









Gravity Sanitary Sewer Design and Construction

Second Edition

Prepared by a Joint Task Force of the Environmental and Water Resources Institute and the Pipeline Division Committee on Pipeline Planning of the American Society of Civil Engineers and the Collection Systems Subcommittee of the Technical Practice Committee of the Water Environment Federation

Edited by Paul Bizier







Library of Congress Cataloging-in-Publication Data

Gravity sanitary sewer design and construction: ASCE manuals and reports on engineering practice no. 60 wef manual of practice no. fd-5/ Prepared by the Joint Task Force on Sanitary Sewers of the American Society of Civil Engineers and the Water Environment Federation

p. cm — (Wef manual; no. 60)

Includes bibliographical references and index.

ISBN 13: 978-0-7844-0900-8

ISBN 10: 0-7844-0900-5

1. Sewerage—Design and construction. I. Bizier, Paul. II. American Society of Civil Engineers. III. Water Environment Federation.

TD678.G715 2007 628'.2—dc22

2007015717

Published by American Society of Civil Engineers 1801 Alexander Bell Drive Reston, Virginia 20191

www.pubs.asce.org

Any statements expressed in these materials are those of the individual authors and do not necessarily represent the views of ASCE or WEF, which take no responsibility for any statement made herein. No reference made in this publication to any specific method, product, process, or service constitutes or implies an endorsement, recommendation, or warranty thereof by ASCE or WEF. The materials are for general information only and do not represent a standard of ASCE or WEF, nor are they intended as a reference in purchase specifications, contracts, regulations, statutes, or any other legal document.

ASCE and WEF make no representation or warranty of any kind, whether express or implied, concerning the accuracy, completeness, suitability, or utility of any information, apparatus, product, or process discussed in this publication, and assume no liability therefor. This information should not be used without first securing competent advice with respect to its suitability for any general or specific application. Anyone utilizing this information assumes all liability arising from such use, including but not limited to infringement of any patent or patents.

ASCE and American Society of Civil Engineers—Registered in U.S. Patent and Trademark Office.

Water Environment Research, WEF, and WEFTEC are registered trademarks of the Water Environment Federation.

Photocopies and reprints. You can obtain instant permission to photocopy ASCE publications by using ASCE's online permission service (www.pubs.asce.org/authors/Rightslink WelcomePage.htm). Requests for 100 copies or more should be submitted to the Reprints Department, Publications Division, ASCE (address above); email: permissions@asce.org. A reprint order form can be found at www.pubs.asce.org/authors/reprints.html.

Copyright © 2007 by the American Society of Civil Engineers and the Water Environment Federation. Permission to copy must be obtained from both ASCE and WEF.

All Rights Reserved. ISBN 978-0-7844-0900-8

ISBN 978-1-57278-240-2

Manufactured in the United States of America.

American Society of Civil Engineers/ Environmental and Water Resources Institute

Founded in 1852, the American Society of Civil Engineers (ASCE) represents more than 140,000 members of the civil engineering profession worldwide, and is America's oldest national engineering society. Created in 1999, the Environmental and Water Resources Institute (EWRI) is an Institute of ASCE. EWRI services are designed to complement ASCE's traditional civil engineering base and to attract new categories of members (non-civil engineer allied professionals) who seek to enhance their professional and technical development.

For information on membership, publications, and conferences, contact

ASCE/EWRI 1801 Alexander Bell Drive Reston, VA 20191-4400 (703) 295-6000 http://www.asce.org

Water Environment Federation

Formed in 1928, the Water Environment Federation (WEF) is a not-forprofit technical and educational organization with 32,000 individual members and 80 affiliated Member Associations representing an additional 50,000 water quality professionals throughout the world. WEF and its member associations proudly work to achieve our mission of preserving and enhancing the global water environment.

For information on membership, publications, and conferences, contact

Water Environment Federation 601 Wythe Street Alexandria, VA 22314-1994 USA (703) 684-2400 http://www.wef.org

MANUALS AND REPORTS ON ENGINEERING PRACTICE

(As developed by the ASCE Technical Procedures Committee, July 1930, and revised March 1935, February 1962, and April 1982)

A manual or report in this series consists of an orderly presentation of facts on a particular subject, supplemented by an analysis of limitations and applications of these facts. It contains information useful to the average engineer in his or her everyday work, rather than findings that may be useful only occasionally or rarely. It is not in any sense a "standard," however; nor is it so elementary or so conclusive as to provide a "rule of thumb" for nonengineers.

