

# Maintenance of Road Bridges in Japan

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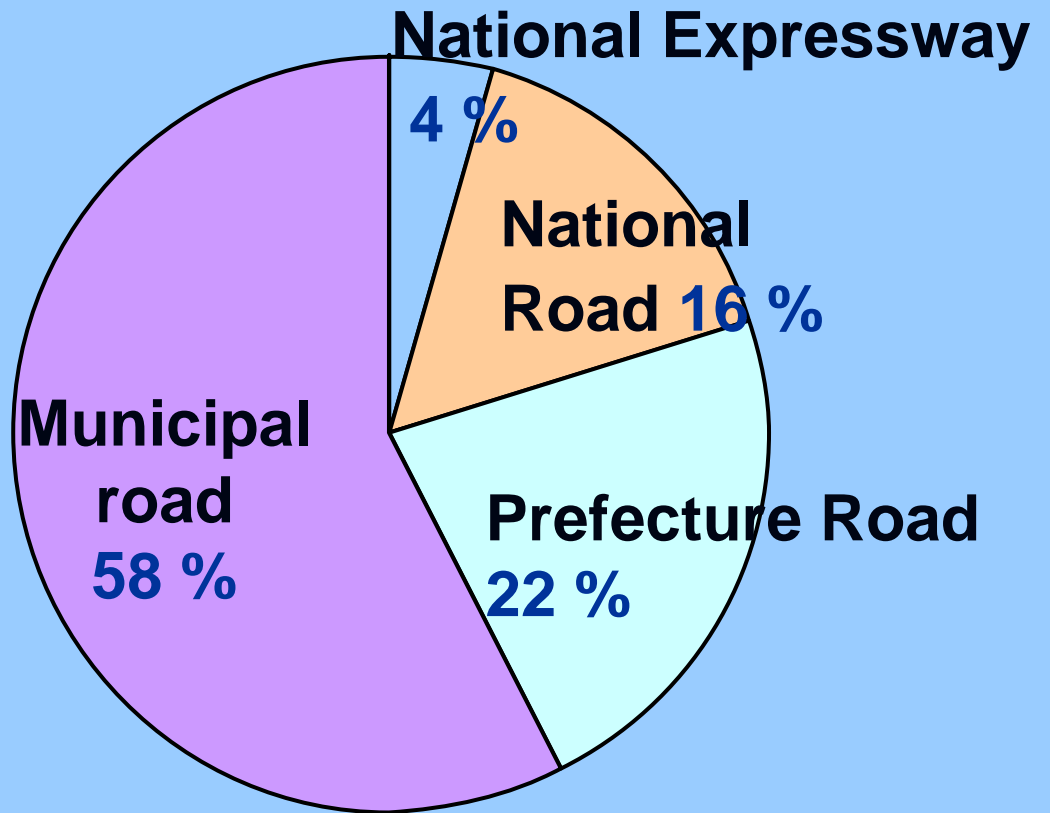
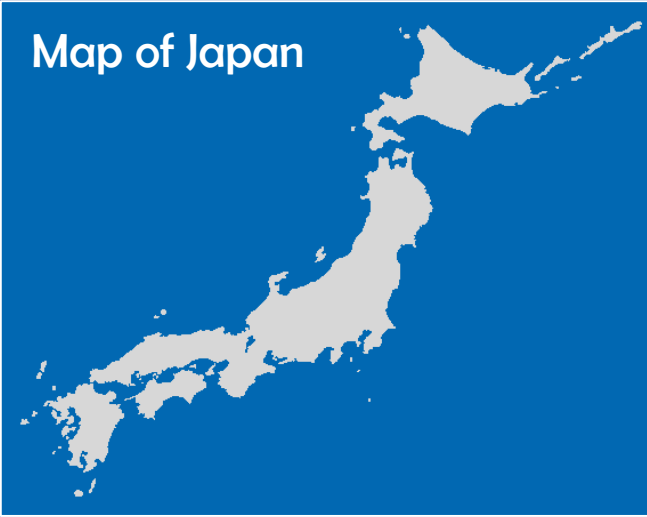
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# Administrative Proportion of Bridges in Japan

