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921 集集（台湾）地震における緊急対応について

On the Emergency Responses during 921 Chi-Chi Earthquake

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概要:1999 年 9 月 21 日に発生した台湾集集地震について、本報告では被災地における緊急対応状況に関して報告する。内容としては、現場での緊急対応組織や現場責任者からのインタビュー結果を基に、地震後の緊急対応の特徴について専門的見地及び報告書を基に評価する。また、災害情報が緊急対応にどのように活用されたかを、県、市町村や国を含む各機関の 15 の現場インタビューを通して、評価する。さらに、今回の台湾集集地震と 1995 年の阪神淡路大震災との比較を行った結果、将来の緊急対応に関する 以下のような改善点を指摘するものである。

1. 緊急対応のあり方に関して、震災後にシステマチックな事後評価を行うべきである。
2. 国、県、市町村を越えた災害情報の共有のための施設づくりの、更なる投資が必要である。
3. 大学研究機関において災害知識に関する蓄積を行い、当該地域の防災に役立てるべきである。
4. 防災研究と防災訓練に関する国際的な協力網を発展させるべきである。
5. 国際間の政治的問題による緊急対応への障害を除くため、人道的緊急援助に関する国際基準を提案すべきである。

キーワード：緊急対応、災害情報、インタビュー、防災組織

1. Sites/Organizations Visited:

October 3, 1999: Feng Yuan, Teng Shih, Town of Shih Kang, Shih Kang Dam, Taichung County;
National Center for Research on Earthquake Engineering, National Taiwan University, Taipei

Monday,

October 4, 1999: Nantou County Emergency Operations Center

12:30 p.m.: Michel Yang, Ph.D., Special Assistant to County Magistrate, Nantou County for Disaster Operations

1:30 p.m.: Chung Chi Lin, Chief, Fire Administration, Nantou County Government,

3:00 p.m.: General, Commander, Helicopter Operations, 6th Division, Army, Nantou County

3:45 p.m.: Nantou County: Colonel, 6th Division, Army, on assignment to Nantou County, responsibilities for establishing tent cities, demolition of damaged buildings

5:00 p.m.: Nantou City Government, Lee Chaou Ching, Mayor, Nantou City

Tuesday,

October 5, 1999: Town of Puli, Emergency Operations Center, Nantou County

10:15 a.m.: Shih Kun Hsiung, Chief of Staff, Town of Puli, Nantou County

11:30 a.m.: Livia Shih-Li Chen, E Guang Doh, Buddhist Temple, Nantou County

1:30 p.m.: Ministry of Interior Emergency Operations Center, Nantou County,

Tai-Lang Chien, Vice Minister, Ministry of Interior, ROC

3:30 p.m.: Nantou County Emergency Operations Center

4:30 p.m.: Town of ChungHua

Wednesday,

October 6, 1999: Taichung Offices, Research, Development and Evaluation Commission, Executive Yuan:

9:30 a.m.: Yeh, Wei-Chuan. Department of Overall Planning, Research, Development &

11:00 a.m.: Evaluation Commission, Executive Yuan.
Webster Kiang, Vice Chairman, Research, Development and Evaluation Commission

1:30 p.m.: *Town of Shih Kang, Taichung County*
Hsieh Chen Ying, Town Manager

2:30 p.m.: Colonel, 99th Division, Marines, Shih Kang, Taichung County Base

6:20 p.m.: *Taichung University, Institute of Public Administration, Taichung*

Thursday, October 7, 1999, Taipei

1:30 p.m.: Patrick Hsu, Deputy Director, Red Cross Society of the Republic of China

3:00 p.m.: Hung-Yi Chen, General Director, National Fire Administration, ROC

4:00 p.m.: Chi-Shean Chan, M.D., Minister of Health, Executive Yuan, ROC

Friday, October 8, 1999, Taipei

9:00 a.m.: Legislative Yuan, Offices of Legislator Chang

12: 30 p.m.: American Institute of Taiwan, Tel. Interview, M. Matthews, Liaison for U.S. SAR Operations

