

## Non-structural Hazards Assessment and Mitigation

GeoHazards Society



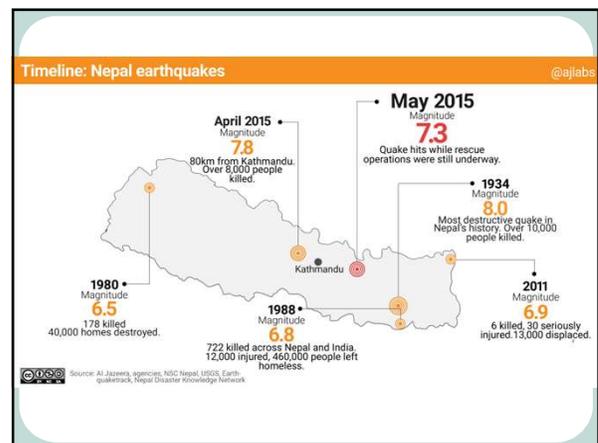
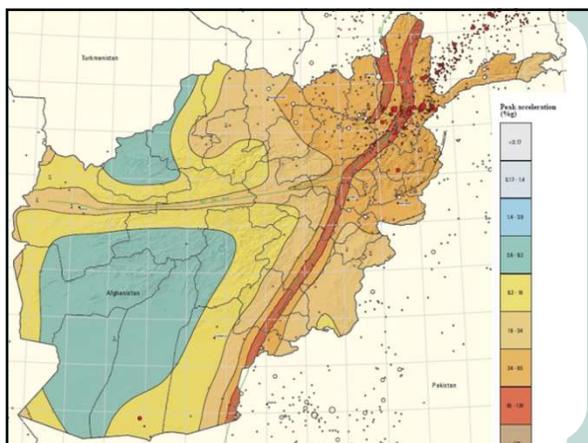
## Multi-Hazard profiles of our countries

