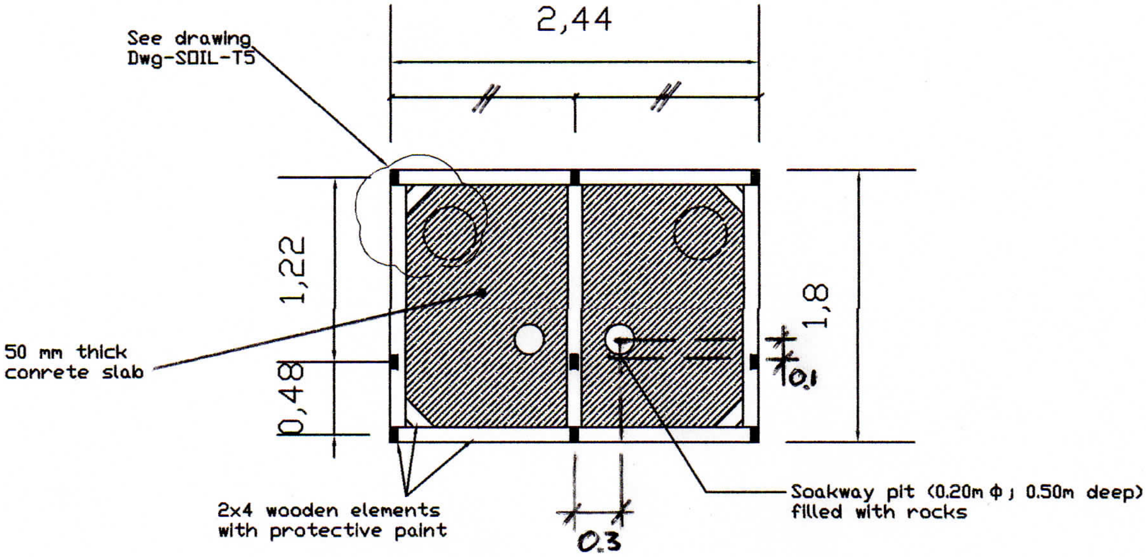
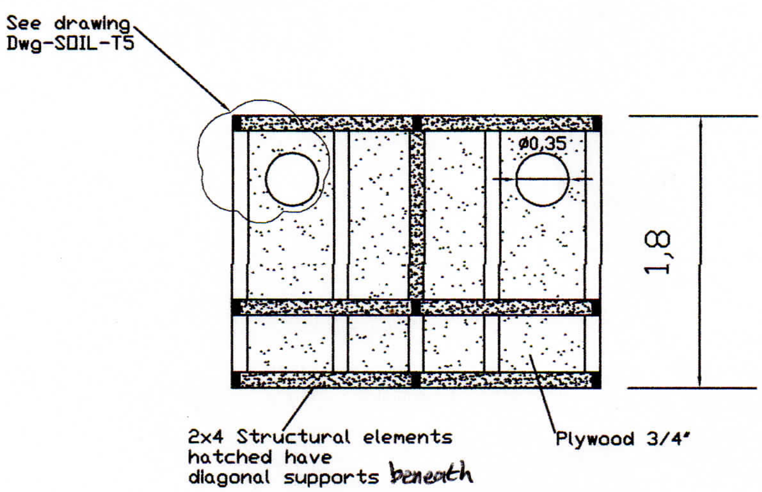


Concrete base level

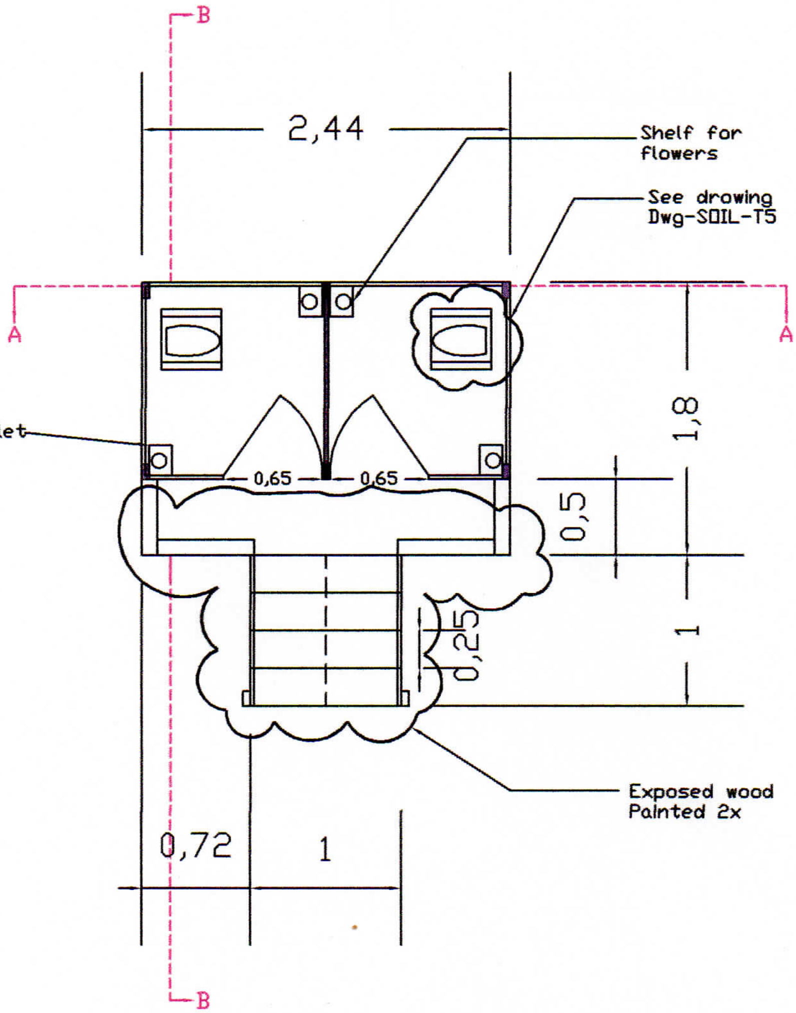


Plywood floor level

NOTES:
1, ALL DIMENSIONS IN METRES

TIT PWOJE (TITRATE PROJECT) KONSTRIKSYON TWALET SECH AN BWA (CONSTRUCTION OF DRY TOILET, WOODEN CONSTRUCTION)	DATE: OCTOBRE 2010
	No PLAN: T1
TIT DESEN AN (TITLE OF THE DRAWING) PLAN (BAZ AK ESTRIKTI TWALET) (PLAN VIEWS)	ECH: 1/50
	SOIL ENGINEERING SERVICES

