulus package**, **large-scale toll discount**

3-2 Recent Toll Discount Scheme

①The Government accepts the JEHDRA's debts. (3 trillion yen)

②JEHDRA discounts the lease fees of the expwy companies.

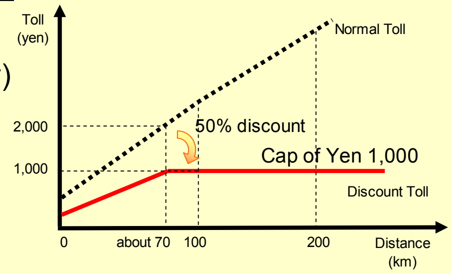
③The expressway companies discount equivalent tolls.



3-3 Major Toll Discount Rates

●**For Passenger Cars (weekends):**

➢Rural Area:
50% off, w/ cap 1,000 yen (all day)



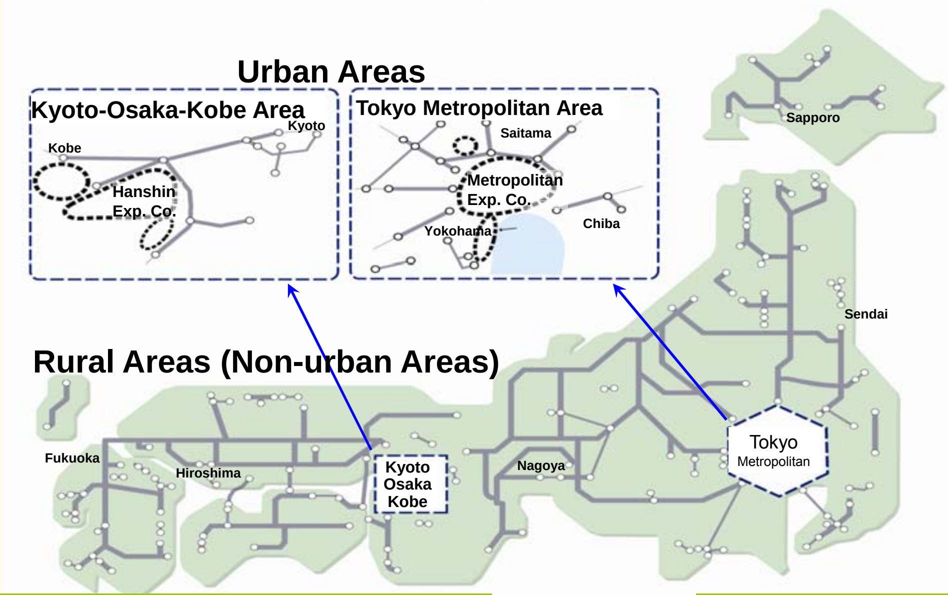
➢Urban Area: 50% off (10pm - 6am), 30% off (6am – 10pm)

●**For Trucks (weekdays)**

➢Rural Area: 50% off (0 -4am, 6 -9am, 5 -8pm),
30% off (4 -6am, 9am -5pm, 8 -10pm)

➢Urban Area: 50% off (10pm -6am)
30% off (8pm -10pm)

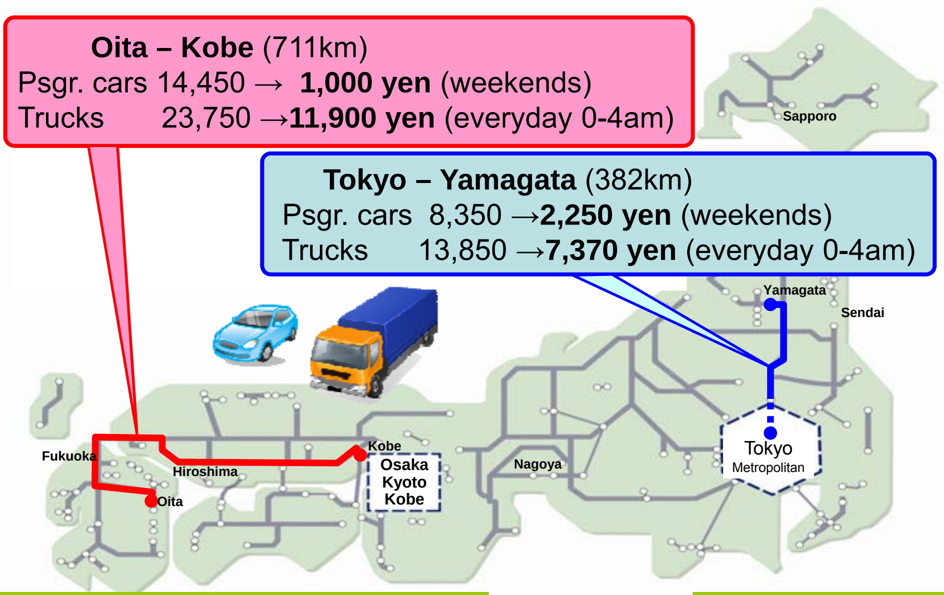
3-4 Toll Discount Area Category



3-5 Example of Discounted Tolls

Oita – Kobe (711km)
Psgr. cars 14,450 → **1,000 yen** (weekends)
Trucks 23,750 →**11,900 yen** (everyday 0-4am)

Tokyo – Yamagata (382km)
Psgr. cars 8,350 →**2,250 yen** (weekends)
Trucks 13,850 →**7,370 yen** (everyday 0-4am)



3-6 Some Results of Discounts

Average Daily Traffic Volume during Summer “Bon” Season (6-16, August)

At major 23 sections across Japan

2009	2008	Change
54,500	47,800	+14%

Congestions Occurred during Summer “Bon” Season

Unit: times

	2009	2008	Change
Congestions MT 10km	498	303	+64%
Congestions MT 30km	54	23	+135%

CONCLUSIONS

CONCLUSIONS

- In 2005, former expressway public corporations were privatized to ensure repaying the total debts of ¥40trillion in 45 years.
- The main factors associated with the toll road business are **traffic risk** and **interest rate risk.**

  - **The traffic risk** can be mitigated by rebalancing the repayment plan **by reducing construction and operation costs**, etc.

  - **The interest risk** are hedged by liability management where **long-term fixed interest bonds** are issued.
- Recently, **toll discounts schemes** have been introduced for the efficient use of expressways as economic stimulus measures.

#Toll-free system will be proceeded considering various aspects through the implementation of pilot programs.

VI REFERENCE

1. History

1) Conference

The 1st Conference on Public Works Research and Development in Asia

Duration	February 15, 1993 - February 26, 1993
Place	Public Works Research Institute, MOC
Program	Keynote Lecture 1) Infrastructure Policies for Economic and Social Development of Asian Countries by Prof. Fumio Nishino, University of Tokyo 2) Progress of Civil Engineering and Its Contribution to Economic and Social Development in Modern Japan － PWRI's 70 Years and Perspective － by Mr. Yukihiko Sumiyoshi, Director-General, Public Works Research Institute 3) The Role of Research and Technology Development in International Technical Cooperation by Mr. Hiroaki Tamamitsu, Vice President, Japan Construction Training Center
	Country Report 1) Outline of Country 2) Public Works System 3) Description of the Department/Institute in charge of R&D of Public Works 4) Major R&D projects in the Department/Institute 5) International Research Exchange Programmes in the Department/Institute 6) Activities concerning "Disaster and Disaster Prevention" 7) Activities concerning "Harmony between the Environment and Improvement of Infra."
	Subject of Common Interests on "Future Perspective for R&D of Disaster Prevention Techniques against Disaster caused by Rainfall" 1) River-Related Disaster 2) Sediment-Related Disaster
	Specific Subjects 1) Sedimentation of Dam Reservoir （China, Japan） 2) Water Pollution Control （Indonesia, Japan） 3) River Environment （Korea, Japan） 4) Soil Improvement （Thailand, Japan） 5) Tunnel （Singapore, Thailand, Japan） 6) Volcanic Disaster, Debris Flow and Road Disaster Prevention （Malaysia, Philippines, Japan） 7) River （China, Japan） 8) Water Quality （Korea, Japan） 9) Soil Mechanics and Foundation Engineering,Traffic Engineering （Malaysia, Thailand, Japan） 10) Pavement （Philippines, Singapore, Thailand, Japan） 11) Highway Bridges （Philippines, Japan）
	Study Tour Hokkaido （Shin-Chitose Airport, CERI, Muroran Hakucho-Bridge, Seikan-Tunnel etc.） Kanto (Trans-Tokyo Bay Highway、Miyagase-Dam）
Participants	Overseas: 8, Japan:37, Guests:35 (Overseas:5, Japan:30)

