

**Training/workshop on  
“Earthquake Vulnerability and Multi-Hazard Risk Assessment:  
Geospatial Tools for Rehabilitation and Reconstruction Effort”**

Islamabad, Pakistan March 2006

# Mapping of Elements at Risk

**Samjwal Ratna Bajracharya**  
**International Centre for Integrated Mountain Development (ICIMOD)**

Material prepared from Lorena Montoya, Paul Hofste, and Cess van Western, ITC

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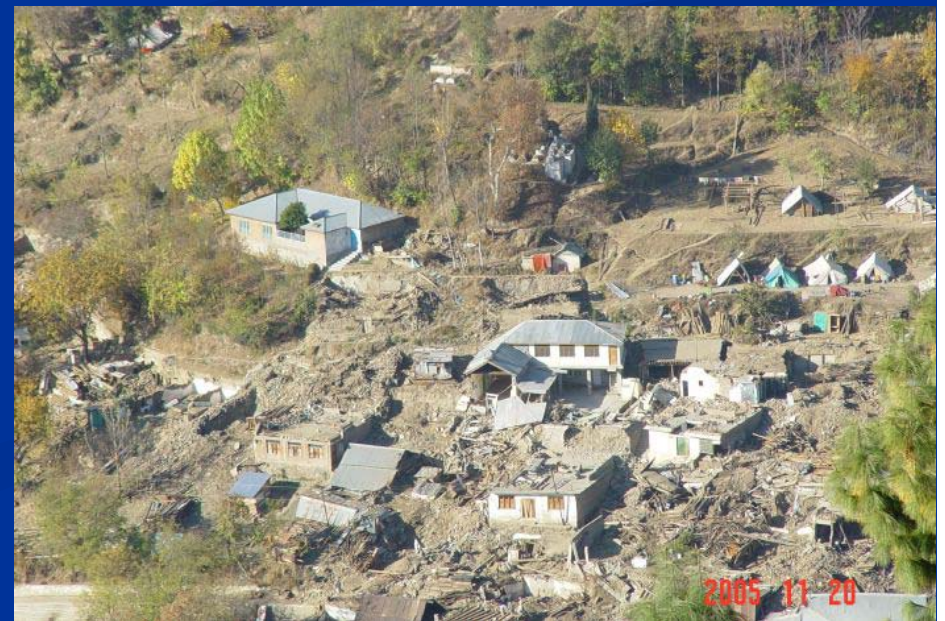
# Hilkot RES1

*Traditional Mud-stone-wood structure*

■ *Collapsed*

*Houses in cluster - 100%*

*isolated houses - about 10%*



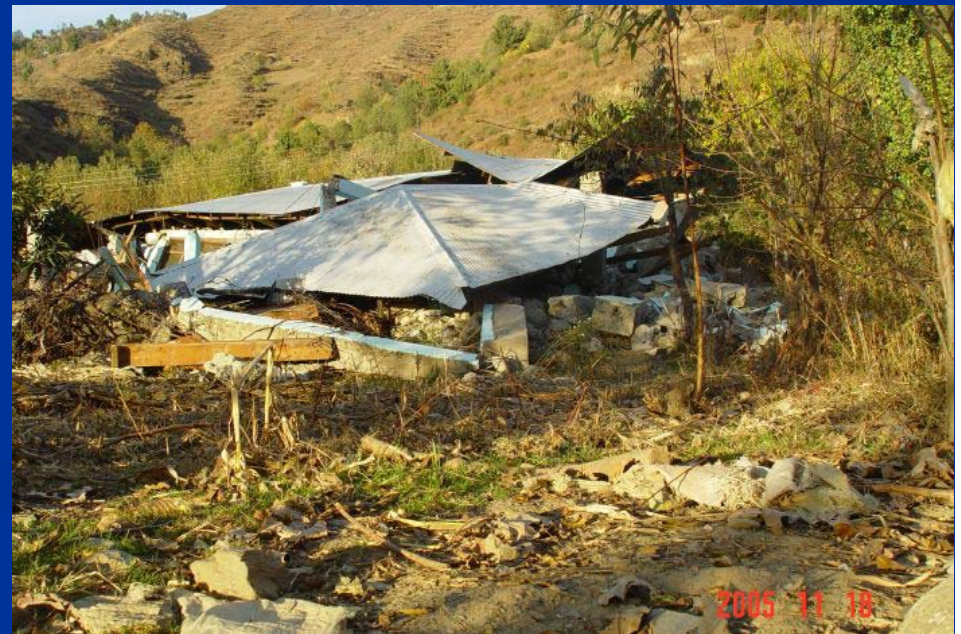
# Hilkot

# RES2

*Light construction with corrugated sheets roof*

*substandard construction, not complying with the local provisions.*

- *Collapsed 100%*



# Battal RES3

- *Reinforce composite construction, fancy, not complying with the latest code provisions.*
- *Totally damaged*



# Hilkot

# RES4

- *Engineered reinforced concrete construction, recently constructed*

*Building Code*

*not proper*



*Proper*



# Balakot COM

- Commercial



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# Attributes for buildings for earthquake hazard

For instance:

- Structural type
- Construction techniques
- Building materials
- Shape (configuration)
- Height (different heights shake at different frequencies)
- Use (e.g. dwelling, hospital, fire station)
- Proximity to other buildings (pounding)
- Age



# Needed for elements at risk mapping

also in **digital format** for a GIS

- **Footprint maps** (urban areas)
- Up-to-date large scale maps (urban areas)
- **Maps with administrative boundaries**
- Topographic maps
- Aerial photography and/or  $< 1\text{m}$  resolution **satellite imagery**
- **Lidar data** for 3-D modeling (flooding)

# Classifications for earthquake vulnerability studies: **adapted to local circumstances**

- Construction type, applied in Lalitpur, Kathmandu valley, Nepal
- Space use (land use), applied in Dehra Dun, India

# Conclusions

- Remote sensing can provide **building footprints** and building height, but the resolution and shadows of satellite images are problematic in high-density areas
- Close sensing (field observation) is needed for attributes that are **only observable in the field**, or require information from inhabitants
- Disaggregation of population data is required for a good insight into the **spatial distribution of population at risk**

