24-26 West Street
London
WC2H 9NA

Calculation Document

for

New opening in brickwork wall

15th April 2020

Project No. 99547

DCL Consulting Engineers Ltd
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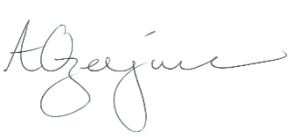
Contents

Revision History

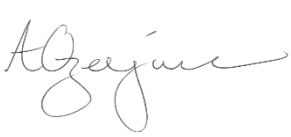
Rev.	Date	Status	Document Ref.	Comments
P1	15/04/20	Information	Calculation Document	Issued for Building Regulations

Prepared By:



Alex Ozegovic *MEng (Hons)*
Senior Engineer

Reviewed by:



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Senior Engineer

Approved by:

Frank Bates *BSc CEng MIStructE*
Managing Director

1 Introduction

This calculation document has been produced by DCL Consulting Engineers Ltd for the proposed opening in the brickwork wall between no. 24 and 26 West Street.

This document is for the exclusive use of the client and is not to be used in whole or part by any third party without the express written permission of DCL.

2 Standards and Design Guides

The following standards and design guides have been used in the production of the enclosed calculation document:

- BS 6399-1:1996 Loadings for buildings. Code of practice for dead and imposed loads.
- BS 6399-2:1997 Loadings for buildings. Code of practice for wind loads.
- BS 6399-3:1988 Loadings for buildings. Code of practice for imposed roof loads.
- BS 8110-1:1997 Structural use of concrete. Code of practice for design and construction.
- BS 5950-1:2000 Structural use of steelwork in building. Code of practice for design. Rolled and welded sections.
- BS 5268-2:2002 Structural use of timber. Code of practice for permissible stress design, materials and workmanship.
- BS 5628-1:2005 Code of practice for the use of masonry. Structural use of unreinforced masonry.
- BS 8004:1986 Code of practice for foundations.
- BS EN 1991-1-1:2002 Eurocode 1: Actions on structures. General actions. Densities, self-weight, imposed loads for buildings.
- BS EN 1992-1-1:2004 Eurocode 2: Design of concrete structures. General rules and rules for buildings.
- BS EN 1993-1-1:2005 Eurocode 3: Design of steel structures. General rules and rules for building.
- BS EN 1995-1-1:2004 Eurocode 5: Design of timber structures. Common rules and rules for buildings.
- BS EN 1996-1-1:2005 Eurocode 6: Design of masonry structures. General rules for reinforced and unreinforced masonry structures.
- BS EN 1997-1:2004 Eurocode 7: Geotechnical design. General rules.
- IStructE – Manual for the design of concrete building structures to Eurocode 2.
- IStructE – Manual for the design of steelwork building structures to Eurocode 3.
- IStructE – Manual for the design of timber building structures to Eurocode 5.
- IStructE – Manual for the design of plain masonry in building structures to Eurocode 6.
- IStructE – Manual for the geotechnical design of structures to Eurocode 7.

3 Existing Loadings

The following loadings have been considered for the design of the new development.

Existing Timber Floor

Timber chipboards and finishes		0.30 kN/m^2
Timber joists and insulation		0.20 kN/m^2
Ceiling and services		0.50 kN/m^2
	G_k	**1.00 KN/m^2**
Live load – Offices + partitions		3.50 kN/m^2
	Q_k	**3.50 KN/m^2**

Existing Solid Brick Wall

Varies in thickness. Density of brickwork		19.00 kN/m^3
	G_k	**19.00 kN/m^3**

4 Discussion

No site inspections have been undertaken prior to this calculation and drawings package completion.

All supporting structural calculations and proposals are to be verified on site to confirm assumptions. No works are to be carried out prior to site inspections by DCL.

The existing structure is known to be of load bearing masonry with steel beams supporting timber floors. There are arched masonry cellars beneath no. 24. The same construction is assumed in no. 26.

The party wall is presumed to be 440mm thick between basement and first floor. First floor to second floor is 330mm thick, whilst 2nd and 3rd floor are presumed to be 215mm thick. The footing is presumed to be a 1000mm wide masonry corbel.

The proposal is to create a new 3.2m wide opening at ground floor in the party wall between no.'s 24 and 26.

The existing and proposed load paths have been assessed.

