The SOIL Guide to Ecological Sanitation

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Sustainable Organic Integrated Livelihoods (SOIL)

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This document is dedicated to SOIL's incredible team. We are so grateful to the people on the ground that made this possible!

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With love and respect,

Sasha Kramer
Co-Founder and Executive Director

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This guide is based on our five years of experience working with ecological sanitation (EcoSan) technologies in Haiti but it would not have been possible without the collective knowledge of many EcoSan practitioners around the world and those that have supported our work over the years, through success and failure.

SOIL was co-founded in 2006 by Sarah Brownell and Sasha Kramer. Though Sarah no longer works with SOIL, many of the ideas and designs in this document were developed while Sarah was still directing the organization and she has made an indelible contribution to the work of SOIL.

SOIL first learned about ecological sanitation through the work of Peter Morgan (Zimbabwe), Cesar Anorve (Mexico), Ron Sawyer (Mexico) and Joseph Jenkins (USA). Building on their years of dedication and experience, we have worked to modify and adapt EcoSan to the cultural and environmental context of Haiti. Innovation is an iterative process and we are proud to be part of the global community that is working to promote EcoSan. It is our hope that this guide can become part of that process, serving as a springboard for new advances.

Though several individuals carried out the writing of this guide, the work described herein was performed by SOIL's incredible staff on the ground in Haiti. We are honoured to work with a team of dedicated Haitians who share our mission of promoting innovative solutions to combat poverty. They have worked selflessly for years to ensure that this technology is presented through engagement and dialogue with local communities and to guide our interventions according to demand and need.

We are especially grateful that Oxfam GB partnered with us for the past two years to help us realize our goals in northern Haiti and Port-au-Prince. Without their support this work would have taken many more years to achieve. We have also benefitted from the input and guidance of DINEPA, the Haitian government agency responsible for water and sanitation, and we look forward to collaborating with them in the future.

And most importantly we are thankful for our families, friends and colleagues around the world who have followed and supported our work, and for the individuals, businesses and foundations who have made this guide possible.

A Note to Our Readers

The SOIL Guide to Ecological Sanitation was created in response to increasing requests from individuals and organizations interested in starting ecological sanitation (EcoSan) projects across the globe. This guide is meant to be as comprehensive as possible within the scope of our experience. This first edition of The SOIL Guide to Ecological Sanitation focuses on urine diversion toilets (also called UD toilets or dry composting toilets), though there exist, and SOIL has built, many other types of EcoSan toilets.

We hope that this guide can help others interested in implementing EcoSan projects to avoid some of the mistakes that we have made and capitalize on our successes. We look forward to your feedback and are anticipating that future editions will be much more thorough as a result of this feedback.

This guide has been created as a resource for all those interested in EcoSan and as such we are pleased to have it shared widely. That said, we ask that the following guidelines are respected. The SOIL Guide to Ecological Sanitation may be copied and distributed without SOIL's permission with the following conditions:

1. No information is changed,
2. SOIL is credited for the document, and
3. the distribution is not for profit.

We also wish to add that although this guide contains an overview of our work to date and of the lessons we have learned, many of the details will not be applicable in every situation. In particular, we wish to draw your attention to the following:

1. The implementation of a successful ecological sanitation project is heavily dependent upon appropriate training, education and community buy-in. The relevant sections in The SOIL Guide to Ecological Sanitation on software should be read closely before attempting to construct EcoSan hardware (toilets or compost facilities).
2. Technical terminology in English or American English has been used wherever possible in this document and in the technical specification. However, the document was created in Haiti and certain elements have been described in Creole, e.g. 'Blok 15' instead of '15 cm wide cinderblock'.

SOIL assumes no responsibility for the success or failure of other's projects; we only hope that our experiences will provide some insight that will be useful.

Thank you for your interest in ecological sanitation and good luck in your future endeavours.

Contents

Glossary of Terms

Term	**Definition**
A	
Ascaris worm	A pathogenic worm which is the most resistant of all the pathogens to heat, and therefore to treatment of excreta by thermophilic composting. Ascaris is used as an indicator organism for determing pathogen kill-off in thermophilic compost treatment.
Arborloo	A simple toilet technology. Essentially a very shallow pit latrine which is covered with earth when full, and then a tree planted in it.
B	
Bagas	Sugarcane bagas is the shredded husks of the sugarcane. It is usually created as a waste product by factories which use sugarcane to produce alcohol.
C	
Chamber, toilet	Toilet chamber: Usually refers to the space beneath the toilet cubicle where the poop is collected or composted, i.e. the space beneath the poophole.
Child User	Toilet user, child. Defined by having a physical size unable to effectively use a standard UD toilet seat. Child user age is usually less than 6 years old.
Communal toilet	A toilet shared and managed by a small population, e.g. 5 families. Only members of these families have a key to access the toilet.
Composting	The process of decomposing organic matter to create humus.
Compost site	Location where composting occurs, usually containing specialized compost structures.
Compost structure	A specialized structure designed and constructed to hold a compost pile.
Compost pile	A mass of compost, irrespective of the structure (or lack thereof) containing it.
Compost operative	Trained staff member working at compost site.
Cubicle, toilet	Toilet cubicle: Usually refers to the space above the poophole where the user sits and poops.
D	
Drums	A vessel of variable size and material. The guide often refers to drums, meaning the 15 gallon poop drums which collect the poop.

Term	**Definition**
Double vault UD toilet	A UD toilet with 2 vaults, or chambers, beneath the cubicle. When one vault is full, the poophole is closed and a new poophole is opened above the new vault.
E	
F	
Female User	Adult toilet user, female.
G	
H	
Hardware	Tangible, or 'hard', components of an EcoSan project, i.e. construction.
Household toilet	A private toilet for use by a single household. The household is responsible for maintenance of the toilet.
Humanure compost	Compost created using human excreta.
Humanure toilet	A simple EcoSan toilet designed by Joe Jenkins, which collects both urine and faces arrive in the same container.
Humus	Completely decomposed organic matter.
I	
IDP	Internally Displaced Person. Some 1.5 million IDPs lived in IDP camps after the 2010 Haiti earthquake.
J	
Ji kaka	Kreyol for leachate from a compost pile'
K	
Kaka	Kreyol for 'Poop'.
L	
Leachate	Liquid from a compost pile, usually dark brown and turbid with a high microbial content. Often referred to as 'ji kaka'.
M	
Male User	Adult toilet user, male.
N	
O	
Operator	Used to describe the person responsible for the good operation of the toilet, either paid or unpaid. Term

Term	**Definition**
	covers a multitude of alternatives including: Toilet cleaner, Toilet manager, Responsab twalet, Responsable assainissement.
P	
Poop	Human excreta.
Poophole	Hole built into toilet seat structure to allow poop to pass from the toilet seat to the poop collecting vessel below.
Public toilet	A toilet open to the public, regardless of which community they come from. Public toilets can be free or cost.
Q	
R	
S	
Soak away (or soak away pit)	A hole in the ground, in-filled with granular material such as rocks or gravel, which allows liquid such as urine to infiltrate the soil and soak away.
Software	Intangible, or 'soft', components of an EcoSan project, i.e. education.
SOIL UD toilet	The finished constructed urine diversion toilet designed by SOIL, can be of wood or concrete construction.
SOIL UD seat	The urine diversion seat used in the SOIL UD toilet, designed and fabricated by SOIL.
T	
The SOIL Guide / The Guide	The SOIL Guide to Ecological Sanitation
U	
UD toilet	Urine diversion (UD) toilet, sometimes referred to as a 'dry' toilet. Uses a special UD toilet seat to separate urine and faeces and directs them to separate containers.
User	Toilet user of adult age, male or female.
V	

Term	Definition
W	
WASH	A professionally used acronym for: Water, Sanitation, Hygiene.
X	
Y	
Z	

Introduction to Ecological Sanitation

What is ecological sanitation?

Some call it feces and some call it humanure and some call it other things not fit for this document, but for simplicity's sake, let's just call it poop. Everybody poops and it has to go somewhere. So it should be important to everyone where it goes…

"Our poop does more for this community than you do."

Community leader Madam Bwa of Shada speaking to an on-looker who was making fun of community members who emptied a dry toilet in her neighborhood.

Ecological sanitation (EcoSan) is an integrated sanitation strategy developed through traditional knowledge and biological science in which natural processes are utilized to transform human wastes (poop and pee) into fertile soil (Esrey, 2001). EcoSan is based on three principles:

1. the prevention of pollution rather than an attempt to control or mitigate it after the fact;
2. the sanitization of urine and poop; and
3. using the resulting safe products to enhance agricultural production.

EcoSan provides an innovative, low-cost solution to multiple problems faced by the world's poor and has the potential to simultaneously improve a community's:

- **Health** by reducing open defecation and contamination of drinking water supplies that lead to waterborne illnesses and associated diarrhea, malnutrition, growth stunting, and death.
- **Environment** by keeping human wastes out of rivers, lakes, and oceans (where it causes nitrification and algae blooms and kills fish) while providing organic fertilizer for agriculture and reforestation.
- **Food access/nutrition** by improving agricultural yields through organic fertilizers.
- **Economy** through sales of compost, development of small scale community waste management businesses in urban areas, increases in agricultural yields and reduced medical costs and sick days.
- **Aesthetics** by keeping beaches, streams, ravines, fields, forests and city streets beautiful, safe and stink free.

Why is ecological sanitation important?

Despite the fact that the United Nations General Assembly dedicated a decade (1981-1990) to water and sanitation issues, as of 2010 diarrhea related to poor sanitation, water, and hygiene still accounts for 2 million deaths per year worldwide (WHO, 2011). The burden of waterborne illness falls disproportionately on children, contributing significantly to high mortality rates in those under age five, malnutrition and growth stunting.

Nearly half of the world's population has no access to a sanitation system and most sewer water in impoverished countries is discharged without treatment, posing a serious public health risk and contaminating aquatic ecosystems.

Meanwhile, as nutrients from human wastes accumulate in estuaries and other aquatic ecosystems, much of the world's farmland is being progressively degraded, and in many regions of the world productive capacity has stagnated or even declined. This phenomenon disproportionately affects poor farmers, who seldom have access to fertility-enhancing agricultural inputs and are, therefore, dependent on ecosystem services to maintain soil fertility. Without substantial inputs of organic matter to balance harvests, soil biological activity and nutrient availability are reduced and yields decline. Low soil fertility forces many small farmers to find other land, or leave their land and families in search of other work, fracturing the social fabric of rural communities.

The environmental, social, and public health crises faced by poor rural communities point to the urgent need to combat rural poverty and to promote research geared towards regenerating the deteriorated resource base of rural communities. Improved quality of life in rural communities has a much wider scope, as it can reduce the flood of people and resources into already overburdened urban centers.

History of Ecological Sanitation

The concepts behind ecological sanitation are based on natural processes and, as such, have been understood and practiced by indigenous cultures for centuries. In China, human wastes, called "night soil", have been collected and used to enhance agricultural productivity for over 500 years (McNeill, 2004). Throughout Africa and Latin America, peasants will explain that their most productive fruit trees can be found on or near old latrine sites. Even an observant suburban American has noticed that the grass is greener near the septic tank.

Organized efforts to study and promote ecological sanitation as a development strategy are relatively new. The first International Conference on Ecological

Sanitation (EcoSan) was held in Nanning, China, in 2001 and included scientists and promoters from Europe, Africa, Asia and Latin America. Since that time, EcoSan projects have been initiated around the world. These projects however, have mostly been small pilot projects and examples of large scale implementation are lacking.

Issues with Traditional Approaches: The Price of Sewers and the Problem with Pits

The two primary sanitation approaches promoted globally are:

1. to flush the wastes away with water through sewers that lead (sometimes) to a treatment plant, or
2. to soak the wastes into the ground and let the soil filter it as is done for deep-pit latrines and septic tanks.

Both of these approaches remove raw human wastes from the immediate household environment, and, as such, the spread of these technologies has significantly reduced the transmission of waterborne disease (Montgomery M., 2007). However, both approaches have unintended environmental consequences, which affect both public health and the long-term sustainability of these sanitation systems.

<u>Sewer systems</u>

The standard approach to sanitation in industrialized countries is to use water to carry sewage away from the source. Water flush toilets can range from manual pour-flushing into an underground holding tank to automatic flushing into a municipal sewage system. The public health and environmental consequences of water flush toilets is highly dependent on how the sewage is treated after it leaves the toilet. The vast majority of sewage produced in Africa, Asia and Latin America is discharged into aquatic systems without treatment, and is a major source of water pollution. All water flush toilets share the feature that they require significant amounts of water (up to 6 gallons per flush).

Problems with water borne sewage arise when:

- ***Public money is tight:*** many developing countries do not have the resources for sewer projects for cities that have burgeoned with unplanned settlements and are stressed beyond the capacity for which they were designed.

- ***Sewage is discharged untreated***: when raw sewage is discharged into aquatic ecosystems it increases both nutrient concentrations and faecal pathogen loads. If these aquatic systems are near or upstream from human habitations sewage can pose a serious public health risk. Even when sewage is discharged far from humans, the nutrients can cause shifts in aquatic ecosystems, which ripple throughout the food chain.

- ***Water is scarce:*** when water is scarce or people live far from a water source, flush toilets are dependent on constant labor(usually performed by women and children) and often experience problems with clogged pipes. Access to running water is largely determined by economic status, and flush toilets are not designed to cater to the poor. As clean water resources become more and more scarce it will become increasingly difficult to maintain flush toilets, even in wealthy countries.

<u>Pits and septic tanks</u>

Deep pit latrines can be anywhere from 6-25 feet deep and are often lined to prevent collapse. The pit latrine is one of the simplest and cheapest means of disposing of human wastes. If well designed and built, correctly sited and well maintained, it contributes significantly to the prevention of diseases transmitted through human wastes. If pits are dug at least 30 meters from water sources and at least 1.5 m above the water table then the faecal material will be slowly decomposed over a period of years and safely converted to soil.

Problems with pits arise when:

- ***Groundwater is high or the area floods:*** When the groundwater rises above the bottom of the pit, nutrients and microorganisms from human wastes mix with the water table and can cause serious environmental and public health problems.
- ***Mosquitoes breed in the sludge:*** Because volumes of urine are so much higher than faeces, pit latrines generally contain standing water, especially in clay soils which can be breeding zone for flies and the mosquitoes that carry malaria and dengue fever.
- ***Ventilation is poor:*** Pit latrines can have terrible

odors when they are not well ventilated.

- ***Soil is vulnerable to collapse:*** deep latrines are prone to collapse in some soils, particularly if they are not lined. Pit collapses can be fatal depending on the depth of the latrine and the construction material.
- ***Latrine fills up:*** When pit latrines are full the only options are to abandon the latrine or pay someone to empty it. In many countries these latrines must be emptied by hand, which is a difficult and dangerous task. Latrines are often emptied into water sources, like the ocean or river to dispose of the wastes, and are sometimes left in gutters on the sides of streets.

Septic tanks similarly dispose of wastes on site by settling out the solids from flush water in a tank or series of tanks and filtering the excess water into the surrounding soil, often through a leach field. Again if they are correctly sited away from water sources, above the water table, and with enough drainage space, they can safely manage wastes. But they have similar problems to pit latrines in areas with high water tables or flooding and must also be emptied when full.

Ecological Sanitation Addresses These Problems

Ecological sanitation is a concept that grew out of traditional knowledge, recommendations and observations from people with experience using pit latrines. Many people with pit latrines have noticed that addition of ash or soil speeds the decomposition process, reduces smell and cuts down on fly and mosquito breeding. Ecological sanitation seeks to harness ecological processes to ameliorate some of the problems associated with traditional sanitation approaches by:

- **Using shallow pits or above ground structures:** Arborloos and Fossa Alternas are variations of the traditional pit latrine with the major difference being the depth of the pits. These are always shallow, not more than 1 meter deep, so they are less likely to reach the groundwater table. It is possible, however, that these shallow pit toilets cause groundwater contamination in areas with a very high water table or during floods. Urine diversion (UD) toilets, which will be the focus of this document, are completely above ground and there is no contamination of the toilet site.
- **Reducing standing water:** the addition of ash and/or other carbon materials to composting pit latrines and urine diversion toilets reduces moisture to avoid having standing water where mosquitoes can breed. Reducing standing water also cuts down on smells and flies.
- **Reusing contents as fertilizer:** the reuse of composted human wastes constitutes a beneficial way to treat the wastes and means that the

structures can be used for long periods of time as the contents are removed for fertilizer.

- **Keeping nutrients and pathogens in the soil and out of the water:** well-maintained ecological sanitation systems do not seek to dispose of waste but rather to transform it into rich soil, where nutrients are conserved and pathogens are killed during the composting process.
- **Not requiring water:** ecological toilets do not require water to flush or maintain, reducing the environmental costs by conserving a precious resource.

How can ecological sanitation create livelihood opportunities?

Ecological sanitation not only benefits the public, by reducing the spread of disease and improving environmental quality, it can also benefit the individual or family using or promoting the toilets by providing livelihood opportunities. The compost and urine that is collected from ecological toilets are valuable fertilizers that can either be sold or used to enhance agricultural productivity on the home garden or family farm. Family income can also be increased by improved health resulting from sanitation as healthy family members are more able to work and less money must be spent on hospital bills.

There are also numerous small business opportunities associated with ecological sanitation. Toilet seats for the various types of toilets can be manufactured and sold by entrepreneurial promoters, as can fruit trees for Arborloo toilets, encouraging the development of nursery businesses. Also, as many people will not want to maintain their own toilets, individuals, businesses, and governments can provide cleaning services, whereby they remove the compost and resell it to farmers. In many countries where deep pit latrines are prevalent there are people who are paid to empty the latrines. This is a dirty and dangerous job that requires coming in contact with untreated human wastes. With ecological sanitation these same people could be employed but their jobs would have the added dignity of harvesting a much-needed resource and the reduced risk of handling only composted, pathogen-free waste.

EcoSan is for Everyone

EcoSan is not just for the poor. As potable water supplies become scarce and more people crowd onto the earth, it makes less and less sense to use gallons of perfectly good drinking water to flush away our poop every time we go to the bathroom. Cities that experience water shortages are starting to ration water and even recycle their wastewater back to the drinking water plant (with treatment, of course) (American Chemical Society, 2008). We must ask the question, then, where does all that dirty water go? In the US alone, more than

50 billion gallons of water needs to be treated every day before being dumped back into rivers and oceans. Mexico City treats approximately 10% of its wastewater (LEAD, 2004) and every time it rains in San Francisco or New York those cities combined storm sewers dump millions of gallons of untreated wastewater into the ocean. Because of these problems, some wealthy cities have decided it makes more sense to keep the poop out of the water to start with.

Ecological sanitation projects are popping up all over the world. These projects range from small composting toilets in National Parks in the United States to large scale development projects in South Africa and Malawi (Morgan, 2007).

Why is ecological sanitation important in Haiti?

One of the most severe examples in the Western Hemisphere of both soil fertility and sanitation problems is located just 700 miles off the coast of Florida. Haiti, once known as the *"Pearl of the Antilles"* for its incredible productive capacity, is now a largely deforested landscape where the vast majority of the country's eight million inhabitants live in abject poverty. Environmental degradation is both the cause and the consequence of poverty in Haiti.

Many of Haiti's resources have been mined over the past two hundred, as a growing population struggles to recover from slavery and colonialism while continuously servicing massive international debt. Haiti's current resource crisis did not occur in isolation nor did it originally spring from mismanagement of resources on the part of the majority of Haitians, but rather the international pillaging of Haiti's extraordinary fertility began with slavery and colonialism, and continues through the more subtle and insidious forces of economic globalization.

Agricultural exportation using slave labor was only the beginning of the massive exportation of Haitian soil, first to Europe in the form of produce and wood products, and later to the sea from the deforested mountains. Haiti suffered the unique and economically devastating punishment of having to pay reparations to French slave-owners after the revolution of 1804, a struggle that represents the only successful slave revolution in history. In 1825 the Haitian people were forced to assume a debt to France of 90 million gold francs (equivalent to US $21.7 billion today) as "reparations" to their former "owners" in return for diplomatic recognition and trade. It took Haiti over 100 years to pay off the debt. To make the first payment the government had to close the few public schools that existed at the time, in what is called the hemisphere's first case of structural adjustment. In addition to preventing the newly independent nation from establishing a basic infrastructure for development, these payments to France contributed to massive deforestation, as Haiti's trees were exported to service the debt.

