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व्यापक परिचालन मसौदा

हमारा संदर्भ : सीईडी 47/टी-5 **18 जुलाई 2025**

तकनीकी समिति: पत्तन, पोताश्रय और अपतट अधिष्ठापन विषय समिति, सीईडी 47

प्राप्तकर्ता:

क) सिविल इंजीनियरी विभाग परिषद, सीईडीसी के सभी सदस्य
ख) सीईडी एवं 47 इसके पैनल के सभी सदस्य
ग) रूचि रखने वाले अन्य निकाय।

महोदय/महोदया,

निम्नलिखित मसौदा संलग्न है:

प्रलेख संख्या	शीर्षक
सीईडी 47 (28402)WC	**पत्तनों और पोताश्रयों की योजना और रूप — रीति संहिता भाग 5 अभिन्यास, कार्यात्मक और पर्यावरणीय अपेक्षाएँ का भारतीय मानक मसौदा** [IS 4651 (भाग 5) *का पहला पुनरीक्षण*] ICS 93.140

कृपया इस मसौदे का अवलोकन करें और अपनी सम्मतियाँ यह बताते हुए भेजे कि यह मसौदा प्रकाशित हो तो इन पर अमल करने में आपको व्यवसाय अथवा कारोबार में क्या कठिनाइयाँ आ सकती हैं।

सम्मतियाँ भेजने की अंतिम तिथि: 22 अगस्त 2025

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धन्यवाद।

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WIDE CIRCULATION DRAFT

Our Ref: CED 47/T-5 **18 July 2025**

TECHNICAL COMMITTEE: PORTS, HARBOURS AND OFFSHORE INSTALLATIONS SECTIONAL COMMITTEE, CED 47

ADDRESSED TO:

a) All Members of Civil Engineering Division Council, CEDC
b) All Members of CED 47 and its panels and working group
c) All other interested

Dear Sir/Madam,

Please find enclosed the following draft:

Doc. No.	Title
CED 47 (28402)WC	**Draft Indian Standard Planning and Design of Ports and Harbours — Code of Practice Part 5 Layout, Functional and Environmental Requirements** [*First Revision* of IS 4651 (Part 5)] ICS 93.140

Kindly examine the attached draft and forward your views stating any difficulties which you are likely to experience in your business or profession, if this is finally adopted as National Standard.

Last Date for Comments: 22 August 2025

Comments if any, may please be made in the enclosed format and emailed at ced47@bis.gov.in or sent at the above address. Additionally, comments may be sent online through the BIS e-governance portal, www.manakonline.in.

In case no comments are received or comments received are of editorial nature, kindly permit us to presume your approval for the above document as finalized. However, in case comments, technical in nature are received, then it may be finalized either in consultation with the Chairman, Sectional Committee or referred to the Sectional Committee for further necessary action if so desired by the Chairman, Sectional Committee.

The document is also hosted on BIS website www.bis.gov.in.

Thanking you,

Yours faithfully,

Sd/-
(Dwaipayan Bhadra)
Scientist 'E' & Head
Civil Engineering Department
Email: ced47@bis.gov.in

Encl: As above

FORMAT FOR SENDING COMMENTS ON BIS DOCUMENTS

(Please use A-4 size sheet of paper only and type within fields indicated. Comments on each clause/sub-clause/table/fig etc. be started on a fresh box. Information in column 3 should include reasons for the comments and suggestions for modified working of the clauses when the existing text is found not acceptable. Adherence to this format facilitates Secretariat's work) {Please e-mail your comments to ced47@bis.gov.in

DOC. NO.- CED 47 (28402) WC

TITLE: Draft Indian Standard Planning and Design of Ports and Harbours — Code of Practice Part V Layout, Functional and Environmental Requirements [*First Revision* of IS 4651 (Part 5)] ICS 93.140

LAST DATE OF COMMENTS: **22/08/2025**

NAME OF THE COMMENTATOR/ORGANIZATION: _____

Sl No.	Clause/ Para/ Table/ Figure No. commented	Type of Comment (General/ Technical/ Editorial)	Comments/ Modified Wordings	Justification of Proposed Change
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NOTE- Kindly insert more rows as necessary for each clause/table, etc.

BUREAU OF INDIAN STANDARDS

DRAFT FOR COMMENTS ONLY

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Draft Indian Standard

Planning and Design of Ports and Harbours — Code of Practice
Part V Layout, Functional and Environmental Requirements

[*First Revision of IS 4651* (*Part 5*)]

PORTS, HARBOURS AND OFFSHORE INSTALLATIONS SECTIONAL COMMITTEE, CED 47	Last Date of Comments **22 August 2025**

FOREWORD

(*Formal Clauses to be added later*)

Based on the need felt towards formulating Indian standard recommendations relating to various aspects of waterfront structures, the IS 4651 series of standards were established. This standard is one of this series formulated on this subject and deals with Layout, functional and environmental requirements. The other parts in the series are given below:

Part 1 Site Investigation
Part 2 Geotechnical Engineering
Part 3 Loading
Part 4 General Design Considerations

This standard outline some of the desirable technical characteristics of ideal ports and harbours and is intended to provide some guidelines to the planners and designers who may be required to select a specific site, with in the general locality specified, and develop a new or an existing port and harbour.

