Centre for Affordable Water and Sanitation Technology

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

Contents

1 Introduction 2
2 Design Basics 2
3 Calculations Using Design Tables 3
3.1 Pit Shape 3
3.2 Soil Type 4
3.3 Design Tables 5
3.4 Practice Questions 8
4 Calculations by Hand 9
4.1 Calculating Infiltration Area for Pits and Trenches Based on Dimensions 9
4.1.1 Rectangular Pit 9
4.1.2 Circular Pit 13
4.2 Calculating Infiltration Area Based on Usage 16
4.3 Summary of Equations 19
4.4 Example Questions 20
4.4.1 Rectangular Soak Pit Calculation – Finding Depth 20
4.4.2 Circular Soak Pit Calculation – Finding Depth 23
4.4.3 Infiltration Trench – Finding Length 26
5 Additional Resources 29
6 References 29

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

1 Introduction

This Technical Brief explains how to design soak pits and infiltration trenches used to manage domestic wastewater. A soak pit is a dug pit that allows wastewater to be safely infiltrated into the ground. Trenches can be used in situations where a soak pit is unable to infiltrate the total amount of wastewater. See CAWST's Technical Brief: Domestic Wastewater Management for further information.

The following information is provided in this Technical Brief:

- Design tables for soak pits and infiltration trenches
- Practice questions using the design tables
- Explanations of the equations used for soak pit and infiltration trench calculations
- Step-by-step sample calculations with full solutions

2 Design Basics

There are five pieces of information that must be considered to design a soak pit or infiltration trench:

1. **Infiltration area (iA):** The surface area required to infiltrate the amount of wastewater entering the pit. **IMPORTANT**: This is the surface area of just the sides of the pit. This does not include the surface area of the bottom or top of the pit. This is because the bottom clogs quickly and does not infiltrate very much water.

2. **Pit dimensions:**

    - **Length (L)** and **width (W)** for a rectangular or square pit.
    - **Diameter (d)** (the distance from one side of the circle to the opposite through the middle) for a circular pit.

3. **Soil infiltration rate (iR):** The rate at which water moves from the pit into the soil. This depends on the characteristics of the soil.

4. **Wastewater loading (Q):** The amount of wastewater entering the pit throughout a day.

5. **Pit depth (D):** How deep the pit is.

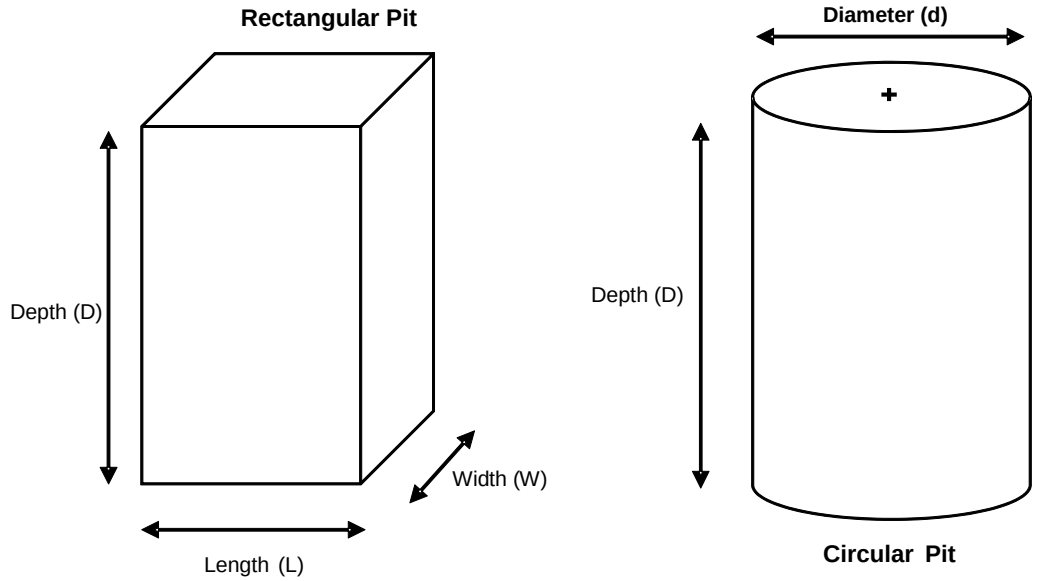
Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

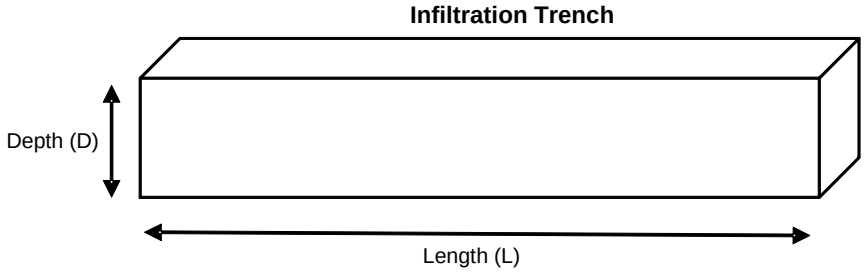
3 Calculations Using Design Tables

This section provides tables that can be used to design a soak pit or infiltration trench. These tables do not cover all possible options. If none of the options are appropriate for your needs, then you will have to design your soak pit or infiltration trench by hand. Section 4 Calculations by Hand explains how to do this.

3.1 Pit Shape

You first need to decide whether you are constructing a soak pit or infiltration trench. If building a soak pit, you then need to choose the pit shape. Soak pits can be either rectangular or circular. Infiltration trenches are normally rectangular.

