STRUCTURAL CALCULATIONS FOR

KINGPOST RETAINING STRUCTURE AT

5 HILLSIDE CLOSE LODON NW8 0EF

CLIENT

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Vineyards Business Centre
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Primrose Hill, London
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STRUCTURAL ENGINEER

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Date: 19th June 2023

Job Reference: SH2304

Prepared By: N Khan (BEng. MSc.)
Senior Structural Engineer

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KEY:

King posts	152 UC 30kg S355 with 2.0m Space c/c & 2.2m depth Insersion using 350 Augar bores C30 concrete.
Panels	Concrete or D30 200x125 deep timbers

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PROJECT :-

To support existing Retaining structure at the rear of Property located at 4 Hillside close London NW8 0EF to facilitate real new retaining structure over piles. Temporary King Post retaining structure is proposed to facilitate above. The design has been carried out according to British standards & NHBC Requirement

King Post Retaining structure + concrete panels inbetween to retain soil @ max 2.0m height with 2.0m c/c

The steel posts (king posts) will be inserted in 350mm Auger bore filled with C30 N/mm² concrete. The steel strength to be 355 N/mm²

Assumptions:- Surcharge = 10 kN/m²

soil density = 20 kN/m³

ϕ = 30°

Ka = 0.33

Kp = 3.33.

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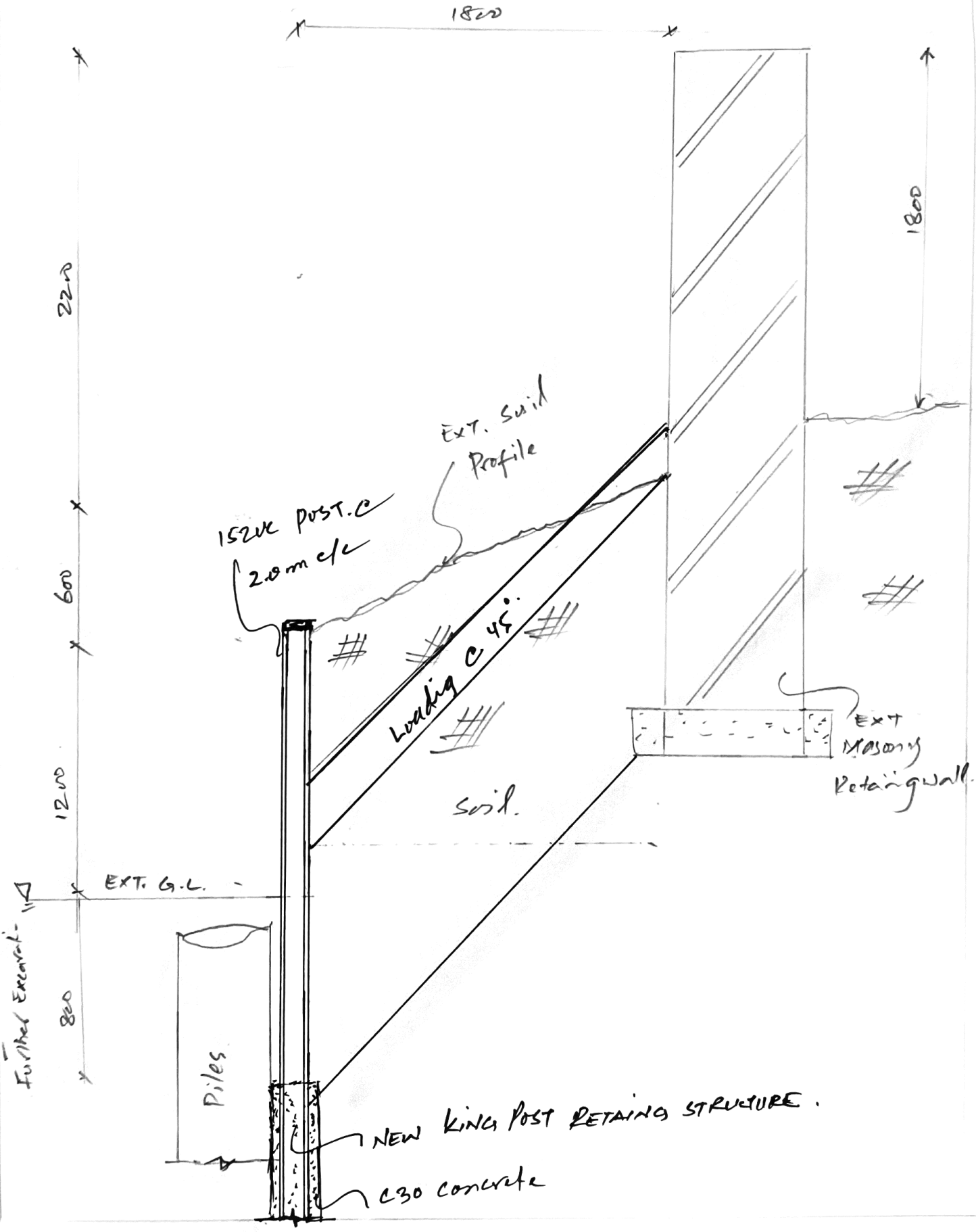

