TECHNICAL NOTE

FILLING RATE OF PIT LATRINES A CASE STUDY

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As part of a comprehensive Urban Upgrading Program, OXFAM (a U.K based charity organization) has been involved in the provision of basic sanitation facilities like improved pit latrines, domestic sewage disposal, flood prevention retaining walls, etc. in an area located in the Center of Addis Ababa specifically Higher 4 Kebele 29.

Having an area of about 10.1 hectares and a population of about 6,000 Kebele 29 is located in the Teklehaimanot Awraja area which has been the target of infrastructural upgrading programs by various NGOs. A first visit is enough to convince anyone that environmental sanitation is a serious problem. A general awareness of it was also observed among the beneficiaries.

Of the main sanitation problems, the inappropriate disposal of human wastes (excreta) was the most serious and potentially hazardous; unawareness of the community of the relation between disease and sanitation, the lack of safe and affordable waste disposal facilities aggravated the already dangerous situation. It was then imperative to build appropriate and usable toilets in the already overcrowded Kebele.

As one of the simplest and cheapest excreta disposal facilities, the pit latrine was the selected for implementation, however, other better possibilities were also considered, but based on cost, sustainability, availability of local resources (manpower and materials) community know-how, and management, and other relevant factors, an improved version of the pit latrine with various modifications to adapt it to the highly congested kebele was considered the most appropriate option. The actual construction concentrated on building communally used latrines with one common pit, and a reinforced concrete slab, the slab being partitioned into cubicles and each cubicle serving two to three families.

In the design process, non existence of filling rates of a pit latrine (that is the amount of excreta or faeces and urine discharged per person, per a given period of time, days or months or a year) were not available and hence it was not possible to determine the actual volume of a pit latrine needed to serve a fixed number of users for a given period of time.

In practice the pit latrine should have an adequate volume, so that it may not fill up too quickly but should serve between two to three years enabling the users (in Kebele 29 at least) to get enough time to save for the desludging costs (desludging is the standard means of emptying pit latrines in Addis Ababa).

Among other things, filling rate of pit latrines depend on the following factors:

1. Diet
2. Climate
3. Ground water level
4. Water input into the pit
5. Soil percolation capacity
6. Type of anal clearing materials
7. Rate of decomposition, etc.

Observations spanning two to four years gave the following filling rates. As shown on the table and graphs, 70% of the data fall between 0.28 - 2 liters/person/day. From these and average rate of 1.25 liters/person/day may be taken as an initial design rate. As the time span of the use of a pit latrine increases the filling rates seen to be getting progressively lower, this is in accordance with the law of decomposition and consequent volume reduction. Higher filling rates of 5.41/p/d to 7.5 1/p/d are outside the expected ranges and were due to other factors like, flooding of pits, excessive dumping of sullage water, etc. and should not be taken as indicative values. But in case sullage water is desired

to be dumped into the pit, the designer should make the necessary allowances.

Available data on filling rates may then be used in the design planning of pits, primarily to specify actual dimensions: desludging interval, or even specifying the number, and volume of suction trucks needed, etc.

Design Example

Pit volume calculation may be carried out, after the following formula.

$$V = NFD$$

where V = Volume of pit (m^3)
N = Number of users
F = Filling rate (m^3/person/year)
D = Frequency of desludging

Let the number of users be 20, and the frequency of desludging be 2 years
Filling rates – 1.25 l/p/day = (1.25)(350)/1000 days – 0.456 = 0.5 m^3/year

Therefore et olume of pit,

$$V = NFD$$

V – (20)(0.5) m^3/p/yr x 2yrs. = 20m^3

Let pit depth be 3m (This figure may be changed according to actual needs).

