Analysis of the Periodic Inspection Results of Sheds, Large Culverts, etc.

(Research period: FY2018 to FY2020)

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1. Introduction

Road structures that were widely built during the period of rapid economic growth in Japan need to be efficiently maintained for continued use, and since FY2014, statutory inspections of road structures such as tunnels have been conducted once every five years. NILIM is collecting and organizing the results of periodic inspections of sheds, large culverts, etc. conducted by the government and other road administrators in order to efficiently maintain road earthwork structures, and is studying the rationalization of periodic inspections, etc.
This paper reports the results of analysis on the periodic inspection data of about 3,400 sheds and shelters and about 8,600 large culverts for the first five years (first round) from FY 2014 to FY 2018 and the first year of the second round in FY2019.

2. Organization of results from periodic inspection of sheds and shelters

The results of the soundness diagnosis for the sheds and shelters nationwide are as follows: about 6% are classified as Judgment Category I (sound), about 49% as Judgment Category II (preventive maintenance stage), about 45% as Judgment Category III (early action stage), and 0.2% as Judgment Category IV (emergency action stage) (**Fig. 1**). Of these, the results organized by shed material are shown in **Fig. 2**. By material, steel sheds in about 60% of the facilities were classified as Judgment Category III, which is a higher percentage than RC and PC sheds. This may be partly due to the fact that many of the steel sheds are old (**Fig. 3**).
As regards the installation environment of government-managed sheds, about 90% of the facilities are installed in areas designated as snow-covered area or cold region (including areas designated as both) (**Fig. 4**). The ratio of Judgment Category III is about 45% for facilities installed in snow-covered area or cold region, which is higher than outside the region (**Fig. 5**). This would be attributable to the effects of freezing and thawing, as well as the tendency of deterioration by salt damage resulting from the dispersion of snow-melting agents.

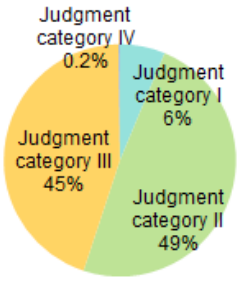


Fig. 1: Percentage of Judgment Category (Shed, shelter)

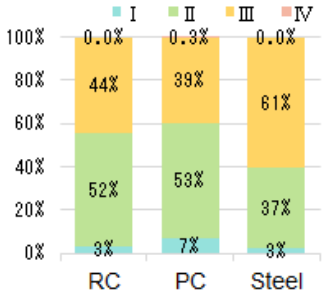


Fig. 2: Percentage of Judgment Category by material (Shed)

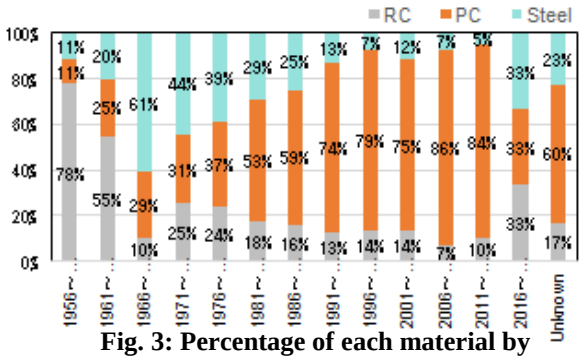


Fig. 3: Percentage of each material by construction year (Sheds)

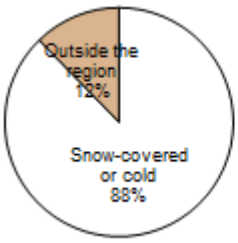


Fig. 4: Percentage of facilities by snow-covered area / cold region (Shed)

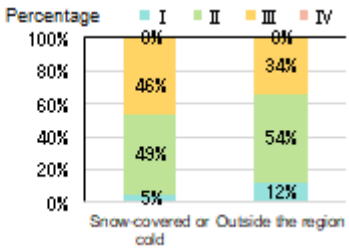


Fig. 5: Ratio of Judgment Category by snow-covered area / cold region (Shed)

3. Organization of results from periodic inspections of large culverts

The results of diagnosis on the soundness of large culverts nationwide showed about 20% were in Judgment Category I, about 72% in II, about 8% in III, and 0.01% in IV (**Fig. 6**). In general, for the soundness by construction year (decade basis), the older the construction, the lower the number categorized as

Judgment Category I, and the higher the number categorized as Judgment Categories II and III (**Fig. 7**). **Figures 8 and 9** show the diagnostic results for each year of construction since 1990, which were organized by material for the facilities managed by the government. For cast-in-place culverts, there is no trend over time in the percentage of judgment categories. For precast culverts, the trend of soundness was higher for the facilities of newer construction, although there are some differences depending on the construction year. The number of occurrences of deformation aggregated by type is shown in **Fig. 10**. Cracks are the most common type of occurrences of deformation, accounting for about 53% (31,950/60,386 locations) of the total number of deformation occurrences.

