VIDEO RECORDING OF HUMAN BEHAVIORS UNDER SEISMIC SHAKINGS — BRIEF INTERPRETATION OF COLLECTED DATA AND PILOT TEST FOR SYSTEMATIC OBSERVATION —

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SUMMARY

This paper deals with video recordings of human behavior under strong seismic shakings for the purpose to find the optimal way of mitigating casualties at an earthquake. There are two parts in this paper. First, a brief interpretation of a few telecasted video records, obtained during the 1983 Nihonkai-chubu, Japan, earthquake, is described so as to demonstrate the importance to know how behavioral performance of human beings is deteriorated at an earthquake. Second, a pilot test for planning a future systematic observation of human behaviors during and immediately after an earthquake is outlined.

INTRODUCTION

Losses of human lives and injuries due to an earthquake are strongly related to the feature of human responses as well as to the behavioral performance under strong seismic shakings. Earthquake disaster prevention problems such as earthquake fire protection at each dwelling house and safe evacuation of crowded people in a public space, are also dependent to the human response during an earthquake (Ref. 1). So, to know human behaviors during an earthquake is fundamentally important to mitigate earthquake disasters of loss of human lives and injuries especially. It is certain that main effort of the field surveys after a destructive earthquake has been concentrated even now to the investigation of structual damages. But, investigations for human responses and behaviors during an earthquake have been increasing from time to time (Ref. 2). These new attempts have been performed usually by means of retrospective questionnaire and interview method and revealed human behaviors during an earthquake to some extent. Though these methods are efficient, these are too indirect and insufficient to reproduce a variety of actual behaviors and to estimate, for example, necessary time to evacuate from dangerousness. So, it is desired to develop a direct and visual method by which human behaviors during an earthquake can be traced time-sequentially.

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As for attacking this problem we consider two strategies in this paper. One is to collect and interpret visual data including human behaviors at a recent destructive earthquake. These data give us suggestive knowledge about deterioration of behavioral performance of human being against an earthquake.

Another way is to obtain visual records during an earthquake positively with the similar intention of strong motion seismometry. From this point of view, a pilot test for new visual recording system of human behaviors under seismic shaking is also described in this paper.

BRIEF INTERPRETATION OF COLLECTED VISUAL RECORD AT THE 1983 NIHONKAI-CHUBU EARTHQUAKE

The first approach to this problem is finding of visual data obtained during past destructive earthquakes. Some of such visual records can be found through TV news which were caught by chance during an earthquake. These records, in spite of fragmentary data, give us precious information about human response under seismic shakings. Using these data, somewhat detailed study of human response can be performed with an investigation of surrounding and background circumstances. In this paper, the visual records of the 1983 Nihonkai-chubu, Japan, earthquake are introduced as an example.

Examples at the 1983 Nihonkai-chubu, Japan, Earthqauke

This earthquake attacked North Japan on May 26, 1983. Its epicenter is located in the Japan Sea as shown in Figure 1 (a). Magnitude of this earthquake is reported as 7.7, and more than one hundred persons were killed by tsunami inundation. Intensive seismic intensity surveys were carried out using a method of questionnaire survey (Ref. 3). Intensities at all municipalities in the felt area are calculated and smoothed isoseismals are drawn as shown in Figure 1 (a). These values are indicated by JMA (Japan Meteolological Agency) Intensity Scale. Intensity V in JMA scale corresponds approximately to VIII in MM scale.

This earthquake occurred just after noontime on Monday. At the moment many in-and out-door TV cameras were on working and some of them were just telecasting on the spot. A lot of visual records were obtained during this earthquake, but there are few complete records in the sense of including the onset of shaking. Most records were obtained by the cameraman's manual starting immediately after the recognition of the quake. These visual records were obtained by NHK (Japan Broadcasting Corporation) and other local commercial TV stations. In this study, by means of the original data which were collected with a collaboration of NHK, human behaviors under shaking are disscussed.

