Third Edition



PLANNING AND DESIGN GUIDELINES FOR Small Craft Harbors

ASCE Manuals and Reports on Engineering Practice No. 50

ASCE

COPRI COASTS, OCEANS, PORTS AND RIVERS INSTITUTE

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Planning and Design Guidelines for Small Craft Harbors

Third Edition

Prepared by
the Task Committee on Marinas 2020
of the Coasts, Oceans, Ports, and Rivers Institute
of the American Society of Civil Engineers

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PREFACE

Marina development has changed significantly since ASCE Manuals and Reports on Engineering Practice No. 50, "Planning and Design Guidelines for Small Craft Harbors," was last revised in 1994. The demand for access to our nation's oceans, lakes, and rivers has steadily increased, but the maintenance and new construction of harbor infrastructure—such as breakwaters, dredging, piers, boat slips, and launch ramps—have not kept pace. Furthermore, public access to the water that was traditionally provided by older, outdated marinas and boat launches is being lost to more profitable land uses.

These factors create a demand for new harbors and waterfront facilities. In many cases, blighted and contaminated waterfront sites are all that are currently available for development. Collaboration is needed among many professions during all phases of harbor design and development, often requiring public-private partnerships to get these projects built. This revised ASCE Manual 50 final report provides the civil engineer with new, state-of-the-art guidelines for the planning, design, and development of small craft harbors. It is not in any sense a "standard," however, nor is it so elementary or so conclusive as to provide rules of thumb for nonengineers. This is the work of a technical committee selected to assemble and convey information on the topic of planning and designing small craft harbors.

The boating market has become increasingly sophisticated in its demand for convenient and attractive facilities that not only meet the functional needs of mooring boats in a safe environment, but also serve the cultural and social needs of the boating community. At the same time, the general public wants sustainable waterfront development with both visual and physical access to the water. Finally, the real estate developer and marina owner (private or public) require an efficient and profitable operation. These three general objectives usually shape initial project

goals. Every harbor development project presents unique market opportunities, regulations, land conditions, and financing options. Once clear objectives are established and all constraints are understood, an optimal solution can be defined through a sustainable design process that addresses the important economic, social, and environmental aspects of the project. This holistic design approach incorporating integrated technical, scientific, and financial analyses results in consensus on the small craft harbor master plan.

We have learned much about the technical aspects of planning and designing small boat harbors in the past 18 years. Manufacturers as well as marine contractors can now provide products that are much more predictable in their performance and, therefore, more cost-effective. Thanks to improved design methodologies available to today's engineer, the risk associated with capital improvements can be assessed at the outset of the project. This technical report will give the design engineer a set of guidelines with which to approach the harbor planning and design process.

The report is organized into four parts. Chapter 1: Planning, Environmental, and Financial Considerations suggests a logical, analytical planning process and provides approaches to funding and financing small craft harbors. Chapter 2: Entrance, Breakwater, and Basin Design covers the protection of mooring facilities and basin configuration. Chapter 3: Inner Harbor Structures provides a guide to the design of improvements along the perimeter of the boat basin and within the harbor itself. Finally, Chapter 4: Land-Based Support Facilities offers insights into the role and features of landside facilities such as parking, roads, promenades, and boater service buildings essential to the successful operation of small craft harbors and marinas.

This report provides a valuable reference to the professional civil engineer by presenting the factors involved in harbor development and by providing basic background information needed as design input. Additional references are listed at the end of each chapter for those readers who are interested in researching a particular topic in greater detail. Because this specialized area of civil engineering practice continues to evolve with time, it is recommended that the harbor designer keep informed of the state-of-the-art approaches to planning, design, and construction of harbors through continuing education.

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ACKNOWLEDGMENTS

The Task Committee on Marinas 2020 was formed in 2005 for the purpose of updating ASCE Manuals and Reports on Engineering Practice No. 50, "Planning and Design Guidelines for Small Craft Harbors." This Task Committee was chaired by Fred Klancnik, with Jack Cox and Mark Pirrello serving as Control Group members. The following members served as chapter editors and primary authors: Fred Klancnik for Chapter 1, Planning, Environmental, and Financial Considerations; Jack Cox for Chapter 2, Entrance, Breakwater, and Basin Design; Mark Pirrello for Chapter 3, Inner Harbor Structures; and Cassie Goodwin for Chapter 4, Land-Based Support Facilities.

Roundtable discussions were conducted on the content of the four chapters of this publication at the Docks & Marinas National Conferences sponsored by the University of Wisconsin in Madison, Wisconsin on October 17–19, 2005 and again on October 15–17, 2007; at Ports 2007 sponsored by ASCE in San Diego, California on March 26, 2007; and at ICOMIA's International Marina Conference in Oostende, Belgium on May 25–28, 2008. Fred Klancnik, Jack Cox, and Coy Butler, the chapter editors at the time of these conferences, presented the basic information contained in the chapters and led discussions at sessions dedicated to the planning and design of small craft harbors. Both written and verbal suggestions were received from the members at large during and after these conferences.

