The Ministry of Tourism and Antiquities
The Ministry of Planning

Detailed Design for Tourism Sector Development Project in the Hashemite Kingdom of Jordan

Final Report

Supporting Report
Volume 1SR
Amman Downtown Tourist Zone

August 2000

The JICA D/D Study Team
Joint Venture:
Pacific Consultants International, Tokyo
Yamashita Sekkei Inc

AMMAN DOWNTOWN TOURIST ZONE SUB-PROJECT

TABLE OF CONTENTS

VOLUME 7SR

A. DESIGN CALCULATION SHEETS
STRUCTURE

B. TAKE OFF SHEETS FOR QUANTITY SURVEY

C. OTHER SUPPLEMENTAL SURVEY REPORTS FOR DESIGN
ENVIRONMENTAL CONSIDERATION

A. DESIGN CALCULATION SHEETS

Tibah Consultants Amman - Jordan E-Mail : tibah@go.com.jo	Job Number		Sheet
	Job Title		
	Client		
	Calcs by	Checked by	Date

Retaining Wall Design :

Input Data

C14

H1	3.0	C	0.25			Soil Frict.	30	FS OT	1.5	
H2	0.5							F.S Sl.	1.5	
						Wall Fric	27	DL Fach	1.4	
		Ah	0.3			ρ_{conc}	24	LL Fach	1.7	
		At	0.2			ρ_{Soil}	20	Bearing Cap	200	
		cov. Wall	5 cm			ρ_{cv}	24			
D	1.0	cov. Base	5 cm			γ_y	425			

Seepage allowed

Theory : Coulomb
Wall type : Cantilever

SEISMIC ANALYSIS SETTINGS:

Seismic Analysis ON/OFF:OFF

VALUES OF PRESSURE COEFFICIENTS:

Active Pressure coefficient Ka :0.312
Passive Pressure coefficient Kp :8.539
Base frictional constant μ :0.577

FORCES ACTING ON THE WALL:
All forces/moments are per m width

Description	FORCES (kN) and their LEVER ARMS (m) F Horizontal left (+)	Lever arm	F Vertical down (+)	Lever arm
Destabilizing forces:				
Total Active pressure Pa	24.551	1.000	13.655	0.217
Stabilizing forces:				
Passive pressure on base Pp	-21.347	0.167		
Weight of the wall + base			22.350	0.269
Weight of soil on the base			57.740	0.725

EQUILIBRIUM CALCULATIONS AT SLS
All forces/moments are per m width

1.Moment Equilibrium

Point of rotation: bottom front corner of base.

For Overturning moment Mo calculate as follows:
Mo = Sum(hor. forces x l.a.) - Sum(vert. forces x l.a.)
For Stabilizing moment Mr calculate as follows:
Mr = -Sum(hor. forces x l.a.) + Sum(vert. forces x l.a.)
where l.a. = lever arm of each force.

Stabilizing moment Mr : 51.41 kNm
Destabilizing moment Mo : 21.59 kNm

Safety factor against overturning = Mr/Mo = 2.381

2.Force Equilibrium

Sum of Vertical forces Pv :	93.74 kN
Frictional resistance Pfric :	54.12 kN
Passive Pressure on shear key :	0.00 kN
Passive pressure on base :	21.35 kN
=> Horizontal resistance Fr :	75.47 kN
Horizontal sliding force Fh :	24.55 kN

Safety factor against overall sliding = Fr/Fh = 3.074

SOIL PRESSURES UNDER BASE

Maximum pressure :196.48 kPa
Minimum pressure : 0 kPa at 0.30 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	24.50	0.00	334.46	326.30
0.06	23.89	0.00	327.79	325.00
0.11	22.64	0.00	312.27	323.70
0.17	21.34	0.00	295.98	322.40
0.22	20.04	0.00	279.45	321.10
0.28	18.78	0.00	263.22	319.80
0.33	17.57	0.00	247.56	318.50
0.39	16.41	0.00	232.49	317.20
0.44	15.30	0.00	217.99	315.90
0.50	14.25	0.00	204.07	314.60
0.55	13.24	0.00	190.70	313.30
0.61	12.28	0.00	177.90	312.00
0.66	11.37	0.00	165.64	310.70
0.72	10.51	0.00	153.91	309.40
0.77	9.69	0.00	142.72	308.10
0.83	8.91	0.00	132.04	306.80
0.88	8.18	0.00	121.88	305.50
0.94	7.49	0.00	112.22	304.20
0.99	6.84	0.00	103.05	302.90
1.05	6.23	0.00	94.37	301.60
1.10	5.65	0.00	86.16	300.30
1.16	5.11	0.00	78.41	299.00
1.21	4.61	0.00	71.12	297.70
1.27	4.14	0.00	64.27	296.40
1.32	3.71	0.00	57.85	295.10
1.38	3.30	0.00	51.86	293.80
1.43	2.93	0.00	46.27	292.50
1.49	2.58	0.00	41.08	291.20
1.54	2.27	0.00	36.27	289.90
1.60	1.98	0.00	31.84	288.60
1.65	1.72	0.00	27.78	287.30
1.71	1.48	0.00	24.06	286.00
1.76	1.26	0.00	20.67	284.70
1.82	1.07	0.00	17.61	283.40
1.87	0.89	0.00	14.86	282.10
1.93	0.74	0.00	12.40	280.80
1.98	0.61	0.00	10.22	279.50
2.04	0.49	0.00	8.31	278.20
2.09	0.39	0.00	6.64	276.90
2.15	0.30	0.00	5.21	275.60
2.20	0.23	0.00	4.00	274.30
2.26	0.17	0.00	2.99	273.00
2.31	0.12	0.00	2.16	271.70
2.37	0.09	0.00	1.50	270.40
2.42	0.06	0.00	0.99	269.10
2.48	0.03	0.00	0.61	267.80

2.53	0.02	0.00	0.35	266.50
2.59	0.01	0.00	0.17	265.20
2.64	0.00	0.00	0.07	263.90
2.70	0.00	0.00	0.02	262.60
2.75	0.00	0.00	0.00	261.30

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	325.00
0.05	-0.08	0.00	1.09	325.00
0.08	-0.32	0.00	4.37	325.00
0.10	-0.72	0.00	9.84	325.00
0.13	-1.27	0.00	17.49	325.00
0.15	-1.99	27.33	0.00	325.00
0.17	26.18	359.28	0.00	325.00
0.20	-1.99	0.00	27.33	325.00
0.23	-1.99	27.33	0.00	325.00
0.25	26.18	359.28	0.00	325.00
0.28	25.03	343.49	0.00	325.00
0.30	23.91	328.05	0.00	325.00
0.33	22.81	312.97	0.00	325.00
0.35	21.74	298.25	0.00	325.00
0.38	20.69	283.88	0.00	325.00
0.40	19.67	269.86	0.00	325.00
0.42	18.67	256.20	0.00	325.00
0.45	17.70	242.89	0.00	325.00
0.47	16.76	229.94	0.00	325.00
0.50	15.84	217.34	0.00	325.00
0.53	14.95	205.10	0.00	325.00
0.55	14.08	193.21	0.00	325.00
0.57	13.24	181.68	0.00	325.00
0.60	12.43	170.50	0.00	325.00
0.63	11.64	159.68	0.00	325.00
0.65	10.87	149.21	0.00	325.00
0.68	10.14	139.10	0.00	325.00
0.70	9.43	129.34	0.00	325.00
0.72	8.74	119.94	0.00	325.00
0.75	8.08	110.89	0.00	325.00
0.78	7.45	102.20	0.00	325.00
0.80	6.84	93.86	0.00	325.00
0.82	6.26	85.87	0.00	325.00
0.85	5.70	78.24	0.00	325.00
0.88	5.17	70.97	0.00	325.00
0.90	4.67	64.05	0.00	325.00
0.93	4.19	57.48	0.00	325.00
0.95	3.74	51.28	0.00	325.00
0.97	3.31	45.42	0.00	325.00
1.00	2.91	39.92	0.00	325.00
1.02	2.53	34.77	0.00	325.00
1.05	2.19	29.98	0.00	325.00
1.07	1.86	25.55	0.00	325.00
1.10	1.56	21.47	0.00	325.00
1.13	1.29	17.74	0.00	325.00
1.15	1.05	14.37	0.00	325.00
1.18	0.83	11.36	0.00	325.00
1.20	0.63	8.69	0.00	325.00
1.23	0.47	6.39	0.00	325.00
1.25	0.32	4.44	0.00	325.00

