Building Safety and Urban Resilience in Bangladesh

Joint Launch of the Urban Building Safety Project (JICA) & Urban Resilience Project (World Bank)

19 December, 2015
Outline of Presentation

- Overview of natural hazards in Bangladesh and progress made in disaster risk reduction
- Current Situation
- Challenges in urban resilience, building safety
- Some recent disasters
- Role Government, Private Sector and other actors to overcome the situation.
- Education, Training and Research
- The Way Forward
Natural Hazards Affecting Bangladesh

- Floods
  - River Water Overflow
  - Rain water stagnation
- Earthquakes
- Tornadoes
- Thunderstorms *(Nor’westers)*
- Lightning
- Landslides
- Cyclones and Storm Surge
- Tsunami
- River Bank Erosion
- Arsenic Contamination
- Salinity Intrusion
- Drought

Some of these (viz. Floods, Thunderstorms, Landslides, Cyclones and Storm Surge, River Bank Erosion, Salinity intrusion and Drought are likely to be aggravated by Global Climate Change)
Most Important Natural Hazards

❖ Floods
  • Every year, one third \((1/3)\) of the country goes under water
  • 1998 : two thirds \((2/3)\) of the country went under water
  • Much better prepared ; evacuation to higher land
  • better forecasting and warning systems

❖ Cyclones and Storm Surge
  • 12 November, 1970 : 500,000 people killed
  • 29 April, 1991 : 138,000 people killed
  • 15 November, 2007 : 3,500 people killed

❖ Earthquakes
Cyclones and Storm Surge (contd.)

- Master Plan for Multipurpose Cyclone Shelters prepared in 1992
- **High Risk Area** (HRA) identified
  - 6.4% of total area, 5% of total population of Bangladesh
- around 3,000 multipurpose cyclone shelters constructed in the HRA
- modern forecasting and warning system
- **Cyclone Preparedness Programme (CPP)** Volunteers (about 48,000) help in public awareness, warning dissemination and evacuation
Multipurpose Cyclone and Storm Surge Shelter
(Red Crescent Society)
Cyclone shelter in Chittagong, Bangladesh
Shelter on Killa
Japanese Funded Multipurpose Cyclone Shelters Primary Schools
Earthquakes
## List of Major Earthquakes Affecting Bangladesh

<table>
<thead>
<tr>
<th>Date</th>
<th>Name of Earthquake</th>
<th>Magnitude (Richter)</th>
<th>Intensity at Dhaka (EMS)</th>
<th>Epicentral Distance from Dhaka (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 January, 1869</td>
<td>Cachar Earthquake</td>
<td>7.5</td>
<td>V</td>
<td>250</td>
</tr>
<tr>
<td>14 July, 1885</td>
<td>Bengal Earthquake</td>
<td>7.0</td>
<td>VII</td>
<td>170</td>
</tr>
<tr>
<td>12 June, 1897</td>
<td>Great Indian Earthquake</td>
<td>8.7*</td>
<td>VIII</td>
<td>230</td>
</tr>
<tr>
<td>8 July, 1918</td>
<td>Srimongal Earthquake</td>
<td>7.6</td>
<td>VI</td>
<td>150</td>
</tr>
<tr>
<td>2 July, 1930</td>
<td>Dhubri Earthquake</td>
<td>7.1</td>
<td>V+</td>
<td>250</td>
</tr>
<tr>
<td>15 January, 1934</td>
<td>Bihar-Nepal Earthquake</td>
<td>8.3</td>
<td>IV</td>
<td>510</td>
</tr>
<tr>
<td>15 August, 1950</td>
<td>Assam Earthquake</td>
<td>8.5</td>
<td>IV</td>
<td>780</td>
</tr>
</tbody>
</table>
Z represents the maximum considered earthquake (MCE) ground acceleration (g) in these zones. Probabilistically it is considered to have a return period of 2475 years i.e., 2% probability of exceedance in 50 years.

The Design Basis motion is taken as 2/3 of maximum considered motion.
<table>
<thead>
<tr>
<th>City Corp.</th>
<th>Fault Name</th>
<th>Extensive - moderate Building Damage</th>
<th>Complete Building Damage</th>
<th>Casualties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dhaka</td>
<td>Madhupur Fault (Mw=7.5)</td>
<td>≈86,000</td>
<td>≈72,000</td>
<td>88,000 (2 AM) 61,000 (2 PM)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chittagong</td>
<td>Plate Boundary Fault-1 (Mw=8.5)</td>
<td>≈25,000</td>
<td>≈142,000</td>
<td>95,000 (2 AM) 73,000 (2 PM)</td>
</tr>
<tr>
<td>Sylhet</td>
<td>Dauki Fault (Mw=8.5)</td>
<td>≈16,000</td>
<td>≈25,000</td>
<td>10,000 (2 AM) 6,000 (2 PM)</td>
</tr>
</tbody>
</table>
12 June, 1897 Earthquake Damage

Masonry building suffered extensive damage around 500 km away from the epicentre.
# Recent Earthquakes in Bangladesh

