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Asian Disaster Preparedness Center

Asian Disaster Management News

January - April 2010 Vol.16, no. 1

Earthquake Risk Management

CONTENTs

Editor's Note

Mr. Aloysius J. Rego
Editor in chief

In the first quarter of 2010, the world experienced a series of devastating earthquakes which struck four countries: starting from the magnitude-7.0 Haiti earthquake on January 12, followed by the 8.8-magnitude Chile earthquake in the coast of the Maule Region on February 27, the 7.2-magnitude Mexico quake which hit Baja California on April 4, and the Yushu earthquake in Qinghai province, China struck on April 14 with magnitude of 6.9. Although scientists say the level of earthquake activity is nothing out of the ordinary considering an average of 16 earthquakes of magnitude 7 or greater has struck worldwide every year since 1900; it is an extraordinary and heartbreaking experience for the people affected by the disasters, and for organizations involved in humanitarian response and recovery.

“Cities in poor countries are most vulnerable because they often have widespread sub-standard housing and a weak infrastructure.”

Certainly, earthquakes are the deadliest natural hazard. In the past decade, nearly 60 percent of the people killed by disasters died because of earthquakes, according to the Centre for Research on Epidemiology of Disasters (CRED). Earthquakes pose a serious threat for millions of people worldwide and in urban communities as eight out of the ten most populous cities in the world are on earthquake fault-lines. Cities in poor countries are most vulnerable because they often have widespread sub-standard housing and a weak infrastructure.

Earthquakes strike without warning. Asia, in particular, is very prone to earthquakes. According to the 2009 *Global Assessment Report* published by UN International Strategy for Disaster Reduction (UNISDR), seven out of ten most vulnerable countries to earthquake in terms of absolute human exposure are in Asia including Japan, Philippines, Indonesia, China, India and Pakistan. Therefore, it is crucial to enhance preparedness in advance and increase resilience through mitigation and safe construction before an earthquake strikes. With proper mitigation and preparedness, the damages and losses caused by an earthquake can be minimized and lives and properties saved. The recent Haiti and Chile earthquakes are cases in point. The reason why there was so much less destruction in Chile than Haiti despite the fact that the 8.8-magnitude earthquake that hit Chile on February 27 was orders of magnitude stronger than the 7.0 quake that killed an estimated 230,000 Haitians in January is simple: Chile was better prepared and had more effective building codes.

It is timely that this latest issue of *Asian Disaster Management News* is focusing on **earthquake risk management**. There are 12 articles presented here including five thematic articles – ‘Overview of Urban Earthquake Risk Reduction in Asia,’ ‘Earthquake-Resistant Construction practices for non-engineered housing construction’, ‘Preventing building collapse’, ‘Re-orientation of disaster management plans in Asian countries in view of recent earthquakes in China, Chile and Haiti’, and the importance of Topography in Seismic Amplification’ as well as seven country specific article coverages – Bangladesh, Indonesia, Iran, Pakistan and the Philippines.

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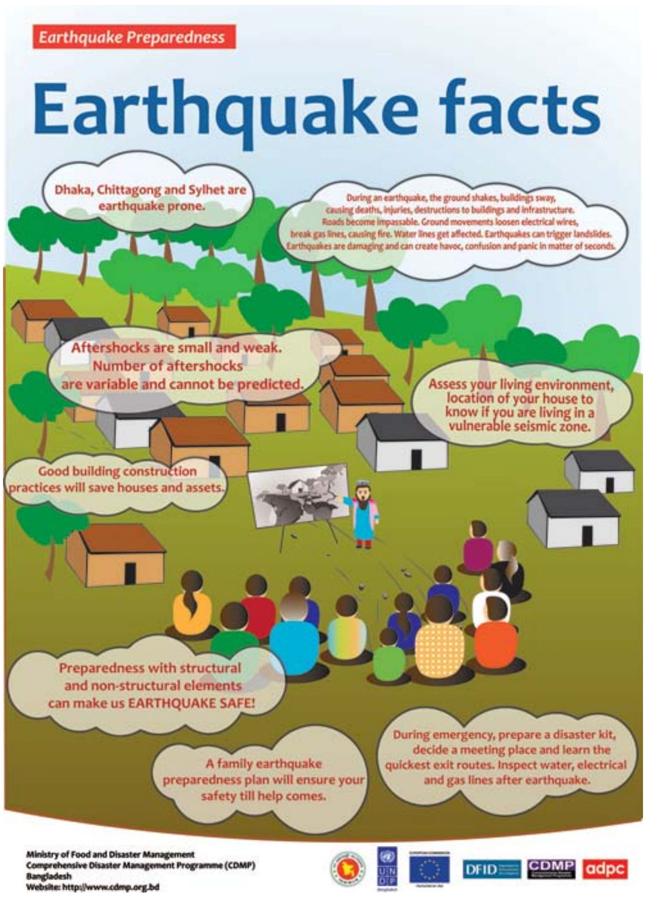
I would like to express our sincere thanks to all invited contributors with special mention of the Urban Disaster Risk Management (UDRM) team of ADPC for their tireless efforts for this publication.

ADPC
Earthquake Risk Management

__ADPC has been involved in earthquake risk reduction__ and preparedness since 1995 starting with the Asian Urban Disaster Mitigation Program (AUDMP). Over the years, ADPC has continued to increase its engagement in the field through providing technical assistance to countries in Asia and Pacific region.

AUDMP, funded by USAID, was conducted between 1995 and 2000, with the aim to reduce the disaster vulnerability of urban populations, infrastructure, critical facilities, and shelters in selected cities throughout Asia. For example, the Kathmandu Valley Earthquake Risk Management Project, one of AUDMP's projects launched in September 1997 aimed to reduce earthquake vulnerability of Kathmandu Valley area by establishing appropriate earthquake risk management policies, putting a great emphasis on community-based initiatives which created community ownership in earthquake vulnerability reduction, public awareness through commemoration of Earthquake Safety Day and safer construction of school buildings.



In the aftermath of the Bam earthquake on December 26, 2003, there was urgent need for Iran to intensify its effort to prepare for future disaster events. Hence, ADPC implemented activities in Kerman and Gourgan, which are among the highly disaster prone cities of Iran to strengthen the capacity of the local actors and stakeholders to reduce earthquake risk and develop an action plan for earthquake risk management and emergency response, especially through promoting community based approaches and public awareness through the five-year Strengthening Capacities for Disaster Risk Management in Iran 2005-2009 program in partnership with Iranian government and UNDP.

When an earthquake of magnitude 7.6 struck Northern parts of Pakistan and the border area of Indian Kashmir on October 8, 2005, ADPC, in partnership with the Habitat for Humanity International, undertook a rapid assessment of the direct impact of the event and identify the issues to be considered in meeting the shelter needs, during the immediate aftermath as well as in the long-term recovery phase.

ADPC also provided technical and research inputs for the Technical Assistance Project: Providing Emergency Response to Wenchuan (Sichuan, China) Earthquake in 2008, which was initiated by the Asian Development Bank at a request from the Government of China after a massive earthquake measuring 8.0 on the Richter scale struck southwest China on May 12, 2008 killing at least 68,000 people.

In Uttaranchal state of India, ADPC implemented an Asian Development Bank funded project which focused on Earthquake Risk Reduction including review of municipal Bye-Laws, training of masons and engineers and demonstration of safe construction practices.

Recently, ADPC successfully undertook projects on Earthquake and Tsunami preparedness in the Comprehensive Disaster Management Program (CDMP) of the Government of Bangladesh and has prepared Seismic Hazard and Vulnerability Mapping of Dhaka, Chittagong and Sylhet city corporation areas.

ADPC is currently working on several earthquake related projects in different countries. Since August 2009, ADPC has been working on "Seismic Hazard and Vulnerability Mapping and Risk Assessment" project in Rangamati, Bandarban and Khagrachari Municipalities, Bangladesh in partnership with the Chittagong Hill Tracts Development Facility (CHTDF) of UNDP. The rationale of the project comes from the idea that it is urgently needed to understand the nature, severity and consequences of likely damage and loss, given Bangladesh is susceptible to damaging earthquakes, having experienced several significant earthquake events recorded in the past few hundred years and because of the fast growing city development.

In addition, ADPC is involved in a seismic risk assessment in Myanmar by carrying out the following activities: collecting and analyzing past seismic monitoring data and existing reports on the historical losses due to past earthquake events; mapping the seismic hazard sources, vulnerabilities and risks due to potential earthquakes; detailing out physical exposures to earthquakes, and other collateral hazards using the GIS database; analyzing and quantifying the projected losses in the absence of mitigation investments.

Another one of ADPC's key activities in earthquake risk management is to develop capacity building through training courses. ADPC delivered five courses on Seismic Hazard Mitigation from 1992 to 1997. Earthquake Vulnerability Reduction course (EVRC) has trained thousands participants from government offices, national and local level ministries, private sector corporations, builders, infrastructure developers, emergency response agencies, as well as UN/NGO personnel working on disaster mitigation since 2002.

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Overview of Urban Earthquake Risk Reduction in Asia

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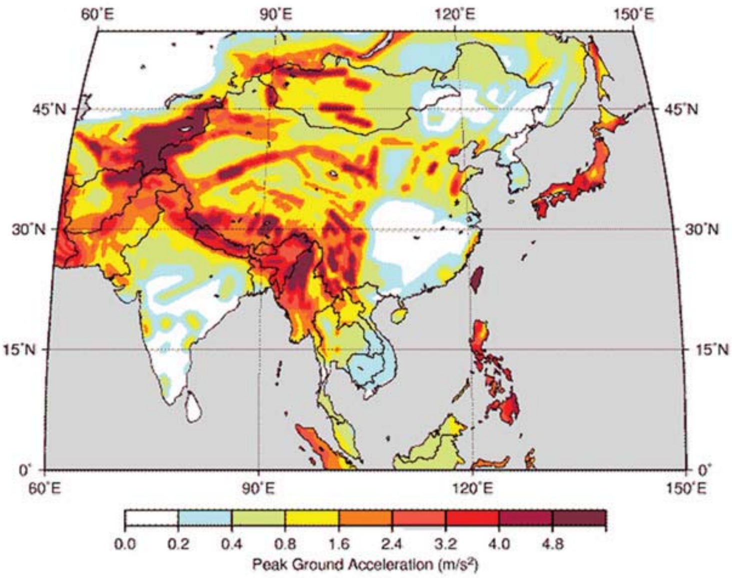
Earthquakes in Asia

Asia has been a hot spot for earthquake disasters. There have been a number of earthquakes in Asia that claimed thousands of lives during the past 10 years alone (Ref. 1); among them are the 2001 Gujarat, India, earthquake (20,085 deaths), the 2004 Sumatra, Indonesia, earthquake and tsunami (227,898 deaths), the 2005 Pakistan earthquake (86,000 deaths), and the 2008 Eastern Sichuan, China, earthquake (87,587 deaths). The map below illustrates the seismic hazard for a part of Asia (Ref. 2). Darker shades of color represent areas of high seismic hazard in the continent. Some of these high hazard areas overlay densely-populated urban cities where a major earthquake event can cause monumental economic and live losses. Measures, both at the national and local levels, must be taken to mitigate the chance of disastrous consequences of the future earthquakes.



Hazard, Vulnerability, and Risk

The use of the terms "hazard", "vulnerability", and "risk" sometimes causes confusion among social scientists and engineers. It may be worthwhile to revisit the definitions of these terms here. According to the definitions provided by the United Nation International Strategy for Disaster Reduction (UNISDR) (Ref. 3), hazard refers to a potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Vulnerability is the conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards. And lastly, risk is the probability of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human-induced hazards and vulnerable conditions. The relationship among hazard, vulnerability, and risk can be expressed mathematically in the following form.

$$\text{Risk} = \text{Hazard} \times \text{Vulnerability}$$

Reducing risk is always the main goal for disaster management policy makers and implementers alike. Per the above expression, risk reduction can be achieved from either lowering the hazard or lowering the vulnerability. However, like many other natural hazards, many aspects of the earthquake hazard reduction are unattainable since the hazard itself is an uncontrollable act of nature. Risk reduction, however, can be accomplished through the mitigation of seismic vulnerability. Physically, vulnerability of the built-environments is lessened through many seismic retrofitting and upgrading options, while socially raising public awareness and preparedness of the earthquakes can be equally effective.

The Tales of Haiti and Chile

A good lesson learned from what have happened after the Haiti and the Chile earthquakes is that disaster preparedness is a key in preventing possible disastrous events or at least minimizing their impacts on the society. The two earthquakes that occurred in Central and South Americas, respectively, are of large magnitudes. The magnitude-7.0 earthquake in Haiti resulted in widespread collapse and extensive damage of buildings and infrastructures throughout the city of Port-au-Prince, the country's capital. Much of the city became unrecognizable as the earthquake debris scatter. On the other hand, for the even larger Chile earthquake (magnitude 8.8), though there were some buildings collapsed, the cases were much more isolated. Cities lying closest to the rupture source of this strong earthquake surprisingly were spared from the destructive force of this mega-quake. In terms of the quakes' impacts on human lives, while over 200,000 people perished from the earthquake in Haiti, only about 500 lost their lives following the Chile earthquake.

Figure 1. Building Collapsed when the magnitude 8.8 earthquake struck Chile in February 2010, © AIR Worldwide 2010

Figure 2. Magnitude 8.8 earthquake struck Chile in February 2010, © AIR Worldwide 2010

Several post-disaster damage assessment reports revealed that one of the contributing factors for such discrepancy between Haiti and Chile is the readiness of the cities and their people to potential disaster. Chile has been known for a long time as a country of very high seismicity. In fact, the largest earthquake ever recorded on earth took place just off the coast of Chile in 1960. As a result, the Chileans are well-aware of the possibility of large earthquakes in their country; therefore measures for mitigating their risks have been taken. The Chilean seismic design provisions for buildings and infrastructures are quite advanced. For some regions in Chile, the requirements are as stringent as in those adopted in California. On the Haiti's side, many of the residential buildings in Haiti are constructed of non-engineered materials such as bamboo, mud, and mud bricks. Even modern multi-storey buildings in Port-au-Prince were built without seismic detailing. These buildings virtually have no resistance to the earthquake forces. They will most likely yield in the event of strong earthquakes and will collapse, potentially burying their occupants inside them. It is evident therefore that governance capability to strictly enforce the seismic design codes in Chile has proved to be a difference maker in such a major earthquake event.

Seismic Risk of Urban Cities in Asia

Earthquake risk mitigation planning for an urban city differs considerably from a similar action applying at regional and national levels. The site response of earthquake ground motion as well as the buildings' vulnerability may vary significantly from one location to the others within a city, depending on the underlying soil conditions and quality of the constructions. Often times after an earthquake, it can be observed that buildings in certain areas of a town suffer significantly higher degree of damage than in other areas nearby. City-level disaster risk reduction planning usually requires detailed assessment of the earthquake risk which allows policy makers to prioritize and allocates available resources on a risk-based basis. Many urban areas in Asia are exposed to high seismic hazard. On top of that, rapid urbanization without proper planning and regulations in some of those areas can lead to highly vulnerable building stocks. These are the ingredients that can lead to substantial damage from an earthquake, as was evident from the Haiti's case.

To this end, there have been several initiatives for disaster risk reduction in Asia over the past decade. The Comprehensive Disaster Management Program (CDMP) of the Government of Bangladesh is a long-term program with its aim on improving the disaster management system in Bangladesh. One component of the program was to carry out detailed seismic hazard and vulnerability mapping of Dhaka, Chittagong, and Sylhet, all of which are rapidly developing urban areas in Bangladesh. Outcomes from this project will be used for planning and execution of management and mitigation of seismic disaster in the study areas. More recently, UNISDR has initiated a 2010-11 World Disaster Reduction Campaign entitled "Making Cities Resilient: My city is getting ready," calling for urgent action of the world's leaders to address issues of local governance and urban risk. These represent a few examples of the programs designed to reduce the risk from earthquakes or other hazards in urban settings.

