MasterSeries – Masonry Wall Design
Sample Output

The following output is from the Masonry Wall Design program.

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4 Cavity wall panel with door and window openings (to EC)
6 Single leaf garden wall with piers (BS)
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9 Cavity wall panel with beam point loads (BS)
11 External wall panel with multiple openings and wind post (EC)
13 Panel with lateral line load (EC)
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15 Cavity wall panel with in plane racking forces (EC)
Cavity wall panel with wind

TWO WAY SPANNING, VERTICALLY AND LATERALLY LOADED, CAVITY WALL

DESIGN TO BS EN 1996-1-1:2005

Summary of Design Data

EuroCode National Annex
Using UK values: A1 2012
Wall Dimensions
h=3.000 m, hef=2.206 m (Eqn. 5.8), L=5.000 m, Lef=5.000 m
Support Conditions
Bottom Cont., Top Simple, Left Simple, Right Simple
Lateral Loads
Wx=0.75 kN/m²
Cavity Wall (mm)
t1=102.5, t2=100, tef=127.6
Limiting Dimensions
λ=17.3 ≤ λlim = 27, L/tef = 39.2, H/tef = 23.5, Hence
H/tef ≤ 52.4

Outer-Leaf Design

Partial Safety Factor (γmc/γmf)
Units Category II, Execution Control Class 2
3/2.7

Material
Clay bricks with water absorption over 12%

Compressive Strength (fk)
Group 1, γ=20 kN/m³
fkk = 20 N/mm²

Section Properties
Area=1025 cm²/m, Zp=1751 cm³/m

Flexural Strength fak2 (Perpendicular)
fak2=0.3, gd=0.03 N/mm²

Flexural Strength fak1 (Parallel)
fak1=0.25, gd=0.03 N/mm²

Critical axial compressive case
Max local stress @
X=0 m, Y=1.5 m < f /γmc
0.08 N/mm²
OK

Critical axial buckling case
Max axial buckling force @
X=2.5 m, Y=1.5 m averaged over width of 1.025 m
8.3kN/m

Moments from Lateral Load
Mwx,top = 0.000 kN.m
Mwx,mid = 0.064 kN.m

Capacity reduction factor top, ~Fex=0.0 mm, hef=2206 mm, tef=127.6 mm, t=102.5 mm
0.900

Critical axial compressive case
Max local stress @
X=0 m, Y=1.5 m < f /γmc
0.08 N/mm²
OK

Critical axial buckling case
Max axial buckling force @
X=2.5 m, Y=1.5 m averaged over width of 1.025 m
8.1kN/m

Moments from Lateral Load
Mwx,top = 0.000 kN.m
Mwx,mid = 0.064 kN.m

Capacity reduction factor top, ~Fex=0.0 mm, hef=2206 mm, tef=127.6 mm, t=102.5 mm
0.900

Inner-Leaf Design

Partial Safety Factor (γmc/γmf)
Units Category II, Execution Control Class 2
3/2.7

Material
Concrete blocks, γ=20 kN/m³

Compressive Strength (fk)
Group 1
fkk = 4.44 N/mm²

Section Properties
Area=1000 cm²/m, Zp=1667 cm³/m

Flexural Strength fak2 (Perpendicular)
fak2=0.25, gd=0.03 N/mm²

Flexural Strength fak1 (Parallel)
fak1=0.25, gd=0.03 N/mm²

Critical axial compressive case
Max local stress @
X=0 m, Y=1.5 m < f /γmc
0.08 N/mm²
OK

Critical axial buckling case
Max axial buckling force @
X=2.5 m, Y=1.5 m averaged over width of 1 m
8.1kN/m

Moments from Lateral Load
Mwx,top = 0.000 kN.m
Mwx,mid = 0.064 kN.m

Capacity reduction factor top, ~Fex=0.0 mm, hef=2206 mm, tef=127.6 mm, t=100.0 mm
0.900

Creep coef. = 1.5, ehm = 0.120 mm, h=2.206
0.693

Fr=ψfc tk/γmc
0.693 x 6.17 x 102.5 / 2.7 = 146.1 kN/m

Fd/Fr = 8.3/146.1 = 0.057
OK

Mro=fkxk2.Zp/γmf
0.584 kN.m/m

Mro=fkxk1.Zb/γmf
0.247 kN.m/m
## MasterSeries Sample Output

3 Castle Street  
Carrickfergus  
County Antrim BT38 7BE  
Tel: 028 9036 5950

### Design for Lateral Loads

<table>
<thead>
<tr>
<th>Design Lateral Load Wd</th>
<th>1.5 Wx</th>
<th>1.125 kN/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield Line Analysis</td>
<td>Load Factor, $\lambda_0$</td>
<td>1.149</td>
</tr>
<tr>
<td>$U_t=1/\lambda_0$</td>
<td></td>
<td>0.870</td>
</tr>
</tbody>
</table>
Cavity wall panel with door and window openings

