The Challenges of Managing Aging Road Infrastructure in Japan

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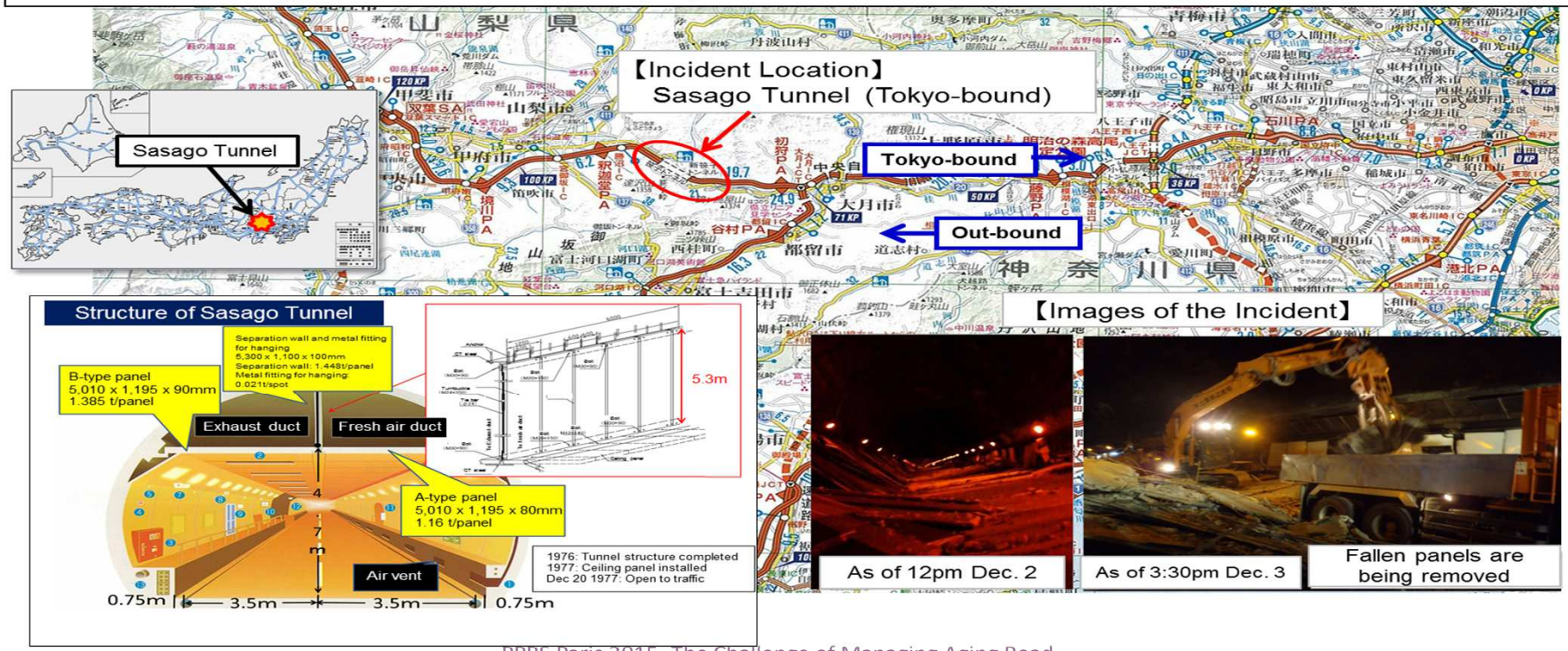
The Great East Japan Earthquake

- 2:46 pm March 11, 2011
- Magnitude 9.0 (The 4th largest earthquake in the world since 1900)
- Number of Deaths: 15,884
  Number of Missing: 2,633
  (As of the end of March, 2014)

Sasago Tunnel Ceiling Collapse : Incident Summary

- Date : Sunday, December 2, 2012 at 8:03am
- Location: Tokyo-bound Sasago Tunnel
- Incident: 130-meter-section of ceiling panels fell at 1.7km from the east portal of the 4.7km-long-tunnel, crushing three vehicles and catching two of those on fire. Nine people were killed and two others were injured.



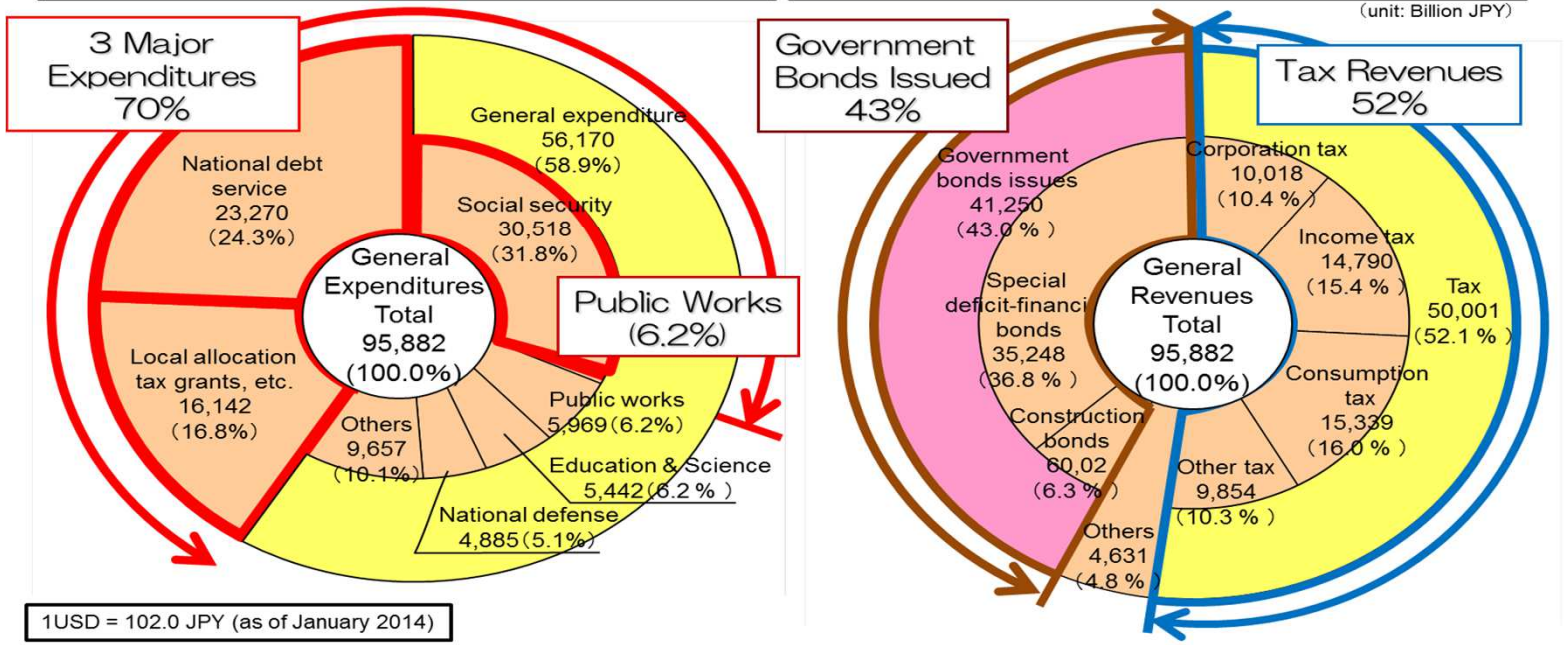
NATIONAL BUDGET FOR PUBLIC WORKS | 1

Outline of FY2013 National Government Budget

General Expenditures
-Social Security(30.5 trillion JPY)
-National Debt Service(23.3 trillion JPY)
-Local allocation tax grants, etc.(16.1 trillion JPY)
account for about 70% of the total budget

