

65 New Large 3-D Earthquake Simulator For Training And Awareness Raising Purposes In Turkey

BACKGROUND

A new Large 3-D Earthquake Simulator has been built and put into operation for training and awareness raising purposes, in Ankara, Turkey, in 2004. Earthquake motions up to an intensity VIII+ in the MM Scale can be simulated. Light, sound, smoke and projected video image effects accompany and highly dramatize the vibratory motions. The operation is automated and can be fully remote controlled. The Simulator is housed in an independent building, specially constructed and equipped for this purpose. Unique design, construction and software development work has been accomplished locally, except importing certain specialized equipment.

OBJECTIVES

The Earthquake Simulator is jointly owned by the Civil Defense College and Ankara Search & Rescue Unit, both connected to the Ministry of the Interior, through the General Directorate of Civil Defense. The main purpose of having such a Simulator is to train search & rescue personnel, but it is equally intended to keep it open to visits of students, vocational institutions, governmental / non-governmental organizations, voluntary groups and the general public. Due to the precision of the motion generation mechanism, the Simulator can also be used in educational activities and for scientific experiments on people, on models of soils, structures and equipment.

ACTIVITIES

The main activities undertaken during the project can be outlined as follows:

■ **Designing and manufacturing the vibrating platform assembly and the actuation mechanism:** The vibrating platform is a precision steel construction assembly with plan dimensions of 7.00 meters by 4.00 meters, and gets its actuation in each of the three (i.e., x, y and z) directions, from an independent ultra-high power servomotor, driven by its own control-amplifier that, in turn, is fed from 380 V three-phase electric lines and

controlled by a PC, dedicated to 3-D motion management. Extent of displacements, velocities and accelerations along each direction are sufficiently large to perform an VIII+ intensity earthquake motion in the MM Scale.



■ **Developing simulation software and 3-D earthquake motion database:** The simulation activity is fully automated. In other words, it is possible to call upon one of the several worked out scenarios by means of the remote controller. An earthquake scenario has a certain 3-D motion in its core either really "recorded" or "synthesized", stored in digital form, and consists of a series of "pre-recorded human-voice announcements", "light and sound effects", supplemented by "smoke generation", "moving image projection" and specific controls (green/red warning lights, screen rolling etc.) arranged in an orderly sequence. They are controlled by a set of three computers, coupled in a certain fashion, each being dedicated to specific functions. What makes them perform in harmony is the scenario software. New scenarios can still be tailored and stored, as new strong earthquakes are recorded or new requirements arise.

■ **Constructing the Simulator building and its equipment:** Simulation activity takes place in a building of monolithic reinforced concrete shear-wall structure, designed and constructed in a mini-theater fashion, equipped with professional quality "surround-stereo audio" and "stage lighting" systems, supplemented by "strokes", "smoke generators" and "video projectors". The plan dimensions are 11 meters by 22 meters. The number of observer seats has been limited to 130, not to lose the training-hall character.

■ **Developing the training program:** Generally the attendees sit in their seats and about 8 volunteers are invited to occupy the designated places in the Simulator. Having

previously been instructed on how to behave during a destructive earthquake, the volunteers try to put their knowledge into practice. Watchers get their training by criticizing volunteers' behavior. The roles are then interchanged and/or repeated, as many times as necessary. Activities can be monitored and/or documented with the use of a "dome camera". Great interaction and information exchange takes place. Different **training programs** can be developed as needed. Feedback is taken in every opportunity.



ACHIEVEMENTS

From the technical point, the new **Earthquake Simulator** has a number of novel features. Eg. no hydraulics are involved for excitation. At present, this **Earthquake Simulator** is the largest in the world, among those of its kind (ie. with direct electric-servomotor actuation). In addition to the weight of its own and of the mock-up decoration, the **vibrating platform** can perform movements specified above, while carrying a payload of 2,000 kgf. **Scenario software** works properly.

LESSONS

The new **Earthquake Simulator** has proved to be an extremely useful and valuable asset in training and awareness raising activities. Generally the media and the general public have distorted opinions about the character, extent and duration of earthquake motions, e.g. in the movies it is not uncommon to watch unrealistically large-amplitude motions, lasting minutes. The simulator offers excellent opportunities to adjust the internal scale of people to realistic rates and develop reflexes.

FUTURE

■ Turkey is an earthquake country and such **Simulators** should be established in major sites of settlement, for training and awareness raising purposes. **The same is true for other earthquake-prone regions of the world.** For an ordinary person living in such a region, it is very likely to experience a number of minor and moderate tremors within his or her lifetime. Although it may kill thousands when it happens, an encounter with a really intensive one is quite rare in statistical sense.

■ With its controlled environment, the **Simulator** offers repeated training at unusually high intensities without posing any danger. After several years of continued operation, the percentage of the population acquainted with survival techniques, having developed seismic-consciousness and an internal scale for proper perception of the pertinent risk, may reach a considerable level.

■ "Demo" motions of unusual extent can be "synthesized" and employed to familiarize persons to violent motions and letting them acquire special skills.

■ New decorations such as a "classroom", a "hospital room" and a "factory hall corner", can be considered, in addition to the currently designed "kitchen and living room".



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