## 148,223 Bridges

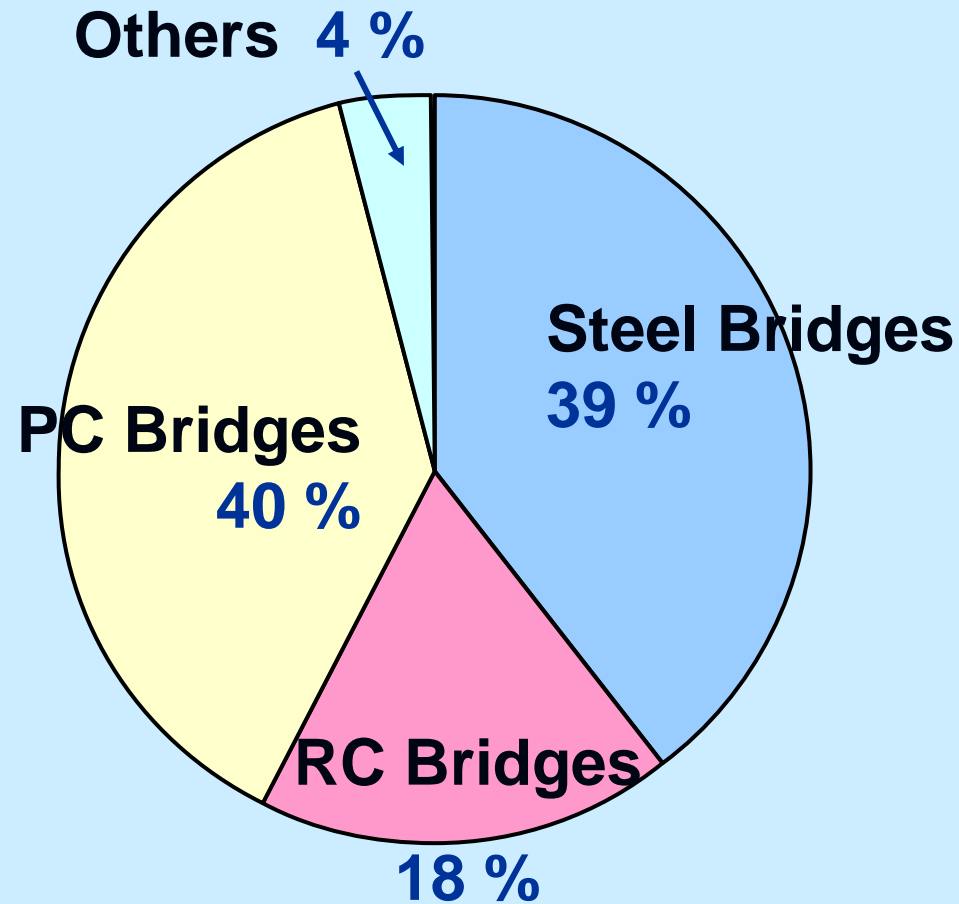
Map of Japan



Bridges with the length longer than 15m

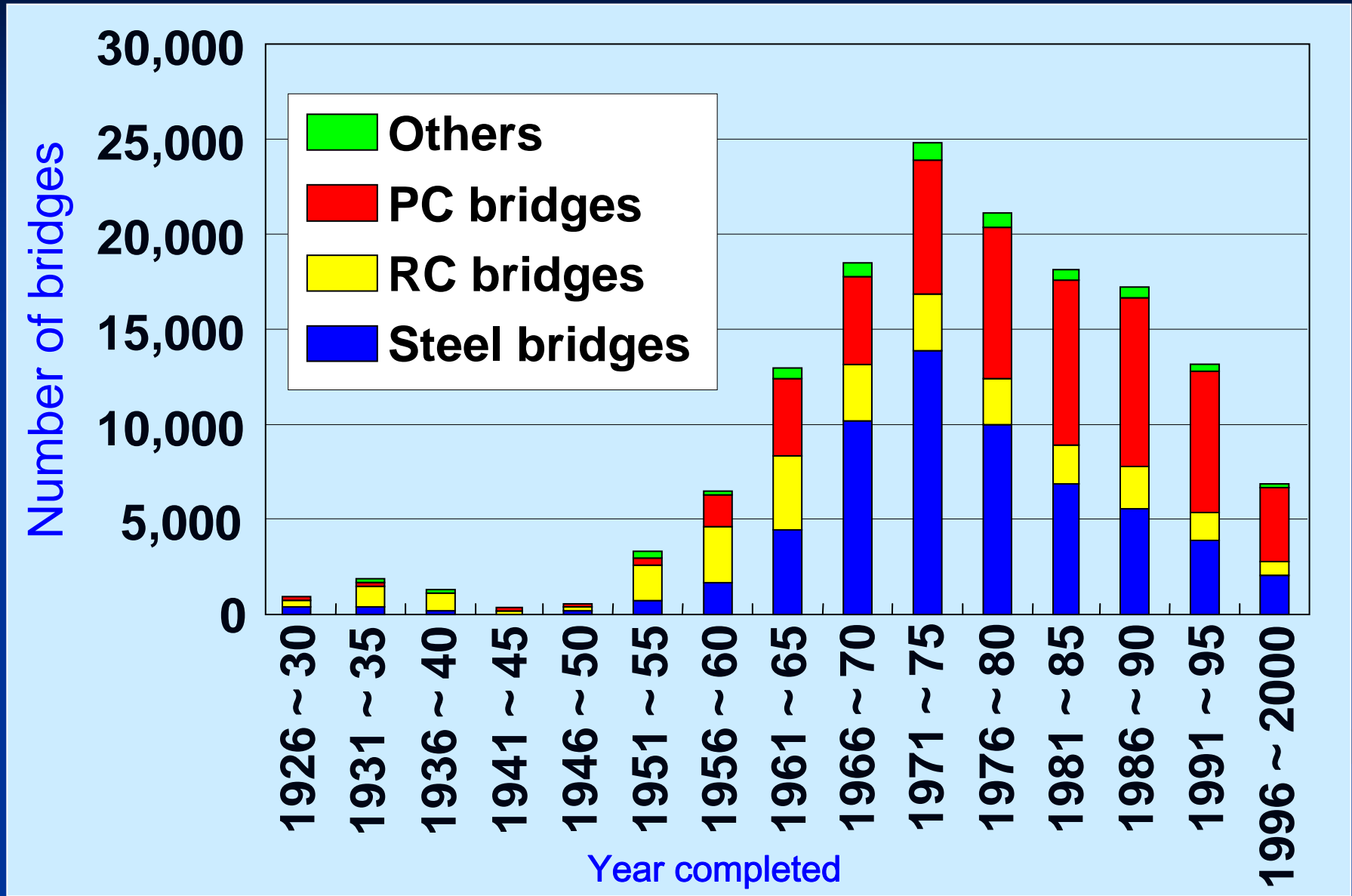
# Material Proportion of Bridges in Japan

