

MANAGEMENT

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Lecture 1: Jan 4, 2021

TERMINOLOGIES

① Risk

- Hazard - topographical condition e.g. seismic zone
- Vulnerability - present condition of structure
- ~~Exposure~~ (infrastructure) ~~non-engineers~~ engineers
- Exposure people / buildings in the topography
 dense space (dense is more exposed to calamities)

Disaster

about Natural
 Earth man-made

$$\boxed{\text{RISK} = \text{Hazard} \times \text{Vul} \times \text{Exp.}}$$

↳ High, low, Moderate (Qualitatively)

~~box~~

→ Risk in % (Quantitatively)

→ Each of H, V, Exp are assigned a score

DISASTER - extent of damage-fatalities

↳ realisation of risk - i.e. damage, fatalities

Example = Earthquake

Hazard - force reqd. to be resisted by a building in a given seismic zone

e.g. Nuclear
 ↳ 500 yrs

building - Prob. of exceedance of an event (design life) - more the prob. of exceedance, more the severity of a particular event.

Vulnerability : buildings < engineered non-engineered

Hazard

Natural - cannot change

Man Made - possible to prevent to a certain extent

Vuln

- Precautions
- Some engineering
- Old + traditional sys.

Exposure

- Cannot change - depends on requirement

Risk

- ↳ by reducing vulnerability

Disaster

- ↳ MUST PREVENT

Classification

① Causes

- Natural
- MM

② Speed of onset

- sudden ↗ no/little warning time for preparedness

eg. Earthquakes

↳ can't prepare

Cyclone

↳ can prepare

Pandemic

- slow — Develop, Emergency, Disaster

eg. Epidemic, Drought

- High Powered Committee classification

Examples

Bhuj 2001 - (N) Earthquake

Uttarakhand 2013 - MM + (N) { flood

Kerala 2018 - (N)

Hyd 2020 - house constructed in Lakes

Drought - Raj, Maha, Guj.

Cyclone - Vishakha patnam 2014
WB, 2020

Landslides - Kedarnath 2013

Volcanoes - Japan 2017 Indonesia 2018

Avalanche - Kashmir 2017

Bushfire - California, Australia, Amazon forests
2017 2020

Disaster events by Type

- | | |
|-------------------------|------|
| ① Flood | 44 % |
| ② Storm | 28 % |
| ③ Earthquake | 8 % |
| ④ Temperature (extreme) | 6 % |
| ⑤ Landslide | |
| ⑥ Drought | |

Total no. of ppe affected

- | | |
|--------------|------|
| ① Flood | 41 % |
| ② Drought | 35 % |
| ③ Storm | 18 % |
| ④ Earthquake | 3 % |

Deaths

- | | |
|--------------|------|
| ① Earthquake | 58 % |
| ② Storm | 16 % |
| ③ Extr. Temp | 13 % |
| ④ Flood | 9 % |

(Not earthquake-proof but
earthquake resistant)

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India Vulnerability

- ① Earthquake 65% landmass / area
- ② Flood 5%
- ③ Drought 70%
- ④ Storm 8%
- ⑤ Landslides 3%

Worldwide Seismic

- ① Ring of Fire
 - ↳ Plate boundaries

- plates hit each other
- go under other -

- ② Mountains
 - ↳ Himalayan region
 - ↳ Indo Alpine belt

Tsunami

- ↳ seismic activity on sea

2011 Japan

2004 India

Japan, New Zealand, US

30 years ahead
structural elements
do not collapse
achieved no-collapse

Landslides

- ↳ hilly areas

Himalaya, Ghats, Nilgiris, Vindhyas

Floods

↳ 4 zones

- ① Brahmaputra
- ② Ganga
- ③ N-W River - Indus, Beas, Sutlej
- ④ Central / Deccan India

In addition,

- Andaman / Nicobar
- Lakshadweep

Tornadoes

Wind Storms

Squalls

Thunder storms

↳ 6 zones

more along East coast than West coast

Cyclones

~ 6 cyclones per year

Man made Disaster

Hiroshima, 1945

Bhopal 1984/85

Chernobyl

New York (Twin towers) WTC 2001

[Ground zero]

Pollution - Slow Disaster

Oil spills

Train accidents

→ Structure build for intensity not magnitude of eq

→ structure damage → 5.

