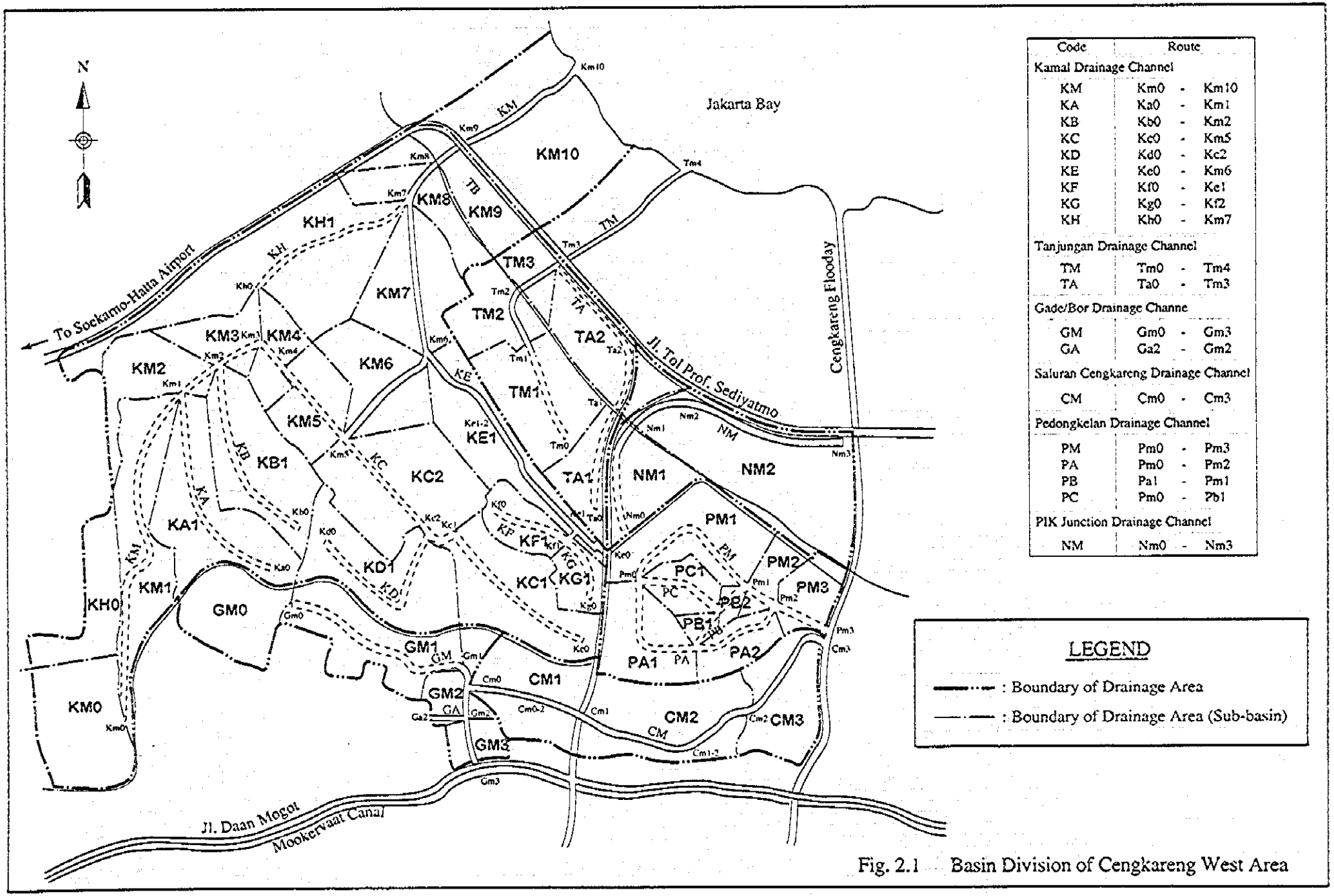
Figures



Code	Route
Kamal Drainage Channel	
KM	Km0 - Km10
KA	Ka0 - Km1
KB	Kb0 - Km2
KC	Kc0 - Km5
KD	Kd0 - Kc2
KE	Ke0 - Km6
KF	Kf0 - Ke1
KG	Kg0 - Kf2
KH	Kh0 - Km7
Tanjungan Drainage Channel	
TM	Tm0 - Tm4
TA	Ta0 - Tm3
Gade/Bor Drainage Channe	
GM	Gm0 - Gm3
GA	Ga2 - Gm2
Saluran Cengkareng Drainage Channel	
CM	Cm0 - Cm3
Pedongkelan Drainage Channel	
PM	Pm0 - Pm3
PA	Pm0 - Pm2
PB	Pa1 - Pm1
PC	Pm0 - Pb1
PIK Junction Drainage Channel	
NM	Nm0 - Nm3

LEGEND

: Boundary of Drainage Area

: Boundary of Drainage Area (Sub-basin)

