



Structural Calculations OF RESTURANT BASEMENT

Project: Tourism Sector Development Project in the Hahonake Region of Japan

Consulting Agency: The Ministry of Tourism and Antiquities, The Ministry of Planning (S&P-PR02/01)

Site: Dead Sea Panarabic Complex

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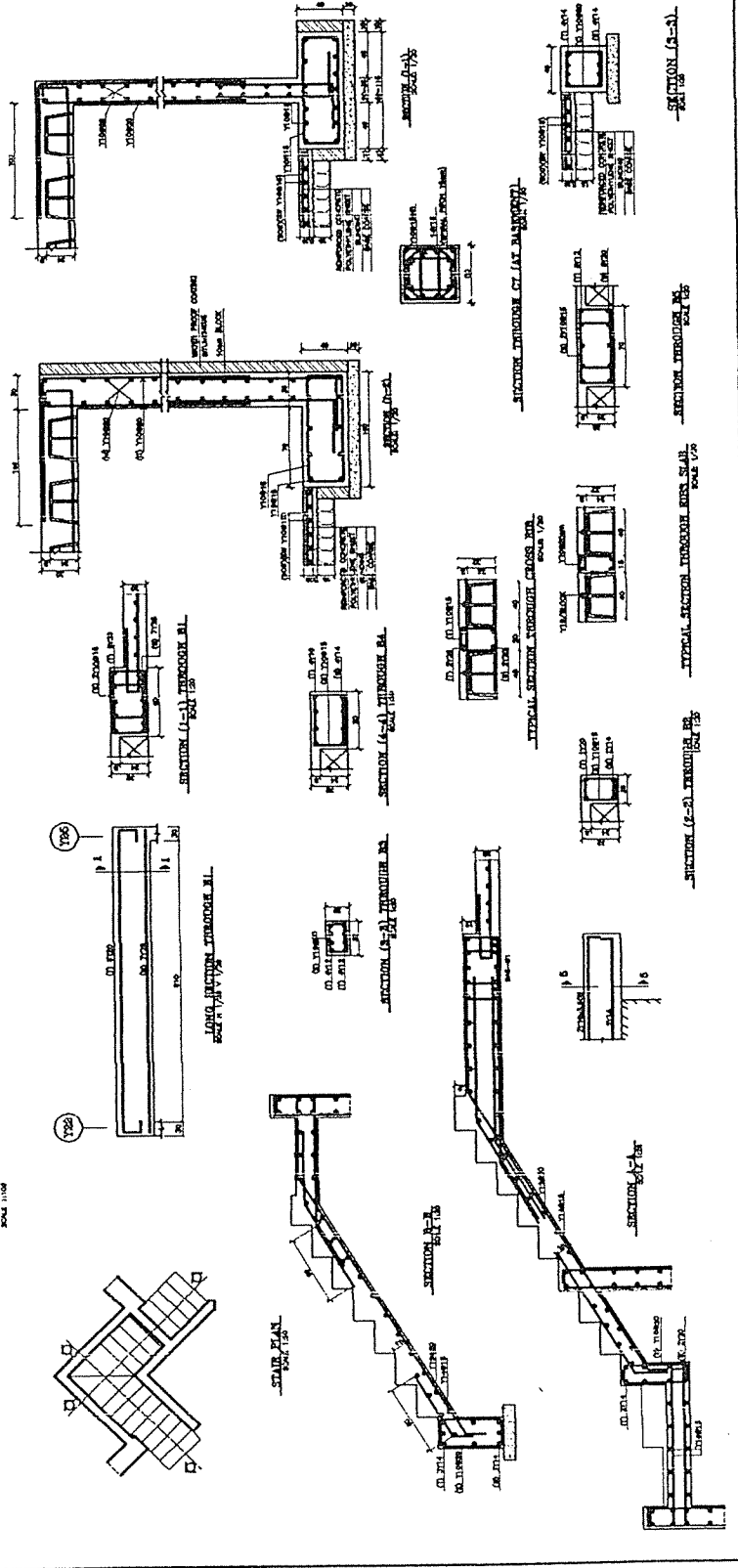
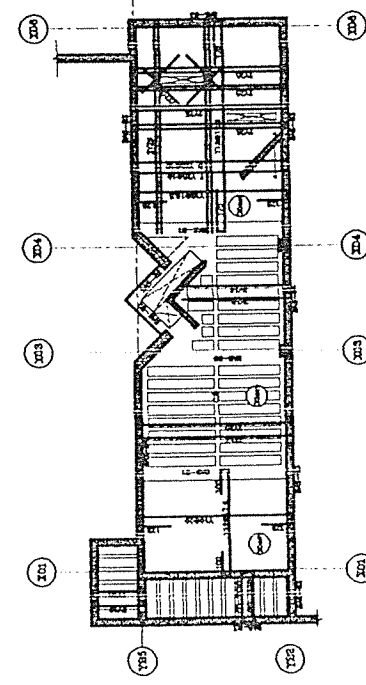
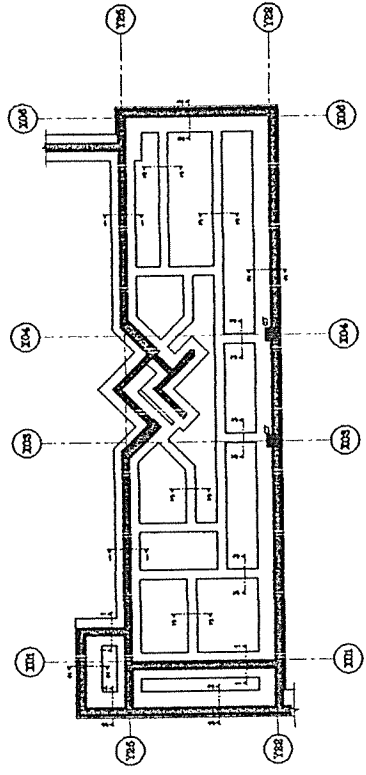
Designed by: Japan International Cooperation Agency (JICA)

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Subcontracted Local Consultants: CONSULTING ENGINEERS FOR ARCHITECTURE, INTERIOR DESIGN, MECHANICAL, ELECTRICAL & SANITARY ENGINEERING

Drawing Title: RESTAURANT BASEMENT PLAN STRUCTURAL DETAILS

Scale: Drawing No.1





BAS-B1

Number of spans = 1 Number of load cases = 1

Span	Length	Width	Depth	Flange thickness	Flange width
1	3.600	0.500	0.320	0.000	0.500

Load case number : 1

Span	UDL	Load 1		Load 2		Load 3		Load 4		Load 5	
		Val	Dis	Val	Dis	Val	Dis	Val	Dis	Val	Dis
1	61.70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Span Line Load From Length Intensity

Support	Width	Redistribution
1	0.000	0 %
2	0.000	0 %

Envelope

Span	lft BM	span BM	rgt BM	lft SF	rgt SF
1	0.0	100.0	-0.0	111.1	-111.1

Required Steel Areas (mm square)

Span	Top L	Bot L	Top M	Bot M	Top R	Bot R
1	217	0	0	1137	217	0

Maximum Spacing of Shear Stirrups in mm

Span	leg L-zone	spacing	dia.	R-zone	spacing	dia.	Rest-spc	dia.
1	2	0.90	175	8	0.90	175	8	175

Span	1
Span/Depth	12.6
Allowable	24.6

217	0	217	Requ. Top
0 Φ 10	4 Φ 10	4 Φ 10	
0 Φ 0	0 Φ 0	0 Φ 0	
314	314	314	Prov. Top

0	span 1	0	Requ. Bot
0 Φ 0	1137	0 Φ 0	
0 Φ 0	4 Φ 20	0 Φ 0	
0 Φ 0	0 Φ 0	0 Φ 0	
0	1256	0	Prov. Bot



SPANS Bent and Beam Analysis Program V4.1 SPANS
SPANS Prepared by H. Saffarini 2/2/93 SPANS

BAS-B2

Number of spans = 1 Number of load cases = 1

Span	Length	Width	Depth	Flange thickness	Flange width
1	6.500	0.500	0.320	0.000	0.500

Load case number : 1

Span	UDL	Load 1		Load 2		Load 3		Load 4		Load 5	
		Val	Dis	Val	Dis	Val	Dis	Val	Dis	Val	Dis
1	5.60	111.1	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Span	Line Load	From	Length	Intensity
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Support	Width	Redistribution
1	0.000	0 %
2	0.000	0 %

Envelope

Span	lft BM	span BM	rgt BM	lft SF	rgt SF
1	0.0	63.9	0.0	120.8	-26.7

Required Steel Areas (mm square)

Span	Top L	Bot L	Top M	Bot M	Top R	Bot R
1	217	0	0	681	217	0

Maximum Spacing of Shear Stirrups in mm

Span	leg L-zone spacing	dia.	R-zone spacing	dia.	Rest-spc dia.	dia.			
1	2	1.60	149	8	1.60	175	8	175	8

Span	1
Span/Depth	0.0
Allowable	0.0

217	0	217	Requ. Top
0 Φ 0	0 Φ 0	0 Φ 0	
0 Φ 0	4 Φ 10	0 Φ 0	
0	314	0	Prov. Top

0	span 1	0	Requ. Bot
0 Φ 0	605	0 Φ 0	
0 Φ 0	0 Φ 0	0 Φ 0	
0 Φ 0	4 Φ 18	0 Φ 0	
0	1017	0	Prov. Bot



Number of spans = 2

Number of load cases = 1

Span	Length	Width	Depth	Flange thickness	Flange width
1	4.500	0.600	0.320	0.000	0.600
2	4.600	0.600	0.320	0.000	0.600

Load case number : 1

Span	UDL	Load 1		Load 2		Load 3		Load 4		Load 5	
		Val	Dis	Val	Dis	Val	Dis	Val	Dis	Val	Dis
1	63.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	63.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Span	Line Load	From	Length	Intensity
Support	Width	Redistribution		
1	0.000	0 %		
2	0.000	0 %		
	0.000	0 %		

Envelope

Span	lft BM	span BM	rgt BM	lft SF	rgt SF
1	0.0	89.0	-164.4	106.3	-179.4
2	-164.4	95.8	0.0	181.8	-110.3

Required Steel Areas (mm square)

Span	Top L	Bot L	Top M	Bot M	Top R	Bot R
1	260	0	0	966	2039	0
2	2039	0	0	1049	260	0

Maximum Spacing of Shear Stirrups in mm

Span	leg	L-zone spacing	dia.	R-zone spacing	dia.	Rest-spc dia.
1	2	1.13	146	8	1.13	146
2	2	1.15	146	8	1.15	146

Span	1	2
Span/Depth	15.8	16.1
Allowable	30.4	28.0

260	0	2039	0	260	Requ. Top
0 Φ 10	4 Φ 10	5 Φ 25	4 Φ 10	4 Φ 10	
0 Φ 0	0 Φ 0	0 Φ 0	0 Φ 0	0 Φ 0	
314	314	2453	314	314	Prov. Top

0	span 1	0	span 2	0	Requ. Bot
0 Φ 0	966	0	1049	0	
0 Φ 0	5 Φ 16	0 Φ 0	5 Φ 16	0 Φ 0	
0 Φ 0	0 Φ 0	0 Φ 0	0 Φ 0	0 Φ 0	
0	1005	0	1005	0	Prov. Bot



Number of spans = 2			Number of load cases = 1		
Span	Length	Width	Depth	Flange thickness	Flange width
1	3.600	0.500	0.320	0.000	0.500
2	5.000	0.500	0.320	0.000	0.500

Load case number : 1

Span	UDL	Load 1		Load 2		Load 3		Load 4		Load 5	
		Val	Dis	Val	Dis	Val	Dis	Val	Dis	Val	Dis
1	30.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	30.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Span	Line Load	From	Length	Intensity
Support	Width	Redistribution		
1	0.000	0 %		
2	0.000	0 %		
3	0.000	0 %		

Envelope

Span	lft BM	span BM	rgt BM	lft SF	rgt SF
1	0.0	11.2	-74.8	33.2	-74.8
2	-74.8	56.3	0.0	90.0	-60.0

Required Steel Areas (mm square)

Span	Top L	Bot L	Top M	Bot M	Top R	Bot R
1	217	0	0	217	813	0
2	813	0	0	593	217	0

Maximum Spacing of Shear Stirrups in mm

Span	leg	L-zone spacing	dia.	R-zone spacing	dia.	Rest-spc	dia.
1	2	0.90	175	8	0.90	175	8
2	2	1.25	175	8	1.25	175	8

ϵ_n	1	2
Span/Depth	12.6	17.5
Allowable	49.1	39.1

217	0	813	0	217	Requ. Top
4 Φ 10	4 Φ 10	4 Φ 18	4 Φ 10	4 Φ 10	
0 Φ 0	0 Φ 0	0 Φ 0	0 Φ 0	0 Φ 0	
314	314	1017	314	314	Prov. Top

0	span 1	0	span 2	0	Requ. Bot
0 Φ 0	217	0	593	0	
0 Φ 0	4 Φ 12	0 Φ 0	4 Φ 16	0 Φ 0	
0 Φ 0	0 Φ 0	0 Φ 0	0 Φ 0	0 Φ 0	
0	452	0	804	0	Prov. Bot



BAS-B5

Number of spans = 1

Number of load cases = 1

Span	Length	Width	Depth	Flange thickness	Flange width
1	2.500	0.500	0.320	0.000	0.500

load case number : 1

Span	UDL	Load 1		Load 2		Load 3		Load 4		Load 5	
		Val	Dis	Val	Dis	Val	Dis	Val	Dis	Val	Dis
1	62.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Span	Line Load	From	Length	Intensity
Support				
1	Width	Redistribution		
2	0.000	0 %		

Envelope

Span	lft BM	span BM	rgt BM	lft SF	rgt SF
1	0.0	48.4	0.0	77.5	-77.5

Required Steel Areas (mm square)

Span	Top L	Bot L	Top M	Bot M	Top R	Bot R
1	217	0	0	504	217	0

Maximum Spacing of Shear Stirrups in mm

Span	leg L-zone spacing	dia.	R-zone spacing	dia.	Rest-spc dia.	dia.	
1	2	0.63	175	8	0.63	175	8

span	1
span/Depth	8.8
Allowable	34.3

217	0	217	Requ. Top
0 Φ 10	4 Φ 10	4 Φ 10	
0 Φ 0	0 Φ 0	0 Φ 0	
314	314	314	Prov. Top

span 1			
0	504	0	Requ. Bot
0 Φ 0	4 Φ 14	4 Φ 0	
0 Φ 0	0 Φ 0	0 Φ 0	
0	615	0	Prov. Bot



bas-b6

Number of spans = 2

Number of load cases = 1

Span	Length	Width	Depth	Flange thickness	Flange width
1	2.200	0.250	0.320	0.000	0.250
2	1.000	0.250	0.320	0.000	0.250

Load case number : 1

Span	UDL	Load 1		Load 2		Load 3		Load 4		Load 5	
		Val	Dis	Val	Dis	Val	Dis	Val	Dis	Val	Dis
1	20.00	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	20.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Span	Line Load	From	Length	Intensity
Support	Width	Redistribution		
1	0.000	0 %		
2	0.000	0 %		
3	0.000	0 %		

Envelope

Span	lft BM	span BM	rgt BM	lft SF	rgt SF
1	0.0	-14.3	-52.8	0.0	-46.0
2	-52.8	-23.9	0.0	62.8	42.8

Required Steel Areas (mm square)

Span	Top L	Bot L	Top M	Bot M	Top R	Bot R
1	108	0	147	108	608	0
2	608	0	248	108	108	0

Maximum Spacing of Shear Stirrups in mm

Span	leg	L-zone spacing	dia.	R-zone spacing	dia.	Rest-spc dia.
1	2	0.55	214	8	0.55	214
2	2	0.25	214	8	0.25	214

Span	1	2
Span/Depth	7.7	3.5
Allowable	10.3	51.8

108	147	608	248	108	Requ. Top
2 Φ 14	2 Φ 14	2 Φ 14	2 Φ 14	2 Φ 14	
0 Φ 0	0 Φ 0	0 Φ 0	0 Φ 0	0 Φ 0	
308	308	308	308	308	Prov. Top

span 1		span 2		
0	108	0	108	0 Requ. Bot
0 Φ 0	2 Φ 14	0 Φ 0	2 Φ 14	0 Φ 0
0 Φ 0	0 Φ 0	0 Φ 0	0 Φ 0	0 Φ 0
0	308	0	308	0 Prov. Bot



SPANS Bent and Beam Analysis Program V4.1
 SPANS Prepared by H. Saffarini 2/2/93
 bas-b7

Number of spans = 1 Number of load cases = 1

Span	Length	Width	Depth	Flange thickness	Flange width
1	1.800	0.300	0.320	0.000	0.300

Load case number : 1

Span	UDL	Load 1		Load 2		Load 3		Load 4		Load 5	
		Val	Dis	Val	Dis	Val	Dis	Val	Dis	Val	Dis
1	100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Span	Line Load	From	Length	Intensity
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Support	Width	Redistribution
1	0.000	0 %
	0.000	0 %

Envelope

Span	lft BM	span BM	rgt BM	lft SF	rgt SF
1	0.0	40.5	0.0	90.0	-90.0

Required Steel Areas (mm square)

Span	Top L	Bot L	Top M	Bot M	Top R	Bot R
1	130	0	0	434	130	0

Maximum Spacing of Shear Stirrups in mm

Span	leg L-zone	spacing	dia.	R-zone	spacing	dia.	Rest-spc	dia.
1	2	0.45	214	8	0.45	214	8	214

Span	1
Span/Depth	6.3
Allowable	32.4

130	0	130	Requ. Top
0 Φ 10	3 Φ 10	3 Φ 10	
0 Φ 0	0 Φ 0	0 Φ 0	
236	236	236	Prov. Top

span 1			
0	434	0	Requ. Bot
0 Φ 0	3 Φ 16	4 Φ 0	
0 Φ 0	0 Φ 0	0 Φ 0	
0	603	0	Prov. Bot

Retaining Wall Design : Propped cantilever exam

Input Data

Wall Dimensions				Live Loads		General Parameters		Design Parameters	
H1 (m)	4.05	C (m)	0.4	w (kN/m ²)	2	Soil Frict (°)	35	SF Overt.	1.5
H2 (m)	.8	F (m)		P (kN)	155	Fill slope (°)		SF Slip	1.5
H3 (m)		xf (m)		xp (m)	.15	Wall Frict (°)	12	DL Factor	1.2
Hw (m)		At (m)	.3	L (kN/m)		Conc Density	25	LL Factor	1.6
Hr (m)		Ab (m)	.3	xl (m)		Soil Density	20	Pmax (kPa)	250
B (m)	1	Cover: wall	50	Lh (kN/m)		fcu (MPa)	25		
D (m)		Cover: base	50	x (m)		fy (MPa)	414		

Seepage allowed

Theory : Coulomb
Wall type : Propped cantilever

SEISMIC ANALYSIS SETTINGS:

Seismic Analysis ON/OFF: ON

Hor Accel. (g)	.15
Vert Accel. (g)	.05
Include LL's	Y

Active Pressure coefficient Ka : 0.25
Passive Pressure coefficient Kp : 5.76
Seismic Active Pressure coefficient Kas : 0.33
Seismic Passive Pressure coefficient Kps : 2.58
Base frictional constant μ : 0.70

FORCES ACTING ON THE WALL:

Description	FORCES (kN) and their LEVER ARMS (m)			
	F Horizontal left (+)	Lever arm	F Vertical down (+)	Lever arm
Destabilizing forces:				
Total Active pressure Pa	54.080	1.605	11.272	1.300
Siesmic component of Pa	12.842	2.430	2.730	1.300
As a result of surcharge w	2.488	2.025	0.529	1.300
Siesmic wall inertia	5.466	2.025		
Stabilizing forces:				
Passive pressure on base Pp	-16.499	0.267		
Siesmic component of Pp	20.360	0.480		
Weight of the wall + base			38.356	0.989
Weight of soil on the base			7.600	0.500
Point load of 155.00 kN on backfill			19.136	1.150
UDL of 2.0 kN/m ²			0.000	1.300

EQUILIBRIUM CALCULATIONS AT SLS

1. Force Equilibrium

Sum of Vertical forces Pv : 94.1 kN
Frictional resistance Pfric : 65.9 kN
Passive Pressure on shear key : -0.0 kN
Passive pressure on base : 16.5 kN
Horizontal reaction at top : 17.0 kN

→ Horizontal resistance Pr : 119.7 kN

Horizontal sliding force F_h : 62.0 kN

Safety factor against overall sliding = $F_r/F_h = 1.93$

Reaction at base : 45.1 kN

Resistance at base : 82.4 kN

Safety factor against base sliding = $F_r(\text{base})/R(\text{base}) = 2.28$

SOIL PRESSURES UNDER BASE

Maximum pressure : 100.3 kPa

Minimum pressure : 87.9 kPa

Maximum pressure occurs at right hand side of base

WALL MOMENTS (ULS) AND REINFORCEMENT TO BS8110 - 1997

Position from base top (m)	Moment (kNm)	Front Reinforcing (mm^2/m)	Back Reinforcing (mm^2/m)	Nominal (0.13%) (mm^2/m)
0.00	21.97	0.00	245.05	390.00
0.07	18.94	0.00	211.19	390.00
0.15	15.94	0.00	177.78	390.00
0.22	13.01	0.00	145.04	390.00
0.29	10.16	0.00	113.25	390.00
0.36	7.41	0.00	82.63	390.00
0.44	4.79	0.00	53.44	390.00
0.51	2.31	0.00	25.78	390.00
0.58	-0.03	0.36	0.00	390.00
0.66	-2.24	25.00	0.00	390.00
0.73	-4.32	48.17	0.00	390.00
0.80	-6.27	69.88	0.00	390.00
0.88	-8.08	90.16	0.00	390.00
0.95	-9.78	109.02	0.00	390.00
1.02	-11.34	126.49	0.00	390.00
1.09	-12.79	142.58	0.00	390.00
1.17	-14.11	157.32	0.00	390.00
1.24	-15.31	170.73	0.00	390.00
1.31	-16.39	182.83	0.00	390.00
1.39	-17.36	193.63	0.00	390.00
1.46	-18.22	203.16	0.00	390.00
1.53	-18.96	211.45	0.00	390.00
1.61	-19.59	218.50	0.00	390.00
1.68	-20.12	224.34	0.00	390.00
1.75	-20.53	229.00	0.00	390.00
1.82	-20.85	232.48	0.00	390.00
1.90	-21.06	234.82	0.00	390.00
1.97	-21.17	236.03	0.00	390.00
2.04	-21.17	236.13	0.00	390.00
2.12	-21.09	235.15	0.00	390.00
2.19	-20.90	233.10	0.00	390.00
2.26	-20.63	230.01	0.00	390.00
2.34	-20.26	225.89	0.00	390.00
2.41	-19.80	220.77	0.00	390.00
2.48	-19.25	214.67	0.00	390.00
2.55	-18.62	207.60	0.00	390.00
2.63	-17.90	199.59	0.00	390.00
2.70	-17.10	190.66	0.00	390.00
2.77	-16.22	180.83	0.00	390.00
2.85	-15.25	170.11	0.00	390.00
2.92	-14.22	158.54	0.00	390.00
2.99	-13.10	146.12	0.00	390.00
3.07	-11.92	132.89	0.00	390.00
3.14	-10.66	118.86	0.00	390.00
3.21	-9.33	104.05	0.00	390.00
3.28	-7.93	88.48	0.00	390.00
3.36	-6.47	72.18	0.00	390.00
3.43	-4.95	55.16	0.00	390.00
3.50	-3.36	37.44	0.00	390.00



PROKON

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Job Number

Job Title

Client

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Date

3.65 0.00 0.00 0.00 390.00

BASE MOMENTS (ULS) AND REINFORCEMENT TO BS8110 - 1997

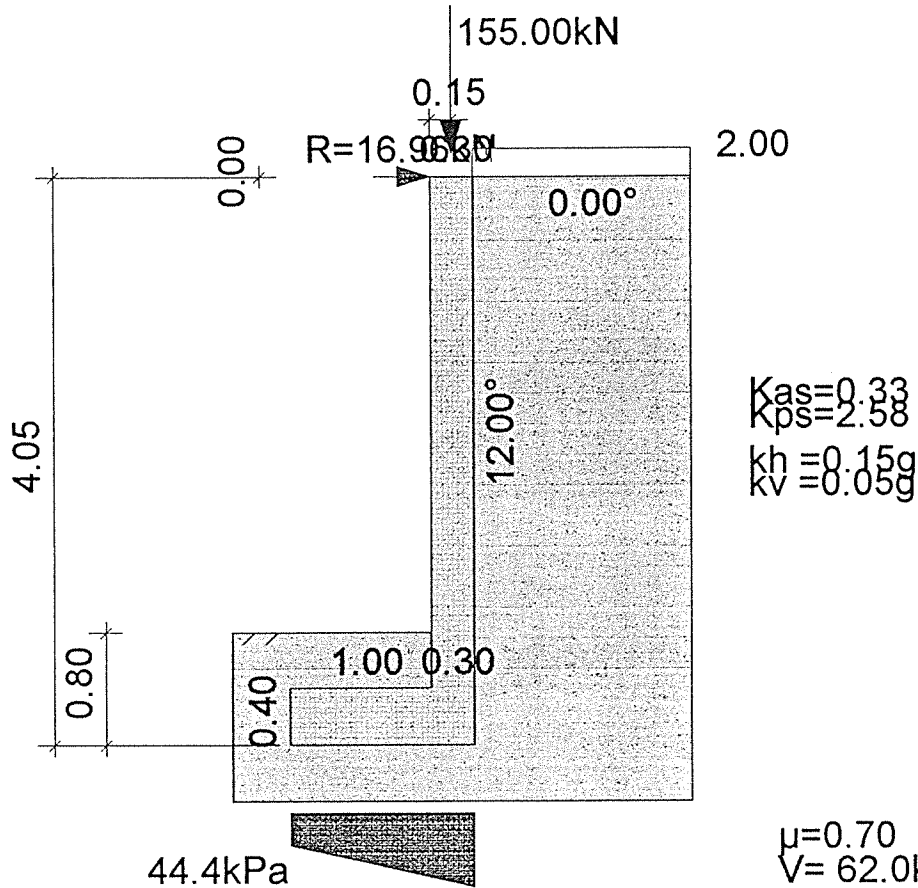
Position from left (m)	Moment (kNm)	Top Reinforcing (mm ² /m)	Bot Reinforcing (mm ² /m)	Nominal (0.13%) (mm ² /m)
0.03	-0.00	0.00	0.00	520.00
0.05	-0.02	0.00	0.16	520.00
0.08	-0.08	0.00	0.64	520.00
0.10	-0.18	0.00	1.44	520.00
0.13	-0.33	0.00	2.56	520.00
0.16	-0.51	0.00	4.00	520.00
0.18	-0.73	0.00	5.76	520.00
0.21	-1.00	0.00	7.84	520.00
0.23	-1.30	0.00	10.24	520.00
0.26	-1.65	0.00	12.96	520.00
0.29	-2.03	0.00	15.99	520.00
0.31	-2.46	0.00	19.35	520.00
0.34	-2.93	0.00	23.03	520.00
0.36	-3.43	0.00	27.03	520.00
0.39	-3.98	0.00	31.35	520.00
0.42	-4.57	0.00	35.99	520.00
0.44	-5.20	0.00	40.94	520.00
0.47	-5.87	0.00	46.22	520.00
0.49	-6.58	0.00	51.82	520.00
0.52	-7.33	0.00	57.74	520.00
0.55	-8.13	0.00	63.98	520.00
0.57	-8.96	0.00	70.53	520.00
0.60	-9.83	0.00	77.41	520.00
0.62	-10.75	0.00	84.61	520.00
0.65	-11.70	0.00	92.13	520.00
0.68	-12.70	0.00	99.96	520.00
0.70	-13.74	0.00	108.12	520.00
0.73	-14.81	0.00	116.60	520.00
0.75	-15.93	0.00	125.39	520.00
0.78	-17.09	0.00	134.51	520.00
0.81	-18.29	0.00	143.95	520.00
0.83	-19.53	0.00	153.70	520.00
0.86	-20.81	0.00	163.78	520.00
0.88	-22.13	0.00	174.18	520.00
0.91	-23.49	0.00	184.89	520.00
0.94	-24.89	0.00	195.93	520.00
0.96	-26.33	0.00	207.28	520.00
0.99	-27.82	0.00	218.96	520.00
1.01	-29.34	0.00	230.95	520.00
1.04	-30.90	0.00	243.27	520.00
1.07	-32.51	0.00	255.91	520.00
1.09	-34.15	0.00	268.86	520.00
1.12	-35.84	0.00	282.14	520.00
1.14	-37.57	0.00	295.73	520.00
1.17	-39.34	0.00	309.65	520.00
1.20	-39.75	0.00	312.90	520.00
1.22	-1.43	11.23	0.00	520.00
1.25	-1.07	8.43	0.00	520.00
1.27	-0.69	5.40	0.00	520.00
1.30	-0.39	3.04	0.00	520.00

SHEAR CHECK AT WALL-BASE JUNCTION TO BS8110 - 1997

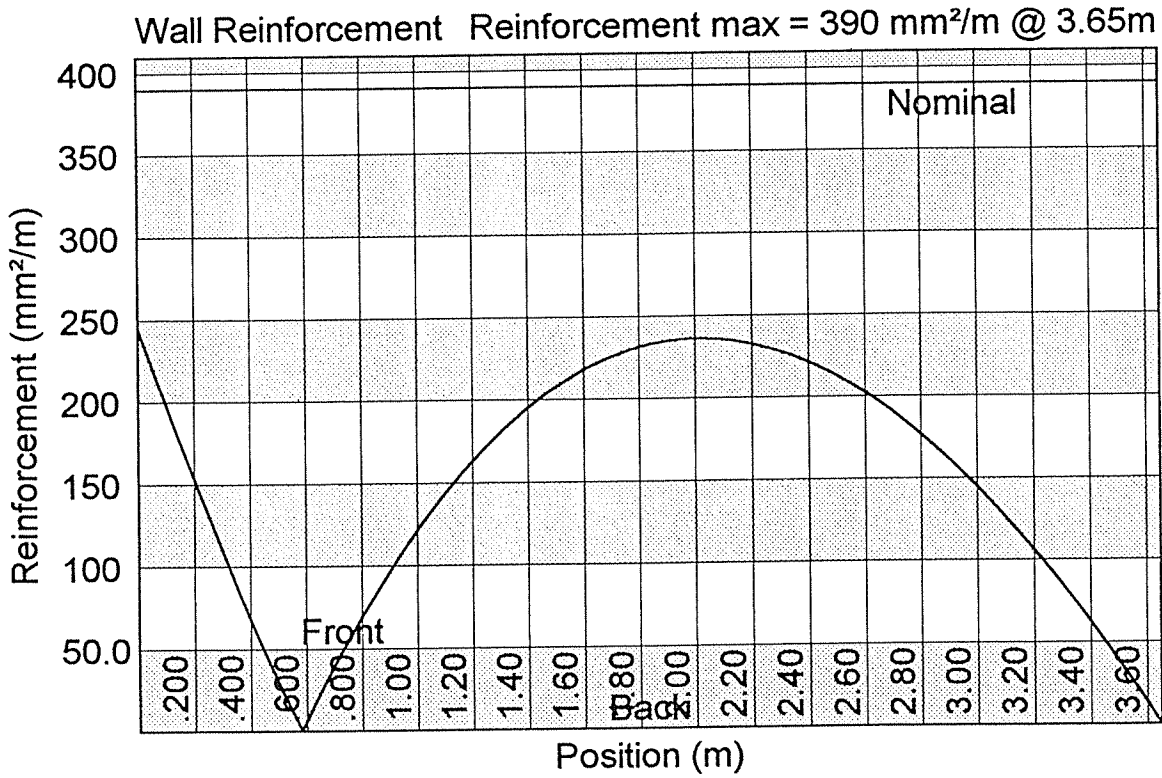
Shear force at bottom of wall $V = 62.0$ kN
 Shear stress at bottom of wall $v = 0.26$ MPa OK
 Allowable shear stress $vc = 1.04$ MPa (based on Wall tensile reinf.)

