

STRUCTURAL METHOD STATEMENT TO ACCOMPANY THE BIA FOR

253 GOLDHURST TERRACE LONDON NW6 3EP

REF:24078/SR-001/SN REV P1 DECEMBER 2024

The Institution of **StructuralEngineers**

DOCUMENT CONTROL SHEET

Project Title: 253 Goldhurst Terrace

Report Title: Structural Method Statement to Accompany Basement Impact Assessment

<u>Summary</u>: Structural Engineer's Construction Methodology, initial calculations and structural scheme to be included with a Basement Impact Assessment for submission to the Planning Authorities relevant to the proposed works at 256 Goldhurst Terrace, NW6 3EP.

Control Date: 13th December 2024

Record of Issue

Issue	Status	Author	Date	Check	Date	Authorised	Date
Rev P1	Issued for Review	Stephanos Nicolaou	13.12.2024	Ryan Seagreen	13.12.2024	Antonis Savvides	13.12.2024

Distribution

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Client	Matteo & Anna Falivene	Electronic / pdf

Section

- 1.0 Introduction
- 2.0 Site Investigation
- 3.0 Construction Me
- 4.0 Initial Scheme Dr
- 5.0 Monitoring
- 6.0 Preliminary Calci



CONTENTS

sheet

	3
n/Desk Stud/Screening/Scoping	4
ethodology / Method Statement	6
rawings	9
	14
ulations	17

253 GOLDHURST TERRACE LONDON NW6 3EP

1.0 INTRODUCTION / NON TECHNICAL SUMMARY

1.0 INTRODUCTION

We, ads consultancy, were requested by SF ARCHITECT to compile a structural report consisting of a Construction Methodology / Method Statement to accompany a Basement Impact Assessment (BIA) for the proposed basement at 253 Goldhurst Terrace to supplement the planning application for the proposed development at the aforementioned site. A Basement Impact Assessment has been carried out and compiled by "ground&water" (report reference GWPR6303/BIA&GIR/December 2024) and which includes the Desk Study, Screening and Scoping etc. This report is to compliment that BIA with a Construction Methodology and an initial Structural Scheme. We are Chartered Engineers (Engineering Council UK) and Members of both the Institution of Structural Engineers and the Institution of Engineering and Technology. We have considerable experience in the design and construction of new build and retro-fitted basements in London and have worked on several prestigious basement developments with the UK's top basement Contractors as both Design and Build Engineers and Project Engineers for the Client.

1.1 SITE DESCRIPTION - EXISTING ARRANGEMENT

The site is situated on 253 Goldhurst Terrace, and comprises a four storey semidetached residential property, which includes a basement, ground, first, second and third floors. The northern boundary is formed by Goldhurst Terrace, the southern boundary is formed by gardens. To the east is No.251 with which there is a shared Party Wall, and to the West is No. 255 which is detached. The site is circa 500m East of South Hampstead Overground Station and circa 800m West of Kilburn High Road Overground Station.

1.2 SCHEME PROPOSAL

The scheme consists of the extension of the existing basement to the rear, side (i.e. to suit the existing ground floor flank masonry wall towards No. 255) and partly towards the front of the property, i.e. up to and under the existing ground floor wall between the kitchen and bedroom 1. The level of the extended basement will remain the same as the existing basement's level. An opening within the existing ground floor kitchen will also be created to accommodate a new staircase between the basement and ground floors. The proposed scheme also includes rebuilding the existing conservatory to the rear of the ground floor in cavity wall construction, as well as creating an opening through the ground floor wall between the rear reception and the corridor. The latter will require some new steel structure (i.e. a box frame around or steel beam over the new opening).

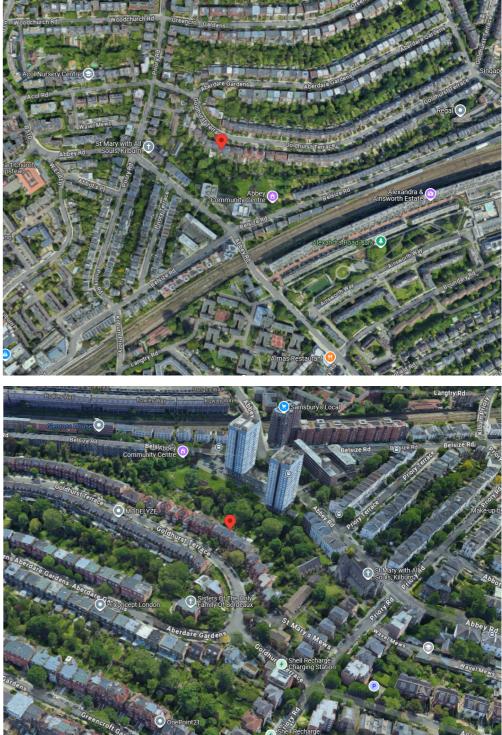
The new basement extension will be formed of new reinforced concrete retaining walls, constructed in underpinning sequence. The underpins will be constructed in circa 1.0m sections and in a typical staggered underpinning sequence similar to that of typical underpinning. This would negate the need for major temporary works to the existing building. None of the existing Party Walls (i.e. with No. 251) will be underpinned as the proposed extension is inside the boundaries with any of the adjacent properties. A new reinforced concrete ground bearing slab will form the floor of the new basement areas and a mix of timber joists and flat slabs will form the new ground floor to the footprint of the new basement.

Please refer to the attached drawings and sketches in the Drawing Appendix at the rear of this report.

1.4 WORKS PROGRAMME

• The total anticipated construction length will be circa 9-12 months.







• The total duration of the basement works will be circa 5-6 months.

Aerial views of 253 Goldhurst Terrace from Google Maps

253 GOLDHURST TERRACE LONDON NW6 3EP

2.0 SITE INVESTIGATION / DESK STUDY / SCREENING / SCOPING

2.0 SITE INVESTIGATION

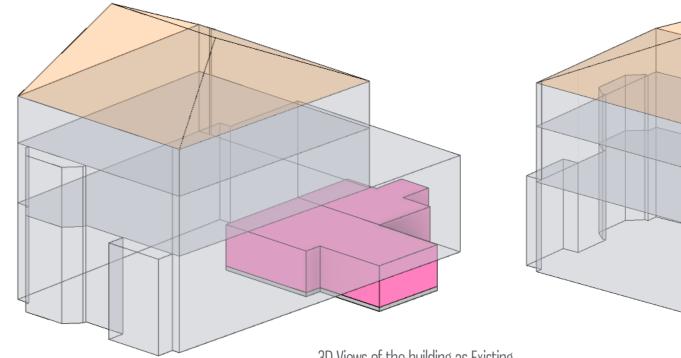
A detailed site investigation had been carried out on site on 7th November 2024 by "ground & water" who are specialist geotechnical engineers, to determine the structural characteristics of the soil along with hydrogeology characteristics. A Basement Impact Assessment report has been prepared by ground&water (report no. GWPR6303/ BIA&GIR dated December 2024) which includes their findings which we summarise below.

From consultation with the British Geological Survey (BGS) maps and the recent site investigation report prepared by "ground & water", it appears that the site is located over the London clay formation, with no superficial deposits or made ground found within 250m of the site.

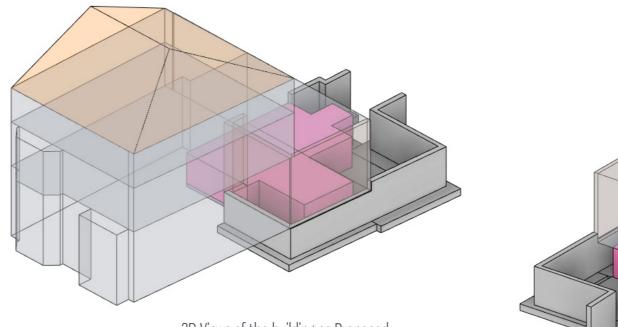
(http://mapapps.bgs.ac.uk/geologyofbritain/home.html)

<u>2.1 DESK STUDY / SCREENING / SCOPING</u>

These have been included in the BIA report prepared by ground&water (report no. GWPR6303/BIA&GIR dated December 2024) - this report compliments the aforementioned BIA with a Construction Methodology / Method Statement and an Initial Structural Scheme.

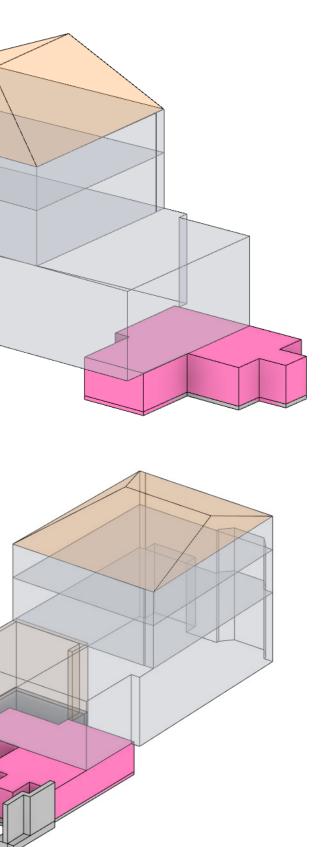






3D Views of the building as Proposed





4

253 GOLDHURST TERRACE London NW6 3EP

2.0 SITE INVESTIGATION / DESK STUDY / SCREENING / SCOPING

2.2 FLOOD RISK

The flood risk of the site has been assessed in the Basement Impact Assessment prepared by "ground&water" (report no. GWPR6303/BIA&GIR dated December 2024) and summarised below - for more details please refer to the aforementioned BIA report.

2.2.1 From rivers and sea

The site lies within Flood Zone 1

2.2.2 From reservoirs

The site is not considered to be at risk of flooring from reservoirs, even when rivers are flooded.

2.2.3 From Surface Water

The site is at very low risk of flooding from surface water.

2.2.4 From Groundwater

The site is not in an area with increased susceptibility of elevated ground water. Some properties around and withing 250m from the site have historical issues with flooding from groundwater though.

2.2.5 From Sewers

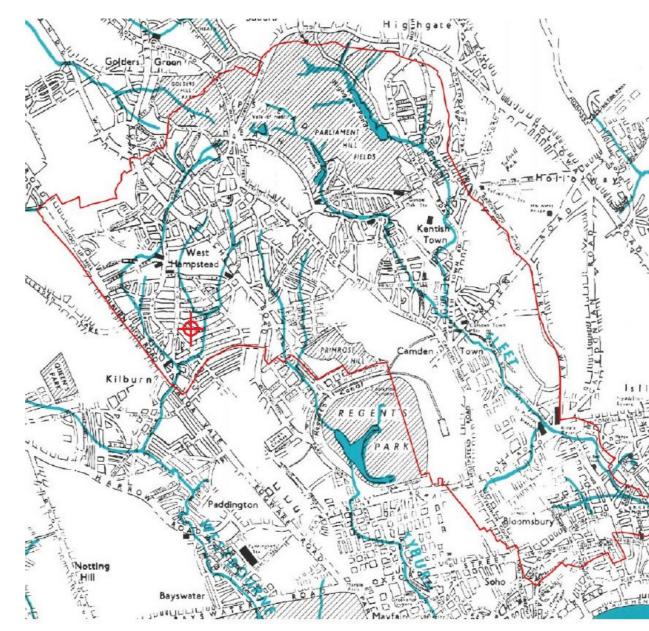
Some records of internal and external sewer flooding have been recorder within the site's postcode area.

2.2.6 Old Rivers

The site does not lie on any old / lost rivers. Streams which join the Westbourne are to the West and East of the site.

<u>2.2.7 Critical Drainage Areas/Local Flood risk</u> <u>Areas</u>

Please refer to Basement Impact Assessment report no. GWPR6303/BIA&GIR dated December 2024, prepared by ground&water for more details on local flood incidents etc.



Source - Barton, Lost Rivers of London



BASEMENT IMPACT ASSESSMENT



Camden Geological, Hydrogeological and Hydrological Study Watercourses

253 GOLDHURST TERRACE London NW6 3EP

3.0 CONSTRUCTION METHODOLOGY / METHOD STATEMENT

3.0 Construction Methodology

1) Once the site has been made safe, underpinning of the relevant existing perimeter masonry walls from inside of the building will commence. There are three walls that will be underpinned and these are indicated in the graphic on page 7 and in the scheme plans starting from page 9. The proposed RC retaining walls underpinning the existing masonry (i.e. RW1 & RW2) have been designed to provide lateral stability for the retained soil, and hence no additional temporary works will be required for these.

2) Commence construction of the rest of the proposed 300-350mm thick reinforced concrete retaining walls at the same time as point 1 above. This will be done in typical underpinning sequence which is indicated in sketch 24078_SK01 & SK03. Final sequencing of underpinning is to be agreed with the Contractor and Structural Engineer prior to works commencing.

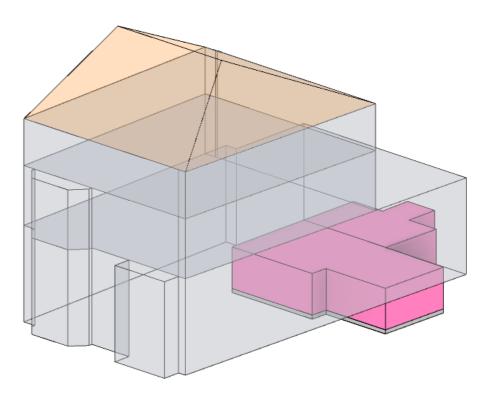
All the wall types forming the proposed basement extension (i.e. RW1, RW2, RW3, RW4) have been designed to provide lateral stability and therefore no additional temporary props will be required during the construction of said retaining walls.

3) After all the new retaining walls have been constructed in underpinning sequence, the soil remaining between the existing basement wall and the newly constructed retaining walls can be removed/excavated down to formation level. The existing basement walls of the existing utility room (which is circa 560mm higher in level than the rest of the basement) can be carefully demolished and the level lowered down to formation level.

5) Construct the new 200mm thick basement floor ground bearing RC slab and subsequently the new ground floor (either a 200mm thick RC slab or a timber joist floor) to the footprint of the new basement extension.

6) Proceed with minor internal alterations to achieve the Architect's requirements and introduce lintels / steel beams as required. At the same time construct retaining wall RW5 along the boundary with No. 255, to allow for raising the external level behind RW3 per the Architect's requirements - RW3 has been designed for the two stages, i.e. initially as unpropped to retain the lower/existing soil level, and subsequently as propped at the base to support the proposed/higher external level.

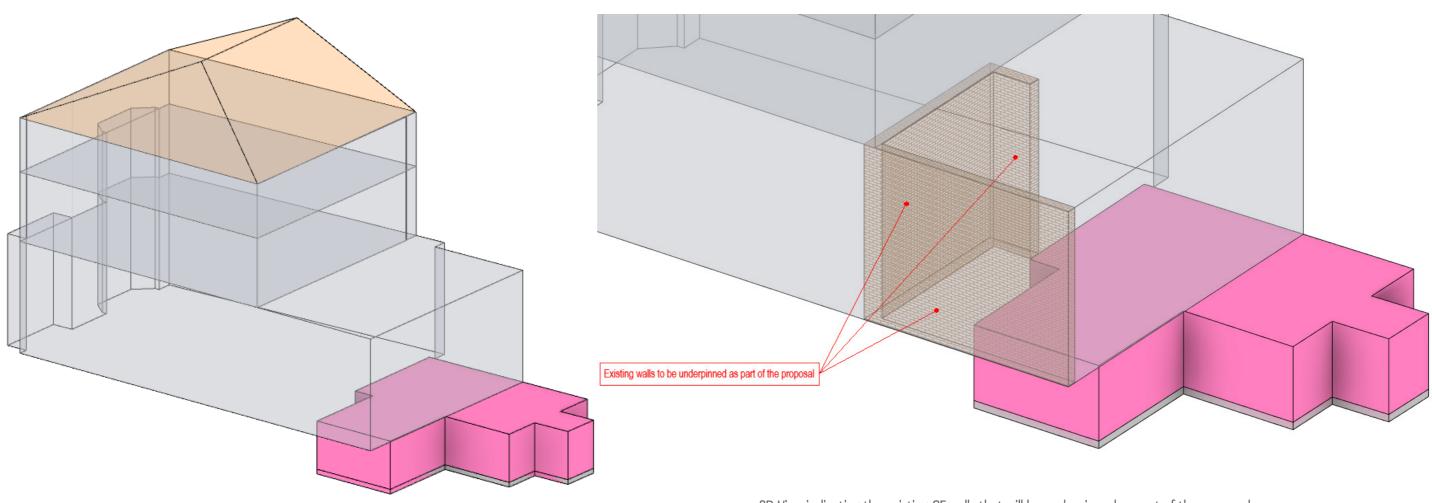
7) In the event that minor ingress of ground water occurs during the execution of the works this will be dealt with by the use of temporary sump pumps. In the permanent condition waterproofing to the new basement will be based on the Architects proposed details.



3D View of the building as Existing



3.0 CONSTRUCTION METHODOLOGY / METHOD STATEMENT

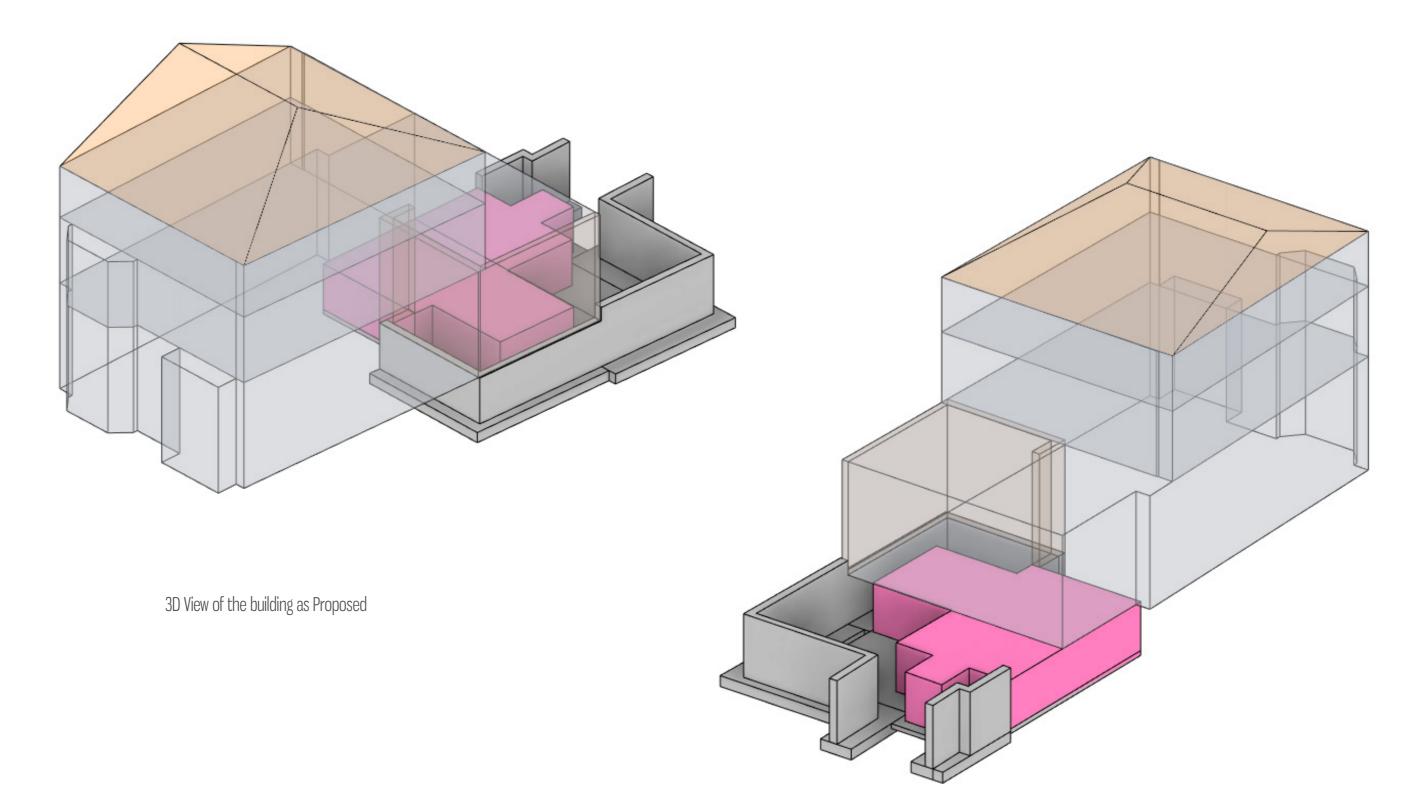


3D View of the building as Existing

3D View indicating the existing GF walls that will be underpinned as part of the proposal



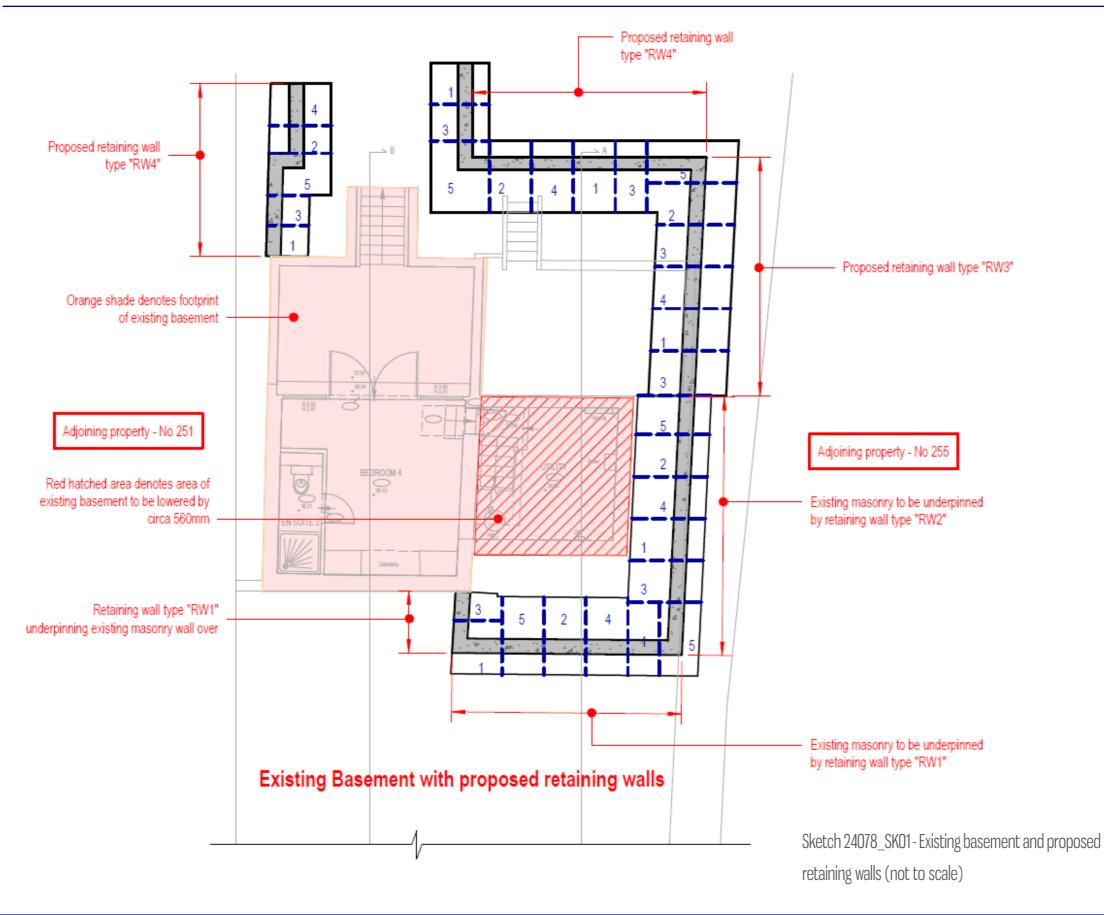
3.0 CONSTRUCTION METHODOLOGY / METHOD STATEMENT



