

DEP SPECIFICATION

**DESIGN OF JETTY FACILITIES
(AMENDMENTS/SUPPLEMENTS TO BS 6349-1/2/4)**

DEP 35.00.10.10-Gen.

February 2013

DESIGN AND ENGINEERING PRACTICE



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PART I INTRODUCTION

1.1 SCOPE

This DEP specification gives requirements and recommendations for the design and engineering of fixed marine facilities for ships loading and unloading crude oil and oil products, LPG/LNG and petrochemical products.

Requirements for the design of topworks including piping, product transfer arms and other mechanical and electrical installations are not explicitly included in this DEP. Requirement for offshore structures are listed in separate DEPs, such as DEP 37.19.00.10-Gen.

Requirements for the design of buoy-moored marine facilities such as single point moorings and other offshore loading facilities are outside the scope this DEP.

This DEP is based upon BS 6349-1, BS 6349-2 and BS 6349-4 which are adopted subject to the amendments and supplements set out in Parts III, IV and V (see Part II).

This is a revision of the DEP of the same number dated February 2007; see (1.6) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

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This DEP is intended for use in facilities related to oil and gas production, gas handling, oil refining, chemical processing, gasification, liquefaction, distribution and supply/marketing. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects. In all cases, the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project, or operation or maintenance of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that designs, manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

Term	Definition
Accidental or Overload Operating Conditions	The conditions for a design situation when a jetty or marine facility is considered to be in operational use by ships berthing, de-berthing or in a moored condition consistent with the Operating Limits for the facility but exceptional conditions occur due to deviation from facility operational procedures or equipment malfunction.
Berth	A location at which a ship can be held in position by means of mooring lines and or chains and or fendering. The last phase of the approach of a ship ("...to berth a ship...").
Berth monitoring systems	Equipment to monitor the operation of the berth in service and to assist in berthing, de-berthing. Such systems may include docking aids, mooring line load measurement and recording systems and systems for recording and making available in real time metocean conditions at the berth and approaches.
Breakwater	A structure designed to provide shelter to the berth from waves and currents
Capital dredging	Dredging operations which are part of the construction/ expansion of the harbour/jetty to create sufficiently deep water for the intended purpose.
Catwalks	A structure providing pedestrian access to a dolphin/ platform.
Causeway	A solid, closed coastal structure (earth or rock dam or caissons) often used to link the shoreline to the root of the trestle across shallow water.
Design working life	Design working life of a structure is the assumed period for which a structure or part of it is to be used for its intended purpose with anticipated maintenance but without major repair being necessary.
Docking Aid	System for measurement and display of velocity and position/orientation of a ship during the berthing operation,
Dolphin	An isolated structure or strong point used either to • manoeuvre a ship (turning dolphin) or to • secure a ship and prevent it from moving away from a berth due to wind, wave or current action (mooring dolphin) and/or to • take the impact of a berthing ship and to hold it when being pushed against a berth by wind, waves or current (breasting or berthing dolphin).
Extreme Operating Conditions	The conditions for a design situation when the jetty is subject to extreme environmental conditions exceeding the Operating Limits and not in operational use by ships berthing, de-berthing, nor in a moored condition.
Fender systems	A provision primarily to absorb the berthing energy exerted by a berthing ship, and secondly to resist loads applied from a moored ship as part of the mooring system, keeping the ship in place during loading/unloading operations.

