

FROM WENCHUAN *M8.0* EARTHQUAKE ANALYSIS CHINESE LIFELINE SYSTEM EARTHQUAKE PREVENTION AND MITIGATION

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Abstract:

Based on the WENCHUAN *M8.0* earthquake status in south-western China, this paper analyses the situation of China's lifeline of the earthquake prevention and mitigation system. It can be expected that in the future, china's lifeline basic research and earthquake prevention and mitigation research will be great development. And proceeded to put forward the urban lifeline earthquake prevention and mitigation system including engineering and non-engineering measures, the two measures do not function the same, not mutually replaceable. Then starting from the comprehensive earthquake prevention and mitigation, this paper gives scientific innovation model of city lifeline safety control system. Finally, according to the author's concept of earthquake prevention and mitigation measures proposed lifeline system specific post-earthquake emergency relief measures.

Key words: Lifeline systems; Earthquake prevention and mitigation; Measures; Safety regulatory model

Preface

Lifeline system is the basic engineering facilities to maintain modern city functions and regional economic function, including transportation, telecommunications, water, electricity, gas and oil, and other engineering systems (GE XUELI 1998). Lifeline system is one important bearing entity of the urban to natural disaster, technological disaster and the threat of man-made disaster, serious damage when a disaster, affected by a wide range of social impact, serious secondary disaster and so on. May 12, 2008, in Wenchuan County in Sichuan Province has happened *M8.0* earthquake. It is the most devastating earthquake since the foundation of new China, one of the most difficult rescue earthquake (figure1 and figure2). Beichuan County, Yingxiu town and some other towns almost razed to the ground. Most of the victims were caused of the collapse of the housing.

Facing to earthquake, local departments in charge of buildings has taken many positive responses, to ensure that the lifeline of security in the fight against earthquake disaster made enormous efforts. Wenchuan earthquake fully shows that more than 90 percent loss of the earthquake disaster, directly or indirectly, was due to earthquakes on building structures devastating result of the earthquake. Earthquake prevention need do a good job in construction work to reduce loss of a major earthquake disaster. The earthquake itself is not wounding, causing casualties, it is triggered by the collapse of the housing, trigger secondary earthquakes such as landslides. In view of earthquake prediction is still the world problems, so the current technology on the human capacity, reduce the loss of earthquake disaster the best way to improve the building works should be placed on seismic design.

But we should also see that in some places, staff still lack the scientific concept of earthquake prevention, emergency response mechanism, and related building standards have to be perfect. Therefore, strengthening the scientific resilience and enhance scientific awareness of earthquake prevention, improve the scientific earthquake mitigation system, to effectively protect people's lives and property safety, is an important duty of governments and the whole society's common topics.

