SRI LANKA STANDARD 745 : PART 1 : 2004

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CODE OF PRACTICE FOR

THE DESIGN AND CONSTRUCTION OF SEPTIC TANKS AND ASSOCIATED EFFLUENT DISPOSAL SYSTEMS

PART 1 – SMALL SYSTEMS DISPOSING TO GROUND

(FIRST REVISION)

SRI LANKA STANDARDS INSTITUTION

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Sri Lanka Standards are subject to periodical revision in order to accommodate the progress made by industry. Suggestions for improvement will be recorded and brought to the notice of the Committees to which the revisions are entrusted.

This standard does not purport to include all the necessary provisions of a contract.

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CODE OF PRACTICE FOR THE DESIGN AND CONSTRUCTION OF SEPTIC TANKS AND ASSOCIATED EFFLUENT DISPOSAL SYSTEMS
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FOREWORD

This Sri Lanka Standard code of practice was approved by the Sectoral Committee on Building and Construction Materials and was authorized for adoption and publication as a Sri Lanka Standard by the Council of the Sri Lanka Standard Institution on 2004-08-18.

This Standard was first published in 1986. This is the first revision and is presented in two parts, Part 1 is applicable to small systems disposing effluent into the ground (soakage / soil absorption systems) and Part 2 for larger systems and for systems disposing effluent to the surface or for onsite effluent reuse (to be developed later). This code of practice is intended to serve as a guide for the design and construction of septic tanks and associated effluent disposal systems in Sri Lanka. It is intended for use by consultants, designers, manufacturers, certifying bodies, installers and regulators.

Septic tanks are widely used in Sri Lanka for the disposal of domestic wastewater. At present, at least 80 per cent of the urban and suburban population of Sri Lanka use septic tanks. However, unless a septic tank and associated effluent disposal system are properly designed and implemented, failures occur with consequent aesthetic nuisance, public health hazard and environmental pollution.

In the past, the most common single cause of failure of septic tank systems in Sri Lanka has been the indiscriminate application of soakage pits for the disposal of septic tank effluents into the ground. This has often been done without due consideration to local soil conditions, groundwater table and urban congestion leading to widespread failures. Often, this has been due to the lack of awareness of implementers and regulators of appropriate alternative cost-effective means of effluent disposal. This code attempts to rectify this situation by providing detailed guidelines for the proper selection and implementation of such systems.

SI units are used throughout this code.

The word “shall” has been used as an imperative in this code and conditions which are preceded by “shall” are mandatory requirements, which must be complied with in order to claim compliance with this Code.

The word “may” has been used as a discretionary term in this code and conditions associated with “may” are not compulsory requirements as far as this Code is concerned.

Pipe diameters specified in this code refer to the internal diameter of pipes.
In the preparation of this standard Code of Practice the assistance derived from the publications of the British Standards Institution, Standards Australia and Standards New-Zealand are gratefully acknowledged.

1. SCOPE

Part 1 of this Code of Practice covers the design, construction, testing and maintenance of septic tanks for the disposal of domestic wastewater including allwaste, blackwater and greywater systems for small installations disposing effluent into the ground and is limited to systems producing an average daily effluent flow of 5 m^3/day or less.

Part 1 also recommends guidelines for the selection, design, construction and maintenance of soakage systems for the on-site disposal of effluent from septic tanks into the ground. The systems recommended are soakage pits, seepage trenches, and seepage beds.

Where such systems are found to be inapplicable within the stipulations of this code, or where effluent is to be disposed to the surface or reused on-site, Part 2 of this Code shall apply.

NOTE : *In general, the systems covered under Part 1 are applicable where the seasonal high groundwater table is greater than 1.5 m below the surface, the soil percolation rate is between 25 mm/h and 250 mm/h., and the ground slope is less than 25 percent.*

2. DEFINITIONS

The following definitions shall apply for the purpose of this Code:

2.1 access opening : An opening on the top of the tank fitted with a removable cover to allow access for desludging and other maintenance activity.

2.2 allwaste : Combined blackwater and greywater.

2.3 blackwater : Waste discharged from the human body through toilets and urinals.

2.4 desludging : The removal of accumulated scum and sludge from a septic tank.

2.5 domestic wastewater : Wastewater originating from household and personal activities including toilets, baths showers, sinks, kitchens and non-commercial laundries. This includes such wastewater from homes, schools, shops, offices, hotels, etc., while specifically excluding wastewater from industrial processes.

2.6 effluent: The liquid discharged from a wastewater treatment unit (e.g. septic tank).

2.7 freeboard : The height of the air space between the liquid level and the ceiling of a tank.

2.8 greywater: Domestic wastewater from baths, showers, washbasins, kitchens etc., other than blackwater.

2.9 groundwater table : The level below the ground surface at which groundwater is first encountered during excavation.

2.10 influent : The wastewater entering a tank or treatment unit.

2.11 inlet : The device through which influent is fed into a tank or treatment unit during normal operation.

2.12 inspection port : An opening in the top of a tank which allows inspection of the contents.

2.13 invert : The lowest point on the inside of a pipe or drain at a given cross section.

2.14 liquid depth : The distance between the liquid level and the inside bottom of a tank.

2.15 liquid level : The liquid level in a tank during normal operation of the tank.

2.16 outlet : The device through which effluent leaves a tank or treatment unit during normal operation.

2.17 partition : An internal wall which separates compartments of a tank or treatment unit.

2.18 scum : The floating mass of solids which form an accumulating layer on the liquid surface inside a septic tank.

2.19 seepage bed : A bed of prepared aggregate (i.e. gravel, broken stones or similar inert material) through which effluent is allowed to seep into the ground.

2.20 seepage trench : A trench filled with prepared aggregate (i.e. gravel, broken stones or similar inert material) through which effluent is allowed to seep into the ground.

2.21 septic tank : A single or multiple-chambered tank in which wastewater is retained sufficiently long to permit separation of solid particles and partial digestion of accumulated solids.

NOTE : *Septic tank alone, does not constitute a complete effluent treatment system.*

2.22 serviceable life : The period of time in which a unit performs satisfactorily with only normal and routine maintenance.

2.23 sewage : Any wastewater, including all faecal matter, urine, household and commercial wastewater that contains human waste.

2.24 sludge : Settled solids in a semi-liquid state.

2.25 soakage pit : A pit from which septic tank effluent is allowed to seep into the surrounding soil.

2.26 vent : A device, usually a pipe, which allows gases to escape from a wastewater treatment unit.

2.27 wastewater : The spent or used water of domestic or commercial origin which contains dissolved and suspended matter.

2.28 working capacity : The volume of wastewater that would be contained in a tank during normal use.

3. INFORMATION REQUIRED

Prior to proceeding with the design, the following information shall be gathered. Accurate site information and assessment is vital to avoid failure of septic tank systems.

