Threadlines of Geotechnical and Engineering Geology firms in the Greater Los Angeles Metro-Southern California Area

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Corps of Engineers Threadline

The **Los Angeles District of the Army Corps of Engineers** played an important role in the development of geotechnical engineering and engineering geology practice in southern California. After passage of the River & Harbors Act of 1896, and the recommendations of the Walker Board appointed by President Cleveland in March 1897, the Corps involvement with developing a viable deep-water port for southern California led to the establishment of the Los Angeles District of the Army Corps of Engineers in December 1898. The Corps began dumping rock into San Pedro Bay off Point Firmin in late April 1899. The granite for this first breakwater was quarried on Catalina Island. The project gradually picked up speed as contractors developed more efficient methods of placing the rock, and the breakwater project was completed between 1902-05.

In 1902 the Pacific Electric Railway connected Long Beach and San Pedro to their expanding system serving southern California. In 1905 the Los Angeles & Salt Lake Railroad made connection with the fledgling Port of Los Angeles, providing a second transcontinental rail link, with the Santa Fe Railway at the Hobart Yard in Los Angeles with the Union Pacific transcontinental line, in Ogden, Utah. In 1907 the Los Angeles Harbor Commission was established, which oversaw the continual evolution and development of the new port facilities. Everyone on the west coast expected the Panama Canal, then under construction, to b ring increased maritime commerce. In 1909 the citizens of San Pedro and Wilmington voted to annex themselves to the City of Los Angeles. With similar visions the Southern Pacific Railroad completed their first major wharf facility at the port in 1912.

Captain Charles T. Leeds (1879-1960) became the Los Angeles District Engineer in 1909 and he would remain in Los Angeles the rest of his life, exerting a marked influence on the civil engineering practice there. During his first three-year term as the District Engineer, the 1,900 ft gap between Point Firmin and the first breakwater was filled-in, creating a continuous breakwater 9,250 ft long, using three million tons of quarried rock.

Siltation and navigation problems

Major setbacks to harbor development occurred with the storms of Feb 1914 and Jan 1916. The storms of February 1914 deluged southern California, overtopping dams and rail lines in San Diego and Los Angeles Counties, leading to the establishment of the Los Angeles County Flood Control District in 1915 (Leeds had a significant role in effecting these responses). The damage to the new port facilities was horrendous, with three to five million cubic yards of silt being dumped into the San Pedro/Wilmington and Long Beach Harbors by the various channels that discharged into Wilmington Bay. The massive infusion of silt left the new wharves "high and dry," at the most inopportune time because the Panama Canal opened six months later, in August 1914. It took 1-1/2 years to dredge and dispose of the enormous volume of silt and sand from the 1914 storm when disaster struck again, in Jan 1916. This time silt from the Los Angeles River filled the newly excavated channels and wharves in Long Beach Harbor, making it inoperable and bankrupting the Los Angeles Dock & Terminal Co., which had developed the facilities. The City of Long Beach stepped in and took over ownership and operation of their new port.

In March 1917 the United States entered the World War in Europe and Charles Leeds volunteered to return to Army duty as the Los Angeles District Engineer. This allowed the younger career officers to be released for duty in Europe. The two ports (Los Angeles and Long Beach) grew dramatically because of U.S. Maritime Commission was ordering a record number of cargo ships, to any yard able to throw a vessel together. These contracts were a real boon for the fledgling Ports of Los Angeles and Long Beach. In 1914 the Port of Los Angeles handled about 150,000 tons of cargo per month. By the time the First World War

ended, four years later, the Port of Los Angeles was handling 2,500,000 tons/month. Commercially speaking, it was now a force to be reckoned with.

After the First World War the Corps of Engineers began tackling the siltation problem by constructing five miles of levees along Nigger Slough and Compton Creek, between 1920-23. These improvements were then turned over to the newly-formed Los Angeles County Flood Control District (LACFCD), which developed the Dominguez Channel improvements. This was a series of concrete channel improvements that stretched nearly 16 miles, draining a 115 square mile area tributary to the harbor. It took the LACFCD nearly 40 years to complete the entire project.

From 1931 onward the Corps began viewing Los Angeles-Long Beach as an integrated facility, and the port continued to expand through placement of sandy hydraulic fill behind semi-flexible rock and timber bulkheads to reclaim vast tracts of land from what used to be offshore shoals. Between 1932-48 the Corps of Engineers set about constructing the detached breakwaters that protect the Ports of Los Angeles and Long Beach, employing the joint venture Rohl-Connolly, who used granite quarried on Catalina Island. Three great breakwaters were completed: the first was extended 1,900 ft and a navigational beacon was fixed on its eastern terminus, marking the main entrance to the Los Angeles Channel. This western breakwater extended 11,152 feet from Point Fermin and was christened the San Pedro Breakwater. The Middle Breakwater was completed in 1937 with a length of 18,500 ft; leaving a 1200 ft gap for the main Long Beach Shipping Channel. The Long Beach Breakwater, east of the channel gap, was not completed to its final length of 13,350 feet until after the war, in 1946-48.

The port was surprising little damaged by the March 1933 Long Beach earthquake (because there wasn't much hydraulic fill in place at that time), but problems with ground settlement began to manifest themselves during the Second World War, due to the withdrawal of petroleum in the Wilmington-Signal Hill oil field. By 1945 Los Angeles-Long Beach was the largest man-made port in the world, but the problems of flooding, siltation, earthquakes, and ground subsidence combined to make it one of the most geoetechnically challenging harbor facilities in the world.

The outbreak of the European War in September 1939 brought increased congressional appropriations for construction of military facilities in, beginning in 1940-41. The Corps of Engineers was charged with the design and construction of the domestic military facilities during the Second World War. The staff of the Los Angeles District grew by 400% between June 1939 and June 1942, and another 150% by the end of the war. These figures hardly reflect the volume of construction they were responsible for supervising, which increased $20 million per month after the attack on Pearl Harbor in December 1941.

The Ports of Los Angeles-Long Beach were enlarged considerably during the war, with the construction of the Long Beach Naval Complex, which included the Naval Shipyard - Long Beach, a Naval Air Station, four associated housing areas in Los Alamitos, Palos Verdes, San Pedro, and Whites Point; Naval Station Long Beach and its two associated housing areas at Savannah/Cabrillo and Taper Avenue; and the Long Beach Naval Hospital. The shipyard included warehouses with rail access, three dry docks (one able to handle fleet carriers), fitting docks, wharves, and the Navy Mole, where wartime modifications could be made on even the largest vessels (such as upgrading radar antennas, etc.).

In 1943-44 additional work was undertaken to develop Alamitos Bay, along the east side of Long Beach, which had been plagued by flooding and siltation emanating from the mouth of the San Gabriel River. Twin jetties were constructed along the entry channel, the eastern of which trains silt-laden flows from the San Gabriel into deeper water offshore, keeping the Alamitos Bay channel clear. This work was carried out in cooperation with the LACFCD.

After the war, the Corps of Engineers let the last contract to complete the remaining segment of the massive breakwater structures for the Ports of Long Beach and Los Angeles. In 1954-55 parallel breakwaters along the Los Angeles River Channel were extended through the Long Beach Harbor to convey sediment to deeper waters, well offshore.

Terminal Island was expanded dramatically, through the use of hydraulically-dredged sand fill, excavated from the adjacent channels. The Port of Los Angeles became a major ship-building center, with construction of the West Basin around Smith Island and similar facilities chiseled into the old shoreline around Mormon Island, the East Basin, and the northwestern side of Terminal Island. In 1953 the American Society of Civil Engineers named the Los Angeles & Long Beach Harbors among the "Seven Wonders of Civil Engineering in the Los Angeles Region" (Hoover Dam and the Colorado River Aqueduct were selected as two of the Seven Modern Wonders of Civil Engineering in 1958).

Grievous settlement problems

By war's end in 1945 the most vexing problem the port faced was increasing settlement, which eclipsed a rate of two feet per year by 1947, endangering the usefulness of many constructed facilities, such as Southern California Edison's (SCE) power station on Terminal Island. In 1948 SCE and Stanford Research Institute brought in soil mechanics pioneer **Karl Terzaghi** (1883-1963) and petroleum engineer **Charles Dodson** to assess the settlement problems, which seemed to be worsening. Terzaghi soon learned from Dodson that 600 million barrels of oil and 200 million barrels of water had been pumped out of the ground over the previous 20 years (1932-52), as well as enormous quantities of natural gas. These consultations resulted in the most voluminous reports ever prepared by Terzaghi, some which (in 1952) exceeded 400 pages in length. When Terzaghi's predictions were exceeded in the early 1950s, other experts, including Professors **Ralph Peck** (1912-2008) and **Nabor Carrillo-Flores** (1911-67), were brought into the work. After several years of intense testing and analysis, everyone was surprised to find that the siltstones of Pliocene and Pleistocene age, lying 2000 to 6000 ft deep, were actually the culprits, which no one, not even Terzaghi, initially believed plausible (the oil and gas was being withdrawn from the porous sandstone lying between the low density siltstone beds).

Flood control improvements

The Corps became increasingly involved in shoreline protection and enhanced harbor navigation during the 1930s, which was augmented to develop projects for the Works Project Administration (WPA). The Corps' responsibilities were enlarged considerably with passage of the Federal Flood Control Act of 1936, which expanded their responsibilities to include provision of flood control, in cooperation with local agency sponsors. The Los Angeles District was authorized to construct $70 million worth of flood control improvements envisioned in Los Angeles County's Comprehensive Plan. This led to a complete re-organization of the Los Angeles District, with a much-increased emphasis on flood protection. This work included major improvements to the Los Angeles, Rio Hondo, and San Gabriel Rivers. From 1941-53 **Burnham H. Dodg**e served as Chief of the Hydrology and Flood Operations Section, who authored the classic article titled ***Debris Control*** (Ch. 19) in the classic 1950 tome **Applied Sedimentation**. Over the next two decades (1940-66) the Corps expended $350 million on flood protection works and the LACoFCD spent $1.5 billion. Between 1898-1964 the Los Angeles District constructed $1.33 billion in military facilities and $570 million of civil works in the Los Angeles District.

