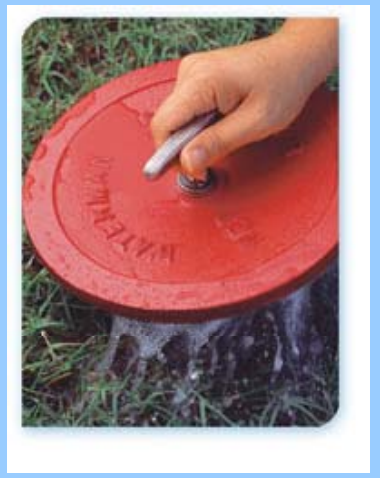


Irrigation System

BWCDD Zanjero Training

Session #7

2/13/2008

Irrigation System

- The (main) intake structure directs water from the source of supply, such as a reservoir or a river, into the irrigation system.
- The conveyance system assures the transport of water from the main intake structure or to the field ditches.
- The distribution system assures the transport of water through field ditches to the irrigated fields.
- The field application system assures the transport of water within the fields.
- The drainage system removes the excess water (caused by rainfall and/or irrigation) from the fields.

Main Intake Structure

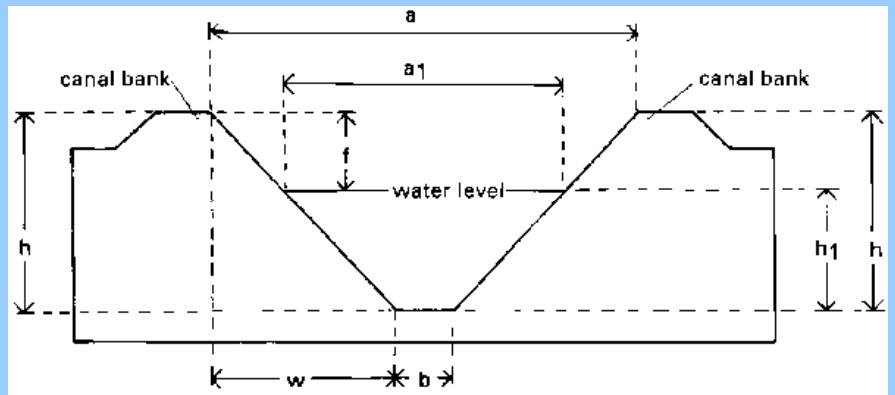
- The intake structure is built at the entry to the irrigation system

Conveyance and distribution system

- The conveyance and distribution systems consist of canals transporting the water through the whole irrigation system. Canal structures are required for the control and measurement of the water flow.

Canal Characteristics

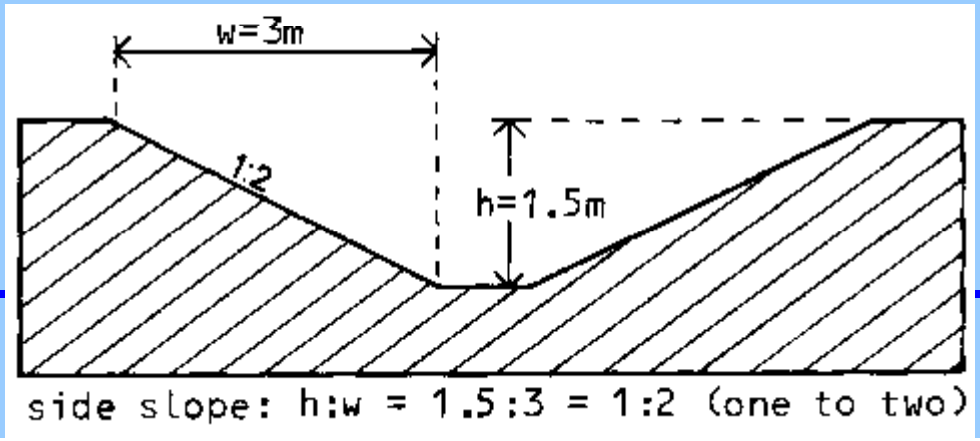
- According to the shape of their cross-section, canals are called rectangular, triangular, trapezoidal, circular, parabolic, and irregular or natural
- The most commonly used canal cross-section in irrigation and drainage, is the trapezoidal cross-section.