3.1 Intended use of building

The intended and/or current use of the building shall be identified (e.g. individual home, shop, office building, etc.). Possible future uses, which could differ from the current use, should also be identified as, usually, septic tanks are not refitted when buildings undergo change of usage.

3.2 Number and type of users

The maximum number of users who would reasonably be expected to use the building and facilities on a daily basis shall be estimated as accurately as possible. It should be noted that septic tank systems shall be designed for the **maximum** and not the **average** number of daily users. In the case of separate dwelling units, the number of estimated users shall be at least 5.

In the case of commercial buildings, the number of each type of users such as residents, day-time users, visitors, customers, service staff etc. shall be determined.

3.3 Site plan

A site plan and layout of the building/s and facilities shall be obtained. The plan should show all relevant details such as building outlines, location of water sumps, wells, property boundaries, street lines, etc.

3.4 Natural drainage and ground water table

The natural drainage features of the site shall be assessed, either by means of a contour plan of the site or by visual assessment or both. Storm water drainage paths should be identified. The highest seasonal level of the local groundwater table shall be determined. This could be done either by observing water levels in wells on the site or in the immediate vicinity, or by digging trial pits to determine the location of the groundwater table. Information on seasonal variation of the local groundwater table can often be obtained by interviewing residents in the locality.

3.5 Soil conditions

The soil shall be explored to sufficient depth to ascertain the soil types, grading structure, stability and permeability. A percolation test shall be carried out as described in Appendix **A**.

3.6 Elevations

Invert elevations of all wastewater outlets from the building shall be determined, together with any external factors which might affect the invert elevation of the inlet to the septic tank.

3.7 Existing soakage pits

The locations and size of any existing soakage pits in the vicinity shall be noted.

3.8 Neighbourhood land use and environment

The land use and local environmental conditions in the immediate neighbourhood of the site shall be investigated and relevant details noted (e.g. presence of any drinking water wells in the immediate vicinity; presence of any streams used for drinking / bathing downstream; likelihood of local flooding etc.).

4. FLOW ESTIMATION

The average daily flow of wastewater to the system shall be estimated as accurately as possible. In the absence of more accurate information, the flow shall be estimated for each category of user by multiplying the maximum number of users in each category by the respective per capita daily flows. The average daily flow is the summation of the flows of all the contributory user categories.

The per capita daily flow for each category of user is given in Table **1** below.

Example computations of average daily flow based on Table **1** are given in Appendix **B.**

TABLE 1 - Per capita daily flows for different user categories

User Category		**Per Capita Wastewater Flow (litres/person/day)***		
		Allwaste	**Blackwater**	**Greywater**
Houses, Housing estates and Apartment Complexes				
Luxury	- Residents	240	60	180
Non Luxury	- Residents	200	50	150
Low income	- Residents	160	40	120
Shops, Offices, etc.	- Daytime employees	50	30	20
	- Overnight employees	200	50	150
	- Customers / Visitors	10	5	5
Schools, Universities, etc	- Residents	200	50	150
	- Daytime	50	30	20
Restaurants (dine-in)	- Overnight employees	200	50	150
	- Day-time employees	50	30	20
	- Meals served	25 l/meal	10 l/meal	15 l/meal
Restaurants (take-away)	- Overnight employees	200	50	150
	- Day-time employees	50	30	20
	- Meals served	15 l/meal	N/A	15 l/meal
Hotels	- Guest	240	60	180
	- Staff (residential)	200	50	150
	- Staff (non-residential)	100	50	50
	- Kitchen	15 l/meal	N/A	15 l/meal
	- Swimming pool	10 l/user/d	N/A	10 l/user/d

*Except where otherwise shown

5. DESIGN

5.1 Process selection

a) In the past, the indiscriminate use of soakage pits for the disposal of septic tank effluent without due consideration to local site conditions has resulted in the failure of a large number of septic tank systems. The proper selection of an appropriate effluent disposal process is essential to the satisfactory functioning of a septic tank.

b) This Code of Practice recommends the use of soakage pits, seepage beds and seepage trenches, for the disposal of septic tank effluent into the ground. Where these options are not possible within the guidelines stipulated, Part 2 of this code shall be applicable.

5.2 Septic Tanks

5.2.1 General

a) The main function of a septic tank is to separate, retain and partially digest, settleable and floatable solids in wastewater. The working capacity of a septic tank shall be sufficient for all these functions to occur.

b) Septic tanks shall be water-tight, with sufficient structural strength and integrity to withstand external soil pressures, internal and external water pressures and any likely imposed loading. Septic tanks situated under driveways and parking areas shall be designed to carry the appropriate vehicle loads.

5.2.2 Location

a) Septic tanks shall be located in an open area wherever possible. However they may be located under car parks, driveways, terraces etc., in order to save space, provided due consideration is given to the structural integrity of the tank and adjacent features.

b) Sufficient access to the tank shall be available for inspection and desludging activities.

5.2.3 Tank geometry

a) The preferred geometry of a septic tank is rectangular, with length between 2 to 4 times the width. Tanks of other shapes such as circular section (with axis either horizontal or vertical) may be used provided the area of the water surface in the tank during normal operation is sufficient to ensure proper solids separation.

b) In the absence of detailed analysis, the minimum surface area requirement may be estimated empirically as follows;

Minimum surface area (m^2) = working capacity of tank (m^3) / 3.

c) In the case of multi-compartment tanks the compartments shall be of unequal size to avoid mass oscillations of liquid in the tank.

5.2.4 Dimensions

a) The working capacity of the septic tank shall be estimated as described in Appendix **C**.

b) In any event the working capacity of a single tank shall always be greater than 1m^3 and less than 12 m^3.

c) Where the required working capacity exceeds 12 m^3, parallel sets of tanks shall be used such that the working capacity of each is less than 12 m^3.

d) The minimum internal width of a tank shall be 750 mm.

e) The minimum internal depth below liquid level shall be 1 m.

Appendix **D** shows the arrangement of a typical septic tank.

5.2.5 Inlet and outlet arrangements

a) Tee fittings, elbows or baffles shall be provided at the inlet and outlet.

b) The inlet fitting shall extend a minimum of 20 per cent of the liquid depth below the liquid level. Tee fitting at the end of the inlet pipe should be secured firmly to prevent it separating and falling over with time.

c) The outlet fitting shall extend a minimum of 300 mm below the liquid level of the tank.

d) The invert of the outlet pipe shall be at least 50 mm below the invert of the inlet pipe.

5.2.6 Access openings

a) One or more access openings shall be provided for inspection and desludging.

b) Openings maybe circular, square or rectangular. Circular access openings shall be at least 500 mm in diameter. Square or rectangular openings shall have a minimum minor dimension of 500 mm.

c) Openings shall be provided with a suitable cover to prevent the ingress of surface and groundwater into the tank.

