The maintenance of national road network in Japan
Today’s Presentation: Contents

1. Japan’s road stock

2. Financial situation

3. Issues in the maintenance and management of road stock
1. Japan’s road stock
### Classification of roads and total length of the road network

<table>
<thead>
<tr>
<th>Category</th>
<th>Length (km)</th>
<th>Share of traffic volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expressways</td>
<td>7,600</td>
<td>9%</td>
</tr>
<tr>
<td>State-managed national highways</td>
<td>22,900</td>
<td>19%</td>
</tr>
<tr>
<td>Regionally-managed national highways</td>
<td>31,900</td>
<td>13%</td>
</tr>
<tr>
<td>Prefectural roads</td>
<td>129,400</td>
<td>59%</td>
</tr>
<tr>
<td>Municipal roads</td>
<td>1,016,100</td>
<td>33%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,201,000</strong></td>
<td><strong>Approx. 70%</strong></td>
</tr>
</tbody>
</table>

- **Large goods vehicles**
  - Expressways: 24%
  - State-managed national highways: 29%
  - Regionally-managed national highways: 14%
  - Prefectural roads: 13%
  - Municipal roads: 33%

- **Share of traffic volume (Vehicle kilometers travelled)**
  - Expressways: 5.2%
  - State-managed national highways: 17%
  - Regionally-managed national highways: 13%
  - Prefectural roads: 59%
  - Municipal roads: 33%

**As of April 1, 2009**

---

**Approx. 70%** is the total share of traffic volume for Municipal roads.

**Approx. 40%** is the share of traffic volume for Prefectural roads.

**Approx. 1.9%** is the length of State-managed national highways in percent.

**Approx. 0.6%** is the length of Expressways in percent.
## Breakdown of road structure stock

As of April 1, 2009

<table>
<thead>
<tr>
<th>Structure</th>
<th>Length [km]</th>
<th>Bridge</th>
<th>Tunnel</th>
<th>Paving</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of locations</td>
<td>Length [km]</td>
<td>No. of locations</td>
<td>Length [km]</td>
</tr>
<tr>
<td>Expressway</td>
<td>7,642 (1%)</td>
<td>6,813 (4%)</td>
<td>1,175 (12%)</td>
<td>801 (9%)</td>
</tr>
<tr>
<td>State–managed highway</td>
<td>22,874 (2%)</td>
<td>11,902 (8%)</td>
<td>1,414 (15%)</td>
<td>1,257 (13%)</td>
</tr>
<tr>
<td>Regionally–managed highway</td>
<td>31,916 (3%)</td>
<td>13,227 (9%)</td>
<td>939 (10%)</td>
<td>2,325 (25%)</td>
</tr>
<tr>
<td>Prefectural road</td>
<td>129,377 (11%)</td>
<td>33,730 (22%)</td>
<td>2,566 (27%)</td>
<td>2,494 (27%)</td>
</tr>
<tr>
<td>Municipal road</td>
<td>1,016,058 (84%)</td>
<td>89,487 (58%)</td>
<td>3,504 (37%)</td>
<td>2,497 (27%)</td>
</tr>
<tr>
<td>National total</td>
<td>1,207,867 (100%)</td>
<td>155,159 (100%)</td>
<td>9,598 (100%)</td>
<td>9,374 (100%)</td>
</tr>
</tbody>
</table>
The number of bridges constructed yearly shows a peak during the period of high economic growth, with a significant increase around 1964. The chart indicates the following:

- **Now (2010)**: Total 155,000 bridges (15 m or more in length), with 8% being over 50 years old.
- **10 years from now (2020)**: 53% of bridges will be over 50 years old.
- **20 years from now (2030)**: 80,000 bridges will be over 50 years old.