The brickwork consists of London Stock bricks with a presumed characteristic strength of 5N/mm^2. The mortar is presumed to be designation III which gives a characteristic strength of 4N/mm^2. The design stress resistance for the brickwork has been calculated to be 0.63N/mm^2. The brickwork and mortar are to be inspected and assessed on site to ensure the brickwork can reasonably achieve this value.

The proposed loads are within acceptable limits and are subject to a site inspection.

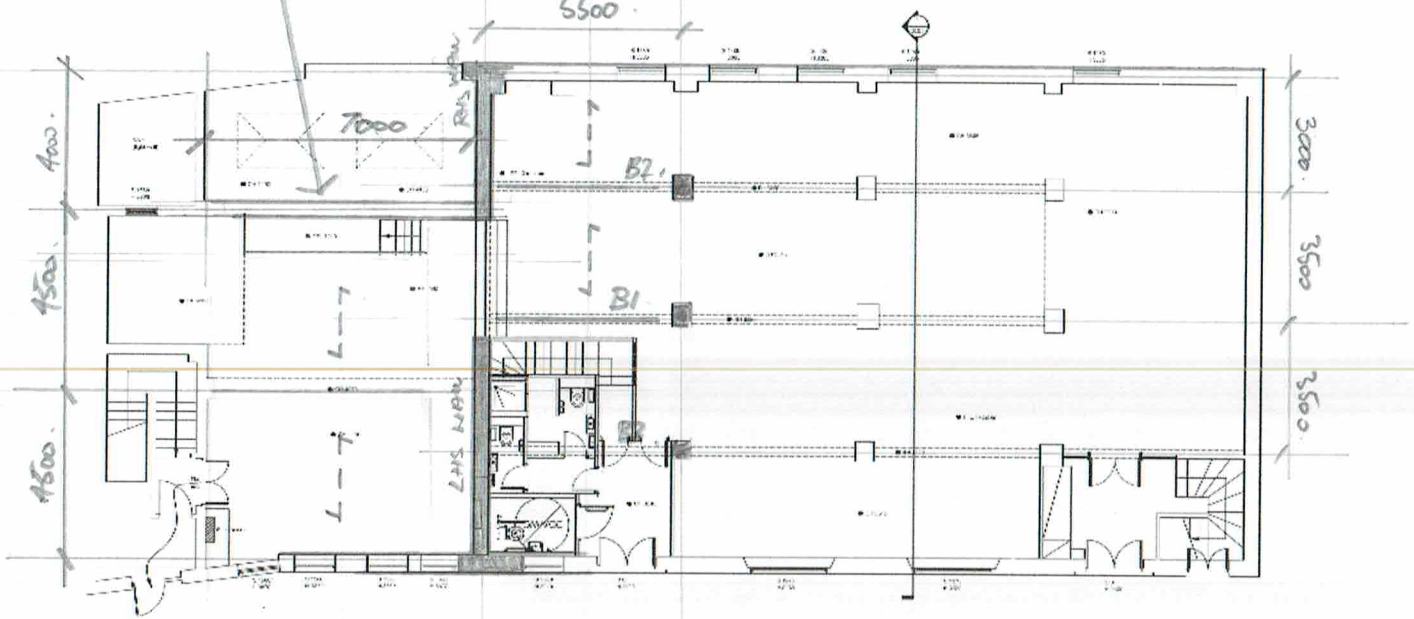
Nearby BGS records have been assessed and the bearing strata for the footings are presumed to be on Stiff London Clay of circa bearing capacity between 150kN/m^2 and 200kN/m^2. This is to be confirmed on site and approved by Building Control.

The proposed foundation loads are within acceptable limits subject to a site inspection and approval from Building Control.

The calculation document can be found from page 6 onwards.

6.

PRESUMED. TRANSFER BEAM CARRYING NO 26.
REAR ELEVATION.



1 GROUND FLOOR PLAN
1:50

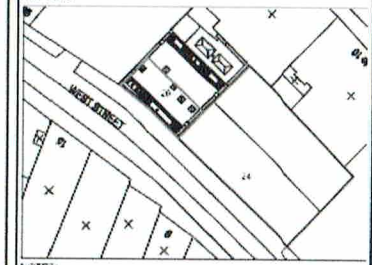
CLIENT

STRUCTURAL ENGINEER

SERVICES ENGINEER

CONSULTANT

KEY PLAN



NOTES

DO NOT SCALE FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING. CHECK DIMENSIONS ON SITE AND REPORT DISCREPANCIES TO THE ARCHITECT.