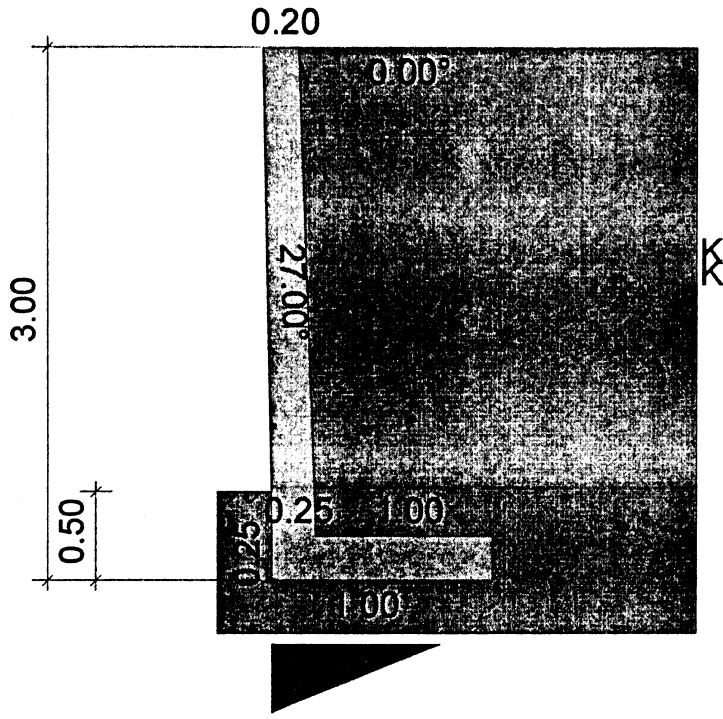
SHEAR CHECK AT WALL-BASE JUNCTION TO BS8110 - 1997

Shear force at bottom of wall V = 34.4 kN
Shear stress at bottom of wall v = 0.26 MPa OK
Allowable shear stress vc = 0.52 MPa (based on Wall tensile reinf.)

Tibah Consultants Amman - Jordan E-Mail : tbah@go.com.jo	Job Number		Sheet
	Job Title		
	Client		
	Calcs by	Checked by	Date

Sketch of Wall

Design code: BS8110 - 1997



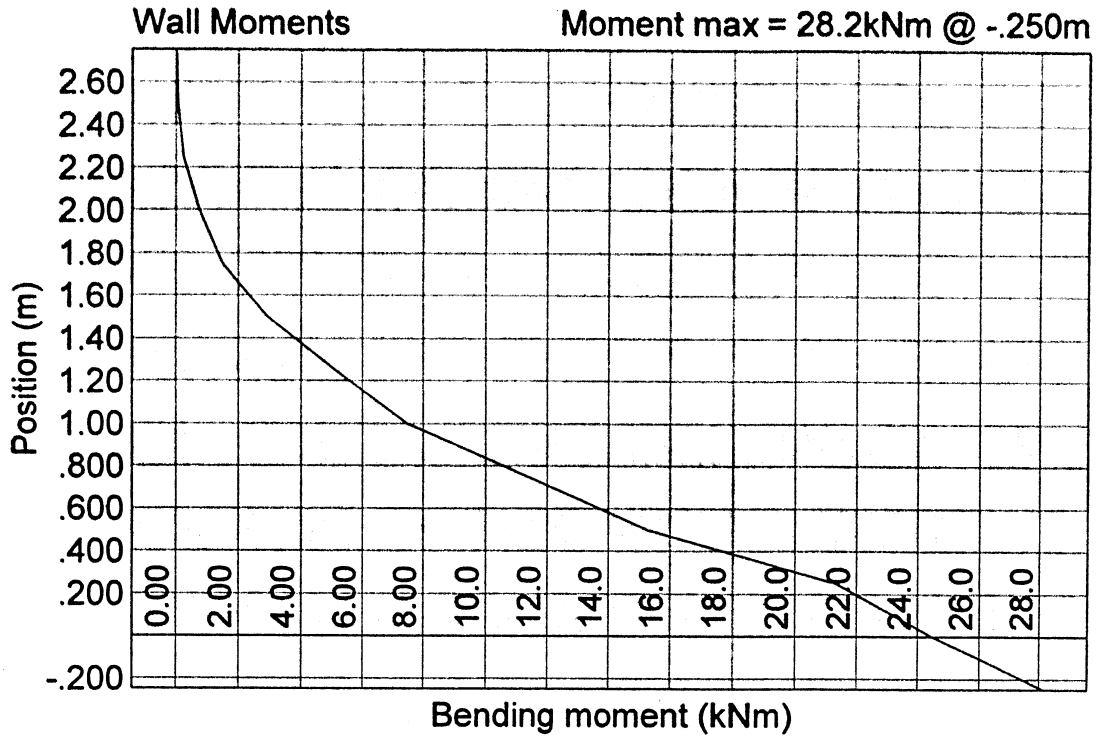
μ=0.58
V= 34.4kN
v= 0.26MPa
vc= 0.52MPa

Wall type: Cantilever
Theory: Coulomb

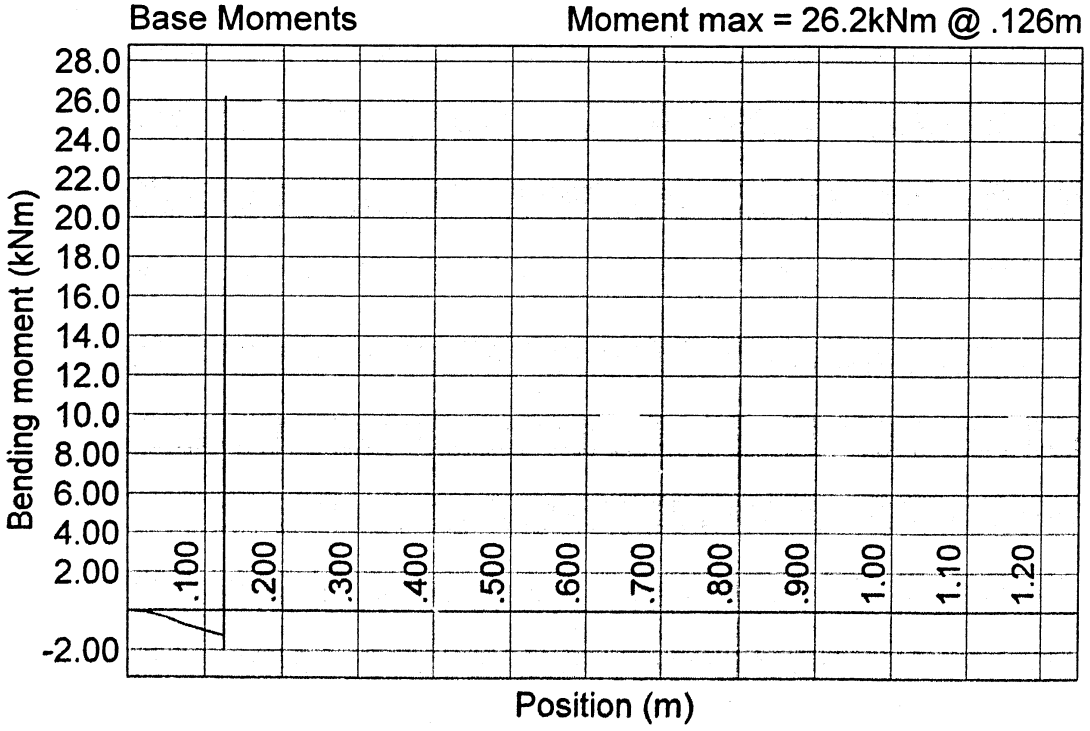
SFslip = 3.07
SFovt = 2.38

Tibah Consultants Amman - Jordan E-Mail : tibah@go.com.jo	Job Number		Sheet
	Job Title		
	Client		
	Calcs by	Checked by	Date