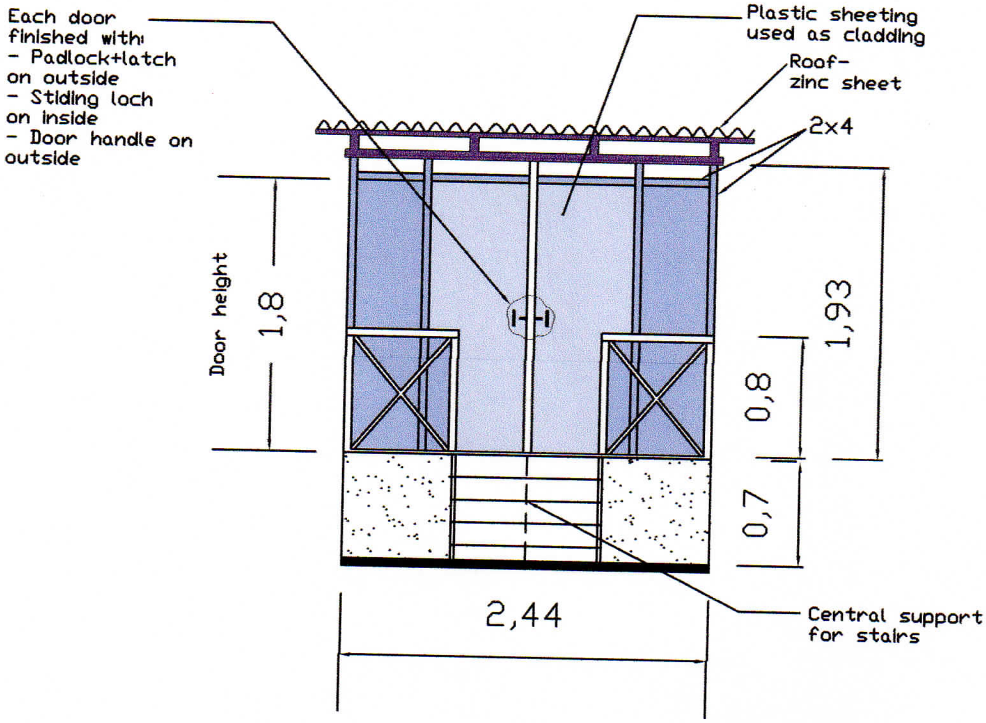
SUSTAINABLE ORGANIC INTEGRATED LIVELIHOODS



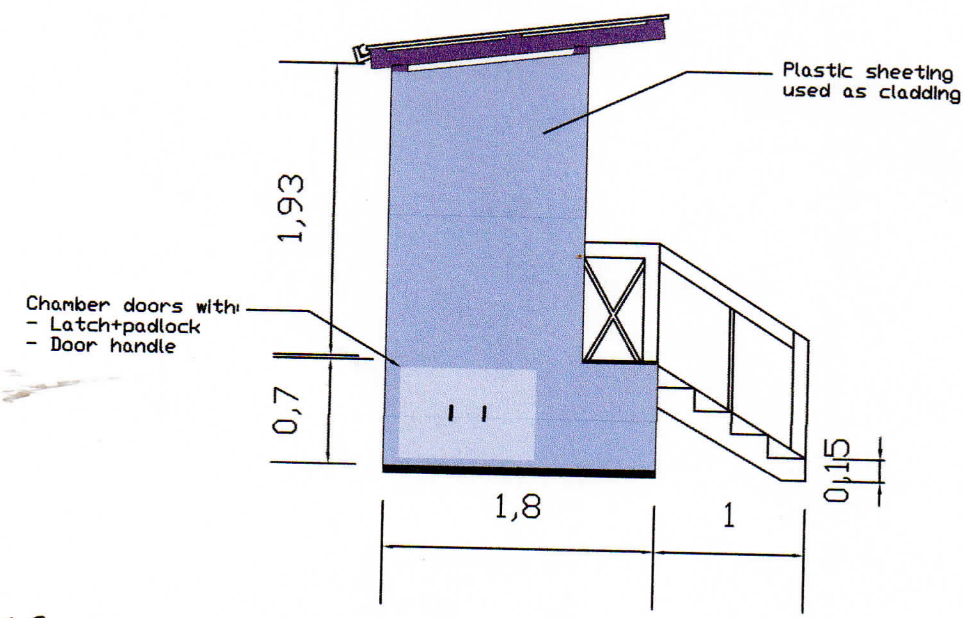
Plan view

NOTES
1, ALL DIMENSIONS IN METRES

SOIL SUSTAINABLE ORGANIC INTEGRATED LIVELIHOODS	TIT PWOJE (TITRATE PROJECT) KONSTRIKSYON TWALET SECH AN BWA (CONSTRUCTION OF DRY TOILET, WOODEN CONSTRUCTION)	DATE: OCTOBER 2010 No PLAN: T2
	TIT DESEN AN (TITLE OF THE DRAWING) PLAN DISTRIBISYON (PLAN VIEW)	ECH: 1/50 SOIL ENGINEERING SERVICES



