PART II RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF MOBILE OFFSHORE DRILLING UNITS

TITLE MODU – MOBILE OFFSHORE DRILLING UNITS

SECTION 2 STRUCTURE

CHAPTERS

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CHAPTER A
SCOPE

CHAPTER CONTENT

A1. APPLICATION

100. Application

101. The requirements of this Title MODU Section 2 apply to the materials, welding and hull construction systems, of mobile offshore drilling units hereafter designated as “units”.

102. 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.

200. Definitions

201. Structural elements in welded steel constructions areclassed into three categories: second, first and special categoriesas listed:

202. Second category: Second category elements are structuralelements of minor importance, the failure of whichmight induce only localised effects.

203. First category: First category elements are main load carryingelements essential to the overall structural integrityof the unit.

204. Special category: Special category elements are parts offirst category elements located in way or at the vicinityof critical load transmission areas and of stress concentrationlocations.

300. Scantlings
[IACS UR D3]

301. Scantlings of the major structural elements of the unit are to be determined inaccordance with the Requirements as set forth herein. Scantlings of structural elementswhich are subject to local load only, and which are not considered to be effective componentsof the primary structural frame of the unit, shall comply with the applicable requirements ofthe Ship Rules.

302. Surface type drilling units are to have scantlings that meet the Rules. Also, specialconsideration is to be given to the items noted in E.5.

a. Where the unit is fitted with an acceptable corrosion protection system, the scantlings may be determined from E.2 in conjunction with allowable stresses given in E2.500, 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 E.24 and D3.5, and no reduction will be permitted on scantlings determined by the use of the Rules.

CHAPTER B
DOCUMENTS, REGULATIONS AND STANDARDS

CHAPTER CONTENTS

B1. DOCUMENTS TO BE SUBMITTED TO RBNA

100. Documents required

101. The plans and documents required for this Chapter are in Part I, Title 01, Section 2, Chapter C, Subchapter C1 of the Rules.

B2. REGULATIONS AND STANDARDS

100. Application

101. The Regulations applicable to this Chapter are in Part I, Title 01, Section 2, Chapter B of the Rules.

B3. STANDARDS

100. National and International Standards

101. Whenever there are not specific requirements in the Rules related to any system, the national and international standards are to be researched and applied.

102. Specific Chapters of this Section 3 are based on national and international standards. Where this is the case, such standards are clearly stated.

B4. REFERENCES

100. References

101. References for this Section are:

- IMO MODU CODE
- IACS UR D
- IACS Rec 11

CHAPTER C
MATERIALS AND WORKMANSHIP

CHAPTER CONTENT

C1. MATERIALS FOR SURFACE TYPE UNITS [IACS Rec 11]

100. Materials Selection Guideline for MobileOffshore Drilling Units

101. Material selection for surface (ship or barge) type units is to be based on the material requirementscontained in Ship Rules Part III Title 61 Section 2..

102. Structural elements for self-elevating and column stabilized units are to be considered in association witha defined minimum service temperature, influencing factors and application.

C2. MINIMUM SERVICE TEMPERATURE

100. Minimum service temperature of materials

101. The minimum service temperature of the steel shall be assumed equal to the lowest of theaverage daily atmospheric temperatures, based on meteorological data, for any anticipated area ofoperation.

102. If data giving the lowest daily average temperature is not available and some othercriterion is used (such as lowest monthly average temperature), the RBNAshall use this Guideline with discretion.

200. Influencing Factors

201. A particular application in association with a defined minimum service temperature depends ontoughness parameters, taking the following influencing factors into account:

a. Stress Relieving: A lower service temperature than stipulated in the Tables for the relevant steel grade may be considered when a stress relieving heat treatment is employed.

b. Cold Forming: When cold forming subjects the extreme fiber to greater than about 3% strain consideration shall be given to applying a suitable heat treatment.

c. Steel Manufacturing Process: When a steel manufacturing process, such as normalizing, controlled or TM rolling, or grain refinement, is utilized when not specifically required by Requirement W11, a lower service temperature may be used subject to agreement of the RBNA.

C3. USE OF STEEL GRADES FOR VARIOUS HULL MEMBERS

100. Categories of Structural Members

101. For the purpose of this guide, structural members have been grouped into three applicationcategories of increasing importance as follows:

a. **Secondary:** Structural elements of minor importance, failure of which is unlikely to affect the
b. overall integrity of the unit.

c. **Primary:** Structural elements essential to the overall integrity of the unit.

d. **Special:** Those portions of primary structural elements which are in way of critical load transfer
e. points, stress concentrations, etc.