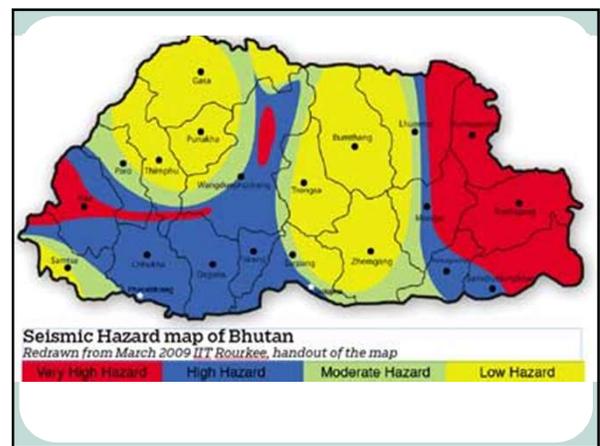
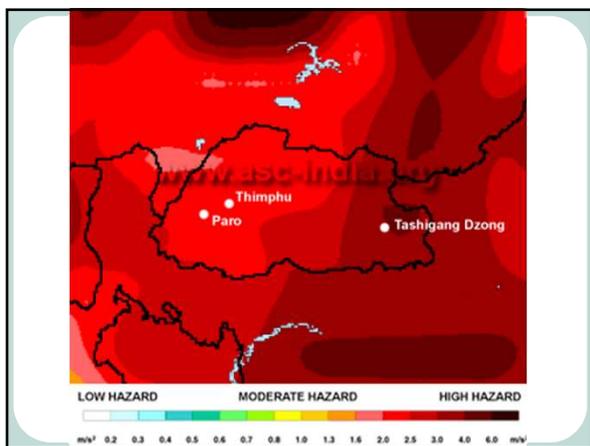
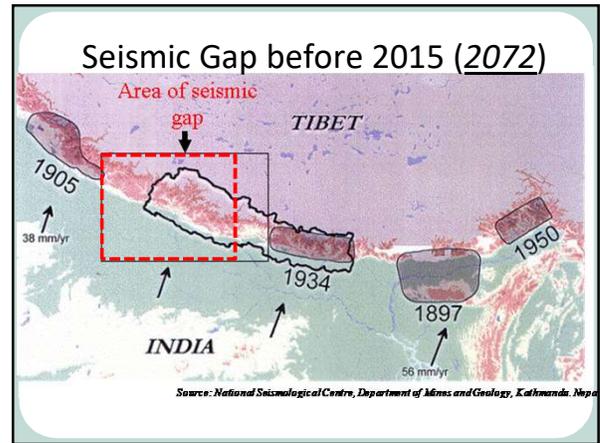
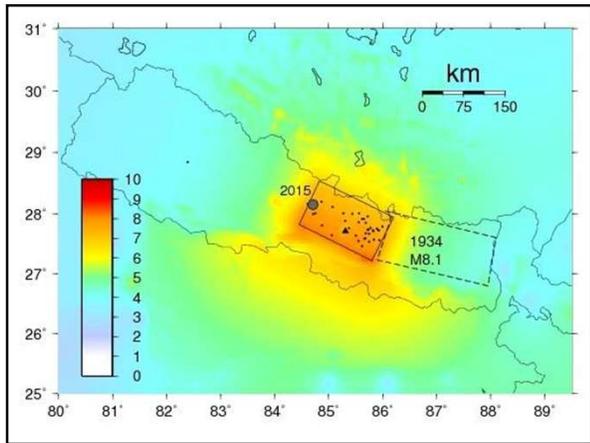
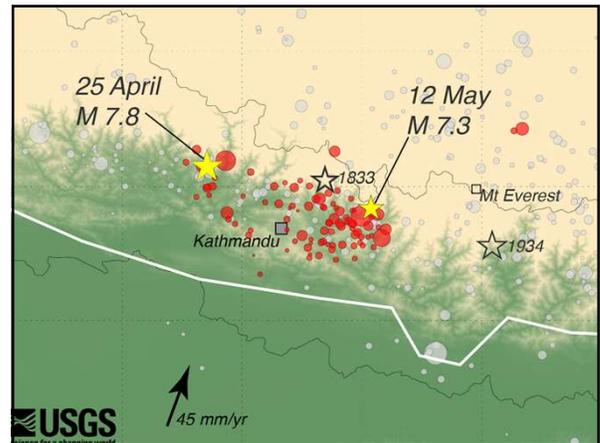
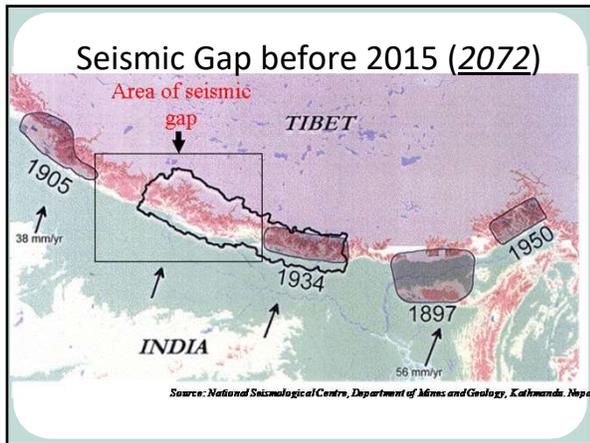
### What hazards should we plan for?

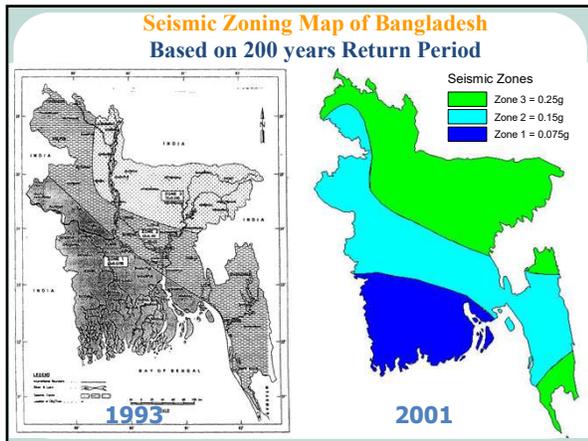
- Earthquake
- Landslides
- Windstorms
- Rock falls
- Fires
- GLOF
- Tsunami
- Flood
- ...Be aware of every hazard that can affect you

### Earthquakes

- Afghanistan
- India
- Nepal
- Bhutan
- Bangladesh
- Srilanka and Maldives have low earthquake risks