Four records are obtained by NHK at the points shown with solid circles in Figure 1 (b). The first one is obtained at Kurokawa oil field located north of Akita City. This record catches the whole scenes which includes the beginning of the earthquake shaking. At that time, an opening ceremony for a new oil well was celebrated just in front of the well. Attendants were standing under an open temporary tent. At the moment of the earthquake occurrence, all attendants were frightened and put up with keeping to stand. Some people clinged to a stay of the tent, but nobody crouched down. The ceremony was continued with no significant interruption. The intensity of Akita City is reported as the middle of V(JMA) (Ref. 3), but an intensity at this place is assumed to be somewhat lower than in the down town of Akita City, because of its location at the tertiary mountaineous area.

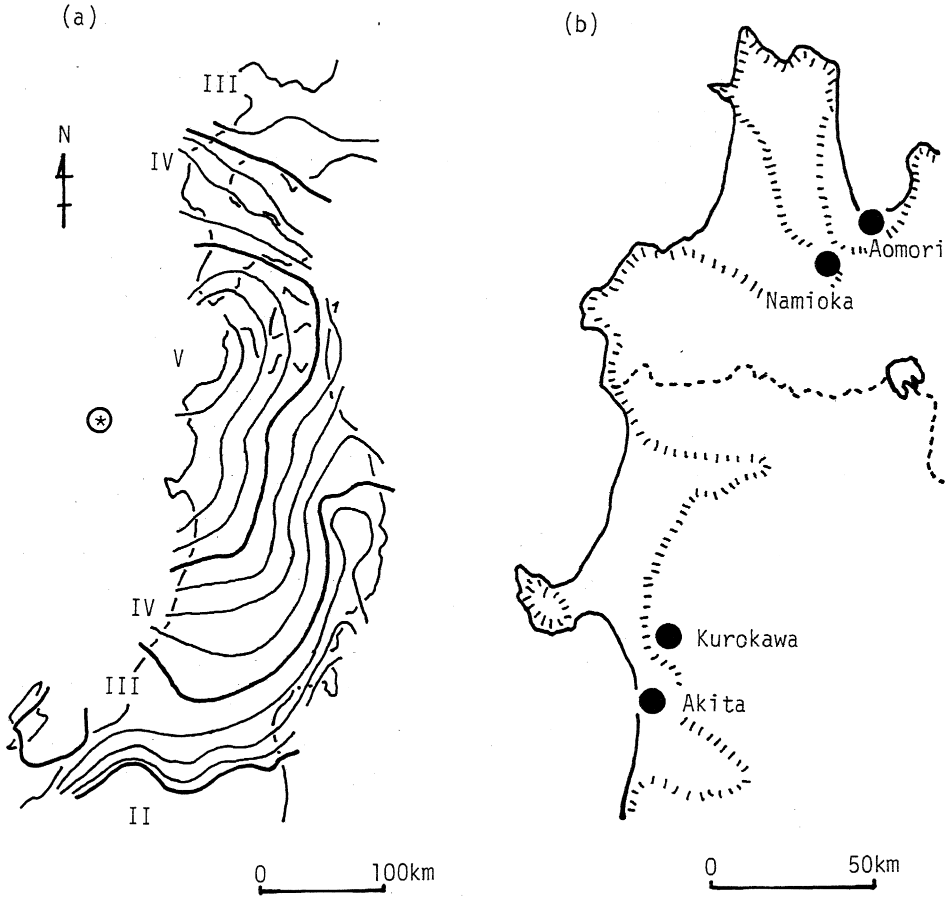

Fig. 1 (a). Isoseismals in JMA (Japan Meteolological Agency) scale of the 1983 Nihonkai-chubu earthquake.

Fig. 1 (b). A location map of the places where visual records were obtained during this earthquake.