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Steel post with concrete sleepers design.

For 2.0 m height Soil Retain.

Surcharge say = 10.0 kN/m²

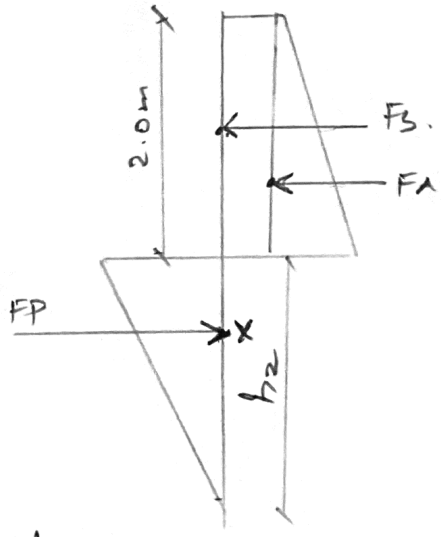
Soil density = 20 kN/m³

ϕ = 30°

k_a = 0.33

k_p = 3.33

h = 2.0



$$F_A = \frac{1}{2} \gamma h^2 k_a$$

$$= 1/2 \times 20 \times (2.0)^2 \times 0.33 = 13.2 \text{ kN/m}$$

$$F_s = s \times k_a$$

$$= 10 \times 0.33 = 3.3 \text{ kN/m.}$$

ϕ post @ 2.0 m

F_A = 26.4 kN.

F_s = 6.6 kN.

Take moment at point x

$$M_y = F_A \left(\frac{2.0}{3} + h_2/3\right) + F_s \left(\frac{2.0}{2} + \frac{h_2}{3}\right) = 0.$$

$$= \frac{26.4}{3}(2 + h_2) + 3.3\left(1 + \frac{h_2}{3}\right) = 0.$$

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$\therefore M_4 = 17.60 + 8.8h_2 + 3.3 + 1.1h_2 = 0.$

$\Rightarrow h_2 = 2.11$ Say 2.2 m deep

$\therefore$ Use 2.2 m deep Insertion

Design moment for steel post

$M = F_A\left(\frac{2.0}{3}\right) + F_4\left(\frac{2}{2}\right)$

$\Rightarrow M = \left(26.4\left(\frac{2}{3}\right) + 6.6\right) \times 1.4 = 33.88$ kN-m.

Capacity of 152 UC 30 kg/m $\Rightarrow M_x = 67.6$ kN-m OK

Tedds analysis Page 6, 7

Passive Resistance :-

$F_p = \frac{1}{2}\gamma h_2^2 \times k_p$

$= \frac{1}{2} \times 20 \times (2.2)^2 \times 3.33 \times \frac{2}{3} \times 0.35$

$= 37.6$ kN OK.

