EWC 461: River Engineering and Flood Management
3 Credit Hour

Md. Atikuzzaman
Lecturer
Department of EWCE

Lecture-8

Flood Zoning

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

Syllabus of Sec-B: 1.0 Credit

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 Flood Zones

- Floodplain is the land which has been or may be covered by floodwater during a regional flood which has a 1% chance of occurring in any given year or 100 year flood.
- Flood plain zones are geographic areas that the Federal Emergency Management Administration (FEMA) has determined to be a flood risk to nearby communities and property.

What is Flood Zoning

- Flood zoning is a non structural measure of flood mitigation and procedure to identify areas of varying flood hazard.
- FEMA rates Flood zones for their severity of risk, and designates them as low-to-moderate risks, high risks, coastal areas, and undetermined risks.
- Each zone reflects the severity or type of flooding in the specified area.

Advantage of Flood Zoning

- Flood-plain zoning reduces the risk and cost of damages flooding causes.
- Local governments may pass flood zone laws that restrict land use. These laws prevent or limit building and development in flood zones to lesson the risks associated with flooding.
- Additionally, specific building standards and construction materials may be required to reduce potential flood damage.

Disadvantage of Flood Zoning

- The expansion of an urban area is limited if there aren't any other suitable building sites.
- It's no help in areas that have already been built on.

Flood Map

- In flood-plain management Flood Insurance Rate Map (FIRM), Flood Boundary and Floodway Map (FBFM), and Flood Hazard Boundary Map (FHBM) are all flood maps that have been produced by FEMA.
- flood maps must show flood risk zones and their boundaries, and may also show floodways, Boundaries and Base Flood Elevations (BFEs).
- The FIRM is the most common map and includes all information of others two.

Flood Insurance Rate Map (FIRM)

- FIRMs support the National Flood Insurance Program (NFIP) and provide the basis for community floodplain management regulations and flood insurance requirements.
- It is used in town planning, insurance industry, by individuals for protecting properties and also used to set rates of insurance against risk of flood.
- FEMA's Digital Flood Insurance Rate Map (DFIRM) Database.

Flood Zones Classifications

- Flood Zone 1 -Low Probability land which have probability of river or sea flooding less than 1 in 1,000 annual(<0.1%).
- Flood Zone 2 –Medium Probability zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% –0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% –0.1%) in any year.
- Flood Zone 3a–High Probability zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea(>0.5%) in any year.
- Flood Zone 3b –The Functional Floodplain zone comprises land where water has to flow or be stored in times of flood

Flood Zones Classified by FEMA

High Risk Areas	High Risk Coastal Areas	Moderate to Low Risk Areas	Undetermined Risk Areas

High Flood Risk Areas

A: Areas inundated by 1%-annual-chance flood event generally determined using approximate methodologies.

AE and A1-30 - Areas subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods. Base Flood Elevations (BFEs) are shown.

AH: Areas inundated by 1%-annual-chance shallow flooding (areas of ponding)

AO: Areas inundated by 1%-annual-chance shallow flooding (sheet flow on sloping terrain)

AR: Areas decertificated of a previously accredited flood protection system

A99 : Areas subject to inundation by 1%

High Risk Coastal Areas

V

Areas along coasts, inundated by 1%-annual-chance flood event along with storm-induced waves.

VE, V1-V30

Areas along coasts inundated by 1%-annual-chance flood event along with storm-induced velocity wave action.

LiMWA

The Limit of Moderate Wave Action (LiMWA) identifies areas that will be affected by waves with a 1.5 foot wave height or greater within the coastal A zone.

Moderate Risk Areas

B, X (shaded): Area of moderate flood hazard

C, X (unshaded): outside the high-risk zones

Undetermined Risk Areas

D: **Unstudied areas where flood risks are undetermined**

Approaches of Flood Zoning

Historic approach is based on past flood events	Conventional approach	Modeling approach
• Using Written reports, old maps or photographs to delineate flood zoning map	• Using watermarks on buildings and reported cases in the news media	• Using estimation of design floods & as well as the flooding process

Data Required for Flood Zoning

- **Topography:** Aerial photography, Satellite imagery from Google Earth, The national geodetic survey etc.
- **Surface elevation:** Topographic maps with contour lines
- **Past flood events and disasters:** Information about past (historic)events
- **Hydrologic data:** Hydrologic data are relevant to estimate peak discharge from the Hydro-meteorological Service
- **Hydraulic data:** To describe the discharge conditions in & around the channel, channel depth, width.
- **Land use and cover:** used for hydrological and hydraulic modeling from National statistical bureau, Satellite data etc.
- **Social and socio-economic data:** Used for assessment of exposure & vulnerability from Insurance companies, Satellite information.

FLOOD RISK ZONES DETERMINATION

Runoff discharge of the study area

- Q= 0.28*Cs*C*I*A
- Where, Q= runoff rate [m3/sec], C= Runoff Coefficient, Cs= Storage Coefficient, I= Rainfall Intensity [mm/hr], A= Drainage area [Km2]
- Determines maximum flood of an area under consideration

Runoff Concentration on Elevation

- The discharge concentration values decreases as elevation decreases, indicating a slow runoff rate that can generate flooding

Flood Risk Areas

- Represent by pixel values Pixel values are clearly grouped in low, moderate & high risk zones by reclassify method.