

Structural Calculations

Design Stage Feb 2023

FOR

MASONRY RETAINING WALL

AT

4 HIGH STREET
RHOS

4 High St

Rhos

Important Note

All Calculation should be checked by Building control officer for Approval.

All measurement to be carried out by the Contractor and agreed by the Engineer Prior ordering the Steel.

Retaining Wall Design

Retaining Wall 1

Adjacent to highway

Wall height = 2.8m

Angle of fill above wall = 0 degrees

Surcharge= 10KN/m²

From computer output use blockwork concrete wall as shown on detailed drawing.

Retaining Wall 2

Wall support parking bay.

Wall height = 2.8m

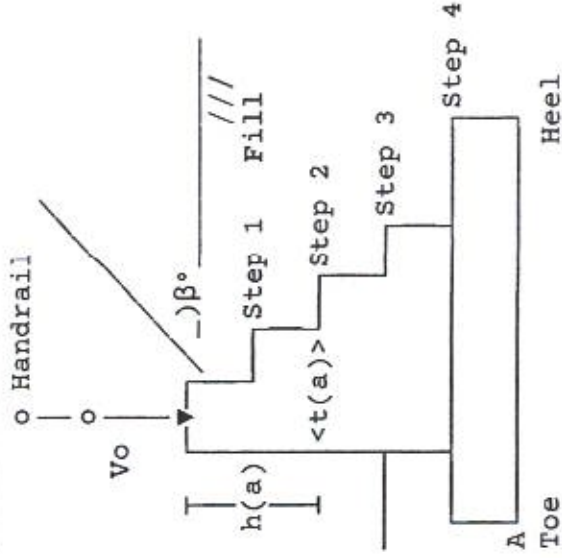
From computer output use blockwork concrete wall as shown on detailed drawing.

Location: Wall Adjacent to Highway

Masonry gravity wall

Designed in accordance with BS5628:Part 1:1992.

Soil details



Steps are numbered down from the top

$h(a)$ = height at step (a) from the top
 $t(a)$ = thickness at step (a)
 V_o = vertical point load on wall

As a masonry wall has limited capacity the design will assume the backfill is drained i.e. no water pressure behind the wall.

Weight/unit volume of soil & wall $w_e=18 \text{ kN/m}^3$

Internal angle of friction (fill) $\phi=35^\circ$

Angle of backfill $\beta=0^\circ$

Active soil pressure is applicable.

Sine angle of internal friction $\sin(\phi)=0.5736$

Active pressure coefficient

$$K_a = \frac{1 - \sin(\phi)}{1 + \sin(\phi)} = \frac{1 - 0.5736}{1 + 0.5736} = 0.271$$

Masonry details

Mortar designation to Table 1 mortar=2

Masonry type (1=clay 2=cal silicate 3=conc brick 4=block)
 $\text{typ}(1)=4$

Concrete block dimensions:

Height

$h_b=100 \text{ mm}$

Least horizontal dimension

$l_{hd}=215 \text{ mm}$

ratio height/least horiz. dim

$r_b = h_b / l_{hd} = 100 / 215 = 0.4651$

Compressive strength of blocks

$p_o = 7.3 \text{ N/mm}^2$

Characteristic flexural strength

$f_b(a) = \text{TABLE 3.71 for } p_o=7.3, \text{ mortar}=2$

250mm thick - Table 3

$= 0.15 \text{ N/mm}^2$

Partial safety factor material

$\gamma_{mam}=3.5$

0

External loading



Applied moment at top of wall $xm=0$ kNm
 Applied vertical load on the wall $Vo=4$ kN
 Applied shear at top of wall $xv=0.5$ kN
 Weight/unit area of surcharge $ws=10$ kN/m²
 Load factor external loads at top $gamx=1.6$
 Load factor surcharge $gams=1.6$
 Load factor earth pressure $game=1.4$
 Load factor self weight $gamf=0.9$

Wall design

Step 1 Typical Analysis which is repeated for each step

Proposed height at step $h(1)=0.7$ m
 Proposed thickness at step $t(1)=0.45$ m
 Moment at height h earth $me=cexwe \cdot h(a)^3/6=0.271 \cdot 18 \cdot 0.7^3/6$
 $=0.2788$ kNm
 surcharge $ms=cexws \cdot h(a)^2/2=0.271 \cdot 10 \cdot 0.7^2/2$
 $=0.6639$ kNm
 Ultimate moment at height h :

$$\begin{aligned} mu &= me \cdot game + ms \cdot gams + (xm + xv \cdot h(a)) \cdot gamx \\ &= 0.2788 \cdot 1.4 + 0.6639 \cdot 1.6 + (0 + 0.5 \cdot 0.7) \\ &\quad \cdot 1.6 \\ &= 2.013 \end{aligned}$$

