Midland Brick
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# Versaloc® 200 Series

Comparative Calculations between Versaloc® 200 Series and 200 Series Masonry Units

April 2018

## 1. BENDING CAPACITY

*Check has been completed on a 2m high retaining wall, where tensile steel is located with 50mm cover.*

| | |
|---|---|
| Grout Strength | 20MPa |
| Proposed steel reinforcement | N16@400 vertically and N12@400 horizontally |
| Tested Strength of Versaloc® with 20MPa grout | 10.2MPa (refer UQ test certificate) |

### STANDARD MASONRY

$M_d \leq \emptyset f_{sy} A_{sd} d[1-(0.6 f_{sy} A_{sd}/1.3 f'_m bd)]$
$f_{sy}$ = 500 MPa
$A_{sd} = 2.5 \times \varpi/4 \times 16^2 = 503mm^2/m$
Ø = 0.75 (Table 4.1 AS3700 for reinforced masonry)
d = 190mm – 50mm cover – 16/2 = 132mm
$f'_m$ = 8.06 MPa (Clause 3.3.2 AS3700 for 15MPa masonry unit)
b = 1000mm

**Therefore:**
$M_d \leq 0.75 \times 500 \times 503 \times 132 \times [1 - (0.6 \times 500 \times 503 / 1.3 \times 8.06 \times 1000 \times 132)]$
$M_d \leq 22.18$ kNm/m

### VERSALOC®

$M_d \leq \emptyset f_{sy} A_{sd} d[1-(0.6 f_{sy} A_{sd}/1.19 f'_c bd)]$
(1.19 due to the variance in height of the tested Versaloc® Wallette to the typical concrete cylinder test)
All values the same except :
Ø = 0.8 (Table 2.2.2 AS3600)
d = 190 – 5 – 50 – 16/2 = 127mm
Additional 5mm deducted for bevel on Versaloc® unit
$f'_c$ = 10.2 MPa (UQ test results)

**Therefore:**
$M_d \leq 0.8 \times 500 \times 503 \times 127 \times [1 - (0.6 \times 500 \times 503 / 1.19 \times 10.2 \times 1000 \times 127)]$
$M_d \leq 23.05$ kNm/m

### COMPARISON

Standard Block = 22.18 kNm/m
Versaloc® = 23.05 kNm/m
Versaloc® capacity is greater by 3% in bending.

## 2. SHEAR CAPACITY

*Same grout and steel configuration.*

### STANDARD MASONRY

$V_d \leq \emptyset[f'_{vm} b_w d + f_{vs} A_{st} + f_{sy}(A_{sv} d/s)]$
Ø = 0.75 (Table 4.1 AS3700 for reinforced masonry)
$f'_{vm}$ = 0.35MPa
$b_w$ = 1000mm
d = 190mm – 50mm cover – 16mm diameter bar – 12/2 = 118mm
$f_{vs}$ = 17.5MPa
$A_{st} = 503mm^2/m$
$A_{sv} = 0\ mm^2$

**Therefore:**
$V_d \leq 0.75 \times [0.35 \times 1000 \times 118 + 17.5 \times 503]$
$V_d \leq 37.6$kN/m

### VERSALOC®

$V_{uc} = \beta_1 \beta_2 \beta_3 b_v d_o f_{cv} (A_{st}/b_v d_o)^{1/3}$
$\beta_1 = 1.1\ (1.6 - d_o/1000)$
$d_o$ = (190-60mm (for 2 x 30mm face shells) – 20 (balance of 50mm cover) – 16 (bar diameter) – 12/2)
$d_o$ = 88mm
$\beta_1 = 1.66$
$\beta_2 = 1.0$
$\beta_3 = 1.0$
$A_{st} = 503mm^2/m$
$f_{cv} = f'^{1/3}_{cg} = 10.2^{1/3} = 2.2$

**Conservative analysis :**
Check for $b_w$ = 800mm
(allows for no shear capacity for 200mm of Versaloc® unit web)

**Therefore:**
$V_{uc} = 1.66 \times 800 \times 88 \times 2.2 \times (503/(800 \times 88))0.33$
$V_{uc} = 49.5$ kN/m
$\emptyset V_{uc} = 0.7 \times 49.5 = 34.7$kN/m