This standard (Part 5) was first published in 1980 under the title ‘Layout, functional requirements’. In this revision, the title has been modified to ‘Layout, Functional and Environmental Requirements’. In the formulation of this standard due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country.

The first revision of this standard has been taken up to incorporate further modifications necessary in the light of comments received from the users of this Standard. The following significant changes have been made in this revision:

a) In Hydrographic and Hydrological Factors, current velocity and meteorological factors clause modified.
b) In Navigation channel, stopping distance clause modified.
c) Clause on sheltering from wind, currents and wave has been modified.

d) Navigation studies (shipping maneuverability study, passing ship analysis) have been included.
e) Environmental impact assessment & environmental management plan (EIA & EMP) for ports have been included.

For the purpose of deciding whether a particular requirement of this Part of the Code is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2: 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this Part.

Draft Indian Standard

PLANNING AND DESIGN OF PORTS AND HARBOURS — CODE OF PRACTICE PART V LAYOUT, FUNCTIONAL AND ENVIRONMENTAL REQUIREMENTS

[*First Revision of IS 4651 (Part 5)*]

Ports, Harbours and offshore Installations Sectional Committee, CED 47	Last Date of Comments **22 August 2025**

1 SCOPE

1.1 This standard (Part V) lays down functional requirements for the planning and developing of commercial ports and harbours and gives a general recommendation for the layout, functional and environmental requirements:

a) Site investigation;
b) Navigation Channel;
c) Navigation studies (shipping manoeuvrability study, passing ship analysis);
d) Harbour basin;
e) Piers and wharves;
f) Storage areas and sheds and storage of hazardous/obnoxious cargo;
g) Open storage area;
h) Other functional and operational buildings;
j) Roads and port railways;
k) fire protection measures;
m) EIA and EMP for Port Projects;
n) Dredging & Reclamation including disposal (Reuse of dredge material);
p) Tranquility of port; and
q) Material Handling system (Semi mechanised or fully mechanised, optimum handling facility).

2 REFERENCE

The standards given below contain provisions which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of these standards.

IS No.	*Title*
IS 7314: 2023	Port and Harbour Engineering — Glossary of Terms (*first revision*)

3 TERMINOLOGY

3.1 For the purpose of this standard, the definitions given in IS 7314 shall apply.

4 SELECTION OF HARBOUR SITE

For selection of site of ports and harbours the following factors need consideration.

4.1 Access

Direct access with existing means of internal communications and dispersion such as rivers, highways, canals and railways is desirable. Where topography at sites contiguous to inland communication is not favorable, cost of providing connection to such facilities should be balanced against savings in the cost of developing remote sites.

4.2 Size and Depth

Adequate size of area and sea front, inshore of breakwaters, if any, and depth without excessive dredging should be available to accommodate expected traffic. There should be room for future expansion.

4.3 Physical and Topographical Features

4.3.1 *Sheltering from Winds and Ocean Waves*

Natural sheltering features such as headlands, off-shore shoals and bars, would reduce the artificial sheltering requirements, such as breakwaters, and thereby reduce cost. Headlands offer protection from winds and waves.

4.3.2 *Subsoil Conditions*

Sites should be suitable for the construction of port structures and development of water area. Availability of rock at shallow depths may be good for structures but unworkable for water area to be dredged or used as anchorage. Very soft bottom does not also provide good holding conditions for anchors. Clay or other firm tenacious materials would form better holding ground for anchorage. Characteristics of soil/ rock at design depth level would this influence the choice of the harbour site.

4.3.3 *Dredging*

Minimum capital and maintenance dredging and freedom from dredging large quantities of rock or other hard bottoms should be an important consideration.

4.3.4 *Shore Line Stability*

Non-eroding shore lines should be preferred. Land adjacent to shore line should gradually slope away from the beach. Locations with pronounced topographical relief such as cliffs adjacent to shore line may create problems.

4.3.5 *Upland Drainage*

Upland areas should be naturally well drained and there should, not be health hazards due to local drainage conditions.

4.4 Hydrographic and Hydrological Factors

4.4.1 *Tides*

Locations with tidal bore and high tidal range shall be given special consideration.

4.4.2 *Current Velocity*

Current velocity should preferably not exceed 4 knots (7.4 km/h) anywhere within the harbour. If the current velocity is more than 4 knots numerical study shall be carried out to estimate the mooring force. Navigation study considering site specific environmental conditions and bridge simulation study is essential.

4.5 Meteorological Factors

The port and harbour should be designed for return period of at least twice the design life of the structure.

4.6 Construction Materials, etc.

Availability of construction material, particularly rock for breakwater and other construction works and adequate fresh water supply will be an advantage and will reduce cost.

