Lecture-3

EWCE 461
River Engineering and Flood Management
3 Credit Hour

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Lecturer

Department of Environmental, Water Resources and Coastal Engineering

Sec-B: Flood Management- 1.0 Credit



Syllabus of Sec-A: 2.0 Credit

- Behavior of alluvial rivers
- River channel pattern and fluvial processes
- Aggradations and degradation
- Local scours
- River training and bank protection works
- Navigation and dredging of sediment movement in river channels
- Bed form and flow regimes
- Case studies



Syllabus of Sec-B: 1.0 Credit

- Flood and its causes
- Flood process in urban and rural area
- Flood management measures: structural and non-structural measures such as dams, reservoirs
- Diversion channels and floodways
- Improvement of channel capacity by dredging
- Land management, Flood proofing, Flood zoning, Flood hazard mapping
- Flood forecasting and warning, Flood damage assessment

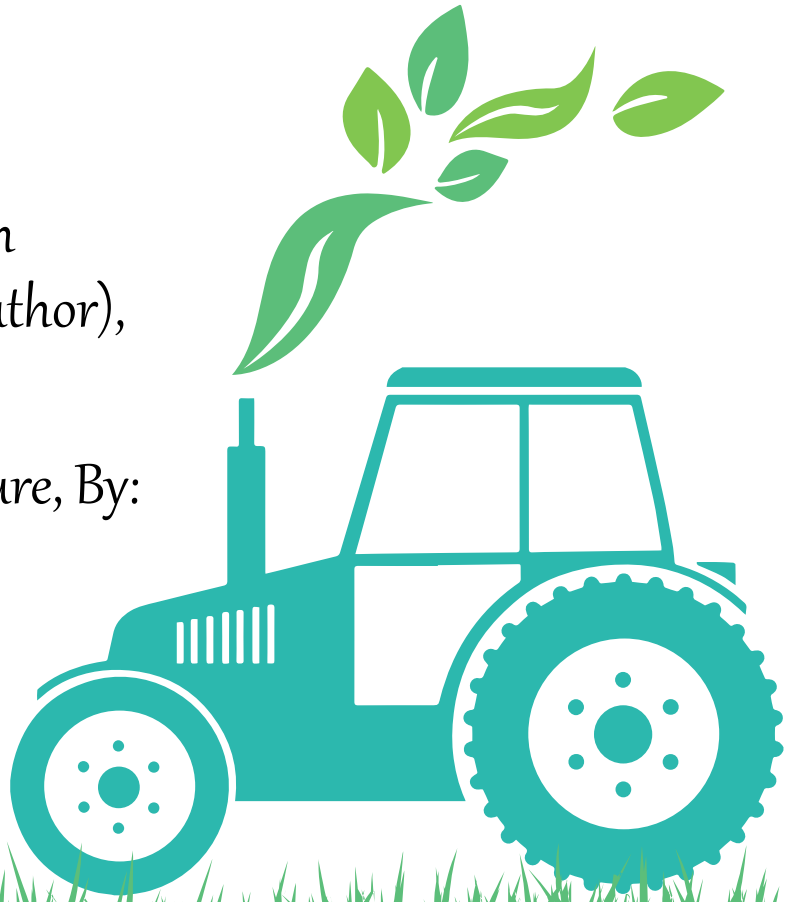


Course Outcome (CO)

CO1	Be able to explain the relationships of river planforms with the river Morphological parameters
CO2	Be proficient in calculating and estimating sediment distribution and sediment load of a river
CO3	Be able to apply different engineering perceptions to estimating the scour depth.
CO4	Be familiar with different bank protection and river training work and understand the dredging and navigation processes
CO5	Apply knowledge of flood processes and management strategies to analyze and assess flood risk.

Reference Books

- Any book on Flood Management and Mitigation
- **Water Resources Engineering by R. K. Linsley, J. B. Franzini, D. L. Freyberg and G. Techobanojlous**
- Fluvial Processes in River Engineering (1992) by H. H. Chang
- **Flood Control and Drainage Engineering, Fourth Edition, S.N. Ghosh**
- Urban Flood Management; by Chris Zevenbergen (Author), Adrian Cashman (Author), Niki Evelpidou (Author), Erik Pasche (Author), Stephen Garvin (Author), Richard Ashley (Author)
- Flood Risk: Planning, Design and Management of Flood Defence Infrastructure, By: Paul Sayers
- Vulnerability and Adaptation to Climate Change in Bangladesh: Processes, Assessment and Effects by MD Aboul Fazal Younus
- **Flood Action Plan**



