Pit latrine

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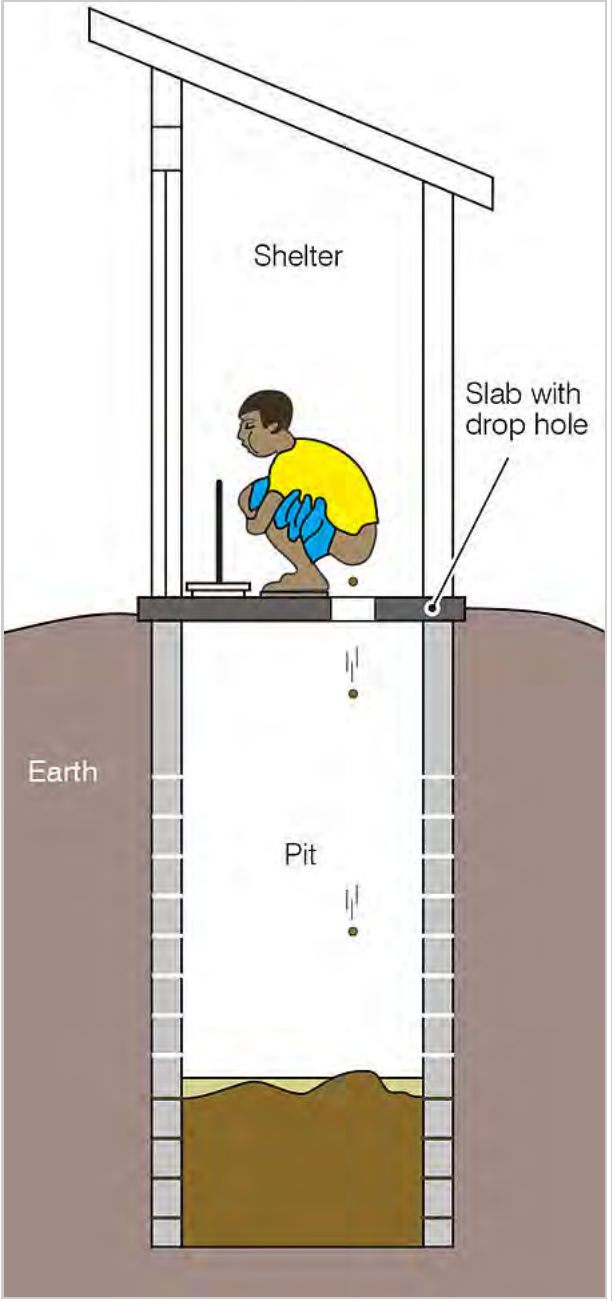
A **pit latrine** or **pit toilet** is a type of toilet that collects human feces in a hole in the ground. They use either no water or one to three liters per flush with pour-flush pit latrines.[2] When properly built and maintained they can decrease the spread of disease by reducing the amount of human feces in the environment from open defecation.[3][4] This decreases the transfer of pathogens between feces and food by flies.[3] These pathogens are major causes of infectious diarrhea and intestinal worm infections.[4] Infectious diarrhea resulted in about 700,000 deaths in children under five years old in 2011 and 250 million lost school days.[4][5] Pit latrines are the lowest cost method of separating feces from people.[3]



Drawing of a simple pit latrine with a squatting pan and shelter[1]

A pit latrine generally consists of three major parts: a hole in the ground, a slab or floor with a small hole, and a shelter.[2] The shelter is often known as an outhouse. The pit is typically at least 3 meters (10 feet) deep and 1 m (3.2 feet) across.[2] The World Health Organization recommends they be built a reasonable distance from the house balancing issues of easy access versus that of smell.[3] The distance from groundwater and surface water should be as large as possible to decrease the risk of groundwater pollution. The hole in the slab should not be larger than 25 centimeters (9.8 inches) to prevent children falling in. Light should be prevented from entering the pit to reduce access by flies. This may require the use of a lid to cover the hole in the floor when not in use.[3] When the pit fills to within 0.5 meters (1.6 feet) of the top, it should be either emptied or a new pit constructed and the shelter moved or re-built at the new location.[6] Fecal sludge management involves emptying pits as well as transporting, treating and using the collected fecal sludge. If this is not carried out properly, water pollution and public health risks can occur.