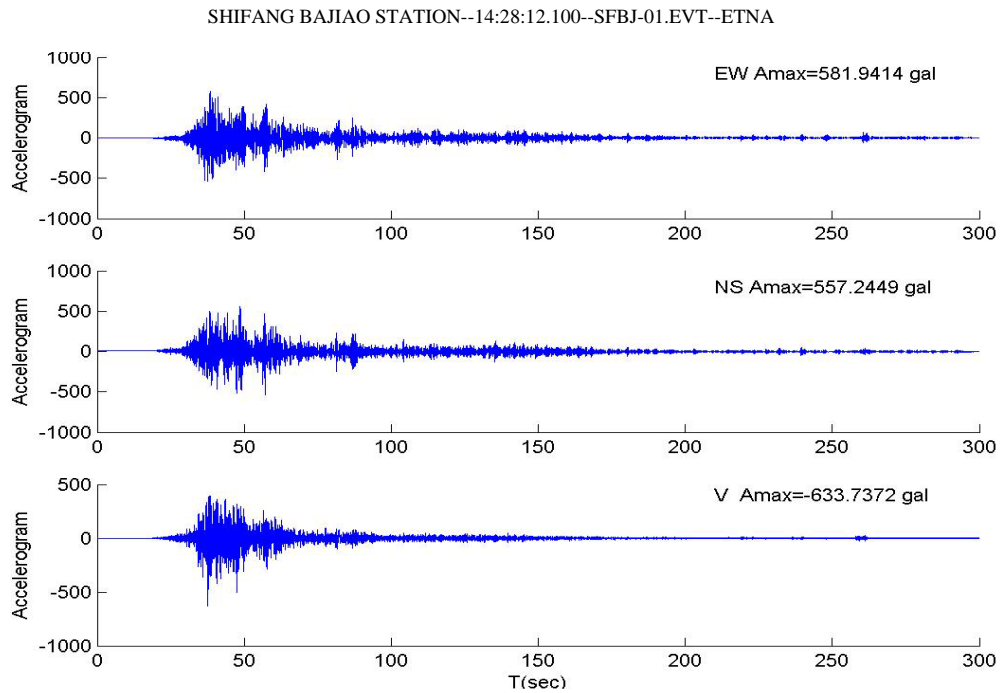


Figure1. Earthquake acceleration time curve (from SHIFANG BAJIAO STATION)

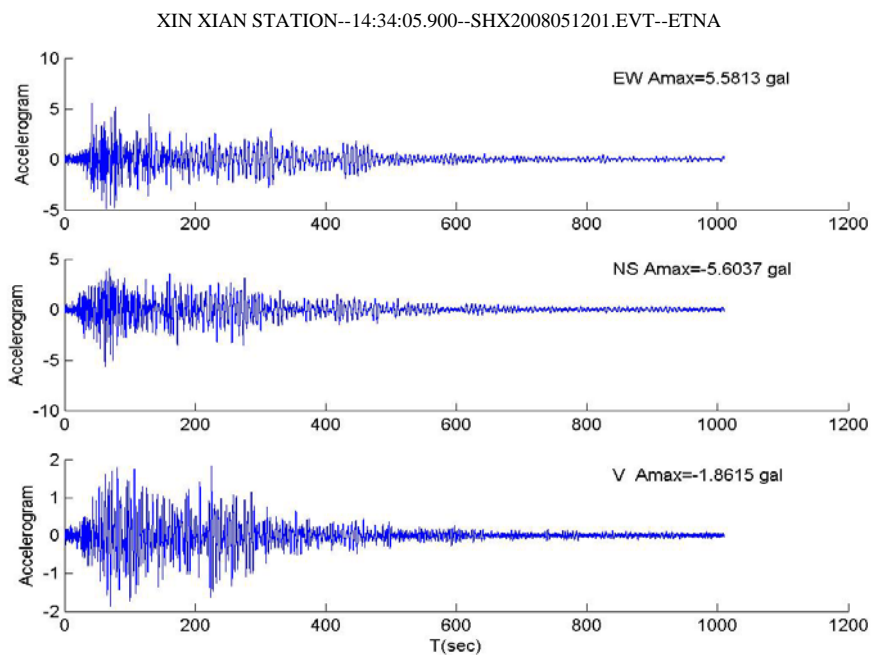


Figure2. Earthquake acceleration time curve (from XIN XIAN STATION)

Lifeline system progress on earthquake prevention and mitigation

Lifeline system works Progress

As the major civil engineering projects related to earthquake, engineering reliability and durability of the system, structural engineering and engineering systems of monitoring and control of security, such as civil engineering in the development of a series of key science and technology issues, ranging from a sense research has become the lifeline of the modern civil engineering study the basic driving force (LI JIE 2005; TONG LINXU 2000). In the past 10 years or so, the lifeline engineering studies at home and abroad have made important progress in the series. Lifeline works to the earthquake design and performance of state control as the core, the further development of the traditional lifeline engineering field of study, works in the earthquake, wind engineering, engineering antiknock, anti-geological earthquakes such areas comprehensively promote the lifeline of progress. Can be expected in the future, China's lifeline basic research will be the basic development trend in the performance as follow:

- (1) Attach importance to the role of earthquake research. By numerical simulation and field measurement combination of means, further in-depth understanding of large-scale seismic market, local winds and earthquake chain effect which formed the basic mechanism, so as to structural design and engineering systems designed to provide scientific support for background;
- (2) In non-linear failure mechanism from the basic research component to the constitutive equation materials, structural performance at both ends of extension. In the whole process, the whole concept of life under the guidance of the design, in-depth understanding of material injury constitutive relations, the structure of the destabilizing accumulation and the collapse mechanism, structure and performance degradation of the environment and a range of issues and the relationship between the nature of the objective for the establishment of a modern structure Fine To provide the basic design theory;
- (3) Regional earthquake risk analysis of major projects and network system security, reliability on the combination. In the foreseeable future, people will no longer satisfied with simply using the functions in accordance with the requirements of the lifeblood of network system design, and an attempt to integrate regional earthquake background, the system can bear the risks, economic and social development level of such factors, integrated network of complex works The design and maintenance;
- (4) Attach importance to the development of underground space in the new issue, in the underground lifeline of the engineering study will make new technological advances. Here, the development of modern experimental technology and test technology and the integration of numerical simulation technology will become the basic characteristics of the development;
- (5) Advanced composite materials, smart materials, advanced sensor technology, modern information technology in the lifeline of the engineering study will further play an important role. In some of these aspects, is very likely to trigger an upsurge continued research and to provide a new lifeline engineering technical support tool;
- (6) Develops the concept of structural health monitoring, the system works in the security monitoring and earthquake early warning system to form a new field of study;
- (7) Lifeline of the durability of engineering systems will gradually constitute a new research focus;
- (8) Composite lifeline system of earthquake simulation and control of the site will lead to a broader range of concerns.

Lifeline system progress on earthquake prevention and mitigation

How to build, protect and manage urban systems has been a lifeline for people to seriously consider the important issues. General city facing the lifeline system accidents are: water, electricity, gas, heat, traffic, and so on. A rational and practical, urban lifeline system reliability and safety of a comprehensive, we should reflect no particular fault, durability and maintainability.

In the past 20 years, China's lifeline in earthquake prevention and mitigation system in the study made a series of important progress. To guard against and reduce the earthquake disaster as an example, to clear the monitoring and forecasting, earthquake damage defense, emergency relief system. Put forward to some new ideas of earthquake prevention and mitigation, seeing below on the specific contents.

Lifeline System measures to earthquake prevention and mitigation

Different types of lifeline systems, in accordance with different types of earthquakes, can take two types of non-engineering projects and earthquake prevention and mitigation measures (WANG SHAOYU, FENG BAIXIA 2005). Lifeline works earthquake prevention and mitigation measures, more representative of the view that earthquake prevention and control of design and durability; non-engineering earthquake prevention and mitigation measures is in addition to works from all the measures of earthquake mitigation activities in accordance with the law, including: innovative management system , To establish sound management of institutions to develop and perfect laws and regulations, planning and preparation of contingency plans for earthquake prevention, earthquake outreach knowledge, the insurance system, reserves and earthquake relief funds and materials to treat post-earthquake psychological trauma, and various other aspects (LIANG ZHIYONG 2002). Engineering and non-engineering measures are two aspects of earthquake prevention and mitigation, can not replace each other.

Engineering measures and their limitations

Earthquake as an objective of a natural phenomenon and can not be completely avoided. According to the current level of technological development, people can not even accurately predict earthquakes, hurricanes, floods, tsunamis, landslides, mudslides and other natural disaster in time and place. The city is the lifeline systems may be based on the forecast of earthquakes, in accordance with the standards set by the construction of the defense. In general, the standard defense by the degree of awareness of the earthquake, investment and the level of construction, and other factors, can not increase indefinitely, it is difficult to avoid exceeding the standard defense of the building earthquakes. In addition, too many earthquakes defense project will cause ecological disaster, or become a new source of earthquake. In addition to the unpredictability of earthquakes and the defense limited standards, the city itself constitute a lifeline of the complexity of the project is also earthquake prevention and mitigation measures to increase the difficulty of a factor. With urbanization and the development of Lifeline system, greater coverage of space, or even across several countries and regions, Lead the environment more complex and difficult to control. Therefore, from the engineering point of view can not be totally avoided accidents.

