Vale Consultancy

Consulting Civil & Structural Engineers

Title: Retaining Wall Calculations.

Project: Ty Twyn, Mill Road, Dinas Powys, Vale of Glamorgan, CF64 4BT.

Client: Mr T Woodward.

Document No: 01
Project No: 6154
Prepared By: N.Clifford
Checked By: J.Mathias

Revision: -

Date: 13th August 2017

29 Bocam Park, Old Field Road, Pencoed, Bridgend CF35 5LJ.
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Project No. 6154 Prepared by NC
Sheet No. 01 Checked by TM

SCOPE & DESIGN

- THE EXISTING FRONT GARDEN WALL TO TY TWYN MILL ROAD ALONG ROWYS, LACE OF GLAMORGAN CFGG 4RT, FRONTED ONTO THE ADOPTED HIGHWAY, MILL ROAD BETWEEN THE WALL AND CARRIAGEWAY IS A NARROW TARMAC FOOTPATH VERGE & STANDARD KERB DETAIL. MIDWAY ALONG THE FRONTAGE IS A TIMBER POLE SUPPORTING WESTERN POWER DISTRIBUTION CABLES. IN ADDITION THERE ARE ALSO BURIED SERVICES WITHIN THE VERGE.

- THE EXISTING WALL HAD FAILED AND WAS FULLY REMOVED DUE TO THE REMAINING RISK OF FURTHER COLLAPSE ONTO THE PUBLIC HIGHWAY. THE ORIGINAL WALL APPEARED TO BE PREDOMINANTLY A DRY STONE CONSTRUCTION, AND HAD CONSIDERABLE ESTABLISHED IVY AND TREE GROWTH FROM WITHIN THE FACE AND TOP OF THE WALL.

- THE REMOVAL OF THE WALL EXPOSED A STEPPED ROCK FACE, WHICH IS PARTIALLY TERRACED. THE BASE OF THE ROCK OUTCROP IS ABOVE THE HIGHWAY VERGE WHICH CONTAINS SERVICES

- V of G HIGHWAYS HAVE COMMENTED ON A PREVIOUS SCHEME THAT WAS SUBMITTED, WHICH WAS APPROVED. THIS CURRENT SCHEME IS BASED ON THE SAME PRINCIPALS WITH SOME VARIATIONS TO SUIT SITE CONDITIONS & CONSTRAINTS. NAMELY THE ALIGNMENT OF THE ROCK FACE, THE ELEVATION OF THE ROCK OUTCROP ABOVE THE HIGHWAY VERGE AND PRESENCE OF EXISTING SERVICES IN THE HIGHWAY VERGE.

- TO CONSTRAIN THE WALL HEIGHT, THE WALLS WILL BE TERRACED, WITH TWO WALLS TO LIMIT THE HEIGHT OF EACH WALL. PRACTICALLY & TO PROVIDE STABILITY THE WALLS WILL BE CONSTRUCTED OFF THE TOP FACE OF THE ROCK OUTCROP, OTHERWISE THE WALLS WOULD HAVE TO BE CONSTRUCTED OFF COMPACTED FILL, WHICH DUE TO THE LOCATION & CONSTRUCTION SITE CONDITIONS WOULD NOT BE ACHIEVABLE.

- A TOPOGRAPHIC SURVEY OF THE SITE HAS BEEN USED TO ESTABLISH THE ALIGNMENT AND FORMATION LEVEL OF EACH WALL. AS SHOWN IN THE CALCULATIONS & DRAWINGS THE

SCOPE & DESIGN (CONT)

RETAINED HEIGHT ABOVE THE WALL BASE FOR THE BOTTOM & TOP WALLS ARE 1.85m & 1.0m RESPECTIVELY. AS PER Vol 4 HIGHWAYS COMMENTS ON THE PREVIOUS SCHEME A 2.5KN/M^2 SURCHARGE HAS BEEN APPLIED TO BOTH WALLS TO ALLOW FOR PARKING ON THE DRIVEWAY ABOVE THE UPPER WALL & CONSTRUCTION LOADS ON BOTH WALLS.

- THE WALL CONSTRUCTION CONSISTS OF A MASONRY CAVITY BLOCKWORK WALL WITH REINFORCED CONCRETE CORE, & REINFORCED CONCRETE BASE. THE WALL IS IN A CONSERVATION AREA, AND AS SUCH WILL BE CLAD IN NON STRUCTURAL BONDED STONE FACING. AS THE LOWER LEVEL WALL FOUNDATION WILL BE ABOVE THE ROAD VERGE LEVEL, THE STONE FACING WILL BE SUPPORTED ON A STAINLESS STEEL ANGLE SUPPORT SYSTEM (CAST INTO THE FOUNDATION FACE) TO MASK THE FOUNDATION.

- DUE TO THE ELEVATED POSITION OF THE LOWER WALL AN EFFECTIVE DRAINAGE SYSTEM IS NOT FEASIBLE. IT IS PROPOSED TO TO PROVIDE A FILTER CHANNEL TO THE WALL BASE TO PREVENT GROUND WATER RUNOFF FROM THE WALL/ROCK FACE TRACKING ACROSS THE HIGHWAY VERGE. THERE WILL ALSO BE FILTER CHANNELS CROSSING THE VERGE TO CHANNEL WATER INTO THE NEARBY HIGHWAY GULLEY.