THIS DRAWING IS COPYRIGHTED BY OUR PRINTS

ALL AREAS HAVE BEEN MEASURED FROM CURRENT DRAWINGS. THEY MAY VARY DUE TO USE OF DIFFERENT SURVEY, DESIGN DEVELOPMENT, CONSTRUCTION TOLERANCES, STATUTORY REQUIREMENTS OR RE-DEFINITION OF THE AREAS TO BE MEASURED.

P1	24.02.22	FIRST ISSUE FOR INFORMATION	GP NKN
No.	Date	Comment	Chkd

Revisions

Issue Status
PRELIMINARY

tp bennett
architecture
interiors
planning

One America Street London 020 7208 0000 UK +44 (0) 20 7208 0000 www.tpbennett.com

Project
24-25 WEST STREET
REFURBISHMENT

Drawing Title
PROPOSED GENERAL LAYOUT

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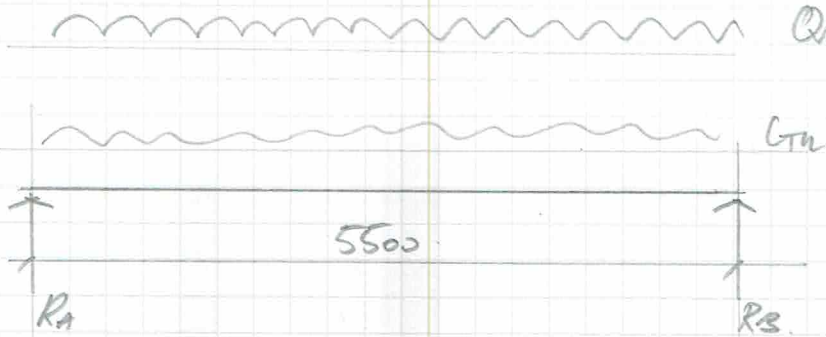
Sheet No. 7. Rev. P1

Calculation sheet

Project 24. West Street.

Project No. 99547.
Date 15.04.20.
Calculations by AO. Scale —.

EXT. B1.



Q_K = 12.25 kN/m.

G_K = 3.5 kN/m.
+ 0.5 kN/m
4 kN/m.

NOTE:

- LOADS NOT CHANGING ∴ NO CHECKS REQ'D FOR EXT. BEAM.
- INSPECTION ON SITE TO CHECK CONDITION ONLY WILL OCCUR.

SLS REACTIONS.

$R_A = R_B \rightarrow G_K$ = 11 kN.

Q_K = 34 kN.

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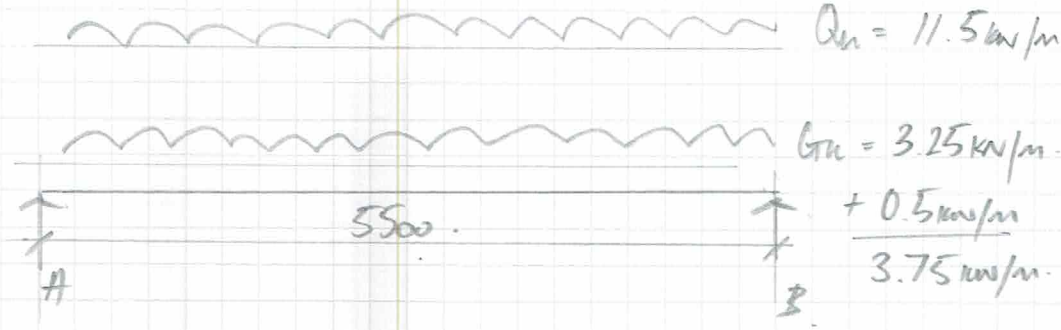
Sheet No. 8. Rev. P1.

Calculation sheet

Project 24. West Street.

Project No. 99547.
Date 15.04.20.
Calculations by TO. Scale —

Extr. B2.



NOTE:

- Same as Extr. B1 → to be checked on site.

SLS Reactions.

$R_A = R_B$ → G_{kn} = 10 kN.

Q_{kn} = 32 kN.

