D3 General design parameters

(1979)
(Rev.1 1987)
(Rev.2 1989)
(Rev.3 1990)
(Rev.4 1996)
(Corr. July 2001)
(Corr.2 Oct 2007)
(Rev.5 Jan 2012)
(Rev.6 Nov 2018)

D3.1 Material

D3.1.1 Unless otherwise specified, the Requirements are intended for units to be constructed of hull structural steel, manufactured and having the properties as specified in the Rules. Where it is proposed to use steel or other material having properties differing from those specified in the Rules, the specification and properties of such material shall be submitted to the Society for consideration and special approval. Due consideration is to be given to the ratio of yield to ultimate strength of the materials to be used, and to their suitability with regard to structural location and to design temperatures.

D3.2 Scantlings

D3.2.1 Scantlings of the major structural elements of the unit are to be determined in accordance with the Requirements as set forth herein. Scantlings of structural elements which are subject to local load only, and which are not considered to be effective components of the primary structural frame of the unit, shall comply with the applicable requirements of the Rules.

D3.2.2 Surface type drilling units are to have scantlings that meet the Rules. Also, special consideration is to be given to the items noted in D6.

D3.2.3

(a) Where the unit is fitted with an acceptable corrosion protection system, the scantlings may be determined from D3.4 in conjunction with allowable stresses given in D3.5, in which case no corrosion allowance is required. If scantlings are determined from the Rules, reductions for corrosion protection may be as permitted by the Rules.

(b) Where no corrosion protection system is fitted or where the system is considered by the Society to be inadequate, an appropriate corrosion allowance will be required on scantlings determined from D3.4 and D3.5, and no reduction will be permitted on scantlings determined by the use of the Rules.

Notes:

1. Rev.5 of this UR apply to mobile offshore drilling units contracted for construction on and after 1 January 2013.

2. The "contracted for construction" date means the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. For further details regarding the date of "contract for construction", refer to IACS Procedural Requirement (PR) No. 29.

3. Rev.6 of this UR apply to mobile offshore drilling units contracted for construction on and after 1 January 2020.

D3 (cont)

D3.3 Structural design loadings

D3.3.1 General

A unit's modes of operation are to be investigated using realistic loading conditions, including gravity loadings together with relevant environmental loadings due to the effects of wind, waves, currents, ice and, where deemed necessary by the owner (designer), the effects of earthquake, sea bed supporting capabilities, temperature, fouling, etc. Where applicable, the design loadings indicated herein are to be adhered to all types of mobile offshore drilling units. The owner (designer) will specify the environmental conditions for which the unit is to be approved. Where possible, the design environmental criteria determining the loads on the unit and its individual elements should be based upon significant statistical information and should have a return period (period of recurrence) of at least 50 years for the most severe anticipated environment. If a unit is restricted to seasonal operations in order to avoid extremes of wind and wave, such seasonal limitations must be specified.

D3.3.2 Wind loadings

Sustained and gust velocities, as relevant, are to be considered when determining wind loadings. Sustained wind velocities specified by the owner (designer) are not to be less than 25,8 m/s (50 knots). However, for unrestricted service, the wind criteria for intact stability given in D3.7.2 are also to be applicable for structural design considerations, for all modes of operation, whether afloat or supported by the sea bed. Pressures and resultant forces are to be calculated to the satisfaction of the Society. Where wind tunnel data obtained from tests on a representative model of the unit by a recognized laboratory are submitted, these data will be considered for the determination of pressures and resulting forces.

D3.3.3 Wave loadings

(a) Design wave criteria specified by the owner (designer) may be described either by means of design wave energy spectra or deterministic design waves having appropriate shape, size and period. Consideration is to be given to waves of less than maximum height where, due to their period, the effects on various structural elements may be greater.

(b) The forces produced by the action of waves on the unit are to be taken into account in the structural design, with regard to forces produced directly on the immersed elements of the unit and forces resulting from heeled positions or accelerations due to its motion. Theories used for the calculation of wave forces and selection of relevant coefficients are to be acceptable to the Society.

(c) Consideration is to be given to the possibility of wave induced vibration.

D3.3.4 Current loadings

Consideration should be given to the possible superposition of current and waves. In those cases where this superposition is deemed necessary, the current velocity should be added vectorially to the wave particle velocity. The resultant velocity is to be used to compute the total force.

D3.3.5 Loadings due to vortex shedding

Consideration should be given to the possibility of flutter of structural members due to von Karman vortex shedding.

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D3.3.6 Deck loadings

As indicated in D1.3, a loading plan is to be prepared for each design. This plan is to show the maximum design uniform and concentrated loadings for all areas for each mode of operation. Design loadings are not to be less than:

(i) Crew spaces (walkways, general traffic areas, etc.)

