



ပြည်ထောင်စုသမ္မတမြန်မာနိုင်ငံတော်အစိုးရ
ပို့ဆောင်ရေးနှင့်ဆက်သွယ်ရေးဝန်ကြီးဌာန
ရေကြောင်းပို့ဆောင်ရေးညွှန်ကြားမှုဦးစီးဌာန

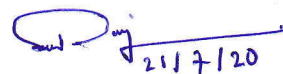
ညွှန်ကြားချက် အမှတ် ၈ / ၂၀၂၀

၁၃၈၂ခုနှစ်၊ ဒုတိယဝါဆိုလဆန်း ၂ ရက်

(၂၀၂၀ ပြည့်နှစ်၊ ဇူလိုင်လ ၂၁ ရက်)

၁။ ပို့ဆောင်ရေးနှင့်ဆက်သွယ်ရေးဝန်ကြီးဌာန၊ ရေကြောင်းပို့ဆောင်ရေးညွှန်ကြားမှုဦးစီးဌာနသည် မြန်မာနိုင်ငံကုန်သည်သင်္ဘောအက်ဥပဒေ ပုဒ်မ ၂၉၄-ခ ပုဒ်မခွဲ (ခ) အရ အပ်နှင်းထားသော လုပ်ပိုင်ခွင့်ကိုကျင့်သုံး၍ “ဝမ်းလောင်းကုန်စည်တင်ဆောင်သော ဘေးကိုယ်ထည် တစ်ထပ်တည်းရှိသည့် ကုန်တင်သင်္ဘောများ၏ ဘေးဘက်ကိုယ်ထည်ပိုင်း တည်ဆောက်မှု စံချိန်စံညွှန်းဆိုင်ရာညွှန်ကြားချက်” ကိုထုတ်ပြန်လိုက်သည်။

၂။ မြန်မာအလံလွှင့်ထူထားသည့် အပြည်ပြည်ဆိုင်ရာခရီးစဉ်သွားသင်္ဘောများ၏ပိုင်ရှင်များ၊ အသိအမှတ်ပြုအဖွဲ့အစည်းများနှင့် အလံတင်နိုင်ငံ၏ တိုင်းတာစစ်ဆေးရေးမှူးများသည် ပင်လယ်ပြင်၌ အသက်အန္တရာယ်ကင်းရှင်းရေးအတွက် အပြည်ပြည်ဆိုင်ရာ ကွန်းဗင်းရှင်း (International Convention for the Safety of Life at Sea, 1974 (SOLAS 74)) နှင့် ယင်း၏ နောက်ဆက်တွဲစာချုပ်များ (Protocols) ပါ အခန်း ၂-၁ နှင့် အခန်း ၁၂၊ စည်းမျဉ်း ၁၄ တို့ပါ ဝမ်းလောင်းကုန်စည် တင်ဆောင်သော ဘေးကိုယ်ထည် တစ်ထပ်တည်းရှိသည့် ကုန်တင်သင်္ဘောများ၏ ဘေးဘက်ကိုယ်ထည်ပိုင်း တည်ဆောက်မှုဆိုင်ရာ စံချိန်စံညွှန်းများနှင့် စပ်လျဉ်းသည့် ပြဋ္ဌာန်းချက်များအရ ထုတ်ပြန်ထားသော နောက်ဆက်တွဲ (က) တွင် ဖော်ပြထားသည့် ဆုံးဖြတ်ချက် အမ်အက်စ်စီ-၁၆၈ (၇၉) နှင့် နောက်ဆက်တွဲ (ခ) တွင် ဖော်ပြထားသည့် ဆုံးဖြတ်ချက် အမ်အက်စ်စီ-၁၇၀ (၇၉) တို့ပါ စံချိန်စံညွှန်းများအား လိုက်နာကျင့်သုံးရမည်။


၂၀၂၀/၇/၂၁

စိုးနိုင်

ညွှန်ကြားရေးမှူးချုပ် (ပူးတွဲတာဝန်)

စာအမှတ်၊ ရညန/ညွှန်ကြားချက်/ ၀၇၄၉

ရက်စွဲ၊ ၂၀၂၀ ပြည့်နှစ်၊ ဇူလိုင်လ ၂၁ ရက်

ဖြန့်ဝေခြင်း

မြန်မာ့ကြယ်ငါးပွင့်သင်္ဘောလုပ်ငန်းကုမ္ပဏီလီမိတက်

နိုင်ငံခြားသွားသင်္ဘောပိုင်ရှင်များအသင်း

ကမ်းရိုးတန်းသွားရေယာဉ်ပိုင်ရှင်များအသင်း

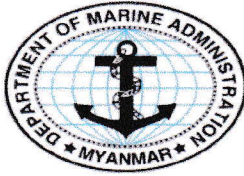
ညွှန်ကြားရေးမှူးချုပ်

ပုံနှိပ်ရေးနှင့်ထုတ်ဝေရေးဦးစီးဌာန

} ပြည်ထောင်စုသမ္မတ မြန်မာနိုင်ငံတော်ပြန်တမ်း အပိုင်း(၁)တွင်
ထည့်သွင်းကြေညာပေးပါရန် မေတ္တာရပ်ခံချက်ဖြင့်ပေးပို့ပါသည်။

မိတ္တူကို

- ပို့ဆောင်ရေးနှင့်ဆက်သွယ်ရေးဝန်ကြီးဌာန၊
- ပြည်ထောင်စုရှေ့နေချုပ်ရုံး၊
- ရုံးလက်ခံ။



The Republic of the Union of Myanmar
Ministry of Transport and Communications
Department of Marine Administration

Directive No. 8 / 2020

The 2nd Waxing Day of Second Waso, 1382 M.E.

(21th July, 2020)

1. The Department of Marine Administration (DMA) issues this directive relating to **“Provisions of the standards and criteria for side structure in single-side skin bulk carrier”** in the exercise of the powers conferred by sub-section (b) of section 294-(B) of Myanmar Merchant Shipping Act-
2. Flag state surveyors, Recognized Organizations and shipowners of all Myanmar flagged ships engaged on international voyage shall comply with the standards and criteria for side structure of bulk carriers in single-side construction adopted by IMO Resolution MSC.168 (79), prescribed in Annex (A), and IMO Resolution MSC.170 (79), prescribed in Annex (B), to apply the provisions relating to Chapter II-1 and Chapter XII, Regulation 14 of the International Convention for the Safety of Life at Sea, 1974 (SOLAS 74) and its protocols.

