

# STUDY ON RURAL AND URBAN SPATIAL PLANNING OF STRONG EARTHQUAKE ZONE IN CHINA

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## ABSTRACT :

This paper focuses on the scientific planning on different function zones of urban places, based on the distribution of China's strong earthquake zone as well as with the distribution of the tectonic cracks and faults using geographical information system (GIS). In addition, there is a more thorough presentation of the principle and the proposals of urban and rural areas spatial sites selection, spatial functional zonation and planning of lifeline systems, using GIS spatial analysis function combined spatial planning of Tangshan city, especially spatial planning of lifeline systems such as city green belt, emergency shelter, transportation, underground pipe network etc.

## KEYWORDS:

Strong earthquake zone, Rural and urban spatial planning, Geographic information systems, Geological structure

## 1. INTRODUCTION

### *The Ruinous Earthquakes*

As one of the biggest natural disasters, earthquakes threaten people's lives and property safety. A devastating earthquake often breaks out in a very short period of time causing heavy casualties or even destroying a city. For example, in 1923 in Japan's Kanto, earthquake, magnitude of 8.2, caused more than 100 thousand people died in the earthquake and more than 100 million people left homeless after the earthquake. In December 26, 2004, near the Indonesian island of Sumatra, strong earthquake with magnitude of 7.9 and the tsunami happened, affecting more than 10 countries around the Indian Ocean, causing more than 200,000 people died or missing. In 2003, in Iran's earthquake, the epicenter was in Bam in Iran's southeastern Kerman region with magnitude of 6.3 which killed 40,000 people and 70% of the homes in Bam were razed to the ground in ancient Silk Road.

China is one of the countries breaking out the world's most serious earthquake disaster. There were more than 50% death in China because of the earthquake, and the two major earthquakes have occurred in China with the total death more than 200000 people. In the May 12, 2008, 5.12 Wenchuan earthquake affected area over 100,000 square kilometers, directly affected a population of more than 10 million, of which nearly 70,000 people were killed and 220,000 people were injured and direct economic losses was more than five 100 billion Yuan. A lesson from warns us again: the destruction in earthquakes area from the earthquake disaster is great, or even destructive.

Faced with this painful lesson, we triggered a strong consideration to earthquake zone on China's regional urban and rural spatial planning. In this paper, the temporal and spatial distribution of China's earthquake pattern was analyzed, and made some suggestions on the regional urban and rural planning in earthquakes strip.

## 2. THE TEMPORAL AND SPATIAL DISTRIBUTION OF CHINA'S EARTHQUAKE PATTERN ANALYSIS

China is located in the east of the continent of Asia, the West of Pacific, and the land area is about 9.6 million square kilometers. North China's territory is in the north of Mohe in Heilongjiang river (latitude  $53^{\circ} 30'$ ), the south to the south of the Nansha Islands Zengmuansha (latitude  $4^{\circ}$ ), crossing latitude 49 degrees, the east to the confluent area of Heilongjiang and Wusuli River (east longitude  $135^{\circ} 05'$ ), and the west to the Pamirs (longitude  $73^{\circ} 40'$ ), crossing over 60 degrees longitude. From south to north, from east to west, the span is more than 5,000 kilometers, in. complex geological structure, and distribution of fault-intensive. Figure 1 is the distribution of China's active fault zone, and Figure 2 is the seismic zoning map of peak acceleration in China.