- THE FINAL ALIGNMENT OF BOTH WALLS WILL BE DETERMINED WHEN ALL LOOSE MATERIAL HAS BEEN REMOVED FROM THE FACE OF THE ROCK OUTCROP.

- A GROUND BEARING PRESSURE OF 200KN/M^2 ONTO THE UPPER FACE OF THE ROCK HAS BEEN ADOPTED IN THE DESIGN. THE LOWER WALL WILL ALSO HAVE BEEN ANCHORED DOWELS INTO THE ROCK FACE AT THE REAR OF THE FOUNDATION FOR FURTHER STABILITY.

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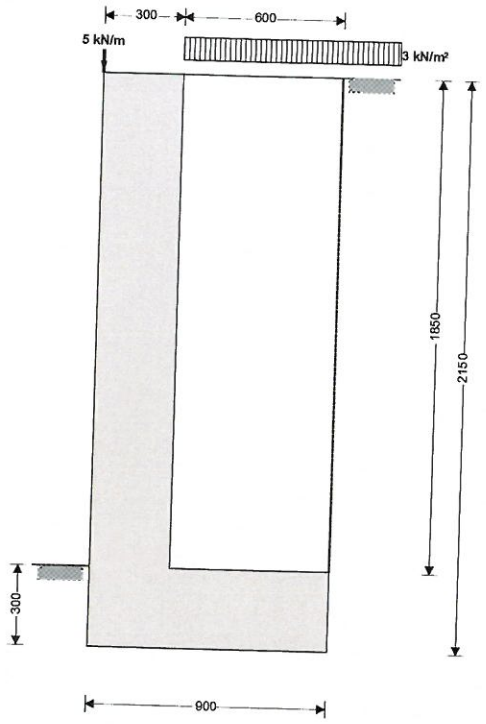
RETAINING WALL ANALYSIS (BS 8002:1994)

TEDDS calculation version 1.2.01.06



Wall details

Retaining wall type	**Cantilever**		
Height of wall stem	h_{stem} = **1850** mm	Wall stem thickness	t_{wall} = **300** mm
Length of toe	l_{toe} = **0** mm	Length of heel	l_{heel} = **600** mm
Overall length of base	l_{base} = **900** mm	Base thickness	t_{base} = **300** mm
Height of retaining wall	h_{wall} = **2150** mm		
Depth of downstand	d_{ds} = **0** mm	Thickness of downstand	t_{ds} = **300** mm
Position of downstand	l_{ds} = **450** mm		
Depth of cover in front of wall	d_{cover} = **0** mm	Unplanned excavation depth	d_{exc} = **0** mm
Height of ground water	h_{water} = **0** mm	Density of water	γ_{water} = 9.81 kN/m³
Density of wall construction	γ_{wall} = **20.0** kN/m³	Density of base construction	γ_{base} = **23.6** kN/m³
Angle of soil surface	β = **0.0** deg	Effective height at back of wall	h_{eff} = **2150** mm
Mobilisation factor	M = **1.2**		
Moist density	γ_m = **17.5** kN/m³	Saturated density	γ_s = **21.0** kN/m³
Design shear strength	ϕ' = **29.3** deg	Angle of wall friction	δ = **18.6** deg
Design shear strength	ϕ'_b = **27.5** deg	Design base friction	δ_b = **21.3** deg
Moist density	γ_{mb} = **18.0** kN/m³	Allowable bearing	$P_{bearing}$ = **200** kN/m²

Using Coulomb theory

Active pressure	K_a =**0.306**	Passive pressure	K_p = **5.571**
At-rest pressure	K_0 = **0.511**		

Loading details

Surcharge load	Surcharge = **2.5** kN/m²		
Vertical dead load	W_{dead} = **4.7** kN/m	Vertical live load	W_{live} = **0.0** kN/m
Horizontal dead load	F_{dead} = **0.0** kN/m	Horizontal live load	F_{live} = **0.0** kN/m

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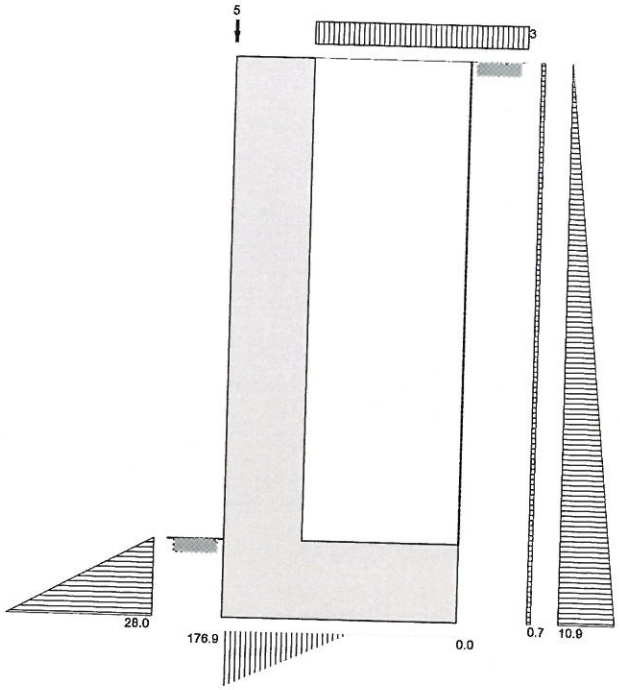
Position of vertical load l_{load} = **0** mm