Post-war drawdown

The post-war era also witnessed the resumption of emphasis on flood control infrastructure. Between 1948-58 the Los Angeles District averaged between $50 and $100 million per year in construction projects. By 1958 the district office employed 1,350 people, occupying five floors of the office building at 8th and Figueroa. It was the second largest Corps district in the nation (New Orleans employed as many as 4,000). Construction worked peaked in 1961 ($92 million), and by 1965 the district staff had been whittled down to 876 employees, and they moved into the 6th and 7th Floors of the new Federal Office Building in downtown Los Angeles. By 1966 the Corps was still studying 19 areas in southern California that were awaiting flood control projects (upper Santa Ana, upper San Jacinto, upper Santa Clara watersheds, Santa Barbara and San Diego Counties, as well as the upper Mojave River Basin).

Foundations and Materials Branch – Los Angeles District

The first geologist hired by the Los Angeles District was **Mason K. Read** (1891-1962; BA Geol 1913 Illinois) in 1935, as a Quarry Stone Inspector for the LA Harbor Breakwater, after having worked at the Catalina Island Quarry, teaching geology at Pasadena City College, and working in the oil industry. In 1946, a new **Foundations and Materials Branch** was added to the district. The Branch Chief of the **Foundations Group** was geological engineer **Vladamir "Wally" Pentegoff** (1899-1982; profiled below) from 1946 until his retirement in 1963. The **Materials Group** was under the direction of former LADWP engineer by **Elton Knight** (1916-60). **John M. (Jack) Bird** (1916-91) left his position teaching soil mechanics at the University of Tennessee to become Chief of the Foundations Section, and **Mason Read** became Chief of the District's new **Geology Section** (Read was a charter member of CAEG when it formed in 1957). After Read retired in Nov 1960, **Vernon F. Minor** became Chief of the Geology Section, assisted by engineering geologist **Brandt D. Jorgensen**. The district was also assisted by **George D. Roberts,** CEG (1910-80) (BS GeoE '33 CSM) in 1965-67, one of the Corps' most capable engineering geologists at that

time. Roberts worked for Dames & Moore's San Francisco office between 1963-65 and 1967-75, before retiring to Laguna Hills, where he passed away in 1980.

During the Second World War one of the district's structural engineers, **L.T. Evans**, was dispatched to set up a soils and foundation engineering laboratory. Evans started one of the first soil mechanics firms in Los Angeles in 1946 (described below). At that time the Branch provided personnel to perform tests and provide inspection of the work during construction (concrete, including placement of rebar, and soils). During investigation of potential construction sites, the drilling, backhoe excavations, and soil sampling was performed by District personnel from the Geology Section.

When Jack Bird moved to the Corps' new Snow, Ice, and Permafrost Research Center in July 1953, his former student **Claude Fetzer** (1922-2001) replaced him. **Fetzer** received his BSCE from Tennessee in 1943 and served as Navy Seabee officer during the war, followed by work with Freese & Nichols in Houston. In 1947-48 he completed his master's in soil mechanics at the University of Illinois under Ralph Peck. He joined the Los Angeles District in December 1948.

In 1953 **Fetzer** was joined by two experienced geotechnical engineers, **Jack W. Rolston** (BSCE '47 Harvard; ME '48 Stanford) from Charles Lee in San Francisco and **Joseph C. Sciandrone**, (BSCE '48 Kansas), who transferred in from the Kansas City District. Rolston had received formal training in soil mechanics at Harvard and Stanford (profiled below), and **Sciandrone** (1924-2007) went onto to become the Corps' senior geotechnical expert on levees in California, working out of the Sacramento District. Fetzer achieved considerable notoriety solving embankment problems for the Corps of Engineers across the country. The soils engineering group in Los Angeles was joined by **Gilbert Reyes**, **Neal Parker**, and **Gene Mahoney** in the late 1950s.

When Wally Pentegoff retired in 1963, Claude Fetzer was transferred to the Ohio River Division and **Jack Bird** returned to Los Angeles to become the new Branch Chief in 1964, until he retired in the mid-1970s. Other people working in their geotechnical group in the 1960s-70s included: **James R. Townsend, John S. Ferguson, Charles W. Orvis**, **Terrence J. Smith**, and **Filmore Turner**. In 1960 Rolston started his own consulting firm (Foundation Engineers, profiled below), but returned in 1969, working full-time and part-time as their senior geotechnical consultant over the next 40+ years! **Larry Luro** replaced Bird as Chief of the District's Geotechnical Branch when he retired.

Geotechnical firms spun off by the Los Angeles District

Leeds and Barnard (1913-1930)

Charles T. Leeds graduated #2 in the Class of 1903 from West Point, just behind Douglas MacArthur. He and MacArthur were both selected for duty in the Army's elite Corps of Engineers. Leeds was sent to MIT to obtain additional engineering training, receiving a second bachelor's degree in civil engineering in 1906. He was sent to Los Angeles as the new District Engineer in 1909, where he also served on the California Debris Commission from 1909-12. During this time, most of the district's work was associated with improvement of the expanding Port of Los Angeles in San Pedro Bay (described above). In 1912 Leeds was granted a medical discharge for "injuries sustained in the line of duty." After his discharge he remained in Los Angeles, and in March 1913, formed a partnership with **Wilfred K. Barnard** (1879-1936). They began working together in late 1912 to see if they felt compatible. Both men were prominent consulting engineers with sterling reputations for integrity and honesty during the early days of Los Angeles' meteoric growth.

Will Barnhard was a native of St. Joseph, Missouri, whose father was president and general manager of the Ohio & Mississippi Railroad, followed by the Baltimore & Ohio Southwestern Railroad. Young Barnard attended the Sheffield Scientific School at Yale, receiving his bachelor's degree in 1901. He worked for the Pennsylvania Railroad, and moved west in Feb 1904 to work on the construction of the Los Angeles & Salt Lake Railroad between the Port of San Pedro and Salt Lake City (absorbed by the Union Pacific system in 1921).

Leeds and Barnhard's partnership continued through 1930, a period when Los Angeles was literally exploding with growth. The firm had a pioneering role in developing flood control systems for the lower Santa Ana River, the Coachella Valley, the development of Newport Harbor (from 1923 onward), land appraisals for railroads in Colorado, Arizona, New Mexico, and Utah, comprehensive plans for the enlargement of the Port of Los Angeles (San Pedro had been absorbed into the city in 1909), shore protection for Venice, water supply system for Montecito (Buell Dam and Doulton Tunnel), etc.

Charles Leeds was a pivotal figure in the development of flood control in Los Angeles and Orange Counties. He was named to the Board of Engineers for Flood Control appointed by Los Angeles County Board of Supervisors after the Flood of 1914, who prepared two important reports. The first report, released on May 2, 1914, addressed the damage that occurred in February 1914; while a more exhaustive report, released in July 1915, formalized a long-term plan of flood control for Los Angeles County, which included the Dominguez Diversion of the Los Angeles River. Leeds made headlines when he pointed out that Los Angeles had suffered 41 floods in the previous 37 years (between 1878-1914). Leeds also spared publicly with **J.W. Reagan**, who was critical of the Board of Engineers report and who succeeded in being named the first County Flood Control Engineer in 1916. However, both men agreed that floods were becoming more frequent because of widespread development and the appurtenant construction of impervious surfaces, as well as summertime irrigation.

Will Barnard was left to manage the affairs of the firm during the First World War (1917-18) when Leeds availed himself to serve as the interim District Engineer for the Los Angeles District. Leeds was promoted to major and in addition to his administrative duties at the district office in downtown Los Angeles, he also managed to teach military science and tactics courses to the newly established ROTC detachment at Throop Institute in Pasadena (which became Caltech in 1921).

Leeds was promoted to Lt Colonel in the Army Reserve in 1924, and was thereafter referred to as "Colonel Leeds" by the media. During the late 20s and 30s he was named to numerous high-visibility investigative panels, including those charged with examining the March 1928 St. Francis Dam failure, the reassessment of its sister structure, Mulholland Dam, in 1931, the design review board for the Bouquet Canyon Dams in 1931-32, the panel investigating the effects of the March 1933 Long Beach earthquake, the board of experts charged with assessing the deadly Jan 1934 Montrose-LaCresenta floods, and the board of engineers charged with evaluating the record floods of March 1938, which devastated much of southern California.

Barnard served on the Greater Harbor Committee of 200 in 1922 (sponsored by the LA Chamber of Commerce), where he played a major role in the unification of the various railroads serving the ports of Los Angeles-Long Beach (they used common trackage), as well as establishment of the Harbor Belt Railroad serving both ports. Bernard was also an early advocate of a centralized Union railroad terminal in downtown Los Angeles, which was eventually ordered by the State Railway Commission and opened in May 1939. In June 1931 Leeds and Barnard received a patent for a concrete block groin or sea wall system they devised during the 1920s. In 1930 the firm joined Quinton, Code and Hill, described below, under the U.S. Reclamation Service threadline.

L. T. Evans Foundation Engineers (1946-58), and L.T. Evans Corporation-Consulting Foundation Engineers, Los Angeles (1958-78)

L.T. Evans (RCE 5241) was born in 1902 and grew up in New Albany, Indiana. He received his BSCE degree from Purdue University in 1924, where he was educated as a structural engineer. He immigrated to southern California in 1932 and his son L. T. Evans, Jr. was born on March 8, 1933. L.T. was unable to find any engineering work until three days after the birth of his son, because of the Long Beach earthquake of March 10, 1933. The day after the devastating quake the City of Long Beach hired him to inspect structural damage. In 1935 he joined the Los Angeles District of the Corps of Engineers, where he served as Head of their Structural Design Subdivision, between 1936-45. During the Second World War he visited a number of universities back east to ascertain what would be needed to create a soils and foundation engineering laboratory for the Corps' district office, which needed soils engineering for many of their wartime projects.

In July 1945 Evans started his own consulting engineering firm out of his home in Long Beach. He moved to Sherman Oaks in 1950, and moved the business to Los Angeles, just west of downtown, where he offered soil mechanics and foundation engineering services. His son **Tom** (**L.T. Evans, Jr**) (RCE 12072/GE 302) received his BSCE from Stanford in 1955 and MS in structures in 1958, before re-joining his father's firm. L.T. Evans did a lot of work for the Hollywood movie studios, UCLA, and many of the colleges and high schools in the Los Angeles area. They never did single family residence work in the hills, finding it "too competitive."

