4 Steps For Quality Sewer Performance In Perpetuity

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A well maintained and functional sewer system is necessary for a society to live in a prosperous, disease free environment. Centuries ago, society recognized that sewage effluent would need to be collected and removed in a systematic way or disease would be widespread. Even today in some third world countries around the globe, disease and high mortality rates are commonplace due to inadequate sewage disposal facilities.

Since the late 1800s, sewage conveyance has been accomplished through the construction of pipelines. Early pipelines were constructed of wood until other more sophisticated materials such as clay, metal and concrete were utilized with plastic now being a popular choice of materials for sewer lines.

Time has, however, taken its toll on the life of the sewer infrastructure which has deteriorated and, in many cases, failed. With minimal maintenance and care, this deterioration has become widespread in North America today. The Environmental Protection Agency (EPA) estimates that the United States has a deteriorated sewer infrastructure that, over the next 20 years, will cost an estimated $388 billion to fix. This estimated cost is certainly overwhelming. Therefore, the repair of the sewer infrastructure must be developed on a systematic basis to accomplish a long term sewer renewal that will serve the next generations far into the future.

This process can be summarized by four key steps.

Step 1 – Where to begin

Many municipalities have hundreds or thousands of miles of sewer pipe constructed from as early as the 1800s to more recent additions due to expansions and development from growth in their community. Over the years, a variety of pipe materials have been used including clay, concrete, asbestos cement, composite, fiberglass, steel, cast iron and more plus a number of pipe wall configurations to meet a variety of design conditions.

The first step is to inspect each section of sewer pipeline using common repeatable defect identification and coding system language. The Pipeline Assessment Certification Program (PACP) and Manhole Assessment Certification Program (MACP) are two such programs developed by NASSCO and are being used on a national basis.

The NASSCO PACP/MACP programs are designed to assist the CCTV operator and engineer to recognize and define sewer pipe defects and record the information in accordance with a national uniform and consistent standard. This approach ensures that the most comprehensive data is collected for subsequent renewal recommendations. This comprehensive defect data is recorded and archived and can be used in subsequent years to determine deterioration trends in an existing pipeline. This data is then used as a basis for taking the next step. Once the condition of each section of sewer line is determined, the engineer can apply a condition rating and set priority schedules for needed pipeline renewal. Once the priorities are defined, the municipality can move forward with a well-documented program for renewal rather than a best guess approach for determining which pipes should be renewed first.

Step 2 – Selecting the renewal technology

Once the pipe renewal priorities have been established, a renewal technology must be selected for each priority line section. Does the pipe need to be structurally replaced? Does the pipe require an increase in capacity? Does the pipe need to be water tight? One frequent question is: "How to select the best, most cost effective-technology for each pipe section to be renewed?" This selection involves not only short-term product characteristics but also the long-term life cycle or longevity of the selected product. There is little value in selecting a lower initial cost alternative and then finding out that it will need to be replaced long before its anticipated useful life has expired.

If we examine history and examine the longevity of sewer pipeline materials, we see that some pipe materials have performed well over time. Clay sewer pipe has held up well against corrosion but the joint materials have failed over time. Clay sewer pipe and cast iron water pipe installed in the late 1800s and excavated over 100 years later has been found to be generally in very good structural condition, needing some cleaning and maintenance.

With the advent of new materials such as plastics pipe, the life expectancy of these new products should be at least 50 - 100 years. The life of the new product depends on how they are applied. Some systems are factory manufactured while others are manufactured in the field using the existing pipe as a form. Each product's life cycle or longevity must be examined, tested and verified so that the best technology is selected for the sewer pipeline renewal

The toolbox of available technologies is large, including sliplining, pipebursting, panel liners and many cured-in-place pipe (CIPP) and folded pipe lining technologies. The engineer/designer must select the best, most cost effective technology solution for renewing the old pipe with a new pipe having an equally long expected service life. To assist in this selection process a detailed description and application recommendation must be available for each commercial technology that can be effectively used for sewer pipe renewal.

To respond to this need, NASSCO has commissioned the development of a Technology Assessment Guide (TAG) by Louisiana Tech University's Trenchless Technology Center (TTC). The TAG will be an interactive tool for engineers, designers and municipalities to select the best technology application based on pipe defect data input. This program should be available later this year or early 2008 for use by NASSCO members and industry professionals.

Step 3 – Writing a performance-based specification

Once the sewers defects have been identified and the best technology has been selected, a specification must be created that will instruct the contractor on what is expected and required.