Hence section is Adequate

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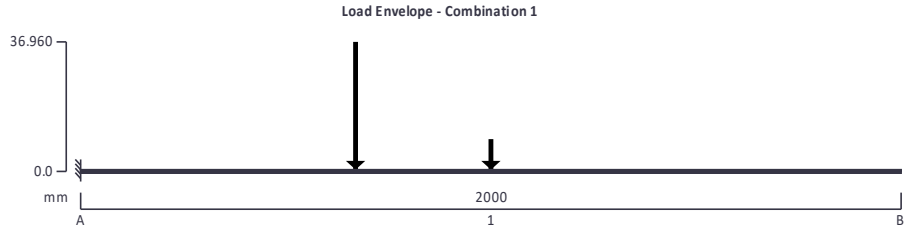
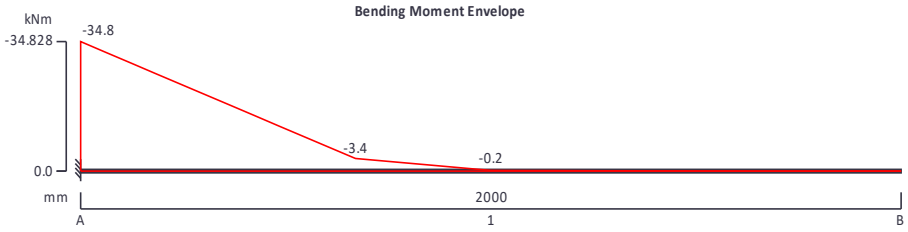
	Section King post			Sheet no./rev. 6	
	Calc. by N.K	Date 19/06/2023	Chk'd by	Date	App'd by	Date

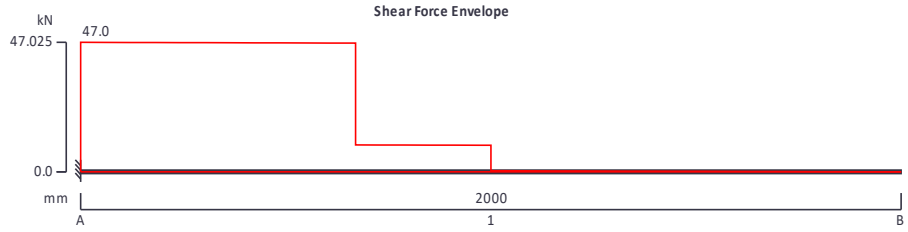
STEEL BEAM ANALYSIS & DESIGN (BS5950)

In accordance with BS5950-1:2000 incorporating Corrigendum No.1

TEDDS calculation version 3.0.05







Support conditions

Support A	Vertically restrained
	Rotationally restrained
Support B	Vertically free
	Rotationally free

Applied loading

Beam loads	Dead self weight of beam × 1
	Dead point load 26.4 kN at 670 mm
	Dead point load 6.6 kN at 1000 mm

Load combinations

Load combination 1	Support A	Dead × 1.40
		Imposed × 1.60
		Dead × 1.40
		Imposed × 1.60

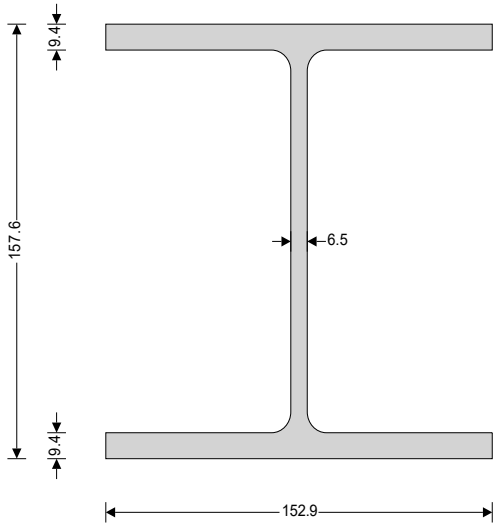
	Support B	Dead × 1.40
		Imposed × 1.60

Analysis results

Maximum moment	M_{max} = **0** kNm	M_{min} = **-34.8** kNm
Maximum shear	V_{max} = **47** kN	V_{min} = **0** kN
Deflection	δ_{max} = **4.6** mm	δ_{min} = **0** mm
Maximum reaction at support A	R_{A_max} = **47** kN	R_{A_min} = **47** kN
Unfactored dead load reaction at support A	R_{A_Dead} = **33.6** kN	
Maximum reaction at support B	R_{B_max} = **0** kN	R_{B_min} = **0** kN