A peer review committee of the ASCE Ports & Harbor Committee, consisting of Doug Sethness, Vice President, Ports & Maritime Group, CH2MHILL, Houston, Texas; Walt Ritchie, Retired Chief Engineer, Port of Seattle, Seattle, Washington; Allan Schrader, Retired Chief Engineer, Port of Tampa, Tampa, Florida; and Varoujan Hagopian, Principal Engineer, Sasaki Associates Inc., Watertown, Massachusetts, reviewed a draft of the report and contributed commentary, which was incorporated into

this manual during editing. In addition, Jeffrey Layton (President and Senior Coastal Engineer, Layton & Sell, Inc., PS, Kirkland, Washington) and Bill Curry (Retired Supervising Engineer, California Department of Boating and Waterways, Sacramento, California) served as both readers and sounding board during the writing and editing process. Special thanks to Terri Severson, Tina Lassen, Julie Self, Barbara Whiton, and Cheryl Johnson who served as the administrative assistants and technical writers for this technical document.

CHAPTER 1

PLANNING, ENVIRONMENTAL, AND FINANCIAL CONSIDERATIONS

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Daniel J. Williams, R.L.A.

INTRODUCTION

In everyday conversation the terms "harbor" and "marina" are often used interchangeably. For civil engineers involved in the planning, development, or operation of such waterfront facilities, the terms have different meanings. *Small craft harbors* are defined as basins in a body of water that provide protection from the elements (waves, wind, tides, ice, currents, etc.) for a variety of commercial and recreational watercraft. These facilities typically provide boat berthing (docks and moorings), launching and retrieval capabilities, basic boater supplies, auto parking lots, walkways, and associated land-based support facilities and services. Full-service marinas provide additional services and amenities designed to meet the needs of an increasingly sophisticated boating community. Marina patrons are typically boat owners who desire safe, comfortable, and attractive facilities that support recreational boating, including stable and aesthetically pleasing boat berths with utility service, restrooms and showers, fueling and sanitary pump-out stations, food service, and other amenities. The boating public is generally willing to pay for the convenience of an easily accessible and properly appointed "second home" atmosphere, above and beyond the mere provision of a safe place to store their boat.

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Providing visual and physical access to the water's edge is an important design consideration for small boat harbors, especially for harbors located in parks or along public waterfront bicycle and pedestrian trail systems. Finding ways to both maintain public access to the waterfront and provide the facilities and amenities of modern small boat harbors is an achievable goal.

This manual uses the term "small craft harbors" rather than "marinas" when referring to the boat basins and the landside facilities that provide the basic support systems necessary to operate the small craft harbor.

Sheltered boat basins can be natural or constructed; in many cases, however, breakwaters are typically required at the harbor entrance to provide a desired level of protection for boats approaching and mooring in the harbor. The harbor site should be deep enough to provide safe anchorage, while minimizing the need for expensive protective structures and dredging. Ideally, a small craft harbor is accessible from land and water and has the infrastructure required to serve the user of the facility.

The planning of small craft harbors is a complex undertaking requiring a careful blending of sophisticated technical analyses and creative design ideas. Typically, a team of professionals from a variety of backgrounds assembles at the outset of the planning process. This team often requires expertise from outside the profession of civil engineering, due to heightened interest in environmental issues and increased demand for improved access to the recreational opportunities that the waterfront affords. A typical marina design team might consist of such diverse professionals as civil, structural, and geotechnical engineers, as well as architects, landscape architects, planners, lawyers, market and financial analysts, environmental scientists, and marina managers.

Many factors can complicate small craft harbor development. Access can be limited by rail lines and highways, which often run parallel to the water's edge. Waterfront sites are typically characterized by poor soil conditions, deteriorated bulkheads, piers and pile foundations, wetlands, and sensitive near-shore environments. The destructive power of wind, waves, and currents often requires expensive harbor and flood protection. Varying water levels and tides pose a special challenge in achieving the desired land–water interface. In addition, overlapping governmental jurisdictions, a maze of permit requirements, and fragmented land ownership patterns all add to developmental difficulties and costs.

Attractive and cost-effective solutions to address these development constraints are available. By blending the technical expertise of civil engineers with the experience and skills of the other contributing professionals, concepts can be translated into built projects that meet the public's

and private developer's goals and satisfy the public's desire for an improved waterfront environment. Although these may sometimes seem like conflicting objectives, a successful development plan can integrate civil engineering solutions with creative site planning to achieve the objectives of all interest groups.

Because of the high costs and great difficulties associated with waterfront development, public-private partnerships are often formed to share the financial risks. Public bodies have shown a willingness to invest in the infrastructure of small craft harbors, recognizing that the economic impacts of such facilities often benefit a large and broad spectrum of the community. With government participation, sites once thought to be undevelopable because of physical or regulatory constraints often prove to be feasible for development. This joint development approach presents many ownership and operating options to achieve a successful development strategy. In some instances revenue from commercial upland development can effectively offset a portion of the debt associated with the waterside development.

Small craft harbors must be planned on a project-specific basis. What works for a municipal marina project in Hawaii may fail miserably for a privately developed Great Lakes yacht club. The purpose of this chapter is to present basic planning principles and financial considerations in a logical sequence. It begins with an overview of the planning process, followed by a discussion of market demand analysis. The chapter then progresses through location criteria; environmental, legal and regulatory issues; and technical considerations. Finally, it addresses a variety of financing issues and funding methods associated with the development of successful small craft harbor development.

THE PLANNING PROCESS

The first step in planning a small craft harbor is to determine the goals of the project and to establish a program for the design, construction, and operation of the facility. Intelligent programming of the project at the start can eliminate wasted time and considerable expense. This is especially true if the project's sponsor is not experienced with waterfront development. Once goals have been established and a preliminary program developed, it is important to engage in community input, especially if public approval is required for funding and/or construction permits.

Consensus Building

Identify project stakeholders to define goals and objectives for the project. Community leaders, city and community staff, marina manage-