NOTES ON LOW COST SANITATION

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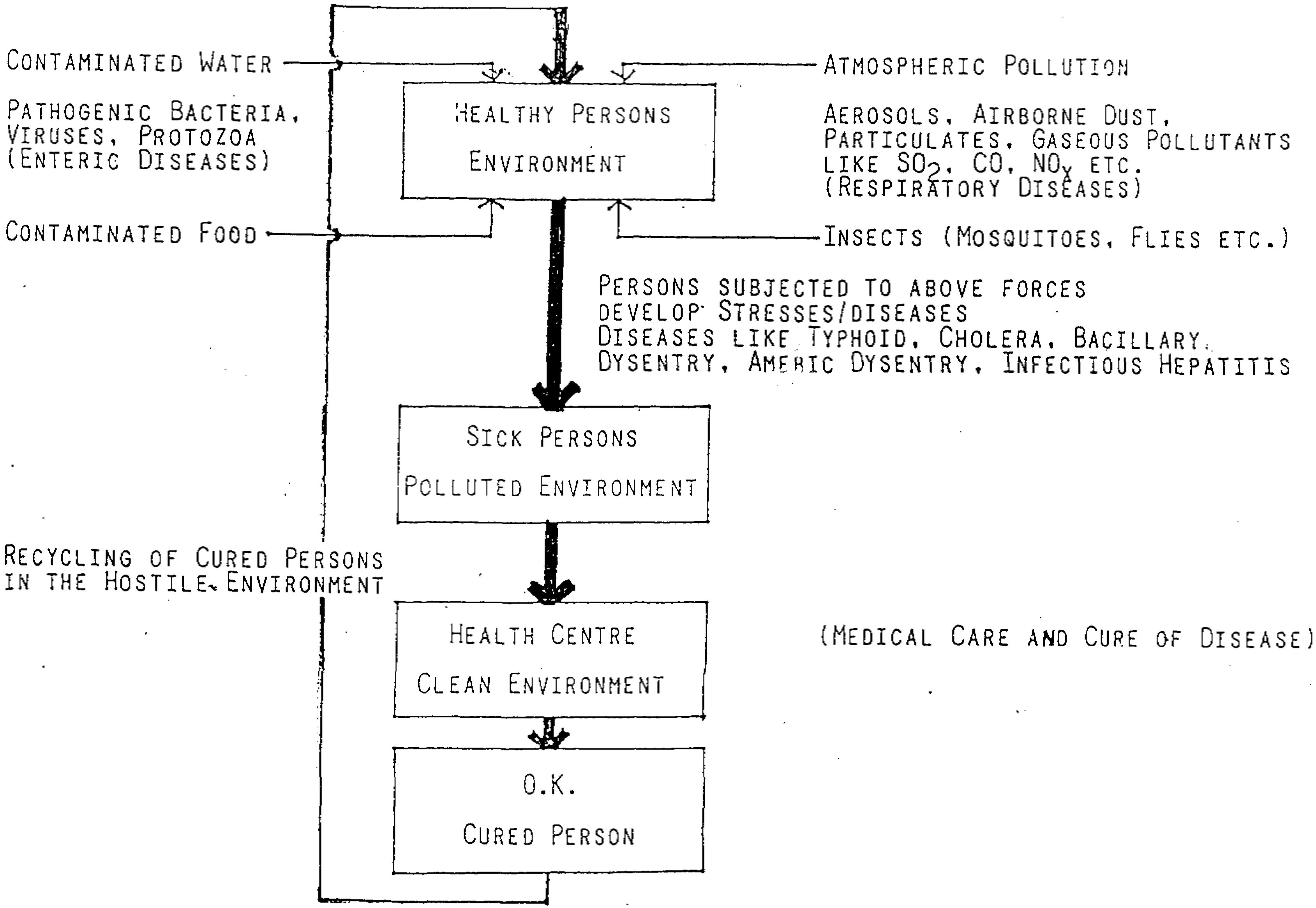

"PREVENTION IS BETTER THAN CURE"

MORE ATTENTION IS REQUIRED IN ABATING POLLUTION

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SANITATION

PATHOGENS IN EXCRETA AND RELATED DISEASES :

HUMAN EXCRETA

VIRUS	BACTERIA	PROTOZOA	HELMINTH
Poliomyelitis	Diarrhoea	Diarrhoea	Hookworm
Paralysis	Typhoid fever	Dysentry	Ascariasis
Meningitis	Paratyphoid fever	Colonic ulceration	Enterobiasis
Infectious hepatitis (Epidemic jaundice)	Food poisoning	Amebic dysentery	Fascioliasis
Fever	Leptospirosis	Liver abscess	Gastrodiscoidiasis
Myocarditis	Bacillary dysentery	Malabsorption	Schistosomiasis
Congenital heart anomalies	Cholera		Strongyloidiasis
Diarrhoea	Septicemia		Taeniasis
Pleurodynia			Trichuriasis
Encephalitis			
Eye infections			
Common cold			
Rash			
Respiratory disease			

HUMAN URINE

Leptospirosis
Schistosomiasis

TRANSMISSION OF DISEASES :

Main transmission routes for diseases associated with human excreta are
(i) direct ingestion
(ii) penetration of skin
(iii) vectors like flies, cockroach etc.

WATER-BORNE	pathogens are present in water supplies	**WATER-WASHED (WATER-SCARCE)**	spread of the pathogen is affected by amounts of water available for hygiene
example:	diarrhoeal infections, cholera, typhoid	example:	scabies, trachomas, pinworm infection
control:	water quality, hygiene education	control:	water quantity, soap hygiene education
WATER-BASED	the pathogen must spend part of its life cycle in aquatic intermediate host or hosts	**WATER-RELATED INSECT VECTOR**	the pathogen is spread by insects that feed or breed in water (flies and mosquitoes)
example:	1 guinea worm infection 2 schistosomiasis 3 lung fluke infection	example:	malaria, yellow fever, Bancroftian filariasis Onchocerciasis
control:	excreta disposal (2,3) water quality (1) water access (1,2)	control:	surplus water drainage and management, insecticides
SOIL-BASED	the excreted organism is spread through the soil		
example:	hookworm infection	control:	excreta disposal

SANITATION

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PATHOGENS IN EXCRETA AND RELATED DISEASES :

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Table III-6. Survival times of excreted pathogens in faeces nightsoil and sludge, fresh water and sewage, and in soil at 20-30°C (Feachem et al. 1983)

Pathogen	Surviavl time in faeces, nightsoil and sludge ,days	Survival time in fresh water and sewage, days	Survival time in soil, days
Viruses			
Enteroviruses	<100 but usually <20	<120 but usually <50	<100 but usually <20
Bacteria			
Fecal coliforms	<90 but usually <50	<60 but usually <30	<70 but usually <20
Salmonella spp.	<60 but usually <30	<60 but usually <30	<70 but usually <20
Shigella spp.	<30 but usually <10	<30 but usually <10	<20 but usually <10
Vibrio cholerae	<30 but usually <5	<30 but usually 10	
Protozoa			
Entamoeba histolytica cysts	<30 but usually <15	<30 but usually <15	20 but usually <10
Helminths			
Ascaris lumbricoides eggs	Many months	Many months	Many months

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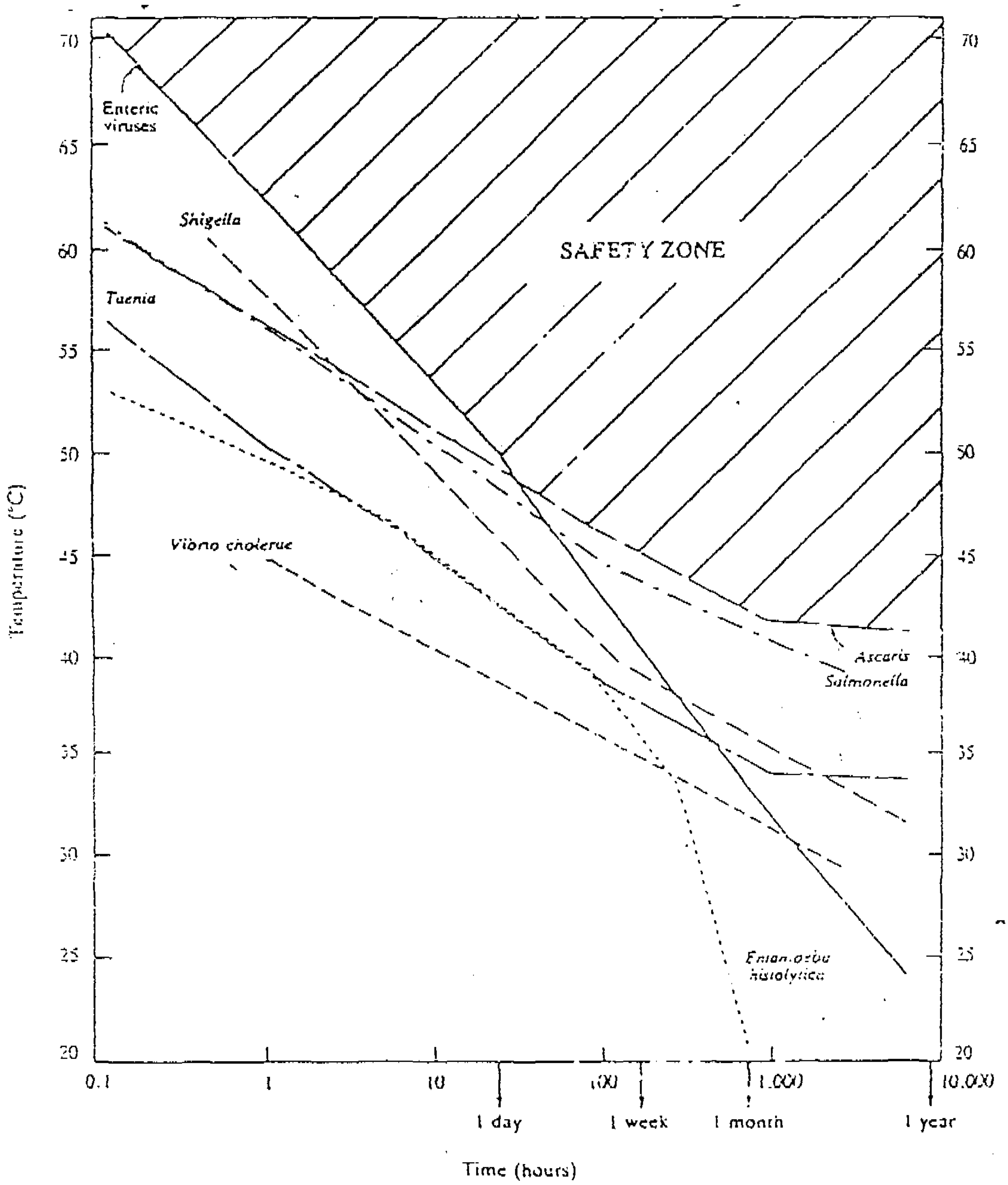


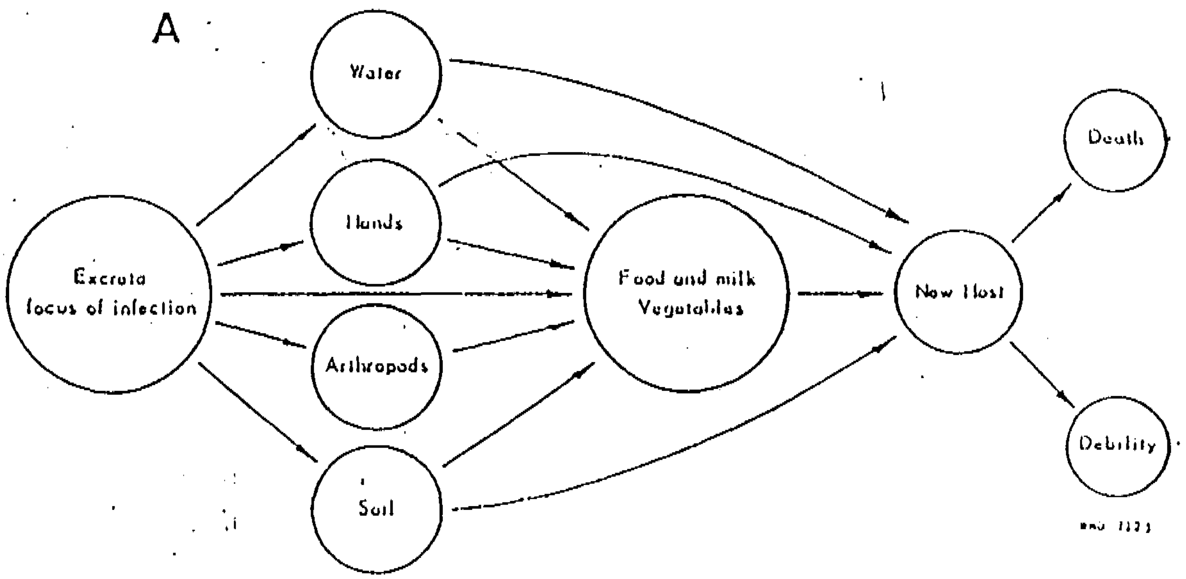
Suitable time-temperature properties include:

at least 62°C for 1 hour;
at least 50°C for 1 day;
at least 46°C for 1 week;
at least 43°C for 1 month;
at least 42°C for 1 year.

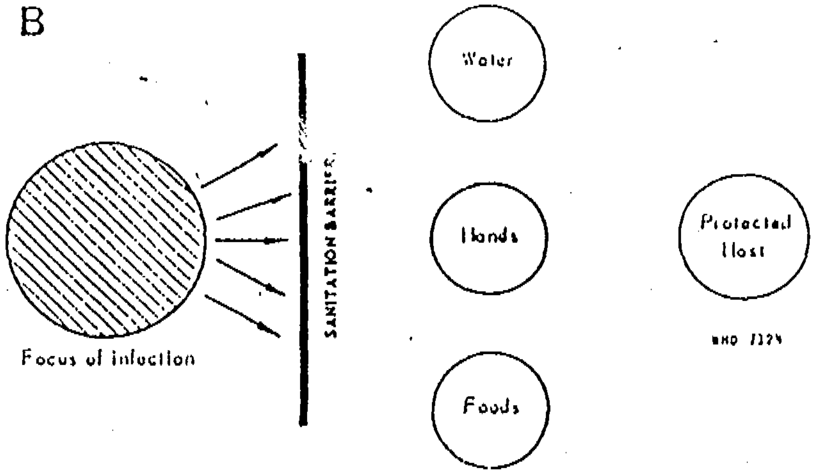
Fig.3 3.The influence of time and temperature on selected excreted pathogens (Feachem et al. 1983)

FIG. TRANSMISSION OF DISEASE FROM EXCRETA

CHANNELS OF TRANSMISSION OF DISEASE FROM EXCRETA



STOPPING THE TRANSMISSION OF FAECAL-BORNE DISEASES
BY MEANS OF SANITATION



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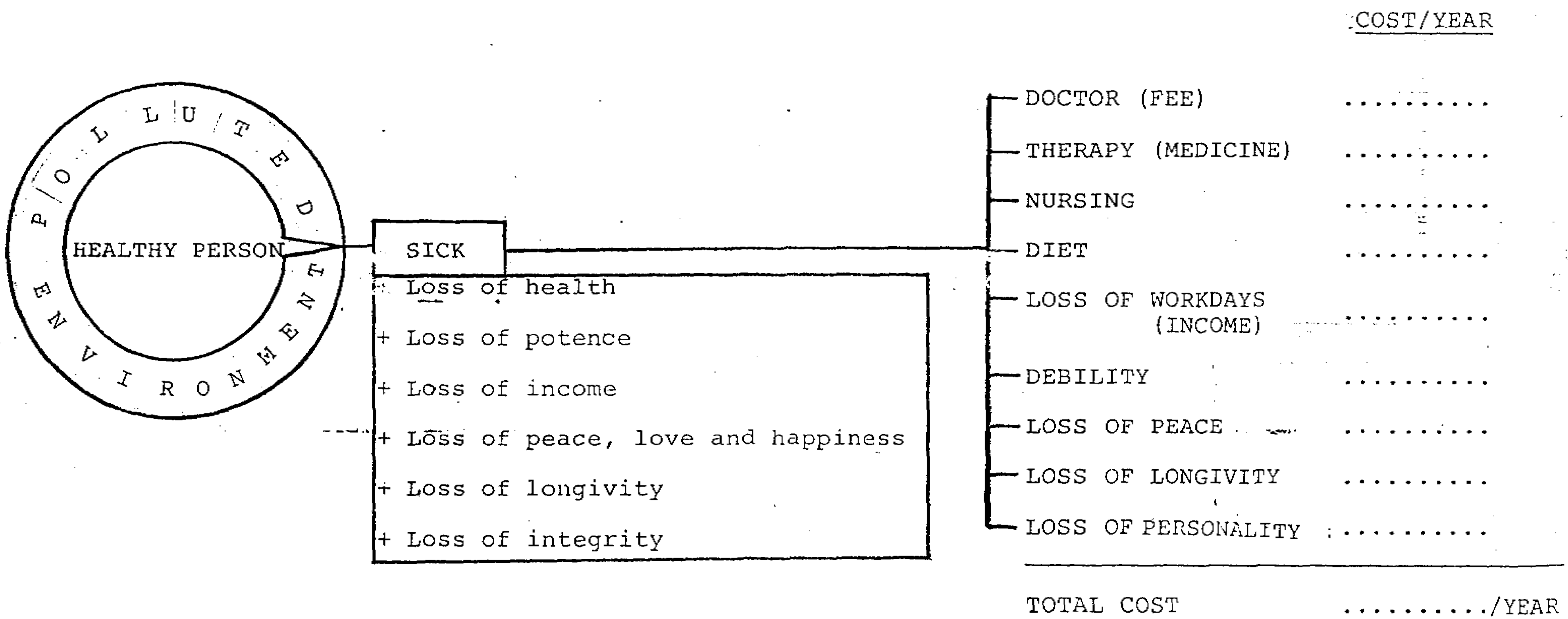
ECONOMICS OF SANITATION
FOR INDIVIDUALS



± 5 YEARS' EXPENDITURE DUE TO SICKNESS=COST OF LATRINE FOR SANITATION THAT LASTS FOR 30 YEARS

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SANITATION PROJECT

ECONOMICS FOR POURASHAVA

COST OF MAINTENANCE OF ONE SERVICE LATRINE

	COST/YEAR
PART OF SALARY OF SCAVENGER	....
TIPS FROM HOUSEHOLD	....
EQUIPMENT, TANK, TRAILER	....
TOOLS, BUCKET	....
DETERGENTS, SOAP, VIM	....
CHEMICALS, BLEACHING POWDER, KEROSENE	....
MANAGEMENT	....
RISK FOR SCAVENGER	....
DISPOSAL AREA FOR NIGHT SOIL/SLUDGE	....
ADOPTION OF SCAVENGER (INHUMANITY)	....
ENVIRONMENTAL POLLUTION	....
TOTAL COST	..../YEAR

±5 YEARS COST OF MAINTENANCE OF SERVICE LATRINE = COST OF LATRINE FOR SANITATION THAT LASTS FOR 30 YEARS

SANITARY LATRINE

FROM A PURELY TECHNICAL POINT OF VIEWS, A LATRINE OR OTHER DISPOSAL METHOD SHOULD SATISFY THE FOLLOWING SEVEN REQUIREMENTS (EHLERS & STEEL).

1. THE SURFACE SOIL SHOULD NOT BE CONTAMINATED.

2. THERE SHOULD BE NO CONTAMINATION OF GROUND WATER THAT MAY ENTER SPRINGS OR WELLS.

3. THERE SHOULD BE NO CONTAMINATION OF SURFACE WATER.

4. EXCRETA SHOULD NOT BE ACCESSIBLE TO FLIES OR ANIMALS.

5. THERE SHOULD BE NO HANDLING OF FRESH EXCRETA; OR, WHEN THIS IS INDISPENSABLE, IT SHOULD BE KEPT TO A STRICT MINIMUM.

6. THERE SHOULD BE FREEDOM FROM ODOURS OR UNSIGHTLY CONDITIONS.

7. THE METHOD USED SHOULD BE SIMPLE AND INEXPENSIVE IN CONSTRUCTION AND OPERATION.

THE DESIGN OF LATRINE SHOULD CATER FOR MODESTY NEEDS AND PERSONAL CLEANSING PRACTICES OF USERS.

