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Date	Sheet No.
Eng. PS	PC-14
Job No. 16440	

28 Canfield Gardens NW6.

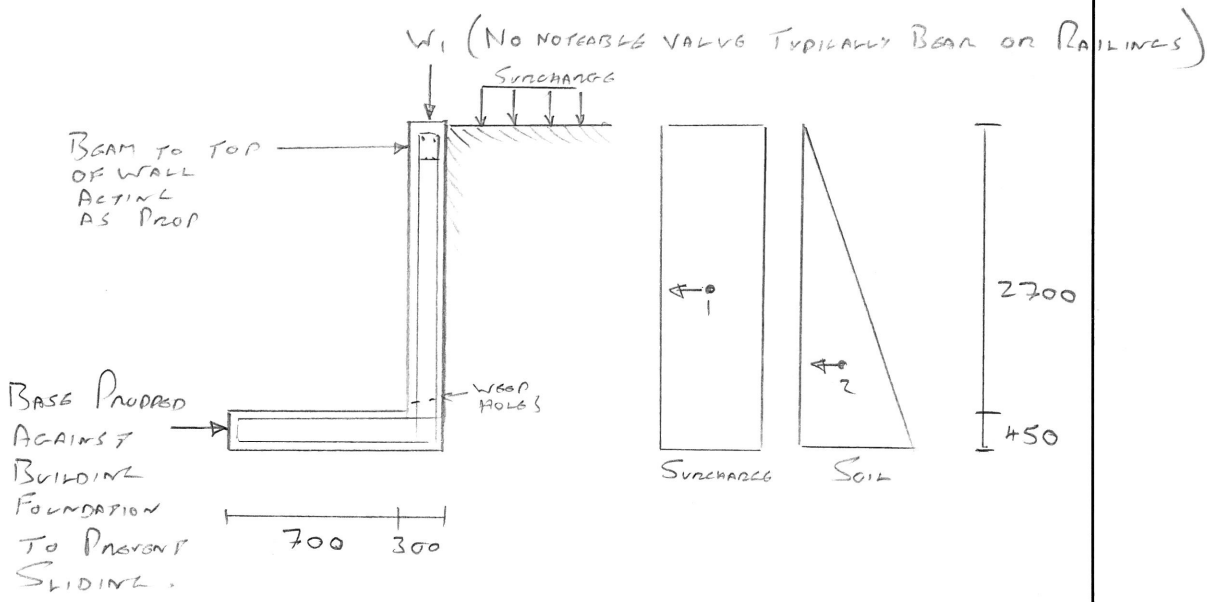
External Lightwell Retaining Wall Design.

Surcharge Load Cases : Similar to other External Walls.

Front (Vehicle Axels) = 10.0 kN/m²

Rear (Garden) = 5.0 kN/m²

Water Pressure : Lined weep holes are to be formed near the base of the wall. Water to run into drainage (by others) in the base of the lightwells.



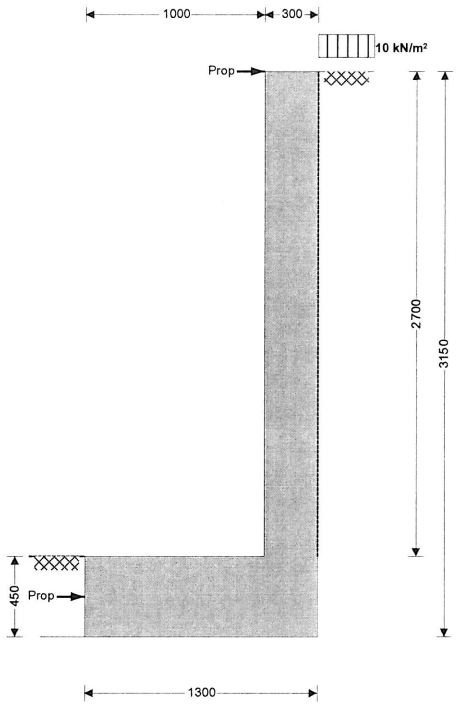
General wall design carried out using Tedds program & assuming:

- C-35(sr) Grade Concrete
- H16 Bars @ 200mm ctrs Top & Bottom to Base.
- H16 Bars @ 200mm ctrs to both faces in wall vertically.
- H12 Bars @ 250mm ctrs to both faces in wall horizontally.

