cold regions utilities monograph

Third Edition

Technical Editor:
D.W. Smith

ASCE

cold regions utilities monograph

Third Edition

Technical Editor: D.W. Smith

Steering Committee and Contributing Authors:
D.W. Smith, Co-Chair
W.L. Ryan, Co-Chair
V. Christensen
J. Crum
G.W. Heinke

Special Contributions:

L. Barber
E. Bjornstad
R.H. Boon
J.J. Cameron
S. Cheema
R. Dalton
G. Eddy
K. Egelhofer
R. Feilden
A.J. Hanna
T. Heintzman
R. Kent
W.O. Mace
C. Marianayagam
M. Mauser
J. O'Neill
D. Prince
R.L. Scher
D.H. Schubert
A. Shevkenek
M. Stafford
S.J. Stanley
W. Tobiasson
J. Vogel
J. Warren

Editor: N. Low

Principal Proponents: Technical Council on Cold Regions Engineering
American Society of Civil Engineers

Cold Regions Engineering Division
Canadian Society for Civil Engineering

Published by

ASCE American Society of Civil Engineers

1801 Alexander Bell Drive
Reston, Virginia 20191-4400

This page intentionally left blank

PREFACE

The concepts related to the design, construction and operation of infrastructure components for the delivery of water, the removal of liquid and solid wastes, and the provision of power for services are relatively new in the extremely cold environment found in the far north or south. The development of these systems was originally limited to the communities founded in the early 1900s during the initial period of gold exploration. A second period of significant interest started during the Second World War with the need to protect the northern part of North America from invasion and to supply allies with equipment and support. The Cold War lead to a sustained engineering effort in the creation of community industrial and military infrastructure.

Early efforts at the provision of community utilities in Alaska and the Canadian Arctic regions were plagued with many challenges and system failures. The Arctic Health Research Center in Alaska, an arm of the U.S. Public Health Service along with the U.S. Army Cold Regions Research and Engineering Laboratory, the Department of Public Health, and later the Northern Technology Centre in Canada became the center of each country's research, design and development efforts.

In an attempt to share the knowledge being gained through the various civilian and military-based studies made by both governments, a variety of professional conferences and meetings dealing with permafrost were initiated. These gatherings also included many geotechnical and engineering issues. In the 1960s and early 1970s a few professional conferences were held that focused on engineering issues alone. In 1978, the first in a series of conferences based on utilities systems was held in Edmonton, Alberta. Over the following ten years four professional conferences were held on related issues (three in Edmonton, one in Fairbanks). In a related effort, a series of two cold regions engineering conferences was held at the University of Alaska in Fairbanks. In 1979 after the American Society of Civil Engineers (ASCE) formed the Technical Council on Cold Regions Engineering under the leadership of Amos "Joe" Alter, the first of a continuing series of cold regions engineering conferences was held in Anchorage, Alaska. That series of professional conferences was expanded to address issues common to Alaska, Canada, and the northern tier of the United States. With global networking and communications the exchange of technical information has expanded to the point that new developments anywhere in cold regions can now be shared throughout the world.

This document developed out of an initial effort at the first utilities delivery conference in 1976 in Edmonton, Alberta. The need to document the results of the many research, design, construction and operation investments was obvious. Following that conference, the Northern Technology Centre was funded to initiate the planning of a reference manual for utilities systems in cold regions. In 1976 a group of Canadian and United States engineers agreed to cooperate in the development of such a document. The manual was to be a reference document for professional engineers trained in more temperate climates. It was to introduce the issues of planning design, construction and operation of utilities systems in cold, freezing conditions. That objective continues in this third edition of the document.

The Cold Climate Utilities Delivery Manual (1979) was originally published by Environment Canada (in both English and French) and republished by the U.S. Environmental Protection Agency. The second edition, entitled the Cold Climate Utilities Manual (1986), was produced by Environment Canada, the Government of the Northwest Territories and the Canadian Society for Civil Engineering (CSCE), and was marketed by the CSCE. Through a cooperative agreement between the American Society of Civil Engineers and the Canadian Society for Civil Engineering, the Cold Regions Utilities Monograph has been produced and marketed by ASCE. The Technical Council on Cold Regions Engineering sponsored the monograph as a part of their monograph series. The series includes the following volumes:

- Design for Ice Forces
- Cold Regions Construction
- Frost Action and Its Control
- Freezing and Thawing of Soil-Water Systems
- Thermal Design Considerations in Frozen Ground Engineering
- Embankment Design and Construction in Cold Regions
- Arctic Coastal Processes and Slope Protection Design

This page intentionally left blank

Table of Contents