Additionally, it is noted that as of April 1, 2009, there were 155,000 bridges, with a total of 13,000 over 50 years old.
Tunnel stock

【Number of tunnels constructed yearly】

(Year of construction)

Expressway
State-managed highway
Regionally-managed highway
Prefectural road
Municipal road

No. of tunnels over 50 years old:
1,700
2,900
4,400

Total 9,400 locations

As of April 1, 2009
2. Financial situation
<table>
<thead>
<tr>
<th></th>
<th>Expenditures</th>
<th>Tax revenues</th>
<th>Issue of government bonds</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td>65.9</td>
<td>54.9</td>
<td>6.6</td>
</tr>
<tr>
<td>1990</td>
<td>69.3</td>
<td>54.4</td>
<td>7.3</td>
</tr>
<tr>
<td>1991</td>
<td>70.5</td>
<td>51</td>
<td>9.5</td>
</tr>
<tr>
<td>1992</td>
<td>75.1</td>
<td>51.9</td>
<td>16.2</td>
</tr>
<tr>
<td>1993</td>
<td>75.9</td>
<td>52.1</td>
<td>16.5</td>
</tr>
<tr>
<td>1994</td>
<td>78.8</td>
<td>49.4</td>
<td>21.2</td>
</tr>
<tr>
<td>1995</td>
<td>78.5</td>
<td>50.7</td>
<td>21.7</td>
</tr>
<tr>
<td>1996</td>
<td>84.4</td>
<td>47.2</td>
<td>18.5</td>
</tr>
<tr>
<td>1997</td>
<td>89</td>
<td>47.9</td>
<td>34</td>
</tr>
<tr>
<td>1998</td>
<td>89.3</td>
<td>43.3</td>
<td>37.5</td>
</tr>
<tr>
<td>1999</td>
<td>84.8</td>
<td>45.6</td>
<td>33</td>
</tr>
<tr>
<td>2000</td>
<td>83.7</td>
<td>49.1</td>
<td>31.3</td>
</tr>
<tr>
<td>2001</td>
<td>82.4</td>
<td>51</td>
<td>31.3</td>
</tr>
<tr>
<td>2002</td>
<td>84.9</td>
<td>49.1</td>
<td>33.2</td>
</tr>
<tr>
<td>2003</td>
<td>85.5</td>
<td>54.3</td>
<td>30</td>
</tr>
<tr>
<td>2004</td>
<td>84.7</td>
<td>45.6</td>
<td>35.3</td>
</tr>
<tr>
<td>2005</td>
<td>81.4</td>
<td>49.1</td>
<td>35.5</td>
</tr>
<tr>
<td>2006</td>
<td>81.8</td>
<td>51</td>
<td>35.3</td>
</tr>
<tr>
<td>2007</td>
<td>84.7</td>
<td>51</td>
<td>35.5</td>
</tr>
<tr>
<td>2008</td>
<td>84.7</td>
<td>54.3</td>
<td>33.2</td>
</tr>
<tr>
<td>2009</td>
<td>101</td>
<td>54.3</td>
<td>30</td>
</tr>
<tr>
<td>2010</td>
<td>95.3</td>
<td>45.6</td>
<td>35.3</td>
</tr>
<tr>
<td>2011</td>
<td>94.7</td>
<td>49.1</td>
<td>35.5</td>
</tr>
</tbody>
</table>

(¥ trillion)
Major expenses making up general account expenditures

- **National debt service**
- **Local allocation tax, etc.**
- **Social security**
- **Other**
  - Education, promotion of science
  - Defence costs, etc.
- **Public works**

<table>
<thead>
<tr>
<th>Year</th>
<th>National debt service</th>
<th>Local allocation tax, etc.</th>
<th>Social security</th>
<th>Other</th>
<th>Public works</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>1.5</td>
<td>11.1</td>
<td>51.2</td>
<td>17.4</td>
<td>6.5</td>
</tr>
<tr>
<td>1970</td>
<td>3.5</td>
<td>14.1</td>
<td>43.2</td>
<td>17.6</td>
<td>6.5</td>
</tr>
<tr>
<td>1980</td>
<td>12.7</td>
<td>18.8</td>
<td>36.6</td>
<td>15.9</td>
<td>6.5</td>
</tr>
<tr>
<td>1990</td>
<td>20.7</td>
<td>23</td>
<td>16.6</td>
<td>10</td>
<td>6.5</td>
</tr>
<tr>
<td>2000</td>
<td>24</td>
<td>17.7</td>
<td>19.7</td>
<td>13.3</td>
<td>6.5</td>
</tr>
<tr>
<td>2011</td>
<td>22.8</td>
<td>18.4</td>
<td>27.9</td>
<td>24.4</td>
<td>6.5</td>
</tr>
</tbody>
</table>
Shift from dedicated revenue sources to general revenue
3. Issues in the maintenance and management of road stock
◆ Estimate of future maintenance and repair costs (impression)