Director General (Acting)

Department of Marine Administration

RESOLUTION MSC.168(79)
(adopted on 9 December 2004)
STANDARDS AND CRITERIA FOR SIDE STRUCTURES OF
BULK CARRIERS OF SINGLE-SIDE SKIN CONSTRUCTION

RESOLUTION MSC.170(79)
(adopted on 9 December 2004)
AMENDMENTS TO THE INTERNATIONAL CONVENTION FOR THE
SAFETY OF LIFE AT SEA, 1974, AS AMENDED

ANNEX 3

**RESOLUTION MSC.170(79)
(adopted on 9 December 2004)**

**ADOPTION OF AMENDMENTS TO THE INTERNATIONAL CONVENTION
FOR THE SAFETY OF LIFE AT SEA, 1974, AS AMENDED**

THE MARITIME SAFETY COMMITTEE,

RECALLING Article 28(b) of the Convention on the International Maritime Organization concerning the functions of the Committee,

RECALLING FURTHER article VIII(b) of the International Convention for the Safety of Life at Sea (SOLAS), 1974 (hereinafter referred to as "the Convention"), concerning the amendment procedure applicable to the Annex to the Convention, other than the provisions of chapter I thereof,

HAVING CONSIDERED, at its seventy-ninth session, amendments to the Convention, proposed and circulated in accordance with article VIII(b)(i) thereof,

I. ADOPTS, in accordance with article VIII(b)(iv) of the Convention, amendments to the Convention, the text of which is set out in the Annex to the present resolution;

2. DETERMINES, in accordance with article VIII(b)(vi)(2)(bb) of the Convention, that the said amendments shall be deemed to have been accepted on 1 January 2006, unless, prior to that date, more than one third of the Contracting Governments to the Convention or Contracting Governments the combined merchant fleets of which constitute not less than 50% of the gross tonnage of the world's merchant fleet, have notified their objections to the amendments;

3. INVITES SOLAS Contracting Governments to note that, in accordance with article VIII(b)(vii)(2) of the Convention, the amendments shall enter into force on 1 July 2006 upon their acceptance in accordance with paragraph 2 above;

4. REQUESTS the Secretary-General, in conformity with article VIII(b)(v) of the Convention, to transmit certified copies of the present resolution and the text of the amendments contained in the Annex to all Contracting Governments to the Convention;

5. FURTHER REQUESTS the Secretary-General to transmit copies of this resolution and its Annex to Members of the Organization, which are not Contracting Governments to the Convention.

ANNEX

**AMENDMENTS TO THE INTERNATIONAL CONVENTION FOR
THE SAFETY OF LIFE AT SEA, 1974, AS AMENDED**

CHAPTER II-1

**CONSTRUCTION - STRUCTURE, SUBDIVISION AND STABILITY, MACHINERY
AND ELECTRICAL INSTALLATIONS**

Regulation 2 - Definitions

I The following new paragraph I4 is added after existing paragraph I3:

"I4 *Bulk carrier* means a bulk carrier as defined in regulation XII/I.I."

CHAPTER XII

ADDITIONAL SAFETY MEASURES FOR BULK CARRIERS

I2 The existing text of chapter XII is replaced by the following:

"Regulation 1

Definitions

For the purpose of this chapter:

****** Refer to resolution MSC.I63(78) - Performance standards for shipborne simplified voyage data recorders (S-VDRs).

I *Bulk carrier* means a ship which is intended primarily to carry dry cargo in bulk, including such types as ore carriers and combination carriers*.

2 *Bulk carrier of single-side skin construction* means a bulk carrier as defined in paragraph I, in which:

- .1 any part of a cargo hold is bounded by the side shell; or
- .2 where one or more cargo holds are bounded by a double-side skin, the width of which is less than 760 mm in bulk carriers constructed before 1 January 2000 and less than 1,000 mm in bulk carriers constructed on or after 1 January 2000 but before 1 July 2006, the distance being measured perpendicular to the side shell.

Such ships include combination carriers in which any part of a cargo hold is bounded by the side shell.

3 *Bulk carrier of double-side skin construction* means a bulk carrier as defined in paragraph I, in which all cargo holds are bounded by a double-side skin, other than as defined in paragraph 2.2.

4 *Double-side skin* means a configuration where each ship side is constructed by the side shell and a longitudinal bulkhead connecting the double bottom and the deck. Hopper side tanks and top-side tanks may, where fitted, be integral parts of the double-side skin configuration.

5 *Length* of a bulk carrier means the length as defined in the International Convention on Load Lines in force.

6 *Solid bulk cargo* means any material, other than liquid or gas, consisting of a combination of particles, granules or any larger pieces of material, generally uniform in composition, which is loaded directly into the cargo spaces of a ship without any intermediate form of containment.

7 *Bulk carrier bulkhead and double bottom strength standards* means "Standards for the evaluation of scantlings of the transverse watertight vertically corrugated bulkhead between the two foremost cargo holds and for the evaluation of allowable hold loading of the foremost cargo hold" adopted by resolution 4 of the Conference of Contracting Governments to the International Convention for the Safety of Life at Sea, 1974 on 27 November 1997, as may be amended by the Organization, provided that such amendments are adopted, brought into force and take effect in accordance with the

* Reference is made to:

- .1 For ships constructed before 1 July 2006, resolution 6, Interpretation of the definition of "bulk carrier", as given in chapter IX of SOLAS 1974, as amended in 1994, adopted by the 1997 SOLAS Conference.
- .2 The Interpretation of the provisions of SOLAS chapter XII on Additional safety measures for bulk carriers, adopted by the Maritime Safety Committee of the Organization by resolution MSC.79(70).
- .3 The application provisions of Annex I to the Interpretation of the provisions of SOLAS chapter XII on Additional safety measures for bulk carriers, adopted by the Maritime Safety Committee of the Organization by resolution MSC.89(71).

provisions of article VIII of the present Convention concerning the amendment procedures applicable to the Annex other than chapter I.

8 *Bulk carriers constructed* means bulk carriers the keels of which are laid or which are at a similar stage of construction.

9 *A similar stage of construction* means the stage at which:

- .1 construction identifiable with a specific ship begins; and
- .2 assembly of that ship has commenced comprising at least 50 tonnes or one per cent of the estimated mass of all structural material, whichever is less.

10 *Breadth (B)* of a bulk carrier means the breadth as defined in the International Convention on Load Lines in force.

Regulation 14

Restrictions from sailing with any hold empty

Bulk carriers of 150 m in length and upwards of single-side skin construction, carrying cargoes having a density of 1,780 kg/m³ and above, if not meeting the requirements for withstanding flooding of any one cargo hold as specified in regulation 5.1 and the Standards and criteria for side structures of bulk carriers of single-side skin construction, adopted by the Organization by resolution MSC.168(79), as may be amended by the Organization, provided that such amendments are adopted, brought into force and take effect in accordance with the provisions of article VIII of the present Convention concerning the amendment procedures applicable to the Annex other than chapter I, shall not sail with any hold loaded to less than 10% of the hold's maximum allowable cargo weight when in the full load condition, after reaching 10 years of age. The applicable full load condition for this regulation is a load equal to or greater than 90% of the ship's deadweight at the relevant assigned freeboard."

