

A Secondary Disaster Due To Inhabitant's Action after a Strong Earthquake: a Case Study of the 2008 Sichuan Earthquake

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Abstract—After a strong earthquake occurs, a secondary disaster due to strong aftershocks, flood, landslide or heavy snow can possible to occur and the secondary disaster due to resident's action also can possible to happen. However, until now seldom researchers have paid attention at it. This paper focused on the Inhabitant's action after the strong earthquake occurs when a terrible even becomes calm. An inappropriate behavior of people with disadvantaged climate after the worse earthquake can bring a tragedy to their life.

Keywords—Sichuan Earthquake, Secondary Disaster, Inhabitant's Action, inappropriate behavior.

I. INTRODUCTION

NATURAL disasters have frequency and severity all over the world. The statistics for the last 30 years clearly show that Asia is the most disaster afflicted region in the world and more than 50% of the total fatalities and economic losses. This is due to various factors, such as global climate change, environmental and ecological imbalances, increasing population density, ad-hoc urbanization, deforestation and desertification [1].

Based on data from the natural disaster data book 2006 which related to disaster type, a proportion of people killed by earthquake in worldwide shows 27.8% (total: 2.22 million people) in 1975 to 2006, 21.6% (total: 27,262 people) in 2006, and 36.4% (total: 16,151 people) for Asia region, respectively. Compounded by these data, the earthquake is the most disaster which is a cause to killed people in the world [1].

After a strong earthquake occurs, the secondary disaster due to major aftershocks, flood, landslide or heavy snow can possible to occur and it can be a cause of further injuries and death to inhabitants [2]. However, after the terrible event calm down, residents often return to their house for taking properties. Furthermore, resident is living and doing business around those buildings which got intense damage.

This paper focused on the inhabitant's action after the situation calm down. An inappropriate behavior of people and

disadvantaged climate can bring a tragedy to their life again as other disasters. We should notice, prohibit people entry to those buildings and move them out immediately along with other activities.

II. THE 2008 SICHUAN EARTHQUAKE

In the afternoon of May 12, 2008 a devastating earthquake struck a mountainous region in western of China. This earthquake became known as the 2008 Sichuan earthquake. The magnitude of the Sichuan earthquake was $M_s=8.0$ and $M_w=8.3$, according to PRC's China Seismological Bureau. The epicenter of the earthquake was located at 103.364° east and 30.986° North. The epicenter was 80 kilometers west-northwest of Chengdu, the capital of Sichuan, with a depth of 19 kilometers. The powerful thrust force collapsed buildings, caused liquefaction, cut off rivers, cracked roads and dams. The earthquake was killed 69,107 people and 373,577 injured, with 18,230 list as missing (as of June 3, 2008). The earthquake left about 4.8 million people homeless, though the number could be as high as 11 million. It is the deadliest and strongest earthquake to hit china since the 1976 Tangshan earthquake, which killed at least 240,000 people and approximately 15 million people lived in the affected area [3].

A. Damage from Aftershocks

After the main shock there were over fifty-two major aftershocks, ranging in magnitude from 4.4 to 6.0, were recorded within 72 hours of the main quake and aftershocks have been occur more than thousands in the past two weeks. The total number of death has been increasing on a daily basis, in part due to the havoc wrought by the aftershocks.

On May 25, a major aftershock of 6.0 Mw hit northeast of the original earthquake's epicenter, in Qingchuan Country, causing 8 deaths, 1,000 injuries and destroyed 70,000 of buildings, 69 dams in the province damaged in the original quake were in danger of bursting their banks. The aftershock damaged more than 200,000 other homes, It also damaged another dam, cutting off several more roads in the region state news media reported [3] [4] [5].

On May 27, two more major aftershocks, a 5.2 Mw in Qingchuan Country and a 5.7 Mw in Ningqiang in Shaanxi Province led to the collapse more than 420,000 homes, 6 critically and injured 63 people. The newly collapsed houses totaled 4.95 million square meters, adding to about a million houses which were already damaged or leveled in previous

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tremors. The new aftershocks have also engendered 146 new geological hazards including cracks and debris slides in the mountainous area [3][6]. Table I shows the damages from the major aftershocks on 25-27 May.

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III. DUJIANGYAN CITY, CHENGDU PREFECTURE

Dujiangyan is a country-level city of Chengdu, Sichuan Province in China. It has area of 1,208 square kilometers and a population of 600,000 with density 496.7/km² (1,286.4/sq mi) in 2003. Fig. 1 is showing a location of Dujiangyan city in Chengdu, Sichuan Province.

On 12 May 2008, the city was the closest to the epicenter of the 2008 Sichuan earthquake and the city severed damage. Xinjian Primary School, JUYuan Middle School, and Xiang'd Middle School collapsed in the earthquake [3] [7].

If you are using *Word*, use either the Microsoft Equation Editor or the *MathType* add-on (<http://www.mathtype.com>) for equations in your paper (Insert | Object | Create New | Microsoft Equation or MathType Equation). "Float over text" should *not* be selected.

A. A Survey in DujiangYan City

We were surveyed for 7 days from 24th to 31st May 2008, in DuJiang Yan (Tokouen) City, ChengDu Province.

Throughout our survey, we find out that after the terrible situation is over and people's mind is getting better and calm, they are going back home to take properties from their house which got intense damage. Some people pull down frame doors, wall and etc.

Furthermore, the residents are living, doing business around and going inside those buildings which got intense damage.

In the middle of staying in the city for 7 days, heavy rain and 3 major aftershocks hit the disaster region and more than 490,000 homes are collapsed.

These actions and bad climate can possible to bring the tragedy to their life as other disasters.