2:00 p.m.: Office of the National Science and Technology Program for Hazards Mitigation, National Centre for Research on Earthquake Engineering
Teng Wei-Hsin, Ph.D., Evaluator, International Search and Rescue Operations

3:30 p.m.: Ministry of Foreign Affairs, Executive Yuan, David Tawei Lee, Deputy Minister of Foreign Affairs; Shangren Lee, Legislator, Chair, Committee on Foreign Affairs, Legislative Yuan

5:00 p.m.: National Emergency Operations Center, National Fire Administration

7:30 p.m.: Institute of Public Administration, National Chengchi University,
Professor Chung-Yuang Jan

2. Characteristics of Emergency Response:

The characteristics of emergency response for this earthquake presented a particularly difficult environment for the rapid mobilization of effective response operations. First, the time and location of the earthquake created an extremely challenging set of conditions. The powerful earthquake (M = 7.6 Richter) occurred at 1:47 a.m. on September 21, 1999, with the epicenter located near the small town of ChiChi in Nantou County, Central Taiwan. The earthquake caused damage in eleven counties, with the largest proportion (approximately 90%) of the damage occurring in Nantou and TaiChung Counties. Twenty-seven towns within this five county area suffered damage from the earthquake, some severely.

When the earthquake occurred very early on Tuesday morning, it was dark. Communications, electrical power, water and sewage distribution systems throughout the damaged region were disrupted. Transportation was limited, as roads were blocked by landslides, bridges were damaged, and railroad tracks were twisted out of operation. Given the extent of the damage, information regarding the affected areas was slow and incomplete in the first hours after earthquake.

Although Taiwan has a national emergency plan, with legal responsibilities for public jurisdictions at the national, county and town levels, many communities were not adequately prepared for a disaster of this magnitude. Not all towns established emergency operations centers immediately. In Central Taiwan, smaller towns relied upon voluntary personnel for their fire departments which had the primary responsibility for search and rescue operations. Without adequate communications, equipment or training, emergency response personnel confronted an extraordinarily difficult set of tasks. Emergency response operations were required over a wide area. Mobilization of personnel, equipment and supplies for timely response demanded a complex set of operations and coordinated action by multiple agencies, governments,

private and nonprofit organizations. With limited communication and transportation, search and rescue operations in most areas were left to immediate family, friends and neighbors who used hand tools and physical strength to rescue trapped victims from the rubble.

In the larger cities and towns, collapsed concrete structures required heavy equipment and advanced search and rescue (SAR) techniques to rescue victims trapped under rubble. Most damaged communities did not have access to either the trained personnel or the equipment to carry out adequate SAR operations.