Area of pit = 20 $m^3/3$ = 6.67 m^2, choose dimensions of width w = 2.5m and length, L – 2.75m

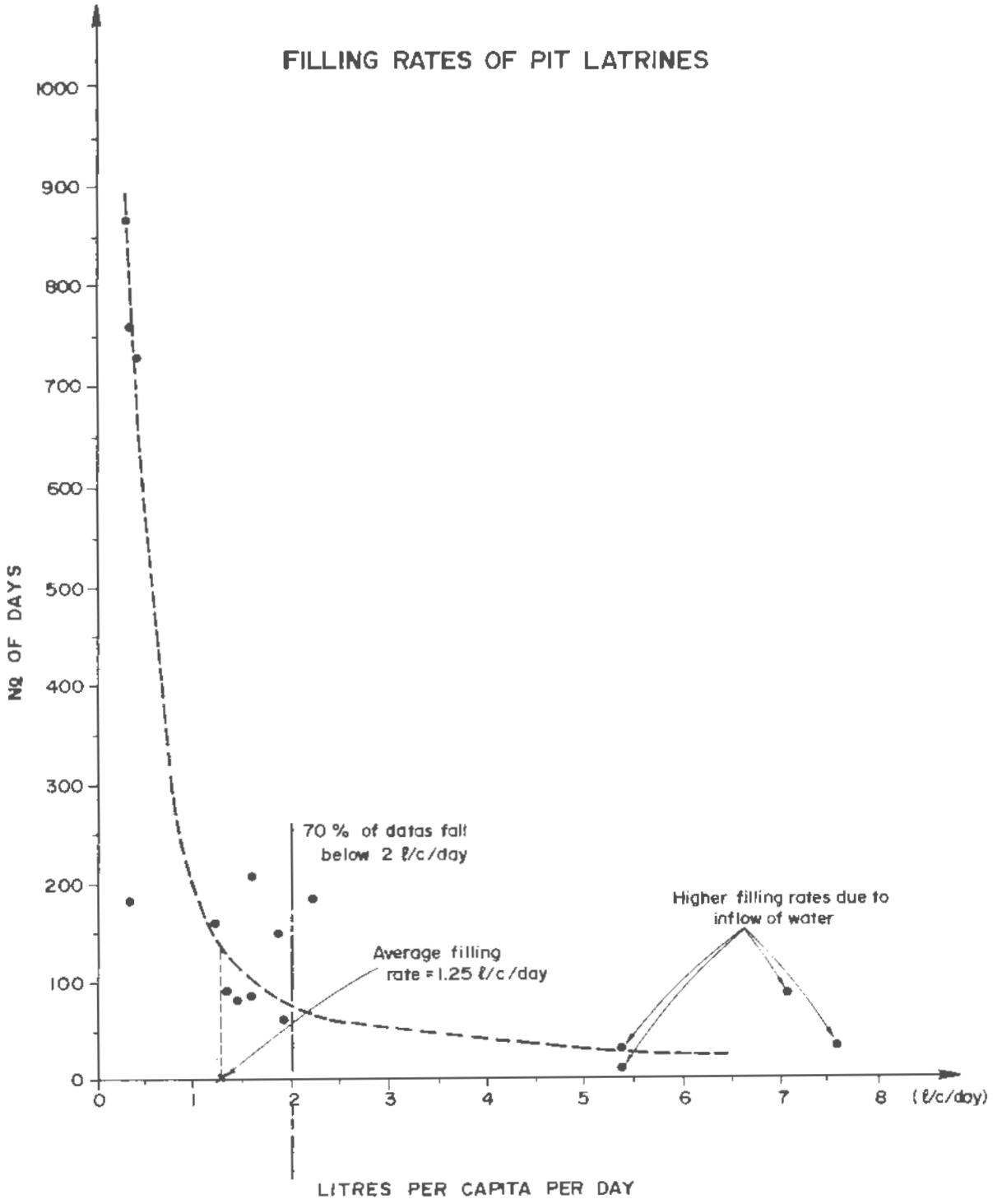
Therefore, pit area – (2.5)(2.75) = 6.87 m^2 OK

