EQE - 3

ENVIRONMENTAL QUALITY DIVISION

RURAL LATRINES

REPORT OF A TECHNICAL ADVISORY GROUP MEETING KUMASI - GHANA

12TH - 15TH JULY, 1977

CIVIL ENGINEERING DEPARTMENT
UNIVERSITY OF SCIENCE & T[redacted]
KUMASI. GHANA

&

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Environmental Quality Division

REPORT ON AN

International Technical Advisory Group Meeting

on

RURAL LATRINES

Kumasi. Ghana.

12th - 15th July 1977

by

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1. INTRODUCTION

In many developing countries, the rural areas get a smaller share of economic infrastructural services like public water supply, electricity, and waste disposal facilities. In the few cases where such services are extended to the rural area, it is often the case that the provision of facilities for the disposal of human excreta lags behind the provision of the other services. In Ghana, for an example, even though programmes have been developed for rural water supply, rural electrification, and rural housing, there has not yet been a comparable programme on rural latrines. In fact in many rural areas in Ghana a latrine is not seen as a necessary part of a house. A house must have bedrooms, living rooms, kitchens, and bathrooms; but not necessarily a latrine. Thus the rural people themselves are often not aware of the significance of latrines, nor are they aware of their impact on health and economic development. This is not surprising for, as Albert Einstein once said, of what is significant in one's life, one is scarcely aware.

It is generally believed that the most widespread diseases in the developing countries today are probably those transmitted by human faeces.[1] It is believed also that faecally-related diseases, together with air-borne diseases and malnutrition account for the majority of deaths among the poorest people in the developing world, particularly among children under the age of five.[1] The ill health resulting from excreta can impose economic costs by reducing the availability of

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1. Health Sector Policy Paper. World Bank. March 1975.

labour, by impairing the productivity of employed workers and capital goods, by wasting current resources, particularly nutrients, and by impeding the development of natural resources, animal wealth, and tourist potential.[1]

Clearly investment in the control of feacally-related diseases can be considered to be a sound and productive investment. The effectiveness of latrines in controlling feacally-related diseases has been demonstrated in several studies. SCHLIESSMAN (1959)[2] has reported that the construction of privies in Costa Rica helped to reduce the death rate from diarrhoea and enteritis by 50% between 1942 and 1954. Studies in several other developing countries have shown that a reduction in the incidence of diarrhoeal diseases can be brought about by better water supply and sanitation facilities;[3] and a recent study by AZURIN and ALVERO (1974)[4] shows that over a period of 5 years the provision of sanitary facilities for human waste disposal can reduce the incidence of cholera by as much as 76%.

Diseases like cholera and typhoid can be controlled not only through the construction of latrines but also through immunization. But in the case of cholera, by comparing the cost-effectiveness of immunization and sanitary measures, it can be shown that latrine

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1. Health Sector Policy Paper. World Bank. March. 1975
2. Schiessman, D.J. (1959) "Diarrhoeal Diseases and the Enviroment" Bulletin of the Wld. Hlth. Org. 21 (3) 381-386, 1959.
3. Van Zijl. W.J. (1966) "Studies on Diarrhoeal Diseases in Seven Countries" Bulletin of Wld. Hlth. Org. 35: 249-261, 1966.
4. Azurin, J.C. & Alvero, M. (1974). "Field Evaluation of Environmental Sanitation Measures Against Cholera". Bulletin of Wld. Hlth. Org. 51: 19-26.

construction is more cost-effective than immunization.[5] The cost-effectiveness of latrine construction is even more glaring when it is considered that latrine construction can reduce the incidence not only of cholera but also of a range of other killing or disabling diseases like typhoid fever, diarrhoeal diseases, bacillary and amoebic dysenteries, infectious hepatitis, hookworm, and schistosomiasis.

In view of these demonstrated links between human excreta, health, and socio-economic development, it is imperative that rural latrine programmes be initiated with utmost urgency to buttress current efforts at rural development. Such programmes, if they are to be successful, must be based on technology that is at once effective and acceptable from economic and socio-cultural standpoints. It is therefore necessary that local engineers and other decision makers should be familiar with the range of technological options available for rural latrines; they should also be aware of their merits and demerits; and they should have a short list of the best available systems from which to make their selection. It was to provide a basis for this type of information that a research programme on the Disposal of Human Excreta in Rural Areas was initiated recently in the Environmental Quality Division of the Civil Engineering Department at the

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5. Cvjetanovic, B "Sanitation versus Vaccination in cholera control: Cost-effective and cost-Benefit Aspects" World Health Organisation, strategy of cholera Control, BD/CHOLERA/71. 5, p.36 Geneva, WHO 1971.

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The project which is supported by a grant from the International Development Research Centre of Canada (IDRC), is aimed at assembling and evaluating technical information on existing technologies for rural excreta disposal to permit selection and field trials and further development of appropriate systems to meet the needs of the rural poor.

Information which was collected on existing types of rural latrines being used in different parts of the world was compiled into a background paper for review at an International Technical Advisory Group Meeting.

2. DESCRIPTION OF MEETING

The International Technical Advisory meeting on Rural Latrines was held at the University of Science and Technology in Kumasi, Ghana, from 12th to 15th July 1977. It was organised by the University of Science and Technology and sponsored by the IDRC. Participants to the meeting came from Botswana, Canada, Ghana, India, Nigeria, and Tanzania.

The meeting was opened by Professor E. Bamfo Kwakye, Vice-Chancellor of the University. Following a keynote address by the Vice-Chancellor, the Chairman for the meeting moved a vote of thanks and presented the objectives of the meeting as follows:

i. To review and rank the different types of rural latrine systems which had been compiled in the background paper for the meeting.

ii. To make recommendations on

(a) latrine systems that may be used in the rural latrine research programme in Ghana.

(b) methodology that may be followed in the Ghana rural latrine programme.

Following the adoption of the draft programme for the meeting, participants were invited to introduce themselves.

3. RANKING OF SYSTEMS

Twenty-five different rural latrine systems were selected for review at the meeting. The extent to which each system possessed each of twenty-six different weighted attributes was estimated and given a numerical score by consensus. The systems were then ranked on the basis of their total scores.

3.1. Selection and Weighting of Attributes

Table 1 shows the 26 attributes considered desirable in rural latrines. These attributes were sorted out into six major classes, namely, cost, health, technology, aesthetics, safety, and ecology. Relative weights were assigned to each class of attributes; the highest ranked class was cost followed by health and technology. Table 1a shows the relative weight of each class. Next the relative weight for each class was distributed among the members of the class. The relative weight of 40 assigned to the class of "cost" was shared equally between the two members of this class; but in the class of "health" the relative weight was distributed among the four class members as follows:

Hygienic	:	12
Fly-free	:	12
Rodent-free	:	4
Mosquito-free	:	4

TABLE 1

Selected Attributes

Class Designation	Attribute No	Attribute Description	Definition (where necessary)	Relative Weight: Class Member	Relative Weight: Class Total
COST	1	Low Construction Cost		20	40
	2	Low Operating & Maintenance Cost		20	
HEALTH	3	Fly-free	Flies have no access to faeces or if they do they cannot escape from latrine.	12	32
	4	Hygienic	System has low potential for disease transmission	12	
	5	Mosquito-free		4	
	6	Rodent-free		4	
SAFETY	7	Safe to user	User is unlikely to fall into latrine	8	8
AESTHETICS	8	Easy to keep clean		4	16
	9	Odourless		8	
	10	Can be located in private house		4	
ECOLOGY	11	Ecologically Compatible	Has no adverse effect on plant and animal life	2	4
	12	Re-usable End-product		2	
TECHNOLOGY	13	Permanent Squatting Plate	Position of squatting plate does not need to be changed	1	
	14	Permanent System	Complete latrine system is permanent in the sense that capacity is not progressively exhausted necessitating transfer to new site	2	

continued on next sheet .....

Table 1 (Contd.)

Class Designation	Attribute No	Attribute Description	Definition (where necessary)	Relative Weight: Class Member	Relative Weight: Class Total
TECHNOLOGY (Contd.)	15	Permanent Superstructure	Position of superstructure is permanent	1	
	16	Construction materials readily available	(This is not restricted to locally produced materials)	2	
	17	Construction skill readily acquired	Implies simple technology	2	
	18	Special construction equipment unnecessary		1	
	19	Low space needs	Plan area requirement for system is low	1	
	20	Easy to operate by user	Easy to keep system functioning properly	2	24
	21	Easy to maintain	Defects are readily repaired	1	
	22	Desludging is infrequent	This refers to removal of sludge or excreta from system	3	
	23	Insensitive to ablution materials	Anal cleansing materials do not affect or foul system performance.	1	
	24	Low water needs		2	
	25	Operates without water		2	
	26	Operates without power	Operates without mechanical or electric power	3	

TABLE 1a

Ranks and Class Weights of Attributes

Attribute Class	Class Rank	Class Relative Weight
Cost	1	40
Health	2	32
Technology	3	24
Aesthetics	4	1.6
Safety	5	8
Ecology	6	4

In this way each attribute was assigned a numerical weight. The resulting distribution of relative weights for each attribute is also presented in Table 1

3.2 Rating and Scoring Procedure

To reflect numerically the extent to which each system possessed or lacked a particular attribute, the following 5-point rating scale was adopted:

Extent of Possession of Attribute	Corresponding Score
Never	1
Seldom	2
Occasionally	3
Frequently	4
Always	5

With this rating scale a high score indicated that in the opinion of the members at the meeting the system possessed a lot of the particular attribute. Thus considering the attribute "low initial cost", the conventional pit latrine had a score of five as against a score of one by the conventional water carriage system.

Having obtained the unweighted scores, the relative weights of the attributes were then applied. Taking the bucket latrine as an example, its unweighted rating score for "low initial cost" was five; but the relative weight for this attribute is 20. Hence to obtain the weighted attribute score the unweighted rating score of five was multiplied by the relative weight of 20 to obtain a weighted attribute score of 100. Using the same procedure the weighted

attribute score for each of the 26 attributes was determined for all 25 systems. Summation of these weighted attribute scores gave the aggregate weighted scores. The system with the highest aggregate weighted score was ranked first whilst that with the lowest score was ranked last.

4. RESULTS

The results of the ranking exercise are summarized in Tables 2 and 3. Table 2 shows the unweighted total scores whilst Table 3 shows the ranks and aggregate weighted score of each system. From Table 3, the best ranked system is the ReA Latrine or the off-set pit water seal latrine. The second and third ranked systems are the Dug Well Latrine and the Reid's Odourless Earth Closet (ROEC) developed in South Africa. These results indicate that in effect the three highest ranked systems are all modifications of the simple pit latrine. All three modifications seek to eliminate odour and to create a barrier between flies and the excreta in the pit. In the first two the water seal is used to reduce odour and to create the barrier between flies and the excreta. In the third, a vent is used to reduce odour, while darkness in the off-set pit helps to minimize fly nuisance. Furthermore, the ReA and the ROEC improve safety to the user through the use of an off-set pit; the difference between the two lies only in how the faeces are conveyed into the off-set pit. Whereas the ReA uses water to flush the faeces into the pit, the ROEC uses an inclined chute to convey the faeces into the pit. The use of an off-set pit also has two additional advantages; it makes possible the emptying of the pit when it is full without touching the superstructure; it also eliminates the fear that the user of the latrine may fall into the pit. The difference between those two systems also requires that the ReA should be used only where

TABLE 2

UNWEIGHTED ATTRIBUTE SCORES OF RURAL LATRINE SYSTEMS

		ATTRIBUTES / LATRINE TYPES	COST		HEALTH				TECHNOLOGY: OPERATION AND MAINTENANCE								CONSTRUCTION						AESTHETIC			SAFETY	ECOLOGY	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
			LOW INITIAL COST	LOW OPRATION AND MAINTENANCE COS	HYGIENIC	FLY-FREE	RODENT FREE	MOSQUITO FREE	OPERATES WITHOUT MECHELECT POWER	DESLUDGING IS INFREQUENT	EASY TO OPERATE	LOW WATER NEED	OPERATES WITHOUT WATER	EASY TO MAINTAIN	INSENSITIVE TO ABLUTION MATERIAL	READILY AVAILABLE CONSTRUCTION MATERIALS	READILY ACQUIRED CONSTRUCTION SKILL	PERMANENT SYSTEM	PERMANENT SQUATTING PLATE	PERMANENT SUPER-STRUCTURE	LOW SPACE REQUIRED	SPECIAL CONSTRUCTION EQUIPMENT UNNECESSAR	ODOURLESS	EASY TO KEEP CLEAN	CAN BE LOCATED IN PRIVATE HOUSE	PHYSICALLY SAFE TO USERS	ECOLOGICALLY COMPATIBLE	USABLE END PRODUCTS
A	1	BUCKET LATRINE	5	1	1	2	4	4	4	1	3	5	5	2	5	4	5	5	5	5	5	5	1	2	3	5	2	2
B	2	VACUUM TRUCK CARRIAGE SYSTEM	4	2	4	3	3	4	1	2	3	3	1	2	2	3	4	5	5	5	4	5	3	4	4	5	2	4
	3	WATER CARRIAGE SYSTEM	1	3	5	5	1	3	2	5	4	1	1	3	1	1	3	5	5	5	5	5	5	5	5	5	3	2
C	4	CONVENTIONAL PIT LATRINE	5	5	3	1	2	2	5	5	5	5	5	5	5	4	5	1	1	1	3	5	2	3	1	4	4	1
	5	VENTED PIT LATRINE	4	5	4	3	2	2	5	5	5	5	5	5	5	2	5	1	1	1	3	5	4	3	1	4	4	1
	6	OFF-SET DRY PIT LATRINE	4	5	4	3	2	4	5	4	5	5	5	4	5	3	5	4	4	4	3	5	4	3	2	5	4	2
	7	BORE-HOLE LATRINE	4	5	3	2	2	2	5	5	5	5	5	5	5	4	5	1	1	1	3	1	2	3	1	4	4	1
	8	VIETNAMESE VAULT LATRINE	3	5	3	1	5	5	5	3	4	5	5	4	4	3	5	5	5	5	3	5	3	3	1	5	5	5
	9	GOPURI LATRINE	3	5	3	3	3	4	5	3	3	5	5	4	4	3	5	5	1	5	3	5	3	3	1	5	5	5
	10	MULTRUM	3	5	3	3	3	4	5	4	3	5	5	4	4	2	5	5	5	5	4	5	3	4	2	5	5	5
	11	UTAFITI LATRINE	3	5	4	3	3	4	5	4	3	5	5	4	4	2	5	5	5	5	4	5	3	3	2	5	5	5
	12	SINGLE COMPARTMENT UTAFITI LATRINE	3	5	4	3	3	4	5	3	3	5	5	4	4	2	5	5	5	5	4	5	3	3	2	5	5	5
	13	SINGLE VAULT LATRINE	3	4	3	2	2	2	5	3	3	5	5	4	5	2	5	5	5	5	4	5	2	3	1	4	2	2
	14	OFF-SET SINGLE VAULT LATRINE	3	4	4	3	4	2	5	3	5	5	5	4	5	1	5	5	5	5	4	5	4	3	2	5	2	2
	15	OFF-SET COMPOST VAULT LATRINE	3	5	4	3	4	4	5	3	3	5	5	4	4	1	5	5	5	5	4	5	4	3	2	5	5	5
	16	OFF-SET COMPOST PIT LATRINE	4	5	4	3	2	4	5	3	3	5	5	4	4	2	5	4	4	4	4	5	4	3	2	5	5	5
D	17	AQUA PRIVY	3	4	2	2	5	2	3	3	3	4	1	3	4	1	4	5	5	5	3	5	2	2	3	5	3	1
	18	BOTSWANA TYPE B TOILET	2	4	4	3	5	2	3	3	4	4	1	3	4	1	4	5	5	5	3	5	4	4	3	5	3	1
	19	SEPTIC TANK LATRINE	2	5	5	4	5	2	5	3	4	4	1	3	3	1	4	5	5	5	3	5	5	4	2	5	3	2
	20	CHINESE 2-PARTITION 3-TANK TOILET	3	4	3	3	4	3	5	2	4	4	1	4	3	2	4	5	5	5	2	5	3	3	2	5	5	5
	21	DUG WELL LATRINE	4	5	5	4	4	5	5	4	4	4	1	4	3	1	5	1	1	1	4	5	5	4	1	5	4	4
	22	KHATGHAR LATRINE	3	4	4	3	3	3	3	3	4	4	1	3	5	1	5	5	5	5	3	5	3	3	1	5	3	2
	23	WATERGATE LATRINE	1	4	4	3	3	3	5	3	3	3	1	3	5	1	4	4	4	4	3	5	3	3	1	5	3	1
	24	R c A LATRINE	4	5	5	4	4	5	5	4	4	4	1	4	2	1	5	5	5	5	3	5	5	4	4	5	4	4
	25	SEPTIC TANK SYSTEM	1	4	5	5	4	2	3	4	4	1	1	3	1	1	3	5	5	5	1	5	5	5	5	5	4	2

NOTE ON RATINGS :

1 = NEVER ie attribute never present
2 = SELDOM PRESENT
3 = OCCASIONALLY PRESENT
4 = FREQUENTLY PRESENT
5 = ALWAYS PRESENT

TABLE 3

RANKS AND WEIGHTED ATTRIBUTE SCORES OF RURAL LATRINE SYSTEMS.