TWO WAY SPANNING, VERTICALLY AND LATERALLY LOADED, CAVITY WALL
DESIGN TO BS EN 1996-1-1:2005

Summary of Design Data

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall Dimensions</td>
<td>h=2.500 m, hef=2.000 m (Eqn. 5.8), L=5.000 m, Lef=5.000 m</td>
</tr>
<tr>
<td>Support Conditions</td>
<td>Bottom Cont., Top Simple, Left Simple, Right Simple</td>
</tr>
<tr>
<td>Lateral Loads</td>
<td>Wx=0.75 kN/m²</td>
</tr>
<tr>
<td>Cavity Wall (mm)</td>
<td>t1=102.5, t2=100, tef=127.6</td>
</tr>
<tr>
<td>Limiting Dimensions</td>
<td>( \lambda = 15.7, L_{ef} = 39.2, H_{t} = 19.6, H_{tef} = 52.4 )</td>
</tr>
</tbody>
</table>

Outer-Leaf Design

| Partial Safety Factor (y mc/y mf) | Units Category II, Execution Control Class 2 3/2.7 Table NA.1 |
| Material                        | Clay bricks with water absorption over 12% |
| Units and Mortar Strength       | fb = 20 N/mm², fm = Mortar designation M4/(iii) |
| Compressive Strength (fc)       | Group 1, \( \gamma = 20 \) kN/m³ Table NA.4 |
| Section Properties              | Area=1025 cm²/m, Zp=1751 cm³/m |
| Flexural Strength fux (Perpendicular) | fux=0.3, gd=0.025 N/mm² |
| Flexural Strength fux (Parallel) | fux=fux+min(gd, 0.24\( f_{ck}/\gamma_{mc} \))y mf |
| Critical axial compressive case | \( 1.35(y_{tk}.h) \) |
| Max local stress @               | X=0.505 m, Y=1.25 m < f k/y mc |
| Critical axial buckling case     | \( 1.35(y_{tk}.h) \) |
| Max axial buckling force @       | X=4.487 m, Y=1.25 m averaged over width of 1.025 m |
| Moments from Lateral Load        | \( M_{max,2}=0.000 \) kN.m, \( M_{max,ef}=0.000 \) kN.m |
| Capacity reduction factor top, ~F | ex=0.0 mm, hef=1772 mm, tef=127.6 mm, t=102.5 mm |
| Capacity reduction factor mid, ~F | 0.09 N/mm² |
| FFr= Ffr, Zp/ymc                  | 0.051 OK |
| Mro= fux, Zp/ymf                  | 0.584 kN/m/m |
| Mrm= fux, Zb/ymf                   | 0.238 kN/m/m |

Inner-Leaf Design

| Partial Safety Factor (y mc/y mf) | Units Category II, Execution Control Class 2 3/2.7 Table NA.1 |
| Material                        | Concrete blocks, \( \gamma = 20 \) kN/m³ |
| Units and Mortar Strength       | fb = 7 N/mm², fm = Mortar designation M4/(iii) Unit height=215, Least horizontal dimensions=100 2.15 |
| Compressive Strength (fc)       | Group 1 4.44 N/mm² Table NA.4 |
| Section Properties              | Area=1000 cm²/m, Zp=1667 cm³/m |
| Flexural Strength fux (Perpendicular) | fux=0.25, gd=0.025 N/mm² |
| Flexural Strength fux (Parallel) | fux=fux+min(gd, 0.24\( f_{ck}/\gamma_{mc} \))y mf |
| Critical axial compressive case | \( 1.35(y_{tk}.h) \) |
| Max local stress @               | X=0.51 m, Y=1.25 m < f k/y mc |
| Critical axial buckling case     | \( 1.35(y_{tk}.h) \) |
| Max axial buckling force @       | X=4.499 m, Y=1.25 m averaged over width of 1 m |
| Moments from Lateral Load        | \( M_{max,2}=0.000 \) kN.m, \( M_{max,ef}=0.000 \) kN.m |
| Capacity reduction factor top, ~F | ex=0.0 mm, hef=1772 mm, tef=127.6 mm, t=100.0 mm |
| Capacity reduction factor mid, ~F | 0.09 N/mm² |

Diagram: Cavity wall panel with door and window openings.
### MasterSeries Sample Output

