



# TÜRK LOYDU

## TECHNICAL CIRCULAR

Circular No: S-P 23/13

Revision: 1

Page: 1

Adoption Date: 14.05.2013

**Related Requirement: TL- R S31**

**Subject: Retrospective Application for Renewal Criteria for Side Shell Frames and Brackets in Single Side Skin Bulk Carriers and Single Side Skin OBO Carriers not Built in accordance with TL- R S12**

**Entry into Force Date:**

### 1 Application and definitions\*

These requirements apply to the side shell frames and brackets of cargo holds bounded by the single side shell of bulk carriers constructed with single deck, topside tanks and hopper tanks in cargo spaces intended primarily to carry dry cargo in bulk, which were not built in accordance with **TL- R S12**.

In addition, these requirements also apply to the side shell frames and brackets of cargo holds bounded by the single side shell of Oil/Bulk/Ore(OBO) carriers, as defined in **TL- R Z11** but of single side skin construction.

In the case a vessel as defined above does not satisfy above definition in one or more holds, the requirements in **TL- R S31** do not apply to these individual holds.

For the purpose of these requirements, “ships” means both “bulk carriers” and “OBO carriers” as defined above, unless otherwise specified.

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\* 1. *These requirements are to be applied to bulk carriers and OBO carriers of single side skin construction, as defined above, in conjunction with **TL- R Z10.2. TL- R Z10.2.1.1.5** refers.*

2. ***TL- R S31** are to be applied not later than on assessments for compliance commenced on or after 1 July 2008.*

**TECHNICAL CIRCULAR**

**Circular No:** S-P 23/13

**Revision:** 1

**Page:**2

**Date:** 14.05.2013

**Bulk Carriers** subject to these requirements are to be assessed for compliance with these requirements and steel renewal, reinforcement or coating, where required in accordance with these requirements, is to be carried out in accordance with the following schedule and at subsequent intermediate and special surveys.

i. For bulk carriers which will be 15 years of age or more on 1 January 2004 by the due date of the first intermediate or special survey after that date;

ii. For bulk carriers which will be 10 years of age or more on 1 January 2004 by the due date of the first special survey after that date;

iii. For bulk carriers which will be less than 10 years of age on 1 January 2004 by the date on which the ship reaches 10 years of age.

Completion prior to 1 January 2004 of an intermediate or special survey with a due date after 1 January 2004 cannot be used to postpone compliance.

However, completion prior to 1 January 2004 of an intermediate survey the window for which straddles 1 January 2004 can be accepted.

**OBO carriers** subject to these requirements are to be assessed for compliance with these requirements and steel renewal, reinforcement or coating, where required in accordance with these requirements, is to be carried out in accordance with the following schedule and at subsequent intermediate and special surveys.

i. For OBO carriers which will be 15 years of age or more on 1 July 2005 by the due date of the first intermediate or special survey after that date;

ii. For OBO carriers which will be 10 years of age or more on 1 July 2005 by the due date of the first special survey after that date;

iii. For OBO carriers which will be less than 10 years of age on 1 July 2005 by the date on which the ship reaches 10 years of age.

Completion prior to 1 July 2005 of an intermediate or special survey with a due date after 1 July 2005 cannot be used to postpone compliance. However, completion prior to 1 July 2005 of an intermediate survey the window for which straddles 1 July 2005 can be accepted.

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 these requirements, except in cases of unusual side structure arrangements or framing to which these requirements cannot be directly applied. In such cases, the analysis criteria and the strength check criteria are to be in accordance with **TL** Rules.

## TECHNICAL CIRCULAR

Circular No: S-P 23/13

Revision: 1

Page:3

Date: 14.05.2013

### 1.1 Ice strengthened ships

**1.1.1** Where ships are reinforced to comply with an ice class notation, the intermediate frames are not to be included when considering compliance with

**1.1.2** The renewal thicknesses for the additional structure required to meet the ice strengthening notation are to be based on requirements of **TL**.

