Analysis on the serviceability of pavement on national highways under the jurisdiction of the Ministry of Land, Infrastructure, Transport and Tourism

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1. Introduction

In the national government and local governments, etc. in charge of management of road structures, shortage of engineers and financial difficulties associated with depopulation as well as a declining birthrate and aging population have become more and more serious. Among them, since pavement has a short renewal period and requires a large amount of stock, it has become a pressing challenge to establish a maintenance cycle and reduce the life cycle cost (LCC) by increasing the lifespan of pavement. Due to these circumstances, "Pavement Inspection Procedures" were established in October 2016. According to the Procedures, the road administrator shall classify roads into 4 categories according to the traffic volume and the importance of the route, etc., thereby managing the roads with emphasis on key issues. In particular, regarding the national highways under the jurisdiction of the MLIT, according to the Pavement Inspection Procedures" of the MLIT jurisdiction edition ¹⁾ March 2017, inspections shall be carried out once every 5 years, for all the national highways under their jurisdiction. The 1st round of inspections of all the national highways under the jurisdiction of the MLIT was completed during the period from FY 2017 to FY 2021. This paper reports the summarized results of the 1st

round of periodical inspections of the national highways under the jurisdiction of the MLIT, with the goal of further economizing the management of pavements. Also, with a view to grasping the relations between pavement performance and external factors, and reviewing the design methods, it reports the summarized results of the road property survey that grasp the serviceability quantitatively in 12 places of the national highways under the jurisdiction of the MLIT.

2. About the results of inspection in the first round

Regarding the results of pavement inspection carried out during the 5 years from FY 2017 to FY 2021, the inspection data has been summarized. Regarding these data, the target number of years of use and the number of years of service of the surface layer and the results of integrity diagnosis, etc. have been summarized.

(1) Target number of years of use

The target number of years of use is to be set by the road administrator, taking into account the asphalt pavement with wide variations in the speed of degradation, as the surface layer is continued to be used during the target period. This is to inhibit early degradation of sections of the surface layer. The situation of resurfacing the asphalt pavement of the national highways under the jurisdiction of the MLIT (excluding those under the new jurisdiction method) is shown in Fig. 1. The highest ratio of the target number of years of use, in about 45% of the cases is "13 years". This may have been affected by the fact that, during the introduction of the long-term guarantee system for asphalt pavement, a performance guarantee after a period of 13 years was taken into account. In the 2nd round and thereafter, it is required that the target number of years of use be reviewed whenever necessary with the goal of reducing LCC through exclusion of the early degradation section.



Fig. 1: Setting the target number of years of use (ratio of the total length of the lanes with asphalt pavement)

(2) Integrity

The results of integrity diagnosis according to the number of years of service of the surface layer is shown in Fig. 2 and Fig. 3. In the range of around 0 to 20 years in the number of years elapsed, there is a tendency for both asphalt pavement and concrete pavement to deteriorate, as the number of years elapsed increases. However, it can be seen that, with concrete pavement, the ratios of the total length with integrity "II" and "III" are relatively low, and the ratio of maintaining the state of integrity "I" is high. Although it has long been said that concrete pavement has durability that is superior to asphalt pavement, this has been proven by the results of inspection of the national highways under the jurisdiction of the MLIT in practical work as well.

(3) Causes of damage

Of the areas inspected in which the integrity of the surface layer of asphalt pavement and concrete pavement is "III", the results of summary of the ratio of damage that has been a major consideration when making judgments is shown in Fig. 4. In asphalt pavement, the ratios related to "cracking" and "IRI1)" that is an index associated with the ride comfort of the driver are high, were about 47% and 32% respectively. However, the ratio related to "rutting" is low, being about 15%. It is conjectured that this is due to the improvement of the fluidity resistance of pavement by the use of modified asphalt. On the other hand, in concrete asphalt, the ratio related to "IRI" is high, at about 57%. One of the possible reasons is that, in joint portions that are the structurally weak points of ordinary concrete pavement, rainwater infiltrates due to the scattering of joint materials, and level differences occur causing the ride comfort to decrease. Therefore, as shown in the Inspection Procedures, appropriate maintenance and management such as refilling of the joint materials is important.

The survey results for long-term serviceability 3. Periodical inspection of pavement is qualitative evaluation, and quantitative monitoring is necessary to discover degradation trends and make structure evaluation. Therefore, a follow-up survey of the road surface properties such as rutting is implemented in the survey sections of the national highways under the jurisdiction of the MLIT. Road surface property surveys have been implemented in 12 existing locations among the sections of ongoing surveys since around 1989. The tendency of decease in long-term serviceability is being grasped as shown in the typical example in Fig. 5. We plan to continue to accumulate long-term serviceability data and to analyze correlations between the performance of pavement and the external factors such as traffic volume. Our hope is that the work will lead to further streamlining of management by considering the period in which the retention of each performance is assumed and the state during the next time inspection.

4. Outlook for the future

Aiming at the reduction of LCC by increasing the lifespan of pavement, we plan to continue the survey and summarization of inspection and serviceability survey in future as well, in order to further rationalize pavement management, and to use the results of such survey and summarization as the basic material of the revision of inspection procedures and technical standards, and the findings thus obtained will be reflected in the technical standards, etc.



Fig. 5: An example of the results of survey of serviceability (large vehicle traffic volume: 11,148 vehicles/day (FY 2015), Civil Engineering, DID)

For detailed information, refer to the following:

 Pavement Inspection Procedures, Ministry of Land, Infrastructure, Transport and Tourism, March 2017 <u>https://www.mlit.go.jp/road/sisaku/yobohozen/tenken/</u> yobo3 1 10.pdf

2) Features of the results of the 1st round inspection of the pavement in the national highways under the jurisdiction of the MLIT, Satoshi Horiuchi, Yuya Wakabayashi, Kazuhiro Watanabe, Japan Society of Civil Engineers 78th Annual Academic Lecture Meeting, V-151, 2023