SECTION 8
SEWAGE AND WASTE DISPOSAL

Contents

801  PROVISION OF SEWERAGE FACILITIES

801.1  General

802  NEEDS OF TOTAL DEVELOPMENT

803  DEVELOPER TO MEET TOTAL COST OF THE WORK

804  JOINT SYSTEMS

805  ENVIRONMENTAL FACTORS

806  APPROVAL BY THE AUTHORITY

807  PERCOLATION TESTS

808  CONFORMITY WITH BUILDING CODE

809  CONSULTATION PRIOR TO SUBMISSION

810  EMERGENCY POWER FACILITIES

811  EFFLUENT QUALITY

812  DISPOSAL OF TREATED EFFLUENT BY SEA OUTFALLS

813  SEWER SYSTEM

813.1  General
813.2  Separation of Water and Sewer Mains
813.3  Excavation
813.4  Bedding of the Sewer Pipe
813.5  Laying and Jointing of Pipes
813.6  Protection of Sewer Pipe
813.7  Backfilling of Trenches
813.8  House Laterals
813.9  Manholes
813.10  Choice of Systems
813.11  Re-use of the Effluent
813.12  Requirements of the Authority
814 TESTING OF SEWERS

815 TESTING MANHOLES FOR WATERTIGHTNESS

816 SEWAGE TREATMENT PLANTS

816.1 General Requirements
816.2 Approval of Plans

Table 8-1 Approximate Efficiencies of Sewage Systems and Plants

817 SEPTIC TANKS AND SOAKAWAYS

817.1 Use of Septic Tanks
817.2 Design of Septic Tanks
817.3 Location of Septic Tanks
817.4 Construction of Septic Tanks
817.5 Operation
817.6 Maintenance of Septic Tanks
817.7 Soakaways
817.8 Location of Soakaways
817.9 Construction of Soakaways
817.10 Land Drains
817.11 Recommended Length of Land Drains
817.12 Location of Land Drains
SECTION 8

SEWAGE AND WASTE DISPOSAL

801 PROVISION OF SEWERAGE FACILITIES

801.1 General

a) Every building intended for human habitation, or in which human beings are to be employed shall be designed to provide for a sewerage system of drainage to a septic tank or more efficient treatment facility of a design to be approved by the Authority.

b) The developer must provide a system or systems to fully satisfy the need for sewage collection, treatment and disposal of effluent and sludge. The system(s) proposed must direct special attention to the use of topography, the layout of the development, roadways, and the location of treatment plants and outfalls. Sewage flows of 80% of the average daily water consumption rates given in Section 7 should be provided for.

802 NEEDS OF TOTAL DEVELOPMENT

Where the development is phased, the system proposed for sewage and waste water disposal must address the needs of the total development to ensure an orderly solution to those problems.

803 DEVELOPER TO MEET TOTAL COST OF THE WORK

The total cost of the work associated with the development of the sewerage system shall be payable by the developer.

804 JOINT SYSTEMS

a) Where two or more developments are adjacent or in close proximity to each other consideration should be given to a joint system in order that sewage disposal facilities may be integrated without detriment to any of the developments.

b) In any event the proposed sewage disposal system must not adversely affect adjoining developments particularly with respect to the location of treatment facilities and outfalls.
ENVIROMENTAL FACTORS

(a) All systems shall be located and constructed so that with proper maintenance the systems will function in a sanitary manner, do not create sanitary nuisance or health hazards and do not endanger the safety and water quality of fresh ground water lens or domestic water supply.

(b) Arrangements for the management and treatment of sewage and waste water shall take into account the topographical conditions, environmental factors, the proposed use of the land inside and outside of the development, and the relative locations of the sea, surface waters and ground water sources.

(c) The use of effluent for any purpose must be approved by the Ministry of Health.

APPROVAL BY THE AUTHORITY

The proposals and plans for these facilities must be to the satisfaction of the Authority.