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DM

Before Predict, Prevent, Prepare

After - Rescue, Relief, Rehab

Timely decisions

→ better preparedness

→ better warnings

→ reduce vul

prevent future disaster

Mitigatⁿ - measures to minimise effects of D

a. Building codes / zoning

b. Vul. analysis

c. Public educatⁿ

Preparedness - planning how to respond

a. Preparedness plans

b. Mock drills

c. Warning system

Response - Immediate action

a. evacuation

b. Search / Rescue

c. emergency relief

Recovery - returning to Normalcy

a. Temporary shelter

b. Medical care

c. Grants

Rehab
Reconstruction

Concerns

- fail-safe terrestrial communication
- early warning system
- Funding
- DM Plans
- Integrating diff agencies - admin, tech, scientific

Lecture 2 : 7th Jan '21.

- NDMA → (2005) est.
- NDRF - internatⁿ + national
- NIDM - documents, training, research, networking
- SDMA
- DDMA
- High Powered Committee - est. 1999
- ~~Dis~~ DM Act 2005 - financial / coordinatⁿ mechanism

NDMA

- [] National Executive Committee
(Keyojo), ISDR, Rio Declaratⁿ,
2005-15 Milenium Dev Goals
- [] Theme = CBDM common Alerting protocol
- [] 5 divisions = Mitigatⁿ

Finance

dam-induced earthquake
micro zoning — NDMA

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CAP

agencies
IMD — meteorological (cyclone)

CWC — Water

SASE —

INCOIS — ocean

HAM Radio

→ Gsm / Radio / Landline

→ 2 diff levels / langs / priorities

Capacity building

↳ National Level - NIDM

State Level - ATI

13th finance commission fix services

Risk Transfer

↳ Insurance

DM Cycle

Mitigation

Activities } slides
Tools }
Strategies }

→ Structural Mitigation = constructional projects which reduce eco & social impacts

→ Non-structural mitigation = Policies

↳ awareness

↳ Review building codes

↳ Vul Ana updates

↳ Safety codes

↳ preventive health measures

Mitig: Earthquake

- USGS classification - magnitude
 - collapse mag > 5

31 times b/w 2 magnitude

2	56 kg energy release) x 31
3	1800 kg	
	56,000 kg	
	1.8 million kg	

- $F = ma$
(inertia)
- displacement is forced on the building
(not force)
- displacement loading
- Earth is moving
- $m \uparrow F \uparrow$ (a is beyond control)
- To x fro movement depends on
nature, type, material, structure of
building

Lecture 03 = 11th Jan '21

- ### 6 pillars of NDMA: earthquake
- Earthquake resistant design & construct
 - Selective seismic strengthening
 - Hospital
 - Bridges
 - Govt. buildings
 - Priority structures

- Regulatⁿ & Enforcement (building codes)
 - (Italy/France - check if building followed co)
- Awareness & Preparedness
- Capacity Dev
- Emergency Response

not in India because shortage of qualified ppe

↓
non-linear state of buildings not taught
only linear state
elastic state

$$\rightarrow \text{Natural period of building} = 0.1 \times \underbrace{N}_{\substack{\text{no. of} \\ \text{storeys}}}$$

$$T = 2\pi \sqrt{\frac{m}{K}}$$

mass → m
stiffness → K

Dam < Water Tank
 $m \uparrow, k \uparrow$ $m \uparrow, k \downarrow$

Suspension Bridge - $K \downarrow, m \uparrow$

- Earthquake will come in basket of frequencies
- engineer must perform non-linear analysis before structuring building

- Mass unsymmetry - translatⁿ (X)
- Stiffness unsymmetry - twists/rotatⁿ (X)

⊕ no mass/stiffness irregularity across plan & height of build.

