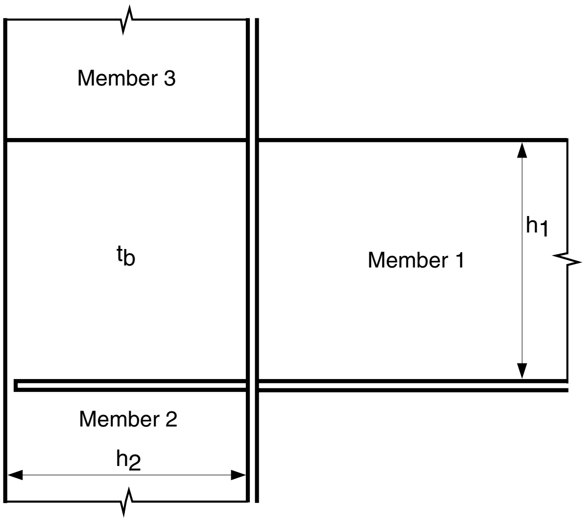
Figure 16 : Bracketless end connections between three primary supporting members



When the flanges of member 2 and member 3 are not continuous, the net thickness of the common part of the webs is to be defined as [4.5.1].

4.5.3 The common part of the webs is to be generally stiffened where the minimum height of the member 1 and member 2 is greater than $100t_b$.

4.5.4 When lamellar tearing of flanges may occur, the flange in way of the connection may be requested to be of Z quality or a 100% ultrasonic testing of the flange in way of the weld may be required prior to and after welding.

4.6 Cut-outs and holes

4.6.1 Cut-outs for the passage of ordinary stiffeners are to be as small as possible and well rounded with smooth edges.

In general, the depth of cut-outs is to be not greater than 50% of the depth of the primary supporting member.

4.6.2 Where openings such as lightening holes are cut in primary supporting members, they are to be equidistant from the face plate and corners of cut-outs and, in general, their height is to be not greater than 20% of the web height.

4.6.3 Openings may not be fitted in way of toes of end brackets.

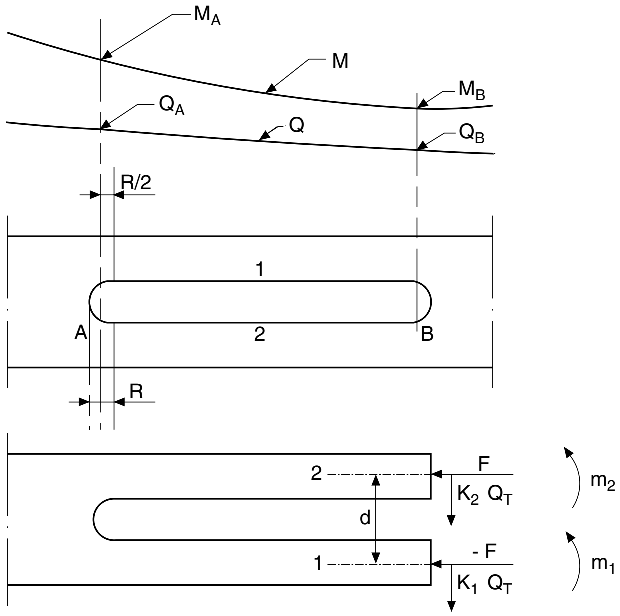
4.6.4 Over half of the span of primary supporting members, the length of openings is to be not greater than the distance between adjacent openings.

At the ends of the span, the length of openings is to be not greater than 25% of the distance between adjacent openings.

4.6.5 In the case of large openings as shown in Fig 17, the secondary stresses in primary supporting members are to be considered for the reinforcement of the openings.

The secondary stresses may be calculated in accordance with the following procedure.

Figure 17 : Large openings in primary supporting members - Secondary stresses



Members (1) and (2) are subjected to the following forces, moments and stresses:

$$F = \frac{M_A + M_B}{2d}$$

$$m_1 = \left|\frac{M_A - M_B}{2}\right| K_1$$

$$m_2 = \left|\frac{M_A - M_B}{2}\right| K_2$$

$$\sigma_{F1} = 10\frac{F}{S_1}$$

$$\sigma_{F2} = 10\frac{F}{S_2}$$

$$\sigma_{m1} = \frac{m_1}{w_1}10^3$$

$$\sigma_{m2} = \frac{m_2}{w_2}10^3$$

$$\tau_1 = 10\frac{K_1 Q_T}{S_{w1}}$$

$$\tau_2 = 10\frac{K_2 Q_T}{S_{w2}}$$

where:

M_A, M_B : Bending moments, in kN.m, in sections A and B of the primary supporting member

m_1, m_2 : Bending moments, in kN.m, in (1) and (2)

d : Distance, in m, between the neutral axes of (1) and (2)

σ_{F1}, σ_{F2} : Axial stresses, in N/mm², in (1) and (2)

σ_{m1}, σ_{m2} : Bending stresses, in N/mm², in (1) and (2)