Through colonialism and economic manipulation, Haiti's resources were used to build Paris, not Port-au-Prince. Haiti's fertile soil was mined to provide the French with luxury imports of rum and coffee, while the majority of Haitians lived (and still live) on the brink of starvation.

The other major cause of deforestation is poverty, much of which can also be traced back to international debt. The lack of electricity infrastructure and inability to afford gas means that wood is the primary source of cooking fuel, and as a result only 3.2% of Haiti's forests remain intact, leading to soil erosion and reduced fertility for farming (Haiti, 2004).

Haiti is the only nation in the Western Hemisphere in which the majority of citizens subsist as small farmers. Over 60% of its 8,000,000 habitants live in rural areas and two-thirds of the workers are employed in agricultural production. Haitian agriculture is practiced by approximately 600,000 small farmers using an average surface area of 1.8 hectares. Yet, 80% of these farmers cannot satisfy the basic food needs of their families and the majority of producers depend on agriculture for less than half of their family revenue. SOIL nutrients have been depleted after 200 years of harvests with minimal nutrient inputs. In the past decade, per capita food production in Haiti has dropped 20% forcing the country to import 54% of its food supply. Haiti's health indicators are the worst in the region with a life expectancy rate hovering around 53 years of age and the incidence of childhood malnutrition is severe (Haiti, 2004).

One of the root causes of poor health in Haiti is lack of sanitation services. Only 12% of rural Haitians and less than 29% of those living in urban areas have access to improved sanitation facilities, by far the lowest coverage in the Western Hemisphere (UNICEF, 2010). Diarrhea and other infectious intestinal diseases cause 5% of all deaths and 15% of deaths in children under five. Acute diarrheal disease is the number one health problem of Haitian children under age five (PAHO, 2010).

Given the severity of the sanitation problem in Haiti and the implications for human health and the environment, there is a need for innovative solutions that can address these problems through interdisciplinary research and community-based implementation.

Introduction to SOIL

Sustainable Organic Integrated Livelihoods (SOIL) was founded in 2006 with the mission to transform wastes into resources in Haiti. From 2006 to 2009, SOIL worked in northern Haiti promoting integrated approaches to the problems of poverty, poor public health, agricultural productivity and environmental destruction. SOIL's primary objective has been to facilitate the community-identified priority of ecological sanitation (EcoSan), where human wastes are converted to valuable fertilizer. Following the earthquake in January 2010, SOIL expanded sanitation activities to Port-au-Prince to respond to the sanitation needs of those affected.

SOIL's work to date includes:

Construction of over 250 public EcoSan toilets in rural and urban areas and in IDP camps in Port-au-Prince. 	Conversion of portable toilets to urine diversion toilets. 
Establishment of 5 composting sites in Port-au-Prince and northern Haiti, the largest of which can treat the wastes of over 30,000 people. 	Production of over 150,000 gallons (568 m3) of compost from human waste. 

As a small, locally based NGO, SOIL has had the luxury of getting to know the communities in which we work making it easier to successfully pilot innovative technologies and adapt them to the needs of both rural and urban Haitians. Our work prior to the earthquake in a development context allowed us the time to make mistakes and respond to them accordingly. We offer this guide in the hope that our successes and failures can serve as a resource for others who wish to promote ecological sanitation.

For more information about SOIL, visit www.oursoil.org.

Frequently Asked Questions

- **Is EcoSan safe?**

  Yes. According to World Health Organization standards, fecal pathogens are killed after one week at a sustained temperature of 122 degrees Fahrenheit. When collected and composted properly, human faeces contain no harmful organisms and is indeed an excellent way, as it replicates nature, to return plant nutrients to the soil.

- **Doesn't it stink?**

  No. If a carbon source is properly added to the toilet and to the compost pile, there should be little to no smell.

- **Will EcoSan work anywhere in the world?**

  Yes, but each location will have different resources and challenges. Materials and management might vary greatly while the principles remain unchanged.

- **What are the advantages of urine diversion?**

  Urine is an excellent source of plant nutrients however it is very high volume and difficult to transport. Mixing urine and poop also leaves toilet contents wet which can cause increased smell and odours unless carbon cover material is significantly increased as well. For ideal composting, urine should be integrated into the compost pile to increase the final nutrient content, however it is often advisable to separate the urine from the poop in the toilets themselves to meet the following objectives:

  - Reduced volume of material requiring sanitization and transportation. In urban contexts, where offsite composting is necessary, urine diversion can significantly reduce transport costs.
  - Less carbon cover material required to reduce odor and flies

  SOIL has built and continues to build non-separating ecological toilets (such humanure toilets and arborloos) in combination with public UD systems. These toilets are primarily used by children (as their anatomy doesn't allow them to properly utilize a urinediversion toilet) and for those unable to climb the steps up to a urine-diversion toilet.

- **Can I do this at home?**

Absolutely! Please see our *Resources* section for further information on building a household EcoSan toilet. As well, SOIL is presently working on household toilet designs and we hope to add this information to future versions of the SOIL Guide to EcoSan.

- **What if I don't have access to bagas or another carbon source?**

Having a carbon source is key to successful primary and secondary composting. In addition, the use of carbon materials greatly reduces odors and makes the toilet and compost much less attractive to flies. Carbon sources will differ from site to site, but the following criteria are important to maintain a properly functioning toilet and compost system:

  - The material should be as fine as possible to ensure that it covers the poop completely, reducing access for disease vectors such as flies.
  - Cover material should have high carbon content and decompose quickly for production of high quality compost.
  - Material must be locally available in quantity.

Good choices are ash, shredded leaves or corn cobs, shredded cardboard or paper, sawdust and wood chips (though some wood products can be very slow to decompose). Soil may also be used if nothing else is available and soil is locally abundant.

- **Will SOIL build a toilet for my organization?**

Unfortunately, SOIL does not have the capacity to build toilets around the country - our operations are solely focused on Port-au-Prince and on the three northern Haiti communities of Cap-Haitien, Milot and Borgne - but we do want to do whatever we can to assist you because SOIL wholeheartedly supports the spread of EcoSan in Haiti and abroad. We worked very hard to include in this document all the best information possible on our toilet designs, compost techniques, lessons learned and best practices, so that your organization has the tools to develop its own EcoSan toilet project.

We also welcome you to come see one of our toilets in person, if your organization is based in, or will be traveling to, one of our project areas. Please contact us at info@oursoil.org for a toilet tour.

- **Where can I find more information?**

  You can find more information about SOIL at www.oursoil.org or you may email us at info@oursoil.org. Please see our Resources section in this document for further information on EcoSan and related topics.

Resources

Documents

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Available in English and French at:
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Joe Jenkins. The Humanure Handbook: A Guide to Composting Human Manure, Third Edition. Joe Jenkins, Inc., 2005.
Available at:
www.josephjenkins.com

Organization Websites

Ecological Sanitation Research Programme
www.ecosanres.org

Centre Régional pour l'Eau Potable et l'Assainissement à faible coût (Centre for Low Cost Water Supply and Sanitation)
www.reseaucrepa.org

Direction Nationale de l'Eau Potable et de l'Assainissement (DINEPA)
http://www.dinepa.gouv.ht/

Humanitarian Response Haiti
http://haiti.humanitarianresponse.info/Default.aspx?tabid=61

Interim Haiti Recovery Commission, Water and Sanitation Goals
http://www.cirh.ht/sites/ihrc/en/Goals/Pages/WaterSanitation.aspx

Sustainable Sanitation and Water Management
http://www.sswm.info/home

Sustainable Organic Integrated Livelihoods (SOIL)
www.oursoil.org

Contact Us

SOIL supports all efforts to increase ecological sanitation practices in Haiti and abroad. We look forward to sharing more information with you about this exciting, low-cost way to provide effective, sustainable sanitation and simultaneously produce valuable fertilizer critical for agriculture and reforestation efforts.

SOIL offers consultation services on a case-by-case basis in the areas of education and waste treatment as related to ecological sanitation.

We hope and expect to have the SOIL Guide to Ecological Sanitation translated into Kreyol and Spanish. As well, we hope to release further editions with even more information and in other languages whenever possible. SOIL is also working in partnership with other organizations and the Haitian government to develop national guidelines for the use of ecological sanitation technologies in Haiti. If you have questions about national regulations or are planning a large scale project in Haiti, please contact DINEPA (the national water and sanitation authority) through their website which is listed on our resources page.

Lastly, we welcome your questions, comments, suggestions, experiences and lessons learned.

Please direct all correspondence regarding The SOIL Guide to Ecological Sanitation and all other SOIL activities to:

info@oursoil.org

We will respond as quickly as we are able. Thank you.

Sustainable Organic Integrated Livelihoods (SOIL) is a 501(c)3 US-based non-profit organization that has been working in some of the poorest areas of Haiti since 2006. SOIL is dedicated to protecting soil resources, empowering communities and transforming wastes into resources in Haiti. SOIL promotes integrated approaches to the problems of poverty, poor public health, agricultural productivity, and environmental destruction.

Visit us at: **www.oursoil.org**.

Introduction to EcoSan Toilets

There are many different toilet structures that could be described as ecological sanitation technologies. However, for the purpose of this section we will focus primarily on the urine diversion (UD) toilet which we have used extensively in Haiti. We have also used the humanure toilet developed by Joe Jenkins and the arborloo which has been widely promoted in Africa. A brief overview of each toilet type will be provided here, but the detailed operations and technical guidelines which follow will focus on the UD toilet as this is the design we have implemented most widely. Our designs are adapted from the work of others and in response to user feedback. The designs are constantly being adjusted to meet the needs and preferences of local communities. This introduction will briefly describe each type of toilet that SOIL has constructed and list some of the most relevant lessons learned.

Arborloo

The arborloo is a very low cost toilet ideal for rural areas where there is ample space and low risk of flooding. This toilet is a simple shallow pit (less than 1 meter) toilet with a light weight superstructure placed over a hole. The toilet itself can be either squatting or sitting and has a single hole with no separation of poop and urine. Each time the toilet is used, cover material (either soil or carbon rich organic material) is added to the pit to reduce odors and flies and speed the decomposition of the wastes. When the toilet is almost full the superstructure is moved to a new hole, the old pit is covered with a layer of soil and a tree is planted in the old pit. The decomposing wastes provide nourishment for the tree and the user never has to handle the wastes. This method is extremely low cost and a toilet can be built using only local materials.

Humanure Toilet

The humanure toilet that we have used in Haiti was designed by Joe Jenkins when he visited us in April 2010. This toilet is also very low cost (~$75 US) and can be constructed using local materials. The toilet itself consists of wooden box with a 15 gallon receptacle below the toilet seat. The box opens to allow easy removal of the receptacle when full and the toilet seat on top of the box provides comfort for users. These toilets do not separate poop and urine and are very good for children and handicapped users who may have difficulty with the UD toilets. This toilet is also an excellent option when the nutrients from the urine are desired in the compost, provided that transportation to an offsite composting facility is not necessary. Each time the user uses the toilet they apply a layer of cover material to reduce flies and odours and when the receptacle is full it is emptied into a compost bin and replaced with a clean receptacle.

Urine Diversion (UD) Toilet

The UD toilet is characterized by a special seat or squat plate which separates the urine and poop, ideally preventing any mixing of the two. Urine can be collected and used in agriculture or compost production or it can be drained into an underground soak away. Poop falls into the chamber below the toilet, which can either be a removable receptacle or a vault that is emptied only after long intervals of storage. UD technology has been used throughout the world but is particularly prevalent in Sweden, South Africa, Germany, India and Mexico. Urine diversion is based on the understanding that from a public health perspective it is most important to remove the poop from the environment, whereas urine does not pose a significant risk to humans. Urine diversion toilets facilitate the removal and treatment of poop, and also have increased user approval. The main benefits are:

- Reduction of odors and flies by reducing the moisture of the wastes
- Reduction in the amount of cover material needed
- Reduction in the volume of wastes needing to be removed from the toilet and treated
- Facilitation of pathogen die off through desiccation of the poop

SOIL has built three types of UD toilets to date, each of them relevant for different development and emergency contexts

A. Double vault toilet: This design was based on models in South Africa where each toilet seat has two chambers underneath. The poop falls directly into the chamber below where it is covered with carbon material. When one chamber fills the toilet seat is moved to the other chamber and the first chamber is sealed. The poop is stored in the first chamber until the second is full (length of storage will be dependent on the size of the chamber and the number of users). When the second chamber fills up the first is emptied so that it can be reused. Under ideal conditions or with very long storage times, the poop may have decomposed by the time it is emptied. However Haiti is a very humid climate and we have found that decomposition and sterilization do not take place in the chambers of our toilets. As such, we recommend rigorous pathogen testing or secondary composting before using the material in the chamber for agriculture.

B. UD toilet with drum: When SOIL began an emergency EcoSan program in Port-au-Prince following the 2010 earthquake we changed to a drum system whereby a 15 gallon plastic drum is placed beneath the toilet to collect poop and carbon material. When the drum is full it is removed and replaced. The removed drum can then be sealed awaiting collection for transport to the compost site. This system requires less handling of wastes but maintenance must happen on a regular basis as opposed to semi annually, as with the double vault model. This system works particularly well when there is extensive usage of the toilet and when offsite composting is required.

C. Portable UD toilet: Following the earthquake over 4000 portable toilet units were brought into the country. As organizations are now shifting their focus from emergency response to long-term development projects, many of these toilets are not currently being used. Portable toilets are extraordinarily expensive to service and maintain. SOIL engineers have modified these extra portable toilets to serve as UD toilets by installing the separating seat and placing a 15 gallon drum beneath the seat. Urine can be collected or diverted into an underground soak away. These toilets are excellent for communal toilets in camps (as they have very low space requirements and lock easily) or for use at community events and festivals.

Table 1: SOIL Toilet Types and Lessons Learned

Toilet type	Positive	Negative
Arborloo	Cheap	Requires a lot of space
	Trees are produced	Floods easily
	No handling of wastes	Not near water source
	Easy for young children	
Humanure toilet	Cheap	Heavy to transport
	Easily removable	Increased cover needed
	Space requirements low	Bucket close to seat
	Conserve urine	Fill quickly
	Easy for children	
Double Vault Toilet	Infrequent waste handling	Expensive
	Long lasting design	Difficult to empty
UD Toilet with drums	Easy to empty	Regular drum removal
	Less contact with wastes	
Portable UD unit	Easy to transport	Urine clogs easily
	Space requirements low	Bucket close to seat

Although the toilet design is certainly an important aspect of any project, the importance of community acceptance cannot be underplayed. We have found that projects are only sustainable when they are demand driven, meaning that the availability of hardware does not guarantee acceptance by the community. This guide encompasses both the technical and social aspects of EcoSan but it should be noted that social implementation strategies are likely to be more widely variant among communities than technical design, so it is important to work with local actors who know the needs and desires of their communities and are able to help develop a social marketing strategy to create demand for EcoSan systems.

The section which follows includes a detailed overview of community education, toilet management and technical designs based on SOIL's experience in Haiti. Examples of several case studies are provided.

It should be noted that this guide is a work in progress and we plan to send frequent updates to our network. Please contact us if you have suggestions for expansion of the guide or if necessary details or explanations are lacking.

Managing Urine Diversion Toilets

While the development of an appropriate design and the actual construction of the toilets are necessary for a successful project, effective management of the toilets is an ongoing requirement that keeps the toilets functioning and clean. Whether the responsibility for the upkeep of toilets falls to members of a household, a community organization or a paid employee, routine maintenance by the operator is essential for the continued, hygienic function of the urine diversion (UD) toilets. Routine repairs should also be the responsibility of the operator while more extensive repairs to the structure are the responsibility of the individuals/group that installed the toilets. While SOIL has found there are many differences between maintenance programs for community-run public toilets and paid public toilets, there are a number of essential points to appropriately maintaining both types of toilets.

Operator Responsibilities:

- Routine cleaning of toilet pedestal to ensure good hygiene and proper use. Care should be taken to prevent chemicals from entering into the poop drum as this will ruin the composting process.
- Cleaning inside and outside of the toilet structure.
- Verifying that sufficient cover material is being applied by users.
- Making cover material available to each user.
- Timely removal and storage of filled drums to avoid any human-fecal contact from overfilled drums.
- Proper installation of drums with the help of the guide in the bottom chambers.
- Periodic verification of clear and functioning urine pipes to avoid blockages in the seat's drain.
- Provision of toilet paper and appropriate disposal of used toilet paper.
- Provision of water and soap for the hand washing system.
- Ensuring that the toilets are accessible to all members of the targeted population.
- Educating first-time users on the basic steps of using a urine-diversion toilet.

Management schemes will vary widely depending on a number of factors, including but not limited to: location, population, access to cover material, funds available to employ toilet operators, etc. Organizations or groups planning on installing UD toilets must commit to working with the targeted communities to identify management schemes that are appropriate for both parties. Interested organizations also must be prepared to adapt to changing needs and concerns that can affect the management and functioning of the installed toilets. Over the past 5 years, SOIL has gained experience from projects in Cap-Haitien as well as in Port-au-Prince implementing both paid-public toilets and community-managed toilets.

Case Study 1: Community-Managed Public Toilets

From 2006 to 2009, SOIL installed over fifty UD toilets in Haiti, with 36 of them concentrated in Cap-Haitien and the surrounding areas of the North Department. Some of these toilets were built at the request of city officials with assurances that individuals would be employed by local government to maintain the toilets. The large majority of these toilets, however, were built after community leaders and local organizations made specific, written requests to SOIL for ecological sanitation toilets to be built in their community.

All of these toilets were installed as double vault urine diversion toilets with composting occurring in the toilet chamber. SOIL's role in maintaining these toilets was limited to periodic check-ins and responding to significant repair requests. SOIL also maintained responsibility for the emptying of the vaults after the toilets became full (typically a 6-9 month period).

Lessons learned

1. Toilets that were installed as a result of formal requests by community groups/organizations were often better managed. This demand-driven model can and should be applied in other contexts to improve ownership of the facilities by the community.
2. Responsibility of finding carbon-rich cover material should not be placed on individual users. In order to ensure that there will be sufficient amounts of an appropriate cover material, implementing groups must identify a large source and make sure it is routinely transported to toilet sites either by the implementing organization or the community group responsible for the toilet.
3. Adequate decomposition of feces was not able to occur in the 6-9 month collection period due to a combination of a humid climate and insufficient cover material put in by users. A large compost site was opened in the fall of 2009 to facilitate the secondary composting phase for the contents of the vaults when emptied. Toilets located in rural areas had individual compost sites that were located immediately adjacent to the toilets.

4. Collaboration with local authorities produced few results, as promises to hire operators to manage the toilet were not kept. Installation of toilets in certain areas at the request of local authorities often proved to be politically motivated.
5. Toilets that were installed at schools and churches were generally better maintained as the responsibility was taken up by members already committed to the general upkeep of the respective institutions.
6. Public toilets that were not managed by paid operators were not well maintained and resulted in unhygienic facilities. This, in turn, led to low usage of the toilets, thus alternative practices persisted (open defecation, use of canals, plastic bags, etc.).

Moving forward

As a result of the lessons learned from the past four years in Cap-Haitien and the past year in Port-au-Prince, toilets in the urban area of Cap-Haitien have been modified: Onsite composting using vault toilets has been replaced by offsite composting using the removable 15 gallon drum system. The new system requires supporting infrastructure including: A drum collection and delivery service provided by the Cap-Haitien SOIL office, and a secondary composting site located in Limonade (a short distance from downtown Cap-Haitien). The photos below show how the vault toilet chamber has been modified with the drum system:

In addition, in response to the cholera outbreak SOIL has employed toilet operators in some of the urban, public toilets to ensure that these remain open, functioning and adequately clean. Periodic supervision of the toilets and the toilet operators has also been put in place to provide feedback and education to toilet operators when necessary to continue to improve the management of the toilets.

