

## 3.3 Country Good Practices

### 3.3.1 Armenia

#### Armenia

##### International Cooperation from Armenia:

##### Emergency Response to the Gujarat Earthquake in 2001

The  $M_w = 7.7$  earthquake occurred at 8:50 local time on January 26, 2001, in the northwest corner of India. The Government of Armenia, in coordination with the Government of India, rushed an 18-member multi-disciplinary Armenian National Survey for Seismic Protection (NSSP) Task Force team for relief operations to the earthquake-affected Gujarat state of India for two weeks. The team included seismologists, structural and communication engineers, geotechnicians, physicians, psychologist and rescuers with a sniffer dog. At the request of the Government of India the team was stationed in Ahmedabad, a city with a population of 5.74 million people.



##### Ground Motion Records in Ahmedabad City

The first ground motion studies through aftershock recordings of the Gujarat earthquake were conducted by the Armenian NSSP Task Force Mission. A temporary ground motion network, consisting of four portable strong SMACH instruments with three-component strong-motion seismometers, was placed in different parts of the city with various geologic conditions.

The comparison of the peak horizontal accelerations calculated by different attenuation models shows a good agreement between the data set and calculated accelerations on the base of the attenuation model for Europe.

##### Building Inspection and Performance of Engineered Structures and Soil Conditions

The Armenian NSSP Task Force inspected 140 buildings (of 4-12 stories) in total, and summarized data for 125 multistoried residential buildings.

##### Summary of results:

The seismic data show that the Bhuj earthquake intensity reached VII according to the European Micro-Seismic Scale (EMS - European 1993) in the area of Ahmedabad city.

The surveyed buildings were subject to differing degrees of damage: 5.3 % of buildings were collapsed or are subject to demolition; 48.2% of buildings required reinforcement; 46.5 % of buildings were subject to normal operation with cosmetic repairs.

Despite the location of Ahmedabad city 270 km from the epicenter of the main shock, the intensity of the earthquake here was estimated to have reached VII according to the EMS scale, and buildings have seriously suffered for the following reasons.

1. Buildings were designed and constructed with serious deviations from or ignoring basic rules of earthquake engineering; built with materials of poor quality; and subject to defects in the design and production of cast-in-place reinforced concrete constructions.
2. The area had a low level of mechanization and thus construction itself was of poor quality.
3. Damage had been caused to load-bearing elements of the structures during their use due to inadmissible changes made by residents.
4. The predominant period of ground motion was 0.3-0.5 s with the consequent high probability of the resonance phenomenon arising mainly in 4-6-storey buildings.

#### **Major achievements**

**In line with the observations above, the following proposals are made:**

1. To revise the Indian Seismic Building Codes taking into consideration analysis of the Bhuj earthquake.
2. To design in complete compliance with the requirements of the codes.
3. To undertake regulated quality control and assurance during construction.
4. To examine and certify building materials for mass construction.
5. To conduct complex investigations of buildings prior to restoration and strengthening work.

#### **Rescue, Medical and Psychological Assistance to Demolition Teams and Earthquake Victims**

The Armenian NSSP Task Force rescuers, physicians, social scientist and psychologist provided assistance with search and rescue activities and participated in demolition operations. Medical assistance was extended to demolition teams and earthquake victims. They also investigated the social impact through meetings and interviews with officials, victims, and emergency managers.

#### **- Background**

The Armenian NSSP is the initiator of many UN, EU, NATO and other international and regional programs and projects, aimed at regional cooperation in the field of seismic safety in the Caucasus and other earthquake-prone regions.

#### **- Objective**

1. To provide scientific and technical expertise and multidisciplinary assistance with respect to immediate post-earthquake relief efforts.
2. To gather data and information to assess the factors that contributed to the disaster, identifying knowledge gaps where focused efforts can contribute to seismic risk (loss) reduction in India, Armenia and other earthquake-prone countries.

#### **- Term/Time Frame**

Two weeks

#### **- Activities Undertaken**

1. Establishment of a temporary array of accelerographs to record strong aftershocks.
2. Engineering assessment of soil and structural performance.
3. Demolition of heavy damaged structures.
4. Rescue, medical and psychological assistance.

#### **- Major achievements**

1. Six strong aftershocks of the earthquake were recorded in Ahmedabad city, and ground geotechnical conditions were studied.
2. One hundred and forty buildings were inspected and tested.
3. Unique operations were implemented jointly with the Ahmedabad fire brigade for the deconstruction and demolition of 14 severely affected buildings.
4. Rescue, medical and psychological assistance was provided.
5. Sociological studies have been carried out through talking with local people.

#### **- Contact Details**

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