CENTRAL BUILDING RESEARCH INSTITUTE, ROORKEE-247667 (INDIA)

BUILDING RESEARCH NOTE

B.R.N. 28

WASTE WATER DISPOSAL SYSTEM FOR RURAL AREAS

Introduction

A large section of Indian population lives in villages and is mainly engaged in agriculture. They belong to weaker section of the society. There is a definite trend of rural population migrating to the urban areas due to lack of employment opportunities, low earnings, insufficient means of transport and insanitary living conditions. The latter is mainly responsible to repel the educated youth from working in rural areas. One source of insanitary condition in rural areas is the drainage of waste water from bathing and cooking areas of dwellings over the *kutcha* roads and lanes having inadequate slopes. The situation is further aggravated due to the movements of carts and animals which result in the creation of pot holes and ditches that gets filled up with dirty stagnant water. The mosquitoes and flies find good breeding centres in these places and spread diseases.

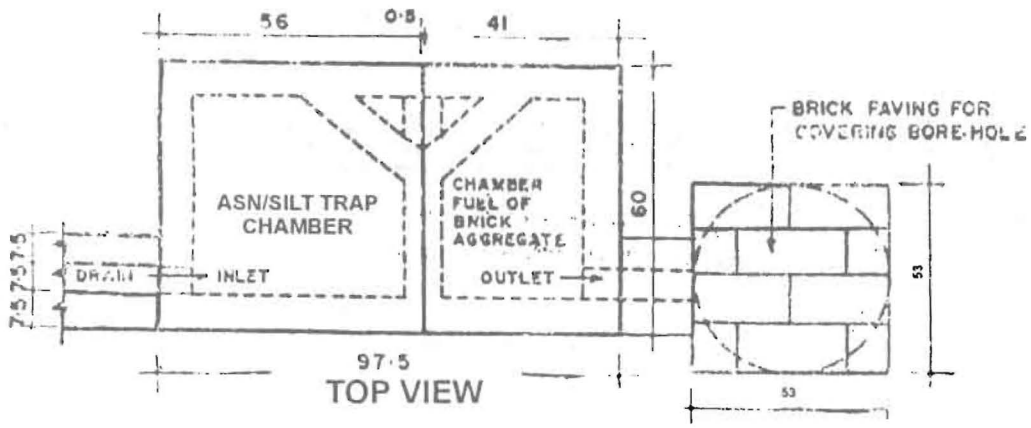
Some of the village roads are brick paved with drains for waste water disposal. But these have not served the required purpose due to improper slopes, insufficient maintenance and unpredictable flow of water. A few rural dwellings, having their own source of water supply like hand pumps, discharge more water on the streets. Furthermore, the agricultural waste and domestic refuse collect in drains obstructing the flow of water and ultimately, all these things appear on the streets.

Some of the village panchayats* have suggested individual pits for collection of waste water and its disposal by intermittent sprinkling on large areas, either in the courtyard or on the streets. The villagers adopt this practice for some time, but their enthusiasm dies with time.

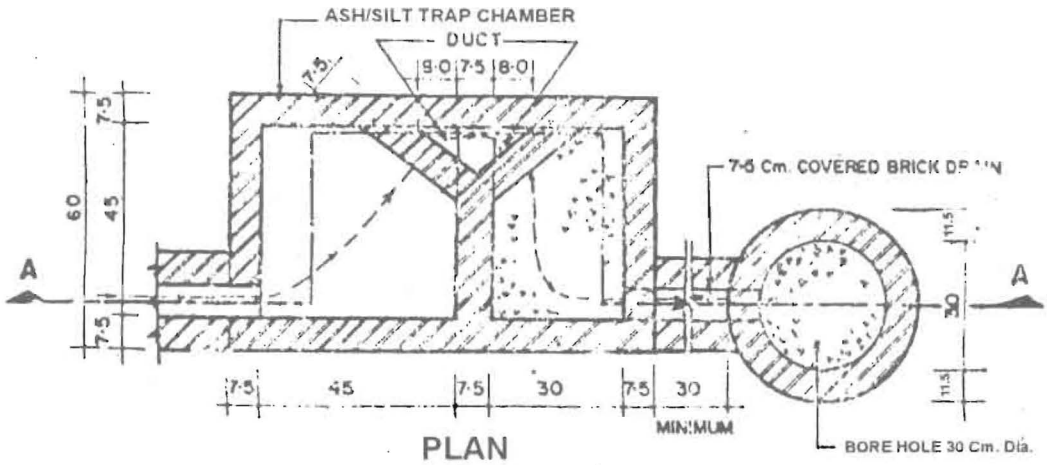
A few progressive farmers have access to the technical know-how and capacity to invest finance to make large sized soakage pits filled with brickbats (to dispose off water underground). These are frequently choked with ash and soil used by the villagers to clean their utensils. This requires cleaning of the pit and involves considerable expenditure. The high cost of construction and costly maintenance make it beyond the reach of the poor.

