Earthquake Hazard and Risk Assessment of Bangladesh

Technical Panel Session #1

GLOBAL EARTHQUAKE MODEL FOUNDATION

9 October 2023

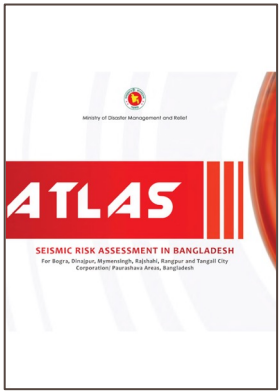# Previous Efforts, and Need for a Nationwide Earthquake Risk Assessment
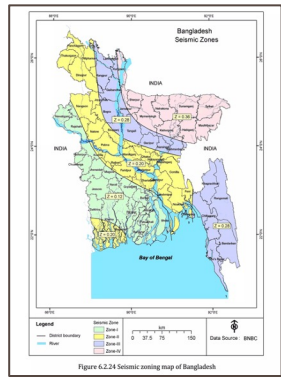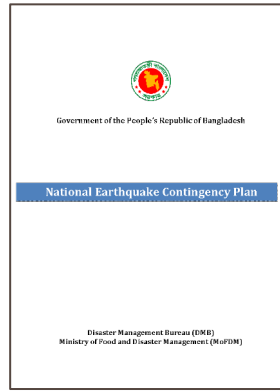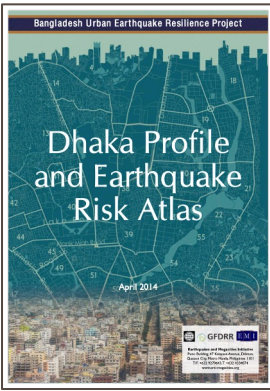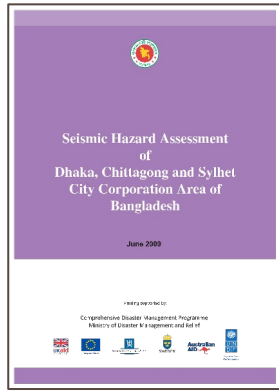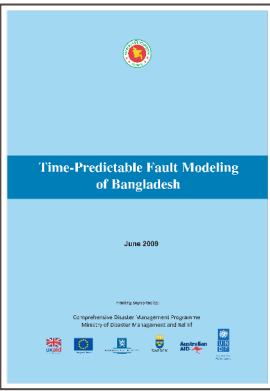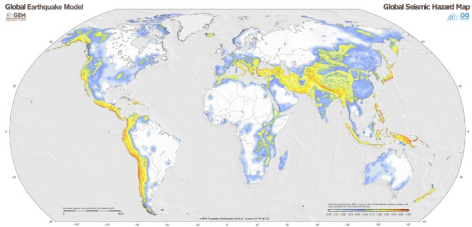
Global Earthquake Model
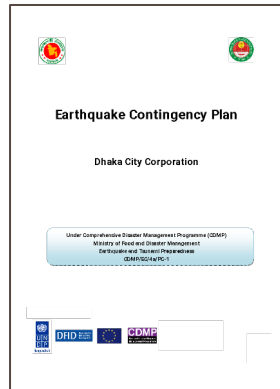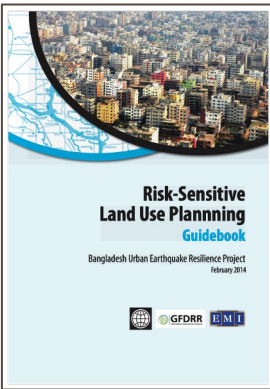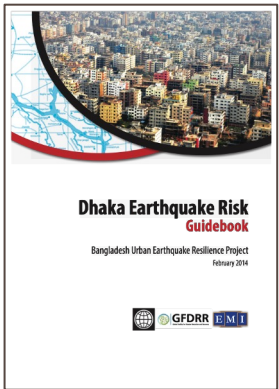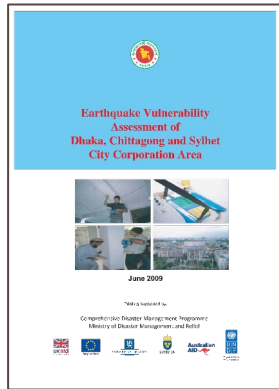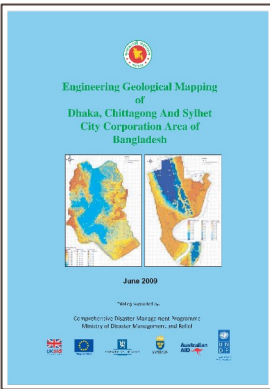
Our Methodology

