
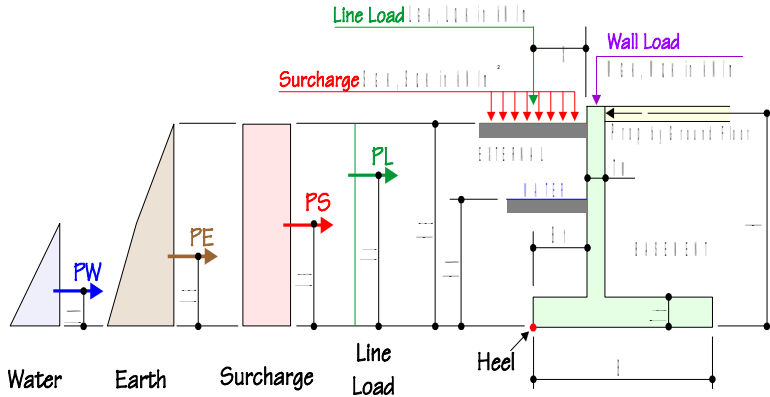


Project	Spreadsheets to BS 8110 etc		REINFORCED CONCRETE COUNCIL		
Client	Advisory Group		Made by	Date	Page
Location	Grid line 2		rc	16-Nov-2019	95
	Basement wall design to BS8110:1997, BS8002:1994. BS 8004:1986 etc.		Checked	Revision	Job No
	Originated from 'RCC61 Basement Wall.xls' on CD © 1999 BCA for RCC		chg	-	R68

IDEALISED STRUCTURE and FORCE DIAGRAMS DESIGN STATUS : VALID

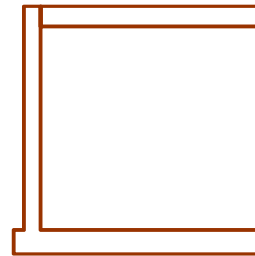


DIMENSION (mm)

H =	<u>3500</u>	B =	<u>3500</u>	Tw =	<u>225</u>
Hw =	<u>0</u>	BI =	<u>150</u>	Tb =	<u>350</u>
He =	<u>2500</u>				

MATERIAL PROPERTIES

fcu =	<u>35</u>	N/mm ²	γm =	<u>1.50</u>	concrete
fy =	<u>460</u>	N/mm ²	γm =	<u>1.05</u>	steel
Cover to tension reinforcement (co) =	<u>40</u>	mm			
Max. allowable design surface crack width (W) =	<u>0.3</u>	mm			
Concrete density =	<u>24.0</u>	kN/m ³			



Wall Geometry

SOIL PROPERTIES

Design angle of int'l friction of retained mat'l (Ø) =	<u>30</u>	degree	
Design cohesion of retained mat'l (C) =	<u>0</u>	kN/m ²	(Only granular backfill considered, ie "C" = 0)
Density of retained mat'l (q) =	<u>20</u>	kN/m ³	
Submerged Density of retained mat'l (qs) =	<u>13.33</u>	kN/m ³	(default=2/3 of q), only apply when Hw > 0
Design angle of int'l friction of base mat'l (Øb) =	<u>20</u>	degree	= 20.00
Design cohesion of base mat'l (Cb) =	<u>0</u>	kN/m ²	
Density of base mat'l (qb) =	<u>10</u>	kN/m ³	

allowable gross ground bearing pressure (GBP) = 150 kN/m²

LOADINGS (unfactored)

Surcharge load -- live (SQK) =	<u>10</u>	kN/m ²
Surcharge load -- dead (SGK) =	<u>10</u>	kN/m ²
Line load -- live (LQK) =	<u>15</u>	kN/m
Line load -- dead (LGK) =	<u>20</u>	kN/m
Distance of line load from wall (X) =	<u>250</u>	mm
Wall load -- live (WQK) =	<u>50</u>	kN/m
Wall load -- Dead (WGK) =	<u>50</u>	kN/m