**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.b and 2.3), is not to be considered to contribute to compliance with

## 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. See 2.1.2

$t_{REN,d/t}$  = thickness criteria based on d/t ratio. See 2.1.2.1

$t_{REN,S}$  = thickness criteria based on strength. See 2.1.2.2

$t_{COAT} = 0.75 t_{S12}$

$t_{S12}$  = thickness in mm as required by **TL- R S12** in S12.3 for frame webs and in S12.4 for upper and lower bracket webs

$t_{AB}$  = 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                  | 2.0                     | 2.5            | 2.0                     | 3.0            |
| 150                   | 2.0                     | 3.0            | 3.0                     | 3.5            |
| ≥ 200                 | 2.0                     | 3.0            | 3.0                     | 4.0            |

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

## TECHNICAL CIRCULAR

**Circular No:** S-P 23/13

**Revision:** 1

**Page:**4

**Date:** 14.05.2013

### 2.1.2 Criteria for webs (Shear and other checks)

The webs of side shell frames and brackets are to 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:

- (a)  $t_{COAT} - t_C$
- (b)  $0.75 t_{AB}$
- (c)  $t_{REN,d/t}$  (applicable to Zone A and B only)
- (d)  $t_{REN,S}$  (where required by 2.1.2.2)

#### 2.1.2.1 Thickness criteria based on d/t ratio

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

$k = 1.0$  for ordinary hull structural steel and according to **TL- R S4** for higher tensile steel.

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

a) Lower brackets

Lower brackets are to be flanged or face plate is to be fitted, ref. 2.1.3.

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

- 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).
- 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.

## TECHNICAL CIRCULAR

**Circular No:** S-P 23/13

**Revision:** 1

**Page:**5

**Date:** 14.05.2013

### b) Tripping bracket alternative

When  $t_M$  is less than  $t_{REN,d/t}$  at section b of the side frames, 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.

The value of  $t_M$  is to be based on zone B according to **TL- R Z10.2**, ANNEX V, see Figure 1.

### c) Immediately abaft collision bulkhead

For the side frames, including the lower bracket, located immediately abaft the collision bulkheads, whose scantlings are increased in order that their moment of inertia is such to avoid undesirable flexibility of the side shell, when their web as built thickness  $t_{AB}$  is greater than  $1.65 \cdot t_{REN,S}$ , 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  $t_{COAT}$ ,  $t_{REN,S}$  is to 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 are to 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**

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

- a) Sand blasting, or equivalent, and coating (see 2.2).
- b) 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. Tripping brackets not connected to flanges are to have soft toe, and the distance between the bracket toe and the frame flange is not to be greater than about 50 mm, see Figure 4.
- c) Maintaining the coating in "as-new" condition (i.e. without breakdown or rusting) at Special and Intermediate Surveys.

## TECHNICAL CIRCULAR

**Circular No:** S-P 23/13

**Revision:** 1

**Page:**6

**Date:** 14.05.2013

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).

When the measured frame webs thickness  $t_M$  is such that  $t_{REN} < t_M \leq t_{COAT}$  and the coating is in GOOD condition, sand blasting and coating as required in a) above may be waived even if not found in "as-new" condition, as defined above, provided that tripping brackets are fitted and the coating damaged in way of the tripping bracket welding is repaired.

### **2.1.3 Criteria for frames and brackets (Bending check)**

When lower end brackets were not fitted with flanges at the design stage, flanges are to be fitted so as to meet the bending strength requirements in 3.4. The full width of the bracket flange is to extend up beyond the point at which the frame flange reaches full width. Adequate back-up structure in the hopper is to be ensured, and the bracket is to be aligned with the back-up structure.

Where the length or depth of the lower bracket does not meet the requirements in **TL- R S12**, a bending strength check in accordance with 3.4 is to be carried out and renewals or reinforcements of frames and/or brackets effected as required therein.

The bending check needs not to be carried out in the case the bracket geometry is modified so as to comply with **TL- R S12** requirements.

### **2.2 Thickness measurements, steel renewal, sand blasting and coating**

For the purpose of steel renewal, sand blasting and coating, four zones A, B, C and D are defined, as shown in Figure 1. When renewal is to be carried out, surface preparation and coating are required for the renewed structures as given in **TL- R Z9** for cargo holds of new buildings.

