CALCULATION REPORT

JACK STRAW'S CASTLE

UNDERPINNING CALCULATION

Project 8149 (rev. 2)

May 2023

Horwitz Associates is the trading style of Horwitz Associates Limited
135-137 New London Road, Chelmsford, Essex CM2 0QT
Tel: 01245 809510
rhh@rhorwitz.co.uk
www.rhorwitz.co.uk

Company Number: 10525469 (Registered in England and Wales), Registered Office Address: 57a broadway, Leigh-on-sea SS9 1PE

Address:	Project: 8149
Jack Straw's Castle – Camden	Engineer: RR

General and Safety Note:

Building Regulations Approval

Most structural alterations will require Building Control approval and must be examined by a Building Inspector prior to concealing or covering structural members. It is the client's and contractor's responsibility to ensure that applications and inspections have been carried out.

Party Wall Agreements

Structural alterations to a Party Wall, or excavations in the vicinity of a neighbour's property, will require the adjoining owner's consent under the Party Wall Act 1996. This will require a Party Wall Agreement to be made before commencement of the works. Advice may be obtained from the government Planning Portal www.planningportal.gov.uk or by contacting a Chartered Building Surveyor.

Temporary Support

Installation of beams, lintels or other supporting structures should be undertaken only with the provision of suitable temporary support to the structure above. Attention should be paid to the nature of the supported loads (from the calculations) and the capacity of props, shores and needle beams as appropriate. If in doubt about the requirements, contact the engineer before commencement of work.

Dimensions etc.

The dimensions given in these documents are for design purposes only and should be checked on site for construction. Beam sizes are given for identification of the section and the span dimension is between centrelines of supports (i.e. neither the length of the beam nor the opening width).

Copyright

Design Standards

EN 1990 Basis of Structural Design
EN 1991 Actions on Structures
EN 1992 Design of Concrete Structures
EN 1993 Design of Steel Structures
EN 1994 Design of Composite Steel & Concrete Structures
EN 1995 Design of Timber Structures
EN 1996 Design of Masonry Structures
EN 1997 Geotechnical Design
The Building Regulations

Address: Jack Straw's Castle – Camden	Project: 8149 Engineer: RR

CALCULATION REPORT			
Page	**Revision**	**Contents**	**Update**
0.1 to 0.3	2	Reference	May-23
L1 to L5	2	Loading	May-23
C1 to C9	2	Calculations	May-23
APPENDICES			
Page	**Revision**	**Contents**	**Update**

New and updated entries shown **BOLD**

PITCHED ROOF (slope)		γ [kN/m^3]	Load [kN/m^2]
	Red clay roof tiles		0.580
	Timber battens		0.200
4 mm	Felt	13.00	0.052
38 mm	Blockboard	5.00	0.190
	Trusses		0.350
	Ealing Joists		0.050
	Plasterboard (13mm), including skim coat		0.180
		Total [kN/m^2]:	1.60

TYPICAL UPPER FLOOR:		γ [kN/m^3]	Load [kN/m^2]
	Timber Partition		0.500
	Floor Finishes (carpet)		0.100
25 mm	Blockboard	5.00	0.125
25 mm	Pugging	18.00	0.450
	Floor joists		0.080
12 mm	Blockboard	5.00	0.060
	Services - residential		0.050
	Plasterboard (13mm), including skim coat		0.180
		Total [kN/m^2]:	1.55

GROUND FLOOR:		γ [kN/m^3]	Load [kN/m^2]
	Floor Finishes		0.500
50 mm	Sand and cement screed	22.00	1.100
175 mm	RC Slab	25.00	4.375
75 mm	Sand and cement screed	22.00	1.650
100 mm	Insulation board, styrofoam (PUR)	0.45	0.045
	Services - residential		0.050
	Plasterboard (13mm), including skim coat		0.180
		Total [kN/m^2]:	7.90

