TOOLS FOR EVALUATING AND SELECTING TRENCHLESS TECHNOLOGIES

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Background

When it comes time for engineers and decision makers to select the proper construction method for installing, replacing or rehabilitating pipelines and manholes, the choices can be overwhelming. There are more than 80 methods to choose from when trying to determine what action to take which can make a young engineer's decision seem impossible. The time it would take to research all available alternatives and their parameters would be a never ending mission. To help shorten the time it would take to track down all of that information, the Trenchless Technology Center (TTC) has been developing tools to assist engineers with their decisions. The TTC developed the Trenchless Assessment Guide (TAG) in collaboration with the National Utility Contractors Association (NUCA) in 2006 and is currently developing the Trenchless Assessment Guide for Rehabilitation (TAG-R) while working closely with the National Association of Sewer Service Companies (NASSCO). TAG-R features more than 60 methods that can be used for the rehabilitation and/or repair of common components found in the municipal pipeline distribution and collection systems including gravity sewers and drainage pipes, pressure pipes, laterals, manholes and vaults. To aid in the acceptance of trenchless technologies south of the border TAG has also been translated into Spanish. Furthermore, aiming at increasing accessibility to this valuable tool the TTC is currently developing a web-based version of TAG on the behalf of the Australasian Society for Trenchless Technology (ASTT), which we expect to launch in the Spring of 2008.

Trenchless Assessment Guide

In 2004, the National Utility Contractors Association (NUCA) commissioned the Trenchless Technology Center, at Louisiana Tech University, to develop a stand-alone software program to assist municipal and utility engineers in evaluating the technical feasibility of various traditional open cut, trenchless construction, and inline replacement methods for their specific projects. The program, titled TAG (Trenchless Assessment Guide), takes into account extensive performance data for 29 construction methods and sub-methods commonly used in utility type projects. The objective of this project was to develop and codify an algorithm to accomplish the three following tasks. First, the program would need to perform a sound technical evaluation as a screening measure to eliminate incompatible construction methods. Next, TAG would need to evaluate the overall perceived risk associated with the competing alternatives. Finally, the program would need to raise awareness and provide guidance regarding to the utilization of trenchless technology methods.

TAG employs a relational database that contains a wide range of information regarding each of the many construction methods in its database. The databases contain general information about each method, which includes a method description, a color picture and the assigned degree of typical environmental impact. The databases also contain data concerning the method's technical capabilities, including the maximum and minimum pipe diameters, the maximum and minimum drive lengths, and the maximum and minimum allowable depths of cover. Other hard-coded data include pipe compatibility information for ten common pipe materials, soil compatibility information for ten types of geological materials, and limitations imposed by the height of the ground water table above the pipe’s invert (if any). The construction method database is updatable,
customizable and expandable. TAG is a living application, which is expected to remain a useful and relevant decision support tool for a prolonged period of time. Figure 1 shows a sample method data form from TAG for Auger Boring, Track Type.

![Method Database](image)

**Figure 1. Technical Data for Auger Boring (Track, Type 2) Method**

The technical evaluation begins by defining the type of problem the user is facing. The vast majority of buried pipe problems can be reduced to either a structural problem or a capacity problem. TAG incorporates a built-in wizard, which employs a series of interactive questions presented to the user. Based on the user's answers, certain categories of construction methods might be eliminated. The next step in the technical evaluation is the input of the project's technical attributes and expected site conditions. Four categories of information are input during this stage. The first category includes performance parameters such as drive length, pipe diameter, depth of cover and elevation of the ground water table. Also included in the input are the desired degrees of accuracy in terms of alignment and profile. The second set of input data deals with the pipe material(s) that are permissible in this project and the user is asked to select one or more pipe types from a list of commonly used pipe materials. The third category of user input deals with soil compatibility parameters. The user is asked to identify up to three dominant soil(s) conditions and their percentage in terms of the overall volume of the in-situ soil along the proposed alignment. The final category deals with information related specifically to the viability of in-line replacement options. This information consists of the degree of sagging and/or misalignment in the host pipe (if any), the desired level of diameter enlargement (if any), and the material type of the host pipe.
Following the technical evaluation stage, methods deemed technically viable for the project under consideration are then evaluated for their perceived level of risk. This is accomplished by considering four categories of direct and implied risk factors. Simply put, the risk score in TAG provides an indicator of the likelihood of undesirable complications arising during the project due to the risk factors considered. The first category is the installation parameters: drive length, pipe diameter, and depth of cover. The second category of risk is assessment of the compatibility of a given construction method with respect to the anticipated geological conditions. The third category of risk is the SET (Specifications, Experience, and Track Record) index, which takes into consideration the availability of specifications, the owner's experience with a given method and the method's track record. The final category of risk includes site accessibility and environmental impact. Each method has an assigned risk value in the database for environmental impact, based on the potential for ground settlement and heave (i.e., potential damage to paved surfaces, nearby utilities and foundations), erosion, removal of trees and flora, creation of temporary hazards (i.e., open trenches), and migration of drilling fluids to the surface. The six primary risk factors described above are then used to compute the initial risk value. Prior to the calculation of the final risk value, a weight from 0 to 100 is assigned by the user to each of the six primary risk factors. The risk value represents the weighted average of the risk score of the method alternative under consideration, and reflects the user’s preferences. The final step adjusts the initial risk value based on the site accessibility condition. The user is asked to choose the site description that best describes their project. Site accessibility determines the ease of a recovery operation if equipment or materials are lost under the surface. If recovery is not possible, or is highly complicated, the overall perceived risk associated with the project increases. The final risk value is displayed by the program for each technically viable method. The risk scores are relative and depend on the user's attitude towards risk (i.e., degree of risk avoidance) as well as project parameters. The user is then able to make an educated decision regarding which method (or methods) is best for his/her particular project.