During the 1950s and '60s L.T. Evans and LeRoy Crandall were the primary geotechnical reviewers for the City of Los Angeles Grading Review Board. In the 1950s Evans used **G. Austin Schroter** of Schroter and Lockwood as his consulting geologist. Schroter and Evans co-authored a 1959 presentation titled "***Engineering Geology and Urban Growth***" for the Rocky Mtn Section Mtg of the Geological Society of

America. In the early 1960s they began using retired USC Geology Professor **Tom Clements** as their consulting engineering geologist, continuing into the early 1970s. Around 1972 they began using **Jim Slosson** as their engineering geologist. This relationship continued until the business was sold to Harding-Lawson in 1978. After the firm's sale, L.T.'s son **Tom Evans** headed to Berkeley (fall of 1979) to work on his doctorate in geotechnical engineering with Professor Mike Duncan, developing a "***Simplified Procedure for Evaluating Lateral Loads of Driven Piles***," completed in 1981. He then returned to Los Angeles area and became Chief Engineer of Converse Consultants in Pasadena, until retiring in 1999. L.T. Evans, Sr. died on August 29, 1988, at age 86.

Harrington Geotechnical Engineering (1990-)

Firm started by **Don P. Harrington, Sr**., PE, GE and his son **Don P. Harrington, Jr.**, REA in 1990, and based in Orange, CA since 1991. Don Sr. began his career as a soils tech for L.T. Evans in 1954 and completed his civil engineering training through the International Correspondence School (ICS) program in 1964, while working for Ed Twining, Sr. at Twinning Labs in Long Beach. He became a registered civil engineer in 1968 and moved to Advanced Foundation Engineering (1968-73), followed by H.V. Lawmaster & Co. in Stanton, from 1973-90. Don Jr. worked for H. V. Lawmaster from 1978-90. Their senior geotechnical engineer and lab manager is **Joseph L. Welch**, PE, GE (BSCE '66 West Point; MS '77 GWU Wash, DC), who joined the firm in 2005, after having worked for Geotek, Petra, Ned Clyde Construction, and other firms, mostly in the San Diego area, from 1985 onward. The firm's engineering geologist is **Christopher L. Tomlin**, PG, CEG (BS Geol '85 SDSU; MBA '95 Univ Phoenix).

Harding Lawson Associates (1978-92)

Orange County office established at 1700 E. Dyer Road, Santa Ana, after purchasing L.T. Evans Foundation Engineers (described above). The original managing partner was **Gerald M. Diaz**, PE, who transferred from Harding's SF Bay headquarters.

Diaz-Yourman & Associates (1992-)

Founded by **Gerald M. (Jerry) Diaz**, GE (BSCE '59 New Mexico State; MS '79 Houston) and **Allen M. Yourman**, Jr., GE (BSCE '76, MS '78 UCLA; MBA Pepperdine) as an MBE and DBE firm. Jerry Diaz was principal of Harding Lawson's southern CA office, where Yourman began working in 1978, after completing his master's at UCLA (he was Ken Lee's last grad student). They were originally located in Tustin, in Dec 1992. Now located in Santa Ana, with a branch office in Oakland. They specialize in ground improvement projects for port facilities (Los Angeles, Long Beach, and Oakland). Since 2004, other principals include **Chris M. Diaz**, PE as President and **V.R. (Nadesh) Nadeswaran,** GE, principal engineer.

Vladimir (Wally) P. Pentegoff, consulting geological engineer

Wally Pentegoff (1899-1982) received his BS GeoE (1928) from the Colorado School of Mines. He went to work for the Army Corps of Engineers in 1940. He was named Chief of the newly formed Foundations and Materials Branch of the Los Angeles District in 1946, shortly after the war. After retiring from the Corps in 1963, he became one of the most sought-after geological engineering consultants, working out of his home in Pasadena on just about every tunneling project in the western US. He was a member of MWD's Board of Consultants between 1966-80. He passed away in 1982.

Foundation Engineering Co. (1960-95)

Jack W. Rolston, GE graduated from Washington High in Los Angeles and attended Colorado School of Mines for three semesters, Sept 1941 through Dec 1942, before enlisting in the Army during World War II. He received additional training at Harvard through the Army in 1943-44 and returned there after the war, completing his MSCE under **Arthur Casagrande** in 1947. This was followed by his MEng at Stanford in '48, where he also taught surveying. He then took a position with the Bay Area Toll Bridges Commission working with Berkeley Prof. **Parker Trask** on the proposed Southern Crossing of the SF Bay Bridge, between 1948-51, then to Afghanistan for Morrison & Knutson (1951-53), and back to San Francisco working for Charles Lee in 1953. Later that year he moved back to Los Angeles to accept a position working for the Soils Design Section of the Los Angeles District of the Corps of Engineers. Jack remained with the Corps full-time until starting his own consultancy.

In 1960 he started **Foundation Engineering** in Tarzana, which merged with **Earth Systems** in 1995. His engineering geologist was **Bill Uhl,** CEG. Jack returned to the Corps of Engineers in 1969, working part-time when business slowed down. He returned to the Corps full-time in 1982, and retired from the Corps in 1985. He was still consulting with them part-time in 2011!

Being one of the only Harvard-trained geotechnical engineers in Los Angeles at the time, Rolston was an integral member of the various ASCE and AEG committees that developed grading and excavation codes in the Los Angeles area between 1957 and 1985. Jack was the long-time AEG representative on their Building Codes Committee, which provided input to various municipalities and ICBO until 1985. His work with promoting building codes also led to the formation of the Soil and Foundation Engineers Association (SAFEA) in 1971, and Rolston served as its first president, in 1971-72. This is now CalGeo, the California Geotechnical Engineers Association.

U.S. Reclamation Service threadline

Most of the region's most prominent civil engineers were engaged in irrigation engineering, because the development of water resources was crucial to southern California's early development. The U.S. Reclamation Service was established in 1902 as a part of the U.S. Geological Survey to aid in the development of water resources on public lands in the semi-arid western United States. Engineers were gleaned from the private sector and employed part-time, on a project-by-project basis. During the first five years the fledgling agency only developed 30 projects. In 1907 the Reclamation Service was established as a separate entity within the Department of Interior and was led by **Frederick H. Newell**, a leading zealot of irrigation engineering. Newell sought the best and brightest young engineers he could find, many of whom became prominent names in the civil engineering profession.

The Reclamation Service's "consulting engineers" were expected to support themselves part-time, performing whatever consultations they could glean from private clients, especially in light of the fact that most of Reclamation's construction projects shut down during the winter. When the Reclamation Service was re-organized into the U.S. Bureau of Reclamation in 1923, their employment structure shifted to that of a governmental civil-service agency, using full-time employees selected by competitive examination, who were forbidden from moonlighting in the same field of expertise (e.g. designing dams).

The use of part-time "consulting engineers" by the old Reclamation Service was how so many Reclamation engineers came to work in southern California. These included: **J. B. Lippincott**, **John H. Quinton**, **William H. Code**, **Louis C. Hill, Raymond A. Hill, Frank A. Nickell, A.H. Ayers, Trent Dames, Robert Stone,** and **Bill Wahler**. These are some of the engineers who subsequently established engineering consulting firms in the Los Angeles area, which specialized in the design and construction of dams, canals, and water resources infrastructure. With Los Angeles being situated along a highly active tectonic margin, all of these structures were impacted, in one way or another, by the various geotechnical hazards presently taken for granted, such as floods, debris flows, earthquakes, landslides, expansive soils, brush fires, water table drawdown, saltwater intrusion, and petroleum and gas withdrawal. These challenges gave rise to an increasing awareness and appreciation of geotechnical hazards, culminating in the establishment of geotechnical engineering consulting firms, beginning in the 1930s.

Quinton and Code (1911-14)

John H. Quinton, M. ASCE (1850-1944) was born in Ireland and graduated from Queen's University in Dublin with a BA in 1871 and Bachelors of Engineering in 1872. He immigrated to California in 1873, initially working on irrigation projects near Fresno and ground leveling projects in the San Joaquin Valley. He then worked on various railroad construction jobs in Oregon until 1891, when he affiliated with the US Geological Survey (1891-94), evaluating various watersheds for development. One of those evaluations included the Hetch Hetchy Valley of the Tuolumne River, which he thought would be suitable for the City of San Francisco's expanding water needs (they selected the site in 1912).

In 1894 Quinton moved to southern California to engage in private practice, which included work on the Santa Ana Canal (in 1894-97), followed by the San Gabriel Power Canal, which included 36 tunnels. This project kept him occupied between 1897-1900. He then established an office in downtown Los Angeles.

In 1903 he was one of four "supervising engineers" hired by the newly formed U.S. Reclamation Service on a per diem basis to help that newly formed agency design dams (the other supervising engineers were Hiram N. Savage, C.H. Fitch, and J.B. Lippincott). Quinton was credited with designing the Minidoka

Dam on the Snake River in Idaho, the Uncompaghre Project, Lower Yellowstone Project, Belle Forche Dam, Strawberry Project, Pathfinder Dam & Interstate Canal, North Platte Project, Yuma Project, Laguna Dam, Orland Project, Klamath Project, Grand Valley Project, Huntley Project, Milk River Project, Hondo Project and several others. In 1910-11 he supervised construction of the Truckee-Carson Project and he continued working off and on for Reclamation and the Indian Service until 1915. Quinton continued consulting on a wide variety of water resources projects, not only in southern California, but also in Arizona, western Canada, and South America.

By 1921 J. H. Quinton listed himself as "Consulting Engineer, Los Angeles" in a discussion published in the 1921 ASCE Transactions. Although he died on July 7, 1944, a separate firm named **Quinton Engineers**, which he likely started after separating from Quentin, Code & Hill around 1940, operated out of downtown Los Angeles, into the mid to late 1960s (their chief engineer was **Don Moran** in 1965).

William Henry Code, PE (1864-1951) (RCE 153) was a native of Saginaw, Michigan and received his BSCE from the University of Michigan in 1892. Between 1892-1902 he was chief engineer of the Consolidated Canal System in Arizona's Salt River Valley. He took a position with the newly formed Reclamation Service in 1902, where he remained until 1911. Code was a member of ASCE's Committee of the Irrigation Division that authored "*A National Reclamation Policy*," published in the 1931 ASCE Transactions. At that time his affiliation is given as "Consulting Engineer, Los Angeles." He also co-authored the necrology of Dr. Elwood Mead published in the 1937 ASCE Transactions.

In early 1911 Quinton and Code were named to the three-man Board of Engineers for Apportionment of Surplus Waters of the Los Angeles Aqueduct. On November 1, 1911 they formed a partnership named "Quinton and Code, Consulting Engineers," with an office in #601 of the Wright & Calendar Building, in downtown Los Angeles. Three years later they were joined by another former Reclamation engineer, Louis C. Hill, described below.