Table: - Generic Classification of Sanitation Systems

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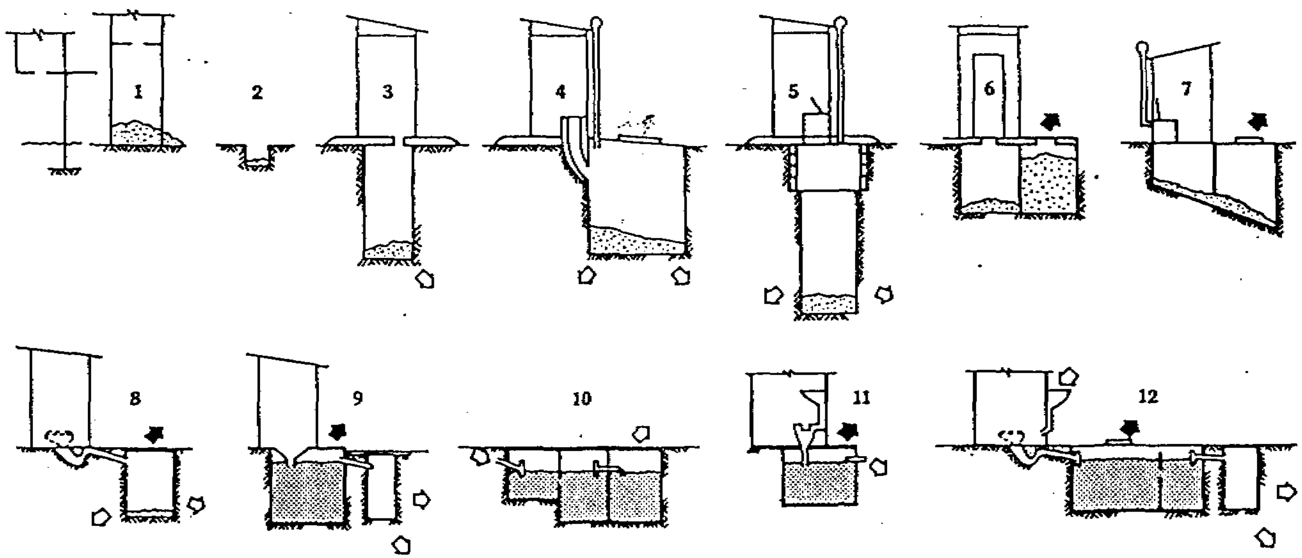
Sanitation system

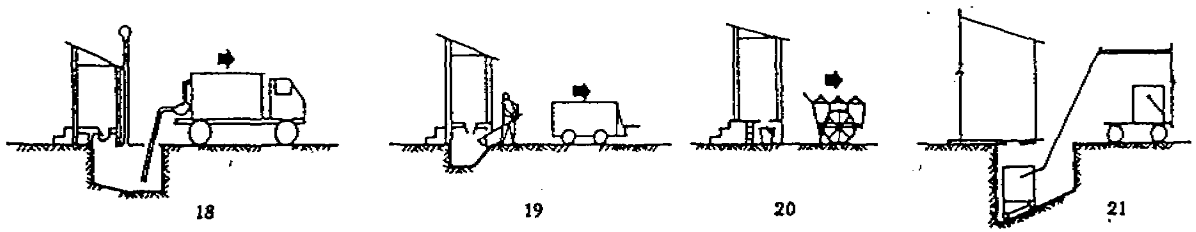
- On-site
  - Dry
    1. Overhung latrine
    2. Trench latrine
    3. Pit latrine
    4. Reed Odorless Earth Closet
    5. Ventilated Improved pit latrine
    6. Batch-composting latrine
    7. Continuous-composting latrine
  - Wet
    8. Pour-flush latrine, soakaway
    9. Pour-flush latrine, aquaprivy, soakaway
    10. Pour-flush, septic tank, vault
    11. Sullage-flush, aquaprivy, soakaway
    12. Sullage-flush, septic tank, soakaway
    13. Conventional septic tank
- On-site or off-site
  - Wet
    14. Low-volume cistern-flush, soakaway, or sewer
    15. Low-volume cistern-flush, aquaprivy, soakaway, or sewer
    16. Low-volume cistern-flush, septic tank, soakaway, or sewer
- Off-site
  - Wet
    17. Conventional sewerage
  - Dry
    18. Vault and vacuum tank
    19. Vault, manual removal, truck, or cart
    20. Bucket latrine
    21. Mechanical bucket latrine



13 Same as 12 except conventional cistern-flush.

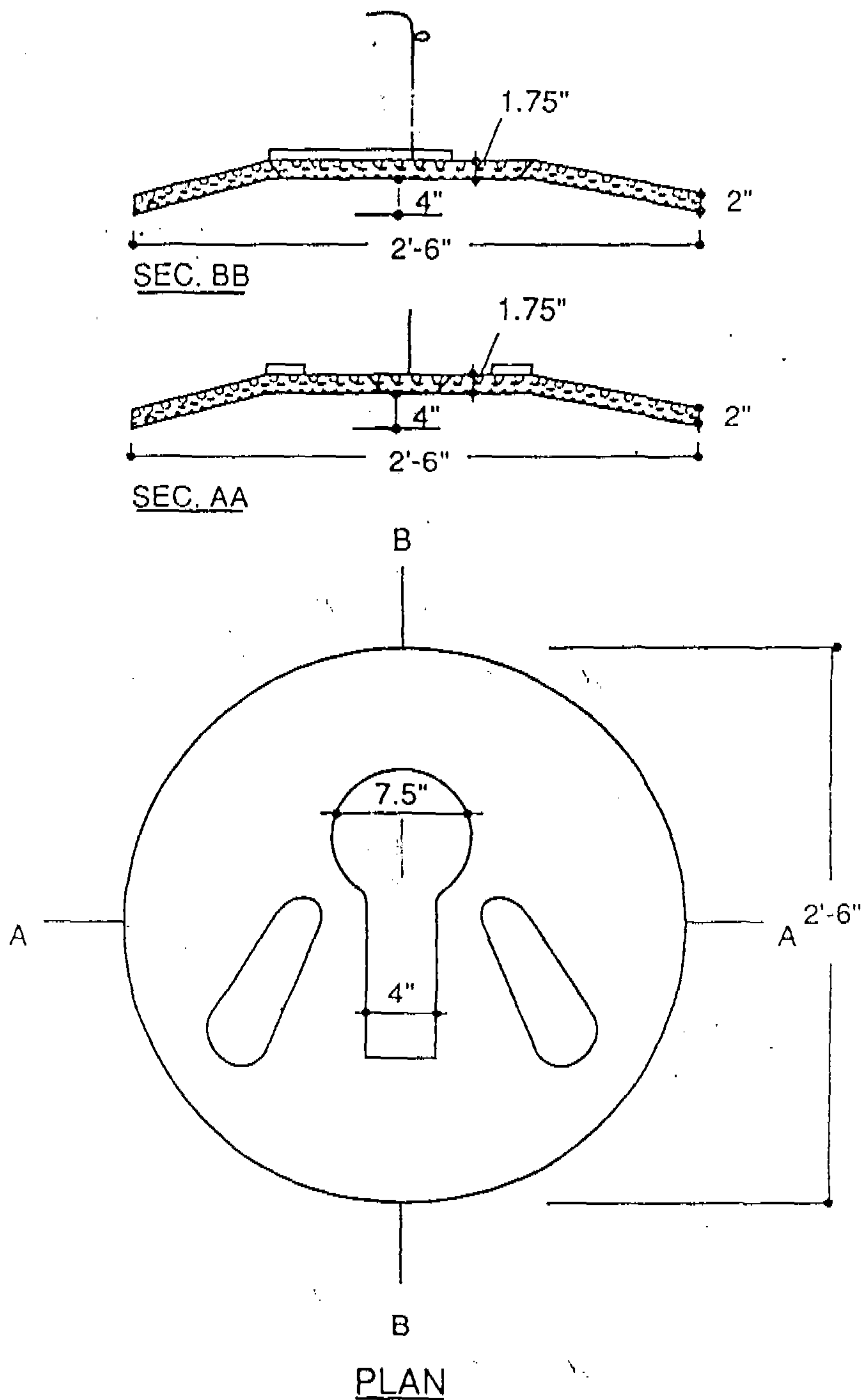
14, 15, 16 Same as corresponding configuration in 8 to 12, except for elevated cistern with low volume-flush.

17 See standard manuals and texts.



Movement of liquids; movement of solids.

Source: The World Bank, Water Supply and Waste Disposal, Poverty and Basic Needs Series (Washington, D.C., September 1980).



MOZAMBIQUE TYPE DOME SLAB LATRINE

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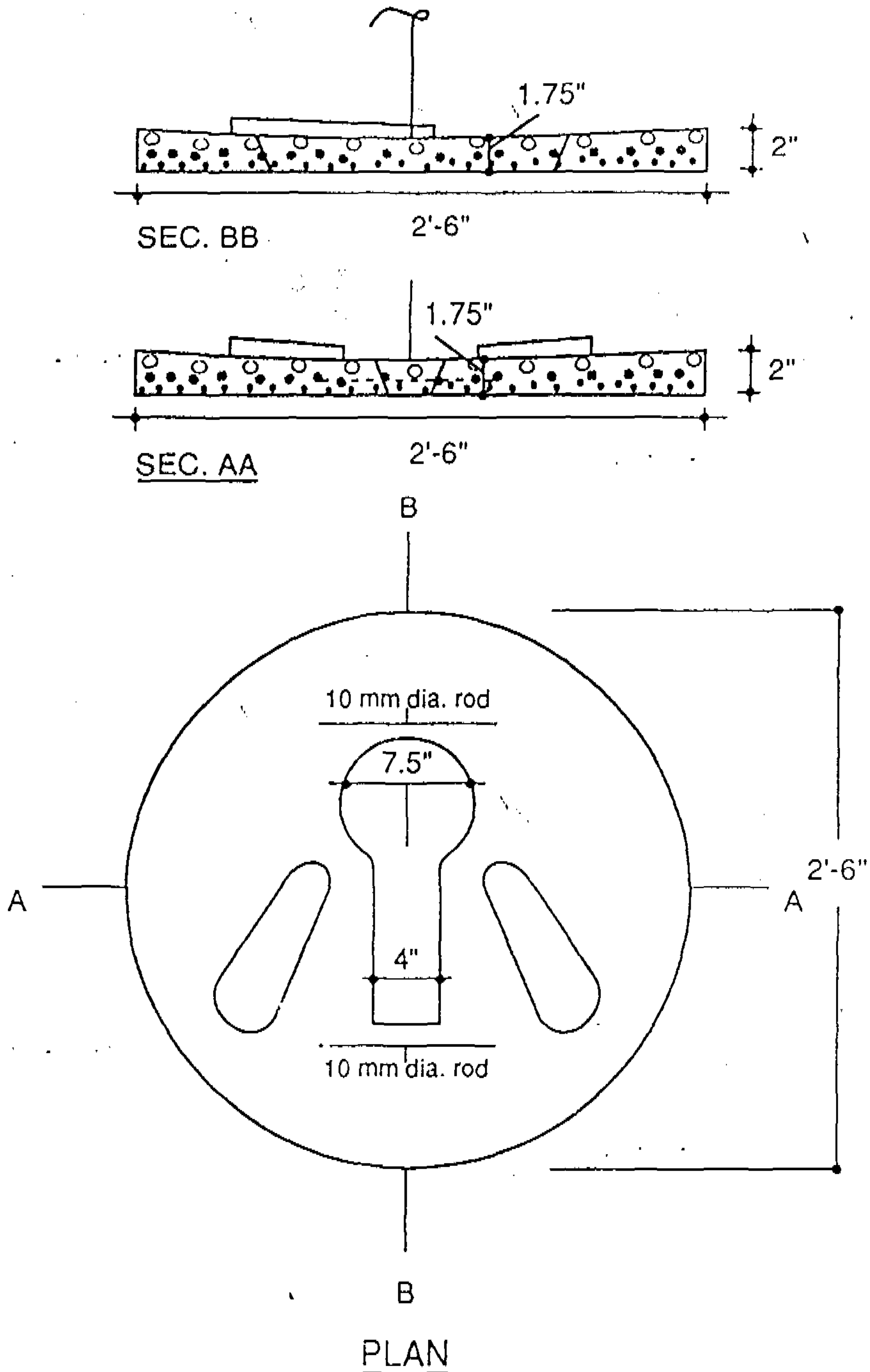
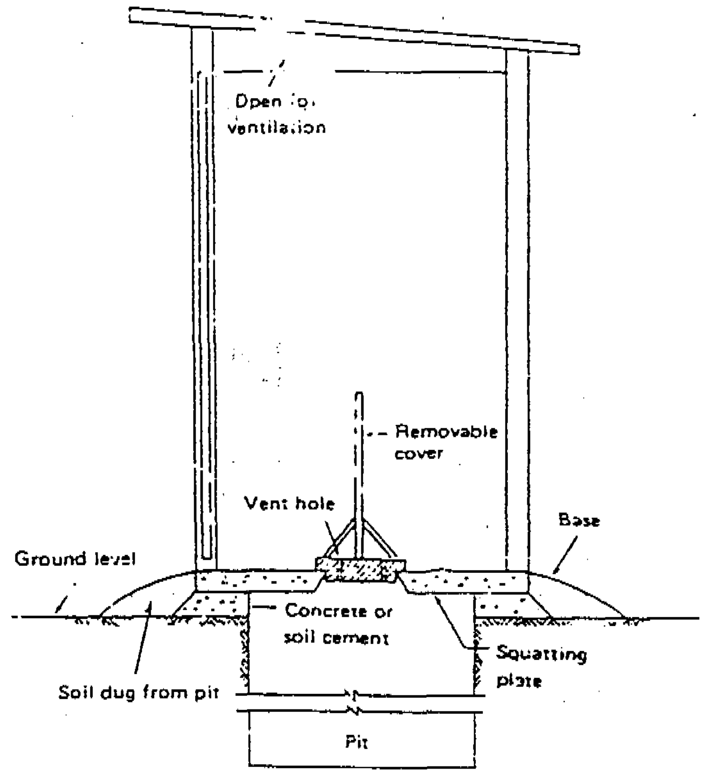
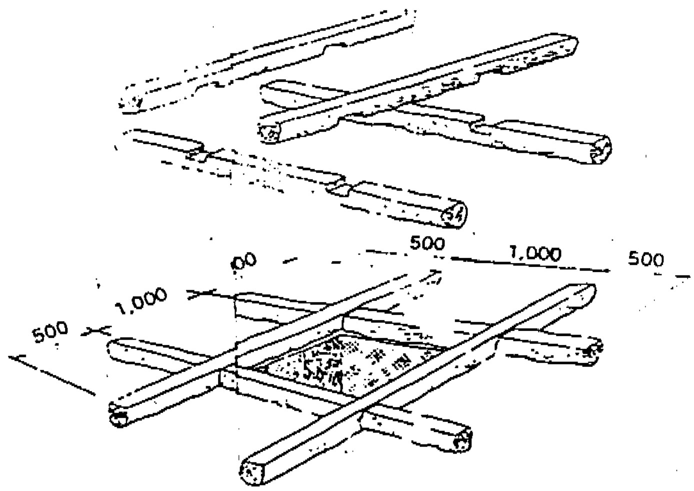


MALAWI TYPE SANPLAT LATRINE



Side view

(Dimensions in millimeters)



Altenative base using hewn logs

Note: In termite-infested areas, use treated wood or termite barrier.
(Source:Kalberatten et al. 1982)

Fig.4.2.Conventional unimproved pit latrine

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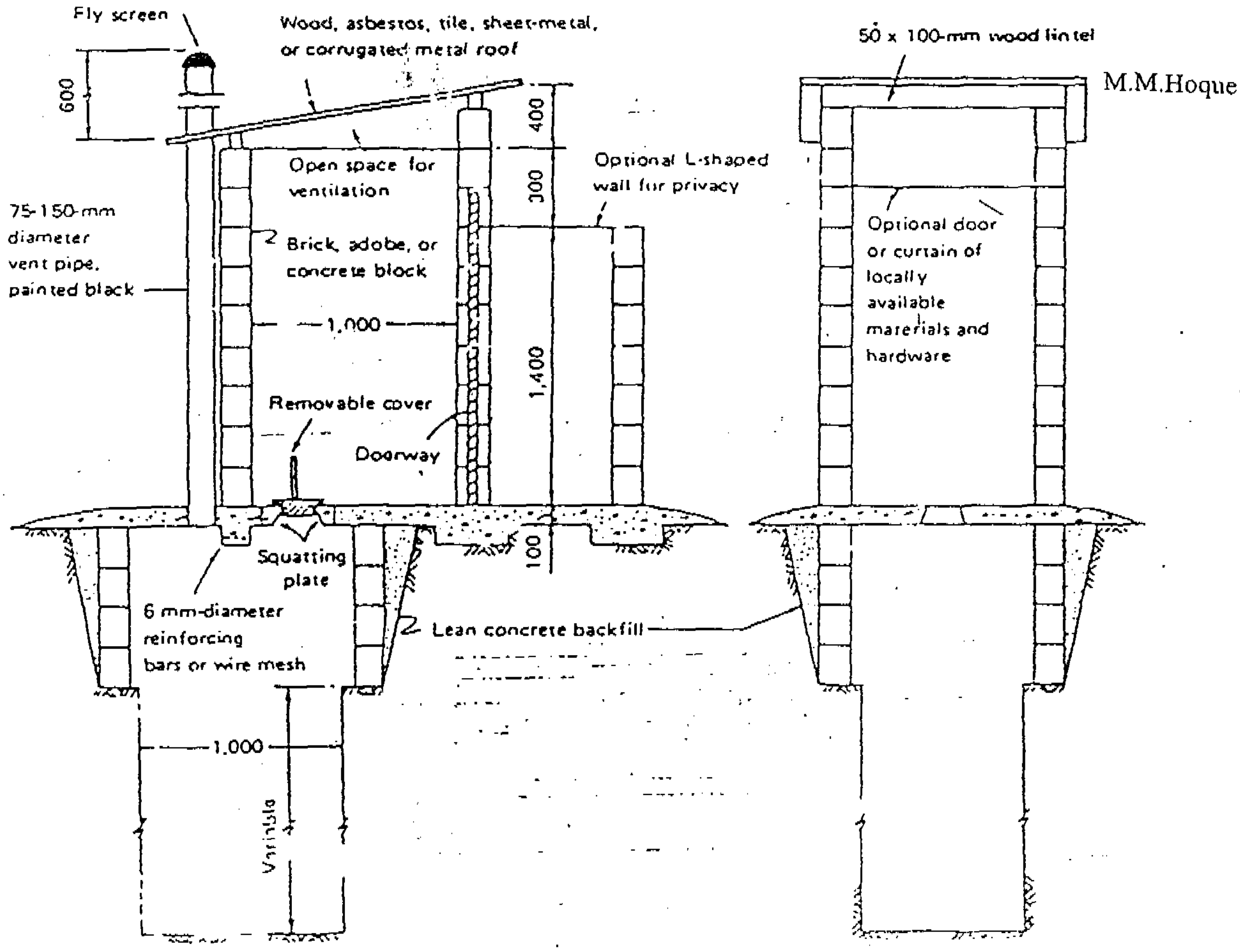
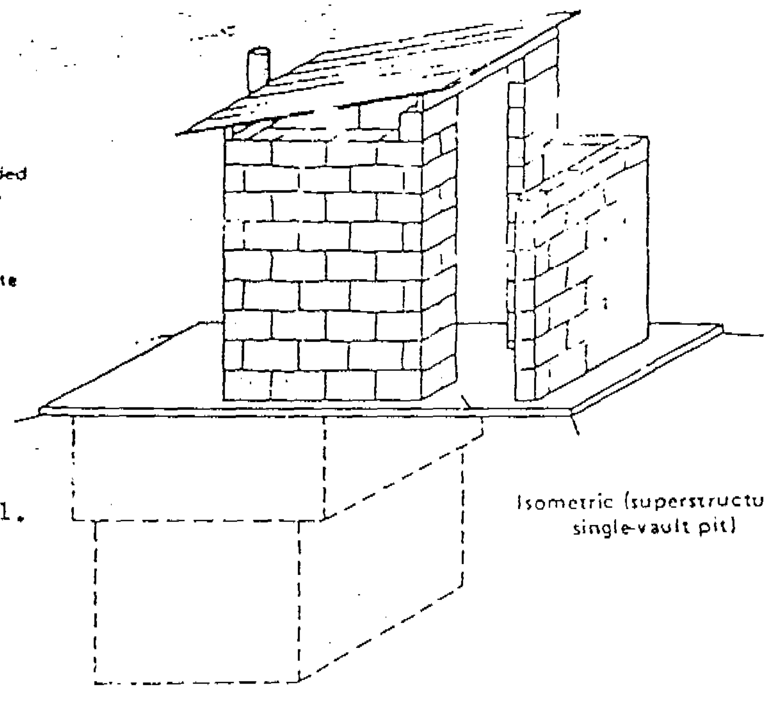


Side view (section)

(Dimensions in millimeters)

Front view (superstructure; L-shaped wall and vent not shown)

Note: Side view. Pedestal seat or bench may be substituted for squatting plate. An opening for desludging may be provided next to vent. Dimensions of the brick or concrete blocks may vary according to local practice. Wooden beams, flooring, and siding may be substituted for concrete block walls and substructure.