Height of horizontal load h_{load} = **0** mm



Loads shown in kN/m, pressures shown in kN/m²

Check stability against sliding

Total horizontal load on wall F_{total} = **13.3** kN/m

Resistance to sliding F_{res} = **20.4** kN/m

PASS - Resistance force is greater than sliding force

Check stability against overturning

Overturning moment M_{ot} = **10.1** kNm/m

Restoring moment M_{rest} = **16.2** kNm/m

PASS - Restoring moment is greater than overturning moment

Check bearing pressure

Total vertical reaction R = **43.1** kN/m

Distance to reaction x_{bar} = **162** mm

Eccentricity of reaction e = **288** mm

Reaction acts outside middle third of base

Bearing pressure at toe p_{toe} = **176.9** kN/m²

Bearing pressure at heel p_{heel} = **0.0** kN/m²

PASS - Maximum bearing pressure is less than allowable bearing pressure

RETAINING WALL DESIGN (BS 8002:1994)

TEDDS calculation version 1.2.01.06

Ultimate limit state load factors

Dead load factor γ_{f_d} = **1.4**

Live load factor γ_{f_l} = **1.6**

Earth pressure factor γ_{f_e} = **1.4**

Design of reinforced concrete retaining wall heel (BS 8002:1994)

Material properties

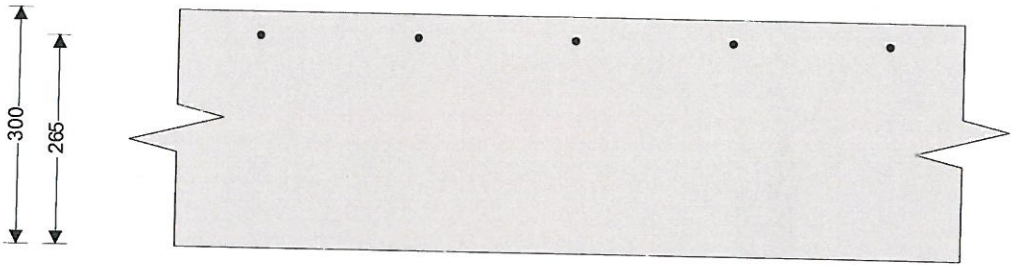
Strength of concrete f_{cu} = **35** N/mm²

Strength of reinforcement f_y = **500** N/mm²

Base details

Minimum reinforcement k = **0.13** %

Cover in heel c_{heel} = **30** mm



Design of retaining wall heel

Shear at heel V_{heel} = **35.5** kN/m

Moment at heel M_{heel} = **16.1** kNm/m

Compression reinforcement is not required

Check heel in bending

Reinforcement provided **A393 mesh**

Area required $A_{s\_heel\_req}$ = **390.0** mm²/m

Area provided $A_{s\_heel\_prov}$ = **393** mm²/m

PASS - Reinforcement provided at the retaining wall heel is adequate

Check shear resistance at heel

Design shear stress v_{heel} = **0.134** N/mm²

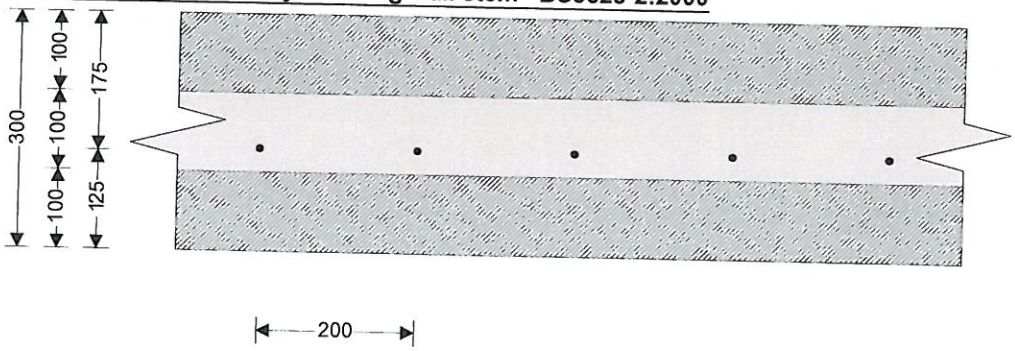
Allowable shear stress v_{adm} = **4.733** N/mm²

