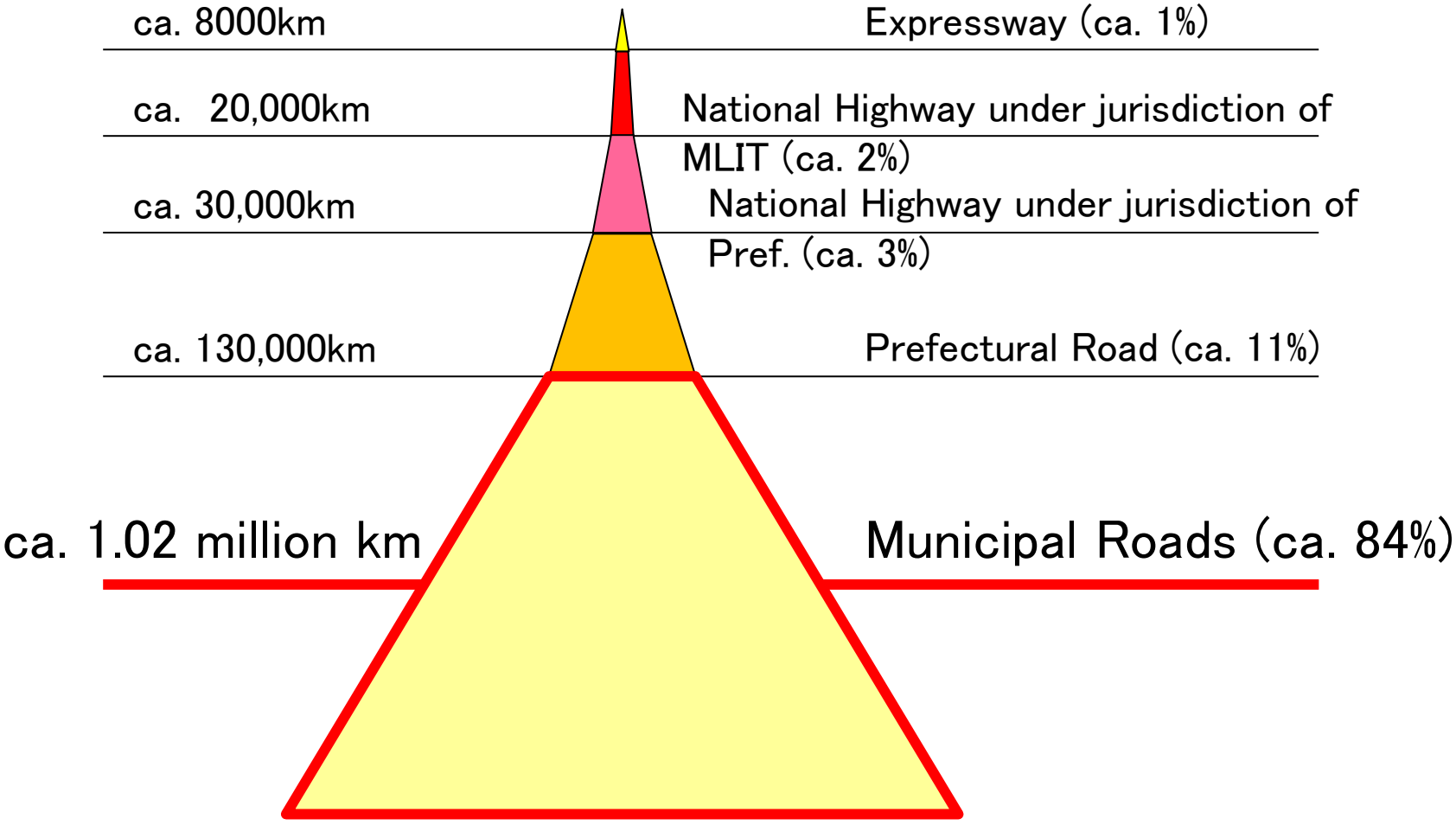
Road Maintenance in Japan: Problems and Solutions

Road Lengths by Road Type

The total road length in Japan is ca. 1.21 million km. Municipal roads account for 80% of total length.

