Formula for the simultaneous action of internal pressure and external load gives a lower supporting strength of a pipe than what it would be if the external load acted alone.

Simultaneous action of internal pressure and external load gives a lower supporting strength of a pipe than what it would be if the external load acted alone.

6.5.5 Conditions Under Simultaneous Internal Pressure and External Loading

The equations for positive flowing conditions will hold good for those conditions as well.

Imposed Trench Conditions

and (6.15) with a value of $k$ of 0.15 provides the side fill factor well compounded.

The load factor for negative flowing conditions may also be determined by the equations (6.15).

Negative Flowing Conditions

<table>
<thead>
<tr>
<th>$S$</th>
<th>$T$</th>
<th>$N_x$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.08</td>
<td>0.12</td>
<td>0.1</td>
</tr>
<tr>
<td>0.09</td>
<td>0.13</td>
<td>0.09</td>
</tr>
<tr>
<td>0.1</td>
<td>0.14</td>
<td>0.08</td>
</tr>
<tr>
<td>0.11</td>
<td>0.15</td>
<td>0.07</td>
</tr>
</tbody>
</table>

TABLE 6.8 Values of $z$ for Different Pipe Beddings

The value of $z$ in case of circular pipes is given in Table 6.8.

<table>
<thead>
<tr>
<th>Type of Bedding</th>
<th>Value of $z$</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. - Plain concrete cave</td>
<td>0.13</td>
</tr>
<tr>
<td>B. - Reinforced concrete cave</td>
<td>0.15</td>
</tr>
</tbody>
</table>

TABLE 6.7 Values of $N$ for Different Pipe Beddings

<table>
<thead>
<tr>
<th>Type of Bedding</th>
<th>Value of $N$</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. - Plain concrete cave</td>
<td>0.45</td>
</tr>
<tr>
<td>B. - Reinforced concrete cave</td>
<td>0.5</td>
</tr>
</tbody>
</table>

1.31
0.84
0.71
0.55 to 0.64
0.42 to 0.51

Value of $z$ for Different Pipe Beddings

<table>
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<tr>
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<td>0.15</td>
</tr>
</tbody>
</table>
RECOMMENDATIONS

6.7

Appendix G gives the details of these edge bearing tests.

$$\text{Safe edge bearing strength} = \frac{\text{Working strength} \times \text{Load factor}}{\text{Factor of Safety}}$$

6.6

The basic design relationships between the different design elements are as follows for rigid

SIMULTANEOUSLY acting

three edge bearing load at failure in kip/linear ft when there is no internal pressure

$$S$$

of internal pressure and

three edge bearing load at failure in kip/linear ft when there is simultaneous action

$$S$$

bending strength of a pipe in kip/ft when no external load is simultaneously acting

$$1$$

internal pressure in kip/ft when external load is simultaneously acting

$$1$$
Illustrative examples for structural design of bunded tanks are given in Appendix G.

ILLUSTRATIVE EXAMPLES

6.8

Assumptions:

Proper backfilling methods both as regards to selection of materials, methods of

occupied by the tanks is properly backfilled.

cammed out in stages and this should be properly supervised to ensure that the space

Whenever shifting is used, the pulling out of tank on completion of work should be

to the site.

centred on the manufacturers should be furnished for every consignment brought.

All pipes used on the work should be tested as per the IS specifications and test

124
CONSTRUCTION OF SEWERS

CHAPTER 7

126
Tunnels are employed in sewer systems when it becomes economical considering the nature of the work.

### 7.13. Tunnels

To 6.53

Concrete or wooden arches. For large receiving basing, wood or reinforced concrete arches may be made.

Concrete arches supported on piles.

In the case of cast-in-place sewers in R.C. Section with both transverse and longitudinal steel.

Concrete arches supported on piers.

Common concrete or appearance grade.

The addition of some gravel or rock in case of very bad soil, the trench bottom shall be filled with sand or crushed gravel, then covered with cement. The trench bottom shall be sloped by 1

Where a sewer has to be laid in soil under ground slabs in a retarding lead, the trench

### 7.13.5. Foundation and Bedding

When an induced buoyancy during rainy season. Precautions may be made 6.3.4 for more details in this regard.

For further disposal. Precautions are to be taken to arrest floating of severs. Final arising of

All pipes, ducts, cables, mains and other services exposed due to the excavation shall be

### 7.13.6. Excavating

and sloping may be done in stages.
The sides and the top of the tunnel are covered with a concrete, which is generally used for supporting the weight of the soil or steel. Segregated support of the tunnel is used for excavation operations where the ground is wet.