Case Study 2: Public Toilets in IDP Camps

Soon after the earthquake on January 12th, 2010, SOIL, with the financial assistance of Oxfam Great Britain (GB), introduced ecological sanitation to IDP camps, schools and churches within the Port-au-Prince metropolitan area. While many of the sites were identified by SOIL as in need of sanitation services, committees from other sites approached SOIL staff in the field or made requests at our office upon hearing of the project and testimonies from individuals at other sites where SOIL was functioning. Urine diversion toilets, modified from the double vault system to the current single vault system that utilizes 15 gallon drums, were installed in 32 different sites.

By August of 2010, SOIL had installed 196 toilets across these 32 sites with the majority of them spread across the communes of Cite Soleil, Tabarre and Delmas. At the peak of displaced populations living in spontaneous camps, the number of beneficiaries for these toilets was an estimated 20,600 individuals. For the construction aspect of this project, over 130 masons and carpenters were trained and hired in ecological sanitation construction. All toilets were separated into men, women and child facilities and privacy for users was assured by the installation of locks in each toilet. Collection and delivery of drums for each site occurred once a week, with cover material provided at most sites in large quantities from time to time. At sites where space allowed, 125 gallon rainwater fed stations were constructed to provide water for hand-washing. Other sites had smaller buckets along with taps to ensure that all users could wash hands.

At each site, the committees played an essential role in the implementation and ongoing management of SOIL's program. Their responsibilities included:

- Introducing SOIL to the site (either by request at SOIL office or sought out by SOIL staff on first visit).
- Taking part in the initial ecological sanitation education seminar and making a decision as to whether this sanitation option was appropriate and desirable for the particular site.

- With SOIL engineers, identifying location, quantity, and type of toilets to be installed by SOIL.
- Identifying carpenters, masons, and other laborers for the construction phase of the project.
- Nominating a representative who remained in regular contact with SOIL, reporting toilets in need of repair, cleaning material needs, and any other social issues that may come up.
- Assisted employing and supervising toilet operators for all public toilets (200 HTG for each 8 hour shift). Some committees appointed 2 individuals responsible for maintaining the toilets while others employed systems that resembled Cash-For-Work programs where toilet operators changed every week or every 2 weeks.

All cleaning materials needed for the toilets were provided, including but not limited to: bleach, disinfectant, toilet paper, insect spray, brooms, gloves, masks and liquid soap. Depending on the system employed by each site, the identified representative(s) would come to the SOIL office to pick up payment for the toilet operators as well as the necessary cleaning supplies. At larger sites, depots were identified and cleaning materials were able to be stored for one month at a time.

In terms of monitoring, SOIL's site supervisors would visit each site at least twice each week, verifying the quality of maintenance provided by the toilet operator as well as identifying any repairs that needed to be completed. These regular visits by SOIL staff worked to further develop relationships with the committees as well as the populations and allowed for early identification of potential problems within each site. Although initially all repairs were done by SOIL staff, committee members in many of the sites were trained on how to deal with the periodic plumbing issues to ensure that repairs were made as quickly as possible and that the toilets remained open and functioning.

Lessons learned

1. We found it critical to our program to develop and maintain solid relationships with the camp committees in order to receive feedback on toilet design as well as management. Furthermore, it created a sense of empowerment among committee members where they felt directly involved in the project and thus were committed to maintaining and promoting the toilets.

2. Increasing participation of committees in other activities of SOIL (seminars on ecological sanitation, visits to compost site) can improve understanding of overall program and can indirectly improve management of toilets.
3. It is essential to pay operators to take care of public toilets. Other programs where toilets where the responsibility of the camp committee or other individuals on a voluntary basis were often not well maintained.
4. Operators employed for one or two weeks at a time were often not effectively trained by committees to properly manage the toilets. Long-term operators, however, were able to develop relationships with SOIL staff and committee and continuously improve on the management of the toilets.


A toilet operator moves a clean empty drum into a SOIL UD toilet.

5. The appearance of toilets can be linked to quality of management, as a good-looking toilet can instill a sense of pride and motivate operators to manage the toilets well and keep them clean.
6. Without controls on cleaning supplies excess amounts are used and in some camps may have been sold by the committees. Monitoring usage of cleaning supplies at each site and using model sites to estimate appropriate quantities for other sites can help to reduce these costs.
7. The most common problem with the toilet is the clogging of urine pipes, which can be traced back to plumbing as well as management issues (see toilet photos document). A potential solution to the management side of this could be putting the responsibility for adding cover material solely in the hands of the toilet operator.
8. Regular supervision improves toilet management and enables repairs and other issues to be dealt with rapidly.
9. Providing each toilet facility with a garbage can lead to an improved appearance in the area outside the toilet as well as reducing the potential for trash to be put into the toilets.
10. Monitoring of drums is necessary to prevent theft but also enabled SOIL to track sites that were either not using sufficient cover material or

were unable to prevent users from disposing of other materials in drums that could negatively affect the composting process.

11. Men continue to urinate outdoors. Urinals were installed at all sites, but did not solve the problem. Increased promotion is needed to increase usage of urinals by men.
12. Most people will wash their hands if provided with adequate facilities. Each site was upgraded to include rainwater catchment systems, larger reservoirs, and adequate liquid soap in order to ensure that hand washing would be available.

Moving forward

In general, the almost 200 toilets that have been installed in sites across Port-au-Prince continue to function properly and have been a tremendous success.

SOIL is currently transitioning away from systems which place large amounts of control in the hands of the camp committee (cleaning materials, the selection of toilet operators, facilitating payments, etc.) and systems with a high turnover of toilet operators.

SOIL is putting more responsibility in the hands of toilet operators, training individuals on ecological sanitation and how to perform simple plumbing and structural repairs.

The next edition of The SOIL Guide to EcoSan will include a case study on communal toilets. This toilet management approach will be implemented in small camps where there is adequate space to provide several families with a toilet of their own. Each family will have a key to the communal toilet and all families will be responsible for managing it, thereby obviating the need for paid toilet managers.

Community Outreach and Education

Initial Training with Community Representatives

The initial education and training of potential users is perhaps the most important step of realizing a successful ecological sanitation (EcoSan) project. While SOIL has experienced extremely high user acceptance with projects in Haiti, failure to properly approach and educate users from the start would seriously hinder an EcoSan project's chances. Improper use of urine diversion (UD) toilets could result in low user acceptance not only due to the inevitable smells and fly-breeding but also because of the extremely unhygienic conditions for toilet managers and those that are emptying/cleaning the toilet drums that arise from misuse of toilets.

Initial meeting w/Dotwa IDP camp committee, Port-au-Prince, June 2010

Assuming that the local population has already been contacted or has made a specific request for the installation of an EcoSan toilet, the first step is a formal meeting with these individuals or groups.

This initial meeting with the committee or community offers an opportunity for hygiene promotion and general education around the benefits of proper sanitation as well as a forum to introduce ecological sanitation as a viable solution to sanitation needs. Prior to constructing any toilets, the community should not only understand the differences between EcoSan toilets and other existing sanitation options, but also understand the benefits and responsibilities that come along with operating and managing a EcoSan toilet. Below is an example of a meeting outline that SOIL has utilized in approaching communities new to EcoSan.

Community Meeting Outline

1. Introduction of committee/community members, as well as partners present.
2. Explanation by community members of current sanitation situation.

3. Explanation of what ecological sanitation is by a SOIL representative
4. Introduction of benefits of EcoSan in regards to a population's health, the environment and for those working in the agricultural sector. Also, the benefits of EcoSan in comparison to other traditional sanitation options should be stressed here.
5. Present the different types of EcoSan toilets and how different interventions depend on a variety of factors (water table, resources available, space, land owner issues).
6. Present SOIL's compost site set-up, how pathogens are killed, the testing for pathogens as well as nutrients, and what will be done with the final compost.
7. Proper use of UD toilets, which includes a participatory activity that engages the audience and allows them to act out in front of others how to properly use the UD toilet (materials required: separating seat, toilet paper, bagas, willing participants). For participatory activity, see "11 Steps to Using a Urine Diversion Toilet" in sections T4 and T5.
8. Responsibilities of toilet operator in keeping the toilet(s) functioning properly (see general management section).
9. Discuss possible management solutions with the committee that take into account capacity of partners and resources available.
10. Explanation of collection/distribution system that ensures constant access to cover material as well as a long-term (1-2 weeks) stock of drums.
11. General Q&A.
12. Committee decides if they would like to move forward with EcoSan or whether they would rather have SOIL identify another organization that can help with more traditional options. If there is general agreement, it is possible to identify the location for the toilets immediately.

Once the community or committee has decided that they would like to implement an EcoSan program, the construction phase begins. To further integrate the community into the project, the construction of the toilets should include carpenters, masons and laborers from the same community as much as possible. Once the toilets are finished, these individuals should have a general understanding of the technical aspects of the toilets and can be called upon for repairs when needed.

Educating the General Population

Prior to opening the toilet for use by the larger population, implementing organizations should discuss with the committee or community organization about the most appropriate method of educating households regarding ecological sanitation and how to properly use the toilets. Where time and funds allow, the method that ensures almost 100% of families gain a sufficient understanding of the toilets is one where hygiene promoters can do door-to-door education campaigns within the area where the toilets are located. This two-way communication method is unique in that it allows each user the opportunity to ask questions and voice doubts and it provides the implementing organization with valuable data on the perceptions of users prior to the toilets being opened. Focus should be put on having each household know the "11 Steps to Using a Urine Diversion Toilet" (see sections T4 and T5).

In situations where door-to-door education campaigns are not possible, community events can be organized with the community to draw large audiences and allow one education seminar to reach a large number of people. As one cannot expect all members of a community to be present at one inauguration, the goal is to educate those present and have the message diffuse to others via relationships within and between families, friends and neighbors.

Well-known Haitian musician BelO performing at an inauguration in Port-au-Prince, 2010

Inaugurations

Approaches to inaugurations are different from the initial education seminar done for the community leaders. While the initial meeting's objective is for individuals to gain a comprehensive understanding of ecological sanitation, proper use of the toilets, and the responsibilities for the committee, the inaugurations should focus on proper use of the toilets. While the animator/emcee should take the opportunity of to communicate the basics of ecological sanitation, the presentation should build towards the participatory activity: "11 Steps to

Using a Urine Diversion Toilet”

To increase attendance and interest in the event, implementing organizations should look to the community leaders to mobilize large numbers of people. Any opportunity to collaborate with local musicians or comedians will increase interest in the event and give more weight to messages you are trying to get across.

Effective Strategies for Inauguration Events

- Effectively scheduling when majority of population is likely to be available (often Friday or Saturday evenings)
- Making use of visuals and photos (existing toilets, compost site, experimental gardens)
- Attendance and endorsement by well-known local personalities to increase interest
- Animator/emcee should be an experienced community mobilizer and should be able to engage a large audience around a topic that is not commonly focused on, i.e. toilets
- Education portion should build up to the participatory activity, which concludes the educational portion of the event

Eleven Steps to Using a Urine Diversion Toilets

To ensure that the urine diversion (UD) toilets are being used properly by target populations, SOIL has devised a simple, participatory activity that aids communities and individuals in learning the correct way of using these toilets; it also really makes people laugh!

This activity involves the animator/emcee going slowly through the 11 steps, voicing each step to the rest of the audience, the rationale behind each action, while also acting out the step with the available visual aids (toilet seat, bagas, buckets, toilet paper). When the 11 steps have been completed and any questions have been answered, members from the audience are selected to come forward and try to complete the steps without help from others. It is important to note that participants should verbalize what they are doing while going through the 11 steps.

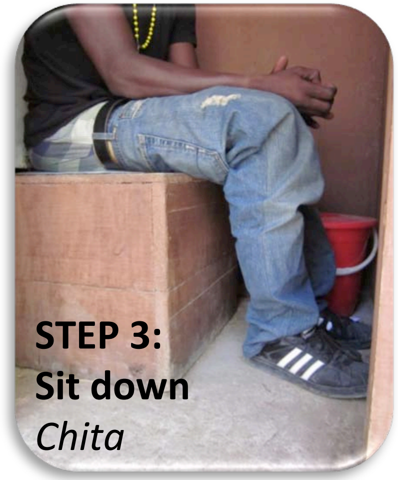
This participatory activity can be turned into a game, where the audience can be split by neighborhood, sex or some other variable and each individual can support the individual that is representing them. Winners are determined, of course, by completing all the steps without error or help from others. It will be up to the animator to gauge the situation and determine whether participants need encouragement or stricter refereeing. This activity is meant to be educational but also entertaining for all those involved.

For an example of how SOIL incorporates these steps into a participatory activity during toilet inaugurations, follow this link for a video of SOIL's Baudeler Maglore going through the steps with a community in Grand Riviere du Nord, Haiti: http://www.youtube.com/watch?v=0JWEaqXAAsU.

SOIL's 11 STEPS TO USING A URINE DIVERSION TOILET

STEP 1:
Open the toilet seat
Dekouvri twalet la

STEP 2:
Remove your Pants
Desann pantalon'w



STEP 3:
Sit down
Chita

STEP 4:
Poop!
Kaka! Twalet!

STEP 5:
Stand up
Kanpe

STEP 6:
Take the toilet paper, wipe, and throw it in the garbage
Pran papye a, siye deye'w, e jete nan poubel la

SOIL's 11 STEPS TO USING A URINE DIVERSION TOILET

STEP 7:

Pull up your pants

Monte pantalon'w

STEP 8:

Take the bagas and empty it into the back hole

Pran bagas la, vide'l nan twou kote twalet la tonbe a

STEP 9:

Close the lid

Fème kouvèti a

STEP 10:

Wash your hands

Lave men'w

STEP 11:

And you're off!

Gaz kole!

Monitoring and Evaluation

Once the construction phase and the education/inauguration events are complete, the toilet is ready for use! By now, the implementing organization has worked with the community to put in place a management scheme that works for both parties. Despite the great deal of work completed to arrive at this stage, the work for these two groups is not complete; public toilets always require regular monitoring and evaluation, or 'supervision'.

Supervision comprises:

- Identification of hardware problems and scheduling repairs
- Encouraging and supporting toilet operators
- Receiving feedback from *operators*, especially concerning potential hardware and software improvements
- Receiving feedback from *users*, especially concerning potential hardware and software improvements

In the event of toilets being managed by long-term operators, routine monitoring is necessary to ensure that the operator is taking their responsibilities seriously and the toilet remains clean and functioning. In urban settings like in Port-au-Prince, SOIL found that visiting each site and speaking with the toilet operators a minimum of two times each week had a strong impact on the cleanliness and usability of the toilets. Supervisors are required to work through a checklist of previously identified requirements for each toilet site to function properly. An example of this checklist can be found in section T7, Toilet Monitoring Checklist.

Each week, supervisors submit a report for each toilet site. The report provides:

- A historical record of toilet use, toilet problems and toilet maintenance
- A discussion document to facilitate full-team (including engineers, animators, managers, supervisors, and community liaison officers) discussions
- A tool used for discussion during the interface with each site's representative during the weekly payroll and cleaning materials delivery

While the community should be supervising toilet operators and checking up on repairs on their own, monitoring reports are a method of holding the community/committee accountable and showing the organization's commitment to a successful project.

Sipevizyon Twalet

Nom Inspekte:___________________

Nom Sit la:_________________________

Mwa Sipevizyon: ___________________

(Ekri WI ou NON nan bwat)

			Lavaj Men Yo			TWALET: Cham, Pa anba, Deyo								Twalet Konpost		Irinwa	Lot Bagay?
Dat	Jeran an la?	Poubel la presan?	Gen dlo nan boukit la?	Savon likid ladan?	Drenaj la bon?	Cham twalet la pwop?	Deyo twalet la pwop?	Li santi?	Gen mouch?	Gen papye ijinik?	Tout kadna yo la?	Doum byen plase?	Tiyo pipi a konekte?	Li pwop?	Pa gen mouch?	Li ok?	

Technical Specifications for Urine Diversion Toilets[1]

Introductory Notes

1. This section does not address hand washing. A toilet without a designated hand washing point is unacceptable and a space should ALWAYS be reserved adjacent to the toilet, for hand washing.

Section Objectives

1. To provide the reader with a technical specification, to be used in conjunction with the drawings and photos in this guide, to construct a SOIL Urine Diversion (UD) toilet with drums as opposed to vaults.
2. To provide the reader with some background to the development of the SOIL UD toilet, by including as footnotes, information on previous designs and lessons learned.
3. To provide the reader with a part of the SOIL Guide to Ecosan, which, if thoroughly studied, provides a complete package of information and instructions on how to implement a successful EcoSan project.

Performance Objectives (POs)

The Performance Objectives (POs) guide the design, construction and operation of the SOIL UD toilet. If one of the POs does not achieve its PO criteria then the toilet will not perform properly. If more than one of the POs fails to meet its criteria by a large margin, then the toilet may fail completely and will need to be closed to users. The POs and their criteria are shown in the table below:

PO	PO	PO Criteria
1	Acceptability	Toilet acceptable to 90% of users[2].
2	Operation	Toilet designed and constructed so as to be accepted by 100% of operators

[1] This technical section of the document focuses solely in the urine diversion (UD) toilet design that SOIL has used in IDP camps in Port-au-Prince. These specifications can be used as general principles to adapt the design to local needs, including substituting materials. In future editions of this guide we plan to include complete technical guidelines for other SOIL toilet models. If you have specific questions about other models please contact us at info@oursoil.org.

[2] It is rare that any public toilet will be acceptable to 100% of users. A 90% target is a realistic and practical target.

3	Excreta capture	100% of excreta should be captured in the poop drum.
4	Urine drainage	100% of urine should be drained away from the SOIL UD toilet seat, without blockage of the drainpipe or spilling of urine.
5	Odour	0 odour in the cubicle and in the chamber
6	Vectors	0 vectors in the cubicle and in the chamber

Technical Specification

Ref	Specification	Reference Documents.
4.1	POSITION & ORIENTATION	
	A SOIL UD toilet has good ventilation, but will nevertheless get hot under a Caribbean sun. Positioning the toilet in shade to stay cool during the day is a good idea.	PHOTO T16a
	Sufficient space (at least 60cm but ideally 100cm) should be left at the front and sides of the toilet structure to allow for user access to the front, and operator access to the front and sides. If possible, the same space should be allowed at the back of the toilet for any eventual maintenance.	PHOTO T16b, T16c
	The toilet should be sited in such a location as to allow privacy for the user, but not so much so that the toilet is obscure to the point of insecurity, from its community of users.	PHOTO T16a
4.2	DESIGN LIFE	
	All materials specified for use with the SOIL UD toilet have a design life of more than 2 years.	
	The design life of the SOIL UD toilet (wooden structure) is, of course, entirely dependent upon the number of users, their respect for the good function of the toilet, and the performance of the toilet operators. At the time of publishing this edition, it is estimated that	

Ref	Specification	Reference Documents.
	the design life of the SOIL UD toilet is between 1 and 2 years[3].	
	Periodic maintenance is necessary for the toilet to last until the end of its design life.	
4.3	TOILET SEAT	
	The SOIL UD toilet seat comprises: • A wooden box pedestal • A fiberglass SOIL UD toilet seat.	PHOTO T13, T15 Dwg.T5
	The wooden pedestal has a double coat of paint on the inside and outside. The pedestal is made using 4 pieces of ¾" plywood, connected together with 2.5" wood nails and wood screws.	Dwg.T5
	The SOIL UD toilet seat was made in Port-au-Prince. Its components and characteristics are: • A cover that closes tightly. • A very comfortable sitting area. • A proven design which easily and comfortably separates urine and poop. • An easy material to clean. • A material that is easy to repair by a fiberglass specialist.	PHOTO T15
	The weak point in the SOIL UD toilet seat is the metal hinge that connects the seat to the cover. There are 2 points of consideration for the metal hinge: • The metal hinge will oxidize and perish very quickly in the toilet environment. IT IS ESSENTIAL that the hinges on the toilet seat have protective painting. • The screws must be the correct head size and screw length in order to hold the hinge.	
	The SOIL UD toilet seat is screwed into the pedestal using wood screws. The spaces left in the corners of	PHOTO T13

[3] The first SOIL UD toilet in Port-au-Prince was commissioned in March 2010. It is still achieving all of its POs. None of the SOIL UD toilets were noticeably damaged after Tropical Storm Matthew of October 2010.

