Indian Standard

CODE OF PRACTICE FOR CONSTRUCTION OF WASTE STABILIZATION PONDS (FACULATIVE TYPE)

(First Revision)

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BUREAU OF INDIAN STANDARDS
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Indian Standard

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(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 28 January 1987, after the draft finalized by the Water Supply and Sanitation Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Waste stabilization ponds are at present increasingly adopted for treatment of sewage of small communities and townships in view of their simplicity and satisfactory performance indicated by actual usage in different parts of the country. They should, however, be properly designed, constructed and operated so that they give the expected level of treatment and do not become a source of health hazard and nuisance to public.

0.3 The waste stabilization action in the pond is due to the combined activity of algae, bacteria, and zoo plankton. Algae in the presence of sunlight liberate free oxygen by photo-synthesis action. The oxygen so liberated is utilized by the bacteria which break the organic matter present in the waste. During the process of assimilation, ammonia, carbondi-oxide and other substances are liberated which are synthesized by the algal cells. Thus a symbiotic cycle is established between the bacteria and algae in these ponds.

0.4 Under prevailing climatic conditions, stabilization ponds in India have shown an average reduction ranging from 80 to 90 percent of biochemical oxygen demand (BOD) at a loading rate of 150 to 325 kg/ha/day. The performance of stabilization ponds is comparable to that of conventional sewage treatment plants such as trickling filters, activated sludge process, etc, with regard to BOD removal, and higher in the removal of pathogenic organism.

0.5 Following are three types of waste stabilization ponds.

a) aerobic,

b) faculative, and

c) anaerobic.

This code is limited to faculative type ponds for which considerable working data under Indian conditions are available.

0.6 This standard was first published in 1970. The major changes made in this revision are given below:

a) More details have been added in the figures.

b) Pond operation has been covered in detail.

c) Length to breadth ratio of pond has been specified.

d) For preventing excessive seepage losses, guidance for providing pond bottom has been covered.

e) Disposal of pond effluent by maturation ponds have been given.

0.7 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2 - 1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value of this standard.

1. SCOPE

1.1 This standard covers design, construction, commissioning, operation and maintenance of waste stabilization pond of the faculative type for treatment of sewage.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definition shall apply.

2.1 Waste Stabilization Pond — Waste stabilization pond of the faculative type has shallow basins, usually 1 to 1·5 m deep, which is used for the treatment of sewage, involving the action of bacteria and algae in the presence of sunlight. These ponds are predominantly aerobic in the upper layers and anaerobic in the lower layers.

*Rules for rounding off numerical values (*revised*).

3. PRELIMINARY INVESTIGATIONS

3.1 It is important to know the nature and quantity of waste and mode of final disposal of effluent. Pond effluent may be profitably used first for acquaculture and then agriculture.

3.2 Field survey maps showing the relative levels or contours of the site including description of the adjacent area should be obtained.

3.3 Data should be obtained regarding the following:

a) *Meteorological* — Temperature, solar radiation, prevailing winds and rainfall.

b) *Geographical* — Altitude and distance from habitation.

c) *Soil Characteristics* — Ground water table, percolation characteristics of soil and possibility of ground water pollution.

3.4 Provision for expansion should also be considered.

4. BASIS OF DESIGN

4.1 Pond Loading — Organic loading of waste stabilization pond depends on several factors, such as temperature, nature of sewage, intensity of solar radiation (as modulated by sky cloudiness), type of algae and its radiation conversion efficiencies. In India, climatic conditions vary considerably over the subcontinent and organic loadings of 150 to 325 kg/ha/day have been adopted with generally satisfactory results. The recommended values corresponding to latitudes are given in Table 1.

TABLE 1 POND LOADING FOR DIFFERENT LATITUDES

LATITUDE °N	POND LOADING OF BOD kg/ha/day
36	150
32	175
28	200
24	225
20	250
16	275
12	300
8	325

4.1.1 The values given in Table 1 are approximate and may help in simplification of pond design. Meteorological conditions may vary widely in certain instances such that stabilization ponds situated at two places on the same latitude may require different loading rates.

4.1.2 It is found that for pond design for domestic sewage in most parts of India, adoption of depth of 1 to 1·5 m and surface area based on the organic loading given in Table 1 give sufficient detention time (minimum six days) for the removal of 80 to 90 percent BOD (based on filtered effluent BOD) at the average winter temperatures usually encountered.

4.1.3 However, in the cases of ponds located in regions having very cold temperatures at high altitudes, detention period should be increased taking into account the decrease in the rate of biological activity at lower temperatures. Detention period may be increased either by an increase in depth (up to 1·5 m) or by increasing the surface area of the pond. Where prolonged periods of sky cloudiness are experienced, the surface area should be suitably increased.