Performance Specifications communicate the customer's requirements to the contractor. They translate the operational requirements of the owner into technical language that gives the contractor:

- A detailed description of an acceptable installed product;
- The criteria for determining an acceptable product;

- The Quality Assurance/Quality Control and testing requirements that the Owner will implement to determine if the product is acceptable; and
- The consequence to the contractor if the installed product does not meet the requirements of the contract and is not acceptable.

The more common specification used in the industry today is the prescriptive type, which specifies which technology or group of technologies is to be installed and defines details of how the contractor should install the technology.

Typically, when writing a prescriptive specification, the engineer must know exactly how the product should be installed and what is expected for the finished product. If that knowledge can be effectively communicated and all goes well on the project, then everyone is satisfied. However, when the engineer is not totally clear or precise on how the product should be installed, the specifications tell the contractor "how to" and "review/approve all steps and processes." If the project does not go well and the contractor has relied on and constructed the project as per the contract specifications, then the engineer and the contractor must negotiate contract change orders typically resulting in extra costs to the contract.

Like prescriptive specifications, performance specifications are very detailed but eliminate unnecessary "how to" and "review/approve all steps and processes" and allow the Contractor to provide the best means and methods for completing the project on time and on budget. Performance specifications state requirements in terms of expected results, provide the criteria for performance and detailed methods for verifying that the product meets the contract requirements.

In order to write an effective performance specification, the engineer must understand the availability of applicable products and technologies, the many alternatives available and the flexibility or limitations for meeting the owner's project requirements. For instance, when rehabilitating a sewer pipe with a liner system, some criteria in a performance specification might include the detailed size, condition and problems with the existing piping system. The performance requirements of the installed liner may include language such as the following:

The pipe liner will:

- Structurally stand alone, or structurally enhance the existing pipe;
- Be sealed to the existing pipe and will not leak from infiltration, inflow or other sources;
- Fit tight within the existing pipe within specified tolerances;
- Function under specified hydrostatic head loads;
- Have specified corrosion resistance requirements;
- Service connections reinstated to a specified criteria;
- Meet manufacturers physical properties and quality claims;
- Provide no less than 50 years of service;
- Be tested for a variety of specified requirements;
- Marked with detailed information as specified;
- Delivered and stored as specified; and
- Other information as appropriate or required.

In general, performance specifications should reflect the following characteristics:

- The specification should be quantitative rather than qualitative;
- The specific integrated product and installation technology can be specified but the performance requirement must be clearly spelled out; and
- The engineer and the contractor must be equally clear on the contract requirements.

The contract requirements must be verifiable. Through quality assured/quality controlled and testing procedures, the engineer must be able to verify that the contract requirements have been met.

Performance specifications should allow for interchangeability with like technologies that will deliver the required final result.

Performance specifications should be material and process dependent. The contractor should be able to provide his selected means and methods without changing the customer's required product delivery. Key elements of performance specification would typically include:

- A performance work statement;
- Detailed performance requirements;
- Measurable performance standards;
- Remedies for non-performance;
- Incentives for performance;
- Quality assurance plan (QAP);
- Quality control implementation plan;
- Testing requirements; and
- Warranty requirements.

Performance based specifications are being written in a generic format by NASSCO for member and industry use. Example performance-based specifications for CIPP and folded pipe technologies have been completed and are available on the NASSCO web site at www.nassco.org. Specifications for manhole coatings and linings will be available later this year.

Step 4 – Educating, training the engineer, field inspector

Over the last several years, municipalities and engineers have asked for additional training, particularly applicable to sewer pipe renewal technologies. This training would be directed at engineers and inspectors who typically write the specifications and perform the inspection of field installations. The program will have to be geared to those who need a comprehensive understanding of the different technologies and what specific areas of expertise they will need to ensure that a trenchless renewal project is built correctly and meets the requirements of the contract documents.

The training program needs to be structured to clearly define the inspector's responsibility and authority, as well as the contractor's need to build a project that meets the requirements of the contract documents. It is the ultimate responsibility of the contractor to deliver the final product to the customer as specified. It is the responsibility of the inspector to make sure that the project meets the intent of the contract documents and to observe all aspects of the installation and caution the contractor when any segment does not conform to the contract requirements.

The development of the NASSCO Inspector Training and Certification Program is underway and should be available later this year or early next year for select technologies.

The development of this program takes the engineer or designer from the early stages of condition assessment, to selecting the correct technology solutions, to writing a contract specification that clearly outlines the customer's requirements, and then providing the training for engineers and inspectors to fully understand what is being installed. This program is designed to be a guide for the engineer and municipality to assist them towards developing a plan for quality sewer performance in perpetuity.

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