SPACE
CONSULTANT LTD

# EARTHQUAKE RISK MITIGATION INITIATIVE

## Stakeholders in Action

GEM Semi-Annual Meeting

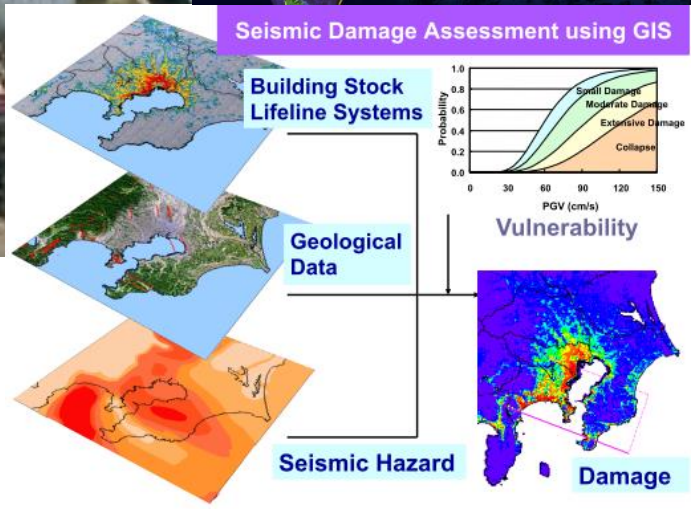
*Taipei, 6-8 June 2012*

# Seismic Loss Estimation for Three Major Cities in Bangladesh


Pennung Warnitchai

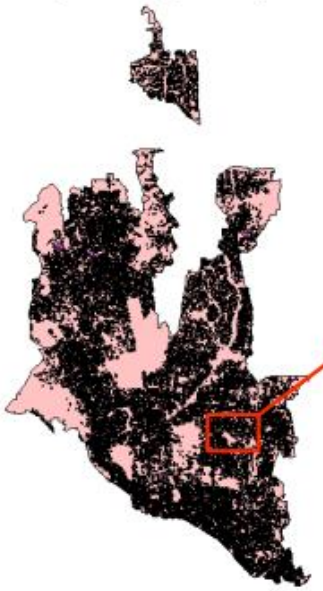
*Asian Institute of Technology*








**Building GIS Database (Existing Data)**



**Number of buildings in each city**

| | | |
|---|---|---|
| Dhaka | : | 326,825 |
| Chittagong | : | 182,277 |
| Sylhet | : | 52,176 |

## Required Data for General Building Stock

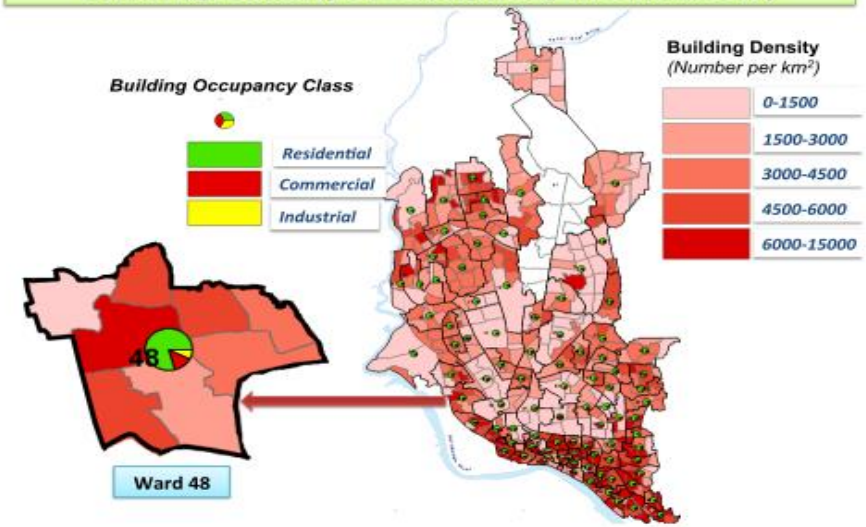
- Building Floor area
- Number of stories
- Building occupancy class (28+ classes)