4.2 Multiple Units — Ponds smaller than 0·5 ha area may be a single unit. Larger ponds may be in multiple units working in parallel or in series. The arrangement is advantageous in case of repairs, maintenance and other unforeseen circumstances. Ponds in series have functioned more satisfactorily and are usually recommended for larger installations. To avoid anaerobic conditions in the primary ponds, its area may be 65 to 70 percent of the total area or provision may be made to pump the final effluent to the first tank in order to freshen it.

4.3 Pond Shape — It is not necessary that the pond shape should be of any particular type. It may be reclangular or polygonal depending on the site contours. Elongated rectangular shapes with $l : b$ ratio between 3 : 1 to 2 : 1 are better to avoid short-circuiting to ensure desired detention period. The ponds should be rounded at the corners in order to minimize accumulation of floating material and creation of dead pockets. There should be no islands or peninsulas in the pond as they tend to promote local nuisance conditions and reduce circulation in the pond.

5. LOCATION

5.1 Distance from Habitations — Pond site should be as far away as practicable from habitation taking into account possible future development of the area. No pond should be located less than 200 m and preferably 500 m from residential colonies.

5.2 Prevailing Winds — If practicable, ponds should be so located that local prevailing winds are in the direction of uninhabitated areas. Orientation of ponds should be such that the longest dimensions are at right angles to the local prevailing wind to avoid short-circuiting of the flow.

5.3 Distance from Trees — Trees should be removed with a distance of 30 m from the pond edge.

5.4 Surface Run-Off – Proper arrangement should be made to divert the rain water away from the pond.

5.5 Ground Water Pollution — In homogenous soils, no well should be within a distance of 15 m from the pond and preferably be 50 m away. It is not possible to indicate the safe distance between a waste stabilization pond and a ground water source located in areas of fissured rock formation, lime stone or gravel deposit. In such instances a critical evaluation of ground water pollution shall be made before selecting the site to avoid any health hazards or other undesirable conditions.

6. CONSTRUCTION DETAILS

6.1 A typical plan of a single unit waste stabilization pond is shown in Fig. 1.

6.2 Embankments

6.2.1 *Material* — Embankments or bunds should be constructed of impervious materials and compacted sufficiently. Vegetation and debris should be removed from the area upon which bunds are to be constructed The excavated material, if suitable, may be used for the bunds. Suitable top soils relatively free of debris may be used as cover material on the outer slopes of the embankments.

6.2.2 *Top Width* — The minimum top width of embankment should be 1·5 m. In case access to vehicles is desired for maintenance purposes, the minimum width should be 3 m.

6.2.3 *Slopes* — Embankment slopes should not be steeper than:

a) 2 to 2·5 horizontal to 1 vertical for unprotected earthern embankments, and

b) 1·5 horizontal to 1 vertical for pitched or lined embankments.

6.2.3.1 In case of sandy and unstable soils flatter slopes may be used.

6.2.4 *Free Board* — Free board shall not be less than 0·6 m.

6.2.5 *Turfing* — Embankments may be protected on the outer side from erosion by growing grass turfing.

6.2.6 *Lining* — In unpitched slopes, rip-rap lining of flat stone, plain concrete slabs or any other suitable material up to 300 mm above and 300 mm below the water line is recommended to check erosion due to wave action and also to avoid mosquito nuisance and grass growth at the water edge. Typical details of lining on the embankment surface are shown in in Fig. 2.

6.3 Pond Botton

6.3.1 *Soil Formation* — Soil formation for the bottom should be relatively impervious to avoid percolation. Trial pits to determine the characteristic of the soil and subsoil of the pond floor should be made as a part of the preliminary survey to select the pond sites; where lime stone and gravel are encountered, the pond floor should be treated to make it impervious. If excessive (10 percent) seepage loads are anticipated, the pond bed should be lined with (300 mm) puddle clay, polythene sheeting or other appropriate material.

6.3.2 *Vegetation* — Care should be taken at all points where trees were formerly located that all roots should be removed to a depth at least 300 mm below ground surface before compaction is commenced.

6.3.3 *Uniformity of Level* — The pond bottom shall be made gently sloping towards the sluice for draining the contents.

