

Road Asset Management -Approaches of Ministry of Land, Infrastructure and Transport -

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Aging Roads in Japan

Road maintenance and improvement went into high gear at the end of World War II during the high economic growth period (1955-73), the government started constructing many bridges and tunnels: those bridges occupy 40 % of the total existing bridges and those tunnels 25 % of existing tunnels (Fig.1). In addition, in ten years, the number of more than 50-year-old bridges will increase four times as many as those now, and seventeen times in 20 years and as to tunnels, tree times in 10 years and twelve times in 20 years. Like this, the aging of roads and tunnels will be increasingly significant (Fig. 2).

In these years, the credibility and safety of road facilities have been questioned by the public, for they have learned about many cases of deterioration of aging roads such as concrete abruptions, fallings and metal fatigue on the corners of steel piers of expressways in reports.

Compared these deteriorations of roads with roads in USA, road facilities in Japan seem to have been sliding down to the conditions, so-called “America in shambles,” and they are verging to the time of massive renewals.

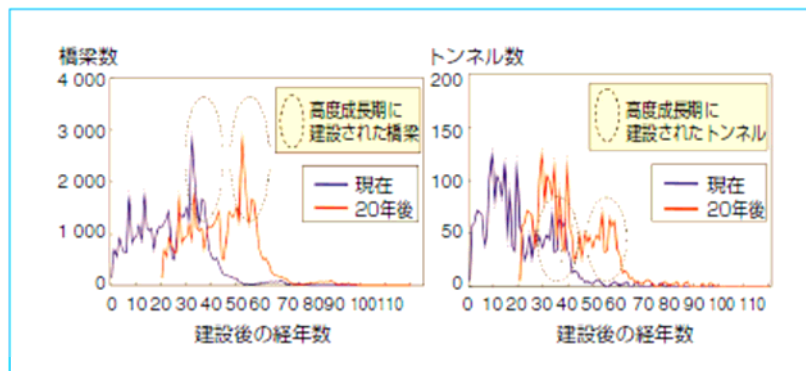


Fig.1: Nos. of aging bridges and tunnels

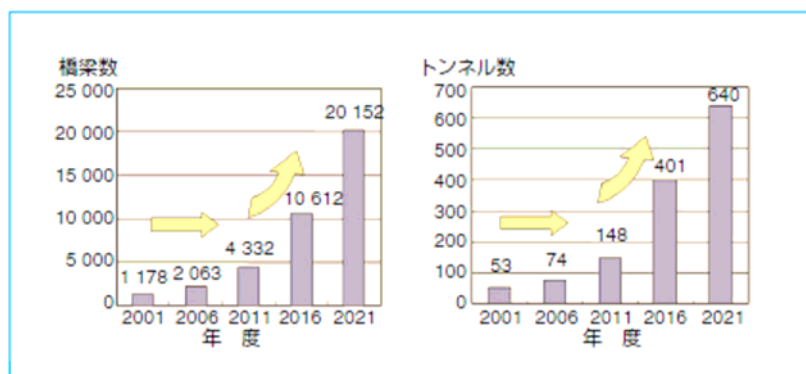


Fig.2: Nos. of bridges and tunnels more than 50 years old

Conventional Road Management and Suggestions from “America in Shambles”

The Japanese government has placed emphasis on road construction so far. That is hardly considered as sufficient investments in road management and maintenance from a long-term viewpoint. Conventional road repair and maintenance is to mend only damaged parts and areas of roads only when they were found in check-ups and inspections.

Another hindrance to development of road management system is that the public has not properly understood the importance of road maintenance and management due to undeveloped management system, called PDCE-Plan, Do, Check, and Action. The lack of communication of the governmental side with the public caused to the hindrance, too. The government should have made more efforts to explain the public the importance of proper road management and maintenance and the risks of losing national assets in future.