<table>
<thead>
<tr>
<th>Date</th>
<th>Epicentre of Earthquake</th>
<th>Magnitude ($M_b$)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 May, 1997</td>
<td>Sylhet (Jaintiapur)</td>
<td>5.6</td>
<td></td>
</tr>
<tr>
<td>21 November, 1997</td>
<td>Bandarban (Myanmar Border)</td>
<td>6.1</td>
<td>20 people killed in Ctg</td>
</tr>
<tr>
<td>22 July, 1999</td>
<td>Moheshkhali</td>
<td>5.1</td>
<td>6 people killed</td>
</tr>
<tr>
<td>19 December, 2001</td>
<td>Dhaka (Manikganj)</td>
<td>4.2</td>
<td>20 injured</td>
</tr>
<tr>
<td>22 July, 2005</td>
<td>Rangamati (Barkal)</td>
<td>5.5</td>
<td>2 killed</td>
</tr>
<tr>
<td>27 October, 2005</td>
<td>Jessore (Narail)</td>
<td>4.3</td>
<td></td>
</tr>
<tr>
<td>5 July, 2008</td>
<td>Rajshahi (Tanore)</td>
<td>4.1</td>
<td></td>
</tr>
<tr>
<td>27 July, 2008</td>
<td>Mymensingh (Haluaghat)</td>
<td>4.9</td>
<td></td>
</tr>
<tr>
<td>13 December, 2009</td>
<td>Chittagong (Chandanaish?)</td>
<td>5.2</td>
<td></td>
</tr>
<tr>
<td>10 September, 2010</td>
<td>Chandpur (Matlab Bazar)</td>
<td>4.8</td>
<td></td>
</tr>
<tr>
<td>3 May, 2011</td>
<td>Comilla</td>
<td>4.6</td>
<td></td>
</tr>
</tbody>
</table>
Importance of Urban Safety

- Bangladesh population: 160 million
- Density: 1,100 per sq. km.
- Present urban population: around 30%
  - increasing @ 4% per year
- Population likely to stabilize around 250 million with density of 1,700 per sq. km.; about 70% urban
- Greater Dhaka city
  - population around 16 million; area 1,528 sq.km.
  - growing @ 5% per year
- Large number of old buildings; vulnerable to earthquakes
- Large number of new buildings being built without considering earthquake forces
Some Recent Building Disasters

- 2005, 11th April: *Spectrum Garments Factory Collapse*, 64 killed

- 2012, 24th November: *Tazreen Fashions Fire*, 117 killed

- 2013, 24th April, *Rana Plaza Collapse*; deadliest in recent world history; 1,135 killed
Rana Plaza

Before collapse

After collapse
Rana Plaza

- No approval from RAJUK, the regulatory authority
- 2005: Savar Municipal Corporation approval for 6 storied commercial building
- signed by Engineer (?) with fake Registration number
- inaugurated in 2009
- 3 more stories added (Savar Municipality approval ??)
- Total violation of Building Construction Act and Building Construction Regulations
Reasons for Structural Collapse

- Cracks appeared on 23rd April; building evacuated
- Next morning, workers forced to resume work
- Vibrations from emergency generators triggered the collapse
- Poor quality of concrete
  - strength around 1,500 pounds per square inch
  - perhaps half the strength assumed by designer
- Part of foundation on loosely filled up water body
- Designed as a commercial building; most floors used for RMG industries
- Steel reinforcement inadequate; beam-column joints weak
Measures to improve Structural and Fire Safety

- Design and Construction of all the Readymade Garments Factories are being reviewed by Bangladeshi and international professionals
- Non-compliant factory buildings are being retrofitted
- Government, Private sector (BGMEA, BKMEA), Accord and Alliance, ILO and JICA involved
Legal Framework for Construction, Use and Maintenance of Buildings

- Building Construction Act 1952 (with amendments in 2008)
- Town Improvement Act, 1953
- Water Bodies Act
- Fire Act
- Local Bodies Act
- Bangladesh National Building Code
Education, Training and Research

- **Education**
  - Earthquake and disaster management courses in universities
  - Polytechnics for “Diploma” students

- **Training**
  - Engineers and Architects
  - Building technicians

- **Research**
  - Housing and Building Research Institute
  - Universities
Some Recent Projects related to Earthquake Vulnerability Reduction

- CDMP, funded by UNDP, EU, UK, Australia, Norway and Sweden
  - Seismic Risk Assessment, Vulnerability Reduction for Dhaka, Chittagong, Sylhet, Rajshahi, Rangpur City Corporations and Bogra, Dinajpur, Mymensingh, and Tangail Paurashava Areas,

- Science and Technology Research Partnership for Sustainable Development (SATREPS) : Japan Science and Technology Agency (JST) and JICA
  - HBRI, PWD, BUET, UAP, AUST
  - 2016-19
Some Recent Projects related to Earthquake Vulnerability Reduction

- **CNCRP : JICA – PWD**
  - Retrofitting Techniques
  - Manuals prepared

- **Bangladesh Urban Earthquake Resilience Project : World Bank**
  - Dhaka Earthquake Risk Guidebook
Enforcement of BNBC

- October 2010: High Court directed the government to establish a **National Building Code Enforcement Authority** within a year under the provisions of Bangladesh National Building Code.

- National Building Code 2015 (waiting to be approved by government) has provisions for setting up Bangladesh National Building Regulatory Authority.
Goal 9: **Build resilient infrastructure, promote sustainable industrialization and foster innovation**

- Target “*Develop quality, reliable, sustainable and resilient infrastructure,*............”
“Building Safety and Urban Resilience” in Sustainable Development Goals

- **Goal 11:** *Make cities inclusive, safe, resilient and sustainable*

- **Targets:** By 2030,
  - ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums
  - enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries
  - significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, …”
The Way Forward

- Enforcement of Building Code
  - Strengthen Regulatory Bodies
- Public Awareness
- Education, Training and Research
  - Strengthen Housing and Building Research Institute
  - Strengthen Fire Service and Civil Defence: provide equipment for Search and Rescue
- Cooperation and Assistance of Development Partners (e.g. WB, JICA, UNDP) will help accelerate the process
Thank you