Concluding Remarks

As many urban areas in Asia are prone to damage from earthquakes, measures must be taken to mitigate such risk. It is strongly recommended that the following actions are considered.

- *First and foremost, the fundamental way for managing earthquake risk must change. Reactive approaches for handling natural disasters as being exercised by many Asian nations must be replaced by a more proactive attitude against the risk.*

- *Cities need to carry out periodic loss estimation exercises based on detailed hazard, vulnerability and risk assessment as the decisions cannot be taken only by applying general understanding on earthquakes at a regional or national level to a city. Scientific assessments always help us to take optimum risk reduction decisions.*

- *Building codes need to be practiced in the design and construction process by engineers. Public should know that it is an essential task to have the building designs checked by qualified engineers if they are living in an area with recorded earthquake history. Local government authorities need to build special capacity among the technical staff in order to have a proper enforcing and monitoring processes.*

- *More stakeholders should get involved in key areas of earthquake risk reduction. At present very few institutions work in key areas such as building safety which is the key to earthquake vulnerability reduction. Current trend in climate change related initiatives globally, has somewhat reduced the interest of institutions to work in earthquake risk reduction initiatives although they are equally important.*

- *Uncertainties are inherited with earthquakes. Earthquake magnitude cannot be predicted precisely and its intensity may vary due to various factors. Therefore complete risk mitigation is not practical unless authorities consider risk financing measures in larger cities in addition to physical risk reduction measures and policy interventions.*

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Dhaka's Peripheral Development and Vulnerability to Earthquake Liquefaction Effects

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***Dhaka is gradually** expanding towards all directions through rapid development of housing estates. The Master Plan for the city that was prepared under the name of Dhaka Metropolitan Development Plan (DMDP) has two parts: Dhaka Structure Plan is valid during 1995-2015, whereas the Urban Area Plan was valid during 1995-2005. This plan indicates about keeping at least eight flood-flow zones undisturbed (Dhaka West, DND Triangle, Eastern Fringe polders, Kamrangir Char, Jinjira, Narayanganj West, Dhaka NW, Narayanganj East). Unfortunately, this is not happening. Already two flood-flow zones are being filled up by unscrupulous developers, something that RAJUK (a prime Planning Authority of Bangladesh) has failed to prevent (Ferdousi, 2006). Low lying areas and flood flow zones are encroached both by public and private sector initiated housing projects. The biological resources like flora, fauna and particularly fish species decreased in number, area of cultivable land is reduced and crop production came down a considerable amount over last one decade (Rahman, 2007). The following discussions analyze the present scenarios of housing estate development in Dhaka's periphery. These cases represent the circumstances of housing estates development on marshy lands during last one and half decade that is ultimately leading to a large development which might be vulnerable to earthquake liquefaction effect.*

Dhaka's Development on Marshy Lands

Dhaka is expanding gradually towards different directions on marshy lands. This phenomenon is common for eastern fringe, western areas and southern periphery. Followings are some examples as to how these areas are being developed on the loose soils (mostly filled by sands) and developed gradually.

The eastern part goes under water during rainy season quite regularly. This part also serves as the retention area to hold the run off of rain water for a large portion of the city through a number of natural drains. It reveals that 47% area is usually affected by annual flooding (JICA, 1992). Most of the lands are submerged during this season. During last decade, about 19 housing projects have been initiated in the eastern fringe. It is expected that other housing estates will be implemented within next 10 years (Rahman, 2007). Most of these housing estates are developed by filling low land with sand, soil and solid waste. Analyzing IRS (Image Range Simulator) images of 1996 and 2000, it is evident that about 2,300 sq meters of water bodies were filled in during development of Bashundhara and Bashumoti Housing Estates.

Similarly, after analyzing IRS image of Aftabnagar area, it is evident that there was branch of natural drain and large water bodies covering an area of 66 acres. At the same time, there were agricultural land and green spaces covering an area of 273 acres.

In the southern part of river Buriganga, RAJUK initiated a residential project on an area of 381 acres. The project site used to remain under water most of the year. The site is demarcated as a water retention pond in Dhaka Master Plan, but it has been filled by sand over last 2 years for housing development. Apart from this, it is evident that about 3,000 sq meter natural water bodies have disappeared during the development Riverview Housing Estate in the southern fringe on the bank of river of Buriganga. There was a natural canal through the site of river view housing estate in the past (Rahman, 2007).

On the western part of Dhaka, a number of housing estates have been initiated during last two decades. There were 211 acres of water bodies in Mohammedia housing estate and Adabbor area in 1996. The process of housing estate development by different developers, about 91 acres of water bodies disappeared between 1996 and 2006 and about 68 acres of water bodies has disappeared due to the process of earth filling for housing development between 2006 and 2009.

What is Liquefaction and why we should worry?

Liquefaction is a physical process that takes place during some earthquakes that may lead to ground failure. As a consequence of liquefaction, soft, young, water-saturated, well sorted, fine grain sands and silts behave as viscous fluids rather than solids. Liquefaction takes place when seismic shear waves pass through a saturated granular soil layer, distort its granular structure, and cause some of its pore spaces to collapse. The collapse of the granular structure increases pore space water pressure, and decreases the soil's shear strength. If pore space water pressure increases to the point where the soil's shear strength can no longer support the weight of the overlying soil, buildings, roads, houses, etc., then the soil will flow like a liquid and cause extensive surface damage. On September 19, 1985, an earthquake struck Mexico City with a magnitude of 8.1 on the Richter scale. The epicenter of the earthquake was 240 miles from the city. Since the city is situated on land once covered by Lake Texcoco and was filled in for habitation, hundreds of buildings in Mexico City collapsed due to the heavy shaking of the ground and the long duration of the quake, which lasted three to four minutes. Similarly, the Niigata earthquake, together with the Alaska earthquake in 1964, brought liquefaction phenomena and devastating effects on the cities. Hundreds of buildings collapsed and were damaged due to liquefaction affects from the earthquake.

Figure 1. Collaspe of building after Niigata earthquake in 1964

Figure 2. Liquifiction effect after Mexico Earthquake in 1985

What Dhaka should be worried about?

A recent study conducted by Comprehensive Disaster Management Program (CDMP) of the Government of Bangladesh in 2009 on Liquefaction Susceptibility on Dhaka City indicates that Eastern and South-Western parts of Dhaka are within the range of high to very high Liquefaction Susceptibility. The identified areas by the study are the same places where recent development has taken place filling marshy lands. CDMP study also has identified several active faults within Bangladesh based on the historical events and evidences of geological investigations. Madhupur and Dauki faults which is about 90 and 230 miles respectively from Dhaka is among the faults identified by the experts. During Mexico City earthquake in 1985, there was a considerable amount of damage even the source was 240 miles from the city.

In the case of Dhaka, an earthquake, either from Madhupur or Dauki, may cause severe liquefaction effects to buildings especially that are developed on marshy lands in the eastern and western fringe. It requires proper land use control mechanism to ensure the future development considering the possible liquefaction effect of earthquake in the east, west and southern periphery of Dhaka. In depth study and research in this regard would be helpful for the preparedness of Dhaka's development

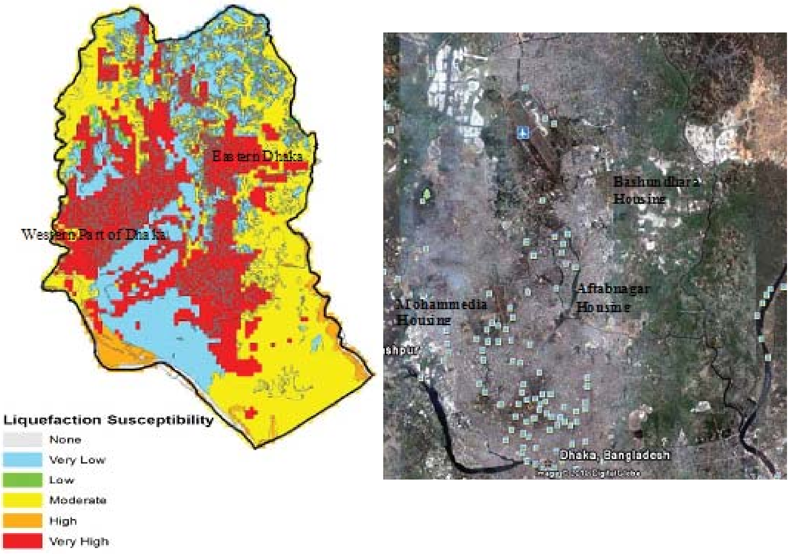

Figure 3. Liquefaction Susceptibility Map of Dhaka City and Surrounding Areas (left) shows liquefaction susceptibility ranges in different areas. On the right is the aerial view of Dhaka City represents the areas with possible Liquefaction susceptibility effect to earthquake where development is taking place on marshy lands (© Seismic Hazard Map of Dhaka, CDMP, 2009 and Google Earth Map)

Part A *Part B* *Part C* *Part D*

Figure 4.
Part A: Aftabnagar Housing Area (on the east of Dhaka) in 1996. The circled areas show the water bodies over the places.
Part B: The scenario of Aftabnagar in 2001. Many of the water bodies are disappeared during Housing Estate Development.
Part C & D: Aerial View of Aftabnagar respectively in 2006 and 2009 represent the gradual changes in the process of physical development in the area.
(© IRS Image 1996 & Google Earth Image)

Part A *Part B* *Part C* *Part D*

Figure 5.
Part A: Western Part of Dhaka in 1996. The circled areas show the water bodies over the places.
Part B: The scenario of Mohammedia Housing Estate and Surrounding Areas in 2001. Many of the water bodies are disappeared during Housing Estate Development.
Part C & D: Aerial View of Area respectively in 2006 and 2009 represent the gradual changes in the process of physical development in the area. (© IRS Image 1996 & Google Earth Image)

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Earthquake-Resistant Construction Practices For Non-Engineered Housing Construction

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Seismic vulnerability *of non-engineered housing construction has been the main cause of excessive human and economic losses in the past earthquakes, including the most significant earthquakes of the last decade: Bhuj, India (2001); Bam, Iran (2003); the Great Sumatra earthquake and Indian Ocean tsunami (2004); Pisco, Peru (2007); Sichuan, China (2008); Padang, Indonesia (2009); and Haiti (2010). These earthquakes affected both rural and urban areas and most fatalities resulted from inadequate seismic performance of housing construction. In rural areas, building damage and fatalities were mainly caused by the vulnerability of traditional unreinforced masonry construction. In urban areas, on the other hand, the losses were mainly due to non-engineered or inadequately engineered concrete construction, such as reinforced concrete frames with masonry infill walls. With a growing urban population and more extensive use of reinforced concrete and cement-based masonry construction both in urban and rural areas, it is expected that future earthquakes will continue to confirm significant vulnerability of these modern forms of non-engineered construction. Detailed information about housing construction practices worldwide is available in the World Housing Encyclopedia (www.world-housing.net), which documents both vulnerable construction practices that performed poorly in earthquakes and good practices that performed well in earthquakes.*

The following three approaches offer alternatives for improving seismic performance of non-engineered housing construction, thereby reducing human and economic losses: 1) improve existing construction practices, 2) develop sustainable seismic retrofitting technologies, and 3) introduce new construction practices.

The first approach - Improving existing construction practices is illustrated by the example of traditional stone masonry construction practice that was improved in the area affected by the 1993 Killari, India 6.4-magnitude earthquake. More than 8,000 people were buried under the rubble of their stone masonry dwellings in the earthquake. Before the earthquake, rounded stone boulders and mud mortar were used for the wall construction. The walls consisted of two exterior wythes (faces) built using large stone boulders and an interior wythe filled with small stones and rubble, and the overall wall thickness was often more than 900 mm (Figure 1a). The most common damage in the earthquake was delaminating (separation) of exterior wall wythes, thereby causing either partial or total wall collapse. In the post-earthquake rehabilitation program managed by the Government of Maharashtra, stone masonry walls were built using shaped (cut) stones and cement mortar. The wall thickness was limited to 450 mm, and through-stones were provided to connect the exterior wall wythes (Figure 1b). These improvements in traditional construction practices are expected to result in significantly better performance of stone masonry in an earthquake of intensity similar to the 1993 Killari earthquake.

An example of **the second approach - Developing sustainable seismic retrofitting technologies** is related to adobe construction made using sun-dried mud blocks, which are usually manufactured by local communities. Adobe buildings have shown extremely poor performance in the past earthquakes, largely because of their heavy weight and low strength combined with the brittle nature of adobe masonry. Approximately 30% of the world's population lives in such earthen dwellings, including regions of high seismic risk, such as Latin America, South East Asia and the Middle East. Researchers from the Catholic University of Peru (PUCP) have recently developed a new technology for reinforcing adobe houses using polymer mesh (geomesh) attached to adobe walls by nylon strings and covered by mud plaster (Figure 2a). A few full-scale models of adobe buildings reinforced with geomesh demonstrated excellent seismic performance in shake-table experiments (Figure 2b). The geomesh reinforcement proved to be effective in increasing the stiffness, strength and deformation capacity of adobe walls.

An additional benefit is enhanced life safety in major earthquakes, since the geomesh encases the building and prevents a complete disintegration and collapse of the walls. This technology can be used both for new and existing construction. Easy-to-understand training materials for home owners and local artisans have been developed in Peru and a few field applications were made after the 2007 Pisco earthquake.

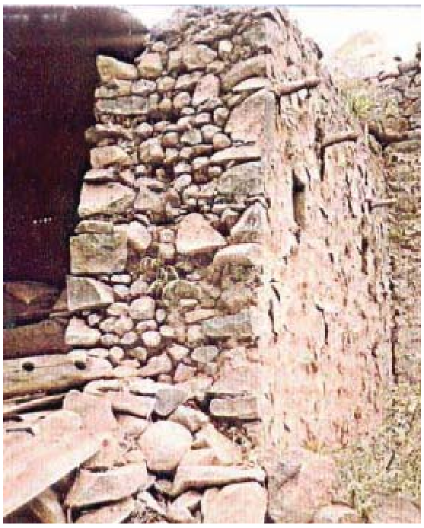
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Figure 1. Stone masonry construction in Maharashtra, India: a) traditional construction (before the earthquake), and b) improved construction practice.

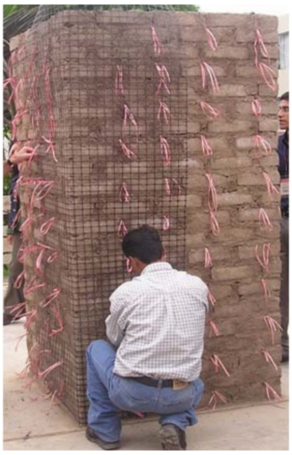
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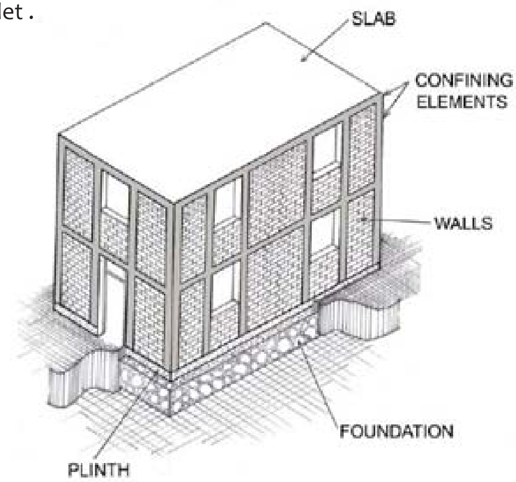
Figure 2. Stone masonry construction in Maharashtra, India: a) traditional construction (before the earthquake), and b) improved construction practice.