Ref	Specification	Reference Documents.
	the pedestal are filled in with small pieces of plywood, also painted.	
4.4	DRAINAGE	
	Drainage from the SOIL UD toilet seat down to the soak away is the most important function in achieving PO's 1 & 2, 4 & 5. The toilet will not work if the drainage is poorly executed[4].	PHOTOS BAD T1 - T5
	The PVC pipe and fittings which are used for the drainage from the UD toilet seat are, from top to bottom: Filter, comprising: ½" cap with a 2" long straight piece inserted with glue. Once the glue for the filter has set, 8 - 3mmØ holes are drilled around the edge whilst 1 hole is drilled in the top in order to attach the security cord. Toilet seat connection, comprising: ¾" male adaptor (screw-end) with a 1.5" long straight piece inserted with glue. The toilet seat connection is formed into the SOIL UD toilet seat using fiberglass. Drainpipe comprising: ¾" female adaptor (screw end) glued to ¾" drainpipe. ¾" drainpipe: 2 pieces of approximate lengths, 20cm and 100cm, connected with a 45 degree bend.	PHOTO T14b PHOTO T14a PHOTO T15 PHOTO T13b
	The drainpipe should descend at least 100mm down into the soak away pit. If it does not, then urine may spill out onto the concrete floor, causing smell.	PHOTO T1 PHOTO BAD T6
4.5	FOUNDATION & SOAKAWAY	
	The concrete slab base to the toilet structure has several functions: • To provide a level, clean surface to the toilet chamber. • To provide a protective layer between the	PHOTO T1, T2 Dwg T1

[4] Early SOIL UD toilets used ½" pipe with 90 degree bends. This arrangement blocked frequently, was more expensive, and required frequent repairs. Also, early SOIL UD toilet seats did NOT have the filter.

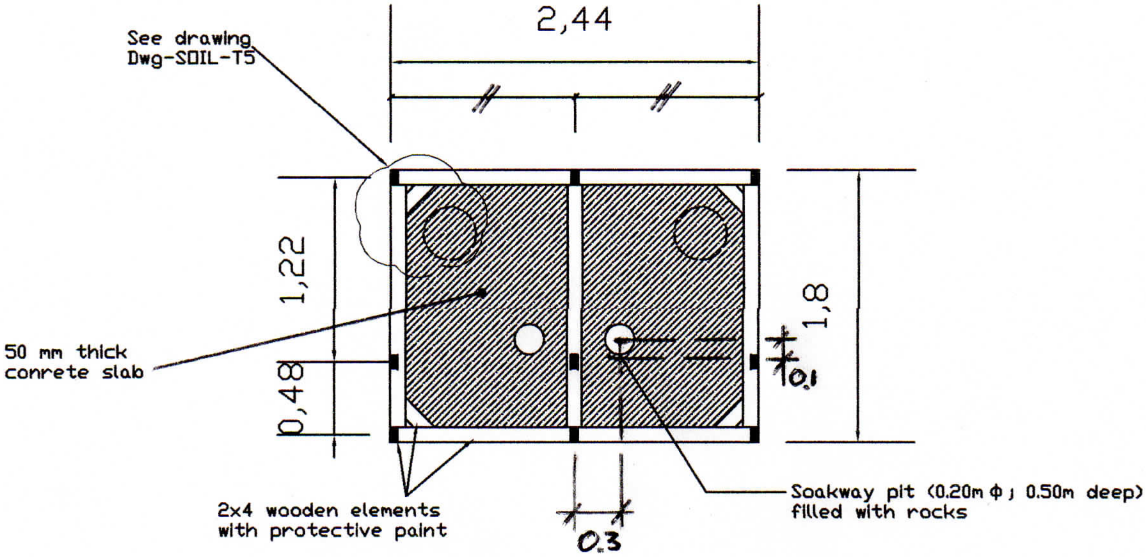
Ref	Specification	Reference Documents.
	ground and the wooden structure. • To provide a load-bearing raft upon which the wooden structural elements can sit.	
	The soak away is located so that the urine drainpipe does not interfere with the positioning and removal of the poop drum.	PHOTO T3 Dwg T1
	The dimensions of the soak away have been proven adequate to provide a good area for the urine to soak away. However, an engineering assessment of underlying ground conditions and permeability should be made before siting the SOIL UD toilet.	PHOTO T4 Dwg T1
	The concrete slab is constructed using the following concrete materials: 1 - sack of cement. 1 - 55 gallon drum of sandy gravel. Water.	
4.6	STRUCTURE GENERAL	
	Plastic sheeting is used as cladding material. Different grades of plastic sheeting are available and a higher grade of plastic sheeting will provide a more durable and better-looking toilet.	PHOTO T7
	Plastic sheeting is attached to the wooden structure using 1” nails. If executed carefully, a very good tight finish to the cladding is possible.	
	If a good tight finish is achieved on the structure, the plastic sheeting will not detach, unless it is detached deliberately. E.g. by children.	PHOTO BAD T7
	Even the strongest plastic sheeting is not heat-resistant and will be damaged if exposed to heat. I.e. do not position the toilet next to a cooking site.	PHOTO BAD T9
	The SOIL UD toilet is often fitted with a rainwater collection gutter on the roof, which feeds a central hand washing point. The roof structure is strong and will support this.	
	Materials used for the wooden structure are shown in	PHOTO T10

Ref	Specification	Reference Documents.
	the Bill of Quantities. The central plywood wall that separates the cubicles MUST be well fit.	
4.7	CHAMBER	
	The chamber's main function is to provide just enough clearance to get the 15 gallon poop drum in to position under the poophole when the drum is empty, and out safely and easily when it is full. Accordingly, the chamber is not tall and the toilet structure is very solid.	PHOTO T1, T2
	The ergonomics of drum positioning and drum removal is an important factor in achieving POs 2,3 and 5. The drum guide and the plywood drum platform are ESSENTIAL elements in this and should be constructed and positioned carefully. Early toilet designs involved raising the poop drum on removable pieces of 2*4. This proved cumbersome and did not always allow for accurate alignment beneath the poophole.	PHOTO T1 Dwg_T5 PHOTO BAD T8
	The wooden elements in contact with the concrete floor are susceptible to moisture damage: from rain & damp and also from stray urine. These elements should be treated with a double coat of paint before being nailed to the concrete floor.	Dwg_T1
	Double-leaf chamber doors with internal door-stops and external locks provide chamber access.	PHOTO T11, T12
	Diagonal bracing struts (1" * 4") are provided on the main elements of the chamber frame.	Dwg T1
	Ventilation to the chamber is not needed if the toilet is used properly. There should be no odour and no flies.	
4.8	CUBICLE	
	The cubicle has dimensions large enough to be accessible to most disabled users, but there is no wheelchair access.	Dwg T2
	There are 2 shelving units in the cubicle, the shelf visible upon opening the door is for flowers. Flowers	PHOTO T17

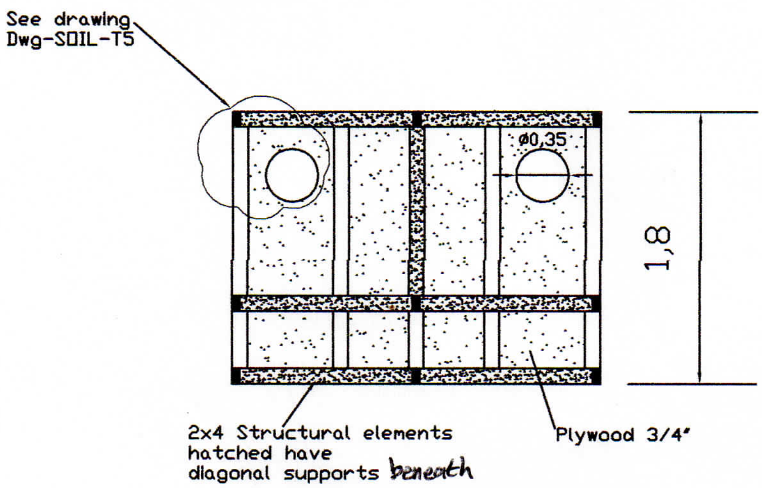
Ref	Specification	Reference Documents.
	are a key part in achieving PO 1. The shelf visible only upon closing the door inside the cubicle is for toilet paper, which if located on the other shelf, would be visible, and could be stolen.	
	The wooden slats visible from the inside of the cubicle should be arranged so that the central slat is at a height suitable for the toilet seat cover to rest against it when the toilet seat is up.	PHOTO T9
	Education and software are the most important factors in achieving all POs. As such, an information poster 'On EcoSan' should be affixed in each cubicle, facing the toilet seat.	
	The poophole is cut in the plywood floor using the 15-gallon drum lid as a guide. The drum guide (see 4.7) if fixed AFTER the poohole is cut.	PHOTO T5, T6 Dwg T5
4.9	BALCONY, STAIRS AND ACCESS	
	The handrail on the stairs, constructed in accordance with the technical drawings, is essential for disabled access to the balcony and the toilet cubicles.	
	The central element to the stairs is essential in preventing deflection, and eventual failure of the stairs unit.	PHOTO T8 Dwg T2
	The balcony also provides access to fill up the cistern of an adjacent hand washing point if one is constructed next to the toilet.	
	The balcony and stairs are the only wooden element not protected by the roof. These elements require treating with a double coat of wood paint to protect them from dust and wind and rain.	
	A 60cm wide gravel pathway should be provided at the front and sides of the toilet structure to allow for operator access to the chamber doors.	Dwg T2

List of Drawings: SOIL Toilets

Drawing no.	Toilet Type	Drawing Title	Drawing Creation Date	Rev.
T.01	SOIL UD Toilet: Wood	Plan views on toilet chamber	October 2010	-
T.02	SOIL UD Toilet: Wood	Plan view on toilet cubicle	October 2010	-
T.03	SOIL UD Toilet: Wood	Front & Side Elevations	October 2010	-
T.04	SOIL UD Toilet: Wood	Front & Side Sections	October 2010	-
T.05	SOIL UD Toilet: Wood	Details	21st Feb. 2011	-



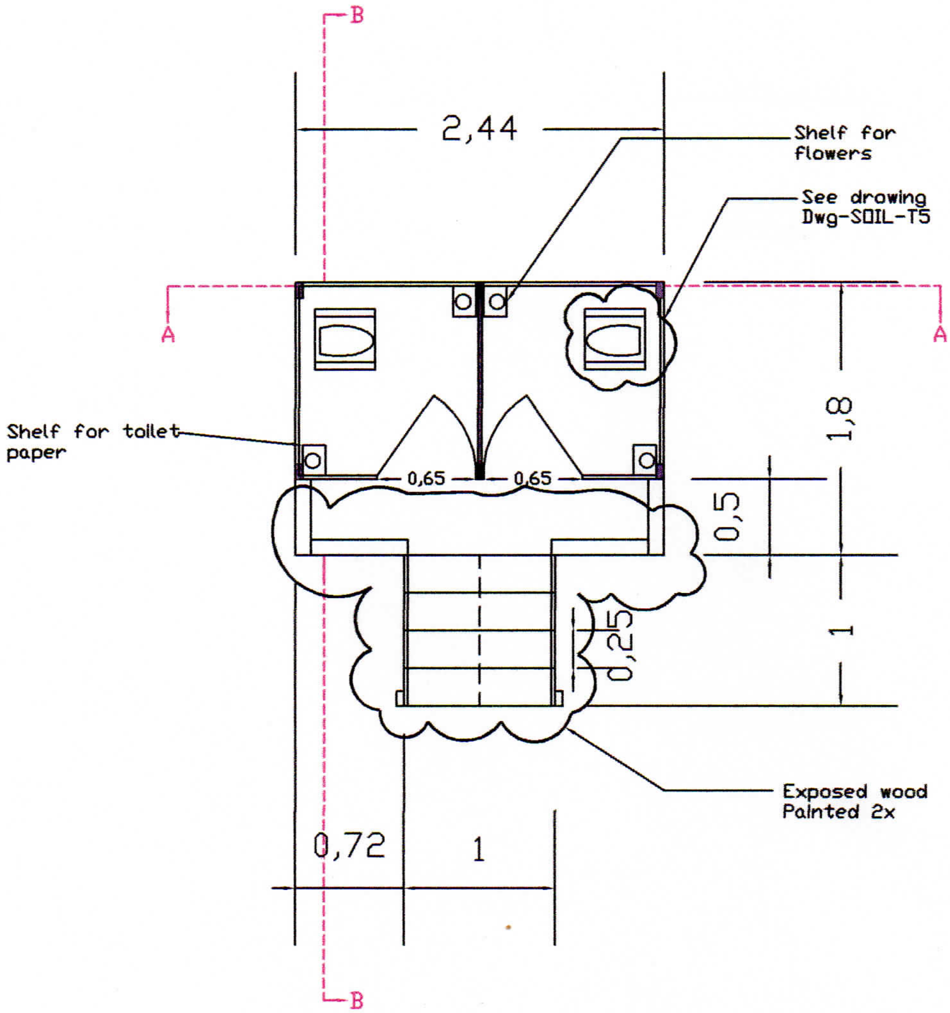
Concrete base level



Plywood floor level

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: T1
	TIT DESEN AN (TITLE OF THE DRAWING) PLAN (BAZ AK ESTRIKTI TWALET) (PLAN VIEWS)	ECH: 1/50 SOIL ENGINEERING SERVICES

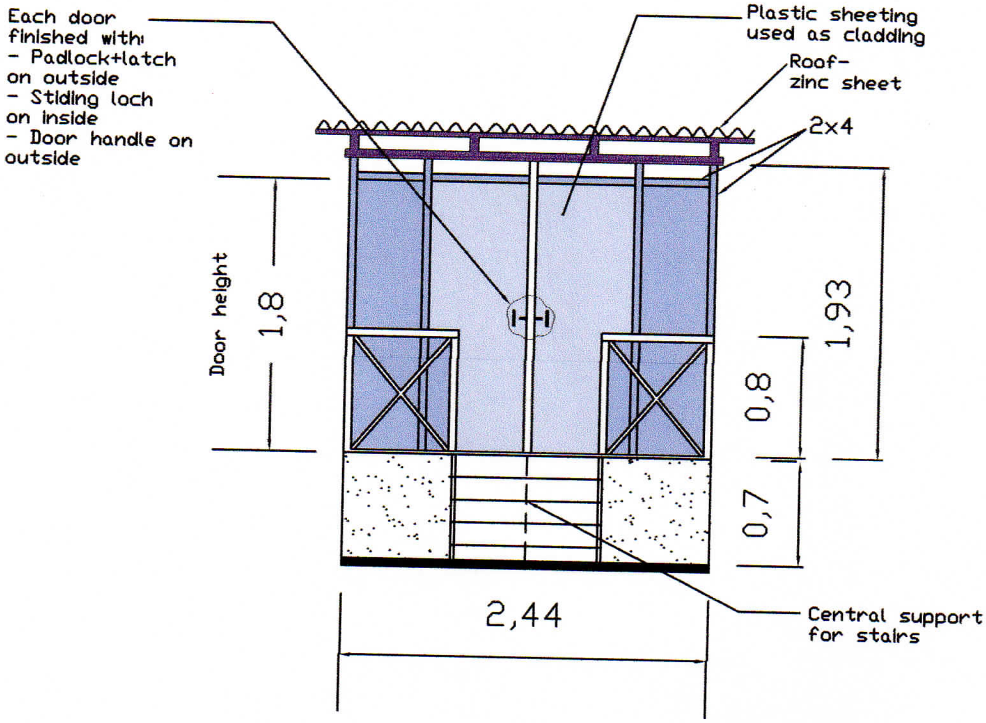


Plan view

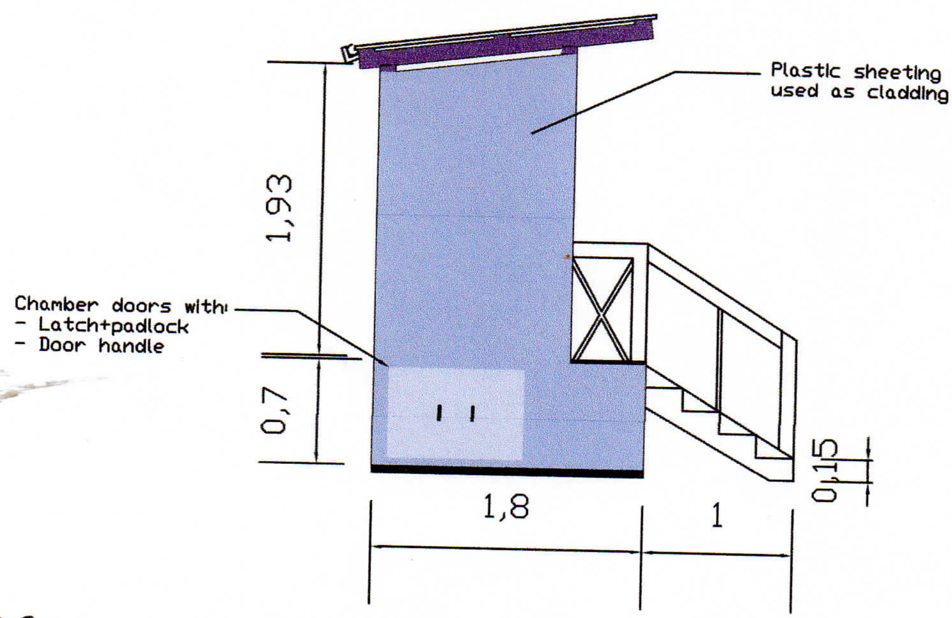
NOTES
1, ALL DIMENSIONS IN METRES

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 elevetion

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)

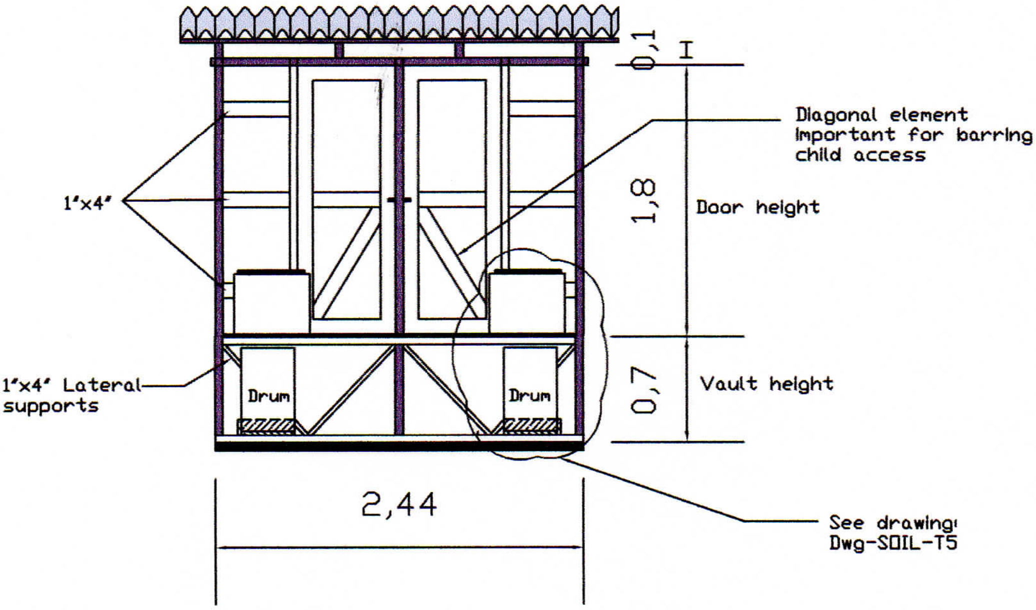
TIT DESEN AN (TITLE OF THE DRAWING)
FASAD DEVAN, A GOCH
(ELEVATIONS)

