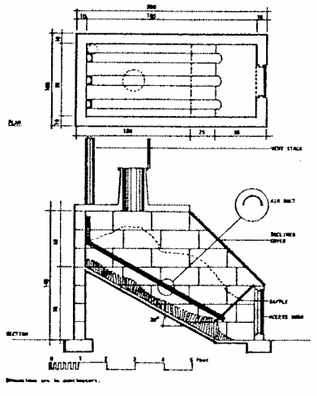
However, during the fall (early September) the glass cover proved necessary as the open bag was unable to achieve temperatures higher than 25-35°C. The glass cover was also seen to play an important role in retarding heat loss in the afternoon.
To summarise, the overall performance during the summer months was found to be satisfactory; the average daily efficiency of the bag alone being between 35-40%. The water temperature exceeded 50°C, the target. The collector was able to deliver 80 litres per square metre per day of hot water on a Montreal summer day (isolation: 500-700 langleys).

CONCLUSIONS
It is possible to construct an extremely cheap water heater for as little as $1.48, that will provide 100 litres of water at at least 40°C. Techniques have been evolved for fabricating a 'pillow' type reservoir by modifying a standard polyethylene plastic garbage bag. On the basis of experiments it is felt that the most cost-effective configuration for such a 'pillow' type solar water heater is that of an exposed bag on an insulated base, without side insulation, transparent cover or reflector. This experiment has not determined the exact life of the polyethylene bag.

TWO INEXPENSIVE TOILETS

1980

THE MINIMUS
The MINIMUS is an on-site toilet based on the Clivus Multrum design and adapted by us to concrete block construction. People have built them in Canada, the United States, Switzerland, Dubai, Guatemala, Mexico, and the Philippines. The concrete blocks (4" or 10 cm) are laid up in conventional fashion with cement mortar, or may be laid up dry and coated with a surface-bonding material such as 'Surewall', which also acts as a waterproofing membrane. In the case of conventional construction, a coat of cement mortar should be applied to the inside of the compartment. The bottom of the MINIMUS is built up with sand or gravel, and coated with a thin layer of concrete. The lower baffle is made out of wood. The air ducts are made out of PVC or non-corrosive materials such aluminium, asbestos-cement or fibreglass. The top of the toilet is most easily fabricated from cast on-site reinforced concrete, but could be out of wood. The inclined cover of the MINIMUS could be out of black painted metal, if the units is oriented south. This would, in a warm climate, serve as a solar collector and would facilitate the composting process. The vent stack should be at least 4" (10 cm) in diameter and as tall as possible.
Care should be taken that the construction is air tight. All openings such as the vent pipe and small vents in the access door should be fly-screened. The access door may be of wood, or metal, and should have approximately 5 square inches (30 aquare cm) of fly-screened vent opening.
In warm climates the MINIMUS can be built out-of-doors, even taking advantage of solar heat. In temperate climates the MINIMUS **must** be located in a heated space, usually the cellar or basement.
The temperature within a Multrum type toilet rarely surpasses 90°F (32°C) and most organisms are consequently not destroyed by heat but by the long decomposition period, sometimes referred to as mouldering. The moudlering period in a MINIMUS may be as long as 3-4 years.
In order to start a Multrum type toilet is is necessary to build up a layer of rich top soil and sufficient absorptive material (peat moss, sawdust, dried grass) to absorb initial urine. Sufficient dry material **must** be added to the MINIMUS at all times to control the pH balance and to prevent urine build-up. When organic

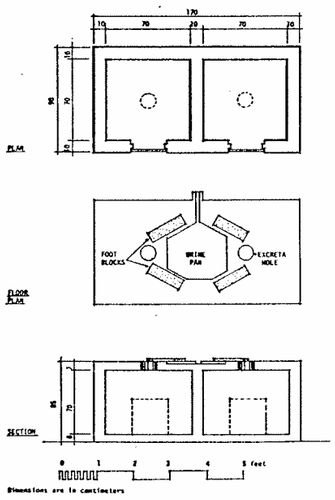


The Minimus

waste materials are not available, sawdust, peat moss, wood ash, grass clippings, or other materials high in carbon, should be added.
The size of the MINIMUS toilet should be able to handle the excreta of 4-6 persons, when used on a regular basis, or more if used infrequently. The main problems encountered are liquid build–up and excessive fly populations in the container. These can usually be resolved through improved ventilation. Do not add pesticides, chemicals or toxins to a MINIMUS.

THE DVC TOILET

The DVC toilet (also known variously as the **doublt vault composting toilet** , the **Gopuri**, the **Vietnamese composting toilet** and paradoxically as the **double septic bin**) is an on–site composting toilet that is shown here built out of 4" (10 cm) concrete blocks, but which could equally be built out of soil cement blocks, bricks, stones and mortar or poured–in–place concrete. The DVC toilet is built on a concrete slab and, importantly, is raised above grade to prevent flooding.
Construction of the DVC toilet is extremely simple. It consists of two compartments with small access doors. The floor of the DVC toilet comprises two excreta holes (with raised foot blocks) and a central depression for carrying off urine. It should be pointed out that both men and women, in the squatting position, urinate naturally and effectively. **No urine is allowed to enter the composting chamber**. Unlike the MINIMUS, there is no need for ventilating the interior.
The DVC toilet is an anaerobic composting toilet and the temperature rarely exceeds 32°C.
Procedure for use is as follows. The first vault is put into use; a small amount of ash is added each time defacation takes place. The urine is carried off to one side and collected either in a tank partially filled with water, or in a container half–filled with wood ashes. This uine is then used in the garden. No organic garbage is added to the composting chamber. When the chamber is full the pile is levelled with a stick and a layer of ashes is sprinkled over the pile. The vault is then sealed and the other chamber put into use. When the second chamber is full the first is then emptied of composted material and the process recommences. The holding period is typically 45-60 days.
According to Krisno Nimpuno, who has examined DVC toilets in Vietnam in 1979, "... organic matter decomposes in two phases: as long as the toilet is in use there is ample oxygen available. Since the faeces are always sprinkled with ashes the pile remains porous and aerated and the process is aerobic. After the vault is closed the oxygen is rapidly exhausted and the process turns anaerobic."
The key to the low cost of the DVC toilet is the separation of urine from faeces. The excreta produced by a single adult in one year comprises approximately 95 lbs (43 kg) of faeces and 950 lbs (430 kg) of urine, hence the solid portion is only 10% of the liquid. The small size of the DVC toilet is adequate to deal with the relatively small volume of solid excreta.



The Gopuri