A basic pit latrine can be improved in a number of ways. One includes adding a ventilation pipe from the pit to above the structure. This improves airflow and decreases the smell of the toilet. It also can reduce flies when the top of the pipe is covered with mesh (usually made out of fiberglass). In these types of toilets a lid need not be used to cover the hole in the floor.[6] Other possible improvements include a floor constructed so fluid drains into the hole and a reinforcement of the upper part of the pit with bricks, blocks, or cement rings to improve stability.[2][6]

As of 2013 pit latrines are used by an estimated 1.77 billion people.[7] This is mostly in the developing world

as well as in rural and wilderness areas. In 2011 about 2.5 billion people did not have access to a proper toilet and one billion resort to open defecation in their surroundings.[8] Southern Asia and Sub-Saharan Africa have the poorest access to toilets.[8] In developing countries the cost of a simple pit toilet is typically between 25 and 60 USD.[9] Ongoing maintenance costs are between 1.5 and 4 USD per person per year which are often not taken into consideration.[10] In some states of India the "No Toilet, No Bride" campaign has been used in rural areas to promote toilets by encouraging women to refuse to marry a man who does not own a toilet.[11][12] This type of campaign is embedded in other change efforts promoted by the Indian government in the "Clean India Mission".[13]

Contents

Definitions

Pit latrines are sometimes also referred to as "dry toilets" but this is not recommended because a "dry toilet" is an overarching term used for several types of toilets and strictly speaking only refers to the user interface.[2] Depending on the region, the term "pit latrine" may be used to denote a toilet that has a squatting pan with a

water seal or siphon (more accurately termed a pour-flush pit latrine – very common in South East Asia for example) or simply a hole in the ground without a water seal (also called a simple pit latrine) – the common type in most countries in sub-Saharan Africa. Whilst a dry toilet can be with or without urine diversion, a pit latrine is almost always without urine diversion. The key characteristic of a pit latrine is the use of a pit, which infiltrates liquids into the ground and acts as a device for storage and very limited treatment.[2]

Improved or unimproved sanitation

A pit latrine may or may not count towards the Millennium Development Goals (MDG) target of increasing access to sanitation for the world's population, depending on the type of pit latrine: A pit latrine without a slab is regarded as unimproved sanitation and does not count towards the target. A pit latrine with a slab, a ventilated improved pit latrine and a pour flush pit latrine connected to a pit or septic tank are counted as being "improved sanitation" facilities as they are more likely to hygienically separate human excreta from human contact.[14]

Design considerations

Size of the drop hole

The user positions themself over the small drop hole during use. The size of the feces drop hole in the floor or slab should not be larger than 25 centimeters (9.8 inches) to prevent children falling in. Light should be prevented from entering the pit to reduce access by flies.This requires the use of a lid to cover the hole in the floor when not in use.[3] However, in practice, such a lid is not commonly used as it is easy to lose it or for the lid to get very filthy.

Squatting pan or toilet seat

On top of the drop hole there can either be nothing (this is the simplest form of a pit latrine) or there can be a squatting pan, seat (pedestal) or bench which can be made of concrete, ceramic, plastic or wood.

Shelter

A shelter, shed, small building or "super-structure" houses the squatting pan or toilet seat and provides privacy and protection from the weather for the user. Ideally, the shelter or small building should have handwashing facilities available inside or on the outside (e.g. supplied with water from a rainwater harvesting tank on the roof of the shelter) although this is unfortunately rarely the case in practice. In the shelter, anal cleansing materials (e.g. toilet paper) and a solid waste bin should also be available. A more substantial structure may also be built, commonly known as an outhouse.

Locating the pit

Liquids leach from the pit and pass the unsaturated soil zone (which is not completely filled with water). Subsequently, these liquids from the pit enter the groundwater where they may lead to groundwater pollution. This is a problem if a nearby water well is used to supply groundwater for drinking water purposes. During the passage in the soil, pathogens can die off or be adsorbed significantly, mostly depending on the travel time between the pit and the well.[15] Most, but not all pathogens die within 50 days of travel through the subsurface.[16]

The degree of pathogen removal strongly varies with soil type, aquifer type, distance and other environmental factors.[7] For this reason, it is difficult to estimate the safe distance between a pit and a water source – a problem that also applies to septic tanks. Detailed guidelines have been developed to estimate safe distances to protect groundwater sources from pollution from on-site sanitation.[17][18] However, these are mostly ignored by those building pit latrines. In addition to that, household plots are of a limited size and therefore pit latrines are often built much closer to groundwater wells than what can be regarded as safe This results in groundwater pollution and household members falling sick when using this groundwater as a source of drinking water.