**Developed for all buildings**

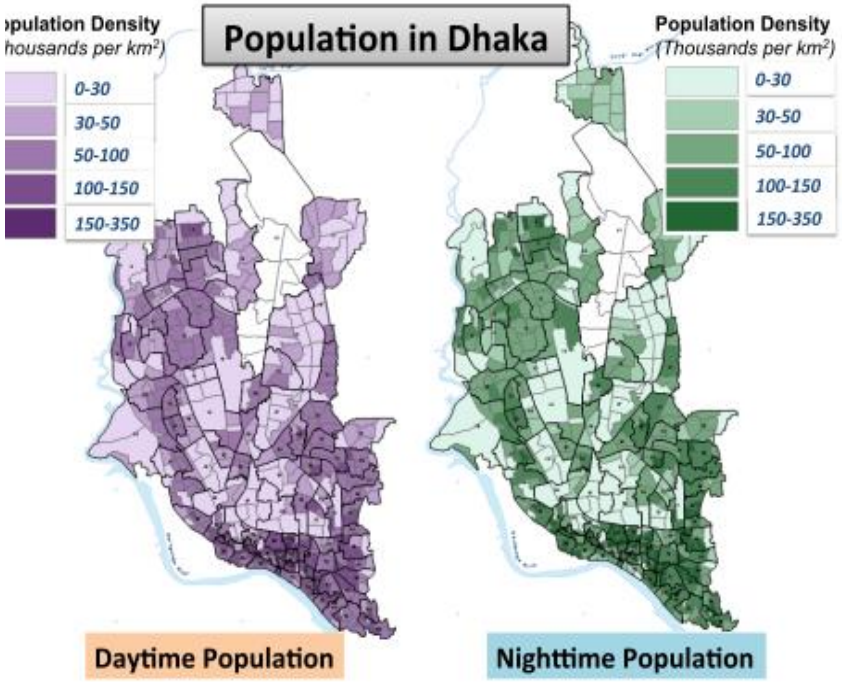
- Number of occupants (day, night)
- Structural types (36+ types)
- Building Vulnerability Characteristics
- Replacement cost, Content cost

**Developed for Selected buildings based on the structure type**

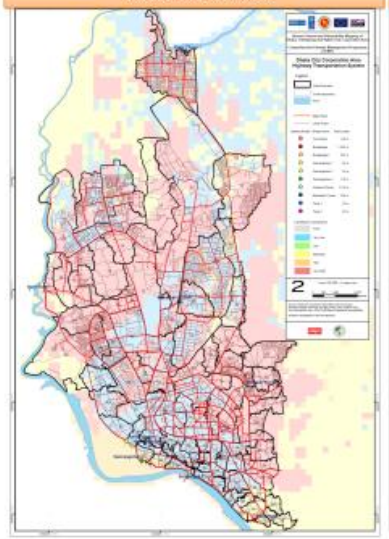
## Building Density & Occupancy in Dhaka City