148,223 Bridges

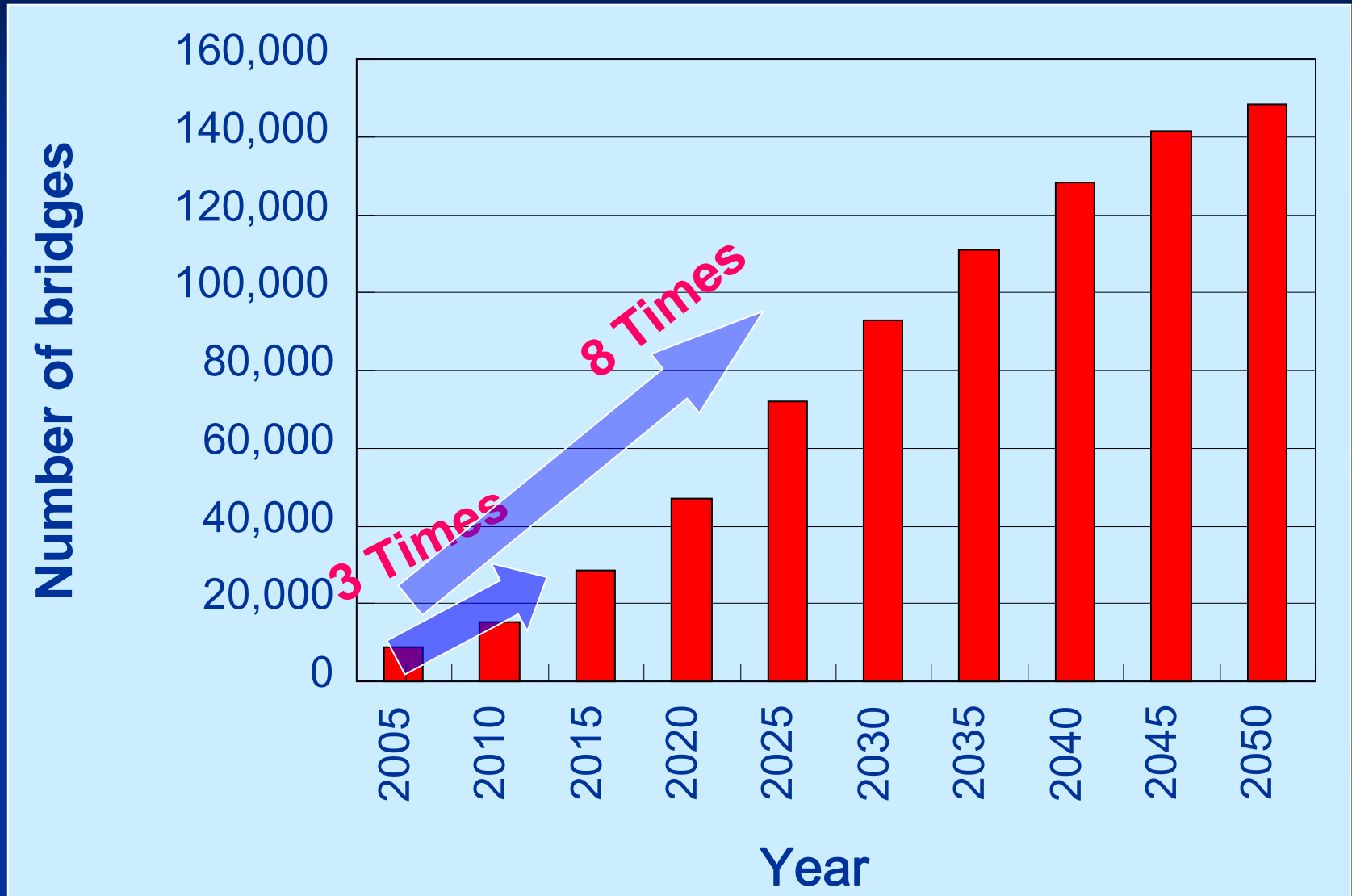


Bridges with the length longer than 15m

# Number of Bridges by Year Completed



# Increase in Number of Bridges over 50 Years Old



Bridges with the length longer than 15m

# Problem

Very Rapid Aging of Japanese Bridges  