Tedds Martin Redston Associates 4 Edward Square London N1 0SP	Project 28 CANFIELD GARDENS, LONDON				Job no. 16.440	
	Calcs for LIGHTWELL RETAINING WALL SECTION (front)				Start page no./Revision Dc-15	
	Calcs by PS	Calcs date 22/12/2016	Checked by	Checked date	Approved by	Approved date

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} = **2700** mm	Wall stem thickness	t_{wall} = **300** mm
Length of toe	l_{toe} = **1000** mm	Length of heel	l_{heel} = **0** mm
Overall length of base	l_{base} = **1300** mm	Base thickness	t_{base} = **450** mm
Height of retaining wall	h_{wall} = **3150** mm		
Depth of downstand	d_{ds} = **0** mm	Thickness of downstand	t_{ds} = **450** mm
Position of downstand	l_{ds} = **-250** 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/m^3
Density of wall construction	γ_{wall} = **23.6** kN/m^3	Density of base construction	γ_{base} = **23.6** kN/m^3
Angle of soil surface	β = **0.0** deg	Effective height at back of wall	h_{eff} = **3150** mm
Mobilisation factor	M = **1.5**		
Moist density	γ_m = **18.0** kN/m^3	Saturated density	γ_s = **21.0** kN/m^3
Design shear strength	ϕ' = **24.2** deg	Angle of wall friction	δ = **0.0** deg
Design shear strength	ϕ'_b = **24.2** deg	Design base friction	δ_b = **18.6** deg
Moist density	γ_{mb} = **18.0** kN/m^3	Allowable bearing	$P_{bearing}$ = **100** kN/m^2

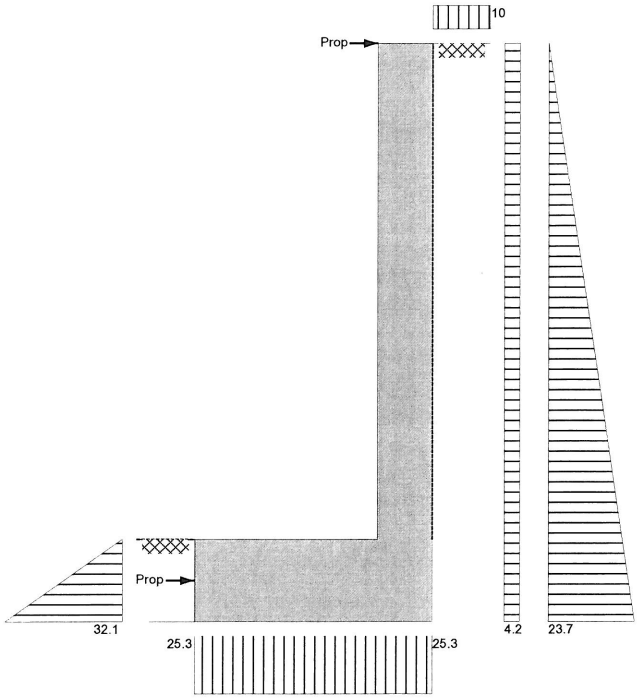
Using Coulomb theory

Active pressure	K_a =**0.419**	Passive pressure	K_p = **4.187**
At-rest pressure	K_0 = **0.590**		

Loading details

Surcharge load	Surcharge = **10.0** kN/m^2		
Vertical dead load	W_{dead} = **0.0** 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
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

Calculate propping force

Propping force F_{prop} = **32.2** kN/m

Check bearing pressure

Total vertical reaction	R = **32.9** kN/m	Distance to reaction	x_{bar} = **650** mm
Eccentricity of reaction	e = **0** mm		

Reaction acts within middle third of base

Bearing pressure at toe	p_{toe} = **25.3** kN/m²	Bearing pressure at heel	p_{heel} = **25.3** kN/m²