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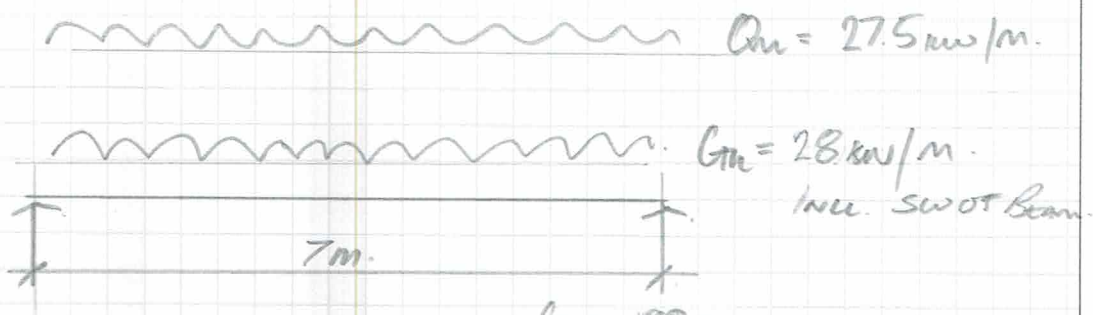
Calculation sheet

Project 24. WEST STREET

Project No. 9954
Date 15.04.20.
Calculations by AO Scale —.

No. 26 REAR ELEVATION LOAD PATH (TB).



Gk = 98kN.
Qk = 96kN.

	Gk	Qk.
• REAR WALL — Assumed 215mm thk (20% Reduction for openings).	20 kN/m.	
• FLOORS: 1st, 2ND 3RD — Assumed Timber Floors. (0.5kN/m²)	3.5 kN/m.	
• ROOF: Lightweight + Manholes. (Incl. Manholes Risk) — Assumed Timber Roof (0.75 kN/m²)	4 kN/m.	
• FLOOR LIVE LOAD. (3.5)		24kN/m.
• ROOF LIVE LOAD (0.75)		3.5kN/m.

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Calculation sheet

Project 24 WEST STREET

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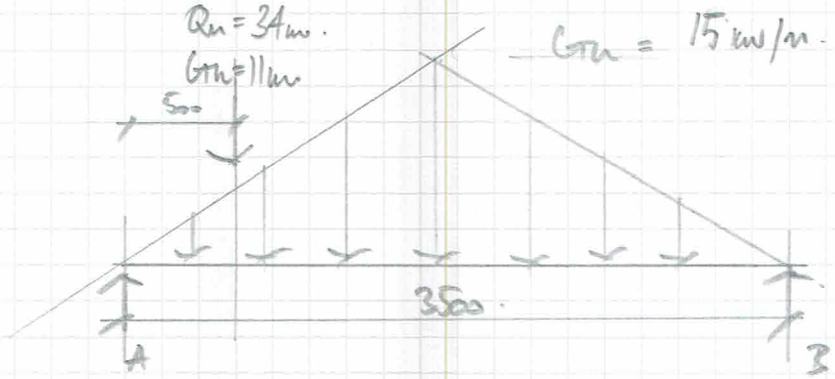
Date 15.04.20
Calculations by AO Scale —

LINTEL LOADING

ASSUMPTIONS

- SOLID BRICK WALL ABOVE. NO OPENINGS ABOVE IN LOAD TRIANGLE + ZONE OF INTERSECTION.
- FLOOR JOISTS RUN PARALLEL TO WALL.
- 45° ZONE - S.W OF WALL ONLY. / POINT LOAD OF 8 KN ADDED.
- 60° INTERSECTION ZONE - NO POINT LOADS OR UDL's IN ZONE.
- TRANSFER BEAM OUTSIDE OF ZONES.



SLS

R_A = G_k = 24kN. Q_k = 29kN

R_B = G_k = 16kN. Q_k = 5kN.

DESIGN ON F.O.S

USE 2NO. 203 UC 46 S275 JO

DCL Consulting Engineers Ltd	Project	24 West Street			Job no.	99547
	Calcs for	Lintel beam design			Start page no./Revision	1
	Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
	AO	15/04/2020	AO	15/04/2020	FB	15/04/2020

STEEL BEAM ANALYSIS & DESIGN (BS5950)

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

TEDDS calculation version 3.0.07

Support conditions

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

Analysis results

Maximum moment	M_{max} = **43.3** kNm	M_{min} = **0** kNm
Maximum shear	V_{max} = **80.4** kN	V_{min} = **-30.6** kN
Deflection	δ_{max} = **2** mm	δ_{min} = **0** mm
Maximum reaction at support A	R_{A_max} = **80.4** kN	R_{A_min} = **80.4** kN
Unfactored dead load reaction at support A	R_{A_Dead} = **24.1** kN	
Unfactored imposed load reaction at support A	$R_{A\_Imposed}$ = **29.1** kN	
Maximum reaction at support B	R_{B_max} = **30.6** kN	R_{B_min} = **30.6** kN
Unfactored dead load reaction at support B	R_{B_Dead} = **16.3** kN	
Unfactored imposed load reaction at support B	$R_{B\_Imposed}$ = **4.9** kN	