4.7 Strategic and Security Conditions

Strategic and security conditions at a particular site shall be given due consideration.

5 NAVIGATION CHANNEL

General

Water ways should be laid out in proper configuration and designed for good control and safe manoeuvrability of ships under all conditions, winds, currents, waves, visibility and in adverse weather conditions. It is difficult to lay down rigid standards on various aspects of navigation channel, as conditions will vary from port to port depending upon its location, natural shelter, tidal and other condition, prevailing depths and various other factors. Strong currents and winds, for example, have a very significant effect on the alignment, width, depth, turning circles, etc. of the proposed channel and can alter the requirements appreciably. The local conditions and the ports own knowledge and experience are very important factors.

5.1 The use of channel for navigation pre-supposes that the channel is adequately marked and lit for night navigation and is provided with necessary lighted transits and modern navigational aids.

5.2 Alignment

The alignment of channels should be such that ships expected to use the channel can navigate with reasonable safety under adverse conditions of tide, current, wave and

wind action. The following are general conditions in determining the optimum channel alignment. The channel should be straight as far as possible.

5.2.1 The channel should be located in areas of maximum natural depth to reduce cost of initial and maintenance dredging.

5.2.2 As far as possible, areas prone to excessive siltation and littoral drift should be avoided.

5.2.3 The number of curves and the angles of deflection of the axis (*see* **5.4**) should be kept down to a minimum.

5.2.4 As far as practicable, a minimum angle between the channel axis and the resultant effect of the direction of the prevailing wind and swell and current should be maintained.

5.2.5 Adequate stopping distance (*see* **5.5**) to bring a vessel to a stop with or without tug, having regards to the requirements of the using agency and experience of the port authorities to handle vessel of a particular size should be provided.

5.2.6 The entrance to the basin should be located on the lee side of the harbour, where possible. If, however, the entrance has to be located on the windward size of the harbour, it should be adequately protected by breakwater.

5.2.7 In critical locations, for example, entrance to harbours, under bridges, approaches to docks, etc. straight approaches long enough for the vessel to become properly aligned to the berth is necessary.

5.3 Types of Channels

5.3.1 *Unrestricted Channels*

An unrestricted channel is a channel of sufficient depth and which has a width more than 10 times the beam of the largest ship likely to navigate the channel at all states of the tide.

5.3.2 *Semi-restricted Channels*

Semi-restricted channels are channels in shallow water where a certain amount of trenching is done by dredging, allowing for side slopes with the adjoining areas raving less depth than in channel (*see* Fig. 1).

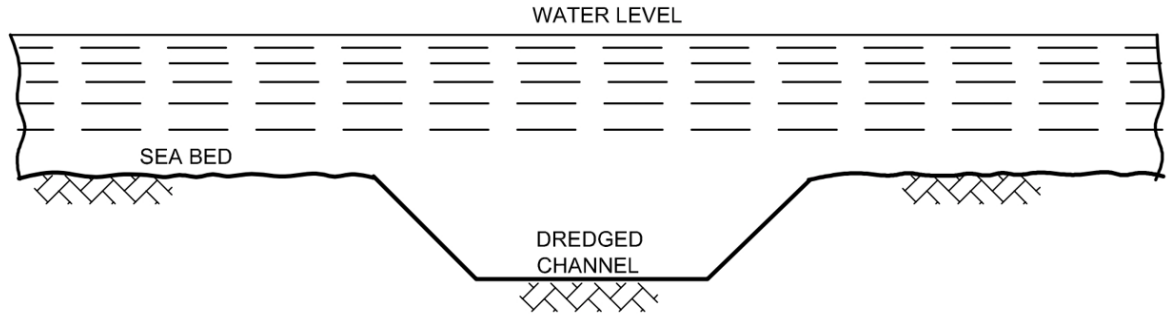

FIG. 1 SEMI-RESTRICTED CHANNEL

5.3.3 *Fully Restricted Channels*

Fully restricted channels are channels which are fully banked and where the entire cross-sectional area of the channel is generally dredged; for example in canals (*see* Fig. 2).

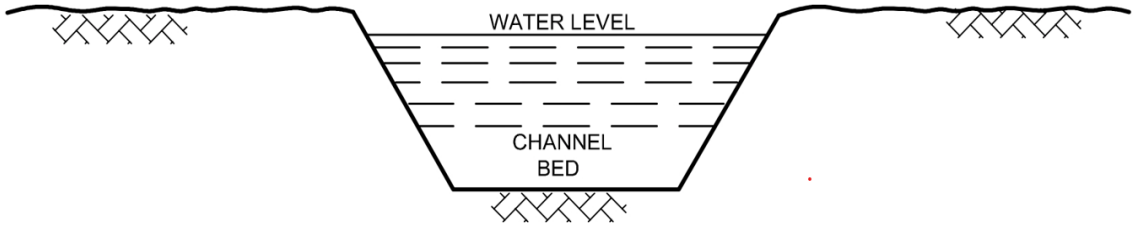

FIG. 2 FULLY-RESTRICTED CHANNEL

5.4 Curves and Bends

Curves, particularly sharp turns, should be avoided. Where these are necessary, the following requirements should be fulfilled as far as possible.