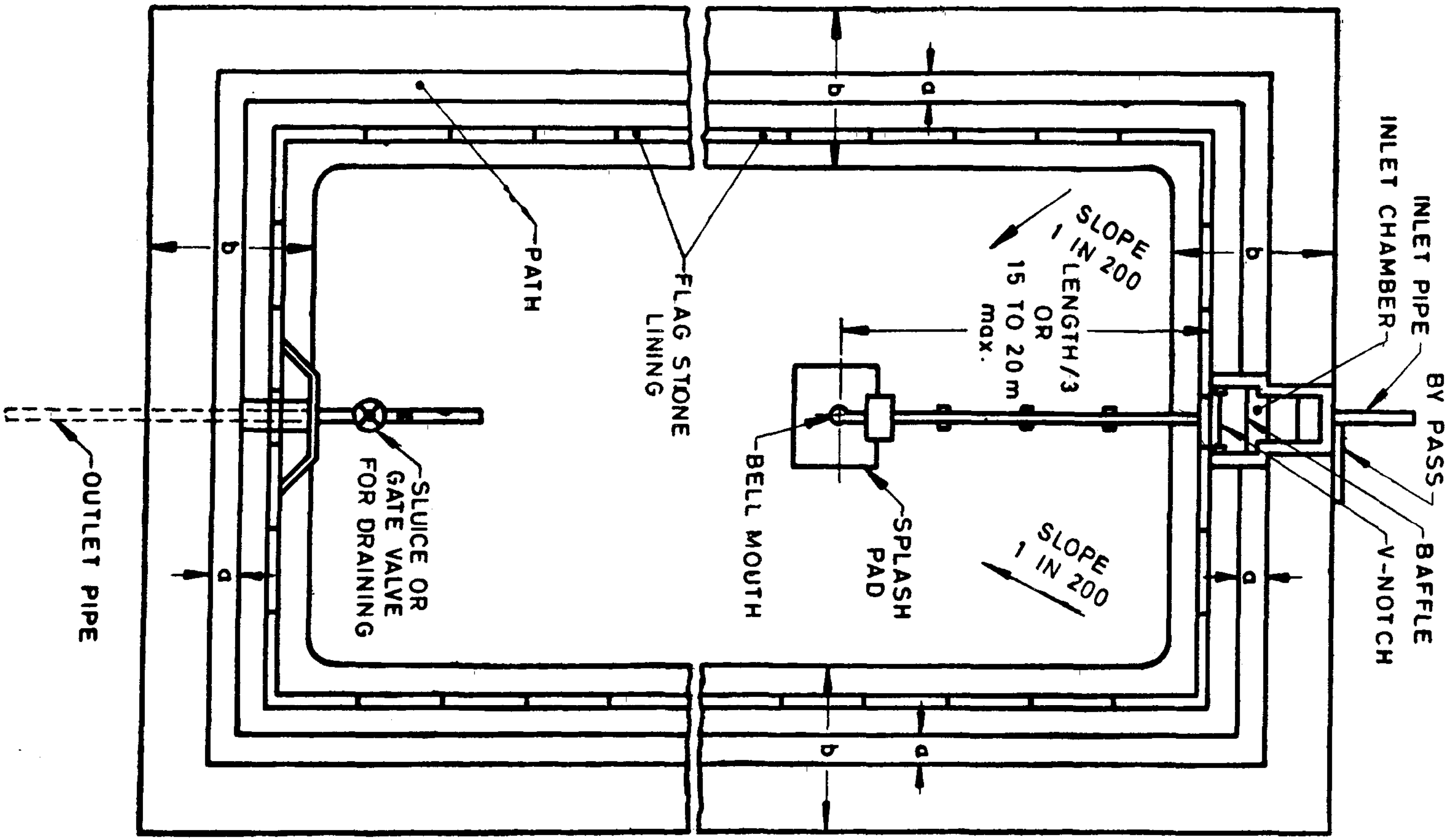
6.3.4 *Percolation* — Generally percolation rates diminish progressively with time owing to sealing of the bottom with sludge. Removal of coarse top soil and proper compaction of subsoil improves water holding characteristics of bottom. In case of very porous soils like sandy gravel, some steps may be taken to artificially seal the pond bottom by using clay or other lining material.

6.4 Inlet Structure

6.4.1 *Inlet Arrangement* — The incoming sewer line may either bring the sewage by gravity, if contours permit or by a pressure line from a pumping station. From the inlet chamber, the flow may be carried well into the pond by means of gravity inlet pipe laid at a constant slope on supports at intervals and terminating in a bend facing downwards over a concrete splash pad. Two typical inlet arrangements are shown in Fig. 3 and 4.

6.4.2 *Pre-treatment* — The sewer line arriving at the pond is generally made to terminate in inlet chamber where coarse screens are provided. Grit chamber may also be provided prior to the pond in certain cases where large quantities of grit is expected and they should conform to the requirements specified in IS : 6279-1971*.

*Specification for equipment for grit removal devices.



a = Top width of the bund.
b = Bottom width of the bund.

