

Solution - Design Example V1 - Clay Brick

Equation 3.1 of Eurocode 6 and Table NA.4 of UK National Annex (NA)

$$f_k = K f_b^{\alpha} f_m^{\beta} = 0,50 \times 42,5^{0,7} \times 4^{0,3} = 10,46 \text{ N/mm}^2$$

Checking Capacity:

$$\text{Effective height, } h_{ef} = \rho_n h = 0,75 \times 3000 = 2250 \text{ mm}$$

$$\text{Effective thickness, } t_{ef} = t = 102,5 \text{ mm}$$

$$\therefore \text{Slenderness ratio} = 2250 / 102,5 = 22.0 < 27 \text{ limiting value}$$

(Therefore the effects of creep may be ignored, NA.2.14 of UK NA)

Hence eccentricity of design vertical load at the top and bottom of the wall,

$$e_i = (M_{id} / N_{id}) + e_{he} \pm e_{init} \geq 0,05t$$

$$\text{Therefore } e_i = 0 + 0 + 5,0 = 5,0 \text{ mm (i.e. } 0,049t)$$

$$\text{where } M_{id}/N_{id} = 0$$

$$e_{he} = 0 \text{ (horizontal loads effect)}$$

$$e_{init} = h_{ef}/450 = (3000 \times 0,75) / 450 = 5,0 \text{ mm}$$

e_i is $0,05 t$ at top and bottom of the wall which are the minimum eccentricity design values to be used

$$\text{Therefore } \phi_i = 1 - 2(e_i / t) = 1 - 2(0,05t / t) = 0,9$$

And eccentricity of design vertical load in the middle of the wall,

$$e_m = (M_{md} / N_{md}) + e_{hm} \pm e_{init} \geq 0,05t$$

$$\text{Therefore } e_{mk} = e_m + e_k = 0 + 0 + 5,0 = 5,0 \text{ mm (i.e } 0,049t)$$

$$\text{where } M_{md}/N_{md} = 0$$

$$e_{hm} = 0 \text{ (horizontal loads effect)}$$

$$e_{init} = h_{ef}/450 = (3000 \times 0,75) / 450 = 5,0 \text{ mm}$$

$$e_k = 0 \text{ (creep effect)}$$

e_{mk} is 0,05 t at mid-height of the wall which is the minimum eccentricity design value to be used

Hence for $E = 1000f_k$ (10460 N/mm²) Part 1.1 Annex G equations or Figure G1 gives:

$\Phi_m = 0,58$ governs design

Class 2 execution control $\therefore \gamma_m = 3,0$

Design resistance per unit length $N_{Rd} = \Phi t f_d$ from Table NA.1 of UK NA

Where design strength, $f_d = \frac{f_k}{\gamma_m}$ for vertical load on the units in the -
- normal direction of loading

$N_{Rd} = 0,58 \times 102,5 \times 10,46 / 3,0 = 207 \text{ kN/m run} > 180 \text{ kN/m}$

This is greater than the design load and therefore the clay brick masonry units and mortar specified are adequate.

Solution - Design Example V1 - Concrete Block

Equation 3.1 of Eurocode 6 and Table NA.4 of UK National Annex (NA)

$$f_k = K f_b^{\alpha} f_m^{\beta} = 0,55 \times 20^{0,7} \times 4^{0,3} = 6,79 \text{ N/mm}^2$$

Checking Capacity:

$$\text{Effective height, } h_{ef} = \rho_n h = 0,75 \times 3000 = 2250 \text{ mm}$$

$$\text{Effective thickness, } t_{ef} = t = 140 \text{ mm}$$

$$\therefore \text{Slenderness ratio} = 2250 / 140 = 16,1 < 27 \text{ limiting value}$$

(Therefore the effects of creep may be ignored, NA.2.14 of UK NA)

Hence eccentricity of design vertical load at the top and bottom of the wall,

$$e_i = (M_{id} / N_{id}) + e_{he} \pm e_{init} \geq 0,05t$$

$$\text{Therefore } e_i = 0 + 0 + 5,0 = 5,0 \text{ mm (i.e. } 0,036t)$$

$$\text{where } M_{id}/N_{id} = 0$$

$$e_{he} = 0 \text{ (horizontal loads effect)}$$

$$e_{init} = h_{ef}/450 = (3000 \times 0,75) / 450 = 5,0 \text{ mm}$$

e_i is 0,05 t at top and bottom of the wall which are the minimum eccentricity design values to be used

$$\text{Therefore } \phi_i = 1 - 2(e_i / t) = 1 - 2(0,05t / t) = 0,9$$

And eccentricity of design vertical load in the middle of the wall,

$$e_m = (M_{md} / N_{md}) + e_{hm} \pm e_{init} \geq 0,05t$$

$$\text{Therefore } e_{mk} = e_m + e_k = 0 + 0 + 5,0 = 5,0 \text{ mm (i.e. } 0,036t)$$

$$\text{where } M_{md}/N_{md} = 0$$

$$e_{hm} = 0 \text{ (horizontal loads effect)}$$

$$e_{init} = h_{ef}/450 = (3000 \times 0,75) / 450 = 5,0 \text{ mm}$$

$$e_k = 0 \text{ (creep effect)}$$

e_{mk} is 0,05 t at mid-height of the wall which is the minimum eccentricity design value to be used

Hence for $E = 1000f_k$ (6790 N/mm²) Part 1.1 Annex G equations or Figure G1 gives:

$$\Phi_m = 0,72 \text{ governs design}$$

$$\text{Class 2 execution control } \therefore \gamma_m = 3,0$$

Design resistance per unit length $N_{Rd} = \Phi t f_d$ from Table NA.1 of UK NA

Where design strength, $f_d = \frac{f_k}{\gamma_m}$ for vertical load on the units in the -
- normal direction of loading

$$N_{Rd} = 0,72 \times 140 \times 6,79 / 3,0 = 228 \text{ kN/m run} > 180 \text{ kN/m}$$

This is greater than the design load and therefore the concrete block masonry units and general purpose mortar specified are adequate.