Term	Definition
Fixed marine facilities	General description encompassing all components of the facilities required to receive ships at a marine terminal including but not limited to berths, dolphins, piles and filled approach structures.
Jetty	A fixed marine structure providing a berth or berths at some distance from the shore. It may be linked to the shore by an approach structure or may be an island berth with product transfer by subsea pipeline. The approach structure usually comprises a causeway and/or a trestle as defined herein although other forms of construction are possible.
Jetty topworks	All equipment, utilities, piping and appurtenances installed on the jetty (loading platforms, trestles) required for or in support of loading/unloading of the ship (incl. personnel, stores etc.), transferring the cargo to the shore and related safety installations. Including but not necessarily limited to: • Gangway towers • Loading arms and/or equipment • Fixed cranes • Fire pumps • Piping • Fire monitors • Berth monitoring systems
Loading platform	Fixed platform directly adjacent to the berthing line capable of accommodating the relevant equipment, piping and appurtenances required for loading or unloading the ship (incl. personnel and stores) including related safety installations. For smaller vessels the loading platform can also be used as berthing and mooring point.
Life cycle cost	The cumulative cost of a facility, which includes the costs of planning, construction, maintenance, decommissioning and financing.
Maintenance dredging	Dredging operations that are required to keep sufficiently deep water for the intended purpose during the operating phase.
Marine facilities	General description encompassing all facilities required to receive ships at a marine terminal or offshore including but not limited to fixed marine facilities, single point mooring facilities, and (offshore) loading structures.
Metoccean conditions	Meteorological and oceanographic conditions such as temperature, wind, waves, currents etc.
Mooring equipment	Bollards and quick release hooks (including capstans, base structure, fairleads, rings and auxiliary) installed on the mooring and breasting dolphin or loading platform to secure a vessel.
Navigation	Moving a ship along a defined course.
Navigation aids	Facilities to assist in the navigation process, such as buoys, landmarks, lights, radar beacons and systems, etc.

Term	Definition
Normal Operating Conditions	The conditions for a design situation when a jetty or marine facility is considered to be in operational use by ships berthing, de-berthing or in a moored condition consistent with the Operating Limits for the facility.
Operating limits	The maximum combination of environmental conditions in which marine operations can proceed (loading, unloading, berthing, arrival and departure) as defined in the facility's operating procedures.
Port	A harbour or place by the sea, or by a river or other waterway, where ships and boats can dock, load, and unload.
Trestle	A piled multi-span bridge structure connecting the loading platform to the shore or causeway to provide vehicular or pedestrian access and/or to support pipes or conveyors.
Weather downtime	Period during which the berth is not available for berthing, mooring and (un)loading operations as a result of adverse weather conditions (wind and visibility) and/or sea state (tide, waves, currents) exceeding the defined Operating Limits.

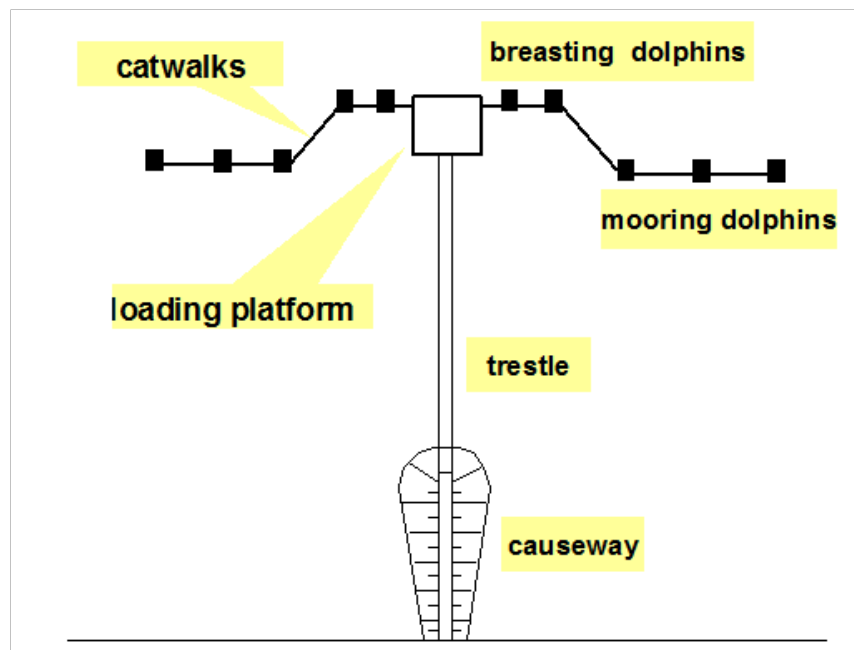


Figure 1 Nomenclature for jetty components

1.3.3 Abbreviations

The following abbreviations are used in this DEP. Other abbreviations are defined at the first place of use.