ANNEX

**AMENDMENTS TO THE PROTOCOL OF 1988 RELATING TO THE
INTERNATIONAL CONVENTION FOR THE SAFETY OF LIFE AT SEA, 1974**

APPENDIX

**MODIFICATIONS AND ADDITIONS TO THE APPENDIX TO THE ANNEX TO THE
INTERNATIONAL CONVENTION FOR THE SAFETY OF LIFE AT SEA, 1974**

Form of Safety Certificate for Passenger Ships

I In the form of the Passenger Ship Safety Certificate, the following new section is inserted between the section commencing with the words "This certificate is valid until" and the section commencing with the words "Issued at":

"Completion date of the survey on which this certificate is based: _ _ _ _ _ ' ' "
(dd/mm/yyyy)

Form of Safety Construction Certificate for Cargo Ships

2 In the form of the Cargo Ship Safety Construction Certificate, the following new section is inserted between the section commencing with the words "This certificate is valid until" and the section commencing with the words "Issued at":

"Completion date of the survey on which this certificate is based: _ _ _ _ _ ' ' "
(dd/mm/yyyy)

Form of Safety Equipment Certificate for Cargo Ships

3 In the form of the Cargo Ship Safety Equipment Certificate, the following new section is inserted between the section commencing with the words "This certificate is valid until" and the section commencing with the words "Issued at":

"Completion date of the survey on which this certificate is based: _ _ _ _ _ ' ' "
(dd/mm/yyyy)

Record of Equipment for the Cargo Ship Safety Equipment Certificate (Form E)

4 Existing section 3 is replaced by the following:

RESOLUTION MSC.168(79)
(adopted on 9 December 2004)
STANDARDS AND CRITERIA FOR SIDE STRUCTURES OF
BULK CARRIERS OF SINGLE-SIDE SKIN CONSTRUCTION

RESOLUTION MSC.168(79)

(adopted on 9 December 2004)

**STANDARDS AND CRITERIA FOR SIDE STRUCTURES OF
BULK CARRIERS OF SINGLE-SIDE SKIN CONSTRUCTION**

THE MARITIME SAFETY COMMITTEE,

RECALLING Article 28(b) of the Convention on the International Maritime Organization concerning the functions of the Committee,

RECALLING ALSO SOLAS chapter XII on Additional safety measures for bulk carriers, which the 1997 SOLAS Conference adopted with the aim of enhancing the safety of ships carrying solid bulk cargoes,

RECALLING FURTHER that, having recognized the need to further improve the safety of bulk carriers in all aspects of their design, construction, equipment and operation, it examined the results of various formal safety assessment (FSA) studies on bulk carrier safety,

RECOGNIZING that banning of alternate hold loading of heavy cargoes in full load condition for bulk carriers of single-side skin construction not meeting appropriate side structural strength requirements would contribute to improving the safety of these ships by reduction of shear forces and bending moments,

NOTING resolution MSC.170(79) by which it adopted, *inter alia*, the revised chapter XII of the 1974 SOLAS Convention, in particular regulation XII/14 – Restrictions from sailing with any hold empty, where reference is made to mandatory standards and criteria which a bulk carrier has to comply with in order to avoid the above-mentioned restrictions,

ACKNOWLEDGING that the International Association of Classification Societies (IACS) has issued the following relevant Unified Requirements:

S12 Rev.2.1 - Side structure in single side skin bulk carriers; and

S31 - Renewal criteria for side shell frames in single side skin bulk carriers not built in accordance with UR S12 Rev.1 or subsequent revisions,

CONSIDERING that the above IACS Unified Requirements embody respectively the standards and criteria necessary to ascertain whether regulation XII/14 of the 1974 SOLAS Convention should apply to a particular bulk carrier, and, therefore, should form the basis of the said standards and criteria,

HAVING CONSIDERED the recommendation made by the Sub-Committee on Ship Design and Equipment at its forty-seventh session,

1. ADOPTS, for the purposes of the application of regulation XII/14 of the 1974 SOLAS Convention:

- .1 the Standards for side structures in single-side skin bulk carriers, set out in Annex 1 to the present resolution; and

- .2 the Renewal criteria for side shell frames and brackets in single-side skin bulk carriers not built in accordance with the Standards for side structures in single-side skin bulk carriers, set out in Annex 2 to the present resolution;
2. INVITES Contracting Governments to the 1974 SOLAS Convention to note that the annexed Standards and Renewal criteria will take effect on 1 July 2006 upon the entry into force of the revised chapter XII of the Convention;
3. REQUESTS the Secretary-General to transmit certified copies of this resolution and the text of the annexed Standards and Renewal criteria to all Contracting Governments to the 1974 SOLAS Convention;
4. FURTHER REQUESTS the Secretary-General to transmit certified copies of this resolution and the text of the annexed Standards and Renewal criteria to all Members of the Organization which are not Contracting Governments to the 1974 SOLAS Convention.

ANNEX 1

STANDARDS FOR SIDE STRUCTURES IN SINGLE-SIDE SKIN BULK CARRIERS

1 Application

For the purpose of SOLAS regulation XII/14, these requirements define the minimum required standards for the side structures within the cargo area of single-side skin bulk carriers of 150 m in length and upwards carrying solid bulk cargoes having a density of 1,780 kg/m³ and above, for them not to be subject to restrictions from sailing with any hold empty.

2 Scantlings of side structures

2.1 The thickness of the side shell plating and the section modulus and shear area of side frames shall be determined according to the criteria of a classification society which is recognized by the Administration in accordance with the provisions of SOLAS regulation XI-1/1, or with applicable national standards of the Administration which provide an equivalent level of safety.

2.2 The scantlings of side hold frames immediately adjacent to the collision bulkhead shall be increased in order to prevent excessive imposed deformation on the shell plating. As an alternative, supporting structures shall be fitted which maintain the continuity of forepeak stringers within the foremost hold.

3 Minimum thickness of frame webs

The thickness of frame webs within the cargo area shall not be less than $t_{w,min}$, in mm, given by:

$$t_{w,min} = C(7.0 + 0.03L)$$

where:

C = 1.15 for the frame webs in way of the foremost hold;
1 for the frame webs in way of other holds.

L = the distance, in m, on the summer load waterline from the fore side of stem to the after side of the rudder post, or the centre of the rudder stock if there is no rudder post. L shall not be less than 96%, and need not be greater than 97%, of the extreme length on the summer load waterline but need not be taken greater than 200 m.

4 Lower and upper brackets

4.1 The thickness of the frame lower brackets shall not be less than the greater of t_w and $t_{w,min} + 2$ mm, where t_w is the fitted thickness of the side frame web. The thickness of the frame upper bracket shall not be less than the greater of t_w and $t_{w,min}$.

4.2 The section modulus SM of the frame and bracket or integral bracket, and associated shell plating, at the locations shown in figure 1, shall not be less than twice the section modulus SM_F required for the frame midspan area.

4.3 The dimensions of the lower and upper brackets shall not be less than those shown in figure 2.

4.4 Structural continuity with the upper and lower end connections of side frames shall be ensured within topside and hopper tanks by connecting brackets as shown in figure 3. The brackets shall be stiffened against buckling according to the criteria of a classification society which is recognized by the Administration in accordance with the provisions of SOLAS regulation XI-1/1, or with applicable national standards of the Administration which provide an equivalent level of safety.

4.5 The section moduli of the side longitudinals and sloping bulkhead longitudinals which support the connecting brackets shall be determined with the span taken between transverses according to the requirements of a classification society which is recognized by the Administration in accordance with the provisions of SOLAS regulation XI-1/1, or with applicable national standards of the Administration which provide an equivalent level of safety. Where other arrangements are adopted at the discretion of the Administration or a recognized classification society, the section moduli of the side longitudinals and sloping bulkhead longitudinals shall be determined according to the applicable criteria for the purpose of effectively supporting the brackets.

5 Side frame sections

5.1 Frames shall be fabricated symmetrical sections with integral upper and lower brackets and shall be arranged with soft toes.

5.2 The side frame flange shall be curved (not knuckled) at the connection with the end brackets. The radius of curvature shall not be less than r , in mm, given by:

$$r = \frac{0.4b_f^2}{t_f}$$

where b_f and t_f are the flange width and thickness of the brackets, respectively, in mm. The end of the flange shall be sniped.