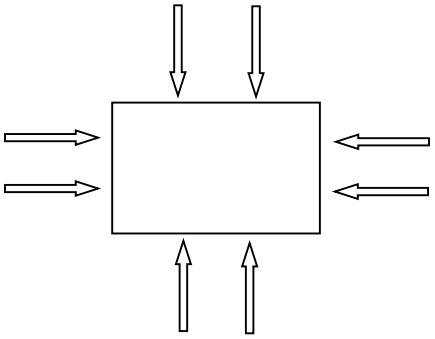




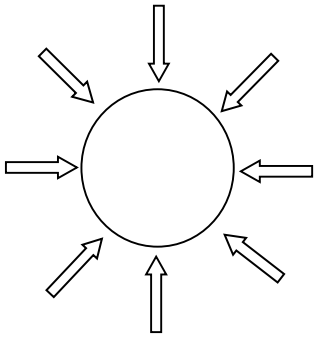
Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

When choosing the shape, remember the following:

- Circular pits are less likely to collapse because the pressure from the surrounding soil is evenly spread.
- Rectangular pits tend to collapse more often because pressure is placed on the four walls. This leaves the corners to absorb the stress.



Pressure from surrounding ground



Pressure from surrounding ground

(Lifewater, 2009)

3.2 Soil Type

You must know the type of soil to make sure you get the right design. The following table shows the different types of soil and their physical descriptions.

Types of Soil and their Physical Description

Soil Type	Physical Description
Gravel, coarse and medium sand	Moist soil will not stick together
Fine and loamy sand	Moist soil sticks together, but will not form a ball
Sandy loam and loam	Moist soil forms a ball, but still feels gritty when rubbed between the fingers
Loam, porous silt loam	Moist soil forms a ball which easily deforms and feels smooth between the fingers
Silty clay loam and clay loam	Moist soil forms a strong ball which smears when rubbed but does not go shiny
Clay*	Moist soil molds like plasticine and feels sticky when wet

(Harvey *et al*., 2002)

* Clay is not suitable for soak pits or trenches since it is difficult for the water to infiltrate the soil.

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

3.3 Design Tables

This section provides tables that can be used to design a soak pit or infiltration trench. The tables can be used to design soak pits or infiltration trenches for inputs of 80, 120 and 160 litres of wastewater daily.

The tables were calculated assuming that the pit or trench will be lined and not filled with rocks. You may want to slightly increase the dimensions of your pit or trench if you will be filling it with rocks instead of lining it.

Practical Considerations

1. A pit deeper than 1.2 metres should be supported by lining or shoring (a temporary support structure) while digging. This will help to prevent it from collapsing on the person digging.

2. The bottom of the pit should be at least 2 metres above the highest annual groundwater level.

3. Infiltration trenches are long, narrow (about the width of a shovel), and shallow. They usually require more space and materials, but can infiltrate a larger amount of water than a soak pit.

Important Information for Soak Pit Tables

The tables are calculated assuming a concrete slab will be placed as a cover. If your soak pit will be buried underground, you will need space for cover, drainage, and backfill. For buried pits, add at least 0.2 metres onto the value found in the table.

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

Soak Pit Design for 1 metre Diameter (Circular) or 1 x 1 metre Square (Rectangular)

Soil Type	Pit Depth (metres)					
	80 litres Daily		120 litres Daily		160 litres Daily	
	Circle	Square	Circle	Square	Circle	Square
Gravel, coarse and medium sand	0.5	0.4	0.8	0.6	1.0	0.8
Fine and loamy sand	0.8	0.6	1.2	0.9	1.5	1.2
Sandy loam and loam	1.1	0.8	1.6	1.3	2.1	1.7
Loam, porous silt loam	1.4	1.1	2.1	1.7	2.8	2.2
Silty clay loam and clay loam	3.2	2.5	4.8*	3.8*	6.4*	5.0*

Soak Pit Design for 1.2 metre Diameter (Circular) or 1.2 x 1.2 metre Square (Rectangular)

Soil Type	Pit Depth (metres)					
	80 litres Daily		120 litres Daily		160 litres Daily	
	Circle	Square	Circle	Square	Circle	Square
Gravel, coarse and medium sand	0.4	0.3	0.6	0.5	0.8	0.7
Fine and loamy sand	0.6	0.5	1.0	0.8	1.3	1.0
Sandy loam and loam	0.9	0.7	1.3	1.0	1.8	1.4
Loam, porous silt loam	1.2	0.9	1.8	1.4	2.4	1.9
Silty clay loam and clay loam	2.7	2.1	4.0	3.1	5.3	4.2

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

Important Information for Infiltration Trench Tables

These tables were calculated for a 0.5 metre depth and a 1.0 metre depth. When you actually go to build the trench, dig at least 0.2 metres deeper so that there is space for soil cover. For example, if you want a trench depth of 0.5 metres, then you must dig 0.7 metres deep. For a 1.0 metre depth, you must dig 1.2 metres deep.