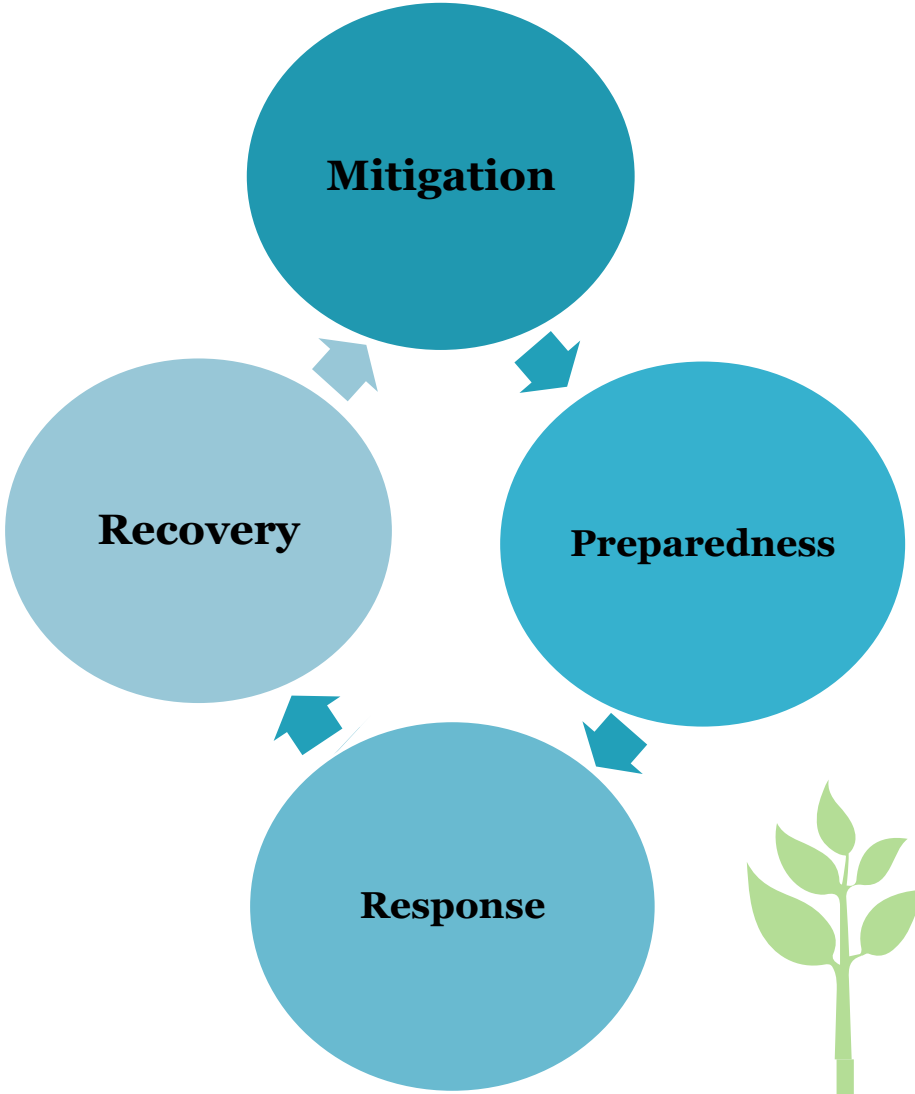
Lecture 3

Flood Management Measure

Flood Managements Measures

Planning for Flood management:

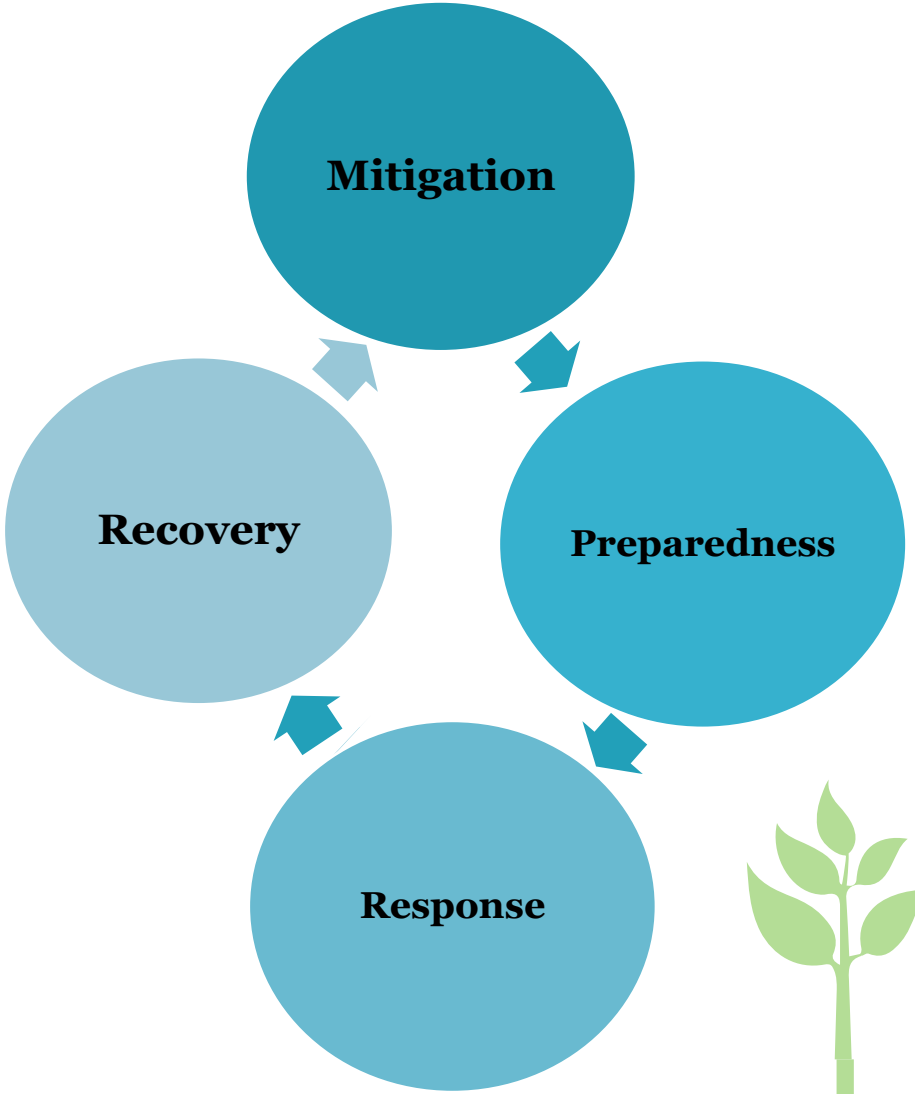
- **Pre-disaster mitigation:** This includes measures to reduce the impact of or prevent a flood event. Examples range from structural measures to public education.
- **Pre-disaster preparedness:** At this stage a response plan for the flood is developed in advance; a warning system for flood is installed and the people responsible for preparedness are trained; the institutional mechanism for implementation is specified.



