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Actions from waves and currents on coastal structures

Effets des vagues et des courants sur les structures côtières

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 21650 was prepared by Technical Committee ISO/TC 98, *Bases for design of structures*, Subcommittee SC 3, *Loads, forces and other actions*.

Introduction

This International Standard, which deals with the actions from waves and currents on structures in the coastal zone and in estuaries, is the first of its kind. Waves and currents and actions from waves and currents on structures in deeper water, especially structures for the petroleum industry, are dealt with in ISO 19901-1 and ISO 19902, ISO 19903 and ISO 19904-1. Some of the structural elements for deeper water structures and coastal structures are the same, especially elements with cylindrical shapes. There will thus be, to some extent, an overlap between this International Standard and other ISO standards on the wave and current actions on cylindrical structural elements. There is though, a difference in wave conditions and wave kinematics between coastal waves and deeper water waves.

Actions from waves and currents on coastal structures

1 Scope

This International Standard describes the principles of determining the wave and current actions on structures of the following types in the coastal zone and estuaries:

- breakwaters:
  - rubble mound breakwaters;
  - vertical and composite breakwaters;
  - wave screens;
  - floating breakwaters;
- coastal dykes;
- seawalls;
- cylindrical structures (jetties, dolphins, lighthouses, pipelines etc.).

For the rubble mound structures it is not possible to determine the forces on and the stability of each individual armour unit because of the complex flow around and between each armour unit. But there are formulae and principles to estimate the necessary armour unit mass given the design wave conditions. Coefficients in these formulae are based on hydraulic model tests. Since the rubble mound structures are heavily used, they are included in this International Standard, although they may not be treated exactly in accordance with ISO 2394.

This International Standard does not include breakwater layout for harbours, layout of structures to manage sediment transport, scour and beach stability or the response of flexible dynamic structures, except vortex induced vibrations.

Design will be performed at different levels of detail:

- concepts;
- feasibility;
- detailed design.

This International Standard is aimed at serving the detailed design.

It is pointed out that the annexes are only informative and are not guidelines/manuals. The annexes have no regulatory power.

Wave and current conditions vary for different construction sites. It is very important to assess the wave and current conditions at a given site. Assessment procedures for these conditions and for their uncertainties are included.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
actions
force (load) applied to the structure by waves and/or currents

2.2
anchors
units placed on the seabed, such as ship anchors, piles driven into the seabed or concrete blocks, to which mooring lines are attached to restrain a floating object from excessive movements

2.3
annual maximum method
method of estimating extreme wave heights based on a sample of annual maximum wave heights

2.4
armour layer
protective layer on a breakwater, seawall or other rubble mound structures composed of armour units

2.5
armour unit
relatively large quarry stone or concrete shaped unit that is selected to fit specified geometric characteristics and density

2.6
astronomical tide
phenomenon of the alternate rising and falling of sea surface solely governed by the astronomical conditions of the sun and the moon, which is predicted with the tidal constituents determined from harmonic analysis of tide level readings over a long period

2.7
breakwater
structure protecting a shore area, harbour, anchorage and/or basin from waves

2.8
buoyancy
resultant of upward forces, exerted by the water on a submerged or floating body, equal to the weight of the water displaced by this body

2.9
chart datum
CD
reference level for soundings in navigation charts

2.10
core
inner portion of a breakwater, dyke and rubble mound structures, often with low permeability

2.11
crest
1. highest point of a coastal structure

2. highest point of a wave profile

2.12
crown wall
concrete superstructure on a rubble mound

2.13
datum level
reference level for survey, design, construction and maintenance of coastal and maritime structures, often set at a chart datum or national geodetic datum

2.14
deep water
water of such a depth that surface waves are little affected by bottom topography, being larger than about one-half the wavelength

2.15
design water level
DWL
water level selected for functional design, structural design and stability analysis of marine structures

NOTE Generally it is the water level that mostly affects the safety of the structures/facilities in question. DWL is chosen in view of the acceptable level of risk of failure/damage.

2.16
density driven currents
currents induced by horizontal gradients of water density generated by changes in the salinity and/or temperature, which are caused by the influx of fresh water from run-off from land through an estuary, heat flux from coastal power stations, or other reasons

2.17
diffractions coefficient
ratio of the height of diffracted waves to the height of incident waves

2.18
directional spreading function
function expressing the relative distribution of wave energy in the directional domain

2.19
directional wave spectrum
function expressing the energy density distribution of waves in the frequency and directional domains, being expressed as the product of frequency wave spectrum and the directional spreading function

2.20
drag coefficient
coefficient used in the Morison equation to determine the drag force

2.21
dyke berms
nearly horizontal area in the seaward and landward dyke slope which are primarily built to provide access for maintenance and amenity and which reduce wave run-up and overtopping

2.22
dyke toe
part of a dyke that terminates the base of the dyke on its seaward face

NOTE Various toe constructions are used to prevent undermining of the dyke.

2.23
extreme sea state
extreme waves
state of waves occurring a few dozen times a year to once in many years, expressed with the significant wave height and the mean or significant wave period at the peak of storm event

2.24
filter
intermediate layer, preventing fine materials of an underlayer from being washed through the voids of an upper layer

2.25
floating breakwater
moored floating object to reduce wave heights in the area behind the floating breakwater

2.26
foreshore
shallow water zone near the shore on which coastal dykes, seawalls and other structures are built

NOTE In beach morphology the term foreshore is used to denote the part of the shore lying between the crest of the seaward berm and the ordinary low water mark.

2.27
frequency wave spectrum
function expressing the energy density distribution of waves in the frequency domain

2.28
geotextile
synthetic fabric which may be woven or non-woven used as a filter

2.29
highest astronomical tide
HAT
tide at the highest level that can be predicted to occur under average meteorological conditions and under any combination of astronomical conditions

NOTE HAT is not reached every year and does not represent the highest sea level that can be reached, because storm surges and tsunamis may cause considerably higher levels to occur.

2.30
highest wave height
height of the highest wave of a given wave record or that in a wave train under a given sea state

2.31
impulsive wave pressure
water pressure of high peak intensity with a very short duration induced by the collision of the front surface of a breaking wave with a structure or the collision of a rising wave surface with a horizontal or slightly inclined deck of a pier

2.32
inertia coefficient
coefficient used in the Morison equation to determine the inertia force

2.33
international marine chart datum
IMCD
chart datum set at the lowest astronomical tide level, as adopted by the International Hydrographic Organization (IHO)

2.34
jetty GB
pier US
deck structure supported by vertical and possibly inclined piles extending into the sea, frequently in a direction normal to the coastline