Sketch of Wall

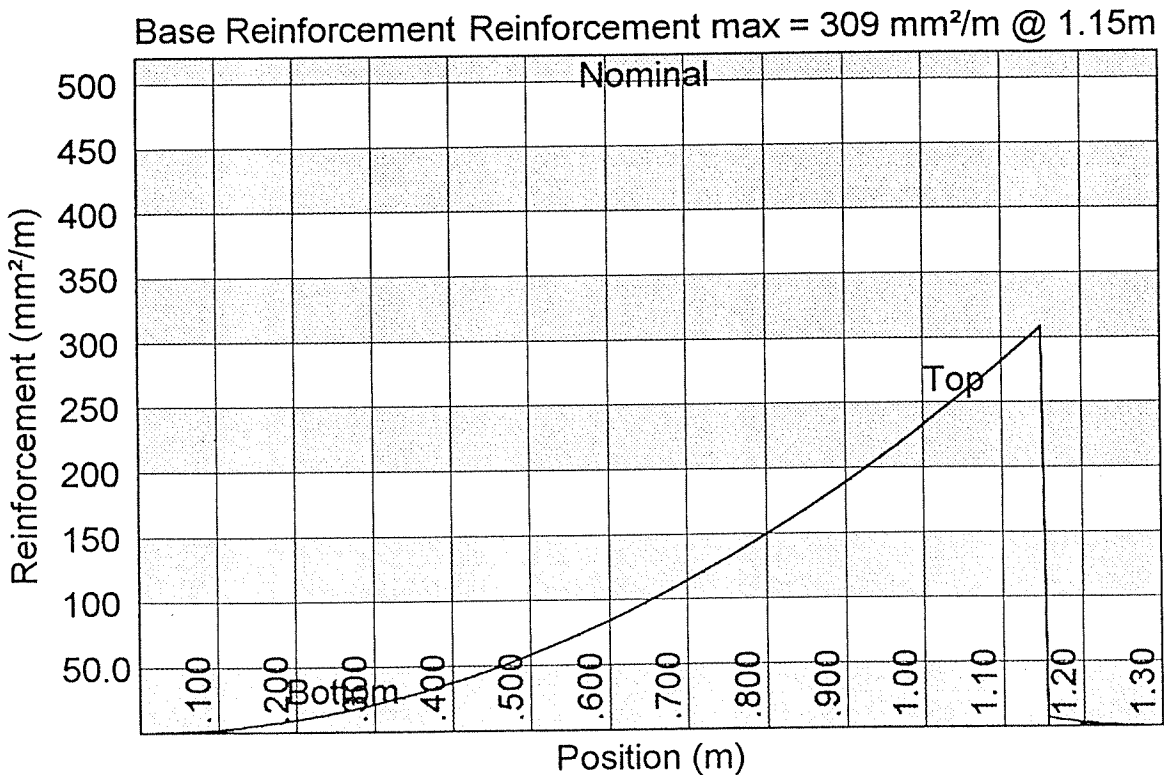
Design code: BS8110 - 1997

Wall type: Propped cantilever
Theory: Coulomb

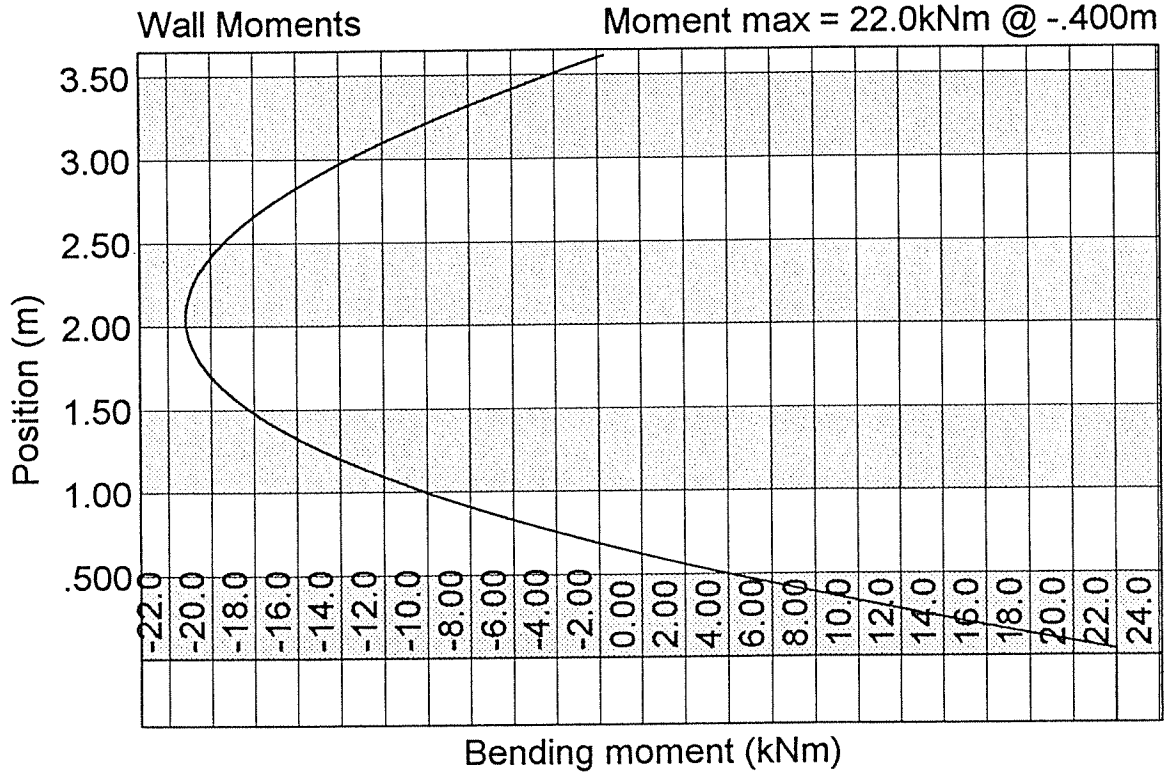
Wall Reinforcement



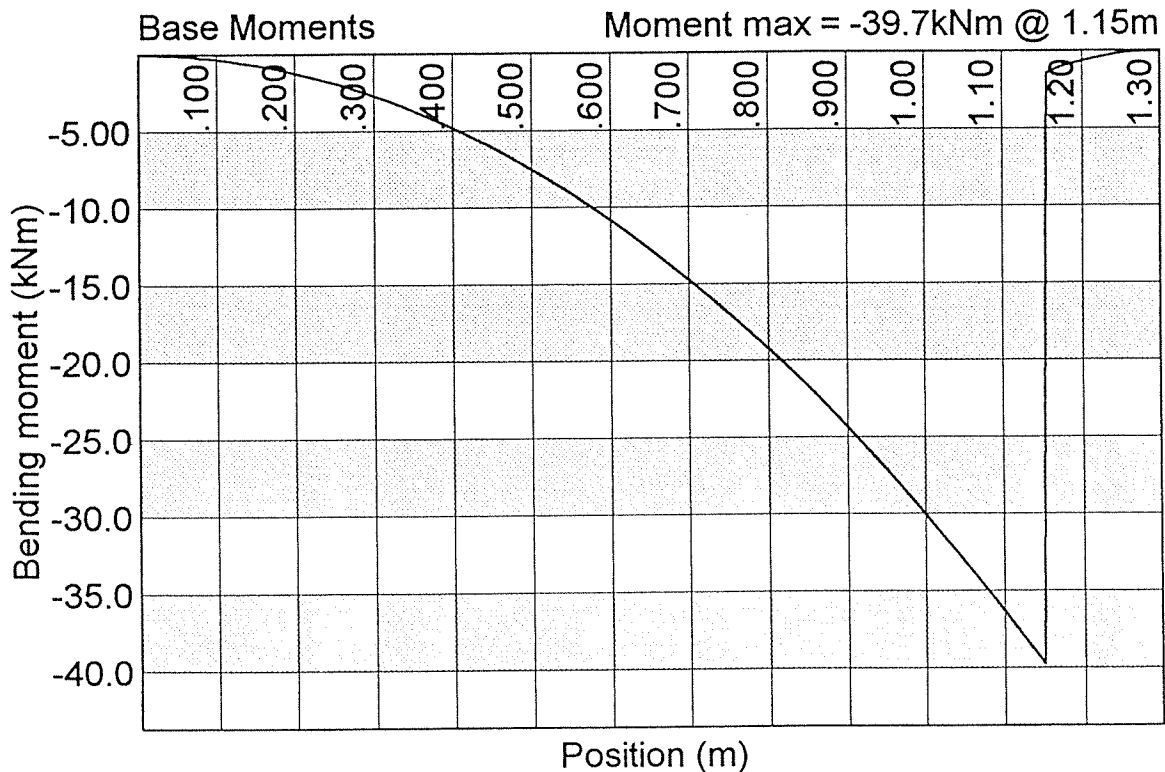
Base Reinforcement



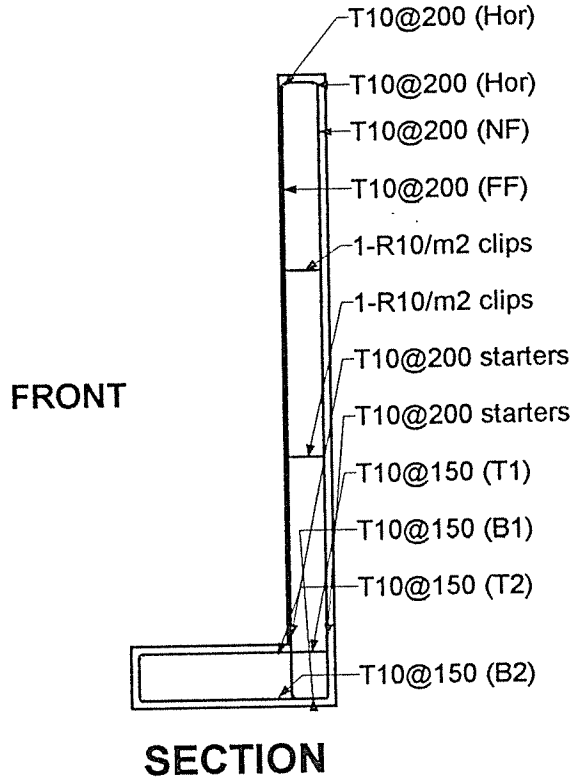
Wall Bending Moments



Base Bending Moments



Schematic Reinforcement



height of exterior wall (Basement) = (3.37 - 6.43) ≈ 3.05 meters

$$l_c/25 = 3050/25 = 122 \text{ mm}$$

From Arch. Drawings ⇒ USE 220 mm

$$e = 25 < h/6 = 36.7 \text{ mm}$$

(ACI) Empirical Design method can be used

Effective length factor $k = 1.0$

$$\phi P_{nw} = 0.55 \phi f_c' A_g \left(1 - \left(\frac{k l_c}{32 h} \right)^2 \right)$$

$$\phi = 0.7$$

$$\phi P_{nw} = 0.55 (0.7) \times 21 \times (1000 \times 220) \left(1 - \left(\frac{1 \times 3050}{32 \times 220} \right)^2 \right)$$

$$= 1444.85 \text{ kN} > 105 \text{ kN}$$

For seismic USE $\rho = .0025$ for vertical & horizontal Reinf.

$$A_s \Rightarrow 0.0025 \times 1000 \times 22 = 5.5 \text{ cm}^2/\text{m}/\text{Two Faces}$$

$$\text{For one side} = 2.75 \text{ cm}^2/\text{m}$$

USE $\phi 10 @ 25 \text{ cm}$ (For Exterior walls)



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Horizontal sliding force F_h : 8.6 kN

Safety factor against overall sliding = $F_r/F_h = 8.55$

Reaction at base : 6.8 kN

Resistance at base : 68.9 kN

Safety factor against base sliding = $F_r(\text{base})/R(\text{base}) = 10.56$

SOIL PRESSURES UNDER BASE

Maximum pressure : 70.5 kPa

Minimum pressure : 66.8 kPa

Maximum pressure occurs at right hand side of base

WALL MOMENTS (ULS) AND REINFORCEMENT TO BS8110 - 1997

Position from base top (m)	Moment (kNm)	Front Reinforcing (mm^2/m)	Back Reinforcing (mm^2/m)	Nominal (0.13%) (mm^2/m)
0.00	1.90	0.00	21.15	390.00
0.07	1.89	0.00	21.07	390.00
0.15	1.78	0.00	19.88	390.00
0.22	1.60	0.00	17.88	390.00
0.29	1.38	0.00	15.39	390.00
0.36	1.14	0.00	12.73	390.00
0.44	0.91	0.00	10.20	390.00
0.51	0.71	0.00	7.94	390.00
0.58	0.52	0.00	5.83	390.00
0.66	0.34	0.00	3.82	390.00
0.73	0.17	0.00	1.90	390.00
0.80	0.01	0.00	0.07	390.00
0.88	-0.15	1.67	0.00	390.00
0.95	-0.30	3.32	0.00	390.00
1.02	-0.44	4.88	0.00	390.00
1.09	-0.57	6.34	0.00	390.00
1.17	-0.69	7.72	0.00	390.00
1.24	-0.81	9.00	0.00	390.00
1.31	-0.91	10.19	0.00	390.00
1.39	-1.01	11.29	0.00	390.00
1.46	-1.10	12.30	0.00	390.00
1.53	-1.18	13.21	0.00	390.00
1.61	-1.26	14.04	0.00	390.00
1.68	-1.32	14.77	0.00	390.00
1.75	-1.38	15.42	0.00	390.00
1.82	-1.43	15.97	0.00	390.00
1.90	-1.47	16.42	0.00	390.00
1.97	-1.51	16.79	0.00	390.00
2.04	-1.53	17.07	0.00	390.00
2.12	-1.55	17.25	0.00	390.00
2.19	-1.56	17.35	0.00	390.00
2.26	-1.56	17.35	0.00	390.00
2.34	-1.55	17.26	0.00	390.00
2.41	-1.53	17.08	0.00	390.00
2.48	-1.51	16.80	0.00	390.00
2.55	-1.47	16.44	0.00	390.00
2.63	-1.43	15.98	0.00	390.00
2.70	-1.38	15.44	0.00	390.00
2.77	-1.33	14.80	0.00	390.00
2.85	-1.26	14.07	0.00	390.00
2.92	-1.19	13.25	0.00	390.00
2.99	-1.11	12.33	0.00	390.00
3.07	-1.02	11.33	0.00	390.00
3.14	-0.92	10.23	0.00	390.00
3.21	-0.81	9.05	0.00	390.00
3.28	-0.70	7.77	0.00	390.00
3.36	-0.57	6.40	0.00	390.00
3.43	-0.44	4.93	0.00	390.00
3.50	-0.30	3.38	0.00	390.00

3.65 0.00 0.00 0.00 390.00

BASE MOMENTS (ULS) AND REINFORCEMENT TO BS8110 - 1997

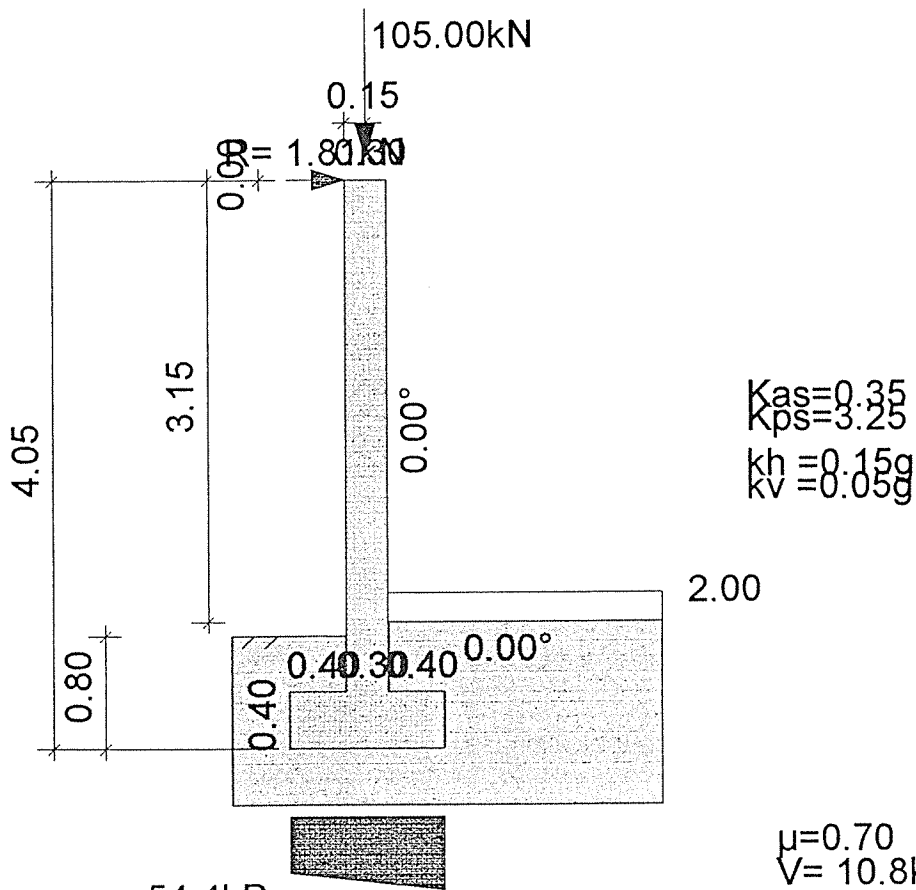
Position from left (m)	Moment (kNm)	Top Reinforcing (mm ² /m)	Bot Reinforcing (mm ² /m)	Nominal (0.13%) (mm ² /m)
0.02	-0.00	0.00	0.00	520.00
0.04	-0.01	0.00	0.11	520.00
0.07	-0.06	0.00	0.44	520.00
0.09	-0.13	0.00	1.00	520.00
0.11	-0.23	0.00	1.78	520.00
0.13	-0.35	0.00	2.77	520.00
0.15	-0.51	0.00	3.99	520.00
0.18	-0.69	0.00	5.44	520.00
0.20	-0.90	0.00	7.10	520.00
0.22	-1.14	0.00	8.99	520.00
0.24	-1.41	0.00	11.10	520.00
0.26	-1.71	0.00	13.43	520.00
0.29	-2.03	0.00	15.98	520.00
0.31	-2.38	0.00	18.75	520.00
0.33	-2.76	0.00	21.75	520.00
0.35	-3.17	0.00	24.96	520.00
0.37	-3.61	0.00	28.40	520.00
0.40	-4.07	0.00	32.07	520.00
0.42	-4.57	0.00	35.95	520.00
0.44	-5.09	0.00	40.05	520.00
0.46	-5.64	0.00	44.38	520.00
0.48	-6.22	0.00	48.93	520.00
0.51	-6.82	0.00	53.70	520.00
0.53	-7.46	0.00	58.70	520.00
0.55	-8.12	0.00	63.91	520.00
0.57	-8.81	69.35	0.00	520.00
0.59	-8.81	69.35	0.00	520.00
0.62	-9.90	77.95	0.00	520.00
0.64	-9.13	71.84	0.00	520.00
0.66	-8.38	65.98	0.00	520.00
0.68	-7.67	60.37	0.00	520.00
0.70	-6.99	55.00	0.00	520.00
0.73	-6.34	49.89	0.00	520.00
0.75	-5.72	45.03	0.00	520.00
0.77	-5.13	40.41	0.00	520.00
0.79	-4.58	36.05	0.00	520.00
0.81	-4.06	31.93	0.00	520.00
0.84	-3.56	28.06	0.00	520.00
0.86	-3.11	24.45	0.00	520.00
0.88	-2.68	21.08	0.00	520.00
0.90	-2.28	17.96	0.00	520.00
0.92	-1.92	15.09	0.00	520.00
0.95	-1.58	12.47	0.00	520.00
0.97	-1.28	10.10	0.00	520.00
0.99	-1.01	7.98	0.00	520.00
1.01	-0.78	6.11	0.00	520.00
1.03	-0.57	4.49	0.00	520.00
1.06	-0.40	3.12	0.00	520.00
1.08	-0.25	2.00	0.00	520.00
1.10	-0.14	1.12	0.00	520.00

SHEAR CHECK AT WALL-BASE JUNCTION TO BS8110 - 1997

Shear force at bottom of wall V = 10.8 kN
 Shear stress at bottom of wall v = 0.05 MPa OK
 Allowable shear stress vc = 1.04 MPa (based on Wall tensile reinf.)

Sketch of Wall

Design code: BS8110 - 1997



$K_{as} = 0.35$
 $K_{ps} = 3.25$
 $k_h = 0.15g$
 $k_v = 0.05g$

$\mu = 0.70$
 $V = 10.8kN$
 $v = 0.05MPa$
 $vc = 1.04MPa$

54.4kPa 70.5kPa
 Wall type: Propped cantilever
 Theory: Coulomb
 $\text{Seep} = 8.55$



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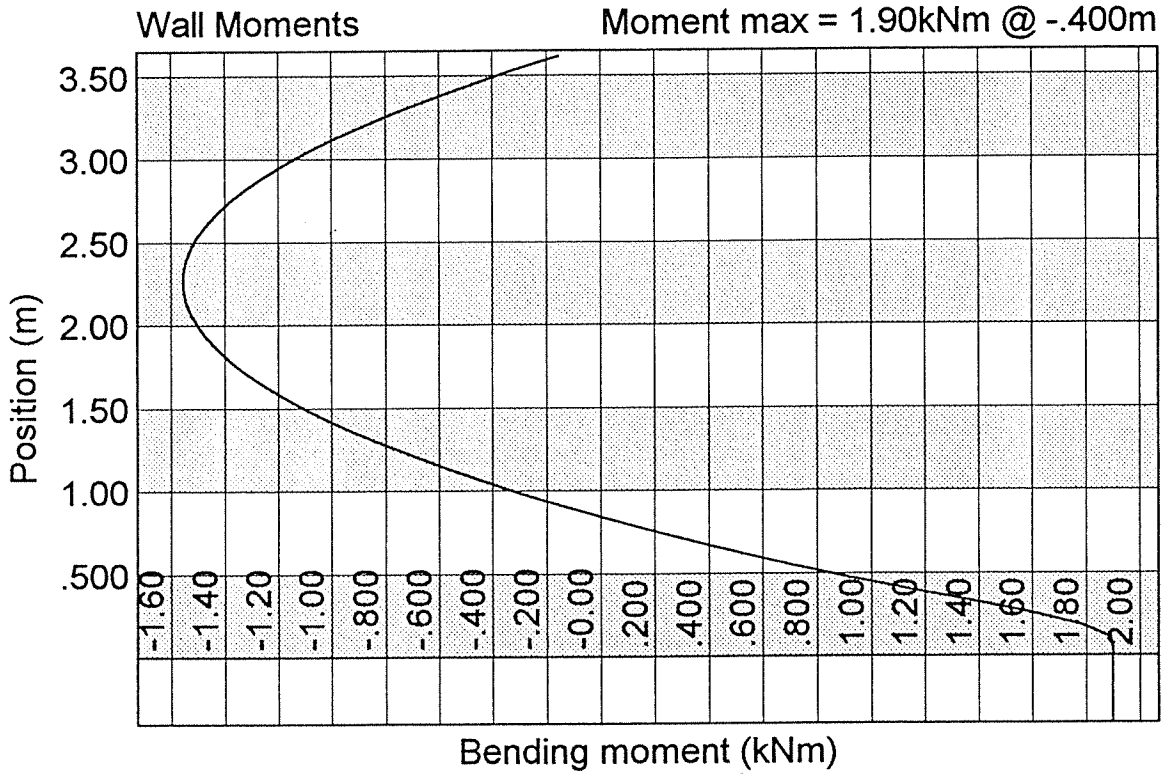
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Calcs by