ASSUMPTIONS

- a) Wall friction is zero
- b) Minimum active earth pressure = 0.25qH
- c) Granular backfill
- h) Design not intended for walls over 3.5 m high

LATERAL FORCES

Ko =	<u>0.50</u>	default Ko = (1-SIN Ø)	<u>0.50</u>
Kac =	<u>1.41</u>	= 2Ko ^{0.5}	

Force (kN)	Lever arm (m)	γ _f	Ultimate Force (kN)
PE = 31.25	LE = 0.833	<u>1.40</u>	43.75
PS(GK) = 12.50	LS = 1.25	<u>1.40</u>	17.50
PS(QK) = 12.50	LS = 1.25	<u>1.60</u>	20.00
PL(GK) = 10.00	LL = 2.29	<u>1.40</u>	14.00
PL(QK) = 7.50	LL = 2.29	<u>1.60</u>	12.00
PW = 0.00	LW = 0.00	<u>1.40</u>	0.00
Total	73.75		107.25

Project	Spreadsheets to BS 8110 etc		REINFORCED CONCRETE COUNCIL		
Client	Advisory Group		Made by	Date	Page
Location	Grid line 2		rc	16-Nov-2019	96
	Basement wall design to BS8110:1997, BS8002:1994. BS 8004:1	Checked	chg	Revision	Job No
	Originated from 'RCC61 Basement Wall.xls' on CD © 1999 BCA for RCC			-	R68

EXTERNAL STABILITY

STABILITY CHECK : **OK**

ANALYSIS - Assumptions & Notes

- 1) Wall idealised as a propped cantilever (i.e. pinned at top and fixed at base)
- 2) Wall is braced.
- 3) Maximum slenderness of wall is limited to 15, i.e [$0.9 \cdot (H_e - T_b/2) / T_w < 15$]
- 4) Maximum Ultimate axial load on wall is limited to 0.1f_{cu} times the wall cross-sectional area
- 5) Design Span (Effective wall height) = H_e - (T_b/2)
- 6) -ve moment is hogging (i.e. tension at external face of wall)
+ve moment is sagging (i.e. tension at internal face of wall)
- 7) " Wall MT. " is maximum +ve moment on the wall.
- 8) Estimated lateral deflections are used for checking the **PA** effect .

UNFACTORED LOADS AND FORCES

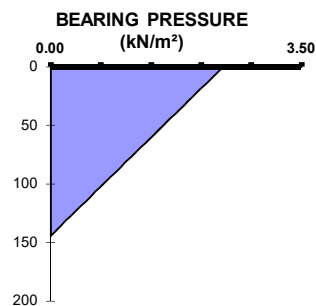
Lateral Force	Force (kN)	Lever arm to base (m)	Base MT. (kNm)	Wall MT. (kNm)	Reaction at Base (kN)	Reaction at Top (kN)	Estimated Elastic Deflection Δ (mm)
PE =	26.98	0.78	-11.46	4.27	24.14	2.84	0.2
PS(GK) =	11.62	1.16	-5.72	2.90	9.28	2.35	0.2
PS(QK) =	11.62	1.16	-5.72	2.90	9.28	2.35	0.1
PL(GK) =	10.00	2.12	-5.25	5.79	5.22	4.78	0.3
PL(QK) =	7.50	2.12	-3.94	4.34	3.91	3.59	0.1
PW =	0.00	0.00	0.00	0.00	0.00	0.00	0.0
Total	67.73		-32.07	20.19	51.82	15.90	0.8

GROUND BEARING FAILURE

LOAD CASE: Wall Load **MAX**
Surcharge **MIN**

Taking moments about centre of base (anticlockwise "+")

Vertical FORCES (kN)	Lever arm (m)	Moment (kNm)
Wall load = 100	1.49	148.75
Wall (sw) = 17.01	1.49	25.30
Base = 29.40	0.00	0.00
Earth = 6.45	1.68	10.80
Water = 0.00	1.68	0.00
Surcharge = 1.50	1.68	2.51
Line load = 20.00	0.00	0.00
Σ V = 174.36		Σ M_v = 187.37