3. Findings/Comparison of Conditions with Kobe Earthquake

1. Initial conditions of damage and mobilization of response operations varied among the different sites that were affected by the earthquake. The capacity for mobilization of response operations depended upon access to communications, local experience in managing complex operations, access to external resources, and degree of preparedness for seismic events. The lack of public awareness of vulnerability to major earthquakes, and the slow declaration of a national emergency after the event were similar to conditions affecting response operations following the Kobe Earthquake.
2. Extent of damaged area was significantly greater in Taiwan than in Kobe. Damage in Kobe was concentrated in a densely populated urban area. In the ChiChi Earthquake, five counties were affected. Approximately 90% of the damage occurred in two counties, Nantou and Taichung, with 27 towns reporting serious damage. Aboriginal communities were affected in isolated mountain areas. Consequently, the logistics required for mobilizing response operations were more difficult and more complex because of the wide area and multiple sites that required immediate assistance.
3. Local towns initiated search and rescue operations with limited equipment and untrained personnel. Most trapped people who survived were rescued by family and friends within 48 hours. Volunteer fire department teams played an important role in search and rescue operations to the limit of their training and equipment. This situation was in some respects similar to the Kobe experience, where a professional urban fire department had limited training for seismic events and was overwhelmed by the size and scope of the disaster, leaving many sections of the city without assistance.
4. International search and rescue teams arrived with advanced technical equipment, trained personnel, but late in process. The Japanese SAR team arrived at 5:00 p.m. on 9.21. The US team arrived at 5:00 p.m. on 9.22. SAR teams arrived from a total of 20 countries, but there was a lack of communication and coordination among the teams. The international teams rescued a total number of 6 live persons. The situation was regrettably similar to that following the Kobe Earthquake.
5. International assistance was complicated by Taiwan's unique situation in the international community. Humanitarian assistance was delayed in several instances by political constraints.
6. Human losses include the number of dead: 2,295; number of missing: 38; number of patients treated for injuries: 8,731; number of persons rescued: 4,964; number of persons needing evacuation: 4,685. The number of dead is significantly lower than in Kobe, at approximately one-third of the lives lost as a consequence of that earthquake. Fortunately, the damaged cities and towns in Taiwan were not ravaged by fire, as in Kobe.
7. Major difficulties in mobilizing response operations included: lack of communications, information, emergency preparedness training, advanced search and rescue equipment. These needs were similar to needs found in response operations for Kobe.
8. The process of inquiry, evaluation and documentation of response operations by government and research agencies was innovative and responsive to the sudden, urgent circumstances of the disaster.

Although there was relatively little integrated information available to policy makers in reference to seismic risk in the affected region prior to the disaster, governmental agencies and national research universities and centers quickly mobilized a knowledge base for the affected counties and towns. In doing so, they used advanced information technologies such as GIS and a distributed information system to link separate knowledge bases of the responsible national ministries into a shared knowledge base accessible to policy makers with responsibilities for disaster operations. Information regarding the disaster was also made available to the public via Web sites established specifically for that purpose.

9. Although the knowledge base was not available to guide the immediate response operations, it was developed quickly following the earthquake with the intention of using it to facilitate the complex process of recovery operations, and to learn from this event in preparation for improving response to future earthquakes. This was an innovative development in disaster management, led by the national governmental agencies and the research centers and universities. It likely reflects both organizational learning from the Kobe Earthquake as well as the advanced state of information technology and experience in Taiwan. It also reflects a bias toward inquiry by governmental ministers in Taiwan, many of whom hold Ph.D. degrees in a range of disciplines and have had formal training in research methods and analysis. This is an unusually favorable situation for transforming a destructive event into an opportunity for organizational learning to mitigate future seismic risk. It further demonstrates a productive collaboration between governmental agencies with responsibilities for disaster management and research institutions with capacity for data collection, analysis and professional evaluation.

4. Recommendations

The following recommendations confirm initiatives that, in most cases, are already underway by the Taiwanese governmental agencies, research centers and universities, and nonprofit organizations. The recommendations make explicit the benefits of these actions for seismic preparedness.

- Conduct a systematic process of after-action review of response operations for this complex event. Informal reviews could be conducted within each organization that had specific responsibilities for disaster response; more formal reviews could be conducted among organizations interacting at the same jurisdictional level: town, county, national. Professional reviews could be conducted by key organizations that hold major responsibilities for response operations across jurisdictional levels, e.g. the Ministry of Internal Affairs, National Fire Administration, Ministry of Health, Ministry of Construction. The benefit of such a review process is to learn from this experience in order to mitigate the continuing problem of seismic risk and other hazards in Taiwan.
- Invest in information infrastructure to support communication, coordination among levels of government involved in emergency response: town, county, national, international
- Use resources of universities to build knowledge base for community vulnerable to seismic and other hazards, as well as to improve training of emergency response personnel
- Develop linkages in research and training with other nations exposed to seismic risk, as a means of expanding knowledge and skills in coping with the recurring problem of earthquakes and other hazards in Taiwan
- Propose international standards for humanitarian assistance in disaster so that needed assistance will not be delayed or affected by political constraint