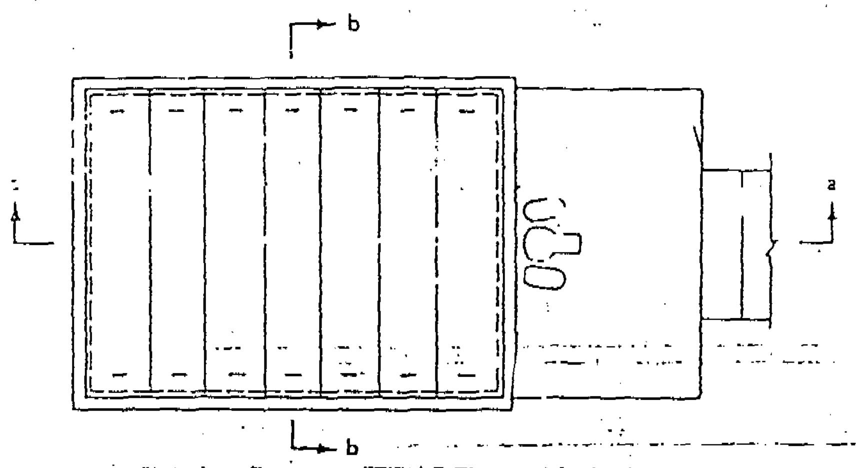


Isometric (superstructure; single-vault pit)

(Source:Kalbermatten et al. 1982)

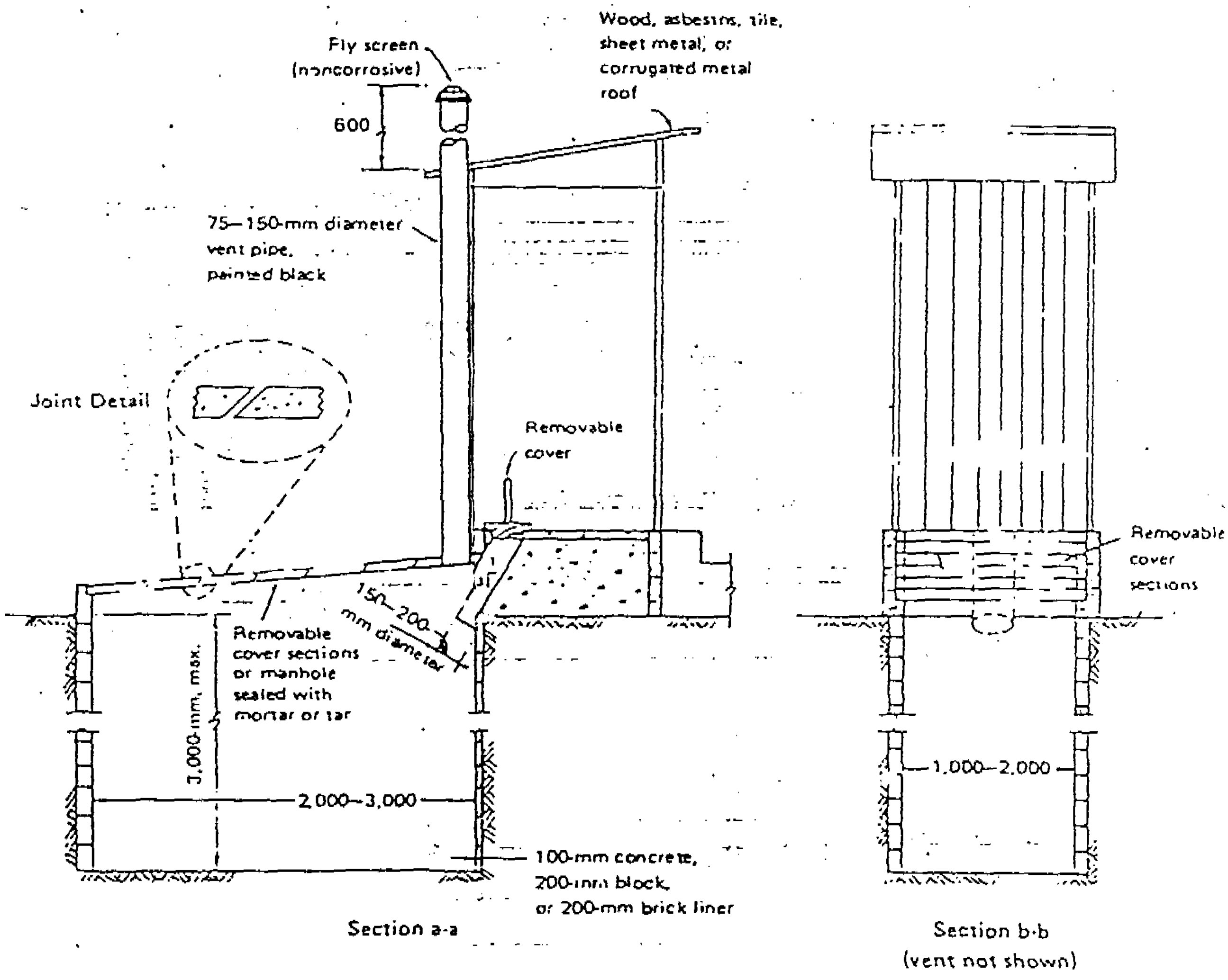
Fig.4.4.Ventilated improved pit latrine

A. Plan



Plan (with latrine superstructure removed)

(Dimensions in millimeters)



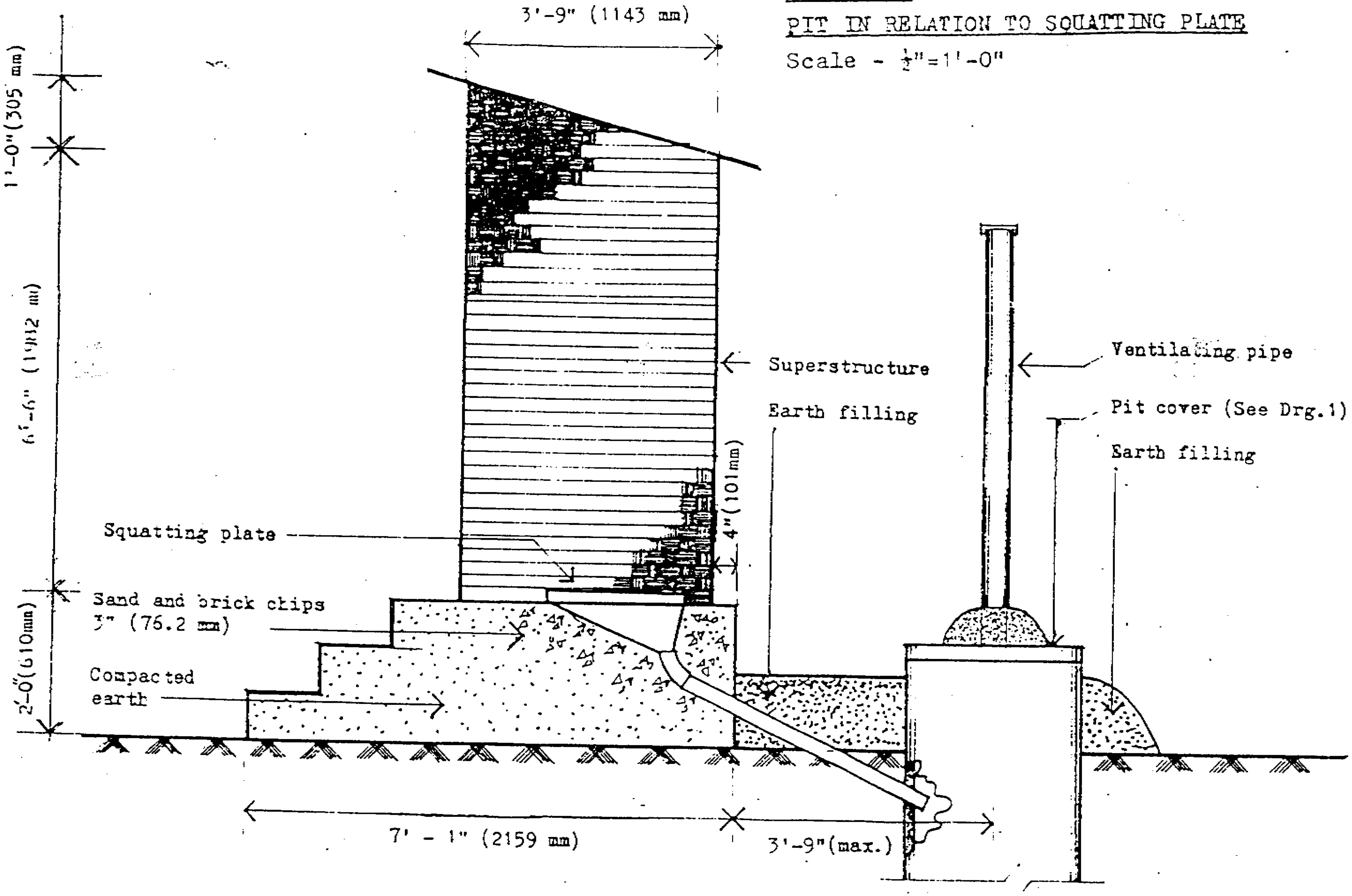
(Source: Kalbermatten et al. 1982)

Fig.4.6.Reed Odorless Earth Closet (ROEC)

DRAWING 3.

PIT IN RELATION TO SQUATTING PLATE

Scale - ½"=1'-0"



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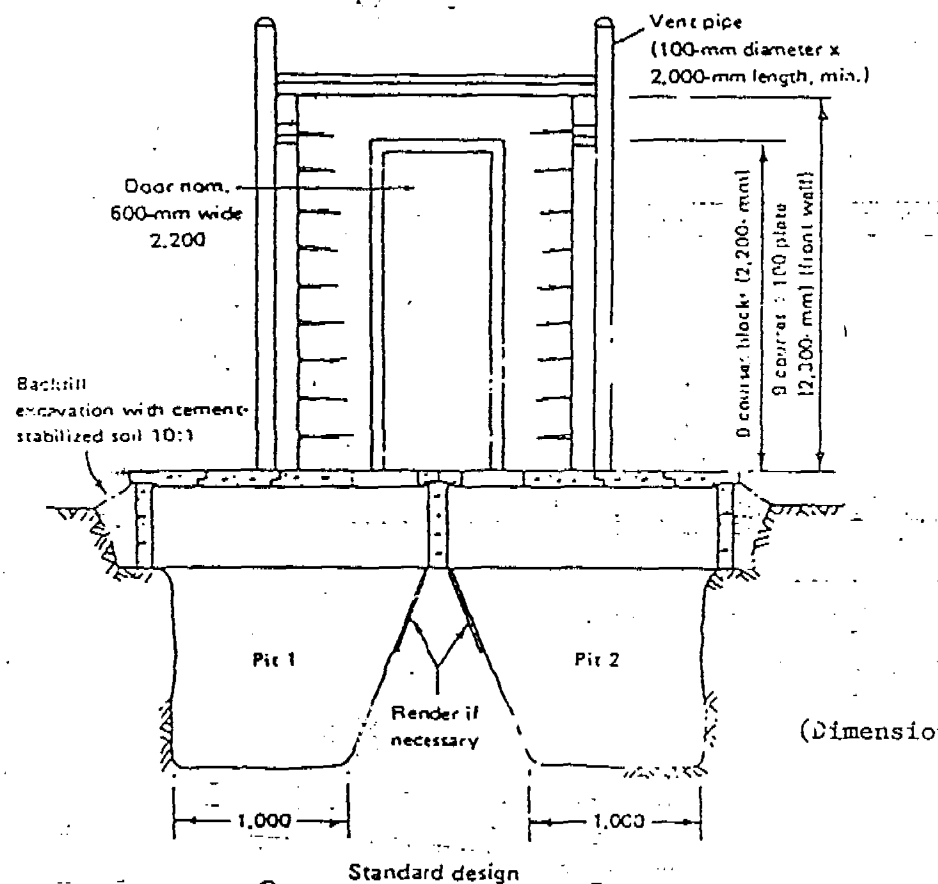
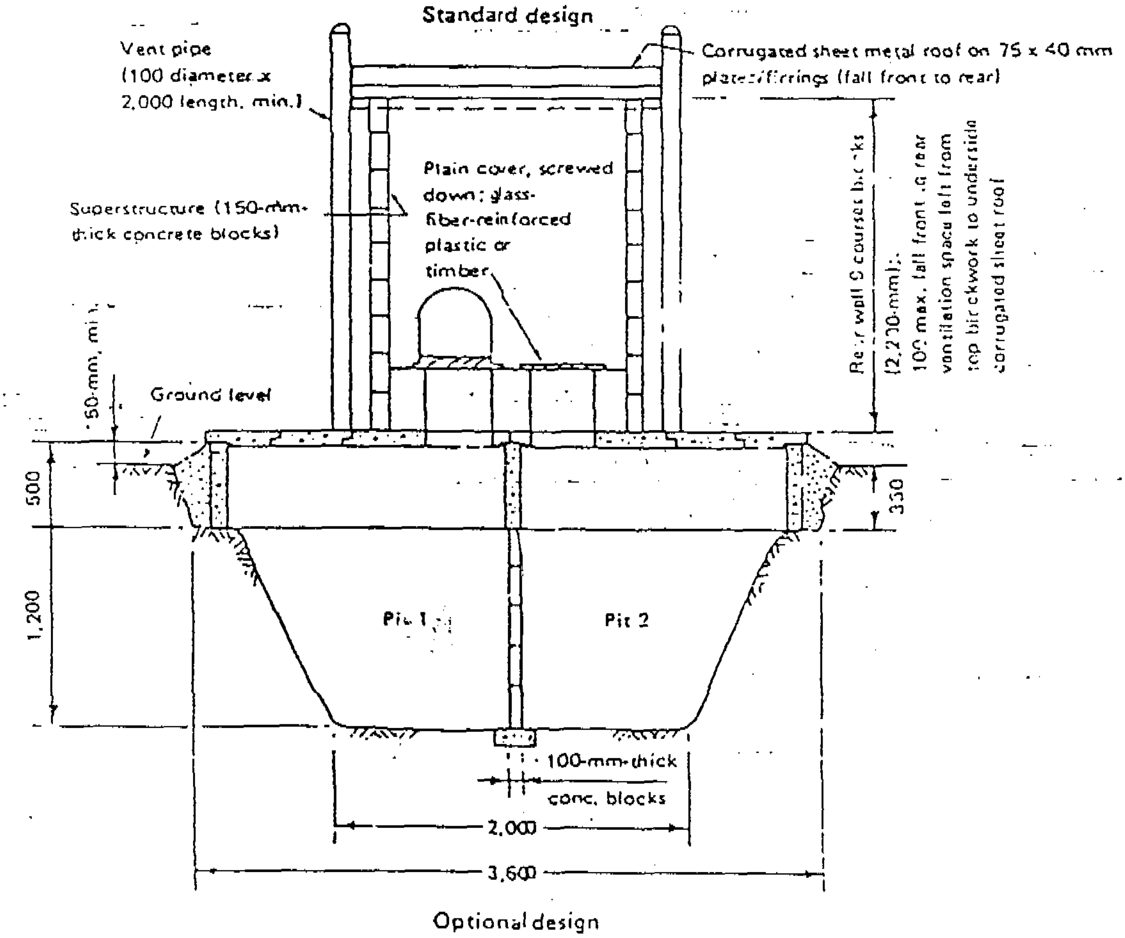
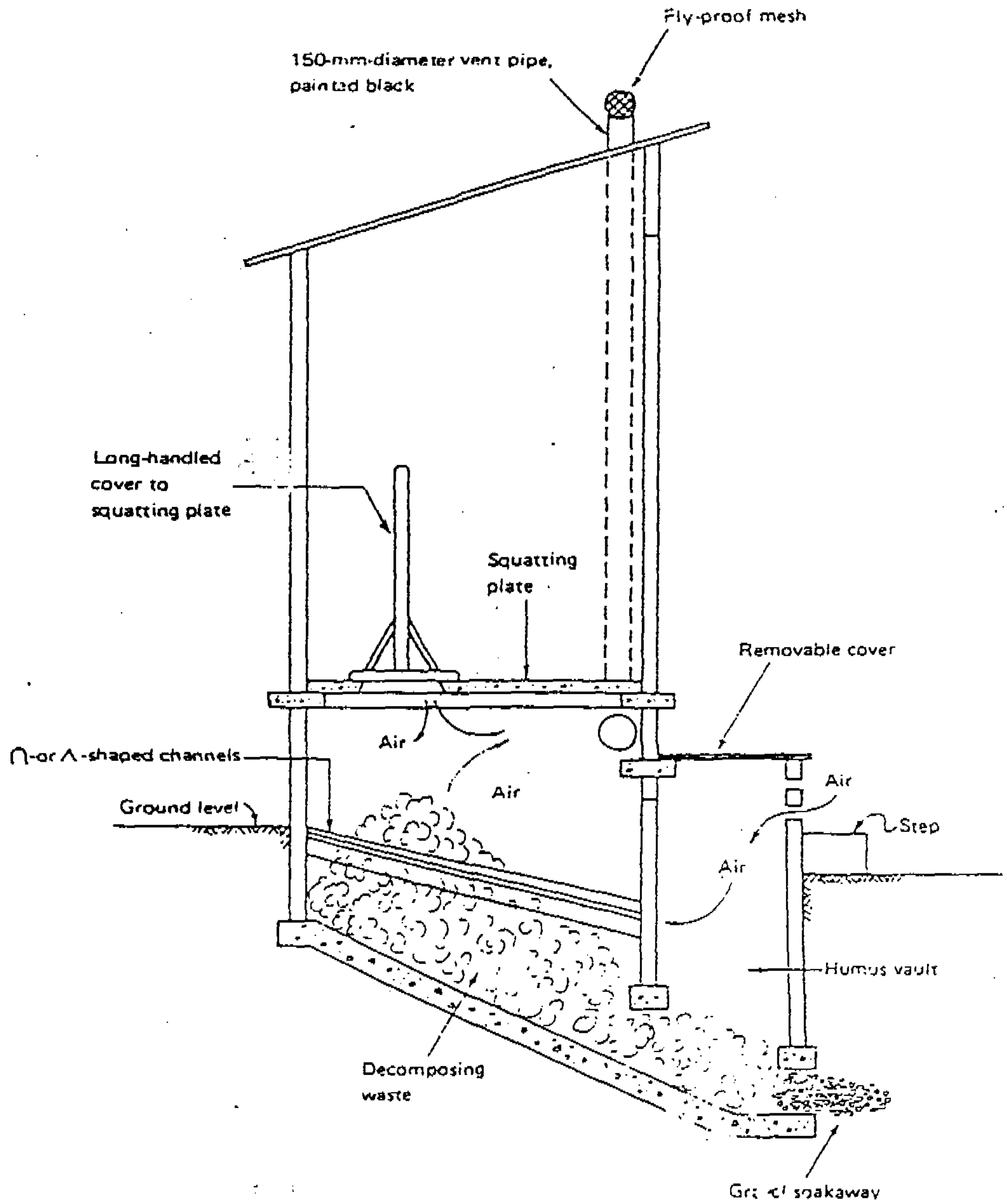


(Dimensions in mm)



(Source:Kalbermatten et al. 1982)

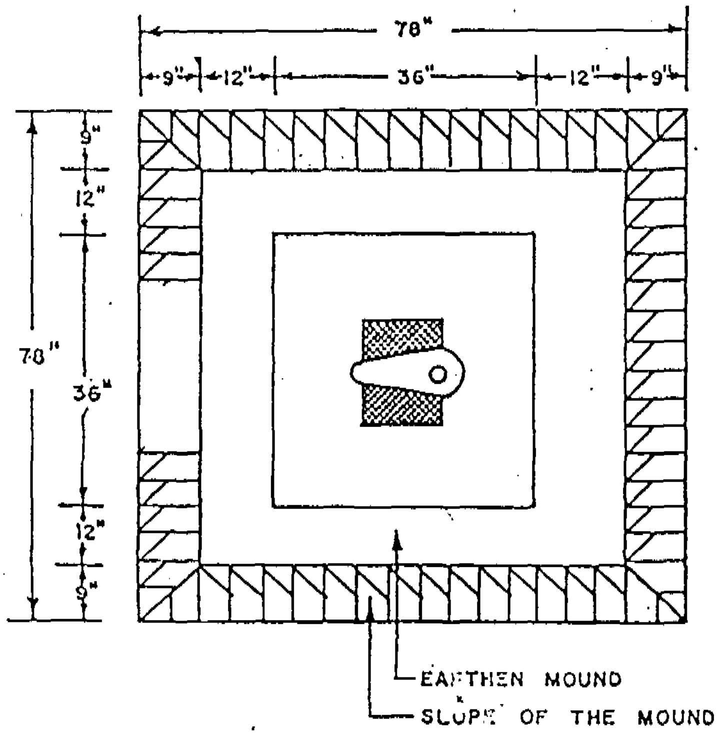
Fig.4.5.Ventilated improved double pit latrine

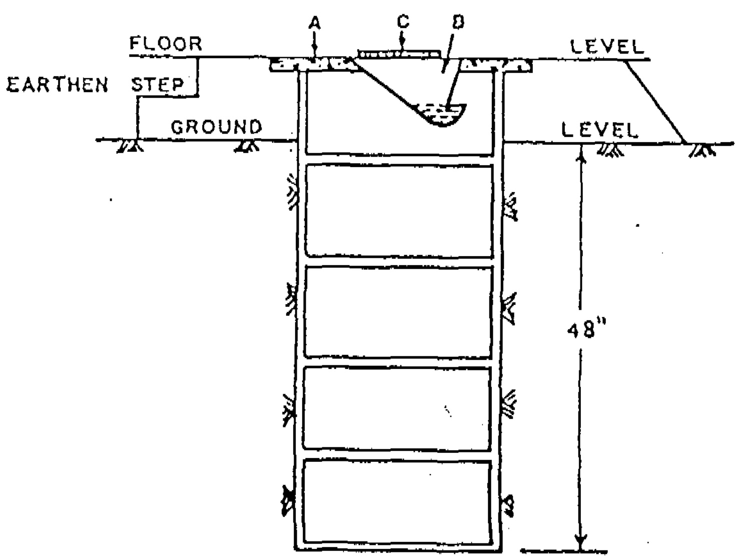


(Source:Kalbermatten et al. 1982)