Wall Bending Moments



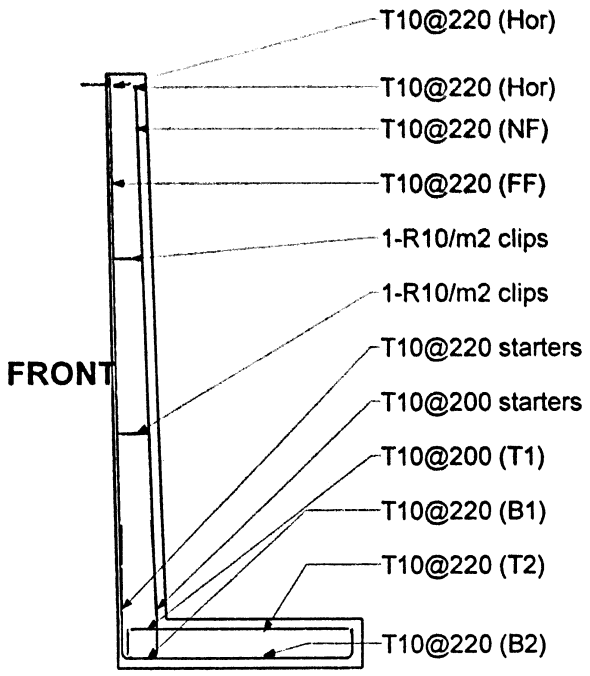
Base Bending Moments



Tibah Consultants
Amman - Jordan
E-Mail : tibah@go.com.jo

Job Number		Sheet
Job Title		
Client		
Calcs by	Checked by	Date

Schematic Reinforcement



SECTION

Retaining Wall Design : Al Jada' Lookout / Type B

Input Data

H_1	3.0	cover(w)	5 mm	F.S.OT	1.5					
H_2	0.0	cover (b)	5 mm	F.S.Sl.	1.5					
B	0.6	Soil friction	25	DL Factor	1.4					
D	0.9	Wall friction	26	LL Factor	1.7					
C	0.2	Soil Density	20 KN/m³	Soil B.C (KPa)	200					
At	0.2	f'c (MPa)	20							
Ab	0.3	fy (MPa)	425							

Seepage not allowed

Theory : Coulomb
Wall type : Cantilever

SEISMIC ANALYSIS SETTINGS:

Seismic Analysis ON/OFF:OFF

VALUES OF PRESSURE COEFFICIENTS:

Active Pressure coefficient Ka :0.372
Passive Pressure coefficient Kp :5.842
Base frictional constant μ :0.466

FORCES ACTING ON THE WALL:
All forces/moments are per m width

Description	FORCES (kN) and their LEVER ARMS (m) F Horizontal left (+)	Lever arm	F Vertical down (+)	Lever arm
Destabilizing forces:				
Total Active pressure Pa	29.497	1.000	15.764	0.867
Stabilizing forces:				
Passive pressure on base Pp	-0.000	0.000		
Weight of the wall + base			29.160	0.804
Weight of soil on the base			51.300	1.325

EQUILIBRIUM CALCULATIONS AT SLS
All forces/moments are per m width

1.Moment Equilibrium

Point of rotation: bottom front corner of base.

For Overturning moment Mo calculate as follows:
Mo = Sum(hor. forces x l.a.) - Sum(vert. forces x l.a.)
For Stabilizing moment Mr calculate as follows:
Mr = -Sum(hor. forces x l.a.) + Sum(vert. forces x l.a.)
where l.a. = lever arm of each force.

Stabilizing moment Mr : 91.39 kNm
Destabilizing moment Mo : 15.83 kNm

Safety factor against overturning = Mr/Mo = 5.771

2.Force Equilibrium

Sum of Vertical forces Pv :	96.22 kN
Frictional resistance Pfric :	44.87 kN
Passive Pressure on shear key :	0.00 kN
Passive pressure on base :	0.00 kN
=> Horizontal resistance Fr :	44.87 kN
Horizontal sliding force Fh :	29.50 kN

Safety factor against overall sliding = Fr/Fh = 1.521

SOIL PRESSURES UNDER BASE

Maximum pressure : 73.92 kPa
Minimum pressure : 32.99 kPa
Maximum pressure occurs at left hand side of base

WALL MOMENTS (ULS) AND REINFORCEMENT TO ACI 318 - 1993

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	28.23	0.00	309.91	979.87
0.05	26.95	0.00	298.15	973.38
0.11	25.34	0.00	282.57	966.89
0.16	23.80	0.00	267.48	960.40
0.22	22.33	0.00	252.88	953.91
0.27	20.92	0.00	238.77	947.42
0.32	19.56	0.00	225.14	940.93
0.38	18.27	0.00	211.98	934.44
0.43	17.04	0.00	199.29	927.95
0.49	15.86	0.00	187.07	921.46
0.54	14.74	0.00	175.31	914.97
0.59	13.67	0.00	164.00	908.49
0.65	12.66	0.00	153.14	902.00
0.70	11.69	0.00	142.72	895.51
0.76	10.78	0.00	132.74	889.02
0.81	9.92	0.00	123.19	882.53
0.86	9.10	0.00	114.07	876.04
0.92	8.33	0.00	105.37	869.55
0.97	7.60	0.00	97.08	863.06
1.03	6.92	0.00	89.20	856.57
1.08	6.28	0.00	81.72	850.08
1.13	5.68	0.00	74.63	843.59
1.19	5.12	0.00	67.93	837.10
1.24	4.60	0.00	61.61	830.62
1.30	4.12	0.00	55.66	824.13
1.35	3.67	0.00	50.08	817.64
1.40	3.25	0.00	44.85	811.15
1.46	2.87	0.00	39.98	804.66
1.51	2.52	0.00	35.44	798.17
1.57	2.19	0.00	31.24	791.68
1.62	1.90	0.00	27.36	785.19
1.67	1.64	0.00	23.79	778.70
1.73	1.40	0.00	20.53	772.21
1.78	1.18	0.00	17.56	765.72
1.84	0.99	0.00	14.88	759.23
1.89	0.82	0.00	12.47	752.75
1.94	0.67	0.00	10.32	746.26
2.00	0.54	0.00	8.42	739.77
2.05	0.43	0.00	6.76	733.28
2.11	0.33	0.00	5.33	726.79
2.16	0.25	0.00	4.11	720.30
2.21	0.19	0.00	3.08	713.81
2.27	0.14	0.00	2.23	707.32
2.32	0.09	0.00	1.56	700.83
2.38	0.06	0.00	1.03	694.34
2.43	0.04	0.00	0.64	687.85

2.48	0.02	0.00	0.36	681.36
2.54	0.01	0.00	0.18	674.88
2.59	0.00	0.00	0.07	668.39
2.65	0.00	0.00	0.02	661.90
2.70	0.00	0.00	0.00	655.41