5.4.1 For vessels proceeding without tug assistance, the minimum radius, of the curve should not be less than 3 L for central angle of the turn up to 25º, 5 L for turns beyond 25º, and 10 L for turns beyond 35º where L is the length of the largest vessel. Where it is not possible to provide these radii, the channel should be suitably widened. As a guide following radius of curvature is desirable, where possible.

$R_{\mathrm{m/n}}$ = 1 200 m for ship less than 150 m long O/A
= 2 000 m for 150 m long O/A
= 2 000 to 3 000 m larger than 150 m but smaller than 210 m long O/A

5.5 Stopping Distance

The stopping distance in channel varies with the displacement/horse power ratio, reverse power, shape of hull of the vessel, etc.

In harbours where the entrance is exposed to weather, the stopping distances should be reckoned from the beginning of the protection work to the center of the turning basin. The degree of protection required for the dredged channel will depend on the sea conditions prevailing in a particular location.

5.6 Depth

The following factors should be taken into account in designing the depth of the channel:

a) Size, draft, shape of hull and speed of the design vessel;
b) Trim of vessel when moving through water (termed drag);
c) Current velocity in the channel;
d) Squat assessed on the ratio between cross-sectional area of the immersed portion of the ship and cross-sectional area of the channel at low water;
e) Whether the channel is fully restricted, semi-restricted or unrestricted;
f) Number of lanes in channels;
g) Wind and wave action;
h) The tidal variation;
j) Dredging pattern and frequency;
k) Salinity and bottom material;
m) Degree of accuracies in hydrographic survey and other accuracies; and
n) Net under keel clearance.

5.6.1 In general, the recommended under keel clearance (UKC) in terms of draft of the vessel is 10 percent at the berth, 15 percent at the turning circle and 20 percent at entrance to the channel in unsheltered areas.

5.6.2 The UKC can be optimised dynamically by ensuring a net UKC of 0.5 m over all other allowances considering the factors (a) to (m) above at the time of transit.

5.7 Width of Channel

The channel is part of the fairway to allow passage of deep draught vessels. In many dedicated channels the buoys will be close to the edge of the channel to indicate the limits of safe navigation, but on those with a range of traffic, the fairway markers may be positioned to allow the passage of smaller vessels on either side of the dredged channel.

Channel alignment should be assessed for following parameters:

a) Shortest channel length;
b) Conditions/basins, etc. at either end of the channel;
c) Need to avoid obstacles or areas of accretion which are difficult or expensive to remove or require excessive (and hence costly) maintenance dredging;
d) Prevailing winds, currents and waves;
e) Avoiding bends, especially close to port entrances; and
f) Environment on either side of the channel, such that ships passing along it do not cause disturbance or damage

The clear width of a restricted channel measured at the bottom of the dredged bed may be taken as the sum of the following three zones:

a) Vessel Manoeuvrability
b) Environmental Condition
    1) Cross wind;
    2) Cross Current;
    3) Longitudinal Current;
    4) Significant Wave height;
    5) Aids to Navigation;
    6) Bottom surface; and
    7) Depth of Water way
c) Bank Clearance

Further each of these 3 parameters shall be bifurcated with respect to the vessel speed in 3 category, Fast, Moderate and Slow.

a) *Vessel Manoeuvring Lane (single lane)*

The basic manoeuvring lane widths for ships with good, moderate and poor ship manoeuvring characteristics. Manoeuvrability of tankers and bulk carriers shall be considered to be generally poor (1.8 B); container vessels, car carriers, Roll-on/Roll-off vessels, LNG and LPG vessels shall be considered to be generally moderate (1.5 B); while twin-propeller ships, ferries and cruise vessels shall be considered to be generally good (1.3 B). Where, B is the beam of the largest passing ship.

b) *Environment Condition*

Additional widths to account for environmental and other navigation effects on manoeuvring shall be considered. These environmental allowances as a function of ship speed and channel exposure to waves. In general, the following table shall be used in selecting channel width dimensions which is based on operational limit conditions.

The indication for the terms Excellent, Good and Moderate is as given below.

Excellent — Channel with Paired lighted buoys with radar reflectors, Lighted leading lines and VTS available along with the availability of the Pilots, DGPS (Differential global navigation satellite positioning systems) and ECDIS (Electronic chart display and information system).

Good — Channel with Paired lighted buoys with radar reflectors and Lighted leading lines available along with the availability of the Pilots and DGPS (Differential global navigation satellite positioning systems).

Moderate — If anything less than the facility listed above in Excellent and Good Condition.

c) *Bank Clearance*

A ship close to the edge of its manoeuvring lane will experience bank effects which are at a controllable.

5.7.1 Where the width of the channel is to be reduced at the harbour entrance for obtaining tranquility conditions, the reduced width between pier heads shall be a minimum of 0.7 to 1 times the length of the largest designed vessel. Where the entrance is between sloping breakwaters the width should be measured at the maximum draft at mean low water.