The 2nd Conference on Public Works Research and Development in Asia

Duration	November 15, 1993 - November 26, 1993
Place	Public Works Research Institute, MOC
Program	Keynote Lecture 1) Role of Civil Engineers for Sustainable Development by Mr. Atsushi Hamamori, President, Japan Overseas Consultants Co. Ltd. 2) Socio-Economic Development and Construction Technology Transfer by Mr. Yukihiko Sumiyoshi, Director-General, Public Works Research Institute 3) Research in Japan -Focusing Civil Engineering- by Prof. Hiroyoshi Shi-igai, University of Tsukuba
	Country Report 1) Outline of Country 2) Public Works System 3) Description of the Department/Institute in charge of R&D of Public Works 4) Major R&D projects in the Department/Institute 5) International Research Exchange Programmes in the Department/Institute
	・Subject of Common Interests on "Disaster and Disaster Prevention" 1) Comprehensive Countermeasure against Floods 2) Countermeasure against Highway Slope Failure ・Subject of Common Interests on "Harmony between the Environment and Improvement of Infrastructure" 1) Measures for Water Quality Control of Reservoirs and Rivers 2) Countermeasures against Air Pollution and Noise caused by Road Traffics in Urban Areas
	Specific Subjects 1) Debris Flow （China, Philippines, Japan） 2) Materials of the Highway Bridges -Concrete- （Indonesia, Japan） 3) Flood Control （Korea, Japan） 4) Care for the Rivers （Malaysia, Japan） 5) Utilization of the Underground Space （Singapore, Japan） 6) Air Pollution （Thailand, Japan） 7) Materials of the Pavement （Indonesia, Japan） 8) Environment Improvement -Water Quality Control- Korea, Thailand, Japan） 9) Creation of the River Environment （Malaysia, Japan） 10) Traffic Management （Singapore, Japan）
	Study Tour Chugoku-Shikoku（Seto-Ohashi） Kyushu（Yoshinogari Historical Park, Rokkaku River, Mt.Unzen etc.） Kanto （Trans-Tokyo Bay Highway）
Participants	Overseas: 7, Japan:41, Guests:60 (Overseas:7, Japan:53)

The 3rd Conference on Public Works Research and Development in Asia

Duration	October 17, 1994 - October 28, 1994
Place	Public Works Research Institute, MOC
Program	Keynote Lecture 1) Viewpoints on Panama Canal Alternative Study by Dr. Akira Ishido, Managing Director, Yachiyo Engineering Co. Ltd. 2) Vision of Construction Technical Research and Development to the 21st Century by Dr. Takashi Iijima, Director-General, Public Works Research Institute 3) Economic Growth, Infrastructure Development and International Cooperation in Asian Counties by Prof. Yuzo Akatsuka, Saitama University
	Trend of Public Works Research and Development 1) Role and Outline of Research Organization in Public Works 2) Activities and Topics of Research and Development in Research Organization 3) Research Management (Implementation of Research, Mid-term or Annual Research Plan, Research Budget, Improvement of Researcher)
	・ Subject of Common Interests on "Environmental Policy of Rivers, Lakes and Marshes" (Improvement of Water Quality, Infrastructure Development with Considerations for the Environment) ・ Subject of Common Interests on "Infrastructure Development in the field of Roads" (Establishment of Road Network, Maintenance and Management of Roads such as Pavement and Bridge)
	Specific Subjects 1) Flood Control (Bangladesh, India Indonesia, Thiland, Japan) 2) Highway Planning, Traffic System (China, Korea, Japan) 3) Soil Improvement (Malaysia, Japan) 4) Water Pollution Control (Philippines, Thailand, Japan) 5) Volcanic Disaster, Debris Flow (Indonesia, Japan) 6) Geological Survey (Malaysia, Japan) 7) Water Quality for Drinking (Philippines, Japan)
	Study Tour Kinki （Akashi Kaikyo Ohashi, Osaka Bay Highway, Kansai International Airport, Asuka Historical Park, Otaki Dam）
Participants	Overseas: 9, Japan:36, Guests:65 (Overseas:7,Japan:58)

The 4th Conference on Public Works Research and Development in Asia

Duration	September 25, 1995 - October 4, 1995
Place	Public Works Research Institute, MOC
Program	Trend of Public Works Research and Development 1) Role and Outline of Research Organization in Public Works 2) Activities and Topics of Research and Development in Research Organization 3) Research Management (Implementation of Research, Mid-term or Annual Research Plan, Research Budget, Improvement of Researcher)
	Subject of Common Interests on " Research and Development for Natural Disaster Reduction"
	Specific Subjects 1) Flood Control (Bangladesh, India, Indonesia, Thailand, Japan) 2) Highway Planning, Traffic System (China, Korea, Japan) 3) Soil Improvement (Malaysia, Japan) 4) Water Pollution Control (Philippines, Thailand, Japan) 5) Volcanic Disaster, Debris Flow (Indonesia, Japan) 6) Geological Survey (Malaysia, Japan) 7) Water Quality for Drinking (Philippines, Japan)
	Study Tour Kinki （Akashi Kaikyo Ohashi, Osaka Bay Highway, Kansai International Airport, Asuka Historical Park, Otaki Dam）
Participants	Overseas: 9, Japan: 36, Guests: 65 (Overseas: 7,Japan: 58)

The 5th Conference on Public Works Research and Development in Asia

Duration	October 25, 1996 - October 22, 1996
Place	Public Works Research Institute, MOC
Program	Keynote Lecture 1) Case Study from my Overseas Work by Dr. Yorio MURAKAMI, Vice President, Kawasaki Geological Engineering Ltd. 2) Report on the Disaster Caused by 1995 Hyogoken Nanbu Earthquake by Mr. Tadahiko SAKAMOTO, Director-General, Public Works Research Institute 3) Development Cooperation and Public Works in Asia by Dr. Akira TAKAHASHI, Professor Emeritus, University of Tokyo
	Subject of Common Interests 1) Harmony between Public Works and Environment 2) Securement and Training of Civil Engineers
	Specific Subjects 1) Earthquake Disaster (India, Philippines, Japan) 2) River Management (Malaysia, Thailand, Japan) 3) Road Technology (China, Japan) 4) Soft Ground (Bangladesh, Korea, Japan) 5) Air Pollution (Indonesia, Nepal, Japan)
	Study Tour Tohoku（Ichinoseki Retarding Basin, Onikobe Road, Sen-en Road)
Participants	Overseas: 9, Japan: 36, Guests: 65 (Overseas: 7,Japan: 58)

The 6th Conference on Public Works Research and Development in Asia

Duration	October 14, 1997 - October 21, 1997
Place	Harbor View Hotel, Okinawa
Program	Keynote Lecture
	1) Regional Development and the Environment Dr. Hosei Uehara, Professor, University of the Ryukyus
	2) Intelligent Transport Systems (ITS) Mr. Seizo Tsuji, Director General, PWRI
	3) Okinawa's Social Capital and Development Technologies Mr. Tamio Shimogami, Engineering General, Okinawa Prefectural Government
	Subject of Common Interests
	"Research and Development of Public Infrastructure Suitable to Environmental and Climatic Condition"
	Specific Subjects
	1) Soil Mechanics and Foundation .... Bangladesh, India, Japan 2) Flood Control .... Thailand, Japan 3) Traffic Management .... China, Nepal, Japan 4) Water Quality Control .... Indonesia, Malaysia, Japan 5) Volcanic Disaster, Debris Flow .... Philippines, Japan
	Study Tour
	Kinjo Dam Gushigawa Sewage Disposal Facility Haneji Dam Okinawa National Memorial Park
Participants	200

The 7th Conference on Public Works Research and Development in Asia

Duration	October 12, 1998 - October 23, 1998
Place	Okinawa Convention Center, Okinawa
Program	Keynote Lectures
	1)Surveyal,Planning,Design and Implementation of Bridge Construction in Japan's Grant Aid Projects Mr. Satoshi Watabe, Pacific Consultants International
	2)Disaster Preventive Project under the Consideration of Nearby Environmental Condition — The Project for Flood Mitigation in Ormoc City, Phillippines Mr. Hitoshi Kin, CTI Engineering Co., Ltd.
	3)Infrastructure Development and Management Prof.Masahiko Kunishima, University of Tokyo
	4)Okinawa's Coastal Waves and Outflow of Red Soil to the Seashore Dr. Seikoh Tsukayama, Professor, University of Ryukyus
	5)New Direction for Sustainable Development in Asia Mr. Yasutake Inoue, Director General, PWRI
	6)Promotion and Development of Okinawa and Its Public Works Technology Mr. Masamichi Shirahase, Vice Director General, Okinawa General Bureau
	Subject of Common Interests
	"Research and Development on the Comprehensive Disaster Prevention Measures Considering Ecological Environment and Social Condition"
	Specific Subjects
	1) Water Pollution .... Bangladesh, India, Japan 2) Flood Control .... Bangladesh, Philippines, Korea, Japan 3) Soil Improvement and Slope Protection...................India, Laos, Malaysia, Japan 4) Pavement .... Indonesia, India, Malaysia, Japan 5) Sedimentation of Dam Reservoir .... Malaysia, Korea, Japan 6) Earthquake Disasters .... Nepal, Japan 7) Coastal Erosion .... Thailand, Japan
	Study Tour
	Haneji Dam Okinawa National Memorial Park
Participants	Oveaseas: 11, Japan: 30, Guests: 60