BASE MOMENTS (ULS) AND REINFORCEMENT TO ACI 318 - 1993

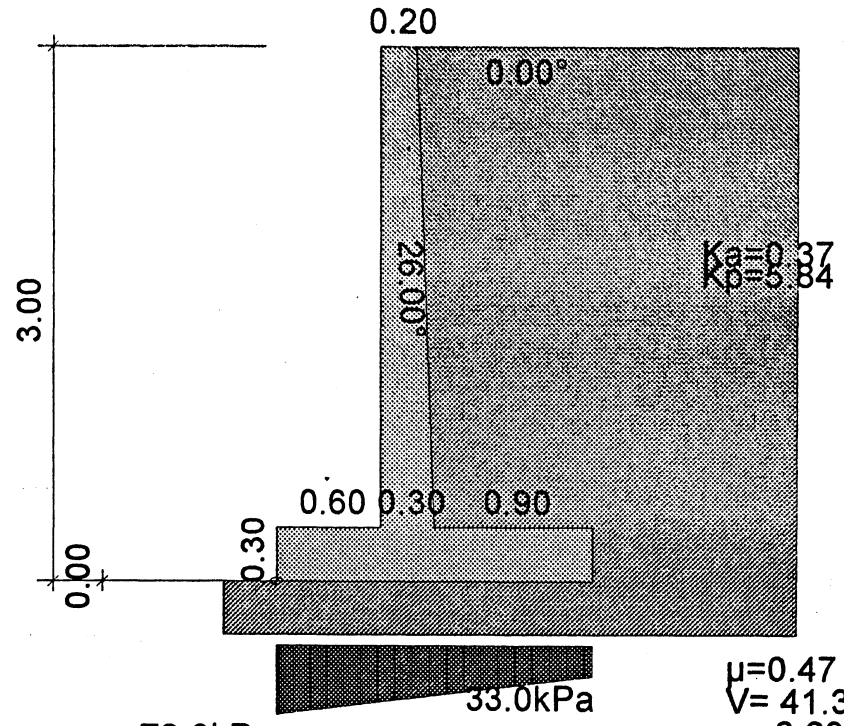
Position from left (m)	Moment (kNm)	Top Reinforcing (mm^2/m)	Bot Reinforcing (mm^2/m)	Nominal (0.138) (mm^2/m)
0.04	-0.00	0.00	0.00	973.38
0.07	-0.06	0.00	0.60	973.38
0.11	-0.22	0.00	2.41	973.38
0.14	-0.50	0.00	5.43	973.38
0.18	-0.89	0.00	9.66	973.38
0.22	-1.38	0.00	15.09	973.38
0.25	-1.99	0.00	21.74	973.38
0.29	-2.71	0.00	29.60	973.38
0.32	-3.54	0.00	38.68	973.38
0.36	-4.49	0.00	48.98	973.38
0.40	-5.54	0.00	60.51	973.38
0.43	-6.70	0.00	73.26	973.38
0.47	-7.97	0.00	87.25	973.38
0.50	-9.36	0.00	102.49	973.38
0.54	-10.85	0.00	118.96	973.38
0.58	-12.46	0.00	136.69	973.38
0.61	-14.18	0.00	155.68	973.38
0.65	-16.00	0.00	175.93	973.38
0.68	-17.94	0.00	197.46	973.38
0.72	-19.99	0.00	220.28	973.38
0.76	-22.15	0.00	244.38	973.38
0.79	-24.03	265.47	0.00	973.38
0.83	15.07	165.54	0.00	973.38
0.86	14.89	163.64	0.00	973.38
0.90	13.88	152.46	0.00	973.38
0.94	12.91	141.68	0.00	973.38
0.97	11.97	131.31	0.00	973.38
1.01	11.07	121.34	0.00	973.38
1.04	10.20	111.77	0.00	973.38
1.08	9.37	102.60	0.00	973.38
1.12	8.57	93.83	0.00	973.38
1.15	7.81	85.46	0.00	973.38
1.19	7.08	77.48	0.00	973.38
1.22	6.39	69.90	0.00	973.38
1.26	5.74	62.71	0.00	973.38
1.30	5.12	55.91	0.00	973.38
1.33	4.53	49.51	0.00	973.38
1.37	3.98	43.50	0.00	973.38
1.40	3.47	37.89	0.00	973.38
1.44	2.99	32.66	0.00	973.38
1.48	2.55	27.82	0.00	973.38
1.51	2.14	23.37	0.00	973.38
1.55	1.77	19.31	0.00	973.38
1.58	1.43	15.64	0.00	973.38
1.62	1.13	12.35	0.00	973.38
1.66	0.87	9.46	0.00	973.38
1.69	0.64	6.95	0.00	973.38
1.73	0.44	4.82	0.00	973.38
1.76	0.28	3.09	0.00	973.38
1.80	0.16	1.74	0.00	973.38

SHEAR CHECK AT WALL-BASE JUNCTION TO ACI 318 - 1993

Shear force at bottom of wall V = 41.3 kN
Shear stress at bottom of wall v = 0.23 MPa OK
Allowable shear stress vc = 0.61 MPa (based on Wall tensile reinf.)