Flood Managements Measures

Planning for Flood managements:

- **Response to disaster:** This includes activities which are undertaken during and immediately after flood, such as emergency aid, evacuation to pre-designated shelters, flood fighting; and assistance and taking measures for minimizing secondary damage and recovery operations.
- **Post-flood recovery:** At this stage support is provided for a return to vital life-support system to minimum operation levels, which is continued until the community returns to normal life.



Flood Managements Measures

- Flood management measures can be classified as

(i) short-term and

(ii) long-term measures.

- The **nature and extent** of flood damages as well as **local conditions** determine the measures to be taken up.

- However, short-term measures are dependent for their effectiveness on long-term measures.

Flood Managements Measures

Short-term measures

These measures are adopted for giving quick results when immediate relief to some pockets or locations is felt necessary and they are:

- Construction of embankments along the banks that are subject to frequent flood spells.
- Construction of raised platforms for temporary shelter during flood.
- Dewatering by pumps of flooded pockets, towns when gravity discharge of floodwater is not possible.
- Construction of floodwalls near congested areas of cities, towns and industrial belts.

Flood Managements Measures

Long-term measures

- Construction of storage reservoirs to moderate the flow peak thereby ensuring regulation of flood downstream.
- Integrated watershed management in the hilly area catchment, which ensures reduction in surface runoff, erosion and increase of infiltration capacity thereby reducing the impact of flood.
- Flood forecasts and warning based on hydro-geomorphological studies which can be given with some lead period, thereby ensuring minimization of property loss and loss of human life by shifting them to safer places.

Measures for Flood Control

Damages from a flood event depend on the following factors:

- location (urban and rural areas need to be treated separately);
- Depth (growth stage of crops is to be considered);
- duration (paddy can tolerate submergence for few days);
- timing (crop calendar is important here); and
- extent of flooding.

Measures for Flood Control

Options for flood damage mitigation:

Measures that can be adopted for flood damage mitigation can be classified into two categories~

- direct or structural measures and
- Indirect or non-structural measures

Measures for Flood Control

Structural measures for flood control

Structural measures can be divided into six categories:

- storage reservoir or detention basins for impounding of excess runoff;
- retarding basin to lower the level of flooding downstream:
- leaves and flood walls to confine flood waters within areas immediately adjacent to the rivers or sea:
- improvement of channel capacity by channel improvement and removing obstructions to flow;
- floodway or flood diversion through by-passes aimed at diversion of excess flows causing flood; and
- watershed management.

Measures for Flood Control

Non-structural Methods:

- Broadly, there are seven types of non-structural measures~
  - flood forecasting and warnings;
  - flood-fighting;
  - flood-proofing;
  - rescheduling of reservoir operations;
  - evacuation and post flood recovery programs;
  - flood insurance; and
  - flood plain zoning.

Measures for Flood Control

General Policy in Flood Control of Bangladesh:

- Flooding is a natural phenomenon, which can not be prevented .
- Complete flood control is not in the interests of most Bangladeshi farmers.
- The flood control measures and policies should be direct to mitigation of flood damage rather than flood prevention.

Measures for Flood Control

To minimize flood losses, the following steps may be taken:

•increasing the forecast lead time by strengthening the flood and warning system through the installation of effective equipment for collection of hydrological and meteorological data and through adequate training for related personnel:

•setting up an efficient system for the dissemination of flood warning;

•encouraging the introduction of zoning laws, especially in urban areas and areas covered by newly-built water-control structures;

•education of the public about flood hazards, especially through the development of flood-risk maps;

Measures for Flood Control

To minimize flood losses, the following steps may be taken:

•the inclusion of disaster relief and preventive health measures in development programs;

•the maintenance of an effective infrastructure for emergency relief operations;

•were reservoirs have been constructed its operational pattern may be properly designed and monitored so that artificial flood is not created at downstream locations;

•where embankments/polders have been constructed, its maintenance is essential to have it effective during flood events. Involvement of local people in planning, design, construction and maintenance of new embankments must be ensured.

STRUCTURAL MEASURE

Dam and Reservoir





What is Dam?

