WATERSHED MANAGEMENT

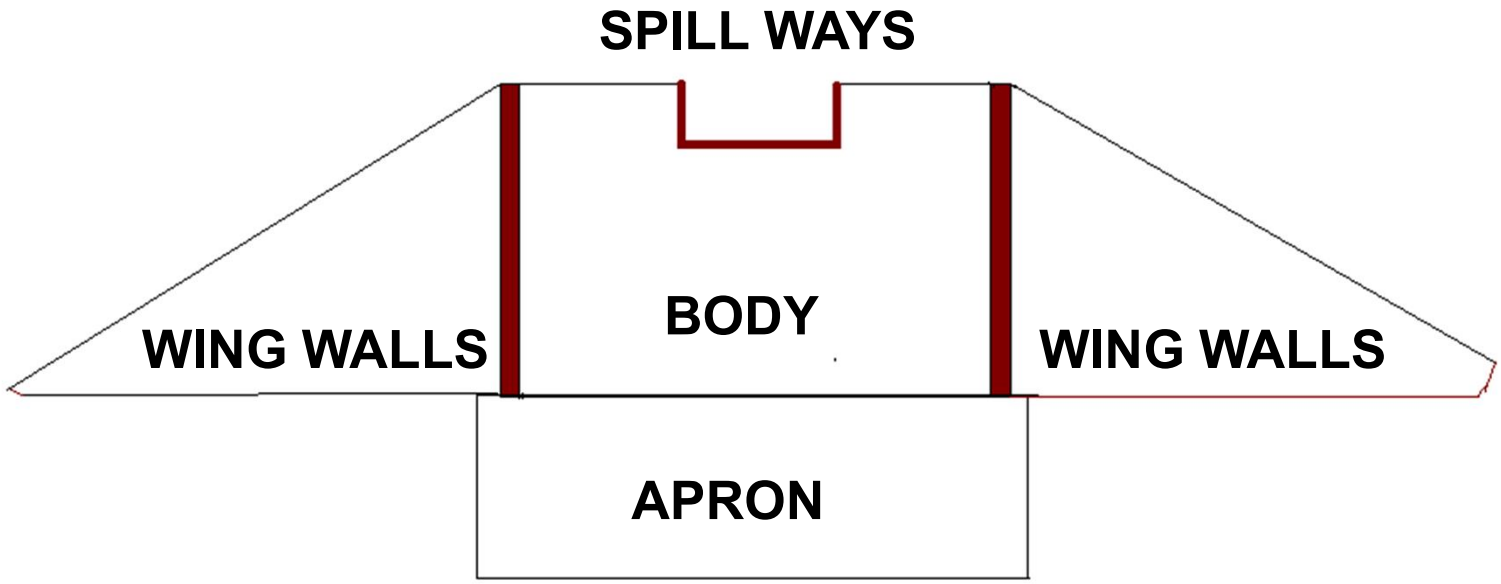
CHECK DAM, FARM PONDS
&
PERCOLATION PONDS

CHECK DAM

- A check dam is a small, temporary or permanent dam constructed across a drainage ditch, swale, or channel to lower the speed of concentrated flows for a certain design range of storm events.

- Check dams reduce the effective slope of the channel, thereby reducing the velocity of flowing water, allowing sediment to settle and reducing erosion

CHECK DAM



CHECK DAMS MAY BE APPROPRIATE IN THE FOLLOWING SITUATIONS:

- To promote sedimentation behind the dam.
- To prevent erosion by reducing the velocity of channel flow
- In small intermittent channels and temporary swales.
- In small open channels that drain 10 acres or less.

- In steep channels where storm water runoff velocities exceed 5 ft/s.
- During the establishment of grass linings in drainage ditches or channels.
- In temporary ditches where the short length of service does not warrant establishment of erosion-resistant linings.