Landslides

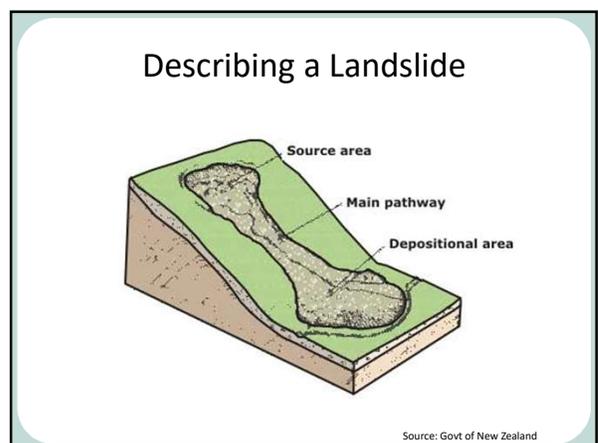
## LANDSLIDES

- ### Landslide Causes
- Precipitation-induced
  - Earthquake-induced
  - Volcanic
  - Human-induced (anthropogenic)
  - Other (such as wildfires)

### Common Landslide Types

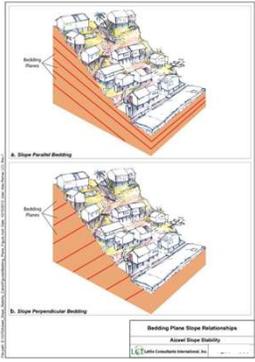
Laipuitiang, 2013

Slide from Kevin Clahan, LCI



**Landslide Hazard a function of:**

- Geomorphology
- Bedrock and Surficial Geology
- Geologic Structure (Bedding, Jointing)
- Slope Angle
- Stream Location and Geometry
- Human Modification



Slide from Kevin Clahan, LCI

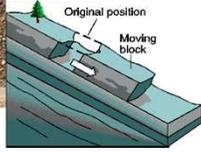
### Landslide Impacts

- Direct Impacts
  - Loss of human or animal life
  - Road closures and utility interruption
  - Repairs, replacement, maintenance resulting from damage
- Indirect Costs and Impacts
  - Loss of productivity (Industrial, agricultural, etc)
  - Reduced property values
  - Costs to prevent or mitigate additional landslide damage
  - Reduced human or animal productivity due to injury or psychological trauma
  - Adverse effects on water quality
  - Secondary physical effects such as landslide caused flooding

### Common Slope Failure Types – Translational Landslides



A down-slope movement of material that occurs along a distinctive surface of weakness such as a fault, joint or bedding plane.



Images courtesy Kevin Clahan, Lettis Consultants International, Inc.

Varanasi, 2017

### Animation of Translational Landslide

and after effects



Animation of Destruction at Uttarakhand ( Demo Copy )

### Common Slope Failure Types – Rock Falls

2072 Gorkha Earthquake




GEER Reconnaissance Report and ekantipur.com

Kevin Clahan, Lettis Consultants Intl.