A dam is a barrier built across a stream, river or estuary to hold and control the flow of water for such uses as drinking water supplies, irrigation, flood control and hydropower generation etc



Fig: Hoover Dam (USA)

Height: 726.4ft

(221.4m)

Length: 1244ft (379m)

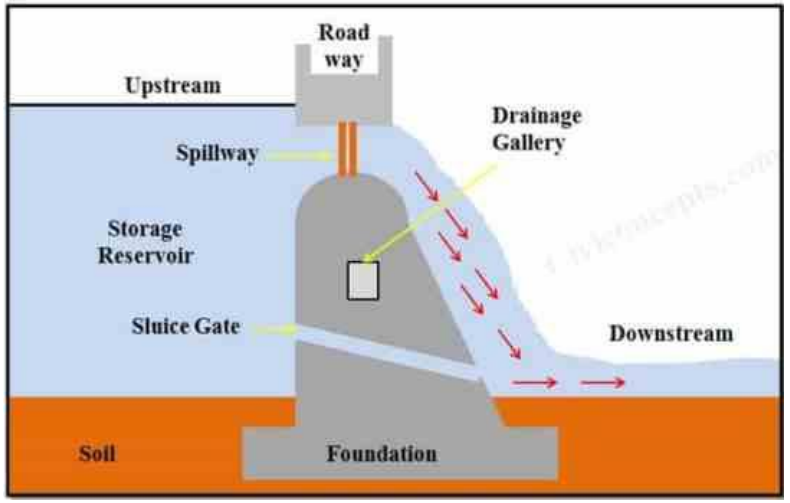
Different Parts of Dam

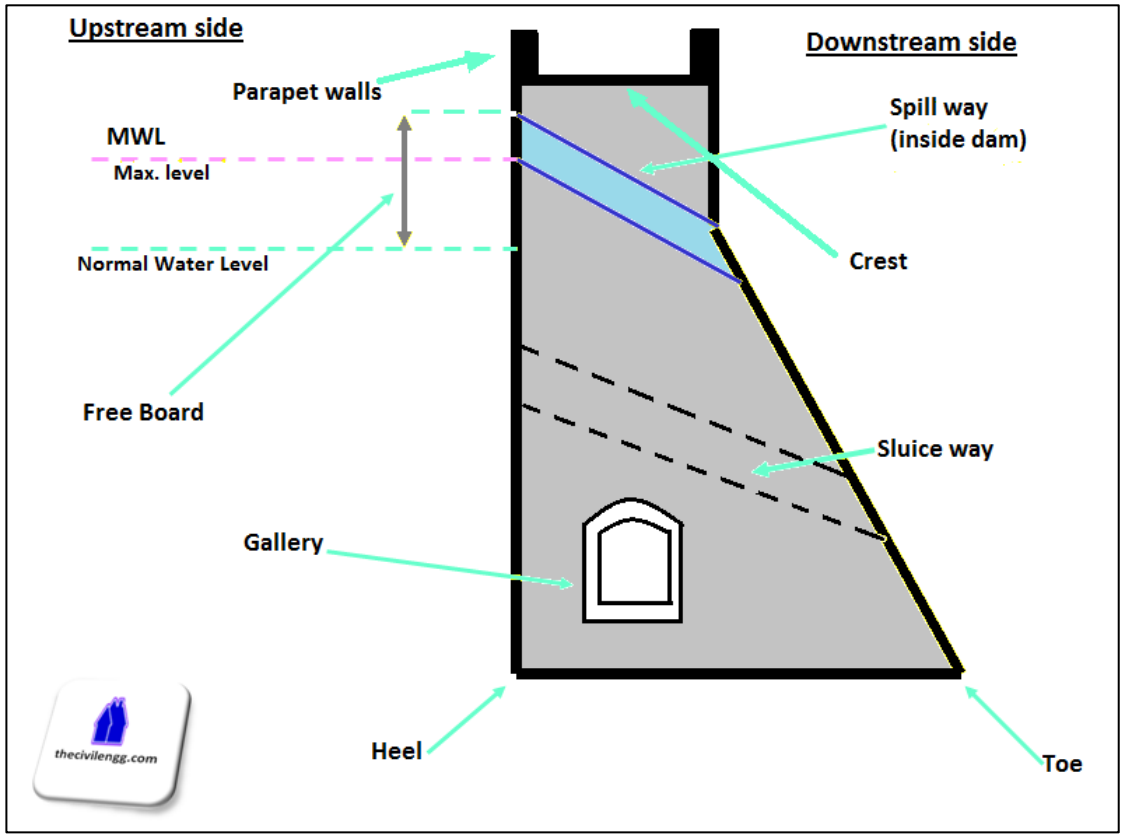
Heel: contact with the ground on the upstream side

Toe: contact on the downstream side

Abutment: Sides of the valley on which the structure of the dam rest

Galleries: small rooms like structure left within the dam for checking operations.



