PETER VINCENT DESIGN

Reinforced Concrete Retaining Wall
Harris View
Epworth

STRUCTURAL CALCULATIONS

Client:
North Lincs Property Holdings Ltd
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Belton
Doncaster
DN9 1WY

PVD19203 – November 2019

Peter Vincent Design Ltd
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Project Brief

A retaining wall is required to support a section of disused railway embankment adjacent to a residential development.

A design for the retaining wall has previously been prepared by Messrs Hannah Reed & Associates in November 2008 and revised in March 2010.

The Hannah Reed design assumed an allowable bearing pressure of 125kN/m^2 was available in the expected natural sand formation below the site – the BGS map indicated Blown Sand deposits.

In September 2018 the client procured a ground investigation in regard to the proposed retaining wall. The investigation was carried out by Messrs TLP Ground Investigations Ltd (TLP) and this concluded an allowable bearing pressure of 90kN/m^2 would be appropriate in medium dense natural silty sand in contrast to the 125kN/m^2 assumed in the Hannah Reed design.

The Hannah Reed design of March 2010 has therefore been reviewed and revised in order to reduce the applied bearing pressure to meet the requirements of the TLP findings.

In essence the retaining wall base has been extended by 1.0 metre to effect a suitable reduction in the applied bearing pressure.

A PVD engineer has not attended site.

Technical Reference

Earth Retaining Structures BS8002
Concrete BS8110
Site Investigation Report dated 17 September 2018 by Messrs TLP Ground Investigations Ltd
Elements of Soil Mechanics 4th ed – G N Smith

Assumptions

All temporary works including excavation support and control of ground water will be designed by the contractor.

It is assumed the works will be undertaken by a competent and experienced civil engineering contractor and the engineering notes and details included on sketch sheet SK01 will be fully considered and applied. Any queries should be referred to the structural engineer.

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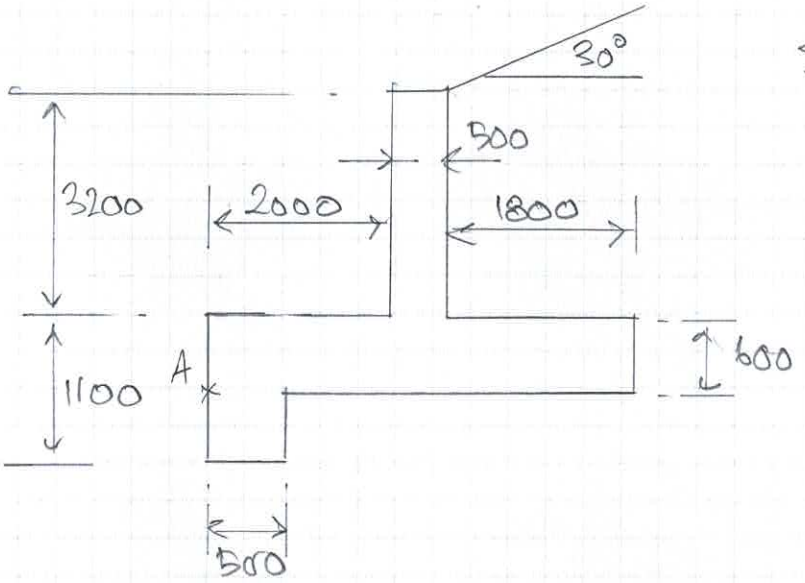
HARRISVIEW. TOPWORTH

REVIEW AND MODIFY PREVIOUS RETAINING WALL DESIGN PREPARED BY MESSRS HANNAH REED & ASSOCIATES IN 2010.

A REDUCTION IN BEARING PRESSURE VS REQUIRED FROM 125kN/m² CALCULATED PREVIOUSLY TO 90kN/m²

AN INCREASE IN THE BASE LENGTH OF THE WALL IS TO BE CONDISERED.



SURCHARGE = 10kN/m²

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Soil Properties

BACKFILL RAIL EMBANKMENT.

$\gamma_M = 18 kN/m^3$

A = 2° (SUB-ANGULAR)
B = 4° (WELL GRADED)
C = 0°

$\phi'_{MAX} = 30 + 2 + 4 = 36°$
$\phi'_{CRIT} = 30 + 2 + 4 = 36°$

$\phi'_{DESIGN} = TAN^{-1}\left[\frac{TAN\,36}{1.2}\right] = 31.2°$

$\delta_{WALL} = 2/3 \times 31.2° = 20.8°$

Cl. 3.2.6 $\delta = TAN^{-1}(0.75 \times TAN\,31.2) = 24.4°$

IGNORE WALL FRICTION DUE TO DRAINAGE PROVISION

$\delta = 0°$ $B = 0°$

FORMATION

$\gamma_M = 18 kN/m^3$ (SILTY SAND)

