

Research and Study on Management Methods to Meet the Required Performance of Embankments, Cuts, etc.

(Research period: FY2017 to FY2020)

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1. Introduction

In recent years, heavy rains and other natural disasters have caused slope failures and other damage to road earthwork structures such as embankments and cuts, which have affected the function of roads. In August 2017, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) established the "Guidelines for Inspection of Road Earthwork Structures"¹⁾

("Inspection Guidelines") to improve the safety and ensure the efficient maintenance of road earthwork structures by identifying deformation and determining the necessity of measures.

The specified earthwork inspection of relatively large road earthwork structures (about 5,000 structures) was conducted on national highways under the direct control of MLIT during the two years of FY2018 and FY2019. This paper reports the results of analyzing the data of this inspection and organizing the trends of deformation in order to obtain basic data for improving reliability, increasing the efficiency of inspection work, and studying effective repair / reinforcement methods.

2. Analysis of inspection results

The Inspection Guidelines classify the soundness levels into I (sound), II (observation stage), III (early action stage), and IV (emergency action stage).

Figure 1 shows the results of inspecting the level of soundness for embankments and cuts. The trend of soundness level distribution of embankments and cuts is almost similar, and Soundness Level III accounts for about 7%.

Figure 2 shows the distribution of soundness levels in each completion year, but there is no clear relationship between the completion year and soundness. **Figures**

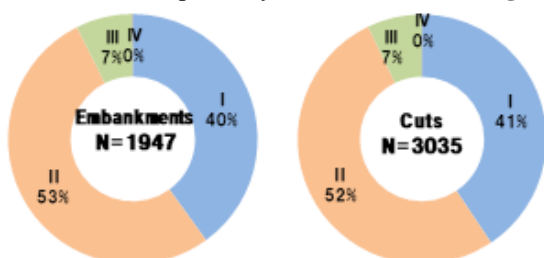


Fig. 1: Soundness judgment result

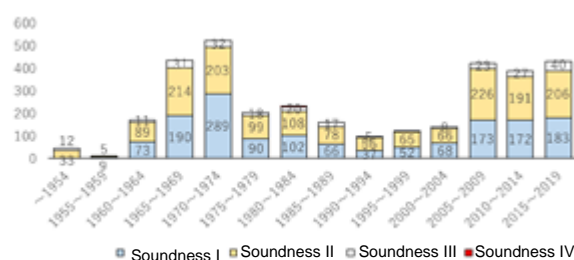


Fig. 2: Distribution of soundness levels in each completion year (construction year)

3 and **4** show the percentage of deformation by facility for embankments and cuts. The top three facilities for both embankment and cut are drainage facilities, sprayed concrete, and concrete retaining walls, which are all concrete facilities. As known from the above, it can be conjectured that soil itself, which is the main component of road earthwork structures, is less affected by deterioration with age. On the other hand, since deformation has often occurred to concrete facilities such as slope protection works and drainage systems, the effect of deterioration with age is expected to be large and the analysis should, therefore, be continued.

3. Organization of the factors of early action stage (Soundness Level III)

Since the Inspection Guidelines explain soundness Level III as "When it is desirable to take measures as soon as possible because the structure is expected to collapse due to the presence of deformation that is expected to progress before the next inspection", we will organize the factors by focusing on this soundness level. **Figures 5 and 6** show the types of deformation identified in the main body of embankments and cuts, as a percentage of each soundness assessment. The following is a list of characteristics of each type and their influence on the judgment, with focus on Soundness Level III.