PERCOLATION TESTS

a) Percolation tests shall be carried out if required by the Authority whenever it is planned to use absorption pits or septic tanks with soakaways or land drains to dispose of the sewage. The approval of the Authority for the use of such systems will depend on the percolation rates found. Percolation criteria for soakaways are given in Table F-3 of Section F of the Building Guidelines:

b) The percolation criteria to be used in determining whether soakaways can be efficient in a given area must be based on the rate of absorption of liquid waste and the area of the absorption surface. In general, soils with absorption rates of less than 1” in 30 minutes are unsuitable for soakaways.

CONFORMITY WITH BUILDING CODE

The arrangement for collection and disposal of sewage and waste water from buildings must be in accordance with this Code.
CONSULTATION PRIOR TO SUBMISSION

Plans for the treatment system proposed be developed in consultation with the Ministry of Health and the Director prior to formal submission of the plans for approval.

EMERGENCY POWER FACILITIES

Subject to the provision of the Electricity Ordinance in force and unless specifically exempted by the Authority, all treatment plant and pumping stations shall be provided with an alternate source of electricity to allow continuity of operation during power failure.

EEFILUENT QUALITY

The quality of the effluent after treatment shall satisfy the following criteria:

i) BOD not to exceed 45 milligrams per liter based on effluent samples collected in a period of seven consecutive days.

ii) Suspended solids not exceeding 45 milligrams per liter based on samples collected in a period of seven consecutive days.

iii) Coliform content not exceeding 400 per 100 milliliters based on effluent samples collected in a period of seven consecutive days.

iv) Other standard criteria as may required by the Authority and/or Ministry of Health.

DISPOSAL OF TREATED EEFLUENT BY SEA OUTFALLS

a) The type, location, and design of the sea outfalls must be based on a detailed study of the character of the sea in which the outfall is placed, the current flows, the present ecology of the area, and the chemical composition of the effluent.

b) The study shall be carried our at the expense of the developer by experienced professionals, and the result of the study shall be forwarded to the Authority. The approval of the Authority is required for the disposal of effluent by sea outfall.

Note: Sea outfalls are not permitted in some States
813 SEWER SYSTEM

813.1 General

a) The sewer system must be designed and constructed to the satisfaction of the Authority.

b) The sewer system must be laid in accordance with the conditions outlined below.

813.2 Separation of Water and Sewer Mains

a) Sewer pipes should not be laid over water mains. If this is unavoidable and the sewer pipes must cross over the water pipes, the sewer pipes should be of ductile iron and encased in a ductile iron sleeve for at least 20 inches on either side of the points of cross over. See also 705.3c).

b) Sewer pipes shall not be laid through a water storage tank.

813.3 Excavation

(a) The trench shall be excavated true to line and grade. The width at the top of the trench will vary with the depth but should not be more than the minimum required to accommodate shoring when required, and to provide adequate working space. The width at the bottom of the trench should not be less than the diameter of the pipe plus 12 inches.

(b) The depth of the trench should be such as to provide a minimum cover of 3 ft 6 inches over the socket of the pipe measured from the finished road surface.

(c) In general, sewers must be sufficiently deep to receive sewage from all adjacent buildings.

(d) If any portion of the trench has been excavated below grade it must be refilled with approved granular material well rammed in 6 inch layers. Adequate bedding must be provided as described in 813.4.

(e) If any portion of the trench is in rocky ground it should be excavated to a depth of 6 inches below grade and refilled with approved bedding material as described in 813.4.

(f) If any portion of the bottom of the trench is in peaty or unstable ground which may not provide adequate support for the pipe, the trench should be excavated to a sufficient depth below grade and be refilled with well rammed 6 inch layers of granular material to provide adequate support for the pipe.
813.4 Bedding of the Sewer Pipe

Subject to the manufacturers' recommendations, sewer pipes constructed of the following material shall be laid on a bed not less than 4 inches thick composed of material having no particle size larger than as specified below:

<table>
<thead>
<tr>
<th>Material</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ductile iron or grey cast iron:</td>
<td>1 inch</td>
</tr>
<tr>
<td>PVC</td>
<td>1/4&quot;</td>
</tr>
</tbody>
</table>

813.5 Laying and Jointing of Pipes

a) The pipes shall be laid carefully in conformity with the manufacturers' requirements. The pipes shall be laid true to line and grade. After each section of the sewer has been laid between successive manhole locations, it shall be cleared of all foreign matter by passing through it a scraper or similar instrument, slightly smaller in diameter than the sewer.

b) In the event of an existing pipeline having been fractured, the damaged portion shall be cut and replaced by a length of plain ended pipe and properly jointed.

c) All pipes should be clean, correctly located and laid in true alignment in horizontal and vertical planes.

