CECW-EH-D Regulation No. 1110-2-1404	Department of the Army U.S. Army Corps of Engineers Washington, DC 20314-1000	ER 1110-2-1404 31 January 1996
	Engineering and Design HYDRAULIC DESIGN OF DEEP-DRAFT NAVIGATION PROJECTS	
	Distribution Restriction Statement Approved for public release; distribution is unlimited.	

DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, DC 20314-1000

ER 1110-2-1404

CECW-EH-D

Regulation
No. 1110-2-1404

31 January 1996

Engineering and Design
HYDRAULIC DESIGN OF DEEP-DRAFT NAVIGATION PROJECTS

1. Purpose

This regulation prescribes the design procedure and rationale for the hydraulic design of deep-draft navigation projects.

2. General

Deep draft, as used in this regulation, generally refers to project depths exceeding 16 ft. Design guidance is contained in the references listed in paragraph 4 and recognized engineering publications.

3. Applicability

This regulation applies to HQUSACE elements, major subordinate commands (MSC), districts, laboratories, and field operating activities having civil works responsibilities.

4. References

a. ER 1110-2-1150, Engineering and Design for Civil Works Projects.

b. ER 1110-2-1403, Hydraulic and Hydrologic Studies by Corps Separate Field Operating Activities and Others.

c. ER 1110-2-1461, Design of Navigation Channels Using Ship-Simulation Techniques.

d. EM 1110-2-1607, Tidal Hydraulics.

e. EM 1110-2-1613, Hydraulic Design of Deep-Draft Navigation Projects.

f. EM 1110-2-2904, Design of Breakwaters and Jetties.

5. Project Rationale

The design of a deep-draft navigation project must result in a plan that provides for a safe, efficient, reliable, and economically justified project with appropriate consideration of environmental and social aspects.

a. Safety concerns the potential hazard to life and property, resulting from the consequences of ship to ship, ship to bridge, ship to moorage, and moored vessel interactions, etc.

b. Efficiency is the optimal combination of channel, turning basin, and anchorage depths, widths, and alignments to allow traverses and maneuvers at normal speeds considering weather, waves, currents, and traffic congestion with minimal assistance from support vessels.

c. Reliability involves the ability to achieve project purposes and proper functioning of facilities such as aids to navigation, bridge pier fendering, jetties, dikes, breakwaters, etc.

This regulation supersedes ER 1110-2-1404, dated 1 June 1994.

d. Economic justification is based on the initial, operational, maintenance, repair, rehabilitation, and replacement costs optimized on an annual cost basis.

e. Environmental and social aspects comprise fish and wildlife protection and restoration, recreational opportunity development, water quality restoration, human resources protection, and wetlands preservation and mitigation of adverse aspects, etc.

6. Project Design Process

a. General. The initial step in the hydraulic design process is to develop a hydraulic design plan. The designer is responsible for developing the recommended design, having studied sufficient alternatives to identify the plan that maximizes net benefits. Applicable Corps policy and guidance are to be followed with particular attention to risk-based processes. Careful consideration of the type and complexity of the hydraulic design studies required at various stages is necessary. An uncomplicated small project may require only basic studies while a complex project may require progression to more sophisticated studies as the design proceeds.

b. Coordination. The hydraulic design study plan will identify inputs of data and results of other studies required to properly conduct the hydraulic design studies. Coordination with other disciplines to assure the timely availability, format, and adequacy of hydraulic design technical information input to and output from the hydraulic studies is essential. The project plan will indicate, by schedule or other means, the timing of the hydraulic design studies, input from others, and interfacing of outputs with the design study progress.

c. Design vessel. The study plan proceeds on the basis of alternative design fleets represented by a design vessel. Determination of the design fleet is the responsibility of the planning discipline. Selecting the design vessel representative of a design fleet is the joint responsibility of engineering and planning disciplines. The project geometries for channels, turning basins, and anchorages (depths, widths, and alignments) are based on the selected design vessel. Using the design vessel, the attributes listed in paragraph 5 are to be fulfilled.

d. Models. It is imperative that all necessary complex and costly studies such as mathematical models, physical models, and ship simulator studies be identified and scheduled in the initial stages of the project study. Data from models must be planned for and obtained in a form adaptable to the probabilistic design evaluation/ trade-off process.

e. Studies. Following assembly of the initial inputs of data and the required study results, the initial hydraulic design studies (hydrodynamic circulation and currents, wind and waves, alignments, widths, depths, etc.) will be undertaken in support of the project study. Alternative designs are to be studied and presented in sufficient detail (including probabilistic analysis) to provide a valid basis for plan comparison and to substantiate the recommended design commensurate with the project design study plan progress. The plan is to be continuously updated in response to project study modifications.