**Non-conservative analysis**
Check for $b_w$ = 1000mm
(allows for shear capacity of Versaloc® webs)

**Therefore:**
$V_{uc} = 1.66 \times 1000 \times 88 \times 2.2 \times (503/(1000 \times 88))0.33$
$V_{uc} = 57.5$kN/m
$\emptyset V_{uc} = 0.7 \times 57.5 = 40.2$kN/m

### COMPARISON

Standard Block = 37.6kN/m
Versaloc® = 34.7kN/m (conservative analysis)
Versaloc® = 40.2kN/m (non-conservative analysis)
Versaloc® has 93% capacity when compared conservatively to standard block.
Versaloc® has 107% when compared non-conservatively to standard block.

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## 3. COMPRESSIVE CAPACITY

*Compressive Capacity has been calculated to AS3600 Simplified Wall design method for the Versaloc® system. AS3600 is currently out for public comment with a revision to the simplified wall design method which may affect these calculations if the amendments are approved. I recommend checking the most current version of AS3600 for compliance. AS3700 has been used for standard masonry calculations. Calculations have been supplied for both 2011 and 2018 versions of the code.*

### STANDARD MASONRY

Assume slenderness ratio = 25
Wall supports slab at top, fully restrained

**2011**

$F_d \leq kF_o$
$F_o = Ø\ [\ f'_m A_b + k_c \sqrt{(f'_{cg}/1.3)} A_g\ ]$
$f'_m = 8.06MPa$
$A_b = 2 \times 30 \times 1000 = 60000mm^2/m$
$k_c = 1.2$ for reinforced masonry
$f'_{cg} = 1.3 \times 15 = 19.5MPa$
$A_g = 190 \times 1000 - 60000 = 130000mm^2/m$
$Ø = 0.5$ for unreinforced masonry as steel is not laterally supported in both directions
$F_o = 0.5 \times [\ 8.06 \times 60000 + 1.2 \times \sqrt{(19.5/1.3)} \times 130000\ ]$
$F_o = 543.9kN/m$
$k = 0.67 - 0.02\ (S_r - 14) = 0.67 - (0.02*11) = 0.45$

**Therefore:**

$F_d \leq 0.45 \times 543.9 = 244.8kN/m$

**2018**

$F_d \leq Øk_{es}\ [\ f'_m A_b + k_c((f'_{cg}/1.3)^{(0.55+0.005f'cg)})A_g + \alpha_r f_{sy} A_s\ ]$
$Ø = 0.75$
$k_{es} = (1 - 0.025S_r)(1\text{-}2e/t)$
$k_{es} = (1 - 0.025 \times 25) \times (1 - 2 \times (190/6)/190)$
$k_{es} = 0.25$
$\alpha_r = 0.4$
$F_d \leq 0.75 \times 0.25 \times [\ 8.06 \times 60000 + 1.2 \times ((20/1.3)^{(0.55 + 0.005 \times 20)}) \times 130000 + 0.4 \times 500 \times 503\ ]$
$F_d \leq 253.6kN/m$

### VERSALOC®

$N^* \leq Ø\ (t_w - 1.2e - 2e_a)\ 0.6f'_c$
$Ø = 0.6$
$t_w = 190 - 5 - 5 = 180mm$ (2 x 5mm bevels, 1 per face)
$e = t/6 = 180/6 = 30mm$
$e_a = H_{we}^2/2500t_w = (0.75 \times 4750)^2/(2500 \times 180) = 28.2mm$
$F'_c = 10.2MPa$
$N^* \leq 0.6 \times (180 - 1.2 \times 30 - 2 \times 28.2) \times 0.6 \times 10.2$
$N^* \leq 321.7kN/m$

### COMPARISON

Standard Masonry, best case = 253.6kN/m
Versaloc® = 321.7kN/m
Versaloc® has significantly better compressive capacity due to method of calculation to AS3600.