813.6 Protection of Sewer Pipe

a) All sewers shall be protected against damage from vehicular traffic and from roots of trees. The protection required would depend on the type of soil in which the sewer is being laid, the location of the sewer and the material with which the sewer is made. Where required the developer shall provide plans of such protection for the approval of the Director.

b) The manufacturers' requirements for special protection should be observed where there are severe conditions of unstable ground or excessive depth below the surface.

813.7 Backfilling of Trenches

a) Sewers which have been laid on a bed of concrete or which have been surrounded with concrete shall not be backfilled until the concrete is at least 7 days old.

b) The trench shall be backfilled to a height of 12" over the pipe with an approved granular material well compacted by hand rammer in 6 inch layers. Thereafter the approved backfill material shall be compacted by hand rammer to a height of 24 inches over the pipe.

(8-7)
c) Thereafter the remainder of the backfill of selected excavated material may be rammed to the surface by mechanical means. In the case of sewers which have been surrounded by concrete the selected material shall be rammed in 6 inch layers. To ensure satisfactory consolidation, the backfill material should be sprinkled with water while being compacted.

813.8 House Laterals

a) The lateral shall be connected to the sewer by means of a 45 degree angle branch or a 45 degree bend. A special fitting incorporating both the branch and the bend may be used provided that adequate stocks are available and can be easily obtained.

b) Where the depth of the sewer is less than 9 feet but greater than 4 feet, the Director may in his discretion permit the lateral to be laid at a gradient steeper than 1 in 30.

c) Where the sewer is more than 9 feet deep the lateral shall be connected to the sewer by a single or double vertical riser and the sewer shall be made using a 45 degree branch set vertically on the sewer and a 45 degree bend connecting the riser to the branch.

813.9 Manholes

a) Manholes shall be provided at all horizontal and vertical changes in direction of the sewer and also on the straight sewer at a maximum interval of 300 feet. Their internal dimensions shall generally be 3 ft 6 in. by 3 ft. The materials of construction must be approved by the Authority.

b) Channels and benchings and all interior surfaces in the manhole shall be smooth and free from obstructions.

c) Manholes greater than 5 feet deep shall be provided with ladders.

d) Each manhole shall be provided with a heavy duty manhole cover frame and gas tight cover with a clear opening of 8 inches.

e) A drop pipe shall be provided for a sewer entering a manhole where the invert of the incoming sewer is more than 3 feet above the invert of the outgoing sewer.

f) To ensure bonding of the pipe to the concrete, all PVC pipes passing through the walls of the manholes shall be roughened.
813.10 Choice of System

a) The choice of an appropriate sewage system depends on the amount of sewage to be treated and the economics of the treatment process. The Authority must approve the choice of the sewage system proposed by the applicant.

b) It can be seen from Table 8-1 that for large systems and where there are no special requirements such as disposal of hazardous substances, nuclear waste and the like, the conventional activated sludge treatment preceded and followed by plain sedimentation will provide a significant reduction in B.O.D., suspended solids and B. coli.

c) Intermittent sand filtration will yield slightly better results. About 98% of the B. Coli bacteria is removed along with 90% to 95% of the suspended solids.

d) Chlorination of raw sewage does not remove suspended solids but removes 90% to 95% of B. coli bacteria.

e) The use of chemical precipitation (mixing chemicals such as ferric chloride with the sewage) removes 70% to 90% of the suspended solids and 40% to 80% of the B. coli bacteria.

f) Settling tanks required to accommodate the sewage from developments with flows of more than one million gallons per day (more than 15,000 persons) would have to be about 12,000 cubic feet and about 1,500 square feet for a retention period of 2 hours and an overflow rate of 800 gallons per sq. ft. per day. Design information for such systems is available in manufacturer's manuals.

g) The capacity of sand filters for treating the discharge of septic tanks which would collect household waste is estimated at 50,000 gallons per acre. For a population of 20,000 the area of the sand filter would be about 20 - 30 acres depending on the calculated daily sewage flow.