BASEMENT:		γ [kN/m^3]	Load [kN/m^2]
	Floor Finishes		0.500
50 mm	Sand and cement screed	22.00	1.100
	Waterproof membrane		0.050
75 mm	RC Slab	25.00	1.875
		Total [kN/m^2]:	3.53

IMPOSED LOADS:	γ [kN/m^3]	Load [kN/m^2]
Imposed load on roof with no access		0.750
	Total [kN/m^2]:	0.75

IMPOSED LOADS:	γ [kN/m^3]	Load [kN/m^2]
Imposed load for residential		1.500
	Total [kN/m^2]:	1.50

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Loads on Foundation

from Pitched Roof

s	=			2.08	m	(spacing)
q_{DL}	=	D.L.(PR) x s	=	4.91	kN/m	(linear loads)
q_{imp}	=	Imposed (PR) x s	=	1.04	kN/m	

from Second Floor

s	=			2.08	m	(spacing)
q_{DL}	=	D.L.(2F) x s	=	3.22	kN/m	(linear loads)
q_{imp}	=	Imposed (2F) x s	=	3.11	kN/m	

from First Floor

s	=			2.08	m	(spacing)
q_{DL}	=	D.L.(1F) x s	=	3.22	kN/m	(linear loads)
q_{imp}	=	Imposed (1F) x s	=	3.11	kN/m	

from Ground Floor

s	=			2.08	m	(spacing)
q_{DL}	=	D.L.(GF) x s	=	16.39	kN/m	(linear loads)
q_{imp}	=	Imposed (GF) x s	=	3.11	kN/m	

from External Wall (Type 1)

H_{EW1}	=			3.28	m	(wall height)
q_{EW1}	=	D.L.(EW1) x H_{SW1}	=	23.97	kN/m	(linear loads)

from External Wall (Type 2)

H_{EW2}	=			8.80	m	(wall height)
q_{EW2}	=	D.L.(EW2) x H_{SW2}	=	64.42	kN/m	(linear loads)

foundation selfweight

q_{DL}	=			7.68	kN/m	(800x400DP)

Total Loads	q_{DL-JSC}	=	123.81	kN/m
	$q_{IMP-JSC}$	=	10.38	kN/m

Note: cutting back the exsiting foundation toe we have an eccentricity on top of the underpinning equal to:

e = 0.096 m (see C1 and C2 pages)

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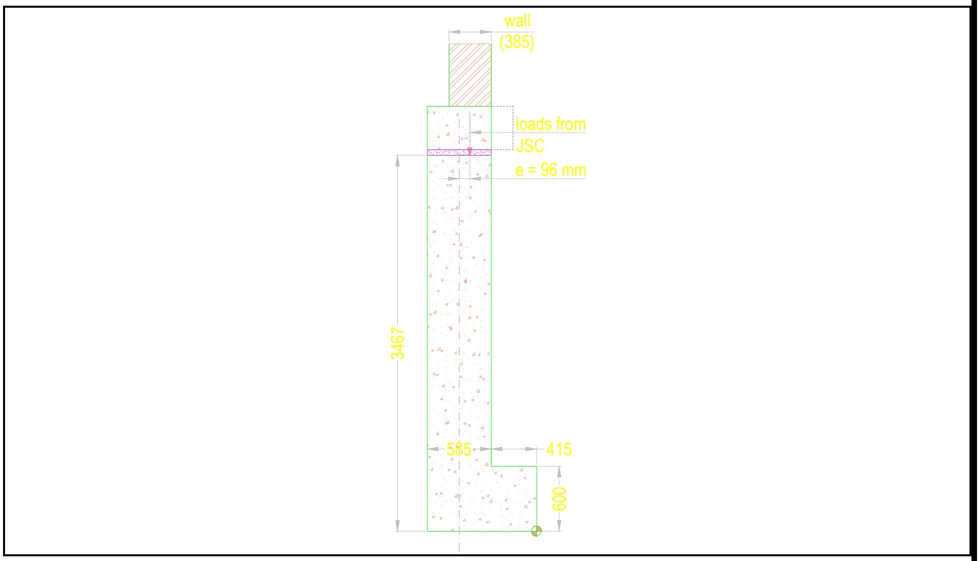
PROJECT	PROJECT NR	SHEET	DATE
JACK STRAW'S CASTLE	8149	L 4	May-23
	ENGINEER		
	RR	LOADING	



