ATC NEWS BULLETIN

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Advancing Engineering Applications for Natural Hazard Mitigation
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ATC READYING INTEGRATED APPROACH TO MULTI-HAZARD MITIGATION

BOARD EXPANDED TO INCLUDE WIND AND COASTAL ENGINEERING EXPERTS

Recognizing that structural damage from wind and wave action has much in common with earthquake damage, the Board recently extended ATC's mandate to address problems in wind and coastal engineering. This move toward an approach that looks at effects and treats the causes as an integrated problem parallels that of the Federal Emergency Management Agency. Two new Board positions were created to assist in expanding ATC's focus to multi-hazard mitigation. **Arthur Chiu**, Professor Emeritus of Civil Engineering, University of Hawaii, and **Robert Dean**, Chair and Graduate Research Professor of the Coastal and Oceanographic Engineering Department of the University of Florida in Gainesville were appointed to these new positions. Dr. Chiu was appointed in April as an at-large member for a three-year term. Dr. Dean took office in July as an at-large member for a two-year term. As ATC Board President John Theiss said, "The expertise of the new Directors includes extensive experience in multi-hazard design, although the most important qualification was the ability to contribute successfully to the Board's newly expanded direction." **Arthur Chiu** has been active in domestic and international

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NEW BOARD MEMBER LEADS TEAM TO STUDY HURRICANE FRAN

As ATC moved to add two members to the Board in the fields of wind and coastal engineering, Hurricane Fran made landfall on the North Carolina coast on September 6, 1996. In response, Robert Dean led an ATC-organized team of Dan Cuoco (Thornton-Tomasetti, New York) and Michael J. Griffin (EQE, South Carolina) on a 2-day mission to gather relevant material for a field reconnaissance study. The team arrived three weeks after the hurricane.

Preliminary conclusions of the team include the following:

- Short- and long-term erosional cycles over both short and long stretches of coastline affect the potential for damage. Damage correlated well with beaches eroded already by previous storms. All beaches in the impacted area suffered a downswing in the short-term erosional cycle.
- Hurricane Fran was the most intense storm in the area since 1954, with a storm surge of 12 to 13 ft.
- Wide beaches, nourished with trucked-in sand, function as energy absorbers, reducing wave energy and crest height. Extra sand also improves the support for piling.

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Photo shows the type of wave-action damage sustained by homes at the ocean's edge. R. Dean photo.

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PREVENTING ANOTHER LENINAKAN IN CENTRAL ASIA

NATO WORKSHOP CO-ORGANIZED BY ATC

Three million people in the Central Asian Republics live, work, and attend school in buildings that are extremely vulnerable to collapse during earthquakes. The tragedies of Armenia and Sakhalin might well be repeated in Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, or Uzbekistan unless structures throughout the urban areas, particularly the capitals, are strengthened before the next major earthquake strikes.

This grim warning was issued by an international team of structural engineers and geophysicists meeting from October 22 to 25, 1996, in Almaty, Kazakhstan, at a NATO Advanced Research Workshop to assess the earthquake hazards of major cities in the region and discuss ways to mitigate them.

The Workshop was organized by GeoHazards International, the Applied Technology Council, the U.S. Geological Survey, and the United Institute of Physics of the Earth (Russian Academy of Science, Moscow).

ATC Executive Director Chris Rojahn, a keynote speaker, and ATC Senior Structural Consultant Craig Comartin were among the invitees meeting with representatives of the five Central Asian republics.

Each republic sent at least three people to the workshop: specialists on earth science and structural engineering, and a public official. These national teams described detailed information on structures in their urban areas, particularly the capital cities.

The assembled experts broke into working groups to quantify the earthquake hazard and suggest ways to mitigate it. The group co-chaired by Chris Rojahn developed a table of expected damage by structure type, detailed below. Table 2 lists effects on the cities' populations.

The NATO Advanced Research Workshop organizing committee was co-chaired by Dr. Brian Tucker of GeoHazards International, Stanford, California and Dr. Vitaly Khalturin of the United Institute of Physics of the Earth.

The Almaty Workshop concluded with a clear call for action that included the following tasks.

- Improve information exchange internally among the republics and with outside institutions.
- Train professionals and students.
- Create legislation governing earthquake safety.
- Raise public awareness of earthquake risk.
- Rehabilitate buildings to a minimum level of seismic safety.
- Establish strong-motion networks in the major cities.