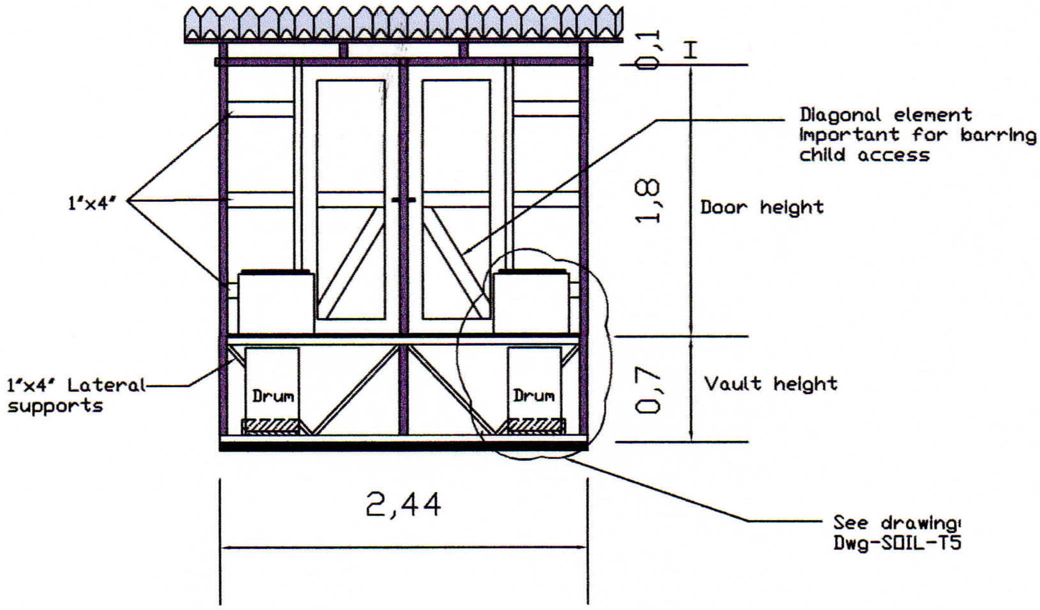
Front elevation



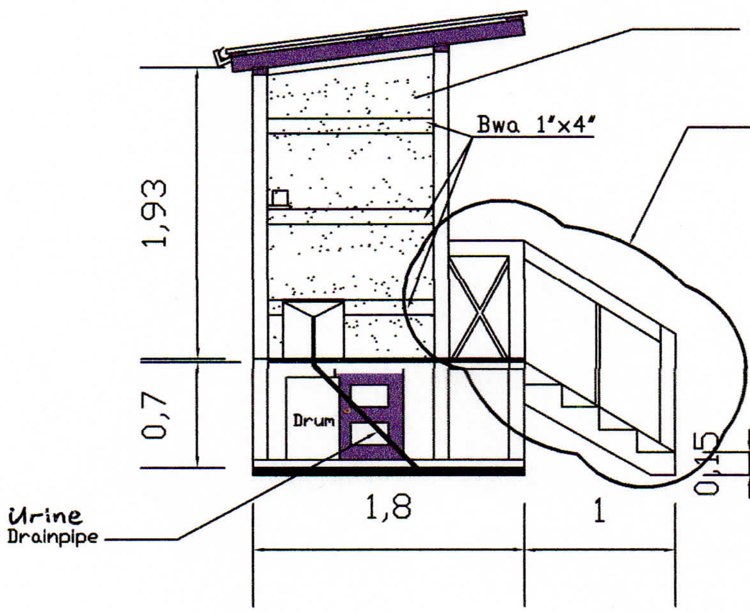
Side elevation

NOTES:
1, ALL DIMENSIONS IN METRES.

SOIL SUSTAINABLE ORGANIC INTEGRATED LIVELIHOODS	TIT PWOJE (TITRATE PROJECT) KONSTRIKSYON TWALET SECH AN BWA (CONSTRUCTION OF DRY TOILET, WOODEN CONSTRUCTION)	DATE: OCTOBRE 2010
		No PLAN: T3
	TIT DESEN AN (TITLE OF THE DRAWING) FASAD DEVAN, A GOCH (ELEVATIONS)	ECH: 1/50
		SOIL ENGINEERING SERVICES



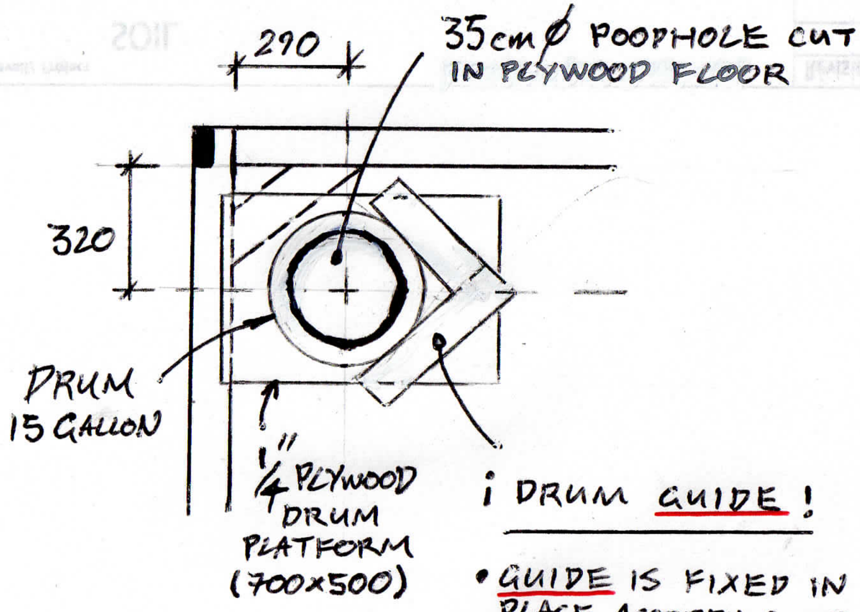
Section AA



Section BB

NOTES
1, ALL DIMENSIONS IN METRES.

