

## CAPACITY DEVELOPMENT FOR RESCUE AND RELIEF ACTIVITIES IN URBAN AREAS USING THE EXPERIENCES OF IRAN EARTHQUAKE

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### ABSTRACT :

The first hours after an earthquake (maximum 72 hours) could be considered as the golden hours for rescuing those trapped under debris. So it is essential to make proper plans for emergency response activities specially search, rescue and relief to use the all potential existing resources in the shortest period of the time for reducing casualties and disabilities that may cause by an earthquake. Such planning needs several prerequisites in different aspects that some of them should be prepared before an earthquake and some of them should be considered after a seismic event. In this paper the necessary issues to be considered for such planning will be discussed by having a look on the experiences gained in Iran's earthquakes in the last two decades. In addition some of the plans developed for promoting preparedness for such activities will be described.

**KEYWORDS:** Search, Rescue, Relief, Emergency Response, Iran

### 1. INTRODUCTION

Each year several earthquakes happen in the world that sometimes they may cause considerable loss and damages in the affected sites. In order to reduce the impacts of such events, it is essential to increase public awareness, reduce vulnerability, and improve emergency response capacities. Among the potential countermeasures, mitigation activities are the most important methods for reducing the impacts of an earthquake, but such activities are normally time consuming and need a lot of financial resources (for renovation vulnerable areas or retrofitting of weak structure, etc.). So it is essential to develop necessary plans for promotions of public awareness and emergency response capacities as well, to be able to increase the preparedness for confronting the effects of an earthquake in short term. In this paper some areas of emergency response activities have been considered including search, rescue and relief. Considering the importance of these activities in reducing casualties after an earthquake, the necessary plans for such activities should be developed in advance. It is very important to notice that such activities should be started in few hours after an earthquake and implemented in an orderly manner to get acceptable results. So proper planning for accelerating these activities could play important role in casualty reduction. Several physical, technological, and social parameters may affect the emergency response planning. So in order to make proper plans, these parameters should be also taken into account. Moreover it would be beneficial to use the experiences of previous earthquakes to see the potential challenges and difficulties. Such issues will be discussed in the following parts considering the Iran's experiences and a summary about existing programs in these areas will be presented.

### 2. PLANING FOR SERACH AND RESCUE

Search and rescue activities could be considered as the first priority after an earthquake. The main objective of search and rescue operations is to save the lives of people, especially those who are trapped or are immediately

in danger. For this purpose, it is essential to assign a sufficient number of capable experts and to set up emergency operation centres in the earthquake-prone areas properly. Moreover necessary training should be provided for the local residents to be able to make self-rescue operations in emergency situations. Considering the responsibilities of different groups in search and rescue and the parameters that may affect emergency operations (including vulnerability level, population density at risk, etc.) necessary plans should be developed considering social and physical parameters that some of them will be discussed in the following parts.

### ***2.1. Operational and command centers of search and rescue***

Normally after an earthquake, the stations and command centres should be operational in a very short time to provide necessary assistances and taking the responsibility for emergency management. So these places need to have earthquake resistant buildings and lifelines that should be constructed on the basis of proper seismic codes appropriate to critical structures. Moreover, these facilities should not be constructed adjacent to the potential geological and man-made hazards that may affect their performance after an earthquake. Experiences show that in Iran some of these structures have not been constructed somehow to resist against potential earthquakes. For example the Red Crescent Society headquarters building and some fire station were destroyed during the Bam Earthquake of 2003, and they could not provide any assistance in search and rescue activities. The destruction of such facilities surely affects the emergency response activities during the golden hours after an earthquake, so retrofitting these places should be implemented with high priority.

Moreover these centres should have proper access to whole the affected areas, so they should be located along the emergency roads with appropriate width and specifications according to the demands of rescue operations. Moreover, the adjacent roads to these centres should not be blocked by debris or any geological or man-made instability. During the 1990, Manjil and 2004, Firouz Abad-Kojour Earthquakes, a number of main roads were blocked by debris and rock-falls, which caused delay in the arrival of rescue teams at the scene (Figure 1).