Table 1. Expected damage to common buildings of Central Asia when subjected to different intensities of shaking (preliminary)

	MSK INTENSITY			
BUILDING TYPE	VI	VII	VIII	IX
Masonry with wood floor	slight to moderate	moderate to heavy	partial collapse	total collapse
Masonry w/ precast floor, <1957	none to slight	slight to moderate	heavy to partial collapse	partial collapse
Masonry w/ precast floor, >1957	none	none to slight	moderate to heavy	heavy to partial collapse
Weak 1st story	none	slight	heavy	heavy to total collapse
Precast frame	none	slight	moderate to heavy	heavy to partial collapse
Adobe	light to moderate	heavy	partial to total collapse	total collapse
Large panel	none	none to slight	slight to moderate	moderate

Table 2. Estimated results of MSK IX in the Central Asian capitals (preliminary)

Capital	Current population (millions)	Estimated deaths (thousands)	Estimated injuries (thousands)
Almaty, Kazakhastan	1.5	75	300
Ashkabud, Turkmenistan	0.7	35	140
Bishkek, Kyrgyzstan	0.8	40	160
Dushanbe, Tajikistan	0.6	30	120
Tashkent, Uzbekistan	2.7	135	540

ATC PREPARES BALLOT VERSION OF FEMA 273 REPORT

GUIDELINES FOR THE SEISMIC REHABILITATION OF BUILDINGS

This extensive ATC-33 project has reached its penultimate stage with the production of the Ballot Version of the *NEHRP Guidelines* and *Commentary* to be reviewed by representatives of the member organizations of the Building Seismic Safety Council. ATC will then produce the final documents, which will reflect consensus changes, in September, 1997. The *Guidelines*, now designated the FEMA-273 Report, are the culmination of 12 years of FEMA-funded efforts to reduce the hazard from earthquakes by increasing the ability of existing buildings to withstand seismic forces.

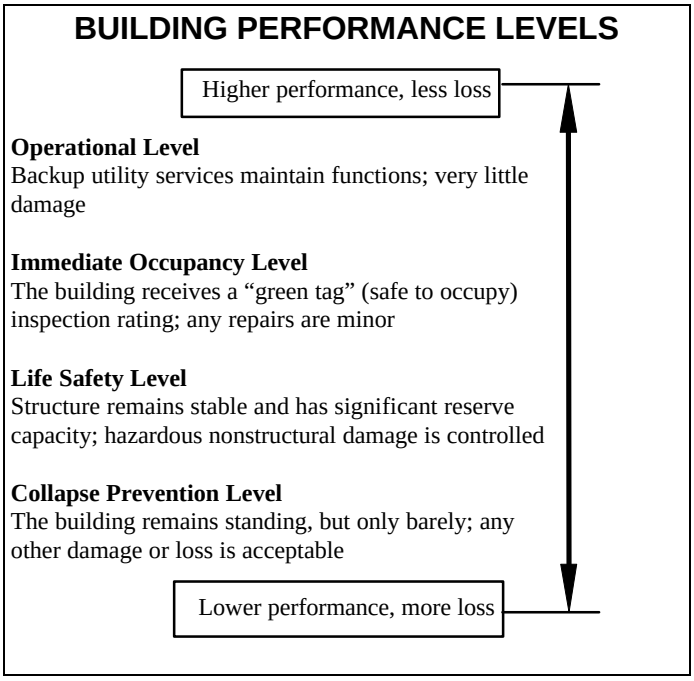
The *Guidelines* provide a nationally applicable approach to the rehabilitation of existing buildings, and consider both a Simplified Method and a more formal and detailed Systematic Rehabilitation procedure.

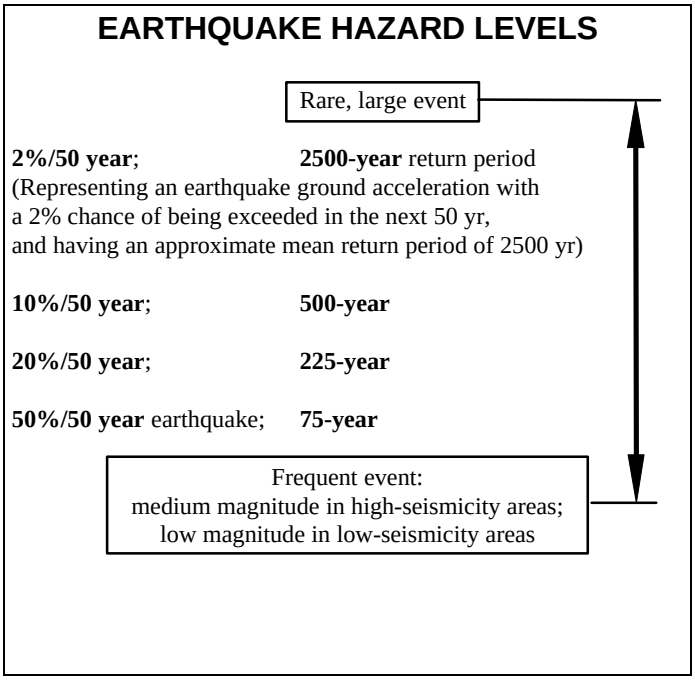
The main body of the *Guidelines* describes the Systematic Rehabilitation of a building to reach a specific level of performance against a specific level of earthquake input. At the same time, it is possible to design for a different performance, perhaps a lower performance with more losses, in response to a larger earthquake. Among the possible combination Rehabilitation Objectives, the Basic Safety Objective is fundamental. As the name implies, this ensures a broad performance capability from a rehabilitated building: to perform at a life-saving level when subjected to ground motions having a 10% probability of being exceeded in 50 years and to perform at a severely damaged but non-collapsing level against the rare, large earthquake. In the first case, the rehabilitated building uses a portion of its ability to deform in a ductile manner and in the second case it fights collapse with all its available ductility.