Infiltration Trench Design for 0.5 metre Deep Trench (not including depth of cover)

Soil Type	Trench Length (metres)		
	80 litres Daily	120 litres Daily	160 litres Daily
Gravel, coarse and medium sand	1.6	2.4	3.2
Fine and loamy sand	2.4	3.6	4.8
Sandy loam and loam	3.3	5.0	6.7
Loam, porous silt loam	4.4	6.7	8.9
Silty clay loam and clay loam	10.0	15.0	20.0

Infiltration Trench Design for a 1.0 metre Deep Trench (not including depth of cover)

Soil Type	Trench Length (metres)		
	80 litres Daily	120 litres Daily	160 litres Daily
Gravel, coarse and medium sand	0.8	1.2	1.6
Fine and loamy sand	1.2	1.8	2.4
Sandy loam and loam	1.7	2.5	3.3
Loam, porous silt loam	2.2	3.3	4.4
Silty clay loam and clay loam	5.0	7.5	10.0

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

3.4 Practice Questions

Use the design tables in Section 3.3 to answer the following questions. Solutions are found at the end of this section.

Question 1

- A family wants to build a rectangular soak pit
- They need to dispose of 80 litres of wastewater each day
- They want to make it 1 metre by 1 metre
- They are digging in sandy loam

How deep should their pit be?

Question 2

- A family wants to build a circular soak pit
- They need to dispose of 120 litres of wastewater each day
- They want to make it with a 1.2 metre diameter
- They are digging in fine and loamy sand

How deep should their pit be?

Question 3

- A family wants to build an infiltration trench.
- They need to dispose of 80 litres of wastewater each day
- The depth of the trench walls is 0.5 metres
- They are digging in sandy loam

How long should their trench be? How deep do they have to dig to account for 0.2 metres of cover?

Answers to Practice Questions:

1. Pit depth = 0.8 metres
2. Pit depth = 1.0 metres
3. Trench depth = 3.3 metres, Dig = 3.5 metres

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

4 Calculations by Hand

This section will explain the equations that are used to design soak pits and infiltration trenches. It will then lead you through sample and practice questions.

There are two ways to calculate the infiltration area: 1) using the dimensions of the pit or trench, or 2) based on how much wastewater will enter the pit or trench.

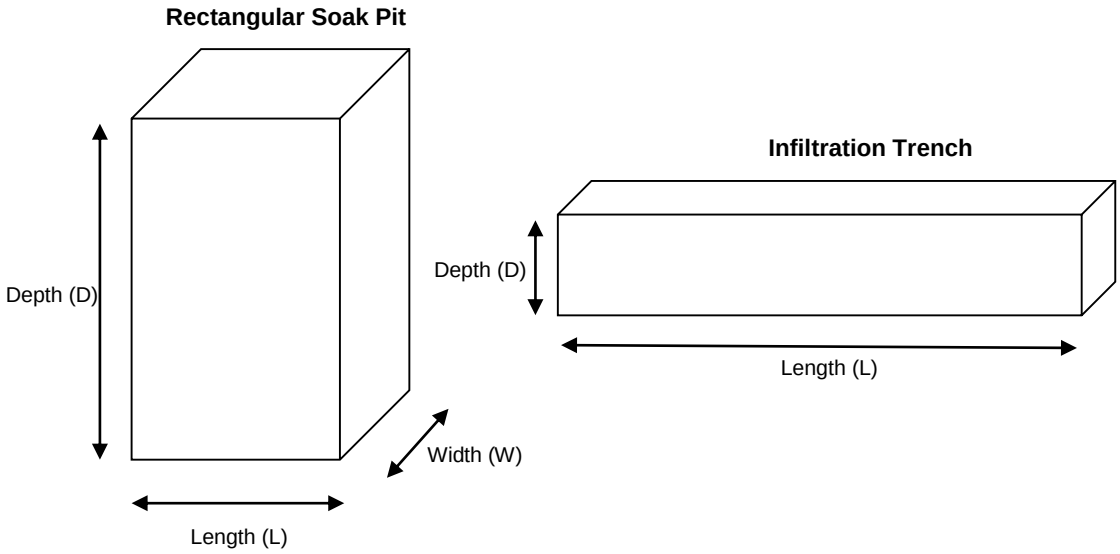
4.1 Calculating Infiltration Area for Pits and Trenches Based on Dimensions

We will start with the pit shapes and the equations that are needed to figure out infiltration area.

4.1.1 Rectangular Pit

The infiltration area for a rectangular pit can be calculated from the three pit dimensions:

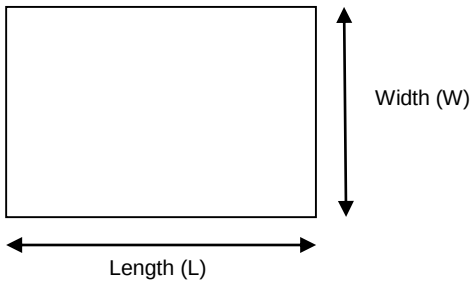
- **Depth**
- **Length**
- **Width**



A rectangular shape is made of three sets of rectangles that have different dimensions.

1. **Top and bottom** are the same
2. **Front and back** are the same
3. **Side and side** are the same

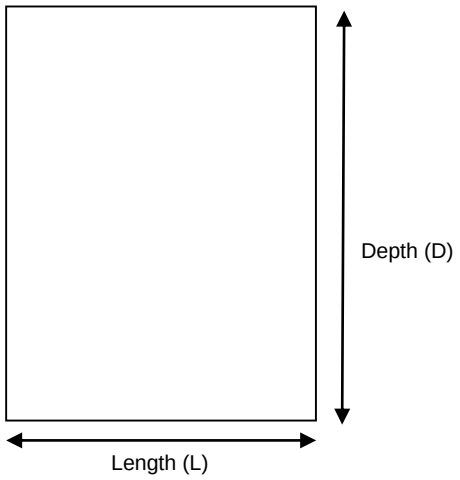
Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches



Top and Bottom

This is the shape that you see when you look at the pit from above.