Figure 1 Damages to main roads caused delay in dispatching the search and rescue teams to the affected sites;  
(A) Rock fall in Manjil Earthquake (1990), and (B) Collapse of Qanats in Bam Earthquake (2003)

### ***2.2. Using damage and loss estimation tools***

Normally after an earthquake quick estimations of the impacts of an earthquake using seismic networks, satellite data or aerial photos are also essential for proper management of available limited resources for search and rescue during the golden hours after an earthquake. After Bam Earthquake of 2003, aerial photos taken by

the National Cartographic Centre were used to prepare a damage estimation map that was quite useful for managing emergency operations (figure 2). Using the experiences of Bam Earthquake and considering the potential impacts of an earthquake in Tehran, Tehran Disaster Mitigation and Management Organization (TDMMO) is now developing a Quick Damage and Loss Estimation (QD&LE) system for the assessment of potential impacts of an earthquake in Tehran. This system that is now under development by assistance of Japan International Cooperation Agency (JICA) is composed of several real time seismometers that will be installed in different parts of the city to transfer the Peak Ground Acceleration (PGA) values of the earthquake to TDMMO. Then by using the GIS databases of population density and built environment; and applying casualty and fragility functions, the distribution and level of losses can be estimated in couple of minutes after an earthquake to be used for response management.



Figure 2 Estimation damages in Bam Earthquake (2003) using aerial photographs

### ***2.3. The role of local residents***

Statistics show that around 80% of the victims of Bam Earthquake of 2003 were rescued by the local residents and neighbours. Such figure that is similar with the worldwide experiences show the important role of local residents in emergency operations. So development the capacities of local peoples by providing special trainings and facilities could improve the capacity for emergency operations. Considering the high number of estimated victims and relatively small number of existing experts and facilities for emergency response in Tehran, TDMMO has prepared a plan to involve volunteers in emergency operation. In this plan, the local residents and volunteers will play the main roles in emergency response at the community (1000 – 5000 persons) and sub-district (5000-30000 persons) levels and special programs for training the residents and volunteer groups are under progress. Moreover necessary equipment for rescue activities has been provided in some areas.

### ***2.4. Auxiliary provinces and armed forces capacities***

In case of occurrence of big earthquakes, the local government could not provide the necessary responses properly by only using its own resources. In such conditions it is necessary to involve professional organizations including the armed forces and auxiliary provinces capacities for supporting emergency response activities. The success level in such cases is dependent on several issues such as preparing and practicing the

necessary measures before an incident and coordination among the different bodies that are active at the scene. Such coordination needs predefined plans and programs that should be prepared in advance. In Tehran at the present time some guidelines were prepared to involve the military forces and auxiliary provinces for emergency response after a big disaster. Based on these guidelines Task Force Organization of Tehran (TFOrg) headed by Tehran Mayor have the authority to ask the military forces and auxiliary provinces to provide necessary emergency operations and logistics after earthquake and each of the Iran's provinces are responsible for providing necessary support for Tehran's districts (totally 22 districts). In addition Isfahan Province is responsible for emergency coordination after a big catastrophe.

### **2.5. Critical information**

Normally after a big disaster, rescue personnel from other provinces or countries are dispatched to the affected areas to assist response activities. After Bam Earthquake (2003) several rescue teams that were equipped with high tech devices for implementing complicated rescue operation in high rise buildings were dispatched to the areas without being able to provide considerable assistances, as most of the collapsed buildings were simple one-story traditional structures. So it is necessary to evaluate and inform effectively the required expertises based on local conditions before dispatching expert groups.

## **3. RELIEF AND MEDICAL CARES IN EMERGENCY SITUATION**

Efficient planning in mass casualty management needs special measures designed to increase the preparedness level and improve the capacity and capabilities of medical care activities before an incident (Cooper, 2006). Experiences of the previous earthquakes show that the existing standards and guidelines for developing medical care activities should be revised to improve their efficiency in emergency conditions. The basic elements for improving emergency medical care services in the seismic prone areas will be summarized in the following parts using Iran's experience.

### **3.1. Community level services**

At the community level, establishment of emergency posts after an earthquake could help victims rescued by ordinary people or expert teams. These centres could play a role as triage posts before sending injured people to the hospitals in order to control flows and prevent overwhelming them, as observed in Bam Earthquake of 2003 (Movahedi, 2005). Their main responsibilities especially during the few days after the disaster are as follows:

- To provide first aids and minimal treatments;
- To carry out triage; and
- To transfer severe cases to hospitals after primary stabilization.

