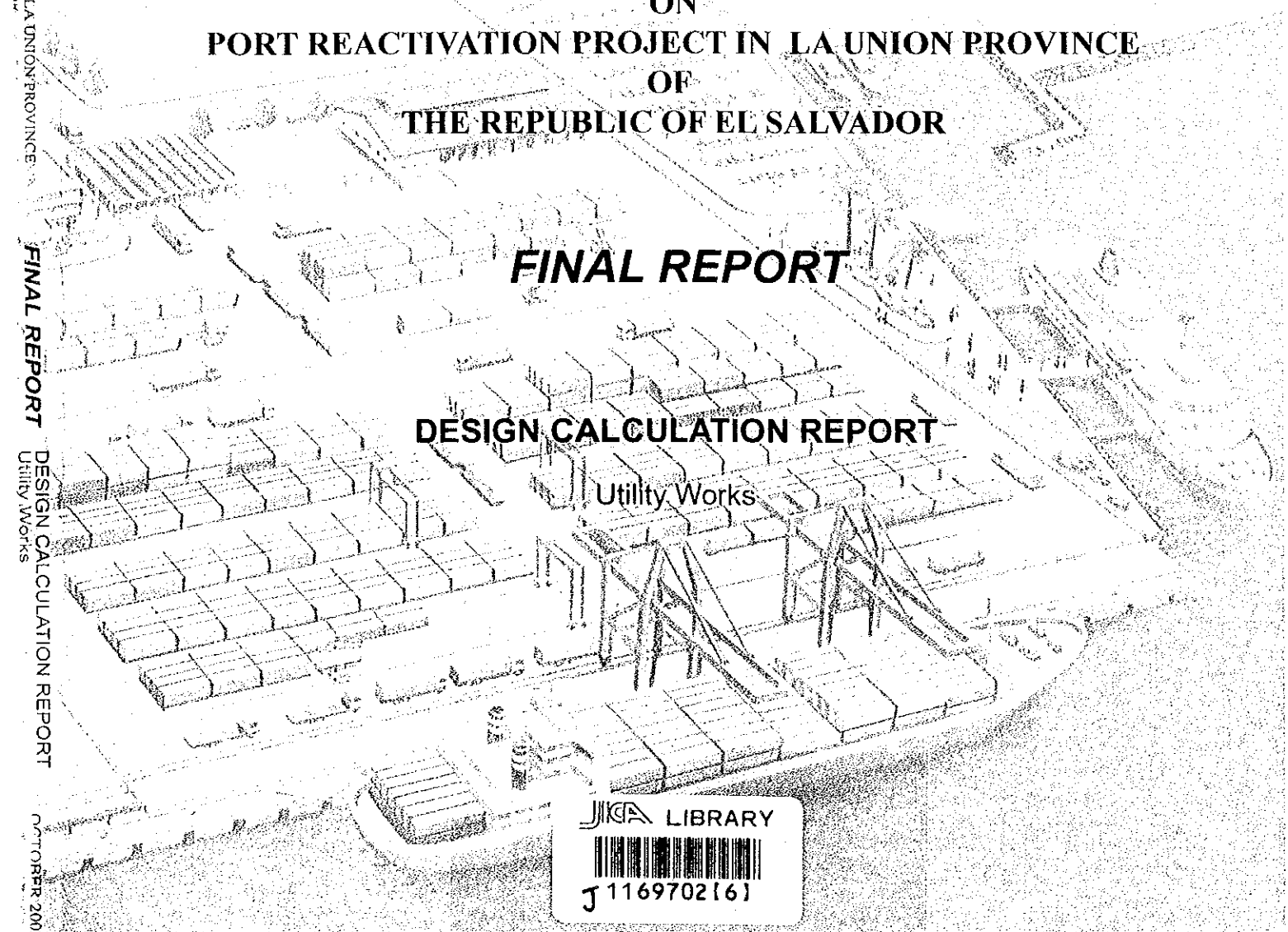
社会開発調査部報告書

No. 04

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
COMISION EJECUTIVA PORTUARIA AUTONOMA (CEPA)

THE DETAILED DESIGN ON PORT REACTIVATION PROJECT IN LA UNION PROVINCE OF THE REPUBLIC OF EL SALVADOR



FINAL REPORT

DESIGN CALCULATION REPORT

Utility Works

OCTOBER 2002

NIPPON KOEI CO., LTD.

THE DETAILED DESIGN ON PORT REACTIVATION PROJECT IN LA UNION PROVINCE
FINAL REPORT
DESIGN CALCULATION REPORT
Utility Works
OCTOBER 2002 NIPPON KOEI

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
COMISION EJECUTIVA PORTUARIA AUTONOMA (CEPA)

THE DETAILED DESIGN
ON
PORT REACTIVATION PROJECT IN LA UNION PROVINCE
OF
THE REPUBLIC OF EL SALVADOR

FINAL REPORT

DESIGN CALCULATION REPORT

Utility Works

OCTOBER 2002

NIPPON KOEI CO., LTD.

WASTEWATER SYSTEM

DESIGN CALCULATION COVER SHEET

Project	Detailed Design on Port Reactivation Project in La Union Province	**Project Code**	JC1N004/2N001
Section	**Utility Works**	Calc. File No.	
Sub-Section	**Wastewater System**	Calc. Index No.	

Subject:

Determination of Diameter and Slope for Pipe

Calculation Objective:

To calculate and check a hydraulic grade line, discharge volume and velocity of pipeline from the building to wastewater treatment facility.

References, Calculation Notes and Comments

Design Condition

1) Velocity within pipe : Maximum 3 m/s, Minimum 0.6 m/s
2) Roughness Coefficient : 0.013 (Concrete Pipe), 0.010 (PVC)
3) Minimum Overburden : Thickness of Pavement with 30cm as clearance
4) Maximum Interval of Manhole : 50 m (D300<)
5) Calculation Model : Manning Formula

$V = 1/n \times R^{2/3} \times I^{1/2}$

$Q = A \times V$

Rev	Prepared by	Prepared Date	No. of Pages	Checked by	Checked Date	Reviewed by	Reviewed Date	Superseded by Calc No.
O	H Irula	02/06/10	2	S. Endo	10 June, 02	via JT	9 July '02	
A								
B								
C								

NIPPON KOEI CO.,LTD.

Project	Detailed Design on Port Reactivation Project in La Union	Calc. File No.	
Section	UTILITY WORK	Calc. Index No.	
Subject	Wastewater System	Page No. 2/2	Rev.

References/

Diameter of Pipe Culvert ; Roughness Coefficie n 0.01 for PVC

60	72
1524	1829

	Q (m3/sec)		Pipe Culvert												
			PVC	Length (m)	Elevation (Manhole)	Minimum Overburden(m)	Bottom elevation of culvert (Outlet)	Grade (%)	Elevation (Inlet)	Name of Manhole	Bottom of Manhole	Depth of Manhole	Diameter (m)	v (m/sec)	Max. Qe (m3/sec)
Administration Building											+4.387				
A				0.00	+5.537	+1.000	+4.387	1.00	+4.387	A	+4.337	+1.200	0.150	1.120	0.020
From A to B	0.0004	0.00039	Pipe-1	7.50	+5.537	+1.000	+4.337	1.00	+4.262	B	+4.212	+1.325	0.150	1.120	0.020
From B to C	0.0004	0.00078	Pipe-2	14.10	+5.537	+1.000	+4.212	1.00	+4.071	C	+3.966	+1.571	0.150	1.120	0.020
F				0.00	+5.602	+1.000	+4.452	1.00	+4.452	F	+4.402	+1.200	0.150	1.120	0.020
From F to G	0.0004	0.00039	Pipe-3	13.16	+5.602	+1.000	+4.402	1.00	+4.270	G	+4.220	+1.382	0.150	1.120	0.020
From G to C	0.0004	0.00078	Pipe-4	20.47	+5.592	+1.000	+4.220	1.00	+4.016				0.150	1.120	0.020
From C to D	0.0016	0.00155	Pipe-5	16.10	+5.537	+1.000	+3.966	1.00	+3.805	D	+3.755	+1.782	0.150	1.120	0.020
H				0.00	+5.602	+1.000	+4.452	1.00	+4.452	H	+4.402	+1.200	0.150	1.120	0.020
From H to I	0.0002	0.00015	Pipe-6	12.00	+5.602	+1.000	+4.402	1.00	+4.282	I	+4.232	+1.370	0.150	1.120	0.020
From I to D	0.0002	0.00015	Pipe-7	38.00	+5.602	+1.000	+4.232	1.00	+3.852				0.150	1.120	0.020
From D to D-1	0.0017	0.00170	Pipe-8	47.14	+5.637	+1.000	+3.755	1.00	+3.283	D-1	+3.233	+2.404	0.150	1.120	0.020
From D-1 to E	0.0017	0.00170	Pipe-9	47.14	+5.637	+1.000	+3.233	1.00	+2.762	E	+2.712	+2.925	0.150	1.120	0.020
J				0.00	+5.857	+1.000	+4.707	1.00	+4.707	J	+4.657	+1.200	0.150	1.120	0.020
From J to K	0.0000	0.00002	Pipe-10	36.30	+5.857	+1.000	+4.657	1.00	+4.294	K	+4.244	+1.613	0.150	1.120	0.020
From K to E	0.0000	0.00002	Pipe-11	18.13	+5.637	+1.000	+4.244	1.00	+4.063				0.150	1.120	0.020
From E to P	0.0017	0.00172	Pipe-12			+1.000	+3.233	1.00	+3.233		+3.183		0.150	1.120	0.020
L				0.00	+5.332	+1.000	+4.182	1.00	+4.182		+4.132	+1.200	0.150	1.120	0.020
From L to P	0.0003	0.00029	Pipe-13	5.00	+5.332	+1.000	+4.182	1.00	+4.132		+4.082	+1.250	0.150	1.120	0.020

Prepared by H. Irala Checked by S. Endo

DESIGN CALCULATION COVER SHEET

Project	Detailed Design on Port Reactivation Project in La Union Province	**Project Code**	JC1N004/2N001
Section	**Utility Works**	Calc. File No.	
Sub-Section	**Wastewater System**	Calc. Index No.	

Subject:

Oil/water Separator-1 for Maintenance and Repair Shop, RTG Repair Yard, Fuel Station and Power Supply External Transformer

Calculation Objective:

To determine the size and details of the tank for the Separator

References, Calculation Notes and Comments

The formulas and variables applied in the calculation are as follows:

Service Design Flow = Qsv(lit/min) = Ac(m2) x 25 (lit/8 hours/m2)

Rain runoff =Qsr(m3/sec)=CiAc(ha)/360

Rise Rate = Vp = 1.79(dp-dc)d^2x10-8/n

Allowable horizontal velocity = Vh = 15Vp, but < 0.05f/s

Surface area = As(m2) = KQ(m3/sec)/Vp(m/sec) = LW

Width = W = √(As/5)

Length = L = from 3W to 5W

Depth = D(m) = Qr(m3)/L(m)W(m)

For the design it is assumed that proper BMPs (Best Management Practices) will be applied for the function of the Shop. Practices such as not disposing the oil removed from motors into the drainage that leads to the Oil/water separator.

The details are defined based on models proposed by USEPA and API

Being:

Ac = catchment area

i=130 mm/hour

dp = density of oil (gm/cc), range 0.82 to 0.95, a mean value of 0.9 assumed

dc = density of water (gm/cc), a value was selected from the attached table, being the water temperature of 30°C

d=diameter of the droplet to be removed (μ),a value was assigned assuming an influent of 750mg/l and considering an effluent of 20mg/l, according to salvadoran requirements: NSO 13.07.03:01

C=Runoff coefficient, dimensionless

n = absolute viscosity of water (poises), a value was selected from the table attached, being the water temperature of 30°C

K = dimensionless factor describing turbulence, range 1.2 to 2.0, a mean value of 1.5 was assumed

Qr = Retained flow rate, which is defined by the required time of retention (Tr) of Q in the tanks in order to separate the oil.

Rev	Prepared by	Prepared Date	No. of Pages	Checked by	Checked Date	Reviewed by	Reviewed Date	Superseded by Calc No.
O	H. Iruta	02/06/10	3	S. Endo	10 June, 02	[illegible]	09 July 02	
A								
B								
C								

Project	La Unión Port Development Project	Calc. File No.	
Section	UTILITY WORK (Wastewater and Sewer Systems)	Calc. Index No.	
Subject	Oil/water Separator-1 (M&R Shop)	Page No.	2/3 Rev.

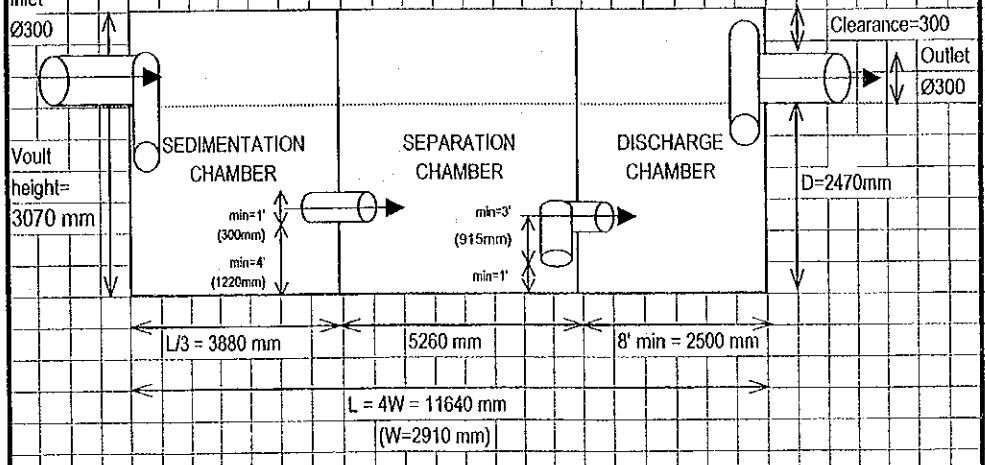
	References/ Notes
1. Design Flow Rate (Q)	
a) Service Flow (Qsv) Maintenance and Reapair Shop	
Qsv(lit/min) = Ac(m2)x25(lit/8 hour/m2)	M&RS=1008m2
Qsv=1008 m2 x 3.125 lit/hour/m2	
Qsv=1008 m2 x 0.05208 lit/min/m2	
Qsv=52.5 lit/min = 0.000875 m3/sec	
b) Storm water runoff (Qsr) RTG Repair, M&R S, Fuel Station and Power Station Catch basins	RTG Ac=480 m2
Qsr(m3/sec)=CiAc(ha)/360	FS catch basin Ac=53.5m2
Qsr=(0.8)(130)(0.0542)/360=0.0157m3/sec	PS catch basin Ac=9.0 m2
c) Total Design Flow Rate (Q)= Qsv+Qsr = 0.016575 m3/sec	Total Ac=542.5m2=0.0542ha
	C=Concrete coefficient=0.8
2. Rise Rate (Vp)	
$Vp = 1.79(dp-dc)d^2 \times 10^{-8} / n$	dp=0.90 gm/cc
$Vp = 1.79(0.90-0.99567)45^2 \times 10^{-8} / 0.00800$	dc=0.99567 gm/cc
Vp = 0.001932 feet/sec=0.000589 m/sec	d=45μ
	n=0.008 poises
3. Allowable horizontal velocity (Vh)	
Vh = 15Vp	
Vh = 15(0.000589 m/sec)	
Vh = 0.008835 m/sec	
4. Surface Area (As)	
As(m2) = KQ(m3/sec)/Vp(m/sec)	K = 1.5
As = (1.5)(0.016575m3/sec)/0.000589m/sec	
As = 42.21 m2	
5. Length and Width	
$W = \sqrt{(As/5)}$	
$W = \sqrt{(42.21m2/5)}$	
W = 2.91m	
L = 4W	
L = 4(2.91m)	
L = 11.64 m	
6. Depth	
D(m) = Qr(m3) / L(m)W(m)	being Tr a value between
Qr(m3)=Tr(min) x Q(m3/min)	45 min to 2 hours,
Qr=(84min)(0.9945m3/min)	a mean value of 1.4 h
Qr = 83.54 m3	is assumed (84 min)
	Q=0.016575m3/sec
Then: D =83.54m3 / (11.64m x 2.91 m)	Q=0.9945 m3/min
D = 2.47 m	
7. Definition of Details	
D= 2.47 m = 2470 mm	
L= 11.64m = 11640 mm	
W= 2.91m = 2910 mm	

	Prepared by		Checked by	
	H. Iroh	08/06/10	S. Endo	10 /Jun /200

Project	Detailed Design on Port Reactivation Project in La Union	Calc. File No.	
Section	UTILITY WORK (Wastewater and Sewer System)	Calc. Index No.	
Subject	Oil/water Separator-1 (M&R Shop)	Page No. 3/3	Rev.