A = 2° (SUB ANGULAR)
B = 2° (MODERATE GRADING)
C = 0°

$\phi'_{MAX} = 30 + 2 + 2 = 34°$
$\phi'_{CRIT} = 30 + 2 + 2 = 34°$

DESIGN $TAN\,\phi = TAN\,34/1.2$ DESIGN $\phi = 29.3°$

$\phi'_{DESIGN} = 29.3°$

DESIGN $TAN\,\delta = 0.75 \times TAN\,29.3 = 0.42$

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ASSESS S.WT OF WALL & BACKFILL

TOE	$0.5^2 \times 24^{\#}$ =	6kN/m
BASE	$4.3 \times 0.6 \times 24^{\#}$ =	61.9kN/m
WALL	$3.2 \times 0.5 \times 24^{\#}$ =	38.4kN/m
BACKFILL	$1.8 \times 3.2 \times 18^{\#}$ =	103.7kN/m
TOP WEDGE	$1.8 \times 1.04 \times \frac{1}{2} \times 18^{\#}$ =	16.8kN/m
		226.8kN/m
SURCHARGE	$1.8 \times 10^{\#}$ =	18kN/m
		244.8kN/m

ACTIVE EARTH PRESSURE

$\beta = 80°$

$\phi'_{DESIGN} = 29.3° < 30°$ ∴ ASSUME $\beta = 29.3°$

$k_a = \cos 29.3 = 0.872$

$P_a = 0.872 \times 18 \times 3.2^2/2 = 80.4kN/m$ ACTING AT H/3 = 1.07m

SURCHARGE: $h_e = \frac{W_S}{\gamma} \times \frac{\sin 90}{\sin[90+29.3]} = \frac{10}{18} \times \frac{\sin 90}{\sin 119.3} = 0.64m$

$P_H = 0.872 \times 18 \times 0.64 \times 3.2 = 32.1kN/m$

HORIZONTAL COMPONENTS = $80.4 \cos 29.3$ = 70.1kN/m @ 1.07m

\+

$32.1 \times \cos 29.3$ = 28kN/m @ 1.6m

PASSIVE EARTH PRESSURE

$k_p = \frac{1+\sin 29.3}{1-\sin 29.3} = 2.92$

$P_p = 2.92 \times 18 \times 1.1^2/2 = 31.8kN/m$

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OVERTURNING CHECK

OVERTURNING ABOUT A

$M_{OVERTURN} = 70.1 \times [1.07 + 0.6] + 28 \times [1.6 + 0.6] = 178.7 kNm/m$

$M_R = [6 \times 0.25] + [61.9 \times 4.3/2] + [38.4 \times 2.25] + [108.7 \times 3.1] + [16.8 \times 3.7] + [18 \times 3.4] = 665.8 kNm/m$

> 178.7 OK

BEARING PRESSURE

$178.7 + 244.8x = 665.8 \quad x = 1.99m. \quad e = \frac{4.3}{2} - 1.99 = 0.16m$

(WITHIN MIDDLE 1/3RD)

$BP = \frac{244.8}{4.3}\left[1 + \frac{6 \times 0.16}{4.3}\right] = 70 kN/m^2 < 90$ OK

DIFFERENCE $= 90 - 70 = 20 kN/m^2 \div 24 \equiv 0.83m$ DEPTH OF CONCRETE.

(NOMINAL 400 MM DEPTH OF LEAN MIX BLINDING REQ'D $BP = (0.4 \times 24) + 70 = 80 kN/m^2 < 90$ OK.)

SLIDING CHECK

DISTURBING FORCE $= 70.1 + 28 = 98.1 kN/m$

SLIDING RESISTANCE $= 31.8 + [244.8 \times 0.42] = 134.6 kN/m > 98.1$

OK.

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SECTION DESIGN

$M_{ULS} = [70.1 \times 1.07 \times 1.4^{hf}] + [28 \times 1.6 \times 1.6^{hf}] = 176.7 kNm/m$

$d = 500 - 50 - 8 - 4 = 438mm$

$K = \frac{176.7 \times 10^6}{1000 \times 438^2 \times 30} = 0.03$ $A_s = \frac{176.7 \times 10^6}{0.95 \times 0.87 \times 500 \times 438} = 976mm^2/m$

$MIN = 0.0013 \times 1000 \times 500 = 650mm^2/m$

PROVIDE 2 No LAYERS B503 MESH

$SPAN/d = \frac{3200}{438} = 7.3$

$M/bd^2 = \frac{176.7 \times 10^6}{1000 \times 438^2} = 0.92$ $M_F = 1.42 \times 7.0 = 9.9 > 7.3OK$