【Road types and their percentages in Japan】

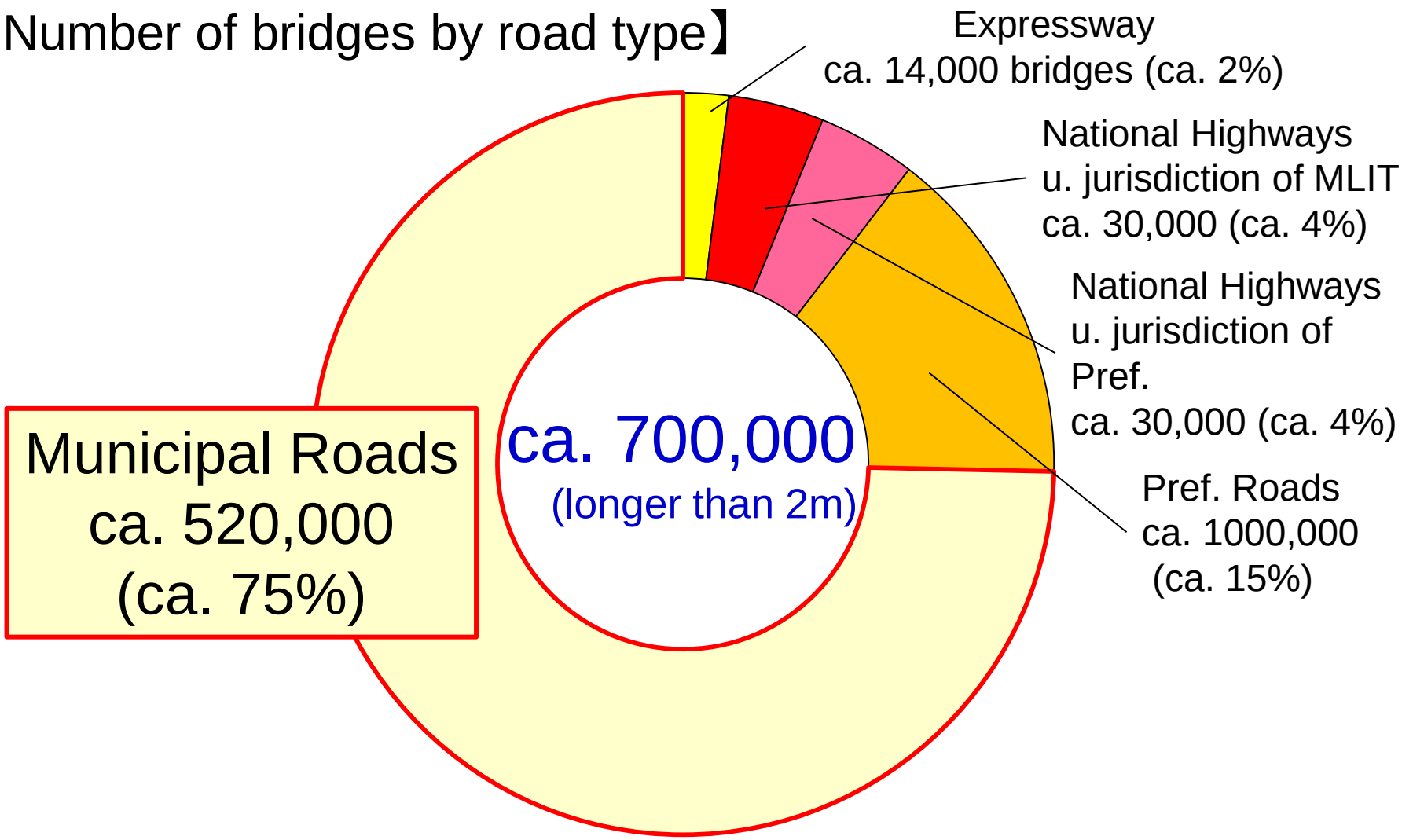


Total ca. 1.21 million km

Number of Bridges by Road Type

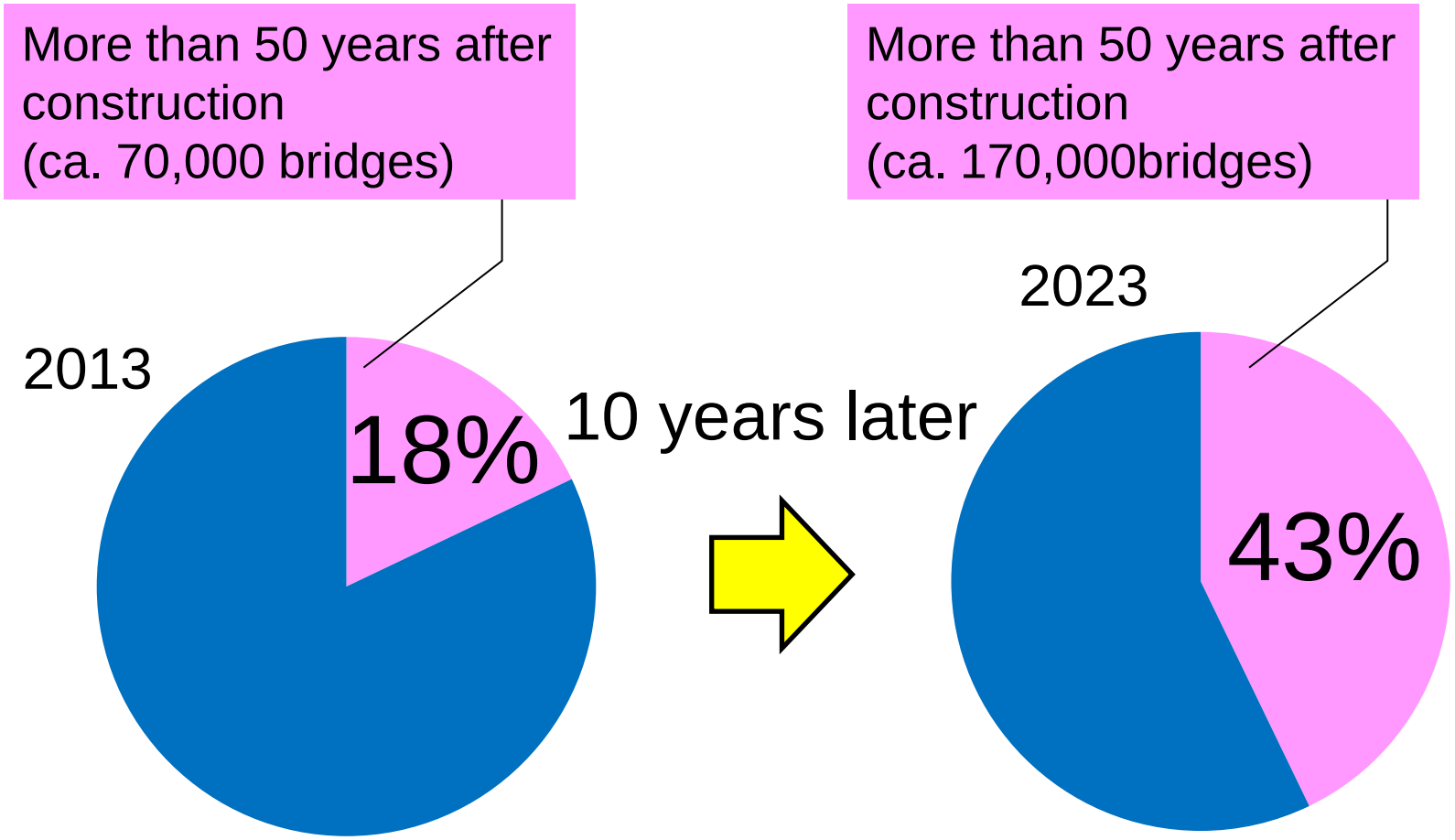
Ca. 70% of total 700,000 bridges are on municipal roads.

【Number of bridges by road type】



Bridges Older than 50 Years

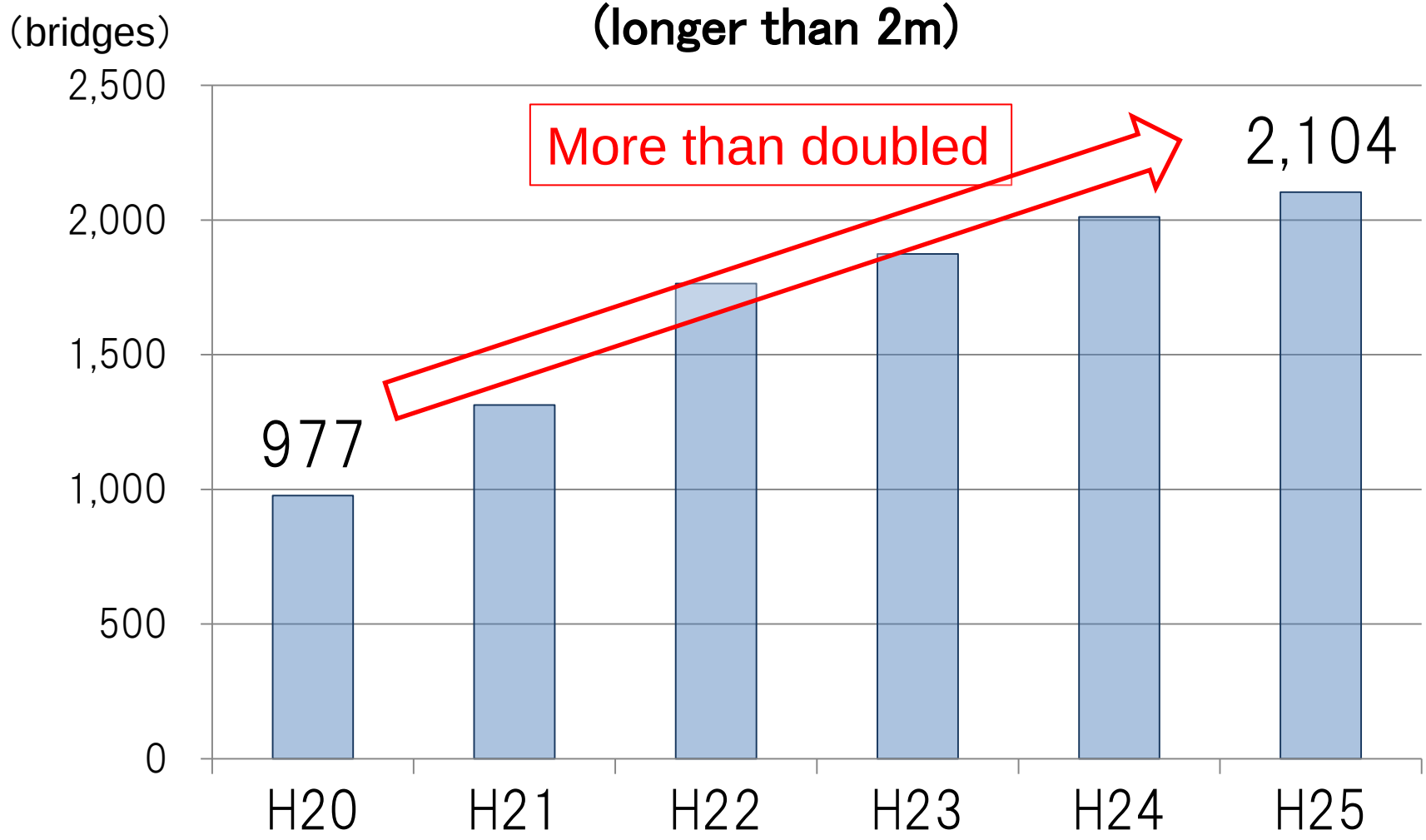
There are ca. 700,000 bridges in Japan. The percentage of bridges that are 50 years old from date of construction increases to 43% within 10 years.