As implied in the figures below, any combination of performance and earthquake can be addressed by the designer. This relationship between a desired Performance Level to any of the specified earthquake shaking levels is one example of the different approach of the *Guidelines*. This innovative philosophy differs from that governing the development of current codes for new buildings.

A chapter on Simplified Rehabilitation suggests corrective measures to remove identified deficiencies, including new potential deficiencies that have become apparent after the recent California earthquakes, particularly the 1994 Northridge earthquake. This method only applies to low- and, in some cases, to mid-rise buildings of regular configuration and well-defined building type.

A further step in the introduction of the *Guidelines'* new ideas to the seismic engineering community occurred September 30, when ATC held a half-day seminar before the SEAOC Annual Meeting. The ATC seminar served as a "kick-off" for the SEAOC technical program on "Performance-Based Design: Today's Applications and Tomorrow's Directions." Later, on November 6-7, BSSC held a Ballot Symposium in Denver, at which ATC-33 project team leaders discussed the *Guidelines* in detail, in preparation for the BSSC representatives' final ballot in December.





NEW DIRECTORS

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collaborative research on wind engineering in China, Japan, Taiwan, India and Hong Kong. He serves on several committees relating the lateral loads due to earthquakes and those due to severe winds. In his 42-year career at the University of Hawaii at Manoa, Dr. Chiu served three years as Chair of the Civil Engineering Department and another four as Associate Dean of the Graduate Division: Research, Training and Fellowships. Educated at Oregon State and MIT, Dr. Chiu received his Ph.D. in Structural Engineering at the University of Florida. He is a licensed professional engineer in Hawaii, in the civil and structural branches.

Robert Dean has been active in efforts to apply engineering research to problems of hydromechanics, long waves, hurricane protection, wave forces, coastal engineering, water problems, storm tides, wave measurement, harbor entrances, natural disasters, breakwater redesign, sea-level change, and coastal erosion zones. A member of the National Academy of Engineering, Dr. Dean was also recognized by ASCE with the Award for Significant Contributions in Coastal Engineering and Wave Hydrodynamics in 1990. Dr. Dean holds a Masters in Physical Oceanography from Texas A&M and an Sc.D. in Civil Engineering from MIT. He has been in academia since 1965, holding positions at the University of Washington in Seattle, the University of Florida, and the University of Delaware in Newark, before returning to the University of Florida in 1982.

HURRICANE FRAN

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Homes on nourished beaches suffered much less damage.

- Heavy floating debris, commonly found in the vicinity of damaged piers, imparts severe damage to piled structures designed to withstand only hydrodynamic forces.
- Breaches opened in the barrier islands, possibly initiated by storm waves and deepened by trapped water returning to the ocean. Structures located in the path of the channels failed spectacularly from scoured foundation piles.
- Except in the immediate vicinity of devastated beach property, electrical power was restored quickly, because sufficient manpower was deployed.

The timing of the trip was appropriate, in that security was still high and the damage intact, the barrier island beach roads were repaired and sand-free, and nearby lodging was available. The duration might have been suitably increased to three days for a more widespread study, but more than two weeks would have been necessary for an in-depth study.

UPCOMING ATC AND SAC REPORTS

ATC-18: *Seismic Design Criteria for Bridges and Other Highway Structures, Current and Future*; a review of current design practice and criteria, ongoing research in seismic design criteria development, and philosophies behind the seismic resistant design of highway structures.
ATC-20-3: *Case Studies in Rapid Postearthquake Safety Evaluation of Buildings*; an in-depth training manual presenting the rapid evaluation methodology and case studies illustrating its use.
ATC-32-1: *Improved Seismic Design Criteria for California Bridges: Resource Document*; a companion to the ATC-32 report, summarizing in detail all reviews, discussions and recommendations that were developed during the multi-year project.
ATC-34: *A Critical Review of Current Approaches to Earthquake-Resistant Design*; includes an overview of current seismic design codes, review and critique of current code approaches, and proposed development of a new model seismic code.
ATC-35-2: *Proceedings of National Earthquake Hazard Mapping Workshop*; workshop focused on four key issues affecting the preparation and use of the national earthquake ground motion maps (required parameters, site conditions, risk representation, and modeling).
ATC-40: *Seismic Evaluation and Retrofit of Existing Concrete Buildings*; presents a performance-based methodology for mitigating hazards posed by older California-owned concrete buildings.

The following SAC reports are also available through ATC (SAC is a Joint Venture of the Structural Engineers Association of California, the Applied Technology Council and the California Universities for Research in Earthquake Engineering.):
SAC-95-08: *Technical Report: Experimental Investigations of Materials, Weldments and Nondestructive Examination Techniques*
SAC-96-01, Parts 1 and 2: *Technical Report: Experimental Investigations of Beam-Column Subassemblages*

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