ON SITE SANITATION
VIP LATRINE
POUR FLUSH LATRINE

Kondisi di Indonesia

Open Defecation

Ventilated Improved Pit Latrine
Traditional Pit Latrine (Cubluk)?

Two Main Disadvantages:
- Attract flies and other disease-carrying breeds
- Smell badly
- Addition: poorly built and dangerous to use

The ventilated improved pit latrine (VIP)

Improvement of traditional pit latrine
- To be safe for the user
- Built to last for a long time

Three main types of VIP latrine:
- Single-pit VIP Latrine
  - Designed to be used for at least 2 years
  - Suitable for rural areas where soil is deep and pit size is limited
- Alternating double-pit VIP Latrine
  - Permanent structures with two pits
  - Suitable for urban areas where people can afford to pay for a permanent latrine
- Multiple-pit VIP Latrine
  - More than one cubicles
  - For communal institutions such as schools

Various Types:
A. Single-pit VIP Latrine
B. Alternating double-pit VIP Latrine
C. Multiple-pit VIP Latrine
Single Pit Latrine

- Two actions:
  - The liquid portion of the excreta soaks away into the soil
  - The solids in the excreta are broken down by biological action, gas will produce and removed by the vent
- Application
  - Rural area
  - Urban area → if there is enough space for two latrine sites on each house plot (alternatively)
- Water use → only needed for hand washing and for cleaning the latrine floor
- Hygiene habits → where bulky anal cleansing materials such as corn cobs or mud balls (pit life will shorten)

Dispersal of pollution from its source

- L: Source of pollution: pit latrine, septic tank, soakaway
- A: Pollution cone
- B: groundwater < 3 m depth
- C: The cone of chemical pollution continues to spread until about 25 metres from the source, and then gradually reduces to almost nothing at a distance of about 100 metres.

Protecting a hand pump from the pollution from a pit latrine

- Hand pump
- Water intake
- Water intake to handpump
- Orientation of groundwater flow
- Water intake needed
- Protection of hand pump

Advantage

- Low annual cost
- Easy construction and maintenance
- All types of anal cleansing materials may be used
- Absence of odours and minimal fly and mosquito nuisance
- Minimal water requirements
- Low level of municipal involvement
- Minimal risk to health

Disadvantage

- Lack of space for relocating the pit in dense urban areas
- Potential for groundwater pollution
- Difficulty of construction in rock or boulder-laden subsoil
- Does not dispose of large quantities of sullage water
Pit lining

- Prevent the pit walls from collapsing → use pit materials.
- Use materials to line the pit that are durable enough → a timber lining would not be suitable for a permanent VIP latrine.
- The soil stable → only top part of pit will need lining.
- Loose soil or groundwater surface is above the bottom → the entire pit will need lining.
- Circular pits are more stable than rectangular.
- Very loose sandy soil, place a layer of gravel around the outside of lining as it is built up.
- Make holes or pit bottom left unlined for liquids in the excreta to pass.

Pit Lining and Foundation

Foundation has two important functions:
- It raises the slab above to prevent from storm water.
- Provides an effective seal between the pit lining and the slab.

Difficult ground conditions

- Raised pit latrine
- Mound latrine
Cover Slab

- The best material: reinforced concrete
- Timber can be used (not recommended)
- Should be 40 cm larger than the diameter of the pit and 75 mm thick
- Very important: design
  - Prefer to sit or no
  - For adults or children

Superstructure

- Follow local house building methods and architectural styled
  - With or without door
  - Rounded or rectangular
  - Adequate ventilation
- Always consult the householder about the design
- The latrine superstructure can easily be replaced or repaired before the pit is full

Cover slab
Privacy screens made from cheap locally available materials

Vent

Have three very important functions:
- Controls odours
- Excludes flies
- Traps flies

Fly screen
- <1.5 mm square
- Not too small → proper ventilation not happen

Ventilation in a VIP latrine
### Lightning

- Untuk pit latrine sebaiknya gelap agar tidak menarik perhatian lalat.
- Sebaiknya pintu bangunan jamban atau ventilasi menghadap barat atau timur. Mengapa???

