

Rural Sanitation

Introductory Level Training – Workbook

This workbook has been prepared by
Quasar Management Services Pty Limited,
for use by Partner Housing Australasia
and its partner organisations.

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Rural Sanitation Training – Introductory Level

Purpose

The purpose is to provide introductory level understanding of rural sanitation to trainees, enabling them to construct pit latrines and similar village sanitation systems, and to undertake more advanced training.

Workbook

- This workbook is for basic skills training for the construction of South Pacific village latrines.
- The workbook employs photographs and diagrams where possible, with minimum use of text.
- More detailed training packages are available for higher level training. At the end of this workbook are extracts from *Solomon Islands Rural Water Supply, Sanitation and Hygiene - Design and Construction Standards, Version 2, November 2015*, which provide the basis for further training.
- The trainee is encouraged to make notes in the space provided.

Trainer

The Trainer must be an experienced builder, who has received instruction in the use of this material.

Training Resource Material

This material is sourced from Power Point presentations, that can be used as:

- Teaching presentations
- Printed work books, to be given to the trainees as a permanent reference
- Printed and laminated posters, that are placed on site
- As a source of details, which can be copied and placed onto project drawings.

Latrine Design

General Considerations and Regulatory Compliance

Partner Housing Latrines (as described in this Training Workbook) are based on the standard designs in the regulation documents of several South Pacific countries, with particular emphasis on the Solomon Islands guidelines. These designs reflect national attitudes age, disability, gender and other relevant regulatory issues. Partner Housing reflects and adheres to these national regulations where they are applicable.

Age Considerations

Partner Housing VIP Latrines are designed as “squat” toilets, because this is the most hygienic design for the remote villages for which they are intended. When specifically requested, a pedestal may be included for the elderly.

Disability Considerations

Partner Housing VIP Latrines are intended for use in remote villages, generally accessed through the jungle via (at best) rough footpaths. A person with disabilities would require assistance to access the latrine. The latrine itself is designed to provide sufficient room to enable both the disabled person and their assistant to move about freely inside.

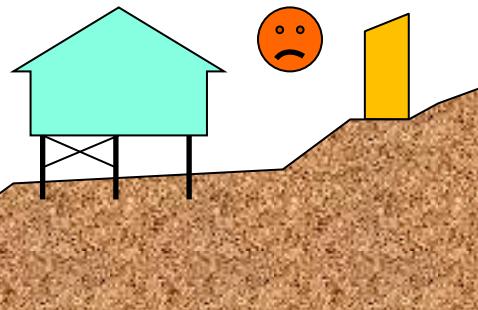
Gender Considerations

Partner Housing VIP Latrines are designed within a weatherproof out-house, with a self-closing lockable door; thus providing maximum privacy for women, men and children. The inside surface is timber, to allow for the mounting of any other toilet fitting as may be required, including those specific to women.

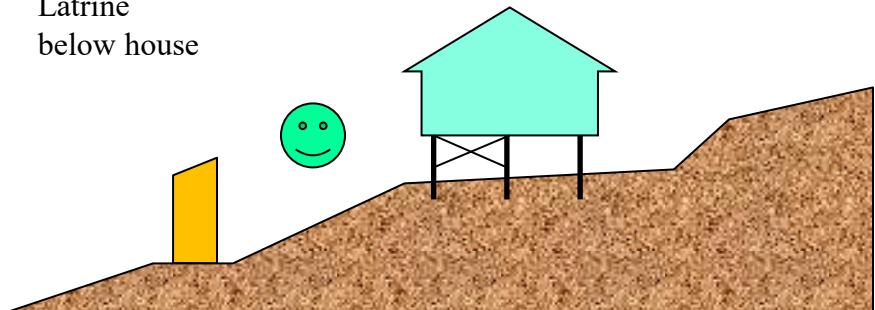
Latrine Location

Latrines should be located below houses and below water sources.

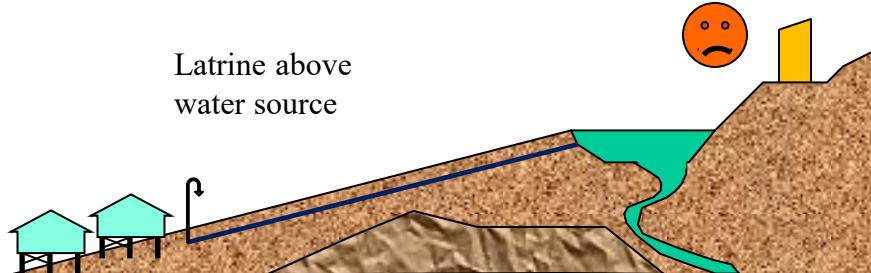
Latrine
above house



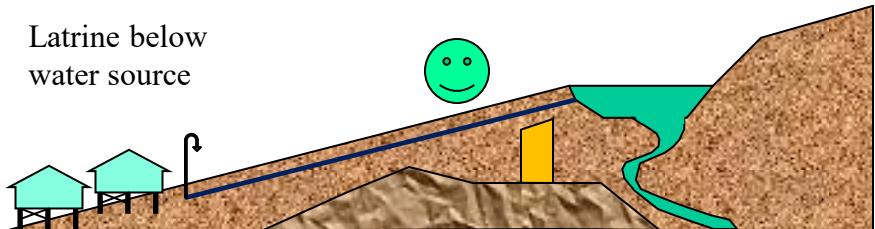
Latrine
below house



Latrine above
water source



Latrine below
water source



Pit Latrine Design

Pit dimensions are based on the volume of faeces and toilet paper (or substitute), and a clearance of 500 mm when at the end of the service life. Pit widths or diameters should not exceed 1.2 m, to ensure that the concrete slab can span without cracking or breaking. Pit depths should not exceed a safe depth of excavation, accounting for the pit width (diameter) and soil type. In no circumstances should the depth exceed the locally regulated depths, or 2.0 metres in stiff clay, 1.5 metres in sandy soil or excavated below the water table.

The service life of a pit latrine (in years) may be calculated by $Y = V / (P f)$, where

Y = service life (years), after which the pit is decommissioned and the latrine is moved.

P = number of people using each pit. Allow 6 people per house, in the absence of local data.

f = typical volume of faeces, deposited in pit latrines $m^3/\text{person/year}$.

V = useable volume of the pit (m^3) allowing for errors in estimating unit usage and for clearance
 $= (3.14 D^2/4) (H-h)$ for a circular pit, or $L W (H-h)$ for a rectangular pit

H = total depth of a pit (m)

h = clearance at the end of the service life

$= 0.500$ m (recommended)

D = diameter of a circular pit (m)

L = length of a rectangular pit (m)

W = width of a rectangular pit (m)

Typical volume of faeces and cleansing material deposited in pit latrines $f, m^3/\text{person/year}$	
Material used for anal cleansing	Bottom of pit <u>above</u> water table
Biodegradable materials (e.g., water, toilet paper)	0.06
Bulky or nonbiodegradable materials (e.g., soil, stones)	0.09
Pits should not be excavated below the water table. Pit depths must account for safety during excavation.	

Pit Latrine Design Example

Number of people using each pit. Allow 6 people per house, in the absence of local data.

$$P = 6 \text{ people}$$

Volume of faeces, deposited in pit latrines. Allow for biodegradable cleaning material.

$$f = 0.06 \text{ m}^3/\text{person/year}$$

Diameter of a circular pit

$$D = 0.900 \text{ m}$$

Clearance at the end of the service life

$$h = 0.500 \text{ m}$$

Total depth of a pit. Assume pit is in stiff clay, above the water table. A safety person is in attendance.

$$H = 2.000 \text{ m}$$

Useable volume of the pit (m^3) allowing for errors in estimating unit usage and for clearance

$$\begin{aligned} V &= (3.14 D^2/4) (H-h) \text{ for a circular pit or } L W (H-h) \text{ for a rectangular pit} \\ &= (3.14 \times 0.900^2/4) (2.000 - 0.500) \\ &= 0.954 \text{ m}^3 \end{aligned}$$

Service life (years), after which the pit is decommissioned and the latrine is moved.

$$\begin{aligned} Y &= V / (P f) \\ &= 0.954 / (6 \times 0.06) \\ &= 2.65 \text{ years} \end{aligned}$$

After a period of about 2 to 3 years, the pit must decommissioned and covered with 500 mm of impermeable clay. The latrine slab and enclosure may be moved to a new locations over a newly-excavated pit.

Ventilated Improved Pit (VIP) Latrine

VIP Latrines may vary in design. The following VIP Latrine consists of :

1. 900 mm diameter x 1-2 metres deep pit. Safety during excavation is of utmost importance, and will limit depth / diameter. A pit liner may be required to prevent collapse. If a larger hole is required, slab must be modified to suit.
2. Reinforced concrete slab with:
 - A large key-hole opening for the squat hole; and
 - Two holes* for the ventilation pipes.
3. Vent pipes sealed into the concrete slab suck out foul air as fresh air is drawn down through the squat hole. *Double vent pipes may be used to achieve the equivalence of a single 150 mm diameter pipe. The top of the vent pipes should extend 500 mm above the roof and be painted black to encourage air flow.
4. A weatherproof timber out-house, painted black inside and outside, to foster air flow, with a self-closing door.

Flies are attracted but cannot pass the fly screen to enter the pipes. Any flies entering the latrine are attracted to the light coming from the vent pipe but are unable to escape once they have gone up the vent pipe and hit the screen. Flies avoid dark spaces. A dark interior and self closing door are critical.