NOTE — In larger and wider ponds more than one inlet pipe be laid at angle from the inlet chamber so that the Belmouths and splash pads are provided at 15 to 25 m apart to cause even distribution of flow in the width. Similarly more than one outlet weir chambers is provided to effect uniform draw off of the effluent and to prevent short-circuiting of flow.

FIG. 1 TYPICAL PLAN OF A WASTE STABILIZATION POND

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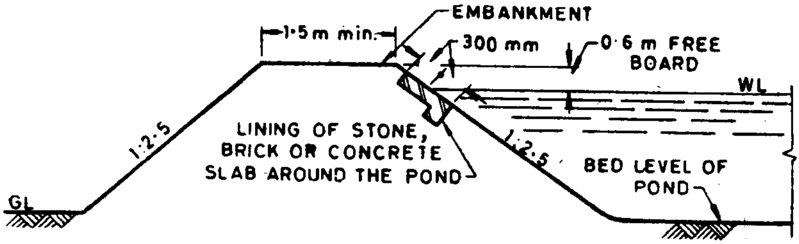


FIG. 2 TYPICAL DETAILS OF LINING ON THE EMBANKMENT SURFACE

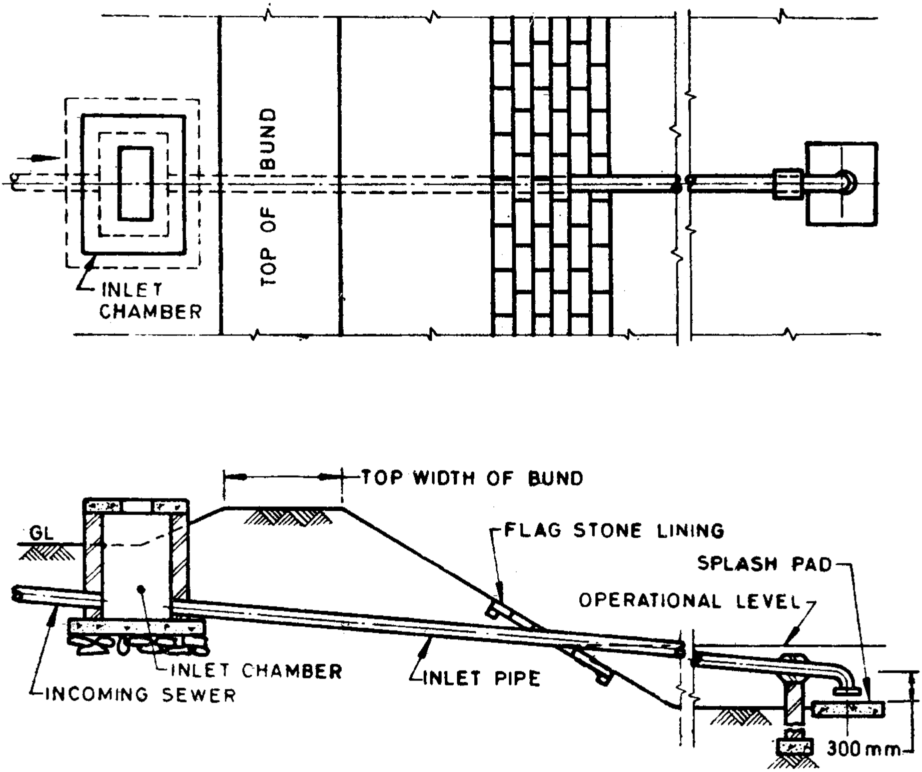


FIG. 3 TYPICAL DETAILS OF INLET ARRANGEMENT WITHOUT SCREEN AND MEASURING ARRANGEMENT

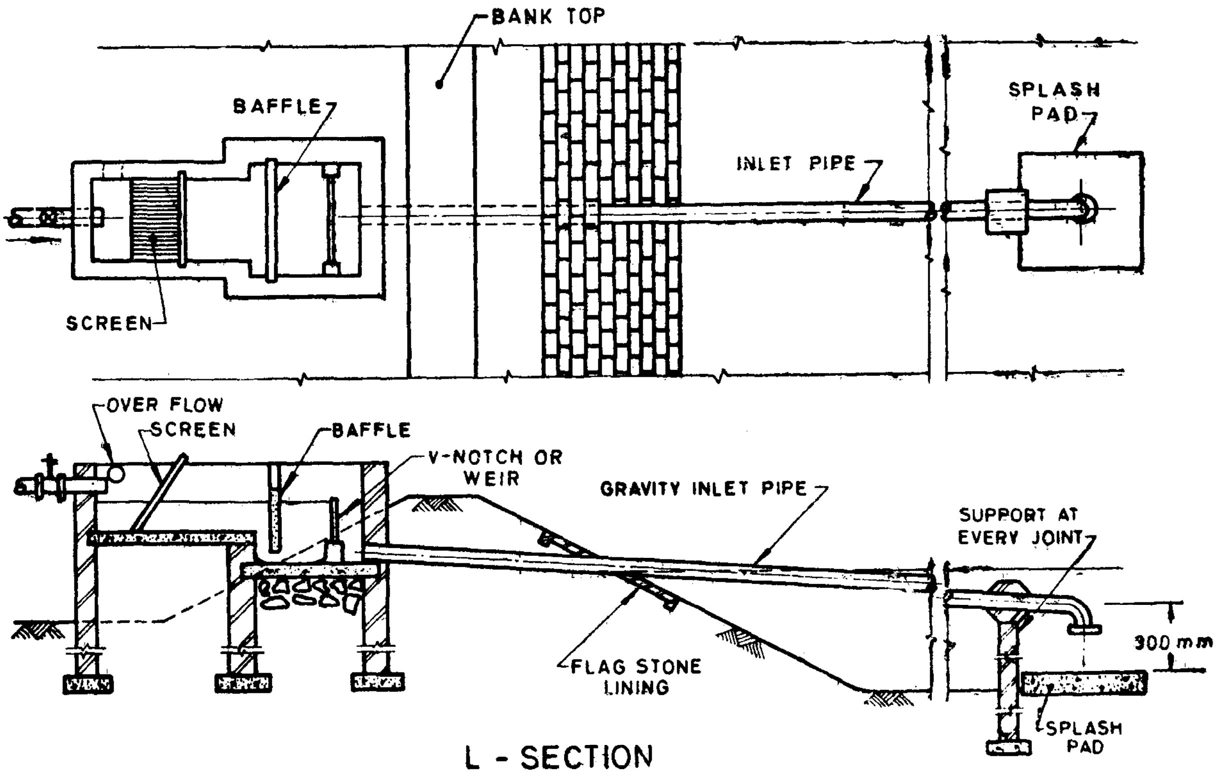


FIG. 4 TYPICAL DETAILS OF INLET CHAMBER WITH SCREEN AND MEASURING ARRANGEMENT

6.4.3 *Measurement of Flow* — Suitable flow measurement device should be provided.

6.4.4 *Inlet Chamber* — The inlet chamber should be of suitable size. It should accommodate coarse screens and flow measuring weirs, where necessary. The level of gravity inlet pipe (*see* **6.4.1**) at the inlet chamber shall be kept at least 300 mm above the operational level of the pond to ensure free fall. A suitable stilling chamber may be provided where flow measurements are to be made.

6.4.5 *Discharge Splash Pad* — Directly below the inlet pipe bend, a concrete or masonry platform may be provided as a splash pad to prevent erosion. Such a pad is made of about $1{\cdot}2 \times 1{\cdot}2$ m square or twice the diameter of the inlet pipe whichever is larger.