Section details

Section type **2 x UKC 203x203x46 (Tata Steel Advance)** Steel grade **S275**

Classification of cross sections - Section 3.5

Tensile strain coefficient ε = **1.00** Section classification **Compact**

Shear capacity - Section 4.2.3

Design shear force F_v = **80.4** kN Design shear resistance P_v = **482.8** kN

PASS - Design shear resistance exceeds design shear force

Moment capacity - Section 4.2.5

Design bending moment M = **43.3** kNm Moment capacity low shear M_c = **273.6** kNm

Buckling resistance moment - Section 4.3.6.4

Buckling resistance moment M_b = **207.7** kNm M_b / m_{LT} = **229.5** kNm

PASS - Buckling resistance moment exceeds design bending moment

Check vertical deflection - Section 2.5.2

Consider deflection due to dead and imposed loads

Limiting deflection δ_{lim} = **7** mm Maximum deflection δ = **2.007** mm

PASS - Maximum deflection does not exceed deflection limit

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Calculation sheet
Project 24 LEST STREET

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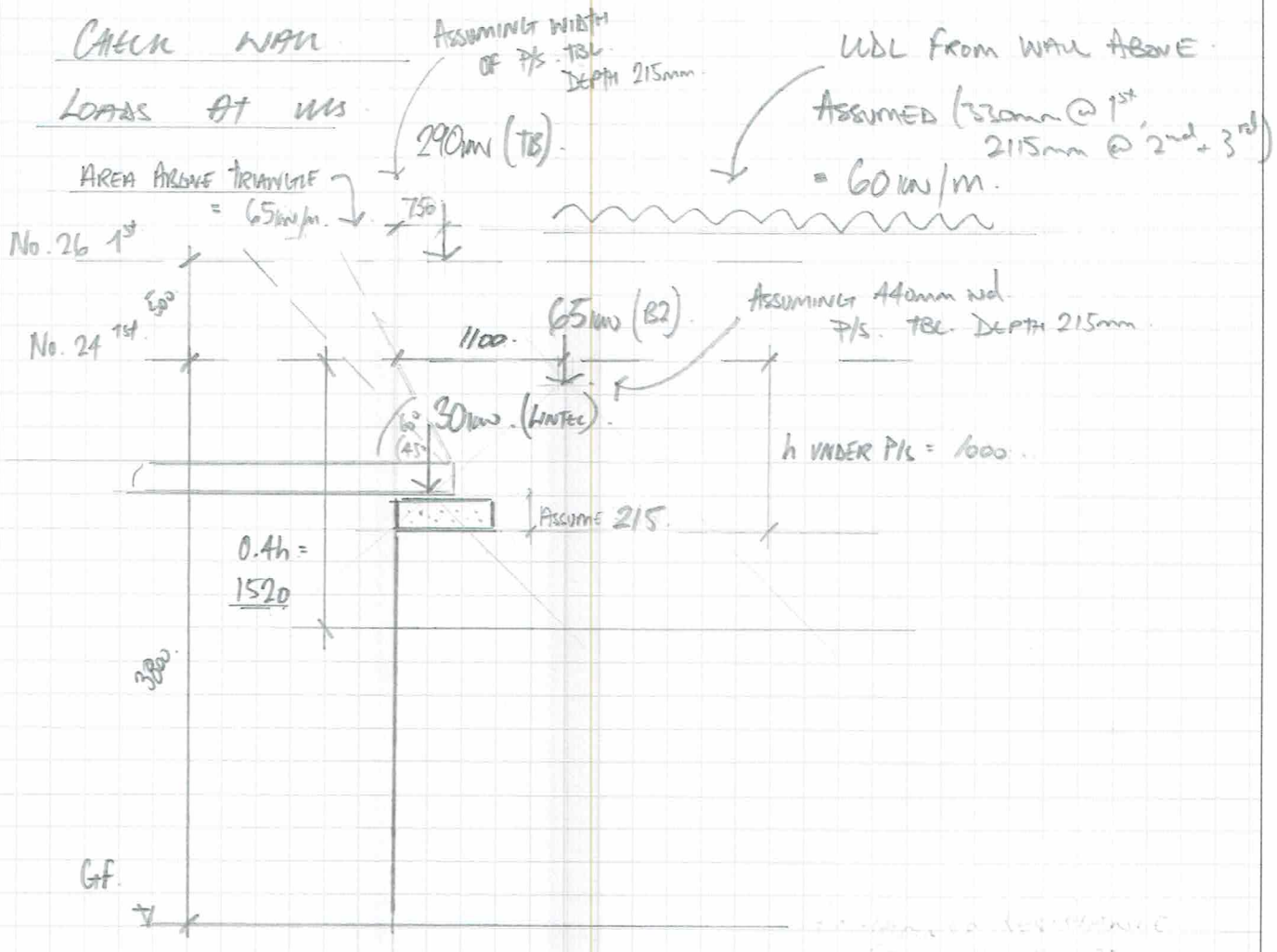
Calculations by AO	Scale —

