ASCE STANDARD

ASCE/COPRI 61–14

Seismic Design of Piers and Wharves

This document uses both the International System of Units (SI) and customary units

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COASTS, OCEANS, PORTS AND RIVERS INSTITUTE

American Society of Civil Engineers

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Published by the American Society of Civil Engineers

Library of Congress Cataloging-in-Publication Data

Seismic design of piers and wharves / American Society of Civil Engineers.
pages cm.
"ASCE/COPRI 61-14."
Includes bibliographical references and index.
ISBN 978-0-7844-1348-7 (print : alk. paper) – ISBN 978-0-7844-7834-9 (ebook)
1. Piers–Design and construction. 2. Piers–Earthquake effects. 3. Wharves–Design and construction. 4. Wharves–Earthquake effects. 5. Earthquake resistant design. I. American Society of Civil Engineers.
TC357.S45 2014
627'.31–dc23

2014008239

Published by American Society of Civil Engineers
1801 Alexander Bell Drive
Reston, Virginia 20191
www.asce.org/pubs

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Errata: Errata, if any, can be found at http://dx.doi.org/10.1061/9780784413487.

ISBN 978-0-7844-1348-7 (paper)
ISBN 978-0-7844-7834-9 (PDF)
Manufactured in the United States of America.

21 20 19 18 17 16 15 14 1 2 3 4 5

STANDARDS

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The following standards have been issued:

ANSI/ASCE 1-82 N-725 Guideline for Design and Analysis of Nuclear Safety Related Earth Structures
ASCE/EWRI 2-06 Measurement of Oxygen Transfer in Clean Water
ANSI/ASCE 3-91 Standard for the Structural Design of Composite Slabs and ANSI/ASCE 9-91 Standard Practice for the Construction and Inspection of Composite Slabs
ASCE 4-98 Seismic Analysis of Safety-Related Nuclear Structures
Building Code Requirements for Masonry Structures (ACI 530-13/ASCE 5-13/TMS 402-13) and Specifications for Masonry Structures (ACI 530.1-13/ASCE 6-13/TMS 602-13)
ASCE/SEI 7-10 Minimum Design Loads for Buildings and Other Structures
SEI/ASCE 8-02 Standard Specification for the Design of Cold-Formed Stainless Steel Structural Members
ANSI/ASCE 9-91 listed with ASCE 3-91
ASCE 10-97 Design of Latticed Steel Transmission Structures
SEI/ASCE 11-99 Guideline for Structural Condition Assessment of Existing Buildings
ASCE/EWRI 12-13 Standard Guidelines for the Design of Urban Subsurface Drainage
ASCE/EWRI 13-13 Standard Guidelines for the Installation of Urban Subsurface Drainage
ASCE/EWRI 14-13 Standard Guidelines for the Operation and Maintenance of Urban Subsurface Drainage
ASCE 15-98 Standard Practice for Direct Design of Buried Precast Concrete Pipe Using Standard Installations (SIDD)
ASCE 16-95 Standard for Load Resistance Factor Design (LRFD) of Engineered Wood Construction
ASCE 17-96 Air-Supported Structures
ASCE 18-96 Standard Guidelines for In-Process Oxygen Transfer Testing
ASCE 19-10 Structural Applications of Steel Cables for Buildings
ASCE 20-96 Standard Guidelines for the Design and Installation of Pile Foundations
ANSI/ASCE/T&DI 21-13 Automated People Mover Standards
SEI/ASCE 23-97 Specification for Structural Steel Beams with Web Openings
ASCE/SEI 24-05 Flood Resistant Design and Construction
ASCE/SEI 25-06 Earthquake-Actuated Automatic Gas Shutoff Devices
ASCE 26-97 Standard Practice for Design of Buried Precast Concrete Box Sections
ASCE 27-00 Standard Practice for Direct Design of Precast Concrete Pipe for Jacking in Trenchless Construction
ASCE 28-00 Standard Practice for Direct Design of Precast Concrete Box Sections for Jacking in Trenchless Construction
ASCE/SEI/SFPE 29-05 Standard Calculation Methods for Structural Fire Protection
SEI/ASCE 30-14 Guideline for Condition Assessment of the Building Envelope
SEI/ASCE 31-03 Seismic Evaluation of Existing Buildings
SEI/ASCE 32-01 Design and Construction of Frost-Protected Shallow Foundations
EWRI/ASCE 33-09 Comprehensive Transboundary International Water Quality Management Agreement
EWRI/ASCE 34-01 Standard Guidelines for Artificial Recharge of Ground Water
EWRI/ASCE 35-01 Guidelines for Quality Assurance of Installed Fine-Pore Aeration Equipment
CI/ASCE 36-01 Standard Construction Guidelines for Microtunneling
SEI/ASCE 37-02 Design Loads on Structures during Construction
CI/ASCE 38-02 Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data
EWRI/ASCE 39-03 Standard Practice for the Design and Operation of Hail Suppression Projects
ASCE/EWRI 40-03 Regulated Riparian Model Water Code
ASCE/SEI 41-06 Seismic Rehabilitation of Existing Buildings
ASCE/EWRI 42-04 Standard Practice for the Design and Operation of Precipitation Enhancement Projects
ASCE/SEI 43-05 Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities
ASCE/EWRI 44-05 Standard Practice for the Design and Operation of Supercooled Fog Dispersal Projects
ASCE/EWRI 45-05 Standard Guidelines for the Design of Urban Stormwater Systems
ASCE/EWRI 46-05 Standard Guidelines for the Installation of Urban Stormwater Systems
ASCE/EWRI 47-05 Standard Guidelines for the Operation and Maintenance of Urban Stormwater Systems
ASCE/SEI 48-11 Design of Steel Transmission Pole Structures
ASCE/SEI 49-12 Wind Tunnel Testing for Buildings and Other Structures
ASCE/EWRI 50-08 Standard Guideline for Fitting Saturated Hydraulic Conductivity Using Probability Density Functions
ASCE/EWRI 51-08 Standard Guideline for Calculating the Effective Saturated Hydraulic Conductivity
ASCE/SEI 52-10 Design of Fiberglass-Reinforced Plastic (FRP) Stacks
ASCE/G-I 53-10 Compaction Grouting Consensus Guide
ASCE/EWRI 54-10 Standard Guideline for Geostatistical Estimation and Block-Averaging of Homogeneous and Isotropic Saturated Hydraulic Conductivity
ASCE/SEI 55-10 Tensile Membrane Structures
ANSI/ASCE/EWRI 56-10 Guidelines for the Physical Security of Water Utilities
ANSI/ASCE/EWRI 57-10 Guidelines for the Physical Security of Wastewater/Stormwater Utilities
ASCE/T&DI/ICPI 58-10 Structural Design of Interlocking Concrete Pavement for Municipal Streets and Roadways
ASCE/SEI 59-11 Blast Protection of Buildings
ASCE/EWRI 60-12 Guidelines for Development of Effective Water Sharing Agreement
ASCE/COPRI 61-14 Seismic Design of Piers and Wharves