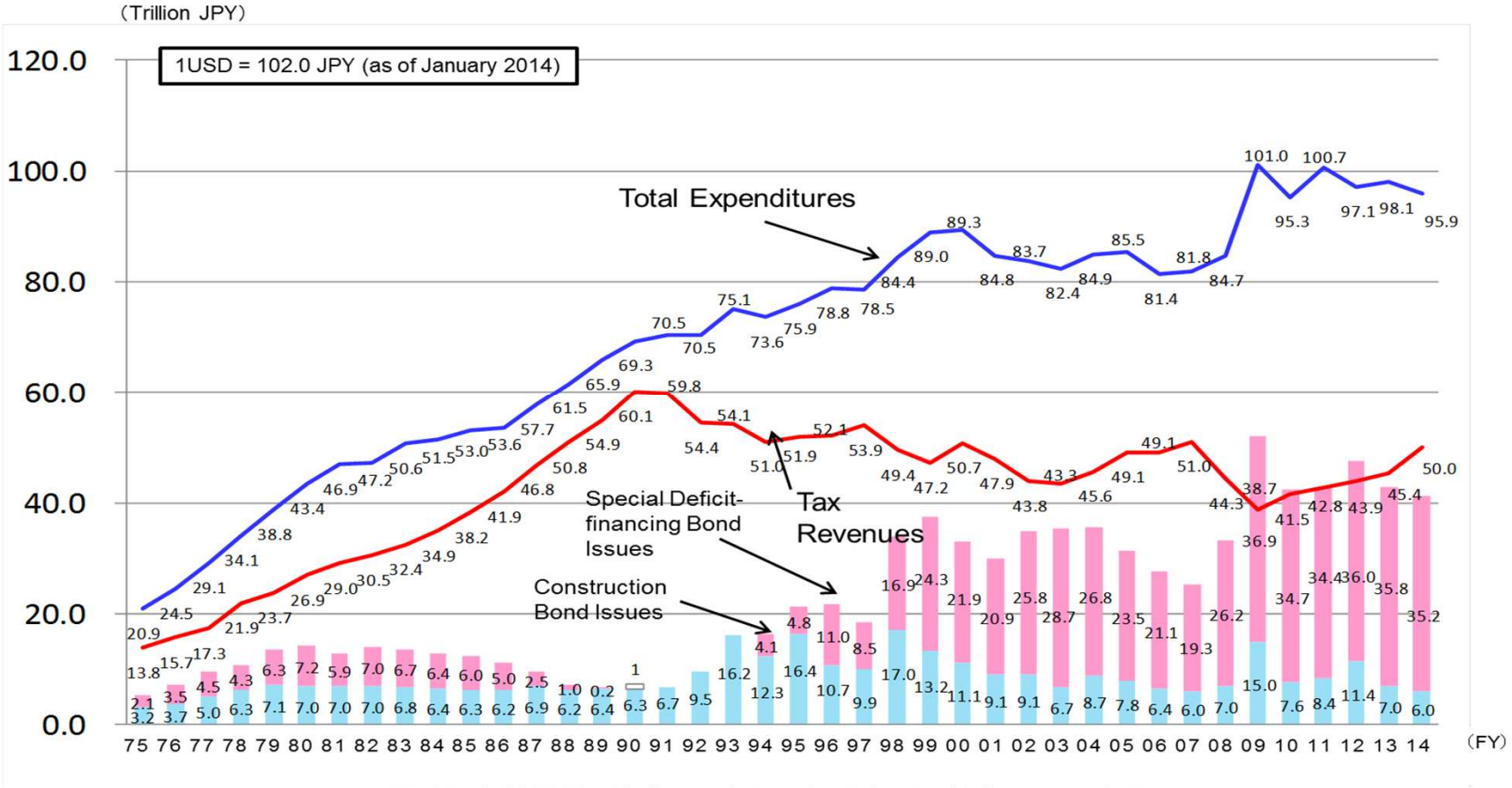
General Revenues
-Tax revenue accounts for only 52%
-The remaining 44 trillion JPY (43%) comes from Government Bonds Issues

(unit: Billion JPY)