References/ Notes

USEPA and API Models



	Prepared by		Checked by	
	H. Iwata	02/06/10	S. Endo	10 Dec 1200

DESIGN CALCULATION COVER SHEET

Project	Detailed Design on Port Reactivation Project in La Union Province	**Project Code**	JC1N004/2N001
Section	**Utility Works**	Calc. File No.	
Sub-Section	**Wastewater System**	Calc. Index No.	

Subject:

Oil/water Separator-2 for Storm Water Route-A

Calculation Objective:

To determine the size and details of the tank for the Oil/water Separator

References, Calculation Notes and Comments

The formulas and variables applied in the calculation are as follows:

Design Flow (Manning Formula): $Q = Ac \times 1/n \times R^{2/3} \times I^{1/2}$

Rise Rate = $Vp = 1.79(dp-dc)d^2 \times 10\text{-}8/n$

Allowable horizontal velocity = $Vh = 15Vp$, but < 0.05f/s

Surface area = $As(m2) = KQ(m3/sec)/Vp(m/sec) = LW$

Width = $W = \sqrt{(As/5)}$

Length = L = from 3W to 5W

Depth = $D(m) = Qr(m3)/L(m)W(m)$

For the design it is assumed that proper BMPs (Best Management Practices) will be applied for the function of the Shop. Practices such as not disposing the oil removed from motors into the drainage that leads to the Oil/water separator.

The details are defined based on models proposed by USEPA and API

Being:

Ac = catchment area

i=60.9 mm/hour (Precipitation Intensity with a return period of one year)

dp = density of oil (gm/cc), range 0.82 to 0.95, a mean value of 0.9 assumed

dc = density of water (gm/cc), a value was selected from the attached table, being the water temperature of 30°C

d=diameter of the droplet to be removed (μ),a value was assigned assuming an influent of 750mg/l and considering an effluent of 20mg/l, according to salvadoran requirements: NSO 13.07.03:01

C=Runoff coefficient, dimensionless

n = absolute viscosity of water (poises), a value was selected from the table attached, being the water temperature of 30°C

K = dimensionless factor describing turbulence, range 1.2 to 2.0, a mean value of 1.5 was assumed

Qr = Retained flow rate, which is defined by the required time of retention (Tr) of Q in the tanks in order to separate the oil.

Rev	Prepared		No. of	Checked		Reviewed		Superseded
	by	Date	Pages	by	Date	by	Date	by Calc No.
0	H. Iraha	02/08/08	4	S. Endo	08 August	[illegible]	09 July '08	
A								
B								
C								

Project	Detailed Design on Port Reactivation Project in La Union	Calc. File No.	
Section	UTILITY WORK (Wastewater and Sewer System)	Calc. Index No.	
Subject	Oil/water Separator-2 (Route-A)	Page No. 2/4	Rev.

References/ Notes

CALCULATIONS FOR STORMWATER DRAINAGE (Pipe Culvert)

Diameter of Pipe Culvert

Inches	18	24	30	36	48	60	72
mm	457	610	762	914	1219	1524	1829

Roughness Coefficient n 0.013

	Catchment Area (ha)				C	I	Q (m3/sec)		Remark	Culvert	Length (m)	Elevation (Inlet)	Bottom elevation of culvert	Grade (%)	Elevation (Outlet)	Diameter (m)	v (m/sec)	Max Qc (m3/sec)
A																		
A-2	90	20	0.180	0.180	0.83	60.9	0.073	0.073		AP-1	20.00	+3.532	+4.222	0.20	+4.182	0.610	0.931	0.254
A-2-1	10	35	0.035	0.035	0.5	60.9	0.009	0.0126		AP-2	40.00	+3.532	+4.222	0.20	+4.142	0.610	0.931	0.254
A-1'	26	40	0.104	0.104	0.45	60.9	0.015	0.041		AP-3	26.00	+3.532	+4.021	0.10	+3.996	0.610	0.687	0.201
A-1	70	40	0.280	0.280	0.83	60.9	0.040											
A-3	Trapezoid		0.188	0.188	0.5	60.9	0.016											
A-4	5	52	0.021	0.073	0.9	60.9	0.003	0.100		AP-4	93.78	+3.532	+4.021	0.20	+3.950	0.610	0.931	0.254
A-5	Trapezoid		0.276	0.276	0.7	60.9	0.033											
A-6	56	56	0.335	0.335	0.7	60.9	0.018											
A-7	26	86	0.224	0.224	0.83	60.9	0.037	0.072		AP-5-1	26.00	+3.836	+4.016	0.10	+3.990	0.610	0.687	0.201
A-8	5	86	0.019	0.019	0.8	60.9	0.003	0.186		AP-5	87.49	+3.836	+3.264	0.20	+3.689	0.762	1.135	0.417
A-9	39	56	0.233	0.233	0.7	60.9	0.031											
A-16	5	91	0.041	0.041	0.8	60.9	0.006											
A-18	60	716	0.645	0.645	0.5	60.9	0.033	0.060		AP-6-1	26.00	+4.923	+3.813	0.10	+3.787	0.610	0.687	0.201
A-10	50	91	0.326	0.326	0.7	60.9	0.027	0.055		AP-6-2	12.65	+4.923	+2.207	0.10	+2.194	0.610	0.687	0.201
A-11	31	91	0.276	0.276	0.8	60.9	0.037											
A-12	92	38	0.323	0.175	0.7	60.9	0.021	0.362		AP-6	93.60	+4.923	+3.509	0.20	+3.322	0.914	1.273	0.835
A-15	26	91	0.236	0.236	0.83	60.9	0.034	0.634		AP-7-1	26.00	+4.731	+3.601	0.10	+3.575	0.610	0.687	0.201
A-13	91	46	0.308	0.308	0.7	60.9	0.035											
A-14	92	54	0.248	0.248	0.7	60.9	0.029											
A-17	86	29	0.277	0.277	0.83	60.9	0.040	0.490		AP-7	28.90	+4.731	+2.993	0.15	+2.949	1.219	1.395	1.557
OE Separator								0.490		AP-7	3.00	+4.731	+3.811	0.10	+3.806	0.300	0.630	0.085

		Prepared by		Checked by	
		H. Ito	02/08/08	S. Endo	08 Aug/2002

Project	La Unión Port Development Project	Calc. File No.	
Section	UTILITY WORK (Wastewater and Sewer Systems)	Calc. Index No.	
Subject	Oil/water Separator-2 (Route-A)	Page No. 3/4	Rev.

References/ Notes

a) Design Flow (Storm Water Runoff = Qsr)

Qsr=	0.085	m3/sec

b) Surface Area (As)

As(m2)=KQ(m3/sec)/Vp(m/sec)

K=	1.2	
Q=	0.085	m3/sec
Vp=	0.000589	m/sec
As=	173.1749	m2

c) Width (W)

W(m)=√ As(m2)/5

W=	5.885149	m

d) Length (L)

L=4W

L=	23.54059	m

e) Depth (D)

D(m)=Qr(m3)/L(m)xW(m)

Qr(m3)=Tr(min) x Q(m3/min)

Tr=	45	min
Qr=	229.5	m3
D=	1.656563	m

Total Depth=D+Φ of pipe + clearence

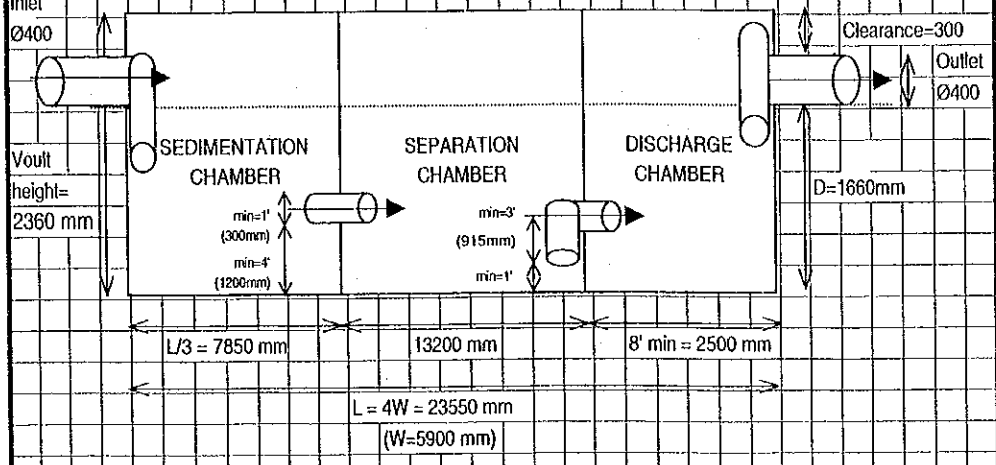
Φ of pipe=	0.4	m
Clearence=	0.3	m
Total Depth=	2.356563	m

Prepared by		Checked by	
H. Iwata	02/08/08	S. Endo	08/Aug/2002

Project	Detailed Design on Port Reactivation Project in La Union	Calc. File No.	
Section	UTILITY WORK (Wastewater and Sewer System)	Calc. Index No.	
Subject	Oil/water Separator-2 (Route-A)	Page No. 4/4	Rev.

References/ Notes

USEPA and API Models



	Prepared by		Checked by	
	H - Iwaki	02/08/08	S Endo	08/Aug/200

DESIGN CALCULATION COVER SHEET

Project	Detailed Design on Port Reactivation Project in La Union Province	**Project Code**	JC1N004/2N001
Section	**Utility Works**	Calc. File No.	
Sub-Section	**Wastewater System**	Calc. Index No.	

Subject:

Oil/water Separator-3 for Storm Water Route-B

Calculation Objective:

Oil/water

To determine the size and details of the tank for the Separator

References, Calculation Notes and Comments

The formulas and variables applied in the calculation are as follows:

Design Flow (Manning Formula): $Q = Ac \times 1/n \times R^{2/3} \times 1^{1/2}$

Rise Rate = Vp = 1.79(dp-dc)d²x10-8/n

Allowable horizontal velocity = Vh = 15Vp, but < 0.05f/s

Surface area = As(m2) = KQ(m3/sec)/Vp(m/sec) = LW

Width = W = √(As/5)

Length = L = from 3W to 5W

Depth = D(m) = Qr(m3)/L(m)W(m)

For the design it is assumed that proper BMPs (Best Management Practices) will be applied for the function of the Shop. Practices such as not disposing the oil removed from motors into the drainage that leads to the Oil/water separator.

The details are defined based on models proposed by USEPA and API

Being:

Ac = catchment area

i=60.9 mm/hour (Precipitation Intensity with a return period of 1 year)

dp = density of oil (gm/cc), range 0.82 to 0.95, a mean value of 0.9 assumed

dc = density of water (gm/cc), a value was selected from the attached table, being the water temperature of 30°C

d=diameter of the droplet to be removed (μ),a value was assigned assuming an influent of 750mg/l and considering an effluent of 20mg/l, according to salvadoran requirements: NSO 13.07.03:01

C=Runoff coefficient, dimensionless

n = absolute viscosity of water (poises), a value was selected from the table attached, being the water temperature of 30°C

K = dimensionless factor describing turbulence, range 1.2 to 2.0, a mean value of 1.5 was assumed

Qr = Retained flow rate, which is defined by the required time of retention (Tr) of Q in the tanks in order to separate the oil.

Rev	Prepared by	Prepared Date	No. of Pages	Checked by	Checked Date	Reviewed by	Reviewed Date	Superseded by Calc No.
0	H. Iwa	02/08/08	4	S. Enda	08 Aug, 02	[illegible]	11 July 02	
A								
B								
C								

Project	Detailed Design on Port Reactivation Project in La Union	Calc. File No.	
Section	UTILITY WORK (Wastewater and Sewer System)	Calc. Index No.	
Subject	Oil/water Separator-3 (Route-B)	Page No. 2/4	Rev.

References/ Notes

CALCULATIONS FOR STORMWATER DRAINAGE (Pipe Culvert)

Diameter of Pipe Culvert :

Inches	18	24	30	36	48	60	72
mm	457	610	762	914	1219	1524	1829

Roughness Coefficient n 0.013

Catchment Area (ha)				C	I	Q (m3/sec)		Remark	Culvert	Length (m)	Elevation (Inlet)	Bottom elevation of culvert	Grade (%)	Elevation (Outlet)	Diameter (m)	v (m/sec)	Max Qc (m3/sec)
B																	
B-1	101	12	0.061	0.061	0.9	60.9	0.005										
B-2	85	6	0.026	0.026	0.85	60.9	0.004										
B-3	121	17	0.103	0.103	0.85	60.9	0.015										
B-6	89	36	0.160	0.160	0.7	60.9	0.019	0.060	BP-1-1	36.00	+3.372	+.1022	0.20	+3.970	0.610	0.971	0.284
B-4	160	35	0.376	0.376	0.85	60.9	0.083										
B-5	91	36	0.164	0.164	0.7	60.9	0.019	0.145	BP-1	83.78	+3.372	+3.820	0.20	+3.691	0.762	1.135	0.517
B-7	37	55	0.139	0.139	0.7	60.9	0.019										
B-8	91	53	0.241	0.241	0.7	60.9	0.029										
B-9	77	38	0.146	0.146	0.7	60.9	0.017	0.065	BP-2-1	36.00	+3.126	+3.816	0.20	+3.764	0.610	0.971	0.284
B-10	25	86	0.215	0.215	0.8	60.9	0.029										
B-11	49	86	0.211	0.211	0.7	60.9	0.023										
B-12	89	53	0.236	0.236	0.7	60.9	0.028										
B-13	70	35	0.126	0.126	0.7	60.9	0.015	0.306	BP-2	97.49	+3.126	+3.512	0.20	+3.337	0.914	1.273	0.835
B-14	32	91	0.233	0.233	0.7	60.9	0.028										
B-15	77	53	0.223	0.223	0.7	60.9	0.026										
B-16	81	38	0.154	0.154	0.7	60.9	0.018	0.073	BP-2-2	26.00	+.4923	+3.413	0.20	+3.361	0.610	0.971	0.284
B-17	35	91	0.226	0.226	0.85	60.9	0.033										
B-18	64	91	0.290	0.290	0.7	60.9	0.034										
B-19	74	58	0.315	0.315	0.7	60.9	0.023										
B-20	77	38	0.146	0.146	0.7	60.9	0.017	0.488	BP-3	93.60	+.4923	+.2824	0.13	+.2664	1.219	1.333	1.557
B-21	41	91	0.213	0.213	0.7	60.9	0.025										
B-22	83	54	0.219	0.219	0.7	60.9	0.026	0.833	BP-3-1	6.00	+.4721	+.2.492	0.20	+.2.480	1.219	1.342	1.598
B-23	35	91	0.227	0.227	0.85	60.9	0.033										
B-24	60	91	0.272	0.272	0.7	60.9	0.037										
B-25	77	54	0.208	0.208	0.85	60.9	0.030										
B-26	160	29	0.462	0.462	0.85	60.9	0.066	0.642	BP-4	20.00	+.4721	+.2.492	0.20	+.2.452	1.219	1.342	1.598
Oil Separator								0.642	AP-7	5.00	+.4318	+.2811	0.13	+.2804	0.400	0.933	0.165

Prepared by		Checked by	
H. Iruta	02/09/08	S. Endo	08 Feb 12002

Project	La Unión Port Development Project	Calc. File No.	
Section	UTILITY WORK (Wastewater and Sewer Systems)	Calc. Index No.	
Subject	Oil/water Separator-3 (Route-B)	Page No. 3/4	Rev.