City lifeline system include not only roads, water supply networks, power systems, and other traditional items, with modern information and communication technologies development, but also gradually expand to electromagnetic, networks, and other unnatural physical space. Practice shows that a large number of projects, resulting in the destruction of the traditional lifeline system be mainly earthquakes, floods and storms and other natural disaster caused unnatural physical space lifeline system damage is the main man-made disaster and technological disaster.

For a long time, earthquakes lifeline of the project has been the destruction of earthquake losses in the most important part. As the city continued concentration of wealth and social development, earthquakes caused by the interruption of business, information lost, people's psychological impact on the community, such as loss of even more serious. The primary function of engineering measures to protect people from earthquakes of the injury, is a kind of external protection, rather than measures to enhance the people's initiative, is the inner strength to withstand earthquakes.

Non-engineering measures to earthquake prevention and mitigation

Comparing with the engineering measures, including non-engineering earthquake prevention and mitigation enrich the content. One earthquake management system, technical legislation, earthquake insurance and earthquake education system constitutes a lifeline for urban earthquake prevention and mitigation of non-engineering system.

(1) Innovative emergency earthquake management system

According to the earthquake lifeline system characteristics, formation of the national, provincial, municipal and corporate multi-level earthquake management agencies, responsible for the implementation of territoriality, and in accordance with earthquake losses and the impact of different classification response to the earthquake management system, to integrate various resources for disaster mitigation, And information sharing to ensure that the lifeline of system security (HU BO 2001).

(2) To develop and improve earthquake prevention and mitigation of laws and regulations

China's deal with unexpected incidents involving the laws, administrative regulations and departmental regulations and the relevant documents, the rule of law constitute an emergency basis. The lifeline system, the competent government departments have also developed a corresponding technical standards and norms, such legislation for earthquake mitigation technology to reduce earthquake losses has played an irreplaceable role, but in some areas there are still missing and the laws and regulations need to be further improved technology has been Standards.

(3) Foster the insurance market in earthquake

Earthquake risk insurance share of the economy, earthquake insurance runs through the whole process of earthquake prevention and relief, the local earthquake-stricken areas of enterprise and family property losses of some economic compensation, the parties to reduce the loss of production and life (TIE YONGBO 2005). The development of earthquake insurance system is the lifeblood of the objective requirements of earthquake recovery, but also the prevention of market-oriented scientific research and industrialization of the needs. With the changes in China's investment system should be established mainly to earthquake insurance, voted with the Government, international assistance and social mutual assistance and other forms of coexistence, giving consideration to fairness of the new relief system, the Government, the engineering sector, the insurance sector should work together to continue to cultivate Lifeline system and the development of the earthquake insurance market, further improve the earthquake response system.

(4) Carrying out earthquake prevention and mitigation education

Earthquake prevention and mitigation as a social welfare, closely related the immediate interests of every citizen. Government departments in earthquake prevention and mitigation should play a leading role, non-governmental

organizations, citizen participation in earthquake prevention and mitigation activities with the legal obligations, with the active participation of citizens and the effects of earthquake mitigation (TIE YONGBO 2005).

Lifeline system safety regulatory models

Lifeline system stress a comprehensive earthquake mitigation capacity-building and indicators to assess, but its principles must be based on risk priority. Because in urban systems, in the urban lifeline system, particularly the face of earthquake can not be lost is a earthquake-preparedness capacity of the lifeblood of network security. The lifeblood of modern urban metropolis of the meaning of integrated earthquake mitigation should be more extensive, it requires not only lifeline of safety protection system hardware configuration and high reliability, but also with the requirements of the corresponding non-engineering strategy and measures of safety. From the integrated emergency management and earthquake mitigation based system for urban lifeline to deal with, and good management will control. This requires new levels to strengthen supervision of the city comprehensive security model of scientific innovation.