3D View of the building as Proposed

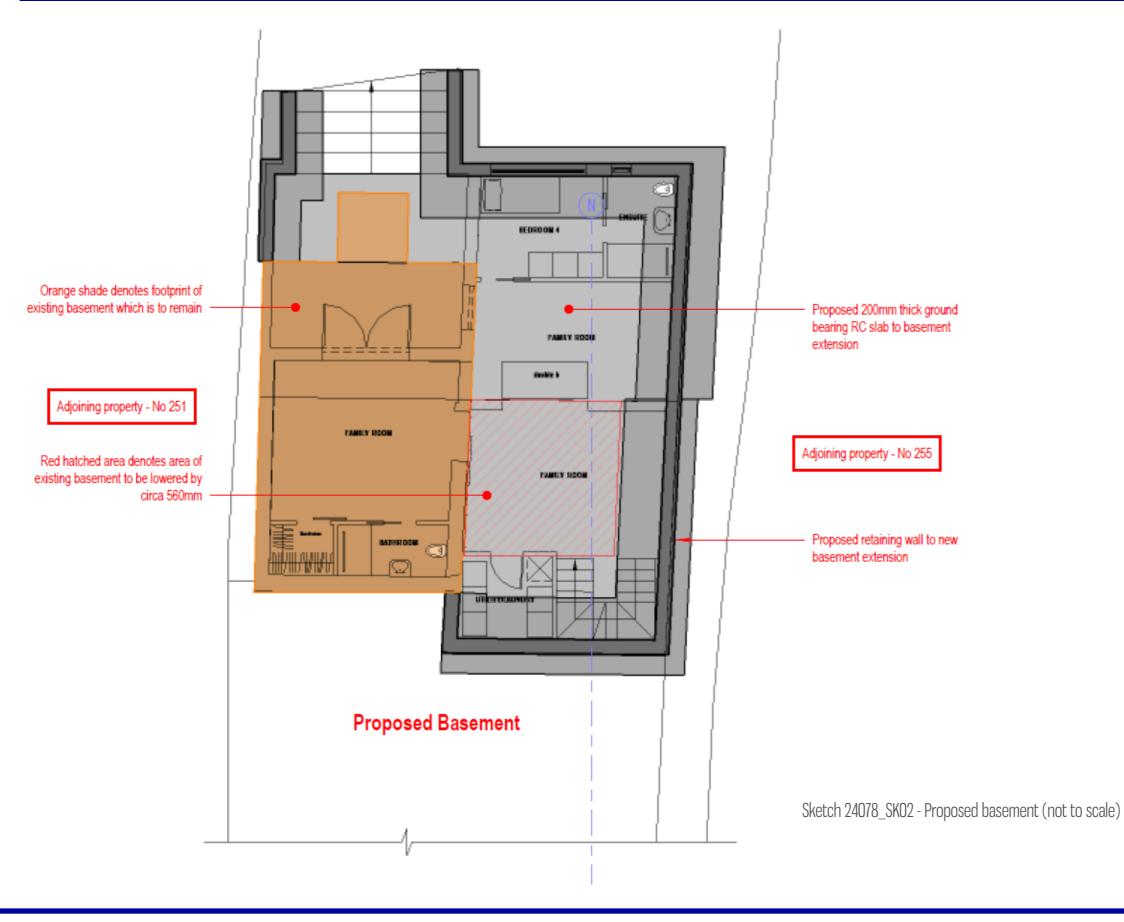






BASEMENT IMPACT ASSESSMENT





BASEMENT IMPACT ASSESSMENT

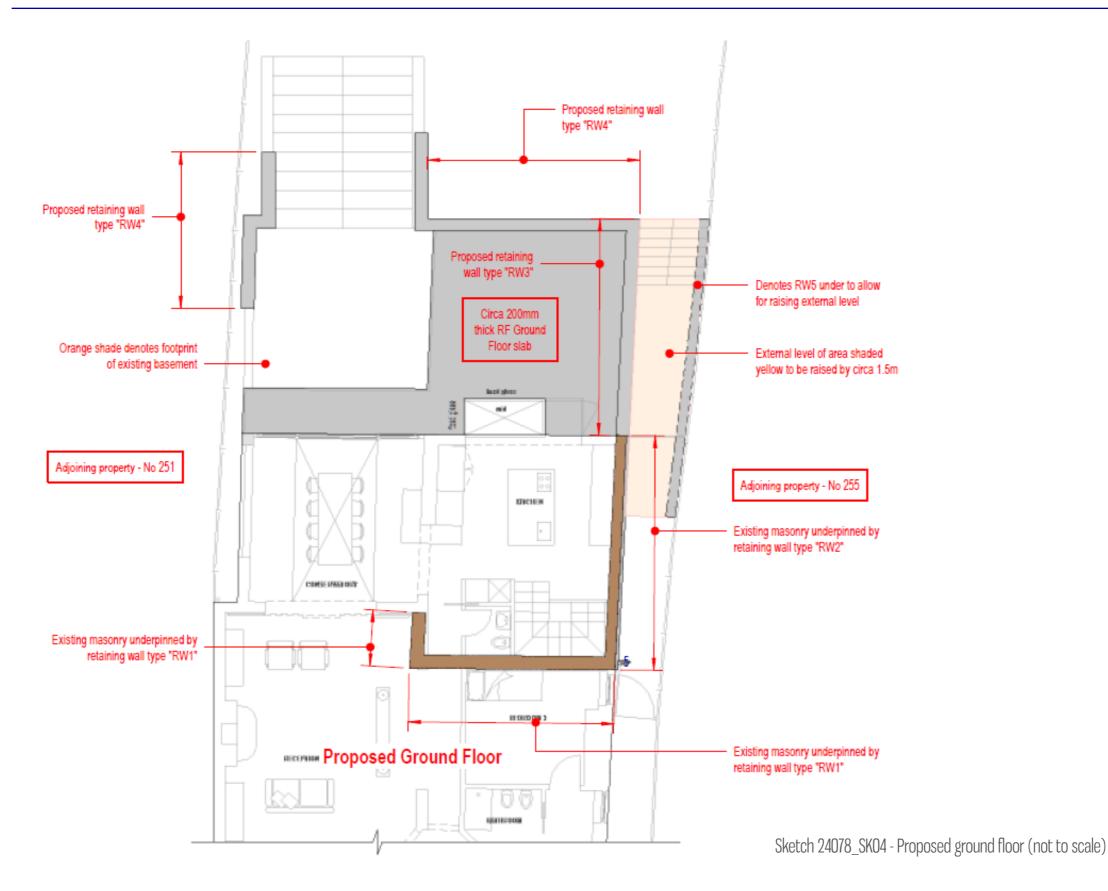


4.0 INITIAL SCHEME DRAWINGS

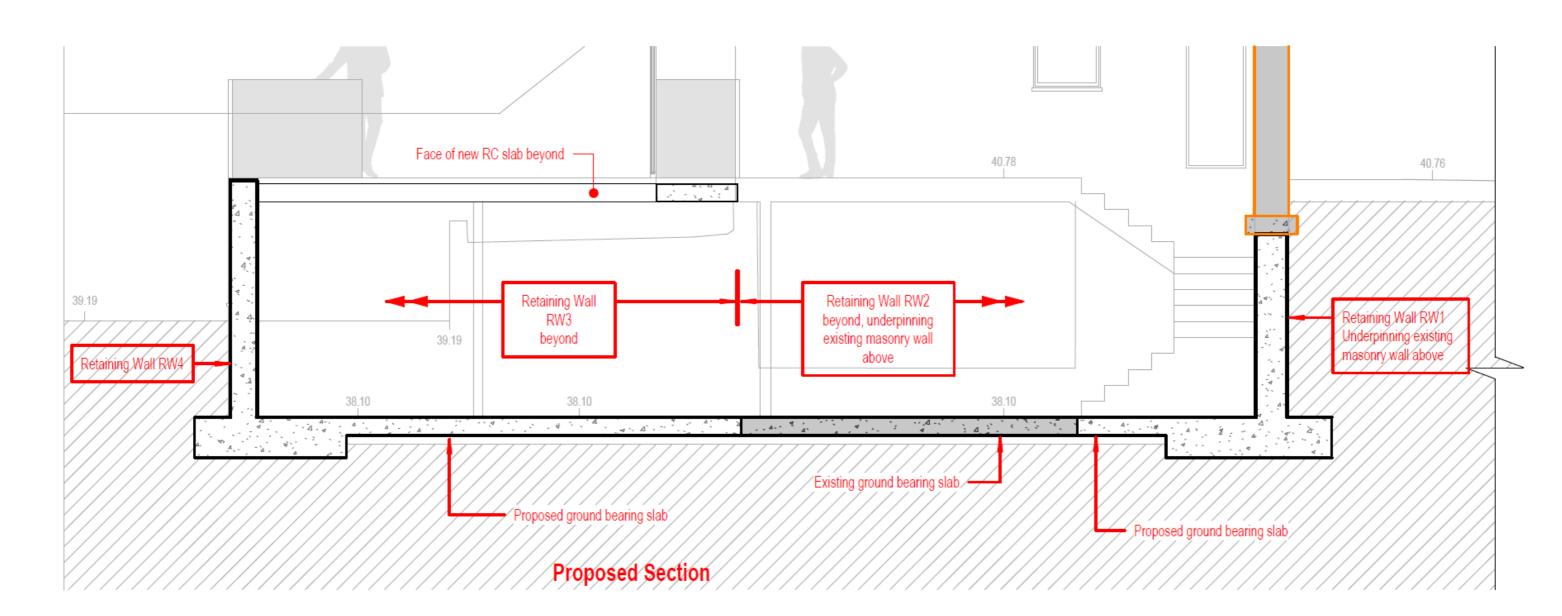
10











Sketch 24078_SK05 - Proposed Section (not to scale)



BASEMENT IMPACT ASSESSMENT

5.1 INTRODUCTION

The adjoining properties to 253 Goldhurst Terrace, NW6 3EP, will be monitored during the underpinning, excavation and throughout the construction period of the proposed basement.

5.2 TARGET POINTS

Target points will be fixed on the elevations of the adjoining properties, as per the marked-up drawings included. These include the front and rear elevation walls of Nos.251 & 255 Goldhurst Terrace. These will need to be agreed and finalised as part of the Party Wall process, prior to commencing any works.

5.3 RESULTS

The results/reading shall be recorded in both tabular and graph forms, and an electronic copy must be circulated within twenty-four hours of the readings (refer to 3.2 below). The results should be clear, and indicate the trigger values as well, for reference and comparison to the readings.

The readings / results shall be circulated to the design team, the Building Owner's Party Wall Surveyor and the Adjoining Owner's Party Wall Surveyor and Advising Engineer.

5.4 READINGS

Readings shall be taken as follows:

Activity	Frequency of readings
During underpinning works	Daily
During excavation	Twice Weekly
During construction of the basement and	Twice Weekly
ground floor RC slabs	
During the rest of the works	Weekly

The above shall be reviewed in case the program of the works is altered due to unforeseen circumstances.

<u>5.5 TRIGGER VALUES</u>

Should a trigger value be reached, the contractor should immediately stop all work that might cause further movement, assesses the situation, and proposes alternative methods of proceeding. The trigger values/limits further to this point can be reviewed and agreed between all parties.

Proposed trigger values for both vertical and horizontal movement of masonry walls of adjoining buildings are to be agreed with

the Adjoining	Owner's party	/ wall surveyor	 a suggestion follows:

AMBER	+/- 5mm
RED	+/- 8mm

Proposed trigger values for both vertical and horizontal movement of garden walls of adjoining buildings are to be agreed with

the Adjoining Owner's party wall surveyor - a suggestion follows:

AMBER	+/- 7mm	All parties notified
RED	+/- 10mm	Works stop and reviewed

5.6 ACTIONS

Should	any		movement	exceed	the	Amber	or	Red	tri
AMB	ER	•	Project E	ngineer	is not	ified im	med	iately	
		• Any work that might cause further moveme							
		•	Readings	frequer	ncy in	creases			
		•	Contract	or propo	ses al	ternativ	e me	ethods	s of
		•	The proje	ect Engin	ieer, A	Adjoinin	g Ov	wner's	s Er
			works an	d decide	if any	y furthe	r act	ions a	re 1
		•	If it is est	ablished	that a	any mov	eme	nt is c	lire
			tor stops	all work	s and	all parti	es re	eview	the
		•	Trigger v	alues fro	m thi	s point o	on a	re revi	iew
RED		•	All works	s stop					
		•	Project E	ngineer	is not	ified im	med	iately	/ A



5.0 MONITORING

All parties notified
Works stop and reviewed

igger Values, the Contractor shall act as follows:

ent is stopped

- f proceeding
- ngineer and PW Surveyor meet on site to review the
- required
- ectly related to the underpinning works, the contrac-
- e works
- ved further and agreed between all parties

All parties review the works



5.0 MONITORING



BASEMENT IMPACT ASSESSMENT

ads consultancy

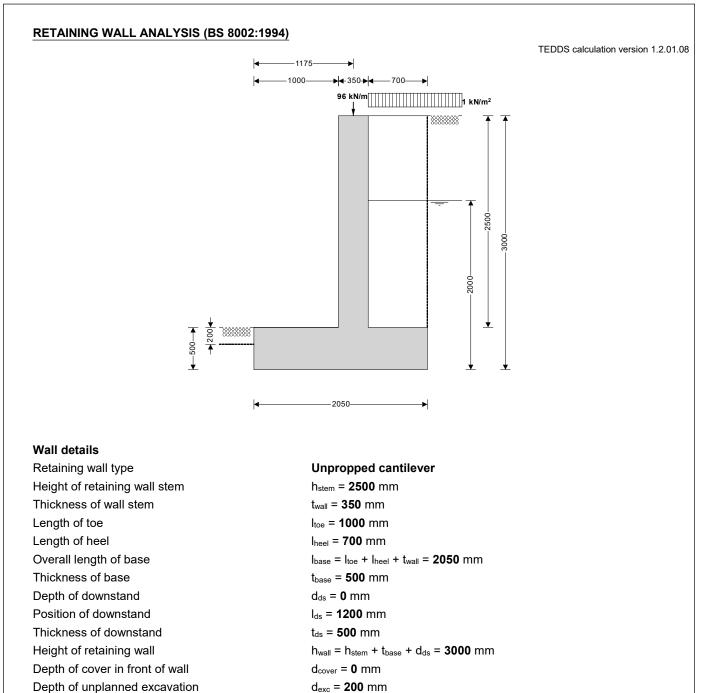
5.0 MONITORING

PRELIMINARY CALCULATIONS



6.0 PRELIMINARY CALCULATIONS

Tekla Tedds	Project 253 Goldhurst Terrace				Job no. 24078	
ads consultancy 130 East Barnet Road	Calcs for F	Start page no./Revision 1				
EN4 8RE - New Barnet	Calcs by SN	Calcs date 05/12/2024	Checked by	Checked date	Approved by	Approved date



Retained material details Mobilisation factor Moist density of retained material

Effective height at virtual back of wall

Height of ground water behind wall

Height of saturated fill above base Density of wall construction

Density of base construction Angle of rear face of wall

Angle of soil surface behind wall

M = **1.5** γ_m = **18.0** kN/m³

h_{water} = 2000 mm

γ_{wall} = **23.6** kN/m³ γ_{base} = **23.6** kN/m³

α = **90.0** deg

 $\beta = 0.0 \text{ deg}$

 $h_{sat} = max(h_{water} - t_{base} - d_{ds}, 0 mm) = 1500 mm$

 $h_{eff} = h_{wall} + I_{heel} \times tan(\beta) = 3000 \text{ mm}$

Tekla Tedds	Project	253 Goldh	urst Terrace			Job no.	4078	
ads consultancy 130 East Barnet Road	Calcs for Retaining Wall RW1 - Preliminary					Start page no./F	Start page no./Revision 2	
EN4 8RE - New Barnet	Calcs by SN	Calcs date 05/12/2024	Checked by	Check	ed date	Approved by	Approved date	
Saturated density of retained m Design shear strength Angle of wall friction	aterial	γ _s = 21.0 ki φ' = 29.3 de δ = 18.6 de	∋g					
Base material details Firm clay Moist density Design shear strength Design base friction		γ _{mb} = 18.0 l φ' _b = 24.2 d δ _b = 18.6 d	leg					
Allowable bearing pressure		$O_b - 10.0$ C $P_{bearing} = 10$	0					
Passive pressure coefficient for	+ $\phi')^2$ / (sin(α) ² base material	$^{2} \times sin(\alpha - \delta) \times [1 +]$., .			
At-rest pressure	- 4		(1) 0 544					
At-rest pressure for retained ma	aterial	$K_0 = 1 - sir$	n(φ') = 0.511					
Loading details Surcharge load on plan Applied vertical dead load on w Applied vertical live load on wal Position of applied vertical load Applied horizontal dead load on Applied horizontal live load on w Height of applied horizontal load	ll on wall n wall wall	Surcharge $W_{dead} = 75.$ $W_{live} = 21.4$ $I_{load} = 1175$ $F_{dead} = 0.0$ $F_{live} = 0.0$ k $h_{load} = 0$ mr	kN/m mm kN/m N/m					
	77.3			0.3 5.2	6.5 1	9.6		
				I	Loads sho	wn in kN/m, pressu	res shown in kN/m	
				I	20003 3110	mini mani, piessu		

Tekla Tedds	Project				Job no. 24078	
ads consultancy 130 East Barnet Road EN4 8RE - New Barnet	Calcs for	Retaining Wall R	W1 - Preliminar	у	Start page no./Re	evision 3
EN4 ONE - NEW Damel	Calcs by SN	Calcs date 05/12/2024	Checked by	Checked date	Approved by	Approved date

Vertical forces on wall	
Wall stem	$w_{\text{wall}} = h_{\text{stem}} \times t_{\text{wall}} \times \gamma_{\text{wall}} = \textbf{20.7 kN/m}$
Wall base	$w_{base} = I_{base} \times t_{base} \times \gamma_{base} = 24.2 \text{ kN/m}$
Surcharge	w _{sur} = Surcharge × I _{heel} = 0.7 kN/m
Moist backfill to top of wall	$w_{m_w} = I_{heel} \times (h_{stem} - h_{sat}) \times \gamma_m = 12.6 \text{ kN/m}$
Saturated backfill	$w_s = I_{heel} \times h_{sat} \times \gamma_s = 22.1 \text{ kN/m}$
Applied vertical load	$W_v = W_{dead} + W_{live} = 96.4 \text{ kN/m}$
Total vertical load	$W_{total} = W_{wall} + W_{base} + W_{sur} + W_{m_w} + W_s + W_v = 176.6 \text{ kN/m}$
Horizontal forces on wall	
Surcharge	$F_{sur} = K_a \times cos(90 - \alpha + \delta) \times Surcharge \times h_{eff} = 0.9 \text{ kN/m}$
Moist backfill above water table	F_{m_a} = 0.5 × K _a × cos(90 - α + δ) × γ_m × (h _{eff} - h _{water}) ² = 2.6 kN/m
Moist backfill below water table	$F_{m_b} = K_a \times cos(90 - \alpha + \delta) \times \gamma_m \times (h_{eff} - h_{water}) \times h_{water} = 10.4 \text{ kN/m}$
Saturated backfill	$F_s = 0.5 \times K_a \times cos(90 - \alpha + \delta) \times (\gamma_{s-} \gamma_{water}) \times h_{water}^2 = 6.5 \text{ kN/m}$
Water	$F_{water} = 0.5 \times h_{water}^2 \times \gamma_{water} = 19.6 \text{ kN/m}$
Total horizontal load	$F_{total} = F_{sur} + F_{m_a} + F_{m_b} + F_s + F_{water} = 40 \text{ kN/m}$
Calculate stability against sliding	

Passive resistance of soil in front of wall Resistance to sliding

Overturning moments

Surcharge Moist backfill above water table Moist backfill below water table Saturated backfill Water Total overturning moment

Restoring moments

Wall stem Wall base Moist backfill Saturated backfill Design vertical dead load Total restoring moment

Check stability against overturning Total overturning moment Total restoring moment

Check bearing pressure

Surcharge Design vertical live load Total moment for bearing Total vertical reaction Distance to reaction Eccentricity of reaction
$$\begin{split} F_{p} &= 0.5 \times K_{p} \times cos(\delta_{b}) \times (d_{cover} + t_{base} + d_{ds} - d_{exc})^{2} \times \gamma_{mb} = \textbf{3.2 kN/m} \\ F_{res} &= F_{p} + (W_{total} - w_{sur} - W_{live}) \times tan(\delta_{b}) = \textbf{55.2 kN/m} \\ \textbf{PASS - Resistance force is greater than sliding force} \end{split}$$

$$\begin{split} M_{sur} &= F_{sur} \times (h_{eff} - 2 \times d_{ds}) / 2 = \textbf{1.3 kNm/m} \\ M_{m_a} &= F_{m_a} \times (h_{eff} + 2 \times h_{water} - 3 \times d_{ds}) / 3 = \textbf{6.1 kNm/m} \\ M_{m_b} &= F_{m_b} \times (h_{water} - 2 \times d_{ds}) / 2 = \textbf{10.4 kNm/m} \\ M_s &= F_s \times (h_{water} - 3 \times d_{ds}) / 3 = \textbf{4.3 kNm/m} \\ M_{water} &= F_{water} \times (h_{water} - 3 \times d_{ds}) / 3 = \textbf{13.1 kNm/m} \\ M_{ot} &= M_{sur} + M_{m_a} + M_{m_b} + M_s + M_{water} = \textbf{35.3 kNm/m} \end{split}$$

$$\begin{split} M_{wall} &= w_{wall} \times (I_{toe} + t_{wall} / 2) = \textbf{24.3 kNm/m} \\ M_{base} &= w_{base} \times I_{base} / 2 = \textbf{24.8 kNm/m} \\ M_{m_r} &= (w_{m_w} \times (I_{base} - I_{heel} / 2) + w_{m_s} \times (I_{base} - I_{heel} / 3)) = \textbf{21.4 kNm/m} \\ M_{s_r} &= w_s \times (I_{base} - I_{heel} / 2) = \textbf{37.5 kNm/m} \\ M_{dead} &= W_{dead} \times I_{load} = \textbf{88.1 kNm/m} \\ M_{rest} &= M_{wall} + M_{base} + M_{m_r} + M_{s_r} + M_{dead} = \textbf{196.1 kNm/m} \end{split}$$

M_{ot} = **35.3** kNm/m M_{rest} = **196.1** kNm/m PASS - Restoring moment is greater than overturning moment

$$\begin{split} &M_{sur_{-}r} = w_{sur} \times (I_{base} - I_{heel} / 2) = \textbf{1.2 kNm/m} \\ &M_{live} = W_{live} \times I_{load} = \textbf{25.1 kNm/m} \\ &M_{total} = M_{rest} - M_{ot} + M_{sur_{-}r} + M_{live} = \textbf{187.2 kNm/m} \\ &R = W_{total} = \textbf{176.6 kN/m} \\ &x_{bar} = M_{total} / R = \textbf{1060 mm} \\ &e = abs((I_{base} / 2) - x_{bar}) = \textbf{35 mm} \end{split}$$