Section modulus at thickness t $z = t(a)^2/6 = 0.45^2/6 = 0.0338$ m³
 Weight/unit area at depth h $gd = (ws + we \cdot h(a) + Vo/t(a)) \cdot gamf/1000$
 $= (10 + 18 \cdot 0.7 + 4/0.45) \cdot 0.9/1000$
 $= 0.0283$ N/mm²

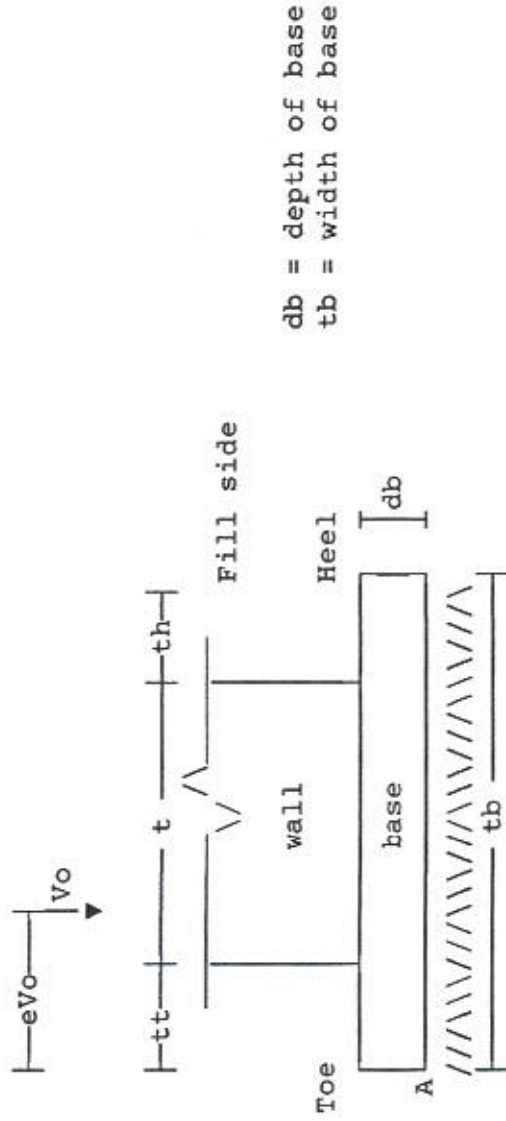
Moment of resistance $mr = (fb(1)/gammam + gd) \cdot z \cdot 1000$
 $= (0.15/3.5 + 0.0283) \cdot 0.0338 \cdot 1000$
 $= 2.403$ kNm

Applied moment less than moment of resistance ($2.013 \leq 2.403$)
 therefore section is satisfactory.

Step 1 width 0.45 m
 height 0.7 m

Step height (m)	Step thickness (m)	Ultimate Moments (kNm) Resistance Applied	0
0.7	0.45	2.403	2.013
1.4	0.9	10.6	8.492
2.1	1.35	26.9	21.78
2.8	1.675	46.46	44.22

Stability and bearing check



Width of toe $tt=0.15$ m
 Width of heel $th=0.15$ m
 Point of application of V_o from A $eVo=0.225$ m
 Thickness of wall $t=1.675$ m
 Height of wall $h=2.8$ m
 Width of base $tb=tt+th=1.675+0.15+0.15=1.975$
 Depth of base $db=0.30$ m
 Overall depth $od=h+db=2.8+0.3=3.1$ m
 Weight of fill and wall $wf=we*(t+th)*h=18*(1.675+0.15)*2.8=91.98$ kN
 Eccentricity from A (fill & wall) $ef=tt+(t+th)/2=0.15+(1.675+0.15)/2=1.063$ m
 Density of base $denb=24$ kN/m³
 Weight of base $wb=tb*db*denb=1.975*0.3*24=14.22$ kN
 Earth horizontal force $sfe=ce*we*od^2/2=0.271*18*3.1^2/2=23.44$ kN
 Moment due to earth pressure $me=sfe*od/3=23.44*3.1/3=24.22$ kNm
 Surcharge horizontal force $sfs=ws*ce*od=10*0.271*3.1=8.401$ kN
 Moment due to surcharge $ms=sfs*od/2=8.401*3.1/2=13.02$ kNm