References/

a) Design Flow (Storm Water Runoff = Qsr)

Qsr=	0.105	m3/sec

b) Surface Area (As)

As(m2)=KQ(m3/sec)/Vp(m/sec)

K=	1.2	
Q=	0.105	m3/sec
Vp=	0.000589	m/sec
As=	213.9219	m2

c) Width (W)

W(m)=√As(m2)/5

W=	6.540977	m

d) Length (L)

L=4W

L=	26.16391	m

e) Depth (D)

D(m)=Qr(m3)/L(m)xW(m)

Qr(m3)=Tr(min) x Q(m3/min)

Tr=	45	min
Qr=	283.5	m3
D=	1.656563	m

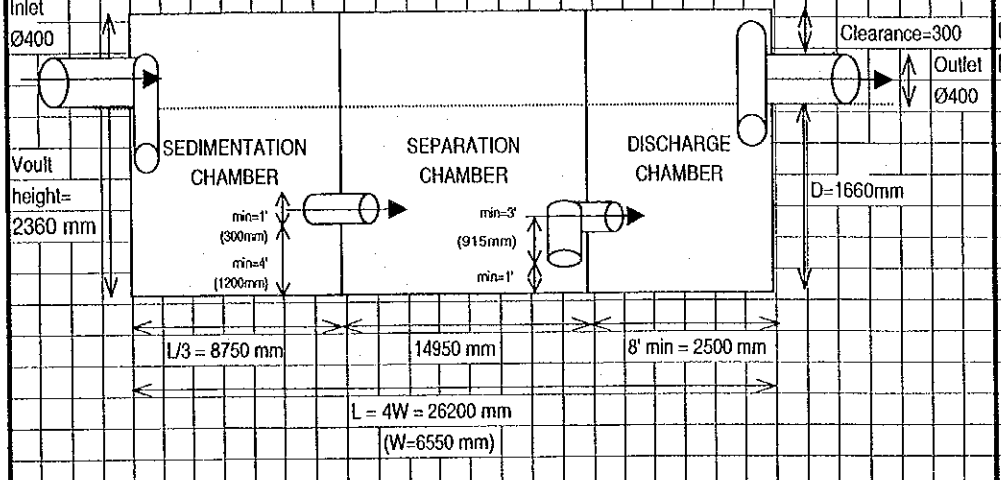
Total Depth=D+Φ of pipe + clearence

Φ of pipe=	0.4	m
Clearence=	0.3	m
Total Depth=	2.356563	m

Prepared by		Checked by	
H. Iruta	07/08/08	S. Endo	08/Aug/2007

NIPPON KOEI CO.,LTD.

Project	Detailed Design on Port Reactivation Project in La Union	Calc. File No.	
Section	UTILITY WORK (Wastewater and Sewer System)	Calc. Index No.	
Subject	Oil/water Separator-3 (Route-B)	Page No. 4/4	Rev.



References/
Notes

USEPA and API
Models

	Prepared by		Checked by	
	H. Iida	02/09/08	S. Endo	08 May 2002

DESIGN CALCULATION COVER SHEET

Project	Detailed Design on Port Reactivation Project in La Union Province	**Project Code**	JC1N004/2N001
Section	**Utility Works**	Calc. File No.	
Sub-Section	**Wastewater System**	Calc. Index No.	

Subject:

Oil/water Separator-4 for Storm Water Route-C

Calculation Objective:

To determine the size and details of the tank for the Oil/water Separator

References, Calculation Notes and Comments

The formulas and variables applied in the calculation are as follows:

Design Flow (Manning Formula): $Q = Ac \times 1/n \times R^{2/3} \times I^{1/2}$

Rise Rate = Vp = 1.79(dp-dc)d²x10-8/n

Allowable horizontal velocity = Vh = 15Vp, but < 0.05l/s

Surface area = As(m2) = KQ(m3/sec)/Vp(m/sec) = LW

Width = W = √(As/5)

Length = L = from 3W to 5W

Depth = D(m) = Qr(m3)/L(m)W(m)

For the design it is assumed that proper BMPs (Best Management Practices) will be applied for the function of the Shop. Practices such as not disposing the oil removed from motors into the drainage that leads to the Oil/water separator.

The details are defined based on models proposed by USEPA and API

Being:

Ac = catchment area

i=60.9 mm/hour (Precipitation Intensity with a Return period of 1 year)

dp = density of oil (gm/cc), range 0.82 to 0.95, a mean value of 0.9 assumed

dc = density of water (gm/cc), a value was selected from the attached table, being the water temperature of 30°C

d=diameter of the droplet to be removed (μ),a value was assigned assuming an influent of 750mg/l and considering an effluent of 20mg/l, according to salvadoran requirements: NSO 13.07.03:01

C=Runoff coefficient, dimensionless

n = absolute viscosity of water (poises), a value was selected from the table attached, being the water temperature of 30°C

K = dimensionless factor describing turbulence, range 1.2 to 2.0, a mean value of 1.5 was assumed

Qr = Retained flow rate, which is defined by the required time of retention (Tr) of Q in the tanks in order to separate the oil.

Rev	Prepared by	Prepared Date	No. of Pages	Checked by	Checked Date	Reviewed by	Reviewed Date	Superseded by Calc No.
O	H. Iruta	02/08/08	4	S. Endo	08 Aug, 02	[illegible]	11 July 02	
A								
B								
C								

Project	Detailed Design on Port Reactivation Project in La Union	Calc. File No.	
Section	UTILITY WORK (Wastewater and Sewer System)	Calc. Index No.	
Subject	Oil/water Separator-4 (Route-C)	Page No. 2/4	Rev.

References/ Notes

CALCULATIONS FOR STORMWATER DRAINAGE (Pipe Culvert)

Diameter of Pipe Culvert

Inchs	18	24	30	36	42	60	72
mm	457	610	762	914	1219	1524	1829

Roughness Coefficient n 0.013

Catchment Area (ha)			C	I	Q (m3/sec)	Remark	Culvert	Length (m)	Elevation (Inlet)	Pipe Culvert: Bottom elevation of	Slope (%)	Elevation (Outlet)	Diameter (m)	v (m/sec)	Max Qc (m3/sec)
C															
C-C	43	22	0.093	0.093	0.9	60.9	0.014	0.014	CP-1	13.00	+5.632	+4.273	0.20	+4.241	0.457	0.893	0.131
C-A-1	50	30	0.038	0.038	0.9	60.9	0.006	0.020	CP-2	20.00	+5.632	+4.273	0.20	+4.233	0.457	0.893	0.131
C-A-2								0.020	CP-3	23.00	+5.632	+4.273	0.20	+4.203	0.457	0.893	0.131
C-A-3	30	30	0.038	0.038	0.9	60.9	0.006	0.006	CP-4-1	20.00	+5.632	+4.273	0.20	+4.233	0.457	0.893	0.131
C-A-4								0.026	CP-4	20.00	+5.632	+4.233	0.20	+4.233	0.457	0.893	0.131
C-M-1	55	25	0.069	0.069	0.9	60.9	0.010	0.010	CP-5-1	8.00	+5.632	+4.273	0.20	+4.259	0.457	0.893	0.131
C-M-2								0.036	CP-5	20.00	+5.632	+4.273	0.20	+4.133	0.457	0.893	0.131
C-M-3								0.046	CP-6	30.00	+5.632	+4.122	0.20	+4.062	0.610	0.971	0.284
C-R-1								0.035	CP-7	23.00	+5.632	+4.273	0.20	+4.203	0.457	0.893	0.131
C-A-5	39	30	0.038	0.038	0.9	60.9	0.006	0.006	CP-8-1	10.00	+5.632	+4.273	0.20	+4.253	0.457	0.893	0.131
C-A-6								0.006	CP-8-3	35.00	+5.632	+4.273	0.20	+4.203	0.457	0.893	0.131
C-A-7	30	30	0.038	0.038	0.9	60.9	0.006	0.006	CP-8-2-1	10.00	+5.632	+4.273	0.20	+4.253	0.457	0.893	0.131
C-A-8								0.011	CP-8-2	30.00	+5.632	+4.213	0.20	+4.233	0.457	0.893	0.131
C-M-4	55	25	0.069	0.069	0.9	60.9	0.010	0.010	CP-8-1-1	20.00	+5.632	+4.213	0.20	+4.213	0.457	0.893	0.131
C-M-5								0.022	CP-8-1	65.00	+5.632	+4.213	0.20	+4.139	0.457	0.893	0.131
C-3'	50	42	0.210	0.210	0.7	60.9	0.035										
C-1'	82	65	0.127	0.127	0.75	60.9	0.024										
C-2'	122	30	0.092	0.092	0.5	60.9	0.012	0.119	CP-8	33.00	+5.632	+4.122	0.20	+4.062	0.610	0.971	0.284
								0.119	CP-9	26.00	+5.332	+3.822	0.20	+3.770	0.610	0.971	0.284
C-1	50	64	0.320	0.320	0.75	60.9	0.041										
C-2	93	36	0.324	0.324	0.85	60.9	0.047										
C-3	87	33	0.152	0.152	0.85	60.9	0.022	0.229	CP-10	33.72	+3.332	+3.918	0.20	+3.746	0.914	1.272	0.835
C-4	50	48	0.240	0.240	0.75	60.9	0.030										
C-5	70	40	0.172	0.172	0.75	60.9	0.022	0.022	CP-11-1	26.00	+5.326	+3.816	0.20	+3.764	0.610	0.971	0.284
C-6	22	86	0.189	0.189	0.85	60.9	0.027										
C-7	48	56	0.206	0.206	0.7	60.9	0.024										
C-8	87	33	0.231	0.231	0.7	60.9	0.022										
C-9	74	38	0.141	0.141	0.7	60.9	0.019	0.376	CP-11	37.40	+5.126	+3.207	0.13	+3.076	1.219	1.733	1.557
C-10	83	134	0.309	0.309	0.7	60.9	0.060										
C-11	141	78	0.530	0.530	0.5	60.9	0.047										
C-12	25	94	0.235	0.235	0.85	60.9	0.034	0.034	CP-12-1	26.00	+4.923	+3.413	0.20	+3.361	0.610	0.971	0.284
C-13	32	94	0.244	0.244	0.7	60.9	0.029										
C-14	24	54	0.200	0.200	0.7	60.9	0.024										
C-15	28	38	0.148	0.148	0.7	60.9	0.018										
C-16	172	39	0.335	0.335	0.5	60.9	0.028	0.418	CP-12	53.60	+4.923	+2.834	0.20	+2.617	1.219	1.542	1.798
C-17	152	54	0.411	0.411	0.5	60.9	0.042										
C-18	59	93	0.247	0.247	0.5	60.9	0.021										
C-19	23	91	0.227	0.227	0.85	60.9	0.033	0.033	CP-13-1	26.00	+4.711	+3.101	0.20	+3.049	0.610	0.971	0.284
C-20	30	91	0.227	0.227	0.7	60.9	0.022										
C-21	78	33	0.215	0.215	0.7	60.9	0.023										
C-22	93	29	0.269	0.269	0.85	60.9	0.039	0.706	CP-13	28.90	+4.711	+2.472	0.20	+2.434	1.219	1.542	1.798
Oil Separator								0.706	A2-7	3.00	+4.711	+3.211	0.18	+3.892	0.400	0.912	0.115

Prepared by		Checked by	
H. Iida	02/08/08	S. Endo	1/200

Project	La Unión Port Development Project	Calc. File No.	
Section	UTILITY WORK (Wastewater and Sewer Systems)	Calc. Index No.	
Subject	Oil/water Separator-4 (Route-C)	Page No. 3/4	Rev.

References/ Notes

a) Design Flow (Storm Water Runoff = Qsr)

Qsr=	0.115	m3/sec

b) Surface Area (As)

As(m2)=KQ(m3/sec)/Vp(m/sec)

K=	1.2	
Q=	0.115	m3/sec
Vp=	0.000589	m/sec
As=	234.2954	m2

c) Width (W)

W(m)=√As(m2)/5

W=	6.845369	m

d) Length (L)

L=4W

L=	27.38148	m

e) Depth (D)

D(m)=Qr(m3)/L(m)xW(m)

Qr(m3)=Tr(min) x Q(m3/min)

Tr=	45	min
Qr=	310.5	m3
D=	1.656563	m

Total Depth=D+Φ of pipe + clearence

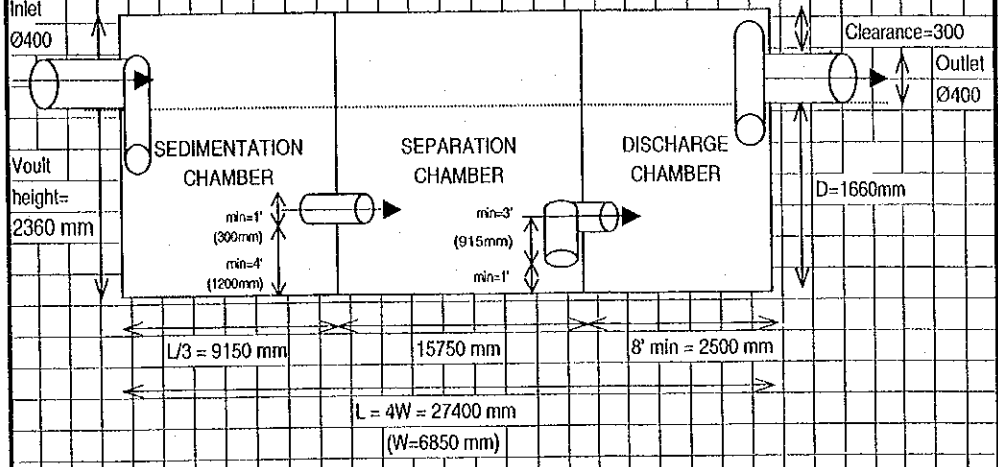
Φ of pipe=	0.4	m
Clearence=	0.3	m
Total Depth=	2.356563	m

Prepared by		Checked by	
A. Iruk	02/08/08	S. Ende	08 May 2008

Project	Detailed Design on Port Reactivation Project in La Union	Calc. File No.	
Section	UTILITY WORK (Wastewater and Sewer System)	Calc. Index No.	
Subject	Oil/water Separator-4 (Route-C)	Page No. 4/4	Rev.

References/ Notes

USEPA and API Models



		Prepared by		Checked by	
		A. Iruta	02/08/08	S. Endo	08 May 2002

DESIGN CALCULATION COVER SHEET

Project	Detailed Design on Port Reactivation Project in La Union Province	**Project Code**	JC1N004/2N001
Section	**Utility Works**	Calc. File No.	
Sub-Section	**Wastewater System**	Calc. Index No.	

Subject:

Oil/water Separator-5 for Storm Water Route-D

Calculation Objective:

To determine the size and details of the tank for the Oil/water Separator

References, Calculation Notes and Comments

The formulas and variables applied in the calculation are as follows:

Design Flow (Manning Formula): $Q = Ac \times 1/n \times R^{2/3} \times I^{1/2}$

Rise Rate = $Vp = 1.79(dp-dc)d^2 \times 10\text{-}8/n$

Allowable horizontal velocity = $Vh = 15Vp$, but < 0.05f/s

Surface area = As(m2) = KQ(m3/sec)/Vp(m/sec) = LW

Width = $W = \sqrt{(As/5)}$

Length = L = from 3W to 5W

Depth = D(m) = Qr(m3)/L(m)W(m)

For the design it is assumed that proper BMPs (Best Management Practices) will be applied for the function of the Shop. Practices such as not disposing the oil removed from motors into the drainage that leads to the Oil/water separator.

The details are defined based on models proposed by USEPA and API

Being:

Ac = catchment area

i=60.9 mm/hour (Precipitation Intensity with a Return period of 1 year)

dp = density of oil (gm/cc), range 0.82 to 0.95, a mean value of 0.9 assumed

dc = density of water (gm/cc), a value was selected from the attached table, being the water temperature of 30°C

d=diameter of the droplet to be removed (μ),a value was assigned assuming an influent of 750mg/l and considering an effluent of 20mg/l, according to salvadoran requirements: NSO 13.07.03:01

C=Runoff coefficient, dimensionless

n = absolute viscosity of water (poises), a value was selected from the table attached, being the water temperature of 30°C

K = dimensionless factor describing turbulence, range 1.2 to 2.0, a mean value of 1.5 was assumed

Qr = Retained flow rate, which is defined by the required time of retention (Tr) of Q in the tanks in order to separate the oil.