TEMPORARY CHECK DAM -TYPES

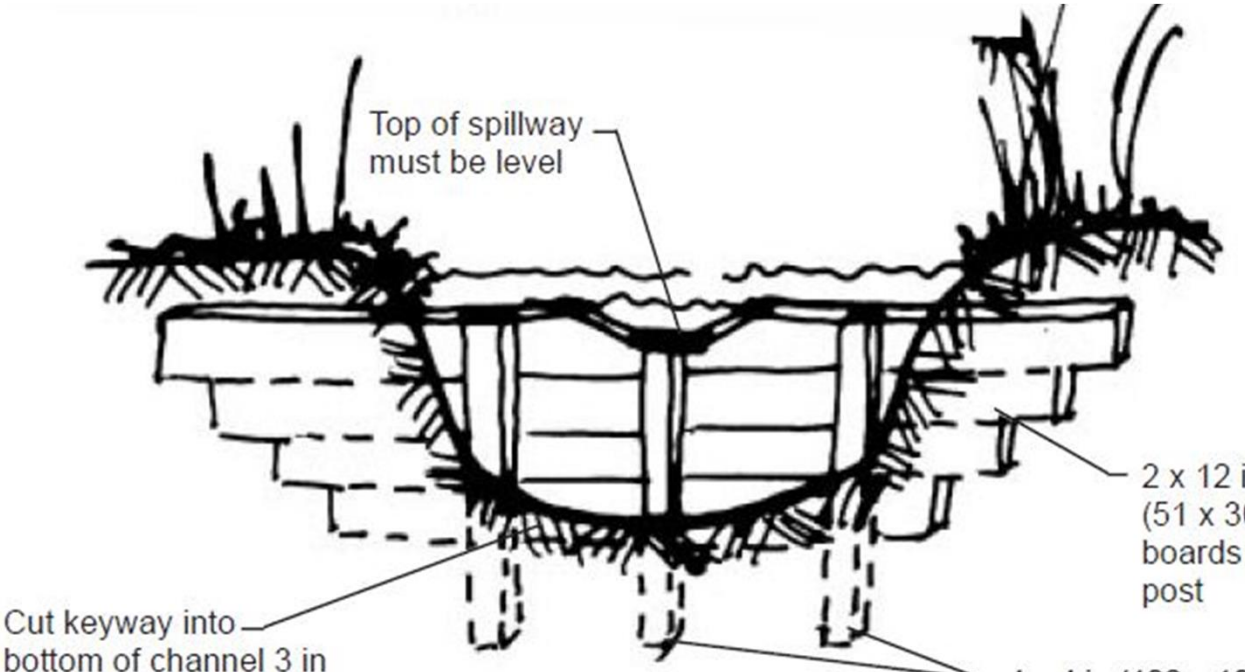
- Single row brushwood dam
- Double row brushwood dam
- Dry stone check dam
- Woven wire check dam
- Log check dam

POINTS TO BE REMEMBERED

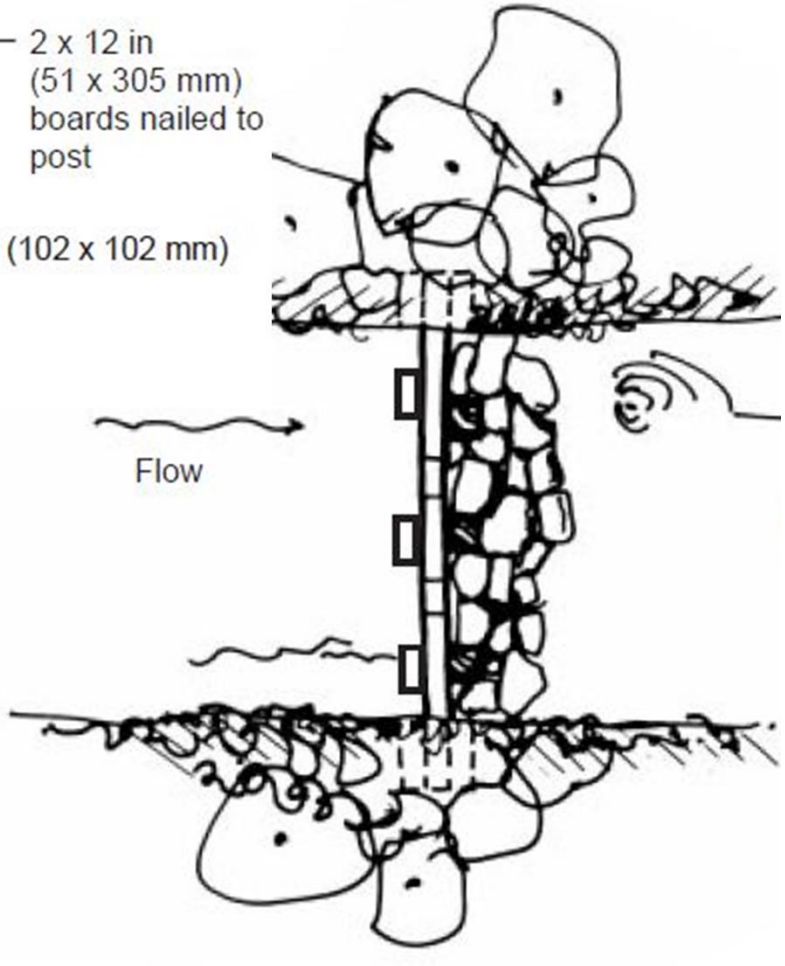
- For temporary check dam construction – a series of low structures rather than a larger one.