0

Wall shearHorizontal shear force

$$\begin{aligned} \text{usf} &= (\text{sfe} * \text{game}) + (\text{sfs} * \text{gams}) \\ &= (23.44 * 1.4) + (8.401 * 1.6) \\ &= 46.25 \text{ kN} \end{aligned}$$

Shear stress at bottom of wall

$$\begin{aligned} \text{uss} &= \text{usf} / (t(\text{steps}) * 1000) \\ &= 46.25 / (1.675 * 1000) \\ &= 0.0276 \text{ N/mm}^2 \end{aligned}$$

Weight at bottom of step 1 $\text{uwt} = t(a) * \text{we} * h(a) * \text{gamf} = 0.45 * 18 * 0.7 * 0.9$

$$= 5.103 \text{ kN}$$

Weight at bottom of step 2 $\text{uwt} = \text{uwt} + (t(a) * \text{we} * h(a) * \text{gamf})$

$$= 5.103 + (0.9 * 18 * 1.4 * 0.9)$$

$$= 25.52 \text{ kN}$$

Weight at bottom of step 3 $\text{uwt} = \text{uwt} + (t(a) * \text{we} * h(a) * \text{gamf})$

$$= 25.52 + (1.35 * 18 * 2.1 * 0.9)$$

$$= 71.44 \text{ kN}$$

Weight at bottom of step 4 $\text{uwt} = \text{uwt} + (t(a) * \text{we} * h(a) * \text{gamf})$

$$= 71.44 + (1.675 * 18 * 2.8 * 0.9)$$

$$= 147.4 \text{ kN}$$

Weight per. unit area

$$\text{ga} = (\text{uwt} + \text{Vo}) / (t(\text{steps}) * 1000)$$

$$= (147.4 + 4) / (1.675 * 1000)$$

$$= 0.0904 \text{ N/mm}^2$$

Permissible shear stress

$$\text{fv} = 0.35 + 0.6 * \text{ga} = 0.35 + 0.6 * 0.0904$$

$$= 0.4042 \text{ N/mm}^2$$

As $\text{uss} \leq \text{fv}$ ($0.0276 \text{ N/mm}^2 \leq 0.4042 \text{ N/mm}^2$), applied shear is less than shear resistance.

OverturningOverturning moment about A

$$\text{om} = \text{me} + \text{ms} + (\text{xm} + \text{xv} * \text{od})$$

$$= 24.22 + 13.02 + (0 + 0.5 * 3.1)$$

$$= 38.79 \text{ kNm}$$

Restoring moment abt A fill/wall

$$\text{rmf} = \text{wf} * \text{ef} = 91.98 * 1.063 = 97.73 \text{ kNm}$$

base

$$\text{rmb} = \text{wb} * \text{tb} / 2 = 14.22 * 1.975 / 2$$

$$= 14.04 \text{ kNm}$$

surcharge

$$\text{rms} = \text{ws} * (t + \text{th}) * \text{ef}$$

$$= 10 * (1.675 + 0.15) * 1.063$$

$$= 19.39$$

vertical load

$$\text{rmVo} = \text{Vo} * \text{eVo} = 4 * 0.225 = 0.9 \text{ kNm}$$

total

$$\text{rm} = \text{rmf} + \text{rmb} + \text{rms} + \text{rmVo}$$

$$= 97.73 + 14.04 + 19.39 + 0.9$$

$$= 132.1$$

Factor of safety

$$\text{fso} = \text{rm} / \text{om} = 132.1 / 38.79 = 3.405$$

Sliding - passive resistance will be ignored

Vertical load on wall will be ignored for the sliding calculations that follow.