200. Column Stabilized Units

201. **Secondary Applications Structure**

a. internal structure including bulkheads and girders in vertical columns, decks, lower hulls, anddiagonal and horizontal bracing, and framing members

b. upper platform decks, or decks of upper hulls except areas where the structure is consideredprimary or special application.

c. certain large diameter vertical columns with low length to diameter ratios, except at intersections

202. **Primary Application Structure**

a. external shell structure of vertical columns, lower and upper hulls, and diagonal and horizontalbraces

b. deck plating, heavy flanges, and bulkhead within the upper hull or platform which form "Box" or"I" type supporting structure which do not receive major concentrated loads

c. bulkheads, flats or decks and framing which provide local re-inforcement or continuity ofstructure in way of intersections except areas where the structure is considered special application

203. **Special Application Structure**

a. external shell structure in way of intersections of vertical columns, decks and lower hulls

b. portions of deck plating, heavy flanges, and bulkheads within the upper hull or platform whichform "Box" or "I" type supporting structure which receive major concentrated loads

c. major intersections of bracing members

d. external brackets, portions of bulkheads, flats, and frames which are designed to receiveconcentrated loads at intersections of major structural members

e. "through" material used at connections or vertical columns, upper platform decks, and upper or
f. lower hulls which are designed to provide proper alignments and adequate load transfer

300. Self Elevating Units

301. **Secondary Application Structure**

a. internal framing, including bulkheads and girders, in cylindrical legs

b. internal bulkheads and framing members of upper hull structure

c. internal bulkheads of bottom mat supporting structure except where the structure is consideredprimary or special application

d. deck, side and bottom plating of upper hull except where the structure is considered primaryapplication

e. 302. **Primary Applications Structure**

a. external plating of cylindrical legs

b. plating of all components of lattice type legs

c. combination of bulkhead, deck, side and bottom plating within the upper hull which form "Box"or "I" type main supporting structure

d. jack-house supporting structure and bottom footing structure which receives initial transfer of loadfrom legs

e. internal bulkheads, shell and deck of bottom mat supporting structure which are designed todistribute major loads, either uniform or concentrated, into the mat structure

303. **Special Application Structure**

a. vertical columns in way of intersection with the mat structure.

b. intersections of lattics type leg structure which incorporate novel construction, including the use

c. of steel castings.

Guidance

When an owner or designer specifies material grades which exceed that indicated by Table T.C3.303.1I (and when they have been approved), approval of materials of lesser quality will not beconsidered without the written consent of the owner or designer.

End of guidance

TABLE T.C3.303.1 - THICKNESS LIMITATIONS (MM) OF HULL STRUCTURAL STEEL ACCORDING TO W11 AND W16 FOR VARIOUS APPLICATION CATEGORIES AND DESIGN TEMPERATURES

Category	Grade	Minimum Design Temperature 0°C	−10°C	−20°C	−30°C	−40°C	−50°C
SECONDARY	A	30	20	10	X	X	X
	B	40	30	20	10	X	X
	D	50	50	45	35	25	15
	E	50	50	50	50	45	35
	AH	40	30	20	10	X	X
	DH	50	50	45	35	25	15
	EH	50	50	50	50	45	35
	FH	50	50	50	50	50	50
	AQ	40	25	10	X	X	X
	DQ	50	45	35	25	15	X
	EQ	50	50	50	45	35	25
	FQ	50	50	50	50	50	45
PRIMARY	A	20	10	X	X	X	X
	B	25	20	10	X	X	X
	D	45	40	30	20	10	X
	E	50	50	50	40	30	20
	AH	25	20	10	X	X	X
	DH	45	40	30	20	10	X
	EH	50	50	50	40	30	20
	FH	50	50	50	50	50	40
	AQ	20	X	X	X	X	X
	DQ	45	35	25	15	X	X
	EQ	50	50	45	35	25	15
	FQ	50	50	50	50	45	35
SPECIAL	A	X	X	X	X	X	X
	B	15	X	X	X	X	X
	D	30	20	10	X	X	X
	E	50	45	35	25	15	X
	AH	15	X	X	X	X	X
	DH	30	20	10	X	X	X
	EH	50	45	35	25	15	X
	FH	50	50	50	50	40	30
	AQ	X	X	X	X	X	X
	DQ	25	15	X	X	X	X
	EQ	50	40	30	20	10	X
	FQ	50	50	50	40	30	20

X" indicates no application

NOTES:

1. Thicknesses greater than shown in the Table will be specially considered by the RBNA

2. Substitution of materials considered to be equivalent to the Grades shown, or steels of differentstrength levels, will be specially considered by the RBNA.

