

# Solutions:

VOLUME II ISSUE 1

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**37% of hospital buildings in the state pose a significant risk of collapse in an earthquake.**

## DIALOGUE

Hospitals provide a community service that stays in the background of most people's daily lives. Yet in the event of a natural disaster, they become the lifelines for cities and regions, providing emergency care that saves lives and speeds the community's recovery. With this important role, the ability of their buildings to withstand natural and man-made disasters becomes imperative.

## LEGISLATION DRIVES HOSPITAL PROJECTS IN CALIFORNIA

In California, the threat of severe earthquakes led to the 1994 passage of Senate Bill (SB) 1953, legislation that mandates that all acute-care hospitals in the state comply with the safety provisions of the California Hospital Code (Title 24). As a result, there has been a significant increase in the number of new and seismically retrofitted hospital projects in California over the past few years.

Legislative attention to seismic design requirements for hospitals in the >



*The existing Peninsula Medical Center in Burlingame will be replaced by a new four- to six-floor facility, pictured above. [see DIRECTIONS inside]*

## > CONTENT

### DIALOGUE

California acute-care facilities race to meet 2008 safety compliance deadline.

### DIRECTIONS

Construction begins on a new medical facility in Burlingame.

### TRANSITIONS

T&R assists in evaluating retrofitting options for a three decade old San Francisco medical facility.

### NEWS

Treadwell & Rollo employees show their artistic nature in first annual Art Show; T&R staff will participate in discussion of legal and economic issues, methane gas hazards and project design and approval at upcoming Landfill Postclosure Symposia.



*Mercy Medical Center in Merced is one of the local medical facilities that has utilized T&R's seismic and design services during construction.*

[cover story]

state began with the 1971 San Fernando earthquake, where local hospitals suffered significant damage. As a result, the 1973 Hospital Seismic Safety Act was passed by the state legislature. The intent of this act was to provide the basis for the design of hospital buildings that would withstand anticipated earthquake forces.

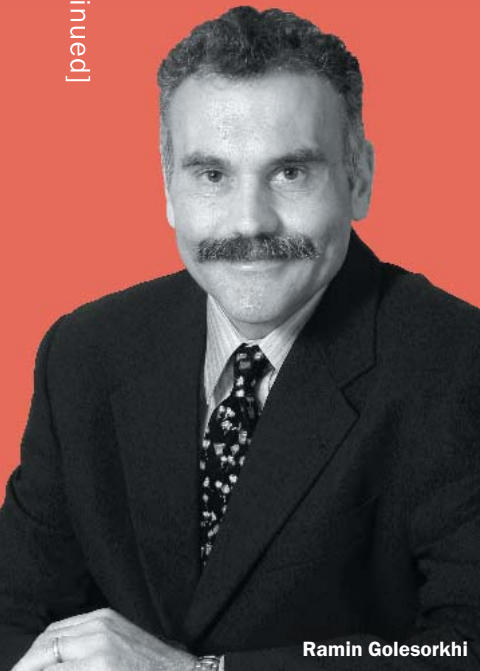
Ten years after the 1973 Act and following a number of earthquakes, the 1983 Alfred E. Alquist Seismic Safety Act was passed. This legislation resulted in the establishment of the Office of Statewide Health Planning and Development (OSHPD). OSHPD has approval jurisdiction over the design of hospitals in California.

In 1990, a study commissioned by the State to survey California hospitals and conducted by Applied Technology Council (ATC 23) concluded that over half of the hospitals surveyed were built before the 1973 Hospital Seismic Safety Act. The results of this survey, along with the devastation of the 1989 Loma Prieta and the 1994 Northridge earthquakes, resulted in the passing of SB 1953 in 1994. This bill is a more comprehensive version of the 1973 Hospital Act with additional regulations from lessons learned from the 1989 Loma Prieta and 1994 Northridge earthquakes, specifically the need for lifeline structures to be operational after major earthquakes.

SB 1953 required all acute-care facilities in California to perform a self-evaluation and submit a report of their findings to OSHPD by January 2001. Based on these evaluation reports, the hospitals were required to submit plans to OSHPD by January 2002 for achieving compliance. SB 1953 mandates a first compliance by 2008 and requires that all hospitals in California be brought into compliance by the second deadline in 2030. Because of the enormity of the tasks mandated by SB 1953, the legislature passed SB 1801, an amendment to the Health and Safety Code. SB 1801 provides hospitals with an extension of up to five years to the 2008 deadline, provided they can demonstrate that compliance with the 2008 deadline would result in “diminished inpatient capacity.”