**3 Castle Street**  
**Carrickfergus**  
**County Antrim BT38 7BE**  
Tel: 028 9036 5950

<table>
<thead>
<tr>
<th>Job ref</th>
<th>My Project</th>
<th>Sheet</th>
<th>My Walls / 5 -</th>
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<td>Made By</td>
<td>ATW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>21 June 2015/ Version 2017.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Checked</td>
<td>GHB</td>
<td></td>
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<tr>
<td>Approved</td>
<td>MOG</td>
<td></td>
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### Design for Lateral Loads

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<thead>
<tr>
<th>Design Lateral Load Wd</th>
<th>1.5 Wx</th>
<th>1.125 kN/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield Line Analysis</td>
<td>Load Factor, λp</td>
<td>1.081</td>
</tr>
<tr>
<td>Ut=1/λp</td>
<td>1 / 1.081</td>
<td>0.925</td>
</tr>
</tbody>
</table>

| Fr=/~F,tk/ymc          | 0.769x4.44x100/3 | 113.7 kN/m |
| Fd/Fr                 | 8.1/113.7        | 0.071 OK    |
| Mri=fz2.Zp/ymf        | 0.588x1667/2.7   | 0.363 kN.m/m |
| Mri=fz1.Zb/ymf        | 0.318x1667/2.7   | 0.196 kN.m/m |

OK
Single leaf garden wall with piers

FREE STANDING, LATERALLY LOADED, STIFFENED SINGLE-LEAF WALL

DESIGN TO BS 5628 : 2005

Summary of Design Data

Wall Dimensions
h=1.200 m, hef=2.400 m, L=5.000 m, Lef=5.000 m

Support Conditions
Free Standing Wall, Bottom Cont.

Lateral Loads
Wx=0.4 kN/m²

Single-leaf Wall (mm)

Limiting Dimensions
\( \lambda = 13.7 \leq \lambda_{\text{lim}} = 27, \ h < 12 \ t_{\text{ef}} \)

Wall Design

Partial Safety Factor (\( \gamma_{mc}/\gamma_{mf} \))
Normal manufacturing, Normal construction

Concrete blocks, \( \gamma = 20 \ \text{kN/m}^3 \)

Material

Units and Mortar Strength
7 N/mm², Mortar designation M4/(iii)

Compressive Strength (fk)

Solid Concrete block wall

6.2 N/mm²

Table 2

Effective Width (be)

H=1.2 m, t=140, tp=325, wp=215, ccp=2250

Area=609 cm²/m, Zb=3267 cm³/m, Zp=3267 cm³/m

695 mm

Section Properties Pier

Zb=13029 cm³/m, Zp=17604 cm³/m

Flexural Strength fkb (Parallel)

fkb=0.223, gd=0.024 N/mm², fkb=fkb+0.9 gd,ymf

0.288 N/mm²

Table 3

Critical axial compressive case

1.4(\( \gamma \cdot t_k \cdot h \))

Max local stress @
X=0 m, Y=0 m < fk/\( \gamma_{mc} \)

0.03 N/mm²

OK

Critical axial buckling case

1.4(\( \gamma \cdot t_k \cdot h \))

Max axial buckling force @
X=2.5 m, Y=0 m averaged over width of 1.4 m

4.7kN/m

Capacity reduction factor top, \( \beta \)

ex=0.0 mm, hef=2400 mm, tef=175.3 mm, t=140.0 mm

0.961

Fr=\( \beta \cdot f_k \cdot t \cdot y_{mc} \)

0.961x6.2x140/3.5

238.3 kN/m

Fd/Fr

4.7/238.3

0.020

OK

Mrf=\( f_k \cdot Z_p \cdot y_{mc} \)

0.522x3267/3

0.569 kN/m

Mrf=\( f_k \cdot Z_p \cdot y_{mc} \)

0.288x3267/3

0.314 kN/m

Mrf=\( f_k \cdot Z_p \cdot y_{mc} \)

0.522x17604/3

3.060 kN/m

Mrf=\( f_k \cdot Z_p \cdot y_{mc} \)

0.288x13029/3

1.250 kN/m

Design for Lateral Loads

Design Lateral Load Wd

1.4 Wx

0.560 kN/m²

Yield Line Analysis

Load Factor, \( \lambda_p \)

1.070

Ut=1/\( \lambda_p \)