Rev	Prepared by	Prepared Date	No. of Pages	Checked by	Checked Date	Reviewed by	Reviewed Date	Superseded by Calc No.
0	H. Iyla	02/08/08	4	S. Endo	08 Aug, 08	EJ	11 July 08	
A								
B								
C								

Project	Detailed Design on Port Reactivation Project in La Union	Calc. File No.	
Section	UTILITY WORK (Wastewater and Sewer System)	Calc. Index No.	
Subject	Oil/water Separator-5 (Route-D)	Page No. 2/4	Rev.

References/ Notes

CALCULATIONS FOR STORMWATER DRAINAGE (Pipe Culvert)

Diameter of Pipe Culvert :

Inche	18	24	30	36	48	60	72
mm	457	610	762	914	1219	1524	1829

Roughness Coefficient n 0.013

Required Discharging Water Volume

D	Catchment Area (ha)				C	I	Q (m3/sec)		Remark
D2-8	10	150	0.190	0.190	0.8	60.9	0.026	0.026	
D2-7	10	152	0.152	0.152	0.85	60.9	0.022	0.048	
D2-6	10	30	0.030	0.030	0.85	60.9	0.004	0.004	
D2-5	20	60	0.060	0.060	0.85	60.9	0.009	0.009	
D2-5	30	60	0.060	0.060	0.85	60.9	0.009	0.069	
D2-4	60	35	0.210	0.210	0.8	60.9	0.028		
D2-3	73	12	0.090	0.090	0.8	60.9	0.012		
D2-2	150	13	0.208	0.208	0.8	60.9	0.028	0.069	
D2-1	160	13	0.208	0.208	0.8	60.9	0.028	0.166	
								0.166	
D1-1	9	90	0.081	0.081	0.05	60.9	0.001	0.001	
D1-2	9	90	0.081	0.081	0.05	60.9	0.001	0.167	
D-3	268	50	0.670	0.670	0.05	60.9	0.009		
D-1	360	370	13.320	13.320	0.05	60.9	0.113	0.118	
D-4	39	90	0.176	0.176	0.05	60.9	0.001		
D-5	268	40	0.536	0.536	0.05	60.9	0.003		
D-6	258	40	0.516	0.516	0.05	60.9	0.004	0.296	
D1-3	9	90	0.081	0.081	0.05	60.9	0.001	0.001	
D1-4	9	90	0.081	0.081	0.05	60.9	0.001	0.001	
D-10	258	50	0.645	0.645	0.05	60.9	0.003		
D-11	30	90	0.225	0.225	0.05	60.9	0.002		
D-12	234	55	0.644	0.644	0.5	60.9	0.054	0.359	
D-13	331	72	0.470	0.470	0.5	60.9	0.040		
D-14	192	78	0.749	0.749	0.5	60.9	0.063		
D-15	166	39	0.324	0.324	0.5	60.9	0.027	0.490	
D-16	97	91	0.253	0.253	0.5	60.9	0.022		
D-17	166	54	0.448	0.448	0.5	60.9	0.038		
D-18	112	29	0.324	0.324	0.85	60.9	0.047	0.596	
Oil Separator								0.596	

Pipe Culvert

Culvert	Length (m)	Elevation (Inlet)	Bottom elevation of culvert	Grade (%)	Elevation (Outlet)	Diameter (m)	v (m/sec)	Max Qc (m3/sec)
DP-1	129.19	+4.250	+3.292	0.50	+4.647	0.457	1.267	0.208
DP-2	20.82	+5.500	+3.743	0.50	+3.639	0.457	1.267	0.208
DP-3	24.13	+5.700	+3.443	0.10	+3.419	0.457	0.567	0.093
DP-4-1	21.75	+5.540	+3.583	0.10	+3.561	0.457	0.567	0.093
DP-4	160.00	+5.530	+4.739	0.10	+4.070	0.610	0.637	0.201
DP-5-1	31.73	+5.540	+3.490	0.10	+3.458	0.610	0.637	0.201
DP-5	37.85	+5.540	+3.936	0.10	+3.882	0.914	0.900	0.590
DP-6	93.85	+4.672	+3.218	0.30	+3.046	0.914	1.273	0.838
DP-7-1	18.25	+5.190	+3.455	0.10	+3.415	0.457	0.567	0.093
DP-7	150.00	+5.190	+3.776	0.10	+3.626	0.914	0.900	0.590
DP-8-1	90.00	+4.625	+3.211	0.10	+3.121	0.914	0.900	0.590
DP-8	90.00	+5.165	+3.730	0.15	+3.615	0.914	1.102	0.723
DP-9-2	18.25	+5.010	+3.235	0.10	+3.215	0.457	0.567	0.093
DP-9-1	150.00	+5.010	+4.033	0.10	+3.503	0.457	0.567	0.093
DP-9	130.50	+5.664	+3.345	0.15	+3.149	1.219	1.335	1.557
DP-10	90.65	+4.867	+3.148	0.15	+3.012	1.219	1.335	1.557
DP-11	28.99	+4.311	+2.192	0.20	+2.134	1.219	1.542	1.798
AP-7	5.00	+4.311	+3.111	0.15	+3.104	0.400	0.533	0.185

Prepared by		Checked by	
H. Iruk	02/08/08	S. Endo	08 May 2002

Project	La Unión Port Development Project	Calc. File No.	
Section	UTILITY WORK (Wastewater and Sewer Systems)	Calc. Index No.	
Subject	Oil/water Separator-5 (Route-D)	Page No. 3/4	Rev.

References/ Notes

a) Design Flow (Storm Water Runoff = Qsr)

Qsr=	0.105	m3/sec

b) Surface Area (As)

As(m2)=KQ(m3/sec)/Vp(m/sec)

K=	1.2	
Q=	0.105	m3/sec
Vp=	0.000589	m/sec
As=	213.9219	m2

c) Width (W)

W(m)=√As(m2)/5

W=	6.540977	m

d) Length (L)

L=4W

L=	26.16391	m

e) Depth (D)

D(m)=Qr(m3)/L(m)xW(m)

Qr(m3)=Tr(min) x Q(m3/min)

Tr=	45	min
Qr=	283.5	m3
D=	1.656563	m

Total Depth=D+Φ of pipe + clearence

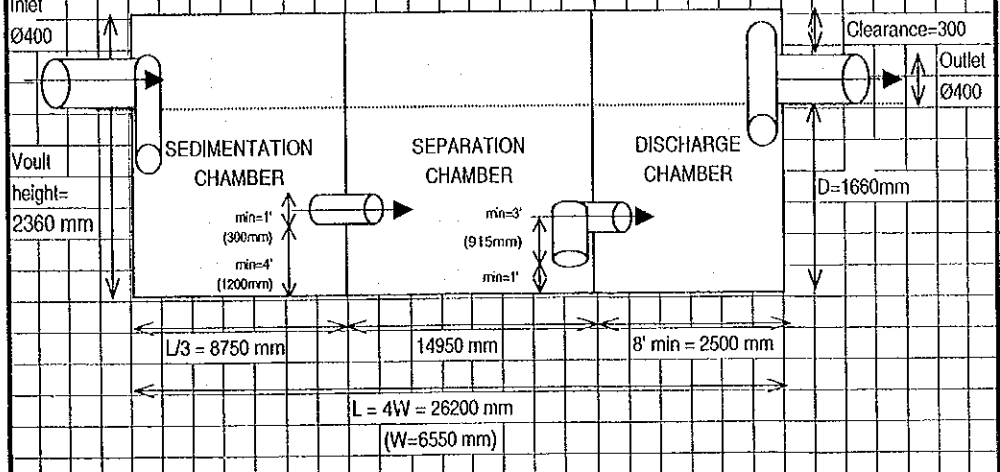
Φ of pipe=	0.4	m
Clearence=	0.3	m
Total Depth=	2.356563	m

Prepared by		Checked by	
H. Iruk	02/08/08	S. Endo	08 Aug 2002

Project	Detailed Design on Port Reactivation Project in La Union	Calc. File No.	
Section	UTILITY WORK (Wastewater and Sewer System)	Calc. Index No.	
Subject	Oil/water Separator-5 (Route-D)	Page No. 4/4	Rev.

References/ Notes

USEPA and API Models



		Prepared by		Checked by	
		A. Iruk	02/08/08	S. Endo	08 Aug 2002

DESIGN CALCULATION COVER SHEET

Project	Detailed Design on Port Reactivation Project in La Union Province	**Project Code**	JC1N004/2N001
Section	**Utility Works**	Calc. File No.	
Sub-Section	**Wastewater System**	Calc. Index No.	

Subject:

Oil/water Separator-1 for Maintenance and Repair Shop, RTG Repair Yard, Fuel Station and Power Supply External Transformer

Calculation Objective:

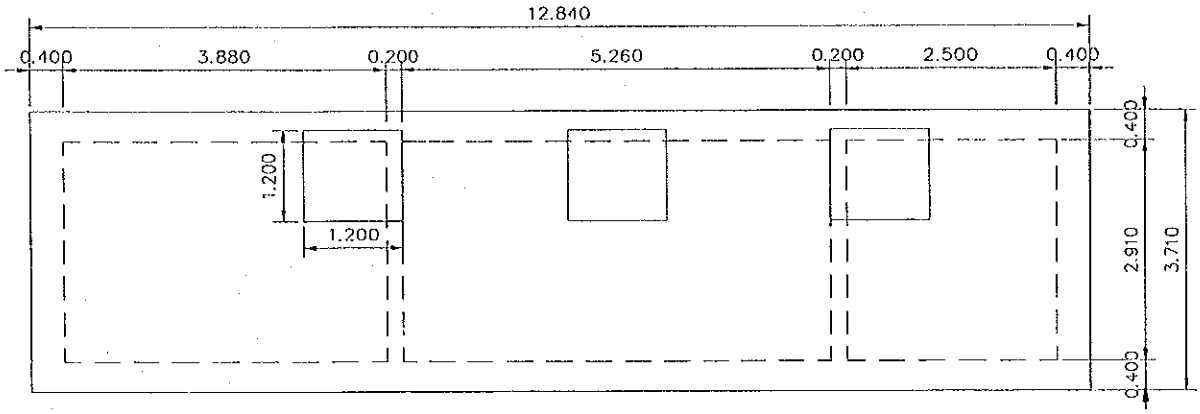
To determine the structural arrangement of the tank for the Oil/water Separator

References, Calculation Notes and Comments

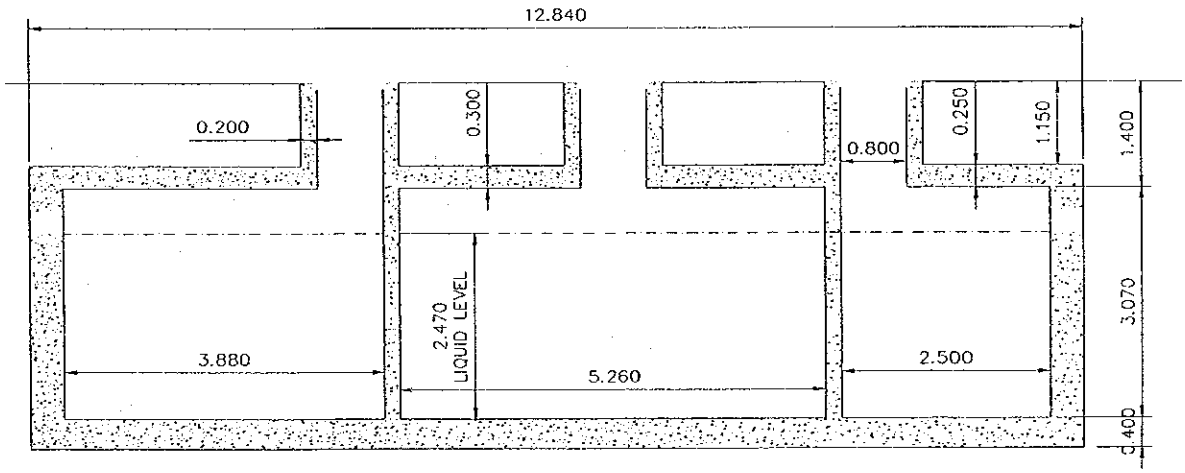
Rev	Prepared by	Prepared Date	No. of Pages	Checked by	Checked Date	Reviewed by	Reviewed Date	Superseded by Calc No.
O	R.M.G.		7	S. Endo	08 Aug, 02	[illegible]	09 July 02	
A	[illegible]							
B								
C								

PROJECT: La Union Port Development Project.	Calc. File No.		Prepared by	R.M.G
SECTION: Utility Work	Calc. Index No.		Checked by	S. Endo
SUBJECT: Structural Design of Oil Separator-1 (M&R Shop)	Date	Aug-02	Page	2/7

OIL SEPARATOR



PLAN



Weight

Foundation =	45.73	ton	Top Slab =	27.12	ton
Exterior Walls =	92.84	ton	Interior Walls =	8.58	ton
γ liquid =	1.00	ton/m³	Liquid =	28.75	ton
γ soil =	1.50	ton/m³	Soil =	74.72	ton
Concrete covers =	6.62	ton	Total weight =	284.4	ton

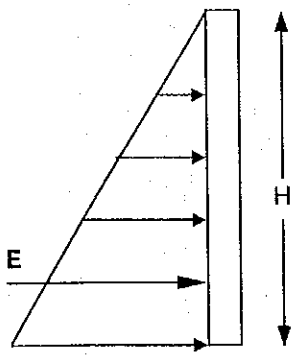
PROJECT: La Union Port Development Project.	Calc. File No.		Prepared by	R.M.G
SECTION: Utility Work	Calc. Index No.		Checked by	S. Ezaki
SUBJECT: Structural Design of Oil Separator-1 (M&R Shop)	Date	Aug-02	Page	3/7

Footing Dimensions

L = 12.84 m Area = 47.64 m²

B = 3.71 m Soil pressure, σ = 5.97 ton/m²
0.60 kg/cm²

a) Exterior Wall design



Earth Pressure (E) = 1/2 γ h² ka

H = 3.07 m ka = tan(45+ϕ/2)

Aditional H = 1.40 m ϕ = 30.00 degrees

h = 4.47 m ka = 0.333

γ = 1.50 ton/m3

E = 5.00 ton/m

Width = 1.00 m Total E = 5.00 ton

Moment at base (ExH/3) = 5.11 ton-m

f'c = 280 kg/cm² fy = 4200 kg/cm²

b = 100 cm h = 40.00 cm

Concrete cover = 5.00 cm d = 34.37 cm

Mu = 1.4Me

Mu = 6.99 ton-m

$fy^2/1.7bf'c\ As^2 - fyd\ As + Mu/\phi = 0$ $\phi = 0.90$

370.59 144333 777039.4

As = 5.46 cm²

Asmin

(4/3)Asreq = 7.28 cm²

(14/fy) b d = 11.46 cm²

Use Asmin = 7.28 cm²

Asmax :

ρb = 0.0459

Asmax (0.75ρb) = 118.43 cm²

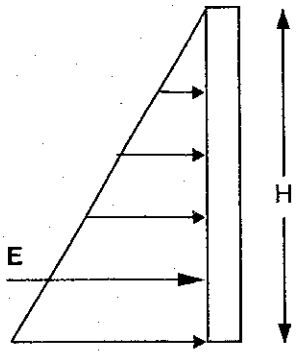
As = 7.28 cm² o.k!! As < Amax

Bar N = 4 Bar area (Av) = 1.27 cm²

# of bars = 5.75 Spacing = 17.40 cm

4 17.40 cm

b) Interior Wall design



Liquid Pressure(E) = 1/2 γ h²

H = 2.25 m

γ = 0.90 ton/m3

E = 2.28 ton/m

Width = 1.00 m Total E = 2.28 ton

Moment at base (ExH/3) = 1.71 ton-m

f'c = 280 kg/cm² fy = 4200 kg/cm²

b = 100 cm h = 20.00 cm

Concrete cover = 5.00 cm d = 14.37 cm

Mu = 1.4Me + 1.7Ml

Mu = 3.19 ton-m

$fy^2/1.7bf'c\ As^2 - fyd\ As + Mu/\phi = 0$ $\phi = 0.90$

370.59 60333 354375

As = 6.10 cm²

Asmin

(4/3)Asreq = 8.14 cm²

(14/fy) b d = 4.79 cm²

Use Asmin = 4.79 cm²

Asmax :