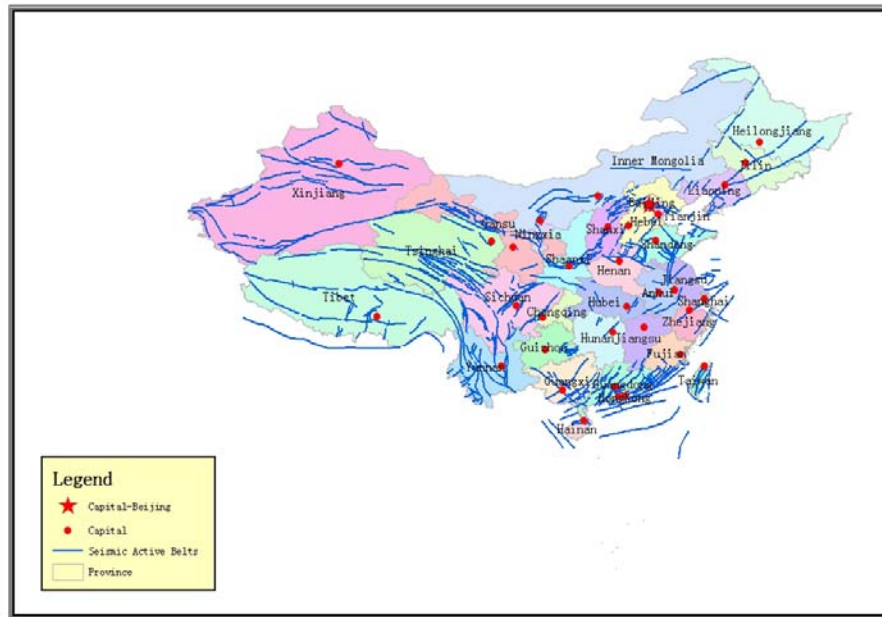


Figure 1. The distribution of active fault zone in China

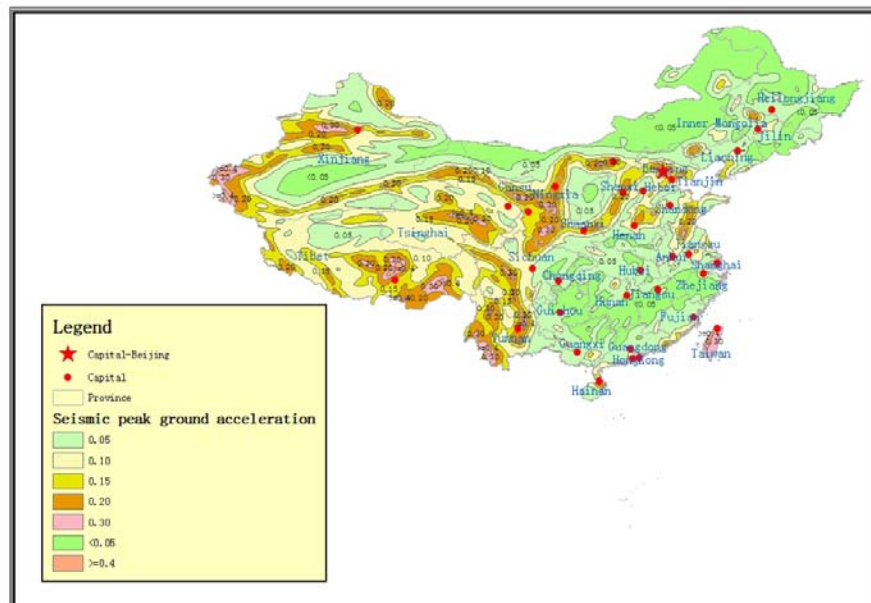


Figure 2. The seismic zoning map of peak acceleration in China

The relationship between the peak acceleration and the basic value of seismic intensity is shown in Table 1:

Table 1. The relationship between the peak acceleration and the basic value of seismic intensity

seismic peak ground acceleration zonation(g)	<math><0.05</math>	0.05	0.1	0.15	0.2	0.3
the basic value of seismic intensity	<math><VI</math>	VI	VII	VII	VIII	VIII

From Table 1, some conclusions were got. The basic value of seismic intensity was above magnitude of 7 where the peak acceleration of ground motion was above 0.10 g. Earthquakes above magnitude of 7 were most located in western and northern China. Figure 3 is distribution of the peak acceleration of ground motion above 0.10 g.

