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Study of Deterioration Prediction Model of Water Distribution System Using the Development of Method of the Amend Indirect Condition Assessment

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Abstract. In the 80's and 90's, a lot of Pipe had been installed and Pipe network has rapidly extented, and those are over 40~50 years old. The concurrent increase of the replacement arrival period makes a large of national financial burden on government and society. For this reason, to build the appropriate and reasonable budget investment strategy, the determination of introduction of asset management system about water treatment and wastewater facilities is desperately needed. Thus, in this study, a pilot area for a particular technology to assess the current state of the diagnostic evaluation and safety inspection of the facility safety analysis to compare the result to derive the correlation between the two diagnostics, environmental characteristics, and tend to apply the aging of Water Distribution System the aging of the proposed prediction model.

Keywords: Infrastructure, Asset management, Deterioration Model, Regression analysis, Condition evaluation

1 Introduction

The water and sewage system in Korea has continuously expanded as the city developed. In particular, a lot of pipe network has been installed in 80s and 90s with the population concentrated in the cities, and the life of these installations reach as much as 40~50 years. Consequently continuing worn out pipes replacement has occurred, the budget for it also occupies enormous size. Since we looked at the point of view of only installation which were decision making method of development era, it brought the absence of facility management point of view for maintenance and management centered.

Continuously and simultaneously increasing the replacement time of worn out pipes becomes a fiscal burden on our country, thus, input timing for appropriate and

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reasonable budget and bringing in of water and sewage asset management system of determined the expense scale was urgently needed.

Recently, A study to establish the comprehensive managing process is advancing in Korea and abroad.

It applies asset management concept for national infrastructure facilities and the current condition of pipe network, predict the long term pipe network deterioration and determine the appropriate time for maintenance and reinforcement.

In particular, the development of regional environmental characteristics and uses characteristic model is more important than comprehensive concept in development of pipe network, based on environmental, construction impact of facilities and current conditions, development of aging facilities model is a necessary course to anticipate future state

For this reason, this study utilized certain pilot area's safety/ technical diagnosis material, studied methodology of developing aging model for water and sewage pipe applied environmental characteristic, and aging tendency.

2 Condition Assessment Status and Problem Analysis for Water Pipe Network

2.1 Study of diagnostic methods by the target facility and characterization

Diagnosis of water pipe network can be classified into safety diagnostics and technical diagnosis. In the safety diagnosis, directed to a water main and a water pipe[1], in the case of diagnosis of technology, it is divided into wide waterwork system and local water service. In case of wide waterwork system, water main in the case of local water service, water main, drain pipe, water supply, are the target.

In case of safe diagnosis, after state evaluation that is presented in the special law about facilities' safety management, can implement repair, reinforcement to C rank (2.5≤ state index ≤3.5) facilities.

In the case of technology diagnosis, after performing the indirect assessment which the evaluation method utilizes the prior information (the tube type, pipe radius, laying year, and etc), it gets to determine the direct evaluation existence and nonexistence according to the evaluation score.(Table 1)

Table 1. Condition evaluation criteria in technology inspection

Division	Range	Condition
Evaluation result	<0.45	Replacement/rehabilitation
	0.45~0.60	Progression
	>0.60	good

2.2 Problem Analysis of diagnostic methods

Indirect evaluation method couldn't present a top score of 1.0 in the even in the initial construction time. In other words, initial construction of steel pipe doesn't start at optimal health score of 1.00. It starts at 0.8433. This applies even if all other conditions to the best state, the condition value to the tube type[2] to be expressed by the indirect assessment criteria applied to the differential equation, sensitively to express the aging process according to the time change is set to indicate a significant limitation.

3 Developing evaluation model of water main deterioration

3.1 Basic direction of development of deterioration evaluation model

Basic direction of the pipe network facilities are follows. First (1) securing each diagnostic data (safety inspection / technical examination) (2) figure out deterioration tendency by analyzing state evaluation index on safety diagnosis that is secured now. (3)Utilize this for analyzing relation between the indirect evaluation result of technology diagnosis and suggest relative safety of diagnostic estimation. (4)Utilize the pipe network characteristic, calculate pipe network state change regression equation after technology diagnosis indirect evaluation.