7. Hydraulic Design Presentation

The hydraulic design presentation in reports must cover the following:

a. General. Basically the hydraulic design portion of all reports forwarded for approval or information should contain sufficient detail to allow an independent assessment as to the soundness of the report conclusions and recommendations. The accuracy of the hydraulic design studies (computations, physical and mathematical models, ship simulation studies, etc.) is dependent on the accuracy of the input data and the degree to which the computational procedure is representative of the phenomena under consideration. The uncertainties involved in project design or modification are to be presented according to current HQUSACE instructions. Report presentations will be sufficiently descriptive (write-ups, drawings, tables, equations, coefficients, model or simulator reports, example computations, etc.) to satisfy the basic requirements given at the beginning of this paragraph.

b. With- and without-project conditions. Both project conditions must be thoroughly described and shown on drawings. This is to assure that the reviewer will understand the entire project functioning as well as the changes proposed.

c. Channel alignment. The channel alignment, including the entrance channel, is to be portrayed by a continuous center line, preferably on hydrographic survey sheets. Location of shoals and nearby side structures such as docks, bridge piers and abutments, is

essential. Bottom materials and their locations need to be identified. Existing and proposed structures to maintain channel alignment such as groins, dikes, jetties, breakwaters, wave absorbers, revetments, etc., must be described and located on drawings.

d. Channel depth. The required channel depth (authorized project depth) is based on the draft of the loaded design vessel plus squat, sinkage in fresh water, effect of wind and wave action, and safety and efficiency clearance. Additional depth may be required because of the location of the vessel saltwater intake and to provide for advanced maintenance and dredging tolerance, but these latter two factors are not included in the authorized project depth. Channel depths are portrayed on drawings by typical cross sections. These cross sections should also show side slopes and their interaction with adjacent structures.

e. Channel width. Factors considered in the determination of channel width are one-way, two-way, or passing traffic; winds, currents, and curvature; and vessel maneuverability, continuous or intermittent bank conditions, etc. Both edges of the channel are to be depicted on drawings throughout the length of the project. As with channel depth, over-width dredging may be used to accommodate dredging tolerance and advanced maintenance, where cost-effective.

f. Turning basins and anchorages. Depict the boundaries of these features and show typical cross sections to indicate side slopes and nearby structural foundations.

g. Water levels. The presentation is to include sufficient information to fully describe water levels from river discharges, tides, storm surges, etc., throughout the project.

h. Waves. Describe the design wave climate (height, period, and direction) for each portion of the channel subject to a distinct climate. Explain the rationale for the selection of the design condition. Show wave roses when appropriate.

i. Wind. Treat the wind climate in the same manner as the wave climate.

j. Currents. Describe the current variability throughout the project and give design (both ebb and flow when applicable) values.

k. Channel shoaling. Present the results of sedimentation studies. These are necessary as substantiation for annual dredging considerations to include disposal provisions.

l. Project safety. Present the existing channel safety record and discuss the improvements envisioned. The U.S. Coast Guard is to be consulted and their written views recorded in regard to channel safety.

m. Navigation aids. As with channel safety, the U.S. Coast Guard is to be consulted and their concurrence as to type and location of navigation aids recorded. The presentation is to cover all kinds of aids proposed for the project including but not limited to buoys, range markers, and electronics such as the differential global positioning system.

n. Pilot/captain interviews. Pilots and shipmasters are to be interviewed to determine their opinions and recommendations on existing channel safety; operational limiting wind, wave, current, and visibility conditions; design vessel; traffic patterns; port operating rules; aids to navigation; tug assistance requirements; and the proposed project design and desired modifications.

o. Dredging and disposal. The location, type, amount, interval, and cost of initial and maintenance dredging are to be discussed and portrayed on drawings. A disposal plan for both initial and maintenance dredging is essential.

p. Environment. The report must present the results of hydraulic studies both mathematical and physical (hydrodynamic, circulation, sedimentation, etc.) as required for environmental studies.

q. Datum. The appropriate low water datum for the project location and its relationship to the National Geodetic Vertical Datum (NGVD) is to be recorded.

r. Operation and maintenance. An Operation, Maintenance, Replacement, Repair, and Rehabilitation (OMRR&R) plan is to be developed. The plan elements should consist of, where appropriate, hydrographic survey extent and frequency; inspection of structures identification and frequency; and records such as tide gage, waves, salinity, etc. A discussion of the plan and identification of plan elements and the annual OMRR&R

costs are required in report presentation. The plan is to be readied prior to completion of the first useful portion of the project. The MSC commander is authorized to approve the project OMRR&R plan.

FOR THE COMMANDER:

ROBERT H. GRIFFIN
Colonel, Corps of Engineers
Chief of Staff