5–3 ROAD

Road construction plans have already been mentioned in section 3 and 4-1-2, so only the outline and cost of the project will be given here.

<u>Outline of the Project</u>

Detailed cross sections of the structural and material designs for the pavements are shown below. The 18M pavement (Primary RoadA)is designed for a 6M(2 lane) highway, but with a capacity to be a 12M(4 lane) highway to accomodate a predictable future increase in traffic. The surface will consist of a hot mix asphalt top layer above an asphalt layer to ease future maintenance, since many of the asphalt surfaced roads in Jakarta's resisential development areas have shown serious damage after only one to two years of use.

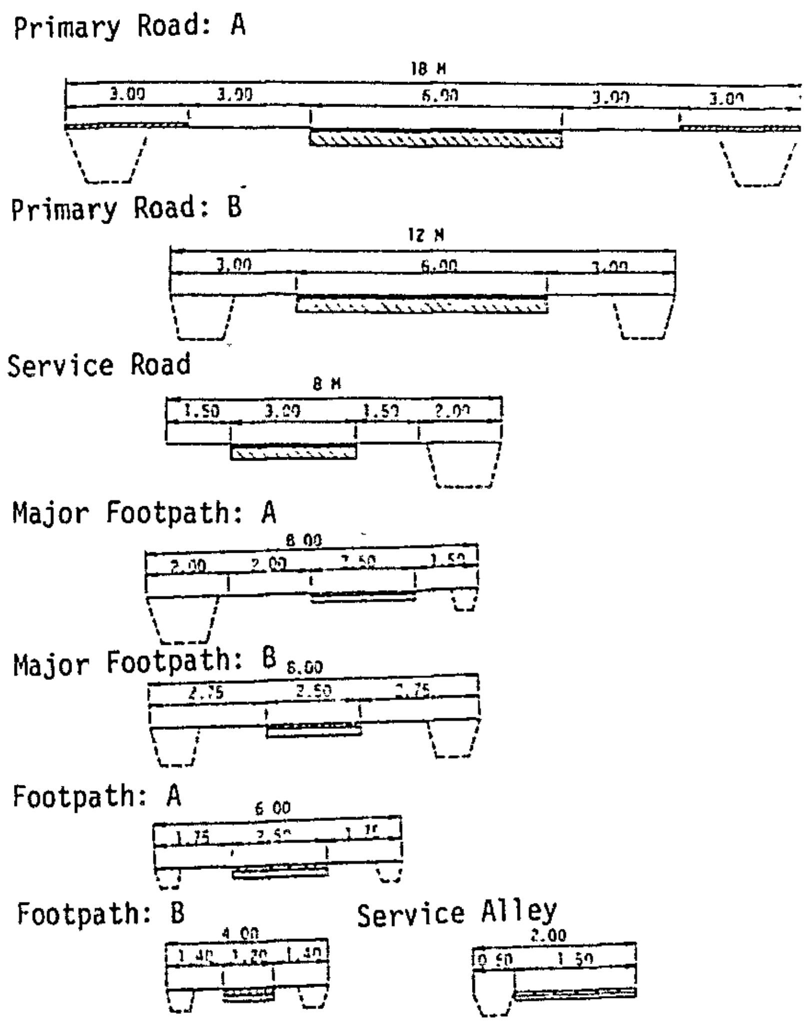


Fig. 5-19 RIGHT OF WAY

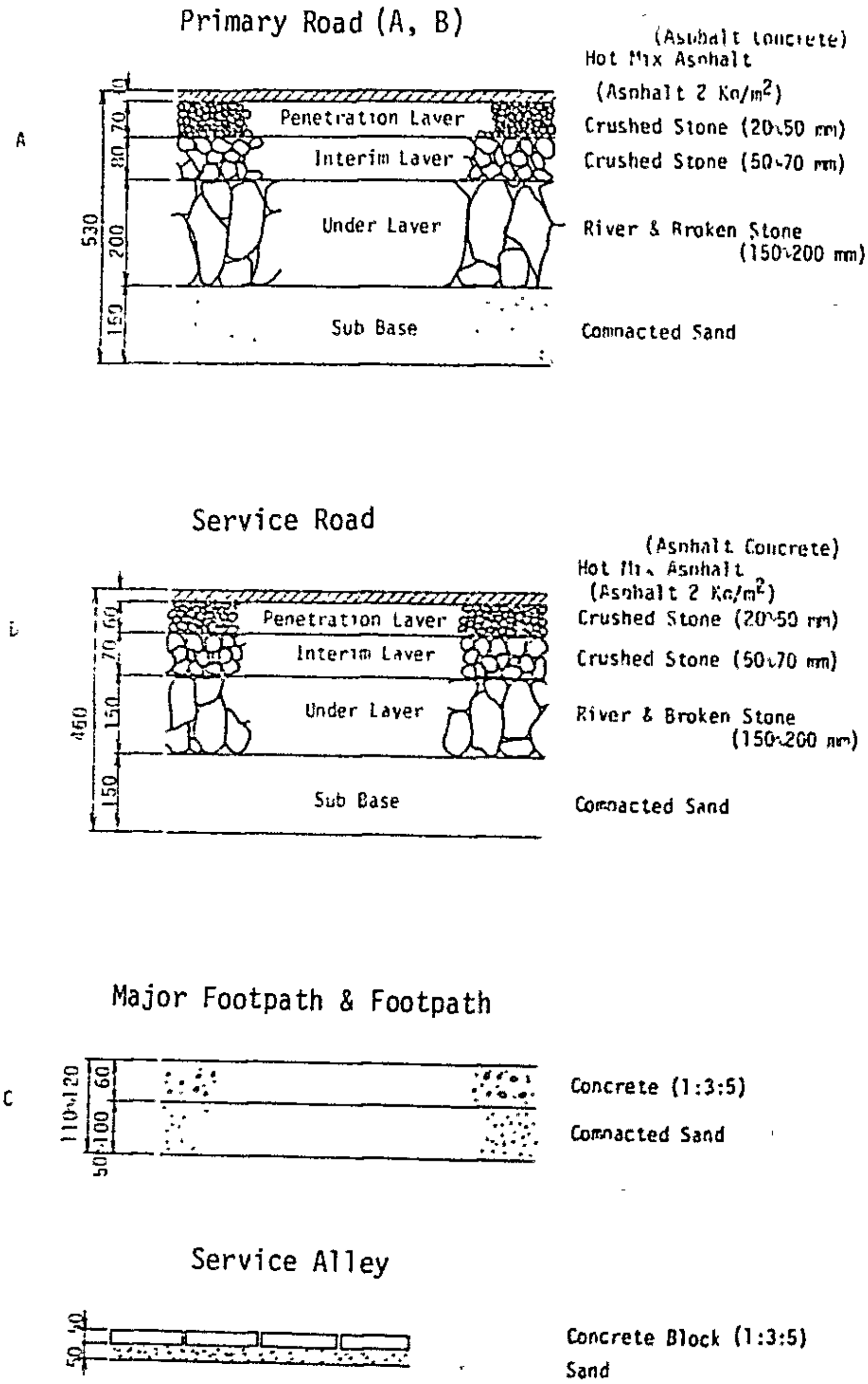
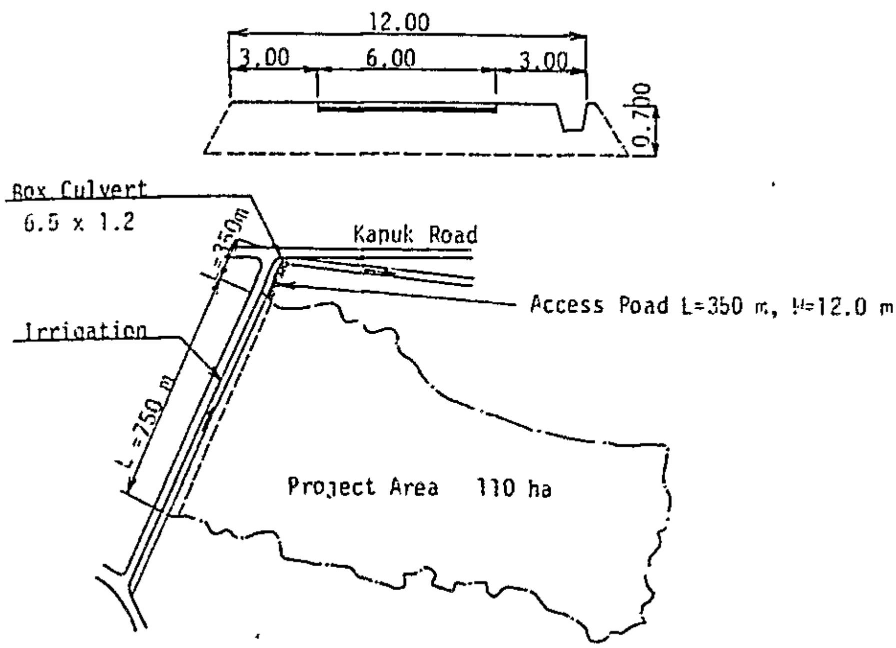


Fig. 5-20 DETAILS OF PAVEMENT

(ACCESS ROAD)



a. Construction costs of access road   Cost in June,1980

1)	Land fill & compaction	
2)	Pavement (W = 6.0m L = 350m)	
3)	Gutter (0.84×0.6×0.6 L = 350m)	
4)	Box culvert (6.5×1.2×10.0)	
5)	Total	34.4 million Rp.
6)	Overhead (5)×0.1	3.4
7)	Taxes (PPN) ((5)+(6))×0.025	0.9
		38.7 million
	Land aquisition	24.5 million

b. Construction costs of road work

(based on figures of June 1980)

I-1 On-site (PERUM PERUMNAS)

1. Road	Width (m)	Pavement area (m^2)	
Primary road A	18	10,140	
Primary road B	12	14,220	
Service road	8	18,930	
Major footpath	8	12,625	
Footpath	6	11,235	
"	4	11,256	
Service alley	2	28,035	
Bus terminal		5,000	
2. Total (net)			548.1
3. Overhead (2)×0.1			54.8
4. Taxes (PPN) ((2)+(3))×0.025			15.1
5. Total-On-site (PERUM PERUMNAS)			618.0 million Rp

I-2 On-site (DKI Jakarta)

1. Road	Width (m)	Pavement area (m^2)	
Primary road B	12	4,200	
2. Total (net)			31.5
3. Overhead (2)×0.1			3.2
4. Taxes (PPN) ((2)+(3))×0.025			0.8
5. Total-On-site (DKI Jakarta)			35.5 million Rp

II Off-site (DKI Jakarta)

		Width (m)	Pavement area (m^2)	
1.	Road			
	Primary road B	12	2,100	
2.	Total (net)			24.5
3.	Overhead (2)×0.1			2.5
4.	Taxes (PPN) ((2)+(3))×0.025			0.7
5.	Total Off-site (DKI Jakarta)			27.7 million Rp

5-4 WATER SUPPLY SYSTEM

5-4-1 Present conditions of water supply system

a. Conditions in DKI Jakarta

The main authority supplying water to DKI Jakarta is PAM-JAYA (Perusahaan Air Minum-JAYA), but it only has the capacity to supply water to about half of DKI Jakarta's population. The remaining inhabitants rely on water vendors or private sources (shallow wells etc.).

PAM-JAYA's current sources of water are Bogor (source: spring) and Pejompongan (source: Ciliwung River), and the total supply capacity is 5,300 ℓ/sec. The supply pressure is low due to the use of old pipes of insufficient dimensions.

b. Conditions in and around the Planning Area

There are no existing supply pipes to the west of the Angke River, and between Grogol and the Angke River, there is only 250ϕ of pipeline. Consequently, apart from one section where deep wells are used, shallow wells supply the remainder of the Planning Area. In some cases, river water is used for purposes other than drinking water.

However, a small scale purification plant is being constructed, using the Angke River's up-stream as a source, to cater for the recently developed housing areas (Cengkareng Indah, Taman Kota etc.) near the Planning Area.

c. Conditions on existing PERUM PERUMNAS housing developments

Water source

With the existence of PAM, the water supply for the urban areas is mainly provided by PAM, but areas without PAM facilities use deep wells and rivers as main water sources. Where water source capacities are insufficient, some use of shallow wells is made. The water sources for the major existing housing developments are as follows:

Klender	:	Deep wells, partial use of shallow wells
Depok	:	PAM
Bandung	:	PAM
Cirebon	:	PAM, partial use of shallow wells
Tangerang	:	PAM
Tanah Abang	:	PAM

Water consumption

With regard to water supply volumes, it is difficult to ascertain the real volume of demand, as every housing estate suffers shortages. According to a recent survey in Klender by PAM-JAYA, the demand is for approximately 90ℓ/capita/day (total use). When the water supply was planned, generally a figure of 80 - 100ℓ/capita/day was used.

Distribution system

The water supply distribution system adopted is usually of the central or zone elevated reservoir system. In special cases, the pumped, direct connection method is employed.

d. PAM-JAYA's future plans

With increased output from Pejompongan and the new plant at Pulo Gadung, PAM-JAYA will increase its supply capacity from the current 5,300 ℓ/sec to 9,900 ℓ/sec by December 1983. At the same time, 800ϕ of new piping will replace the existing 600ϕ by the same completion date, and according to the Master Plan, 800ϕ of supply pipes will be installed along the Jakarta-Tangerang Road, to the west of Grogol, by 1990, as part of the "1st Stage of Future Project". However, this will not be in time for the construction schedule of the Project Area.

5-4-2 Planning of water supply system

a. Preconditions of the planning

Planning area and Project Area

The relationship between the Planning and the Project Area is as follows. The biggest problem in this case is the establishment of a supply source, since the Planning Area is not covered by the public water supply system and there are no definite future plans as to when the supply for the area will be developed. The expense required for the installation of a supply system covering the entire Planning Area (370ha) would be so great that this program will deal initially with the construction of a supply system for the Project Area (110ha).

With each expansion of the area covered by the project, the supply system will be improved accordingly, until the entire 370ha Planning Area is ultimately covered.

As each section in the Project Area develops its own distribution network, adjacent areas will be connected to the system through valves, for mutual back-up.

Water source

The supply system will cover the Project Area as mentioned above. The installation of the system will be treated as an emergency project, and presumes that the area will switch over to a new supply system to be installed as part of future DKI Jakarta's Masterplan covering the Project Area.

Financing of costs

The installation of a water source and transmission pipes outside the Project Area will be financed by the central government, while PERUM PERUMNAS will cover the cost of installation within the area.

b. Outline of the planning

Water consumption per capita

The following was confirmed by the Steering Committee Conference meeting held in Jakarta on November 4th 1980.

The figure to be used for the determination of consumption will be 60ℓ per capita per day for residential consumption, as used in estimating water supply development in REPELITA III. Allowance for leakages, plus recommendations for non-residential utilities will also be based on the same findings. (cf. 5-4-2-c.)

Water source

The following was decided during the meeting of the Steering Committee at the same time as above.

The water will be provided by PAM-JAYA, and will be piped under pressure added by the installation of a booster-pump station at Grogol. (cf. 5-4-2-d.)

Distribution system

The Project Area will be divided into 2 zones and each is to be fed by gravity flow systems from one of the two proposed elevated reservoirs. (cf. 5-4-2-e.)

Counterplan for low-lying areas

Piping materials to be used,

Transmission pipes: Ductile cast-iron pipes
Distribution pipes: PVC-VP (10kg/cm^2)

Sand bedding will be used on condition that ample care is taken during installation.

Cast-iron pipes will be used as covering protection at road crossings.

Preventative methods to avoid shearing of the pipes due to differential settlement, will be considered.

The elevated reservoirs will be erected on concrete pile foundations appropriate to the ground strength.

Construction costs

See 5-4-2-h.

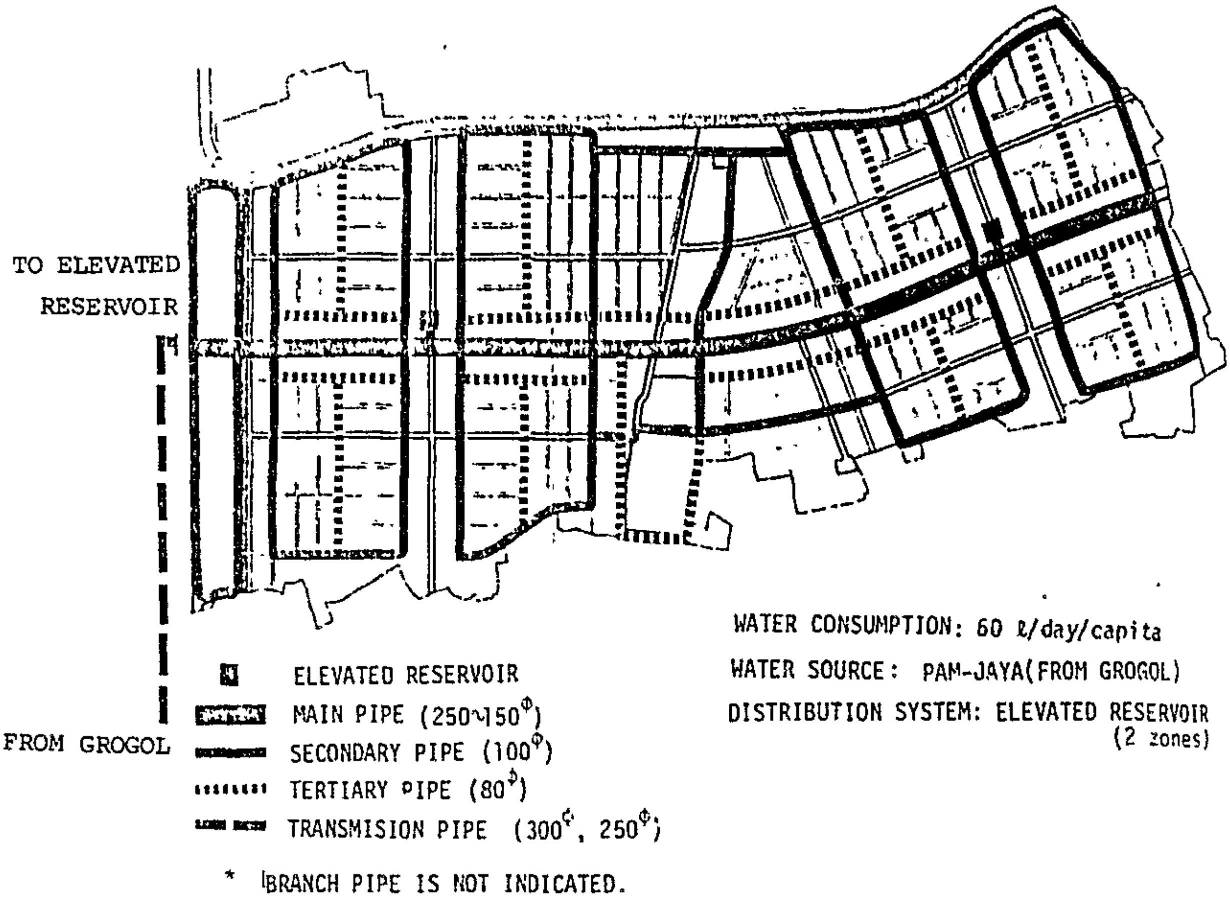


Fig. 5-21 WATER SUPPLY NETWORK

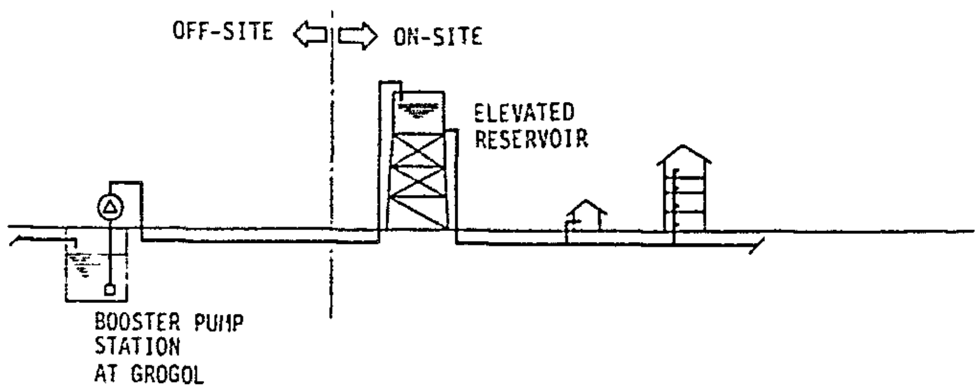


Fig. 5-22 DIAGRAMME OF WATER SYSTEM

c. Assessment of water consumption

The study team presented the following two options to the Steering Committee:

Table 5-7 WATER CONSUMPTION PER CAPITA

	a. Average daily for domestic	b. Average daily for other uses	c. Leak	d. Average daily total	e. Max. daily total
Case A	60 ℓ/d.c	15 ℓ/d.c	11 ℓ/d.c	86 ℓ/d.c	100 ℓ/d.c
Case B	80 "	20 "	15 "	115 "	132.25 "
		a.×0.25	(a.+b.)×0.15	a.+b.+c.	d.×1.15

Case A. represents the figures used by the Indonesian Government in their strategy for water supply development in REPELITA III. Case B represents figures compiled by PERUM PERUMNAS based on data from existing residential areas.

From these alternatives, the Steering Committee chose Case A, due to the fact that this is a government project and that the installation of supply lines outside of the Project Area will be financed by the government, not PERUM PERUMNAS.

However, with a figure of almost 30% less than with Case B, and with a probable increase in future consumption, water shortage problems could arise. Therefore, transmission pipes to be used will have a 20-30% allowance for a possible increase in output.

The cost analysis will be carried out for both Case A and Case B.

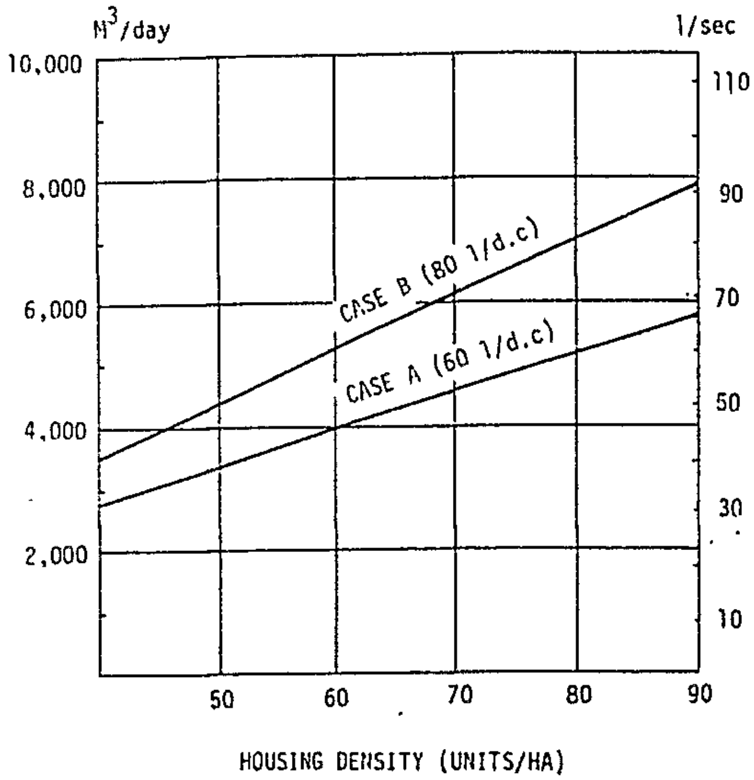


Fig. 5-23 MAXIMUM DAILY WATER CONSUMPTION

d. Water source

The study team shall first look at the following three possible sources:

(1) Supplied by PAM-JAYA

(Conveying water from the existing pipelines at Grogol under pressure added by booster pumps)

PAM-JAYA currently has 250ϕ of pipelines to the east bank of the Angke River, but with only 15m of head at Grogol, direct feeding to the Project Area is not possible. Since the 250ϕ of pipeline will only provide for the surrounding areas, raising of pressure through the construction of a booster pump station is necessary. The route of supply from PAM could either be through PAM-JAYA or PAM-Tangerang but the latter is an organization based outside DKI Jakarta and since the conveying distance is further, PAM-JAYA is the better choice.

Alternatively, the source to the proposed new international airport, to be built about 5km north west of the Project Area, could possibly be used, but since its construction is likely to be behind schedule, the source cannot be considered as a definite alternative.

PAM-JAYA's capacity is to be increased to 9,900 ℓ/sec. by December 1983, but this increased amount will still be insufficient for DKI Jakarta's requirements. However, the amount to be diverted to the Project Area constitutes only 0.5-0.7% of the overall output and is therefore considered a permissible amount which will not seriously affect the other areas.

(2) Construction of a small scale purification plant using the Pesanggrahan River as a source

Due to the relatively large demand (50-70 ℓ/sec approx.) for this project, consideration of the construction of a small scale purification plant using a river as a source is possible. The rivers initially considered as a possible source are as follows:-

i. Angke River (approximately 3km to the east)

ii. Mookervaart River (along the Jakarta-Tangerang Road)

iii. Irrigation channels (adjacent to north and west sides of the Project Area)

iv. Cisadane River (approximately 10km to the west)

According to the existing data on water quality, only the Cisadane River was able to provide the amount and quality of water required for use as a source. The others were deficient, due to shortage during the dry season or because of other use, or they were too polluted due to disposition of factory effluent. However, the distance from the Cisadane River to the Project Area also made it an economically unfavourable choice.

In the field survey during October and November 1980, the Indonesian government suggested the use of the Pesanggrahan River, approximately 5km to the south from the Project Area.

The study team then carried out a field survey and quality tests on the river, and discovered that a section about 3km south of the Jakarta-Tangerang Road, carried enough water so as not to affect the need of the local inhabitants and agricultural irrigation, with sufficient purity. The section also posed no difficulty of reversed flow from sea tides, and was therefore considered as another possibility.

Even when the output by PAM-JAYA is increased, it will still be unable to meet the whole demand, and so a small scale purification plant is of great significance as a back-up system to DKI Jakarta's water supply, or as a step towards developing a supply system to the Kota Madya Jakarta Barat areas.

In order to utilize river water, permission from the Directorate General of Water Resources is required.

(3) Construction of a deep well within the Project Area

The boring data for DKI Jakarta's northern areas was obtained, but due to a restriction on the number of bore-holes and scattered depths, it was difficult to come to a definite conclusion. Consequently the possibility of a deep well had to be sought from information given by those involved with underground water resources, the results of which are given below.

i. Due to excessive use of underground water, a decrease in the level of the water table has been observed.

ii. In the northern sector, considerable salination has been caused by reverse flow from the sea.

iii. The project area is close to the expanding industrial zone, which has a large intake from underground sources. The area's supply capacity is about 5 ℓ/sec. and though saline to a depth of about 100m, suitable water can be obtained from depths of over 200m.

From these factors it was concluded that the available output and the quality of the water are below the required standard, and that the use of a deep well is not suitable, except as a temporary aid. If it is absolutely necessary to adopt this method, boring tests should be carried out in detail.

If a deep well is to be used, the following regulations set in accordance with the "Geological Survey of Indonesia" must be followed.

Maximum allowable extraction rate	:	200 ℓ/min.
Minimum depth of deep well	:	100m
Minimum distance between wells	:	200m

Out of the above three alternatives contemplated by the study team, the following two were submitted to the Steering Committee as possible means of supply.

Case I Supplied from PAM-JAYA (Grogol)

Case II Construction of a small scale purification plant using the Pesanggrahan River as a source.

The Steering Committee then decided in favour of Case I, but only as an Emergency Project, and when the supply system under the Masterplan becomes effective, the concerned area will transfer to the new network and the pipeline from Grogol will probably become redundant.

The cost analysis is presented for both Case I and II.

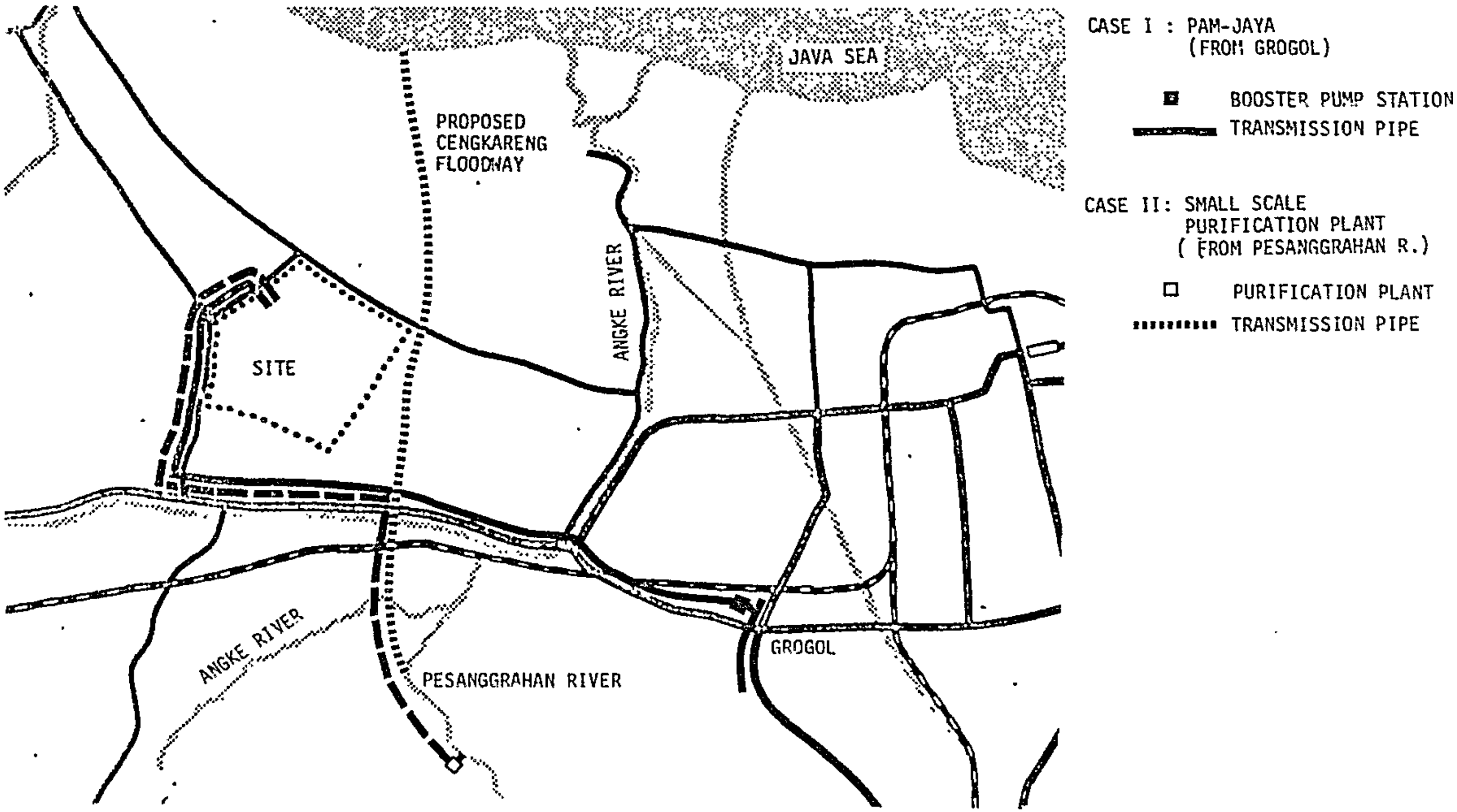
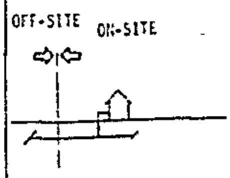
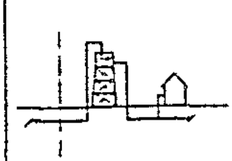
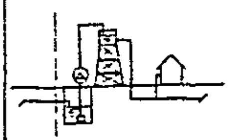
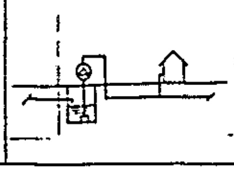


Fig. 5-24 ALTERNATIVES OF WATER SOURCE

e. Distribution system

Selection of the pressurized system

Table 5-8 PRESSURISED SYSTEMS

System	Flow diagram	Construction cost			Operation cost		Adopted system
		Off-site	On-site	Total	Off-site	On-site	
(1) Direct connection		3	1	4	3	1	
(2) Indirect - Elevated reservoir		2	4	3	2	1	o
(3) Indirect - Underground Reservoir + Pump + Elevated reservoir		1	3	2	1	2	
(4) Indirect - Underground Reservoir + Pump		1	2	1	1	3	

* Smaller index number indicates cheaper costs.

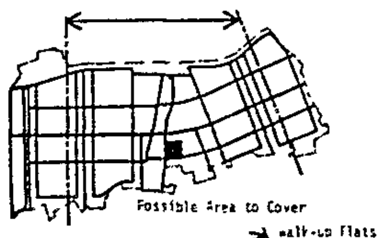
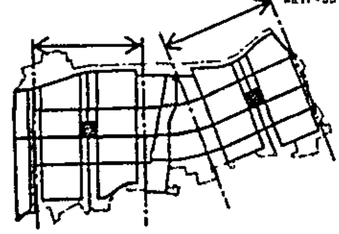
For reasons stated below, system (2) will be adopted.
System (1) would require large diameter transmission pipes to the Project Area since it must have the capacity to carry the peak flow rate, and with the length of the pipeline needed, the construction cost is the highest of the alternatives.
In addition, the water must be pumped directly to houses, making the running costs high, thus the system is not a favourable one.

