The research on Hainan earthquake insurance system

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1 Significance of this research

The coastal area of Southeast China and Hainan province have been in a new seismically active stage since 1986, and a new cycle for intensive seismicity in China Mainland began in 1988. Simultaneously, large shocks occurred frequently all over the world in recent years, which caused large losses. Therefore, the earthquake insurance is one of the most important branches for synthetic earthquake mitigation. Now the earthquake insurance is separated as a single one from the general insurance for property by the People’s Insurance Company of China (PICC), so it is a real urgent need for the research on the earthquake insurance, which is a valid means to realize social cooperation, to lighten the financial load of the government, and to improve the anti-seismic and anti-hazard capability. The earthquake insurance can provide the insured communities and families with sufficient economic compensation in time after an earthquake, sustain the damaged enterprises to recover operation, and help the afflicted people to rebuild their home. Either before or after a shock, the earthquake insurance holds an important role to stabilize the people and the society. So, the research on the earthquake insurance is very important for the anti-earthquake and anti-hazard work.

2 Status in the world and in China

The business of earthquake insurance and the relative research are first developed in USA, Japan and Mexico, which grew rapidly from 1950’s to 1980’s. The earthquake insurance is treated as a specific additional insurance to some basic insurance (e.g. fire insurance) or a single insurance for a commercial purpose. It is protected and restricted by legal items relevant to earthquake and insurance. In Japan, the earthquake insurance is a kind of shared insurance. The earthquake insurance is discussed as a single insurance in other countries of the world.

Common Fire Insurance Items carried out damage in 1951 stipulate the responsibility of insurance for earthquake damage in China. Since the insurance business was resumed in 1979, earthquake risk has been regarded as a basic insurance responsibility in China. The research on earthquake insurance in China began in 1986, it results the scheme to maintain the present general responsibility insurance and build up the insurance fund. All these has done good in China. In

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1988, Ying-Fang Chen and Yi-Zhu Zhao of the Institute of Geophysics of SSB worked on the calculation of earthquake insurance premium ratio, they introduced a new method to calculate the pure loss ratio with the average probability of historical seismic intensity and the vulnerability of structures, then to calculate the additional premium. The earthquake insurance premium ratios are computed for different seismic zones with a additional risk coefficient of 1.6. With the deepening of our reformation and opening, it is very realistic for the earthquake insurance to be an single insurance. The research on the earthquake insurance as an additional one or a single one needs perfecting and developing, so we have done some prime work with the real conditions of Hainan province.

3 Method for calculation

The present calculations for earthquake insurance premium ratio are all based on the prediction of the loss in the earthquake, and the prediction pattern for the loss in an earthquake is:

1. Define the intensity of the hazard $I$.
2. Predict the yearly probability $(P_{s,i})$ for the occurrence of a shock with intensity $I$ in the site $S$;
3. Define the damage grade $J$;
4. Develop a probability matrix when the $L$-th classified property is hit by an event with hazard intensity $I$ and damage grade $J$, that is the vulnerability matrix $P_{L,i,j}$;
5. Provide the loss ratio $B_{L,j}$ (cost for repair/cost for reconstruction) when the $L$-th classified property is damaged with $J$-grade intensity;
6. Calculate the relevant loss expectation $E_{L,i}$ while the $L$-th classified property is hit by an event with hazard intensity $I$, and the loss expectation for yearly hazard $E_{S,L}$ for the $L$-th classified property in the site $S$:

$$E_{L,i} = \sum B_{L,j} \times P_{L,i,j}$$
$$E_{S,L} = \sum P_{S,i} \times E_{L,i}$$

The earthquake intensity is the strength magnitude of the seismic hazard, and the yearly probability prediction for a site to be hit with some intensity is obtained from the following steps:

1. Do the prediction with seismic risk analysis, then use the calculated relevant loss as a reference criterion for the determination of the premium ratio;
2. Calculate the relevant loss using the yearly average probability for the historical earthquake intensity, which is called pure premium ratio. And the value of pure premium ratio times additional risk coefficient is the reference criterion for the premium ratio. The data of the vulnerability matrix are obtained from the calculation of the damage in structures, the investigation of the seismic hazard and the answers from the specialist paper, and the loss ratios are from the investigation of the hazards and markets.

The new trails of our study is in the aspect of the prediction for the yearly probability of the seismic intensity, in which we use not only the seismic risk analysis and the prediction method for the yearly average probability of historical seismic intensity, but also the prediction result for 3~5 years or 5~10 years seismicities, i.e. the mid-term earthquake prediction with probability by using the methods of seismicity episodic analysis, evolution process of seismic sequences and the site investigation for strong shocks. The earthquake insurance premium ratio in Hainan in recent years is evaluated on the basis of synthetic research, and the result shows that the ratio is stable in some mid-term time interval.

4 Earthquake insurance guarantee

Seismic hazards are characterized by sudden occurrence, large loss and long return periods.