We collect and process data worldwide, related to the main components of risk

Currently GEM has fully functional global model components to assess earthquake impact worldwide
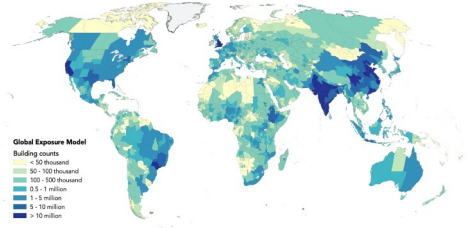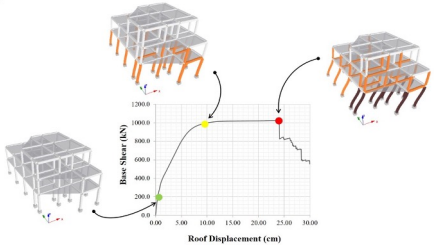
Hazard

Characterizing the potential locations, intensity or magnitude, frequency or probability of earthquakes

Exposure

Characterizing the built environment and people in hazard-prone areas

Vulnerability

Factors which increase the susceptibility of an individual or assets to the impacts of hazards

Global Earthquake Model

Seismic Hazard Assessment
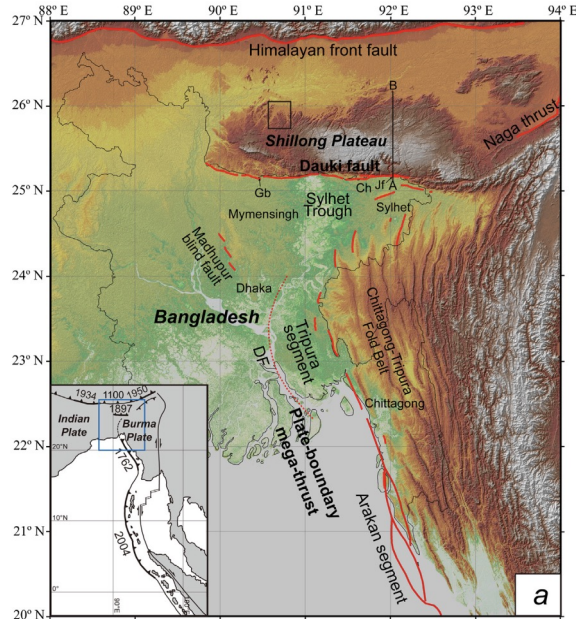
Active fault map of Bangladesh

Morino et al. (2014). A paleo-seismological study of the Dauki fault at Jaflong, Sylhet, Bangladesh: Historical seismic events and an attempted rupture segmentation model. Journal of Asian Earth Sciences, 91, 218–226.
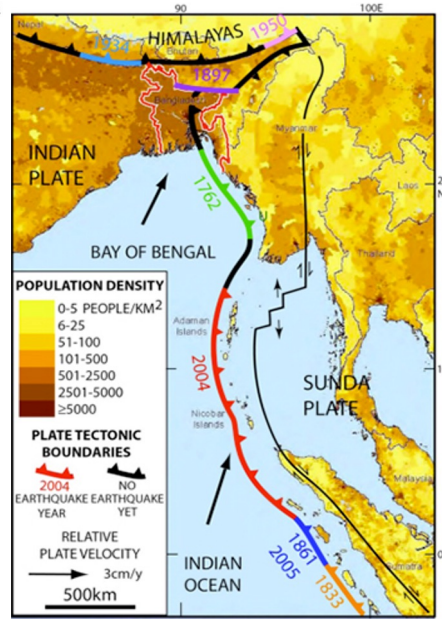
Subduction plate boundaries

Source: Michael Steckler / Lamont-Doherty Earth Observatory

- Identification of active faults
- Historical earthquakes
- Hypothetical future scenarios
- Soil characterization using secondary data
- Ground motion model
- Probabilistic seismic hazard assessment

