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Indian Standard

CODE OF PRACTICE FOR SANITATION WITH LEACHING PITS FOR RURAL COMMUNITIES

UDC 628·423 : 006·76

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

 July 1988

Indian Standard

CODE OF PRACTICE FOR SANITATION WITH LEACHING PITS FOR RURAL COMMUNITIES

0. FOREWORD

0.1 This Indian Standard was adopted by the Bureau of Indian Standards on 20 November 1987, after the draft finalized by the Water Supply and Sanitation in Buildings Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 A large part of rural areas in our country is predominantly agricultural. The village forms the basis unit of community life. The income and affordable levels in rural areas are, however, generally lower than that in the urban areas, warranting a search for even lower cost options, necessitating change in engineering design and technology. Rural latrine schemes have been designed and implemented in different parts of India for over half a century by a number of organizations and institutions. There is, however, no uniformity in latrine designs and specifications. This standard is, therefore, prepared to specify optimum requirements for designing low cost sanitary latrines without sacrificing performance and taking into account socio-economic aspects, social and cultural habits, pollution aspects based on the past studies and experience gained.

0.3 Specification for pan has been separately covered in IS : 11246-1985*.

0.4 In the preparation of this standard, considerable assistance has been derived from the following publication:

> Report of the Committee on Design Criteria for Pour-Flush Waterseal Latrines in Rural Communities of India. The Technology Advisory Group India March 1985, Government of India/UNICEF/UNDP Project IND/84/016 — On Rural Sanitation.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960†. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Glass fibre reinforced polyester resin (GRP) squatting pans.

†Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This code covers the low cost latrines structure, method of safe storage and digestion of sludge and maintenance of such latrines.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Dry Pits — Pits where the ground water table is below the bottom of the pit throughout the year.

2.2 Wet Pits — Pits where the ground water-table is above the bottom of the pit.

3. LATRINE SUPERSTRUCTURE

3.1 Size — The minimum size of the latrine should be 750 × 900 mm while the preferable size should be 800 × 1 000 mm.

3.2 Flooring — Impervious floor should be provided to prevent moist condition. The surface of the floor should be smooth and slightly sloping towards the pan.

3.3 Foot Rests — The length of each foot rest should be 250 mm and width 120 mm. Foot rest should be about 25 mm above the floor level. Front portion of the footrests should be wider up to 150 mm and should be as close as possible to the pan. The foot rest may be made of ceramic, cement concrete, mosaic or bricks plastered smooth.

3.4 Superstructure — The superstructure over the latrine in institutions like schools, primary health centres, etc, should be in harmony with the other structures of the institution. In the household, it should be low cost structure and in conformity with the type of construction of the house. Where concrete or brick superstructure is unaffordable, it may be made of:

a) Mud walls with thatched or tiled roof;

b) Thatch walls with thatched roof;

c) Bamboo matting with bamboo frame and thatched roof; and

d) In hills, walls of slates or small stone pieces and roof of slates.

4. LEACHING PITS

4.1 Design of Leaching Pits

4.1.1 Leaching pits serve the function of storage and digestion of excreted solids and infiltration of the waste water solids. Leaching pits are designed on the basis of the following parameters:

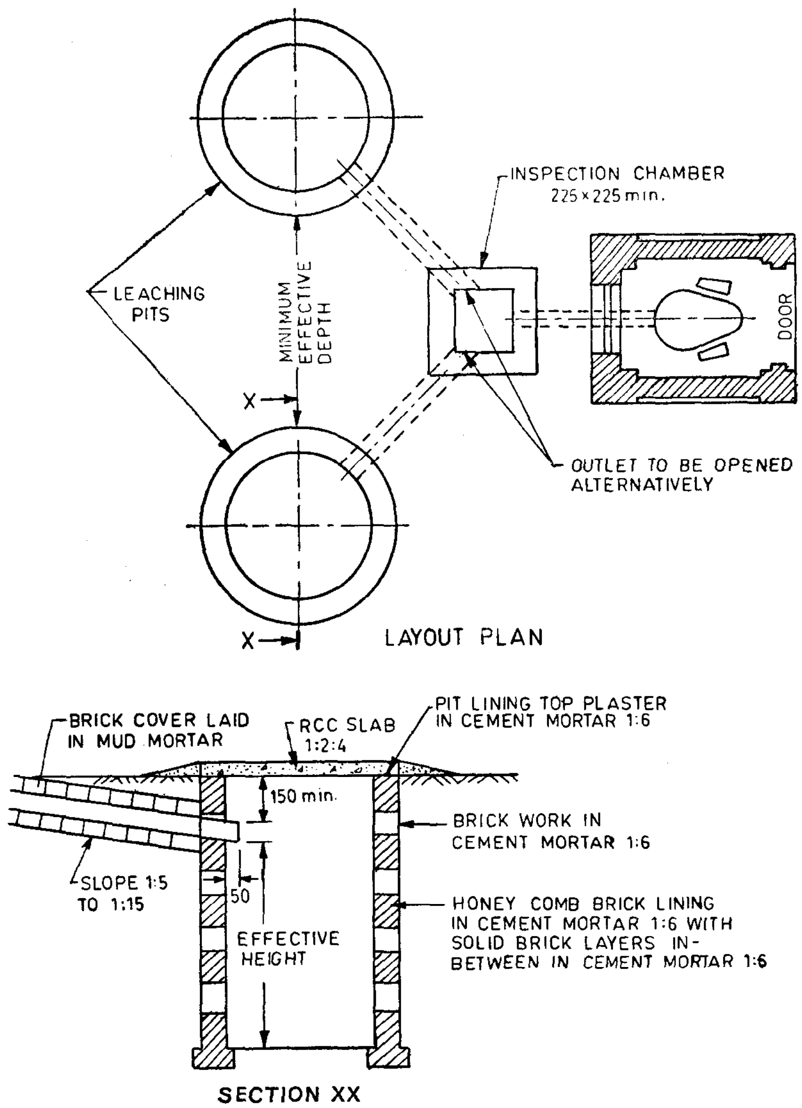
a) The solid accumulation rate,

b) The long term infiltration rate of the liquid fraction across the pit soil interface,

c) Hydraulic loading of the pit, and

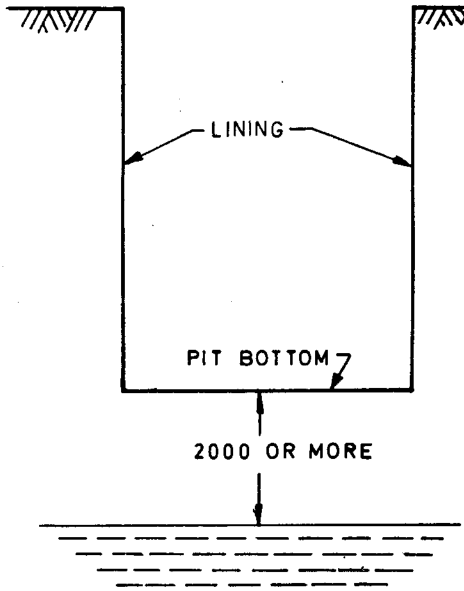
d) The minimum period required for effective pathogen destruction and optimal emptying frequency.

A typical sketch for leaching pits is shown in Fig. 1 and for different soil conditions, typical details of envelops are shown in Fig. 2.



All dimensions in millimetres.

Fig. 1 Typical Sketch of Leaching Pits

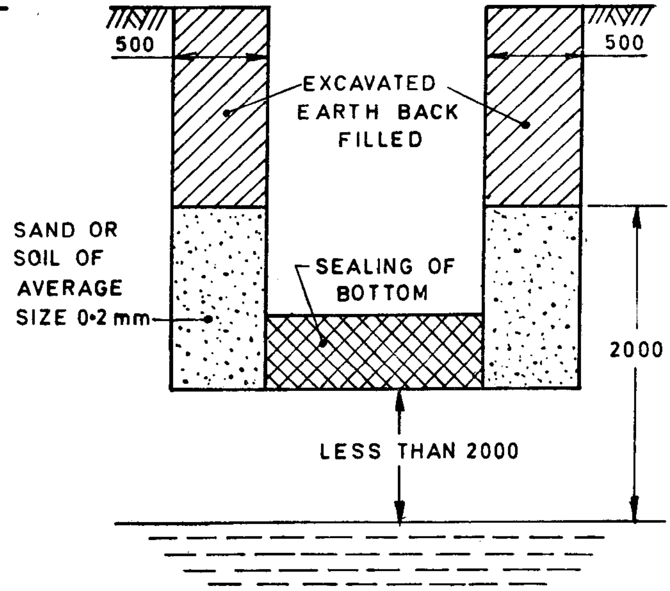


CASE-1

DRY PIT

Water table 2 000 or more below bottom of pit (maximum ground water level reached any time during the year).