The evaluation reports indicated that 37% of hospital buildings in the state posed a significant risk of collapse in an earthquake. A smaller percentage of hospital buildings do not jeopardize life, but might not be functional after a strong tremor.

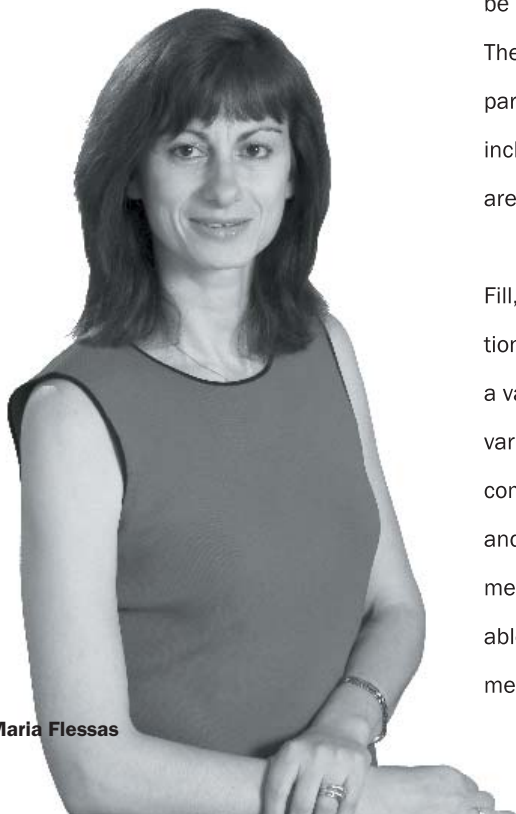
Interestingly, engineering studies have found a link between a building’s ability to withstand strong earthquakes and the likelihood that it could be resistant to explosions and other types of terrorist attacks. With the high probability of a large earthquake in the next century and the ongoing threat of manmade disasters, many of California’s hospitals are undergoing retrofits now that could help communities get back on their feet more quickly after a catastrophe. [rgolesorkhi@treadwellrollo.com](mailto:rgolesorkhi@treadwellrollo.com)



Ramin Golesorkhi

Dr. Ramin Golesorkhi has more than 17 years of experience in seismic analysis and foundation engineering. He has served as a member of the Structural Engineers Association of Northern California (SEAONC) ground motion and foundation committees and several Blue Ribbon panels. He is familiar with the seismic design requirements developed by federal, state, and local agencies.

Maria Flessas is a Senior Associate Engineer with extensive experience in developing design recommendations for foundations, retaining walls, and shoring systems. Her clients include medical and educational organizations, commercial developers, industrial clients, municipalities, and government agencies.



Maria Flessas

## PENINSULA MEDICAL CENTER

Built in the late 1950s and early 1960s with additional major additions in the 1970s, Peninsula Medical Center in Burlingame now consists of 11 separate structures. Following extensive evaluations by two different structural engineering firms, it was determined that the cost of retrofitting to meet the requirements of SB1953 would be prohibitive. A full replacement of the campus was deemed to be the optimal choice.

Replacement plans include construction on this suburban medical campus of a new four- to six-story acute care hospital with 243 private rooms. A medical office building with five stories will be directly connected to the hospital to optimize the delivery of quality patient care. The hospital building footprint area will be approximately 112,575 square feet, and will be base-isolated at the foundation level. The development also includes a four-level parking garage. Associated improvements include new surface parking and roadway areas.

Fill, topsoil, and Colma and Merced formation deposits underlie the site. The fill, a variable mixture of sand, silt and clay, varies significantly in consistency and compressibility. Because of its variability and a lack of information about its placement and compaction, the fill is not suitable for supporting the proposed improvements. The old clayey topsoil below the fill

is compressible and is also unsuitable for support of structures. The Colma formation (mixture of native sand, silt and clay) and Merced formation (primarily sand) are strong and relatively incompressible and can adequately support the proposed improvements. The primary geotechnical issues are large design earthquake forces, support of moderate-to-heavy column loads, the presence of potentially liquefiable soil, and the presence of non-engineered fill and the buried topsoil.

Treadwell & Rollo performed a geologic hazard evaluation and geotechnical investigation for this project. Our services included: evaluating potential geologic hazards at the site; performing a geotechnical investigation for the proposed replacement hospital, new facilities, and associated improvements; developing earthquake design criteria and time histories for use in the structural design; presenting the results of our studies in written reports; and providing consultation during the design phase.