5.7.2 In increasing the width of the channel at curvature the widening of the curve should be done by the parallel bank method. The slope of the transition should be at least 1 in 20.

5.7.3 Additional Width for Passing Distance in Two-Way Traffic To determine additional width for passing distance in two-way traffic, the beam of the largest passing ship should be used whether or not it is the design ship. The additional width is required as passing distance for following criterions.

a) Vessel Speed Fast (Outer Channel): 2.0 B
b) Vessel Speed Moderate (Outer Channel): 1.6 B
c) Vessel Speed Slow (Outer Channel): 1.2 B
d) Vessel Speed Fast (Inner Channel): 1.8 B
e) Vessel Speed Moderate (Inner Channel): 1.4 B
f) Vessel Speed Slow (inner Channel): 1.0 B

Also, for the traffic vessel density, Heavy traffic is defined as more than 3 design vessels per day. In case of heavy (design) vessel traffic, an additional width of 0.5 B shall be added.

5.7.4. For the inland waterways, the design of the channel should consider the vessel size, draft, high flood level, discharge of the rivers, currents, water level, siltation and tide influence, if any.

5.8 Currents and Winds

5.8.1 The current in channel section at harbour entrance should not be too strong or too sluggish to maintain required sediment movement. In general the maximum current should not exceed 4 knots (7.408 km/h) where possible. Where the current velocity exceeds this value, it may be necessary to adjust the channel cross section to maintain an optimum flow.

6 HARBOUR BASIN

6.1 Layout

The following are general considerations in determining the layout of a harbour basin.

6.1.1 Harbours receiving wide range of vessels should preferably be divided into at last two zones – one for larger ships, and the other for smaller crafts to be located in the inner and shallower regions of the basin.

6.1.2 A separate basin on the leeside of the main basin for bulk cargo and cargoes of noxious nature should be provided. Hazardous cargo wharves should be located keeping in view safety distances and clearance from other berths and installations preferably towards the outer end of the harbour or basin. Berths for vessels carrying explosives or petroleum lubricant (POL) products shall be located in isolated anchorage or areas keeping in view the safety distances. In all cases statutory requirements should be complied with.

6.1.3 The dimensions and layout of the basin should be critically examined with respect to short and long period resonance.

6.1.4 The berths and berthing basins should be located in areas which are best protected from wind and disturbance and away from the disturbance incident upon the harbour entrance and resonance.

6.1.5 The turning basin should be located at the head of navigation channel and should occupy the central area of the main basin offshore of the berths.

6.1.6 The anchorage area should be located close to the harbour entrance but well clear off the channel traffic.

6.1.7 Offshore moorings should be located as close as possible to the shore.

6.1.8 A spending beach should be provided, where necessary, opposite harbour entrance.

6.2 Depth

The depth of the harbour basin below the chart datum should be determined based upon tranquillity and salinity conditions. The minimum depth of water within the harbour basin should not be less than the loaded draught of the largest vessel plus an allowance of 0.60 m to 0.75 m for underkeel clearance. Where the harbour bottom is hard, the allowance should be increased to 1 m. Additional clearance may be required in basins where wave energy disturbances exist.

6.3 Water Area

The total water area requirement for the harbour basin would normally comprise of the following:

a) Berthing area;
b) Passage and manoeuvring area;
c) Turning basin/circle; and
d) Anchorages and offshore moorings.

Separate water areas should be allowed for channels, special berths, and spoil grounds if disposal of dredging should be done. The capacity of the water areas within the harbour may be evaluated in terms of numbers, types and sizes of vessels which could be simultaneously anchored within the harbour limits and at pier or wharf berths. Unless the harbour is a natural one, because of economic reason, its size should be kept as small as possible as will permit safe operations to take place.

6.3.1 *Berthing Area*

The space required for berthing of ships should be based on the dimensions of the largest design ship and the number and type of ships using the harbour. This is the area in front of the berthing structure required to accommodate the vessel or vessels and attendant craft.

6.3.1.1 *Length of berthing area*

For long continuous wharf for large ocean giving vessels, the recommended length of the berthing area should not be less than the length of the design vessel plus 10 percent subject to a minimum of 15 m. This may be increased up to 20 percent in basin exposed to strong winds and tidal conditions.

6.3.2 *Passage and Manoeuvring Area*

This is the space beyond the berthing area required for the passage of vessels and tugs, and to permit vessels to enter or leave their berths.

6.3.2.1 The width required to permit a vessel to swing freely into a berth is times the length of the vessel for berths at 90º, 1.50 times for berths at 45º and, 0.60 times the length of the vessel for berthing parallel to the fairway.

6.3.3 *Turning Basin/Circle*

The size and/or diameter of the turning basin would depend on the geometry of water area available and berth arrangement and shall be as follows.

6.3.3.1 The diameter of the turning circle where vessels may be warped round turning dolphins, should be minimum times the length of the largest vessel to be turned.