ρb = 0.0459

Asmax (0.75ρb) = 49.50 cm²

As = 6.10 cm² o.k!! As < Amax

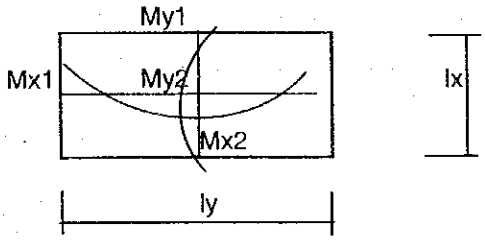
Bar N = 4 Bar area (Av) = 1.27 cm²

# of bars = 4.82 Spacing = 20.76 cm

4 20.00 cm

c) Top Slab design

for 2nd roof



lx= 2.9 m

ly= 5.3 m

ly/lx= 1.8

t= 25 cm

coefficient of bend (thioretical result fix end)

Mx1/(w lx²) =	0.082
Mx2/(w lx²) =	0.040
My1/(w lx²) =	0.057
My2/(w lx²) =	0.010

d = 19.35 cm

fc = 210 kg/cm2

fy = 4200 kg/cm2

wDL= 2.325 t/m2

wLL= 0.610 t/m2

DL

Mx1=	1.61	tm/m	
Mx2=	0.79	tm/m	
My1=	1.12	tm/m	
My2=	0.20	tm/m	

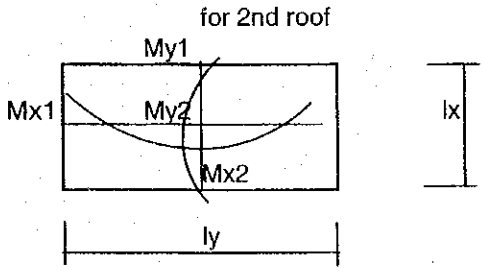
LL

Mx1=	0.42	tm/m	
Mx2=	0.21	tm/m	
My1=	0.29	tm/m	
My2=	0.05	tm/m	

1.4DL+1.7LL			fy2/1.7bfc'	fyd	Mu/f		
Mx1=	2.98	tm/m	494.1	81270	331144.11	As=	4.18 cm²/m
Mx2=	1.45	tm/m	494.1	81270	161533.712	As=	2.01 cm²/m
My1=	2.07	tm/m	494.1	81270	230185.54	As=	2.88 cm²/m
My2=	0.36	tm/m	494.1	81270	40383.428	As=	0.50 cm²/m

	Short Span			Long Span		
	Use Bar	Area cm2	Pitch cm	Use Bar	Area cm2	Pitch cm
End	4	1.27	30.3	3	0.71	24.7
Center	3	0.71	35.4	3	0.71	143.0

d) Bottom Slab design



lx= 2.9 m

ly= 5.3 m

ly/lx= 1.8

t= 40 cm

d = 34.35 cm
fc = 210 kg/cm2
fy = 4200 kg/cm2

coefficient of bend (thioretical result fix end)

Mx1/(w lx²) =	0.082
Mx2/(w lx²) =	0.040
My1/(w lx²) =	0.057
My2/(w lx²) =	0.010

wDL= 6.00 t/m2
wLL= 0.61 t/m2

DL

Mx1=	4.17	tm/m
Mx2=	2.03	tm/m
My1=	2.90	tm/m
My2=	0.51	tm/m

LL

Mx1=	0.42	tm/m
Mx2=	0.21	tm/m
My1=	0.29	tm/m
My2=	0.05	tm/m

PROJECT: La Union Port Development Project.	Calc. File No.		Prepared by	R.M.G
SECTION: Utility Work	Calc. Index No.		Checked by	S. Endo
SUBJECT: Structural Design of Oil Separator-1 (M&R Shop)	Date	Aug-02	Page	7/7

1.4DL+1.7LL

			fy2/1.7bfc'	fyd	Mu/f		
Mx1=	6.55	tm/m	494.1	144270	728100.411	As=	5.14 cm²/m
Mx2=	3.20	tm/m	494.1	144270	355170.932	As=	2.48 cm²/m
My1=	4.56	tm/m	494.1	144270	506118.578	As=	3.55 cm²/m
My2=	0.80	tm/m	494.1	144270	88792.733	As=	0.62 cm²/m

	Short Span			Long Span		
	Use Bar	Area cm2	Pitch cm	Use Bar	Area cm2	Pitch cm
End	4	1.27	24.7	4	1.27	35.7
Center	4	1.27	51.0	4	1.27	205.4

NIPPON KOEI CO.,LTD.

DESIGN CALCULATION COVER SHEET

Project	Detailed Design on Port Reactivation Project in La Union Province	**Project Code**	JC1N004/2N001
Section	**Utility Works**	Calc. File No.	
Sub-Section	**Wastewater System**	Calc. Index No.	

Subject:

Oil/water Separator-2 for Storm Water Drainage Route-A

Calculation Objective:

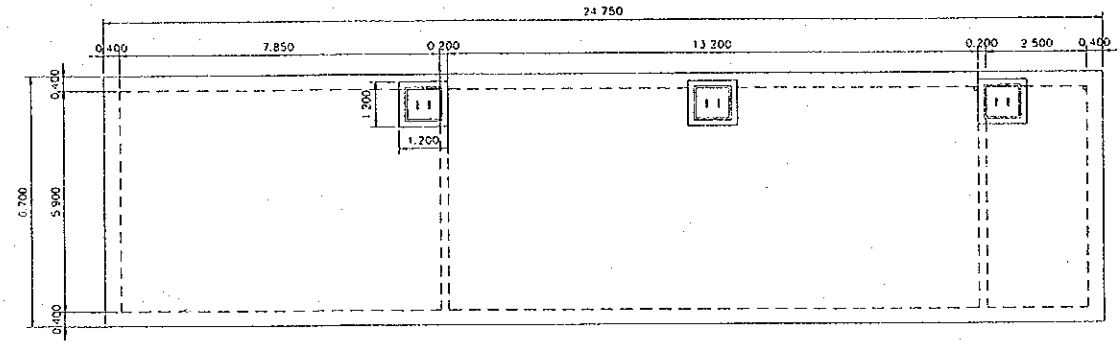
To determine the structural arrangement of the tank for the Oil/Water Separator

References, Calculation Notes and Comments

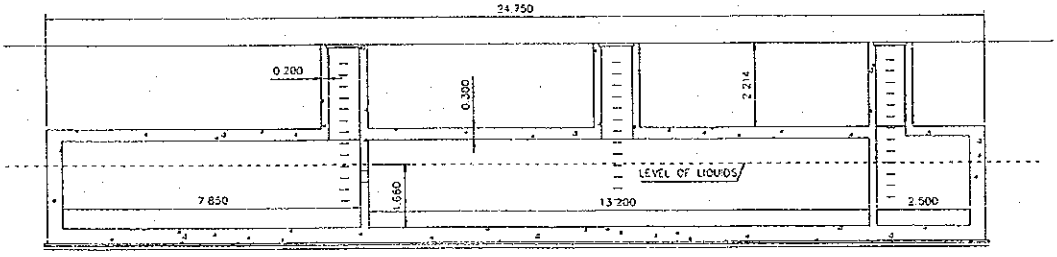
Rev	Prepared		No. of	Checked		Reviewed		Superseded
	by	Date	Pages	by	Date	by	Date	by Calc No.
0	R.M.G.		7	S. Endo	08 Aug, 02	[illegible]	11 July 02	
A	[illegible]							
B								
C								

PROJECT: La Union Port Development Project.	Calc. File No.		Prepared by	R.Martinez
SECTION: Utility Work	Calc. Index No.		Checked by	S. Endo
SUBJECT: Structural Design of Oil Separator-2 (Route A)	Date	Aug-02	Page	2/7

OIL/WATER SEPARATOR - 2 (ROUTE A)



PLAN



ELEVATION

Weight

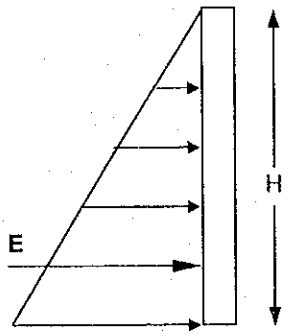
Foundation =	159.19	ton	Interior Walls =	13.37	ton
Exterior Walls =	150.38	ton	Liquid =	39.09	ton
γ liquid =	1.00	ton/m³	Soil =	532.97	ton
γ soil =	1.50	ton/m³	Traffic load =	0.61	ton/m²
Concrete covers =	12.73	ton	Traffic load =	101.15	ton
Top Slab =	116.28	ton	Total weight =	1125.2	ton

Footing Dimensions

L = 24.75 m Area = 165.83 m²

B = 6.70 m Soil pressure, σ = 6.79 ton/m²
0.68 kg/cm²

a) Exterior Wall design



Earth Pressure (E) = 1/2 γ h² ka

H = 2.36 m ka = tan(45+ϕ/2)

Aditional H = 2.21 m ϕ = 30.00 degrees

h = 4.57 m ka = 0.333

γ = 1.50 ton/m3

E = 5.83 ton/m (Earth+Traffic pressure)

Width = 1.00 m Total E = 5.83 ton

Moment at base (ExH/3) = 4.59 ton-m

f'c = 210 kg/cm² fy = 4200 kg/cm²

b = 100 cm h = 40.00 cm

Concrete cover = 5.00 cm d = 34.37 cm

Mu = 1.4Me

Mu = 8.16 ton-m

$fy^2/1.7bf'c\,As^2 - fyd\,As + Mu/\phi = 0$ $\phi = 0.90$

$494.12\,As^2 - 144333As + 907084 = 0$

As = 6.43 cm²

Asmin

(4/3)Asreq = 8.57 cm²

(14/fy) b d = 11.46 cm²

Use Asmin = 8.57 cm²

Asmax :

ρb = 0.0345

Asmax (0.75ρb) = 88.82 cm²

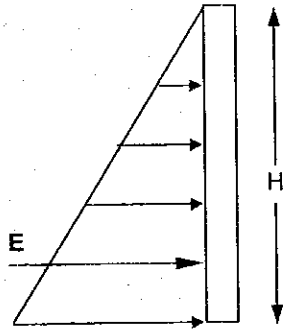
As = 8.57 cm² o.k!! As < Amax

Bar N = 4 Bar area (Av) = 1.27 cm²

# of bars = 6.76 Spacing = 14.78 cm

Use N 4 @ 14.8 cm

b) Interior Wall design



Liquid Pressure(E) = 1/2 γ h²

H = 1.66 m

γ = 0.90 ton/m3

E = 1.24 ton/m

Width = 1.00 m Total E = 1.24 ton

Moment at base (ExH/3) = 0.69 ton-m

f'c = 210 kg/cm² fy = 4200 kg/cm²

b = 100 cm h = 20.00 cm

Concrete cover = 5.00 cm d = 14.37 cm

Mu = 1.4Me + 1.7Ml

Mu = 1.74 ton-m

$fy^2/1.7bf'c\,As^2 - fyd\,As + Mu/\phi = 0$ $\phi = 0.90$

494.12 As² - 60333 As+ 192892 = 0

As = 3.29 cm²

Asmin

(4/3)Asreq = 4.38 cm²

(14/fy) b d = 4.79 cm²

Use Asmin = 4.38 cm²

Asmax :

ρb = 0.0345

Asmax (0.75ρb) = 37.13 cm²

As = 4.38 cm² o.k!! As < Amax

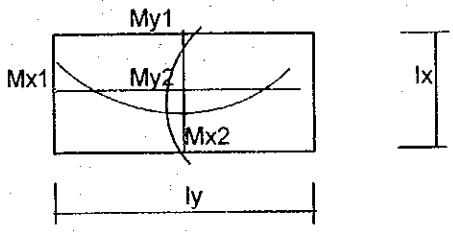
Bar N = 4 Bar area (Av) = 1.27 cm²

# of bars = 3.46 Spacing = 28.92 cm

Use N 4 @ 28.00 cm

c) Top Slab design

for 2nd roof



lx= 5.9 m

ly= 13.2 m

ly/lx= 2.2

t= 30 cm

d = 25.37 cm

fc = 210 kg/cm2

fy = 4200 kg/cm2

coefficient of bend (thioretical result fix end)

Mx1/(w lx²) =	0.08
Mx2/(w lx²) =	0.041
My1/(w lx²) =	0.042
My2/(w lx²) =	0.010

wDL= 2.985 t/m2

wLL= 0.610 t/m2

DL

Mx1=	8.31 tm/m
Mx2=	4.26 tm/m
My1=	4.36 tm/m
My2=	1.04 tm/m

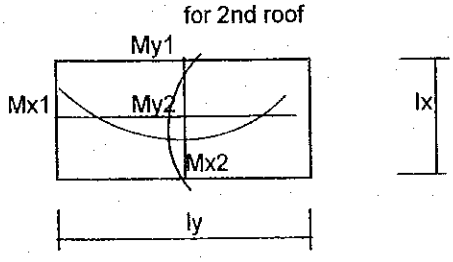
LL

Mx1=	1.70 tm/m
Mx2=	0.87 tm/m
My1=	0.89 tm/m
My2=	0.21 tm/m

1.4DL+1.7LL			fy2/1.7bfc'	fyd	Mu/f		
Mx1=	14.53	tm/m	494.1	106533	1613946.31	As=	16.40 cm²/m
Mx2=	7.44	tm/m	494.1	106533	827147.484	As=	8.07 cm²/m
My1=	7.63	tm/m	494.1	106533	847321.813	As=	8.27 cm²/m
My2=	1.82	tm/m	494.1	106533	201743.289	As=	1.91 cm²/m

	Short Span			Long Span		
	Use Bar	Area cm2	Pitch cm	Use Bar	Area cm2	Pitch cm
End	5	1.98	12.1	4	1.27	15.3
Center	4	1.27	15.7	3	0.71	37.3

d) Bottom Slab design



lx= 5.9 m

ly= 7.9 m

ly/lx= 1.3

t= 40 cm

coefficient of bend (thioretical result fix end)

Mx1/(w lx²) =	0.064
Mx2/(w lx²) =	0.030
My1/(w lx²) =	0.042
My2/(w lx²) =	0.010

d = 34.37 cm

fc = 210 kg/cm2

fy = 4200 kg/cm2

wDL=	6.18	t/m2
wLL=	0.61	t/m2

DL

Mx1=	13.76 tm/m
Mx2=	6.45 tm/m
My1=	9.03 tm/m
My2=	2.15 tm/m

LL

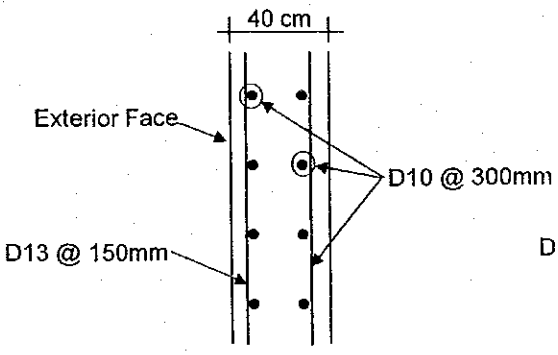
Mx1=	1.36 tm/m
Mx2=	0.64 tm/m
My1=	0.89 tm/m
My2=	0.21 tm/m

1.4DL+1.7LL			fy2/1.7bfc'	fyd	Mu/f		
Mx1=	21.57	tm/m	494.1	144333	2396743.62	As=	17.68 cm²/m
Mx2=	10.11	tm/m	494.1	144333	1123473.57	As=	8.00 cm²/m
My1=	14.16	tm/m	494.1	144333	1572863	As=	11.34 cm²/m
My2=	3.37	tm/m	494.1	144333	374491.19	As=	2.62 cm²/m

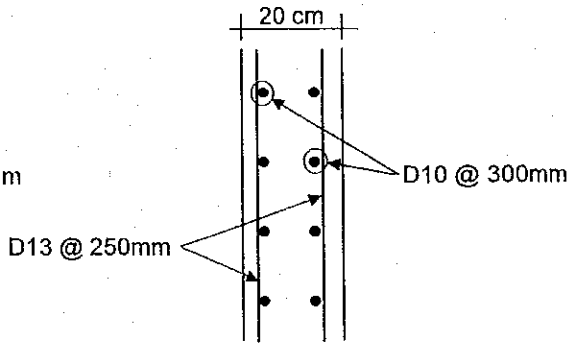
	Short Span			Long Span		
	Use Bar	Area cm2	Pitch cm	Use Bar	Area cm2	Pitch cm
End	5	1.98	11.2	4	1.27	11.2
Center	4	1.27	15.8	4	1.27	48.4

STEEL REINFORCEMENT

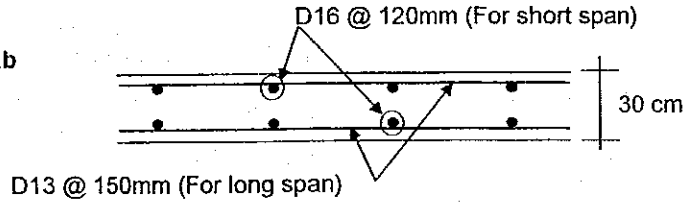
a) Exterior wall



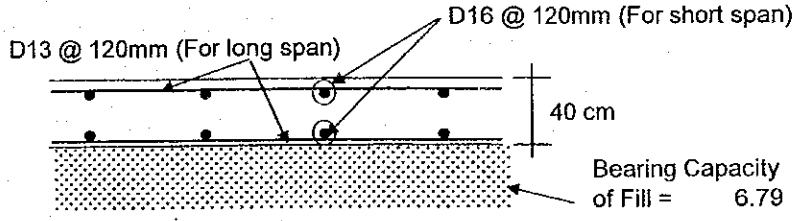
b) Interior wall



c) Top slab



d) Bottom slab



NIPPON KOEI CO.,LTD.