The third approach - Introducing new construction practices will be illustrated by confined masonry construction. This construction technology has evolved through an informal process based on its satisfactory performance in the past earthquakes. Confined masonry construction consists of masonry walls, made either of clay bricks or concrete block units and horizontal and vertical Reinforced Concrete (RC) confining members built on all four sides of a masonry wall panel. Vertical members, called tie-columns, resemble columns in RC frame construction, except that they tend to be of far smaller cross-sections. Horizontal elements, called tie-beams, resemble beams in RC frame construction (Figure 3a). Confined masonry presents an alternative to both unreinforced masonry and non-ductile RC frames with masonry infill, and its application does not require advanced construction skills and tools. In worldwide applications, confined masonry has been used for non-engineered low-rise construction (one- to two-story buildings) and also for engineered construction such as medium-rise apartment buildings (up to six stories high). Basic concepts of confined masonry construction and an overview of global applications have been summarized by Brzev and a comprehensive construction manual was developed by Blondet .



a)


b)

Figure 3. Confined masonry buildings: a) key components, and b) good performance of confined masonry in the 2010 Maule, Chile earthquake (M.O. Moroni Yadlin).

Confined masonry buildings have shown satisfactory performance in the past earthquakes. Buildings of this type may experience some damage; however loss of life related to confined masonry buildings has been insignificant in countries and regions characterized by high seismic risk, such as Latin America. For instance, confined masonry buildings performed very well in Maule, Chile struck by magnitude 8.8 earthquake on February 27, 2010. Figure 3b shows a two-story confined masonry house, which remained virtually undamaged, while the adjacent adobe house collapsed.

A global seismic design guide has recently been developed to promote confined masonry construction in regions of high seismic risk. The recommendations are based on the experience and design codes from countries in which confined masonry construction practice is well established, including Mexico, Peru, Chile, Argentina, Iran, Indonesia, China, Algeria, and Slovenia. The Guide is expected to be a useful resource for design engineers, academics, code development organizations and non-governmental organizations in countries that do not have seismic design provisions for confined masonry construction. Online resources related to confined masonry construction are available through the Confined Masonry Network *(www.confinedmasonry.org).*

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Addressing the Disaster Vulnerabilities of High-risk Communities

Authors: Julie Catherine Paran, Marino Deocariza, Fouad Bendimerad and Jerome Cruz, *Earthquakes and Megacities Initiative*

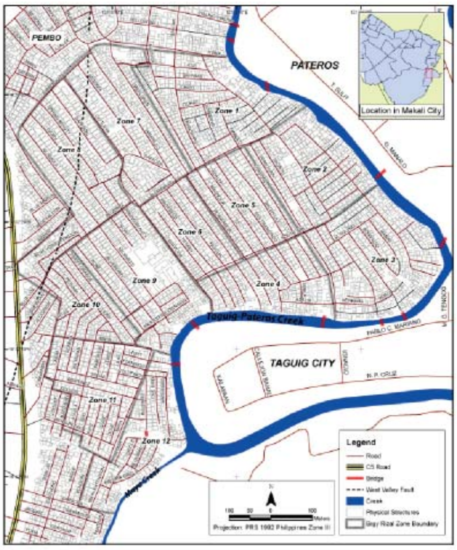

Figure 1. West Valley Fault Traversing Barangay Rizal, © Phivolcs Makati City GIS Division in EMI

***Barangay Rizal** in Makati City, Philippines sits on an active fault, which makes it highly vulnerable to earthquake hazards such as surface rupture, ground shaking, land subsidence, liquefaction and fire following earthquake. The West Valley Fault runs along the northwestern portion of the barangay (Figure 1). According to the Metro Manila Earthquake Impact Reduction Study (MMEIRS 2004), rupture of the fault can cause a magnitude 7.2 earthquake, which has the potential to collapse approximately 40% of the total number of residential buildings within Metro Manila, with 34,000 deaths and 114,000 injuries. Certain portions of the Barangay are expected to suffer serious damage due to ground rupture. Building structures affected by rupture can suffer extensive damage to their foundation and structural framework, which can lead from partial to total collapse. Barangay Rizal is also subject to frequent flooding and other hazards such as fires.*

Figure 2. Bird's-eye view of Barangay Rizal, © EMI

Figure 3. Congested streets and lack of open spaces, © EMI

The physical risk of the area is exacerbated by the area's socio-economic vulnerability. The area is composed of low-middle income households with a large population (about 40,000) and high density and is expected to continue to increase, because of its proximity to the Central Business District. Its physical make-up of congested streets and lack of open spaces make emergency access and evacuation very difficult (Figure 2 and Figure 3). The presence of unsafe buildings and structures and narrow and obstructed roads are the main contributors to the physical risk of the area. There are very few open spaces, which can serve as space for evacuation, temporary shelter, and storage for debris in case of an earthquake or other disaster. The inadequate economic capacity and the presence of highly vulnerable households contribute to the socio-economic vulnerability of the area. Moreover, there is inadequate capacity in terms of emergency preparedness and response.

The Proposed Redevelopment Plan

Reduction of disaster risk and improvement of emergency management capabilities are the driving objectives of the redevelopment plan. The objectives can be achieved to a great extent by the following strategies:

1. **There should be no permanent human settlement** with a "Very High Vulnerability" rating. All structures located on or within five meters from the fault are considered to have very high vulnerability.
2. **Structures with "High Vulnerability" rating** should be further studied to ascertain their vulnerability level. A more competent analysis will be able to determine with higher certainty the actual level of earthquake vulnerability.
3. **There should be a voluntary seismic retrofitting program** for structures rated as High Vulnerability, supported by an incentive package and awareness program.
4. **The acquisition of structures/lots** for open space should be clustered around structures with very high vulnerability to minimize the number of displaced households.
5. **Critical facilities such as schools** (Figure 4) and health facilities as well as structures which can be used for post-emergency centers should be identified and seismically retrofitted or replaced depending on a benefit/cost analysis.
6. **Infrastructure and critical lifelines** (e.g., water, sanitation, power, communication, etc.) should be upgraded for seismic performance as an integral part of the redevelopment plan.
7. **No intervention is planned for structures** with vulnerability of moderate to low. However, households of these structures will be encouraged to participate in the voluntary seismic retrofit program.

Figure 4. Barangay Rizal Elementary School, © EMI

The redevelopment plan proposes the following interventions:

Fault zone park. An easement zone along the fault needs to be established with access roads on both sides (see Figure 5).
The access roads will provide the opportunity to redesign new utility lines and fire protection systems that considers appropriate earthquake motion. Drainage systems will be incorporated to reduce the risk of flooding. Further, the easement can be used as a park, open market, recreational area, playground, parking space, and a community garden. Residents within the fault zone will need to be relocated.
Housing program and pocket open space. New medium density social housing will be provided for the households that will be affected by the redevelopment. The re-housing program should be based on the premise that all relocation will be on-site, i.e., within the Barangay itself.
Retrofit program for high risk structures. A voluntary retrofit program is suggested for structures classified as "High Risk." However, prior to retrofit, more competent structural analysis needs to be undertaken on these structures to ascertain their level of risk considering their construction characteristics and location.

Aside from the abovementioned interventions which directly address physical risk, the following measures are proposed:

Compensation scheme. For those who will be displaced because their existing dwellings are considered to be at very high risk, a compensation scheme that is based on pertinent legal provisions and regulations should be developed.
Incentive program. The voluntary seismic retrofit program needs to be supported by an incentive scheme to favor the engagement of private owners to participate. The incentive scheme can be in various forms such as undertaking all the studies free of charge, providing soft low interest loans, allowing variations in zoning for mixed uses, and others.
Raising Income Level and Improving Economic Conditions. Measures to raise the income and uplift the economic conditions of to reduce the social and economic vulnerabilities include (i) development of neighborhood commercial centers; (ii) development of educational facilities; (iii) formulation of strategic livelihoods and skills enhancement program and (iv) preparation of business and entrepreneurship support program which includes improving people's access to affordable financing and market linkaging.

Other proposed interventions include: the establishment of development controls and density controls, development of an information education communication (IEC) campaign to improve social acceptability of the project, improvement of circulation network and emergency access, traffic management, open space development, disaster preparedness and emergency management and upgrading of critical infrastructure.

Lessons Learned

The project has generated valuable knowledge in terms of both the substantive content and redevelopment planning process for addressing the earthquake risks of a high-risk community. The fact that the project site is virtually all built-up, with small lots and narrow streets, and occupied by predominantly low-income households place extreme limitations on the range of redevelopment options. While the project is a pilot application in a very limited planning area, the methodology used has high potential to be adapted or replicated in other localities.

In spite of the various constraints faced by the project, it was shown that formulating an acceptable redevelopment plan is possible if the planning process is systematic, transparent, participatory and consensus-based. The highly participatory process of exchanging information and ideas was particularly effective in developing consensus and agreements among the stakeholders.

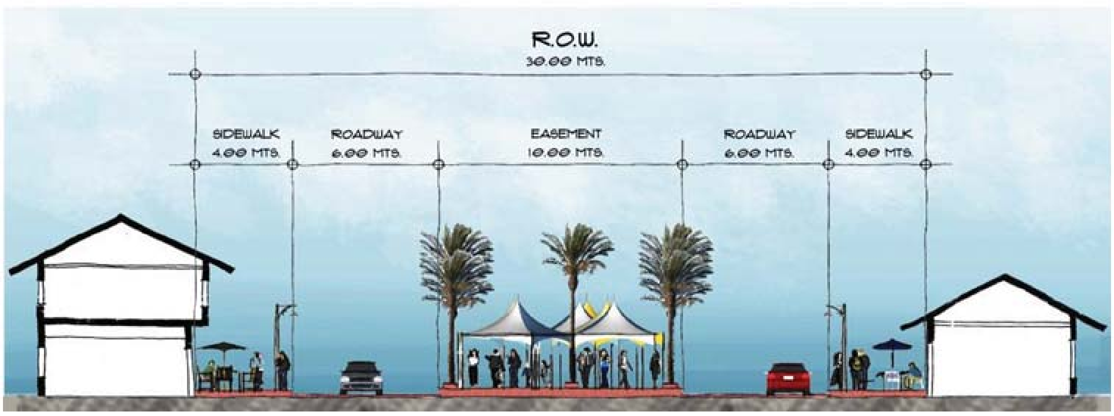

Figure 5. Proposed fault zone park for Barangay Rizal, © EMI

The systematic approach in data gathering, analysis, and presentation at the stakeholder workshops helped significantly in developing a deeper appreciation of the risks that the community faces. A strong multi-disciplinary technical team is needed to collect the detailed data and integrate the many parameters driving the redevelopment while at the same time pursuing the participatory approach. The sensitivity of the City Government representatives and technical experts to the particular culture, socio-economic circumstances, and constraints on the part of the affected households was especially helpful in maintaining a spirit of collaboration and cooperation throughout the planning process.

Figure 6. Stakeholders from Barangay Rizal participate in the Visioning Workshop, © EMI

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Risk-sensitive Urban Redevelopment Plan (RSURP)

The undertaking of a Risk-sensitive Urban Redevelopment Plan (RSURP) of the Barangay was a collaborative project among the Community of Barangay Rizal, the City Government of Makati (CGM), the Earthquakes and Megacities Initiative (EMI) and the Philippine Institute of Volcanology and Seismology (PHIVOLCS). The project involved the preparation of a plan with the goal of transforming the high risk community into a safer, disaster-resilient neighborhood while simultaneously enhancing its urban fabric, economic vibrancy, social cohesion, public safety, and environmental quality. The project demonstrates that land use and redevelopment planning can be powerful tools to lessen the physical, social, and economic vulnerability of high-risk communities.

The RSURP of Barangay Rizal is a part of the project "Mainstreaming Disaster Risk Reduction in Megacities: A Pilot Application in Metro Manila and Kathmandu." The demonstration project aims to enhance the capacities of the two cities in mainstreaming sound disaster risk reduction practices within their governance functions, specifically in land use planning, redevelopment planning and emergency management.

The two-year project was launched in November 2007 and recently concluded in January 2010. The project is funded by the German Federal Foreign Office through the Deutsches Komitee Katastrophenvorsorge (DKKV).

The planning process used a highly participatory and scientific methodology that facilitated a two-way learning experience between the Barangay leaders, residents and the planning team. A single integrated Project Implementation Team was put together including technical specialists and officials from Barangay Rizal and Makati City. Stakeholders were involved in all stages of the planning process, from data collection, validation, problems analysis, visioning (Figure 6), goal formulation, the identification of programs, projects and activities, and the validation and acceptance of findings and proposed redevelopment plan. This helped ensure that the plan reflected all stakeholders' interests, needs and aspirations, which in turn give them ownership and support during the implementation phase.

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1 MILLION SAFE Schools & Hospitals
Make a Pledge, Save a Life.

One Million Safe Schools and Hospitals Initiative

http://www.safe-schools-hospitals.net

When disasters strike, *people in unsafe schools and hospitals are at the greatest risk of harm. The facts bear the truth:*

- *In September 2009, tropical storm Ketsana brought down 42 primary and secondary schools in Metro Manila, causing a damage of USD 1.6 million.*
- *In the same month, a 7.6 magnitude earthquake in Sumatra, Indonesia damaged two private hospitals and affected 270,000 other buildings.*
- *In October 2009, typhoon Pepeng damaged about 30 private and public hospitals and 100 health care centers in the Philippines.*
- *In the 2005 earthquake in Kashmir, India, around 17,000 children lost their lives and 2,448 schools collapsed.*
- *After the December 2004 tsunami, many children in Thailand returned to their classrooms only to find many of their classmates missing.*

Damaged schools mean disruption – if not total loss – of learning opportunities and a decrease in the quality of education delivery. When hospitals and healthcare facilities are destroyed, the treatment of the sick and the saving of victims during disasters become a challenge.

On April 8, the Association of Southeast Asian Nations (ASEAN), the United Nations International Strategy for Disaster Reduction (UNISDR), the World Health Organization (WHO) and other disaster risk reduction advocates launched the "One Million Safe Schools and Hospitals" campaign in Manila, Philippines, to call for hospitals and schools to be safer from disasters. ADPC is one of the organizations which pledge its full support to the initiative. This initiative is part of the Resilient Cities Global Campaign of UNISDR for 2010 and 2011, and builds upon the 2006-2007 Global Campaign on Safe Schools, and the 2008-2009 Global Campaign on Safe Hospitals.

Bam City Reconstruction Experience: Lessons for Urban Scale Reconstruction

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Introducing Bam City

Bam is a small city in south eastern part of Kerman Province located approximately 200 km south-east of Kerman City (the capital of Kerman Province). The main active economic sections in the city are agriculture and gardening. Arge-e-Bam (Bam Citadel) is a historical monument that is 2500 years old. It is located in the northwest part of the city. This monument was an example of a typical Iranian large urban complex of ancient earthen architecture in an arid environment and one of the tourist attraction centers in Kerman Province. Arge-e-Bam was heavily damaged by the 2003 Bam earthquake. The level of destruction was about 70% on major parts of this huge monument.