6.3.3.2 Where vessels turn by free interplay of the propeller and rudder assisted by tugs, the minimum diameter of the turning circle should be 1.50 times to 1.8 times (1.70 for protected locations and for exposed locations) the length of the largest vessel to be turned. Where no tug assistance is available, the diameter of the turning basin may be as large as 4 times the length of design ship.

6.4 Sheltering from Wind, Currents and Wave

6.4.1 *Waves*

As a general rule the wave disturbance within the harbour should not exceed the following tranquillity condition:

	Maximum Significant Wave Height in m	
	At berth	Entrance
General cargo	0.65	1.50
Bulk cargo	0.90	1.50 for berthing 2.50 for operation
Container cargo	0.65	–
Passenger vessel	0.65	–
Trawler and fishing boats	0.60-0.90	–
Trawler and fishning boats	0.3m at berth/0.45m in basin	0.9

The actual figures will depend on the mooring and berthing systems, the methods of loading and unloading used at a particular berth, and with the orientation of the berth in respect of wave directions.

6.4.2 For studying the problem of shelter within the harbour basin and for designing appropriate protective measures with precision, hydraulic models should be resorted to. Models for this type of study should be designed in accordance with the scale relations based on Froude Law. The use of hydraulic models should be combined with marine ship experience and good engineering practice for proper results.

7 SHIP NAVIGATION STUDIES

7.1 The foregoing sections provide overall guidelines to be used at the time of design of the channel and navigational areas only. The design of channel can be done by desktop studies or desk top stimulator studies or full bridge stimulator studies; However, the channel design needs to be optimized and validated using real time ship navigation simulators or full bridge simulators, prior to finalizing the design of channel and navigational areas.

7.1.1 Such full bridge simulators shall be of minimum 180 degree in field of view, comprising of display height of 2.1 m from floor to ceiling and display radius of 4.5 m.

7.1.2 The full bridge simulators shall also have the capabilities to provide navigation inputs through standard consoles, tug stations and embedded hydrodynamic inputs such as currents and water levels. It shall also have navigational aids such as ENCs, Radar stations, etc.,

7.1.3 The simulator shall have facility to provide all other environmental inputs (wind, wave, etc.) in real time during the simulations exercises that are to be carried out by a master mariner only.

7.2 Mooring Facilities

The shape, size and location of mooring devices is dependent on the type of berthing structure, size of vessel to be handled, wind and tidal condition at the berth location.

7.2.1 *Bollards* – For general cargo berth, the spacing of spring line and breast line bollards should be 25 m to 30 m along the length of the berth. For smaller vessel minimum of 4 bollards with appropriate spacing is required.

The bollard shall be located approximately minimum of 0.15 m behind the cope line of the berthing structure. The location of the bollard from the cope line the structure will be progressively increased to minimum of 0.4 m. Larger fittings or corner posts may be installed at the outshore corner of the pier or wharf for handling bow and stern mooring line. Spacing of bollards may be varied to cater for special conditions.

7.2.2 *Cleats*

For handling smaller vessels or harbour crafts, mooring cleats or rings should be installed between mooring bollards along the entire length of the pier or wharf, mooring cleats may be located in line of the bollards and mooring rings approximately 50 cm above the mean high water level.

7.2.3 *Capstans*

These are usually provided to assist the movement of vessels, though entering locks, and passages together with wharfing of vessels, into and out of graving docks and floating docks. Capstans are also provided at offshore berths.

7.2.4 *Mooring Dolphin*

Where the length of the berthing structure is comparatively small, separate mooring dolphins with bollards mounted on top would be necessary for effective handling of bow and stern mooring lines. The number and location of the mooring dolphins should be such that the bow and stern lines from vessels of different sizes can be laid with an angle not steeper than 45º with respect to berthing line in the horizontal plane. Mooring dolphins should be ideally located 30 m to 45 m behind the berthing face wherever possible. Include vertical angle also.

7.2.5 Chains or ladders and staircases suitably recessed into the structure should be provided at suitable intervals along the pier or wharf as a safety measure.

8 ENVIRONMENTAL IMPACT ASSESSMENT & ENVIRONMENTAL MANAGEMENT PLAN (EIA & EMP)

The environment is crucial for sustainable development. Recognizing this, the Ministry of Environment and Forests, Government of India, has established policies to ensure responsible industrial and developmental activities that protect natural resources.

Ports and harbors are vital gateways for maritime trade, driving economic growth and enhancing living standards. As demand for industrialization increases, it is essential for these facilities to adapt and expand to efficiently handle larger volumes of cargo.

Port development can harm the environment through water pollution, sediment contamination, and air pollution. Dredging, waste disposal, and oil leaks contribute to these issues. To address them, we need Environmental Impact Assessments (EIAs) and sustainable practices to promote growth and protect the environment.

Major sources of the adverse effects on environment because of development of port and harbour projects can be categorized into the following types:

a) Location of port;
b) Construction;
c) Port operation, including ship traffic and discharges; and
d) Cargo handling, storage and land transport.