- ADVANTAGE:
  - Less cost
  - Less chance of failure
  - Better protected –vegetative cover
  - Suited for small catchments area

- A spillway of suitable size – safe passage.
- Life depends on –
  - materials used,
  - method of construction,
  - nature of gullies.
- Usually 5 - 10 years.
- Extension wall –to prevent from washing away



Wood Board Check Dam
Section View



WOOD BOARD CHECK DAM

SINGLE ROW BRUSHWOOD DAM

- Small – gullies of depth 2.5m.
- Using brush wood & hay.
- Single row of posts erected across channel.
- Butt end – up streams & tied to the post.
- Sides of gully – sloped to 45 degree.

SINGLE ROW BRUSHWOOD DAM

- 20 cm depth – dug .
- Posts – 10 cm dia. & erected at 0 .75 m.
- Post kept at a depth of 1m .
- Brushwood laid along the flow.
- Tied to both the posts .
- Lower brushwood is longer
- A layer of hay is over the lower brushwood.
- Then subsequent layer .
- A proper notch is needed for discharge.

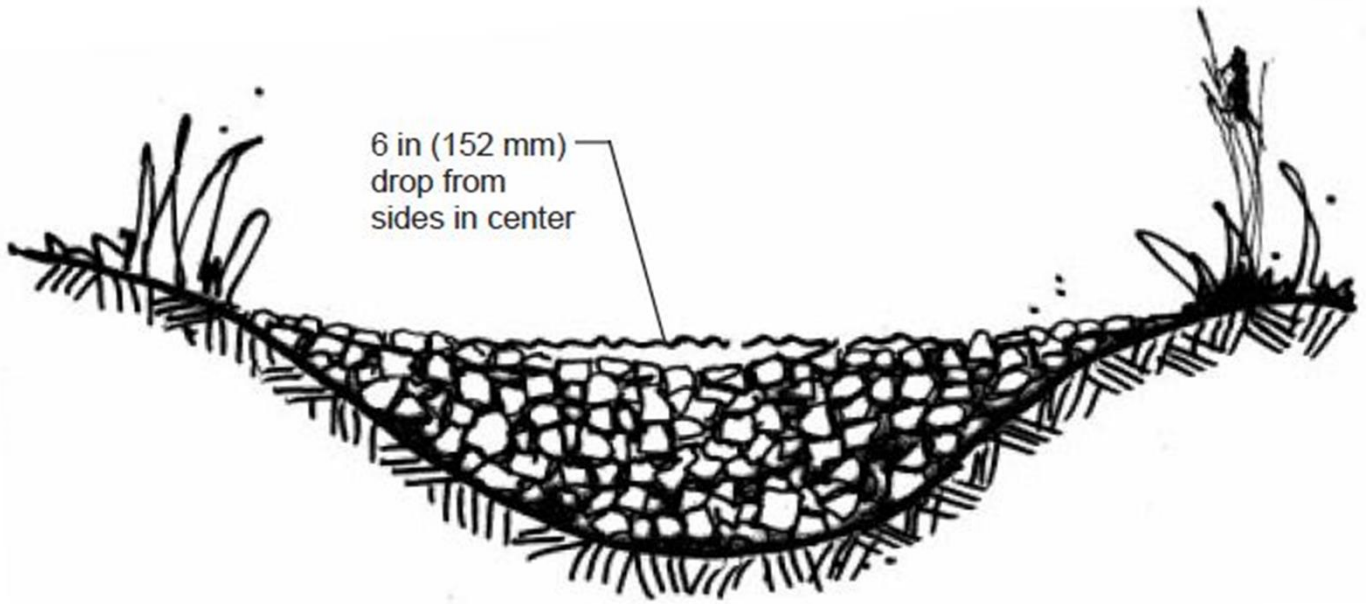
DOUBLE ROW BRUSHWOOD DAM

- Gullies up to 3m & 10 m wide
- Catchment area 25 hec.
- More effective than single row .
- More labour & cost then single row .
- A trench of size -1m &.4m dug across.
- Posts – 15 cm dia. & erected at 1m.
- Post kept at a depth of .9 m in two rows.
- Another line of posts – 2m