5.3 In ships less than 190 m in length, mild steel frames may be asymmetric and fitted with separate brackets. The face plate or flange of the bracket shall be sniped at both ends. Brackets shall be arranged with soft toes.

5.4 The frame web thickness ratio of frames shall not exceed the following values:

- .1 $60 k^{0.5}$ for symmetrically flanged frames;
- .2 $50 k^{0.5}$ for asymmetrically flanged frames;

where:

- $k = 1$ for ordinary hull structural steel;
- $k = 0.78$ for steel with yield stress of 315 N/mm²; and
- $k = 0.72$ for steel with yield stress of 355 N/mm².

The outstanding flange shall not exceed $10 k^{0.5}$ times the net flange thickness.

6 Tripping brackets

In way of the foremost hold, side frames of asymmetrical section shall be fitted with tripping brackets at every two frames, as shown in figure 4.

7 Weld connections of frames and end brackets

7.1 Double continuous welding shall be adopted for the connections of frames and brackets to side shell and hopper and top-side tank plating and web to face plates.

7.2 For this purpose, the weld throat shall be (see figure 1):

.1 0.44 t in zone "a";

.2 0.4 t in zone "b";

where t is the thinner of the two connected members.

7.3 Where the hull form is such as to prohibit an effective fillet weld, edge preparation of the web of frame and bracket may be required, in order to ensure the same efficiency as the weld connection stated above.

8 Minimum net thickness of side shell plating

The thickness of side shell plating located between the hopper and top-side tank shall not be less than $t_{p,min}$, in mm, given by:

$$t_{p,min} = \sqrt{L}$$

Figure 1

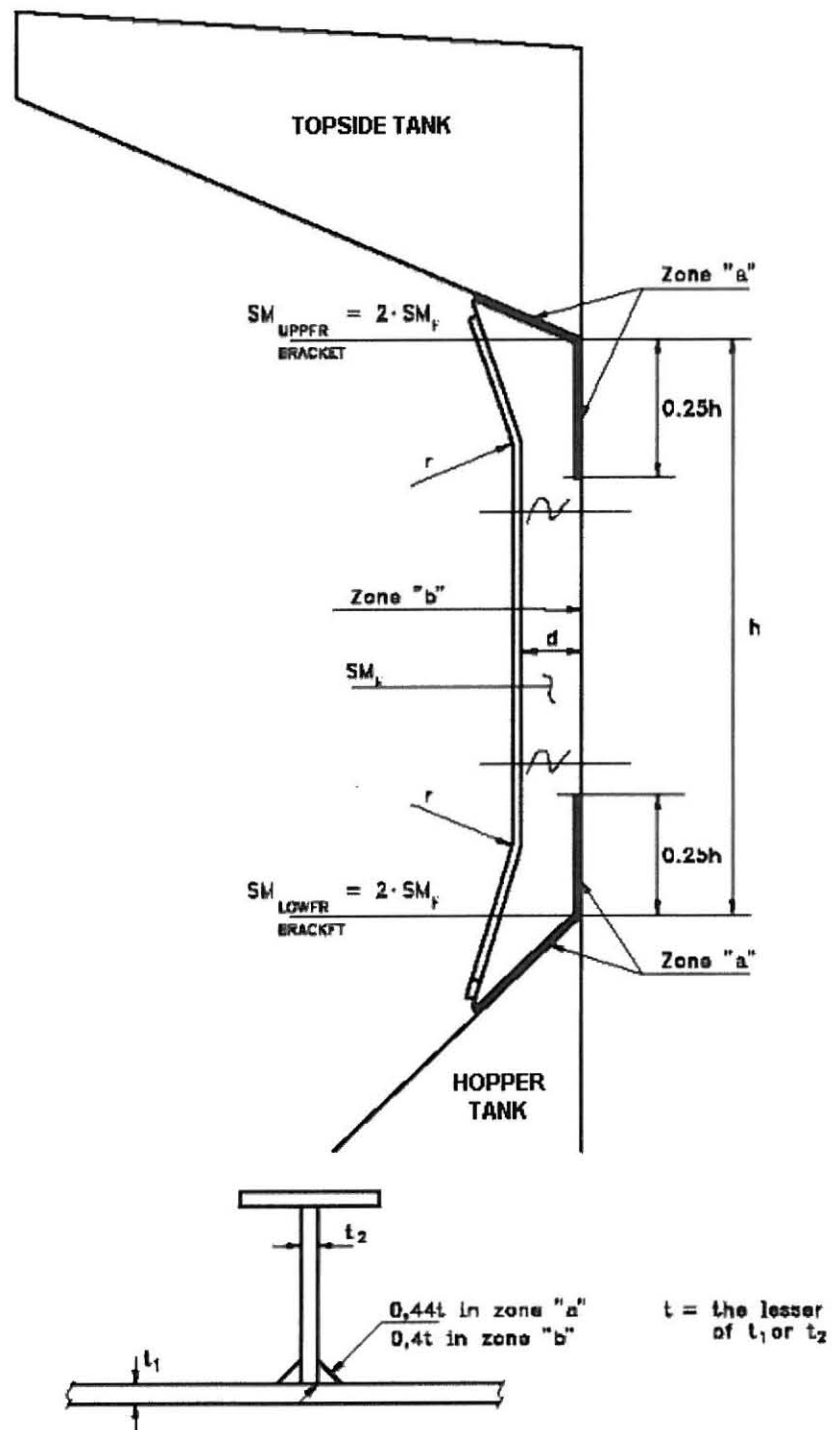


Figure 2

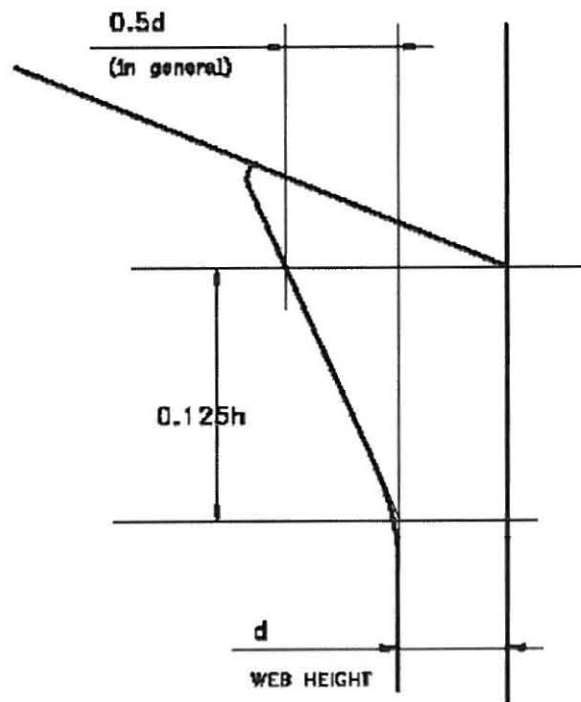


Figure 3

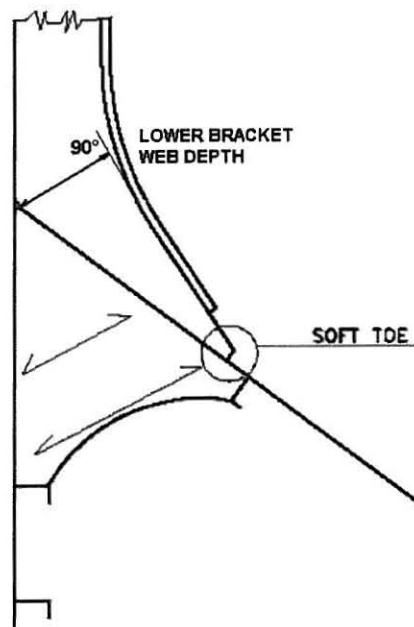
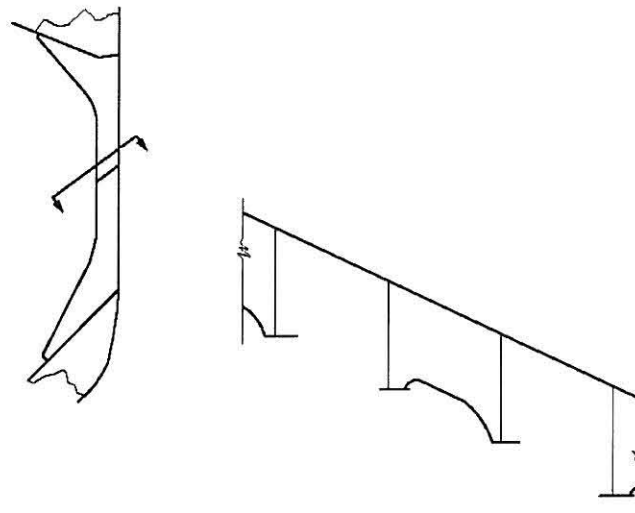


Figure 4 - Tripping brackets to be fitted in way of foremost hold



ANNEX 2

RENEWAL CRITERIA FOR SIDE SHELL FRAMES AND BRACKETS IN SINGLE-SIDE SKIN BULK CARRIERS NOT BUILT IN ACCORDANCE WITH THE STANDARDS FOR SIDE STRUCTURES IN SINGLE-SIDE SKIN BULK CARRIERS

1 Application and definitions

For the purpose of SOLAS regulation XII/14, these requirements apply to the side shell frames and brackets of cargo holds in single-side skin bulk carriers, which were not built in accordance with annex 1, but shall achieve an equivalent level of safety for not being subject to restrictions when sailing with any hold empty.

These requirements define steel renewal criteria or other measures to be taken for the webs and flanges of side shell frames and brackets as per 2.

Reinforcing measures of side frames are also defined as per 2.3.

Finite element or other numerical analysis or direct calculation procedures cannot be used as an alternative to compliance with the requirements of this annex, except in cases of unusual side structure arrangements or framing to which the requirements of this annex cannot be directly applied.

Assessment of compliance with these requirements is to be carried out by the date on which the ship reaches 10 years of age and at each subsequent intermediate and renewal survey.

1.1 Ice strengthened ships

1.1.1 Where bulk carriers are reinforced to comply with an ice class notation, the intermediate frames shall not be included when considering compliance with this annex.

1.1.2 The renewal thicknesses for the additional structure required to meet the ice strengthening notation shall be based on the classification society's requirements.

1.1.3 If the ice class notation is requested to be withdrawn, the additional ice strengthening structure, with the exception of tripping brackets (see 2.1.2.1.2.b and 2.3), shall not be considered to contribute to compliance with this annex.

2 Renewal or other measures

2.1 Criteria for renewal or other measures

2.1.1 Symbols used in 2.1

t_M	=	thickness as measured, in mm
t_{REN}	=	thickness at which renewal is required (2.1.2)
$t_{REN,d/t}$	=	thickness criteria based on d/t ratio (2.1.2.1)
$t_{REN,S}$	=	thickness criteria based on strength (2.1.2.2)
t_{COAT}	=	$0.75 t_{S12}$
t_{S12}	=	thickness, in mm, as required by annex 1 in paragraph 3 for frame webs and in paragraph 4 for upper and lower brackets
t_{AB}	=	thickness as built, in mm
t_C	=	See table 1 below

Table 1 - t_C values, in mm

Ship's length L, in m	Holds other than No.1		Hold No.1	
	Span and upper brackets	Lower brackets	Span and upper brackets	Lower brackets
≤100	2	2.5	2	3
150	2	3	3	3.5
≥ 200	2	3	3	4

Note: For intermediate ship lengths, t_C is obtained by linear interpolation between the above values.

2.1.2 Criteria for webs (shear and other checks)

The webs of side shell frames and brackets shall be renewed when the measured thickness (t_M) is equal to, or less than, the thickness (t_{REN}) as defined below:

t_{REN} is the greatest of:

- .1 $t_{COAT} - t_C$
- .2 $0.75 t_{AB}$
- .3 $t_{REN,d/t}$
- .4 $t_{REN,S}$ (where required by 2.1.2.2)

2.1.2.1 Thickness criteria based on d/t ratio

2.1.2.1.1 Subject to b) and c) below, $t_{REN,d/t}$ is given by the following equation:

$$t_{REN,d/t} = (\text{web depth in mm})/R$$

where:

R = for frames

65 $k^{0.5}$ for symmetrically flanged frames

55 $k^{0.5}$ for asymmetrically flanged frames

for lower brackets (see a) below):

87 $k^{0.5}$ for symmetrically flanged frames

73 $k^{0.5}$ for asymmetrically flanged frames

k = 1 for ordinary hull structural steel;

k = 0.78 for steel with yield stress of 315 N/mm²; and

k = 0.72 for steel with yield stress of 355 N/mm².

2.1.2.1.2 In no instance shall $t_{REN,d/t}$ for lower integral brackets be taken as less than $t_{REN,d/t}$ for the frames they support.

a) Lower brackets

In calculating the web depth of the lower brackets, the following shall apply:

- .1 The web depth of lower bracket may be measured from the intersection of the sloped bulkhead of the hopper tank and the side shell plate, perpendicularly to the face plate of the lower bracket (see figure 3).
- .2 Where stiffeners are fitted on the lower bracket plate, the web depth may be taken as the distance between the side shell and the stiffener, between the stiffeners or between the outermost stiffener and the face plate of the brackets, whichever is the greatest.

b) Tripping bracket alternative

When t_M is less than $t_{REN,d/t}$ at section b) of the side frames (see figure 2), tripping brackets in accordance with 2.3 may be fitted as an alternative to the requirements for the web depth to thickness ratio of side frames, in which case $t_{REN,d/t}$ may be disregarded in the determination of t_{REN} in accordance with 2.1.2.

c) Immediately abaft collision bulkhead

For the side frames located immediately abaft the collision bulkhead, whose scantlings are increased in order that their moment of inertia is such as to avoid undesirable flexibility of the side shell, when their web as built thickness t_{AB} is greater than $1.65t_{REN,S}$, the thickness $t_{REN,d/t}$ may be taken as the value $t'_{REN,d/t}$ obtained from the following equation:

$$t'_{REN,d/t} = \sqrt[3]{t_{REN,d/t}^2 t_{REN,S}}$$

where $t_{REN,S}$ is obtained from 3.3.

2.1.2.2 Thickness criteria based on shear strength check

Where t_M in the lower part of side frames, as defined in figure 1, is equal to, or less than, t_{COAT} , $t_{REN,S}$ shall be determined in accordance with 3.3.

2.1.2.3 Thickness of renewed webs of frames and lower brackets

Where steel renewal is required, the renewed webs shall be of a thickness not less than t_{AB} , $1.2t_{COAT}$ or $1.2t_{REN}$, whichever is the greatest.