8.1 Coastal Regulation Zone (CRZ)

8.1.1 *General*

Development activities along the Indian coast are regulated by the Coastal Regulation Zone (CRZ) notification of 1991, under the Environment Protection Act of 1986. This notification sets guidelines for protecting land within 500 meters of the coast and 100 meters along tidal-influenced water bodies. The Central Government designated areas affected by tidal action, extending 500 meters from the High Tide Line (HTL), as “Coastal Regulation Zone” (CRZ) on February 19, 1991. The Ministry of Environment and Forests replaced the 1991 notification with the Coastal Regulation Zone (CRZ) Notification 2011 and introduced the Island Protection Zone (IPZ) to cover the Andaman & Nicobar Islands and Lakshadweep.

8.1.2 *Objectives of Coastal Regulation Zone*

The main objectives of the Coastal Regulation Zone Notification 2011 are:

a) To ensure livelihood security to the fishing communities and other local communities living in the coastal areas.
b) To conserve and protect coastal stretches.
c) To promote development in a sustainable manner based on scientific principles considering the dangers of natural hazards in the coastal areas and sea level rise due to global warming.

8.1.3 *CRZ Mapping and Classification of CRZ*

The CRZ maps indicating the High Tide Line (HTL), Low Tide Line (LTL), demarcated by one of the authorized agencies and the project layout superimposed on the map should be submitted on 1:5 000 scale map. The State/Union Territory CZM authority shall recommend this map. The CRZ Map delineates the LTL and HTL.

8.1.3.1 *Necessary details to be provided in this map*:

a) A map specifying locations of the state, district and project location.
b) A map of project area and 10 km area from boundary of the proposed/existing project area, delineating protected areas notified under the wildlife (Protection)Act,1972/critically polluted areas as notified by the CPCB from time

to time / notified eco sensitive areas / interstate boundaries and international boundaries.

c) A map covering aerial distance of 15 km on the landward side from the proposed project boundary delineating environmental sensitive areas as specified in Form I of EIA notification dated 14th September 2006.
d) The site layout plan for the proposed development should be submitted at a scale of 1:5 000, clearly marking the layout of breakwaters, navigation channels, harbour basin, moorings, berths, water depths, dry docks, workshops, cargo handling systems, storage yards, warehouses, roads, railway tracks, utilities, and community centers. Boundaries of the proposed port must include latitude and longitude.
e) Area drainage contour map of the project area and 2 km to 5 km from the proposed project area shall be clearly indicated. In case of any proposed diversion of nallah/canal/river, same should be shown in the map.
f) Hydro-graphic charts of the offshore area giving the general morphology of the coastal stretch to a scale of 1:50 000 shall be submitted covering water depth up to 10 m beyond the maximum proposed dredging depths of the project and covering 5 km along the coast from the project limits on both sides.

Coastal Regulation Zones are classified as follows:

a) Zone-I CRZ-I (ecologically sensitive);
b) Zone-II CRZ-II (built-up area);
c) Zone-III CRZ-III (rural area); and
d) Zone-IV CRZ-IV (water area)

The Coastal Regulation Zones are described below:

The Coastal Regulation Zones (CRZ from LTL to HTL + 500 m and water areas) is divided into four categories: CRZ-I (LTL to HTL or ecologically sensitive areas from LTL to HTL+ 500 m), CRZ-II (built-up areas), CRZ-III (rural areas), and CRZ-IV (water areas).

8.1.3.2 *CRZ I (Zone I)*

CRZ-I B is from LTL to HTL and Port and Harbour development is permissible activity. The ecologically sensitive areas (mangroves, sand dunes, coral reefs, mudflats, national parks, turtle nesting grounds etc) identified from LTL to HTL + 500 m is CRZ-I A. No construction including Port and Harbour structure is permitted in CRZ-I A. Special Permission is required for any construction activities.

8.1.3.3 *CRZ II (Zone II)*

The area that have already been developed up to or close to the shoreline (HTL + 500 m). For this purpose, developed area is referred to as that area within the municipal limits or in other legally designated urban areas which is already substantially built up and which has been provided with drainage and approach roads and other infrastructural facilities such as water supply sewerage mains.

Norms for Regulation of activities permissible in CRZ-II:

a) Building shall be permitted only on the landward side of the existing road, or on the landward side of the existing authorized structures.
b) Buildings permitted on the landward side of the existing and proposed roads or existing authorized structures shall be subject to the existing local town and country planning regulations including the 'existing' norms of Floor Space Index or Floor Area Ratio provided that no permission for construction of buildings shall be given on landward side of any new roads which are constructed on the seaward side of an existing road
c) Reconstruction of authorized building to be permitted subject with the existing Floor Space Index or Floor Area Ratio Norms and without change in present use.
d) Facilities for receipt and storage of petroleum products and liquefied natural gas appended to this notification and facilities for regasification of Liquefied Natural Gas.
e) Desalination plants and associated facilities.
f) Storage of non-hazardous cargo, such as edible oil fertilizers and food grain in notified ports.
g) Facilities for generating power by non-conventional power sources and associated and associated facilities.

