



## STRUCTURAL ENGINEERS ASSOCIATION OF HAWAII

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January 17, 2007

### **ATC-20 Post-Earthquake Building Safety Evaluations Performed after the October 15, 2006 Hawai'i Earthquakes**

#### **Summary and Recommendations for Improvements (updated)**

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#### **Summary of the SEAHO Deployment of Structural Engineers for Building Safety Evaluations:**

Approximately one of every 25 homes on the Big Island was damaged by the Oct. 15 earthquakes. The County of Hawaii received over several hundred individual requests each day to evaluate building damage from October 15 up to the end of October. During the first week after the earthquakes, County of Hawaii engineers and inspectors used the ATC-20 Rapid Evaluation procedure to assess the safety status of approximately 1000 homes in just a week. Staffing for these inspections was drawn from county building department engineers and construction inspectors. To fulfill this need, the County shut down all normal building permit reviews and construction inspections.

When the County of Hawaii requested assistance via State Civil Defense four days after the earthquakes, the Structural Engineers Association of Hawaii (SEAHO) activated two groups of structural engineers to assist the County of Hawaii Department of Public Works with post-earthquake safety evaluation of single family homes and other buildings during the second week after the earthquakes. The first group was deployed to the western "Kona" coast, and a second group deployed to the east side of the island.

The ATC-20 evaluations utilize the following designations:

- Green: Inspected; considered safe for lawful occupancy
- Yellow: Restricted Use; entry, occupancy, and lawful use are restricted
- Red: Unsafe; do not enter or occupy; it is NOT a condemnation or a demolition order.

County inspectors were assigned as representatives within each team of one or more structural engineers to accompany them to approximately 10 to 20 building damage sites each day. The inspector put together a daily package of the Civil Defense call-in forms describing each owner's assessment of damage and maps showing the call locations, and served as the county official liaison with the homeowner, after consulting and reaching a consensus with the structural engineer. The county representative was also a key factor in the efficiency of the inspections because of the rural nature of much of the island.

Under Hawaii State Law (Hawaii Revised Statutes Chapter 128, Civil Defense and Emergency Act), persons engaged in civil defense functions (including volunteers whose services are accepted by any authorized person), cannot be held civilly liable for the death of or injury to persons, or property damage, as a result of any act or omission in the course of the employment or duties, except in cases of willful misconduct.

## Recommendations for Improvements:

### 1. Timing:

The ATC-20 volunteers were mobilized for deployment during the second week after the earthquake. **It is recommended that earlier deployment be considered (approximately 3 to 4 days after the event).**

### 2. Call-up Procedure:

It was found that a single-source list of volunteers was not available. **SEAOH needs to produce a verified annual list of potential SEAOH member volunteers and their training status.** Structural engineers can be quickly trained just before deployment. However, this would cover only a portion of the potential pool of volunteers, and SEAOH cannot be responsible for maintenance of an all-inclusive single-source list. In addition, county and state agencies have personnel who either have participated or are interested in ATC-20 and ATC-45 training. **State Civil Defense should maintain the master list and participate in the call-up covering those individuals who are not SEAOH members. Along with the volunteer contact information, the list should include personal contact information in case of emergency during deployment. The list should be verified annually by State Civil Defense and available in electronic and hardcopy form at SCD, County CD agencies, SEAOH and elsewhere as appropriate.**

Many of the initial calls were not answered because of the widespread use of wireless phones in homes. The day-long power outage on the island of Oahu disabled all cordless land line phones, and in some cases, cell phone networks did not initially operate with sufficient reliability. **All potential volunteers should be requested to install at least one corded phone with a message service device, or alternatively, a UPS battery for their wireless phone.**

**We recommend that State Civil Defense and the County Civil Defense Agencies conduct joint workshops with SEAOH on governmental organization and preparation for using ATC-20 volunteers, support, logistics, and data collection and analysis. Standardized policies and procedures should be developed taking into account these recommendations and the experiences of those directly involved in the evaluations and the use of the data.**

### 3. Identification:

Deployment of the SEAOH volunteers was coordinated by the County of Hawaii Department of Public Works, and so the names, contact numbers, and personal contact in case of emergency of all team members were logged in with the County. Volunteers who were originally trained in 1998 were issued volunteer engineer identification cards by State Civil Defense with a 10-year expiration. Volunteers trained in 2006 were not issued any identification cards. The current Vice Director has stated at the December 14, 2006 meeting of the Hawaii Emergency Preparedness Executive Committee that all the ATC-20 volunteers were issued identification cards. **Identification cards should be issued for all trainees and for those who agree to be available in the pool of potential volunteers.**

4. **Capacity:**

It appears that local resources were sufficient to evaluate and tag approximately 2000 structures in the aftermath of this offshore Moment Magnitude 6.7 event. **Demand on resources would increase for a land-based epicenter and for earthquakes of greater magnitude or shallower focus. In those cases, it is probable that out-of-state engineers may need to be requested.**

5. **Training:**

**There is a need for periodic training in ATC-20 and ATC-45, perhaps every 2 to 3 years.** This would allow additional volunteers to be identified to increase the pool. Otherwise, attrition will naturally diminish the number of volunteers over time. The City and County of Honolulu and the County of Maui have expressed interest in further training.