System (2) requires the construction of a large elevated reservoir making its construction cost the second highest system to (1), but its advantage lies in the low running and maintenance costs. At the moment, this system is used in most parts of PERUM PERUMNAS housing areas. System (3) seems the most favourable overall, but calls for demanding maintenance work within the Project Area, and the running costs are marginally higher than system (2). System (4) has low running costs, and is recommended for use in areas with weak soil conditions, but the maintenance of the pumps is a problem and, with it running 24 hours, the operation cost is high.

Zoning of the elevated reservoir

Taking into account the expanse of the Project Area, construction time schedule of the project, pressure required to feed each dwelling, and supply to walk-up flats, the following 2 designs were developed.

Table 5-9 ZONING OF ELEVATED RESERVOIRS

	Piping friction per meter	Construction costs×mil.Rp			Layout	Adopted system
		Elevated reservoirs	Piping etc.	Total		
1 Zone	4mm/m	m^3 unit 800 × 1 199	616	815		
2 Zones	6mm/m	m^3 units 400 × 2 198	626	824		o

Cost in June,1980

Note 1) The pipe friction loss per meter incurred in adopting 25m as the height of the reservoir, and the following figures for the minimum service water pressure needed.

Low rise housing 15m
Walk-up flats 3m

Note 2) Construction costs are for June 1980 with daily water consumption of 60 ℓ/capita/day and with 70 units/ha.

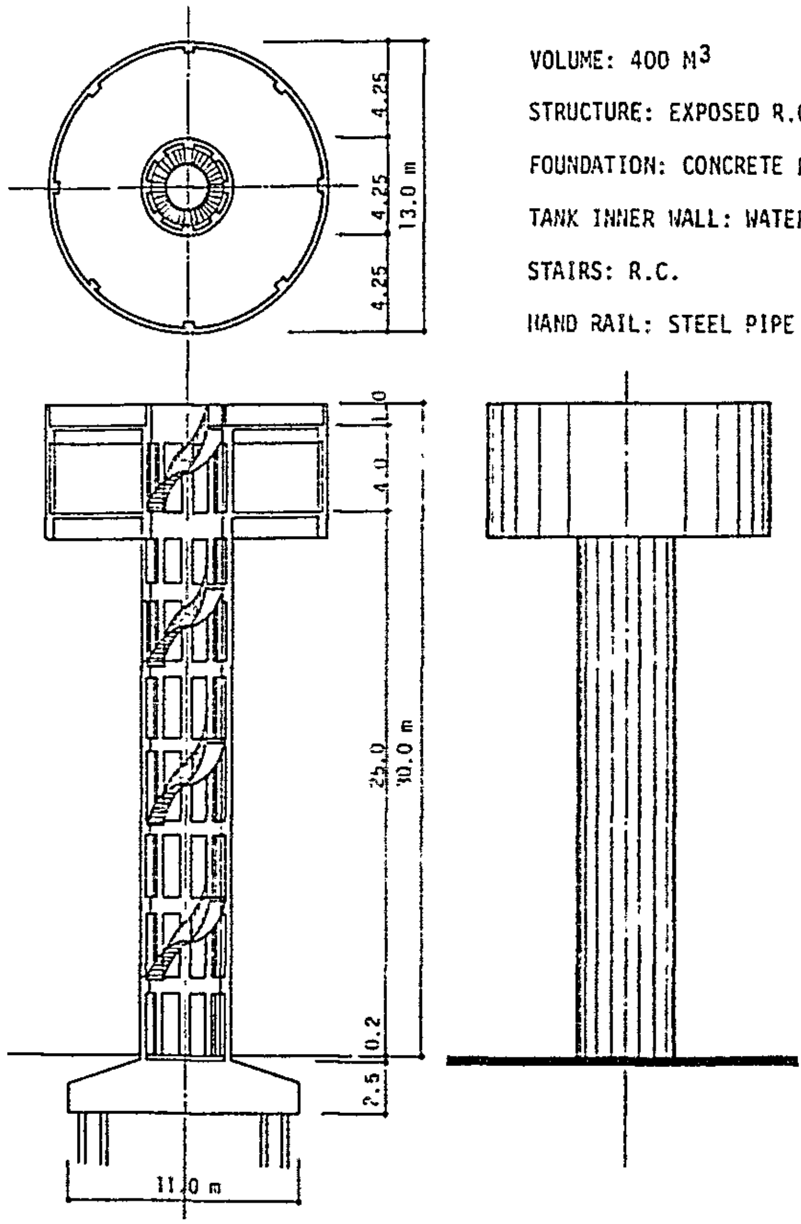
The reasons for choosing a 2 zone system are as follows:

i. The planned schedule is to carry out the construction and sales in the 110ha Project Area in two stages, and an appropriate system was necessary. If only one reservoir is to be erected, the operation would take about more than one year, and comparing this to the construction program of the residential areas, it is not possible to have the reservoir in operation by completion of the first stage. By constructing two reservoirs, the construction time for each reservoir is shortened to approximately 6∿8 months, and is therefore, timewise, more advantageous.

ii. The construction cost of the reservoirs are almost the same for each system, and consequently, the construction of just one reservoir would require a proportionately higher initial expenditure.

iii. With two reservoirs, there is the added advantage that one may supplement the other during breakdown, and since water is a necessity to every day life, a system which can overcome breakdowns would be welcome.

The following shows the outline specifications of the elevated reservoir.



VOLUME: 400 M^3

STRUCTURE: EXPOSED R.C.,PAINTING

FOUNDATION: CONCRETE PILE

TANK INNER WALL: WATER PROOF MORTAR

STAIRS: R.C.

HAND RAIL: STEEL PIPE W/PAINTING

Fig. 5-25 ELEVATED RESERVOIR

f. Counter plans for lowland areas

The major part of the Planning Area is taken up by paddy fields, and therefore, does not constitute an ideal soil conditions. Consequently, the properties of the soil, land development method, traffic load, and road structures, must all be studied in detail, to determine the most economical and suited selection of pipes material, buried pipes depth and pipe foundation, to be employed.

It has already been established that using the land development method suggested in this report (cf. 5-2) will leave the ground with sufficiently strength, but taking into account the degree of precision on site, some room for consolidation and differential settlement should be born.

Material of pipes and buried pipe depth

Pipes are subject to pressure from the weight of back-fill, traffic, and the weight of the pipes themselves when containing water, but the loading due to the back-fill, and traffic, are the main factors affecting pipe selection.

The study team established the following specifications.

Purpose	Material of pipes	Depth buried pipe
Transmission pipe	Ductile cast-iron pipe	> 1m
Distribution pipe	PVC-VP ($10kg/cm^2$)	less than 4": >0.3m (except vehicles roads) more than 4": >1m

Transmission pipes should have high strength and durability. Ductile cast-iron pipes have high pressure tolerance and bending strength, and are widely used in PAM-JAYA.

Distribution pipes must be of sufficient elasticity to tolerate deflection and bending, but at the same time must be cheap, as they are to be used in bulk. For these reasons PVC-VP will be used. The specifications for these pipes are 5% maximum deflection and 225 kg/cm^2 maximum bending strength (Safety factor = 4), which are thought to be sufficient for use in this project.

Pipe bedding

In Republic of Indonesia, sand bedding is widely used, even under bad ground conditions, when piping such as that mentioned above, is used.

Adoption of a bedding system used for bad ground condition would be desirable, but with the conditions given below, the sand bedding system was chosen for this project.

i. Good quality sand is used.

ii. Consolidation of the back fill is carried out with care.

iii. Short pipes and flexible jointing are used when the bed stability is uncertain.

iv. Protective measures will be taken at road crossings.

The reasons for choosing sand bedding are as follows:

i. With the above precautions it is safe to use PVC-VP.

ii. Timber grillage bedding as used in the areas of unstable ground require raw pine timbers, and substitutes are unavailable in Indonesia.

iii. Low costs involved.

Pipe protection at road crossings

This is not a problem only occuring in the swampy areas, but is faced whenever a large load is imposed from above. In Indonesia, cast-iron or galvanised iron pipes are used as covering to protect crushable pipes such as PVC. Other methods available include complete jacketing with reinforced concrete, but since this is not commonly used in Indonesia, the iron pipe method will be used in this project.

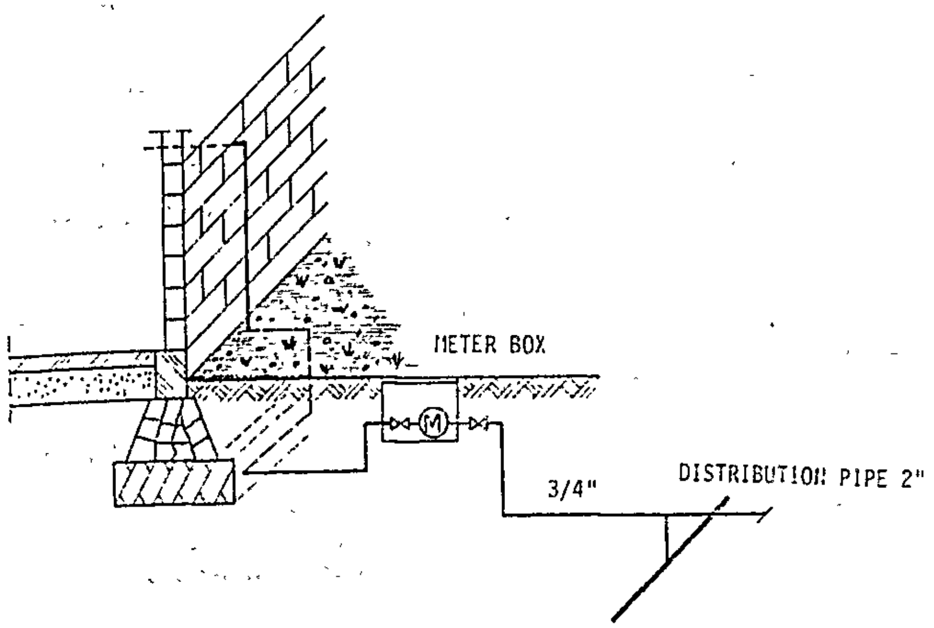
Method of connection to dwellings

With the danger of service pipes shearing due to differential settlement between the structural foundation and the surrounding earth, the following preventative methods can be used.

(1) Use of flexible joints on the service pipes.

(2) Taking the service pipes overground and using an elbow at the emergence to absorb the differential settlement forces.

This project will adopt the second alternative.



CONNECTION TO DWELLINGS

Elevated reservoir

As mentioned in section (e), a concrete pile foundation in accordance with the durability of the ground, is necessary. In addition, a shear prevention system will be installed at the point where the pipes emerge from the ground.

g. Preliminary engineering

The followings have been determined based on standards set by PERUM PERUMNAS.

i. Source capacity: Max. daily water consumption

ii. Booster pump station

Transmission capacity	:	as in i.
Pump	:	(Transmission capacity ÷ 3) × 4 units (including one stand-by pump) Multi-stage volute pump with automatic alternation operation control and on-off control through a pressure gauge.
Storage pit	:	(Transmission load) × 30min., under-ground concrete type.
Others	:	Overground pump house, no generator.

iii. Transmission pipes

Pipe material : Ductile cast-iron pipes

Pipe dimensions : 20-30% allowance for future increase in capacity

Depth of back fill: 1m minimum

iv. Elevated reservoir

Capacity : (Average daily water consumption)×0.2

Required height : 25m

Others : Construct with concrete.

v. Distribution pipes

Pipe material : PVC-VP 10 kg/cm^2

Pipe dimensions : Determine through peak flow rate (= average flow rate × 1.75) subject to minimum dimensions of:

Main pipes	:	4" min.
Branch pipes	:	2" min.
House connection pipes	:	3/4"

Depth of buried pipes :

∿ 2"	:	40cm min.
3 ∿ 4"	:	60cm min.
5 ∿ 6"	:	80cm min.
8" ∿		100cm min.

Protection at road crossings : Cover with cast-iron pipes

vi. Distribution pressure to dwellings:

Low rise & 2 storied houses: 15m
Top floor in walk-up flats : 3m

vii. Installations within dwellings:

Kitchen and WC/mandi

* Mandi: Indonesian style bathroom

viii. Fire protection

Fire hydrants : 4" upright hydrants to be installed at verge of main roads.

Maximum radius of area covered:
Residential area: 200m
Commercial area : 100m

h. Construction costs

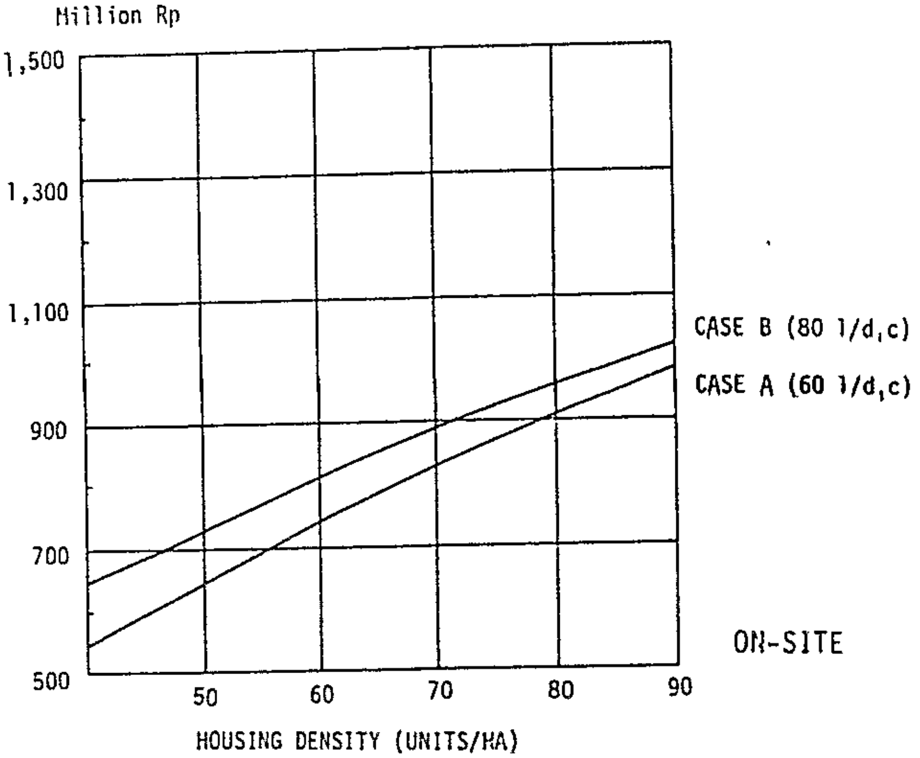
The costs for the following cases are calculated.

Case	Water source	Water consumption per capita
I. A I. B	Case I. PAM-JAYA	Case A. 60 ℓ/d.c Case B. 80 "
II. A II. B	Case II. Small scale purification plant (Pesanggrahan River)	Case A. 60 " Case B. 80 "

The results of the analysis are shown on the graphs below, but the figures used are subject to the following conditions.

i. Construction costs are for June 1980.

ii. 2 Elevated reservoirs will be erected.



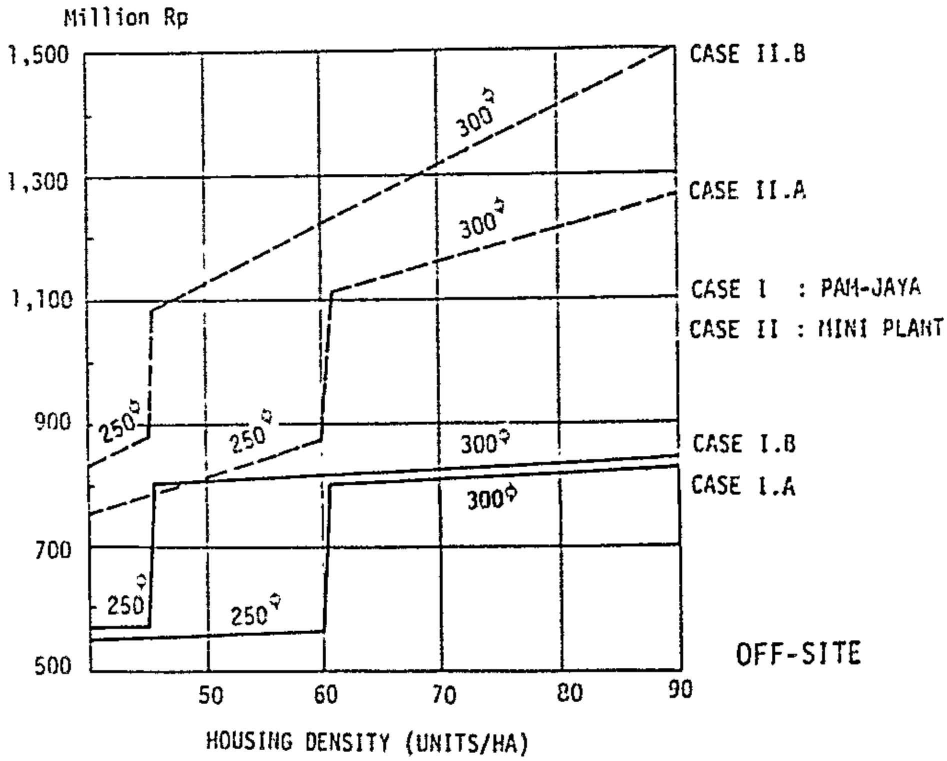


Fig. 5-26 CONSTRUCTION COST OF WATER SUPPLY SYSTEM

Cost in June,1980

The cost analysis procedure for Case IA, 70 units/ha is presented below. (Costs based on figures of June 1980)

I. Off-site

			million Rp
1.	Booster pump station		18.7
	Pump	1,600ℓ/min.×67m×30kW×125ϕ×3units	
	Storage pit	$100m^3$	
2.	Transmission pipe (DCIP)		668.7
	300ϕ	10,000m×66,865 Rp/m (including road repair)	
3.	Pipe bridge		
	300ϕ	150m×120,000 Rp/m	18.0
4.	Railway crossing		8.0
5.	Others (preparation, finish work etc.)		7.1
6.	Total (net)		720.5
7.	Overhead	(6.)×0.1	72.1
8.	Taxes (PPN)	(6.+7.)×0.025	19.8
9.	Total - Off-site		million Rp 812.4

* Land acquisition costs for the booster pump station at Grogol $100m^2$×40,000 Rp/m^2 = 4 million Rp

II. On-site

			million Rp
1.	Transmission pipe (DCIP)		64.7
	300ϕ	400m×61,865 Rp/m	
	250ϕ	1,000m×39,920	
2.	Elevated reservoir		176.0
		$400m^3$×2 units	
3.	Distribution pipe (PVC-VP)		78.4
	250ϕ	105m×27,475 Rp/m	
	200ϕ	870 ×18,785	
	150ϕ	890 ×12,305	
	100ϕ	9,800 × 6,750	

	80ϕ	3,250m×4,225 Rp/m	
	65ϕ	2,000 ×2,990	
	50ϕ	24,300 ×2,415	
4.	House connection		
		(7,700units+250units)×32,700 Commercial etc. Rp/unit	260.0
5.	Major stop values		9.2
6.	Pipe protection at road crossing (CIP)		18.4
7.	Fire hydrant		
	100ϕ	24units×400,000 Rp/unit	9.6
8.	Road repair		6.3
		1,250m×5,000 Rp/m (excluding for footpath)	
9.	Others		11.7
10.	Total (net)		730.6
11.	Overhead	(10)×0.1	73.1
12.	Taxes (PPN)	(10.+11.)×0.025	20.1
			million Rp
13.	Total - On-site		823.8

5-4-3 Relating Data

a. Water Quality Data

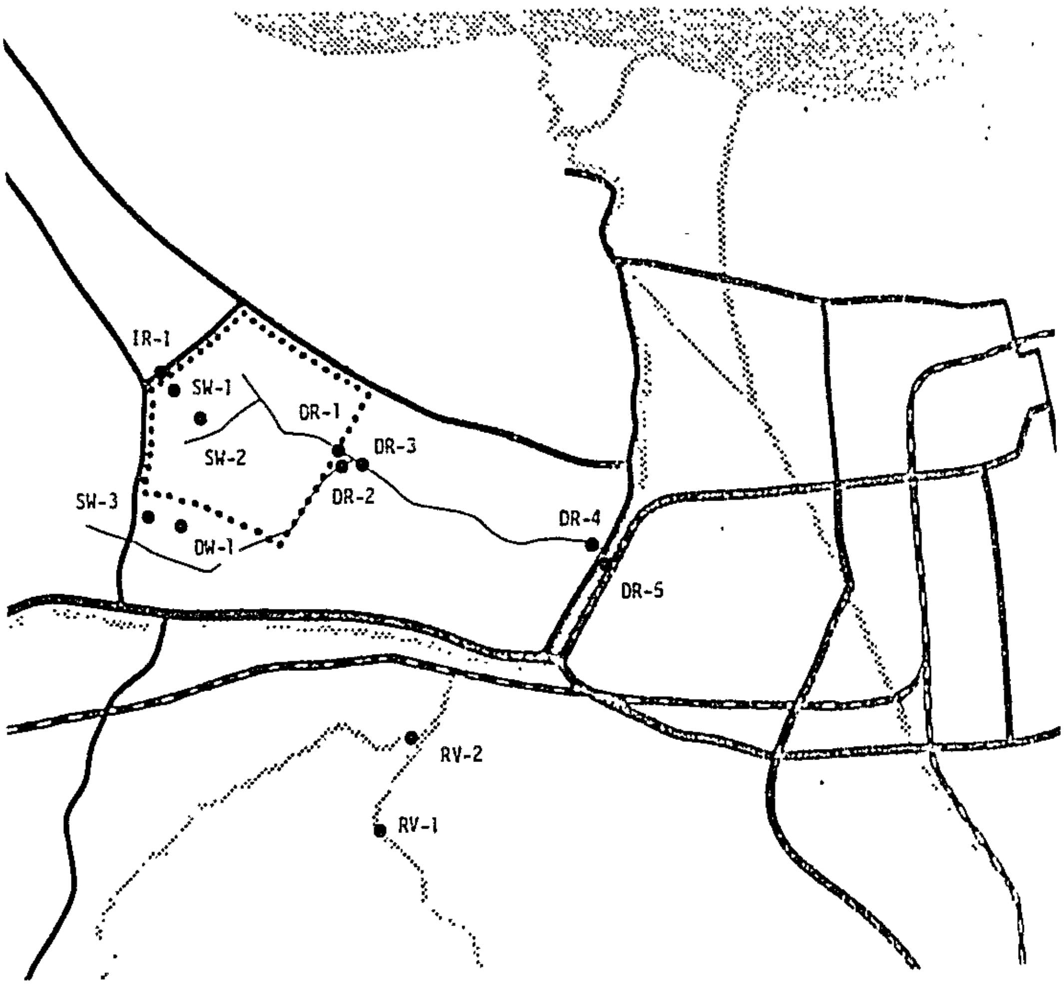


Fig. 5-27 MAP OF SAMPLING POINTS

Table 5-10 WATER QUALITY TEST DATA (1)

Items	Unit	Max. of recommendation	Max. of permission	DW-1	SW-1	SW-2	SW-3	IR-1
Place				Deep well near the site	Shallow well on-site	Shallow well on-site	Shallow well near the site	Irrigation canal near the site
Date		(Standard by Ministry of Health)		31,July,'80	31,July,'80	31,July,'80	31,July,'80	31,July,'80
1. Color		5	50	65	15	15	5	>100
2. Odor		-	-	-	-	-	-	-
3. Taste		-	-	-	-	-	-	-
4. PH		6.5	9.2	7.6	7.0	7.5	6.7	6.3
5. Organic matter	ppm ($KMnO_4$)	-	10	25.28	4.74	4.11	9.48	12.64
6. Carbon dioxide	ppm (CO_2)	-	0.0	17.60	52.8	30.8	35.2	13.20
7. P-Alkalinity	ppm ($CaCO_3$)	-	-	0.0	0.0	0.0	0.0	0.0
8. M-Alkalinity	"	-	-	490.0	310.0	445.0	120.0	45.0
9. Carbonate	"	-	-	0.0	0.0	0.0	0.0	0.0
10. Hydroxide	"	-	-	0.0	0.0	0.0	0.0	0.0
11. Bicarbonate	"	-	-	490.0	310.0	445.0	120.0	45.0
12. Total hardness	°D	5	10	1.0	20.8	7.2	48.0	1.0
13. Calcium	ppm (Ca^{++})	75	200	5.71	48.55	27.13	168.5	5.71
14. Magnesium	ppm (Mg^{++})	30	150	0.86	60.20	14.62	104.92	0.86
15. Iron	ppm (Fe^{++})	0.1	1.0	negative	negative	negative	negative	trace
16. Mangan	ppm (Mn^{++})	0.05	0.5	negative	negative	negative	negative	negative
17. Sulfate	ppm (SO_4)	200	400	negative	440	712	640	negative
18. Phosphate	ppm (PO_4)	-	-	negative	negative	negative	negative	negative
19. Ammonium	ppm (NH_4)	-	0.0	negative	negative	negative	0.25	negative
20. Nitrite	ppm (NO_2)	-	0.0	negative	negative	negative	negative	negative
21. Chloride	ppm (Cl^-)	200	600	24.14	71.0	102.24	1004.65	12.07
22. BOD	ppm							
23. COD	ppm							
24. SS	ppm							

Water samples were tested by the Laboratory of PAM-JAYA (Item No. 1~21) and P.T. Superintending Company of Indonesia (Item No. 22~24)

WATER QUALITY TEST DATA (2)

Items	Unit	Max. of recommendation	Max. of permission	DR-1	DR-2	DR-3	DR-4	DR-5
Place				Drainage near the site	Drainage near the site	Drainage near the site	Drainage near the site	Angke river
Date		(Standard by Ministry of Health)		31, July, '80	31, July, '80	31, July, '80	31, July, '80	31, July, '80
1. Color		5	50	75	65	65	150	>100
2. Odor		-	-	-	-	-	yes	-
3. Taste		-	-	-	-	-	-	-
4. PH		6.5	9.2	6.9	7.1	6.5	6.9	6.7
5. Organic matter	ppm ($KMnO_4$)	-	10	35.70	39.50	21.48	237.63	10.74
6. Carbon dioxide	ppm (CO_2)	-	0.0	22.0	17.60	17.60	127.60	13.20
7. P-Alkalinity	ppm ($CaCO_3$)	-	-	0.0	0.0	0.0	0.0	0.0
8. M-Alkalinity	"	-	-	120.0	120.0	80.0	185.0	40.0
9. Carbonate	"	-	-	0.0	0.0	0.0	0.0	0.9
10. Hydroxide	"	-	-	0.0	0.0	0.0	0.0	0.0
11. Bicarbonate	"	-	-	120.0	120.0	80.0	185.0	40.0
12. Total hardness	°D	5	10	6.8	6.6	6.4	12.4	1.6
13. Calsium	ppm (Ca^{++})	75	200	17.13	24.27	24.27	72.82	2.58
14. Magnesium	ppm (Mg^{++})	30	150	18.92	13.76	12.90	9.46	1.30
15. Iron	ppm (Fe^{++})	0.1	1.0	1.0	1.2	1.4	negative	1.3
16. Mangan	ppm (Mn^{++})	0.05	0.5	negative	trace	positive	negative	positive
17. Sulfate	ppm (SO_4)	200	400	trace	45	25	325	30
18. Phosphate	ppm (PO_4)	-	-	negative	negative	negative	negative	negative
19. Ammonium	ppm (NH_4)	-	0.0	0.6	0.6	negative	0.6	negative
20. Nitrit	ppm (NO_2)	-	0.0	negative	negative	negative	negative	trace
21. Chloride	ppm (Cl)	200	600	84.49	80.23	54.67	41.89	13.49
22. BOD	ppm			380.0	252.0	354.0	290.0	
23. COD	ppm			129.96	249.09	267.14	779.76	
24. SS	ppm			12.0	14.0	16.0	18.0	

Water samples were tested by the Laboratory of PAM-JAYA (Item No. 1~21) and P.T. Superintending Company of Indonesia (Item No. 22~24).

WATER QUALITY TEST DATA (3)

Items	Unit	Max. of recommendation	Max. of permission	RV-1	RV-2
Place				Pesanggrahan river	Pesanggrahan river
Date		(Standard by Ministry of Health)		30,Oct.'80	30,Oct.'80
1. Color		5	50	150	150
2. Odor		-	-	-	-
3. Taste		-	-	-	-
4. PH		6.5	9.2	6.7	6.7
5. Organic matter	ppm ($KMnO_4$)	-	10	6.92	7.26
6. Carbon dioxide	ppm (CO_2)	-	0.0	13.2	13.2
7. P-Alkalinity	ppm ($CaCO_3$)	-	-	0.0	0.0
8. M-Alkalinity	"	-	-	40.0	37.5
9. Carbonate	"	-	-	0.0	0.0
10. Hydroxide	"	-	-	0.0	0.0
11. Bicarbonate	"	-	-	40.0	37.5
12. Total hardness	°D	5	10	1.0	1.0
13. Calsium	ppm (Ca^{++})	75	200	4.284	4.284
14. Magnesium	ppm (Mg^{++})	30	150	1.72	1.72
15. Iron	ppm (Fe^{++})	0.1	1.0	1.2	1.1
16. Mangan	ppm (Mn^{++})	0.05	0.5	negative	negative
17. Sulfate	ppm (SO_4)	200	400	negative	negative
18. Phosphate	ppm (PO_4)	-	-	negative	negative
19. Ammonium	ppm (NH_4)	-	0.0	negative	negative
20. Nitrite	ppm (NO_2)	-	0.0	trace	trace
21. Chloride	ppm (Cl)	200	600	8.52	8.52
22. BOD	ppm				
23. COD	ppm				
24. SS	ppm				

Water samples were tested by the Laboratory of PAM-JAYA (Item No. 1~21) and P.T. Superintending Company of Indonesia (Item No. 22~24).

5–5 SEWERAGE SYSTEM

5-5-1 Present conditions of sewerage system

a. Conditions in DKI Jakarta

There are no sewage treatment facilities in DKI Jakarta, and the sewage is disposed into the Java Sea through rivers and floodways.

Once the waste from the lavatories in the dwellings are collected into septic tanks and pit privies, it is either allowed to be absorbed into the earth or discharged directly into rivers. In many of the squatter villages, there are no lavatory facilities, and the inhabitants dispose into the rivers or open ground.

For these reasons there is lack of hygiene, and sewage has become a significant factor adding to pollution.

A required standard of effluent discharge is currently in the process of being established.

b. Conditions in and around the Planning Area

Similar to the situation presented in (a.) above, most of the villages in the Planning Area are without lavatory facilities. However, since much of the land in the area is under agricultural use (paddy fields) there is a low population density, and domestic waste is not a pollution problem.

c. Conditions on existing PERUM PERUMNAS housing developments

Sewage treatment system

With regard to sewage treatment, the pit privy method is mostly used, but septic tanks or, more recently, oxidation ponds, have been used. The treatment system in the major existing housing developments are as follows:

Klender	:	Pit privy
Depok	:	Pit privy
Bandung	:	Pit privy
Cirebon	:	Oxidation pond, partial use of pit privy
Tangerang	:	Oxidation pond
Tanah Abang	:	Septic tank + sand ded filter

In the case of the use of pit privies and septic tanks, the treatment is only for toilet sewage, and in the case of oxidation ponds, all sewage is treated.

5-5-2 Planning of sewerage system

a. Preconditions of the planning

Planning Area and Project Area

Since the final schedule for the Planning Area has not yet been decided, due to land acquisition problems, the system should be planned to cover the Project Area only. There will be a collector drainage system constructed around the Planning Area and it will be possible to discharge treated sewage into it.

From these factors, the sewage system will be taken to cover the Project Area and will be established within this area. As the Project Area expands to include other areas in the future, additional systems can be established accordingly.

Basic aim of the sewage treatment system

A sewage treatment plant to cover the 110ha within the Project Area will be constructed, to discharge treated sewage into the collector drainage system. The reasons for this are;-

i. According to the soil investigation, it was found that the soil in the area had bad permeability and the underground water level was high. Consequently, the system of underground absorption through septic tanks or pit privies, commonly used in the existing housing areas in PERUM PERUMNAS, is unsuitable for this project.

ii. The project aims at a high density housing area, and so, a relatively close sea or a large river would be needed if the sewage is to be discharged untreated. Neither exists in this case.

iii. DKI Jakarta at the moment does not have a drainage plan which will include the Project Area.

The flow of the sewage will be separated from the rainwater drainage. The treatment will be carried out in a central system, and not divided into zones, because of the difficulties involved in maintenance and simultaneous improvement of the standard of effluent.

Installation of several pumping stations will also be necessary, due to the evenness and largeness of the Project Area. In addition, the pumping stations will be equipped with generators.

Financing of costs

The entire sewerage system will be financed by PERUM PERUMNAS.

b. Outline of the planning

Extent of treatment

During a meeting of the steering committee, held in Jakarta on November 4th 1980, it was directed that a combined treatment system, treating all the waste from the kitchen, toilet, and wc/mandi, should be adopted. (See 5-5-2-c.)

Method of sewage treatment

The Lagoon method will be used. The waste is pumped through 2 pumping stations to a lagoon north-west of the Project Area, where it will receive aeration, sedimentation, and disinfecting processes, and finally be discharged into the collector drainage system. (see 5-5-2-e & f.)