Fig. 2.1 Basin Division of Cengkareng West Area

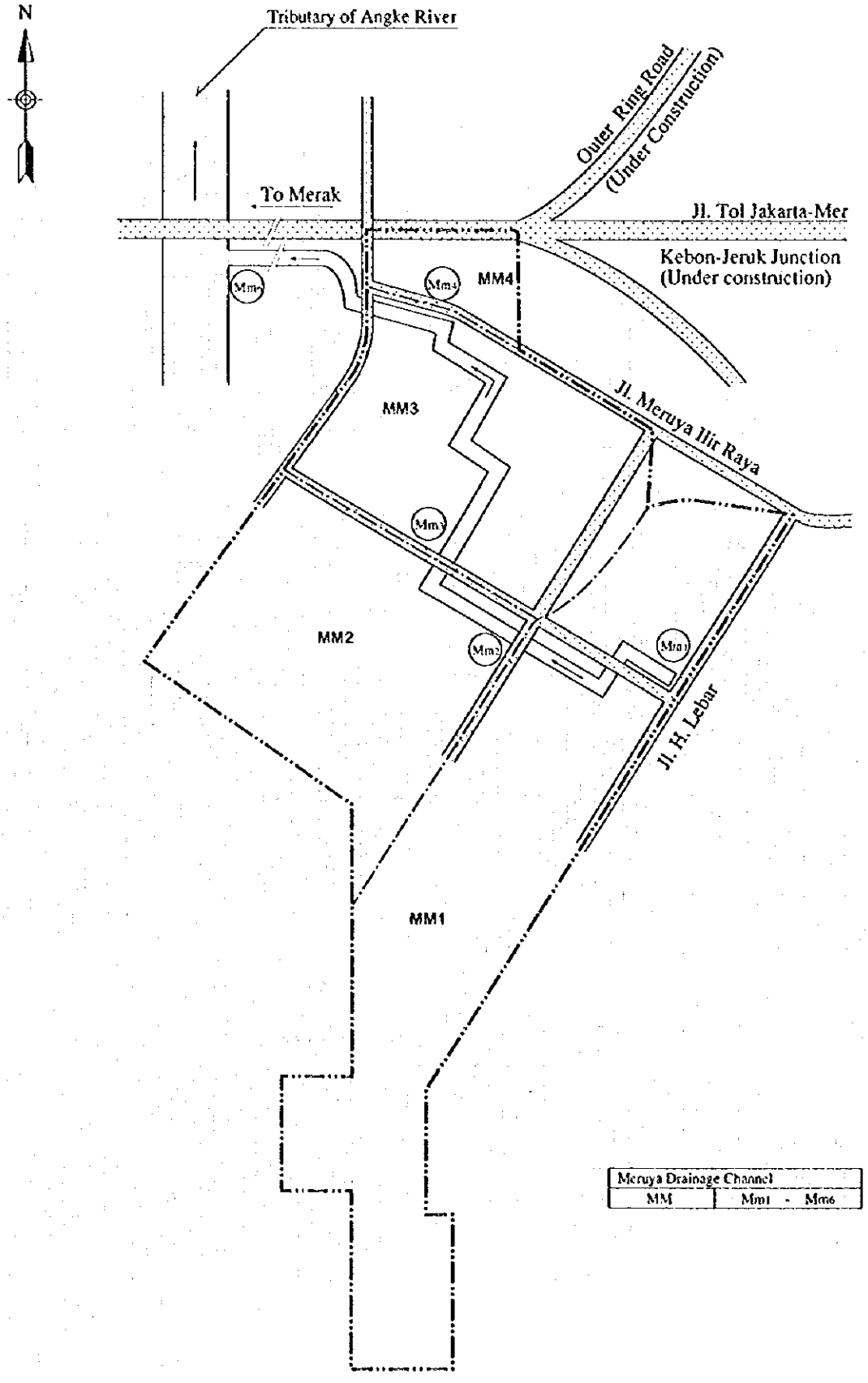


Fig. 2.2 Basin Division of Meruya Area

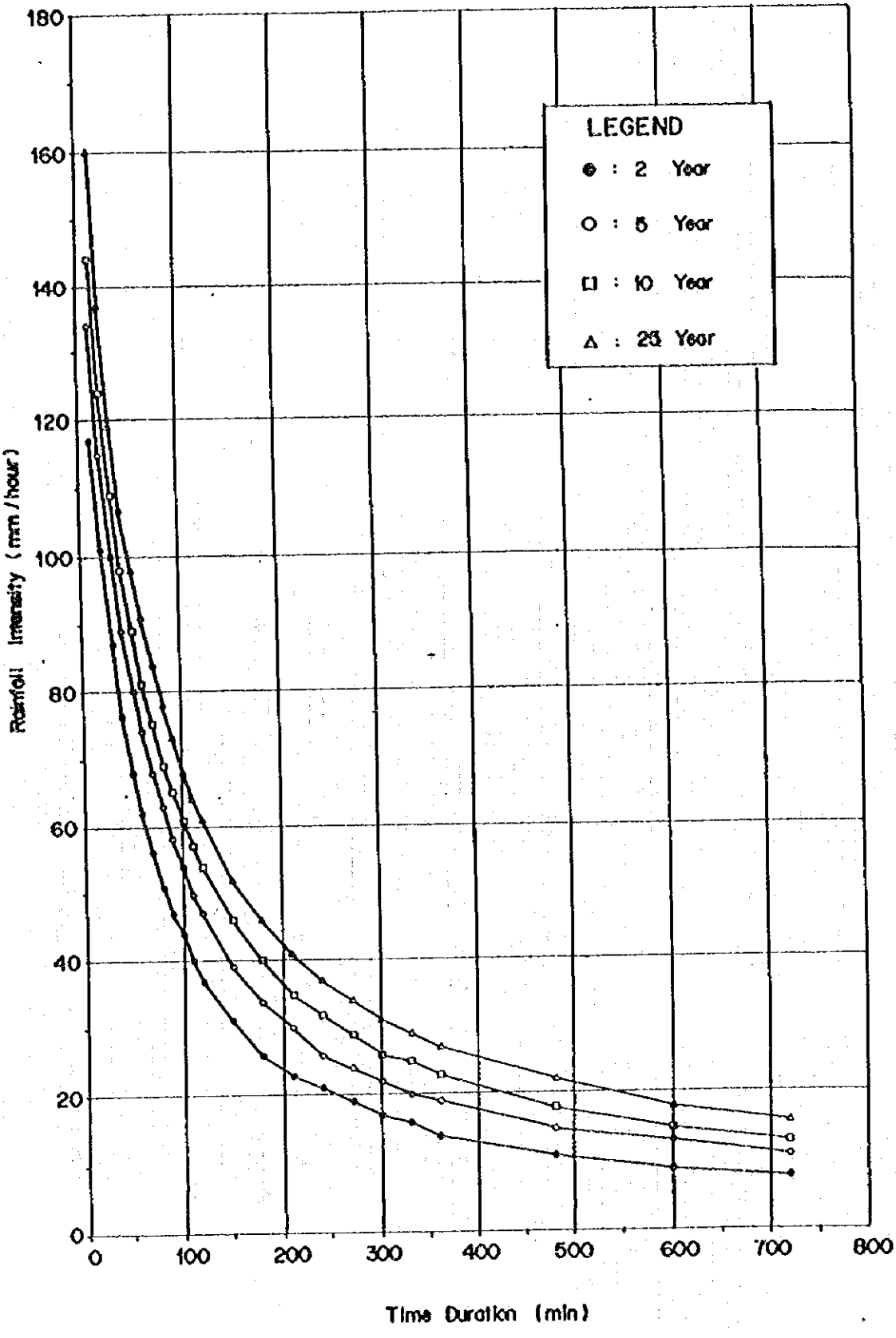


Fig. 2.3 Rainfall Intensity-Duration Curve

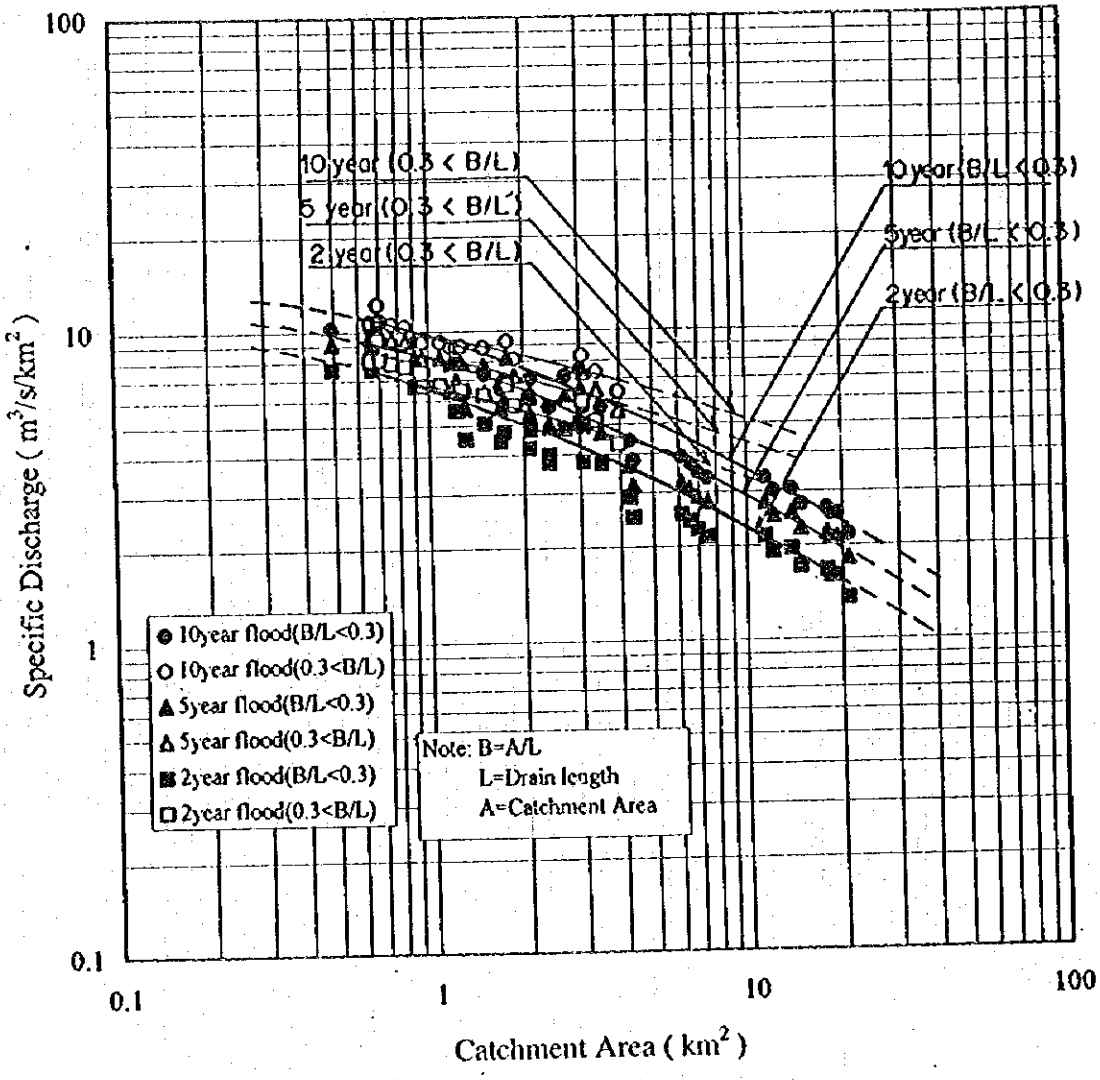


Fig. 2.4 Specific Discharge-Drainage Area Relationship

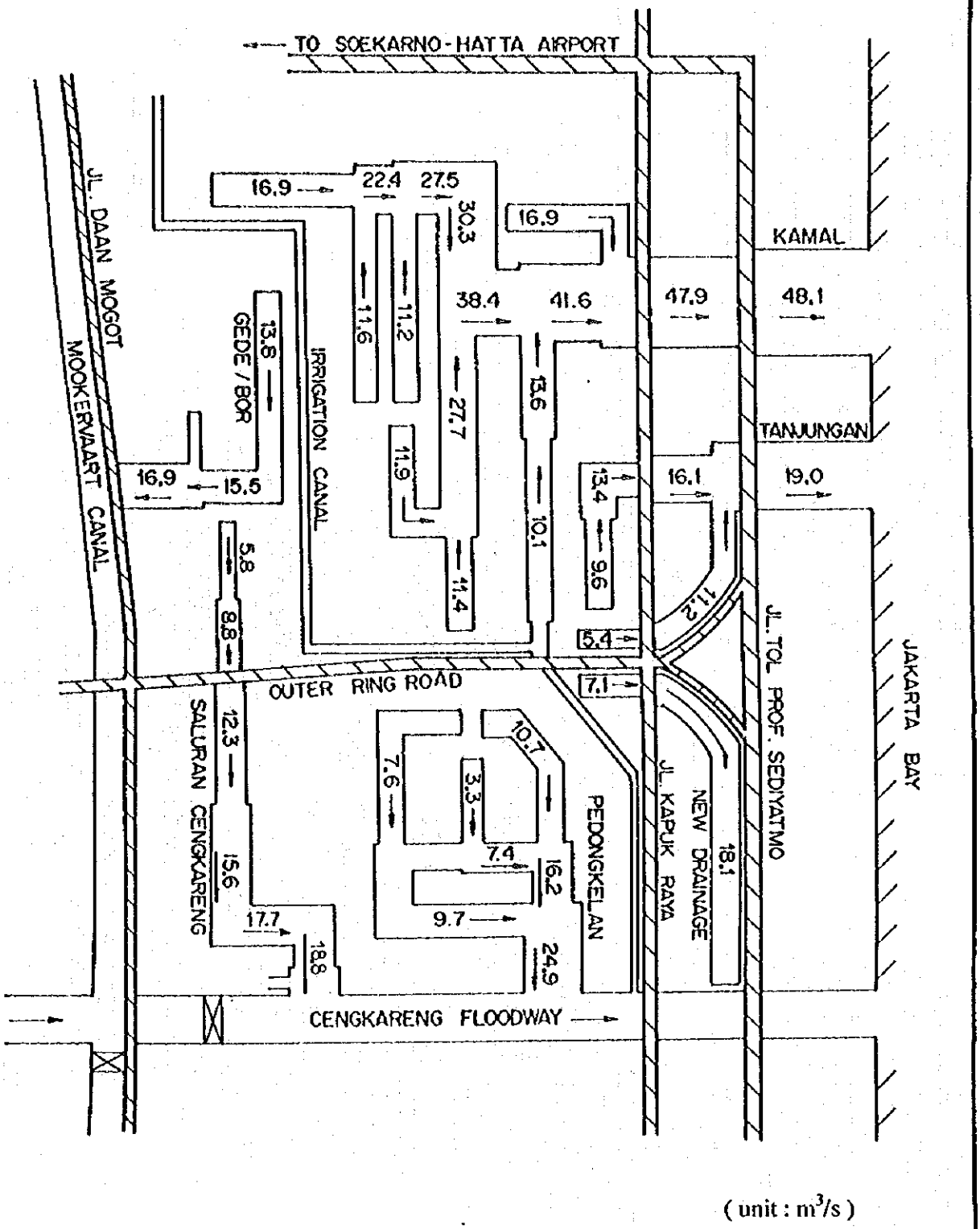


Fig. 2.5 Proposed Flood Discharge Distribution in Cengkareng West Area

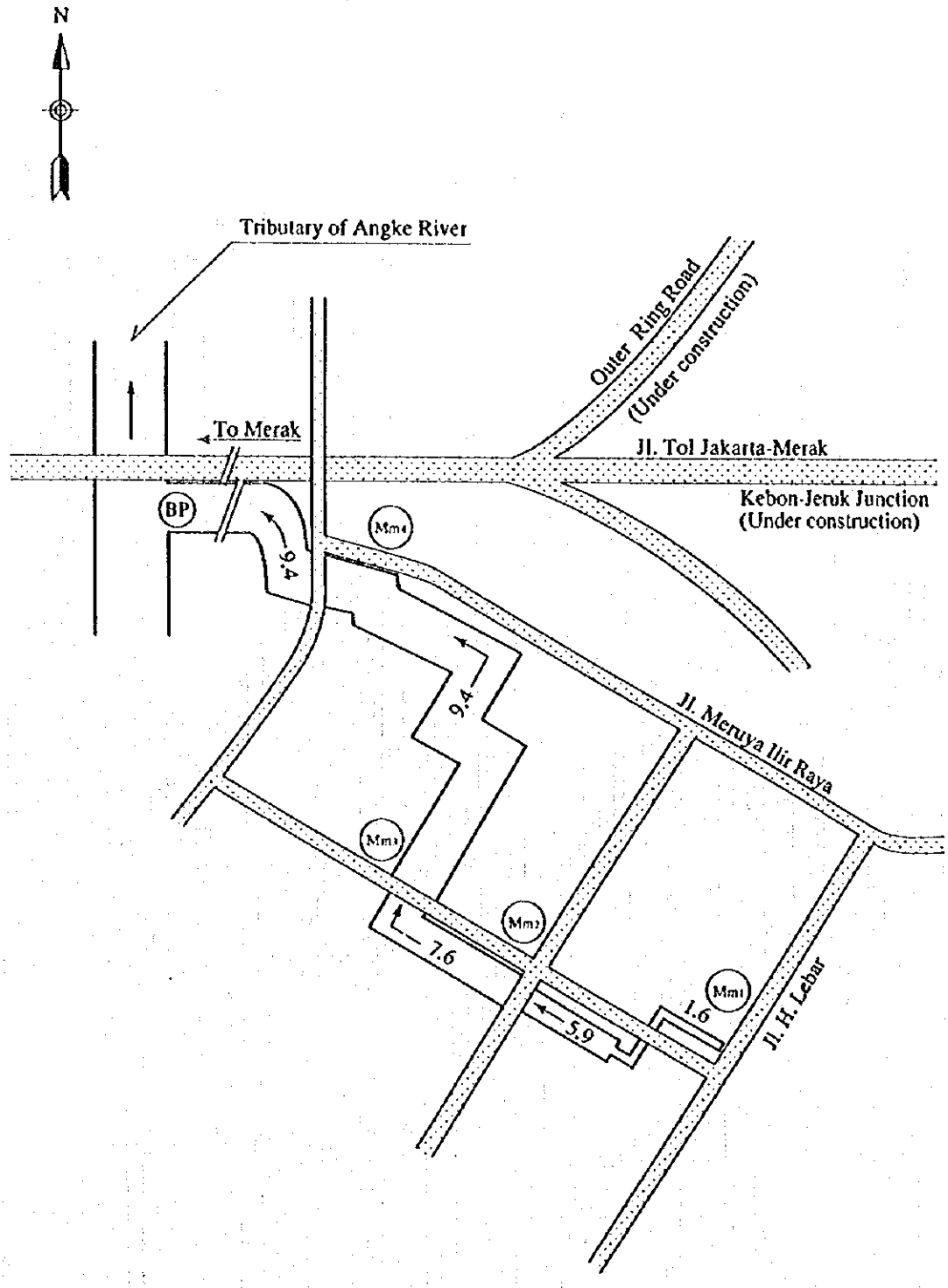


Fig. 2.6 Proposed Flood Discharge Distribution in Meruya Area

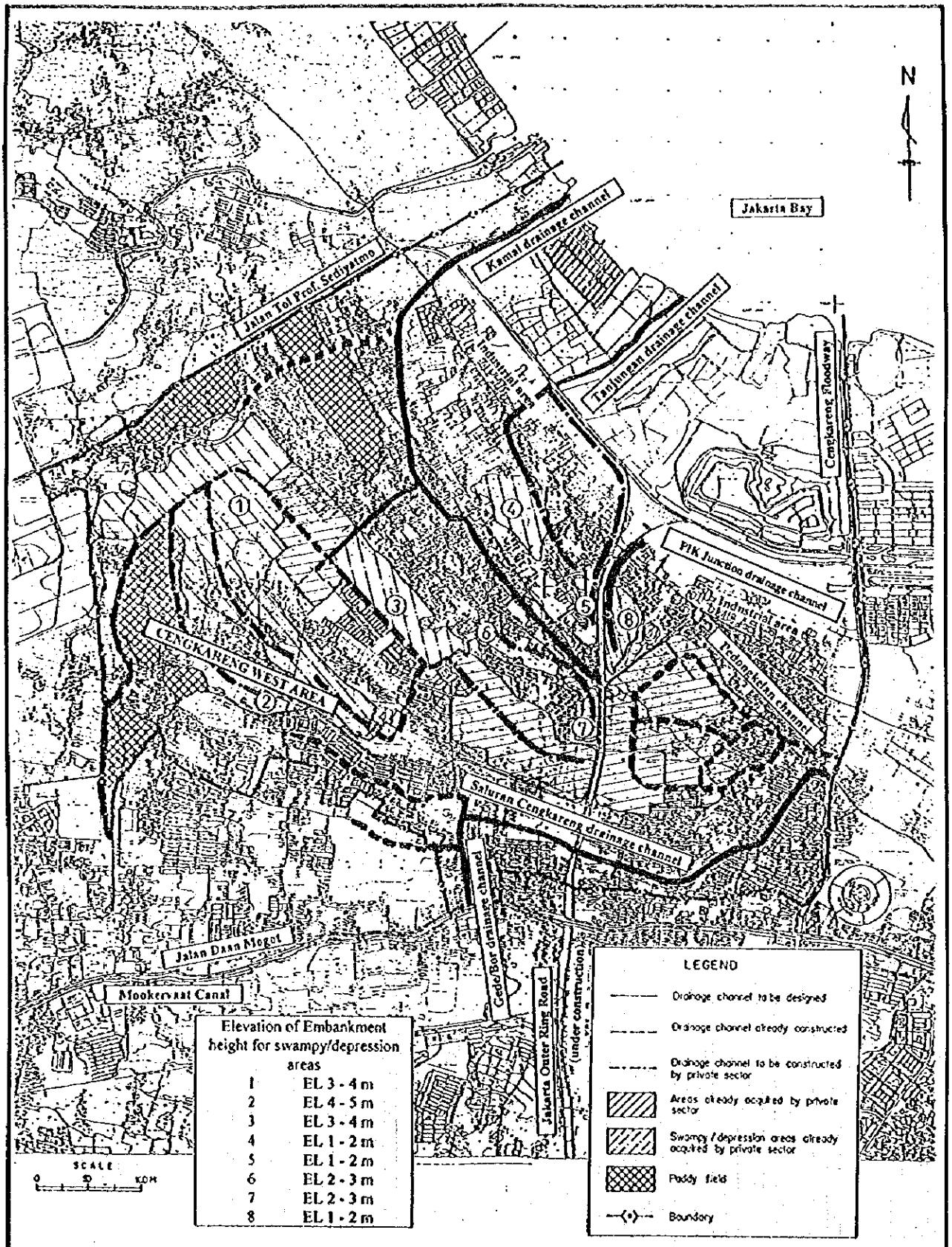


Fig. 2.7 Proposed Drainage Channel Alignment in Cengkareng West Area

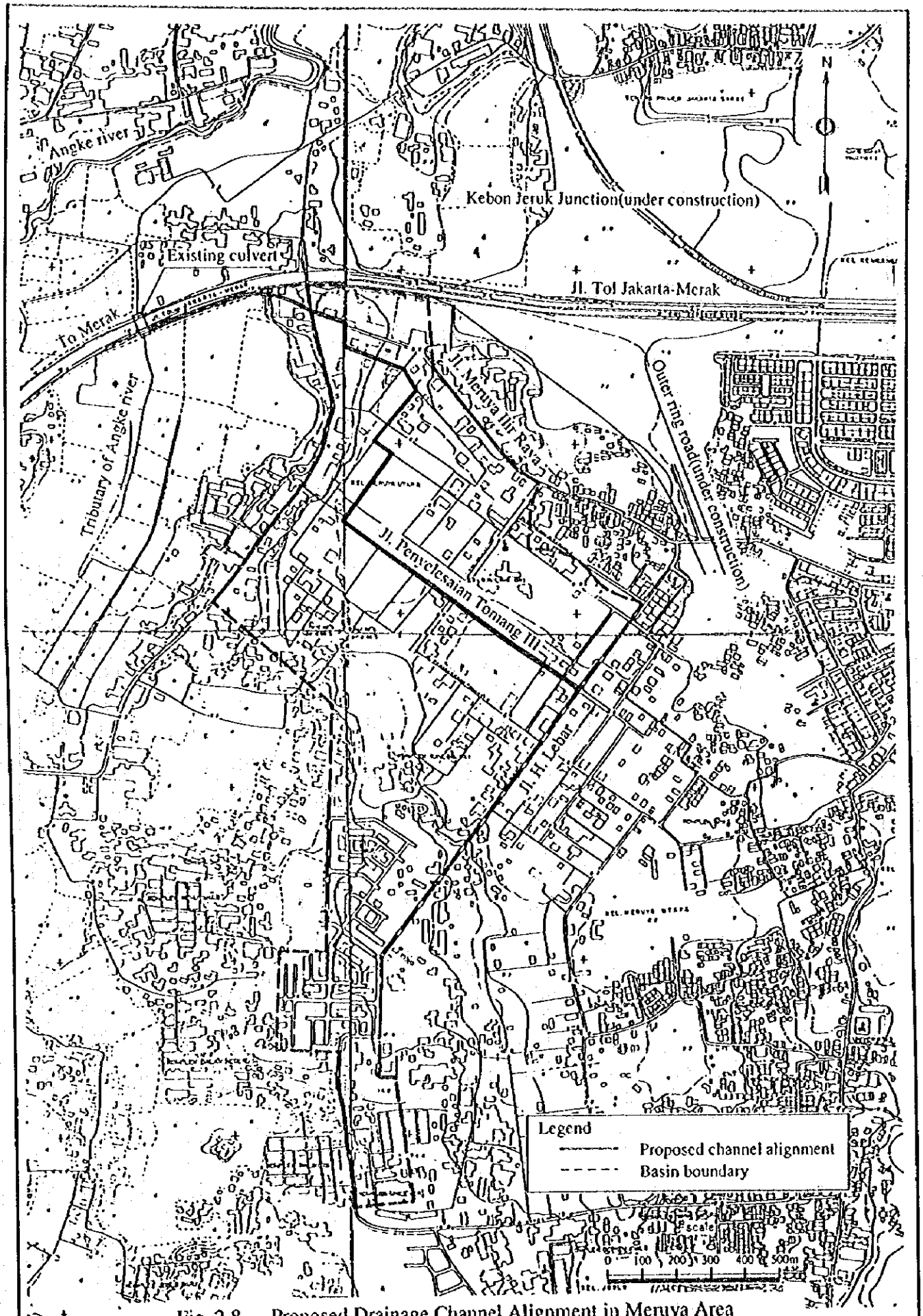


Fig. 2.8 Proposed Drainage Channel Alignment in Meruya Area

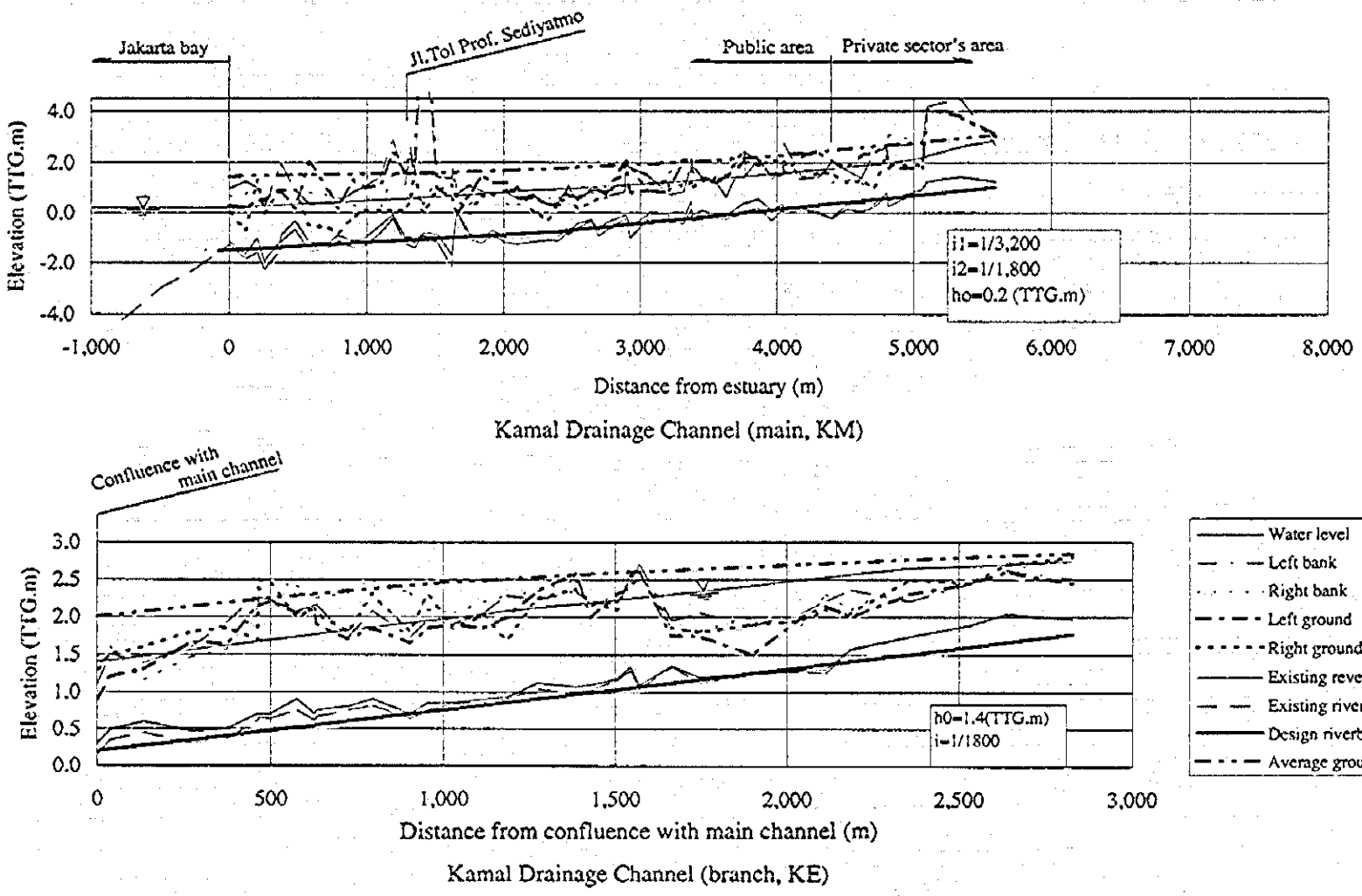
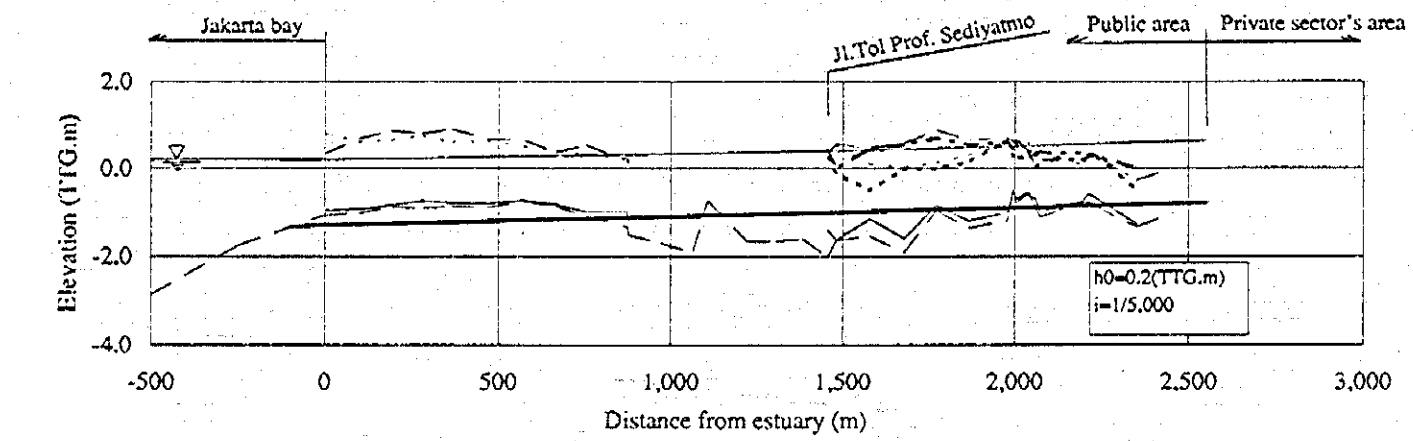
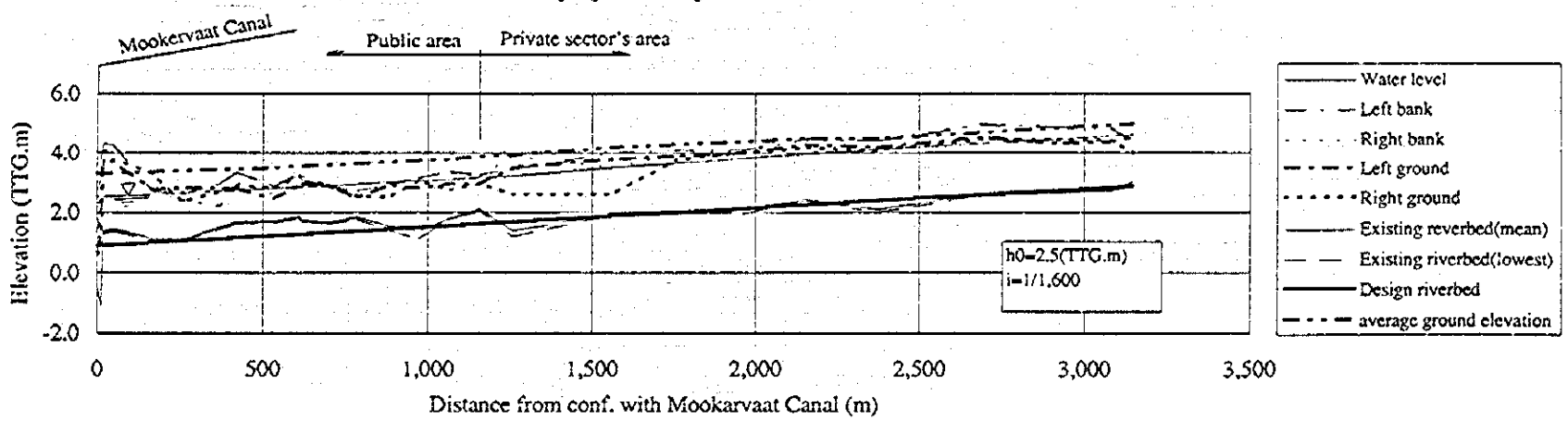


Fig. 2.9 Longitudinal Profile of Proposed Drainage Channel(1/4)



Tanjungan Drainage Channel (TM)



Gede/Bor Drainage Channel (GM)

Fig. 2.9 Longitudinal Profile of Proposed Drainage Channel(2/4)

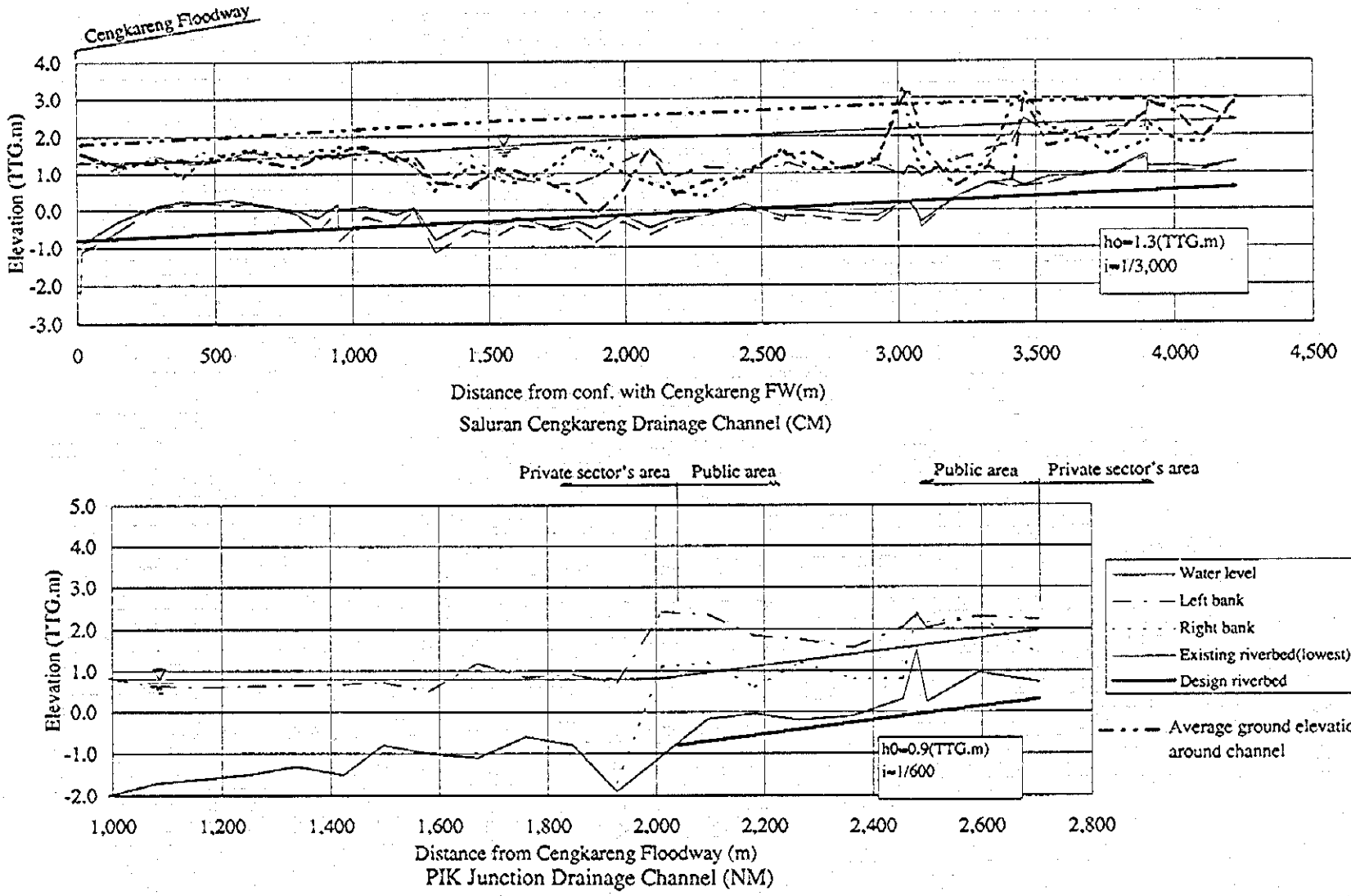
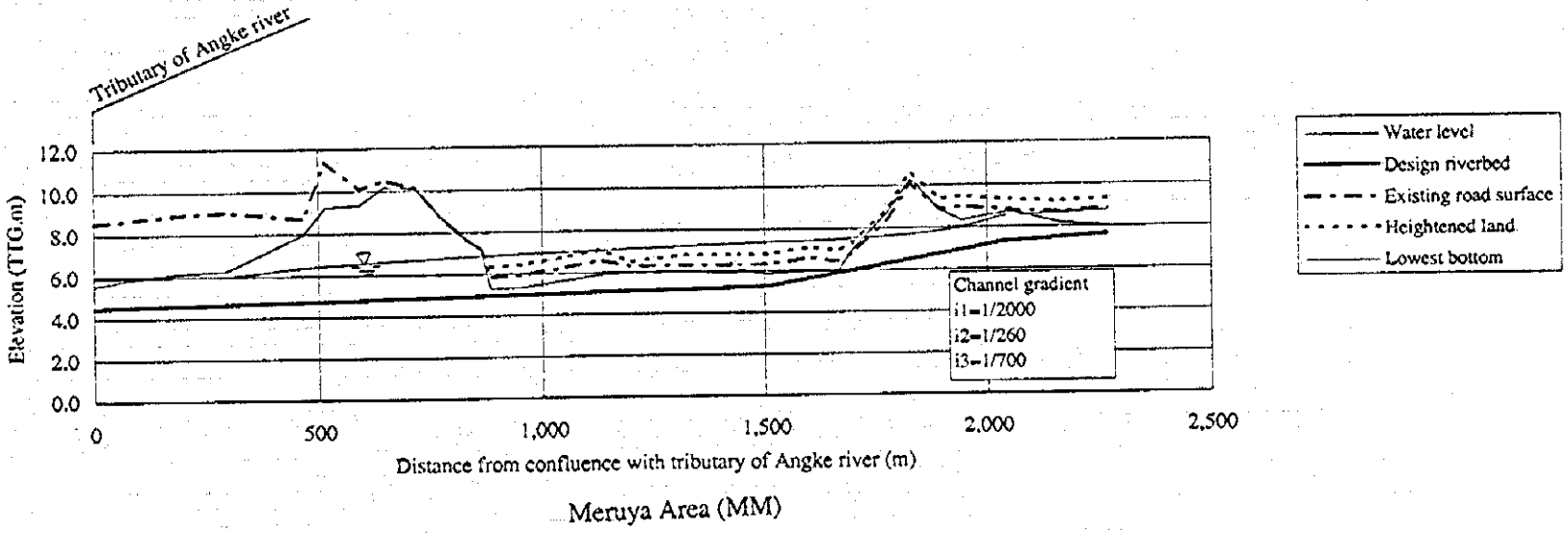
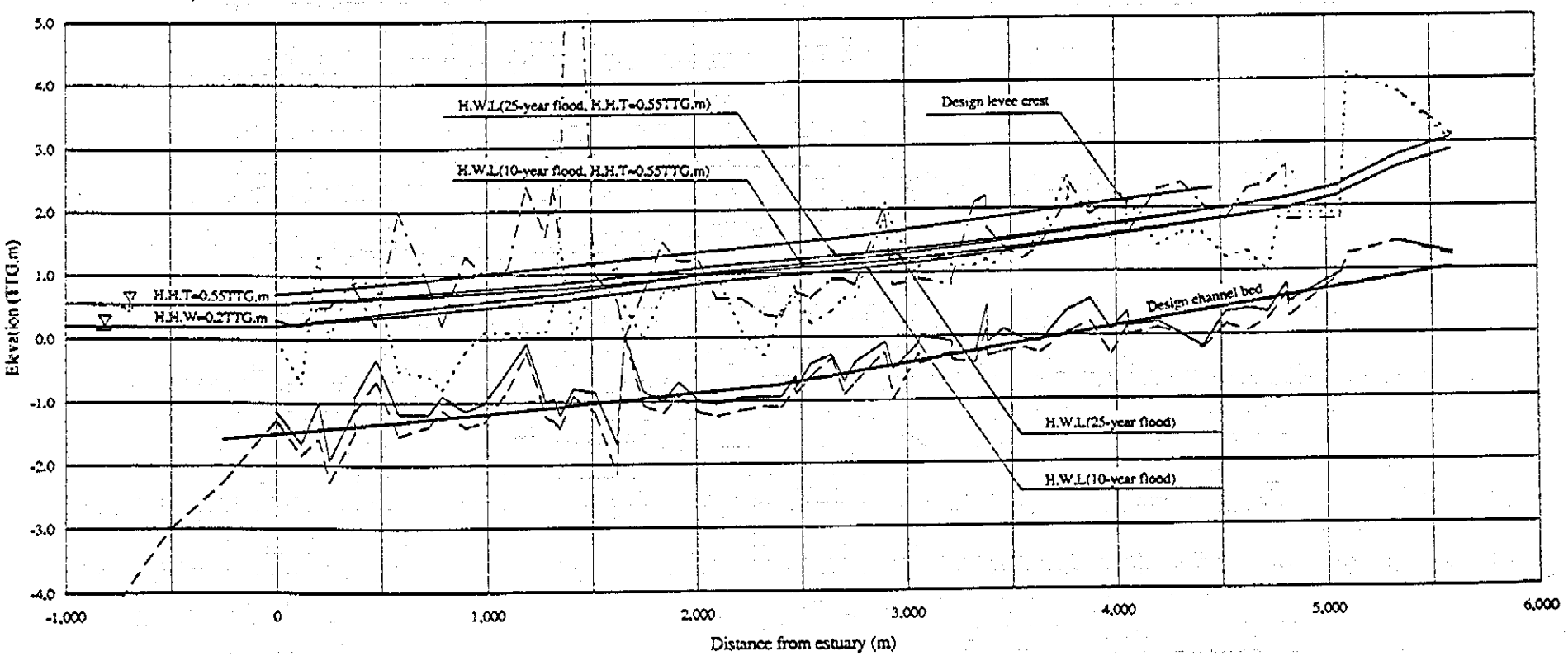


Fig. 2.9 Longitudinal Profile of Proposed Drainage Channel(3/4)



Meruya Area (MM)

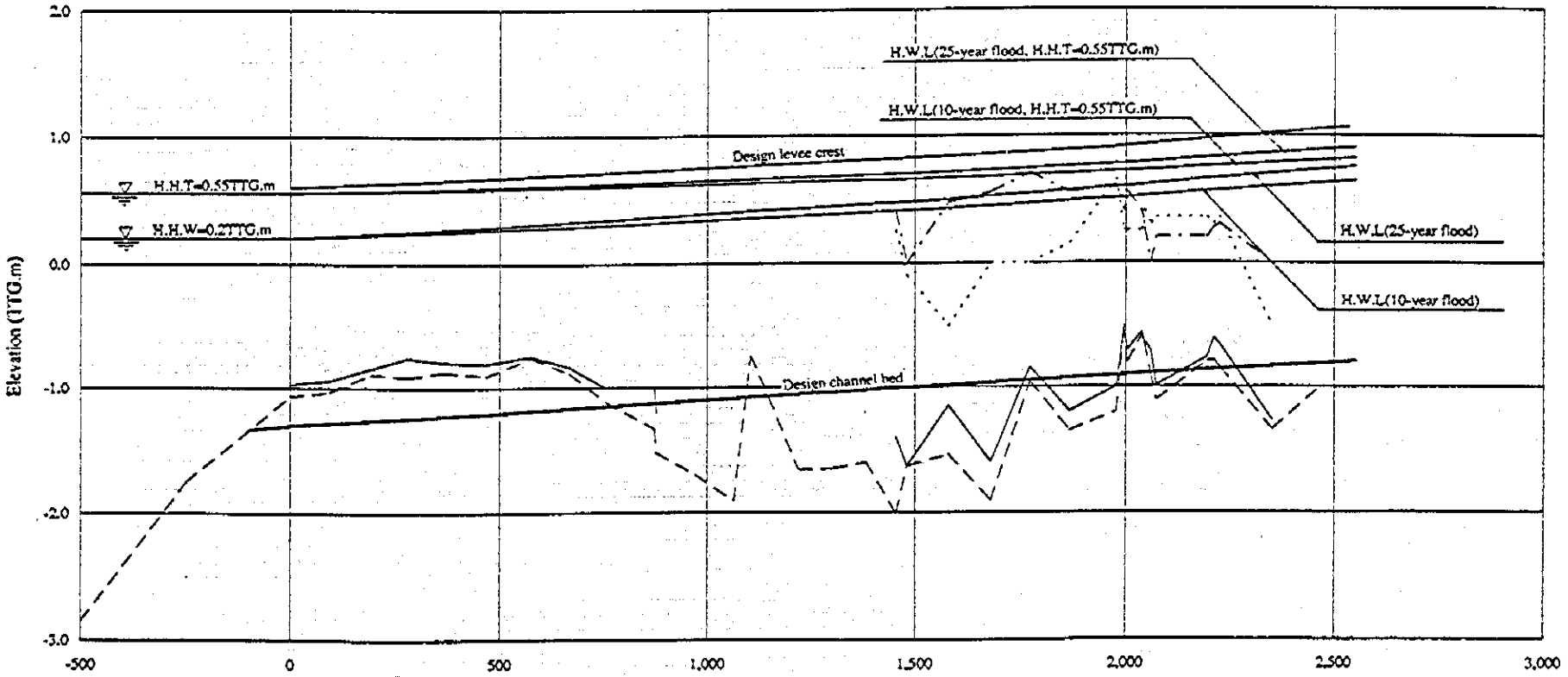
Fig. 2.9 Longitudinal Profile of Proposed Drainage Channel(4/4)



Notes:

H.H.T = past maximun tide(pp+1.54, rounded up at 1.55m)
H.H.W = spring high tide (high high water = PP+1.15m,rounded up at 1.20m)

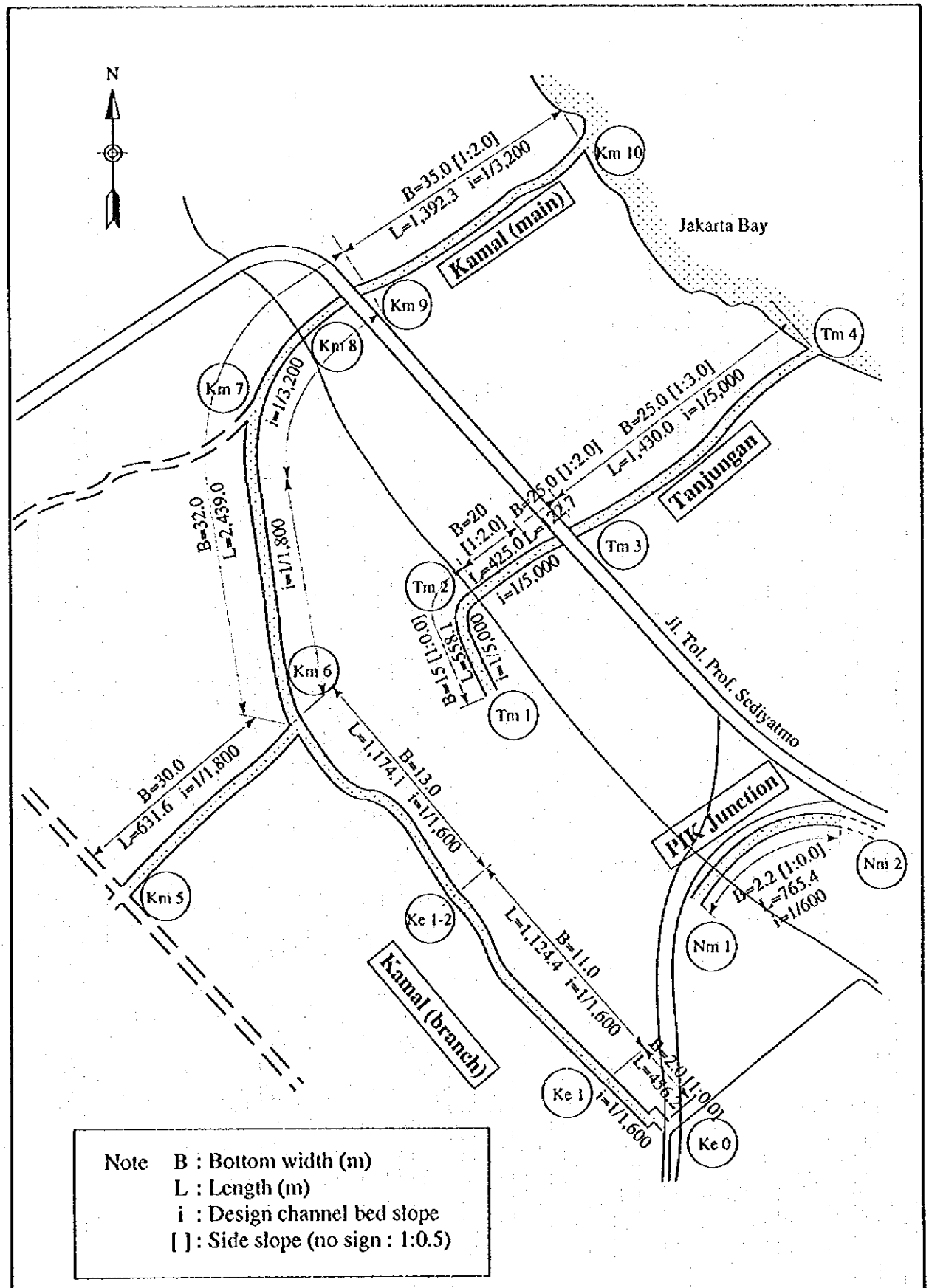
Fig. 2.10 Comparison of Water Surface Profile in Drainage Channel(1/2)
:Kamal Drainage Channel (Main)



Notes:

H.H.T = past maximun tide(pp+1.54, rounded up at 1.55m)
H.H.W = spring high tide (high high water = PP+1.15m,rounded up at 1.20m)

Fig. 2.10 Comparison of Water Surface Profile in Drainage Channel(2/2)
:Tranjungan Drainage Channel



Note B : Bottom width (m)
L : Length (m)
i : Design channel bed slope
[ ] : Side slope (no sign : 1:0.5)

Fig. 2.11 General Plan of Proposed Drainage Channels(1/3)
(Cengkareng West Area, 2/2)