SOIL SUSTAINABLE ORGANIC INTEGRATED LIVELIHOODS	TIT PWOJE (TITRATE PROJECT) KONSTRIKSYON TWALET SECH AN BWA (CONSTRUCTION OF DRY TOILET, WOODEN CONSTRUCTION)	DATE: OCTOBRE 2010 No PLAN: T4
	TIT DESEN AN (TITLE OF THE DRAWING) KOUP VETIKAL (VERTICAL SECTIONS)	ECH: 1/50 SOIL ENGINEERING SERVICES

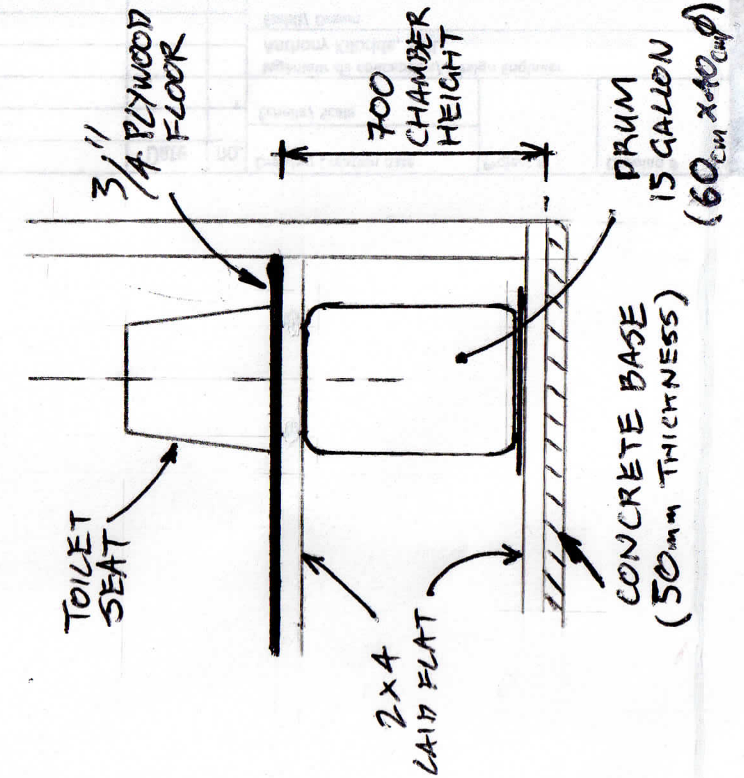


¡ DRUM GUIDE !

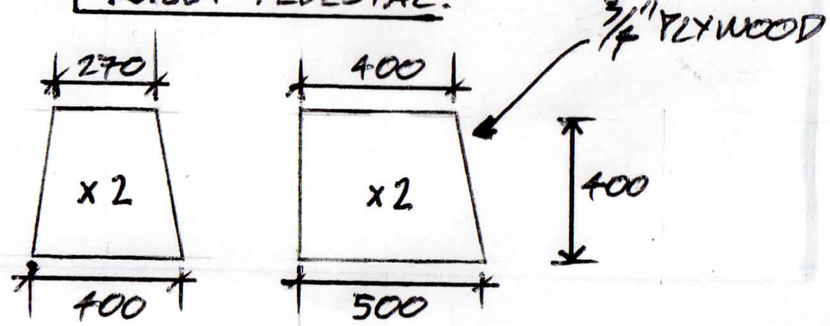
- GUIDE IS FIXED IN PLACE ACCORDING TO POSITION OF DRUM.
- DRUM IS POSITIONED ACCORDING TO POOPHOLE.
- GUIDE USES 2 PIECES 1"x4", 400mm LONG.

PLAN VIEW OF DRUM GUIDE IN CHAMBER.

SIDE VIEW INSIDE CHAMBER



PIECES FOR WOODEN TOILET PEDESTAL.



NOTES
1, ALL DIMENSIONS IN MM UNLESS OTHERWISE STATED,

Project: SOIL UD TOILET : WOOD	Révisions/ Revisions	Date	no.
DETAILS			

Drawing Creation date: 21st Feb. 2011
Échelle/ Scale: 1:20
Project #:
Drawing #: T.05
Ingénieur de conception/ Design Engineer: Anthony Kilbride, SOIL
Établi/ Drawn: Anthony Kilbride

SOIL
SUSTAINABLE ORGANIC INTEGRATED LIVELIHOODS

Toilet Bill of Quantities

Bill Of Quantities for "SOIL UD Toilet_WOOD" construction

Notes:

1, Unit costs are based on 2010 Port-au-Prince prices.