The 8th Conference on Public Works Research and Development in Asia

Duration	October 12, 1999 - October 21, 1999
Place	Kariyushi Urban Resort Naha, Okinawa
Program	Keynote Lectures
	1)Present Situation and Tasks of Japan's ODA－Mainly on Infrastructures Mr. Kenji Kiyomizu, Development Specialist on Civil Engineering of JICA
	2)Infrastructure Development and Management in Asia Prof.Masahiko Kunishima, University of Tokyo
	3)Asian Concrete Model Code Asso. Prof. Tamon Ueda, University of Hokkaido
	Subject of Common Interests
	"Research and Development on the Construction Technology Which is Applicable to the Local Natural Environment and Social Condition"
	Specific Subjects
	1) National Disaster Prevention.. India, Japan 2) Soil Improvement...Bangladesh, Malaysia, Japan 3) Sedimentation of Dam Reservo.................................... Nepal,Philippines, Japan 4) Design Load of Bridges ....Thailand, Japan 5) Under Ground Use ....Indonesia, Korea, Japan 6) Pavement .... Laos, Japan 7) River Management...China, Japan
	Study Tour
	Okinawa National Memorial Park Haneji Dam Seawater Desalination Plant
Participants	200

The 9th Conference on Public Works Research and Development in Asia

Duration	October 10, 2000 - October 19, 2000
Place	National Institute for Land and Infrastructure Management, MLIT Bankoku Shinryokan, Okinawa
Program	Keynote Lectures
	Public Works Management Mr. Akira Fujimoto Research Coordinator for Public Works Management, Research Center for Public Works Management, PWRI Prof. Masahiko Kunishima, University of Tokyo Mr. Takenori Yamashita Head, Management Research Division Research Center for Public Works Management, PWRI Mr. Kenichi Matsui Head, System Development Division Research Center for Public Works Management, PWRI
	Subject of Common Interests
	"Research and Development on Promoting Technology Transfer in the Field of Construction Technology"
	Specific Subjects
	1) River Management..Laos, Japan 2) Water Quality Control.. China, Japan 3) Sedimentation of Dam Reservoir ....Malaysia, Japan 4) Traffic Management ....Nepal, Philippines, Japan 5) Soil Improvement..Thailand, Japan 6) Earthquake Disaster Prevention..India,Indonesia, Japan
	Study Tour
	ITS Information Center Haneji Dam Okinawa National Memorial Park Kanna Dam Historical Road
Participants	130

The 10th Conference on Public Works Research and Development in Asia

Duration	October 16, 2001 - October 25, 2001
Place	National Institute for Land and Infrastructure Management, MLIT Bankoku Shinryokan, Okinawa
Program	Lectures
	Public Works Management Mr. Kenichi Matsui Head, Construction Management Division Research Center for Land and Construction Management, NILIM
	Subject of Common Interests
	"Research and Development on Public Works Concerned with Reducing Environmental Impact for Sustainable Development"
	Specific Subjects
	1) Water Quality Management..India, Japan 2) River Management..Lao, Nepal, Japan 3) Coast Management..Malaysia, Japan 4) Traffic Management ....Thailand, Japan 5 Earthquake Disaster Prevention...... ....Bangladesh, India, Japan
	Study Tour
	1)Arakawa River Channel 2)Kobe Akashi Kaikyo Bridge 3)Okinawa ITS Information Center Electric Power Plant Kanna Dam Plastic Bridge
Participants	100

The 11th Conference on Public Works Research and Development in Asia

Duration	October 15, 2002 - October 24, 2002
Place	National Institute for Land and Infrastructure Management, MLIT Bankoku Shinryokan, Okinawa
Program	Keynote Lectures
	1) Hydrology and Water Resources in Monsoon Asia Dr. Katumi Musiake President, Japan Society of Hydrology and Water Resources Department of Human and Society, Institute of Industrial Science University of Tokyo
	2) Flood and Sediment-related Disasters in Japan Mr. Yasuo Nakano, Director Research Center for Disaster Risk Management, NILIM
	3) Comprehensive Water-Resource Issues of Island Communities Dr. Housei Uehara, Honorary Professor, University of the Ryukyus
	Subject of Common Interest
	"Water Resources and River Management for Sustainable Development"
	Specific Subjects
	1) Specific Subjets [1] a) Flood Control and Water Resources Management .... India, Indonesia, Laos, Philippines, Thailand, Japan b) Water quality.. Malaysia, Sri Lanka, Japan c) Groundwater.. Pakistan, Japan 2) Specific Subjects [2] a) Roads, Pavement, Traffic Management & Safety .... India, Indonesia, Laos, Pakistan, Sri Lanka, Japan b) Volcanic Disaster, Erosion Control & Debris Flow .... Philippines, Malaysia, Thailand, Japan 3) Specific Subjects [3] -Red Soil Erosion Countermeasures & Environmental Preservation in Okinawa- a) Integrated Operation of dams b) Road Construction.. Indonesia, Korea, Laos, Malaysia, Pakistan, Philippines, Sri Lanka, Thailand, Japan
	Study Tour
	1) Kyoto: Ohtsu Auxiliary Conduit, Seta River Weir(Outlet Flow Control) Amagase Dam, Drainage of Lake Biwa and the Incline, 2) Osaka: Legacy of Sayama Pond 3) Okinawa: The Urban Monorail System, Le Village, Haneo Dam, Taiho Dam
Participants	130

The 12th Conference on Public Works Research and Development in Asia

Duration	October 20, 2003 to October 31, 2003
Place	National Institute for Land and Infrastructure Management, MLIT Tokyo International Center, JICA Okinawa Convention Center
Program	**Keynote Lectures** 1) Public Transport in Urban Areas Dr. Fumihiko NAKAMURA Associate Professor, Department of Civil Engineering Yokohama National University 2) Development Trend and Urban Traffic Problem in Okinawa Central and Southern City Area Dr. Takayuki IKEDA Professor, Department of Civil Engineering & Architecture, University of Ryukyus
	Lectures 1) Technical Standard for Pavement and Asset Management in Japan Mr. Masahide ITO Team Leader, Pavement Research Team, Road Technology Research Group, Public Works Research Institute 2) Maintenance of Bridge Mr. Shoichi NAKATANI Head, Bridge Division, Road Dept. NILIM 3) ITS and Transportation - What will be changed? Dr. Harutoshi YAMADA Director, Research Center for Advanced Information Technology, NILIM 4) Environmental Problems in Urban Transport Mr. Michio TANAHASHI Director, Environment Dept., NILIM 5) Promotion of International Mobility of Engineers - APEC Engineer Project Mr. Shigeatsu TAKI Representative, Taki Associates
	Subject of Common Interest Session Traffic and Road - Measures for Urban Traffic Problem in Asian Big Cities
	Discussions of Specific Subjects 1) Technical Standard for Pavement and Asset Management in Japan 2) Maintenance of Bridge 3) Environmental Problems in Urban Transport 4) Restoration of Environment
	Study Tour 1) Tsukuba: Tsukuba Express Railway Construction Site, Tsukuba Space Center 2) Tokyo: Japan Highway Public Corporation(Electronic Toll Collection System, Tokyo Bay Cross Highway: Tokyo Bay Aqua Line) 3) Okinawa: Okinawa Urban Monorail: YUI RAIL, Shurijo Castle, Okinawa Churaumi Aquarium
Participants	130

The 13th Conference on Public Works Research and Development in Asia

Duration	October 18, 2004 - October 29, 2004
Place	National Institute for Land and Infrastructure Management, MLIT Tokyo International Center, JICA Okinawa Convention Center
Program	**Keynote Lectures** 1) Appropriate Sewage Treatment Technology for Developing Region Dr. Hideki HARADA Professor, Environmental Biotechnology Laboratory, Nagaoka University of Technology 2) Water Issues in Ryukyu Islands Dr. Chokei YOSHIDA Board Member, Okinawa P. Public Health Association
	Lectures 1) Treated Wastewater Reuse in Japan Mr. Atsushi TAJIMA Senior Researcher, Wastewater and Sludge Management Division, Water Quality Control Dept. NILIM 2) Occurrence of Endocrine Disrupting Compounds in Wastewater and Their Fate in Wastewater Treatment Plant and Environment Mr. Yutaka SUZUKI Team Leader, Water Quality Team, Water Environment Research Group, PWRI Mr. Hiromasa YAMASHITA Senior Researcher, Recycling Team, Material and Geotechnical Engineering Research Group, PWRI 3) Water Quality Management in Japan Dr. Hiroyuki ITO Senior Researcher, River Environment Division, Environment Dept., NILIM 4) Comprehensive Flood Control Measures Mr. Koichi FUJITA, Head, River Environment Division, Environment Dept., NILIM 5) Urban Flood Management Mr. Tetsuya NAKAMURA Head, Flood Disaster Prevention Division, Research Center for Disaster Risk Management, NILIM 6) Urban Drainage and Inundation Prevention Measures in Japan Mr. Kazuya FUJIU (for Mr. Motoi NASU) Head, Wastewater System Division, Water Quality Control Dept., NILIM 7) The World Water Forum Mr. Hideaki ODA, Secretary General, Japan Water Forum
	Subject of Common Interest Session Management of Urban Water Environment
	Discussions of Specific Subjects 1) Water Quality 2) Flood Control in Urban Areas
	Study Tour 1) Tsuchiura: Kasumigaura Kohoku Regional Sewerage System / Kasumigaura Sewage Treatment Plant, Tsuchiura Bio-Park 2) Tokyo: Morigasaki Water Reclamation Center, Digestive Gas Power Facilities, Ariake Wastewater Treatment Plant, Purification Plant, Odaiba Marine Park, Shiodome Reclaimed Water & Sprincle Test Facilities 3) Okinawa: Naha Sewage Treatment Plant, A Building Using Reclaimed Water in Naha New Urban Center, Makabi Retarding Basin, Kinjo Dam, Shuri Castle
Participants	130