Section details

Section type **UC 152x152x30 (BS4-1)** Steel grade **S355**



Classification of cross sections - Section 3.5

Tensile strain coefficient ε = **0.88** Section classification **Compact**

Shear capacity - Section 4.2.3

Design shear force F_v = **47** kN Design shear resistance P_v = **218.2** kN

PASS - Design shear resistance exceeds design shear force

Moment capacity - Section 4.2.5

Design bending moment M = **34.8** kNm Moment capacity low shear M_c = **87.9** kNm

Equivalent uniform moment factor - Section 4.3.6.6

Equiv uniform mnt factor LTB m_{LT} = **1.000**

Buckling resistance moment - Section 4.3.6.4

Buckling resistance moment M_b = **57.7** kNm M_b / m_{LT} = **57.7** kNm

PASS - Buckling resistance moment exceeds design bending moment

Check vertical deflection - Section 2.5.2

Consider deflection due to dead and imposed loads

Limiting deflection δ_{lim} = **8** mm Maximum deflection δ = **4.637** mm

PASS - Maximum deflection does not exceed deflection limit

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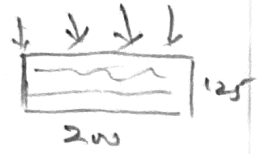
Timber sleepers:

Try 125x200

D30



Ac $F_A + F_S = 13.2 + 3.3 = 16.50$ kN/m

Load on 200 mm sleeper

$P = 16.5 \times 0.2 = 3.30$ kN/m

$L = 2.0$ m

$M = wL^2/8 = 3.30 \times (2)^2/8 = 1.65$ kN-m

A_s $\frac{bd^2}{6} = M/\sigma$

$\sigma_{req} = \frac{6 \times 1.65 \times 10^6}{200 \times (125)^2} = 3.16$ N/mm²

OK

$\Delta = \frac{5}{384} \frac{wL^4}{EI} \leq 0.003 \times L$

$= \frac{5}{384} \times \frac{3.3 \times (2000)^4 \times 12}{720 \times 200 \times (125)^3} \leq 0.003 \times 2000$

$= 2.93$ mm < 6.0

Hence D30 section is adequate.

King post Retaining wall

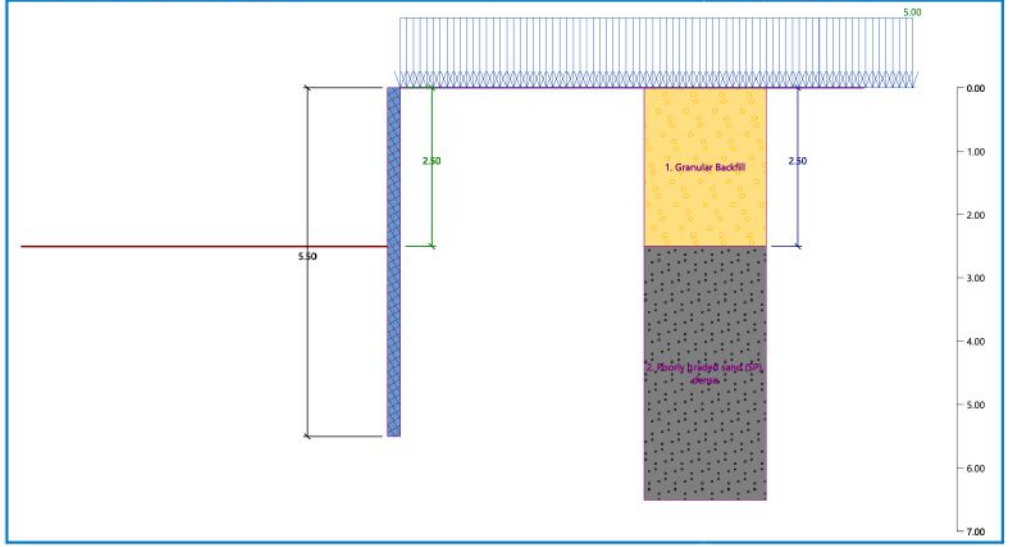
Everything you need to know about a king post retaining wall in 3.5 minutes

