Pipe Structural Reliability Evaluating System

Purdue ECT Team

Purdue University, ectinfo@ecn.purdue.edu

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PIPE STRUCTURAL RELIABILITY EVALUATING SYSTEM

THE NEED
A great deal of construction works involves the repair and maintenance of existing older sewers that are in inferior structural condition. In addition to their poor hydraulic performance, such sewers run the risk of environmental pollution. With the prevailing long term investments in maintenance and rehabilitation, it is generally accepted that visual inspection alone is not sufficient for the assessment of the mechanical-structural condition of the pipe. Some other reliable method or system must be utilized for accurate evaluation of sewer structural reliability under real operating circumstances.

THE TECHNOLOGY
The MAC system (Mecanique d'Auscultation des Conduites, i.e., buried pipelines mechanical inspection) is an integrated mechanical-electronic system that inspects different kinds of pipes (reinforced concrete, plain concrete, masonry, and clay) from 0.7 to 4.0 m in diameter. The system assesses the reliability of the pipe by analyzing the pipe-soil interactive structural behavior. It is made up of two components:

1. Mechanical component: It allows system motion through the pipe in a linear fashion. It also applies the non-destructive loads from the inside of the pipe in specific loading cycles, and measures the resulting displacements.

2. Automated electronic component: It provides the analysis of the measurements and the visual interpretation of results.

![Figure 1 Mechanical and Electronical Components of MAC](image-url)
Before the MAC system is deployed, it is necessary that actual samples are extracted from the pipe and surrounding soil. These samples would provide the parameters needed for the derivation of structural properties of the pipe before the damage has occurred to it. This is done by using the finite-element method. Then, the MAC system traverses the existing buried pipe in a continuous manner applying loads and measuring the corresponding displacements. The existing structural properties are derived from the load-displacement analysis of the load tests performed by the system. By comparing the existing properties to the theoretical ones, and through the analysis of the displacement patterns, the path from the initial to the present state would be determined. Based on this, the combined external loads, that caused the damages or cracks, are calculated. This makes it possible to define the existing structural safety factors, (Diab, 1995).

**The Benefits**
The system allows the evaluation of the structural reliability of the pipe, the forecasting of the short-run and long-run risks involved, and the optimization of the maintenance and rehabilitation methods for the re-establishment of the required safety level. Moreover, it predicts the pipe’s behavior in the future, taking into account the load evolution, materials deterioration, and the evolution of the soil-structure interaction. (Diab, 1995).

**Status**
The system has been used for pipes up to 4 meters in diameter. It is expandable to larger structures. It is greatly efficient, and permits the investigation of 2 KM/day. The method has been applied and tested since 1990. More than 200 KM of aqueducts have been inspected with this methodology. (Diab, 1995).

**Barriers**
There is still no information on the cost associated with such a system. Also, the evaluation of the measurements requires elaborate numerical modeling that cannot be performed on-site.
POINTS OF CONTACT
Youssef Diab
Email: ydiab@univ-mlv.fr

REFERENCES

REVIEWERS
Peer reviewed as an emerging construction technology

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