1 / 1.070

0.935

OK
Cavity wall panel with intermediate wind post

TWO WAY SPANNING, VERTICALLY AND LATERALLY LOADED, CAVITY WALL

DESIGN TO BS EN 1996-1-1:2005

Summary of Design Data

Using UK values: A1 2012

Wall Dimensions
h=3.000 m, hef=2.312 m (Eqn. 5.8), L=10.000 m, Lef=10.000 m

Wind post assumed to act as stiffening, L = 5.500 m, Lef = 5.500 m

Support Conditions
Bottom Cont., Top Simple, Left Simple, Right Simple

Lateral Loads
Wx=0.75 kN/m²

Cavity Wall (mm)
t1=102.5, t2=100, tef=127.6

Limiting Dimensions
λ=18.1<λlim=27, L/tef=43.1, H/tef=23.5, Hence H/tef<49.2

Outer-Leaf Design

Partial Safety Factor (γmc/γmf)
Units Category II, Execution Control Class 2

Material
Clay bricks with water absorption over 12%

Compressive Strength (fk)
Group 1, γ=20 kN/m³

6.17 N/mm²

Section Properties
Area=1025 cm²/m, Zp=1751 cm³/m

Flexural Strength f_{xk2} (Perpendicular)
1.35(y.tk.h)

0.9 N/mm²

Critical axial compressive case
X=0, Y=1.5 m < fk/fyec

0.08 N/mm²

Critical axial buckling case
X=5 m, Y=1.5 m averaged over width of 1.025 m

8.3kN/m

Moments from Lateral Load
Fr=0.670x6.17x102.5/3

141.3 kN/m

Mro=f_{xk2}.Zp/γmf

Mro=f_{xk1}.Zb/γmf

8.1kN/m

Inner-Leaf Design

Partial Safety Factor (γmc/γmf)
Units Category II, Execution Control Class 2

Material
Concrete blocks, γ=20 kN/m³

Compressive Strength (fk)
Group 1

Unit height=215, Least horizontal dimensions=100

Compressive Strength (fk)

4.44 N/mm²

Section Properties
Area=1000 cm²/m, Zp=1667 cm³/m

Flexural Strength f_{xk2} (Perpendicular)
1.35(y.tk.h)

0.331 N/mm²

Critical axial compressive case
X=0 m, Y=1.5 m < fk/fyec

0.08 N/mm²

Critical axial buckling case
X=5 m, Y=1.5 m averaged over width of 1 m

8.1kN/m
**Design for Lateral Loads**

Design Lateral Load $W_d$

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base pinned, Top pinned, Major axis bending</td>
<td>1.5 $W_x$</td>
</tr>
<tr>
<td>Inner leaf discontinuous, outer leaf continuous</td>
<td>1.125 kN/m²</td>
</tr>
</tbody>
</table>

**Moments from Lateral Load**

$$M_{wx,top} = 0.000 \text{ kN.m}, \quad M_{wx,mid} = 0.063 \text{ kN.m}$$

**Capacity reduction factor top, $\sim F_{ex}$**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ex$</td>
<td>0.0 mm</td>
</tr>
<tr>
<td>$hef$</td>
<td>2312 mm</td>
</tr>
<tr>
<td>$tef$</td>
<td>127.6 mm</td>
</tr>
<tr>
<td>$t$</td>
<td>100.0 mm</td>
</tr>
</tbody>
</table>

**Capacity reduction factor mid, $\sim F_{m}$**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$F_{m}$</td>
<td>1.5</td>
</tr>
<tr>
<td>$ehm$</td>
<td>0.118 mm</td>
</tr>
<tr>
<td>$hef$</td>
<td>2312 mm</td>
</tr>
<tr>
<td>$tef$</td>
<td>127.6 mm</td>
</tr>
<tr>
<td>$t$</td>
<td>100.0 mm</td>
</tr>
</tbody>
</table>

**Wind Post Stiffening**

Wind post is assumed to act as stiffener, influencing $hef$

<table>
<thead>
<tr>
<th>Factor</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Fr=\sim F.f_k.t_k/\gamma mc$</td>
<td>98.8 kN/m</td>
</tr>
</tbody>
</table>

**Wind Post Design**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full restrained moment capacity implicitly checked in yield line analysis</td>
<td>OK</td>
</tr>
</tbody>
</table>

**Moments from Lateral Load**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>$M_{wx,top}$</td>
<td>0.000 kN.m</td>
</tr>
<tr>
<td>$M_{wx,mid}$</td>
<td>0.063 kN.m</td>
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**Capacity reduction factor top, $\sim F_{ex}$**

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</table>

**Design for Lateral Loads**

Design Lateral Load $W_d$

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<th>Description</th>
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<tr>
<td>Inner leaf discontinuous, outer leaf continuous</td>
<td>1.125 kN/m²</td>
</tr>
</tbody>
</table>