DATE: OCTOBRE 2010

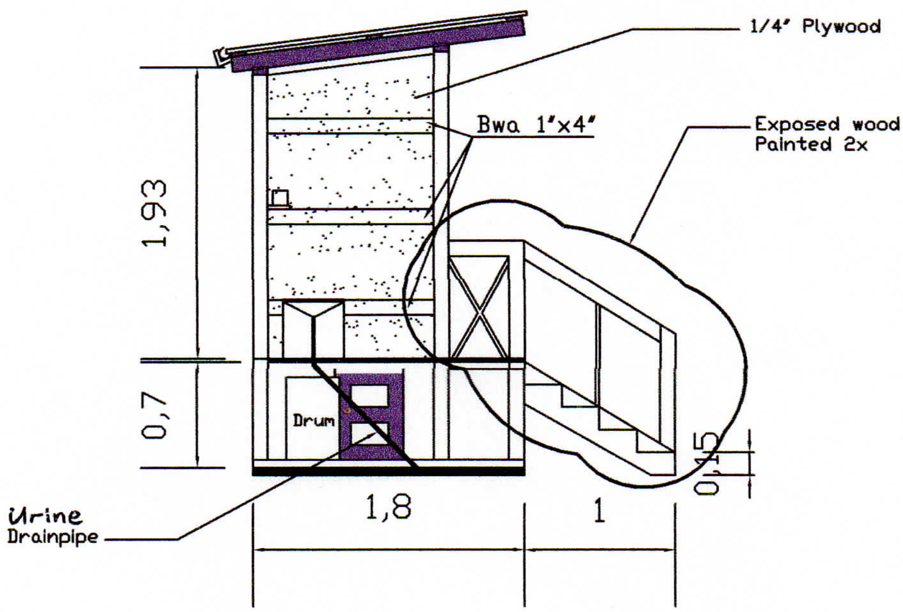
No PLAN: T3

ECH: 1/50

SOIL ENGINEERING SERVICES



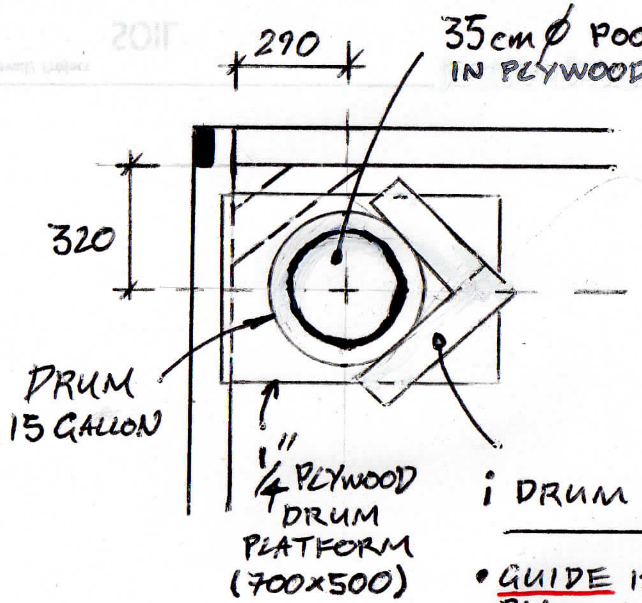
Section AA



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

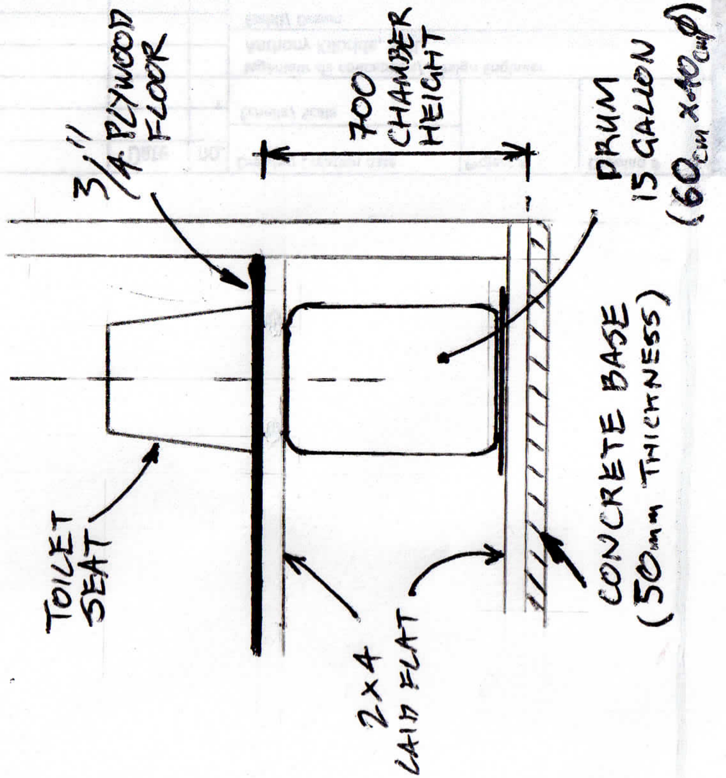


PLAN VIEW OF DRUM GUIDE IN CHAMBER.

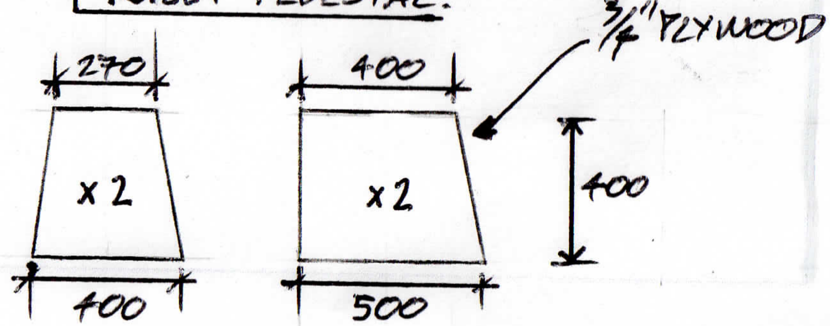
¡ DRUM GUIDE !

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

SIDE VIEW INSIDE CHAMBER



PIECES FOR WOODEN TOILET PEDESTAL.



NOTES
1, ALL DIMENSIONS IN MM UNLESS OTHERWISE STATED,

...ect	Révisions/ Revisions	Date	no.	Drawing Creation date	Project #	Drawing #
SOIL UD TOILET : WOOD				21st Feb. 2011		T.05
				Échelle/ Scale: 1:20		
DETAILS				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

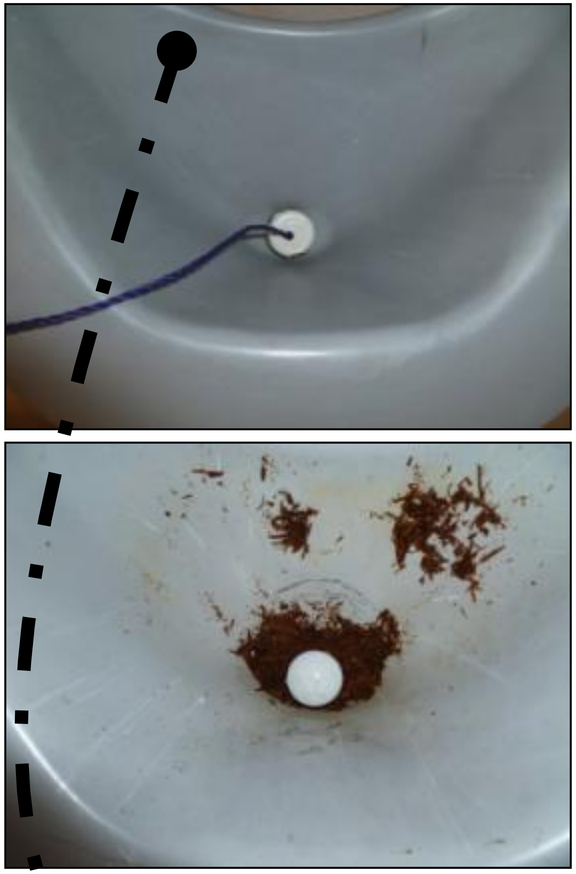


PHOTO T17
Unclogging urine bowl in UD seat

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	

Oxygen

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.

Moisture

[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.

<u>C/N Ratio</u>

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*.

<u>Nutrient Availability</u>

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.

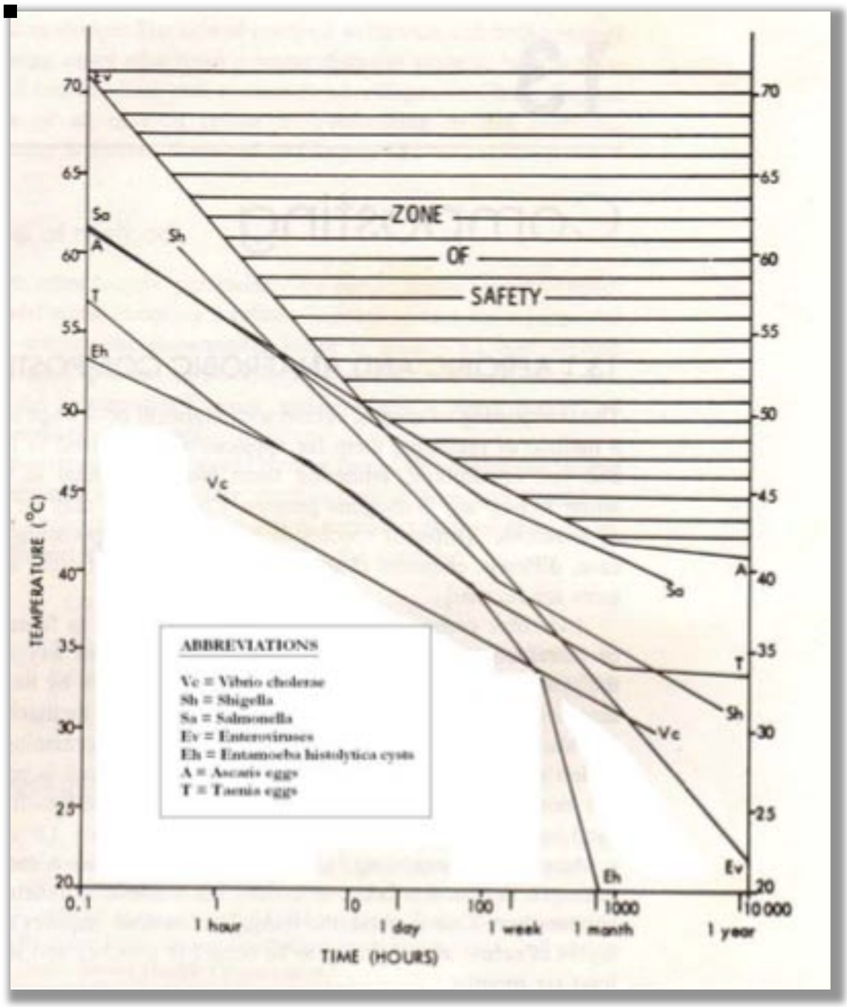
Composting and Public Health

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.

A Word of Warning

EcoSan is a cyclical process moving from sanitation to treatment to reuse. Focusing on only the sanitation aspect of EcoSan can be dangerous and is certainly irresponsible. We encourage those developing EcoSan initiative to think carefully about all steps of the process before constructing toilets. SOIL offers consultancy services in waste treatment on a case-by-case basis and if you have any questions please contact info@oursoil.org.

Compost Operations[1]

Introductory Notes

1. This section concerns the composting of poop from SOIL UD toilets, i.e. there is a very low quantity of urine arriving at the compost site. For compost sites which compost poop and urine combined, different operational measures may be necessary.
2. This section does not cover the handling of urine on its own, nor does it cover nutrient capture from urine.
3. This section does not address the agricultural use of compost, the creation of experimental gardens at the compost site, or ecological toilets. Other documents in this guide will address these issues.
4. Prior to the cholera epidemic of 2010, SOIL was simultaneously operating three compost sites in different communes of Port-au-Prince. This operation was in-line with our goal of sustainable composting through decentralized community compost sites. After the cholera epidemic of 2010, we restructured our compost activities into one single site, located in Pernier, Port-au-Prince.
5. At the time of going to print, the Pernier compost site receives up to 5,000 gallons of human waste per week.
6. This section draws on our experience at Pernier; operations described are those that occur in Pernier; and reference photos are exclusively from Pernier. The size of the compost site facilities (e.g. size of drum cleaning zone) and quantity of operations materials (e.g. amount of cleaning materials, number of compost operatives) will depend upon the quantity of poop received at the compost site. This should be well considered when designing a composting operation.

Section Objectives

1. To provide the reader with instructions, guidelines, best practices and SOIL experiences, on the operation and management of a compost site for treating human wastes.

[1] This operations guide is specifically for an offsite compost facility receiving high volumes of human wastes, though the principles described can be adapted to any system.

2. To provide the reader with a part of the SOIL Guide to EcoSan, which if studied thoroughly, provides a complete package of information and instructions on how to implement a successful EcoSan project.

The Compost Cycle

The compost cycle defines the various stages, processes and physical requirements for composting: from receiving the poop at the compost site to arriving at finished compost. The type of compost cycle is determined by the following three main factors:

- The volume of poop arriving at the compost site.
- The area of land available for composting.
- The area of land available for storing the finished compost.

The SOIL compost cycle at Pernier has 2 steps, described below:

‘Phase 1’ or ‘Controlled’ Composting	‘Phase 2’ or ‘Windrow’ Composting
Duration: 2 months	Duration: 4-6 months
Purpose: *To kill all pathogens in the compost in a safe and controlled environment.*	Purpose: *To decompose the compost in an environment which requires less control and less infrastructure thereby increasing the capacity of the phase 1 structure.*
	
Notes: The 2-month composting period for phase 1 composting begins when the last drum is dumped in the compost pile. Therefore, the majority of compost in the compost structure will have been	Notes: The 6-month composting period required to arrive at a well-decomposed, useful compost, is based on SOIL’s experience in Cap-Haitien. It is not, however, a ‘golden rule’ which all humanure composters

composting for more than 2 months. Because of the risks involved in phase 1 composting, it is highly advisable that a period of at least 2 months is respected.	must obey.

Phase 1 Composting or Controlled Composting

This section addresses composting operations using the SOIL compost structure at Pernier. However, the principals described will be relevant to other compost structures.

<u>Phase 1, Step 1: Preparing the compost structure</u>
(Reference photos: K201)

The compost structure is lined with 150 mm/6" of bagas[2]. This lining is in the 4 sides of the compost structure and on the concrete floor, creating a 'bagas carpet'. This preparation is necessary to ensure that there is a layer of organic material around the edges of the pile which will insulate the compost within the bin so that the entire pile can reach thermophilic conditions.

<u>Phase 1, Step 2: Building the compost pile</u>
(Reference photos: K202, K203)

The 15 gallon poop drums are emptied onto the 'bagas carpet' one by one. After emptying three poop drums, a single drum of bagas is emptied onto the poop, ensuring the entire area of poop is covered. The ratio of 3:1[3] is important; using too much bagas will dry out the compost pile; and using too little bagas will not cover the poop and will attract flies and create odour. The process of emptying drums and covering with bagas continues until all the drums are emptied, or the compost structure is full. Step 2 may take days, weeks, months or even years depending upon the quantity of poop received at the compost site.

<u>Phase 1, Step 3: Finishing the compost pile</u>
(Reference photos: K204a, K204b)

The compost structure should be filled to the top of the walls with the 3:1 ratio

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[2] Bagas is the tried and tested carbon source for SOIL's composting operations in Haiti, other carbon sources are available and may be used. SOIL also tried using wood chips, but they did not decompose rapidly enough by thermophilic composting.

[3] The ration 3:1 is an empirical ratio, based on SOIL's experience with the Pernier compost structure.

of poop to bagas. Finally, a 6-inch ‘bagas lid’ should cover the entire area, creating a mound on top. With gravity, the compost pile will very quickly compact and the top level of the compost pile will decrease. The compost pile represents a very attractive meal for flies, rodents, chickens and other pests. The bagas lid will deter flies, but additional security is required against other pests. The entire surface area of the compost pile is covered using chicken wire once the compost pile is finished *AND ALSO* after each drum emptying operation.

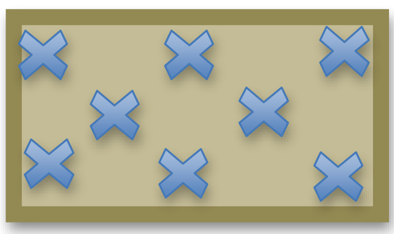
Phase 1, Step 4: Managing the leachate, or ‘jikaka’
(Reference photos: K204c)

Poop can be very wet. Even when mixed with bagas in the SOIL UD toilets, the poop arriving at the compost site can often be more liquid than solid. As such, after each incremental filling of the compost structure (step 2), and after the final filling of the compost structure (step 3), there will be a quantity of leachate, or ‘jikaka’ coming from the drains, that requires management. The compost structure at Pernier collects jikaka from two compost compartments in a 15 gallon drum. When the drum is half full, the compost site supervisor empties it using a smaller bucket, and empties this bucket into *the center* of the compost pile.

The quantity of jikaka varies greatly, and so does its management. The compost supervisor must closely monitor the rate of filling of each 15 gallon drum and be ready to empty them when they are half full. Having a well-defined ‘emptying schedule’ with times of emptying may be necessary for large compost sites[4].

Covering the compost pile with a roof is essential or the quantity of jikaka coming out of the leachate drains will be too great to manage.

Phase 1, Step 5: Compost pile monitoring
(Reference photos: K204d)

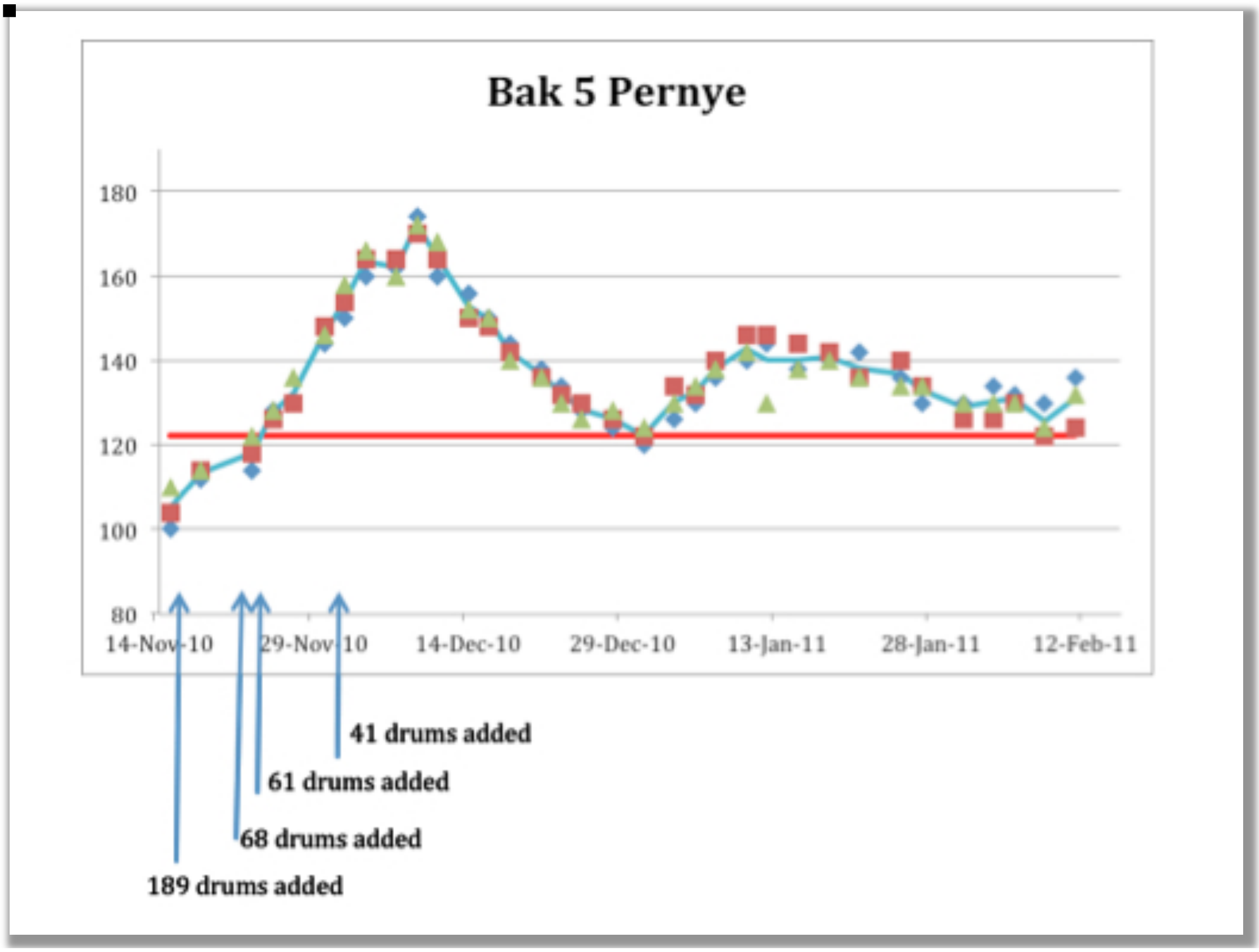


The compost pile must be monitored for temperature using a compost pile thermometer to ensure that thermophilic composting is taking place. The three compost pile objectives: oxygen, humidity, and C/N ratio, can also be monitored using more advanced tools, but these are not

[4] The SOIL compost site in Port-au-Prince empties approximately 25gallons of jikaka per compost compartment per day at the beginning of phase 1 composting, and 1gallon jikaka per compost compartment per day at the end of phase 1 composting.

currently monitored by SOIL in Haiti. It is important to measure temperatures throughout the compost pile. SOIL measures temperature in eight locations in each compost compartment, in the positions indicated by crosses in the adjacent diagram.