2.1.2.4 Criteria for other measures

2.1.2.4.1 When $t_{REN} < t_M \leq t_{COAT}$, measures shall be taken, consisting of all the following:

- .1 sand blasting, or equivalent, and coating (see 2.2);
- .2 fitting tripping brackets (see 2.3), when the above condition occurs for any of the side frame zones A, B, C and D, shown in figure 1; and
- .3 maintaining the coating in "as new" condition (i.e. without breakdown or rusting) at renewal and intermediate surveys.

2.1.2.4.2 The above measures may be waived if the structural members show no thickness diminution with respect to the as-built thicknesses and coating is in "as new" condition (i.e. without breakdown or rusting).

2.1.3 Criteria for frames and brackets (bending check)

Where the length or depth of the lower bracket does not meet the requirements in annex 1, a bending strength check in accordance with 3.4 shall be carried out and renewals or reinforcements of frames and/or brackets effected as required therein.

2.2 Thickness measurements, steel renewal, sand blasting and coating

2.2.1 For the purpose of steel renewal, sand blasting and coating, four zones A, B, C and D are defined, as shown in figure 1.

2.2.2 Representative thickness measurements shall be taken for each zone and shall be assessed against the criteria in 2.1.

2.2.3 In case of integral brackets, when the criteria in 2.1 are not satisfied for zone A or B, steel renewal, sand blasting and coating, as applicable, shall be done for both zones A and B.

2.2.4 In case of separate brackets, when the criteria in 2.1 are not satisfied for zone A or B, steel renewal, sand blasting and coating shall be done for each one of these zones, as applicable.

2.2.5 When steel renewal is required for zone C according to 2.1, it shall be done for both zones B and C. When sand blasting and coating is required for zone C according to 2.1, it shall be done for zones B, C and D.

2.2.6 When steel renewal is required for zone D according to 2.1, it needs only to be done for this zone. When sand blasting and coating is required for zone D according to 2.1, it shall be done for both zones C and D.

2.2.7 Special consideration may be given to zones previously renewed or re-coated, if found in "as new" condition (i.e., without breakdown or rusting) by the Administration or a classification society which is recognized by the Administration in accordance with the provisions of SOLAS regulation XI-1/1.

2.2.8 When adopted, on the basis of the renewal thickness criteria in 2.1, in general coating shall be applied in compliance with the requirements of the organization, as applicable.

2.2.9 Where, according to the requirements in 2.1, a limited number of side frames and brackets are shown to require coating over part of their length, the following criteria apply:

.1 The part to be coated includes:

- the web and the face plate of the side frames and brackets,
- the hold surface of side shell, hopper tank and topside tank plating, as applicable, over a width not less than 100 mm from the web of the side frame.

.2 Epoxy coating or equivalent shall be applied.

2.2.10 In all cases, all the surfaces to be coated shall be sand blasted prior to coating application.

2.3 Reinforcing measures

2.3.1 Reinforcing measures are constituted by tripping brackets, located at the lower part and at midspan of side frames (see figure 4). Tripping brackets may be located at every two frames, but lower and midspan brackets shall be fitted in line between alternate pairs of frames.

2.3.2 The thickness of the tripping brackets shall be not less than the as-built thickness of the side frame webs to which they are connected.

2.3.3 Double continuous welding shall be adopted for the connections of tripping brackets to the side shell frames and shell plating.

2.4 Weld throat thickness

In case of steel renewal, the welded connections shall comply with paragraph 7 of annex 1.

2.5 Pitting and grooving

2.5.1 If pitting intensity is higher than 15% in area (see figure 5), thickness measurement shall be taken to check pitting corrosion.

2.5.2 The minimum acceptable remaining thickness in pits or grooves is equal to:

- .1 75% of the as-built thickness, for pitting or grooving in the frame and brackets webs and flanges; and
- .2 70% of the as-built thickness, for pitting or grooving in the side shell, hopper tank and topside tank plating attached to the side frame, over a width up to 30 mm from each side of it.

3 Strength check criteria

In general, loads shall be calculated and strength checks shall be carried out for the aft, middle and forward frames of each hold. The scantlings required for frames in intermediate positions shall be obtained by linear interpolation between the results obtained for the above frames. When scantlings of side frames vary within a hold, the required scantlings shall also be calculated for the mid-frame of each group of frames having the same scantlings. The scantlings required for frames in intermediate positions shall be obtained by linear interpolation between the results obtained for the calculated frames.

3.1 Load model

3.1.1 Forces

The forces $P_{fr,a}$ and $P_{fr,b}$, in kN, to be considered for the strength checks at sections a) and b) of side frames (specified in figure 2; in the case of separate lower brackets, section b) is at the top of the lower bracket), are given by:

$$P_{fr,a} = P_s + \max(P_1, P_2)$$

$$P_{fr,b} = P_{fr,a} \frac{h - 2h_B}{h}$$

where:

$$P_s = \text{still water pressure force, in kN}$$

$$= s h \left(\frac{P_{s,U} + P_{s,L}}{2} \right) \quad \text{when the upper end of the side frame span } h \text{ (see figure 1) is below the load water line}$$

$$= s h' \left(\frac{P_{s,L}}{2} \right) \quad \text{when the upper end of the side frame span } h \text{ (see figure 1) is at or above the load water line}$$

$$\begin{aligned} P_1 &= \text{wave pressure force, in kN, in head seas} \\ &= sh \left(\frac{P_{1,U} + P_{1,L}}{2} \right) \end{aligned}$$

$$\begin{aligned} P_2 &= \text{wave pressure force, in kN, in beam seas} \\ &= sh \left(\frac{P_{2,U} + P_{2,L}}{2} \right) \end{aligned}$$

$$h, h_B = \text{side frame span and lower bracket length, in m, defined in figures 1 and 2, respectively}$$

$$h' = \text{distance, in m, between the lower end of side frame span } h \text{ (see figure 1) and the load waterline}$$

$$s = \text{frame spacing, in m}$$

$$p_{S,U}, p_{S,L} = \text{still water pressure, in kN/m}^2, \text{ at the upper and lower end of the side frame span } h \text{ (see figure 1), respectively}$$

$$p_{1,U}, p_{1,L} = \text{wave pressure, in kN/m}^2, \text{ as defined in 3.1.2.1, below for the upper and lower end of the side frame span } h, \text{ respectively}$$

$$p_{2,U}, p_{2,L} = \text{wave pressure, in kN/m}^2, \text{ as defined in 3.1.2.2, below for the upper and lower end of the side frame span } h, \text{ respectively}$$

3.1.2 Wave pressure

3.1.2.1 Wave pressure p_1

3.1.2.1.1 The wave pressure p_1 , in kN/m^2 , at and below the waterline is given by:

$$p_1 = 1.50 \left[p_{11} + 135 \frac{B}{2(B+75)} - 1.2(T-z) \right]$$

$$p_{11} = 3k_s C + k_f$$

3.1.2.1.2 The wave pressure p_1 , in kN/m^2 , above the water line is given by:

$$p_1 = p_{1wl} - 7.50 (z - T)$$

3.1.2.2 Wave pressure p_2

3.1.2.2.1 The wave pressure p_2 , in kN/m^2 , at and below the waterline is given by:

$$p_2 = 13.0 \left[0.5B \frac{50C_r}{2(B + 75)} + C_B \frac{0.5B + k_f}{14} \left(0.7 + 2 \frac{z}{T} \right) \right]$$

3.1.2.2.2 The wave pressure p_2 , in kN/m^2 , above the water line is given by:

$$p_2 = p_{2wl} - 5.0 (z - T)$$

where:

p_{1wl} = p_1 wave sea pressure at the waterline

p_{2wl} = p_2 wave sea pressure at the waterline

L = the distance, in m, on the summer load waterline from the fore side of stem to the after side of the rudder post, or the centre of the rudder stock if there is no rudder post. L shall not be less than 96%, and need not be greater than 97%, of the extreme length on the summer load waterline.