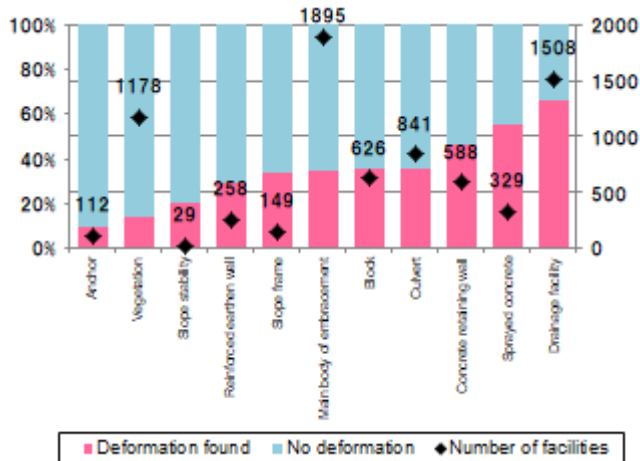


Fig. 3: Ratio of deformation in embankments by facility

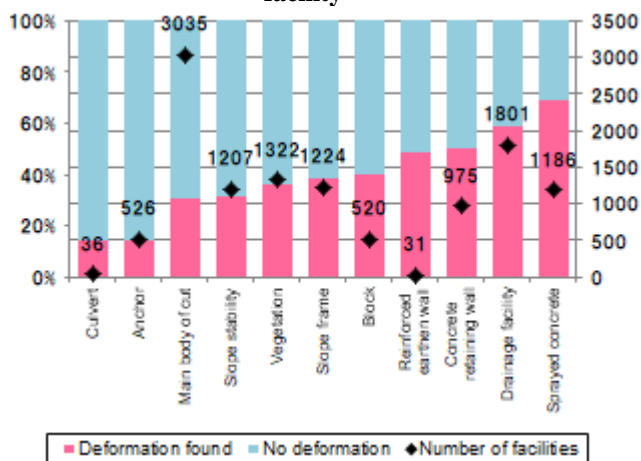


Fig. 4: Ratio of deformation in cuts by facility

[Main body of embankment]

- If there is "collapse" or "swelling," it tends to be judged as Soundness Level III.
- Deformation caused by "surface slippage" tends to be judged as Soundness Level I or II, and is difficult to be judged as Soundness Level III.

[Main body of cut]

- When there is spring, collapse, or level difference, it tends to be judged as Soundness Level III.
- "Swelling" tends to be judged as Soundness Level I or II, but not as III in any example.

As described above, since the tendency of deformation that is likely to be judged as Soundness Level III is different depending on the type of structure, even for road earthwork structures, it is necessary to conduct inspections with a focus on the characteristics of each structure. Note that the inspection results cover a period of two years and the number of facilities analyzed is uneven, so the data will continue to be accumulated.

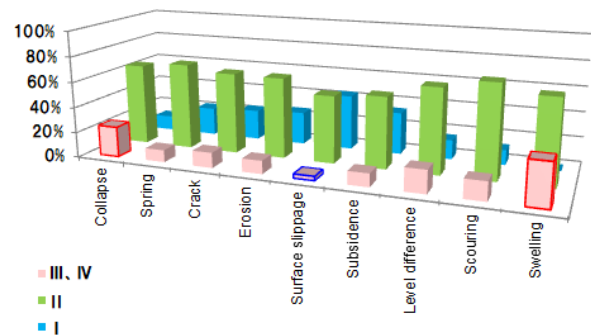


Fig. 5: Soundness judgement for each type of deformation (Embankments)

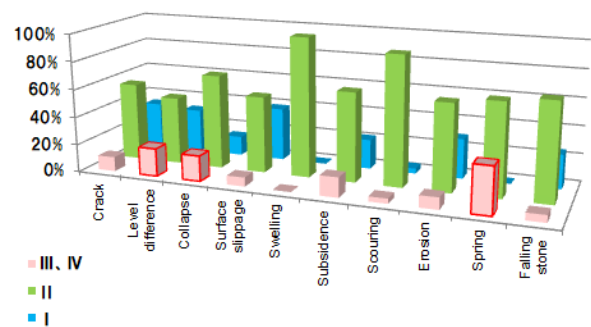


Fig. 6: Soundness judgement for each type of deformation (Cuts)

4. Conclusion

This paper summarized the results of the specified earthwork inspection for two years on directly managed national highways. Although the Inspection Guidelines provide that soundness diagnosis should be conducted based on the identification of deformation, there is also the issue that diagnosis is not directly related to the required performance of the road earthwork structure. We will continue to accumulate inspection results, analyze the facilities and points to focus on in the inspection, and study ways to improve the reliability of the inspection, including the relation to the required performance.

See the following for details.

1) Guidelines for Inspection of Road Earthwork Structures (Aug. 2017)

http://210.248.150.32/road/sisaku/yobohozen/tenken/ty_h2908.pdf