Temperature monitoring for each compost compartment occurs every two days, and occurs in the morning before the daily maximum ambient temperature. Temperature is logged in a notebook onsite, and transferred to a computer at the office where the information can be displayed graphically.



Phase 2 Composting or Windrow Composting

<u>Phase 2, Step 1: Emptying the compost structure</u>
(Reference photos: K212, K213a,b,c)

The SOIL compost structure at Pernier has been designed so that each of the six compost compartments can be individually accessed for compost removal at the end of phase 1 composting. Accessing the compost pile requires:

- Detaching the front pallet walls in order to access the compost.
- Detaching the internal walls during the compost removal process.

With skilled labour and careful supervision, it should be possible to remove the compost without further damage to the compost structure.

At the end of phase 1 composting, once most of the air and liquid has left the compost pile and the solid matter has been compressed by gravity, the volume reduction of the compost pile is 40%-80% (Jenkins, 2005). This compaction means that the walls no longer support the compost pile and the pile will not slump once the pallet walls are removed.

The degree of compaction means that the compost pile is now much more dense than before, and very difficult to move. Moving the pile with manual labour takes a long time, a lot of effort and can be very expensive. Wherever possible, a mechanical excavator should be employed to remove the compost from the compost structure.

Phase 2, Step 2: Forming the windrows (size, orientation)
(Reference photos: K214a,b,c, K215, K216)

The compost is removed from the compost structure mechanically and stored in windrows. Ideally, the windrows will be located on the same compost site, and not too far from the compost structure. The size of the windrows will depend upon the area of land available, and the quantity of Phase 2 compost, but generally windrows are longer than they are wide, and less than 1.5m tall.

SOIL windrow dimensions are: Length = 50m. Width = 4m. Height = 1.30m.

It should be noted that at the time of release of this first edition, SOIL has limited experience of windrow composting. But here are some general considerations that we have learned from our own research:

Turning

Turning the windrows is generally recommended to accelerate the decomposition process. Turning redistributes oxygen, moisture, and heat, in order to create a homogenous compost pile. However; turning is expensive in terms of labour or machinery; and requires additional land space. Turning is not necessary if a Phase 2 composting time of six months is accepted. If faster decomposition is required, say four months, then turning would prove beneficial.

Storage, rainwater protection and drainage

Because the composting windrows no longer contain pathogens, they can be stored on bare earth and do not pose a public health risk. The windrows will benefit from light showers, but heavy downpours will wash away the nutrients and lessen the agricultural potential of the compost. There are many options available to prevent the windrows from suffering heavy nutrient loss but the most relevant options for Haiti are presented here:

1. Cover the windrows with plastic sheeting and provide drainage channels at the base of the windrows.
2. Do NOT cover the windrows with plastic sheeting or provide drainage channels at the base of the windrows. Instead make the drainage channels run to a basin filled with bagas. The bagas will absorb the run-off from the windrows and is later returned to the windrows.

SOIL uses option 2, above, in order to avoid the labour intensive activity of covering and uncovering plastic sheeting.

Access

Allowance must be made to access the windrows in order to form them at the beginning of the Phase 2 period, and to remove the compost at the end of the Phase 2 period. The access requirements will be determined by the volume of compost generated and the machinery used for transporting the compost.

Drum Operations

Offloading & stocking of poop drums
(Reference photos: K205a)

The poop drums are heavy. They can be up to 50 kg if they contain a high volume of urine. As such, the poop drums should be offloaded from the drum truck and stored adjacent to the location where they will be emptied, to avoid time-consuming double-handling of the poop drums prior to emptying them in the compost structure. It is advisable that 15 gallon poop drums are ALWAYS lifted by 2 people; never lifted alone.

Positioning the drums inside the compost structure
(Reference photos: K205b)

Stairs are provided at the compost site to lift the poop drums up and over the walls of the compost structure. The drums are positioned inside the structure prior to being dumped.

Emptying/dumping the poop drums
(Reference photos: K202)

Poop drums are emptied and the compost pile is built as described on the section on 'Phase 1' composting. To upend and empty the poop drums requires a sudden, vigorous action which may strain the backs of the compost operatives if they do not warm up and lift properly.

Drum dumping should be the only activity at the compost site which creates a smell. If the compost site has neighbours, and a strong wind to carry the smell to these neighbours, then the compost operation will not be popular with the local community. Community acceptance is essential for the good function of the compost site. For this reason, drum dumping occurs in the early morning hours, as soon as there is enough light to operate safely.

Another reason to empty the drums in the early morning is so that the stigma associated with handling poop does not manifest itself in the form of offended neighbours, or abusive passers-by.

Cleaning and disinfecting the poop drums and lids
(Reference photos: K206a,b. K207a,b,c. K208, K209)

Immediately after dumping, the poop drums and their lids are moved to a location adjacent to the drum cleaning zone, then cleaned and disinfected. The cleaning is very thorough, ensuring that:

- The drums are completely safe to return to the toilet operators who will be handling the drums at the toilet sites.
- The drums are visibly clean so that they are accepted by the toilet operators.

The drums and drum lids are cleaned according to the 5-step cleaning cycle:

Step	Activity	Equipment
Step 1	Clean drum	Bagas 'sponge'
Step 2	Rinse drum	Running water, ideally pressurised
Step 3	Scrub drum	Scrubbing brush, liquid soap
Step 4	Rinse drum	Running water, ideally pressurised

Step 5	Disinfect drum	Chlorine sprayer, 1% chlorine solution

The cleaning cycle occurs entirely on a special drum cleaning zone which also doubles as a carwash. The drum cleaning zone comprises:

- A sloping concrete slab with a central drainage channel and low block walls.
- A soak away into which drains ALL the liquid from the drum cleaning.
- A solids trap to catch all of the solid matter from the drum cleaning and stop it from entering and blocking the soak away (the solids trap requires regular cleaning or it will not function).
- An adjacent water source[5].
- A roof to protect the drum cleaning operation from the sun and rain.

Water consumption during drum cleaning can be extremely high and should be monitored. Ultimately, water consumption will depend upon the availability of water: a drum cleaning zone with a tap from the local water supply network will use far more water than if the water is required to be trucked in from afar.

Water consumption for cleaning drums at the SOIL compost site is:
2 gallons per 15 gallon drum.

The drum cleaning zone is a controlled space meant for drum cleaning, it is not meant for storage of dirty or clean drums. As soon as the drums are cleaned, they should be removed from the drum cleaning zone. It is necessary to control this by having a 'maximum drum rule' which sets the upper limit for the number of drums on the drum cleaning zone. At the SOIL compost site this maximum drum rule is: 20 drums.

<u>Onsite drum storage and management</u>
(Reference photos: K210, K211)

Up to 300 drums *daily* can be received, emptied, cleaned and stored at the SOIL compost site. The developed site does not have a large amount of free space and careful consideration is needed when storing the dirty drums, storing the clean drums, and moving the drums around the site.

After drum dumping the dirty drums are stored adjacent to the drum washing zone, ready for cleaning.

[5] The SOIL compost site has two 1000 gallon water tanks immediately adjacent to the drum washing zone.

After the cleaning cycle, the drums and drum lids are stored in a controlled protected area away from; the drum cleaning zone; the compost structures; and away from any risk of re-contamination. The storage area should be in the shade, as the plastic drums and plastic drum lids will distort and/or crack with excessive sun exposure.

General Compost Site Facilities

In addition to the facilities described above for Phase 1 and Phase 2 composting, and drum operations, the following site facilities should be included:

Site security and site access

A humanure compost site should be secure, and unauthorized access by pedestrians, vehicles, or stray animals should not be permitted. The entire compost site should be closed off with a fence, or wall, that blocks all forms of unauthorized access. Access points for pedestrians or vehicles should be blocked with a gate.

Signage

Signs should be present throughout the compost site to enforce site rules for both staff and visitors. Signs used in the SOIL compost site are shown in the table below:

Sign	Location of sign
'Respect the 20 drum rule!'	On drum cleaning zone
"Attention: No unauthorized access without permission of the site supervisor!'	At site entry
'Attention: All vehicles leaving site must disinfect tires!'	At site exit for vehicles
'Attention: All pedestrians leaving site must disinfect shoes and wash hands!'	At site exit for pedestrians
'Attention: No food to be consumed onsite!'	Multiple locations
'Attention: No smoking onsite!'	Multiple locations

Storage and control of materials (not including poop drums)

An onsite depot is required to store cleaning materials, miscellaneous construction materials, items of equipment, and other items. The depot should be secured and controlled by the site supervisor.

Roads and drainage

The SOIL compost site receives a fair amount of traffic: pickups, water trucks, construction vehicles, as well as the thrice-weekly visit of the poop drum truck. There is, therefore, a well-compacted gravel road on the site. The site development at the SOIL compost site has stripped the land of all of its vegetation except for large mango trees. The rainwater which previously drained into the ground is now carried offsite by a drainage ditch. Road and drainage are necessary for a compost site if it is to be successfully managed during a Caribbean rainy season.

Water supply

The greatest demand for water at the compost site is for drum cleaning. However, allowance should also be made for other water needs such as:

- Washing clothes and washing equipment
- Washing down vehicles on the carwash
- Gardening

The water need at the compost site should be properly assessed before planning any water supply or water storage infrastructure.

Staff facilities

Work on the compost site is hard (involves heavy manual labour) and stigmatized. Every effort should be taken to provide comfortable staff facilities for the compost staff, including but not limited to:

- An individual changing room with a door for each staff member
- A shower
- A toilet
- A hand washing point
- A sanitary zone with table and chairs for resting and eating
- Potable drinking water

Hygiene infrastructure
(Reference photos: K217, K218a,b, K219a,b,c)

The SOIL compost site has the following hygiene infrastructure:

- A chlorine footbath (using 0.2% chlorine) for disinfecting the soles of shoes of all pedestrians leaving the site.
- A chlorine spray station with chlorine sprayer (using 0.2% chlorine), for disinfecting the surface of tires of vehicles leaving the site.
- A hand washing point (using 0.05% chlorine) at the site exit.
- A carwash (which doubles as a drum cleaning zone), with a motor-driven pressure sprayer, for spraying down and disinfecting vehicles which have been carrying the poop drums.
- Waste bins positioned around the site to collect all burnable waste, and a designated location to burn the waste.
- A chlorine reservoir containing 1.0% chlorine solution. This solution is prepared each Monday morning by the site supervisor using 70% HTH.

Bagas storage area

A bagas storage area is simply a designated area for the storage of bagas used for Phase 1 composting. The bagas store should be located close to the compost structure(s) for ease of access by the compost operatives, and close to the main access road running though the site for convenient bagas delivery.

Health, Safety and the Environment

Site zoning

No unauthorized entry is permitted onto the SOIL compost site, which is divided into two zones:

- Clean zone, containing depot and staff facilities
- Dirty zone, for all composting operations and drum operations

A fence separates the two zones and all hygiene infrastructure is located between the two zones so that there is no contamination of the clean zone by pollutants from the dirty zone.

Protection of soil, groundwater, and surfacewater

All SOIL compost site structures are designed so as to reduce or eliminate the risk of contamination of soil, groundwater and surface water. The most effective environmental protective measure is to choose a compost site location away from surface water sources and high above the groundwater table.

The major risk of contamination on the compost site is accidental spilling of ji kaka. If this does happen during operations, the spill can be absorbed using bagas, which can then be returned to the most recent compost pile.

Protection of staff

The risk of exposure of faecal pathogens to compost staff is even greater than the exposure of faecal pathogens to the soil, groundwater and surface water. Therefore, organizations operating compost sites have a duty to care for their employees and must provide, as a minimum, the following safety measures:

- Training and information on the risks associated with handling faecal matter.
- Training and information on the risks associated with heavy lifting and training on correct lifting techniques.
- Vaccinations for Hepatitis A, Hepatitis B, and Tetanus.
- Personal Protective Equipment (PPE) including: 2 sets of overalls, gloves, face masks.

Protection of community members around the compost site

If all mitigation measures are properly implemented, then the risks associated with humanure composting remain within the confines of the compost site. Likewise, if the drum dumping activity is diplomatically scheduled, then the smells generated by drum dumping remain undetected by those outside the compost site.

However, there is often some degree of objection to humanure composting by community members adjacent to the site, or even by community members from further afield. The host community of the compost site should be informed of the composting operation and to the wider activities and objectives of ecological sanitation. Wherever possible, the host community should be involved in the composting operation itself, and be invited to inspect the site and observe the operation. Efforts should be made to ensure that the local community benefits as much as possible from the initiative, either through provision of toilets or compost or both.

Technical Specification for Offsite Composting Facility

Section Objectives

1. To provide the reader with a technical specification, to be used in conjunction with the drawings and photos in this guide, to construct a SOIL structure developed at Pernier.
2. To provide the reader with some background to the development of the SOIL compost structures, by including as footnotes, information on previous designs and lessons learned.
3. To provide the reader with a part of the SOIL Guide to EcoSan, which if studied completely, provides a complete package of information and instructions on how to implement a successful EcoSan project

Technical Specification

This technical specification is for the 10th version (Mk.X) of compost structure used by SOIL in Haiti. With each filling and emptying of the compost structure, we have learned new lessons and improved upon the design of the structure. We expect this evolution to continue. With the current projected turnover of compost at our site in Port-au-Prince, we expect to arrive at the Mk.XV within a year of publishing this first edition of The SOIL Guide.

Photos K1 to K10 in the compost photos document show the evolution of the SOIL compost structure, from Mk.I to Mk.X.

Ref	Specification	Reference Documents.
4.1	CONCRETE BASE, BLOCK WALLS & DRAINAGE	
4.1.1	CONCRETE BASE	
	The Mk.X SOIL compost structure uses a concrete base, low level block walls, and a drainage channel: 1. To contain all liquids and solids within the compost pile and not waste any material. 2. To protect the environment (i.e. soil, surface water, and groundwater) from pollution.	PHOTO K101

Ref	Specification	Reference Documents.
	Concrete is an ideal material to use as a base: 1. Durability: A well-formed and well-cured concrete base has a design life of 10 years without requiring significant repairs. Importantly, this means that no remedial works are required after each turnover of compost. 2. Forming: The base can be sloped towards the leachate drain, with a controlled gradient.	
	The concrete base must bear the load of the compost as well as additional loads from compost operatives working in the structure and full 15 gallon poop drums resting on the base. The required load bearing capacity of the concrete base demands a concrete thickness of at least 100mm.	
	A gravel:sand:cement mix of 4:2:1 is used for the concrete base.	
	The gradient of the concrete base must allow for drainage of liquids to the leachate drain. The Mk.X has a slope of 75mm in 6000mm, or 1.25%, or 1:80[1]. Therefore, the thickness of the concrete base of the Mk.X is 175mm sloping to 100mm.	Dwg. K1
	A high quality finish ('cirage') to the concrete surface is required so that it remains impermeable over its design life. A sand:cement mix of 2:1 is used for the	PHOTO K102

[1] Earlier models had a shallower gradient and were both difficult to form and did not drain the leachate successfully.

Ref	Specification	Reference Documents.
	cirage. The sand used must be fine sand, sieved.	
	The wooden columns that provide the structural strength for the external and internal walls, as well as the roof supports, are cast into the concrete base. Prior to casting the columns, they are protected by the application of a triple coat of protective wood paint.	Dwg. K1 PHOTO K103
4.1.2	BLOCK WALLS	
	The poop / cover material mix that is dumped into the compost structure has a physical characteristic like a liquid; rather like a congealed wet cereal. This physical characteristic affects the design of the structural elements, the drainage; and determines the manageable surface area for the compost pile.	
	The Mk.X is compartmentalized into 6 units by the low level block walls. Compartmentalisation is necessary for the operability of the Mk.X.[2] Each of the 6 units in the Mk.X has a surface area of 12.5m^2 (5m * 2.5m). This is a manageable area for building a humanure compost pile.	Dwg.K2 PHOTO K104
	The block walls at base level are an essential part of the drainage system of the compost piles. They contain the leachate and direct it to the drainpipe at the corner of the compost structure. The block walls must be mounted atop the concrete base with a very good seal.	PHOTO K105 PHOTO K106 PHOTO K107

[2] Earlier models that were not compartmentalised and had large areas made operations (dumping of drums and building of the compost pile) very difficult.

Ref	Specification	Reference Documents.
	If the seal is not fit for purpose then the leachate will leak between the blocks and the concrete base. A good seal is achieved by: 1. Scabbling the surface of the concrete base as it begins to cure, thus providing a rough surface on which to mount the blocks, and a greater bond between the concrete base and the mortar for the blocks. 2. Using a sand:cement mix of 2:1 for the mortar, and using a large volume of this mortar on the insides of the block walls. The blocks are sand-cement permeable blocks. The entire exposed surface area of the blocks requires rendering after mounting on the mortar.	
	After mounting the blocks on the concrete slab, a triangular area of benching (1m by 2.5m) is formed which directs the ji kaka towards the leachate drain. The benching requires the same sand:cement mix as the cirage on the concrete base, 2:1.	Dwg. K2 Dwg. K6
4.1.3	LEACHATE DRAIN	
	A short length (400mm) of 4“ PVC pipe in the corner of each compost compartment drains the leachate from each compost pile. All the ji kaka from the compost pile will concentrate at this point and so it is here that the structure is most likely to leak. Very careful supervision is needed when installing the drainpipe and forming the mortar around it.	Dwg.K3 Dwg.K7 PHOTO K110
	A fine aluminium mesh fit over the end of the 4” PVC pipe on the *inside* of the compost structure prevents solids from leaving the compost pile in the leachate stream.	Dwg.K7

Ref	Specification	Reference Documents.
	The leachate is very nutrient rich and should be returned to the top of the compost pile after it has drained out. A 15 gallon drum cast into the concrete base collects the leachate from two compartments and stores it until it is returned to the compost pile by the compost site supervisor.	Dwg.K7 PHOTO K108 PHOTO K109
4.2	WALLS	
4.2.1	EXTERIOR WALLS	
	The exterior walls are constructed from pallets (standard pallet dimensions are 1,20m wide by 1,00m high) braced with a single band of lattes around the middle, and with 400mm long segments of lattes at the top and bottom of each pallet junction.	Dwg.K3, K4, K5, K6. PHOTO K111
	The compost pile generates significant horizontal, outward pressure on the exterior walls. This pressure can easily distort the exterior walls if they are not effectively braced using the lateral support provided by the interior walls.	
	The inside of the exterior walls are lined with chicken wire.	
4.2.2	INTERIOR WALLS	
	Interior walls (not considering the blocks at base level) are constructed using: 1. Wooden slats[3] or ‘lattes’ (to provide lateral support to the exterior walls and to support the chicken wire). 2. Chicken wire (to hold in place the bagas). 3. Bagas infill.	Dwg.K6 PHOTO K112
	Interior walls are supported by the low level	

[3] Earlier models used ‘planches’ instead of ‘lattes’ to provide more structural strength. However, the strength in the ‘lattes’ is sufficient for the purpose intended and ‘lattes’ are less expensive than ‘planches’.