6.4.6 *Point of Discharge* — The point of discharge should be such as to avoid short-circuiting. Influent line to rectangular or oval shaped pond should discharge at 1/3 length of ponds but not more than 15 m for small ponds and 20 m for larger ponds.

6.4.7 *Number of Inlets* — Two or more inlets should be provided, wherever possible, except for very small ponds to ensure uniform distribution of the sewage.

6.5 Outlet Structure — Outlet may be in the form of pipe (*see* Fig. 5) or a suitable length of weir (*see* Fig. 6). In either case, it is very desirable to provide baffle wall projecting 150 to 300 mm above water level and tipping about 250 mm below the level of sewage into the pond. The level of draw should be minimum of 250 mm below the water surface (to prevent floating scum as well as algae from passing out with the effluent).

6.6 Interconnection of Ponds — Where interconnections are made for ponds in series, a suitable arrangement as shown in Fig. 7A and 7B may be adopted.

6.7 Miscellaneous

6.7.1 *Fencing* — Pond area shall be enclosed with a suitable fence to prevent the access to children, stray cattle and to discourage trespassing.

6.7.2 *Warning Signs* — Appropriate sign boards should be provided on the fence around the pond to describe the nature of the facility and to warn against trespassing.

6.7.3 *Access Road* — An all weather access road should be provided to the ponds, for inspection and maintenance.