Sliding force

$$\text{sf} = \text{sfe} + \text{sfs} + \text{xv} = 23.44 + 8.401 + 0.5$$

$$= 32.34$$

Details of bearing strata:

$$\text{Angle of friction (u/s of base)} \quad \text{phib} = 40^\circ$$

Soil cohesion	cu=0 kN/m ²	0
Coefficient of friction	cf=TAN(RAD(phib*2/3)) =TAN(RAD(40*2/3)) =0.5022	
Resisting force	fill rff=wf*cf=91.98*0.5022=46.19 kN base rfb=wb*cf+tb*cu/2 =14.22*0.5022+1.975*0/2 =7.142 kN	
	surcharge rfs=ws*(t+th)*cf =10*(1.675+0.15)*0.5022 =9.165 kN	
	total rf=rff+rfb+rfs=46.19+7.142+9.165 =62.5 kN	
Factor of safety	fss=rf/sf=62.5/32.34=1.933	

Bearing pressure

Weight of surcharge	sw=ws*(t+th)=10*(1.675+0.15) =18.25 kN
Moments about centre of base	m=om+(wf+sw)*(tb/2-ef)+Vo*(tb/2-eVo) =38.79+(91.98+18.25)*(1.975/2 -1.063)+4*(1.975/2-0.225) =33.57 kNm
Section modulus of base	zb=tb^2/6=1.975^2/6=0.6501 m ³
Total weight	tw=wf+sw+wb+Vo=91.98+18.25+14.22+4 =128.5 kN
Pressure due to weight	pw=tw/tb=128.5/1.975=65.04 kN/m ²
Pressure due to BM (+ve or -ve)	pm=m/zb=33.57/0.6501=51.64 kN/m ²
Maximum pressure	pmax=pw+pm=65.04+51.64=116.7 kN/m ²
Minimum pressure	pmin=pw-pm=65.04-51.64=13.4 kN/m ²

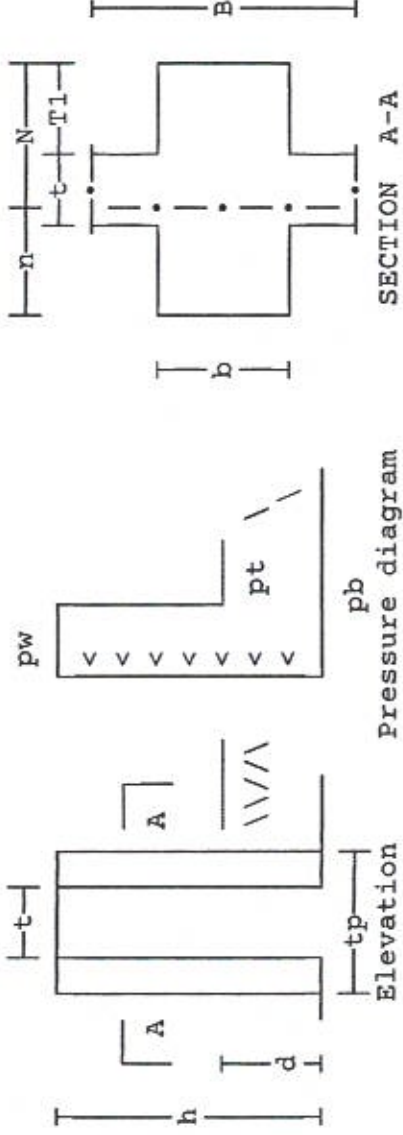
DESIGN SUMMARY

Wall height	2.8 m		
Step height (m)	Step thickness (m)	Ultimate Moments (kNm) Resistance Applied	
0.7	0.45	2.403	2.013
1.4	0.9	10.6	8.492
2.1	1.35	26.9	21.78
2.8	1.675	46.46	44.22
Summary of stability check			
Factor of safety overturning	3.405		
Factor of safety sliding	1.933		
Maximum base pressure	116.7 kN/m ²		

Location: Wall supporting Slab

Freestanding masonry wall

Calculations are in accordance with BS5628-1:2005.



Clear height of wall

$h=2.5$ m

Depth of soil

$d=0$ m

Thickness of wall

$t=450$ mm

Overall thickness of wall

$t(1)=t=450$ mm

Offset of pier

$tp=450$ mm

Width of pier taken as zero

$T1=0$ mm

Width of wall taken as 1.0 m

$b=0$ mm

$B=1.0$ m

Check limiting dimensions

Max permissible height of wall

$h_{max}=12 \cdot t / 1000 = 12 \cdot 450 / 1000$
 $= 5.4$ m

Material & load factor details

Partial safety factor materials

$\gamma_{mam}=3.0$

Removal of panel would affect stability.

