Chapter 7

Common problems in structures

The functioning of an irrigation canal network depends not only on how the network is operated, but also on the condition of the canals and on the condition of the hydraulic structures. This chapter looks at some of the common problems that can affect structures.

7.1 INTRODUCTION

The main problems, which in many cases result from incorrect operation and lack of proper maintenance, that affect the proper functioning of hydraulic structures can be simply summarized as:

- leakage,
- erosion,
- siltation, and
- rot and rust (corrosion).

Problems such as the disappearance of movable parts from structures or vandalism and demolition are difficult to prevent, but they can be minimized by involving farmers in canal operation and maintenance, and by cultivating the sentiment that structures are a communal resource and therefore proper maintenance is a responsibility of the community.

Leakage and erosion can be the result of poor design or construction, such as:

- walls may be too thin,
- foundations of structures may be too weak,
- materials used, such as the blocks from which a structure is made, may not be strong enough for the purpose,
- the concrete mix used in constructions may be too sandy,
- back-fill may not have been compacted sufficiently, or
- the structure may not be properly connected to the canal.

At the time of design and construction, consideration should be given to the supporting capacity and workability of soil involved. Soil conditions such as easily disaggregating soil material will affect the support and bearing capacity as is the case in many organic soils (Histosols), very sandy soils (Arenosols) and hygroscopic saline soils (Solonchaks). Cracking clay soils (Vertisols) are very hard and crack when dry and are sticky and often impassable when wet. The internal movement of these soils may damage structures. Sodic and saline soils and acid sulphate soils (Solonetz, Solonchaks and Thionic Fluvisols respectively) often have a corrosive effect and are best avoided; they are not favourable for irrigation anyway.

FIGURE 51
Leakage around a structure

FIGURE 52
Cut-off walls in concrete intake

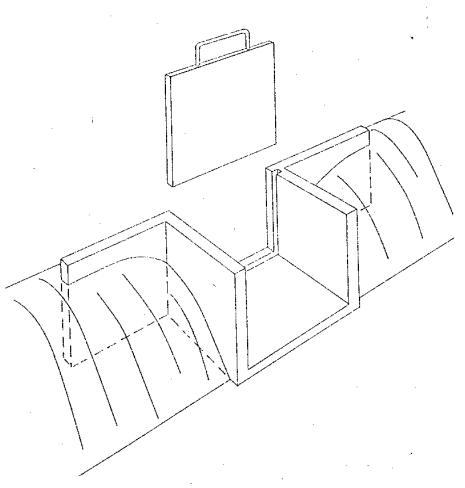
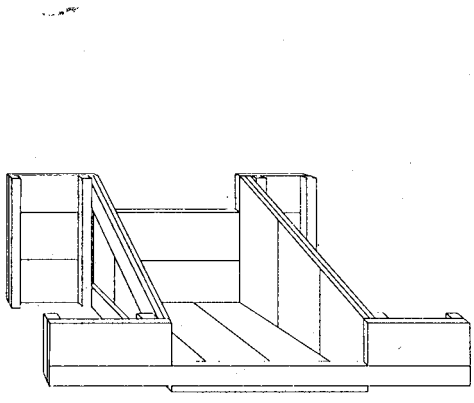


FIGURE 53
Wooden drop structure with cut-offs



It is difficult to improve the functioning of a wrongly designed or constructed structure. Soil scientists and engineers should be consulted in such cases. Minor problems, such as small leaks or early signs of erosion around a structure, can be solved by the users themselves. A description of such small repairs is given in Chapter 8.

7.2 SOME COMMON PROBLEMS IN AND AROUND STRUCTURES

The most common problems seen in structures are leakage, erosion, siltation, rot and rust.

7.2.1 Leakage

The water level upstream of a structure is higher than the downstream water level. Therefore water may search for another way underneath or along the structure, or even through a crack in the bottom or sides of the structure to this lower level. The moment that water has found a small path there is a leakage problem, and at the same time the beginning of an erosion problem. Leaking water will enlarge the path by washing out the soil and so the leakage will increase. Finally the structure will collapse if the process is not stopped.

Such a situation is shown in Figure 51, where the upstream water level is so high that water can flow along the dam. If no action is taken to remedy this the structure can be undermined by erosion and will collapse.

To avoid such a problem, the structure can be equipped with vertical cut-offs. They hinder the water flow along and underneath the structure. The cut-offs are part of a structure and can be driven into the bed and the embankments of a canal. See Figure 52 and Figure 53.