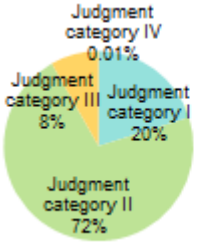


Fig. 6: Percentage of judgment category (Large culvert)

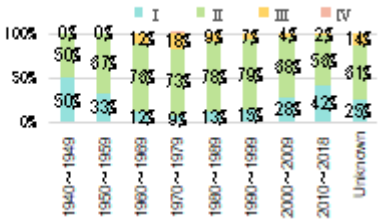


Fig. 7: Percentage of judgment category by construction year (decade, since 1940)

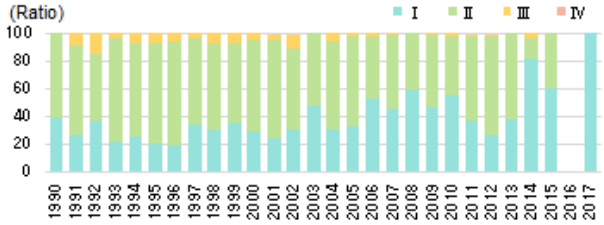


Fig. 8: Percentage of judgment categories by construction year (Cast-in-place culverts, since 1990)

Fig. 9: Percentage of judgment categories by construction year (Precast culvert, since 1990)

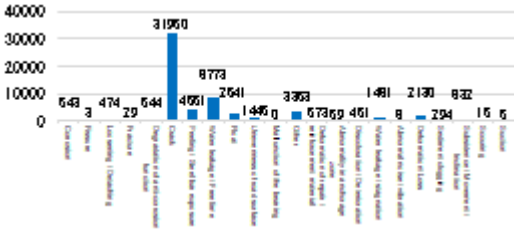
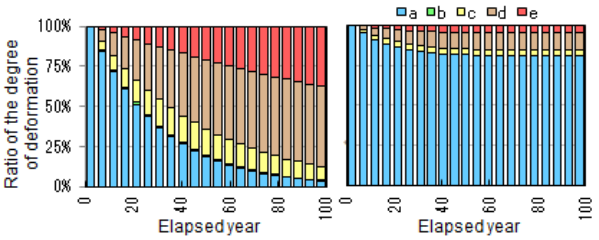


Fig. 10: Number of locations where deformations occurred by type of deformation

4. Comparative analysis of the results of the first and second rounds of periodic inspections

For sheds, shelters, and large culverts, the second round of periodic inspections was started in FY2019. Since 2020, NILIM has been conducting the comparative analysis on the results of the first and second rounds of periodic inspections since FY2020 to study the progress of deformation (deterioration characteristics). In the periodic inspection of government-managed facilities, results are recorded according to the types of deformation for each component by classifying the evaluation results of the degree of deformation into five levels, from Category "a" (no deformation) to Category "e" (the largest deformation). **Figure 11** shows the state probability distribution of the members for each 5-year period of time, based on the evaluation results of the degree of deformation of members in the first and second rounds. The comparison of the "cracks" in RC valley-side columns of RC sheds and PC valley-side columns of PC sheds shows that the RC valley-side columns deteriorate faster than the PC valley-side columns.



(RC shed RC valley side columns, cracks) **(PC shed PC valley side columns, cracks)**

Fig. 11: Example of state probability distribution

5. Conclusion

NILIM has prepared a collection of examples of deformation[2] as reference material for periodic inspections, as well as the analysis results of the first round of periodic inspections shown in this report. [1]. We will continue to conduct a comparative analysis of the results of the first and second rounds of periodic inspections, and to study the application of new technologies, etc., which are expected to lead to proposals for streamlining periodic inspections, etc.

☞See the following for details.

1) Technical Note of NILIM, No. 1145, "Analysis of the Periodic Inspection Results of Sheds, Large Culverts, etc. (1st round)
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn1145.htm
2) Technical Note of NILIM, No. 1135, "Reference Material for Periodic Inspection of Sheds, Large Culverts, etc. (2020 Edition)"
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn1133.htm