The 14th Conference on Public Works Research and Development in Asia

Duration	October 17, 2005 - October 28, 2005
Place	National Institute for Land and Infrastructure Management, MLIT Japan International Cooperation Agency, Sendai International Center
Program	**Keynote Lectures** (1) Disaster Mitigation Perspective – From Engineering to Citizen's Participation Dr. Yujiro OGAWA, Professor, College of Environment and Disaster Research, Fuji Tokoha University (2) Global Disaster – Lessons from the 2004 Sumatra Earthquake and Indian Ocean Tsunami Dr. Fumihiko IMAMURA, Professor, Disaster Control Research Center, Graduate School of Engineering, Tohoku University
	Lectures (1) Mitigation Measures and Risk Management against Flood and Coastal Disaster 1)Dr. Tadashi SUETSUGI, Head, River Division, River Dept. NILIM 2)Mr. Tetsuya NAKAMURA, Head, Flood Disaster Prevention Division, Research Center for Disaster Risk Management, NILIM 3)Mr. Fumihiko KATO, Senior Researcher, Coast Division, River Dept. NILIM (2) Procedure for Setting Area for Restriction on Land Use in order to Reduce Risk due to Sediment-related Disasters Dr. Hideaki MIZUNO, Senior Researcher, Erosion and Sediment Control Division, Research Center for Disaster Risk Management, NILIM (3) Development of Warning and Evacuation System against Sediment-related Disasters Dr. Nobutomo OSANAI, Head, Erosion and Sediment Control Division, Research Center for Disaster Risk Management, NILIM (4) Debris Flows Detection Sensors Mr. Jun'ichi KURIHARA, Team Leader, Volcano and Debris Flow Research Team, Erosion and Sediment Control Research Group, PWRI (5) Development of the Landslide Displacement Detection Sensor Using Optical Fiber Mr. Kazunori FUJISAWA, Team Leader, Landslide Research Team, Erosion and Sediment Control Research Group, PWRI (6) The World Water Forum Mr. Hideaki ODA, Secretary General, Japan Water Forum
	Subject of Common Interest Session Risk Management and Mitigation for Flood and Sediment Related Disasters
	Discussions of Specific Subjects 1) Mitigation Measures and Risk Management against Flood and Coastal Disaster 2) Risk Management and Mitigation for Sediment-related Disasters 3) Flood Forecasting and Warning
	Study Tour 1) Tsukuba Area: 1986 Kokai River Embankment Destruction Part, Kokai River Hakojima Retarding Basin 2) NILIM and PWRI: UNESCO-PWRI Centre, Current Meter Calibration Channel, River Model Test Yard, Coastal Hydraulics Laboratory, Smart Communication & Advanced Cruise-assist Highway Systems 3) Tokyo Area: Kanda River/Loop 7 Underground Regulation Pond Works, Tsurumi River Multipurpose Retarding Basin, Slope Failure Prevention Works in Yokohama, PARI's Large Hydro-Geo Flume and Intelligent Wave Basin for Maritime Environments, NILIM Yokosuka's Airplane Loading Test Systems 3) Tohoku Area: Ishibuchi Dam, Isawa Dam, Chusonji-Temple, Ichinoseki Retarding Basin, Satetsu-River Disaster Restoration Site
Participants	100

The 15th Conference on Public Works Research and Development in Asia

Duration	November 6, 2006 - November 17, 2006
Place	National Institute for Land and Infrastructure Management, MLIT Japan International Cooperation Agency, Aichi Art Center
Program	Keynote Lectures (1) Road Policies in Japan – Brief History and Recent Topics – Dr. Haruo ISHIDA Dept. of Social Systems and Management, Tsukuba University
	Lectures (1) Efforts Towards More Accessible And Functional Expressway System Mr. Kenta HAMAYA Researcher, Traffic Engineering Division, Road Department, National Institute for Land and Infrastructure Management (2)Evaluation of Freight Transport Network Mr. Tatsuo KONO Senior Researcher, Traffic Engineering Division, Road Department, National Institute for Land and Infrastructure Management (3)Comprehensive Implementation of Road Administration Management in Japan Mr. Tetsuya OWAKI Senior Researcher, Traffic Engineering Division, Road Department, National Institute for Land and Infrastructure Management (4)An Overiew of Road Traffic Survey in Japan and Utilization for grasping traffic congestion Mr. Shinji ITSUBO Researcher, Traffic Engineering Division, Road Department, National Institute for Land and Infrastructure Management (5)Trend of Road Accidents and Measures in Japan Dr. Susumu TAKAMIYA Senior Researcher, Advance Road Design Safety Division, Road Department, National Institute for Land and Infrastructure Management (6)Collection and Utilization of Date on Traffic Accidents Mr. Shinsuke SETOSHITA Senior Researcher, Advance Road Design Safety Division, Road Department, National Institute for Land and Infrastructure Management (7)Effects of Traffic safety Measures and Effective Development Methods for Traffic Safety measures Mr. Hiroki HASHIMOTO Researcher, Advance Road Design Safety Division, Road Department, National Institute for Land and Infrastructure Management (8)Environmental Issues of Roads in Japan Mr. Shinri SONE Senior Researcher, Road Environment Division, Environment Department, National Institute for Land and Infrastructure Management (9)Management and System of Road Structures in Japan Mr. Takashi TAMAKOSHI Head, Bridge and structures Division, Environment Department, National Institute for Land and Infrastructure Management (10)General Information on Deterioration of Existing Concrete Structures and Recent Research Topics on The Maintenance Techniques in Japan Mr. Hiroshi WATANABE Team Leader, Structure Management Technology Team, Construction Technology Research Department, Public Works Research Institute

	(11)Maintenance of Steel Bridges Mr. Jun MURAKOSHI Team Leader, Bridge Structure Team,Structures Research Group, Public Works Research Institute (12)Pavement Management Practice in Japan Mr. Kazuyuki KUBO Team Leader, Pavement Team, Road Technology Research Group Public Works Research Institute (13)State of the Art and Future Prospect of Maintenance and Operationof Road Tunnel Dr. Hideto MASHIMO Team Leader, Tunnel Team, Road Technology Research Group Public Works Research Institute (14)Control of Maintenance in Earthworks Dr. Hidetoshi KOHASHI Team Leader, Soil Mechanics Team, Material and Geotechnical Research Group, Public Works Research Institute (15)Capability of ITS for sustainable social infrastructure Dr. Tadashi YOSHIDA ITS deployment strategy Research team, special Committee Team, Japan Society of Civil Engineers
	Subject of Common Interest Session Economic and Social Effects of Road Network Development
	Discussions of Specific Subjects 1)Effect and Evaluation of Road Network Development 2)Road Traffic Safety and Environment a) Road Accidents and Measure b) Effort toward Road Environment 3)Road Structures Management
	Study Tour 1) NILIM and PWRI: Structural Aerodynamics Laboratory, Noise Control Laboratory, Low Noise Pavement and Noise Barrier, Test Track, ITS Laboratory, Pavement Test Field, Vibration Laboratory, Traffic Collision Test Field 2) Tokyo Area: East Tokyo Operation bureau, Harumi Route, Tokyo Wan Aqua-Line, Tokyo Outer Ring Road 3) Chubu Area: Linear motor train Base, Tokai Ring Expressway, Tsutsumi Plant of Toyota Motor Corporation, Nagoya Ring Highway 2, Tobishima Container Terminals
Participants	138