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_heel} = **0.415** N/mm²

v_{heel} < v_{c_heel} - No shear reinforcement required

Design of cavity reinforced masonry retaining wall stem - BS5628-2:2000



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Wall details

Thickness of outer leaf of wall t_{outer} = **100** mm

Thickness of inner leaf of wall t_{inner} = **100** mm

Thickness of reinforced cavity t_{cavity} = **100** mm

Masonry details

Masonry type: **Aggregate concrete blocks no voids**

Compressive strength of units p_{unit} = **7.3** N/mm²

Mortar designation: **ii**

Char. compressive strength f_k = **6.4** N/mm²

Manufacture control of units: **Category I**

Material strength safety factor γ_{mm} = **2.0**

Design of retaining wall stem

Shear at base of stem V_{stem} = **25.2** kN/m

Moment at base of stem M_{stem} = **20.5** kNm/m

Check maximum design moment

Maximum design moment M_{d_stem} = **39** kNm/m

PASS - Applied moment is less than maximum design moment

Check wall stem in bending

Reinforcement provided: **A393 mesh**

Area required $A_{s\_stem\_req}$ = **390.0** mm²/m

Area provided $A_{s\_stem\_prov}$ = **393** mm²/m

PASS - Reinforcement provided at the retaining wall stem is adequate

Check shear resistance at wall stem

Design shear stress v_{stem} = **0.144** N/mm²

Allowable shear stress v_{adm} = **0.261** N/mm²

PASS - Design shear stress is less than maximum shear stress

Check limiting dimensions

Limiting span/eff.depth ratio $ratio_{max}$ = **18.00**

Actual span/eff.depth ratio $ratio_{act}$ = **11.07**

PASS - Span to depth ratio is acceptable

Axial load check

Factored axial load on wall N_{wall} = **22.1** kN/m

Limiting axial load N_{limit} = **192.0** kN/m

Applied axial load may be ignored - calculations valid

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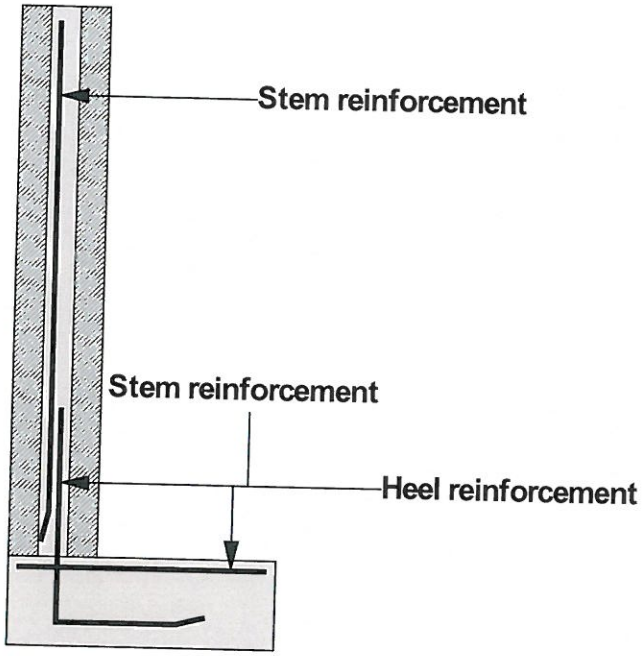
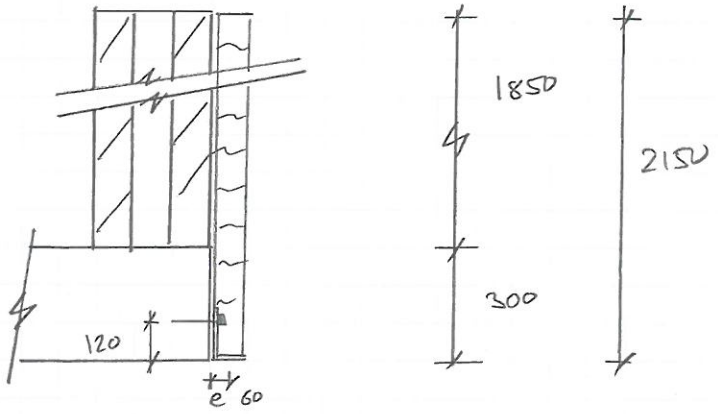
Indicative retaining wall reinforcement diagram



Heel mesh - A393 - (393 mm^2/m)
Stem mesh - A393 - (393 mm^2/m)

LOWER WALL - STONE CLADDING SUPPORT ANGLE



BONDED STONE FACE CLADDING = 22 KN/m³

THICKNESS = 100mm γ_f = 1.4

HEIGHT = 2.15m

VERTICAL LOAD ON ANGLE = 22KN/m³ × 0.1m × 2.15m × 1.4 = 6.6KN/m

SEE HILTI CAST IN ANCHOR CHANNEL OUTPUT FOR CHANNEL CAPACITY / DESIGN. TYPICAL 1m LENGTH.

PROVIDE HILTI HAC-50F CHANNEL HBC-C 50R BOLTS.

ANGLE CHECK.

STONE CLADDING UDL$_{DLT}$ = 6.6 KN/m

ECCENTRICITY 'e' = 60mm.