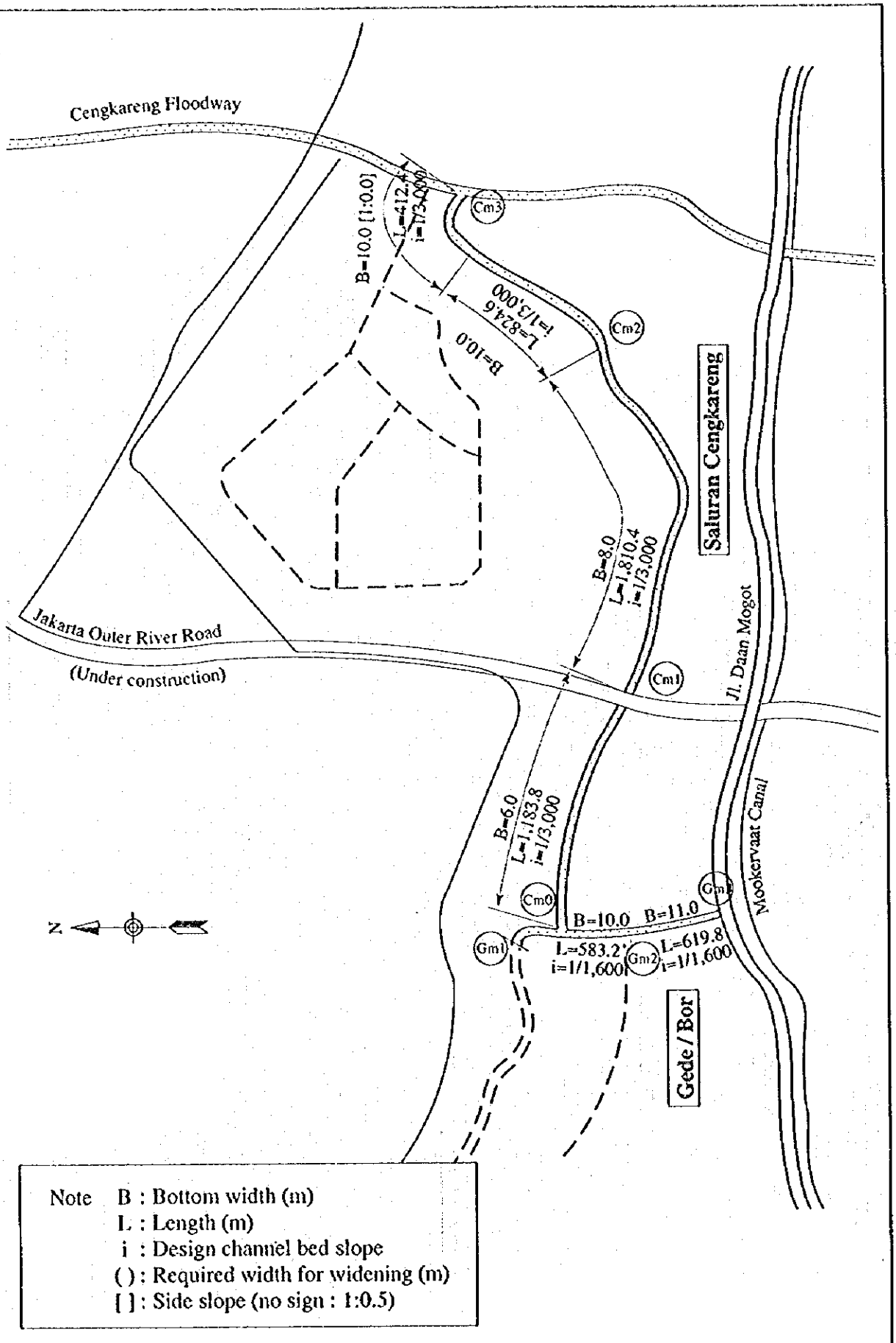


Fig. 2.11 General Plan of Proposed Drainage Channels(2/3)
(Cengkareng West Area,1/2)

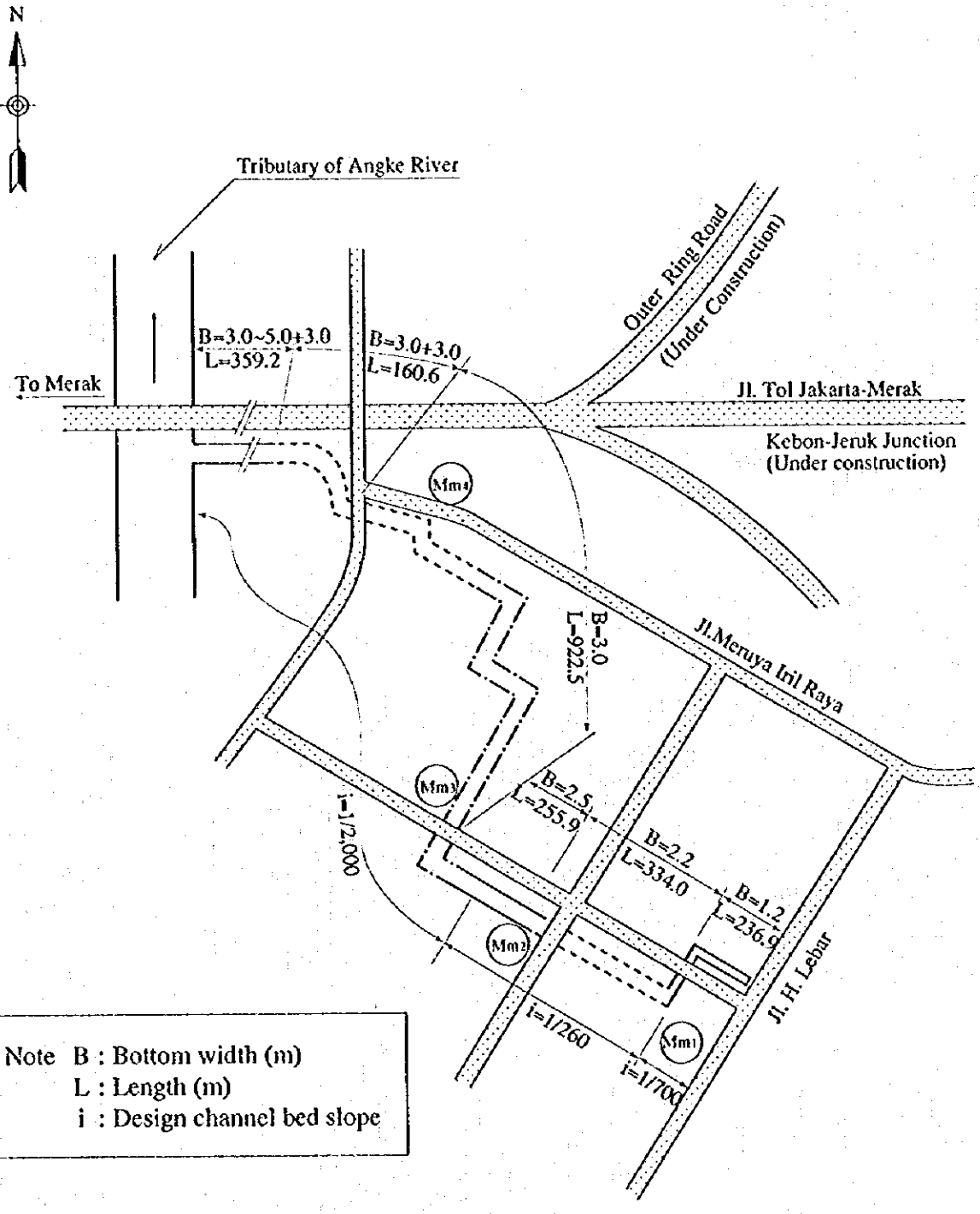


Fig. 2.11 General Plan of Proposed Drainage Channels(3/3)
(Meruya Area)

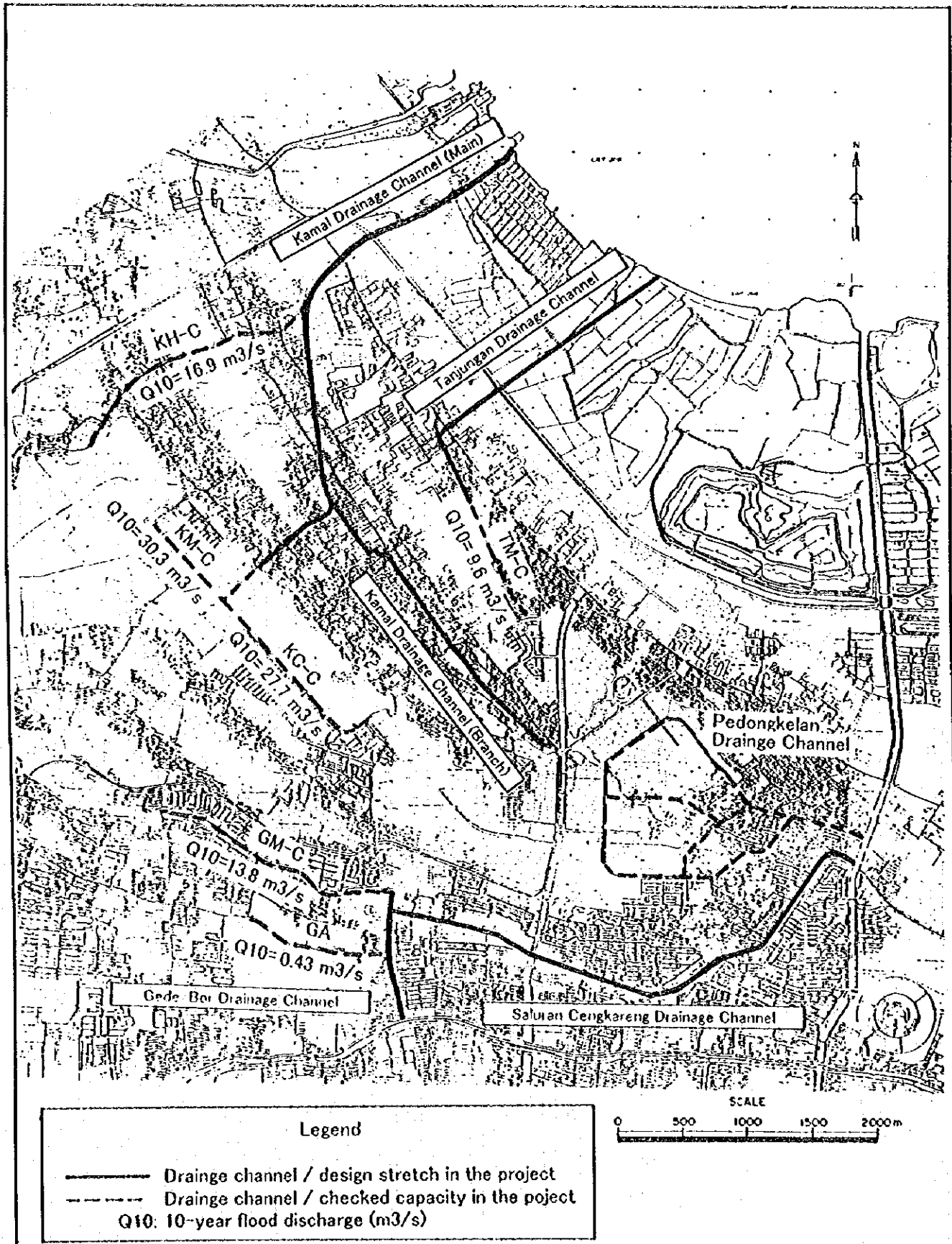


Fig. 2.12 Locations of Drainage Channels for Capacity Check

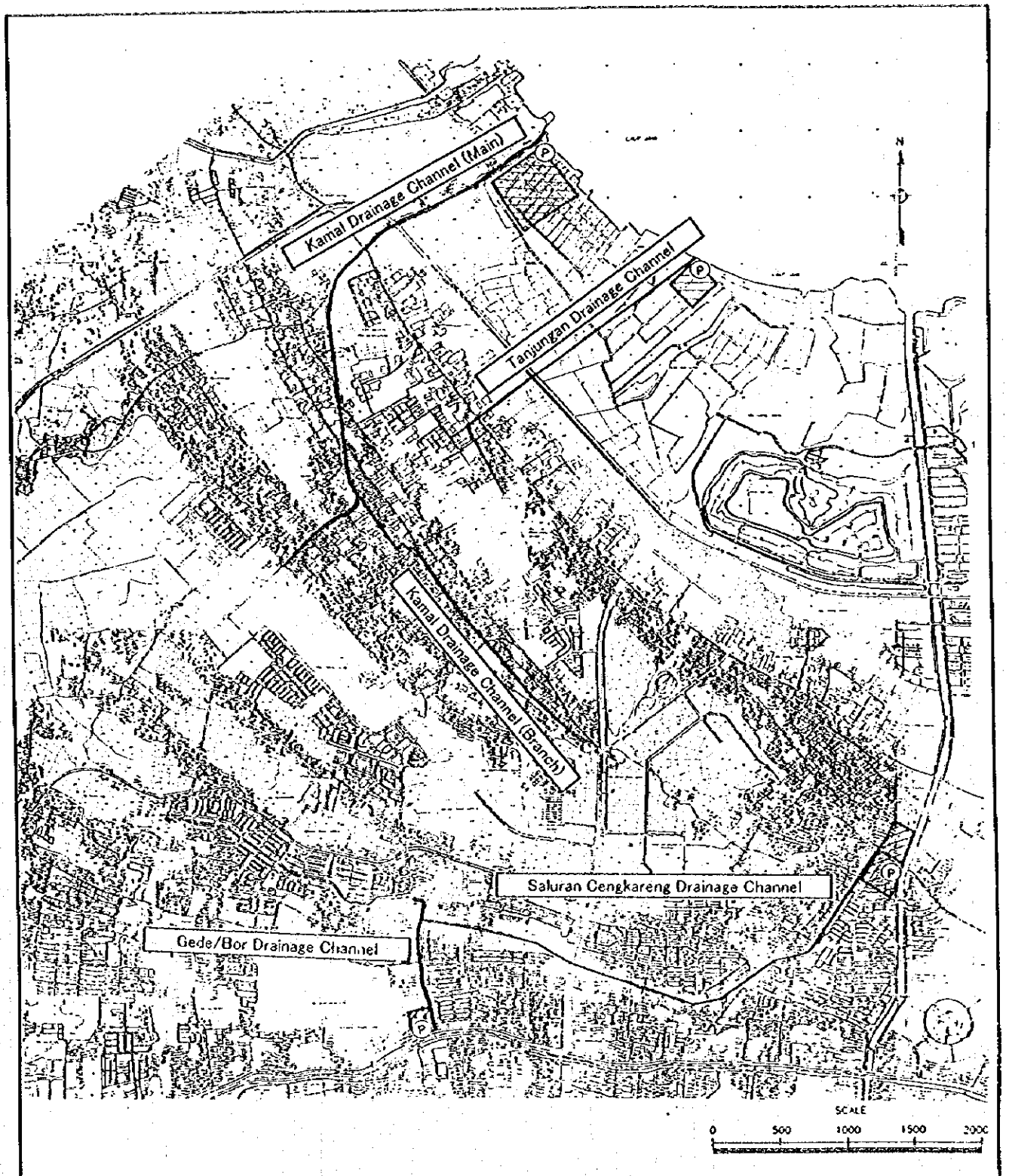


Fig. 2.13 Locations of Regulation Ponds for Pumping System

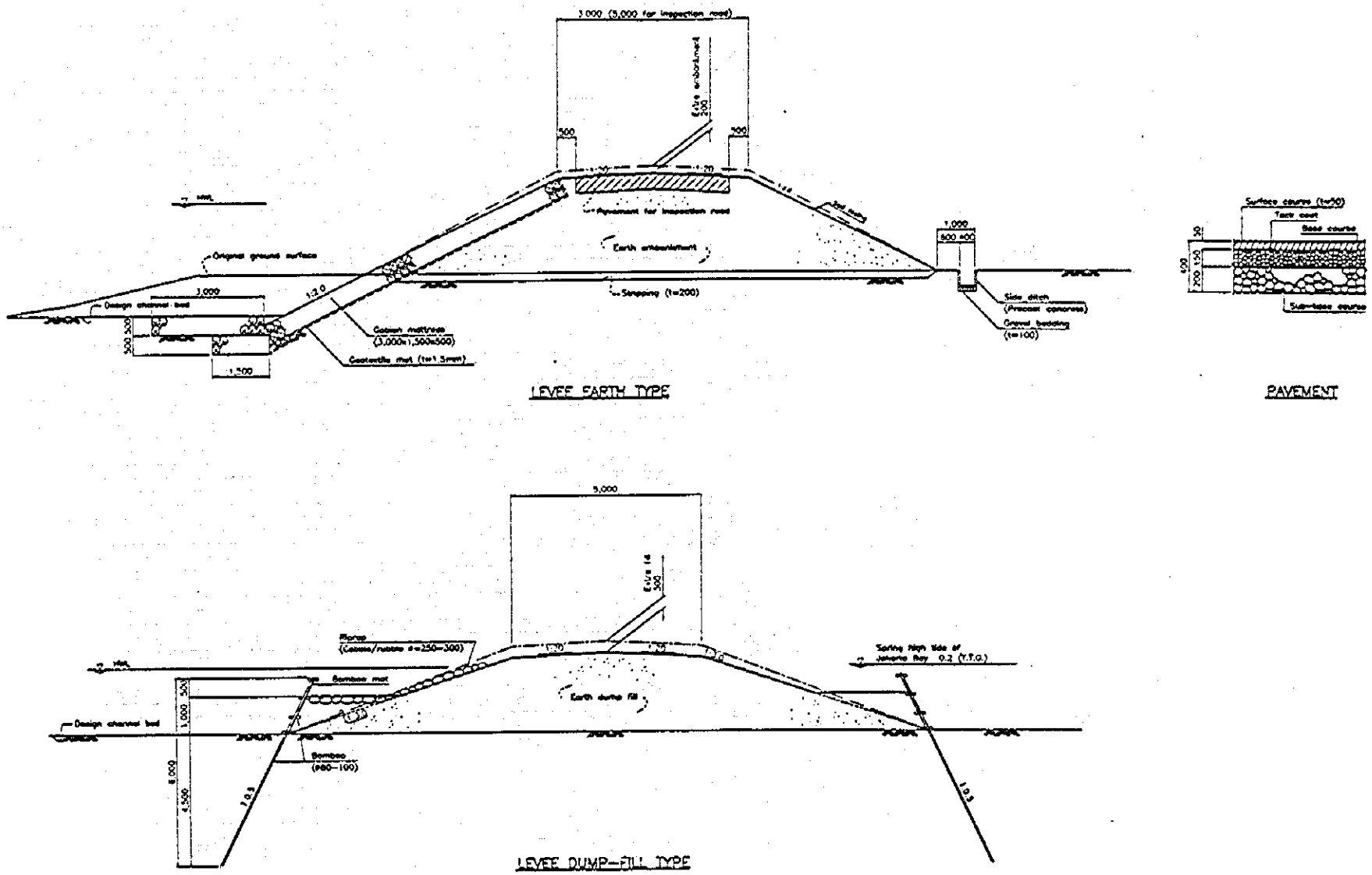


Fig. 3.1 Typical Cross Sections of Levee

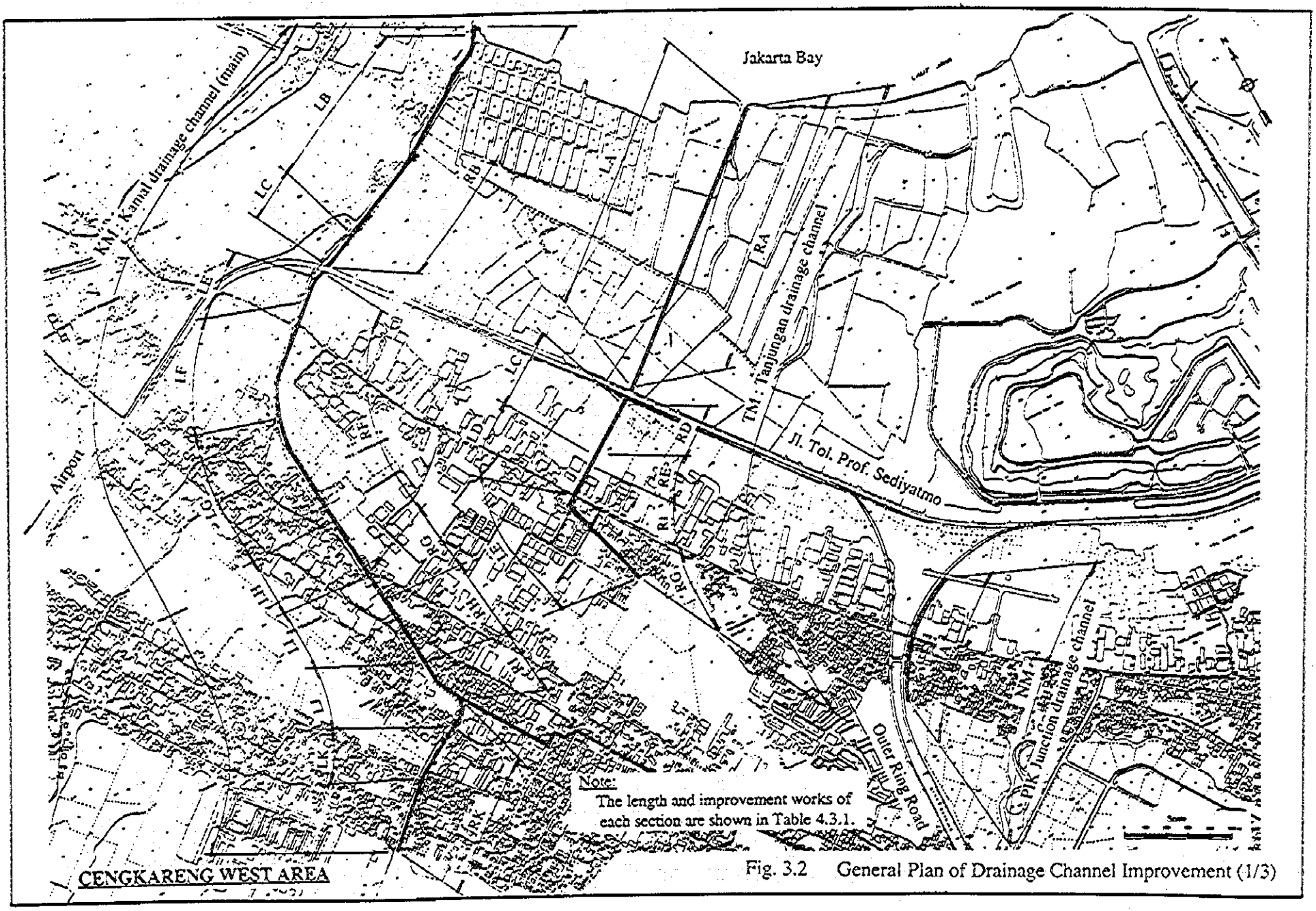


Fig. 3.2 General Plan of Drainage Channel Improvement (1/3)

Fig. 3.2
General Plan of Drainage Channel Improvement (2/3)

Note:
The length and improvement works of each section are shown in Table 4.3.1.

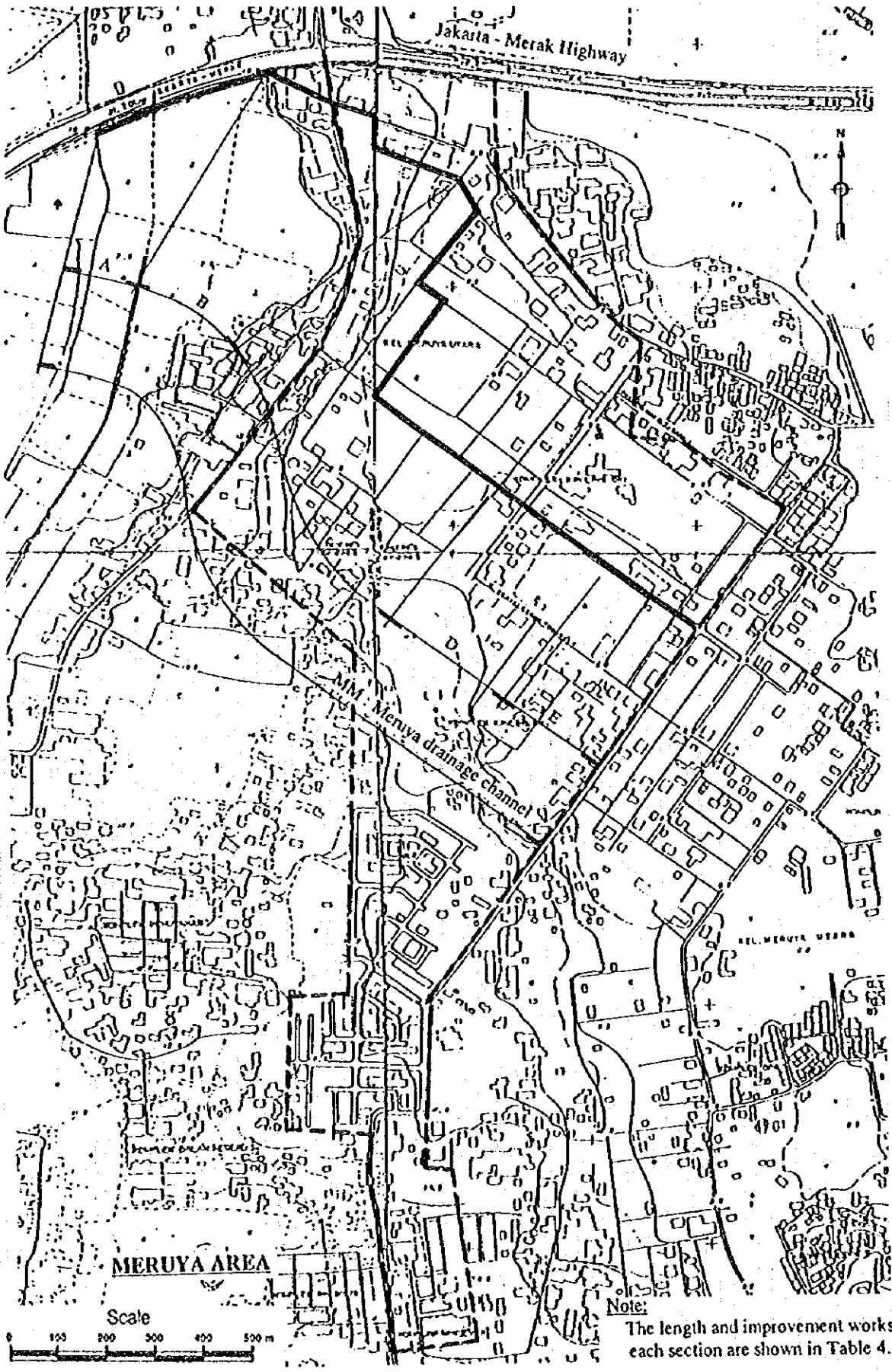


Fig. 3.2 General Plan of Drainage Channel Improvement (3/3).

