Earth Systems group of companies
ENGINEERING FOR THE FUTURE
Summer 2010

Consultant's Corner

Contents

Coastal Development in a Warming World

Pacifica apartments threatened by bluff erosion

As a series of winter storms battered the coast of California, media attention was riveted on the fate of three apartment buildings perched at the edge of an eroding ocean bluff in Pacifica, California. During one storm in December of 2009, approximately 5 feet of bluff was lost. The residents of one of the buildings evacuated amid fears that further crumbling of the cliff would cause the building to break up and tumble to the beach 80 feet below. The building's owners applied for an emergency permit from the California Coastal Commission (CCC) to shore up the base of the cliff. Despite the efforts of contractors working 12-hour days placing massive boulders (rip-rap) at the base of the cliff, several more feet of cliff gave way in January of 2010, forcing evacuation of a second building.

To avoid scenarios such as this, state and local policies have been developed to require that coastal projects be set back from the edges of ocean bluffs. The goal is to place the structure a sufficient distance from the bluff edge that it will not be endangered by erosion or require artificial bluff protection within its design life (considered to be 100 years for a habitable structure). In the past, appropriate setbacks have been determined by estimating future bluff retreat rates based upon historical data (i.e. past surveys or aerial photographs) in combination with assessment of such factors as the geologic strata, the stability of the bluff, and wave characteristics. Currently, documented rises in sea level and concern about the potential implications of global warming (due to natural cycles, human activities, or a combination) have raised doubts about whether past patterns are a reliable predictor of future erosion and bluff retreat.

It is believed that the earth has been experiencing a rise in the average sea level for approximately 20,000 years. Global model projections indicate that sea level will continue to rise, due to a combination of climate change, melting of glaciers and other land-based snow, and thermal expansion as the ocean waters warm. Some experts predict the rate of sea level rise will accelerate over the next century

continued on page 3

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Earth Systems Inc. is Ranked among the Nation's Top 500 Design Firms

Earth Systems Inc. has once again been named as one of the nation's top design firms by Engineering News-Record (ENR). Published annually in April, ENR ranks the 500 largest U.S.-based engineering, architectural, and environmental design firms, both publicly and privately held, based on design-specific revenue.

Despite the challenging economy, this year Earth Systems Inc. was ranked No. 454, up from No. 485 in 2009. Earth Systems has been included in the top 500 design firms continuously since 1986.

Chilean Earthquake Shifts the Earth's Axis

According to scientists at NASA's Jet Propulsion Laboratory, the massive earthquake that shook Chile on February 27, 2010 may have shifted the Earth's axis and changed its pattern of rotation, shortening the length of an Earth day by 1.26 milliseconds. Using a computer model, the scientists estimated that the position of the Earth's figure axis was probably altered by about 3 inches. The Chilean earthquake, at an 8.8 magnitude, was the seventh strongest earthquake in recorded history. It shifted the entire city of Concepcion 10 feet to the west; the capital city of Santiago moved 11 inches to the west.

Strong earthquakes in the past have had similar effects in altering the position of the Earth's axis and affecting the length of days; the 9.1 magnitude earthquake that occurred in Sumatra in 2004 shifted the axis by 2.76 inches and shortened Earth's days by 6.8 microseconds. Although the Chilean earthquake was of less magnitude, scientists attribute its greater impact upon the Earth's axis to its location in the mid-latitudes and steeper fault angle. Visit our website for a list, updated every hour, of earthquakes which have occurred within the last seven days worldwide (http://earthsys.com/cm/earthquakes.html).

Need LEED?

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Rock of the Season

LIMESTONE

Limestone is a sedimentary rock formed by the accumulation of sediments such as shell, coral, plant and animal debris. Most limestone forms in shallow, warm, calm marine waters. The Bahamas Platform is an area where limestone is currently forming from the remains of marine organisms.

Limestone can also form through evaporation. Stalactites, stalagmites and other cave formations are examples of limestone that formed through evaporation. Mammoth Cave in Kentucky, the world's largest known cave system, (shown here to the right) was formed in this manner.

Limestone has so many uses: roads and railroads; construction materials; in agriculture as soil additives and feed supplements; in industrial uses for mine safety, and flux stone for metal refining; in manufacturing as a filler in paper, paint, rubber and plastics.

Some important structures built with limestone include: the Great Pyramid of Giza; most historic buildings in Kingston, Ontario, Canada, nicknamed "Limestone City"; and Windsor Castle.

On the Mohs Hardness Scale, limestone measures three (it can be scratched with a knife).

The poet W.H. Auden wrote "In Praise of Limestone" while visiting the island of Ischia in the Gulf of Naples in 1948.

Coastal Development... *continued from page 1*

because of the increasingly rapid rate at which glaciers are melting worldwide. Further complicating matters are local variations caused by tidal influences, weather events, and short- or long-term climate fluctuations.