MOMENT$_{DLT}$ = 6.6 KN/m × 0.06m = 0.4 KNm/m

P_y = 275 N/mm²

$$Z_{xx\,REQ} = \frac{0.4\,KNm \times 10^6}{275\,N/mm^2} = 1454\,mm^3$$

TRY 5mm THICK ANGLE

$$Z_{xx} = \frac{bd^2}{6} = \frac{1000 \times 5^2}{6} = 4167mm^3 > 1454mm^3$$ ∴ OK

∴ PROVIDE 150 × 90 × 5 STAINLESS STEEL ANGLE

Company:	Vale Consultancy	Page:	9
Specifier:		Project:	Ty Twyn, Mill Road,
Address:		Fastening point:	Lower Wall
Phone | Fax:	|	Location | Date:	13/08/2017
E-Mail:			

Specifier's comments:

1 Input data

Channel type; bolt	**HAC-50 106/1050 F; HBC-C 50R, M10 x 40 mm**
Effective embedment depth	h_{ef} = 106 mm
Channel specification	Length: 1050 mm, anchor spacing: 250 mm, projection: 25 mm, width: b_{ch} = 42 mm, height: h_{ch} = 31 mm
Material	Anchor & Channel: hot-dip galvanized Bolt: stainless
Europ. Tech. Assessment (ETA)	-
Issued I Valid	- | -
Standard	CEN/TS 1992-4-3
Base material	uncracked, C20/25, $f_{ck,cube}$ = 25.0 N/mm², h = ∞ mm
Reinforcement	Exist. Reinf.: Widely spaced Straight edge reinf. present Reinf. to control splitting present
Tolerance data	tolerance interval: -1000 mm/1000 mm most unfavorable tolerance: 0 mm

2 Overall Result

Design ok! (Maximum utilization: 31%)

2.1 Fixtures / Bolt groups / Loads

Fixture 1

3 Load case / Resulting bolt forces

Load case: Design load

3.1 Load distribution

3.1.1 Fixture 1: bolt: HBC-C 50R, M10 x 40 mm

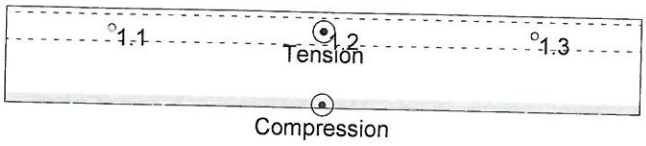
Profile: ; L x W x T = 1000 x 10 x 0 mm

Standoff: No standoff

Plate dimensions: 1000 mm x 150 mm x 10 mm

Anchorplate design calculated: no

Bolt	N [kN]	V [kN]	V_x [kN]	V_y [kN]
1.1	0.959	2.190	0.000	-2.190
1.2	0.959	2.200	0.000	-2.200
1.3	0.959	2.210	0.000	-2.210



3.2 Derivation of forces acting on anchor channels

Anchor forces [kN]

Anchor	N	V
a1	0.377	-0.862
a2	0.725	-1.659
a3	0.671	-1.540
a4	0.726	-1.670
a5	0.377	-0.870

3.3 Verifications for anchor channels under tension loading (CEN/TS 1992-4-3:2009 section 6.2)

	Load [kN], [kNm]	Resistance [kN], [kNm]	Utilization [%]	Status
Bolt	0.959	10.150	10	ok

3.4 Verifications for anchor channels under shear loading (CEN/TS 1992-4-3:2009 section 6.3)

	Load [kN], [kNm]	Resistance [kN], [kNm]	Utilization [%]	Status
Bolt w/o lever arm	2.210	7.308	31	ok

3.5 Combined tension and shear loads (CEN/TS 1992-4-3:2009 section 6.4)

Proof of interaction calculated independently for acting load and load distribution

3.5.1 Bolt (Fixture 1, bolt 1.3)

$\beta_{N,s}^{\alpha} + \beta_{V,s}^{\alpha} = 0.095^{2.0} + 0.302^{2.0} = 0.100 \leq 1.000$

$\beta_{N,s}$: governing failure mode - tension: Bolt (Fixture 1, bolt 1.3)

$\beta_{V,s}$: governing failure mode - shear: Bolt w/o lever arm (Fixture 1, bolt 1.3)

3.5.2 Anchor channel (Anchor a3)

$\beta_{N,a}^{\alpha} + \beta_{V,a}^{\alpha} = 0.037^{1.5} + 0.122^{1.5} = 0.050 \leq 1.000$

$\beta_{N,a}$: governing failure mode - tension: Connection anchor-channel (Anchor)

$\beta_{V,a}$: governing failure mode - shear: Concrete edge failure (Anchor)

Remarks and warnings

- Please consider all details and hints/warnings given in the detailed report!

Design ok! (Maximum utilization: 31%)

