Investigation of landslide and rockfall caused by Wenchuan earthquake of Ms8.0

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Abstract: Some failure characteristics of landslides and rockfalls caused by Wenchuan earthquake of Ms8.0 are summarized, and external causes and internal causes of the geological disasters are listed. In view of large of casualties and properties loss, evaluating work on seismic geological hazards is strongly recommended for choosing new-site of suffered towns or for analogous zone.

Keywords: landslide, rockfalls, strong ground motion, surface rupture

1. Introduction

Many kind of geological disasters caused by Wenchuan earthquake of Ms8.0 make people in the earth to strengthen the awe of nature; to rethink the knowledge and experience had been gotten previously; to calibrate the model parameters based on classical theories; to explore mechanism of new kind of failure phenomena. The project of this document is to summarize geological disasters of this earthquake on junction zone of mountain and plain, so as to guide the plan for choosing new-site of suffered towns or for analogous zone.

Longmenshan fault locates the junction of Tibetan plateau and Sichuan plain, where vertical throw is about 3000-4000m. Many kinds of geological disasters caused by Wenchuan earthquake of Ms8.0 had taken place, such as landslide, rockfall, liquefaction, landflow, which distribute 50km around the Longmenshan fault. the landslide blocks the traffic, creek and river; submerge or demolish civil houses; cause a lots casualty and wealth loss. In this paper, we will focus on landslide and rockfall only.

Source rupture process and displacement filed is given by inversion method of geophysics; acceleration field is given by strong ground motion records and interpolation; seismic intensity distribution is given by in-situ survey as well. But geological failure phenomena on the view point of geotechnical investigator are more complex than given fields, which make many researchers take more care of on them.

The majority of landslide and rockfall locates on heavy disaster area, which is a long and narrow area limited in Longmenshan central fault(Yingxiu-Beichuan), Mao-Wen fault and An-Guan fault. The external causes of landslide and rockfall are the high level strong ground motion and surface rupture, and the internal causes are topography of alpine mountain-canyon, cutting of joints and bedding severely in the rock body, deposition and environmental weathering of overburden soil

layer on the rock.

2. Classic examples of landslide and rockfall

2.1 Example 1

There are 7 huge scale landslides on the road about 1km from Hanwang to Qinping, where is on An-Guan fault. The middle one marked with line in photo 1 is caused by high level of strong ground motion, ground surface rupture, and weak bedding in the rock body. The site is located at 104°10′35.8″, 31°28′32.5″.

Photo 1 Landslide on the An-Guan fault (104°10′35.8″, 31°28′32.5″) , the line denotes weak bedding in the rock body

2.2 Example 2

There is a landslide on the road about 1km from Hanwang to Qinping, where is on An-Guan fault. The landslide in photo 2 is caused by high level of strong ground motion, ground surface rupture, and poor bond between soil layer and rock body. The site is located at 104°10′32.0″, 31°28′22.4″.

Photo 2　Landslide on the An-Guan fault (104°10′32.0″, 31°28′22.4″) , the interface between soil layer and rock body is slippery or friction free

2.3 Example 3

A landslide in photo 3 takes place in Qingchuan county (the phenomena also can be found in other disaster areas, such as Tangjiashan). What should be noted is this kind of ‘the landslide’ is not traditional one, where mountain is high and the slope is very steep and bond between soli layer and rock is poor. The soil layer and rock will be separated and soil layer will be thrown out as Cement Mortar of wall falling, and the mass of soil will block river, which mountain under strong action of horizontal acceleration.

Photo 3　Landslide on alpine gorge region (105°17′51.1″, 32°32′22.9″) , the bond between soil layer and rock body is lost, which caused by asynchrony vibration

2.4 Example 4

A huge landslide in photo 4 takes place at Chifeng, Shifang city, the length is about 1.5km and the height is 500-800m, and several small slides embed in the huge one, see photo 5. A small fault in photo 6 is found on the slide foot, which crosses the hill. Surely, the small fault is touched by Longmenshan fault, in despite of the displacement can not be quantitated. Adjacent hills are intact. Based on above statement, the landslide is caused by the small fault movement.

Photo 4 Landslide in Chifeng (103°46′58.4″, 31°08′18.8″) , A small fault crosses the hill.

Photo 5 A small slides embed in the huge landslide

Photo 6　A small fault is touched by Longmenshan fault

2.5 Example 5

There is a cuboid rockfall on the road from Dujiangyan to Yingxiu, where locates on Longmenshan central fault. Intact rock body, stable system, was cut by joints and beddings in case of deposition and environmental weathering, and change as an unstable system. Several blocks will be separated form rock body and fall down with gravity, which unstable system under strong ground motion and surface rupture.

Photo 7　A rockfall on the road from Dujiangyan to Yingxiu

2.6 Example 6

There is one of several rockfalls on the road from Renjiapin to Beichuan County(photo 8), where locates on Longmenshan central fault. The fall blocks are round or angularity blur, and joints and

beddings is full-fledged, and the interfaces of among block-block and block-soil are clear. The blocks fall down under strong ground motion and surface rupture (photo 9).

Photo 8　A rockfall on the road from Renjiapin to Beichuan County(104°27′43.2″, 31°49′22.7″)

Photo 9　A piece of surface rupture at Renjiaping(104°26′50.3″, 31°48′54.0″), which direction turn to Beichuan county, fault scarp is 1.7-2.5m

3. Conclusion

The majority of landslide and rockfall are caused by strong ground motion and surface rupture induced Longmenshan central fault(yingxiu-beichuan), Mao-Wen fault, An-Guan fault, secondly faults, which are the external causes of landslide and rockfall. The internal causes of landslide and rockfall are topography of alpine mountain-canyon, cutting of joints and bedding in the rock body, deposition and environmental weathering of overburden layer on the rock.

So, some rules should be done for choosing new-site of suffered towns or for analogous zone, and evaluating work on seismic geological hazards is strongly recommended[1], so as to avoid the

tragedy takes place again.

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References

[1] Zhao Jisheng, Zhou Zhenghua, Evaluating Guideline on Seismic Geological Hazards for Choosing New-Site of Suffered Towns[J] , World Earthquake Engineering, 2008, 24(2): 26-31.