Counterplan for low-lying areas

Piping materials to be used,

Gravity waste pipes: PVC-VU (5 kg/cm^2)
Pumping mains : Asbestos cement pipes (ACP)

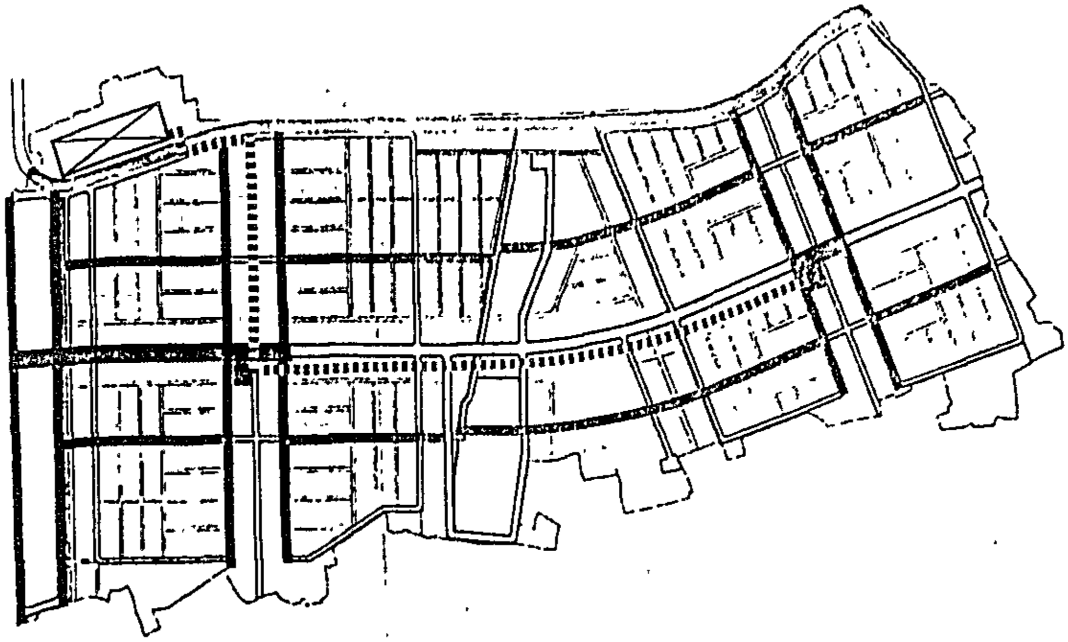
Sand bedding will be used on condition that ample care is taken during installation.

Cast-iron pipes will be used as cover protection at road crossings.

Preventative methods to avoid shearing of the waste pipes due to differential settlement, will be considered. (see 5-5-2-g.)

Construction costs

See (5-5-2-j.)



LAGOON	COMBINED SYSTEM
PUMPING STATION	SEWAGE TREATMENT: LAGOON
MAIN SEWERS	WATER CONSUMPTION: 60 ℓ/day/capita
SECONDARY SEWERS	
PUMPING MAINS	

* BRANCH SEWERS ARE NOT INDICATED.

Fig. 5-28 SEWERAGE SYSTEM

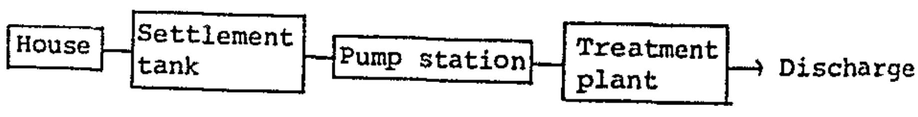
c. Selection of extent of treatment

The study team presented 3 following cases to the Steering Committee on November 4th 1980.

Table 5-11 EXTENT OF TREATMENT

Case I Separate system	Only waste from the toilet will be treated. Wastes from the kitchen and mandi will be discharged into the rainwater drainage systems. Due to the small amount to be treated, one settlement tank will be installed for every 4-5 dwellings, to remove solids. The capacity of pumping stations and treatment station can be reduced.
Case II Semi-combined system	Wastes from toilet and mandi will be treated. Waste water from the kitchen will be discharged into the rainwater drainage systems. The capacity of pumping stations and treatment station can be lowered than as in case III.
Case III Combined system	All wastes from toilets, kitchens and mandis will be treated. Amount required to be treated is large, but this is an environmentally desirable system which treats all domestic discharge.

Case I



Case II, III

From these alternatives, the Steering Committee adopted for Case III, which is already in operation in PERUM PERUMNAS's housing area. It is an environmentally favourable system, especially since Cases I and II have the danger of leaving solids in the drainage system when the flow diminishes during the dry season.

The calculation of discharge load and the cost analysis are presented for 3 cases.

d. Estimation of discharge load

Maximum daily and peak discharge rates are determiend as shown below.

Table 5-12 SEWAGE FLOW

System	Max. Daily flow Q_M (m^3/day)	Peak flow QP (m^3/hr)		
		Branch sewers	Main sewers	Pumping mains
Case I. Separate	40 ℓ/capita/day.	$\frac{QM}{24} \times 9$	$\frac{QM}{24} \times 6$	$\frac{QM}{24} \times 4.5$
Case II. Semi-combined	mdwc.* × Inflow ratio (0.7) × Infiltration ratio of underground water (1.15)	$\frac{QM}{24} \times 6$	$\frac{QM}{24} \times 4$	$\frac{QM}{24} \times 3$
Case III. Combined	mdwc.* × Inflow ratio (0.8) × Infiltration ratio of underground water	$\frac{QM}{24} \times 6$	$\frac{QM}{24} \times 4$	$\frac{QM}{24} \times 3$

* mdwc.: Max. daily water consumption.

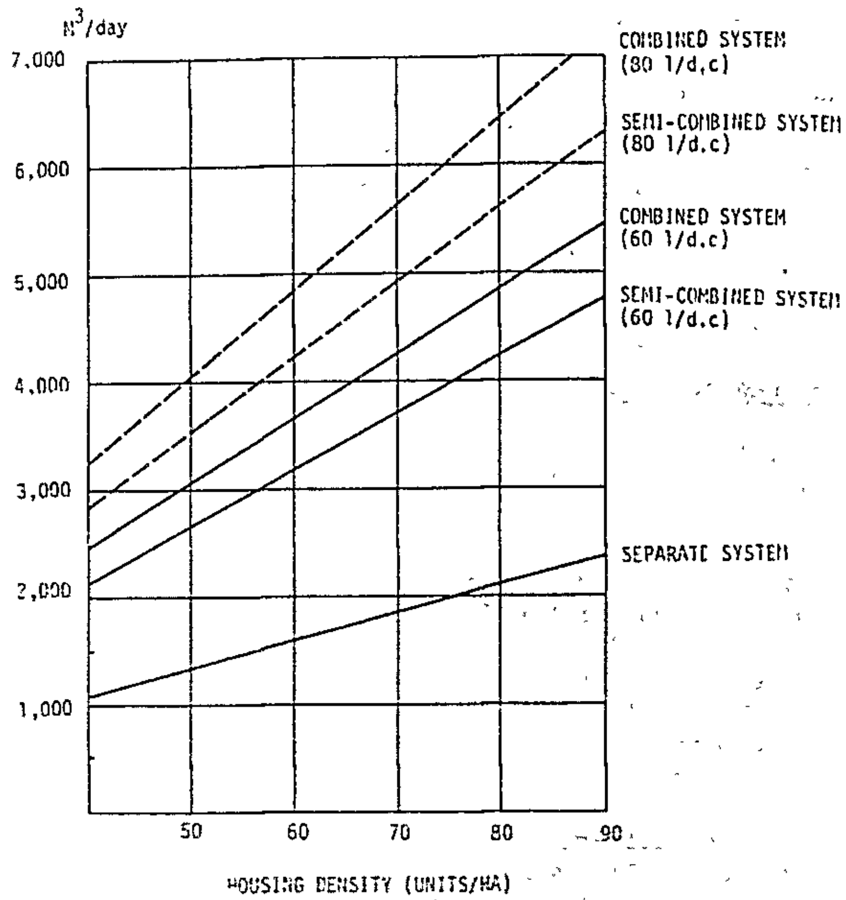


Fig. 5-29 SEWAGE FLOW

e. Sewage treatment system

Strength of sewage

Although the actual strength of sewage will vary for many different conditions, the figures have been estimated as follows.

(in terms of BOD)

Table 5-13 STRENGTH OF BOD

	BOD/capita g/d.c	Max. flow/day/capita* ℓ	BOD load mg/ℓ
Case I Separate system	13	40	325
Case II Semi-combined system	35	55.5 (60ℓ/d.c×1.15×0.7×1.15)	630
Case III Combined system	40	63.5 (60ℓ/d.c×1.15×0.8×1.15)	630

* Figures are for domestic use only.

Quality of treated effluent

The BOD value of the effluent must be below 100 mg/ℓ. The locality of the Project Area is currently used mainly as paddy-fields or fish ponds, especially on the coastal side, and therefore, has few inhabitants. On the other hand, with the river already polluted, there will be little effect from the effluent from the Project Area. Therefore the quality standard has been set accordingly. The standard will be made stricter as need arises.

Outline of the treatment system

In case III, the combined system, the required BOD removal rate is given by (630-100)÷630 = 0.85. Therefore 85% must be removed.

The study team contemplated the possible methods and decided on the lagoon system for the following reasons.

i. Construction costs are relatively low.

ii. Area required for the treatment plant is relatively small.

iii. It would be difficult to increase the BOD removal rate, but a stable rate can be anticipated, and since it is an open system, it is thought to be suited to Indonesian weather conditions.

iv. The system is simple, and maintenance is easy.

v. The design can be based on data from the experimental lagoon system being planned in Tangerang by Cipta Karya.

The general assessments of the possible methods are given below.

(1) Septic tank can only produce a BOD reduction rate of 30% and can only be used in conjunction with an infiltration system. It also produces a strong odour.

(2) Septic tank & biofiltration requires a concrete pit and a special type of piping, making the construction costs high. Strong odour is also emitted from the septic tank. The system is simple, requiring no power supply, and maintenance is easy.

(3) Oxidation pond requires 15ha of operating area and is therefore unsuitable for use in a city. Since it is an open air system, its performnace greatly varies with atmospheric temperature, amount of sunlight, and other meteorological factors. Construction procedures vary according to location, and design is carried out emperically.

(4) Lagoon system is as has been mentioned already. The mechanical aeration method also acts as a clarification system. The construction procedures depend on the location, and since there are no reliable data in existence, it should be reviewed at the detail design stage in accordance with the results from the Tangerang experimental plant.

(5) Oxidation ditch has the highest construction costs and performance, next to the Activated Sludge System. Transportation of sludge and maintenance are relatively difficult.

(6) Activated sludge system will produce a high level of treatment, but maintenance is complex and construction cost is expensive.

Future performnace levels

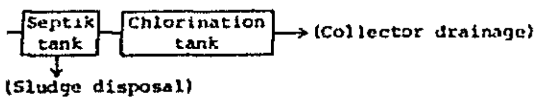
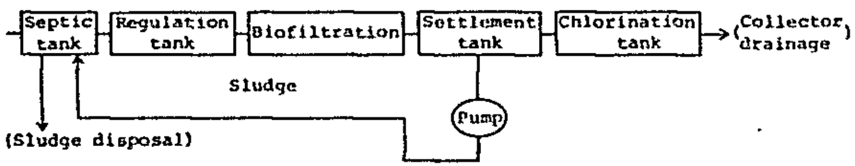
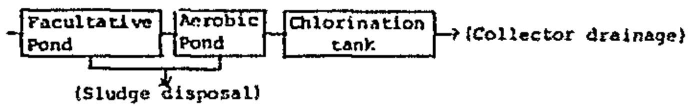
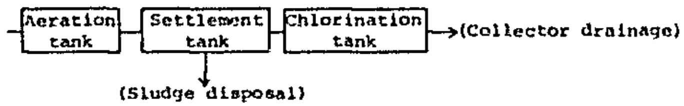
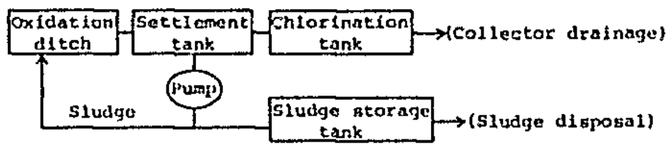
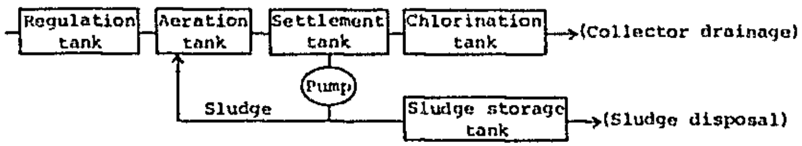
When the quality of the effluent is required to be improved in the future, it would be difficult to do so with only the lagoon system, and the following measures should be undertaken.

i. Adoption of the Activated Sludge System or the similar system.

ii. Include the sand filter system as a secondary sewage treatment. This method will have a reduction level of about 50%, but will become clogged if the level of BOD at the inlet exceeds 30 mg/ℓ, therefore an initial treatment will be necessary.

The selection of a suitable system will require a close examination of the required BOD reduction rate, construction costs, complexity of maintenance, operation costs, space required etc..

Table 5-14 SEWAGE TREATMENT SYSTEMS

System	Flow diagram	Specifications *1	Necessary land area (ha)	Construction cost index *2	Adopted system
(1) Septic tank		Septic tank : 4,250m³ (mdf.×1) Chlorination tank: 45m³	1.0	3	
(2) Septic tank + Biofiltration		Septic tank : 8,500m³ (mdf.×2) Regulation tank : 530m³ (mdf.×1/8) Biofiltration : 1,420m³ (mdf.×1/3) Settlement tank : 530m³ (mdf.×1/8) Sludge pump : 2.2kW Chlorination tank: 45m³	1.5	4	
(3) Oxidation pond		Oxidation pond : 127,500m³ (mdf.×30) Chlorination tank: 45m³	14.5	1	
(4) Lagoon		Aeration tank : 8,500m³ (mdf.×2) Settlement tank : 4,250m³ (mdf.×1) Chlorination tank: 45m³ Aerator : 5.5kW×8 units	2.9	2	o
(5) Oxidation ditch		Oxidation ditch : 8,500m³ (mdf.×2) Rotary machine : 3.7kW×6 units Settlement tank : 530m³ (mdf.×1/8) Chlorination tank: 45m³ Sludge pump : 2.2kW Sludge storage tank: 425m³ (mdf.×0.1)	3.8	5	
(6) Activated sludge		Regulation tank : 530m³ (mdf.×1/3) Aeration tank : 6,400m³ (mdf.×1.5) Settlement tank : 530m³ (mdf.×1/8) Chlorination tank: 45m³ Aerator : 11kW×5 units Sludge pump : 2.2kW Sludge storage tank: 425m³ (mdf.×0.1)	0.9	6	

*1. mdf.: Max. daily flow (m³/day)

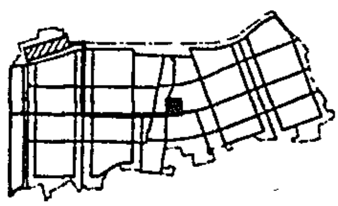
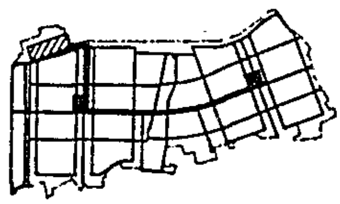
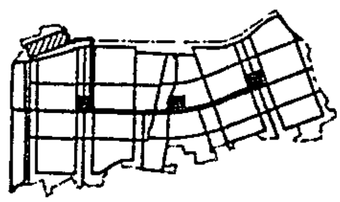
*2. Smaller index number indicates cheaper costs.

f. Pumping station

Considering that an emergency power supply and periodical maintenance will be required for each pumping station, it would be advantageous to concentrate stations, but if a large area needs to be covered, the number of stations should be determined, taking construction costs into account.

The following 3 are given as possible alternatives.

Table 5-15 ZONING OF PUMPING STATIONS

System	Layout	Construction costs* (mil. Rp)	Adopted system
1 unit		986	
2 units		975	o
3 units		994	

* Construction costs are for June 1980 with daily water consumption of 60 ℓ/capita/day and with 70 units/ha.

2 Pumping stations will be taken as optimum for the following owing reasons.

i. It would easily be accommodated by the 2-phase construction plan of the 110ha area.

ii. Low construction costs.

iii. Maximum burial depth of the pipes is about 6m, which is a possible operation.

g. Counter plan for low-lying areas

Material of pipes

PVC-VU (5 kg/cm) will be used, as it will withstand a certain amount of differential settlement. Large diameter (over 250°) asbestos concrete pipe, with high compression tolerance, will be used for pumping mains, but the bedding will have to be laid in accordance with the conditions stated below.

Pipe bedding

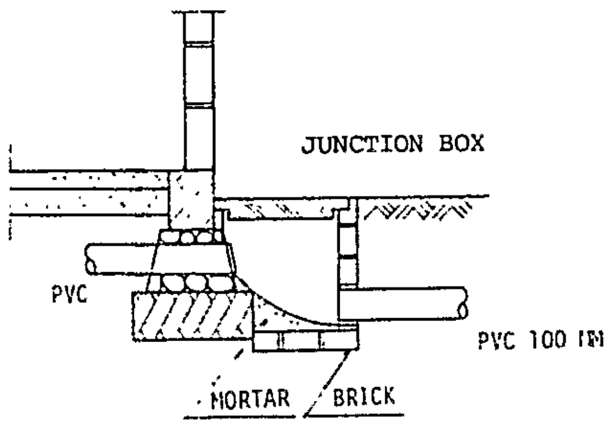
As for water supply pipe, the sand bedding system will be used.

Pipe protection at road crossings

For water supply pipe, cast-iron pipe will be used as covering.

Method of connection to dwellings

The following system will be used to avoid shearing of the waste pipes due to differential settlement. The waste pipes will be subject to maximum force at the point where it emerges from within the foundation to join the outside piping. Therefore, a junction box will be installed at this point, and the outside pipe to the manhole will have enough allowance so as to avoid damage through movement of the building's foundation. The outside piping will also be of PVC-VU to provide toleration against bending forces.



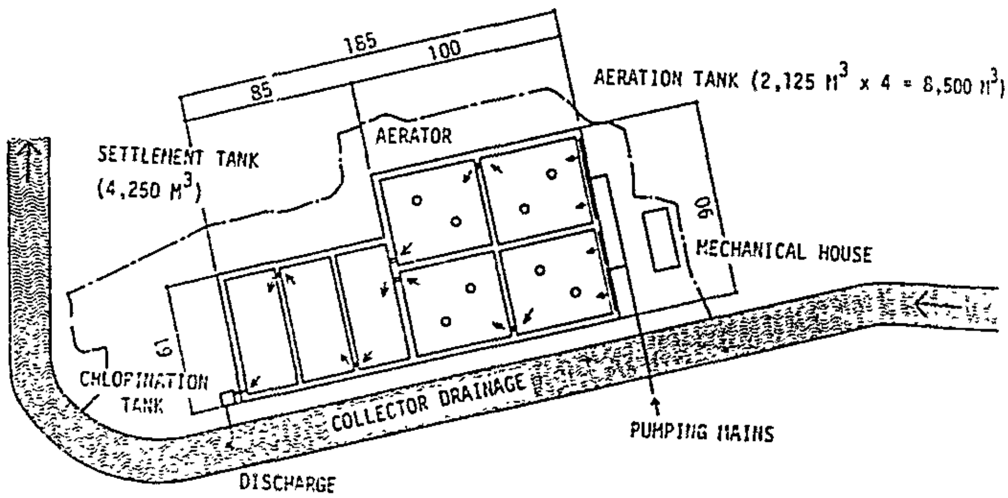
CONNECTION TO DWELLINGS

h. Preliminary engineering

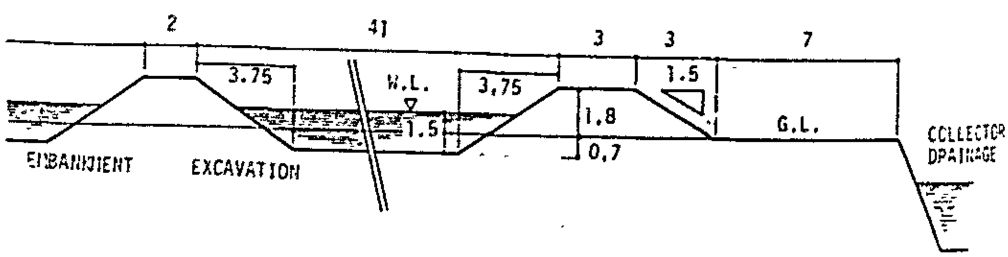
The followings have been determined based on standards set by PERUM PERUMNAS. (As of 70 units/ha)

i. Lagoon

Location	:	A 3ha area in the north west of the 110ha project area.
Aeration tank	:	Maximum daily effluent flow × 2 days Depth 1.5m Excavation & banking
Settlement tank	:	Maximum daily effluent flow × 1 day Depth 1.5m Excavation and soil embankment
Aerator	:	Float type 5.5kW × 8 units Disolved O_2 9kg O_2/h × 8
Chlorination	:	Amount of effluent flow in 15 min. = $50m^3$ Made of concrete



PLAN



SECTION

ii. Pumping station

No. of station : 2

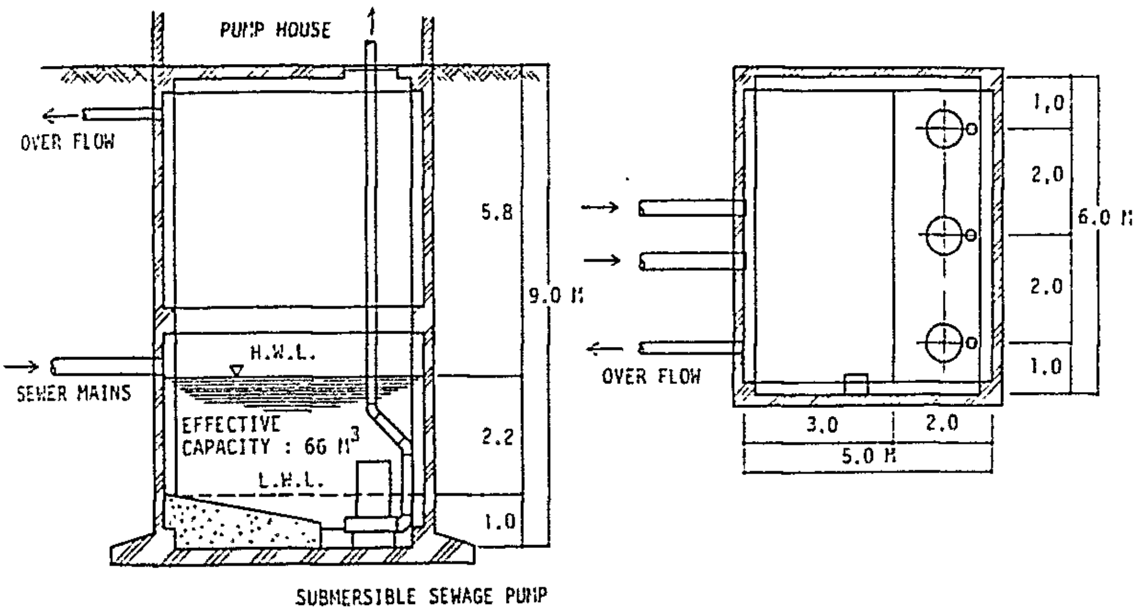
Pumping capacity : See section (d)

Specifications of pumps : No. of units - 3 (including one stand-by pump)
Type - Submerged sewage pump

Control system : Float or mercury operated on-off switch

Pumping pit capacity : Volume pumped in 15 minutes

Others : Generator



PUMPING STATION

iii. Sewage pipes

Material : PVC-VU (5 kg/cm^2)

Specifications, velocity of flow and flow rate:-

Minimum pipe size: 150φ
Velocity of flow : 0.6-2.5 m/s for maximum flow
Calculation of flow : Use Kutta's formula

$$V = 23 + \frac{1}{n} + \frac{0.00155}{I} \cdot \sqrt{R \cdot I} = \frac{N \cdot R}{\sqrt{R} + D}$$

$$Q = A \cdot V$$

V: Velocity of flow (m/sec)
n: Roughness coefficient = 0.012
I: Gradient
N: $(23 + \frac{1}{n} + \frac{0.00155}{I}) \cdot \sqrt{I}$
Q: Rate of flow (m^3/sec)
D: $(23 + \frac{0.00155}{I}) \cdot n$
R: Cross sectional area of flow (m^3)/wetted perimeter (m)

RESULTS OF CALCULATIONS OF Q (m^3/sec) (V = 0.6∿2.5 m/sec)

Size of pipes	Gradient 1/50	1/100	1/150	1/200	1/250	1/300	1/400
100φ	1.5∿5.3	2.4∿4.8	-	-	-	-	-
150φ	1.8∿16.6	2.2∿15.0	3.3∿12.0	-	-	-	-
200φ	-	-	4.1∿27.3	5.2∿23.5	7.1∿21.0	-	-
250φ	-	-	-	-	7.3∿38.7	8.5∿35.3	-
300φ	-	-	-	-	-	-	12.7∿50.8

Depth of buried pipes : Branch pipes 0.3m min.
Main pipes 1.0m min.

Pipe protection at road crossings : Cover with cast iron pipes.

Minimum size of connecting pipes to dwellings : 100φ

iv. Pumping mains

Material	:	Asbestos concrete pipes (ACP)
Pipe size	:	Determine in accordance to pump capacity and pumping rate
Pipe gradient	:	1/500 minimum
Pipe protection at road crossings	:	As in (iii)

v. Manholes

Material	:	Under 3 m deep - Batu Kali
		Over 3 m deep - Concrete

Diameter	Max. Distance (m)	Min. Depth (m)	Min. Dimension (m)
∿ 150	25	0.8	0.5 x 0.5
200	35	1.0	0.7 x 0.7
250 ∿	40 ∿ 50	1.0	0.8 x 0.8

i. Sludge treatment

The estimated per capita production of sludge for the Lagoon system is 90-165 ℓ/annum/capita. Taking the average production to be 130 ℓ/annum/capita with a total population of 45,000, the total production of sludge is about 6,000 m^3/annum. Optimum sludge treatment system should be that of reasonable construction and maintenance costs considering social and economic conditions.

The main alternatives are given below, but this project will adopt system (1) with the opportunity to expand or add to the system according to future need. As to residue, for either dispersion into the sea or on land, the concerned authorities must be consulted.

The use of drying beds is another alternative, but this requires a large site for operation. With an annual sludge production of

$$6{,}000\ m^3 \div \frac{365\ \text{days}}{20\ \text{days}} \div 0.15\ m \doteqdot 2{,}200\ m^2.$$

In addition sufficient dehydration will not take place during the rainy season, and the sludge will need to be dispersed on land or into the sea.

Table 5-16 SLUDGE TREATMENT SYSTEMS

	Flow diagram	Weight ratio $\frac{\text{Treated sludge}}{\text{Raw sludge}}$	Contained water ratio of treated sludge	Remarks
(1)	Raw sludge → Disposal	100%	98.8%	
(2)	Raw sludge → Thickening → Digestion → Disposal	15%	95%	Main purpose is to reduce volume. Requires space for digestion tank and relating facilities.
(3)	Raw sludge → Thickening → Digestion → Dehydration → Disposal	3.5%	75%	Chemicals required for dehydration.
(4)	Raw sludge → Thickening → Dehydration → Incineration → Disposal	1.2%	-	Requires fuel.
(5)	Raw sludge → Thickening → Heating → Secondary thickening → Dehydration → Incineration → Disposal	0.6%	-	Can be used for compost due to low water content and lack of chemical content.

j. Construction costs

Results of the calculations are represented on the diagram below, but the data are subject to the following conditions.

i. Costs based on figures of June 1980.

ii. Lagoon method is used.

iii. 2 pumping stations will be installed.

iv. Per capita water consumption at 60 ℓ/day/capita.

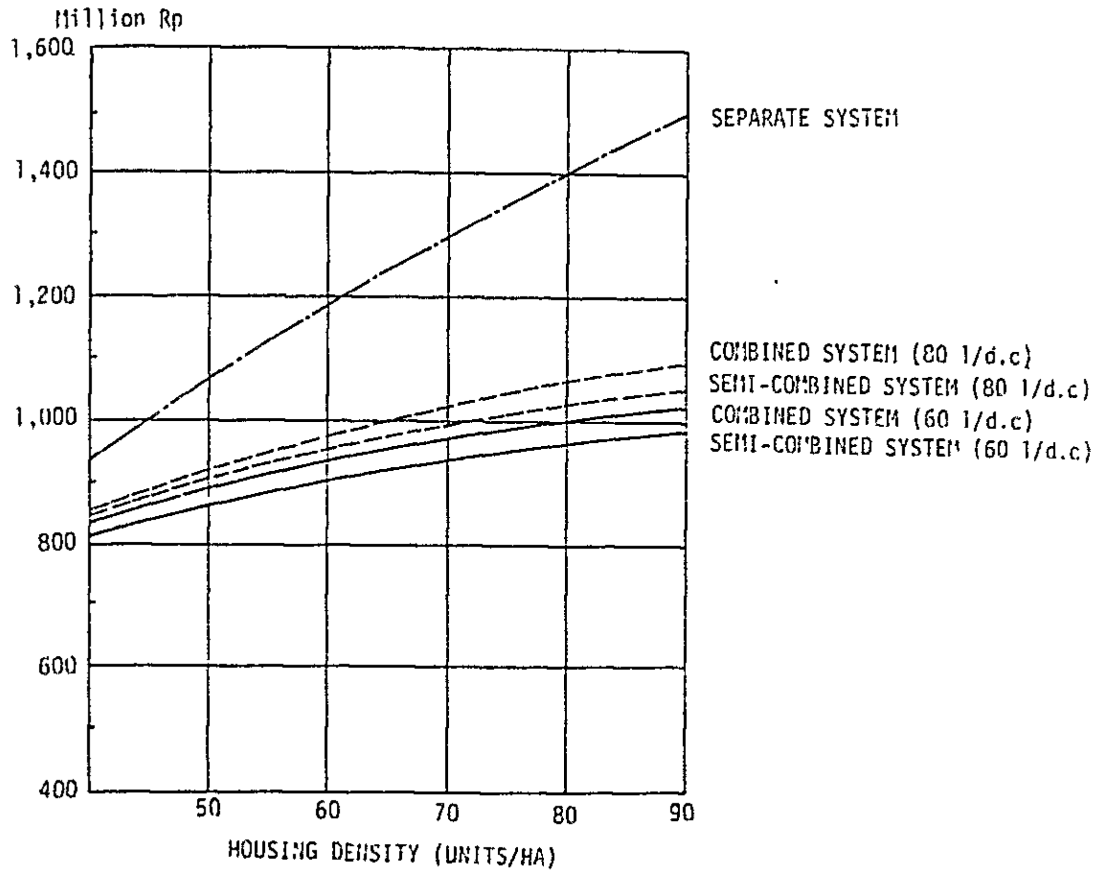


Fig. 5-30 CONSTRUCTION COST OF SEWERAGE SYSTEM

Cost in June,1980

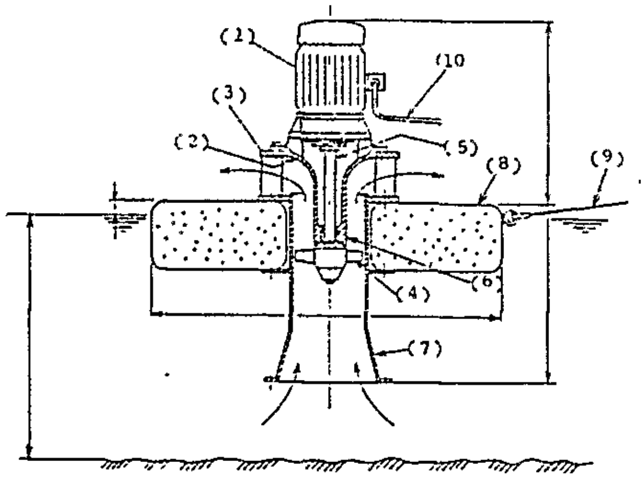
The cost analysis procedure for the combined system is presented below. (60 ℓ/d.c, 70 units/ha, costs based on figures of June 1980)

			million Rp
1.	Lagoon	12,750m³	86.5
2.	Pumping mains (asbestos cement pipe)		38.5
	300ϕ	600m×25,440 Rp/m	
	250ϕ	1,100 ×18,435	
	Pipe bridge	25m×120,000	
3.	Pumping station (2 installations)		47.1
	Pump	2,200ℓ/min.×30mAq×30kW×3units	
	Storage pit	66m³	
	Generator	60kW	

4.	Main sewer	(PVC-VU)	129.7
	350φ	200m×34,815 Rp/m	
	300φ	630 ×26,345	
	250φ	2,000 ×19,565	
	200φ	4,000 ×13,710	
	150φ	1,500 × 8,140	
5.	Branch sewer	(PVC-VU)	250.5
	150φ	31,000m×8,080 Rp/m	
6.	House connection	7,700units×21,700 Rp/unit	167.1
7.	Connection for others		18.1
		250units×72,300 Rp/unit	
8.	Manhole		53.4
	0.7×0.7×3.0m	11×87,400 Rp/unit (Batu kali)	
	0.8×0.8×3.5m	9×365,000 (R.C.)	
	0.8×0.8×4.0m	30×365,000 (R.C.)	
9.	Pipe protection at road crossing (CIP)		34.8
10.	Road repair	1,100m×5,000 Rp/m	5.5
11.	Civil work		25.0
12.	Others		8.5
13.	Total (net)		864.7
14.	Overhead	(13.)×0.1	86.5
15.	Taxes (PPN)	(13.+14.)×0.025	23.8
			million Rp
16.	Total		975.0

5-5-3 Relating Data

a. Aerator



Applied parts and their materials

Item No.	Parts name	Material
1	Motor	Totally enclosed, fan-cooled, sepcial waterproof construction
2	Motor base	Cast iron
3	Pump base	Steel plate
4	Impeller	Brass
5	Main shaft	Steel bar
6	Bearing	Plastics
7	Draft tube	Steel plate
8	Float	Reinforced plastics filled with polyurethane foam
9	Rope	Nylon
10	Cab-tyre cord	Synthetic rubber

Size

Type	Motor shaft output	DF (mm)	A (mm)	I (mm)	B (mm)	F (mm)	Total weight(kg)
ARS-2, 2A	2.2 kW	1260	744	516	about 60	1200	210 ± 10
ARS-5, 5A	5.5 kW	1660	814	623	about 80	1400	350 ± 10
ARS-11 A	11 kW	1880	829	738	about 100	1500	450 ± 10

Performance

Type	Quantity of dissolved O_2 supplied	Circulating flow rate	Sprinkling range
ARS-2, 2A	3.7 kgO_2/h	6.0 m^3/min.	Approx. 4 m diameter
ARS-5, 5A	9.2 kgO_2/h	14.5 m^3/min.	Approx. 6 m diameter
ARS-11 A	19.1 kgO_2/h	29.0 m^3/min.	Approx. 8 m diameter

5–6 SOLID WASTE DISPOSAL SYSTEM

5-6-1 Present conditions of solid waste disposal system

a. Conditions in DKI Jakarta

The city's cleaning department are responsible for the collection and disposal of DKI Jakarta's solid waste, but their rate of disposal is only 60% of the city's output. The remainder of the solid waste is mostly deposited onto vacant lots or into rivers. Disposal into rivers not only causes environmental problems, but also narrows the water outlets to the sea, increasing the risk of floods.