5.2.7 Freeboard

a) A minimum of 200 mm freeboard shall be provided between the liquid level and the highest point on the ceiling of the tank.

b) The air space thus provided shall have a volume equivalent to at least 10 per cent of the total tank volume.

5.2.8 Chamber partitions

In the case of multiple compartment tanks, chamber partitions shall have one or more openings, of total area greater than the area of the inlet to the tank, at a height between 30 per cent to 70 per cent of liquid depth from the bottom of the tank. The minimum dimension of an opening shall be 100 mm.

5.2.9 Vent pipe

a) Each chamber in a septic tank shall be vented through an opening of minimum 25 mm diameter.

b) A vent pipe of minimum 25 mm diameter shall be provided extending outside the tank to a height sufficient to avoid odour nuisance.

c) The open end of the pipe shall be covered with a suitable mosquito proof mesh.

d) A single vent pipe is sufficient, provided the air space in each chamber of the tank is interconnected with another through an opening of minimum 25 mm diameter. If not, multiple vent pipes shall be provided to ensure each chamber of the tank is vented.

5.3 Soakage Pits

5.3.1 General

Soakage pits are used to soak septic tank effluent into the surrounding soil. They do not provide any direct treatment and are based on the principle that the effluent gets treated as it moves through the surrounding soil before entering the groundwater table or other water body.

Applicability

Soakage pits shall be applicable only in areas where the seasonal high groundwater table is greater than 2.5 m below the ground surface and the soil percolation rate is between 25 mm/h and 125 mm/h.

Location

a) Soakage pits shall be located in an open area and satisfy the following requirements.

i) At least 18 m away from the nearest well or other drinking or bathing water source.
ii) At least 5 m away from the nearest building.

iii) A minimum distance from other soakage pits, either existing or proposed, within or outside the property shall be maintained as specified in Table **2** below.

TABLE 2 - Minimum distance between soakage pits

Average daily flow (m^3/day)	Minimum distance between soakage pits (m)
< 2	10
2 – 5	15

NOTE : *In the case of soakage pits receiving flows differing from each other the spacing requirement shall be that required for the pit receiving the highest flow.*

Geometry

Soakage pits are usually circular or square in plan, although other regular shapes may be used.

Dimensions

a) Soakage pits shall be sized to provide sufficient effective area for the absorption of the average daily flow.

b) The effective area of a soakage pit shall be the area of the side walls lying between a level 150 mm below the invert of the inlet pipe and the bottom of the pit.

c) The required effective area shall be determined by multiplying the appropriate specific effective area given in Table **3** by the average daily flow.

TABLE 3 - Specific effective areas for soakage pits

Percolation Rate mm/h	Specific effective area (1/m.day*)
25	34
50	17
75	11
100	8.4
125	6.6
	* 1/m.day is same as m^2/m^3.day

NOTE : *Intermediate values may be determined by linear interpolation.*

d) No single soakage pit shall be designed for an average daily flow greater than 3 m^3/d.

e) Multiple soakage pits may be used in parallel, provided the spacing requirements specified in Table **2** are satisfied.

f) The minor dimension of a soakage pit (in plan) shall be greater than 900 mm and the major dimension less than 3 m.

g) The depth of the soakage pit shall be such that a minimum distance is maintained between the bottom of the pit and the highest seasonal groundwater table (GWT) according to the values given in Table **4** below.

TABLE 4 - Minimum depth to groundwater table from bottom of soakage pit

Percolation rate (mm/h)	Minimum depth to GWT (m)
25 – 50	1.2
50 – 75	1.8
75 – 100	2.4
100 – 125	3.0

h) If a rock layer exists below the soakage pit, a similar minimum distance to the rock layer from the bottom of the pit shall be maintained.

Appendix **E** shows a typical arrangement of a soakage pit.

Cover

a) Soakage pits shall be provided with a suitable permanent cover that prevents the ingress of surface water, insects and rodents into the pit.

b) The cover shall be fixed in place and capable of withstanding reasonable imposed loads.

Seepage beds

General

a) Seepage beds are used to soak septic tank effluent into the surrounding soil in situations where soakage pits are not applicable (see **5.3.2**). They provide some partial treatment of the septic tank effluent prior to soil absorption.

b) Seepage beds are a bed of prepared aggregate, usually gravel, stone chips or other inert media, through which the effluent percolates prior to soaking into the soil. Septic tank effluent is applied to the bed through perforated distributor pipes laid at intervals along the bed.

c) Seepage beds may be either gravity fed or pressure dosed at intervals using an automated pump and sump arrangement.

A typical arrangement of a seepage bed is shown in Appendix **F**

Applicability

Seepage beds shall be applicable only in areas where the seasonal high groundwater table is greater than 1.5 m below the surface, the soil percolation rate is between 25 mm/h and 250 mm/h, and the ground slope is less than 5 per cent.

Location

Seepage beds shall be located in an open area and satisfy the following requirements.

a) At least 18 m away from the nearest well or other drinking water source.
b) At least 5 m away from the nearest building.
c) At least 5 m away from the nearest soakage pit.
d) At least 1 m away from the nearest seepage bed or trench.

Geometry

Seepage beds are usually rectangular but may be of any convenient shape in plan.

Dimensions

a) Seepage beds shall be sized to provide sufficient effective area for the absorption of the average daily flow.

b) The effective area of a seepage bed shall be the area of the bottom of the bed.

c) The required effective area shall be determined by multiplying the appropriate specific effective area given in Table **5** by the average daily flow.

NOTE : *The specific effective area for seepage beds and trenches differs from that of soakage pits. This is due to differences in clogging characteristics and corresponding safety factors.*

TABLE 5 - Specific effective areas for seepage beds and seepage trenches

Percolation rate (mm/h)	Specific effective area (1/m.day*)
25	50.0
50	25.0
75	17.0
100	12.5
125	10.0
150	8.3
175	7.1
200	6.3
225	5.6
250	5.0
	* 1/m.day is same as m^2/m^3.day

d) Minimum, maximum and typical values of bed dimensions are given in Table **6** below.

TABLE 6 - Minimum, maximum and typical dimensions of seepage beds

Bed dimension (1)	Typical Range (mm) (2)	Maximum (mm) (3)	Minimum (mm) (4)
Width	1000-6000	6000	1000
Depth of aggregate	300-600	600	300
Depth of topsoil	100-150	N/A	100
Spacing between beds (sidewall to sidewall)	-	N/A	1000

e) The maximum bed length shall be 20 m.