Common problem: groundwater well (forefront) is in close proximity to the pit latrine (brick building at the back) in Lusaka, Zambia

As a very general guideline it is recommended that the bottom of the pit should be at least 2 m above groundwater level, and a minimum horizontal distance of 30 m between a pit and a water source is normally recommended to limit exposure to microbial contamination.[1]However, no general statement should be made regarding the minimum lateral separation distances required to prevent contamination of a well from a pit latrine.[19] For example, even 50 m lateral separation distance might not be sufficient in a strongly karstified system with a downgradient supply well or spring, while 10 m lateral separation distance is completely sufficient if there is a well developed clay cover layer and the annular space of the groundwater well is well sealed.

If the local hydrogeological conditions (which can vary within a space of a few square kilometres) are ignored, pit latrines can cause significant public health risks via contaminated groundwater. In addition to the issue of pathogens, there is also the issue of nitrate pollution in groundwater from pit latrines. Elevated nitrate levels in drinking water from private wells is thought to have causes cases of blue baby syndrome in children in rural areas of Romania and Bulgaria in Eastern Europe.[20]

Pit lining

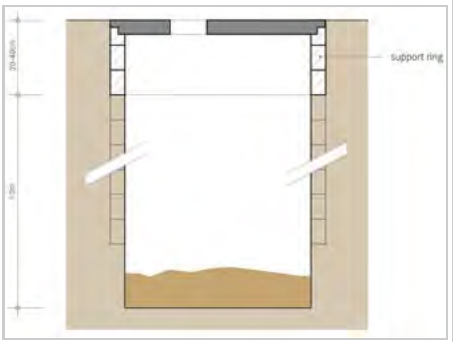
Partial

A "partially lined" pit latrine is one where the upper part of the hole in the ground is lined. Pit lining materials can include brick, rot-resistant timber, concrete, stones, or mortar plastered onto the soil.[2] This partial lining is recommended for those pit latrine used by a great number of people — such as a public restroom in rural areas, or in a woodland park or busy lay-by, rest stop or other similarly busy location — or where the soils are unstable in order to increase permanence and allow emptying of the pit without it collapsing easily. The bottom of the pit should remain unlined to allow for the infiltration of liquids out of the pit.

In Dar es Salaam, Tanzania pit latrines costing up to $300 are 10 ft (3.0 m) deep and lined with concrete slabs, while cheaper “temporary toilets” consist of a pits lined with two stacked oil drums or a stack of tires.[21] These latrines, which are often used by several households, may be emptied by vacuum truck, manual digging, or overflowing into streets during rains.[21]

Fully

A fully lined pit latrine has concrete lining also at the base so that no liquids infiltrate into the ground. One could argue that this is no longer a "pit" latrine in the stricter sense. The advantage is that no groundwater contamination can occur. The major disadvantage is that a fully lined pit latrine fills up very fast (as the urine cannot escape the pit) which results in high costs to empty and maintain the latrine. Increased odour can also be an issue as the pit content is much wetter and emits more odour. This type of pit latrine is used only in special circumstances, e.g. in denser settlements where groundwater protection is paramount.



Schematic of the pit of a pit latrine.[2] The defecation hole in the slab is shown at the top, and the user squats or sits above this defecation hole. Pits can be lined with a support ring at the top of the pit as shown in this schematic.

Appropriateness

Pit latrines are often built in developing countries even in situations where they are not recommended. These include (adapted from [22]):

- Frequent flooding, resulting in inoperable toilet systems and the contamination of water resources;
- Unfavourable soil conditions, such as unstable or rocky soil and high water table, making pit-based sanitation difficult and expensive;
- When groundwater is the primary source of drinking water and is likely to be contaminated by pit-based sanitation (for example in denser settlements or with unfavourable hydrogeological conditions);
- Limited land space restricts the excavation of new pits if full pit latrines are usually not emptied;
- Indoor installations are preferred as they provide greater comfort and security at night thus making them more accessible for all

Digging the pit for an Arborloo, a type of pit toilet in Cap-Haitien, Haiti

In conditions where pit latrines are not suitable for the above-mentioned reasons, the installations of other types of toilets should be considered, e.g. the urine-diverting dry toilet (UDDT).[22]

Types

Pit latrines collects human feces in a hole in the ground. The principle of a pit latrine is that all liquids that enter the pit—in particular urine and water used for anal cleansing—seep into the ground (the only exception are fully lined pit latrines, see below).