Quinton, Code and Hill (1914-1930)

Louis C. Hill, PE (1865-1938) (RCE 152) was a native of Ann Arbor, Michigan. He received his BSCE in 1886 and BSEE in 1890, from the University of Michigan (and an honorary MSE in 1911). He left his faculty position at the Colorado School of Mines to join the newly-formed Reclamation Service in Denver in 1902. He supervised a string of famous projects in the upper and lower Colorado River basins, including Roosevelt Dam (1903-11), the giant siphon under the Colorado River at Laguna Dam, and the design of Elephant Butte Dam, the state-of-the-art concrete gravity dam prior to the completion of Hoover Dam 20 years later. He entered private practice in March 1914, and availed himself as a consultant to the Bureau of Reclamation and Corps of Engineers for the balance of his life. He joined **Quinton, Code, and Hill** in Los Angeles as a full partner, and the firm consulted on a wide range of water supply and flood control projects, across the west. **Louis Hill** served on the Board of Consultants to the Bureau of Reclamation on Hoover Dam (1931-35) and all the major Reclamation dams that followed (e.g. Grand Coulee, Shasta, Friant, etc.), and as President of ASCE in 1937.

The firm designed dams and water supply projects in the American Southwest, Canada, and Mexico. They also managed the construction of these same projects, which included the construction of Camp Kearney for the Army in 1917-18, Pine Flat Dam, Madera Dam, and the Gibraltar Dam north of Santa Barbara, which was the first arch dam to utilize a thrust block on one abutment (completed in 1926, raised in 1948, and retrofitted in 1993).

One of the firm's rising stars in the early 1920s was **Walter E. Jessup** (1888-1984) (AB '10 USC; BSCE '12 Wisconsin), who was a charter member of the Los Angeles Section of ASCE when it formed in 1914 (and a Corps of Engineers Captain in WW1). Jessup served as President of the section in 1929, while in a partnership with **Henry Z. Osborne, Jr**. In August 1930 Jessup became the first editor of ASCE's *Civil Engineering* magazine (which launched in Jan 1931). After three years for service in WW2 with the Chief of Engineers in Washington DC as a Lieutenant Colonel, he was tabbed to run ASCE's new Western Headquarters in Los Angeles. In 1948 Jessup returned to New York to run CE magazine, until retiring in 1958.

In 1926 **Paul Baumann** (1892-1983; BSCE 1918 Federal Inst Technology Zurich) joined Quinton, Code and Hill as Design Engineer to work on Gibraltar Dam, after serving as chief engineer of the Lake Arrowhead Dam project in the San Bernardino Mountains. He became the principal protégée of Louis C. Hill until the latter's death in 1938.

Quinton, Code and Hill-Leeds and Barnard, Engineers Consolidated (1930-1940)

Leeds and Barnard merged with **Quinton, Code and Hill** in May 1930, and were incorporated as **Quinton, Code and Hill-Leeds and Barnard**, **Engineers Consolidated, Los Angeles**. The firm did a great deal of work for the State Division of Public Works in the 1930s and 40s, for whom Charles Leeds often served as a peer reviewer. **Paul Baumann** became their Chief Design Engineer in July 1930 (he became Assistant Chief Engineer of the LACoFCD in Oct 1934).The firm provided technical designs for dozens of dams and irrigation projects in the western United States, including Coolidge Dam. They were most noted in Los Angeles for their work in developing the Port of Los Angeles-Long Beach, and they performed pioneering work in the design of bulkhead wall systems for docks. Baumann's 1935 article for the ASCE Transactions titled "*Analysis of Sheet-Pile Bulkheads*" was awarded the 1936 James Laurie Prize of ASCE. In October 1934 Baumann was appointed Assistant Chief Designer of the Los Angeles County Flood Control District in charge of design, construction, and operation of their facilities, following the embarrassing trials over collusion involving the County's contract with **MacDonald & Kahn** for the ill-fated San Gabriel Dam at the Forks site in the late 1920s (which forced the resignation of Chief Flood Control Engineer E. Cortland Eaton). In 1943, Baumann's published another article in the ASCE Transactions summarizing the "*Design and Construction of the San Gabriel Dam No. 1,*" which was awarded the Society's Thomas Fitch Rowland Prize.

The firm also offered geotechnical engineering services as far back as 1932, with the Quelinda Estate landslides along Pacific Coast Highway. **Wilfred Barnard** died in January 1936 and **Louis C. Hill** died in November 1938, so the firm was re-organized as **Leeds, Hill, Barnard, and Jewett** in 1940.

Leeds, Hill, Barnard, and Jewett (1940-46); Leeds, Hill and Jewett (1946-1978)

In 1940 the firm became **Leeds, Hill, Barnard and Jewett**, which continued throughout the Second World War, until 1946. **Raymond A. Hill** (1892-1973) received his BCE from Michigan in 1914 and a civil engineer degree in 1922 (similar to a master's degree), after working for the Reclamation Service (1909-17). He moved to the Los Angeles area around 1913 and served as a first lieutenant in the Army Engineers during WW1 in France (1917-19). Upon his return from Europe in 1919 he joined **Quinton, Code & Hill**, and was elevated to partner of the firm during the reorganization in 1940. **John Q. Jewett** (1899-1973; RCE 1642) was the third partner.

Ray Hill was well-connected within the various circles of power, and by the mid-1930s, became the youngest member of ASCE's Executive Board. In 1938 his notoriety led to his appointment to negotiate the Rio Grande Compact adjudicating the waters of the Rio Grande River between Colorado, New Mexico, and Texas.

One of Leeds, Hill, Barnard & Jewett's most unusual projects was the Camp San Luis Obispo Dam (renamed the Salinas Dam), which retains Santa Margarita Lake, the mile-long Cuesta Tunnel, and 14 miles of pipeline. The dam was built on the upper Salinas River (which flows north), 15 miles east of the new Army post, which was home to California's 40th Division (National Guard), and on the opposite side of the Santa Lucia Mountains (now crossed by US 101 along the Cuesta Grade). It was the first arch dam to utilize thrust blocks on *both* abutments. Ray Hill brought in Louis Hill's old protégé Paul Baumann as a consultant to oversee the design of the dam, because of its similarity to Gibraltar Dam. The project was completed in 1941-42. The bulk of the firm's work during the Second World War was on defense related projects, including development of Port Hueneme, California as the principal Navy Seabee base on the West Coast, which employed a man-made harbor. The firm also designed and supervised construction of the naval magazines at Seal Beach, the largest ammunition handling facility on the West Coast. They were also associated with ongoing improvements to the Ports of Los Angeles and Long Beach.

Soon after the war the firm was re-organized as **Leeds, Hill & Jewett**. The firm continued its work on defense related projects, such as the construction of Vandenberg Air Force Base, the principal missile launching facility for the Air Force. They also provided consultations to the Coachella Valley Water and Imperial Irrigation Districts, among others. **Omar J. Lillevang** (1914-2000) (BSCE '37 Berkeley) joined the firm in 1938, served three years as a Navy Seabee officer in 1943-46, and then supervised the firm's expanding work on coastal harbors and structures. He served as the firm's Vice President for coastal and harbors works in the early 60s.

Ray Hill was an influential figure in water resources development in California throughout the 1950s and 60s, advising the State of California as a Member of the Board of Engineering Consultants to California Department of Water Resources during the planning, design, and construction of the largest non-federal public works project in American history, the California Water Project, between 1956-71. After the death of **Charles Leeds** in 1960, Ray Hill moved the corporate headquarters to San Francisco, which he

believed to be a more lucrative international marketplace for selling the firm's burgeoning expertise in water resources and dam engineering. For a while **Leeds, Hill & Jewett** maintained offices in Los Angeles and San Francisco (probably between 1960-66, or thereabouts). Some good people departed when the firm closed down its LA office around 1973. **Dallas E. "Dal" Cole** (BSCE '29 Caltech) became the chief engineer of the dwindling Los Angeles office in 1968, after serving on the Colorado River Board for 37 years. **Phillip L. Wagner**, CEG served as the senior geologist of the LA office throughout the 1960s.

Soil Mechanics & Foundation Engineers, Inc. (1964-71); W.A. Wahler & Associates (1972-78)

This was a southern California branch office of the firm, founded by **William A. "Bill" Wahler** (1925-88). Wahler grew up in southern California, graduating from Pasadena City College in January 1944. He completed his BSCE at the University of Colorado in 1950, followed by an MS in 1952. In 1952-53 he and Dr. **Jim Sherard** formed a partnership in Denver, which was short-lived (Sherard joined Woodward Clyde as a partner in 1953). In 1953-54 Wahler went to Harvard to take courses in soil mechanics. He returned to the Denver area to work for the Bureau of Reclamation before moving to the SF Bay Area, around 1956-57. After working for other firms (possibly Bechtel), he started up this firm in 1961, based in Sunnyvale, CA (they also had a branch office in Washington, DC).

The southern California office was originally located in Whittier, then Los Alamitos, and later, in Newport Beach. **James Remmelkamp** was listed as the office principal in May 1964, along with **William S. Merrithew.** By 1969 the southern California office included **Gene Nelson, Dick Harding, Doug Hamilton**, **Frank Kresse**, **Frank Fong**, and **Gerry Nicoll**. Their clients included the Metropolitan Water District, Irvine Company, and Coastal Orange County Land Co.

California Division of Highways threadlines

The Department of Highways was formed by the California Legislature in November 1896, when most of the state's ground transportation were crude dirt roads maintained by county governments as well as some paved roads within the boundaries of the largest cities, such as San Francisco, Los Angeles, and San Diego. In 1907 the Legislature replaced the Department of Highways with the Department of Engineering, within which they created a **Division of Highways**. Voters approved an $18 million bond issue for the construction of a state highway system in 1910 and the first Highway Commission was convened in 1911. The first state highway projects began in August 1912, which also witnessed the founding of the Transportation Laboratory in Sacramento, which would garner national prominence in the years to come.

In 1921, the Legislature changed the name from the State Department of Engineering into the Department of Public Works, which included the Division of Highways. Over the next half century the Division of Highways became the leading highway transportation authority in the United States, garnering many "firsts," such as the painting of centerlines on highways statewide; first to build a freeway west of the Mississippi (the Pasadena Freeway); the first to build a four-level stack interchange; the first to develop and deploy non-reflective raised pavement markers; and one of the first to implement dedicated freeway-to-freeway connector ramps for carpools. Most of this progress was chronicled in a State publication called ***California Highways & Public Works***, which was in print between 1927 and 1967.