Furthermore, material in this series, in distinction from a paper (which expresses only one person's observations or opinions), is the work of a committee or group selected to assemble and express information on a specific topic. As often as practicable, the committee is under the direction of one or more of the Technical Divisions and Councils, and the product evolved has been subjected to review by the Executive Committee of the Division or Council. As a step in the process of this review, proposed manuscripts are often brought before the members of the Technical Divisions and Councils for comment, which may serve as the basis for improvement. When published, each work shows the names of the committees by which it was compiled and indicates clearly the several processes through which it has passed in review, in order that its merit may be definitely understood.

In February 1962 (and revised in April 1982) the Board of Direction voted to establish a series entitled "Manuals and Reports on Engineering Practice," to include the Manuals published and authorized to date, future Manuals of Professional Practice, and Reports on Engineering Practice. All such Manual or Report material of the Society would have been refereed in a manner approved by the Board Committee on Publications and would be bound, with applicable discussion, in books similar to past Manuals. Numbering would be consecutive and would be a continuation of present Manual numbers. In some cases of reports of joint committees, bypassing of Journal publications may be authorized.

MANUALS AND REPORTS ON ENGINEERING PRACTICE

No. Title

No. Title

1 10.	Title	140.	Title
13	Filtering Materials for Sewage Treat- ment Plants	79 80	Steel Penstocks Ship Channel Design
14	Accommodation of Utility Plant Within	81	Guidelines for Cloud Seeding to Aug-
	the Rights-of-Way of Urban Streets		ment Precipitation
	and Highways	82	Odor Control in Wastewater Treat-
35	A List of Translations of Foreign Litera-		ment Plants
	ture on Hydraulics	83	Environmental Site Investigation
40	Ground Water Management	84	Mechanical Connections in Wood
41	Plastic Design in Steel: A Guide and		Structures
	Commentary	85	Quality of Ground Water
45	How to Work Effectively with Consulting Engineers	86	Operation and Maintenance of Ground Water Facilities
46	Pipeline Route Selection for Rural and	87	Urban Runoff Quality Manual
	Cross-Country Pipelines	88	Management of Water Treatment Plan
47	Selected Abstracts on Structural Appli-		Residuals
	cations of Plastics	89	Pipeline Crossings
49	Urban Planning Guide	90	Guide to Structural Optimization
50	Planning and Design Guidelines for Small Craft Harbors	91	Design of Guyed Electrical Transmission Structures
51	Survey of Current Structural Research	92	Manhole Inspection and Rehabilitation
52	Guide for the Design of Steel Transmis-	93	Crane Safety on Construction Sites
_	sion Towers	94	Inland Navigation: Locks, Dams, and
53	Criteria for Maintenance of Multilane	, -	Channels
00	Highways	95	Urban Subsurface Drainage
54	Sedimentation Engineering	96	Guide to Improved Earthquake Perfor
55	Guide to Employment Conditions for	,0	mance of Electric Power Systems
00	Civil Engineers	97	Hydraulic Modeling: Concepts and
57	Management, Operation and Mainte-	71	Practice Practice
37	nance of Irrigation and Drainage	98	Conveyance of Residuals from Water
	Systems	90	and Wastewater Treatment
59	Computer Pricing Practices	99	Environmental Site Characterization
60	Gravity Sanitary Sewer Design and Con-	"	and Remediation Design Guidance
00	struction (Second Edition)	100	Groundwater Contamination by
62	Existing Sewer Evaluation and	100	Organic Pollutants: Analysis and
02	Rehabilitation		Remediation
63	Structural Plastics Design Manual	101	Underwater Investigations
64	Manual on Engineering Surveying	101	Design Guide for FRP Composite Con-
65	Construction Cost Control	102	nections
66	Structural Plastics Selection Manual	103	
67		103	Guide to Hiring and Retaining Great
07	Wind Tunnel Studies of Buildings and	104	Civil Engineers
60	Structures	104	Recommended Practice for Fiber-
68	Aeration: A Wastewater Treatment		Reinforced Polymer Products for
69	Process Sulfide in Wastewater Collection and	105	Overhead Utility Line Structures Animal Waste Containment in
0,	Treatment Systems	100	Lagoons
70	Evapotranspiration and Irrigation Water	106	Horizontal Auger Boring Projects
70	Requirements	107	Ship Channel Design
71	Agricultural Salinity Assessment and	108	Pipeline Design for Installation by
/ 1	Management	100	Horizontal Directional Drilling
72	Design of Steel Transmission Pole	109	Biological Nutrient Removal (BNR)
12	Structures	109	
72			Operation in Wastewater Treatment
73	Quality in the Constructed Project:	110	Plants
	A Guide for Owners, Designers, and	110	Sedimentaion Engineering: Processes,
74	Constructors		Measurments, Modeling, and
74	Guidelines for Electrical Transmission	111	Practice
	Line Structural Loading	111	Reliability-Based Design of Utility Pole
76	Design of Municipal Wastewater Treat-	446	Structures
	ment Plants	112	Pipe Bursting Projects
77	Design and Construction of Urban	113	Substation Structure Design Guide
=0	Stormwater Management Systems		
78	Structural Fire Protection		