Sketch of Wall

Design code: ACI 318 - 1993

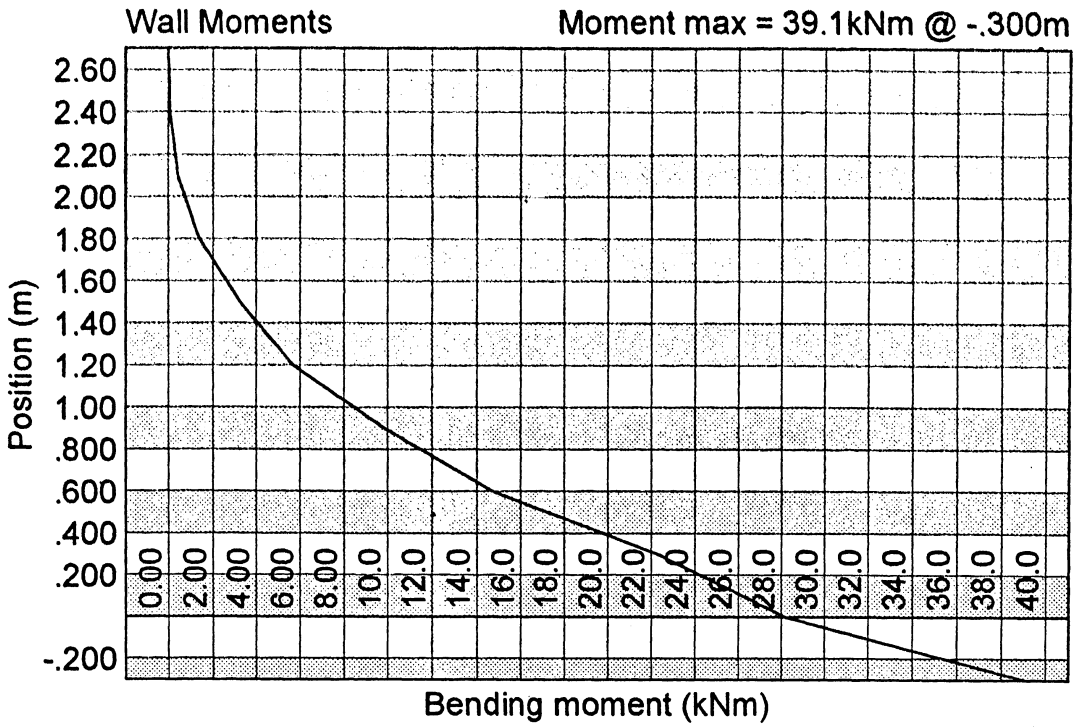


μ=0.47
V= 41.3kN
v= 0.23MPa
vc= 0.61MPa

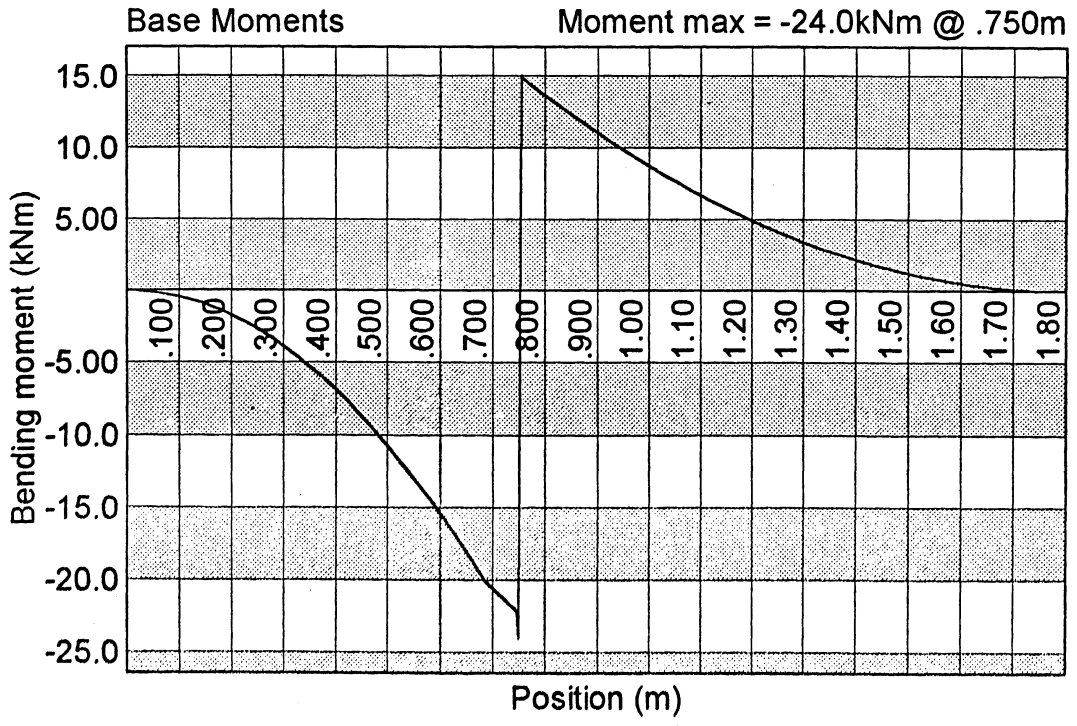
Wall type: Cantilever
Theory: Coulomb

SFslip = 1.52
SFovt = 5.77

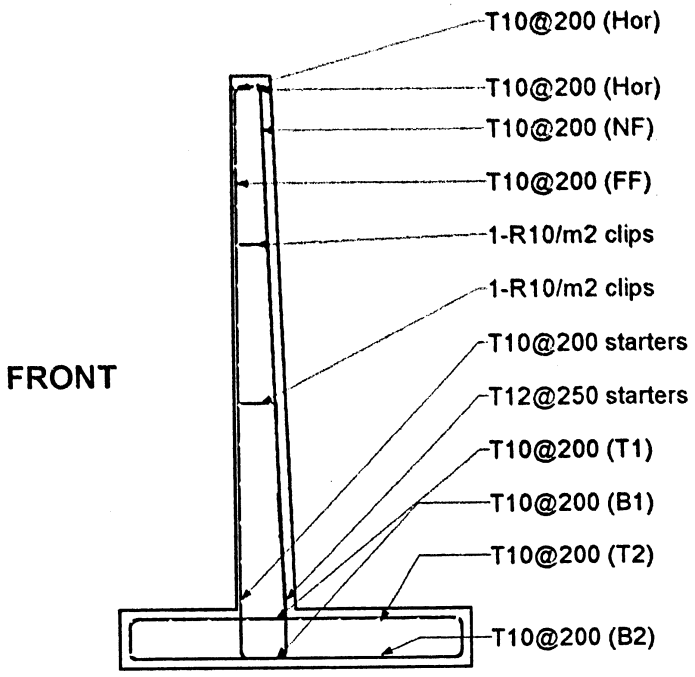
Wall Bending Moments



Base Bending Moments



Schematic Reinforcement



Tibah Consultants Amman - Jordan E-Mail : tibah@go.com.jo	Job Number		Sheet 1/1
	Job Title		
	Client		
	Calcs by S.Z	Checked by	Date 23/3/2000

Retaining Wall Design : (L shape)

C14

Input Data

H	4m	C	0.3			Soil frict	30°	S.F o.T	1.5	
H2	0.5m	F	0.3					S.F slid	1.5	
		X1	1.3			Wall fric	27°	DL Factor	1.4	
		Nt	0.2			Conc. (KN/m³)	24	LL factor	1.7	
		Ab	0.3			Soil (KN/m³)	20	Bearing Cap.	200	(KPA)
		cov (wall)	5cm			fcy (mpa)	24			
D	1.3m	" (base)	5cm			fy (mpa)	425			

Seepage allowed

Theory : Coulomb
Wall type : Cantilever

SEISMIC ANALYSIS SETTINGS:

Seismic Analysis ON/OFF:OFF

VALUES OF PRESSURE COEFFICIENTS:

Active Pressure coefficient Ka :0.308
Passive Pressure coefficient Kp :8.539
Base frictional constant μ :0.577

FORCES ACTING ON THE WALL:
All forces/moments are per m width

Description	FORCES (kN) and their LEVER ARMS (m) F Horizontal left (+)	Lever arm	F Vertical down (+)	Lever arm
Destabilizing forces:				
Total Active pressure Pa	43.283	1.333	23.548	0.267
Stabilizing forces:				
Passive pressure on base Pp	-21.347	0.167		
Weight of the wall + base			35.880	0.423
Weight of soil on the base			99.900	0.925

EQUILIBRIUM CALCULATIONS AT SLS
All forces/moments are per m width

1.Moment Equilibrium

Point of rotation: bottom front corner of base.

For Overturning moment Mo calculate as follows:
Mo = Sum(hor. forces x l.a.) - Sum(vert. forces x l.a.)
For Stabilizing moment Mr calculate as follows:
Mr = -Sum(hor. forces x l.a.) + Sum(vert. forces x l.a.)
where l.a. = lever arm of each force.

Stabilizing moment Mr : 111.09 kNm
Destabilizing moment Mo : 51.43 kNm

Safety factor against overturning = Mr/Mo = 2.160

2.Force Equilibrium

```
    Sum of Vertical forces Pv : 159.33 kN
  Frictional resistance Pfric :  91.99 kN
Passive Pressure on shear key :  33.30 kN
     Passive pressure on base :  21.35 kN
  => Horizontal resistance Fr : 146.64 kN
  Horizontal sliding force Fh :  43.28 kN
```

Safety factor against overall sliding = Fr/Fh = 3.388

SOIL PRESSURES UNDER BASE

Maximum pressure :283.65 kPa
Minimum pressure : 0 kPa at 0.48 m from right hand side of base.
Maximum pressure occurs at left hand side of base

***** MAXIMUM PRESSURE EXCEEDS SPECIFIED ALLOWABLE PRESSURE BY 83.7 kPa *****

WALL MOMENTS (ULS) AND REINFORCEMENT TO BS8110 - 1997

Position from base top (m)	Moment (kNm)	Front Reinfqrcing (mm^2/m)	Back Reinforcing (mm^2/m)	Nominal (0.13%) (mm^2/m)
0.00	60.58	0.00	653.43	392.60
0.07	57.76	0.00	627.43	390.00
0.15	54.38	0.00	595.70	387.40
0.22	51.07	0.00	564.23	384.80
0.30	47.90	0.00	533.69	382.20
0.37	44.86	0.00	504.13	379.60
0.44	41.95	0.00	475.54	377.00
0.52	39.17	0.00	447.93	374.40
0.59	36.52	0.00	421.27	371.80
0.67	33.99	0.00	395.57	369.20
0.74	31.57	0.00	370.81	366.60
0.81	29.28	0.00	346.98	364.00
0.89	27.10	0.00	324.08	361.40
0.96	25.03	0.00	302.10	358.80
1.04	23.07	0.00	281.03	356.20
1.11	21.21	0.00	260.85	353.60
1.18	19.46	0.00	241.56	351.00
1.26	17.80	0.00	223.15	348.40
1.33	16.25	0.00	205.60	345.80
1.41	14.78	0.00	188.91	343.20
1.48	13.41	0.00	173.05	340.60
1.55	12.12	0.00	158.02	338.00
1.63	10.92	0.00	143.81	335.40
1.70	9.80	0.00	130.40	332.80
1.78	8.76	0.00	117.78	330.20
1.85	7.80	0.00	105.93	327.60
1.92	6.91	0.00	94.83	325.00
2.00	6.09	0.00	84.48	322.40
2.07	5.34	0.00	74.85	319.80
2.15	4.65	0.00	65.92	317.20
2.22	4.03	0.00	57.69	314.60
2.29	3.46	0.00	50.12	312.00
2.37	2.95	0.00	43.20	309.40
2.44	2.49	0.00	36.91	306.80
2.52	2.08	0.00	31.22	304.20
2.59	1.72	0.00	26.12	301.60
2.66	1.41	0.00	21.58	299.00
2.74	1.13	0.00	17.57	296.40
2.81	0.90	0.00	14.06	293.80
2.89	0.69	0.00	11.04	291.20
2.96	0.53	0.00	8.47	288.60
3.03	0.39	0.00	6.32	286.00
3.11	0.28	0.00	4.56	283.40
3.18	0.19	0.00	3.15	280.80