The 16th Conference on Public Works Research and Development in Asia

Duration	November 26, 2007 - December 7, 2007
Place	National Institute for Land and Infrastructure Management, MLIT Japan International Cooperation Agency, Hotel Shiragiku
Program	Keynote Lectures (1) Water-related Disaster Management for Adaptation to Climate Change Dr. Kuniyoshi TAKEUCHI Director of the International Centre for Water Hazard and Risk Management (ICHARM), PWRI
	Lectures (1) Predicted Effect of Global Climate Change on precipitation Characteristics in Japan and related research activities in NILIM Mr. Josuke KASHIWAI Research Coordinator for Watershed Management, River Department, NILIM (2) The Investigation on the Drought Risk Assessment in Japan Due to Global Warming Mr. Nario YASUDA Head, Water Management and Dam Division, River Department, NILIM (3) Policy Making and Implementation Processes for Securing Water Resources in the Tokyo Metropolitan Area to Cope with the Rapid Population Growth Mr. Koichi FUJITA Head, River Environment Division, Environmental Department, NILIM (4) The Evaluation of Flood Risk and Prevention of Flood Disaster Mr. Takayuki ISHIGAMI Senior Researcher, River Division, River Department, NILIM (5) Storm Surge Forecast System for Floodfighting Warning Mr. Masaya FUKUHAMA Head, Coast Division, River Department, NILIM (6) Support for Evaluation Ahead of Sediment Disasters - Using Rainfall Indices to Predict the Danger of Sediment Disasters - Mr. Kazuya AKIYAMA Senior Researcher, Erosion and Sediment Control Division, Research Center for Disaster Risk Management, NILIM (7) Planning Adaptation Programs for Future Climate Change Mr. Junichi YOSHITANI Team Leader, Disaster Prevention Team, ICHARM, PWRI (8) Outline of Sewerage Works and The Strategies for The Future in Japan Mr. Osamu FUJIKI Director, Water Quality Control Department, NILIM (9) Urban Stormwater Management Mr. Takashi SAKAKIBARA Head, Wastewater System Division, Water Quality Control Department, NILIM (10) Utilization of Reclaimed Wastewater Mr. Mizuhiko MINAMIYAMA Head, Wastewater and Sludge Management Division, Water Quality Control Department, NILIM (11) Beneficial Use of Biomass at Wastewater Treatment Plants Mr. Masaaki OZAKI Team Leader, Recycling Research Team, Material and Geotechnical Management, PWRI

	Subject of Common Interest Session Integrated Water Resource Management Adapting to the Global Climate Change
	Discussions of Specific Subjects 1) Water Resource Management 2) Water Disaster Management 3) Water Environment and Wastewater Management
	Study Tour 1) NILIM and PWRI: Oceanic and Coastal Experimental Facilities, River Hydraulic Experimental Facilities, Dam Hydraulic Experimental Facilities, Water Quality Experimental Facilities 2) Tsukuba Area: The Meteorological Research Institute 3) Kyusyu Area: The Seawater Desalination Center, Chikugo Ohzeki (The Chikugo River Weir), Suigou Yanagawa (River of Yanagawa)
Participants	111

The 17th Conference on Public Works Research and Development in Asia

Duration	October 21, 2008 - October 29, 2008
Place	National Institute for Land and Infrastructure Management, MLIT Chisun Hotel & Conference Center Niigata
Program	Keynote Lectures (1) Characteristics of Recent Natural Disasters and Their Reduction Ph. D. Yoshiaki KAWATA Director of Research Center for Disaster Reduction System, Disaster Prevention Research institute, Kyoto University
	Lectures (1) Seismic design of dams Mr. Shinya MITSUISHI Head, Water Management and Dam Division, River Department, NILIM (2)Policy and research for seismic retrofit of highway bridges Mr. Toshiaki NANAZAWA Senior Researcher, Bridge and Structures Division, Road Department, NILIM (3)Disaster information system Mr. Yasuhiro SHOJI Head, Earthquake Disasters Prevention Division, Research Center for Disaster Risk Management, NILIM (4)Coastal management against tsunamis Mr. Yoshio SUWA Head, Coast Division, River Department, NILIM (5)Prevention and countermeasures against flood Mr. Hirokatsu KANAZAWA Head, River Division, River Department, NILIM (8)Disaster mitigation of flood and countermeasure for recovery Mr. Hajime KOBAYASHI Senior Researcher, Flood Disaster Prevention Division, Research Center for Disaster Risk Management, NILIM (9)Wave runup forecast system for floodfighting Mr. Fuminori KATO Senior Researcher, Coast Division, River Department, NILIM (10)Practical use of the sediment disaster warning information in case of heavy rainfall Mr. Hideaki MIZUNO Senior Researcher, Erosion and Sediment Control Division, Research Center for Disaster Risk Management, NILIM (11)Countermeasures against natural dams Dr. Nobutomo OSANAI Head, Erosion and Sediment Control Division, Research Center for Disaster Risk Management, NILIM (12)Format for collecting Sediment disaster data” Mr. Shinichi KOJIMA Senior Researcher, Erosion and Sediment Control Division, Research Center for Disaster Risk Management, NILIM
	Subject of Common Interest Session Prevention and Mitigation of National Disasters
	Discussions of Specific Subjects 1) Earthquake and Tsunami Related Disasters 2) Flood and Storm Surge Related Disasters 3) Non-structural Measure for Reducing disaster Risk Caused by Sediment Movement

	Study Tour 1) Tokyo Area: Tokyo Bay Aqua Line Highway Metropolitan Area Outer Underground Discharge Channel 2) Hokuriku Area: Niigata Disaster Prevention Center Oogotsu Diversion Aqueducts, Shinano River Closed river channel(Yamakosi village) Yamakoshi Area Branch Office, Nagaoka City Municipal Office
Participants	107

The 18th Conference on Public Works Research and Development in Asia

Duration	November 9, 2009 - November 18, 2009
Place	National Institute for Land and Infrastructure Management, MLIT Kochi University of Technology
Program	Keynote Lectures (1)Highway Capacity, Operation and Congestion in Japan Dr.Eng. Takashi OGUCHI Professor at Infrastructure Planning & Traffic Eng. Lab., Division of Civil and Environmental Eng., Graduate school of Urban Environmental Sciences Tokyo Metropolitan University
	Lectures (1)Efficient development and operation of road net works Mr. Katsumi UESAKA Head, Traffic Engineering Division, Road Department, NILIM (2)Measures to secure road traffic safety Mr. Masahiro KANEKO Head, Advanced Road Design and Safety Division, Road Department, NILIM (3)Improvement of road environment Mr. Shinri SONE Head, Road environment Division, Environment Department, NILIM (4)Toward realization of smartway in Japan Mr. Hideto HATAKENAKA Head, Intelligent Transport System Division, Research Center for Advanced Information Technology, NILIM (5)Earthquake disaster management for Road Mr. Susumu TAKAMIYA Head, Earthquake Disaster Prevention Division, Research Center for Disaster Risk Management, NILIM (6)Strategy for maintenance of Road structures Mr. Takashi TAMAKOSHI Head, Bridge and Structures Division, Road Department, NILIM (7)Techniques for inspection and reinforcement of bridges Mr. Jun MURAKOSHI Senior Researcher, Bridge and structural Technology Research group, Center for Advanced Engineering Structural Assessment and Research, PWRI (8)Efficient maintenance of pavements and tunnels Mr. Kazuyuki KUBO Senior Researcher, Pavement Research Team, Road Technology Research group, PWRI Mr. Katsunori KADOYU Senior Researcher, Tunnel Research Team, Road Technology Research Group, PWRI (9)Risk Management Strategy in Privatizagion of Expressway Public Corporations in Japan Mr. Katsuhiko NAKAMURA Deputy Director, Planning Division, Japan Expressway Holding and Dept Repayment Agency

	Subject of Common Interest Session Unique Road-policy Applied to The Regional Condition and Issue
	Discussions of Specific Subjects 1) Road Network 2) Road Traffic Safety 3) Road Environment 4) Intelligent Transport System 5)Efficient Maintenance of Road and Bridges
	Study Tour 1) Tokyo Area Tokyo Bay Aqua Line Highway Oohashi Junction(Tokyo outer Ring Road) Hakozaki Operation Bureau, Metropolitan Expressway Company 2) Shikoku Area: Kita Bisan-Seto Bridge Akashi-Kaikyo Bridge
Participants	17

2) Symposium

The 1st Symposium on Public Infrastructure and Civil Engineering in Asia

Date	February 22, 1993
Place	Sapporo Grand Hotel
Host	Public Works Research Institute of MOC, Civil Engineer Research Institute of Hokkaido Development Bureau
Program	Keynote Lecture on "Development and Infrastructure of Hokkaido" by Prof. Hideo IGARASHI, Hokkaido University
	Panel Discussion on "Public Infrastructure Projects in Each Country and Their Technical Problems" Coordinator: Toshitaka OHTA, Director General, CERI, Hokkaido Development Bureau, JAPAN Panelists : Yukihiko SUMIYOSHI, Director-General, PWRI, MOC, JAPAN CHEN Bing Xin, Director, IWHR, CHINA BADRUDDIN Machbub, Director, RIWRD, ARD, MPW, INDONESIA LEE Sang Eun, Vice President, KICT, KOREA Abdul RAHMAN B. Abdullah, Deputy Director General, PWD, MALAYSIA Manuel M. BONOAN, Assistant Secretary for Planning, DPWH, PHILIPPINES TAN Siong Leng, Director, Building Control Div., PWD, SINGAPORE TEERACHARTI Ruenkrairergsa, Director, Road R&D Center, DOH, THAILAND
Participants	200