Pit Latrine Enhancements

In cyclonic areas, the superstructure should be strengthened, so as to resist high winds. Refer to separate detailing.

The slab should be used as is, but could be fitted with pedestal, seat and cover as an option; BUT it must include cement mortar benching inside the pedestal that directs the excreta down the hole, and does not permit it to collect on the slab. This arrangement must be regularly cleaned.

In all cases, there must be close consideration of:

- the sighting of the latrine to prevent contamination of drinking water, living areas or crops by seepage or overflow'
- the availability of flushing and cleaning water; and
- the rate at which the pit will fill and overflow.



Pit Latrine Enhancements



VIP Latrine Enhancements

In cyclonic areas, the superstructure should be strengthened, so as to resist high winds. Refer to separate detailing.

The slab should be used as is, but could be fitted with pedestal, seat and cover as an option; BUT it must include cement mortar benching inside the pedestal that directs the excreta down the hole, and does not permit it to collect on the slab. This arrangement must be regularly cleaned.

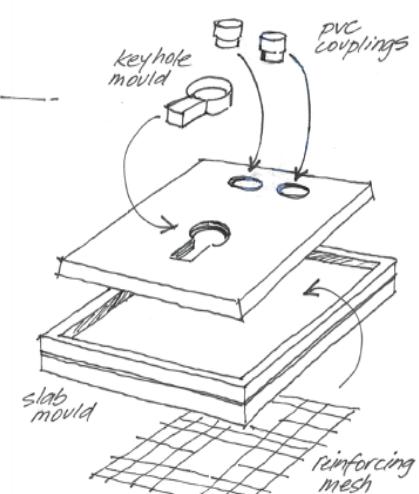
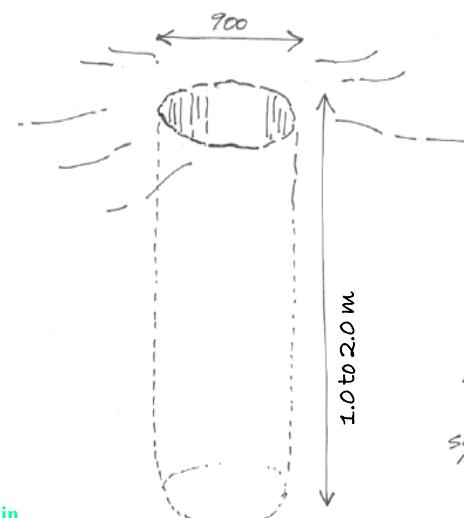
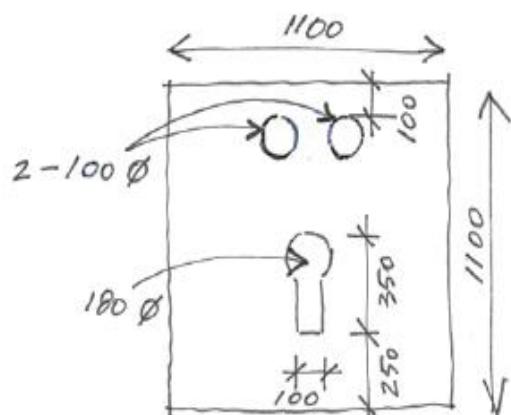
In all cases, there must be close consideration of:

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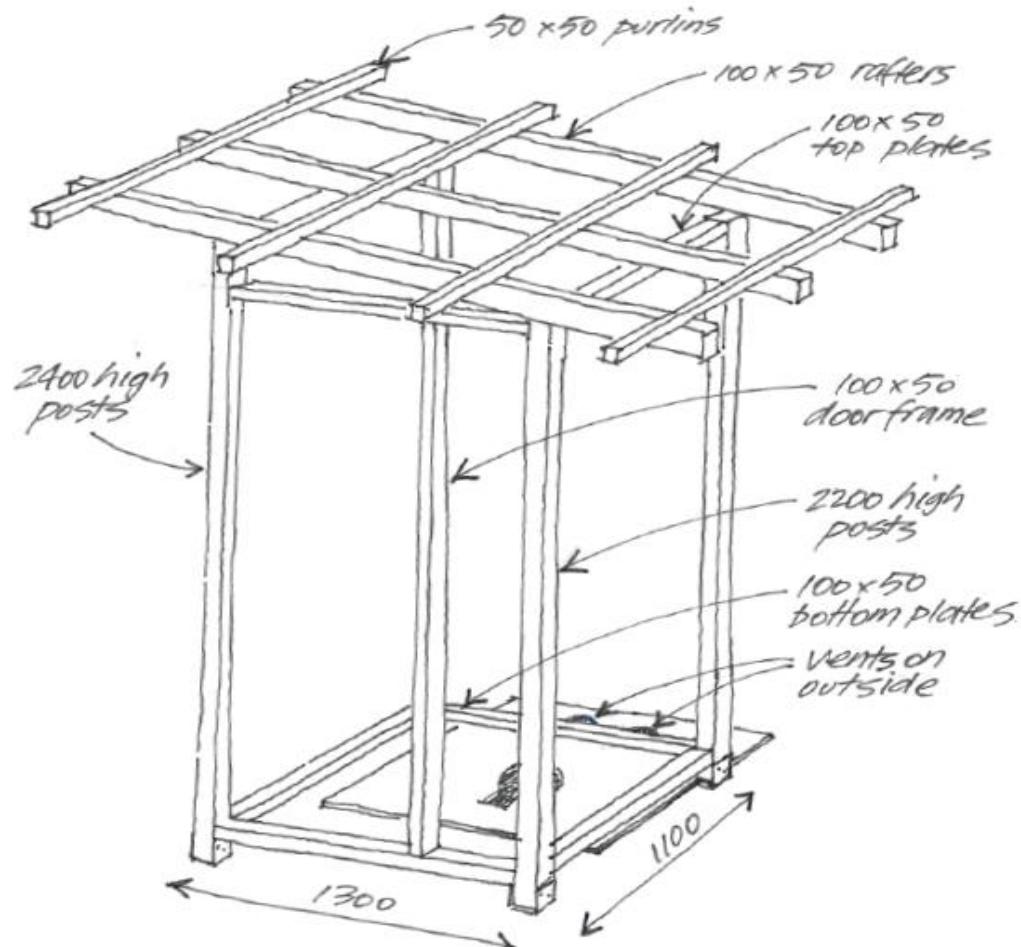
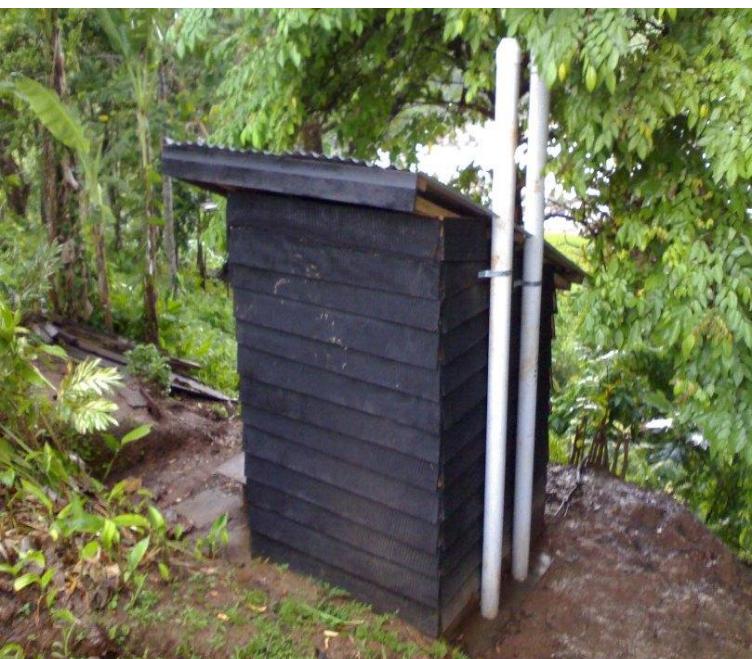
VIP Latrine Construction

- Dig a 900 mm diameter pit, 1 to 2 metres deep. Safety during excavation is of utmost importance, and will limit depth / diameter ratio.
- Locate the pit on high ground, to avoid rainwater flooding pit, below the source of drinking water.
- Locate the concrete slab over the pit. Allow adequate room at edges of the pit for the concrete footings and supports for the slab.
- Cast the concrete slab using a timber mold, reinforcing mesh, keyhole mold for squat and coupling for a vent.
- Oil the mold and keyhole before pouring the concrete, to ease removal from slab.
- Remove the keyhole before the concrete hardens.