STABILITY ON EARTH TYPE LEVEE

SCALE 1/ 250

MINIMUM SAFETY FACTOR		=	6.723	
CENTER OF CIRCLE	X	=	1.63	(m)
	Y	=	4.20	(m)
RADIUS	R	=	8.03	(m)
RESISTING MOMENT	M_R	=	631.44	(tf.m)
SLIDING MOMENT	M_O	=	93.93	(tf.m)

LAYER NUMBER	SATURATED UNIT WEIGHT (tf/m ^{3})	WET UNIT WEIGHT (tf/m ^{3})	INTERNAL FRICTION ANGLE (DEGREE)	COHESION (tf/m ^{2})	RATE OF INCREASE OF COHESION	HORIZONTAL SEISMIC COEFFICIENT	VERTICAL SEISMIC COEFFICIENT
1	1.700	1.700	8.00	4.00	0.00	0.000	0.000
2	1.800	1.800	27.00	4.00	0.00	0.000	0.000

UNIT WEIGHT OF WATER = 1.000 (tf/m ^{3})

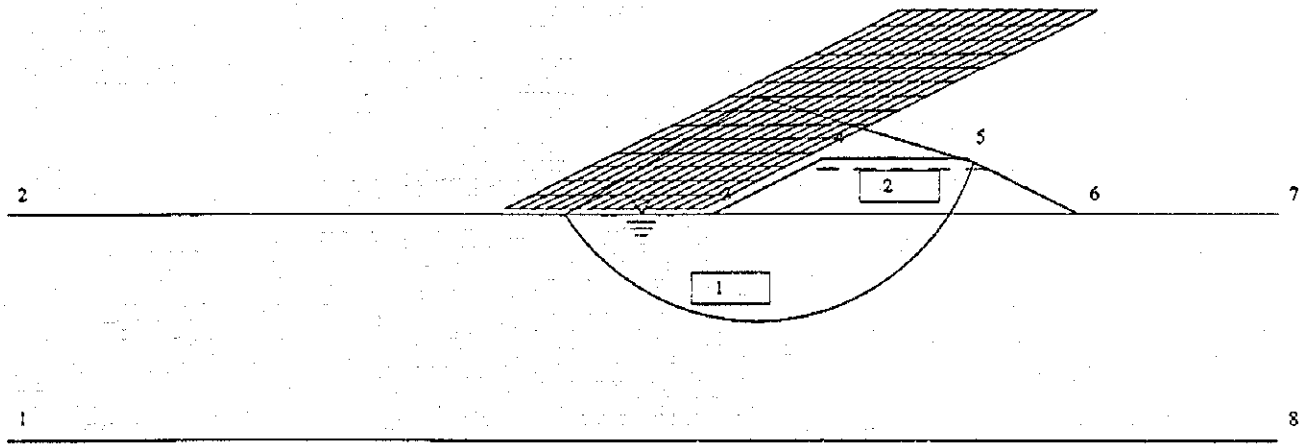


Fig. 3.3 Stability Analysis of Levee

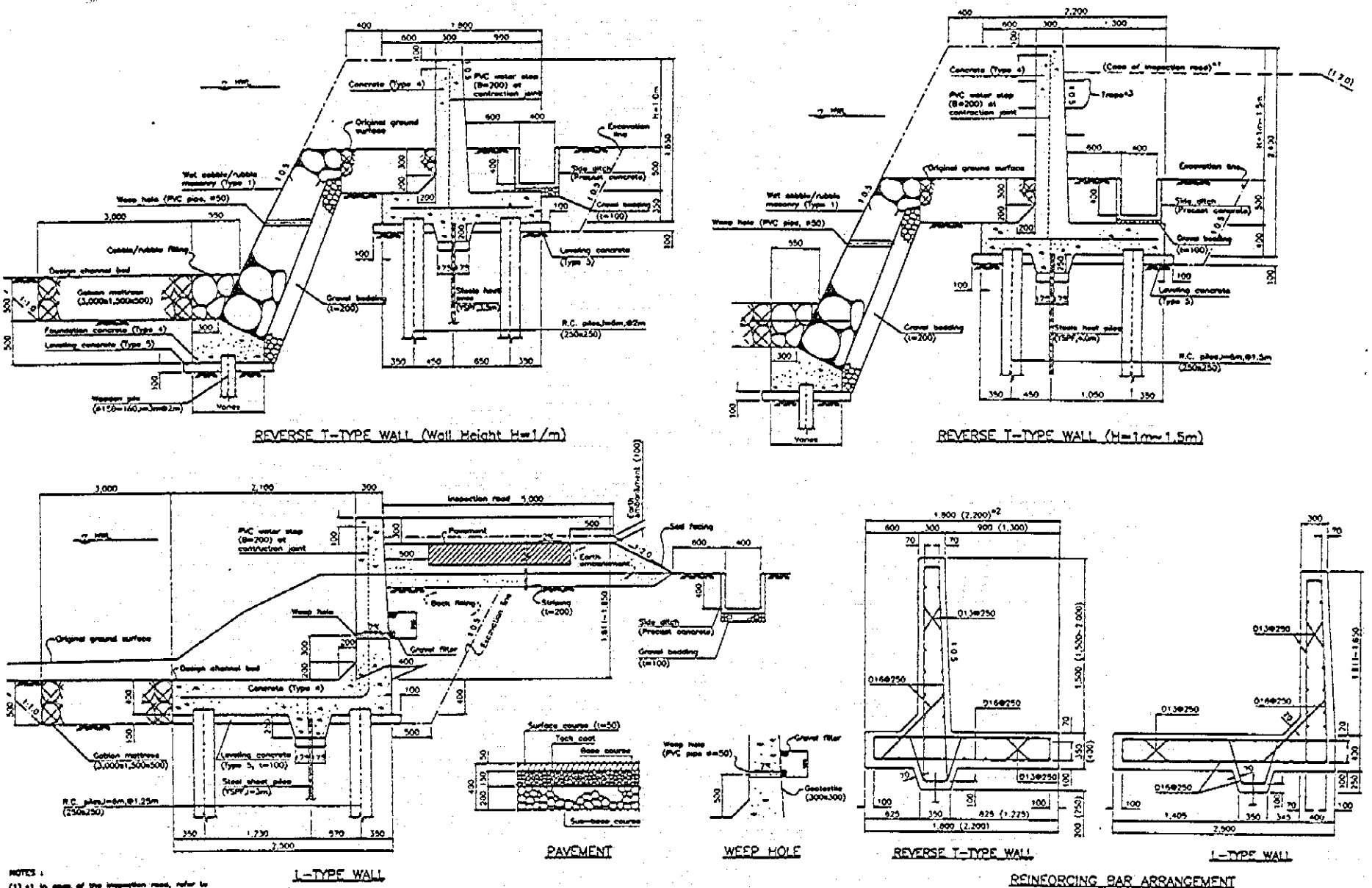
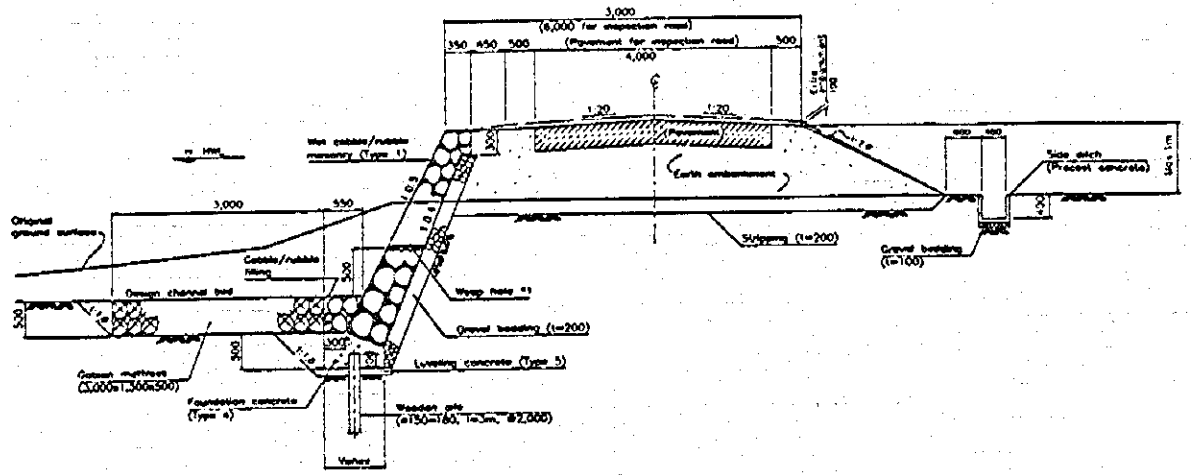
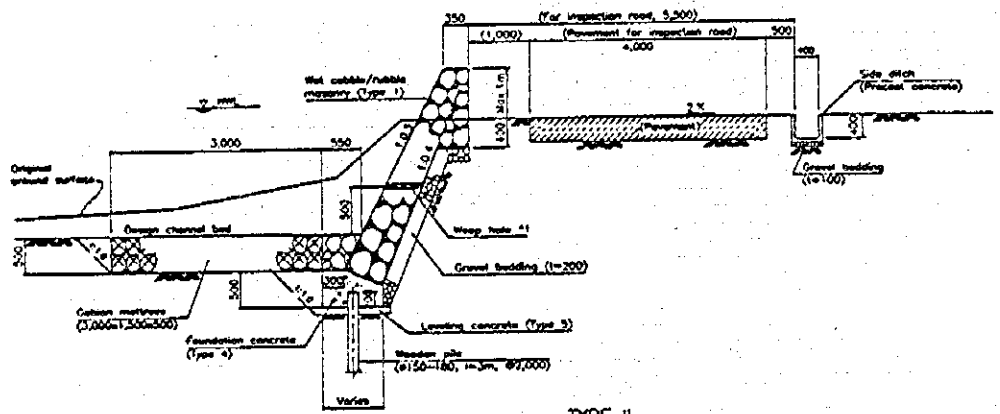


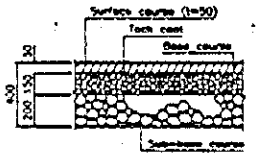
Fig. 3.4 Typical Cross Sections of Parapet Wall



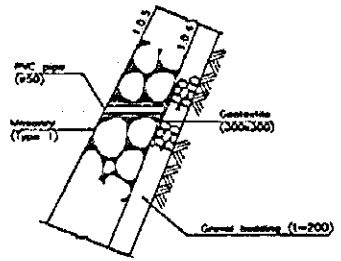
TYPE I



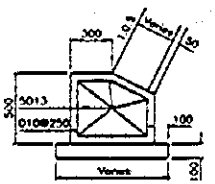
TYPE II



PAVEMENT



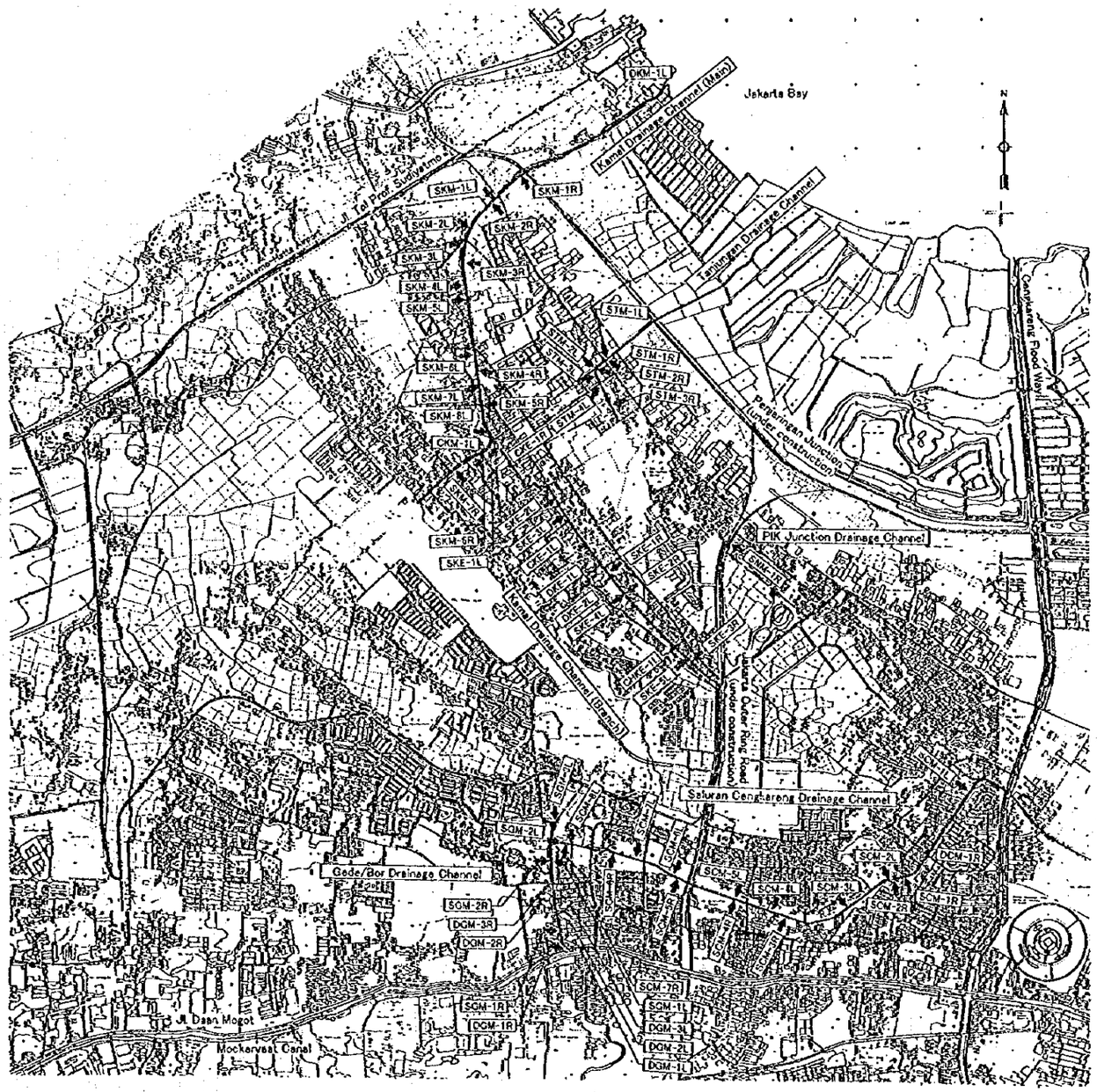
WEEP HOLE



FOUNDATION CONCRETE

NOTE :
*1 One weep hole shall be provided every 4m² of the masonry surface.

Fig. 3.5 Typical Cross Sections of Revetment



CENGKARENG WEST AREA

SCALE
0 500 1000 1500 2000m

MERUYA AREA

SLUICEWAY AND DRAIN-DITCH

Left Bank			Right Bank		
No.	Facilities	Location*	No.	Facilities	Location*
Kanal Drainage Channel (main)					
OKM-1L	Ditch	KM01+24m	SKM-1R	Sluiceway	KM17-20m
SKM-1L	Sluiceway	KM20+18m	SKM-2R	Sluiceway	KM21+ 0m
SKM-2L	Sluiceway	KM24+35m	SKM-3R	Sluiceway	KM27+42m
SKM-3L	Sluiceway	KM28+ 2m	SKM-4R	Sluiceway	KM40+32m
SKM-4L	Sluiceway	KM28+10m	SKM-5R	Sluiceway	KM45+ 6m
SKM-5L	Sluiceway	KM31+56m	SKM-6R	Sluiceway	KM50+31m
SKM-6L	Sluiceway	KM38+ 3m	SKM-7R	Sluiceway	KM54-26m
SKM-7L	Sluiceway	KM42+ 7m			
SKM-8L	Sluiceway	KM46+35m			
OKM-1L	Culvert	KM52- 2m			
Kanal Drainage Channel (branch)					
SKE-1L	Sluiceway	KE01+ 5m	CKE-1R	Culvert	KE01+ 5m
SKE-2L	Sluiceway	KE12-92m	SKE-1R	Sluiceway	KE21+ 5m
SKE-3L	Sluiceway	KE13+ 0m	SKE-2R	Sluiceway	KE25- 0m
CKE-1L	Culvert	KE15- 8m	SKE-3R	Sluiceway	KE31+ 0m
DKE-1L	Ditch	KE18+54m			
DKE-2L	Ditch	KE21-37m			
SKE-4L	Sluiceway	KE25- 5m			
CDKE-1L	Channel	KE30-10m			
SKE-5L	Sluiceway	KE31-45m			
Tanjungan Drainage channel					
STM-1L	Sluiceway	TM25-33m	STM-1R	Sluiceway	TM25-13m
STM-2L	Sluiceway	TM30-10m	STM-2R	Sluiceway	TM30+ 3m
STM-3L	Sluiceway	TM30+18m	STM-3R	Sluiceway	TM35+ 0m
STM-4L	Sluiceway	TM33+13m			

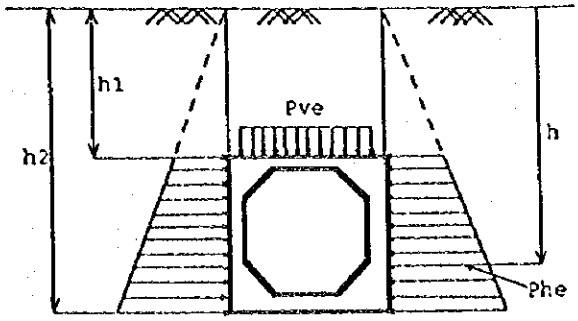
Left Bank			Right Bank		
No.	Facilities	Location*	No.	Facilities	Location*
Gede /Bor Drainage Channel					
DGM-1L	Ditch	GM04-49m	DGM-1R	Ditch	GM03+ 0m
DGM-2L	Ditch	GM06-37m	DGM-1R	Sluiceway	GM04+48m
DGM-3L	Ditch	GM06-28m	DGM-2R	Ditch	GM06+33m
SGM-1L	Sluiceway	GM12+ 0m	DGM-3R	Ditch	GM08-41m
SGM-2L	Sluiceway	GM14- 5m	SGM-2R	Sluiceway	GM12+ 0m
SGM-3L	Sluiceway	GM15+24m			
Saluran Cengkareng Drainage Channel					
SCM-1L	Sluiceway	CM05- 5m	DCM-1R	Ditch	CM09-86m
SCM-2L	Sluiceway	CM18+12m	SCM-1R	Sluiceway	CM15-10m
SCM-3L	Sluiceway	CM20+10m	SCM-2R	Sluiceway	CM18- 4m
SCM-4L	Sluiceway	CM23-21m	SCM-3R	Sluiceway	CM28+ 1m
SCM-5L	Sluiceway	CM30+ 0m	SCM-4R	Sluiceway	CM30+ 0m
SCM-6L	Sluiceway	CM37+30m	SCM-5R	Sluiceway	CM37+ 0m
SCM-7L	Sluiceway	CM41+ 0m	SCM-6R	Sluiceway	CM43-30m
SCM-8L	Sluiceway	CM47+34m	SCM-7R	Sluiceway	CM47+53m
PIK Junction Drainage Channel					
			SKM-1R	Sluiceway	KM34+ 0m

Note: * Based on cross section No. in topographic survey

LEGEND
- Boundary of project area
- Basin boundary (dainage channel)
- Basin boundary (sluiceway, drain-ditch)
- Sluiceway
- Culvert, Ditch or Channel

Fig. 3.6 Locations of Sluiceways and Drain-ditches

Earth pressure



$$Pve = r \cdot h1$$

$$Phe = Ko \cdot r \cdot h$$

where, Pve : vertical earth pressure at rest (t/m^2)

Phe : horizontal erath pressure at rest (t/m^2)

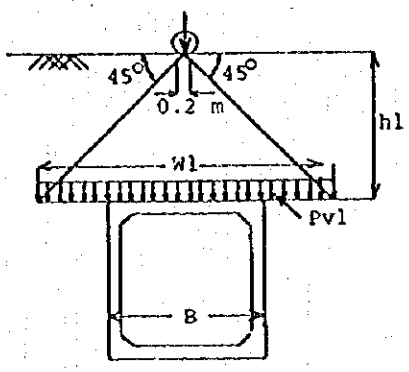
Ko : coeffiecient of earth pressure at rest (= 0.5)

r : unit weight of embankment soil material (t/m^3)

h1 : depth from embankment surface to top slab of culvert (m)

h : depth from embankment surface (m)

Live load



$$Pvl = Pl+i / Wl = Pl+i / (2 \cdot hl + 0.2)$$

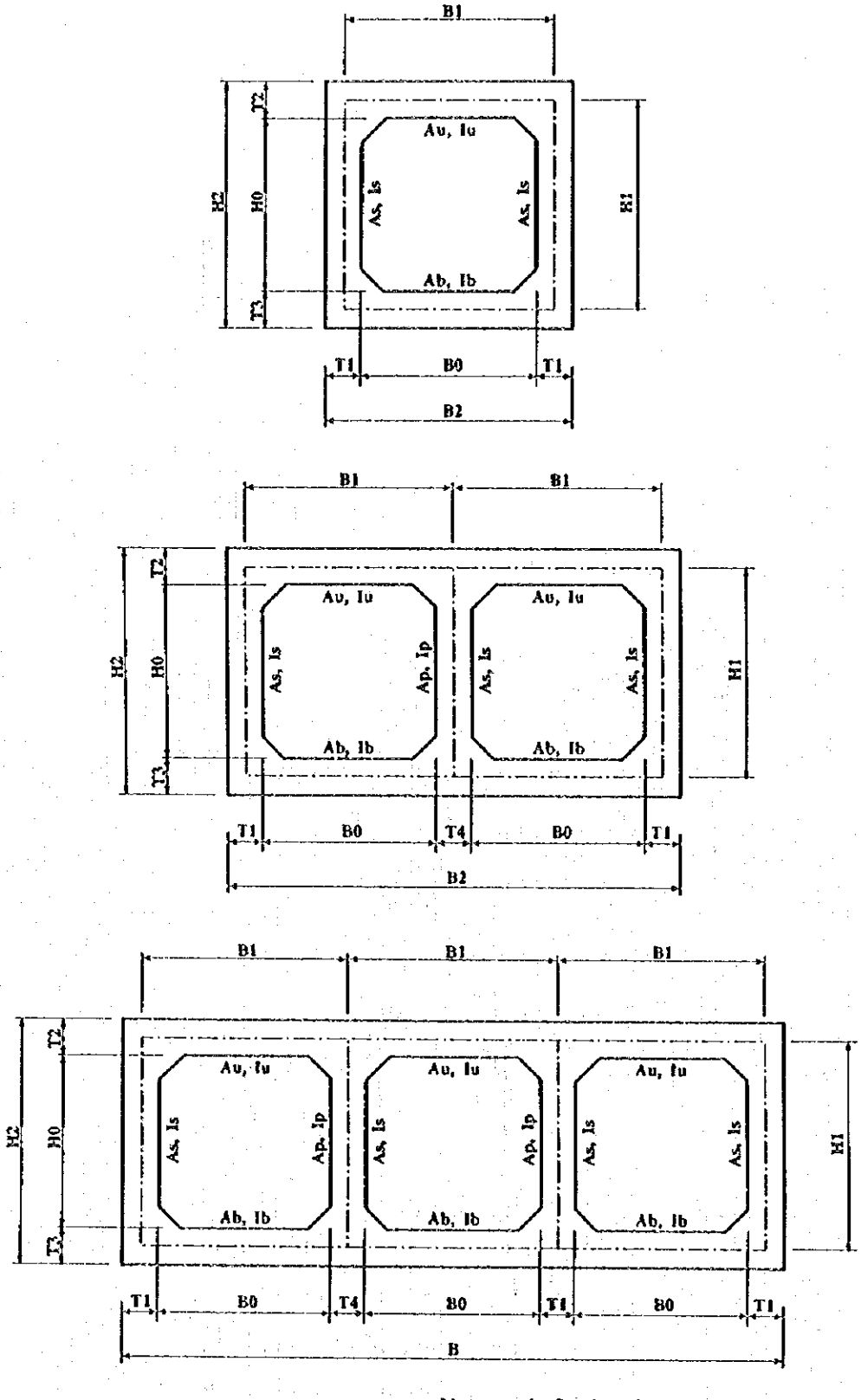
where, Pvl : live load due to track (t/m2)

Pl+i : unit load of rear tires of track (t/m)

Wl : distribution width of live load (m)

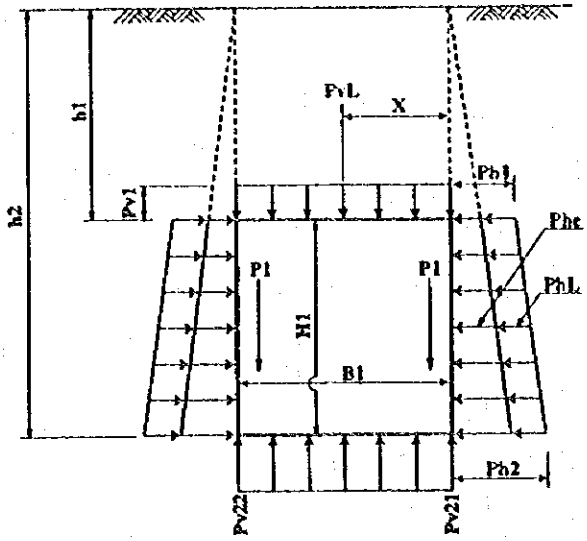
hl : depth from embankment surface (m)

Fig. 3.7 Design Load for Transverse Section of Sluiceway Conduit



Note: A: Section Area
I: Geometrical Moment of Inertia

Fig. 3.8 Structural Dimension of Transverse Section of Sluiceway conduit for Stress Analysis



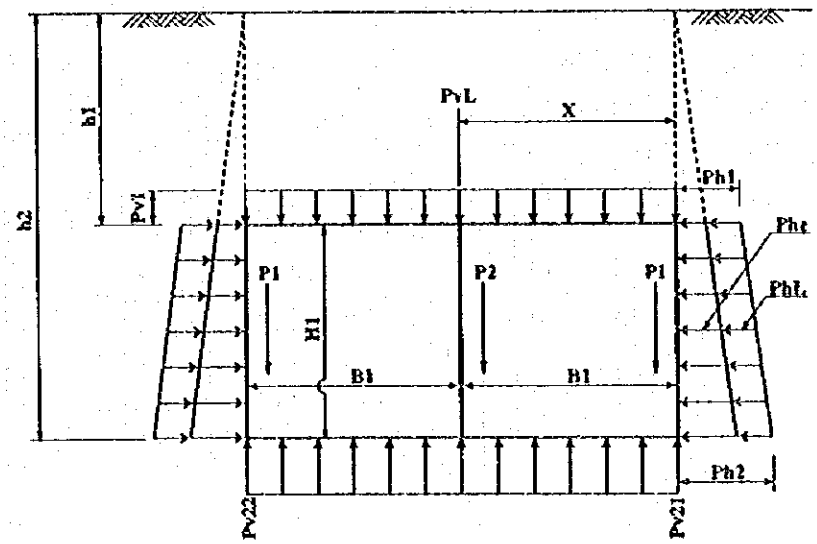
$$Pv1 = Pve + \frac{Dl}{B1}$$

$$Ph1 = Ko\,(r.h1 + 1.0)$$

$$Ph2 = Ko\,(r.h2 + 1.0)$$

$$Ko = 0.5$$

$$P1 = \frac{Ds}{2}$$



$$Pv1 = Pve + \frac{Dl}{2B1}$$

$$Ph1 = Ko\,(r.h1 + 1.0)$$

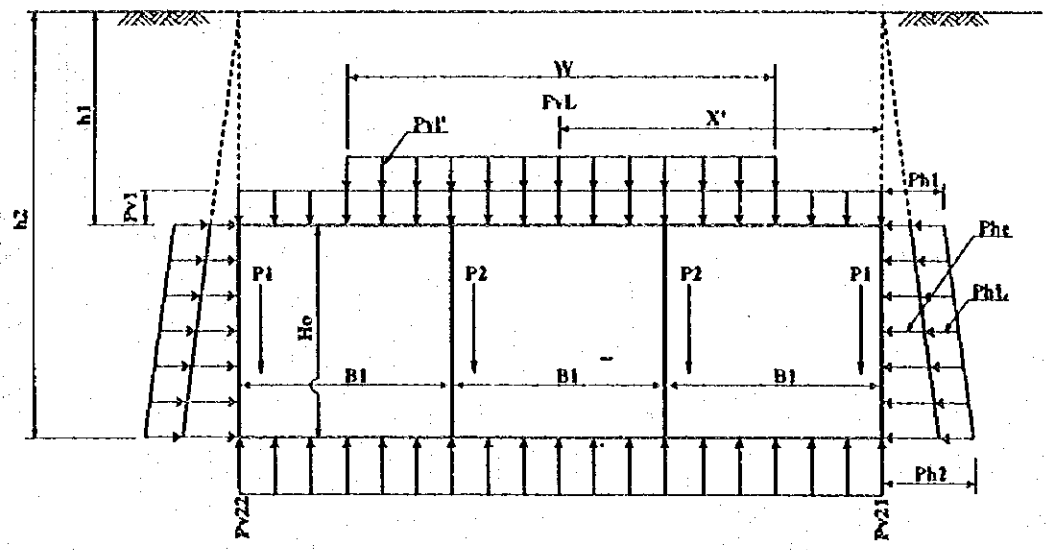
$$Ph2 = Ko\,(r.h2 + 1.0)$$

$$Ko = 0.5$$

$$P1 = \frac{Ds}{2}$$

$$P2 = D\rho$$

Fig. 3.9 Combination of Design Loads for Stress Analysis on Transverse Section of Sluiceway Conduit (1/2)



$$Pv1 = Pve + \frac{Dt}{3B1}$$

$$Ph1 = Ko\,(r.h1 + 1.0)$$

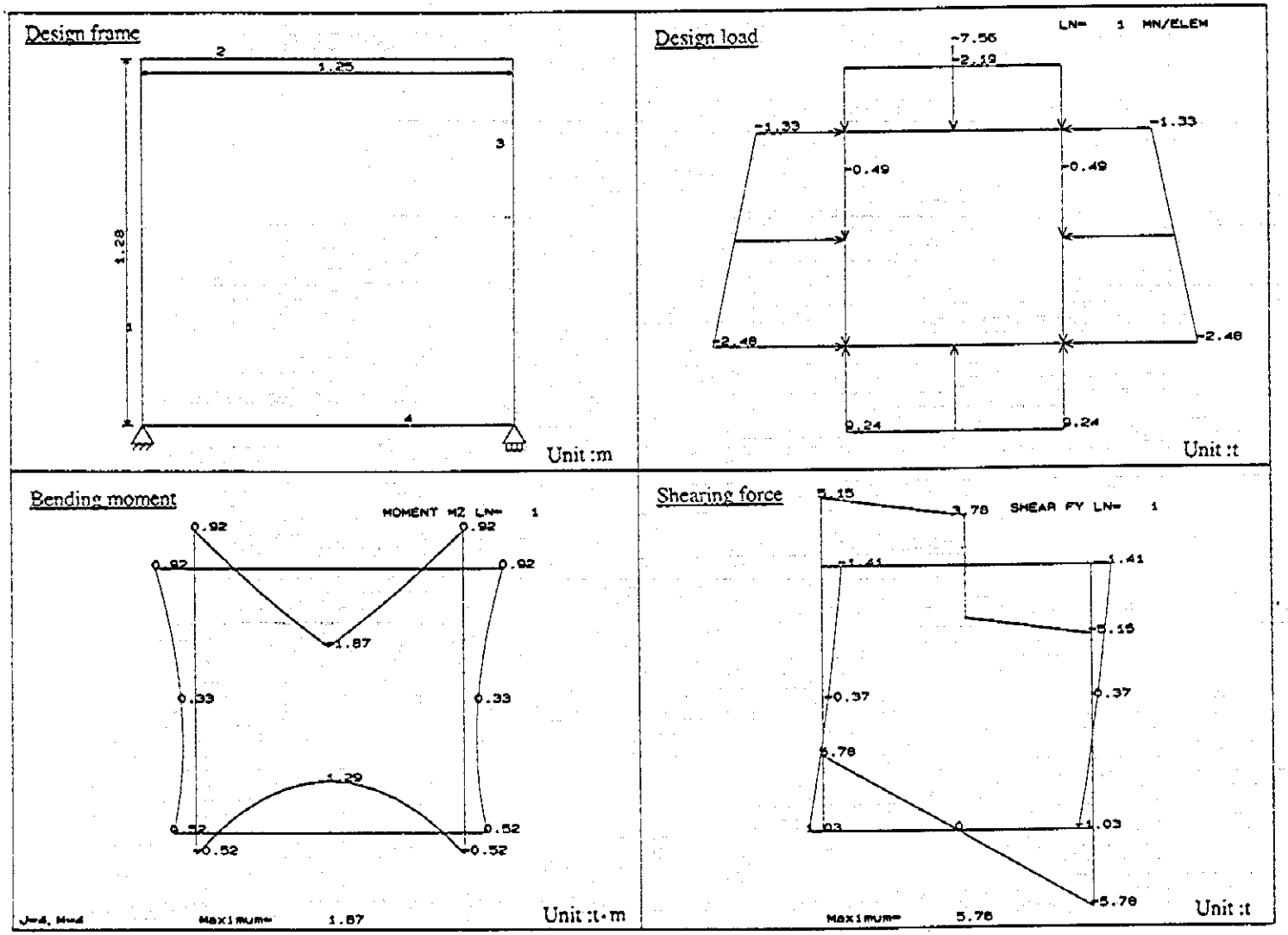
$$Ph2 = Ko\,(r.h2 + 1.0)$$

$$Ko = 0.5$$

$$P1 = \frac{Ds}{2}$$

$$P2 = \frac{Dp}{2}$$

Fig. 3.9 Combination of Design Loads for Stress Analysis on Transverse Section of Sluiceway Conduit (2/2)