Generally, solid waste is initially deposited into garbage boxes located at individual dwellings or in a block, and is then collected by garbage trucks for disposal into landfills. The current amount of solid waste needed to be collected in DKI Jakarta is estimated to be about 900 t/day.

b. Conditions in and around the Planning Area

DKI Jakarta's garbage trucks are used, but the service is insufficient, and disposal into rivers and open areas is evident.

c. Conditions at existing PERUM PERUMNAS housing developments

Collection system

With regard to collection systems, the most common used system is the provision of a garbage box for every few dwellings, from which waste can be removed in hand-carts to garbage depot. Where the service exists, waste is then collected by the waste disposal organization; otherwise waste is burnt locally.
The collection systems in the major existing housing developments are as follows:

Klender : Garbage box → hand-cart → garbage depot → removed by DKI Jakarta

Depok : Garbage box → hand-cart → garbage depot → removed by private company at the request of the local government

Bandung : Garbage box → hand-cart → garbage depot → removed by the local government

Cirebon : Garbage box → hand-cart → garbage depot → burnt

Tangerang: Garbage box → hand-cart → garbage depot → removed by the local government

Solid waste output

With regard to waste quantities, these are unknown, as there is no data, but planning is based on experience.

5-6-2 Planning of solid waste disposal system

a. Preconditions of the planning

Planning Area and Project Area

The solid waste disposal system will be designed to cover only the Project Area, with intentions to expand the coverage in accordance with future expansion of the Project Area.

Disposal of solid waste

The solid waste produced within the Project Area will be transported by DKI Jakarta's garbage trucks for disposal outside the area.

Financing of costs

PERUM PERUMNAS will finance the costs apart from plastic dustbins for individual dwellings to be purchased by the occupants and the garbage trucks to be run by DKI Jakarta.

b. Outline of the planning

Output of solid waste from residential areas is estimated at 10 ℓ/unit/day, but from the total area including commercial establishments is 12 ℓ/unit/day. (see 5-6-2-c)

Collection system

Garbage boxes will be installed intermittently (one for every two low-rise houses, and one for every block of walk-up and two-storied flats) from where the solid waste will be transported to one of the four garbage depots and the garbage trucks will transport it for disposal outside the Project Area. (see 5-6-2-d)

Construction costs

See (5-6-2-f)

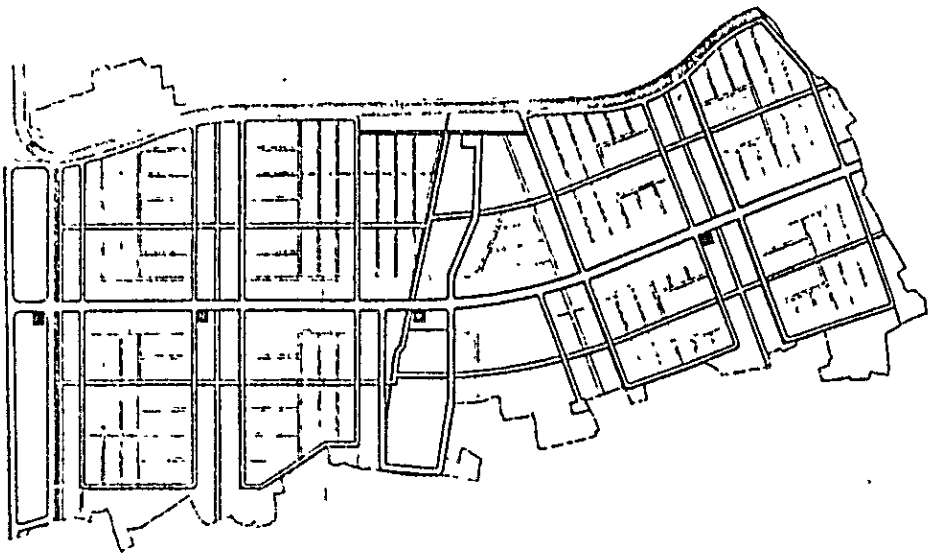


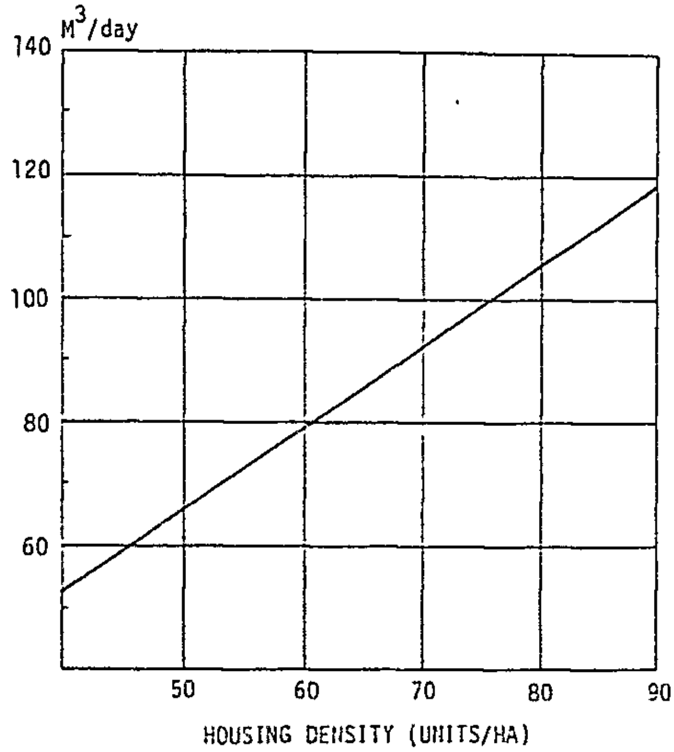
Fig. 5-31 GARBAGE DEPOSIT

c. Solid waste output

Residential output is estimated to be 10 ℓ/unit/day and gross rate output from areas including commercial areas is estimated to be 12 ℓ/day/unit.

Fig. 5-32

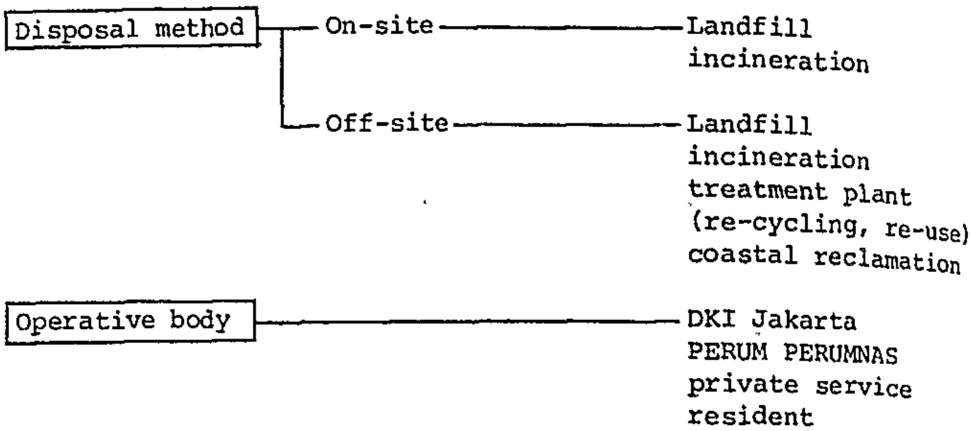
SOLID WASTE OUTPUT



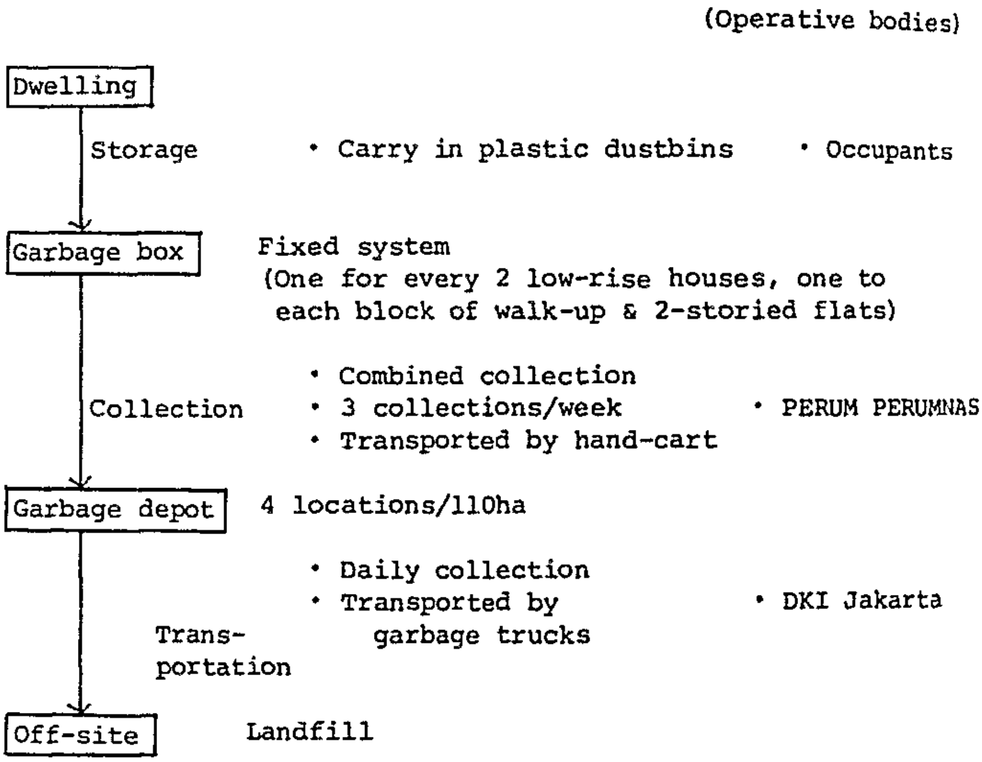
d. Method of solid waste disposal system

The following are possible systems of disposal.

- **Storage method**
  - Storage container — Uncontained / paper bag / plastic dustbin / garbage box
  - Location of storage — Each dwelling / fixed garbage box
- **Collection method**
  - Classification — Combined / divided / burnables only
  - Garbage depot — Have or have not
  - Frequency of collection
  - Transportation — Hand-cart / light truck / garbage truck



The most commonly used system in Indonesia is also the most realistic, and will be adopted in this project as detailed below.



e. Preliminary engineering (as for 70 units/ha)

i. Container (needed to carry solid waste out of dwelling)

Implement capacity : 30ℓ plastic dustbin to be prepared by each household.

ii. Garbage box : (Fixed disposal place for refuse from each dwelling.)

Hand-cart collection : Once every 2 days

Number of boxes : 1 for every 2 low-rise houses, 1 for each block of walk-up & 2 storied flats

Specifications : Side wall - Bataco block, setting bed waterproofing

Floor - R.C.

iii. Garbage depot

Maximum distance to be covered by hand-cart : 700m

Garbage truck collection frequency : Daily

Location : 4 installations/110ha

Dimensions : 7,700 units × 12ℓ/unit/day ÷ 4 × 1.5 = $34.7m^3$

$34.7m^3 \times 0.8 \div 1.5H = 19m^2 \rightarrow 4 \times 5m$

Specifications : Roof - Timber justs, roof tiles
Post - Timber
Side wall - Bataco blocks
Floor - R.C.

iv. Hand-cart

Capacity per unit : 500kg or $1m^3$

Capacity per circuit : $1m^3 \div 20$ ℓ/unit = 50 units/cart/circuit

Rate of circuit : 1 hour/circuit .... 7 circuits/day

Number of carts : 7,700 lots ÷ (50×7)×1.25 = 27.5 → 30 carts (allowance)

Specifications : Timber

f. Construction costs

Results of costing are shown in the graph below under the following conditions.

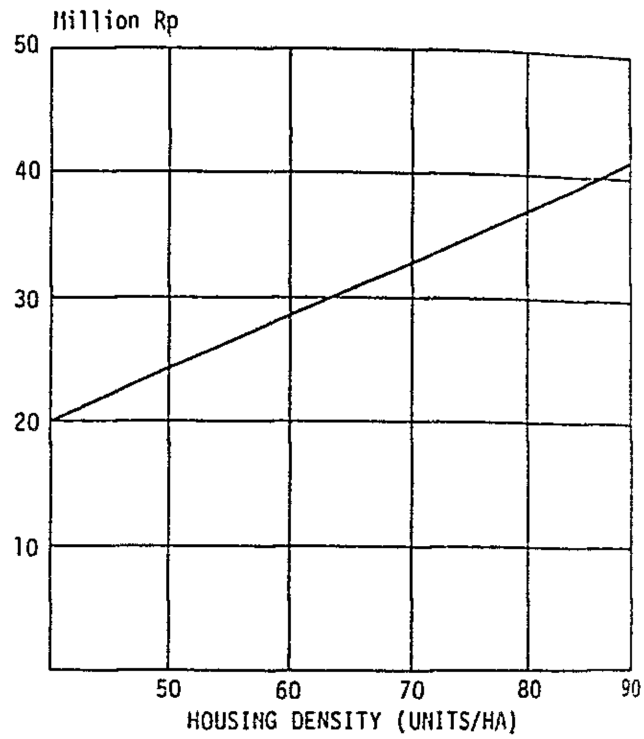
i. Costs as of June 1980.

ii. Dustbins to be provided by each household.

iii. Garbage trucks to be provided by DKI Jakarta.

Fig. 5-33
CONSTRUCTION COST OF SOLID WASTE SYSTEM

Cost in June,1980



The cost analysis procedure for 70 units/ha is presented below (costs based on figures of June 1980).

			million Rp
1.	Dustbins		-
2.	Garbage boxes	7,700 units×3,400 Rp/unit	26.2
3.	Garbage depots	4 × 500,000 Rp/depot	2.0
4.	Hand-carts	30 carts × 25,000 Rp/cart	0.8
5.	Total (Net)		29.0
6.	Overhead	5 × 0.1	2.9
7.	Tax (PPN)	(5.+6.) × 0.025	0.8
8.	Total		million Rp 32.7

5–7 ELECTRICITY

5-7-1 Present conditions of electricity

a. Conditions in DKI Jakarta

The PLN (Perusahan Listrik Negara) is the responsible authority for the supply of electricity in DKI Jakarta, and its capacity in 1975 was 1,200,000 MWh. High Voltage transmission is generally performed at 150kV or 70kV which is then transformed down to 20kV before domestic distribution at 220/380V.
This capacity produced by PLN is not sufficient, and those areas which are not receiving supplies depend either on generators or kerosene lamps.

b. Conditions in and around the Planning Area

A existing 20kV line runs along the Jakarta-Tangerang Road, but only a small number of buildings receive electricity from PLN. Kapuk Street and Kamal Raya Street, near the Planning Area, are having 20kV lines installed with completion due in 1980, and according to PLN there should be sufficient supply to the Planning Area once they are completed.

c. Conditions at existing PERUM PERUMNAS housing developments

The power capacity for each dwelling is, in the case of site & services, 250W per dwelling, in the case of low cost housing, 450W, and for empty lots, 900W. However, if this capacity is found to be insufficient, after occupation, in many cases, negotiations are made individually with PLN, and the capacity can be increased.

5-7-2 Planning of electricity

a. Preconditions of the planning

Planning Area and Project Area

The proposal is for supply to the Project Area only, with intention to improve the supply system as the Project Area expands in the future.

Distribution and voltage of supply

The electricity will be drawn into the site by PLN at 20kV, and after reduction to 220/380V at transformer stations, will be distributed to the dwellings.

Financing of costs and operative bodies

Work within the Project Area will be financed by PERUM PERUMNAS. PLN will undertake the outdoor work to the WH meter of each dwelling, but, construction costs paid by PERUM PERUMNAS to PLN are calculated based on the unit cost per VA which are negotiated between them. The work within the dwellings will be done by PERUM PERUMNAS.

b. Outline of the planning

Supply capacity

The requirements are estimated to be 450VA/unit for dwellings and 850VA/ha for street lights. In addition, other proposed infrastructures will require extra supplies.
(see 5-7-2-c.)

Construction costs

See 5-7-2-d.

c. Requirement of supply capacity

Distribution dwellings

450VA will be supplied each dwelling. In the past, at PERUM PERUMNAS housing area, the common supply was at 250VA/unit for sites & services and 450VA/unit for low-cost houses, but since the supply demand is on the increase, the proposal will be for 450VA/unit throughout. Distribution facilities will not be connected to empty lots at PERUM PERUMNAS's expense, and the owners will have to rely on PLN.

Street lights

In accordance with PERUM PERUMNAS's standards, the following supply loads have been established.

	Load (W)	Distance (m)
Primary road Secondary road Service road	250	70
Major footpath Footpath Service alley	20	20

The electricity demand per ha for street lights is therefore 850VA/ha.

Extra power demands for infrastructures within the Project Area

The following installations will require extra power supplies.

i. Pumps in the pumping stations for sewage.

ii. Aerator for the lagoon in the sewage treatment system.

In addition, there is an off-site booster pumping station for the water supply system, but the supply cost is not included.

d. Construction costs

The diagram below represents the result of the cost analysis with the following conditions.

i. Evaluated at 200 Rp/VA.

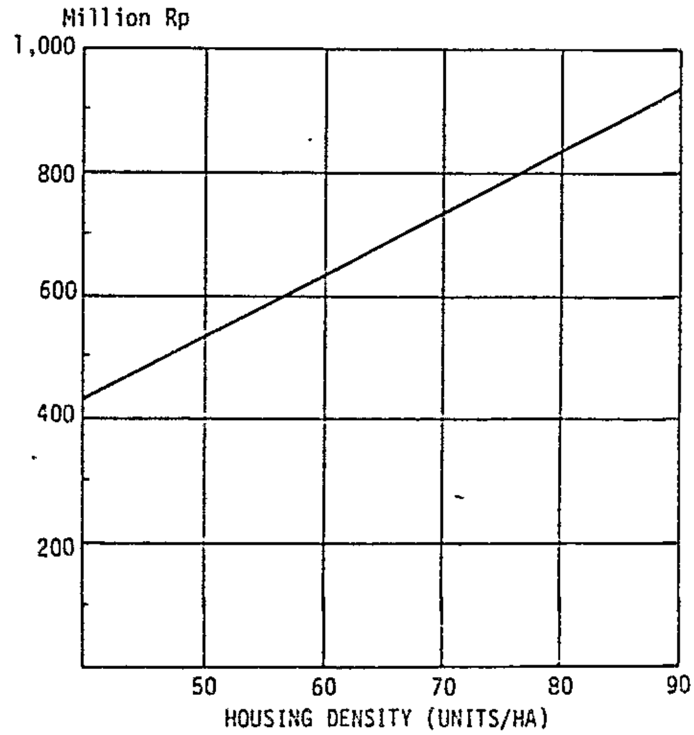
ii. Does not include costs of distribution to empty lots, Commercial lots or Social facilities.

Data based on 70 units/ha are shown below.

Fig. 5-34

CONSTRUCTION COST OF ELECTRICITY

Cost in June,1980



The cost analysis procedure for 70 units/ha is presented below.

			million Rp
1.	For houses	7,700units×450 VA/unit×200 Rp/VA	693.0
2.	Street lights	850 VA/ha×110ha×200 Rp/VA	18.7
3.	Extra installations for infrastructures	119.9KVA × 200RP/VA	24.0
4.	Total		million Rp 735.7

5–8 COSTS AND MANAGEMENT OF INFRASTRUCTURES

5-8-1 Costs of infrastructures

a. Financing bodies of construction costs and land acquisition costs

		Off-site		On-site	
Construction cost	i. Drainage	∘ Macro drainage ∘ Box culverts	PBJR P.P.	∘ Collector drainage ∘ Micro drainage	PBJR P.P.
	ii. Land development	-	-		P.P.
	iii. Road		DKI Jakarta	∘ Access road ∘ Others	DKI Jakarta P.P.
	iv. Water supply	∘ Off-site facilities	CIPTA KARYA		P.P.
	v. Sewerage	-	-		P.P.
	vi. Solid waste	-	-		P.P.
	vii. Electricity	-	-		P.P.
Land acquisition cost	i. Drainage	∘ Macro drainage	PBJR	for all facilities	P.P.
	ii. Road		DKI Jakarta		
	iii. Water supply	∘ Booster pump stations	CIPTA KARYA		

* P.P.: PERUM PERUMNAS

b. Costs of infrastructures

Costs are shown below under the following conditions.

i. Costs as of June 1980.

ii. Excluding costs for detail designs, investigations or overhead etc. of PERUM PERUMNAS.

Item	System	Construction cost (Mil. RP) On-site	Off-site	Total	Remarks
i. Drainage	(1) Direct discharge	52 769	39 1288 574	2,722	*
	(2) Pump-up	52 769	39 2,225 779	3,864	*
	(3) Siphon	52 769	39 4,270 889	6,019	*
ii. Land development		338		338	
iii. Road		36 618	25 39	718	
iv. Water supply	(1) PAM-60 ℓ/d.c (case IA)	824	812 4	1,640	70 units/ha
	(2) PAM-80 ℓ/d.c (case IB)	890	820 4	1,714	
	(3) Plant-60 ℓ/d.c (case IIA)	824	1,160 6	1,990	
	(4) Plant-80 ℓ/d.c (case IIB)	890	1,320 6	2,216	
v. Sewerage	(1) Separate	1,295		1,295	60 l/day capita
	(2) Semi-combined	940		940	70 units/ha
	(3) Combined	975		975	
vi. Solid waste		33		33	70 units/ha
vii. Electricity		736		736	

☐ Construction costs born by Perum Perumnas

☐ Construction costs born by other bodies

▨ Land acquisition costs born by other bodies

* Refer to 5-1-2-d, 5-1-3-d and Fig. 8-3.

5-8-2 Ownership and operating/maintenance bodies of infrastructures

* P.P.: PERUM PERUMNAS

	Ownership after completion	Operating/maintenance bodies	Payment for operating/maintenance
i. Drainage	∘ Off-site - Macro drainage : PBJR	PBJR	
	∘ On-site - Collector drainage: DKI Jakarta Micro drainage : P.P.	DKI Jakarta	-
ii. Road	DKI Jakarta	DKI Jakarta	-
iii. Water supply	∘ Up to the water meter from outside : PAM-JAYA ∘ Inside from the water meter : Building owner	PAM-JAYA	Building owner pays to PAM-JAYA
iv. Sewage	∘ Piping to the public manhole : P.P. ∘ Public manhole to all piping including facilities : Building owner	P.P.	Included in the exploitation cost
v. Solid waste	∘ Dustbins, garbage boxes : Building owner	Building owner	
	∘ Hand-carts, garbage depots : P.P.	P.P.	Included in the exploitation cost
	∘ Garbage truck : DKI Jakarta	DKI Jakarta	
vi. Electricity	∘ Up to the WH meter from outside : PLN ∘ Inside from the WH meter : Building owner	PLN	Building owner pays to PLN

6 HOUSING PLAN

TABLE OF CONTENTS

6-1 TARGETS AND OUTLINE OF HOUSING PLAN

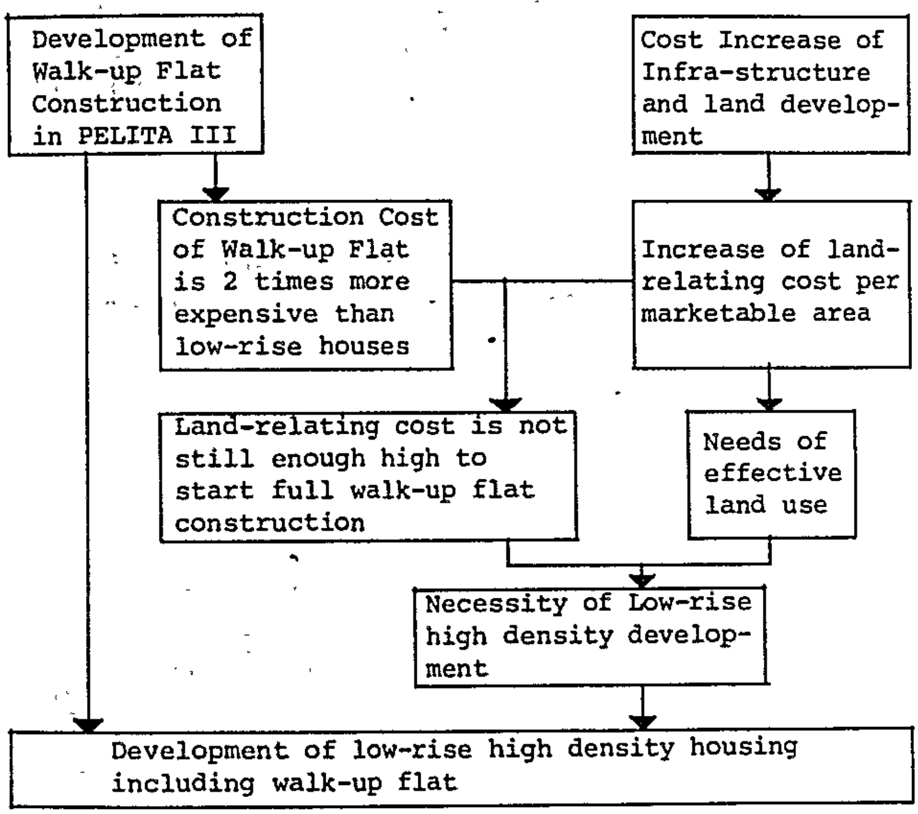
6-1-1 Major targets of housing plan

- Residential area planning -- Study of target housing types, lot size, lot form, layout and surrounding environment corresponds to the higher density requirement (gross density 60 ∿ 80 unit/ha) assessed in Chapter 4.

- Low-rise housing plan -- Technical study of housing types including plans, structural systems, materials and cost estimates.

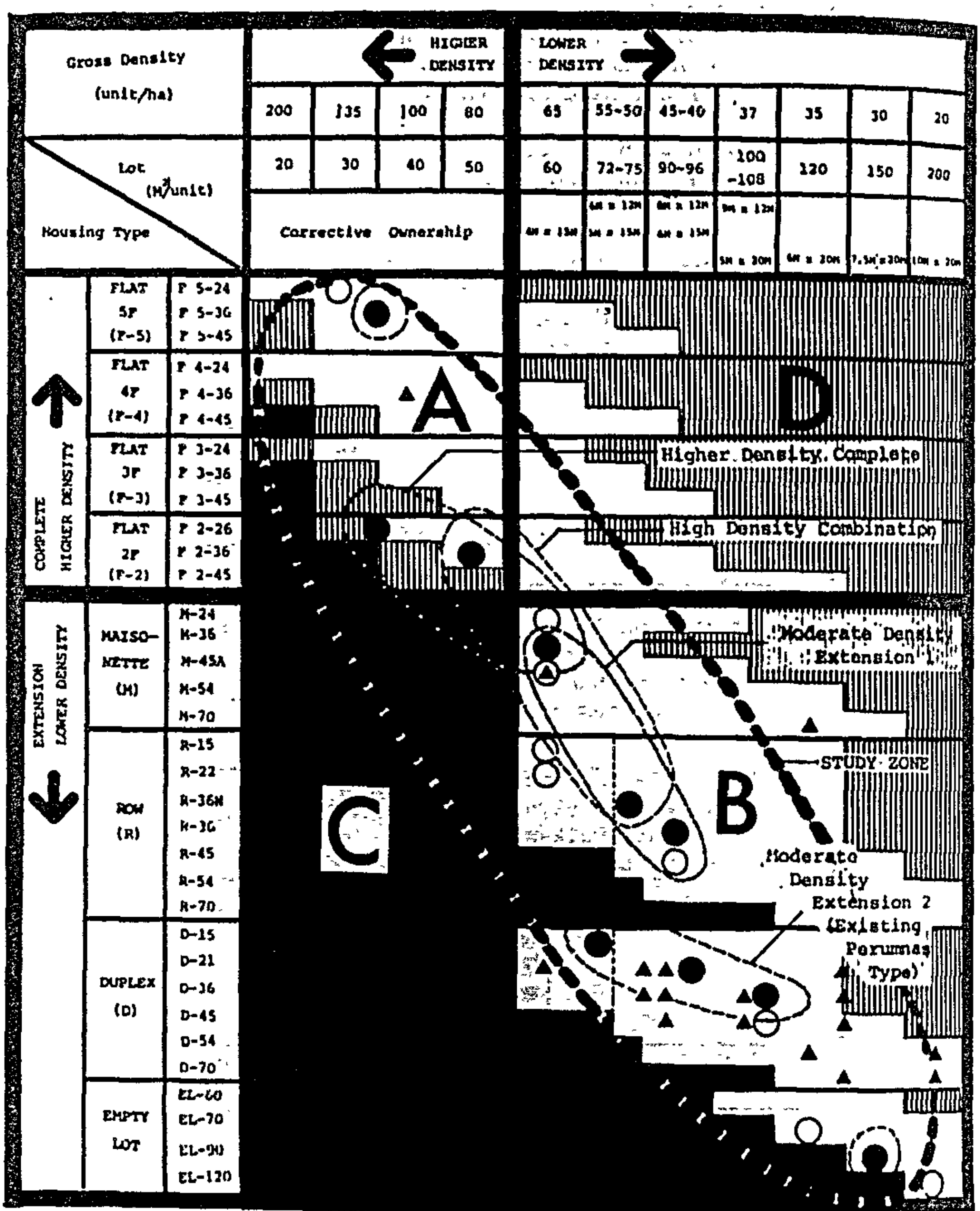
- Walk-up flat plan -- Technical study of walk-up flat including flat building models, flat unit models, structural systems, materials and cost estimates)

6-1-2 Background of housing plan



6-1-3 Outline of housing plan

a. Situation of studied housing types



● Types chosen for Alternative Formulation

○ Studied Types

▲ Existing Perumnas Type

inadequate zone by DKI Regulation

not recommendable zone

not recommendable zone in case of $45M^2$ final floor area is expected

---- Alternative Formulation

Study zone

b. Outline of housing plan by series

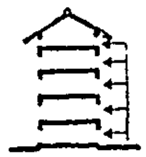
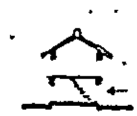
Series	Flat (5~3F)	Flat (2F)	Maissonette	Row house	Duplex
Code name	$F_5 \sim F_3$	F_2	M	R	D
No. of story	5 ∿ 3	2	2	1	1
Studied housing types	24M² $F_{5\sim3}$-24 36M² $F_{5\sim3}$-36 45M² $F_{5\sim3}$-45	26M² F_2-26 36M² F_2-36	24M² M-24 36M² M-36 45M² M-45A	15M² R-15 22M² R-22 36M² R-36N R-36 45M² R-45	15M² D-15 21M² D-21 36M² D-36 45M² D-45
Housing model					
Land ownership	Collective	Collective partly priority garden	Private	Private	Private
Standard no. of unit	4 ∿ 8 unit/F	4 ∿ 6 unit/F	6 unit	6 unit	6 unit
Access system	• Classified into 5 types by access system FG. FS.FS'.FM. FT.	• Upper floor -via common stair • Lower floor -direct access from opposite side	• Direct access via inner stair • Only in M-24 type via common stair • Service access	• Direct access • Service access	• Direct access • Without service access
Extension	• Very difficult • Physical extension possibility can be considered	• Difficult • Physical extension possibility can be considered	• Possible (not 2 storied extension)	• Possible (not 2 storied extension)	• Possible (not 2 storied extension)
Maintenance	• For the maintenance of collective land, sturcture, unit wall, plumbing etc. institutional arrangement is necessary		• Mostly private maintenance can cover the problem. (except unit wall + roof)		
Main structure	Structure: RC 2F floor: RC Wall: brick con. block	Structure: con. block 2F floor: RC	Wall: con. block 2F floor: wooden floor	Wall: con. block	Wall: con. block

Table 6-1 LIST OF FLOOR AREA AND COST BY HOUSING TYPE

Type			No. of Story	Nominal Lot Size Per Unit (M) x (M) = (M^2)	Floor Area (M^2) Net Floor Area (A) Living Area	Veranda St. Inn.Stair	Total	Common Floor Area	(B) Gross Floor Area	(A)/(B)	Construction Cost (x 10^3 RP) June/1980 (C) Total cost/unit	(C)/(A)	(C)/(B)
Duplex	D-15	●	1	6 x 12 = 72	18.00	-	18.00	-	18.00	100	620.83	34.49	34.49
	D-21	●	1	8 x 12 = 96	24.00	-	24.00	-	24.00	100	819.24	34.14	34.14
	D-36	●	1	9 x 12 =108	36.00	-	36.00	-	36.00	100	1246.14	34.62	34.62
	D-45		1	8 x 15 =120	45.00	-	45.00	-	45.00	100	1470.26	32.67	32.67
Row House	R-15		1	4 x 15 = 60	18.00	-	18.00	-	18.00	100	705.44	39.19	39.19
	R-22		1	4 x 15 = 60	25.00	2.00	27.00	-	27.00	100	971.49	35.98	35.98
	R-36N	●	1	5 x 15 = 75	36.00	2.00	38.00	-	38.00	100	1387.73	36.52	36.52
	R-36	●	1	6 x 15 = 90	36.00	3.00	39.00	-	39.00	100	1222.52	31.35	31.35
	R-45		1	6 x 15 = 90	45.00	3.00	48.00	-	48.00	100	1375.71	28.66	28.66
Maissonet	M-24		2	4 x 15 = 60	24.70	1.70	26.40	3.60	30.00	88.0	1162.16	44.02	38.74
	M-36	●	2	4 x 15 = 60	30.00	8.00	38.00	-	38.00	100	1338.13	35.21	35.21
	M-45A		2	4 x 15 = 60	39.00	11.00	50.00	-	50.00	100	1636.67	32.73	32.73
2 Storied Flat	FS-2-26	●	2	35	25.90	-	25.90	2.10	28.00	92.5	1017.41	39.28	36.34
	FS-2-36	●	2	50	33.90	1.80	35.70	2.10	37.80	94.4	1414.47	39.62	37.42
Walk-up Flat	FS-5-24		5			1.56	26.18	4.26	30.80	85.0	2141.61	81.80	69.53
	FS-5-36	●	5	35		1.69	38.78	4.62	43.40	89.4	2956.09	76.23	68.11
	FS-5-45		5			1.62	46.84	4.62	51.46	91.0	3372.08	71.99	65.53
	FG-5-36		5			1.20	38.88	10.86	49.74	78.2	3116.67	80.16	62.66
	FG-5-45		5			2.90	48.06	10.86	58.92	81.6	3668.25	76.33	62.26
	FM-6-36		6			2.58	38.70	7.66	46.36	83.5	3248.61	83.94	70.07
	FM-6-45		6			3.30	46.80	7.66	54.46	75.9	3686.28	78.77	67.69
	FT-5-36		5			1.95	36.90	4.03	40.93	90.2	3141.02	85.12	76.74

● : Selected type for alternative formulation.