LATRINE TYPES			ATTRIBUTES / GENERAL ATTRIBUTES	COST		HEALTH				TECHNOLOGY															AESTHETIC	SAFETY	ECOLOGY		TOTAL SCORES	RANKS
				OPERATION & MAINTENANCE													CONSTRUCTION														
			RELATIVE WEIGHTING	40		32				14							10								16	8	4				
				20	20	12	12	4	4	3	3	2	2	2	1	1	2	2	2	1	1	1	1	8	4	4	8	2	2		
			SPECIFIC ATTRIBUTES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26		
				LOW INITIAL COST	LOW OPERATION AND MAINTENANCE COST	HYGIENIC	FLY - FREE	RODENT - FREE	MOSQUITO - FREE	OPERATES WITHOUT HELMHELECT POWER	DISLODGING IS INFREQUENT	EASY TO OPERATE	LOW WATER NEED	OPERATES WITHOUT WATER	EASY TO MAINTAIN	BIODEGRADABLE TO ABSORBENT MATERIAL	READILY AVAILABLE CONSTRUCTION MAT	READILY ACQUIRED CONSTRUCTION SKILL	PERMANENT SYSTEM	PERMANENT SQUATTING PLATE	PERMANENT SUPERSTRUCTURE	LOW SPACE REQUIRED	SPECIAL CONTRIBUTION EQUIPMENT UNNECESSARY	ODOURLESS	EASY TO KEEP CLEAN	CAN BE LOCATED IN PRIVATE HOUSE	PHYSICALLY SAFE TO USERS	ECOLOGICALLY COMPATIBLE	USABLE END PRODUCTS		
LATRINE TYPES	A	1	BUCKET LATRINE	100	20	12	24	16	16	12	3	6	10	10	2	5	8	10	10	5	5	5	5	8	8	12	40	4	4	360	24
	B	2	VACUUM TRUCK CARRIAGE SYSTEM	80	40	48	36	12	16	3	6	6	6	2	2	2	6	8	10	5	5	4	5	24	16	16	40	4	8	410	20
		3	WATER CARRIAGE SYSTEM	20	60	60	60	4	12	6	15	8	2	2	3	1	2	6	10	5	5	5	5	40	20	20	40	6	4	421	18
	C	4	CONVENTIONAL PIT LATRINE	100	100	36	14	8	8	15	15	10	10	10	5	5	8	10	2	1	1	3	5	16	12	4	32	8	2	438	15
		5	VENTED PIT LATRINE	80	100	48	36	8	8	15	15	10	10	10	5	5	4	10	2	1	1	3	5	32	12	4	32	8	2	468	11
		6	OFF-SET DRY PIT LATRINE	80	100	48	36	8	16	15	12	10	10	10	4	5	6	10	8	4	4	3	5	32	12	8	40	8	4	498	3
		7	BOREHOLE LATRINE	80	100	36	24	8	8	15	15	10	10	10	5	5	8	10	2	1	1	3	1	16	12	4	32	8	2	426	16
		8	VIETNAMESE VAULT LATRINE	60	100	36	48	20	20	15	9	8	10	10	4	4	6	10	10	5	5	3	5	24	12	4	40	10	10	486	6
		9	GOPURI LATRINE	60	100	36	36	12	16	15	9	6	10	10	4	4	4	10	10	1	5	3	5	25	12	4	40	10	10	456	12
		10	MULTRUM	60	100	36	36	12	16	15	12	6	10	10	4	4	4	10	10	5	5	4	5	24	16	8	40	10	10	472	10
		11	UTAFITI LATRINE	60	100	48	36	12	16	16	12	6	10	10	4	4	4	10	10	5	5	4	5	24	12	8	40	10	10	480	7
		12	SINGLE COMPARTMENT UTAFITI LATRINE	60	100	48	36	12	16	15	9	6	10	10	4	4	4	10	10	5	5	4	5	24	12	8	40	10	10	477	8
		13	SINGLE VAULT LATRINE	60	80	36	24	8	8	18	9	6	10	10	4	5	4	10	10	5	5	4	5	16	12	4	32	4	4	392	21
		14	OFF-SET SINGLE VAULT LATRINE	60	80	48	36	16	8	15	9	10	10	10	4	5	2	10	10	5	5	4	5	32	12	8	40	4	4	452	13
		15	OFF-SET COMPOST VAULT LATRINE	60	100	48	36	16	16	15	9	6	10	10	4	4	2	10	10	5	5	4	5	32	12	8	40	10	10	487	5
		16	OFF-SET COMPOST PIT LATRINE	80	100	48	36	8	16	15	9	6	10	10	4	4	4	10	8	4	4	4	5	32	12	8	40	10	10	497	4
	D	17	AQUA PRIVY	60	80	24	24	20	8	9	9	6	8	2	3	4	2	8	10	5	5	3	5	16	8	12	40	6	2	379	22
		18	BOTSWANA TYPE B TOILET	40	80	48	36	20	8	9	9	8	8	2	3	4	2	8	10	5	5	3	5	32	16	12	40	6	2	421	18
		19	SEPTIC TANK LATRINE	40	100	60	48	20	8	15	9	8	8	2	3	3	2	8	10	5	5	3	5	40	16	8	40	6	4	476	9
		20	CHINESE-2 PARTITION -3 TANK TOILET	60	80	36	36	16	12	15	6	8	8	2	4	3	4	8	10	5	5	2	5	24	12	8	40	10	10	329	25
		21	DUO-WELL LATRINE	80	100	60	48	16	20	15	12	8	8	2	4	3	2	10	2	1	1	4	5	40	16	4	40	8	8	517	2
		22	KHATGHAR LATRINE	60	80	48	36	12	12	9	9	8	8	2	3	5	2	10	10	5	5	3	5	24	12	4	40	6	4	422	17
		23	WATERGATE LATRINE	20	80	48	36	12	12	15	9	6	8	2	3	5	2	8	8	4	4	3	5	24	12	4	40	6	2	378	23
		24	RcA LATRINE	80	100	60	48	16	20	15	12	8	8	2	4	2	2	10	10	5	5	3	5	40	16	16	40	8	8	543	1
		25	SEPTIC TANK SYSTEM	20	80	60	60	16	8	9	12	8	2	2	3	1	2	6	10	5	5	1	5	40	20	20	40	8	4	447	14

NOTE: 1 THE WEIGHTED ATTRIBUTE SCORE IS OBTAINED FROM THE PRODUCT OF THE UNWEIGHTED ATTRIBUTE SCORE AND THE RELATIVE WEIGHT OF THE ATTRIBUTE

water is always available whereas the ROEC should be used where water is scarce.

It is noteworthy that of the ten highest ranked systems in Table 3, six are compost or mouldering latrines.

It may be inferred from these results that the most promising systems are the modifications of the simple pit latrine and the compost latrines. Where water is always available the RcA can be used. In other places the ROLC or a compost latrine must be used.

5. RECOMMENDATIONS

5.1. Recommended Systems for the Ghana Sanitation Project

Having ranked the 25 rural latrine systems without regard for any particular country the meeting proceeded to select some of the systems for immediate installation and/or study in Ghana. For this purpose attention was focussed on a short list of ten best ranked systems. Although the Dug Well Latrine was ranked second, it was argued that wherever it could be used the RcA Latrine could also be used at very little extra cost. Consequently the Dug Well Latrine was dropped from the short list. In its place the eleventh ranked vented pit latrine was added to the short list, and all of them were subjected to further analysis. The attributes which were considered in this analysis were as follows:

(a) Whether the system is water independent

(b) Whether the technology for the system is well proven

(c) Whether the public education required for successful use of the system is low

(d) Whether communal adaptation of the system is possible.

Table 4 shows the consensus reached on each of the short listed systems.

On the basis of the information in Table 4, it was decided that the best systems in places where water is not always available would be the Off-set Dry Pit Latrine and the Vented Pit Latrine. Accordingly, it was recommended that these two systems should be selected for use in those places in Ghana where water is scarce. Where water is always available the RoA latrine, the highest ranked system, was recommended.

In view of the potential re-use value of the material from compost latrines, it was also recommended that three types of compost latrines should be selected for further field studies in Ghana. Table 5 shows the list of the recommended systems together with the recommended applications or studies to be conducted on them.

5.2. Possible Improvements on Recommended Systems

Having selected the candidate systems for use and study in Ghana, the meeting further considered the possible improvements that could be made in the selected systems. The recommended areas of further study or possible improvement for each system are summarised in Table 6.

TABLE 4

Some Characteristics of Short-Listed Rural Systems

		Water Independent	Well-proven Technology	Low Educational Requirement	Communal Adaptation Possible
1.	RoA Latrine	No	Yes	Yes	Yes
2	Off-set Dry Pit Latrine	Yes	Yes	Yes	Yes
3	Off-set Compost Pit Latrine	Yes	No	Yes	No
4	Off-set Compost Vault Latrine	Yes	No	Yes	No
5	Vietnamese Double Vault Latrine	Yes	Yes	No	No
6	Utafiti Latrine	Yes	No	Yes	No
7	Simple Compartment Utafiti Latrine	Yes	No	Yes	No
8	Septic Tank Latrine	No	Yes	Yes	Yes
9	Multrun Latrine	Yes	No	Yes	No
10	Vented Pit Latrine	Yes	Yes	Yes	Yes

TABLE 5

Recommended Rural Latrine Systems for Ghana

	System	Application and/or Intended Activity
1	RcA Latrine (Off-set Pit Water Seal Latrine)	Use where water is available
2	Off-set Dry Pit Latrine (ROEC)	Use where water is scarce
3	Vented Pit Latrine	
4	Off-set Compost Pit Latrine	Use for field testing in Ghana
5	Vietnamese Double Vault Latrine	
6	Utafiti Latrine	

TABLE 6

Possible Improvements in Selected Systems

	System	Possible Improvement or Area of further study
1	RoA. Latrine	1. Develop device for extraction of digested nightsoil from pits. 2. Develop seating types in addition to squatting types 3. Develop simple flushing devices for system
2	Off-set Dry Pit Latrine	1. Develop pits having sloping bottom to allow digested excreta to be extracted from deep end of pit as in the case of multrum 2. Investigate possiblity of replacing circular chute with sloping channel not readily fouled. 3. Investigate possibility of using two parallel pits that can be used alternately.
3	Vented Pit Latrine	1. Study possibility of reducing vent diameter to reduce cost
4	Vietnamese Double Vault Latrine	1. Study rise in temperature during composting and estimate extent of destruction of helminths
5	Utafiti Latrine	1. Investigate possible clogging of bottom drainage stones 2. Study required detention period for completion of digestion 3. Study effect of ground water on system performance 4. Study best means of draining off excess water.

5.3 Methodology For the Ghana Project

5.3.1. Objectives

The objectives of the Ghana Rural Sanitation Project were presented as follows:

(i) To identify, adapt and/or innovate technologies which are suitable or potentially suitable for use by the rural poor in Ghana.

(ii) To conduct field tests in various parts of Ghana on such technologies to evaluate their impact on the family, community, and individual in terms of their use, acceptability, changes in habits of hygiene, and additional installations by neighbouring communities and families.

(iii) To determine appropriate methods and materials for construction at the village level and, where necessary, by small industry.

(iv) To conduct cost/effectiveness analysis of each system selected for promotion.

(v) To identify the best modes of promoting the technologies in rural areas and small towns of Ghana and other countries through government infrastructure, with the people themselves constructing, utilizing, and propagating the systems identified

5.3.2 Types of Ownership

In pursuit of these objectives emphasis will be placed on private ownership rather than on communal ownership. However, it was recommended that the following three types of ownership should be tried out initially:

(i) Individual or private ownership

(ii) Communal ownership

(iii) Group ownership, a system in which a limited number of private latrines can be located at one place while each family retains ownership and exclusive use of their own latrine. This system will be considered especially where lack of space will not allow a private latrine to be located on private premises.

5.3.3 Introduction of Selected Systems

The following procedure was recommended:

(i) Development or modification of selected systems to suit local conditions

(ii) Establishment of a base workshop for producing principal parts of the systems and for training of villagers.

(iii) Selection of demonstration villages

(iv) Education of the communities about the system to ensure their understanding, cooperation, and involvement in the project implementation

(v) Installation of systems

(vi) Monitoring of system performance and acceptability including Pre-installation and post-installation surveys.

5.3.4. Demonstration Villages

It was recommended that three types of demonstration areas should be chosen. The first shall be at the University of Science and Technology at Kumasi. For each of the three selected types of latrines, each of the three types of

ownership should be designed and built. The resulting 9 types of latrines should be used for demonstration and training purposes.

The second type of demonstration area shall consist of three villages selected in the dry areas of the country where settlements are dispersed. The most likely areas shall be the Northern and Upper Regions of the country. Only the off-set Dry Pit Latrine and the Vented Pit Latrines shall be installed in these areas. In the first village two of each of the two latrine systems will be installed for communal use; in the second village two of each type will be installed for group ownership; and in the third village five of each of the two types will be installed in private houses.

The third type of demonstration area shall be made up of three villages selected from the wet parts of the country where settlements are nucleated. All three types of systems shall be installed in these areas. In the first and second villages two of each system shall be installed on communal and on group ownership basis, respectively; and in the third village five of each of the three systems shall be installed for private ownership.

These proposals, if adopted, will involve the construction of 13 communal latrines, 13 group type latrines and 28 private latrines, making a total of 54 systems. The distribution of these latrine types is as shown in Table 7.

TABLE 7

Distribution of Latrine Types in Proposed Demonstration Areas

Demonstration Areas	RcA Latrine			Off-set Dry Pit Latrine			Vented Pit Latrine			Totals
	G	C	I	G	C	I	G	C	I	
University Campus	1	1	1	1	1	1	1	1	1	9
Dry Dispersed Areas										
Village No 1	-	-	-	2	-	-	2	-	-	4
No 2	-	-	-	-	2	-	-	2	-	4
No 3	-	-	-	-	-	5	-	-	5	10
Wet Nucleated Villages										
Village No 1	2	-	-	2	-	-	2	-	-	6
No 2	-	2	-	-	2	-	-	2	-	6
No 3	-	-	5	-	-	5	-	-	5	15
Totals	3	3	6	5	5	11	5	5	11	54

Legend: G = Group Ownership

C = Communal Ownership

I = Individual Private Ownership

APPENDICES

APPENDIX A-1

LIST OF PARTICIPANTS

ADDY, DR. H.A.	School of Medical Sciences, U.S.T. Kumasi. Ghana
ANAKWA, MR. A.O.	Environmental Quality Division, Civil Engineering Department U.S.T., Kumasi. Ghana
BALIGA, DR. K.Y.	WHO Public Health Engineer Environmental Quality Division Civil Engineering Department U.S.T., Kumasi. Ghana
BLACKMORE, MR. M.D.	Low Cost Sanitation Research Project Ministry of Local Government and Lands Gaborone. Botswana.
BOATENG, MR. M.K.	Volta River Authority, Lake-Side Health Programme, P.O. Box M.77, Accra. Ghana
HANDA, DR. B.K.	Rural Sanitation Division, NEERI Nehru Marg, Nagpur, India.
HANDA, MR. V.K.	IDRC/Ghana Rural Sanitation Project Environmental Quality Division Civil Engineering Department U.S.T. Kumasi. Ghana.
KLUFIO, MR. G.M.S.	Environmental Protection Council Parliament House, Accra. Ghana
MBERE, MRS. NOMTUSE	Low Cost Sanitation Research Project Ministry of Local Government & Lands Gaborone. Botswana.
McGARRY, DR. M.G.	Associate Director, IDRC, Ottawa. Canada.
MONNEY, MR. J.G.	Environmental Quality Division Civil Engineering Department U.S.T., Kumasi. Ghana
OFORI, MR. D.K.	IDRC/Ghana Iron Removal Project Environmental Quality Division Civil Engineering Department U.S.T., Kumasi. Ghana.

OGUNROMBI, PROF. J.A. (Co-Chairman)	Civil Engineering Department Ahmadu Bello University Zaria. Nigeria.
OWUSU, MR. S.E.	IDRC/Ghana Rural Sanitation Project Department of Housing & Planning Research, U.S.T., Kumasi. Ghana
SIMBEYE, MR. E.K.	Alternative Waste Disposal Research Project Tanzania National Scientific Research Council, P.O. Box 1588, Dar es Salaam, Tanzania.
WRIGHT, PROF. A.M. (Chairman)	IDRC/Ghana Rural Sanitation Project Civil Engineering Department U.S.T., Kumasi. Ghana

APPENDIX A-2

PROGRAMME

TECHNICAL ADVISORY GROUP MEETING

July 12-15, 1977

VENUE FOR MEETINGS: Room 302, Faculty of Engineering, University of Science & Technology.

Tuesday, 12th July 1977

9.00 a.m. Opening Session

- Formal Opening by the Vice-Chancellor, Prof. E. Bamfo Kwakye.
- Introduction of participants
- Consideration of Draft Programme.

10.00 a.m. - Tea/Coffee

10.15 a.m. Selection of Rural Latrine Ranking Criteria

- Desirable Attributes
- Rating and Weighting of Attributes

11.15 a.m. - 12.20 p.m. Ranking of Candidate Systems

- Off-Site Water-Independent Systems.

12.30 p.m. - 2.00 p.m.: Lunch Break
2.00 p.m. - 3.30 p.m.: On-Site-Water-Independent Systems
3.30 p.m. - 3.45 p.m.: Tea
3.45 p.m. - 5.00 p.m.: On-Site Water Independent Systems

Wednesday, 13th July 1977

9.00 a.m. - 10.30 a.m.: On-Site Water-Independent Systems
10.30 a.m. - 10.45 a.m.: Coffee
10.45 a.m. - 12.30 p.m.: On-Site Water-Dependent Systems
12.30 p.m. - 2.00 p.m.: Lunch Break
2.00 p.m. - 3.30 p.m.: On-Site Water-Dependent Systems
3.30 p.m. - 3.45 p.m.: Tea
3.45 p.m. - 5.00 p.m.: On-Site Water-Dependent Systems

Thursday, 14th July 1977

9.00 a.m. - 10.30 a.m. :	Off-Site Water-Dependent Systems
:	Selection of Candidate Systems
10.30 a.m. - 10.45 a.m. :	Coffee
10.45 a.m. - 12.30 p.m. :	Discussion: Possible Improvements in Candidate Systems.
12.30 p.m. - 2.00 p.m. :	Lunch Break
2.00 p.m. - 3.30 p.m. :	Methodology for Rural Latrine Programmes: Planning Considerations
3.30 p.m. - 3.45 p.m. :	Tea
3.45 p.m. - 5.00 p.m. :	Methodology for Rural Latrine Programme: Sociological Aspects
5.00 p.m. :	Closure

Friday, 15th July 1977 : Departure of Participants.

WELCOME ADDRESS BY PROF. BAMFO KWAKYE, VICE-CHANCELLOR, TO THE TECHNICAL ADVISORY GROUP (T.A.G.) MEETING ON IDRC PROJECT ON "THE DISPOSAL OF HUMAN EXCRETA IN RURAL AREAS", TUESDAY 12TH JULY, 1977

MR. CHAIRMAN
DISTINGUISHED SCIENTIFIC COLLEAGUES
LADY AND GENTLEMEN,

I suppose my task this morning is two fold: First, to welcome you to Ghana, to Ashanti and its capital, Kumasi, and especially to the University of Science and Technology. My second privilege is to restate the crucial importance and great expectations which we attach to the assignment before you.

You will probably regard the first act as the usual formalism to which you have been subjected at countless international conferences. As for the second, I realise myself that I shall be preaching to the converted. You will forgive me because my remarks are addressed more to the larger public who stand to benefit from your work.

It is my hope also that I shall be able to demonstrate the solidarity of this University and of the country in general with your group and what you are doing. Should the attempt succeed, it would lend considerable warmth and sincerity to the welcome which I have much pleasure in extending to you.

Our University was founded some twenty-five years ago as a College of Science and Technology to train middle and high level manpower for the industry, agriculture and the health services of an emergent nation. It is deemed to have fulfilled this task with reasonable success.

As the formal course offerings became well established, the University began to turn its attention to research, with considerable emphasis on problem solving research. The high level manpower assembled on the campus

realised that they had to be more directly involved in identifying and doing something about the problems that face small scale and large scale industries, the salient factors that affect the health of the community, the bottlenecks and constraints that limit agricultural production, and the circumstances which generally frustrate well-meaning attempts to improve the quality of life especially for the rural folk who form some 70 to 80% of our people. Considerable research effort has been devoted to this involvement. In our Department of Housing and Planning Research, for example, an intensive search is continuing into materials and techniques for low cost housing. The Department has designed, and trained interested persons to manufacture, relatively cheap cement-based sanitary ware : toilet basins, sinks, latrine squatting plates and similar products for the rural situation.

In another development the University, in establishing a new Medical School in October 1975, decided to place the emphasis of the school on Community Health and Preventive Medicine.

The government of Ghana and the general public have responded most favourably to this new thrust of the University's efforts. It will be recalled that the government of Dr. Busia (1969-1972) made rural development one of the cornerstones of its socio-economic policy. The present military government has also declared "self-reliance" as a basic tenet of its development policy and has welcomed every initiative which promotes the application of appropriate technology in the country. You may conclude from all this that your work on "The Disposal of Human Excreta in Rural Areas" is of tremendous interest to this country and in particular to this University.

Mr. Chairman, I am informed

i. That according to a recent survey by the W.H.O., only 21% of the 1975 rural population in developing countries had adequate excreta disposal facilities.

ii. According to the 1977 report of the Executive Director of the United Nations Environmental Programme (UNEP), excreta-borne diseases together with air-borne and vector-borne diseases constitute the major causes of morbidity and death in the developing countries.

iii. Recent studies have shown that through the provision of adequate facilities for excreta disposal, it is possible to reduce by over 60% the incidence of diseases like cholera and enteritis.

iv. In spite of all this, adequate facilities for excreta disposal are woefully lacking in many rural areas. The provision of such facilities will not only help in the promotion of rural health. It will by implication improve productivity in the rural areas and hopefully help young men and women to make the decision "to migrate or not migrate" in favour of remaining in their rural homes.

Mr. Chairman, the work of the Technical Advisory Group is expected to provide a basis for systematic development and introduction of effective and socially acceptable latrines for the rural poor in the developing countries. It is a mission which must have an impact on the quality of life of the poorest of the poor and its importance cannot be overemphasized.

I hope you will enjoy carrying out this crucial task and enjoy doing so in Kumasi and in our University. I notice that the organisers of the Conference have played down the publicity aspects of this morning's function.