Term	Definition
BDP	Basic Design Package
BfD	Basis for Design
CIRIA	Construction Industry Research and Information Association (UK)
CUR	Centre of Civil Engineering Research and Codes (The Netherlands)
DMA	Dynamic Mooring Analysis

Term	Definition
EAU	Empfehlungen des Arbeitsausschusses "Ufereinfassungen"; (Germany) Recommendations of the Committee for Waterfront Structures, Harbours and Waterways
EPC	Engineering Procurement and Construction
FEED	Front End Engineering Design
ggbs	ground granulated blastfurnace slag
IALA	International Association of Lighthouse Authorities
ISGOTT	International Safety Guide for Oil Tankers and Terminals
HAZID	Hazard Identification Study
OCIMF	Oil Companies International Marine Forum
PIANC	Permanent International Association for Navigation Conferences, which now refers to itself as "The World Association for Waterborne Transport Infrastructure"
PS	Project Specification
ROM	Recomendaciones Obras Maritimas (Spanish Maritime Works Recommendation)
SIGTTO	Society of International Gas Tanker and Terminal Operators Ltd.

1.4 CROSS REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets (). Other documents directly referenced in this DEP are listed in (Part VI).

Listed in (Part VII) are documents on which certain requirements in this DEP have been based. In the text of this DEP, such references are identified by [Ref. x], where x denotes the reference number included in Part VII.

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated February 2007.

Content of the previous version that was background information, explanation and guidance and not required to be communicated to the Contractor, has been moved into the companion document, the "DEP Informative".

The following are the main, non-editorial changes.

Part	Section	Change
All	All	Critical revision of "should" statements and changed to "shall", if deemed appropriate.
II	3.2	Updated and further refined the definitions.
II	1.5.2	Added a paragraph on alternative codes of practice.
II	7.8	Added a new section on electrical storms.
III	All	Inclusion of several clauses from the currently being drafted newer version of BS 6349-1.
III	14	Provisions for scour and accretion assessment emphasised and additional references provided.
III	21.3	Updated Table 2 with reference to the relevant Eurocode.

Part	Section	Change
		Introduction of overload check for oil and gas jetties.
III	31.4.2	Updated of the Minimum Breaking Load for mooring line types.
III	34	Added a normative reference to EN 1994-1-4 for wind actions.
III	40	Added a normative reference to EN 1998-2 for behaviour factors.
III	42	New definition of mooring load requirements.
III	57.3	Added a clause on armour size and grading.
III	58	Clarified concrete and cement durability requirements for jetties additional to DEP 34.19.20.31-Gen.
III	59.2.1	Updated definition of corrosion rates compatible with EN 1993-5. Added a clause on microbiologically induced corrosion (MIC).
III	61	Pile testing requirements clarified.
III	67	Updated Clause 67 on maintenance.
IV	All	Update of the BS 6349-2:1988 to the newer version BS 6349-2:2010.
IV	4.1.1	Added a clause on consequence class.
IV	4.1.6.1	Removal of exclusion zones as they are stated in DEP 80.00.10.11-Gen. Referral to this DEP is made instead.
IV	5.2.2	Clarified clauses on design situations as BS 6349-2 is inconsistent with EN 1990 while BS 6349-2 refers to the Eurocodes for loads/actions.
IV	8.11.2.2	Clarified requirements on acceptance of a centralised remote release system for QRHs.
IV	8.12.11.4	Updated the safety factors for pull-out conditions.
IV	8.14	Reference to DEP 34.14.20.31-Gen. is made for drainage of jetties.
V	4.1	Addition that the jetty fender layout shall be checked for the safe berthing and mooring of tugs.
V	4.9.1	Updated the factors of safety for abnormal energy capacity for fender design.
V	4.9.2	Added a normative reference to EN 1993 for stresses in steel components of a fender.
VII	All	Updated the reference list.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be submitted to the Administrator using one of the following options:

Shell DEPs Online (Users with access to Shell DEPs Online)	Enter the Shell DEPs Online system at https://www.shelldeps.com Select a DEP and then go to the details screen for that DEP. Click on the "Give feedback" link, fill in the online form and submit.
DEP Feedback System (Users with access to Shell Wide Web)	Enter comments directly in the DEP Feedback System which is accessible from the Technical Standards Portal http://swwww.shell.com/standards . Select "Submit DEP Feedback", fill in the online form and submit.
DEP Standard Form (Other users)	Use DEP Standard Form 00.00.05.80-Gen. to record feedback and email the form to the Administrator at standards@shell.com .