Exposure Modelling
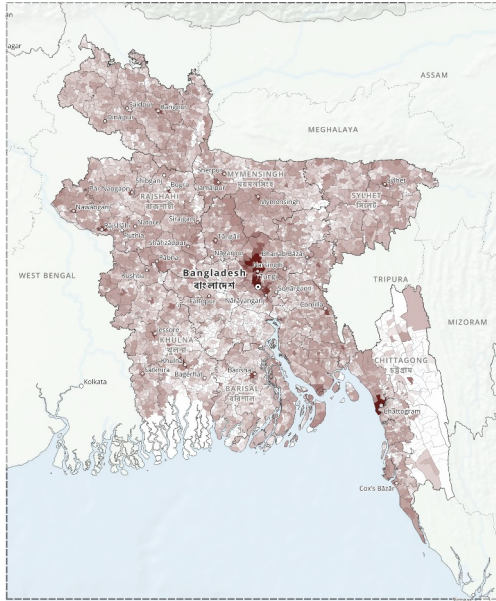
Residential Buildings
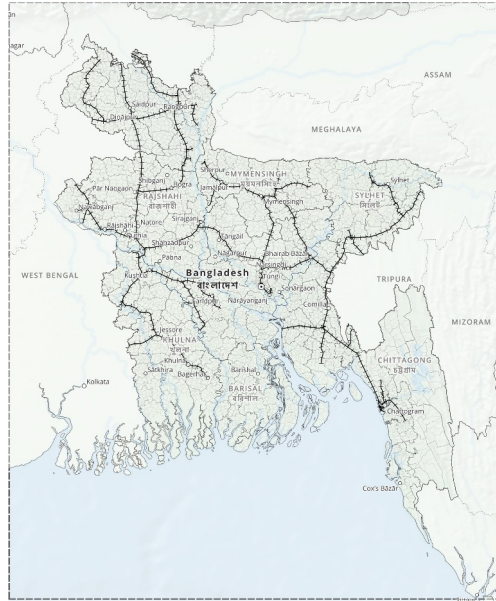
Railway Lines

- **Buildings**
  - Residential
  - Commercial
  - Industrial
  - Healthcare
  - Education
- **Infrastructure**
  - Roads
  - Railways
- **Population**
  - 2022 Census

- **Attributes**
  - Location
  - Typology
  - Valuation
  - Age

Global Earthquake Model

Seismic Vulnerability Analysis

Seismic Intensity
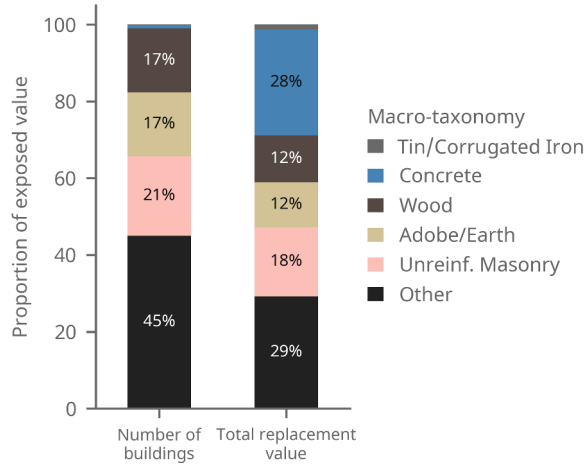
Percentage Distribution of Main Dwelling Structure by Materials of Wall and by Year

Macro-taxonomy
- Tin/Corrugated Iron
- Concrete
- Wood
- Adobe/Earth
- Unreinf. Masonry
- Other

Material	HIES 2022	HIES 2016	HIES 2010
Brick/Cement	47.84	30.50	25.12
C.I. Sheet/Wood	41.97	49.33	38.46
Mud/Unburnt brick	7.25	11.02	16.72
Hay/Straw/Bamboo/leaves	2.69	8.80	19.29
Others	0.25	0.35	0.41

Number of buildings: Other 45%, Unreinf. Masonry 21%, Adobe/Earth 17%, Tin/Corrugated Iron 17%

Total replacement value: Other 29%, Unreinf. Masonry 18%, Adobe/Earth 12%, Wood 12%, Concrete 28%

Proportion of exposed value

Global Earthquake Model

Seismic Risk Assessment; Hazard and Risk Maps

- GEM has published division-level maps of seismic hazard, exposure, and risk for Bangladesh

- The spatial resolution will be improved to upazila level in this project

Global Earthquake Model
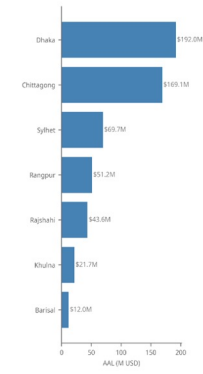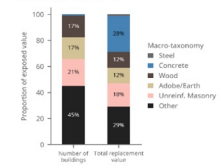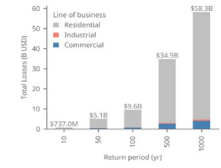
Request for Data from BBS and Previous Ministry Projects

- **BBS**: Population and Housing Census (PHC) 2022 – Upazila level tables

- **BBS**: Household Income and Expenditure Survey (HIES) 2022 – Microdata

- **CDMP**: Engineering Geological Maps for Dhaka, Chittagong, and Sylhet City Corporations

- **CDMP**: Engineering Geological Maps for Bogra, Dinajpur, Mymensingh, Rajshahi, Rangpur, and Tangail Pourashava and City Corporation Areas

- **CDMP**: Building Inventory for Dhaka, Chittagong, and Sylhet

- **MoDMR**: Any other datasets you would like us to include in the risk assessment

Global Earthquake Model

Project Activities
(August to December 2023)