This is certainly not to suggest that your activities must be a guarded secret. On the contrary your efforts and results must be given the widest publicity possible. Under the present political atmosphere in Ghana, however, the organisers concluded, and I agree with them, that any attempt to use the public media at this time might be counter productive. At the appropriate time the public will be informed without any reservation.

We are happy and proud to be associated with your work. Is this not the beginning of the end of that era characterised by the following story: "An African is alleged to have visited an English family, walking some distance before reaching the house. After he had been seated for some time the lady of the house asked him whether he would like to wash his hands. "No thank you", he said. Sometime later the daughter repeated the question with the same result. The father, suspecting that the newcomer was not conversant with this finest of English idioms, again asked the visitor whether he really did not want to wash his hands, to which the amused visitor replied, "No thank you. I washed my hands against a tree on my way here."

Lady and gentlemen, again you are heartily welcome to our University and to Ghana.

RURAL LATRINE TYPES CONSIDERED

A4.1 CLASSIFICATION

Various types of classifications have been used in the review or evaluation of excreta disposal systems. WAGNER & LANOIX (1958) in their review of Excreta Disposal for Rural Areas and Small Communities classified their systems into the privy method and the water carried methods. GRAVA (1969), dealing with "Aspects of Water Pollution Control" classified his systems into individual systems and networks. WINBLAD (1974) in evaluating waste disposal systems for urban low income communities in Africa divided them into the following three categories: removal systems (i.e. those that involve collection and transfer of the excreta for treatment and/or disposal elsewhere);infiltration systems which involve absorption and dispersion in soil and groundwater, and on-site destruction systems. In his review of compost latrines, however, WINBLAD classified his systems into discontinuous, alternating, and continuous systems. And BLACKMORE et al (1976) classified their systems into waterborne and non-waterborne systems. It would appear from the foregoing, that there is no generally accepted classification system, the choice of method of classification being made to meet the purpose of the review.

In the present study, the objective is to identify latrine types suitable for the rural poor. For this purpose the operational method of classification is considered appropriate.

This method employs two operational characteristics for classifying the latrines, namely, the location of the disposal site relative to the defaecation site and whether water is a necessary requirement for the operation of the system. Thus a system may be an off-site disposal system or an on-site disposal system; in addition, it may be water-dependent or water-independent. Four broad categories are therefore identifiable as follows:

(i) Off-site water-independent systems

(ii) Off-site water-dependent systems

(iii) On-site water-independent systems

(iv) On-site water-dependent systems

A4.2 COMPONENTS

In general an excreta disposal system may have up to 5 components, as follows:

(i) Enclosure or Superstructure

(ii) Defaecation unit

(iii) Excreta Transfer system

(iv) Treatment system

(v) Disposal system.

The purpose of the enclosure or superstructure is to provide privacy to the user and protect him and the latrine from the elements of the weather. The type of superstructure is not necessarily peculiar to the type of latrine. It is chosen mainly from standpoint of available resources and technology as well as economic and aesthetic considerations. For this reason the superstructure will not be included in this review. However, it is recognised that the

success of a latrine programme may be largely influenced by the cost and durability of the superstructure.

The defaecation unit has two parts, namely the device on which the user sits or squats for defaecation as well as the receptacle into which fresh excreta initially drop. Although there may be similarities in the seats or squatting plates, wide differences occur in the design of the receptacles.

The excreta transfer system is the means by which excreta in the receptacle are transferred to the point of treatment and/or disposal. It is a necessary part of off-site disposal systems; and it occurs in some on-site disposal systems. It may consist of a carriage medium such as water and a carriage system such as a pipe, vehicle, cart, or man (scavenger). The driving force for carriage may be the gravitational force, pressure induced by pumping, vacuum, automobile power, animal power, or man power.

The treatment system is the means whereby the excreta together with its carrier medium is prepared for disposal to ensure that the waste load is within the waste assimilative capacity of the disposal medium, having regard to ecological considerations and beneficial uses of the medium. Physical, biological, and chemical processes are used for the treatment.

The final disposal is made into a water or a soil medium. It may also be made by re-use of the waste product for purposes like agriculture. As a rule, treatment continues to take place in the disposal medium. Thus sewage with an initial Biochemical Oxygen Demand (BOD) of 300mg/l may be treated to reduce the BOD to 30mg/l before disposal. And following disposal dilution and further physical and biological processes will reduce the BOD to a negligible amount. In this review, such treatment taking place in a final disposal medium will not normally be regarded as treatment. The term treatment will therefore be restricted to an artificial facility for reducing waste strength or otherwise preparing the waste for use or disposal.

4.3 OFF - SITE WATER-INDEPENDENT SYSTEMS

4.3.1 Bucket Latrines

The defaecation unit of this system consists of a bucket placed in a collection chamber situated below a seat or a squatting plate. Excreta fall directly into the bucket during defaecation.

The bucket may be made of seamless galvanised iron, rubber, white enamel, or even woven bamboo. It is about 38cm in diameter at the top, and 30cm deep. It is provided with two handles for lifting and carrying. Figure 1 depicts a typical bucket latrine.

Transfer of the excreta for treatment and/or disposal requires initial manual handling of the bucket. The bucket may be lifted and carried away by conservancy labourers who replace the collected bucket by a clean bucket. Sometimes the excreta in the bucket may be carried away either as a headload or as a bucket cartage on a bamboo pole across the shoulder; alternatively it may be carried away in a wheel barrow or in a specially designed motorised truck.

Treatment methods include dilution and treatment in ponds, digestion and methane production, activated sludge treatment, and incineration.

Final disposal may include burial in shallow trenches, discharge into rivers or the sea, or re-use on the land.

It has the advantage of low installation cost; and it does not require water for its operation other than for bucket cleaning. It is however expensive to operate; furthermore the latrine area is often soiled with night-soil resulting in unsightly conditions, creation of odours, and accessibility of flies to the faeces. Buckets are not hygienically cleaned between uses, and

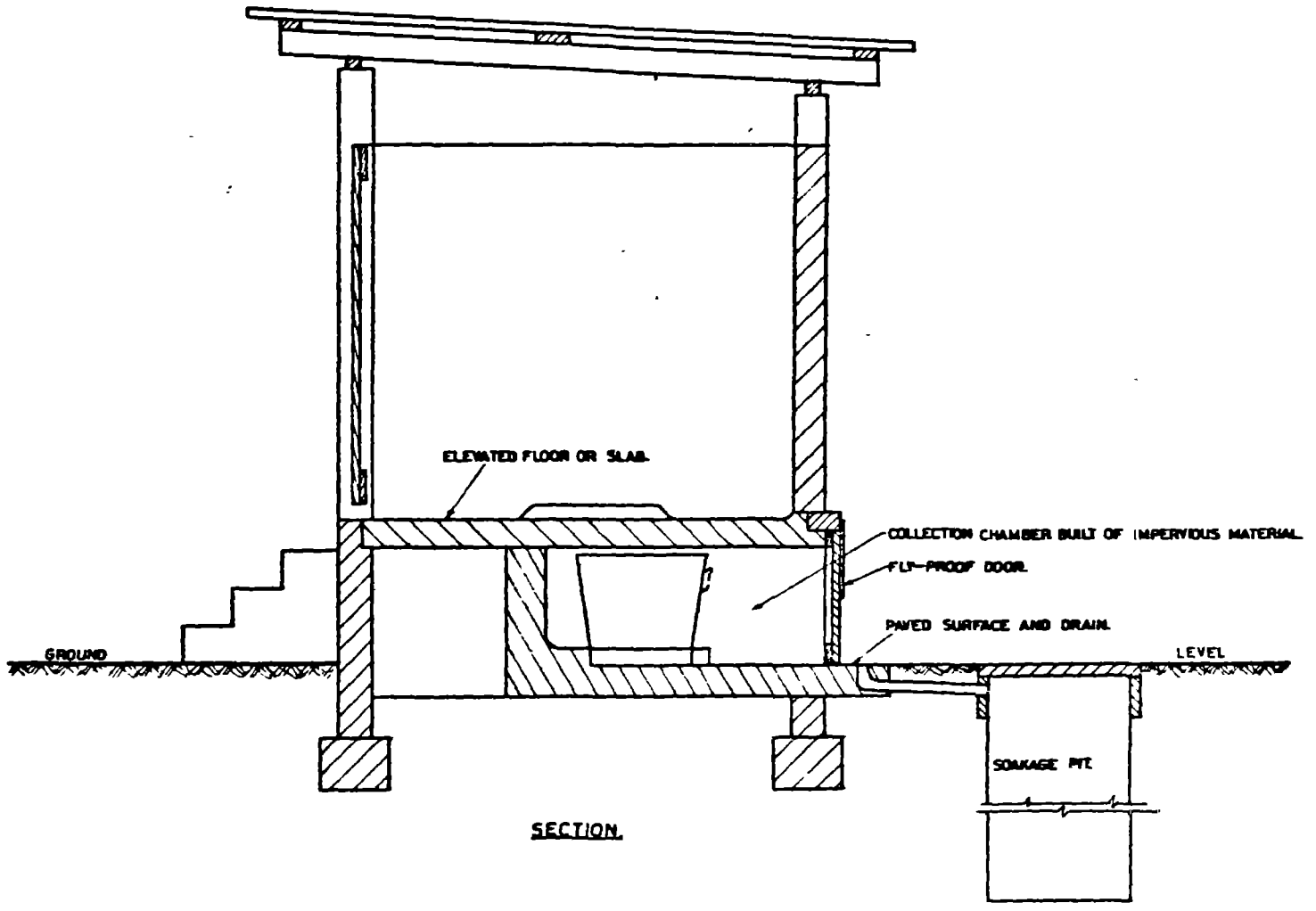


FIG. 1: BUCKET LATRINE.

spillage of the excreta occurs in the vicinity of the latrine and along the transport route. The labourers employed are exposed to excreta-borne diseases, and they often carry a social stigma.

A4.3.2 Vault Latrines

The defaecation unit of the vault latrine consists of a toilet bowl or a squatting plate. The receptacle is normally a precast concrete vented vault which receives excreta either directly or through a hand-flush water seal. Thus although the operations of the system may depend upon water, it is not necessarily water-dependent.

The transfer system may vary from place to place. In Taiwan, for instance, a dipper bucket is used for collection of the excreta. In Japan, however, collection is done at intervals of 3 to 4 weeks by battery operated electric vacuum carts and vacuum trucks. The electric carts are driven solely by a single electric motor to which the vacuum pump is also coupled. After collection from about 15 houses the vacuum cart transfers its contents to a larger vacuum truck for transport to a treatment plant either directly or through a pumping station. Instead of electric vacuum carts and trucks, a hand or mule drawn cart may be used.

Its advantages include low initial cost and flexibility. It could also lend itself to hygienic operation, and water is not a pre-requisite; however, under rural conditions where motorised vehicles may not be available, it can be associated with poor hygienic practices, odour during collection, and adverse sociological factors. The reliance on trucks and motorized carts can lead to high operational costs and maintenance problems.

A4.4 OFF-SITE WATER-DEPENDENT SYSTEM

A4.4.1 Conventional Water Carriage (Sewerage) System

The conventional sewerage system consists of a defaecation unit followed by a sewerage system which is made up of sewers and appurtenances for transfer of the excreta and its carriage water to a treatment unit for treatment and disposal.

The defaecation unit consists of a glazed ceramic seating bowl or squatting plate fixed to a trap which maintains a water seal having a depth of 5-7 cm. Excreta fall directly into the pan of the water closet from which it is flushed out into the sewerage system by about 10 litres of water obtained either from a cistern or direct from the main.

The sewerage system consists of a network of pipes, generally designed to flow by gravity, together with manholes, pumping stations, and other relevant appurtenances.

Various methods of treatment are used in processing the sewage for disposal, the choice of method being dictated by the quantity of sewage, available space as well as economic, social, and ecological considerations. Some of the treatment methods involve the use of Imhoff tanks, oxidation ponds and ditches, trickling filters, activated sludge systems, and sludge digesters.

Final disposal is generally made into a body of water.

The system is convenient, hygienic, and easy to use. It is particularly suited for large communities. But the transfer and treatment components require a large capital outlay for their installation.

They are expensive to operate and maintain, and the technology for their proper maintenance is high.

For these reasons many urban communities in developing countries are still without conventional sewerage systems. They are clearly beyond the means of the rural poor.

A4.5 ON-SITE WATER-INDEPENDENT SYSTEMS

There are two types of on-site water-independent systems. They are the dry pit latrine systems and the compost or mouldering toilet systems.

There are also two basic types of dry pit latrine systems, namely, the direct pit and the off-set pit latrine systems. In the direct pit system the pit is located directly below the squatting plate whereas in the off-set pit latrine, the pit is vertically out of alignment with the squatting plate and superstructure. Examples of the direct pit latrine are the conventional pit latrine, the vented pit latrine, and the borehole latrine. An example of the off-set pit latrine is the Reid's Odourless Earth Closet (ROEC).

The compost latrines have two distinctive features; these relate to the treatment and the disposal systems. Unlike the treatment systems of other varieties of latrines, the compost latrine treatment system operates not only on excreta but also on refuse and other vegetable wastes. This requires education of the user to ensure regular addition of appropriate quantities of refuse. Secondly, the treated waste is not disposed of into an environmental medium without any prior immediate use; on the contrary, the treated waste product is usable as a fertilizer or

soil conditioner to promote food production or gardening.

Compost latrine structures are, as a rule, permanent structures.

4.4.5.1 Conventional Pit Latrine

The defaecation unit of the conventional pit latrine is a squatting platform or seat placed directly over a pit. The platform may be made of wood or concrete, and is generally provided with a foot rest and a central opening through which excreta and ablution material fall directly into the pit below. The pit is a relatively large volume hole dug in the ground with any available tool to a convenient depth. Its shape may be circular or rectangular; but for household latrines, the most popular shape is circular. A single family pit may normally have a diameter of 90 to 110 cm and a depth of about 240 cm. 85 litre of pit volume per person per year is normally required under dry subsoil conditions. Fig 2 depicts a typical pit latrine.

It has no provision for excreta transfer because the pit which serves as part of the defaecation unit also serves as the site for final disposal in the soil. Excreta and ablution material which fall into the pit undergo anaerobic digestion and volume reduction.

Normally, after every use, the fresh excreta are expected to be covered with earth or some other available inert material. When the pit is filled within about 60 cm below the ground level, it is filled up to ground level with earth, a new pit is dug, and the superstructure is transferred from the old to the new pit.

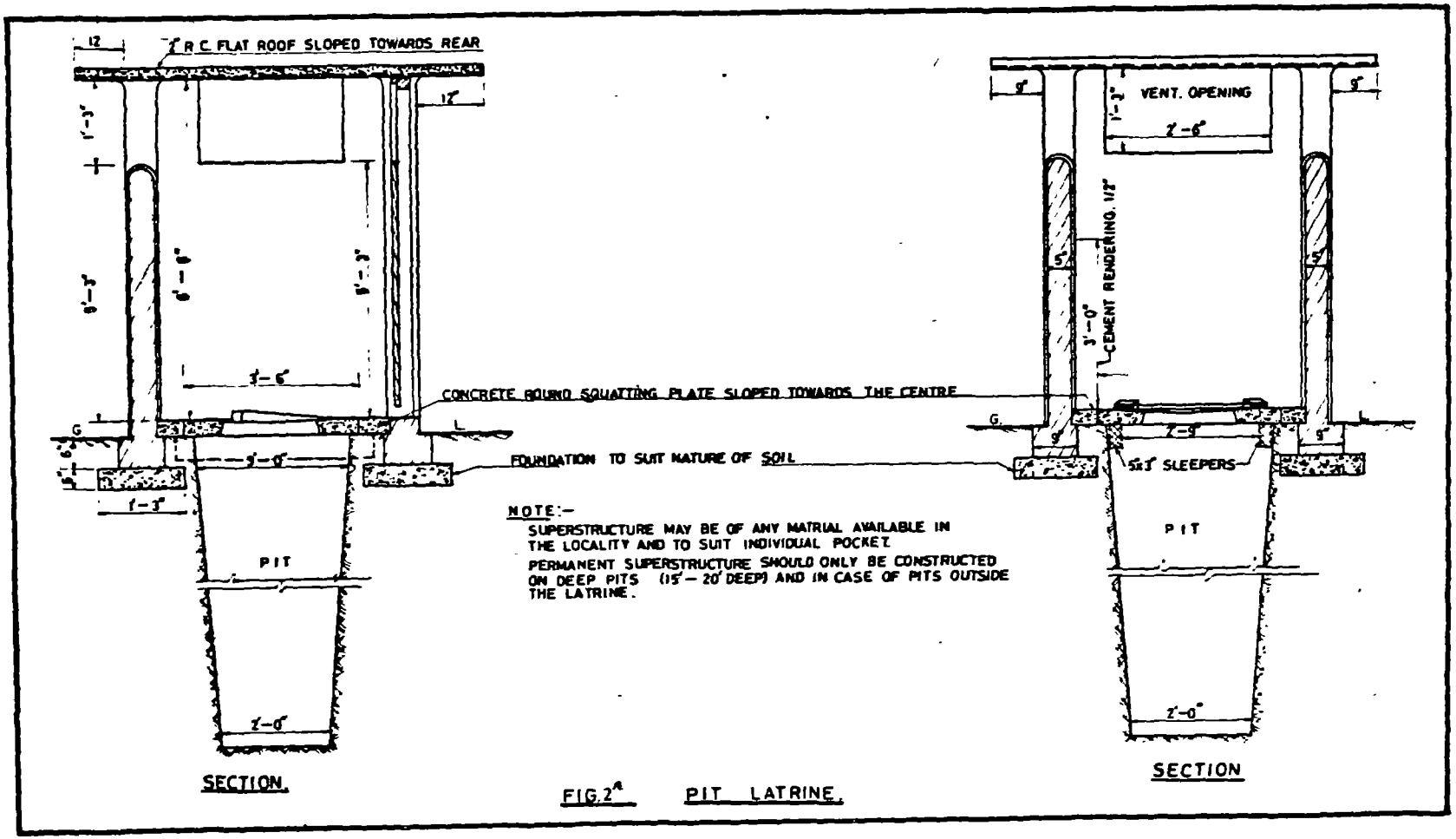


FIG.2 PIT LATRINE.

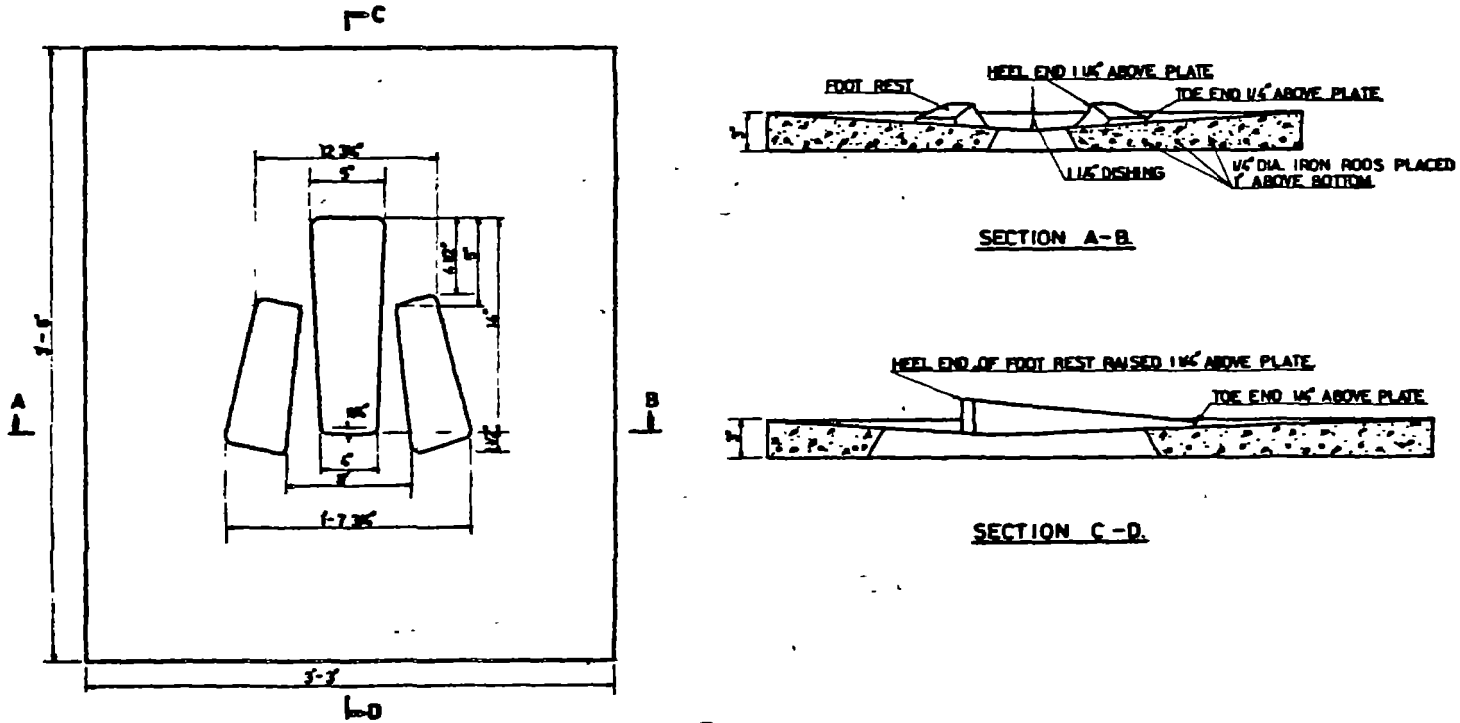


FIG 2: SQUATTING PLATE FOR PIT LATRINE.