4,5 kN/m^2 (94 lb/ft^2)

(ii) Work areas

9 kN/m^2 (188 lb/ft^2)

(iii) Storage areas

13 kN/m^2 (272 lb/ft^2)

(iv) Helicopter platform

2 kN/m^2 (42 lb/ft^2)

D3.4 Structural analysis

D3.4.1 The primary structure of the unit is to be analysed using the loading conditions stipulated below and the resultant stresses are to be determined. Sufficient conditions, representative of all modes of operation, are to be considered, to enable critical design cases to be determined. Calculations for relevant conditions are to be submitted for review. The analysis should be performed using an appropriate calculation method and should be fully documented and referenced.

For each loading condition considered, the following stresses are to be determined for comparison with the appropriate allowable stresses given in D3.4.3 or D3.5:

(i) Stresses due to static loadings only, in calm water conditions, where the static loads include service load such as operational gravity loadings and weight of the unit, with the unit afloat or resting on the sea bed, as applicable.

(ii) Stresses due to combined loadings, where the applicable static loads in (i) are combined with relevant design environmental loadings, including acceleration and heeling forces.

D3.4.2

(a) Local stresses, including those due to circumferential loading on tubular members, are to be added to the primary stresses to determine total stress levels.

(b) The scantlings are to be determined on the basis of criteria which combine, in a rational manner, the individual stress components acting on the various structural elements of the unit. This method is to be acceptable to the Society. (See D3.4.3)

(c) The critical buckling stress of structural elements is to be considered, where appropriate, in relation to the computed stresses.

D3
(cont)

(d) When computing bending stresses, the effective flange areas are to be determined in accordance with 'effective width' concepts acceptable to the Society. Where appropriate, elastic deflections are to be taken into account when determining the effects of eccentricity of axial loading, and the resulting bending moments superimposed on the bending moments computed for other types of loadings.

(e) When computing shear stresses in bulkheads, plate girder webs of hull side plating, only the effective shear area of the web is to be considered. In this regard, the total depth of the girder may be considered as the web depth.

D3.4.3

(a) For plated structures, members may be designed according to the von Mises equivalent stress criterion, where the equivalent stress σ_e is defined as follows:

$$\sigma_e = \sqrt{\sigma_x{}^2 + \sigma_y{}^2 - \sigma_x\sigma_y + 3\tau_{xy}{}^2}$$

where

σ_x = stress in the x direction

σ_y = stress in the y direction

τ_{xy} = shear stress in the x–y plane.

The equivalent stress in plate elements clear of discontinuities should generally not exceed 0,7 and 0,9 of the yield strength of the material, for the loading conditions given in D3.4.1(i) and (ii), respectively.

(b) Members of lattice type structures should be designed in accordance with accepted practice for such members; for example, they may comply with the American Institute of Steel Construction's Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings.

D3.4.4 Fatigue Analysis

D3.4.4.1 The possibility of fatigue damage due to cyclic loading should be considered in the design of self elevating and column stabilized units.

D3.4.4.2 The fatigue analysis will be dependent on the intended mode and area of operations to be considered in the unit's design.

D3.4.4.3 The fatigue life is to be based on a period of time equal to the specified design life of the structure. The period is normally not to be taken as less than 20 years.

D3.4.5 The effect of notches, stress raisers and local stress concentrations is to be taken into account in the design of load carrying elements.

D3.4.6 Critical joints depending upon transmission of tensile stresses through the thickness of the plating of one of the members (which may result in lamellar tearing) are to be avoided wherever possible. Where unavoidable, plate material with suitable through-thickness properties and inspection procedures may be required.

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D3.5 Allowable stresses

D3.5.1 For cases involving individual stress components and, where applicable, direct additions of such stresses, the stress is not to exceed the allowable individual stress σ_i^* or τ_i^*.

where

$\sigma_i^* = \eta\sigma_y$ for axial bending stress

$\tau_i^* = \eta\sigma_y$ for shear stress

σ_y = specified minimum tensile yield stress of the material

η = usage factor

for static loadings (see D3.4.1 (i))

η = 0,6 for axial stress

0,6 for bending stress

0,40 for shear stress

for combined loadings (see D3.4.1 (ii))

η = 0,8 for axial stress

0,8 for bending stress

0,53 for shear stress

D3.5.2 In addition, the stress in structural elements, due to compression, ending, shear or any combination of the three, shall not exceed the allowable buckling stress σ_b^* or τ_b^*

where

$\sigma_b^* = \eta\sigma_{cr}$ for compression or bending

$\tau_b^* = \eta\tau_{cr}$ for shear

η = 0,6 for static loadings

η = 0,8 for combined loadings

σ_{cr} or τ_{cr} = critical compressive buckling stress or shear buckling stress, respectively, σ_y is as defined in D3.5.1.