**Moments from Lateral Load**

$$M_{wx,top} = 0.000 \text{ kN.m}, \quad M_{wx,mid} = 0.063 \text{ kN.m}$$

**Capacity reduction factor top, $\sim F_{ex}$**

<table>
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<tr>
<th>Factor</th>
<th>Value</th>
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<tbody>
<tr>
<td>$ex$</td>
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**Capacity reduction factor mid, $\sim F_{m}$**

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<tbody>
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</tbody>
</table>

**Wind Post Stiffening**

Wind post is assumed to act as stiffener, influencing $hef$

<table>
<thead>
<tr>
<th>Factor</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Fr=\sim F.f_k.t_k/\gamma mc$</td>
<td>98.8 kN/m</td>
</tr>
</tbody>
</table>

**Wind Post Design**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
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<tr>
<td>Full restrained moment capacity implicitly checked in yield line analysis</td>
<td>OK</td>
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<td>0.000 kN.m</td>
</tr>
<tr>
<td>$M_{wx,mid}$</td>
<td>0.063 kN.m</td>
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**Capacity reduction factor top, $\sim F_{ex}$**

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**Capacity reduction factor mid, $\sim F_{m}$**

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<td>2312 mm</td>
</tr>
<tr>
<td>$tef$</td>
<td>127.6 mm</td>
</tr>
<tr>
<td>$t$</td>
<td>100.0 mm</td>
</tr>
</tbody>
</table>

**Wind Post Stiffening**

Wind post is assumed to act as stiffener, influencing $hef$

<table>
<thead>
<tr>
<th>Factor</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Fr=\sim F.f_k.t_k/\gamma mc$</td>
<td>98.8 kN/m</td>
</tr>
</tbody>
</table>

**Wind Post Design**

<table>
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**Moments from Lateral Load**

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<td>$M_{wx,top}$</td>
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**Capacity reduction factor top, $\sim F_{ex}$**

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Cavity wall panel with beam point loads

TWO WAY SPANNING, VERTICALLY AND LATERALLY LOADED, CAVITY WALL

DESIGN TO BS 5628 : 2005

Summary of Design Data

Wall Dimensions
Support Conditions
Lateral Loads
Cavity Wall (mm)
Limiting Dimensions

Outer-Leaf Design
Partial Safety Factor (γmc/γmf)
Material
Units and Mortar Strength
Compressive Strength (fk)
Section Properties
Flexural Strength fkp (Perpendicular)
Flexural Strength fkb (Parallel)
Critical axial compressive case
Max local stress @
Critical axial buckling case
Max axial buckling force @
Capacity reduction factor top, β
Fr=β.fk.tk/ymc
Fd/Fr
Mro=fkp.Zp/γmf
Mro=fkb.Zb/γmf

Inner-Leaf Design
Partial Safety Factor (γmc/γmf)
Material
Units and Mortar Strength
Blocks Ratio
Compressive Strength (fk)
Loads from above
Loads @ this level
Section Properties
Flexural Strength fkp (Perpendicular)
Flexural Strength fkb (Parallel)
Critical axial compressive case
Max local stress @
Critical axial buckling case
Max axial buckling force @
Capacity reduction factor top, β
Fr=β.fk.tk/ymc
Fd/Fr
Mro=fkp.Zp/γmf
Mro=fkb.Zb/γmf
**Point load design method**

Design based on axial load take down for wall compression design. No design for bending due to point loads.

Point Load at 2m
- **gk**: 10 kN, **qk**: 15 kN, Bearing Length: 100 mm width: 50 mm
- **Bearing Stress**: \((1.4 \times 10 + 1.6 \times 15) \times 1000 / (300 \times 100)\) = 1.27 N/mm²
- **Local Bearing Capacity**
  - BS5628-1:2005 Figure 4 - Bearing Type 1, \(1.25 \frac{f_k}{\gamma_m c}\) = 2.54 N/mm²
  - **OK**

Point Load at 3.5m
- **gk**: 13 kN, **qk**: 20 kN, Bearing Length: 150 mm width: 75 mm
- **Bearing Stress**: \((1.4 \times 13 + 1.6 \times 20) \times 1000 / (300 \times 100)\) = 1.67 N/mm²
- **Local Bearing Capacity**
  - BS5628-1:2005 Figure 4 - Bearing Type 1, \(1.25 \frac{f_k}{\gamma_m c}\) = 2.54 N/mm²
  - **OK**

**Bearing Stress**
- \(M_{ri} = f_{kp} Z_p / \gamma_m f\)
- \(M_{ri} = f_{kb} Z_b / \gamma_m f\)
- \(0.75 \times 1667 / 3 = 0.417 \text{kN.m/m}\)
- \(0.855 \times 1667 / 3 = 0.475 \text{kN.m/m}\)