It has the advantage that no special equipment is required for its construction, and the technology for its construction and operation is simple and well within the scope of rural people. It is inexpensive to construct or operate, and it does not require water for its operation. When properly used it can be hygienic and aesthetically acceptable.

Its demerits include its possible association with odours and flies when the excreta level gets within 100 or 70 cm from the top or when it is improperly operated. Another disadvantage is the possible caving in of pit walls; but this can be prevented by lining the wall of the pit with bricks or other suitable material. Still another limitation is the progressive reduction in the capacity of the pit.

4.5.2 Vented Pit Latrine

Developed in Rhodesia by MORGAN (1977) the defaecation unit of the vented pit latrine is a concrete slab placed directly over a pit . The slab has two holes; one of them is the squatting hole and its immediate surroundings are made concave to facilitate cleaning. The second hole which is 20 cm in diameter is fitted with a vent pipe 2.5 m high having a diameter not less than 15 cm.

At the top the vent pipe bells outwards to approximately 25 cm diameter. This bellod aperture is covered with glass fibre mesh to prevent passage of flies and mosquitoes.

The superstructure is kept small and dark with only sufficient light for the user to see.

The strongest light reaching the pit comes from the vent pipe. As a result during the day flies that brood in the pit or enter the pit are attracted to the top of the vent pipe where they stay till they die. Fig 3 shows the vented pit latrine.

The vented pit privy is fly-free and odour-free. It is relatively inexpensive to construct although the vent pipe can add considerably to the cost. Its principal disadvantages are possible caving-in (which can be prevented if it is lined), and progressive reduction of its capacity.

A4.5.3 Off-set Dry Pit Latrine

This is a special type of pit latrine which differs from the conventional pit latrine in two respects. Firstly, instead of the pit being located directly below the seat or squatting plate, it is located adjacent to the squatting plate such that the near face of the pit is in line with the outer face of the closet building. Being vertically out of alignment with the squatting plate, the pit is connected to the squatting hole either by a curved converging pipe or by a smooth surfaced inclined pipe, set at angle of between 50 and 60° to the horizontal. Secondly the pit is ventilated such that a draught of air flows continously from the closet room down the inclined connecting pipe for exhaustion through a vent pipe which must be taller than the topmost part of the latrine building.

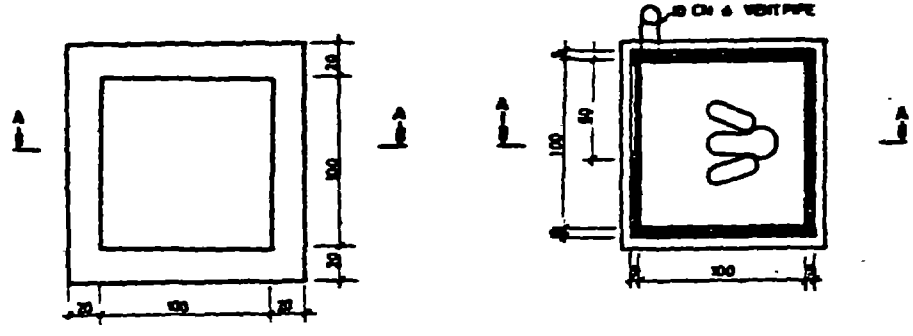


FIG. 1 VENTED PIT LATRINE

Patented in 1944 in South Africa where it is known as Reid's Odourless Earth Closet (R.O.E.C.), it is claimed to be odourless and fly-free. Its operation requires that the seat or squatting hole should not be covered with a lid.

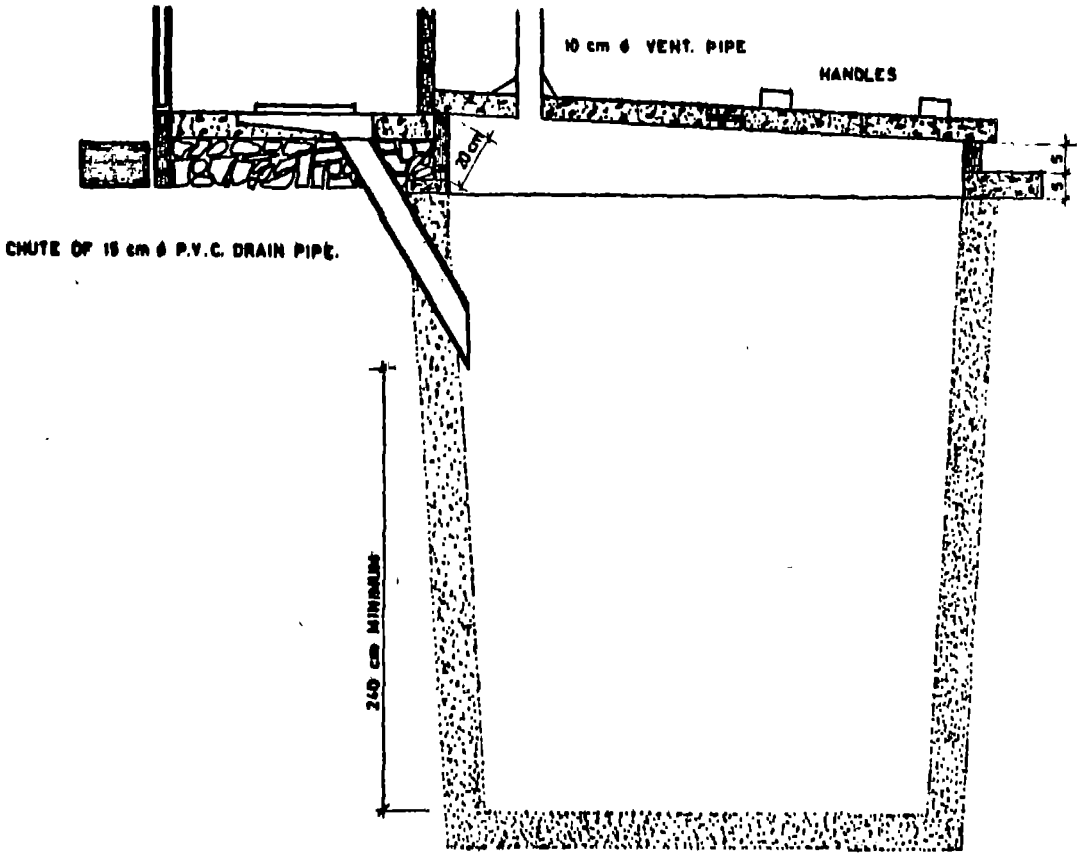
Fig. 4 shows one type of an off-set dry pit latrine being field-tested in Tanzania. Where necessary the pit may be lined, leaving weep holes for seepage. The system can be used for individual households or as communal latrines when a row of closets can be constructed under one roof. It is, however, recommended that in such a case dividing walls must be built up from the bottom of the pit to cover level, and partition walls should be made airtight for successful operation of the draught system. Each closet should also be provided with its own vent pipe.

The advantages of this system over the direct pit latrine include the following: it is odourless and fly-free; and there is possibility for emptying the pit contents without disturbing the structure. It can therefore serve as a permanent latrine. Furthermore, it operates without water.

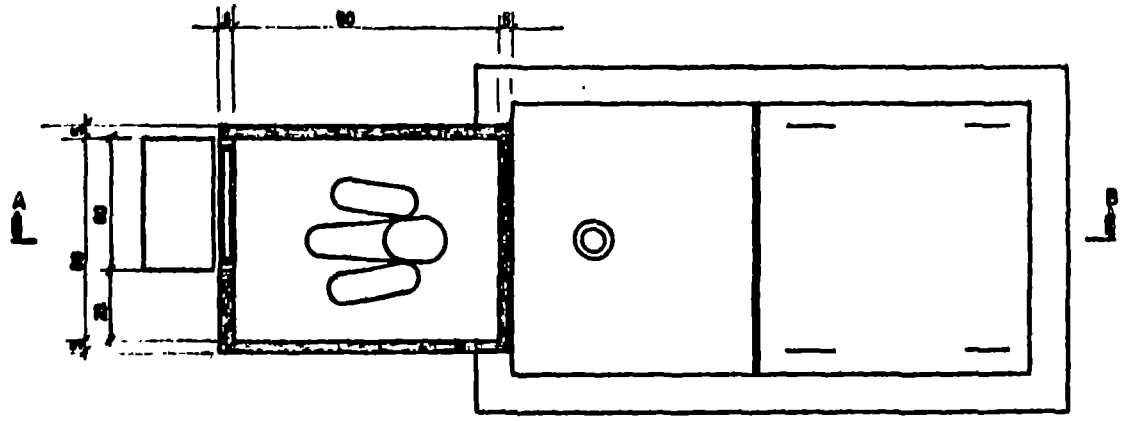
Its principal disadvantage is a relatively higher cost due to the installation of the inclined connecting pipe and vent pipe, and due to the provision of a removable reinforced concrete cover.

A4.5.4 Borehole Latrine

This is a special type of pit latrine which consists of a hole 30 to 40 cm in diameter dug in fairly soft soil by a special hand boring auger to a depth of about 6 m or 1 m below



SECTION A—B.



PLAN.

FIG. 4: OFF-SET PIT LATRINE (B.O.E.C.)

the ground water table. This hole, together with a square or rectangular concrete squatting plate, constitutes the defaecation unit. The narrowness of the hole makes it too dark for flies to enter. In loose soil or sandy area, the hole is lined with bamboo, wooden planking, earthenware rings, or oil drums to prevent caving in of the soil. An earth mound is finally built around the bore. It is illustrated in Fig. 5.

As in the case of the pit latrine, the borehole also serves as the site for final disposal. The operation of the latrine is also basically the same as that of the conventional pit latrine. Sludge accumulation has been estimated to be about 56 to 170 litres per 1000 uses.

It is cheaply and quickly installed; it is hygienic, operates with no fly nuisance, requires minimal maintenance, and does not require water.

Its demerits include the following:

(i) The borehole requires a special tool for boring. The practical problem of providing and operating the auger may pose a handicap.

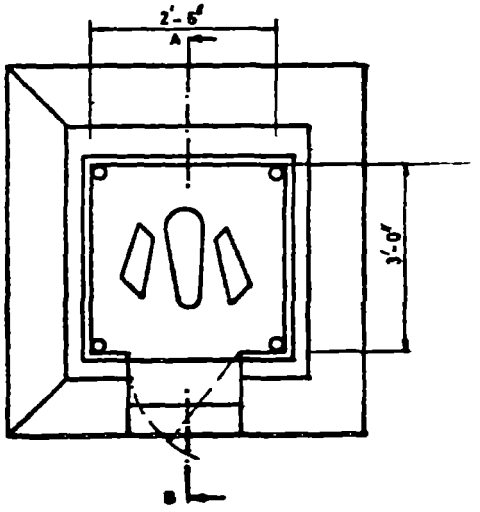
(ii) The narrow bore limits its capacity.

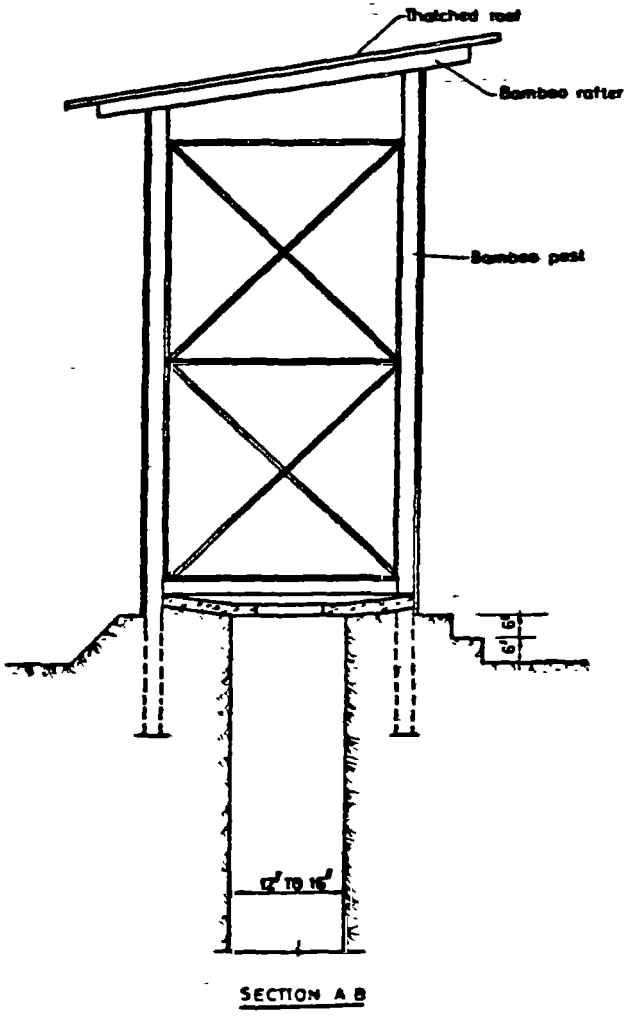
(iii) It may be odorous when it gets filled within one to two meters from the top.

(iv) In very loose soil it may cave in.

(v) It is not a permanent latrine.

Where ground conditions are favourable it may be suitable for a small family; but it is not suitable for common use by a number of families or in a public place.





SECTION A B

FIG-5 BOREHOLE LATRINE

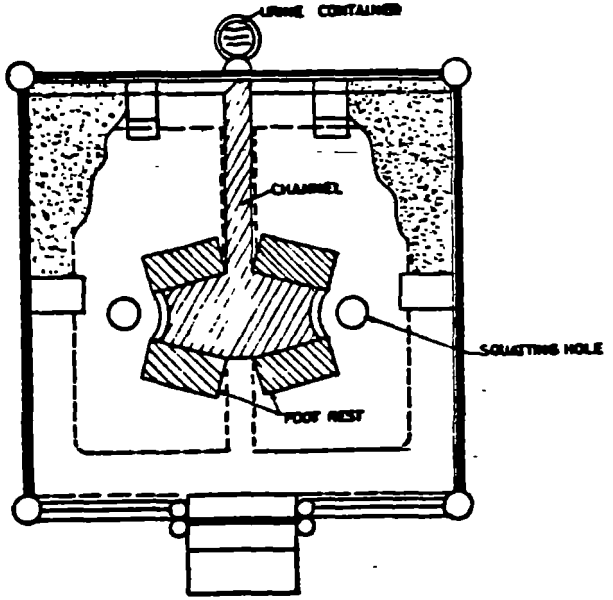
A4.5.5 Vietnamese Double-Vault Latrine

Also known as the double septic tank, the Vietnamese double-vault latrine consists of a watertight vault with two compartments that are used alternately first for defaecation and then for composting. Unlike other compost or mouldering toilets, urine is separated from the faeces to avoid excessive nitrogen in the composting material. This is done by means of a special groove which diverts urine into a separate container. Fig. 6 shows one design of the Vietnamese Double-Vault Latrine.

Before a vault is put into use for defaecation, a layer of ashes or lime is applied to the floor of the vault. Also, after each use, wood ashes are sprinkled over the faeces to absorb odours, and the defaecation hole is closed with a wooden lid. When the vault in use is almost full, the contents are levelled with a stick, and it is filled to the top with ashes. Any openings are then sealed with lime cement or clay; and the materials are allowed to undergo composting for at least 2 months.

To serve a family of 5-10 persons the vault required is 1.2m wide, 0.7m deep and 1.7m long. Construction materials that can be used include clay, lime mortar, stone, rammed earth, bamboo wattle, unbaked bricks, and concrete.

It is reported that 85% reduction of intestinal worm ova can be achieved within 8 weeks. The system has been used extensively in Vietnam. However, its success depends upon effective education of the user and cultural acceptability of the need to extract and use the composted material.



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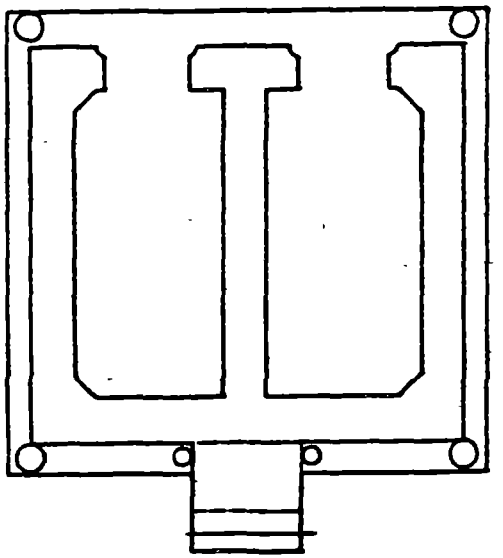


FIG 6 VIETNAMESE DOUBLE VAULT LATRINE.

A4.5.6 Gopuri Latrine

Developed by Shri Appasaheb Patwardan, the first Gopuri latrine was installed in a village called Gopuri located in the Ratnangiri District of Maharastra State in India.

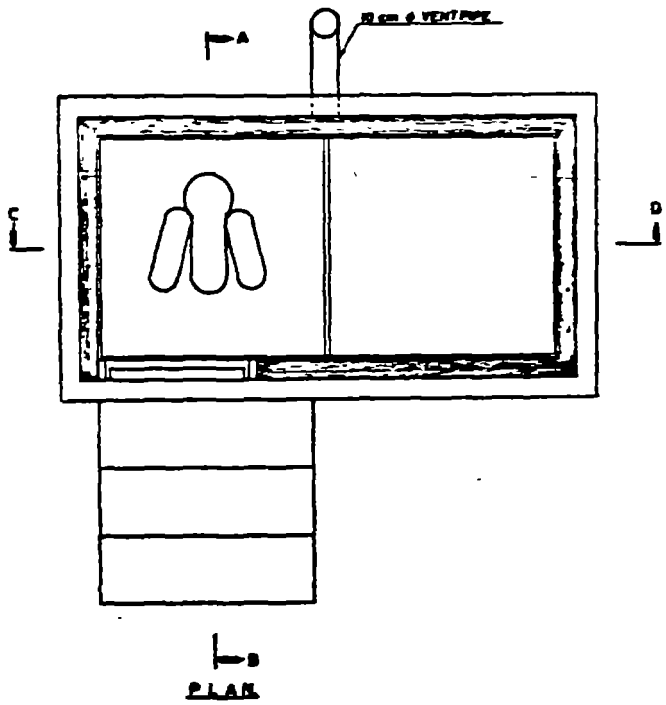
The treatment unit consists of two pits used alternately, which also serve as the part of the defaecation unit which receives the fresh excreta. The squatting plate is mounted on the pit in use while the other pit is covered with a plain galvanised iron sheet in a wooden frame. Also mounted on the pits is a common vent pipe. Materials like dry earth, ash, paddy husk, garbage, or hey, are added to the nightsoil for composting. When both pits are full the contents of the first to be filled up are removed through doors located at the back of the pits, the greater part of which is located above ground as illustrated in Figure 7.