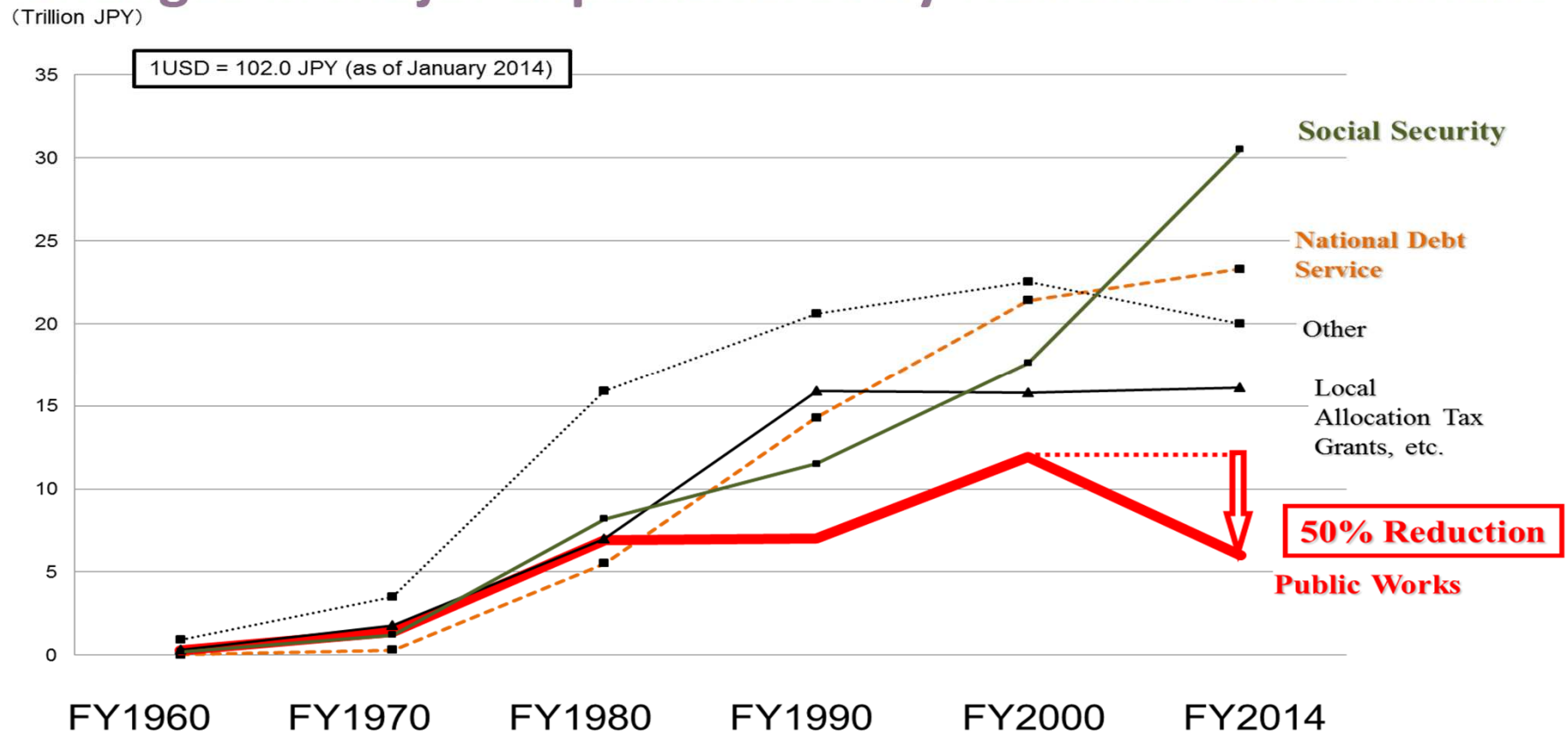


1USD = 102.0 JPY (as of January 2014)

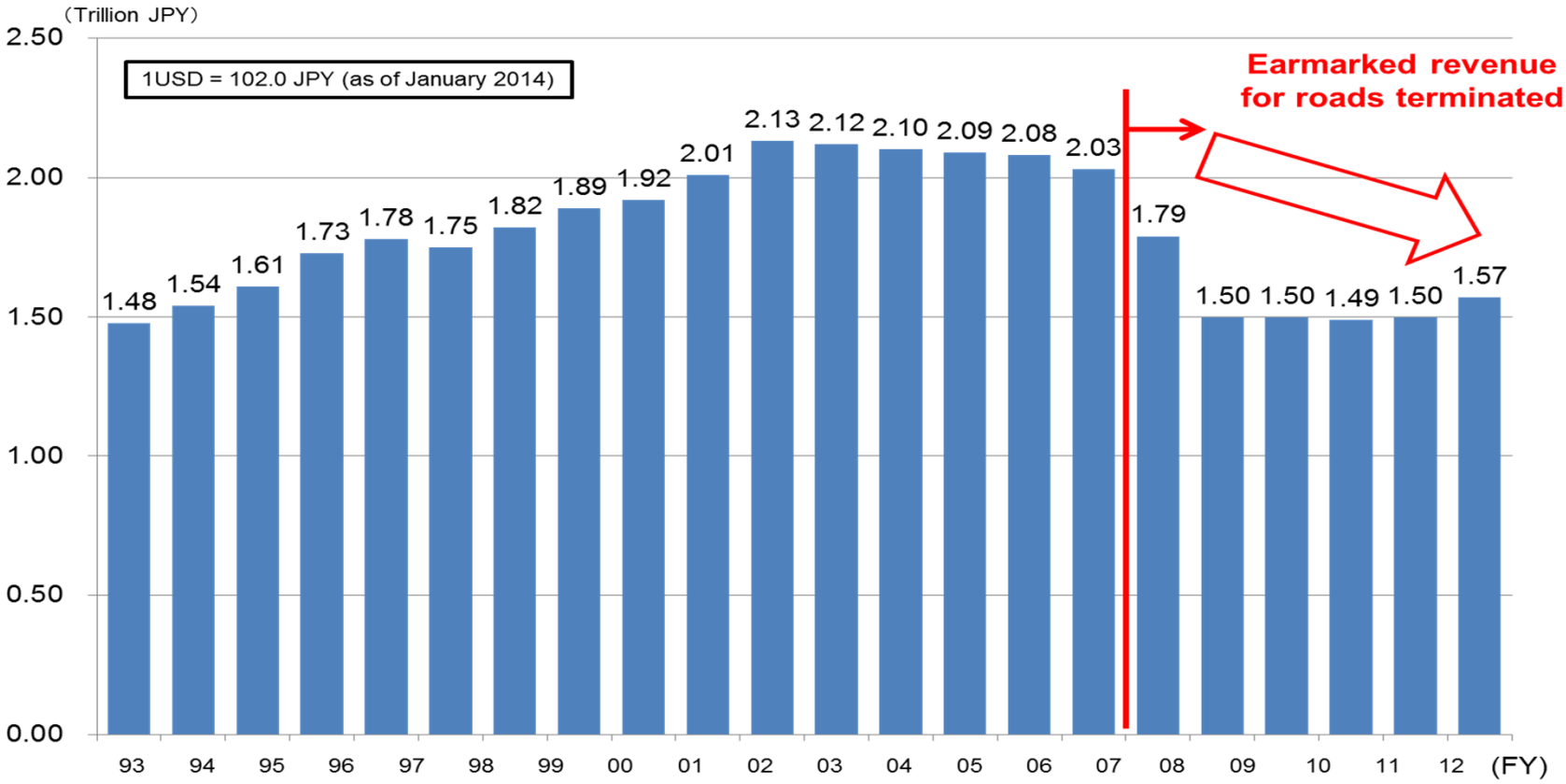
Change in National Government's Revenues and Expenditures