The length and width of the pit are most likely determined by the size of slab you have or can build.

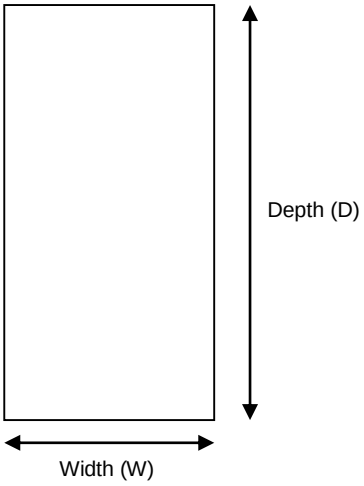


Front and Back

You create the depth as you dig your pit.

The *front and back* rectangle shares the length dimension of the *top and bottom* rectangle.

The dimensions of this rectangle are length (L) and depth (D).



Side and Side

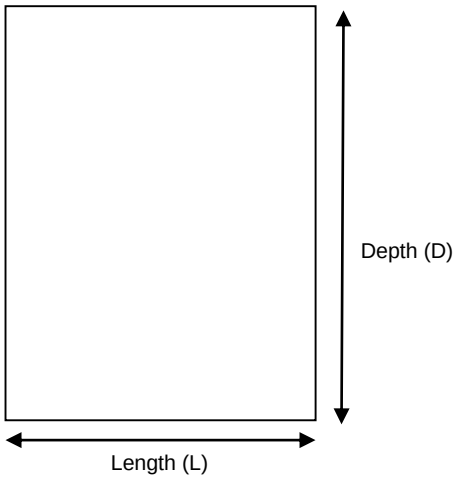
The *side and side* rectangle has the same depth (D) as the *front and back* rectangles.

It also has the same width (W) as the *top and bottom* rectangles.

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

Infiltration Area

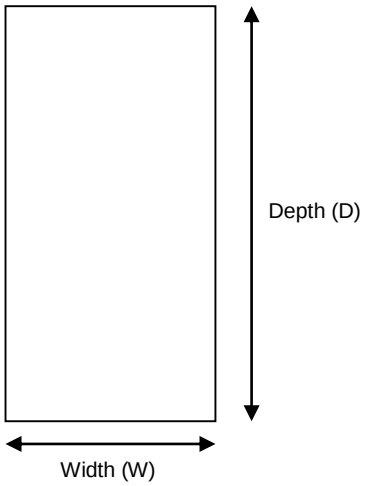
Area of Front and Back Rectangles



$$Area = Length \times Depth$$
$$A = L \times D$$

- Length and depth are measured in metres (m)
- Surface area is measured in square metres (m^2)

Area of Side and Side Rectangles



$$Area = Width \times Depth$$
$$A = W \times D$$

- The side and side rectangle has the same depth (D) as the front and back rectangles.

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

Important Information

In soak pit calculations, *infiltration area* refers to the total area of all the **sides** of the rectangle (this does not include the top and bottom because the bottom clogs so quickly).

In infiltration trench calculations, *infiltration area* refers to the total area of only the two long sides (it does not include the top and bottom because the bottom clogs quickly or the two ends (side and side) because that area is so small). In an infiltration trench the length will always be larger than the depth.

Soak Pit Infiltration Area

The infiltration area of the pit is the total area of the front, back, and two sides.

$$\text{Infiltration area} = \text{Front area} + \text{Back area} + \text{Side area} + \text{Side area}$$

$$iA = (L \times D) + (L \times D) + (W \times D) + (W \times D)$$

$$iA = 2 \times (L \times D) + 2 \times (L \times D)$$

$$\boxed{iA = 2 \times D \times (L + W)}$$

Infiltration Trench Infiltration Area

The infiltration area of the trench is the total area of the front and back.

$$\text{Infiltration area} = \text{Front area} + \text{Back area}$$

$$iA = (L \times D) + (L \times D)$$

$$\boxed{iA = 2 \times L \times D}$$

This equation can be rearranged to find length.

$$\boxed{L = \frac{iA}{2 \times D}}$$

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

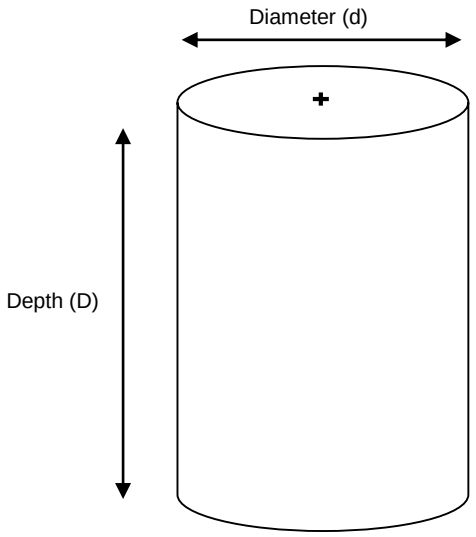
Practical Considerations

Usually, infiltration trenches are no deeper than about 1 metre. This is because it is easier to dig a long shallow trench rather than a deep trench. A soak pit may better meet your needs if you are going much deeper than 1 meter.

Infiltration trenches require a soil cover that is normally at least 0.2 metres. Remember to add this to your total depth after doing your calculations. This is how deep you will actually dig.