B = greatest moulded breadth, in m

C_B = moulded block coefficient at draught d corresponding to summer load waterline, based on length L and moulded breadth B , but not to be taken less than 0.6:

$$C_B = \frac{\text{moulded displacement } [\text{m}^3] \text{ at draught } d}{LBd}$$

T = maximum design draught, in m

C = coefficient

$$= 10.75 - \left(\frac{300 - L}{100} \right)^{1.5} \quad \text{for } 90 \leq L \leq 300 \text{ m}$$

$$= 10.75 \quad \text{for } 300 < L$$

$$C_r = (1.25 - 0.025 \frac{2k_r}{\sqrt{GM}}) k$$

k = 1.2 for ships without bilge keel

= 1 for ships with bilge keel

k_r = roll radius of gyration. If the actual value of k_r is not available

= 0.39 B for ships with even distribution of mass in transverse section (e.g. alternate heavy cargo loading or homogeneous light cargo loading)

= 0.25 B for ships with uneven distribution of mass in transverse section (e.g. homogenous heavy cargo distribution)

GM = 0.12 B if the actual value of GM is not available

z = vertical distance, in m, from the baseline to the load point

k_s = $C_B + \frac{0.83}{\sqrt{C_B}}$ at aft end of L

= C_B between 0.2 L and 0.6 L from aft end of L

= $C_B + \frac{1.33}{C_B}$ at forward end of L

Between the above specified points, k_s shall be varied linearly

k_f = 0.8 C

3.2 Allowable stresses

The allowable normal and shear stresses σ_a and τ_a , in N/mm^2 , in the side shell frames are given by:

$$\sigma_a = 0.90 \sigma_F$$

$$\tau_a = 0.40 \sigma_F$$

where σ_F is the minimum upper yield stress, in N/mm^2 , of the material.

3.3 Shear strength check

3.3.1 Where t_M in the lower part of side frames, as defined in figure 1, is equal to, or less than, t_{COAT} , shear strength check shall be carried out in accordance with the following.

3.3.2 The thickness $t_{REN,S}$, in mm, is the maximum between the thicknesses $t_{REN,Sa}$ and $t_{REN,Sb}$ obtained from the shear strength check at sections a) and b) (see figure 2 and 3.1) given by the following, but need not be taken in excess of $0.75t_{S12}$.

.1 at section a): $t_{REN,Sa} = \frac{1,000 k_s P_{fr,a}}{d_a \sin \phi \tau_a}$

.2 at section b): $t_{REN,Sb} = \frac{1,000 k_s P_{fr,b}}{d_b \sin \phi \tau_a}$

where:

- k_s = shear force distribution factor, to be taken equal to 0.6
- $P_{fr,a}$, $P_{fr,b}$ = pressure forces defined in 3.1.1
- d_a , d_b = bracket and frame web depth, in mm, at sections a) and b), respectively (see figure 2); in case of separate (non integral) brackets, d_b shall be taken as the minimum web depth deducting possible scallops
- ϕ = angle between frame web and shell plate
- τ_a = allowable shear stress, in N/mm^2 , defined in 3.2.

3.4 Bending strength check

3.4.1 When the lower bracket length or depth do not comply with requirements in annex 1, the actual section modulus, in cm^3 , of the brackets and side frames at sections a) and b) shall be not less than:

.1 at section a):

$$Z_a = \frac{1,000 P_{fr,a} h}{m_a \sigma_a}$$

.2 at section b):

$$Z_b = \frac{1,000 P_{fr,a} h}{m_b \sigma_a}$$

where:

- $P_{fr,a}$ = pressure force defined in 3.1.1
- h = side frame span, in m, defined in figure 1
- σ_a = allowable normal stress, in N/mm^2 , defined in 3.2
- m_a , m_b = bending moment coefficients defined in table 2

3.4.2 The actual section modulus of the brackets and side frames shall be calculated about an axis parallel to the attached plate, based on the measured thicknesses. For pre-calculations, alternative thickness values may be used, provided they are not less than:

- .1 t_{REN} , for the web thickness;
- .2 the minimum thicknesses allowed by the renewal criteria for flange and attached plating of a classification society which is recognized by the Administration in accordance with the provisions of SOLAS regulation XI-1/1, or by applicable national standards of the Administration which provide an equivalent level of safety.

3.4.3 The attached plate breadth is equal to the frame spacing, measured along the shell at midspan h .

3.4.4 If the actual section moduli at sections a) and b) are less than the values Z_a and Z_b , the frames and brackets shall be renewed or reinforced in order to obtain actual section moduli not less than $1.2 Z_a$ and $1.2 Z_b$, respectively.

3.4.5 In such a case, renewal or reinforcements of the flange shall be extended over the lower part of side frames, as defined in figure 1.

Table 2 – Bending moment coefficients m_a and m_b

	m_a	m_b		
		$h_B = 0.08 h$	$h_B = 0.1 h$	$h_B = 0.125 h$
Empty holds of ships approved to operate in non homogeneous loading conditions	10	17	19	22
Other cases	12	20	22	26
Note 1: Non-homogeneous loading condition means a loading condition in which the ratio between the highest and the lowest filling ratio, evaluated for each hold, exceeds 1.2 corrected for different cargo densities.				
Note 2: For intermediate values of the bracket length h_B , the coefficient m_b is obtained by linear interpolation between the table values.				

Figure 1 – Lower part of side frames

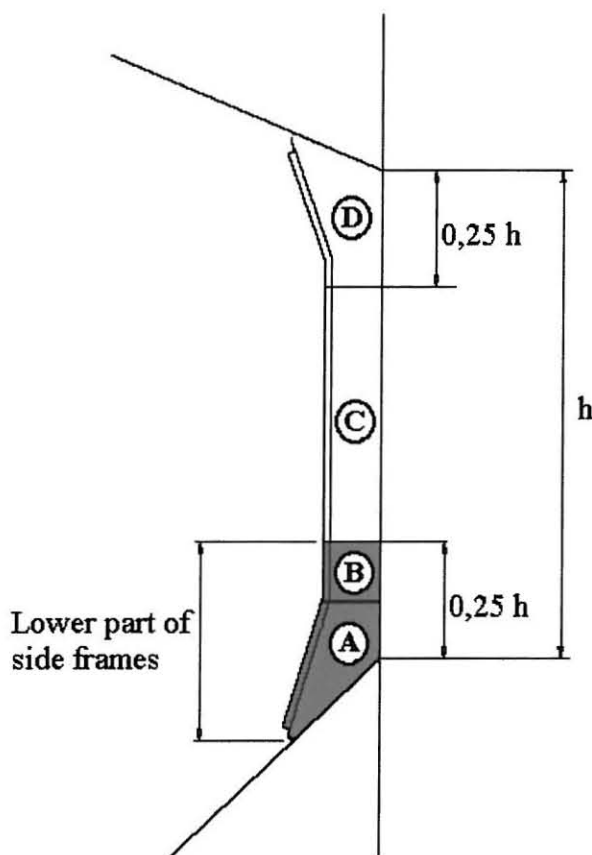


Figure 2 – Sections a) and b)