Figure 1. Bam City location in Kerman Province and in Iran, © Hisada et al. 2005

Figure 2 and 3. Arge-e-Bam before and after the earthquake

Earthquake Characteristics and Damages

On December 26, 2003 at 05:56 (local time), a devastating earthquake of Mw=6.5 occurred in South-West of Bam City. This earthquake caused catastrophic damage to the Bam city and neighboring villages with a collective population of about 142,000. More than 26,000 people were killed, 30,000 injured, up to 75,000 left homeless, and 85% of the housing and infrastructure were destroyed.

Reconstruction Plan

Bam reconstruction was based on a planning process that was the first case in reconstruction experiences in Iran. This planning process was developed from the Comprehensive Plan of Bam City. According to the reconstruction plan to protect the natural environment, historical sites and structures, the least changes should be done in the physical and spatial layout of the city. This indicates that the transportation routes are not widened and the city's social and cultural characteristics should be protected. Therefore, on site construction was the main strategy during reconstruction and relocations were prevented.

Another important feature in this experience was reviving the economy. The agriculture and gardening sectors could rehabilitate quickly due to the existence of palm and orange trees. To rehabilitate the business sector, some projects were defined and about 4,000 commercial units were identified.

Reconstruction Policies

Different policies were considered in Bam reconstruction, such as: (Housing Foundation 2004)

- *Policies on construction management and community participation* - The construction management of damaged houses was assigned to owners and the Housing Foundation was responsible for technical assistance and material provision.
- *Financial policies* - including provision of loans with low rate of interest to construct earthquake resistant housing units, gratuitous aids and public investment in technical services such as debris removal, materials provision, construction supervision etc.
- *Policies on housing square* - based on reconstruction plan approval, financial aids were allocated to construct 80 m^2 in cities and 60 m^2 in rural areas.
- *Policies on production of construction materials* - these policies were based on local sources. So these policies would be applicable for local labor - economically reasonable and environmentally sound.
- *Policies on organizational and bureaucratic matters* - these policies include population distribution in cities and villages, avoiding parallel activities by different organizations and accelerating bureaucratic affairs.
- *Policies on design and planning* - these policies include preserving local designs and standards and restraining any relocation or integration without technical problems.

Executive Organization of the Reconstruction

The main constitution for planning and policy making was "Bam Reconstruction Guiding Task Force". The task force members were the authorities of the responsible organizations. The main activities of the task force were promoting community participation, creating suitable situation for scientific and technical institutes to participate in reconstruction and improving the construction quality in the affected areas.

Four working groups were organized by the task force to facilitate its responsibilities. These working groups were:

- Provision and goal setting for public and donated aids;
- Provision and goal setting for international aids;
- Plan formulating and design making for Bam Reconstruction;
- Organizing Bam provincial reconstruction task force.

Preparing implementation plans

To protect the City's identity, it was decided that qualified consulting companies to be settled in Bam City. These companies prepared the housing plans based on architectural and urban planning standards and considering the residents expectations. About 26,000 plans were prepared for residential and commercial units. In general, 33 consulting companies settled down in Bam City. Some residential units with less damage were investigated to get reinforced and about 1,000 residential and 500 commercial units were reinforced. Some training courses were held for construction employees such as local builders, contractors and welders by the reconstruction task force. (Housing Foundation, 2006)

Reconstruction Challenges

• Earthquake disaster management and damage reduction did not take into consideration of other matters such as socio-cultural issues other than considering distances from seismic faults and permitted land-uses near faults, other issues such as building density, location and the distribution of necessary infrastructures for disaster management like traffic routes, hospitals and rescue-relief stations were not taken into consideration.
• The time frame for the reconstruction, considering the amount of work, was rather short and construction inside the city had many challenges. (Housing Foundation, 2006)
• Purchasing of the private lands located among main traffic routes was another problem. The Municipality approved about $50 million for this purpose, yet the land owners believed that the prices were not based on the real prices in pre-earthquake period. After the event, in some areas, the land prices were decreased due to the earthquake faults and in some other areas far from the faults the prices increased.

Conclusion

The Bam City Earthquake reconstruction experience had to deal with many challenges since urban scale reconstructions are very complicated. There were several positive aspects in this experience such as formulating reconstruction plan, on-site reconstruction and avoiding relocations, protecting the city's layout and its social and cultural characteristics, environmental concerns during reconstruction etc. However, there were some aspects that need to be improved like integrating earthquake risk management along with social matters in reconstruction plans, legal issues and realistic time frame. One of the important parameters in time saving during reconstruction is using local sources in terms of human as well as material, thereby improving the sufficiency of the affected areas and avoids dependency on outside resources. In Bam, unfamiliarity with the affected environment and culture by the task forces members caused delays in reconstruction. Urban reconstruction is a multi-dimensional topic that due to urban environments characteristics has to be implemented in a comprehensive way with action-oriented policies while encouraging community participation and being replicable in the future.

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Preventing Building Collapse
A challenge reminded by recent earthquakes and earthquakes in waiting

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The world experienced *many catastrophic earthquakes in the first four months of year 2010. These earthquakes have impacted both urban as well as rural communities. The last four months we have seen that earthquake events devastating life and economic losses. As I write this article, China prepares to mourn the victims of a strong earthquake in northwest China's Qinghai Province, which left more than 2,000 people dead and several thousands injured and homeless.*

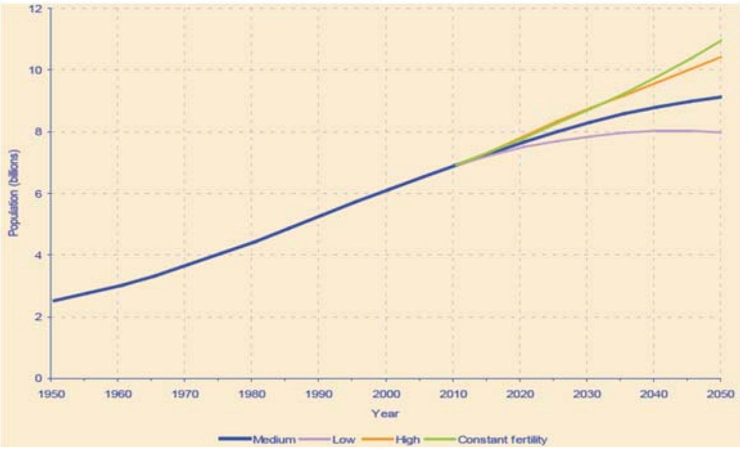
Population Demographics, Construction Boom and Seismic Risk

According to the 2008 Revision of World Population Prospects (Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat), the world population, which stood at 6.8 billion in 2009, is projected to reach 7 billion in late 2011 and 9 billion in 2050. Most of the additional 2.3 billion people expected by 2050 will be concentrated in developing countries, whose population is projected to rise from 5.6 billion in 2009 to 7.9 billion in 2050 (Figure 1).

The rapid increase in global population has raised concerns about the earth experiencing overpopulation and accompanying increase in usage of scarce resources. A major challenge for these countries is to provide basic services, housing/ building, education, employment in the face of less predictable cycles of economic and financial crisis. One of the biggest concerns in earthquake prone regions is the neglect of earthquake resistant design and construction practice in the building boom. The loss of lives due to building collapse following an earthquake is testament that the knowledge of earthquake science and safe construction practice has not reached the people/society. Roger Bilham in his research paper 'Seismic future of cities' mentioned, "I conclude that in the past several decades we have lost an opportunity to build safe structures in the world's rapidly growing urban settlements, mostly in the developing nations, and that as a result, a rising death toll from earthquakes in the next several decades is inevitable."

The conclusion from his research paper and all other papers published and discussed worldwide indicates one thing in common – earthquake resistant construction is essential. Seismology studies have improved and with today's cutting edge knowledge it is possible to be

Figure 1. Population of the world, 1950-2050, according to different projections and variants



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Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (2009). World Population Prospects: The 2008 Revision. New York: United Nations.

better prepared and informed on the basis of long-term prediction (years), short-term prediction (precursory phenomena, days/hours) and instantaneous warning (seconds). Integrated earthquake hazard studies indicate a better forecast of future ground shaking and this can be taken as an advantage to reduce the vulnerability of the built environment and improving the quality of new construction in the region.

Stark contrasts have emerged between technologically advanced (developed) nations and the developing countries. Investment in risk reduction and continuous monitoring and enforcement regime over decades has significantly reduced the vulnerability of the built environment in developed countries. In a rapidly urbanizing world the expansion of the informal construction practice (no-engineered/semi-engineered, including multi-storied buildings) largely goes unaddressed by the national/province and the local government. Evidence from developing countries largely reveals that institutions at all levels are largely failing to address this challenge. This is in spite of advancement in the field of earth sciences, civil/structural/earthquake and specialized branches of engineering, advancement in material science, urban planning, economics, information technology, risk communications etc. The answer to earthquake risk reduction still lies in the "human". Application of strategies in a time bound manner can soothe the complexities of earthquake risk mitigation.

Improving Building Safety: The Shift Towards The Safety Culture

By understanding the socio-economic conditions and the earthquake preparedness knowledge of the communities, it is possible to tailor solutions. Technical disciplines related to earthquake hazard and vulnerability reduction includes experts and professionals for seismology, geology, civil/structural/earthquake engineering, architecture, material manufacturer, insurance, private sector, law enforcement/regulator, economist, urban-regional planner, construction artisan, risk management experts, media, community leaders, public policy among others. As of now in many developing countries, there is a relatively small appreciation among these disciplines towards developing a comprehensive approach to increase earthquake safety.

The distressing images of collapsed homes and mounting number of death toll can be minimized through a holistic application of strategies. Action and Strategies will be needed in number of areas (followings are not in order of importance):

- Building stock data (the Vulnerability Atlas of India 2007 gives a matrix of housing risk tables at the district level. The risk table indicates types of buildings and vulnerability in terms of damage levels from hazards such as earthquake, floods, wind and cyclone). Detail inventories in urban areas will guide to prepare urban protection plans;
- Development of credible loss scenario and expand the scope to model the effectiveness and cost of alternative mitigation strategies;
- Adoption of the scenario planning exercise results by owners and regulators of local government officials that show clearly the consequences of earthquake event as a function of investments in risk mitigation, preparedness, and increasing response capabilities;
- Understand the behavior of the prevalent building systems in a region so as to identify the deficiencies and in order to draw in a techno-financial regime to ensure that new buildings are designed with seismic resistant features and old buildings are retrofitted to significantly reduce life loss and economic loss;
- Delineate the area by hazard zones and allow building in areas of potentially lower hazard. This can be useful for decision-making for protection;
- Reducing densities (existing high risk areas) and limiting densities (new growth areas) is desirable in many ways. The concentration of people in poor building stock represents picture of tragedies in the waiting;
- The training of the building professionals and artisans on codes is the responsible of the Government and only licensed professionals with adequate skills is allowed to practice. The implementation and enforcement lies completely with the local approving body. Building code enforcement/safe construction should be a national priority;
- Continued public awareness is the key to direct and draw the perspective of safety in the construction of buildings;
- It is high time to regulate unsafe construction, extensions to existing buildings and construction of high-rise reinforced concrete buildings without competent engineering design and construction professionals. A formal system of review of structural drawings must be introduced;
- Seismic retrofitting of existing buildings has to begin. It is no doubt a long-haul process, but time is running as no significant effort has been undertaken in developing countries. One common factor can be noticed across all the earthquake prone regions - the time between mitigation (retrofitting of existing buildings) and the next earthquake is getting closer by passing of every second.

All the above mentioned pointers will have to be initiated at the earliest. Solving this problem will require decades of constant engagement and commitment. Building professionals and artisans, social scientists, public policy experts among others will have their part to play in developing better understanding of the problems, options and solutions. We cannot afford to ignore the large building stock, which is seismic deficient by design and the people living in these buildings. Closure to this article is best provided by what Seismologist Roger Bilham mentioned during his visit to Haiti "In my visit to the region in the weeks after the earthquake, the reason for the disaster was clear in the mangled ruins — the buildings had been doomed during their construction. Every possible mistake was evident: brittle steel, coarse non-angular aggregate, weak cement mixed with dirty or salty sand, and the widespread termination of steel reinforcement rods at the joints between columns and floors of buildings where earthquake stresses are highest". He went ahead to say that, "**In recent earthquakes, buildings have acted as weapons of mass destruction**".

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Converting Adversity into Opportunity: Integration of DRR in Reconstruction for the Sustainable Development In October 2005 Earthquake Affected Areas, Pakistan

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1. Introduction

The October 2005 earthquake that struck the northern parts of Pakistan was the most devastating natural disaster to affect the nation. It made colossal damages by killing over 73,000 people, injured over 128,000, over 5,000 educational facilities destroyed and killed over 18,000 children, 600,000 houses destroyed and rendered 3.5 million people homeless in an area of 30,000 square kilometers rugged mountainous terrain. A reconstruction bill of over 5 billion USD was left behind for the nation.

The Government of Pakistan established the Earthquake Reconstruction and Rehabilitation Authority (ERRA) on October 24, 2005, to undertake the colossal task of reconstruction and rehabilitation. The idea behind the creation of ERRA was to unify and integrate all efforts and activities, pertaining to post disaster reconstruction and rehabilitation in the quake affected areas of both AJ&K and NWFP. Since its establishment, the Earthquake Reconstruction and Rehabilitation Authority has been committed to its primary mandate of policy planning, financing, project approval, and monitoring and evaluation of the reconstruction and rehabilitation efforts, besides coordinating and facilitating the implementing partners across the affected areas. ERRA is working in twelve priority sectors and three cross cuttings programs which include Hard Core Sectors Housing, Education, Health, Water and Sanitation, Governance, Power, Telecommunication and Transportation, Soft Core Sectors Livelihood, Social Protection, Environment, Tourism & Cross-cutting Themes Disaster Risk Reduction, Environmental Safeguards and Gender Mainstreaming. DRR being one of the cross cutting program, is duly reflected in all sectors of ERRA's reconstruction and rehabilitation efforts.

Figure 1. Destruction in Muzaffarabad City

2. ERRA's Risk Reduction Interventions for Sustainable Development

At the very outset ERRA made the resolve to build back the affected communities better and reduce their vulnerability by adopting risk conscious and multi-disciplinary stakeholder approach in all sectoral strategies. The authority seized the prevailing enabling environment for integrated risk reduction program as donors were willing to support, government was responsive and implementing partners were eager for collaboration, and more importantly the communities were sensitised and receptive. ERRA integrated disaster risk reduction in all its reconstruction efforts and strived to convert the adversity into opportunity by reconstructing the lost and destroyed facilities following highest standards of reconstruction methods with the motto "**Build Back Better**" for the sustainable development in the nine earthquake affected districts in North West Frontier Province and Azad Jammu & Kashmir.

2.1. Land use Planning

Land use planning is critical for development planning, through which use of land is regulated for its effective utilization. Seismic micro-zonation was carried out in the selected urban centres. International experts were also involved to ascertain the vulnerability of the affected area. As a result of such surveys Balakot town (old city) was declared unsafe (red zone) and a new Balakot city is being developed to relocate the highly vulnerable population.

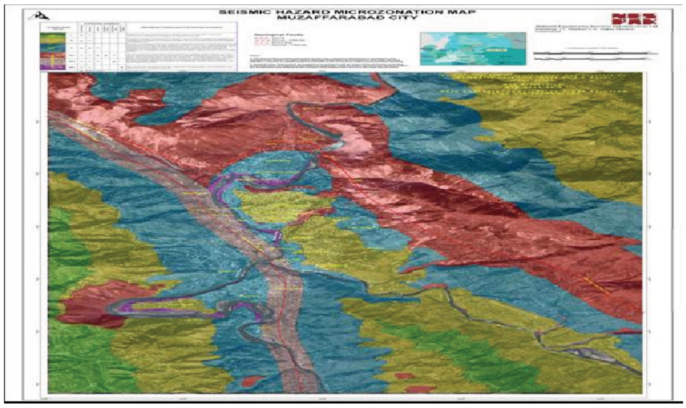

Figure 2. Seismic micro zonation map

ERRA made a broad policy for public buildings that no public facility, particularly education and health facilities would be constructed falling within 100 meters on either side of the known fault lines.