MOMENT due to LATERAL FORCES, M_o = -22.42 kNm

RESULTANT MOMENT, M = M_v + M_o = 164.95 kNm

ECCENTRICITY FROM BASE CENTRE, M / V = 0.95 m

MAXIMUM GROSS BEARING PRESSURE = 144.58 kN/m² < 150 **OK**


SLIDING AT BASE (using overall factor of safety instead of partial safety f: F.O.S = 1.50)

SUM of LATERAL FORCES, P = 51.82 kN

BASE FRICTION, F_b = - (V TANØ_b + B.C_b) = -63.46 kN

Factor of Safety, F_b / P = 1.22 < 1.50 **FAIL .. but**

therefore, LATERAL RESISTANCE to be provided by BASEMENT SLAB = 14.27 kN

Project	Spreadsheets to BS 8110 etc		REINFORCED CONCRETE COUNCIL		
Client	Advisory Group		Made by	Date	Page
Location	Grid line 2		rc	16-Nov-2019	98
	Basement wall design to BS8110:1997, BS8002:1994. BS 8004:198	Checked	chg	Revision	Job No
	Originated from 'RCC61 Basement Wall.xls' on CD © 1999 BCA for RCC			-	R68

OUTER BASE (per metre length)

BS8110
reference

$\gamma_f = 1.50$ (ASSUMED)

Ult. Shear = 10.35 kN (AT d from FACE of WALL)
Ult. MT. = 1.66 kNm TENSION - BOTTOM FACE

BOTTOM REINFORCEMENT :
Min. As = 455 mm²
 $\phi = 12$ mm
centres = 225 mm < 762 OK
As = 503 mm² > 455 OK

Table 3.25

MOMENT of RESISTANCE :
d = 304 mm
Z = 289 mm
As' = 0 mm²
Mres = 63.60 kNm > 1.66 OK

3.4.4.4

SHEAR RESISTANCE:
100As/bd = 0.29%
vc = 0.42 N/mm²
Vres = 126.35 kN > 10.35 OK

Table 3.8
3.5.5.2

CHECK CRACK WIDTH IN ACCORDANCE WITH BS8007 :

X = 60.69 mm $\epsilon_m = -0.00166$
Acr = 115.54 mm W = -0.38 mm < 0.30 OK

BS8007
App. B.2

INNER BASE (per metre length)

Ult. Shear = -71.40 kN (AT d from FACE of WALL)
Ult. MT. = 49.77 kNm TENSION - BOTTOM FACE

BOTTOM REINFORCEMENT :
Min. As = 455 mm²
 $\phi = 12$ mm
centres = 225 mm < 762 OK
As = 503 mm² > 455 OK

Table 3.25

MOMENT of RESISTANCE :
d = 304 mm
Z = 289 mm
As' = 0 mm²
Mres = 63.60 kNm > 49.77 OK

3.4.4.4

SHEAR RESISTANCE:
100As/bd = 0.17%
vc = 0.42 N/mm²
Vres = 126.35 kN > 71.40 OK

Table 3.8
3.5.5.2


CHECK CRACK WIDTH IN ACCORDANCE WITH BS8007 :

X = 60.69 mm $\epsilon_m = -0.00033$
Acr = 115.54 mm W = -0.07 mm < 0.30 OK

BS8007
App. B.2

REINFORCEMENT SUMMARY for BASE

	Type	ϕ mm	centres mm	As mm ²	Min. As mm ²	
TOP	T	12	225	503	455	OK
BOTTOM	T	12	225	503	455	OK
TRANSVERSE	T	12	225	503	455	OK

Project	Spreadsheets to BS 8110 etc		REINFORCED CONCRETE COUNCIL		
Client	Advisory Group		Made by	Date	Page
Location	Grid line 2		rc	16-Nov-2019	99
	Basement wall design to BS8110:1997, BS8002:1994. BS 8004:1997	Checked	chg	Revision	Job No
	Originated from 'RCC61 Basement Wall.xls' on CD © 1999 BCA for RCC			-	R68