Second one is recorded at Namioka Town, Aomori Prefecture. The intensity of this town is estimated as VI^-(JMA), and many buildings, including a reinforced concrete 5 storied hospital, were damaged. At the moment of the earthquake occurrence, a cameraman was going to ride in his car. Within 1 minute, he started video recording. His camera angle and moving trace are illustrated in Figure 2. The first scene shows severely shaking gasoline station, and an employee can not do anything other than looking around. The following scenes are crouched woman beside a house, tumbled down bycicle with a child and squatted down old woman to a sidewalk. These visual records reproduce severe impact by shaking of intensity VI^-(JMA).

The third one is obtained at a front yard of the baseball ground in the central area in Akita City. At that time, a baseball game was just over and a cameraman was on the way back to his office. About 2 minutes later, the video was started, and evacuating people were recorded. Some people croached down to the pavement, but there was no much confusion. This good fortune may be caused by the conditions that the intensity is not so high and the place is wide and open.

The last one was recorded in the NHK branch office at the down town of Aomori City, of which intensity is estimated as the middle of V(JMA). Camera was started about 3 minutes after the quake occurrence. In the first scene, all stuffs are standing up, then they move to work hurry-scurry for broadcasting this earthquake. No fallen down or moved furniture is observed, though hanging objects are swinging. But early events followed by the onset of the quake are not known from this record.

Other video records were also obtained by other local TV stations. It is also expected to find other data such as amateur video records. Accumulating these data, more features about human behaviors during this earthquake will revealed.

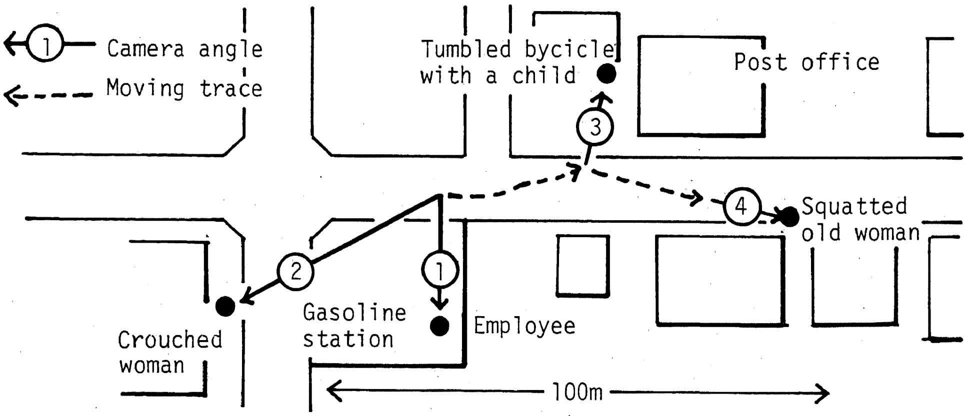

Fig. 2. A sketch map of the cameraman's movement and his camera angles at Namioka Town.

PILOT TEST FOR FUTURE SYSTEMATIC OBSERVATION

Testing equipment

A new and systematic observation equipment for automatic recording of human behaviors during an earthquake is desired to be composed. To realize an automatic recording, some kind of seismometer is necessary as a trigger equipment. It is very helpful to get strong motion records simultaneously for understanding human responses, since human behaviors are considered depending strongly upon ground motion factors. So, testing equipment for a simultaneous recording of human behaviors with strong motion is proposed in connection of strong motion seismograph with visual recording instrument.

In general there are two candidate places where pilot test can be conducted. One is indoor and the other is outdoor space. It might be preferable to set a cammera in indoor space such as in a residential house in order to record details about human behaviors under seismic shaking, but before going into such a test we should overcome delicate problems originating from residents' privacy etc. On the other hand there occurs no such difficulty if the pilot test will be done somewhere in outdoor space. So, in this study a large open space is chosen as an observation field for a pilot test.