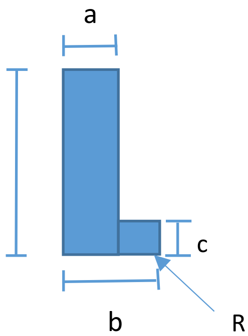
SOIL PARAMETER (WET CONDITION)

ϕ = 22.5 degrees $\gamma_{\phi'}$ = 1.25

γ_{soil} = 18.0 kN/m^3

γ_{water} = 10.0 kN/m^3

ϕ' = atan[tan (ϕ) / $\gamma_{\phi'}$] = 18.33



UNDERPINNING GEOMETRY

a = 0.585 m

b = 1.00 m

c = 0.60 m

h = 4.95 m $h_{underpinning}$ = 3.47 m

$\gamma_{concrete}$ = 25 kN/m^3

SW_{up1} = 50.75 kN/m (underpinning selfweight -1)

SW_{up2} = 6.23 kN/m (underpinning selfweight -2)

from Soil (horizontal)

S_{soil} = 1/2 x γ_{soil} x h^2 x $\tan^2[45-\phi'/2]$ = 114.99 kN/m

from Water (horizontal)

h_{water} = $h_{underpinning}$ - 1 = 2.47 m

S_{water} = h_{water} x γ_{water} = 24.70 kN/m

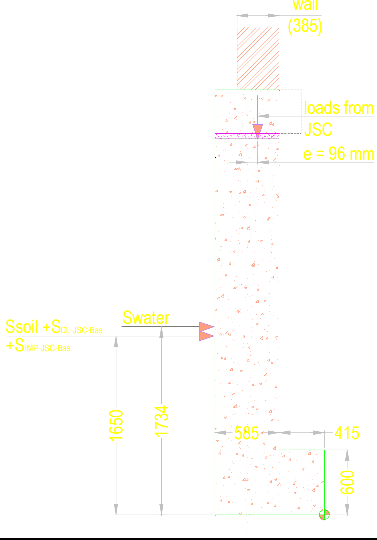
from Jack Straw's Castle (vertical)

$S_{DL\text{-}JSC}$ = 123.81 kN/m

$S_{IMP\text{-}JSC}$ = 10.38 kN/m

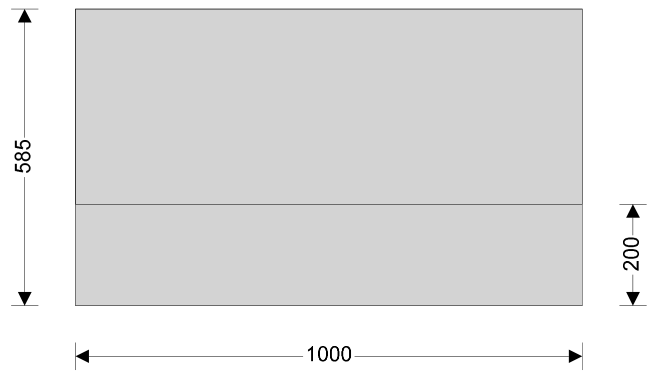
from Jack Straw's Castle Basement

$q_{DL\text{-}JSC\text{-}Bas}$							=	3.53	kN/m^2
$q_{IMP\text{-}JSC\text{-}Bas}$							=	1.50	kN/m^2
$S_{DL\text{-}KSC\text{-}Bas}$	=	$q_{DL\text{-}JSC\text{-}Bas}$	x	h	x	$\tan^2[45-\phi'/2]$	=	9.11	kN/m
$S_{IMP\text{-}KSC\text{-}Bas}$	=	$q_{IMP\text{-}JSC\text{-}Bas}$	x	h	x	$\tan^2[45-\phi'/2]$	=	3.87	kN/m



