

symmetrical arrangement of connection to transverse members is to be incorporated. This can be achieved by fitting backing structure on the opposite side of the transverse web or bulkhead.

1.28.8 Where a bracket is fitted to the primary member web plate in addition to a connected stiffener it is to be arranged on the opposite side to, and in alignment with, the stiffener. The arm length of the bracket is to be not less than the depth of the stiffener, and its cross-sectional area through the throat of the bracket is to be included in the calculation of the area of the primary web stiffener in way of the connection.

1.28.9 Alternative arrangements will be considered on the basis of their ability to transmit load with equivalent effectiveness. Details of the calculations made and testing procedures are to be submitted.

1.29 Openings

1.29.1 Manholes, lightening holes and other cut-outs are to be avoided in way of concentrated loads and areas of high shear. In particular, manholes and similar openings are not to be cut in vertical or horizontal diaphragm plates in narrow cofferdams or in floors and double bottom girders close to their span ends, or below the heels of pillars, unless the stresses in the plating and the panel buckling characteristics have been calculated and found satisfactory.

1.29.2 Manholes, lightening holes and other openings are to be suitably framed and stiffened where necessary.

1.29.3 Air and drain holes, notches and scallops are to be kept at least 200 mm clear of the toes of end brackets and other areas of high stress. Openings are to be well rounded with smooth edges. Closely spaced scallops are not permitted. Widely spaced air or drain holes may be accepted, provided that they are of elliptical shape, or equivalent, to minimise stress concentration and are, in general, cut clear of the weld connection.

1.30 Fittings and attachments, general

1.30.1 The quality of welding and general workmanship of fittings and attachments as given in *Pt 6, Ch 3, 1.31 Bilge keels and ground bars* and *Pt 6, Ch 3, 1.32 Other fittings and attachments* are to be in accordance with *Ch 13 Requirements for Welded Construction* of the Rules for Materials.

1.31 Bilge keels and ground bars

1.31.1 It is recommended that bilge keels are not fitted in the forward $0,3L_R$ region on ships intended to navigate in ice conditions.

1.31.2 Bilge keels are to be attached to a continuous ground bar as shown in *Figure 3.1.8 Bilge keel construction*. Butt welds in shell plating, ground bar and bilge keels are to be staggered.