### Common Slope Failure Types – Debris Flows

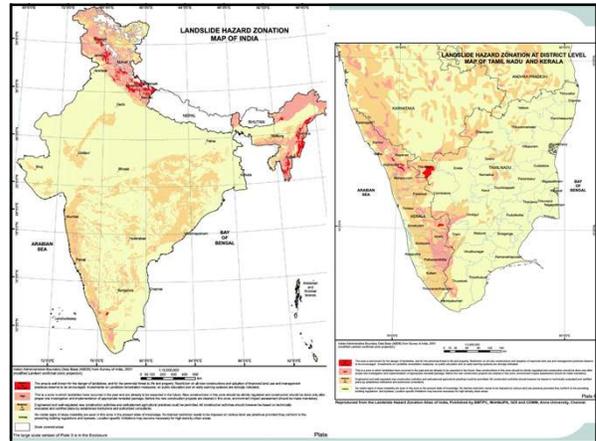
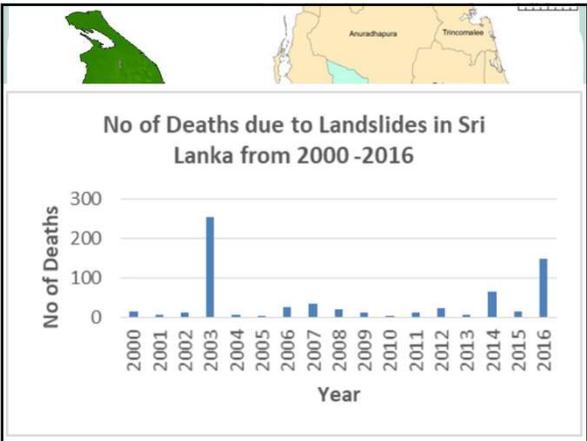
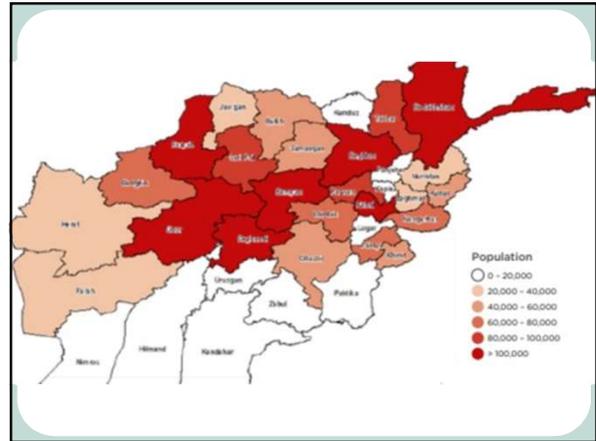
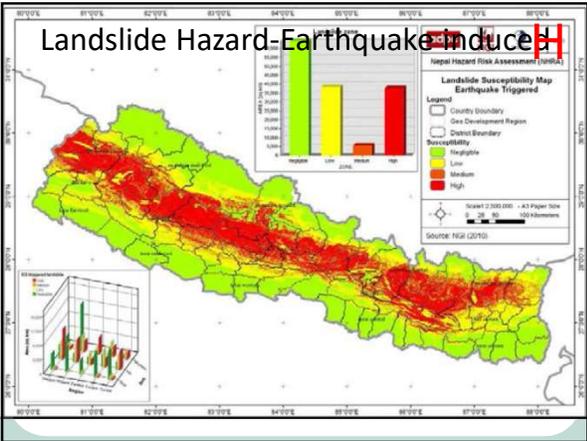
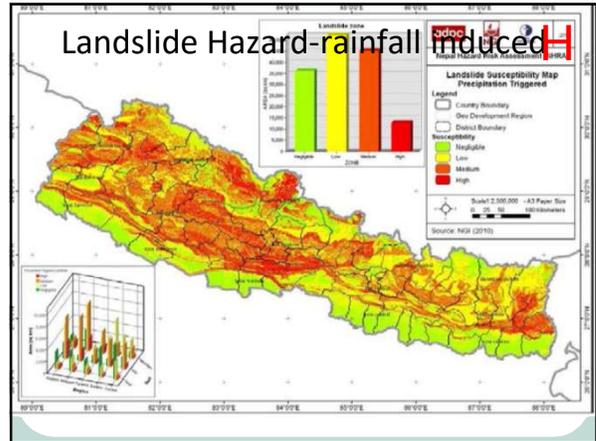


Concern for subsequent monsoons

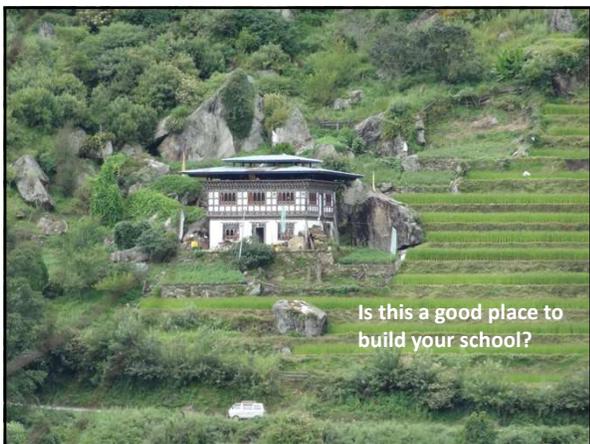
Bajhang, 2017

## Landslide Risk Mitigation

- **Increase Capacity**
  - Awareness generation
  - Community Preparedness, training on warnings
  - Early warning system
- **Decrease Vulnerability**
  - Landslide mapping
  - Land use planning
  - Improve drainage
  - Green Cover (based on type)
  - Landslide mitigation measures
  - Redundancy of Lifelines