3. Interpolation of thicknesses for intermediate temperatures may be considered.

C4. WELDERS

100. Welders

201. The welders employed in the construction shall be qualified by the RBNA for the welding types that they carry out in the form prescribed in Part III Title 61 Section 2 of the ShipRules.

CHAPTER E
DESIGN PRINCIPLES OF LOCAL STRUCTURE

CHAPTER CONTENT

E1. ENVIRONMENTAL LOADINGS
[UR D 3.3 / MODU CODE 2.3]

100. General

101. A unit’s modes of operation are to be investigated using realistic loading conditions, includinggravity loadings together with relevant environmental loadings due to the effects of wind,waves, currents, ice and, where deemed necessary be the owner (designer), the effects ofearthquake, sea bed supporting capabilities, temperature, fouling, etc.

102. Where applicable, thedesign loadings indicated herein are to be adhered to for all types of mobile offshore drillingunits.

103. The owner (designer) will specify the environmental conditions for which the unit is tobe approved.

104. Where possible, the design environmental criteria determining the loads on theunit and its individual elements shall be based upon significant statistical information andshall have a return period (period of recurrence) of at least 50 years for the most severeanticipated environment. If a unit is restricted to seasonal operations in order to avoidextremes of wind and wave, such seasonal limitations must be specified.

200. Wind loadings

201. Sustained and gust velocities, as relevant, are to be considered when determining windloadings.

202. Sustained wind velocities specified by the owner (designer) are not to be less than25,8 m/s (50 knots).

203. However, for unrestricted service, the wind criteria for intact stabilitygiven in Part II, Title MODU, Section 1, Chapter H of the Rules are also to be applicable for structural design considerations, for all modes ofoperation, whether afloat or supported by the sea bed. Pressures and resultant forces are tobe calculated to the satisfaction of the RBNA.

204. Where wind tunnel data obtained from testson a representative model of the unit by a recognized laboratory are submitted, these datawill be considered for the determination of pressures and resulting forces.

300. Wave loadings

301. Design wave criteria specified by the owner (designer) may be described either bymeans of design wave energy spectra or deterministic design waves having appropriateshape, size and period. Consideration is to be given to waves of less than maximumheight where, due to their period, the effects on various structural elements may begreater.

302. The forces produced by the action of waves on the unit are to be taken into account inthe structural design, with regard to forces produced directly on the immersed elementsof 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 coefficientsare to be acceptable to the RBNA.

303. Consideration is to be given to the possibility of wave induced vibration.

400. Current loadings

401. Consideration shall be given to the possible superposition of current and waves. In thosecases where this superposition is deemed necessary, the current velocity shall be addedvectorially to the wave particle velocity. The resultant velocity is to be used to compute thetotal force.

402. Loadings due to vortex shedding: Consideration shall be given to the possibility of flutter of structural members due to vonKarman vortex shedding.

403. Deck loadings: a loading plan is to be prepared for each design. This plan is to showthe maximum design uniform and concentrated loadings for all areas for each mode ofoperation. Design loadings are not to be less than:

a. Crew spaces (walkways, general traffic areas, etc.)
4,5 kN/m2 (94 lb/ft2)

b. Work areas
9 kN/m2 (188 lb/ft2)

c. Storage areas
13 kN/m2 (272 lb/ft2)

d. Helicopter platform
2 kN/m2 (42 lb/ft2)

500. Loading due to vortex shedding

501. Consideration shall be given to loading induced in structural members due to vortex shedding.

600. Deck loading

601. A loading plan shall be prepared to the satisfaction of the RBNA showing the maximum design uniform and concentrated deck loading for each area for each mode of operation.

700. Other loadings

701. Other relevant loadings shall be determined in a manner to the satisfaction of the RBNA.

E2. STRUCTURAL STRENGTH REQUIREMENTS
[IACS UR D 3 - MODU CODE 2.3]

100. Primary structure

101. The primary structure of the unit is to be analysed using the loading conditionsstipulated 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 casesto be determined. Calculations for relevant conditions are to be submitted for review. Theanalysis shall be performed using an appropriate calculation method and shall be fullydocumented and referenced.