CHECK WALL LOADS AT LLS



ASSUMPTIONS

- EFFECTIVE HEIGHT = 3800 × 1.0 = 3800.
- EFFECTIVE THICKNESS = 440. → S.R = $\frac{3800}{440}$ = 8.6 < 27 ∴ ok
- ECCENTRICITY BASED ON NET MOM ON WALL = 0.12t.

  BASED ON INCOMING BEAMS. BEARING 225mm

  NET e = $\frac{(290 \times 0.108) - (65 \times 0.108) \times 6^3}{290 + 60 + 65 + 30 + 110}$ = 44mm. → $\frac{44}{440}$ = 0.1 ∴ ok

β = 0.88. (INTERPOLATED FROM TABLE 14 ISTRUCTE MANUAL).

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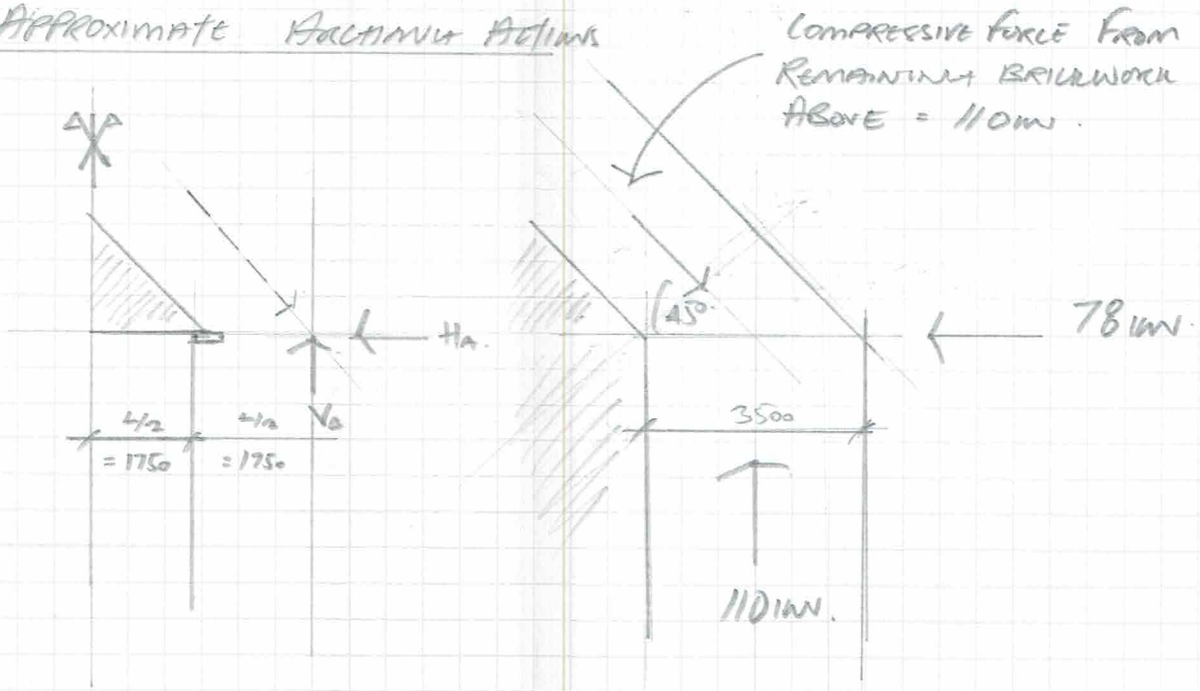
CHECK RAKESTONE.