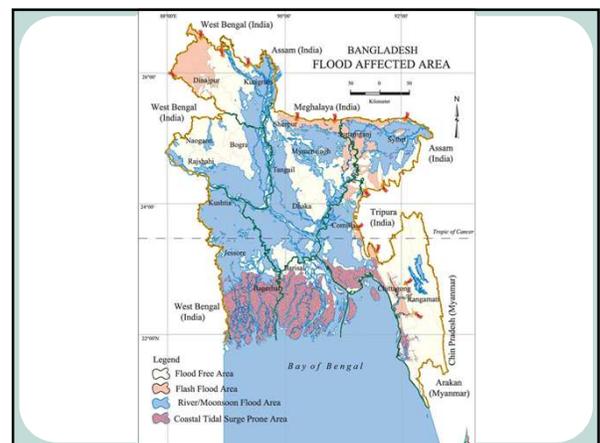
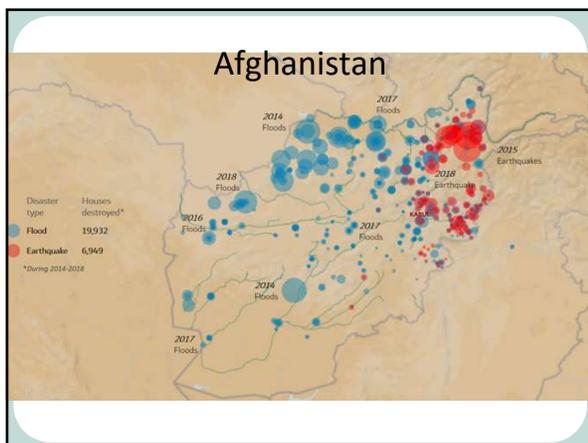
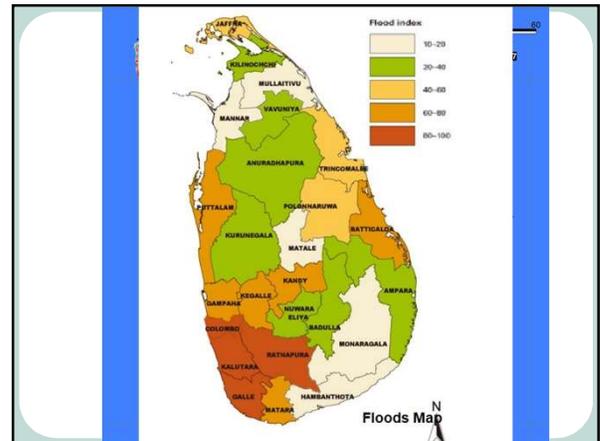
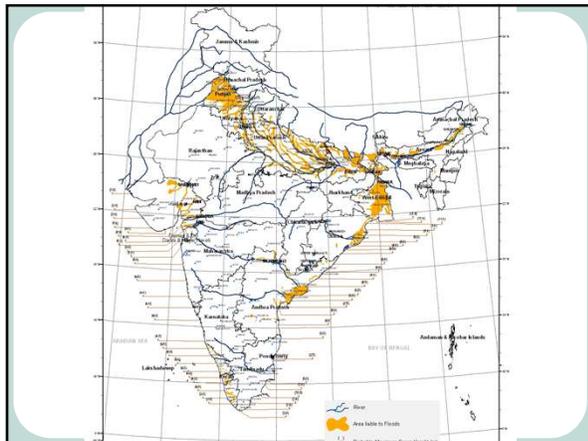
ROCKFALLS  
**ROCK FALLS**



# FLOODS

## Flood Hazard in South Asia

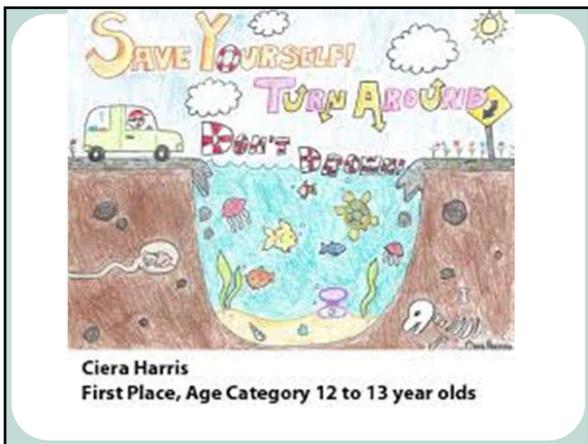
- Flood is a major recurring hazard in the region.
- River flooding is not limited to monsoon season but happens due to cloud bursts as well, specially in the hilly terrain.
- Beside river flooding a new threat has emerged which is also known as “urban flooding”.
- Low lying areas gets flooded during heavy showers.
- Climate change will exacerbate frequency and intensity of flooding in coming years.



### Flood Hazard

- Is the site likely to be affected by a flood?
- Likely to be cut off in a flood?
- Is it in the Flood Risk zone?
- Has it flooded before?.
- River, stream in close proximity to the site?
- Does the site has proper drainage system?