No sand envelope or bottom sealing needed.

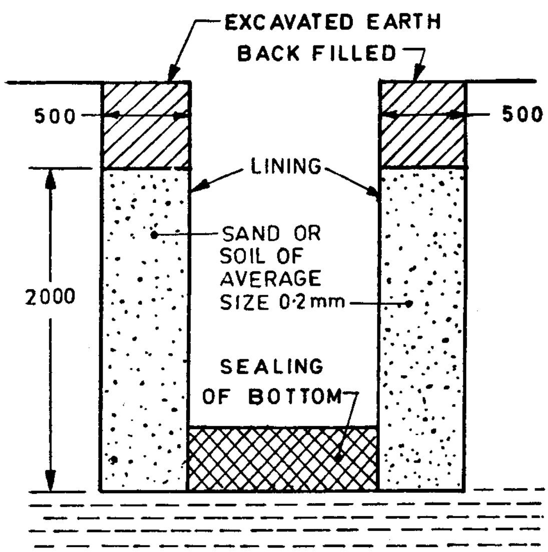


CASE-2

DRY PIT

Water table less than 2 000 below the bottom of pit (maximum ground water level reached any time during the year).

Sand or soil envelope alround the pit up to 2 000 height from maximum water-table and bottom to be sealed.

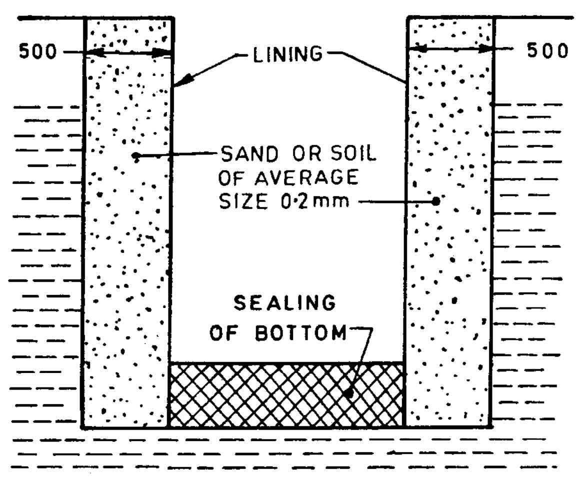


CASE-3

WET PIT

Water table at the bottom of the pit (maximum ground water level reached any time during the year).

Sand or soil envelope alround the pit up to 2 000 height from highest water table and sealing of bottom needed.



CASE-4

WET PIT

Water table above the bottom of the pit (maximum ground water level reached any time during the year).

Sand envelope alround the pit and sealing of bottom needed.

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 15 mm wide.

All dimensions in millimetres.

FIG. 2 TYPICAL DETAILS OF ENVELOPE AROUND LEACHING PITS

4.1.2 *Solid Storage Volume* — The local soil and hydrogeology affects the design of the pit. The solids accumulation rate is function of a wide range of variables including water table level, pit age, water and excreta loading rate, microbial conditions in the pit, and temperature and local soil conditions. Where the distance between bottom of the pit and the maximum ground water level throughout the year is 2 metre or more (*see* Fig. 2), the solid accumulation rate may be taken as 0·04 m^3 per capita per annum. A typical design example of dry pit is given in Appendix A.

Where the ground water table is above the bottom of the pit (*see* Fig. 2) and in soils with low permeability, like clay, there will be progressive build-up of liquid in the pit due to reduction of the effective area and the lesser driving head for percolation and ultimately the liquid build up will reach the level of inlet to the pit. In such hydrogeological conditions, the life of the pit is governed by the total liquid and solid accumulation in the pit. Recommended design values for solids accumulation rate is given in Table 1 A typical design example of wet leaching pit is given in Appendix A.

TABLE 1 RECOMMENDED VALUES FOR SOLIDS ACCUMULATION

Desludging Interval Years	Volume m^3 per Capita per Annum
(1)	(2)
2	0·095
3	0·067
4	0·051
5	0·041
6	0·035

4.1.3 *Long Term Infiltration Rate* — On account of clogging of soil pores around the leaching pits, infiltrative capacity of the soil is always less than the percolative capacity. Recommended maximum effluent loading rates of the long term infiltrative capacity are given in Table 2.