102. For each loading condition considered, the following stresses are to be determined focomparison with the appropriate allowable stresses given in E2.300 or E2.500:

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

b. Stresses due to combined loadings, where the applicable static loads in E2.102.a arecombined with relevant design environmental loadings, including acceleration andheeling forces.

200. Local stresses

201. Local stresses, including those due to circumferential loading on tubular members, areto be added to the primary stresses to determine total stress levels.

202. The scantlings are to be determined on the basis of criteria which combine, in a rationalmanner, the individual stress components acting on the various structural elements ofthe unit. This method is to be acceptable to the RBNA. (See E2.300)

203. The critical buckling stress of structural elements is to be considered, whereappropriate, in relation to the computed stresses.

204. When computing bending stresses, the effective flange areas are to be determined inaccordance with ‘effective width’ concepts acceptable to the RBNA. Whereappropriate, elastic deflections are to be taken into account when determining theeffects of eccentricity of axial loading, and the resulting bending momentssuperimposed on the bending moments computed for other types of loadings.

205. 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 totaldepth of the girder may be considered as the web depth.

300. Plated and lattice structures

301. For plated structures, members may be designed according to the von Mises equivalentstress criterion, where the equivalent stress $\sigma_e$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.

302. The equivalent stress in plate elements clear of discontinuities shall generally not exceed0,7 and 0,9 of the yield strength of the material, for the loading conditions given in E2.101.a. and E2.101.b., respectively.

303. Members of lattice type structures shall be designed in accordance with acceptedpractice for such members; for example, they may comply with the American Institute ofSteel Construction’s Specifications for the Design, Fabrication and Erection ofStructural Steel for Buildings.

400. Fatigue Analysis

401. The possibility of fatigue damage due to cyclic loading shall be considered in thedesign of self elevating and column stabilized units.

402. The fatigue analysis will be dependent on the intended mode and area of operationsto be considered in the unit’s design.

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

404. The effect of notches, stress raisers and local stress concentrations is to be takeninto account in the design of load carrying elements.

405. Critical joints depending upon transmission of tensile stresses through the thicknessof the plating of one of the members (which may result in lamellar tearing) are to be avoidedwherever possible. Where unavoidable, plate material with suitable through-thicknessproperties and inspection procedures may be required.

406. The accumulative fatigue damage at each spot is to be calculated using the Palgreen-Miner rule and an appropriate SN-curve taking into account joint classification, thickness effect and the degree of corrosion protection.

500. Allowable stresses

501. For cases involving individual stress components and, where applicable, directadditions of such stresses, the stress is not to exceed the allowable individualstress σ_i^*orτ_i^*

where

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

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

σ_y= specified minimum tensile yield stress of the material

η= usage factorfor static loadings (see E2.102.a)

η= 0,6 for axial stress

0,6 for bending stress

0,40 for shear stress

For combined loadings (see E2.102.b)

η= 0,8 for axial stress

0,8 for bending stress

0,53 for shear stress

502. In addition, the stress in structural elements, due to compression, ending, shear orany combination of the three, shall not exceed the allowable buckling stress σ_b^*orτ_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, y σis as defined in E2.501.

503. In addition, when structural members are subjected to axial compression or combinedaxial compression and bending, the extreme fibre stresses shall comply with the followingrequirement:

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

where

σ_a = computed axial compressive stress

σ_{ab} = computed compressive stress due to bending

$\sigma_{ab}^* = \sigma_i^*$ or σ_b^* for bending stress, as defined in E2.501or E2.502

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

$$\sigma_a^* = \eta \sigma_{cr,e}\, 0,87 \text{ if } \lambda < \lambda_0$$

σ_a^* shall not exceed σ_{ab}^*

$$\lambda = \frac{k}{r}$$

$$\lambda_0 = \sqrt{2\,\pi^2 \frac{E}{\sigma_y}}$$

*

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

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

ηis as defined in E2.502

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 E2.501.

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

$$\frac{D}{t} > \frac{E}{9\,\sigma_y}$$

where

D = mean diameter

t = wall thickness

(D and t expressed in the same units)

σ_yσ is as defined in E2.501
E is as defined in E2.503

($\sigma_y$and E expressed in the same units)

are to be checked for local buckling in addition to the overall buckling as specified in E2.503..

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

506. Note 1: the allowable stresses as stated in E2.500 are intended to reflect uncertainties inenvironmental data, determination of loadings from the data and calculation of stresses whichmay exist at the present time. It is envisioned that the requirements may eventually allow forthe adoption of separate load factors or usage factors for the above influences, so thatallowance can be given for improvements in forecasting, load estimation or structuralanalysis, as the technology or expertise in any one of these areas improves.