PAD FOOTING ANALYSIS AND DESIGN (BS8110-1:1997)

Tedds calculation version 2.0.07



Pad footing details

Length of pad footing;	L = **1000** mm
Width of pad footing;	B = **585** mm
Area of pad footing;	$A = L \times B =$ **0.585** m^2
Depth of pad footing;	h = **400** mm
Depth of soil over pad footing;	h_{soil} = **0** mm
Density of concrete;	ρ_{conc} = **23.6** kN/m^3

Column details

Column base length;	l_A = **1000** mm
Column base width;	b_A = **385** mm
Column eccentricity in x;	e_{PxA} = **0** mm
Column eccentricity in y;	e_{PyA} = **100** mm

Soil details

Dense, moderately graded, rounded, sand and gravel

Mobilisation factor;	m= ;**1.5**;
Density of soil;	ρ_{soil} = **18.0** kN/m^3
Design shear strength;	ϕ' = **23.4** deg
Design base friction;	δ = **18.0** deg
Allowable bearing pressure;	$P_{bearing}$ = **150** kN/m^2

Axial loading on column

Dead axial load on column;	P_{GA} = **123.8** kN
Imposed axial load on column;	P_{QA} = **10.4** kN
Wind axial load on column;	P_{WA} = **0.0** kN
Total axial load on column;	P_A = **134.2** kN

Foundation loads

Dead surcharge load;	F_{Gsur} = **0.000** kN/m^2
Imposed surcharge load;	F_{Qsur} = **0.000** kN/m^2
Pad footing self weight;	$F_{swt} = h \times \rho_{conc}$ = **9.440** kN/m^2
Soil self weight;	$F_{soil} = h_{soil} \times \rho_{soil}$ = **0.000** kN/m^2
Total foundation load;	$F = A \times (F_{Gsur} + F_{Qsur} + F_{swt} + F_{soil})$ = **5.5** kN

Calculate pad base reaction

Total base reaction;	$T = F + P_A$ = **139.7** kN
Eccentricity of base reaction in x;	$e_{Tx} = (P_A \times e_{PxA} + M_{xA} + H_{xA} \times h) / T$ = **0** mm

Eccentricity of base reaction in y; $e_{Ty} = (P_A \times e_{PyA} + M_{yA} + H_{yA} \times h) / T =$ **96** mm

Check pad base reaction eccentricity

$abs(e_{Tx}) / L + abs(e_{Ty}) / B =$ **0.164**

Base reaction acts within middle third of base

Calculate pad base pressures

$q_1 = T / A - 6 \times T \times e_{Tx} / (L \times A) - 6 \times T \times e_{Ty} / (B \times A) =$ **3.558** kN/m^2

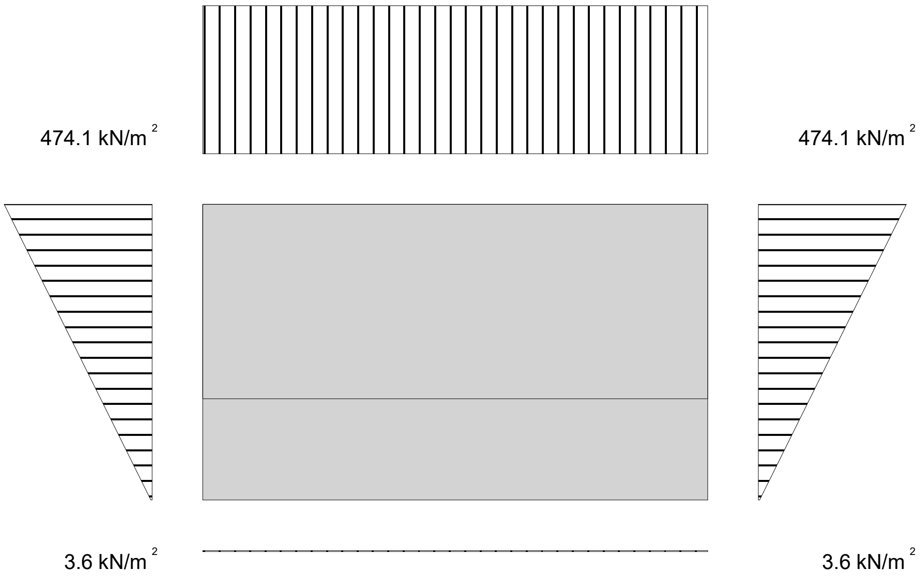
$q_2 = T / A - 6 \times T \times e_{Tx} / (L \times A) + 6 \times T \times e_{Ty} / (B \times A) =$ **474.091** kN/m^2