DESIGN CALCULATION COVER SHEET

Project	Detailed Design on Port Reactivation Project in La Union Province	**Project Code**	JC1N004/2N001
Section	**Utility Works**	Calc. File No.	
Sub-Section	**Wastewater System**	Calc. Index No.	

Subject:

Oil/water Separator-3 & 5, for Storm Water Drainage Route-B & D

Calculation Objective:

To determine the structural arrangement of the tank for the Oil/water Separator

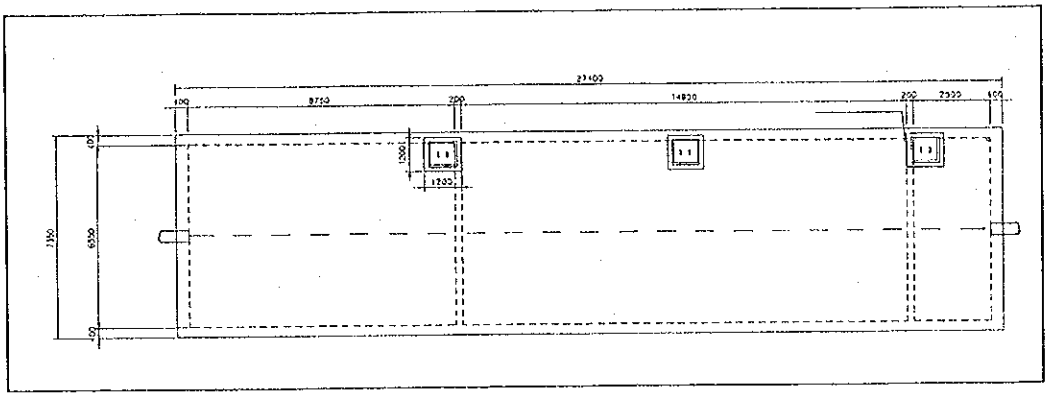
References, Calculation Notes and Comments

Rev	Prepared		No. of	Checked		Reviewed		Superseded
	by	Date	Pages	by	Date	by	Date	by Calc No.
O	R.M.G.		7	S. Endo	08 Aug 02	[illegible]	12 July 02	
A	[illegible]							
B								
C								

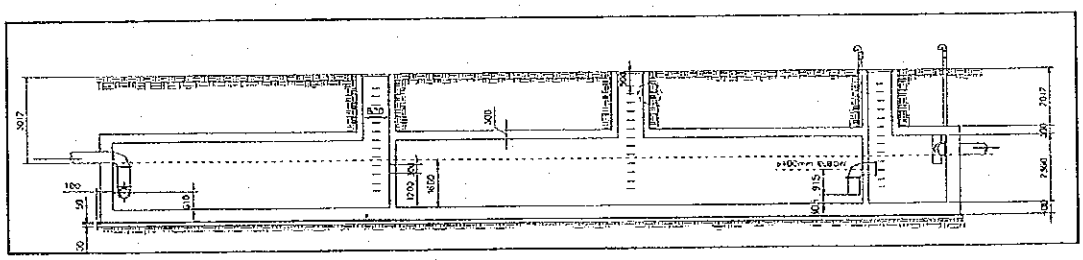
NIPPON KOEI CO.,LTD.

PROJECT: La Union Port Development Project.	Calc. File No.		Prepared by	R.Martinez
SECTION: Utility Work	Calc. Index No.		Checked by	J. Calo
SUBJECT: Design of Oil Separator-3&5 (Route B&D)	Date	Aug-02	Page	2/7

OIL/WATER SEPARATOR - 3 & 5 (ROUTE B & D)



PLAN



ELEVATION

Weight

Foundation =	193.33	ton	Interior Walls =	14.84	ton
Exterior Walls =	153.83	ton	Liquid =	43.49	ton
γ liquid =	1.00	ton/m³	Soil =	579.39	ton
γ soil =	1.50	ton/m³	Traffic load =	0.61	ton/m²
Concrete covers =	15.02	ton	Traffic load =	122.85	ton
Top Slab =	141.89	ton	Total weight =	1264.6	ton

NIPPON KOEI CO.,LTD.

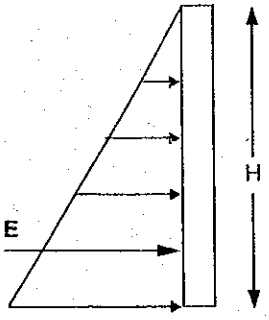
PROJECT: La Union Port Development Project.	Calc. File No.		Prepared by	R.Martinez
SECTION: Utility Work	Calc. Index No.		Checked by	S. Gdo
SUBJECT: Design of Oil Separator-3&5 (Route B&D)	Date	Aug-02	Page	3/7

Footing Dimensions

L = 27.40 m Area = 201.39 m²

B = 7.35 m Soil pressure, σ = 6.28 ton/m²
0.63 kg/cm²

a) Exterior Wall design



Earth Pressure (E) = 1/2 γ h² ka

H = 2.36 m ka = tan(45+ϕ/2)

Aditional H = 2.61 m ϕ = 30.00 degrees

h = 4.97 m ka = 0.333

γ = 1.50 ton/m3

E = 6.78 ton/m (Earth+Traffic pressure)

Width = 1.00 m Total E = 6.78 ton

Moment at base (ExH/3) = 5.33 ton-m

f'c = 210 kg/cm² fy = 4200 kg/cm²

b = 100 cm h = 40.00 cm

Concrete cover = 5.00 cm d = 34.37 cm

Mu = 1.4Me

Mu = 9.49 ton-m,

$fy^2/1.7bf'c\,As^2 - fyd\,As + Mu/\phi = 0$ $\phi = 0.90$

$494.12\,As^2 - 144333As + 1054326 = 0$

As = 7.50 cm²

Asmin

(4/3)Asreq = 10.00 cm²

(14/fy) b d = 11.46 cm²

Use Asmin = 10.00 cm²

Asmax :

ρb = 0.0345

Asmax (0.75ρb) = 88.82 cm²

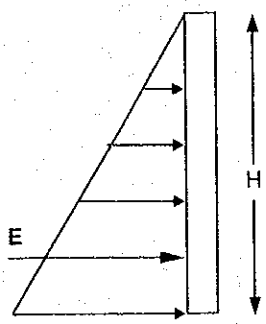
As = 10.00 cm² **o.k!! As < Amax**

Bar N = 4 Bar area (Av) = 1.27 cm²

# of bars = 7.89 Spacing = 12.67 cm

Use N 4 @ 12.7 cm

b) Interior Wall design



Liquid Pressure(E) = 1/2 γ h²

H = 1.66 m

γ = 0.90 ton/m3

E = 1.24 ton/m

Width = 1.00 m Total E = 1.24 ton

Moment at base (ExH/3) = 0.69 ton-m

f'c = 210 kg/cm² fy = 4200 kg/cm²

b = 100 cm h = 20.00 cm

Concrete cover = 5.00 cm d = 14.37 cm

Mu = 1.4Me + 1.7Ml

Mu = 1.74 ton-m

$fy^2/1.7bf'c\,As^2 - fyd\,As + Mu/\phi = 0$ $\phi = 0.90$

$494.12\ As^2 - 60333\ As + 192892 = 0$

As = 3.29 cm²

Asmin

(4/3)Asreq = 4.38 cm²

(14/fy) b d = 4.79 cm²

Use Asmin = 4.38 cm²

Asmax :

ρb = 0.0345

Asmax (0.75ρb) = 37.13 cm²

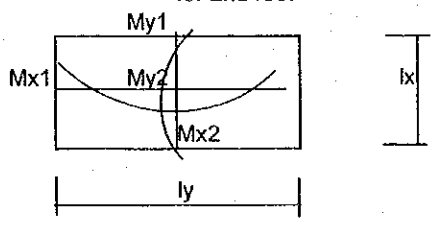
As = 4.38 cm² o.k!! As < Amax

Bar N = 4 Bar area (Av) = 1.27 cm²

# of bars = 3.46 Spacing = 28.92 cm

Use N 4 @ 28.00 cm

c) Top Slab design



lx= 6.55 m

ly= 14.95 m

ly/lx= 2.3

t= 30 cm

d = 25.37 cm

fc = 210 kg/cm2

fy = 4200 kg/cm2

coefficient of bend (thioretical result fix end)

Mx1/(w lx²) =	0.08
Mx2/(w lx²) =	0.041
My1/(w lx²) =	0.042
My2/(w lx²) =	0.010

wDL= 3.431 t/m2

wLL= 0.610 t/m2

DL

Mx1=	11.77	tm/m
Mx2=	6.03	tm/m
My1=	6.18	tm/m
My2=	1.47	tm/m

LL

Mx1=	2.09	tm/m
Mx2=	1.07	tm/m
My1=	1.10	tm/m
My2=	0.26	tm/m

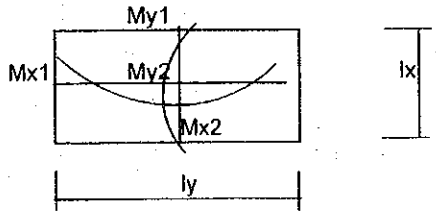
1.4DL+1.7LL

			fy2/1.7bfc'	fyd	Mu/f		
Mx1=	18.26	tm/m	494.1	106533	2029269.18	As=	21.12 cm²/m
Mx2=	10.27	tm/m	494.1	106533	1141338.54	As=	11.31 cm²/m
My1=	10.52	tm/m	494.1	106533	1169176.07	As=	11.60 cm²/m
My2=	2.51	tm/m	494.1	106533	278375.255	As=	2.65 cm²/m

	Short Span			Long Span		
	Use Bar	Area cm2	Pitch cm	Use Bar	Area cm2	Pitch cm
End	5	1.98	9.4	4	1.27	10.9
Center	4	1.27	11.2	3	0.71	26.9

d) Bottom Slab design

for 2nd roof



lx= 6.55 m

ly= 8.75 m

ly/lx= 1.3

t= 40 cm

coefficient of bend (thioretical result fix end)

Mx1/(w lx²) =	0.064
Mx2/(w lx²) =	0.030
My1/(w lx²) =	0.042
My2/(w lx²) =	0.010

d = 35.37 cm

fc = 210 kg/cm2

fy = 4200 kg/cm2

wDL= 5.67 t/m2

wLL= 0.61 t/m2

DL

Mx1=	15.57	tm/m
Mx2=	7.30	tm/m
My1=	10.22	tm/m
My2=	2.43	tm/m

LL

Mx1=	1.67	tm/m
Mx2=	0.79	tm/m
My1=	1.10	tm/m
My2=	0.26	tm/m

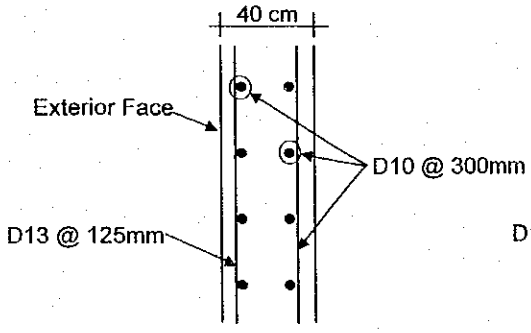
PROJECT: La Union Port Development Project.	Calc. File No.		Prepared by	R.Martinez
SECTION: Utility Work	Calc. Index No.		Checked by	
SUBJECT: Design of Oil Separator-3&5 (Route B&D)	Date	Aug-02	Page	7/7

1.4DL+1.7LL			fy2/1.7bfc'	fyd	Mu/f			
Mx1=	23.22	tm/m	494.1	148533	2579776.97	As=	18.51	cm²/m
Mx2=	11.55	tm/m	494.1	148533	1283420.27	As=	8.90	cm²/m
My1=	16.17	tm/m	494.1	148533	1796788.38	As=	12.63	cm²/m
My2=	3.85	tm/m	494.1	148533	427806.758	As=	2.91	cm²/m

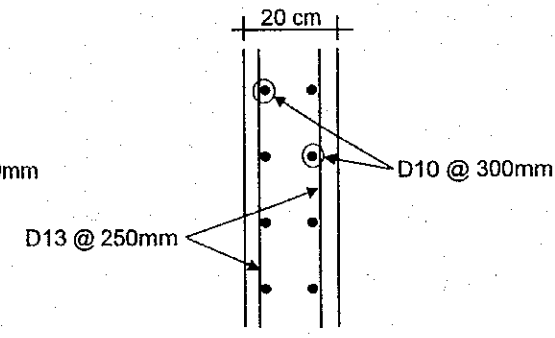
	Short Span			Long Span		
	Use Bar	Area cm2	Pitch cm	Use Bar	Area cm2	Pitch cm
End	5	1.98	10.7	4	1.27	10.0
Center	4	1.27	14.2	4	1.27	43.6

STEEL REINFORCEMENT

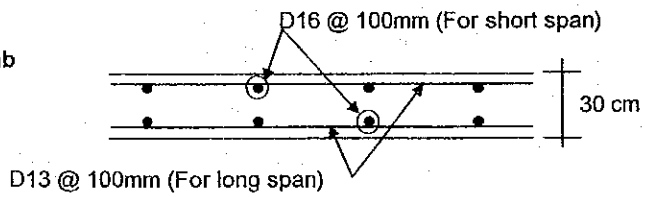
a) Exterior wall



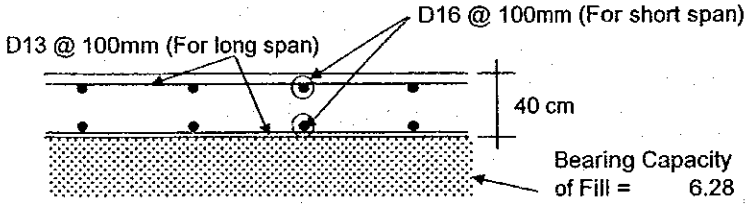
b) Interior wall



c) Top slab



d) Bottom slab



NIPPON KOEI CO.,LTD.