VIP Latrine Construction

- Build the frame.
- Position the frame ensuring that the vent hole is on the outside.
- Attach the post anchors and concrete in the footings.
- Strap the rafters to the frame



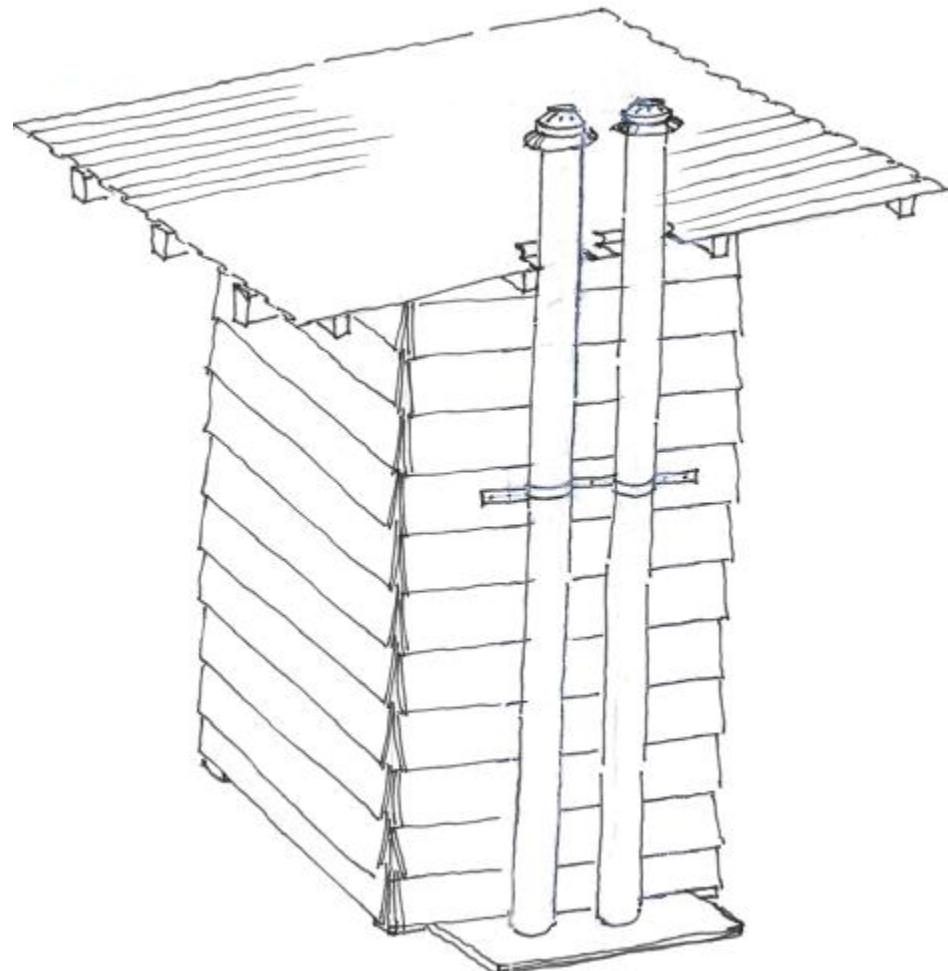
VIP Latrine Construction

- Fix two sheets of corrugated roofing.
- Bend up the corners of the sheeting if hazardous.
- Fix the weatherboard cladding and corner beads.
- Allow sufficient overlap to ensure a completely dark internal space.
- Seal any internal gaps at floor level with cladding to suit.



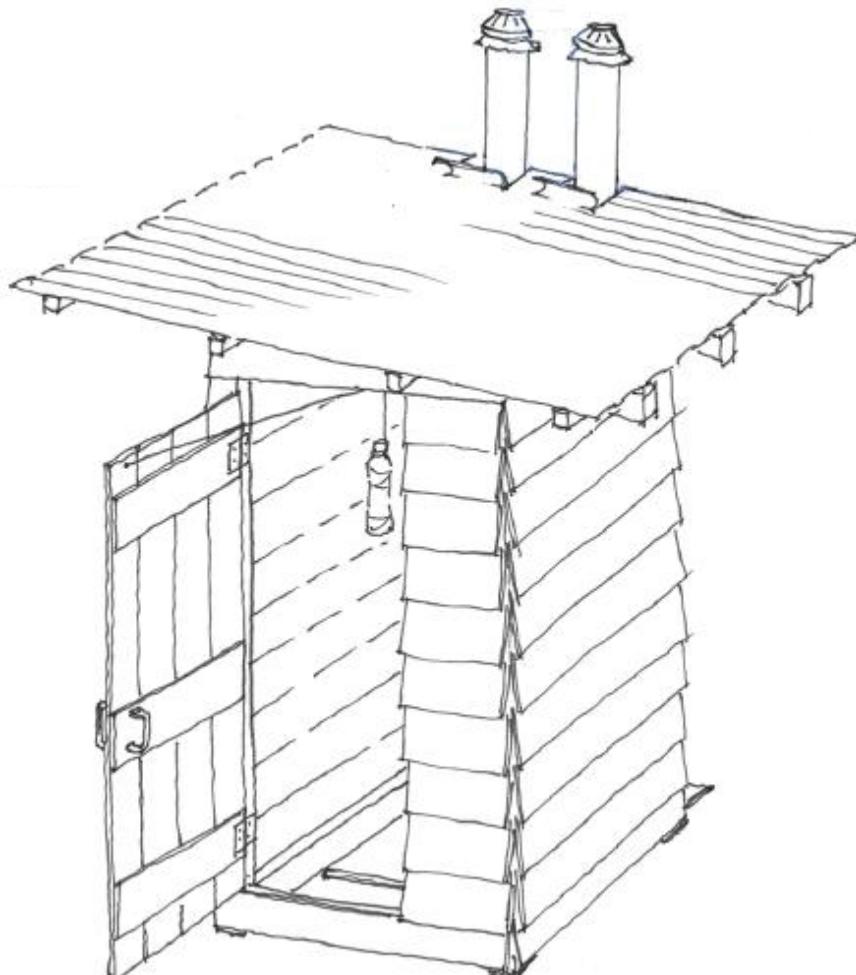
VIP Latrine Construction

- Cut back the roof sheeting and peel back to allow clearance for the vent pipe.
- Cover the vent pipe with flyscreen mesh and vent cap.
- Before inserting the vent pipe, notch the bottom of the coupling to allow built-up gas to escape up vent.
- Strap the vent pipe to the wall.



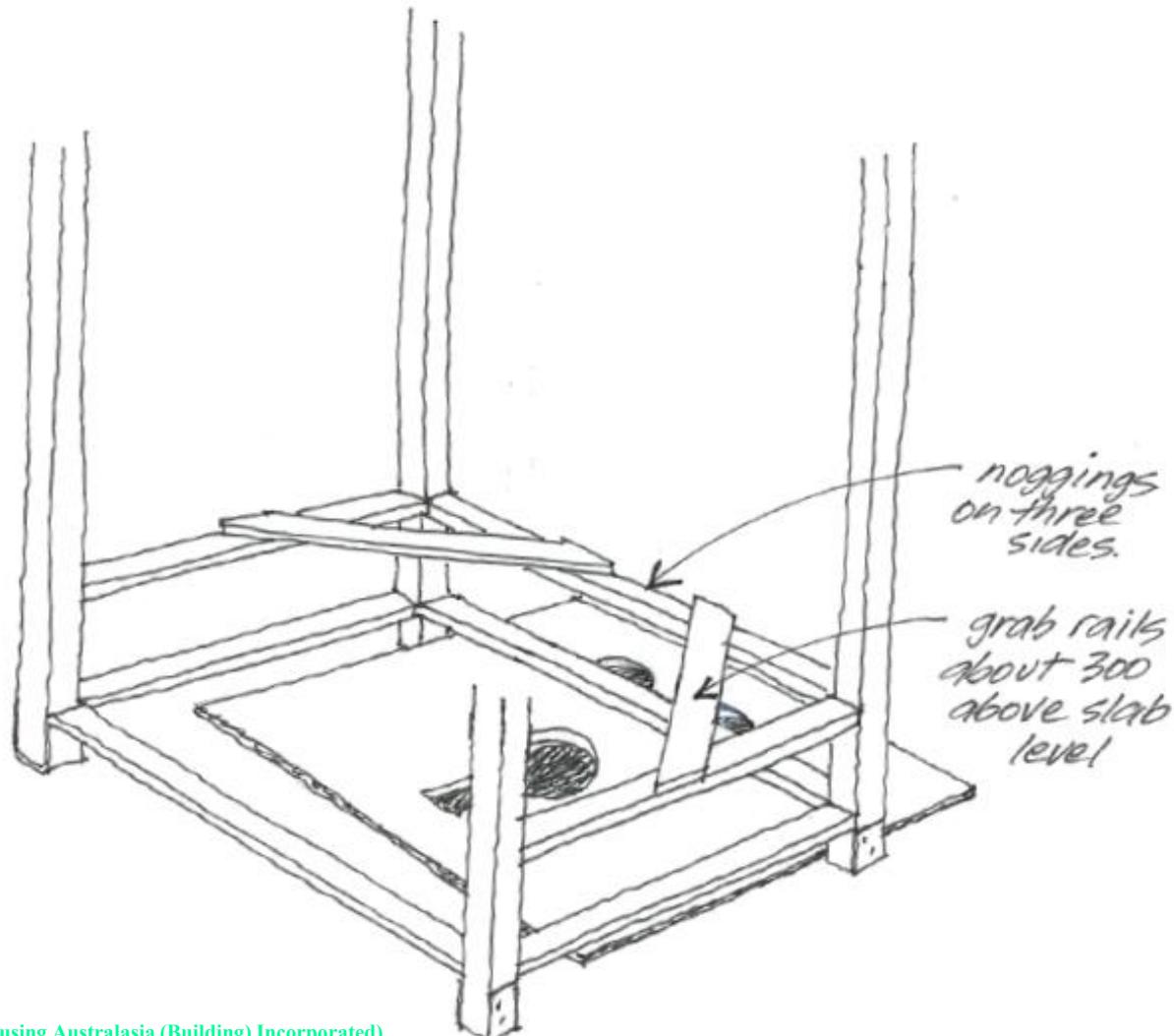
VIP Latrine Construction

- Make the door using cladding, ensuring minimal gaps between the boards.
- Fix the hinges, handles and lock if required. Door should swing out.
- Make the door closer with a water-filled 600ml plastic drink bottle and fishing line.
- Paint the shed.