Tekla Tedds	Project 253 Goldhurst Terrace				Job no. 24078	
ads consultancy 130 East Barnet Road EN4 8RE - New Barnet	Calcs for F	Retaining Wall R	RW1 - Prelimina	ary	Start page no./Re	evision 4
	Calcs by SN	Calcs date 05/12/2024	Checked by	Checked date	Approved by	Approved date

Bearing pressure at toe Bearing pressure at heel Reaction acts within middle third of base

 $p_{toe} = (R \mid I_{base}) - (6 \times R \times e \mid I_{base}^2) = 77.3 \text{ kN/m}^2$

 p_{heel} = (R / I_{base}) + (6 × R × e / I_{base}²) = **94.9** kN/m²

PASS - Maximum bearing pressure is less than allowable bearing pressure

Tekla. Tedds		253 Goldh	urst Terrace		24	1078	
ads consultancy Ca	alcs for	Retaining Wall F	N/1 - Prelimin	any	Start page no./F	Revision 5	
EN4 8RE - New Barnet	alcs by	Calcs date	Checked by	Checked date	Approved by	Approved	
	SN	05/12/2024	Checked by		Approved by	Approved	
RETAINING WALL DESIGN (BS 8	8002:1994)				TEDDS calculatio	n version 1.2.	
Ultimate limit state load factors							
Dead load factor		γ _{f_d} = 1.4					
Live load factor		γ _{f_l} = 1.6					
Earth and water pressure factor		γ _{f_e} = 1.4					
Factored vertical forces on wall							
Wall stem		$W_{wall_f} = \gamma_{f_d}$	$\times \; h_{\text{stem}} \times t_{\text{wall}} \times $	γ _{wall} = 28.9 kN/n	n		
Wall base	$W_{base_f} = \gamma_{f_c}$	$_{\rm b} imes {\sf I}_{\rm base} imes {\sf t}_{\rm base} imes$	χ _{base} = 33.9 kN	/m			
Surcharge		$W_{sur_f} = \gamma_{f_l}$	< Surcharge ×	l _{heel} = 1.1 kN/m			
Moist backfill to top of wall		$W_{m_w_f} = \gamma_{f_c}$	$I \times I_{heel} \times (h_{stem})$	- h _{sat}) × γ _m = 17.	6 kN/m		
Saturated backfill		$W_{s_f} = \gamma_{f_d} \times$	$I_{heel} \times h_{sat} \times \gamma_s$	= 30.9 kN/m			
Applied vertical load		$W_{v_f} = \gamma_{f_d}$	$\langle W_{dead} + \gamma_{f_l} \times V_{dead}$	W _{live} = 139.2 kN/	/m		
Total vertical load				$W_{sur_f} + W_{m_w_f} + V$		1.6 kN/m	
Factored horizontal at-rest force	s on wall						
Surcharge		F _{sur} f = γ _f ι ×	K ₀ × Surchar	ge × h _{eff} = 2.5 kN	l/m		
Moist backfill above water table			_	n × (h _{eff} - h _{water}) ² =			
Moist backfill below water table	$F_{m b f} = \gamma_{f e} \times K_0 \times \gamma_m \times (h_{eff} - h_{water}) \times h_{water} = 25.7 \text{ kN/m}$						
Saturated backfill	$F_{s_f} = \gamma_{f_e} \times 0.5 \times K_0 \times (\gamma_{s} - \gamma_{water}) \times h_{water}^2 = 16 \text{ kN/m}$						
Water	$F_{water f} = \gamma_{f e} \times 0.5 \times h_{water}^2 \times \gamma_{water} = 27.5 \text{ kN/m}$						
Total horizontal load		$F_{\text{total }f} = F_{\text{sur }f} + F_{\text{m }a} f + F_{\text{m }b} f + F_{\text{s}} f + F_{\text{water }f} = 78.1 \text{ kN/m}$					
Passive resistance of soil in front of	of wall	_		$(\delta_b) \times (d_{cover} + t_{ba})$	-	× ν _{mb} = 4.5	
kN/m		· • •		(**) (*********************************		1	
Factored overturning moments							
Surcharge		M _{sur_f} = F _{sur}	$_{f} \times (h_{eff} - 2 \times c)$	l _{ds}) / 2 = 3.7 kNn	n/m		
Moist backfill above water table		M _{m a f} = F _m	_{a f} × (h _{eff} + 2 ×	h _{water} - 3 × d _{ds}) /	3 = 15 kNm/m		
Moist backfill below water table				× d _{ds}) / 2 = 25.7			
Saturated backfill			•	_s) / 3 = 10.7 kNm			
Water		M _{water_f} = F _v	vater_f × (hwater -	$3 \times d_{ds}) / 3 = 18.3$	3 kNm/m		
Total overturning moment		M _{ot_f} = M _{sur_}	_f + M _{m_a_f} + M _n	n_b_f + Ms_f + M _{wat}	_{ter_f} = 73.4 kNm	/m	
Restoring moments							
Wall stem		$M_{wall f} = W_{wall}$	$_{\text{all}_{f}} \times (I_{\text{toe}} + t_{\text{wall}})$	/ 2) = 34 kNm/m			
Wall base		_	_{ase_f} × I _{base} / 2 =				
Surcharge		_	-	/ 2) = 1.9 kNm/	m		
Moist backfill				eel / 2) + W m_s_f × (= 30 kNm/	
Saturated backfill				2) = 52.5 kNm/m			
Design vertical load			× I _{load} = 163.6				
Total restoring moment				$M_{sur_f} + M_{m_r_f} +$	$M_{s r f} + M_{v f} = 3$	816.7 kNm	
Factored bearing pressure							
Total moment for bearing		$M_{\text{total}} = M_{\text{total}}$	est_f - M _{ot_f} = 24 3	3 3 kNm/m			
Total vertical reaction			= 251.6 kN/m	••• ···			
Distance to reaction			f / R _f = 967 m	m			
Eccentricity of reaction			ase / 2) - Xbar_f) =				
-		((,/		within middle	third of h	

Tekla Tedds	Project	253 Goldh	Job no. 24078				
ads consultancy 130 East Barnet Road	Calcs for	Retaining Wall F	RW1 - Prelimir	ary	Start page no./Revision 6		
EN4 8RE - New Barnet	Calcs by SN	Calcs date 05/12/2024	Checked by	Checked date	Approved by	Approved da	
Bearing pressure at toe		$p_{toe_f} = (R_f / R_f)$	I _{base}) + (6 × R _f	$\times e_f / I_{base}^2$) = 14	3.7 kN/m ²		
Bearing pressure at heel		p _{heel_f} = (R _f	/ I_{base}) - (6 × R	$_{\rm f} \times {\bf e}_{\rm f} / {\bf I}_{\rm base}^2$) = 10	1.8 kN/m ²		
Rate of change of base reaction	I	rate = (p _{toe} _	_f - p _{heel_f}) / I _{base}	= 20.45 kN/m²/n	n		
Bearing pressure at stem / toe		$p_{stem_toe_f} =$	max(p _{toe_f} - (ra	te × I _{toe}), 0 kN/m ²	²) = 123.3 kN/n	1 ²	
Bearing pressure at mid stem		p _{stem_mid_f} =	max(p _{toe_f} - (ra	$te \times (I_{toe} + t_{wall} / 2)$	2)), 0 kN/m²) =	119.7 kN/m ²	
Bearing pressure at stem / heel		$p_{stem_heel_f} =$	max(p _{toe_f} - (ra	ate × (I_{toe} + t_{wall})),	0 kN/m²) = 11	6.1 kN/m²	
Design of reinforced concrete	retaining wall	toe (BS 8002:1	994 <u>)</u>				
Material properties							
Characteristic strength of concre		f _{cu} = 40 N/r					
Characteristic strength of reinfo	rcement	f _y = 500 N/r	nm²				
Base details							
Minimum area of reinforcement		k = 0.13 %					
Cover to reinforcement in toe		c _{toe} = 50 m	m				
Calculate shear for toe design	Ì						
Shear from bearing pressure				_f) × I _{toe} / 2 = 133 .			
Shear from weight of base		$V_{toe_wt_base} = \gamma_{f_d} \times \gamma_{base} \times I_{toe} \times t_{base} = 16.5 \text{ kN/m}$					
Total shear for toe design		$V_{toe} = V_{toe_t}$	ear - V _{toe_wt_base}	= 117 kN/m			
Calculate moment for toe des	ign						
Moment from bearing pressure				m_mid_f) × (I_{toe} + t_{wa}			
Moment from weight of base				$t_{base} \times (I_{toe} + t_{wall} / $	(2) ² / 2) = 11.4	kNm/m	
Total moment for toe design		$M_{toe} = M_{toe}$	bear - M _{toe_wt_bas}	_e = 82.3 kNm/m			
500	>						
	• •	•	•	• •	•		
	• • ← 150→	•	•	• •	•		
Check toe in bending	• •	•	•	•••	•		
<u>↓</u>	• •	• b = 1000 m	• ım/m	•••	•		

Lever arm

Constant

Area of tension reinforcement required Minimum area of tension reinforcement $d_{toe} = t_{base} - c_{toe} - (\phi_{toe} / 2) = 444.0 \text{ mm}$ $K_{toe} = M_{toe} / (b \times d_{toe}^2 \times f_{cu}) = 0.010$

Compression reinforcement is not required

$$\begin{split} z_{\text{toe}} &= \min(0.5 + \sqrt{(0.25 - (\min(K_{\text{toe}}, 0.225) / 0.9)), 0.95) \times d_{\text{toe}}} \\ z_{\text{toe}} &= \textbf{422} \text{ mm} \\ A_{\text{s_toe_des}} &= M_{\text{toe}} / (0.87 \times f_{\text{y}} \times z_{\text{toe}}) = \textbf{448} \text{ mm}^2/\text{m} \end{split}$$

 $A_{s_toe_min}$ = k × b × t_{base} = 650 mm²/m

ads consultancy 130 East Barnet Road EN4 8RE - New Barnet Area of tension reinforcement re	Calcs for Calcs by SN	Retaining Wall F	RW1 - Prelimir		Start page no./	Revision	
		-		Retaining Wall RW1 - Preliminary			
Area of tension reinforcement re		05/12/2024	Checked by	Checked date	Approved by	Approved d	
Area of tension reinforcement re							
	quired			A _{s_toe_min}) = 650 n	nm²/m		
Reinforcement provided			a.bars @ 150 r	nm centres			
Area of reinforcement provided			754 mm²/m				
		PASS - Rein	itorcement pr	ovided at the re	taining wall to	e is adequ	
Check shear resistance at toe							
Design shear stress		$v_{toe} = V_{toe} /$	$(b \times d_{toe}) = 0.2$	263 N/mm ²			
Allowable shear stress		v _{adm} = min((0.8 × √(f _{cu} / 1 ľ	N/mm²), 5) × 1 N/	/mm² = 5.000 M	V/mm²	
		PASS -	Design shea	r stress is less t	than maximun	n shear str	
From BS8110:Part 1:1997 – Tal	ole 3.8						
Design concrete shear stress		v _{c_toe} = 0.4					
			Vto	be < Vc_toe - No sh	near reinforce	ment requi	
Design of reinforced concrete	retaining wa	all heel (BS 8002:	:1994 <u>)</u>				
Material properties							
Characteristic strength of concre	te	f _{cu} = 40 N/r	mm²				
Characteristic strength of reinfor	cement	f _y = 500 N/mm ²					
Base details							
Minimum area of reinforcement		k = 0.13 %					
Cover to reinforcement in heel		c _{heel} = 50 mm					
Calculate shear for heel design	ı						
Shear from bearing pressure		V _{heel_bear} =	(p _{heel_f} + p _{stem_h}	$_{eel_f}) \times I_{heel} / 2 = 7$	6.3 kN/m		
Shear from weight of base		Vheel wt base	= γ _{f d} × γ _{base} ×	I _{heel} × t _{base} = 11.6	kN/m		
Shear from weight of moist back	fill		w _{m_w_f} = 17.6				
Shear from weight of saturated b			w _{s_f} = 30.9 kN/				
Shear from surcharge		V _{heel_sur} = w	v _{sur_f} = 1.1 kN/r	n			
Total shear for heel design		V _{heel} = - V _h	neel_bear + Vheel_v	vt_base + V _{heel_wt_m} ·	+ V _{heel_wt_s} + V _h	_{eel_sur} = -15.	
kN/m							
Calculate moment for heel des	ign						
Moment from bearing pressure		M _{heel_bear} =	$(2 \times p_{\text{heel}_f} + p_s)$	tem_mid_f) × (Iheel +	t _{wall} / 2)² / 6 = 4	1.3 kNm/m	
Moment from weight of base				$t_{\text{base}} \times (I_{\text{heel}} + t_{\text{wal}})$			
Moment from weight of moist bac	ckfill			- t _{wall}) / 2 = 9.3 kN			
Moment from weight of saturated				all) / 2 = 16.2 kNn			
Moment from surcharge				_{vall}) / 2 = 0.6 kNm			
Total moment for heel design				_wt_base + Mheel_wt_m		M _{heel sur} = -8	
kNm/m					- <u>_</u> <u>-</u> -		
As the moment is	negative th	e design of the re	etaining wall h	neel is beyond ti	he scope of th	nis calculat	

Material properties	
Characteristic strength of concrete	f _{cu} = 40 N/mm ²
Characteristic strength of reinforcement	f _y = 500 N/mm ²
Wall details	
Minimum area of reinforcement	k = 0.13 %
Cover to reinforcement in stem	c _{stem} = 50 mm
Cover to reinforcement in wall	c _{wall} = 50 mm

Tekla Tedds	Project 253 Goldhurst Terrace				Job no. 24078	
ads consultancy 130 East Barnet Road	Calcs for Retaining Wall RW1 - Preliminary				Start page no./Revision 8	
EN4 8RE - New Barnet	Calcs by SN	Calcs date 05/12/2024	Checked by	Checked date	Approved by	Approved date
Factored horizontal at-rest for	rces on stem					
Surcharge		$F_{s_sur_f} = \gamma_{f_i}$	$\times \ K_0 \times Surcha$	$rge \times (h_{eff} - t_{base} - t_{base})$	d _{ds}) = 2 kN/m	
Moist backfill above water table		$F_{s_m_a_f} = 0$	$5 imes \gamma_{f_e} imes K_0 imes f$	$\gamma_{m} \times (h_{eff} - t_{base} - d_{base})$	_{ds} - h _{sat}) ² = 6.4	kN/m

Moist backfill below water table Saturated backfill

Water

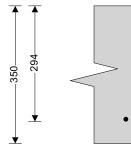
Calculate shear for stem design Shear at base of stem

Calculate moment for stem design Surcharge Moist backfill above water table Moist backfill below water table

Saturated backfill

Water

Total moment for stem design



$V_{stem} = F_{s_sur_f} + F_{s_m_a_f} + F_{s_m_b_f} + F_{s_s_f} + F_{s_water_f} = 52.2 \text{ kN/m}$
$M_{s_sur} = F_{s_sur_f} \times (h_{stem} + t_{base}) / 2 = 3.1 \text{ kNm/m}$
$M_{s_m_a} = F_{s_m_a_f} \times (2 \times h_{sat} + h_{eff} - d_{ds} + t_{base} / 2) / 3 = 13.4 \text{ kNm/m}$
$M_{s_m_b} = F_{s_m_b_f} \times h_{sat} / 2 = 14.5 \text{ kNm/m}$
$M_{s_s} = F_{s_s} \times h_{sat} / 3 = 4.5 \text{ kNm/m}$
$M_{s_water} = F_{s_water_f} \times h_{sat} / 3 = 7.7 \text{ kNm/m}$

 $F_{s_m_b_f} = \gamma_{f_e} \times K_0 \times \gamma_m \times (h_{eff} - t_{base} - d_{ds} - h_{sat}) \times h_{sat} = 19.3 \text{ kN/m}$

 $F_{s_s_f} = 0.5 \times \gamma_{f_e} \times K_0 \times (\gamma_{s_} \gamma_{water}) \times h_{sat}^2 = 9 \text{ kN/m}$

 $F_{s_water_f} = 0.5 \times \gamma_{f_e} \times \gamma_{water} \times h_{sat}^2 = \textbf{15.5} \text{ kN/m}$

 $M_{stem} = M_{s_sur} + M_{s_m_a} + M_{s_m_b} + M_{s_s} + M_{s_water} = 43.2 \text{ kNm/m}$

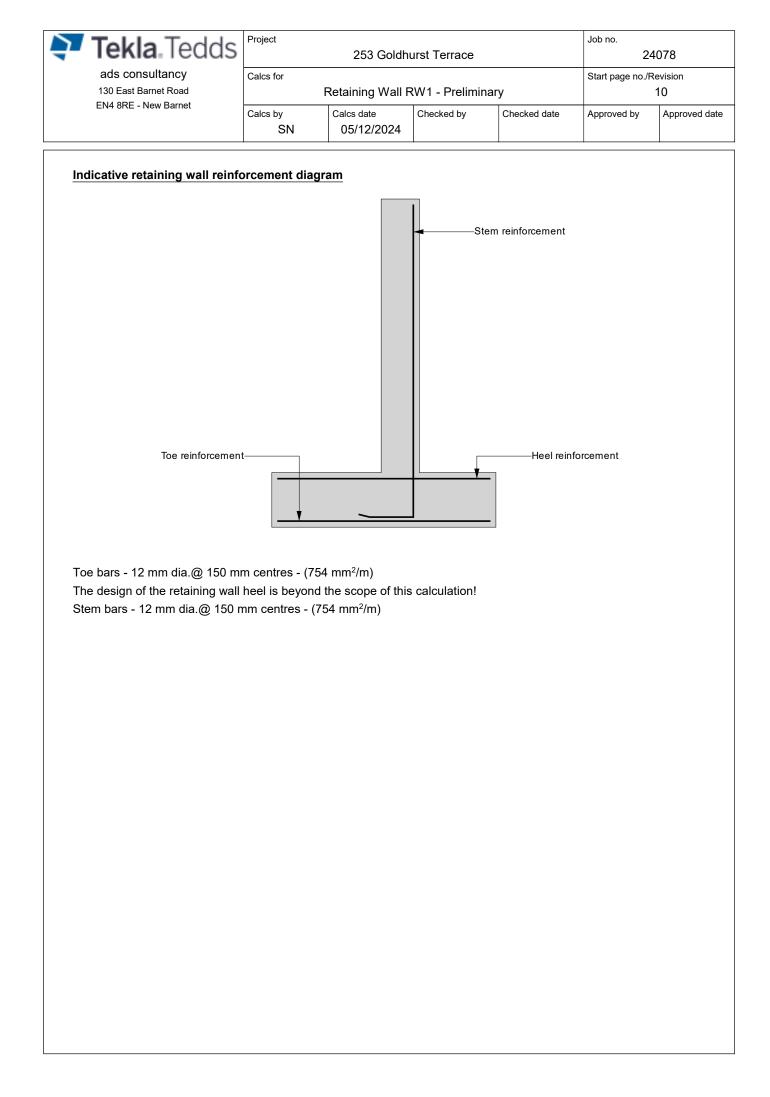
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Check wall stem in bending	
Width of wall stem	b = 1000 mm/m
Depth of reinforcement	d _{stem} = t _{wall} – c _{stem} – (φ _{stem} / 2) = 294.0 mm
Constant	$K_{stem} = M_{stem} / (b \times d_{stem}^2 \times f_{cu}) = 0.012$
	Compression reinforcement is not required
Lever arm	z_{stem} = min(0.5 + $\sqrt{(0.25 - (min(K_{stem}, 0.225) / 0.9)), 0.95) \times d_{stem}}$
	z _{stem} = 279 mm
Area of tension reinforcement required	$A_{s_stem_des} = M_{stem} / (0.87 \times f_y \times z_{stem}) = 355 \text{ mm}^2/\text{m}$
Minimum area of tension reinforcement	$A_{s_stem_min} = k \times b \times t_{wall} = 455 \text{ mm}^2/\text{m}$
Area of tension reinforcement required	A _{s_stem_req} = Max(A _{s_stem_des} , A _{s_stem_min}) = 455 mm ² /m
Reinforcement provided	12 mm dia.bars @ 150 mm centres
Area of reinforcement provided	A _{s_stem_prov} = 754 mm ² /m
	PASS - Reinforcement provided at the retaining wall stem is adequate
Check shear resistance at wall stem	
Design shear stress	v_{stem} = V_{stem} / (b × d _{stem}) = 0.178 N/mm ²
Allowable shear stress	v_{adm} = min(0.8 × $\sqrt{(f_{cu} / 1 \text{ N/mm}^2)}$, 5) × 1 N/mm ² = 5.000 N/mm ²
	PASS - Design shear stress is less than maximum shear stress
From BS8110:Part 1:1997 – Table 3.8	
Design concrete shear stress	v _{c_stem} = 0.507 N/mm ²

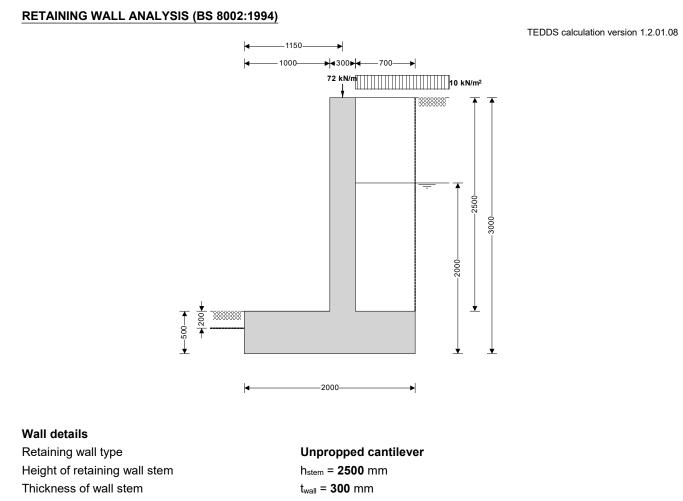
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Tekla Tedds	Project 253 Goldhurst Terrace				Job no. 24078	
ads consultancy 130 East Barnet Road	Calcs for	Retaining Wall R	W1 - Preliminar	У	Start page no./Re	evision 9
EN4 8RE - New Barnet	Calcs by SN	Calcs date 05/12/2024	Checked by	Checked date	Approved by	Approved date

		v _{stem} < v _{c_stem} - No shear reinforcement required
Check retaining wall defle	ection	
Basic span/effective depth	ratio	ratio _{bas} = 7
Design service stress		$f_{s} = 2 \times f_{y} \times A_{s_stem_req} / (3 \times A_{s_stem_prov}) = 201.2 \text{ N/mm}^{2}$
Modification factor	factor _{tens} = min(0.	55 + (477 N/mm ² - f_s)/(120 × (0.9 N/mm ² + (M _{stem} /(b × d _{stem} ²)))),2) = 2.00
Maximum span/effective de	epth ratio	$ratio_{max} = ratio_{bas} \times factor_{tens} = 14.00$
Actual span/effective depth	n ratio	ratio _{act} = h _{stem} / d _{stem} = 8.50
		PASS - Span to depth ratio is acceptable



Tekla Tedds	Project 253 Goldhurst Terrace				Job no. 24078	
ads consultancy 130 East Barnet Road	Calcs for F	Retaining Wall R	W2 - Preliminar		Start page no./Re	evision 1
EN4 8RE - New Barnet	Calcs by SN	Calcs date 05/12/2024	Checked by	Checked date	Approved by	Approved date