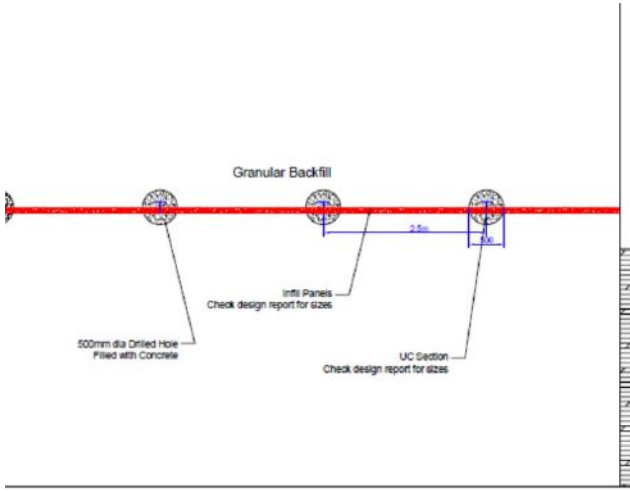
Bob Evans

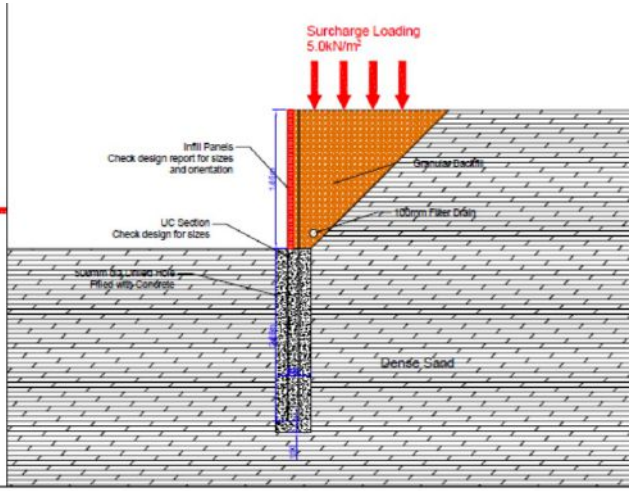
Retaining Wall Solutions

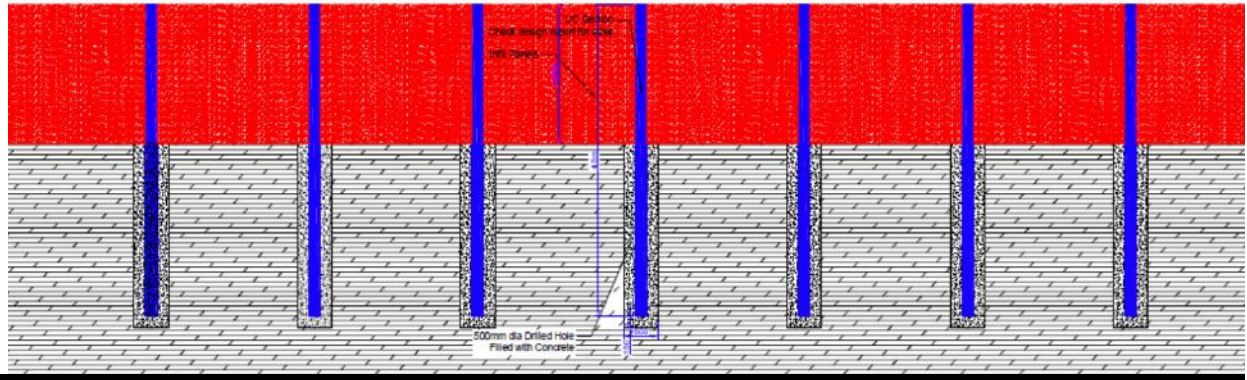
No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	2.50	0.00 .. 2.50	Granular Backfill	
2	-	2.50 .. ∞	Poorly graded sand (SP), dense	