**Design for Lateral Loads**

Design Lateral Load **Wd**
- \(1.4 \times W_x\) = 1.050 kN/m²

Yield Line Analysis
- **Load Factor, \(\lambda_p\)**
- \(\frac{1}{1.611}\) = 0.621
- **OK**
External wall panel with multiple openings and wind post

TWO WAY SPANNING, VERTICALLY AND LATERALLY LOADED, CAVITY WALL

DESIGN TO BS EN 1996-1-1:2005

Summary of Design Data

EuroCode National Annex
Using UK values: A1 2012

Wall Dimensions
h=3.000 m, hef=2.272 m (Eqn. 5.8), L=8.000 m, Lef=8.000 m

Wind Post L reduction
Wnd post assumed to act as stiffening, L = 5.300 m, Lef = 5.300 m

Support Conditions
Bottom Cont., Top Simple, Left Simple, Right Simple

Lateral Loads
Wx=0.75 kN/m²

Cavity Wall (mm)
t1=102.5, t2=100, tef=127.6

Limiting Dimensions
λ=17.8<=λlim=27, L/t,Nef=41.5, H/tef=23.5, Hence H/tef<=49.6

Outer-Leaf Design

Partial Safety Factor (γmc/γmf)
Units Category II, Execution Control Class 2

Material
Clay bricks with water absorption over 12%

Compressive Strength (fk)
Group 1, γ=20 kN/m³

Section Properties
Area=1025 cm²/m, Zp=1751 cm³/m

Flexural Strength f, (Perpendicular)
f,=0.3, gd=0.035 N/mm²
f,=f,+(gd, 0.2fk/γmc)γmf
0.394 N/mm²

Critical axial compressive case
Max local stress @
X=4.949 m, Y=1.5 m < fk/γmc
0.14 N/mm²

Critical axial buckling case
Max axial buckling force @
X=5.1 m, Y=1.5 m averaged over width of 0.8 m
13.44kN/m

Capacity reduction factor top,  ~F
Fr=F,tk/γmc
0.977

Moments from Lateral Load
Mwx,top=0.000 kN.m, Mwx,mid=0.000 kN.m

Inner-Leaf Design

Partial Safety Factor (γmc/γmf)
Units Category II, Execution Control Class 2

Material
Concrete blocks, γ=20 kN/m³

Compressive Strength (fk)
Group 1

Section Properties
Area=1000 cm²/m, Zp=1667 cm³/m

Flexural Strength f, (Perpendicular)
f,=0.25, gd=0.035 N/mm²
f,=f,+(gd, 0.2fk/γmc)γmf
0.344 N/mm²

Critical axial compressive case
Max local stress @
X=4.954 m, Y=1.5 m < fk/γmc
0.15 N/mm²

Critical axial buckling case
Max axial buckling force @
X=5.1 m, Y=1.5 m averaged over width of 0.8 m
13.11kN/m

Moments from Lateral Load
M,d=0.000 kN.m, M,mid=0.000 kN.m

ex=0.0 mm, hef=900 mm, tef=127.6 mm, t=102.5 mm
0.90
<table>
<thead>
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<th>Design for Lateral Loads</th>
<th></th>
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<tbody>
<tr>
<td>Design Lateral Load Wd</td>
<td>1.5 Wx 1.125 kN/m²</td>
</tr>
<tr>
<td>Wind Post Data</td>
<td>Base pinned, Top pinned, Major axis bending</td>
</tr>
<tr>
<td>Leaf Continuity at Wind Posts</td>
<td>Inner leaf continuous, outer leaf continuous</td>
</tr>
<tr>
<td>Wind posts at 2.7m</td>
<td>100x50 PFC 10 (S 355), $M_{pl} = 14.768$ kN.m</td>
</tr>
<tr>
<td>Yield Line Analysis</td>
<td>Load Factor, $\lambda$ 1.072</td>
</tr>
<tr>
<td>$U_l=1/A_p$</td>
<td>1 / 1.072 0.933 OK</td>
</tr>
<tr>
<td>Wind Post Design</td>
<td>Full restrained moment capacity implicitly checked in yield line analysis</td>
</tr>
</tbody>
</table>
Panel with lateral line load