Materyo	Materials	Quantity	Unit	Unit Cost	Total (HTG)	Total ($H)	Total ($US)
Bois 2x4x16	Wood, 2*4, 16'	17	Unit	625	10625	2125	265.6
Bois 1x4x14	Wood, 1*4, 14'	20	Unit	300	6000	1200	150.0
Plywood ¾ in	Plywood ¾ in	5	Unit	1700	8500	1700	212.5
Planches 1x8x12	Wood, 1*8, 12'	3	Unit	550	1650	330	41.3
Tôles 6 ft	Zinc sheeting, 6ft	6	Unit	275	1650	330	41.3
Clous tôle	Nails, zinc sheet	1	Llbs	60	60	12	1.5
Clous 4", llbs	Nails, 4"	4	Llbs	40	160	32	4.0
Clous 3 in	Nails, 3"	10	Llbs	40	400	80	10.0
Clous 21/2 in	Nails, 2.5"	10	Llbs	40	400	80	10.0
Clous 1 in	Nails, 1"	2	Llbs	40	80	16	2.0
Sac de ciment	Ciment	1	Unit	300	300	60	7.5
Cadenas	Padlocks	4	Unit	100	400	80	10.0
Paire couplet 3x3	Door hinges, 3"	6	Unit	35	210	42	5.3
Charnière à cadenas	Latch for padlocks	4	Unit	30	120	24	3.0
Manches pour portes	Door handles	2	Unit	125	250	50	6.3
Taquet 4 in	Internal door lock	2	Unit	75	150	30	3.8
Crochet	Hook & Chain	4	Unit	50	200	40	5.0
Siege SOIL UD	SOIL UD Toilet Seat	2	Unit	2800	5600	1120	140.0
Bâche	Plastic Sheeting	2	Unit	1500	3000	600	75.0
Peinture (gal.)	Paint	2	Gallon	650	1300	260	32.5
Drum	15 Gallon Drum	2	Unit	500	1000	200	25.0
Tuyaux 3/4"	3/4" PVC drainpipe	1	Unit	165	165	33	4.1
Courbe 45, 3/4"	3/4" 45deg. Bend	1	Unit	20	20	4	0.5
Adapteur femal, 3/4"	3/4" female adaptor	1	Unit	30	30	6	0.8
Colle PVC (1/4 boite)	PVC Glue	1	1/4 Oz. bottle	100	100	20	2.5
				Total	**42370**	**8474**	**1059.3**

PHOTO T1:
Chamber beneath toilet

PHOTO T2:
Drum in position beneath poophole

PHOTO T3:
Digging urine soakaway pit after concrete base construction

PHOTO T4:
Urine Soakaway pit

PHOTO T5:
Poophole cut in plywood floor

PHOTO T6:
View of poophole inside wooden box seat

PHOTO T7:
Plastic Sheeting cladding
on wooden structure

PHOTO T8:
Stairs with central support

PHOTO T9:
Internal Walls

PHOTO T10:
Wooden Structure

PHOTO T11:
Sideview of toilet showing chamber doors

PHOTO T12:
Close-up on chamber doors

PHOTO T13a:
SOIL UD toilet seat,
view on outside

PHOTO T13b:
SOIL UD toilet seat,
view from poophole

PHOTO T13c:
SOIL UD toilet seat,
view on outside

PHOTO T14a:
PVC filter with security cord attached

PHOTO T14b:
PVC pipe fittings for SOIL UD toilet seat

PHOTO T15: SOIL UD Toilet seat from fibreglass

PHOTO T16a:
SOIL UD toilet positioned in shade. Positioned for privacy, but too obscure?

PHOTO T16b:
GOOD positioning of SOIL UD toilet with just enough space for chamber access

PHOTO T16c:
BAD positioning of SOIL UD toilet with not enough space for chamber access

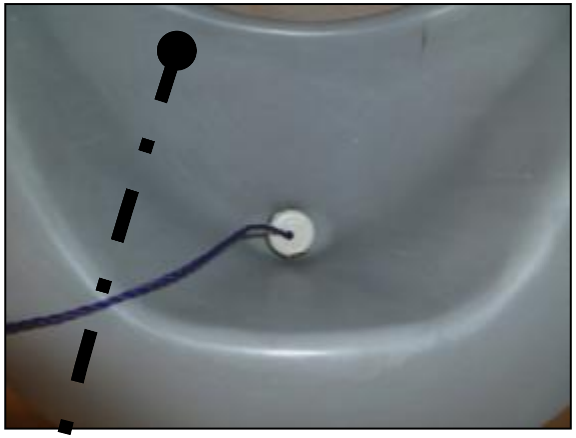


PHOTO T17
Unclogging urine bowl in UD seat

PHOTO BAD T1:
SOIL UD toilet, blocked drainpipe.

PHOTO BAD T2:
SOIL UD toilet, blocked drainpipe detached from SOIL UD seat.

PHOTO BAD T3:
SOIL UD toilet, detached drainpipe with urine spilling onto chamber floor.

PHOTO BAD T4a: Early SOIL UD toilet seat with holes for urine drainage, NO filter.

PHOTO BAD T4b: Early SOIL UD toilet seat, drainage holes forceably enlarged to unblock drainpipe.