Feedback that has been registered in the DEP Feedback System by using one of the above options will be reviewed by the DEP Custodian for potential improvements to the DEP.

PART II GENERAL REQUIREMENTS

1.1 GENERAL

Parts III, IV and V of this DEP are written as amendments and supplements to BS 6349-1, BS 6349-2 and BS 6349-4, as follows:

Part III BS 6349-1:2000, Code of practice for general criteria

Part IV BS 6439-2:2010, Code of practice for the design of quay walls, jetties and dolphins

Part V BS 6349-4:1994, Code of practice for design of fendering and mooring systems

Any clauses in BS 6349-1, BS 6349-2 and BS 6349-4 that are not amended by this DEP shall remain valid as written.

Structural design and engineering of jetties shall comply with DEP 34.00.01.30-Gen. 'Structural design and engineering of onshore structures' and the amendments and supplements to BS 6349-2 as set out in this document.

Reference to structural design to BS EN Eurocodes in BS 6349-2 is amended by this DEP to include the requirements of DEP 34.19.20.31-Gen. and DEP 34.28.00.31-Gen.

The following wording is used throughout this DEP to identify any changes in the relevant parts of the BS 6349:

Add: This text shall be considered as additional to the referenced BS 6349 clause.

Delete: Quoted BS 6349 text part shall be deleted.

Replace: Replace quoted text parts from BS 6349 by presented new text.

1.2 ALTERNATIVE CODES OF PRACTICE

For countries that do not adopt BS 6349-1, BS 6349-2 and BS 6349-4, the Contractor shall propose to the Principal alternative national codes and design standards that shall meet the minimum requirements of those of BS 6349-1, BS 6349-2, BS 6349-4 and this DEP. In the event of conflict between the two sets of specifications the more stringent shall be selected and submitted to the Principal for review and comment.

The Contractor shall also determine by careful scrutiny which of the requirements in national and/or local regulations are more stringent than in the applied codes and this DEP. In all cases, the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with the national and/or local regulations.

PART III AMENDMENTS AND SUPPLEMENTS TO BS 6349-1

Section 2. Environmental considerations

7 Meteorology and climatology

7.1 General

Add:

A minimum 10 year continuous time series of metocean conditions shall be defined for the assessment of expected weather downtime occurrence and persistency at the proposed location of a new or expanded jetty.

Metocean conditions derived by hindcasting and/or other forms of numerical modelling shall be validated with actual site measurements during project development.

Data shall be obtained at the early design stages (Assess/Select) of the project and be confirmed during subsequent design development (FEED/Define Stage). Data collection and analysis shall be adequate for definition of all relevant meteorological and oceanographic parameters including extreme and operating conditions and seasonal and annual variations in conditions.

7.2 Wind

7.2.1 General

Add:

Wind roses and wind scatter diagrams shall be prepared considering seasonal effects to enable an assessment of the optimum berth orientation and vessel approach route relative to the wind. In the absence of detailed or local information on the relationship between mean hourly wind speeds (U_{3600}) and gust values, which shall be used for the calculation of wind loads on ships and structures, the following relationship shall be taken:

$$U(t) = U_{3600} (1.277 + 0.296 \tanh(0.9 \log_{10}(45/t))) \quad (t \text{ in seconds}) \quad [Ref. 1]$$

Daily variations in wind direction and wind speed shall be taken into account in the jetty design and the planning of ship handling operations.