400 mts away from river



Ciera Harris  
First Place, Age Category 12 to 13 year olds





### Four strategies for Flood Disaster Risk Management

- Keep flood away from the people (schools)
- Keeping people away from the floods
- Preparing people from the flood disasters
- Helping people in flood disasters

### Schools safe from such hazards

- Mark high flood levels
- Linkage to proper early warning system
- Plan for actions if early warning is received
- Keeping critical and important items on the upper floor
- Generator, Electrical panels, fuel tank, water pumps should be at a height above HFL.

### Winds and Cyclones

- Can affect in the form of
  - Cyclone.
  - Tornadoes
  - Thunderstorms

### Windstorms



### Wind hazard management

- Design the structure considering expected wind speed in the region.
- Consider constructing a safety shelter in cyclone and tornado prone region
- Listen carefully to warning
- Fix the non-structural elements well before hand, such as:
  - Tin/plastic fiber roof
  - Glass
  - Water tanks
  - Radio/communication towers etc.

### Cyclone Fani

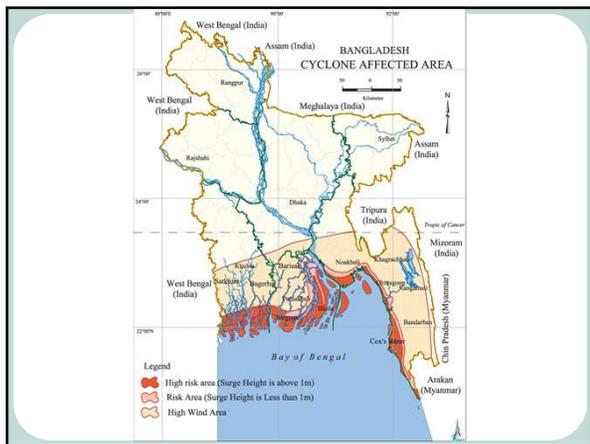
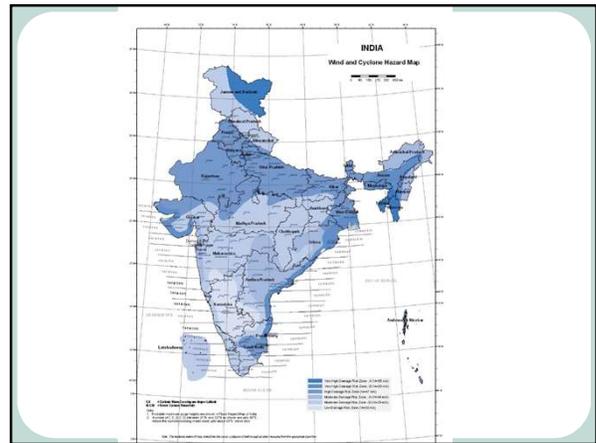


Courtesy - Twitter/@mehhokar015

### Wind damage reported from Bhutan



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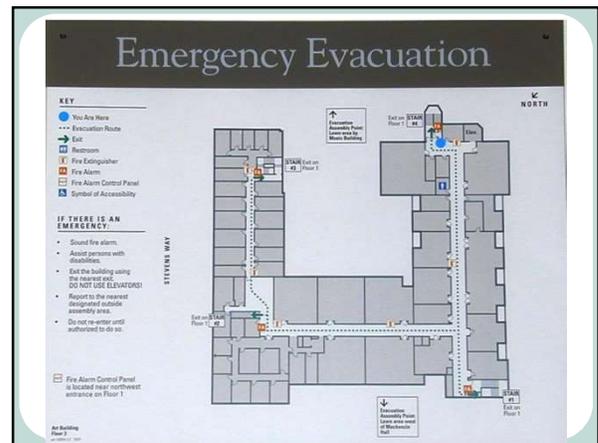


# Fire Safety



### Planning for Fire Safety

- Minimizing the chance of fire
- Early discovery
- Restricting fire spread
- Extinguishing the fire &
- Evacuating the building.



### What are we preparing for?

- What all can happen in and around our School
  - What can affect the School?
  - What can affect the community from where the children are coming
- Consider all hazards
  - That can affect the school
  - That can affect the community

- Consider all hazards that can affect the location
- An example from India

### Siting

- Learning from past disasters is very important

### All hazards

- Are we building it right?
- Are we siting it right?

Do we build back there?  
Or build back better elsewhere?



- Learning from other's mistakes is the easiest but rarest trait.

Few would disagree that our children deserve the right  
a safe  
to education...



GEOHAZARDS INTERNATIONAL

..yet time and time again we fail our children  
with unsafe, unprepared schools



- Let us change that!!
- Thanks!
- Hari Kumar
- [hari@geohaz.org](mailto:hari@geohaz.org)

