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Soil-Water Conservation Engineering and Structures

Presented By-

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Earthen Embankment

- An earthen embankment is a raised confining structure made from compacted soil to confine runoff either for surface storage or for ground water recharge.
- These are also used for increasing infiltration; detention and retention of water to facilitate deep percolation and also to provide additional storage.
- The cross-section of embankments is usually trapezoidal in shape. When constructed across natural channel to induce channel storage, the embankment also called earthen dam.



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- The earthen embankment meant to collect surface runoff or overland flow can be compared with field bunds in many respect except the difference in height and catchment area.
- In the case of field bunds, the height are usually less than 50 cm and catchment area is limited up to 0.5 ha whereas in case of embankments the minimum height is 3 m and can be as high as 10m and catchment area can be tens of hectare.



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The major advantages include.

- Local natural materials are used.
- Design procedures are straightforward.
- Comparatively small plant and equipment are required.
- Foundation requirements are less stringent than for other types of dam. The broad base of an earth dam spreads the load on the foundation.
- Earth fill dams resist settlement and movement better than more rigid structures and can be more suitable for areas where earth movements are common.



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The disadvantages are-

- An earth embankment is easily damaged or destroyed by water flowing on, over or against it. Thus, a spillway and adequate upstream protection are essential for any earth dam.
- Designing and constructing adequate spillways is usually the most technically difficult part of any dam building work. Any site with a poor quality spillway should not be used.
- If it is not adequately compacted during construction, the dam will have weak structure hence prone to seepage.
- Earth dams require continual maintenance to prevent erosion, tree growth, subsidence, animal and insect damage and seepage.



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Types of Embankment

1. Homogenous embankment
2. Zoned embankment.



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Homogenous embankment

- It is composed of one kind of material (excluding slope protection). The material used must be sufficiently impervious to provide an adequate water barrier, and the side slopes must be moderately flat for stability and ease of maintenance
- The homogeneous soil material is either keyed in to the impervious base (see Fig. 23.1 A) or impervious soil material can be placed as blanket to the upstream slope of the embankment (see Fig. 23.1 B).



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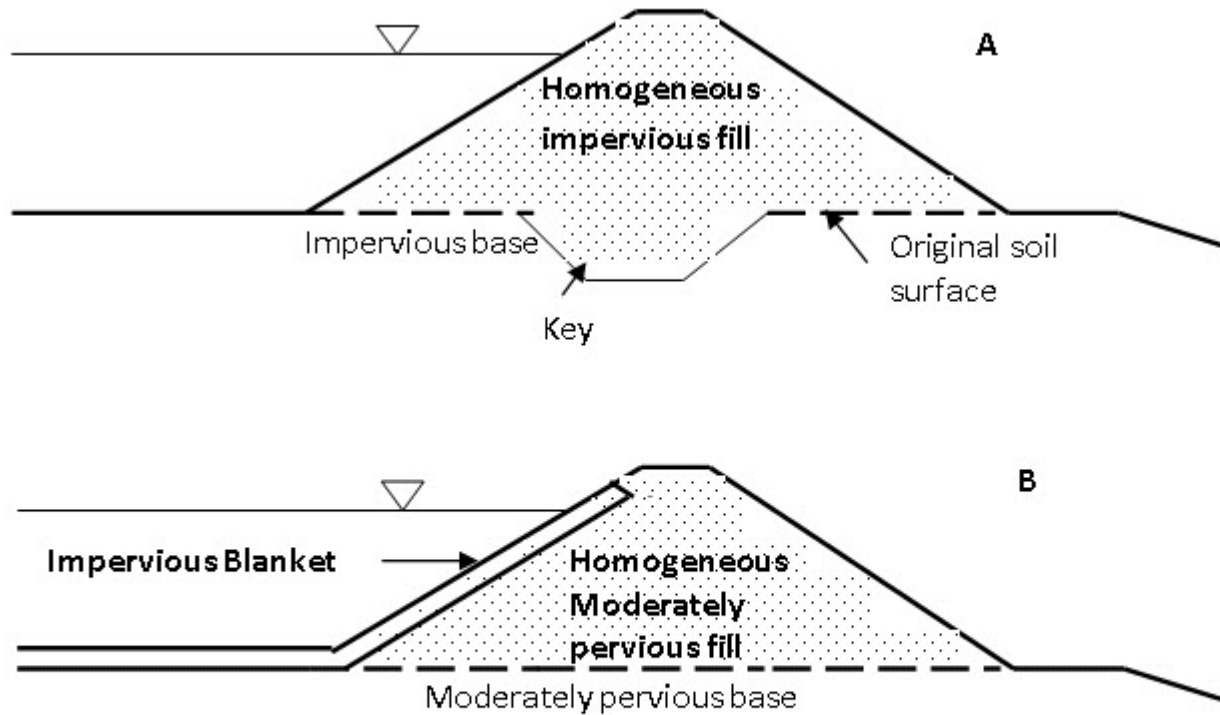


Fig. 23.1. Different types of Homogeneous earthen embankment/dam.

