Solution – Design Example V6 – Concrete Block

Slenderness ratio:

Effective thickness of inner leaf, t_{ef} = 156mm as Design Example 3

Effective height = 2250 mm as Design Example 3

$\frac{h_{ef}}{t_{ef}}$ = 14,4 as Design Example 3

Eccentricity of 1st floor loading (10 kN/m) = t/6 as Design Example 3

Hence eccentricity of design vertical load, $e_i = (M_{id} / N_{id}) + e_{he} \pm e_{init} \geq 0{,}05t$

Therefore $e_i = +1{,}80 + 5{,}77 \pm 5{,}0 = 12{,}6$ mm (i.e. 0,090t)

where $M_{id}/N_{id} = (10 \times 140) /(130 \times 6) = \pm 1.80$ *mm (- top and + base)*

$e_{he} = (WL/12) / N_{id} = (3{,}0 \times 3000) / (12 \times 130) = +5{,}77$ *mm*

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

e_i is 0,09t at top or base of the wall (base governs as eccentricities are all additive)

Therefore $\phi_i = 1 - 2(e_i / t) = 1 - 2(0{,}09t / t) = 0{,}82$

And eccentricity of design vertical load, $e_m = (M_{md} / N_{md}) + e_{hm} \pm e_{init} \geq 0{,}05t$

Therefore $e_{mk} = e_m + e_k = 0 + 2{,}88 + 5{,}0 = 7{,}9$ mm (i.e 0,056t)

where $M_{md}/N_{md} = 0$ *(point of contraflexure of double curvature strut)*

$e_{hm} = (WL/24) / N_{md} = (3{,}0 \times 3000) / (24 \times 130) = +2{,}88$ *mm*

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

$e_k = 0$ *(creep effect)*

e_{mk} is 0,056t at mid-height of the wall

Hence for $E = 1000f_k$ Part 1.1 Annex G equations or Figure G1 gives:

$\Phi_m = 0{,}74$

Where, $f_k = Kf_b^{\alpha}f_m^{\beta} = 0{,}75 \times 9{,}5^{0,7} \times 4^{0,3} = 5{,}50$ N/mm^2

And design strength, $f_d = \dfrac{f_k}{\gamma_m}$ = 5,50 / 2,3 = 2,39 N/mm^2

Design resistance per unit length $N_{Rd} = \Phi_{min}\ t\ f_d$

Therefore N_{Rd} = 0,74min. x 140 x 2,39 = 247 kN/m run > 130 kN/m design load -
- applied

Wall will carry 247 kN/m vertical design loading in addition to a horizontal design wind loading (suction) of 1,0 kN/m^2

Solution – Design Example V6 – Clay Brick

Slenderness ratio:

Effective height , h_{ef} = 2250 mm as Design Example 2

Effective thickness of inner leaf, t_{ef} = $t_{ef} = \sqrt[3]{t_1^3 + t_2^3}$

= $t_{ef} = \sqrt[3]{(102{,}5^3 + 102{,}5^3)}$ = 129 mm

Effective height = 0,75 x 3000 = 2250 mm

$\frac{h_{ef}}{t_{ef}} = \frac{2250}{129} = 17{,}44$

Eccentricity of 1st floor loading (10 kN/m) = t/6 as Design Example 3

Hence eccentricity of design vertical load, $e_i = (M_{id} / N_{id}) + e_{he} \pm e_{init} \geq 0{,}05t$

Therefore $e_i = +1{,}31 + 5{,}77 \pm 5{,}0 = 12{,}1$ mm (i.e. 0,118t)

where $M_{id}/N_{id} = (10 \times 102{,}5) / (130 \times 6) = \pm 1.31$ *mm (- top and + base)*

$e_{he} = (WL/12) / N_{id} = (3{,}0 \times 3000) / (12 \times 130) = +5{,}77$ *mm*

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

e_i is 0,118 t at top or base of the wall (base governs as eccentricities are all additive)

Therefore $\phi_i = 1 - 2(e_i / t) = 1 - 2(0{,}118t / t) = 0{,}76$

And eccentricity of design vertical load, $e_m = (M_{md} / N_{md}) + e_{hm} \pm e_{init} \geq 0{,}05t$

Therefore $e_{mk} = e_m + e_k = 0 + 2{,}9 + 5{,}0 = 7{,}9$ mm (i.e 0,077t)

where $M_{md}/N_{md} = 0$ *(point of contraflexure of double curvature strut)*

$e_{hm} = (WL/24) / N_{md} = (3{,}0 \times 3000) / (24 \times 130) = +2{,}88$ *mm*

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

$e_k = 0$ *(creep effect)*

e_{mk} is 0,077t at mid-height of the wall

Hence for $E = 1000f_k$ Part 1.1 Annex G equations or Figure G1 gives:

Φ_m = 0,63 governs design

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

And design strength, $f_d = \dfrac{f_k}{\gamma_m}$ = 10,46 / 2,3 = 4,55 N/mm^2

Design resistance per unit length $N_{Rd} = \Phi_{min}\, t\, f_d$

Therefore N_{Rd} = 0,63min. x 102,5 x 4,55 = 294 kN/m run > 130 kN/m design load -
- applied

Wall will carry 294 kN/m vertical design loading in addition to a horizontal design wind loading (suction) of 1,0 kN/m^2

Note: The calculation for wall capacity represents one load case and will need to be repeated for the various combinations of vertical loading and horizontal wind loading appropriate to the particular design, carefully noting the sign convention of applied moments from vertical and horizontal load combinations at top middle and bottom of the wall being considered.

All six of these design examples assume no carry-over design moment from the storey walling above at the wallhead being considered. If carry-over design moments exist from the storey above these need to be added in the M_d/N_d reduction calculation for effective eccentricity.