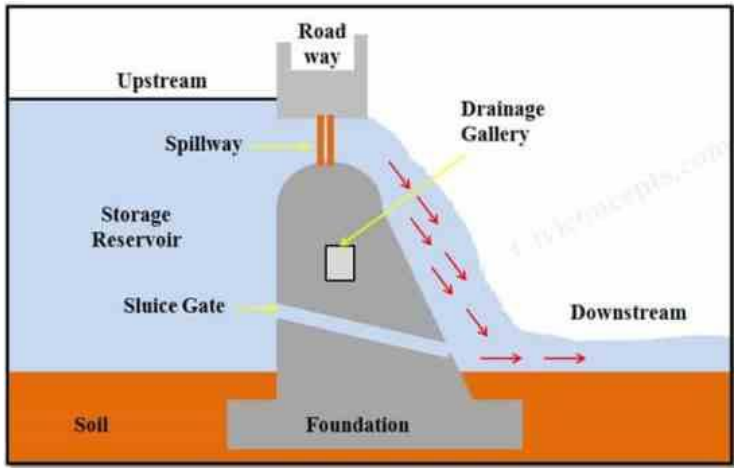


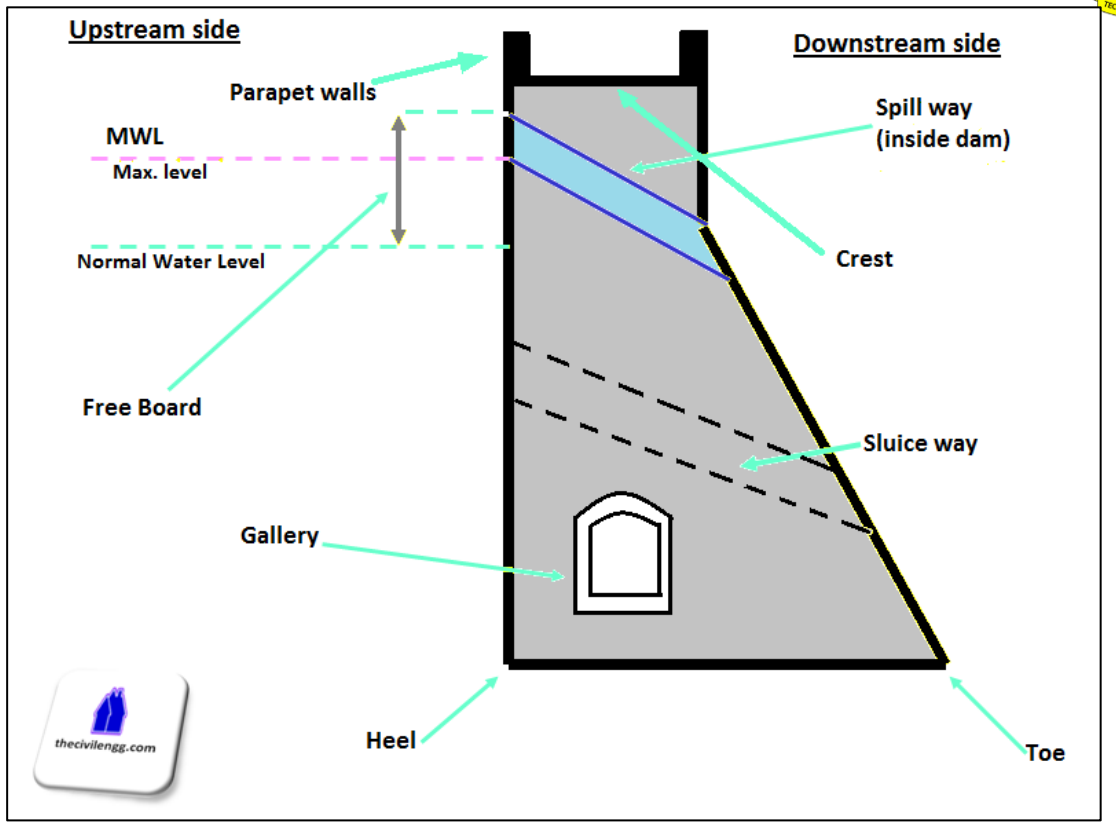
Different Parts of Dam

Diversion tunnel: Tunnels are constructed for diverting water before the construction of dam. This helps in keeping the river bed dry.

Spillways: It is the arrangement near the top to release the excess water of the reservoir to downstream side

Sluice way: An opening in the dam near the ground level, which is used to clear the silt accumulation in the reservoir side.