Q_T : Shear force, in kN, equal to Q_A or Q_B, whichever is greater

τ_1, τ_2 : Shear stresses, in N/mm², in (1) and (2)

w_1, w_2 : Net section moduli, in cm³, of (1) and (2)

S_1, S_2 : Net sectional areas, in cm², of (1) and (2)

S_{w1}, S_{w2} : Net sectional areas, in cm², of webs in (1) and (2)

I_1, I_2 : Net moments of inertia, in cm⁴, of (1) and (2) with attached plating

$$K_1 = \frac{I_1}{I_1 + I_2}$$

$$K_2 = \frac{I_2}{I_1 + I_2}$$

The combined stress σ_C calculated at the ends of members (1) and (2) is to be obtained from the following formula:

$$\sigma_c = \sqrt{(\sigma_F + \sigma_m)^2 + 3\tau^2}$$

The combined stress σ_C is to comply with the checking criteria in Ch 7, Sec 3, [3.6] or Ch 7, Sec 3, [4.3], as applicable. Where these checking criteria are not complied with, the cut-out is to be reinforced according to one of the solutions shown in Fig 18 to Fig 20:

- continuous face plate (solution 1): see Fig 18
- straight face plate (solution 2): see Fig 19
- compensation of the opening (solution 3): see Fig 20
- combination of the above solutions.

Other arrangements may be accepted provided they are supported by direct calculations submitted to the Society for review.

Figure 18 : Stiffening of large openings in primary supporting members - Solution 1

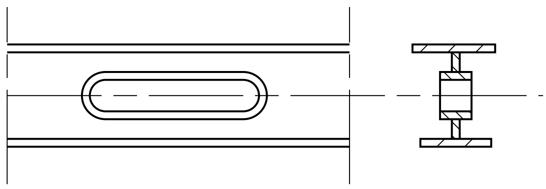


Figure 19 : Stiffening of large openings in primary supporting members - Solution 2

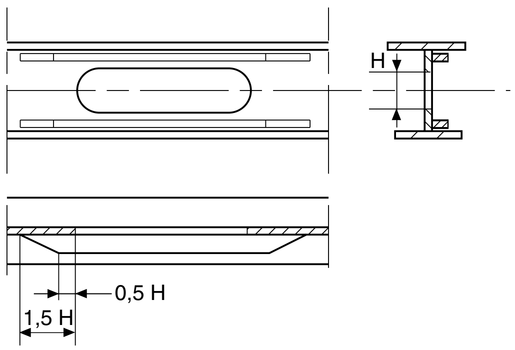
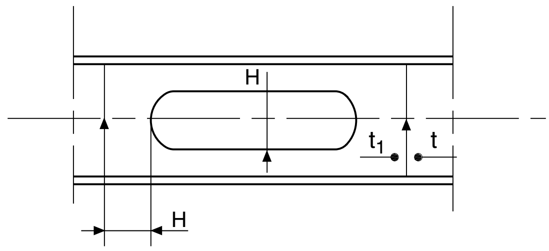


Figure 20 : Stiffening of large openings in primary supporting members - Solution 3



4.7 Stiffening arrangement

4.7.1 Webs of primary supporting members are generally to be stiffened where the height, in mm, is greater than 100t, where t is the web net thickness, in mm, of the primary supporting member.

In general, the web stiffeners of primary supporting members are to be spaced not more than 110t.

4.7.2 Where primary supporting member web stiffeners are welded to ordinary stiffener face plates, their net sectional area at the web stiffener mid-height is to be not less than the value obtained, in cm², from the following formula:

$$A = 0{,}1\,k_1(\gamma_{S2}p_S + \gamma_{W2}p_W)s\ell$$

where:

k_1 : Coefficient depending on the web connection with the ordinary stiffener, to be taken as:
- k_1 = 0,30 for connections without collar plate (see Fig 8)
- k_1 = 0,225 for connections with a collar plate (see Fig 9)
- k_1 = 0,20 for connections with one or two large collar plates (see Fig 10 and Fig 11)

p_S, p_W : Still water and wave pressure, respectively, in kN/m², acting on the ordinary stiffener, defined in Ch 7, Sec 2, [3.3.2] or Ch 8, Sec 4, [3.3.2]

γ_{S2}, γ_{W2} : Partial safety factors, defined in Ch 7, Sec 2, Tab 1 or Ch 8, Sec 4, Tab 1 for yielding check (general).

4.7.3 The net section modulus of web stiffeners of non-watertight primary supporting members is to be not less than the value obtained, in cm³, from the following formula:

$$w = 2{,}5\ s^2\ t\ S_s^2$$

where:

s : Length, in m, of web stiffeners

t : Web net thickness, in mm, of the primary supporting member

S_s : Spacing, in m, of web stiffeners.

Moreover, web stiffeners located in areas subject to compression stresses are to be checked for buckling in accordance with Ch 7, Sec 2, [4].