ASSUMPTIONS ON BRICK.

- LONDON STOCKS - f_b UNIT = $5\ N/mm^2$.
- MORTAR DESIGNATION III - f_m = $4\ N/mm^2$.
- IN GOOD CONDITION SUBJECT TO SITE VISIT + INSPECTION.
- f_k = $2.5\ N/mm^2$.
- LOADS BEARING TYPE 3 $\therefore$ $f_d = \frac{2.5 \times 2.5}{3.5} = 1.43\ N/mm^2$.
- ARCHING EFFECT ABOVE LINTEL TO BE TAKEN INTO ACCOUNT ON P/S DESIGN.

APPROXIMATE ARCHING ACTIONS



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STRESS BENEATH P/S FROM ALL LOADS.

ADDITIONAL WALL BETWEEN 1ST + P/S.

$$\frac{290\times10^3}{440\times2050} + \frac{65\times10^3}{440\times1900} + \frac{60\times10^3}{440\times1000} + \frac{12\times10^3}{440\times1000} + \frac{110\times10^3}{440\times3500}$$

$$= 0.63\ N/mm^2$$

DESIGN STRESS RESISTANCE BELOW P/S = $1.43\ N/mm^2$

AVAILABLE REMAINING = $1.43 - 0.63 = 0.8\ N/mm^2$

PADSTONE LENGTH

$$L = \frac{30\times10^3}{440\times0.8} = 95\ mm$$

USE 440mm x 440mm x 215mm Lp.

C20/25 GRADE CONC. P/S

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Calculation sheet

Project 27 WEST STREET

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Calculations by AO Scale —

CHECK WALL FOR BUCKLING AT 0.4h FROM TOP.

DESIGN RESISTANCE = $\frac{0.88 \times 2.5}{3.5}$ = 0.63 N/mm².

DESIGN STRESS AT 0.4h.

ADDITIONAL WALL LOADS.

$\frac{290 \times 10^3}{440 \times 2550}$ + $\frac{65 \times 10^3}{440 \times 2400}$ + $\frac{60 \times 10^3}{440 \times 1000}$ + $\frac{18 \times 10^3}{440 \times 1000}$ + $\frac{140 \times 10^3}{440 \times 4000}$

+ $\frac{30 \times 10^3}{440 \times 1000}$ = 0.63 N/mm².

∴ BY INSPECTION ACCEPTABLE.

+ SUBJECT TO SITE INSPECTIONS + OPENING UP WORKS.

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Calculation sheet	
Project	24 WEST STREET

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CHECK LATERAL RESISTANCE OF WALL

ASSUMPTIONS

- PARTY WALL ACTS AS MAIN STRUCTURE FOR LATERAL STABILITY OF BOTH STRUCTURES IN NE-SE DIR.
- 2.5% OF ULS VERTICAL LOAD ACTING HORIZONTALLY.
- CIRCA 1900 kN ACTING VERTICALLY ABOVE PARTY WALL.
- HORIZONTAL = 1900 x 2.5% = 48 kN @ HIGH LEVEL GF.
- SPLIT FORCE INTO BOTH WALLS BASED ON STIFFNESS.

LHS WALL = 6.5 L , RHS WALL = 4.5 L

∴ LHS = 60% , RHS = 40%

∴ LHS = 29 kN , RHS = 19 kN.

SHEAR STRESS ABOVE WALL.

$LHS = 0.15 + 0.6 \times \frac{975 \times 10^3}{440 \times 6500} = \underline{0.35\ N/mm^2}$, $RHS = 0.15 + 0.6 \times \frac{925 \times 10^3}{440 \times 4500} = \underline{0.43\ N/mm^2}$

∴ WORST CASE SHEAR RESISTANCE = $\frac{0.25}{2.5} = \underline{0.14\ N/mm^2}$.

SHEAR STRESS = $\frac{29 \times 10^3}{440 \times 650} = 0.01\ N/mm^2$ ∴ BY INSPECTION SHEAR OK.

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Project 21 WEST STREET.

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CHECK FOOTINGS

ASSUMPTIONS

- 1m WIDE CORBEL FOOTING AT BASEMENT.
- LOADS AT SERVICE. FOR SIMPLE CASE + CONSERVATIVE. ULS LOAD DIVIDED BY 1.4.
- BASEMENT LOAD IS CIRCA 25 kN/m FOR BRICK WALL.
- BRICK WALLS SUPPORTING ARCHES + GROUND FLOOR SPANNING PERPENDICULAR TO WALL ∴ NO IMPACT.