Well maintained pit latrine at a rural household near Maseru, Lesotho.

Pit latrine from the inside at a household near Maseru, Lesotho (same toilet as shown left from the outside).

School children in Zimbabwe digging a shallow pit for an Arborloo toilet (a variation of a pit latrine), Epworth in Harare, Zimbabwe.

Traditional pit latrine in North Kamenya, Kenya.

This display shows children what toilets in rural areas in Germany used to look like in the recent past.

Abandoned pit latrine in the peri-urban area of Durban, South Africa.

Interior of an outhouse the structure usually built over the pit to provide privacy.

Ventilated improved pit

The ventilated improved pit latrine (VIP) is a pit latrine with a black pipe (vent pipe) fitted to the pit and a screen (flyscreen) at the top outlet of the pipe. VIP latrines are an improvement to overcome the disadvantages of simple pit latrines, e.g. fly and mosquito nuisance and unpleasant odors. The smell is carried upwards by the chimney effect and flies are prevented from leaving the pit and spreading disease.[2]

The principal mechanism of ventilation in VIP latrines is the action of wind blowing across the top of the vent pipe. The wind creates a strong circulation of air through the superstructure, down through the squat hole, across the pit and up and out of the vent pipe. Unpleasant fecal odors from the pit contents are thus sucked up and exhausted out of vent pipe, leaving the superstructure odor-free. In some cases solar-powered fans are added giving a constant outwards flow from the vent pipe.

Flies searching for an egg-laying site are attracted by fecal odors coming from the vent pipe, but they are prevented from entering by the flyscreen at the outlet of the vent pipe. Some flies may enter into the pit via the squat hole and lay their eggs there. When new adult flies emerge, they instinctively fly towards light. However, if the latrine is dark inside, the only light they can see is at the top of the vent pipe. Since the vent pipe is

covered by a fly screen at the top, flies will not be able to escape and eventually will die and fall back into the pit.

To ensure that there is a flow of air through the latrine, there must be adequate ventilation of the superstructure. This is usually achieved by leaving openings above and below the door, or by constructing a spiral wall without a door.[23]

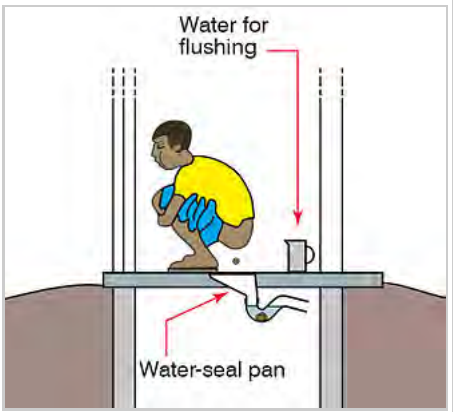
Covering the feces with an absorbent decreases smell and discourages flies. These may include soil, sawdust, ash, or lime, among others.[6] In developing countries, the use of absorbents in pit toilets is not commonly practiced.

Twin pit designs

A further possible improvement is the use of a second pit which is used in alternation with the first pit. It means that the first pit can rest for the duration of time it takes to fill up the second pit. When the second pit is also full, then the first pit is emptied. The fecal sludge collected in that first pit has in the meantime undergone some degree of pathogen reduction although this is unlikely to be complete. This is a common design for so-called twin-pit pour flush toilets and increases the safety for those having to enter the pit.[2] Also VIPs are sometimes built with two pits, although for VIP toilets one problem can be that the users may not stick to this alternation method and fill up both pits at the same time.

Pour-flush pit latrine

In a pour–flush pit latrine, a squatting toilet with a water seal (U-trap or siphon) is used over one or two offset pits instead of a plain hole or seat. Therefore, these types of toilets do require water for flushing but otherwise have many of the same characteristics as simple pit latrines and are for this reason subsumed under the term "pit latrine". The fecal sludge that is removed from the full pits of twin-pit pour-pour flush pit latrines is somewhat safer to handle and reuse than the fecal sludge from single pit pour-flush latrines, although significant health risks remain in either case and are a cause for concern.