Partial safety factor for loads

$\gamma_{maf}=1.4$

Mortar designation to Table 1

mortar=3

Masonry density

$\rho_{den}(1)=15$ kN/m³

Masonry type (1=clay 2=calc silicate 3=conc brick 4=block 5=other)

$\gamma_{typ}(1)=4$

Concrete Blocks

Compressive strength

$p_o=7.3$ N/mm²

Characteristic flexural strength for bed failure and leaf greater than 250mm thick - Table 3

$f_b(a)=\text{TABLE 3.71 for } p_o=7.3, \text{ mortar}=3$
 $=0.15$ N/mm²

Section modulus of wall length 1 m

0

Wall width

$$b_{max}=b_{max}=1 \text{ m}$$

Plan area of wall

$$\begin{aligned} A &= (1000 \times b_{max} + t \times (tp - t)) / 1E6 \\ &= (1000 \times 1 \times 450 + 0 \times (450 - 450)) / 1E6 \\ &= 0.45 \text{ m}^2 \end{aligned}$$

Depth to neutral axis

$$\begin{aligned} N &= (b \times tp^2 / 2 + (b_{max} \times 1000 - b) \times t \times (T1 + t / 2)) / (A \times 1E9) \\ &= (0 \times 450^2 / 2 + (1 \times 1000 - 0) \times 450 \times (0 + 450 / 2)) / (0.45 \times 1E9) \\ &= 0.225 \end{aligned}$$

$$n = tp / 1000 - N = 450 / 1000 - 0.225$$

$$= 0.225 \text{ m}$$

Moment of inertia

$$\begin{aligned} I1 &= b \times tp^3 / 12 + b \times tp \times (tp / 2 - N \times 1000)^2 \\ &= 0 \times 450^3 / 12 + 0 \times 450 \times (450 / 2 - 0.225 \times 1000)^2 \\ &= 0 \text{ mm}^4 \\ I2 &= (b_{max} \times 1000 - b) \times t^3 / 12 \\ &= (1 \times 1000 - 0) \times 450^3 / 12 \\ &= 7.5938E9 \text{ mm}^4 \\ I3 &= (b_{max} \times 1000 - b) \times t \times (t / 2 + T1 - N \times 1000)^2 \\ &= (1 \times 1000 - 0) \times 450 \times (450 / 2 + 0 - 0.225 \times 1000)^2 \\ &= 0 \text{ mm}^4 \end{aligned}$$

$$\begin{aligned} I &= (I1 + I2 + I3) / 1E12 = (0 + 7.5938E9 + 0) / 1E12 \\ &= 0.0075938 \text{ m}^4 \end{aligned}$$

Minimum section modulus

$$Z = I / N = 0.0075938 / 0.225 = 0.03375 \text{ m}^3$$

Ultimate moment and shear applied to wall

Soil density

$$sdens = 18 \text{ kN/m}^3$$

Soil angle of internal friction

$$theta' = 30^\circ$$

$$theta = RAD(theta') = 0.5236 \text{ radians}$$

Surcharge pressure

$$surch = 5 \text{ kN/m}^2$$

Wind pressure

$$WL = 0.4 \text{ kN/m}^2$$

At REST pressure coefficient

$$\begin{aligned} k &= 1 - SIN(theta) = 1 - SIN(0.5236) \\ &= 0.5 \end{aligned}$$

Pressure at top of soil

$$pt = gamma_f \times k \times surch = 1.4 \times 0.5 \times 5$$

$$= 3.5 \text{ kN/m}^2$$

Pressure at base of wall

$$pb = gamma_f \times k \times (surch + d \times sdens)$$

$$= 1.4 \times 0.5 \times (5 + 0 \times 18)$$

$$= 3.5 \text{ kN/m}^2$$

Moment from soil at wall base

$$\begin{aligned} Ms &= B \times (pt \times d^2 / 2 + (pb - pt) \times (d / 2) \times (d / 3)) \\ &= 1 \times (3.5 \times 0^2 / 2 + (3.5 - 3.5) \times (0 / 2) \times (0 / 3)) \\ &= 0 \text{ kNm} \end{aligned}$$

Moment from wind at wall base

$$\begin{aligned} Mw &= B \times (gamma_f \times WL \times (h - d) \times (0.5 \times (h - d) + d)) \\ &= 1 \times (1.4 \times 0.4 \times (2.5 - 0) \times (0.5 \times (2.5 - 0) + 0)) \\ &= 1.75 \text{ kNm} \end{aligned}$$