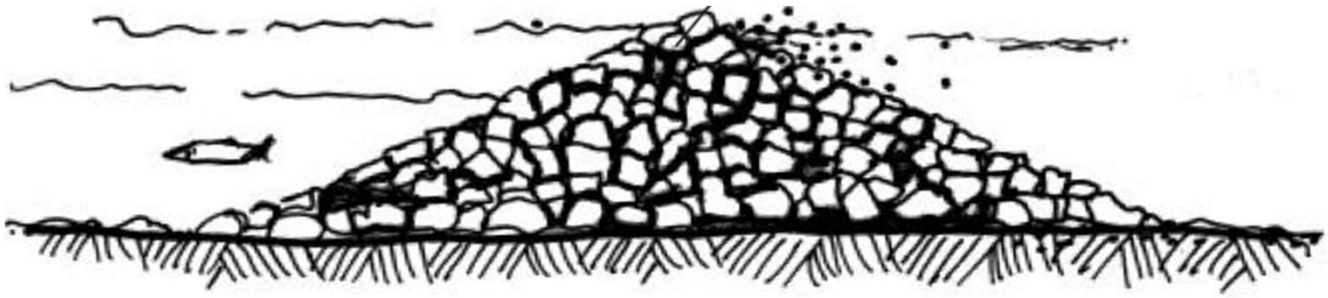
DRY STONE CHECK DAM

- Stones – readily available.
- Arc shaped with the convex side facing the currents.
- Double the width of gully.
- Foundation at a depth of 1.5 m.
- Width of foundation – thrice the top .
- Apron is dug at a depth of 15cm infront.
- Larger stones at the bottom.
- Width is reduced like a step towards upstreams.
- The wing wall is placed deep in the side walls of the gully.

ROCK CHECK DAM



constructed of 8 to 12 in. rock.



Rock Check Dam
Section View

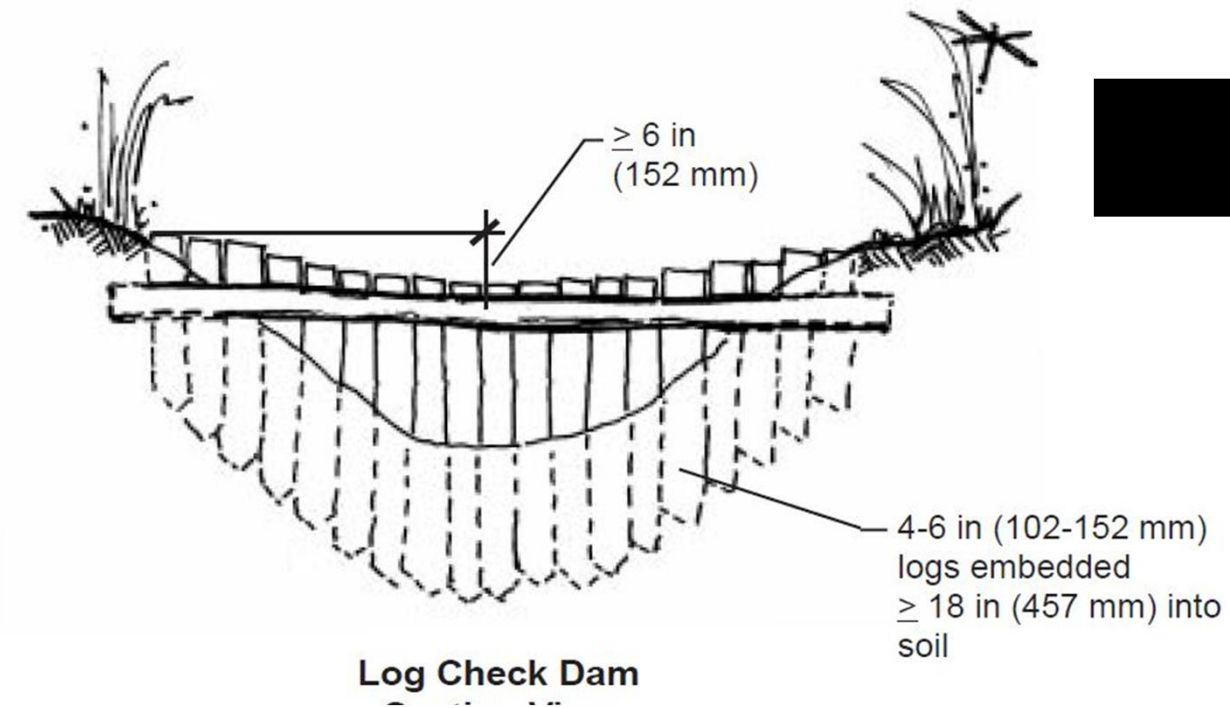
WOVEN WIRE CHECK DAM

- Modification of dry stone check dam .
- Woven wire mesh – keep the stones in place.
- Wire mesh placed – foundation & stone are kept in it .
- Wing wall & apron – using wire mesh.
- Costly – but effective.