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

When zone B is made up of different plate thicknesses, the lesser thickness is to be used for the application of the requirements in

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, are to be done for both zones A and B.

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 is to be done for each one of these zones, as applicable.

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

## TECHNICAL CIRCULAR

**Circular No:** S-P 23/13

**Revision:** 1

**Page:**7

**Date:** 14.05.2013

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 is to be done for both zones C and D.

Special consideration may be given by **TL** to zones previously renewed or re-coated, if found in “as-new” condition (i.e., without breakdown or rusting).

When adopted, on the basis of the renewal thickness criteria in 2.1, in general coating is to be applied in compliance with the requirements of **TL- R Z9**, as applicable.

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.

a) 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.

b) Epoxy coating or equivalent is to be applied.

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

When flanges of frames or brackets are to be renewed according to **TL- R S31**, the outstanding breadth to thickness ratio is to comply with the requirements in **TL- R S12.5**.

### **2.3 Reinforcing measures**

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 are to be fitted in line between alternate pairs of frames.

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

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

Where side frames and side shell are made of Higher Strength Steel (HSS), Normal Strength Steel (NSS) tripping brackets may be accepted, provided the electrodes used for welding are those required for the particular HSS grade, and the thickness of the tripping brackets is equal to the frame web thickness, regardless of the frame web material.

### **2.4 Weld throat thickness**

In case of steel renewal the welded connections are to comply with **TL-R S12.7**.

## TECHNICAL CIRCULAR

**Circular No:** S-P 23/13

**Revision:** 1

**Page:**8

**Date:** 14.05.2013

### **2.5 Pitting and grooving**

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

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

- 75% of the as built thickness, for pitting or grooving in the frame and brackets webs and flanges
- 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.

### **2.6 Renewal of all frames in one or more cargo holds**

When all frames in one or more holds are required to be renewed according to **TL- R S31**, the compliance with the requirements in **TL- R S12** may be accepted in lieu of the compliance with the requirements in **TL- R S31**, provided that:

- It is applied at least to all the frames of the hold(s)
- The coating requirements for side frames of “new ships” are complied with
- The section modulus of side frames is calculated according to the Rules of **TL**.

### **2.7 Renewal of damaged frames**

In case of renewal of a damaged frame already complying with **TL- R S31**, the following requirements apply:

- The conditions accepted in compliance with **TL- R S31** are to be restored as a minimum.
- For localised damages, the extension of the renewal is to be carried out according to the standard practice of **TL**.

## **3 Strength check criteria**

In general, loads are to be calculated and strength checks are to be carried out for the aft, middle and forward frames of each hold. The scantlings required for frames in intermediate positions are to 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 are also to be calculated for the mid frame of each group of frames having the same scantlings.

The scantlings required for frames in intermediate positions are to be obtained by linear interpolation between the results obtained for the calculated frames.



## TECHNICAL CIRCULAR

**Circular No:** S-P 23/13

**Revision:** 1

**Page:**9

**Date:** 14.05.2013

### 3.1 Load model

The following loading conditions are to be considered:

- Homogeneous heavy cargo (density greater than 1,78 t/m<sup>3</sup>)
- Homogeneous light cargo (density less than 1,78 t/m<sup>3</sup>)
- Non homogeneous heavy cargo, if allowed
- Multi port loading/unloading conditions need not be considered.

#### 3.1.1 Forces

The forces P<sub>fr,a</sub> and P<sub>fr,b</sub>, 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<sub>s</sub> = still water force, in kN

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

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

P<sub>1</sub> = wave force, in kN, in head sea

$$= sh \left( \frac{P_{1,U} + P_{1,L}}{2} \right)$$

P<sub>2</sub> = wave force, in kN, in beam sea

$$= sh \left( \frac{P_{2,U} + P_{2,L}}{2} \right)$$

h, h<sub>B</sub> = side frame span and lower bracket length, in m, defined in Figures 1 and 2, respectively

h' = distance, in m, between the lower end of side frame span h (see Figure 1) and the load water line

