Building Damage on Surface Faulting of 2016 Kumamoto Earthquake, and Counter Measures

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This paper reports the results for investigating building damage near the surface faulting of the 2016 Kumamoto earthquake, and counter measures of building. The results of the building investigation indicated that most of severe damage occurred in those directly above the surface faulting, because of its slip deformation. And, almost all severe damaged buildings were very old wooden houses/apartments, whereas new wooden or RC buildings showed very minor damage. In the Shimojin area, for examples, the ground motion was probably not strong enough to cause severe damage, and thus, the highest damage was Grade 3. All of them were very old wooden buildings and directly above the surface faulting. Even though the best counter measure for buildings near active faults is to avoid them, it is unrealistic to prohibit regular buildings in such areas shown in this study, because the exact locations of the surface faulting are very difficult to identify. In fact, they differed from those of the actual surface faulting, because of the young alluvial/volcanic sediments and the artificial land development. In addition, the recurrence intervals of the active faults are extremely long (usually several thousand years), as compared with the lifetime of a building. And the most importantly, various safety counter measures are effective, even for the building directly above the surface faulting. For example, the new wooden houses with the mat foundation of RC could prevent the slip deformation from reaching the building, and the combinations of the shear wall and light roofs prevented severe damage. On the other hand, the old Japanese traditional houses generally suffered severe damage, but their structural flexibilities could prevent collapsing by following the slip deformation. The collapsed buildings were generally very old and lacked both the sufficient earthquake-resisting structural members and the effective connections among them.

Keywords: 2016 Kumamoto Earthquake, Surface Faulting, Damage and Counter Measures of Building

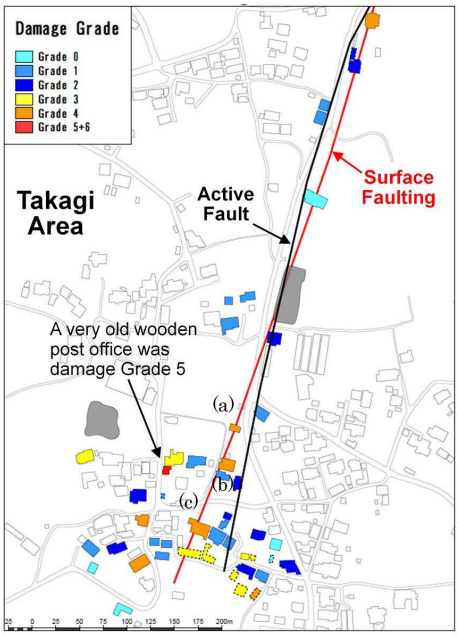

図１　地表地震断層近傍の建物被害分布（高木地区）

表１　地表地震断層近傍の建物被害統計（高木地区）

構造	棟数	割合
木造	35	90%
S造	3	8%
RC造	1	3%
合計	39	100%

築年	棟数	割合
30年以上	17	44%
30～10年	12	31%
10年以下	10	26%
合計	39	100%

古い建物

被害度	棟数	割合
Grade 0	0	0%
Grade 1	6	50%
Grade 2	3	25%
Grade 3	1	8%
Grade 4	2	17%
Grade 5	0	0%
Grade 6	0	0%
合計	12	100%
全壊	2	17%
倒壊	0	0%

非常に古い建物

被害度	棟数	割合
Grade 0	0	0%
Grade 1	5	29%
Grade 2	5	29%
Grade 3	2	12%
Grade 4	4	24%
Grade 5	1	6%
Grade 6	0	0%
合計	17	100%
全壊	5	29%
倒壊	1	6%

断層直上のみ

被害度	棟数	割合
Grade 0	1	14%
Grade 1	1	14%
Grade 2	2	29%
Grade 3	0	0%
Grade 4	3	43%
Grade 5	0	0%
Grade 6	0	0%
合計	7	100%
全壊	3	43%
倒壊	0	0%

断層直上以外

被害度	棟数	割合
Grade 0	3	9%
Grade 1	15	47%
Grade 2	7	22%
Grade 3	3	9%
Grade 4	3	9%
Grade 5	1	3%
Grade 6	0	0%
合計	32	100%
全壊	4	13%
倒壊	1	3%

(1) 古い在来木造住宅　(2) 新しい軽量鉄骨住宅　(3) 非常に古い伝統木造住宅

写真１　御船町高木地区における地表地震断層直上の建物被害の例