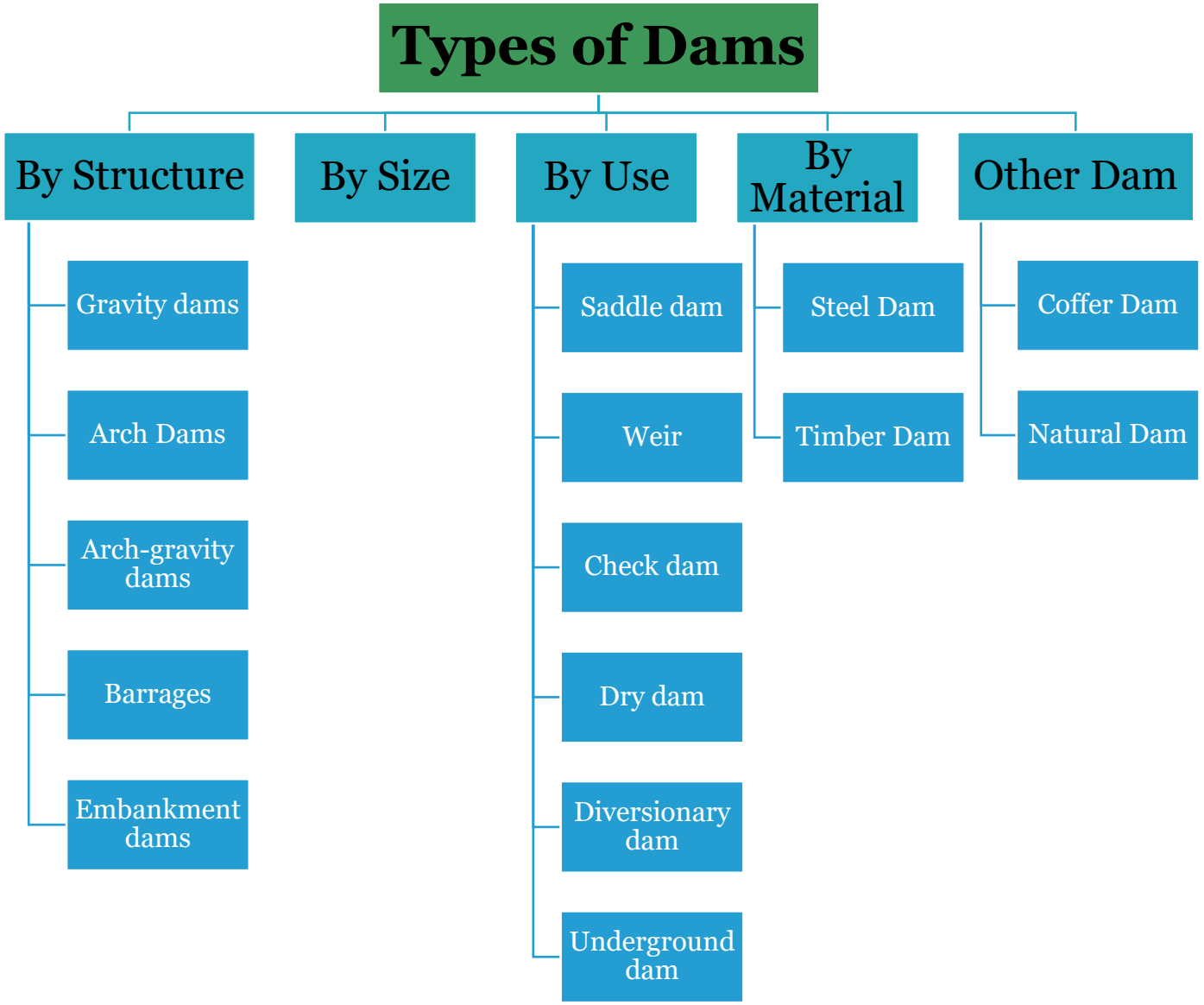
Basic Layout



Needs for dam construction

- Drinking and domestic water supply
- Flood control
- Irrigation
- Industrial water supply
- Hydroelectric energy production
- Retention and control of sediments
- Inland navigation, Improvement of water quality, Fish Farming, Recreation facilities

Classification of dams



Classification of dams

Arc Dam

- Arch shaped dam.
- Stability is obtained by combination of arch and gravity.
- Single and multiple arch dams are available.

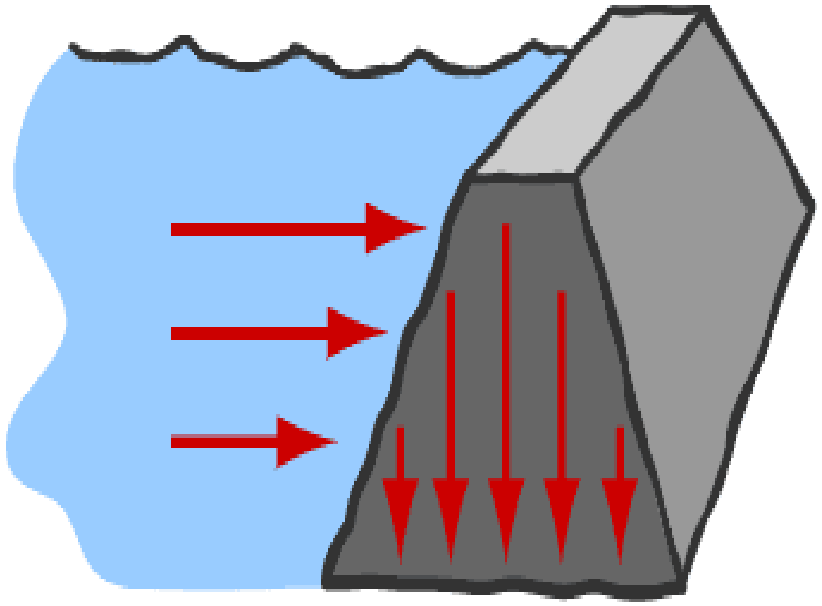




Classification of dams

Gravity Dam

- Overturning water pressure on the dam counter balanced by it's own weight.
- More useful to control flood pressure.
- classified as solid (widely used) or hollow (economical) and are generally made of either concrete or masonry.
- Hollow or Buttress dams are supported by series of buttress or supports.