6. **Reporting:**

ATC-20 forms were filled out and submitted daily without any retained copies for the engineers. This hampered the production of summary reports for SEAOH's investigative purposes. **A copy of the form for each building inspected should be made for the engineers. Also, SEAOH should produce a standardized electronic form for its own summary reports. The address and TMK / GPS coordinates of each home inspected should be entered on the ATC-20 form as well as on the SEAOH summary report form. The sponsoring county agency should furnish this information to the volunteer engineer. Photographs should be taken of the damaged portion of each home evaluated by either SEAOH or County personnel, in order to document the damage or failure modes exhibited by each structure. Any soil and slope failures should be reported. If the owner is present, a building history should be included.**

7. **Accommodations:**

The county furnished airfare, lodging, and a per diem meal allowance. The quality level of these accommodations was quite satisfactory, except for the fact that high-speed internet access was not available. Communications by internet are vital for coordination amongst SEAOH engineers in the field and also for communications with their home offices. **Since the volunteers have simultaneous professional commitments that must be kept with clients, internet access should be furnished at the selected lodging.**

8. **Daily Operations:**

**SEAOH believes that the most efficient team consists of a local county representative and a single Hawaii Structural Engineer.** It was never found that more than one Hawaii Structural Engineer was necessary to make a correct ATC-20 posting. It was observed that Structural Engineers from out-of-state may tend to stay in groups because they desire to discuss damage for reporting purposes outside of the scope of the ATC-20 mission, and because they are less familiar with local conditions. In the case of

out-of-state engineers unfamiliar with Hawaii construction, it may be advisable to initially attach such individuals to a local team for the first day.

There appeared to be a significant delay in obtaining the daily list of homes to be inspected in the Kona area. The inspections teams in Kona left the staging area approximately 2 hours or more later each day than the Hilo teams. It is our understanding that this information is issued from Hilo. **Improvements in that system or increased staffing to compile the daily inspection lists could significantly increase the number of homes that could be evaluated each day.**

It appears that county building division and public works personnel familiar with construction, but who are not structural engineers, can reliably make correct Rapid Evaluations of building safety if they utilize the ATC-20 procedures. **Structural Engineers are most valuable in performing the Detailed Evaluations necessary for structures with greater damage, and in performing verifications of red or yellow posting made by non-engineers.** At such properties, a longer period of time for the evaluation and on-site briefing to the owner should be expected.

## 9. Vulnerabilities of Housing:

Based on approximately 230 ATC-20 inspections performed by members of the Structural Engineers Association of Hawaii, most of the single family homes that were red-tagged as unsafe were of post and pier construction. Since the posts are resting and are not connected to the foundation, if the relative movement between posts and the supporting foundation exceeds the size of the “tofu block”, or successive shaking leads to “walking” of the posts, the building may fall off the foundations. Among damaged homes, the incidence of red- and yellow- tagged conditions was a factor of 2.5 times higher for the elevated post and pier homes than the incidence rate for homes on slab. **The post and pier type of construction should be retrofitted to preclude lateral movement of the building and mitigate against foundation failures.**

There were many failures of residential rock walls. These walls typically consisted of individual, rough lava rocks stacked dry, or with minimal mortar. The walls were commonly 3 to 5 feet in height, although in some cases taller. **In the County of Hawaii, the building code allows walls of up to 6 feet to be constructed without engineering drawings. This exemption should be revised.**

Several large multi-family buildings were unsafe due to flaws in masonry construction, where grouting of the masonry was omitted among other deficiencies in construction.

**SEAOH expects to issue further recommendations in the future relating to buildings and public safety, building codes, standards and enforcement procedures.**

**10. Analysis of Data:**

**We would recommend GIS mapping of each inspected home or building be performed every few days to help maintain an active accounting of status. Certain building construction attributes can be obtained by linkage to the TMK-based property tax database.** This would allow analysis of building risk factors, including construction and soil conditions. SEAOH has done this for the 230 homes its members inspected where the construction features were directly observed, but a more comprehensive analysis could be done if the entire dataset of inspected homes were linked to the property tax database. Once validated, these building risk factors could be used to perform additional mapping of earthquake-vulnerable structures for various earthquake scenarios or for a risk-consistent map based on the USGS seismic hazard data layer and soil type data layer created through the Hawaii State Earthquake Advisory Committee.

**11. Public Response:**

It was reported by the County of Hawaii Department of Public Works that the public was reassured by the building safety posting system, even when that resulted in the discovery of an unsafe condition that prohibited occupancy. In general, the ATC-20 evaluations demonstrated that the county was attending to the safety of the public, and it helped remove the uncertainty about personal safety that many homeowners had prior to the evaluation. It appears that the public responds very favorably with confidence in evaluations made by a licensed Structural Engineer. SEAOH has been told by the County that the ATC-20 evaluations were a very successful effort. The volunteers reported that it was a gratifying public service that they would support again.

**Anecdotal evidence of homeowner concern about the meaning of yellow and red tags should be addressed through clear communication with the public immediately after similar future events. With a clear understanding of the tagging process, and the benefit of requesting an evaluation, homeowners should be reassured that calling in will not jeopardize their property. It should also be clarified that the inspections are only provided for the determination of building safety based on damage specifically resulting from the earthquake event and aftershocks.**