A detailed study of the problem, including the living habits of rural population, was conducted by the Central Building Research Institute, Roorkee. The urban type of underground drainage system was not found suitable because of the settlement of silt and ash in drains; insufficient quantity of water for self-cleaning of the drains; high maintenance and running cost. The lack of interest in the maintenance of community services leads one to conclude that the proposed system should be such that it should make the individuals responsible to run their own waste water disposal system. At the same time, the system should be within the economic reach of a villager who can maintain it

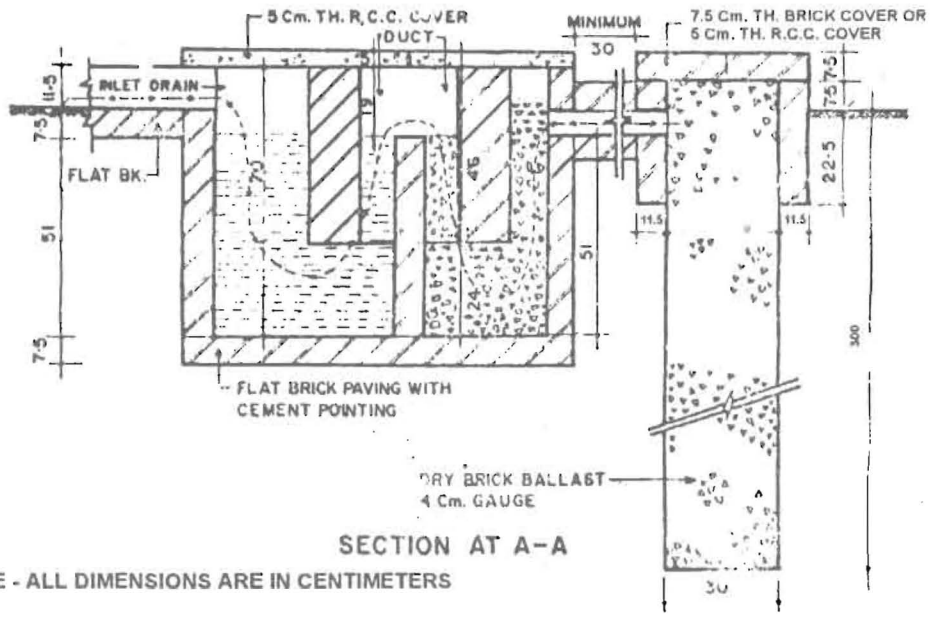
* Panchayat : Elected body to administer the village.



TOP VIEW



PLAN



SECTION AT A–A

NOTE - ALL DIMENSIONS ARE IN CENTIMETERS

WASTE WATER DISPOSAL SYSTEM FOR RURAL AREAS

FIG. 1

without outside help. Keeping in view all these factors, a system has been developed at this Institute to dispose off waste water in rural areas. Salient features of this system are given below :

Improved System

The proposed system consists of an ash/silt trap chamber and a bore hole.

The ash silt trap chamber (Fig. 1) is rectangular in shape having 7.5 cm thick wall of burnt brick laid in 1:6 cement sand mortar and is constructed near waste water outlet. It is divided into two compartments by a 7.5 cm thick wall and is covered with a R.C.C. or reinforced brick lid. The sizes of first and second compartment are made as 45×45×70 cm and 30×45×70 cm respectively. Triangular ducts 8×8 cm in size and 46 cm deep are made in corners adjacent to each other in both compartments, diagonally opposite to inlet. A hole is left in the partition wall 19.0 cm below the top of the duct portion to provide connection between the two ducts. The second compartment is filled with 4 cm size brick ballast. In the first compartment, heavier particles of silt and ash, flowing with waste water, settle down, and floating and greasy materials get trapped. The water having only colloidal and suspended particles rises through the duct of the first compartment and flows to the bottom of the second compartment through the duct. The suspended and colloidal particles get stuck to the brick ballast and only clear water is allowed to flow into the bore hole for final-disposal underground. When the first compartment gets filled with ash and silt, the lower mouth of the duct will be closed and water will stop flowing to the second compartment. This will cause flooding of the first compartment and back-flow of water indicating that the compartment requires cleaning. The system is reactivated by removing ash and silt from the first compartment.

The bore hole of 30 cm in dia. is made with the help of auger and this is deep enough to reach the first layer of sand subject to maximum of 3 m deep. It is also filled with 4 cm size brick aggregates. It is proposed to construct this system in the courtyard of the house owner so that, in case of choking of the chamber, he would have it cleaned to avoid nuisance created by overflowing water.