507. Note 2: the specific minimum yield point may be determined, for the use of E1 and E2, by the drop of thebeam or halt in the gauge in the testing machine or by the use of dividers or by 0,5% totalextension under load. When no well defined yield phenomenon exists, the yield strengthassociated with a 0,2% offset or a 0,5% total extension under load is to be considered theyield strength.

600. Units resting on the sea bed

601. Units designed to rest on the sea bed are to have sufficient positive downwardgravity loadings on the support footings or mat to withstand the overturning moment of thecombined environmental forces from any direction, with a reserve against the loss of positivebearing 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 RBNA.

E3 SELF-ELEVATING DRILLING UNITS [IACS UR D4 / MODU CODE 2.7]

100. General

101. This section applies to the self-elevating unit type.

200. Hull scantlings

201. The hull strength shall be evaluated in the elevated position for the specified environmental conditions with maximum gravity loads aboard and with the unit supported by all legs. The distribution of these loads in the hull structure shall be determined by a

method of rational analysis. Scantlings shall be calculated on the basis of this analysis, but shall not be less than those required for other modes of operation.

202. The unit shall be so designed as to enable the hull to clear the highest design wave including the combined effects of astronomical and storm tides. The minimum clearance may be the lesser of either 1.2 m or 10% of the combined storm tide, astronomical tide and height of the design wave above the mean low water level.

203. Scantlings of the hull structure, except as outlined below, are to meet the ship Rules.

204. Deckhouses: Deckhouses are to have sufficient strength for their size, function and location, and are to beconstructed to approved plans. Their general scantlings are to be as indicated in the ship Rules.

205. Where they are close to the side shell of the unit, their scantlings may be required to conformto the RBNA'srequirements for bulkheads of unprotected house fronts

300. Legs

301. Legs may be either shell type or truss type. Shell type legs may be designedas either stiffened or unstiffened shells. In addition, individual footings may be fitted orlegs may be permanently attached to a bottom mat.

302. Where footings or mats are not fitted, proper consideration shall be given to the leg penetration of the sea bed and the end fixity of the leg.

303. Legs shall be designed to withstand the dynamic loads which may be encountered by their unsupported length while being lowered to the bottom, and also to withstand the shock of bottom contact due to wave action on the hull. The maximum design motions, sea state and bottom conditions for operations to raise or lower the hull shall be clearly stated in the operating manual.

304. When evaluating leg stresses with the unit in the elevated position, the maximum overturning moment on the unit due to the most adverse combination of applicable environmental and gravity loadings shall be considered.

305. Legs shall be designed for the most severe environmental transit conditions anticipated including wind moments, gravity moments and accelerations resulting from unit motions. The RBNA shall be provided with calculations, an analysis based on model tests, or a combination of both. Acceptable transit conditions shall be included in the operating manual. For some transit conditions, it may be necessary to reinforce or support the legs, or to remove sections to ensure their structural integrity.

306. Structural members which transmit loads between the legs and the hull shall be designed for the maximum loads transmitted and so arranged as to diffuse the loads into the hull structure.

307. When a mat is utilized to transmit the bottom bearing loads, attention shall be given to the attachment of the legs so that the loads are diffused into the mat.

308. Where tanks in the mat are not open to the sea, the scantlings shall be based on a design head using the maximum water depth and tidal effects.

309. Mats shall be designed to withstand the loads encountered during lowering including the shock of bottom contact due to wave action on the hull.

310. The effect of possible scouring action (loss of bottom support) shall be considered. The effect of skirt plates, where provided, shall be given special consideration.

311. Except for those units utilizing a bottom mat, the capability shall be provided to pre-load each leg to the maximum applicable combined load after initial positioning at a site. The pre-loading procedures shall be included in the operating manual. Where footings or mats are not fitted, proper consideration shall be given to the leg penetration of the sea bed and the end fixity of the leg.

312. Legs are to be designed for a bending momentcaused by a 6° single amplitude of roll or pitch at the natural period of the unit, plus120% of the gravity moment caused by the legs' angle of inclination. The legs are to beinvestigated for any proposed leg arrangement with respect to vertical position duringfield transit moves, and the approved positions shall be specified in the OperatingBooklet. Such investigation shall include strength and stability aspects.

