EWC 461: River Engineering and Flood Management
3 Credit Hour

Md. Atikuzzaman
Lecturer
Department of EWCE

Lecture-4

Diversion Channels and Floodways

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**

What is Diversion Channels?

- Diversion channels are constructed to divert waters from the main channel for purposes such as flood control, municipal water supply, and irrigation.
- A type of diversion channel used for flood control is a flood bypass channel or floodway.



What is Floodways?

- Diversion channels or floodways are man-made channels
- offer a different route for excess water to flow
- mitigating the effects of flooding and
- restoring rivers to their natural water level.



What is Floodways?

- Control structures maybe located at the head of the diversion channel to divert flows during periods of high water and return flows during low water.
- Some diversion channels bypass the flood flows into an adjacent waterway, while others return the flows back into the same stream a distance downstream from the point of the diversion



Advantage of Diversion Channel

- diversion channels are built around major cities and towns to mitigate the effects of flooding in communities and urban areas.
- If it is designed only for periodic flood flows, the diversion channel can have multiple benefits such as an urban greenbelt, recreation, pasture for grazing, and a wildlife food source.
- If the invert of the diversion channel is too low, it will convey both low and high flows, thus continually staying wet.
- If adjacent low-lying areas or old abandoned river courses are used for diversion purposes, some terrestrial habitat may be lost or converted to a wetland habitat.

Disadvantage of Diversion Channel

- diversion channels generally have steeper slopes than the main channel. This can lead to stability problems such as erosion of the channel bed and banks.
- Although the diversion structure may be small, the right-of-way for the channel (canal) may require significant land to allow for maintenance roads, account for bank erosion and stabilization, and safety fencing
- The bed of tributary channels may be higher than that of the floodway channel and resulting in excessive sediment transport and deposition in the floodway.
- State laws may prohibit inter basin transfer of water.
- diversion flows can have an adverse impact on the stability of the main channel.

Classification of River Diversion

Classification made based on the purpose, physical and arrangement, and hydraulic operation of river diversion works.

- Flood diversion in tunnel
- Flood diversion in conduits
- Flood diversion in channel
- Floodplain diversion/bypass channel
- Temporary diversion with laterally constriction of the river.

Flood diversion in tunnel

diversion is implanted in valleys, having in mind that in these conditions the other solutions are difficult to implement.

The river diversion tunnel is the structure that has the highest costs associated with starting, resorting to this solution when the others are not viable.



Flood diversion in Conduits

The river diversion for conduit constitutes an alternative to river diversion tunnel, when the surrounding rock does not have enough quality to carry out a tunnel.



Flood diversion in Channel

This type of river diversion has application in situations where it is not economically feasible to make a tunnel or implant a conduit.

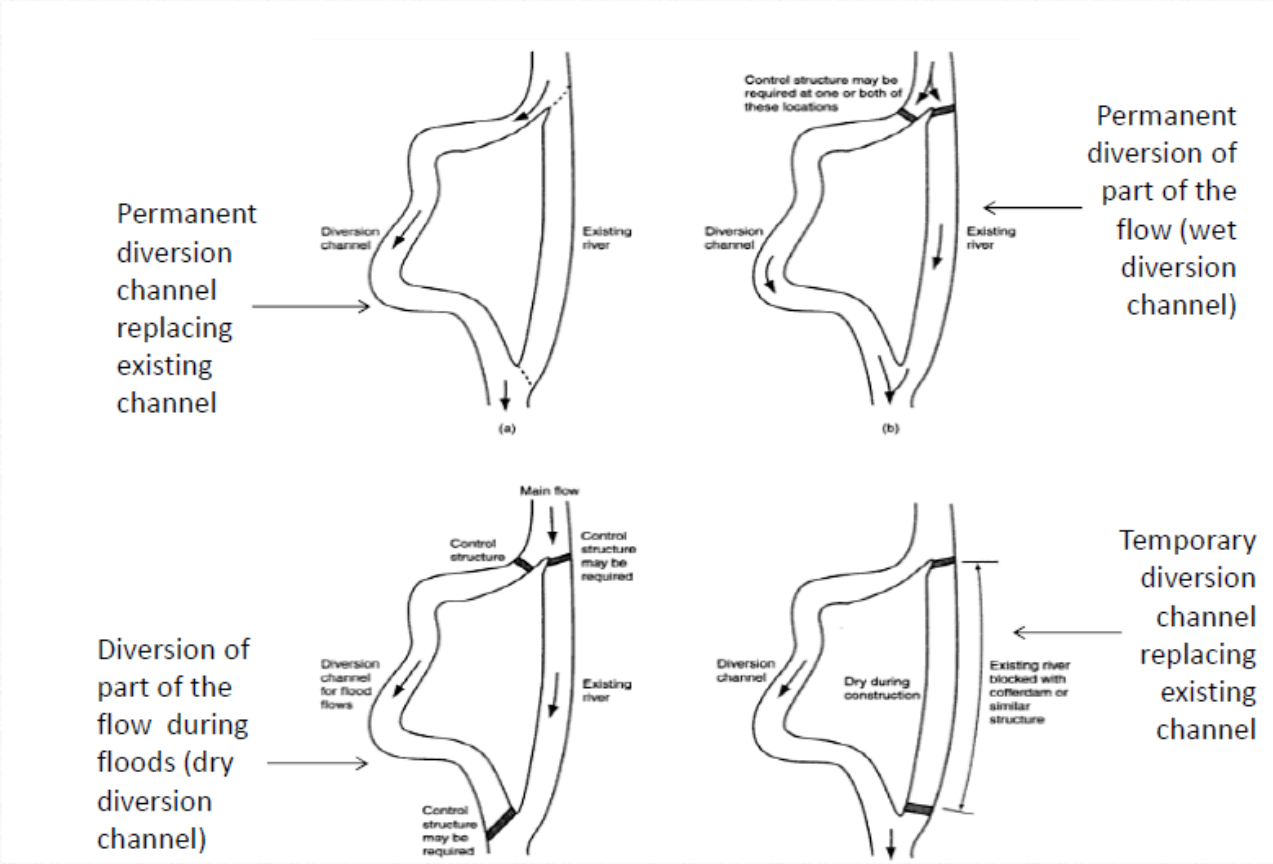
The construction of diversion channels is possible in embankment and concrete dams, having site topography characterized by flattened valleys.