Pour–flush pit latrine schematic showing squatting pan with water seal

An alternative to U-trap or siphon designs is to incorporate a counter-weighted trap door mechanism that provides an air-tight water seal in the closed position.[24] Addition of a small amount of water (generally less than 500 ml) overcomes the counterweight and allows the fecal matter to enter the pit.[25] The devices are sold under the name of "SaTo pan" for as little as $1.85 USD and more than 800,000 of them have been installed worldwide since introduction in 2013.[26]

Cat hole

A cat hole is a one-time use pit toilet often utilized by campers, hikers and other outdoor recreationalists. It is also called the "cat method" and simply means digging a little hole just large enough for the feces of one defecation event which is afterwards covered with soil.

Maintenance

The requirements for safe pit emptying and fecal sludge management are often forgotten by those building pit latrines, as the pit will "only" fill up in a few years time. However, in many developing countries safe fecal sludge management practices are lacking and causing public health risks as well as environmental pollution.[27] Fecal sludge that has been removed from pits manually or with vacuum tankers is often dumped into the environment indiscriminately, leading to what has been called "institutionalized open defecation".

A counterweight slab (called SaTo pan) installed in a pit latrine in Rwanda, converting it to a pour flush pit latrine

Pit emptying

When the pit is full, the toilet is no longer usable. The time it takes to fill the pit depends on its volume, the number of users, the soil permeability and groundwater level. It can typically take between one and ten years or even longer in some exceptional cases. At that point, the pit latrine is either covered and abandoned, and a new one built if space on the property permits this. The new pit latrine may reuse the shelter (super-structure). For pit latrines in more densely populated areas or at schools, the full pits are more likely to be emptied so that the toilets can continue to be used at the same location. The emptying can be done manually with shovels and buckets (manual scavenging), with manually powered pumps or with motorized pumps mounted on a vacuum truck which carries a tank for storage.[27] For the fecal sludge to be pumpable, water usually needs to be added to the pit and the content stirred up, which is messy and smelly.

Manual pit emptying of a pit latrine near Durban, South Africa

Sludge management

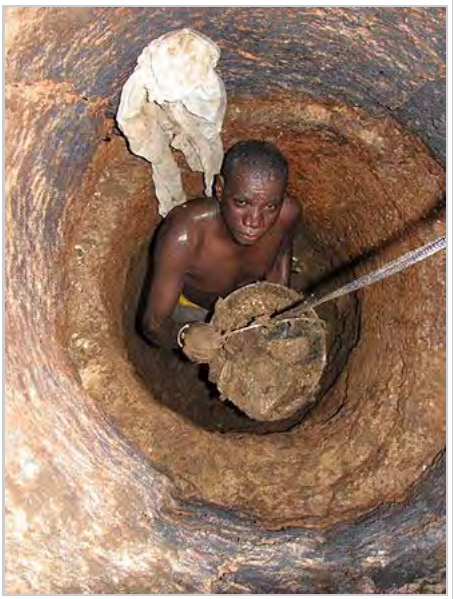
The fecal sludge may be transported by road to a sewage treatment facility, or to be composted elsewhere. There are numerous licensed waste hauling companies providing such service in areas where it is needed in developed countries, although in developing countries such services are not well regulated and are often carried out by untrained, unskilled and unprotected informal workers.

When managed and treated correctly to achieve a high degree of pathogen kill, fecal sludge from pit latrines could be used as a fertilizer due to its high nitrogen, phosphorus and organic matter content. However, it is hard to ensure that this is done in a safe manner. The number of viable helminth eggs is commonly used as an indicator organism to make a statement about the pathogen load in a fecal sludge sample. Helminth eggs are very persistent to most treatment methods and are therefore a good indicator.

Pit additives

A range of commercial products are available which claim to help reduce the volume of feces in a latrine, and reduce odor and fly problems. They are collectively described as a pit additive and many of them are based on the concept of effective microorganisms. The intention is to add specific strains of microbes to aid the decomposition process – but their effectiveness is disputed and recent research found no effect in scientific test conditions.[28][29]

Wood ash or sawdust can also be added on top of the feces to decrease the smell.[6] However, this is rarely done for pit latrines (more commonly done for dry toilets) as the users find that too much hassle and generally do not expect a pit latrine to be odour free and rather put up with some smell. In the case of Arborloos it is recommended to add some leaves, soil or compost into the pit after defecation.



Bad practice example: An unprotected worker emptying the pit of a pit latrine in Fada N'Gourma in the East of Burkina Faso. The man works without gloves, boots and mask, because these are too expensive. Boots would be useless as in the beginning of the emptying process the sludge normally reaches up to the emptier's knees.