Funds for Reconstruction is Insufficient



# Solution

Introduction of Concept of Asset Management

# Major Damage of Bridges in Japan

## 1. Fatigue cracks at corner of steel pier, and slab

Almost all piers will be repaired in FY 2007.

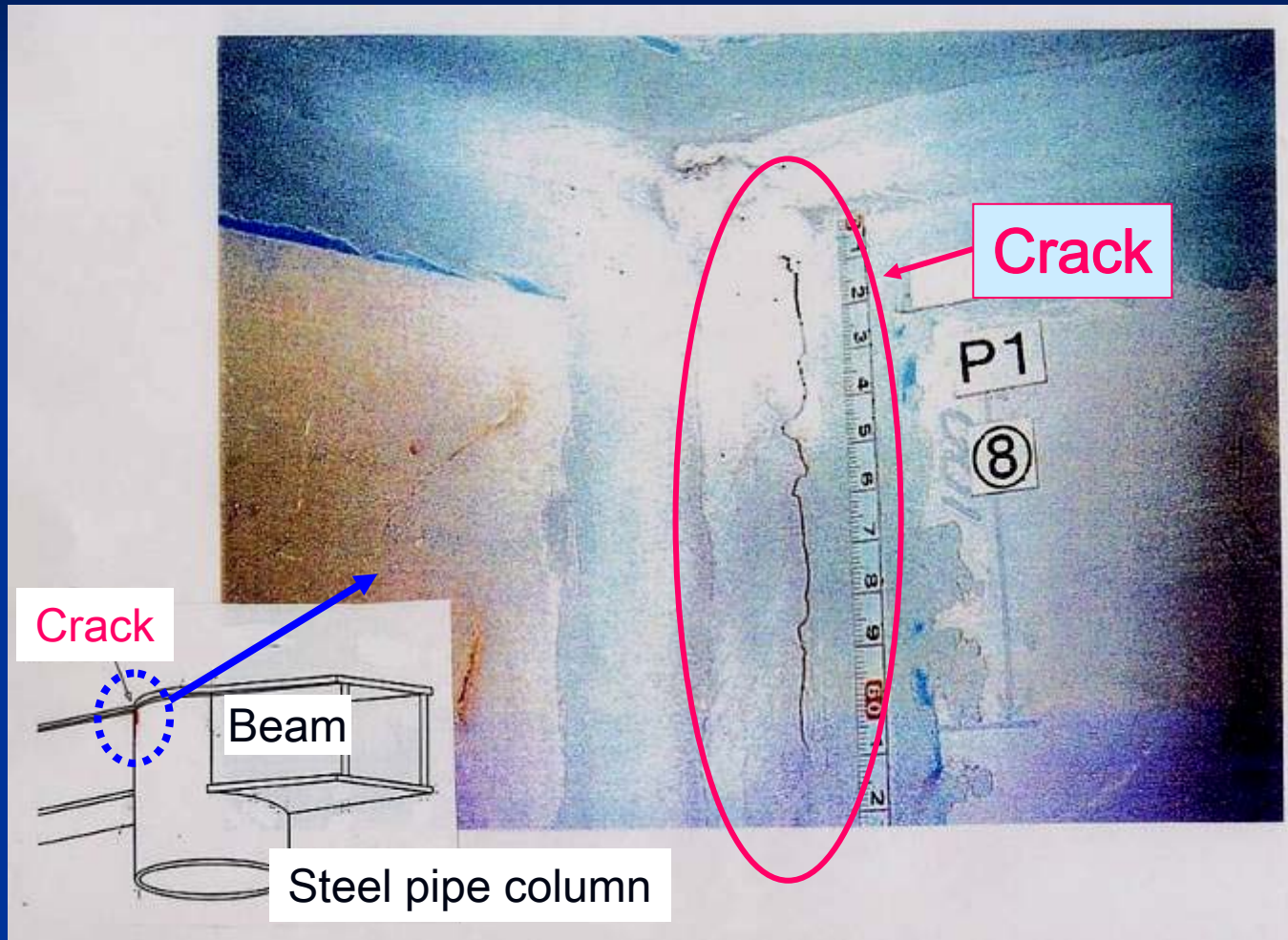
## 2. Chloride damage in concrete bridges