a = top width of the canal
a_1 = top width of the water level
h = height of the canal
h_1 = heigth or depth of the water in the canal
b = bottom width of the canal
h:w = side slope of the canal
f = free board (= $h-h_1$)

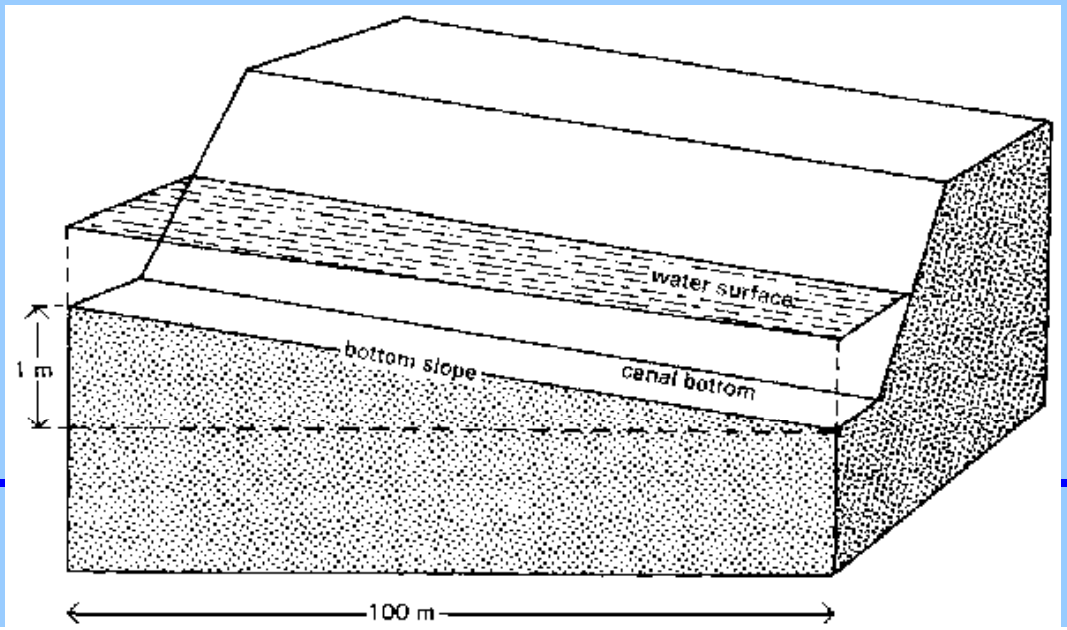
Freeboard & Side Slope

- The freeboard of the canal is the height of the bank above the highest water level anticipated. It is required to guard against overtopping by waves or unexpected rises in the water level.
- The side slope of the canal is expressed as ratio, namely the vertical distance or height to the horizontal distance or width.



Bottom Slope

- The bottom slope of the canal does not appear on the drawing of the cross-section but on the longitudinal section. It is commonly expressed in percent or per mil.



Earthen Canals

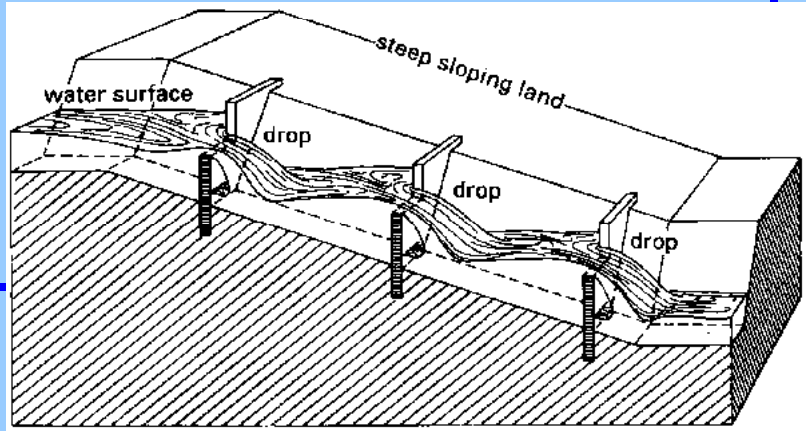
- The disadvantages of earthen canals are the risk of the side slopes collapsing and the water loss due to seepage. They also require continuous maintenance in order to control weed growth and to repair damage.