Changes in Major Expenditures by National Government



Change in Road Expenditure by National Government



CHALLENGES OF MANAGING AGING ROAD INFRASTRUCTURE | 2

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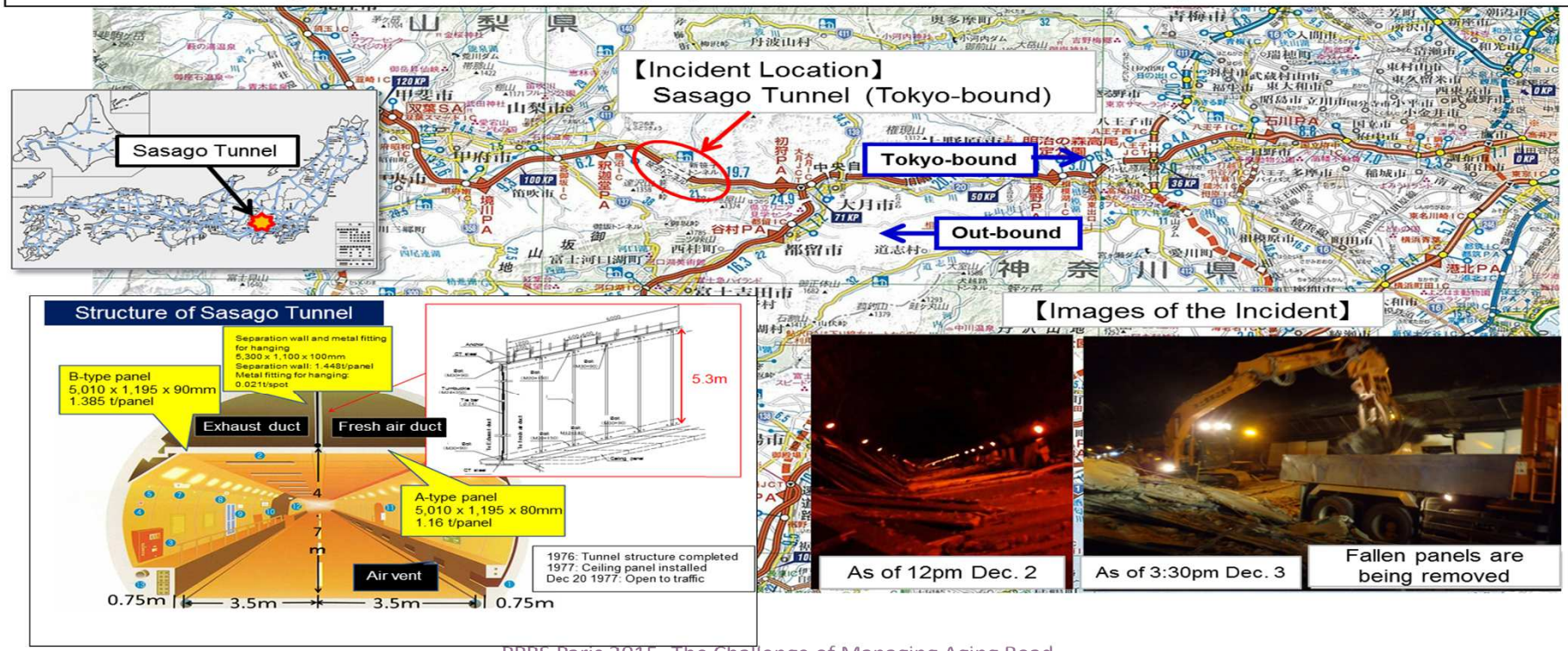


A Survey of Road Structure in Japan

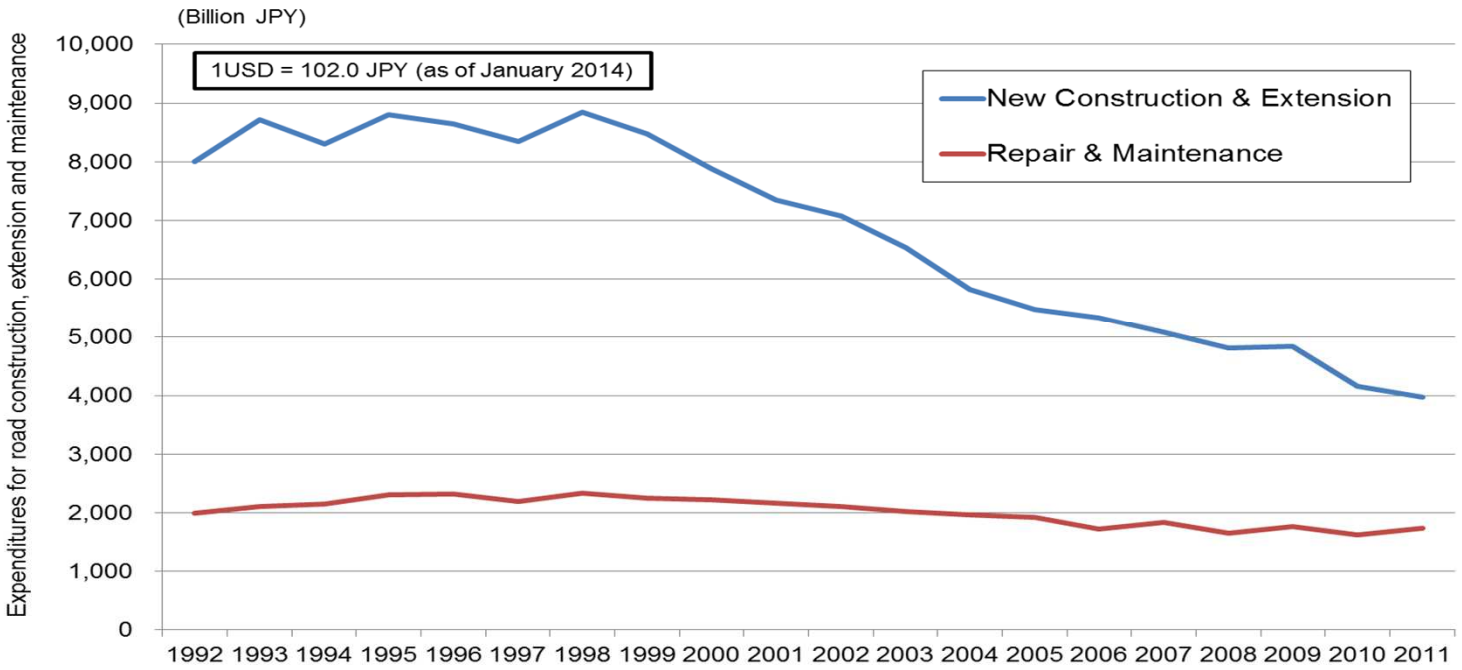
	Length [km]	Structure				
		Bridge*		Tunnel		Earthwork
		No. of locations	Length[km]	No. of locations	Length[km]	Length[km]
Expressway	8,358 (1%)	8,422 (5%)	1,475 (18%)	970 (10%)	983 (12%)	5,900 (71%)
National highway under jurisdiction of MLIT	23,517 (2%)	13,538 (9%)	1,677 (7%)	1,412 (14%)	843 (4%)	20,996 (89%)
National Highway under jurisdiction of Prefecture	31,915 (3%)	13,871 (9%)	1,000 (3%)	2,444 (24%)	1,110 (3%)	29,806 (93%)
Prefectural road	129,375 (11%)	25,402 (16%)	2,748 (2%)	2,598 (26%)	858 (1%)	125,768 (97%)
Municipal road	1,023,962 (84%)	94,089 (61%)	3,712 (0%)	2,620 (26%)	452 (0%)	1,019,798 (100%)
National total	1,217,128 (100%)	155,322 (100%)	10,612 (1%)	10,044 (100%)	4,246 (0%)	1,202,269 (99%)

As of April 1, 2013

*includes bridges only over 15m long

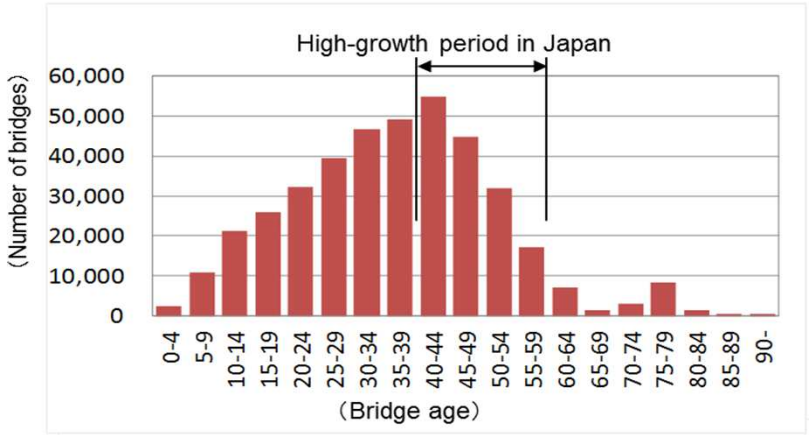
New Construction Budget vs. Maintenance Budget for Roads