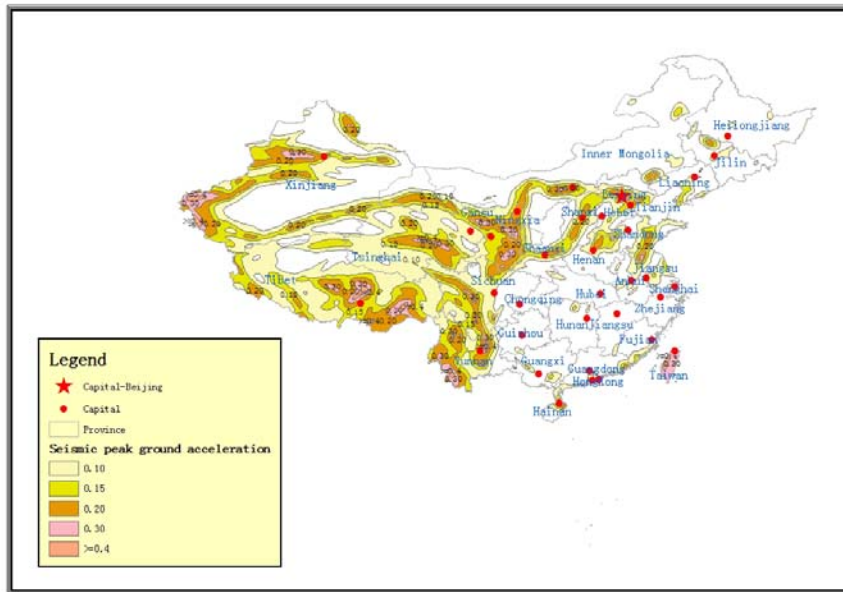


Figure 3. The distribution of the peak acceleration of ground motion above 0.10 g  
The earthquakes above magnitude 7 were shown in Table 2 and Table 4 from 1950.

Table 2. The earthquakes above magnitude 7 from 1950

The name of earthquake	Time	Site	Ms	Death toll
Chayu earthquake	At 22:9:34 in August 15, 1950	Chayu, Tibet	8.5	4000
Xingtai earthquake	From March 5 to March 22, 1966	Longrao and Ningjin, Hebei	6.8 7.2	8064
Tonghai earthquake	At 1:0:34 in January 5, 1970	Tonghai, Yunnan	7.7	15621
Haicheng earthquake	At 19:36:6 in February 4, 1975	Haicheng, Liaoning	7.3	1328
Tangshan earthquake	At 3:42:54 in July 28, 1976	Tangshan, Hebei	7.8	242000
Lancang, Gengma	At 21:3 and 21:16 in June 6, 1988	Lancang and Gengma, Yunnan	7.6	743
Wenchuan earthquakes	At 14:28 in May 12, 2008	Wenchuan, Sichuan	8.0	69200