In the 1980s, the American society where deteriorating road stock appeared around undertook reconstructions of the deteriorating roads by means of drawing up guidelines for bridge inspections, institutionalizing checker qualification systems and establishing federal aid systems. Learning from the shambling society in America, the Japanese society should rapidly develop asset management systems against the rapid aging of road facilities

Basic outline of Road Asset Management

When anticipating tighter human and economic resources, the government needs to take measures accordingly: to extend serviceable period of road facilities with proper

maintenance and repair works, to level the time of renewal and to minimize Life Cycle Cost (LCC) from foundation to renewal.

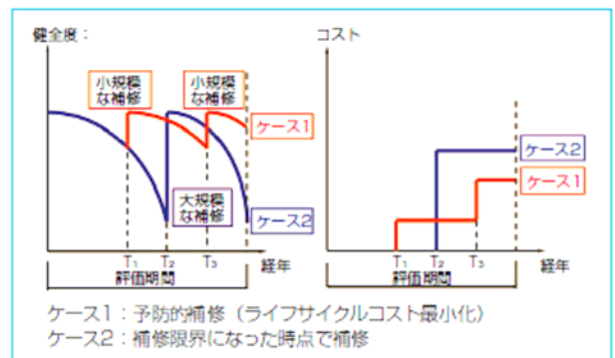


Fig. 3: Image of minimization of Life Cycle Cost

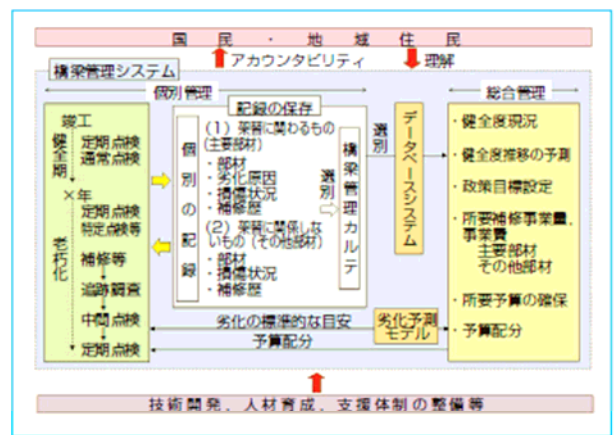


Fig. 4: Basic outline of Road Asset Management (in bridges)

Ministry of Land, Infrastructure and Transport (MLIT) has considered and discussed on the establishment of road management systems. Fig.4 shows the outline of the asset management systems. (Fig. 4) The key concepts are as follows:

- Individual and collective approaches should be employed.
- Individual approach is to conduct inspections of each facility and repair needed parts/ areas of the subject facility, and to record the details obtained at the inspections and use them to create most effective management methods. Especially, damages on the major structural parts

should be identified the causes of the damages and be repaired properly at an early stage.

- Collective approaches is to figure out most effective investment strategies how to secure enough budgets and allocate them wisely, based on the data on soundness and possible future conditions of a subject facility on both local and national levels.

Major Components of Asset Management Systems

Facility Inspection

Facility inspection is to be done based on the understanding of road facility's present condition and comprehensive view of determining that facility's soundness, estimating possible deteriorations and planning repair/ maintenance work to be done as a sequence. It is important to quantitatively and objectively record facility's conditions with statistics and image data as much as possible: cracks, furrows, and flatness on pavements, erosions of steel sections, rifts and cracks on floor slabs of bridges and cracks on concrete lining, fallings and water seepage on tunnels.

Concerning countermeasures against brine damages on concrete bridges, for example, it is very effective to measure chloride iron concentration on those bridges' steel parts so as to apply some protections like coating on their surface before cracks occur on them. (Table. 1) MLIT conducts a so-called special inspection focusing on a specific damage besides a regular checkup.