D3
(cont)

D3.5.3 In addition, when structural members are subjected to axial compression or combined axial compression and bending, the extreme fibre stresses shall comply with the following requirement:

$$\sigma_a / \sigma_a^* + \sigma_{ab} / \sigma_{ab}^* \leq 1,0$$

where

$\sigma_a =$ computed axial compressive stress

$\sigma_{ab} =$ computed compressive stress due to bending

$\sigma_{ab}^* = \sigma_i^*$ or σ_b^* for bending stress, as defined in D3.5.1 or D3.5.2

$\sigma_a^* = \eta\sigma_{cr,i}(1 - 0,13\lambda / \lambda_0)$ if $\lambda < \lambda_0$
$\sigma_a^* = \eta\sigma_{cr,e} 0,87$ if $\lambda \geq \lambda_0$

σ_a^* shall not exceed σ_{ab}^*

$\lambda = kl/r$
$\lambda_0 = \sqrt{2\pi^2 E / \sigma_y}$

$\sigma_{cr,i} =$ inelastic column critical buckling stress

$\sigma_{cr,e} =$ elastic column critical buckling stress

η is as defined in D3.5.2

kl = effective unsupported length

r = governing radius of gyration associated with *kl*

E = modulus of elasticity of the material

σ_y is as defined in D3.5.1.

D3.5.4 Unstiffened or ring-stiffened cylindrical shells subjected to axial compression or compression due to bending, and having proportions which satisfy the following relationship:

$$D / t > E / 9\sigma_y$$

where

D = mean diameter

t = wall thickness

(D and t expressed in the same units)

D3
(cont)

σ_y is as defined in D3.5.1

E is as defined in D3.5.3

(σ_y and E expressed in the same units)

are to be checked for local buckling in addition to the overall buckling as specified in D3.5.3.

D3.5.5 Designs based upon novel methods, such as plastic analysis or elastic buckling concepts, will be specially considered.

NOTE 1

The allowable stresses as stated in D3.5 are intended to reflect uncertainties in environmental data, determination of loadings from the data and calculation of stresses which may exist at the present time. It is envisioned that the Requirements may eventually allow for the adoption of separate load factors or usage factors for the above influences, so that allowance can be given for improvements in forecasting, load estimation or structural analysis, as the technology or expertise in any one of these areas improves.

NOTE 2

The specific minimum yield point may be determined, for the use of D3, by the drop of the beam or halt in the gauge in the testing machine or by the use of dividers or by 0,5% total extension under load. When no well defined yield phenomenon exists, the yield strength associated with a 0,2% offset or a 0,5% total extension under load is to be considered the yield strength.

D3.6 Units resting on the sea bed

D3.6.1 Units designed to rest on the sea bed are to have sufficient positive downward gravity loadings on the support footings or mat to withstand the overturning moment of the combined environmental forces from any direction, with a reserve against the loss of positive bearing of any footing or segment of the area thereof, for each design loading condition. Variable loads are to be considered in a realistic manner, to the satisfaction of the Society.

D3.7 Stability

D3.7.1 General

All units are to have positive stability in calm water equilibrium position, for the full range of draughts when in all modes of operation afloat, and for temporary positions when raising or lowering. In addition, all units are to meet the stability requirements set forth herein for all applicable conditions.

D3.7.2 Intact stability

All units are to have sufficient stability (righting ability) to withstand the overturning effect of the force produced by a sustained wind from any horizontal direction, in accordance with the stability criteria given in D3.8, for all afloat modes of operation. Realistic operating conditions are to be evaluated, and the unit should be capable of remaining in the operating mode with a sustained wind velocity of not less than 36 m/s (70 knots). The capability is to be provided to change the mode of operation of the unit to that corresponding to a severe storm condition, with a sustained wind velocity of not less than 51,5 m/s (100 knots), in a reasonable period of

D3
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time for the particular unit. In all cases, the limiting wind velocities are to be specified and instructions should be included in the Operating Booklet for changing the mode of operation by redistribution of the variable load and equipment, by changing draughts, or both. For restricted operations consideration may be given to a reduced sustained wind velocity of not less than 25,8 m/s (50 knots). Particulars of the applicable service restrictions should be recorded in the Operating Booklet. For the purpose of calculation it is to be assumed that the unit is floating free of mooring restraints. However, the possible detrimental effects of mooring restraints are to be considered.

D3.7.3 Damage stability

(1) All units are to have sufficient stability to withstand the flooding from the sea of any single compartment or any combination of compartments consistent with the damage assumption set out in D4.4.1, D5.6.1 and D6.4.1, for operating and transit modes of operation. The unit is to possess sufficient reserve stability in the damaged condition to withstand the additional heeling moment of a 25,8 m/s (50 knots) sustained wind superimposed from any direction.

(2) Additionally, column stabilized units are to have sufficient stability to withstand, in any operating or transit condition with the assumption of no wind, the flooding of any single watertight compartment located wholly or partially below the waterline in question, which is a pump room, a room containing machinery with a salt water cooling system or a compartment adjacent to the sea.