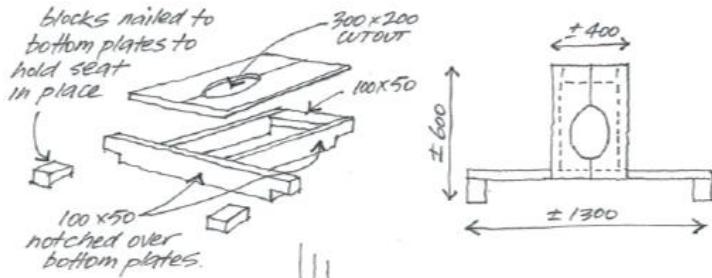
VIP Latrine Grab Rails

Grab rails are to assist the disabled and elderly in returning to an upright position.



VIP Latrine Seat

The VIP Latrine seat is a simple addition to latrines for people who have difficulty in assuming or maintaining the squat position. By using materials readily available within the village the seat can either be made at the time of latrine construction or retro-fitted when required. As the seat does not touch the slab, this allows the entire area of the slab to be cleaned. This can be done by either leaving the seat in place or lifting the seat out completely. The seat is designed to correspond to the standard latrine keyhole –no enlargement is necessary thus avoiding any child safety issues. The seat is sufficiently elevated to minimise spillage onto the slab yet gives adequate support. The seat can also provide assistance when returning to an upright position. It is suitable for use by children.

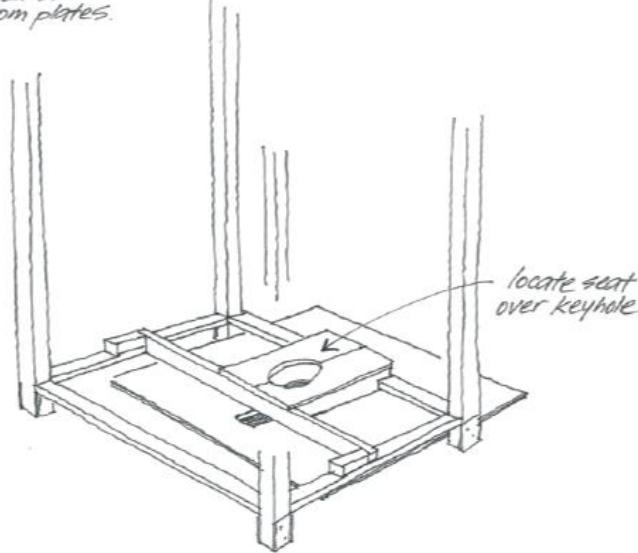


Materials

1 -100 x 50 x 3m length of timber

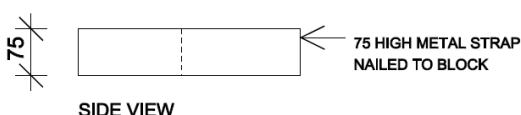
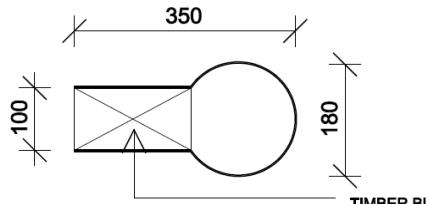
1 -200 x 20 x 1.2m length of timber as used for weatherboard

Cladding nails

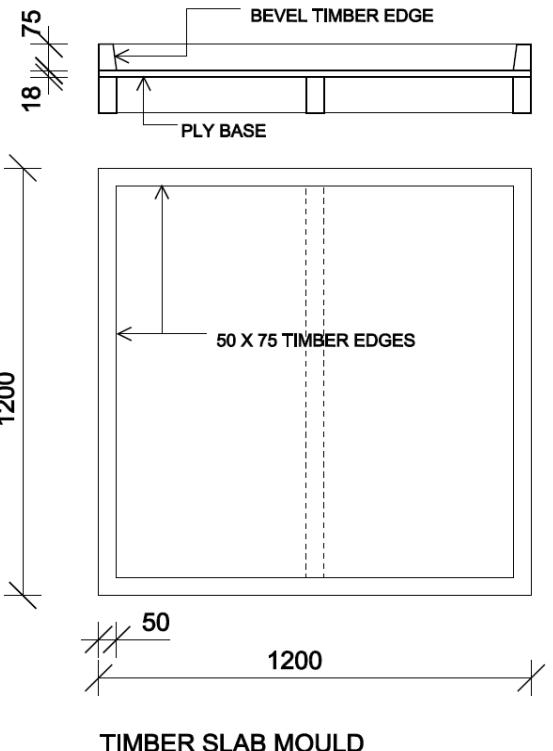


Concrete VIP Latrine Base

SL 62 steel mesh OR
4 / N10 x 1150 steel reinforcement each way

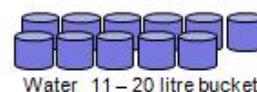
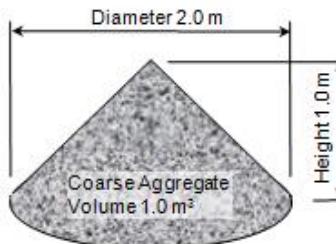
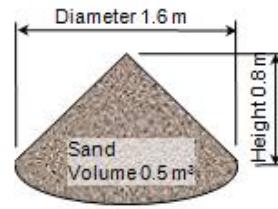


KEYHOLE MOULD



	1	10
Approximate mix (by volume) 1 : 2 : 4	VIP Latrine Slab	VIP Latrine Slabs
Volume of concrete	m^3	0.10
Wastage included	%	10%
GP or GB cement	40 kg bags	1
Clean sharp sand	m^3	0.05
20 mm rock aggregate	m^3	0.10
SL 62 steel mesh	No-mesh $\text{m} \times \text{m}$	1 - SL62 1.15 x 1.15
Timber formwork	m	75 X 50 HW x 8.4 (re-use)
Plywood formwork		18 plywood 1.2 x 1.2 (re-use)

For 1 cubic metre (1 m^3)
of 20 MPa concrete



Water Sealed Toilets



Water Sealed Toilets Construction

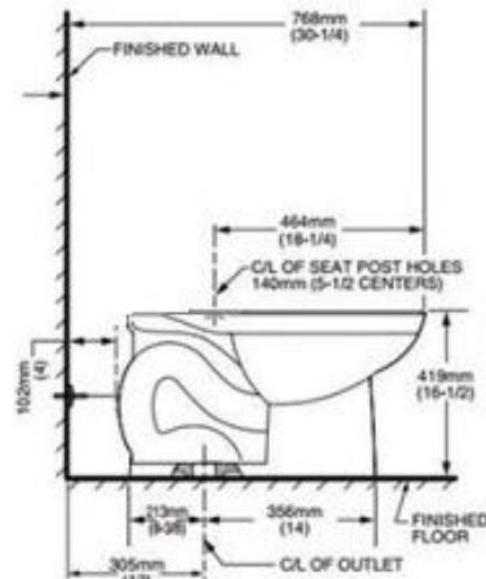
This specification is additional to the requirements for VIP Latrines.

Water-sealed toilets shall:

1. Only be used where a sufficient quantity of water for flushing is available throughout the year, rainwater is not considered as a sufficient source for flushing;
2. Have a toilet slab made of reinforced concrete (or fibreglass, plastic or other technically sound material)
3. When discharging into a pit below, have an easily removable slab and superstructure for easy relocation.

Additional requirements for off-set pits, water-sealed toilets shall:

1. Have a drain pipe with a minimum diameter of 100 mm, laid in a straight line, less than a 45° bend and a minimum of 5% slope for the drain pipe;
2. Have drain pipes between 3 and 6 m length from permanent housing or toilets constructed inside a building;
3. Have drain pipes fitted with air vents(s) to prevent air locks;
4. Have inspection ports at pipe junctions etc.



Siphon-type toilet pan with small diameter outlet pipe

Water Sealed Toilets Further Considerations

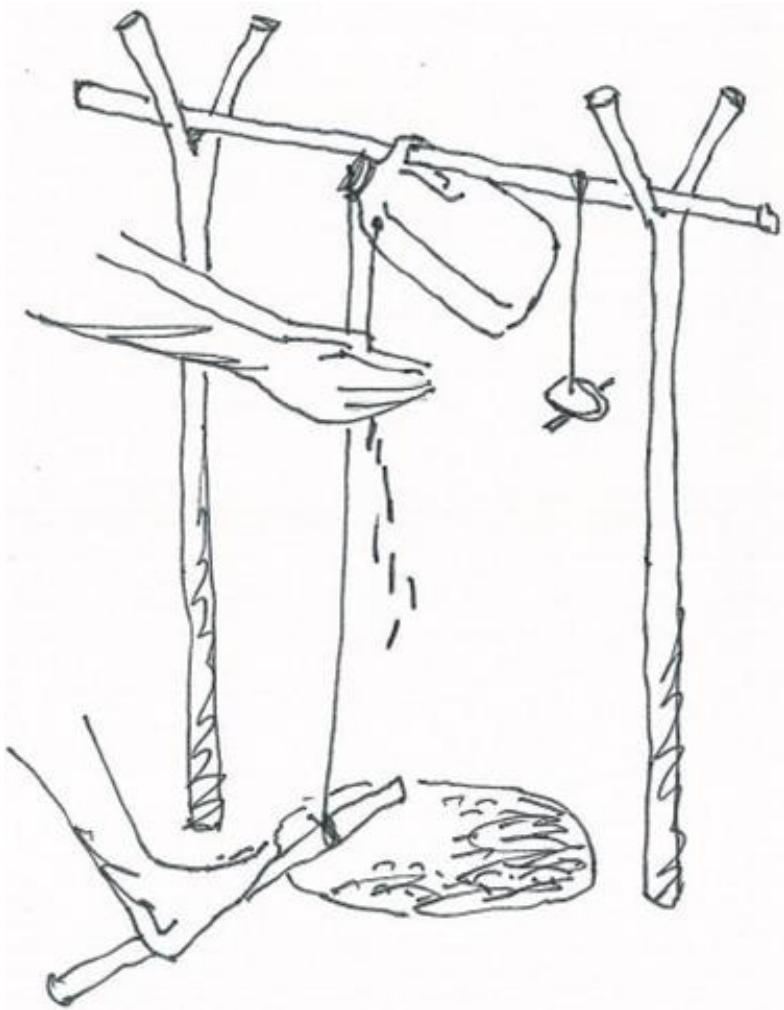


The pit must be of sufficient dimensions to cater for the excreta and flushing water. Porous sandy soil, loose rock and rock fissures will help drain the pit.