The existing hospital will remain in operation until the new hospital is constructed, requiring that new facilities be constructed in five phases. The foundation system of the replacement hospital will be a state-of-the-art base-isolation system, the first in an acute care hospital in Northern California. [mgflessas@treadwellrollo.com](mailto:mgflessas@treadwellrollo.com)

Over the last 6 years Scott Walker has provided project management, project engineering, construction observation, and subsurface investigation services for various projects throughout the Bay Area including medical and educational facilities and commercial and residential developments.



Scott Walker

### THREE DECADE OLD MEDICAL FACILITY TO BE RETROFITTED

With their location 10 kilometers from the San Andreas Fault, Moffitt Hospital and the Medical Sciences Building at the Parnassus Campus of UCSF have a strong likelihood of being subjected to very strong shaking during the next major earthquake. As a critical-care facility, Moffitt Hospital in particular must meet the standards set in California Senate Bill 1953. The buildings are over three decades old and are not in compliance with current building codes, so the goal of this evaluation was to determine their likely resistance to a strong tremor and provide the information necessary for any retrofitting that might be needed.

Treadwell & Rollo was retained to provide geotechnical and earthquake engineering services for these two important medical facilities. We reviewed available subsurface information, and developed estimates of design earthquake ground motions in terms of site-specific response spectra, which is a representation of a structure's dynamic response to earthquake shaking for given soil conditions, magnitude earthquake and distance from fault rupture.

We also provided geotechnical foundation criteria for existing walls and footings, using available and supplemental subsurface information for the site and its vicinity.

Moffitt Hospital is a 15-story concrete structure over one basement level. The Medical Sciences Building is comprised of two wings: the northern wing is a 13-story structure over one basement level and the southern wing is a 14-story structure at grade. Moffitt Hospital, because it is a critical-care facility, was evaluated in accordance with Chapter 16A Division VI-R of the 2001 California Building Code (CBC), while the Medical Sciences Building will be seismically upgraded in accordance with the FEMA 356 guidelines.

To supplement the available subsurface data, we performed a downhole seismic velocity survey in an approximately 100 foot-deep boring. A downhole seismic velocity survey measures the shear wave velocity of the soil which can be used to classify the site. Because the severity of shaking at a site is dependent on the subsurface conditions, it is critical to have an appropriate understanding of these conditions. A seismic survey is another tool which is used to characterize the site.

Because the site is located within 10 kilometers of a major fault, we also included near-source effects in the development of the recommended spectra. Near-source effects are a phenomenon where the ground motion can be amplified because the site is close to and in line with the rupture of the fault. This phenomenon is similar to a sonic boom, where an airplane breaks the sonic barrier; as it flies faster than the speed of sound, it "pushes" on

the sound waves in front of it. However, sound waves cannot travel faster than the speed of sound, and so the waves pile up against each other and generate a shock wave. As a fault begins to rupture towards a site at a speed faster than the earthquake waves, the waves from the earthquake pile up against each other and amplify the ground motion. This amplification may be critical to the stability and performance of the structure and needs to be taken into account when designing the structure.

We developed response spectra for two levels of ground shaking using probabilistic and deterministic approaches. A probabilistic approach takes into account the seismicity and geometry of each fault and randomly assigns epicenter locations along each potential fault source. Using appropriate ground motion attenuation relationships for the given soil conditions that describe the rate of attenuation of ground motion with increasing distance from the fault, this approach develops an estimate of the ground shaking at a site. A deterministic approach is a relatively simple approach that considers a scenario earthquake, generally the maximum earthquake, occurring on the closest fault to the site. The two levels of ground shaking are then used to evaluate the survivability of the structures after an earthquake.

In addition, we developed recommendations regarding vertical, lateral, and rotational stiffness parameters of existing

foundations using FEMA 356 guidelines as well as ultimate bearing and lateral capacity of the existing foundations. These geotechnical parameters were used by the structural engineer to evaluate the seismic behavior of the structures.

Because hospitals are considered critical care facilities and need to be in operation after an earthquake to provide emergency response, they are under the review of the California Geologic Survey (CGS) and Office of Statewide Planning and Development (OSHPD). Both the ground motions and geotechnical parameters used to evaluate the structure have been reviewed and approved by CGS and OSHPD.