Advantages claimed for this latrine include the following: it operates without water; it is simple, cheap, and easy to build; it yields a useful product, helps in the disposal not only of excreta but also of garbage. It is reported to be capable of operation without offensive odours or flies.

Its disadvantage is the need to relocate the squatting plate from time to time. The product also requires further composting to reduce risk of helminthic infection. The additional composting time is however not known.

A4.5.7 Multrum Latrine

Also known as the Clivus, Multrum is a compost latrine consisting of a concrete or a prefabricated fiberglass container with a sloping floor. The slope of the floor must be



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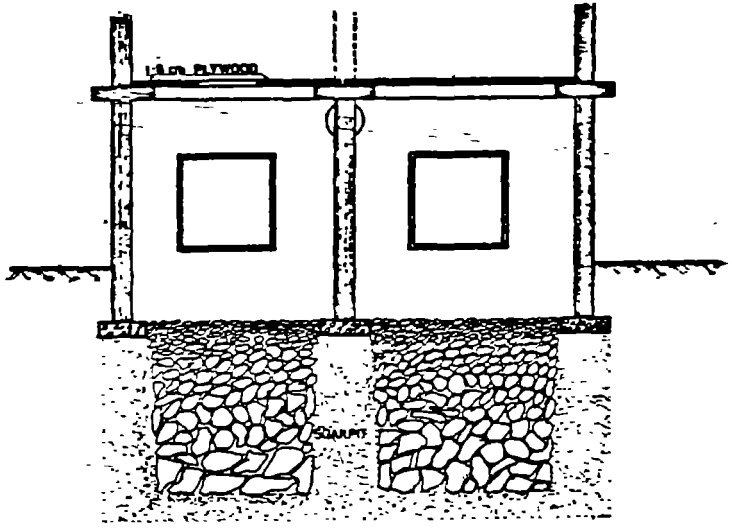
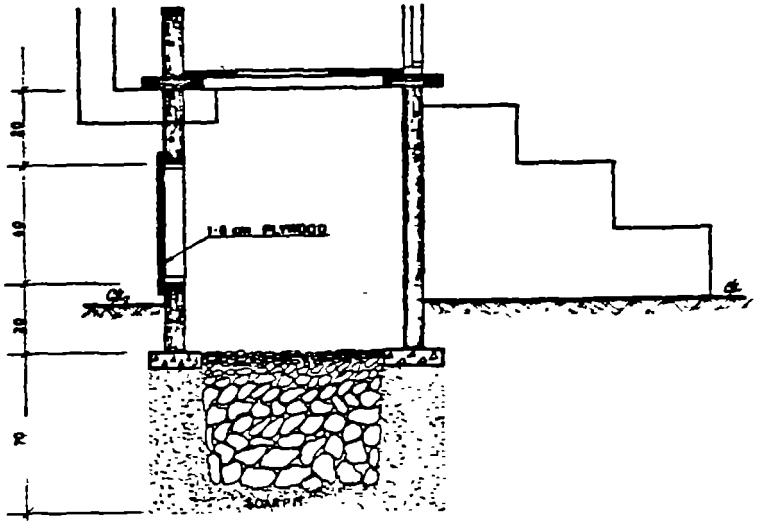


SECTION C–D



SECTION A–B

FIG. 7 : GOPURI LATRINE.

between 1 in 4 and 1 in 3 (i.e. 14° and 18·5°). The container is divided into three communicating compartments, each fitted with a lid-covered opening the first is as a non-water seal toilet bowl, the second is used as a kitchen refuse chute, and the third is used for removing the end-product. The third compartment has an air intake, and, through inverted V-shaped or inverted V-shaped conduits, the air is drawn through the compost to a vent pipe. Both air intake and vent pipe are covered with fine wire screen to exclude insects and vermin. Fig. 8 shows one type of the Multrum being studied in Tanzania.

The unit can be installed either as an integral part of a house or attached to an outhouse privy. It may be placed either in a basement or partly below ground.

Before being put into operation for the first time, the floor of the container is covered with a layer of peat or humus-rich garden soil and grass-cuttings. The soil layer absorbs liquids while the soil/grass mix provides a microbial seed for the oxidation process.

The end product is scooped out for the first time after five years, and thereafter annually. The finished compost is reported to be free from pathogenic organisms and odours.

Its advantages are similar to those listed for the Gopuri latrine. In addition the sloping floor enables the most stabilized compost to be pushed to the lowest part from where it is collected. The long detention time and the aeration helps to complete the stabilization process thereby making it possible to use the compost immediately it is collected.

The principal drawback is the size and price of the unit. Where

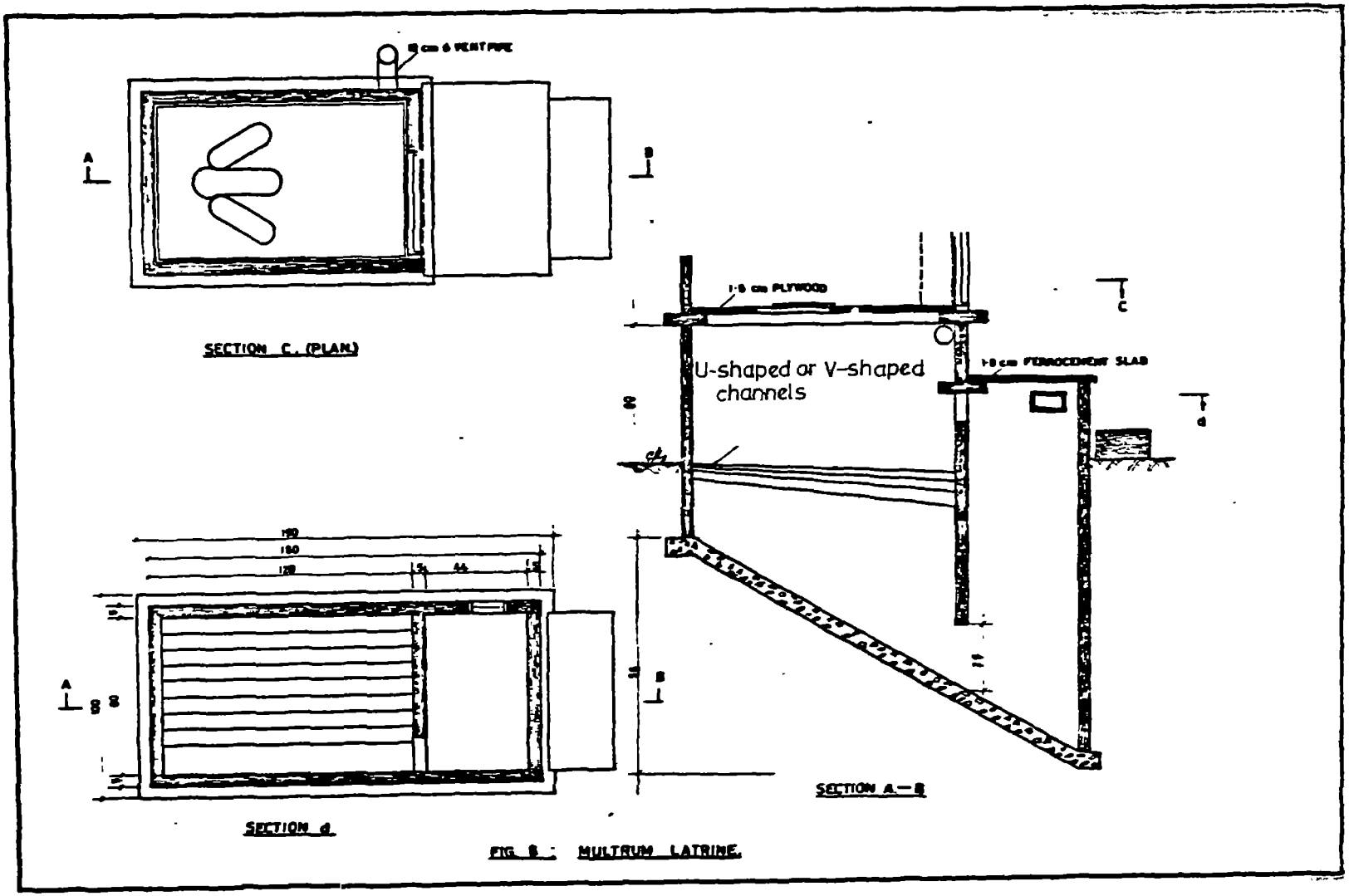


FIG 8 : MULTRUM LATRINE.

water is used for ablution accumulation of excess water in the Multrum can interfere with the composting process.

4.4.5.8 Utafiti Latrine

As illustrated in Fig. 9, the Utafiti latrine is basically the same as the Multrum with the following special features. The squatting plate incorporates a flap-trap to reduce odours and accessibility of the latrine contents to flies and vermin. No V-shaped or U-shaped channels are used; and a length of absorption trench is provided for the disposal of excess liquid. In addition, unlike the Multrum, it is open at the bottom.

The system is likely to have all the advantages of the Multrum. In addition the construction is likely to be cheaper.

Its performance is currently being tested in Tanzania.

4.4.5.9 The Single Compartment Utafiti Latrine

Fig. 10 shows the single compartment Utafiti latrine. Its features are the same as the conventional Utafiti Latrine except that it does not have a second chamber between the defaecation chamber and the absorption trench. It is smaller and cheaper than the conventional Utafiti; and its performance is currently being tested in Tanzania where it was developed.

4.4.5.10 Single Vault Latrine

In the W.H.O. compost latrines excreta, household refuse, animal manure, and urine-soaked earth or straw are composted under anaerobic conditions. The composting process is a modification of the Bangalore process.

The single-vault compost latrine consists of a pit, much the

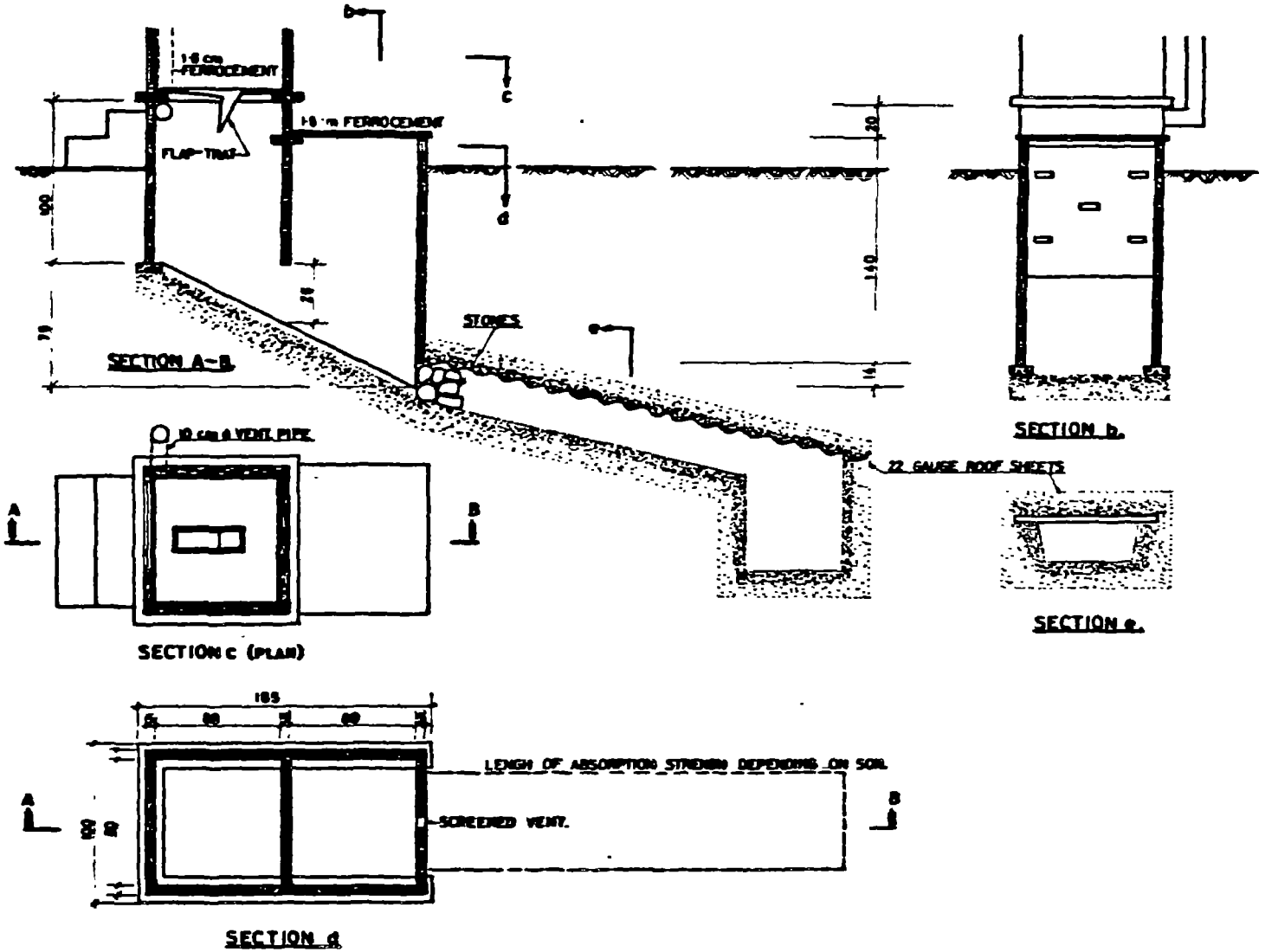
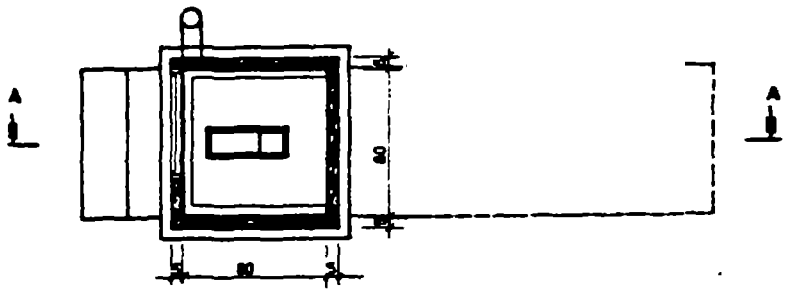


FIG. 9: UTAFITI LATRINE.



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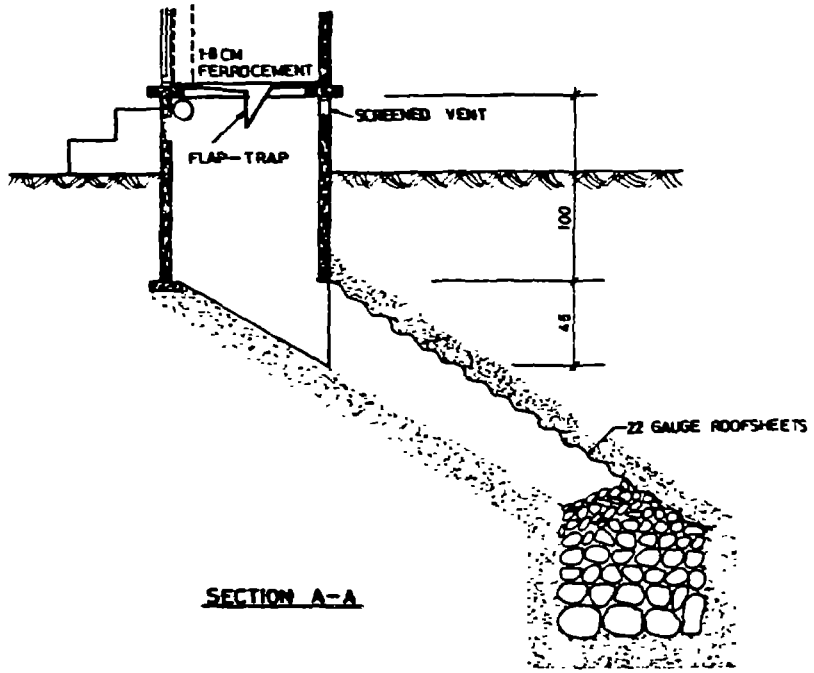


SECTION A-A

FIG. 10 SINGLE COMPARTMENT UTAFITI LATRINE.

same as the conventional pit latrine on which is placed a squatting plate through which excreta and the other materials to be composted fall to the pit. The bottom of the pit is covered with grass cuttings, fine leaves, garbage, and paper. During operation, a few kilograms of grass and fine-textured leaves are thrown into the pit. An example is shown in Fig. 10.

A4.5.11 Off-Set Single Vault Latrine

This is a modification of the Reid's Odourless Earth Closet. In place of a horn-shaped chute, a 15-cm diameter PVC drain pipe is used as a chute to transfer the excreta to an off-set vault, as shown in Fig. 12.

The use of a straight drain pipe in place of a horn-shaped chute simplifies construction; but at the same time it promotes the tendency for faecal matter to stick to the inclined pipe fairly close to the squatting level, thereby facilitating accessibility of flies to such faeces. Periodic cleaning of the chute with a brush having a long handle is required.

A4.5.12 Off-Set Compost Vault Latrine

Illustrated in Fig. 13, this latrine combines the features of the Multrum with those of the Reid's Odourless Earth Closet.

In the conventional Multrum the toilet superstructure is located directly above the composting chamber. But in the Off-Set Compost Vault Latrine, the composting chamber is located outside the closet room thereby making it easier to install it in existing buildings.

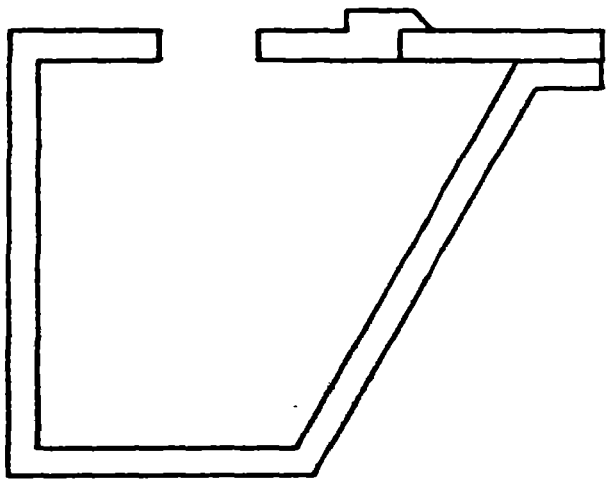
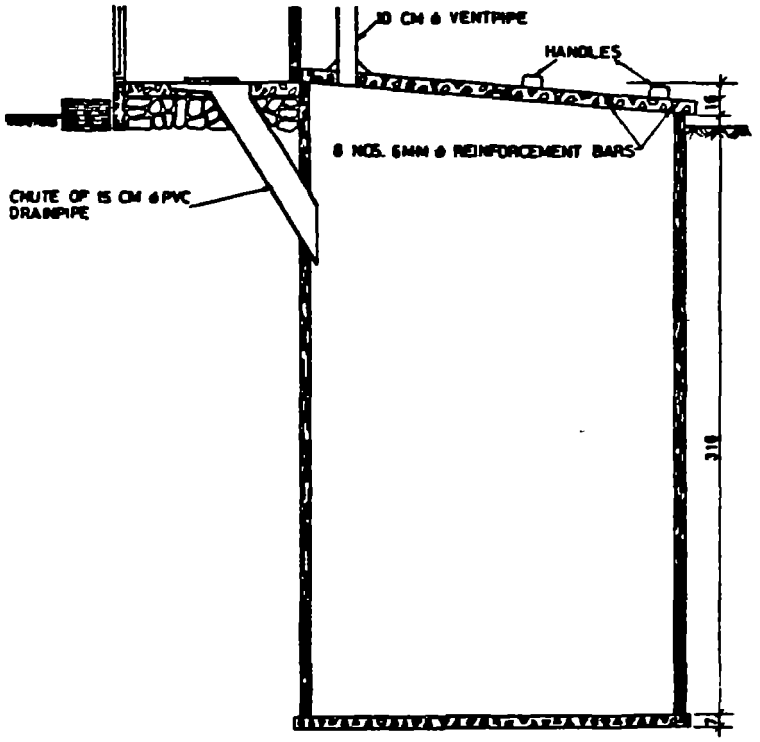


FIG. 11 SINGLE VAULT LATRINE.