(3) For all types of units, the ability to compensate for damage incurred, by pumping out or by ballasting other compartments, etc., is not to be considered as alleviating the above requirements. For the purpose of calculation, it is to be assumed that the unit is floating free of mooring restraints. However, possible detrimental effects of mooring restraints are to be considered.

D3.7.4 Light ship weight and centre of gravity

An inclining test will be required for the first unit of a design when as near to completion as possible, to determine accurately the light ship weight and position of centre of gravity. An inclining test procedure is to be submitted to the Society for review prior to the test, which is to be witnessed by a Surveyor of the Society. For successive units of a design, which are basically identical with regard to hull form, with the exception of minor changes in arrangement, machinery, equipment, etc., and with concurrence by the Society that such changes are minor, detailed weight calculations showing only the differences of weight and centres of gravity will be satisfactory, provided the accuracy of the calculations is confirmed by a deadweight survey. The results of the inclining test, or deadweight survey and inclining experiment adjusted for weight differences, should be reviewed by the Society prior to inclusion in the Operating Booklet.

D3.8 Stability criterion under wind force

D3.8.1 Intact condition

Righting moment curves and wind heeling moment curves related to the most critical axis, with supporting calculations, are to be prepared for a sufficient number of conditions covering the full range of draughts corresponding to afloat modes of operation (cf. Fig. 1). Where drilling equipment is of the nature that it can be lowered and stowed, additional wind heeling moment and stability curves may be required, and such data should clearly indicate the position of such equipment. In all cases, except column stabilized units, the area under the righting moment curve to the second intercept or downflooding angle, whichever is less, is not

D3 (cont)

to be less than 40% in excess of the area under the wind heeling moment curve to the same limiting angle. For column stabilized units, the area under the righting moment curve to the angle of downflooding is not to be less than 30% in excess of the area under the wind heeling moment curve to the same limiting angle. In all cases, the righting moment curve is to be positive over the entire range of angles from upright to the second intercept.

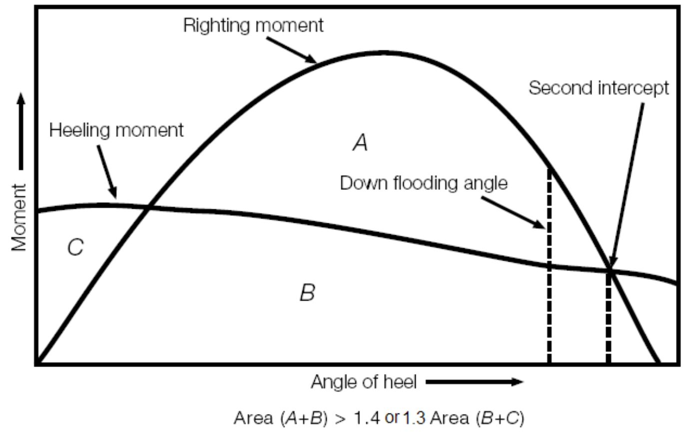

Fig.1 Righting moment and heeling moment curves

D3.8.2 Wind heeling moment

The wind heeling moment is to be calculated at several angles of inclination for each mode of operation. The calculations should be performed in a manner to reflect the range of stability about the most critical axis. The lever for the heeling force should be taken vertically from the centre of lateral resistance or, if available, the centre of hydrodynamic pressure, of the underwater body to the centre of pressure of the areas subject to wind loading. In calculating wind heeling moments for shipshaped hulls, the curve may be assumed to vary as the cosine function of the vessel's heel.

Wind heeling moments should be based on wind forces calculated by the following formula:

F = $0{,}5_p C_s\ C_h\ AV^2$

where

F = the wind force (N)

p = the air mass density (1.222 kg/m^3)

C_s = the shape coefficient

C_h = the height coefficient
A = the projected area of all exposed surfaces in either the upright or the heeled condition (m^2)

v = the wind velocity (m/s)

NOTE: All units are to be consistent.

D3 (cont)

(i) The values of the coefficient Cs depend on the shape of the wind-exposed area and should be based on the following:

Shape	C_S
Spherical	0.4
Cylindrical	0.5
Large flat surface (hull, deckhouse, smooth under-deck areas)	1.0
Drilling derrick	1.25
Wires	1.2
Exposed beams and girders under deck	1.3
Small parts	1.4
Isolated shapes (crane, beam, etc.)	1.5
Clustered deckhouses or similar structures	1.1

Shapes or combinations of shapes which do not readily fall into the specified categories will be subject to special consideration by the Society.