$q_3 = T / A + 6 \times T \times e_{Tx} / (L \times A) - 6 \times T \times e_{Ty} / (B \times A) =$ **3.558** kN/m^2

$q_4 = T / A + 6 \times T \times e_{Tx} / (L \times A) + 6 \times T \times e_{Ty} / (B \times A) =$ **474.091** kN/m^2

Minimum base pressure; $q_{min} = min(q_1, q_2, q_3, q_4) =$ **3.558** kN/m^2

Maximum base pressure; $q_{max} = max(q_1, q_2, q_3, q_4) =$ **474.091** kN/m^2



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ROTATION CHECK

Favorable Loads (factored)

$S_{Wup1(f)}$	=	0.9	x	SW_{up1}	=	45.67	kN/m
$S_{Wup2(f)}$	=	0.9	x	SW_{up2}	=	5.60	kN/m
$S_{DL\text{-}JSC(f)}$	=	0.9	x	$S_{DL\text{-}JSC}$	=	111.43	kN/m
$S_{IMP\text{-}JSC(f)}$	=	0.0	x	$S_{IMP\text{-}JSC}$	=	0.00	kN/m

Unfavorable Loads (factored)

$S_{soil(f)}$	=	1.1	x	S_{soil}	=	126.49	kN/m
$S_{water(f)}$	=	1.1	x	S_{water}	=	27.17	kN/m
$S_{DL\text{-}JSC\text{-}Bas(f)}$	=	1.1	x	$S_{DL\text{-}KSC\text{-}Bas}$	=	10.02	kN/m
$S_{IMP\text{-}JSC\text{-}Bas(f)}$	=	1.5	x	$S_{IMP\text{-}KSC\text{-}Bas}$	=	5.81	kN/m

Resistent Moment (R-rotation point)

$M_{SWup(f)1}$	=	$S_{Wup(f)1}$	x	[(a/2) + (b-a)]	=	32.29	kNm
$M_{SWup(f)2}$	=	$S_{Wup(f)2}$	x	[(b-a)/2)]	=	1.17	kNm
$M_{SDL\text{-}JSC(f)}$	=	$S_{DL\text{-}JSC(f)}$	x	[((a/2)-e) + (b-a)]	=	68.08	kNm
$M_{SIMP\text{-}JSC(f)}$	=	$S_{IMP\text{-}JSC(f)}$	x	[((a/2)-e) + (b-a)]	=	0.00	kNm
				M_R	=	**101.54**	**kNm**

Moment (R-rotation point)

$M_{Ssoil(f)}$	=	$S_{soil(f)}$	x	h/3	=	208.70	kNm
$M_{Swater(f)}$	=	$S_{water(f)}$	x	h_{water} /2	=	33.55	kNm
$M_{SDL\text{-}JSC\text{-}Bas(f)}$	=	$S_{DL\text{-}KSC\text{-}Bas(f)}$	x	h/2	=	24.81	kNm
$M_{SIMP\text{-}JSC\text{-}Bas(f)}$	=	$S_{IMP\text{-}KSC\text{-}Bas(f)}$	x	h/2	=	14.37	kNm
				M	=	**281.44**	**kNm**

M / M_R = 2.772 > **1** **(not verified)**

important note: we have to provide a temporary propping system.