SECTION A — A

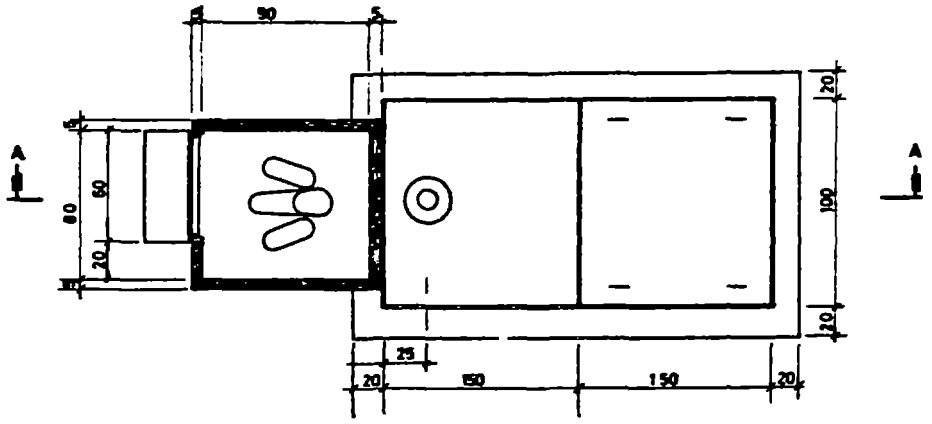


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FIG. 12 OFF-SET SINGLE VAULT LATRINE.

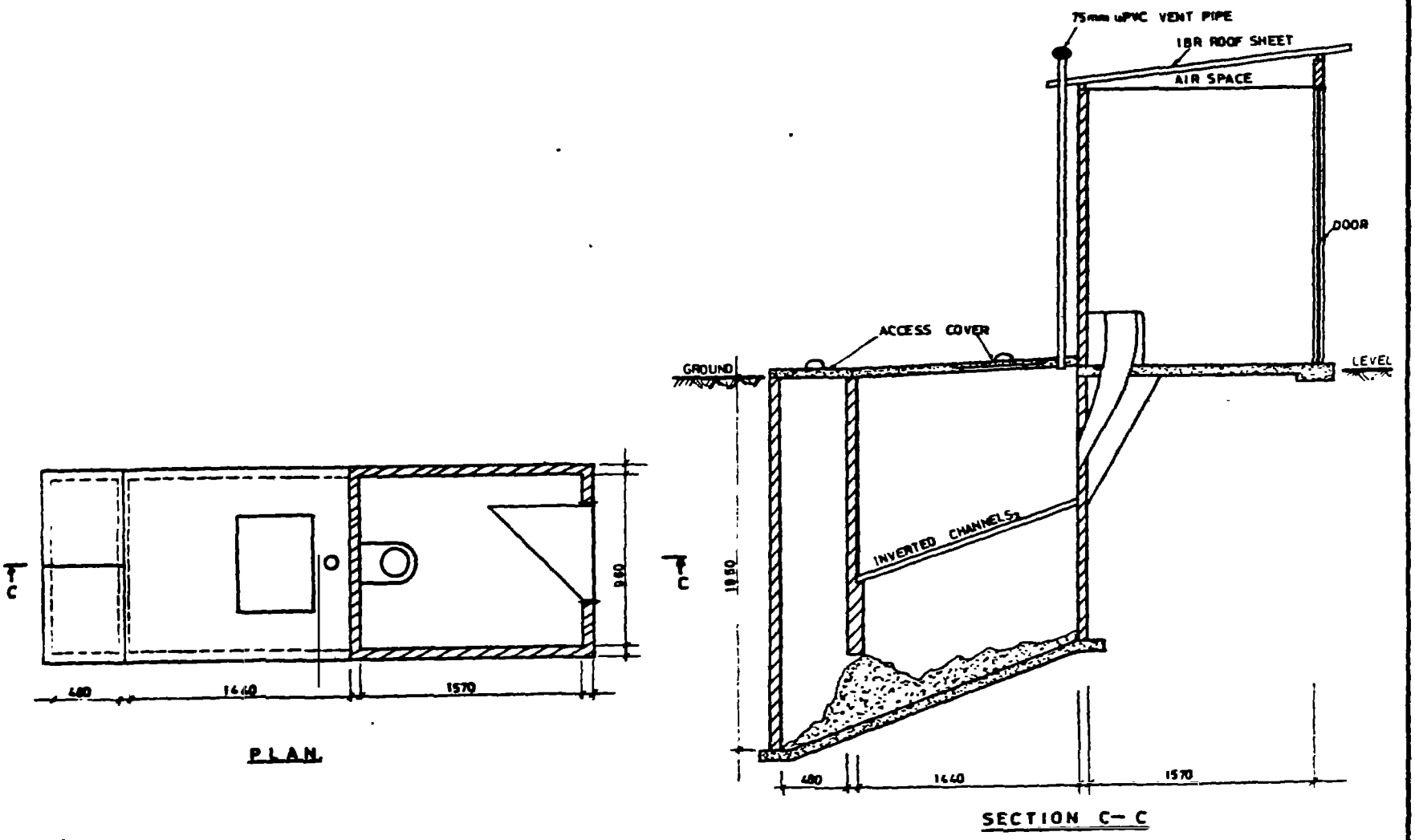


FIG 13 OFF-SET COMPOST VAULT LATRINE.

Where compost latrines are culturally acceptable, the off-set compost vault would appear to be an improvement over the conventional Multrum.

44.5.13 Off-Set Compost Pit Latrine

Illustrated in Fig 14, it is basically like the off-set pit latrine with a straight inclined pipe except that it is designed to accept refuse and to operate as a compost toilet. Although a vent is provided, no air inlets or inverted ventilation channels are provided. It is therefore likely to operate mostly as an anaerobic compost latrine. The composting rate is therefore likely to be slow. It is still being field-tested.

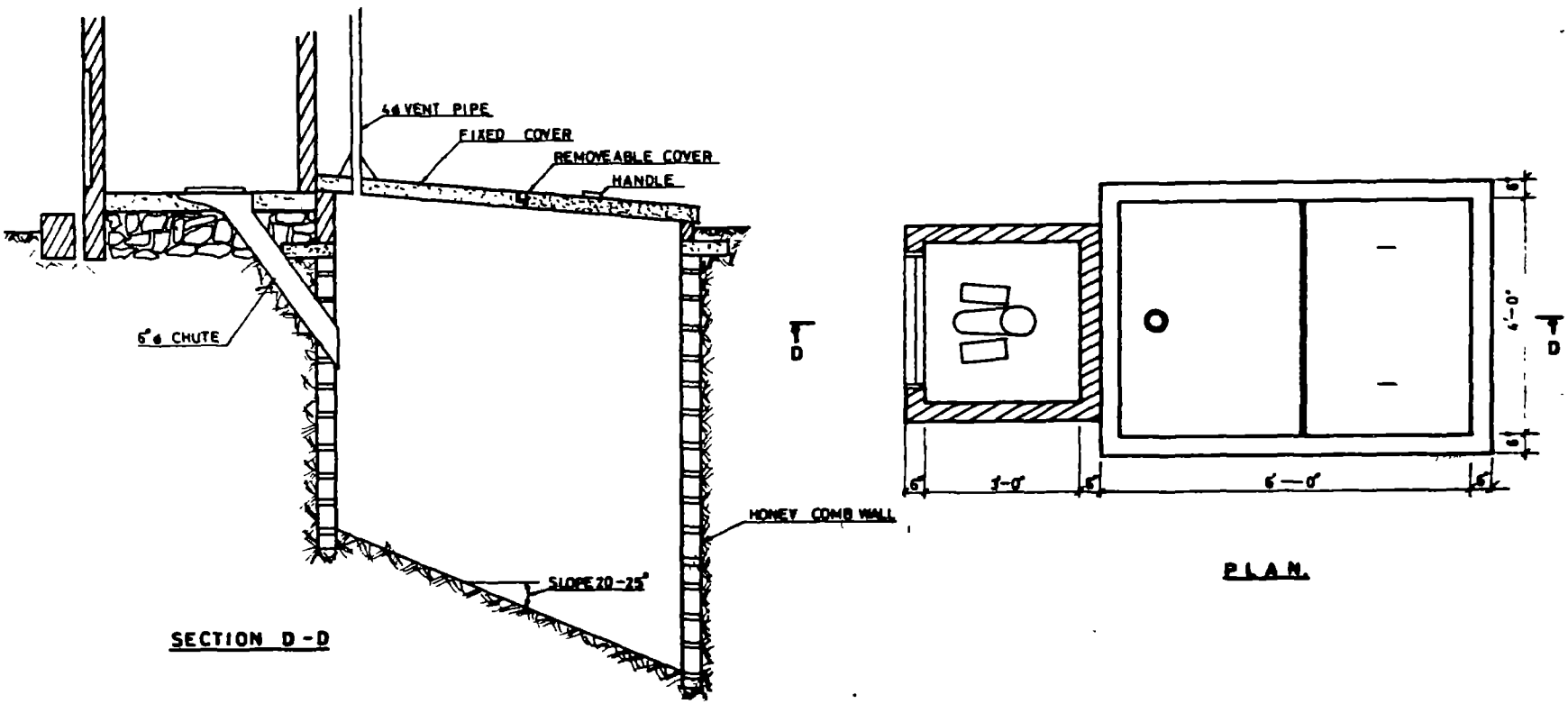


FIG. 14 OFF-SET COMPOST PIT LATRINE

A4.6 ON-SITE WATER-DEPENDENT SYSTEMS

A4.6.1 Aqua Privy

The aqua privy consists of a vented water-tight tank containing water into which dips a chute or a drop pipe hanging from the latrine floor as shown in Fig. 15.

Excreta fall through the drop pipe into the tank where they displace an equivalent volume of water through an overflow arrangement into an adjacent soil absorption system for final disposal. The excreta undergo anaerobic digestion in the tank leaving an accumulation of digested sludge which must be removed for disposal at intervals of about 5-10 years.

It can be used both as a domestic or a communal latrine. When used for a family a liquid capacity of $1 m^3$ per family is recommended, and a liquid depth of 1 to 1.5 m is maintained.

As a treatment facility is is analogous to the septic tank or Imhoff tank. There is therefore a tendency for scum to develop on the liquid. top. This must be disintegrated daily using a plunger with a 10 cm disc at its end. Successful operation depends upon the relative amount of water in the privy. Periodic addition of water is desirable.

It has a low water requirement but it can be expensive to install. Improperly maintained, it is associated with odours and nuisance.from flies which can gain access to privy contents in the chute.

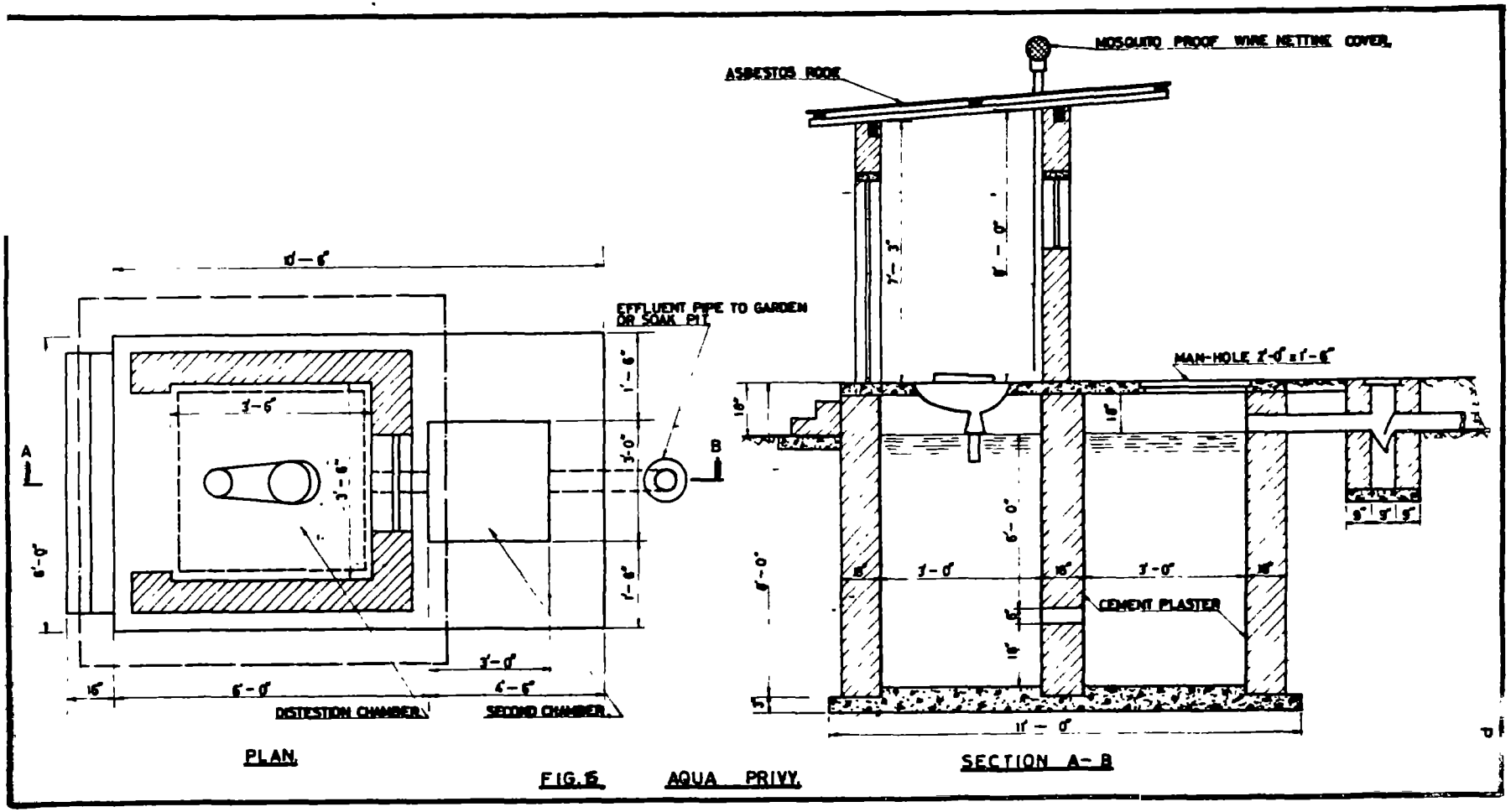


FIG. 15 AQUA PRIVY.

A4.6.2 Botwana Type B Toilet

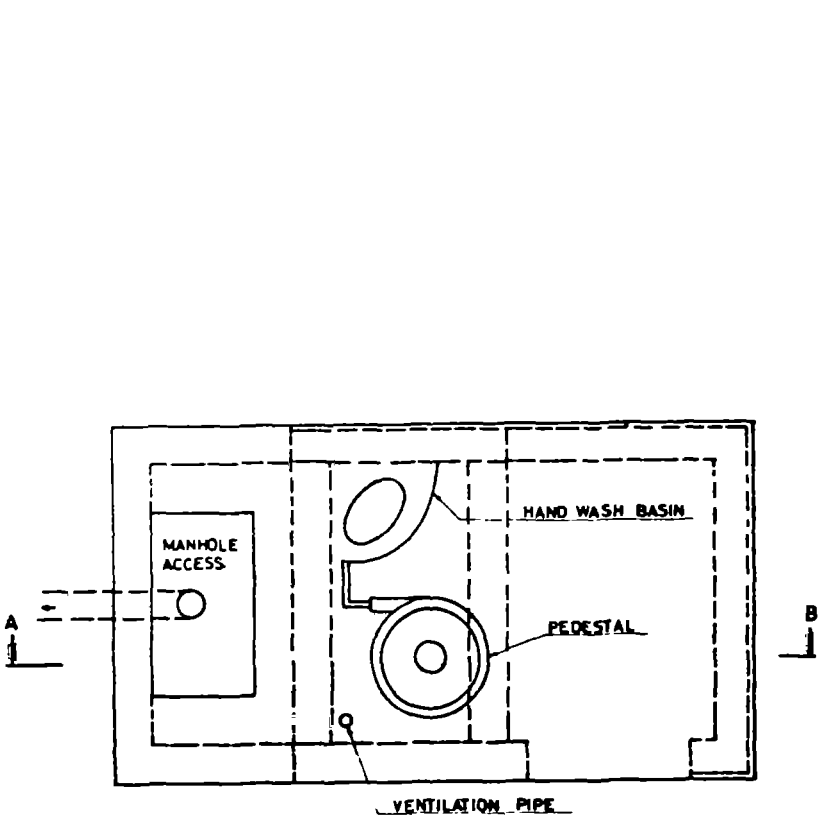
This is a domestic aqua privy designed not only for excreta collection, treatment, and disposal, but also for collection of other household liquid wastes. The defaecation unit consists of a circular pedestal designed to induce spiral flow during flushing. Below its rim is an inlet from the wash basin.

The septic chamber is so located that half of it is below the closet room while the other half is outside. This arrangement allows the chute from the pedestal to dip below the chamber water level while providing an external access manhole for desludging when necessary. Fig. 16 is an illustration of the toilet.

Its principal advantage consists in the provision for accepting other household liquid wastes, thereby overcoming the problem of inadequate water content in some aqua privies. This advantage may prove to be a possible disadvantage if excessive water is used thereby reducing the detention period unduly and limiting the extent of treatment in the privy chamber. An adequate soil absorption system is necessary for proper operation.

A4.6.3 Septic Tank Latrine

The septic tank latrine has features of both the conventional septic tank system and the aqua privy. Like the conventional septic tank system, it consists of a water seal bowl or squatting plate, a water-tight concrete box or septic chamber, and a soil absorption system. However, whereas in the conventional septic tank system, the water seal bowl or squatting plate is located away from the septic chamber to which it is connected by a pipe, in the septic



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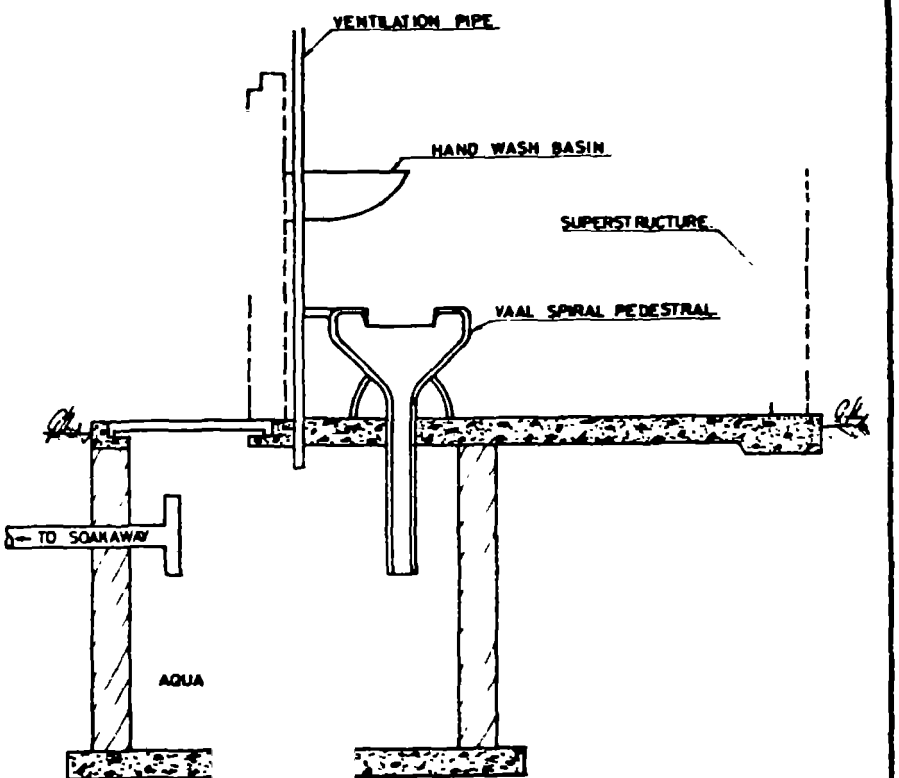


SECTION A—B

FIG. 16 : BOTSWANA TYPE 'B' TOILET.

tank latrine, the water seal squatting plate is located directly above the septic chamber as shown in Fig. 17. It is in this respect that it resembles the aqua privy in that both of them have a water-tight septic chamber located immediately below the squatting plate; and the overflow from their respective septic chambers goes out for disposal in a soil absorption pit or trench. The difference between the septic tank latrine and the aqua privy lies in the use of a water seal bowl in the case of one whereas the other employs a chute that dips into the water in the septic chamber.