APPROXIMATE WEIGHT OF REINFORCEMENT per metre length of wall

		No.	Type	Dia	Length	Unit Wt	Weight
WALL	VERTICAL - External face	5	T	20	3310	2.466	40.81
	VERTICAL - Internal face	5	T	25	3350	3.853	64.54
	TRANSVERSE (Ext.+ Int.)	30	T	10	1000	0.617	18.50
BASE	TOP (MAIN)	5	T	12	3596	0.888	15.96
	BOTTOM (MAIN)	5	T	12	3596	0.888	15.96
	TRANSVERSE (T & B)	32	T	12	1000	0.888	28.41
	WALL STARTERS (Ext.)	5	T	20	1385	2.466	17.08
	WALL STARTERS (Int.)	5	T	25	1625	3.853	31.31

SUMMARY Total reinforcement per metre length of wall (kg) **233**

DATA FOR DIAGRAMS I

sheet 1 of 2



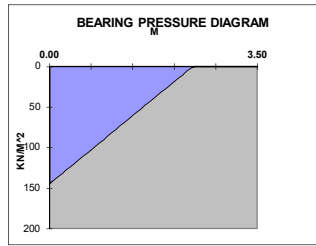
XX= 0

$$IF(ECCY > (B/1000)/6, IF(XX > (B/1000)/2 - ECCY) * 3.0, ((B/1000)/2 - ECCY) * 3 - XX, ((B/1000)/2 - ECCY) * 3) * BP, ((VL/(B/1000)) * (1 - (6 * ECCY)/(B/1000)))) + (B/1000 - XX)/(B/1000) * (BP - (VL/(B/1000)) * (1 - (6 * ECCY)/(B/1000))))$$

$$IF(ABS(ECCY) > (B/1000)/6, IF((B - XX) > (B/1000)/2 - ABS(ECCY)) * 3.0, ((B/1000)/2 - ABS(ECCY)) * 3 - (B - XX), ((B/1000)/2 - ABS(ECCY)) * 3) * BP, ((VL/(B/1000)) * (1 - (6 * ABS(ECCY))/(B/1000)))) + (B/1000 - (B - XX))/(B/1000) * (BP - (VL/(B/1000)) * (1 - (6 * ABS(ECCY))/(B/1000))))$$

$$IF(ABS(ECCY) > (B/1000)/6, IF(XX > (B/1000)/2 - ABS(ECCY)) * 3.0, ((B/1000)/2 - ABS(ECCY)) * 3 - XX, ((B/1000)/2 - ABS(ECCY)) * 3) * BP, ((VL/(B/1000)) * (1 - (6 * ABS(ECCY))/(B/1000)))) + (B/1000 - XX)/(B/1000) * (BP - (VL/(B/1000)) * (1 - (6 * ABS(ECCY))/(B/1000))))$$

0	0.00	144.5786
1	0.07	144.579
2	0.14	140.383
3	0.21	136.187
4	0.28	131.991
5	0.35	127.795
6	0.42	123.599
7	0.49	119.403
8	0.56	115.207
9	0.63	111.011
10	0.70	106.815
11	0.77	102.619
12	0.84	98.423
13	0.91	94.227
14	0.98	90.031
15	1.05	85.835
16	1.12	81.640
17	1.19	77.444
18	1.26	73.248
19	1.33	69.052
20	1.40	64.856
21	1.47	60.660
22	1.54	56.464
23	1.61	52.268
24	1.68	48.072
25	1.75	43.876
26	1.82	39.680
27	1.89	35.484
28	1.96	31.288
29	2.03	27.092
30	2.10	22.896
31	2.17	18.700
32	2.24	14.504
33	2.31	10.309
34	2.38	6.113
35	2.45	1.917
36	2.52	0.000
37	2.59	0.000
38	2.66	0.000
39	2.73	0.000
40	2.80	0.000
41	2.87	0.000
42	2.94	0.000
43	3.01	0.000
44	3.08	0.000
45	3.15	0.000
46	3.22	0.000
47	3.29	0.000
48	3.36	0.000
49	3.43	0.000
50	3.50	0