(ii) The values of the coefficient C_h depend on the height of the centre of the wind exposed area sea level and are given below:

Height				C_h
Metres		Feet		
Over	Not Exceeding	Over	Not Exceeding	
0	15,3	0	50	1,0
15,3	30,3	50	100	1,10
30,5	46,0	100	150	1,20
46,0	61,0	150	200	1,30
61,0	76,0	200	250	1,37
76,0	91,5	250	300	1,43
91,5	106,5	300	350	1,48
106,5	122,0	350	400	1,52
122,0	137,0	400	450	1,56
137,0	152,5	450	500	1,60
152,5	167,5	500	550	1,63
167,5	183,0	550	600	1,67
183,0	198,0	600	650	1,70
198,0	213,5	650	700	1,72
213,5	228,5	700	750	1,75
228,5	244,0	750	800	1,77
244,0	259,0	800	850	1,79
above 259		above 850		1,80

(iii) In calculating the wind forces, the following procedures are recommended:

(a) In the case of units with columns, the projected areas of all columns should be included; i.e. no shielding allowance should be taken.

(b) Areas exposed due to heel, such as underdecks, etc., should be included using the appropriate shape coefficients.

(c) The block projected area of a clustering of deckhouses may be used in lieu of calculating each individual area. The shape coefficient may be assumed to be 1,1.

D3
(cont)

(d) Isolated houses, structural shapes, cranes, etc., should be calculated individually, using the appropriate shape coefficient.

(e) Open truss work commonly used for derrick towers, booms and certain types of masts may be approximated by taking 30% of the projected block area of each side, e.g. 60% of the projected block area of one side for double-sided truss work. An appropriate shape coefficient is to be taken from the table.

D3.8.3 Damage conditions

(1) Self elevating and surface type units are to have sufficient stability per D3.7.3(1), such that the final waterline is located below the lower edge of any opening that does not meet the watertight integrity requirements of D7.4.2.

For self-elevating units particularly, the flooding of any single compartment with the assumption of no wind while meeting the following criterion:

$$RoS = \theta_m - \theta_s \geq Max\left\{ \left(7^\circ + 1.5\theta_s\right) \;,\quad 10^\circ \right\}$$

where:

RoS = range of stability, in degrees

θ_m = maximum angle of positive stability, in degrees
θ_s = static angle of inclination after damage, in degrees

The range of stability is determined without reference to the angle of downflooding. Refer to Fig.2.

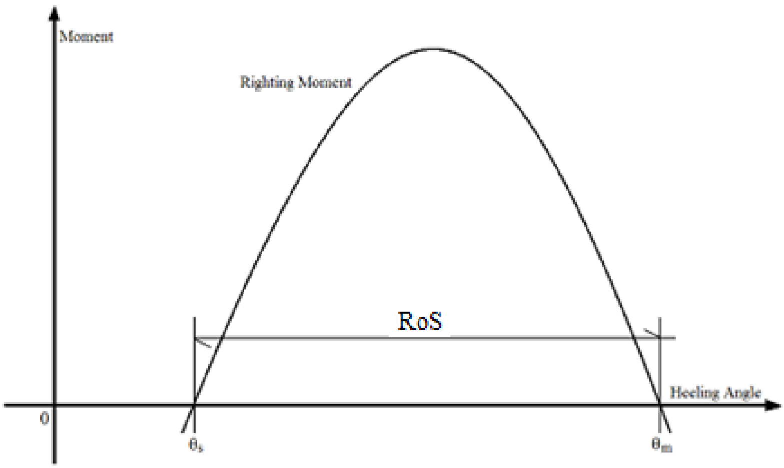

Fig.2 Residual stability for self-elevating units

(2) Column stabilized units are to have sufficient stability per D3.7.3(1) such that:

(a) the final waterline is located below the lower edge of any opening that does not meet the watertight integrity requirements of D7.4.2 (Attention is drawn to 3.4.3 of the 2009 IMO MODU Code [Res A.1023(26)] which limits the inclination of the unit relative to this final waterline, to be not greater than 17 degrees. Refer to Fig.3. Compliance with this limitation may be required by some Administrations).

D3
(cont)

(b) within the provided extent of weathertight integrity the damage righting moment curve is to have a range of at least 7 degrees beyond its first intercept with the 25,8 m/sec (50 knots) wind heeling moment curve to its second intercept or downflooding angle, whichever is less. Further, the damage righting moment curve is to reach a value of at least twice the wind heeling moment curve, both measured at the same angle. Refer to Fig.3.

(c) openings within 4 m above the final waterline are to be made weathertight.