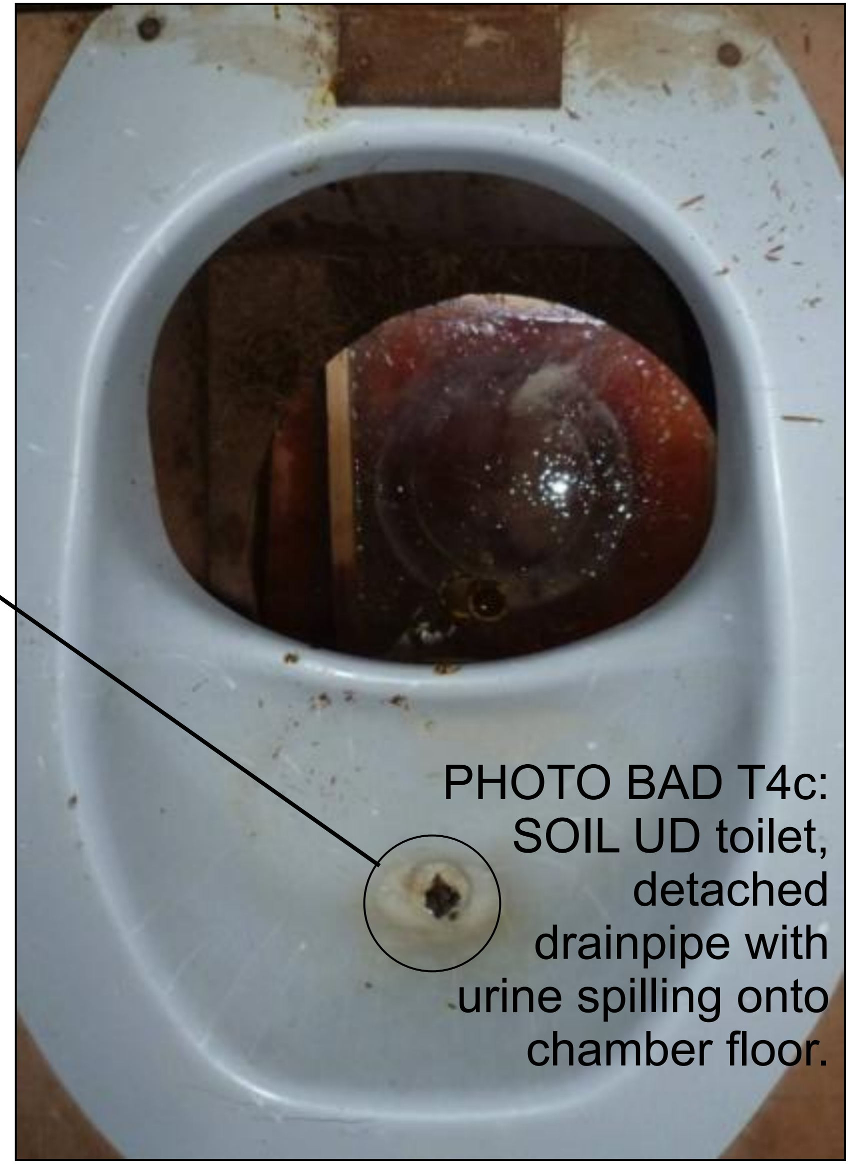


PHOTO BAD T4c: SOIL UD toilet, detached drainpipe with urine spilling onto chamber floor.

PHOTO BAD T5:
Early plumbing with 90 degree bends causing drainpipe blockages.

PHOTO BAD T6:
Poorly installed drainpipe not entering into soakaway pit.

PHOTO BAD T8:
Early drum guide using removeable pieces of 2*4 to raise poop drum.

PHOTO BAD T7:
Plastic sheeting deliberately detached by children, for access.

PHOTO BAD T9:
Heat damage to plastic sheeting on side of SOIL UD toilet.

Toilet Construction Checklist

Construction Checklist: SOIL UD toilet

Name of Supervisor	
Date	
Name & Location of toilet	

COMPONENT	SPECIFIK (en creole)	Specification (en Anglais)	☑	☒	Comments
Fondasyon	2 sac cimen	2 sacs of ciment used per slab			
(Foundation)	Melanj beton kòrèk (Gravye : Sab : siman - 4: 2: 1)	Concrete mix correct (Gravier: Sable: Cimen – 4:2:1)			
	Epesè beton kòrèk	Concrete thicknes correct (at least 50mm)			
	Fòs pèdi pou pipi (20cmØ * 50cm pwofodè)	Urine soakaway pit constructed (20cmØ *50cm depth)			
	Travay sou platfòm beton nan 24è	Concrete cured for 24hours before loading with structure			
Estrikti	Wotè ramp eskalye kòrèk	Guiderails at the correct height			
(Access and Structure)	Wotè mach eskalye kòrèk	Steps with the right height			
	Lajè mach eskalye kòrèk	Steps at the right width			
	Supo lateral byen fet enba estrikti	Lateral supports in place beneath structure			
	Balis yo byen fèt	Balistrade strong and at correct height			
	Pwela byen mete	Plastic sheeting strong and tight			
Cham twalet	Pòt kabin twalèt louvri andedan	Toilet door opening: opens inward			
(Toilet cubicle)	Bwat twalèt kache dèyè pòt	Toilet door opening: opens toward toilet seat			
	Mezi bwat yo kòrèk	Toilet seat box: dimensions correct			
	Etajè pou papye yo fèt	Shelf for toilet paper in place			
	Wotè twati twalèt la kòrèk	Height of toilet roof correct			
	Etajè pou flè yo la	Shelf for flowers in place			
	Manch pòt yo ak chanyè deyò yo monte	Door handle and external lock correct			
	Chanye andedan yo monte	Interior lock correct			
Cham Anba	Pòt byen monte	Doors well fixed with smooth opening			
(Toilet Chamber)	Pòt louvri deyò sèlman	Door stop on doors			
	Gen espas pou pòt louvri deyò	Adequate space outside doors for opening			
	!! Wotè ray ak aret yo kòrèk !!	**!! Guiderails for drum correctly placed !!**			
Penti	Logo yo fèt (SOIL, Oxfam, Fanm, Gason)	All signs present (Famn, Gason, SOIL, Oxfam)			
(Painting)	Penti sou bwa yo byen fèt (epesè penti, bwa ki pa kouvri ak pwela)	Exposed wood painted (2 coats of paint needed)			
Plonbri	Bwat yo byen fikse, nan bon sans	Wooden toilet pedestal attached to floor, with correct orientation			
(Plumbing for UD seat)	Siej yo byen fikse	SOIL UD Toilet Seat well fastened to pedestal			
	Tiyo pipi 3/4“ itilize	Urine pipe used: 3/4“ diameter			
	Tiyo Pipi byen konekte anwo	Urine pipe connected on top			
	Tiyo Pipi byen konekte anba	Urine pipe connected on bottom			
	Tiyo Pipi descend nan tou foss pedi minimum 10cm	Urine pipe descends into soakawy pit by at least 10cm			
Artik operasyon	Doum pou bagas a la	1 * Large Drum (50 Gallon) for bagas			
(Operational items)	Ti bokit bagas andedan	2 * little buckets for bagas (1 per cubicle)			
	Ti Bokit pou papye ijenik andedan	2 * little buckets for toilet paper (1 per cubicle)			
	Cham enba femen ak Kadna, 2 kle ak comite, 1 kle ak SOIL	Chamber below closed with padlocks, 3 key sets			

Introduction to Composting of Human Wastes

Inherent in all ecological sanitation (EcoSan) initiatives is the treatment and transformation of the wastes from the toilets, converting potentially dangerous human wastes into organic agricultural inputs. Composting is the key to shifting waste treatment from a linear process to a cyclical one. In EcoSan systems, instead of polluting aquatic ecosystems and posing a public health risk, human wastes are safely treated and recycled into the land where the nutrients can be reused by crops, boosting local agricultural production and reducing the need for imported fertilizers.