6–2 BASIC CONDITIONS OF HOUSING PLAN

6-2-1 Basic conditions of PERUMNAS low cost housing plan

a. General basic conditions

i. Family composition

Average household number;	6 persons/household (source : Home interview survey in Klender and Depok, Oct. 1980; to be abbreviated hereafter as HIS '80)
o Average age of family head at time of start of occupancy;	39 yr. old (source; HIS '80)

o Assumed family composition;

F + M + C + C + G + S	2 children	F: father
F + M + C + C + C + S	3 "	M: mother
F + M + C + C + C + G	3 "	C: child
F + M + C + C + C + C	4 "	G: grand parent
		S: maid etc.

ii. Life cycle and sleeping model

o Computation of sleeping mode infringement

Condition;
- Average age of family head at start of occupancy is 39 years old.
- 0 ∿ 2 rooms expansion will be done by the age of 42 or so.
- Children leave home at age of 20.
- Separate sleeping by sex starts when girls are 13 years old.
- Sleeping mode priority and its infringement values are as follows.

  Separate sleeping of parents and child of older than 6 years of age(2.5 points)

  Separate sleeping by sex (2.0 points)

  Independent room for child older than 18 (1.5 points)

  Sleeping in living room (1.0 points)

  Own sleeping space for grand parent or maid (0.5 points)

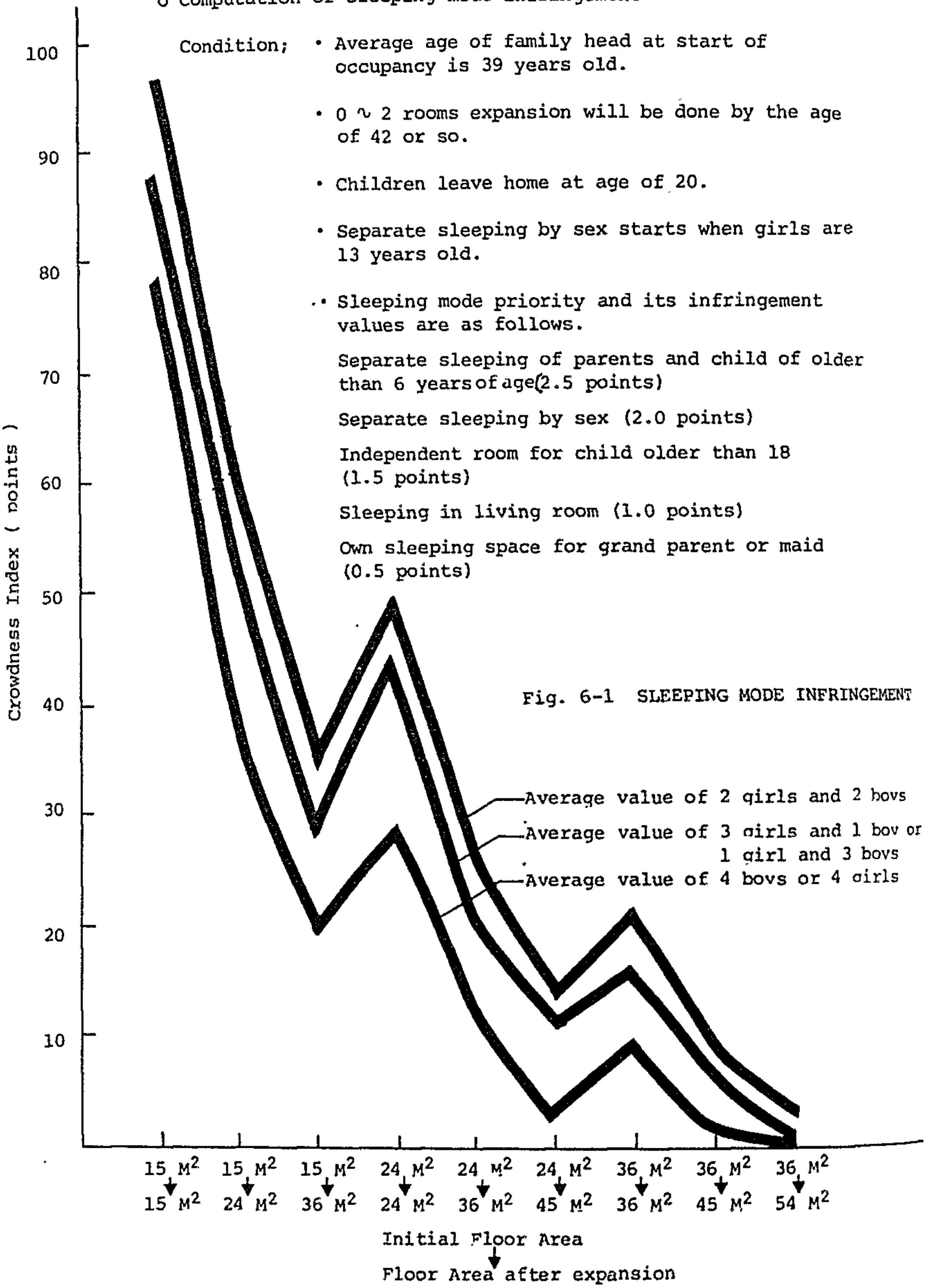
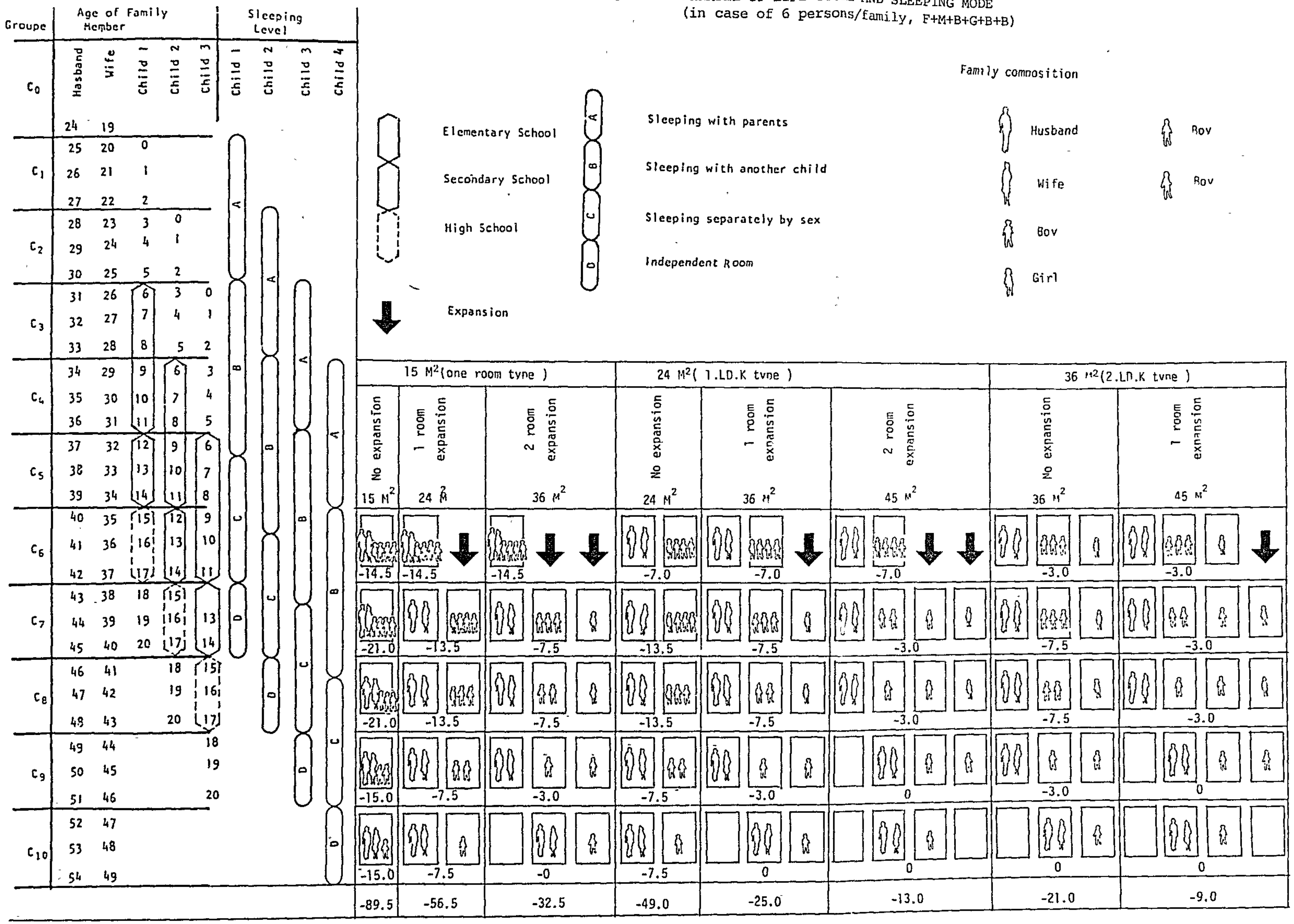


Fig. 6-1 SLEEPING MODE INFRINGEMENT

o Example of life cycle and sleeping mode

Fig. 6-2 EXAMPLE OF LIFE CYCLE AND SLEEPING MODE
(in case of 6 persons/family, F+M+B+G+B+B)



iii. Expansion and floor area

o Target floor area after expansion

- Flat → difficult to expand
  - → 45 m^2 type → ideal but too expensive and not realistic for mass-supply
  - → 36 m^2 type → realistic
  - → 24 m^2 type
    - → for smaller household (household mobilization concept)
    - → for special purpose (dormitory etc.)
- Low-rise house → possible to expand
  - → 45 m^2 target type → for relatively higher income group
  - → 36 m^2 target type → for relatively lower income group

o Present conditions of expansion

- Half of the households expand by one or two rooms in about two years after the start of occupancy (HIS '80).
- The prescribed family ages at the start of occupancy are 39 for family head, 34 for wife and 14, 11, and 8, for children and it is considered that the necessary number of rooms is larger for the next six years than at any other time.
- Expansion is popular among less than 24m^2 houses.
- The addition of veranda + awning is popular with all types of houses.
- There are also many cases of interior and exterior improvement or renovation.

iv. Life mode

o One-day cycle

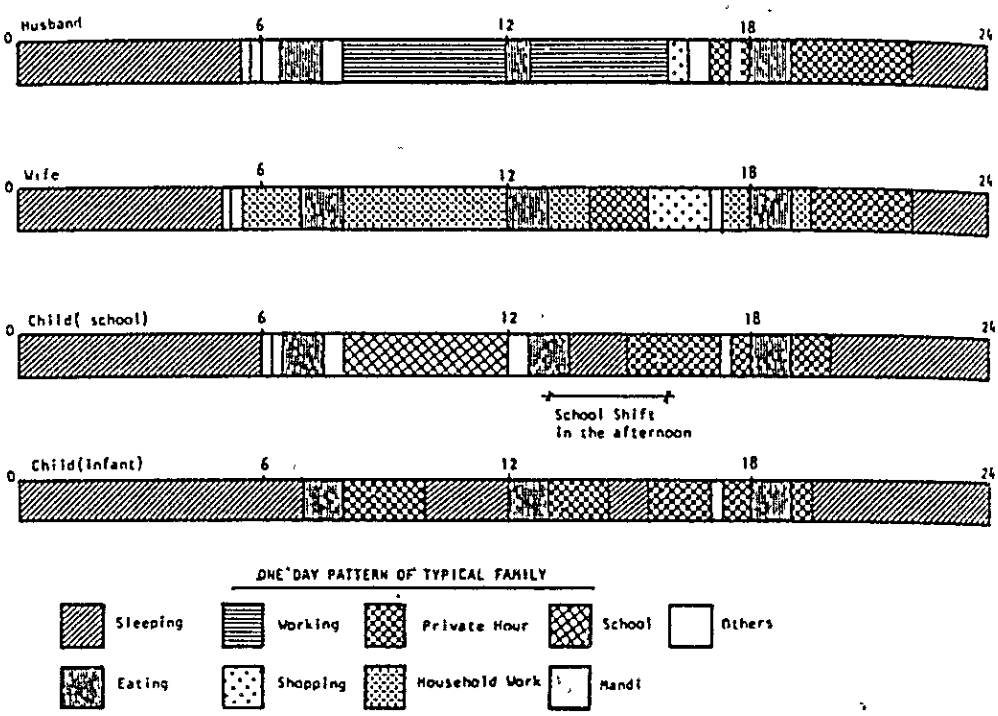


Fig. 6-3 ONE DAY PATTERN OF TYPICAL FAMILY

o Cooking, washing and water use

- Cooking method - Kerosene most popular, in some case firewood, LPG.
  → Kerosene taken for granted
- Water supply for kitchen - Seldom both in general and PERUMNAS case.
  → Water supply for kitchen
- Kitchen table - In half of general and PERUMNAS case available
  → Terrazzo kitchen table
- Dish washing - Often washed at WC/M.
  → Sink for kitchen
- Washing clothes - Often at WC/M
  → Same as above
- Laundry drying - In the garden. Under the eaves or indoor in rainy days.
  → Private yard for low-rise type
  → Communal yard for walk-up flats.
- Garbage disposal - Usually discarded. Garbage from PERUMNAS houses is brought to public garbage deposit.
  → Polyethylene buckets + public deposit system

- Types of garbage - mostly kitchen raw garbage, followed by paper and grass.
- Frequency of garbage dumping - Often once a day. Some household do it twice.
- Number of times mandi is used - Mostly twice a day.
  - Peak time: 6:00 and 17:00 ∿ 18:00.
- Frequency of bowl movement and time
  - Mostly once a day.
  - Most at mandi time of 6:00 AM.

o Sleeping

- Sleeping place for adults - mostly use beds.
- Sleeping place for children - many use double bunks.
- Sleeping place for babies - many sleep in mother's bed.

o Living, out-side life and neighbour-relations.

- TV-watching - 2 ∿ 5 hours a day.
- Neighbourhood association - exchange of greeting 50%
  - chatting 50%
- Overnight stay of guest - 50% of all household have relatives or friends stay once or twice a week.
- Party and ceremony - 30% of people have parties once to three times a year.
- Circle activities - Someone from households of the same level participates in RT, LINKUNGAN, sports and religious functions.
- Mosque going - 2/3 of people go to mosque once a day.
- Gardening - Half of the people enjoy gardening.
- Pets and animals - 1/7 ∿ 1/9 of people keep small birds or chicken respectively.
- Out-door life - Space under covered veranda provided on the front side of the house is used as a "living room" during the day and the evening.
  - Dish-washing and household chores are often done outdoors.
  - → Lot space for covered veranda expansion.

*Mandi: Indonesian style bathroom.
Also means taking a bath.

o Personal effects and storage

- Furniture - What is owned by more than half of the household:
  beds (adults), double bunks (children), bedside table, closets and sofa sets (for 3 ∿ 6 persons)

- Consumer durable - What is owned by more than half of the household:
  foot-operated sewing machines
  - Items people especially want to buy: refrigerator, washing machines, stereo and TV sets

- Water-supply, drainage and sanitary ware
  - What is owned by more than half of all households:
    conventional stools
  - Items people especially want to buy: low-tank Western-style stools

- Books - average 0.5 ∿ 1 M of books

- Bedding - 6 pillows, 2 bolsters and 3 mattresses

- Clothes - 3 jackets, 2 sweaters, 13 shirts, 10 pair of trousers, 8 skirts, 10 underskirts, 6 pair of socks, 8 saloons, 3 pajamas, 6 pair of shoes and 2 pair of sandals.

- Vehicles - 4 out of every 10 people have motorcycles, and 2 of every 10 people have bicycles.

v. Natural conditions

o Wind

- Wind direction and wind force
  - Jakarts; NW in wet season
    E in dry season
  - Wind are mostly breezy

- Ventilation and privacy
  - Ventilation has priority over privacy in housing unit

- Sun shine - In the tropical area, there is no north south directional character by subshine.
  - People are averse to sunlight from the west (particularly during dry season).

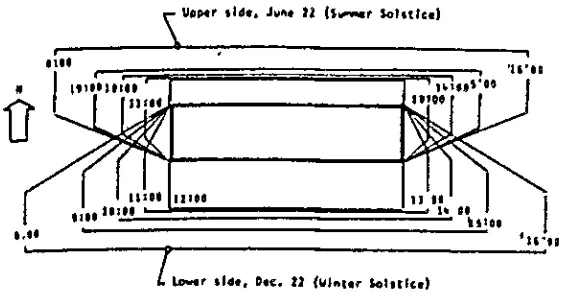


Fig. 6-4 SOLAR SHADE TRANSITION OF WALK-UP FLAT BUILDING IN E-W AXE POSITION

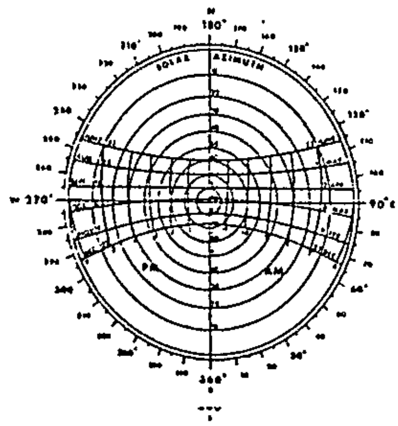


Fig. 6-5 LATITUDE 6° SOUTH

vi. Others

- ·Security against crime - People are highly aware of security against crime and want eagerly to have lock
  Main door; lock
  Other outer door; simple hook
  Strong desire to lock room doors
  Occupants provide lock and key by themselves.

- ·Delivered good - news papers (60%), magazines (30%) milk (10%)
  - Few homes have mailboxes.

- ·Preference for building material
  - People care very much for bricks. They care little for bamboo.

- ·Preference for housing types
  - People care very much for detached houses

- ·Preference for floors
  - People care very much for low-rise houses

6-2-2 Standards and regulations

i. Space requirement

o Standard size of each room and arrangement of furniture

CIPTA KARYA STANDARD (in case of 3 childrdn)

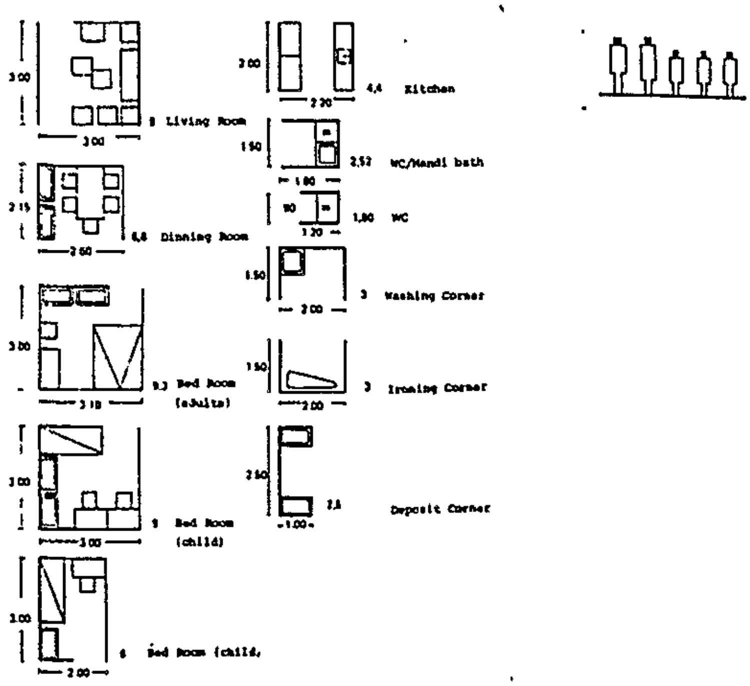


Fig. 6-6 ROOM SPACE STANDARD OF CIPTA KARYA

ii. Various load regulations

o Line load

For floor Table 6-2 LIVELOAD FOR FLOOR

	Indonesia	Japan
Floor of small size house	150kg/m²	180kg/m²
Floor of other house (incl.2.F)	200kg/m²	180kg/m²
Stair, Porch and Corridor of house	200kg/m²	180kg/m²
Roof covered Veranda of house	200kg/m²	180kg/m²
Floor of office and Shop	250kg/m²	300kg/m²
Floor of class room in school	200kg/m²	230kg/m²
Stair and Corridor of office,(school)	300kg/m²	300 (230)kg/m²
Floor of Concert room, Exhibition room, Congress Hall, Movie Theater, Trainning room and Balcony	400kg/m²	360kg/m²
Floor of dance hall, Stair, Corridor of church, Concert Hall, Theatre	500kg/m²	360kg/m²
Floor of congress hall, Movie Theatre and Sports hall	500kg/m²	360kg/m²
Auditorium with only sitting seats	400kg/m²	300kg/m² (fixed seat)
Auditorium with standing space	500kg/m²	360kg/m²
Garage for car	550kg/m²	550kg/m²
Factory min.	400kg/m²	

For colum axial force (for foundation)

Table 6-3 LIVELOAD FOR FOUNDATION

Position	Correcting Coefficient	
	Indonesia*1	Japan*2
Roof	1.0	1.0
Top story	1.0	0.95
Second story from the top	0.9	0.90
Third	0.8	0.85
4th	0.7	0.80
5th	0.6	0.75
6th	0.5	0.70
7th	0.4	0.65
8th	↓	0.60
9th		↓
Bottom story	0.4	0.60

*1 : Reduction Coefficient from the floor load's.

*2 : Reduction Coefficient from the colum & girder load's.

For earthquake

Table 6-4 LIVELOAD FOR EARTHQUAKE kg/m²

	Seismic Load (Reduction Coefficient)	
	Indonesia	Japan
House	(0 3) 45 60 normal	60
Office	(0.5)125	80
Class room	(0.5)100	110
Restaurant Shop	(0.5)125	130
Factory	(1.0)more than 400	depend upon the condition

o Seismic load

Conception of seismic intensity

The acceleration at height (i) expressed by the next formula:

$$a_i = K_i \times K_d \times K_t$$

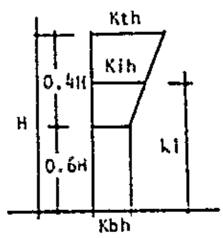
ai: Vertical·horizontal acceleration at height (i).

Ki: Vertical·horizontal seismic coefficient at height (i)

Kd: Area coefficient

Kt: Ground coefficient

Ki (Coefficient by height)



$H<10m$: $K_0 = 0.1$

$10m<H<40m$: $\frac{Kih}{Kbh} = 1+0.05H$

$Kbh = \frac{1}{10+0.1H}$

Kth : Top floor
Kbh : Bottom floor

Kd (Area coeifficient)

The following values are used for the four parts into which the entire Indonesia is divided (see map)

Division	III	II	I	0
Kd	1.0	0.5	0.25	0

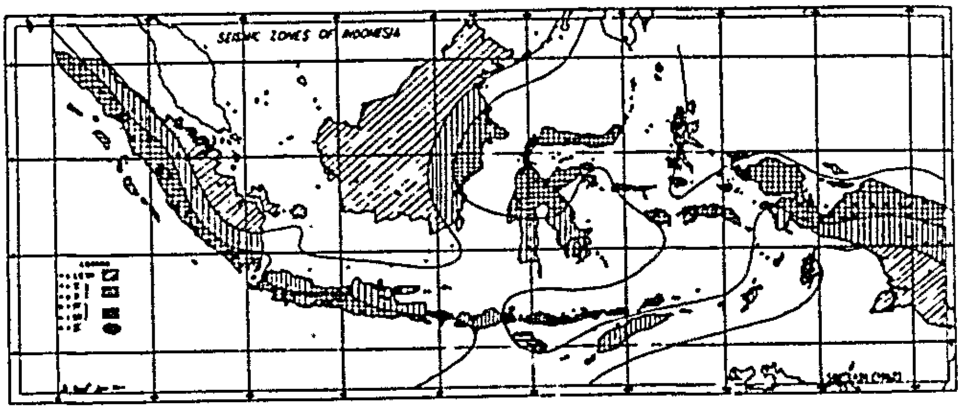


Fig. 6-7 SEISMIC MAP OF INDONESIA

Kt (Ground coefficient)
Table 6-5 Kt-VALUE

Soil		Type of structure			
Type	Bearing cap. (kg/cm²)	Steel	R.C.	Timber	Masonry
Hard	> 5	0.6	0.8	0.6	1.0
Average	2 - 5	0.8	0.9	0.8	1.0
Soft	0.6-2	1.0	1.0	1.0	1.0
Very soft	0 - 0.5	1.0	1.0	1.0	1.0

If H >40m dynamic analysis is obligated.

Coefficients by Different Parts of Building

The coefficient of the above-mentioned basic coefficient Kih is increased for the parts indicated below.

Table 6-6 COEFFICIENTS BY DIFFERENT PART OF BUILDING

Portion of building	Direction of force	Seismic coefficient
1	2	3
Exterior bearing and non bearing walls, interior non bearing walls.	Horizontal	$2k_{Ih}$
Cantilever parapet and other cantilever walls, except retaining walls.	Horizontal	$5k_{Ih}$
a. When connected to or a part of a building : towers, tanks plus contents chimneys, smokestacks and pent houses b. Individual elevated tanks plus content (not supported by a building).	Horizontal	$2k_{Ih}$
Cantilevers, balconies and any other car' 'ever-typed structural members.	Vertical	$5k_{Ih}$

iii. Sound insulating regulations

Though no sound insulation regulations apparently exist in Indonesia, the following are set as target values:

Sound insulation capacities of walls between housing units and floors of walk-up flats

Freauency (Hz)	125	500	1,000	2,000
Transmission loss (dB)	25	40	45	50

Approximately 35 dB (1000 Hz) is permissible as the sound insulating capacity of unit-to-unit walls of low-rise housing, and occupants themselves are excepted to make improvements, if necessary.

iv Fire regulations

o Fire regulation for walk-up flat

Since no unified fire regulations exist, the Japanese regulations for fire fireproof and semi-fireproof structures and the Peraturan Bangunan Nasional regulations of Indonesia are shown below. A direct comparison of fire resisting time, etc. is impossible because of the difference of standards for capacity evaluation.

Table 6-7 COMPARISON OF FIRE REGULATION FOR WALK-UP FLAT

Section \ Regulation	PERATURAN BANGUNAN NASIONAL		JAPANESE		
	Fire Resistant Construction	Semi-Fire Resistant Construction	Fire Resistant Construction	Semi-Fire Resistant Construction	
Wall – Outer Wall – Bearing Wall	4hr	4hr	1hr. (2hr.)	FR	SNFM
Wall – Outer Wall – Non-Bearing Wall – within flamable distance	3hr.+NFM (upper part of wndow etc. 0.8M)	2hr.	1hr. (1hr.)		FP
Wall – Outer Wall – Non-Bearing Wall – beyond flamable distance			0.5hr. (0.5hr.)		SNFM
Wall – Bearing Partition	4hr.	4hr.	1hr. (2hr.)		SNFM
Colomn	4hr	3hr.	1hr. (2hr.)		NFM
Floor			1hr. (2hr.)		NFM+FR
Beam	3hr.	3hr.	1hr. (2hr.)		NFM
Roof			0.5hr. (0.5hr.)	NFM+FP	FR
Stair	FR	FR	FR		SNFM
Fire Resistant Wall+Door			every1500m²	every 500m²	every 1000m²
Cornice	3hr.+NFM(≥0.6m)				
Wall between two houses			FR or FP	FR or FP	
Upper part of wall between two houses			FR or FP every 1f ≥300m² → 12m	FR or FP every 1f≥300m² → 12m	
Note	Difinitions of fire resistance is based on the differant material combination and performancial assumptions.		3 ~4F (5 ~11F)	3 ~4F or 2 nd floor>300m² A-Type SFR	B-Type SFR

NFM : Non- flamable material
SNFM . Semi non- flamable material
FR : fireresistant
SFR : Semi fire resistant
FP : fire proof

o Fire regulations for low-rise housing

Two items are targeted as follows:

- Fire proof structure must, as a principle, be used if the total floor area of rooms in a building exceeds 300M².
- Walls between housing units must be fireproof and reach up to the roof truss.