Canal Structures

- The flow of irrigation water in the canals must always be under control.
- For this purpose, canal structures are required.
- They help regulate the flow and deliver the correct amount of water to the different branches of the system and onward to the irrigated fields.

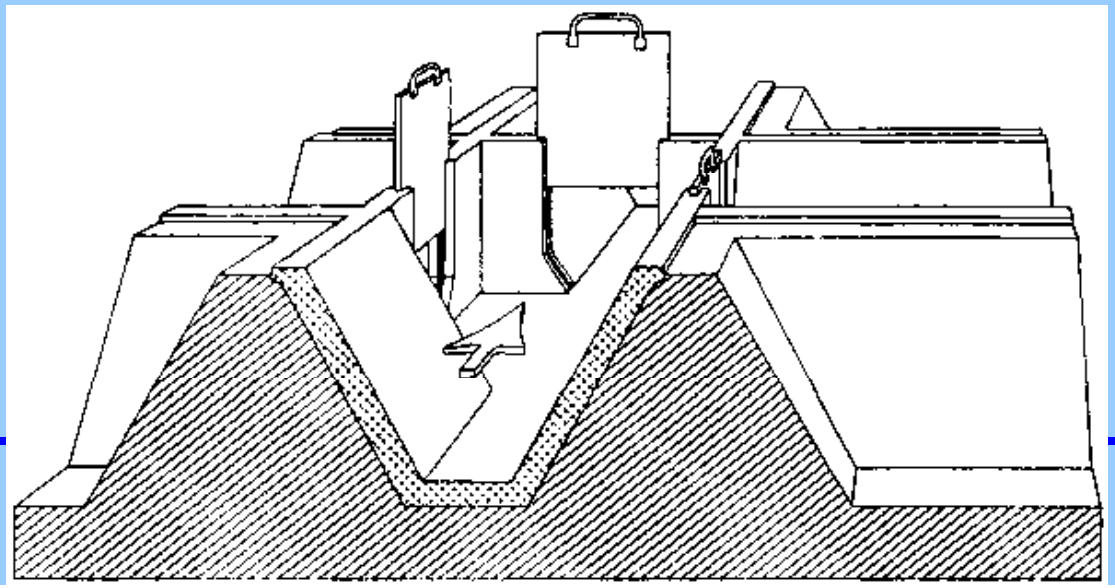
Erosion Control Structures

- Water flowing in steep canals can reach very high velocities.
- Soil particles along the bottom and banks of an earthen canal are then lifted, carried away by the water flow, and deposited downstream where they may block the canal and silt up structures.
- Drop structures or chutes are required to reduce the bottom slope in order to avoid high velocity of the flow and risk of erosion.