B. Site of Photographs

(1) Photograph1: Dangerous Demolition

Photograph1 shows a demolishing of building which used human labor and truck. A whole state of building is severely damaged, all walls are demolished, columns are intense damaged and some columns shifted from central position and glass windows are breaking. At the left side of 1st floor, demolition work is done by a truck and at the 2nd and 3rd floor demolishing work is done by human labor.

In the middle of demolishing, the building can possible to collapse any time, but a housebreaker has used human labor to demolish inside of building along with using truck for demolishing building.

For demolishing of building, should not used human labor and not allow people to go inside demolished building.

(2) Photograph2: Inappropriate Action

A building quiet old and has a big damage, a fragment of broken buildings has littered surround building and resident possible to injury in the falling objects.

But inhabitants are going inside their house to take properties. Soldieries have watched around area but sound as they recognize those actions. Residents should not entire to the damage building witch not confirming the safety yet. Photograh2 is showing the inappropriate action.

(3) Photograph3: Dangerous Action

An apartment building of brick structure is near collapse state. Have large vertical cracks occur in an edge of L type building and have big diagonal cracks occur in around the walls. The brick columns in first and second floor are collapse and a floor is falling down. The building is losing structural support part and in the state that can't be reinforced. But, residents are going inside for taking their furniture and properties from the apartment for moving out. Moreover, have a man is detaching the window frame work in the next door. The building where structural support part is lost possible to unexpected collapsed by aftershocks and vibrations. Inhabitants should not entire or be around such the building. Photograph3 shows the dangerous action.

(4) Photograph4: Dangerous Business

The wall has destroyed partially and early reinforcement is needed. Structure type is unconfirmed but bricks are showing at column. Before entire to the building rapid structural checked is needed. But resident is doing shop business in the building which not checked the safety and has intense damage. These actions can be a caused of expanding damage further. Photograph4 shows the dangerous business state.

(5) Photograph5: Danger posted by the Falling Objects

During his detaching work, these flower baskets can fall down anytime by the aftershocks or the shakes from the works but he isn't notice it. These actions can possible to make resident injured. A post earthquake quick inspection of damaged building to evaluate the risk of building collapse, fall of exterior walls and window glass and so on are needed.

IV. SETTLEMENT PROPOSAL

- (1) Do not use human labor for interior with upper stairs demolishing work.
- (2) Execute a post earthquake quick inspection of damage building immediately.
- (3) Post-evaluation placards posted on damaged building inform the risks not only for inhabitants but also for passersby.
- (4) Do not allow people to go inside, living or running any business in the building which not confirming the safety yet.
- (5) Never enter the building unknowing of its hazard.
- (6) Keep people out from the unsafe building.
- (7) Reinforce the damaged building which has a possibility of reuse as soon as possible.
- (8) To improve awareness of disaster prevention must educated and train and make a conscious effort to inhabitants.

V. CONCLUSION

After the Sichuan Earthquake hit China, have many disasters

have hit and 2nd, 3rd disaster have occurred around disasters area until now. We could not stop the effect from natural disaster and for developing country is very difficult to reinforce all of dwelling for resistance from these disasters and our

wrong action can bring a tragedy to the saved life, but we can protect the saved life from the tragedy which caused from the inappropriate behavior by our self.

TABLE I
 DAMAGE DUE TO AFTERSHOCKS*

Date	Epicenter	Magnitude	Deaths	Injuries	Building Collapses
May 25	Qingchuan, Sichuan Province	6.0 Mw	8	1,000	70,000
May 27	Qingchuan, Sichuan Province	5.4 Mw		63	420,000
	Ningqiang, Shaanxi Province	5.7 Mw			

* China National Seismological Network; State Media News;

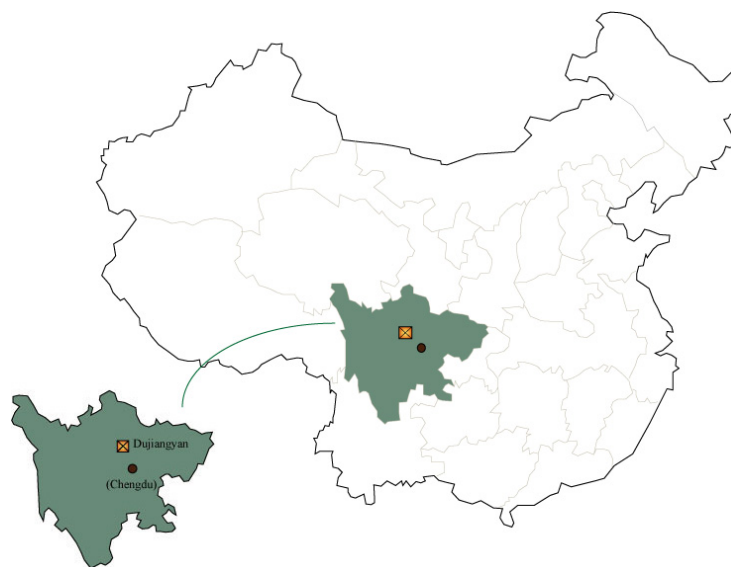


Fig. 1 Location of Dujangyan in Chengdu, Sichuan, China



Photograph1. Dangerous Demolition



Photograph2. Inappropriate Action



Photograph3. Dangerous Action



Photograph4. Dangerous Business



Photograph5. Danger posted by the Falling Objects

REFERENCES

- [1] Natural Disaster Data Book 2006.
- [2] BBC News, May 27, 2008.
- [3] Wikipedia, the free encyclopedia.
- [4] Toll Rises in China Quake - NYTimes.com
- [5] Yuli Yang and Samson Desta. CNN.com, May 26, 2008.
- [6] Mu Xuequan, www.chinaview.cn, May 28, 2008.
- [7] New York Times, May 25, 2008.