813.11 Re-use of the Effluent

a) Treatment of the effluent from an activated sludge plant or from an intermittent sand filter with the appropriate chlorine dosage will reduce the B.O.D to reasonably acceptable proportions for disposal into tile drains, for re-use in gardens or water closets or for disposal into a properly designed sea outfall depending the policy of the Government.

b) The re-use of effluent offers significant advantages where conservation of water is important. However such effluent must be to reduce both suspended solids and the B. coli bacteria to an acceptable standard. The Ministry of Health must approve the plans for re-use of effluent.
813.12 Requirements of the Authority

a) The Authority would require that plans for the collection and disposal of sewage show:
   i) the size and distribution of the collection system
   ii) the location of the final disposal of the effluent and
   ii) the area available for siting and constructing treatment plants.

b) The applicant must show in the plans submitted to the Authority for approval all details of the design and construction of the plant including:
   ■ population to be served
   ■ type and quantity of waste to be treated
   ■ sewage treatment flow diagram
   ■ details of collection system
   ■ land area required for treatment system
   ■ construction details of treatment plant
   ■ quality of effluent to be discharged
   ■ design of final disposal of the effluent
   ■ detailed plans for maintenance of the system and for disposal of sludge.
   ■ stand-by power

814 TESTING OF SEWERS

a) All sewers shall be tested by the developer before being backfilled or surrounded with concrete. They shall also be retested after backfilling.

b) The test shall conform to the following procedure:
   i) The sewer shall be tested in length between successive manholes.
ii) The pipe shall be slowly filled with water until the water surface is 4 feet above the invert of the pipe or above ground water level at the higher end. In the case of asbestos cement pipe, the water must be allowed to stand in the pipe for 24 hours, at the end of which time sufficient water shall be added for it to reach its original level of 4 feet above the invert or ground level.

iii) The criterion for a successful test shall be that the loss of water in 30 minutes should not exceed 0.2 gallons per hour per 100 feet of pipe per inch diameter. Should the result of the test be unsatisfactory, the developer shall correct the fault. The test shall then be repeated.

c) Sewage pumping mains shall be tested in the manner described in 705.6.

d) The developer shall be responsible for meeting the cost of carrying out the testing of the sewer system to the satisfaction of the Director.

815 TESTING MANHOLES FOR WATERTIGHTNESS

a) All pipes entering and leaving the manholes shall be plugged and the manhole shall be filled with water to 6 inches to the underside of the cover slab and shall remain filled for 24 hours. Sufficient water shall then be added for the surface of the water to regain its original level.

b) The level shall be observed for a period of 12 hours. The criterion for a successful test is that the water level should not fall in 12 hours to a lower level than in the opinion of the Director could be explained by evaporation.

c) Should the test result be unsatisfactory the developer shall correct the defects and the manhole shall be retested until a satisfactory test result has been obtained.

d) The developer shall be responsible for meeting the cost of and for carrying out the testing of the manholes to the satisfaction of the Director.

816 SEWAGE TREATMENT PLANTS

816.1 General Requirements

a) Complete data on the proposed treatment system must accompany all applications including:
(i) Engineer's Report

(ii) Prints of drawings

(iii) Specifications of equipment

(iv) Data sheet giving full details of design loading ie:

(v) Maintenance schedule.

(vi) Method of disposal of effluent

b) Facilities should be provided for the removal of grit and debris prior to the influent entering a pumping station or treatment plant. All pumps should be equipped with strainers capable of removing solids greater than provided for in the design of downstream processes.

c) The plant as designed must be capable of treating sewage to produce an effluent to the standards shown in 811.

d) Sewage may be discharged into a septic tank linked with a biological filter or with land drains or soakaway pit provided that:

i) If the system is connected to a proprietary tank or disposal system discharging an effluent approved by the Ministry of Health such effluent may be discharged directly from such tank or system and recycled for use as approved by the Ministry of Health.

ii) If the system is connected to a septic tank the effluent must be discharged into land drains or soakaway pits constructed in accordance with this Code and approved by the Ministry of Health.

e) Construction of cess pits may not be approved by the Ministry of Health.