313. **Legs in the ocean transit condition:** Legs shall be designed for acceleration andgravity moments resulting from the motions in the most severe anticipatedenvironmental transit conditions, together with corresponding wind moments.

a. Calculation or model test methods, acceptable to the RBNA, may be used.

b. Alternatively, legs may be designed for a bending moment caused by minimum design criteria of a 15° single amplitude of roll or pitch at a 10 second period, plus 120% of the gravity moment caused by the legs' angle of inclination. For ocean transit conditions, it may be necessary to reinforce or support the legs, or to remove sections of them. The approved condition shall be included in the Operating Booklet.

314. **Unit in the elevated position**: When computing leg stresses, the maximum overturningload on the unit, using the most adverse combination of applicable variable loadingstogether with the loadings as outlined in E2, is to be considered. Forces and momentsdue to

lateral frame deflections of the legs are to be taken into account.

315. **Leg scantlings:** Leg scantlings are to be determined in accordance with a method ofrational analysis, to the satisfaction of the RBNA.

316**. Annex to UR D4 as Recommendations on Operation of Legs:**

a. Legs while lowering to bottom: Legs are to be designed to withstand the dynamic loads which may be encountered by their unsupported length just prior to touching bottom, and also to withstand the shock of touching bottom while the unit is afloat and subject towave motions.

b. Instructions for lowering legs: The maximum design motions, bottom conditions and sea state while lowering legs shall be clearly indicated in the Operating Booklet, and the legs are not to be permitted to touch bottom when the site conditions exceed the allowable.

400. Structure in way of jacking or other elevating arrangements

401. Load carrying members which transmit loads from the legs to the hull are to be designed forthe maximum design loads and are to be so arranged that loads transmitted from the legs areproperly diffused into the hull structure.

500. Hull structure

501. The hull is to considered as a complete structure having sufficient strength to resist allinduced stresses while in the elevated position and supported by all legs. All fixed andvariable loads are to be distributed, by an accepted method of rational analysis, from thevarious points of application to the supporting legs. The scantlings of the hull are then to bedetermined consistent with this load distribution, but are not to be less than those required be

502. Scantlings of units having other than rectangular hull configurations will be subject tospecial consideration.

600. Wave clearance

601. The unit is to be designed for a crest clearance of either 1,2 m (4 ft), or 10% of the combinedstorm tide, astronomical tide and height of the maximum wave crest above the mean lowwater level, whichever is less, between the underside of the unit in the elevated position andthe crest of the design wave. This crest elevation is to be measured above the level of thecombined astronomical and storm tides.

700. Bottom mat

701. When the bottoms of the legs are attached to a mat, particular attention is to be given to theattachment and the framing and bracing of the mat, in order that the loads resulting from thelegs are properly distributed. The

envelope plating of tanks which are not vented freely to thesea is not to be less in thickness than would be required by the Rules for tanks, using a headto the design water level, taking into account the astronomical and storm tides. The effects ofscouring on the bottom bearing surface shall be considered. The effects of skirt plates,where provided, will be specially considered. Mats are to be designed to withstand the shockof touching bottom while the unit is afloat and subject to wave motions.

800. Preload capability

801. For units without bottom mats, all legs are to have the capability of being preloaded to themaximum applicable combined gravity plus overturning load. The approved preloadprocedure shall be included in the Operating Booklet.

900. Sea bed conditions

901. Classification will be based upon the designer's assumptions regarding the sea bedconditions. These assumptions shall be recorded in the Operating Booklet. It is theresponsibility of the operator to ensure that actual conditions do not impose more severeloadings on the unit.

E4. COLUMN STABILIZED DRILLING UNITS [IACS UR D5]

100. General

101. This section applies to column stabilized drilling units.

102. For units of this type, the highest stresses may be associated with less severe environmentalconditions than the maxima specified by the owner (designer).

103. Where considerednecessary by the RBNA, account shall be taken of the consequent increased possibilityof encounter of significant stress levels, by either or both of the following:

a. Suitable reduction of the allowable stress levels for combined loadings given in E2.

b. Detailed investigation of the fatigue properties.

104. Particular attention shall also be given to the details of structural design in critical areassuch as bracing members, joint connections, etc.

105. Local structures in way of fairleads, winches, etc., forming part of the positionmooring system, shall be designed to the breaking strength of the mooring line.