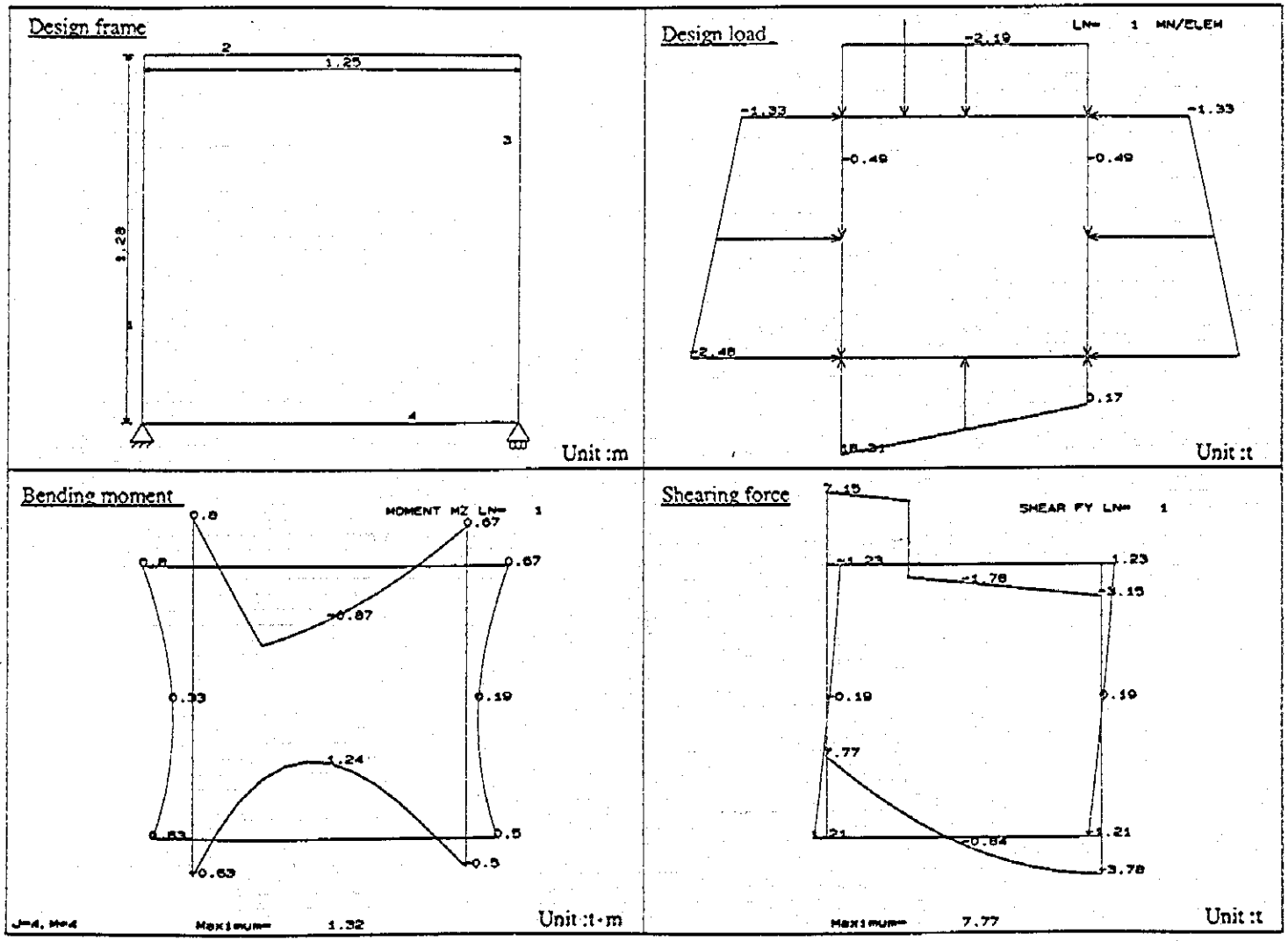
I. 1 lane sluiceway

1-1 Category 1
(Conduit size:1.0×1.0)

Load : Case1*

Note: * See Table

Fig. 3.10 Stress Analysis on Transverse Section of Sluiceway Conduit (1/12)



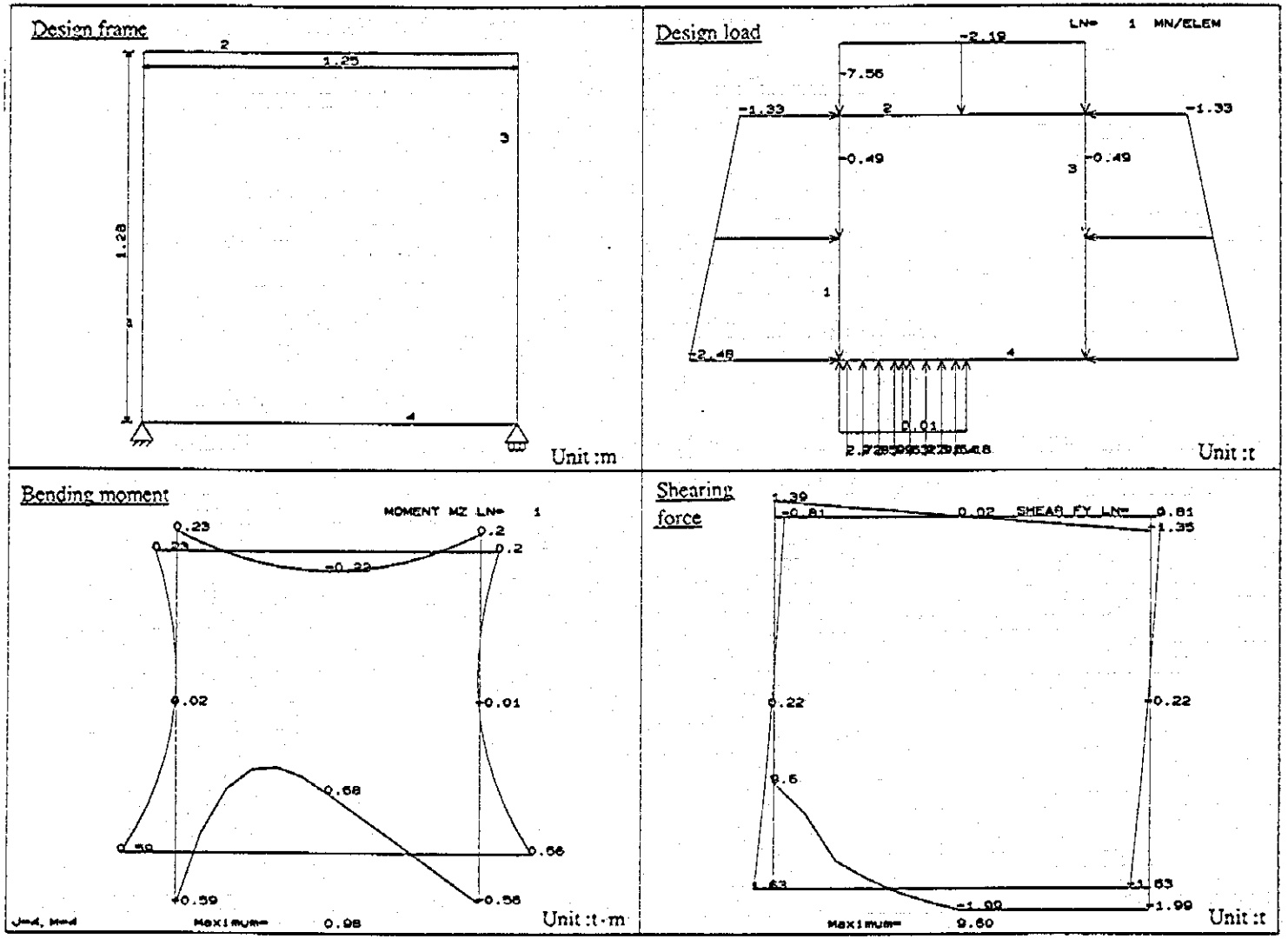
I. 1 lane sluiceway

1-1 Category 1
(Conduit size:1.0×1.0)

Load : Case2*

Note: * See Table

Fig. 3.10 Stress Analysis on Transverse Section of Sluiceway Conduit (2/12)



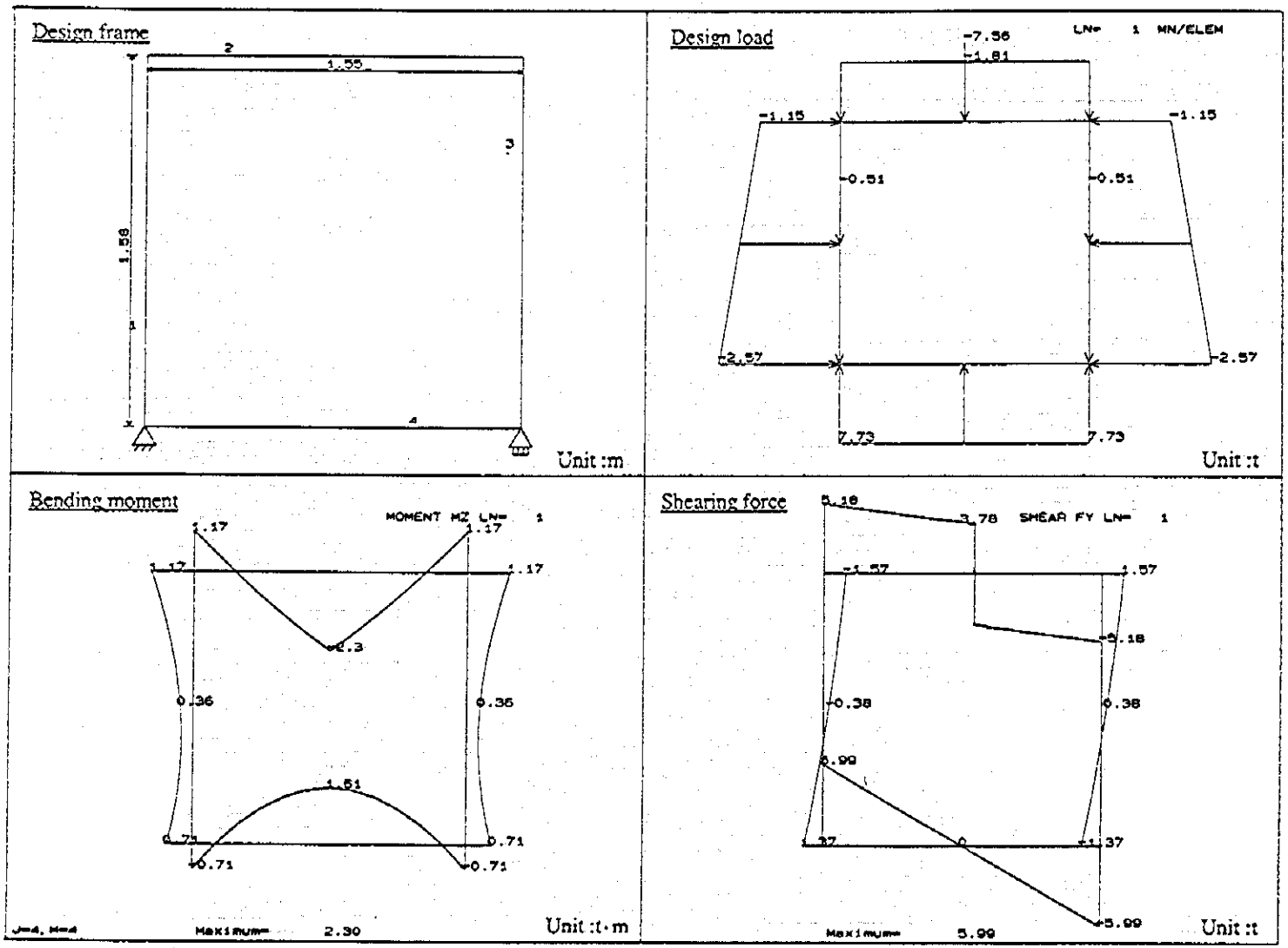
I. 1 lane sluiceway

1-1 Category I
(Conduit size:1.0×1.0)

Load : Case3*

Note: * See Table

Fig. 3.10 Stress Analysis on Transverse Section of Sluiceway Conduit (3/12)



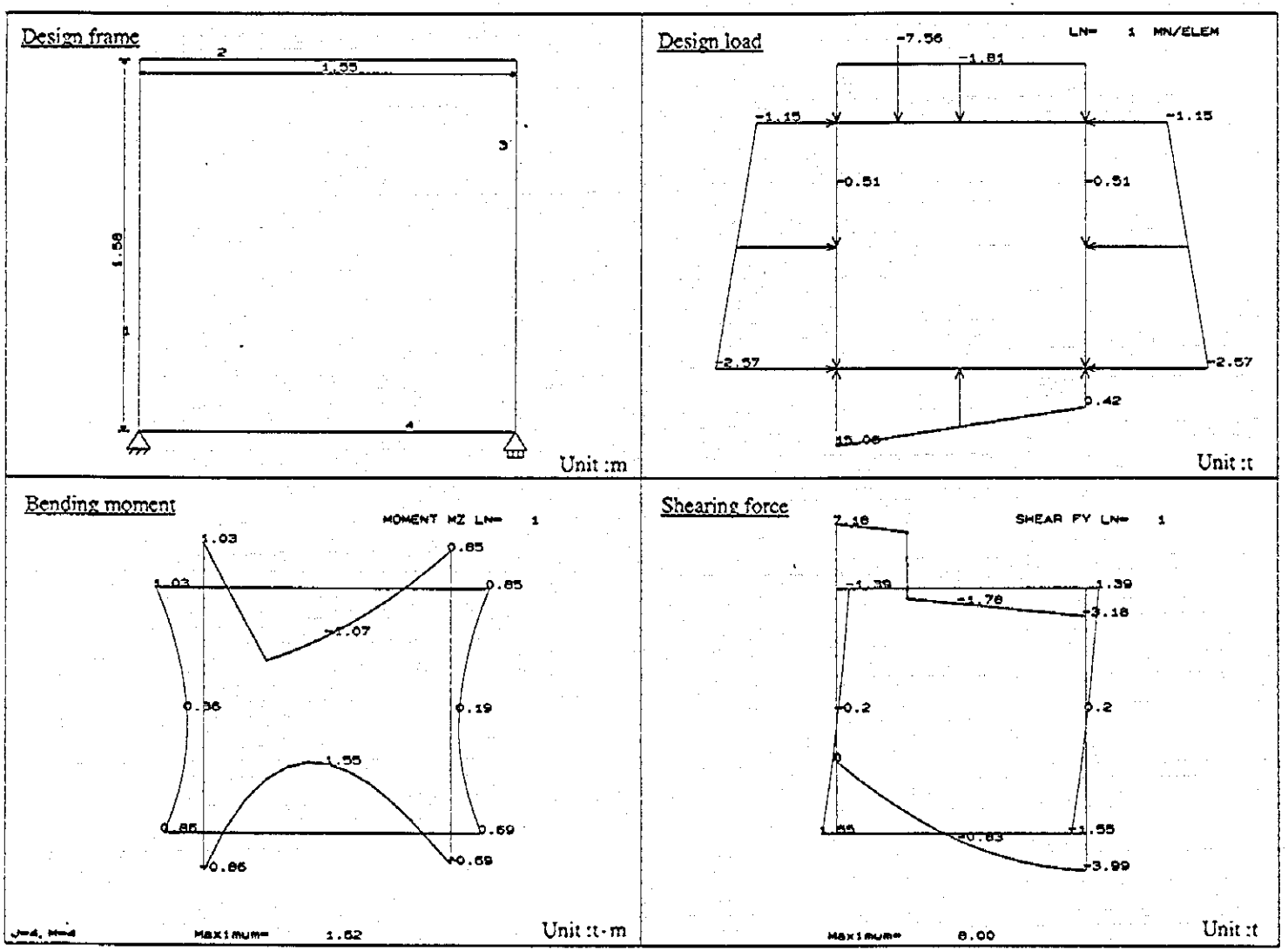
I. 1 lane sluiceway

1-2 Category 2
(Conduit size:1.3×1.3)

Load : Case1*

Note: * See Table

Fig. 3.10 Stress Analysis on Transverse Section of Sluiceway Conduit (4/12)



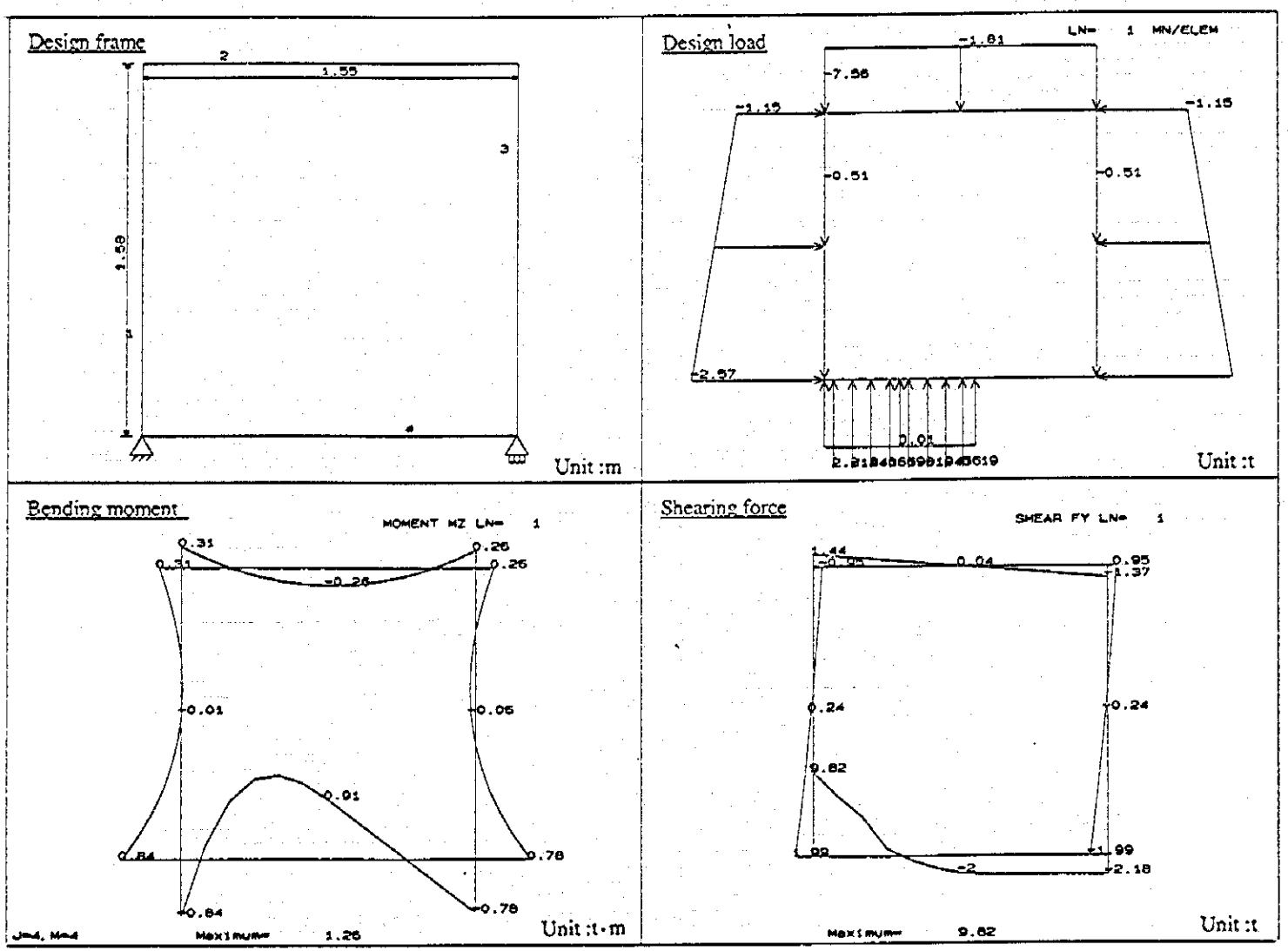
I. 1 lane sluiceway

1-2 Category 2
(Conduit size:1.3×1.3)

Load : Case2*

Note: * See Table

Fig. 3.10 Stress Analysis on Transverse Section of Sluiceway Conduit (5/12)



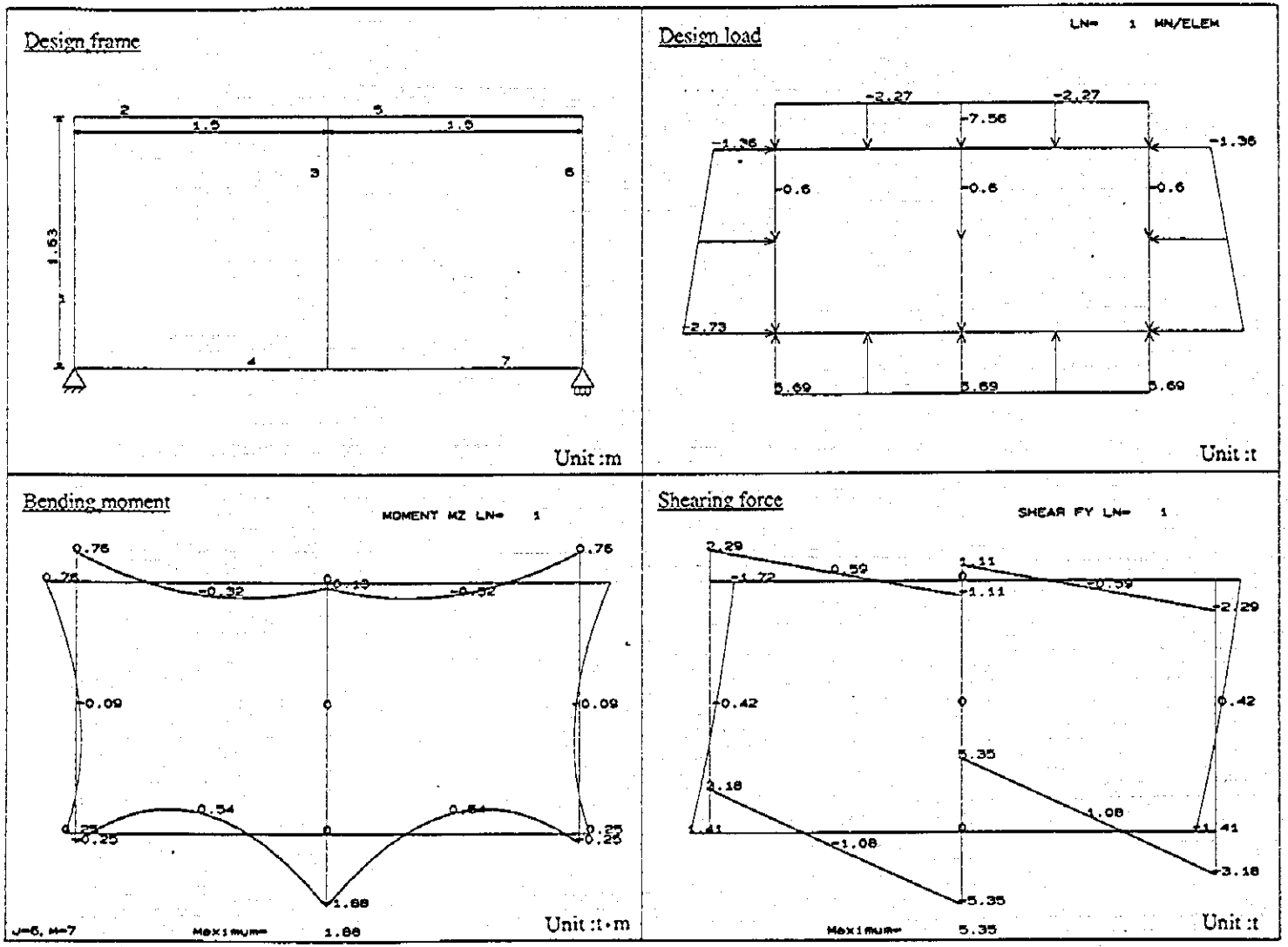
I. 1 lane sluiceway

1-3 Category 2
(Conduit size:1.3×1.3)

Load : Case3*

Note: * See Table

Fig. 3.10 Stress Analysis on Transverse Section of Sluiceway Conduit (6/12)