Increase of Traffic Restrictions on Bridges

Traffic restrictions on municipality administration bridges have increased more than 2 times in the last 5 years.

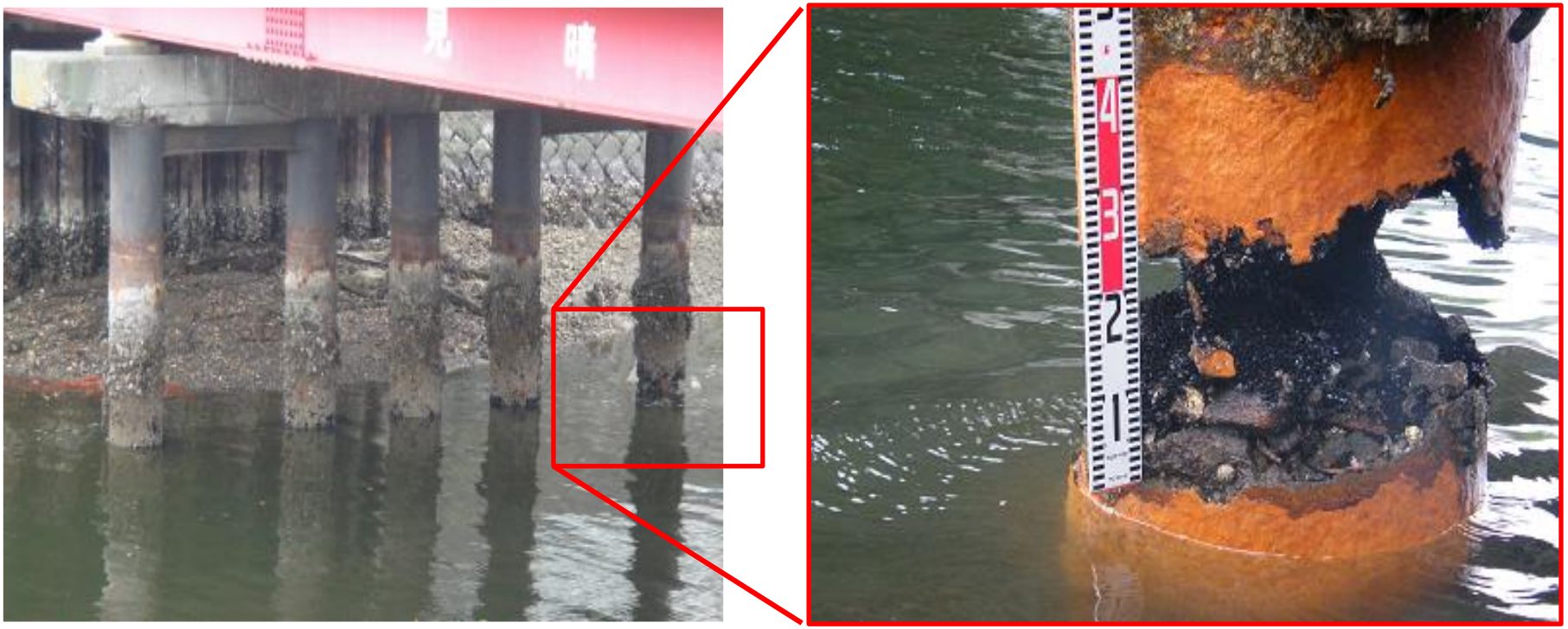
Traffic restrictions on municipality administration bridges (longer than 2m)



Example of Severe Damage

Deformation due to aging has become obvious in some parts of the structures, especially in those that are constructed rapidly or that are located in severe environments.

■Miharashi-bridge (Shin Yamashita, municipal road 8, Central-ward, Yokohama City) Damage is detected 37 years after construction.



Example of Bridge Life Extension

This bridge has been functioning more than 80 years without major damage due to proper repairs and enhancements.