200. Upper structure

201. The scantlings of the upper structure are not to be less than those required by theRules in association with the loadings indicated on the deck loading plan. (These loadingsare not to be less than the minima specified in E1.403). In addition, when the upper structureis considered to be an effective member of the overall structural frame of the unit, thescantlings are to be sufficient to withstand actual local loadings plus any additional loadings, superimposed due to frame action, within the stress limitations ofE1 and E2.

202. When the upper structure is designed to be waterborne in any mode of operationor damaged condition, or to meet stability requirements, it will be subject to special consideration.

203. Deckhouses fitted to the upper structure are to be designed in accordance with theRules, with due consideration given to their location and to the environmental conditionsin which the unit will operate.

300. Columns, lower hulls and footings

301. Main stability columns, lower hulls or footings may be designed as either framedor unframed shells.In either case, framing, ring stiffeners, bulkheads or other suitablediaphragms which are used are to be sufficient to maintain shape and stiffness under all theanticipated loadings.

302. Portlights or windows including those of the non-opening type, or other similar openings,are not to be fitted in columns.

303. Where columns, lower hulls or footings are designed with stiffened plating,the minimum scantlings of plating, framing, girders, etc., may be determinedin accordance with the requirements for tanks as given in Part II, Title MODU, Section 1, H2.403.

a. Where an internal space is a void compartment, the design head used in association with the above is not to be less that that corresponding to the maximum allowablewaterline of the unit in service. In general, the scantlings are not to less than required for watertight bulkheads in association with a head equivalent to the maximum damaged waterline, and for all areas subject to wave immersion, a minimum head of 6,0 m (20 ft) shall be used.

304. Where columns, lower hulls or footings are designed as shells, either unstiffenedor ring stiffened, the minimum scantlings of shell plating and ring stiffenersare to be determined on the basis of established shell analysis using theappropriate usage factors and the design heads as given in E4.303.a.

305. Scantlings of columns, lower hulls or footings as determined in (a) and (b)are minimum requirements for hydrostatic pressure loads. Where wave andcurrent forces are superimposed, the local structure of the shell is to beincreased in scantlings as necessary, to meet the strength requirements ofE2.102.b.

306. When the column, lower hull or footing is an effective member of the overallstructural frame of the unit, the scantlings are to be sufficient to meet therequirements of E4.300 plus any additional stresses superimposed due to frameaction, within the stress limitations of E2.

307. Particular consideration is to be given to structural details, reinforcement,etc., in areas subject to high local loadings, or to such loadings that maycause shell distortion; for example:

a. bottom bearing loads, where applicable;

b. partially filled tanks;

c. local strength against external damage;

d. continuity through joints;

e. wave impacts.

308. For units designed to rest on the sea bed, the effect of scouring action (lossof bottom support) is to be considered. The effects of skirt plates, where provided,will be specially considered.

400. Bracing members

401. Stresses in bracing members due to all anticipated loadings are to be determinedin accordance with the following requirements in conjunction with therelevant requirements of E1 and E2.

402. Bracing members are to be designed to transmit loadings and to make thestructure effective against environmental forces and, when the unit is supportedby the seabed, against the possibility of uneven bearing loads.

a. Although designed primarily as brace members of the overall structure under the designated loadings, the bracing must also be investigated, if applicable, for superimposed local bending stresses due to buoyancy, wave and current forces.

403. Where relevant, consideration is to be given to local stresses due to waveimpact.

404. When bracing members are of tubular section, ring frames may be requiredto maintain stiffness and roundness of shape.

405. When bracings are watertight, they are to be suitably designed to prevent collapsefrom external hydrostatic pressure.

500. Wave clearance

501. Afloat condition: Unless deck structures are designed for wave impact, to the satisfaction of the

RBNA, reasonableclearance between the deck structures and the wave crests is to be ensured for allafloat modes of operation, taking into account the predicted motion of the unit relative tothe surface of the sea. Calculations, model test results, or prototype experiences are to besubmitted for consideration.

502. On-bottom condition: For on-bottom modes of operation, clearances are to be in accordance with those specifiedin E3.600 for self-elevating units.

600. Structural Redundancy

601. When assessing structural redundancy for column stabilized units, the followingassumed damage conditions shall apply:

a. The unit’s structure shall be able to withstand the loss of any slender bracing member without causing overall collapse of the unit’s structure.

b. b. 2. Structural redundancy will be based on the applicable requirements of:

E1, E2
E2.100 – E2.400
E2.500
E2.600

except:

i. Maximum calculated stresses in the structure remaining after the loss of a slender bracing member are to be in accordance with E2.500. in association with usage factors not exceeding 1.0. This criteria may be exceeded for local areas, provided redistribution of forces due to yielding or buckling is taken into consideration.

ii. When considering environmental factors, a one year return period may be assumed for intended areas of operations. (see D1.100.).

iii. The structural arrangement of the upper hull is to be considered with regard to the structural integrity of the unit after the failure of any primary girder.