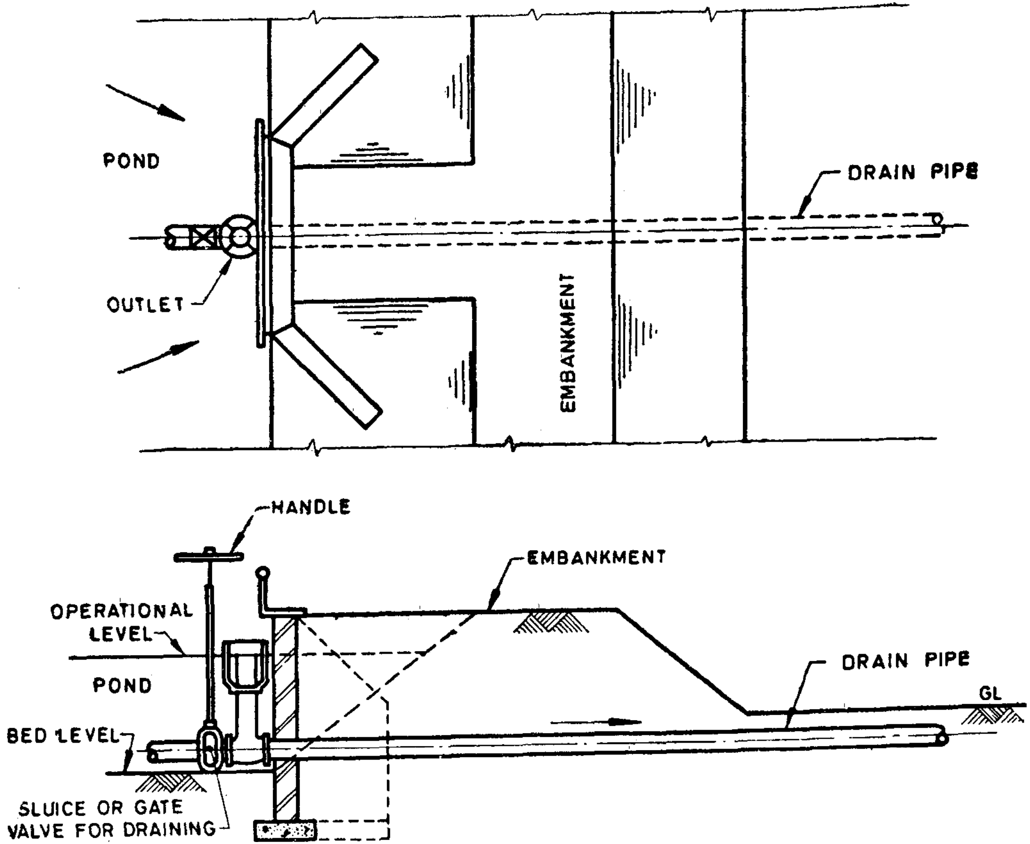
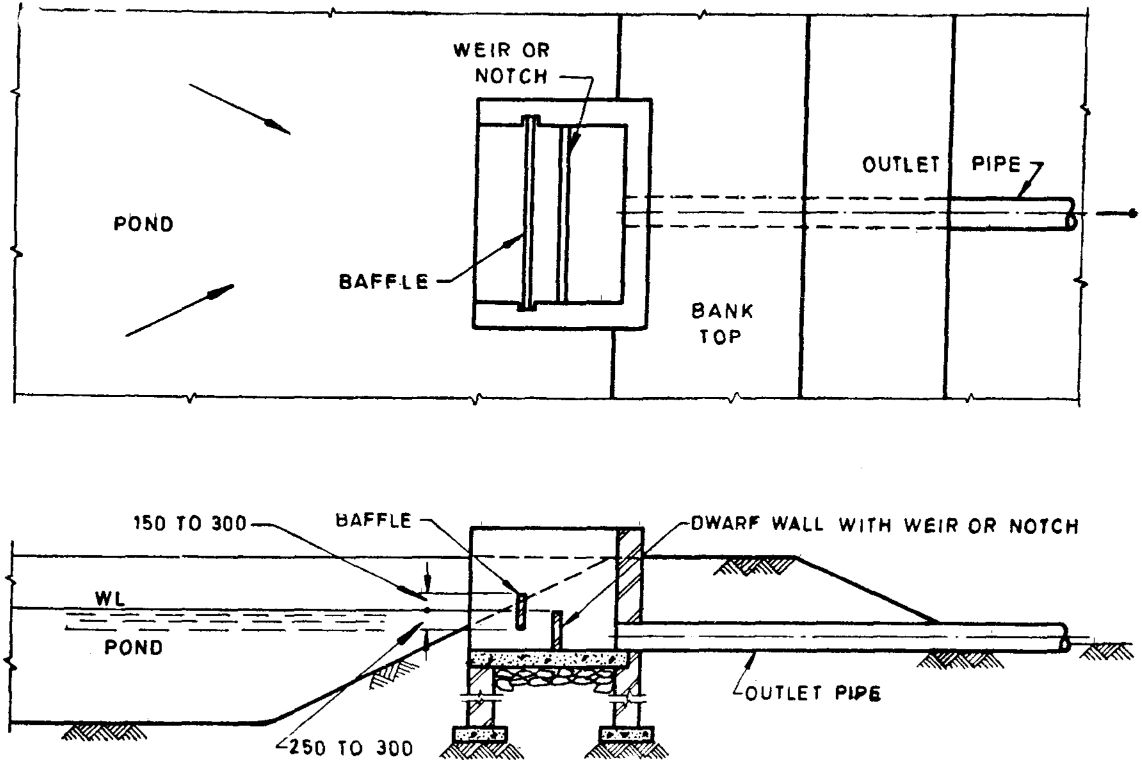