2.2. Integration of DRR in Planning & Sectoral Linkages

2.2.1. Housing Sector

ERRA has focused on seismically resistant construction techniques in the target area. Land use planning and zoning techniques were employed for urban development. ERRA formulated building codes & designs for seismic resistant construction. Manuals, reading materials, seismic resistant design sketches, leaflets posters and other awareness raising material developed and made available to public.

Figure 3. Seismic resistant rural house

To ensure seismically resistant reconstruction of rural houses, the payment of installments of housing grant was linked to compliance with seismically resistant construction standards.

2.2.2. *Awareness Raising and Capacity Building*

Figure 4. Seismic resistant rural house

ERRA has conducted a series of programs to create awareness among the affected population to construct seismically resistant houses. ERRA has built local capacities in the construction of seismic resistant housing. Over nine thousand persons from a cross section of the society were trained and Housing Reconstruction Centres (HRCs) established.

2.3. *Initiating Disaster risk Management Program*

ERRA initiated a Disaster Risk Management Program as part of preparedness for the local communities and government officials. The program comprises three components addressing the requirements of HFA priority actions.

a.Assessment and mapping
b.Mainstreaming DRR
c.Community Based Disaster Risk Management (CBDRM)

2.3.1 *Assessment and Mapping*

Information about prevailing hazards in the target areas is the prerequisite base line information for disaster risk management i.e. reducing existing risks and avoiding build up of new risks by identifying the conflict areas between hazards susceptible location and built environment in the entire districts. In conformity with the HFA Priority Action-2, assessment of most frequent and common natural hazards such as landslide, debris flow, floods and snow avalanches are taken into account and hazard susceptibility maps are produced through different modeling (numerical and disposition modeling) techniques.

2.3.2. *Mainstreaming Disaster Risk Reduction*

Figure 5. Landslide stabilization techniques

To ensure disaster risk conscious development interventions, district development planning processes were evaluated and project planning documents were reviewed. For integrating DRR in development process a checklist has been developed as part of development planning. A guidebook for mainstreaming DRR for thematic sectors has also been compiled under this program. This component addresses HFA Priority Action 1.

2.3.3. *Community Based Disaster Risk Management*

Considering the vulnerability of the country to a multitude of hazards, it was considered important to implement the HFA priority action-5. In this regard ERRA initiated a Community Based Disaster Risk Management program (CBDRM) in the target districts. Disaster Management Committees and Response Teams are established in the union councils and so far trained over 10,000 community volunteers and government officials of line departments in basic response themes i.e. crisis management planning, mainstreaming, hazard vulnerability capacity assessments, information and communication, search and rescue, first aid, fire fighting, administration and logistics. Besides, a number of response and relief items are provided to District Disaster Management Authorities (DDMA) and at each union council to strengthen the response capacities of the local governments.

Figure 6. A union council Response Team

2.3.4. *Gender Considerations*

Keeping in view the role of women in disasters, an effort was made to ensure women participation in union council level disaster management trainings. During social mobilization there were some obstacles like cultural, socio-economic and religious against women participation. Nonetheless, our trainers were successful in winning the confidence and trust of the communities to encourage female participation. They were informed that in emergencies women are more vulnerable and sustained injuries. Women need to be trained in disaster management for attending to women casualties.

3. Conclusion

ERRA's mandate was not an enviable one; in the sense that the organization did not have the luxury of time for establishing, developing to maturity and then undertaking the assigned responsibility. ERRA was required to deliver from the day the Government of Pakistan decided to establish it, as the inflicted communities needed immediate succor and could not wait. One of ERRA's former official aptly described the situation as "we were running and at the same time tying our shoe laces". Nearly four and half years later when we reflect at ERRA's performance, the feeling is that of assurance, satisfaction and achievement. The one single factor for this success is the wisdom in ERRA's institutional development. ERRA is a dynamic and vibrant institution which draws its human resource from multi sectoral back ground that combines a wealth of knowledge and experience.

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Structural Assessment of Heritage And Non Heritage Buildings In Old Dhaka

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Abstract

Dhaka, the capital of Bangladesh, is one of the most densely populated cities among the developing countries. Despite rapid urban growth in Dhaka, there is a problem of general neglect of systematic urban environmental management. Like most cities of the developing world, Dhaka is a poorly managed city, which leads to the deterioration of urban living conditions, especially in the housing sector. Government tried to cope with the situation, but could not be successful. Many of the city areas are congested and comprise with old and vulnerable buildings. A large number of people are living in these vulnerable buildings with high risk to their live and properties. For example, eight people died in 2004 when an old building collapsed at Shakhara Bazar in old Dhaka. Considering this reality, Town Planning Department of Dhaka City Corporation has taken initiative to assess the old and risky buildings at Shakhari Bazar and Biren Bosh Street Dhaka City Corporation area.

This paper depicts the vulnerability of selected 113 buildings in Ward no. 66, 72 and 73 of Dhaka City Corporation.

Study Goals

The main objective of this study was to identify the vulnerability of selected 113 buildings in ward number 66, 73 and 73. It also aims to categorize the buildings in accordance with building vulnerability.

Methodology Adopted For Structural Vulnerability Assessment

Several Protocols provided by Federal Emergency Management Authority (FEMA 310, 1998) were used for evaluating structural vulnerability of the buildings in this study. First of all, building structural as well as the architectural types had been identified. The load transfer mechanism of the buildings had been determined. Level I and level II survey of the building were done to identify the basic vulnerability factors such as soft story, heavy overhang, pounding possibility etc. Then with the help of Turkish and Rapid Visual Screening (RVS) method (ATC-21, 1988) the strength score of the building was generated. After that, with the help of ground floor plan, structural check was done. From the rapid visual screening method detailed level of assessment requirements had been identified. Among the 113 buildings 97 buildings did not satisfy the score; hence most of the buildings were undertaken for the detailed assessment. For detailed assessment of buildings FEMA 310, FEMA 356 and the modified Turkish method were adopted in this study (Rai Durgesh C. 2005).

Level-1 survey *Level-2 survey*

Figure 1. Level-1 and level-2 building surveys

The soil class D was used for seismic vulnerability score generation in Rapid Visual Screening Method Ref. "Seismic Hazard Map of Dhaka City" – a recent completed project under Comprehensive Disaster Management Program (CDMP) of Ministry of Food and Disaster Management of Bangladesh Government. For assessment of the buildings several steps were followed. These include level I and Level II building survey, share test for measuring the strength of mortar, and consideration of soil type of the area. Figure 2 shows the outline of the steps followed during the study.

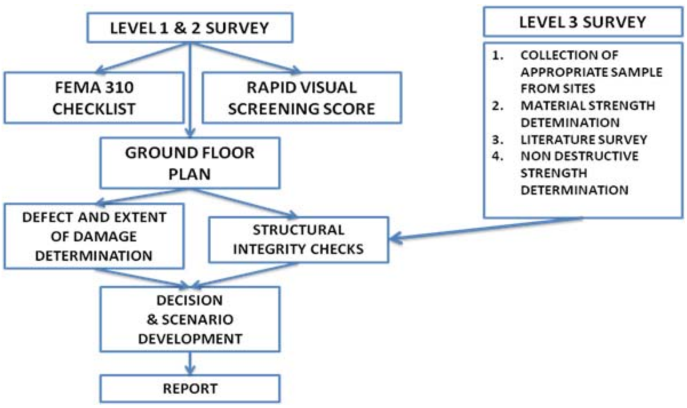
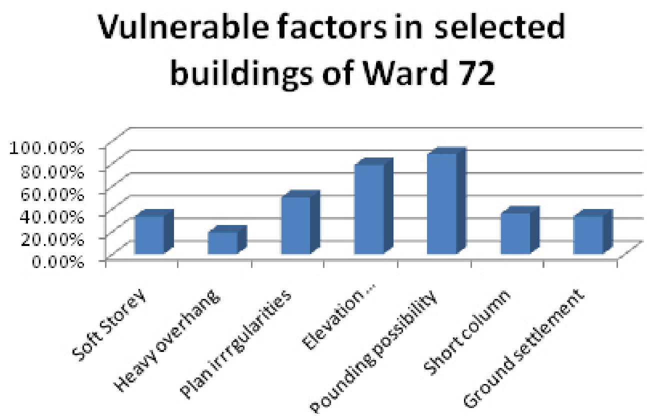


Figure 2. Outline of the Methodology followed.



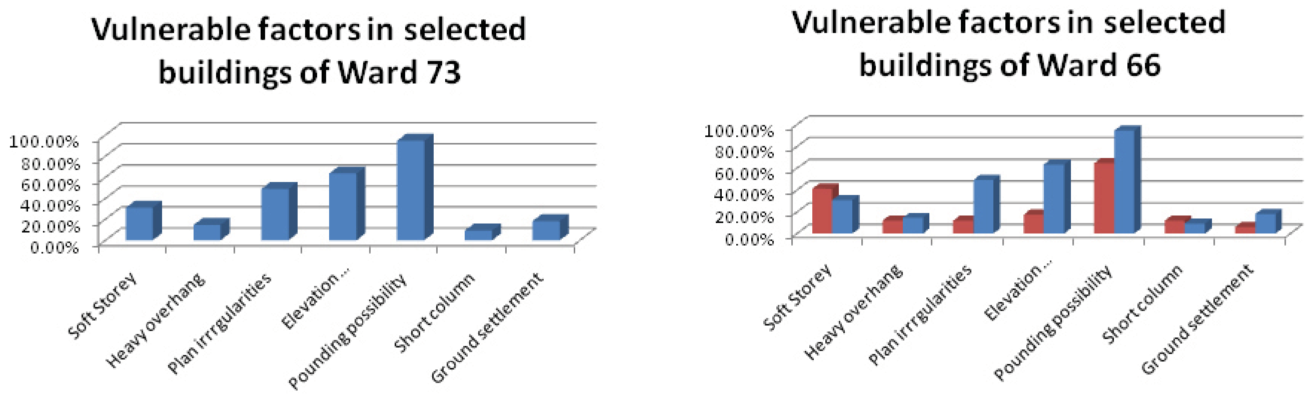


Figure 3. Vulnarale factors of selected building in 3 different wards of Old Dhaka

Summary of the Outcomes

Among the surveyed buildings both in Shakhari Bazar & Biren Bosh Street, about 81% are of Unreinforced Masonry (URM) and 19% is Reinforced Concrete (RC) . In Shakhari Bazar, 86% of the buildings are URM. On the other hand, in Biren Bosh Street, about 56% of the surveyed buildings are URM rest are RC structure. In this area, many of the old buildings were constructed within last two to three decades. About 76% of the surveyed buildings are more than 150 years old and owned by individual and these buildings are constructed on limited area. About 61% of the surveyed buildings appear to be poor in quality assessment. About 28% of the buildings are in average condition since these were repaired time to time by the owners.

Several structural features are considered to be the factor affecting vulnerability of buildings. These factors include (1) soft story, (2) heavy overhang, (3) short column, (4) pounding possibility between adjacent buildings, and (5) visible ground settlement. During this study, in the selected buildings a number of vulnerable factors were identified that are briefly discussed below.

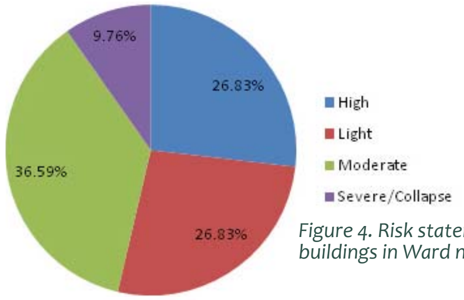


Figure 4. Risk statement for surveyed buildings in Ward no. 72

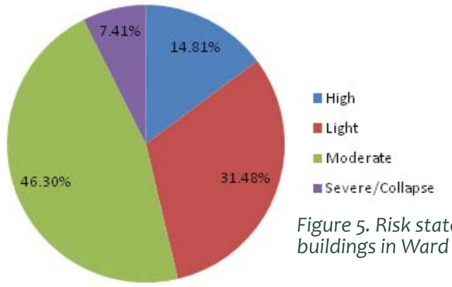


Figure 5. Risk statement for surveyed buildings in Ward no. 73

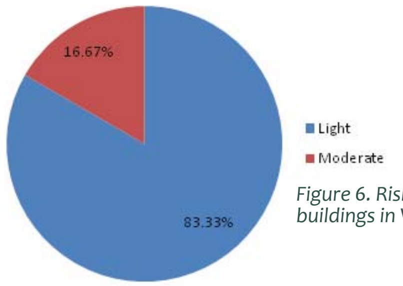


Figure 6. Risk statement for surveyed buildings in Ward no. 66

Conclusion

From the assessment, it was evident that many of the buildings in Shakhari Bazar area are under high to severe risk. There are serious lacks in maintenance of buildings by the owners. Among the surveyed buildings in Shakhari Bazar of Ward 72, about 27% buildings are within high risk group where as for in ward 73 of Shakhari Bazar, high risk group is about 15%. For Biren Bose Street of ward 66, the risk is mostly moderate and light. Many of the buildings have not satisfied the minimum required score developed in this project. Since then, some buildings have been declared as the heritage building, seismic retrofitting is the recommended technique to minimize the earthquake effects.

To minimize the economical impact on owners of having to rehabilitate their buildings, the Bangladesh Government should implement phased programs such as prioritizing the critical items, monetary compensation to the owner etc. Followings are the key elements included in a typical rehabilitation program:

(a) Extra Stories of the building should be demolished and the building should be restored to original shape and storey.

(b) Some extensions constructed by the owner recently such as the heavy overhangs or cantilevers should be demolished.

(c) According to the assessment result, height to thickness ration is the most governing issue to be addressed for the retrofitting options. In cases when the height to thickness ratio of the walls exceeds the limits of stability, rehabilitation consists of reducing the spans of the wall to a level that their thickness can support.

(d) For gravity load, Shakhari Bazar is most vulnerable, hence immediate remedial measures should be provided for the study area with priority to Shakharibazar area.

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Re-Orientation of Disaster Management Plans in Asian Countries in View of Recent Earthquakes in China, Haiti and Chile

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The present decade could be aptly described as a disaster decade. There have been a number of large mega geo events such as Sumatran Earthquake of magnitude 9.3 on December 26, 2004, destructive earthquakes in India (Bhuj earthquake of January 26, 2001), Pakistan (Kashmir earthquake of October 08, 2005), and China (Sichuan earthquake of May 12, 2008). About half a million lives have been lost in these disasters.

