Strategic Maintenance of Bridges of the Tokaido Shinkansen

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More than thirty-nine years have passed since the Tokaido Shinkansen began operations in 1964. The Shinkansen is used by 130 million persons annually, and it supports nearly 80 percent of the flow of commuters between Tokyo and Osaka. In order to meet future transportation needs, the Superconductivity Maglev, which has a high potential of running, is being developed and is currently undergoing the final stage of experiments.

Although the rolling stock, signaling, and power system of the Shinkansen have been drastically updated, infrastructure systems, such as bridges and tunnels, remain almost the same as when initially constructed except for minor improvements.

Since many large-scale infrastructures in Japan were rapidly constructed during the 1960s, selecting the optimum approach to infrastructure management will become more important in the near future. The optimum approach is considered to be based on life-cycle cost analysis (LCCA). Numerous LCCA methods are being developed to take into account many complex factors, such as prediction of long-term deterioration, evaluation of cost-effectiveness of treatments, and assessment of user costs. To date, due to budgetary constraints, many final decisions concerning maintenance of structures are made from an engineering standpoint based on past experiences rather than by applications of LCCA, in general.

In view of LCCA, preventive maintenance approaches at an extremely high level have been adopted into the Tokaido Shinkansen, which is considered to be an indispensable infrastructure to the national economy. These approaches include periodical in-depth inspection of steel bridges, loading tests of experimental steel bridge girders, and surface protection of all reinforced concrete structures. The methodologies developed for the bridges of the Tokaido Shinkansen can be applied to other socially important structures.

Keywords:
Carbonation of concrete: A phenomenon in which carbon dioxide in the air neutralizes the alkalinity of concrete, causing corrosion of embedded reinforcing steel bars.

Passivity film: A very thin oxide-film on the surface of metal, which prevents metal from corroding.

Surface protection: A method to limit corrosion by minimizing free air and water in the capillaries of concrete, and by preventing further chloride intrusion from migrating through cracks and reaching reinforcement bars.