## TECHNICAL CIRCULAR

**Circular No:** S-P 23/13

**Revision:** 1

**Page:**10

**Date:** 14.05.2013

s = frame spacing, in m

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

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

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

### 3.1.2 Wave Pressure

#### 1) Wave pressure $p_1$

- The wave pressure  $p_1$ , in  $\text{kN/m}^2$ , at and below the waterline is given by:

$$p_1 = 1.50 \left[ p_{11} + 135 \frac{B}{2(B+75)} - 1.2(T-z) \right]$$
$$p_{11} = 3k_s C + k_f$$

- The wave pressure  $p_1$ , in  $\text{kN/m}^2$ , above the water line is given by:

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

#### 2) Wave pressure $p_2$

- The wave pressure  $p_2$ , in  $\text{kN/m}^2$ , at and below the waterline is given by

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

- The wave pressure  $p_2$ , in  $\text{kN/m}^2$ , 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 = Rule length, in m, as defined in **TL- R S2**

## TECHNICAL CIRCULAR

**Circular No:** S-P 23/13

**Revision:** 1

**Page:**11

**Date:** 14.05.2013

B = greatest moulded breadth, in m

$C_B$  = block coefficient, as defined in UR S2, but not to be taken less than 0.6

T = maximum design draught, in m

$$\begin{aligned} C &= \text{coefficient} \\ &= 10.75 - \left( \frac{300 - L}{100} \right)^{1.5} \quad \text{for } 90 \leq L \leq 300 \text{ m} \\ &= 10.75 \quad \text{for } 300 \text{ m} < L \end{aligned}$$

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

k = 1.2 for ships without bilge keel

= 1.0 for ships with bilge keel

kr = roll radius of gyration. If the actual value of kr 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. homogeneous 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

$$\begin{aligned} k_s &= C_B + \frac{0.83}{\sqrt{C_B}} \quad \text{at aft end of L} \\ &= C_B \quad \text{between } 0.2 L \text{ and } 0.6 L \text{ from aft end of L} \\ &= C_B + \frac{1.33}{C_B} \quad \text{at forward end of L} \end{aligned}$$

Between the above specified points,  $k_s$  is to be interpolated linearly.

kf = 0.8 C

### 3.2 Allowable stresses

The allowable normal and shear stresses  $\sigma_a$  and  $\tau_a$ , in  $\text{N/mm}^2$ , in the side shell frames and brackets are given by:

## TECHNICAL CIRCULAR

Circular No: S-P 23/13

Revision: 1

Page:12

Date: 14.05.2013

$$\begin{aligned}\sigma_a &= 0.90 \sigma_F \\ \tau_a &= 0.40 \sigma_F\end{aligned}$$

where  $\sigma_F$  is the minimum upper yield stress, in N/mm<sup>2</sup>, of the material.

### 3.3 Shear strength check

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

The thickness  $t_{REN,S}$ , in mm, is the greater of 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  $0.75t_{S12}$ .

$$\begin{aligned}\text{- at section a): } t_{REN,Sa} &= \frac{1000 k_S P_{fr,a}}{d_a \sin\phi \tau_a} \\ \text{- at section b): } t_{REN,Sb} &= \frac{1000 k_S P_{fr,b}}{d_b \sin\phi \tau_a}\end{aligned}$$

where:

$k_S$  = shear force distribution factor, to be taken equal to 0.6

$P_{fr,a}$ ,  $P_{fr,b}$  = pressures 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,  $d_b$  is to be taken as the minimum web depth deducing possible scallops

$\phi$  = angle between frame web and shell plate

$\tau_a$  = allowable shear stress, in N/mm<sup>2</sup>, defined in 3.2.

### 3.4 Bending strength check

Where the lower bracket length or depth does not meet the requirements in **TL- R S12**, the actual section modulus, in cm<sup>3</sup>, of the brackets and side frames at sections a) and b) is to be not less than:

**TECHNICAL CIRCULAR**

**Circular No:** S-P 23/13

**Revision:** 1

**Page:**13

**Date:** 14.05.2013

- at section a):

$$Z_a = \frac{1000 P_{fr,a} h}{m_a \sigma_a}$$

- at section b)