The septic tank latrine consists of a water-tight tank 145 cm x 60 cm x 90 cm deep below the water line. There are two hanging baffles dipping 22.5 cm into the water and projecting 15 cm above it. It has a 10 cm effluent pipe with a light trap to prevent fly breeding. This pipe leads to an effluent channel. A dip pipe and a sludge valve are provided for desludging once a year or every six months. To allow sludge to be withdrawn at ground level, the tank may be built in cut and fill, about 45 cm into the ground and 85 cm above. The walls of the tank may be built of brick in lime mortar plastered with cement inside; and they may be protected by a bank of earth outside.

It is an improvement over the aqua privy, the borehole latrine, and the pit privy in that, given proper maintenance and operation, it can have a long life. It is also odourless and fly-free.

Its disadvantages include high cost and the need for periodic desludging.

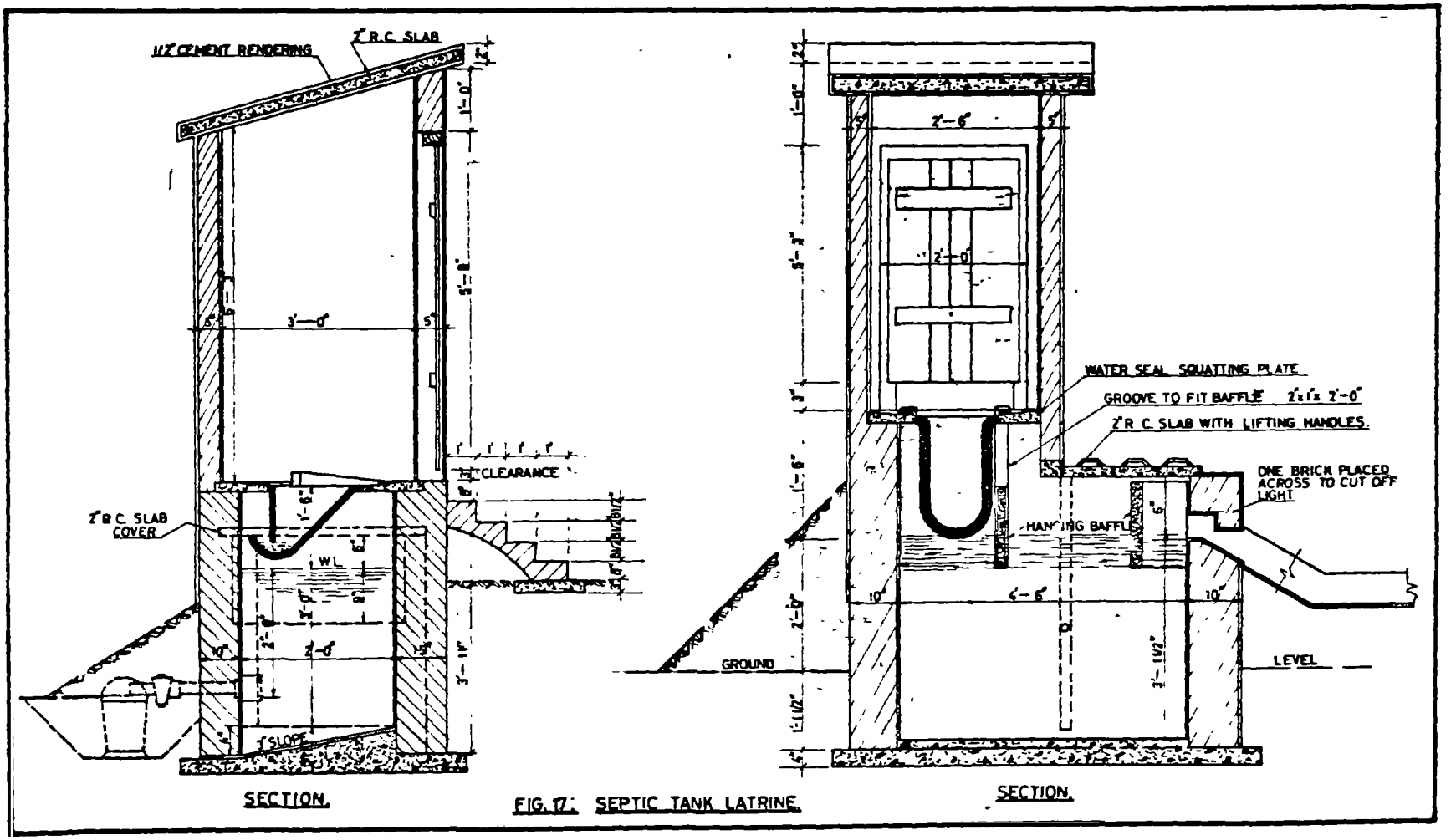


FIG. 17: SEPTIC TANK LATRINE.

Where a water seal is used its water requirements may prove to be a handicap.

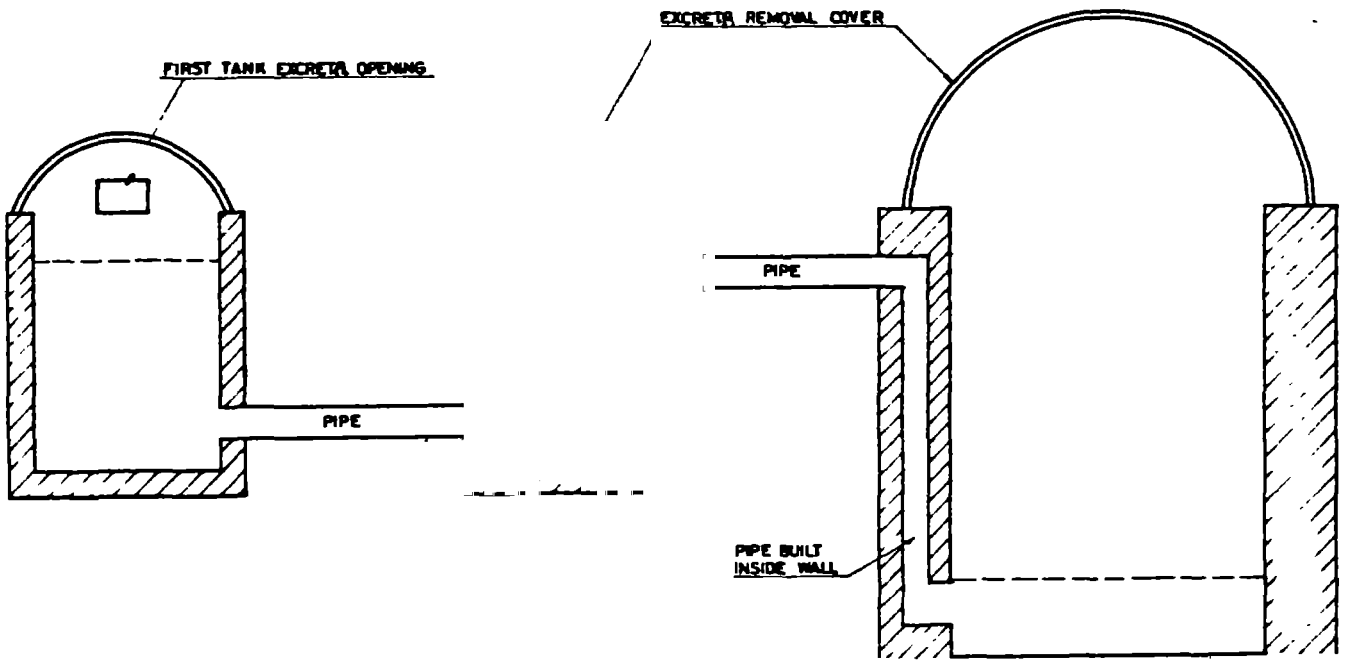
4.4.6.4 Chinese Two-Partitions-Three-Tanks Toilet

Designed in response to Chairman Mao's appeal to "completely eliminate the schistosomiasis", the Chinese two-partitions-three-tank-toilet has three principal components, namely, a defaecation unit, a short transfer unit, and a treatment unit.

The defaecation unit is a closet provided with shallow squatting pits or with buckets. The treatment unit is a three-tank triangular arrangement. The first two tanks are each designed to have a capacity for 10 days' production of excreta while the third tank is designed for 30 days' production. Total tank capacity is therefore for 50 days capacity calculated on the basis of 2 litres of excreta per person per day. (This includes the excreta and the water used for bucket washing). Figure 18 shows a sketch of the three tanks in line.

Excreta from the closet drop into an excreta collection trough built with a slope not less than 38°. The trough is constructed to exclude light and, hence, flies. It is connected to the first of the three tanks by means of a 30 cm long excreta slip trough having a slope of 45°.

The first tank which serves as the fresh excreta inlet tank is first filled with water up to the level of the opening that leads to the second tank. The connection between the second and third tanks is submerged to ensure anaerobic conditions. Digested



SECTIONAL VIEW OF TANKS.

FIG. 18: CHINESE TWO-PARTITIONS-THREE-TANK TOILET.

excreta are removed from the third tank for agricultural uses, care being taken to leave enough excreta in the tank to ensure continued submergence of the inlet of the second tank to the third tank.

The system has the advantage of low water requirement and use of the end product for agricultural purposes. Recent studies indicate, however, that the capacity of the second tank may have to be increased to improve the efficiency of destruction of Ascarid eggs.

4.4.6.5 Dug Well Latrine

Also known as a water seal pit latrine and as a direct pit latrine, the dug well latrine is basically the same as the conventional pit latrine except that instead of a squatting plate or a seat from which excreta fall directly into the pit below, the squatting plate of the dug well latrine has an integral trap which provides a water seal of about 2 cm as shown in Fig. 19. This is a hand flush squatting plate reported to have been developed in Ceylon. The ablution water used ordinarily is sufficient to flush the plate and eject the excreta into the pit which is located directly below the water seal.

To prevent caving in, the pit is lined with locally made pottery rings about 20 to 30 cm deep. A brick or concrete ring about 4 cm deep is provided. The squatting plate is installed about 22.5 cm above the ground level to prevent rain water from getting into the pit directly.

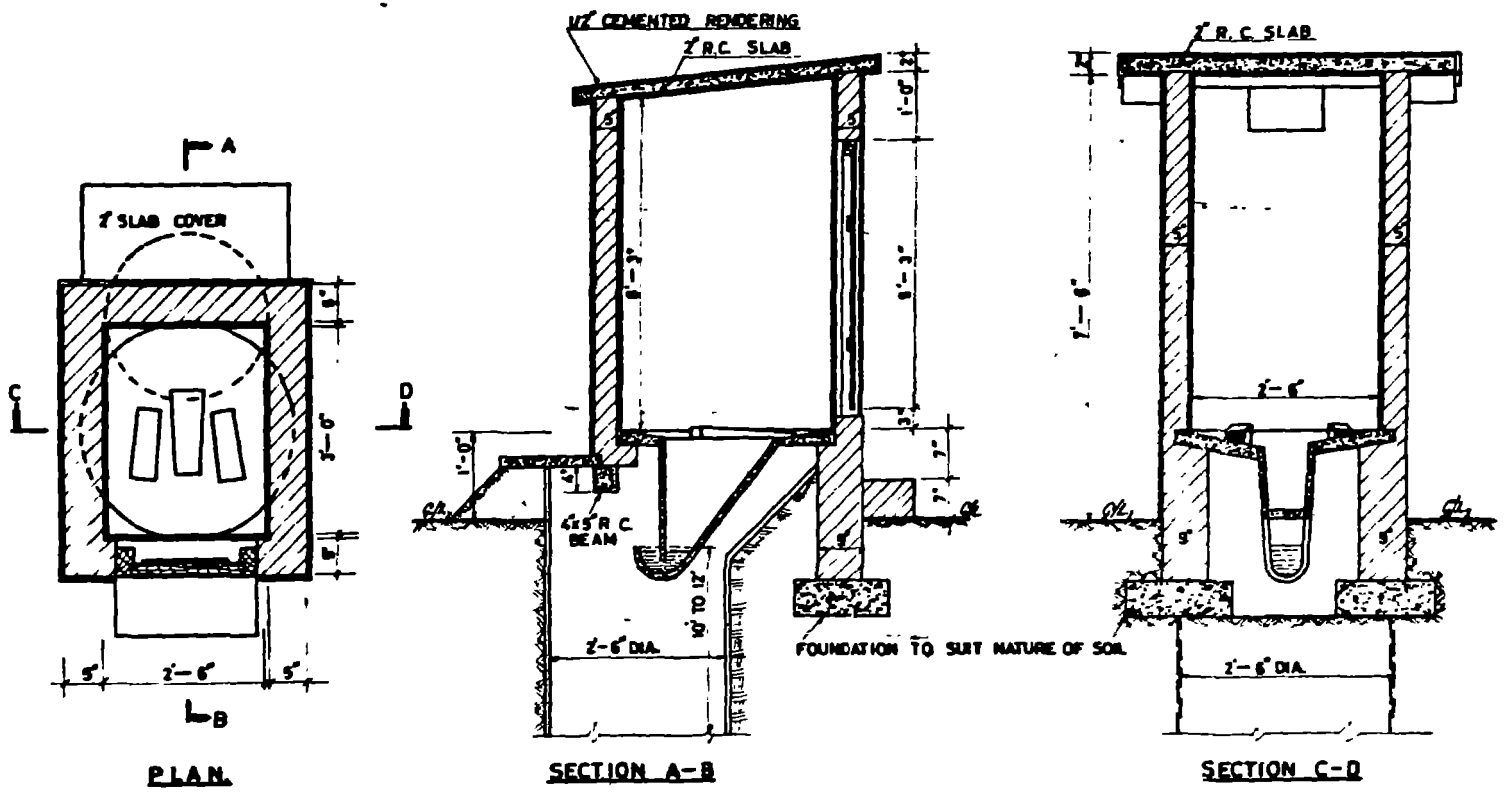


FIG 19 : DUG WELL LATRINE

When the pit is filled up, a new pit can be dug close by and the same water seal squatting plate can be placed over the pit.

The dug well latrine is aesthetically congenial; it is odourless and such that flies do not have access to the excreta. The construction is simple, and does not require special equipment. The cost is not excessive, and it can be installed close to a house without creating any nuisance. Its water requirements are low.

On the other hand the latrine is not permanent, a new latrine becoming necessary every time a pit is filled. Unless water is readily available, proper maintenance is not applied.

A4.6.6 Khatghar Latrine

The seal of the khatghar latrine consists of a cement pan to which is attached an automatically operated galvenized iron plate. The plate serves as a water seal with a small quantity of water. With the weight of the excreta and ablution water, the plate empties its content into the treatment tank below and reverts itself to the original position automatically. The nightsoil sticking to the plate is washed away by the ablution water. It is illustrated in Fig. 20.

A treatment tank designed for 10 to 12 users consists of a masonry chamber 1.3m x 1m x 1m together with an auxiliary tank of 0.3m x 0.3m x 1m. Effluent from the auxiliary tank is diverted into adjoining refuse pits to accelerate decomposition of the refuse. The partially decomposed excreta is collected periodically from the tanks for use as manure.

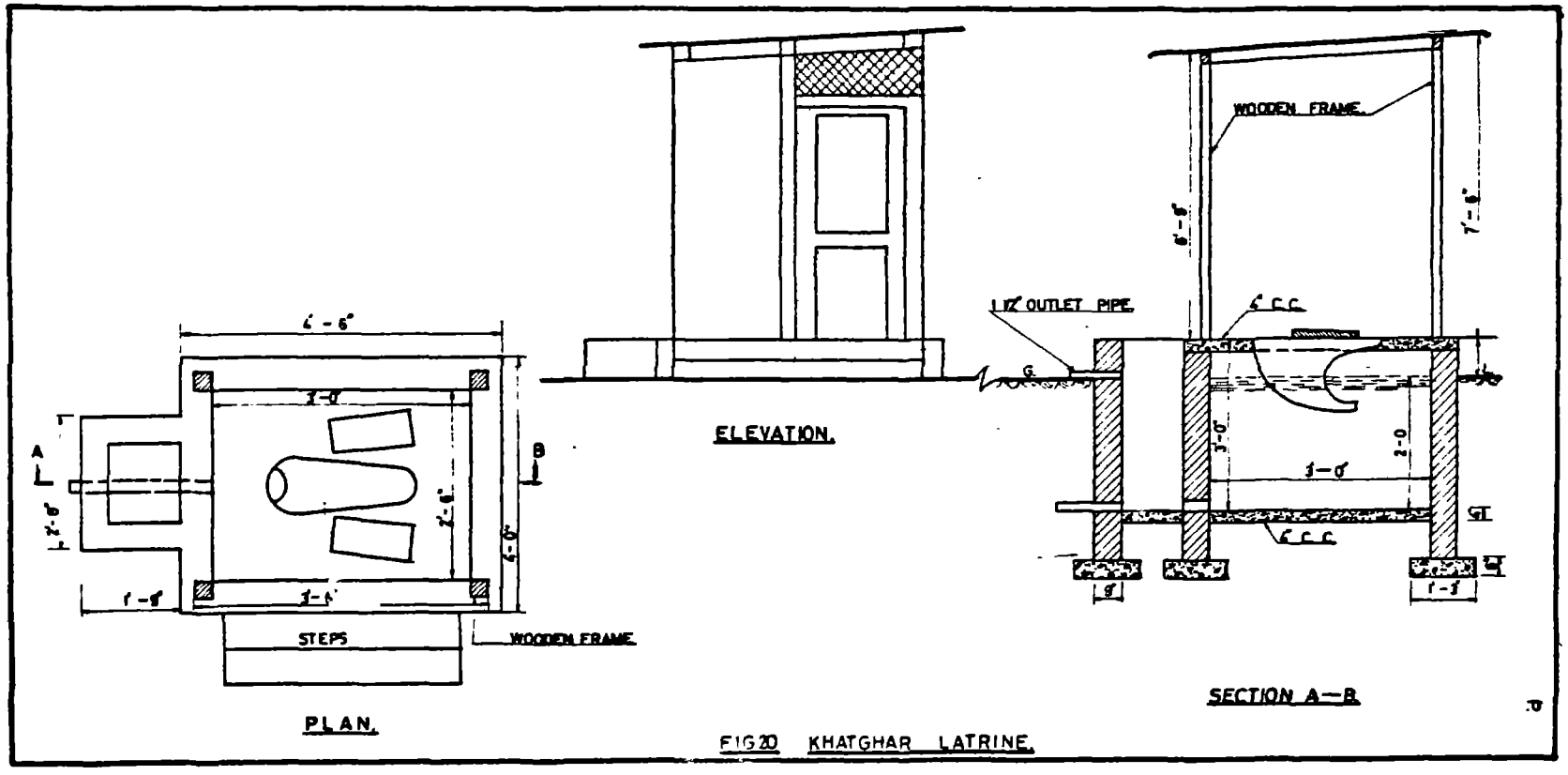


FIG 20 KHATGHAR LATRINE.