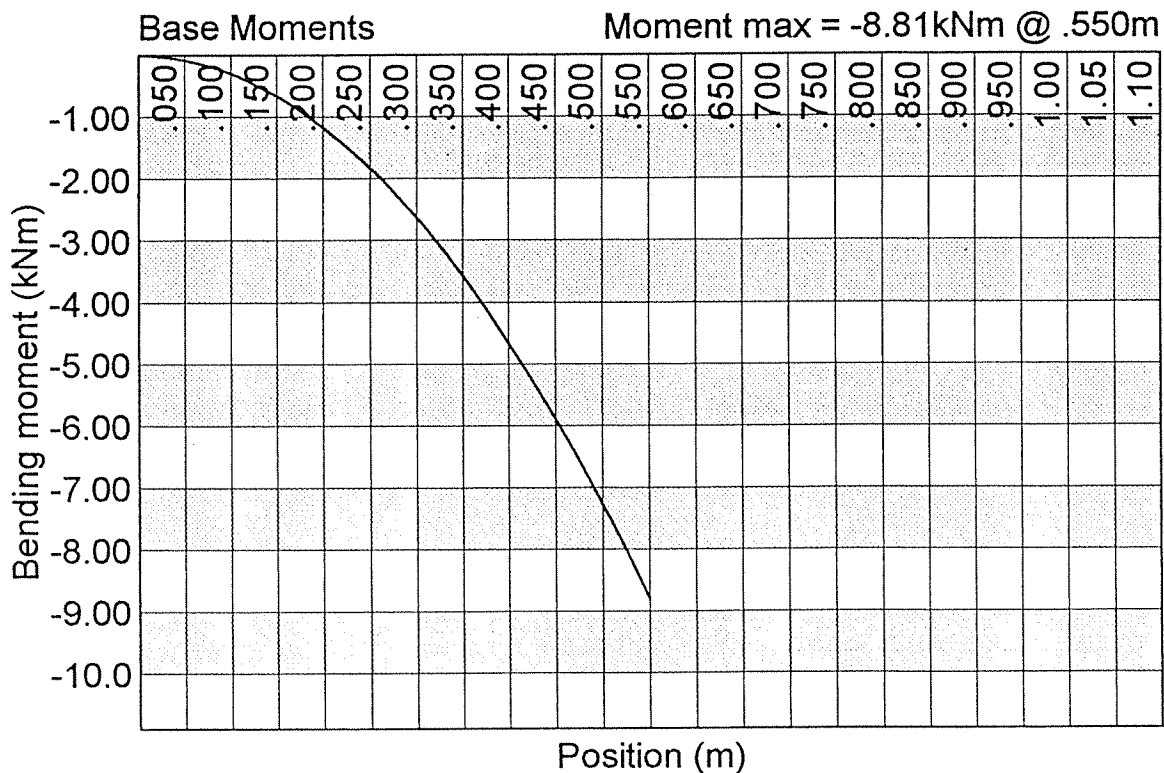
Checked by

Date

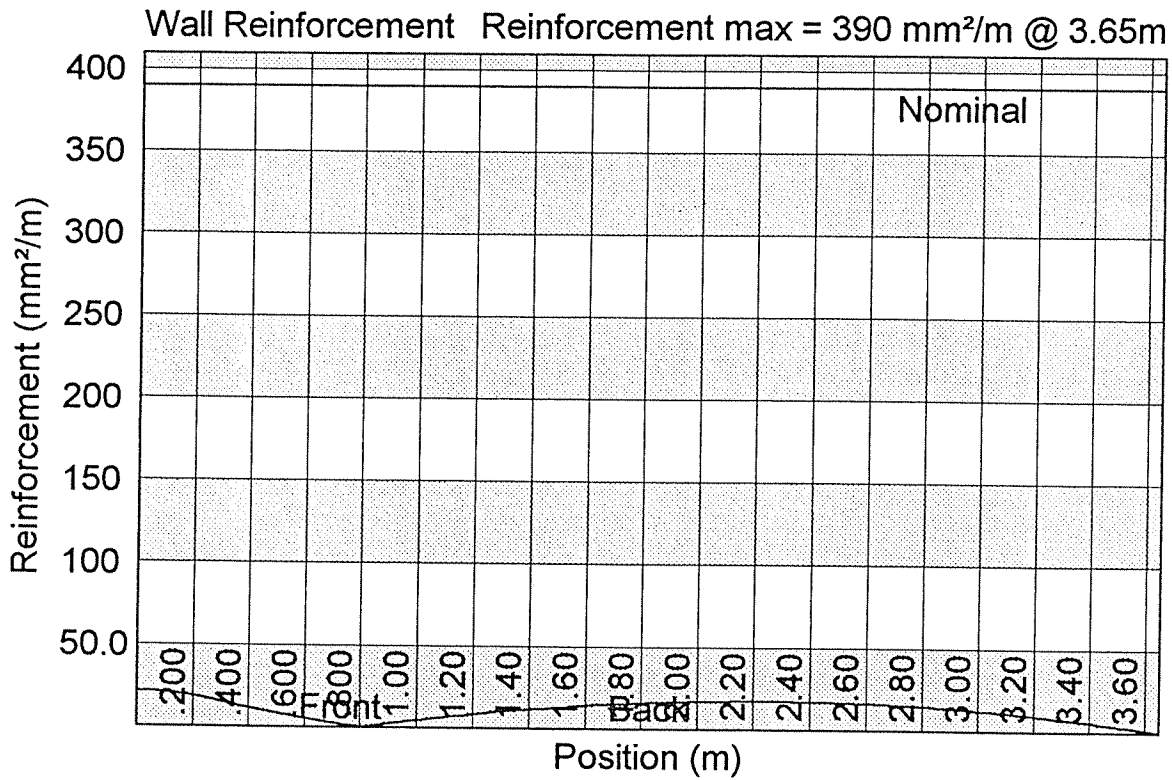
Wall Bending Moments



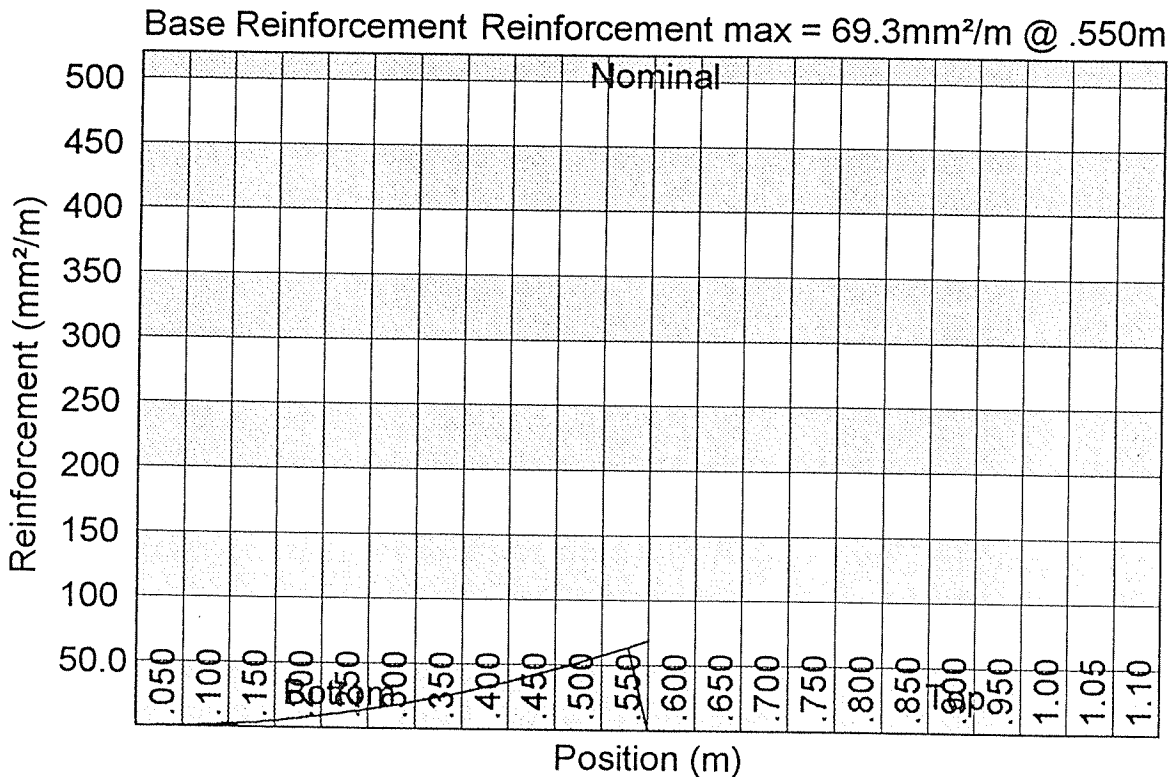
Base Bending Moments



Wall Reinforcement



Base Reinforcement



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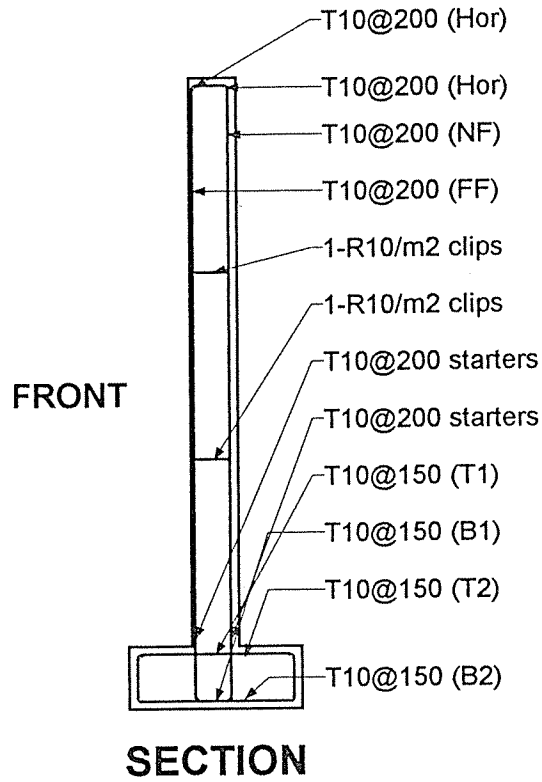
Client

Calcs by

Checked by

Date

Schematic Reinforcement



Concrete Base Design :

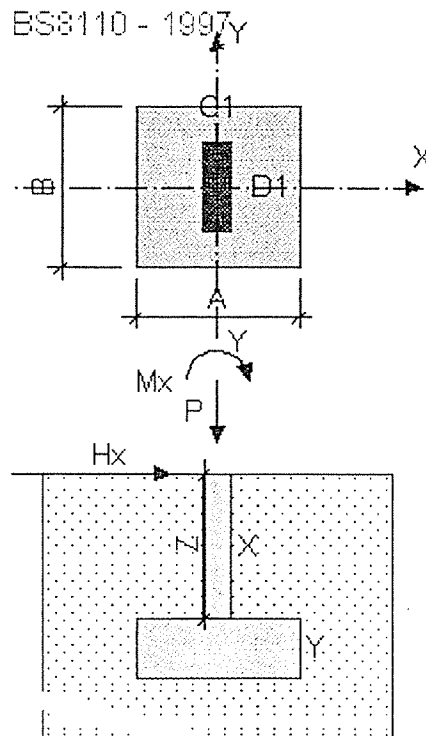
Input Data

Base Length A (m)	1.1
Base Width B (m)	1.1
Column(s)	Col 1 Col 2
C (m)	.2
D (m)	.6
E (m)	
F (m)	
Stub column height X (m)	1
Base Depth Y (m)	0.40
Soil Cover Z (m)	1
Concrete Density (kN/m ³)	25
Soil Density (kN/m ³)	20
Soil friction angle (°)	35
Base friction constant	1.4
Reinf. depth top X (mm)	50
Reinf. depth top Y (mm)	50
Reinf. depth bottom X (mm)	50
Reinf. depth bottom Y (mm)	50
Min Load Factor: self weight	1.5

Allow Bearing Press. (kN/m ²)	250
S.F. Overturning (ULS)	1
S.F. Slip (ULS)	1.5
f _{cu} base (MPa)	25
f _{cu} columns (MPa)	25
f _y (MPa)	414

		Loads						
Load Case	Column no.	LF min	LF max	P (kN)	H _x (kN)	H _y (kN)	M _x (kNm)	M _y (kNm)
1	1	1.45	1.45	250				

Sketch of Base



Output for Load Case 1

OUTPUT FOR LOAD CASE 1	
Max. soil pressure (kPa)	237.11
SF overturning (SLS)	>100
SF overturning (ULS)	>100
Safety Factor slip (ULS)	>100
Safety Factor uplift (ULS)	>100
BOTTOM:	
Design moment X (kNm)	30.39
Reinforcement X (mm ² /m)	232
Design moment Y (kNm)	9.38
Reinforcement Y (mm ² /m)	72
TOP:	
Design moment X (kNm)	0.00
Reinforcement X (mm ² /m)	0
Design moment Y (kNm)	0.00
Reinforcement Y (mm ² /m)	0
Linear shear X (kN)	0.094
vc X (MPa)	0.347
Linear shear Y (kN)	0.000
vc Y (MPa)	0.347
Linear shear other (kN)	0.000
Punching shear (kN)	0.000
vc Punch	0.347

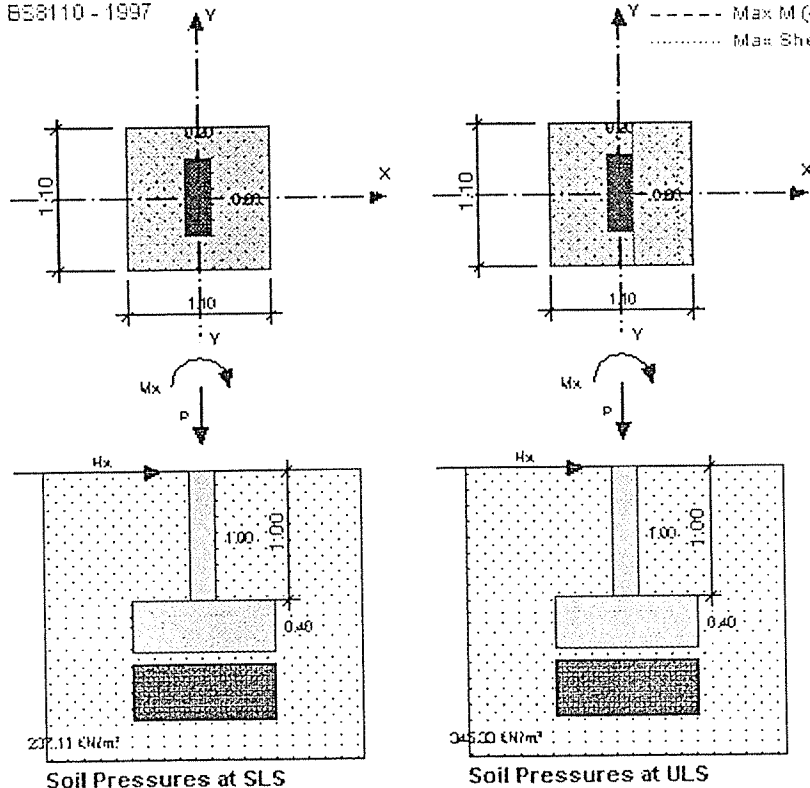
1

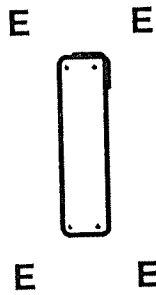
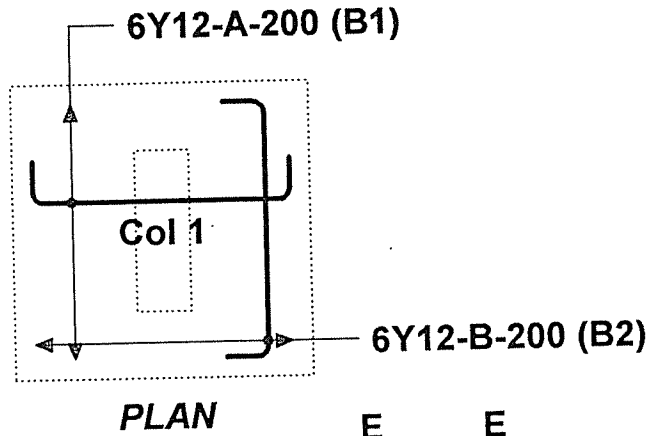
Load Case:1

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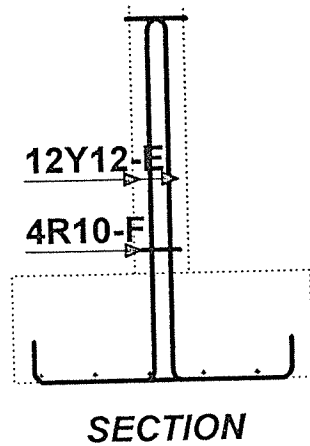
Legend

..... Max M (+)
- - - - - Max M (-)
..... Max Shear



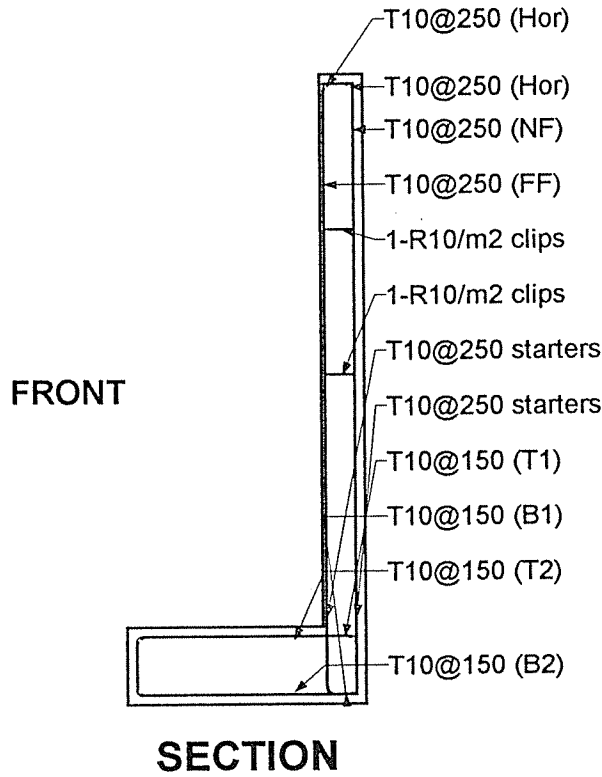


Section:Column 1

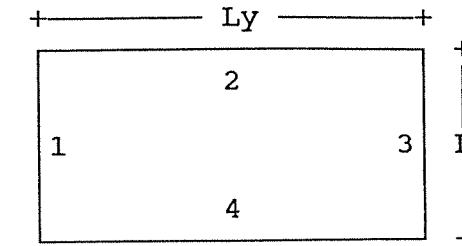


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Client		
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Schematic Reinforcement



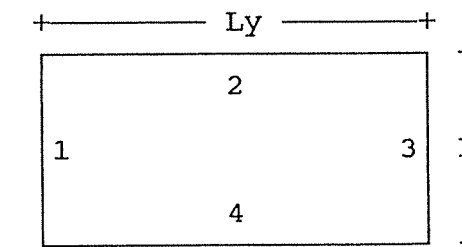

RECTANGULAR PANELS SUPPORTED ON FOUR SIDES

$f_{cu} = 25$ MPa $f_y = 414$ MPa $L_x = 6.2$ metres $L_y = 8.7$ metres $w = 20$ kN/m ² $h = 200$ mm	SIDE 1 Free SIDE 2 Free SIDE 3 Free SIDE 4 Free	
--	--	---

	M	d	R	x/d	p	p'	As	As'
SIDE 1	+0.0	150	0.00	0.00	0.00	0.00	0	0
SIDE 2	+0.0	150	0.00	0.00	0.00	0.00	0	0
SIDE 3	+0.0	150	0.00	0.00	0.00	0.00	0	0
SIDE 4	+0.0	150	0.00	0.00	0.00	0.00	0	0
SPAN x	+67.0	150	2.98	0.35	0.98	0.00	1475	0
SPAN y	+43.1	150	1.91	0.21	0.59	0.00	881	0

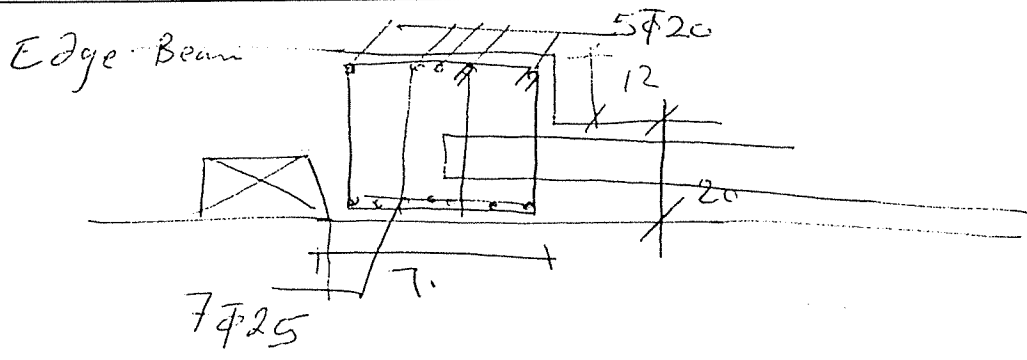
غير
 16 @ 12.5
 12 @ 12.5
 طول

RECTANGULAR PANELS SUPPORTED ON FOUR SIDES

$f_{cu} = 25$ MPa $f_y = 414$ MPa $L_x = 4.2$ metres $L_y = 6.2$ metres $w = 20$ kN/m ² $h = 200$ mm	SIDE 1 Free SIDE 2 Free SIDE 3 Free SIDE 4 Free	
--	--	--