3.26	0.12	0.00	2.06	278.20
3.33	0.07	0.00	1.25	275.60
3.40	0.04	0.00	0.69	273.00
3.48	0.02	0.00	0.33	270.40
3.55	0.01	0.00	0.13	267.80
3.63	0.00	0.00	0.03	265.20
3.70	0.00	0.00	0.01	262.60

BASE MOMENTS (ULS) AND REINFORCEMENT TO BS8110 - 1997

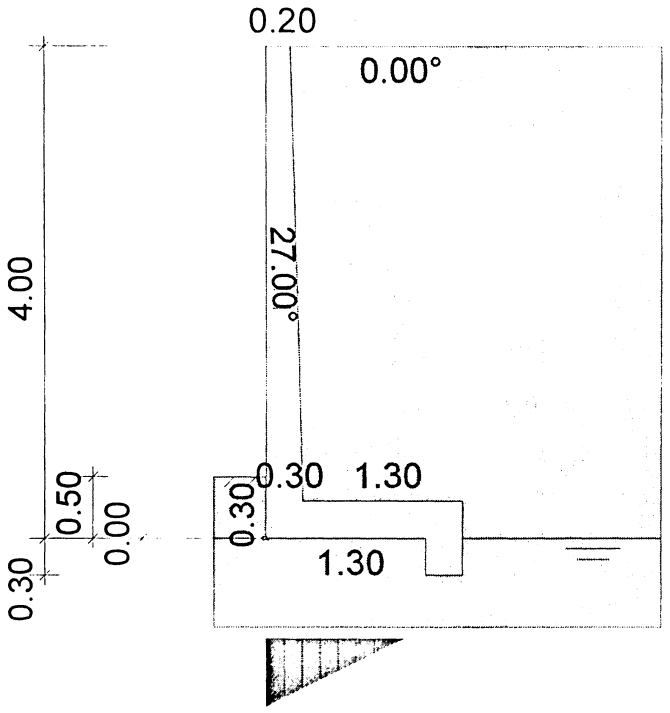
Position from left (m)	Moment (kNm)	Top Reinforcing (mm^2/m)	Bot Reinforcing (mm^2/m)	Nominal (0.13%) (mm^2/m)
0.03	-0.00	0.00	0.00	390.00
0.06	-0.37	0.00	4.00	390.00
0.10	-1.47	0.00	15.99	390.00
0.13	-3.31	0.00	35.98	390.00
0.16	-5.89	0.00	63.97	390.00
0.19	-8.09	87.84	0.00	390.00
0.22	64.40	703.64	0.00	390.00
0.26	63.51	693.37	0.00	390.00
0.29	60.72	661.12	0.00	390.00
0.32	57.99	629.99	0.00	390.00
0.35	55.33	601.08	0.00	390.00
0.38	52.72	572.75	0.00	390.00
0.42	50.18	545.15	0.00	390.00
0.45	47.71	518.24	0.00	390.00
0.48	45.29	492.00	0.00	390.00
0.51	42.94	466.45	0.00	390.00
0.54	40.65	441.57	0.00	390.00
0.58	38.42	417.38	0.00	390.00
0.61	36.26	393.87	0.00	390.00
0.64	34.16	371.04	0.00	390.00
0.67	32.12	348.90	0.00	390.00
0.70	30.14	327.43	0.00	390.00
0.74	28.23	306.65	0.00	390.00
0.77	26.38	286.55	0.00	390.00
0.80	24.59	267.12	0.00	390.00
0.83	22.87	248.38	0.00	390.00
0.86	21.20	230.33	0.00	390.00
0.90	19.60	212.95	0.00	390.00
0.93	18.07	196.25	0.00	390.00
0.96	16.59	180.24	0.00	390.00
0.99	15.18	164.91	0.00	390.00
1.02	13.83	150.26	0.00	390.00
1.06	12.55	136.29	0.00	390.00
1.09	11.32	123.00	0.00	390.00
1.12	10.16	110.39	0.00	390.00
1.15	9.06	98.47	0.00	390.00
1.18	8.03	87.22	0.00	390.00
1.22	7.06	76.66	0.00	390.00
1.25	6.15	66.78	0.00	390.00
1.28	5.30	57.58	0.00	390.00
1.31	4.52	49.06	0.00	390.00
1.34	3.80	41.23	0.00	390.00
1.38	3.14	34.07	0.00	390.00
1.41	2.54	27.60	0.00	390.00
1.44	2.01	21.81	0.00	390.00
1.47	1.54	16.70	0.00	390.00
1.50	1.13	12.27	0.00	390.00
1.54	0.78	8.52	0.00	390.00
1.57	0.50	5.45	0.00	390.00
1.60	0.28	3.07	0.00	390.00

SHEAR CHECK AT WALL-BASE JUNCTION TO BS8110 - 1997

Shear force at bottom of wall V = 60.6 kN
Shear stress at bottom of wall v = 0.34 MPa OK
Allowable shear stress vc = 0.54 MPa (based on Wall tensile reinf.)