When expanding, it is necessary to have the above items observed as mush as possible.

v. Lighting and ventilating regulations

o Effective day-light intake area

10% of room floor area (PERUMNAS standard) o Effective ventilating area

2% of room floor area excluding NACO window (PERUMNAS standard)

vi. Collective regulation

o Coverage ratio and volume ratio of walk-up flat site

Table 6-8 DKI REGULATION-Bz-OKT AREA (NEW AREA & SUBURBS)

No. of Story	Free Distance (M)	Coverage Ratio: High Density Zone	Coverage Ratio: Medium Density Zone	Coverage Ratio: Low Density Zone	Volume Ratio: High Density Zone	Volume Ratio: Medium Density Zone	Volume Ratio: Low Density Zone
I	4.00	75%	60%	50%	0.75	0.6	0.5
II	4.50				1.50	1.2	1.0
III	5.00				2.25	1.8	1.5
IV	5.50				3.0	2.4	2.0
V	6.00	60%	50%	40%	3.5	3.0	2.0
VI	6.50						
VII	7.00						
VIII	7.50						
IX	8.00	50%	40%	30%	4.0	3.0	2.0
X	8.50						
XI	9.00						
XII	9.50						
XIII	10.00						
XIV	10.50						
XV	11.00						
XVI	11.50						
XVII	12.50	40%	30%	20%	4.5	4.0	3.0
XVIII	"						
XIX	"						
XX	"						
XXI	"						
XXII	"						
XXIII And up	"	40%	30%	20%	5.0	4.0	3.0

Table 6-9 DKI REGULATION – TK-CT AREA (CENTRAL CITY)

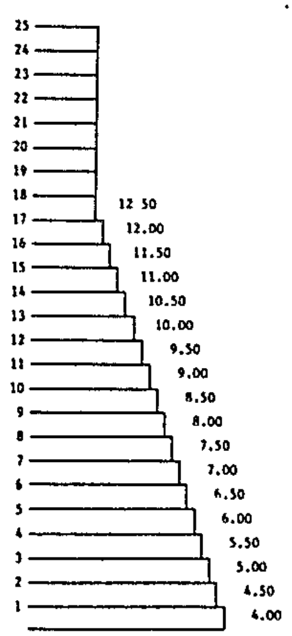
No. of Story	Free Distance (M)	Coverage Ratio: High Density Zone	Coverage Ratio: Medium Density Zone	Coverage Ratio: Low Density Zone	Volume Ratio: High Density Zone	Volume Ratio: Medium Density Zone	Volume Ratio: Low Density Zone
I	4.00	75%	60%	50%	0.75	0.6	0.5
II	4.50				1.5	1.2	1.0
III	5.00				2.25	1.8	1.5
IV	5.50				3.0	2.4	2.0
V	6.00	60%	50%	40%	3.5	3.0	2.0
VI	6.50						
VII	7.00						
VIII	7.50						
IX	8.00	50%	40%	30%	4.0	3.0	2.0
X	8.50						
XI	9.00						
XII	9.50						
XIII	10.00						
XIV	10.50						
XV	11.00						
XVI	11.50						

o Coverage ratio and volume ratio of low-rise housing site

Table 6-10 DKI REGULATION (DRAFT FINAL)

ITEM \ DKI	SMALL HOUSE: High Density Zone	SMALL HOUSE: Medium Density Zone	SMALL HOUSE: Low Density Zone
Lot Size (M^2/Lot)	60 ~ 100	80 ~ 200	100 ~ 250
Min Frontage (M)	4	5	6
Side Building Line (M)			
Single	1.5	2	2.5
Semi-Detached	0/2	0/2.5	0/3
Row	0	0	0
Rear Building Line (M)			
Single	3	3	3
Semi-Detached	3	3	3
Row	3	3	3
Height of Building or No. of Floor	I/II/II	I/II/II	I/II/II
Max. Coverage Ratio	0.6	0.5	0.4
Max. Volume Ratio	0.6/1.1/1.5	0.5/0.9/1.3	0.4/0.7
Durability	Permanent	Permanent	Permanent/ Semi-Permanent
Front Yard	Min. 20% of front yard should be green		

Table 6-11 DKI REGULATION (FREE DISTANCE BY NO. OF STORY)

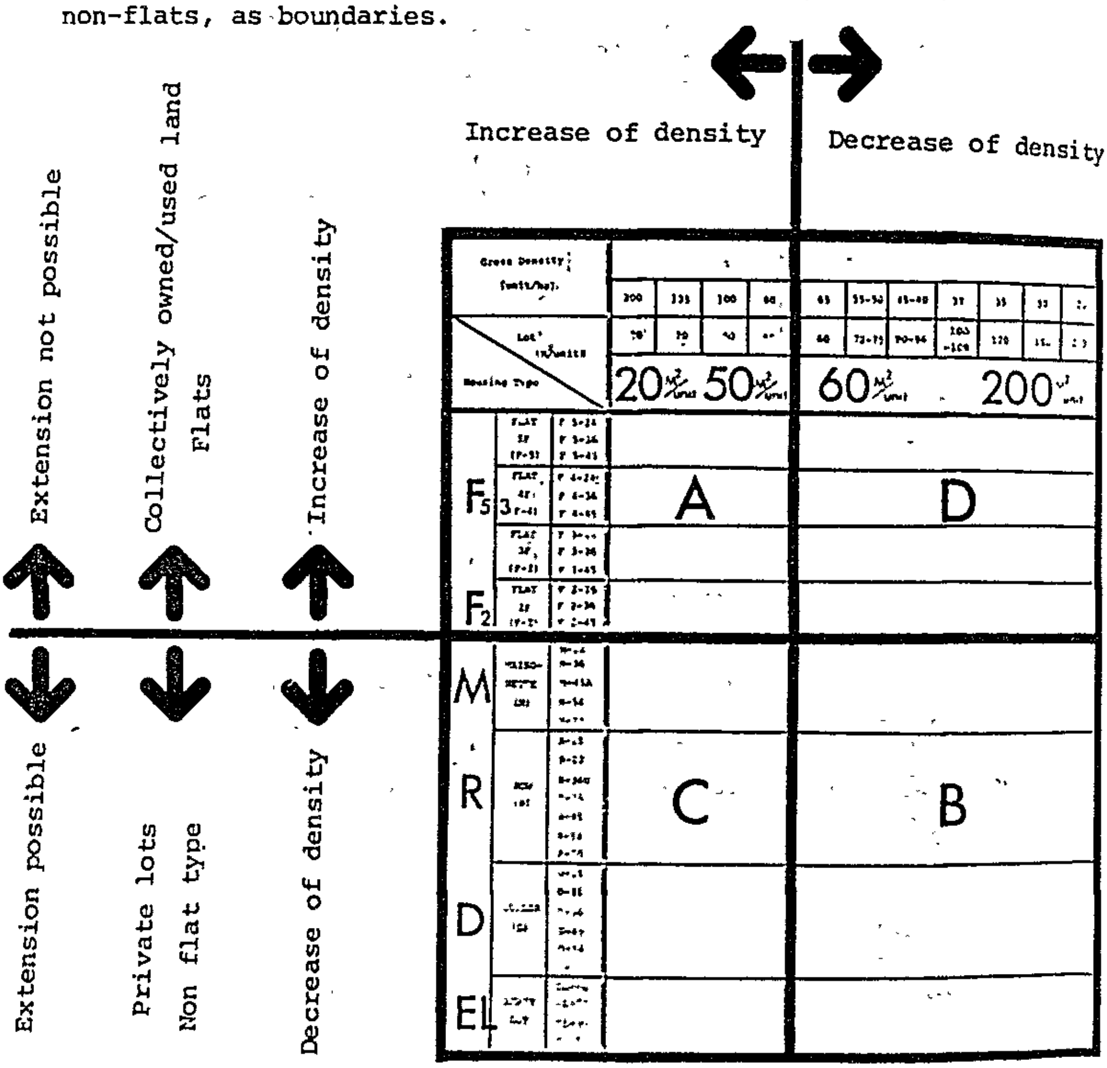


6–3 RESIDENTIAL AREA PLANNING

6-3-1 Lot size and high-density housing types

a. Setting of target housing types

The following chart shows an arrangement where housing types considered to be study targets in this housing plan, are arranged in the order of densities, are used as the axis of ordinates, and their per unit lot sizes (m^2/unit) are used as the axis of abscissa. Further, the chart is divided into four zones of 60m^2/unit or more, less than 60m^2/unit, flats and non-flats, as boundaries.



These zones, A to D, have the following characteristics:

A: Zone suitable for flat type

This is a high-density flat housing type where extension is impossible. This zone presupposes collectively used/owned lots.

B: Zone suitable for non-flat type

This is a town-house type covering everything from low density to relatively high density. Expension is possible. This zone presupposes privately owned lots.

C: Zone not approved by DKI Regulation

Less than minimum lot size ($60m^2$/unit)

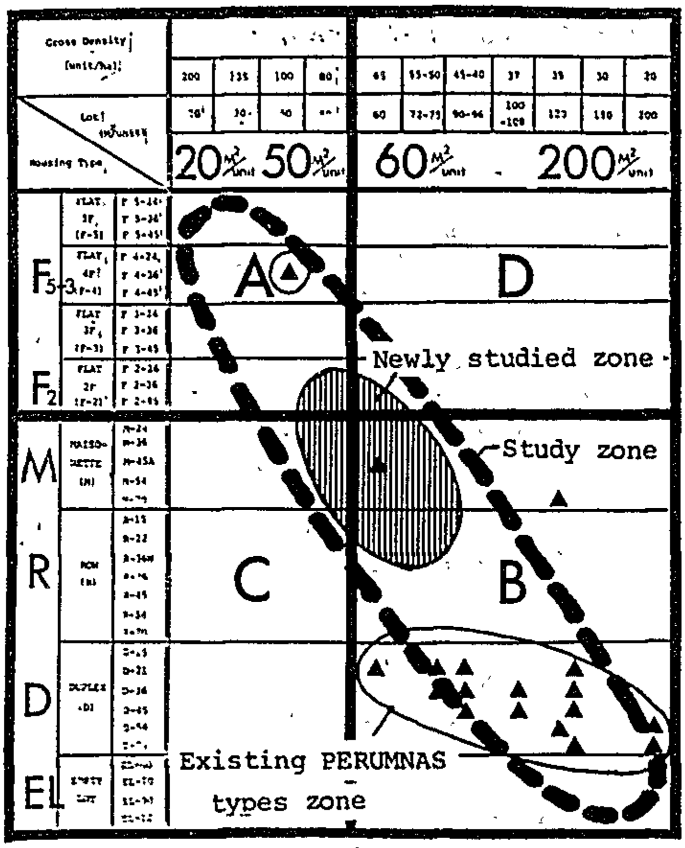
D: Flat type large lot zone

Properly, this is a zone of flats generally not recommendable from the view-point of effective use of land.

As can be seen from their characteristics, A and B zones are within the range of the study targets under this housing plan.

The main PERUMNAS LCH housing of the past comprises the relatively lower right part of B zone, namely, the duplex type and the type that partially incorporates R and M. Recently, efforts have begun to include walk-up flats. However, supplying housing in the form of walk-up flats only (A zone only) is not realistic, since the construction cost of walk-up flats is 2 to 2.5 times that of low-rise houses, and land prices in the Cengkareng area, even considering future increases, are not sufficiently high to offset the high construction cost of walk-up flats. It is also a fact that the conventional system of supplying PERUMNAS housing that provides sufficient lots for each dwelling unit, can no longer cope with land prices in the Cengkareng area and the infrastructure and other land-related costs by lot conditions there. Hence, the importance of attempting to increase density within the range of low-rise housing.

The following chart can be obtained by plotting the conventional PERUMNAS housing supply type.



The zone is divided between two extremes: the walk-up flat type in the upper left part and the duplex type in the lower right type, leaving space for the M.R types near the center, particularly the types of small floor area. This zone is mainly composed of various relatively high density types is suitable for development of suburban housing areas: two-storied flats (F-2), maisonettes (M) and row-houses (R). It is the development of these types that we want to stress in this study. → Development of low-rise high-density housing.

b. Present condition of floor areas and Per-unit lot sizes

The distribution of housing types (combination of floor area and per-unit lot size in the PERUM PERUMNAS housing complexes (including plans) in JABOTABEK, and the proportions of fllor area by type and per-unit lot size by type in the total number of houses, are shown below:

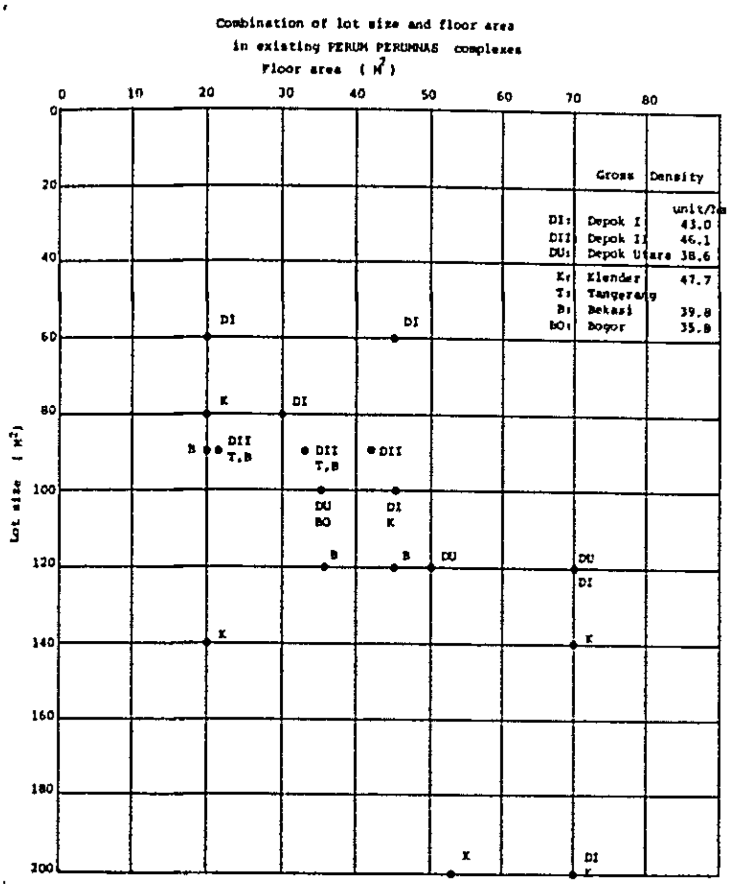


Fig. 6-8 COMBINATION OF LOT SIZE AND FLOOR AREA IN EXISTING PERUMNAS COMPLEXES (SOURCE:BEKASI II REPORT)

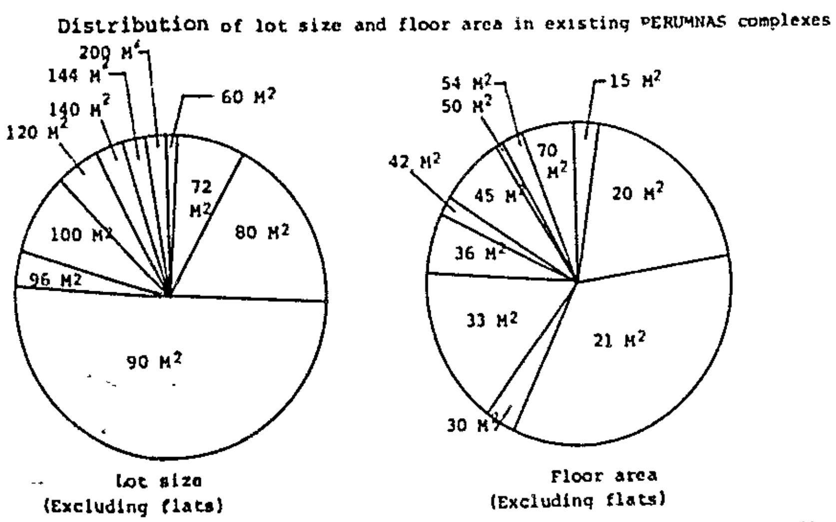


Fig. 6-9 DISTRIBUTION OF LOT SIZE AND FLOOR AREA IN EXISTING PERUMNAS COMPLEXES (SOURCE:BEKASI II REPORT)

It can be seen from the above that the types are widely distributed, but types from D-33 down, in floor area, represent 3/4 of all, and types from $90m^2$ down in per unit lot size also represent 3/4 of the entire amount.

c. Target floor area and living mode

As stated in 6-2-1: General Conditions, floor area viewed from the standpoint of living mode in these houses with regard, to sleeping, mainly made may be considered as follows:

- On floor area less than $36m^2$ (2.LD.K) conditions, would be very crowded for a family of six and expansion in early stage would be necessary.

- On $36m^2$, a family of six would be obliged to use the living room for sleeping.

- On $45m^2$ (3.LD.K), dwelling can be made fairly agreeable and expansion is not especially necessary from the viewpoint of separate sleeping.

- The difference of floor area between $24m^2$ (one room type) and $36m^2$, is far greater than that between $36m^2$ and $45m^2$.

- Adding roofed verandas as space to enjoy outdoor life - a life style peculiar to Indonesia - is a common practice. These serve as living rooms and places for house chores during the day. So, sleeping in the living room at night does not cause much inconveniences.

  → Use of veranda as living room

From the above, it would be understood that, as far as the mode of living is concerned, $36m^2$ (2.LD.K) may be used as the target floor area, while $45m^2$ (3.LD.K) or larger(2.LD.K) is a floor area for people with relatively high income.

d. Target floor area and expansion

There is a problem of whether this target floor area of $36m^2$ should be achieved by expansion, or whether to build houses of $36m^2$ from the beginning. The initial construction cost can be minimized by counting on expansion by the occupant and, by this system, the burden of the occupant himself naturally can be small at the beginning. But at the housing sites covered by this plan, which aims at a density higher than that of any existing housing complex, a system counting largely on expansion by occupants involves the danger of producing a housing complex that is disorderly as a house environment, unless careful contractual and institutional preparations concerning expansion are made beforehand. This danger is, indeed, worth considering.

As for the flats that are new study here, the land is collectively owned and, physically, expansion is extremely difficult. It is, therefore, necessary to use $36m^2$ from the beginning as the target floor area for flat-type housing and take types of less than $36m^2$ for such special purposes as housing for small families or as dormitories etc. Otherwise, these may, primarily out of financial considerations, be allocated to people of the lowest income level.

e. Target per-unit lot size, net coverage ratio and volume ratio (Study of housing lot environment)

The net coverage ratio and the volume ratio are, indeed, important indexes for the study of environment in housing lots. In DKI Jakarta, 60% is the maximum converage ratio for non-flat housing. However, the coverage ratio and the volume ratio are difficult to define for flats and particularly in planning grouped flats, their values differ, depending on what is conceived as the extent of lots. The control imposed by DKI Regulations on the coverage ratio and the volume ratio as applicable to flats is too lax for application to the development of large public flats, because the Regulations also apply to small private developments.

Since no definite information is available on the present designation of sectors in the Cengkareng area, with respect to the control of the coverage ratio and the volume ratio by DKI Regulations, control values for the high-density sector (PADAT), the medium-density sector (KURANG PADAT) and the low-density sector (TIDAK PADAT) are set as follows, by tentatively applying the value of the BZ-OKT area (new area or suburb);

• High-density sector max. value (PADAT)	Inadequate zone
• Medium-density sector max. value (KURANG PADAT)	Not recommendable zone
• Low-density sector max. value (TIDAK PADAT)	Recommendable zone

Also, the present study zones have been further clarified by tentatively setting zones with much too high grades (see following charts).

Table 6-12 ADEQUATE HOUSING TYPES CHECKED BY COVERAGE RATIO

(in case of 36 M^2 final floor area after expansion is expected)

Gross Density (unit/ha)			← HIGHER DENSITY				LOWER DENSITY →						
			200	135	100	80	65	55-50	45-40	37	35	30	20
Lot (M^2/unit)			20	30	40	50	60	72-75	90-96	100 -108	120	150	200
Housing Type			Corrective Ownership				4M x 15M	6M x 12M / 5M x 15M	8M x 12M / 6M x 15M	9M x 12M / 5M x 20M	6M x 20M	7.5M x 20M	10M x 20M
COMPLETE HIGHER DENSITY ↑	FLAT 5F (F-5)	F 5-24	30%	20%	15%	12%	10%	9- 8%	7- 6%	5%	5%	4%	3%
		F 5-36	40	27	20	16	13	11-10	9- 8	8	7	5	4
		F 5-45	50	33	25	20	17	14-13	11-10	9	8	7	5
	FLAT 4F (F-4)	F 4-24	38	25	19	15	13	10-10	8- 8	7	6	5	4
		F 4-36	50	33	25	20	17	14-14	11-10	9	8	7	5
		F 4-45	63	42	31	25	21	17-17	14-13	12	10	8	6
	FLAT 3F (F-3)	F 3-24	50	33	25	20	17	14-13	11-10	9	8	7	5
		F 3-36	67	44	33	27	22	19-18	15-14	13	11	9	7
		F 3-45	83	56	42	33	28	23-22	19-17	15	14	11	8
	FLAT 2F (F-2)	F 2-26	65	43	33	26	22	18-17	14-14	13	11	9	7
		F 2-36	95	63	48	38	32	26-25	21-20	18	16	13	10
		F 2-45	-	78	59	47	39	33-31	26-24	22	20	16	12
EXTENSION LOWER DENSITY ↓	MAISONETTE (M)	M-24					40	33-32	27-25	22	20	16	12
		M-36					30	25-24	20-19	17	15	12	9
		M-45A					38	31-30	25-23	21	19	15	11
		M-54					45	38-36	30-28	25	23	18	14
		M-70					58	49-47	39-36	28	29	23	18
	ROW (R)	R-15					60	50-48	40-38	33	30	24	18
		R-22					60	50-48	40-38	33	30	24	18
		R-36N					60	50-48	40-38	33	30	24	18
		R-36					60	50-48	40-38	33	30	24	18
		R-45					75	63-60	50-47	42	38	30	23
		R-54					90	75-72	60-56	50	45	36	27
		R-70					-	98-93	78-73	65	58	47	35
	DUPLEX (D)	D-15					60	50-48	40-38	33	30	24	18
		D-21					60	50-48	40-38	33	30	24	18
		D-36					60	50-48	40-38	33	30	24	18
		D-45					75	63-60	50-47	42	38	30	23
		D-54					90	75-72	60-56	50	45	36	27
		D-70					-	98-93	78-73	60	58	47	35
	EMPTY LOT	EL-60					100	83-80	67-63	56	50	40	30
		EL-70					-	97-93	78-73	65	58	47	35
		EL-90					-	-	100-94	83	75	60	45
		EL-120					-	-	-	-	100	80	60

- Inadequate zone by DKI Regulation (min. lot size 60 M^2/unit)
- Inadequate zone by DKI Regulation (BZ-OKT Area). F5>55%, F4~F2>60%, Other>60%
- Not recommendable zone (BZ-OKT Area). F5>35%, F4~F2>40%, Other>60%
- High grade zone. F5≤10%, F4≤13%, F3≤16%, F2≤19%, M≤22%, R.D.EL≤25%
- Not recommendable zone in case of 45M^2 final floor area is expected.

Table 6-13 ADEQUATE HOUSING TYPES CHECKED BY VOLUME RATIO

(in case of 36 M^2 final floor area after expansion is expected)

			← HIGHER DENSITY				LOWER DENSITY →						
Gross Density (unit/ha)			200	135	100	80	65	55-50	45-40	37	35	30	20
Lot (M^2/unit)			20	30	40	50	60	72-75	90-96	100 -108	120	150	200
Housing Type			Corrective Ownership				4M x 15M	6M x 12M 5M x 15M	8M x 12M 6M x 15M	9M x 12M 5M x 20M	6M x 20M	7.5M x 20M	10M x 20M
COMPLETE HIGHER DENSITY ↑	FLAT 5F (F-5)	F 5-24	150%	100%	75%	60%	50%	42-40%	30-31%	27%	25%	20%	15%
		F 5-36	200	133	100	80	67	56-43	44-42	38	33	27	20
		F 5-45	250	167	125	100	83	69-67	56-52	46	42	33	25
	FLAT 4F (F-4)	F 4-24	150	100	75	60	50	42-40	33-31	27	25	20	15
		F 4-36	200	133	100	80	67	56-53	44-42	38	33	27	20
		F 4-45	250	167	125	100	83	69-67	56-52	46	42	33	25
	FLAT 3F (F-3)	F 3-24	150	100	75	60	50	42-40	33-31	27	25	20	15
		F 3-36	200	133	100	80	67	56-53	44-42	38	33	27	20
		F 3-45	250	167	125	100	83	69-67	56-52	46	42	33	25
	FLAT 2F (F-2)	F 2-26	130	87	65	52	43	36-35	29-27	26	22	17	13
		F 2-36	190	127	85	76	63	53-51	42-40	35	32	25	19
		F 2-45	235	157	118	94	78	65-63	52-49	54	39	31	24
EXTENSION LOWER DENSITY ↓	MAISO-NETTE (M)	M-24					60	50-48	40-38	33	30	24	18
		M-36					60	50-48	40-38	33	30	24	18
		M-45A					75	63-60	50-47	42	38	30	23
		M-54					90	75-72	60-56	50	45	36	27
		M-70					116	97-93	73-73	65	58	47	35
	ROW (R)	R-15											
		R-22											
		R-36N											
		R-36											
		R-45											
		R-54											
		R-70											
	DUPLEX (D)	D-15											
		D-21											
		D-36											
		D-45											
		D-54											
		D-70											
	EMPTY LOT	EL-60											
		EL-70											
		EL-90											
		EL-120											

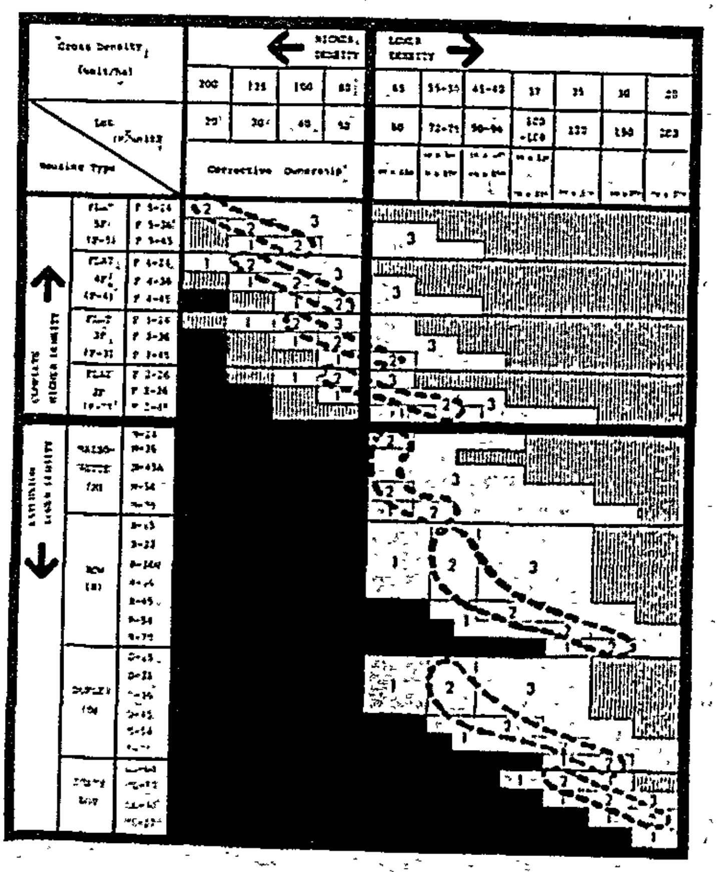
Inadequate zone by DKI Regulation (min. lot size 60 M^2/unit)
Inadequate zone by DKI Regulation (BZ-KOT Area). F5>300%, F4>240%, F3>180%, F2,M>120%
Not recommendable zone (BZ-OKT Area). F5>200%, F4>160%, F3>120%, F2>80%
High grade zone. F5≤55%, F4≤50%, F3≤45%, F2≤35%

Now, grades in the present study zones are set by housing types by the following principle:

Table 6-14 GRADING OF STUDY ZONE

Housing Type		Grade 1	Grade 2	Grade 3
FLAT		Volume Ratio		
	F_5	200% ∿ 150%	150% ∿ 100%	100% ∿ 50%
	F_4	160% ∿ 120%	120% ∿ 80%	80% ∿ 40%
	F_3	120% ∿ 90%	90% ∿ 60%	60% ∿ 30%
	F_2	80% ∿ 60%	60% ∿ 40%	40% ∿ 20%
		Coverage Ratio		
		40% ∿ 30%	30% ∿ 20%	20% ∿ 10%
OTHER	M ∿ EL	Coverage Ratio		
		60% ∿ 50%	50% ∿ 40%	40% ∿ 20%

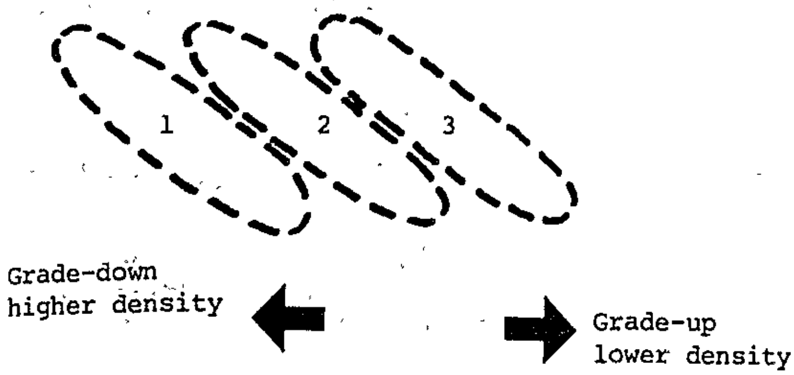
EL:EMPTY LOT



Ex. (2) grade 2

Fig. 6-10 GRADING OF STUDY ZONE

As is clear from the chart, the grades -- with the exception of the M-type -- form gently sloped diagonal regions as illustrated below:



Grades increase and densities decrease in the right direction. The tendency is reverse in the left direction.

In view of the aim at density, increase under this study, per unit lot size for each housing type is set in the regions of Grade 1 and Grade 2.

f. Check of design environments by semi-gross coverage ratio and volume ratio (Study of environment around houses)

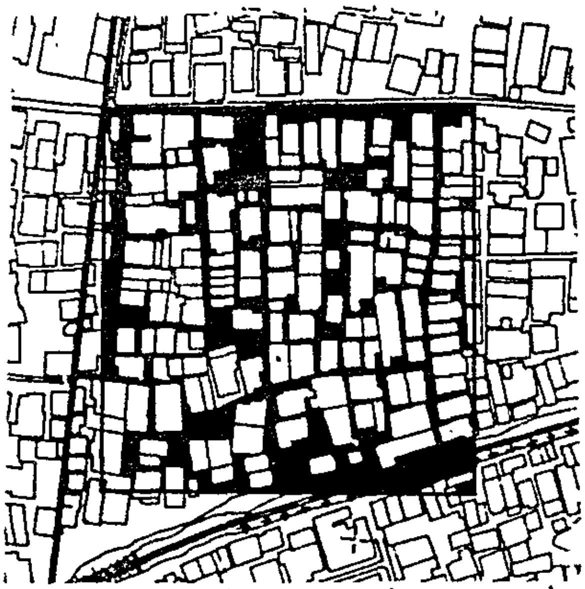
The semi-gross coverage ratio and the volume ratio are indexes suitable for the study of the environment around houses.

Generally, neither semi-gross coverage ratio nor vo lume ratio is certainly defined, but in this study, the following extent is included so that the environment of low-rise housing areas in existing urban districts, the PERUMNAS walk-up flat complexes and the plan of this study may be simultaneously compared.

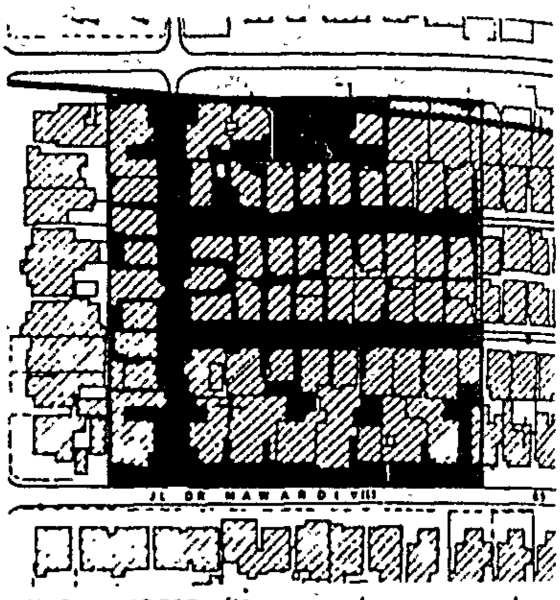
- o Housing lots
- o Approaches to houses and alleys -- not including main roads and major foot path
- o Open space around houses
- o Small play lots found in every extent of 100m × 100m

As can be seen from the above definition, the semi-gross coverage ratio and the volume ratio are suitable for the study of housing environment (particularly in areas with houses of the same type). Notable in such as this project, where high-density types are considered, these ratios can be regarded as a guide to the size of public gardens,inhabitants can have in the vicinity of their houses, especially since they cannot have any decent garden in their private housing lots.

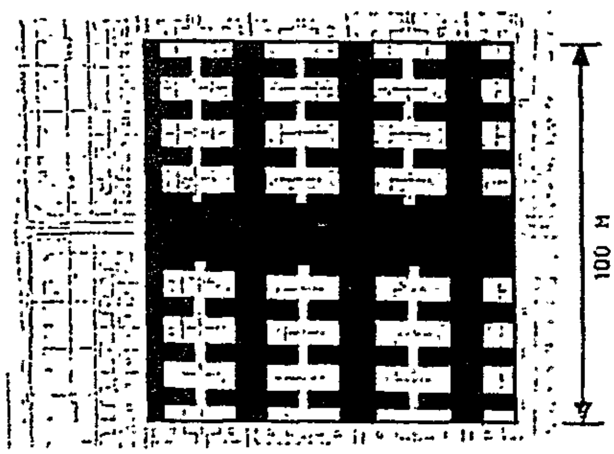
Semi-gross coverage ratios are compared below with respect to the D-21/72 type in two examples in the existing urban districts of Jakarta City: PERUM PERUMNAS Klender Housing Complex (S & S) and Bekasi II and the various housing types covered by the present plan.