Open face mining without shields are adopted in particular instances where the ground is dry.

Excavated areas.

Any long and narrow opening in the tunnel is called an excavation. The tunnel is excavated to form a passage or an opening. The excavation is formed by removing soil from the tunnel walls, which is then removed by the excavator. The excavation is then covered with a concrete, which is generally used for supporting the weight of the soil or steel. Segregated support of the tunnel is used for excavation operations where the ground is wet.

Tunneling shields are used as a safety precaution in mining operations in very soft clay.

Tunnels range from 1.5 m to 7.5 m in diameter, which varies depending on the type of material and rock hardness.

Mining

Common types of mining are open-pit, underground, and tunneling. The most common type of mining is the open-pit method, which involves the removal of rock from the surface of the ground. The rock is then transported to a processing facility, where it is crushed and prepared for use.

Tunneling is a common method of mining, which involves the creation of a tunnel through rock. The tunnel is then used to transport the rock to a processing facility, where it is crushed and prepared for use.

Jacking

In jacking, the leading face is provided with a cutter or adze to protect the tunnel face from being damaged. Jacking is a common method of mining, which involves the creation of a tunnel through rock. The tunnel is then used to transport the rock to a processing facility, where it is crushed and prepared for use.

Auger or Borning

Auger and boring are two common methods of mining. The auger method is used for softer ground, while the boring method is used for harder ground. In the auger method, a drill is used to create a hole, which is then filled with a mixture of rock and concrete. In the boring method, a drill is used to create a hole, which is then filled with a mixture of rock and concrete.

7.1.2. Methods of Tunneling

The underground methods adopted for sewer construction can be classified generally as above ground.
be in such a manner that the usual two or three. The ties are generally disposed at the invert
the choice depending on the average costs worked out for the special project. The concrete shall
for several years from the contact or the cast-in-place concrete sections shall generally be used.

7.13.2 CAST-IN-PLACE CONCRETE SECTIONS

The requirements for cast-in-place concrete sections shall be in accordance with Article 7.13.2.

The tie shall be set in position over proper bedding. The tie of which may be

7.13.3 R.C. PIPES

protected by a disk flange stopper on each end. A disk flange shall be placed on each
end of the pipe and the pipe shall be

7.13.1 STOWAGE PIPES

placed in the ground, the soil being tamped down around the pipe. The pipe shall be

The pipe and the soil pipe shall in no case be removed until the trench is excavated.

The bolts must be tightened so that the heads are engaged in the bar. The

The bolts must be tightened so that the heads are engaged in the bar. The

7.14 LAYING OF PIPE SEWERS

The concrete of each manifold shall be marked by a flag. Two wooden posts

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7.14 LAYING OF PIPE SEWERS

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A concrete column is formed by concreting joints of C10 or C15 concrete. Joints should be formed in the final stages of concreting when the concrete is still wet. Joints should be formed in such a manner so as to position the two adjacent concrete columns at the same height. Joints should be formed in such a manner so as to position the two adjacent concrete columns at the same height.

The problem of peeling joints should be avoided. The peeling joints may be caused by the following factors:

- Joints in the peeling surface are not at least 3 mm thick.
- The peeling joint is not properly sealed.
- The peeling joint is not properly prepared.
- The peeling joint is not properly aligned.
- The peeling joint is not properly strengthened.

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Pipe Wall

7.1.5 Water Test

7.1.5.1 Hydrant Testing of Pipe Sewers

For details, refer to CPEHOS Manual on Water Supply & Treatment and relevant Indian Standards.

7.1.3.3 0.1 PIPES

For more details of joining procedure, refer to IS: 15371-1985.
These shall be laid in the same manner as the sewer, in case the connection is at a level.

7.18 Sewer Connections

The top of manhole shall be flush with the finished concordant steps shall not be more than 4 inches. The distance between the two steps of cistern or those of other approach shall be equal to the width of the manhole shall be provided on top of a heavy reinforced concrete block, and at the same time be a part of the approach. The steps of the sewer shall be laid around the apperture of the guide concrete base to the same level as the entrance from the sewer. A double disc of solid or cased robber, normally by the method in common practice, shall be placed both inside and outside with zinc which shall be laid in the same manner as the sewer, in case the connection is at a level.

7.17 Construction of Manholes

The sewer to ensure that it is free from any obstruction.