The intake structure in Figure 52 is provided with cut-offs. They are dug deep into the canal banks and into the canal bed.

The drop structure in Figure 53 is also equipped with cut-offs. After installation, the earth of the canal banks around the cut-offs should be well compacted.

Figure 54 shows the result of a leakage that has been neglected for a long time. Most probably the connection between the canal lining and the pipe was not correctly made and water could leak between them and then flow along the pipe, and as a result has washed away the soil around the drum.

7.2.2 Erosion

Sections of an unlined canal immediately downstream of a structure or downstream of a lined canal section often suffer from erosion.

Downstream of a structure the canal bed may suffer from a water jet that flows through a gate or pipe, or it will be caved in by water that spills over a weir.

In both situations a stilling basin is needed to dissipate the energy of the incoming water. The basin should be constructed immediately downstream of the weir or pipe. It is usually part of the structure. See also Chapter 6.

The transition from a lined section of a canal to an unlined section is also a risk zone, as shown in Figure 55. If no care is taken, the lining will be undermined and will finally collapse. (See Section 8.3 of this Manual.)

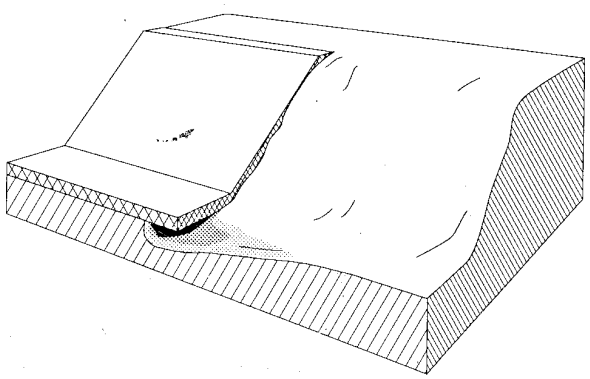
FIGURE 54
Leakage that resulted in erosion

7.2.3 Siltation

The deposition of soil and debris can affect the functioning of a structure. If, for instance, a stilling basin collects soil deposits the available water mass dimin-ishes and energy dissipation will be less effective. Similarly in the case of soil deposits in a flow division box, the division of the flow will be less accurate due to changes in flow velocities and water levels.

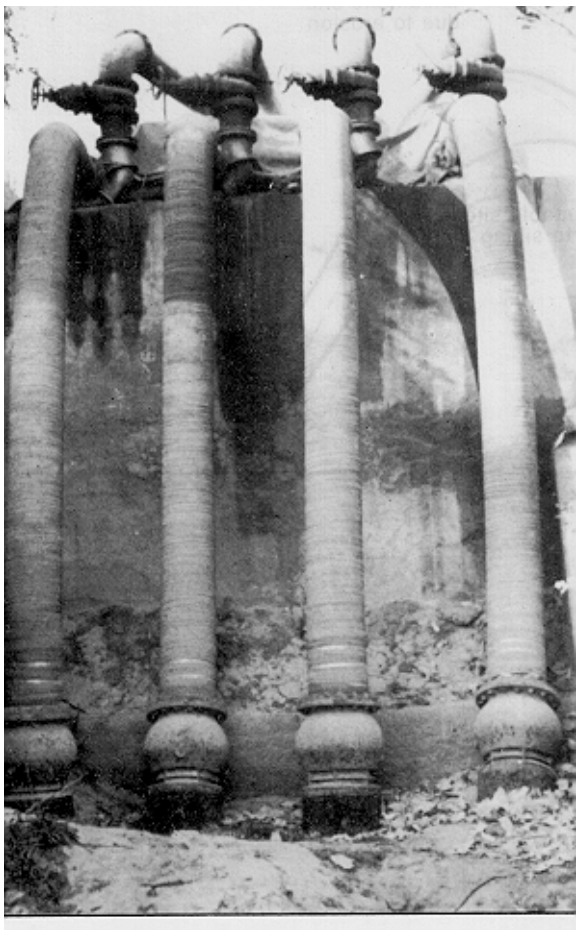
The same applies for intake structures, such as the pumping station in Figure 56. Large volumes of sand in the intake chamber of the pumps causes damage to the pumps and will lead to sand deposits in the canal system too.

FIGURE 55
Transitional canal section



Siltation is difficult to avoid. Depending on the local conditions, large sand traps could be constructed at the upper end of the main canal. Deposition of sand will be concentrated in these traps and can be removed by regular cleaning.