	M	d	R	x/d	p	p'	As	As'
SIDE 1	+0.0	150	0.00	0.00	0.00	0.00	0	0
SIDE 2	+0.0	150	0.00	0.00	0.00	0.00	0	0
SIDE 3	+0.0	150	0.00	0.00	0.00	0.00	0	0
SIDE 4	+0.0	150	0.00	0.00	0.00	0.00	0	0
SPAN x	+32.1	150	1.43	0.15	0.43	0.00	639	0
SPAN y	+19.8	150	0.88	0.09	0.25	0.00	382	0

غير
 12 @ 17.5
 10 @ 20
 طول



SITE WORK

Input Data

Wall Dimensions				Live Loads		General Parameters		Design Parameters	
H1 (m)	3.5	C (m)	.45	wV (kN/m ²)	2	Soil Frict (°)	35	SF Overt.	1.5
H2 (m)	.5	F (m)		P (kN)		Fill slope (°)	0	SF Slip	1.5
H3 (m)	0	x1 (m)		xp (m)		Wall Frict (°)	12	DL Factor	1.4
Hw (m)	0	At (m)	.25	L (kN/m)		Conc Density	25	LL Factor	1.6
Hr (m)		Ab (m)	.3	x1 (m)		Soil Density	20	Pmax (kPa)	400
B (m)	.3	Cover: wall	50	Lh (kN/m)		fcu (MPa)	25		
D (m)	1.05	Cover: base	50	x (m)		fy (MPa)	414		

Seepage not allowed

Theory : Coulomb
 Wall type : Cantilever

SEISMIC ANALYSIS SETTINGS:

Seismic Analysis ON/OFF:ON

Hor Accel. (g)	.15
Vert Accel. (g)	.05
Include LL's	Y

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Job Title		
Client		
Calcs by	Checked by	Date

Retaining Wall Design : WALL W3

Input Data

C14


Seepage not allowed

Theory : Coulomb
 Wall type : Cantilever

SEISMIC ANALYSIS SETTINGS:

Seismic Analysis ON/OFF:ON

VALUES OF PRESSURE COEFFICIENTS:

Active Pressure coefficient K_a :0.26
 Passive Pressure coefficient K_p :5.76
 Seismic Active Pressure coefficient K_{as} :0.34
 Seismic Passive Pressure coefficient K_{ps} :2.58
 Base frictional constant μ :0.70

FORCES ACTING ON THE WALL:

Description	FORCES (kN) and their LEVER ARMS (m)			
	F Horizontal left (+)	Lever arm	F Vertical down (+)	Lever arm
Destabilizing forces:				
Total Active pressure Pa	41.124	1.372	9.249	0.580
Seismic component of Pa	9.595	2.100	2.205	0.570
As a result of surcharge w	2.185	1.750	0.502	0.579
Seismic wall inertia	5.352	1.750		
Stabilizing forces:				
Passive pressure on base Pp	-6.445	0.167		
Seismic component of Pp	7.953	0.300		
Weight of the wall + base			37.555	0.620
Weight of soil on the base			62.581	1.108
UDL of 2.0 kN/m ²			2.090	1.100

EQUILIBRIUM CALCULATIONS AT SLS

1. Moment Equilibrium

Point of rotation: bottom front corner of base.

For Overturning moment M_o calculate as follows:

$$M_o = \text{Sum}(\text{hor. forces} \times \text{l.a.}) - \text{Sum}(\text{vert. forces} \times \text{l.a.})$$

For Stabilizing moment M_r calculate as follows:

$$M_r = -\text{Sum}(\text{hor. forces} \times \text{l.a.}) + \text{Sum}(\text{vert. forces} \times \text{l.a.})$$

where l.a. = lever arm of each force

Stabilizing moment Mr : 96.0 kNm
Destabilizing moment Mo : 64.0 kNm

Safety factor against overturning = Mr/Mo = 1.50

2. Force Equilibrium

Sum of Vertical forces Pv : 112.0 kN
Frictional resistance Pfric : 78.4 kN
Passive Pressure on shear key : 0.0 kN
Passive pressure on base : 6.4 kN
=> Horizontal resistance Fr : 84.9 kN
Horizontal sliding force Fh : 48.7 kN

Safety factor against overall sliding = Fr/Fh = 1.74

SOIL PRESSURES UNDER BASE

Maximum pressure : 261.0 kPa
Minimum pressure : 0 kPa at 0.8 m from right hand side of base.
Maximum pressure occurs at left hand side of base

WALL MOMENTS (ULS) AND REINFORCEMENT TO BS8110 - 1997

Position from base top (m)	Moment (kNm)	Front Reinforcing (mm ² /m)	Back Reinforcing (mm ² /m)	Nominal (0.13%) (mm ² /m)
0.00	74.42	0.00	826.45	391.30
0.06	71.18	0.00	793.81	390.00
0.12	67.80	0.00	759.26	388.70
0.18	64.52	0.00	725.56	387.40
0.24	61.34	0.00	692.70	386.10
0.31	58.26	0.00	660.68	384.80
0.37	55.27	0.00	629.48	383.50
0.43	52.38	0.00	599.12	382.20
0.49	49.59	0.00	569.58	380.90
0.55	46.88	0.00	540.87	379.60
0.61	44.27	0.00	512.96	378.30
0.67	41.75	0.00	485.87	377.00
0.73	39.32	0.00	459.58	375.70
0.79	36.98	0.00	434.10	374.40
0.85	34.72	0.00	409.40	373.10
0.92	32.55	0.00	385.50	371.80
0.98	30.47	0.00	362.39	370.50
1.04	28.46	0.00	340.05	369.20
1.10	26.54	0.00	318.49	367.90
1.16	24.69	0.00	297.70	366.60
1.22	22.93	0.00	277.68	365.30
1.28	21.24	0.00	258.41	364.00
1.34	19.63	0.00	239.89	362.70
1.40	18.09	0.00	222.13	361.40
1.46	16.63	0.00	205.10	360.10
1.52	15.24	0.00	188.81	358.80
1.59	13.92	0.00	173.24	357.50
1.65	12.67	0.00	158.40	356.20
1.71	11.48	0.00	144.27	354.90
1.77	10.37	0.00	130.86	353.60
1.83	9.31	0.00	118.14	352.30
1.89	8.33	0.00	106.12	351.00
1.95	7.40	0.00	94.80	349.70
2.01	6.54	0.00	84.15	348.40
2.07	5.74	0.00	74.18	347.10
2.13	4.99	0.00	64.87	345.80
2.20	4.31	0.00	56.23	344.50
2.26	3.68	0.00	48.24	343.20
2.32	3.10	0.00	40.89	341.90
2.38	2.58	0.00	34.18	340.60

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2.50	1.69	0.00	22.64	338.00
2.56	1.32	0.00	17.80	336.70
2.62	1.00	0.00	13.55	335.40
2.68	0.73	0.00	9.91	334.10
2.74	0.50	0.00	6.84	332.80
2.81	0.32	0.00	4.36	331.50
2.87	0.18	0.00	2.44	330.20
2.93	0.08	0.00	1.08	328.90
2.99	0.02	0.00	0.27	327.60
3.05	0.00	0.00	0.00	326.30

BASE MOMENTS (ULS) AND REINFORCEMENT TO BS8110 - 1997

Position from left (m)	Moment (kNm)	Top Reinforcing (mm ² /m)	Bot Reinforcing (mm ² /m)	Nominal (0.13%) (mm ² /m)
0.03	-0.00	0.00	0.00	585.00
0.07	-0.18	0.00	1.23	585.00
0.10	-0.72	0.00	4.94	585.00
0.13	-1.62	0.00	11.11	585.00
0.16	-2.88	0.00	19.75	585.00
0.20	-4.50	0.00	30.87	585.00
0.23	-6.48	0.00	44.45	585.00
0.26	-8.82	0.00	60.50	585.00
0.30	-11.51	0.00	79.02	585.00
0.33	-14.57	0.00	100.01	585.00
0.36	-17.99	0.00	123.46	585.00
0.40	-21.77	0.00	149.39	585.00
0.43	-25.91	0.00	177.79	585.00
0.46	-30.40	0.00	208.66	585.00
0.50	-33.45	0.00	229.58	585.00
0.53	68.66	471.20	0.00	585.00
0.56	67.30	461.82	0.00	585.00
0.59	63.61	436.52	0.00	585.00
0.63	60.03	411.93	0.00	585.00
0.66	56.55	388.06	0.00	585.00
0.69	53.17	364.90	0.00	585.00
0.73	49.90	342.45	0.00	585.00
0.76	46.73	320.71	0.00	585.00
0.79	43.67	299.69	0.00	585.00
0.82	40.71	279.37	0.00	585.00
0.86	37.85	259.78	0.00	585.00
0.89	35.10	240.89	0.00	585.00
0.92	32.45	222.72	0.00	585.00
0.96	29.91	205.25	0.00	585.00
0.99	27.47	188.51	0.00	585.00
1.02	25.13	172.47	0.00	585.00
1.06	22.90	157.15	0.00	585.00
1.09	20.77	142.54	0.00	585.00
1.12	18.75	128.64	0.00	585.00
1.16	16.82	115.46	0.00	585.00
1.19	15.01	102.98	0.00	585.00
1.22	13.29	91.22	0.00	585.00
1.25	11.68	80.18	0.00	585.00
1.29	10.18	69.84	0.00	585.00
1.32	8.78	60.22	0.00	585.00
1.35	7.48	51.31	0.00	585.00
1.39	6.28	43.12	0.00	585.00
1.42	5.19	35.63	0.00	585.00
1.45	4.21	28.86	0.00	585.00
1.48	3.32	22.81	0.00	585.00
1.52	2.54	17.46	0.00	585.00
1.55	1.87	12.83	0.00	585.00
1.58	1.30	8.91	0.00	585.00
1.62	0.83	5.70	0.00	585.00
1.65	0.47	3.21	0.00	585.00

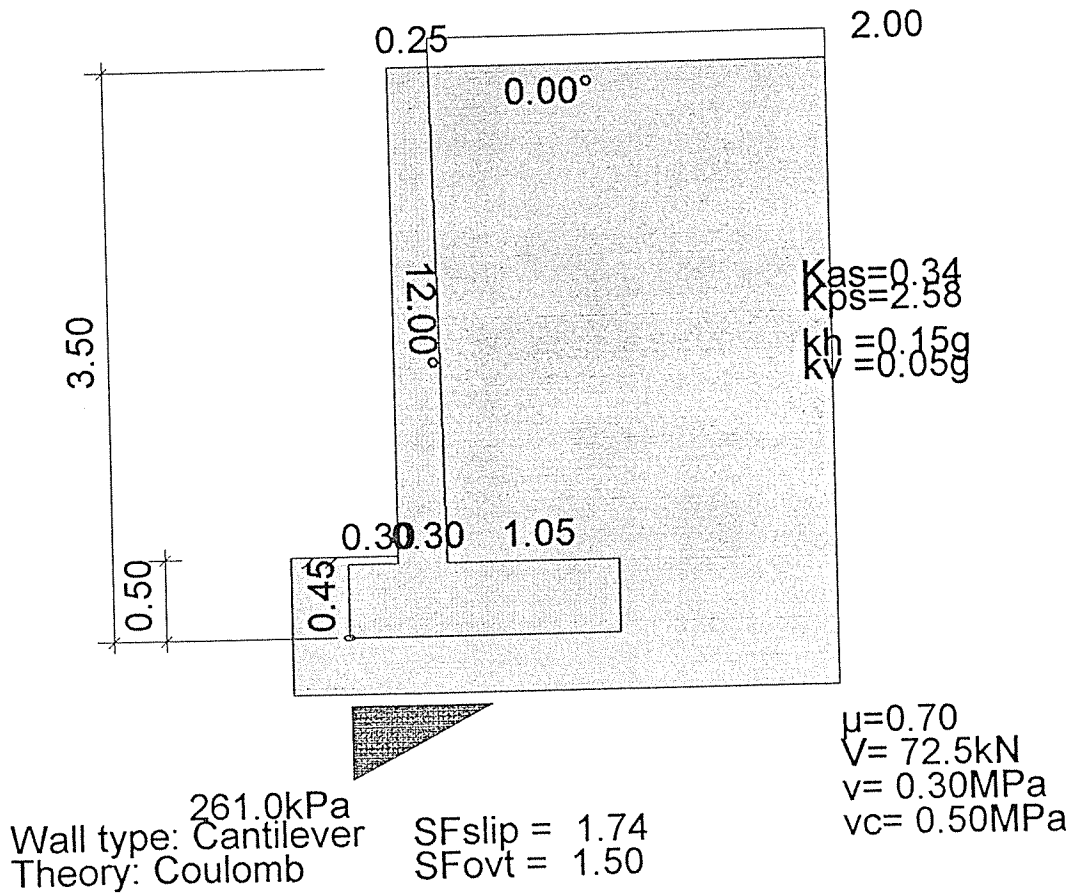
SHEAR CHECK AT WALL-BASE JUNCTION TO BS8110 - 1997

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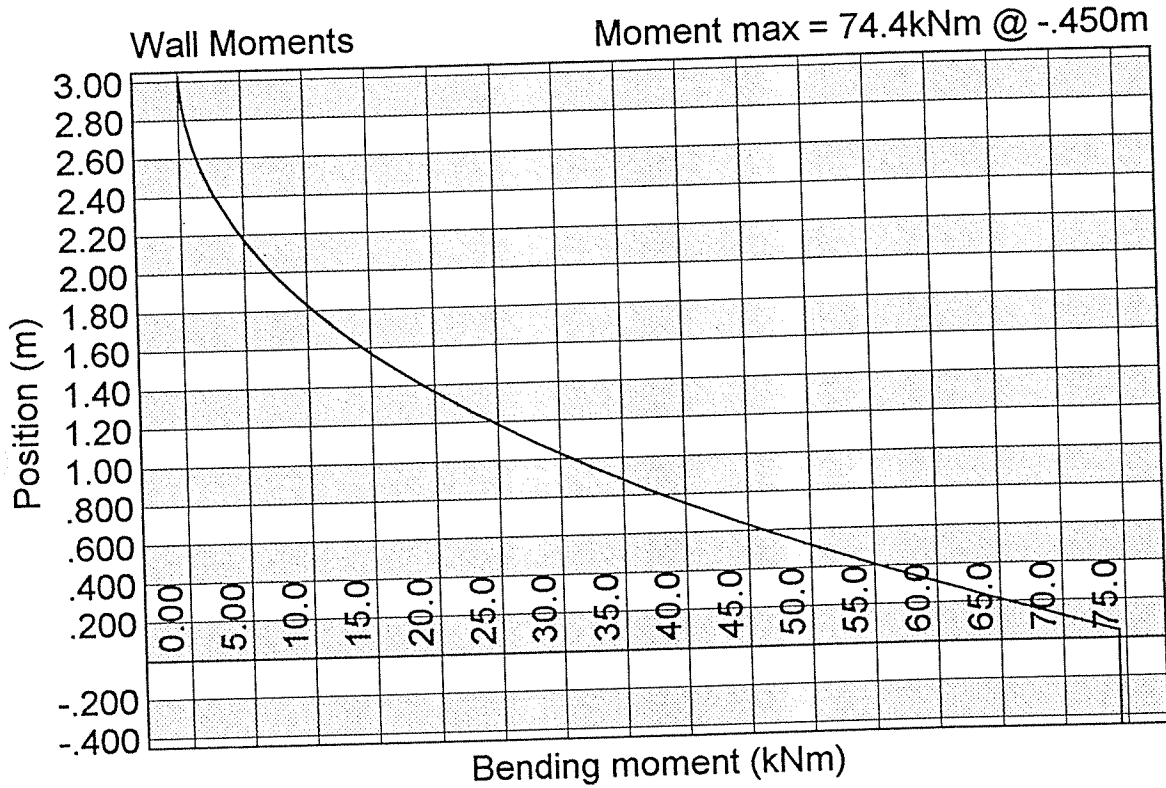
Shear force at bottom of wall $V = 72.5 \text{ kN}$
Shear stress at bottom of wall $v = 0.30 \text{ MPa OK}$
Allowable shear stress $vc = 0.50 \text{ MPa}$ (based on Wall tensile reinf.)