Structural

unsymmetry in strength & stiffness of building

- ① Tooth pick columns - Open ground system
- ② one storey = no columns
- ③ walls get separated from column
- ④ short column / Captive columns
- ⑤ Pounding - tilt buildings hit each other
(too close to each other)
- ⑥ Using pre-cast constructions which aren't earthquake resistant

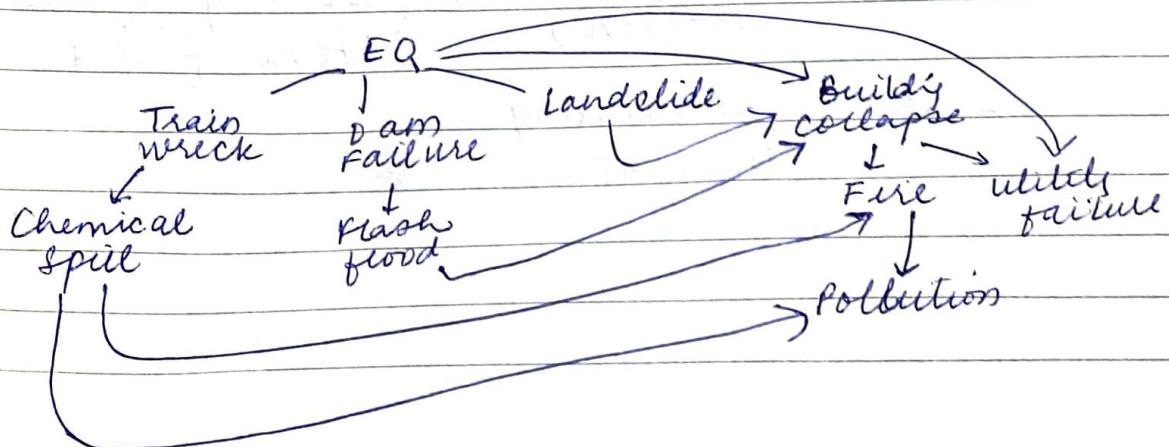
Non structural elements

- shelves - wall mounted devices
- Electric power failures
- Pipes
- Overhead safety - tubelights, false
- glass buildings

→ Reduce downtime

→ ^{s. zone}
Koyna I → IV
Killari / Latru I → III

→ Intraplate EQ / Interplate } Hidden seismic faults
→ Temp struct - 5-10 yrs }
Building - 50 - 100 years } designed for minimum seismic force



Wind } → Bracing in structure (diagonal elements fitted
with hydraulic system)

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Structures (Normal)

↳ min. lateral stiffness

" " strength

" " deformability

Lifeline structures — (site-specific studies)

↳ more of above 3.

↳ no or less damage

to exceed
code
compliance

Mitig: Flood

NDMA = Flood

| river flooding

| urban flooding

Automatic weather station

GSM

high resolution ALTM

Flood techno-legal Regime

Best Practices

- Flood Vents
- Elevated Homes
- Good foundation system
- House owner guides to be followed
- Hard engineering (erosion) ↗ lining of canals ↗ EROSION
stone filled
- Soft engineering (Natural)

- EQ } → Base isolat" of buildings from ground - so displacement
 → sacrificial components - pendulum
 → elements like fuse - when excessive deformation that element will fail

~~is taken by~~
 Pendulum
 Page

Neoprene
 get heated up
 by energy
 of EQ

NDMA = wind

EQ - mass

wind - mass ✓

cyclone shelters

- { all weather approach roads } Bridges, Road links
 link Roads to shelters }
- Standard Operating Procedure for }
 maintenance
 widen drains
 divert canals
 repair saline embankments
 strengthen Communicat" towers, Power Transmission Network
 Canal, water tanks