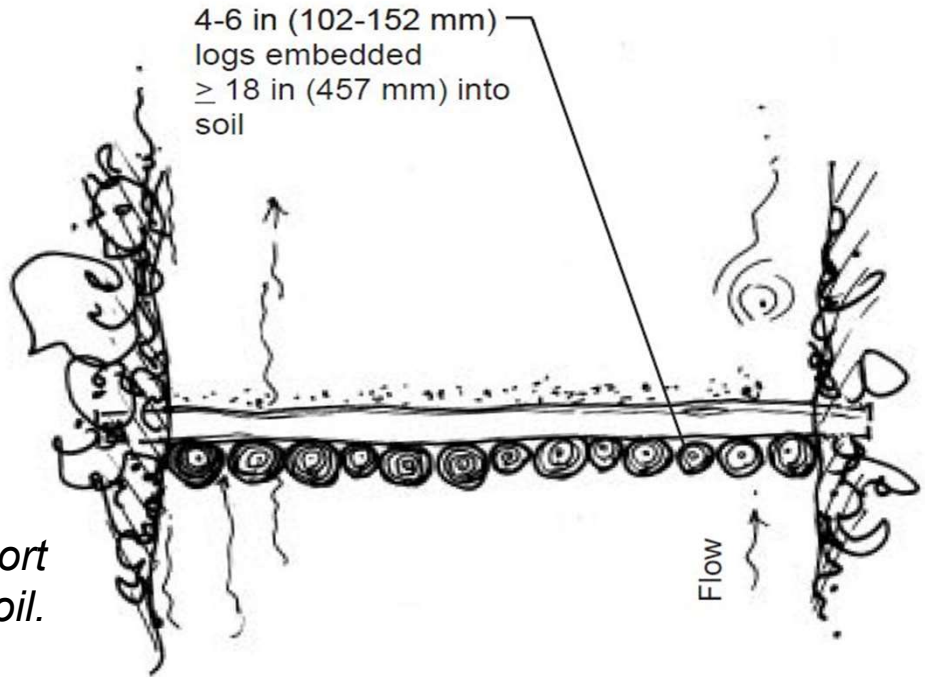
LOG CHECK DAM

- Using logs of woods.
- A series – logs in a gully bed at 1.5 m.
- Small logs both across & along – form a wall.
- Stones – between the logs to obstruct the flow
- Logs – tied.

LOG CHECK DAM

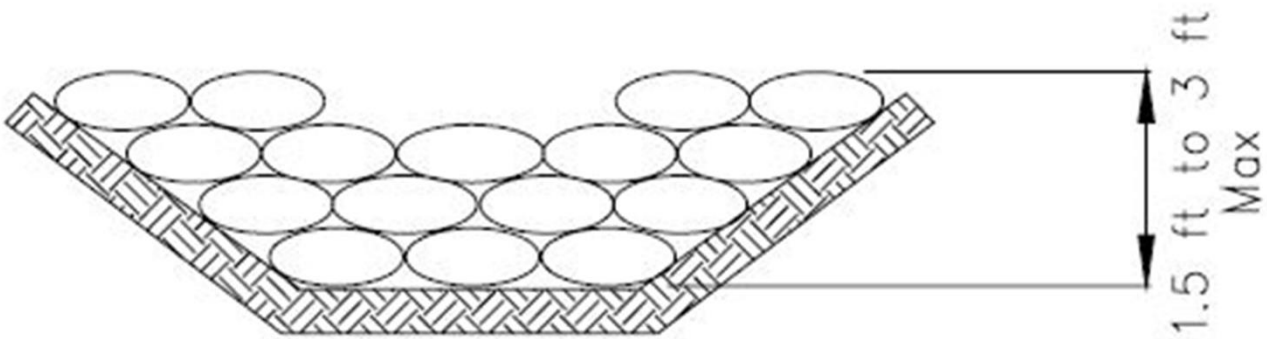


Log Check Dam



Logs can be bolted or wired to vertical support logs that have been driven or buried into the soil.

GRAVEL BAG CHECK DAM



GRAVEL BAG CHECK DAM ELEVATION

NOT TO SCALE

- *Gravel bags and sandbags should not be stacked any higher than 3 ft.*
- *Fiber rolls and straw bales must be trenched in and firmly staked in place.*

PERMANENT CHECK DAMS

- Rubble masonry dam
- Concrete dam.
- Earthen dam.

RUBBLE MASONRY DAM

- Width of side walls, apron, cut off walls – minimum 30cm
- Slope - 0.5 - 1 below spillway.
- Upstream slope – 10 degree.
- Length apron- 1.5 times to the ht.
- Weep holes - base.

CONCRETE DAM

- Width 30cm minimum
- Upstream slope – 10 degree.
- Good grade cement
- Length apron- 1.5 times to the ht.
- Weep holes - base.

EARTHEN DAM.

- Easiest to construct .
- Control gullies in forest areas .
- Passage across the gullies.