(Source: Samra, et al., 2002)



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Diaphragm Type

- The bulk of material used for construction of the embankment is pervious. A thin diaphragm of impermeable material like (concrete, steel, butyl etc.) is provided to act as barrier against seepage through the fill. The full diaphragm condition occurs when the upper crest of diaphragm and design water depth are at the same level (see Fig. 23.2 A). There are cases when the full diaphragm is difficult to adopt, partial diaphragm can be adopted in conjunction with core wall (Fig. 23.2 B). The core walls usually are made of the earth with low hydraulic conductivity.



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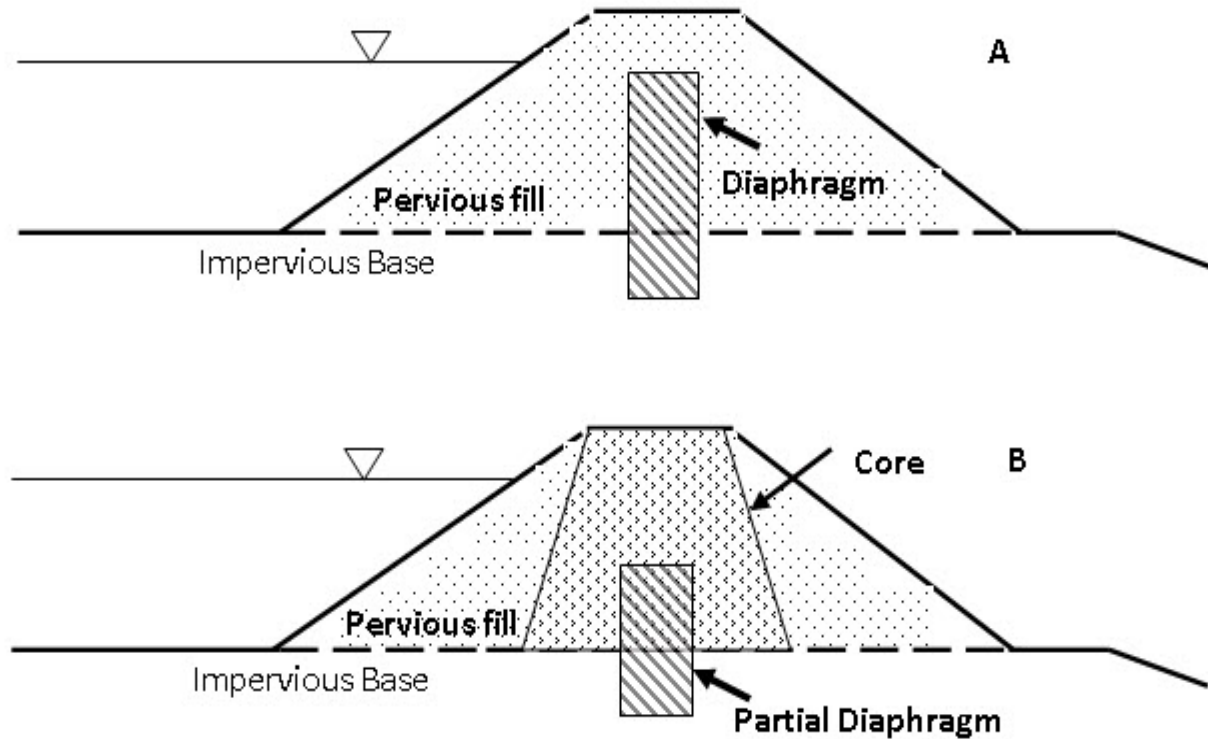


Fig. 23.2. Different Diaphragm typed earthen embankment/dam.

(Source: Samra, et.al., 2002)