816.2 Approval of Plans

Detailed plans and technical data as required as at 816.1 a) will be reviewed by the Director and by the Authority in consultation with the Ministry of health. Approval of the Authority for the installation of the sewage treatment system will be given only if all of the technical data supplied by the owner is satisfactory, and if satisfactory arrangements have been made for the maintenance and repair of the system. The Authority shall require that stand-by systems for major components such as power plant be supplied and maintained.
### Table 8-1

*Approximate Efficiencies of Sewage Systems and Plants*

<table>
<thead>
<tr>
<th>Treatment, operation or process</th>
<th>Percent removal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B.O.D</td>
</tr>
<tr>
<td>Fine screening</td>
<td>5-10</td>
</tr>
<tr>
<td>Chlorination of raw or settled sewage</td>
<td>15-30</td>
</tr>
<tr>
<td>Plain sedimentation</td>
<td>25-40</td>
</tr>
<tr>
<td>High rate trickling filtration preceded and followed by plain sedimentation</td>
<td>65-95</td>
</tr>
<tr>
<td>Low-rate trickling sedimentation preceded and followed by plain sedimentation</td>
<td>80-95</td>
</tr>
<tr>
<td>Conventional activated sludge treatment preceded and followed by plain sedimentation</td>
<td>75-95</td>
</tr>
<tr>
<td>Intermittent sand filtration</td>
<td>90-95</td>
</tr>
<tr>
<td>Chlorination of biologically treated sewage</td>
<td>-</td>
</tr>
</tbody>
</table>

*From Date Book for Civil Engineers, Third Edition – Elwyn E. Seelye*

#### 817 SEPTIC TANKS AND SOAKAWAYS

817.1 Use of Septic tanks

a) Septic tanks are used to provide primary treatment to sewage from buildings with sewage flows of no greater than about 10,000 gallons per day. The design and construction of septic tanks are discussed in 817.2, 817.3 and 817.4.

b) Sewage may be discharged into a septic tank linked with a biological filter or with land drains or soakaway pit provided that:

i) If the system is designed to serve less than 20 persons the sewage may be discharged directly into an absorption pit so long as the absorption area is designed and constructed as per 817.7, 817.8 and 817.9, or the land drains constructed as at 817.10 and 817.11.

ii) If the system is connected to a proprietary tank or disposal system discharging an effluent approved by the Authority such effluent may be discharged directly from such tank or system as may be approved by the Director.
iii) The system of disposal of the effluent from the tank is approved by the Ministry of Health.

817.2 Design of Septic Tanks

a) The basic function of a plain settling or septic tank is to received domestic sewage, partially treat it, segregate the solids, and discharge the liquid to a tile field or soakaway.

b) In order to provide for maximum solids removal, adequate tank capacity is necessary. The appropriate volume of the tank is a function of the amount of liquid being discharged into the tank and the volume may be calculated as follows:

i) For flows up to 500 gallons per day, the net volume to be at least 750 gallons.

ii) For flows of 500 gallons to 1500 gallons per day, tank volume to be at least 1-1/2 days sewage flow.

iii) For flows larger than 1500 gallons per day, the minimum tank liquid volume should equal the following:

\[ V = 1125 + .75Q \]

where \( V \) is the net volume of the tank in gallons, and \( Q \) the daily flow of sewage in gallons.

iv) For flows above 15,000 gallons per day a septic tank would not be suitable, and the owner must examine another system such as an Imhoff tank or proprietary aerobic treatment plant as per 816.

c) The design, construction, maintenance and operation of septic tanks must be carried out in accordance with the guidelines of the Central Board of Health (Ministry of Health).

817.3 Location of Septic tanks

a) Tanks shall be located where the largest possible area is available for the disposal of effluent either by soakaways or by leaching fields (land drains).

b) The Following guidelines must be taken into account in the location of the septic tank:

i) The tank must be downstream of any water cistern

ii) at least 5 ft. away from any building
iii) at least 8 ft. away from any property line/boundary

iv) at least 10 ft. away from any large trees

v) at least 25 ft. away from any stream, and

vi) at least 150 ft. away from any drinking water well.