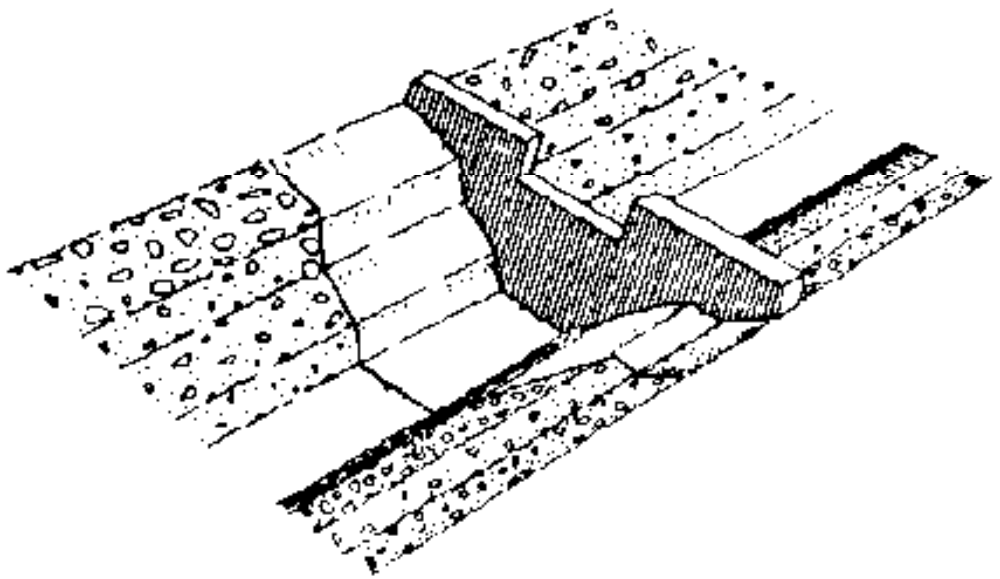
Distribution Control Structures

- Division boxes are used to divide or direct the flow of water between two or more canals or ditches. Water enters the box through an opening on one side and flows out through openings on the other sides. These openings are equipped with gates



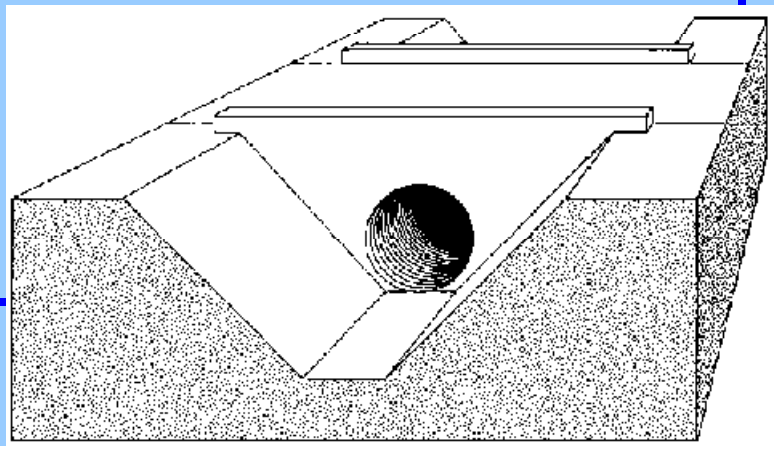
Checks

- To divert water from the field ditch to the field, it is often necessary to raise the water level in the ditch. Checks are structures placed across the ditch to block it temporarily and to raise the upstream water level. Checks can be permanent structures or portable.