Fig.4.15.Continuous composting toilet

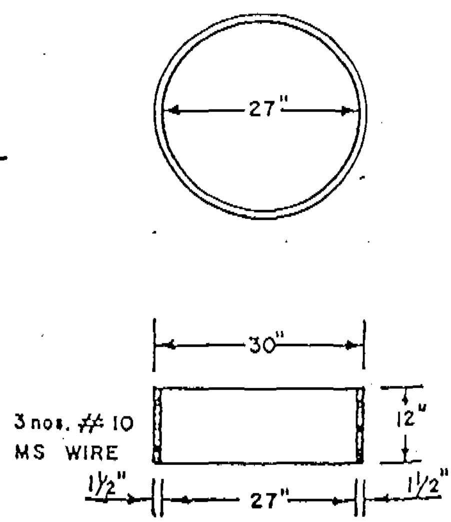
WATER SEAL LATRINE — DIRECT PIT DISPOSAL





1. SQUATTING PLATE — A
2. WATER SEAL PAN REAR DISCHARGE — B
3. FOOT REST — C

DETAILS OF RCC RING



একটি রিং ও একটি স্ল্যাব দিয়ে পায়খানা তৈরি করুন।

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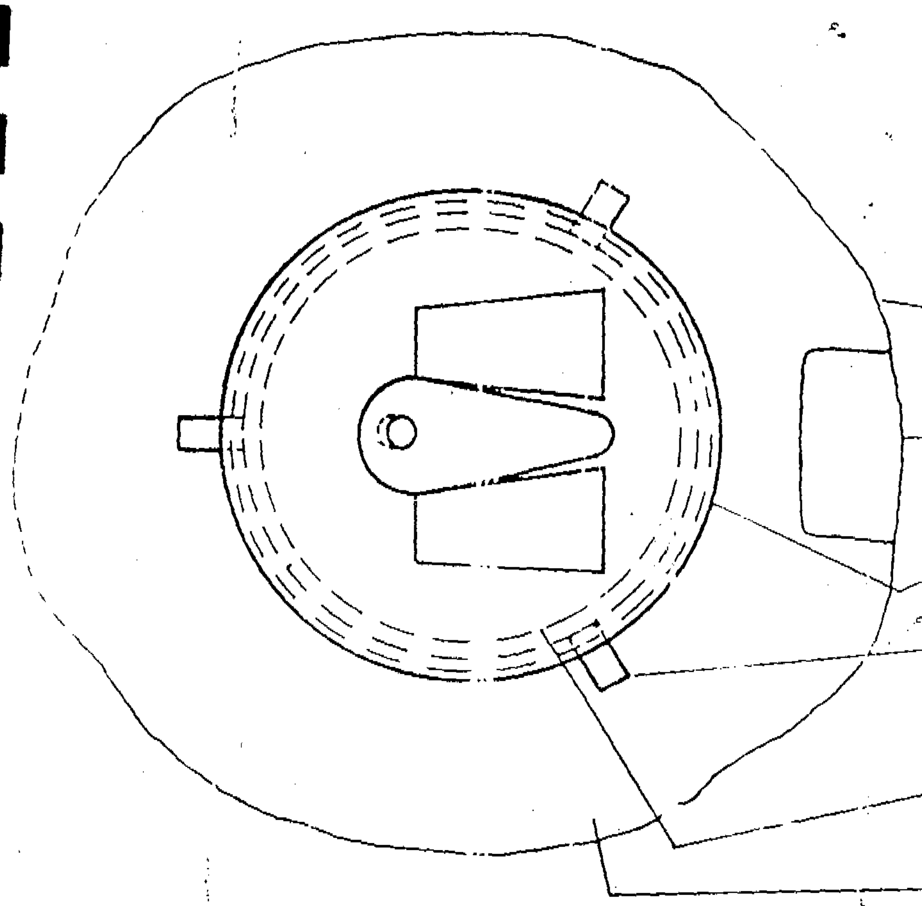
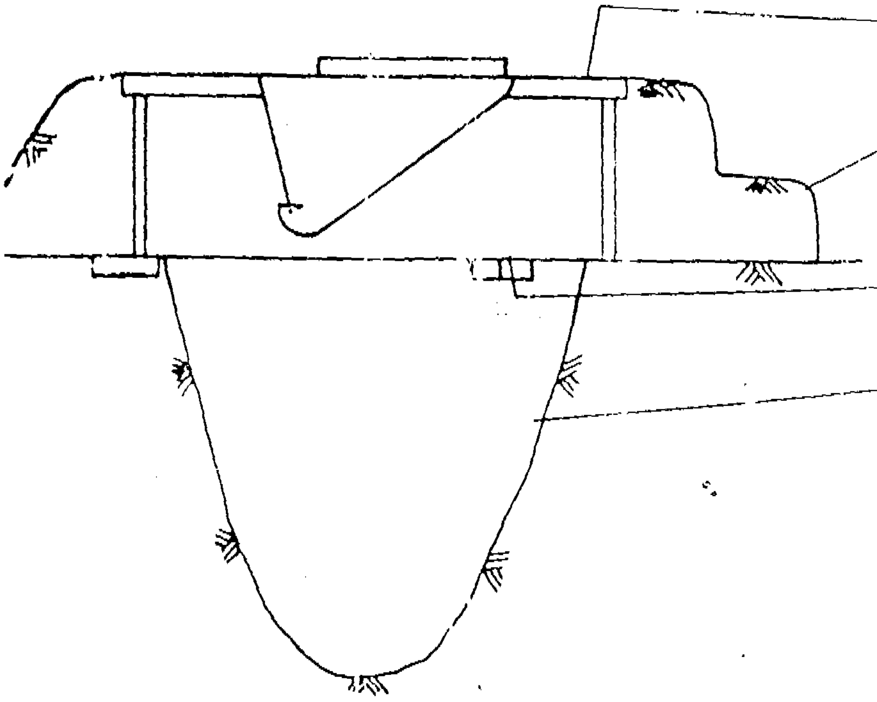
(কেনা ও পরিবহনের খরচ কমান)

- শুধুমাত্র একটি রিং ও একটি স্ল্যাব দিয়েই মজবুত ও ভাল পায়খানা বানানো যায়।
- এতে গর্ত ভর্তি হয়ে গেলে তা মাটি চাপা দিয়ে সহজেই রিং ও স্ল্যাবটিকে সরিয়ে নতুন গর্তে বসানো যায়।
- অথচ মাটির নিচে অতিরিক্ত রিং থাকলে গর্ত ভরে যাবার পর কাঁচা ময়লা নিষ্কাশন করতে হয়। তাতে স্বাস্থ্যের ওপর ঝুঁকি থাকে।





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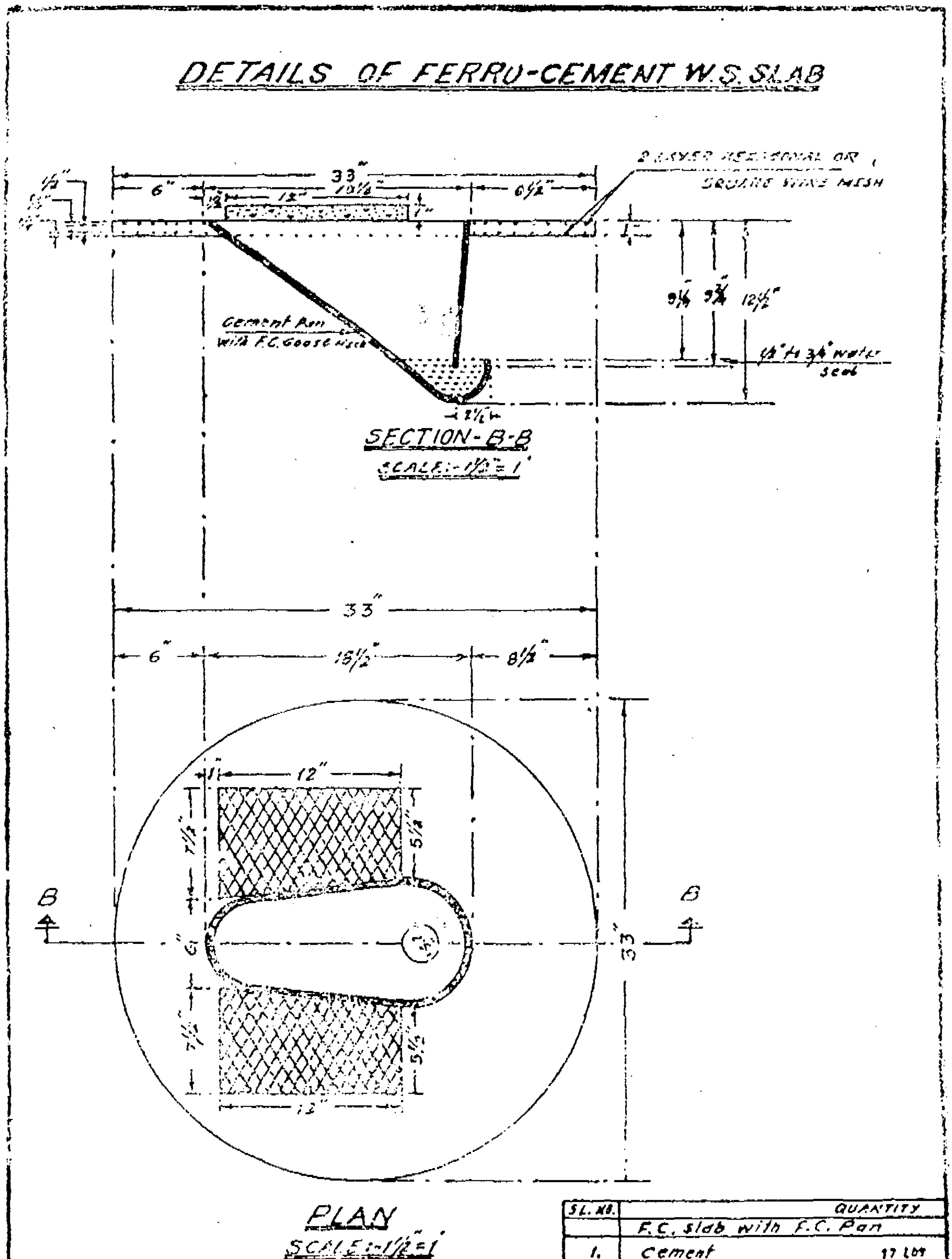
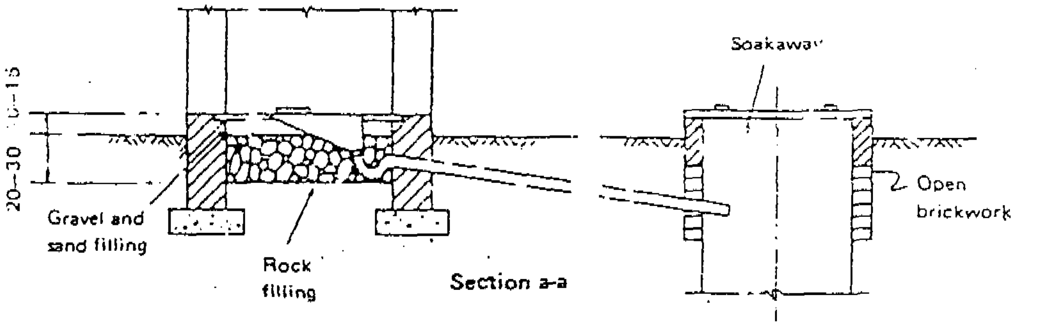
DETAILS OF FERRO CEMENT SQUATTING SLAB, PAN AND WATER SEAL

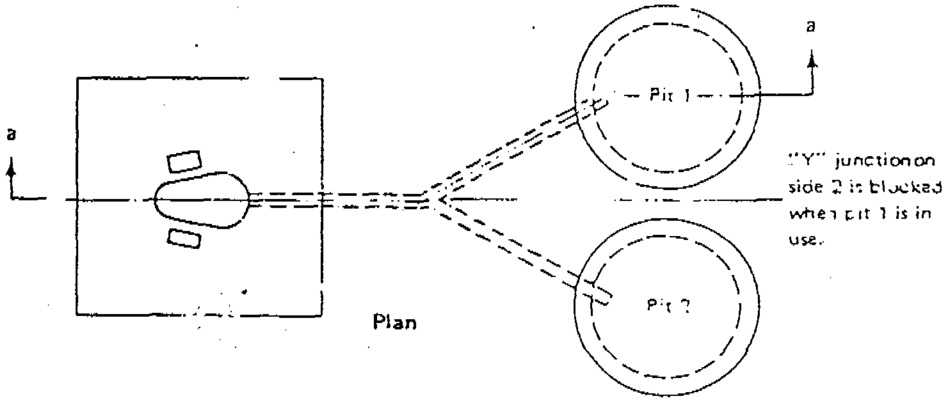


SL. NO.	QUANTITY	
	F.C. slab with F.C. Pan	
1.	Cement	17 Lbs
2.	Sand	·60 Cft
3.	C.W. MESH	16 Sft.
	F.C. PAN	
1.	Cement	10 Lbs.
2.	Sand	0·15 cft.
3.	5"x12" size C.W. MESH	

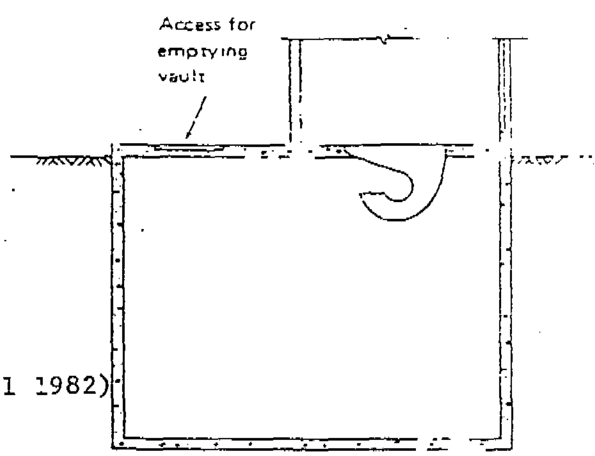
20.3.83	20/3/83
ASSISTANT ENGINEER PHE V.S. DIVISION	EXECUTIVE ENGINEER PHE V.S. DIVISION



(Dimensions in centimeters)



(b) Offset pit design



(Source:Kalberrmatten et al 1982)

(a) Direct discharge design

Note: in the offset pit design, the pit is placed at site of "Y" junction if only one pit is installed.

Fig.4.18.Alternative designs for Pour-flush toilets

DRAWING NO 1

ISOMETRIC VIEW OF POUR FLUSH WATERSEAL LATRINE

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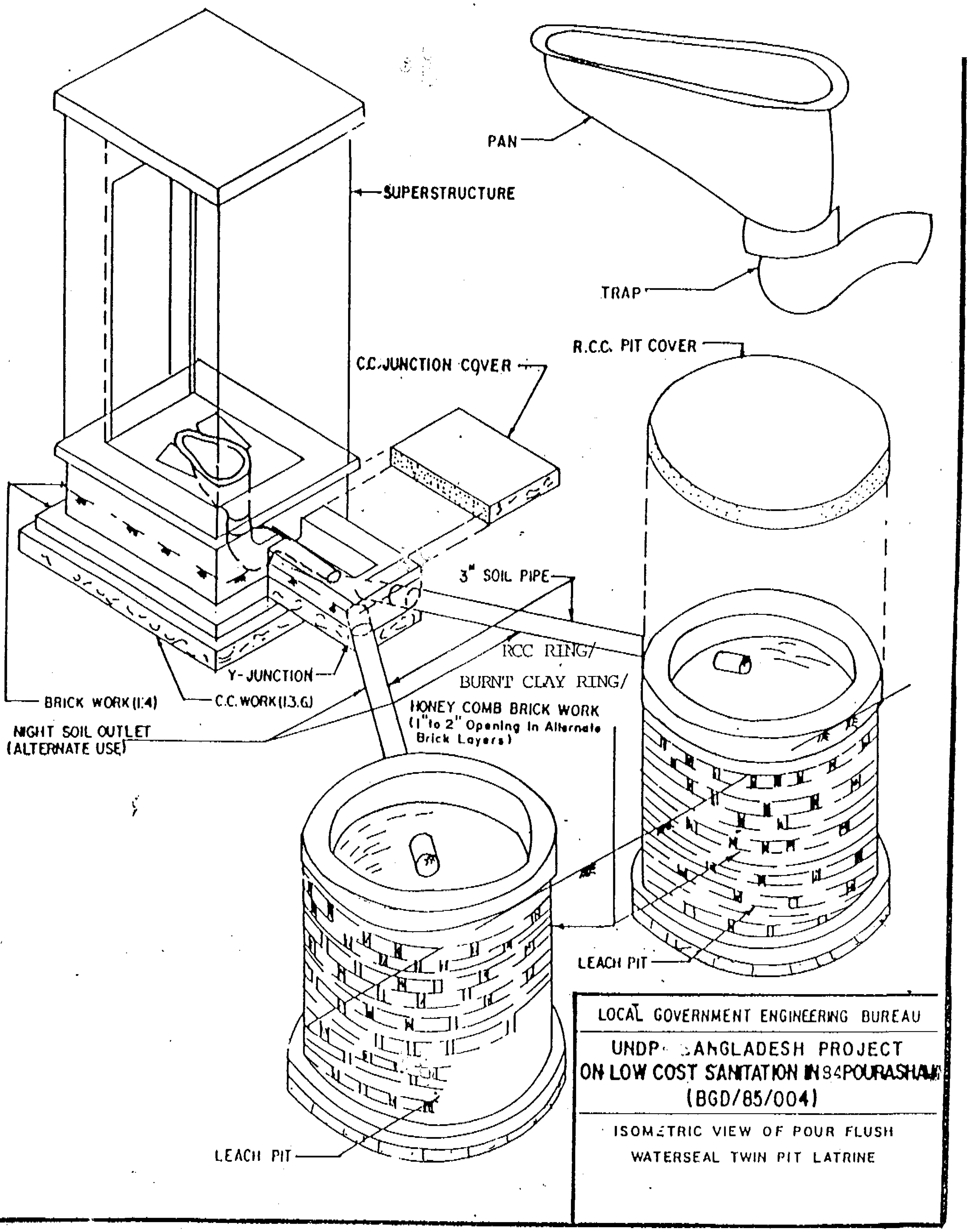

DRAWING NO. 4

TWIN PIT WATERSEAL LATRINE IN FLOODED AREA

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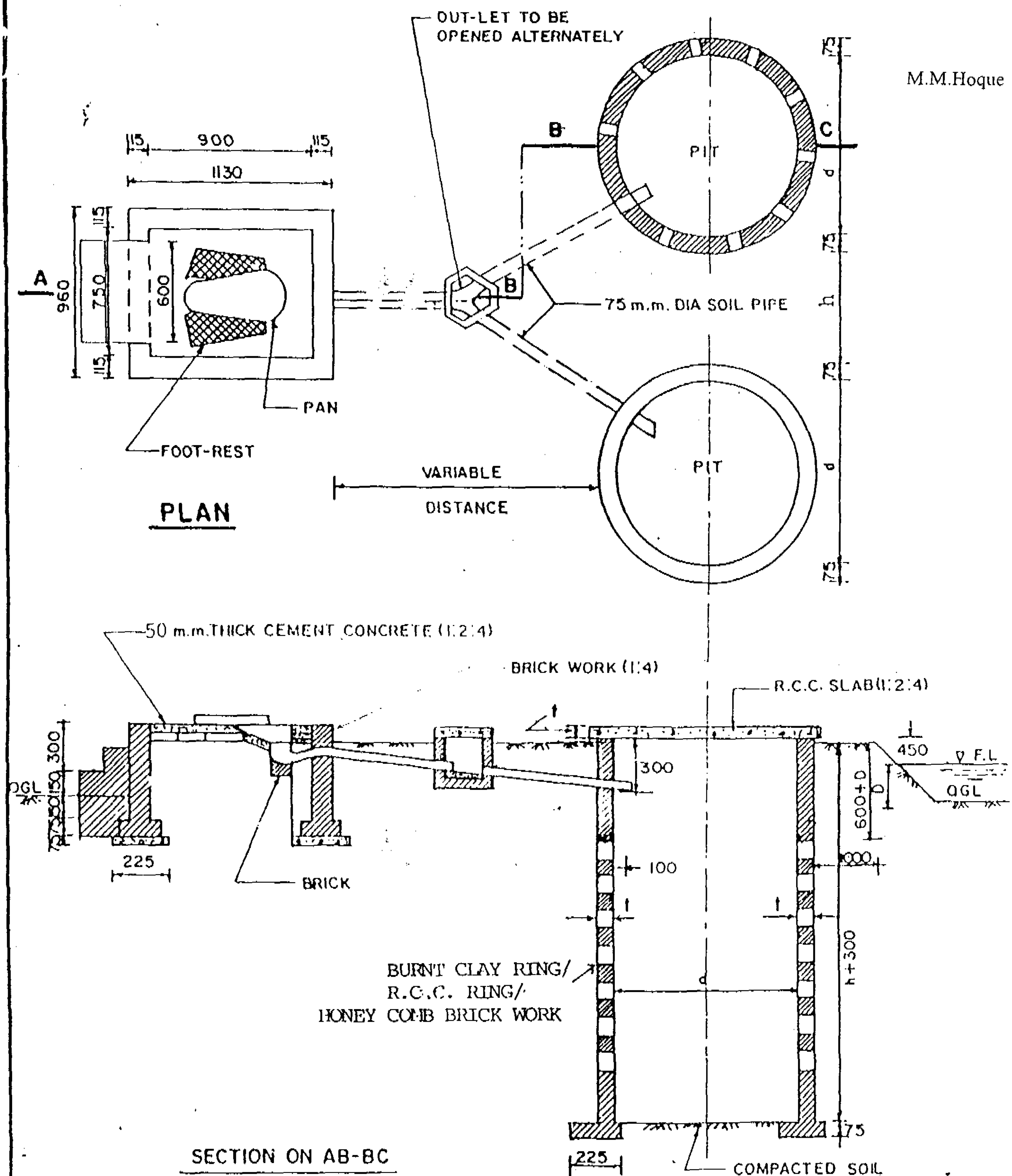