- Needs and Gaps Assessment (Aug–Sep 2023)

- Technical Panel Formation and Initial Consultations (Oct–Dec 2023)

- Seismic Hazard Mapping (Aug-Nov 2023)

- Exposure Mapping (Aug-Oct 2023)

- Seismic Vulnerability Assessment (Oct-Nov 2023)

- Seismic Risk Mapping and Interpretation (Nov–Dec 2023)

- Stakeholder Consultation and Validation; Preliminary Model Dissemination and Training Workshop (~Feb 2024)

Technical Panel Formation and Engagement

- **Panel formation** – Technical Leadership by MoDMR

- **Engagement** – Wider Expertise on Earthquake in BD

- **Online sessions** – 3-5 Online Session

- **Workshops** – 2-3 Days with different stakeholders

University of Dhaka

Bangladesh University of Engineering and Technology

Ministry of Housing and Public Works

Chair

MoDMR

Geological Survey of Bangladesh

Bangladesh Bureau of Statistics

Independent Experts from Bangladesh

Global Earthquake Model
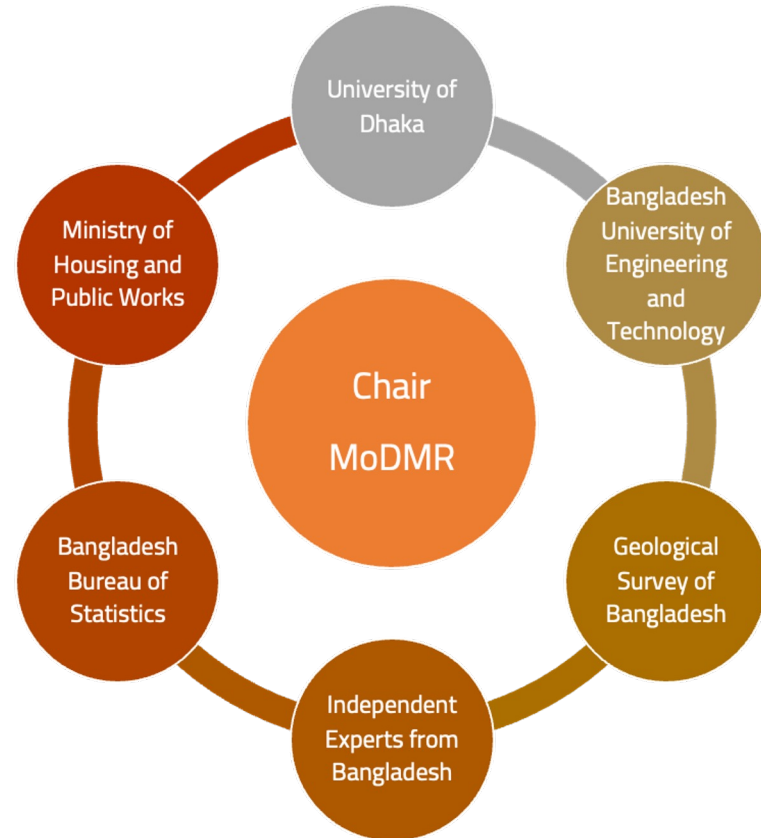
Highly Relevant Domain Expertise of the Technical Panel

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Sadat, M. R., Huq, M. S., & Ansary, M. A. (2010). Seismic vulnerability assessment of buildings of Dhaka city. *Journal of Civil Engineering (IEB)*, *38*(2), 159–172.

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Haque, D. M. E., Khan, N. W., Selim, M., Maksud Kamal, A. S. M., & Chowdhury, S. H. (2020). Towards Improved Probabilistic Seismic Hazard Assessment for Bangladesh. *Pure and Applied Geophysics*, *177*(7), 3089–3118. https://doi.org/10.1007/s00024-019-02393-z

Rahman, M. Z., Siddiqua, S., & Maksud Kamal, A. S. M. (2020). Seismic source modeling and probabilistic seismic hazard analysis for Bangladesh. *Natural Hazards*, *103*(2), 2489–2532. https://doi.org/10.1007/s11069-020-04094-6

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Siddique, S., & Sharmin, F. (2023). *Seismic Hazard Maps of Bangladesh*. Design Planning and Management Consultants Ltd. http://dx.doi.org/10.13140/RG.2.2.23257.29286

Technical Panel – Proposed Sessions

- Oct 09 – Introductory session (today)

- Oct 3rd/4th week – Probabilistic seismic hazard and scenarios

- Nov 3rd/4th week – Exposure and seismic vulnerability

- Dec 2nd/3rd week – Seismic risk and social vulnerability

- Feb 2024 – In person workshops, data and model transfer

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Further clarification, questions and answers

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Thank you!

Please attribute to the GEM Foundation with a link to:
https://www.globalquakemodel.org