Sketch of Wall

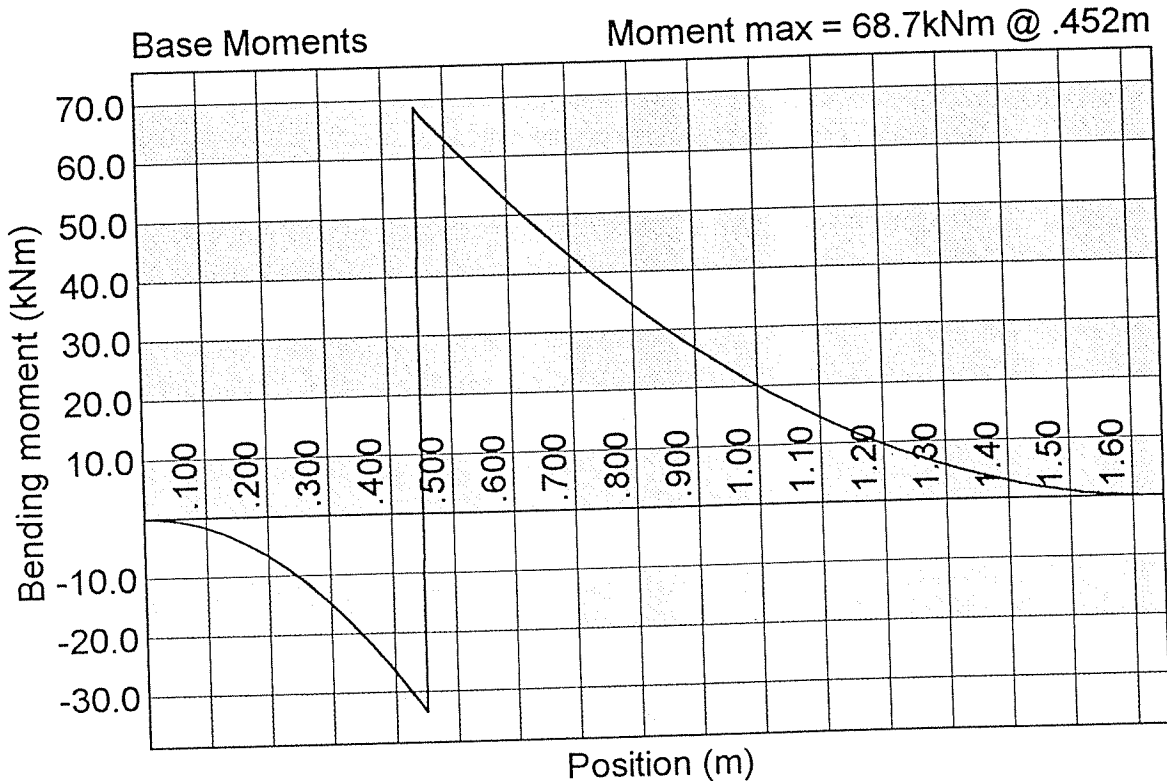
Design code: BS8110 - 1997



Wall Bending Moments

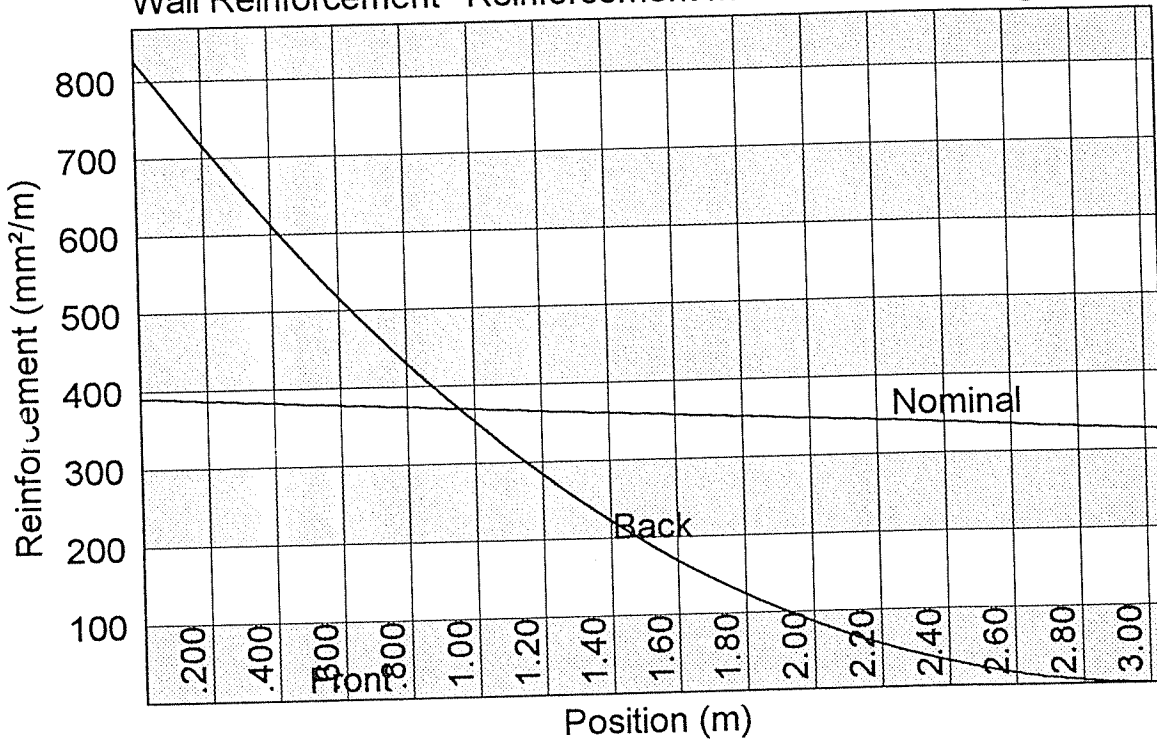


Base Bending Moments



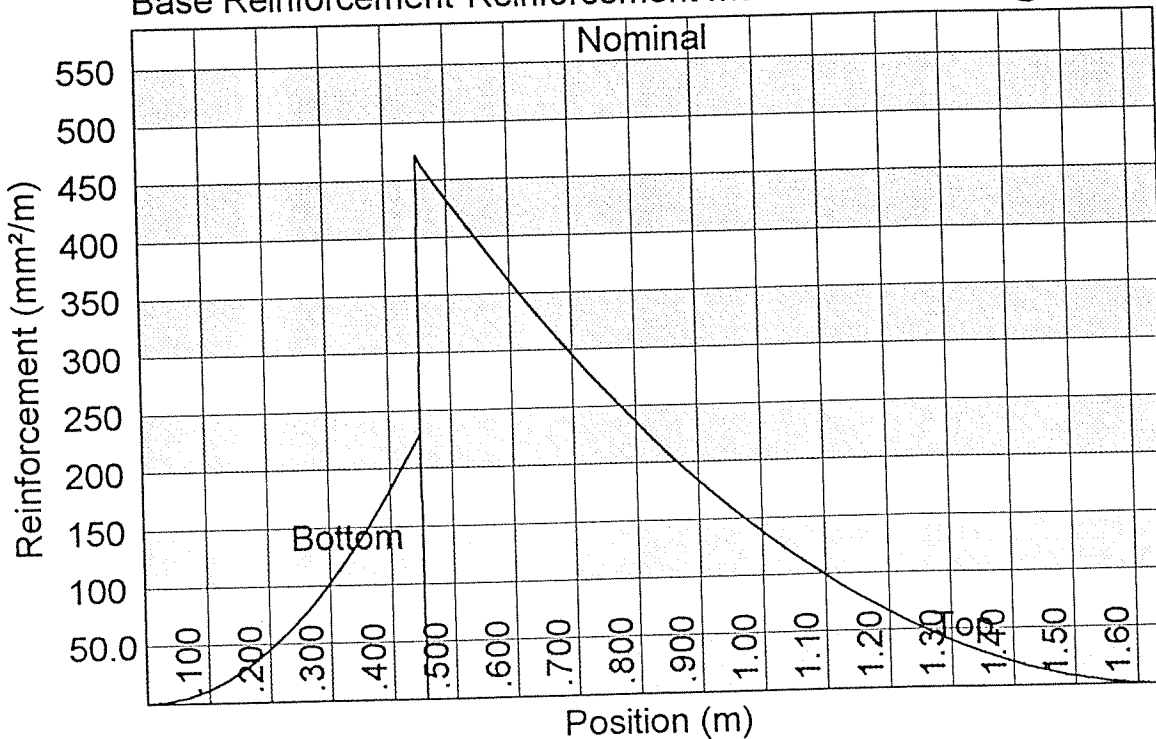
Wall Reinforcement

Wall Reinforcement Reinforcement max = 826 mm²/m @ 0.00m

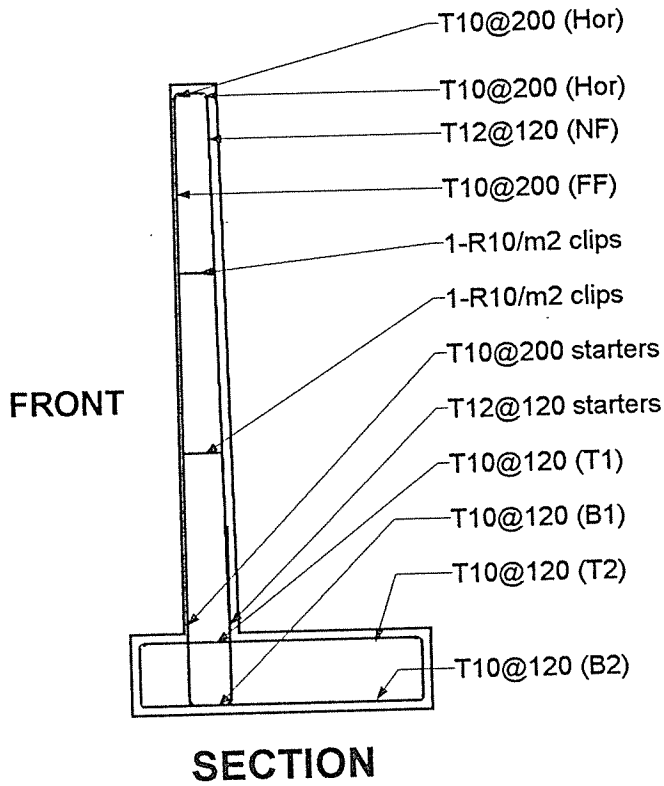


Base Reinforcement

Base Reinforcement Reinforcement max = 471 mm²/m @ .452m



Schematic Reinforcement



Input Data

Wall Dimensions				Live Loads		General Parameters		Design Parameters	
H1 (m)	2.5	C (m)	.45	w (kN/m ²)	2	Soil Frict (°)	35	SF Overt.	1.5
H2 (m)	.5	F (m)		P (kN)		Fill slope (°)	0	SF Slip	1.5
H3 (m)	0	xf (m)		xp (m)		Wall Frict (°)	12	DL Factor	1.4
Hw (m)	0	At (m)	.25	L (kN/m)		Conc Density	25	LL Factor	1.6
Hr (m)		Ab (m)	.25	xl (m)		Soil Density	20	Pmax (kPa)	400
B (m)	.3	Cover: wall	50	Lh (kN/m)		fcu (MPa)	25		
D (m)	.65	Cover: base	50	x (m)		fy (MPa)	414		

Seepage not allowed

Theory : Coulomb
 Wall type : Cantilever

SEISMIC ANALYSIS SETTINGS:

Seismic Analysis ON/OFF: ON

Hor Accel. (g)	.15
Vert Accel. (g)	.05
Include LL's	Y

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Retaining Wall Design : WALL W3

C14


Input Data

Seepage not allowed

Theory : Coulomb
 Wall type : Cantilever

SEISMIC ANALYSIS SETTINGS:

Seismic Analysis ON/OFF: ON

VALUES OF PRESSURE COEFFICIENTS:

- Active Pressure coefficient K_a : 0.25
- Passive Pressure coefficient K_p : 5.76
- Seismic Active Pressure coefficient K_{as} : 0.33
- Seismic Passive Pressure coefficient K_{ps} : 2.58
- Base frictional constant μ : 0.70

FORCES ACTING ON THE WALL:

Description	FORCES (kN) and their LEVER ARMS (m)			
	F Horizontal left (+)	Lever arm	F Vertical down (+)	Lever arm
Destabilizing forces:				
Total Active pressure Pa	20.747	0.983	4.295	0.550
Seismic component of Pa	4.893	1.500	1.040	0.550
As a result of surcharge w	1.536	1.250	0.326	0.550
Seismic wall inertia	3.401	1.250		
Stabilizing forces:				
Passive pressure on base Pp	-6.445	0.167		
Seismic component of Pp	7.953	0.300		
Weight of the wall + base			23.869	0.509
Weight of soil on the base			26.505	0.859
UDL of 1.9 kN/m ²			1.235	0.875

EQUILIBRIUM CALCULATIONS AT SLS

1. Moment Equilibrium

Point of rotation: bottom front corner of base.

For Overturning moment M_o calculate as follows:
 $M_o = \text{Sum}(\text{hor. forces} \times \text{l.a.}) - \text{Sum}(\text{vert. forces} \times \text{l.a.})$
 For Stabilizing moment M_r calculate as follows:
 $M_r = -\text{Sum}(\text{hor. forces} \times \text{l.a.}) + \text{Sum}(\text{vert. forces} \times \text{l.a.})$
 where l.a. = lever arm of each force

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Stabilizing moment Mr : 37.1 kNm
Destabilizing moment Mo : 24.0 kNm

Safety factor against overturning = Mr/Mo = 1.54

2. Force EquilibriumSum of Vertical forces Pv : 56.2 kN
Frictional resistance Pfric : 39.4 kN
Passive Pressure on shear key : 0.0 kN
Passive pressure on base : 6.4 kN
=> Horizontal resistance Fr : 45.8 kN
Horizontal sliding force Fh : 25.7 kN

Safety factor against overall sliding = Fr/Fh = 1.78

SOIL PRESSURES UNDER BASEMaximum pressure : 161.6 kPa
Minimum pressure : -133.5 kPa
Maximum pressure occurs at left hand side of base**WALL MOMENTS (ULS) AND REINFORCEMENT TO BS8110 - 1997**

Position from base top (m)	Moment (kNm)	Front Reinforcing (mm ² /m)	Back Reinforcing (mm ² /m)	Nominal (0.13%) (mm ² /m)
0.00	26.18	0.00	368.78	325.00
0.04	24.98	0.00	351.94	325.00
0.08	23.82	0.00	335.49	325.00
0.13	22.68	0.00	319.48	325.00
0.17	21.58	0.00	303.94	325.00
0.21	20.51	0.00	288.88	325.00
0.25	19.47	0.00	274.28	325.00
0.29	18.47	0.00	260.13	325.00
0.34	17.49	0.00	246.43	325.00
0.38	16.55	0.00	233.18	325.00
0.42	15.64	0.00	220.37	325.00
0.46	14.77	0.00	207.99	325.00
0.50	13.92	0.00	196.04	325.00
0.55	13.10	0.00	184.51	325.00
0.59	12.31	0.00	173.39	325.00
0.63	11.55	0.00	162.69	325.00
0.67	10.82	0.00	152.39	325.00
0.71	10.11	0.00	142.48	325.00
0.76	9.44	0.00	132.97	325.00
0.80	8.79	0.00	123.84	325.00
0.84	8.17	0.00	115.09	325.00
0.88	7.58	0.00	106.72	325.00
0.92	7.01	0.00	98.71	325.00
0.97	6.47	0.00	91.07	325.00
1.01	5.95	0.00	83.78	325.00
1.05	5.46	0.00	76.85	325.00
1.09	4.99	0.00	70.26	325.00
1.13	4.54	0.00	64.00	325.00
1.18	4.12	0.00	58.08	325.00
1.22	3.73	0.00	52.49	325.00
1.26	3.35	0.00	47.21	325.00
1.30	3.00	0.00	42.25	325.00
1.34	2.67	0.00	37.60	325.00
1.39	2.36	0.00	33.26	325.00
1.43	2.07	0.00	29.21	325.00
1.47	1.81	0.00	25.45	325.00
1.51	1.56	0.00	21.98	325.00
1.55	1.33	0.00	18.78	325.00
1.60	1.13	0.00	15.86	325.00
1.64	0.94	0.00	13.21	325.00

هاتف: ٨٨.٦٤٤.٦١٢٣٧٧ فاكس: ٦١٢٣٨٠ ص.ب. ٨٣.٧٤٦ عمان - الأردن



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1.72	0.62	0.00	8.68	325.00
1.76	0.48	0.00	6.80	325.00
1.81	0.37	0.00	5.16	325.00
1.85	0.27	0.00	3.75	325.00
1.89	0.18	0.00	2.58	325.00
1.93	0.12	0.00	1.64	325.00
1.97	0.06	0.00	0.91	325.00
2.02	0.03	0.00	0.40	325.00
2.06	0.01	0.00	0.10	325.00
2.10	0.00	0.00	0.00	325.00

BASE MOMENTS (ULS) AND REINFORCEMENT TO BS8110 - 1997

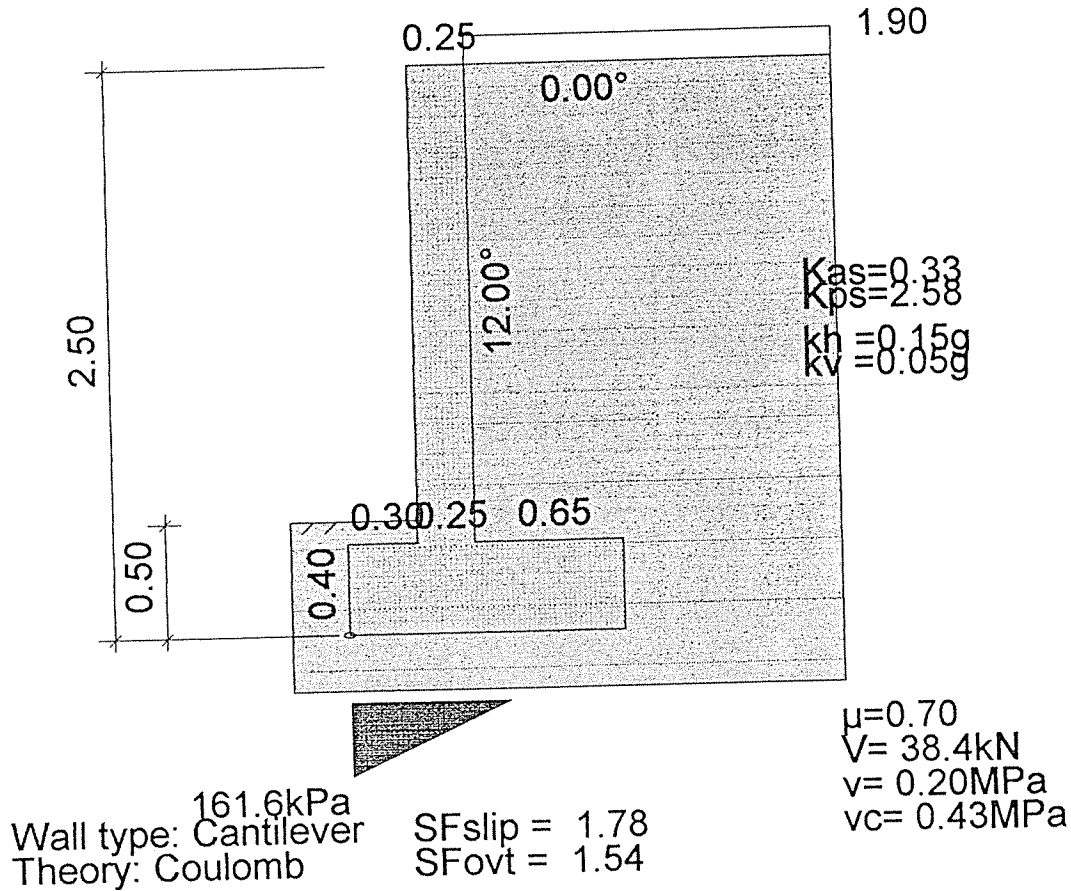
Position from left (m)	Moment (kNm)	Top Reinforcing (mm ² /m)	Bot Reinforcing (mm ² /m)	Nominal (0.13%) (mm ² /m)
0.02	-0.00	0.00	0.00	520.00
0.05	-0.05	0.00	0.43	520.00
0.07	-0.22	0.00	1.71	520.00
0.10	-0.49	0.00	3.86	520.00
0.12	-0.87	0.00	6.86	520.00
0.14	-1.36	0.00	10.71	520.00
0.17	-1.96	0.00	15.43	520.00
0.19	-2.67	0.00	21.00	520.00
0.22	-3.48	0.00	27.42	520.00
0.24	-4.41	0.00	34.71	520.00
0.26	-5.44	0.00	42.85	520.00
0.29	-6.59	0.00	51.85	520.00
0.31	-7.84	0.00	61.70	520.00
0.34	-9.20	0.00	72.42	520.00
0.36	-10.67	0.00	83.98	520.00
0.38	-12.25	0.00	96.41	520.00
0.41	-13.94	0.00	109.69	520.00
0.43	-15.73	0.00	123.83	520.00
0.46	-17.07	134.37	0.00	520.00
0.48	20.91	164.57	0.00	520.00
0.50	20.53	161.61	0.00	520.00
0.53	19.27	151.67	0.00	520.00
0.55	18.04	142.04	0.00	520.00
0.58	16.86	132.73	0.00	520.00
0.60	15.72	123.73	0.00	520.00
0.62	14.62	115.05	0.00	520.00
0.65	13.55	106.69	0.00	520.00
0.67	12.53	98.64	0.00	520.00
0.70	11.55	90.91	0.00	520.00
0.72	10.61	83.49	0.00	520.00
0.74	9.70	76.39	0.00	520.00
0.77	8.84	69.60	0.00	520.00
0.79	8.02	63.13	0.00	520.00
0.82	7.24	56.97	0.00	520.00
0.84	6.50	51.13	0.00	520.00
0.86	5.79	45.61	0.00	520.00
0.89	5.13	40.40	0.00	520.00
0.91	4.51	35.51	0.00	520.00
0.94	3.93	30.93	0.00	520.00
0.96	3.39	26.67	0.00	520.00
0.98	2.89	22.73	0.00	520.00
1.01	2.43	19.10	0.00	520.00
1.03	2.00	15.78	0.00	520.00
1.06	1.62	12.78	0.00	520.00
1.08	1.28	10.10	0.00	520.00
1.10	0.98	7.73	0.00	520.00
1.13	0.72	5.68	0.00	520.00
1.15	0.50	3.95	0.00	520.00
1.18	0.32	2.53	0.00	520.00
1.20	0.18	1.42	0.00	520.00

Shear Check at Wall-Base Junction to BS8110 - 1997

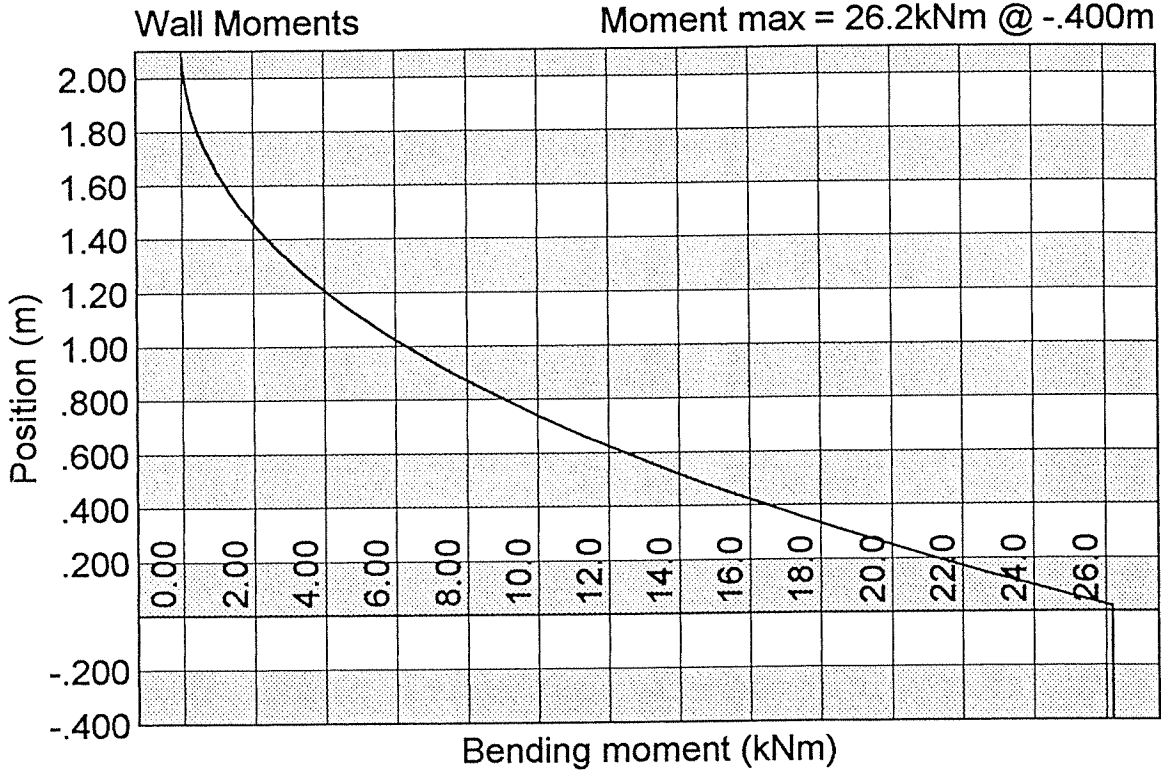
Shear force at bottom of wall $V = 38.4 \text{ kN}$
 Shear stress at bottom of wall $v = 0.20 \text{ MPa OK}$
 Allowable shear stress $vc = 0.43 \text{ MPa}$ (based on Wall tensile reinf.)