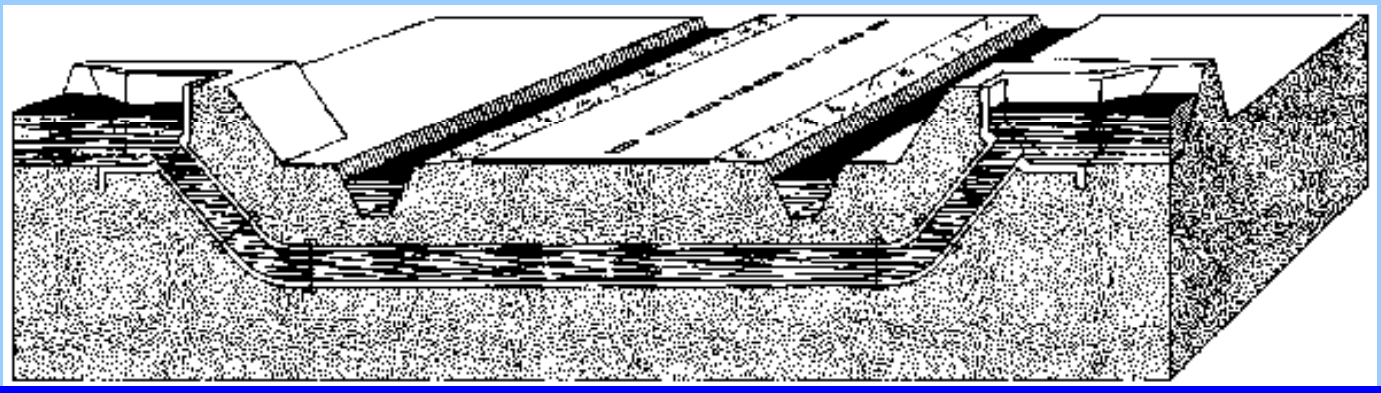
Crossing Structures

- Flumes are used to carry irrigation water across gullies, ravines or other natural depressions. They are open canals made of wood, metal or concrete which often need to be supported by pillars
- Culverts are used to carry the water across roads. The structure consists of masonry or concrete headwalls at the inlet and outlet connected by a buried pipeline



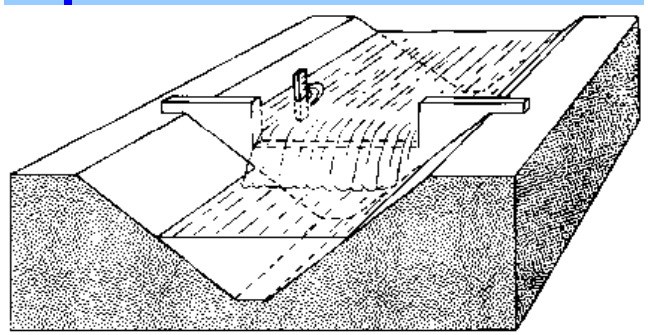
Crossing Structures

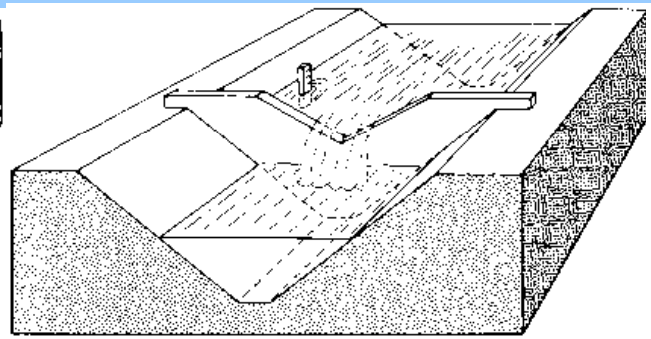
- When water has to be carried across a road which is at the same level as or below the canal bottom, an inverted siphon is used instead of a culvert. The structure consists of an inlet and outlet connected by a pipeline.