FEMA

- ↳ Hardened rooms — entire separate structure
 ↳ community wind shelter

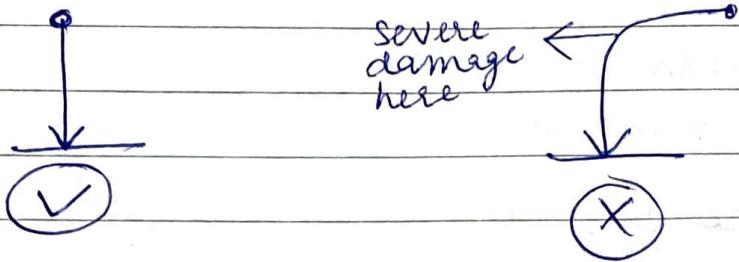
Preparedness

→ Lec 4 : 18th Jan '21

Earthquake Mitigation

- ↳ Regularity - archit & str. eng. together
- NSE : Best Practices
- ↳ pipes (doesnt deform)
 Anchored NSE < machines (doesnt fall/topple)
 Load path for force to deviate (from NSE)
 should be direct (not-indirect)
 ↓ straight
 from source to foundat"

no turns in load paths



sufficient slack in gas pipes to avoid breaks

allow free movement of sewage pipes that run across slots / attached to floors

flexible water pipe b/w building & water tank.

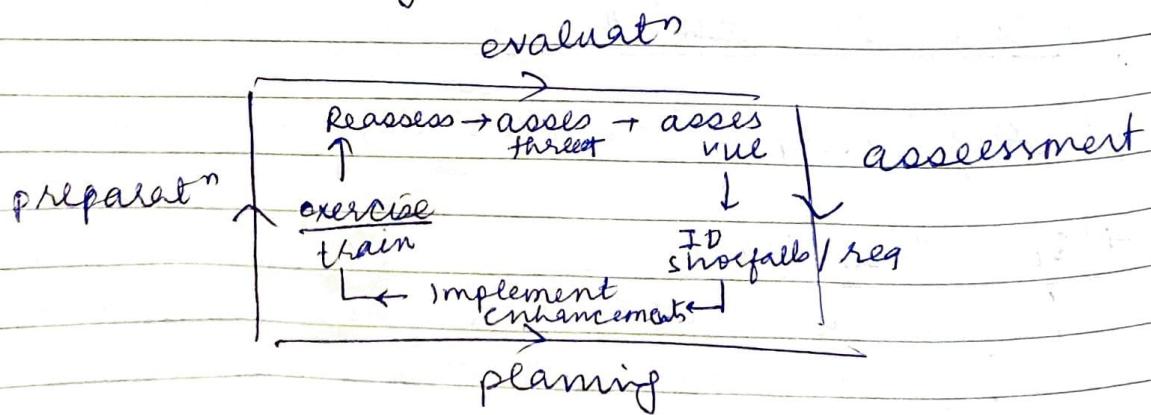
front panel / string and vertical space in shelves

Preparedness

to achieve satisfactory level of readiness to respond to emergency

→ Seawalls built for Japanese coastlines

→ Preparedness cycle



- Seismic gap — gap b/w 2 earthquakes
- return period

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Disaster Risk Reductⁿ (DRR)

- ↳ action plan implemented before
during disaster
after
- ↳ policy, planning, Capacity build.
- ↳ Physical preventⁿ
eg- build seawalls.

Emergency Operations Plan (EOP)

- ↳ Statement of purpose
 - ↳ what the plan seeks to achieve for citizens
- ↳ statements of emergency events - actual or potential
- ↳ org. & assignment of responsibilities
- ↳ concept of operatⁿ - interactⁿ & distributor^s of roles
 - ↳ diff. agencies
 - ↳ govt, private
- ↳ exercising EOP (slides)

Ensure Strategic Reserves

- ↳ Food, equipment, medicines, water

Theme - Prepare together. (slides)

- ↳ evacuation plan for kids, pets etc.
- ↳ fire extinguisher
- ↳ turn off utilities
- ↳ assemble emergency supply kits
- ↳ know the neighbourhood.