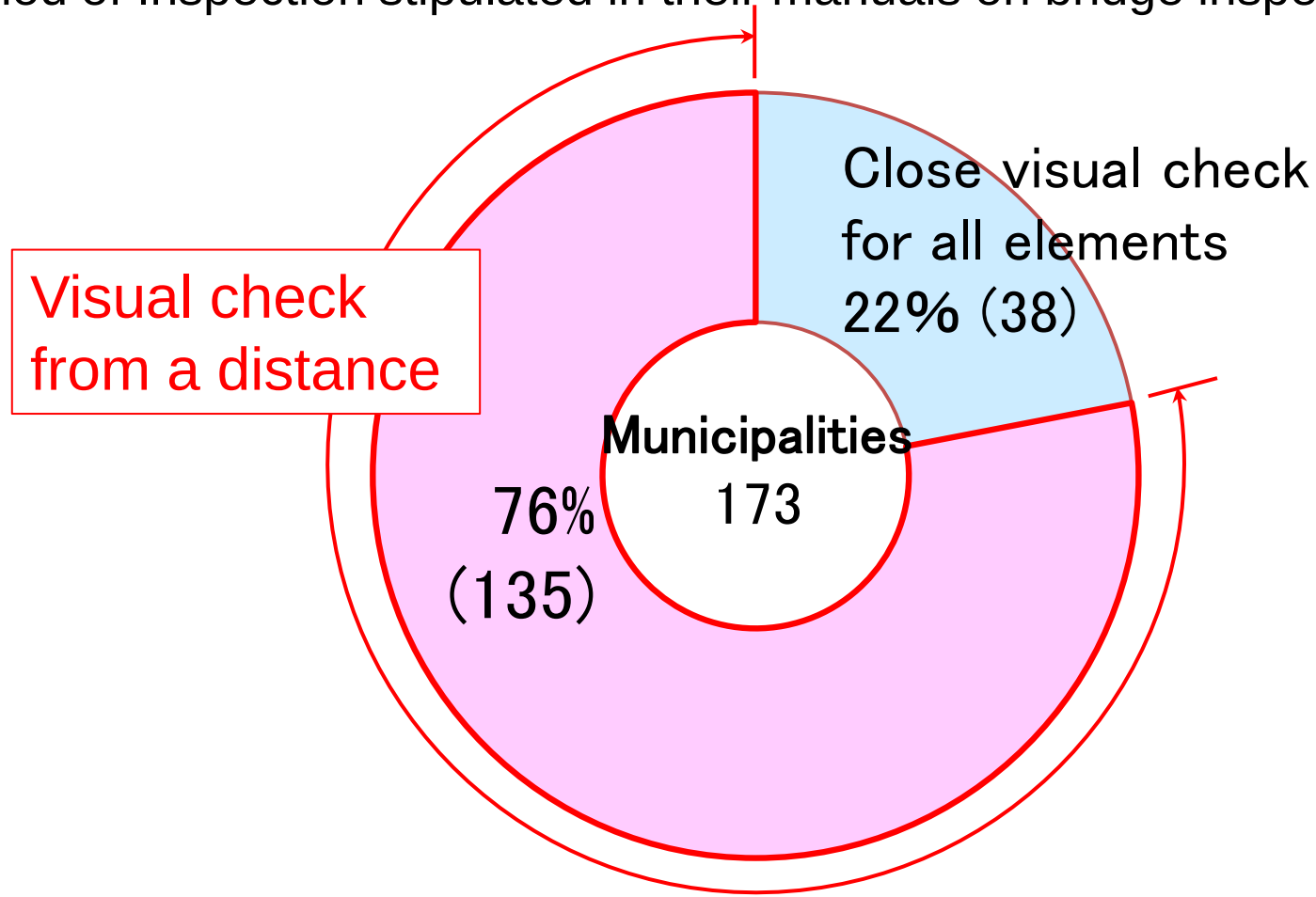
■Saigawa-Ohashi (National Highway 157, Kanazawa City)

Opened in 1924

Status of Municipality Inspection Methods

80% of the Manuals on Bridge Inspection developed by municipalities stipulated visual checks from a distance as an appropriate inspection method, but the quality of that inspection can be problematic.

■Method of Inspection stipulated in their manuals on bridge inspection:

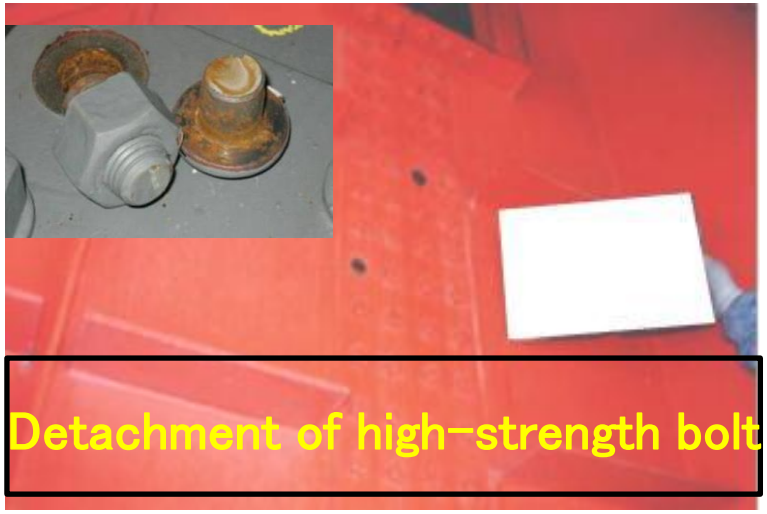


Necessity of Close Visual Checking

■Examples of blind spots

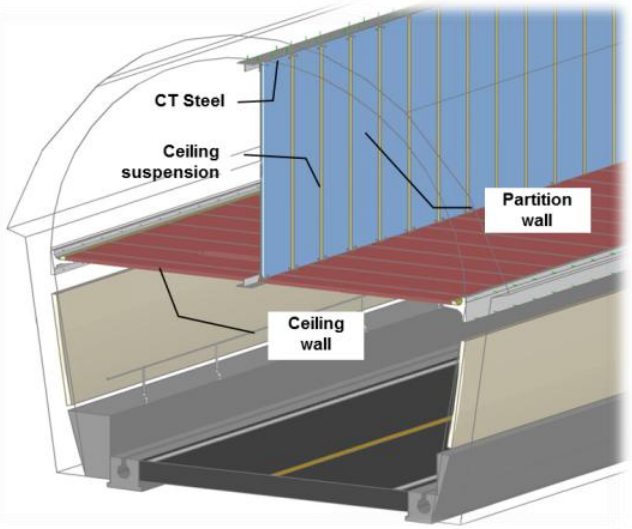
Risk of overlooking does exist

■Loosen/detached bolts

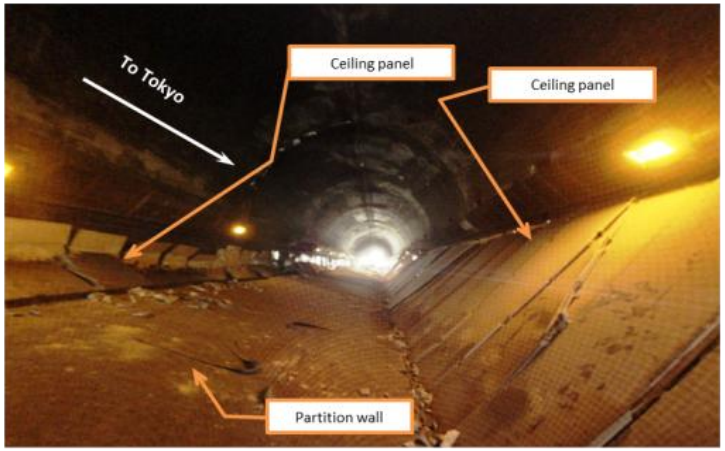


Ceiling Panel Collapse in the SASAGO Tunnel

- December 2, 2012
- Tunnel opened: 1977 (35 years old)
- Daily Traffic Volume: 40,576 (both directions, as of 2010)
- 3 vehicles involved, 9 dead, 2 injured
- Dec. 29: Re-opened a single-lane in each direction
  Feb. 8, 2013: Fully re-opened

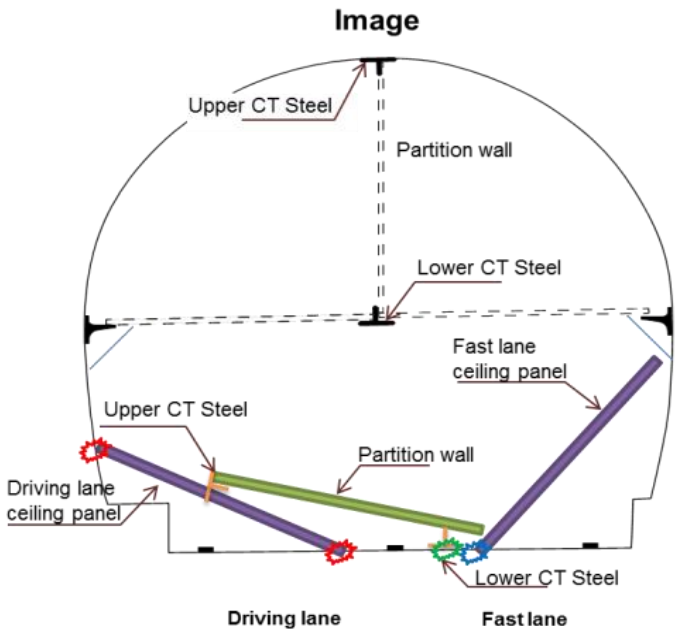


Sasago Tunnel (east bound) to Tokyo



driving lane fast lane

(Dec. 5, 2012)



Urgent and Concentrated Inspection

Urgent inspections were implemented, and confirmed the minimum safety necessary to prevent damage to a third party.