The pit must not drain into drinking water

Provide a large container or mandi to store a reserve of flushing water, and bucket large enough to hold sufficient water to flush the pedestal.

Hand Washing



Hand Washing

Hand-washing with soap helps prevent diarrheal diseases and pneumonia, which together are responsible for the majority of child deaths estimated at more than 3.5 million each year.

Washing with water alone is significantly less effective than washing hands with soap. Using soap and a small amount of water breaks down the grease and dirt which carries most germs.

The critical times when hands should be washed with soap are after using the latrine or cleaning a child's bottom and before handling food.

By making hand-washing with soap normal practice at these times would make a significant contribution to meeting one of the UN's Millennium Development Goals of reducing deaths among children under the age of five by two-thirds by 2015.

The Tippy Tap consists of a container hanging in a timber frame and a rope fixed to a stick. By treading on the stick the container tips over and a small trickle of water comes out of the hole in the container. When the stick is released the container comes back to the neutral position which cuts off the water supply. As hands are not required to operate the tap contamination of the water is thus prevented.

Materials

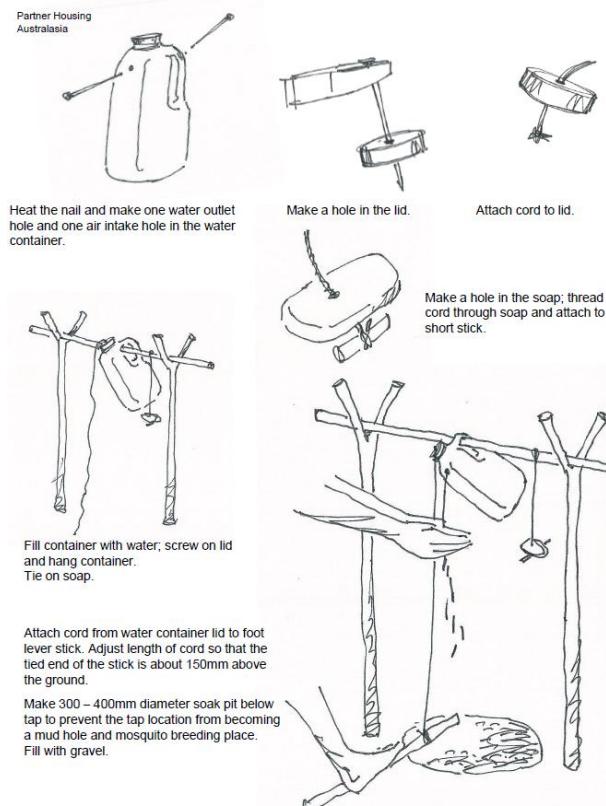
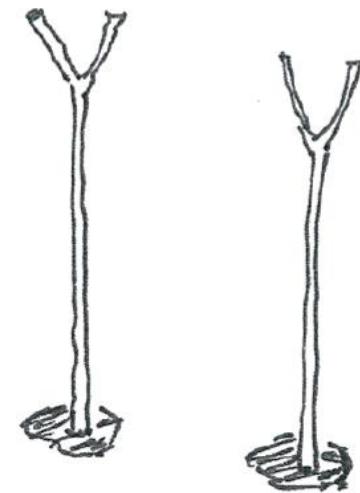
- 3 litre plastic container for water
- 2 x 1.8m forked sticks
- 2 x 1m sticks
- 1 x 500mm length cord
- 1 x 1m length cord
- A piece of soap

Tools

- 1 x 100mm (4") nail
- Pliers
- Candle or lighter
- Handsaw
- Spade or shovel
- A large bucket of gravel

Hand Washing Device Construction

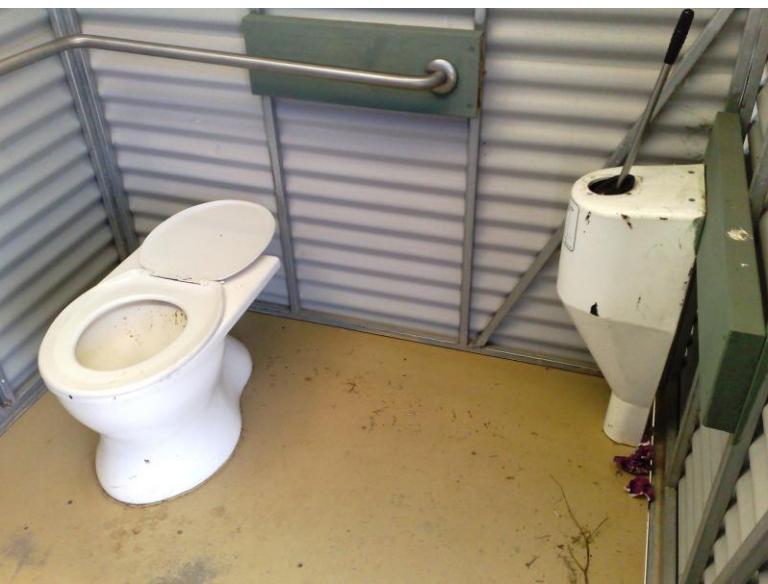
- Dig two holes about 600mm deep and about 600mm apart.
- Place the sticks into holes ensuring that forks are level.
- To protect the sticks from termites paint lower part of sticks with used car oil or 'carbonise' over a fire.
- Fill the holes with soil and rocks and pack tightly.
- Heat the nail and make one water outlet hole and one air intake hole in the water container.
- Make a hole in the lid.
- Attach the cord to the lid.
- Make a hole in the soap; thread the cord through soap and attach to a short stick.
- Fill the container with water; screw on lid and hang container.
- Tie on the soap.
- Attach a cord from water container lid to foot lever stick. Adjust the length of cord so that the tied end of the stick is about 150mm above the ground.
- Make a 300 to 400mm diameter soak pit below tap to prevent the tap location from becoming a mud hole and mosquito breeding place.
- **Fill with gravel**