Waste treatment is carried out through composting and in order to ensure that all pathogens are killed during the composting process, the compost pile must reach a minimum temperature of 122° F (50° C) for a period of at least one week (WHO, 2006).

SOIL's early experiments with double vault urine diversion toilets showed incomplete composting of the wastes inside the chamber of the toilet. Given these results, we strongly recommend either vigorous pathogen testing of the toilet materials collected from double vault toilets or secondary composting to ensure proper pathogen die-off prior to agricultural use.

The specific method of composting used will vary depending on the space available where the toilets are constructed. In many rural areas it will be possible to compost the waste onsite using very simple structures. In urban areas, however, it will often be necessary to collect the waste and transport it to an offsite composting area which may require more sophisticated structures to safely treat wastes from multiple sources.

This section of the guide will give a brief overview of the general principles of composting as well as the various methods that SOIL has piloted in Haiti. Next is an in-depth technical guide to the development of a larger offsite composting facility based on SOIL's experience in Port-au-Prince. In future editions of this guide we hope to have detailed specifications for other composting approaches.

Basic Principles of Composting Human Wastes

There are two components to composting human wastes:

1. Treatment of the wastes by achieving high enough temperatures to ensure pathogen die-off
2. Production of a valuable agricultural input

These following objectives are common to all models of composting of human wastes, and provide the foundation for the technical specifications in the next section.

Overall Objective, *for successful composting:*	The correct temperature and thorough decomposition		
Compost Pile Objectives, *for achieving the correct temperature:*	Oxygen	Moisture	C/N Ratio
Compost Pile Objectives, *for producing a quality compost*	Nutrient availability	Adequate decomposition	
Compost Structure Objectives, *for achieving the compost pile objectives:*	Operabililty	Durability	

<u>Oxygen</u>

Compost requires the cultivation of aerobic, or oxygen-loving, bacteria in order to ensure thermophilic decomposition. The design components for providing oxygen to the compost pile, or 'achieving good aeration', are listed below:

- Create interstitial air spaces within the compost pile by 'bulking up' the compost material using a carbon source with interstitial air spaces, e.g. sugarcane bagas.
- Provide good drainage to the compost structure so that anaerobic conditions do not prevail at the bottom of the compost pile.
- Make any walls (internal or external) of the compost structure air-permeable, so air can penetrate into the compost mass[1].
- Site the compost structure in a location with good aeration.

<u>Moisture</u>

[1] Large scale composting facilities in industrialised countries often use forced aeration with large air blowers and air ducts beneath the compost pile.

In order for the compost pile to reach thermophilic composting temperatures, the aerobic microbial mass present in the compost pile requires H_2O, but not too much as this may result in anaerobic conditions and increase the potential for leaching and nutrient loss. In order to avoid the compost drying out completely or becoming too moist, we recommend the following:

- Either install a permanent roof over your compost or cover it with a tarp during large rainstorms.
- During dry periods it may be necessary to water the compost and water availability should be taken into consideration when choosing a site.

C/N Ratio

The C/N ratio is the Carbon/Nitrogen ratio. A good C/N ratio for composting is 30/1 (Jenkins, 2005). The C/N ration in poop (5-10/1) is too low and therefore an additional carbon source is required. If this additional carbon is not added, the microbes will be starved of the food they need to be 'active', and the temperatures required for thermophilic composting will not be reached. Acceptable materials for mixing into the compost include but are not limited to the following:

- *Agricultural byproducts* such as sugarcane bagas, rice husks or shredded banana trunks and leaves.
- *Industrial byproducts* including sawdust or food scraps left over during food processing. It is important to note that many wood products do not decompose quickly and it is important to make sure that the products have not been treated with any chemicals which may slow decomposition.
- *Household byproducts* such as food scraps and shredded cardboard and paper. Again always ensure that the carbon source has not been treated with chemicals that could slow bacterial processes.
- *Organic market wastes*.

Nutrient Availability

As mentioned in earlier sections of this guide, the addition of urine to the compost will significantly increase the nutrient content of the final product. This can be achieved through the use of a non-separating toilet, as described in the section *Introduction to EcoSan Toilets* or by reincorporation of the urine into the compost heap following separation in the toilets. Reincorporation of the urine is easy at sites where the compost and the toilets are in close proximity but becomes more challenging when transportation is required due to the high volume and weight of urine. It may be possible to collect urine from households near the compost site to supplement the nutrient content of compost derived from UD toilets.

Adequate Decomposition

While sterilization of the pile should take only several weeks, the time for complete decomposition to occur can take anywhere from 3-10 months. The decomposition rate will depend on the factors listed above as well as the composition of the materials mixed into the pile. It is important to avoid carbon materials that have been chemically treated or that have very slow decomposition rates.[2]

Operability

The three compost pile objectives will only be achieved if the compost structure can be safely and efficiently operated. Safe and efficient operation comprises:

- Safe access to the compost structure by the compost operatives.
- Adequate space inside and around the compost structure for composting operations.
- Facilitation of emptying the compost structure by mechanical means, when the compost is safe to be moved.