4 Remarks; Your Cooperation Duties

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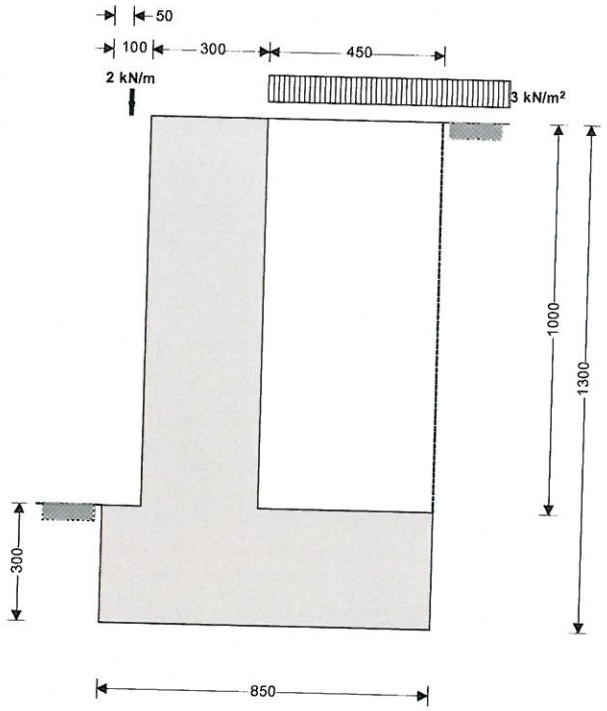
RETAINING WALL ANALYSIS (BS 8002:1994)

TEDDS calculation version 1.2.01.06



Wall details

Retaining wall type	**Cantilever**		
Height of wall stem	h_{stem} = **1000** mm	Wall stem thickness	t_{wall} = **300** mm
Length of toe	l_{toe} = **100** mm	Length of heel	l_{heel} = **450** mm
Overall length of base	l_{base} = **850** mm	Base thickness	t_{base} = **300** mm
Height of retaining wall	h_{wall} = **1300** mm		
Depth of downstand	d_{ds} = **0** mm	Thickness of downstand	t_{ds} = **300** mm
Position of downstand	l_{ds} = **450** mm		
Depth of cover in front of wall	d_{cover} = **0** mm	Unplanned excavation depth	d_{exc} = **0** mm
Height of ground water	h_{water} = **0** mm	Density of water	γ_{water} = 9.81 kN/m³
Density of wall construction	γ_{wall} = **20.0** kN/m³	Density of base construction	γ_{base} = **23.6** kN/m³
Angle of soil surface	β = **0.0** deg	Effective height at back of wall	h_{eff} = **1300** mm
Mobilisation factor	M = **1.5**		
Moist density	γ_m = **17.5** kN/m³	Saturated density	γ_s = **21.0** kN/m³
Design shear strength	ϕ' = **24.2** deg	Angle of wall friction	δ = **18.6** deg
Design shear strength	ϕ'_b = **27.5** deg	Design base friction	δ_b = **21.3** deg
Moist density	γ_{mb} = **18.0** kN/m³	Allowable bearing	$P_{bearing}$ = **150** kN/m²

Using Coulomb theory

Active pressure	K_a = **0.369**		
At-rest pressure	K_0 = **0.590**	Passive pressure	K_p = **5.571**

Loading details

Surcharge load	Surcharge = **2.5** kN/m²		
Vertical dead load	W_{dead} = **2.0** kN/m	Vertical live load	W_{live} = **0.0** kN/m
Horizontal dead load	F_{dead} = **0.0** kN/m	Horizontal live load	F_{live} = **0.0** kN/m

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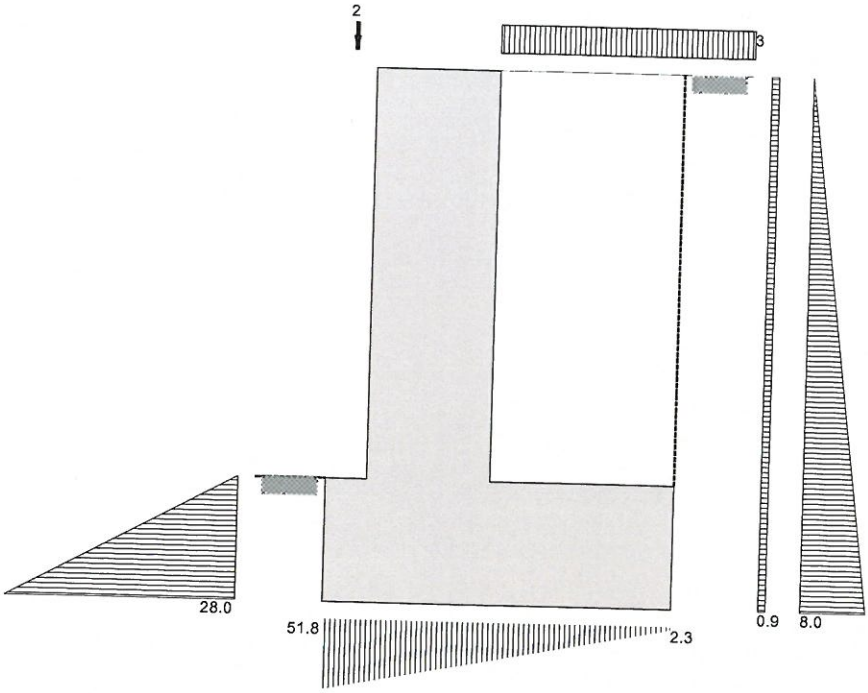
Position of vertical load l_{load} = **50** mm