The 2nd Symposium on Public Infrastructure and Civil Engineering in Asia

Duration	November 22, 1993
Place	Soralia Nishi-Tetsu Hotel
Host	Public Works Research Institute and Kyushu Regional Construction Bureau, MOC
Program	Keynote Lecture on "Regional Development and Civil Engineering Technology in Kyushu" by Prof. Takeshi CHISHAKI, Kyushu University
	Panel Discussion on "Striving for a Better Environment -Regional Development Projects, Disaster Prevention, Environmental Issue-" Coordinator: Yukihiko Sumiyoshi, Director-General, PWRI, MOC, JAPAN Panelists: Eiki ARAMAKI, Director General, Kyushu Regional Construction Bureau, MOC, JAPAN WU Ji Shan, Director, IMHE, CHINA SOEDARMANTO Darmonegoro, Secretary, ARD, MPW, INDONESIA KIM Keung Hwan, Director, Planning & Coordination Div., KICT, KOREA TEH Siew Keat, Director of River Engineering, DID, MALAYSIA Jose H. ESPIRITU, Director, BRS, DPWH, PHILIPPINES KHOR Poh Hwa, Chief Civil Engineer, PWD, SINGAPORE ANUSORNANT Mahavinichaimontri, Director, Materials and Research Div., PWD, THAILAND
Participants	200

The 3rd Symposium on Public Infrastructure and Civil Engineering in Asia

Duration	October 24, 1994
Place	Mainichi Oval Hall
Host	Public Works Research Institute and Kinki Regional Construction Bureau, MOC
Program	Keynote Lecture on "Struggling to Develop the New Construction Technology" by Mr. Koutaro HASHIMOTO, Director General, Kinki Regional Construction Bureau, MOC Keynote Lecture on "Cultural Exchange in Global Age" by Prof. Nobuyuki HATA, National Museum of Ethnology
	Panel Discussion on "Public Infrastructure and Development of Construction Technology in Asia" Coordinator: Hiroji NAKAGAWA, Professor, Kyoto University, JAPAN Panelists : Takashi IIJIMA, Director-General, PWRI, MOC, JAPAN Abdul Wahed CHOWDURI, Joint Secretary, MHPW, BANGLADESH XIONG Qiu Shui, Senior Engineer, SPTD, Min. of Com., CHINA Kewal Krishan MADAN, Director General, CPWD, MUD, INDIA Mohamad Yusuf GAYO, Director of MIER, DGWRD, MPW, INDONESIA KIM Il-Joong, Director, Technology Promotion Div., MOC, KOREA Abdul KADIR bin Awang Hamat, Director, IKRAM, PWD, MOW, MALAYSIA Luis A. MAMITAG, Jr., Chief of R&D Div., BRS, DPWH, PHILIPPINES WIJARN Thunthithum, Senior Engineer, DWD Sub-Div., SED, PWD, THAILAND
Participants	300

The 4th Symposium on Public Infrastructure and Civil Engineering in Asia
（Session of Ministers' Forum on Infrastructure Development in the Asia-Pacific Region）

Duration	September 27, 1995
Place	Hotel New Otani Osaka
Host	Public Works Research Institute and Kinki Regional Construction Bureau, MOC
Program	Panel Discussion on "Research and Development and International Research Cooperation for Great Natural Disaster Reduction" Coordinator: Takashi IIJIMA, Director-General, PWRI, MOC, JAPAN Panelists : Yasuyuki KOGA, Director, Earthquake Disaster Prevention Dept. ,PWRI, MOC, JAPAN Abdul MAJID Khan, Director General, RRI, BANGLADESH Guowei YANG, Senior Engineer, CWRC, CHINA Digvijai SINGH, Director General, CRRI, MST, INDIA PATANA Rantetoding, Director General, IRE, MPW, INDONESIA Antonio A. STA. ELENA, Regional Director, DPWH, Region Ⅸ, PHILIPPINES SURAPOL Pongthaipatana, Deputy Director General, TTI, PWD, MOI, THAILAND
Participants	200

The 5th Symposium on Public Infrastructure and Civil Engineering in Asia

Duration	October 21, 1996
Place	Sendai International Center
Host	Public Works Research Institute and Tohoku Regional Construction Bureau, MOC
Program	Panel Discussion on "Harmony between Regional Development Projects and Environment" Coordinator: Tadahiko SAKAMOTO, Director-General, PWRI, MOC, JAPAN Panelists : Toshiki AOYAMA, Director-General, Tohoku Regional Construction Bureau, MOC, JAPAN MD. Siddique Ullah, Chief Engineer, Public Works Department, Ministry of Housing and Public Works, BANGLADESH Zhang Yuan-fang, Deputy Director, Research Institute of Highway, Ministry of Communications, CHINA Surinder Kumar Chawla, Chief Engineer, Central Public Works Department, Ministry of Urban Affairs and Employment, INDIA Joelianto Hendro Moeljono, Director General, Agency for Research and Development, Ministry of Public Works, INDONESIA Hong Sung-Wan, Vice President, Korea Institute of Construction Technology, KOREA Keizrul Bin Abdullah, Deputy Director General I, Department of Irrigation and Drainage, Ministry of Agriculture, MALAYSIA Nestor V. Agustin, Assistant Regional Director, Region IV, Department of Public Highways ,Region IX, PHILIPPINES Siripong Hungspreug, Director, Project Planning Division, Royal Irrigation Department, THAILAND Mohan Bahadur Karki, Director General, Department of Roads, Ministry of Works and Transport, NEPAL
Participants	200

The 6th Symposium on Public Infrastructure and Civil Engineering in Asia

Duration	October 17, 1997	
Place	The Busena Terrace Beach Resort	
Host	Public Works Research Institute Okinawa General Bureau and Okinawa Prefectural Government	
Program	Keynote Address	Prof. Kiyoshi UEMA "Okinawa's Heritage and Social Infrastructure"
	Panel Discussion	"Research and Development of Social Infrastructure Suitable to the Environment and Climatic Condition"
Panelists	Tamio Shimogami	Engineer General, Okinawa Prefectural Government, JAPAN
	Azizul Haque	Additional Chief Engineer, Public Works Department Under Ministry of Works, Govt. of BANGLADESH
	Qi Ji	Vice Director, China Building Technology Department Center, CHINA
	Krishan Kumar	Chief Engineer & Project Manager, Parliament Library Project, Central Public Works Department, INDIA
	Zulkarnaen Aksa	Executive Secretary Agency for Public Works' Research and Development, Ministry of Public Works, INDONESIA
	Ahmad Fuad Bin Embi	Director, Drainage Division, Department of Irrigation and Drainage, MALAYSIA
	Devendra Prasad Rimal	Joint Secretary, Ministry of Works and Transport, NEPAL
	Salvador L. Manto	Division Chief, Portworks & Shore Protection Division Bureau of Construction, Department of Public Works and Highway's, PHILIPPINES
	Vidhaya Samaharn	Director, Research and Laboratory Division, Royal Irrigation Department, THAILAND
	Coordinator Seizo Tsuji	Director - General, PWRI
Participants	200	

The 7th Symposium on Public Infrastructure and Civil Engineering in Asia

Duration	October 18, 1999	
Place	Okinawa Convention Center	
Host	Okinawa General Bureau	
Program	Theme	"R&D of Paving Technologies Suited to Environmental and Climatic Conditions"
	Keynote Address	"Recent Development in Paving Technology" Tamotsu Kobayashi, Research Coordinator for Traffic Safety, PWRI
		"R&D of Paving Technologies in Okinawa" Kaoru Seto, Sr. Officer, Planning & Coordination, Development Construction Department, Okinawa General Bureau
	Site Visits	Test Site: Semi-Flexible Pavement（Nakanishi Area, Urasoe City）
Paticipants	A. K. M. Mukitur Rahman	Additional Chief Engineer, Public Works Department, BANGLADESH
	Indu Prakash	Chief Engineer, Ministry of Surface Transport（Road Wing）, INDIA
	Mohammad Sjahdanulirwan	Acting Director, Institute of Road Engineering, Agency for Research and Development of Public Works, Ministry of Public Works, INDONESIA
	Chai Sung Gee	Research Fellow, Korea Institute of Construction Technology, KOREA
	Laokham Sompheth	Project Manager, Ministry of Communication Transport, Post, and Construction, LAOS
	Haji Ghazali Bin Omar	Director, Drainage Division, Department of Irrigation & Drainage, MALAYSIA
	Abdul Razak Bin Dahalan	Deputy Director, Department of Irrigation & Drainage, Perak, MALAYSIA
	Lekh Raj Upadhyay	Director General, Department of Building, Ministry of Housing and Physical Planning, NEPAL
	Manuel Agyao Y. Swegen	Regional Director, Cordillera Administrative Region, Department of Public Works and Highways, PHILIPPINES
	Thiraphan Thongpravati	Chief Engineer, Public Works Department, Ministry of Interior, THAILAND
	Masamichi Shirahase	Vice Director-General, Okinawa General Bureau
Others	70	

The 8th International Symposium on National Land Development and Civil Engineering in Asia