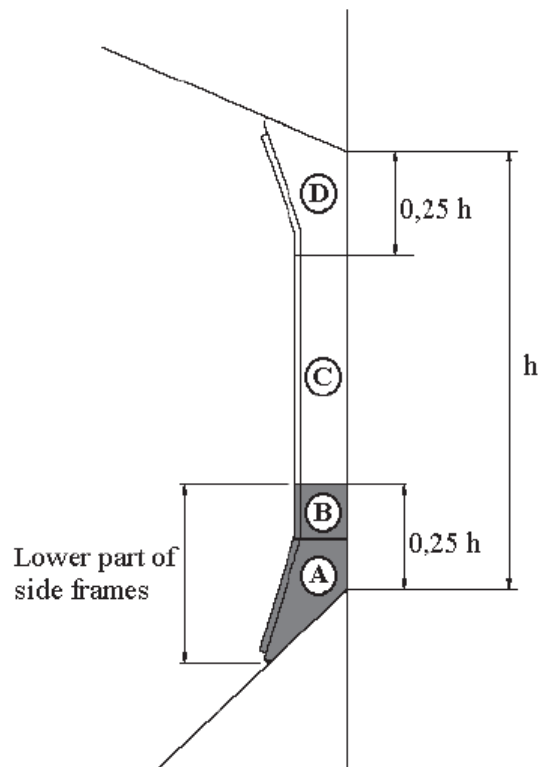
$$Z_b = \frac{1000 P_{fr,a} h}{m_b \sigma_a}$$

where:

$P_{fr,a}$  = pressures force defined in 3.1.1

$h$  = side frame span, in m, defined in Figure 1

**Figure 1 – Lower part and zones of side frames**



$\sigma_a$  = allowable normal stress, in N/mm<sup>2</sup>, defined in 3.2

$m_a, m_b$  = bending moment coefficients defined in Table 2

## TECHNICAL CIRCULAR

**Circular No:** S-P 23/13

**Revision:** 1

**Page:**14

**Date:** 14.05.2013

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

-  $t_{REN}$ , for the web thickness

- the minimum thicknesses allowed by the renewal criteria of **TL** for flange and attached plating.

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

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

In such a case, renewal or reinforcements of the flange are to be extended over the lower part of side frames, as defined in Figure 1.

**Table 2 – Bending moment coefficients  $m_a$  and  $m_b$**

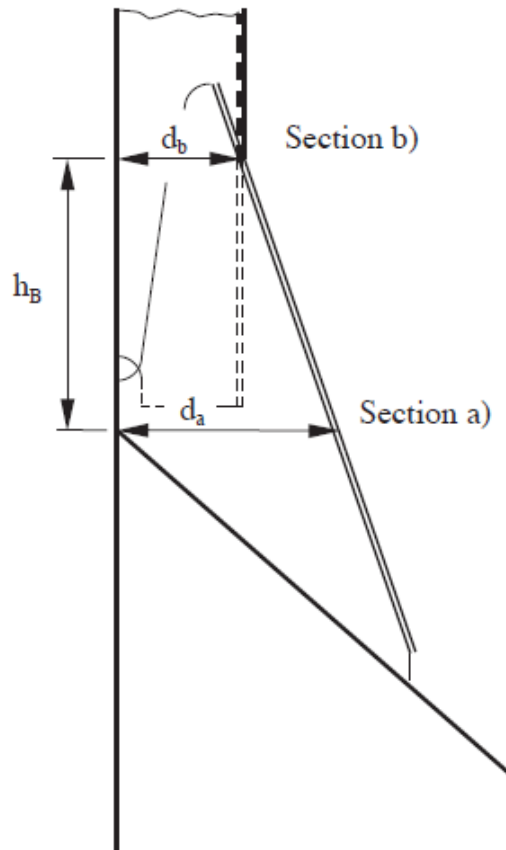
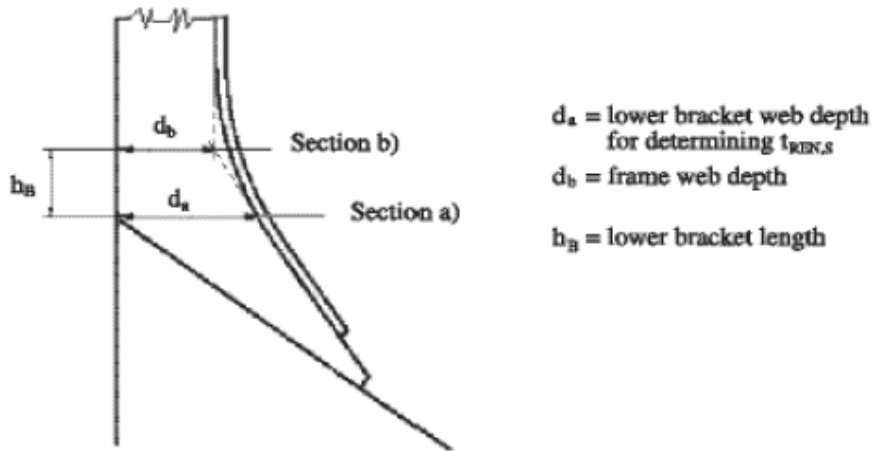
|  | $m_a$ | $m_b$            |              |                   |
|--|-------|------------------|--------------|-------------------|
|  |       | $h_B \leq 0.08h$ | $h_B = 0.1h$ | $h_B \geq 0.125h$ |
| Empty holds of ships approved to operate in non homogeneous loading conditions | 10    | 17               | 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 1.20 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.