Length of toe Length of heel Overall length of base Thickness of base Depth of downstand Position of downstand Thickness of downstand Height of retaining wall Depth of cover in front of wall Depth of unplanned excavation Height of ground water behind wall Height of saturated fill above base Density of wall construction Density of base construction Angle of rear face of wall Angle of soil surface behind wall Effective height at virtual back of wall **Retained material details**

Retained material details Mobilisation factor

Moist density of retained material

I_{toe} = **1000** mm I_{heel} = **700** mm $I_{\text{base}} = I_{\text{toe}} + I_{\text{heel}} + t_{\text{wall}} = 2000 \text{ mm}$ t_{base} = **500** mm d_{ds} = **0** mm I_{ds} = 600 mm t_{ds} = **500** mm $h_{wall} = h_{stem} + t_{base} + d_{ds} = 3000 \text{ mm}$ d_{cover} = 0 mm d_{exc} = **200** mm h_{water} = 2000 mm h_{sat} = max(h_{water} - t_{base} - d_{ds}, 0 mm) = **1500** mm γ_{wall} = 23.6 kN/m³ γ_{base} = 23.6 kN/m³ α = **90.0** deg $\beta = 0.0 \deg$ $h_{eff} = h_{wall} + I_{heel} \times tan(\beta) = 3000 \text{ mm}$

M = **1.5** γ_m = **18.0** kN/m³

Tekla Tedds	Project		Job no.	24078		
ads consultancy 130 East Barnet Road	Calcs for	Detaining Wall	Start page no./	Start page no./Revision		
EN4 8RE - New Barnet	<u></u>	Retaining Wall F	2			
	Calcs by SN	Calcs date 05/12/2024	Checked by	Checked date	Approved by	Approved da
Saturated density of retained ma	aterial	γ _s = 21.0 kl	N/m ³			
Design shear strength		φ' = 29.3 de	eg			
Angle of wall friction		δ = 18.6 de	eg			
Base material details						
Firm clay						
Moist density		γ _{mb} = 18.0	kN/m³			
Design shear strength		φ' _b = 24.2 c	leg			
Design base friction		δ _b = 18.6 d	eg			
Allowable bearing pressure		P _{bearing} = 1 ()0 kN/m²			
Using Coulomb theory						
Active pressure coefficient for re	etained materi	al				
$K_a = sin(\alpha - \alpha)$	+ φ')² / (sin(α)	$^2 \times \sin(\alpha - \delta) \times [1 + 1]$	+ √(sin(φ' + δ) :	$ imes$ sin(ϕ ' - eta) / (si	$n(\alpha - \delta) imes sin(lpha +$	- β)))]²) = 0 .
Passive pressure coefficient for	base materia	I				
	K _p = sir	n(90 - φ'♭)² / (sin(90) - δ _b) × [1 - √($sin(\phi_{P} + \delta_{P}) \times si$	n(փ'♭) / (sin(90 +	$\delta_b)))]^2) = 4.$
At-rest pressure						
At-rest pressure for retained ma	terial	K ₀ = 1 – sir	n(¢') = 0.511			
Loading details						
Surcharge load on plan		Surcharge	= 10.0 kN/m ²			
Applied vertical dead load on wa	W _{dead} = 60.0 kN/m					
Applied vertical live load on wall		W _{live} = 12.0) kN/m			
Position of applied vertical load	on wall	I _{load} = 1150	mm			
Applied horizontal dead load on	wall	F _{dead} = 0.0	kN/m			
Applied horizontal live load on w	all	F _{live} = 0.0 k	:N/m			
Height of applied horizontal load	l on wall	h _{load} = 0 mi	n			
		72 ↓ □□□□□□	111111111111111111111111111111111111111	0		
			1888888888			
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	8888					
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21.4	87.2		67.8	2.9 5.2 6.5	19.6	
					,	
				Loads sh	nown in kN/m, pressu	ires snown in k

Tekla Tedds	Project	Job no. 24078				
ads consultancy 130 East Barnet Road EN4 8RE - New Barnet	Calcs for F	Retaining Wall R	W2 - Preliminar	у	Start page no./Re	evision 3
EN4 ONE - NEW Damel	Calcs by SN	Calcs date 05/12/2024	Checked by	Checked date	Approved by	Approved date

Vertical forces on wall	
Wall stem	$w_{wall} = h_{stem} \times t_{wall} \times \gamma_{wall} = 17.7 \text{ kN/m}$
Wall base	$w_{base} = I_{base} \times t_{base} \times \gamma_{base} = 23.6 \text{ kN/m}$
Surcharge	w _{sur} = Surcharge × I _{heel} = 7 kN/m
Moist backfill to top of wall	$w_{m_w} = I_{heel} \times (h_{stem} - h_{sat}) \times \gamma_m = 12.6 \text{ kN/m}$
Saturated backfill	$w_s = I_{heel} \times h_{sat} \times \gamma_s = 22.1 \text{ kN/m}$
Applied vertical load	$W_v = W_{dead} + W_{live} = 72 \text{ kN/m}$
Total vertical load	$W_{total} = W_{wall} + W_{base} + W_{sur} + W_{m_w} + W_s + W_v = 155 \text{ kN/m}$
Horizontal forces on wall	
Surcharge	F_{sur} = K _a × cos(90 - α + δ) × Surcharge × h _{eff} = 8.7 kN/m
Moist backfill above water table	$F_{m_a} = 0.5 \times K_a \times cos(90 - \alpha + \delta) \times \gamma_m \times (h_{eff} - h_{water})^2 = 2.6 \text{ kN/m}$
Moist backfill below water table	$F_{m_b} = K_a \times cos(90 - \alpha + \delta) \times \gamma_m \times (h_{eff} - h_{water}) \times h_{water} = 10.4 \text{ kN/m}$
Saturated backfill	$F_{s} = 0.5 \times K_{a} \times cos(90 - \alpha + \delta) \times (\gamma_{s}\text{-} \gamma_{water}) \times h_{water}^2 = \textbf{6.5} \ kN/m$
Water	F_{water} = 0.5 × h_{water}^2 × γ_{water} = 19.6 kN/m
Total horizontal load	$F_{total} = F_{sur} + F_{m_a} + F_{m_b} + F_s + F_{water} = 47.9 \text{ kN/m}$
Calculate stability against sliding	
Passive resistance of soil in front of wall	$F_{p} = 0.5 \times K_{p} \times cos(\delta_{b}) \times (d_{cover} + t_{base} + d_{ds} - d_{exc})^{2} \times \gamma_{mb} = 3.2 \text{ kN/m}$

PASS - Resistance force is greater than sliding force

 $M_{sur} = F_{sur} \times (h_{eff} - 2 \times d_{ds}) / 2 = 13.1 \text{ kNm/m}$ $M_{m a} = F_{m a} \times (h_{eff} + 2 \times h_{water} - 3 \times d_{ds}) / 3 = 6.1 \text{ kNm/m}$ $M_{m_b} = F_{m_b} \times (h_{water} - 2 \times d_{ds}) / 2 = 10.4 \text{ kNm/m}$ $M_s = F_s \times (h_{water} - 3 \times d_{ds}) / 3 = 4.3 \text{ kNm/m}$ $M_{water} = F_{water} \times (h_{water} - 3 \times d_{ds}) / 3 = 13.1 \text{ kNm/m}$ $M_{ot} = M_{sur} + M_{m_a} + M_{m_b} + M_s + M_{water} = 47 \text{ kNm/m}$

 $F_{res} = F_p + (W_{total} - W_{sur} - W_{live}) \times tan(\delta_b) = 49.0 \text{ kN/m}$

 $M_{wall} = w_{wall} \times (I_{toe} + t_{wall} / 2) = 20.4 \text{ kNm/m}$ $M_{\text{base}} = w_{\text{base}} \times I_{\text{base}} / 2 = 23.6 \text{ kNm/m}$ $M_{m_r} = (w_{m_w} \times (I_{base} - I_{heel} / 2) + w_{m_s} \times (I_{base} - I_{heel} / 3)) = 20.8 \text{ kNm/m}$ $M_{s_r} = w_s \times (I_{base} - I_{heel} / 2) = 36.4 \text{ kNm/m}$ $M_{dead} = W_{dead} \times I_{load} = 69 \text{ kNm/m}$ Mrest = Mwall + Mbase + Mm r + Ms r + Mdead = 170.1 kNm/m

Mot = 47.0 kNm/m Mrest = 170.1 kNm/m PASS - Restoring moment is greater than overturning moment

 $M_{sur_r} = W_{sur} \times (I_{base} - I_{heel} / 2) = 11.6 \text{ kNm/m}$ Mlive = Wlive × Iload = 13.8 kNm/m M_{total} = M_{rest} - M_{ot} + M_{sur} + M_{live} = **148.5** kNm/m R = W_{total} = **155.0** kN/m $x_{bar} = M_{total} / R = 958 mm$ e = abs((I_{base} / 2) - x_{bar}) = 42 mm

Resistance to sliding

Overturning moments

Surcharge Moist backfill above water table Moist backfill below water table Saturated backfill Water Total overturning moment

Restoring moments

Wall stem Wall base Moist backfill Saturated backfill Design vertical dead load Total restoring moment

Check stability against overturning Total overturning moment Total restoring moment

Check bearing pressure

Surcharge Design vertical live load Total moment for bearing Total vertical reaction Distance to reaction Eccentricity of reaction

Tekla Tedds	Project 253 Goldhurst Terrace				Job no. 24078	
ads consultancy 130 East Barnet Road	Calcs for Retaining Wall RW2 - Preliminary				Start page no./Revision 4	
EN4 8RE - New Barnet	Calcs by SN	Calcs date 05/12/2024	Checked by	Checked date	Approved by	Approved date

Reaction acts within middle third of base

Bearing pressure at toe Bearing pressure at heel
$$\begin{split} p_{\text{toe}} &= (\mathsf{R} \ / \ \mathsf{I}_{\text{base}}) + (6 \times \mathsf{R} \times e \ / \ \mathsf{I}_{\text{base}}^2) = \textbf{87.2} \ \mathsf{kN}/m^2 \\ p_{\text{heel}} &= (\mathsf{R} \ / \ \mathsf{I}_{\text{base}}) - (6 \times \mathsf{R} \times e \ / \ \mathsf{I}_{\text{base}}^2) = \textbf{67.8} \ \mathsf{kN}/m^2 \end{split}$$

PASS - Maximum bearing pressure is less than allowable bearing pressure

Tekla. Tedds		253 Goldh	24078			
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EN4 8RE - New Barnet		Retaining Wall F				
	alcs by SN	Calcs date 05/12/2024	Checked by	Checked date	Approved by	Approved da
RETAINING WALL DESIGN (BS	8002:1994)					
Ultimate limit state load factors					TEDDS calculation	n version 1.2.0
Dead load factor		γ _{f_d} = 1.4				
Live load factor		γ _{f_l} = 1.6				
Earth and water pressure factor		γ _{f_e} = 1.4				
Factored vertical forces on wall						
Wall stem		$\mathbf{W}_{wall_f} = \gamma_{f_d}$	imes h _{stem} $ imes$ t _{wall} $ imes$	_{γwall} = 24.8 kN/n	n	
Wall base		$W_{\text{base f}} = \gamma_{\text{f}}$	$_{ m l} imes {\sf I}_{ m base} imes {\sf t}_{ m base} imes$	γ _{base} = 33 kN/m	ı	
Surcharge				I _{heel} = 11.2 kN/m		
Moist backfill to top of wall			-	- h _{sat}) × γ _m = 17.		
Saturated backfill			$I_{heel} \times h_{sat} \times \gamma_s$, .		
Applied vertical load			-	W _{live} = 103.2 kN/	/m	
Total vertical load			. –	N _{sur_f} + W _{m_w_f} + V		0.7 kN/m
Factored horizontal at-rest force	s on wall	_				
Surcharge		$F_{sur} f = \gamma f + \lambda$	Ko x Surchard	ge × h _{eff} = 24.5 k	N/m	
Moist backfill above water table			-	$h \times (h_{eff} - h_{water})^2 =$		
Moist backfill below water table				$f_{\rm ff} - h_{\rm water}) \times h_{\rm water}$		
Saturated backfill				γ_{water} × h_{water}^2 = γ		
Water				× γ_{water} = 27.5 k		
Total horizontal load		_ • =		$\sim \gamma$ water = 27.9 K _b_f + Fs_f + Fwater		n
Passive resistance of soil in front	of wall			$(\delta_b) imes (d_{cover} + t_{ba})$		
kN/m		1 p_1 /1_6 A				
Factored overturning moments						
Surcharge		M _{sur_f} = F _{sur}	$_{f} \times (h_{eff} - 2 \times c)$	l _{ds}) / 2 = 36.8 kN	im/m	
Moist backfill above water table		$M_{m_a_f} = F_{m_a}$	_a_f × (h _{eff} + 2 ×	h _{water} - 3 × d _{ds}) /	3 = 15 kNm/m	
Moist backfill below water table		$M_{m_b_f} = F_m$	_b_f × (h _{water} - 2	× d _{ds}) / 2 = 25.7	kNm/m	
Saturated backfill		$M_{s_f} = F_{s_f} >$	\times (h _{water} - 3 \times d _d	_s) / 3 = 10.7 kNn	n/m	
Water		$M_{water_f} = F_v$	vater_f × (h _{water} - 3	3 × d _{ds}) / 3 = 18.	3 kNm/m	
Total overturning moment		M _{ot_f} = M _{sur_}	_f + M _{m_a_f} + M _m	$h_b_f + M_{s_f} + M_{wat}$	_{ter_f} = 106.5 kNr	m/m
Restoring moments						
Wall stem		$M_{wall_f} = W_{wall_f}$	$_{\text{all}_{f}} \times (I_{\text{toe}} + t_{\text{wall}})$	/ 2) = 28.5 kNm/	m	
Wall base			_{ase_f} × I _{base} / 2 =			
Surcharge		_	-	ı / 2) = 18.5 kNm	ı/m	
Moist backfill				, el / 2) + W _{m_s_f} × (= 29.1 kNm
Saturated backfill		•	•	2) = 50.9 kNm/m		
Design vertical load			× I _{load} = 118.7			
Total restoring moment				/I _{sur_r_f} + M _{m_r_f} +	$M_{s_r_f} + M_{v_f} = 2$	278.7 kNm/
Factored bearing pressure						
Total moment for bearing		M _{total} f = M _{re}	est_f - Mot_f = 17 2	2.2 kNm/m		
Total vertical reaction			= 220.7 kN/m			
Distance to reaction			_{l_f} / R _f = 780 m	m		
Eccentricity of reaction		e _f = abs((l _{ba}	_{ase} / 2) - x _{bar_f}) =	= 220 mm		
				Reaction acts	within middle	third of ba

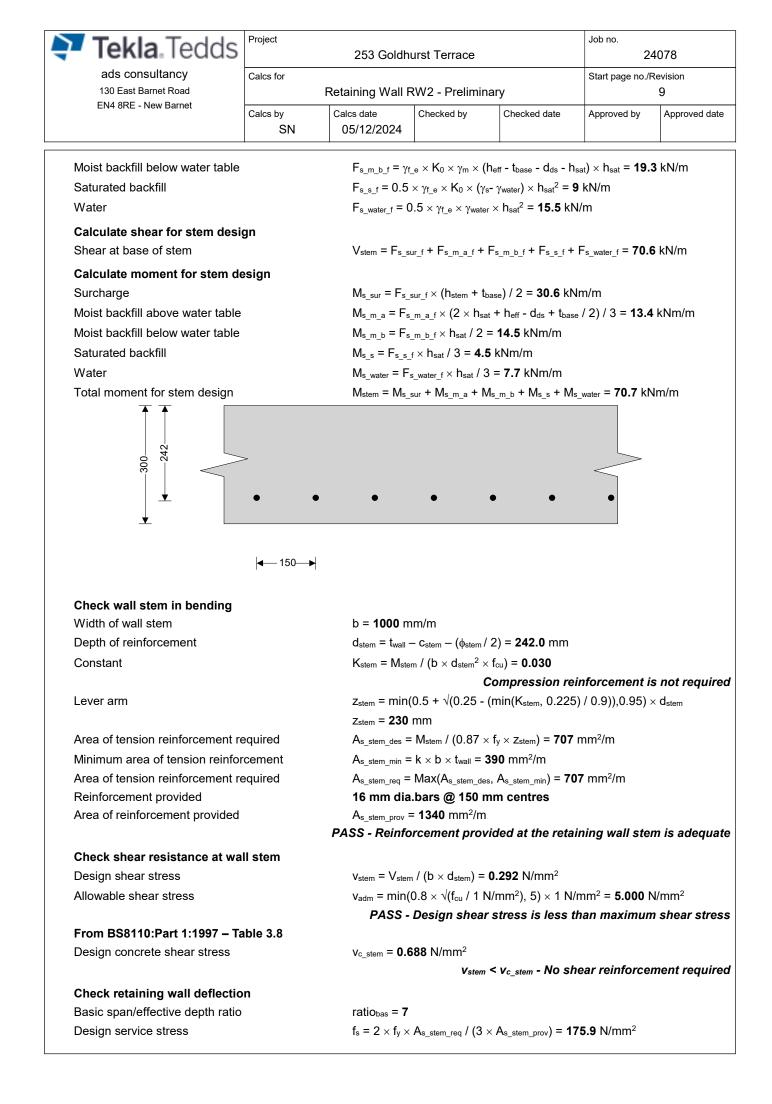
Tekla Tedds	253 Goldh	Job no. 24078					
ads consultancy	Calcs for		Start page no./Revision				
130 East Barnet Road EN4 8RE - New Barnet	Retaining Wall RW2 - Preliminary					6	
Live one - new Damer	Calcs by SN	Calcs date 05/12/2024	Checked by	Checked date	Approved by	Approved da	
Bearing pressure at toe		$p_{toe_f} = (R_f)$	$(I_{base}) + (6 \times R)$	$R_{f} \times e_{f} / I_{base}^{2}$ = 18	3.1 kN/m²		
Bearing pressure at heel		$p_{heel_f} = (R_f)$	/ I_{base}) - (6 × F	$R_f \times e_f / I_{base^2} = 37$.6 kN/m²		
Rate of change of base reaction	n	rate = (p _{toe}	_f - p _{heel_f}) / I _{bas}	_e = 72.72 kN/m²/n	า		
Bearing pressure at stem / toe		$p_{\text{stem_toe_f}} =$	max(p _{toe_f} - (ra	ate × I _{toe}), 0 kN/m ²	²) = 110.4 kN/r	n²	
Bearing pressure at mid stem		p _{stem_mid_f} =	max(p _{toe_f} - (r	ate \times (I _{toe} + t _{wall} / 2)), 0 kN/m²) =	99.5 kN/m ²	
Bearing pressure at stem / heel		Pstem_heel_f =	max(p _{toe_f} - (r	rate × (I_{toe} + t_{wall})),	0 kN/m²) = 88	.5 kN/m²	
Design of reinforced concrete	retaining wa	III toe (BS 8002:1	<u>994)</u>				
Material properties							
Characteristic strength of concre		f _{cu} = 40 N/r					
Characteristic strength of reinfor	rcement	f _y = 500 N/	mm²				
Base details							
Minimum area of reinforcement		k = 0.13 %					
Cover to reinforcement in toe		c _{toe} = 50 m	m				
Calculate shear for toe design	ı						
Shear from bearing pressure		$V_{toe_bear} = ($	p _{toe_f} + p _{stem_toe}	e_f) × I _{toe} / 2 = 146.	7 kN/m		
Shear from weight of base		$V_{toe_wt_base}$ = $\gamma_{f_d} \times \gamma_{base} \times I_{toe} \times t_{base}$ = 16.5 kN/m					
Total shear for toe design		$V_{toe} = V_{toe_t}$	oear - V _{toe_wt_base}	_e = 130.2 kN/m			
Calculate moment for toe des	ign						
Moment from bearing pressure	•	M _{toe bear} = (2 × p _{toe f} + p _{ste}	$_{em_{mid_f}} \times (I_{toe} + t_{wa})$	"/2)²/6 = 10 2	2.6 kNm/m	
Moment from weight of base				$ t_{base} \times (I_{toe} + t_{wall}) $			
Total moment for toe design				_{se} = 91.7 kNm/m	, ,		
5 00	• •	•	·	• •	•		
.	← 150						
Check toe in bending		h - 4000	m/m				
Width of toe Depth of reinforcement		b = 1000 m		?) = 444.0 mm			
Constant			$- c_{\text{toe}} - (\phi_{\text{toe}} / 2)$ / (b × d _{toe} ² × f _{cl}				
Constant		rx _{toe} - IVI _{toe}	•	Compression re	inforcement	s not requir	
Lever arm		$z_{\rm min} = \min\{0\}$		(min(K _{toe} , 0.225) /		-	
		z _{toe} = 422 r		(IIIII (INtoe, U.223) /	0.9)),0.90) × (JIOE	
Area of tension reinforcement re	equired	$A_{s_toe_des} =$	M_{toe} / (0.87 $ imes$ f	$f_y \times z_{toe}$) = 500 mm	n²/m		
				_			

 $A_{s_toe_min} = k \times b \times t_{base} = \textbf{650} \text{ mm}^2\text{/m}$

Minimum area of tension reinforcement

Tekla Tedds	Project	253 Goldh	urst Terrace		Job no. 2	4078
ads consultancy	Calcs for		Start page no./Revision			
130 East Barnet Road EN4 8RE - New Barnet			7			
EIN4 ORE - New Damet	Calcs by SN	Calcs date 05/12/2024	Checked by	Checked date	Approved by	Approved of
Area of tension reinforcement re	equired	A _{s_toe_req} =	Max(A _{s_toe_des} ,	A _{s_toe_min}) = 650 r	mm²/m	
Reinforcement provided		12 mm dia	.bars @ 150 r	mm centres		
Area of reinforcement provided			754 mm²/m			
		PASS - Rein	forcement pr	ovided at the re	taining wall to	be is adequ
Check shear resistance at toe)					
Design shear stress		$v_{toe} = V_{toe}$ /	$(b \times d_{toe}) = 0.2$	293 N/mm²		
Allowable shear stress		v _{adm} = min(0.8 × √(f _{cu} / 1 I	N/mm²), 5) × 1 N	/mm ² = 5.000	N/mm ²
		PASS -	Design shea	r stress is less i	than maximur	n shear str
From BS8110:Part 1:1997 – Ta	able 3.8					
Design concrete shear stress		v _{c_toe} = 0.4 0				
			Vte	_{oe} < v _{c_toe} - No sl	hear reinforce	ment requ
Design of reinforced concrete	e retaining w	all heel (BS 8002:	<u>1994)</u>			
Material properties						
Characteristic strength of concr	f _{cu} = 40 N/r	nm²				
Characteristic strength of reinfo	f _y = 500 N/	mm²				
Base details						
Minimum area of reinforcement		k = 0.13 %				
Cover to reinforcement in heel		c _{heel} = 50 m	ım			
Calculate shear for heel desig	ın					
Shear from bearing pressure		V _{heel_bear} =	(p _{heel_f} + p _{stem_h}	neel_f) × I _{heel} / 2 = 4	4.2 kN/m	
Shear from weight of base				I _{heel} × t _{base} = 11.6		
Shear from weight of moist back	kfill	V _{heel_wt_m} =	Wm_w_f = 17.6	kN/m		
Shear from weight of saturated	backfill	$V_{heel_wt_s} = v_{heel_wt_s}$	w _{s_f} = 30.9 kN/	/m		
Shear from surcharge		$V_{heel_sur} = w$	/sur_f = 11.2 kN	/m		
Total shear for heel design kN/m		$V_{heel} = -V_{heel}$	neel_bear + Vheel_v	$w_{t_{base}} + V_{heel_wt_m}$	+ V _{heel_wt_s} + V _h	neel_sur = 27.
Calculate moment for heel de	sign					
Moment from bearing pressure		M _{heel_bear} =	$(2 \times p_{\text{heel}_f} + p_s)$	$stem_mid_f) \times (I_{heel} +$	$t_{wall} / 2)^2 / 6 = 2$	2 1 kNm/m
Moment from weight of base				$\times t_{base} \times (I_{heel} + t_{wast})$		
Moment from weight of moist ba	ackfill			+ t _{wall}) / 2 = 8.8 kN		
· · · · · · · · · · · · · · · · · · ·	d backfill			/all) / 2 = 15.4 kNr		
Moment from weight of saturate						
Moment from weight of saturate Moment from surcharge		$M_{heel sur} = v$	$V_{sur_f} \times (I_{heel} + t_w)$	_{wall}) / 2 = 5.6 kNm	ı/m	