4.1.2 Circular Pit

Infiltration area for a circular pit can be calculated from the two pit dimensions: **depth and diameter** (the distance across the circle through the middle)**.**



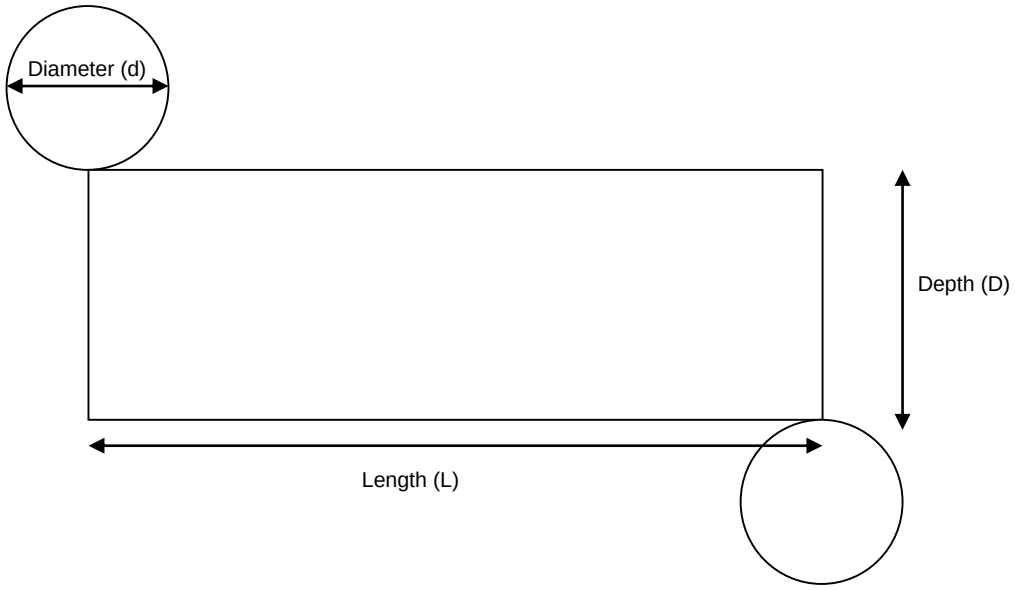
Circular Pit

Important Information

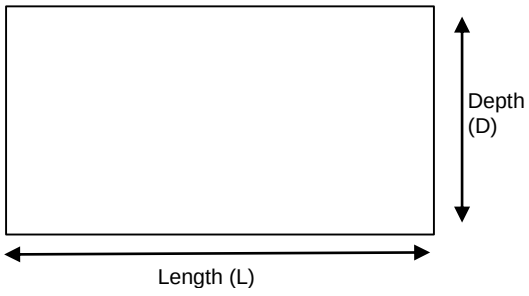
In soak pit calculations, *infiltration area* refers to the total side area of a circular pit (this does not include the top and bottom). This is because the bottom will clog very quickly and not infiltrate much water.

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

A circular pit shape is called a cylinder. It is made up of two identical circles that are the top and the bottom, and a rectangle that wraps around them. If you were to unroll a cylinder and lay it flat on the ground it would look like this:



The rectangular part of the unrolled cylinder is the sides of the pit. Therefore the area of this rectangle is the **infiltration area**.

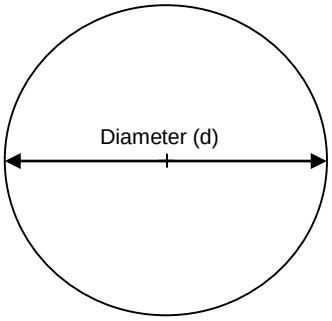


$$\text{Infiltration Area} = \text{Length} \times \text{Depth}$$
$$iA = L \times D$$

- Length and depth are measured in metres (m)
- Surface area is measured in square metres (m^2)

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

When designing a circular pit we do not know the length of the rectangle. What we do know is that the length of the rectangle is equal to the distance around one of the circles, also known as circumference of a circle. We can figure out the circumference and therefore the length based on the diameter of the pit.



$$\text{Length} = \text{Diameter} \times 3.14$$
$$L = d \times 3.14$$

- Diameter is measured in metres (m)
- Length is measured in metres (m)
- 3.14 is a rounded value for the ratio pi (π)

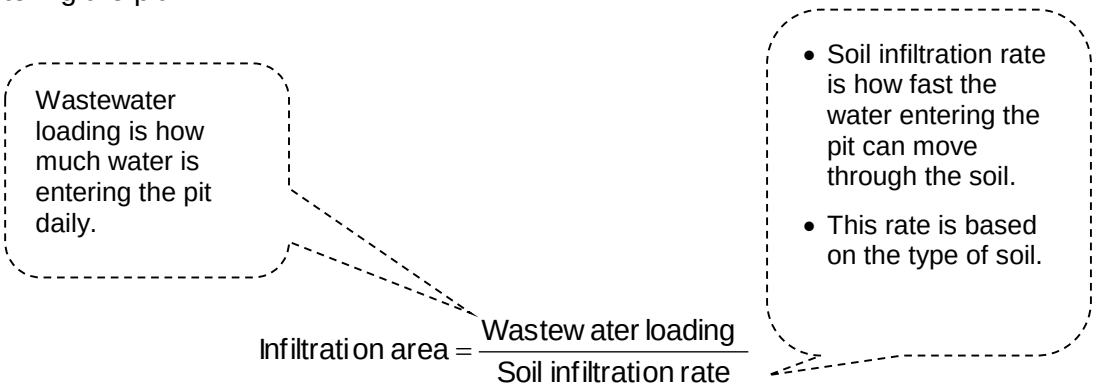
Therefore, the equation for the **infiltration area** of a circular pit is:

$$\text{Infiltration Area} = \text{Length} \times \text{Depth}$$
$$iA = L \times D$$
$$iA = d \times 3.14 \times D$$

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

4.2 Calculating Infiltration Area Based on Usage

The following equation tells us how much infiltration area is needed based on how much water will be entering the pit.



$$iA = \frac{Q}{iR}$$

The following table gives soil infiltration rates based on the type of soil where the pit will be dug.