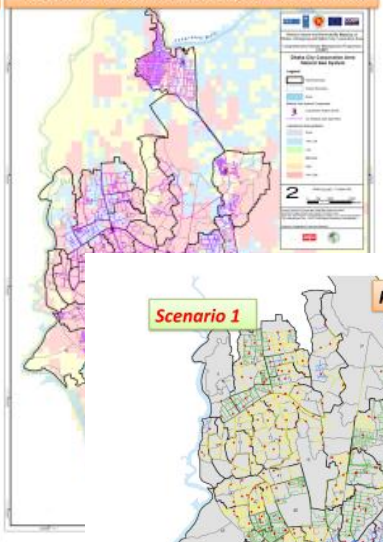

## Population in Dhaka



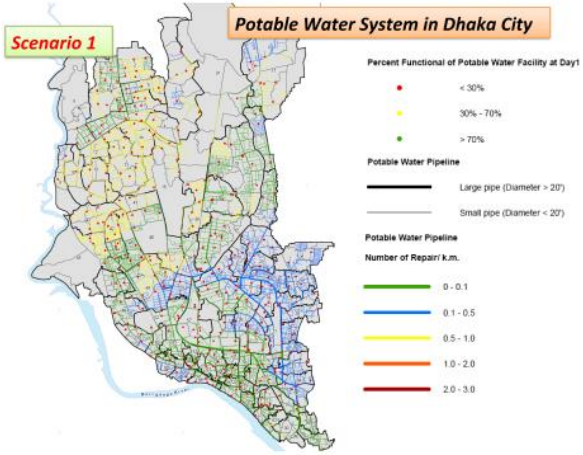

## Road Network



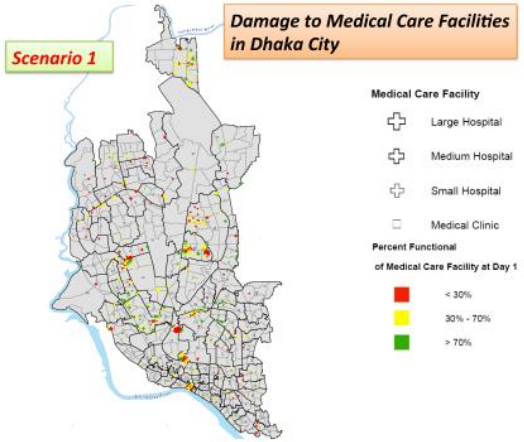
## Natural Gas Distribution Network



## Potable Water System in Dhaka City




## Damage to Medical Care Facilities in Dhaka City



# Damage to Concrete Buildings in Dhaka City

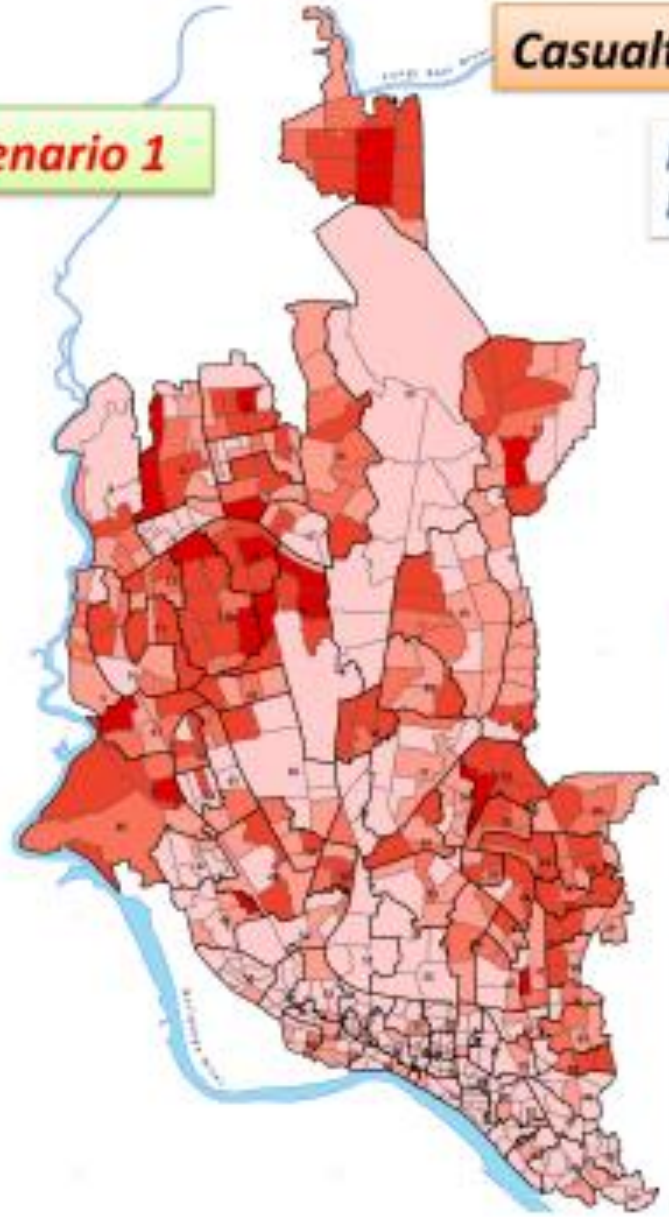
Scenario 1

Number of Damaged Concrete Buildings (moderate-complete)