Due to uncertainty associated with sea level change and the dynamic constantly changing nature of ocean bluffs, there is no global or even nation-wide consensus regarding methodologies for establishing appropriate bluff setbacks for coastal developments, although several states have recently revised their policies regarding coastal development. In South Carolina, shorefront development has been greatly restricted, and Maine limits development in any area that would be eroded by a rise in sea level of 90 centimeters (about 3 feet).

Changes in California Coastal Commission Policies

In California, the policies of the CCC have evolved in an effort to more accurately predict future bluff erosion rates and avoid situations such as what recently occurred in Pacifica. In determining long-term bluff retreat rates, the CCC currently requires that historical changes in the configuration of the bluff edge be assessed for a minimum period extending from 50 years ago to the present, if the data are available. To take into consideration future rises in sea level, an increase in sea level of 2 feet (rather than 1 foot as was previously assumed) must be used when calculating wave run-up.

The setback based upon projected bluff retreat for the project's design life is added to any setbacks necessary to assure stability of the bluff, as determined by a qualified geologist. A 10-foot buffer zone is then added. According to the CCC, the purpose of the buffer zone is to account for uncertainties in the analysis, to allow for unusual episodic events that could increase bluff retreat, and to provide additional protection against the foundation becoming undermined or requiring remedial augmentation within the structure's 100-year design life.

A seawall protects against bluff erosion along the California coast

As for the apartment buildings in Pacifica, the construction of a massive seawall was planned at an estimated cost of about $6 million. This was in addition to the $500,000 already spent by the building owners to place boulders at the base of the cliff. Work on the wall began in January, but was later halted for financial reasons when the owners were unable to obtain supplementary funds. In late April, a 75-foot chunk of the seawall collapsed, forcing the evacuation of the remaining apartment dwellers.

In the words of a spectator witnessing the construction efforts, "The ocean is sculpting the shore, which it's done for millennia. We are just passengers."

page 3

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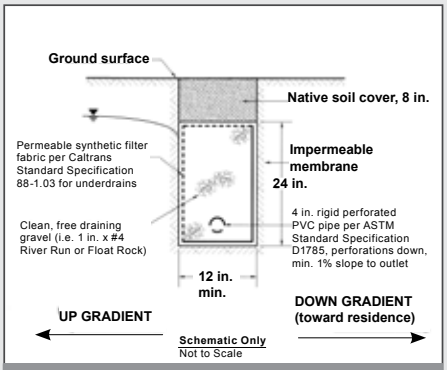
Mitigating Subsurface Water

SUBSURFACE WATER IS A COMMON phenomenon in many areas of California. Sources of subsurface water include springs, surface drainage that gains access to the subgrade, high groundwater tables, permeable soil zones that transmit water, and artificial sources such as leaking water pipes. Damp or wet soils can lead to a myriad of problems, including foundation movement due to expansion or hydrocollapse of soils, landsliding, rotting of wood members, musty odors, and mold growth.

Conventional measures such as vapor retarders, water resistant mastics, etc., are often sufficient to protect slabs, walls, and subfloor areas from dampness. When subsurface water is known to exist, however, additional measures should be taken. As the optimum time to mitigate a subsurface water problem is *during* construction (rather than attempting to apply remedial measures later), subsurface investigation prior to construction can be a valuable tool. Borings drilled during a soils engineering investigation often reveal the condition and allow the geotechnical engineer to assess the depth, extent, and potentially the source of the water. Sometimes, even in areas where subsurface water is known to be prevalent, water is not encountered in borings. This can be due to the time of the year the borings are drilled, ongoing droughts, or boring locations that miss localized water-bearing zones. In such cases, a geotechnical engineer's knowledge of the local soil conditions can be invaluable.



Typical French Drain Detail

Whether water is encountered or simply suspected, a geotechnical engineer can prescribe mitigation measures that can be implemented during construction. Such measures may include French drains to intercept the water originating from an upgradient source before it can gain access to the structure. In situations where the source of water is a high groundwater table, a gravel blanket drain beneath the structure may be recommended. Where raised wood floors are planned, often the best solution is to simply grade the subfloor areas to a low point and install drain inlets. Particular attention should always be paid to proper vapor protection beneath slabs, retaining wall drainage and waterproofing, and subfloor ventilation.

Words for Words

A Group of Collective Terms for Groups of Animals

A group of jellyfish are a smuck, snails are a walk, swallows are a gulp, walruses are a huddle, and ferrets are a business.

A Collection of Words about Letters

Alphabetically-ordered *aeiou* words: a word in which the five vowels appear in alphabetic order, such as *abstemious*, *facetious*, and *caesious*.

Abstemious words: a word lacking the five vowels, such as *gypsy*, *nymph*, *pygmy*, *slyly*, and *rhythm*.

page 4

Can You Help Me Remember My Mnemonic?

How to spell "rhythm":
Rhythm **H**elps **Y**our **T**wo **H**ips **M**ove.