ASCE Manuals and Reports on Engineering Practice No. 119

Buried Flexible Steel Pipe

Design and Structural Analysis

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Prepared by
the Task Committee on Buried Flexible (Steel)
Pipe Load Stability Criteria & Design of
the Pipeline Division of
the American Society of Civil Engineers

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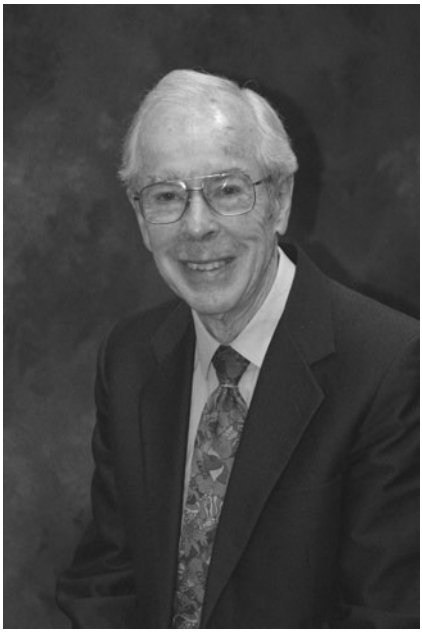

We dedicate this manual of practice to

Dr. Reynold King Watkins, our beloved mentor.

This book would not have been possible without your tireless efforts.

With our warmest gratitude and appreciation, we thank you.

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PREFACE

Most Americans take for granted that every time they open the faucet, clean, clear water flows out. There is never any thought to the reality that the piping systems used to transport the water is vitally important. But when service is interrupted, then the importance of buried pipe systems to the community becomes a reality and a priority. Without a reliable buried pipe system, an entire community can be momentarily incapacitated.

The purpose of this manual is to provide information on the structural design and analysis of buried steel water and wastewater pipe consistent with the latest pipe and soil design concepts of the industry. Structural design of welded steel pipe ensures adequate performance for the service life of the pipe. Design must be based on required lifetime performance and on limits of performance, sometimes referred to as "failure." This manual also covers the performance limits, which are based on principles of pipe mechanics and soil mechanics, and on the analysis of pipe–soil interaction. This manual, however, does not describe manufacturing procedures, which are satisfactorily addressed by standards from the American Water Works Association and other standards-setting organizations.

An understanding of the principles included in this manual is essential before applying the individual concepts to a design. Otherwise, extracting single design excerpts without that understanding may lead to an erroneous evaluation.

In 1958, Spangler and Watkins published the Modified Iowa Formula for predicting the ring deflection of buried flexible pipe. Flexible pipe deflects under soil load. Ring deflection is a function of stiffness of the ring and support of the ring by soil at the sides of the pipe. The term E' was first promulgated in the Modified Iowa Formula as a measure of that horizontal passive soil support at the sides of the flexible pipe influenced