In late 1972, the Legislature approved a reorganization (suggested by a study initiated by Governor Ronald Reagan), in which the Department of Public Works was merged with the Department of Aeronautics to become the modern Department of Transportation, known simply as **Caltrans**. Caltrans operations are spilt into twelve districts statewide, with the Headquarters, Transportation Laboratory, and Bridge Engineering Group in Sacramento and the rock slope engineering group based in San Luis Obispo.

Caltrans Engineers and Geologists who transitioned to the private sector

Many of the State's most prominent transportation and structural engineers, as well as engineering geologists, have come from the ranks of the Division of Highways, Bay Toll Crossings and their successor agency, Caltrans. One of the most famous personages in pavement and geotechnical engineering was **O. James 'Pappy" Porter** (1901-67), profiled below. Other Division of Highways personnel who went onto stellar careers in the private sector include engineers **Ralph A. Tudor** (founder Tudor Engineering Co San Francisco), **Donald R. Warren** (founder Donald R. Warren Co. in Los Angeles) and **Leroy Crandall**

(founder Crandall & Associates in Los Angeles), **Stanley D. Wilson** (founder of Shannon & Wilson in Seattle), **Douglas C. Moorhouse** (CEO of Woodward Clyde Consultants in San Francisco), **Jack Rolston** (founder of Foundation Engineering Co.), **C. Lee Lowry** (founder of Lowry & Associates), **Harry Cedergren** (renown seepage expert in Sacramento), **Ret Moore** and **Ray Taber** (founders of Moore & Taber), **Dick Frankian** (founder of R.T. Frankian & Associates), **E. Duane Lyon** (CEO of the RMA Group); **Jim Kleinfelder** (founder of Kleinfelder & Associates), **Tom Wallace** (founder of Wallace-Kuhl Associates), **Ron Carducci** (founder of Cal-West Consultants), **Gerald M. Diaz** (founder of Diaz-Yourman), **Abel Soares** (founder Soares Geotechnical), **Herb Volin** (founder of Diablo Soils Engineers), **Douglas J. Kuhl** (founder of Wallace Kuhl & Associates), **Alan L. Kropp** (founder of Kropp & Associates), and **Robbie M. Warner**, GE (founder of Geo-Logic). Engineering geologists who began their careers at the Division of Highways included **Jack T. Eagen**, CEG (grouting expert with Moore & Taber), **Charlie Marek**, CEG (pioneering work with hydraugers and cast-in-ground caissons), **Marvin L. McCauley**, CEG (pioneer in engineering geologic characterization of proposed highway alignments), **Adlai Goldschmidt**, CEG (senior engineering geologist with the Caltrans Bridge Department in Sacramento for several decades), **James H. Gamble**, CEG (became Chief Geologist of PG&E), and **David G. Heyes**, CEG (partner at Geo-Risk Associates).

O.J. Porter & Co. (1942-55); Porter & O'Brien (1952-68); Porter, Urquhart, McCreary & O'Brien (1955-60)

O.J. Porter & Co. was founded by **Omer James "Pappy" Porter** (1901-67) of the California Division of Highways in Sacramento, around 1945. Porter was a native of Mt. Pleasant, Utah born on November 28, 1901. Porter was a third generation Mormon, born in Mt. Pleasant, Utah in November 1901. He attended Alberta Agricultural College in Olds, and then transferred to the University of Alberta, receiving his BSCE degree in 1924. He took a part-time position with the California Division of Highways in 1924, mixing and testing concrete specimens in Sacramento. The quality of his work and his enthusiasm for tinkering soon landed him a full-time position in the transportation lab.

Porter went onto to serve as Associate Physical Testing Engineer, then as Staff Materials and Research Engineer in the Materials & Research Department of the State Division of Highways in Sacramento, under the direction of Materials & Research Engineer **Thomas E. Stanton, Jr.**, PE (BSCE 1904 Berkeley). Their collaboration was one of the most prolific in pavement design and geotechnical engineering.

Between 1927-30 Porter developed the **California Bearing Ratio** (CBR) and soil swell tests, building on his relative compaction test. The CBR test measured penetration of compacted soil to evaluate the relative stiffness of pavement subgrades and base courses, by comparing the penetration resistance of these materials with that of crushed limestone. The stated intent of the CBR test was to evaluate the load bearing capacity of the pavement subgrade.

In 1928-29 Porter then developed the nation's first compaction test procedure for the Division of Highways, a simple device and scheme that measured a soil's wet unit density and determined the optimum moisture content, using a very similar scheme to that made famous by Ralph Proctor five years later, in 1933. Known as the "California impact compaction test" or the "relative compaction test," it is still used by Caltrans as **California Test Method 216** (described in T.E. Stanton, 1938, Highway Soil Studies: *Calif Hwys Pub Wks*, v14:6 (June), pp. 12-14; and in T.E. Stanton, 1938, Soil Stabilization, *Calif Hws Pub Wks*, v14:7 (July), pp.12-15).

In the early 1930s Porter also pioneered the use of sand [wick] drains, which were installed on the eastern approaches to the San Francisco-Oakland Bay Bridge in 1933-35, along with standpipe piezometers to record pore pressure induced by the fill surcharge. These are generally considered the first successful employment of wick drains in the United States (see Porter, O.J., 1936, Studies of fill construction over mud flats: *Proc. Int'l Conf Soil Mech & Fdn Eng*, Cambridge, v. 1:229-235).

Between 1930-47 Porter developed a series of retractable plug piston samplers in an array of sizes, between one and four inches in diameter, and between 1.5 and three feet long. They were initially known as "**Porter Type Soil Samplers**," then as "**Porter Tube Samplers**," or simply "**Porter Samplers**." Competing drive samplers (without retractable plugs) were developed by Moran & Proctor, the Gow Division of Raymond, Sprague & Henwood, Dames & Moore, and Pitcher Drilling Company (see description under "Evolution of Porter Soil Samplers 1930-47").

In 1942, soon after the United States entered the Second World War, Porter formed his own consulting company, **O.J. Porter & Co.**, specializing in soils, pavement design, and foundation engineering, based in Sacramento. Pappy Porter did a lot of consulting work for the Navy's Bureau of Yards & Docks and

the Army Corps of Engineers (which continued through 1964). He also became the central figure of the Corps of Engineers ***Airfield Pavement Design Advisory Council***, providing advice on a program of extensive pavement tests at the "Stockton Test Track" at Stockton Airfield, south of Sacramento, which led to the development of Flexible Pavement Design Manuals and the Modified Proctor Compaction Test in 1945. Porter was also dispatched by the Army to Guam, Saipan, and Tinian in 1944 to advise the Corps of Engineers on airfield construction for the B-29 Superfortress bombers. In 1946 Porter began submitting patent applications for a number of devices, including a massive 240 ton rubber tired "supercompressor," intended to increase the insitu density of pavement subgrade for airfields.

In 1947 Porter established an east coast office in Montclair, New Jersey, moving there permanently. The lure was the plethora of settlement problems in the New Jersey Meadows area, where the government was trying to construct the New Jersey Turnpike. In the post-war period Porter employed sand drains and surcharge embankments to allow development of settlement-prone wetlands, similar to the technique he used in the early 1930s.

Around 1949-50 Porter moved the office to Newark, New Jersey, where they provided consulting services on a wide range of projects in the Eastern and Midwestern US. In addition to the original office in Sacramento, branch firms/offices were established in San Francisco and **Los Angeles**, as well as overseas field offices, mostly associated with defense design and construction contracts. Porter eventually maintained offices in Sacramento, San Francisco, Los Angeles, Montclair, NJ, and later, Newark, NJ, up thru his untimely death, in December 1967. **Porter-Urquhart** was the firm name used in the Newark-New York City area, from 1950-53. This became **Porter, Urquart & Beavin**, and later, **Porter, Armstrong, Ripa & Associates**, which operated in Newark, NJ (from 1962-68) and Sacramento (from mid-1966 to mid-1968).

A separate entity with the same Newark address, named **Porter & O'Brien,** was incorporated in New Jersey and California in 1952, between Porter and civil engineer **Kenneth O'Brien**. They offered full architectural-engineering design services for military installations, targeting work with the Army Corps of Engineers and Department of Defense, mostly on overseas airfields (e.g. Morocco). O'Brien then moved to Los Angeles to manage the Los Angeles office of **Porter, Urquhart, McCreary & O'Brien** in 1952, which became **Porter, O'Brien & Armstrong** in 1962, and continued operating through early 1968.

The firm name **O.J. Porter & Co** operated until 1953, when each office became a separate partnership. These sister offices continued operating in Sacramento, San Francisco, and Los Angeles for many years thereafter, using the same addresses. **Porter & O'Brien** was incorporated in Newark, New Jersey and California in 1952, as a partnership between Porter and civil engineer **Kenneth O'Brien**. They offered full architectural-engineering design services for military installations, targeting work with the Army Corps of Engineers and Department of Defense, incusing overseas airfields (e.g. Morocco).

After the federal government brought lawsuit against them for work on air forces bases in North Africa, Porter-Urquhart ceased doing business in 1955 and Porter formed a new partnership with geological engineer **Bruce McCreary** (Stanford '38) and civil engineer **Ken O'Brien** to form **Porter, Urquhart, McCreary & O'Brien**, which operated from offices in Newark, Los Angeles, and San Francisco, primarily design work for transportation projects (the Los Angeles Yellow Pages listed **O. J. Porter & Co.** as well as **Porter & O'Brien** at the same address throughout the late 1950s and early 60s). Porter appears to have spent most of his time in Newark, while **Ken O'Brien** directed the Los Angeles office (from 1952-67), McCreary the San Francisco office, and Porter's son James in the Sacramento office. After Bruce McCreary departed (in 1960), the San Francisco and Los Angeles' offices became **Porter, O'Brien & Armstrong**, while the Sacramento office reverted back to **Porter & O'Brien (**which had been incorporated in CA in 1952).