### Other factors

<table>
<thead>
<tr>
<th>Sitting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sited alongside the house, not too far from the house</td>
</tr>
<tr>
<td>Mosquito breeding larvae, small quantities specials oils</td>
</tr>
<tr>
<td>Maintenance:</td>
</tr>
<tr>
<td>Disinfectant to wash the floor slab, small quantities</td>
</tr>
<tr>
<td>The fly screen</td>
</tr>
<tr>
<td>Sign of erosion should be filled in immediately</td>
</tr>
</tbody>
</table>

| Relocated the pit: |
| The pit reaches within 0.5m of the underside of the slab |
| New design at least 2m away |
| Sludge disposal |
| The waste abandoned and pit rebuilt in a different place |
| With the alternating VIP |
| A non alternating VIP |

### Pit Volume

<table>
<thead>
<tr>
<th>Sludge accumulation rate (m³/person/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry: 0.05 m³/person/year</td>
</tr>
<tr>
<td>Wet: 0.02 m³/person/year (flooded or water from washing)</td>
</tr>
<tr>
<td>Increased by 50% (using bulky or cleansing materials that do not decompose quickly)</td>
</tr>
</tbody>
</table>

| Number of people |
| Filling time (years) |

**Note:**
- The volume should be increased by making the pit at least 0.5 m deeper than calculated.
- Do not make more than about 1.5 m wide because → expensive.

### Principles of Pit Latrine calculation

| The pit should have sufficient storage capacity for all the sludge that will accumulate during its operational life or before its planned emptying. |
| At the end of the pit's operational life there should still be sufficient space left for the contents to be covered with a sufficient depth of soil to prevent surface contamination with pathogenic organisms (soil seal depth). |
| There should be sufficient wall area available at all times to enable any liquid in the pit to infiltrate the surrounding soil. |
The storage volume required to accommodate the sludge that accumulates in the pit during its operational life can be calculated from:

\[ V = N \times P \times R \]

where

\[ V = \text{the effective volume of the pit (m}^3\text{)} \]
\[ N = \text{the effective life of the pit (years)} \]
\[ P = \text{the average number of people who use the pit each day} \]
\[ R = \text{the estimated sludge accumulation rate for a single person (m}^3\text{ per year).} \]

Once the effective volume of the pit has been calculated, the plan area is decided. This should be based on local preference, ground conditions and construction materials, and is generally circular or rectangular in shape. Note that only the area inside the lining is utilized for sludge accumulation, not the excavated area.

### Example

A family of six intends to dig a pit latrine with an operational life of 20 years. The family uses newspaper and corncobs for anal cleaning, and sullage is disposed of separately.

- Sludge volume?
- The values of \( N \) and \( P \) are given (20 years and 6 people) but the sludge accumulation rate \( R \) is not.
- The accumulation rate cannot be determined without some knowledge of the depth to the water table. Assuming this is greater than the likely pit depth, an accumulation rate of 90 L/year is used (see Table 5.3).

\[ V = 6 \times 20 \times (90/1000) = 10.8 \text{ m}^3 \]

If it is found that the pit does enter the groundwater, then the calculation should be done again using the appropriate sludge accumulation rate (60 L/year, from Table 5.3).

The pit will be rectangular, with internal dimensions of 1.2 m by 2.0 m. Thus the depth required for sludge is:

\[ (10.8/1.2 \times 2) = 4.5 \]

### Suggested maximum sludge accumulation rates (litres per person per year)

<table>
<thead>
<tr>
<th>Sludge accumulation rate</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste removed in water where digestible anal cleaning materials are used</td>
<td>40</td>
</tr>
<tr>
<td>Waste removed in water where non-digestible anal cleaning materials are used</td>
<td>60</td>
</tr>
<tr>
<td>Waste removed in dry conditions where digestible anal cleaning materials are used</td>
<td>60</td>
</tr>
<tr>
<td>Waste removed in dry conditions where non-digestible anal cleaning materials are used</td>
<td>90</td>
</tr>
</tbody>
</table>