First, the scientific method from the security earthquake mitigation must be the implementation of safety planning, design for the first, from urban safety for the risk assessment of manpower, the urban lifeblood of the status quo system of the venues and security risk location; urban lifeline by other defense systems to combat the kind of earthquake Regional security; urban lifeline systems for normal and emergency conditions of different standby mode; existing urban public gathering places, large public buildings and facilities have an impact, residential projects, such as different levels of the lifeline system configuration security standards. In determining urban lifeline system uses different acceptable risk standards, under the premise is the lifeblood of different subsystems of the evaluation index. City Lifeline system can promote the safety and security of the mature technology is a professional network, the intelligent use of flexible interface to ensure that in the advent of the earthquake still smooth operation. This requires the technical approach to urban lifeline Scholars earthquake prevention and mitigation system for earthquake preparedness planning and urban planning, urban planning, such as evacuation system coordination. In addition, we should also study the lifeline system, and other key urban facilities to withstand terrorist attacks, such as risk assessment.

The second is from the city management methods, in particular the implementation of risk based on the principle of priority, improve the urban lifeline systems for earthquake preparedness capacity of the full attention and improve the management of important standards.

Lifeline system post-earthquake emergency relief

The so-called emergency relief is that in case of emergency from national organizations of human, material and financial resources to assist the loss of citizens, legal or illegal units restore production and rebuild homes relief methods. Generalized emergency relief includes a variety of reasons, narrow emergency relief due to natural earthquakes refer only to the rescue. Sudden earthquakes crisis led to a state of emergency is only a reason, not all of the crisis will cause a state of emergency (WANG SHAOYU, FENG BAIXIA 2005). According to the aforementioned idea of earthquake prevention and mitigation, emergency lifeline system post-earthquake rescue the specific measures are as follows:

(1) Establishing an emergency relief agencies

Faced to a major earthquake, many resources were involved to integration and management, including financial, material, personnel, the sector alone the general lack of authority. Establish a lead by the State Council leaders, including the handling of natural earthquakes, pollution of all kinds of unexpected crisis coordination department, not the establishment of a separate administrative department, but the relevant departments of power and resources integration.

(2) Improving the legal system of emergency relief

The adoption of legislation to improve from the main emergency treatment, emergency administrative measures to deal with emergency legal consequences, the main emergency relief, methods, measures and violations of the legal responsibilities of the emergency relief constitute the legal system. To a considerable extent and scope, in responding to sudden earthquake events, policies and administrative measures also replace the function of the law.

(3) Developing emergency plans

Sudden public events should be developed contingency plans, and to adopt legislation to be determined; earthquake prevention funds into all levels of national economic and social development plans, the establishment of earthquake relief funds. Earthquake contingency plans for dealing with sudden earthquakes, emergency action, through the development plan, a clear emergency system's organizational structure, including the vertical and horizontal level of organization of the functional departments and the corresponding set of responsibilities, rights and obligations.

(4) The establishment of emergency rescue team

Establish professional and non-professional integration of emergency relief teams. According to the distribution of the earthquake, the establishment can be a highly centralized command of the regional earthquake emergency relief professionals, to bear in peacetime earthquake relief task force for rescue training and knowledge training, and equipped with advanced can adapt to all kinds of complicated conditions of earthquake emergency rescue equipment; We should establish by the relevant professional training and access to emergency rescue teams from medical, power, communications, construction machinery, and other aspects of professionals; to build urban communities and rural grassroots earthquake response team, the first time on the Help to provide emergency relief, this is by the sudden earthquake, the regional decision.

Conclusions

Can be expected in the future, China's lifeline basic research projects will be greater development. With the modernization and the increased scale and expansion of people's lifeline for the increasingly rely on the system.

The occurrence of earthquakes, the lifeline system has serious damage when the earthquake, affected by a wide range of social impact, derivatives earthquakes and serious earthquake recovery a long time and so on. With the development of information technology, networking, communications and other, new lifeline systems be more vulnerable to vandalism.

City lifeline system, including earthquake prevention and mitigation measures and non-engineering measures, measures two different functions. Earthquake prevention and mitigation measure is the material basis, protecting people from earthquakes harm, rather than measures to enhance the people's initiative to improve the earthquake

response capacity. Engineering and non-engineering measures are two aspects of earthquake prevention and mitigation, can not replace each other.

Starting from the comprehensive earthquake prevention and mitigation, urban lifeline system need do deal with good management, to strengthen safety control of the city scientific innovation model.

According to the author's concept of earthquake prevention and mitigation measures proposed lifeline system post-earthquake emergency relief of specific measures.

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