Tekla. Tedds [№]	ect	253 Goldh	Job no. 24078					
ads consultancy Call 130 East Barnet Road	cs for	Retaining Wall F	Start page no./Revision 8					
EN4 8RE - New Barnet Cal	cs by SN	Calcs date 05/12/2024	Checked by	Checked date	Approved by	Approved date		
4	150 _							
500 444	•	•	•	• •	•			
Check heel in bending Width of heel		b = 1000 m						
Depth of reinforcement Constant	$d_{heel} = t_{base} - c_{heel} - (\phi_{heel} / 2) = 444.0 \text{ mm}$ $K_{heel} = M_{heel} / (b \times d_{heel}^2 \times f_{cu}) = 0.002$							
Ounstant		Tyneer - Twinee		Compression re	inforcement i	s not require		
Lever arm	z _{heel} = min(0.5 + √(0.25 - (min(K _{heel} , 0.225) / 0.9)),0.95) × d _{heel} z _{heel} = 422 mm							
Area of tension reinforcement requi			f _y × z _{heel}) = 81 m	m²/m				
Minimum area of tension reinforcem	ent		$\mathbf{k} \times \mathbf{b} \times \mathbf{t}_{base} =$					
Area of tension reinforcement requi	red	As_heel_req =	Max(As_heel_des	, A _{s_heel_min}) = 650) mm²/m			
Reinforcement provided		12 mm dia.bars @ 150 mm centres						
Area of reinforcement provided			754 mm²/m	vided of the vet		olio odoaura		
		PASS - Reilli	orcement pro	vided at the reta	anning wan ne	ei is auequa		
Check shear resistance at heel Design shear stress		$V_{\text{hand}} = V_{\text{hand}}$	/ (b × d _{bab}) – r	061 N/mm ²				
Allowable shear stress		v _{heel} = V _{heel} / (b × d _{heel}) = 0.061 N/mm ² v _{adm} = min(0.8 × √(f _{cu} / 1 N/mm ²), 5) × 1 N/mm ² = 5.000 N/mm ²						
, montable official official				stress is less t				
From BS8110:Part 1:1997 – Table	3.8		-					
Design concrete shear stress		Vc_heel = 0.4	09 N/mm ²					
			Vhee	ı < v _{c_heel} - No sł	near reinforce	ment require		
Design of reinforced concrete ret	aining wal	I stem (BS 8002	:1994 <u>)</u>					
Material properties			—					
Characteristic strength of concrete	f _{cu} = 40 N/r	nm²						
Characteristic strength of reinforcer	nent	f _y = 500 N/r	mm²					
Wall details								
Minimum area of reinforcement		k = 0.13 %						
Cover to reinforcement in stem	c _{stem} = 50 mm							
Cover to reinforcement in wall		c _{wall} = 50 m	IM					
Factored horizontal at-rest forces	on stem							
Surcharge		$F_{s_sur_f} = \gamma_{f_l} \times K_0 \times Surcharge \times (h_{eff} - t_{base} - d_{ds}) = 20.4 \text{ kN/m}$						
Moist backfill above water table		$F_{s_m_a_f} = 0.5 \times \gamma_{f_e} \times K_0 \times \gamma_m \times (h_{eff} - t_{base} - d_{ds} - h_{sat})^2 = 6.4 \text{ kN/m}$						



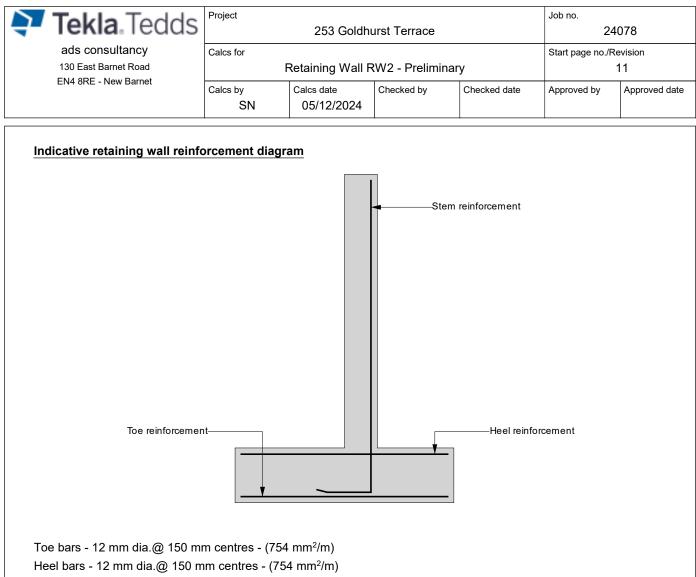
Tekla. Tedds	Project	Project 253 Goldhurst Terrace				
ads consultancy 130 East Barnet Road	Calcs for Retaining Wall RW2 - Preliminary				Start page no./Re	evision 10
EN4 8RE - New Barnet	Calcs by SN	Calcs date 05/12/2024	Checked by	Checked date	Approved by	Approved date

Modification factorfactor_tens = min(0.55 + (477 N/mm² - f_s)/(120 × (0.9 N/mm² + (M_{stem}/(b × d_{stem²})))),2) = **1.74**Maximum span/effective depth ratioratio_max = ratio_bas × factor_tens = **12.18**

Actual span/effective depth ratio

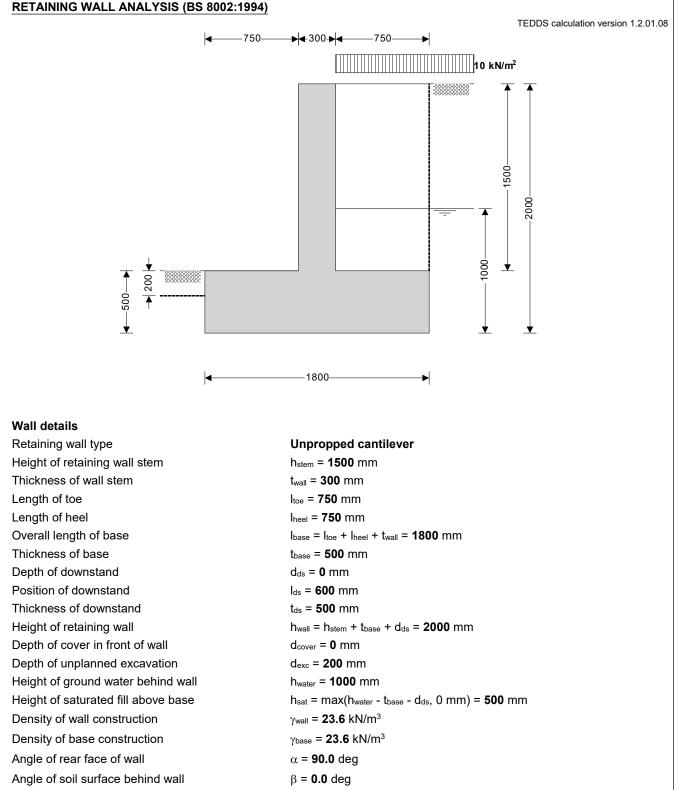
ratio_{act} = h_{stem} / d_{stem} = **10.33**

PASS - Span to depth ratio is acceptable



Stem bars - 16 mm dia.@ 150 mm centres - (1340 mm²/m)





 $h_{eff} = h_{wall} + I_{heel} \times tan(\beta) = 2000 \text{ mm}$

M = 1.5

γ_m = **18.0** kN/m³

Retained material details Mobilisation factor

Moist density of retained material

Effective height at virtual back of wall

page no./Revision 2
oved by Approved date
× sin(α + β)))] ²) = 0.306 sin(90 + δ_b)))] ²) = 4.187
sin(30 + 06)))]) =
9.8
sir

Tekla Tedds	Project	253 Goldh	urst Terrace		Job no. 2	4078
ads consultancy	Calcs for	· · · · · · · · · · · · · · · · · · ·			Start page no./	
130 East Barnet Road EN4 8RE - New Barnet		aining Wall RW3 /				3
	Calcs by SN	Calcs date 12/12/2024	Checked by	Checked date	Approved by	Approved o
Vertical forces on wall						
Wall stem		w _{wall} = h _{stem}	$_{ m v} imes t_{ m wall} imes \gamma_{ m wall}$ =	10.6 kN/m		
Wall base		$w_{base} = I_{base}$	$x \times t_{base} \times \gamma_{base} =$	= 21.2 kN/m		
Surcharge		w _{sur} = Surc	harge × I _{heel} = 7	7.5 kN/m		
Moist backfill to top of wall		$w_{m_w} = I_{heel}$	× (h _{stem} - h _{sat}) ×	γ _m = 13.5 kN/m	ı	
Saturated backfill		$w_s = I_{heel} \times$	h _{sat} × γ _s = 7.9 k	۸/m		
Total vertical load		W _{total} = w _{wa}	II + Wbase + Wsur	+ w _{m_w} + w _s = 60).7 kN/m	
Horizontal forces on wall						
Surcharge		F _{sur} = K _a ×	$\cos(90 - \alpha + \delta)$	× Surcharge × h	n _{eff} = 5.8 kN/m	
Moist backfill above water table			,	$(\alpha + \delta) \times \gamma_m \times (h_e)$		6 kN/m
Moist backfill below water table		_		$(1.10) \times \gamma_m \times (h_{eff} - h_{was})$	-	
Saturated backfill				$(\gamma_{s} - \gamma_{water}) \times (\gamma_{s} - \gamma_{water})$		
Water			$\times h_{water}^2 \times \gamma_{water}$,,		
Total horizontal load				$F_{s} + F_{water} = 20.2$	2 kN/m	
			· · · · · · · · · · · · · · · · · · ·			
Calculate stability against slic	-			ام با با م	al \2	- 2. 2. 1/1/100
Passive resistance of soil in from	nt of wall					
Resistance to sliding		⊢ _{res} = ⊢ _p +		tan(ð₅) = 21.1 kN sistance force i		n sliding f
Overturning moments					U	Ū
Surcharge		M _{sur} = F _{sur} :	× (h _{eff} - 2 × d _{ds})	/ 2 = 5.8 kNm/n	n	
Moist backfill above water table		$M_{m_a} = F_{m_a}$	$_{a} \times (h_{eff} + 2 \times h_{v})$	vater - $3 \times d_{ds}$) / 3	= 3.5 kNm/m	
Moist backfill below water table		$M_{m_b} = F_{m_b}$	$b \times (h_{water} - 2 \times 0)$	d _{ds}) / 2 = 2.6 kNr	m/m	
Saturated backfill		$M_s = F_s \times (I)$	h_{water} - $3 imes d_{ds}$) /	′ 3 = 0.5 kNm/m		
Water		M _{water} = F _{wa}	$_{ m ter} imes$ (h _{water} - 3 $ imes$	d _{ds}) / 3 = 1.6 kN	Nm/m	
Total overturning moment		M _{ot} = M _{sur} +	+ M _{m_a} + M _{m_b} +	• M _s + M _{water} = 14	l.1 kNm/m	
Restoring moments						
Wall stem		$M_{wall} = W_{wall}$	\times (I _{toe} + t _{wall} / 2)) = 9.6 kNm/m		
Wall base		M _{base} = w _{ba}	$_{se} \times I_{base} / 2 = 1$	9.1 kNm/m		
Moist backfill		$M_{m_r} = (w_{m_r})$	_w $ imes$ (Ibase - Iheel /	2) + $w_{m_s} \times (I_{base})$	e - I _{heel} / 3)) = 1	9.2 kNm/m
Saturated backfill		$M_{s_r} = w_s \times$	(I _{base} - I _{heel} / 2)	= 11.2 kNm/m		
Total restoring moment		$M_{rest} = M_{wal}$	I + M _{base} + M _{m_r}	+ M _{s_r} = 59.1 kN	Nm/m	
Check stability against overtu	Irning					
Total overturning moment		M _{ot} = 14.1	kNm/m			
Total restoring moment		M _{rest} = 59.1	kNm/m			
		PASS	- Restoring m	oment is greate	er than overtu	rning mon
Check bearing pressure						
Surcharge		$M_{sur_r} = W_{sur}$	$_{\rm r} imes (I_{\rm base} - I_{\rm heel} / 2$	2) = 10.7 kNm/m	ı	
Total moment for bearing		M _{total} = M _{res}	t - Mot + Msur_r =	55.7 kNm/m		
Total vertical reaction		R = W _{total} =	60.7 kN/m			
Distance to reaction		$x_{bar} = M_{total}$	/ R = 918 mm			
Eccentricity of reaction		e = abs((I _{ba}	_{ase} / 2) - x _{bar}) = ·	18 mm		
				Reaction acts	within middl	e third of b
Bearing pressure at toe		$p_{toe} = (R / I)$	$_{base})$ - (6 × R × 6	e / I _{base} ²) = 31.7 k	κN/m²	
				-		

 p_{heel} = (R / I_{base}) + (6 × R × e / I_{base}²) = **35.8** kN/m²

Bearing pressure at heel

Tekla. Tedds	Project	Job no. 24078				
ads consultancy 130 East Barnet Road	Calcs for Retaini	Start page no./Revision 4				
EN4 8RE - New Barnet	Calcs by SN	Calcs date 12/12/2024	Checked by	Checked date	Approved by	Approved date

PASS - Maximum bearing pressure is less than allowable bearing pressure

Tekla. Tedds	Project	253 Goldhi	Job no. 24078			
ads consultancy 130 East Barnet Road	Calcs for Retaining Wall RW3 - Permanent (Preliminary)				Start page no./Revision 1	
EN4 8RE - New Barnet	Calcs by SN	Calcs date 12/12/2024	Checked by	Checked date	Approved by	Approved date

RETAINING WALL ANALYSIS (BS 8002:1994) TEDDS calculation version 1.2.01.08 -900-► —750— ▶ 300 --16 kN/m I 10 kN/m² 2500 3000 2000 Pron 1800-Wall details Cantilever propped at base Retaining wall type h_{stem} = **2500** mm Height of retaining wall stem Thickness of wall stem t_{wall} = 300 mm

I_{toe} = **750** mm Length of toe Length of heel I_{heel} = **750** mm Overall length of base Ibase = Itoe + Iheel + twall = 1800 mm Thickness of base t_{base} = **500** mm Depth of downstand d_{ds} = **0** mm l_{ds} = **600** mm Position of downstand Thickness of downstand t_{ds} = **500** mm Height of retaining wall $h_{wall} = h_{stem} + t_{base} + d_{ds} = 3000 \text{ mm}$ $d_{cover} = 0 mm$ Depth of cover in front of wall d_{exc} = **200** mm Depth of unplanned excavation Height of ground water behind wall h_{water} = 2000 mm Height of saturated fill above base h_{sat} = max(h_{water} - t_{base} - d_{ds}, 0 mm) = **1500** mm Density of wall construction γ_{wall} = 23.6 kN/m³ Density of base construction γ_{base} = 23.6 kN/m³ Angle of rear face of wall α = **90.0** deg Angle of soil surface behind wall $\beta = 0.0 \text{ deg}$ $h_{\text{eff}} = h_{\text{wall}} + I_{\text{heel}} \times \tan(\beta) = 3000 \text{ mm}$ Effective height at virtual back of wall **Retained material details** M = 1.5 Mobilisation factor Moist density of retained material γm = 18.0 kN/m³

Tekla Tedds	Project	253 Goldh	urst Terrace		Job no. 2	4078
ads consultancy	Calcs for				Start page no./I	
130 East Barnet Road EN4 8RE - New Barnet		ning Wall RW3 -				2
	Calcs by SN	Calcs date 12/12/2024	Checked by	Checked date	Approved by	Approved
Saturated density of retained n	naterial	γ _s = 21.0 k	N/m ³			
Design shear strength		φ' = 29.3 d	eg			
Angle of wall friction		δ = 18.6 de	eg			
Base material details						
Firm clay						
Moist density		γ _{mb} = 18.0	kN/m³			
Design shear strength		φ' _b = 24.2 α	deg			
Design base friction		δ _b = 18.6 d	0			
Allowable bearing pressure		P _{bearing} = 10	00 kN/m²			
Using Coulomb theory						
Active pressure coefficient for			1			
	., ,	$^{2} \times \sin(\alpha - \delta) \times [1 - \delta]$	+ √(sin(φ' + δ) >	< sin(φ' - β) / (sin($(\alpha - \delta) \times \sin(\alpha + \delta)$	· β)))]²) = 0
Passive pressure coefficient fo					(11) / (-: (00)	s))) 1 2) - 4
	K _p = sin	(90 - ¢'₅)² / (sin(90	J - δ _b) × [1 - √(s	$\sin(\phi_{\rm b} + \delta_{\rm b}) \times \sin(\phi_{\rm b})$	(φ [·] ь) / (sin(90 +	δ _b)))] ²) = 4
At-rest pressure		., , ,	(.). .			
At-rest pressure for retained m	aterial	$K_0 = 1 - si$	n(փ') = 0.511			
Loading details						
Surcharge load on plan		-	= 10.0 kN/m ²			
Applied vertical dead load on v		W _{dead} = 12				
Applied vertical live load on wa		W _{live} = 4.0				
Position of applied vertical load Applied horizontal dead load o		l _{load} = 900 ı F _{dead} = 0.0				
Applied horizontal live load on		F _{live} = 0.0 k				
Height of applied horizontal loa		$h_{load} = 0 m$				
0 11		16				
		↓ [[]]]]]]	10			
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					ł	
	888888888					
A	Prop					
				9 5.2 6.5 19.6		
21.4	99.0		2.9	9 5.2 6.5 19.6		
				Loads sho	wn in kN/m, pressu	res shown in
				Loads sho	wn in kN/m, pressu	ires s

Tekla. Tedds	Project	253 Goldh	urst Terrace		Job no. 2	4078			
ads consultancy 130 East Barnet Road	Calcs for Reta	ining Wall RW3 -	Permanent (P	reliminary)	Start page no./ł	Revision 3			
EN4 8RE - New Barnet	Calcs by SN	Calcs date 12/12/2024	Checked by	Checked date	Approved by	Approved dat			
Vertical forces on wall									
Wall stem		w _{wall} = h _{stem}	$x \times t_{wall} \times \gamma_{wall} =$	17.7 kN/m					
Wall base	w _{base} = I _{base}	$w_{base} = I_{base} \times t_{base} \times \gamma_{base} = 21.2 \text{ kN/m}$							
Surcharge	w_{sur} = Surcharge × I _{heel} = 7.5 kN/m								
Moist backfill to top of wall		$w_{m_w} = I_{heel} \times (h_{stem} - h_{sat}) \times \gamma_m = 13.5 \text{ kN/m}$							
Saturated backfill		$w_s = I_{heel} \times h_{sat} \times \gamma_s = 23.6 \text{ kN/m}$							
Applied vertical load		$W_v = W_{dead} + W_{live} = 16 \text{ kN/m}$							
Total vertical load		W _{total} = w _{wa}	II + Wbase + Wsu	$w_{ase} + w_{sur} + w_{m_w} + w_s + W_v = 99.6 \text{ kN/m}$					
Horizontal forces on wall									
Surcharge		F_{sur} = $K_a \times$	cos(90 - α + δ) × Surcharge × ł	n _{eff} = 8.7 kN/m				
Moist backfill above water table		F _{m_a} = 0.5	$F_{m_a} = 0.5 \times K_a \times cos(90 - \alpha + \delta) \times \gamma_m \times (h_{eff} - h_{water})^2 = 2.6 \text{ kN/m}$						
Moist backfill below water table		$F_{m_b} = K_a \times$	$F_{m_b} = K_a \times cos(90 - \alpha + \delta) \times \gamma_m \times (h_{eff} - h_{water}) \times h_{water} = 10.4 \text{ kN/m}$						
Saturated backfill	$F_s = 0.5 \times I$	$F_s = 0.5 \times K_a \times cos(90 - \alpha + \delta) \times (\gamma_{s} - \gamma_{water}) \times h_{water}^2 = 6.5 \text{ kN/m}$							
Water	ater			F_{water} = 0.5 × h_{water}^2 × γ_{water} = 19.6 kN/m					
Total horizontal load		$F_{total} = F_{sur}$	$F_{total} = F_{sur} + F_{m_a} + F_{m_b} + F_s + F_{water} = 47.9 \text{ kN/m}$						
Calculate propping force									
Passive resistance of soil in fror	nt of wall	$F_p = 0.5 \times I$	$F_p = 0.5 \times K_p \times cos(\delta_b) \times (d_{cover} + t_{base} + d_{ds} - d_{exc})^2 \times \gamma_{mb} = 3.2 \text{ kN/m}$						

F_{prop} = 15.0 kN/m

Passive resistance of soil in front of wall Propping force

Overturning moments

Surcharge Moist backfill above water table Moist backfill below water table Saturated backfill Water Total overturning moment

Restoring moments

Wall stem Wall base Moist backfill Saturated backfill Design vertical dead load Total restoring moment

Check bearing pressure Surcharge Design vertical live load Total moment for bearing Total vertical reaction

Distance to reaction Eccentricity of reaction

Bearing pressure at toe Bearing pressure at heel
$$\begin{split} M_{ot} &= M_{sur} + M_{m_a} + M_{m_b} + M_s + M_{water} = \textbf{47 kNm/m} \\ M_{wall} &= w_{wall} \times (I_{toe} + t_{wall} / 2) = \textbf{15.9 kNm/m} \\ M_{base} &= w_{base} \times I_{base} / 2 = \textbf{19.1 kNm/m} \\ M_{m_r} &= (w_{m_w} \times (I_{base} - I_{heel} / 2) + w_{m_s} \times (I_{base} - I_{heel} / 3)) = \textbf{19.2 kNm/m} \\ M_{s_r} &= w_s \times (I_{base} - I_{heel} / 2) = \textbf{33.7 kNm/m} \\ M_{dead} &= W_{dead} \times I_{load} = \textbf{10.8 kNm/m} \end{split}$$

 $F_{prop} = max(F_{total} - F_p - (W_{total} - w_{sur} - W_{live}) \times tan(\delta_b), 0 \text{ kN/m})$

 $M_{m a} = F_{m a} \times (h_{eff} + 2 \times h_{water} - 3 \times d_{ds}) / 3 = 6.1 \text{ kNm/m}$