TWO WAY SPANNING, VERTICALLY AND LATERALLY LOADED, SINGLE-LEAF WALL

DESIGN TO BS EN 1996-1-1:2005

Summary of Design Data

Using UK values: A1 2012
Wall Dimensions
h=3.000 m, hef=2.630 m (Eqn. 5.8), L=8.000 m, Lef=8.000 m
Support Conditions
Bottom Cont., Top Simple, Left Simple, Right Simple
Lateral Loads
Wx=0.25 kN/m²
Lateral Line Loads
2.0=kN/m, X1=2.1 m, Y1=2.1 m, X2=6.0 m, Y2=2.1 m
Single-leaf Wall (mm)
t=215, tef=215
Limiting Dimensions
λ=12.2<λlim=27, L/tef=37.2, H/tef=14, Hence
H/tef<=58.4

Wall Design

Partial Safety Factor (γmc/γmf)
Units Category II, Execution Control Class 2
Concrete blocks, γ=20 kN/m³
Group 1
2.15
4.44 N/mm²
Flexural Strength f_{s1} (Perpendicular)
f_{s1}=0.173, gd=0.03 N/mm²
2.245 N/mm²
Critical axial compressive case
1.35(y.t.k.h)
0.08 N/mm²
Capacity reduction factor top, ~F
ex=0.0 mm, hef=2630 mm, tef=215.0 mm, t=215.0 mm
0.900
Creep coef. =1.5, ehm = 0.000 mm, hef = 2.630
0.801
Fr=1.5, Fy,k/γmc
0.801x4.4x215/3
254.7 kN/m
Fd/Fr
17.4/254.7
0.068
Mr=M_{s1},Zp/γmf
0.399x7704/2.4
1.282 kN.m/m
0.788 kN.m/m

Design for Lateral Loads

Design Lateral Load Wd
1.5 Wx
0.375 kN/m²
Yield Line Analysis
Load Factor, λ_p
1 / 1.019
Tel: 028 9036 5950
Blockwork column vertically loaded

VERTICALLY SPANNING, VERTICALLY AND LATERALLY LOADED, MASONRY COLUMN

DESIGN TO BS EN 1996-1-1:2005

Summary of Design Data

- **Column Dimensions**: h=3.000 m, hef xx=3.000 m, hef zz=2.250
- **Support Conditions**: Vertically Spanning Column, Top Simple, Bottom Cont.
- **Lateral Loads**: Wx=0.25 kN/m
- **Masonry Column**: t=215 mm, b=325 mm, tef=215 mm, bef=325 mm
- **Limiting Dimensions**: λ=14<=λlim=27, h<=35 tef

Column Design

- **Material**: Concrete blocks, γ=20 kN/m³
- **Units and Mortar Strength**: fb = 7.3 N/mm², fm = Mortar designation M4/(iii)
- **Blocks Ratio**: Unit height=100, Least horizontal dimensions=215
- **Compressive Strength (fc)**
  - **Group 1**: 2.77 N/mm², Small Area
  - **Section Properties**: Area=699 cm², Zx=2504 cm³
  - **Flexural Strength f_{x1} (Parallel)**: 0.173, gd=0.431 N/mm²
  - **Capacity reduction factor, ~F**: 0.672 N/mm²

Fr = ~F.f_{x1}.Area/ymc
Fd/Fr = 1.25(γ.Area.h+gk+gku)+1.5qk+1.5qku = 62.7/64.6 = 0.972 OK

Bending Moment Coefficient
- **Vertically Spanning**: 0.086
- **Non-Spanning**: 0.0623 kN.m

Design for Lateral Loads

- **Mdx=1.5 α.Wx.h²**: 1.5x0.086x0.25x3² = 0.290 kN.m
- **Mdz=1.5 α.Wz.h²**: 1.5x0.086x0.25x3² = 0.000 kN.m
- **Moment Capacity Check**: 0.290/0.623+0.000/0.940 = 0.465 OK
Cavity wall panel with in plane racking forces

TWO WAY SPANNING, VERTICALLY AND LATERALLY LOADED, CAVITY WALL

DESIGN TO BS EN 1996-1-1:2005

Summary of Design Data

EuroCode National Annex
Using UK values: A1 2012
Wall Dimensions
h=2.350 m, h_eff=1.747 m (Eqn. 5.8), L=4.000 m, L_eff=4.000 m
Support Conditions
Bottom Cont., Top Simple, Left Simple, Right Simple
Lateral Loads
Wx=0.75 kN/m²
Horizontal Loads
Qz=23.0 kN, Mz=12.0 kN.m, 50% Resisted by the outer leaf
Cavity Wall (mm)
t=102.5, t_eff=127.6
Limiting Dimensions
λ=13.7<λ_eff=27, L_eff/t=31.3, H_eff/t=18.4, Hence H_eff/t_low=76

Outer-Leaf Design

Partial Safety Factor (γ_m/c/γ_m/f)
Units Category II, Execution Control Class 2
3/2.7
Material
Clay bricks with water absorption over 12%