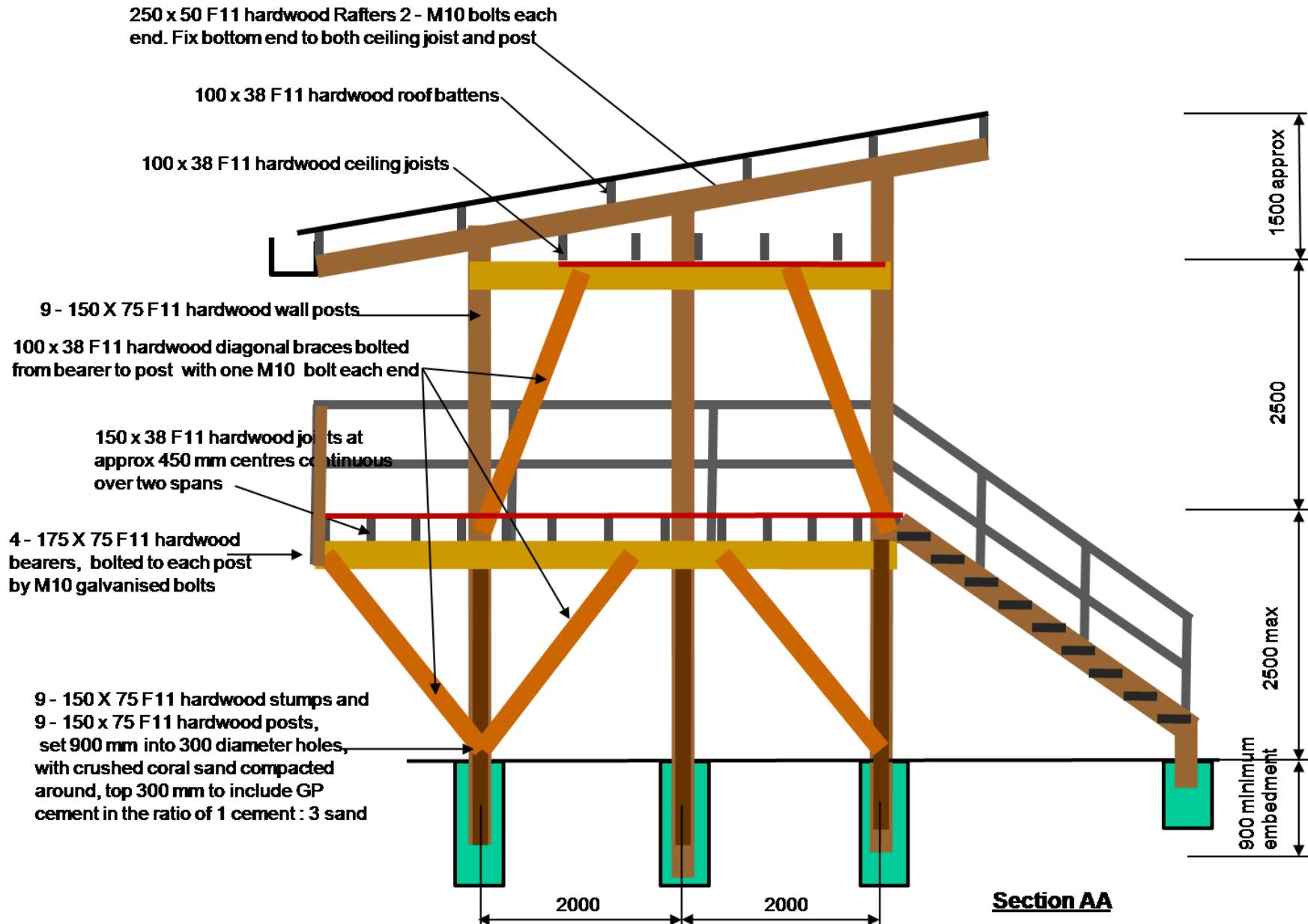
Rural Septic Toilets



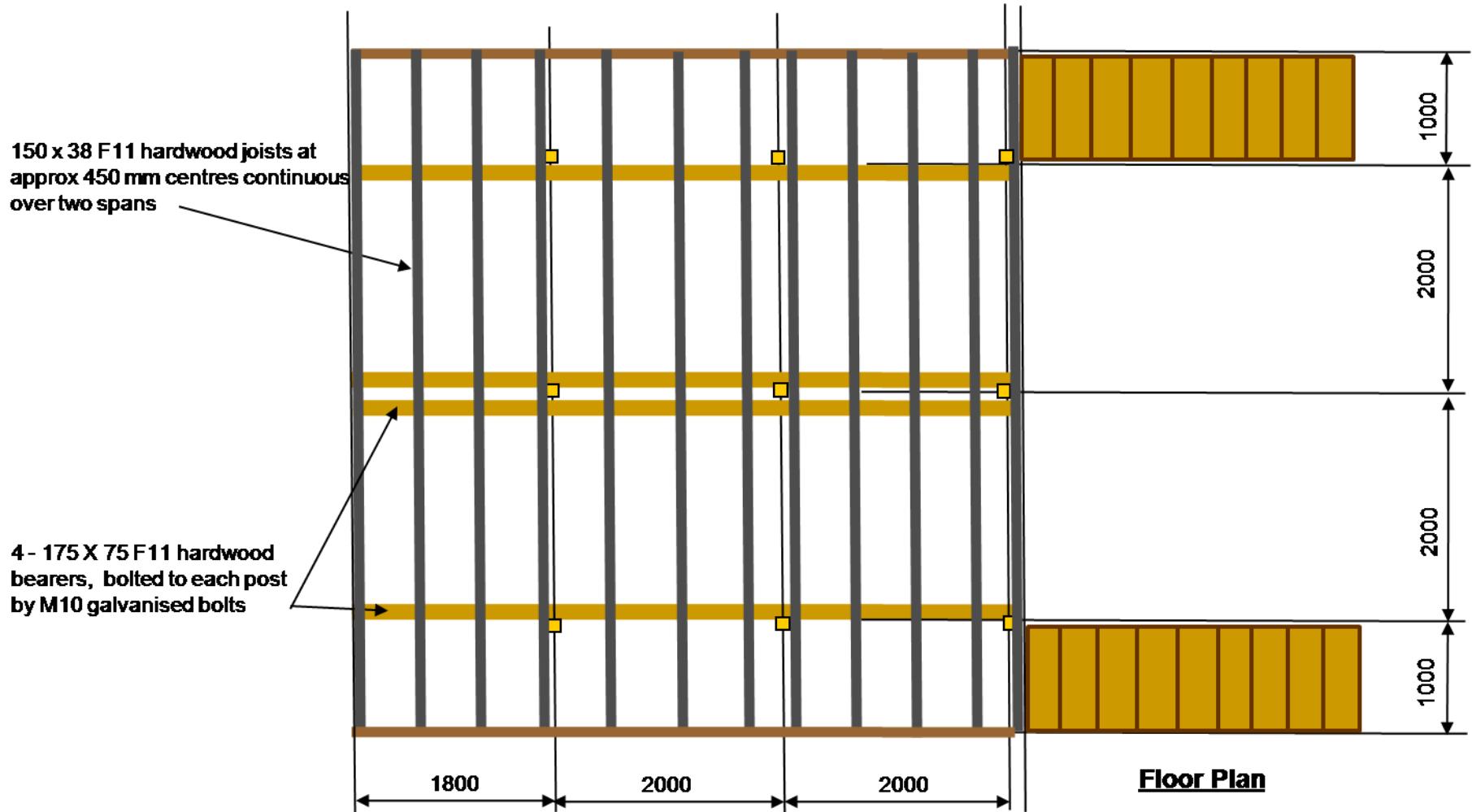
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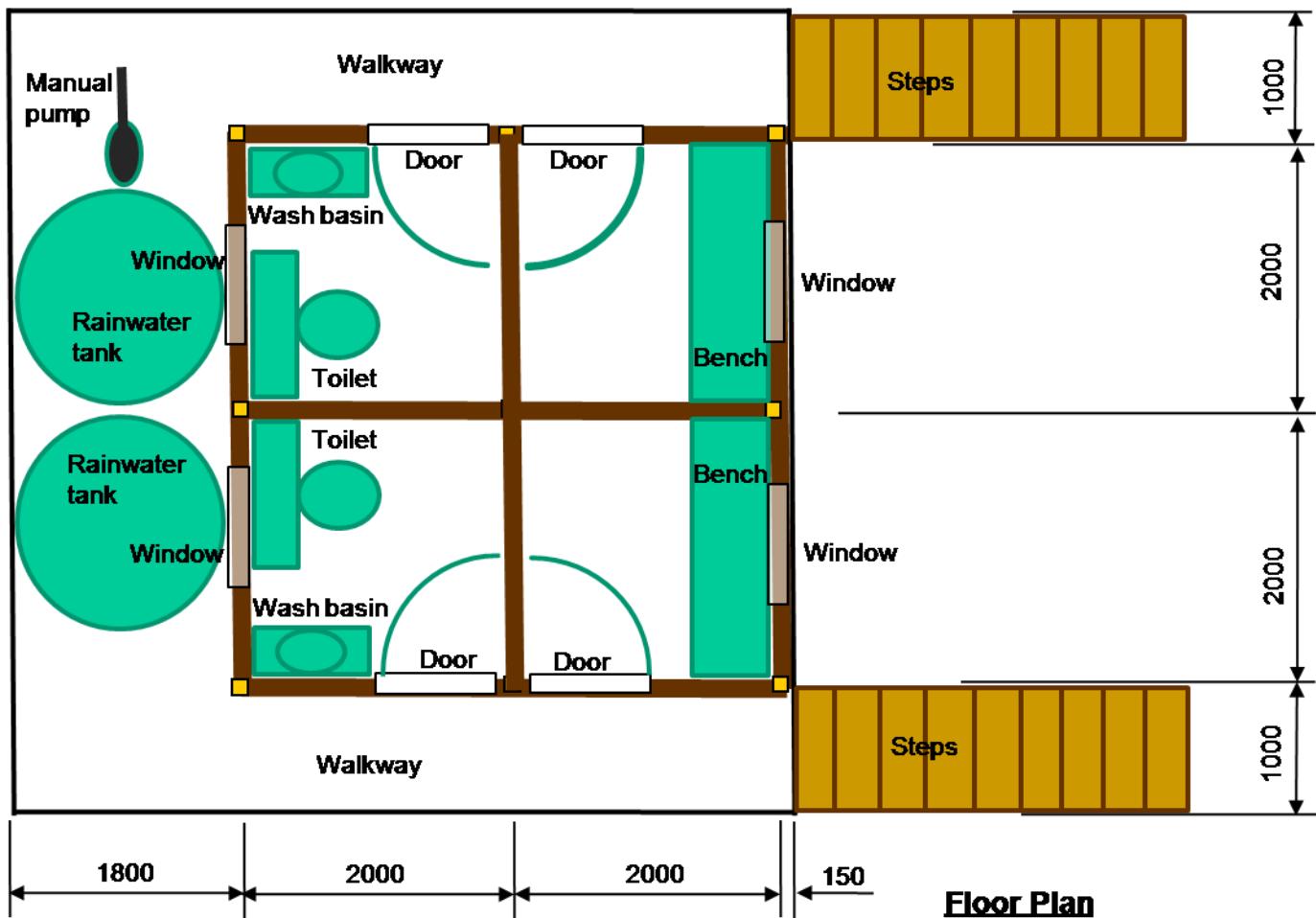
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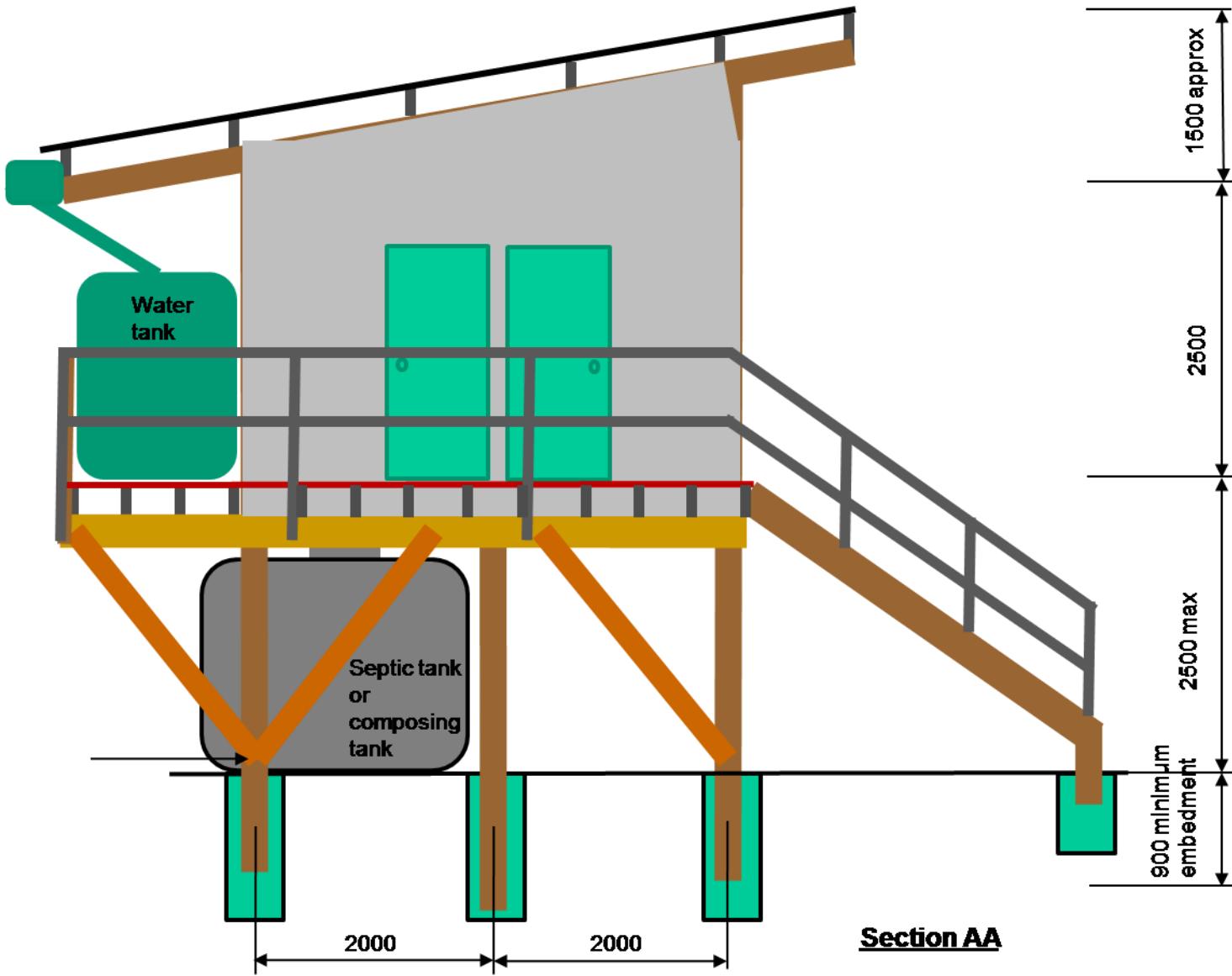
Rural Septic Toilets