As required by Clause 34, the 30 sec wind gust speed and 60 sec wind gust speed shall be estimated for use in mooring studies for large oil and gas carriers.

7.5 Visibility

7.5.1 General

Add:

Minimum visibility requirements for ship approach, departure and manoeuvring should be agreed with the Principal based upon operational considerations (ref Clause 15). For preliminary purposes for the planning of data collection requirements it may be assumed that a limiting visibility of 1000 m due to fog, dust rain, snow or other meteorological effects would prevent approach and departure of large tankers and gas carrier.

Data collection for jetty design should ensure that information on visibility will be adequate for evaluation in the design process to assess the effect on weather downtime for the marine facilities.

Add new section:

7.8 Lightning

Requirements for lightning protection at the jetty location shall be assessed. Reference is made to DEP 33.64.10.10-Gen. for electrical isolation of jetties.

8 Bathymetry

8.5 Spacing and direction of sounding profiles

Add:

For surveys of navigational channels and other areas for navigation or marine operations, the requirements of the International Hydrographic Organisation (IHO) [Ref. 17] shall be adopted and the survey method shall achieve full ensonification of the bed.

10 Water level

10.4 Tidal observations

10.4.1 General

Add:

For all jetties in areas remote from existing tidal monitoring stations with tidal differences in excess of 2 m, or when directed by the Principal, site-specific tidal measurements and analysis shall be carried out during preliminary design of the marine facility to establish full astronomical tidal predictions through the 18.6 year tidal cycle relative to mean sea level for incorporation to the Basis for Design.

Water levels shall also be recorded throughout the construction period of the jetty and comprehensive tidal analysis shall be carried out from these extended observations to produce updated tide tables for the operation of the facilities.

11 Water movement

11.1 General

Add:

The direction and variation with time and depth of currents at jetties and in the approaches used by shipping have important consequences for location, dimensions and orientation of jetties, approach channels and turning area and as shall therefore be adequately measured and characterised by means of site measurements supplemented as appropriate by numerical modelling taking into account geostrophic currents, tidal effects, seasonal river flows and other local effects.

Numerical modelling shall in particular be used to assess any change in current regime caused by the proposed works where new or extended causeways, breakwaters, groynes, new dredged channels or other such works are proposed.

13 Water quality

13.5 Marine life

Add:

Hydraulic design of seawater intakes shall ensure that intake velocities and velocity gradients are reduced to minimise the risk of marine life such as fish, jellies, turtles, etc. being drawn into the intake screens.

The effect of marine growth on piles shall be taken into account in determination of drag factors and wave and current loading.

14 Sediment transport

14.1 General

Add:

An assessment shall be made of the anticipated effect on sediment transport processes and shoreline morphology in the selection of the location, form and layout of the jetty structure, and to the sedimentation at the berth and approaches and the consequent need for maintenance dredging. The scope and methodology of the assessment may include

desk studies, field data collection, comparison of historical aerial or satellite imagery and numerical modelling and shall be agreed with the Principal.

14.3 Sediment transport with waves

14.3.2 *Littoral drift*

Add:

Special attention shall be paid to the impact of the jetty/causeway structure on coastline and river bank erosion, accretion and morphology.

14.4 Accretion and scour

14.4.1 *General*

Add:

The existing baseline sediment transport regime at the location of the proposed jetty or other marine works shall be quantitatively assessed based upon data collected for the pre-development condition. Empirical methods supplemented by numerical modelling should be used to assess the effects of the works on the existing regime.

Numerical models for prediction of accretion or scour should be validated against existing baseline conditions.

Physical models should be used to supplement numerical model studies in some circumstances, particularly for the assessment of scour effects and for the design of local scour protection works.

Specialist advice should be sought in respect of physical models study; scale effects (typically, non-cohesive sediment scaling down to a size that is cohesive) can cause serious problems with such tests when a large spatial extent is to be modelled.

In all cases, uncertainty in assessment of impacts should be assessed quantitatively. In most cases when using numerical models a deterministic approach should be adopted and uncertainty shall be quantified by investigating consequences of credible ranges of values for input and model parameters. In some cases, where sufficient data exists to support the approach, a probabilistic assessment should be adopted to quantify the range of uncertainty in predictions.