BPO	0	144.58
BPE	0.15	135.59
BPI	0.375	122.1
BPZ	3.5	0

0	144.58	0.0700	10.12	1.16	0.07	10.12	0	0.00
1	140.38	0.07	9.83	0.44	0.07	9.83	0	0.00
2	136.19	0	0.00	0.00	0.07	9.53	0	0.00
3	131.99	0	0.00	0.00	0.07	9.24	0	0.00
4	127.79	0	0.00	0.00	0.07	8.95	0	0.00
5	123.60	0	0.00	0.00	0.07	8.65	0	0.00
6	119.40	0	0.00	0.00	0.07	8.36	0	0.00
7	115.21	0	0.00	0.00	0.07	8.06	0	0.00
8	111.01	0	0.00	0.00	0.07	7.77	0	0.00
9	106.82	0	0.00	0.00	0	0.00	0	0.00
10	102.62	0	0.00	0.00	0	0.00	0	0.00
11	98.42	0	0.00	0.00	0	0.00	0	0.00
12	94.23	0	0.00	0.00	0	0.00	0	0.00
13	90.03	0	0.00	0.00	0	0.00	0	0.00
14	85.84	0	0.00	0.00	0	0.00	0	0.00
15	81.64	0	0.00	0.00	0	0.00	0	0.00
16	77.44	0	0.00	0.00	0	0.00	0	0.00
17	73.25	0	0.00	0.00	0	0.00	0	0.00
18	69.05	0	0.00	0.00	0	0.00	0	0.00
19	64.86	0	0.00	0.00	0	0.00	0	0.00
20	60.66	0	0.00	0.00	0	0.00	0	0.00
21	56.46	0	0.00	0.00	0	0.00	0	0.00
22	52.27	0	0.00	0.00	0	0.00	0	0.00
23	48.07	0	0.00	0.00	0	0.00	0	0.00
24	43.88	0	0.00	0.00	0	0.00	0	0.00
25	39.68	0	0.00	0.00	0	0.00	0	0.00
26	35.48	0	0.00	0.00	0	0.00	0	0.00
27	31.29	0	0.00	0.00	0	0.00	0	0.00
28	27.09	0	0.00	0.00	0	0.00	0	0.00
29	22.90	0	0.00	0.00	0	0.00	0	0.00
30	18.70	0	0.00	0.00	0	0.00	0	0.00
31	14.50	0	0.00	0.00	0	0.00	0	0.00
32	10.31	0	0.00	0.00	0	0.00	0	0.00
33	6.11	0	0.00	0.00	0	0.00	0	0.00
34	1.92	0	0.00	0.00	0	0.00	0	0.00
35	0.00	0	0.00	0.00	0	0.00	0	0.00
36	0.00	0	0.00	0.00	0	0.00	0	0.00
37	0.00	0	0.00	0.00	0	0.00	0	0.00
38	0.00	0	0.00	0.00	0	0.00	0	0.00
39	0.00	0	0.00	0.00	0	0.00	0	0.00
40	0.00	0	0.00	0.00	0	0.00	0	0.00
41	0.00	0	0.00	0.00	0	0.00	0	0.00
42	0.00	0	0.00	0.00	0	0.00	0	0.00
43	0.00	0	0.00	0.00	0	0.00	0	0.00
44	0.00	0	0.00	0.00	0	0.00	0	0.00
45	0.00	0	0.00	0.00	0	0.00	0	0.00
46	0.00	0	0.00	0.00	0	0.00	0	0.00
47	0.00	0	0.00	0.00	0	0.00	0	0.00
48	0.00	0	0.00	0.00	0	0.00	0	0.00
49	0.00	0	0.00	0.00	0	0.00	0	0.00
50	0.00	0	0.00	0.00	0	0.00	0	0.00
			19.95	1.61		80.51		0.00