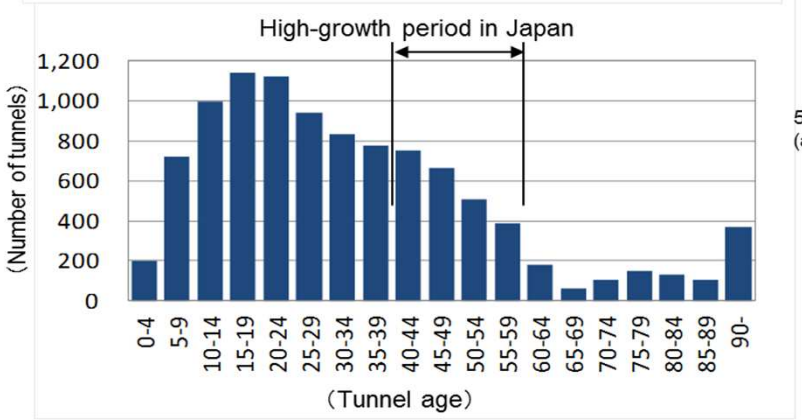
-Budget constraints have resulted in the reduction of new construction & extension expenditures.
-On the other hand, maintenance expenditures have basically remained steady at around 2 trillion JPY.

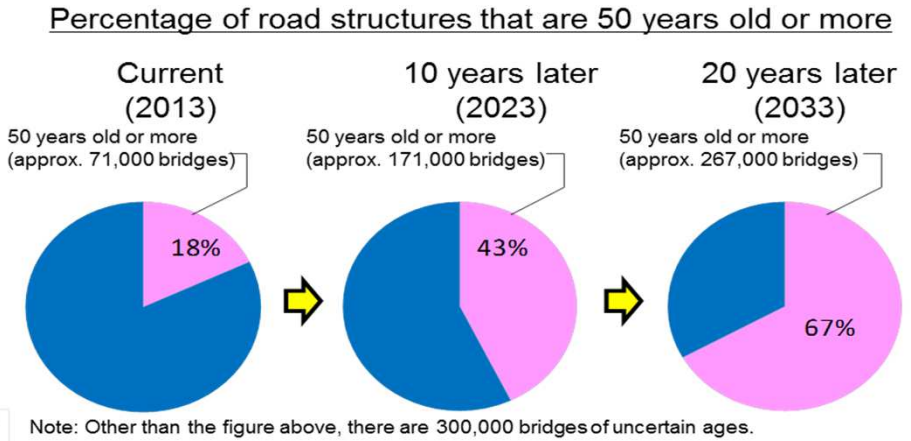


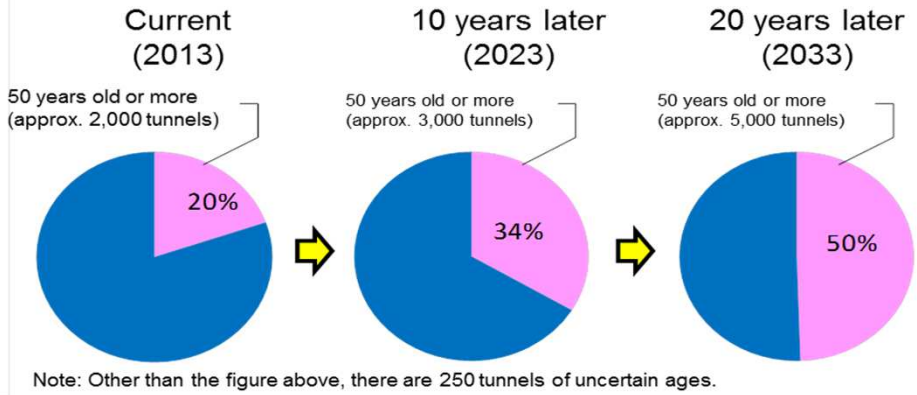
Note: Includes only expenditures by National Government and Local Public Entities