The following guidance should be followed for the design and layout of check dams:

- Install the first check dam approximately 16 ft from the outfall device and at regular intervals based on slope gradient and soil type.
- Check dams should be placed at a distance and height to allow small pools to form between each check dam.
- Backwater from a downstream check dam should reach the toes of the upstream check dam.

- A sediment trap provided immediately upstream of the check dam will help capture sediment. Due to the potential for this sediment to be resuspended in subsequent storms, the sediment trap must be cleaned following each storm event.
- High flows (typically a 2-year storm or larger) should safely flow over the check dam without an increase in upstream flooding or damage to the check dam.
- Where grass is used to line ditches, check dams should be removed when grass has matured sufficiently to protect the ditch or swale.

LIMITATIONS

- Not to be used in live streams or in channels with extended base flows.
- Not appropriate in channels that drain areas greater than 10 acres.
- Not appropriate in channels that are already grass-lined unless erosion is expected, as installation may damage vegetation.
- Require extensive maintenance following high velocity flows.
- Promotes sediment trapping which can be re-suspended during subsequent storms or removal of the check dam.
- Removal of temporary check dams should be difficult

FARM POND

- Farm ponds are small tanks or reservoirs constructed for the purpose of storing water essentially from surface runoff.
- Farm ponds are useful for irrigation, water supply for the cattle, fish production etc.

Types of Ponds :

Depending on the source of water and their location with respect to the land surface, farm ponds are grouped into four types.

These are

(1) Dug out ponds
(2) Surface ponds
(3) Spring or Creek fed ponds and
(4) Off-stream storage ponds.

DUGOUT PONDS

- Dugout Ponds are excavated at the site and the soil obtained by excavation is formed as embankment around the pond.
- The pond could either be fed by surface runoff or groundwater wherever aquifers are available.
- In case of dugout ponds, if the stored water is to be used for irrigation, the water has to be pumped out.

SURFACE WATER PONDS

- Surface water ponds are the most common type of farm ponds.
- These are partly excavated and an embankment is constructed to retain the water.
- Generally a site which has a depression already is chosen for this pond construction.

SPRING OR CREEK FED PONDS

- Spring or creek fed ponds are those where a spring or a creek is the source of water supply to the pond.
- Construction of these ponds, therefore, depends upon the availability of natural springs or creeks.

OFF-STREAM STORAGE PONDS

- Off-stream storage ponds are constructed by the side of streams which flow only seasonally.
- The idea is to store the water obtained from the seasonal flow in the streams.
- Suitable arrangements need to be made for conveying the water from the stream to the storage ponds.

COMPONENTS OF A FARM POND:

The pond consists of the

- Storage area,
- Earthen dam,
- Mechanical spillway &
- Emergency spillway.

MECHANICAL SPILLWAY	EMERGENCY SPILLWAY
The mechanical spillway is used for letting out the excess water from the pond and also as an outlet for taking out the water for irrigation.	The emergency spillway is to safeguard the earthen dam from overtopping when there are inflows higher than the designed values.