Rural Septic Toilets



Rural Septic Toilets



Design and Construction Checklist				
Site				
Activity	Pit Latrines			
Item or Product	Inspection Required	Accept Criteria	Hold or Witness	Date & Inspector
Installation procedures	Inspect latest copy of the documents	Latest issue of documents with the relevant information in file	Hold	
Location	Visual inspection	Away from water table & buildings	W	
Diameter & depth of pit	Visual inspection	900 x 300 mm	Hold	
Framing	Visual inspection	As per drawing	W	
Cladding and roof	Visual inspection	Fixed in position	W	
Door	Operate door	Swing freely & close	W	
Concrete base	Visual inspection	As per drawing	W	
Vent	Visual inspection	Fixed & connected	W	
Grab rails	Visual inspection	In position	W	
Hand washing device	Operate device	Operates correctly	W	

Assignment

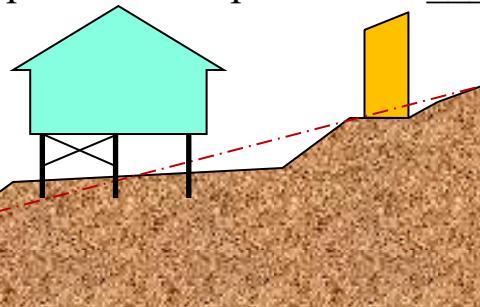
Please complete your name, email address and postal address; and answer the following questions using the notes in this workbook. Submit this page to the tutor, or email this page to rod@electronicblueprint.com.au. The tutor will assess it and reply with comments and will complete the Training Certificate.

Name: _____ Email: _____

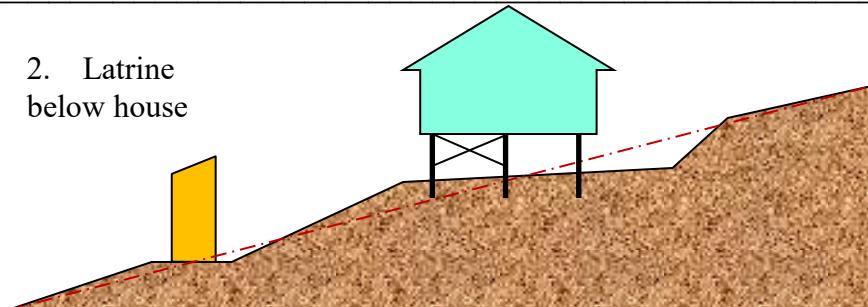
Postal Address: _____

1. What is the correct position of a pit latrine ? _____

1. Latrine above house



2. Latrine below house



2. What is the correct mix for normal concrete (20 MPa [megapascals]) ?

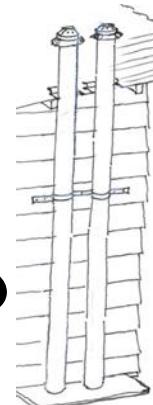


_____ 40 kg bags portland cement _____ m³ sand _____ m³ gravel _____ litres water



3. What is the purpose of the vent pipe? _____

?



Training Certificate

I hereby certify that

has completed course material in

Rural Sanitation Training – Introductory Level

prepared by Quasar Management Services Pty Limited.

Signed:

Name:

Date:



Quasar Management Services Pty Limited
ABN 21 003 954 210
Not-for-profit consulting structural and civil engineer
Subsidiary of Partner Housing Australasia (Building) Incorporated
69 Renwick Street, Redfern NSW 2016, Australia
Phone: +61 432 611 550
Email: RodJohnstonAUS@gmail.com

This certificate is valid only if signed and
dated by an authorised officer of Quasar
Management Services Pty Limited.

Solomon Islands Rural Water Supply, Sanitation and Hygiene



THE SOLOMON ISLANDS RURAL WATER SUPPLY, SANITATION & HYGIENE DESIGN AND CONSTRUCTION STANDARDS

Technical requirements for rural WASH
Projects

Version 2, Nov 2015



The Rural Water Supply, Sanitation, and Hygiene Program
Environmental Health Division Ministry
of Health and Medical Services
P.O. Box 349
Honiara, Solomon Islands
Phone: 28105

Solomon Islands Rural Water Supply, Sanitation and Hygiene



THE SOLOMON ISLANDS
RURAL WATER SUPPLY, SANITATION & HYGIENE
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Common Standards

4.3.1 Common standards

Toilets shall:

- Take into account local cultural aspects (i.e.: separate for male/female, privacy aspects etc.);
- Where required, be adapted for handicapped users;
- Be constructed such as to prevent flies and other disease carrying insects from having access to excreta (sealed floor slab and squat hole or riser covered);
- Be constructed such as to prevent surface water from entering the pit;
- Not be constructed in flood prone areas (dips, gullies etc.);
- Incorporate lining of the pit where necessary to prevent the pit wall from collapsing;
- Not cause a nuisance to the public or the neighbors;
- Not pollute the sub-soil waters if these waters are likely to be used for domestic purposes;
- Be 30 meters away from any well or other potable water source or 100m, depending on soil conditions;
- Have the following minimum internal dimensions for the superstructure: length x width = 1000 x 800mm. The height must be sufficient for users to be able to stand;
- Where applicable have a squat hole of no more than 360 x 180mm;
- Be reasonably well-lit inside the superstructure;
- Be located in consultation with the users;

4.3 Toilet construction standards:

The following applies to subsidised sanitation facilities, i.e. for schools, health facilities, PLWD, and some particularly vulnerable environments (like atolls). With the new RWASH Policy dictating no-subsidy and sanitation triggering as key elements of the sanitation approach in the Solomon Islands, households will construct their own toilets as they see fit. The main objective of the RWASH Policy's sanitation approach is behaviour change, a process which would be stifled by dictating narrow technical standards.