Height of horizontal load h_{load} = **0** mm



Loads shown in kN/m, pressures shown in kN/m²

Check stability against sliding

Total horizontal load on wall F_{total} = **6.3** kN/m

Resistance to sliding F_{res} = **12.7** kN/m

PASS - Resistance force is greater than sliding force

Check stability against overturning

Overturning moment M_{ot} = **3.0** kNm/m

Restoring moment M_{rest} = **9.1** kNm/m

PASS - Restoring moment is greater than overturning moment

Check bearing pressure

Total vertical reaction R = **23.0** kN/m

Distance to reaction x_{bar} = **295** mm

Eccentricity of reaction e = **130** mm

Reaction acts within middle third of base

Bearing pressure at toe p_{toe} = **51.8** kN/m²

Bearing pressure at heel p_{heel} = **2.3** kN/m²

PASS - Maximum bearing pressure is less than allowable bearing pressure

VALE CONSULTANCY
29 Bocam Park, Old Field Road
Pencoed, Bridgend
CF35 5LJ

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Upper wall				13
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NC	11/08/2017	JM	11/08/2017	JM / 11/08/2017

RETAINING WALL DESIGN (BS 8002:1994)

TEDDS calculation version 1.2.01.06

Ultimate limit state load factors

Dead load factor γ_{f_d} = **1.4**
Live load factor γ_{f_l} = **1.6**
Earth pressure factor γ_{f_e} = **1.4**

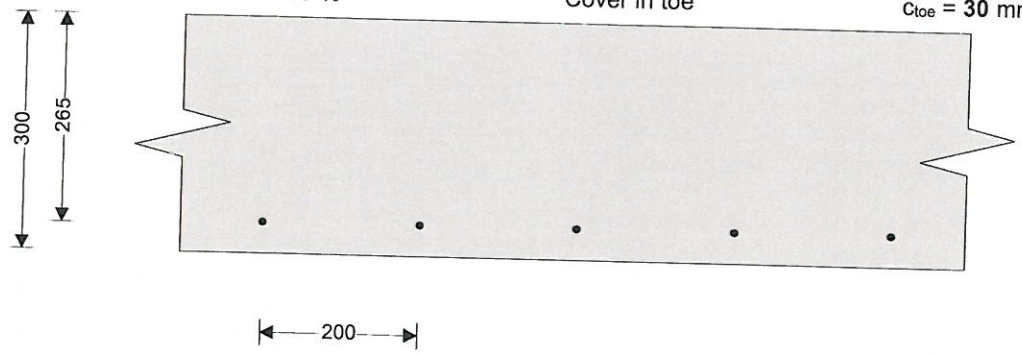
Design of reinforced concrete retaining wall toe (BS 8002:1994)

Material properties

Strength of concrete f_{cu} = **35** N/mm²
Strength of reinforcement f_y = **500** N/mm²

Base details

Minimum reinforcement k = **0.13** %
Cover in toe c_{toe} = **30** mm



Design of retaining wall toe

Shear at heel V_{toe} = **8.8** kN/m
Moment at heel M_{toe} = **2.6** kNm/m

Compression reinforcement is not required

Check toe in bending

Reinforcement provided **A393 mesh**
Area required $A_{s\_toe\_req}$ = **390.0** mm²/m
Area provided $A_{s\_toe\_prov}$ = **393** mm²/m

PASS - Reinforcement provided at the retaining wall toe is adequate

Check shear resistance at toe

Design shear stress v_{toe} = **0.033** N/mm²
Allowable shear stress v_{adm} = **4.733** N/mm²

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_toe} = **0.415** N/mm²

$v_{toe} < v_{c\_toe}$ - No shear reinforcement required

Design of reinforced concrete retaining wall heel (BS 8002:1994)

Material properties

Strength of concrete f_{cu} = **35** N/mm²
Strength of reinforcement f_y = **500** N/mm²

Base details

Minimum reinforcement k = **0.13** %
Cover in heel c_{heel} = **30** mm

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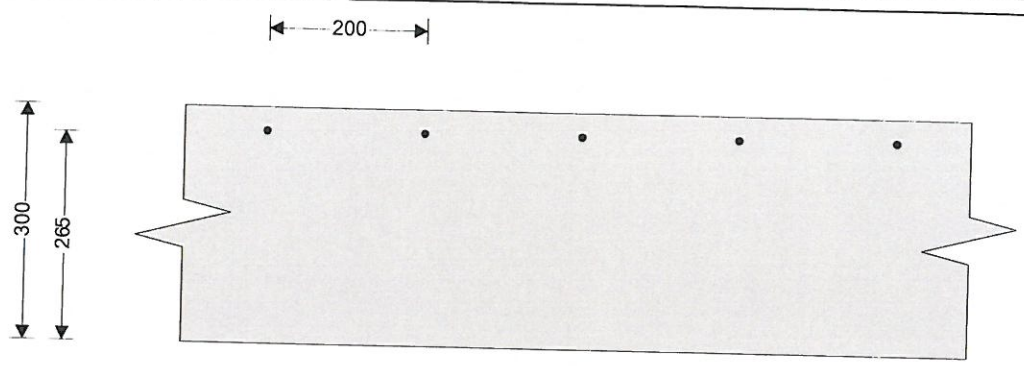
Upper wall				14	
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
NC	11/08/2017	JM	11/08/2017	JM	11/08/2017



