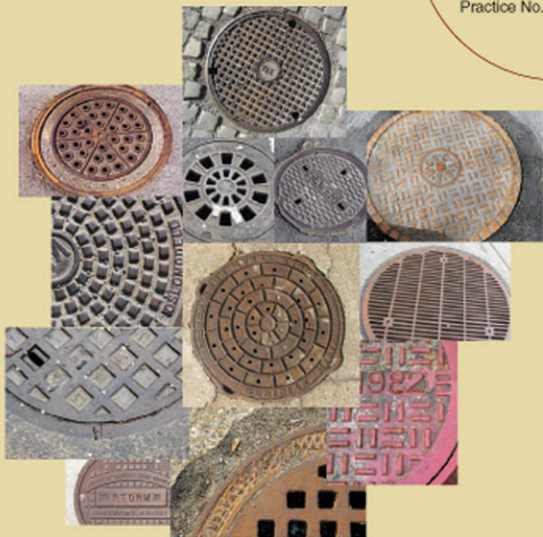


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Manhole Inspection and Rehabilitation

Second Edition

ASCE

Manhole Inspection and Rehabilitation

Second Edition

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Edited by
Joanne B. Hughes

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1

INTRODUCTION

The phrase “manhole” was first used to describe the access holes between the decks of old sailing ships. The word “manhole” (initially) had nothing to do with sewers. It wasn’t until later that the term was used to describe the structure through which access to sewers for maintenance could be achieved. Perhaps the name was adopted because it was, in essence, a hole into which a person would go to do maintenance, or possibly it was adopted because a man would make his way from one level (street level) to another level (the sewer beneath the street). The word “sewer” is derived from the term “seaward” in Old English. Early sewers in the London area were open ditches that led to the Thames River, and from there on down to the sea (“seaward”).

Manhole structures are a significant asset to communities and the principal means of access for collection system maintenance. As of 2007, there were an estimated 20 million manholes in the United States alone. Evaluating and estimating the life of these structures is of considerable importance in the financial planning of agencies, particularly in respect to depreciation allowances and rates of return on investment. However, the actual estimate of economic life (the age when a manhole becomes more cost effective to replace than to rehabilitate) is a function that must be recognized on a local basis. One of the goals of this book is to provide an inspection and condition grading protocol that provides logical follow-up steps that can be taken to maintain and improve on the health of these structures.

The construction industry has witnessed evolutionary improvements in materials and standards. The evolution in manhole materials is occurring from brick to concrete to plastic materials. These changes have occurred because of manpower requirements and the ease of construction

and environmental laws. Brick, commonly used through the 1930s, was labor intensive to install, considering the number of bricks needing placement as a structure was built. Concrete materials were seen as a significant development, and because the manhole could be built in lifts (or segments), using precast materials, the construction culture evolved. Today, another factor driving change results from attacks of nature in the forms of water infiltration and hydrogen sulfide (H_2S). H_2S issues have driven the industry to look for new construction materials that would resist infiltration and corrosion, as well as allowing for structures to be built in lifts. Manholes are now being created from inert materials, for example, fiberglass and polyethylene.

Corrosion severely compromises the structural integrity of both brick and concrete components, costing millions of dollars yearly for repairs. A naturally occurring compound, H_2S exists in a dissolved state within wastewater. When released into a gaseous state, it comes in contact with the moist surfaces of manhole walls, and as concentration levels rise, bacteria colonies proliferate, forming an extremely corrosive slime layer that can rapidly cause weakening and decomposition of even the most massive concrete and steel structures. Plastic materials have proven themselves to be resistant to this attack while maintaining their integrity.

In managing manhole assets, there are two key objectives, first to minimize the overall cost to the community of creating, maintaining, and replacing the structure, and second to achieve intergeneration equity through a planned approach to maintain and increase the longevity until eventual replacement of the manhole is required.

Through an effective manhole inspection program, agencies can accurately identify, inventory, and evaluate the condition of these structures. An archival history of trends also aids in determining the most cost-efficient times for rehabilitation. Methods to remove excessive manhole infiltration and inflow (I/I), reduce corrosion, improve manhole structural integrity, address public safety related issues, and to implement general system maintenance needs can be identified through consistent data gathering techniques. Furthermore, infiltration generally enters through structural deficiencies. Once the structural condition is compromised, future problems will likely occur.

Excessive infiltration and inflow (I/I) are serious problems for wastewater collection and treatment systems. The hydraulic effects of these extraneous flows are particularly important because they use valuable collection and treatment system capacity that is needed for urban growth. Public health and economic issues, as well as the environmental impacts of bypassed, spilled, and untreated wastewater flows caused by I/I, are deterrents to the overall objective of protecting our water resources. Furthermore, they can be a public health hazard. Prolonged leakage can create voids outside a manhole structure with the potential of removing

soil fines, resulting in the loss of lateral soil support and creating structural issues. This book provides technical guidance for implementing a successful manhole inspection and rehabilitation program. The following aspects of manhole inspection and rehabilitation are addressed:

- safety;
- manhole inspection, including
 - condition assessment and
 - data recording;
- quantification of I/I and structural conditions;
- manhole rehabilitation methods;
- cost-effectiveness analysis and rehabilitation method selection;
- construction inspection and quality control; and
- terminology.

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2

SAFETY

Asset management, including the inspection, repair, replacement, and installation of underground systems without digging, necessitates a higher worker awareness and preparedness than ever before. Manhole access and entry to these potentially dangerous environments requires strict compliance to all applicable local, state, and federal standards. Successfully performing inspection and work without injury or death should be a primary concern of everyone providing services in this hazardous environment.

Evaluation of the manholes requiring access and accurate identification of a safety plan is necessary on every project. Workers must be aware of the hazards that are present within manholes, as well as the methods and equipment necessary to perform safely within such environments.

The next section illustrates and discusses the hazards associated with manholes, especially those related to sewer manholes, and the procedures before entry, on entry, and for rescue operations that should be incorporated into any existing safety program.

POTENTIAL HAZARDS

The many hazards to which personnel can be exposed while performing operations in manholes include the following:

- traffic,
- material use,
- atmospheric conditions,
- entrapment or engulfment,