**TECHNICAL CIRCULAR**

**Figure 2 – Sections a) and b)**



**TECHNICAL CIRCULAR**

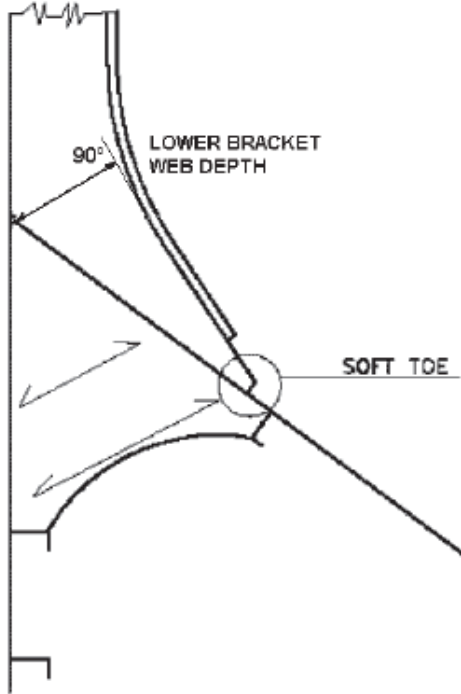
**Circular No: S-P 23/13**

**Revision: 1**

**Page:16**

**Date: 14.05.2013**

**Figure 3 – Definition of the lower bracket web depth for determining  $t_{REN, dt}$**





**TECHNICAL CIRCULAR**

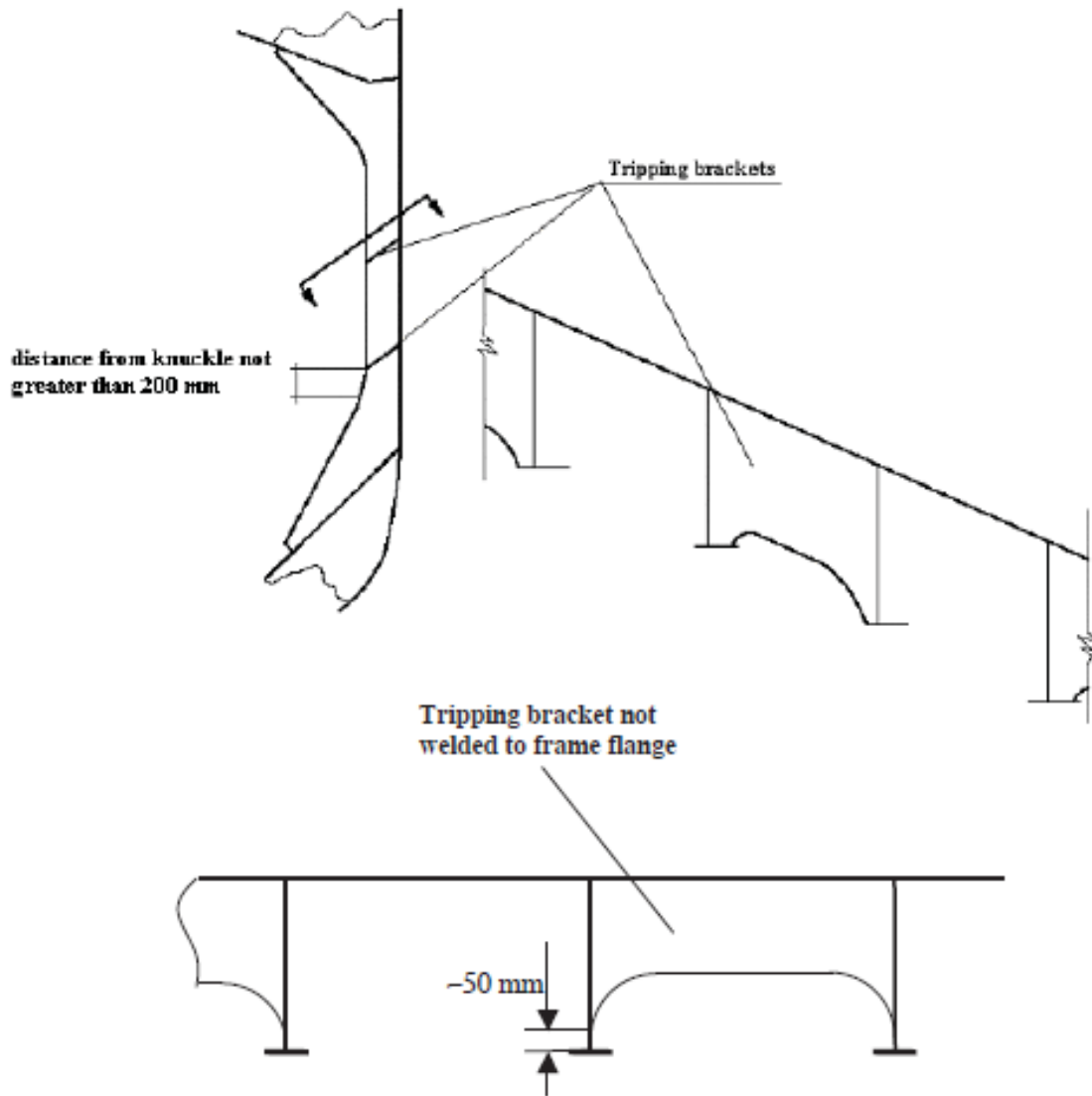
**Circular No: S-P 23/13**

**Revision: 1**

**Page:17**

**Date: 14.05.2013**