### Ventilated Improved Double Pit Latrine

- There is difficulty in constructing deep pits
- Insufficient room exists for constructing another latrine once the pit is full
- VIP latrine only initiates having two pits
  - Constructing a separation wall in the pit
  - Constructing two separate pits
- Pit depth can be varied:
  - Reflect soil conditions and emptying frequency
- Operation and maintenance same for pit emptying as that of the VIP → one pit should be used until full and then sealed while the second pit is in use
Multiple-Pit VIP Latrines

- Design for not more than 25 users per cubicle
- Can be designed to operate as a series of alternating double pit VIP latrines with half the pit compartments sealed off and half in use at any one time
- Each pit, except the two at the ends, will have two squat holes and only one is in use at any time
- The vents on these pits need to be particularly efficient

Pour-Flush Toilets
Introduction

**Main Disadvantage**
- Very expensive
- Use large quantities of water and so require a water supply with multiple in-house connections and sewers

**Two General types**
- Single-pit pour flush → water seal trap in built into the underside the slab
- Double-pit pour flush toilets → excreta are transported from the toilet compartment to a nearby leachy pit by flushing water which is poured by hand into the toilet bowl

**Main Disadvantage**

**Two actions take place**
- The flushing water (1-2m) and the liquid portions of excreta percolate into the surrounding soil
- The solids are digested biologically which greatly reduce the rate that solids accumulate in the pit

**Applications**
- In-house
  - Installed on the upper floors of low-rise buildings
- Urban-areas
Advantage and Disadvantage

<table>
<thead>
<tr>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inexpensive</td>
<td>Need separate sullage disposal facilities</td>
</tr>
<tr>
<td>A long term solution for excreta</td>
<td>Water (min 4L/person/day) must be available throughout the year</td>
</tr>
<tr>
<td>Use low volumes of water for flushing</td>
<td>Clog easily where bulky anal cleansing materials are used</td>
</tr>
<tr>
<td>Can be upgrade to connect to a sewer system</td>
<td>Area with high ground water, construction is more difficult and expensive</td>
</tr>
<tr>
<td>Eliminate odours, insect and fly breeding</td>
<td>There is a risk that pour-flush toilets with pollute water supplies</td>
</tr>
<tr>
<td>Only low level of municipal involvement is required</td>
<td></td>
</tr>
<tr>
<td>The possibility exists of in-house location</td>
<td></td>
</tr>
<tr>
<td>Potential for resource recovery</td>
<td></td>
</tr>
<tr>
<td>No need to carry and transport excreta</td>
<td></td>
</tr>
</tbody>
</table>

Pit Volume

- The required effective volume:
  \[ V_c = AR^*N*T \]

  Where:
  - AR: sludge accumulation rate (m³/person/year) usually 0.04 m³/person/year
  - N: number of users
  - T: filling time in years (double-pit: 2 years)

Dimention of the Pour Flush Pan and Waterseal

Knock Down
Pit Shape

- The soil is not very permeable → surface area available for infiltration may have to be increased
- Must be lined to their full depth → collapsing when saturated with water from the pit
- Most common lining materials → brick and stone
- In areas with a high water table → raise the pit walls above ground level should be watertight, built a sand filter around the pit to limit disease

Pit Cover

- The pit are generally covered by slabs
- The pit covers can be located above or below ground level or actually at ground level
- Seal any gaps to prevent insects or odours escaping from the pit

Superstructure

- Local materials → the most suitable and cheapest
- Must be well ventilated

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Ventilation

- The toiled bowl and the floor should be regularly washed, using a mild disinfectant
- Latrine superstructure should be kept in good repair
- Sludge disposal
  - Single → removed by pump truck → stabilization ponds or composting
  - Double pit → removed sludge after two years

Maintenance
excreta disposal in refugee camps

A trench defecation field with guidance markers

Shallow trench latrine

Source: Reed (1944)

Source: Rapaport & Shiffman (1974)
<table>
<thead>
<tr>
<th>Deep trench latrine 1</th>
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<tbody>
<tr>
<td><img src="image-url" alt="Diagram of deep trench latrine" /></td>
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</tbody>
</table>