Each earthquake has a different signature, and each earthquake teaches something new. It is the duty of earthquake researchers that the lessons learnt from these seismic contingencies should be scientifically studied, analyzed and significant inferences and conclusions should be taken to the common man with a view of increasing the seismic safety of the society in general and human lives in particular. It is a fact that despite several laudable researches in the fields of earthquake and disaster managements, it has not been possible to save a single life during any earthquake. The hind-casting exercises of above earthquakes have shown a number of reliable seismic precursors. The situation appears to be moving in skew directions. On one hand, scientists have been coming forward with sufficient degree of confidence about reliable seismic precursors. On the other hand, the disaster management experts vehemently say that earthquake cannot be predicted. The result is more concentration of equipment, instruments, and remedial measures during the post-seismic period by the disaster management offices. Unfortunately, it could be observed that the present disaster management plans almost do the work of clearing of debris and corpses during the post-seismic periods. **Apparently, no work is being undertaken during the pre-seismic periods. This has to be changed immediately. It is essential that new policies have to be formulated. These have to be based on the lessons learnt from various earthquakes.**

The Sumatran earthquake was perhaps the most powerful earthquake in this century. Some post-seismic hind casting exercises have given new findings. The Sea Surface Temperature (SST) of the area above the Epicentral region was higher by about 3.0° to 4.0° C for about a week or so before the occurrence of earthquake. The SST is available from various satellite pictures. A watch could be kept on different seismically vulnerable locations on land and sea. After this event, a number of computer generated models have been developed in various countries. Most of these models give with sufficient precision details about the time the tsunami waves would take to reach a particular coastal region. Efforts should be made to calculate the likely locations of nodal and anti-nodal points of the tsunami waves on the coast. This would help in identifying the most vulnerable coastal region.

The Bhuj earthquake of January 26, 2001 in India and the Kashmir earthquake of October 08, 2005 have shown the likely damaging effect of Rayleigh waves from large magnitude earthquake. The Rayleigh waves which are long period waves (period 12 to 18 seconds) from a large earthquake of magnitude more than 7.0 to 7.5 have a special property. These waves adversely affect tall structures, height more than 17 m, situated beyond distance of 150 km and less than 550 km from the epicenter. Such a phenomenon was observed for the first time during the Mexican earthquake of September 1985. Mexico City is located at a distance of about 550 km from the magnitude 8.0 earthquake. Only tall structures in Mexico City (h > 17 m) have suffered heavy damage while structures with one, two or three floors did not suffer any damage or the damage was almost minimal. During the Bhuj (India) earthquake, tall buildings in Ahmedabad City located at a distance of about 320 km from the epicenter have suffered heavy damage. During the Kashmir (Pakistan) earthquake a ten-story building in Islamabad, situated at a distance of about 150 km from the epicenter, had totally collapsed. Keeping in view of these field observations, it would be necessary to draw a new vulnerability map of Asian Cities with high sky line. If the areas within about 550 km from these locations could generate magnitude 7.0 or more earthquakes then the tall structures need to be protected from Rayleigh waves.

It was widely reported that prior to the Wenchuan (Sichuan) earthquake in China, a large number of toads were leaving ponds and roaming on road. The abnormal animal behavior (which cannot be explained within the presently established scientific framework) should be accepted as a reliable seismic precursor. Recent research in US has shown that the number of charged particles in atmosphere increases several times than the normal. The excessive charged particles could be a likely reason for the abnormal behavior. A few researchers had informed the Chinese Government about the likely occurrence of a massive earthquake in Wenchuan (Sichuan). But these forecast and forewarnings were not taken seriously and it did not receive the desired attention.

The Haiti earthquake has given two most significant observations. It is well known that prior to the occurrence of moderate to large earthquake, the changes in the geomagnetic field adversely affect the propagation and reception of radio waves in the potential Epicentral area. This effect is known as ‘Seismo-Electromagnetic Effect’. About a day before the occurrence of Haiti earthquake, the radio communication was heavily obstructed and at times blocked. Another observation from Haiti is about disaster management. At a number of locations in Haiti, houses are located on hill slopes and hill tops. There is only one road connecting various hills and houses are built on either sides of the road. During the earthquake the available single road was blocked due to landslide or fall of houses and the entire road was blocked. As a result, the medical team, rescue team and earth moving equipment could not reach the required point. This had caused more damage. There are a number of towns and cities in various Asian countries, having similar situation in the hilly region. In case there is only one single road connecting most of the localities, then suitable provision for alternate route or by pass route should be made to avoid blockade of roads.

The Chile earthquake was not preceded by large number of foreshocks. This is somewhat unusual. There is an interesting story about the foreshock of previous large magnitude earthquake of 1960. The May 22, 1960 Chile earthquake of magnitude 8.7 was preceded by two foreshocks. One of magnitude 7.0 and the other of magnitude 7.5. Everybody thought that magnitude 7.0 is foreshock and the 7.5 earthquake is the final seismic event. But both the earthquakes were foreshocks of the very large magnitude earthquake of magnitude 8.7 on 22 May 1960. These observations are interesting. At present, the matter is under study and some interesting observations would emerge. If everybody should learn and educate himself from the observations earthquake it would be possible to mitigate the earthquake disaster. The **ultimate aim of disaster management should be saving of human lives.**

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Reconstruction of Schools and Basic Health Units

by the Swiss Agency for Development and Cooperation – Humanitarian Aid Section (SDC-HA) in the earthquake affected area in Districts Mansehra and Battagram, NWFP, Pakistan

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On October 8, 2005, *an earthquake with magnitude 7.6 on the Richter scale, the most devastating for a century in the region, destroyed entire cities and villages in Azad Jammu Kashmir (AJK) and in the North West Frontier Province (NWFP), leaving more than two and a half million people homeless. Officials reported a death toll of more than 88,000 deaths and over 100,000 injured.*

The earthquake's impact was spread over an area of 27,000 sq. km. In five districts of NWFP and four districts of AJK, public buildings, private housing, infrastructure, social services, livelihoods and businesses were largely damaged or destroyed. Even today, the rugged geography of the affected areas, combined with scattered settlement pattern, pose significant challenges for both humanitarian and reconstruction efforts. A high proportion of the schools were completely destroyed or severely damaged. According to official figures by Earthquake Reconstruction & Rehabilitation Authority (ERRA) of the Government of the Islamic Republic of Pakistan, 2,766 schools would need to be totally or partially reconstructed in the North West Frontier Province alone.

Following the relief operations, SDC-HA committed itself to assist the Government of Pakistan (GoP) in activities beyond Emergency Relief in the Districts of Battagram and Mansehra in NWFP. One of three basic action lines carried out through the Reconstruction and Livelihood Program (RLP) was the reconstruction of public infrastructure, in particular of Schools and Basic Health Units (BHU) in the two Districts. The school project was specifically referred to achieve universal primary education and eliminate gender disparity in primary and secondary education. All reconstruction and rehabilitation programs in the earthquake-affected area were guided by the national strategy of "BUILDING BACK BETTER" and are coordinated by ERRA. ERRA has acknowledged that the structures built through SDC-HA commit the highest standards in terms of earthquake resistance, quality and durability.

Figure 1. Governmetal Primary School in Goray Pher, © SDC

The school, design based on a modular design, was developed by the University of Engineering and Technology (UET), Peshawar and has passed SDC-HA's internal quality check. The Earthquake Engineering Department of the UET has been recognized as the leading institution in developing structural standards, model designs and building codes in Pakistan. UET continues to provide its consultancy services for the design/approval stage during the program implementation. Through the Consultancy Cooperation agreement between UET and SDC-HA, the project was able to further improve and to document and disseminate earthquake resistant construction standards as well as to promote adequate building technologies and methods. All agencies engaged in the reconstruction process work under the overall strategy and guidance of ERRA through a MoU (memorandum of understanding). ERRA retains the authority on decisions for allocation of building sites to donor agencies and issues NOCs (no objection certificates) once the location specific designs are approved. NESPAK, a semi-public Engineering Consultant Company carries out the hazard assessment and approves the technical and structural design.

The assessment of the Disaster Risk Reduction (DRR) potential of this project is carried out according SDC's guidelines on DRR, and responds to the following key criteria:

- The schools reconstruction is carried out within a high-risk earthquake zone. The structural design is based on a ground acceleration of agd=3.2m/s2 thus complying with international standards. Following the current rules of schools architecture in the area, the earthquake safety factor is further considered by constructing only single-storey buildings and concise shape.
- The hazard risk assessment is carried out site-specific for each location and is based on desktop data (location of hazard zones, fragile fault lines etc.) as well as field inspection on site (e.g. landslide prone area).
- The risk of students exposed to the consequences of an earthquake is minimized through behavior change and knowledge trained in lectures.
- Aspects to natural resource management are considered by using locally available material, use of the same size of land available pre-earthquake, provision of rainwater catchments, septic tanks, soak away pits and use of locally adapted construction methods.

One of the guiding principles of ERRA is that all stakeholders are involved during planning, implementation and construction, while selecting the sites and setting of priorities. Special emphasis is placed on community integration with the aim of fostering ownership of these infrastructures.

The presently approved modular design, quality and standards conform to UNICEF standards and international common practice. Jointly with the respective Department and ERRA the school sites are identified following a set of criteria, e.g. pre- and post student enrolment, previous existing structures, accessibility, requirements, feasibility etc. A balanced selection in respect of girl/boy schools ratio and geographical coverage are considered and coordinated with other implementing agencies. Emphasis is given to primary school and girls' education. Transitional or prefabricated structures are not part of SDC-HA's projects objectives as the commitment is made to build permanent and solid "Brick & Mortar" buildings with construction methods adapted suitable in the region.

The actual construction activities of the first phase started early October 2006. The staged implementation was based on the fact that experience needed to be gained and included in the subsequent phases.Up to date 19 schools and five Basic Health Units -funded by SDC-HA-, are completed in addition to one school funded by PWA Swansea and 42 funded by UNICEF. With this result UNICEF recognizes SDC-HA's implementation capacity, the quality and the technically excellent standards of the structures. This partnership led DFID to mandate SDC-HA for 14 schools as well.

Aim of the project/program will be the construction of total 91 schools by the end of 2010 or, to meet the requirements of about 12,800 students in 320 class rooms. The quota of female students, -128 class rooms allocated to 5,120 female students-, lays significantly above the average found in NWFP. The live span of the low maintenance schools is 50+ years. An average size school with three to five classrooms is completed within six to seven months depending on site access, weather conditions and the contractor's capacity.

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Lessons from the Reconstruction of Houses in Aceh after the Tsunami of December 26, 2004

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Note: This is an excerpt of a paper written 4 years after the December 26, 2004 Tsunami by Teddy Boen and that this paper is part of a series of papers written earlier as indicated in the references. It is thought that maybe what was written could prevent similar mistakes during the reconstruction of houses in other earthquake stricken areas.

Almost 4 years *after the December 26, 2008 tsunami in Aceh, it can be said that the quality of constructed houses is still poor. The reasons which caused poor reconstruction, among others, are following:*

1. Needs Assessment and Site Specific Information

Needs assessment is a statement of what needs to be done. It is a prerequisite for the success of any reconstruction. They must have appropriate and timely information about what has happened, what needs to be done, and what resources are available. One of the important components in the needs assessment for a reconstruction is in-depth study of the site specific information, local wisdom and expertise. The reconstruction strategy should be localized and site-specific as far as possible. Economic, environmental, social and cultural factors must all be taken into account when developing disaster risk mitigation strategies and solutions must be anchored in the prevailing circumstances of local situations. A detailed and accurate disaster assessment is a very important factor for a successful planning and execution of the rehabilitation and reconstruction. Such assessment is expected to produce reliable data of beneficiaries of houses such as: to which target group they belong; numbers of IDPs eligible for the program at the transition stage as well as the long term; number of persons who do not possess land and are permanent evacuees; the suitability and availability of site for relocation; the availability of the resources (human, material and fund) necessary to carry out such a huge undertaking, namely building thousands of houses within a very short time span. All those data is vital prior to commencing the actual reconstruction. In Aceh, within six months after the tsunami, many foreign "experts" introduced all sorts of house types which are not the prevailing practice and many are culturally unacceptable.

Figure 1. Lack of need assessment caused many houses that were ready were not yet occupied.

2. Directives from the Authority

Any successful reconstruction needs a capable authority with strong leadership that can provide clear directions and requirements concerning the type of buildings and the standards to be followed from the onset. The approval/ permit system must be strictly enforced and all parties (Government, NGOs, and other organizations) involved in the reconstruction of houses should provide continuous qualified technical assistance and inspect their respective works on a consistent basis.

In developing countries, if earthquake resistant design codes exist, they have been adopted by some larger cities only and very few if not any have been adopted and enforced for smaller cities and rural areas. Also most codes are incomplete; almost no standards have been developed for non-engineered buildings. Past experience showed that in developing countries, unfortunately, most earthquake disasters occurred in rural areas, thus affecting non-engineered buildings. Codes are also designed to regulate new developments and not the repair, retrofitting, and strengthening of existing and/or damaged buildings. In other words, the minimum standards contained in the codes are meant to build new buildings or rebuilding totally damaged ones and do not address the issue of repair and strengthening, the most common situation with most buildings after an earthquake disaster. This is one of the main reason why no provisions to prevent future losses are taken into account after an earthquake disaster since people has no understanding and is not aware about repair, retrofitting, and strengthening methods.

3. Differentiation between Emergency Shelters, Transition and Permanent Houses

Figure 2. "Temporary/ transition" houses become permanent. Pictures were taken at the end of November 2008.

Reconstruction of houses after a disaster must be planned within the overall context of phases from emergency shelter to durable solutions. Immediately after the disaster, displaced people moved to emergency shelters provided by the government and NGOs. They will soon be shifted to transition houses until permanent housing can be built. Differentiation between emergency shelters, transition houses and permanent houses shall be made.

In Aceh, in the early stage of reconstruction, several NGOs did not differentiate type of houses between immediate shelter needs (which were already built by the government); medium term/ transition houses and permanent houses (which are appropriate to restore their livelihood).

Therefore, in the early stage, many of the houses already built were of the transition type but built on permanent former lands belonging to recipients. Many of those "temporary/ transition" houses become permanent and the final reconstruction stage failed to materialize. The need for "permanent" housing was in part reflected the large amount of funding available and was articulated in terms of reconstruction rather than the recovery. This leads to a focus on physical construction, rather than how the process of rebuilding can lead to economic activity and the role than shelter plays in meeting needs and allowing families to return home and carry out their livelihoods.

Also no phase construction which will allow phasing of occupancy is observed. Usually phase construction is adopted to construct transition houses on the site and allow early occupation while the permanent houses are being constructed. Programs to provide semi-permanent shelter sought to provide this assistance, quickly and economically but were superseded by the demand created for "permanent" housing, and affected by poor quality timber.

4. Influx of Local and Foreign "Experts"

In major disasters, developing countries are often offered and accept large amount of technical assistance as foreign aid and most of the time such assistance may not be linked with the actual needs of the disaster victims.

In Aceh, the lack of immediately available site-specific information is coupled with the influx of many so-called "experts" (local and foreign) offering an endless number of earthquake resistant building type "solutions" causing unsatisfactory results. Most of those "experts" lack technical capacity and a clear understanding of the local building culture and the social order of the community as well as the ability to adapt disaster resistant techniques to local styles and situations. Many NGOs ended in trying to "re-invent the wheel" by introducing house types defying the local culture. It is not advisable for experts to try to "teach" local people, but instead they must try to absorb and understand the local wisdom regarding why it was done the way it is. Having understood the local way of thinking, experts must try to facilitate locals in among others making their houses earthquake resistant but without introducing abrupt changes or use new "alien" materials. The "experts" need to draw upon the past knowledge and practice of that area and try to incorporate their expertise and latest developments to develop an appropriate, doable solution to ensure that their reports and works are meaningful and also useful.

5. Alien Type of Construction, Culturally Inappropriate and NOT Sustainable

The trouble with most of the "imported solutions" is that the buildings last only as long as the fund is still available. The village people learn how to fit up the alien buildings, but as soon as the free materials stop arriving, the village people are as badly off as ever – except, of course, for the buildings they already have. The point is that they can not employ the skills they have learned because they can not afford the materials. "Alien methods", in fact, merely succeeds in giving the village people an illusory feeling of progress and superiority while tempting them into the most frustrating blind alleys, a sophisticated trade that will inevitably be shut to them a short time later. In Indonesia, disaster victims rely more upon family, neighborhood, friends, and other local coping mechanism and such mechanism must be encouraged and supported.