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PREFACE

This is the first edition of this standard. This standard has been developed by a group of practicing structural engineers, geotechnical engineers, owners, and academics with specific expertise and experience in the marine and waterfront industries. It is intended to reflect the current practice of seismic design of piers and wharves, aspects of which differ considerably from conventional design of buildings or building-like structures. For example, load combinations for piers and wharves are unique and include berthing and mooring loads that may govern the lateral load design in low seismic regions. Geotechnical issues are a prime concern for these types of structures, with pile foundations often penetrating through weak soil layers. Liquefaction, lateral spreading, and ground failures affecting slopes and earth structures are all primary considerations for the analysis and design of piers and wharves. It is often not practical to eliminate these hazards; rather, structures are designed to accommodate permanent ground deformations within specified performance requirements.

This standard contains displacement-based design methods that have become widely used in the industry for more than a decade and have been supported by a number of industry-sponsored testing programs.

This standard is intended to benefit designers and owners by providing a method for considering the economic importance of a structure in addition to meeting life safety requirements. It is also intended to benefit building officials who do not routinely deal with waterfront structures.

Compliance with this standard should not be considered a guarantee that the desired performance goals will be achieved. Variation between the desired performance levels and actual performance should be expected because of the inherent uncertainties in prediction of seismic ground motion, liquefaction, and other seismic effects and because of the inherent uncertainties in levels of workmanship, material strengths, levels of maintenance, structure condition, and other effects.

This standard has been prepared in accordance with recognized engineering principles and should not be used without the user's competent knowledge for a given application. The publication of this standard by ASCE is not intended to warrant that the information contained herein is suitable for any general or specific use, and ASCE takes no position respecting the validity of patent rights. The user is advised that the determination of patent rights or risk of infringement is entirely his or her own responsibility.

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