- 0-50
- 50-100
- 100-150
- 150-250
- 250-450

# Casualties in Dhaka City

**Scenario 1**



**Number of Injuries Levels 2+3+4**

- 0-50
- 50-100
- 100-300
- 300-600
- 600-1200

**Severity Level 1**: Injuries will require medical attention but hospitalization is not needed

**Severity Level 2**: Injuries will require hospitalization but are not considered lift-threatening

**Severity Level 3**: Injuries will require hospitalization and can become lift-threatening if not promptly treated

**Severity Level 4**: Victims are killed by the earthquake

# Field Survey Work

**Level 0** — **Level I** — **Level II** — **Level III**

- Structural type (36 types)
- Occupancy class (33 classes)
- Number of stories
- Building age (<10, 10-30, >30 yr)
- Number of occupants (day, night)
- Visible physical condition *(poor, average, good)*
- Vulnerability factors *(soft story, heavy overhang etc.)*
- Photos of building

**Level I** +

- **Plan sketch**
- **Dimensions of key building components (column size, wall layout etc.)**
- **Slab system (cast-in-place, pre-cast)**
- **Vulnerability details (short column, floor opening etc.)**

## Field Survey Results

| Town | All Buildings in Database (No.) | Level I Survey | | Level II Survey | |
|---|---|---|---|---|---|
| | | No. | % | No. | % |
| Dhaka | 326,825 | 8,741 | 2.67 | 875 | 0.27 |
| Chittagong | 182,277 | 6,175 | 3.39 | 494 | 0.27 |
| Sylhet | 52,176 | 3,536 | 6.78 | 507 | 0.97 |
| Total | 561,278 | 18,452 | 3.29 | 1,876 | 0.33 |

Note: Level I survey rate = 10 buildings/1 team/1 day
Level II survey rate = 1-2 buildings/1 team/1 day
1 team = 2 man, 1 day = 8 working hour (8.00-17.00)

Ferro scan Test on Frame elements

- Stirrups location
- Main bar location
- Diameter measurements for main bars

BUILDING SURVEY LEVEL 1 & 2

LEVEL3 SURVEY-Schmidt Hammer

**Direct shear test for masonry structures**

**Boring with Standard Penetration Test (SPT)**

adpc
Asian Disaster Preparedness Center
Dhaka Office : House # 531/4 (3rd Floor), Lane #11 (west), Baridhara DOHS, Dhaka 1206, Bangladesh. Tel : 88 (0)666 2617 574

# Project on "Seismic Hazard & Vulnerability Assessment in Dhaka, Chittagong & Sylhet city areas, Bangladesh"

By

Mohammad Ashraful Kamal
(Geologist)

***Project Implementation Partners of ADPC***

- OYO International Corporation, Japan
- Asian Institute of Technology (AIT), Thailand
- National Society for Earthquake Technology (NSET), Nepal
- Dhaka University
- Chittagong University of Engineering Technology (CUET)
- Shahjalal University of Science and Technology Sylhet

# ADPC Initiatives under Comprehensive Disaster Management Program (CDMP) of Bangladesh

- **Seismic Hazard & Vulnerability Assessment** of Dhaka, Chittagong and Sylhet City Corporation Areas
- **Contingency Planning** for earthquake hazard
- **Training, Advocacy and Awareness** with regards to earthquake and tsunami hazards
- Support for a **Disaster Management Information Network**