6. Main Target is Numbers and not Quality

At the onset of the reconstruction of houses in Aceh and Nias, one of missions of Indonesia's Reconstruction and Rehabilitation Agency (BRR) was community driven or community based reconstruction. Basically, community based construction is a bottom up model: beneficiaries are involved, jointly with the professionals, in planning and implementation. They are engaged in decisions about the project through discussions among themselves and professionals. Within the community there will be a range of experiences, skills and resources among the beneficiaries. The ideal is for each to participate according to his or her special abilities. In reality, however, not all will contribute, and, in most communities, the collaboration with professionals will be largely left in the hands of representatives or local leaders.

One year after tsunami, I have suggested to go beyond numbers for the reconstruction of houses and to concentrate on the technical as well as quality of the houses. However, until today (almost four years after), the main target is still numbers and not quality.

Figure 3. Site engineering construction activity did not run parallel with the site layout planning. All pictures were taken at the end of November 2008.

7. Site Development and Infrastructure

The other important aspect in the reconstruction of houses process is the planning of site engineering design and infrastructure such as the drainage, the arrangement of access roads and foot paths, provision for sanitary facilities, provision of water supply and utilities. It must run parallel to the planning of the site layout and must be constructed during the site preparation stage. However, in Aceh, almost four years after, the engineering design still was left out.

8. Mis-interpretation of Community Based Reconstruction

Local communities will need to be actively involved in planning, decision-making and implementation in most sectors if reconstruction is to be successful. Experience with disaster reconstruction all over the world has shown that community participation is a fundamental requirement that helps in reducing trauma, ensuring appropriate solutions, equity, community ownership, transparency and accountability. It will also be essential to set up a fair and accessible grievance redress system. Basic safety regulations must be developed within the context of community based construction and this is a challenge for technicians: closing the gap between communities based and safe structural methods is a priority. Only thereafter one can expect to build a safe but affordable building. Participation stimulates self reliance, because, people who participate in their own house building, will be confident about problems and less dependent on outside agencies.

9. Core Housing, Building Completion and Further Extension

Core houses are frequently introduced but seldom really understood. Many architects working for NGOs as well as World organizations were suggesting that the 36 m2 house should be considered as a core house that can be extended by the beneficiaries at a later date by the beneficiaries. Such opinion becomes very common in Aceh and Nias, while in fact, in earthquake prone countries like Indonesia, it is not advisable to encourage beneficiaries to extend their houses unless the extension is pre-designed and all the connections for the extension are already in place.

Extensions are not advisable without engineering assistance. Unless already pre-designed, earthquake engineers will not recommend the idea of extending core houses for the following reasons: seismic resistance depends upon wholeness of building action in which building acts as one integrated unit and not as a loose assembly of pieces. Therefore, the continuity and rigidity of construction that is so required is difficult to ensure when the completion of core structures and their physical expansion over a larger plan area is undertaken without technical supervision. Extension and original core house must be united structurally to act as one integral unit when shaken by earthquakes. The newly extended house must be re analyzed because the new extended house will behave differently than the original core house. Or the extension house shall be structurally completely separated from the core house.

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A Handbook for Reconstructing after Natural Disasters,

a joint publication of the World Bank and Global Facility for Disaster Reduction and Recovery (GFDRR), launched at ADPC Head Office in Bangkok, Thailand on March 18th, 2010.

Best Practices in Post-disaster housing and community reconstruction are constantly evolving. Disasters are increasing in frequency and severity while technology is changing how reconstruction is done. Reconstruction projects must be planned to ensure that what is rebuilt is safer than what was there before. At the same time, the roles of communities and government in reconstruction are moving in new directions.

Safer Homes, Stronger Communities gives policy makers and project managers the information to carry out housing and community reconstruction projects that empower communities affected by disasters and reduce their future vulnerability.

Case studies from around the globe illustrate how the policies and practical approaches presented have been used on the ground. The handbook also provides links to extensive technical information on each of the handbook topics.

GFDRR Global Facility for Disaster Reduction and Recovery
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The Importance of Topography in Seismic Amplification

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Seismic amplification

Every year earthquakes lead to massive destruction and high rates of casualties. It is noted, however, that not all earthquakes cause similar seismic shaking and resulting damage. Damage can vary strongly from one location to the other on a scale of a few hundred of meters or even less. There are several factors that play a crucial role in the amount of shaking occurring on a particular site. The intensity of ground shaking that any location will experience during an earthquake is a function of three main factors: 1) earthquake source, 2) medium and propagation, and 3) site factors. Source effects are the earthquake magnitude, depth, and mechanism. Large and shallow earthquakes at convergent faults usually produce ground motions with large amplitudes and long durations. In addition, large earthquakes produce strong shaking over much larger areas than smaller earthquakes. The distance of a site from an earthquake affects the actual amplitude of ground shaking at that specific location. In general, the amplitude of ground motion decreases with increasing distance from the focus of an earthquake. The frequency content of the seismic signal also changes with distance. Close to the epicenter, both high- and low-frequency motions are present. Farther away, low-frequency motions (slow deformation) are dominant, a natural consequence of wave attenuation in rock, thereby, in general, reucing the damage potential.

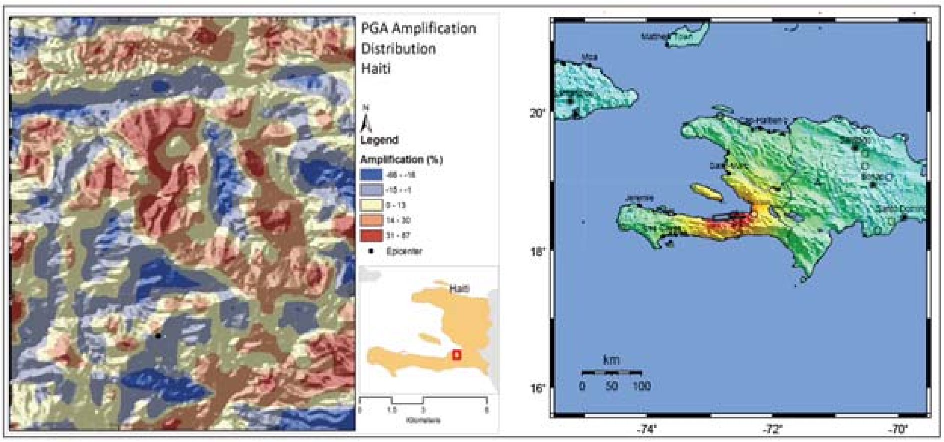

Figure 1. Amplification map for Haiti (left) based on ASTER DEM (after Anggreani et al., 2010). Map indicates (de)-amplification in % with respect to situation without topography. Clearly visible is the amplification effect on ridges and de-amplification in valleys and as 'shadow' effect on slopes that are facing towards the earthquake source. Clearly is seen that the much higher detail is provided on local PGA extremes compared to output from ShakeMap (right). The result could be combined with results from ShakeMap to provide more accurate PGA values after an earthquake.

Analyses of earthquake damage worldwide suggest that the severity of shaking depends on several local site specific factors besides the distance and magnitude of an earthquake. Local site conditions can lead to amplification of seismic waves and to unusual high damage. Unconsolidated materials, such as sediments and landfills, amplify ground motions. Certain frequencies of ground shaking may generate disproportionately large motions because of wave resonance and/or focusing in basins. Two famous cases of such local amplification effects have been in Mexico City (1967) where amplification at specific frequencies occurred in the sediment basin underneath the city, and in Seattle (1965) where subsurface topography lead to focusing of seismic energy and very local amplification in part of the city.

Role of Topography

Seismologists have since long being aware of the role of topography, in influencing the intensity of seismic response. The impact of topography on the uneven distribution of seismic response and associated devastation has frequently been observed and documented during seismic events. Recent large events in Pakistan (Kashmir earthquake, 2005), China (Wenchuan earthquake, 2008), and the recent 2010 earthquake in Haiti all show manifestations of seismic amplification due to the topography. This effect has been studied extensively, numerically and experimentally, at a local scale (single slope or hill), and has shown amplification of seismic response at ridge crests and de-amplification at ridge toes. This effect has, however, rarely been investigated at a regional scale. Recently, seismologists have been working towards the development of techniques for near-real time ground shaking prediction at regional scale. These techniques predict the spatial variation of ground shaking at a regional scale, i.e. large areas without exact boundary and comprising of many topographic features. The most common and frequently applied tool has been developed by the USGS, i.e. ShakeMap. This, and other, models do not consider topography as an independent parameter in the estimation of ground shaking. And the relevance is illustrated by observations that topography can change Peak Ground Acceleration (PGA) values by over 100% in rugged terrain. Since most of the seismically active areas are associated with rugged terrain, investigating and incorporating the topographic impact on seismic response is important for the seismic hazard assessment, mitigation and near-real time seismic shaking prediction.

Impact of Topography on Regional Scale

Predicting the realistic regional impact of topographic seismic response is strongly dependent on the resolution and accuracy of regional topographic information. With the widespread availability of the digital terrain representations generally referred to as Digital Elevation Model (DEM), many terrain analysis studies have explored the utility of DEMs and their derived topographic parameters. The resolution and the accuracy of a DEM have a significant impact on the quality of DEM derivatives such as slope, relative height, aspect and curvature of the terrain, all very important factors in topographic seismic amplification analysis. Terrain features smaller than the DEM resolution cannot be represented distinctly and with their true value, but instead are averaged to a single pixel value, which is important when DEM derivatives are used for predictive modeling, such as for topographic seismic response prediction.

Shuttle Radar Topography Mission (SRTM) DEM and Space borne Thermal Emission and Reflection Radiometer (ASTER) derived DEM at 90m and 30m resolution, respectively, can be acquired with (almost) global coverage and free of charge. This readily available data can be utilized for exploring the topographic seismic response at regional and local scale, particularly in near-real time. Recent studies (e.g. Shafique et al., 2009; Anggreani et al., 2010) evaluate topographic attributes and seismic parameters computed from such DEMs, to investigate the impact of quality and resolution on the derived topographic seismic response. Methodologies are being developed to readily derive the spatial distribution of relevant topographic attributes and seismic parameters. The impact of DEM source and resolution on slope gradient, relative height of terrain and shear wave velocity (top 30 meters; VS 30) are evaluated through full waveform modeling using a spectral finite element modeling code (SPECFEM3D). It is observed that although relatively coarse resolution DEM's (30 to 90 meter) underestimate the critical sites of steep slope gradient and the lower VS 30 areas, it has little impact on derived regional topographic amplification factors. The slope gradient is observed to be the most sensitive topographic attribute to amplified seismic response, followed by the relative height between the bottom of the mountain and the top. Such seismic amplification models can be used in the future for rapid assessment of areas experiencing increased seismic amplification or for hazard studies by running various earthquake scenarios.

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SPECFEM3D: http://www.geodynamics.org/cig/software/packages/seismo/specfem3d/

Tibetan School Shake-out

GeoHazards Society INDIA
http://www.geohaz.in/

Earthquake safe drills were organized in Tibetan Schools across Himachal Pradesh, Uttarakhand, Jammu Kashmir, Delhi, Meghalaya and West Bengal in India on April 5, 2010. The annual event, called 'Tibetal Schools Shake-out' was launched in 2009 to commemorate the 104th anniversary of the Kangra Earthquake, which killed more than 20,000 people in 1905.

Children attending the Earthquake drill in Tibetan Children's Village in Ladakh.

Total 16,500 students and school staff members participated in the drills through the 2010 Tibetan School Shake-out and it is the largest school earthquake drill in the country now.

At 11:00 am on April 5, 2010, a special bell announced the start of the earthquake (drill) and students immediately did the 'Drop, Cover and Hold on' exercise till the second bell gave them the signal to start the evacuation as planned under the guidance of the teachers. The activity was aiming to create a safe learning environment for school children and allow schools to prepare emergency situation as most of the schools are situated in high hazard zones. This is also a token way of keeping the memory of the Kangra earthquake alive so that the lessons are not lost, as a School principal emphasized "It is important to be reminded of past events in order that we can be prepared for the future."

Children in Sambhota Tibetan School

The response to the 'Tibetan School Shakeout' has exceeded expectations and students, staff and parents in these schools now feel the need to carry forward the initiatives. This initiative of the Tibetan Schools is sending a strong message of preparedness to all the Schools in hazard prone regions.

The annual Tibetan school Shake-out is a collaborative effort of GeoHazards International, GeoHazards Society and the Library of Tibetan Works and Archives (LTWA) in conjunction with Tibetan schools under Central Tibetan Schools under Central Tibetan School (CST) Administration, Sambhota Tibetan School (STS), Administration and Tibetan Children's village (TCV) schools. The local government agencies and Disaster Management authorities of the concerned districts played an important role in carrying out the activities.

ADPC Highlights

SREX Seminar

ADPC organized the Seminar for the IPCC Special Report on "Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation" (SREX) in Bangkok, Thailand during January 7-8, 2010 with the generous support of the Ministry of Foreign Affairs of the Royal Norwegian Government. The workshop was structured to bring together members of an important community (academics, NGO representatives, and other stakeholders) to discuss near-term SREX deliverables and how it can further contribute by highlighting the impacts, adaptation, and vulnerability (IAV) research agenda, in the context of disaster risk reduction. The goal of the seminar was to strengthen the regional inputs of Asia into the SREX volume, with an additional benefit of identifying critical information and research opportunities in advance, timely enough to feed into the IPCC Fifth Assessment Report (AR5) development cycle.
For more information, check out *http://www.adpc.net/ipcc/*

Regional Course on Mainstreaming DRR into Local Governance

ADPC conducted the 4th Regional Course on Mainstreaming Disaster Risk Reduction into Local Governance (MDRRG-4) during 25 - 29 January 2010 in Manila, Philippines. The objective of the course was to allow a cadre of local government professionals and development partners to sensitize themselves to issues posed by recurrent urban hazards, by enhancing the knowledge and capacity in mainstreaming DRR into urban development. The course featured pre-disaster preparedness and post-disaster experiences of the recent typhoons Ketsana and Parma through the participation of the Mayor of Dagupan Hon. Mr. Alipio Fernandez and Dr. Lenny Fernando from Marikina City.

Regional Conference on Climate Change and Extreme Cyclones

The conference was held in Dhaka on February 17 and 18, bringing together climate scientists and academic researchers with disaster management experts and professionals, to delve into the current and projected trends, and discuss how future risks can be best managed. It was co-organized by ADPC and the Bangladesh Disaster Preparedness Center (BDPC).

The 8th Meeting of Regional Consultative Committee on Disaster Management

The 8th Regional Consultative Committee on Disaster Management (RCC-8) was held during 22-24 February 2010 in Manila, Philippines, inaugurated by the Hon. Norberto B. Gonzales Secretary, Department of National Defense and Chairman of the National Disaster Coordinating Council, of the Government of the Philippines. The meeting, attended by 22 officials from national disaster management offices representing 17 countries in the Asia and Pacific region, along with 14 observers from UN agencies, international organizations, NGOs, donor agencies and development bank adopted the Manila RCC-8 statement on Implementing national programs on CBDRR in high risk communities. The Statement reiterated the fact that the most serious impact of a disaster is always felt by the local communities and their immediate environment and therefore it is urgently needed to scale up community level action for DRR in all high risk communities. RCC 8 calls upon every RCC member country to develop and implement national programs on CBDRR with the following components: a) Legal and Policy Frameworks enabling CBDRR; b) Technical Support to Community Level Action on DRR; c) Strengthening Partnership on CBDRR between Local Authorities, Implementing Partners and Community Organization (CBOs), Civil Society Organizations and Private Sector; d) Resourcing CBDRR and Linking with Local Development Programs; e) Strengthening Capacity on CBDRR. During the RCC meeting, ADPC also arranged a special session on "Pre-Disaster Natural Hazard Loss Estimation" The intention was to brief RCC representatives on the Regional Program for Pre-Disaster Natural Hazard Loss Estimation, discuss a proposed regional training course on the subject, and obtain inputs on the methodology presented.