8.1.3.4 *CRZ III (Zone III)*

Areas that are relatively undisturbed (HTL + 500 m). These will include coastal zone in the rural areas (developed and undeveloped). A critical aspect of CRZ-III is the No Development Zone (NDZ), which restricts construction within a certain distance from the High Tide Line (HTL). In CRZ-III A, the NDZ is typically HTL+ 50 meters, while in CRZ-III B, it is HTL+200 meters.

8.1.3.5 *CRZ IV (Zone IV)*

The water area from the Low Tide line to 12 nautical miles on the seaward side. It shall also include the water areas of the tidal influenced water body from the mouth of the water body at the sea up to the influence of tide which is measured as 5 ppt (parts per thousand) during the driest season of the year.

8.1.4 Environment Clearance

The steps for construction of major project on marine work includes

a) Preliminary Project Report/ Technical Feasibility Report
b) Form-I duly filled in along with Terms of Reference (TOR)
c) Clearance from the state government:

    1) Clearance from State Pollution Board to be obtained for giving consent for establishment (COE) of Port facility.
    2) Clearance from state Forest Department for establishment of port facility (Chief Wild Life Warden of the state government).

3) CRZ approval based on public hearing, state CZMA presentation

d) The expert committee of MOEF will after scrutiny of the Form I will send final terms of reference (TOR) to be submitted to the committee covering any additional TOR they may require apart from those already mentioned in Form I by the Developer.
e) Detailed Project Report.

8.1.4.1 *Documents required for the proposed project in chronological order*:

a) Form-1;
b) Rapid EIA Report;
c) Comprehensive EIA Report;
d) Disaster Management Report;
e) Risk Assessment Report;
f) Management Plan;
g) No Objection Certificate; and
h) Four Separate CRZ Maps

8.1.4.2 *After submission of documents*:

a) Recommendations from the CZMA;
b) Clearance from the MoEF – EIA - CRZ within 60 days; and
c) Processing Fees - Charges towards CZMA

Project construction commences within five years of clearance being issued. Half yearly compliance reports submitted to CZMA (1st June and 31st December). Compliance Report will be displayed on the website of regulatory authority post clearance monitoring.

The stages of environmental clearance process for new projects: -

a) *Screening* — The clearance depending upon the Nature and Location of Project.
b) *Scoping* — All relevant environmental concerns for the preparation of an EIA report in respect of the project or activity for which prior environmental clearance is sought.
c) *Public Consultation* — The process by which the concerns of local affected persons and others.
d) *Appraisal* — Detailed inspection by the Expert Appraisal Committee (EAC) and State Expert Appraisal Committee (SEAC) of the EIA report.

The validity of environmental clearance allowed for ports and harbours sector is valid for a period of five years. The regulatory authority concerned may extend this validity period by a maximum period of five years.

8.1.5 One Season and Comprehensive Study

The one season and comprehensive study of a location for construction of new port includes the following:

a) CRZ classification of LTL/HTL/CRZ;
b) Risk analysis and disaster management;

c) Terrestrial EIA study;
d) Rapid marine environment impact assessment study;
e) Bathymetry survey;
f) Study on migration of olive turtle;
g) Study on effect of mangrove growth;
h) Disposal study of dredged material and its impact on marine environment;
j) Shoreline evaluation study;
k) Littoral drift study;
m) Geotechnical study;
n) Side scan study of sea bed;
p) Shallow seismic study;
q) Public hearing;
r) Environmental impact on dredging activities;
s) Study on marine environment on construction of berths;
t) Details of cargoes to be handled and their impacts on air, water and noise pollution due to such handling;
u) Details of drainage system in berth and stock yard of effluent treatment to treat the discharge/run off from stockyard;
v) Details of monitoring programme;
w) Details of mangrove plantation year wise with action plan for implementation with expenditure;
y) Details of waste generation along with treatment facilities including sewage treatment plant;
z) Details of EMP report with financial outlays proposed;
aa) Details of water resources for construction and operation of project and approval of competent authority for drawl of ground water;
bb) Details of transportation of stones for breakwaters and groynes and their impact;
cc) Details of stone quarries proposed for construction materials;
dd) Details of reclamation and its impact on terrestrial ecology to be studied; and
ee) Details of monitoring on impact of marine ecology and shore line changes during operation of project.

8.1.6 EMP and Monitoring

Environment Management Plan (EMP) and Monitoring includes the following:

a) Summary of potential impacts & recommended mitigation measures.
b) Allocation of resources and responsibilities for plan implementation.
c) Administrative and technical setup for management of environment.
d) Institutional arrangements proposed with other organizations/Govt. authorities for effective implementation of environmental measures proposed in the EIA.
e) Safe guards/mechanism to continue the assumptions/field conditions made in the EIA Environmental specifications for contractors should cover the required safeguards during the design and construction stage.