【Urgent Inspections】

Equipment within the tunnels (jet fan, lighting, sign)

【Concentrated Inspections】

Bridges and tunnels on major arterial highways

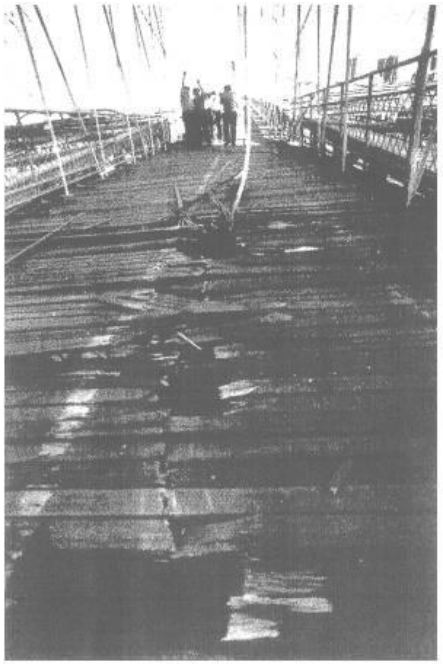
Inspection of tunnel equipment

Bridge Inspection

“America in Ruins” in the 1980s

In June 1981, cables on the aging Brooklyn Bridge broke and a pedestrian was hit, killing him.

Brooklyn Bridge (full view, 1980)



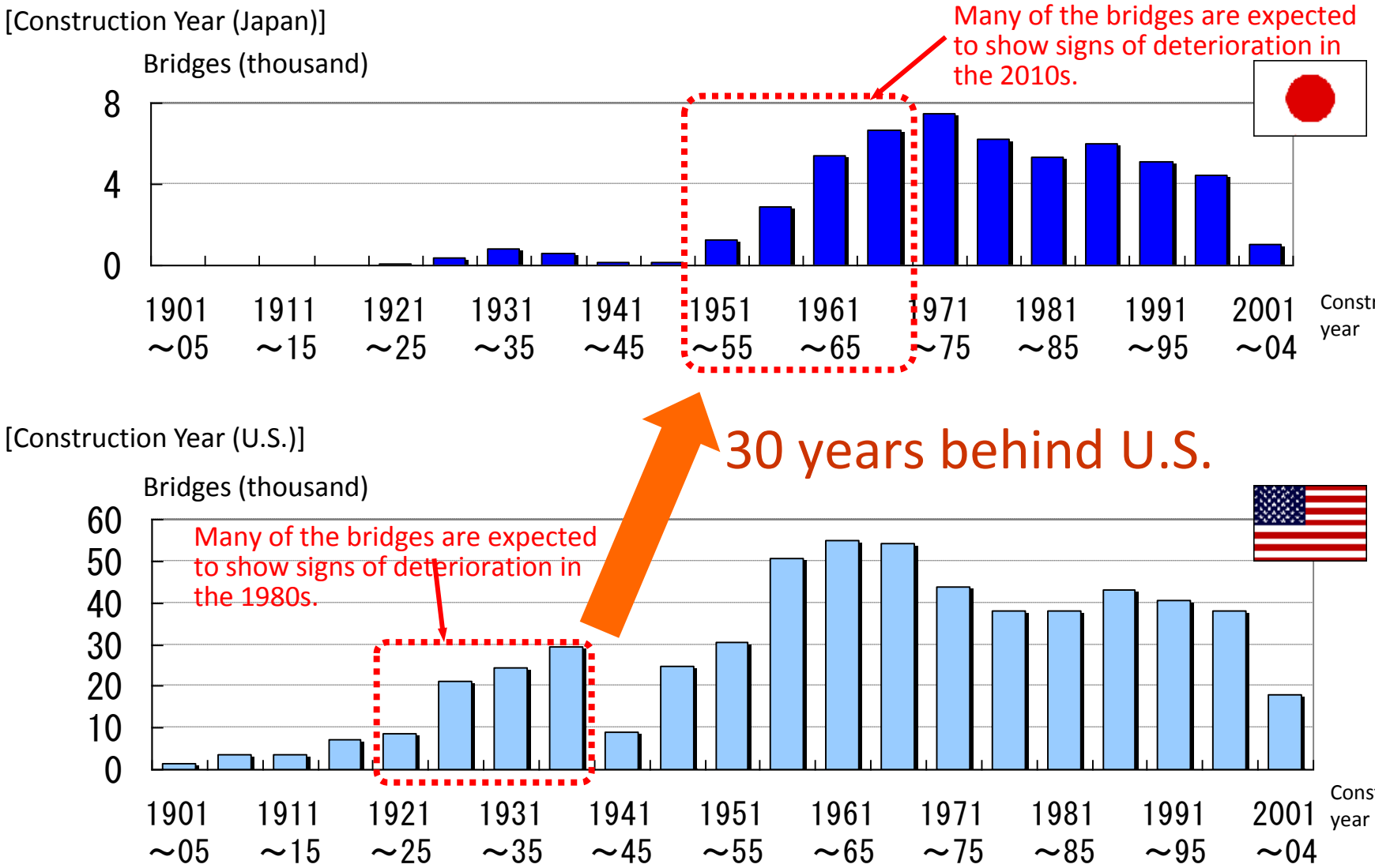
Walkway damaged by snapped cables

(New York Times, 8th October 1984)

- On the afternoon of June 28th, 1981, two cables (length: 180cm, diameter: 5cm) on the Brooklyn Bridge broke.
- One of the cables made holes in the walkway and the other cable hits a pedestrian.
- It was the first fatal pedestrian accident in the 100 years of the Brooklyn Bridge’s history.

Aging Bridges

A number of U.S. bridges started deteriorating in the 1980s, 30 years earlier than bridges in Japan.