 $M_{sur} = F_{sur} \times (h_{eff} - 2 \times d_{ds}) / 2 = 13.1 \text{ kNm/m}$

 $M_s = F_s \times (h_{water} - 3 \times d_{ds}) / 3 = 4.3 \text{ kNm/m}$

 $M_{m_b} = F_{m_b} \times (h_{water} - 2 \times d_{ds}) / 2 = 10.4 \text{ kNm/m}$

 $M_{water} = F_{water} \times (h_{water} - 3 \times d_{ds}) / 3 = 13.1 \text{ kNm/m}$

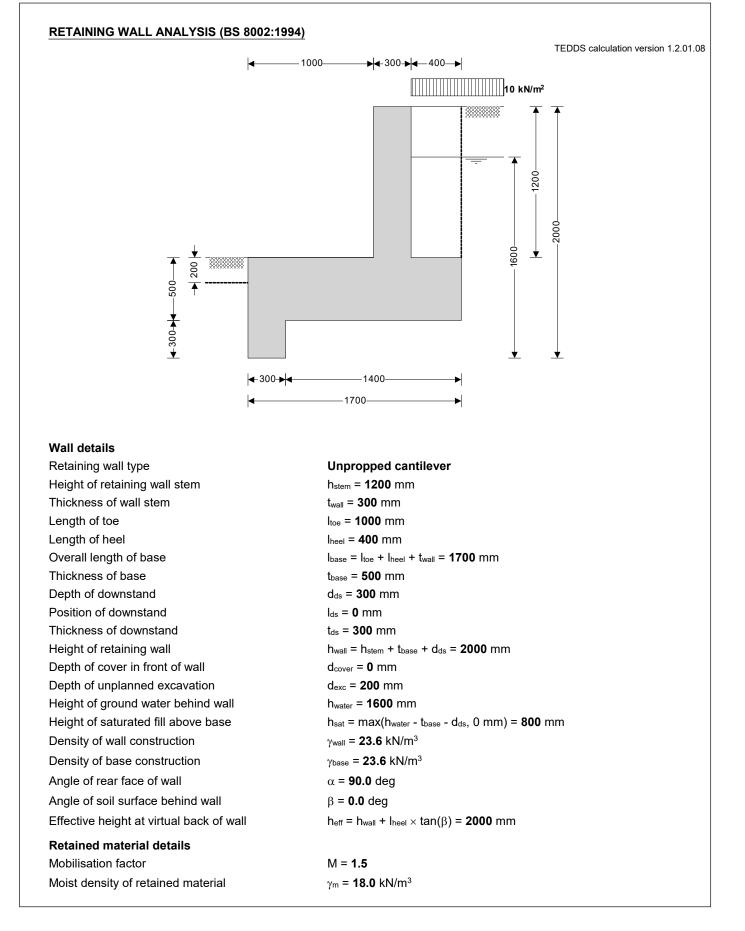
M_{rest} = M_{wall} + M_{base} + M_m r + M_s r + M_{dead} = **98.7** kNm/m

$$\begin{split} M_{sur_r} &= w_{sur} \times (I_{base} - I_{heel} \mid 2) = \textbf{10.7 kNm/m} \\ M_{live} &= W_{live} \times I_{load} = \textbf{3.6 kNm/m} \\ M_{total} &= M_{rest} - M_{ot} + M_{sur_r} + M_{live} = \textbf{66 kNm/m} \\ R &= W_{total} = \textbf{99.6 kN/m} \\ x_{bar} &= M_{total} \mid R = \textbf{663 mm} \\ e &= abs((I_{base} \mid 2) - x_{bar}) = \textbf{237 mm} \\ \hline \textbf{Reaction acts within middle third of base} \\ p_{toe} &= (R \mid I_{base}) + (6 \times R \times e \mid I_{base}^2) = \textbf{99 kN/m}^2 \\ p_{heel} &= (R \mid I_{base}) - (6 \times R \times e \mid I_{base}^2) = \textbf{11.7 kN/m}^2 \end{split}$$

PASS - Maximum bearing pressure is less than allowable bearing pressure

Tekla. Tedds	Project	Job no. 24078				
ads consultancy 130 East Barnet Road EN4 8RE - New Barnet	Calcs for Retainii	ng Wall RW3 - F	Start page no./Re	evision 4		
EIN4 ORE - New Barnet	Calcs by SN	Calcs date 12/12/2024	Checked by	Checked date	Approved by	Approved date

Tekla. Tedds	Project	Project J 253 Goldhurst Terrace				078
ads consultancy 130 East Barnet Road EN4 8RE - New Barnet	Calcs for F	Retaining Wall R	Start page no./Re	evision 1		
	Calcs by SN	Calcs date 13/12/2024	Checked by	Checked date	Approved by	Approved date



ecta ledas	roject	253 Goldh	urst Terrace		Job no. 2	4078
130 East Barnet Road	Calcs for Start page Retaining Wall RW4 - Preliminary					Revision 2
EN4 8RE - New Barnet C	alcs by SN	Calcs date 13/12/2024	Checked by	Checked date	Approved by	Approved date
Saturated density of retained mate	erial	γ _s = 21.0 k	N/m ³			
Design shear strength		φ' = 29.3 d	eg			
Angle of wall friction		δ = 18.6 de	∋g			
Base material details						
Firm clay						
Moist density		γ _{mb} = 18.0				
Design shear strength		φ' _b = 24.2 c	leg			
Design base friction		δ _b = 18.6 d	0			
Allowable bearing pressure		P _{bearing} = 10)0 kN/m²			
Using Coulomb theory						
Active pressure coefficient for reta						
		$^{2} \times sin(\alpha - \delta) \times [1 - \delta]$	+ √(sin(φ' + δ) :	$\times \sin(\phi' - \beta) / (\sin \phi)$	$(\alpha - \delta) \times \sin(\alpha +$	$(\beta)))]^{2}) = 0.3$
Passive pressure coefficient for ba					/. . \ / /	a)))501
	K _p = sin	l(90 - φ'ь)² / (sin(90)- δ _Ϸ) × [1 - √($\sin(\phi_b + \delta_b) \times \sin(\phi_b + \delta_b)$	(ф'ь) / (sin(90 +	δ _b)))] ²) = 4.1
At-rest pressure						
At-rest pressure for retained mater	rial	$K_0 = 1 - si$	n(ø') = 0.511			
Loading details						
Surcharge load on plan		Surcharge	= 10.0 kN/m ²			
Applied vertical dead load on wall		W _{dead} = 0.0) kN/m			
Applied vertical live load on wall		W _{live} = 0.0				
Position of applied vertical load on		I _{load} = 0 mn				
Applied horizontal dead load on wa		F _{dead} = 0.0				
Applied horizontal live load on wal		F _{live} = 0.0 k				
Height of applied horizontal load o	n wali	h _{load} = 0 m	m			
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	888888					
				2.9 2.1		
42.9	29.4		2	2.9 2.1 2.7	5.2 15.7	
				Loads sho	wn in kN/m, pressu	res shown in kN
Vertical forces on wall					·	
Wall stem		w _{wall} = h _{ster}	$1 \times t_{wall} \times \gamma_{wall} =$	• 8.5 kN/m		

Tekla Tedds	Project	253 Goldh	urst Terrace		2	4078
ads consultancy 130 East Barnet Road	Calcs for	Retaining Wall I	Start page no./I	Revision 3		
EN4 8RE - New Barnet	Calcs by SN	Calcs date 13/12/2024	Checked by	Checked date	Approved by	Approved
Wall base		W _{base} = I _{base}	$h_{a} \times \mathbf{t}_{base} \times \gamma_{base}$	= 20.1 kN/m		
Wall downstand			$t_{ds} \times \gamma_{base} = 2.$			
Surcharge			harge × I _{heel} =			
Moist backfill to top of wall			-	× γ _m = 2.9 kN/m		
Saturated backfill			$h_{sat} \times \gamma_s = 6.7$			
Total vertical load			-	+ W_{sur} + W_{m_w} + v	v _s = 44.3 kN/m	
Horizontal forces on wall						
Surcharge		Fsur = Ka ×	cos(90 - α + δ) × Surcharge × ł	n _{eff} = 5.8 kN/m	
Moist backfill above water table				$-\alpha + \delta$) × γ_m × (h _e		i kN/m
Moist backfill below water table		—	•	δ) × γ_m × (h _{eff} - h _w	,	
Saturated backfill				$(\iota + \delta) \times (\gamma_{s} - \gamma_{water})$		
Water			•	er = 12.6 kN/m		
Total horizontal load				+ F _s + F _{water} = 26 .	3 kN/m	
Calculate stability against slid	lina					
Passive resistance of soil in fro		$F_{\rm p} = 0.5 \times 10^{-10}$	$K_n \times \cos(\delta_n) \times \delta_n$	(d _{cover} + t _{base} + d _d	s - dexc) ² × vmr =	= 12,9 kN/n
Resistance to sliding				tan(δ _b) = 26.4 kN	, .	
i constantos to situlity		ries – r p r		esistance force		n sliding f
Overturning moments						
Surcharge		M _{sur} = F _{sur}	\times (h _{eff} - 2 \times d _{ds}	s) / 2 = 4.1 kNm/r	n	
Moist backfill above water table		$M_{m_a} = F_{m_a}$	$_{a} \times (h_{eff} + 2 \times h)$	lwater - $3 \times d_{ds}$) / 3	= 0.6 kNm/m	
Moist backfill below water table		$M_{m_b} = F_{m_b}$	$_{\text{b}} imes$ (h _{water} - 2 $ imes$	d _{ds}) / 2 = 1.7 kNi	m/m	
Saturated backfill		$M_s = F_s \times ($	h_{water} - $3 imes d_{ds}$)	/ 3 = 1 kNm/m		
Water		M _{water} = F _{wa}	ater × (h _{water} - 3	× d _{ds}) / 3 = 2.9 kt	Nm/m	
Soil in front of wall		$M_{p_o} = F_p \times$	$[2 \times d_{ds}$ - t_{base}	- d _{cover} + d _{exc}] / 3	= 1.3 kNm/m	
Total overturning moment		$M_{ot} = M_{sur} + $	⊦ M _{m_a} + M _{m_b} ·	+ M _s + M _{water} + M	_{p_o} = 11.5 kNm	/m
Restoring moments						
Wall stem				2) = 9.8 kNm/m		
Wall base			$_{\rm se} imes I_{\rm base} / 2 = 1$			
Wall downstand			$(I_{ds} + t_{ds} / 2) =$			
Moist backfill				$/2) + W_{m_s} \times (I_{bas})$	_e - I _{heel} / 3)) = 4	.3 kNm/m
Saturated backfill			. ,	= 10.1 kNm/m		
Total restoring moment		$M_{rest} = M_{wal}$	I + M _{base} + M _{ds}	$+ M_{m_r} + M_{s_r} = 4$	1.5 kNm/m	
Check stability against overtu	Irning					
Total overturning moment		M _{ot} = 11.5				
Total restoring moment		M _{rest} = 41.5			_	_
		PASS	- Restoring m	noment is greate	er than overtu	rning mon
Check bearing pressure						
Surcharge				2) = 6 kNm/m		
Total moment for bearing			st - Mot + Msur_r	= 36 kNm/m		
Total vertical reaction			44.3 kN/m			
Distance to reaction			/ R = 814 mm	26 mm		
Eccentricity of reaction		e = abs((l _{ba}	_{ase} / 2) - x _{bar}) =	36 mm Reaction acts	within middle	a third of l
				Reaction acts	kN/m²	

Tekla. Tedds	Project	253 Goldhu	Job no. 24078			
ads consultancy 130 East Barnet Road	Calcs for F	Start page no./Revision 4				
EN4 8RE - New Barnet Calcs by SN	,	Calcs date 13/12/2024	Checked by	Checked date	Approved by	Approved date

Bearing pressure at heel

 p_{heel} = (R / I_{base}) - (6 × R × e / I_{base}^2) = 22.7 kN/m²

PASS - Maximum bearing pressure is less than allowable bearing pressure

Tekla Tedds	Project 253 Goldhurst Terrace			Job no. 24078	
ads consultancy 130 East Barnet Road EN4 8RE - New Barnet	Calcs for Retaining Wall RW5 - Preliminary			Start page no./Revision 1	
	Calcs by SN	Calcs date 13/12/2024	Checked by	Checked date	Approved by

TEDDS calculation version 1.2.01.08

RETAINING WALL ANALYSIS (BS 8002:1994)

Wall details

Retaining wall type Height of retaining wall stem Thickness of wall stem Length of toe Length of heel Overall length of base Thickness of base Depth of downstand Position of downstand Thickness of downstand Height of retaining wall Depth of cover in front of wall Depth of unplanned excavation Height of ground water behind wall Height of saturated fill above base Density of wall construction Density of base construction Angle of rear face of wall Angle of soil surface behind wall Effective height at virtual back of wall

Retained material details Mobilisation factor

Moist density of retained material

Cantilever propped at top h_{stem} = **1725** mm t_{wall} = **250** mm $I_{toe} = 0 \text{ mm}$ I_{heel} = **500** mm $I_{\text{base}} = I_{\text{toe}} + I_{\text{heel}} + t_{\text{wall}} = 750 \text{ mm}$ t_{base} = **300** mm $d_{ds} = 0 \text{ mm}$ I_{ds} = **200** mm t_{ds} = **300** mm $h_{wall} = h_{stem} + t_{base} + d_{ds} = 2025 \text{ mm}$ d_{cover} = **150** mm d_{exc} = **0** mm h_{water} = **1500** mm h_{sat} = max(h_{water} - t_{base} - d_{ds}, 0 mm) = **1200** mm γ_{wall} = 23.6 kN/m³ γ_{base} = 23.6 kN/m³ α = **90.0** deg β = **0.0** deg $h_{eff} = h_{wall} + I_{heel} \times tan(\beta) = 2025 \text{ mm}$

M = **1.5** γ_m = **18.0** kN/m³

Tekla Tedds	Project	253 Goldh	nurst Terrace		Job no.	4078
ads consultancy 130 East Barnet Road	Calcs for	Retaining Wall	RW5 - Prelimir	nary	Start page no./I	Revision 2
EN4 8RE - New Barnet	Calcs by SN	Calcs date 13/12/2024	Checked by	Checked date	Approved by	Approved date
Saturated density of retained m	aterial	γ _s = 21.0 k				
Design shear strength		∳' = 29.3 d	eg			
Angle of wall friction		δ = 22.8 de	eg			
Base material details						
Firm clay						
Moist density		γ _{mb} = 18.0	kN/m ³			
Design shear strength		φ' _b = 24.2 α	deg			
Design base friction		δ _b = 18.6 d	leg			
Allowable bearing pressure		P _{bearing} = 1	00 kN/m²			
Using Coulomb theory						
Active pressure coefficient for re	etained materia	al				
$K_a = sin(\alpha)$	+ $\phi')^2 / (\sin(\alpha)^2)$	$\times \sin(\alpha - \delta) \times [1 + \delta]$	+ √(sin(φ' + δ)⇒	< sin(φ' - β) / (sin(α - δ) × sin(α +	· β)))]²) = 0.304
Passive pressure coefficient for	base material					
	K _p = sin((90 - φ' _b)² / (sin(90	0 - δ _b) × [1 - √(s	$\sin(\phi_{\rm b} + \delta_{\rm b}) \times \sin(\phi_{\rm b})$	φ' _b) / (sin(90 +	δ _b)))] ²) = 4.187
At-rest pressure						
At-rest pressure for retained ma	aterial	K ₀ = 1 – si	n(ǫ') = 0.511			
Loading details						
Surcharge load on plan		Surcharge	= 10.0 kN/m ²			
Applied vertical dead load on w	all	W _{dead} = 0.0				
Applied vertical live load on wal		$W_{live} = 0.0$				
Position of applied vertical load		$I_{load} = 0 mn$				
Applied horizontal dead load on		F _{dead} = 0.0				
Applied horizontal live load on v		F _{live} = 0.0	⟨N/m			
Height of applied horizontal load	d on wall	h _{load} = 0 m				
			10			
	Prop —			l.		
				A		
				<u>A</u>		
	⊿ *****	-				
			目		١	
	32.1 87.	7	2.8	2.6 4.7 14.7		
				Loads show	vn in kN/m, pressu	res shown in kN/m ²
					••	

Tekla Tedds	Project				Job no.	-	
		253 Goldh	24	4078			
ads consultancy 130 East Barnet Road EN4 8RE - New Barnet	Calcs for		Start page no./Revision 3				
		Retaining Wall F					
	Calcs by SN	Calcs date 13/12/2024	Checked by	Checked date	Approved by	Approved date	
Vertical forces on wall							
Wall stem		w _{wall} = h _{stem}	$\times t_{wall} \times \gamma_{wall} =$	10.2 kN/m			
Wall base		w _{base} = I _{base}	$\times \; t_{\text{base}} \times \gamma_{\text{base}}$	$_{se} \times \gamma_{base}$ = 5.3 kN/m			
Surcharge		w _{sur} = Surcharge × I _{heel} = 5 kN/m					
Moist backfill to top of wall		$w_{m_w} = I_{heel}$	× (h _{stem} - h _{sat})	× γ _m = 4.7 kN/m			
Saturated backfill		$w_s = I_{heel} \times h_{sat} \times \gamma_s = 12.6 \text{ kN/m}$					
Total vertical load		$W_{total} = W_{wall} + W_{base} + W_{sur} + W_{m_w} + W_s = 37.8 \text{ kN/m}$					
Horizontal forces on wall							
Surcharge	Surcharge		F_{sur} = K _a × cos(90 - α + δ) × Surcharge × h _{eff} = 5.7 kN/m				
Moist backfill above water table		$F_{m_a} = 0.5 \times K_a \times cos(90 - \alpha + \delta) \times \gamma_m \times (h_{eff} - h_{water})^2 = 0.7 \text{ kN/m}$					

Moist backfill above water table Moist backfill below water table Saturated backfill Water Total horizontal load

Calculate propping force

Passive resistance of soil in front of wall Propping force

Overturning moments

Surcharge Moist backfill above water table Moist backfill below water table Saturated backfill Water Total overturning moment

Restoring moments

Wall stem Wall base Moist backfill Saturated backfill Total restoring moment

Check bearing pressure

Propping force Surcharge Total moment for bearing Total vertical reaction Distance to reaction Eccentricity of reaction

Bearing pressure at toe Bearing pressure at heel
$$\begin{split} F_{p} &= 0.5 \times K_{p} \times cos(\delta_{b}) \times (d_{cover} + t_{base} + d_{ds} - d_{exc})^{2} \times \gamma_{mb} = \textbf{7.2 kN/m} \\ F_{prop} &= max(F_{total} - F_{p} - (W_{total} - w_{sur}) \times tan(\delta_{b}), \ 0 \ kN/m) \\ F_{prop} &= \textbf{6.6 kN/m} \end{split}$$

 $F_{m b} = K_a \times cos(90 - \alpha + \delta) \times \gamma_m \times (h_{eff} - h_{water}) \times h_{water} = 4 \text{ kN/m}$

 $F_s = 0.5 \times K_a \times \cos(90 - \alpha + \delta) \times (\gamma_s - \gamma_{water}) \times h_{water}^2 = 3.5 \text{ kN/m}$

 $F_{water} = 0.5 \times h_{water}^2 \times \gamma_{water} = \textbf{11} \text{ kN/m}$

 $F_{total} = F_{sur} + F_{m a} + F_{m b} + F_{s} + F_{water} = 24.9 \text{ kN/m}$

$$\begin{split} M_{sur} &= F_{sur} \times (h_{eff} - 2 \times d_{ds}) / 2 = \textbf{5.7 kNm/m} \\ M_{m_a} &= F_{m_a} \times (h_{eff} + 2 \times h_{water} - 3 \times d_{ds}) / 3 = \textbf{1.2 kNm/m} \\ M_{m_b} &= F_{m_b} \times (h_{water} - 2 \times d_{ds}) / 2 = \textbf{3 kNm/m} \\ M_{s} &= F_{s} \times (h_{water} - 3 \times d_{ds}) / 3 = \textbf{1.8 kNm/m} \\ M_{water} &= F_{water} \times (h_{water} - 3 \times d_{ds}) / 3 = \textbf{5.5 kNm/m} \\ M_{ot} &= M_{sur} + M_{m_a} + M_{m_b} + M_{s} + M_{water} = \textbf{17.2 kNm/m} \end{split}$$

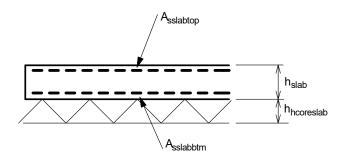
$$\begin{split} M_{wall} &= w_{wall} \times (I_{toe} + t_{wall} / 2) = \textbf{1.3 kNm/m} \\ M_{base} &= w_{base} \times I_{base} / 2 = \textbf{2 kNm/m} \\ M_{m_r} &= (w_{m_w} \times (I_{base} - I_{heel} / 2) + w_{m_s} \times (I_{base} - I_{heel} / 3)) = \textbf{2.4 kNm/m} \\ M_{s_r} &= w_s \times (I_{base} - I_{heel} / 2) = \textbf{6.3 kNm/m} \\ M_{rest} &= M_{wall} + M_{base} + M_{m_r} + M_{s_r} = \textbf{11.9 kNm/m} \end{split}$$

$$\begin{split} \mathsf{M}_{\text{prop}} &= \mathsf{F}_{\text{prop}} \times (\mathsf{h}_{\text{wall}} - \mathsf{d}_{\text{ds}}) = \textbf{13.4 kNm/m} \\ \mathsf{M}_{\text{sur}_r} &= \mathsf{w}_{\text{sur}} \times (\mathsf{I}_{\text{base}} - \mathsf{I}_{\text{heel}} / 2) = \textbf{2.5 kNm/m} \\ \mathsf{M}_{\text{total}} &= \mathsf{M}_{\text{rest}} - \mathsf{M}_{\text{ot}} + \mathsf{M}_{\text{prop}} + \mathsf{M}_{\text{sur}_r} = \textbf{10.7 kNm/m} \\ \mathsf{R} &= \mathsf{W}_{\text{total}} = \textbf{37.8 kN/m} \\ \mathsf{x}_{\text{bar}} &= \mathsf{M}_{\text{total}} / \mathsf{R} = \textbf{283 mm} \\ \mathsf{e} &= \mathsf{abs}((\mathsf{I}_{\text{base}} / 2) - \mathsf{x}_{\text{bar}}) = \textbf{92 mm} \\ \hline \textit{Reaction acts within middle third of base} \\ \mathsf{p}_{\text{toe}} &= (\mathsf{R} / \mathsf{I}_{\text{base}}) + (\mathsf{6} \times \mathsf{R} \times \mathsf{e} / \mathsf{I}_{\text{base}}^2) = \textbf{87.7 kN/m}^2 \\ \mathsf{p}_{\text{heel}} &= (\mathsf{R} / \mathsf{I}_{\text{base}}) - (\mathsf{6} \times \mathsf{R} \times \mathsf{e} / \mathsf{I}_{\text{base}}^2) = \textbf{13.2 kN/m}^2 \\ \hline \textit{PASS} - \textit{Maximum bearing pressure is less than allowable bearing pressure} \end{split}$$

ads	Project				Job no.		
consultancy		24078					
ads consultancy 130 East Barnet Road	Calcs for Gro	Calcs for Ground Bearing Basement Slab - Preliminary				Start page no./Revision 1	
New Barnet Herts - EN4 8RE	Calcs by SN	Calcs date 09/12/2024	Checked by	Checked date	Approved by	Approved date	