Sketch of Wall

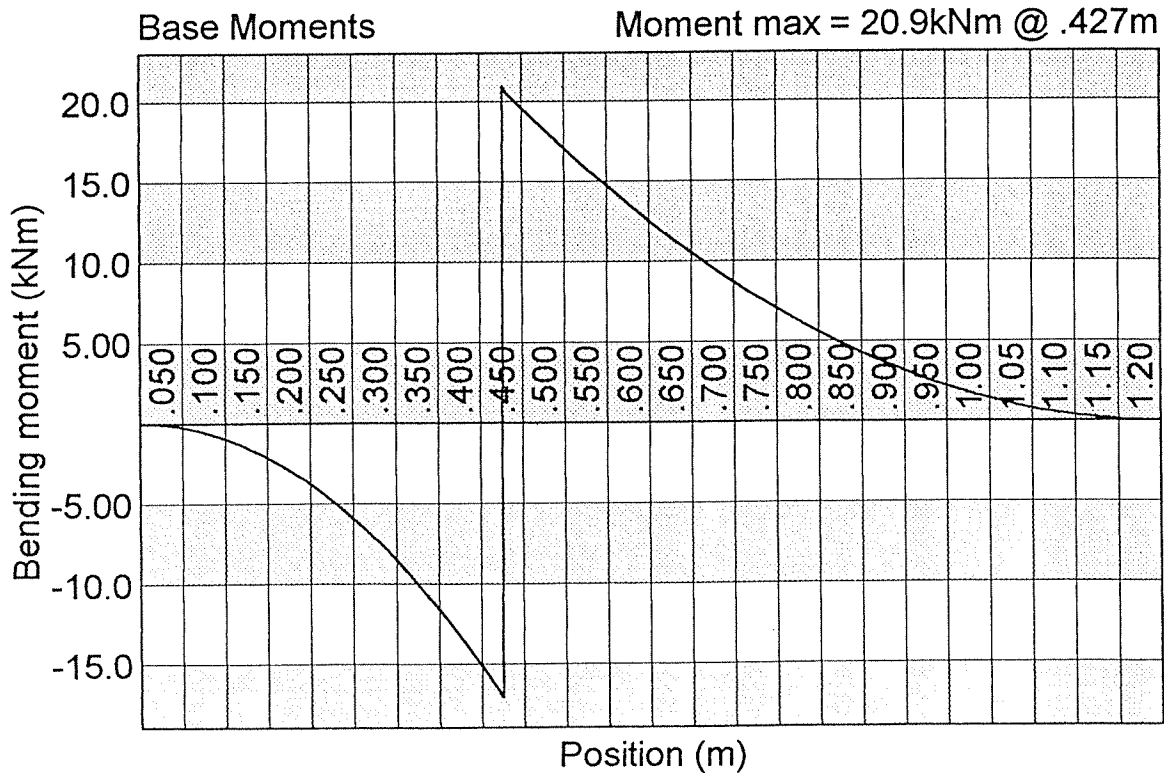
Design code: BS8110 - 1997



Wall Bending Moments

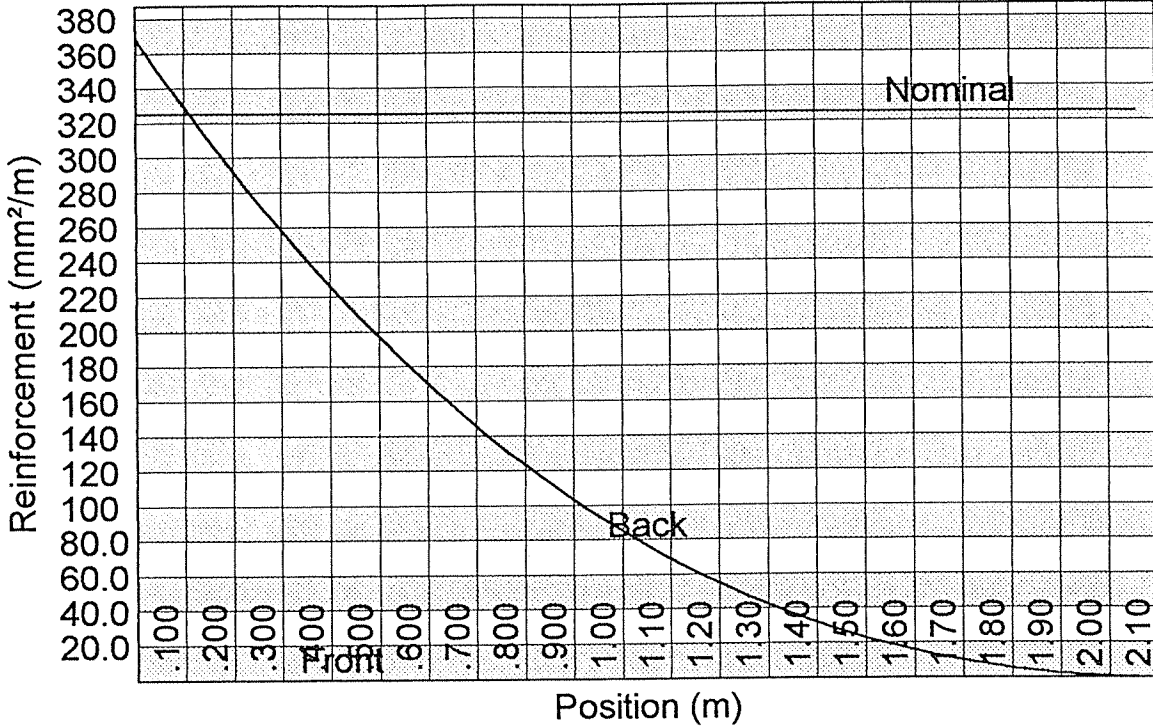


Base Bending Moments



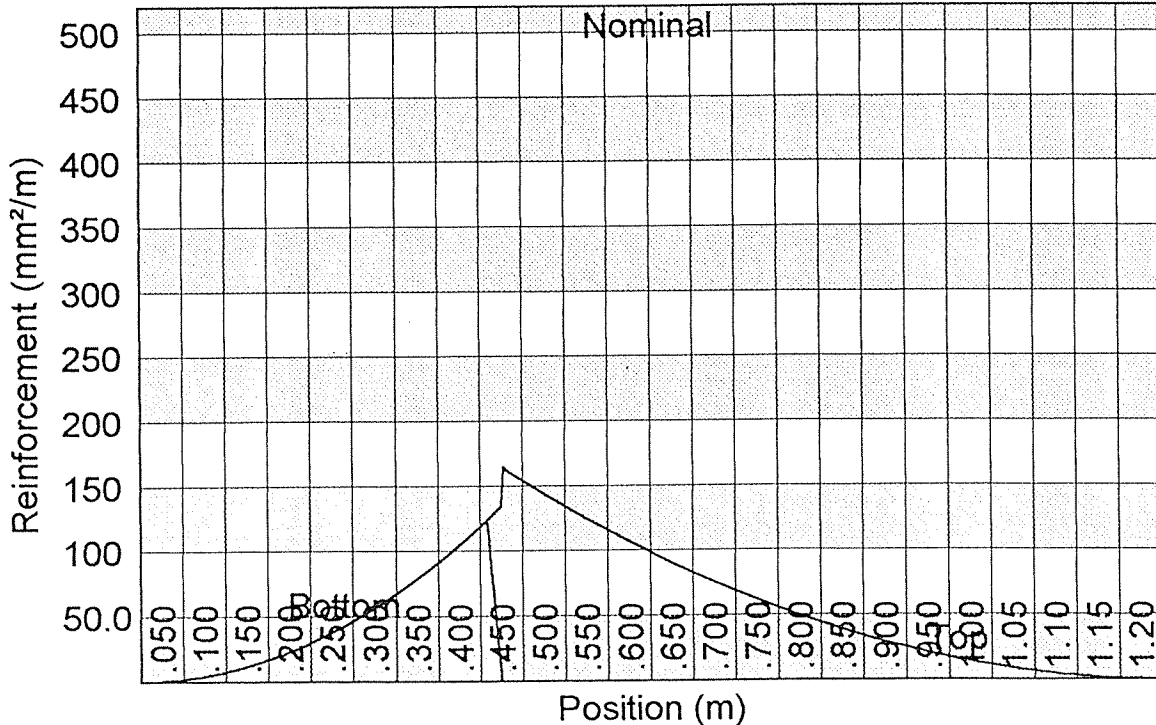
Wall Reinforcement

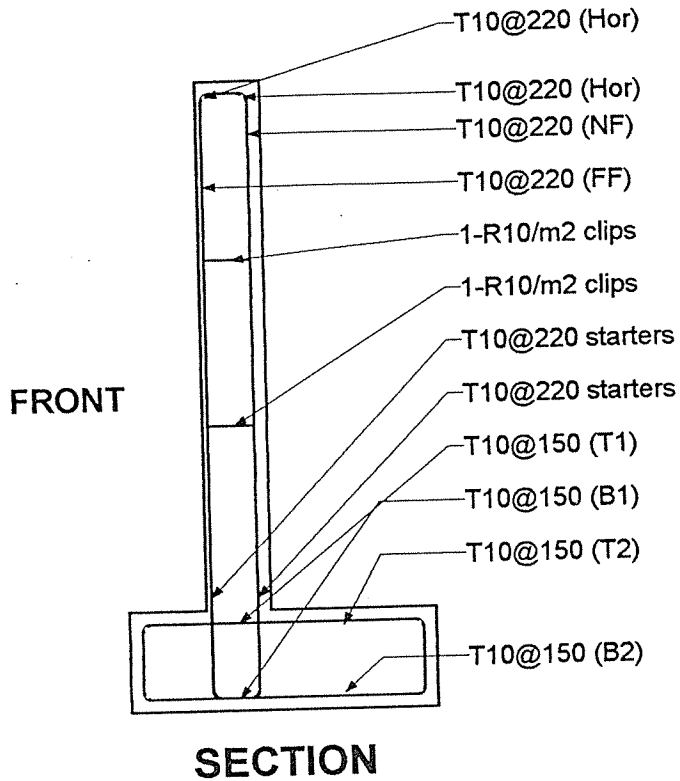
Wall Reinforcement Reinforcement max = 369 mm²/m @ 0.00m



Base Reinforcement

Base Reinforcement Reinforcement max = 165 mm²/m @ .427m



Schematic Reinforcement

Stabilizing moment M_r : 12.0 kNm
Destabilizing moment M_o : 5.7 kNm

Safety factor against overturning = $M_r/M_o = 2.13$

2. Force Equilibrium

Sum of Vertical forces P_v : 23.5 kN
Frictional resistance P_{fric} : 16.4 kN
Passive Pressure on shear key : 0.0 kN
Passive pressure on base : 6.4 kN
=> Horizontal resistance F_r : 22.9 kN
Horizontal sliding force F_h : 10.4 kN

Safety factor against overall sliding = $F_r/F_h = 2.20$

SOIL PRESSURES UNDER BASE

Maximum pressure : 57.6 kPa
Minimum pressure : -45.9 kPa
Maximum pressure occurs at left hand side of base

WALL MOMENTS (ULS) AND REINFORCEMENT TO BS8110 - 1997

Position from base top (m)	Moment (kNm)	Front Reinforcing (mm^2/m)	Back Reinforcing (mm^2/m)	Nominal (0.13%) (mm^2/m)
0.00	5.79	0.00	81.62	325.00
0.02	5.56	0.00	78.35	325.00
0.05	5.33	0.00	75.07	325.00
0.07	5.10	0.00	71.81	325.00
0.10	4.87	0.00	68.56	325.00
0.12	4.64	0.00	65.36	325.00
0.14	4.42	0.00	62.20	325.00
0.17	4.20	0.00	59.10	325.00
0.19	3.98	0.00	56.08	325.00
0.22	3.77	0.00	53.15	325.00
0.24	3.57	0.00	50.31	325.00
0.26	3.38	0.00	47.56	325.00
0.29	3.19	0.00	44.90	325.00
0.31	3.00	0.00	42.33	325.00
0.34	2.83	0.00	39.84	325.00
0.36	2.66	0.00	37.45	325.00
0.38	2.49	0.00	35.14	325.00
0.41	2.34	0.00	32.91	325.00
0.43	2.18	0.00	30.77	325.00
0.46	2.04	0.00	28.71	325.00
0.48	1.90	0.00	26.73	325.00
0.50	1.76	0.00	24.83	325.00
0.53	1.63	0.00	23.01	325.00
0.55	1.51	0.00	21.27	325.00
0.58	1.39	0.00	19.60	325.00
0.60	1.28	0.00	18.01	325.00
0.62	1.17	0.00	16.50	325.00
0.65	1.07	0.00	15.06	325.00
0.67	0.97	0.00	13.70	325.00
0.70	0.88	0.00	12.40	325.00
0.72	0.79	0.00	11.18	325.00
0.74	0.71	0.00	10.03	325.00
0.77	0.63	0.00	8.94	325.00
0.79	0.56	0.00	7.93	325.00
0.82	0.50	0.00	6.98	325.00
0.84	0.43	0.00	6.09	325.00
0.86	0.37	0.00	5.27	325.00
0.89	0.32	0.00	4.52	325.00
0.91	0.27	0.00	3.82	325.00
0.94	0.23	0.00	3.19	325.00

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Date

اتحاد المستشارين
للهندسة والبرنة
Sheet

0.98	0.15	0.00	2.11	325.00
1.01	0.12	0.00	1.65	325.00
1.03	0.09	0.00	1.26	325.00
1.06	0.07	0.00	0.92	325.00
1.08	0.04	0.00	0.63	325.00
1.10	0.03	0.00	0.40	325.00
1.13	0.02	0.00	0.22	325.00
1.15	0.01	0.00	0.10	325.00
1.18	0.00	0.00	0.02	325.00
1.20	0.00	0.00	0.00	325.00

BASE MOMENTS (ULS) AND REINFORCEMENT TO BS8110 - 1997

Position from left (m)	Moment (kNm)	Top Reinforcing (mm ² /m)	Bot Reinforcing (mm ² /m)	Nominal (0.13%) (mm ² /m)
0.02	-0.00	0.00	0.00	390.00
0.03	-0.01	0.00	0.09	390.00
0.05	-0.03	0.00	0.37	390.00
0.07	-0.07	0.00	0.83	390.00
0.08	-0.13	0.00	1.47	390.00
0.10	-0.21	0.00	2.30	390.00
0.12	-0.30	0.00	3.31	390.00
0.14	-0.40	0.00	4.51	390.00
0.15	-0.53	0.00	5.89	390.00
0.17	-0.67	0.00	7.46	390.00
0.19	-0.83	0.00	9.21	390.00
0.20	-1.00	0.00	11.14	390.00
0.22	-1.19	0.00	13.26	390.00
0.24	-1.40	0.00	15.56	390.00
0.26	-1.62	0.00	18.05	390.00
0.27	-1.86	0.00	20.72	390.00
0.29	-2.11	0.00	23.57	390.00
0.31	-2.39	0.00	26.61	390.00
0.32	-2.67	0.00	29.83	390.00
0.34	-2.98	0.00	33.24	390.00
0.36	-3.30	0.00	36.83	390.00
0.37	-3.64	0.00	40.60	390.00
0.39	-4.00	0.00	44.56	390.00
0.41	-4.37	0.00	48.70	390.00
0.42	-4.76	0.00	53.03	390.00
0.44	-5.16	57.54	0.00	390.00
0.46	3.15	35.09	0.00	390.00
0.48	3.15	35.09	0.00	390.00
0.49	2.90	32.34	0.00	390.00
0.51	2.66	29.70	0.00	390.00
0.53	2.44	27.17	0.00	390.00
0.54	2.22	24.76	0.00	390.00
0.56	2.01	22.46	0.00	390.00
0.58	1.82	20.27	0.00	390.00
0.59	1.63	18.19	0.00	390.00
0.61	1.45	16.23	0.00	390.00
0.63	1.29	14.37	0.00	390.00
0.65	1.13	12.63	0.00	390.00
0.66	0.99	11.00	0.00	390.00
0.68	0.85	9.49	0.00	390.00
0.70	0.72	8.08	0.00	390.00
0.71	0.61	6.79	0.00	390.00
0.73	0.50	5.61	0.00	390.00
0.75	0.41	4.55	0.00	390.00
0.77	0.32	3.59	0.00	390.00
0.78	0.25	2.75	0.00	390.00
0.80	0.18	2.02	0.00	390.00
0.82	0.13	1.40	0.00	390.00
0.83	0.08	0.90	0.00	390.00
0.85	0.05	0.51	0.00	390.00

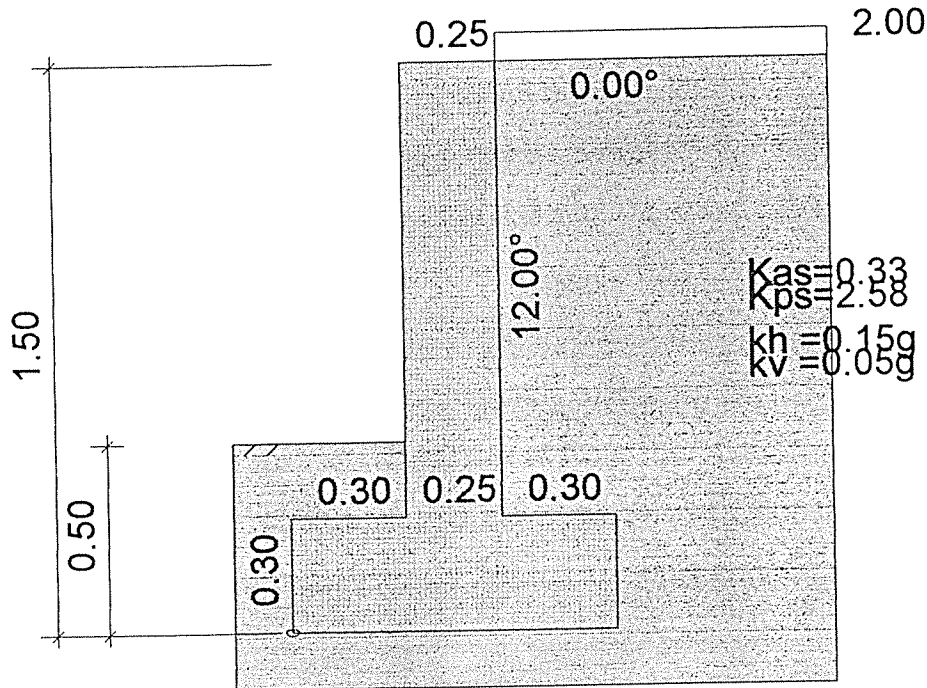
SHEAR CHECK AT WALL-BASE JUNCTION TO BS8110 - 1997

هاتف: ٦٦٢٣٧٧، ٦٦٢٣٨٠ فاكس: ٦٦٢٣٨٠ ص ب ٧٤٦ عمان - الأردن

Shear force at bottom of wall $V = 15.7 \text{ kN}$
 Shear stress at bottom of wall $v = 0.08 \text{ MPa OK}$
 Allowable shear stress $vc = 0.40 \text{ MPa}$ (based on Wall tensile reinf.)