The 8th Meeting of RCC was held in Manila, Philippines during 22-24 February

Visit of the Executive Secretary of UNESCAP

Ms. Noeleen Heyzer, the Executive Secretary of the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) visited Head Office of Asian Disaster Preparedness Center (ADPC) in Bangkok on March 25th, 2010 to discuss about current and future cooperation with ADPC in disaster risk reduction (DRR) in the Asia and Pacific region. Headed by Dr. Bhichit Rattakul, Executive Director and Mr. Aloysius J. Rego, Deputy Executive Director from ADPC, the meeting was started with welcome remark by Dr. Bhichit, followed by ADPC presentation on organization's brief introduction, its activities on DRR in the region and partnership between UNESCAP and ADPC.

Training Needs Assessment, China

Dr. Bhichit Rattakul, ADPC Executive Director, visiting Disaster Preparedness Center of the Red Cross Society of China, Changsha branch

Given that China has become a more socially and economically dynamic society, new and emerging problems are inevitable. One of the problems the Chinese society is witnessing is more frequent and severe natural hazards occurred all over the country. In this regards, ADPC seeks to contribute to create an understanding of Disaster Risk Management which covers all phases and hazard types, particularly in the area of climatic, hydro-meteorological, geologic, biological and environmental nature. Therefore, a team of ADPC conducted a Training Need Assessment in Beijing, Sichuan and Hunan when they held a series of meetings with Red Cross Society China, IFRC and ICRC during 15 - 19 March 2010. The team also had field visits to the 2008 Sichuan earthquake affected areas meeting with volunteers and trainers to find out how to enhance their capacity. Based on the need assessment, ADPC has proposed a curriculum and expects to deliver trainings to meet their needs soon.

[Activity Updates]

Climate Risk Management (CRM)

Training Manual Consultation Workshop on Early Warning Systems, Indonesia

Palang Merah Indonesia (PMI), in collaboration with ADPC and the American Red Cross (ARC), organized a two-day training manual consultation workshop in Jakarta on February 3-4, 2010. The objective of the consultation workshop was to develop a need based training manual for PMI staffs on Earl Warning Systems focusing on translating hazard risk information of all time scales into impact outlook and response options for contingency planning and targeted emergency response. The consultation meeting resulted in adapting a manual outline in the context of Indonesia and within PMI's mandate. A total of 35 experts from PMI Head Quarters (Disaster Management, Health and Training Division), PMI Chapters and experts from Meteorology Climatology and Geophysics Agency (BMKG), Center for Volcanology and Geological Hazard Mitigation, and the National Agency for Disaster Management (BNPB) participated in the workshop.

For more information, contact Mr. Jaiganesh Murugesan at jaiganeshm@adpc.net

Workshop on "Local Capacity Building and Hazard Assessment," Hue Province of Vietnam

ADPC in collaboration with the National Hydro-Meteorological Services of Vietnam (NHMS), work on the "End-to-end Early Warning System: Capacity Enhancement for Generation and Application of Location Specific Hazard Risk Information Project". As an initiative of the project implementation in Hue Province, a multi-stakeholders workshop was hold in Thua Thien Commune on April 20, 2010, with participation from NHMS, PHMS, Regional Hydro-Meteorological Service Center (KTTV), Provincial Red Cross (PRC), District Committee for Flood and Storm Control (DCFSC), ADPC, and other stakeholders at the commune level to build the capacity on historical hazard impacts, community and household vulnerabilities, coping strategies, and user needs. There were four introductory presentations from ADPC, PHMS, DCFSC, and PRC in the morning section regarding the weather forecasting method, early warning system and community preparedness. In the afternoon, all participants were divided into four groups for a discussion, focusing on risk assessment, copping strategy, feedback on forecast, and user needs. Due to their active participation, four sets of detailed outcome were generated as basis for the next step activities at local level. The workshop was an eye opener at the community level to strengthen the cooperation between NHMS and local stakeholders, understanding weather and flood forecasting system and develop a response plan based on the early warning information.

Demonstration to develop a response plan at community

For more information, please contact Mr. Mr.S H M Fakhruddin at fakhruddin@adpc.net

Disaster Management Systems (DMS)

Strengthen Implementation of Flood Preparedness Programs (FPPs) at Provincial, District and Commune Levels in the Lower Mekong Basin

In partnership with the Mekong River Commission (MRC) and with support from European Commission Humanitarian Aid (ECHO), ADPC working in close collaboration with the National Disaster Management Offices of Cambodia, Lao PDR and Vietnam has recently completed Phase IV of the Flood Preparedness Program. Significant progress has been made in preparing for Mekong River floods by developing Flood Preparedness Plans (FPPs) at the District and Provincial levels; existing FPPs have been reviewed, including their priority implementation activities, in addition to new District FPPs being developed. The FPPs have also been linked with the Development Plans of the three countries. School Flood Safety Programs (SFSP), also part of this project, have been successful in raising the awareness of the teachers and students in the pilot schools, and also their families and communities about flood safety. Training of trainers for the Disaster Management Committees at District level was expanded so that these trainers could pass on their training to commune level Disaster Management Committee members to help them to prepare for floods. Regional cooperation and awareness of the Mekong countries has also been raised by numerous knowledge and experience sharing workshops and conferences, and by the improved documentation of good practices and case studies.

For more information, please contact Mr. Aslam Perwaiz at aslam@adpc.net

Mainstreaming DRR into the Education Sector in Cambodia, Lao PDR and the Philippines

In partnership with UNDP and with support from ECHO, ADPC working in close collaboration with the National Disaster Management Offices and Ministry of Education in Cambodia, Lao PDR and the Philippines has recently completed the Phase II of the initiative on Mainstreaming Disaster Risk Reduction (DRR) into the Education sector. The initiative has facilitated the development and approval of a DRR module for one grade into the national curriculum of each country to cover chapters on topics on various aspects of disaster risk reduction.

[Activity Updates] continue...

The DRR modules have been taught in a pilot scheme in schools by teachers trained in teaching these modules, and IEC material has been reviewed and developed in close collaboration with other development partners as part of this project to provide learning materials to complement the curriculum module. DRR curriculum framework plans have also been developed in each of the three countries to identify grades, subjects and topics for further integration of disaster risk reduction. Additionally, each country has developed a national guideline (in the case of the Philippines the existing document on School Facilities Handbook) document for safe construction of school buildings taking into account the risk from natural hazards. The Guideline developed in close collaboration with Ministry of Education and development partners involved in the Education Sector aim to provide guidance in integrating disaster risk reduction into planning, design, construction and maintenance of school buildings. ***For more information, please contact Mrs.Ronilda R. Co at ronilda@adpc.net***

DRR Workshop, Myanmar

ADPC, in collaboration with Relief and Resettlement Department and Myanmar Engineering Society (MES), held a Workshop on Disaster risk reduction (DRR) with focus on mainstreaming from 28 to 30 April in Bago, Myanmar. The three-day workshop brought nearly 50 participants from various Ministries and Departments and City Development body and Government department including Mandalay Division Peace and Development Council, Mandalay City Development Committee, Government Departments and private engineers and orient them on mainstreaming DRR in development planning. The resource persons were drawn from Government of Myanmar, ADPC, Myanmar Engineering Society, Myanmar Geosciences Society and UNDP. The workshop served as the initial step for identification of actions for disaster risk reduction in Bago as well as for identification of activities for mainstreaming DRR in departmental activities.

For more information, please contact Mr. Sudhir Kumar at sudhir@adpc.net

Public Health in Emergencies (PHE)

Communities in disaster affected areas are the real sufferers and are the first responders as well. Oftentimes when disaster strikes, professional response are delayed, especially when major routes and access to the affected site are damaged like roads, bridges, ports and airports. Therefore, it is critical to develop community-based response capacity to enhance vulnerable groups in times of actual catastrophes. The Community Action for Disaster Response (CADRE) has been initiated in the nine PEER (Program for Enhancement of Emergency Response) countries, namely Bangladesh, Cambodia, India, Indonesia, Lao PDR, Nepal, Pakistan, Philippines, and Vietnam along the idea that by increasing local awareness and response capacity, we are actually reducing mortality rate and increasing resilience. The more we empower local communities the better the chances of integrating it to the community emergency preparedness network. During 8-12 March 2010, ADPC undertook a Regional Pilot course in Manila, Philippines. The outcome of this has led to a CADRE Curriculum product and materials which are reaching readiness for implementation of the first National Pilot Implementation of CADRE course from 1-22 May 2010. The course participants are coming from Philippine Red cross and Bureau of Fire Protection Personnel of Bacolod City who will replicate this course down to grass roots level in the future.

For more information, please contact Mr.Frederick John Abo at fjbabo@adpc.net

Community Flood Risk Map of Barangay Santolan, Pasig , Philippines

Urban Disaster Risk Management (UDRM)

PROMISE City Demonstration Projects in Bangladesh, Indonesia and Philippines
Establishing community based Early Warning System

From 22 to 25 February 2010, ADPC team conducted the flood vulnerability analysis and prepared the community based risk maps in Jamalpur, Bangladesh. On February 23, selected community volunteers attended a one-day training course on Community-Based Disaster Risk Reduction (CBDRR) to prepare them to conduct the community risk mapping. On February 24, ADPC carried out community risk mapping activities with the assistance of volunteers and respective ward councilors and the activity resulted in the community risk and resource maps of each ward, which then were validated both by the communities in a transect walk and by the Jamalpur TWG. Community Map and Resource Mapping, allowing community to understand climate change impact – rainfall pattern, cropping pattern, flood water level, migration pattern due to flood, livelihood pattern, health related problems, etc.


Community Flood Risk Mapping, Jamalpur, Bangladesh

For more information, please contact Ms.Gabrielle Iglesias at iglesias@adpc.net

PROMISE Philippines held CBDRRM training for Barangay Santolan

Barangay Santolan in Pasig City was the first pilot community to receive the PROMISE Community-Based Disaster Risk Reduction and Management (CBDRRM) training on March 18-19, 2010. With 40 participants representing different sectors of the community, the CBDRRM training provided the participants with an opportunity to learn how to make simple hazard maps and action plans.

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[ADPC upcoming Events]

- ***The 2nd Workshop on ASEAN Defence Establishments and Civil Society Organizations (CSOs) Cooperation on Non-Traditional Security (Disaster Management), June 28 - 29, 2010, Bangkok, Thailand.***

This will be co-hosted by Brunei Darussalam, the Republic of the Philippines and Thailand.

Inquiry: Bill@adpc.net

- ***Workshop for the Pilot Testing for the new Zoonotic Diseases Training Package 'One Health Initiative', August 2-6, 2010, Bangkok, Thailand***

The Workshop will be an opportunity for delegates to contribute to the review and finalization of the Zoonotic Diseases Training Package; a set of modules which have been developed by the Murdoch University Faculty of Health Sciences (Australia), University of Chiang Mai School of Veterinary Medicine, and Macro International. The Training Package is being coordinated by ADPC, with input from Ministries of Health, Livestock/Agriculture, UN Agencies, academic institutions and NGOs, as well as medical and animal health practitioners.

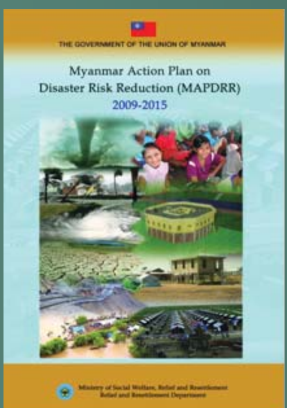
Inquiry: janette@adpc.net

[ADPC upcoming training courses]

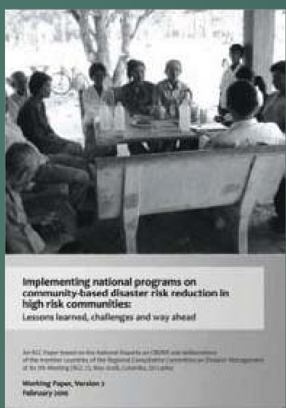
- The 1st Regional Training Course of the RCC on Main streaming Disaster Risk Reduction into National Devel opment Processes (MDRD-1), 21-25 Jun 2010 | Bangkok, Thailand
- The 9th Training Course on Public Health in Complex Emergencies (PHCE-9), 12-24 Jul 2010| Bangkok, Thailand
- The 19th Regional Learning Workshop on Community Based Disaster Risk Reduction (CBDRR-19), 19-30 Jul 2010| Bangkok, Thailand
- The 5th Regional Training Course GIS for Disaster Risk Management - Level I (GIS4DM-I), 16-27 Aug 2010| Bangkok, Thailand
- The 10th Public Health and Emergency Management in Asia and the Pacific (PHEMAP-10), Aug 2010 (detailed date TBA)| Bangkok, Thailand
- The 7th International Course on Hospital Emergency Preparedness and Response (HEPR-7), 20-24 Sep 2010| Bangkok, Thailand
- The 10th International Training Course on Flood Disaster Risk Management (FDRM-10), 11-22 Oct 2010| Bangkok, Thailand
- The Nutrition in Emergencies Regional Training (NIE), Oct 2010| Thailand (detailed date & venue TBA)
- The 6th Regional Training Course on GIS for Disaster Risk Management - Level II (GIS4DM-II), 1-12 Nov 2010| Bangkok, Thailand
- The 40th Regional Training Course on Disaster Management (DMC-40), 1-19 Nov 2010| Bangkok, Thailand
- The 2nd Regional Training Course on Incident Command System for Disaster Management (ICS-2), 22-28 Nov 2010| Phuket, Thailand

Inquiry: tsu@adpc.net

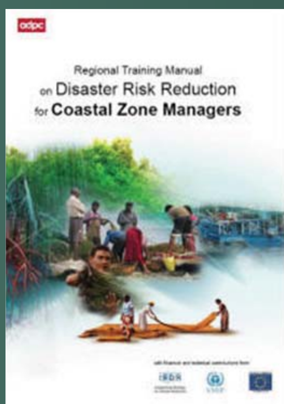
[ADPC New Publications]



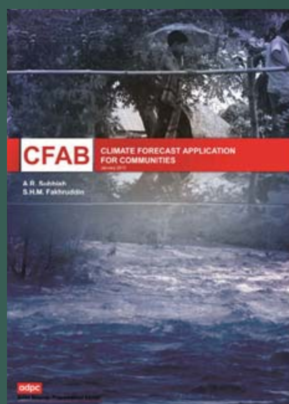
Myanmar Action Plan on Disaster Risk Reduction (MAPDRR), 2009-2015



RCC Working Paper Version 2: Implementing National Programs on Community-Based Disaster Risk Reduction in High Risk Communities - Lessons Learned, Challenges, and Way Ahead



Regional Training Manual on Disaster Risk Reduction for Coastal Zone Managers, developed under the partnership of ADPC, UNEP and UNISDR with support European Commission AIDCO Program



Climate Forecast Application for Communities

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Asian Disaster Preparedness Center

Asian Disaster Management News

January-April 2010 Vol.16, no.1

The Asian Disaster Management News is published by the Asian Disaster Preparedness Center, to serve as a channel of communication and source of information for disaster risk management practitioners and development workers in Asia and the Pacific.

Online versions are available at: ***http://www.adpc.net***

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