

A Study on Design Approach for Two-Layer Structure Pipes

Whole term

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(Purpose)

The sewer pipe rehabilitation has showed remarkable progress in technological developments and construction results adopting various newly developed materials and construction methods. This institute has issued more than 20 examination certificates for the pipeline rehabilitation technologies by the end of fiscal 2003. "A Guide to Pipeline Rehabilitation" issued in March 2001 shows the standard concept of design and construction management of rehabilitation of sewer pipes.

However, the application scope of the "A Guide to Pipeline Rehabilitation" is limited to self-sustained pipes (strength of existing pipes is not counted in with respect to their structures) and composite pipes (existing pipes and rehabilitating materials are integrated). Two-layer structure pipes, which are structured by applying inversion method or forming method to existing pipes and maintain strength, are not included in this guideline.

The purpose of this study is to compile the technological information that provide the design approach for two-layer structure pipes, based on the concept that a two-layer structure pipe is "structured in such manners that the rehabilitating pipe structured by inversion method or forming method internally touches the damaged existing pipe and both the existing pipe and the rehabilitating pipe bear the external force jointly."

(Contents)

(1) Scope of Application

These technological data are applied to such cases in which the existing pipe (reinforced concrete) is corroded, or the existing pipe (reinforced concrete, ceramic) is damaged by crack(s) in axial/circumferential direction or by infiltrating water, and the existing pipeline is rehabilitated in the form of two-layer structure pipe because its residual strength can be counted in.

(2) Functions and Effects Required of Two-Layer Structure Pipes

As in the case of self-supporting performance requirements, double layer structural pipes are required of same or even higher performance than new pipes in load bearing capacity, chemical resistance, abrasion resistance and strain corrosion resistance. Besides, two-layer structure pipes are required of such functions as safety when degradation of the existing pipes progresses, and safety when repeated loading is applied.

Moreover, by introducing the design approach for double layer structural pipes, matters can also be expected such as practice of effective pipeline rehabilitation by the existing pipeline assessment, practice of effective pipeline rehabilitation businesses, improvement of the construction workings, and improvement of water flow capacity.

(3) Construction Management of Two-Layer Structure Pipes

In the construction of two-layer structure pipes, full attention needs to be paid to the construction and quality management in accordance with "Technical manual for quality control of sewer rehabilitation methods- March 2005" (Japan Institute of Wastewater Engineering Technology). Of particular importance is to grasp the damage statuses of the existing pipelines, as the application of two-layer structure pipes is judged based on such damage statuses. Further, although thinner wall thickness of the rehabilitating pipes than that of self-supporting pipes enables easier construction working, more importance has to be placed on the wall thickness and material quality management.

(4) Design Approach for Two-Layer Structure Pipes

In designing two-layer structure pipes, the damage patterns are classified according to the pipe internal status survey results, and the applicability of two-layer structure pipes is judged. Then, the larger of the rehabilitating pipe wall thickness, required either for soil pressure and live load, or for external water pressure, shall be decided as the design rehabilitating pipe wall thickness, in consideration of the rehabilitating pipe wall thickness reduction coefficient effected by strength deterioration of existing pipe.

1) Design Method for Soil Pressure and Live Load

The larger value of the following two shall be adopted; rehabilitation pipe wall thickness required for bending strength, or for deflection rate, in consideration of the rehabilitating pipe wall thickness reduction coefficient effected by strength deterioration of existing pipe.

2) Design Method for External Water Pressure

When external water pressure is applied by ground water to the rehabilitating pipe inside the existing pipe, the rehabilitating pipe wall thickness shall be set which is sufficiently safe against buckling and to prevent the rehabilitating pipe from internal deformation.

There are two cases: The rehabilitating pipe bears loading such as soil pressure, and Only external water pressure is applied to the rehabilitating pipe. Calculate the wall thickness by using Timoshenko's formula for thin-walled cylinder buckling.

By the abovementioned composition, we have compiled the technological data regarding our design approach for double layer structural pipes.

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key words

Pipe Rehabilitation, Two-Layer Structure Pipes, Construction Management
Pipe Wall Thickness Reduction Coefficient