Roadway Infrastructure is Aging

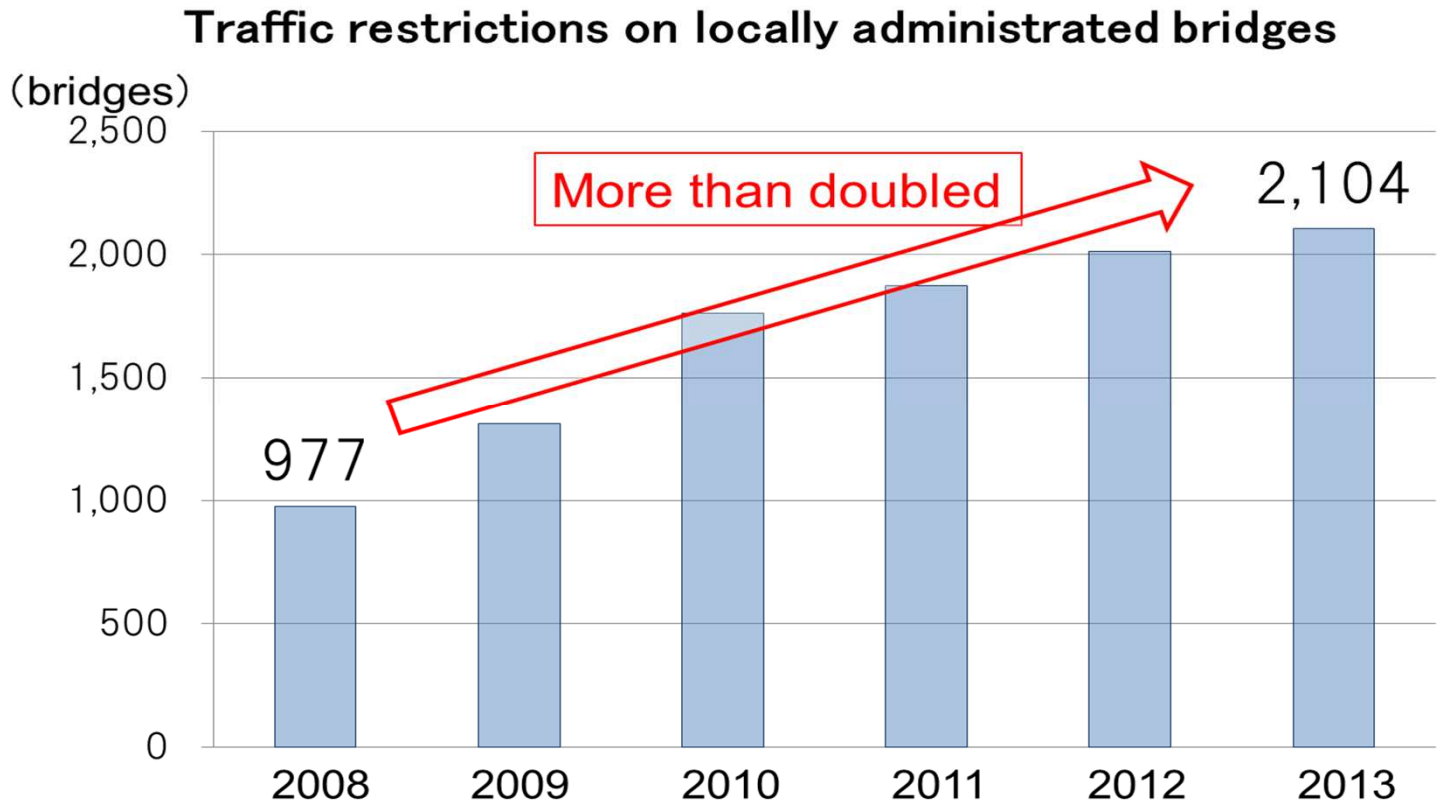






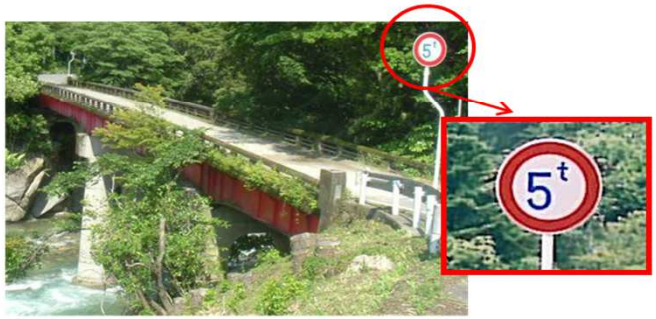


Increase of Traffic Restrictions on Bridges



Examples of Aged Bridges and Pavements

Severe corrosion of bridge pier
Miharashi-bridge(Yokohama)
Constructed about 40 years ago



Load Limitation (25t to 5t) caused by severe distress of concrete slab
Kamihouri-bridge(Miyazaki)

Severe pavement distresses in Expressways

Alligator crack

Government Responses to the Sasago Incident

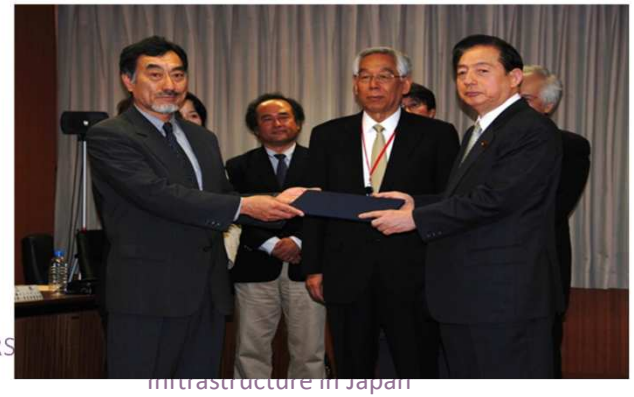
Dec. 2012 : The Sasago Tunnel Incident

Mar. 2013 : Basic plan established for emergency measures

Jun. 2013 : Road Law revised

- Specify inspection standard for road infrastructures
- Establish a new rule to assist local governments

Apr. 2014 : Road Council Report "Final Warning" submitted



Road Council Report Recommendations

Establish a "Maintenance Cycle"

Inspection
- Periodical inspection for bridges and tunnels with a standardized method

Evaluation
- Evaluation of structural soundness by standardized scale

Repair
- Strategic execution of repair works based on the results of inspection & evaluation

…

Record
- Keep the records of inspection, evaluation and repair works

Policies to support the Maintenance Cycle

Finance
- Expressways (toll roads)
- National Highways
- Local Roads

Organization
- Organize "Road Maintenance Panel" in each Prefecture
- Technical assistance for local govs

…

Technology
- Qualification system for maintenance engineers
- Development of new technologies for road maintenance

…

Progress of Measures

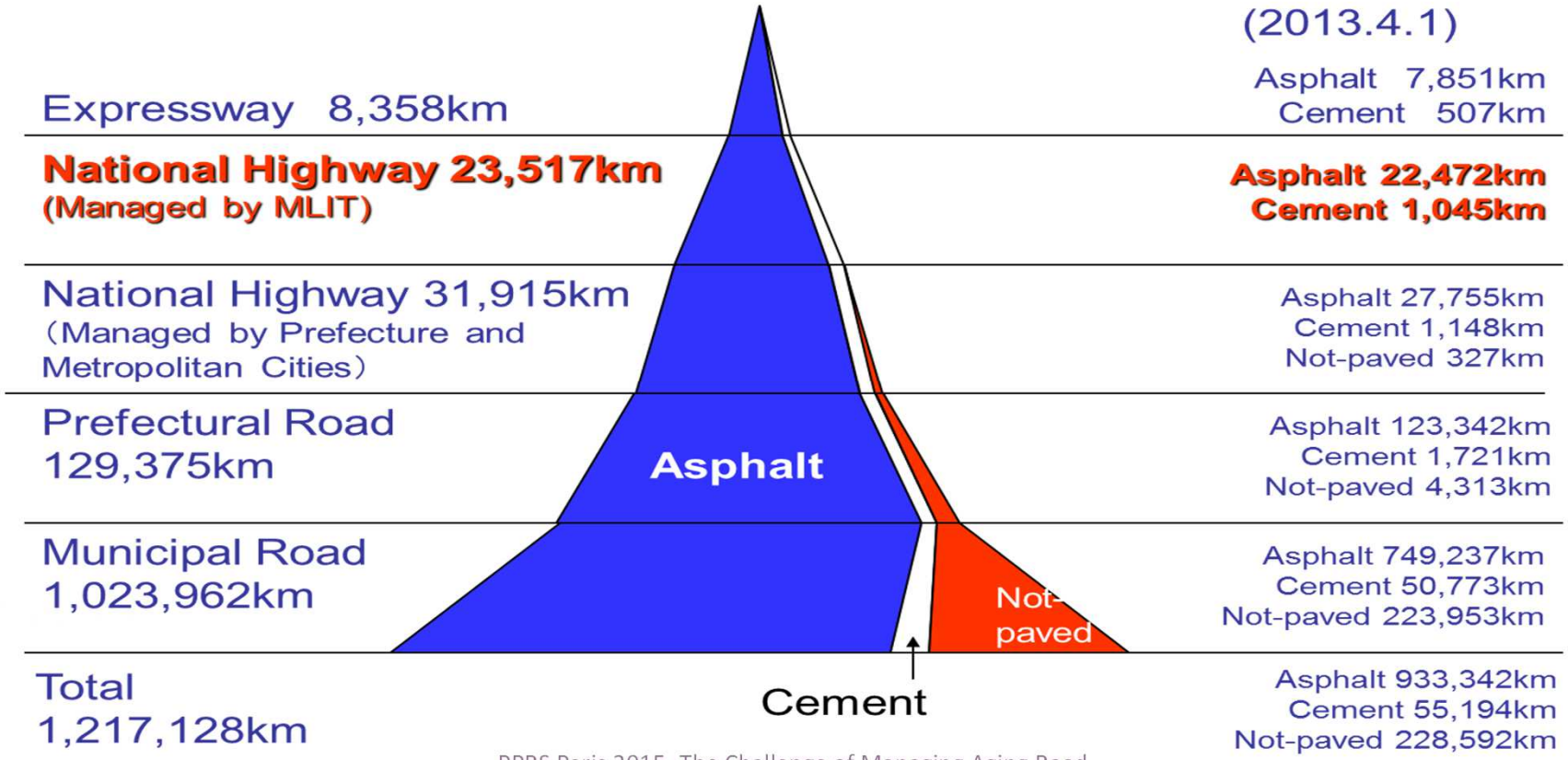
Amendment of the Road Law (June 5, 2013)