Typical Soil Infiltration Rates According to Soil Type

Soil Type	Physical Description	Infiltration Rate of Wastewater (L/m^2/day)
Gravel, coarse and medium sand	Moist soil will not stick together	50
Fine and loamy sand	Moist soil sticks together, but will not form a ball	33
Sandy loam and loam	Moist soil forms a ball, but still feels gritty when rubbed between the fingers	24
Loam, porous silt loam	Moist soil forms a ball which easily deforms and feels smooth between the fingers	18
Silty clay loam and clay loam	Moist soil forms a strong ball which smears when rubbed but does not go shiny	8
Clay*	Moist soil molds like plasticine and feels sticky when wet	Unsuitable for soak pits or infiltration trenches

(Harvey *et al*., 2002)

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

An infiltration rate test can be done if you cannot determine the soil type and infiltration rate from the above table. This test measures how much water infiltrates into the ground in a specific period of time. For accurate results, the test should be done at the same depth as the base of the planned pit or trench.

Method

1. Force an open steel or plastic cylinder or tube (approximately 30 cm diameter) into the ground.
2. Insert a ruler or other measure marked in millimetres into the tube.
3. Fill the tube with clean water and measure the fall in water level over time. For example measurements can be taken at 5, 10, 20, 30 and 60 minutes.
4. Determine the infiltration rate for each time period in mm/day using the calculation below:

$$\text{Infiltration rate (mm/day or L/m}^2\text{/day)} = \frac{\text{Fall in water level (mm)}}{\text{Time (min)}} \times 1440 \text{ (min/ day)}$$

NOTE: mm/day and L/m^2/day are the same unit, just expressed differently. Infiltration rate tables often use L/m^2/day.

5. Calculate the average using the calculation below:

$$\textit{Average Infiltration rate (mm/day)} = \frac{\textit{Sum of infiltration rates}}{\textit{Number of infiltration rates}}$$

6. Estimate the infiltration rate for wastewater. To do this, use the following Table: Typical Infiltration Rates Comparing Clean Water and Wastewater, and find the range that your rate fits in under the ‘clean water’ column. From this value you can see the corresponding wastewater infiltration rate for that soil type.

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

Typical Infiltration Rates Comparing Clean Water and Wastewater

Soil Type	Description	Infiltration Rate L/m^2/day	
		Clean Water	Wastewater
Gravel, coarse and medium sand	Moist soil will not stick together	1,500-2,400	50
Fine and loamy sand	Moist soil sticks together but will not form a ball	720-1,500	33
Sandy loam and loam	Moist soil forms a ball but still feels gritty when rubbed between the fingers	480-720	24
Loam, porous silt loam	Moist soil forms a ball which easily deforms and feels smooth between the fingers	240-480	18
Silty clay loam and clay loam	Moist soil forms a strong ball which smears when rubbed but does not go shiny	120-240	8
Clay	Moist soil molds like plasticine and feels sticky when wet	24-120	Unsuitable for soak pits or trenches

(Harvey *et al*., 2002)

The infiltration rates for wastewater given in the table above are much lower than those for clean water. This is because the spaces between the soil particles become clogged by suspended particles and organic matter in the wastewater. Also, these rates are very likely to decrease over time.

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

4.3 Summary of Equations

Use the information in this section as a reference and to help work through the example questions.

Summary of Equations to Design Soak Pits and Infiltration Trenches

Dimension	Formula	Variables
Geometric Infiltration Area: Rectangular Soak Pit	$iA = 2 \times D \times (L + W)$	iA: Infiltration area (m^2) D: Depth (m) L: Length (m) W: Width (m)
Geometric Infiltration Area: Circular Soak Pit	$iA = d \times 3.14 \times D$	iA: Infiltration area (m^2) d: Diameter (m) D: Depth (m)
Geometric Infiltration Area: Infiltration Trench	$iA = 2 \times L \times D$	iA: Infiltration area (m^2) D: Depth (m) L: Length (m)
Usage Infiltration Area	$iA = \frac{Q}{iR}$	iA: Infiltration area (m^2) iR: Infiltration rate ($l/m^2/day$) Q: Wastewater loading (L/day)
Infiltration Trench Length	$V = D \times A$	D: Depth (m) A: Area (m^2)

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

4.4 Example Questions

The following are examples with the solutions to help you practice designing soak pits and infiltration trenches using equations.

4.4.1 Rectangular Soak Pit Calculation – Finding Depth

- A family needs to dispose of 100 litres of wastewater per day
- They want the soak pit to have a length of 1.2 metres and a width of 1.0 metre
- They are digging in sandy loam

How deep should their soak pit be?