Aggregate

a) Gravel, stone chips or any other suitable inert material, which is insoluble in water and resistant to the corrosive nature of septic tank effluent, may be used as aggregate.

b) The depth of aggregate in the bed shall be greater than 300 mm and less than 600 mm.

c) The nominal aggregate size shall be greater than 20 mm and less than 40 mm.

Soil cover

a) A minimum depth of 100 mm of topsoil shall be provided above the bed as a soil cover.

b) An effective soil barrier such as a reverse filter arrangement, filter cloth or polyethylene liner shall be provided between the soil cover layer and the aggregate layer in the bed to prevent infiltration of soil into the bed.

c) The soil cover may be turfed or vegetated with shallow rooted plants.

Distribution pipes

a) The minimum internal diameter of distribution pipes shall be 100 mm.

b) Perforations in pipes shall be between 10 mm to 15 mm diameter with a minimum total area of 10,000 mm^2 / m length of pipe (three rows of holes on the bottom and sides of the pipe is typical).

c) The minimum spacing between adjacent pipes in a bed shall be between 300 mm minimum and 2000 mm maximum.

d) Pipes shall be laid horizontally.

e) A minimum of two distributors shall be provided per bed.

Pressure dosed systems

a) For pressure dosed systems, the dosing arrangement shall be automatic.

b) The volume of a single dose shall always be less than the sum of the volume within the distribution system plus one fifth the bed volume.

5.5 Seepage trenches

5.5.1 General

Seepage trenches are similar to seepage beds except that they are suitable for sloping ground where the ground slope is less than 25 per cent.

A typical arrangement of a seepage trench is shown in Appendix **G.**

5.5.2 *Applicability*

Seepage trenches shall be applicable only in areas where the seasonal high groundwater table is greater than 1.5 m below the surface, the soil percolation rate is between 25 mm/h and 250 mm/h and the ground slope is less than 25 per cent across trenches and less than 5 per cent along trenches.

5.5.3 ***Location***

Seepage trenches shall be located in an open area and satisfy the following requirements.

a) At least 18 m away from the nearest well or other drinking water source.
b) At least 5 m away from the nearest building.
c) At least 5 m away from the nearest soakage pit.
d) At least 1 m away from the nearest seepage bed or trench.

5.5.4 ***Geometry***

Seepage trenches are rectangular in plan.

5.5.5 ***Dimensions***

a) Seepage trenches shall be sized to provide sufficient effective area for the absorption of the average daily flow.

b) The effective area of a seepage trench shall be the area of the trench bottom.

c) The required effective area shall be determined by multiplying the appropriate specific effective area given in Table **5** by the average daily flow.

d) Minimum, maximum and typical values of trench dimensions are given in Table **7** below.

TABLE 7 – Minimum, Maximum and Typical dimensions of seepage trenches

Trench dimension **(1)**	**Typical Range (mm)** **(2)**	**Maximum (mm)** **(3)**	**Minimum (mm)** **(4)**
Width	300-600	600	300
Depth of aggregate	300-600	600	300
Depth of topsoil	100-150	N/A	100
Spacing between adjacent trenches (side wall to side wall)		N/A	1000

e) The maximum length of a trench shall be 20 m.

5.5.6 *Aggregate*

a) Gravel, stone chips or any other suitable inert material, which is insoluble in water and resistant to the corrosive nature of septic tank effluent, may be used as aggregate.

b) The depth of aggregate in the bed shall be greater than 300 mm and less than 600 mm.

c) The nominal aggregate size shall be greater than 20 mm and less than 40 mm.

5.5.7 *Soil cover*

a) A minimum depth of 100 mm of topsoil shall be provided above the bed as a soil cover.

b) An effective soil barrier such as a reverse filter arrangement, filter cloth or polyethylene liner shall be provided between the soil cover layer and the aggregate layer in the bed to prevent infiltration of soil into the bed.

c) The soil cover may be turfed or vegetated with shallow rooted plants.

5.5.8 *Distribution pipes*

a) The minimum internal diameter of distribution pipes shall be 100 mm.

b) Perforations in pipes shall be between 10 mm to 15 mm diameter with a minimum total area of 10,000 mm^2 per metre length.

c) Pipes shall be laid horizontal.

5.5.9 *Pressure dosed systems*

a) For pressure dosed systems, the dosing arrangement shall be automatic.

b) The volume of a single dose shall always be less than the sum of the volume within the distribution system plus one fifth the bed volume.

6 MATERIALS AND CONSTRUCTION

6.1 Tanks

a) Septic tanks may be constructed in-situ in reinforced concrete, lined brick masonry or lined cement solid block masonry. Alternatively, they may be pre-cast in reinforced concrete, steel, glass fibre or Polyethylene.

b) The material and construction details of pre-cast septic tanks are outside the scope of this code[1]. However, In all cases, tanks shall be water-tight, structurally sound, and resistant to the corrosive nature of a septic, anaerobic environment.

c) Brick masonry shall not be used in situations where the tank would be either wholly or partly below the seasonal high groundwater table. However, cement solid block masonry may be used in such cases.

d) Materials used in the construction of tanks, such as cement, reinforcing steel, aggregate, etc., shall conform to the relevant Sri Lanka Standard.

6.2 Soakage pits

The walls of soakage pits shall be constructed with open jointed brick or open jointed cement block masonry and left unlined in the main. However, walls shall be lined and made impervious up to an appropriate distance from the top of the soakage pit in order to prevent ingress of surface water into the pit, where necessary.

6.3 Aggregate media

a) Aggregate media in seepage beds and seepage trenches shall be immersed in water and washed free of fines and debris prior to placing in the beds.

b) Where a minimum size of aggregate has been specified, all aggregate shall be sieved through a sieve with the appropriate mesh size and only aggregate retained in the sieve shall be used.

c) Due care shall be taken when placing aggregate to avoid damage to sidewalls, trench / bed bottoms and pipework.

6.4 Excavation

Excavation for seepage beds and trenches shall be done with due care to avoid damaging and / or compacting the surrounding soil.
Damage can be done by

a) Smearing, where the soil surface is smoothed, filling cracks and pores.
b) Compacting, where the soil porosity is reduced.
c) Puddling, where washed clay settles on the base of the trench / bed.

The following guidelines shall be applicable for excavation of seepage beds and trenches to reduce the risk of damage to the soil.

a) Plan to excavate only when the weather is fine.

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[1] A separate Sri Lanka Standard for pre-fabricated tanks is anticipated in the future.

b) During wet seasons or when construction cannot be delayed until weather becomes fine, smeared soil surfaces shall be raked carefully with a fine-tined rake to restore a more natural soil surface. Care shall be taken to rake only at the surface.

c) Avoid excavation when soil has a moisture content above the plastic limit. If the soil forms a “wire” when rolled between the palms, it is generally above the plastic limit.

d) When excavating by machine, use a bucket with “raker teeth” and excavate in small “bites” to minimize compaction.

e) Avoid compaction by keeping people off the finished trench or bed floor.

f) If rain is likely, cover any open trenches to protect them from rain damage.

g) Excavate parallel to the contours of sloping ground, wherever possible.

h) Ensure that trench or bed bottoms are horizontal.

i) Divert all surface water well away from excavations.