## 3. ASR in concrete bridges

Almost all bridges will be repaired in FY 2007.

## 4. Fracture and spall of concrete slab

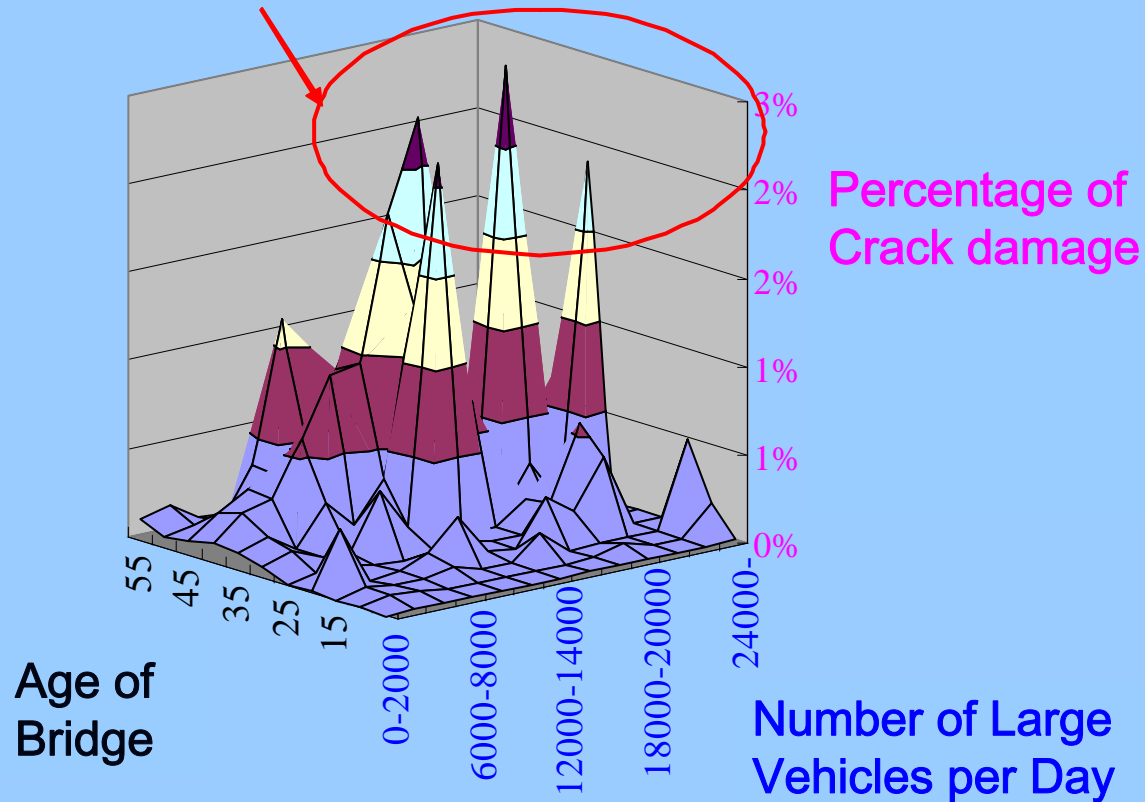
# Fatigue Cracks at Welding of Steel Pier