Refer to PIANC Minimising harbour siltation [Ref. 19] for guidance on strategies for design and operation of marine facilities to minimise the requirements for maintenance dredging arising from sediment accretion in muddy environments.

14.4.2 Trial Trench Method

Delete 14.4.2 and replace by the following:

14.4.2 *Scour*

Scour is the local removal of sediment due to a change in the hydrodynamic regime resulting from the following mechanisms:

- Introduction of a new structure or channel or modifying an existing structure or channel or basin.
- The direct action of vessel propulsion systems,

The potential for scour arising from both type types of effects shall be assessed so that the effects of design are taken into account in overall stability and strength of propped structures, including jetty piling and quay walls, and to ensure that existing structures are not destabilised by the proposed works.

The rate and extent of scour for a particular site should initially be assessed empirically using the methods of assessment of scour at some common structures (e.g., a slender, cylindrical pile in a steady current; horizontal pipeline on a flat bed in a steady current) from [Ref. 2], [Ref. 20], [Ref. 21] and [Ref. 22]. Assessment should include local scour effects

(e.g., at a pile in a jetty) and global scour effects caused by a whole structure or by impact of dredging or other such works.

For circumstances not covered by published empirical methods, or where preliminary estimates indicate a requirement for further investigations of scour effects, then numerical or physical modelling should be carried out.

The estimated scour depth shall be included in the design of jetty substructure including for assessment of stability of laterally loaded piles and bearing capacity of vertically loaded bearing piles.

Section 3. Operational considerations

15 General

Replace entire clause 15 with the following:

15.1 General

Consultation between the port authority, terminal or facility operator, ship operators, pilots and tug operators shall be initiated at the feasibility stage before the location and layout of the port, terminal or berth has been fixed. Simulation studies (see 18.2) shall be undertaken in order to ensure that the maximum operational benefits can be obtained in terms of safe and economic functioning of the finished installation. The following subjects shall be considered for possible individual study in each case:

- a) numbers, types, sizes and shapes of present and/or expected vessels;
- b) provision of tugs, navigational aids and marine traffic control;
- c) pilotage;
- d) berthing;
- e) mooring patterns, practices, systems and load measurements;
- f) berth occupancy, ship queuing times, port downtime and the effects of sea and weather conditions;
- g) requirements of cargo and product handling, including the need or otherwise to allow for future change, or flexibility in operational usage;
- h) requirements for safety zoning and other health, safety and environmental considerations affecting layout, particularly for terminals handling hazardous cargoes including oil, gas and petrochemical berths;
- i) integration with existing port operations or ship movements at or near to the proposed location;
- j) regulations affecting any of the previous operations a) to h)

15.2 Health and safety

Safety in operation should be the primary consideration in design and planning of facilities for navigation, berthing and mooring of ships and for handling of cargo. Therefore liaison between the appropriate port, terminal and shipping operators and designers shall take place to ensure adequate transfer of information and appreciation of operational procedures.

In addition to operational safety requirements of a facility, the particular health and safety risks of construction and future maintenance shall also be considered. In this respect, Designers shall consider risk minimization and shall inform the Principal of the requirements arising from such considerations.

Liaison and coordination between appropriate port, terminal and shipping operators and designers shall commence during the early conceptual design stages and be maintained as the design and construction plans are developed. The Principal shall determine the appropriate channels of communication for such a liaison.

Port, terminal and marine facilities expansion and refurbishment projects require particular close coordination between design, construction and operational teams to ensure that the risks and particular requirements of construction works in proximity to ongoing simultaneous port operations are fully considered.

Attention is drawn to the requirements set out in ISGOTT 5th Edition, International Safety Guide for Oil Tankers and Terminals (2006) by ICS, OCIMF and IAPH and PIANC Maritime Committee WG 55 report, Safety Aspects of Berthing Operations of Oil & Gas Tankers (expected in 2012).