Durability

The compost structure should be durable enough to survive its design life. Many factors will determine the design life of the structure (e.g. available budget; construction materials used; size of structure) and the design life will determine the durability of the structure. For example, a small garden compost structure receiving poop from a single household will not need to be as durable as a large municipal structure receiving poop from public toilets in a city. A compost structure whose durability is fit for purpose, whatever that purpose may be, will facilitate achievement of the three compost pile objectives.

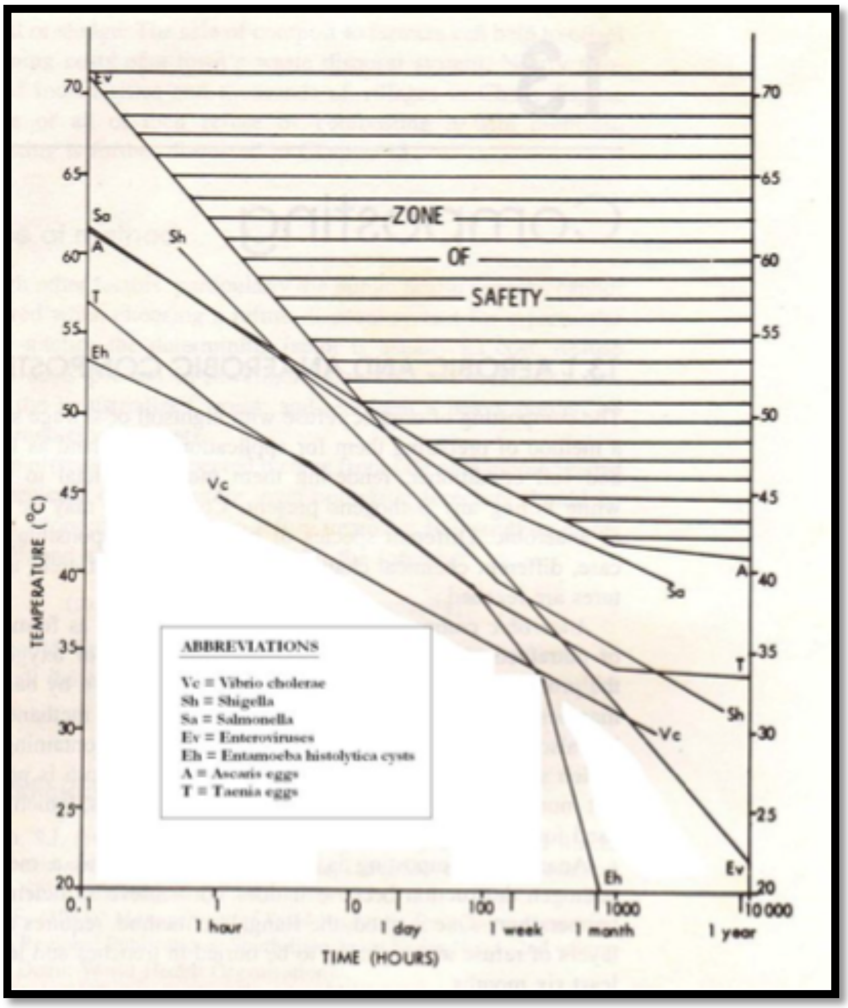
Composting and Public Health

SOIL encourages all those interested in implementing EcoSan, from individuals to large organizations, to carry out independent research on the public health issues associated with compost treatment of human excreta. Based on our own academic literature reviews and our experience in Haiti, we are confident that

[2] When SOIL began working in Port-au-Prince we used a sawdust byproduct from a local factory producing Amaris oil. Although the material provided excellent cover in the toilets it decomposes very slowly and even after 10 months there is still a good deal of sawdust in the compost. Sugarcane bagas, however, decomposed completely within 6 months.

thermophilic composting of poop is a proven method of treating excreta for safe use.

The following graph on "The Influence of Time and Temperature on Excreted Pathogens in a Compost (Carincross et al, 1993)" represents the most intuitive piece of research on composting and public health:



From the above graph, we may conclude the following key points:

- Ascaris is the best indicator organism to use for assurance of complete pathogen destruction.
- Achieving temperatures above 122° F (50° C), for at least one week is the minimum requirement for safe treatment of fecal pathogens using composting.

Ultimately, the only way to be certain of the microbial content, including pathogenic content, of finished compost, is to undertake analysis of representative samples from the specific compost pile, in a competent professional laboratory[3].

SOIL's Compost Designs, Past and Present

Onsite Composting

In rural areas it will often be possible to compost the toilet material nearby the toilet, eliminating the need for collection and transport. We have tried several low-cost systems where the compost structure is made out of wood scraps or pallets close to the toilet. When the toilet is emptied (whether it is a double vault system or a system with drums) it can be emptied directly into the compost bin where it will be mixed with a rich carbon material such as sugarcane bagas or dried grass and food scraps. These systems do not have cement foundations and as such some leaching can occur into the soil. Given the potential for leaching they should be situated at least 30 meters from water sources and not placed in areas that are prone to flooding or have very high groundwater.

Offsite Composting for Multiple Toilets

In urban areas or where space is limited it may be necessary to collect the toilet wastes and transport them to an offsite facility for secondary composting. When collecting wastes from multiple sources we recommend putting a cement foundation under the compost pile during the initial sterilization phase to ensure that no pathogens leach into the ground. This foundation also helps to prevent nutrient loss. Although this design is much more expensive than the household composting system it is much safer for large scale composting to ensure that there is no contamination of the surrounding environment. Detailed technical specifications are provided for our offsite composting model in the following section.

[3] Laboratory testing of compost is not covered in this document. SOIL has some experience of testing compost using the 'Laboratoire Nationale' in Port-au-Prince, but this experience was not conclusive and we are exploring other options.