Classification of dams

BHAKRA DAM
HIMACHAL, INDIA

HEIGHT
741 feet
(226 m)



Gravity Dam

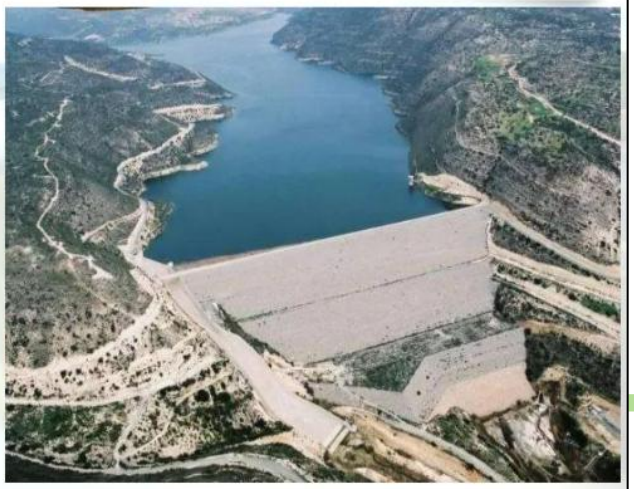
FONTANA DAM
NORTH CAROLINA, USA

HEIGHT
700 feet
(210 m)



NUREK DAM
TAJIKISTAN

HEIGHT
984 feet
(300 m)



Classification of dams

Arch Gravity Dam

- Combination of Arch and Gravity Dam.
- Areas with massive amounts of water flow but less material available for a purely gravity dam.
- Allowed thinner dam.



Hoover Dam

Classification of dams

Embankment Dam

- Made from compacted soil, sand, clay, or rock.
- Like gravity dam.



Mica Dam in Canada

Classification of dams

Barrage

- Special kind of Dam.
- Consists of a line of large gates that can be opened or closed to control the amount of water passing the dam at different sages.
- Often used to control and stabilize water flow for irrigation systems.



Red Bluff Diversion Dam

Classification of dams

Large Dam and Major Dam

- large dams are higher than 15 m, crest length min 500m, capacity of the reservoir min 1million cubic meter and max capacity of flood discharge is min 2000 million cubic meter per sec.
- Major dams are over 150 m (490 ft) in height.
- The one of the tallest dam in the world is the 300 m-high (980 ft.) Nurek Dam in Tajikistan



Nurek Dam

Classification of dams

Detention Dam

- Water is stored during and release in a safe rate without affecting downstream areas.
- Detention dams are constructed for flood control. A detention dam retards the flow in the river on its downstream during floods by storing some flood water. Thus the effect of sudden floods is reduced to some extent

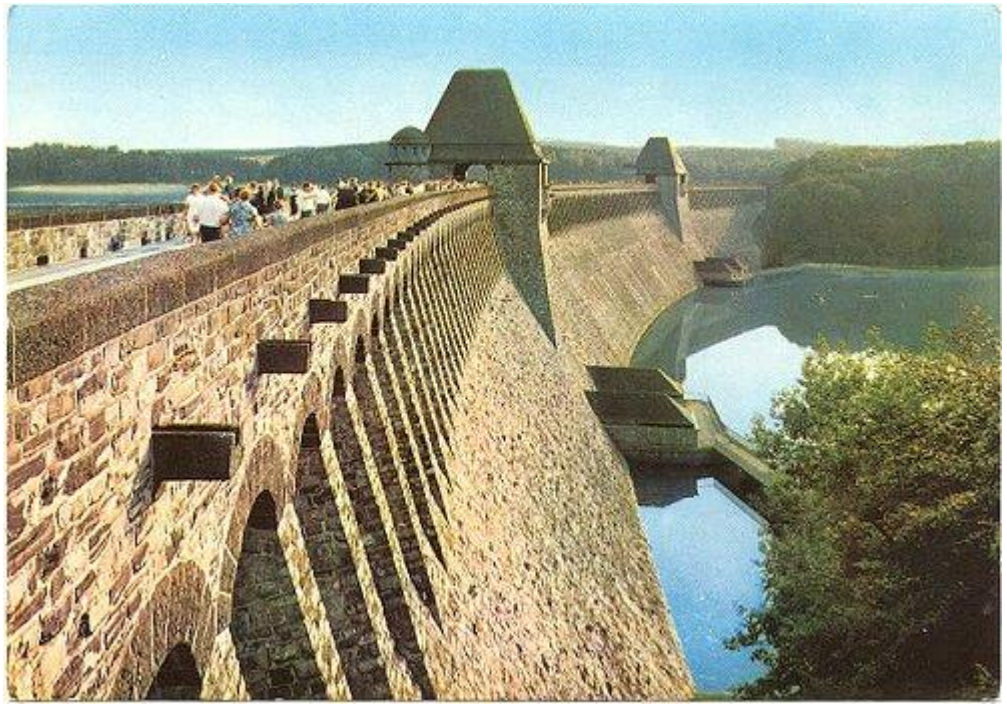


Flooded Hoover Dam

Classification of dams

Dry Dam

- normally holds back no water and allows the channel to flow freely, except during periods of intense flow that would otherwise cause flooding downstream.
- A flood control structure



Dry Dam

Classification of dams

Diversion Dam

- Excess or a portion of water is diverted to canals or tunnels through diversion structures.
- For irrigation or hydropower purpose or simply to protect bank from overflow.



Red Bluff Diversion Dam

Classification of dams

Weir

- Dams that overflow excess water.
- Impoundment lake for water.
- Use for flow measurement.
- Weir and barrages are types of diversion dam.