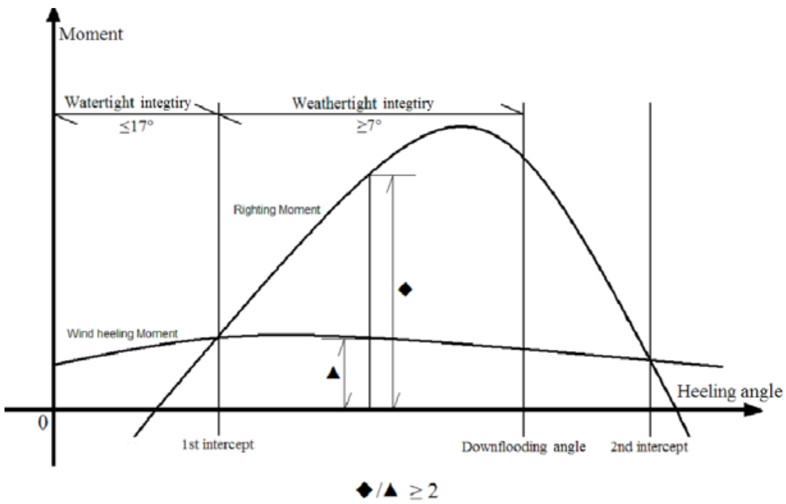

Fig.3 Residual damage stability requirements for column stabilized units

(3) Column stabilized units are to have sufficient stability per D3.7.3(2) such that:

(a) the equilibrium waterline is located below the lower edge of any opening that does not meet the watertight integrity requirements of D7.4.2 (Attention is drawn to 3.4.4 of the 2009 IMO MODU Code [Res A.1023(26)] which limits the inclination of the unit, relative to this equilibrium waterline, to be not greater than 25 degrees. Compliance with this limitation may be required by some Administrations).

(b) sufficient margin of stability is provided. (Attention is drawn to 3.4.4 of the 2009 IMO MODU Code [Res A.1023(26)] which requires a range of positive stability of at least 7 degrees beyond the first intercept of the righting moment curve and the horizontal coordinate axis of the static stability curve to the second intercept of them or the downflooding angle, whichever is less. Compliance with this range may be required by some Administrations).

D3.8.4 Wind tunnel tests

Wind heeling moments derived from authoritative wind tunnel tests on a representative model of the unit may be considered as alternatives to the method given herein. Such heeling moment determination is to include lift effects at various applicable heel angles, as well as drag effects.

D3.8.5 Other Stability Criteria

(1) Alternative stability criteria may be considered acceptable provided the criteria afford adequate righting moment to resist the heeling effects of operating and environmental forces and sufficient margins to preclude downflooding and capsizing in intact and damaged conditions.

D3 (cont)

(2) The following will be considered in determining the adequacy of alternative criteria submitted for review:

(a) Environmental conditions representing realistic winds (including gusts) and waves appropriate for various modes of operations;

(b) Dynamic response of a unit. Where appropriate, the analysis should include the results of wind tunnel tests, wave tank model tests and nonlinear simulation. Any wind and wave spectra used should cover sufficient frequency ranges to ensure that critical motion responses are obtained;

(c) Potential for downflooding, taking into account dynamic responses and wave profile;

(d) Susceptibility to capsizing considering the unit's restoration energy, static inclination due to mean wind speed and maximum dynamic responses;

(e) A safety margin consistent with the methodology to account for uncertainties;

(f) Damage assumptions at least equivalent to the requirements contained in Sections D4.4.1, D5.6.1 and D6.4.1;

(g) For column stabilized units one compartment flooding assumptions at least equivalent to the requirement contained in D3.7.3(2).

D3.9 Load line

D3.9.1 Any unit to which a load line is required to be assigned under the applicable terms of the International Convention on Load Lines should be subject to compliance with the Convention. All other units are to have load line marks which designate the maximum permissible draught when the unit is in the afloat condition. Such markings are to be placed at suitable visible locations on the structure, to the satisfaction of the Society. These marks, where practicable, are to be visible to the person in charge of mooring, lowering or otherwise operating the unit. The permissible draughts are to be established on the basis of meeting the applicable stability and structural requirements as set forth herein for afloat modes of operation, with such seasonal allowances as may be determined. In no case is the draught to exceed that permitted by the International Convention on Load Lines, where applicable. A load line, where assigned, is not applicable to bottom-supported units when resting on the sea bed, or when lowering to or raising from such position.

D3.9.2 Column Stabilized Units

1. The hull form of column stabilized units makes the calculations of geometric freeboard in accordance with the provisions of the Load Line Convention impracticable. Therefore, the minimum freeboard of each column stabilized unit should be determined by meeting the applicable requirements for:

   a) the strength of unit's structure
   b) the minimum clearance between passing wave crests and deck structure and
   c) intact and damage stability requirements.

2. The enclosed deck structure of each column stabilized unit should be specially considered by the Society for each unit.

D3 (cont)

3. Societies should also give special consideration to the position of openings which cannot be closed in emergencies, such as air intakes for emergency generators having regard to the intact righting arm curves and the final waterline after assumed damage.

D3.10 Helicopter deck

D3.10.1 General

Plans showing the arrangement, scantlings and details of the helicopter deck are to be submitted. The arrangement plan is to show the overall size of the helicopter deck and the designated landing area. If the arrangement provides for the securing of a helicopter or helicopters to the deck, the predetermined position(s) selected to accommodate the secured helicopter, in addition to the locations of deck fittings for securing the helicopter, are to be shown. The helicopter for which the deck is designed is to be specified, and calculations for the relevant loading conditions are to be submitted. The identification of the helicopter which is used for design purposes should be included in the Operating Booklet.