E5. SURFACE TYPE DRILLING UNITS [IACS UR D6]

100. General

101. This section applies to surface drilling units.

200. Ship type drilling units

201. Scantlings of the hull structure are to meet the Rules. Special consideration is,however, to be given to items which may require some deviation or additions to the Rules, inparticular the items indicated in E5.202-E5.204.

202. The required strength of the unit is to be maintained in way of the drilling well, andparticular attention is to be paid to the transition of fore and aft members so as to maintaincontinuity of the longitudinal material. In addition, the plating of the well is to be suitablystiffened to prevent damage due to foreign objects which may become trapped in the wellwhile the unit is under way.

203. The deck area in way of large hatches is to be suitably compensated wherenecessary to maintain the strength of the unit.

204. The structure in way of heavy concentrated loads resulting from the drilling derrick,pipe rack, set back, drilling mud storage, etc., is to be suitably reinforced.

205. Local structure in way of fairleads, winches, etc., forming part of the position mooringsystem, shall be designed to the breaking strength of the mooring line.

300. Barge type drilling units

301. Scantlings of the hull structure are to meet the Rules. Special consideration, whereapplicable, is to be given to items listed in E5.200.

CHAPTER I
STRUCTURAL COMPLEMENTS

CHAPTER CONTENTS

I1. HELICOPTER DECK
[IACS UR D3.10]

100. General

101. Plans showing the arrangement, scantlings and details of the helicopter deck are to besubmitted. The arrangement plan is to show the overall size of the helicopter deck and thedesignated landing area. If the arrangement provides for the securing of a helicopter orhelicopters to the deck, the predetermined position(s) selected to accommodate the securedhelicopter, in addition to the locations of deck fittings for securing the helicopter, are to beshown. The helicopter for which the deck is designed is to be specified, and calculations forthe relevant loading conditions are to be submitted. The identification of the helicopter which is used for design purposes shall be included in the Operating Booklet.

200. Structural design

201. Scantlings of helicopter decks and supporting structure are to be determined on the basis ofthe following design loading conditions in association with the allowable stresses shown inTable T.I1.201.1.

(i) Overall distributed loading: A minimum distributed loading of 2 kN/m2 (42 lb/ft2) is to betaken over the entire helicopter deck.

ii) Helicopter landing impact loading: A load of not less than 75% of the helicopter maximumtake-off weight is to be taken on each of two square areas, 0,3 m x 0,3 m (1 ft x 1 ft). Thedeck is to be designed for helicopter landings at any location within the designated area. Forthe design of girders, stanchions truss supports, etc., the structural weight of the helicopterdeck shall be considered in addition to the helicopter impact loading. Where the upper deckof a superstructure or deckhouse is used as a helicopter deck and the spaces below arenormally manned (quarters, bridge, control room, etc.) the impact loading is to be multipliedby a factor of 1,15.

(iii) Stowed helicopter loading: If provisions are made to accommodate helicopters secured tothe deck in a predetermined position, the structure is to be designed for a local loading equalto the manufacturer’s recommended wheel loadings at maximum take-off weight, multipliedby 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 distributedloading of 0,5 kN/m2 (10,5 lb/ft2), representing wet snow or ice, is to be considered, ifapplicable. For the design of girders, stanchions, truss supports, etc., the structural weight ofthe helicopter deck shall also be considered.

TABLE T.I1.201.1 - ALLOWABLE STRESSES

Condition	**Allowable stress**		
	Plating	**Beams**	**Girders, stanchions,**
1. Overall distributed loading	0,6 σ_y (See Note 1)	0,6 σ_y	0,6 σ_y*
2. Helicopter landing impact loading	**	σ_y	0,6 σ_y
3. Stowed helicopter loading	σ_y	0,96 $\sigma_y^{(*)}$	0,8σ_y

(*) σy = DEFINITION
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 RBNA, in association with the method of analysis presented. The RBNA may consider an allowable stress that exceeds *Y* σ, providedthe 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 bythe RBNA.

3. Wind loadings and possible wave impact loadings on helicopter decks are to beconsidered in a realistic manner, to the satisfaction on the RBNA.

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