The required number of these centres depends on several factors including access, population density and vulnerability, but as a rough estimation, they should be available in all affected areas and close to the existing hospitals. These places can be organized by sub-district governmental offices or even community people, but they should be in direct contact and coordination with the hospitals, and other emergency command centres. Emergency water resource and electricity should be available in these places. Moreover necessary equipment such as oxygen supplies, ventilators, first-aid kits and devices for stabilising broken bones should be also provided for these units.

It would be also necessary to provide a detailed program for supplying medical staff and logistics and training some local residents to assist in the operation of these units, as the latter are more easily available after an earthquake. By using these criteria and considering the potential casualties of a strong earthquake in Tehran, establishment of 3000 medical posts for mass casualty management was proposed in Tehran Disaster

Management Master Plan (TDMMP) to provide necessary emergency medical cares for the estimated casualties within 24 hours after the earthquake. In case of Bam earthquake some medical posts established in the most affected areas after some days to provide necessary services for health and treatment as shown in figure (3), but these centers could not provide any services as triage posts.



Figure 3 Establishment of medical posts at community level after Bam Earthquake of 2003

### 3.2. *Emergency hospitals*

Hospitals are important elements in the emergency medical care cycle, and most of the necessary medical treatments should be provided efficiently at these places. Planning for development the capacities of hospitals in seismic zones needs special consideration, that some of them would be presented in this paper based on the experiences of previous earthquakes in Iran.

The most important criterion for selecting a hospital for emergency situation is its building resistance to a potential earthquake. In fact the hospitals should have earthquake-resistant structures, infrastructures and non-structural elements and should be placed in safe areas far from potential hazards. Unfortunately the experiences in Iran show that some of the existing buildings of hospitals are not safe against earthquake. For example in Bam, 2003 and Manjil, 1990 earthquakes, the existing hospitals and medical care units at the areas were heavily damaged. In addition considerable damages to non-structural elements and medical equipments (such as ICU, CCU and laboratory instruments) of existing medical care centres were observed in Bam case.

The second physical issue is related to the architecture of the hospitals. In order to facilitate the activities under emergency conditions, the critical places for emergency operations should be placed at ground levels. Hospitals should be also equipped with emergency telecommunication system, power generators, water and fuel supplies for running at least for a few days after the earthquake. The existing hospitals in earthquake prone areas should have also the capability for expanding their capacities after an earthquake, so enough spaces and facilities should be available within or around the hospitals for this purpose. Hospitals must also support helicopter operation and frequent ambulance services to transfer earthquake victims more efficiently.

Establishment of field hospitals at the affected sites is another solution to cope with the impacts of earthquake. During the recent earthquakes of Iran, several field hospitals were established after the earthquakes that provided important medical care assistances to the earthquake victims including receiving patients from the scene, evacuation the existing inpatients from the damaged hospitals and supporting emergency functions of the

existing hospitals (figure 4). In order to set up field hospitals some open lots should be selected preferably around the existing hospitals and emergency water and power supplies should be provided in these sites. Field hospitals can be also developed as part of the existing hospital expansion and in such cases they should not be set up independently from them but should avail themselves of their services.



Figure 4 Establishment of a field hospitals in a play ground after Bam Earthquake of 2003

The other important issue is related to capacity building in the existing hospitals for making them prepared to encounter the effects of earthquakes. In fact, hospitals within earthquake prone zones normally should be able to carry out numerous activities in a short space of time. Past experiences show that a number of hospitals normally may lose their capacities due to lack of Incident Command System (ICS) or improper planning for emergency conditions (Smith, 2000). So in order to facilitate emergency medical care activities, hospitals should have a response plan for different levels of disaster in advance which include the methods for receiving patients in time of crisis, forms of leadership, resource management, plans for cooperation with other hospitals and health centres, and so on.

One of the most important challenges of hospitals under emergency conditions is the methods used by hospitals to receive victims. Based on prior experiences, the majority of victims may not require hospitalization after initial care. Historically, approximately 10%-15% of mass casualty incident victims evaluated at local medical stations actually require hospitalization for their injuries/illnesses (Barbera and Macintyre, 2002). So in general, it is essential to check the situation of injured victims at triage posts before accepting by a hospital. For those patients who directly come to the hospitals, a triage post could be established at the entrance of the hospitals to make the necessary check immediately.