6.6 Pipework

All pipes, fittings, sealers and solvents used shall conform to the relevant Sri Lanka Standard and installed according to the manufacturers’ recommendations.

7 INSPECTION AND TESTING

All systems shall be inspected for structural defects, defects in construction and conformity with the design specifications prior to commissioning. All such defects detected shall be repaired and rectified such that the original requirements have been satisfied prior to commissioning the system.

In addition to the above, the following pre-commissioning tests shall be performed .

7.1 Water tightness

All septic tanks shall be tested for water-tightness and leaks as follows.

Step 1.

Once construction and installation has been completed, empty any water in the tank and clean the tank, making sure to clear the tank bottom of any construction debris, mud, clay, sand etc. and brush the tank walls and bottom thoroughly with a stiff bristled brush. Close the tank and let it stand for 24 hours.

Step 2

Inspect the tank walls and bottom for any signs of water leaking in. If evidence of leaks exist, repair as necessary and repeat steps 1 and 2 prior to proceeding to step 3.

Step 3

Fill all chambers of the tank up to the liquid level and let it stand for 24 hours.

Step 4

Check for any drop in water level. If there is a drop in water level, top up to the liquid level and re-check after a further 24 hours. If the drop in level persists, empty the tank and repair or replace as necessary and repeat steps 3 and 4.

7.2 Partition test

All multiple chambered septic tanks shall be subject to the following test after satisfying the water tightness test in **7.1** above.

Step 1

Fill one side only of each partition wall with water up to the level of the lowest opening in the partition wall. Keep the other side empty, and let it remain for 24 hours.

Step 2

Inspect the partition wall for cracks or other structural damage. If water has leaked to the other side, the depth of such water shall be less than 250 mm.

7.3 Flow distributor test for pressure dosed systems

a) All pressure dosed seepage beds and seepage trenches, shall be tested as follows after all on-site components, including the pump, float switches etc., have been installed, but prior to covering the effluent distribution system in the trench or bed.

b) Fill the sump with water up to the 'pump on' level, start the pump and allow to run until the level in the sump drops to the 'pump off' level.

c) Check effluent distributor network and ensure water flows uniformly from all perforations.

d) Check pumping line and ensure that there are no leaks.

8. COMMISSIONING

a) Septic tanks shall be filled up to the liquid level with water prior to commissioning.

b) Septic tanks may be ‘seeded’ to accelerate the startup of the anaerobic process in the tanks.

c) Seeding shall be done by adding a small quantity (up to one fifth the working capacity of the tank) of digesting sludge from a functioning septic tank, or fresh cow dung slurry or pig slurry. The ‘seed’ shall be added to the first chamber of the tank, in the case of a multiple chambered septic tank.

d) Seeding shall be considered mandatory for septic tanks receiving only kitchen wastewater from restaurants and hotels.

9. MAINTENANCE

Appropriate and timely maintenance is the key to the successful continued function of any system and due care and attention shall be given to inform and educate users and owners of septic tanks and associated effluent disposal systems of all the routine maintenance requirements of their system.

9.1 Septic Tanks

9.1.1 *Desludging*

a) Septic tanks shall be desludged at the appropriate intervals according to the design and use of the tank. Typically, this is when the tank is between one third and one half full of sludge and / or scum.

b) The depth of sludge and scum in a septic tank can be effectively measured using the ‘white towel’ test described in Appendix **H**.

c) Tanks should not be completely emptied during desludging. Between 100 mm to 150 mm of sludge should be left in the bottom of the tank as ‘seed’ for the next cycle of operation.

d) Septage from desludged septic tanks shall be either disposed in a facility intended for that purpose, such as a sewage treatment plant, or where no such facility is available, shall be buried in a pit with due care being taken not to pollute the local groundwater and the neighbouring environment.

9.1.2 *Access covers*

a) All access covers shall be properly replaced and sealed after each opening.
b) Broken and damaged access covers shall be promptly repaired or replaced.

9.1.3 *Mosquitoes*

Septic tanks are a prime breeding location for mosquitoes. Due care shall be taken to ensure that tanks are properly sealed, with particular attention being given to prompt repair of structural cracks which allow mosquitoes to enter the tank. The mosquito-proof mesh cover over vent pipes shall be inspected regularly and replaced as required.

9.1.4 *Blockages*

The most common form of blockage is due to solids blocking the inlet device in a septic tank. This may be cleared by rodding the inlet device from above (through an access opening or inspection port) with a suitably flexible rod.

APPENDIX A

PERCOLATION TEST

A.1 Whenever soil absorption of septic tank effluent is considered a percolation test shall be performed as follows prior to the design of a soil absorption system.

A.2 The percolation test shall be carried out at the location where the soil absorption system is to be installed. In cases where this is uncertain, several percolation tests at likely locations shall be performed.

A.3 A square or circular hole of size (or diameter) between 100 mm to 300 mm and depth 500 mm shall be dug or bored at the depth where soakage is to take place. A larger hole may be dug up to the depth required prior to digging the specified hole in order to facilitate access to conduct the test.

A.4 The bottom and sides of the hole shall be carefully scraped with a fine tined fork to remove any smeared soil and restore a natural soil surface.

A.5 All loose materials shall be removed from the bottom of the hole and fine gravel or coarse sand of nominal size approximately 6 mm placed at the bottom to a depth of 50 mm.

A.6 The hole shall then be filled with water up to a depth of 300 mm above the gravel layer and let stand for 24 hours.

A.7 After 24 hours, the water level in the hole shall be adjusted to 150 mm above the gravel layer, and the drop in water level over a 30 minute period shall be measured.

A.8 The percolation rate shall be calculated as follows.

Percolation rate (mm/h) = drop in water level (mm) / (0.5 h.)

A.9 Where there is no water remaining in the hole after step **A.6**, water shall be added to the hole up to a level 150 mm above the gravel layer and the drop in water level measured at 30 minute intervals over a period of 4 hours, topping up the level to 150 mm after each measurement. The drop in water level over the final 30 minute period shall be taken to calculate the percolation rate.

A.10 Where the water in the hole drains out completely, within the 30 minute measurement period, the soil percolation rate exceeds 300 mm/h., and is unsuitable for soakage of septic tank effluent.

APPENDIX B

EXAMPLE COMPUTATIONS OF AVERAGE DAILY FLOW BASED ON TABLE 1.