RAFT FOUNDATION DESIGN (BS8110 : PART 1 : 1997)

Tedds calculation version 1.0.13



Soil and raft definition

Soil definition	
Allowable bearing pressure	q _{allow} = 50.0 kN/m ²
Number of types of soil forming sub-soil	One type only
Soil density	Firm
Depth of hardcore beneath slab	$h_{hcorestab} = 0 \text{ mm}$ (Dispersal allowed for bearing pressure check)
Density of hardcore	γ _{hcore} = 20.0 kN/m ³
Basic assumed diameter of local depression	φ _{depbasic} = 1500 mm
Diameter under slab modified for hardcore	$\phi_{depslab} = \phi_{depbasic} - h_{hcoreslab} = 1500 \text{ mm}$
Raft slab definition	
Max dimension/max dimension between joints	I _{max} = 5.000 m
Slab thickness	h _{slab} = 200 mm
Concrete strength	f _{cu} = 40 N/mm ²
Poissons ratio of concrete	v = 0.2
Slab mesh reinforcement strength	f _{yslab} = 500 N/mm ²
Partial safety factor for steel reinforcement	$\gamma_s = 1.15$
From C&CA document 'Concrete ground floors' Ta	ble 5
Minimum mesh required in top for shrinkage	A142
Actual mesh provided in top	A393 (A _{sslabtop} = 393 mm ² /m)
Mesh provided in bottom	A393 (A _{sslabbtm} = 393 mm ² /m)
Top mesh bar diameter	$\phi_{slabtop} = 10 \text{ mm}$
Bottom mesh bar diameter	φ _{slabbtm} = 10 mm
Cover to top reinforcement	c _{top} = 35 mm
Cover to bottom reinforcement	c _{btm} = 50 mm
Average effective depth of top reinforcement	$d_{tslabav} = h_{slab} - c_{top} - \phi_{slabtop} = 155 \text{ mm}$
Average effective depth of bottom reinforcement	$d_{bslabav} = h_{slab} - c_{btm} - \phi_{slabbtm} = 140 \text{ mm}$
Overall average effective depth	d _{slabav} = (d _{tslabav} + d _{bslabav})/2 = 148 mm
Minimum effective depth of top reinforcement	$d_{tslabmin} = d_{tslabav} - \phi_{slabtop}/2 = 150 \text{ mm}$
Minimum effective depth of bottom reinforcement	$d_{bslabmin} = d_{bslabav} - \phi_{slabbtm}/2 = 135 \text{ mm}$
Slab edge reinforcement	
Mesh provided in top	A393 (A _{sedgetop} = 393 mm ² /m)
Mesh provided in bottom	A393 (A _{sedgebtm} = 393 mm²/m)

ads consultancy	253 Goldh	urst Terrace	Job no. 24078						
ads consultancy	Calcs for				Start page no./F	Revision			
130 East Barnet Road	Gro	und Bearing Base	ment Slab - Pr	eliminary		2			
New Barnet Herts - EN4 8RE	Calcs by SN	Calcs date 09/12/2024	Checked by	Checked date	Approved by	Approved date			
			1			_			
Internal slab design checks									
Basic loading									
Slab self weight		w _{slab} = 24 k	$N/m^3 \times h_{slab} = 4$	4.8 kN/m²					
Hardcore		$W_{hcoreslab} = \gamma$	$h_{hcore} imes h_{hcoreslab}$	= 0.0 kN/m ²					
Applied loading									
Uniformly distributed dead load		w _{Dudl} = 3.0	kN/m²						
Uniformly distributed live load		w _{Ludl} = 1.5	kN/m²						
Internal slab bearing pressure	check								
Total uniform load at formation lo	evel	$w_{udl} = w_{slab}$	+ W _{hcoreslab} + W[Dudl + WLudl = 9.3	kN/m²				
		$PASS - W_{udl} <$	= q _{allow} - Appli	ied bearing pres	ssure is less t	han allowab			
Internal slab bending and she	ar check								
Applied bending moments									
Span of slab		I _{slab} = φ _{depsla}	ıb + d _{tslabav} = 16	55 mm					
Ultimate self weight udl		w _{swult} = 1.4	× wslab = 6.7 kM	N/m²					
Self weight moment at centre		$M_{csw} = W_{swult} \times I_{slab}^2 \times (1 + v) / 64 = 0.3 \text{ kNm/m}$							
Self weight moment at edge		M_{esw} = $w_{swult} \times I_{slab}^2$ / 32 = 0.6 kNm/m							
Self weight shear force at edge		V _{sw} = w _{swult}	$V_{sw} = w_{swult} \times I_{slab} / 4 = 2.8 \text{ kN/m}$						
Moments due to applied unifo	rmly distribu	ted loads							
Ultimate applied udl			\times W _{Dudl} + 1.6 \times	w _{Ludl} = 6.6 kN/m	1 ²				
Moment at centre		$M_{cudl} = W_{udll}$	$_{\rm ult} \times {\rm I}_{\rm slab}^2 \times (1 +$	v) / 64 = 0.3 kNr	m/m				
Moment at edge		$M_{eudl} = W_{udlult} \times I_{slab}^2 / 32 = 0.6 \text{ kNm/m}$							
Shear force at edge		$V_{udl} = W_{udlult}$	t × I _{slab} / 4 = 2.7	kN/m					
Resultant moments and shear	s								
Total moment at edge	•	M _{Σe} = 1.1 k	Nm/m						
Total moment at centre		M _{Σc} = 0.7 k							
Total shear force		V _Σ = 5.5 kN/m							
Reinforcement required in top									
K factor		K _{slabtop} = M ₂	$\Sigma_{e}/(f_{cu} \times d_{tslabav}^2)$) = 0.001					
Lever arm		$z_{slabtop} = d_{tsl}$	_{labav} × min(0.95	5, 0.5 + √(0.25 - k	(_{slabtop} /0.9)) = 1	47.3 mm			
Area of steel required for bendin	g	Asslabtopbend	= M _{Σe} /((1.0/γ _s) :	$\times f_{yslab} \times z_{slabtop}) =$	18 mm²/m				
Minimum area of steel required		A _{sslabmin} = 0	$.0013 \times h_{slab} =$	260 mm²/m					
Area of steel required		Asslabtopreq = max(Asslabtopbend, Asslabmin) = 260 mm ² /m							
PASS - Asslabtopreg <= ,	Asslabtop - Area	a of reinforcemer	nt provided in	top to span loc	al depressior	ns is adequa			
Reinforcement required in bot	tom								
K factor		K _{slabbtm} = M	$_{\Sigma c}/(f_{cu} \times d_{bslabav}^2)$	²) = 0.001					
Lever arm		$z_{slabbtm} = d_{bs}$	$h_{btm} = d_{bslabav} \times min(0.95, 0.5 + \sqrt{(0.25 - K_{slabbtm}/0.9))} = 133.0 \text{ mm}$						
Area of steel required for bendin	g	Asslabbtmbend	= M _{Σc} /((1.0/γ _s)	$\times f_{yslab} \times z_{slabbtm}$)	= 12 mm²/m				
Area of steel required			•	_{end} , A _{sslabmin}) = 26					
PASS - Asslabbtmreq <= Asslab	btm - Area of	reinforcement pr	rovided in bot	tom to span loc	al depressior	ns is adequa			
Shear check									
Applied shear stress		$v = V_{\Sigma}/d_{tslab}$	_{min} = 0.037 N/n	nm²					
Tension steel ratio		ρ = 100 × A	A _{sslabtop} /d _{tslabmin} =	= 0.262					

consultancy	253 Goldh	253 Goldhurst Terrace			Job no. 24078	
	Calcs for				Start page no./F	Revision
130 East Barnet Road	Gro	und Bearing Base	ment Slab - Pi	eliminary		3
New Barnet C Herts - EN4 8RE	Calcs by SN	Calcs date 09/12/2024	Checked by	Checked date	Approved by	Approved of
From BS8110-1:1997 - Table 3.8						
Design concrete shear strength		v _c = 0.604				
			PASS - v <=	v _c - Shear capa	acity of the sla	ıb is adeqı
Internal slab deflection check						
Basic allowable span to depth rat	io	Ratio _{basic} =				
Moment factor			$c/d_{bslabav}^2 = 0.0$			
Steel service stress				nd/Asslabbtm = 10.0		_
Modification factor		MF _{slab} = mi MF _{slab} = 2. 0	-	(477N/mm² - f₅)/((120 × (0.9N/m	m ² + M _{factor}
Modified allowable span to depth	ratio	Ratio _{allow} =	$Ratio_{\text{basic}} \times MF$	slab = 52.000		
Actual span to depth ratio		Ratio _{actual} =	= I _{slab} / d _{bslabav} =	11.821		
		PASS - Rat	io _{actual} <= Rati	o _{allow} - Slab spa	n to depth rat	io is adequ
Slab edge design checks						
Basic loading						
Hardcore		$W_{hcoreslab} = $	$\gamma_{hcore} imes \mathbf{h}_{hcoreslab}$	= 0.0 kN/m ²		
Slab self weight			$(N/m^3 \times h_{slab} =$			
·	o oli	0.45				
Slab edge bearing pressure che Total uniform load at formation le			/D	_{slab} + W _{hcoreslab} = 9	$3 \text{ kN}/\text{m}^2$	
	VCI	PASS - Wudledge <				han allowa
				.		
Slab odgo bonding chock						
Slab edge bending check Considering a 1.0m width of slab						
Considering a 1.0m width of slab		հավ = 10.0				
Considering a 1.0m width of slab Divider for moments due to udl's		β _{udl} = 10.0				
Considering a 1.0m width of slab Divider for moments due to udl's Applied bending moments		,		650 mm		
Considering a 1.0m width of slab Divider for moments due to udl's Applied bending moments Span of slab		l _{edge} = φ _{deps}	$hab + d_{tslabmin} = 1$			
Considering a 1.0m width of slab Divider for moments due to udl's Applied bending moments Span of slab Ultimate self weight udl		l _{edge} = φ _{deps} W _{edgeult} = 1.	$4 \times w_{slab}$ = 6.7	kN/m²		
Considering a 1.0m width of slab Divider for moments due to udl's Applied bending moments Span of slab Ultimate self weight udl Self weight bending moment		l _{edge} = φ _{deps} W _{edgeult} = 1. M _{edgesw} = w	$4 \times w_{slab} = 6.7$ $v_{edgeult} \times l_{edge}^2/10$	kN/m²) = 1.8 kNm/m		
Considering a 1.0m width of slab Divider for moments due to udl's Applied bending moments Span of slab Ultimate self weight udl Self weight bending moment Self weight shear force		l _{edge} = φ _{deps} W _{edgeult} = 1. M _{edgesw} = w V _{edgesw} = w	$4 \times w_{slab}$ = 6.7	kN/m²) = 1.8 kNm/m		
Considering a 1.0m width of slab Divider for moments due to udl's Applied bending moments Span of slab Ultimate self weight udl Self weight bending moment Self weight shear force Moments due to applied uniform	mly distribu	l _{edge} = φ _{deps} W _{edgeult} = 1. M _{edgesw} = w V _{edgesw} = w	$4 \times w_{slab} = 6.7$ $v_{edgeult} \times l_{edge}^2/10$ $edgeult \times l_{edge}/2 =$	kN/m² 0 = 1.8 kNm/m = 5.5 kN/m		
Considering a 1.0m width of slab Divider for moments due to udl's Applied bending moments Span of slab Ultimate self weight udl Self weight bending moment Self weight shear force Moments due to applied uniform Ultimate udl	mly distribu	I _{edge} = φ _{deps} W _{edgeult} = 1. M _{edgesw} = w V _{edgesw} = w Ited loads W _{edgeudl} = w	4 × w _{slab} = 6.7 [/] edgeult × ledge ² /10 edgeult × ledge/2 = [/] udlult = 6.6 kN/r	kN/m ² D = 1.8 kNm/m = 5.5 kN/m n ²		
Considering a 1.0m width of slab Divider for moments due to udl's Applied bending moments Span of slab Ultimate self weight udl Self weight bending moment Self weight shear force Moments due to applied uniform Ultimate udl Bending moment	mly distribu	l _{edge} = φ _{deps} W _{edgeult} = 1. M _{edgesw} = w V _{edgesw} = w ited loads W _{edgeudl} = w M _{edgeudl} = w	$4 \times w_{slab} = 6.7$ $v_{edgeult} \times l_{edge}^2/10$ $edgeult \times l_{edge}/2 =$ $v_{udlult} = 6.6 \text{ kN/r}$ $v_{edgeudl} \times l_{edge}^2/\beta^2$	kN/m ² D = 1.8 kNm/m = 5.5 kN/m n ² 		
Considering a 1.0m width of slab Divider for moments due to udl's Applied bending moments Span of slab Ultimate self weight udl Self weight bending moment Self weight shear force Moments due to applied uniforn Ultimate udl Bending moment Shear force	-	l _{edge} = φ _{deps} W _{edgeult} = 1. M _{edgesw} = w V _{edgesw} = w ited loads W _{edgeudl} = w M _{edgeudl} = w	4 × w _{slab} = 6.7 [/] edgeult × ledge ² /10 edgeult × ledge/2 = [/] udlult = 6.6 kN/r	kN/m ² D = 1.8 kNm/m = 5.5 kN/m n ² 		
Considering a 1.0m width of slab Divider for moments due to udl's Applied bending moments Span of slab Ultimate self weight udl Self weight bending moment Self weight shear force Moments due to applied unifor Ultimate udl Bending moment Shear force Resultant moments and shears		I _{edge} = φ _{deps} W _{edgeult} = 1. M _{edgesw} = w V _{edgesw} = w ited loads W _{edgeudl} = w M _{edgeudl} = w V _{edgeudl} = w	$4 \times w_{slab} = 6.7$ 4 = 4 + 4 + 4 + 4 + 4 + 4 + 4 + 4 + 4 +	kN/m ² D = 1.8 kNm/m = 5.5 kN/m n ² 		
Considering a 1.0m width of slab Divider for moments due to udl's Applied bending moments Span of slab Ultimate self weight udl Self weight bending moment Self weight shear force Moments due to applied unifor Ultimate udl Bending moment Shear force Resultant moments and shears Total moment (hogging and sagg		$I_{edge} = \phi_{deps}$ $W_{edgeult} = 1.$ $M_{edgesw} = W$ $V_{edgesw} = W$ $Ited loads$ $W_{edgeudl} = W$ $M_{edgeudl} = W$ $V_{edgeudl} = W$ $W_{edgeudl} = W$	4 × w _{slab} = 6.7 [/] edgeult × ledge ² /10 edgeult × ledge/2 = [/] udlult = 6.6 kN/r [/] edgeudl × ledge ² /2 [/] edgeudl × ledge/2 = 6 kNm/m	kN/m ² D = 1.8 kNm/m = 5.5 kN/m n ² 		
Considering a 1.0m width of slab Divider for moments due to udl's Applied bending moments Span of slab Ultimate self weight udl Self weight bending moment Self weight shear force Moments due to applied unifor Ultimate udl Bending moment Shear force Resultant moments and shears Total moment (hogging and sagg Maximum shear force		I _{edge} = φ _{deps} W _{edgeult} = 1. M _{edgesw} = w V _{edgesw} = w ited loads W _{edgeudl} = w M _{edgeudl} = w V _{edgeudl} = w	4 × w _{slab} = 6.7 [/] edgeult × ledge ² /10 edgeult × ledge/2 = [/] udlult = 6.6 kN/r [/] edgeudl × ledge ² /2 [/] edgeudl × ledge/2 = 6 kNm/m	kN/m ² D = 1.8 kNm/m = 5.5 kN/m n ² 		
Considering a 1.0m width of slab Divider for moments due to udl's Applied bending moments Span of slab Ultimate self weight udl Self weight bending moment Self weight shear force Moments due to applied uniforn Ultimate udl Bending moment Shear force Resultant moments and shears Total moment (hogging and sagg Maximum shear force Reinforcement required in top		$I_{edge} = \phi_{deps}$ $W_{edgeult} = 1.$ $M_{edgesw} = W$ $V_{edgesw} = W$ $Medgeudl = W$ $M_{edgeudl} = W$ $V_{edgeudl} = W$ $V_{edgeudl} = W$ $V_{edgeudl} = W$ $V_{edgeudl} = 1$	4 × w _{slab} = 6.7 /edgeuit × ledge ² /10 edgeuit × ledge/2 = /udiuit = 6.6 kN/r /edgeudi × ledge ² /2 /edgeudi × ledge/2 = 6 kNm/m .0 kN/m	kN/m ² D = 1.8 kNm/m = 5.5 kN/m n ² hudi = 1.8 kNm/m = 5.4 kN/m		
Considering a 1.0m width of slab Divider for moments due to udl's Applied bending moments Span of slab Ultimate self weight udl Self weight bending moment Self weight shear force Moments due to applied unifor Ultimate udl Bending moment Shear force Resultant moments and shears Total moment (hogging and sagg Maximum shear force Reinforcement required in top K factor		$I_{edge} = \phi_{deps}$ $W_{edgeult} = 1.$ $M_{edgesw} = w$ $V_{edgesw} = w$ $M_{edgeudl} = w$ $M_{edgeudl} = w$ $V_{edgeudl} = w$ $M_{\Sigma edge} = 3.$ $V_{\Sigma edge} = 11$ $K_{edgetop} = M$	4 × w _{slab} = 6.7 /edgeuit × ledge ² /10 edgeuit × ledge/2 = /udluit = 6.6 kN/r /edgeudi × ledge ² /β /edgeudi × ledge/2 = 6 kNm/m .0 kN/m 1 _{Σedge} /(fcu × dtslat	kN/m ² D = 1.8 kNm/m = 5.5 kN/m n ² sudl = 1.8 kNm/m = 5.4 kN/m		
Considering a 1.0m width of slab Divider for moments due to udl's Applied bending moments Span of slab Ultimate self weight udl Self weight bending moment Self weight shear force Moments due to applied uniforn Ultimate udl Bending moment Shear force Resultant moments and shears Total moment (hogging and sagg Maximum shear force Reinforcement required in top K factor Lever arm	ing)	$I_{edge} = \phi_{deps}$ $W_{edgeult} = 1.$ $M_{edgesw} = W$ $V_{edgesw} = W$ $Medgeudl = W$ $M_{edgeudl} = W$ $V_{edgeudl} = W$ $M_{\Sigma edge} = 3.$ $V_{\Sigma edge} = 11$ $K_{edgetop} = M$ $Z_{edgetop} = dt$	4 × w _{slab} = 6.7 /edgeult × ledge ² /10 edgeult × ledge/2 = /udlutt = 6.6 kN/r /edgeudt × ledge ² /β /edgeudt × ledge/2 6 kNm/m .0 kN/m 1Σedge/(fcu × dtslat slabmin × min(0.5	kN/m ² D = 1.8 kNm/m = 5.5 kN/m n ² hudi = 1.8 kNm/m = 5.4 kN/m bmin ²) = 0.004 D5, 0.5 + √(0.25 -		
Considering a 1.0m width of slab Divider for moments due to udl's Applied bending moments Span of slab Ultimate self weight udl Self weight bending moment Self weight shear force Moments due to applied uniforn Ultimate udl Bending moment Shear force Resultant moments and shears Total moment (hogging and sagg Maximum shear force Reinforcement required in top K factor Lever arm Area of steel required for bending	ing)	$I_{edge} = \phi_{deps}$ $W_{edgeult} = 1.$ $M_{edgesw} = w$ $V_{edgesw} = w$ $Ited loads$ $W_{edgeudl} = w$ $M_{edgeudl} = w$ $V_{edgeudl} = w$ $V_{edgeudl} = w$ $V_{edgeudl} = 1.$ $K_{edgeudl} = 1.$	$4 \times w_{slab} = 6.7$ $k_{edgeult} \times k_{edge^2/10}$ $k_{edgeult} \times k_{edge^2/2} = 0$ $k_{udlult} = 6.6 \text{ kN/r}$ $k_{edgeudl} \times k_{edge^2/2}$ $k_{edgeudl} \times k_{edge^2/2}$ 6 kNm/m $k_{edgeudl} \times k_{edge^2/2}$ 6 kNm/m $k_{edge^2/(f_{cu} \times d_{tslal})$ $k_{slabmin} \times min(0.8)$ $= M_{\Sigma edge}/((1.0))$	kN/m ² D = 1.8 kNm/m = 5.5 kN/m n ² y _{udl} = 1.8 kNm/m = 5.4 kN/m pomin ²) = 0.004 pomin ²)	_{op}) = 59 mm²/m	
Considering a 1.0m width of slab Divider for moments due to udl's Applied bending moments Span of slab Ultimate self weight udl Self weight bending moment Self weight shear force Moments due to applied uniforn Ultimate udl Bending moment Shear force Resultant moments and shears Total moment (hogging and sagg Maximum shear force Reinforcement required in top K factor Lever arm Area of steel required for bending Area of steel required	ing)	$I_{edge} = \phi_{deps}$ $W_{edgeult} = 1.$ $M_{edgesw} = W$ $V_{edgesw} = W$ $Ited loads$ $Wedgeudl = W$ $M_{edgeudl} = W$ $V_{edgeudl} = W$ $M_{\Sigma edge} = 3.$ $V_{\Sigma edge} = 11$ $K_{edgetop} = M$ $Z_{edgetop} = dt$ $A_{sedgetopbend}$	$4 \times w_{slab} = 6.7$ $\frac{4}{4 \times w_{slab}} = 6.6 \text{ kN/r}$	kN/m^{2} p = 1.8 kNm/m s 5.5 kN/m m^{2} $s_{udl} = 1.8 kNm/m$ s 5.4 kN/m $p_{omin}^{2} = 0.004$ $p_{5}, 0.5 + \sqrt{0.25} - \frac{1}{3}$ $p_{s} > x f_{yslab} \times Z_{edgetc}$ $p_{oend}, A_{sslabmin} = 26$	_{op}) = 59 mm²/m 60 mm²/m	1
Considering a 1.0m width of slab Divider for moments due to udl's Applied bending moments Span of slab Ultimate self weight udl Self weight bending moment Self weight shear force Moments due to applied uniforn Ultimate udl Bending moment Shear force Resultant moments and shears Total moment (hogging and sagg Maximum shear force Reinforcement required in top K factor Lever arm Area of steel required for bending Area of steel required	ing) SS - Asedgetor	$I_{edge} = \phi_{deps}$ $W_{edgeult} = 1.$ $M_{edgesw} = w$ $V_{edgesw} = w$ $Ited loads$ $W_{edgeudl} = w$ $M_{edgeudl} = w$ $V_{edgeudl} = w$ $V_{edgeudl} = w$ $V_{edgeudl} = 1.$ $K_{edgeudl} = 1.$	$4 \times w_{slab} = 6.7$ $\frac{4}{4 \times w_{slab}} = 6.6 \text{ kN/r}$	kN/m^{2} p = 1.8 kNm/m s 5.5 kN/m m^{2} $s_{udl} = 1.8 kNm/m$ s 5.4 kN/m $p_{omin}^{2} = 0.004$ $p_{5}, 0.5 + \sqrt{0.25} - \frac{1}{3}$ $p_{s} > x f_{yslab} \times Z_{edgetc}$ $p_{oend}, A_{sslabmin} = 26$	_{op}) = 59 mm²/m 60 mm²/m	1
Considering a 1.0m width of slab Divider for moments due to udl's Applied bending moments Span of slab Ultimate self weight udl Self weight bending moment Self weight shear force Moments due to applied unifor Ultimate udl Bending moment Shear force Resultant moments and shears Total moment (hogging and sagg Maximum shear force Reinforcement required in top K factor Lever arm Area of steel required for bending Area of steel required PAS	ing) SS - Asedgetor	$I_{edge} = \phi_{deps}$ $W_{edgeult} = 1.$ $M_{edgesw} = W$ $V_{edgesw} = W$ $Medgeudl = W$ $M_{edgeudl} = W$ $V_{edgeudl} = W$ $M_{edgeudl} = W$ $M_{edgeudl$	$4 \times w_{slab} = 6.7$ $\frac{4}{4 \times w_{slab}} = 6.6$ $\frac{4}{4 \times w_{slab}} = 6.6$ $\frac{4}{4 \times w_{slab}} = 6.6$ $\frac{4}{4 \times w_{slab}} = 6.7$ $\frac{4}{4 \times w_{slab}} = 6.6$ $\frac{4}{4 \times w_{slab}} = 6.6$ $\frac{4}{4 \times w_{slab}} = 6.7$	kN/m ² D = 1.8 kNm/m = 5.5 kN/m n^2 $u_{udl} = 1.8 kNm/m$ = 5.4 kN/m p_{omin}^2) = 0.004 $p_{5}, 0.5 + \sqrt{0.25 - 100}$ p_{ys}) × fyslab × Zedgeto pend, Asslabmin) = 26 (cement provide)	_{op}) = 59 mm²/m 60 mm²/m	1
Considering a 1.0m width of slab Divider for moments due to udl's Applied bending moments Span of slab Ultimate self weight udl Self weight bending moment Self weight shear force Moments due to applied uniforn Ultimate udl Bending moment Shear force Resultant moments and shears Total moment (hogging and sagg Maximum shear force Reinforcement required in top K factor Lever arm Area of steel required for bending Area of steel required FAS Reinforcement required in botto K factor	ing) SS - Asedgetor	$I_{edge} = \phi_{deps}$ $W_{edgeult} = 1.$ $M_{edgesw} = W$ $V_{edgesw} = W$ $Medgeudl = W$ $M_{edgeudl} = W$ $V_{edgeudl} = W$ $V_{edgeudl} = W$ $M_{\Sigma edge} = 3.$ $V_{\Sigma edge} = 11$ $K_{edgetop} = M$ $Z_{edgetop} = dt$ $A_{sedgetopreq} = 0$ $Dreq <= A_{sedgetop} - A$ $K_{edgebtm} = N$	$4 \times w_{slab} = 6.7$ $4 \times w_{slab} = 6.6$ $4 \times w_{slab} = 6.7$ $4 \times w_{slab} = 6.6$ $4 \times w_{$	kN/m ² D = 1.8 kNm/m = 5.5 kN/m n ² hudl = 1.8 kNm/m = 5.4 kN/m Domin ²) = 0.004 D5, 0.5 + $\sqrt{(0.25 - 1)^{3/2}} \times 10^{-1}$ D5, 0.5 + $(0.25 $	_{op}) = 59 mm²/m 60 mm²/m ed in top of sla	nb is adequ
Considering a 1.0m width of slab Divider for moments due to udl's Applied bending moments Span of slab Ultimate self weight udl Self weight bending moment Self weight shear force Moments due to applied unifor Ultimate udl Bending moment Shear force Resultant moments and shears Total moment (hogging and sagg Maximum shear force Reinforcement required in top K factor Lever arm Area of steel required for bending Area of steel required for bending Area of steel required for bending	ing) SS - A _{sedgeto} , om	$I_{edge} = \phi_{deps}$ $W_{edgeult} = 1.$ $M_{edgesw} = W$ $V_{edgesw} = W$ $Medgeudl = W$ $M_{edgeudl} = W$ $V_{edgeudl} = W$ $V_{edgeudl} = W$ $M_{\Sigma edge} = 3.$ $V_{\Sigma edge} = 11$ $K_{edgetop} = M$ $Z_{edgetop} = dt$ $A_{sedgetophend}$ $A_{$	$4 \times w_{slab} = 6.7$ $\frac{4}{4} \times \frac{1}{4} = 6.7$ $\frac{1}{4} \times \frac{1}{4} = 6.7$ $\frac{1}{4} \times \frac{1}{4} = 6.6 \text{ kN/r}$ $\frac{1}{4} \times \frac$	kN/m ² D = 1.8 kNm/m = 5.5 kN/m n^2 $u_{udl} = 1.8 kNm/m$ = 5.4 kN/m p_{omin}^2) = 0.004 $p_{5}, 0.5 + \sqrt{0.25 - 100}$ p_{ys}) × fyslab × Zedgeto pend, Asslabmin) = 26 (cement provide)	_{op}) = 59 mm²/m 60 mm²/m ed in top of sla - K _{edgebtm} /0.9))	n b is adequ = 128 mm