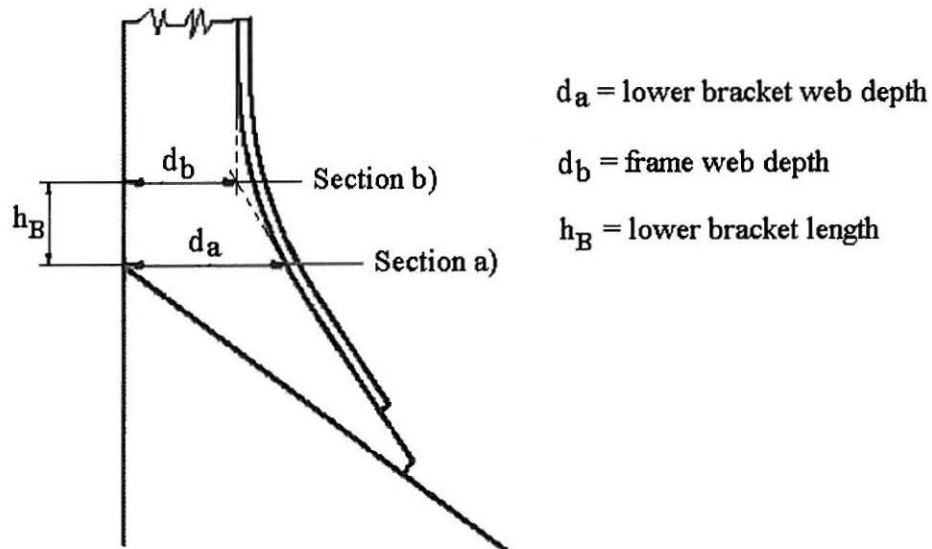


Figure 3 – Definition of the lower bracket web depth

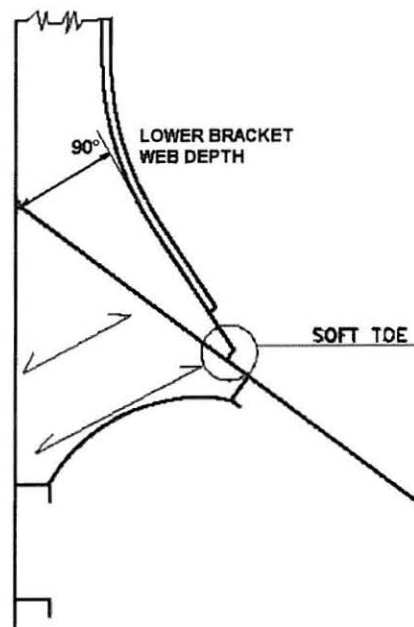


Figure 4 – Tripping brackets

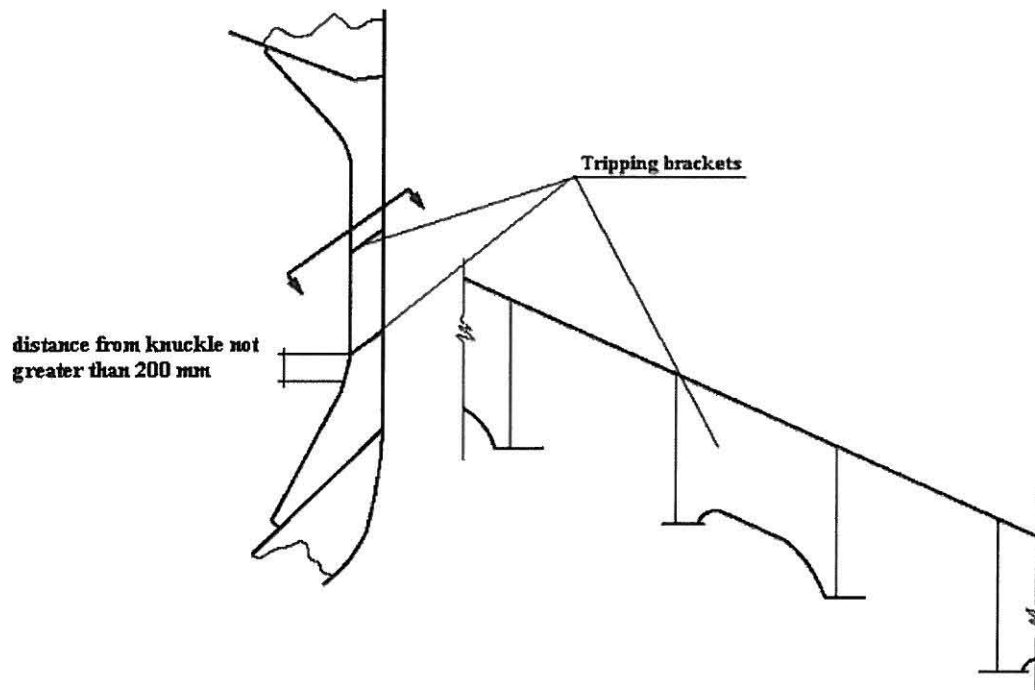
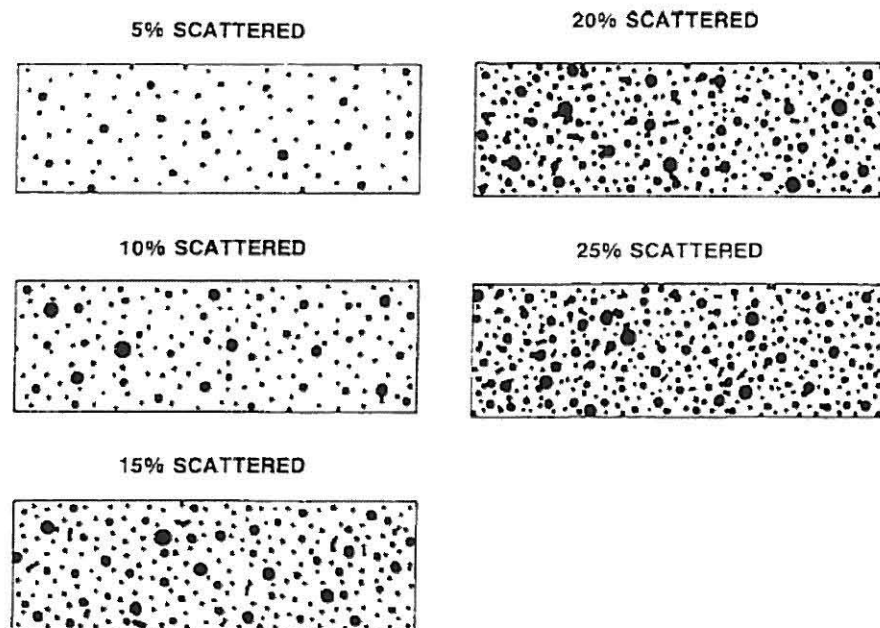


Figure 5 - Pitting intensity diagrams (from 5% to 25% intensity)



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