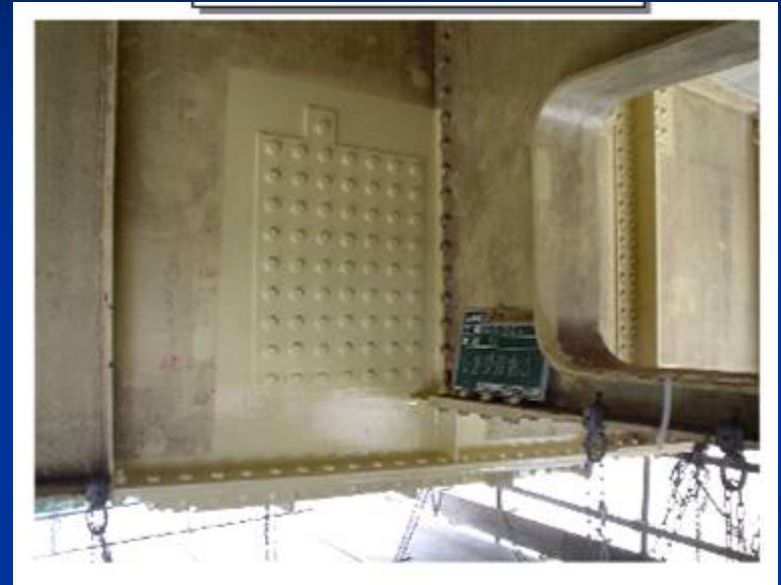
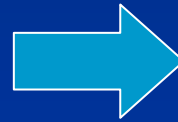
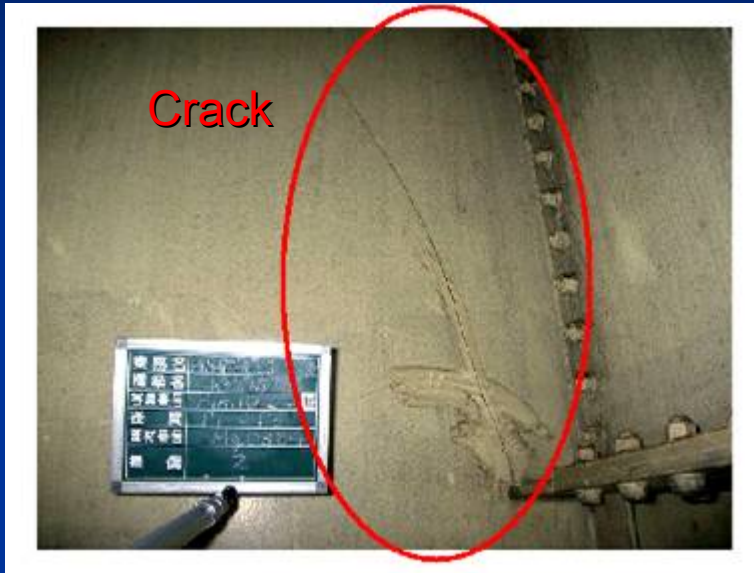


# Relationship between Percentage of Fatigue Crack Damage and Number of Large Vehicle on Steel Bridge

Greater Number of Large Vehicles,  
Higher Percentage of Crack Damages



# Repair Work for Crack



Drilling of stopping hole to prevent extension of fatigue crack, and stiffening by steel plate

# Chloride Damage in RC Bridge



Coastal Area of Japan Sea



# Chloride Damage in PC Bridge





# Repair Work for Chloride Damage



Partial Repair:  
Sacrificial anodes and  
filling concrete



Total Repair:  
Sacrificial anodes and  
carbon fiber sheets





Damage due to Alkali Silica Reaction

# Breaking of Reinforcing Bars by ASR

Damaged Gas Pressure Weld Point  
(Main Reinforcements)



Breaking at Corner of the Stirrups

# Repair Work for ASR



Injection of ASR-retarding agent (Sub-nitric acid lithium) into cracks



Damage



Paint Coating



Wrapping by Carbon Fiber Sheets



# Spalling of Concrete Slab



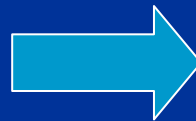
# Repair Work for Fatigue Crack of RC Slab



Water-proof, injection, and carbon fiber sheets



Extra lateral beams



Extra stringers

Steel plate adhesion

# Damage by Earthquake in Japan



Falling Down of Superstructure  
by Niigata Earthquake (1964,  
M7.5)



Collapse of Substructure by  
Kobe Earthquake (1995, M7.3)