In order to control the flow of earthquake victims to the existing hospitals in Tehran, a method is introduced in Tehran Disaster Management Master Plan (TDMMP) as shown at figure (5). In this method only those injured tagged yellow at triage post are permitted to be transferred to existing hospitals in the district. Transportation measures will be prepared by District municipality or Red Crescent Society because equipped ambulances of Tehran EMS may be totally busy especially during the first few days. Serious cases should be then transferred to the more advanced hospitals by helicopters or other existing means of transportation. Non-critical patients among existing patient/disaster victims can be also moved to the back-up hospitals in other provinces by plane (Hosseini and Amini Hosseini, 2005).

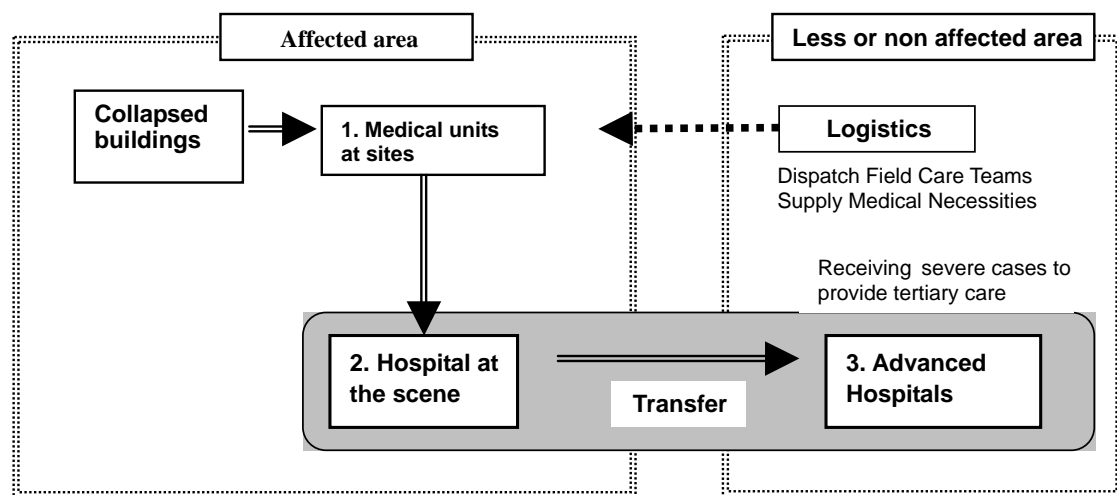


Figure 5: Methodology adopted in TDMMP for prevention of overwhelming of existing hospitals after an earthquake in Tehran

Resource management is another important issue in emergency medical care planning. As a general rule, regardless of location and ownership, all available resources in the public and private sectors should be mobilized to treat injured people. Moreover in order to support onsite post/existing hospitals, the necessary logistics (such as tents, blankets, beds, electric generators, etc.) should be provided from the no/less affected sites. A work-plan for staffing and supply of necessary material at emergency conditions should be also prepared for special occasions such as national holidays. For example Broujerd Earthquake of 2006 occurred during the Iranian New Year holidays. As most of the medical staffs were on vacation at that time, some shortages on medical personnel and essential medicines were observed and reported during the first three days.

#### 4. CONCLUSION

In this paper some challenges and experiences in emergency response planning and operation in the field of search, rescue and relief were presented. A summary about the key points and results of this study can be presented as follow:

- Information flow about the effects of earthquake is very important for planning search, rescue and relief activities. So it is appropriate to use the advanced technologies in these fields;
- The initial action plans needs to be developed by the government to facilitate coordination and commanding system in emergency situation;
- The mobilization of the rescue and relief team should be implemented as soon as possible after an earthquake to use the golden hours in saving lives of victims;
- Coordination among the related organization in different tasks need to be improved for using all the benefits and capacities available;
- Individuals and community-based organization (CBOs) could provide essential assistance at the first hours after an earthquake. Training them and providing the necessary means and tool for them will assist the success of their activities;
- Co-ordination on decision making at provincial, districts and central authorities should be improved to used all resources in proper manner;
- Response teams from other provinces contributed to the relief operations need training on standardized and comprehensive national guidelines, procedures and protocols for different aspects of disaster management within an agreed upon and advertised contingency plan.

It could be observed that most of the above mentioned items could be considered in preparing emergency response plans, but these issues should be trained to the authorities and related staffs and should be practiced in



drills before an earthquake.

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