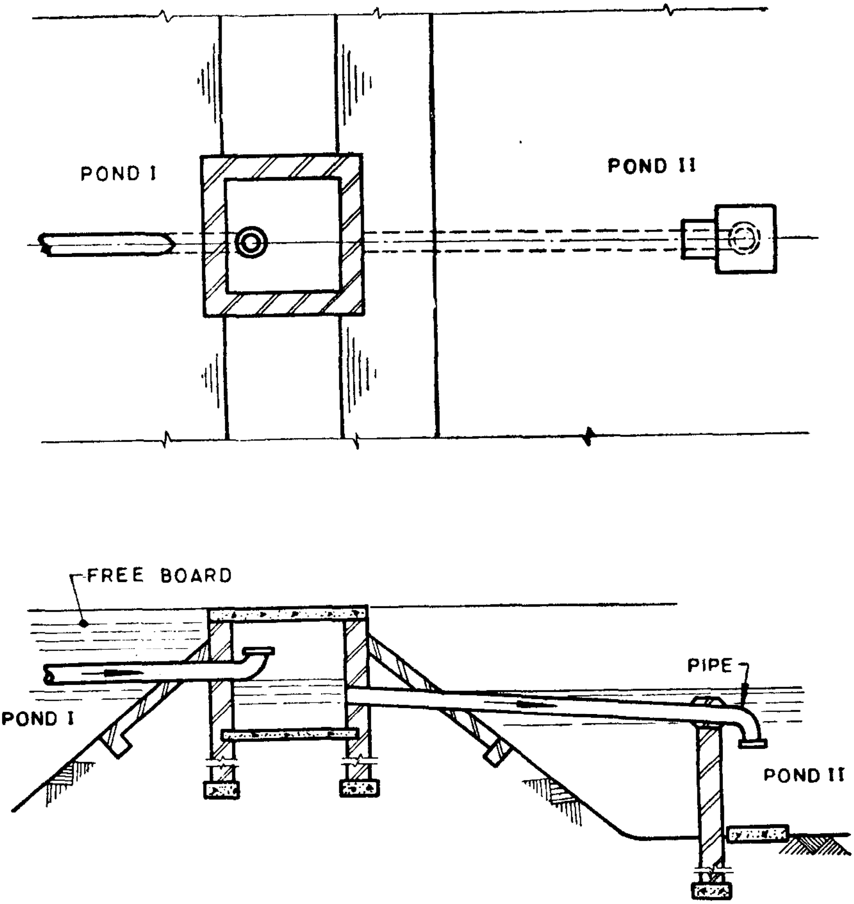


