

Management of Sewers

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1. Introduction

Sewers constructed rapidly since the late 1960s have deteriorated in recent years, demanding appropriate maintenance and large rehabilitation works. It is predicted that population decrease makes it difficult to secure satisfactory budgets for sewer management. From now on, measures must be taken to minimize the failure risk such as road sinkholes and to reduce or level expenses.

This report introduces a study of micro-management, which is a part of sewer asset management.

2. Micro-management of sewers

The core of asset management consists of medium- to long-term rehabilitation cost predictions based on statistical analysis of survey results (macro-management) and prioritizing of rehabilitation or maintenance works in individual spans (sewer lines between manholes) (micro-management).

In FY 2009, risk assessments were studied on micro-management. Risk assessments are quantitative evaluations performed by combining “probability of sewer failure” and “consequence which failed sewers might cause.” Prioritizing rehabilitation or maintenance to minimize the risk such as road sinkholes is studied by this method.

3. Studying risk assessments

Quantifying the probability of sewer failure is conducted by analysis based on the relationship of sewer survey results (e.g., corrosion or infiltration as in Photo 1) with sewerage registry items (e.g., type of material, age, diameter). Since sewers are buried under a variety of urban environments and ground conditions, registry items cannot cover all factors which influence the occurrence of failure.

This study combines two approaches: logistic regression analysis applied for registry items, and the AHP method for factors other than registry items. Logistic regression analysis is a study approach using sewer survey results and registry items obtained from sampled cities. The AHP method is conducted through a questionnaire survey of engineers of major cities who have much experience in sewer maintenance.



Photo 1. Examples of failed sewers

Equation 1 is a probability equation for failure occurrence with registry items as the independent variables and sewer survey results as the dependent variable, while Equation 2 is an assessment equation by the AHP method. The quantification of the consequence of failure is studied similarly using the above AHP method.

$$\Pr(Y=1) = \frac{1}{1 + \exp[-(\beta_0 + \beta_1 X_1 + \beta_2 X_2 \cdots + \beta_r X_r)]}$$

Equation 1

(β_i : coefficients, X_i : independent variables (registry items), r : number of independent variables)

Assessment of probability of failure occurrence
= (Weight of large vehicle passage) × (Score of large vehicle passage) + (Weight of tree planted zones) × (Score of tree planted zones) + ----- + (Weight of ground conditions) × (Score of ground conditions)

Equation 2

4. Conclusion

This assessment is a simple method which can be adopted in medium and small cities where expertise of city engineers is limited, contributing greatly to the introduction of nation-wide asset management.

References

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