RESOLUTION A.650(16)

Adopted on 19 October 1989
Agenda item 10

AN EXAMPLE OF ALTERNATIVE INTACT STABILITY CRITERIA FOR TWIN-PONTOON COLUMN-STABILIZED SEMISUBMERSIBLE UNITS

THE ASSEMBLY,

RECALLING Article 15(j) of the Convention on the International Maritime Organization concerning the functions of the Assembly in relation to regulations and guidelines concerning maritime safety,

RECALLING ALSO that, by resolution A.649(16), it adopted the Code for the Construction and Equipment of Mobile Offshore Drilling Units, 1989 (1989 MODU Code) to promote the international operation of mobile offshore drilling units,

NOTING that mobile offshore drilling units continue to be moved and operated internationally,

RECOGNIZING the need to establish a more rational method for reviewing the intact stability criteria based on advanced technological computerized means and more realistic environmental conditions,

FURTHER RECOGNIZING that chapter 3 of the 1989 MODU Code allows for alternative stability criteria to be considered by Administrations,

HAVING CONSIDERED the recommendation made by the Maritime Safety Committee at its fifty-seventh session,

1. ADOPTS an example of alternative intact stability criteria for twin-pontoon column-stabilized semisubmersible mobile offshore drilling units, 1989, as set out in the Annex to the present resolution;

2. RECOMMENDS that Governments concerned accept the application of this example as being an equivalent to the provisions of paragraph 3.3.1.2 of the 1989 MODU Code;

3. INVITES all Governments concerned to consider putting this alternative into effect and to evaluate its use;

4. FURTHER INVITES all Governments concerned, through the Organization, to exchange experience gained as a result of the application of this alternative;

5. AUTHORIZES the Maritime Safety Committee to amend the alternative as necessary after consultations with relevant organizations.

ANNEX

AN EXAMPLE OF ALTERNATIVE INTACT STABILITY CRITERIA FOR TWIN-PONTOON COLUMN-STABILIZED SEMISUBMERSIBLE UNITS

1.1 The criteria hereunder constitute alternative intact stability criteria for column-stabilized units under the provisions of section 3.3.3 of the Code for the Construction and Equipment of Mobile Offshore Drilling Units, 1989 (1989 MODU Code). These criteria apply only to twin-pontoon column-stabilized semisubmersible units in severe storm conditions which fall within the following range of parameters:

V_p/V_t	is between 0.48 and 0.58
$A_{wp}/(V_c)^{2/3}$	is between 0.72 and 1.00
$I_{wp}/[V_c \times (L_{ptn}/2)]$	is between 0.40 and 0.70

The parameters used in the above equations are defined in paragraph 1.3.

1.2 **Intact stability criteria**

1.2.1 The stability of a unit in the survival mode of operation should meet the following criteria:

.1 *Capsize criteria*

These criteria are based on the wind heeling moment and righting moment curves calculated as shown in section 3.2 of the 1989 MODU Code at the survival draught. The reserve energy area 'B' must be greater than 10% of the dynamic response area 'A' as shown in figure 1.1.

Area 'B'/Area 'A' $\geqslant 0.10$

Where:

Area 'A' is the area under the righting arm curve measured from θ_1 to $(\theta_1 + 1.15\ \theta_{dyn})$

Area 'B' is the area under the righting arm curve measured from $(\theta_1 + 1.15\ \theta_{dyn})$ to θ_2

θ_1 is the first intercept with the 100 knot wind moment curve

θ_2 is the second intercept with the 100 knot wind moment curve

θ_{dyn} is the dynamic response angle due to waves and fluctuating wind

$\theta_{dyn} = (10.3 + 17.8C)/(1 + GM/(1.46 + + 0.28BM))$

$C = (L_{ptn}{}^{5/3} * VCP_{w1} * A_w * V_p * V_c{}^{1/3})/(I_{wp}{}^{5/3} * V_t)$

Parameters used in the above equations are defined in paragraph 1.3.

.2 *Downflooding criteria*

These criteria are based on the physical dimensions of the unit and the relative motion of the unit about a static inclination due to a 75 knot wind measured at the survival draught. The initial downflooding distance (DFD_o) must be greater than the reduction in downflooding distance at the survival draught as shown in figure 1.2.