TAG on the Web

Recently the Australasian Society for Trenchless Technology (ASTT) engaged the TTC to create an on-line version of TAG (in SI units) that is accessible to its own members over the internet. This project would provide the ASTT with an international version of TAG that would be tailored to their specific needs. The project is quickly nearing completion and soon will become another valuable tool in assisting owners, managers and design professionals in keeping up-to-date with the rapidly evolving field of trenchless technologies. The web-based software will be housed at a server located at the TTC, allowing frequent up-dates and improvements to be implemented with relative ease.

TAG for Rehabilitation

In 2007, the National Association of Sewer Service Companies (NASSCO) commissioned the TTC to develop a stand-alone sister program to TAG covering rehabilitation methods for sanitary and storm sewers, force mains, potable water pipes, laterals, manholes and vaults. TAG-R will be incorporated as part of NASSCO’s new Inspector Training and Certification Program (ITCP). TAG-R includes performance data for more than 60 methods used for rehabilitation of buried infrastructure elements. Much like TAG, TAG-R will perform a technical evaluation and provide additional considerations based on the user inputs.
TAG-R has a relational database similar to that of TAG containing a wealth of information for each method category. The databases contain much of the same general information about each method, such as a detailed method description and a color image, as well as data concerning the method's technical capabilities, including the maximum and minimum pipe diameters and lengths. The remaining data is specific to rehabilitation projects such as the level of pipe deterioration, ability to negotiate bends and ovality of the host pipe. Other parameters considered include cross-section reduction and capacity loss, degree of flow control needed, host pipe geometry and access to the pipe. Figure 2 shows a sample method data form from TAG-R for CIPP Inversion, Structural.

Figure 2. Technical Data for CIPP Inversion (Structural) Method

TAG-R begins with the technical evaluation where the user must first select the type of system to be rehabilitated. This allows the software to determine the database(s) which are applicable for the technical evaluation (i.e., gravity pipes, pressure pipes, laterals or access structures). Next, the user is prompted to enter the project specific attributes including the desirable performance parameters, the condition rating of the host structure and other relevant site specific information. Based on the input data and the methods’ attributes stored in the various databases the user is presented with a list of technically viable methods. Next, the user is prompted to conduct a secondary evaluation during which the degree of relevance of complications and challenges known to be encountered during rehabilitation projects is established for each technically viable construction method. In the final stage the user is presented with a list of technically viable rehabilitation methods and potential issues to be aware of. A Beta version of TAG-R is expected to be available by the fall of 2008. Our vision is to combine TAG and TAG-R into a single, web-based, powerful application capable of addressing a wide range of projects and site conditions which will serve owners, managers and designers of buried pipeline networks around the world.
TAG Going International

The TTC has initiated the development of translated versions of TAG so that it may be used by a larger number of people. TAG was translated into Spanish by a Mr. Juan Carlos Gutierrez, a TTC M.S. student. The resulting stand-alone version of Spanish TAG has been reviewed by users from Mexico, Colombia and Brazil and has been presented in the recent 1st Latin America No-Dig conference held earlier this year in São Paulo, Brazil. Currently, Spanish TAG is being converted into a web format which will then be made available through a new TAG website “Trenchless Technology World” (http://ttworld.latech.edu). We are also working on translating TAG to Chinese and an stand-alone version of the Chinese TAG is expected to be available by the end of this year.

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