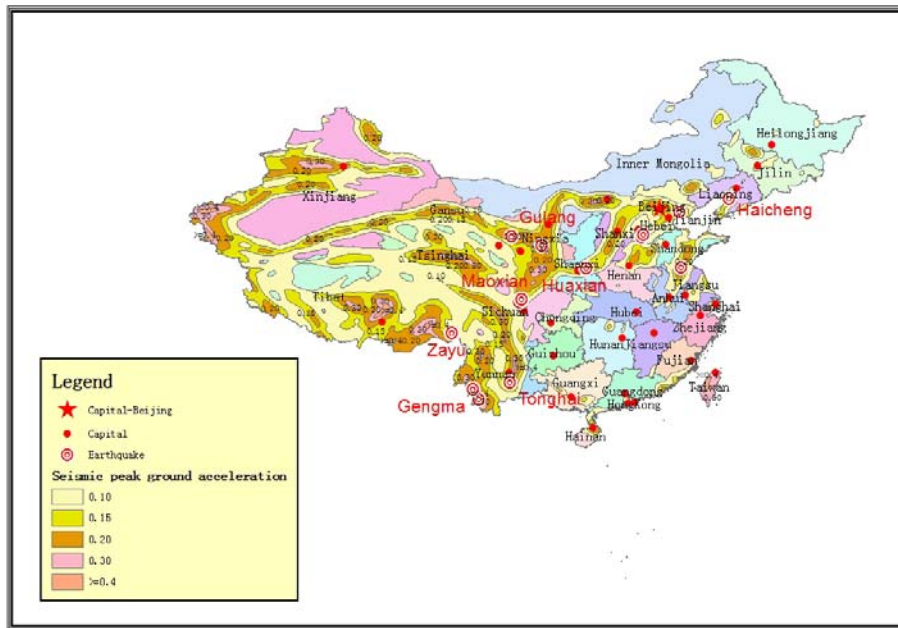


Figure 4. The distribution of earthquake above magnitude of 7 in China

### 3. SOME CONSIDERATION ABOUT REGIONAL URBAN AND RURAL SPATIAL PLANNING IN EARTHQUAKES

China has a long history, and cities often have a history of hundreds of years. The sites of ancient cities and towns were limited by scientific and technological level, and the underground geological structures were unknown to them, and the main town sites based on the surface, terrain, topography, water and other natural conditions. In this case, many important cities and towns are located in the active fault zones on or near active fault zones, such as the earthquake-stricken area of Wenchuan, Beichuan, Tangshan and so on. In modern science and technology conditions, facing analysis of the seismic situation in China, the hot issues of common concern is how to regular urban and rural planning scientifically and rationally in China's earthquakes strip. The following are some suggestions about this issue.

#### *Launch regional spatial integrated planning of rural and urban*

The overall goal for regional spatial integrated planning in strong seismic zone is to gradually increase the urban and rural comprehensive anticknock capacity, minimize the damage caused by the earthquake disaster, and protect the people's lives and property safety in earthquake and the smooth progress of economic after earthquake. The city in the earthquake impact equivalent to basic intensity, its vital systems will not be serious damaged, its important industrial and mining enterprises will be normal or can quickly restore production, and people's lives keep normal.

At present the overall planning and regional planning are based on the city, and with the progress of urbanization, the big regional planning and national planning have been gradually attention. Because of China's strong earthquake country with a wide range of regional, large area, so it must be unified planning to carry out regional urban and rural planning in strong earthquake country.

To carry out rural and urban regional spatial integrated planning is extremely significant for protecting national security and stability, and improving national comprehensive earthquake disaster prevention capacity. Adopting planning ideas of both status quo and development and establishing reasonable medium and long-term planning are the requirements of the times to earthquake disaster prevention planning that raised by regional urban and

rural construction and development in China's strong earthquake country. People-oriented, combining the situation peacetime and disaster, to strengthen the practicability and operability of planning is a current important subject in disaster prevention planning and development. Not only the status of seismic disaster prevention issues should be taken seriously, but also the problems, which may be encountered in the future earthquake disaster, should be taken more attention.

### ***Strengthen earthquake research, jointing multidisciplinary planning***

In urban and rural planning of strong earthquake country, both topography, geomorphology, engineering geology, hydrogeology, and other conventional factors, and the local cultural history, local customs, and so on, have to be considered, in order to conduct reasonable planning in urban and rural region and ensure sustainable development of strong seismic belt. The strong earthquake research and the advantages of multi-disciplinary should be jointed to plan the strong earthquake country:

- (1) Deepen geological tectonic movement study, master the Chinese and global geodynamics law; provide a scientific basis for earthquake prediction.
- (2) Launch the analysis study about the relation between urban and rural construction, geological stress and the bearing capacity, strengthen the monitoring of geological structure and land subsidence monitoring, research the impact of outside to the earthquake.
- (3) Strengthen the study of earthquake observation, joint multidisciplinary to observation, such as carrying out the joint observation of electricity, gravity, electromagnetic wave, groundwater, crustal deformation, and other multi-disciplinary. Research the theories and methods about jointing multidisciplinary observations and provide support for earthquake research, and, at the same time, provide more comprehensive basis for earthquake prediction.
- (4) Explore new study technologies about earthquake, such as remote sensing, infrared and other new technology research, in order to provide new ideas for earthquake research.
- (5) Land, water conservancy, urban construction, immigration, and so on, should be considered all together to planning synthetically strong earthquake country. Conducting seismic disaster prevention planning, the city and countryside comprehensive space pattern arriving in strong earthquake country, developing strategy and so on, should be bethought contemporaneously.
- (6) Assess synthetically the existing urban and rural pattern in strong earthquake country from the geological structure and the distribution of strong seismic zone, restrict the scale of towns on the active rift zone, change its development layout, and even consider resiting the towns whenever it is necessary.
- (7) With a new perspective to consider and study urban and rural construction materials of strong earthquake country, and research the regional housing reinforced and shock-proof schemes;
- (8) Establish a regional early-warning and emergency-response support platform about strong earthquake country, which can warn and provide the support to early-warning, emergency-response and decision, for earthquake and its secondary disasters (landslides and debris flows, floods, Yan Sehu, etc.) in strong earthquake country.

