R4 Solution. Grouted cavity retaining wall

The design value of the moment applied,

M_{Ed} $= \gamma_{G,sup} G_k + \gamma_Q Q_{k,1}$ = (1,35 x 7,9 x(1,8/3)) + (1,5 x 4,9 x(1,8/2)) = 13,01 kNm

Serviceability limiting span [BS EN 1996-1-1 Table 5.2]

Limiting span to effective depth ratio is 18

Hence effective depth must exceed $l_{ef}/18 = 1800/18$ =100 mm

f_b is the normalised strength of a masonry unit.

For a Group 1 440 x 215 x 100 mm dense aggregate masonry unit

f_b = 7 x 1,38 x 1 = 9,66 N/mm^2 [Annex A of BS EN 772-1]

M6 mortar to be used

Characteristic compressive strength of the masonry f_k = 0,75(9,66)^{0,7}(6)^{0,3} = 6,3 N/mm^2

[Equation 3.1 of BS EN 1996-1-1 and National Annex to BS EN 1996-1-1]

For the higher level of site supervision required for reinforced masonry γ_m =2

Design compressive strength of the masonry f_d = 6,3/2 = 3,15 N/mm^2

$Q = \frac{M_{Ed}}{bd^2} = \frac{13{,}01 \times 10^6}{10^3 \times 165^2} = 0{,}478$ [PD 6697:2010]

$Q = 2c(1-c)f_d = 0{,}478$

6,3c^2 – 6,3c + 0,478 =0

c = 0,92

Hence lever arm =0,92 x 165 = 152 mm

$A_s = \frac{M_{Rd}}{f_{yd} Z}$

f_{yd} = 500/1,15 = 435 N/mm^2

$A_s = \frac{13{,}01 \times 10^6}{435 \times 152} = 197$ mm^2

<u>Therefore the steel selected is adequate.</u>

Check limit on compressive strength of concrete masonry unit [Equation 6.24 of BS EN 1996-1-1]

$M_{Rd} \leq 0{,}4 f_d\, b\, d^2$ =0,4 x 3,15 x 10^3 x 165^2 x 10^{-6} = 34 kNm Therefore O.K.

Check minimum brick strength required

F_b =9,66 =brick strength x 0,85 x 1,0 = 11,36 N/mm^2

Therefore the brick selected is O.K.

Check shear capacity

Design value of the shear load V_{Ed} = 7,9 x 1,35 + 4,9 x 1,5 = 18.01 kN per m run of wall

$$f_{vd} = \frac{(0{,}35+17{,}5\rho)}{\gamma_m}$$ [Equation J1 of BS EN 1996-1-1]

$$\rho = \frac{A_s}{bd} = \frac{252}{10^3 \times 165} = 0{,}0015$$

$\gamma_{M\ shear}$ = 2.0

$$f_{vd} = \frac{(0{,}35+(17{,}5\times 0{,}0015))}{2} = 0{,}19 \text{ N/mm}^2$$

$V_{Rd} = f_{vd}\, b\, d$ = 0,19 x 10^3 x165 x 10^{-3} = 31,35 kN

Therefore the shear resistance is adequate.