Example 1:

For an office building with 10 day-time employees, 2 overnight employees and 25 customers / day, the average daily flow would be computed as follows

Average daily flow (all waste) = (10 day-time employees x 50 l/day per person
+
2 overnight employees x 200 l/day per person
+
25 customers x 10 l/day per person)

= **1150 l/day**

Average daily flow (blackwater) = (10 day-time employees x 30 l/day per person
+
2 overnight employees x 50 l/day per person
+
25 customers x 5 l/day per person)

= **525 l/day**

Average daily flow (greywater) = (10 day-time employees x 20 l/day per person
+
2 overnight employees x 150 l/day per person
+
25 customers x 5 l/day per person)

= **625 l/day**

Example 2:

For a guesthouse building with 5 rooms, 3 residential staff, 3 non-residential staff, serving a maximum of 50 meals/day, the average daily flow would be computed as follows

Average daily flow (all waste) = (5 rooms x 2 guests/ room x 240 l/day per person
+
3 non-residential staff x 100 l/day per person
+
3 residential staff x 200 l/day per person
+
50 meals/day x 15 l/meal.)

= **4050 l/day**

Average daily flow (blackwater) = (5 rooms x 2 guests/room x 60 l/day per person
+
3 non-residential staff x 50 l/day per person
+
3 residential staff x 50 l/day per person)

= **900 l/day**

Average daily flow (greywater) = (5 rooms x 2 guests/room x 180 l/day per person
+
3 non-residential staff x 50 l/day per person
+
3 residential staff x 150 l/day per person
+
50 meals/day x 15 l/meal)

= **3150 l/day**

Example 3:

For a restaurant with 10 non-residential staff, 3 residential staff, serving a maximum of 50 dine-in meals / day and 100 take-away meals / day, the average daily flow would be computed as follows

Average daily flow (all waste) = (10 non-residential staff x 50 l/day per person
+
3 residential staff x 200 l/day per person
+
50 dine-in meals /day x 25 l/meal
+
100 take-away meals / day x 15 l/meal)

= **3850 l/day**

Average daily flow (blackwater) = (10 non-residential staff x 30 l/day per person
+
3 residential staff x 50 l/day per person
+
50 dine-in meals /day x 10 l/meal)

= **950 l/day**

Average daily flow (greywater) = (10 non-residential staff x 20 l/day per person
+
3 residential staff x 150 l/day per person
+
50 dine-in meals /day x 15 l/meal
+
100 take-away meals / day x 15 l/meal)

= **2900 l/day**

APPENDIX C

DETERMINATION OF WORKING CAPACITY OF SEPTIC TANKS.

C.1 The working capacity of a septic tank shall be the sum of the volumes required for settling, sludge digestion and sludge and scum storage and shall be estimated as follows.

C.2 The volume required for settling, shall be calculated as follows.

$V_s = t_s .Q$

Where, V_s = volume required for settling (m^3)

Q = average daily flow of wastewater (m^3/day)

t_s = time required for settling (days)
= (1.5 – 0.3.logQ), (> 0.2) (days.)

C.3 The volume required for sludge digestion shall be calculated as follows.

$V_d = q_s .t_d.p$

Where, V_d = Volume required for sludge digestion (m^3)

q_s = Volume of fresh sludge per day per person (m^3/ day per person)
= 0.001 m^3/ day per person for all waste or grey water
and = 0.00055 m^3/ day per person for black water only

t_d = time required for sludge digestion (days)
= 33 days (for an ambient temperature of 20^{0}C)

p = population equivalent.
= Q (m^3/day)/ 0.2 (m^3/ day per person) for allwaste
= Q (m^3/day)/ 0.05 (m^3/ day per person) for blackwater
= Q (m^3/day)/ 0.15 (m^3/ day per person) for greywater

C.4 The volume required for sludge storage shall be calculated as follows.

V_{st} = r.p.n

Where, V_{st} = volume required for sludge storage (m^3)

n = desludging interval in years(> 1)

r = Volume of digested sludge per year per person (m^3/ year per person)
= 0.04 m^3/ year per person) for allwaste or grey water
= 0.022 m^3/ year per person) for black water only

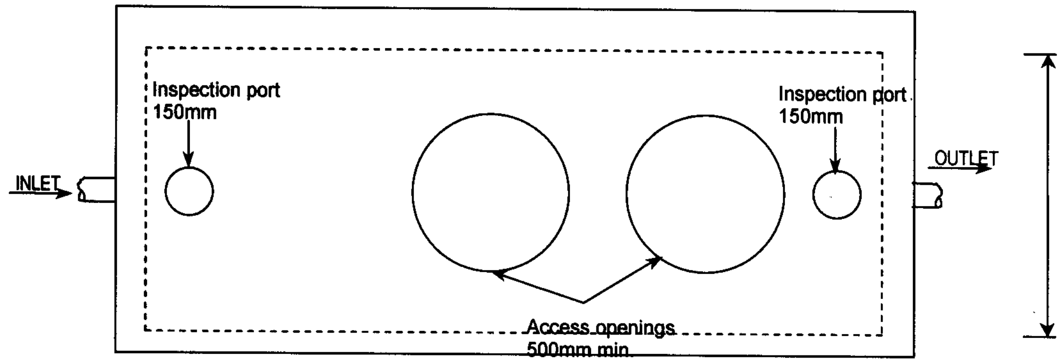
C.5 The volume required for scum storage shall be taken as $0.5V_{st}$.