Sketch of Wall

Design code: BS8110 - 1997



Ka=0.31
Kp=8.54

μ=0.58
V= 60.6kN
v= 0.34MPa
vc= 0.54MPa

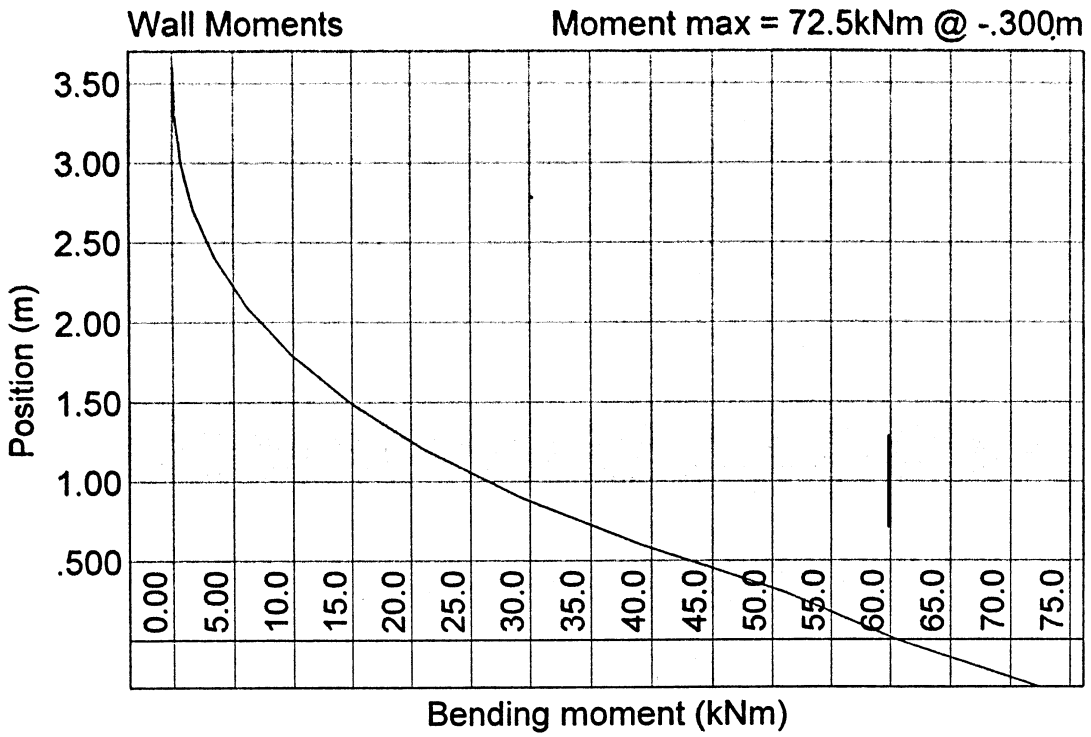
Wall type: Cantilever
Theory: Coulomb

SFslip = 3.39
SFovt = 2.16

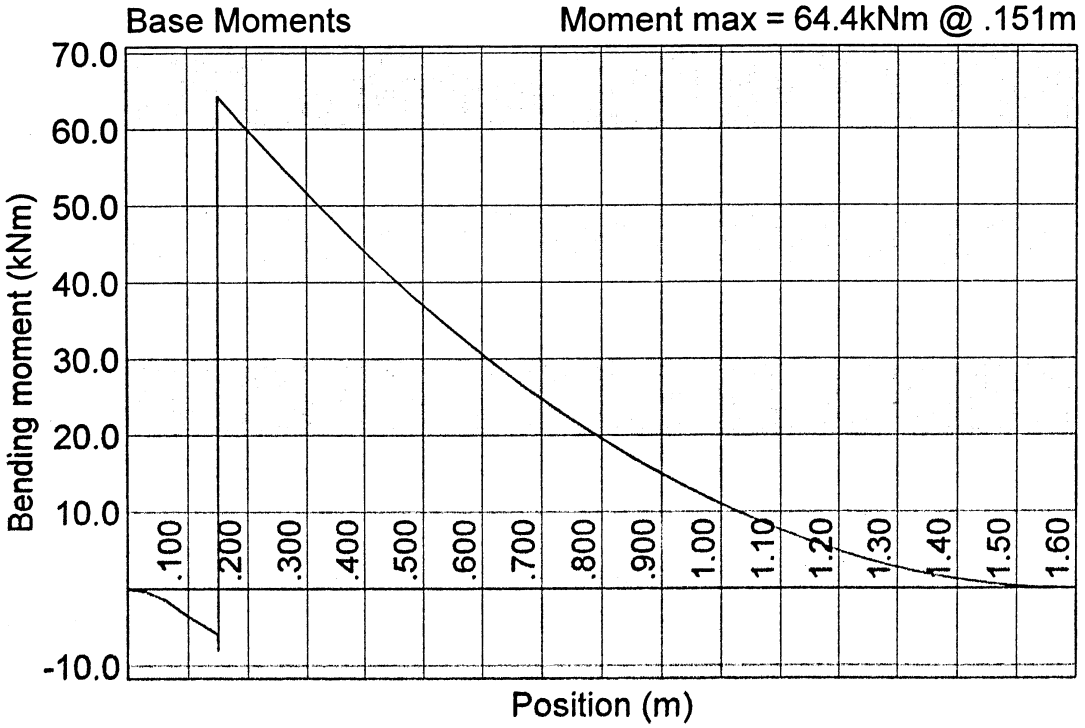
Tibah Consultants
Amman - Jordan
E-Mail : tibah@go.com.jo

Job Number		Sheet
Job Title		
Client		
Calcs by	Checked by	Date

Wall Bending Moments



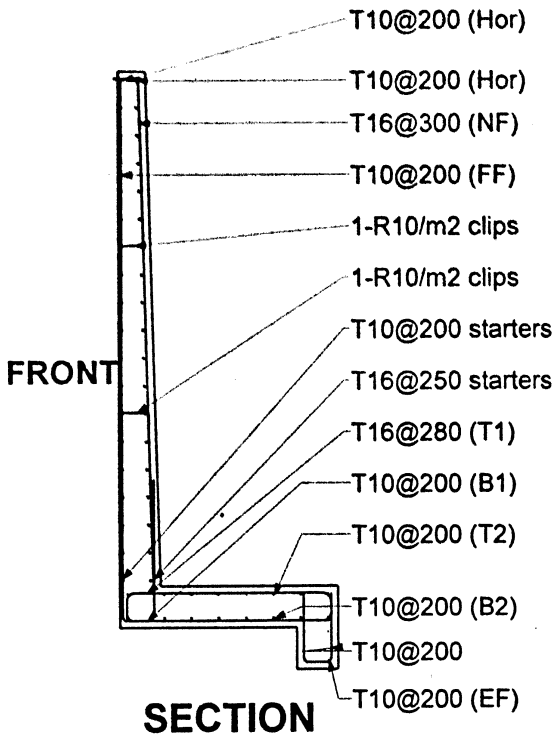
Base Bending Moments



Tibah Consultants
Amman - Jordan
E-Mail : tibah@go.com.jo

Job Number		Sheet
Job Title		
Client		
Calcs by	Checked by	Date

Schematic Reinforcement



Retaining Wall Design :

Input Data

C14

H1	2.0 m	C	0.2 m	Soil fric	30			SF ovt.	1.5
H2	0.0 m			Wall fric	27			SF Slid.	1.5
				Pconc	24 KN/m³			DL Fact.	1.4
		At	0.2 m	Psoil	20 KN/m³			LL Fact.	1.7
		Ah	0.2 m	fc	20 MPa			Bearing Cap	200 kPa
B	0.4 m	Cov. wall	50 mm	fy	425 MPa				
D	0.5 m	Cov Bas	50 mm						

Seepage allowed

Theory : Coulomb
Wall type : Cantilever

SEISMIC ANALYSIS SETTINGS:

Seismic Analysis ON/OFF:OFF

VALUES OF PRESSURE COEFFICIENTS:

Active Pressure coefficient Ka :0.296
Passive Pressure coefficient Kp :8.539
Base frictional constant μ :0.577

FORCES ACTING ON THE WALL:
All forces/moments are per m width

Description	FORCES (kN) and their LEVER ARMS (m) F Horizontal left (+)	Lever arm	F Vertical down (+)	Lever arm
Destabilizing forces:				
Total Active pressure Pa	10.553	0.667	5.377	0.600
Stabilizing forces:				
Passive pressure on base Pp	-0.000	0.000		
Weight of the wall + base			13.920	0.519
Weight of soil on the base			18.000	0.850

EQUILIBRIUM CALCULATIONS AT SLS
All forces/moments are per m width

1.Moment Equilibrium

Point of rotation: bottom front corner of base.

For Overturning moment Mo calculate as follows:
Mo = Sum(hor. forces x l.a.) - Sum(vert. forces x l.a.)
For Stabilizing moment Mr calculate as follows:
Mr = -Sum(hor. forces x l.a.) + Sum(vert. forces x l.a.)
where l.a. = lever arm of each force.