- Road management authorities shall conduct inspections of roads from a preventive maintenance perspective.
- The national government may assist local governments with repair work that requires technical skills.

1. Detailed requirement for inspection method (Bridges & Tunnels)
   (Ministerial Ordinance, March 31, 2014)
2. Practical inspection manual
   ("Guidelines for periodical inspection", June 25, 2014)
3. Standard evaluation scale
   (Ministerial Notification, March 31, 2014)
4. Securing the budget for large-scale rehabilitation of Expressways
   (Amendment of the Road Law to extend repayment period of expressways, June 4, 2014)
5. Financial assistance for local government
   ("Grant for disaster prevention and safety", FY2013-)
6. Technical assistance for local government
   (Establishment of Prefectural Road Maintenance Panels …)

PAVEMENT MANAGEMENT AND TECHNOLOGIES | 3

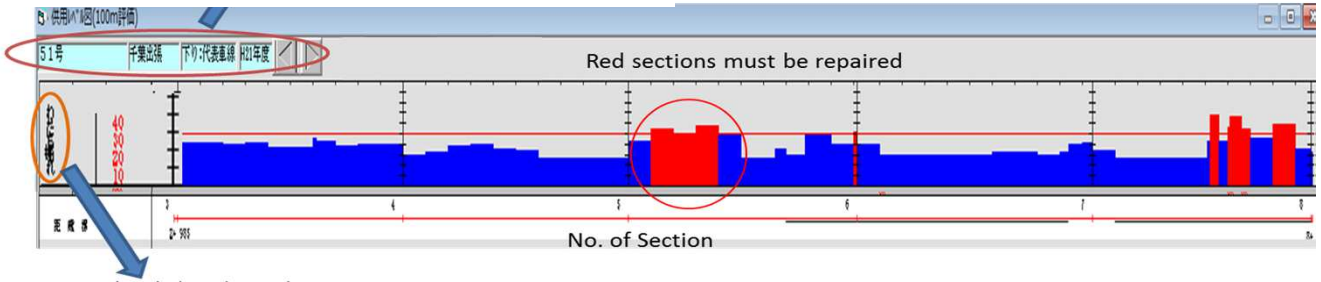
Road Networks and Pavement Types in Japan



Monitoring of Pavement Conditions on National Highways

- Total length of national highways
  - About23,500km
- Annual monitoring length
  - About 7,800km > the whole network is monitored every 3 years
- Pavement condition indices
  - Cracking ratio
  - Rut depth
  - Roughness

Monitoring at night

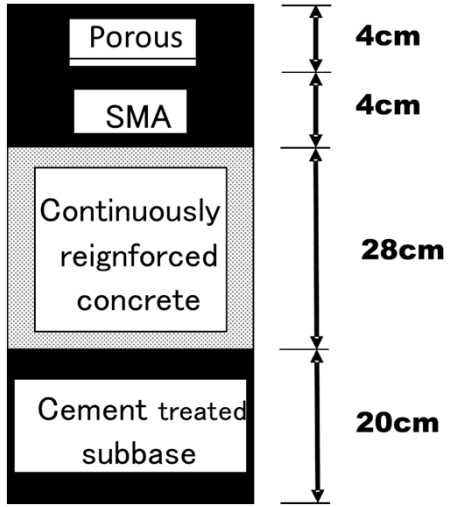


Rut depth (mm) : In this case, repair criteria is set to 30mm

Long-Life Pavement on Expressways

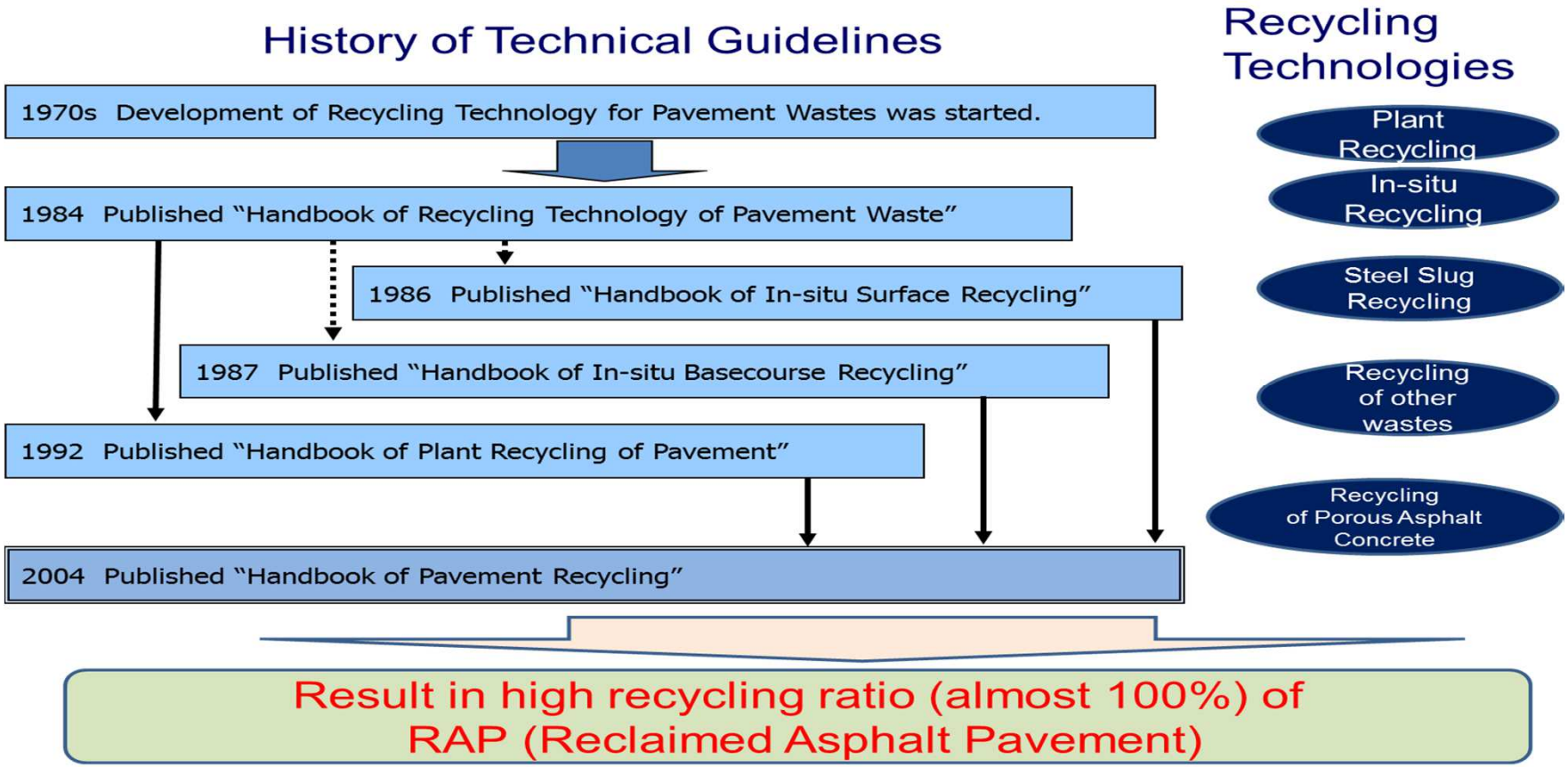
- New-Tomei Expressway is the latest major expressway opened April, 2012.
- "Composite pavement" was used on the New-Tomei Expressway,
  - Porous asphalt pavement for surface
    - In order to Improve traffic safety
  - Cement concrete pavement as base
    - For longer repair cycle