TABLE 2 MAXIMUM EFFLUENT LOADING RATES

Sl No.	Soil Type	Long Term Infiltrative Loading Rate Litres per m^2 per Day
(1)	(2)	(3)
1.	Sand	50
2.	Sandy loam, loams	30
3.	Porous silty loams, porous clay loams	20
4.	Compact silty loams, compact silty clay loams, clay	10

4.1.4 *Emptying Frequency* — A minimum of two year storage volume should be provided. A free space of at least 150 mm should be left at the top of the pit above the invert level of the pipe or drain. There should be sufficient resting time while the pit is essentially empty for the regeneration of the infiltrative surface; approximately one month is required for aerobic bacteria to oxidize the compounds responsible for clogging the pit soil interface; so the infiltrative capacity of the leach pit is restorted to close to its original value.

4.2 Number of Pits — Single leach pits are appropriate only if they can be desludged mechanically by a vacuum tanker since their contents contain pathogen. Twin leach pits are recommended where pits are to be desludged manually as the resting period ensures the material to be removed is not hazardous to handle.

Note — Both the pits should be constructed simultaneously where these are to be cleaned manually since sometimes second pit may not be constructed in time and after the first pit got filled up, the latrine will become unserviceable.

4.3 Shape — The shape of the pit may be circular, square/rectangular or a combination of the two. However, circular pits should be preferred as these are more stable and cost less.

4.3.1 The ratio of diameter to depth of pit is an important factor. The greater the depth, more is the cost of excavation, lining and cleaning while bigger the diameter, more is the cost of cover. The economical depth and diameter ratio should be worked out for every region based on the rates of labour and material.

4.4 Spacing Between Two Pits — The minimum space between the two pits should be equivalent to at least the effective depth of the pit. The spacing between the two pits can be reduced by providing a barrier like cut-off screen or puddle wall.

4.5 Siting of Pits — The ideal position of locating the pits is that the pits are placed symmetrically at the back side of the latrine pan. However, if site conditions do not permit this layout, the pits may be placed on the sides or even in front of the pan.

4.6 Distance of Leaching Pits from Existing Structure — In many cases, the space available for constructing leaching pits may be small and placement of pits near existing structures may be unavoidable. The digging of pits and subsequent seepage may disturb the soil around the pits. The distance of the leach pits from foundations of existing building depends upon the soil characteristics, depth as well as type of foundation of the building and the depth of leaching pits. The minimum safe distance of leaching pits from foundation structure in different types of soil and depth of leaching pits for a two storeyed building are given in Table 3.

TABLE 3 MINIMUM DISTANCE OF LEACHING PITS FROM EXISTING FOUNDATION STRUCTURE

(*Clause* 4.6)

Type of Soil	For Pits Within Premises		For Pits Outside Premises	
	Total Depth of Pit m	Distance of Pit from the Existing Structure m	Total Depth of Pit m	Distance of Pit from the Existing Structure m
(1)	(2)	(3)	(4)	(5)
Clayed sand (sand 50%)	1·30	0·22	1·96	0·54
	1·73	0·43	2·27	0·72
	2·05	0·60	2·56	0·88
Sandy clay (clay and silt 50%)	1·30	0·32	1·96	0·80
	1·73	0·60	2·27	1·06
	2·05	0·88	2·56	1·30

4.6.1 However, in cases where the leaching pits are quite close to the existing building foundation, the opening in the brick work lining of the leaching pit may be reduced to 12-15 mm.

4.7 Location of Pits in Depressions or Water-Logged Areas — Location of pits should be avoided, as far as possible, in depressions where waste water or rain water is likely to remain collected alround and over the pits. If it cannot be avoided or the pits are to be constructed adjacent to ponds or tanks, the top of pits should be raised by 0·6 to 0·8 m above the ground level and earth filling be done alaround the pits up to a distance of 1·5 m right up to the pit top. The raising of the pit may necessitate raising of the latrine floor also.

4.8 Lining of Pits — The pits should be lined. Lining should be with honey-comb brick work, stones or laterite bricks or ferro-cement. Burnt clay or concrete rings with perforations may also be used. Lining should be done with treated bamboos or blanks or tar drums also but the life of such lining is limited.