USERS	DIAMETER d	HEIGHT h	THICKNESS t	FLOOD DEPTH
6	900	1100	50	D
10	1100	1400	60	(Variable)
15	1250	1600	75	

LOCAL GOVERNMENT ENGINEERING BUREAU

UNDP-BANGLADESH PROJECT

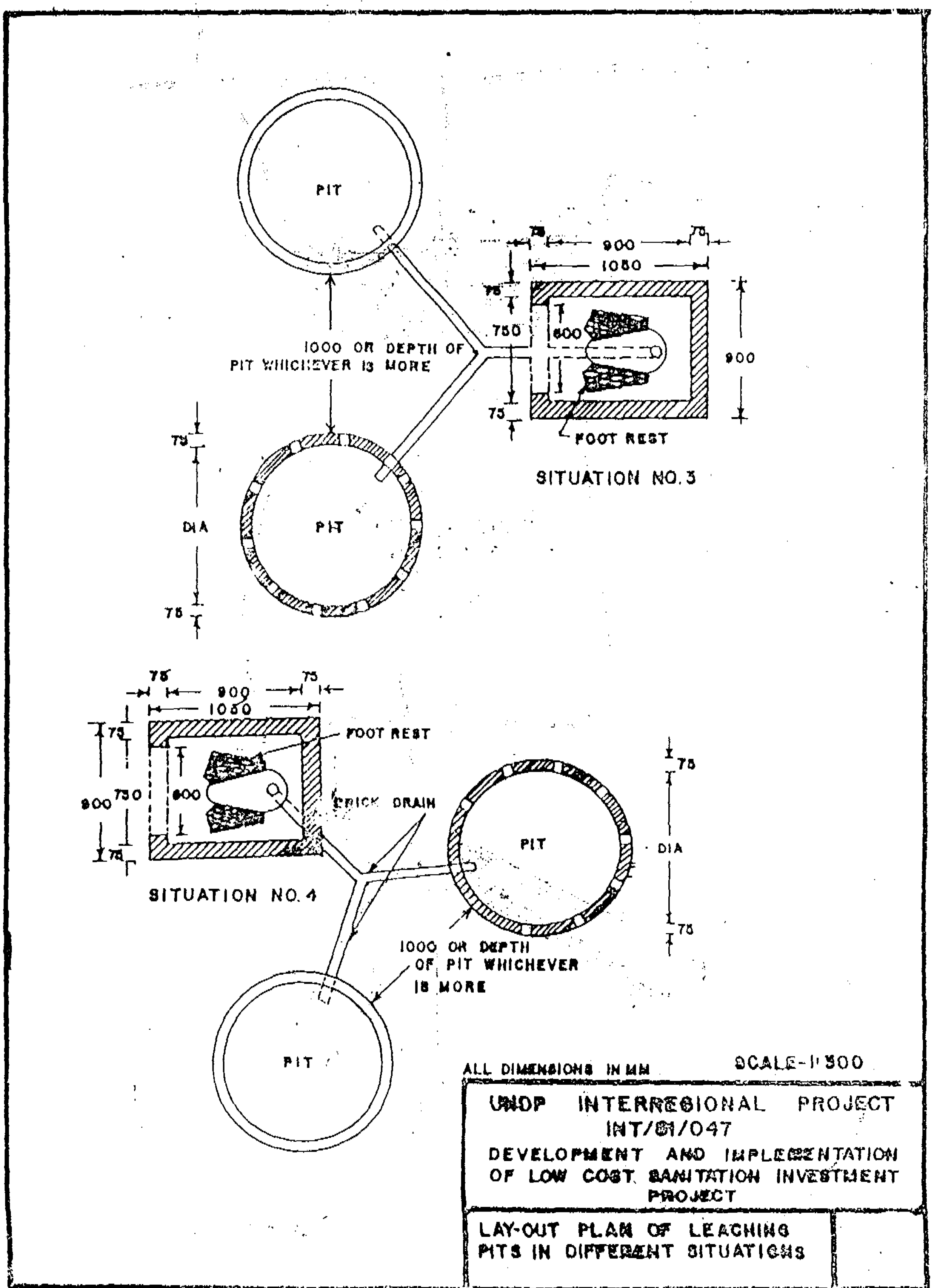
(BGD/85/004)

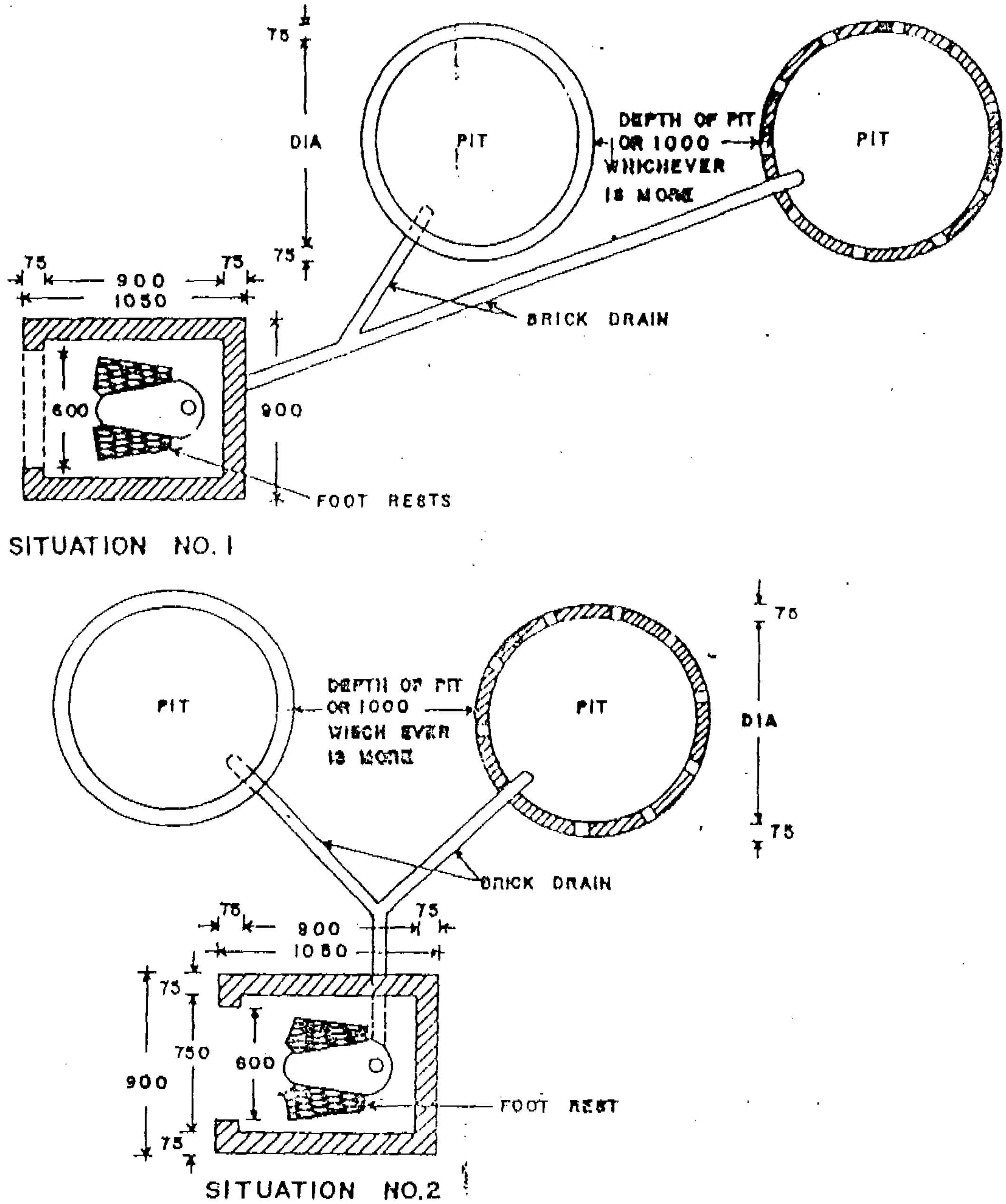
ON LOW COST SANITATION

DESIGN OF POUR FLUSH WATER-SEAL LATRINE FOR PITS LOCATED IN FLOODED AREA

ALL DIMENSIONS IN m.m

SCALE 1:30

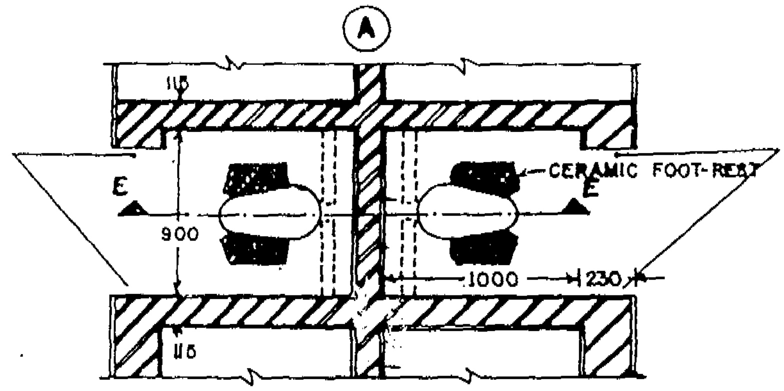

PIT
PIT
1000 OR DEPTH OF PIT WHICHEVER IS MORE
900
1050
750
600
900
75
DIA
FOOT REST
SITUATION NO.3
FOOT REST
BRICK DRAIN
PIT
DIA
SITUATION NO.4
1000 OR DEPTH OF PIT WHICHEVER IS MORE
PIT
ALL DIMENSIONS IN MM
SCALE-1:500
UNDP INTERREGIONAL PROJECT
INT/81/047
DEVELOPMENT AND IMPLEMENTATION OF LOW COST SANITATION INVESTMENT PROJECT
LAY-OUT PLAN OF LEACHING PITS IN DIFFERENT SITUATIONS



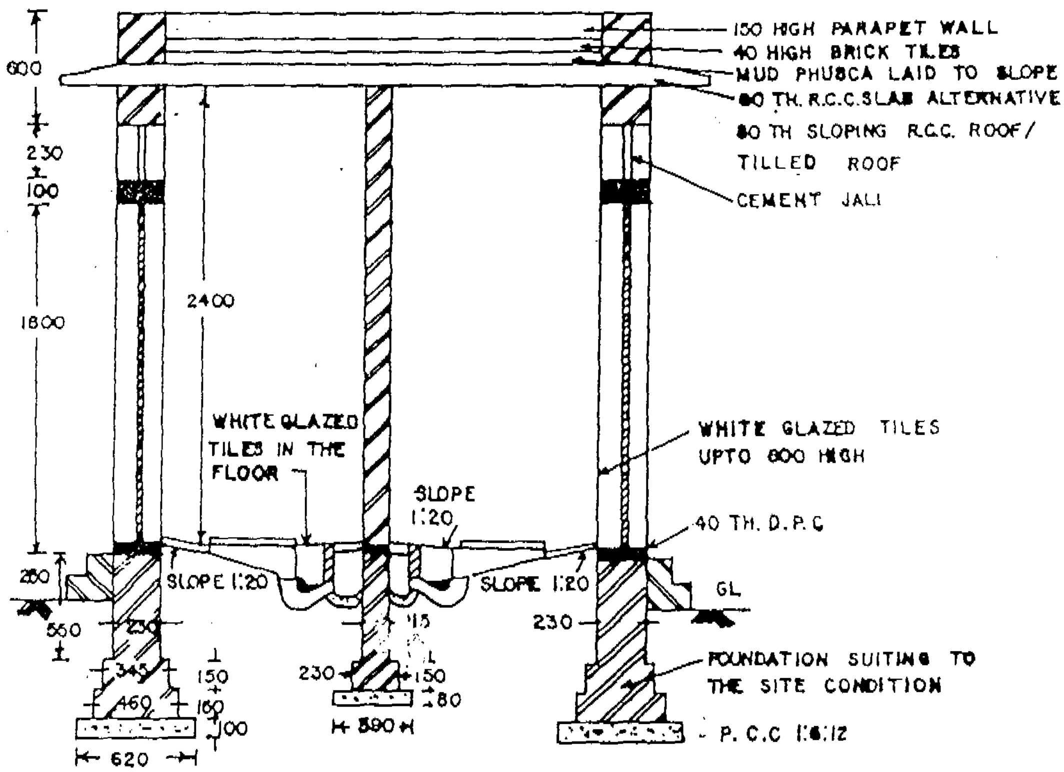
ALL DIMENSIONS IN MM SCALE:-1:500

UNDP INTERREGIONAL PROJECT
INT/81/047
DEVELOPMENT AND IMPLEMENTATION OF LOW COST SANITATION INVESTMENT PROJECT

LAYOUT PLAN OF LEACHING PITS IN DIFFERENT SITUATIONS



DETAIL AT A



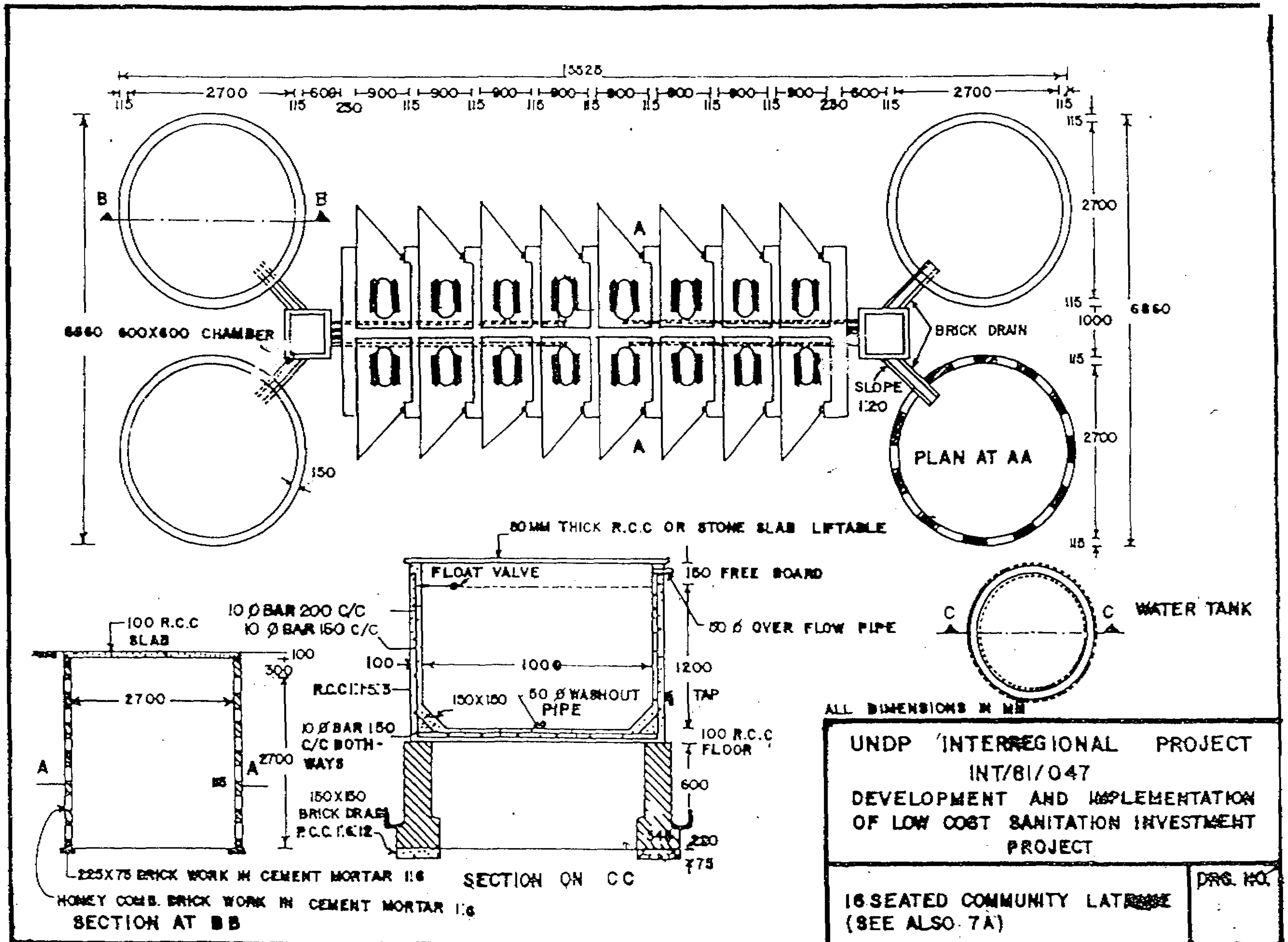
SECTION EE

ALL DIMENSIONS IN MM SCALE:- 1:300

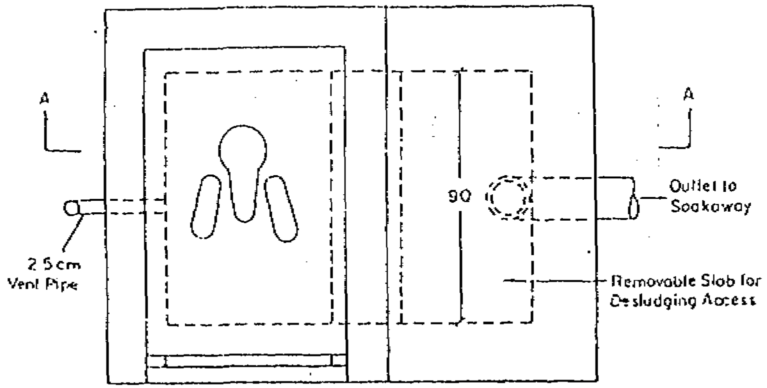
UNDP INTERREGIONAL PROJECT
INT/81/047
DEVELOPMENT AND IMPLEMENTATION OF LOW COST SANITATION INVESTMENT PROJECT

4,6,8,10,12, & 16 SEATED COMMUNITY LATRINE, DETAIL AT A	DRG. NO.

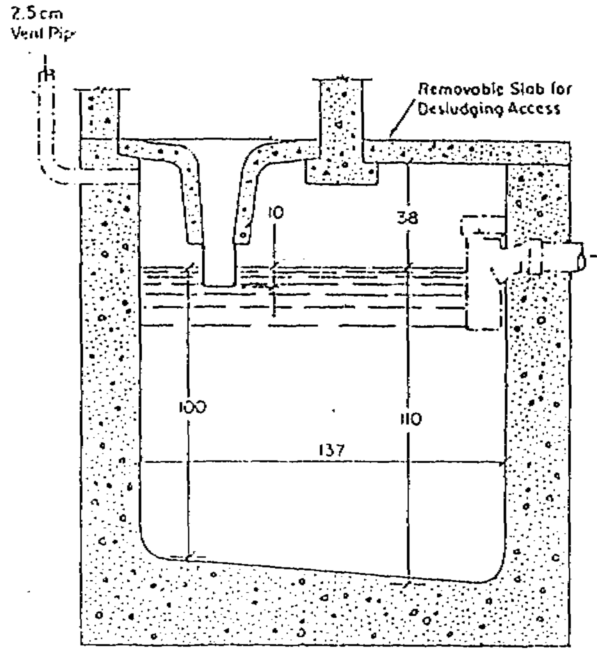
M.M.H


15528
2700
2700
PLAN AT AA
6860 600X600 CHAMBER
BRICK DRAIN
SLOPE 1:20
80 MM THICK R.C.C OR STONE SLAB LIFTABLE
FLOAT VALVE
150 FREE BOARD
10 Ø BAR 200 C/C
10 Ø BAR 150 C/C
50 Ø OVER FLOW PIPE
100 R.C.C SLAB
R.C.C 1:1.5:3
150X150
50 Ø WASHOUT PIPE
TAP
10 Ø BAR 150 C/C BOTH-WAYS
100 R.C.C FLOOR
150X150 BRICK DRAIN
225X75 BRICK WORK IN CEMENT MORTAR 1:6
HONEY COMB. BRICK WORK IN CEMENT MORTAR 1:6
SECTION AT BB
SECTION ON CC
WATER TANK
ALL DIMENSIONS IN MM
UNDP INTERREGIONAL PROJECT
INT/81/047
DEVELOPMENT AND IMPLEMENTATION OF LOW COST SANITATION INVESTMENT PROJECT
16 SEATED COMMUNITY LATRINE
(SEE ALSO 7A)
DRG. NO.