ads	Project	253 Goldh	urst Terrace		Job no.	4078
consultancy	Calcs for	200 001011				
ads consultancy		und Bearing Base	ment Slab - Pr	eliminarv	Start page no./i	4
130 East Barnet Road New Barnet	Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved of
Herts - EN4 8RE	SN	09/12/2024			, pprovod by	, pprovou e
Area of steel required		Asedgebtmreq	= max(A _{sedgebtm}	ibend, A _{sslabmin}) = 2	60 mm²/m	
PAS	S - A _{sedgebtmreq} <	= A _{sedgebtm} - Area	of reinforcem	ent provided in	bottom of sla	nb is adequ
Applied shear stress		$v_{edge} = V_{\Sigma ed}$	_{lge} × 1.0m/(100	0 mm \times d _{tslabmin}) =	• 0.073 N/mm ²	
Tension steel ratio		ρ_{edge} = 100	$\times A_{sedgetop} \times 1.$	0m/(1000mm × 0	d _{tslabmin}) = 0.262	2
From BS8110-1:1997 - Table	3.8					
Design concrete shear streng	gth	v _{cedge} = 0.6				
		PASS - v	_{edge} <= V _{cedge} -	Shear capacity	of the slab is	not excee
Slab edge deflection check						
Basic allowable span to dept	h ratio	Ratiobasiced	_{je} = 26.0			
Moment factor		M _{factoredge} =	$M_{\Sigma edge}/d_{bslabmin}$	² = 0.199 N/mm ²		
Steel service stress				$tmbend/A_{sedgebtm} = $		
Modification factor		MF _{edge} =mir	n(2.0,0.55+[(47	′7N/mm²-f _{sedge})/(′	120×(0.9N/mm	² +M _{factoredge}
		MF _{edge} = 2.				
Modified allowable span to de	epth ratio			$_{\rm ge} \times {\sf MF}_{\sf edge} = 52.0$	000	
Actual span to depth ratio			_{ge} = l _{edge} / d _{tslabm}			
	F	PASS - Ratio _{actuale}	_{edge} <= Ratio _{allo}	owedge - Slab spa	n to depth rat	io is adequ
Corner design checks						
Basic loading						
-	nack					
Corner bearing pressure ch		W(M5	v + w	9 3 kNl/m ²	
-	on level			Vslab + Whcoreslab =		han allowa
Corner bearing pressure ch Total uniform load at formatic	on level	Wudlcorner = \ PASS - Wudlcorner <				han allowa
Corner bearing pressure ch Total uniform load at formatic Slab corner bending check	on level I	PASS - Wudlcorner <	≔ q _{allow} - Appl	ied bearing pres		han allowa
Corner bearing pressure ch Total uniform load at formatic Slab corner bending check Cantilever span of slab at cor	on level I	PASS - Wudlcorner <	≔ q _{allow} - Appl			han allowa
Corner bearing pressure ch Total uniform load at formatic Slab corner bending check Cantilever span of slab at cor Moment and shear due to s	on level // rner self weight	PASS - Wudlcorner <	≔ q _{allow} - Appl	ied bearing pres		han allowa
Corner bearing pressure ch Total uniform load at formatic Slab corner bending check Cantilever span of slab at cor Moment and shear due to s Considering triangular loading	on level mer self weight g	PASS - Wudlcorner < I _{corner} = φdep	≔ q allow - AppI _{slab} /√(2) + d _{tslaba}	ied bearing pre : _{av} /2 = 1138 mm	ssure is less t	han allowa
Corner bearing pressure ch Total uniform load at formatic Slab corner bending check Cantilever span of slab at cor Moment and shear due to s Considering triangular loading Maximum ultimate self weigh	on level mer self weight g	PASS - Wudicorner < Icorner = ¢dep Wswult = 1.4	≔ q_{allow} - Appl _{slab} /√(2) + d _{tslab} × Wslab × ∳depsla	ied bearing pres av/2 = 1138 mm ⊳/√(2) = 7.1 kN/m	ssure is less t	han allowa
Corner bearing pressure ch Total uniform load at formatic Slab corner bending check Cantilever span of slab at cor Moment and shear due to s Considering triangular loading	on level mer self weight g	PASS - Wudicorner < Icorner = φdep Wswult = 1.4 Mcornersw = γ	≔ q_{allow} - Appl slab/√(2) + dtslaba × Wslab × ∮depsla Nswult × Icorner ² /(6	ied bearing pres av/2 = 1138 mm b/ $\sqrt{(2)}$ = 7.1 kN/m $\delta \times \phi_{depslab}/\sqrt{(2)}$ =	ssure is less t 1 1.5 kNm/m	han allowa
Corner bearing pressure ch Total uniform load at formatic Slab corner bending check Cantilever span of slab at cor Moment and shear due to s Considering triangular loading Maximum ultimate self weigh	on level mer self weight g	PASS - Wudicorner < Icorner = φdep Wswult = 1.4 Mcornersw = γ	≔ q_{allow} - Appl slab/√(2) + dtslaba × Wslab × ∮depsla Nswult × Icorner ² /(6	ied bearing pres av/2 = 1138 mm ⊳/√(2) = 7.1 kN/m	ssure is less t 1 1.5 kNm/m	han allowa
Corner bearing pressure ch Total uniform load at formatic Slab corner bending check Cantilever span of slab at con Moment and shear due to s Considering triangular loading Maximum ultimate self weigh Self weight bending moment	on level rner s elf weight g t udl	PASS - Wudicorner < Icorner = φdep Wswult = 1.4 Mcornersw = γ	≔ q_{allow} - Appl slab/√(2) + dtslaba × Wslab × ∮depsla Nswult × Icorner ² /(6	ied bearing pres av/2 = 1138 mm b/ $\sqrt{(2)}$ = 7.1 kN/m $\delta \times \phi_{depslab}/\sqrt{(2)}$ =	ssure is less t 1 1.5 kNm/m	han allowa
Corner bearing pressure ch Total uniform load at formatic Slab corner bending check Cantilever span of slab at cor Moment and shear due to s Considering triangular loading Maximum ultimate self weigh Self weight bending moment Self weight shear force	on level rner s elf weight g t udl	PASS - Wudlcorner < Icorner = φdep Wswult = 1.4 Mcornersw = γ Vcornersw = γ	≔ q_{allow} - Appl slab/√(2) + dtslaba × Wslab × φdepsla Nswult × Icorner²/(€ Vswult × Icorner/(2	ied bearing pres av/2 = 1138 mm b/ $\sqrt{(2)}$ = 7.1 kN/m $\delta \times \phi_{depslab}/\sqrt{(2)}$ =	ssure is less t 1 1.5 kNm/m 3.8 kN/m	
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Corner bearing pressure ch Total uniform load at formatic Slab corner bending check Cantilever span of slab at cor Moment and shear due to s Considering triangular loading Maximum ultimate self weigh Self weight bending moment Self weight shear force Moment and shear due to u Maximum ultimate udl	on level rner s elf weight g t udl	PASS - Wudlcorner < Icorner = φdep Wswult = 1.4 Mcornersw = V Vcornersw = V Wcornerudl = (≔ q allow - Appl slab/√(2) + dtslabd × Wslab × ¢depsla Nswult × Icorner²/(6 Vswult × Icorner/(2 (1.4×WDudi)+(1. Wcornerudl × Icorner	ied bearing pres $_{av}/2 = 1138 \text{ mm}$ $_{b}/\sqrt{(2)} = 7.1 \text{ kN/m}$ $\delta \times \phi_{depslab}/\sqrt{(2)} = 3$ $\delta \times W_{Ludl}) \times \phi_{depslab}$	ss <i>ure is less t</i> 1.5 kNm/m 3.8 kN/m ⊳/√(2) = 7.0 kN)) = 1.4 kNm/m	/m
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Corner bearing pressure ch Total uniform load at formatic Slab corner bending check Cantilever span of slab at cor Moment and shear due to s Considering triangular loading Maximum ultimate self weigh Self weight bending moment Self weight shear force Moment and shear due to u Maximum ultimate udl Bending moment Shear force Resultant moments and sh	on level rner self weight g t udl	PASS - Wudlcorner $<$ $l_{corner} = \phi_{dep}$ $w_{swult} = 1.4$ $M_{cornersw} = w$ $V_{cornersw} = v$ $w_{cornerudl} = ($ $M_{cornerudl} = w$	≔ q_{allow} - Appl slab/√(2) + dtslaba × Wslab × φdepsla Vswult × Icorner²/(6 Vswult × Icorner/(2 (1.4×WDudI)+(1. WcornerudI × Icorner/ VcornerudI × Icorner/	ied bearing pres $a_{v}/2 = 1138 \text{ mm}$ $b/\sqrt{(2)} = 7.1 \text{ kN/m}$ $\delta \times \phi_{depslab}/\sqrt{(2)} = 3$ $\delta \times W_{Ludl}) \times \phi_{depslab}/\sqrt{(2)}$ $(2 \times \phi_{depslab}/\sqrt{(2)})$	ss <i>ure is less t</i> 1.5 kNm/m 3.8 kN/m ⊳/√(2) = 7.0 kN	/m
Corner bearing pressure ch Total uniform load at formatic Slab corner bending check Cantilever span of slab at cor Moment and shear due to s Considering triangular loading Maximum ultimate self weigh Self weight bending moment Self weight shear force Moment and shear due to u Maximum ultimate udl Bending moment Shear force Resultant moments and sh Total design moment	on level rner self weight g t udl	PASS - Wudicorner < Icorner = φdep Wswuit = 1.4 Mcornersw = V Vcornersw = V Wcornerudi = (Mcornerudi = V Vcornerudi = V MΣcorner = N	≔ q_{allow} - Appl slab/√(2) + dtslab × Wslab × ¢depsla Nswult × Icorner²/(€ Vswult × Icorner/(2 (1.4×WDudI)+(1. WcornerudI × Icorner VcornerudI × Icorner	ied bearing press av/2 = 1138 mm b/ $\sqrt{2}$ = 7.1 kN/m $\delta \times \phi_{depslab}/\sqrt{2}$ = 3 $\delta \times W_{Ludl}$ = 3 $2^{2}/(6 \times \phi_{depslab}/\sqrt{2})$ $\sqrt{2}$ = 3 $\sqrt{2}$ = 3	ss <i>ure is less t</i> 1.5 kNm/m 3.8 kN/m ⊳/√(2) = 7.0 kN	/m
Corner bearing pressure ch Total uniform load at formatic Slab corner bending check Cantilever span of slab at cor Moment and shear due to s Considering triangular loading Maximum ultimate self weigh Self weight bending moment Self weight shear force Moment and shear due to u Maximum ultimate udl Bending moment Shear force Resultant moments and sh Total design moment Total design shear force	on level	PASS - Wudlcorner < $l_{corner} = \phi_{dep}$ $w_{swult} = 1.4$ $M_{cornersw} = v$ $V_{cornersw} = v$ $w_{cornerudl} = ($ $M_{cornerudl} = v$ $V_{cornerudl} = v$ $M_{\Sigma corner} = N$ $V_{\Sigma corner} = V_{corner}$	≔ q_{allow} - Appl slab/√(2) + dtslaba × Wslab × φdepsla Vswult × Icorner²/(6 Vswult × Icorner/(2 (1.4×WDudI)+(1. WcornerudI × Icorner/ VcornerudI × Icorner/	ied bearing press av/2 = 1138 mm b/ $\sqrt{2}$ = 7.1 kN/m $\delta \times \phi_{depslab}/\sqrt{2}$ = 3 $\delta \times W_{Ludl}$ = 3 $2^{2}/(6 \times \phi_{depslab}/\sqrt{2})$ $\sqrt{2}$ = 3 $\sqrt{2}$ = 3	ss <i>ure is less t</i> 1.5 kNm/m 3.8 kN/m ⊳/√(2) = 7.0 kN	/m
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Corner bearing pressure ch Total uniform load at formatic Slab corner bending check Cantilever span of slab at cor Moment and shear due to s Considering triangular loading Maximum ultimate self weigh Self weight bending moment Self weight shear force Moment and shear due to u Maximum ultimate udl Bending moment Shear force Resultant moments and sh Total design moment Total design shear force Reinforcement required in the K factor	on level	$PASS - Wudlcorner <$ $l_{corner} = \phi_{dep}$ $w_{swult} = 1.4$ $M_{cornersw} = v$ $V_{cornersw} = v$ $w_{cornerudl} = v$ $V_{cornerudl} = v$ $M_{\Sigma corner} = N$ $V_{\Sigma corner} = V$ $V_{\Sigma corner} = V$	allow - Appl a a a b a b b a b b a b b b b b b c c c c c c c c	ied bearing pres av/2 = 1138 mm b/ $\sqrt{2}$ = 7.1 kN/m $\delta \times \phi_{depslab}/\sqrt{2}$ = 2.9 kNm/m $\sqrt{2} + \frac{2}{6} + \frac{2}{6} + \frac{2}{2} + \frac{2}{2$	ssure is less t 1.5 kNm/m 3.8 kN/m ⊳/√(2) = 7.0 kN)) = 1.4 kNm/m = 3.8 kN/m	/m
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Corner bearing pressure ch Total uniform load at formatic Slab corner bending check Cantilever span of slab at cor Moment and shear due to s Considering triangular loading Maximum ultimate self weigh Self weight bending moment Self weight shear force Moment and shear due to u Maximum ultimate udl Bending moment Shear force Resultant moments and sh Total design moment Total design shear force Reinforcement required in the K factor Lever arm Area of steel required for bear	ears top of slab at co	PASS - Wudlcorner < $ corner = \phi dep$ $w_{swult} = 1.4$ $M_{cornersw} = v$ $V_{cornersw} = v$ $w_{cornerudl} = ($ $M_{cornerudl} = v$ $V_{cornerudl} = v$ $w_{cornerudl} = v$ $w_{corner} = M_{\Sigma}$ $w_{corner} = M_{\Sigma}$ $w_{corner} = M_{\Sigma}$ $w_{corner} = m_{\Sigma}$ $w_{corner} = m_{\Sigma}$	≔ <i>qallow - Appl</i> slab/√(2) + dtslaba × Wslab × ¢depsla Vswult × lcorner²/(6 Vswult × lcorner/(2 (1.4×WDud1)+(1. %cornerud1 × lcorner/ Vcornerud1 × lcorner/ Ncornerud1 × lcorner/ lcornersw+ Mcorneruc corner/(fcu × dtslab abmin × min(0.95 = MΣcorner/((1.0/- ax(Ascornerbend, J	ied bearing press av/2 = 1138 mm b/ $\sqrt{2}$ = 7.1 kN/m $5 \times \phi_{depslab}/\sqrt{2}$ = 2 $6 \times W_{Ludl}$) $\times \phi_{depslab}/\sqrt{2}$ = 2 $6 \times W_{Ludl}$) $\times \phi_{depslab}/\sqrt{2}$ $\sqrt{2} \times \phi_{depslab}/\sqrt{2}$	ssure is less t 1.5 kNm/m 3.8 kN/m b/√(2) = 7.0 kN) = 1.4 kNm/m = 3.8 kN/m ≤ 3.8 kN/m ≤ 3.8 kN/m	/m 43 mm
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Corner bearing pressure ch Total uniform load at formatic Slab corner bending check Cantilever span of slab at cor Moment and shear due to s Considering triangular loading Maximum ultimate self weigh Self weight bending moment Self weight shear force Moment and shear due to u Maximum ultimate udl Bending moment Shear force Resultant moments and sh Total design moment Total design shear force Reinforcement required in the K factor Lever arm Area of steel required for bear	ears top of slab at co	PASS - Wudlcorner < $ corner = \phi dep $ $w_{swult} = 1.4$ $M_{cornersw} = w$ $V_{cornersw} = w$ $V_{cornerudl} = w$ $V_{cornerudl} = w$ $V_{cornerudl} = w$ $M_{\Sigma corner} = M_{\Sigma}$ $V_{\Sigma corner} = M_{\Sigma}$ $K_{corner} = M_{\Sigma}$ $Z_{corner} = d_{tsla}$ $A_{scornerbend} = m$ $A_{scorner} = m$ etop - Area of reiminents weather the statement of the statem	≔ <i>qallow - Appl</i> slab/√(2) + dtslaba × Wslab × ¢depsla Vswult × lcorner²/(6 Vswult × lcorner/(2 (1.4×WDud1)+(1. %cornerud1 × lcorner/ Vcornerud1 × lcorner/ Ncornerud1 × lcorner/ lcornersw+ Mcorneruc corner/(fcu × dtslab abmin × min(0.95 = MΣcorner/((1.0/- ax(Ascornerbend, J	ied bearing pres av/2 = 1138 mm b/ $\sqrt{2}$ = 7.1 kN/m $5 \times \phi_{depslab}/\sqrt{2}$ = $6 \times W_{Ludl}$) $\times \phi_{depslab}/\sqrt{2}$ = $6 \times W_{Ludl}$) $\times \phi_{depslab}/\sqrt{2}$ = $(2 \times \phi_{depslab}/\sqrt{2})$	ssure is less t 1.5 kNm/m 3.8 kN/m b/√(2) = 7.0 kN) = 1.4 kNm/m = 3.8 kN/m ≤ 3.8 kN/m ≤ 3.8 kN/m	/m 43 mm

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ads consultancy 130 East Barnet Road	Calcs for Gro	und Bearing Base	Start page no./I	Revision 5		
New Barnet Herts - EN4 8RE	Calcs by SN	Calcs date 09/12/2024	Checked by	Checked date	Approved by	Approved date
Design concrete shear strength V _{ccorner} = 0.604 N/mm ² Pass - V _{ccorner} <= V _{ccorner} - Shear capacity of the slab is not exceed						not over a de d
Slab corner deflection cho	eck	Pass - Vcori	ner <= Vccorner -	Shear capacity	of the slab is	not exceeded

Basic allowable span to depth ratio	Ratio _{basiccorner} = 7.0
<i>l</i> oment factor	$M_{factorcorner} = M_{\Sigma corner}/d_{tslabmin}^2 = 0.128 \text{ N/mm}^2$
Steel service stress	$f_{scorner}$ = 2/3 × f_{yslab} × $A_{scornerbend}/A_{sedgetop}$ = 39.369 N/mm ²
Iodification factor	MF _{corner} =min(2.0,0.55+[(477N/mm ² -f _{scorner})/(120×(0.9N/mm ² +M _{factorcorner}))])
	MF _{corner} = 2.000
Nodified allowable span to depth ratio	Ratio _{allowcorner} = Ratio _{basiccorner} × MF _{corner} = 14.000
Actual span to depth ratio	Ratio _{actualcorner} = I _{corner} / d _{tslabmin} = 7.588
	PASS - Ratio _{actualcorner} <= Ratio _{allowcorner} - Slab span to depth ratio is adequate