C.6 Then the design working capacity of the septic tank shall be

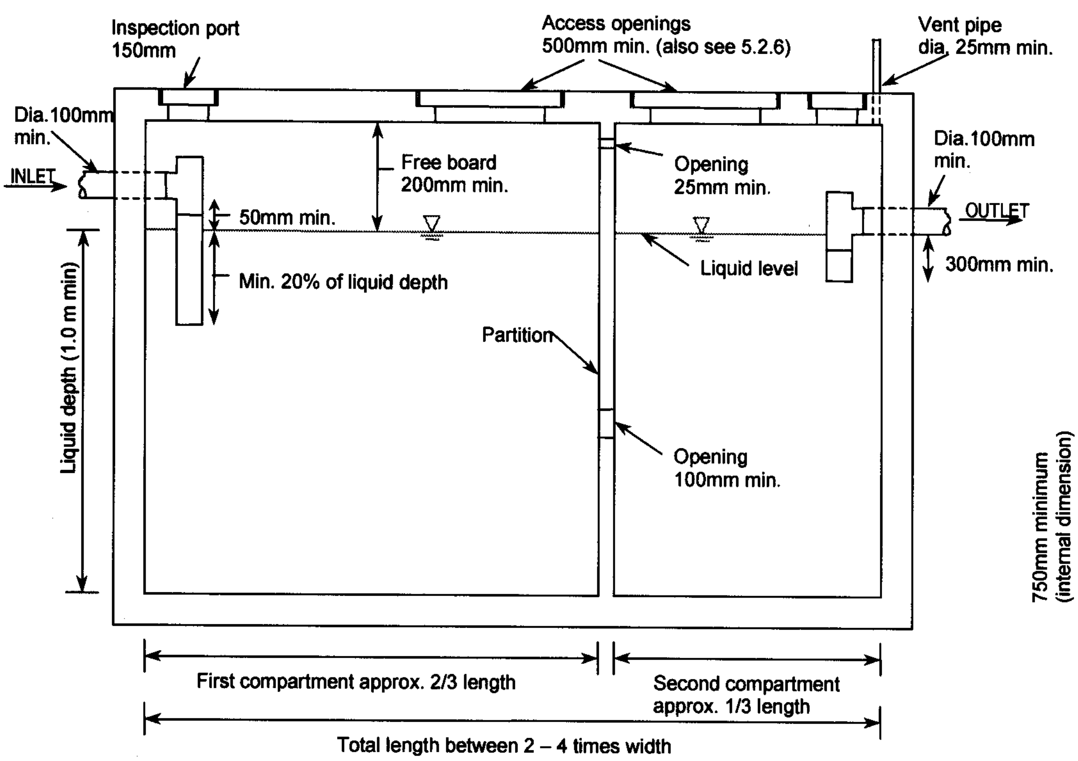
Required volume, $V = V_s + V_d + 1.5V_{st}$ (m^3)

APPENDIX D

TYPICAL SEPTIC TANK ARRANGEMENT



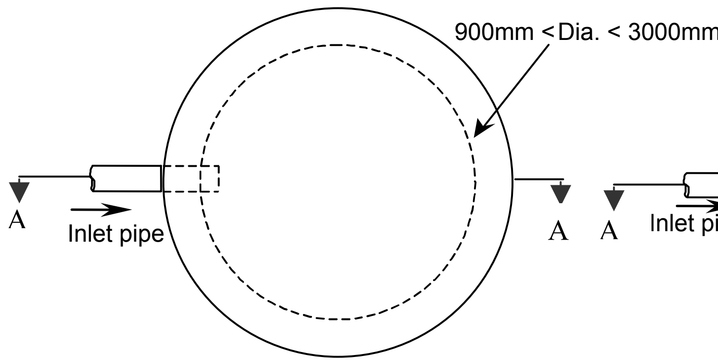
PLAN



SECTION

APPENDIX E

TYPICAL SOAKAGE PIT ARRANGEMENT



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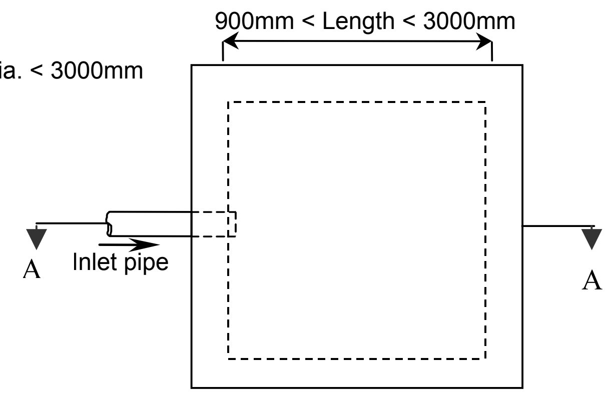

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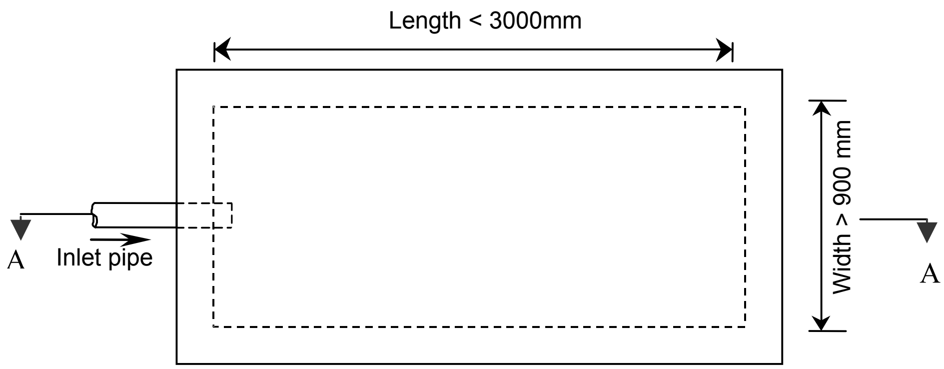

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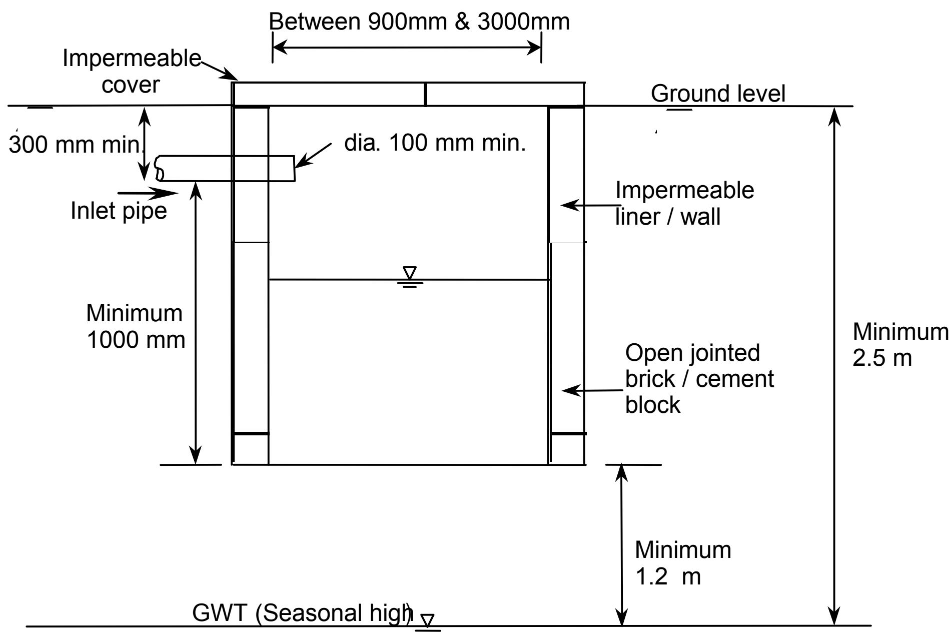
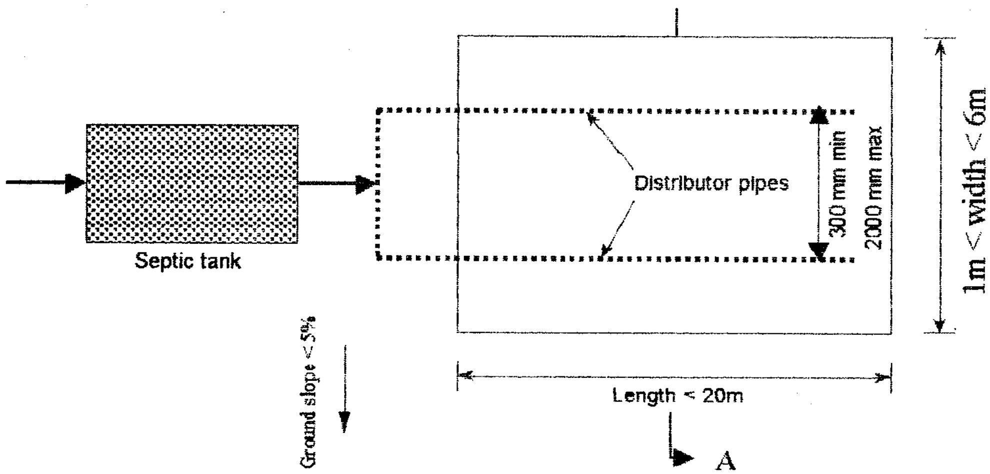