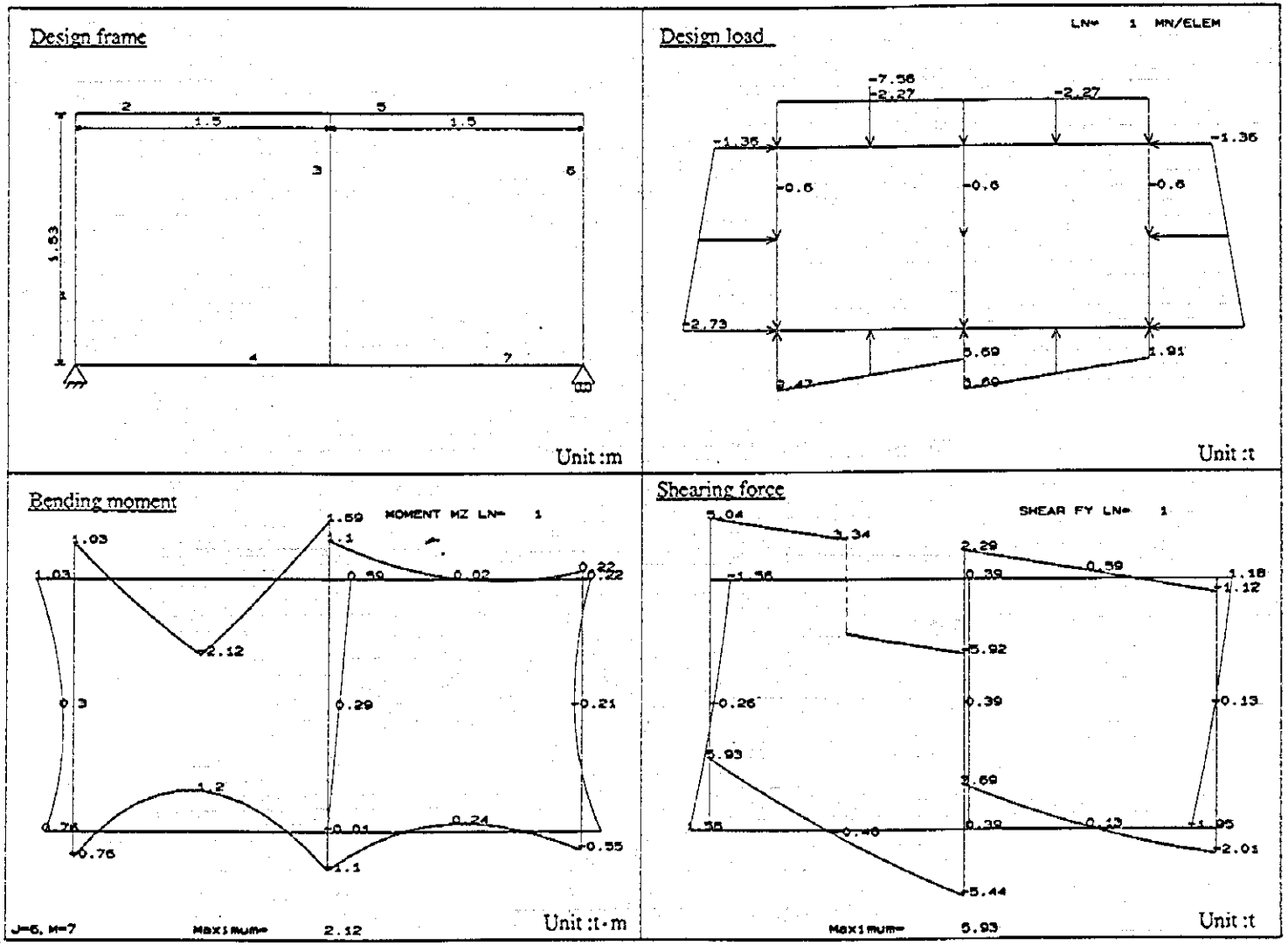
II. 2 lane sluiceway

2-1 Category 3
(Conduit size:1.2×1.2)

Load:Case1*

Note: * See Table

Fig. 3.10 Stress Analysis on Transverse Section of Sluiceway Conduit (7/12)



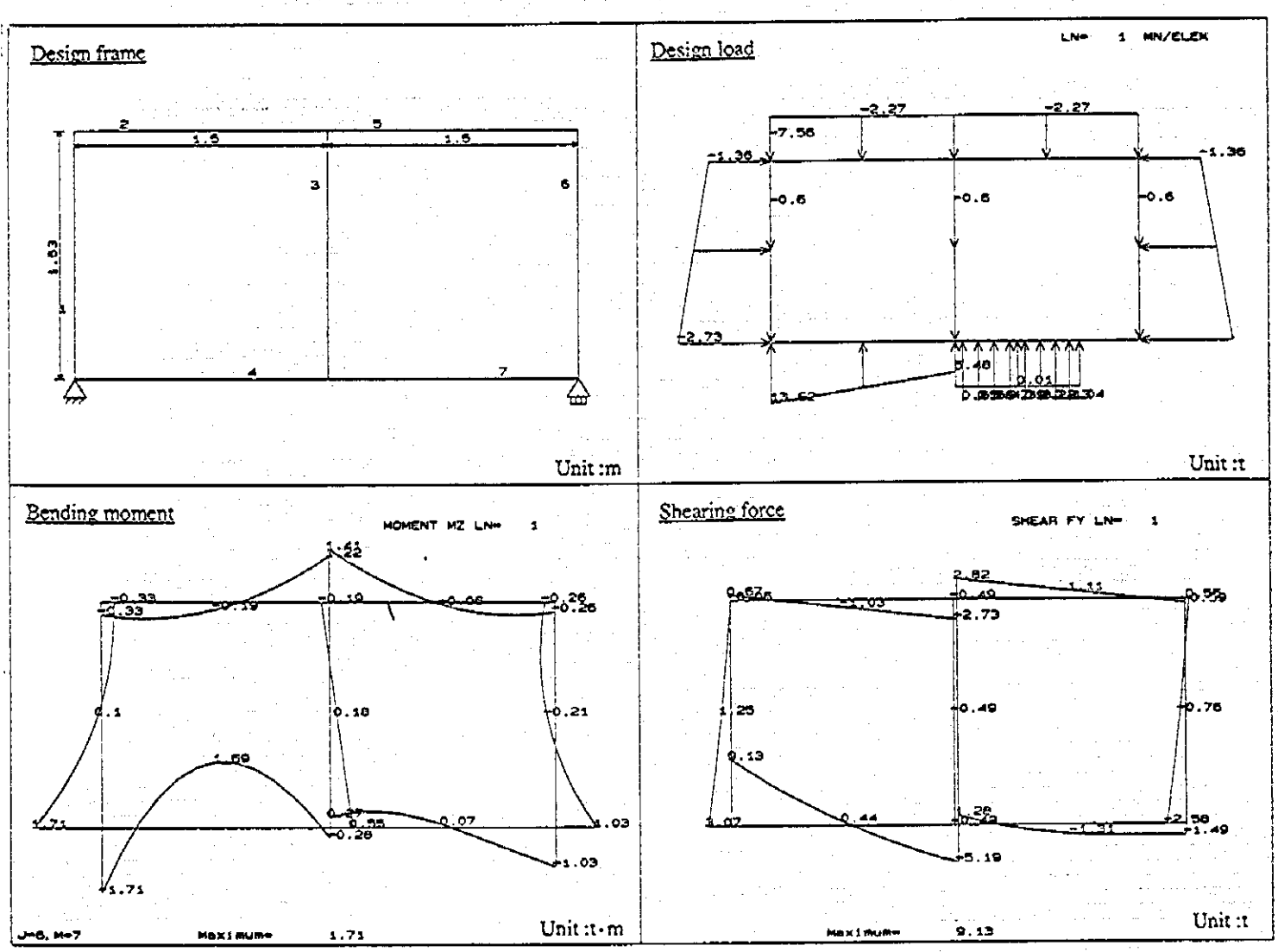
II. 2 lane sluiceway

I-1 Category 3
(Conduit size:1.2X1.2)

Load:Case2*

Note: * See Table

Fig. 3.10 Stress Analysis on Transverse Section of Sluiceway Conduit (8/12)



II. 2 lane sluiceway

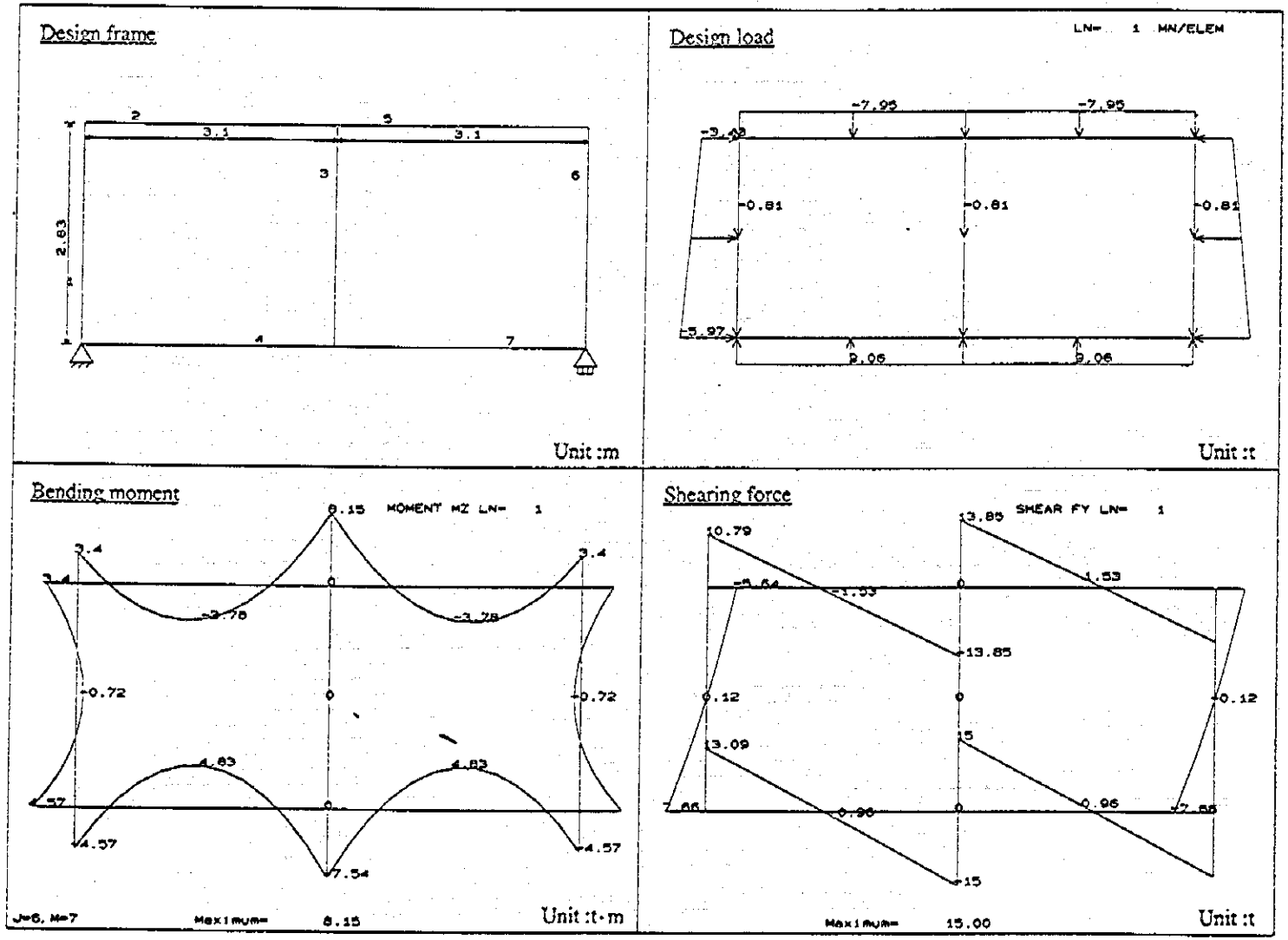
1-1 Category 3
(Conduit size:1.2×1.2)

Load:Case3*

Note: * See Table

1:40

Fig. 3.10 Stress Analysis on Transverse Section of Sluiceway Conduit (9/12)



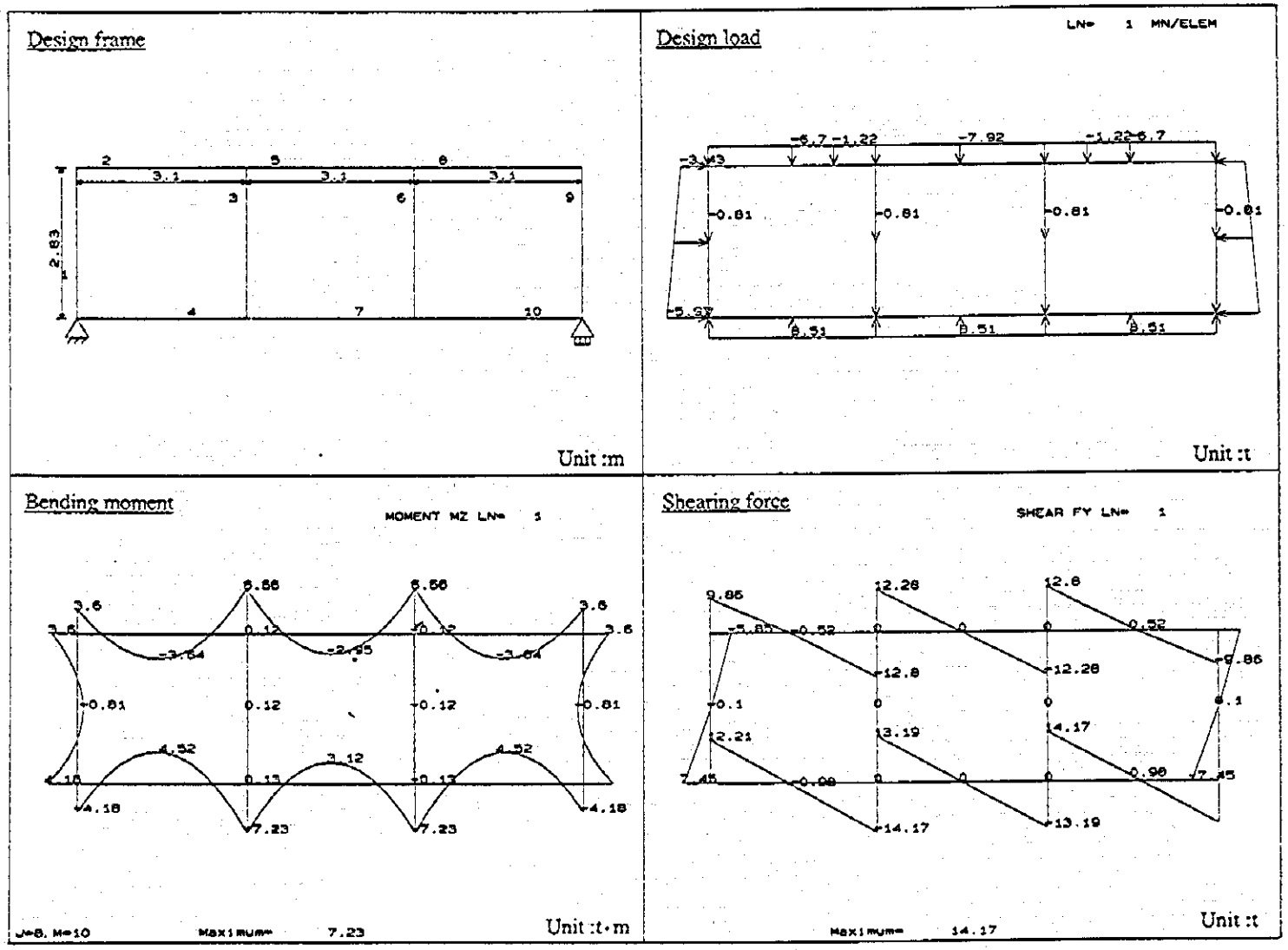
III. Outlet sluiceway of
S. Cengkareng drainage channel

3-1 2 lane sluiceway
(Conduit size:2.7×2.3)

Load : Case1*

Note: * See Table

Fig. 3.10 Stress Analysis on Transverse Section of Sluiceway Conduit (10/12)



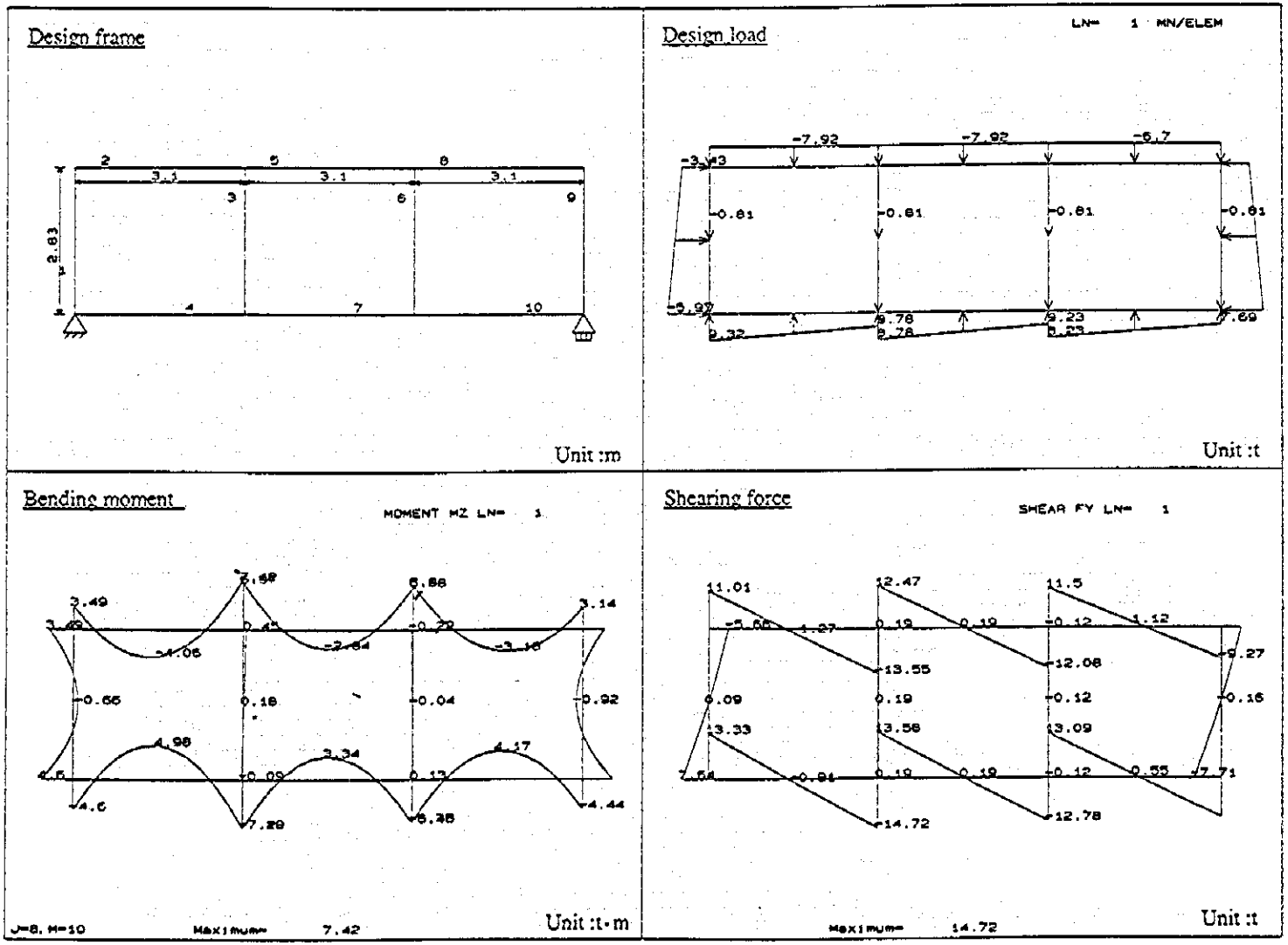
III. Outlet sluiceway of
S. Cengkareng drainage channel

3-2 3 lane sluiceway
(Conduit size: 2.7×2.3)

Load : Case1*

Note: * See Table

Fig. 3.10 Stress Analysis on Transverse Section of Sluiceway Conduit (11/12)



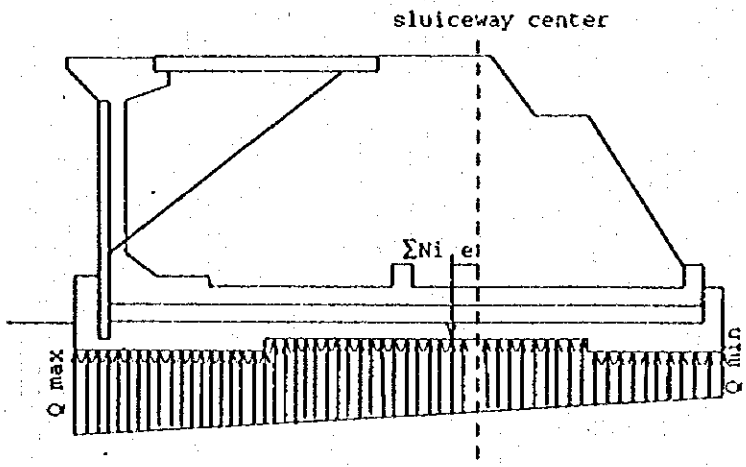
III. Outlet sluiceway of
S. Cengkareng drainage channel

3-2 3 lane sluiceway
(Conduit size: 2.7×2.3)

Load : Case4*

Note: * See Table

Fig. 3.10 Stress Analysis on Transverse Section of Sluiceway Conduit (12/12)



$$Qmax = \Sigma Ni \cdot (1 + 6 \cdot e / B) / B$$

$$Qmin = \Sigma Ni \cdot (1 - 6 \cdot e / B) / B$$

where, Qmax : maximum ground reaction (t/m^2)
Qmin : minimum ground reaction (t/m^2)
Ni : design load (t/m)
B : conduit length (m)
e : eccentric distance (m)
Σ : symbol of summation

Fig. 3.11 Ground Reaction at Sluiceway

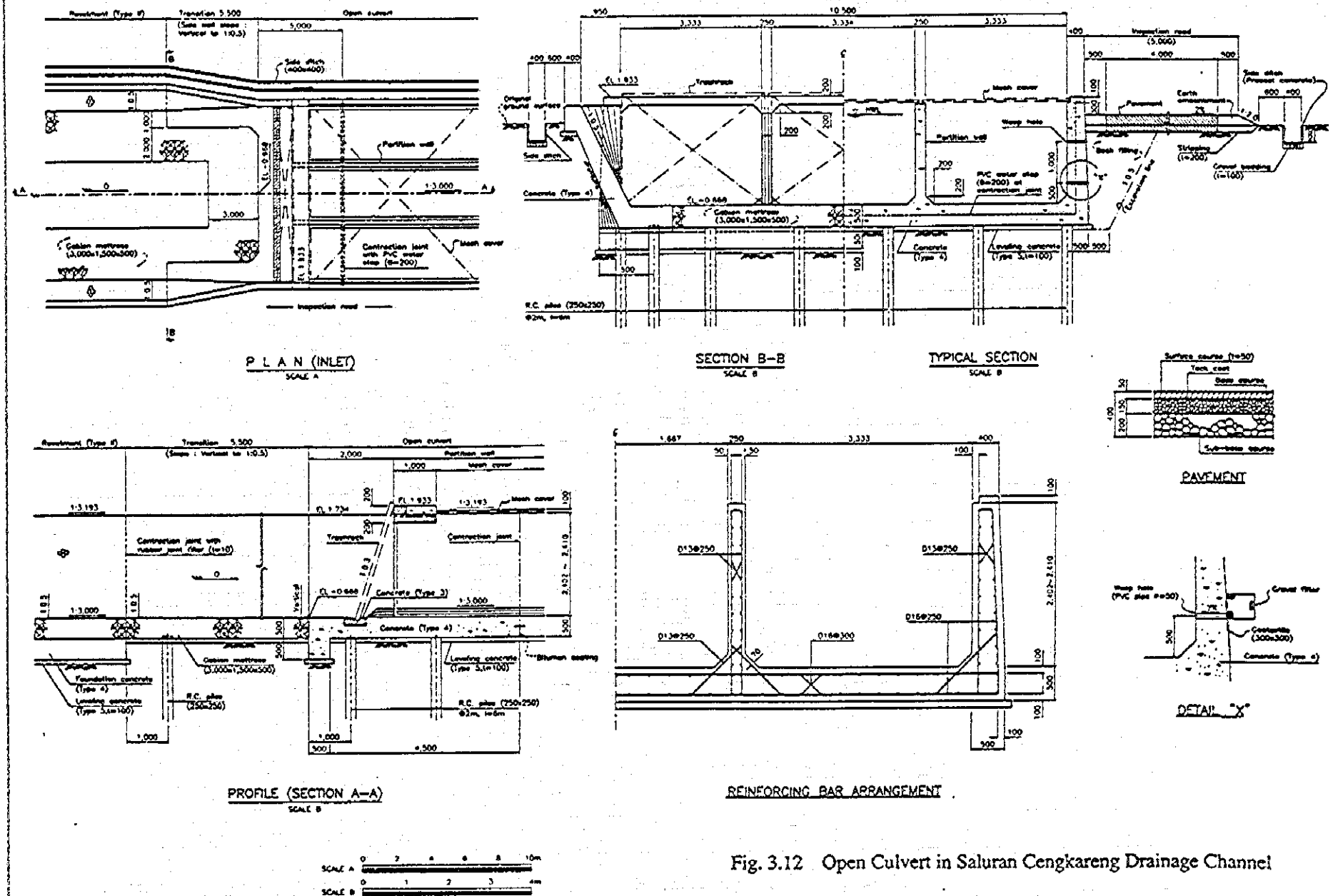
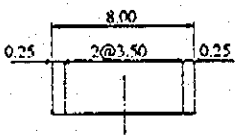
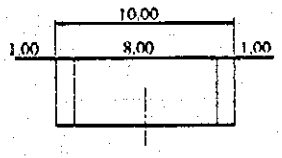
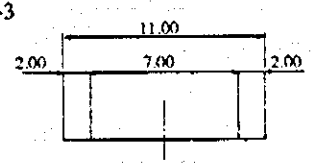
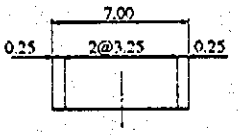
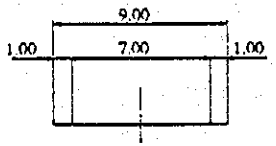
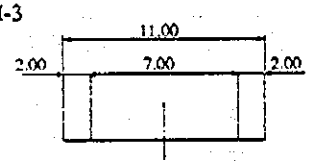
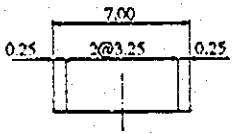
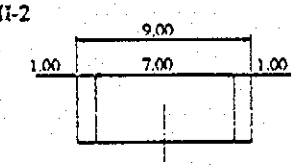
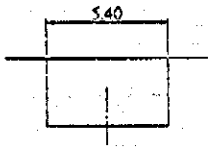
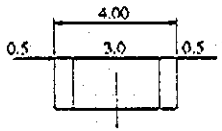
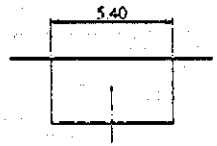


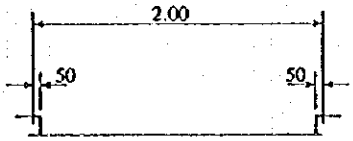
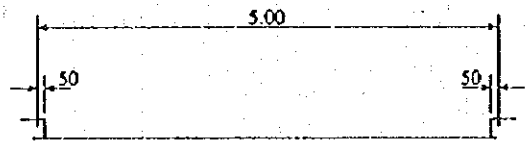
Fig. 3.12 Open Culvert in Saluran Cengkareng Drainage Channel

Type II			2Lanes / 1Lane for Class IV		Particular Case	Remarks
			Without Sidewalk	With Sidewalk		
Arterial	≥20.000	Class I	Type I-1  B=8.00+2×0.60=9.20	I-2  B=9.00+2×0.30=10.60	I-3  B=11.00+2×0.60=12.20	Particular case is proposed for the case of including both Shoulder. (1.5.1.2.B.D.C) Loading class : BD 100
	<20.000	Class II	Type II-1  B=7.00+2×0.60=8.20	II-2  B=9.00+2×0.30=9.60	II-3  B=11.00+2×0.60=12.20	Particular case is proposed for the case of including both Shoulder. (1.5.1.2.B.D.C) Loading class : BD 70
Collector	≥6.000					
	<6.000	Class III	Type III-1  B=7.00+2×0.60=8.20	III-2  B=9.00+2×0.30=9.60	III-3  B=5.40+2×0.60=6.60	Particular case is proposed for the case of 2-lanes with 5-6m width. (1.5.1.2.B.D.C) Loading class : BD 70
Local	≥500					
	<500	Class IV	Type IV-1  B=7.00+2×0.3=4.60		IV-3  B=5.40+2×0.60=6.60	Particular case is proposed for the case of 2-lanes with 5-6m width. (1.5.1.2.B.D.C) Loading class : BD 70

Remarks : "B" indicates the total width including that of curb (300mm) and sidewall (300mm) or just side wall.