16 Design working life

Replace the first four paragraphs of this clause with the following:

The design working life of a structure is the assumed period for which a structure or part of it is to be used for its intended purpose with anticipated maintenance but without major repair being necessary.

Indicative categories of design working life are given in Table 1. The values given in Table 1 shall be used to determine time-dependent performance (e.g., fatigue related calculations). The design working life shall be agreed with the Principal.

Table 1 Overview of design working life categories

Design working life category	Indicative design working life (years)	Examples
1	10	Temporary structures ⁽¹⁾
2	25	Piled jetties and mooring and berthing structures dedicated to specific oil, gas or petrochemical operations.
3	50	Port infrastructure including reclamation, shore protection, breakwaters, gravity quall walls.
NOTE (1): Structures or parts of structures that can be dismantled with a view to being re-used shall not be considered as temporary.		

17 Ship data

17.1 General

Replace this clause with the following:

Comprehensive details of vessels to be accommodated shall be defined as part of the Basis for Design for jetties, ports and marine terminals.

Such details shall be obtained from the relevant authorities, end-users, owners and operators for the actual vessels to be accommodated and those likely in the anticipated lifetime of the structure.

Vessel details and characteristics that shall be considered shall include but not be limited to:

- Cargo type, including any potentially hazardous cargos.
- Size and shape (laden and in ballast), including overall length, beam, draft, flat of side extents, air draft, wind areas.
- Ship handling and navigational requirements (refer also to Clause 18 and Clause 19).
- Cargo capacity (measured according to cargo type in cubic metres, tons).

- e) Cargo or passenger handling and personnel transfer requirements.
- f) Product transfer manifolds types and position (for liquid bulk tankers and gas carriers).
- g) Mooring equipment including deck plans of winch and fairleads, mooring line type and capacities and winch capacities.
- h) Vessel servicing and waste reception requirements.
- i) Propulsion systems including thrusters and other water jets that can cause erosion and scour.
- j) Allowable imposed loadings on the hull.

Characteristic dimensions and hull forms of many ships vary considerably according to function, age and operational region.

17.2 Tonnage and displacement

Replace Clause 17.2 from:

For the purpose of preliminary planning the following relationships can be used...

by:

The size of ships for transport of LNG and LPG is generally expressed as the gas carrying capacity in m³ of gas. For initial planning purposes the displacement tonnage of gas carriers may be estimated as follows:

- LNG carriers:
 - o Displacement (in tonnes) = 20,000 + 0.6 x (gas carrying capacity) (in m³)
- LPG carriers:
 - o Displacement (in tonnes) = 5,000 + 0.9 x (gas carrying capacity) (in m³)
- Oil tankers:
 - o Displacement (in tonnes) = 2.1 x (DWT)^{0.95}

17.3 Typical container ship and bulk carrier dimensions

Delete Clause 17.3: Typical container ship and bulk carrier dimensions

Add new clause:

17.3 Typical dimensions gas carriers, oil tankers and tugs

Detailed dimensions and characteristics of the present and/or expected vessels shall be specified per facility in the Basis for Design. For the design of the facility, important vessel design parameters shall be defined.

18 Navigation in approach channels

18.2 Studies

Replace this clause with the following:

The layout, alignment and dimensions planning and design of approach channels and manoeuvring areas shall be determined by consideration of:

- a) The size and handling characteristics of the ships that will navigate to and from the facility.
- b) Any requirement for other ships to use the approach channel concurrently.
- c) The availability, drive system and capacity of tugs taking into account effect on operability of tugs of prevailing metocean conditions.
- d) The hazards associated with the products carried by the ships.

- e) The meteorological and oceanographic conditions at the particular location.
- f) The engineering constraints of channel construction and maintenance arising mainly from soil conditions and the morphological environment.

Approach channels shall be designed in accordance with the principles set out in [Ref. 3]. The particular requirements of oil and gas tanker operations shall be addressed according to the risk-based approach in the PIANC Maritime Committee WG 55 report, Safety Aspects of Berthing Operations of Oil and Gas Tankers (expected in 2012).