# Seismic Hazard & Vulnerability Assessment

**Seismic Hazard Assessment:**

- Report on Scenario Earthquake
- Setting of fault model
- EQ vulnerability map for each city
- Study on sub surface soil properties
- Engineering geological maps and reports

**Vulnerability & Risk Assessment:**

- Development of GIS inventory of Building footprints and Lifelines
- Assessment of Physical Vulnerability of Buildings and Lifeline Infrastructure
- Production of vulnerability maps & reports
- Loss Estimation study report for the city corporation area

# Contingency Planning

**Facilitate rapid emergency response by allowing planners, in advance to:**

- Consider the likely consequences of an emergency before it occurs
- Identify the key resources, both human and physical, which may be available for emergency
- Identify the critical areas for immediate action
- Build and train the emergency response team in advance
- Define general policies and approach to the emergency in advance
- Include actions designed to prevent an emergency as well as limit its consequences

**Main Responses**

- Search and Rescue
- Health and Medical Service
- Request for External assistance for search and rescue
- Law Enforcement & Security
- Emergency Shelter & Mass Care
- Fire-fighting/Rescue
- Communications
- Damage Assessment etc

# Training, Advocacy and Awareness Building

- Develop guidebook & conduct training for decision makers, planners and relevant professionals
- Guidebook & Training for safety and evacuation training
- Aware and educate religious leaders against earthquake danger
- Preparation of manual & training for masons & bar binders
- Documentary to develop awareness of earthquake hazard & vulnerability
- Production & dissemination of poster and leaflet on earthquake vulnerability reduction measures

# Support for a Disaster Management Information Network

- Status of existing links for information for information dissemination between source and community level

- Review options for strengthening existing links and filling gaps where appropriate

- Carry out “mock drills” for rapid onset “emergency” hazards

- Undertake post-event audits to assess information flow between warning source flow between warning source

- Design and test appropriate information network(s) to priority hazard types to priority hazard types