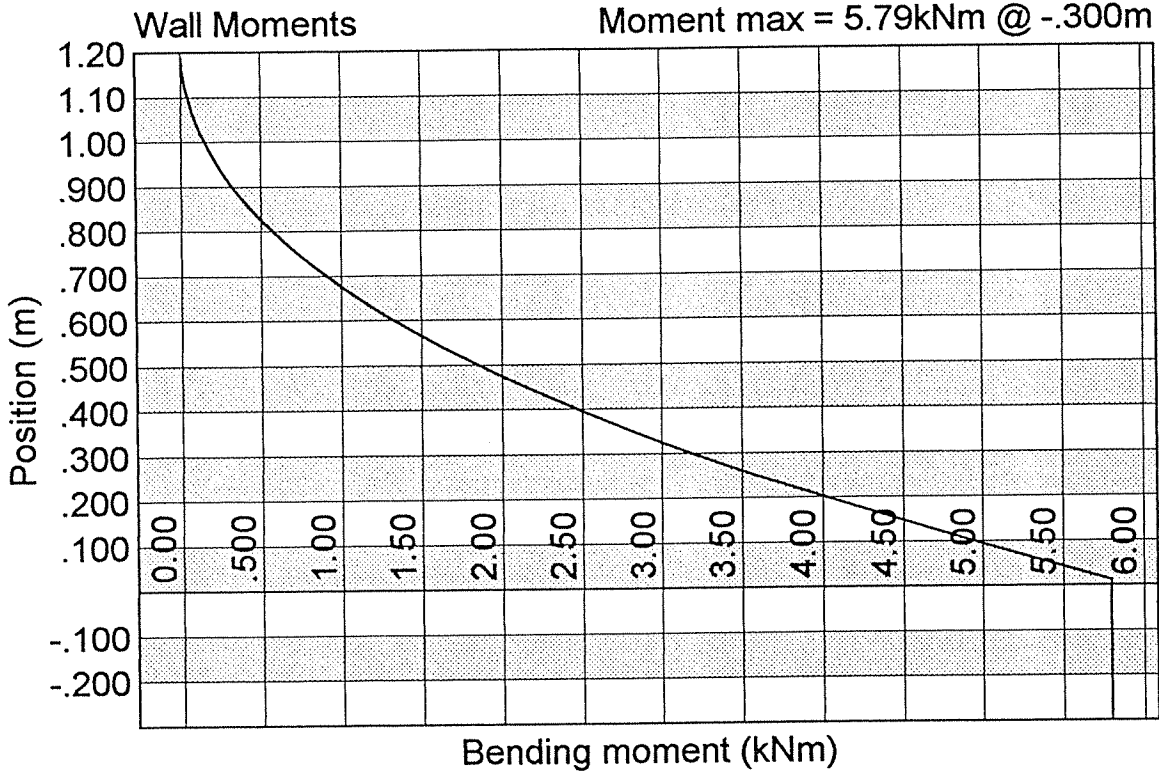
Sketch of Wall

Design code: BS8110 - 1997

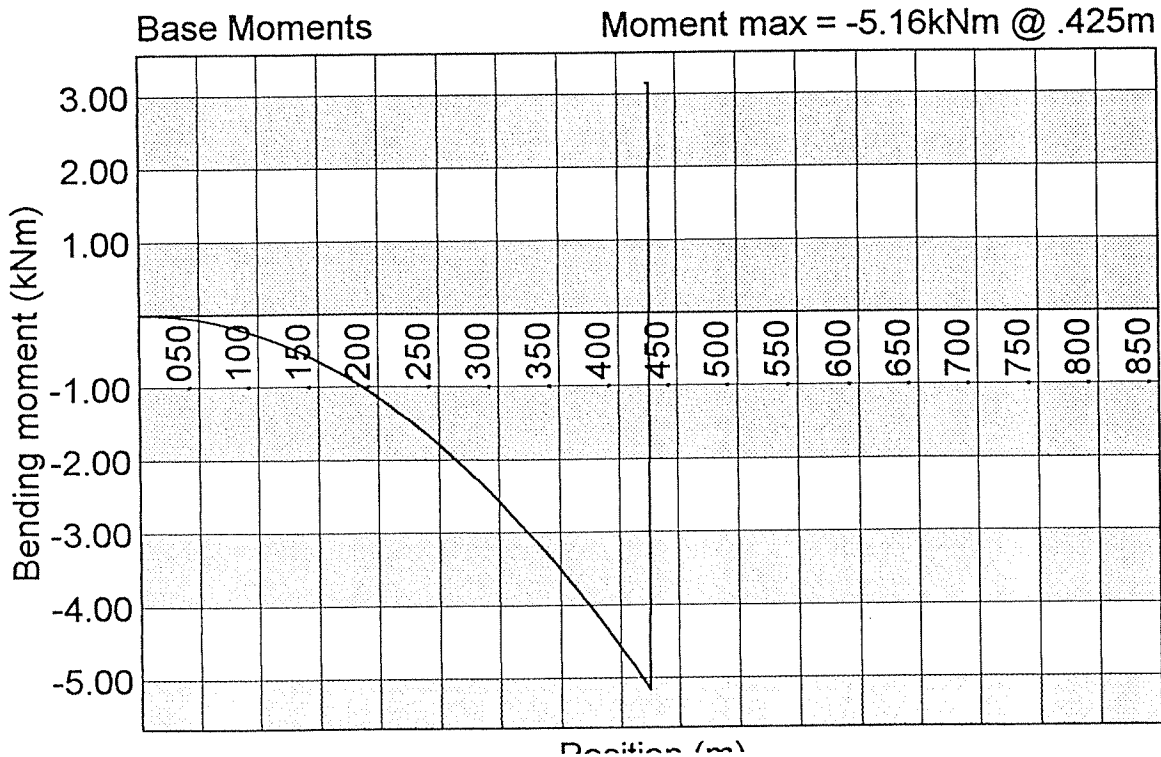


Wall type: Cantilever
 Theory: Coulomb
 57.6 kPa
 $\mu = 0.70$
 $V = 15.7 \text{ kN}$
 $v = 0.08 \text{ MPa}$
 $vc = 0.40 \text{ MPa}$
 $SF_{\text{slip}} = 2.20$
 $SF_{\text{ovt}} = 2.13$

Wall Bending Moments

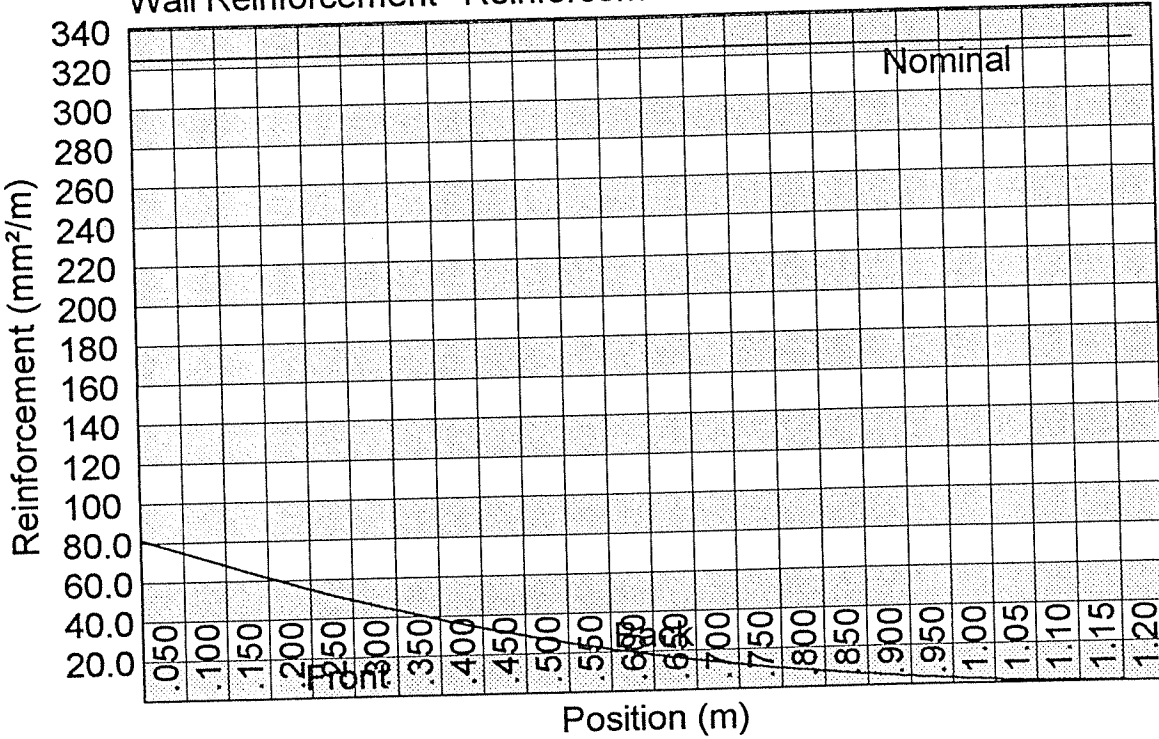


Base Bending Moments



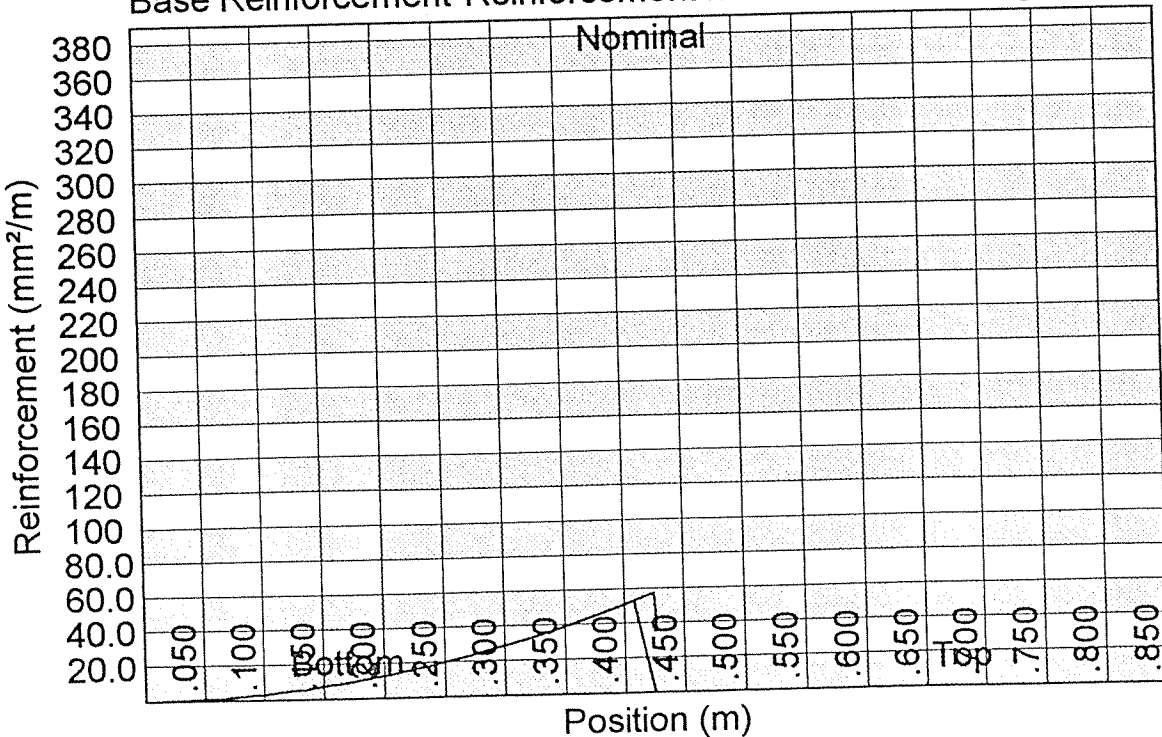
Wall Reinforcement

Wall Reinforcement Reinforcement max = 325 mm²/m @ 1.20m



Base Reinforcement

Base Reinforcement Reinforcement max = 57.5mm²/m @ .425m



PROKON

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Job Number

Job Title

Client

Calcs by

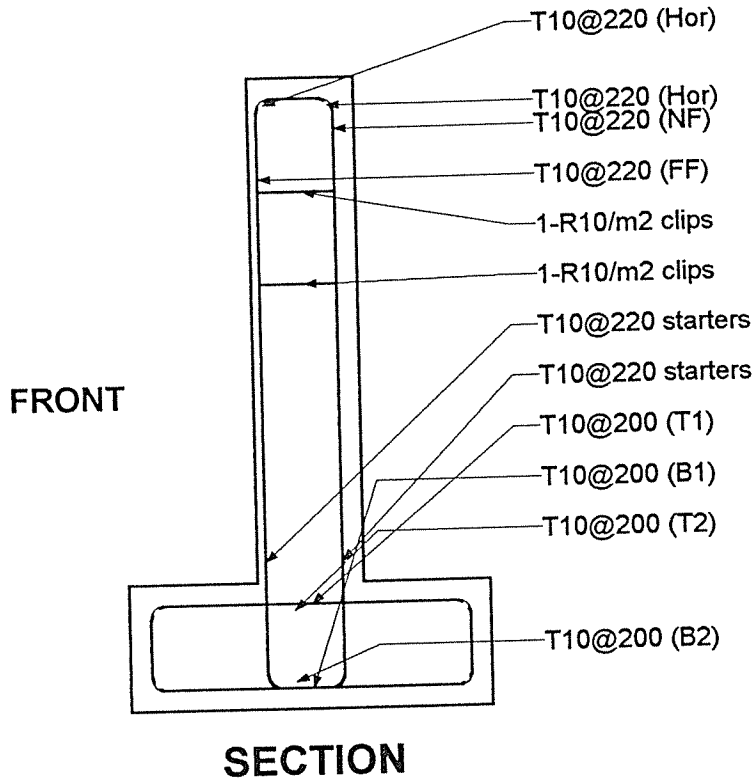
Checked by

Date

CC

انجاء المستشارين
للهندسة والبناء

Schematic Reinforcement





APPENDIX

الجدول رقم ٢٢ : بلاطات مستطيلة محملة بحمولة مثلثية

$$M_K = \alpha_K P; M_D = \alpha_D P; \bar{M}_K = -\beta_K P; \bar{M}_D = -\beta_D P; \bar{M}_{KB} = -\beta_{KB} P; \bar{M}_{KD} = -\beta_{KD} P; \\ \bar{M}_{DB} = -\beta_{DB} P; \bar{M}_{DH} = -\beta_{DH} P; P = \frac{1}{2} \rho l_D l_K$$

l_D/l_K	الشكل ١					الشكل ٢				
	α_K	α_D	β_K	β_{DH}	β_{DB}	α_K	α_D	β_{KB}	β_{KD}	β_{DB}
1,00	0,0184	0,0208	0,0448	0,0562	0,0332	0,0206	0,0184	0,0562	0,0332	0,0448
1,10	0,0205	0,0190	0,0477	0,0538	0,0302	0,0218	0,0160	0,0576	0,0363	0,0411
1,20	0,0221	0,0173	0,0496	0,0506	0,0271	0,0227	0,0137	0,0580	0,0367	0,0372
1,30	0,0229	0,0166	0,0504	0,0470	0,0237	0,0231	0,0112	0,0577	0,0376	0,0336
1,40	0,0235	0,0137	0,0508	0,0431	0,0204	0,0233	0,0090	0,0569	0,0380	0,0302
1,50	0,0241	0,0120	0,0510	0,0387	0,0168	0,0233	0,0072	0,0556	0,0382	0,0276

l_D/l_K	الشكل ٣				الشكل ٤			
	α_K	α_D	β_K	β_D	α_K	α_D	β_K	β_D
1,00	0,0216	0,0194	0,0502	0,0588	0,0194	0,0216	0,0588	0,0502
1,10	0,0229	0,0178	0,0516	0,0554	0,0211	0,0198	0,0614	0,0480
1,20	0,0236	0,0161	0,0521	0,0517	0,0228	0,0178	0,0633	0,0435
1,30	0,0239	0,0146	0,0522	0,0477	0,0243	0,0153	0,0644	0,0418
1,40	0,0241	0,0131	0,0519	0,0432	0,0257	0,0132	0,0650	0,0390
1,50	0,0241	0,0117	0,0514	0,0387	0,0271	0,0120	0,0652	0,0357

l_D/l_K	الشكل ٥				الشكل ٦			
	α_K	α_D	β_K	β_D	α_K	α_D	β_K	β_D
1,00	0,0246	0,0172	0,0538	0,0598	0,0172	0,0246	0,0598	0,0538
1,10	0,0248	0,0163	0,0538	0,0553	0,0178	0,0244	0,0640	0,0535
1,20	0,0250	0,0153	0,0535	0,0510	0,0180	0,0242	0,0677	0,0533
1,30	0,0250	0,0142	0,0529	0,0469	0,0182	0,0244	0,0709	0,0533
1,40	0,0247	0,0128	0,0522	0,0429	0,0180	0,0249	0,0739	0,0536
1,50	0,0245	0,0114	0,0514	0,0390	0,0177	0,0261	0,0765	0,0555