$DFD_o - RDFD > 0.0$

Where:

DFD_o	=	initial downflooding distance to D_m in metres
RDFD	=	reduction in downflooding distance in metres
	=	SF (k * QSD_1 + RMW)
SF	=	1.10, which is a safety factor to account for uncertainties in the analysis, such as non-linear effects.
k (correlation factor)	=	$0.55 + 0.08\,(a - 4.0) + 0.056\,(1.52 - GM)$
a	=	$(FBD_o/D_m)(S_{ptn} * L_{ccc})/A_{wp}$ (a cannot be taken to be less than 4.0) (GM cannot be taken to be greater than 2.44 m)
QSD_1	=	DFD_o – Quasi-static downflooding distance at θ_1, in metres, but not to be taken less than 3.0 m.
RMW	=	Relative motion due to waves about 0_1 in metres
	=	$9.3 + 0.11(X-12.19)$
X	=	$D_m(V_t/V_p)(A_{wp}^2/I_{wp})(L_{ccc}/L_{ptn})$ (X cannot be taken to be less than 12.19 m)

The parameters used in the above equations are defined in paragraph 1.3.

1.3 Geometric parameters

A_{wp} is the waterplane area at the survival draught including the effects of bracing members as applicable (in square metres).

A_w is the effective wind area with the unit in the upright position (i.e. the product of projected area, shape coefficient and height coefficient) (in square metres).

BM is the vertical distance from the metacentre to the centre of buoyancy with the unit in the upright position (in metres).

D_m is the initial survival draught (in metres).

FBD_o is the vertical distance from D_m to the top of the upper exposed weathertight deck at the side (in metres).

GM for paragraph 1.2.1.1, GM is the metacentric height measured about the roll or diagonal axis, whichever gives the minimum restoring energy ratio, 'B'/'A'. This axis is usually the diagonal axis as it possesses a characteristically larger projected wind area which influences the three characteristic angles mentioned above.

GM for paragraph 1.2.1.2, GM is the metacentric height measured about the axis which gives the minimum downflooding distance margin (i.e. generally the direction that gives the largest QSD_1) (in metres).

I_{wp} is the waterplane second moment of inertia at the survival draught including the effects of bracing members as applicable (in metres to the power of 4).

L_{ccc} is the longitudinal distance between centres of the corner columns (in metres).

L_{ptn} is the length of each pontoon (in metres).

S_{ptn} is the transverse distance between the centreline of the pontoons (in metres).

V_c is the total volume of all columns from the top of the pontoons to the top of the column structure, except for any volume included in the upper deck (in cubic metres).

V_p is the total combined volume of both pontoons (in cubic metres).

V_t is the total volume of the structures (pontoons, columns and bracings) contributing to the buoyancy of the unit, from its baseline to the top of the column structure, except for any volume included in the upper deck (in cubic metres).

VCP_{w1} is the vertical centre of wind pressure above D_m (in metres).