PASS - Maximum bearing pressure is less than allowable bearing pressure

Calculate propping forces to top and base of wall

Propping force to top of wall	F_{prop_top} = **14.767** kN/m	Propping force to base of wall	F_{prop_base} = **17.480** kN/m

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**

Calculate propping force

Propping force F_{prop} = **32.2** kN/m

Calculate propping forces to top and base of wall

Propping force to top of wall $F_{prop\_top\_f}$ = **31.931** kN/m Propping force to base of wall $F_{prop\_base\_f}$ = **45.947** kN/m

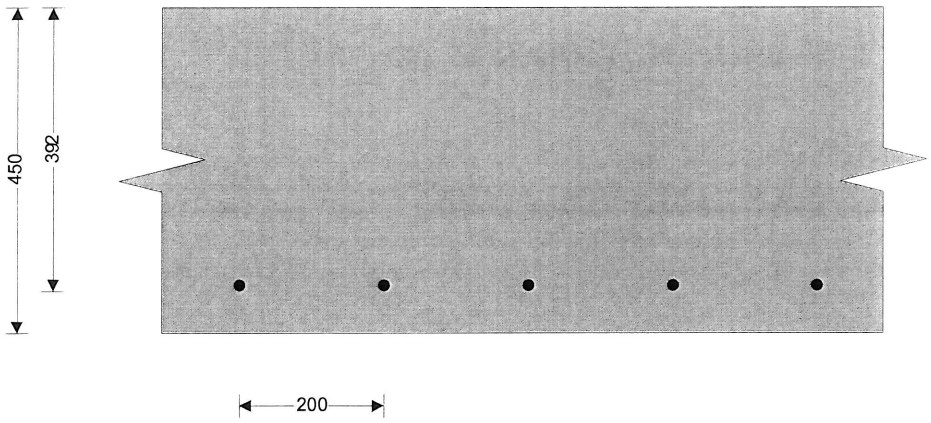
Design of reinforced concrete retaining wall toe (BS 8002:1994)

Material properties

Strength of concrete f_{cu} = **35** N/mm^2 Strength of reinforcement f_y = **500** N/mm^2

Base details

Minimum reinforcement k = **0.13** % Cover in toe c_{toe} = **50** mm



Design of retaining wall toe

Shear at heel V_{toe} = **20.6** kN/m Moment at heel M_{toe} = **13.6** kNm/m

Compression reinforcement is not required

Check toe in bending

Reinforcement provided **16 mm dia.bars @ 200 mm centres**

Area required $A_{s\_toe\_req}$ = **585.0** mm^2/m Area provided $A_{s\_toe\_prov}$ = **1005** mm^2/m

PASS - Reinforcement provided at the retaining wall toe is adequate

Check shear resistance at toe

Design shear stress v_{toe} = **0.053** N/mm^2 Allowable shear stress v_{adm} = **4.733** N/mm^2