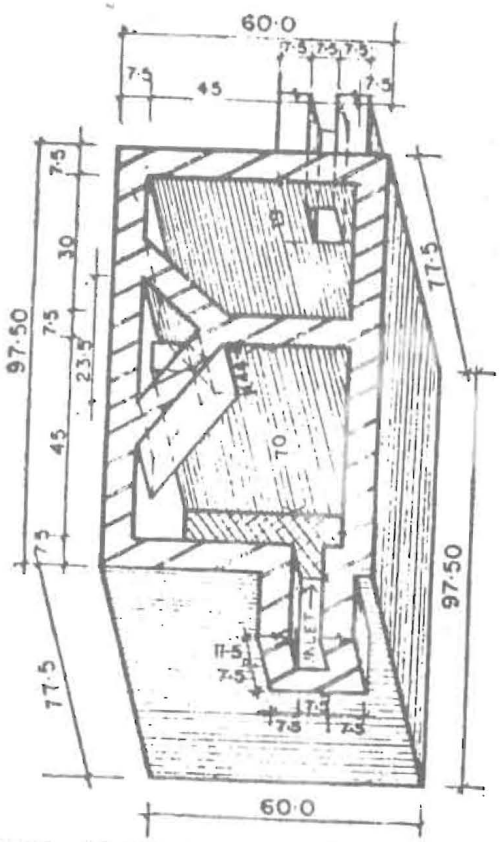
Unlike the existing soakage systems where the ash and silt directly flow into the soakage pit and cause choking, the proposed system provides for their retention in ash/silt trap chamber and its subsequent cleaning, when the water starts overflowing. The materials required for the construction of one unit include cement (1/2 bag), Bricks (160 Nos.), 6 mm dia. M.S. bars (3 kg), Brick ballast (0.35 Cu.m.), Sand (0.15 Cu.m.), 6 mm size crushed stone (0.02 Cu.m.), Skilled labour (one man day) and unskilled labour (2 man days). The cost of these materials and labour at Roorkee rates (July 2003) has been estimated as Rs. 875/- (U.S. $ 20). The retention of water in the first compartment and its passage through the brick aggregates (filled in second compartment and bore hole) is also expected to reduces the BOD before the water reaches the subsoil water level. A prototype of the proposed soakage system was built in the colony of poor people in a village near Roorkee about thirty years ago. After its satisfactory performance four such soakage systems were provided in four different houses in another village and now thousands are functioning without any problem.

Construction Procedure

A pit equal to the outer dimensions (60 × 100 × 66 cm) of the chamber is excavated. A layer of flat bricks in mud mortar is laid at the bottom of the pit to form floor of the chamber. The walls 7.5 cm thick in burnt bricks with 1:6 cement sand mortar are built as per the design (Fig. 2). This chamber is divided into two compartments by a wall of 7.5 cm thick. The sizes of the first and the second compartment are made as 45 × 45 × 70 cm and 30 × 45 × 70 cm respectively. A triangular duct 8 × 8 × 46 cm is made diagonally opposite to the inlet of the first compartment. A similar duct is made adjacent to the first duct in the second compartment.

A hole is left in partition wall 19.0 cm below the top of the duct portion to provide connection between the two ducts. All the walls of the chamber are made 11.5 cm above ground level. Two precast R.C.C. (1:2:4) covers of 5 cm thickness and 56 × 60 cm and 41 × 60 cm size respectively are made to cover ash/silt trap chamber. The second compartment is filled with 4 cm size brick ballast.

Bore hole 30 cm in dia. is made with the help of an



NOTE - All dimensions are in centimeters
FIG. 2 ASH SILT TRAP CHAMBER

auger at a minimum distance of 30 cm from the chamber. It is taken upto the first layer of sand or upto 3 m. depth whichever is less. The bore hole should be made at least 6 m away from the hand-pump or well. A drain covered with brick is made 51 cm above floor level of chamber to connect bore hole with chamber. Brickwork 11.5 cm thick 30 cm deep is carried out around the circular hole to protect the top from collapsing. The bore hole is also filled with 4 cm size brick ballast. The top of the bore hole is covered by laying flat brick plastered with 1:6 cement-sand mortar or with 5 cm thick R.C.C. cover.

Observations

Observations were made about the working of this proposed system on the prototype constructed about thirty years ago in the villages near Roorkee. They were found satisfactory for a period of four months and, after that, water started overflowing. On inspection it was found that the first compartment of ash/silt trap chamber was filled with ash, choking the lower mouth of the connecting duct. It was cleaned by the owner of the house and put back into service. Further observations lead to conclude that, inspite of the introduction of the ash/silt trap chamber, some suspended material and ash may flow into the bore hole before the complete closure of the duct. Therefore, it is recommended that even if the back-flow of water due to closing of the duct does not take place, the first compartment of ash/silt trap chamber should be cleaned once in four months and the brick aggregate of the second compartment at least once in eight months to avoid chance of such flow and failure of the hole.

Conclusions

The proposed soakage system is a small compact unit designed for individual dwelling. This simple technique involves the use of locally available materials and labour. The technique is compatible to the average villager's economic level. This whole system is covered and is below the ground level enabling free traffic movement above it. Chances of mosquito breeding are completely eliminated. Pollution of rivers and ponds are avoided in this system.

Only an auger for making the bore hole is required and this could be procured by village panchayats or social welfare organizations.

The simplicity of construction and low cost, it is hoped, should encourage villagers to adopt this system, thereby improving the environmental conditions of the village as a whole.

The plus point of this system is recharging of ground water. This system can also be constructed using ferro cement technology by maintaining internal dimensions of the system.

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