FIGURE 56
A silted-up pumping station



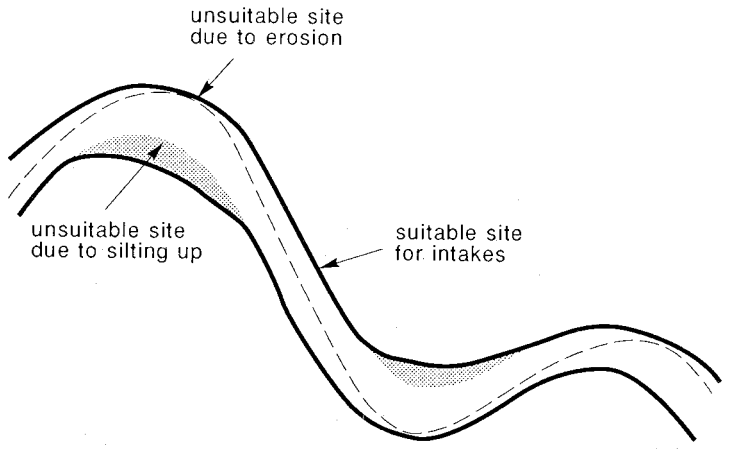
Siltation of the intake of an irrigation scheme can be reduced by choosing the right location. In general, one can say that in case of a river intake, the intake should be located on a relatively straight section. An intake located on an inner curve of a river will suffer from siltation, and if sited on an outer curve, it will suffer from erosion. See Figure 57.

7.2.4 Rot and rust

Wooden and steel parts in structures suffer from being alternately wet and dry. The wooden parts will rot and disintegrate, while steel parts will rust, expand and get jammed in the slides. All such corrosion affects in a negative way the operation of the structures.

Routine maintenance is necessary to avoid these problems, or to reduce their effect to a minimum.

FIGURE 57
Locating an intake from a river



Chapter 8

Maintenance and repair works

A properly designed and constructed hydraulic structure functions well for as long as it is operated well and maintained with care. That means that there is neither leakage nor erosion, that the channels and structures are clean, and that there are no rusty or rotten movable parts in the structures.

To achieve such a situation, regular maintenance is required, and even if maintenance is well carried out, repairs may be needed after some time. This chapter deals with maintenance and describes some common minor repair works.

It should be noted that the general remarks concerning maintenance and repairs which are made in Chapter 5 of Training Manual 7, *Canals*, apply equally here and so will not be repeated.

8.1 INSPECTION AND MAINTENANCE OF STRUCTURES

Minor problems in structures, like a leakage or rusty iron parts, may become important if they are neglected. Frequent inspections and regular maintenance will help limit any damage.

8.1.1 Inspection

A canal system, and in particular the structures, can be safeguarded from problems such as leakage, erosion, siltation, rot and rust by regular inspection and immediate repair action.

Since the canals are inspected regularly, structures can be inspected at the same time. This makes it possible quickly to spot the beginning of leakage, erosion or rust. A quickly executed repair will stop the problem while it is still a small one, and before it escalates into serious damage.

Inaccessible structures and lots of plant growing on the canal embankments make inspection time-consuming, and it will also be difficult to see water leaking if the walls of a structure are hidden from view. See also Training Manual 7, *Canals*, on this subject.

8.1.2 Maintenance

Maintenance of structures consists of two main activities:

- cleaning and de-silting, and
- painting and lubricating.

Cleaning and de-silting

Sand deposits and plant growth can cause changes in flow velocity through structures, and so the functioning of the structure will be less effective.

Removal of sand deposits and other obstacles such as stones and plants should be carried out frequently. Plant growth should also be removed from the outside of structures. This is necessary to allow quick inspection. See also Training Manual 7, *Canals*, and Section 7.2.3 of this manual.

Painting and lubrication

Structures are alternately wet or dry, and this causes rot in wooden parts and rust to form on iron parts. Frequent painting preserves these parts from rot or rust.

To prevent movable iron parts like sluice gates and valves from being jammed, regular lubrication is essential.

8.2 HOW TO REPAIR A LEAK

A crack in a wall or in the floor of a structure and through which water leaks must be repaired as soon as it is observed. Such a repair on a check structure constructed of blocks is described here.