DESIGN OF FARM POND

(1) Selection of site

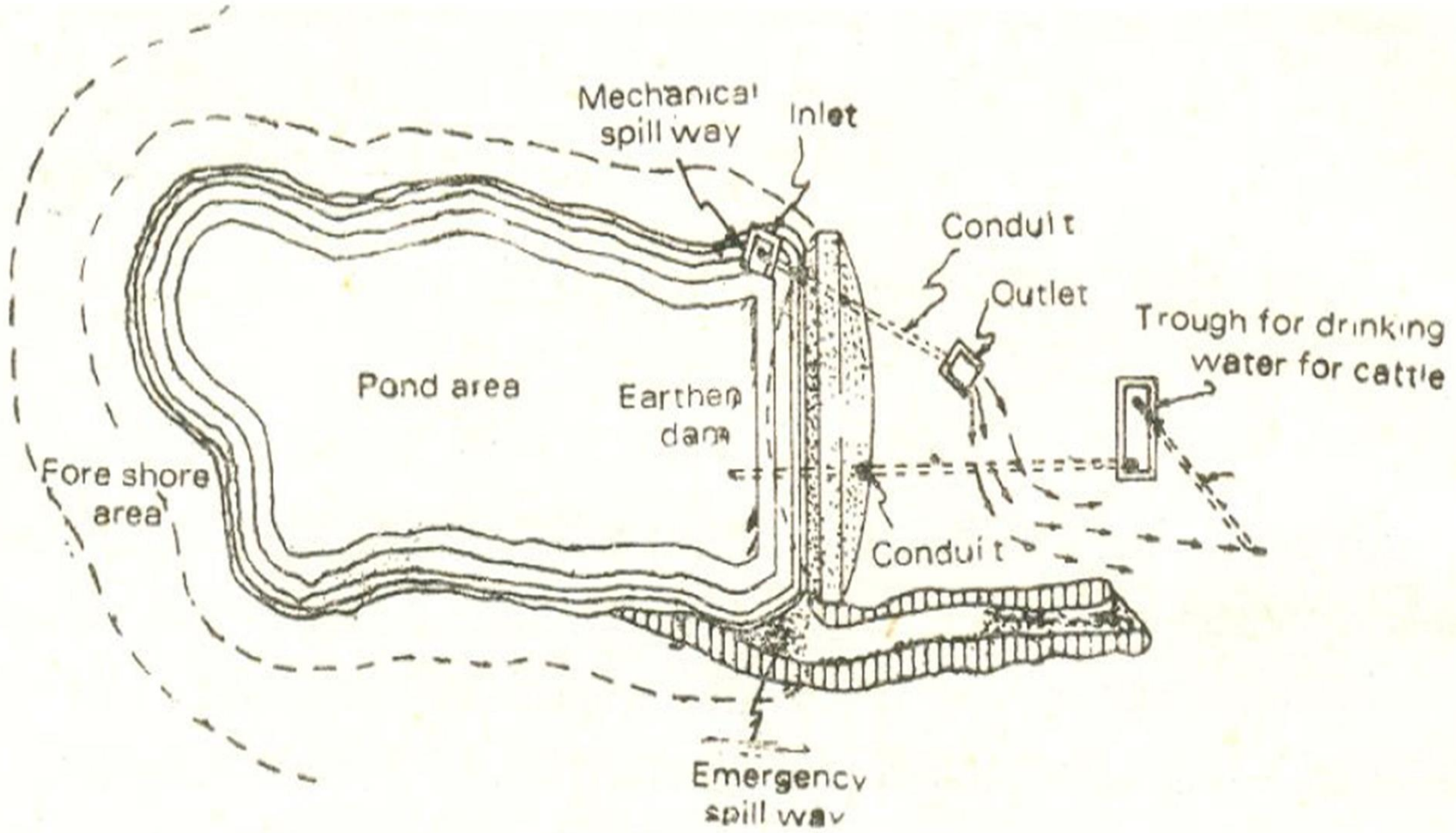
(2) Determination of the capacity of the pond

(3) Design of the embankment

(4) Design of the mechanical spillway

(5) Design of the emergency spillway

(6) Providing for seepage control from the bottom


Mechanical spill way
Inlet
Conduit
Outlet
Trough for drinking water for cattle
Pond area
Earthen dam
Fore shore area
Conduit
Emergency spill way

SELECTION OF SITE

It is important as the cost of construction as well as the utility of the pond depend upon the site. The site for the pond is to be selected keeping in view of the following considerations:

1. The site should be such that largest storage volume is available with the least amount of earth fill. A narrow section of the valley with steep sides slopes is preferable.

2. Large areas of shallow water should be avoided as these will cause excessive evaporation losses and also cause water weeds to grow.
3. The site should not cause excessive seepage losses.
4. The pond should be located as near as possible to the area where the water will be used. When the water is to be used for irrigation, gravity flow to the areas to be irrigated is preferable.

CAPACITY OF THE POND

- It is determined from a contour survey of the site.
- From the contour plan of the site the capacity is calculated for different stages using the trapezoidal or simpson's rule.
- For this purpose, the area enclosed by each contour is measured using a planimeter.

- According to the trapezoidal rule, the volume V between two contours at an interval H and having areas A1 and A2 is given by,