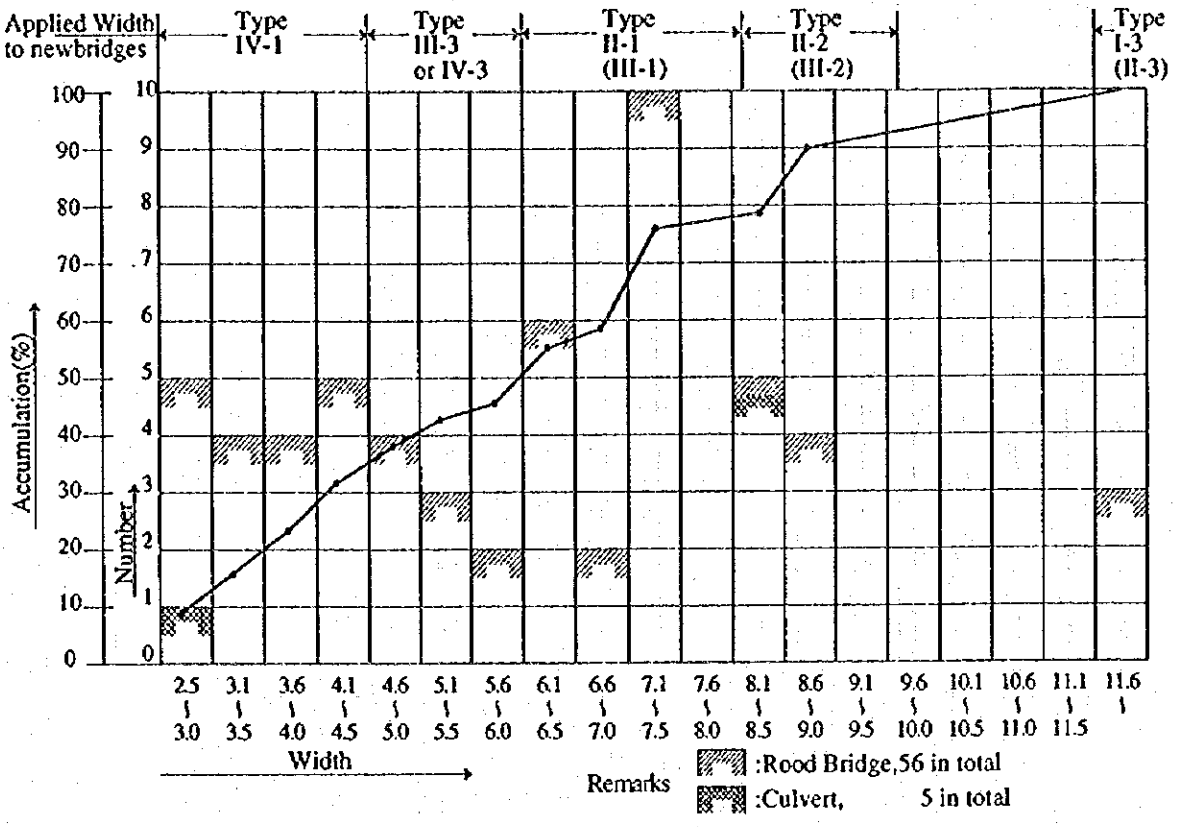
Reference : (1) Geometric Design Standard. 1988
(2) Bridge Design Code (B.D.C). 1992

Fig.4.1 Road Classification and Width of Roadway

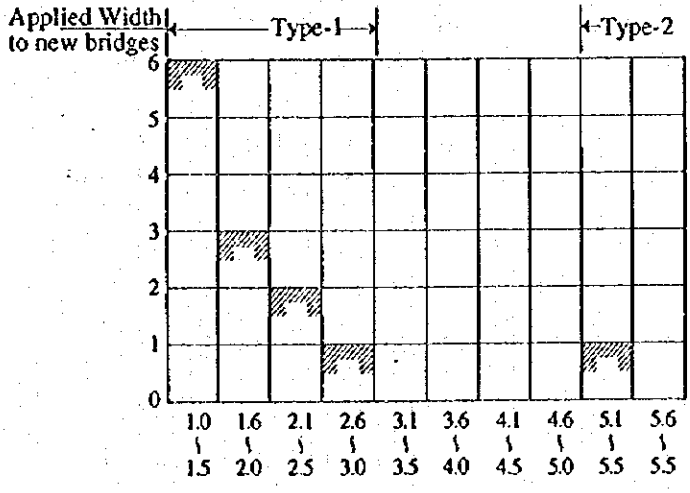
	Width
Type 1	 B*=2.00+2×0.25 = 2.50
Type 2	 B*= 5.00+2×0.25 = 5.50

Remarks for * : Indicates the total width
including that of curb stone.

Fig.4.2 Width of New Pedestrian Bridge

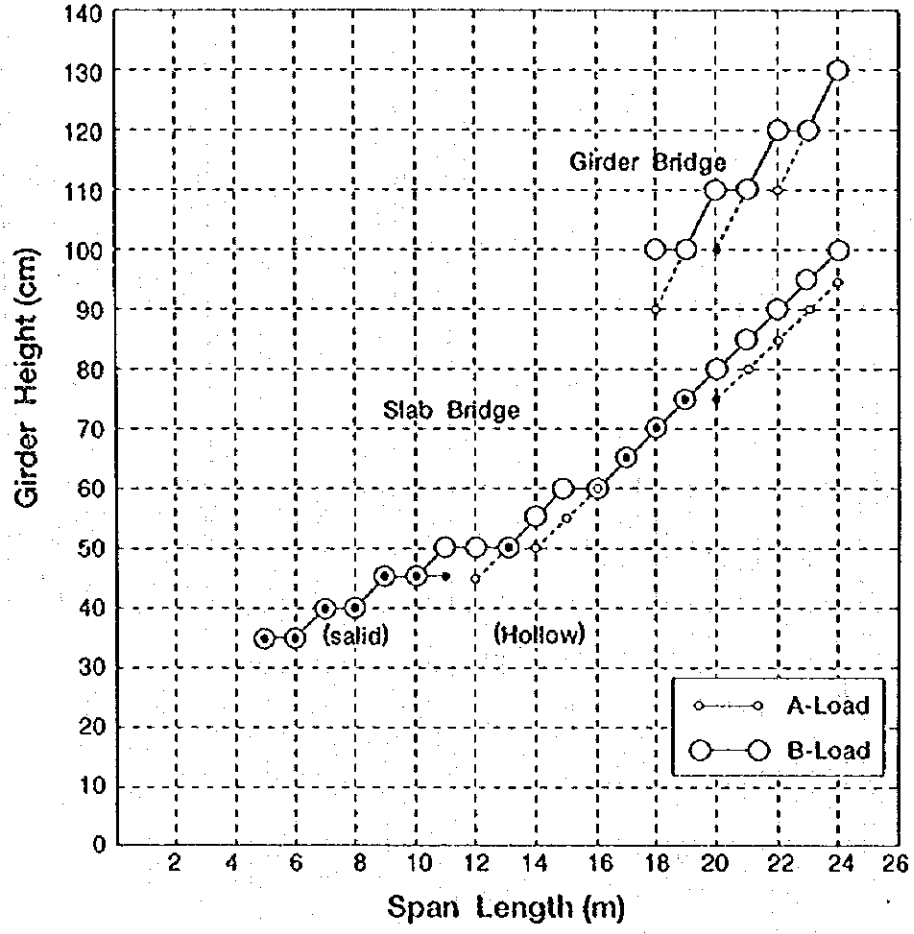


a)Road Bridge and Culvert



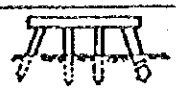
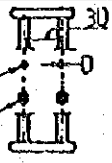
a)Pedestrian Bridge :13in total

Fig.4.3 Width of Existing Bridges and New Ones

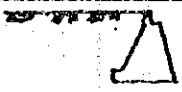
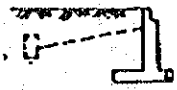
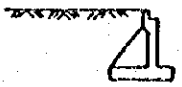
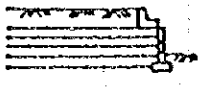


Remarks A-Load: is closely iquivalent to BM 80 in Indonesia.
B-Load:is same as BM100.

Fig 4.4 **Relation between Span Length and Girder Height in Case of Japanese Standard**

PIER TYPE	TYPICAL HEIGHT (m) 0 10 20 30
PILE TRESTLE PIER Two rows of pile is the usual minimum 	
SINGLE COLUMN PIER Circular piers are preferred in stream flow 	5 – 15
WALL PIER Round ends and aligning wall to flow direction helps to reduce flow forces and local scour. 	5 – 25
SINGLE STOREY RIGID FRAME PIER (DOUBLE OR MULTI COLUMN) Circular piers are preferred in stream flow Separation of piers by 20 or more help stream flow. 	5 – 15
DOUBLE STOREY RIGID FRAME PIER 	15 – 25
I-SECTION WALL PIER This section has poor stream flow characteristics and is preferred for use on land. 	25

a) Pier Types

ABUTMENT TYPE	TYPICAL HEIGHT (m) 0 10 20 30
GRVITY RETAINING WALL ABUTMENT 	3 4
CANTILEVER RETAINING WALL ABUTMENT Optional tie-back 	8
COUNTERFORTED RETAINING WALL ABUTMENT 	6 8
SPILL-THROUGH ABUTMENT 	
SPILL-THROUGH PILE TRESTLE ABUTMENT (OR DUAL BORED PILES) 	
REINFORCED EARTH ABUTMENT 	5 – 15

b) Abutment Types

Reference: Bridge Design Manual, 1992

Fig 4.5 Typical Type of Substructure

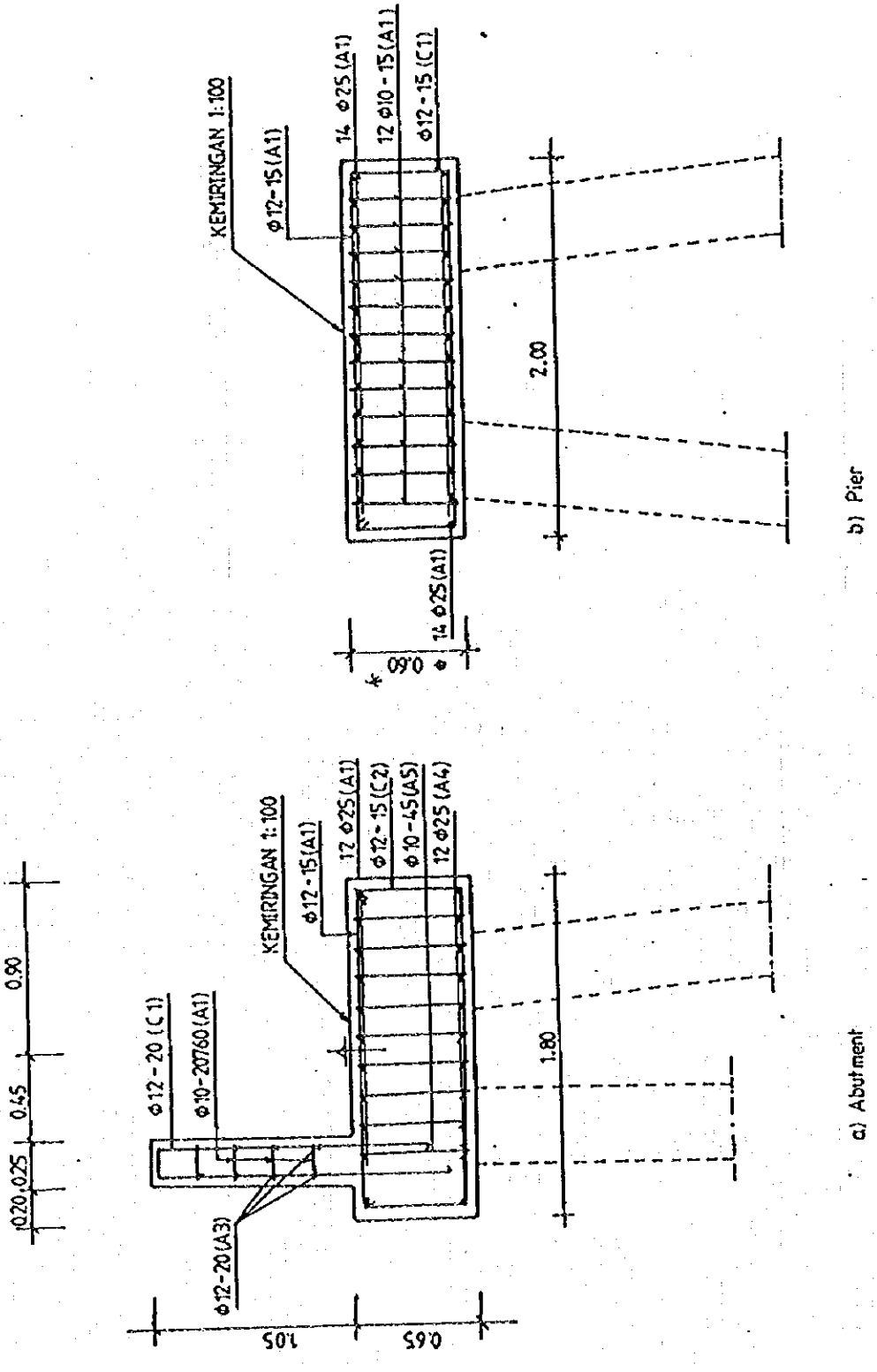
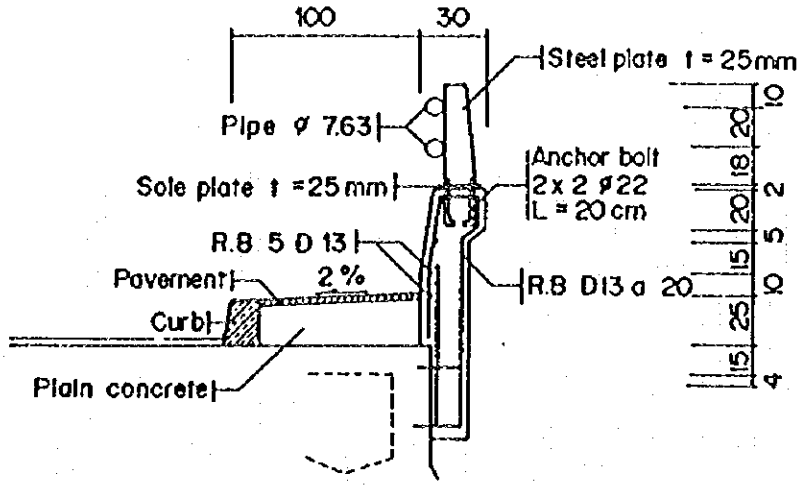
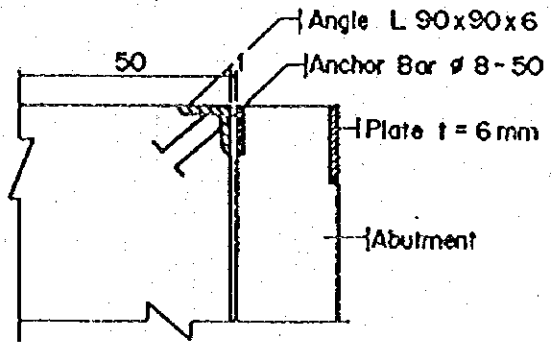


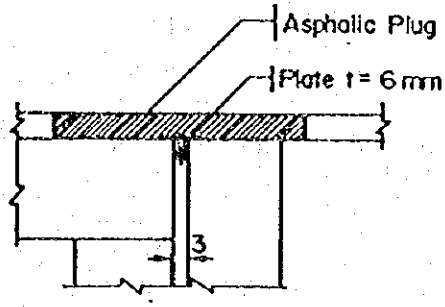
Fig 4.6 Substructure of Pile Trestle



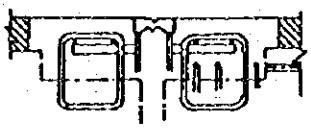
(1). Walkway and Guardrail



a). Open Type

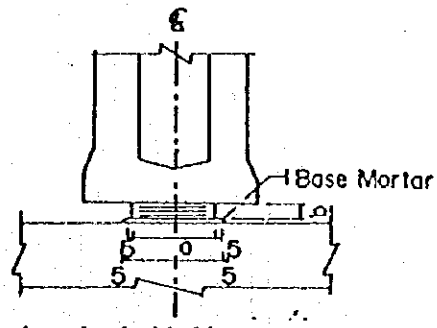


b) Close Type



c) Rubber Type

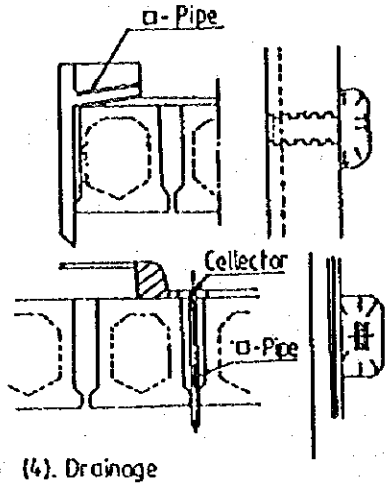
(2). Expansion



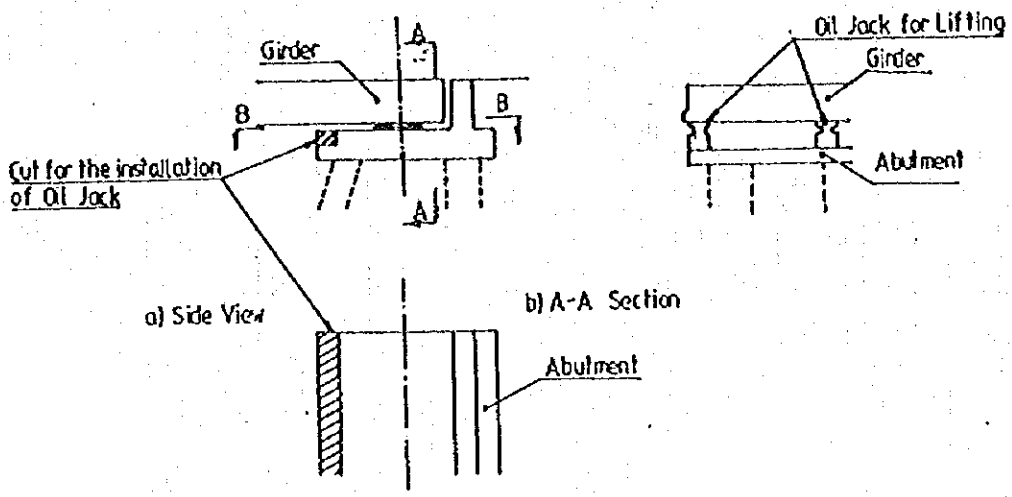
a,b: to be desided by reactive force.

(3) Bearing (Lamination Elastomer)

Fig 4.7 Ancillary Structure(1/2)



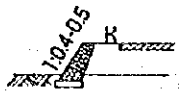
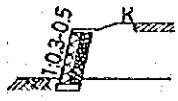
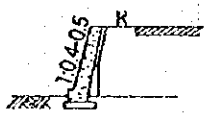
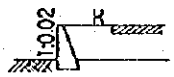
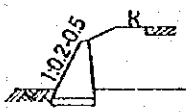
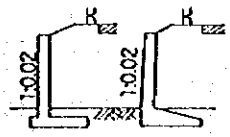
(4). Drainage



(5) Pits for lifting bridges with Oil Jack

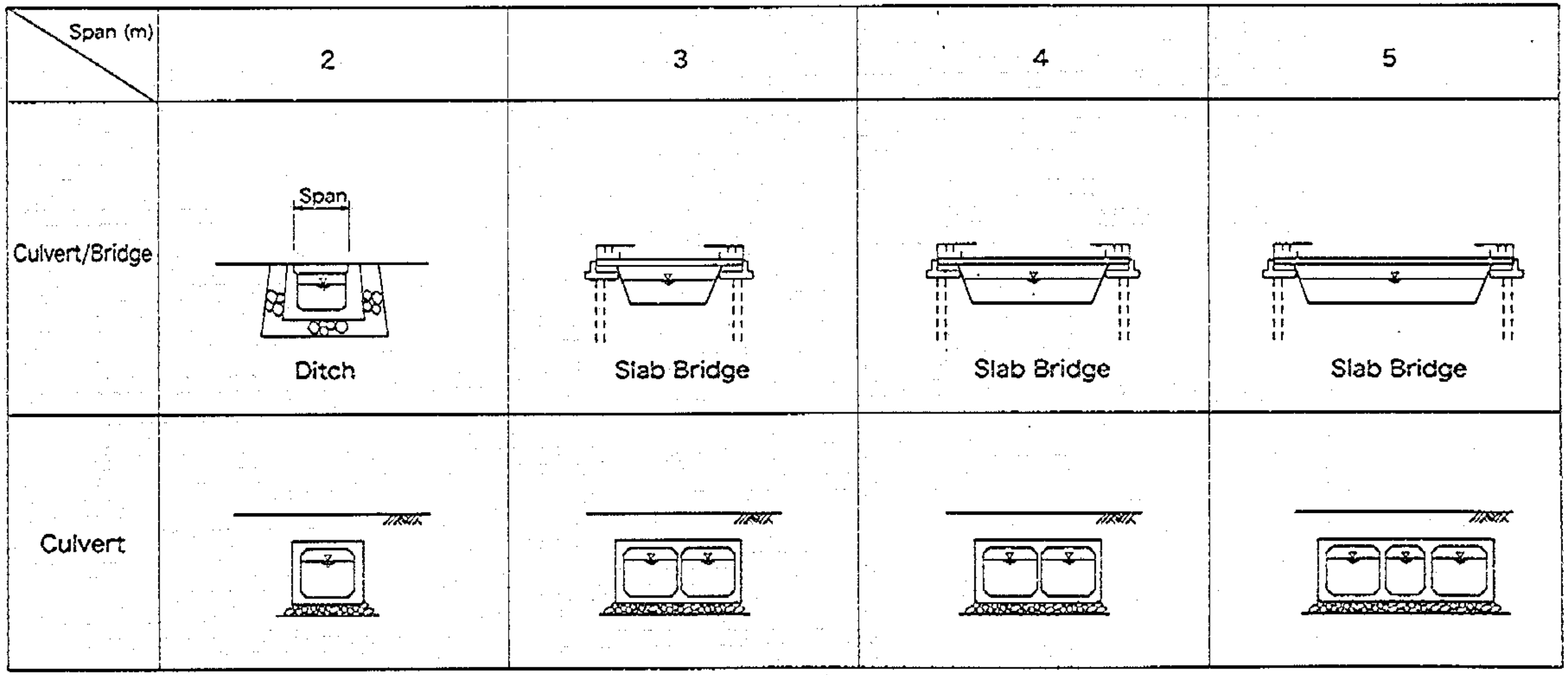
Remarks : In case of the usage of flat jack with 30-40mm depth, the corner cut is not necessary.

Fig 4.8 Ancillary Structure (2/2)

Type	Height	Figures	Application
Wet Masonry	1m 2m 3m 4m		H≦1m ○
Block Masonry	5m		H>1m ○
Lean Type	8m		H≧2m ○
Small Gravity			H≦1m ◎
Gravity	5m		H>1m ◎
U Shape			—
Reversed T/L Shape	8m		—

Legend, ◎ :Most Applicable
○ :Companatively Applicable

Fig. 4.9 Typical Type of Retaining Wall for Approach Road



Remarks: Typical Slab Bridge is shown bellow:

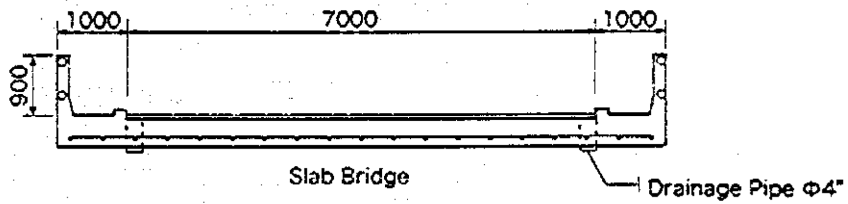


Fig 4.10 Classification of Crossing Structure

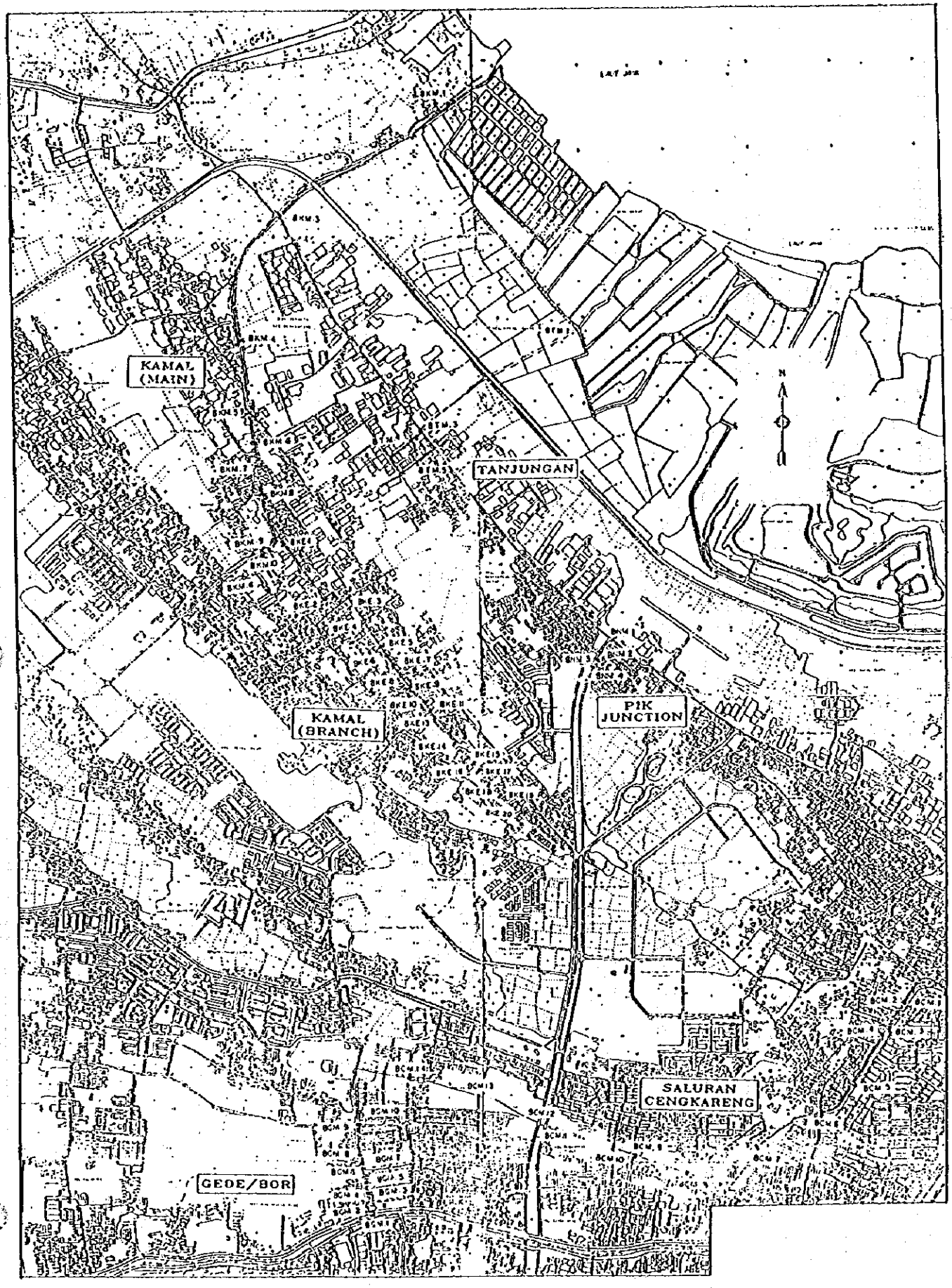


Fig 4.11 Location Map of Bridge and Culvert (1/2)

(Cengkareng West Area)

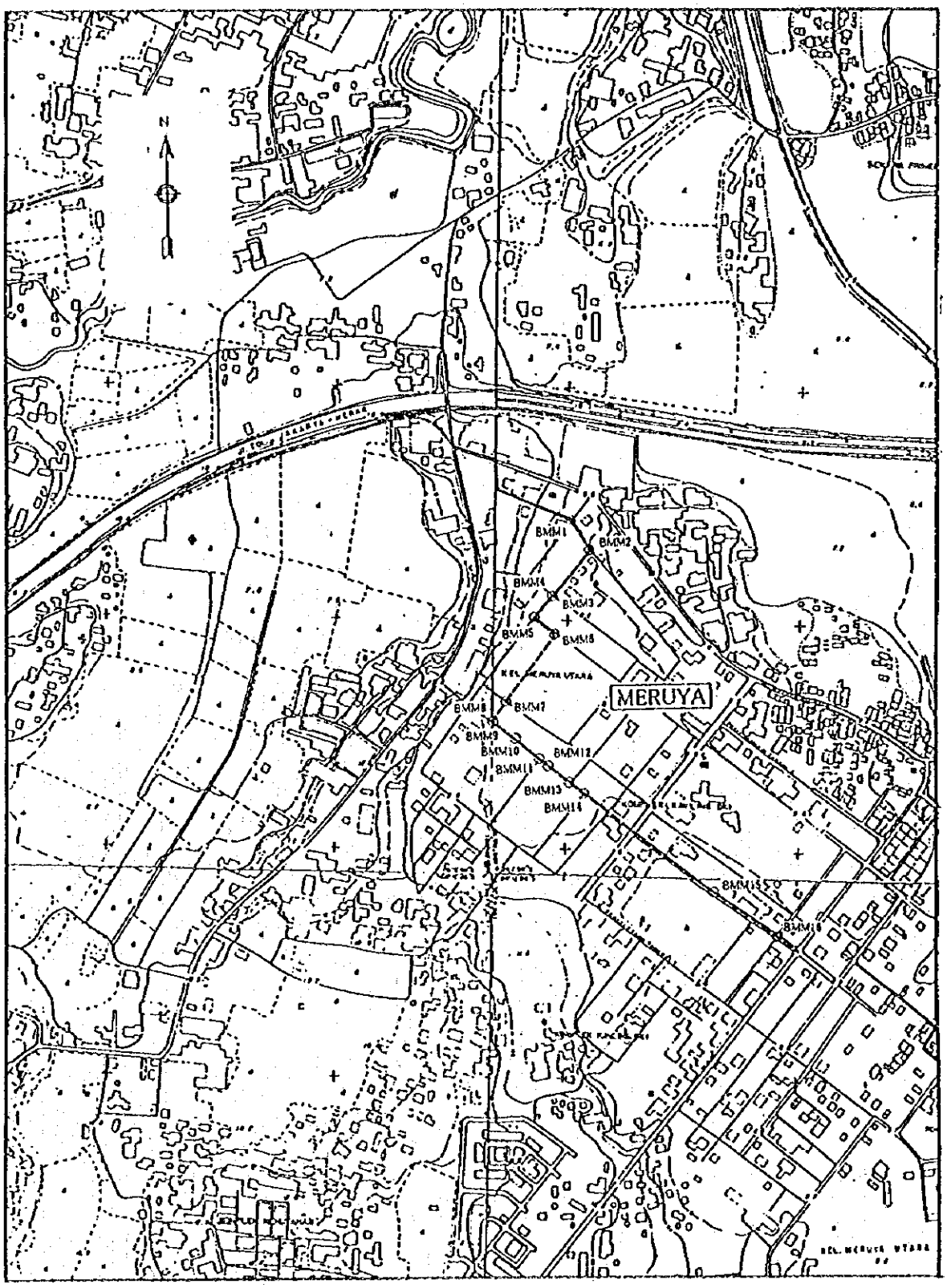


Fig 4.11 Location Map of Bridge and Culvert (2/2)
(Meruya Area)