Design moment

$$M = Ms + Mw = 0 + 1.75 = 1.75 \text{ kNm}$$

Design shear

$$\begin{aligned} V &= B \times (gamma_f \times WL \times (h - d) + (pt + pb) \times d / 2) \\ &= 1 \times (1.4 \times 0.4 \times (2.5 - 0) + (3.5 + 3.5) \times 0 / 2) \\ &= 1.4 \text{ kN} \end{aligned}$$

Design moment of resistance

0

Design vert. load per unit area

$$gd = 0.9 \times \text{den}(1) \times h = 0.9 \times 15 \times 2.5 = 33.75 \text{ kN/m}^2$$

Ref BS5628 Clause 32.5.3

$$\begin{aligned} \mu &= (fb(1) \times 1000 / \text{gammam} + gd) \times Z \\ &= (0.15 \times 1000 / 3 + 33.75) \times 0.03375 \\ &= 2.8266 \text{ kNm} \end{aligned}$$

Since $\mu \geq M$ (2.8266 kNm $\geq$ 1.75 kNm) design moment of resistance is greater than the ultimate design moment, and therefore the wall section is O.K.

Shear strength of masonry wall

Characteristic shear strength

$$\begin{aligned} f_v &= 0.15 + 0.6 \times gd / 1000 \\ &= 0.15 + 0.6 \times 33.75 / 1000 \\ &= 0.17025 \text{ N/mm}^2 \end{aligned}$$

Partial safety factor for shear

$$\gamma_{mav} = 2.5$$

Ultimate shear resistance

$$\begin{aligned} V_u &= A \times f_v \times 1000 / \gamma_{mav} \\ &= 0.45 \times 0.17025 \times 1000 / 2.5 \\ &= 30.645 \text{ kN} \end{aligned}$$

Since $V_u \geq V$ (30.645 kN $\geq$ 1.4 kN) design shear resistance is greater than the ultimate shear force, and therefore wall section is O.K.

DESIGN SUMMARY

Wall height	2.5 m
Wall thickness	450 mm
Section modulus	0.03375 m ³
Characteristic flex strength	0.15 N/mm ²
Design bending moment	1.75 kNm
Bending moment resistance	2.8266 kNm
Design shear	1.4 kN
Ultimate shear resistance	30.645 kN

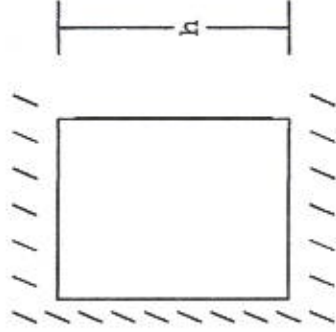
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Masonry wall panel to BS5628 (Table 8)

Location: Wall on grid line A/1-2

Calculations in accordance with BS5628-1:2005



Panel reference J
 in BS5628 Table 8

Masonry details

Length of wall panel $L=6.0$ m
 Height of wall panel $h=2.8$ m
 Outer leaf density $den(1)=16$ kN/m³
 Thickness of outer leaf $t(1)=450$ mm
 Mortar designation (Table 1) mortar=3
 Outer leaf (1=clay 2=calc silicate 3=conc brick 4=block) typ(1)=4
 Concrete Blocks
 compressive strength $po(1)=7.3$ N/mm²
 Characteristic flexural strength for bed failure and leaf greater than 250mm thick - Table 3 $fb(a)=TABLE\ 3.71$ for $po=7.3$, mortar=3
 $=0.15$ N/mm²
 Characteristic flexural strength for perp failure and leaf greater than 250mm thick - Table 3 $fp(a)=TABLE\ 3.81$ for $po=7.3$, mortar=3
 $=0.35$ N/mm²
 Partial safety factor materials $\gamma_{mam}=3$

Design parameters

Effective thick is outer leaf $t_{ef}=t(1)=450$ mm
 Ratio $h'L/h/L=2.8/6=0.46667$

Limiting dimensions

50 times effective thickness $limit=50*t_{ef}/1000=50*450/1000$
 $=22.5$ m
 Panel height within maximum allowable (Clause 32.3).
 Panel length within maximum allowable (Clause 32.3).
 Area of panel $area=h*L=2.8*6=16.8$ m²
 Panel supported on three edges with less than two continuous edges.
 Permitted maximum area $limit=1350*(t_{ef}/1000)^2$
 $=1350*(450/1000)^2$
 $=273.38$ m²
 Panel area within allowable (Clause 32.3).