The Los Angeles office included engineers **Ken O'Brien**, PE, **Fred Pratley**, PE and **J. R. Holderman**, PE (BSCE '56 ColoState) between 1957-67. **Herbert J. Dix**, PE (BSCE '56; MS '59 Northwestern) had graduate training in soil mechanics, so he oversaw operation of the firm's soil mechanics labs in Newport Beach and Reno. He also became Managing Engineer of the firm's Los Angeles office (1961-65) Their clients included the Department of Defense, the Irvine Ranch Company, the State of California, and Orange County, and their work included airport runway designs (e.g. Orange County Airport, now John Wayne Int'l). **Robert E. Beckes** was the senior geologist in Los Angeles (he departed to join Boeing-Seattle in 1966), assisted by **Walter H. Johnson,** throughout the 1960s, when their office was located at 4201 Sunset Blvd. One of the firm's projects in 1960-61 was surveying possible sites for 150 missile silos and 15 missile control facilities around the United States, mostly at remote sites, for the Air Force Ballistic Systems Division of the Air Force Systems Command. Porter & O'Brien continued operations in Los Angeles until 1968, shortly before/after Pappy Porter died (in December 1967). In 1968 Ken O'Brien started his own firm, **Ken O'Brien & Associates**, which operated out of Long Beach (**R. L. Miller**) and Ventura (**J. R. Holderman**).

A successor firm, **O'Brien Engineering & Consulting** (assumed by son Ken's son, Dan O'Brien) operated out of Reno for many years thereafter.

Geo-Engineering (1955-56); Moore & Taber, Engineers and Geologists (1956-74); Moore & Taber Geotechnical Engineers & Geologists (1974-90); M&T Agra (1990-onward)

Between 1947-55 Caltech alumnus **Return F. "Ret" Moore**, PE, CEG (BSCE '47 Caltech) worked as a senior bridge engineer with the State Division of Highways in Sacramento. **Harmon Ray Taber**, PE, CEG (1927-2011) (BS Geol '48 Stanford) attended Stanford for about a year on the Navy V-12 program during the Second World War, and returned to Stanford and finished his BS in geology in 1948. In 1949-50 he returned to Stanford for graduate work in civil engineering so he could secure an engineering position with the Division of Highways in Sacramento. In June 1950 he began working in the bridge department with Ret Moore. From 1950-55 Moore and Taber developed written procedures to guide bridge engineering studies, which included a thorough engineering geologic examination of all sites, including borings on both upstream and downstream ends of any supporting bent.

In 1955 **Ret Moore** left the Division of Highways and founded his own firm, named **Geo-Engineering.** About seven months later he persuaded **Ray Taber** to join him as a principal. In 1956 they formed **Moore & Taber**, with Moore as president, and shortly thereafter, Ret Moore opened their office in southern California, while Ray Taber operated the office in Sacramento. Ray was a charter member of the California Association of Engineering Geologists in 1957 and served as AEG President in 1963-64, when the association went national.

The firm's southern California office was located in Fullerton in 1964; later in Anaheim, Bakersfield, Sacramento, and San Diego. Ray Taber lived in Davis and worked out of the Sacramento office. In 1974 the firm split into two separate firms, **Moore & Taber Northern California** and **Southern California**. In 1983 the northern California entity was renamed **Taber Consultants**.

Other key players at the southern California office included **Douglas R. Brown**, CEG (former LA Co Geologist, who joined the firm in Dec '62), **Carl Bock**, **Peter Tresselt, Thomas D. Hays**, and **Jerry McNey** in the 1960s. In the mid-1980s some of the key personnel included: **Scott Kerwin**, CEG, **Donald Clark**, CEG and **Gary Lass**, CEG all out of the Anaheim office. **Clark** subsequently served as the supervising geologist in their San Diego office. **Jack T. Eagen**, CEG left the CA Division of Highways in 1962 and worked for Stone Geological Associates before joining Moore & Taber, around 1965. He became Senior Vice President at their office in Anaheim, then out of Woodland Hills in the early 70s. He became a subject matter expert on grouting in the 1970s and 80s. **Bob Dickey**, CEG took over the reins of the successor firm in southern California, called **M&T Agra**, in the early 1990s, when the firm was performing a lot of geoenvironmental work.

Stockton Testing & Controls (1961-66); J. H. Kleinfelder & Associates (1966-85); Kleinfelder West (1985- present)

James H. Kleinfelder, GE received his BSCE degree from U.C. Berkeley in 1954, and worked for the California Division of Highways. He then took a position with the City of Stockton as a staff engineer, and found himself coordinating the hiring of soils and testing firms based out of Sacramento who weren't servicing Stockton in a timely manner. In 1961 Jim and his brother Ed started **Stockton Testing & Controls** to serve the growing market in San Joaquin County. Jim went back to graduate school in geotechnical engineering at Berkeley, securing his MS degree in 1964. In 1963 he bought out his brother's share and established the firm's first branch office in Merced. In 1966 he changed the name of the firm to **J.H. Kleinfelder & Associates**. In 1968 they purchased the assets of Porter, Armstrong & Ripa in Sacramento, after O.J. Pappy Porter died in Dec '67. In this acquisition they picked up **Michael E. Mahoney**, who managed the Sacramento operations. The firm was unusual in that they owned and operated their own drilling rigs longer than many other firms. They began doing international work in Beirut in 1968, expanding into Saudi Arabia in 1974.

The firm opened it third office in Fresno in 1970, managed by **Cyril M. "Bud" McRae**, CEG, GE (BSCE '62, MS '79 Berkeley) and assisted by **Michael V. Smith**, CEG. A fourth office was established in Walnut Creek in 1971, where **Michael E. Mahoney**, GE served as the first manager (Mahoney came to Kleinfelder when they acquired Porter, Armstrong & Ripa in1967, and he initially managed the Sacramento office). In 1975 they acquired a local firm in Reno and established another branch office.

In 1979 they relocated their corporate headquarters from Stockton to Walnut Creek. Kleinfelder created and implemented strategic plans in the late 1980s that allowed it to expand dramatically over the next two decades, into the Los Angeles and San Diego areas in the 1980s. In 1982 the firm expanded their operations into southern California, and leveraged all of the firm's service for the first time on the Squaw Creek Project at North Lake Tahoe, beginning in 1983. During this time (1983-84) Jim Kleinfelder also served as President of ASFE. In 1985 the firm expended its services to include geoenvironmental assessments and In 1985 **Kleinfelder West, Inc**. assumed ownership of the operations in the western United States (Kleinfelder Central, Kleinfelder Southeast, and Kleinfelder East being established over the next 15 years, overseeing their respective regions of the country). In 1988 Kleinfelder established regional branch offices in Washington, Arizona, and Utah and acquired Mandeville & Associates of southern California to leverage their services in air quality and solid waste management.

In 1989 Kleinfelder established an Employee Stock Ownership Plan (ESOP) to transition ownership and enable their employees to share in firm's financial success. Kleinfelder ended the 1980s with almost 600 employees and $37 million in annual revenues. Bud McRae took over the reins as president in 1989, and became CEO in 1993 when Jim Kleinfelder retired.

In 1994 the firm expanded its operations into Mexico and purchased Geospectra from J.P. Singh. By 1996 Kleinfelder had 21 offices in California.

In 1997 **Gerald J. Salontai**, GE (BSCE '77 CSPU Pomona; MS '81 CSULB) became the firm's new CEO. He joined Kleinfelder in 1981 and witnessed its near meteoric rise to prominence. In 1998 they acquired Lincoln Devore, Inc. with offices in Colorado Springs and Pueblo, Colorado. In 1999 the firm moved its national headquarters to San Diego, with Salontai continuing as President and CEO until 2009. In 1999 they acquired Trinity Engineering and Testing, with 13 offices in Texas. Kleinfelder concluded the 1990s with 1,200 employees and about $92 million in annual revenues.

In 2002, Kleinfelder expanded its operations into the Midwest by acquiring GeoSystems, Inc. In 2004 they acquired controlling interest in Kakona Insurance Co. as a captive carrier for a variety of insurance lines. In 2005 they established an East Coast presence by acquiring Geologic Services, Inc. In January 2006 the firm expanded its operations along the Mid-Atlantic States, from Philadelphia to Florida, through the acquisition of Powell-Harpstead. In 2008 they established satellite offices in the Carolinas by purchasing Trigon Engineering. In 2010 the firm established the *James H. Kleinfelder Fellowship in Geotechnical Engineering*, which grants $10,000 per annum to deserving students at U.C. Berkeley.

In 2009 **Bill Siegel** (BSCE '84; MS '86 UN-Reno) succeeded Salontai as Kleinfelder' s fourth CEO. In 2010 they expended their operations into Guam and Australia and acquired Buys & Associates and LPG Environmental & Permitting Services, expanding their operations in Florida, Utah, and Colorado. In 2011 they purchased InSite Environmental of Stockton, and in 2012 Corrigan Consulting of Houston, Texas. In 2012 Kleinfelder also opened an office in Calgary, Canada.

Before the October 2008 recession, Kleinfelder had 70 plus offices nationwide and 2000+ employees. By 2011 these figures had decreased to 54 offices and 1,850 employees, in the US, Australia, and Guam. **John S. Lohman**, GE (BSCE '82 CP Pomona; MS CSULB) serves as the firm's technical discipline leader in geotechnical and geologic engineering, working out of the San Diego office. Kleinfelder West's principal engineering geologist is **Bruce R. Hilton**, CEG (BA Geol '78 CSULA), working out of the firm's Sacramento office (Hilton also served as AEG President in 2010-11). Kleinfelder West employs an aggregate staff of about 1,100 people.

R.T. Frankian & Associates (1963-present)

Richard T. 'Dick' Frankian (1929-2010) founded R.T. Frankian & Associates in 1963, basing it in Burbank. Dick Frankian graduated from Burbank High in 1947 and received his civil engineering education at Berkeley in the 1950s (BSCE '52, MS '55 Berkeley). Upon graduation in 1952 he worked two years for the Division of Highways Bridge Department in Los Angeles, then returned to Berkeley to work on his master's degree, ***the first consulting engineer in the LA area with an advanced degree in soil mechanics from UC Berkeley***. After securing his master's in 1955, he worked for Dames & Moore, Bechtel, and Parsons, before opening his own firm in 1963.

The firm did lots of work on hillside housing tracts. Some of Frankian's projects included Albertson Ranch/Calabasas, Valencia/Santa Clarita and Newhall Ranch. Before that, he had conducted research on projects in several other communities including San Pedro, Glendale, Pasadena, Catalina Island, and

Portuguese Bend in Rolling Hills. He also did a significant amount of consulting work for the Department of Defense on the Atlas Missile sites, the Atomic Energy Commission, and Caltrans.

Between 1955-65 Dick Frankian lectured in soil mechanics at UCLA, and was a founding member of the Soil and Foundation Engineers Association (SAFEA) of California in 1973 (now called CalGeo). He also wrote the chapter titled ***Analysis of Buttress Fills*** in Scullin's 1983 text, *Excavation and Grading Code Administration, Inspection, and Enforcement*. **Doug Moran**, PE, CEG, **Tom Gray**, and **Alan Seward**, CEG were among many notables who worked for Frankian in the 1960s (Seward joined LA Co in 1966); while **Fred Curtis**, CEG and **Dave Varella** worked for the firm in the late 1970s. The firm was still doing business in 2009, headed by Dick's youngest son, **James A. Frankian**.

