Strengthening Disaster Resilience: Aabadiyeh's GIS-Powered Future

A Story of Innovation, Technology, and Community Preparedness
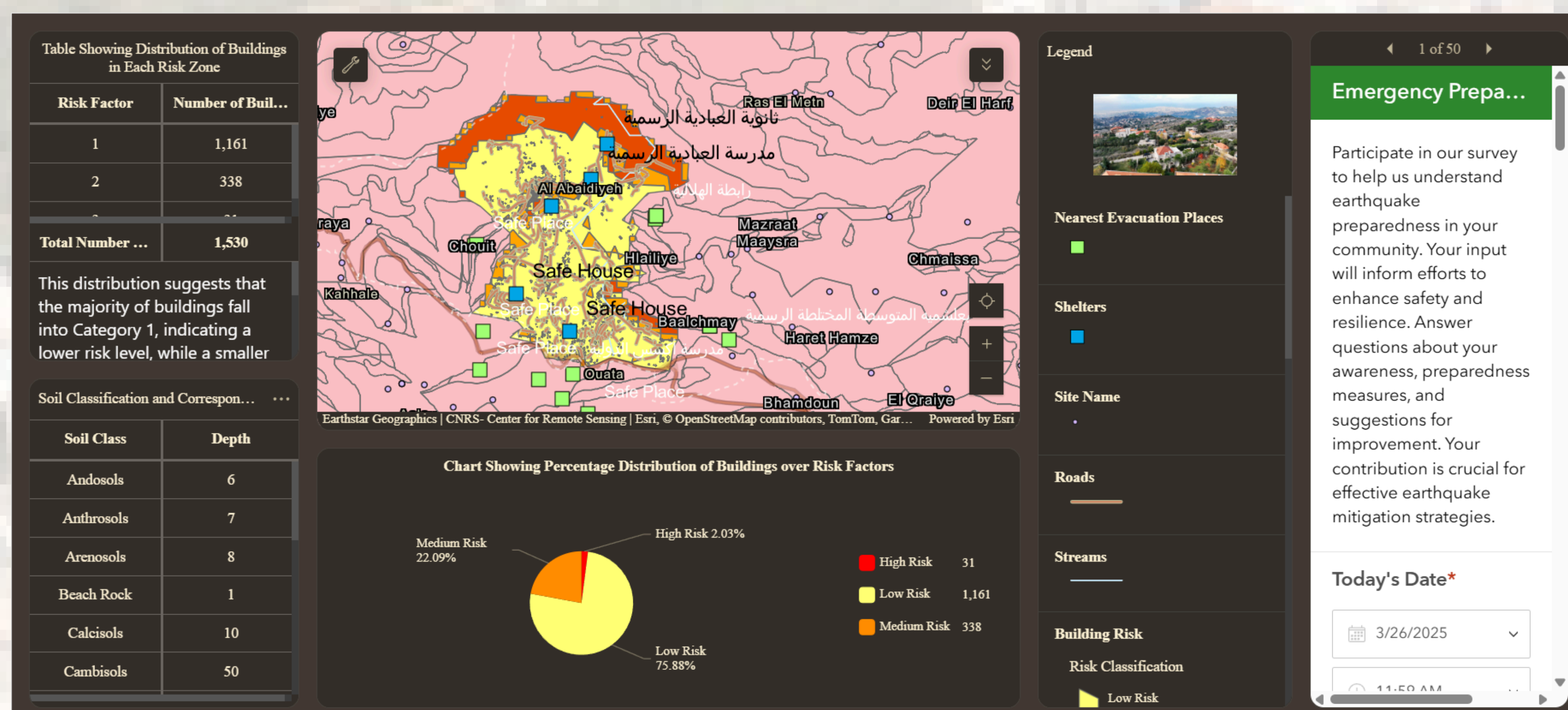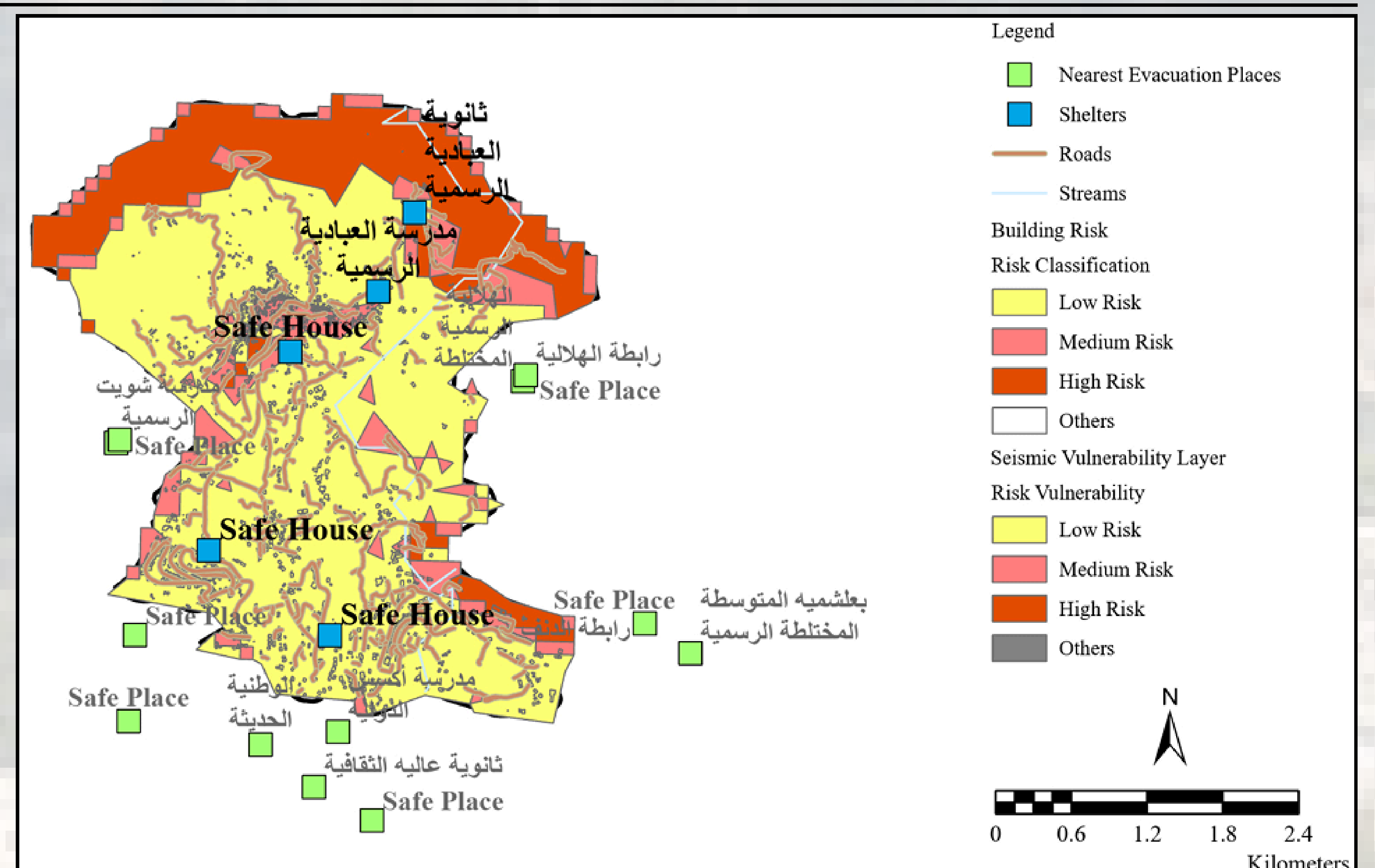
Introduction :