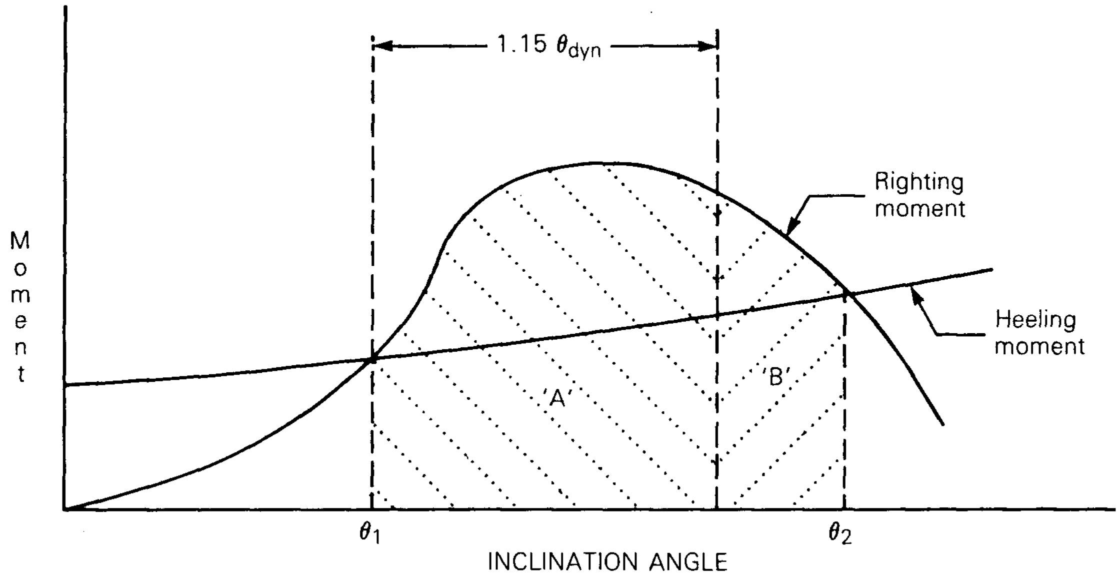

Figure 1.1 – *Righting moment and heeling moment curves*

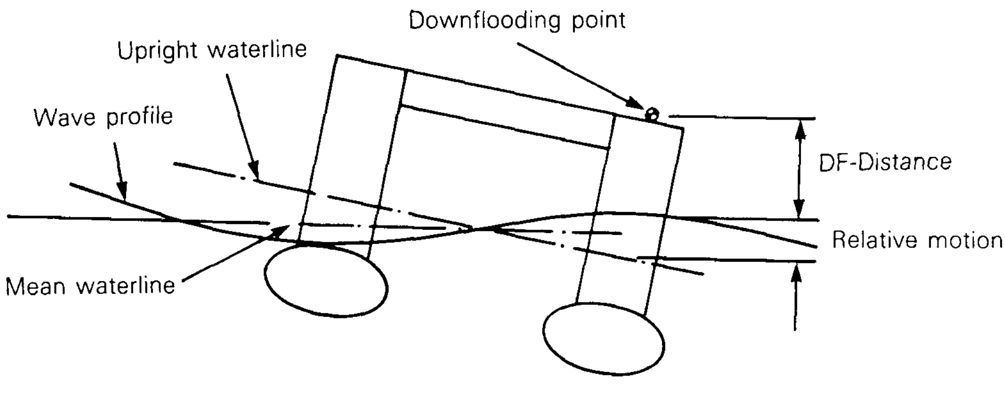

Figure 1.2 – *Definition of downflooding distance and relative motion*

1.4 Capsize criteria assessment form

Input data

GM	______	= ______	m
BM	______	= ______	m
VCP_{wl}	______	= ______	m
A_w	______	= ______	m^2
V_t	______	= ______	m^3
V_c	______	= ______	m^3
V_p	______	= ______	m^3
I_{wp}	______	= ______	m^4
L_{ptn}	______	= ______	m

Determine

θ_1	______	= ______	deg
θ_2	______	= ______	deg
$C = (L_{ptn}{}^{5/3} * VCP_{w1} * A_w * V_p * V_c{}^{1/3})/(I_{wp}{}^{5/3} * V_t)$		= ______	m^{-1}
θ_{dyn}	$(10.3 + 17.8C)/(1.0 + GM/(1.46 + 0.28BM))$ ______	= ______	deg
Area 'A'	______	= ______	m-deg
Area 'B'	______	= ______	m-deg

Results Reserve energy ratio:

'B'/'A' = ______ (min = 0.10)

GM = ______ m (KG = ______ m)

Note: The minimum GM is that which produces a 'B'/'A' ratio = 0.10

1.5 Downflooding criteria assessment form

Input data

DFD_o	______	= ______	m
FBD_o	______	= ______	m
GM	______	= ______	m
D_m	______	= ______	m
V_t	______	= ______	m^3
V_p	______	= ______	m^3
A_{wp}	______	= ______	m^2
I_{wp}	______	= ______	m^4

L_{ccc}	____	= ________	m
L_{ptn}	____	= ________	m
S_{ptn}	____	= ________	m
SF	____	= ________	1.10

Determine

θ_1	____	deg
DFD_1	____	m
$QSD_1 =$	$DFD_o - DFD_1$ __________________________________	m

$a = (FBD_o/DM)(S_{ptn} * L_{ccc})/A_{wp} =$ _____ $(A_{MIN} = 4.0)$

$k = 0.55 + 0.08(a–4.0) + 0.056(1.52–GM) =$ _____ $(GM_{MAX} = 2.44$ m)

$X = D_m(V_t/V_p)(A_{wp}^2/I_{wp})(L_{ccc}/L_{ptn}) =$ ______ m

= $(X_{MIN} = 12.19$ m)

$RMW = 9.3 + 0.11(X–12.19)$	= ________	m
$RDFD = SF\ (k * QSD_1 + RMW)$	= ________	m

Results downflooding margin:

$DFD_o - RDFD =$ __________ (min = 0.0 m)

GM = ______ m (KG = ______ m)

Note: The minimum GM is that which produces a downflooding margin = 0.0 m.