CONVENTIONAL AQUA-PRIVY



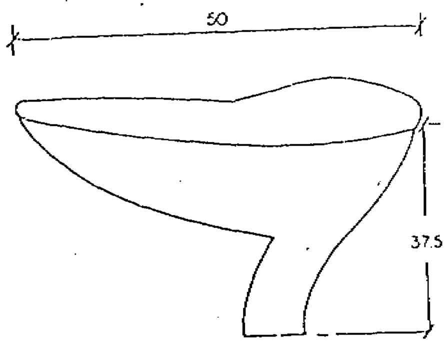
Plan



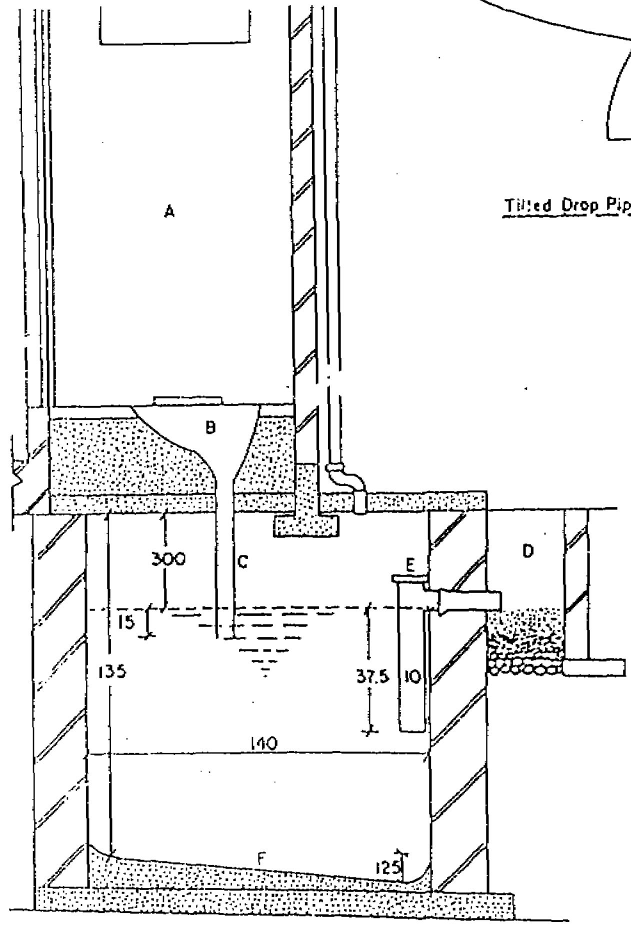
Section A - A

(Source:ENSIC, Dec, 1981)

AQUA - PRIVY

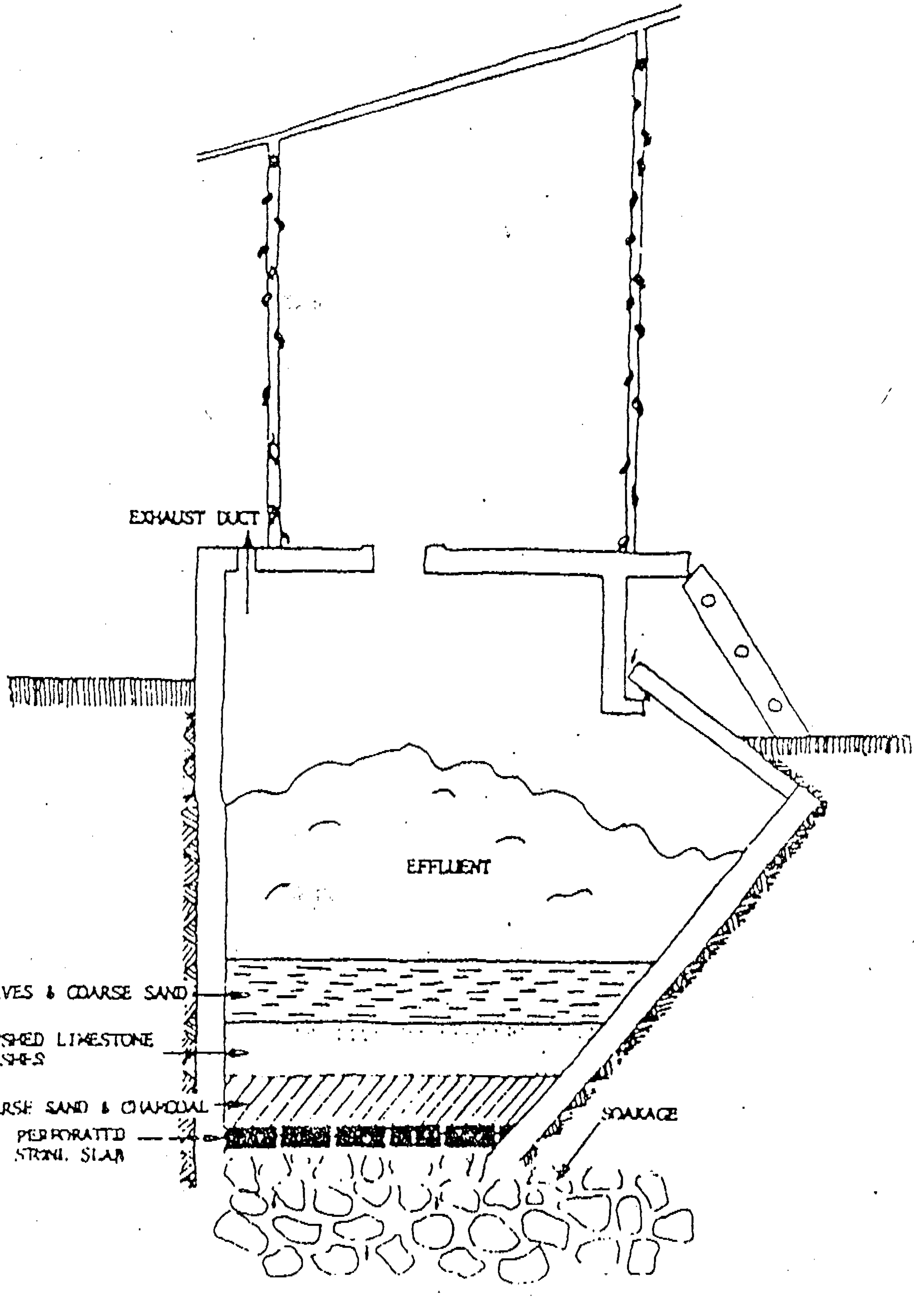


Tilted Drop Pipe Naigaon Model



A - Latrine
B - Tub with Vertical Drop-Pipe
C - Open Space within Tank
D - Filter Chamber
E - Outlet Pipe
F - Tank
G - R.C. Beam
H - Vent Pipe

Fig.4.25.Aqua-privy



Biopot. Complete decomposition and pastorisation through high temperature composting. Chemical filter controls humidity even in humid tropical climate. Yields valuable manure.

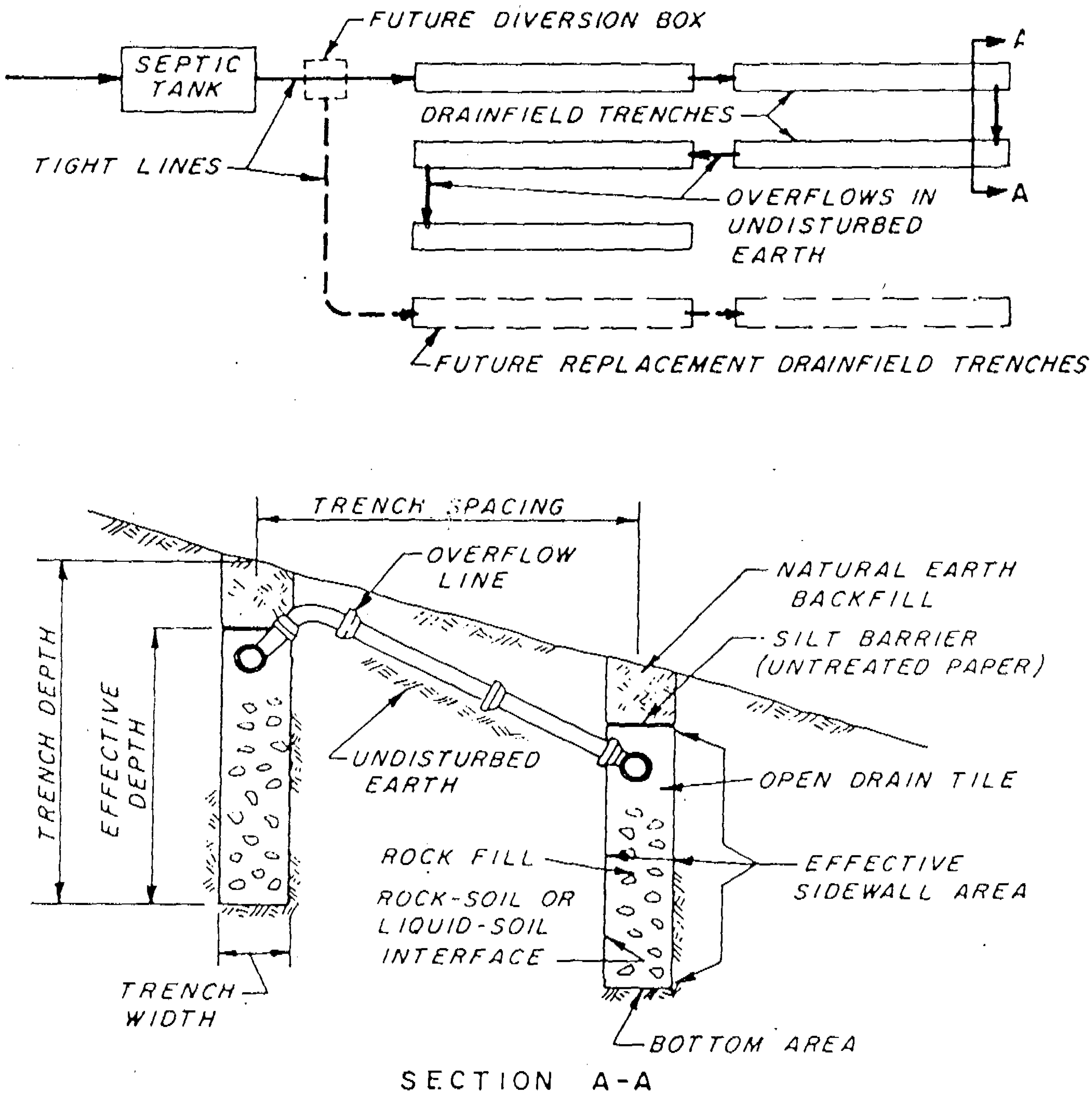


Fig. . A typical drain.e(d arrangement. (From Cotteral & Norris).

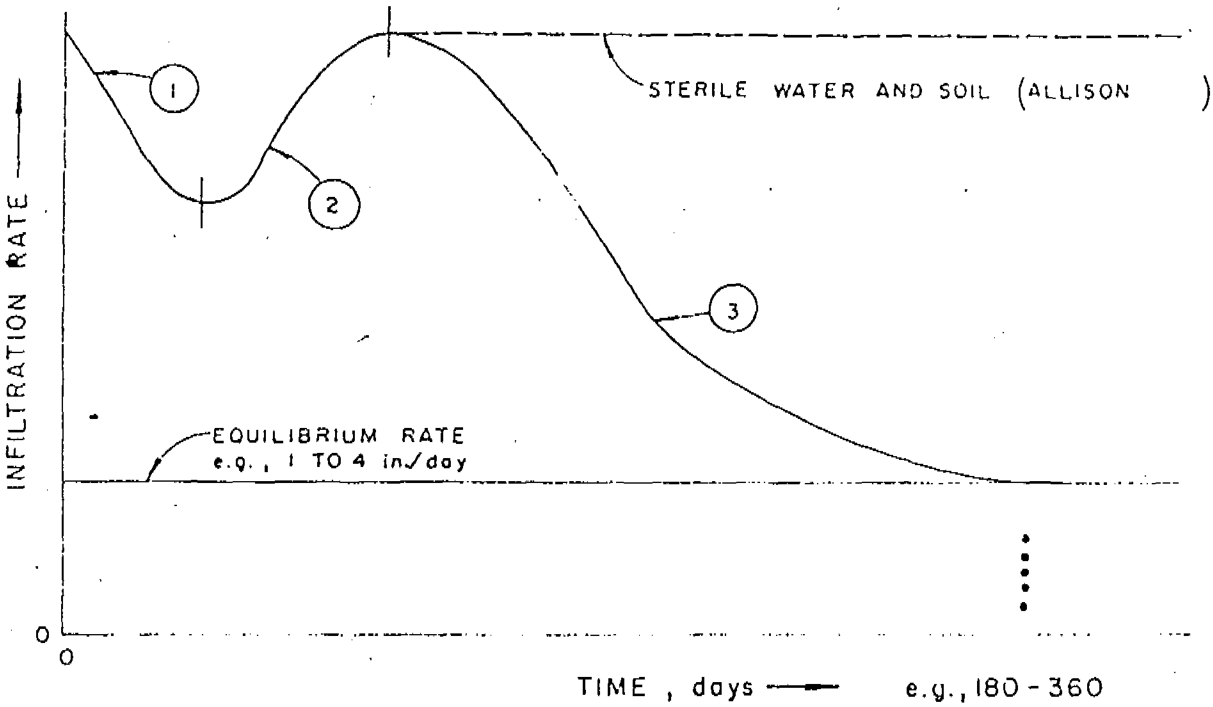


FIGURE . TYPICAL TIME-RATE INFILTRATION CURVE FOR WATER

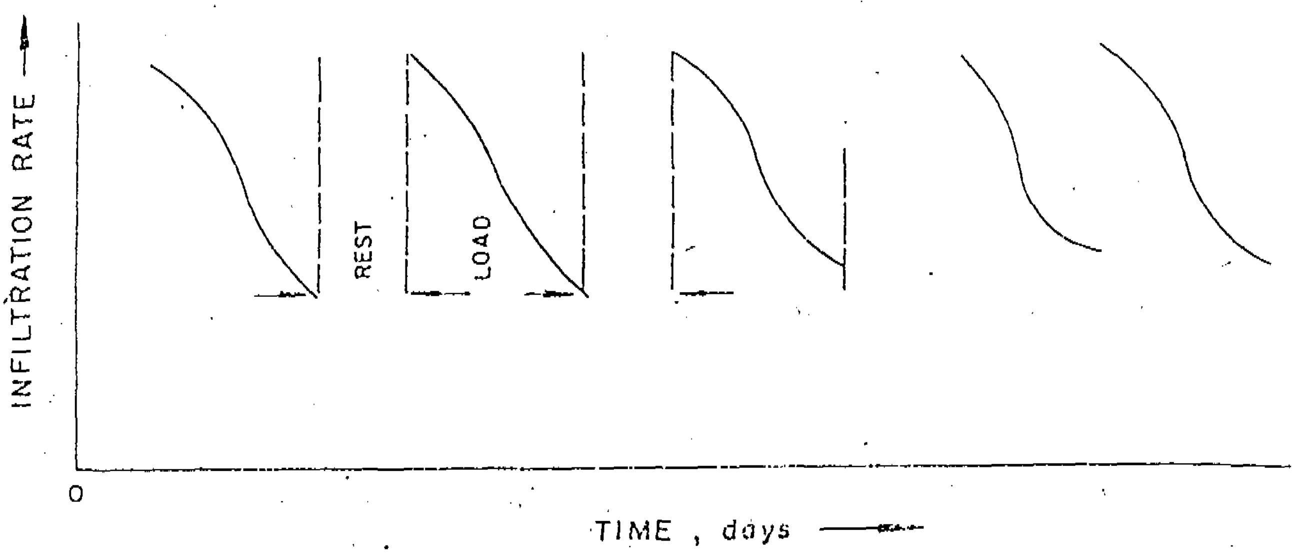


FIGURE . TYPICAL RESTORATION OF INFILTRATIVE CAPACITY BY CYCLICAL OPERATION

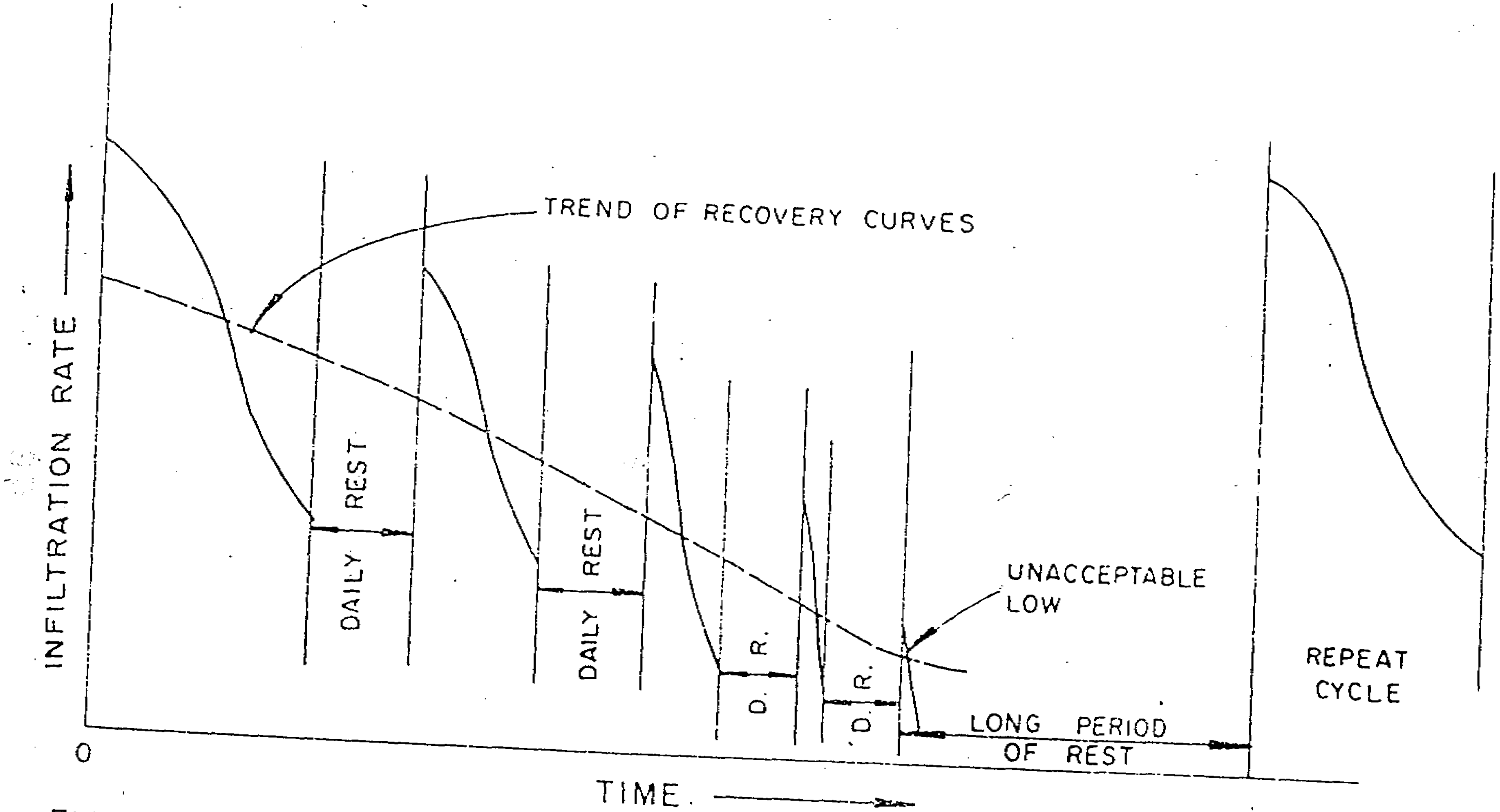


FIGURE THEORETICAL PATTERN OF RESTORATION OF INFILTRATIVE CAPACITY OF A TRENCH SIDEWALL

RATE OF ACCUMULATION OF SLUDGE

CONDITION OF LATRINE/USERS' PRACTICES	AV. RATE OF ACCUMULATION OF SLUDGE, m^3/P/YR
DRY CONDITION (ROY ET AL, 1982)	0.045
WET CONDITION-WHERE THE GROUNDWATER TABLE IS ABOVE THE PIT BOTTOM AT ANY TIME OF THE YEAR (ROY ET AL, 1982)	0.067
WET CONDITION OF THE PIT WITH THE ABLUTION WATER, (WAGNER & LANOIX, 1958; BHASKARAN, 1962)	0.025-0.034
WHERE ANUAL CLEANSING MATERIALS LIKE STONES, CORN COBS, MUDBALLS, CEMENT BAGS ARE USED AND WHICH ARE NOT READILY DECOMPOSED	0.09