DESIGN CALCULATION COVER SHEET

Project	Detailed Design on Port Reactivation Project in La Union Province	**Project Code**	JC1N004/2N001
Section	**Utility Works**	Calc. File No.	
Sub-Section	**Wastewater System**	Calc. Index No.	

Subject:

Oil/water Separator-4 for Storm Water Drainage Route-C

Calculation Objective:

To determine the structural arrangement of the tank for the Oil/water Separator

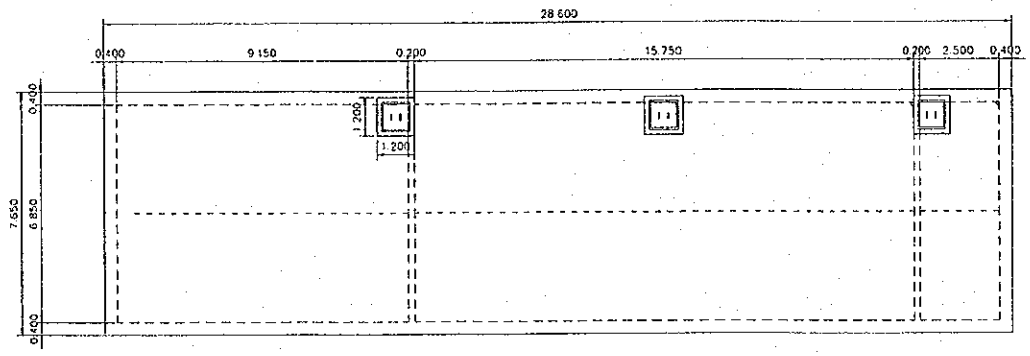
References, Calculation Notes and Comments

Rev	Prepared		No. of	Checked		Reviewed		Superseded
	by	Date	Pages	by	Date	by	Date	by Calc No.
O	R.M.G.		7	S. Endo	08 Aug, 12	[illegible] FT	13 Aug, 12	
A								
B								
C								

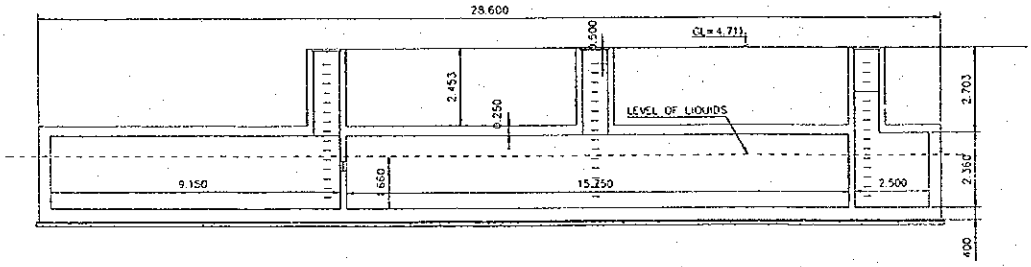
NIPPON KOEI CO.,LTD.

PROJECT: La Union Port Development Project.	Calc. File No.		Prepared by	R.Martinez
SECTION: Utility Work	Calc. Index No.		Checked by	
SUBJECT: Design of Oil Separator-4 (Route C)	Date	Aug-02	Page	2/7

OIL/WATER SEPARATOR - 4 (ROUTE C)



PLAN



ELEVATION

Weight

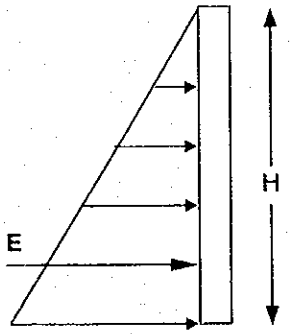
Foundation =	210.04	ton	Interior Walls =	15.52	ton
Exterior Walls =	160.63	ton	Liquid =	45.48	ton
γ liquid =	1.00	ton/m³	Soil =	661.56	ton
γ soil =	1.50	ton/m³	Traffic load =	0.61	ton/m²
Concrete covers =	15.57	ton	Traffic load =	133.46	ton
Top Slab =	158.54	ton	Total weight =	1400.8	ton

Footing Dimensions

L = 28.60 m Area = 218.79 m²

B = 7.65 m Soil pressure, σ = 6.40 ton/m²
0.64 kg/cm²

a) Exterior Wall design



Earth Pressure (E) = 1/2 γ h² ka

H = 2.36 m ka = tan(45+ϕ/2)

Aditional H = 2.70 m ϕ = 30.00 degrees

h = 5.06 m ka = 0.333

γ = 1.50 ton/m3

E = 7.02 ton/m (Earth+Traffic pressure)

Width = 1.00 m Total E = 7.02 ton

Moment at base (ExH/3) = 5.52 ton-m

f'c = 210 kg/cm² fy = 4200 kg/cm²

b = 100 cm h = 40.00 cm

Concrete cover = 5.00 cm d = 34.37 cm

Mu = 1.4Me

Mu = 9.83 ton-m

$fy^2/1.7bf'c\,As^2 - fyd\,As + Mu/\phi = 0$ $\phi = 0.90$

$494.12\,As^2 - 144333As + 1091771 = 0$

As = 7.77 cm²

Asmin

(4/3)Asreq = 10.36 cm²

(14/fy) b d = 11.46 cm²

Use Asmin = 10.36 cm²

Asmax :

ρb = 0.0345

Asmax (0.75ρb) = 88.82 cm²

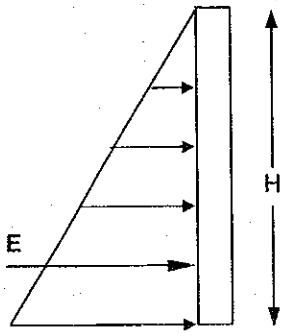
As = 10.36 cm² o.k!! As < Amax

Bar N = 4 Bar area (Av) = 1.27 cm²

# of bars = 8.18 Spacing = 12.23 cm

Use N 4 @ 12.2 cm

b) Interior Wall design



Liquid Pressure(E) = 1/2 γ h²

H = 1.66 m

γ = 0.90 ton/m3

E = 1.24 ton/m

Width = 1.00 m Total E = 1.24 ton

Moment at base (ExH/3) = 0.69 ton-m

f'c = 210 kg/cm² fy = 4200 kg/cm²

b = 100 cm h = 20.00 cm

Concrete cover = 5.00 cm d = 14.37 cm

Mu = 1.4Me + 1.7Ml

Mu = 1.74 ton-m

$fy^2/1.7bf'c\,As^2 - fyd\,As + Mu/\phi = 0$ $\phi = 0.90$

494.12 As² - 60333 As+ 192892 = 0

As = 3.29 cm²

Asmin

(4/3)Asreq = 4.38 cm²

(14/fy) b d = 4.79 cm²

Use Asmin = 4.38 cm²

Asmax :

ρb = 0.0345

Asmax (0.75ρb) = 37.13 cm²

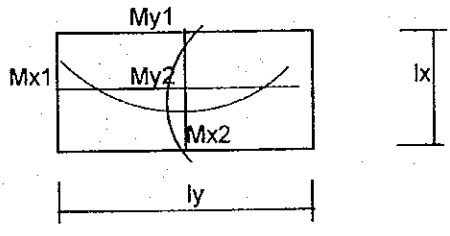
As = 4.38 cm² o.k!! As < Amax

Bar N = 4 Bar area (Av) = 1.27 cm²

# of bars = 3.46 Spacing = 28.92 cm

Use N 4 @ 28.00 cm

c) Top Slab design



lx= 6.85 m

ly= 15.75 m

ly/lx= 2.3

t= 30 cm

d = 25.37 cm

fc = 210 kg/cm2

fy = 4200 kg/cm2

coefficient of bend (thioretical result fix end)

Mx1/(w lx²) =	0.08
Mx2/(w lx²) =	0.041
My1/(w lx²) =	0.042
My2/(w lx²) =	0.010

wDL= 3.575 t/m2

wLL= 0.610 t/m2

DL

Mx1=	13.42	tm/m
Mx2=	6.88	tm/m
My1=	7.04	tm/m
My2=	1.68	tm/m

LL

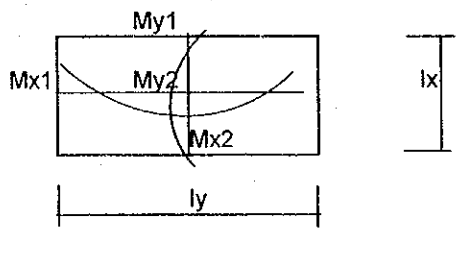
Mx1=	2.29	tm/m
Mx2=	1.17	tm/m
My1=	1.20	tm/m
My2=	0.29	tm/m

1.4DL+1.7LL			fy2/1.7bfc'	fyd	Mu/f			
Mx1=	20.73	tm/m	494.1	106533	2303498.52	As=	24.38	cm²/m
Mx2=	11.62	tm/m	494.1	106533	1291376.54	As=	12.89	cm²/m
My1=	11.91	tm/m	494.1	106533	1322873.53	As=	13.23	cm²/m
My2=	2.83	tm/m	494.1	106533	314969.888	As=	3.00	cm²/m

	Short Span			Long Span		
	Use Bar	Area cm2	Pitch cm	Use Bar	Area cm2	Pitch cm
End	5	1.98	8.1	4	1.27	10.6
Center	5	1.98	15.4	3	0.71	23.8

d) Bottom Slab design

for 2nd roof



lx= 6.85 m

ly= 9.15 m

ly/lx= 1.3

t= 40 cm

d = 35.37 cm

fc = 210 kg/cm2

fy = 4200 kg/cm2

coefficient of bend (thioretical result fix end)

Mx1/(w lx²) =	0.064
Mx2/(w lx²) =	0.030
My1/(w lx²) =	0.042
My2/(w lx²) =	0.010

wDL=	5.79	t/m2
wLL=	0.61	t/m2

DL

Mx1=	17.40	tm/m
Mx2=	8.15	tm/m
My1=	11.42	tm/m
My2=	2.72	tm/m

LL

Mx1=	1.83	tm/m
Mx2=	0.86	tm/m
My1=	1.20	tm/m
My2=	0.29	tm/m

PROJECT: La Union Port Development Project.	Calc. File No.		Prepared by	R.Martinez
SECTION: Utility Work	Calc. Index No.		Checked by	S. Endo
SUBJECT: Design of Oil Separator-4 (Route C)	Date	Aug-02	Page	7/7

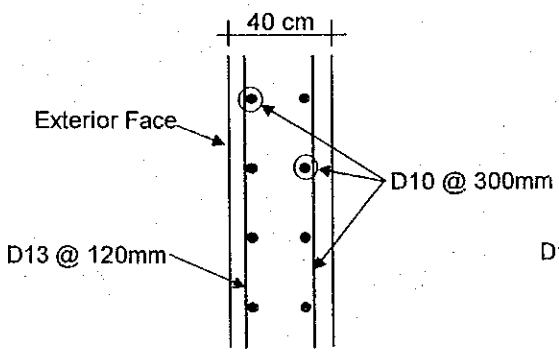
1.4DL+1.7LL

			fy2/1.7bfc'	fyd	Mu/f		
Mx1=	25.91	tm/m	494.1	148533	2878911.49	As=	20.83 cm²/m
Mx2=	12.88	tm/m	494.1	148533	1430587.48	As=	9.96 cm²/m
My1=	17.12	tm/m	494.1	148533	1901900.86	As=	13.40 cm²/m
My2=	4.29	tm/m	494.1	148533	476862.493	As=	3.25 cm²/m

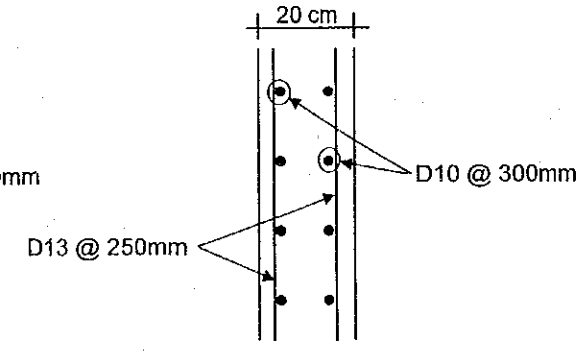
	Short Span			Long Span		
	Use Bar	Area cm2	Pitch cm	Use Bar	Area cm2	Pitch cm
End	5	1.98	9.5	4	1.27	9.5
Center	4	1.27	12.7	4	1.27	39.0

STEEL REINFORCEMENT

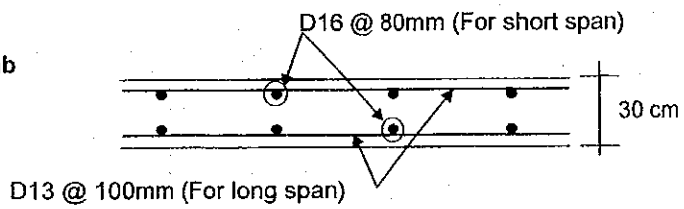
a) Exterior wall



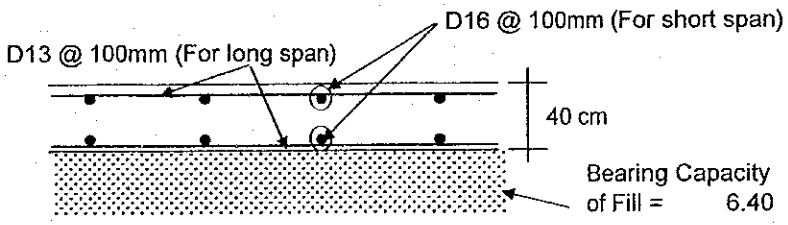
b) Interior wall



c) Top slab



d) Bottom slab



WATER SUPPLY SYSTEM

DESIGN CALCULATION COVER SHEET

Project	Detailed Design on Port Reactivation Project in La Union Province	**Project Code**	JC1N004/2N001
Section	**Utility Works**	Calc. File No.	
Sub-Section	**Water Supply System**	Calc. Index No.	

Subject:

Pipe Strength Analysis

Calculation Objective:

To calculate and check the allowable stress and deflection ratio for PVC pipe such as VU and VP.

References, Calculation Notes and Comments

Design Condition

1) Specific Weight : 18 kN/m3
2) Overburden : 1m
3) Load : 250kN (RTG)
4) Allowable Stress and Deflection Ration : 17.7N/mm2 and 5 %
5) Formula for Allowable Stress

$\sigma=((k1 \times qd + k2 \times qt) \times r^2)/Z$

6) Fomula for Allowable Deflection Ration

$\delta= ((k3 \times qd + k4 \times qt) \times r^4) / (E \times I)$

$V = (\delta/(h - t)) \times 100$ (%)

Rev	Prepared by	Prepared Date	No. of Pages	Checked by	Checked Date	Reviewed by	Reviewed Date	Superseded by Calc No.
O	S. Endo	08 Aug 02	2	S. Endo	08 Aug 02			
A								
B								
C								

Project	Detailed Design on Port Reactivation Project in La Union Province	Calc. File No.	
Section	UTILITY WORK	Calc. Index No.	
Subject	Water Supply Pipes	Page No. 2/2	Rev.