Then, (5)analyze diagnosis result, draw a correlation (pattern) that was suggested. And finally match (5) the correlation pattern to technology diagnosis regression equation, and suggest final pipe network deterioration model. It suggests a way to apply the criteria presented it in the local public enforcement regulations.

3.2 Development deterioration model that reflect pipe network characteristic through comparison analysis of safety/technology diagnosis

The safety test deterioration tendency and technology diagnosis indirect evaluation deterioration tendency were calculated according to the expiration year number change. The correlation about this was analyzed. First, it is organized in order to convert to the absoluteness unit standard which is used in the technical diagnosis and compare by the same standard. As shown in Fig. 1, and are also different from the initial aging indicators it may be found to be expressed also very different from the tendency of each of the slope.

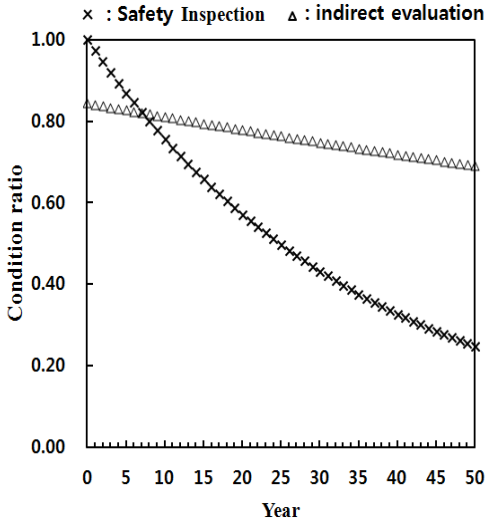

Fig. 1. Residual analysis(D1650)

In order to improve these problems, diagnostic initial value is adjusted to be the same and so the impact on the results of the diagnostic technique, each of which has adjustment and methodology are necessary. First, analyze the gap between two graphs for this and reorganize residuals of the derived value from the gap analysis in regression equation and add to indirect evaluation index and push conversion ahead to indirect evaluation result value. The result was carried to the correlation analysis and direct evaluation result value.

When this is based on the criteria that have been shown to Table 1 in those corresponding to, 0.6 which is the reference of a good state is about 18years. Exchange, and rehabilitation state 0.45 is analyzed about 29years.

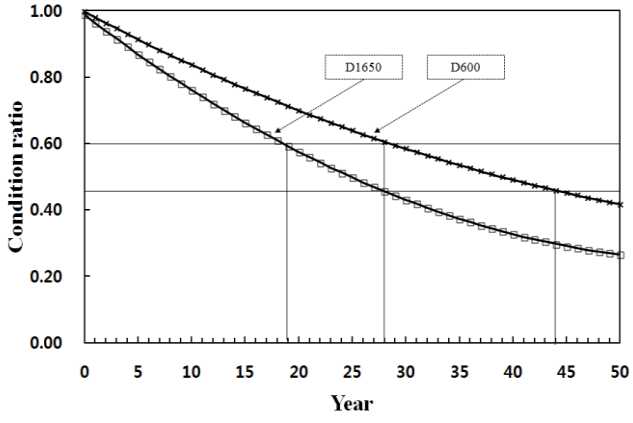

Fig. 2. Deterioration predict model

4 Conclusion

This study is about deterioration prediction model to apply asset management concept for pipe network in national infrastructure. It is displayed characteristics and problems that appear in each method by analyzing two diagnosis methods.(Safety diagnosis/ Technology diagnosis)

Based on this, figure out state index tendency according to the number of years and present a result that evaluates site state directly in safety diagnosis data. And after technology diagnosis indirect evaluation by utilizing the data of the area, it drew deterioration tendency same to safety diagnosis.

It presented applicability to take advantage of the development of aging models to develop aging models for various pipe type used for domestic distribution network.

References

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