D3.10.2 Structural design

Scantlings of helicopter decks and supporting structure are to be determined on the basis of the following design loading conditions in association with the allowable stresses shown in Table 1.

(i) Overall distributed loading: A minimum distributed loading of 2 kN/m^2 (42 lb/ft^2) is to be taken over the entire helicopter deck.
(ii) Helicopter landing impact loading: A load of not less than 75% of the helicopter maximum take-off weight is to be taken on each of two square areas, 0,3 m x 0,3 m (1 ft x 1 ft). The deck is to be designed for helicopter landings at any location within the designated area. For the design of girders, stanchions truss supports, etc., the structural weight of the helicopter deck should be considered in addition to the helicopter impact loading. Where the upper deck of a superstructure or deckhouse is used as a helicopter deck and the spaces below are normally manned (quarters, bridge, control room, etc.) the impact loading is to be multiplied by a factor of 1,15.

(iii) Stowed helicopter loading: If provisions are made to accommodate helicopters secured to the deck in a predetermined position, the structure is to be designed for a local loading equal to the manufacturer's recommended wheel loadings at maximum take-off weight, multiplied by a dynamic amplification factor based on the predicted motions of the unit for this condition, as may be applicable for the unit under consideration. In addition, a uniformly distributed loading of 0,5 kN/m^2 (10,5 lb/ft^2), representing wet snow or ice, is to be considered, if applicable. For the design of girders, stanchions, truss supports, etc., the structural weight of the helicopter deck should also be considered.

D3
(cont)

Table 1 Allowable stresses

Condition	Allowable stress		
	Plating	Beams	Girders, stanchions, truss supports, etc.
1. Overall distributed loading	$0{,}6\sigma_Y$ (See Note 1)	$0{,}6\sigma_Y$	$0{,}6\sigma_Y$ *
2. Helicopter landing impact loading	**	σ_Y	$0{,}9\sigma_Y$ *
3. Stowed helicopter loading	σ_Y	$0{,}9\sigma_Y$	$0{,}8\sigma_Y$ *

σ_Y = specified minimum tensile yield strength of the material

* For members subjected to axial compression, the yield stress or critical buckling stress, whichever is less, is to be considered.

** To the satisfaction of the Society, in association with the method of analysis presented. The Society may consider an allowable stress that exceeds σ_Y, provided the rationale of the analysis is sufficiently conservative.

NOTES
1. The thickness of plating for the overall distributed loading condition is not to be less that the minimum required by the Rules.
2. Helicopters fitted with landing gear other than wheels shall be specially considered by the Society.
3. Wind loadings and possible wave impact loadings on helicopter decks are to be considered in a realistic manner, to the satisfaction on the Society.

D3.11 Position keeping systems and components

D3.11.1 General

D3.11.1.1 Units provided with position keeping systems equipment in accordance with D3.11 will be eligible to have a special optional notation included in the classification designation in accordance with the policy of the Society.

D3.11.2 Anchoring Systems

D3.11.2.1 General

Plans showing the arrangement and complete details of the anchoring system, including anchors, shackles, anchor lines consisting of chain, wire or rope, together with details of fairleads, windlasses, winches, and any other components of the anchoring system and their foundations are to be submitted to the Society.

D3.11.2 .2 Design

D3.11.2.2.1 An analysis of the anchoring arrangements expected to be utilized in the unit's operation is to be submitted to the Society. Among the items to be addressed are:

1. Design environmental conditions of waves, winds, currents, tides and ranges of water depth.

2. Air and sea temperature.

3. Ice conditions (if applicable).

D3 (cont)

4. Description of analysis methodology.

D3.11.2.2.2 The anchoring system should be designed so that a sudden failure of any single anchor line will not cause progressive failure of remaining lines in the anchoring arrangement.

D3.11.2.2.3 Anchoring system components should be designed utilizing adequate factors of safety (FOS) and a design methodology suitable to identify the most severe loading condition for each component. In particular, sufficient numbers of heading angles together with the most severe combination of wind, current and wave are to be considered, usually from the same direction, to determine the maximum tension in each mooring line. When a particular site is being considered, any applicable cross sea conditions are also to be considered in the event that they might induce higher mooring loads.

D3.11.2.2.3.1 When the Quasi Static Method is applied, the tension in each anchor line is to be calculated at the maximum excursion for each design condition defined in D3.11.2.2.3.2, combining the following steady state and dynamic responses of the Unit:

(a) steady mean offset due to the defined wind, current, and steady wave forces;

(b) most probable maximum wave induced motions of the moored unit due to wave excitation.