Reduction of Maintenance Spending on National Highways

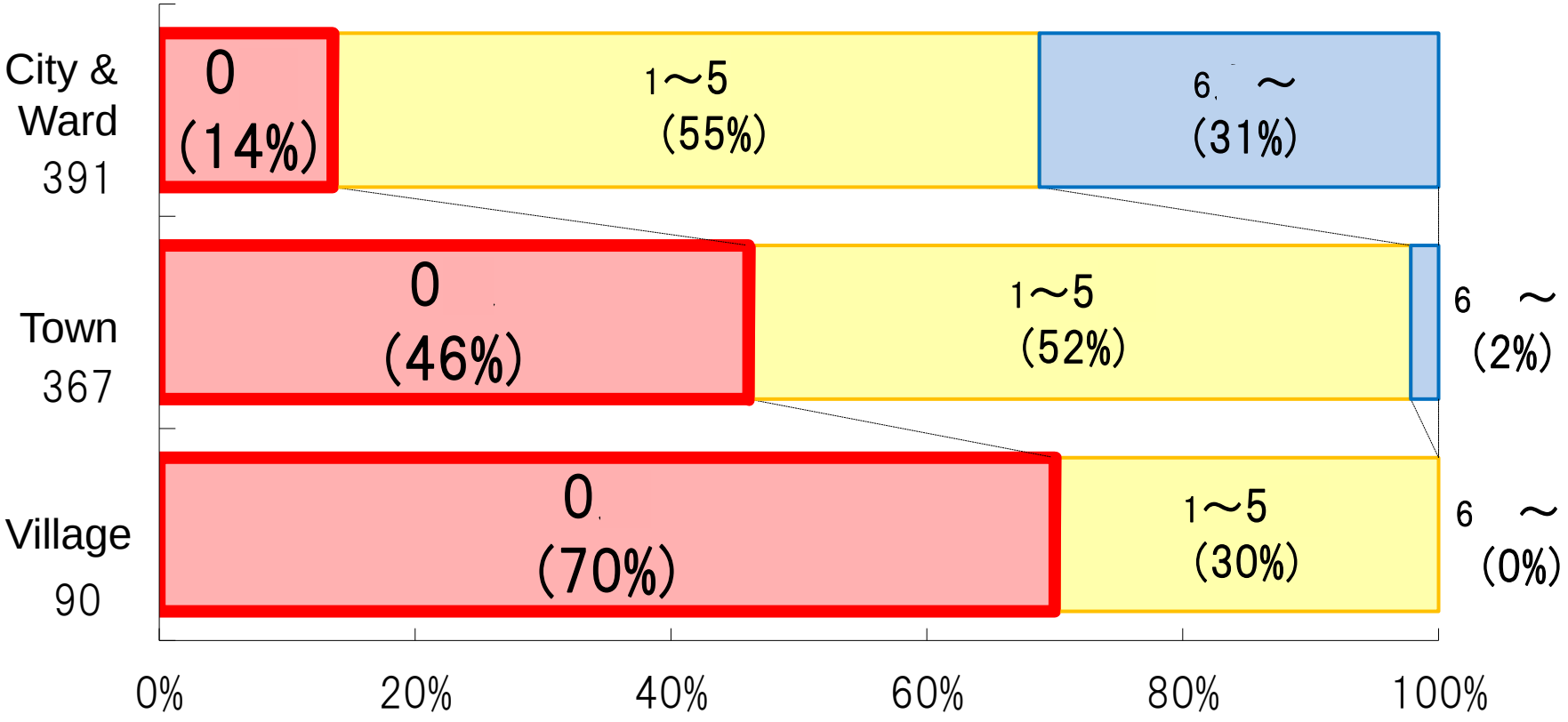
Spending on national highways has reduced by 30% in the last 10 years.
Although spending on maintenance and repairs should have increased, it has been reduced by 20%.

Spending on National Highways and their maintenance and repairs

Reality of Municipality's Maintenance (engineer shortage)

50% of all towns and 70% of all villages in the country have no civil engineering technicians for bridge maintenance in their workforce.

Number of bridge maintenance engineers in the workforce of three types of municipal governments:



Overview of Current State (2 Fundamental Problems)

Current Status of Road Structures

- 500,000 out of 700,000 bridges are maintained by municipalities.
- Deterioration of some bridges is already surfacing.
- The number of municipal bridges that have traffic restrictions has doubled in the last 5 years.

Overview of Current State (2 Fundamental Problems)

Aging Problem

Maintenance/repair spending for National Highways has reduced by 20% in the last 10 years.

50% of towns and 70% of villages have no civil engineering technicians for bridge maintenance in their workforce.

Some municipal inspections include distant visual inspection that can prove problematic.

Directions Ahead

Facilitate maintenance of municipal roads by focusing on the following 2 components:

1) Establish a maintenance cycle (clear responsibility for administrators)

Each road administrator takes charge of the whole maintenance cycle.

Inspection | Evaluation | Action | Record

2) Establish a mechanism to facilitate the maintenance cycle (support)

Establish a mechanism to facilitate the maintenance cycle in a sustainable way.

Budget | System | Skill | Public Acceptance/support

Implementation of Ministerial Ordinance and Public Notice and Notification of Inspection Guideline (Clear statement of responsibilities for road administrators)

[Inspection] Implement, once-every-five-years, a close visual inspection of all bridges and tunnels, according to the uniform national standard.




An excerpt from the Ordinance for Enforcement of Road Act (promulgated on Mar 31, 2014 and enacted on July 1)

(Technical standards for road maintenance and repair)
Basically, a close visual inspection shall be carried out once every five years.

Evaluation of structure conditions across the nation using a uniform standard.

The ministerial ordinance and notice for classification of tunnel conditions (promulgated on Mar 31, 2014 and enacted on July 1, 2014.)

Tunnel evaluation results shall be classified into the following categories according to their conditions:

Category		Condition
Ⅰ	Good	No structural deficiency
Ⅱ	Preventive maintenance	Preventive maintenance is desirable, although no structural deficiency is found.
Ⅲ	Early rehabilitation	The structure needs early rehabilitation, or it can become deficient
Ⅳ	Emergency rehabilitation	The structure needs emergency rehabilitation, because it is deficient or it will most likely become deficient.

Periodic inspection guidelines are notified to all road administrators on June 25.

National Guideline for Periodic Bridge Inspection

MLIT has developed a periodic inspection guideline containing types of bridge deformations to be looking for and case examples to technically assist municipalities in carrying out their inspections.

道路橋定期点検要領

Guideline for Periodic Road Bridge Inspection

平成２６年６月

国土交通省　道路局

Prepared by Road Bureau, MLIT (June 2014)

Damage on concrete parts	4. Cracking	3／4

Damage Category : IV	**[Emergency rehabilitation stage]** The structure needs emergency rehabilitation, because it is deficient or it will most likely become deficient.

Example

Main girder has prominent cracks near the fulcrum, which substantially deteriorates the supporting capability of the girder.

Example

Main parts have a significant number of cracks, showing the possibility of a fracture ~~of~~ inside steel.

Example

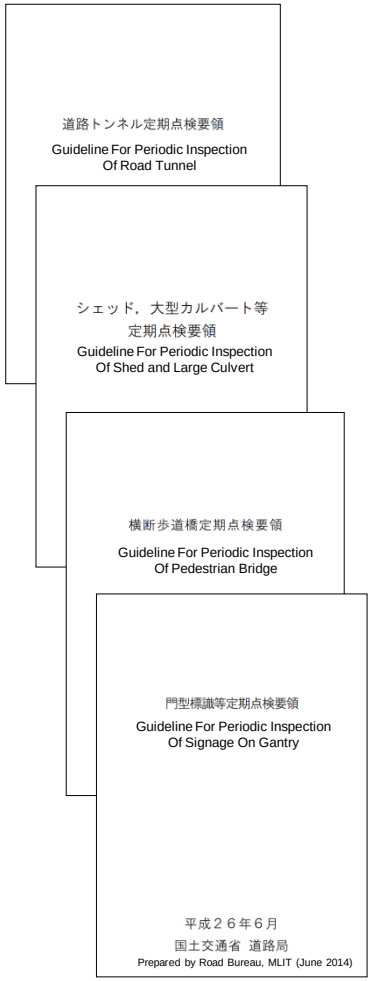
Receiving beam and other critical parts have prominent cracks, which can cause a bridge collapse.