Area to be excavated should, however, account for the extra volume needed for the pit lining. If pit is masonry lined and has a width of say 0.5m. This length should be added on both ends of the dimensions, that is the length and width. Hence final dimensions will be;

Length = 2.75m + 0.5 + 0.5m + 3.75m
Width = 2.5 + 0.5 + 0.5 = 3.50
Depth – 3.0m remains constant
final pit excavation dimensions are therefore:
3.75m by 3.50m by 3.0m

Datas on Pit Latrines

No.	Location Higher.kebele House No.	Type of Lineing (If any)	No. of Users	Volume of Pit (M^3)	Last Date Emptying or 1st day of use	Present Date of Emptying	Intervals in Days	Filling Rate l/p/day	Amount of Wate Added/Average
1	4 - 29 (568 - 575)	Masonary	52	3.36	Jan. 21, 1993	Feb 2, 1993	12	5.38	10lt/week
2	4 - 29 (236 - 247)	"	75	12.11	Jan. 5, 1993	Feb. 3, 1993	30	5.38	40lt/week
3	4 - 29 (346 - 361)	"	65	14.68	Jan. 2, 1992	Feb. 2, 1993	30	7.52	30lt/week
4	4 - 29 (607 - 610)	"	23	10.56	Jan 1993	Mar. 2, 1993	60	7.65	
5	4 - 29 (263 - 268)	"	33	13.89	Dec. 1992	Feb 3, 1993	60	7.01	20lt/week
6	4 - 29 (256 - 262)	"	30	3.36	Dec. 2, 1992	Feb 2, 1993	60	1.86	20lt/week
7	4 - 29 (248 - 255)	"	57	7.03	Nov. 12, 1992	Feb. 3, 1993	83	1.48	20lt/week
8	4 - 29 (658 - 674)	"	77	9.88	Nov. 1992	Feb. 3, 1993	90	1.43	20lt/week
9	4 - 29 (016 - 024)	"	67	10.32	Oct. 27, 1992	Feb. 3, 1993	96	1.60	30lt/week
10	4 - 29 (398 - 422)	"	80	22.50	Sep., 1992	Feb. 3, 1993	150	1.87	20lt/week
11	4 - 29 (028 - 032)	"	23	4.68	Aug. 21, 1992	Feb. 3, 1993	162	1.26	10lt/week
12	4 - 29 (211 - 213)	"	19	7.53	Aug., 1992	Feb. 2, 1993	180	2.20	30lt/week
13	4 - 29 (456 - 460)	"	25	7.92	July 7, 1992	Feb. 3, 1993	206	1.54	20lt/week
14	4 - 29 (705 - 708)	"	29	10.63	Apr 1992	Mar. 2, 1993	330	1.11	
15	4 - 29 (698 - 715)	"	73	22.08	Jan. 1991	Feb. 2, 1993	730	0.41	30lt/week
16	4 - 29 (224 - 231)	"	33	8.64	Dec. , 1990	Feb. 2, 1993	730	0.41	30lt/week
17	4 - 29 (575 - 578)	"	25	8.53	Sep., 1990	Feb. 2, 1993	870	0.39	20lt/week
18	4 - 29 (523 - 525)	"	18	15.10	Oct. 24, 1988	Feb. 2, 1993	1526	0.55	30lt/week
19	4 - 29 (695 - 697)	"	21	9.35	Sep. wt, 1988	Feb 2, 1993	1580	0.28	40lt/week
20	4 - 29 (270 316)	"	144	10.00	Aug., 1992	Feb 2, 1993	180	0.38	20lt/week


FILLING RATES OF PIT LATRINES
1000
900
800
700
600
500
400
300
200
100
0
No OF DAYS
70 % of datas fall below 2 ℓ/c/day
Higher filling rates due to inflow of water
Average filling rate = 1.25 ℓ/c/day
0
1
2
3
4
5
6
7
8
(ℓ/c/day)
LITRES PER CAPITA PER DAY