For relatively deep water, the effect from damping and inertia forces in the anchor lines is to be considered in the analysis. The effects of slowly varying motions are to be included for MODUs when the magnitudes of such motions are considered to be significant.

D3.11.2.2.3.2 When the Quasi Static Method outlined in D3.11.2.2.3.1 is applied, the following minimum factors of safety at the maximum excursion of the unit for a range of headings should be considered:

DESIGN CONDITION	FOS
Operating	2,7
Severe storm	1,8
Operating – one line failed	1,8
Severe storm – one line failed	1,25

where:

FOS = PB/Tmax

Tmax = characteristic tension in the anchor line, equal to the maximum value obtained according to D3.11.2.2.3.1

PB = minimum rated breaking strength of the anchor line

Operating: the most severe design environmental condition for normal operations as defined by the owner or designer

Severe storm: the most severe design environmental condition for severe storm as defined by the owner or designer

Operating – one line failed: following the failure of any one mooring line in the operating condition

Severe storm – one line failed: following the failure of any one mooring line in the severe storm condition

D3 (cont)

When a dynamic analysis is employed, other safety factors may be considered to the satisfaction of the Society.

The defined Operating and Severe Storm are to be the same as those identified for the design of the unit, unless the Society is satisfied that lesser conditions may be applicable to specific sites.

D3.11.2.2.3.3 In general, the maximum wave induced motions of the moored unit about the steady mean offset should be obtained by means of model tests. The Society may accept analytical calculations provided that the proposed method is based on a sound methodology which has been validated by model tests.

In the consideration of column stabilized MODUs, the value of C_S and C_H, as indicated in D3.8.2, may be introduced in the analysis for position keeping mooring systems. The intent of D3.8.3 – Wind tunnel tests, and of D3.8.4 – Other stability requirements, may also be considered by the Society.

D3.11.2.2.3.4 The Society may accept different analysis methodologies provided that it is satisfied that a level of safety equivalent to the one obtained by D3.11.2.2.3.1 and D3.11.2.2.3.2 is ensured.

D3.11.2.2.3.5 The Society may give special consideration to an arrangement where the anchoring systems are used in conjunction with thrusters to maintain the unit on station.

D3.11.3 Equipment

D3.11.3.1 Windlasses

D3.11.3.1.1 The design of the windlass is to provide for adequate dynamic braking capacity to control normal combinations of loads from the anchor, anchor line and anchor handling vessel during the deployment of the anchors at the maximum design payout speed of the windlass. The attachment of the windlass to the hull structure is to be designed to withstand the breaking strength of the anchor line.

D3.11.3.1.2 Each windlass is to be provided with two independent power operated brakes and each brake is to be capable of holding against a static load in the anchor lines of at least 50 percent of its breaking strength. Where the Society so allows, one of the brakes may be replaced by a manually operated brake.

D3.11.3.1.3 On loss of power to the windlasses, the power operated braking system should be automatically applied and be capable of holding against 50 percent of the total static braking capacity of the windlass.

D3.11.3.2 Fairleads and Sheaves

D3.11.3.2.1 Fairleads and sheaves should be designed to prevent excessive bending and wear of the anchor lines. The attachments to the hull or structure are to be such as to withstand the stresses imposed when an anchor line is loaded to its breaking strength.

D3.11.4 Anchor line

D3.11.4.1 The Society is to be ensured that the anchor lines are of a type that will satisfy the design conditions of the anchoring system.

D3
(cont)

D3.11.4.2 Means are to be provided to enable the anchor lines to be released from the unit after loss of main power.

D3.11.4.3 Means are to be provided for measuring anchor line tensions.

D3.11.4.4 Anchor lines are to be of adequate length to prevent uplift of the anchors under the maximum design condition for the anticipated area(s) of operation.

D3.11.5 Anchors

D3.11.5.1 Type and design of anchors are to be to the satisfaction of the Society.

D3.11.5.2 All anchors are to be stowed to prevent movement during transit.

D3.11.6 Quality Control

D3.11.6.1 Details of the quality control of the manufacturing process of the individual anchoring system components are to be submitted. Components should be designed, manufactured and tested in accordance with recognized standards insofar as possible and practical. Equipment so tested should, insofar as practical, be legibly and permanently marked with the Society's stamp and delivered with documentation which records the results of the tests.

D3.11.7 Control Stations

D3.11.7.1 A manned control station is to be provided with means to indicate anchor line tensions at the individual windlass control positions and to indicate wind speed and direction.

D3.11.7.2 Reliable means are to be provided to communicate between locations critical to the anchoring operation.

D3.11.7.3 Means are to be provided at the individual windlass control positions to monitor anchor line tension, windlass power load and to indicate amount of anchor line payed out.

D3.11.8 Dynamic Positioning Systems

D3.11.8.1 Thrusters used as a sole means of position keeping should provide a level of safety equivalent to that provided for anchoring arrangements to the satisfaction of the Society.