Basic Pit Latrine

4.3.2 ***Basic pit latrine***

Basic pit latrines shall:

- Have either a squat hole or use a seat;
- When of the squatting type, be fitted with handles inside the superstructure for support of the user;
- Have the bottom of the pit at least 0.5m above highest groundwater level;
- Use renewable local materials for the superstructure;

Raised Pit

4.3.3 *Raised pit:*

Raised pits shall:

- Have the bottom of the pit at least 0.5m above highest groundwater level;
- Have a mound of sufficient height;
- Have the mount made of sufficiently strong and/or compacted material to prevent collapse;
- Have the mount protected against erosion where necessary;
- Allow for easy access for all users regardless of age and ability;

VIP Latrines

4.3.4 *VIP Latrines*

VIP toilets shall:

- Have a vent pipe sealed into the toilet slab/base;
- Have an open vent pipe of at least 150mm diameter for smooth materials, or 200mm for rough materials to allow easy passage of air and movement of flies;
- Have the top outside part of the vent pipe painted in a dark color to promote ventilation;
- Have the open vent pipe extending at least 500mm above the roof of the toilet superstructure and with fly netting covering the opening at the top;
- Have a toilet slab made of reinforced concrete or timber, the latter sealed with clay or mud or similar to prevent insects from having access to the pit;
- Have a lid closing but not sealing the squat hole to prevent insects from accessing the pit³;

Water-sealed Toilets

4.3.5 *Water-sealed toilets*

Water-sealed toilets shall:

- Only be used where a sufficient quantity of water for flushing is available throughout the year; rainwater is **not** regarded as a sufficient source for flushing;
- Have a toilet slab made of reinforced concrete, fiber-glass, plastic or any other technically sound material;
- When off-set pits are used, have a drain pipe with a minimum diameter of 100mm, laid in a straight line or with less than a 45° bend and with a minimum of 5% slope for the drain pipe;
- Have drain pipes between 3 and 6m length from permanent housing or toilets constructed inside a building;
- Have drain pipes fitted with air vent(s) to prevent air locks;
- Have inspection ports at pipe junction etc.;
- Have an easily removable slab and superstructure when placed directly over a pit to allow easy relocation when the pit is full;

Septic Tanks

4.3.6 *Septic tanks*

On-site septic tanks shall:

- have dual chambers, either with a conventional or a baffled liquid retention chamber;
- Be made of poured reinforced concrete, stone masonry, bricks or concrete blocks;
- Be made watertight to prevent leakage of wastewater into the environment;
- Not be buried more than 500mm below the topsoil;
- Have removable manhole covers over each compartment, large enough to allow a person to have access;
- Have a concrete roof thickness of 100mm or more, with minimum of 6mm reinforcement steel;
- Have inspection openings over both inlet and outlet fittings;
- Have manhole and inspection covers at ground level; where the septic tank is buried, watertight extensions for the covers are necessary;
- If required, have an up-flow filter or any other appropriate outlet filter;
- Have a soak pit or absorption trench sized with a sealed top according to local, recent percolation test;
- have a liquid retention time of at least 36 hours;
- have a minimum internal width of 600mm;
- have a depth of at least 2, but not more than 3 times the width ;
- have a total length of at least 3 times the width, with the solids retention chamber being double the size of the liquid retention chamber;
- have inlet and outlet fittings of no less than 100mm diameter;
- Have the inlet and outlet fittings extend upwards from the *outlet* invert no less than 150mm to prevent scum from spilling into them;
- have the outlet invert at least 300mm below the cover slab;
- have the top of the fitting at least 50mm below the tank roof or tank rim, whichever is the lower;
- have the outlet fitting extending downward to 40% into the liquid depth;
- have a fall between the inlet invert and outlet invert of at least 50mm;
- the drain pipes not exposed;
- have the drain pipes between 3 and 6m away from toilet/building
- have minimum of 3 x 100mm diameter openings connecting the chambers
- have a screened vent pipe with a minimum of 50mm diameter extending high enough not to cause an nuisance, either on the drainage pipe or the septic tank.

Prefabricated fiberglass or poly septic tanks are allowed for households up to 10 people provided the capacity is at least 2,500 liters for black water only, or 4,500 liters for both black and grey water. These tanks may be single chamber only.

Composting Toilets

4.3.7 *Compost toilets*

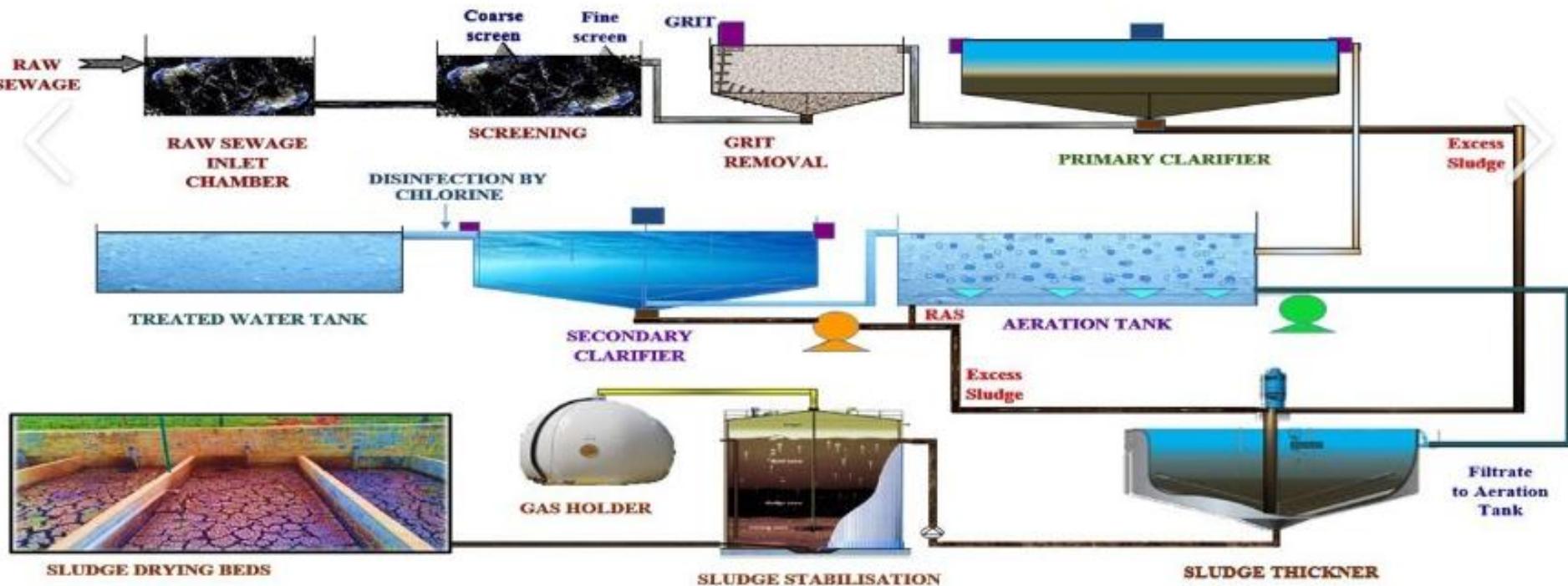
Compost toilets shall:

- have dual chambers or 2 separate toilets may be used to allow one chamber/toilet to complete the composting process while the other one is used;
- have the chambers made of reinforced cement blocks, bricks or masonry or reinforced poured concrete, or any other durable, water tight material (i.e: wheelie bins);
- Have the (squat) slab made of reinforced concrete or sustainable materials;
- Be made watertight to prevent leakage of wastewater into the environment;
- Have easily accessible and easy to empty chambers;
- Allow 6 months or more for the composting process;
- Have each chamber ventilated by means of a ventilation pipe (50mm minimum), covered with fly netting;
- Not utilise the "false floor" method to separate the liquids from the solids;
- Shall not use urine separators incorporated in the toilet riser or toilet floor, unless requested by the user;
- Have a drainage 50mm (minimum) drain pipe with 2mm (minimum) sized slots (cut with handsaw);
- Have the liquids drained to a watertight structure where vegetation is able to take it up and render it harmless; minimum dimensions: 300x500x1000mm;

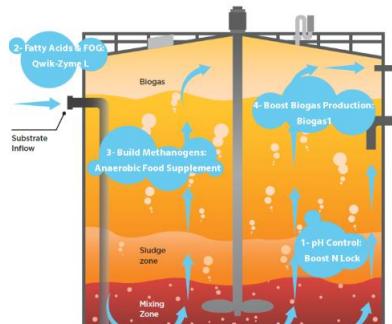
The superstructure may be made from locally available materials.

Sewage Treatment for Large Populations

This section of the training package is to provide an very brief insight into the treatment of sewage in large population centres and cities, where there is a reticulated sewerage system. It is for background information only, and is not intended as a substitute for formal training in sewage and wastewater management, or detailed design of systems and components.



Sewage Treatment



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Sewage Treatment

Package sewage treatment plants can be designed, fabricated, transported to site and installed to service small communities.



[Sewage Works - Bing images](#)

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This training package covers broad engineering principles and building practices, with particular emphasis on village infrastructure in the Asia-Pacific region. These broad principles and practices must be translated into specific requirements for particular projects by professional architects, engineers or builders with the requisite qualifications and experience. Associated sample specifications and drawings are available in electronic format, with the express intention that architects, engineers and builders will edit them to suit the particular requirements of specific projects. The design, construction and costing of structures must be carried out by qualified and experienced architects, engineers and builders, who must make themselves aware of any changes to the applicable standards, building regulations and other relevant regulations. The authors, publishers and distributors of these documents, specifications and associated drawings do not accept any responsibility for incorrect, inappropriate or incomplete use of this information.

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