- Replacement: 約1.2兆円
- Repair: 約1.8兆円

Passage of time →
The cycle of inspection-diagnosis-repair for bridges

**Contents and time of measures**

- **Bridge name**: CO Bridge
  - **Road Name**: National highway No.
  - **Bridge length**: 50
  - **Year of construction**: 2006
  - **In-service period**: 13
  - **Inspected year**: 2000

- **Bridge name**: D.O. Bridge
  - **Road Name**: National highway No.
  - **Bridge length**: 30
  - **Year of construction**: 2004
  - **In-service period**: 41
  - **Inspected year**: 2010

- **Bridge name**: O.O. Bridge
  - **Road Name**: Prefectural road No.
  - **Bridge length**: 40
  - **Year of construction**: 2005
  - **In-service period**: 28
  - **Inspected year**: TBD

- **Bridge name**: CTI Bridge
  - **Road Name**: National highway No.
  - **Bridge length**: 80
  - **Year of construction**: 2007
  - **In-service period**: 71
  - **Inspected year**: 2010

- **Bridge name**: D.O. Bridge
  - **Road Name**: National highway No.
  - **Bridge length**: 50
  - **Year of construction**: 2004
  - **In-service period**: 41
  - **Inspected year**: 2012

- **Bridge name**: O.O. Bridge
  - **Road Name**: Prefectural road No.
  - **Bridge length**: 40
  - **Year of construction**: 2005
  - **In-service period**: 28
  - **Inspected year**: 2013

- **Bridge name**: D.O. Bridge
  - **Road Name**: National highway No.
  - **Bridge length**: 50
  - **Year of construction**: 2004
  - **In-service period**: 41
  - **Inspected year**: 2014

- **Bridge name**: D.O. Bridge
  - **Road Name**: National highway No.
  - **Bridge length**: 50
  - **Year of construction**: 2004
  - **In-service period**: 41
  - **Inspected year**: 2015

**Estimation necessary budget**

- **Replacement**: 2000
- **Securing of budget**: 5000
- **Result of inspection**: 1500
- **Additional bridges found to need attention**

**Example of measures taken on directly-managed national highways**

<table>
<thead>
<tr>
<th>Year</th>
<th>Bridges needing attention</th>
<th>Bridges attended to</th>
<th>Bridges inspected</th>
<th>Result of inspection</th>
<th>Additional bridges found to need attention</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>7,000</td>
<td>2,000</td>
<td>5,000</td>
<td>1,500</td>
<td>2,000</td>
</tr>
<tr>
<td>2011</td>
<td>6,500</td>
<td>2,000</td>
<td>5,000</td>
<td>2,000</td>
<td>2,000</td>
</tr>
</tbody>
</table>

**Review of life-extending repair plan**
The switchover to preventative maintenance

- Corrective maintenance
  - Severe cracking requires replacement of the deck slab

- Preventative maintenance
  - Inspection reveals minor cracks in concrete
  - Applying carbon fiber to the underside of the bridge prevents the cracks becoming worse

Reduction of life cycle costs

- Total cost
  - Actual (¥100 millions)
  - Extending the life of the bridge further is difficult: The bridge is replaced
  - Replacement of main beam to ensure load-bearing capacity
  - Corrosion progresses even after cross-sectional repairs
  - The life of the bridge is extended

- Appropriate management (Estimated figures)
  - Cross-sectional repairs, cladding
  - Repair of cracking
  - Electrolytic protection

Applying carbon fiber to the underside of the bridge prevents the cracks becoming worse.
The cycle of inspection-diagnosis-repair for tunnels

【Inspection flow-chart】

1. Inspection work plan

2. On-site work
   Close-range visual inspection, hammering test, emergency measures (dislodging with a hammer, etc.)

3. Evaluation of inspection results
   Recording of inspection results
   Standard survey as necessary
   Tunnel with marked damage/deformation
   Emergency measures
   Standard survey
   Emergency measures
   Next inspection (5 years later)
   Next inspection (2 years later)

Close-range visual search for cracking

An inspection vehicle carries out non-destructive testing
Estimate of future maintenance and repair costs (impression)

- Reduction of total cost
- Evening-out of yearly cost

Passage of time →

Maintenance and repair costs

- Replacement
- Repair
Thank you very much for your kind attention