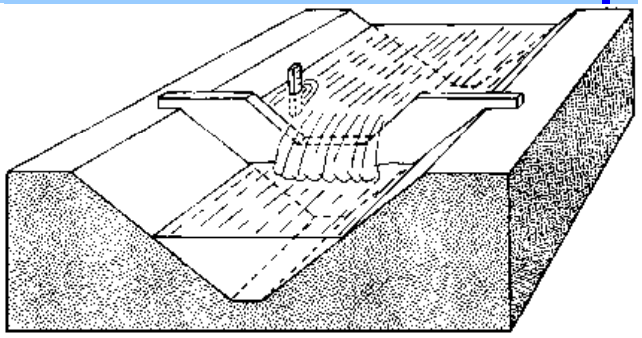


Water Measurement Structures

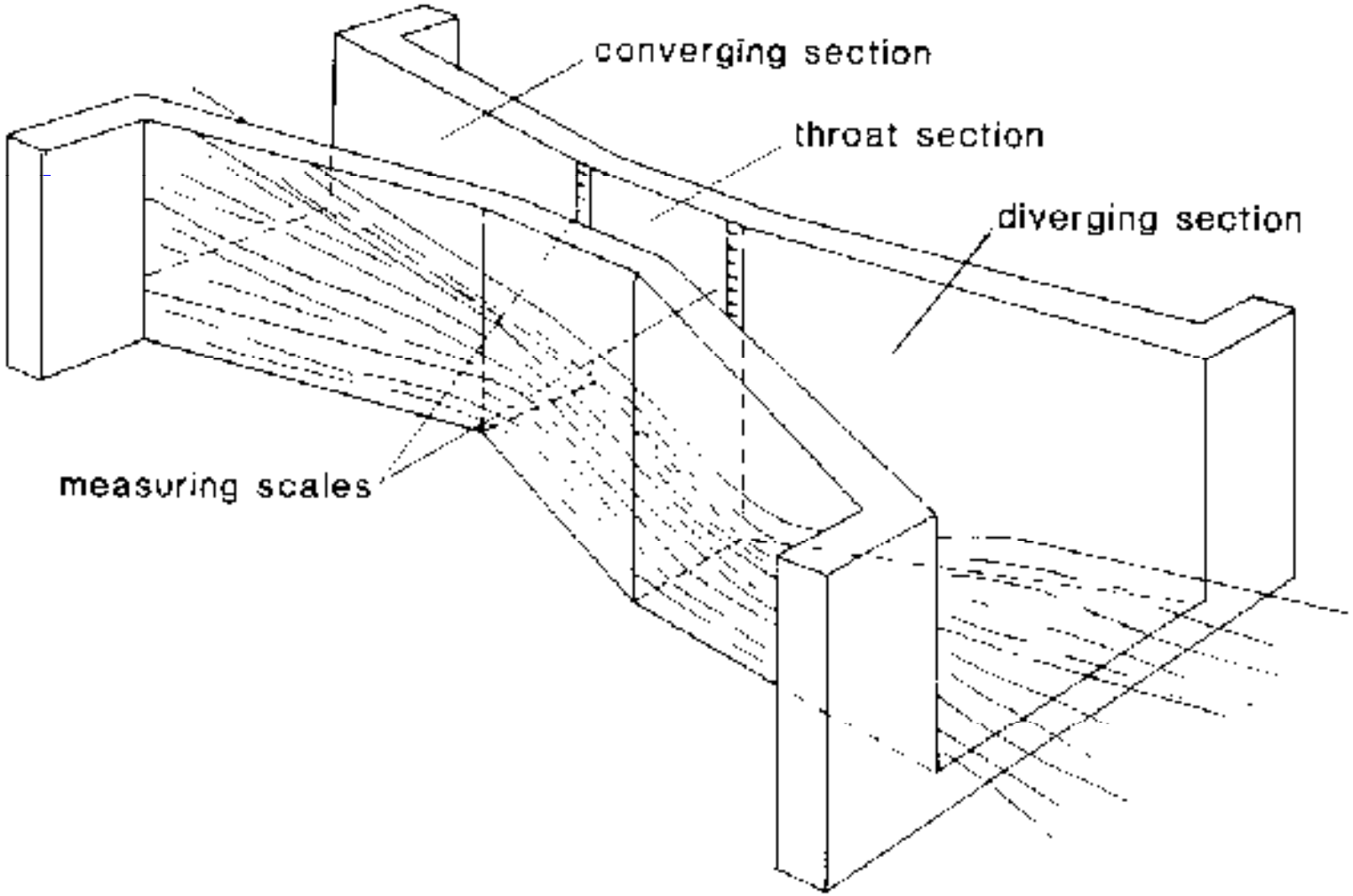
- The most commonly used water measuring structures are weirs and flumes.
- In these structures, the water depth is read on a scale which is part of the structure.
- Using this reading, the flow-rate is then computed from standard formulas or obtained from standard tables prepared specially for the structure