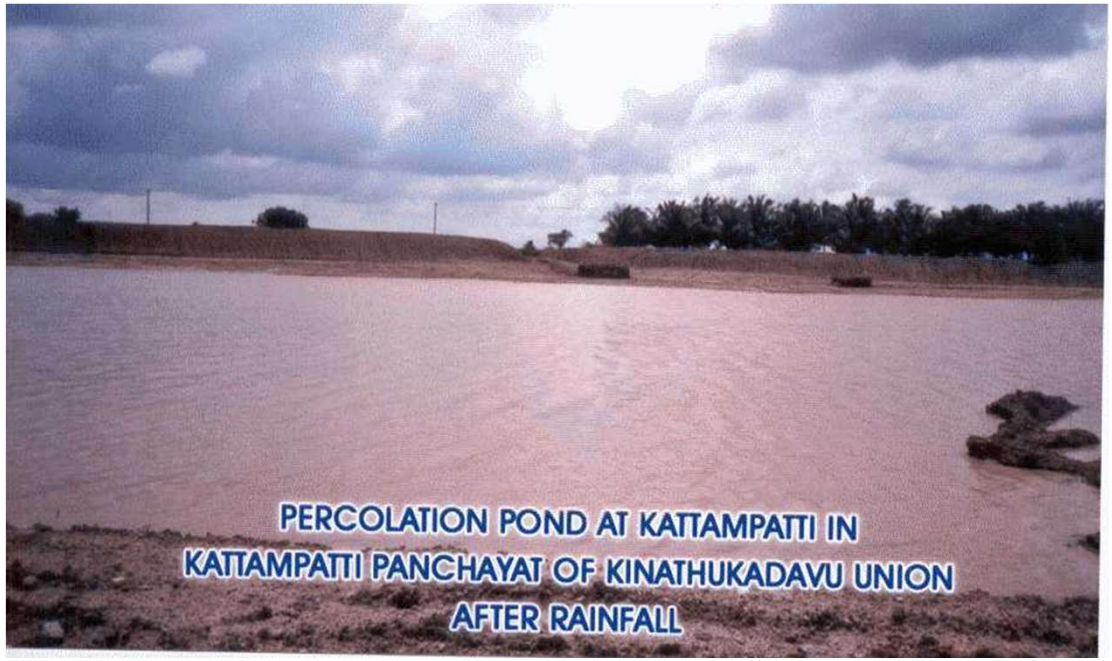
$$V = \frac{H}{2}(A_1 + A_2)$$

- Using Simpson's rule the volume between any odd number of contours is given by,

$$V = \frac{H}{3}\left[\begin{array}{l}\text{Twice the area of odd contours} + 4 \text{ times area of even contours} + \\ \text{Area of the first and last contours}\end{array}\right]$$

This formula is also known as the prismodial rule. For using this equation, the number of contours should be odd i.e. the number of intervals considered should be even.

PERCOLATION POND



- Percolation pond allows water to percolate (or seep) through layers of rock and gravel

- The water is cleaned as it slowly travels downward and eventually reaches an underground aquifer

- The purpose of man made percolation ponds is both to clean the water and to keep the ground from sinking

- Hard rock terrain covering two-third of the country - These are quite popular in the states of Maharashtra, Andhra Pradesh, Madhya Pradesh, Tamil Nadu, Karnataka and Gujarat.
- The percolation tank is more or less similar to check dams or nala bund with a fairly large storage reservoir.
- A tank can be located either across small streams by creating low elevation check dams or in uncultivated land adjoining streams, through excavation and providing a delivery canal connecting the tanks and the stream.

- Constructed in a terrain with highly fractured and weathered rock
- The aquifer to be recharged should have sufficient thickness of permeable Vadose zone to accommodate recharge (3 m below the ground level to minimize the possibility of water logging)
- A minimum well density of 3 to 5 per square kilometres is desirable.
- The nature of the catchment is to be evaluated based on Strange's Table for classification under Good, Average and Bad Category. It is advisable to have the percolation tank in a good/ average catchment.

- Location - downstream of runoff zone or in the upper part of the transition zone, with a land slope gradient of 3 to 5%.

- The yield of a catchment area is generally from 0.44 to 0.55 MCM/sq.km in a low catchment area. Accordingly, the catchment area for small tanks varies from 2.5 to 4 sq.km and for larger tanks from 5 to 8 sq.km.

- Generally, a percolation tank is designed for a storage capacity of 2.25 to 5.65 MCM. (Design capacity should normally not be more than 50 percent of the total quantum of utilizable runoff from the catchment)

- The height of the ponded water column about 3 to 4.5 m above the bed level.

DESIGN ASPECTS

On the basis of

(a) the topographical setting of the impounded area, to calculate the height and length of the dam wall, its gradient, width and the depth of the foundation, taking into account the nature of the underlying formation;

(b) details of the cut-off trench, to reduce seepage losses;

(c) height of stone pitching on the upstream slope to avoid erosion due to ripple action and on the down stream slope from rain by suitable turfing;

(d) upstream and downstream slopes to be moderate so that shear stress is not induced in the foundation beyond a permissible limit; and

(e) stability of the dam.

- normally earthen dams with masonry structures only for the spillway.
- Construction materials consist of a mixture of soil, silt, loam, clay, sand, gravel, suitably mixed and laid in layers and properly compacted to achieve stability and water tightness.
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- The dam is not to be over-tapped, by providing adequate length of waste weir and adequate free board.
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- A waste weir is provided to discharge surplus water when the full pond level is reached.

REFERENCE

- *S.S NEGI., ISBN NO.:81-7089-212-0 HAND BOOK OF FOREST ENGINEERING 1994, INTERNATIONAL BOOK DISTRIBUTORS , RAJPUR ROAD,DEDRA DUN-248001 INDIA*
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