Example

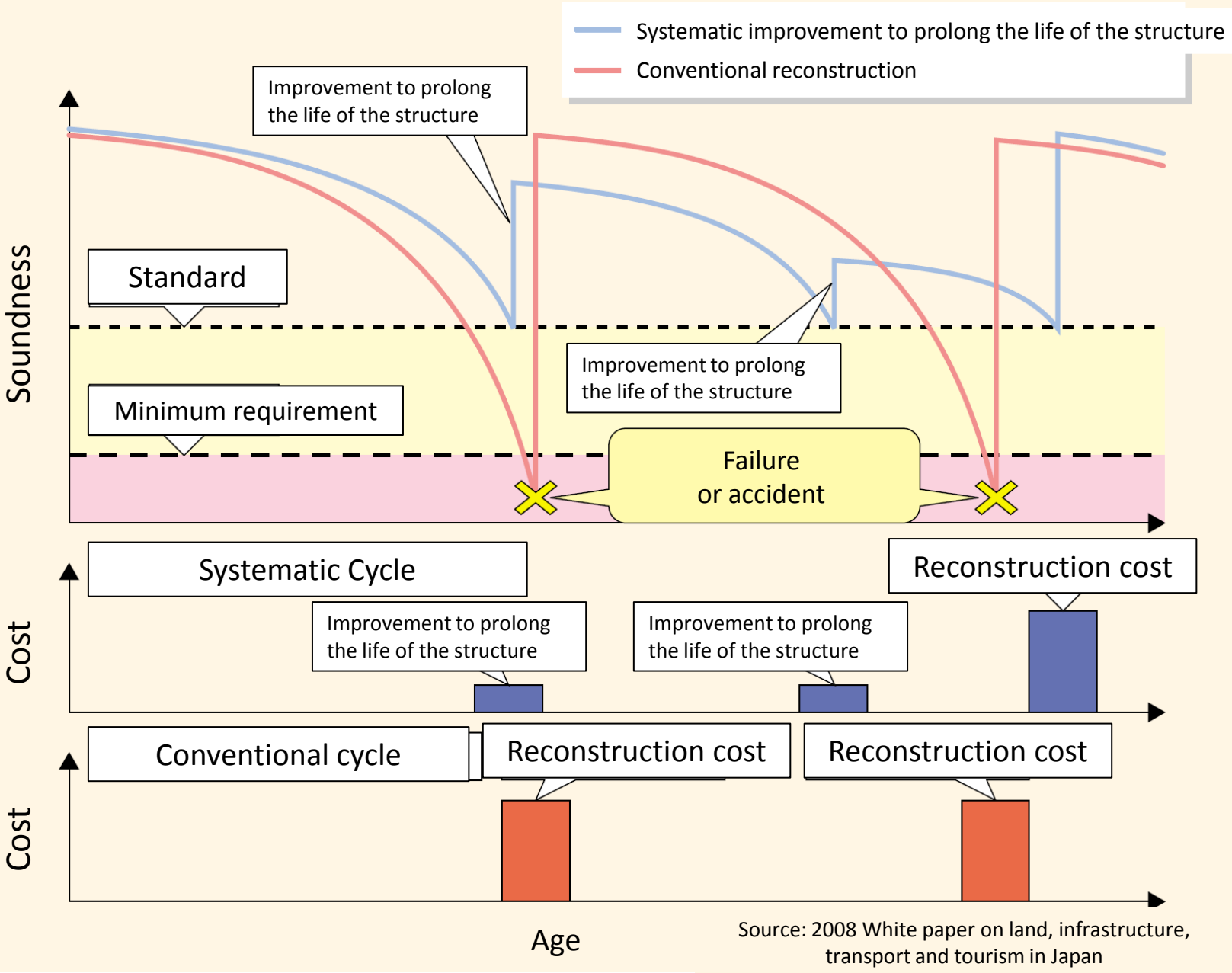
Girders and pillars in the substructure have prominent cracks, which can cause a bridge collapse if the deterioration proceeds.

Remark

If cause of cracks and influences on the parts are not easily determined, further detailed inspection should be done.



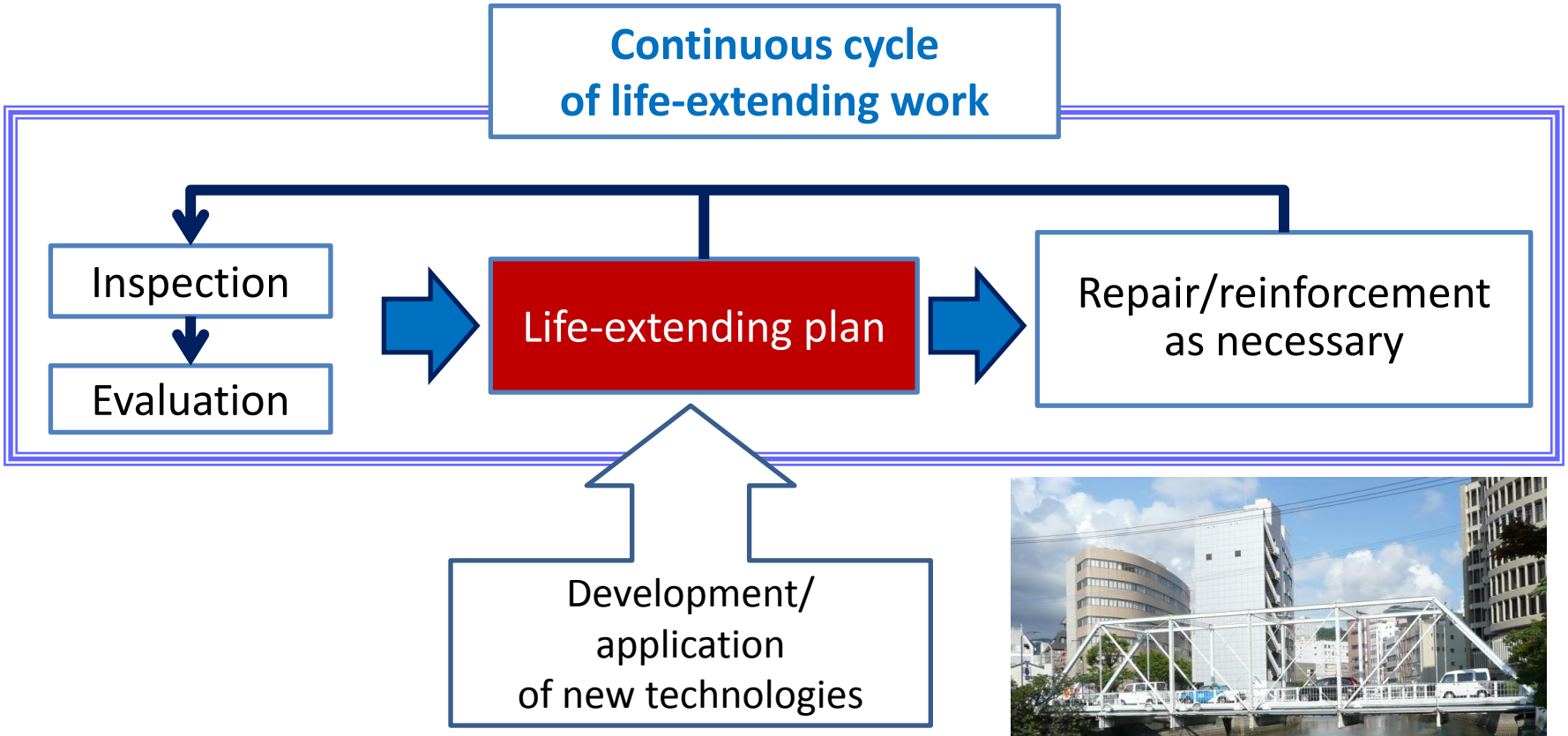
Saving Life Cycle Costs through Preventive Maintenance