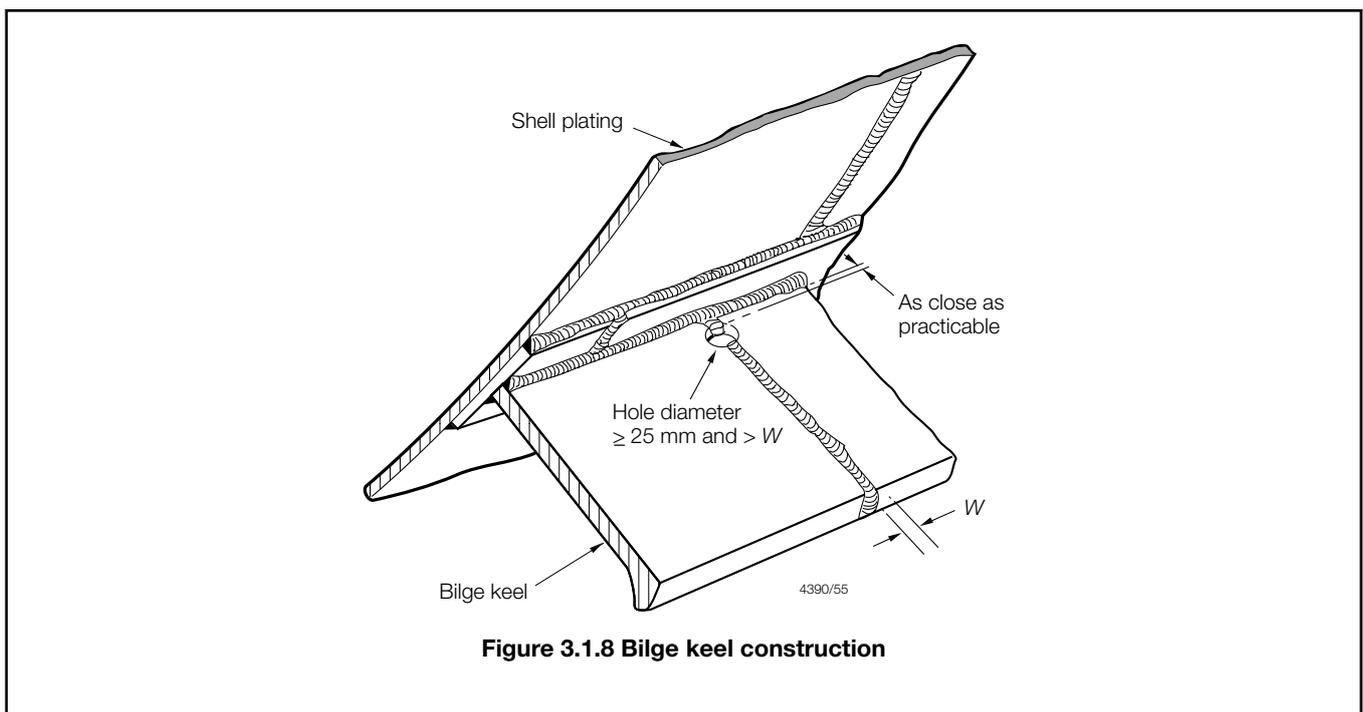


Figure 3.1.8 Bilge keel construction

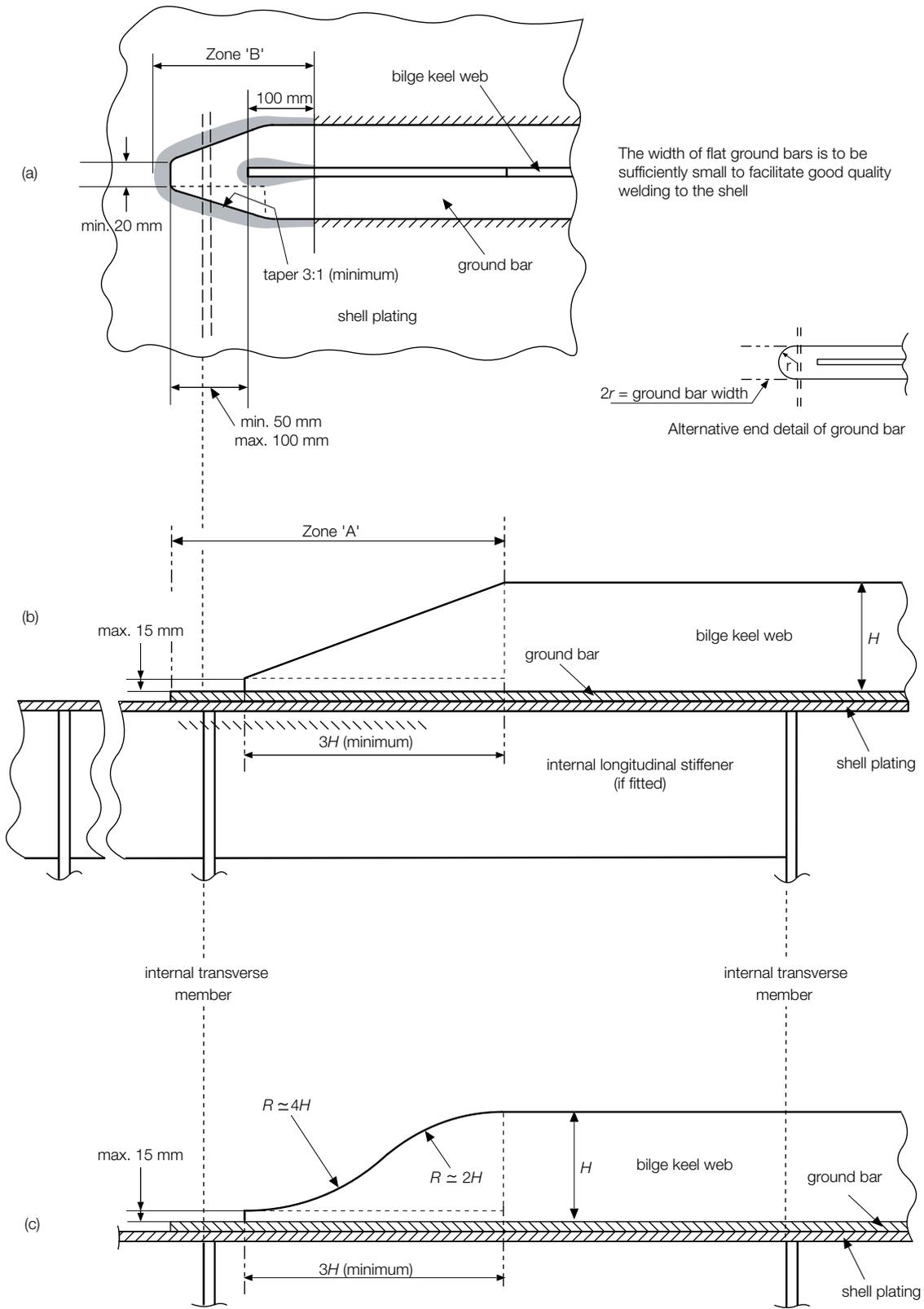
1.31.3 The thickness of the ground bar is to be not less than the thickness of the bottom shell or 6 mm, whichever is the greater, but need not be taken as greater than 12 mm.

1.31.4 The material class, grade and quality of the ground bar are to be similar to those of the adjacent shell plating.

1.31.5 The ground bar is to be connected to the shell with a continuous fillet weld and the bilge keel to the ground bar with a light continuous fillet weld.

1.31.6 Direct connection between ground bar butt welds and shell plating, and between bilge keel butt welds and ground bar is to be avoided.

1.31.7 The end details of bilge keels and intermittent bilge keels, where adopted, are to be as shown in *Figure 3.1.9 Bilge keel end design*.



5794/01

Figure 3.1.9 Bilge keel end design