### ***From the macro, meso and microscopic perspective to carry out regional urban and rural spatial planning in strong earthquake country***

During the period of urban and rural spatial planning of China, it's needed to consider synthetically from macro, meso and microscopic perspective, in order to improve the seismic disaster overall prevention capability in strong earthquake country.

#### ***3.3.1. On macro perspective***

- (1) Antiknock factors should be taken into account in urban and rural layout. The urban and rural land use should avoid landslides, subsidence, fault zones, soft soil and soil liquefaction zone.
- (2) Nuclear facilities of national infrastructure should avoid building in strong earthquake country.

#### ***3.3.2. On meso perspective***

- (1) Urban layout should adopt the delegation, organizing green wedge into city, which can provide convenience for shock absorbers and evacuation in earthquake.
- (2) Planning rational urban and rural road network, ensure rescue team arriving timely after earthquake.

(3) Toxic, flammable and explosive chemical plant should be far away from the cities, to reduce the probability of secondary disasters caused by gas leak, explosion, fire, and so.

#### *3.3.3. On microcosmic perspective*

(1) Reasonable planning earthquake disaster prevention facilities, the reasonableness of earthquake disaster prevention system space layout is an important guarantee for those facilities to play their role. Almost all the earthquake occurred, space for evacuating and isolating population was needed, so they, including city parks, green space, the square, open space mainly based on ecological afforestation land, are became the main vector space of the city's comprehensive disaster prevention.

(2) Arranging reasonable evacuation routes and evacuation space, residential areas can be evacuated to nearby parks, sports venues, etc. Evacuation channels should have enough width, only in this way, even buildings on both sides collapsed, access will not be blocked.

(3) Improve the building antiknock level in commercial district(such as department stores, shopping centers, stores, banks, schools, insurance companies, stock exchanges, commercial office buildings, hotels, restaurants, dance halls, cinemas, etc.), reasonable planning evacuation space.

(4) Medical units should be focused on, to improve the antiknock structure. Some key protection units, such as the substation, inflammable and explosive storage, coal gas and gas storage, and so, should be identified.

(5) It is important to protect the urban life system during planning, including urban transport, communications, water supply, gas, fire protection, medical systems, etc. When the earthquake occurred, it ensures that the urban system should be operating normally or be resumed in short time.

### ***3.4 Establish regional urban and rural spatial planning integrated information platform in strong earthquake country***

The establishment of regional urban and rural spatial planning integrated information platform based GIS will greatly improve the reasonableness on planning. GIS (Geographic Information System, for short GIS) as the important tools, technology and science in acquisition, processing, management and analysis of geospatial data, has been widespread concerned in recent years, and has a rapid development. Earthquake is a natural disasters relating closely to geographical space. The distribution of seismic zone and seismic disaster belong to spatial information areas, regional urban and rural spatial planning in strong earthquake country is based on complicated geographical and cultural information, so GIS is to meet this demand. It has the ability to analyze and manage mass information. GIS, used in regional urban and rural spatial planning, can establish analysis model throng analyzing distribution information of seismic zone, basic spatial geographic information, lifeline engineering, buildings, cultural, and economic position. On the basis of analysis model, it can improve planning efficiency and level, but also improve the science and rationality of planning to use GIS on regional urban and rural spatial planning.

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