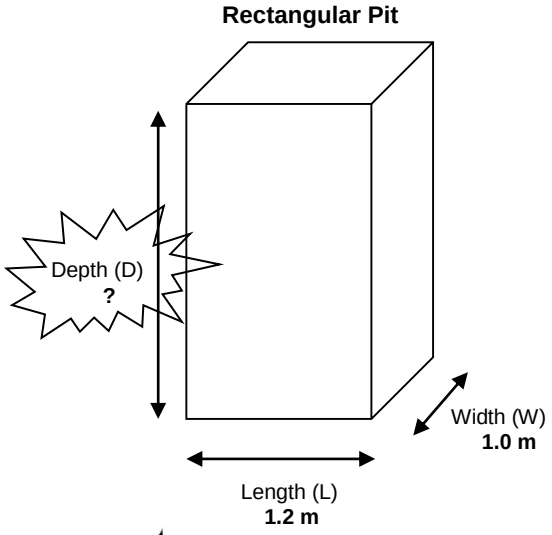
Solution

Step 1: Known information – Write down the variables and their values. Identify the variable that you need to solve for.

Shape = Rectangular
Wastewater Loading **Q** = 100 (litres/day)
Length **L** = 1.2 metres
Width **W** = 1.0 metre
Infiltration Rate **iR** = 24 (litres/ metres^2/day)
Depth **D** = ?

We are using an infiltration rate of 24 (L/m^2/day) because we are digging in sandy loam.

Step 2: Draw and Label Your Diagram – Draw a diagram of the pit and label all dimensions.



We are trying to find the depth (D) of the pit.

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

Step 3: Formulas – Write down the formula for the variable you are trying to solve for. Check if you have the value for each variable in it. If the values are not given, then find an equation to give you the missing value of the variable you want. Be sure that you are using the formula for the right shape.

$$D = \frac{iA}{2 \times (L + W)} \longrightarrow \begin{array}{l} iA = ? \\ L = 1.2m \\ W = 1.0m \end{array}$$

$$iA = \frac{Q}{iR} \longrightarrow \begin{array}{l} Q = 100(L/day) \\ iR = 24(L/m^2/day) \end{array}$$

- *The first equation gives the depth but we don't know the value of iA (infiltration area).*
- *The second equation gives the value for iA (infiltration area).*

Step 4: Fill in the formula that you know the value of all the variables for.

$$iA = \frac{Q}{iR}$$

$$iA = \frac{100(L/day)}{24(L/m^2/day)}$$

$$\boxed{iA = 4.2m^2}$$

We are finding the value for iA (infiltration area) first because we know the values for both Q (wastewater loading) and iR (soil infiltration rate).

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

Step 5: Fill in the formula that you know the value of all the variables for.

$$D = \frac{iA}{2 \times (L + W)}$$

$$D = \frac{4.2m^2}{2 \times (1.2m + 1.0m)}$$

$$D = \frac{4.2m^2}{2 \times 2.2m}$$

$$D = \frac{4.2m^2}{4.4m}$$

$$\boxed{D = 1.0m}$$

From the previous equation we now know the value of iA. We can now solve for D.

- *Fill in all the values for the variables.*
- *Do the addition inside the brackets first.*
- *Do the multiplication.*
- *Do the division.*

Step 6: Write out the answer.

The depth must be 1.0 metre for the pit to infiltrate 100 litres of wastewater each day. This is assuming the pit has a slab for a cover. If soil will be used for cover, then at least 0.2 metres must be added to the depth.

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

4.4.2 Circular Soak Pit Calculation – Finding Depth

- A family needs to dispose of 100 litres of wastewater per day
- They want the soak pit to have a diameter of 1.3 metres
- They are digging in porous silt loam

How deep should their soak pit be?

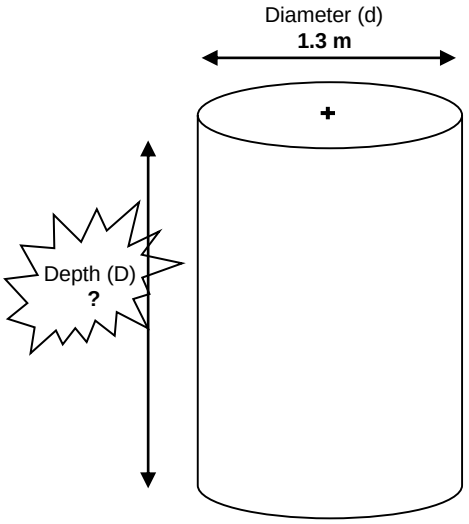
Solution

Step 1: Known information – Write down the variables and their values. Identify the variable that you need to solve.

Shape = circular
Wastewater Loading **Q** = 100 (litres/day)
Diameter **d** = 1.3 metres
Infiltration Rate **iR** = 18 (litres/metres^2 / day)
Depth **D** = ?

We are using an infiltration rate of 18 (L/m^2/day) because we are digging in porous silt loam.

Step 2: Draw and Label Your Diagram – Draw a diagram of the pit and label all dimensions.



Circular Pit

We are trying to find the depth (D) of the pit.

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

Step 3: Formulas – Write down the formula for the variable you are trying to solve for. Check if you have the value for each variable in it. If the values are not given, then find an equation to give you the missing value of the variable you want. Be sure that you are using the formula for the right shape.

$$D = \frac{iA}{3.14 \times d} \longrightarrow iA = ? \quad d = 1.3m$$

$$iA = \frac{Q}{iR} \longrightarrow Q = 100\ (L/day) \quad iR = 18\ (L/m^2/day)$$

- *The first equation gives the depth but we don't know the value of iA (infiltration area).*
- *The second equation gives the value for iA (infiltration area).*

Step 4: Fill in the formula that you know the value of all the variables for.

$$iA = \frac{Q}{iR}$$

$$iA = \frac{100(L/day)}{18(L/m^2/day)}$$

$$\boxed{iA = 5.6m^2}$$

We are finding the value for iA (infiltration area) first because we know the values for both Q (wastewater loading) and iR (soil infiltration rate).