Permanent and Temporary diversion

The type of diversion depending on the time span

1.Permanent diversion

2.Temporary diversion



Design Considerations

Selection and design of diversion methods should consider many factors, including:

- Size of stream, tributary watershed area and anticipated flow rates during construction. Special consideration should be given to large streams with large tributary areas with higher flow rates .
- Any special water quality or aquatic life conditions the waterway.
- Nature of surrounding land use, property ownership, and easements in the project area are important considerations in determining feasibility and methods for temporary diversions. For example, in a highly urbanized setting or an area with limited right-of-way, there may not be adequate space to construct a diversion channel.

Design Considerations

- Seasonal variations in stream hydrology (base flow vs. peak flow).

  Irrigation flows: If an irrigation ditch enters the stream, it is recommended that the ditch company be contacted to confirm when flows from the ditch may be expected.

  Weather (storm runoff): If diversions are constructed in summer months when thunderstorms and flash flooding can occur, contractors will need to track weather forecasts closely and provide additional protection when higher flows from runoff are anticipated.

Design Considerations

- Probability of flood flows exceeding diversion capacity and/or diversion failure. Consider the consequences of failure such as:
  - Public safety
  - Environmental
  - Legal
  - Regulatory
  - Economic
  - Project disruption/delay
- Realistic estimation of project duration and time of year during which construction will occur.

Design of Flood Bypass

1. Determine if a diversion is appropriate based on appropriate uses and design considerations stated earlier.

2. Determine project duration.

3. Determine the time of year in which construction will occur.

4. Gather necessary temporary diversion sizing parameters that may include tributary area, imperviousness, project duration, safety factor, and seasonal sizing coefficient.

5. Apply applicable sizing methodology and perform necessary calculations (provided following this section). Use engineering judgment to determine if the temporary diversion design flow is adequate for the specific project.

Design of Flood Bypass

6. Determine appropriate method of diversion. Follow the design steps for the selected method discussed below.

7.Consider developing an emergency action plan, as a precaution, for rapidly removing equipment and materials with potential to contribute pollutants to runoff from the waterway in advance of imminent runoff with the potential to exceed diversion capacity. The emergency action plan should designate an individual who will be on the site throughout most of the construction project with the authority to order that work be halted and equipment and materials with potential to contribute to storm water pollution be moved to high ground outside of the active channel. The emergency action plan should identify where equipment and materials removed from the channel will be stored temporarily during a runoff event that is expected to exceed temporary diversion capacity.

What is Flood wall?

- A flood wall (or floodwall) is a primarily vertical artificial barrier designed to temporarily contain the waters of a river or other waterway which may rise to unusual levels during seasonal or extreme weather events.
- Flood walls often have floodgates which are large openings to provide passage except during periods of flooding, when they are closed.
- The substantial costs of flood walls can be justified by the value of commercial property thus protected from damage caused by flooding.