FIG. 5 TYPICAL DETAILS OF OUTLET SYSTEM WITH PIPE OUTLET FOR DRAINAGE OF SMALL PONDS

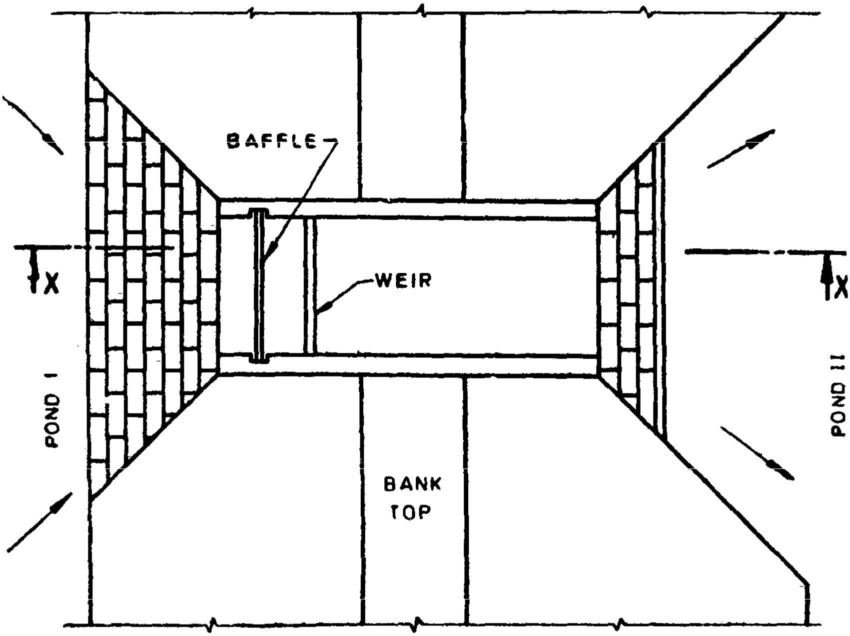


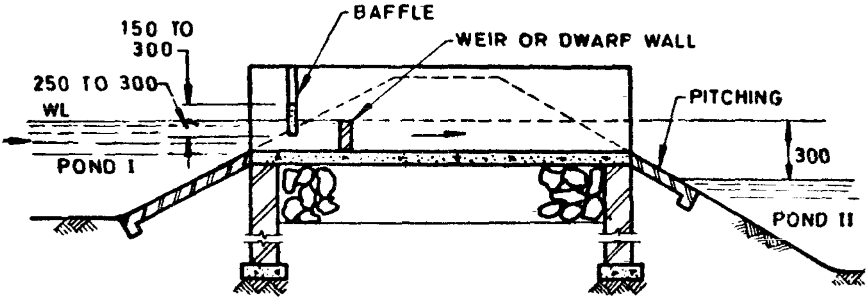
All dimensions in millimetres.

FIG. 6 TYPICAL DETAILS OF OUTLET CHAMBER OF WEIR TYPE



7A Interconnecting Arrangement of Ponds (Type I) (*Continued*)





SECTION XX

All dimensions in millimetres.

7B Interconnecting Arrangement of Ponds (Type II)

FIG. 7 TYPICAL INTERCONNECTING ARRANGEMENT OF PONDS

7. COMMISSIONING OF PONDS

7.1 Soils generally harbour the spores of various algae and a spontaneous growth of algae is likely to take place within a week or two after the sewage is admitted to the pond. Hence the artificial addition of algae culture is not necessary. Raw sewage may be admitted to thetiond gradually so that anaerobic conditions do not set in and proper growth of algae is obtained. Commissioning of the ponds may be done by any of the methods described in **7.1.1** and **7.1.2**.

7.1.1 Normally, the ponds are filled gradually but ideally it is better to fill them with water and some digested sludge before introducing waste water. If the pond is filled gradually with untreated waste water, it is desirable to place small dikes about 500 mm high across the pond. Temporary diking assists in sealing the bottom rapidly while maintaining sufficient depth of water to control weeds.

7.1.2 Alternatively the pond is filled as rapidly as possible with waste water to a depth of 1 m and left undisturbed for 10 to 20 days or until the pond turns greenish or bluish green. The adaptation period, consists of two phases, bacterial phase followed by algal phase.

8. OPERATION

8.1 Although operation of a waste stabilization pond does not call for a highly technical skill, it requires a regular checking of the pond, measurement of incoming and outgoing flows to know seepage and evaporation and periodic examination of the samples to know the purification obtained. The useful tests in this connection are determination of biochemical oxygen demand (BOD) and *p*H. Microscopic examination of algae and dips for mosquito larvae should be carried out regularly. Excessive sludge build up should be avoided by removing it once in five years. Scum from the pond surface be removed to allow penetration of sunlight into pond depth and promote photo-synthesis. If anaerobic conditions have been established in the pond, pumping of effluent may be considered.

9. MAINTENANCE

9.1 The surface of the pond should be kept clean from floating material like scum, twigs, leaves, etc. Normally, the floating material collects in the corner or near the edges of the ponds from where it may be easily removed by a basket. The inside slope of the pond should be kept free of weeds and marginal vegetation. Regular upkeep of the pond is essential to maintain them free from mosquito nuisance. Larvicidal measures, if adopted, should be usea with caution to avoid any possible ill effects on pond algae. The earthen embankments should be properly maintained by occasional trimming and dressing of slopes.

10. DISPOSAL OF EFFLUENT

10.1 The treated effluent may be disposed of as irrigation water or for fish culture or may be discharged into a stream, if local regulations permit.

10.2 Maturation Ponds — Where land is available, faculative stabilization ponds may be followed by one or more maturation ponds. These ponds are wholly aerobic and remove further suspended solids, BOD and bacteria helminths, and make the effluent safe and easy to utilize on land or to dispose of in bodies of water. These ponds provide excellent ground for breeding of edible fish, which may pay back the cost of treatment. These ponds are designed for a retention period of five days. These ponds are constructed with earthen embankment to contain a liquid depth of one metre.

(*Continued from page* 2)

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5-8-56C, L.N. Gupta Marg, Nampally Station Road, HYDERABAD 500001	20 10 83
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