Table. 1: Deterioration process and ways of repair

劣化過程		桁の損傷状況	補修方法	費用
潜伏期	塩化物イオンの侵入		表面塗装	安い
進展期	鋼材の腐食		断面修復	やや高い
加速期	ひび割れ発生		電気防食	高い
劣化期	耐荷力の低下		架替え	非常に高い

Determination of Soundness and Estimation of Deterioration

Determining soundness and estimating deterioration are important procedures to take in asset management system. Concerning pavements, the ministry estimates future deterioration of pavements along with setting quantitative evaluation index for damages such as crack, furrow and flatness.

Also, they assess the damages and deterioration of bridges and tunnels and evaluate those conditions at an inspection; the mechanism of deterioration varies widely by region due to materials used and contributing factors to deterioration. Aging is another factor making accurate deterioration prediction difficult, even if accurate possible. While a macro-level prediction of deterioration is necessary to deal with many groups of facility in some case, individualized prediction is needed in another case

Thus, most updated data on basic information of road facilities such as specifications, and the year of establishment and the data of records of inspections and repair and maintenance should be utilized to implement appropriate methods for predicting deterioration according to the

facilities' usages and purposes. Together with collecting these data, it is requested for revising and improving the accuracy of deterioration prediction models as needed are requested for. The ministry has been reviewing the deterioration prediction models focusing on the specific damages and deterioration on major regions which can affect the serviceable period of bridges, testing with the data about the bridges.

Analysis of Life-Cycle Costs (LCC)

In order to plan road maintenance and repair work and strategic investment, it is necessary to analyze the Life Cycle Costs (LCC) of roads during a certain evaluation period. Basic procedures for analyzing the LCC are to standardize the procedures and costs for repair and maintenance work, and then calculate the total costs according to several scenarios of maintenance and repair projects.

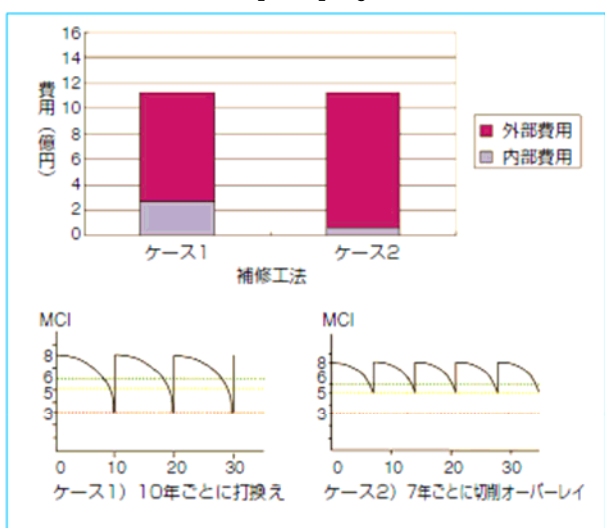


Fig. 5: Examples of LCC analysis for pavement

In LCC analysis, a key point is how to manage not only internal costs for repair and maintenance work but also external costs to occur relating to that work on progress. It is especially important to make a fair evaluation

of the lost-time costs caused from traffic congestions in case of such repair work as traffic controls are needed for, like on pavement (Fig. 5). The ministry has been testing the procedures of LLC analysis for pavements using the data on pavement repair and maintenance corrected by their office.

Database Systems

Establishment of database is an essential tool to provide necessary information contributing to making investment analysis, contributing as a basis for evaluations of soundness and deterioration predictions of road facilities. The ministry has been compiling a database of the basic information of road facilities and the records on pavements, bridges and tunnels obtained from inspections and repair and maintenance work, and making a system to utilize these data in individual and collective approaches of management gradually.

Future Developments and Challenges

Road facilities' present conditions and the ministry's approaches to asset management have been discussed. What to be done towards the coming period of road facility renewal is to establish a comprehensive asset management system while further developing their approaches of managing the facilities as soon as possible.

It is challenging but important to develop nondestructive inspection methods and effective repair and maintenance techniques and strengthen industry-government-academia cooperation to promote training of highly skilled engineers who are able to conduct facility inspections and evaluations. Last, road administrators are expected to deepen the

understanding of the PDCA system of asset management enough to properly manage the facility.