📍 Location: Mount Lebanon Governorate, 16 km east of Beirut

🧑 Population: ~14,000 residents across 1,530 buildings

🏞️ Topography: Elevation ranges from 230 to 1,050 meters

🏘️ Size: Spans a diverse landscape covering 1,000 hectares

🔷 Background:
- Lebanon is prone to seismic activity due to its position along the Dead Sea Transform fault system.
- Abadiyeh, a mountainous region, faces high seismic risk due to soil composition and structural vulnerability.

◎ Objective:
- Assess earthquake hazards and vulnerabilities in Abadiyeh using GIS-based spatial analysis.
- Develop a risk map to identify high-risk areas and propose mitigation strategies.

Study Area & Data Sources :

📍 Study Area

🏔️ Location: Abadiyeh, Mount Lebanon Governorate

🏘️ Key Features: Population density, building structures, proximity to fault lines

📁 Data Sources:
- 🌍 Seismic Data: Global and Lebanese seismic catalogs (USGS, CEDRE, LARI)
- 🗺️ Topographic Data:
  ◦ Digital Elevation Model (DEM): Shuttle Radar Topography Mission (SRTM) (30m & 12.5m resolution) – USGS EROS SRTM
  ◦ Projected Coordinate System: WGS 1984 UTM Zone 36N
- 🛢️ Geological & Soil Data: Geological Survey of Lebanon, FAO Soil Grids
- 🏘️ Building Infrastructure: OpenStreetMap (OSM), municipality data, Building H Journal Satellite Imagery
- 🧑 Population Data: Census, remote sensing imagery, WorldPop 100m x 100m Raster 2024

🛰️ Raster & Satellite Data Used:
- Land Use/Land Cover (LULC): ESA WorldCover 10m (2020–2024)
- Seismic Hazard Raster: USGS ShakeMap, GEM GRID 250m resolution
- Satellite Imagery: World Imagery WGS 84
- Additional Model Used: Microsoft Bing Model Hot Area

🔷 Building Area and Height Source: Derived from Building H Journal via WSF3D Global Dataset

Seismic Risk Assessment and Evacuation Plan :

Legend
- Nearest Evacuation Places
- Shelters
- Roads
- Streams

Building Risk
Risk Classification
- Low Risk
- Medium Risk
- High Risk
- Others

Seismic Vulnerability Layer
Risk Vulnerability
- Low Risk
- Medium Risk
- High Risk
- Others

0 0.6 1.2 1.8 2.4 Kilometers

Table Showing Distribution of Buildings in Each Risk Zone

Risk Factor	Number of Buil...
1	1,161
2	338
Total Number ...	1,530

This distribution suggests that the majority of buildings fall into Category 1, indicating a lower risk level, while a smaller

Soil Classification and Correspon...

Soil Class	Depth
Andosols	6
Anthrosols	7
Arenosols	8
Beach Rock	1
Calcisols	10
Cambisols	50

Chart Showing Percentage Distribution of Buildings over Risk Factors

- High Risk 2.03%
- Medium Risk 22.09%
- Low Risk 75.88%

High Risk	31
Low Risk	1,161
Medium Risk	338

Legend
- Nearest Evacuation Places
- Shelters
- Site Name
- Roads
- Streams
- Building Risk
  - Risk Classification
  - Low Risk

Emergency Prepa...

Participate in our survey to help us understand earthquake preparedness in your community. Your input will inform efforts to enhance safety and resilience. Answer questions about your awareness, preparedness measures, and suggestions for improvement. Your contribution is crucial for effective earthquake mitigation strategies.

Today's Date*
3/26/2025

📊 Key Findings & Results

- 🌍 Seismic Hazard: High PGA in central & western Abadiyeh.
- 🏘️ Building Vulnerability:
  ◦ 60% of pre-1990 buildings at risk.
  ◦ Hospitals & schools need reinforcement.
- 🚸 Evacuation & Safe Zones:
  ◦ Key roads may be blocked during quakes.
- 🗺️ Maps & Visuals:
  ◦ Seismic Hazard Map
  ◦ Building Risk Map
  ◦ Evacuation Route Map
- 📍 Risk Distribution
  ◦ 📊 Total Buildings: 1,530 🟡 Low Risk: 1,161 (75.88%)
  ◦ 🟠 Medium Risk: 338 (22.09%)
  ◦ 🟢 High Risk: 31 (2.03%)
- Discussion
  - Older buildings & critical infrastructure need urgent retrofitting.
  - Blocked roads pose evacuation risks, requiring alternative routes.
  - Public awareness & structural reinforcements are key to mitigation.

📢 Conclusion & Recommendations

◎ Key Takeaways

🌍 Western Abadiyeh is most vulnerable due to soil type & building density.

🔧 Urgent retrofitting needed for older structures & public buildings.

🗺️ Evacuation plans should include alternate routes & temporary shelters.

🚩 Future Work

🔍 Real-time GIS-based earthquake monitoring.

🖥️ AI-powered damage prediction models.

References:

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📅 Date: March 2025