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

Step 5: Fill in the formula that you know the value of all the variables for.

$$D = \frac{iA}{3.14 \times d}$$

$$D = \frac{5.6m^2}{3.14 \times 1.3m}$$

$$D = \frac{5.6m^2}{4.1m}$$

$$D = 1.4m$$

- *From the previous equation we now know the value of iA. We can now solve for D.*

- *Fill in all the values for the variables.*
- *Do the multiplication first.*
- *Do the division.*

Step 6: Write out the answer.

The depth must be 1.4 metres for the pit to infiltrate 100 litres of wastewater each day. This is assuming the pit has a slab for a cover. If soil will be used for cover, then at least 0.2 metres must be added to the depth.

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

4.4.3 Infiltration Trench – Finding Length

- A family needs to dispose of 80 litres of wastewater per day
- They want the walls of their infiltration trench to be 0.5 metres deep
- They are digging in sandy loam

How long should their trench pit be?

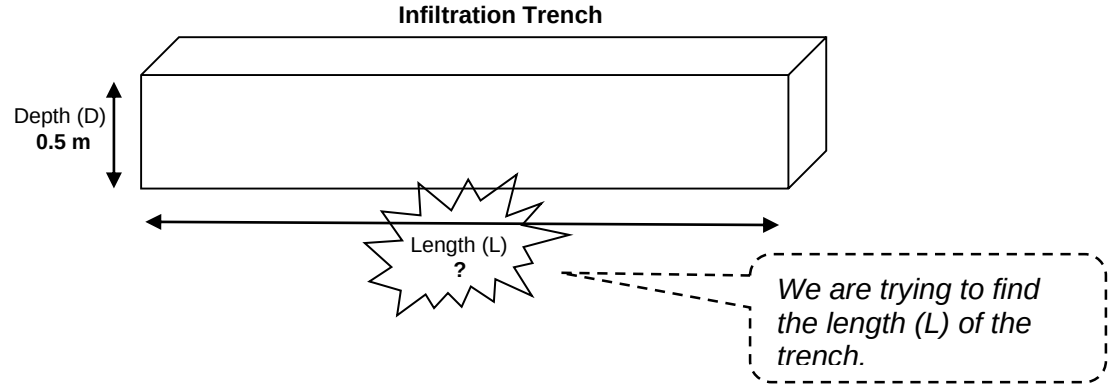
Solution

Step 1: Known information – Write down the variables and their values. Identify the variable that you need to solve for.

Amount of Wastewater to be Infiltrated **Q** = 80 (litres/day)
Infiltration Rate **iR** = 24 (litres/ metres ^{2}/day)
Depth **D** = 0.5 metres
Lenght **L** = ?

We are using an infiltration rate of 24 (L/m^2/day) because we are digging in sandy loam.

Step 2: Draw and Label Your Diagram – Draw a diagram of the pit and label all dimensions.



Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

Step 3: Formulas – Write down the formula for the variable you are trying to solve for. Check if you have the value for each variable in it. If the values are not given, then find an equation to give you the missing value of the variable you want. Be sure that you are using the formula for the right shape.

$$L = \frac{iA}{2 \times D} \longrightarrow iA = ?, \quad D = 0.5m$$

$$iA = \frac{Q}{iR} \longrightarrow Q = 80(L/day), \quad iR = 24(L/m^2/day)$$

- *The first equation gives the length but we don't know the value of iA (infiltration area).*
- *The second equation gives the value for iA (infiltration area).*

Step 4: Fill in the formula that you know the value of all the variables for.

$$iA = \frac{Q}{iR}$$

$$iA = \frac{80(L/day)}{24(L/m^2/day)}$$

$$\boxed{iA = 3.33m^2}$$

We are finding the value for iA (infiltration area) first because we know the values for both Q (wastewater loading) and iR (soil infiltration rate).

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

Step 5: Fill in the formula that you know the value of all the variables for.

$$L = \frac{iA}{2 \times D}$$

$$L = \frac{3.33m^2}{2 \times 0.5m}$$

$$L = \frac{3.33m^2}{1.0m}$$

$$\boxed{L = 3.33m}$$

From the previous equation we now know the value of iA. We can now solve for L.

- *Fill in all the values for the variables.*
- *Do the multiplication.*
- *Do the division.*

Step 6: Write out the answer.

The length must be 3.33 metres for the pit to infiltrate 80 litres of wastewater each day. A soil cover at least 0.2 metres must be added to the depth.

Technical Brief: Design Calculations for Soak Pits and Infiltration Trenches

5 Additional Resources

CAWST (2015). Technical Brief: Domestic Wastewater Management. CAWST, Calgary, Canada. Available at: www.cawst.org/resources

- This Technical Brief discusses how to safely and properly dispose domestic wastewater, including greywater and overflow water. Grease traps, soak pits and infiltration trenches are explained.

6 References

Harvey, P., Baghri, S., and B. Reed (2002). Emergency Sanitation: Assessment and Programme Design. WEDC, Loughborough, UK. Retrieved from: www.who.or.id/eng/contents/aceh/wsh/books/es/es.htm

Lifewater International (2009). Sanitation Latrine Design and Construction. Lifewater International, California, USA.

CAWST (Centre for Affordable Water and Sanitation Technology)
Calgary, Alberta, Canada
Website: www.cawst.org Email: resources@cawst.org
Wellness through Water.... Empowering People Globally
Last Update: July 2015