Except where agreed with the Principal, planning and design of jetties, approach channels and turning areas shall include numerical simulation of vessel approach and departure to optimise layout of facilities and dredged channels using one or more of the following methods:

- Method 1: PC based fast time simulations
- Method 2: PC based real time simulations
- Method 3: Real time bridge simulations with a 260° to 360° visual projection of the surroundings.

The methods of simulation shall be selected in consultation with the Principal according to the stage in the design process and the risks and issues to be investigated for the particular location and usage.

The scope of numerical simulation studies at the design stage shall be adequate to give an assessment of environmental Operating Limits for the facility in order to inform design-stage assessment of weather downtime for the operations envisaged at the facility.

Attention is drawn to the need to involve appropriate operational personnel in navigation simulations and layout planning as noted in Clause 15.1.

18.3 Depth of channels

Delete the last paragraph and replace with:

Where the bottom of the channel consists of mud or silt, it is possible for Port Authorities to define a nautical depth as being from the water surface to the level at which the density of the bottom sediment is equal to or greater than a prescribed value.

The adoption of a nautical depth approach in the design of new channels used by oil and gas carriers shall only be in exceptional circumstances, which is normally associated with environmental constraints on dredging and high sedimentation rates and shall be subject to the Principal's approval.

18.4 Width of channels

Replace the third and subsequent paragraphs by:

For preliminary design purposes the width of the approach channel shall be assessed on the basis of the recommendations included in [Ref. 3] for the section where no tugs are used or are effective. The width of the approach channel shall be confirmed with navigation studies as discussed in Clause 18.2, if the final width of the approach channel is less than the value concluded from [Ref. 3] or where it may be appropriate to reduce the width in view of the availability of tug assistance.

19 Ship handling

19.1 Manoeuvring inside harbours

Replace these sentences in paragraph 3:

As a general guide, a turning circle with a diameter of four times the ship's length should be allowed where no tug assistance is available. The diameter can be halved where tugs are used regularly and can be further reduced if the critical vessels are equipped with bow thrusters.

by:

If tug assistance is available, then the preliminary layout of turning areas should be based upon a circle of diameter of two times the length of the ship. Design of a turning area shall be verified by navigation simulations taking into account the limiting environmental conditions and the proximity of other facilities and hazards.

19.2 Berthing

Replace in second paragraph:

Jetty-based electronic instrument systems can be provided to indicate speed and distance from the jetty during this manoeuvre.

by:

Jetty-based and hand-held electronic instrument systems shall be provided on all new LNG, LPG and VLCC jetties to indicate approach velocity and distance from the jetty during this manoeuvre.

Consideration should be given to provision of approach velocity monitoring systems for jetties handling smaller liquid cargo ships where berthing operations are difficult or critical.

19.3 Mooring

Replace in second paragraph:

Where possible, mooring loads should be established on a line by line basis by means of a suitable computer program.

by:

Methods of estimating mooring line loads shall be subject to the Principal's approval and may include numerical model studies supplemented by physical model studies where necessary.

For berths subject to wave action (sea and swell) and/or non-uniform current fields, due consideration shall be given to the dynamic response of moored ships.

Refer also to Clause 31 and Clause 42.

Section 4. Sea state

21 Wave characteristics

21.1 Wave forms

Replace in third paragraph:

For certain applications in these situations sinusoidal wave theory or solitary wave theory can give a better idealization of the wave behaviour than sinusoidal theory.

by:

In shallow waters the evaluation of wave characteristics shall be carried out on the basis of streamline function theories, such as the Rienecker-Fenton theory [Ref. 4]. Except where agreed with the Principal for straight coastlines with a gentle bathymetry, parallel depth contours and uniform wave fields, comprehensive physical or mathematical modelling shall be carried out. Results of this modelling shall be used to assess the wave characteristics as indicated in Clause 21.2.

21.3 Sea state properties

21.3.8 Return period and design wave condition

Add at the end of the last paragraph:

Fixed coastal structures designed deterministically according to BS 6349-2 and (Part IV) of this DEP shall be designed on the basis of the wave conditions for extreme events of return period set out in Table 2.