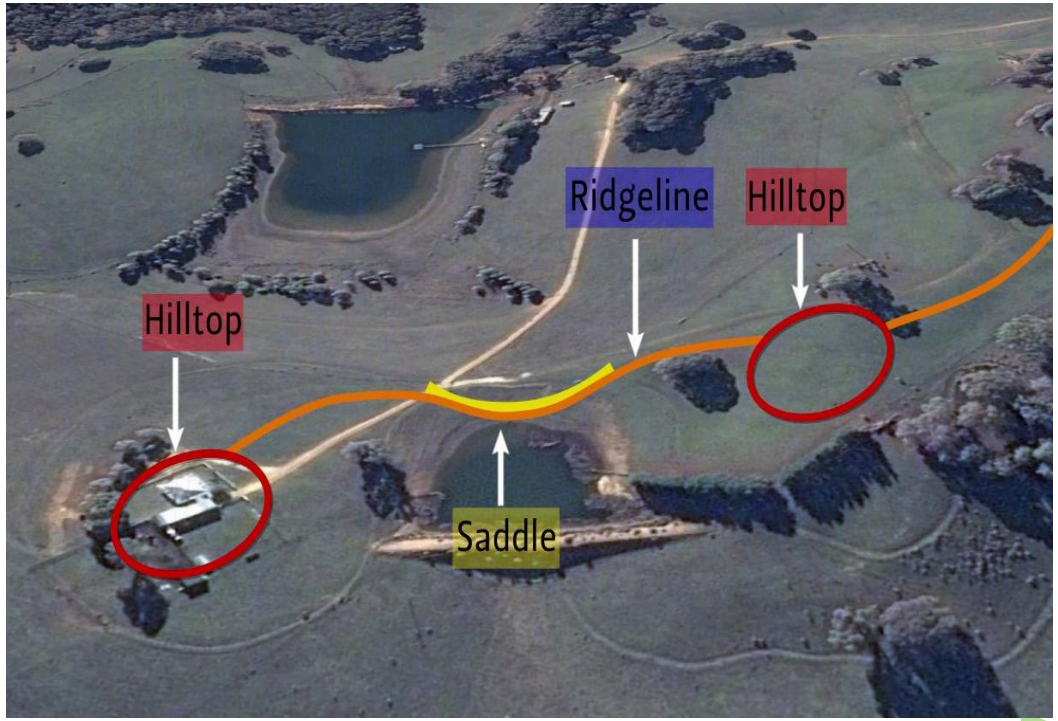


Horns mill Weir

Classification of dams

Saddle Dam

- An auxiliary dam is constructed in a low spot or "saddle" through which the reservoir would otherwise escape.
- Similar to Dike and Levee that reserve water and thereby protect from flooding .



Classification of dams

Check Dam and Wing dam

- small dam designed to reduce flow velocity and control soil erosion.
- wing dam partly restricts a waterway, creating a faster channel that resists the accumulation of sediment.



A check Dam at Kudumboor

Classification of dams

Tailing Dam

- Used to store tailings produced during mining operations after separation of valuables.
- Have an impervious liner to prevent seepage.



Classification of dams

Timber Dam

- Widely used in earlier due to easy and speed of work.
- Rarely built now for short lifespan and limited height.



Classification of dams

Steel Dam

- uses steel plating (at an angle) and load-bearing beams as the structure.
- Experimental dams to find out cheaper dam.



Classification of dams

Coffer Dam

- Temporary barrier constructed to exclude water from an area that is normally submerged.
- Usually used during construction and repair of different hydraulic structures.



Classification of dams

Natural Dam

- Created by natural geographic forces.
- Volcanic dam forms when lava flows.
- Similarly landslide and earthquake may cause landslides dam.
- Even glacier ice sheet can cause pool of water.



Flathead Lake

Classification of dams



Usoi Dam at Tajjikistan (567 meter tall)

Usoi Dam viewed from behind. Sarez Lake is on the right, and the smaller body of water to the left is Shadau Lake.

Classification of dams

Beaver Dams

- Beavers create dams primarily out of mud and flooded particular area.
- Well hidden from predators.
- Winter food security.



McIntire Beaver Dam

Features of Flood Control Projects

- Many conventional flood mitigation measures like flood control reservoirs, flood diversion or flood by-passes are infeasible inside Bangladesh because of its extreme flat topography.

- Main approaches are-

❑ Full protection of agricultural lands and urban areas against river flooding by constructing embankment along the rivers and providing appropriate drainage structures to minimize internal flooding.

❑ Partial protection against river flooding by constructing low height submersible embankments which are designed to delay pre-monsoon floods so as to ensure a safe winter crop (boro rice) harvest and to be overtopped during monsoon and remain submerged during the entire monsoon season

Features of Flood Control Projects

- Many conventional flood mitigation measures like flood control reservoirs, flood diversion or flood by-passes are infeasible inside Bangladesh because of its extreme flat topography.

- Main approaches are-

❑ Evacuating unwanted rainwater from behind the embankment or from within the poldered area by gravity through drainage regulators and sluices incorporated with the embankments (regulators and sluices prevent back flow from high river levels into the low-lying areas during monsoon and drain the water from the area to be protected when the river water level gets below than that inside).

❑ Providing drainage by pumps in selected large projects to pump out accumulated water from the project area. The types of implemented flood control projects include flood control (FC), flood control and drainage (FCD), flood control, drainage and irrigation (FCDI), and drainage (D) projects



Thank You!