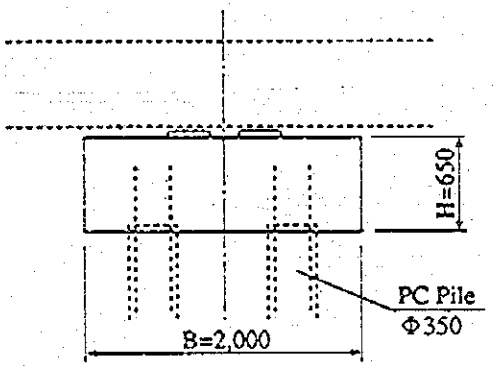
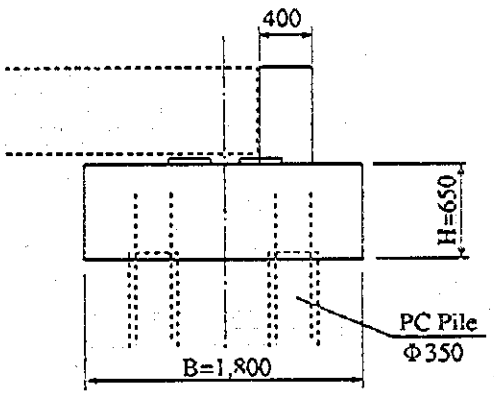
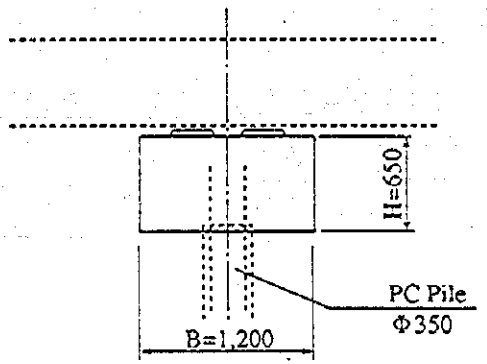
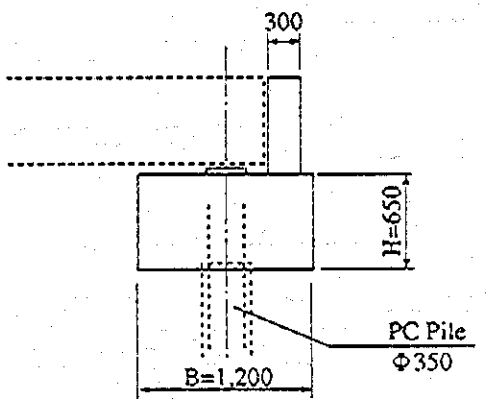
TYPE	PIER	ABUTMENT	APPLICATION
[A] DOUBLE SQUAD PILES	 B×H=2.0M×65M	 B×H=1.8M×0.65M	① SPAN L > 11M FOR BM70 ② SPAN L > 11M FOR BM100 ③ PIER WITH MULTI --SPANS
[B] SINGL SQUAD PILES	 B×H=1.2M×0.65M	 B×H=1.2M×0.65M	① SPAN L < 11M FOR BM70 ② ALL PEDESTRIAN BRIDGES

Fig.4.12 Typical Section of Abutment and pier

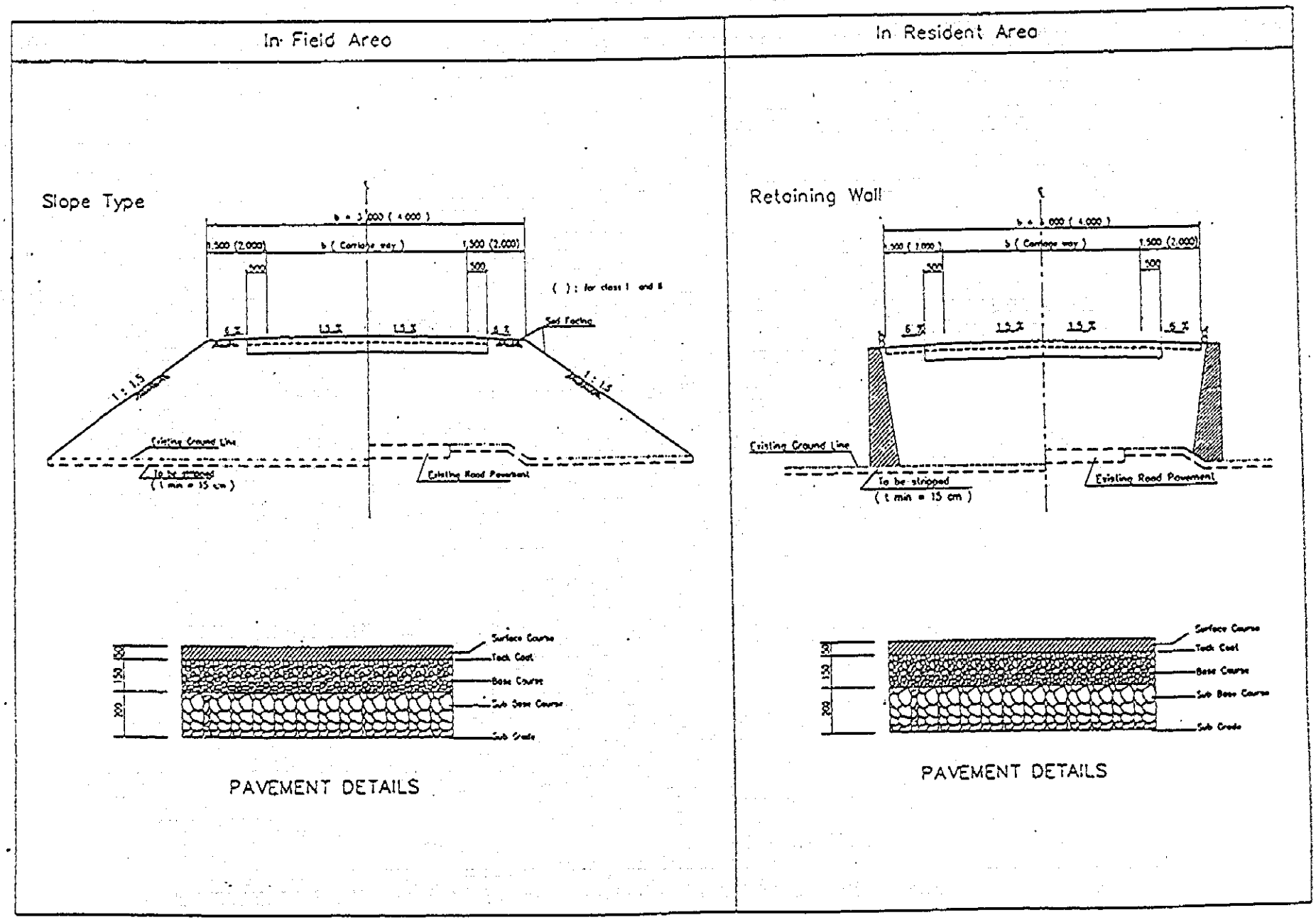
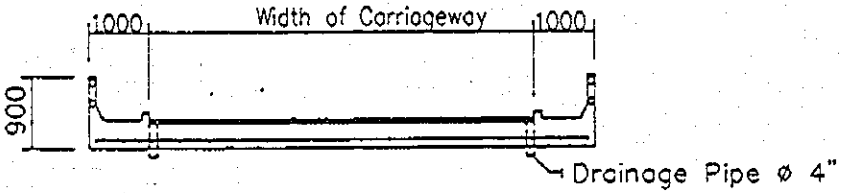


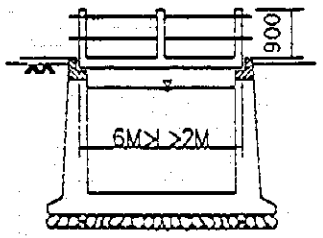
Fig. 4.13 Typical Section of Approach Road

[A] SPAN : 6M>L>2M

IN-SITU SLAB BRIDGE



a) Slab Bridge

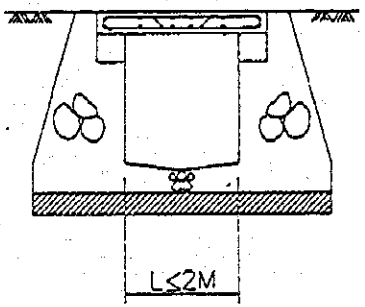


b) foundation

Remarks for x :
The top of wall will be heighten for the subsidance occurred in future.

[B] SPAN : L ≤ 2M

CULVERT



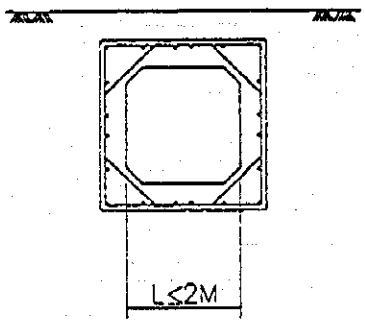


Fig4.14 Typical Section of In-Situ Slab Bridge and Culvert

No. 6

Work Quantity Calculation

TABLE OF CONTENTS

1 DRAINEGE FACILITIES

1.1 Summary of Work Quantities

SUMMARY OF WORK QUANTITIES FOR DRAINAGE FACILITIES (1/5)

	Description	Unit	Total	Package 1	Package 2	Package 3
2	DRAINAGE CHANNEL					
2.1	Drainage Channel					
	Excavation	cu.m	293,587	205,452	41,894	46,241
	Demolishing, hauling and disposing concrete structures	cu.m	2,485	48	2,437	
	Demolishing, hauling and disposing asphalt/masonry structures	cu.m	10,756	5,133	160	5,463
2.2	Levee and Inspection/Relocation Road					
	Coffering and care of water including dewatering	L.S.				
	Demolishing, hauling and disposing concrete structures	cu.m				
	Demolishing, hauling and disposing asphalt/masonry structures	cu.m				
	Stripping, grubbing and clearing	sq.m	74,565	37,097	4,634	32,834
	Excavation	cu.m	39,574	20,949	3,042	15,583
	Embankment	cu.m	71,015	30,812	2,956	37,247
	Dump filling with provision of pollution prevention measures	cu.m	46,580		46,580	
	Backfilling with selected material	cu.m	293			293
	Filling-up by random material	cu.m	2,190	1,146	180	864
	Geo-textile, t=1.5mm	sq.m	59,931	30,988	4,495	24,448
	Sod facing	sq.m	22,862	11,518	1,070	10,274
	Cobble/rubble for rip-rap	sq.m	11,585		11,585	
	Gabion mattress, 3.0x1.5x0.5 m, PVC coated wire	cu.m	44,141	22,911	3,402	17,828
	Gabion mattress, 3.0x1.5x0.5 m, galvanized wire	cu.m				
	Bamboo mat	sq.m	4,866		4,866	
	Bamboo waling	lin.m	46,335		46,335	
	Bamboo pile, diam. 80-100mm	lin.m	64,772		64,772	
	Sub-base course	cu.m	8,021	3,563	400	4,058
	Base-course	cu.m	6,017	2,672	300	3,045
	Asphalt pavement	sq.m	40,074	17,794	2,000	20,280
2.3	Concrete Parapet Wall					
	Coffering and care of water including dewatering	L.S.				
	Demolishing, hauling and disposing concrete structures	cu.m				
	Demolishing, hauling and disposing asphalt/masonry structures	cu.m				
	Excavation for footing of parapet wall	cu.m	6,505	1,616		4,889
	Backfilling with selected material	cu.m	3,036	726		2,310
	Geo-textile, t=1.5 mm	sq.m				
	Gravel filter	cu.m				
	Gabion mattress, 3.0x1.5x0.5 m, PVC coated wire	cu.m	1,144	288		856
	Gabion mattress, 3.0x1.5x0.5 m, galvanized wire	cu.m				
	PVC pipe for weep hole, diam. 50 mm	lin.m				
	Furnishing steel sheet pile, YSPF W= 400mm	sq.m	6,603	1,726		4,877
	Driving steel sheet pile, for Item No. 2.3/11	sq.m	6,603	1,726		4,877
	Furnishing RC piles, 250 x 250 mm	lin.m	14,160	3,684		10,476
	Driving RC piles, for Item No. 2.3/13	lin.m	14,160	3,684		10,476
	Concrete, type 4, for footing and wall	cu.m	2,772	707		2,065
	Concrete, type 5, for leveling	cu.m	435	114		321
	Form, type F1, for Item No. 2.3/15	sq.m	1,461	381		1,080
	Form, type F2, for Item No. 2.3/15	sq.m	5,798	1,427		4,371
	Reinforcing bars, for Item No. 2.3/15	kg	221,461	56,450		165,011
	PVC waterstop, W=200 mm	lin.m	7,648	1,955		5,693
	Rubber joint filler, t=10 mm	sq.m	4	2		2
	Bitumen coating	sq.m	469	119		350
	Furnishing and installing trap	kg	789	187		602
2.4	Concrete Wall					
	Coffering and care of water including dewatering	L.S.				
	Demolishing, hauling and disposing concrete structures	cu.m				
	Demolishing, hauling and disposing asphalt/masonry structures	cu.m				
	Excavation for footing of L-type concrete wall	cu.m	4,124		4,124	
	Backfilling with selected material	cu.m	1,453		1,453	
	Geo-textile, t=1.5 mm	sq.m	48		48	
	Gravel filter	cu.m	14		14	

SUMMARY OF WORK QUANTITIES FOR DRAINAGE FACILITIES (2/5)

	Description	Unit	Total	Package 1	Package 2	Package 3
	Gabion mattress, 3.0x1.5x0.5 m, PVC coated wire	cu.m	1,702		1,702	
	Gabion mattress, 3.0x1.5x0.5 m, galvanized wire	cu.m				
	PVC pipe for weep hole, diam. 50 mm	lin.m	208		208	
	Furnishing steel sheet pile, YSPF, W= 400mm	sq.m	3,404		3,404	
	Driving steel sheet pile, for Item No. 2.4/11	sq.m	3,404		3,404	
	Furnishing RC piles, 250 x 250 mm	lin.m	10,920		10,920	
	Driving RC piles, for Item No. 2.4/13	lin.m	10,920		10,920	
	Concrete, type 4, for footing and wall	cu.m	2,016		2,016	
	Concrete, type 5, for leveling	cu.m	286		286	
	Form, type F1, for Item No. 2.4/15	sq.m	3,414		3,414	
	Form, type F2, for Item No. 2.4/15	sq.m	2,104		2,104	
	Reinforcing bars, for Item No. 2.4/15	kg	161,208		161,208	
	PVC waterstop, W=200 mm	lin.m	1,034		1,034	
	Rubber joint filler, t=10 mm	sq.m	4		4	
	Bitumen coating	sq.m	404		404	
	Furnishing and installing trap	kg				
2.5	Heightening of Existing Masonry Revetment					
	Demolishing, hauling and disposing asphalt/masonry structures	cu.m				
	Wet cobble/rubble masonry, type 1	cu.m	88	88		
	PVC pipe for weep hole, diam. 50 mm	lin.m				
	Rubber joint filler, t=10 mm	sq.m				
2.6	Masonry Revetment, Type I					
	Coffering and care of water including dewatering	L.S.				
	Demolishing, hauling and disposing concrete structures	cu.m				
	Demolishing, hauling and disposing asphalt/masonry structures	cu.m	261			261
	Excavation	cu.m	25,973	15,552		10,421
	Backfilling	cu.m	2,223	1,281		942
	Geo-textile, t=1.5 mm	sq.m	347	198		149
	Gravel bedding	cu.m	3,455	1,983		1,472
	Cobble/rubble filling	cu.m	1,326	753		573
	Wet cobble/rubble masonry, type 1	cu.m	7,021	4,035		2,986
	Gabion mattress, 3.0x1.5x0.5 m, PVC coated wire	cu.m	8,875	5,276		3,599
	Gabion mattress, 3.0x1.5x0.5 m, galvanized wire	cu.m	419			419
	PVC pipe for weep hole, diam. 50 mm	lin.m	2,121	1,236		885
	Furnishing and driving wooden piles, diam. 15-18cm	lin.m	9,378	5,322		4,056
	Concrete, type 4, for foundation	cu.m	1,550	881		669
	Concrete, type 5, for leveling	cu.m	617	350		267
	Form, type F2, for Item No. 2.6/14	sq.m	7,827	4,458		3,369
	Reinforcing bars, for Item No. 2.6/14	kg	61,649	35,021		26,628
	Rubber joint filler, t=10 mm	sq.m	1,195	686		509
2.7	Masonry Revetment, type II					
	Coffering and care of water including dewatering	L.S.				
	Demolishing, hauling and disposing concrete structures	cu.m				
	Demolishing, hauling and disposing asphalt/masonry structures	cu.m	34			34
	Excavation	cu.m				
	Backfilling	cu.m	30,508	12,695	1,056	16,757
	Geo-textile, t=1.5 mm	sq.m	2,620	1,129	123	1,368
	Gravel bedding	cu.m	484	197	21	266
	Cobble/rubble filling	cu.m	3,361	1,346	140	1,875
	Wet cobble/rubble masonry, type 1	cu.m	1,595	688	75	832
	Gabion mattress, 3.0x1.5x0.5 m, PVC coated wire	cu.m	12,857	5,252	550	7,055
	Gabion mattress, 3.0x1.5x0.5 m, galvanized wire	cu.m	8,052	4,831	521	2,700
	PVC pipe for weep hole, diam. 50 mm	lin.m	3,153			3,153
	Furnishing and driving wooden piles, diam. 15-18cm	lin.m	3,031	1,231	130	1,670
	Concrete, type 4, for foundation	cu.m	11,268	4,857	528	5,883
	Concrete, type 5, for leveling	cu.m	1,853	802	85	966
	Form, type F2, for Item No. 2.7/14	sq.m	760	323	36	401
	Reinforcing bars, for Item No. 2.7/14	kg	9,602	4,116	443	5,043
	Rubber joint filler, t=10 mm	sq.m	73,966	32,003	3,457	38,506

SUMMARY OF WORK QUANTITIES FOR DRAINAGE FACILITIES (3/5)

	Description	Unit	Total	Package 1	Package 2	Package 3
2.8	Concrete Ditch and Culvert					
	Coffering and care of water including dewatering	LS.				
	Demolishing, hauling and disposing concrete structures	cu.m				
	Demolishing, hauling and disposing asphalt/masonry structures	cu.m	18			18
	Stripping, grubbing and clearing	sq.m	156			156
	Excavation of channel including trench cut	cu.m				
	Rubble bedding	cu.m	36,356	2,589	7,267	26,500
	Geo-textile, t=1.5mm	sq.m	2,247	328	583	1,336
	Backfilling	cu.m	201	27	67	107
	Gravel filter	cu.m	8,325	1,189	2,809	4,327
	PVC pipe for weep hole, diam. 50 mm	lin.m	106	8	21	77
	Gabion mattress, 3.0x1.5x0.5 m, PVC coated wire	cu.m	1,578	118	295	1,165
	Gabion mattress, 3.0x1.5x0.5 m, galvanized wire	cu.m	1,840	664	1,166	10
	Furnishing steel sheet pile, YSPF, W= 400mm	sq.m	129			129
	Driving steel sheet pile, for Item No. 2.8/13	sq.m	269		53	216
	Furnishing RC piles, 250 mm x 250 mm	lin.m	269		53	216
	Driving RC piles, for Item No. 2.8/15	lin.m	7,164			7,164
	Concrete, type 3, for blockout concrete	cu.m	7,164			7,164
	Concrete, type 4, for ditch and culvert	cu.m	5			5
	Concrete, type 5, for leveling	cu.m	12,354	915	1,957	9,482
	Form, type F1, for Item Nos. 2.8/17 and 2.8/18	sq.m	1,550	142	240	1,168
	Form, type F2, for Item Nos. 2.8/17 and 2.8/18	sq.m	18,945	1,640	3,780	13,525
	Reinforcing bars, for Item Nos. 2.8/17 and 2.8/18	kg	14,951	1,225	3,103	10,623
	PVC waterstop, W=200mm	lin.m	742,761	54,893	118,275	569,593
	Joint bar, diam. 25 mm, L=1m	nos.	3,582	320	613	2,649
	Rubber joint filler, t= 10 mm	sq.m	3,033	392	651	1,990
	Bitumen coating	sq.m	3			3
	Furnishing and installing traps	kg	740	33	54	653
	Furnishing and installing of trashrack and accessories	kg				
	Furnishing and installing steel mesh cover	kg	10,617			10,617
	Galvanized steel pipe, diam. 1 1/4"	kg	54,150			54,150
	Galvanized steel pipe, diam. 3/4"	kg	153			153
	Fence, H=2.5m	sq.m	35			35
3	DRAINAGE FACILITIES					
3.1	Sluiceway					
	Coffering and care of water including dewatering	L.S.				
	Demolishing, hauling and disposing existing concrete structures	cu.m	65			65
	Demolishing, hauling and disposing existing asphalt/masonry	cu.m	112			112
	Stripping, grubbing and clearing	sq.m				
	Excavation including trench cut	cu.m	6,667	2,493	549	3,625
	Backfilling with selected materials	cu.m	1,523	614	78	831
	Filling-up with excavated materials	cu.m				
	Geo-textile, t=1.5 mm	sq.m	48	23	6	19
	Sod facing	sq.m	62			62
	Gravel bedding	cu.m	362	157	24	181
	Cobble/rubble filling	cu.m	82	41		41
	Wet cobble/rubble masonry, type 1	cu.m				
	Wet cobble/rubble masonry, type 2	cu.m	780	334	57	389
	Gabion mattress, 3.0x1.5x0.5 m, PVC coated wire	cu.m	654	277	78	299
	Gabion mattress, 3.0x1.5x0.5 m, galvanized wire	cu.m	36			36
	PVC pipe for weep hole, diam. 50mm	lin.m	85	37	9	39
	Bitumen coating	sq.m	114	4		110
	Furnishing steel sheet pile, YSPF, W= 400mm	sq.m	765	354	20	391
	Driving of steel sheet pile, for Item No. 3.1/18	sq.m	765	354	20	391
	Furnishing RC Piles, 250 mm x 250 mm	lin.m	3,666	1,703	560	1,403
	Driving of RC piles, for Item No. 3.1/20	lin.m	3,666	1,703	560	1,403
	Furnishing RC Piles, 300 mm x 300 mm	lin.m	560			560
	Driving of RC piles, for Item No. 3.1/22	lin.m	560			560
	Concrete, type 3, for blockout concrete	cu.m	64	24	9	31
	Concrete, type 4, for sluiceway structures and revetment	cu.m	1,382	377	71	934
	Concrete, type 5, for leveling	cu.m	175	57	12	106

SUMMARY OF WORK QUANTITIES FOR DRAINAGE FACILITIES (4/5)

	Description	Unit	Total	Package 1	Package 2	Package 3
	Base mortar	cu.m	196	84	14	98
	Form, type F1, for Item Nos. 3.1/24 and 3.1/25	sq.m	4,766	1,944	228	2,594
	Form, type F2, for Item Nos. 3.1/24 and 3.1/25	sq.m	1,503	474	128	901
	Reinforcing bars, for Item Nos. 3.1/24 and 3.1/25	kg	164,120	44,216	7,914	111,990
	Joint bars, diam. 25mm, L=1m	nos.	78	10		68
	PVC waterstop, W=200mm	lin.m	75	10		65
	Rubber joint filler, t= 10 mm	sq.m	82	45	4	33
	Precast concrete ditch, 600x600mm	lin.m				
	Precast concrete ditch, 600x800mm	lin.m				
	Precast concrete ditch, 800x800mm	lin.m				
	Sub-base course	cu.m	22			22
	Base-course	cu.m	16			16
	Asphalt pavement	sq.m	106			106
	Furnishing and installing traps	kg	125			125
	Steel galvanized pipe, diam. 1 1/4"	kg	28			28
	Steel galvanized pipe, diam. 3/4"	kg	61			61
	Embedded metal for stoplog groove	kg	260			260
	Steel slide gate including hoist, guide frame, accessories and spare parts, W= 0.6 m x H = 0.6 m	set				
	Steel slide gate including hoist, guide frame, accessories and spare parts, W= 0.7 m x H = 0.7 m	set	1	1		
	Steel slide gate including hoist, guide frame, accessories and spare parts, W= 0.8 m x H = 0.8 m	set	16	7	4	5
	Steel slide gate including hoist, guide frame, accessories and spare parts, W= 0.9 m x H = 0.9 m	set	2	1		1
	Steel slide gate including hoist, guide frame, accessories and spare parts, W= 1.0 m x H = 1.0 m	set	14	4	3	7
	Steel slide gate including hoist, guide frame, accessories and spare parts, W= 1.1 m x H = 1.1 m	set	8	3	1	4
	Steel slide gate including hoist, guide frame, accessories and spare parts, W= 1.2 m x H = 1.2 m	set	6	2		4
	Steel slide gate including hoist, guide frame, accessories and spare parts, W= 1.3 m x H = 1.3 m	set	2	1		1
	Steel slide gate including hoist, guide frame, accessories and spare parts, W= 1.5 m x H = 1.3 m	set	1	1		
	Steel slide gate including hoist, guide frame, accessories and spare parts, W= 2.3 m x H = 2.3 m	set	5			5
	Steel flap gate including guide frame, accessories and spare parts, W= 0.4 m x H = 0.4 m	set	5	4	1	
	Timber stoplog, W = 0.4 m x H = 0.4 m	set	1	1		
	Timber stoplog, W = 0.6 m x H = 0.6 m	set				
	Timber stoplog, W = 0.7 m x H = 0.7 m	set	1	1		
	Timber stoplog, W = 0.8 m x H = 0.8 m	set	1	1		
	Timber stoplog, W = 0.9 m x H = 0.9 m	set	1	1		
	Timber stoplog, W = 1.0 m x H = 1.0 m	set	1	1		
	Timber stoplog, W = 1.1 m x H = 1.1 m	set	1	1		
	Timber stoplog, W = 1.2 m x H = 1.2 m	set	1	1		
	Timber stoplog, W = 1.3 m x H = 1.3 m	set	1	1		
	Timber stoplog, W = 1.5m x H = 1.3 m	set	1	1		
	Timber stoplog, W = 2.3 m x H = 2.3 m	set	2			2
	Steel stand for portable hanger	set	10			10
	Portable hanger, handling tools and slings for 2.3mx2.3m	set	2			2
	Maintenance tool for gate, stoplog and hoist	set	2	2		
3.2	Connection Canal / Cross Drain					
	Coffering and care of water including dewatering	L.S.				
	Demolishing, hauling and disposing existing concrete structures	cu.m				
	Demolishing, hauling and disposing existing asphalt/masonry	cu.m				
	Trench excavation	cu.m	4,687	2,064	300	2,323
	Backfilling with excavated materials	cu.m	936	423	60	453
	Geo-textile, t= 1.5 mm	sq.m	142	142		
	Gravel bedding	cu.m	820	365	57	398
	Wet cobble/rubble masonry, type 2	cu.m				

SUMMARY OF WORK QUANTITIES FOR DRAINAGE FACILITIES (5/5)

	Description	Unit	Total	Package 1	Package 2	Package 3
	PVC pipe for weep hole, diam. 50 mm	lin.m				
	Concrete, type 4, for slab, strut and facing concrete of wet rubble masonry	cu.m	19	18		1
	Concrete, type 5, for leveling	cu.m	6	5		1
	Form, type F2, for Item No. 3.2/10	sq.m	103	95		8
	Reinforcing bars, for Item No. 3.2/10	kg	1,009	963		46
	Rubber joint filler, t=10 mm	sq.m	8	6		2
	Precast concrete culvert, 400x400mm	lin.m	100	46	8	46
	Precast concrete side ditch, U-type, 400x400mm	lin.m	17,912	7,556	1,017	9,339
	Precast concrete side ditch, L-type, 300x300mm	lin.m	1,145	825	320	