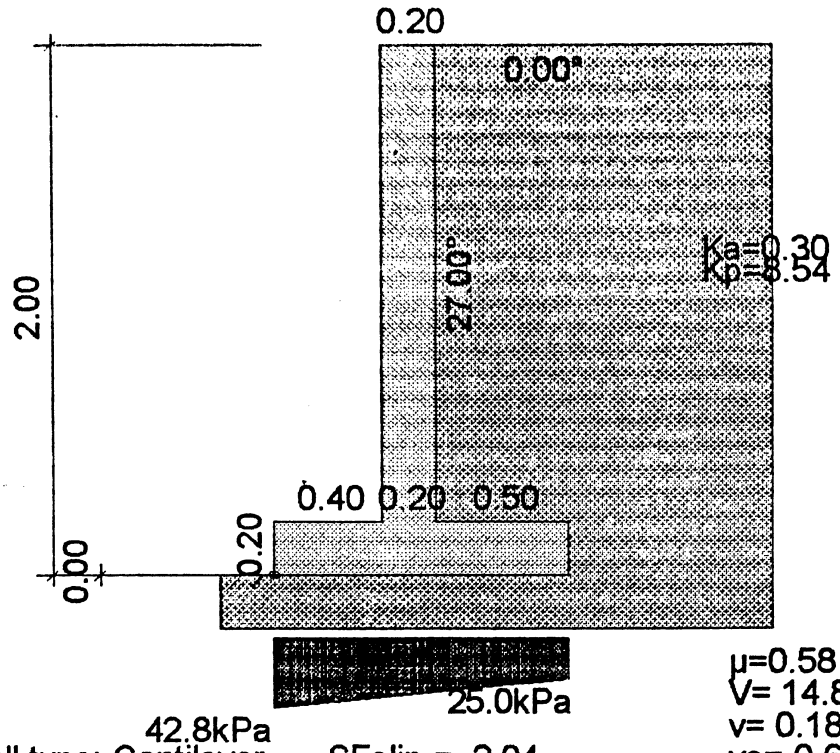
Stabilizing moment Mr : 22.52 kNm
Destabilizing moment Mo : 3.81 kNm

Safety factor against overturning = Mr/Mo = 5.913

Tiben Consultants Amman - Jordan E-Mail : tiben@go.com.jo	Job Number	Sheet 1
	Job Title	
	Open	
	Sales by Sari Zuayter / Checked by / Date 28/11/99	

Sketch of Wall

Design code: ACI 318 - 1993



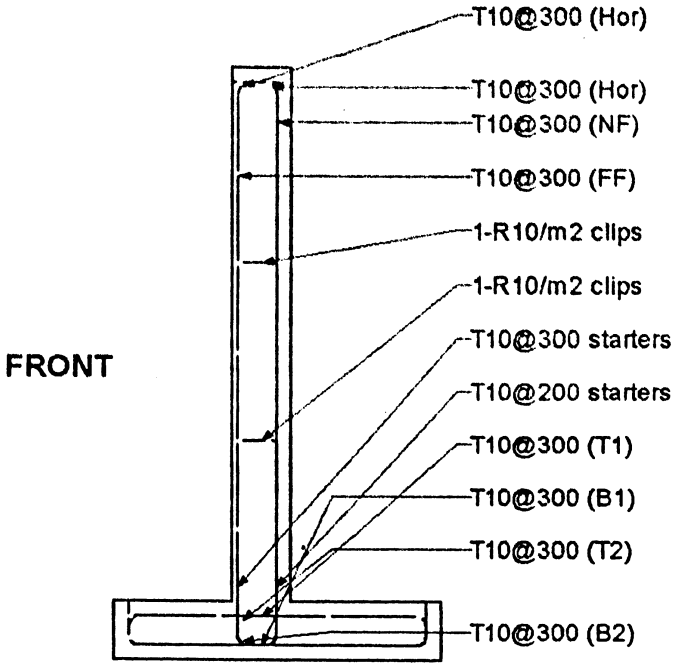
μ=0.58
V= 14.8kN
v= 0.18MPa
vc= 0.60MPa

Wall type: Cantilever
Theory: Coulomb

SFslip = 2.04
SFovt = 5.91

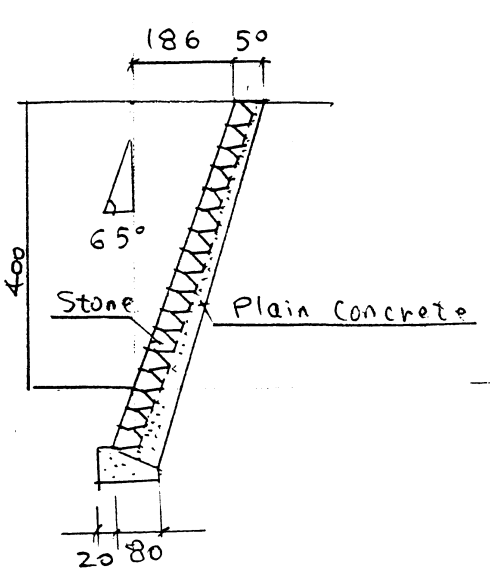
Tibah Consultants Amman - Jordan E-Mail: tibah@go.com.jo	Job Number Job Title Client	Sheet 26
Calcs by: Sari Zuayter	Checked by	Date 28/11/99

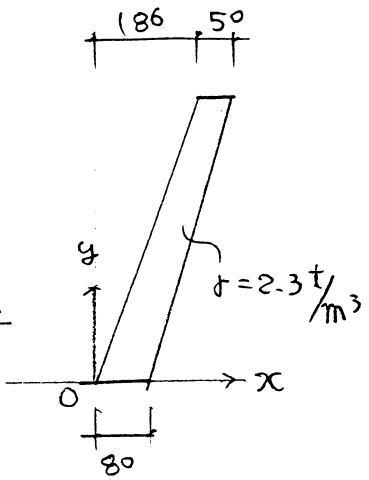
Schematic Reinforcement

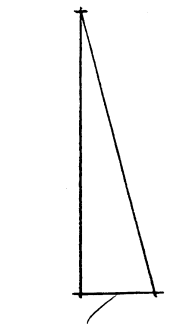


SECTION

Structural Drawing No.AD.ST-003 Section K—K







K.γ.H
= 0.4 × 1.7 × 4.0
= 2.72 t/m

(2)Over Turning about 0 Point

① Over Turning Moment by Self Weight of Wal.

W1=2.3t/m3×0.5m×4.0m×1.0m=4.6t

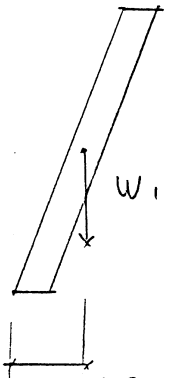
W=2.3t/m3×(0.8-0.5)m×4.0m×1.0m=1.38t

ΣW=5.98t

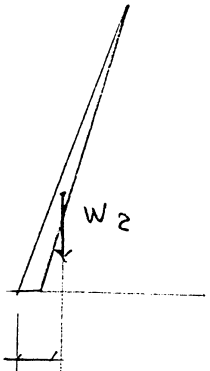
x1=(1.86+0.5)/2=1.18m

x2=1.86/3+0.5+(0.8−0.5)/3=1.22m

ΣMw=−(W1×x1+W2×x2)=−(4.6×1.18+1.38×1.22)=−7.11tm



$x_1 = (186-50)/2$
= 118 cm



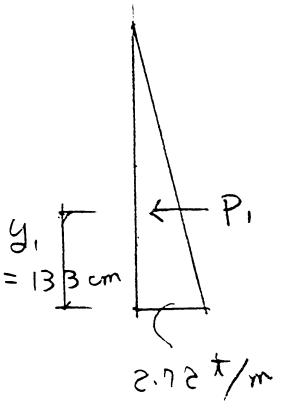
$x_2 = 186/3 + 50 + (80-50)/3$
= 122 cm

5

② Over Turning Moment by Soil Pressure

P=2.72×4/2=5.44

Mp=5.54×4/3=7.25tm



③ Total Over Turning Moment

ΣM=ΣMw+Mp=-7.11+7.25=0.14tm

④ Eccentricity

e=ΣM/ΣW=0.14/5.98=0.02<B/6=0.8/6=0.133 OK

(3)Sliding

Safety Factor Fs=(ΣW×μ+τ×B')

=(5.98t×0.7+5.0kg/cm2×60cm×100cm/1000)/5.44

=(4.18+30)/5.44=6.2>aFs=1.5 OK

(4)Vertical Loading

Total Weight of Wall=5.98+2.3×1.0×1.0=8.28t

w=8.28t/(1.0m×1.om)=8.28t/m2<15t/m2 OK