Good Practice 8

Simplified Sewerage

Sewerage is a network of pipes ('sewers') that takes away all the domestic wastewater (i.e., mixed yellow, brown, beige and grey waters) from the houses where it is generated, to be treated and then disposed of elsewhere (often into a surface water or for use in aquaculture and/or agriculture). With conventional sewerage very conservative values for minimum sewer diameters, gradients and depths have accrued in design codes of practice over the last hundred years or so, with the result that per household construction costs are extremely high (see 'Poor Practice 1'). With simplified sewerage (also known as 'condominial' sewerage), which was developed in Brazil in the early 1980s to serve high-density periurban areas (Figures 1-3), these conservative design codes are relaxed in order to reduce the sewer diameter, minimum gradient and depth, while maintaining rigorous hydraulic design principles - in fact simplified sewerage is more rigorously designed than conventional sewerage (Mara et al., 2001).

The minimum sewer diameter used in simplified sewerage is 100 mm and, for a minimum tractive tension of 1 kN/m^2 (which ensures self-cleansing of the sewer), the minimum sewer gradient is 1 in 200 (i.e., 5‰). A 100-mm diameter sewer laid at this gradient can serve ~200 households of five persons with a water consumption of 100 litres per person per day. A cost comparison between conventional and simplified sewerage for the mining town of Parauapebas in the northern Brazilian state of Pará is given in Table 1 (Melo, 2005), which shows that the cost of simplified sewerage is ~60% of that of conventional sewerage. Similar cost savings have been reported in South Africa (ZAR 2500-3000 vs. ZAR 6000-7000) (DWAF, 2002). Depending on the population density, simplified sewerage can be less expensive than on-site sanitation systems such as VIP latrines and pour-flush toilets (see 'Good Practice 2' and 'Good Practice 4', respectively) (Figure 4).

Table 1. Comparative costs (1997 USD) of conventional and simplified sewerage in Parauapebas

Item	Conventional sewerage		Simplified sewerage	
	Total cost	Cost per connection	Total cost	Cost per connection
Excavation	263,000	39	186,000	28
Inspection chambers	181,000	27	85,000	13
Sewers	185,000	28	102,000	15
Total	629,000	94	373,000	56

Source: Melo (2005).

Simplified sewer networks are very flexible, with the sewers often laid inside a housing block, in the front garden, or under the pavement (sidewalk), rather than in the centre of the road as with conventional sewerage. This results in considerably less disruption to existing structures and major cost savings in construction. Simplified sewerage is appropriate both for existing unplanned periurban settlements and also for new housing estates with more regular layouts (Figure 2).

In upstream parts of the network, where the flow is intermittent, wastewater solids are gradually moved along the sewer each time a toilet is flushed. This transport process of 'move→ settle→move→settle' is much more efficient in small diameter sewers than in unnecessarily large diameter sewers – "small flows flow better in small sewers". PVC pipes are normally used, with simple joints and minimal resulting leakage or infiltration. Simple low-cost sewer junctions and cleanout and inspection units are used in place of expensive manholes (Figure 3). The water and sewerage company for Brasília and the Federal District uses simplified sewerage in both rich and poor areas.

Operation and maintenance is straightforward. In Brazil the state water and sewerage companies (SWC) use several methods of O&M. For example, in Brasília residents report blockages to the local SWC office which then despatches a van equipped with a water-jet unit; this is inserted in a junction box upstream of the blockage which is jetted to the next downstream junction box from where it is

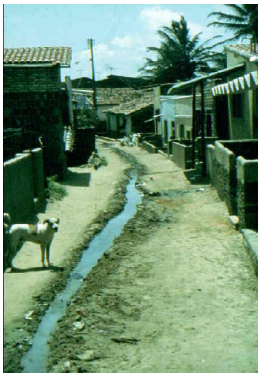

Figure 1. Typical situation in periurban areas: a stream of wastewater in the road.

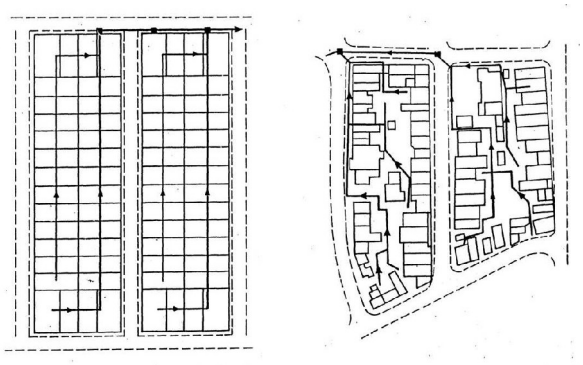

Figure 2. Simplified sewerage can be installed in new well-planned areas (left) and also in existing unplanned areas (right).

Figure 3. Low-cost plastic sewer junction which is now commonly used in Brazil.

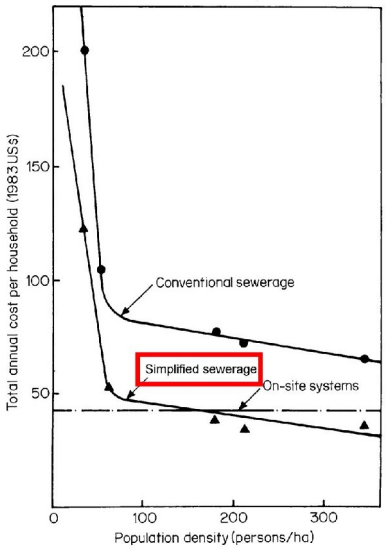

Figure 4. Variation of costs of conventional sewerage, simplified sewerage and on-site sanitation with population density, Natal, northeast Brazil, 1983. In this case simplified sewerage was cheaper than on-site systems above the relatively low population density of ~160 persons per hectare.

removed. In Recife in the northeastern state of Pernambuco the SWC employs small local engineering firms to do the O&M: typically a firm locates a technician engineer and 1- 2 labourers in the area it is responsible for to whom residents report any blockages; the team then visits the blocked sewer and cleans it manually.

The wastewater collected by simplified sewers can be discharged into a conventional trunk sewer if there is one nearby, or it can be treated at a (new) local wastewater treatment plant.

References

DWAF (2002). *Sanitation for a Healthy Nation: Sanitation Technology Options*. Pretoria: Department of Water Affairs and Forestry, Government of South Africa; available at: www.dwaf.gov.za/dir_ws/content/lids/PDF/Technical.pdf.

Mara, D. D., Sleigh, P. A. and Tayler, K. (2001). *PC-Based Simplified Sewerage Design*. Leeds: School of Civil Engineering, University of Leeds; available at: www.efm.leeds.ac.uk/CIVE/Sewerage/.

Melo, J. C. (2005). *The Experience of Condominial Water and Sewerage Systems in Brazil: Case Studies from Brasília, Salvador and Parauapebas.* Lima: Water and Sanitation Program Latin America; available at: http://www.wsp.org/filez/pubs/BrasilFinal2.pdf.

See also:

Mara, D. D. (2007). Simplified sewerage, website at: www.personal.leeds.ac.uk/~cen6ddm/simpsew.