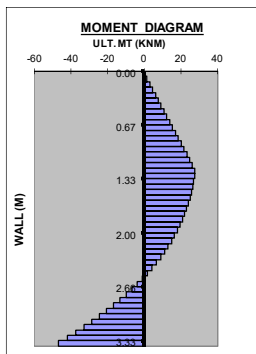
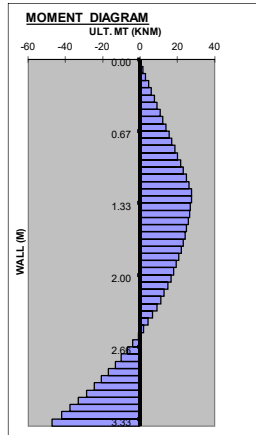


MOMENTS
 YY= 3.875
 MTE2= 0.09
 MTE1= -28.59 -2.41 96.673
 MTLG= -8.12 26.65
 MTLQ= -6.09 19.99
 MTSQ= -11.58 37.539
 MTSQ= -11.58 37.54
 MTW= -0.28 0.09

SHEARS
 $SE2=IF(Y Y >=(L-ANALYSIS \& STABILITY)M28),Ka*(q-QS)*(Y Y-(L-ANALYSIS \& STABILITY)M28))^(2)/2$

UTM= -96.12
 -96.12

0	0.00	0	0.00
1	0.07	1.5594	0.07
2	0.13	3.1189	0.13
3	0.20	4.6783	0.20
4	0.27	6.2378	0.27
5	0.33	7.7972	0.33
6	0.40	9.3567	0.40
7	0.47	10.916	0.47
8	0.53	12.476	0.53
9	0.60	14.035	0.60
10	0.67	15.594	0.67
11	0.73	17.154	0.73
12	0.80	18.713	0.80
13	0.86	20.273	0.86
14	0.93	21.832	0.93
15	1.00	23.392	1.00
16	1.06	24.92	1.06
17	1.13	26.378	1.13
18	1.20	27.761	1.20
19	1.26	27.669	1.26
20	1.33	27.163	1.33
21	1.40	26.569	1.40
22	1.46	25.885	1.46
23	1.53	25.105	1.53
24	1.60	24.227	1.60
25	1.66	23.245	1.66
26	1.73	22.156	1.73
27	1.80	20.956	1.80
28	1.86	19.639	1.86
29	1.93	18.204	1.93
30	2.00	16.644	2.00
31	2.06	14.956	2.06
32	2.13	13.137	2.13
33	2.19	11.181	2.19
34	2.26	9.0849	2.26
35	2.33	6.8444	2.33
36	2.39	4.4554	2.39
37	2.46	1.9138	2.46
38	2.53	-0.785	2.53
39	2.59	-3.644	2.59
40	2.66	-6.668	2.66
41	2.73	-9.861	2.73
42	2.79	-13.23	2.79
43	2.86	-16.77	2.86
44	2.93	-20.5	2.93
45	2.99	-24.41	2.99
46	3.06	-28.51	3.06
47	3.13	-32.8	3.13
48	3.19	-37.3	3.19
49	3.26	-41.99	3.26
50	3.33	-46.89	3.33