Compressive Strength (f_k)
Group 1, γ=20 kN/m³
4.44 N/mm²

Section Properties
Area=1025 cm²/m, Z_p=1751 cm³/m, Z_z=266667 cm³

Flexural Strength f_xk2 (Perpendicular)
0.9 N/mm²

Critical axial compressive case
1.25(y.t.k.h)

Moments from Lateral Load
M_{x=2.000 kN.m, M_{z=1751 cm³/m, Z_{z}=273333 cm³

Capacity reduction factor top, ~F
ex=0.0 mm, h_eff=1747 mm, t_eff=127.6 mm, t=102.5 mm
1.00

f_m=ax=F.f_k/γ_m/c
0.772x6.17/3
1.589 N/mm²

Dead plus Live
1.25 Dead + 1.5 Live
V=12.044 kN, L_eff=4.0 m
0.029 N/mm²
OK

Dead plus Live plus Wind(Mz+Qz)
1.25 Dead + 1.05 Live + 1.5 (Mz+Qz)
M_{z=9.0 kN.m, V=12.044 kN, Lef=3.758 m
0.069 N/mm²
OK

Shear Stress vh/f_vk
Qz=17.25 kN, (17250/385213)/(0.212/2.5)
0.529
OK

Bending Moment Coefficient
h/L=0.59, ~m=0.40
0.031
Annex E

Inner-Leaf Design

Partial Safety Factor (γ_m/c/γ_m/f)
Units Category II, Execution Control Class 2
3/2.7
Material
Concrete blocks, γ=20 kN/m³

Compressive Strength (f_k)
Group 1
4.44 N/mm²

Section Properties
Area=1000 cm²/m, Z_p=1667 cm³/m, Z_z=266667 cm³
0.588 N/mm²

M_ro=f_xk2.Z_p/γ_m/f
0.9x1751/2.7
0.584 kN.m/m
MasterSeries Sample Output

Flexural Strength $f_{x1}$ (Parallel)  $f_{x1}=0.25, \text{gd}=0.023 \text{ N/mm}^2$

Critical axial compressive case  $1.25(y.t.k.h)$

Max local stress  $< \frac{f_k}{\gamma_{mc}}$

Moments from Lateral Load $M_{\text{ASD}}=0.000 \text{ kN.m}, M_{\text{LS,FV}}=0.000 \text{ kN.m}$

Capacity reduction factor top, $\sim F_{\text{ex}}=0.0 \text{ mm}, h_{\text{ef}}=1747 \text{ mm}, t_{\text{ef}}=127.6 \text{ mm}, t=100.0 \text{ mm}$

Capacity reduction factor mid, $\sim F_{\text{mv}}$ Creep coef. $=1.5, e_{\text{hm}}=0.000 \text{ mm}, h_{\text{ef}}=1.747$

$\frac{f_{x1}}{f_{x1}+\min{(gd, 0.24k_{\gamma_{mc}}/\gamma_{mf})}}$ $0.772\times 4.44/3 = 1.143 \text{ N/mm}^2$

Dead plus Live  $1.25 \text{ Dead} + 1.5 \text{ Live}$

$\frac{f_{xax}}{V/\gamma_{mf}}$ $0.06 \text{ N/mm}^2$ OK

Dead plus Live plus Wind($Mz+Qz$)  $1.25 \text{ Dead} + 1.05 \text{ Live} + 1.5 \text{ (Mz+Qz)}$

$\frac{f_{xax}}{V/\gamma_{mf}}$ $0.071 \text{ N/mm}^2$ OK

Shear Stress $vh/f_{xk}$ $0.720$

Dead plus Wind($Mz+Qz$)  $1.35 \text{ Dead} + 1.5 \text{ (Mz+Qz)}$

$\frac{f_{xax}}{V/\gamma_{mf}}$ $0.069 \text{ N/mm}^2$ OK

Shear Stress $vh/f_{xk}$ $0.685$

Design for Lateral Loads

Design Lateral Load $Wd$ $1.5 \text{ Wx} \ (Wxo=0.647 \text{ kN/m}^2, Wxi=0.478 \text{ kN/m}^2)$ $1.125 \text{ kN/m}^2$

$M_{do}=\alpha_{o}.Wxo.L^2 = 0.031\times0.647\times4.000^2 = 0.325 \text{ kN.m/m}$

$M_{di}=\alpha_{i}.Wxi.L^2 = 0.026\times0.478\times4.000^2 = 0.202 \text{ kN.m/m}$

$Ut=M_{do}/M_{ro}=M_{di}/M_{ri} = 0.325/0.584 = 0.202/0.363 = 0.556$

OK