As for visual recording equipments, there are at least three choices. Those are sequential photos by a camera with automatic winding mechanics, 8 or 16mm cinefilm and video tape. Among those, video recording equipment was chosen taking account of convenience in connecting with seismograph and in reproducing for later analyses.

A block diagram of the equipment is indicated in Figure 3. As a detector of seismic motions, strong motion seismograph to cover wide

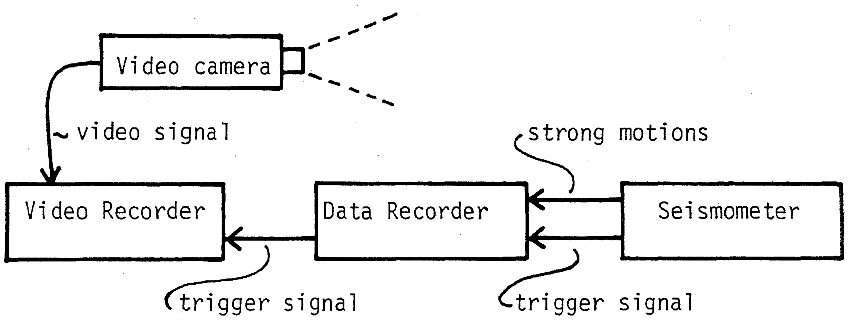

Fig. 3. A block diagram of the testing equipment.

amplitude range up to 2,000 gals is adopted. Seismograph unit is consist of three component force balance type accelerometers. Acquisition is done by digital data recorder (cassette magnetic tape) with 12 bit A/D converter. Video recorder is popular household type and is controlled by the seismograph unit. As a video camera, black and white type is selected from high resolving power. Multi-colour information is not necessary in this stage.

At an earthquake, the acquisition equipment starts recording of strong motions to cassette tape by a certain trigger level of signal from the seismometer, and sequentially video recording also starts by the controll signal from the acquisition system.

Pilot test

As a pilot test field, the square space in front of Kawasaki railroad station, Kawasaki City, south of Tokyo, is chosen (see Figure 4). This square is about 100m x 200m in area and contains bus depots, taxi stands and sidewalks, and is crowded all day long with passengers of railroads, buses and taxies. This area is surrounded by 5-10 storied buildings and an elevated railroad as shown in Figure 5.

As for setting of video camera, a higher position at which one can catch the whole view of the square is surely desirable. Best way is to build an independent observation tower, but it is unfeasible. So, in this pilot test, an existing building is used. After surveying camera angle and other conditions of several buildings, one building is selected for the observation point. This building is 7 storied department store and video camera is fixed at the top floor of the building so as to observe passenger's movements. The focal distance of video camera is determined by considering both factors of visual range and resolution. In this test, from the condition that movements of people can be detected and can be traced for sufficient time, the focal distance is selected as f=16mm. The coverage of visual angle becomes as shown in Figure 5. Photo 1 shows an example of the picture to be recorded. The seismograph and video recorder are installed at the base floor of the same building.

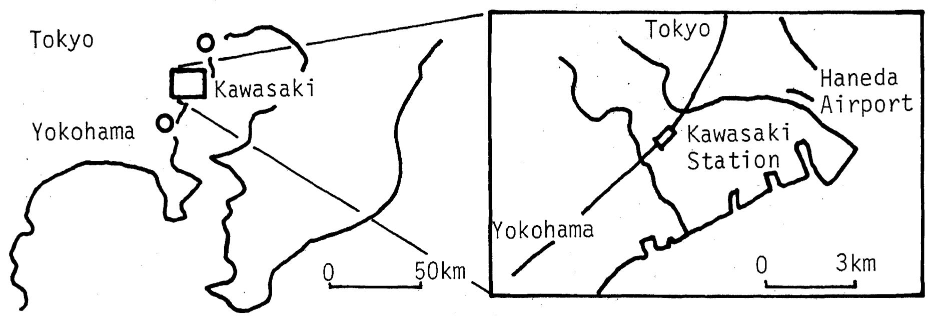

Fig. 4. A location map of the pilot test field.