Step 1 Clean the wall or the floor round the crack. Remove any sand, clay and plant growth. (Figure 58)

Step 2 Make the crack larger and deeper. (Figure 59)

Step 3 Fill the hole with a cement-sand mortar and smooth with a trowel. (Figure 60)

8.3 HOW TO AVOID UNDERMINING OF A STRUCTURE

It happens often that the bed and banks of a canal immediately downstream of a

FIGURE 58
Cleaning the area around the crack

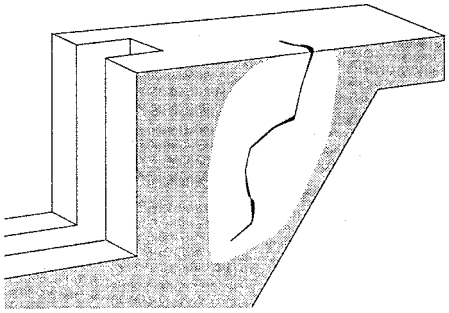


FIGURE 59
Enlarging the crack

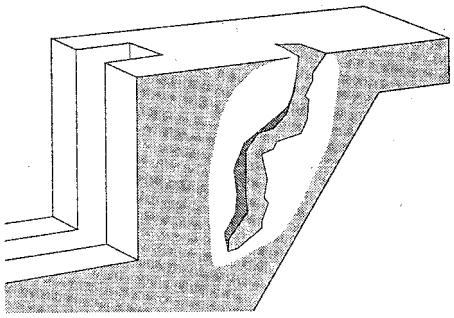
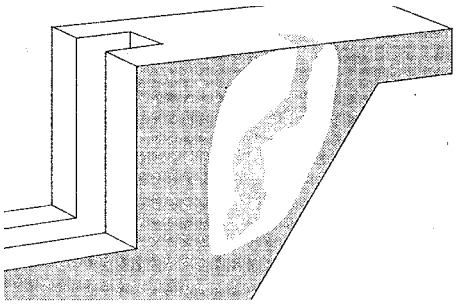


FIGURE 60
Filling and smoothing



structure, or downstream of a lined canal section, are undercut by the erosive forceof the water flow and cave in. If such an erosion process is allowed to continue the structure or canal lining will be undermined and finally it will collapse, as was illustrated in Figure 55.

Undermining can be avoided by the construction of a screen or cut-off. The cut-off protects the foundation of the structure.

A procedure for the repair of an undermined structure and the construction of a screen is given opposite, and illustrated by Figure 61 to Figure 64.

Step 1 Excavate a trench in the eroded canal bed and sides. The trench should be at least 0.20 m deeper than the eroded bed. (Figure 61)

Step 2 Refill the hole under the lining with earth, and compact. (Figure 62)

Step 3 Erect a concrete or masonry screen in the canal bed and in the banks of the canal, and connect it correctly to the lining of the canal or structure. (Figure 63)

Step 4 Refill the rest of the hole and firmly compact the backfill. (Figure 64)

FIGURE 61
Excavating a trench in the canal bed and sides

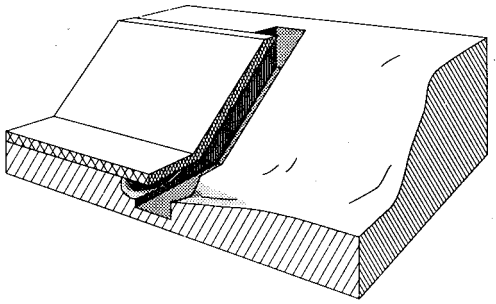


FIGURE 62
Refill partly

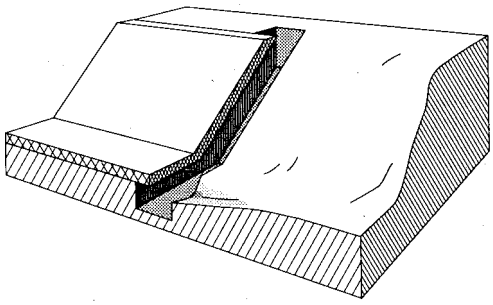


FIGURE 63
Erect the screen

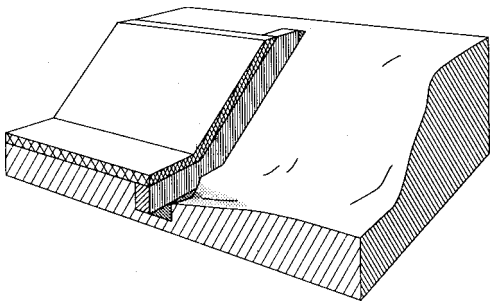


FIGURE 64
Refill the canal bed and sides