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SLIDING CHECK

Favorable Loads (factored)

$S_{Wup1(f)}$	=	0	x	SW_{up1}	=	0.00	kN/m
$S_{Wup2(f)}$	=	0	x	SW_{up2}	=	0.00	kN/m
$S_{DL\text{-}JSC(f)}$	=	1	x	$S_{DL\text{-}JSC}$	=	111.43	kN/m
$S_{IMP\text{-}JSC(f)}$	=	0	x	$S_{IMP\text{-}JSC}$	=	0.00	kN/m
		.		S_{tot}	=	111.43	kNm

$\mathbf{S_R = S_{tot} \times \tan(\phi') = 36.92\ kN}$

Unavorable Loads (factored)

$S_{soil(f)}$	=	1	x	S_{soil}	=	114.99	kN/m
$S_{water(f)}$	=	1	x	S_{water}	=	24.7	kN/m
$S_{DL\text{-}JSC\text{-}Bas(f)}$	=	1	x	$S_{DL\text{-}KSC\text{-}Bas}$	=	9.11	kN/m
$S_{IMP\text{-}JSC\text{-}Bas(f)}$	=	1	x	$S_{IMP\text{-}KSC\text{-}Bas}$	=	3.87	kN/m
				$\mathbf{S_R}$	=	**152.67**	**kNm**

$\mathbf{S}$ / $\mathbf{S_R}$ = 4.135 > **1** **(not verified)**

important note: we have to provide a temporary support at the bottom of the underpinning.

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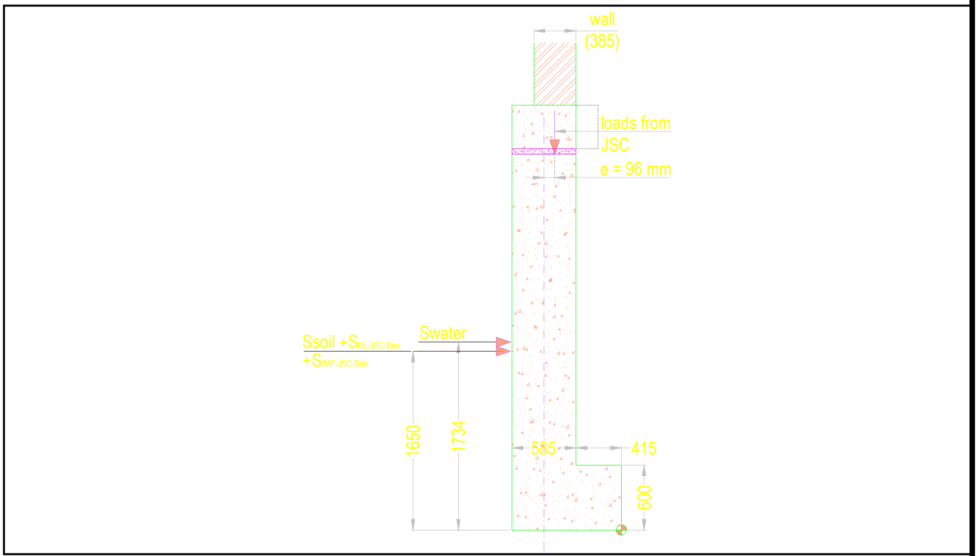
from Jack Straw's Castle Basement

$q_{DL\text{-}JSC\text{-}Bas}$ = 3.53 kN/m^2

$q_{IMP\text{-}JSC\text{-}Bas}$ = 1.50 kN/m^2

$S_{DL\text{-}KSC\text{-}Bas} = q_{DL\text{-}JSC\text{-}Bas} \times h \times \tan^2[45\text{-}\phi'/2] = 9.11$ kN/m