A recording length of strong motion is set to 1 minute tentatively, and that of video recording is set to 10 minutes because human responses due to a severe earthquake may continue much longer. Trigger level is set at about 10 gals and the system has been standing by ready to obtain simultaneous records of visual movement of human beings and strong ground motions. In this district, an earthquake of intensity IV in JMA scale (25-80 gals), in which most of walking persons in outdoor are affected and some of behavioral performance is reduced to an extent, is expected once in one or two years. Until now, a few records of small earthquakes has been obtained, but no special human response is recognized in the video records. It is expected to have informative data in near future.

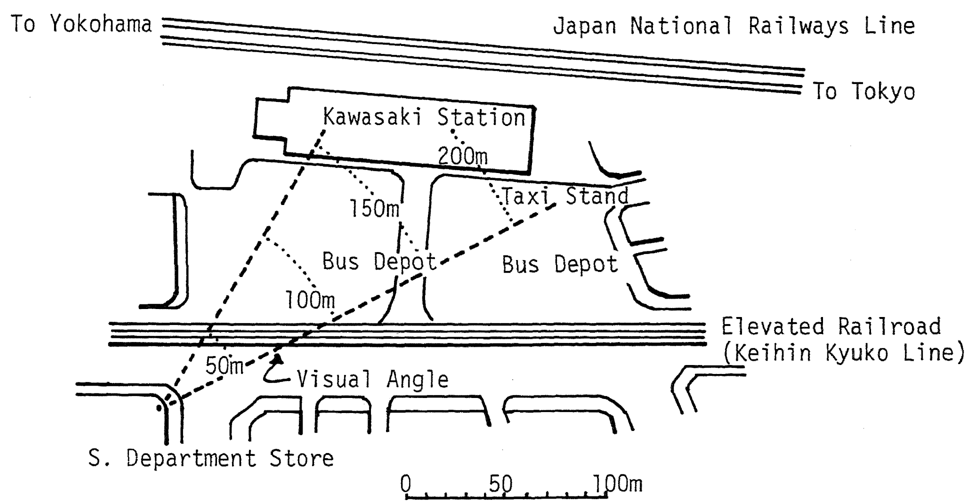

Fig. 5. A plot plan of the test field, Kawasaki Station square.

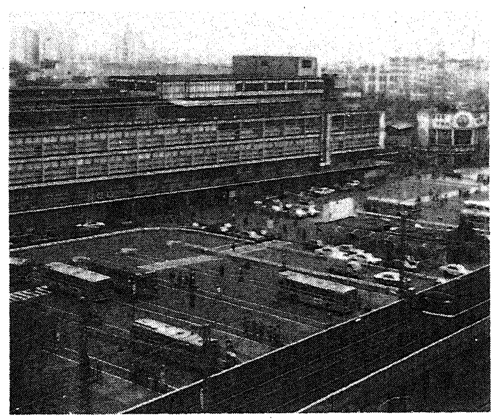

Photo 1. An example of the picture to be recorded.

CONCLUSIONS

In this paper, an applicability to earthquake engineering field of video recording data on human responses under seismic shaking is investigated, and two approaches are attempted. One is to find out visual records in the past earthquakes. As the first example, the data of the 1983 Nihonkai-Chubu earthquake are collected and briefly interpreted. These visual records are discussed in relation with an index of seismic intensity.

The other way is to accumulate positively visual records during an earthquake, and a pilot test for better visual recording system of human behaviors under seismic shaking is proposed. Testing system is linked with strong motion seismometer, so as to have simultaneous records of visual human behaviors and strong motions. This system was set at the station square to catch passengers' movements during an earthqake, and has been standing by.

For further development, a study how to analyse these visual records should be taken in mind. In this study, information of strong motions will play an important role.

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