78 Structural Fire Protection

Manuals of Practice of the Water Environment Federation

The WEF Technical Practice Committee (formerly the Committee on Sewage and Industrial Wastes Practice of the Federation of Sewage and Industrial Wastes Associations) was created by the Federation Board of Control on October 11, 1941. The primary function of the Committee is to originate and produce, through appropriate subcommittees, special publications dealing with technical aspects of the broad interests of the Federation. These publications are intended to provide background information through a review of technical practices and detailed procedures that research and experience have shown to be functional and practical.

Water Environment Federation Technical Practice Committee Control Group

- B. G. Jones, Chair
- J. A. Brown, Vice Chair
- S. Biesterfeld-Innerebner
- R. Fernandez
- S. S. Jeyanayagam
- Z. Li
- M. D. Nelson
- S. Rangarajan
- E. P. Rothstein
- A. T. Sandy
- A. K. Umble
- T.O. Williams
- J. Witherspoon

ABSTRACT

This Manual provides both theoretical and practical guidelines for the design and construction of gravity sanitary sewers.

The initial chapter introduces the organization and administrative phases of the sanitary sewer project. Subsequent chapters are presented in a sequence detailing the parameters necessary to establish the design criteria, complete the design, and award a construction contract. The Manual concludes with a discussion of the commonly used trenchless and conventional methods of sanitary sewer construction.

This Manual is intended to be of practical use to the designer of a gravity sanitary sewer system and is based upon the experience of engineers in the field of sanitary sewer structural and hydraulic design. Charts, illustrations, and example problem solutions are used liberally throughout to reinforce the text.

Joint Task Force on Sanitary Sewers

Richard Thomasson, Chairman, Chapter 6 Dennis Doherty, Vice-Chair, Chapter 12* Paul Bizier, EWRI Liason, Chapters 6, 9 Marsha Slaughter, Secretary Matt Cassel, Chapter 8* Rao Chitikela John Christopher, Chapter 8* Jacques Delleur, Chapter 3* John Duffy Angie Essner, Chapter 7* Mike Glasgow James Joyce, Chapter 4* Karen Karvazy, Chapter 10* Lisa Lassi, Chapter 10* LaVere Merritt, Chapter 3* Terry Moy Mike Murphy Mohammad Najafi, Chapter 12* Aaron Nelson, Chapters 2, 7* Paul Passaro, Chapter 1* Morris Sade Sam Samandi, Chapter 9 Howard Selznick, Chapter 3* Mark M. Smith, Chapter 4 Carl Sutter, Chapter 10* John Trypus, Chapter 1* Michael VanDine

In addition to the Task Force, Blue Ribbon Panel reviewers included:

Wayne Dillard, Burns & McDonnell Terry Walsh, Greeley and Hanson Heidi Dexheimer, G. C. Wallace, Inc.

Staff assistance was provided by Lorna Ernst for the Water Environment Federation and Suzanne Coladonato for the American Society of Civil Engineers.

This is a preview. Click here to purchase the full publication.

^{*}principal contributing author.

CONTENTS

FOREWORDxiii					
1	ORGANIZATION AND ADMINISTRATION OF SANITARY SEWER PROJECTS	1			
1.1	Introduction	1			
1.2	Definition of Terms and Classification of Sanitary Sewers	2			
1.3	Phases of Project Development	4			
1.4	Interrelations of Project Development Phases	6			
1.5	Parties Involved in Design and Construction of Sanitary				
	Sewer Projects	7			
1.6	Role of Parties in Each Phase	9			
1.7	Control of Sanitary Sewer System Use	10			
1.8	Federal and State Planning and Funding Assistance	12			
1.9	Local Funding	13			
1.10	Safety	16			
1.11	National Environmental Policy Act of 1969	18			
1.12	Capacity, Management, Operations, and				
	Maintenance (CMOM)	19			
1.13	Measurement Units	21			
	References	23			
2	SURVEYS AND INVESTIGATIONS	25			
2.1	Introduction	25			
2.2	Types of Information Required	26			
2.3	Sources of Information	28			
2.4	Surveys for Different Project Phases	30			
2.5	Investigations	32			
	References	34			