

# Summarization and analysis of tunnel inspection results

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## 1. Object of Research

NILIM performs considerations on the increase in the efficiency of the methods for inspecting road tunnels, as well as on rational design, construction, and maintenance, considering inspection results.

In order to obtain the basic information required for such considerations, NILIM performs an analysis of the occurrence and trends in the deformation of tunnels constructed with the steel arch support and lagging method and NATM based on the results of periodic road tunnel inspections.

## 2. Research Contents

In periodic road tunnel inspections, the deformation of each lining span in the tunnel is focused on to determine the soundness of each tunnel. In addition, deformations are classified into external force, material deterioration, and water leakage by occurrence factor. To analyze the progressiveness of deformations, the results of the periodic inspection of 100 tunnels (50 tunnels constructed based on the steel arch support and lagging method and 50 tunnels constructed based on NATM), which had been inspected several times in the past were compared and analyzed. Since the indexes used for determination were changed because of the revision of the inspection procedures in 2014, the results were converted for comparison (Table 1).

Table 1 Comparison between old and new categories for determining each span

Periodic road tunnel inspection procedures (June 2014)		Past (Before FY 2014)
Determination categories (Five categories)		Determination of inspection result (Three categories)
I: Sound		S (No or slight deformation)
II: Preventive maintenance stage	II b: Preventive maintenance stage (Monitoring is required)	B (Deformed: Low risk, investigation is required)
	II a: Preventive maintenance stage (Monitoring and countermeasures are required)	
III: Early measure stage (Early measures are required)		A (Severe deformation: High risk, emergency measures and investigation are required)
IV: Emergency measure stage (Emergency measures are required)		

Figures 1 and 2 show that the ratio of the spans exhibiting a deteriorating trend (orange and red) in all spans constructed based on NATM is lower than that constructed based on the steel arch support and lagging method concerning all deformation occurrence factors, including external force, material deterioration, and water leakage. In particular, concerning the deformation caused by water leakage, approximately one-third of the spans constructed based on the steel arch support and lagging method exhibited a deteriorating trend, but only three percent of the spans constructed based on NATM

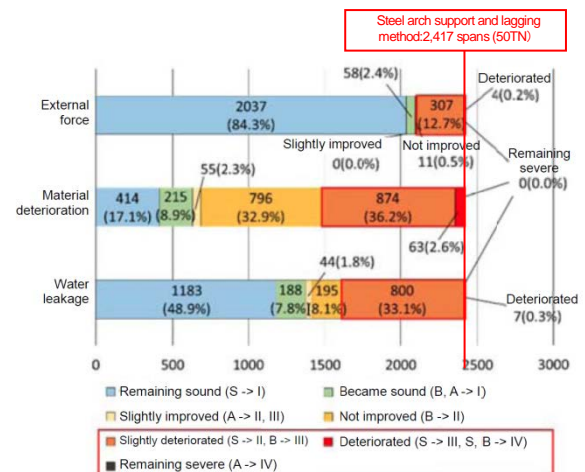


Figure 1 Progress of deformations in each span (Steel arch support and lagging method)

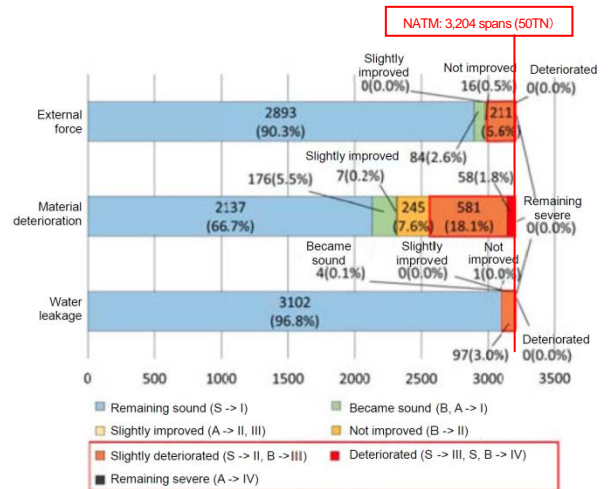


Figure 2 Progress of deformations in each span (NATM)

exhibited a deteriorating trend.

This is considered to be because the occurrence and progression of deformation caused by water leakage were reduced by the waterproof finish on the back of the lining concrete, which has been applied since the change of standard tunnel construction method from the steel arch support and lagging method to NATM.

## 3. Conclusion

We will continue to utilize the results of periodic road tunnel inspections to grasp the soundness of tunnels, analyze deformation occurrence factors, and consider the increase in efficiency and the simplification of the periodic tunnel inspection method.