Allan E. Seward & Associates (1978-80); Allan E. Seward Engineering Geology (1980-present); AESEGI Consultants (2009-present)

Founded by **Allan E. Seward**, CEG (1934-2014) of the Los Angeles County of Public Works Geotechnical Section, after passage of Proposition 13 in 1978 hastened the layoff of county staff. Seward had also previously worked for Dick Frankian in Burbank (profiled above) . The firm was formally incorporated as Allen E. Seward Engineering Geology in September 1980. In the 1980s the firm initially provided the engineering geology expertise to compliment R.T. Frankian's geotechnical engineering for the Newhall Land Company when they were developing that portion of the Canyon Country area that presently comprises most of Santa Clarita. Alan's son **Eric J. Seward**, CEG (BS Geol '92 CSUN) now runs the firm, which is based in Valencia. **Stuart K. Mayes**, CEG is Senior Associate Geologist.

Geo-Logic Associates (1991-present)

Founded in March 1991 by **Gary L. Lass**, CEG, CHG (BS Geol '74 UCLA; MS '78 CSULA) and based in Claremont. He originally used **Bryan A. Stirrat**, PE (BSCE '67 Missouri-Rolla; MS Pet Eng '72 and EnvEng '74 USC) of Bryan A. Stirrat & Associates (BAS) in Diamond Bar as his engineer, until about 1999. Prior to this Gary Lass had worked for Moore & Taber (1977-90), serving as President and Principal Geologist. Geo-Logic Associates specializes in geoenvironmental engineering, with particular emphasis on landfills. Senor associates include: **Sarah Battelle** PG, CHg, VP in San Diego; **Stacy Baird** VP and Construction Services Mgr in San Bernardino; **Ralph Murphy** PG, CEG, CHg, VP in San Bernardino; **Robbie M. Warner**, GE (BA '86 UCSC; BSCE '87 and MS Berkeley, formerly with Caltrans and Rizzo & Assoc); **Lam Dang** - Laboratory Manager in Orange County office. They also own a subsidiary firm, the Kunkel Engineering Group in Beaver Dam, Wisconsin, which performs their civil engineering work.

Other early workers in southern California

Smith-Emery Company (1910-onward); Smith-Emery GeoServices (1972-)

Smith-Emery Co. was originally founded in 1904 in San Francisco, and began performing inspection and testing of commercial structures following the San Francisco earthquake and fire of April 1906. They opened up a branch office in Los Angeles around 1910, which provided the lion's share of chemical and materials testing for the Los Angeles area during that era. In the 1920s their stationary read "Smith-Emery Company, chemical engineers and chemists, metallurgical and testing engineers." **E. O. Slater** was a staff engineer in 1928.

They provided an increasing volume of geotechnical testing and inspection services during the post-war boom years of Los Angeles County, following the Second World War. In the 1980s they had offices in Anaheim and Los Angeles. The company now includes three subsidiaries: **Smith-Emery-Laboratories**, **Positive Lab Service**, and **Smith-Emery GeoServices**, established in 1972. The GeoServices arm provides environmental and geotechnical testing and inspection services, employing geotechnical engineers, engineering geologists, and environmental specialists.

The principal geotechnical person in the Anaheim office in the 1980s was **Paul Bogseth,** CEG (from Highland Geotechnical Consultants), while the firm's principal geotechnical engineer was **Lutz "Yogi" Kunze**, GE, who also served as CalGeo President in 1996-97. He oversaw the geotechnical operations from the Los Angeles office between 1994-2001, before moving to Earth Systems Southwest in Rancho Cucamonga and Bermuda Dunes.

Consulting geologist Harry R. Johnson (1920s and 30s)

Harry Roland Johnson (1885-1968) earned a BA degree in geology from Stanford in 1909, working under John Branner. Between 1906-10 Johnson and his USGS supervisor **Ralph Arnold** (PhD Geol 1902 Stanford) conducted a series of pioneering geological studies memorialized in a series of publications, including an article in *Science* titled "***The so-called volcano in the Santa Monica Mountains near Los Angeles, California***" (1907). Johnson then worked for the USGS evaluating oil and gas resources in Santa Barbara County, Coalinga, the Carrizo Plain, Kern and San Luis Obispo Counties. In 1917 Johnson became one of the founding members of the American Association for Petroleum Geologists. He was also on the Board of Directors of the Seismological Society of America in the mid-1920s.

By 1920 Johnson was established as consulting petroleum geologist working out of his office at 1101 Stock Exchange Building in downtown Los Angeles. In 1929, shortly after oil had been discovered in the Ellwood Field at Goleta, Tom Dibblee's father Wilson Dibblee hired Johnson to evaluate the oil or gas potential on the 22,000 acre Rancho San Julian in the western Santa Ynez Mountains, which led to Tom Dibblee choosing to pursue geology at Stanford University, Johnson's alma mater (see T.W. Dibblee in the U.C. Santa Barbara threadline).

In the fall of 1932 Johnson was hired by **Quinton, Code, Hill, Leeds, and Barnard Engineers** to perform an engineering geologic study of the slope stability problems associated with the troubled Quelinda Estate in Pacific Palisades, which had fostered a massive landslide that closed Pacific Coast Highway (described in R.A. Hill, 1934, "Clay stratum Dried out to prevent slippage:" *Civil Engineering*, v. 4:8 (Aug), pp. 403-407).

The following year Harry Johnson prepared a report for the Los Angeles County Board of Education on seismic conditions in Southern California area after the March 1933 Long Beach Earthquake, which is archived in the Jan Law Collection at Cal State Long Beach.

In 1939 Johnson was briefly retained by the USGS during establishment of Naval Oil Reserves Nos. 1 and 2 in the Elk Hills west of Bakersfield. Johnson is also quoted in a historical publication on *Oil: The Other Gold in California*, on pages 70 and 106, and referred to as a "consulting geologist." He was accorded the annual Honorary Life Membership Award by the Pacific Section of AAPG in 1965, their highest honor.

Consulting Geologist Louis Z. Johnson (1920s and 30s)

During the 1920s and 30s consulting geologist **Louis Z. Johnson** geologist who operated out of an office at 2121 11th Street in Los Angeles. He attended Vienna University in Austria, followed by two years at Jena, Germany, and finishing his degree work at Imperial Polytechnic Institute in Moscow, around 1910, before the Russian Revolution. He was named to Los Angeles County District Attorney Asa Keyes's Panel to Investigate the Failure of the St. Francis Dam in March 1928 (noteworthy because that panel was comprised of three engineers and two geologists).

Caltech faculty threadlines

Caltech Geology program (1926-)

In January 1926 **John Buwalda** left his faculty position at Berkeley to develop a Department of Geology at the new California Institute in Pasadena, which presently exists as their **Division of Geological and Planetary Science**. Within a few months Buwalda hired **Chester Stock**, one of his former Berkeley colleagues, as Professor of Paleontology, establishing the Department of Geology as one of four major science divisions at Caltech. With Carnegie's Seismological Laboratory a part of their program, Caltech was the first school to offer courses in geology, paleontology, economic geology, and geophysics in a single program. During his first decade Buwalda succeeded in recruiting **Leslie Ransome, W.P. Woodring, Ian Campbell, Charles Richter, Hugo Benioff, Beno Gutenberg,** and **Dick Jahns.**

Buwalda placed an enormous emphasis on field training. At Caltech he instituted what was probably the most unique program of study in the United States, requiring undergraduates to take two summer field camps; one between their junior and senior year, and another, after their senior year! In addition, during the junior year all students were required to take a year-long introductory field course, which convened on weekends. Students were *also required* to complete a senior thesis that was based upon independent field mapping somewhere in southern California. Buwalda continued as the chair of the Geology Division at Caltech for 21 years until his retirement in 1947, at age 60 (when he was succeeded by Chester Stock).

The emphasis on field training was removed from the curriculum around 1956 (two years after Buwalda died), when **Bob Sharp** took over the reins of the department. With this decision to pursue analysis-

centered research and the departure of Dick Jahns from the faculty in 1960, Caltech's impact on applied geology gradually decreased, but they managed to maintain the highest level of research funding per student of any institution in the world. Three of their graduates went onto become Directors of the U.S. Geological Survey: **Henry W. Menard** (BS '42, MS '47), **Dallas L. Peck** (BS '51, MS '53), and **Gordon P. Eaton** (MS '53, PhD '57).

Prof. F. Leslie Ransome, Consulting Geologist (1927-35)

A native of Oakland, **Leslie Ransome**, PhD, NAS (1868-1935) attended the University of California in Berkeley, graduating with bachelor's degree in geology in 1893 and his PhD in 1896. He was one of the four original civil servant geologists hired by the USGS (Ransome, Mendenhall, Spencer, and Willis). He achieved considerable fame as a USGS economic geologist, based in Washington DC and was elected to the National Academy of Sciences in 1916. He retired from the USGS in 1922 to become Dean of Mining School at University of Arizona, where he hired William Morris Davis to teach geomorphology! When the Arizona faculty voted the university's president out of office in 1926, Ransome felt compelled to tender his resignation, as this man had hired him and placed him in a position of considerable responsibility. He was lured to Caltech by John Buwalda in 1927, where he remained until his death in 1935.

Ransome did much pioneering work in engineering geology, beginning with his assignment by the USGS to assist the Bureau of Reclamation in their studies of the geology of various dam sites in Boulder and Black Canyons of the Colorado River in 1921-22. These consultations were resumed in 1931, when construction began on Hoover Dam. He was named to the Governor's Commission to Investigate the Failure of the St. Francis Dam in March 1928, and numerous dam safety panels thereafter. In May 1929 he prepared the first engineering geologic report on a landslide in southern California, making an evaluation of the January 1929 Point Fermin Landslide for Los Angeles City Engineer John C. Shaw, which continued creep for many years thereafter, destroying the structures along Paseo del Mar. Ransome also performed the original geologic explorations for the Pine Canyon Dam site (now Morris Dam) in San Gabriel Canyon for the City of Pasadena in 1930. Between 1928-34, he was retained for numerous consultations for US Bureau of Reclamation, State of California, and the newly formed Metropolitan Water District of Southern California, to examine their plans for the massive Colorado River Aqueduct.