Ref	Specification	Reference Documents.
	block wall, and as such, the width of the interior walls matches the width of these blocks, i.e. 15cm.	
	A much more durable (but also more expensive) material to use instead of chicken wire is a steel grill, 'grille metallique'.	
	The interior walls distort (degree of distortion will depend upon quality of construction) with the pressure exerted by the growing compost pile. For the interior walls to be effective holders of bagas, the walls should be filled with bagas BEFORE the compost structure is commissioned for use, i.e. before drum dumping begins.	PHOTO K113
4.3	ROOF	
	The main objective of the roof is to protect the compost pile from rain. It should be a permanent structure, high enough to provide aeration to the surface of the pile and to not obstruct composting operations, yet low enough to minimize wind-generated negative air pressures which would cause roof damage.	
	The Mk.X roof is constructed using a frame of wooden lattes, covered by toles. The roof is mounted on the 21 no. wooden 2*4 columns.	Dwg.K5 PHOTO K114, K115
	The cheapest and simplest possible roof structure; a plastic tarpaulin covering the compost pile, is not recommended because: 1. The tarp does not allow for aeration of the top surface of the compost pile. 2. The tarp is difficult to support and will yield under the weight of rainwater, making it very difficult to channel rainwater off its surface. 3. The tarp is removable according to the	PHOTO K6c

Ref	Specification	Reference Documents.
	weather and the compost operations. I.e. ON during rain and during nights and OFF during dry spells in the daytime. This is a labour intensive operation that requires supervision.	
4.4	ACCESS BY COMPOST OPERATIVES	
	A 50cm wide walkway around the front and sides of the compost structure facilitates safe composting operations by providing a safe platform from which to enter inside the compost structure, or to inspect the compost piles from the outside.	Dwg. K1 PHOTO K116
4.5	MAINTENANCE	
	The SOIL Mk.X compost structure has not been operated for a sufficient length of time for to give a comprehensive and thorough schedule of maintenance requirements. However, it can be stated that up until the date of issue of this edition of The Guide, the most common failure of the structure is leaking of ji kaka though the block walls, and therefore the most common maintenance requirement is cement rendering of patches of the block walls which are leaking.	PHOTO K117, K118, K119
	It is anticipated that with each emptying of the compost structure, the following maintenance will be required before the structure can be re-filled: • Rendering of the 'cirage' on the block walls. • Realignment of the exterior pallet walls. • Tightening of the wooden slats which support the internal and external walls. • Replacement of the chicken wire used for the internal wall.	

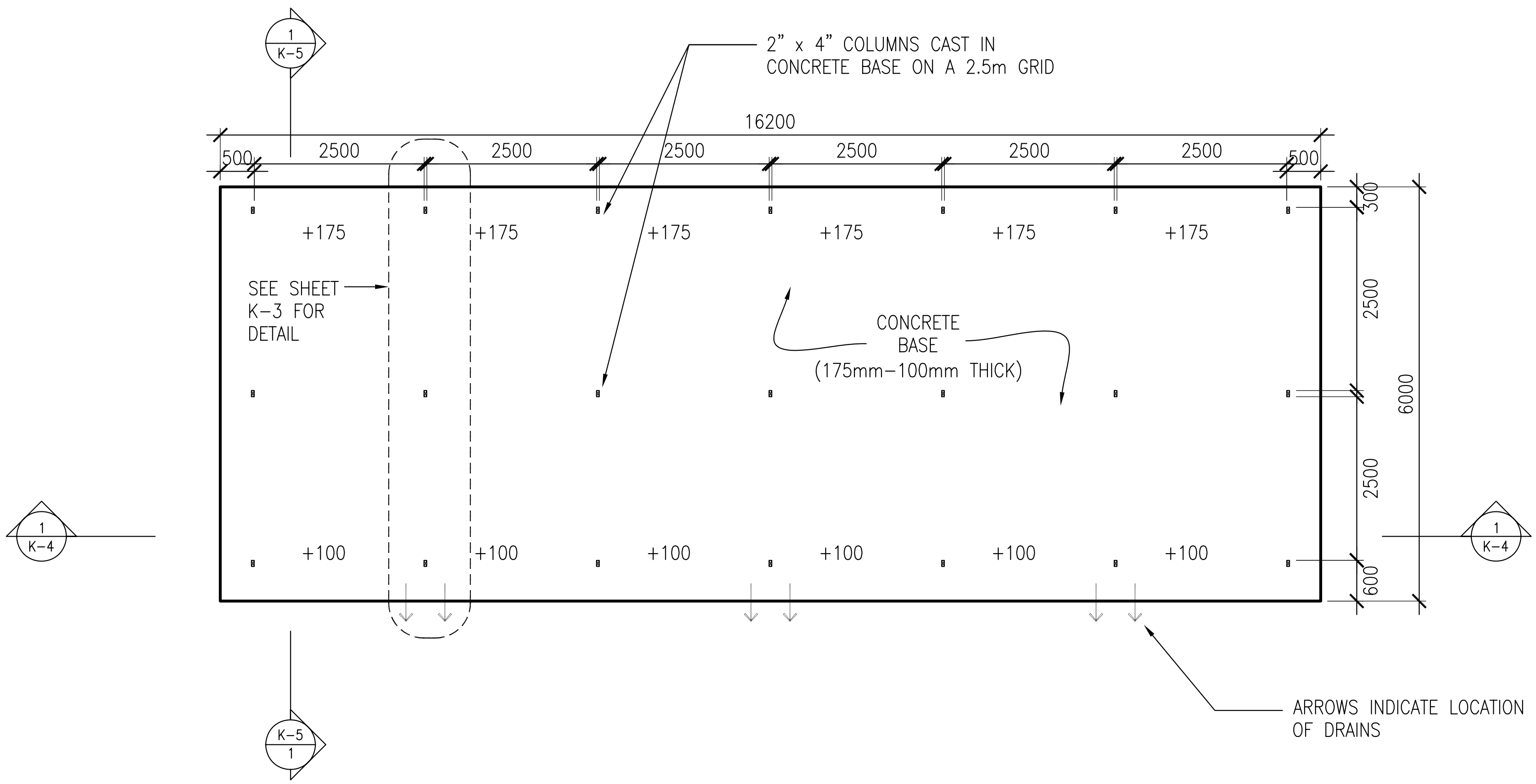
Ref	Specification	Reference Documents.
	The above list is not exhaustive and there may well be other maintenance requirements which will be a function of: • The quality and durability of the materials used. • The quality of workmanship during construction. • The care taken when operating the structure; filling and emptying with compost.	

List of Drawings: SOIL Compost Structure Mk.X

Drawing no.	Drawing Title	Drawing Creation Date	Revision
K1	Plan on concrete base	30th Jan. 2011	-
K2	Plan on block walls	30th Jan. 2011	-
K3	Walls detail	30th Jan. 2011	-
K4	Long section	30th Jan. 2011	-
K5	Short section	30th Jan. 2011	-
K6	Zoom on long section	30th Jan. 2011	-
K7	Leachate drain detail	30th Jan. 2011	-

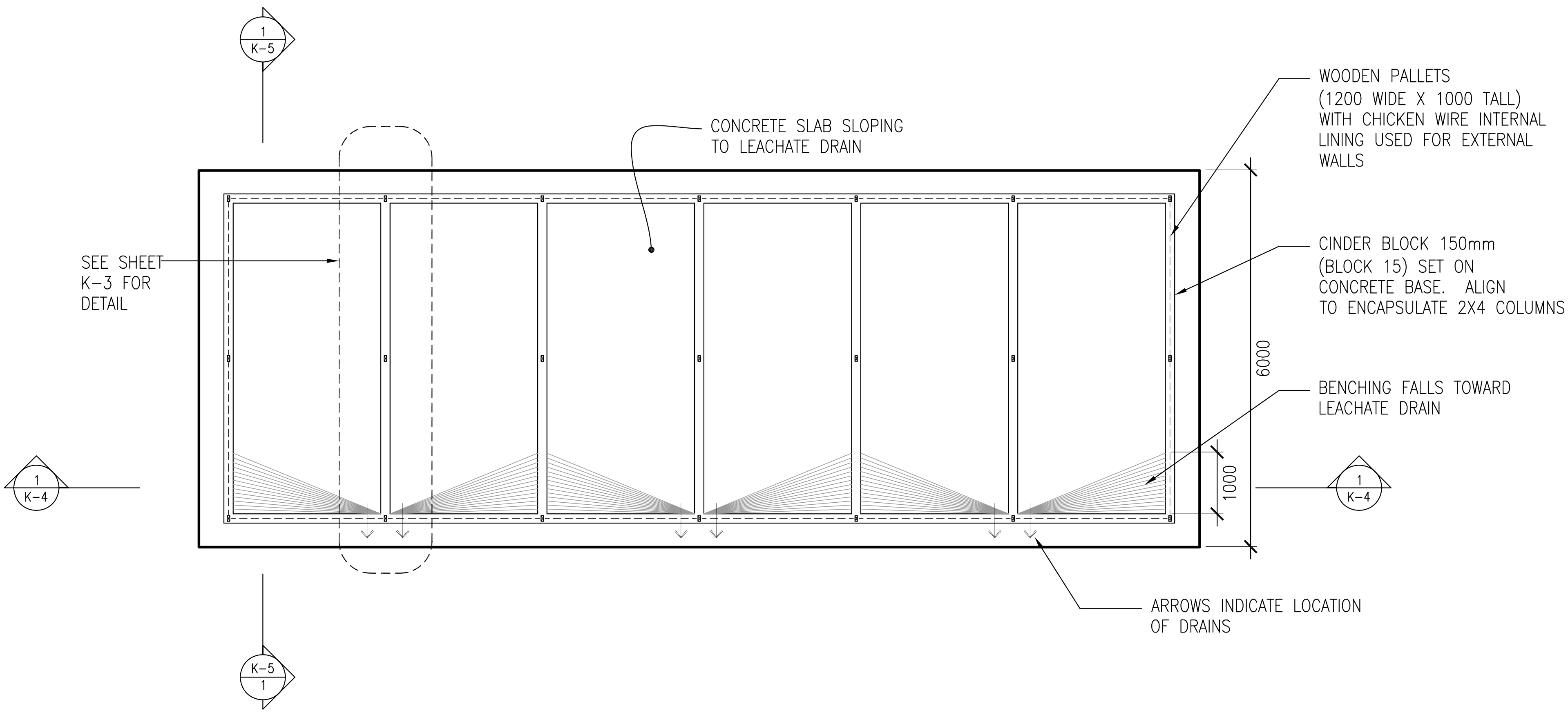
Notes on Drawings:

1. All dimensions are given in mm, unless otherwise stated.



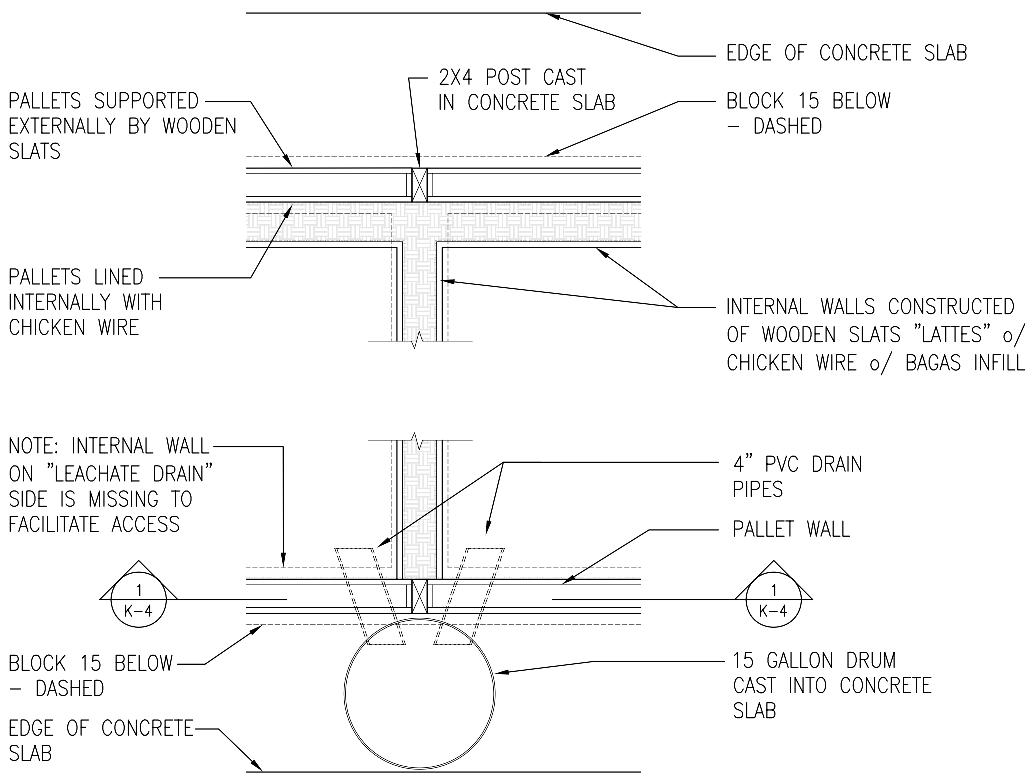
Travail/ Project	Révisions/ Revisions	Date	no.	Drawing Creation date	Project #	Drawing #
SOIL Compost Structure				30th Jan. 2011		K-1
				Échelle/ Scale: 1:100		
Plan on Concrete Base				Ingénieur de conception/ Design Engineer: Anthony Kilbride, SOIL		
				Établi/ Drawn: Hill Pierce, Noreen Shinohara, Architecture for Humanity		

SOIL — SUSTAINABLE ORGANIC INTEGRATED LIVELIHOODS

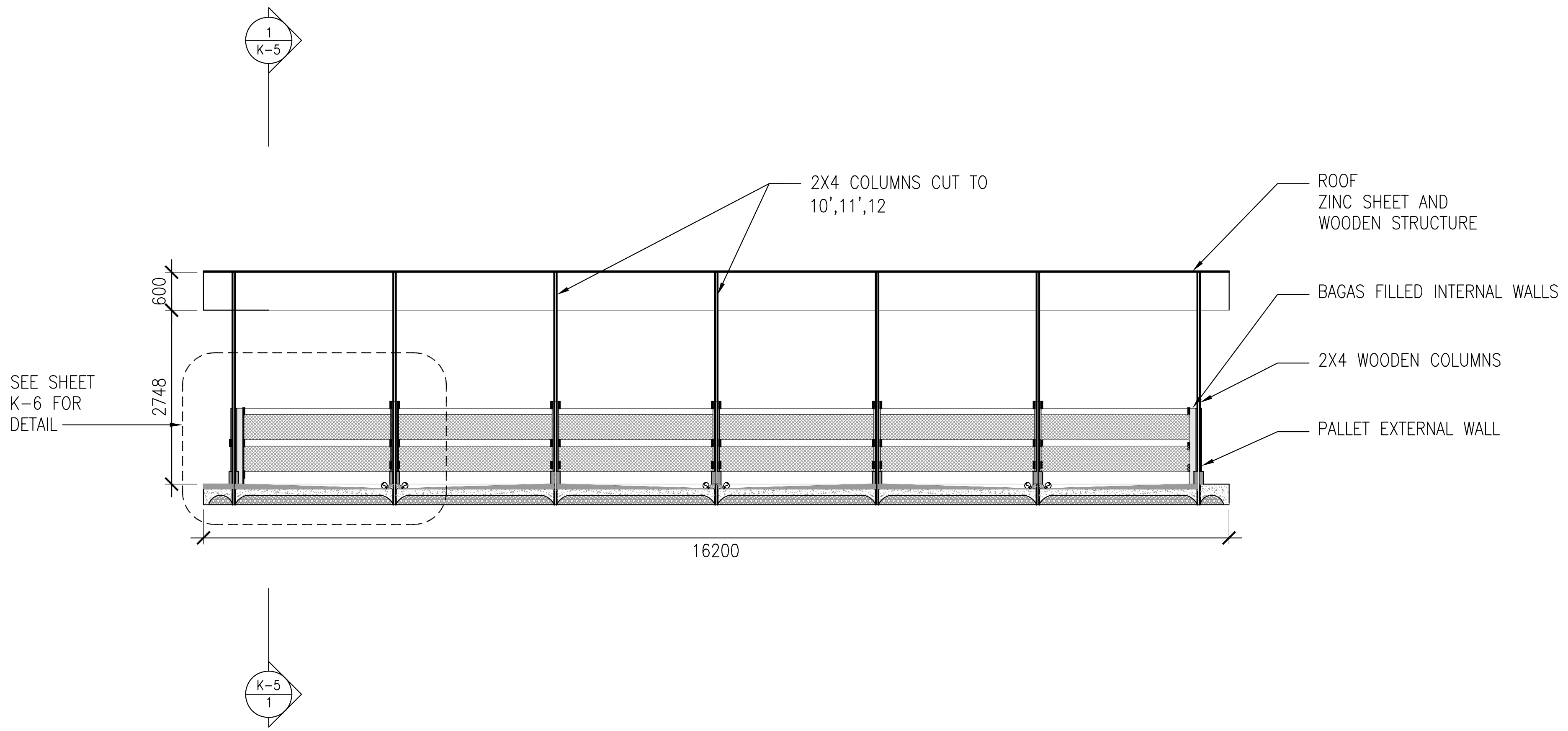


Travail/ Project	Révisions/ Revisions	Date	no.	Drawing Creation date	Project #	Drawing #
SOIL Compost Structure				30th Jan. 2011		K-2
				Échelle/ Scale 1:100		
Plan on Block Walls				Ingénieur de conception/ Design Engineer Anthony Kilbride, SOIL		
				Établi/ Drawn Hill Pierce, Noreen Shinohara, Architecture for Humanity		