817.4 Construction of Septic Tanks

a) Tanks shall preferably be of two (rather than one) water tight chambers to achieve better clarity of effluent.

b) Tanks shall preferably be constructed of reinforced concrete block work rendered on the inside and base, or of 2500 psi reinforced concrete. The cover of the tank should be of reinforced concrete and capable of withstanding loads of 100 lbs per square foot. There must be removable manhole covers over inlets and outlets.

c) Inlets and outlets with sanitary T branches shall be so located as to avoid disturbance of the surface scum. An air space of 12 inches should be provided.

d) The septic tank should be rectangular with the length at least three times the width. The inlet compartment of the tank should have about 75% of the total capacity of the total tank capacity. The minimum depth of the tank should be 4 feet.

e) Septic tanks shall not be undersized or be constructed in series as the velocity of flow through two identical tanks is the same as the velocity through one of them. This type of arrangement virtually doubles the velocity and results in the carry over of 70% of the suspended material. The heavier solids settle to the bottom forming a blanket of sludge and the lighter material rises to the surface to form a layer of scum.

817.5 Soakaways

a) Soakaways shall be used where sub-surface conditions allow. They shall never be used where there is a likelihood of contaminating underground water supplies and fresh water lenses. The developer may find that land drains or leaching fields (817.10) are suitable in some soil conditions in the State.

b) It is important that a test be carried out at each building site as soil types vary widely and the size of the pit depends on the type of soil and the volume of effluent to be absorbed. The test must be carried out to the specifications of the Ministry of Health and the results used to design the size and type of soakaway to be constructed.
c) The area required for absorption in a pit shall be based on the effective vertical wall area of the pit. No allowance shall be made for the pit bottom or the area above the inlet.

817.6 Location of Soakaways

a) No soakaway shall be within:

- 10 feet of a site boundary,
- 15 feet from a building,
- 100 feet from a stream used for water supply
- 150 feet from a well.

Where two soakaways are to be constructed they shall be located not less than three times the largest of the surface dimensions apart.

b) The sub-surface disposal system must be located downstream of any water cistern, and the area selected for construction of a soakaway pit shall be large enough to allow for additional pits in the event of a failure.

c) The location of size, and construction of soakaways must be to the approval of the Director in consultation with the Ministry of Health.

817.7 Construction of Soakaways

The soakaway pit is to be lined with stones, or concrete blocks laid up dry with open joints backed with at least 3" with coarse gravel to a depth of at least 1 foot. The cover shall be made of reinforced concrete and be capable of withstanding loads of 100 lb. per sq.ft.

817.8 Land Drains

Where land drains are used, the drains which are constructed of pipes with open joints or holes linked to septic tanks, shall be laid in open areas not surfaced with impervious materials in accordance with the following requirements:

a) Pipe trenches shall be a minimum width of 1’ 6”, a minimum depth of 3’ 0” and a maximum length of 100’ 0”

b) No pipe runs shall be located within 5’ 0” of one another or of a building or a site boundary.

c) No pipe runs shall be located within 50’ 0” If any well or stream or open water source.
d) Pipes shall be a maximum length of 2’ 0” or alternatively shall have perforations or holes equal to not less than 20 percent of their surface area.

e) Pipes shall be laid on a minimum 6” bed of gravel at a gradient not shallower than 1:96.

f) Pipes shall be laid with 1/4” open joints and the joints shall be covered with strips of asphalt bonded building paper not less than 4” wide.

g) Trenches shall be backfilled with gravel to a minimum of 3” over the cover of the pipes.

817.9 Recommended Length of Land Drains

a) Where permeability tests on the pipe trenches give a water drop of not less than 4” an hour over a period of 24 hours, 1’ 0” run of pipes shall be allowed for each 8 gallons of septic tank capacity.

b) Where permeability tests on the pipe trenches give a water drop of 2” to 4” an hour over a period of 24 hours, 1’ 0” run of pipe shall be allowed for each 4 gallons of septic tank capacity.

817.10 Location of Land Drains

The location of the system should be as per 817.6.