[jgouchon@treadwellrollo.com](mailto:jgouchon@treadwellrollo.com)

[sawalker@treadwellrollo.com](mailto:sawalker@treadwellrollo.com)



**John Gouchon estimates settlements, evaluates liquefaction potential and slope stability, performs seismic hazard studies, and develops seismic response spectra and time-histories for structural analyses for several hospital facilities.**

## > DID YOU KNOW?

Treadwell & Rollo has provided geotechnical, earthquake, and environmental engineering services for hospital and medical centers, through out the Bay Area and northern California including:

John Muir Medical Center Expansion, Walnut Creek

Mills-Peninsula Replacement Hospital, Burlingame

St. Luke's Hospital, San Francisco

Moffitt Hospital/Medical Science Building, UCSF Parnassus Campus

Cathedral Hill Hospital, California Pacific Medical Center, San Francisco

Mercy Medical Center, Merced

Pacific and California Campuses, California Pacific Medical Center, San Francisco

UCSF Mount Zion Campus, San Francisco

Palo Alto Medical Foundation, Fremont Center, Fremont

Palo Alto Medical Center, Palo Alto

Veterans Home of California – Holderman Hospital, Yountville

1701 Divisadero Street Medical Building, San Francisco

Alexian Brothers Hospital, San Jose

North Coast Medical Building, Morgan Hill

Dominican Community Hospital Seismic Upgrade, Santa Cruz

John Muir Medical Center Expansion, Walnut Creek

Children's Hospital Oakland Research Institute (CHORI) – Ferritometry Building, Oakland

St. Mary's Hospital and Medical Center, Radiation Therapy Remodel, San Francisco

UCSF Parnassus Campus Ambulatory Care Center, MRI Facility, San Francisco

Washington Hospital Pedestrian Bridge and Medical Office Building, Fremont

2330 Post Street Medical Building, San Francisco

Kentfield Rehabilitation Hospital, Kentfield

2400 Sutter Medical Building, San Francisco



"I never quite know how the pieces I've collected for sculpting, over some 16 years, will finally nestle together" says Peter Levine, a Senior Field Engineer.

"Rock Ball Bearing" (on wall) granite from southern Chilean fjords, steel, redwood

"Spiked Slice of Harmony" (on table) granite from Death Valley CA, steel, sycamore

## HIDDEN TALENTS

On October 26th, Treadwell & Rollo showcased its employees' hidden talents in the firm's inaugural art show.

Exhibits included a wide variety of sculpture, paintings, photography, poetry, hand-made jewelry, pottery, music, and graphic artwork.

In the Kids Art Showcase, young

# NEWS

## LANDFILL POSTCLOSURE LAND USE SYMPOSIUM

T&R is pleased to be participating in Landfill Postclosure Land Use Symposium sponsored by the California Integrated Waste Management Board in February. The symposia will bring together engineers, developers, solid waste regulators, planners and other stakeholders to discuss the unique issues that are involved with building projects on or adjacent to closed landfills.

**Sigrida Reinis** and **Jeff Ludlow** of T&R will offer insight on designing and building-specific landfill gas mitigation systems.

**Dorinda Shipman** will join representatives from regulatory agencies and law firms in discussing the legal and economic aspects of landfill redevelopment.

While **Dean Iwasa** has been invited to talk about the successful implementation of the Sutter's Landing project located in Sacramento.

budding artists also displayed their talents.

We thank our friends and displaying artists for making the evening a huge success.



To attain unpredictable colors, textures and lusters in his pottery, Logan Medieros, a Staff Engineer at Treadwell & Rollo, uses Raku, a firing technique that dates back to 16th century Japan.

## TAKE NOTE

**MARKETING DIRECTOR** Andrea Oman

**MANAGING EDITOR** Faith Ragan

**CONTRIBUTING EDITOR** Danielle Machotka

**DESIGN** McGraw+Company

**PRODUCTION** Carole Nuttall and Faith Ragan

**PHOTOGRAPHY** Frank Tapia

**TYPOGRAPHY** Franklin Gothic, Bell Gothic, Love Letter

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amoman@treadwellrollo.com

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# Treadwell&Rollo

[www.treadwellrollo.com](http://www.treadwellrollo.com)

## SAN FRANCISCO

555 Montgomery St, Suite 1300  
San Francisco, CA 94111  
[415] 955 9040

## OAKLAND

501 14th St, 3rd Floor  
Oakland, CA 94612  
[510] 874 4500

## SACRAMENTO

777 Campus Commons Rd, Suite 200  
Sacramento, CA 95825  
[916] 565 7412

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