Duration	October 18, 1999	
Place	Kariyushi Urban Resort Naha	
Host	Okinawa General Bureau and Okinawa Prefectural Government	
Program	Keynote Lecture	Prof. Takeshi OSHIRO "Corrosive Environment and Salt Induced Damage of RC Structures"
	Panel Discussion	"Research and Development on the construction technology which is applicable to the local natural environment and social condition"
Panelists	Ayumu Yasukawa	Engineer General, Okinawa Prefectural Government, JAPAN
	Morshed Uddin	Additional Chief Engineer, Public Works Department Under Ministry of Works, Govt. of BANGLADESH
	Qian, Min	Vice Director General, Huaihe River Commission, Ministry of Water Resources, CHINA
	Prabodh Gopal Dhar Chakrabartir	Director, Ministry of Urban Development, INDIA
	Supardiyono Sobirin	Director, Research Institute for Human Settlements, INDONESIA
	Hong, Sung Wan	Senior Research Fellow, Korea Institute of Construction Technology, KOREA
	Math Sounmala	Director General, Cabinet Office, Ministry of Communication Transport Post and Construction, LAOS
	Wahid bin Omar	Deputy Director General Ⅱ, Public Works Department, MALAYSIA
	Kedar Prakash Rizal	Project Director, Water Induced Disaster Prevention Technical Centre, Ministry of Water Resources, NEPAL
	Eleno Uttoh Colinares,Jr	Regional Director, Department of Public Works and Highways, Region Ⅴ, PHILIPPINES
	Samart Yolpak	Chief Engineer, Public Works Department, Ministry of Interior, THAILAND
	Coordinator Tomomitsu Fujii	Director - General, PWRI
Participants	200	

The 9th International Symposium on National Land Development and Civil Engineering in Asia

Duration	October 17, 2000
Place	Bankoku Shinryokan, Okinawa
Host	Public Works Research Institute Okinawa General Bureau and Okinawa Prefectural Government
Program	Lectures Dr. Tetsuya YABUKI, Professor, University of the Ryukyus "Case of Japan Ⅰ" －New Developments in Bridges－ Mr. Takeshi HASHIMOTO, Deputy Director General, Okinawa General Bureau, Okinawa Development Agency "Case of Japan Ⅱ" －Infrastructure Development in Okinawa- Mr. Subhash Chander VASUDEVA, Additional Director General, Central Public Works Department, Ministry of Urban Development, INDIA "Case of INDIA" Ir. SAROSO Bambang Suksmono, Operation Management Director, The Research Institute for Road Infrastructure Technology, Ministry of Settlement & Regional Development, Republic of INDONESIA "Case of Republic of INDONESIA" Dr. Hyoseop WOO, Senior Research Fellow, Korea Institute of Construction Technology, Republic of KOREA "Case of KOREA" Mr. Jesus Pedro CAMMAYO, Assistant Secretary, Department of Public Works and Highways, Republic of the PHILIPPINES "Case of PHILIPPINES"
Participants	130

The 10th International Symposium on National Land Development and Civil Engineering in Asia

Duration	October 23, 2001
Place	Bankoku Shinryokan, Okinawa
Host	National Institute for Land and Infrastructure Management Okinawa General Bureau and Okinawa Prefectural Government
Program	Lectures Dr. Toshiya SHINJO, Professor, University of the Ryukyus "Case of Japan Ⅰ″ －Foundation Work on the Limestone Ground Layer of the Southwest Islands－ Mr. Tadayuki TAZAKI, Director-General, National Institute for Land and Infrastructure Management "Case of Japan Ⅱ″ －Public Works Environmental Technology in Japan－ Dr. Gyn-Jin Bae, Director, Civil Engineering Research Division, Korea Institute of Construction Technology, Republic of KOREA "Case of KOREA" Mr. Hin Seang SAW, Director, Coastal Engineering Division, Department of Irrigation and Drainage, MALAYSIA "Case of Republic of MALAYSIA" Mr. Amoda Nand MISHRA, Director-General, Department of Water Induced Disaster Prevention, Kingdom of NEPAL "Case of Kingdom of NEPAL" Mr. Oravit HEMACHUDHA, Chief, Public Works Planning Subdiv., Department of Public Works, Bangkok Metropolitan Administration, Kingdom of THAILAND "Case of Kingdom of THAILAND" Mr. Hirokazu MIYAO, Engineer General, Okinawa Prefecture Government "Case of OKINAWA" －Okinawa Prefecture's Infrastructure Development for the 21st Century－
Participants	100

The 11th International Symposium on National Land Development and Civil Engineering in Asia

Duration	October 22, 2002
Place	Bankoku Shinryokan, Okinawa
Host	National Institute for Land and Infrastructure Management Okinawa General Bureau and Okinawa Prefectural Government
Program	Lectures Dr. Housei UEHARA, Honorary Professor, University of the Ryukyus "Case of Japan Ⅰ″ －Comprehensive Water -Resource Issues of Island Communities－ Mr. Haruhiko OKUNO, Director-General, National Institute for Land and Infrastructure Management "Case of Japan Ⅱ″ －Tokyo Metropolitan Region and Tonegawa－ Dr. Lee Jang-Hwa, Senior Research Fellow Structural Materials Research Group Korea Institute of Construction Technology, Republic of Korea "Case of Korea" Mr. Kaushal N. AGRAWAL, Additional Director General, Central Public Works Department Ministry of Urban Development, India "Case of India" Ms. Sofia Torio SANTIAGO, Project Manager, and OIC Assistant Director Bureau of Design Department of Public Works & Highways, Philippines "Case of Philippines" Mr. Zubair Emran KHAWAJA, Director Road Research and Material Testing Institute/ Praivate Sector Project Investment Cell Communication & Works Department Government of Punjab, Lahore, Pakistan "Case of Pakistan" Mr. Tamio SHIMOGAMI, Deputy Director General, Okinawa General Bureau, Okinawa Development Agency "Case of Okinawa" －Integrated Dam Management and the Development of Okinawa's Water Resources－
Participants	130

The 12th International Symposium on National Land Development and Civil Engineering in Asia

Duration	October 30, 2003
Place	Okinawa Convention Center, Okinawa
Host	National Institute for Land and Infrastructure Management
Support	Okinawa General Bureau and Okinawa Prefectural Government
Program	**Keynote Speech "Development Trend and Urban Traffic Problem in Okinawa Central and Southern City Area"** Dr. Takayuki IKEDA Professor, Department of Civil Engineering & Architecture, University of the Ryukyus
	Lectures 1) Case of Japan Mr. Haruhiko OKUNO, Director General, National Institute for Land and Infrastructure Management 2) Case of Cambodia Mr. VONG Pisith, Deputy Director General, Ministry of Public Works and Transport 3) Case of China Mr. LU, Kangcheng, Professor of Tunnel and Underground Works, Chang'an University 4) Case of Korea Dr. KIM, Yeon Bok, Senior Research Fellow, Highway Research Dept., and Group Leader, Advanced Highway System Group, Highway Research Dept., Korea Institute of Construction Technology 5) Case of Laos Mr. Houngla SENGMUANG, Director of Luangnamtha Province, Department of Communication, Transport, Post and Construction 6) Case of Malaysia Mr. LAU Hieng Ung, Deputy Director Kuching North City Commission 7) Case of Nepal Mr. Sharad Kumar SHRESTHA, Senior Divisional Engineer, Maintenance Branch, Department of Roads, Ministry of Physical Planning and Works 8) Case of Pakistan Mr. Aziz Ul Haq MIRZA, Member (Operations), National Highway Authority, Ministry of Communications 9) Case of Sri Lanka Mr. Ranasinghe Hewawasamge KARUMARATNE, Provincial Director, Road Development Authority 10) Case of Okinawa Mr. Hirokazu MIYAO, Engineer-General Okinawa Prefectural Government
Participants	130

The 13th International Symposium on National Land Development and Civil Engineering in Asia

Duration	October 28, 2004
Place	Okinawa Convention Center, Okinawa
Host	National Institute for Land and Infrastructure Management
Program	**Keynote Speech "Water Issues in Ryukyu Islands"** Dr. Chokei YOSHIDA Board Member, Okinawa P. Public Health Association
	Lectures 1) Case of Japan Mr. Tatsuo HAMAGUCHI, Director General, National Institute for Land and Infrastructure Management 2) Case of Bangladesh Mr. A. K. M. Jafar ULLAH, Superintending Engineer & Project Director, Water Supply System Expansion & Rehabilitation Project (WSSERP), Dhaka Water Supply & Sewerage Authority 3) Case of Bhutan Mr. Passang DORJI, District Engineer, Dzongkhag Engineering Sector(District) 4) Case of Cambodia Dr. Visoth CHEA, Assistant General Director, Phnom Penh Water Supply Authority 5) Case of China Dr. LIU Dongfang, Vice Chief Engineer/Director of R/D Center, Tianjin Capital Environmental Protection Company Limited 6) Case of India Mr. Sukamal BHATTACHARYA, Executive Engineer, Public Works Department, Government of Tripura 7) Case of Indonesia Dr. Ramalis Subandi PRIHANDANA, Senior Researcher, Research Institute for Human Settlement, Ministry of Settlement and Regional Infrastructure Development 8) Case of Korea Dr. Youngsug KIM, Research Fellow, Construction Environment Research Division, Korea Institute of Construction Technology 9) Case of Laos Mr. Phouthasenh ARKHAVONG, General Deputy Director, Urban Research Institute, Ministry of Communication Transport Post and Construction 10) Case of Malaysia Mr. Mohd Ridhuan Bin ISMAIL, Deputy Director General, Sewerage Services Department, Ministry of Energy, Water and Communications 11) Case of Nepal Mr. Bishnu Prasad TIMILSINA, Divisional Chief (Engineer) Water Supply and Sanitation Division Office, Department of Water Supply and Sewerage, Ministry of Physical Planning and Work 12) Case of Pakistan Mr. Tahir AZIM, Project Director, NWFP Urban Development Project, Local Govt. Elections & Rural Development Department, Government of North West Frontier Province 13) Case of Okinawa Mr. Masaki MATSUI Engineer- General, Okinawa Prefectural Government
Participants	130