0.000			
1.559	1.559	0.00	0.00
3.119	1.559	0.00	0.00
4.678	1.559	0.00	0.00
6.238	1.559	0.00	0.00
7.797	1.559	0.00	0.00
9.357	1.559	0.00	0.00
10.916	1.559	0.00	0.00
12.476	1.559	0.00	0.00
14.035	1.559	0.00	0.00
15.594	1.559	0.00	0.00
17.154	1.559	0.00	0.00
18.713	1.559	0.00	0.00
20.273	1.559	0.00	0.00
21.832	1.559	0.00	0.00
23.392	1.559	0.00	0.00
24.920	1.528	0.00	0.00
26.378	1.458	0.00	0.00
27.761	1.383	27.76	1.20
27.669	-0.092	0.00	0.00
27.163	-0.507	0.00	0.00
26.569	-0.593	0.00	0.00
25.885	-0.684	0.00	0.00
25.105	-0.779	0.00	0.00
24.227	-0.878	0.00	0.00
23.245	-0.982	0.00	0.00
22.156	-1.089	0.00	0.00
20.956	-1.201	0.00	0.00
19.639	-1.316	0.00	0.00
18.204	-1.436	0.00	0.00
16.644	-1.560	0.00	0.00
14.956	-1.688	0.00	0.00
13.137	-1.820	0.00	0.00
11.181	-1.956	0.00	0.00
9.085	-2.096	0.00	0.00
6.844	-2.240	0.00	0.00
4.455	-2.389	0.00	0.00
1.914	-2.542	0.00	0.00
-0.785	-2.698	0.00	0.00
-3.644	-2.859	0.00	0.00
-6.668	-3.024	0.00	0.00
-9.861	-3.193	0.00	0.00
-13.228	-3.367	0.00	0.00
-16.772	-3.544	0.00	0.00
-20.497	-3.725	0.00	0.00
-24.408	-3.911	0.00	0.00
-28.509	-4.101	0.00	0.00
-32.803	-4.294	0.00	0.00
-37.296	-4.492	0.00	0.00
-41.990	-4.694	0.00	0.00
-46.891	-4.901		

27.76 1.20

Geometry

0	0		
0	350		
150	350		
150	3650		
3500	3650		
3500	3350		
375	3350		
375	3650		
375	350		
3500	350		
3500	0		
0	0	3650	3500

Project Spreadsheets to BS 8110 etc

Location Grid line 2

CRACK WIDTH CALCULATIONS



Basement wall design to BS8110:1997, BS8002:1994. BS 8004:1986 etc. Made by rc Job No R68

Originated from 'RCC61 Basement Wall.xls' on CD © 1999 BCA for RCC

Date 16-Nov-19

WALL

MR= 15.06	MS= 241	Asreq = 1545	fs = 217.14	sprov%= 1.2647
As/bd= 0.013	MSS= 255	Assreq = 1140	fs = 250.44	sprov%= 0.7979
X= 78.56	MSBB= 762	ASBBreq= 13	fs = 7.9875	sprov%= 0.1653
lc= 451482320	MSBT= 762	ASBTreq= 393	fs = 239.99	sprov%= 0.1653
STS= 0.000502				
ST1= 0.000783				
ST2= 0.0002616				
Acr= 111.64709				
W= 0.09				
ϵ_m = 0.0005				
MR= 15.06	MR= 15.06			
AsBB/bd= 0.0017	AsBB/bd= 0.0017			
X= 60.69	X= 60.69			
lc= 522535043	lc= 522535043			
STS= 0.0000	STS= 0.0012			
ST1= 0.0000	ST1= 0.0014			
ST2= 0.001711	ST2= 0.001711			
Acr= 115.54115	Acr= 115.54115			
W= -0.38	W= -0.07			
ϵ_m = -0.0017	ϵ_m = -0.0003			

Disclaimer

All advice or information from the British Cement Association and/or Reinforced Concrete C the significance and limitations of its contents and take responsibility for its use and applica for any loss resulting from such advice or information is accepted by the BCA, RCC or their should note that all BCA software and publications are subject to revision from time to time possession of the latest version.

This spreadsheet should be used in compliance with the accompanying publication '*Spreat EC2*' available from British Cement Association, Telford Avenue, Crowthorne, Berkshire R

Status of spreadsheet

Public release version.

Revision history **RCC61 Basement Wall.xls**

Date	Version	Action
06-Aug-99	RCC61 v1.0	First public release. Includes β version comments

Notes

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*dsheets for concrete design to BS 8110 and
345 6YS.*

Size (kB)
398

Notes