SUSTAINABLE ORGANIC INTEGRATED LIVELIHOODS

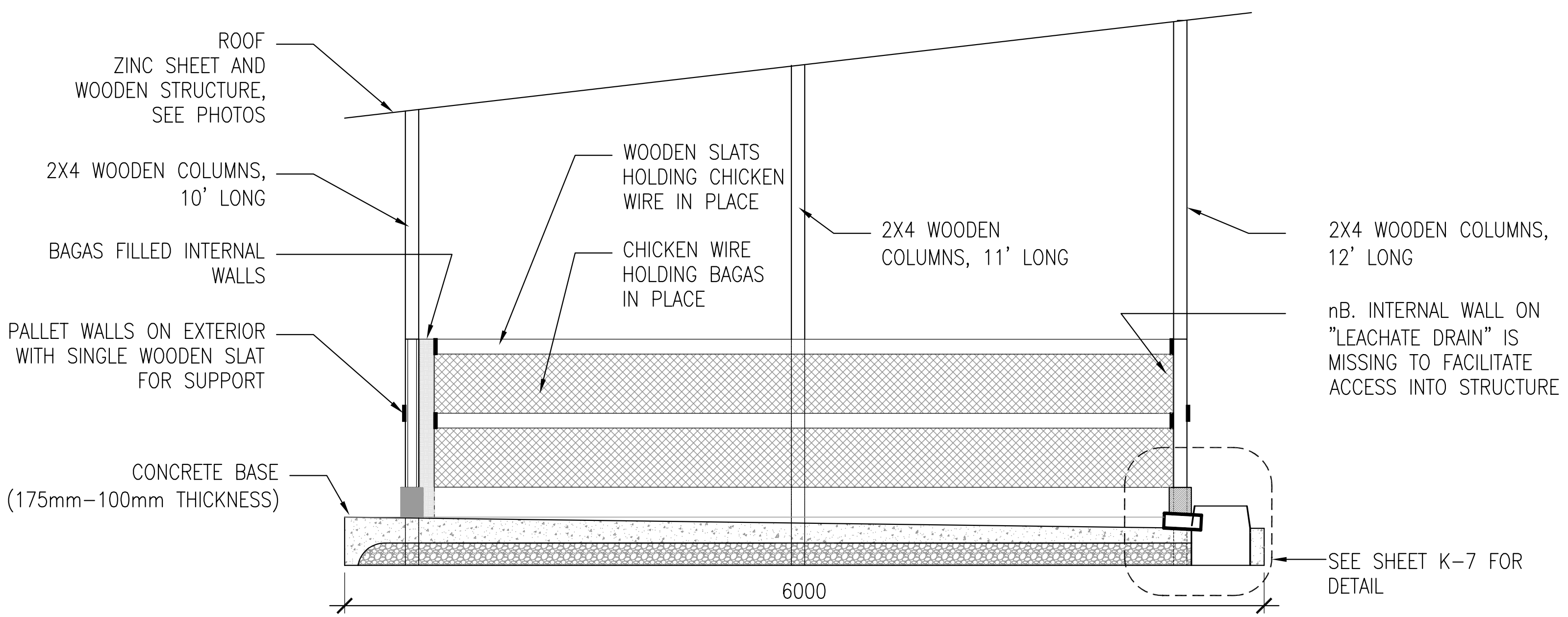


Travail/ Project SOIL Compost Structure	Révisions/ Revisions	Date	no.	Drawing Creation date 30th Jan. 2011	Project #	Drawing # K-3	
				Échelle/ Scale 1:20			
Planview Wall Detail				Ingénieur de conception/ Design Engineer Anthony Kilbride, SOIL			
				Établi/ Drawn Hill Pierce, Noreen Shinohara, Architecture for Humanity			

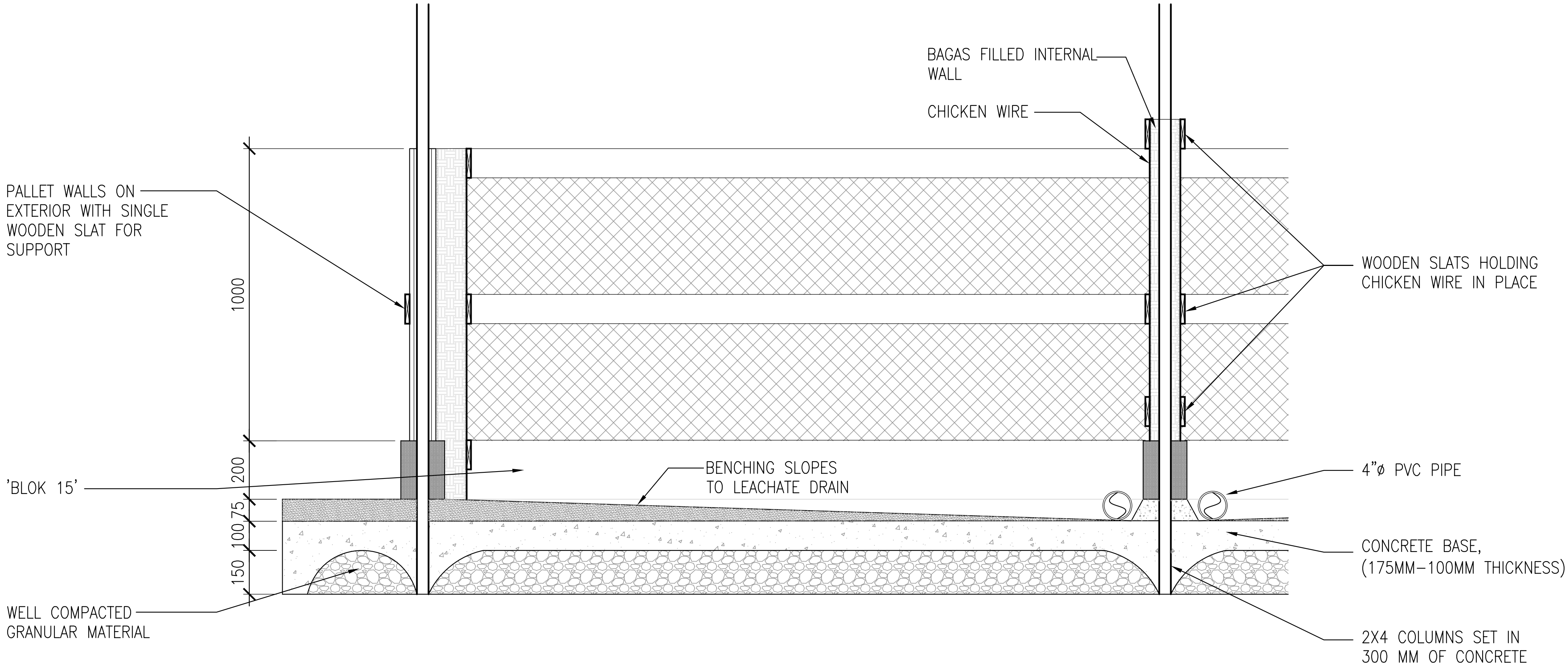


Travail/ Project SOIL Compost Structure	Révisions/ Revisions	Date	no.	Drawing Creation date 30th Jan. 2011 Échelle/ Scale 1:100	Project #	Drawing # K-4
Long Section				Ingénieur de conception/ Design Engineer Anthony Kilbride, SOIL Établi/ Drawn Hill Pierce, Noreen Shinohara, Architecture for Humanity		

SUSTAINABLE ORGANIC INTEGRATED LIVELIHOODS

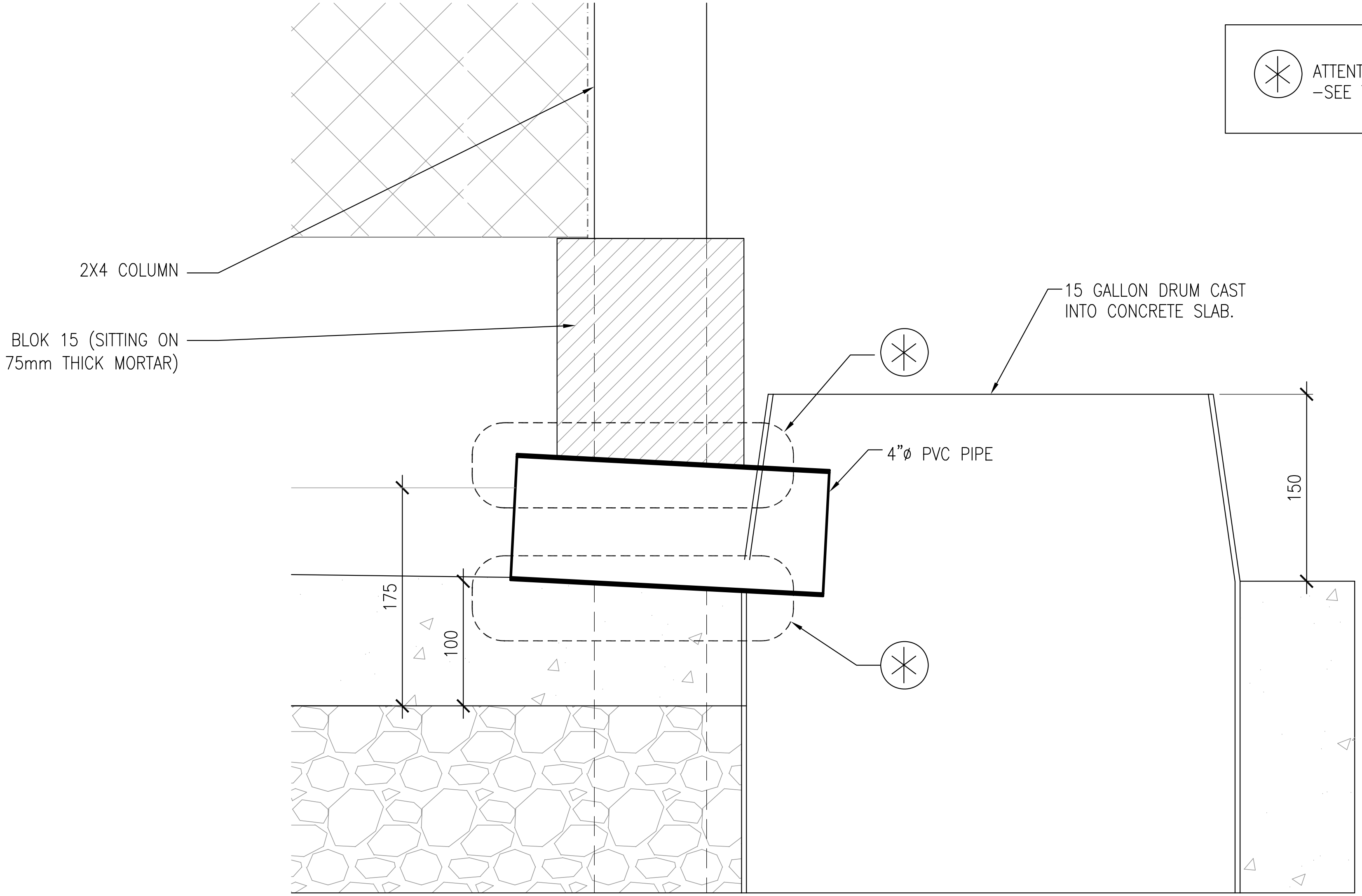


Travail/ Project	Révisions/ Revisions	Date	no.	Drawing Creation date	Project #	Drawing #
SOIL Compost Structure				30th Jan. 2011		K-5
				Échelle/ Scale: 1:50		
Short Section				Ingénieur de conception/ Design Engineer: Anthony Kilbride, SOIL		
				Établi/ Drawn: Hill Pierce, Noreen Shinohara, Architecture for Humanity		



Travail/ Project	Révisions/ Revisions	Date	no.	Drawing Creation date	Project #	Drawing #
SOIL Compost Structure				30th Jan. 2011		K-6
				Échelle/ Scale: 1:20		
Zoom on Long Section				Ingénieur de conception/ Design Engineer: Anthony Kilbride, SOIL		
				Établi/ Drawn: Hill Pierce, Noreen Shinohara, Architecture for Humanity		

SOIL
SUSTAINABLE ORGANIC INTEGRATED LIVELIHOODS



Travail/ Project SOIL Compost Structure	Révisions/ Revisions	Date	no.	Drawing Creation date 30th Jan. 2011		Project #	Drawing # K-7
				Échelle/ Scale 1:5			
Leachate Drain Detail				Ingénieur de conception/ Design Engineer Anthony Kilbride, SOIL			
				Établi/ Drawn Hill Pierce, Noreen Shinohara, Architecture for Humanity			

SUSTAINABLE ORGANIC INTEGRATED LIVELIHOODS

Compost Bill of Quantities

Activity schedule and Bill of Quantities for SOIL Compost Structure Mk.X

Notes:

Activity schedule for labour costs

1, Labour costs per activity are not provided and should be negotiated with a competent contractor

Item (en KREYOL)	Item (en Anglais :)	Length	Width	Height/Depth	Total	Unit	Unit cost (H$$)	Total cost (H$$)
Remblai	Granular foundation material	16.2	6	0.2	19.44	m³		0
Beton	Concreting	16.2	6	0.13	12.636	m³		0
Cirage	Floating concrete	16.2	6	1	97.2	m²		0
Coffrage, longuer	Formwork, length	16.2	2	1	32.4	m		0
Coffrage, largeur	Formwork, width	6	2	1	12	m		0
Blok 15	Setting 15cm cinder blocks	162.5	1	1	162.5	Unit		0
Crepis Blok	Rendering blocks	65	0.55	1	35.75	m²		0
Monter poteau	Installing columns	21	1	1	21	Unit		0
Placement Panno interieur (latte + twil)	Constructing Walls: Interior	90	1	1	90	m		0
Placement Palet Panno exterieur (Palett + latte + twil)	Constructing walls: Exterior	40	1	1	40	m		0
Toiture	Roof construction	17	6	1	102	m2		0
Placer Tiyo 4"	Placing leachate drains	6	1	1	6	Unit		0
Plasmen doum 15 gallon	Placing juskaka drum	3	1	1	3	Unit		0
							Total H$	**-**
							5%	**-**
							Total H$	**-**
							Total HTG	**-**
							Total US$	**-**

Bill Of Quantities

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

Item (en KREYOL)	Item (en Anglais :)	Total	Unit	Unit cost (H$$)	Total cost (H$$)
Remblai	Granular foundation material	3	6 m³ camion	450	1350
Gravier	Gravel	2	6 m³ camion	800	1600
Sable	Sand	2	6 m³ camion	800	1600
Ciment	Ciment	55	Unit	60	3300
Blok 15	15cm cinder blocks	170	Unit	5	850
Planches (for coffrage)	Wood, 1*8, 12', for formwork	10	Unit	120	1200
2*4, 16' (poteau)	Wood, 2*4, 16', for columns	21	Unit	135	2835
2*4, 16' (toiture)	Wood, 2*4, 16', for roof	21	Unit	135	2835
Lattes (panno)	Wood, 1*4, 14', for walls	65	Unit	80	5161.5
Lattes (toiture)	Wood, 1*4, 14', for roof	22	Unit	80	1760
Twil (100' * 3')	Chicken wire, 1/4", 100' * 3'	9	Unit	450	4050
Pallets	Palett	32	Unit	50	1600
Feuilles toles	Zinc sheet	80	Unit	65	5200
Clous, Toles	Nails, zinc sheet	20	Llbs	40	800
Clous, 4"	Nails, 4"	10	Llbs	40	400
Clous, 2.5"	Nails, 2.5"	10	Llbs	40	400
Tiyo 4", 10'	PVC drainpipe, 4", 10'long	1	Unit	50	50
Doum 15 Gallon	15Gallon drum jikaka	3	Unit	200	600
Mixer + Operateur	Rental of Concrete mixer	1	Lump Sum	500	500
peiture	Paint	2	gallon	100	200
				Total H$	**36,292**
				Total HTG	**181,458**
				Total US$	**4,536**
			TOTALS LABOUR + MATERIALS:	**Total H$**	
				Total HTG	
				Total US$	

Photo K1:

Mk.I Compost Structure: Simple wooden structure immediately behind toilet, no floor, no roof.

Location: Cap-Haitien

Photo K2:

Mk.II Compost Structure: Angled wood/toles roof and walls, no floor.

Location: Cap-Haitien

Photo K3 a,b,c:

Mk.III Compost Structure: Block walls, concrete floor with drainage, removable wood/toles roof and walls.

Location: Cap-Haitien

Photo K4:

Mk.IV Compost Structure: Pallet walls, long structure, earth floor.

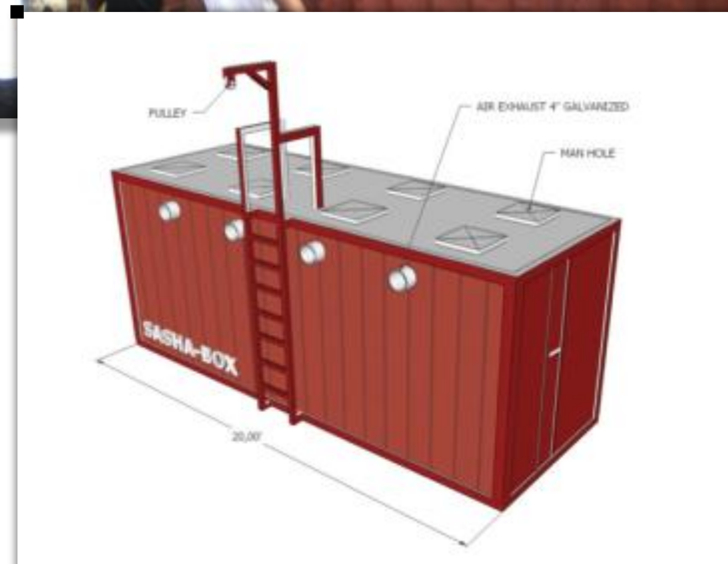


Photo K5 a,b:

Mk.V Compost Structure: Steel shipping container modified with air ducts, manholes in roof, ladder access, and pulley.

Photo K6 a,b,c:

Mk.VI Compost Structure: Pallet walls with hessian sack lining, earth floor, plastic sheeting cover.

Photo K7:

Mk.VII Compost Structure: Pallet walls with hessian sack lining, square structure, sloped concrete floor with drain, perimeter wall constructed with blocks.

Photo K8 a,b:

Mk.VIII Compost Structure: External walls with hessian sack lining, internal space compartmentalized by wooden internal walls, sloping concrete floor with drain, removable toles roof.

Photo K9:

Mk.VIX Compost Structure: Pallet walls with bagas lining, internal bagas walls, concrete floor sloping to drain, permanent roof.

Photo K10:

Mk.X Compost Structure: Pallet walls with bagas lining, internal bagas walls, concrete floor sloping to MANIFOLD drain, permanent roof.

Photo K101:

Concrete base with wooden columns.

Photo K102:

Finishing the concrete base; ‘cirage’.

Photo K103:

Setting the columns before concreting the base.

Photo K104:

Low level block walls creating the
6 compost compartments

Photo K105:

Jikaka leaking through block walls on inside of compost structure

Photo K107:

Rendering the block walls to prevent jikaka leaching through

Photo K106:
Jikaka leaking through block walls on outside of compost structure

Photo K108:
Leachate drain from 2 compost compartments collected in a single 15 gallon drum

Photo K109:

Leachate drain from 2 compost compartments collected in a single 15 gallon drum

Photo K110:

Jikaka leaking through space beneath leachate drain

Photo K111:

Exterior walls construction.

Photo K112:

Interior walls construction.

Photo K113:

Filling bagas walls BEFORE drum dumping begins

Photo K115:

The Mk. X roof from the inside

Photo K114:

The Mk.X wooden roof structure

Photo K116:

The finished structure from the outside, showing concrete walkway around structure.

Photo K117:

Jikaka leaking through walls and beneath leachate drains on the Mk.VIII compost structure.

Photo K118:

Juskaka leaking through the rendered walls of the Mk. IX compost structure.

Photo K119:

Repairs to exterior walls required to stop jikaka leakage.

Photo K201:

Lining the sides of the compost structure with bagas

Photo K202:

Building the compost pile: Emptying the poop drums

Photo K203:

Building the compost pile: Adding bagas

Photo K204a:

Unwelcome pests on the compost pile

Photo K204b:

Compost pile covered with chicken wire

Photo K204c:

Returning the jikaka onto the compost pile

Photo K204d:

Measuring the temperature of the compost pile

Photo K205a:

Stocking the poop drums

Photo K205b:

Positioning the poop drums inside the compost structure

Photo K206a,b:

The drum cleaning zone or ‘carwash’, with and without roof structure

Photo K207a,b,c:

Cleaning the poop drums

Photo K208:

Solids trap on drum cleaning zone

Photo K209:

Breaking the '20 drum rule' creates unsanitary conditions for cleaning the drums

Photo K210:

Dirty drums next to drum cleaning zone, ready for cleaning

Photo K211:

A clearly delineated clean drum depot in the shade of a mango tree

Photo K212:

Compacted compost pile at end of phase 1 composting

Photo K213 a, b, c:

Moving a compost pile manually is very slow, labour intensive and expensive.

Photo K214a,b,c:

Forming the phase 2 windrows using machinery

Photo K216:

Example windrows at Grand Marnier, Cap-Haitien

Photo K215:

A SOIL windrow

Photo K217:

Chlorine footbath

Photo K218a,b:

Chlorine spray station for vehicles

Photo K219a,b,c:

Spraying down poop drum truck on carwash

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