# Earthquake-proof Work



Movement restriction chains



Strengthening of RC piers by RC, steel plate, or carbon fiber sheet

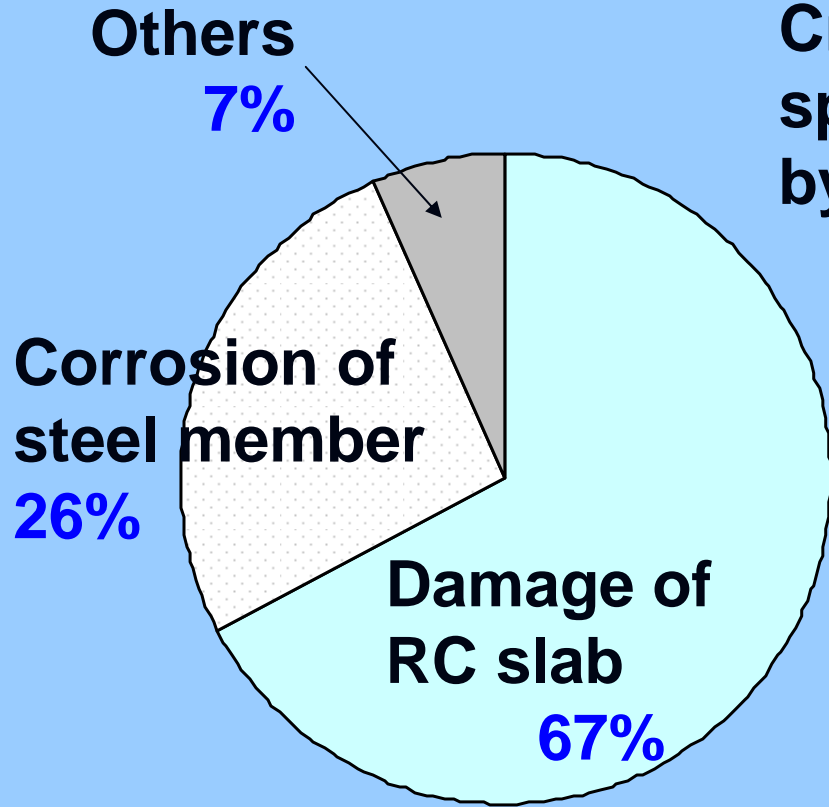


Connection of adjoining girders

## Earthquake-proof work:

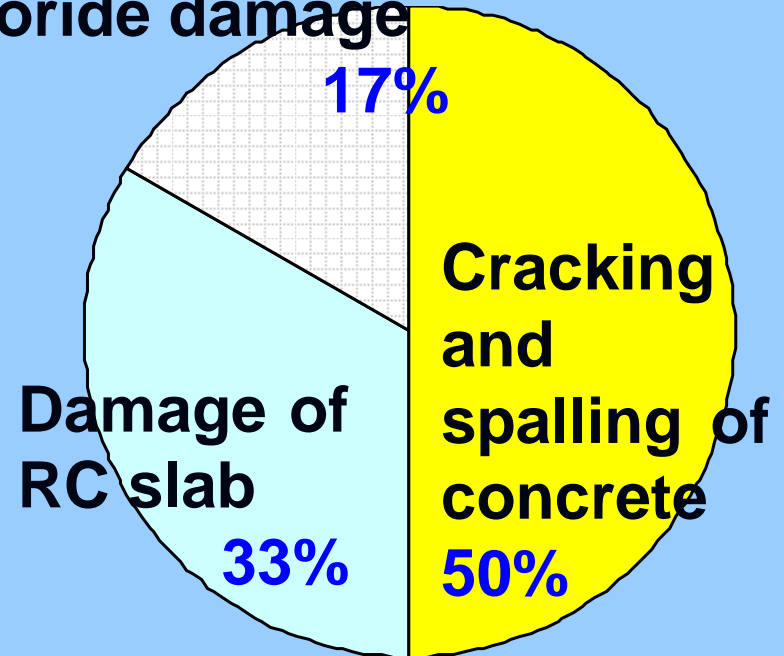
- \*All of bridges on national expressway and national roads will be completed in 2007.
- \*Other bridges on priority roads will be completed in 2007.