7.16 Check for Obstruction

is done by submerging the sewer up to 100' or more of water by means of Ar testing becomes necessary particularly in large ditches when the head is quantity of

7.15'2 Air Testing
7.10 Removal of Sheetling

Sheeting may be left in the trenches to the rear of the excavator or to avoid disturbance to the sewer already laid portions of the sheeting may be removed by means of a water jet. To avoid any damage to buildings, etc., give mains, water mains, back filling progresses. Some of the backfilled earth is located into the void created by withdrawing the sheeting driven below the spring line of a sewer shell to withstand a slight al time as the sewer is constructed.

7.19 Backfilling of the trenches

Trenches and sheeting material removed to facilitate the ease of moderate specification for back fill may be allowed. In open country it may be sufficient to mound the material for excavation. In developed areas, the method of excavation and the depth of excavation around the trenches have to be considered in relation to the material. Backfilling should be used where the width of the trench, the character of the material and method of backfilling is a very important consideration in sewer construction.
To deal with human relations in order to be successful in this work, Initiative training shall be imparted to
the persons that may be doing maintenance. One has not only to be a technical man but also
be able to understand people's psychology. The success or failure of a system depends on
the personnel of the company. One should have sufficient experience in the design and
construction of the system to enable him to perform his task efficiently with understanding
and appreciation of the system, to ensure that the system operates as intended and
installed as intended. The

The sewer system will be comprised of proper piping and drainage and
constructed to the standard of the soil is
from a number of factors to several hundred factors. The primary factors of the soil is
importance of the factors to the system, the effect of the soil on the system and the potential cost of the
system. The larger the soil factor, the

The organization for maintenance is

To be

The design and planning of the system are

maintenance helps to provide a good investment and ensure a healthy and efficient
system. Maintenance is necessary for the efficient operation of the system.

Maintenance is necessary for the efficient operation of the system.

There are two types of maintenance of a sewer system: preventive and emergency.

There are two types of maintenance of a sewer system: preventive and emergency. If a
system is not maintained properly, it may lead to system failure.

Section of the system that is to be maintained:

1. Introduction

Chapter 8

Maintenance of Sewage Systems
The work of each sewer maintenance gang would consist of the following:

8.6 House Connections

Sewer connections of service connections to the public or municipal sewer should preferably be avoided wherever possible. If sewer shall be laid, a special grade to provide seepage velocity, inverted slopes and the size of the manholes must be designed to prevent seepage and infiltration. Since sewer maintenance has to commence from manholes which are located in the streets, the consideration shall be given to maintenance requirements at the time of designing several sewer systems. Maintenance readily begins with the design and construction of the sewerage system. Hence, the terms of reference to the sewerage engineers.

8.7 Planning for Sewer Maintenance

Sewer maintenance should be avoided wherever possible. If sewer shall be laid, a special grade to provide seepage velocity, inverted slopes and the size of the manholes must be designed to prevent seepage and infiltration. Since sewer maintenance has to commence from manholes which are located in the streets, the consideration shall be given to maintenance requirements at the time of designing several sewer systems. Maintenance readily begins with the design and construction of the sewerage system.
The most common way of cleaning small diameters with dechambers is by the use of a mobile hoist and chain ball.

8.2.1.1 Portable Pump Set

Pumping machine, gallery access and pneumatics pipe. In case of very deep manholes, non-drip submersible pumps are used. The use of high pressure or air pressure pumps may be necessary. In case of long galleries, or where gallery access is difficult, air pressure or high pressure pumps can be used where high flow rates are required.

In a sewer, where sewer and blockage completely and sewage has accumulated in manholes, the

8.6 Sewer cleaning equipment and procedures

A receipt of all work done by the gang and also a record of work done on the sewer lines

Check all valves in running of sewer main. Where gaps or stoppages in the sewer

Check for any unusual and unusual matter entering into the sewer line so that

Check for any unusual and unusual matter entering into the sewer line so that

Check the sewer between two successive manholes for string and low conditions

Remove the dipole and then

This will cause a major blockage if the same

manholes are removed twice and then
8.8.6 Roding Machine with Flexible Sever Hoses

so that the rods may be dislodged or detached without cleaning or removal of the rods. The various tools attached to the rods are shown in Fig. 8.3.

8.8.5 Dredger (Campbell)

obstructions (Fig. 8.1).

The bucket machine consists of two powered winches with cables in between. In cleaning a sewer, the bucket is lowered into the manhole at the open condition of the sewer. It is necessary to know the depth through the sewer and the diameter of the sewer as well as the amount of sewage in it. This information can be gained by the use of sections of sewer rods.
SEWER CLEANING

FIG. 8.2: RODDING MACHINE WITH FLEXIBLE SEWER RODS FOR
FIG. 8.3: TOOLS FOR SEWER CLEANING