LTRC RESEARCH PROJECT CAPSULE

MARCH 2008

08–6GT

TECHNOLOGY TRANSFER PROGRAM

JUST THE FACTS

Start Date:
January 1, 2008

Duration:
15 Months

End Date:
April 1, 2009

Funding:
State

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SPECIAL POINTS OF INTEREST:

- Problem Addressed
- Objectives of Research
- Methodology Used
- Implementation Potential

Performance Evaluation of Buried Pipe Installation

PROBLEM

The Louisiana Department of Transportation and Development (LADOTD) is in the process of revising the current specifications to obtain a more cost efficient design and installation of buried pipes for highway infrastructure. It aims to develop a process of alternate bidding and alternate construction for buried pipe installation so the construction budget can be wisely used. Therefore, having a better understanding of the soil-structure interaction (SSI) among bedding, backfill, fill cover, and pipes of different materials (concrete, metal, plastic, etc.) and mechanical properties will be beneficial.

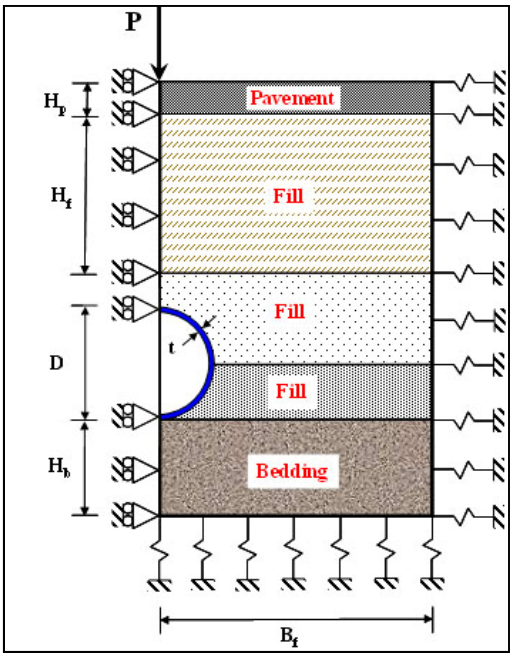

Fig. 1. Schematic representation of the cross-section FE model of the buried pipe system.

OBJECTIVES

The research project aims at determining the effects of geometric and mechanical parameters characterizing the soil structure interaction developed in a buried pipe installation. Parameters such as pipe ring stiffness, bedding thickness, and fill cover height need to be considered.

METHODOLOGY

Pipes of various materials will simultaneously be evaluated for their performance considering the impact of various bedding, backfill, and fill cover height requirements. The project is organized in two different phases. The first phase employs simplified linear elastic finite element (FE) analysis and will provide as results a first basis for justification of accepting and revising the current provisions for minimum bedding thickness, fill cover height, and installation quality for pipes buried under transportation facilities. It will study the effects on buried pipe performance that are due to:

- bedding height (H_b),
- excavation width (B_t),
- fill cover height (H_f),
- local soil stiffness at bottom and sides of trench (E_v, E_h),
- mechanical properties (stiffness: E_b) and grade of compaction (variation of E_b depending on compaction and position of the soil around the pipe) of the fill material,

- Importance of facility (different loadings and different requirements on deformation performance), and
- pipe material (stiffness: E_p, and yield strength: σ_y) and geometric properties (diameter: D, and thickness: t).

The deliverables of Phase 1 will be:

- sensitivity analysis of maximum stress in the pipe,
- sensitivity analysis of maximum deflection at the pipe crown,
- sensitivity analysis of maximum surface dip depth,
- data collected in the form of plots and tables to be used for acceptance and revision of current provisions for minimum and optimal bedding thickness and fill cover height,
- identification of the application limits of performed research , and
- suggestions for further improvement.

The second phase will employ advanced nonlinear hysteretic FE models to evaluate the sensitivity of buried pipe system performance in modeling parameters and SSI effects. Soil and pipe materials, as well as soil-pipe interface, will be modeled by using widely accepted nonlinear constitutive models. The sensitivity of buried pipe systems to installation procedures and construction phases will also be considered by using staged nonlinear FE analysis. The deliverables produced in Phase I will be revised and improved based on the analysis results obtained from the more realistic, more advanced modeling tools employed in the second phase of the research.

IMPLENTATION POTENTIAL

The results of this project should be incorporated into LADOTD Specifications. The entire pipe industry will be able to take advantage of the results of this research. The obtained results and developed modeling tools will be of great value for future research with even broader impact and will be beneficial to AASHTO, FHWA, US Army Corps of Engineers and state DOTs.