Design of retaining wall heel

Shear at heel V_{heel} = **13.6** kN/m

Moment at heel M_{heel} = **5.3** kNm/m

Compression reinforcement is not required

Check heel in bending

Reinforcement provided **A393 mesh**

Area required $A_{s\_heel\_req}$ = **390.0** mm²/m

Area provided $A_{s\_heel\_prov}$ = **393** mm²/m

PASS - Reinforcement provided at the retaining wall heel is adequate

Check shear resistance at heel

Design shear stress v_{heel} = **0.051** N/mm²

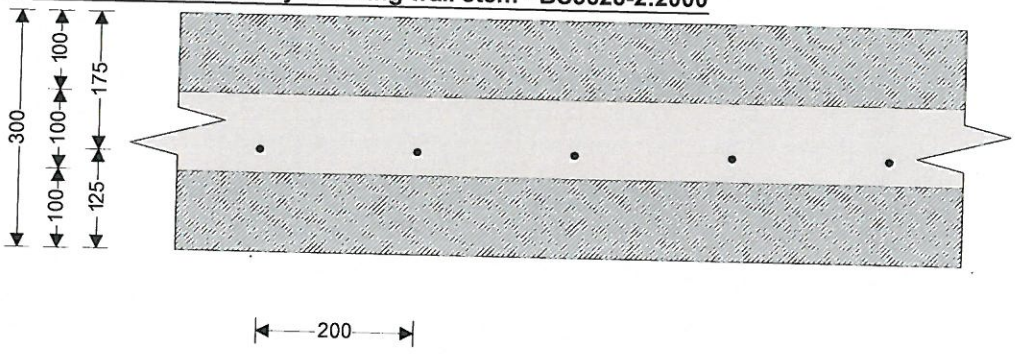
Allowable shear stress v_{adm} = **4.733** N/mm²

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_heel} = **0.415** N/mm²

$v_{heel} < v_{c\_heel}$ - No shear reinforcement required

Design of cavity reinforced masonry retaining wall stem - BS5628-2:2000



Wall details

Thickness of outer leaf of wall t_{outer} = **100** mm

Thickness of inner leaf of wall t_{inner} = **100** mm

Thickness of reinforced cavity t_{cavity} = **100** mm

Masonry details

Masonry type **Aggregate concrete blocks no voids**

Compressive strength of units p_{unit} = **7.3** N/mm²

Mortar designation **ii**

Char. compressive strength f_k = **6.4** N/mm²

Manufacture control of units **Category I**

Material strength safety factor γ_{mm} = **2.0**

Design of retaining wall stem

Shear at base of stem V_{stem} = **9.6** kN/m

Moment at base of stem M_{stem} = **5.0** kNm/m

Check maximum design moment

Maximum design moment M_{d_stem} = **39** kNm/m

PASS - Applied moment is less than maximum design moment

Check wall stem in bending

Reinforcement provided **A393 mesh**

Area required $A_{s\_stem\_req}$ = **390.0** mm²/m Area provided $A_{s\_stem\_prov}$ = **393** mm²/m

PASS - Reinforcement provided at the retaining wall stem is adequate

Check shear resistance at wall stem

Design shear stress v_{stem} = **0.055** N/mm² Allowable shear stress v_{adm} = **0.341** N/mm²

PASS - Design shear stress is less than maximum shear stress

Check limiting dimensions

Limiting span/eff.depth ratio $ratio_{max}$ = **18.00** Actual span/eff.depth ratio $ratio_{act}$ = **6.21**

PASS - Span to depth ratio is acceptable

Axial load check

Factored axial load on wall N_{wall} = **11.2** kN/m Limiting axial load N_{limit} = **192.0** kN/m

Applied axial load may be ignored - calculations valid

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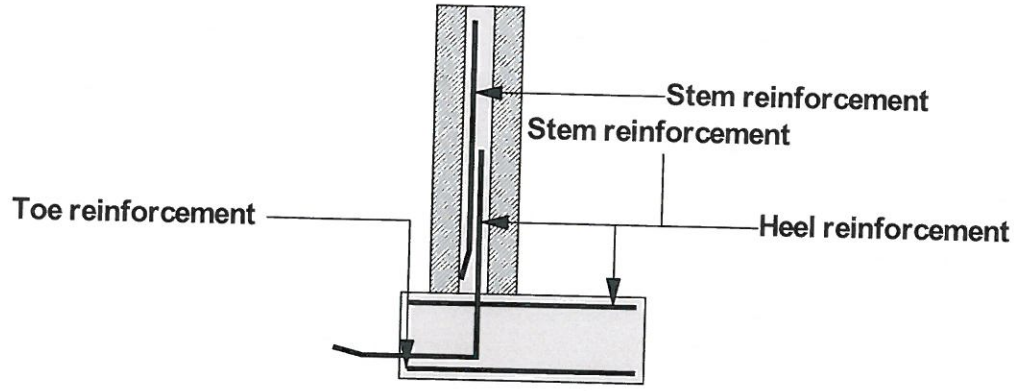
Indicative retaining wall reinforcement diagram



Toe mesh - A393 - (393 mm^2/m)
Heel mesh - A393 - (393 mm^2/m)
Stem mesh - A393 - (393 mm^2/m)