C-BDP (Slides)

- ↳ vul analysis
- ↳ capability assessment
- ↳ plan development

- Use knowledge of local community eg. NGOs
eg. Ekra housing in Sikkim.

- Medical Preparedness

Emergency Medical Response (EMR)

EOC - Emergency Operatⁿ Center

MFR medical first responders

Transportation & evacuation of Casualties

Integrated Ambulance Network

Accident Relief Medicin Wans in 7 strategic locations - Train accidents

↓
via trains also (large network)

Specialised communication

Trauma center - Apex, Zonal, Regional, Distn

Integrated Hospitals & fire, police, helpline services

Blood banks, burn centers and special labs.

eg. Chernobyl (Slides)

Loc 5 = 21st January '21 (slides)

Response

Immediate Assistance

Initial Repair of damaged infra

Humanitarian

Rehab.

Networking - marking safe

Q. Earthquake

↳ to access buildings choose strategy & equipment depending on tall/short buildings, material, structural sys.

First, make a ^{Region} Meiso-Sesma Map
intensity in areas.

Then, know Housing / Populatⁿ density

↳ then make strategy based on threat factor ($R = H \times V \times E = H \times E$) and zone of search.

Then, Resuce

(i) Search - Physical & Electronic
(ii) Access .

↳ safety of NDRF & trapped pple

then, when accessing buildings =

- ① Sensing - whether survivors ont
- ② Shoring - support a precariously placed building after EQ
- ③ Accessing - decide path of entry & mark/decide paths of no entry

① Sensing

↳ Noise of victim

↳ check dB (decible) & find how far are survivors from rescuers.

② Shoring

↳ support unstable parts

③

Sideways, top-down.

Location of Survivors

- ① Slab & beam leave voids for survival
- ② strong furniture may resist building collapse pressure & create cavities
- ③ Stronger SE

- which equipments & capacity of equipments to lift fallen structural elements like slabs
- Capture Image inside
 - ↳ using flexible pipe attach video camera
 - ↳ thermal camera
- Checking for hazardous gases
 - ↳ check air quality
 - ↳ stop gas supply

(Slides)

Incident Response System

IAP - alerting protocol

- ① Early Warning Received
- ② Activate Incident Response Team (IRT)

IAP (Slides)

- ↳ alerts depending on severity

IRT (Slides)

① Local district level - IRT

- Area Command
- Unified Command

} Read Slides

② Metropolitan cities - work differently

- └ complex administrative setup
- └ independent hierarchical setups
- └ unified command - more appropriate
(slides)

③ UTs

└ VC appropriate

④ Remote Areas

- └ Islands
- └ NE
- └ Hill areas

} dominance of some departments & agencies

→ village/ward-level IRTs

Community Participation

- └ NGOs, SHGs, CD, NRHM, ICDS

IRs for chemical / biological / Nuclear / Radiological (CBRN) Emergency Response

Nuclear

- └ specialised Crisis Management groups
eg. Dept. of Atomic Energy
- └ offsite incident response

└ RO / District Magistrate

(Dist. Collect.) DC act as Incident Commander

- Train SDRF & help of NDRF

EOC (Emergency Operatⁿ Centre)

Offsite facility - like headquarter

ICP (Incident Command Post)

Locatⁿ at which primary command functions are performed.

Q

Diff b/w area command & unified command.
& IRT.