Loading details

0

Characteristic wind load per unit area $WL=0.85 \text{ kN/m}^2$
 Removal of panel would affect stability.
 Partial safety factor for loads $\gamma_{maf}=1.4$

Outer leaf allowable loadsBending

Enhance orthogonal strength ratio by allowing for the effects of self weight at mid height of the panel and any additional dead loads applied to the top of this leaf.

Self weight vert load /unit area $gas=0.9*den(a)*(h/2)/10^3$

$$=0.9*16*(2.8/2)/10^3$$

$$=0.02016 \text{ N/mm}^2$$

Additional vert DL on panel $w(1)=10 \text{ kN/m}$

Additional vert DL per unit area $gaa=0.9*w(a)/t(a)=0.9*10/450$

$$=0.02 \text{ N/mm}^2$$

Design vert load /unit area $ga=gas+gaa=0.02016+0.02=0.04016 \text{ N/mm}^2$

Orthogonal strength ratio $\mu=(fb(a)+\gamma_{mam}*ga)/fp(a)$

$$=(0.15+3*0.04016)/0.35$$

$$=0.7728$$

Section modulus $Z=1000*t(a)^2/6=1000*450^2/6$

$$=33.75E6 \text{ mm}^3/\text{m}$$

Design moment of resistance $Md=fp(a)*Z/(\gamma_{mam}*10^6)$

$$=0.35*33.75E6/(3*10^6)$$

$$=3.9375 \text{ kNm/m}$$

Bending moment coefficient $\alpha=\text{TABLE 8.1 for } \mu=0.7728, h'L$

$$=0.46667$$

$$=0.026285$$

Allowable load on leaf (bending) $L(1)=Md/(\alpha*\gamma_{maf}*L^2)$

$$=3.9375/(0.026285*1.4*6^2)$$

$$=2.9722 \text{ kN/m}^2$$

Shear

Design load/unit area at found $ga=2*gas+gaa=2*0.02016+0.02$

$$=0.06032 \text{ N/mm}^2$$

Charact shear strength at found $fvf=0.15+0.6*ga=0.15+0.6*0.06032$

$$=0.18619 \text{ N/mm}^2$$

Charact shear strength at side $fvs=0.35 \text{ N/mm}^2$

Partial safety factor for shear $\gamma_{maf}=2.5$

Des shear strength wall at found $gvf=fvf/\gamma_{maf}=0.18619/2.5$

$$=0.074477 \text{ N/mm}^2$$

Des shear strength wall at sides $gvs=fvs/\gamma_{maf}=0.35/2.5=0.14 \text{ N/mm}^2$

Allowable load in shear at found $lf(1)=gvf*L*t(a)=0.074477*6*450$

$$=201.09 \text{ kN}$$

Allow load in shear side of wall $ls(1)=gvs*h*t(a)=0.14*2.8*450$

$$=176.4 \text{ kN}$$

0

Bending check

Allowable lateral load $L_{max} = L(1) = 2.9722 \text{ kN/m}^2$
 Wall satisfactory - $WL \leq L_{max}$ ($0.85 \text{ kN/m}^2 \leq 2.9722 \text{ kN/m}^2$)
 characteristic wind load less than allowable.

Shear check

Max area panel support on sides $sarea = h \cdot L = 2.8 \cdot 6 = 16.8 \text{ m}^2$
 Design shear on side wall $Vs = sarea \cdot \gamma_{maf} \cdot WL = 16.8 \cdot 1.4 \cdot 0.85$
 $= 19.992 \text{ kN}$

Max area panel supported on found $farea = L \cdot h / 2 = 6 \cdot 2.8 / 2 = 8.4 \text{ m}^2$
 Design shear on foundation $Vf = farea \cdot \gamma_{maf} \cdot WL = 8.4 \cdot 1.4 \cdot 0.85$
 $= 9.996 \text{ kN}$

Allowable load on side of wall $Ls = Ls(1) = 176.4 \text{ kN}$
 Allow load at foundation of wall $Lf = Lf(1) = 201.09 \text{ kN}$
 Since $Vs \leq Ls$ ($19.992 \text{ kN} \leq 176.4 \text{ kN}$) design shear on side of wall
 is within allowable.
 Since $Vf \leq Lf$ ($9.996 \text{ kN} \leq 201.09 \text{ kN}$) design shear at foundation
 of wall is within allowable.