Source: 2008 White paper on land, infrastructure, transport and tourism in Japan

Life Extending Cycle

- Periodic inspection and evaluation: Identify what is causing the damage
- Life-Extending Repair Plan: Specify countermeasures and frequencies/timing for their implementation
- Prioritizing countermeasures will reduce the total cost and the level of annual expenses



Dejima Bridge (Nagasaki Pref.)
Built in 1910 (about 102 years old)

Road Maintenance Panels to Assist Municipalities

Road Maintenance Panels were launched to facilitate cooperation between interested parties, to grasp and share the current issues, and to assist with creating effective measures for aging roads.

Members

-Regional Development Bureau (under MLIT)

-Municipalities (prefectures, cities, towns and villages)

-Expressway companies (NEXCOs, Tokyo Metropolitan Expressways, and others) and Prefectural Road Public Corporation

Roles

1. Facilitate training and dissemination of inspection standards.
2. Selection and confirmation of prioritized roads for inspection and repair.
3. Organization, evaluation, and publication of current inspection and repair work.
4. Assistance for area-wide package ordering of inspection work.
5. Technical assistance.

Miyazaki Prefecture road maintenance panel meeting on May 28, 2014

Raising Public Awareness (a mechanism to facilitate the maintenance cycle)

Raise public awareness of aging roads and countermeasures by holding an on-site tour.

On-site tour

Facilitate a bridge tour for the local residents and students in cooperation with universities.

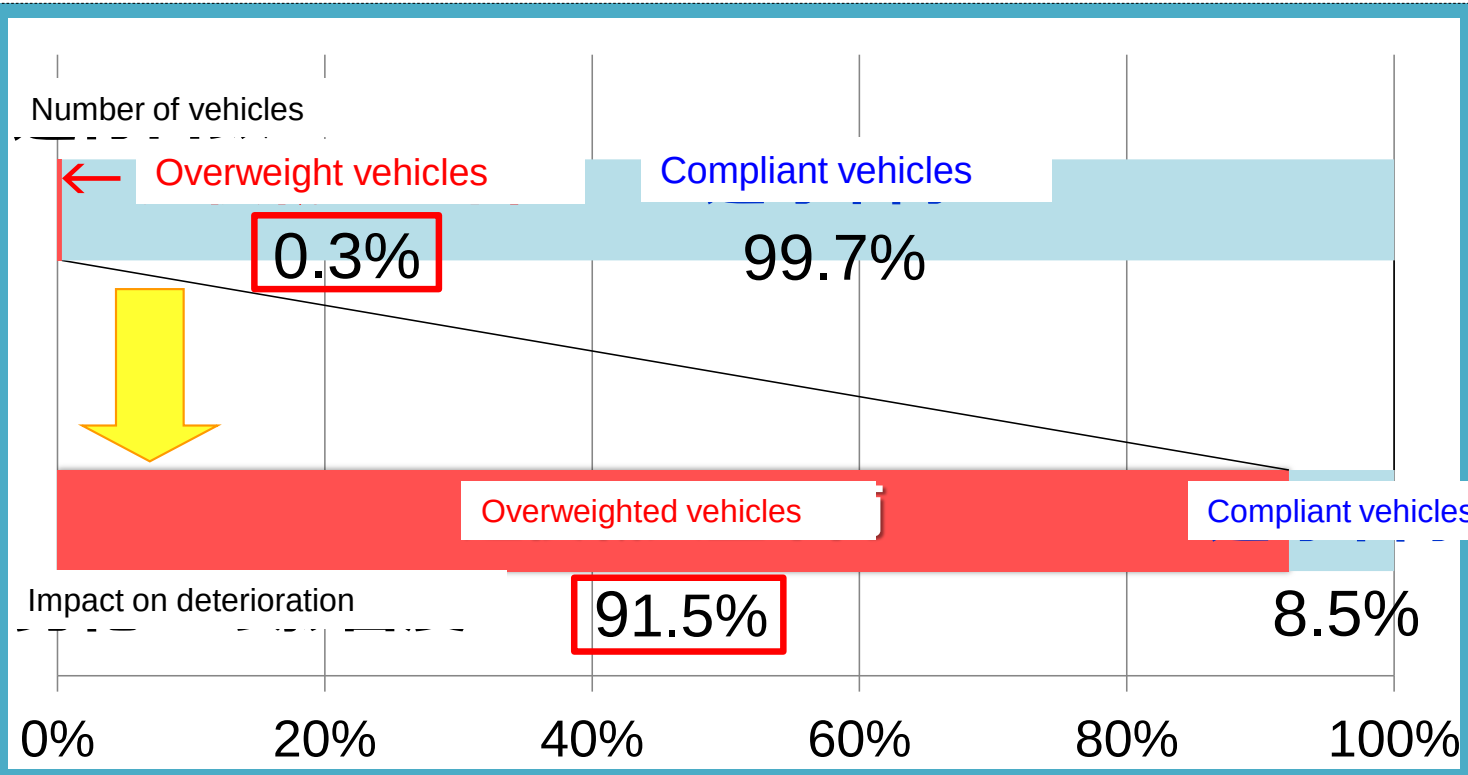
[1st On-site tour for road maintenance in Fukui Pref.]
-Date: Thursday, May 29, 2014
-Participants: Fukui Office of River and National Highway, Kinki Regional Development Bureau, Kanazawa Branch of NEXCO Central, several civil engineering offices, municipalities in the prefecture, construction technology research center of Fukui Pref., Fukui prefectural public corporation for construction technology, Fukui University (46 participants) and 3 other companies (Fukui Shimbun, Engineering & Construction News and Fukui Television).

Impact of Heavy Goods Vehicle Traffic on Roads

Overweight HGVs, accounting for only 0.3% of all traffic, are responsible for 90% of road bridge deterioration.

1. A national experiment found that deterioration of the RC floor slab of a road bridge is proportional to a vehicle's weight to the power of 12.

2. The impact of a truck with a 20t axle load on a road bridge is equivalent to 4,000 trucks with 10t of axle load.



Source: estimated from Weigh-in-Motion measurement data (39 locations across the country)

Thank you for listening