Lecture 6 = 25 - 01 - 2021

Response

- Relief - immediate help - food, clothing, shelter
- Recovery - post disaster (long term)
 - Repair
 - Retrofitting - structures < scientific repair
 - Rehabilitation < livelihood strengthen bringing back normalcy
 - Reconstruction - structures in terms of locality township — adoption of villages

Relief (Slides)

It has to be prompt, adequate & follow approved standards

Relief Camp (slide)

- ↳ if shelter already - schools etc
- ↳ otherwise build / set-up :
 - ↳ prefabricated construct" (set up camps for syrian refugees)
 - ↳ mobile toilets
- ↳ Area req. per person 3.5 m^2

Food - guidelines < hygiene expiry date

Water - 3L pp

Sanitation - 1 toilet for 3 pple

Mobile Medical Teams

Joint
acc to DC
or local
guardian

Widows & Orphans

within 45 days
financial relief in Public sector bank

Recovery (slides)

Challenges

- International / Nation relief does not include rehab. / reconstruction
- Bottlenecks & needs ~~surplus~~ energy / power — equipment / tools
- material funds

Political commitment

Rehabilitation

Restoration of structures

Repair (EQ)

Crack

- cement slurry grouting
- wire mesh
- applicatⁿ of polymers

Repair (Earthquake)

- plates (metal) on corner
- L-shaped

Retrofitting (Earthquakes)

- adding shear wall — Steel

- to add strength

- Jacketing — increase strength of beams / columns by providing jacket of concrete ← additional material around steel or the existing structure. — S

L external bracing

L transfer load of existing structure to a new structure (external)

Butressing - external support to building

Wind = / cyclone = Retrofilling

f Rope tie backs

f Small overhangs

supported by attaching to buildings

Reconstruction

Sendai framework (more quantitative)
L (2015-30)

Owner-driven

but give assistance

Plug gaps

in educatⁿ - do not teach EQ eng. - basic level or linear behavior / Statute only of build.

Replace damaged buildings = open areas/parks

Lec 7: 28th Jan '21

Sendai Framework for DRR

Hyogo

- Qualitative
- Reducing risk
- improving risk info & early warning

Sendai

- Quantitative
- investing in DRR
- Strengthening DR governance
- Build back better

SDMA

→ Need for SDMA

NE / HP ← mushrooming on hills
no. of turns to be taken by force is high

→ reduce size of column but straight line

- inclined columns
- bad foundation
- loose sand

→ prepare hazard-profile of state

- [Hydro-meteorological]
- [Geological]
- [Industrial]
- [Man-Made]
- [Biological]

✓ level of risk in areas

- Vulnerability & Risk analysis
- Housing Vulnerability
- Which areas more prone to 'x' disaster
- on-site & off-site emergency plans

Responsibility Matrix by NDM Plan 2016
18 tasks

Institutional Framework

Trigger Mechanism

Emergency Support Function

Fund (SDRF) - Response Fund

{ from state share

center share

SDRF

{ govt.

{ external assistance

{ contributn by pple/inst.tutn/commu

{ generated from assets

Risk Transfer = Risk Insurance

Projects

- State Highways & Landslides
- Retrofitting lifeline buildings
- Stabilising slopes
- Warning system
- Heritage buildings

Flood

- controlled demolition of garbage
- rivers swell 10x

Causes

{ Natural

{ Human-induced - if constructn in
way of water | banks | catchment
areas

2 types

- | Flash floods { cloud burst
| too much rain
- | River floods { rivers swell

Flash floods - greater loss of LIFE

| dry climate & rocky terrain

| less infiltratⁿ due to loss of
vegetation

River Floods

- | loss of property
 - { large rivers
 - excessive runoff

100-year flood

$$P(r) = \frac{1}{100}$$

Techno Legal Regime

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Rainfall

$$P = \text{Direct runoff} + \text{Initial loss} + \text{Continuing loss}$$

Flood Plain

Urban flooding

- └ urbanisation leads to foemats of catchments
- └ more damage due to ↑ density
- └ quick flooding due to fast flow time