4.8.1 The lining of bricks should be in honey-comb brick work with appropriate number of rings of solid brick layer at suitable intervals in between. The thickness of brick lining should be 75 mm for pits within premises and 115 mm for pits outside the premises. The brick work should be either in cement mortar 1 : 6 or lime or any other suitable mortar of equivalent strength. As an alternative if it is economical, the lining should be done in 115 mm width in pits within premises with honey-comb brick work with no mortar; however, solid rings would be in cement mortar 1 : 6. In stone masonry, the vertical joints should be kept open, that is, should not have mortar. The size of the holes in honey-comb brick work will be the height of brick layer and one third length of the brick. However, in case the soil is sandy or sand envelope is provided or where the foundation of the building is very close to the pit, the width of openings should be reduced to 12 to 15 mm that is vertical joints of brick work should not have any mortar. A ring of solid brick layer in cement mortar 1 : 6-115 mm width in 75 mm thick lining and 225 mm in 115 mm thick lining should be provided as foundation below the bottom of the pit. A solid layer of brick work in mortar may also be provided over the foundation layer. The lining above the invert level of drain or pipe (entering the pits) up to the bottom of pit cover will also be in solid brick work, that is, without any openings.

4.8.2 In black cotton soils, a vertical fill 300 mm in width with gravel or ballast should be provided alround the pit outside the lining.

5. PIT COVER

5.1 Where the space permits, the leaching pits should be constructed within the premises of the households as it would be economical as well as facilitate their cleaning. However, where, due to space constraints, construction of pits within the premises may not be possible, pits may be constructed in places like lanes, streets and roads. The cover for pits located inside the premises should be designed for bearing an anticipated live load.

5.2 The pit covers may be of reinforced cement concrete, stone slabs, treated wooden planks or bamboos. Selection of material for pit covers will depend upon the cost, availability and site conditions.

6. REMOVAL AND UTILIZATION OF PIT CONTENTS

6.1 After one pit is filled up, the flow is diverted to the second pit. The contents of the filled up pit are then allowed to digest and remain undisturbed for a period of at least two years, when it will not be hazardous to handle the digested humus.

7. COMMUNITY LATRINES

7.1 Properly maintained community latrines, preferably a latrine for a group of houses, could be provided for the households where space for construction of individual latrines is not available. Number of seats to be provided may be determined on the basis of one seat for every 10 persons in case of shared latrines and 20 persons in case of community latrines.

8. EDUCATION

8.1 It has been observed that even after the construction of latrine in the household, all the members of the family do not use the latrine. The pan is not cleaned, resulting in the development of black spots and calcarious deposits. For flushing, usually 1·5 to 2 litres of water is required but since the householder does not keep a can of the required capacity, the flushing is normally done by buckets. It is, therefore, very essential that the people are educated in using and properly maintaining the latrines. Every household getting the latrine should keep (a) a brush having a long handle for cleaning the pan, (b) a can of 2 litre capacity for flushing, and (c) a set of instructions for proper use and maintenance of the latrine. Since in rural areas, the households do not have tap connection and even where there is a connection, the supply is only for a few hours, a small container, say of 25 litre capacity, to store water for ablution and flushing may also be kept outside the latrine. This container may be filled in daily. It will ensure easy availability of water for latrine use and flushing. Similarly, a container of about 100 litres capacity may be provided in the institution.

9. SAFE DISTANCE FROM DRINKING WATER SOURCES

9.1 In unsaturated soil conditions, that is, where the distance between the bottom of the pit and the maximum ground-water level throughout the year is 2 m and more:

a) The pits can be located at a minimum distance of 3 m from the drinking water sources such as tubewells and dugwells if the effective size (ES) of the soil is 0·2 mm or less; and

b) For coarser soils (with ES greater than 0·2 mm), the same distance can be maintained if the bottom of the pit is sealed off by an impervious material, such as puddle clay or plastic sheet, and a 500 mm thick envelope of fine sand of 0·2 mm effective size is provided alround the pit.

9.2 In wet pit or saturated soil conditions, that is, where the distance between the bottom of the pit and the maximum ground-water level during any part of the year is less than 2 m:

a) The pits can be located at a minimum distance of 10 m from the drinking water sources, such as tubewells and dugwells if the ES of the soil is 0·2 mm or less; and

b) For coarser soils (with ES more than 0·2 mm), minimum distance of 10 m should be maintained if the pit is sealed off by an impervious material, such as puddle clay or plastic sheet, and a 500 mm thick envelope of fine sand of 0·2 mm effective size is provided allaround the pit.