Porous Asphalt Pavement



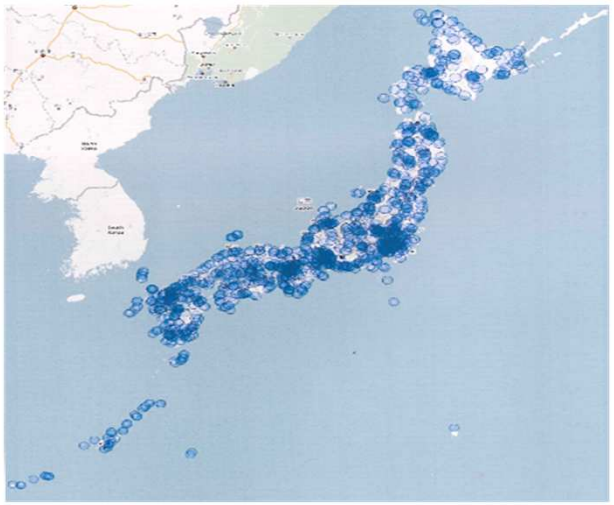
Typical Structure of the Pavement

Asphalt Pavement Recycling (1)

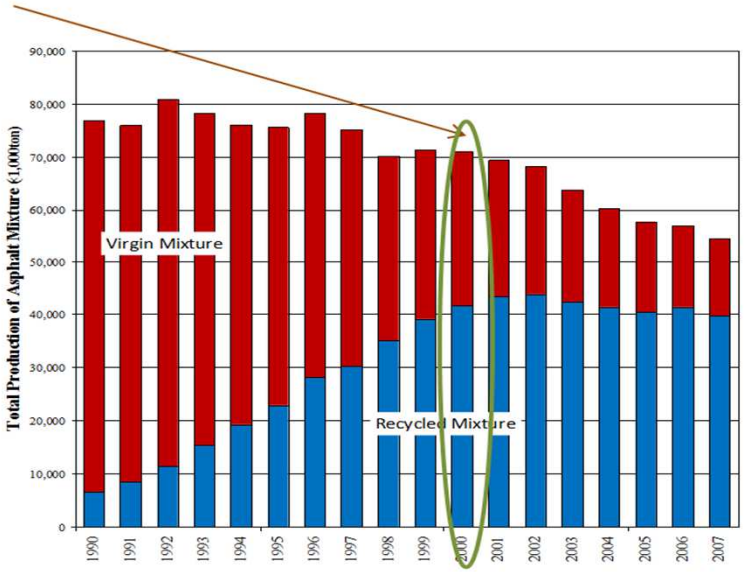


Asphalt Pavement Recycling (2)

- Most popular method is plant recycling in Japan
  - More than 1,200 asphalt plants across Japan
- Recycled asphalt mixture has been promoted to use according to the law
  - Law on Promoting Green Purchasing, enacted in FY2000



Location of Asphalt Plants



Cool Pavement

Water retention pavement

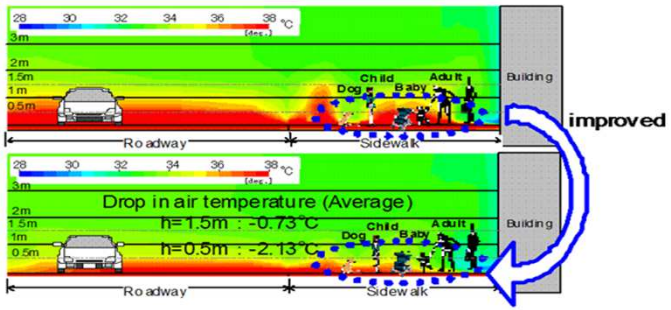
- Store water inside pavement
- Uses the mechanism of latent heat

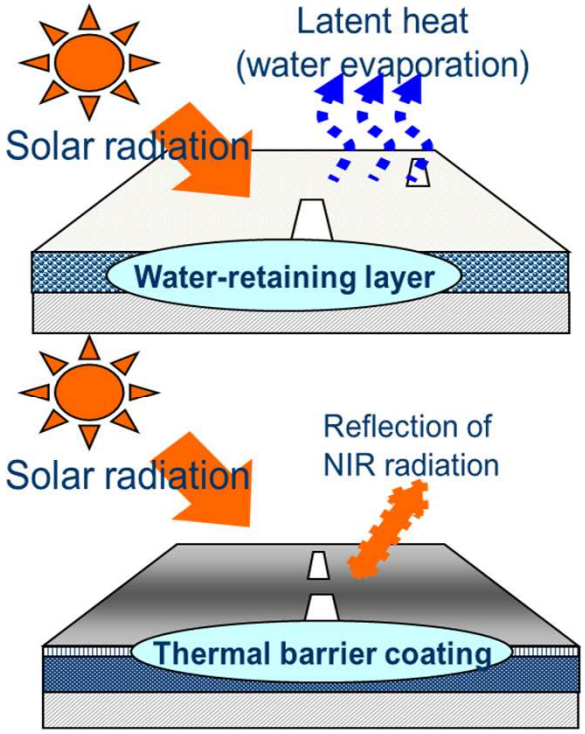
Heat shield pavement

- Paint special coating
- Reflection of near-infrared ray (NIR)

These two types of cool pavement

- can drop road surface temperature by 10℃
- are expected to reduce urban heat island effect





Thank you for your attention!