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Integration of Alternative Highway Drainage Pipe Selection and Asset Management

MICHAEL MAHER, GREGORY HEBELER AND ANDREW FUGGLE, GOLDER ASSOCIATES

It is estimated that up to 20% of investment in highway construction is for drainage components. Given the scale of investment, as well as tightening budgets, it is more critical than ever to optimize value for money in terms of cost and performance. Additionally, the last few decades have seen huge improvements in drainage pipe materials and products. However, these innovations have yet to be fully embraced by agencies and individual design firms, as it is difficult to keep up with the dizzying array of new pipe options and individual pipe systems. By streamlining the pipe design and selection process, alternative pipe bidding is practical and this can form the basis for future pipe asset inventories.

Overview

A three-year research project (NCHRP 10-86) funded by the National Cooperative Highway Research Program in the United States has developed an automated design and selection process to implement more widespread and streamlined alternative drainage pipe bidding systems. Starting from an inventory that can include hundreds of different pipe systems, and with basic pipe design input parameters, the process can select all pipe systems suitable to meet any required set of performance requirements. The process systematically evaluates hydraulic capacity, structural adequacy and durability in terms of predicted service life (Figure 1). The objective is to ensure that the right set of pipe systems are selected for the right application, while minimizing the engineering design effort.

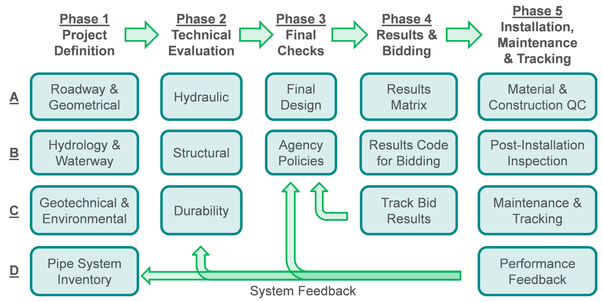

FIGURE 1 – FLOWCHART FOR ALTERNATIVE PIPE BIDDING AND INVENTORY SYSTEM

Selection process

The pipe selection process begins from an inventory of all approved drainage pipes and available diameters. Using the project-specific design criteria, all suitable pipe options are identified by applying a systematic selection process that comprises (Figure 2):

- Site characteristics
- Suitable hydraulic performance
- Adequate strength to resist deflection
- Appropriate service life for application
- Constructability and performance

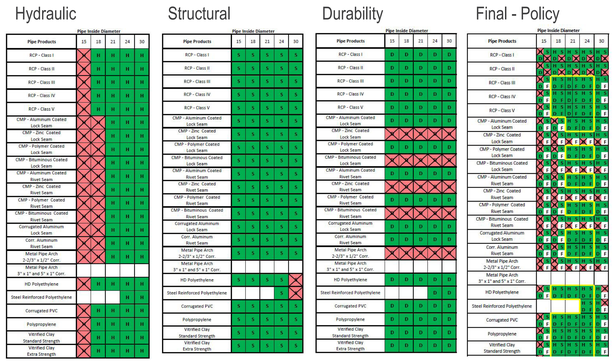

FIGURE 2 – EXAMPLE OF PIPE SELECTION MATRIX

Matrix Approach

The matrix approach to pipe selection is:

- Systematic
- Structured
- Thorough
- Transparent
- Flexible

The pipe inventory can be updated as new pipe products are approved. Unique product codes can be generated for each pipe product to facilitate the preparation of bid documents and to feed into pipe asset inventories (Figure 3).

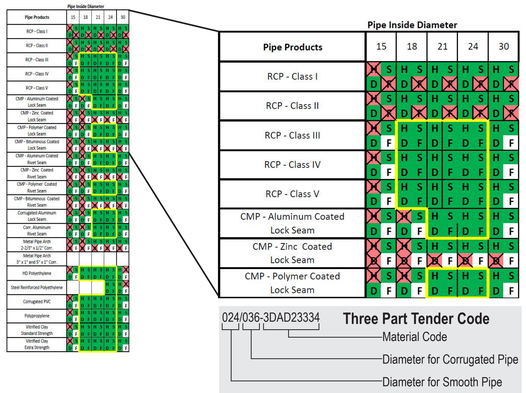

FIGURE 3 – USE OF UNIQUE CODE FOR INCORPORATION INTO BID DOCUMENTS AND FOR FUTURE INVENTORY

From Pipe Selection to Asset Management

This automated process for selecting alternative pipe systems to meet defined service lives, can be expanded or linked into a computerized tool for documenting and managing culvert and storm drain facilities. By integrating pipe design and selection with asset management and performance monitoring, the actual field performance can be used to enhance and refine the various service life prediction models over time leading to better initial designs.

A great deal of guidance has been developed on culvert durability, inspection procedures, and rating systems. This information has been used by departments of transportation as well as local agencies to estimate service life and level of deterioration of their culvert infrastructure. In addition, a number of highway agencies have implemented, to various degrees, culvert inspection programs, which incorporate formalized inspection scheduling and documentation. Most of these programs, however, are not comprehensive in addressing all structural, hydraulic, geotechnical, and environmental issues, and do not produce condition and performance data compatible with culvert management strategies and systems.

There is a need for a comprehensive, state-of-the-art computerized tool for documenting and managing culvert and storm drain facilities once they are identified, evaluated, and rated. A culvert management system would serve as a database for culverts and storm drain pipe inventories and assist with recording locations, tracking evaluations of condition and performance, scheduling inspection and maintenance activities, and selecting and budgeting rehabilitation and replacement activities.

The development of the pipe selection software tool would be a complimentary tool to any future development of a system for managing culvert inventories. For example, the Ministry of Transportation (MTO) has linked their alternative pipe bidding system with their pipe inventory system so that predicted material service lives can be compared to actual service lives achieved in the long term. Such systems could be linked to provide information on field performance of culverts that could be integrated back into the pipe selection process.

With better tracking of highway drainage pipe performance, the original pipe selection process can be continually improved and the optimum timing for pipe rehabilitation or replacement can be identified and budgeted for in advance.


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1. HDPE PIPE IN SERVICE
2. CONCRETE PIPE READY FOR INSTALLATION
3. CORRUGATED STEEL PIPE PAST ITS SERVICE LIFE
4. INVERT DAMAGE IN CONCRETE PIPE
5. A WIDE RANGE OF METAL PIPE SIZES TO CHOOSE FROM