EXISTING LOADS AT SLS.

POINT LOADS ON WALL = $\frac{395}{14}$ = 28 kN/m + 102 kN/m.

= 130 kN/m.

1m WIDE CORBEL ∴ 130 kN/m²

BGTS LOG STATES STIFF CLAY → ASSUMED 150 - 200 kN/m² A.B.P.
T.B.C ON SITE.

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Project 24 WEST STREET	

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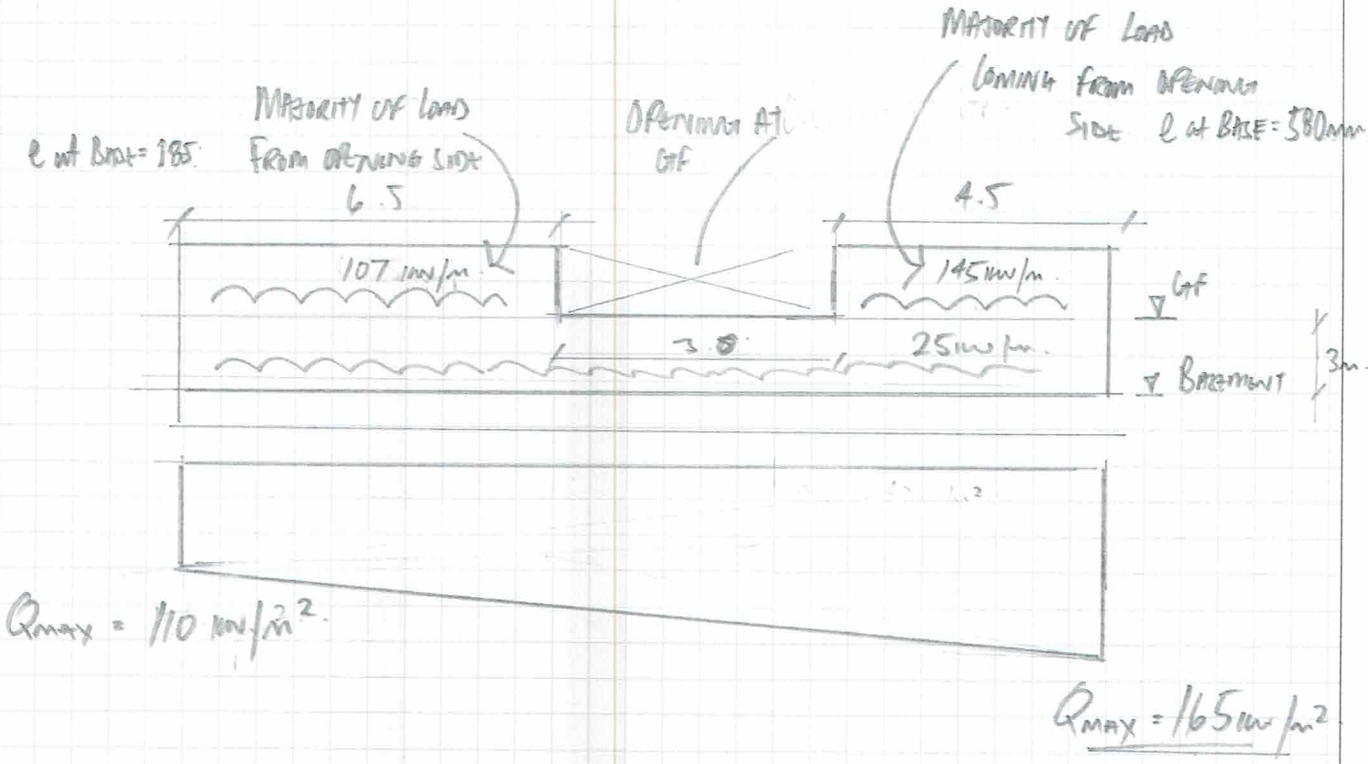
Calculations by AO	Scale —

PROPOSED LOADINGS AT FOOTINGS S23



$Q_{MAX} = 110\ kN/m^2$.

$Q_{MAX} = 165\ kN/m^2$.

BY INSPECTION FOUNDATION ON TBC ON SITE + BY BUILDING INSPECTOR.