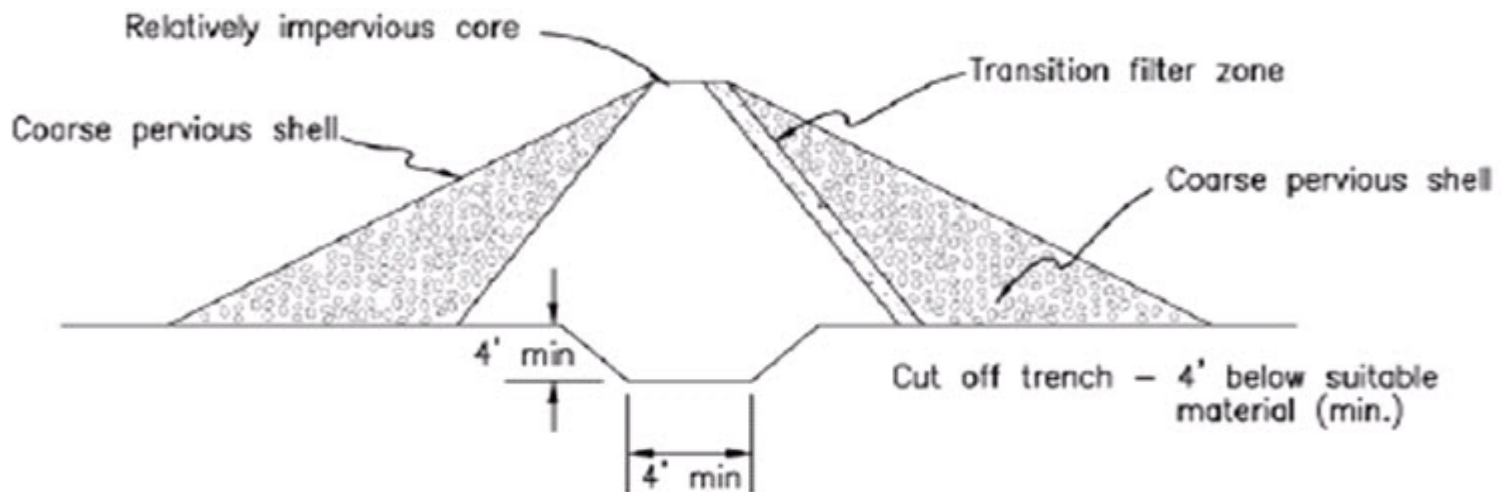


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Zoned Earth Dams

It contains a central impervious core, surrounded by zones of more pervious material, called shells. These pervious zones or shells support and protect the impervious core





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Methods of Construction

- (a) **Rolled Fill Dam**
- (b) **Hydraulic Fill Dam**

Rolled Fill Dam: In this type of dams, successive layers of moistened or damp soils are laid one over one another. Each layer not exceeding 20 cm in thickness is properly consolidated at optimum moisture content which is maintained by sprinkling water and compacted by mechanical roller only then the next layer laid.



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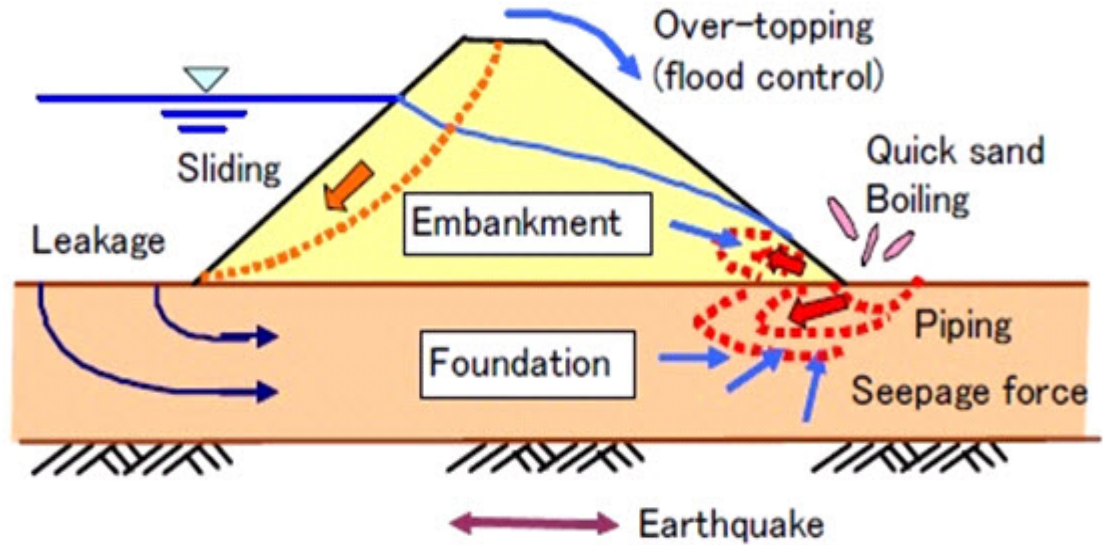
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Hydraulic Fill Dam: In this type of dams, the construction, excavation, transportation of the earth is done by hydraulic methods. Outer edges of the embankments are kept slightly higher than the middle portion of each layer. During construction, a mixture of excavated materials in slurry condition is pumped and discharged at the edges. This slurry of excavated materials and water consists of coarse and fine materials. When it is discharged near the outer edges, the coarser materials settle first at the edges, while the finer materials move to the middle and settle there. Fine particles are deposited in the central portion to form a water tight central core. In this method, compaction is not required.



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© Damage of embankment

- Sliding (by pore-water pressure, earthquake)
- Deformation (settlement and lateral deflexion)
- Leakage
- Hydraulic fracture (quick sand and piping)

© Damage of foundation

- Bearing capacity
- Settlement
- Leakage
- Hydraulic fracture
- Liquefaction

Fig. 23.4. Damages in Embankment and Foundation.