REFER TO ENGINEERING NOTES

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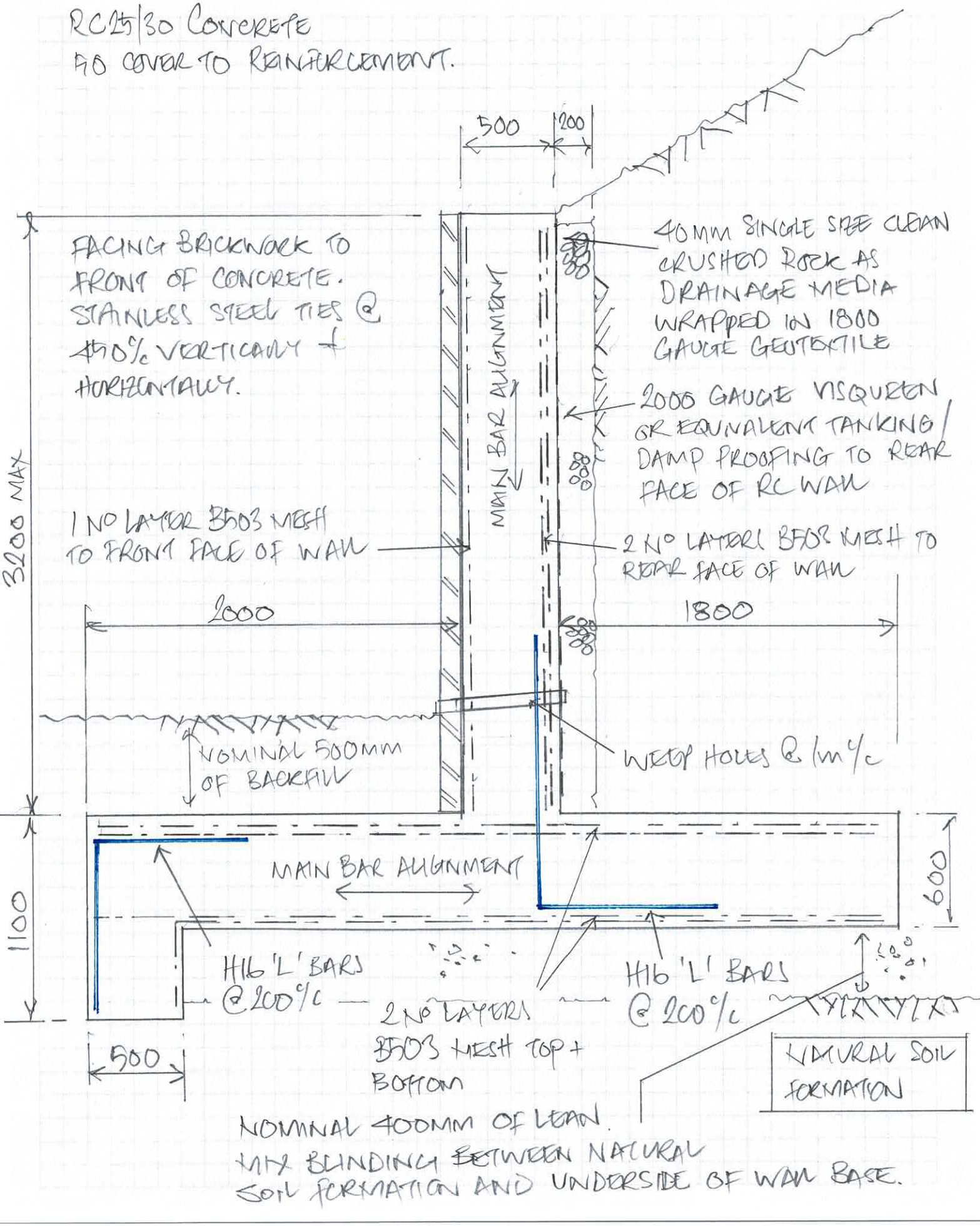

Engineering Notes

1. All dimensions to be confirmed on site prior to construction. The dimensions on the sketch sheets are for calculation purposes only.
2. All temporary works to be designed erected and maintained by the contractor. The calculations consider the structural adequacy of the permanent works only.
3. All concrete workmanship to comply with the requirements of BS8110.
4. Refer to Site Investigation Report dated 17 September 2018 prepared by Messrs TLP ground Investigations Ltd.
5. The proposed retaining wall is to be founded on a medium dense natural silty sand formation in line with the recommendations of the site investigation report. Where necessary inferior soils shall be removed and replaced with lean mix concrete placed and compacted in uniform layers not exceeding 250mm in thickness.