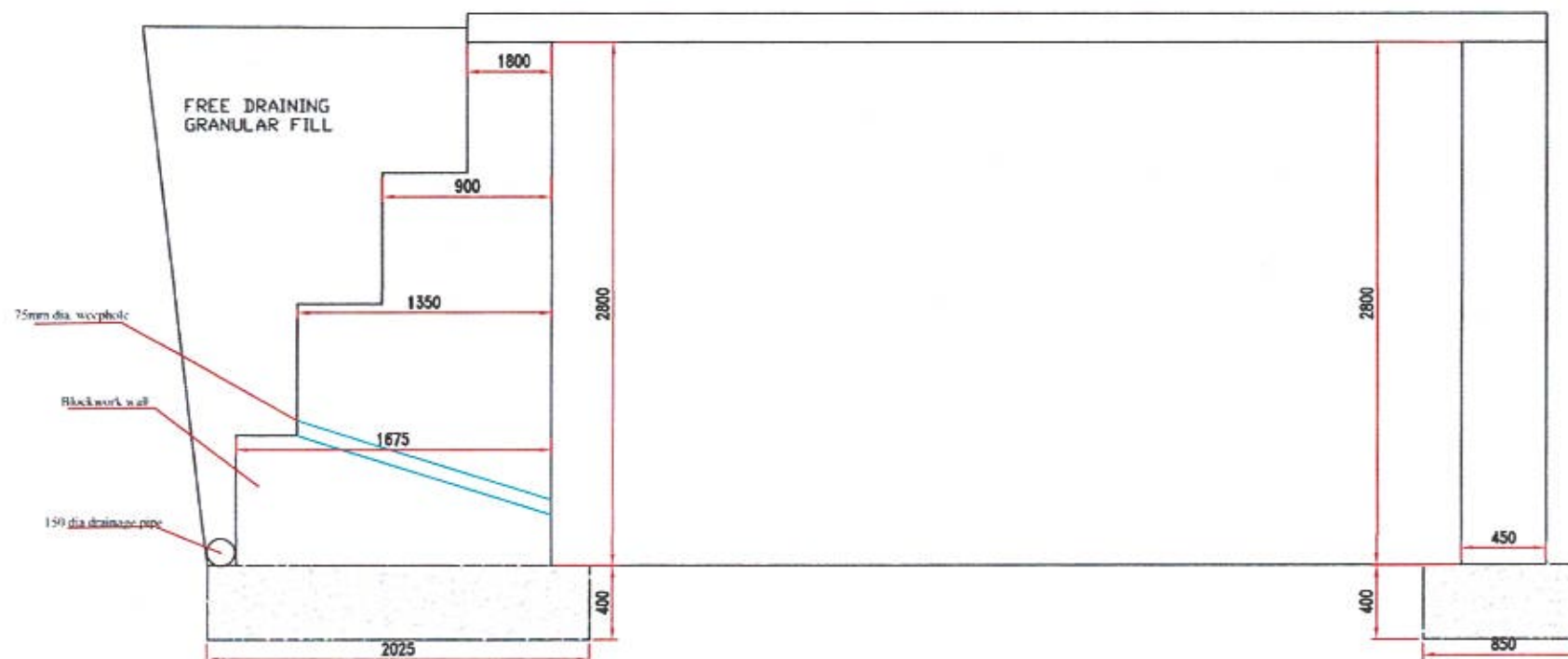
DESIGN SUMMARY

Panel length	6 m
Panel height	2.8 m
Thickness	450 mm
Char flex strength (bed)	0.15 N/mm ²
Char flex strength (perp)	0.35 N/mm ²
Char wind pressure	0.85 kN/m ²
Char wind capacity (bend)	2.9722 kN/m ²
Design shear on sides	19.992 kN
Shear strength of sides	176.4 kN
Design shear on founds	9.996 kN
Shear strength of founds	201.09 kN
Material safety factor	3
Load safety factor	1.4

No505

All measurements to be carried out by the contractor and approved by the Engineer.

Concrete to be Grade C40/20.
Surcharge is 100kN/m².
Blockwork strength is 7.5N/mm².



5 High Street
Rhos
Not To SCALE