# Data Collection for DMIS

Soil sample collection for geo-technical investigation

Shallow seismic data collection

Micro-tremor data collection

Field work for active fault study

# Data Collection for DMIS

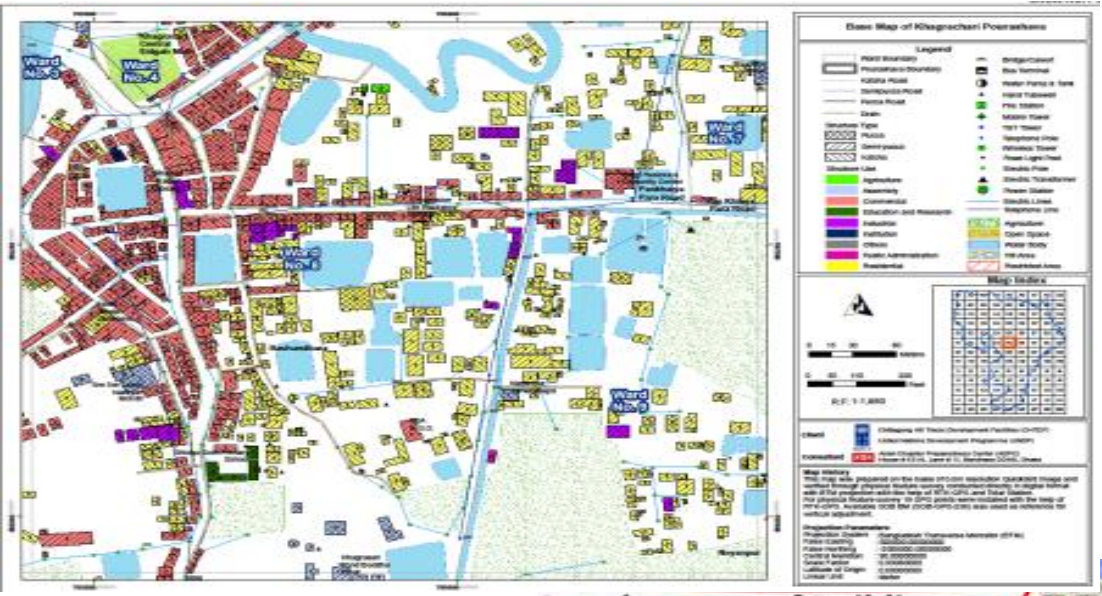
Active fault study

Geophysical survey for Surface wave

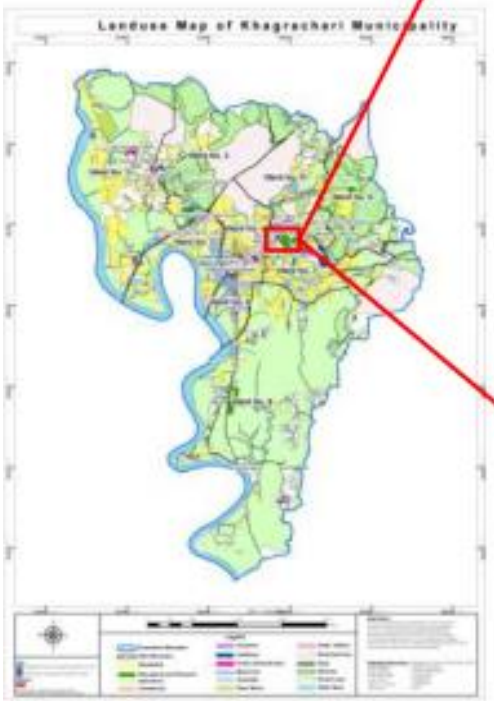
PS logging (down hole test) for shear wave velocity

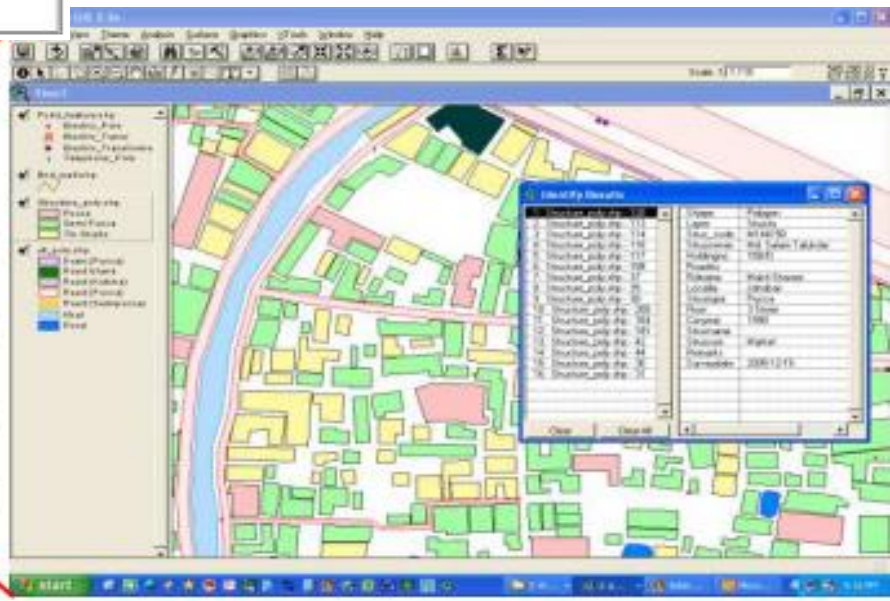
# Field Work for Base Map Preparation

Field Work for Base Map Preparation



## Development of Building Database



### Number of buildings in each Municipalities

| | |
|---|---|
| Rangamati | : 18773 |
| Bandarban | : 7410 |
| Khagrachari | : 11936 |

SPACE
CONSULTANT LTD

## CONNECT

Engr. Arif M. Khan
+880 17 5568 0801
opusakhan@gmail.com