Bad practice example: Fecal sludge that has been manually removed from pits is dumped into the local river at Korogocho slum near Nairobi, Kenya

Advantages

Advantages of pit latrines may include:[2]

- Can be built and repaired with locally available materials
- Low (but variable) capital costs depending on materials and pit depth
- Small land area required

Measures to improve access to safe water, sanitation and better hygiene, which includes the use of pit latrines instead of open defecation, is believed to be able to prevent nearly 90% of deaths due to infectious diarrhea.[30]

Disadvantages

Disadvantages of pit latrines may include:[2]

- Flies and odours are normally noticeable to the users
- The toilet has to be outdoors with the associated security risks if the person is living in an insecure situation
- Low reduction in organic matter content and pathogens
- Possible contamination of groundwater with pathogens and nitrate
- Costs to empty the pits may be significant compared to capital costs
- Pit emptying is often done in a very unsafe manner
- Sludge (called fecal sludge) requires further treatment and/or appropriate discharge
- Pit latrines are often relocated or re-built after some years (when the pit is full and if the pit is not emptied) and thus need more space than urine-diverting dry toilets for example and people are less willing to invest in a nice high-quality super-structure as it will have to be dismantled at some point.

Costs

In developing countries the construction cost for a simple pit toilet is between about US$25 and 60.[9] This cost figure has a wide range because the costs vary a lot depending on the type of soil, the depth and reinforcement of the pit, the superstructure that the user is willing to pay for, the type of toilet squatting pan or toilet seat

chosen, the cost of labour, construction materials (in particular the cost of cement can differ a lot from one country to the next), the ventilation system and so forth.

Rather than looking only at the construction cost, the whole of life cost (or life-cycle cost) should be considered, as the regular emptying or re-building of pit latrines may add a significant expense to the households in the longer term.[31]

Society and culture

User experiences

Pit latrines may or may not be an enjoyable experience to use. Problems may occur when the pit latrine is shared by too many people, is not cleaned daily and not emptied when the pit is full. In such cases, flies and odour can be a massive nuisance. Also, pit latrines are usually dark places which are difficult to keep clean. Often, handwashing facilities are missing. For these reasons, shared pit latrines can be quite uncomfortable to use in developing countries. Also, there might be cultural preferences for open defecation and these may be difficult to overcome with unattractive toilet designs. This is currently being discussed amongst experts for the example in the case of rural India where behaviour change campaigns are needed to reduce open defecation.[32]

School pit latrine after maintenance has been neglected at Ambira Boys High School, Nyanza Province, Kenya

Promotion

In 2011 about 2.5 billion people did not have access to a proper toilet and one billion defecate outside.[33] Southern Asia and Sub-Saharan Africa have the poorest access to toilets.[8] Pit latrines are often promoted by government agencies and NGOs in rural areas as a low-cost quick fix solution (even in areas where other types of toiles, such as dry toilets, might be the better solution for example due to high groundwater table).

For example, in the rural part of Haryana state in India the "No Toilet, No Bride" or "No loo, no "I do"" slogans has been used to promote toilets (usually pour flush pit latrine toilets) by encouraging women to refuse to marry a man who does not own a toilet.[11][12] The important initiative of the Indian government since 2014 called the "Clean India Mission" is using various approaches such as the one mentioned above in the different states of India to encourage behavior change with regards to toilet use.

The community-led total sanitation campaigns which have been successful in many developing countries usually also result in the construction of pit latrines (typically with pour flush in Asia, without pour flush in sub-Saharan Africa) as a first step to get away from open defecation.

See also

- Bucket toilet
- Cathole
- Swachh Bharat Abhiyan (Clean India Mission)
- Outhouse

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External links

- Single pit latrine on eCompendium website (http://ecompendium.sswm.info/sanitation-technologies/single-pit?group_code=s), the online version of the Eawag-Sandec Compendium
- WEDC knowledge database filtered for WEDC guide and latrine (https://wedc-knowledge.lboro.ac.uk/search.html?q=series%3A%22WEDC+Guide%22AND+%22latrine%22&l=10&s=score&o=desc) (WEDC, Loughborough University, UK)
- Photos of pit latrines: Search for "pit latrine" in the Sustainable Sanitation Alliance photo database on flickr (https://www.flickr.com/photos/gtzecosan/)
- Storage and Treatments On-site storage and treatment technologies (http://www.sswm.info/category/implementation-tools/wastewater-treatment#On-site) in Sustainable Sanitation and Water Management (SSWM) toolbox

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