The 14th International Symposium on National Land Development and Civil Engineering in Asia

Duration	October 27, 2005
Place	Sendai International Center, Miyagi
Host	National Institute for Land and Infrastructure Management
Theme	Flood, Sediment and Tsunami Related Disasters in Asia
Program	**Keynote Speech "Global Disaster – Lessons from the 2004 Sumatra Earthquake and Indian Ocean Tsunami"** Dr. Fumihiko IMAMURA Professor, Disaster Control Research Center, Graduate School of Engineering, Tohoku University
	Lectures 1) Case of Japan Mr. Tsuneyoshi MOCHIZUKI, Director General, National Institute for Land and Infrastructure Management 2) Case of Tohoku District Mr. Masaharu SHINOHARA, Director, River Department, Tohoku Regional Bureau, Ministry of Land, Infrastructure and Transport 3) Case of Korea Dr. Chang Wan KIM, Research Fellow, Korea Institute of Construction Technology 4) Setting up the International Centre for Water Hazard and Risk Management (ICHARM) under the auspices of UNESCO Mr. Akira TERAKAWA, Director, Secretariat for Preparatory Activities of UNESCO-PWRI Centre, Public Works Research Institute
	Panel Discussion "Flood, Sediment and Tsunami Related Disasters in Asia" - M.C.: Mr. Ryosuke TSUNAKI, Director, Research Center for Disaster Risk Management, NILIM - Panelists: 1) Dr. Fumihiko IMAMURA, Professor, Tohoku University 2) Mr. Tsuneyoshi MOCHIZUKI, Director General, NILIM 3) Mr. Masaharu SHINOHARA, Director, River Department, Tohoku Regional Bureau 4) Dr. Bunna YIT, Director, Public Works Research Center, Ministry of Public Work and Transport, Kingdom of Cambodia 5) Mr. Janak Jerambhai SIYANI, Chief Engineer (R&B) & Add Secretary, Roads & Buildings Department, Government of Gujarat, India 6) Dr. Chang Wan KIM, Research Fellow, Water Resources Research Department, Korea Institute of Construction Technology, Republic of Korea 7) Mr. Keophilavanh APHAYLATH, Director General, Urban Research Institute, Ministry of Communication, Transport, Post and Construction, Lao People's Democratic Republic 8) Ms. Rebecca Trazo GARSUTA, Chief, Development Planning Div. Planning Service, Dept. of Public Works and Highways (DPWH), Republic of the Philippines 9) Mr. Akkapong BOONMASH, Director, Improvement and Maintenance Division, Office of Hydrology and Water Management, Royal Irrigation Department, Ministry of Agriculture and Cooperatives, Kingdom of Thailand 10) Mr. NGUYEN Xuan Hien, Deputy Director, Sub-Institute for Water Resources Planning (SIWRP), Ministry of Agriculture and Rural Development, Socialist Republic of Viet Nam
Participants	80

The 15th International Symposium on National Land Development and Civil Engineering in Asia

Duration	November 16, 2006
Place	Aichi Arts Center, Nagoya
Host	National Institute for Land and Infrastructure Management
Theme	Economic and Social Effects of Road Network Development in Asia
Program	**Lectures** 1) Automotive Safety Technologies Toward Achieving Sustainable Mobility" Mr. Takashi SHIGEMATSU, Managing Officer, Toyota Motor Corporation 2) Case of Japan Mr. Tsuneyoshi MOCHIZUKI, Director General, NILIM 3) Case of Chubu District Mr. Toshio SAKAI, Director, Road Department, Chubu Regional Bureau 4) Case of Korea Dr. Weon-Eui KANG, Director of Highway Engineering Research Department, Korea Institute of Construction Technology
	Panel Discussion "Economic and Social Effects of Road Network Development in Asia" - M.C.: Mr. Hiroshi SATO, Director, Road Department, NILIM - Panelists: 1) Mr. Tsuneyoshi MOCHIZUKI, Director General, NILIM 2) Mr. Toshio SAKAI Director, Road Department, Chubu Regional Bureau, MLIT 3) Mr. Guang-Tao YIN, Senior Engineer, Vice Director, Urban Transport Institute, China Academy of Urban Planning and Design, People's Republic of China 4) Mr. Hikmat ISKANDAR, Head, Traffic & Envir. Lab., Research and Development Centre for Road and Bridges, Republic of Indonesia 5) Dr. Weon-Eui KANG, Director, Highway Engineering Research Dept. Korea Institute of Construction Technology, Republic of Korea 6) Mr. Pothong NGONPHACHANH, Deputy Director General, Department of Roads, Ministry of Communication, Transport, Post and Construction, Lao People's Democratic Republic 7) Mr. Amrullah KAMAL, Deputy Director 3, Public Work Department, Malaysia 8) Mr. Ramesh Raj BISTA, Deputy Director General, Department of Road, Nepal 9) Mr. Bashir AHMED, Director (Roads), Ministry of Communication, Islamic Republic of Pakistan 10) Mr. Raul Conde ASIS, Assistant Secretary, Department of Public Works and High ways, Republic of the Philippines
Participants	120

The 16th International Symposium on National Land Development and Civil Engineering in Asia

Duration	December 3, 2007
Place	Hotel Shiragiku, Beppu
Host	National Institute for Land and Infrastructure Management
Theme	Integrated Water Resource Management Adapting to the Global Climate Change in Asia
Program	**Lectures** 1) Integrated Water Management under the Global Warming Scenario –Case Study of Northern Kyusyu with Scarce Water Resources– Dr. Kenji JINNO Professor, Faculty of Engineering, Kyushu University
	Presentation and Discussion "Integrated Water Resource Management Adapting to the Global Climate Change in Asia" - M.C.: Mr. Kazunori OODAIRA, Director, River Dept., NILIM -Panelists: 1) Dr. Kenji JINNO, Professor, Faculty of Engineering, Kyushu University 2) Mr. Shin TSUBOKA, Director General, NILIM 3) Mr. Yoshinori ASHIDA, Director, Planning Dept.,Kyusyu Regional Bureau, MLIT 4) Mr. Dhinadhayalan MURUGESAN, Assiatant Adviser of Public Health and Environmental Engineering, Central Public Health and Environmental Engineering Organization, Ministry of Urban Development, India 5) Dr. Seok-Young YOON Director, Policy Research Division , Korea Institute of Construction Technology, Republic of Korea 6) Mr. Wan Abd Rahim Bin WAN ABDULLAH, Director, Sewerage Services Dept., Ministry of Energy, Water & Communication, Malaysia 7) Dr. Judy Famoso SESE, Director Ⅲ, Bureau of Research & Standards, Dept. of Public Works and Highways, Republic of the Philippines 8) Ms. Paniyanduwage Nalanie Sriyalatha YAPA, Deputy General Manager, National Water Supply & Drainage Board, Democratic Socialist Republic of Sri Lanka 9) Ms. DANG Anh Thu, Expert (environmental management and urban planning), Department of Urban Technical Infrastructure, Ministry of Construction, Socialist Republic of Vietnam ,
Participants	100

The 17th International Symposium on National Land Development and Civil Engineering in Asia

Duration	October 28, 2008
Place	Chisum Hotel & Conference Center Niigata
Host	National Institute for Land and Infrastructure Management
Theme	Prevention and Mitigation of Natural Disasters in Asia
Program	**Lectures** 1) Feature of Ground Disaster in 2004 Chuetsu Earthquake Dr. Satoru OHTSUKA Professor, Department of Civil and Environmental Engineering, Nagaoka University of Technology **Presentation and Discussion** "Prevention and Mitigation of Natural Disasters in Asia" - M.C.: Mr. Haruo NISHIMOTO, Director, Research Center for Disaster Risk Management., NILIM -Panelists: 1) Dr. Satoru OHTSUKA, Nagaoka University of Technology 2) Mr. Akihiko NUNOMURA Director General, NILIM 3) Mr. Shinji YAMAGUCHI, Deputy Director Planning Dept., Hokuriku Regional Bureau, MLIT 4) Mr. Habibullah HABIB, Islamic Republic of Afghanistan 5) Mr. Katry PHUNG (Ph.D.), Kingdom of Cambodia 6) Mr. Amit JAIN, Republic of India 7) Mr. Dading SUGANDHI, Republic of Indonesia 8) Mr. Hojjat Ali SHAYANFAR, Islamic Republic of Iran 9) Mr. Mushtaq Ali ZAKA, Islamic Republic of Pakistan 10) Ms. Janette Mati SADIE, Republic of the Philippines 11) Ms. Huong Thi Lan HUYNH, Socialist Republic of Viet Nam
Participants	107

TECHNICAL NOTE of NILIM
No. 599 June 2010

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