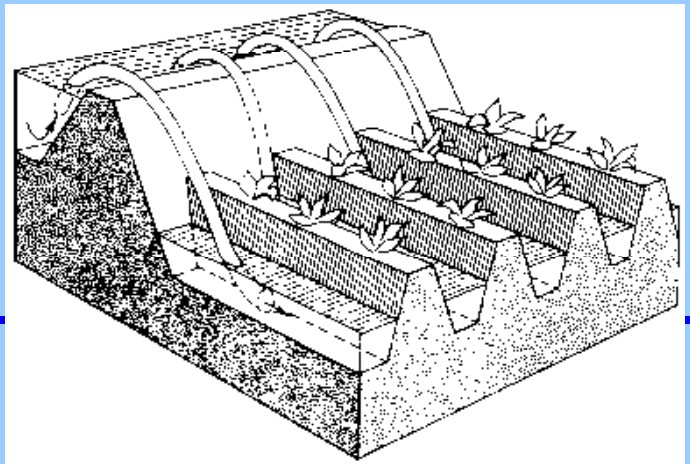


Flumes


converging section
throat section
diverging section
measuring scales

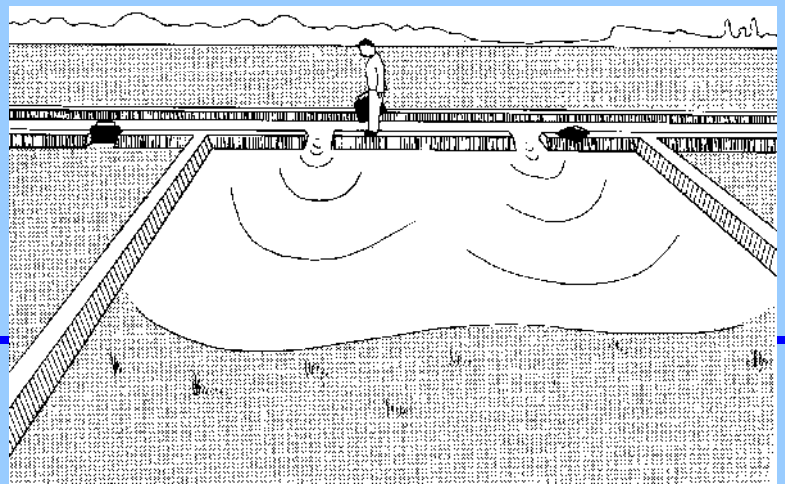
Furrow Irrigation

- Furrows are narrow ditches dug on the field between the rows of crops. The water runs along them as it moves down the slope of the field.
- The water flows from the field ditch into the furrows by means of siphons. Siphons are small curved pipes that deliver water over the ditch bank



Border Irrigation

- In border irrigation, the field to be irrigated is divided into strips (also called borders or border strips) by parallel dikes or border ridges
- The water can also be released by means of siphons. The sheet of flowing water moves down the slope of the border, guided by the border ridges

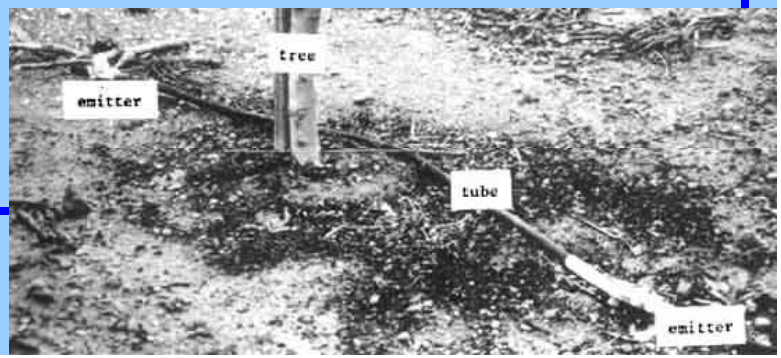


Sprinkler Irrigation

- With sprinkler irrigation, artificial rainfall is created.
- The water is led to the field through a pipe system in which the water is under pressure.
- The spraying is accomplished by using several rotating sprinkler heads or spray nozzles or a single gun type sprinkler.

Drip Irrigation

- In drip irrigation, also called trickle irrigation, the water is led to the field through a pipe system.
- On the field, next to the row of plants or trees, a tube is installed.
- At regular intervals, near the plants or trees, a hole is made in the tube and equipped with an emitter.
- The water is supplied slowly, drop by drop, to the plants through these emitters



Drainage System

- A drainage system is necessary to remove excess water from the irrigated land. This excess water may be e.g. waste water from irrigation or surface runoff from rainfall. It may also include leakage or seepage water from the distribution system.