**Figure 4 – Tripping brackets**



**TECHNICAL CIRCULAR**

**Circular No: S-P 23/13**

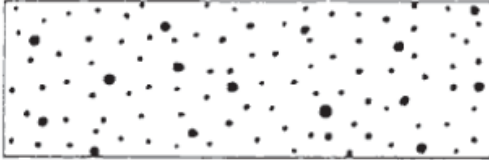
**Revision: 1**

**Page:18**

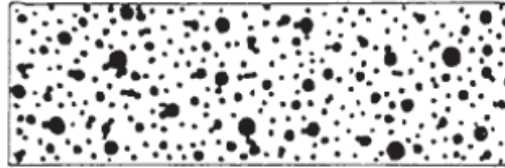
**Date: 14.05.2013**

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

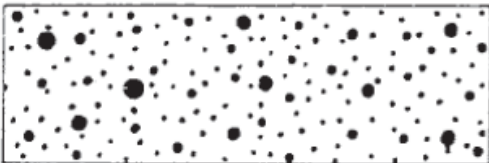
5% SCATTERED



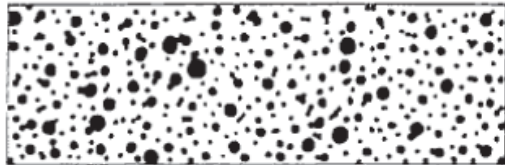
20% SCATTERED



10% SCATTERED



25% SCATTERED



15% SCATTERED