Name : Profile and assignment **Stage - analysis : 1 - 0**









King Post Structural Design and Sketch

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Pile vibration and auger drilling methods for post installation

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Textured finish to concrete panels

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Plain concrete finish panels

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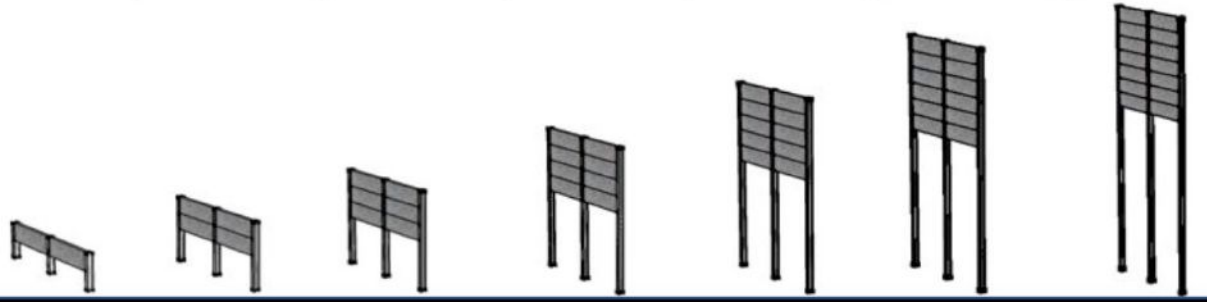
Height (mm)	500	1000	1500	2000	2500	3000	3500
Post Centers (mm)	2000	2000	2000	2000	2000	2000	2000
Post Section	152 x 152 UC	152 x 152 UC	152 x 152 UC	203 x 203 UC	203 x 203 UC	203 x 203 UC	254 x 254 UC
Post weight (kg)	23 kg	23 kg	30 kg	46 kg	60 kg	86 kg	107 kg
Post Embedment (m)	0.5	1.0	1.5	2.5	3.5	4.5	5.5
Post Length (m)	1.0	2.0	3.0	4.5	6.0	7.5 m	9.0
Post Hole Diameter (mm)	450	450	450	450	450	450	450
Surcharge	10kn/m²	10kn/m²	10kn/m²	10kn/m²	10kn/m²	10kn/m²	10kn/m²
Factor of Safety	M=1.5	M=1.5	M=1.5	M=1.5	M=1.5	M=1.5	M=1.5
Sketch							

Design table to give you some examples for various wall heights

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Design | Types | Case studies | Knowledge base | Contact us | Get price guide

Retaining wall design and price guide

Which retaining wall type is the most economical to build? **Download the design guide** to learn more about each retaining wall type and get a price comparison.

Design price guide | Ask a question

How much do they cost?

Retaining Wall Solutions

Our simple 3 steps
Design process

1 Step 1 - Decide on the type of retaining wall

One of the hardest things to do is to select the right retaining wall type.

Each retaining wall type has pros and cons.

Our support can help you select the right one for your requirements and budget.

2 Step 2 - Design the retaining wall

Our structural engineer is a specialist retaining wall expert. We can turn around retaining wall designs in a matter of days.

You will receive a full retaining wall report, a complete set of calculations, and a sketch showing you the design, including the material specifications.

You will also be protected by our professional indemnity insurance allowing you to sleep at night.

3 Step 3 - Use our supply chain to get the best build price

We have a comprehensive supply chain for the supply only or supply and installation of your retaining wall once it has been designed.

We can prepare material schedules and bills of quantities to give you a budget to work from.

You can save time and money trying to find suitable suppliers and contractors using our service.

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Bob Evans

The Next Step

- Tell us about your project.
- Complete the form.
- We are here to support you.