

## DESIGN NOTE 2: Deep beams

The design information for reinforced masonry in BS EN 1996-1-1 is based on BS 5628 Part 2 but there are some important points of detail, such as the limits on the stresses in the compression zone for certain types of masonry unit, which have been changed. The UK National Annex to BS EN 1996-1-1 does permit the use of Informative Annex J which provides the shear enhancement previously found in BS 5628 Part 2. Additional design information for reinforced masonry has been retained in PD 6697.

A subject that was not specifically covered in BS 5628 is guidance on the design of deep beams which is now covered in BS EN 1996-1-1. Deep masonry beams are vertically loaded walls, or parts of walls, bridging openings, such that the ratio of the overall height of the wall above the opening to the effective span of the opening is at least 0,5.

### Key clauses are:

**Clause 5.5.2.3** which indicates that the effective span of a deep beam may be taken as:

$$l_{ef} = 1,15 l_{cl} \text{ where } l_{cl} \text{ is the clear width of the opening} \quad (5.12)$$

All vertical loading acting on that part of the wall above the effective span needs to be considered unless loads are taken by some other means. The deep beam may be treated as simply supported between supports when determining the bending moments.

**Clause 6.6.4** which indicates that the design moment of resistance can be obtained from equation 6.23 and indicates that the lever arm may be taken as the lesser of the values obtained from equations 6.30 and 6.31.

As is the normal case for reinforced masonry design, the design value of the moment of resistance determined from equation 6.23, based on the reinforcement, is checked for the compression zone as calculated by either Equation 6.32 a or b as dictated by the Group and type of masonry unit.

In order to resist cracking reinforcement is needed in the bed joints above the main reinforcement to a height of  $0,5l_{ef}$  or  $0,5d$  whichever is the lesser. Reinforcing bars need to be properly lapped and anchored as shown in the detailing section of BS EN 1996-1-1. It is also necessary to check the resistance of the compression zone against buckling (6.1.2) and verify the beam for vertical loading near the supports.

**Clause 6.7.4** covers the checking of deep beams subjected to shear loading and indicates that the design shear force should be taken at the edge of the support and that the effective depth of the beam should be taken as 1,3 times the lever arm.