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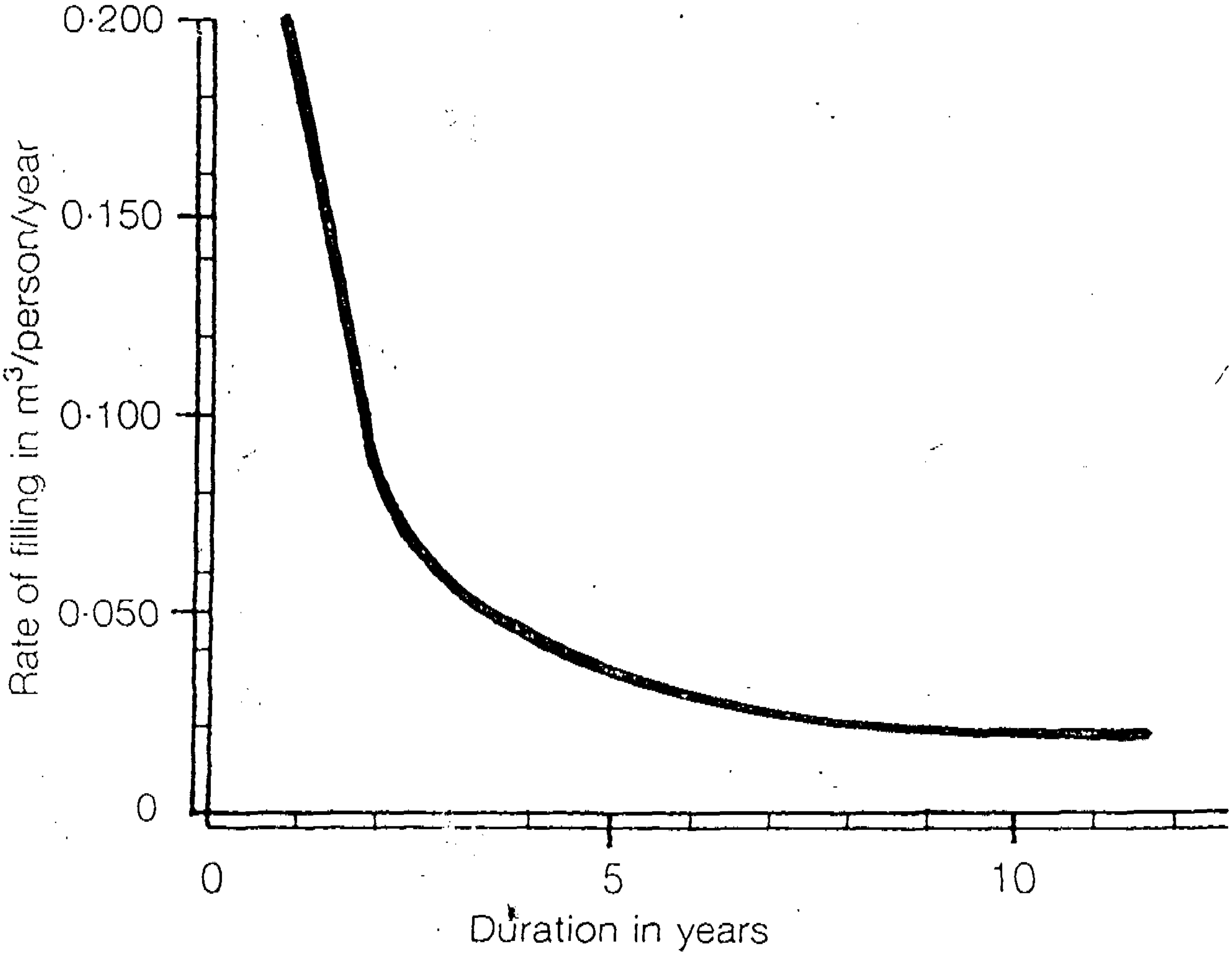
Pit size



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DESIGN VALUES FOR WET PITS

DESLUDGING INTERVAL, (YEARS)	VOLUME $m^3/p/yr$
2	0.095
3	0.067
4	0.051
5	0.041
6	0.035

SLOPE OF THE PIPE FROM BOWL TO LEACH PIT:

$$V = \frac{1}{n} R^{2/3} S^{1/2}$$

WHERE

V = SELF CLEANSING VELOCITY, 1 m/s

N = MANNING'S ROUGHNESS COEFFICIENT
(0.013 FOR CONCRETE PIPE)

R = HYDRAULIC RADIUS

S = SLOPE OF THE PIPE
(NOT LESS THAN 0.025)

THE ULTIMATE INFILTRATION RATE OR LONG TERM SEPTAGE ACCEPTANCE RATE (LTAR)

$$LTAR = 40K - \frac{0'049}{LOG_{10} \; 197K}$$

K = INFILTRATION CAPACITY OF SOILS, M/S

INFILTRATION CAPACITY OF SOIL, M/DAY (KINORI, 1970)

TYPE OF SOIL	INFILTRATION CAPACITY, M/DAY
SANDY SOIL	0.45 - 0.55
SANDY LOAM	0.30 - 0.45
CLAY LOAM WITH GRAVEL, SANDY CLAY LOAM, GRAVEL CEMENTED WITH CLAY PARTICLES, CLAY LOAM	0.23 - 0.30
SILTY SOIL	0.15 - 0.23
MEDIUM CLAY LOAM	0.10 - 0.15
IMERVIOUS CLAY LOAM	0.07 - 0.10

FOR SHORT TERM USE OR FOR FREQUENT EMPTYING, THE RECOMMENDED MAXIMUM

EFFLUENT LOADING RATES FOR EACH PIT

SOIL	LONG TERM INFILTRATIVE LOADING RATE, $l/m^2 d$
SAND	50
SANDY LOAN, LOAMS	30
POROUS SILTY LOAMS POROUS SILTY CLAY LOAMS	20
CAMPACT SILTY LOAMS COMPACT SILTY CLAY LOAMS	10

IN EXPANSIVE CLAYS POURFLUSH LATRINE IS INFEASIBLE

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GROUND WATER POLLUTION

I. Bacteriological
II. Chemical

Controlled by :

Soil type, formation, porosity etc.

Water table

Water movement

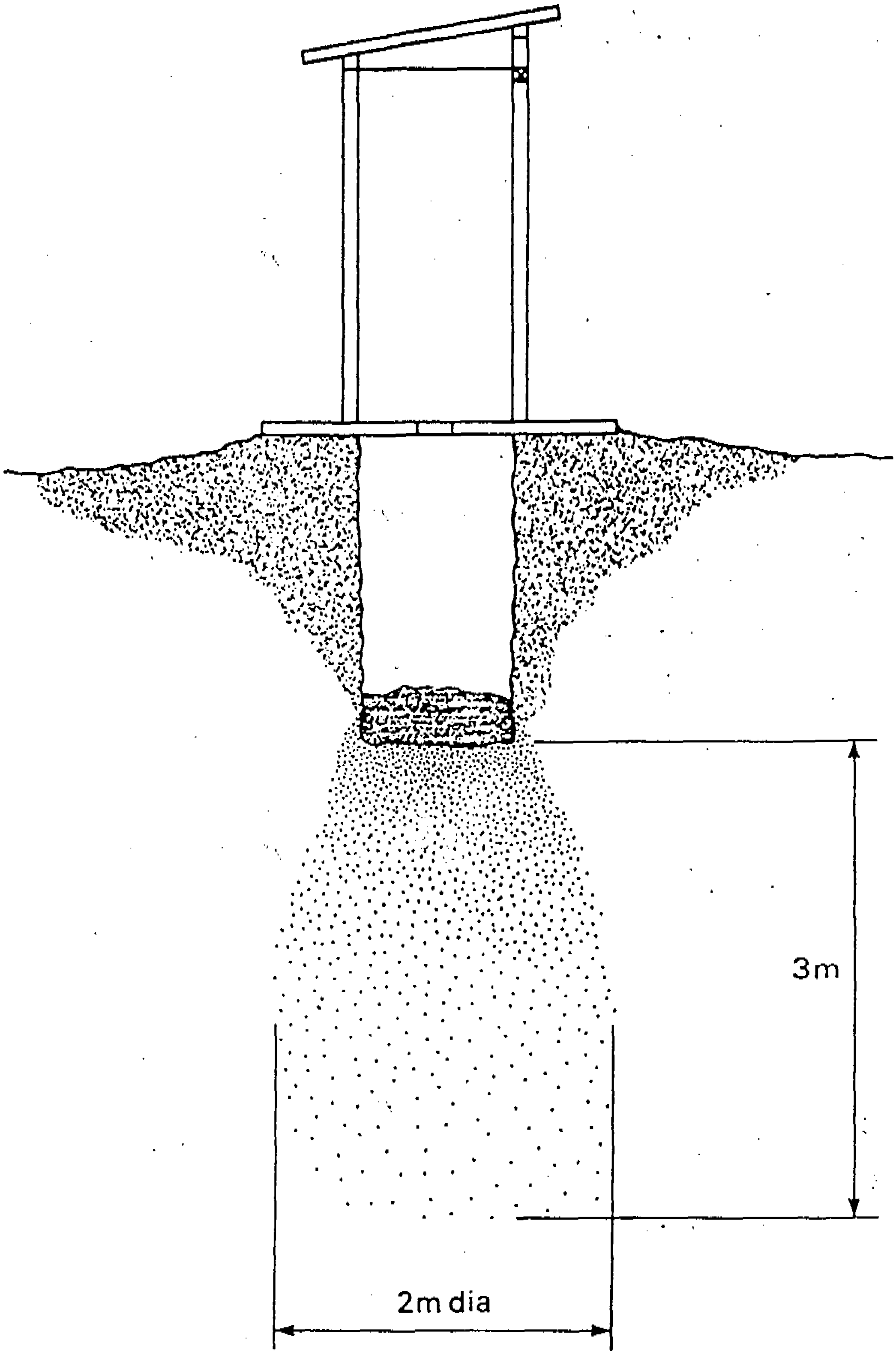

Figure Spread of polution in dry soil. There is little migration of bac'eria and chemical substances, and hardly any lateral movement

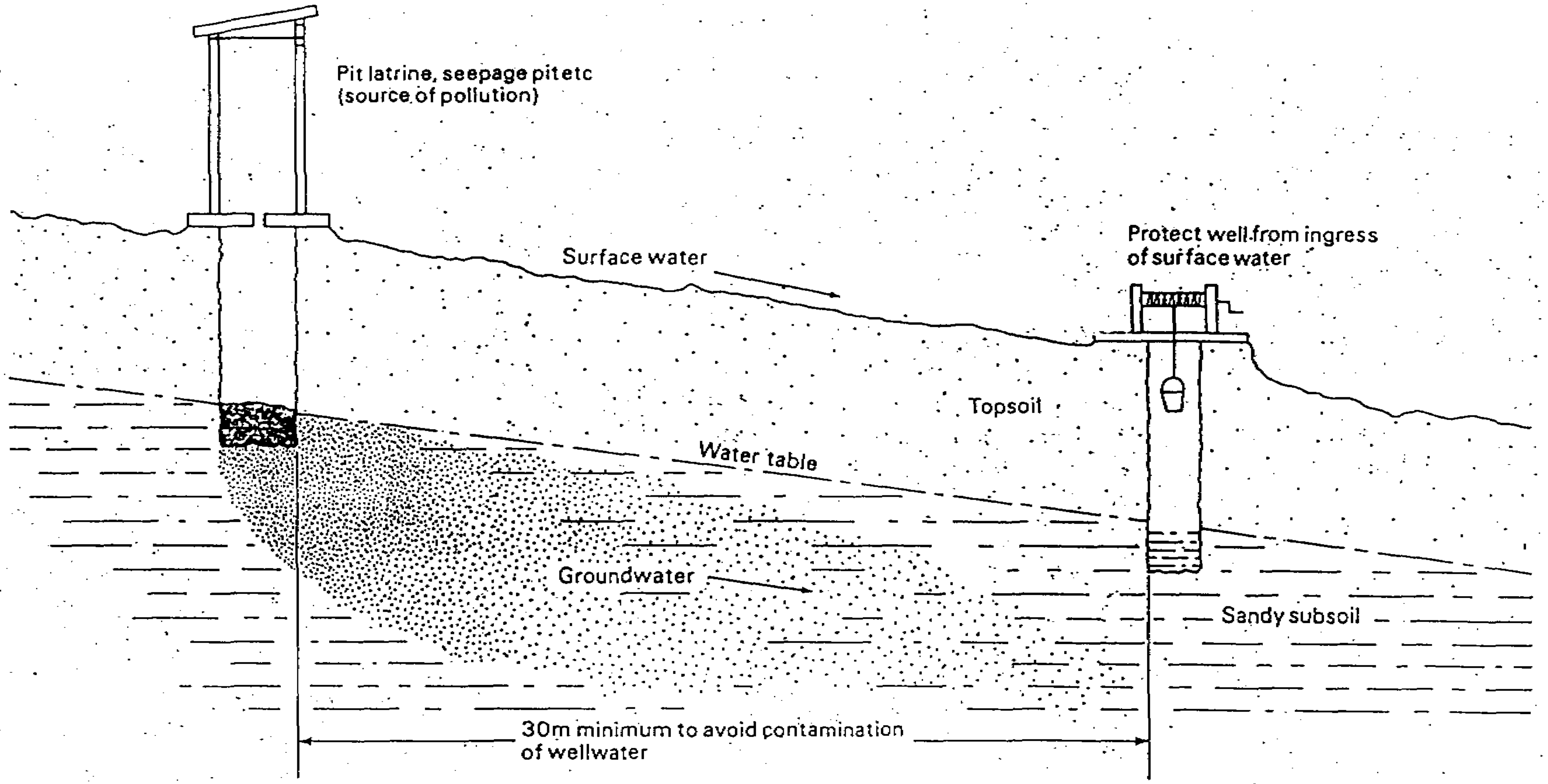

Figure Siting of latrines relative to water supplies. Latrines should be downhill from a water source. If they must be located uphill they should be at least 30 m from a well

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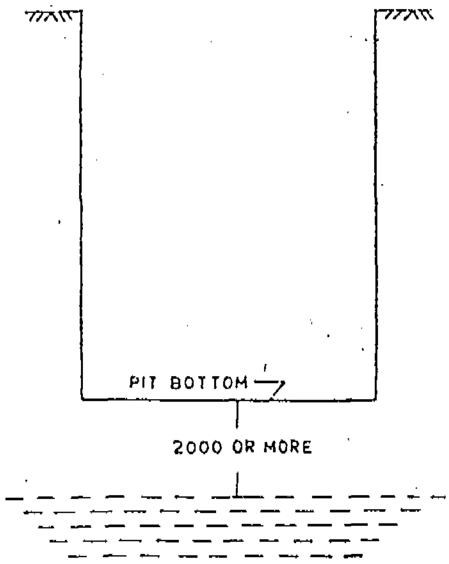
DRY PIT

WATER TABLE 2000 OR MORE BELOW BOTTOM OF PIT (MAXIMUM GROUND WATER LEVEL REACHED ANY TIME DURING THE YEAR)

NO SAND ENVELOPE OR BOTTOM SEALING NEEDED

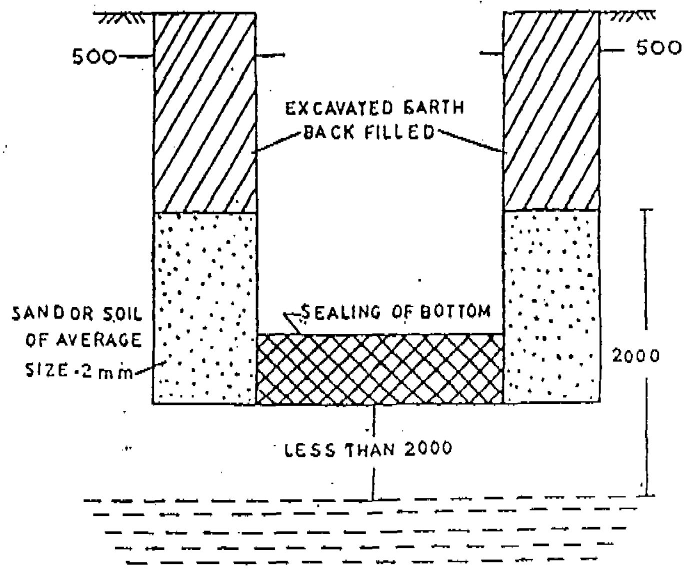


CASE _ 1

DRY PIT

WATER TABLE LESS THAN 2000 BELOW THE BOTTOM OF PIT (MAXIMUM GROUND WATER LEVEL REACHED ANY TIME DURING THE YEAR)

SAND OR SOIL ENVELOPE ALLROUND THE PIT UPTO 2000 HEIGHT FROM MAXIMUM WATER-TABLE AND BOTTOM TO BE SEALED

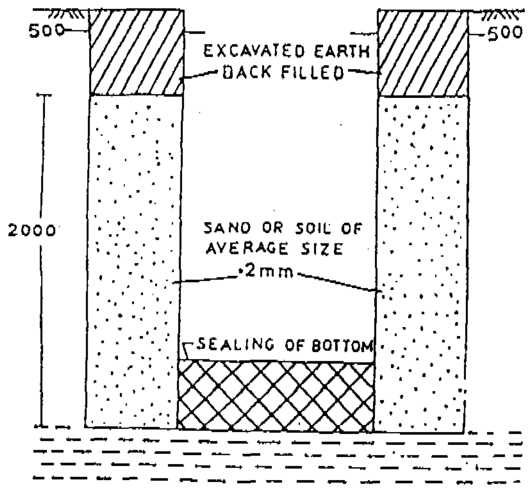


CASE _ 2

WET PIT

WATER TABLE AT THE BOTTOM OF THE PIT (MAXIMUM GROUND WATER LEVEL REACHED ANY TIME DURING THE YEAR)

SAND OR SOIL ENVELOPE ALLROUND THE PIT UP-TO 2000 HEIGHT FROM HIGHEST WATER TABLE AND SEALING OF BOTTOM NEEDED

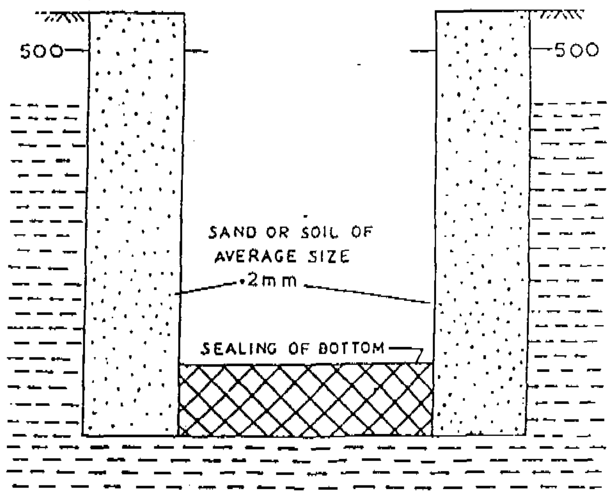


CASE _ 3

WET PIT

WATER TABLE ABOVE THE BOTTOM OF THE PIT (MAXIMUM GROUND WATER LEVEL REACHED ANY TIME DURING THE YEAR)

SAND ENVELOPE ALLROUND THE PIT AND SEALING OF BOTTOM NEEDED



CASE _ 4

NOTE _ WHEN ENVELOPE IS PROVIDED, LINING OF PITS SHOULD NOT BE IN HONEY COMB BRICK WORK BUT SHOULD BE IN MASONRY WITH VERTICAL JOINTS OPEN (WITHOUT MORTAR) 12 TO 15mm WIDE

ALL DIMENSIONS IN MM

SAFE DISTANCE BETWEEN LATRINE PIT AND WATER SUPPLY MAINS

LATERAL DISTANCE BETWEEN THE LEACH PIT AND THE WATER MAIN SHOULD BE AT LEAST 3 M PROVIDED THE WATER TABLE DOES NOT RISE DURING ANY PART OF THE YEAR ABOVE THE PIT BOTTOM AND THE INLET OF PIPE OR DRAIN TO THE LEACH PIT IS BELOW THE LEVEL OF WATER MAIN. IF THE WATER TABLE RISES ABOVE THE BOTTOM OF THE PIT, THE SAFE LATERAL DISTANCE SHOULD BE KEPT AS 8 M. IF THIS CANNOT BE ACHIEVED, THE PIPE SHOULD BE COMPLETELY ENCASED TO A LENGTH OF A LEAST 3 M ON EITHER SIDE OF THE PIT.

WHEN THE PITS ARE LOCATED EITHER UNDER THE FOOT PATH OR UNDER THE ROAD, OR THE WATER SUPPLY MAIN IS WITHIN A DISTANCE OF 3 M FROM THE PITS, THE INVERT OF THE INLET PIPE SHOULD BE KEPT AT LEAST 1 M BELOW THE GROUND LEVEL. THIS WOULD ENSURE THAT THE LIQUID LEVEL IN THE PITS DOES NOT REACH THE LEVEL OF THE WATER MAIN AS THE WATER MAINS ARE GENERALLY LAID AT 0.9 M DEPTH.