It is reported to be odourless and fly-free. It yields material that is used as fertilizer. But the mechanically operated self-flushing water seal device is liable to fall into disrepair in a rural area, and thereby lead to odour production and fly nuisance. However, a number of the khatghar latrines are reported to be functioning satisfactorily in the Maharashtra State of India.

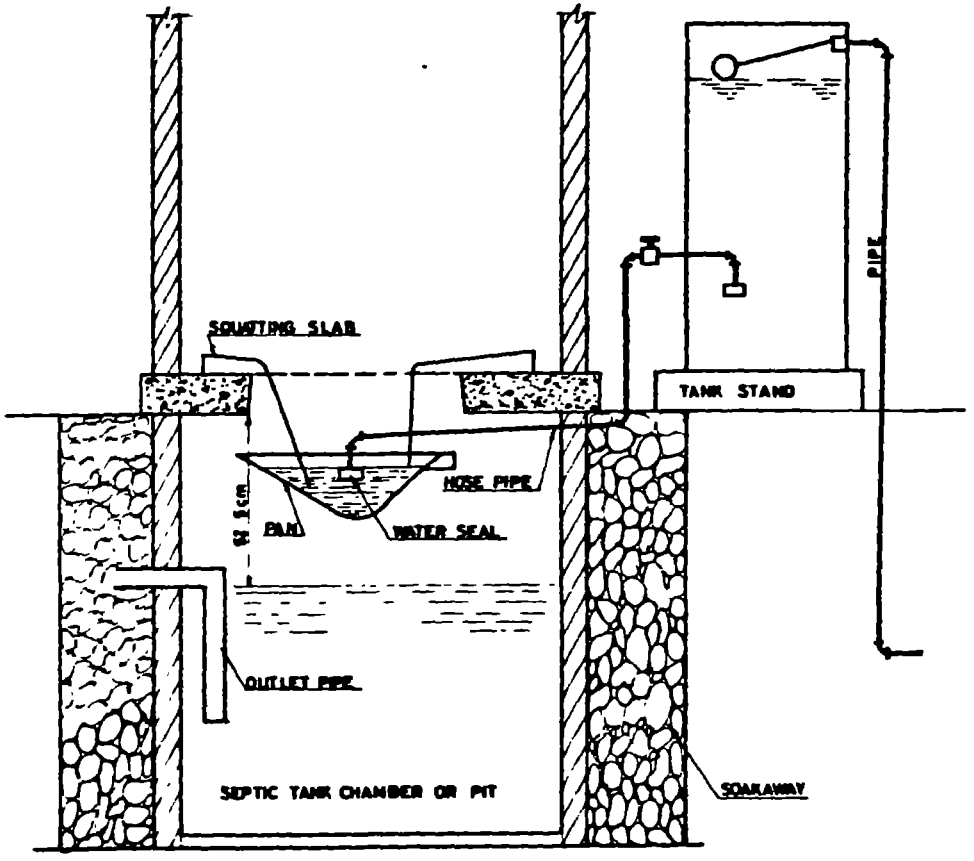
4.6.7 Watergate Self-Flushing Latrine

Developed by the Blair Research Laboratory in Rhodesia, this latrine relies on a water seal that is formed by water held in a pan beneath a wide chute. The pan is pivoted and counterbalanced so that it holds about 1.7 litres of water to form a seal around the lower rim of the chute. The addition of a further 1.7 litres of water or solids sets the pan off balance causing it to tip its contents into the septic chamber. The pan then returns and refils with water to form a new seal, and remains in such a state until further materials are added. It is illustrated in Fig. 21.

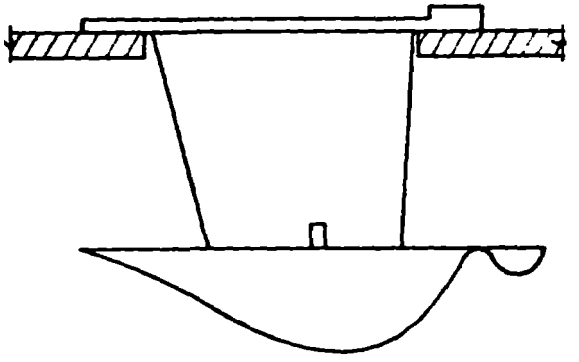
The device usually flushes once during two visits and requires approximately one litre of water per flush.

The "Watergate" unit is supported by a reinforced concrete slab with a central hole which is about 45 cm x 45 cm. The squatting pad section sits on the slab while the chute is suspended through the hole.

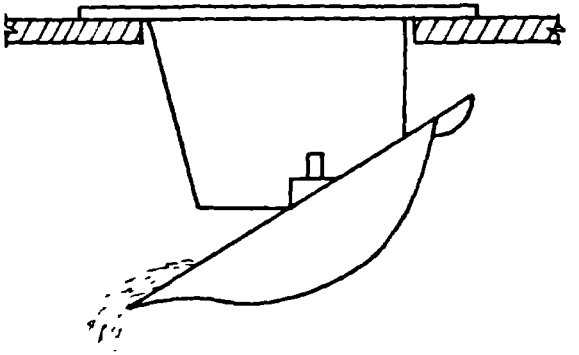
The form of the anaerobic chamber located immediately below the unit may vary. It may be a simple unlined earth pit where the



(Pit Volume: 0·05 m³ /person/year. Liquid Volume for Septic Tank : Up to 10 persons 1m³. Add 1m³ for each additional 10 persons.)



NORMAL POSITION OF PAN.



FLUSHING POSITION OF PAN.

FIG.7 : WATERGATE SELF FLUSHING LATRINE.

ground is stable, or it may be a pit lined with bricks or well-liners. Water-tight septic chambers may also be constructed out of appropriate materials.

The unit is supplied with water from a tank which may be installed at ground level, using a conventional ball valve.

Its advantages include the following: low installation cost, low water requirements, reliable, can accept any ablution material without blockage. Furthermore it prevents the escape of odours and the passage of flies to the excreted material.

4.4.6.8 Off-Set Pit Water Seal System - The RcA Latrine

An off-set pit water seal latrine has the following principal features:

(i) The latrine pan has a trap which maintains a water seal which can be flushed by hand.

(ii) The disposal system is a pit located outside the closet rather than directly below the pan and trap.

(iii) It has a connecting pipe which links the trap to the pit.

Developed in India, several types of hand flush off-set pit water seal latrines are available including the following: the PRaI latrine, the NEERI latrine, the I.C.M.R. latrine and the RcA latrine. Their principal features are the same, with only minor differences in geometry of the pan and trap. For this reason, it will be sufficient to describe only one of them, namely, the RcA latrine.

RcA Latrine: This latrine, which is shown in Fig. 22, is made up of a squatting plate, a pan, a trap, a disposal pit, and a short connecting pipe. The trap is designed to maintain a water seal of about 2 cm. Provision is made for two or three pits to be constructed, one at a time and connected in turn to the trap as the pits in use became filled up. Initially only one pit is constructed. It is lined with pottery rings, sand/cement rings, or soil/cement briquettes 7.5 cm wide by 7.5 cm deep by any suitable length. The pit is covered with a dome shaped concrete cover which can be reinforced with steel or bamboo. When the first pit is full, a new pit is dug, and the curved connecting pipe is turned from the old pit to the new pit. The pit cover from the old pit is also transferred to the new pit while the old pit is topped with soil. After about one year, the contents of the first pit are deemed to have been fully digested and suitable for use as fertilizer.

The advantage of this latrine include the following:

(i) The latrine floor is easily kept clean

(ii) The water seal eliminates odours and prevents access of the excreta to flies.

(iii) Only about 1.5 litres of water is required for flushing.

(iv) The materials for construction are few and readily available locally in many parts of the world.

(v) Technology for construction is easily acquired.

(vi) The cost of the latrine is reasonable.

(vii) Maintenance is minimal.

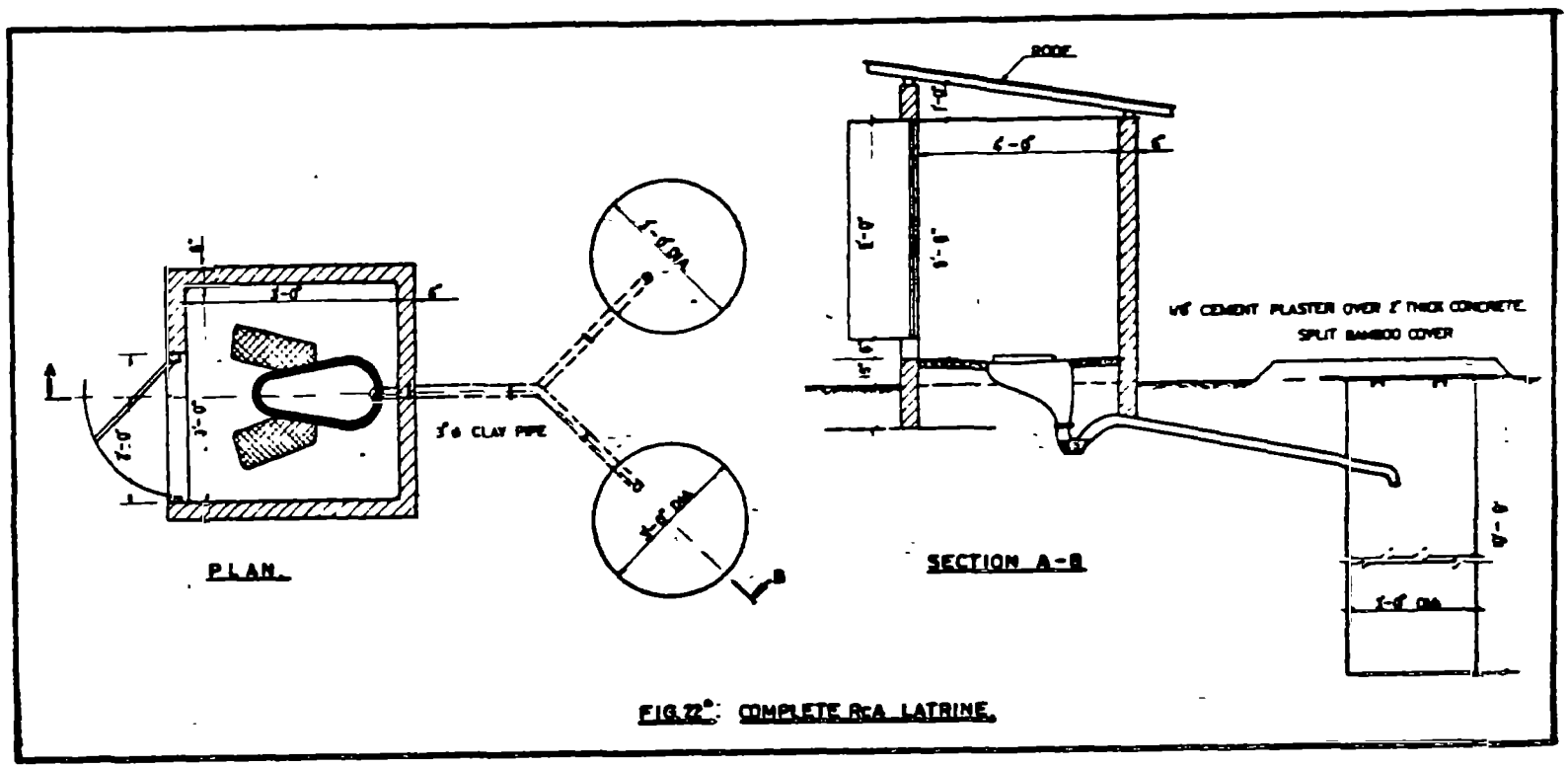
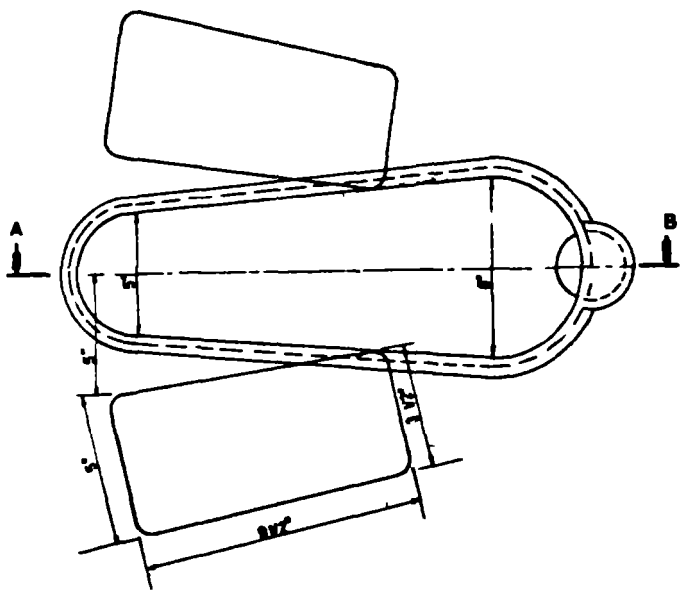
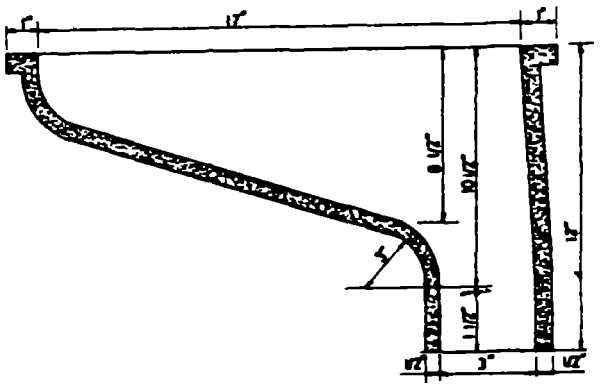


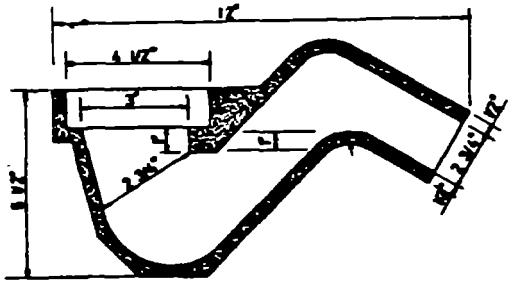
FIG 22: COMPLETE RCA LATRINE.



PLAN.



SECTION A-B



SECTION OF TRAP.

FIG. 22: RCA LATRINE: PAN AND TRAP.

(viii) Acceptability is high in places where it has been introduced.

Its disadvantages include the following:

(i) Since its operation depends on water, it is not suitable where water is scarce.

(ii) The need to remove the decomposed excreta from a filled up pit after some time has been found to create certain cultural problems. Even after a years storage, the old pit contents are found to have a high moisture content. This tends to make the removal of the pit contents a little messy.

(iii) It is designed to accept only excreta. Other household wastes - liquid or solid - are excluded.

A4.6.9 Septic Tank System

This is an on-site water-dependent system consisting of a defaecation unit, a short transfer system, a treatment unit, and a disposal system.

The defaecation unit typically consists of a glazed ceramic seating bowl or squatting plate fixed to a trap which maintains a water seal having a depth of 5-7 cm. Excreta fall directly into the water in the water closet bowl from which it is flushed out by about 10 litres of water through a short system of pipes and manholes into a treatment unit located in the vicinity of the closet.

The treatment unit is a buried water-tight tank known as a septic tank. It is used for the sedimentation of settleable solids,

anaerobic stabilization of biodegradable materials, and for the storage of solids in between desludging periods which, in properly designed and operating systems, may be at intervals of about five years.

The disposal system is typically a soil absorption system or a soakaway pit. Disposal into water is also done following further treatment in small trickling filters, oxidation ditches or in anaerobic upflow filters.

The system is hygienic, odourless, and fly-free. But its water requirements are high. It is also costly to install, a factor which keeps it out of the reach of the rural poor even though it is used by the well-to-do in some rural areas. Clogging of the soil/water interface in absorption fields leads to failure of the disposal system and the creation of nuisance. This problem may be overcome by the use of two parallel soil absorption systems used alternately. (After resting a clogged soil absorption system for about a year it recovers its infiltrative capacity).

A septic tank system with two parallel soakaway pits is illustrated in Fig. 23.

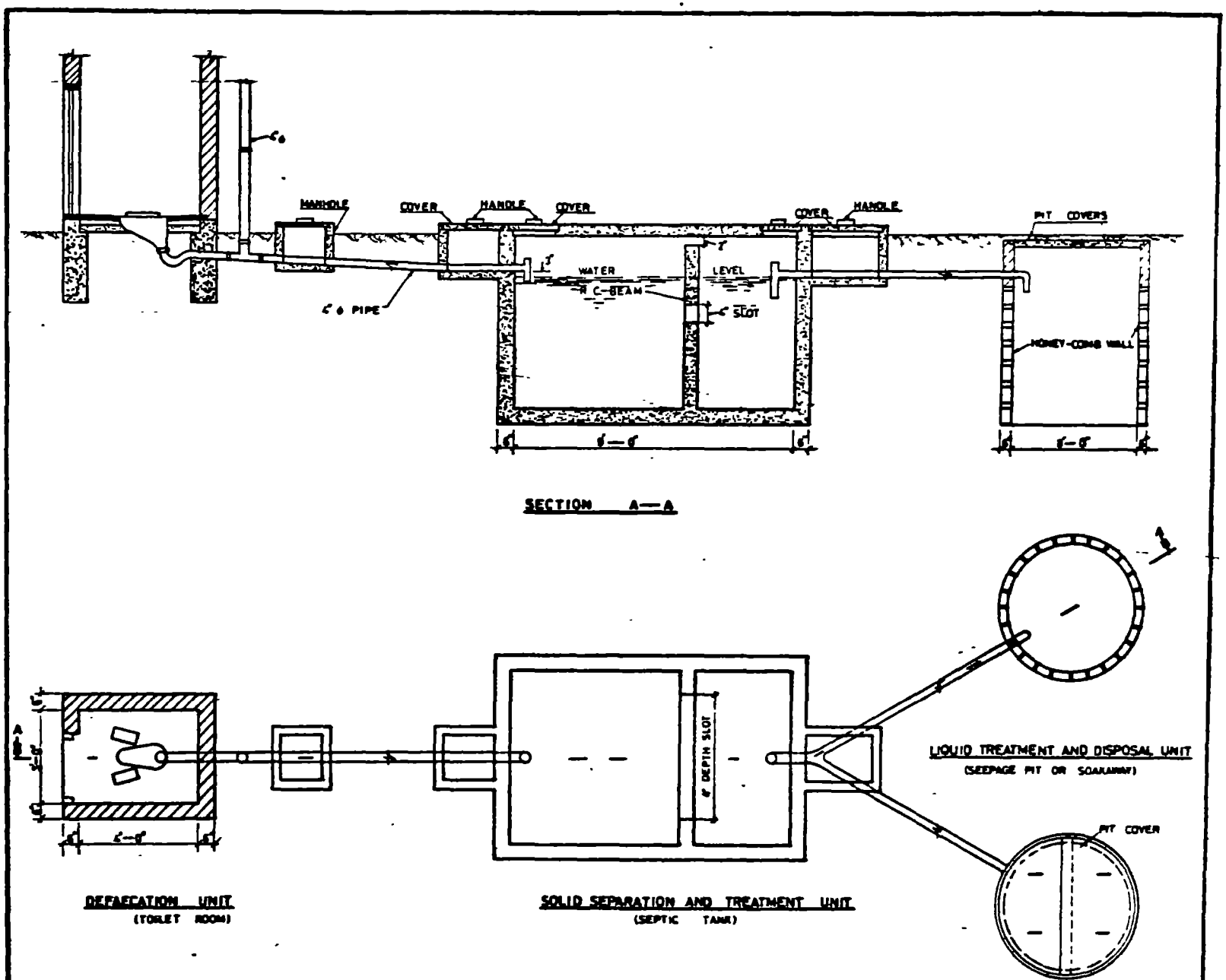


FIG. 23 SEPTIC TANK SYSTEM