Flood Management

└ FPM
└ FR
└ FR

~~Notes~~

Lec 8 : 1st Feb '21

Flood Case Study : Uttarakhand 2013

[flash flood]

Area liable to flood :

- Indo-gangetic Plain *
- East & Coastal lines
- NE portion

* also susceptible/prone to flood/plains eq,

soil amplification

↳ amplifies seismic waves
amplified due to soft soil

weak sole,

more fault lines

{ alluvial soil

- Chamoli, Uttarakashi
- History of FF in Uttarakhand
 - 1989 - 2012
 - less casualties

But in 2013

4094 deaths	11 K live stock death
----------------	-----------------------------

- ① Heavy precipitation in upper Ut.
- ② Bursting of glacial lakes
- ③ Increase debris-laden discharge in streams - even big stones
- ④ Rise of water level
- ⑤ Heavy toe erosion & flooding
- ⑥ Landslides on river banks/slopes
- ⑦ Loss of property

Sediment load - huge boulders

Heavy Rainfall

Shortcomings

- ① → No formulatⁿ of disaster management plan
- ② → Bad warnings
- ③ → Human Interference
 - ④ agricultural practices ↑ vul
 - ⑤ mushrooming of buildings, ↑ erosion
 - ⑥ dams
 - ⑦ deforestation
 - ⑧ tourism influx

Actions:

- ① National green Tribunal issued notice asking for explanation for massive constructⁿ on hills and whether this was informed permission decision or EIA (env. impact assessment)

~~Deficit~~Shortcomings contd.

④ Climate change

- └ monsoon came 1 month earlier

~~Lessons~~Weakness

- └ issues in coordination & administration
- └ Early warning
- └ Capacity to manage large scale
- └ illegal encroachment along rivers *
- └ Human interference
 - └ river bed mining, granite blasting, quarrying etc.
 - └ unscientific construction
- * ribbon development
- └ development issues

Lesson

- Mitigation
 - └ come up w/ land-use planning wherein implement "flood plain zoning"
 - └ develop legal framework to avoid construct'n within flood plain, on steep/unstable slopes
 - └ remove past encroachments & prohibit future "
 - └ hydro power projects must be carried out after EIA and DIA
 - └ Muck disposal plan
 - └ transport & disposal site
→ above flood level)

- explore alternate energy sources
- landslide management
 - [zonation (micro-level)]
 - | monitor micro-movement of hill soil to get early warnings
 - | avoid blasting to avoid fissures in rocks where water can seep in.
 - and use load on rocks (to prevent destabilization of weak rocks)
- river bed mining must be based on scientific investigations
 - | stop unsustainable & illegal mining
- use of M-sand instead of river sand.

Preparedness & (Slides)

- Plans & policies
- Telecommunication system
- Early Warning System (fail-safe communication)
- Tourism capacity
 - | register for entering
- Capacity Building
- IDRN utilisation (SLIDE)
 - (India Disaster Resource Network)
- Search, Rescue, Evacuation
- Psycho-Socio Care
- Critical Health Care

Bihar 2016 (Riverine Flood)

↳ happened in 3 phases

East
West
Central

- ⊕ efficient ^{review} radio & monitoring system
 - ↳ with involvement of all district officials & departments
- ② SOP in place
- ③ Pre-determined shelters
- ④ Reasonable well managed sundus
- ⑤ Reduced response time by pre-positioning NDRF/SDRF at 14 places.
- ⑥ Engagement of Police, first responders in Cap. Build.
- ⑦ Training program for firemen & policemen
- ⑧ Active communication system helped in timely decision & response
- ⑨ SMS based EWS
- ⑩ Evacuation, distribution, relief camps & even cattle camps on huge level = boats/ NDRF/ SDRF teams
- ⑪ Special care for old, women, physically challenged ppl

China

- Yellow River (1938) flood

Dike / Levees - wall along river
↳ blasted this wall deliberately
to prevent Japanese from entering