# Reasons for Bridge Reconstruction 1986 - 1996



**Steel Bridges**  
(140 bridges)

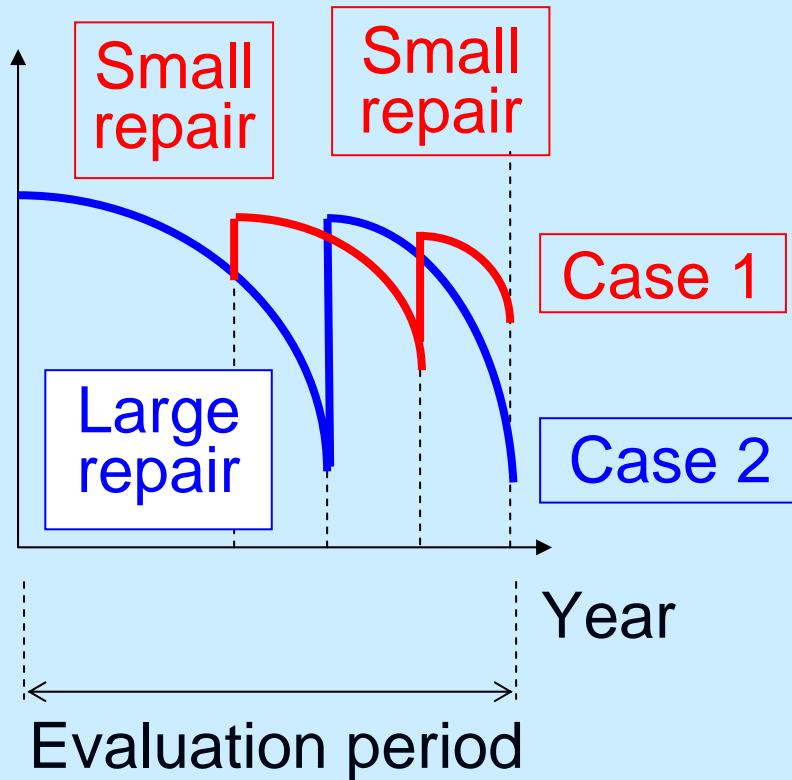
Cracking and spalling of concrete by chloride damage



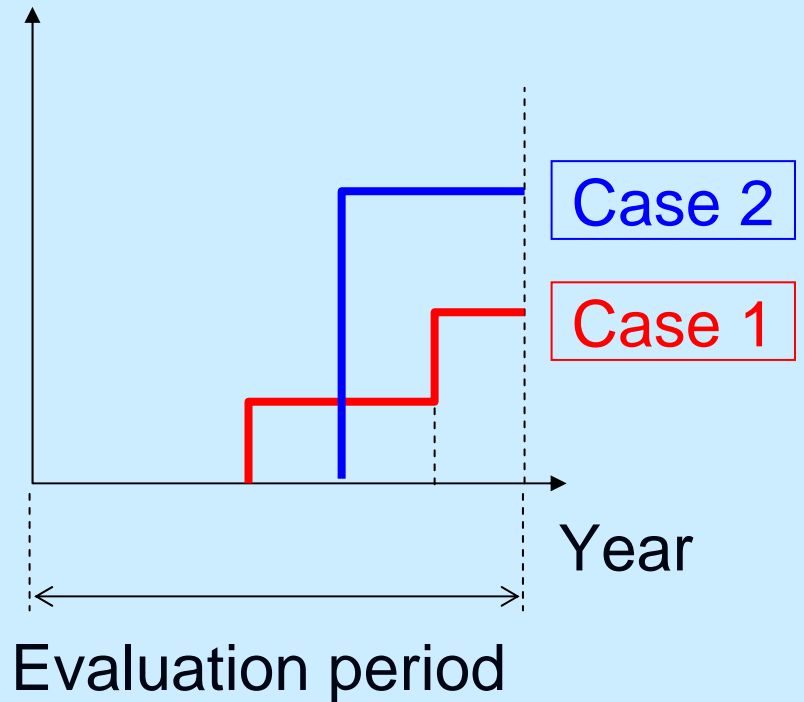
**PC Bridges**  
(23 bridges)

# Relationship between type of repair and cost

Soundness



Cost



Case 1 : Preventive repair ➡ **Minimizing Life Cycle Cost**

Case 2 : Repair at the repairable limit state

# Outline of periodic bridge inspection (National roads)

Frequency	Once every 5 years
Elements	All members
Scope	<ul style="list-style-type: none"><li>*Check of type and condition of damage</li><li>*Evaluation of degree of damage</li><li>*Determination of necessity of counter-measures</li><li>*Recording data</li></ul>
Method	Close-range visual inspection

# Classification of necessity of countermeasures

## (Periodic inspection manual)

Classification	Description
A	Very little or no damage: No need for repair
B	Repair may be necessary depending on condition
S	Need for in-depth investigation
C	Prompt repair or other remedial action required
E	Emergency measures must be taken



**Thank you for your attention**