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_toe} = **0.451** N/mm^2

v_{toe} < v_{c_toe} - No shear reinforcement required

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

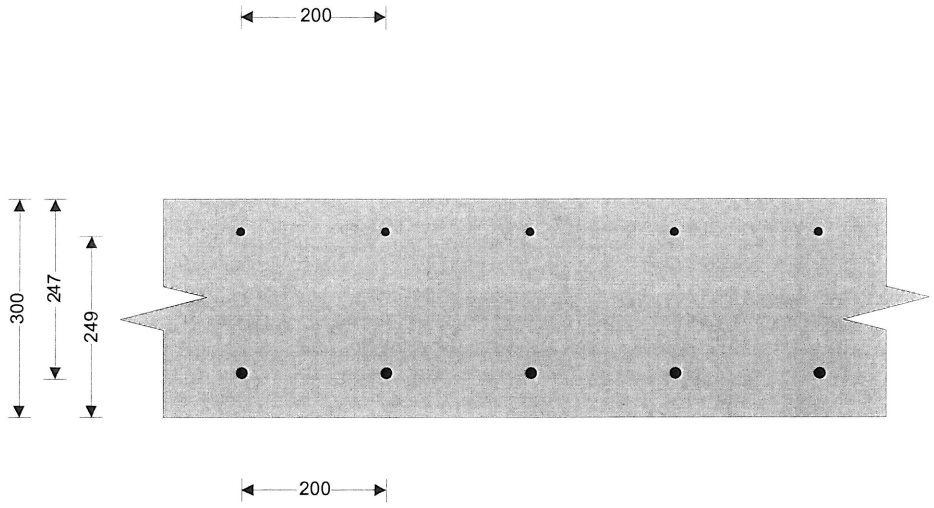
Material properties

Strength of concrete f_{cu} = **35** N/mm^2 Strength of reinforcement f_y = **500** N/mm^2

Wall details

Minimum reinforcement k = **0.13** %

Cover in stem c_{stem} = **45** mm Cover in wall c_{wall} = **45** mm



Design of retaining wall stem

Shear at base of stem V_{stem} = **57.4** kN/m Moment at base of stem M_{stem} = **33.2** kNm/m

Compression reinforcement is not required

Check wall stem in bending

Reinforcement provided **16 mm dia.bars @ 200 mm centres**

Area required $A_{s\_stem\_req}$ = **390.0** mm²/m Area provided $A_{s\_stem\_prov}$ = **1005** mm²/m

PASS - Reinforcement provided at the retaining wall stem is adequate

Check shear resistance at wall stem

Design shear stress v_{stem} = **0.233** 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_stem} = **0.591** N/mm²

$v_{stem} < v_{c\_stem}$ - No shear reinforcement required

Design of retaining wall at mid height

Moment at mid height M_{wall} = **15.7** kNm/m

Compression reinforcement is not required

Reinforcement provided **12 mm dia.bars @ 200 mm centres**

Area required $A_{s\_wall\_req}$ = **390.0** mm²/m Area provided $A_{s\_wall\_prov}$ = **565** mm²/m

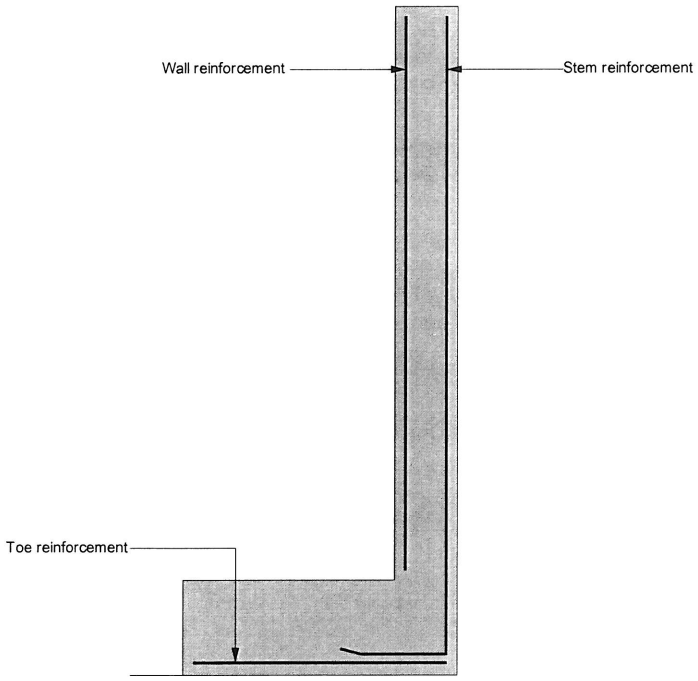
PASS - Reinforcement provided to the retaining wall at mid height is adequate

Check retaining wall deflection

Max span/depth ratio $ratio_{max}$ = **40.00** Actual span/depth ratio $ratio_{act}$ = **10.93**

PASS - Span to depth ratio is acceptable

Indicative retaining wall reinforcement diagram



Toe bars - 16 mm dia.@ 200 mm centres - (1005 mm^2/m)
Wall bars - 12 mm dia.@ 200 mm centres - (565 mm^2/m)
Stem bars - 16 mm dia.@ 200 mm centres - (1005 mm^2/m)