9.3 In both the cases **9.1**(b) and **9.2**(b):

a) The sand envelope should be taken at least up to 2 m above the possible highest maximum water level and edges chamfered to see that no water stagnates on top of the sand filling.

b) Where the bottom of the pit is submerged below the maximum ground-water level:

   i) The top of the pits should be raised above the ground level, if necessary, so that the inlet pipe into the pit is at least 0·75 m above the maximum ground water level;

   ii) The sand envelope is taken up to 0·3 m above the top of the inlet and confined suitably to exclude any surface drainage including rain water directly entering the sand envelope;

   iii) In mound type latrines, 1 m high earth filling should be provided for at least 0·25 m beyond the sand envelope with the edges chamfered to lead away the rain or surface water; and

   iv) The honey-comb brick work for the pit lining should be substituted by brick work in cement mortar 1 : 6 with open vertical joints, that is, without mortar.

10. SAFE DISTANCE FROM WATER SUPPLY MAINS

10.1 Lateral distance between the leaching 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 pipes should be completely encased to a length of at 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 should be kept at least 1 m below the existing water mains. This would ensure that the liquid level in the pits does not reach the level of the water main.

The water pipe should not cut across the pit but where this 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. No joint of water main should be permitted in the pit.

APPENDIX A

(*Clause* 4.1.2)

LEACH PIT DESIGN

A-1. DRY PIT

A-1.1 Design Example of Twin Leach Pit for 10 Users.

A-1.1.1 *Assumptions*

a) Water needed for anal cleansing per use per member of the family is 1½ litres,

b) The latrine is used for excretion twice a day by each family member,

c) Water needed for flushing after every use is 2 litres,

d) Water needed for flushing urine (only when urine is passed) is one litre per member per day,

e) Average urine + excreta production per day per members is 1½ litres,

f) The water table remains 2 metres or more below ground level throughout the year,

g) The local soil is sandy loam or loam, and

h) The pits have been designed for 2 years capacity.

A-1.1.2 The solution is as follows:

The waste water flow (q) in litre per capita per day (*lcd*).

$$q = N_f (V_w + V_c) + (V_f + V_u) + (aN_u V_v)$$

$$q = 2 (2 + 1{\cdot}5) + 1{\cdot}5 + (1 \times 1 \times 1)$$

$$q = 9{\cdot}5 \; lcd$$

where

q = volume of water reaching the leach pit litres per capita per day (*lcd*);

N_f = number of times faeces passed per day (usually two);

V_w = volume of flushing water, litres per flush (usually 2 litres per usage);

V_c = volume of Water used for anal cleansing, litres per cleansing (usually 1·5 litres per cleansing);

V_f = volume of faeces passed, *lcd* (approximately equivalent to the wet weight of faeces in kg/day; typical values lie between 0·25 and 0·35);

V_u = volume of urine produced, *lcd* (typically 1·2);

a = 1 if the toilet is flushed after urine is only pased;

= 0 if it is not;

N_u = number of times urine passed per day by a person; and

V_v = volume of water used for flushing when only urine is passed (usually one litre per day).

The total waste water flow (Q) in litres per day (adding 5 litres for latrine floor washing and pan cleaning):

$$Q = 10 \times 9{\cdot}5 + 5 = 100 \text{ litres per day}$$

Assuming a pit of 1 000 mm internal diameter (inside lining 75 mm thick with brick on edge and effective depth 1 000 mm), check for infiltrative surface area (A_j)$_2$ which is given by:

$$A_j = \pi dh$$

where d is the external diameter and h is the effective depth of the pit.

$$A_j = \pi \times 1{\cdot}15 \times 1 = 3{\cdot}61 \text{ m}^2$$

If the soil is sandy loam or loam, the infiltrative area required is 100/30 that is, 3·33 m²; hence the infiltrative area provided is sufficient.

The solids storage volume (V), assuming solids accumulation rate as 0·04 m³ per capita per year for a dry pit with water being used for anal cleansing and for a desludging interval of 2 years and a household size of 10 persons:

$$V = 0{\cdot}04 \times 2 \times 10 = 0{\cdot}8 \text{ m}^3$$

$$\text{Volume of pit proposed} = \pi \times \tfrac{1}{4} \times 1 \times 1 = 0{\cdot}79 \text{ m}^3$$

Hence, the pit proposed has sufficient storage capacity.

A-2. WET PIT

A-2.1 Design Example of Twin Leach Pit for 10 Users

The ground-water table is 500 mm below the ground surface but all other assumptions are the same as in the above example.

The pit size is determined by taking the sludge accumulation rate from Table 1. Assuming the pit desludging period as 2 years:

$$\text{Volume of pit} = 0{\cdot}095 \times 2 \times 10 = 19 \text{ m}^2$$

Allowing a free board of 0·225 m, pit dimensions come as follows:

Internal diameter	1 500 mm
Total depth	1 400 mm

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