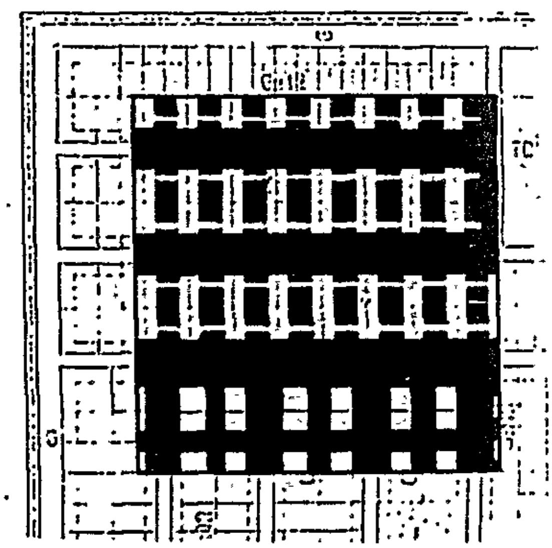
KEL. DURIPULO (Temporary house area)
70.52%



KEL. GROGOL (Masonry house area)
62.67%



Klender S & S 40.05% (21.68 %)

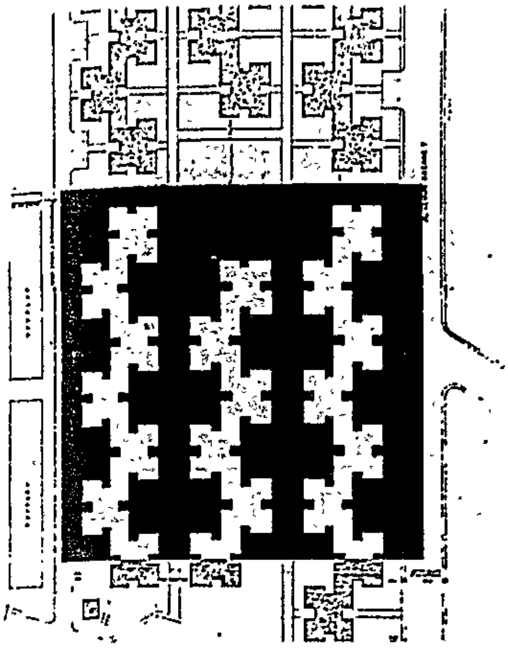


Bekasi II 33.63% (24.39%)

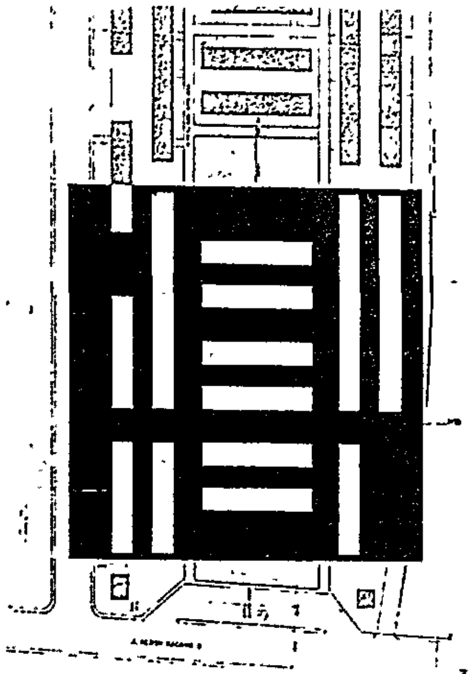
Fig. 6-11 COMPARISON OF COVERAGE RATIO IN EXISTING JAKARTA CITY AREA AND PERUMNAS HOUSING AREA

( ): Before expansion

Fig. 6-12 ENVIRONMENT AROUND FLAT TYPE HOUSING

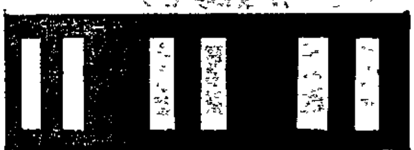


Tanah Abang Flat 1 lot: 30.41 M^2/unit
Coverage ratio: 33.65 %
Volume ratio : 1.35
Grade 1



Tanah Abang Flat 2 lot: 34.35 M^2/unit
Coverage ratio: 31.33 %
Volume ratio : 1.25
Grade 1

36.6 M^2/unit



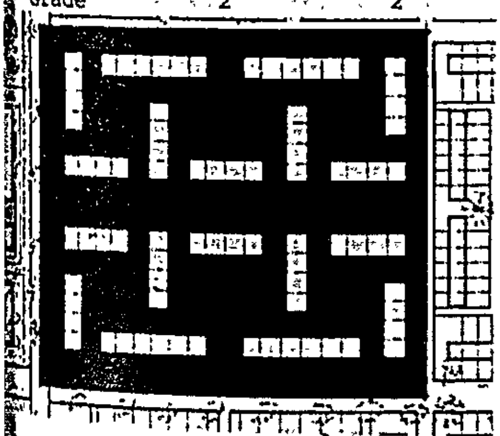
35.25 M^2/unit

FS '5-36 Cengkareng Project	upper	lower
Coverage ratio	23.72 %	24.62 %
Volume ratio	1.19	1.23
Grade	2	2

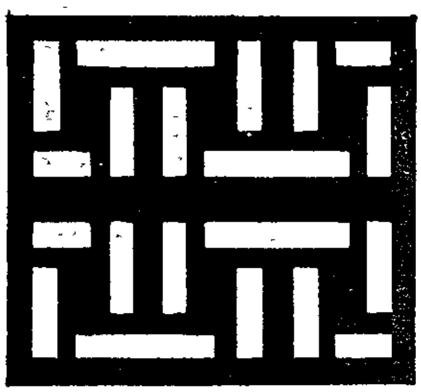
30.21 M^2/unit

26.44 M^2/unit

FS'-5-36 Cengkareng Project	upper	lower
Coverage ratio	28.73	32.83
Volume ratio	1.44	1.64
Grade	2	2

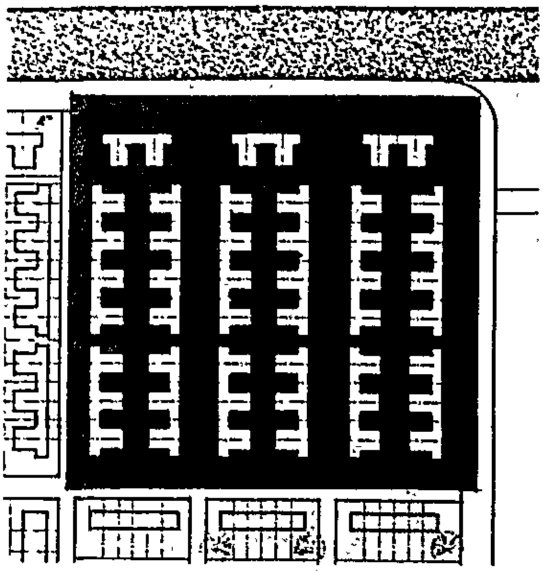


FS' 2-26 34.78 M^2/unit
Cengkareng Project

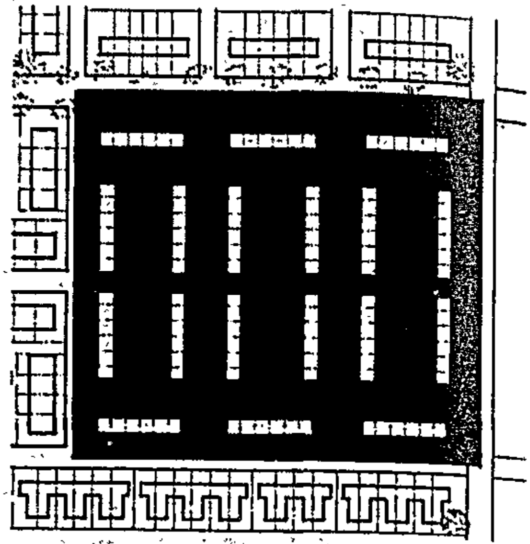


FS' 2-36 50.15 M^2/unit
Cengkareng Project

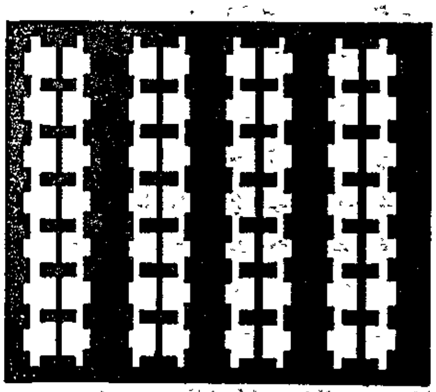
Fig. 6-13 ENVIRONMENT AROUND LOW RISE TYPE HOUSING



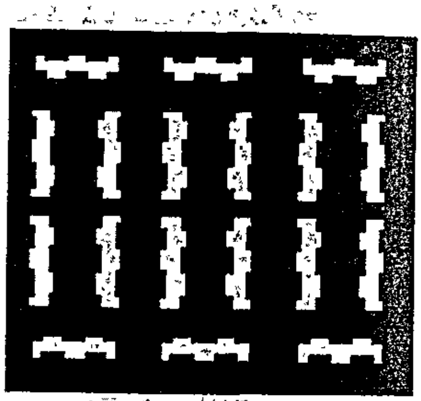
R-36N Lot:75 M/unit
Semigross coverage ratio;29.14%
Net coverage ratio;50.67%
Grade;1



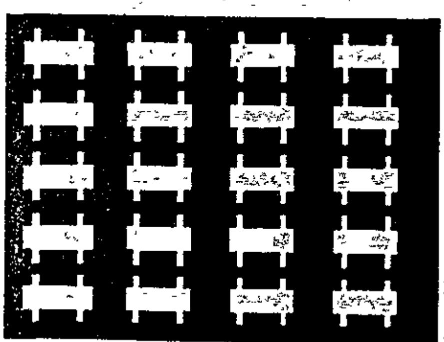
M-36 Lot;60 M/unit
Semigross coverage ratio;18.08%
Net coverage ratio;31.67%
Grade;3



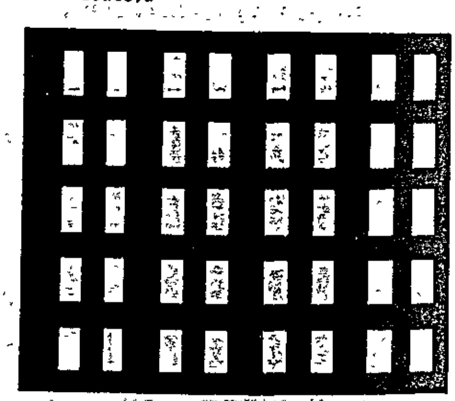
D-15 Lot;72 M/unit
Semigross coverage ratio; 35.53%
Nt Net coverage ratio;50.00%
Grade;1



R-36 Lot;90 m/unit
Semigross coverage ratio;22.84%
Net coverage ratio; 40.00%
Grade;2



D-21 Lot;96 m/unit
Semigross coverage ratio; 26.24%
Net coverage ratio;34.38%
Grade;3



D-36 Lot;108 M/unit
Semigross coverage ratio:25.91%
Net coverage ratio;33.33%
Grade;3

g. Lot form and set back line

o Frontage and Depth of Private Housing Lot

The frontage and the depth are as follows:

• Case where the depth of the nominal lot is 15m

Table 6-15 NOMINAL LOT (DEPTH 15M)

ROW of Facing Road (m)	4 ∿ 6			8 ∿ 10			12 ∿ 18		
Front Setback* (m)	3			5			6		
Nominal Lot Size (m^2)	Lot Size (m^2)	Frontage (m)	Depth (m)	Lot Size (m^2)	Frontage (m)	Depth (m)	Lot Size (m^2)	Frontage (m)	Depth (m)
60	60	4	15	68	4	17	-	-	-
75	75	5	15	85	5	17	-	-	-
90	90	6	15	102	6	17	-	-	-
120	-	-	-	136	8	17	120	6	20
150	-	-	-	170	10	17	150	7.5	20
200	-	-	-	-	-	-	200	10	20

• Case where the depth of the nominal lot is 12m

Table 6-16 NOMINAL LOT (DEPTH 12M)

ROW of Facing Road (m)	4 ∿ 6			8 ∿ 10			12 ∿ 18		
Front Setback* (m)	3			5			6		
Nominal Lot Size (m^2)	Lot Size (m^2)	Frontage (m)	Depth (m)	Lot Size (m^2)	Frontage (m)	Depth (m)	Lot Size (m^2)	Frontage (m)	Depth (m)
60	60	5	12	70	5	14	-	-	-
72	72	6	12	84	6	14	-	-	-
84	84	7	12	98	7	14	-	-	-
96	96	8	12	112	8	14	-	-	-
120	-	-	-	140	10	14	120	6	20
150	-	-	-	-	-	-	150	75	20
200	-	-	-	-	-	-	200	10	20

* Setback wall surface line determined according to ROW of a facing road.

* $120m^2$, $150m^2$, and $200m^2$, are the areas of empty lots for sale. $90m^2$ and $96m^2$ are the areas of both empty lots for sale and housing units. (building and land)

* ROW: Right of Way

- Frontage saving is necessary for the effective use of land for the following reasons and, of the above two examples, adoption of the case utilizing a depth of 15m is desirable.

o Frontage saving

A study has been made of frontage saving as one of the way to achieve density increase and in some types the frontage is reduced to 4m ∿ 5.4m from 6m ∿ 8m existing level.

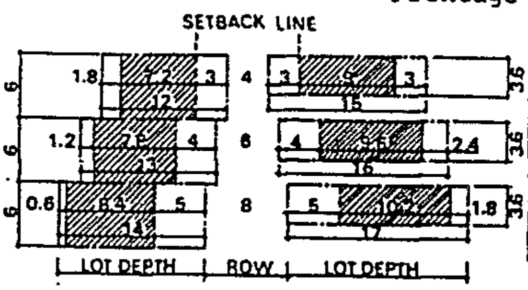
The merits are as follows:

- The area within set back line where the building is not allowed shall be reduced as far as possible. Further, with the increase of road width, increase in the area of the above-mentioned part not allowed for building, can be avoided.

- Reduction of the road ratio.

Frontage 6 M

Lot Size M2	Constructable Area M2 *
6x12 72	6x7.2 43.2
6x13 78	6x7.8 46.8
6x14 84	6x8.4 50.4



Frontage 3.6 M

Constructable Area M2	Lot Size M2
3.6x9 32.4	3.6x15 54
3.6x9.6 34.56	3.6x16 57.6
3.6x10.2 36.72	3.6x17 61.2

* 60% of lot size.

Fig. 6-14 FRONTAGE SAVING

h. Summary (Table on target floor areas and per-unit lot sizes by type)

The following can be obtained by consolidating items a to g in 6-3-1 above:

Table 6-17 TARGET FLOOR AREA AND PER UNIT LOT SIZE

<table>
<tr><td colspan="2">Repayement System</td><td colspan="3">Fixed Repayment</td><td colspan="3">Gradual Repayment</td></tr>
<tr><td colspan="2">Target Group</td><td colspan="2">Relatively Low Income Group</td><td>Relatively High Income Group</td><td colspan="2">Relatively Low Income Group</td><td>Relatively High Income Group</td></tr>
<tr><td rowspan="4">Target Floor Area
(After expansion)</td><td>F5</td><td colspan="2">36 M^2</td><td>36 M^2</td><td colspan="2">36 M^2</td><td>36 M^2</td></tr>
<tr><td>F2</td><td colspan="2">26 ∿ 36 M^2</td><td>-</td><td colspan="2">26 ∿ 36 M^2</td><td>-</td></tr>
<tr><td>M</td><td colspan="2">36 M^2</td><td>45 M^2</td><td colspan="2">36 M^2</td><td>45 M^2</td></tr>
<tr><td>R.D.</td><td colspan="2">36 M^2</td><td>45 M^2</td><td colspan="2">36 M^2</td><td>45 M^2</td></tr>
<tr><td rowspan="4">Initial Floor Area</td><td>F5</td><td colspan="2">36 M^2</td><td>36 M^2</td><td colspan="2">36 M^2</td><td>36 M^2</td></tr>
<tr><td>F2</td><td colspan="2">26 ∿ 36 M^2</td><td>-</td><td colspan="2">26 ∿ 36 M^2</td><td>-</td></tr>
<tr><td>M</td><td>24 M^2</td><td>36 M^2</td><td>36 M^2</td><td>24 M^2</td><td>36 M^2</td><td>36 M^2</td></tr>
<tr><td>R.D.</td><td>15∿24 M^2</td><td>36 M^2</td><td>36 M^2</td><td>15∿24 M^2</td><td>36 M^2</td><td>36 M^2</td></tr>
<tr><td rowspan="4">Target Lot Size Per Unit</td><td>F5</td><td colspan="2">∿35 M^2</td><td>∿40 M^2</td><td colspan="2">∿35 M^2</td><td>∿40 M^2</td></tr>
<tr><td>F2</td><td colspan="2">35 ∿ 50 M^2</td><td>-</td><td colspan="2">35 ∿ 50 M^2</td><td>-</td></tr>
<tr><td>M</td><td colspan="2">60 M^2</td><td>60 M^2</td><td colspan="2">60 M^2</td><td>60 M^2</td></tr>
<tr><td>R.D.</td><td colspan="2">60 ∿ 75 M^2</td><td>75 ∿ 90 M^2</td><td colspan="2">60 ∿ 75 M^2</td><td>75 ∿ 90 M^2</td></tr>
<tr><td colspan="2">Note:</td><td>*1</td><td></td><td></td><td>*2</td><td></td><td></td></tr>
</table>

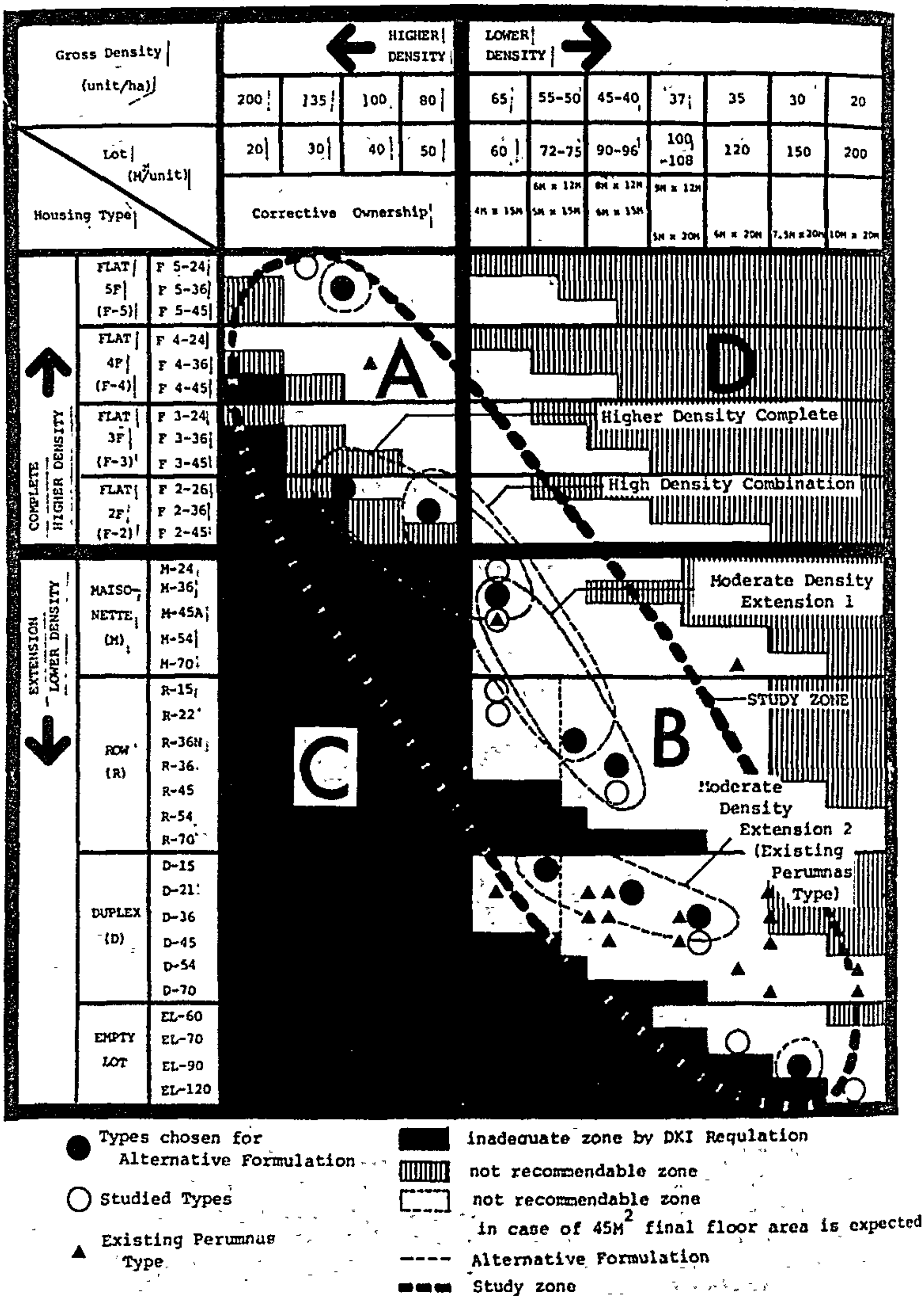
*1 Environmental condition after expansion will be in confusion.

*2 expansion ability of occupant is questionable.

These values must be studied and checked in further details at the detailed design stage.

Types for preparing alternative plans must be selected from among the above extensively studied housing types and lot sizes, from different points of view, including purchasing and construction capacity. The framework for alternative plans from the angle of housing plan and residential area plan, is shown in the following chart:

Fig. 6-15 POSITION OF HOUSING TYPES



6-3-2 Study of residential plan by housing types

a. Layout plan by housing types

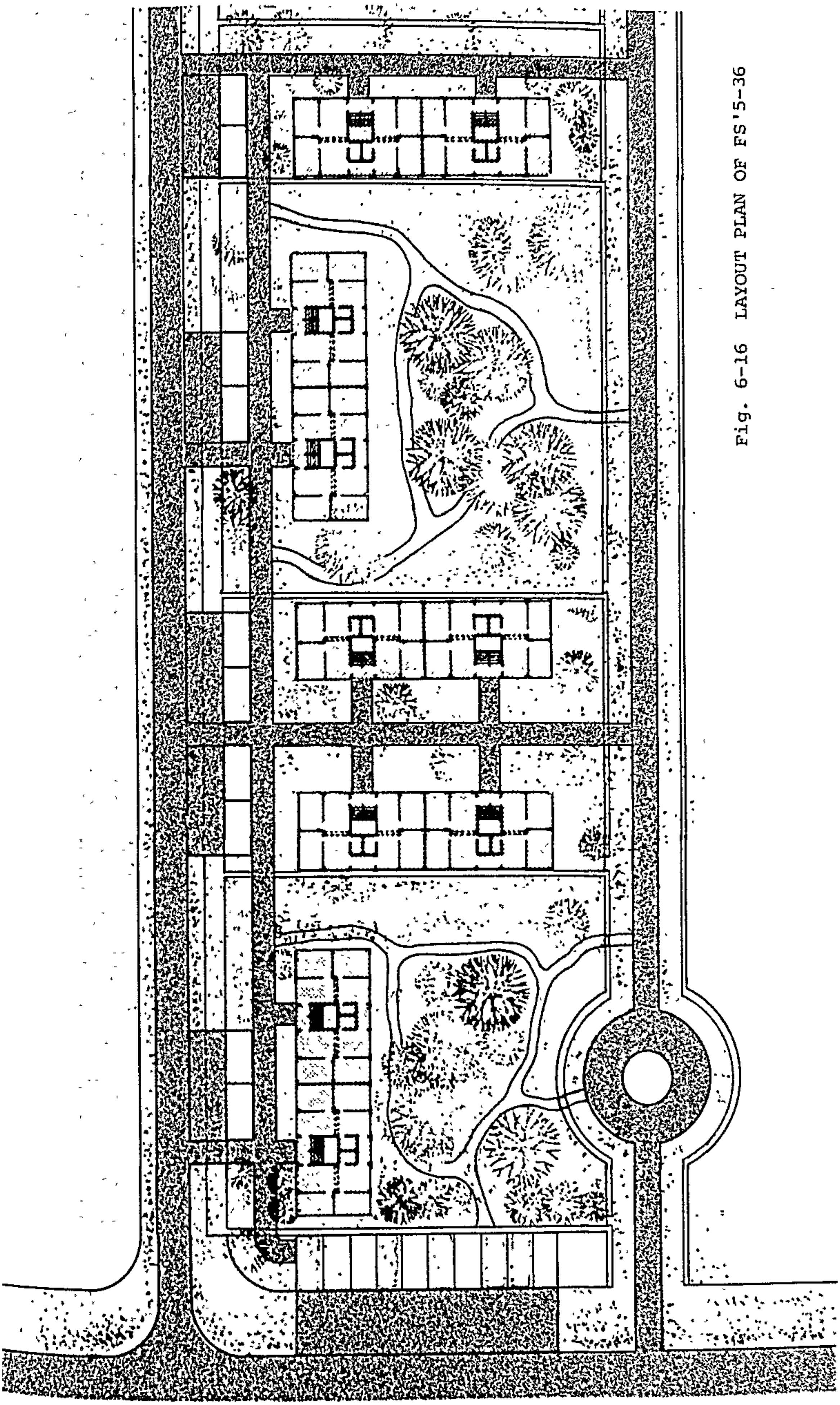


Fig. 6-16 LAYOUT PLAN OF FS'5-36

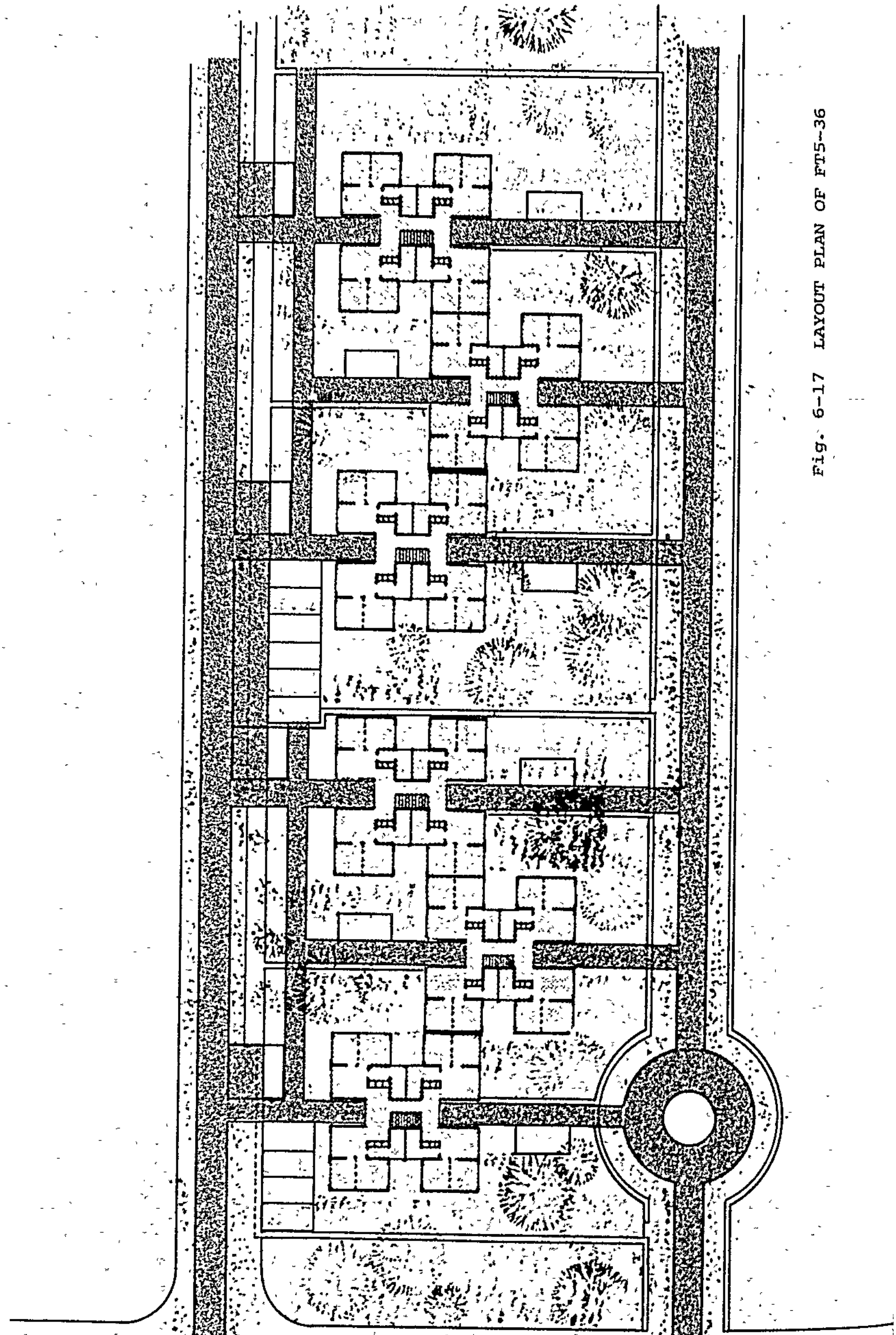


Fig. 6-17 LAYOUT PLAN OF FT5-36

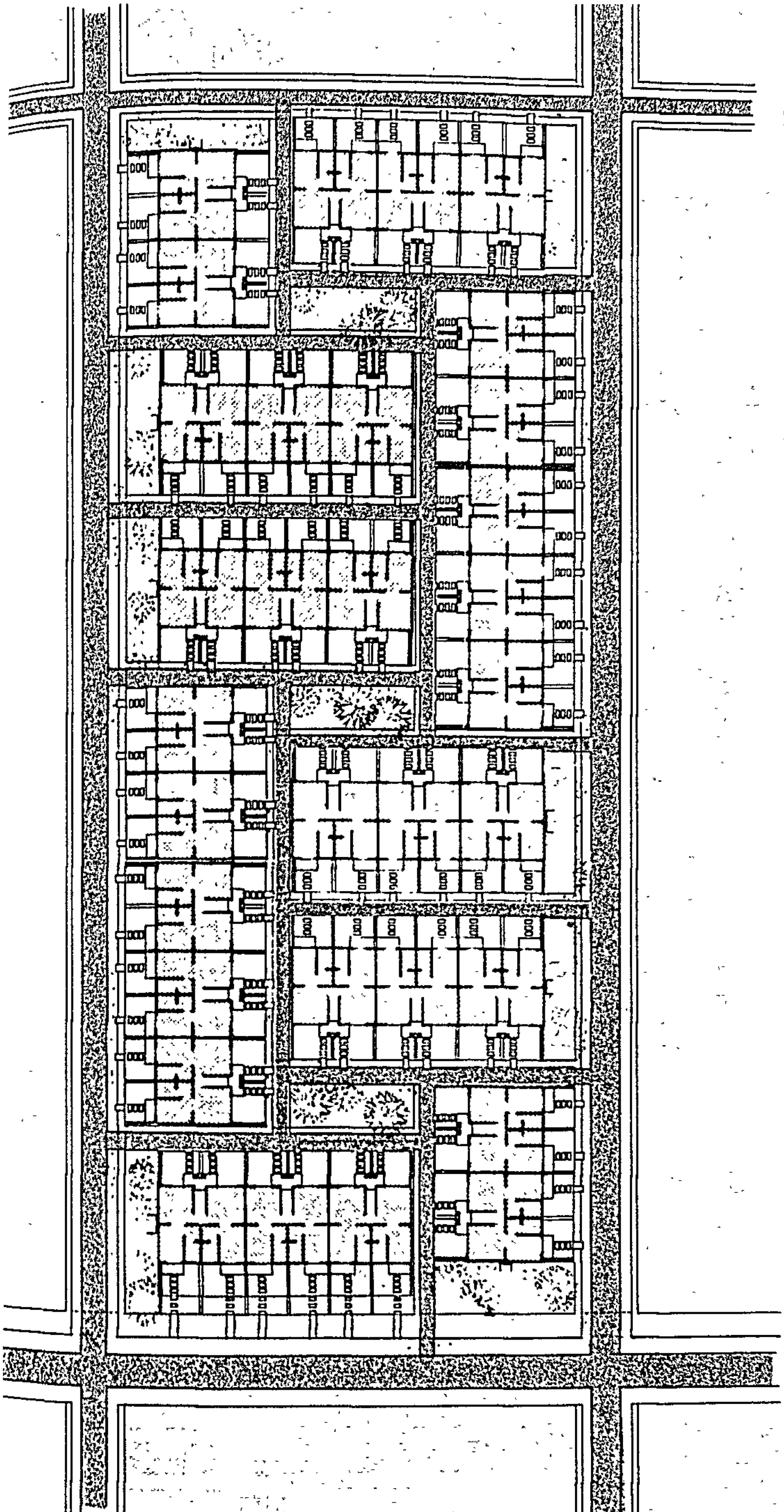


Fig. 6-18 LAYOUT PLAN OF FS'2-26

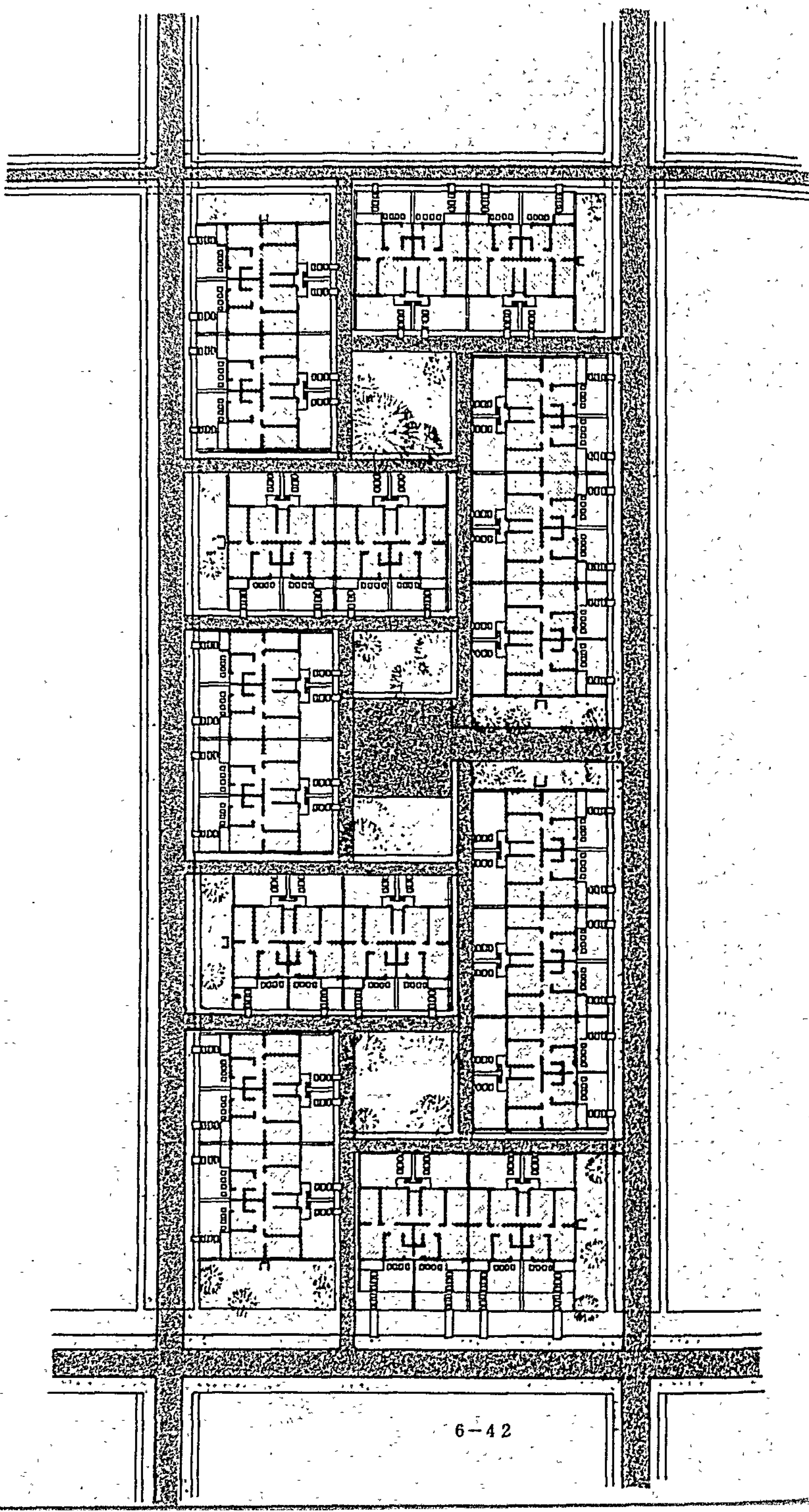


Fig. 6-19 LAYOUT PLAN OF FS'2-36

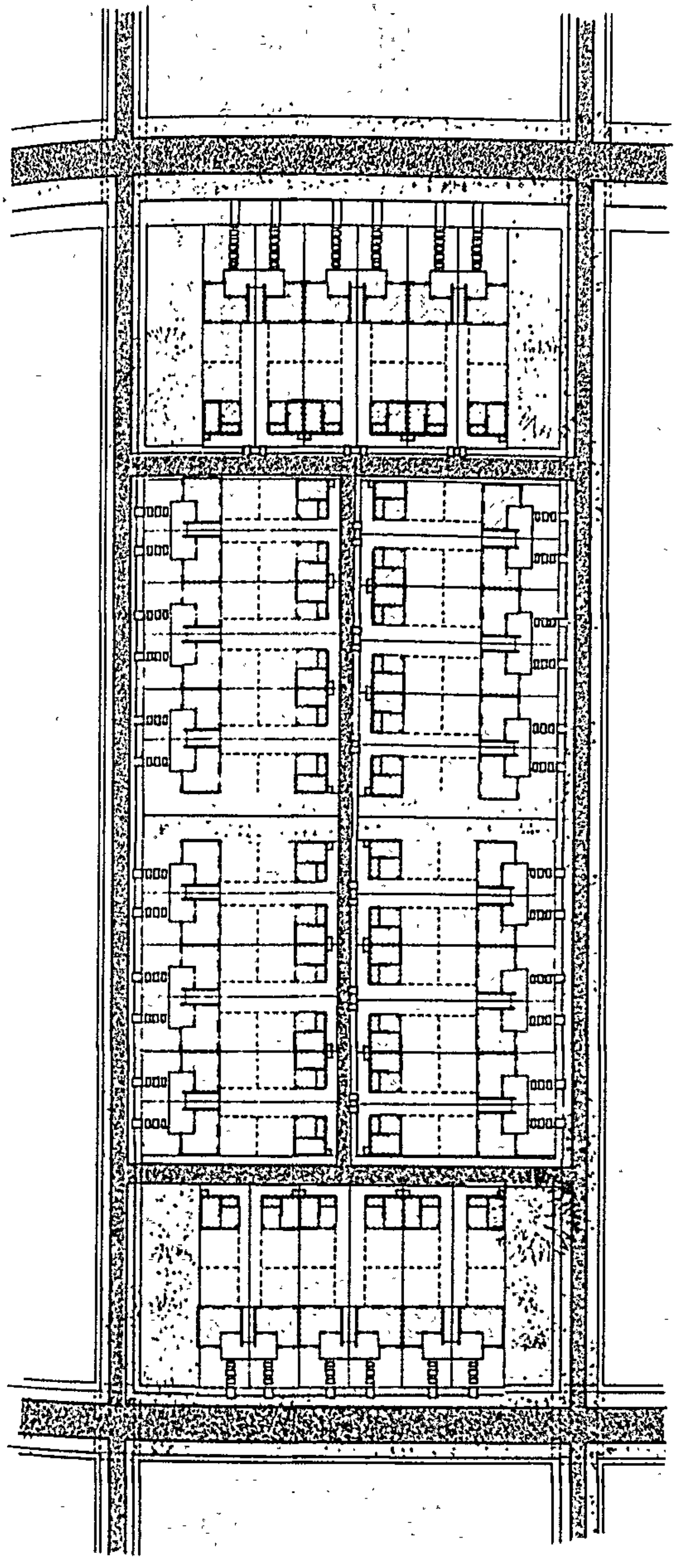


Fig. 6-20 LAYOUT PLAN OF M-24

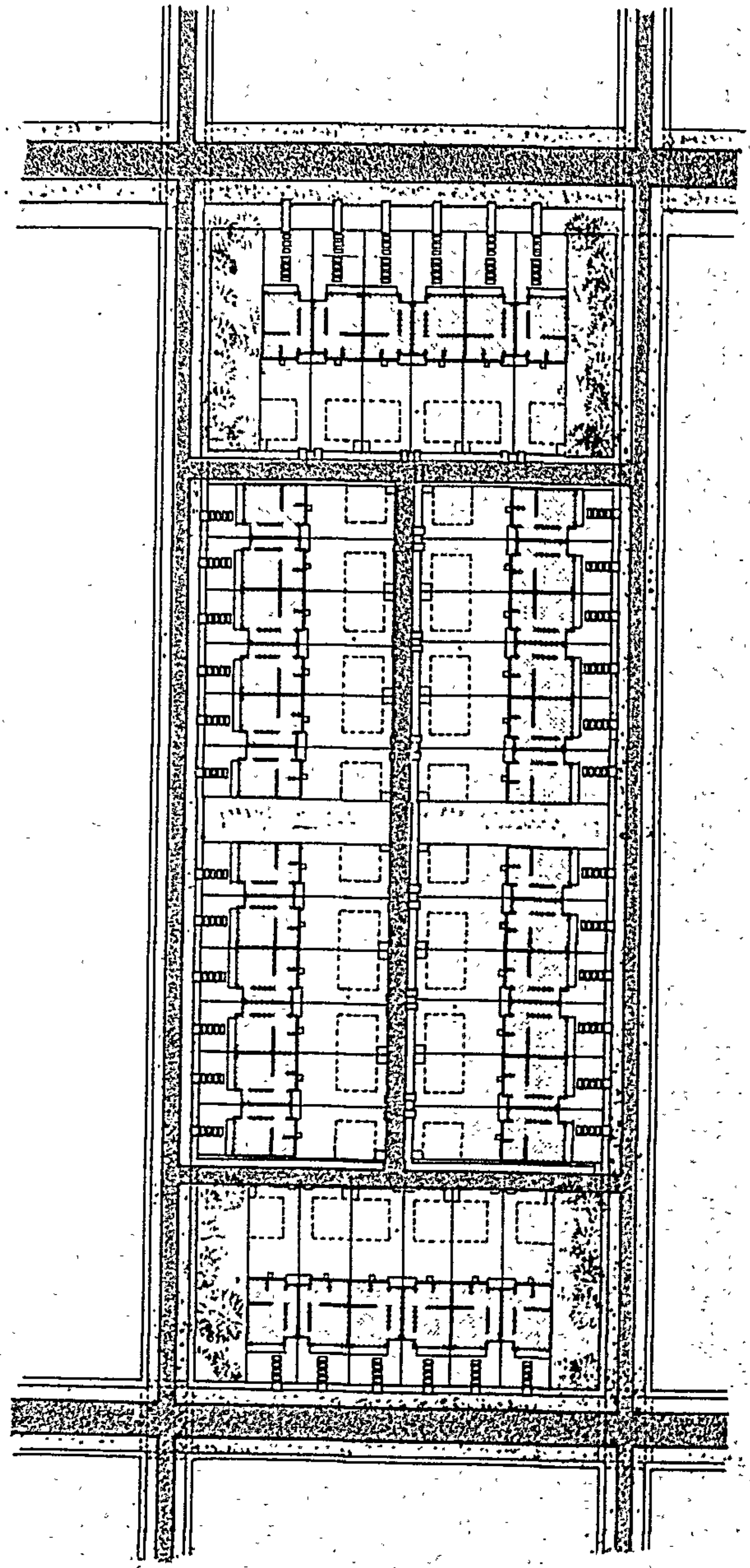


Fig. 6-21 LAYOUT PLAN OF M-36

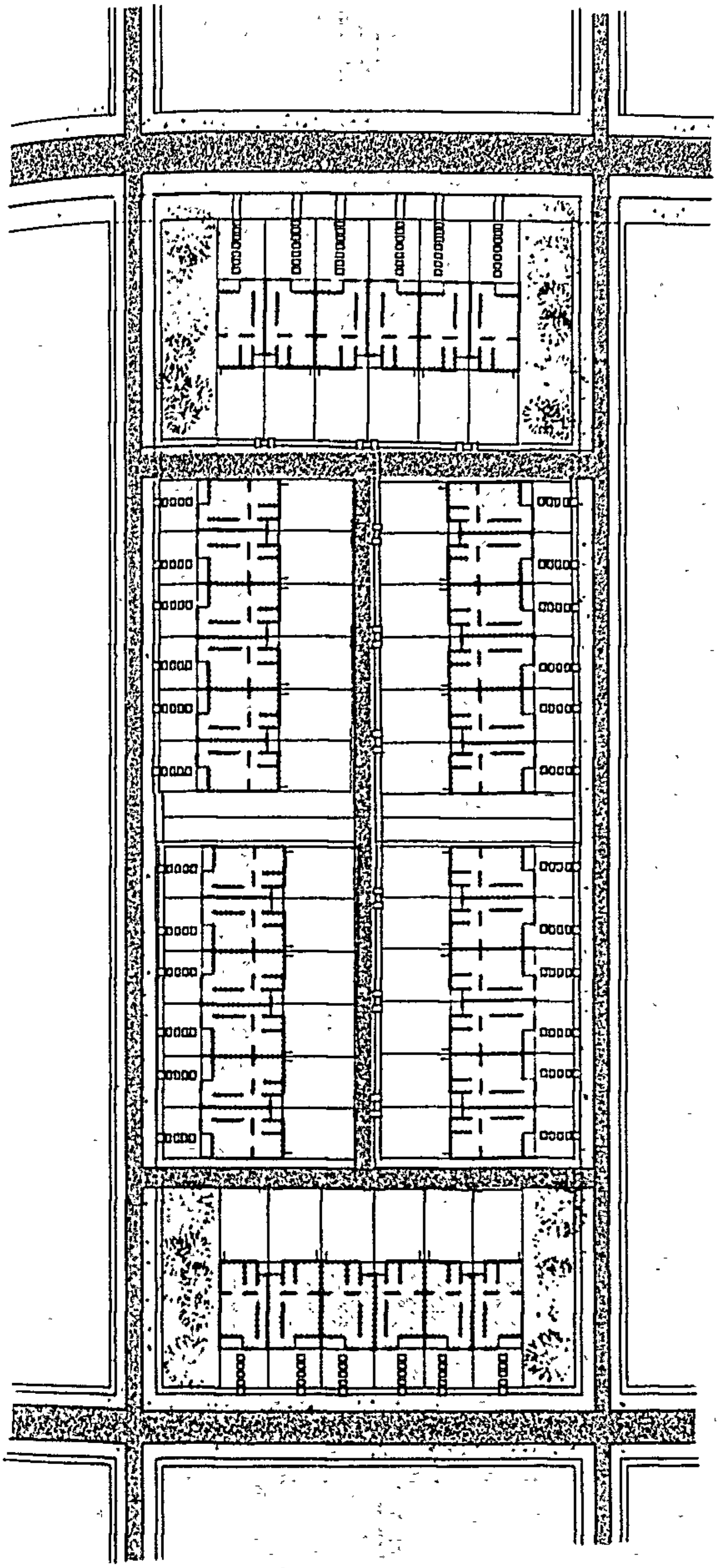


Fig. 6-22 LAYOUT PLAN OF M-45A

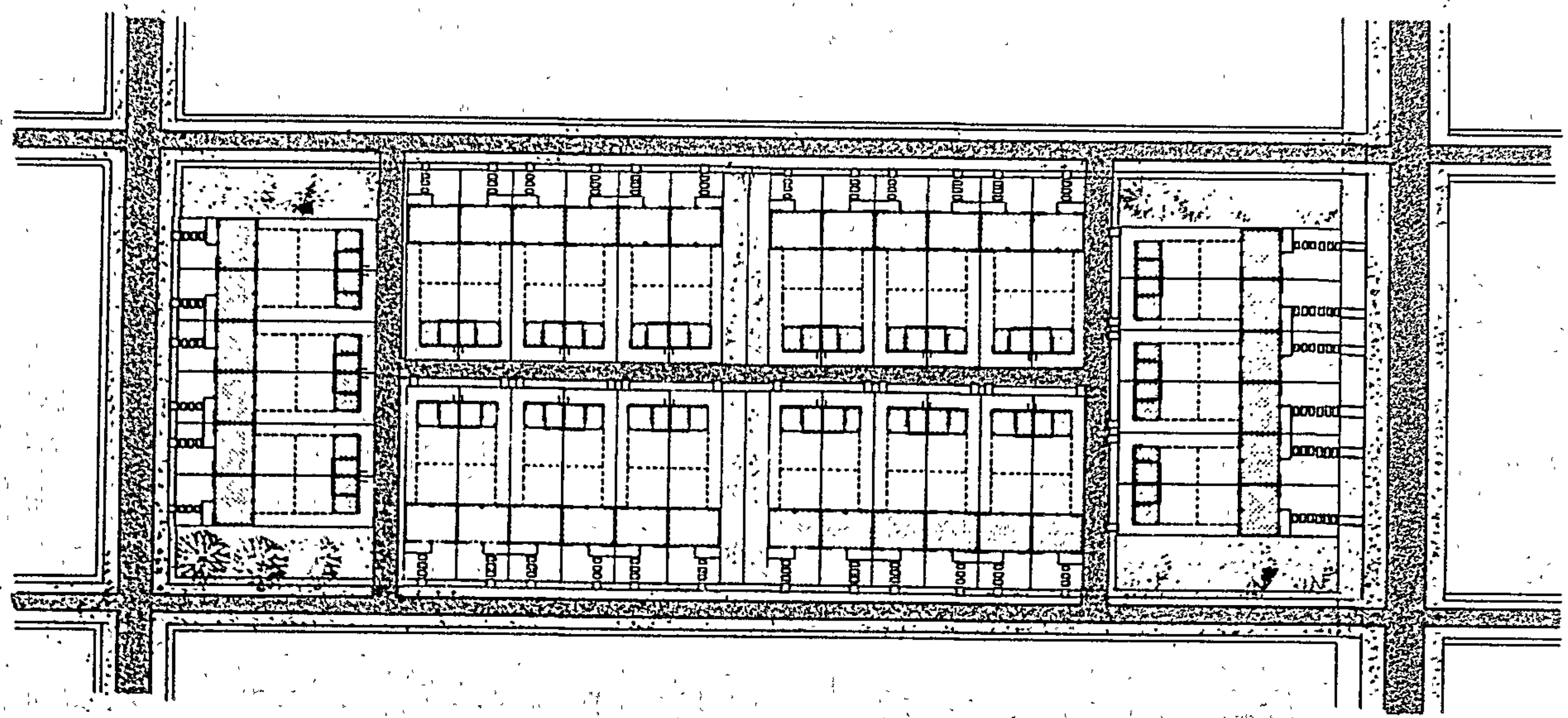


Fig. 6-23 LAYOUT PLAN OF R-15

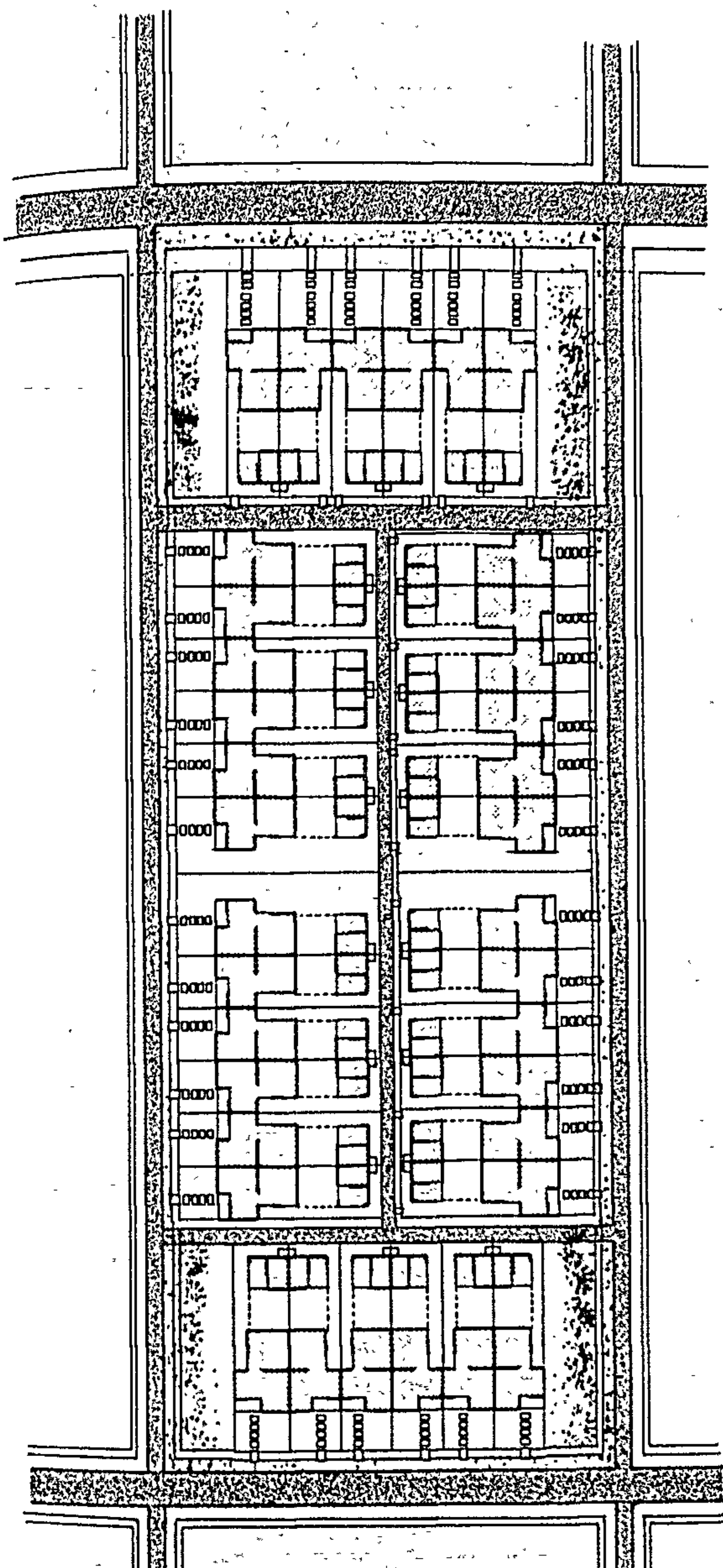


Fig. 6-24 LAYOUT PLAN OF R-22

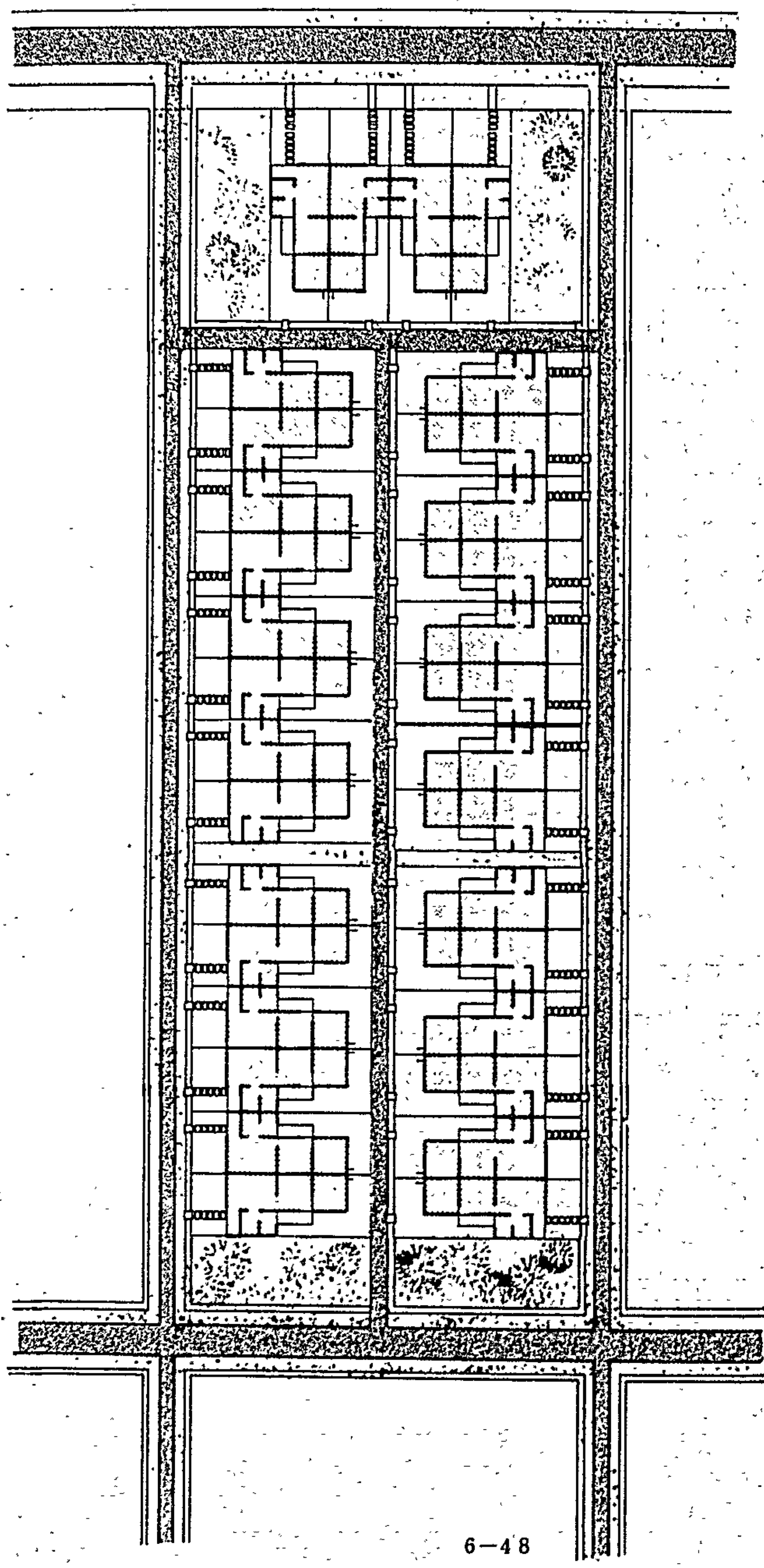


Fig. 6-25 LAYOUT PLAN OF R-36N

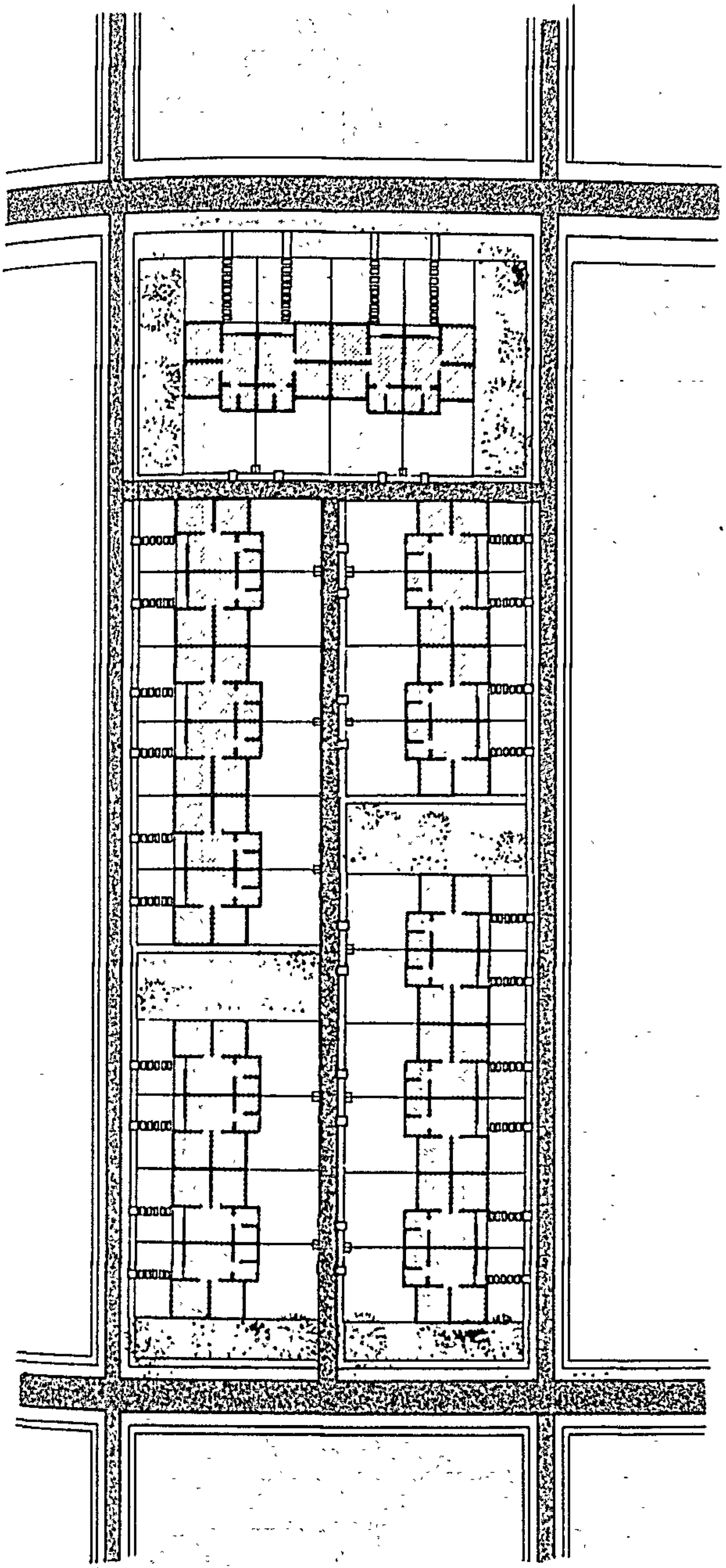


Fig. 6-26 LAYOUT PLAN OF R-36

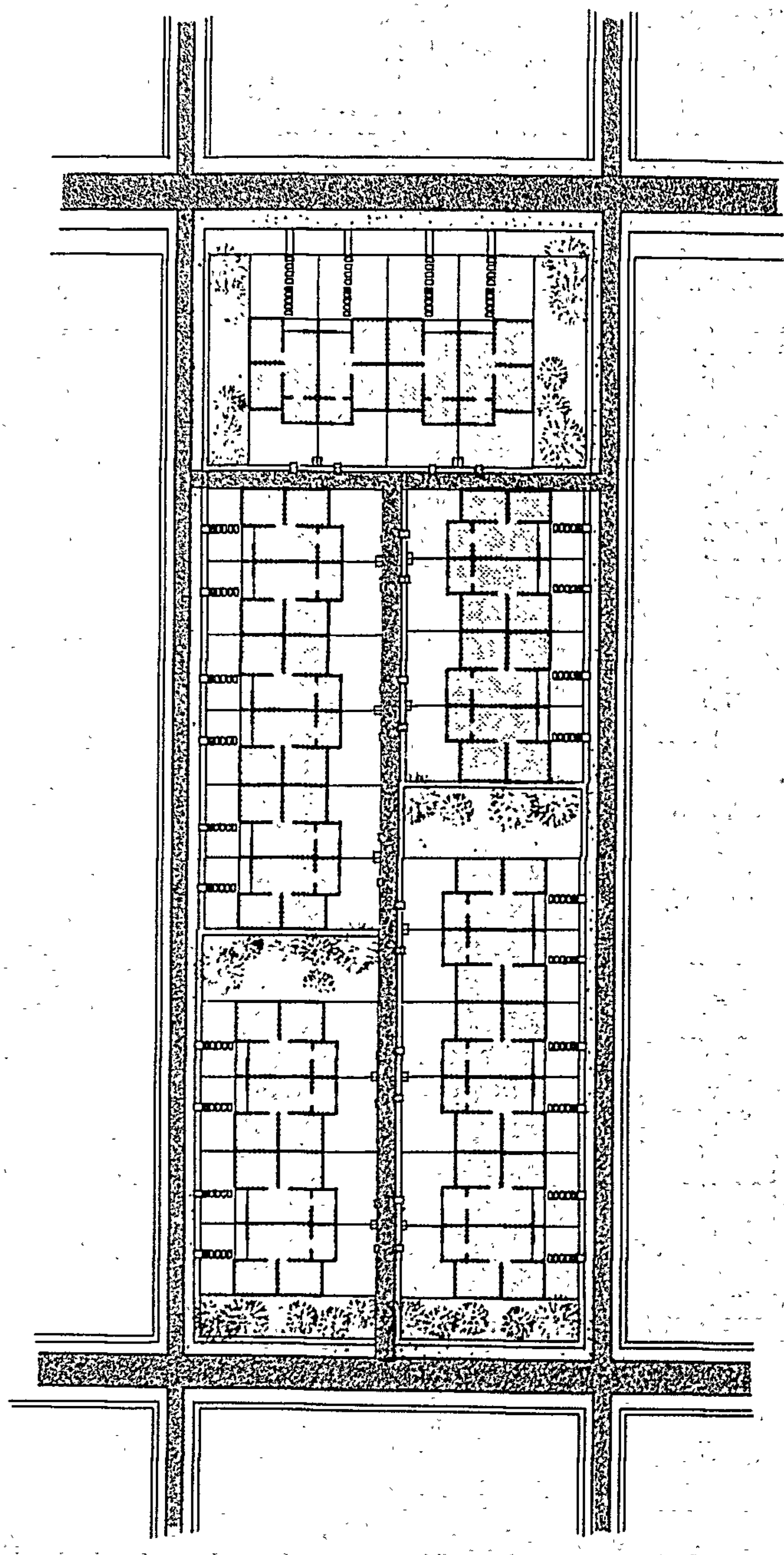


Fig. 6-27 LAYOUT PLAN OF R-45

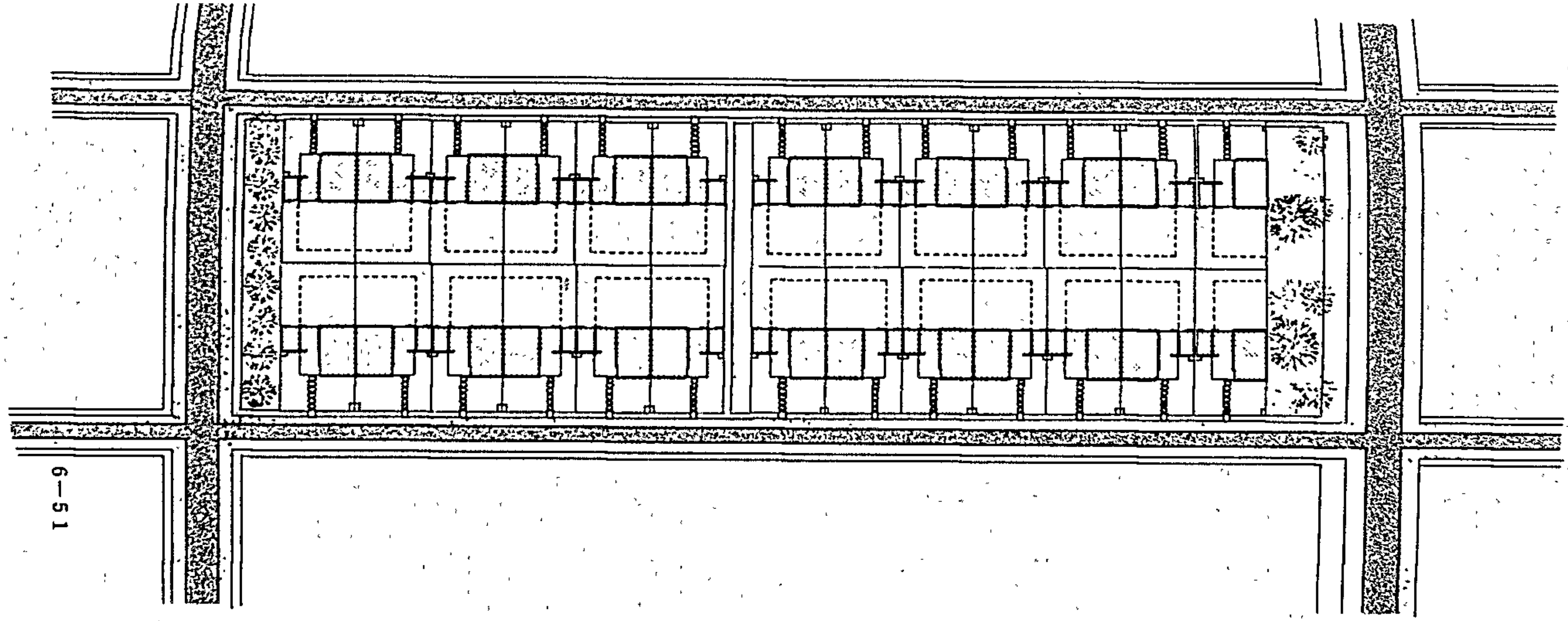


Fig. 6-28 LAYOUT PLAN OF D-15