THE WATER PIPE SHOULD NOT CUT ACROSS THE PIT BUT WHERE IT IS UNAVOIDABLE, THE WATER PIPE SHOULD BE COMPLETELY ENCASED FOR A LENGTH OF 3 M ON EITHER SIDE OF THE PIT INCLUDING THE PORTION ACROSS THE PIT TO PREVENT INFILTRATION OR EXFILTRATION.

SMALL BORE SEWERAGE

APPLICABILITY

ADVERSE HYDROGEOLOGICAL SITUATION (FLAT LAND, LOW PERMEABILITY, SHALLOW ROCK ETC) FOR ON-SITE DISPOSAL

- BUCKET LATRINE
- CONVENTIONAL SEWERAGE
- SMALL BORE SEWERAGE

BUCKET LATRINE SYSTEM REQUIRES HIGH DEGREE OF ORGANIZATIONAL CAPABILITY.

CONVENTIONAL SEWERAGE IS VERY EXPENSIVE (US$ 650 - 4000 /FAMILY)
SMALL BORE SEWERAGE COSTS 25-35% LESS THAN THAT OF CONVENTIONAL SEWERAGE.

FAVOURABLE WHERE WET SYSTEM EXISTS (LIKE P-F TOILET/SEPTIC TANK)

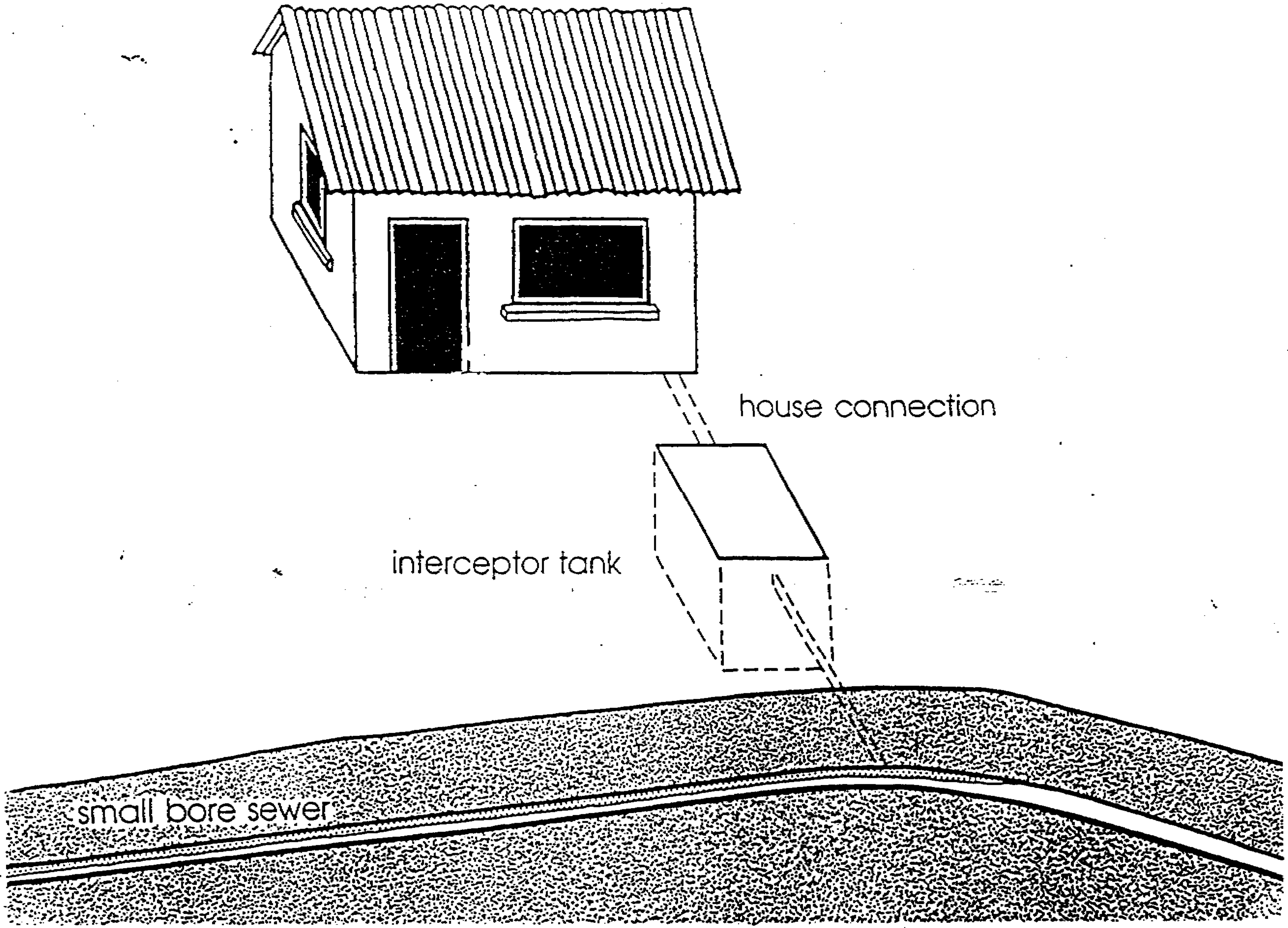


Figure 1. Schematic diagram of a small bore sewer system

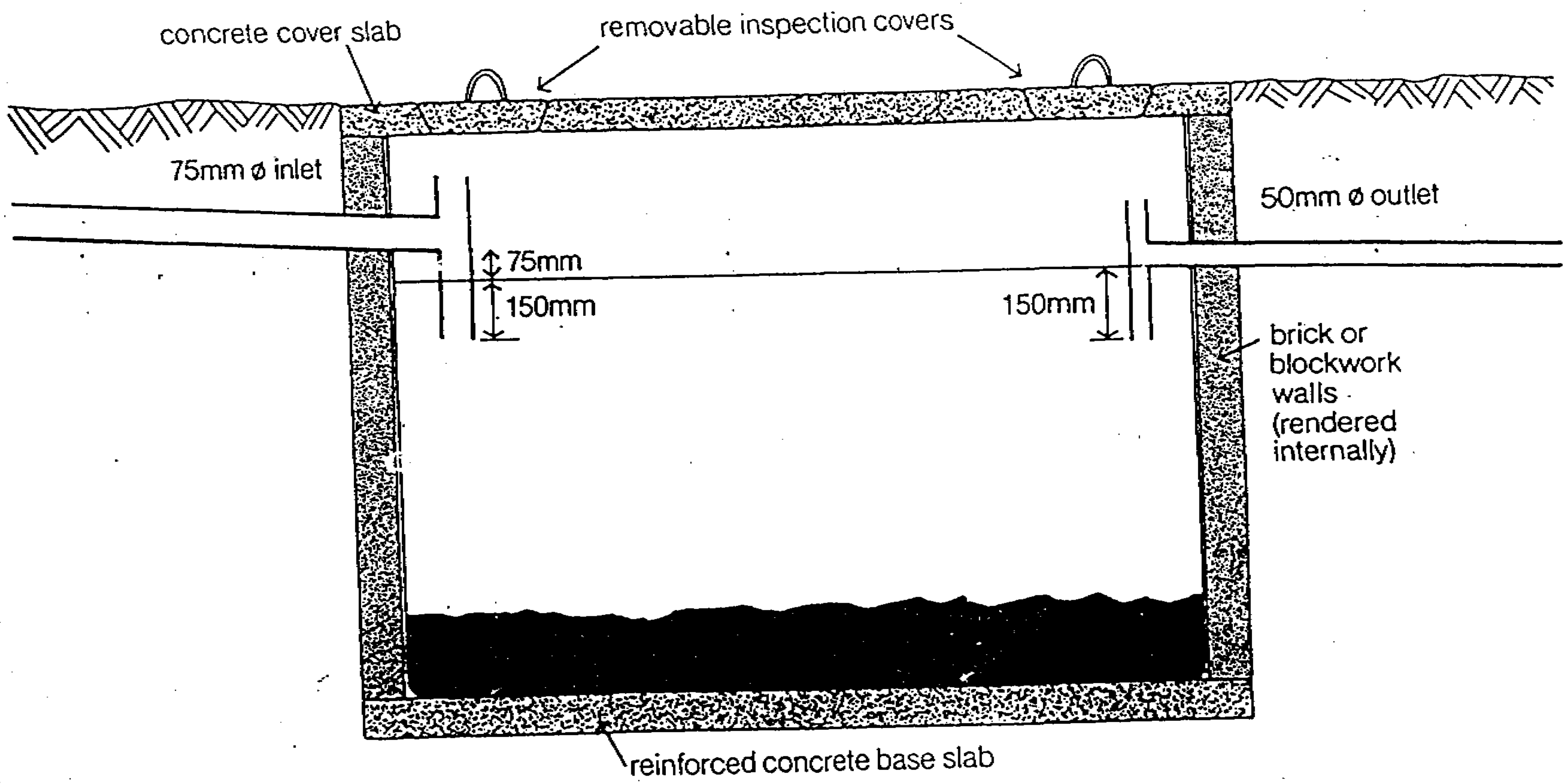


Figure . Typical solids interceptor tank. [The tank may be buried by 300 mm or more to prevent unauthorized access by children or for garbage disposal.]

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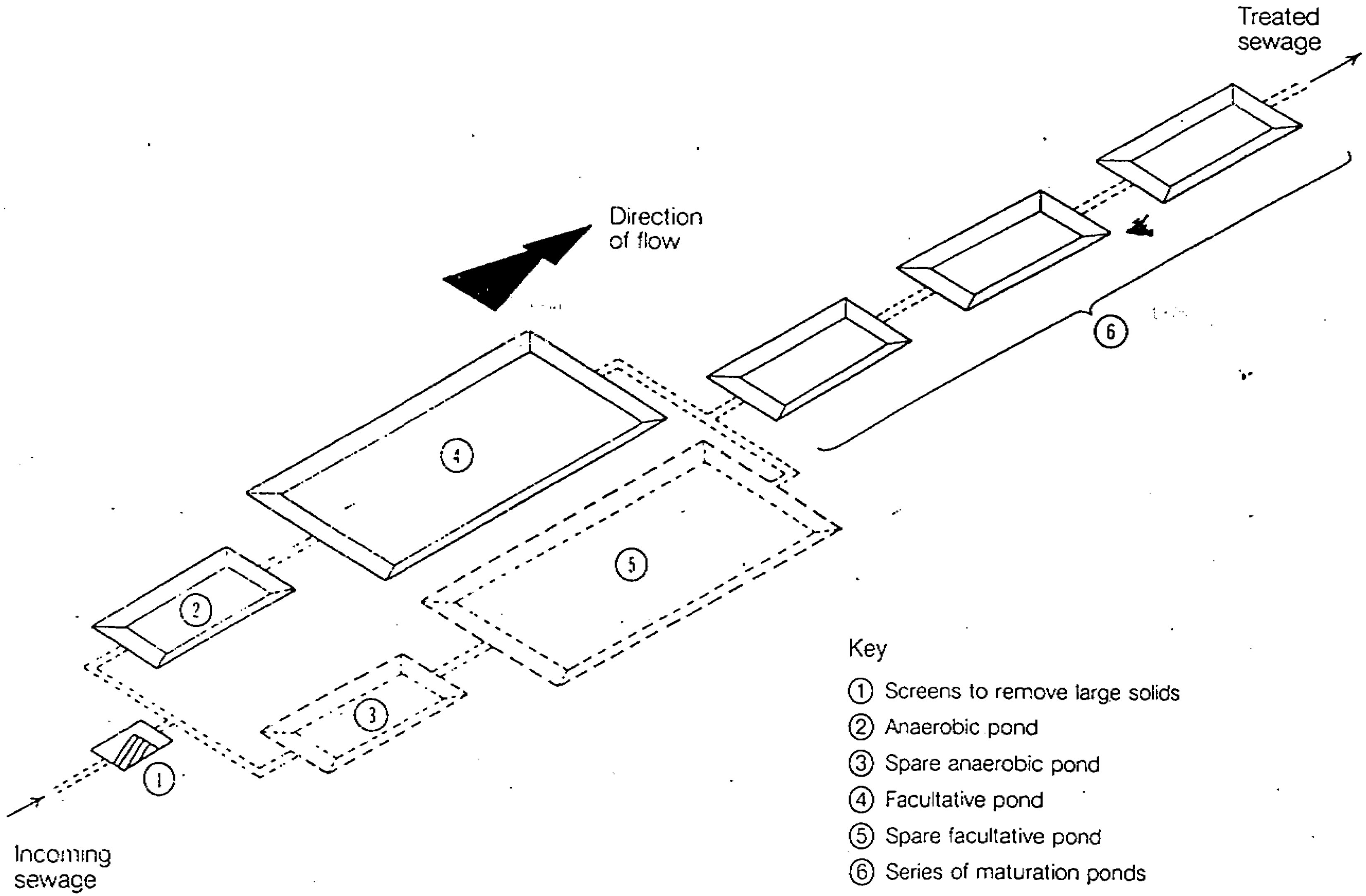
A possible system of waste stabilisation ponds using several types of pond might look like this:



Key

1. Screens to remove large solids
2. Anaerobic pond
3. Spare anaerobic pond
4. Facultative pond
5. Spare facultative pond
6. Series of maturation ponds

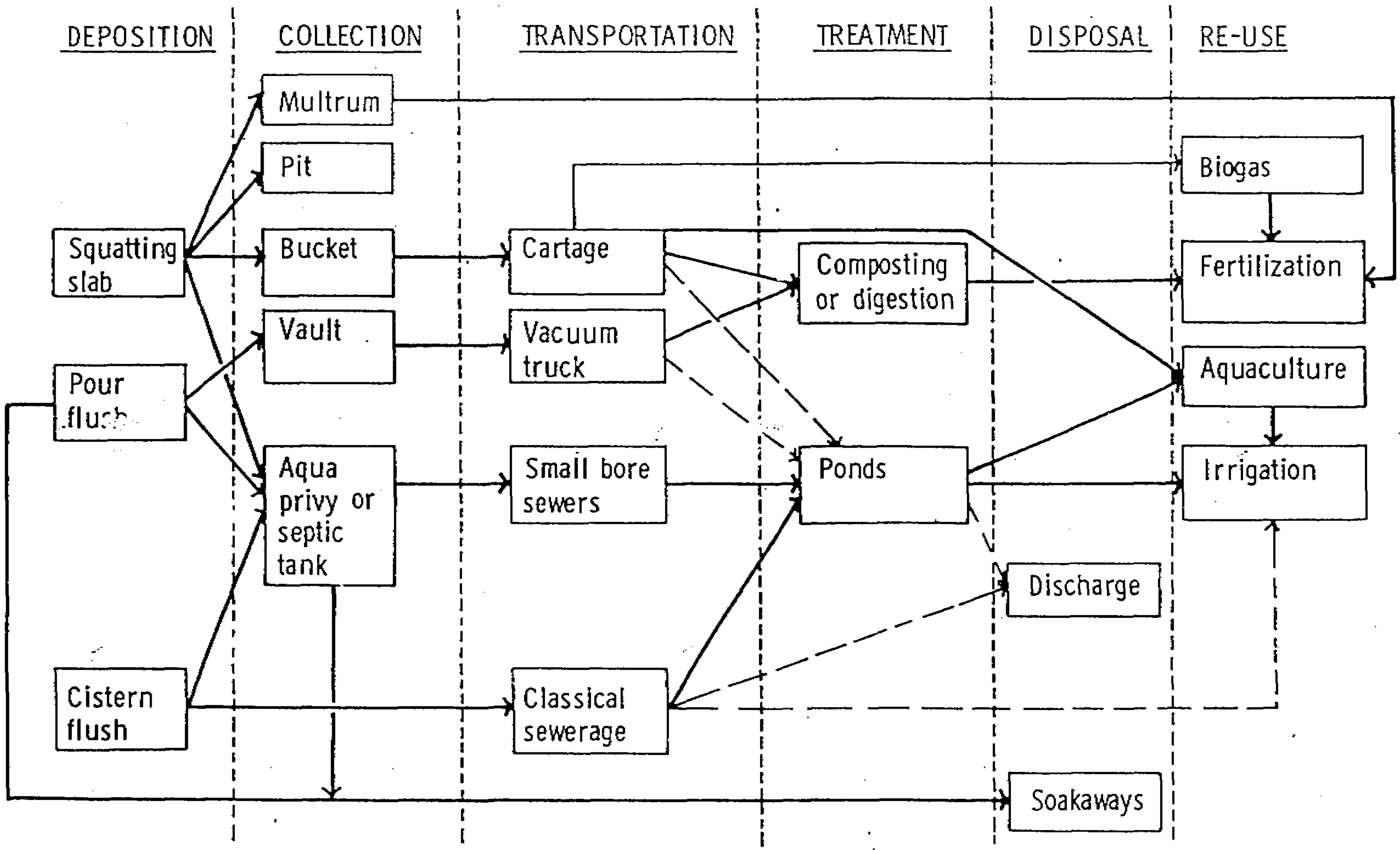


Fig. 1. The elements of an excreta disposal system and the various ways in which they can be combined.

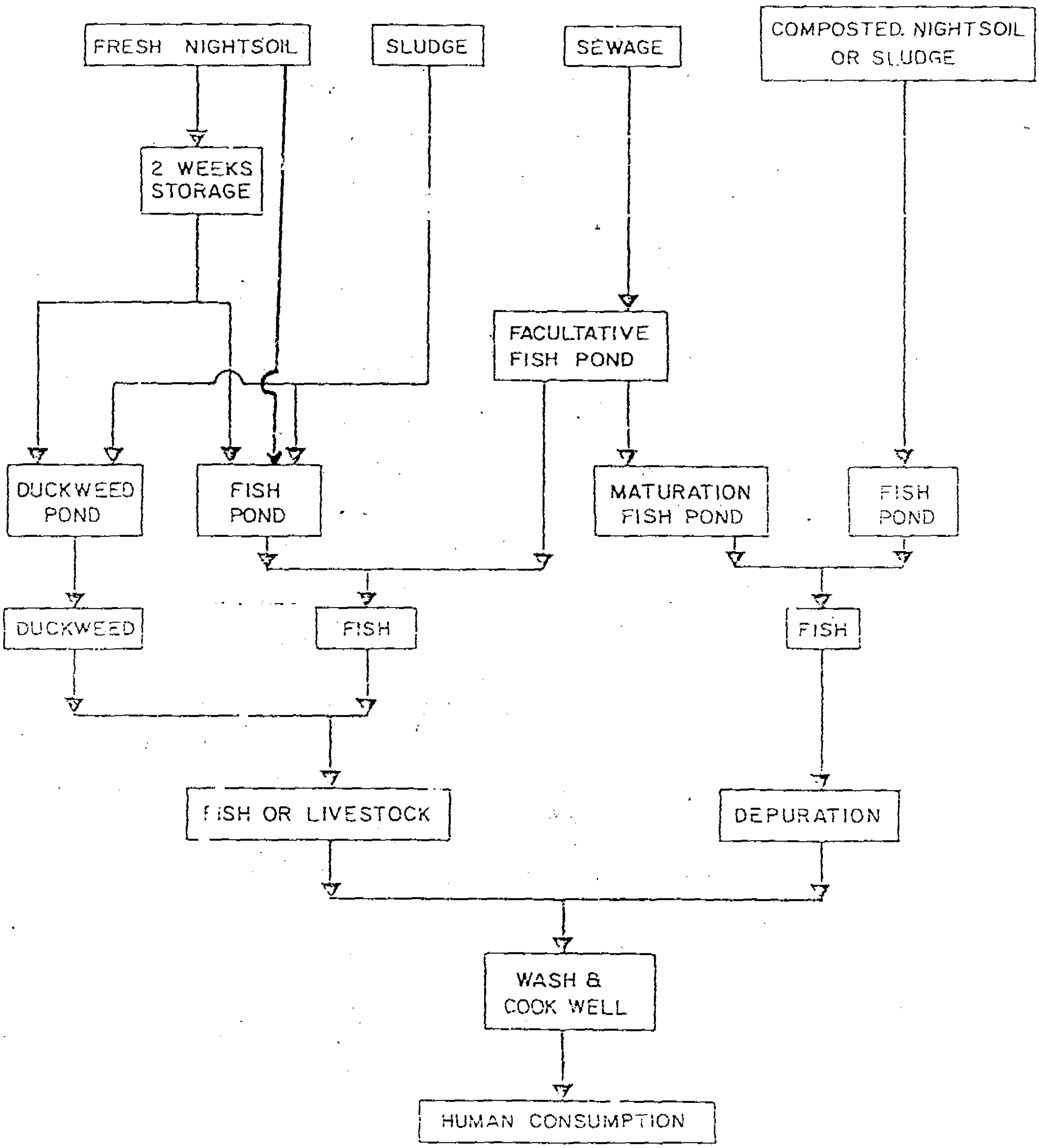


Fig. 1 Aquaculture reuse strategies with different types of excreta to safeguard public health.