SECTION A - A

APPENDIX F

TYPICAL ARRANGEMENT OF A SEEPAGE BED



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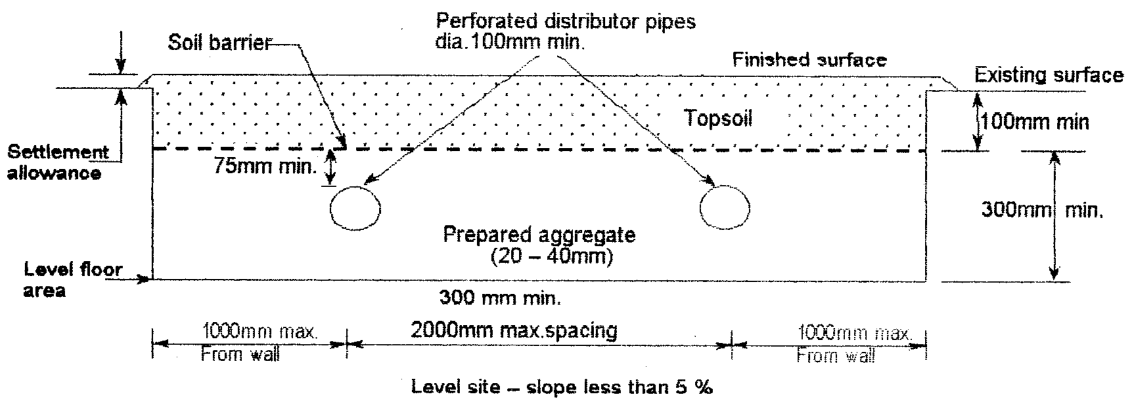
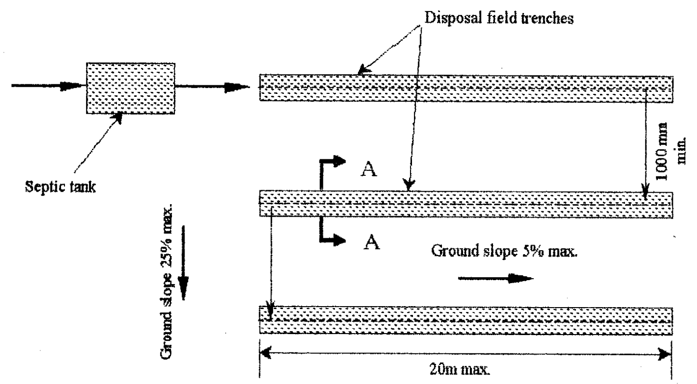


SECTION A –A (Not to scale)

APPENDIX G

TYPICAL ARRANGEMENT OF A SEEPAGE TRENCH SYSTEM



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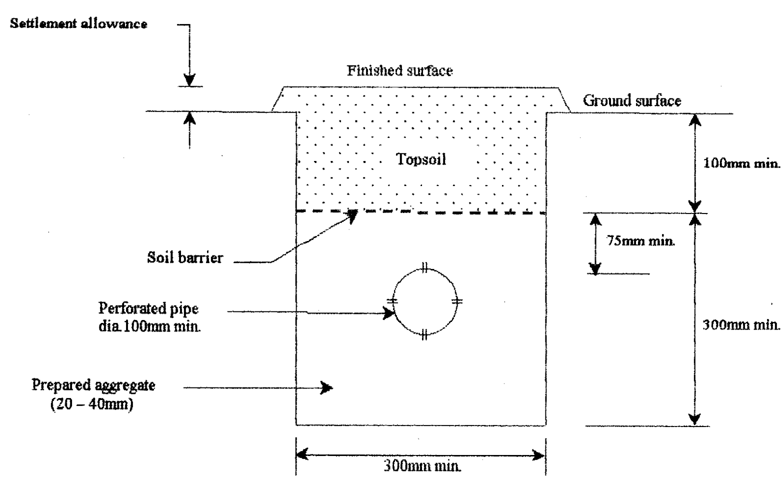

SECTION A-A (Not to scale)

APPENDIX H

WHITE TOWEL TEST FOR SEPTIC TANKS.

H.1 The scum depth in a septic tank may be measured as follows.

H.1.1 Insert a wire nail (approximately 100 mm long) perpendicularly into the end of a long pole or rod so that the nail protrudes horizontally when the pole is held vertical.

H.1.2 Lower the end with the nail carefully through the layer of scum in the septic tank. The pole should be lowered vertically until the nail is felt to break through the bottom of the scum layer.

H.1.3 With the nail below the bottom of the scum layer, rotate the pole through an angle of 90 degrees and slowly lift the pole upwards until resistance is felt.

H.1.4 Mark the position of the top of the scum layer on the pole.

H.1.5 Pull the pole out of the tank and measure the length between the mark and the nail. This is the depth of scum in the tank.

H.1.6 The sludge depth in a tank may be measured as follows.

H.1.7 Wrap the end of a long pole with a light coloured towelling material up to 1.0 m to 1.5 m from the bottom of the pole.

H.1.8 Lower a pipe of 100 mm diameter (or greater), vertically into the septic tank until the end is resting on the bottom of the tank.

H.1.9 Remove any scum that may be inside the pipe and lower the pole wrapped in cloth vertically into the tank through the pipe until it reaches the bottom and pull out again.

H.1.10 Lay the pole horizontally and measure the length from the bottom of the pole up to the point where there is no sludge adhering to the cloth. This length is equal to the depth of sludge in the tank.

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