$S_{IMP\text{-}KSC\text{-}Bas} = q_{IMP\text{-}JSC\text{-}Bas} \times h \times \tan^2[45\text{-}\phi'/2] = 3.87$ kN/m



ROTATION CHECK

Favorable Loads (factored)

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$S_{DL\text{-}JSC(f)}$	=	0.9	x	$S_{DL\text{-}JSC}$	=	111.43	kN/m
$S_{IMP\text{-}JSC(f)}$	=	0.0	x	$S_{IMP\text{-}JSC}$	=	0.00	kN/m

Unfavorable Loads (factored)

$S_{soil(f)}$	=	1.1	x	S_{soil}	=	126.49	kN/m
$S_{water(f)}$	=	1.1	x	S_{water}	=	27.17	kN/m
$S_{DL\text{-}JSC\text{-}Bas(f)}$	=	1.1	x	$S_{DL\text{-}KSC\text{-}Bas}$	=	10.02	kN/m
$S_{IMP\text{-}JSC\text{-}Bas(f)}$	=	1.5	x	$S_{IMP\text{-}KSC\text{-}Bas}$	=	5.81	kN/m

Resistent Moment (R-rotation point)

$M_{SWup(f)1}$	=	$S_{Wup(f)1}$	x	[(a/2) + (b-a)]	=	32.29	kNm
$M_{SWup(f)2}$	=	$S_{Wup(f)2}$	x	[(b-a)/2)]	=	1.17	kNm
$M_{SDL\text{-}JSC(f)}$	=	$S_{DL\text{-}JSC(f)}$	x	[((a/2)-e) + (b-a)]	=	68.08	kNm
$M_{SIMP\text{-}JSC(f)}$	=	$S_{IMP\text{-}JSC(f)}$	x	[((a/2)-e) + (b-a)]	=	0.00	kNm
				M_R	=	**101.54**	**kNm**

Moment (R-rotation point)

$M_{Ssoil(f)}$	=	$S_{soil(f)}$	x	h/3	=	208.70	kNm
$M_{Swater(f)}$	=	$S_{water(f)}$	x	h_{water} /2	=	33.55	kNm
$M_{SDL\text{-}JSC\text{-}Bas(f)}$	=	$S_{DL\text{-}KSC\text{-}Bas(f)}$	x	h/2	=	24.81	kNm
$M_{SIMP\text{-}JSC\text{-}Bas(f)}$	=	$S_{IMP\text{-}KSC\text{-}Bas(f)}$	x	h/2	=	14.37	kNm
				M	=	**281.44**	**kNm**

M / M_R = 2.772 > **1** **(not verified)**

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SLIDING CHECK

Favorable Loads (factored)

$S_{Wup1(f)}$	=	0	x	SW_{up1}	=	0.00	kN/m
$S_{Wup2(f)}$	=	0	x	SW_{up2}	=	0.00	kN/m
$S_{DL-JSC(f)}$	=	1	x	S_{DL-JSC}	=	111.43	kN/m
$S_{IMP-JSC(f)}$	=	0	x	$S_{IMP-JSC}$	=	0.00	kN/m
		.		S_{tot}	=	111.43	kNm

S_R = S_{tot} x $\tan(\phi')$ = 36.92 kN

Unavorable Loads (factored)

$S_{soil(f)}$	=	1	x	S_{soil}	=	114.99	kN/m
$S_{water(f)}$	=	1	x	S_{water}	=	24.7	kN/m
$S_{DL-JSC-Bas(f)}$	=	1	x	$S_{DL-KSC-Bas}$	=	9.11	kN/m
$S_{IMP-JSC-Bas(f)}$	=	1	x	$S_{IMP-KSC-Bas}$	=	3.87	kN/m
				S_R	=	**152.67**	**kNm**