References/

Checking for Allowable Stress (VU)

Vertical Earth Pressure	q_d	18	kN/m2					
Specific Weight	r	18	kN/m3					
Overburden	h	1	m					
Live Load	q_L	111.6	kN/m2					
Load	P	250	kN					
Impact Coefficient	I	0.5						
Decrease Coefficient	β	0.9						
Bending Stress	σ	13.55	N/mm2	<	Allowable Stress	17.7	N/mm2	OK
	k_1	0.107						
	k_2	0.079						
Central Radius of Pipe	r	79.75	mm					
Section Modules	Z	5.04	mm3/mm					
Vertical Earth Pressure	q_d	0.0180	N/mm2					
Specific Weight	q_L	0.1116	N/mm2					

Checking for Deflection Ratio

Deflection	δ	4.56	mm					
	k 3	0.07						
	k 4	0.03						
Modulas Ratio	E	2942	N/mm2					
Geometrical Moment of Inertia	I	13.9	mm4/mm					
Deflection Ratio	V	2.86	%	<	Allowable Stress	5	%	OK

Checking for Allowable Stress (VP)

Vertical Earth Pressure	q_d	18	kN/m2					
Specific Weight	r	18	kN/m3					
Overburden	h	1	m					
Live Load	q_L	111.6	kN/m2					
Load	P	250	kN					
Impact Coefficient	I	0.5						
Decrease Coefficient	β	0.9						
Bending Stress	σ	4.21	N/mm2	<	Allowable Stress	17.7	N/mm2	OK
	k_1	0.107						
	k_2	0.079						
Central Radius of Pipe	r	77.7	mm					
Section Modules	Z	15.4	mm3/mm					
Vertical Earth Pressure	q_d	0.0180	N/mm2					
Specific Weight	q_L	0.1116	N/mm2					

Checking for Deflection Ratio

Deflection	δ	0.77	mm					
	k 3	0.07						
	k 4	0.03						
Modulas Ratio	E	2942	N/mm2					
Geometrical Moment of Inertia	I	73.7	mm4/mm					
Deflection Ratio	V	0.50	%	<	Allowable Stress	5	%	OK

	Prepared by		Checked by	
	S. Endo	08 Aug, 02	S. Endo	08 Aug, 02

DESIGN CALCULATION COVER SHEET

Project	Detailed Design on Port Reactivation Project in La Union Province	**Project Code**	JC1N004/2N001
Section	**Utility Works**	Calc. File No.	
Sub-Section	**Water Supply System**	Calc. Index No.	

Subject:

Pipeline Network Analysis

Calculation Objective:

To calculate and check a water head, hydraulic grade line, discharge volume and velocity of pipeline from water storage tank to port area by using a program of pipeline network analysis.

References, Calculation Notes and Comments

Design Condition

1) Water Level of Reservoir : L..W.L
2) Velocity within pipe : Maximum 3 m/s
3) Effective Head : Between 15 m and 75 m
4) Piezometric Head : 80 $^{0}/_{00}$
5) Calculation Model : Hazen Willoams Formula

$H=10.666 \times C^{-1.85} \times D^{-4.87} \times Q^{1.85} \times L$

H: Loss Head (m)

C : Velocity Coefficient : 110

D : Diameter of Pipeline (m)

Q : Discharge (m^3/s)

L : Length of pipe between panel point (m)

Rev	Prepared		No. of	Checked		Reviewed		Superseded
	by	Date	Pages	by	Date	by	Date	by Calc No.
O	S. Endo	08 Aug 02	2	S. Endo	08 Aug 02	[illegible]	12 Aug 02	
A								
B								
C								

CALCULATION		
Detailed Design on Port Reactivation Project in La Union Province		
CALC FILE No.:		
CALC INDEX No.:		PAGE 2
	INITIAL	DATE
PREPARED BY	S. Endo	08 Aug 02
CHECKED BY	S. Endo	08 Aug 02

Name of File	La Union-1		
Number of Reservoir	1 Nos.	Hydraulic Water Head (Max)	42.343 m
Number of Point of Contact	101 Nos.	Hydraulic Grade Line	10.179 %
Number of Pipe	105 Nos.	Velocity (Max)	0.992 m/s
Number of Pump	0 Nos.		
Accuracy of Convergence	0.08 cm		
Number of Repetition	16 Nos.		

Input Data						Output Data									
No.	Water Head (m)	Ground Level (m)	Effective Water Head (m)	Discharge Volume (l/s)	Remarks	ST	EN	Diameter of Pipe (mm)	Length of Pipe (m)	Coefficient	Discharge Volume (l/s)	Velocity (m/s)	Hydraulic Grade Line (%)	Loss of Head (m)	Pressure-reducing Water head (m)
1	50.000	47.000		3.000	-17.857	1	2	200	37.900	110	17.857	0.569	2.597	0.098	0.000
2	49.902	45.000		4.902	0.000	2	3	200	63.200	110	17.857	0.569	2.597	0.164	0.000
3	49.737	38.500		11.237	0.000	3	4	200	59.300	110	17.857	0.569	2.597	0.154	0.000
4	49.583	36.000		13.583	0.000	4	5	200	249.400	110	17.857	0.569	2.597	0.648	0.000
5	48.936	27.000		21.936	0.000	5	6	200	47.900	110	17.857	0.569	2.597	0.124	0.000
6	48.811	25.000		23.811	0.000	6	7	200	46.400	110	17.857	0.569	2.597	0.121	0.000
7	48.691	21.000		27.691	0.000	7	8	200	17.000	110	17.857	0.569	2.597	0.044	0.000
8	48.647	20.000		28.647	0.000	8	9	200	37.000	110	17.857	0.569	2.597	0.096	0.000
9	48.550	16.000		32.550	0.000	9	10	200	71.000	110	17.857	0.569	2.597	0.184	0.000
10	48.366	7.000		41.366	0.000	10	11	200	393.900	110	17.857	0.569	2.597	1.023	0.000
11	47.343	5.000		42.343	0.000	11	12	150	30.500	110	9.072	0.514	3.008	0.092	0.000
12	47.251	5.000		42.251	0.000	12	13	150	5.000	110	+++++	+++++	+++++	+++++	+++++
13	-----	5.000	-----	-----	-----	12	14	150	14.000	110	9.072	0.514	3.008	0.042	0.000
14	47.209	5.000		42.209	0.000	14	15	80	40.000	110	0.305	0.061	0.120	0.005	0.000
15	47.204	20.000		27.204	0.305	14	93	150	5.000	110	8.767	0.496	2.824	0.014	0.000
16	47.045	5.000		42.045	0.000	93	94	100	40.000	110	+++++	+++++	+++++	+++++	+++++
17	-----	5.000	-----	-----	-----	93	16	150	53.000	110	8.767	0.496	2.824	0.150	0.000
18	47.011	5.000		42.011	0.000	16	17	150	5.000	110	+++++	+++++	+++++	+++++	+++++
19	47.010	7.000		40.010	0.031	16	18	150	12.000	110	8.767	0.496	2.824	0.034	0.000
20	46.944	5.000		41.944	0.000	18	19	40	20.000	110	0.030	0.024	0.049	0.001	0.000
21	46.863	5.000		41.863	0.000	18	20	150	24.000	110	8.736	0.495	2.805	0.067	0.000
22	-----	5.000	-----	-----	-----	20	21	150	29.000	110	8.736	0.495	2.805	0.081	0.000
23	46.753	5.000		41.753	0.000	21	22	150	5.000	110	+++++	+++++	+++++	+++++	+++++
24	46.387	5.000		41.387	0.000	21	23	150	39.000	110	8.736	0.495	2.805	0.109	0.000
25	46.387	5.000		41.387	0.000	23	24	150	36.000	110	17.522	0.992	10.179	0.366	0.000
26	46.387	7.000		39.387	0.009	24	25	150	48.000	110	0.009	0.001	0.000	0.000	0.000
27	-----	5.000	-----	-----	-----	25	26	30	12.000	110	0.009	0.013	0.021	0.000	0.000
28	-----	5.000	-----	-----	-----	25	27	150	88.000	110	+++++	+++++	+++++	+++++	+++++
29	-----	5.000	-----	-----	-----	27	28	80	30.000	110	-----	-----	-----	-----	-----
30	-----	5.000	-----	-----	-----	28	29	150	57.000	110	-----	-----	-----	-----	-----
31	-----	5.000	-----	-----	-----	29	30	150	96.000	110	-----	-----	-----	-----	-----
32	-----	5.000	-----	-----	-----	30	31	150	5.000	110	+++++	+++++	+++++	+++++	+++++
33	-----	5.000	-----	-----	-----	30	32	150	56.000	110	-----	-----	-----	-----	-----
34	-----	5.000	-----	-----	-----	32	33	150	5.000	110	+++++	+++++	+++++	+++++	+++++
35	-----	5.000	-----	-----	-----	32	34	150	90.000	110	-----	-----	-----	-----	-----
36	-----	5.000	-----	-----	-----	34	95	150	32.000	110	-----	-----	-----	-----	-----
37	-----	5.000	-----	-----	-----	95	96	80	30.000	110	+++++	+++++	+++++	+++++	+++++
38	-----	5.000	-----	-----	-----	95	35	150	28.000	110	-----	-----	-----	-----	-----
39	43.885	5.000		38.885	0.000	35	36	150	5.000	110	+++++	+++++	+++++	+++++	+++++
40	43.804	5.000		38.804	0.000	35	37	150	66.000	110	-----	-----	-----	-----	-----
41	-----	5.000	-----	-----	-----	37	38	150	5.000	110	+++++	+++++	+++++	+++++	+++++
42	43.041	5.000		38.041	0.000	37	97	150	21.000	110	-----	-----	-----	-----	-----
43	-----	5.000	-----	-----	-----	97	98	150	30.000	110	+++++	+++++	+++++	+++++	+++++
44	42.187	5.000		37.187	0.000	97	39	150	46.000	110	+++++	+++++	+++++	+++++	+++++
45	42.180	5.000		37.180	5.830	24	81	150	42.000	110	17.513	0.992	10.170	0.427	0.000
46	41.778	5.000		36.778	0.000	81	82	150	5.000	110	+++++	+++++	+++++	+++++	+++++
47	41.772	5.000		36.772	5.830	81	85	150	53.000	110	17.513	0.992	10.170	0.539	0.000
48	41.679	5.000		36.679	0.000	85	86	150	5.000	110	+++++	+++++	+++++	+++++	+++++
49	41.673	5.000		36.673	5.830	85	89	150	56.000	110	17.513	0.992	10.170	0.570	0.000
50	41.679	5.000		36.679	0.000	89	90	150	5.000	110	+++++	+++++	+++++	+++++	+++++
51	41.679	5.000		36.679	0.000	89	39	150	95.000	110	17.513	0.992	10.170	0.966	0.000
52	41.679	5.000		36.679	0.000	39	40	150	8.000	110	17.513	0.992	10.170	0.081	0.000
53	-----	5.000	-----	-----	-----	40	41	150	5.000	110	+++++	+++++	+++++	+++++	+++++
54	41.679	5.000		36.679	0.000	40	42	150	75.000	110	17.513	0.992	10.170	0.763	0.000
55	41.679	5.000		36.679	0.000	42	43	150	5.000	110	+++++	+++++	+++++	+++++	+++++
56	-----	10.000	-----	-----	-----	42	99	150	39.000	110	17.513	0.992	10.170	0.397	0.000
57	41.679	5.000		36.679	0.000	99	100	80	30.000	110	+++++	+++++	+++++	+++++	+++++
58	41.679	5.000		36.679	0.000	99	44	150	45.000	110	17.513	0.992	10.170	0.458	0.000
59	41.679	5.000		36.679	0.000	44	45	150	5.000	110	5.830	0.330	1.326	0.007	0.000
60	-----	5.000	-----	-----	-----	44	101	150	45.000	110	11.683	0.661	4.806	0.216	0.000
61	41.679	5.000		36.679	0.000	101	102	80	30.000	110	+++++	+++++	+++++	+++++	+++++
62	-----	5.000	-----	-----	-----	101	46	150	40.000	110	11.683	0.661	4.806	0.192	0.000
63	-----	5.000	-----	-----	-----	46	47	150	5.000	110	5.830	0.330	1.326	0.007	0.000
64	-----	5.000	-----	-----	-----	46	48	150	74.000	110	5.853	0.331	1.336	0.099	0.000
65	-----	5.000	-----	-----	-----	48	49	150	5.000	110	5.830	0.330	1.326	0.007	0.000
66	41.679	5.000		36.679	0.000	48	50	150	8.000	110	0.023	0.001	0.000	0.000	0.000
67	-----	5.000	-----	-----	-----	50	51	150	94.000	110	0.023	0.001	0.000	0.000	0.000
68	41.679	5.000		36.679	0.000	51	52	150	2.000	110	0.000	0.000	0.000	0.000	0.000
69	41.679	7.000		34.679	0.023	52	53	150	2.000	110	+++++	+++++	+++++	+++++	+++++
70	41.679	5.000		36.679	0.000	51	54	150	24.000	110	0.023	0.001	0.000	0.000	0.000
71	-----	5.000	-----	-----	-----	54	55	80	54.000	110	0.000	0.000	0.000	0.000	0.000
72	-----	5.000	-----	-----	-----	55	56	80	30.000	110	+++++	+++++	+++++	+++++	+++++
73	-----	7.000	-----	-----	-----	54	57	150	32.000	110	0.023	0.001	0.000	0.000	0.000
74	-----	5.000	-----	-----	-----	57	58	150	52.000	110	0.023	0.001	0.000	0.000	0.000
75	-----	7.000	-----	-----	-----	58	59	150	2.000	110	0.000	0.000	0.000	0.000	0.000
76	-----	5.000	-----	-----	-----	59	60	150	2.000	110	+++++	+++++	+++++	+++++	+++++
77	-----	5.000	-----	-----	-----	58	61	150	120.000	110	0.023	0.001	0.000	0.000	0.000
78	47.230	5.000		42.230	0.000	61	62	150	16.000	110	+++++	+++++	+++++	+++++	+++++
79	-----	5.000	-----	-----	-----	62	63	150	44.000	110	-----	-----	-----	-----	-----
80	47.150	5.000		42.150	0.000	62	64	150	44.000	110	-----	-----	-----	-----	-----
81	45.960	5.000		40.960	0.000	64	65	150	89.000	110	-----	-----	-----	-----	-----
82	-----	5.000	-----	-----	-----	61	66	150	3.000	110	0.023	0.001	0.000	0.000	0.000
83	-----	5.000	-----	-----	-----	66	67	150	5.000	110	+++++	+++++	+++++	+++++	+++++
84	-----	5.000	-----	-----	-----	66	68	150	52.000	110	0.023	0.001	0.000	0.000	0.000
85	45.421	5.000		40.421	0.000	68	69	40	20.000	110	0.023	0.018	0.029	0.001	0.000
86	-----	5.000	-----	-----	-----	68	70	150	42.000	110	0.000	0.000	0.000	0.000	0.000
87	-----	5.000	-----	-----	-----	70	71	150	5.000	110	+++++	+++++	+++++	+++++	+++++
88	-----	5.000	-----	-----	-----	71	72	150	47.000	110	-----	-----	-----	-----	-----
89	44.851	5.000		39.851	0.000	72	73	40	30.000	110	-----	-----	-----	-----	-----
90	-----	5.000	-----	-----	-----	72	74	150	15.000	110	-----	-----	-----	-----	-----
91	-----	5.000	-----	-----	-----	74	75	30	10.000	110	-----	-----	-----	-----	-----
92	-----	5.000	-----	-----	-----	74	76	150	13.000	110	-----	-----	-----	-----	-----
93	47.195	5.000		42.195	0.000	11	78	150	40.000	110	8.785	0.497	2.835	0.113	0.000
94	-----	20.000	-----	-----	-----	78	79	150	32.000	110	+++++	+++++	+++++	+++++	+++++
95	-----	5.000	-----	-----	-----	78	80	150	28.000	110	8.785	0.497	2.835	0.079	0.000
96	-----	15.000	-----	-----	-----	80	23	150	140.000	110	8.785	0.497	2.835	0.397	0.000
97	-----	5.000	-----	-----	-----	81	83	150	83.000	110	+++++	+++++	+++++	+++++	+++++
98	-----	15.000	-----	-----	-----	83	84	150	170.000	110	-----	-----	-----	-----	-----
99	42.644	5.000		37.644	0.000	84	58	150	83.000	110	+++++	+++++	+++++	+++++	+++++
100	-----	15.000	-----	-----	-----	85	87	150	83.000	110	+++++	+++++	+++++	+++++	+++++
101	41.971	5.000		36.971	0.000	87	88	150	170.000	110	-----	-----	-----	-----	-----
102	-----	15.000	-----	-----	-----	88	57	150	83.000	110	+++++	+++++	+++++	+++++	+++++
						89	91	150	83.000	110	+++++	+++++	+++++	+++++	+++++
						91	92	150	170.000	110	-----	-----	-----	-----	-----
						92	51	150	83.000	110	+++++	+++++	+++++	+++++	+++++