S / S_R = 4.135 > **1** **(not verified)**

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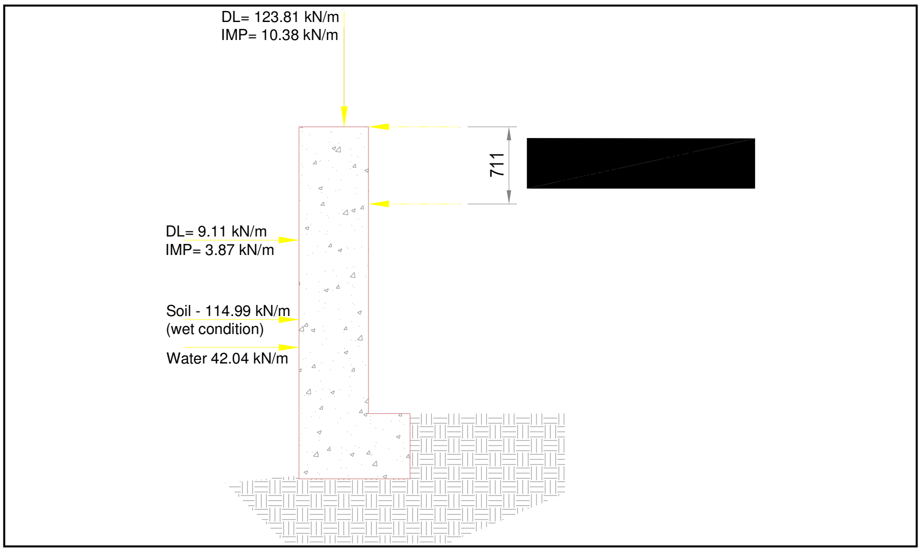

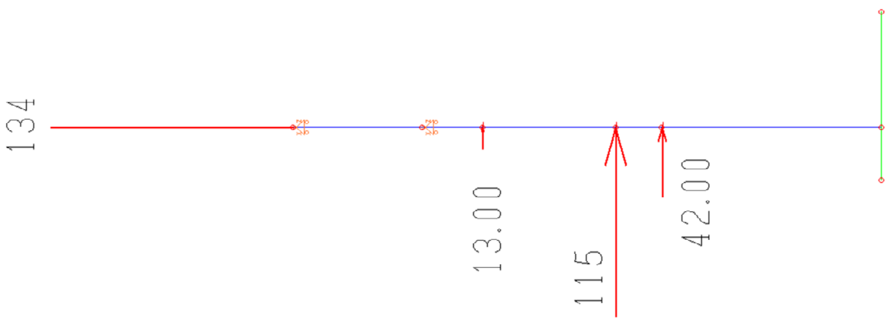

LOADING (SLS)

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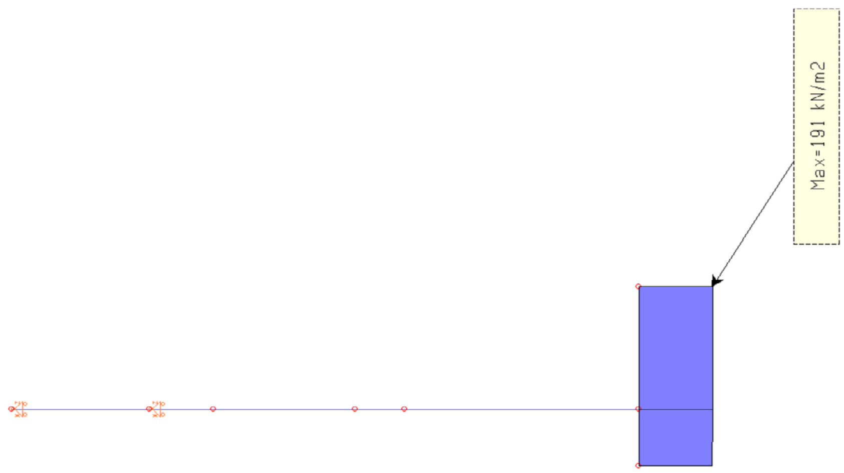

MAXIMUM BEARING PRESSURE