Prof. John P. Buwalda, Consulting Geologist (1934-54)

John P. Buwalda (1886-1954) was the father of Caltech's geology program. He earned his BS in geology from Berkeley in 1912, followed by a PhD in 1915. He taught geology at Yale from 1917-21, then at Berkeley from 1921-25. He joined Caltech as chairman of their newly-formed Earth Sciences Division in 1925, a position he retained until retirement in 1947, after having assembled the largest geology program in the world. After Prof. Ransome began experiencing health problems in 1933, Buwalda succeeded him as the principal engineering geology consultant to MWD for the next 21 years, until his death in August 1954. He exhibited remarkable insights on potential pitfalls of Garvey Reservoir site, back in 1952, which later proved prophetic (after the 1987 Whittier Narrows earthquake). Buwalda' s renown as an expert field geologist was imprinted on Caltech's geology program during his lifetime (in 1956 the Caltech faculty made a conscious decision to shift their emphasis from field geology to more theoretical pursuits).

Buwalda also played an important role in developing earthquake resistant building codes, following the April 1933 M6.3 Long Beach earthquake, by providing numerous interviews to newspapers in support of the Riley and Field Acts, passed that year by the State Legislature. He also served on the Joint Technical Committee on Earthquake Protection, which had a major role in shaping building codes for all of California. In the mid-1930's Buwalda also served as a consultant to San Bernardino Valley College when an apparent fault was discovered during construction of the administration and library buildings. His assessment was that it was the San Jacinto fault, and at his recommendation, a structural setback zone was established for all future buildings. Unfortunately, his map was forgotten in the 1950s and 60s when several new buildings were constructed across the fault zone!

Some of Buwalda' s students who made notable contributions to engineering geology included: **Tom Clements, Frank Nickell**, **Rollin Eckis**, **David J. Varnes**, **John R. Schultz**, and **Bruce Lockwood**.

Prof. Richard H. Jahns, Consulting Engineering Geologist (1946-83)

A native of Los Angeles, **Richard H. 'Dick' Jahns**, CEG (1915-83) grew up in Seattle. He entered Caltech at age 16 (1931), living with his grandparents in Alhambra. He received his BS in geology in1935,

followed by MS at Northwestern in 1937, after which he worked for the USGS for the next nine years, while working on his doctorate at Caltech (from 1939-43). He completed his doctorate in 1943 (during the Second World War) and accepted a position as a professor of geology at Caltech in 1946, where he remained till 1960. One of his pioneering efforts was in evaluating the subsidence in the Wilmington Oil Field in the early 1950s, which subsequently impacted the Baldwin Hills Reservoir. While teaching at Caltech he began working with Caltech soil mechanics professor Fred Converse, and developed a course in engineering geology for geology and civil engineering students. He also developed a life-long relationship with Los Angeles home builder Barney Morris, who later endowed the Morris Chair in Geology at Stanford (1985).

Dick accepted the position as department chair at Penn State in 1960, then Dean of the College of Mineral Industries in 1962. In the summer of 1965 he moved to Stanford to be the Dean of the School of Earth Sciences, where he began a Department of Applied Geology, which included engineering geology. Dick's course in engineering geology was one of the most popular on campus, and he continued teaching it every fall, even after his retirement in 1979.

Dick Jahns had an enormous impact on the development of grading and excavation codes and general awareness of geologic hazards during the 1950s, when Los Angeles was bursting with hillside development. Dick served on the ad hoc Geologic Hazards Committee appointed by the City of Los Angeles in January 1956, following a two-day storm which wreaked havoc on parts of the Santa Monica and western San Gabriel Mountains. This led to the establishment of the City of Los Angeles Engineering Geologist Qualifications Board in February 1958, to which professor Jahns was appointed Chairman. The board then prepared an article titled "*Desired Content of Geological Reports*," which was edited by Jahns and widely distributed, beginning in May 1960. In June 1962 Jahns wrote "*Desired content of geological reports submitted to the Department of Building & Safety, City of Los Angeles.*" He also served on MWD Board of Geologic Consultants, between 1963-80.

He was one of the original members of the ***California Seismic Safety Commission*** when it was formed in 1975. He possessed a vibrant sense of humor and self-demeaning character that endeared him to most everyone he met. He passed away on December 31, 1983 at the age of 68, much to everyone's regret. Some of Dick's students who went onto distinguished careers in engineering geology included: **Clarence R. Allen**, **Gordon Eaton, Gene Shoemaker**, **Perry Rahn, Tom Holzer, John Williams, Karl Vonder Linden, Jim Baker, Kerry Sieh, Gary Holzhausen, Rex Upp,** and **Betsy Mathieson**, among others.

Prof. Robert P. Sharp (1947-76)

A native of Oxnard, Robert P. "Bob" Sharp (1911-2004) did his undergraduate and master's work in geology at Caltech, receiving his BS degree in 1934 and MS in 1935. He went onto Harvard for his PhD under Kirk Bryan, a renowned geomorphologist and pioneer engineering geologist. Sharp's doctoral research focused on the structure and geomorphology of the Ruby Mountains of the East Humboldt Range in Nevada, completed in 1938. He then taught at the University of Illinois until joining the Army Air Corps from 1943-45, working on Arctic survival manuals. He took a faculty position at the University Minnesota for two years before landing a faculty position at Caltech, focusing on physical geologic processes and geomorphology.

Sharp became the resident expert on California geology, and advised graduate students working on a wide range of topics, which included glacial processes, mechanics of sand dunes, long-runout landslides (like the Blackhawk Slide), mechanisms of debris flows, and examining the mechanics of boulders that are slowly blown across the Racetrack Playa in Death Valley, just to name a few. Sharp served as the geology Division Chair from 1952-68, during which time he championed Caltech's pursuit of geochemistry and planetary geology. Bob Sharp did not feel that professors should "moonlight" as consultants, so he refrained from ever doing so.

A number of Bob Sharp's students went onto memorable careers in engineering and applied geology, such as USGS engineering geologist **Reuben Kachadoorian**, Whittier College Professor **Beach Leighton,** UCLA Geomorphology Professor **Ron Shreve**, University of Minnesota Geomorphology Professor **Roger LeB. Hooke**, and consultants **Joe Birman**, **Beach Leighton**, **Don Asquith, Walt Reiss, Don Lamar**, and **Dwight L. Carey**.

Prof. Frederick J. Converse (1920-66)

Frederick J. Converse, PE, SE (1892-1987) graduated from the University of Rochester with a degree in mechanical engineering in 1914. He began his engineering career in 1916 as an instructor of engineering in Rochester, New York. During the First World War he worked for the U.S. Bureau of Aircraft Production doing physical testing of aircraft parts and served in the military providing engineering services

for military facilities and war related projects throughout the western United States. He then moved west and took a position as Design Engineer for the Los Angeles City Bureau of Power & Light, working on San Francisquito Powerhouse No. 2 (which was destroyed by the flood from the St Francis Dam failure in March 1928). In 1920 Converse began teaching civil engineering courses in the Engineering Division at the Throop Institute in Pasadena, which became the California Institute of Technology (Caltech) in 1922.

In 1930 Converse began a professional association with foundation engineer **Robert V. Lebarre**, who cultivated an interest in the enraging specialty of soils mechanics and foundation engineering. He began doing part-time engineering design work for Lebarre. In 1933 Converse was promoted to assistant professor and established a consulting partnership with R V. LaBarre (described below). In April 1933 Converse published his first article on soil mechanics titled "***Distribution of Pressure Under a Footing***," which appeared in Civil Engineering magazine (published by ASCE). It describes a plunger style pressure cell developed by Converse for ascertaining the pressure exerted beneath foundation footings. He began teaching soil mechanics as a graduate course at Caltech in the spring semester of 1934 using the text ***"A Practical Method for the Selection of Foundations Based on Fundamental Research in Soil Mechanics,"*** by Professor William S. Housel at the University of Michigan (University of Michigan Engineering research Bulletin No. 13, Oct., 1929).

Converse and Lebarre parted ways in 1936 and became sole proprietors. In 1940 Converse established a limited partnership with **Donald R. Warren**, a civil/structural engineer who had supervised much of the construction of the San Francisco Bay Bridge, before enrolling at Caltech to complete his bachelor's degree in civil engineering in June 1938 (described previously). This partnership only lasted two years because Warren's company took on so much work during the Second World War, growing more than ten-fold. From 1946-49 Converse operated a modest consultancy known as **Converse Foundation Engineering Co.** In 1949 Converse hired one of his former students **James R. "Bob" Davis** (1924-82) (BSCE '48, MS '49 Caltech) as his first full-time employee. This firm was always based in Pasadena and grew with the region during the 50s, becoming Converse Foundation Engineers in 1960. When Fred Converse retired from Caltech in 1966, the firm's name became **Converse, Davis & Associates**. In 1978 they joined Joseph A. Ward & Associates to become **Converse-Ward-Davis-Dixon**, and in 1983 (these firms are profiled below), **Converse Consultants.**

Fred Converse was an influential figure in the close-knit group of Caltech engineers who influenced much of the post-war engineering practice in Los Angeles, such as **William J. Carroll** (BSCE '48; MS '49 Caltech), who became CEO of J.M. Montgomery, the largest sanitary engineering firm in the nation (also based in Pasadena), and **LeVal Lund** (BSCE '47 Caltech), a fellow Navy V-12 officer with Bob, who rose through the ranks of the Los Angeles Department of Water & Power to become chief engineer of their water division, between 1971-89; **Ret Moore** (BSCE '47), who founded Moore & Taber in 1956, **Bill Jones** (MSCE '50 Caltech), who started a string of geotechnical firms in the Bay Area, and **Harry J. Sutcliffe** (MSCE '51 Caltech), who became head of Bechtel's Transportation Engineering Group. There also existed a small but influential cadre of older Caltech alumni who were well-positioned to influence which firms received consulting work, such as **Markham E. "Ham" Salsbury** (BSCE '25 Caltech), long-time Assistant and then Chief Engineer of the LACoFCD (from 1943-65). Fred Converse was the dean of soil mechanics practitioners in southern California when he passed away in 1987.

Prof. Ronald F. Scott (1958-98)

Ronald F. Scott, PhD, PE (1929-2005) grew up in Perth, Scotland and received his BSCE from Glasgow University in 1951, and attended MIT for graduate school, receiving his MSc in 1953 and ScD in soil mechanics in 1955, working under Harl Aldrich on the numerical analysis of consolidation problems. After graduation, he worked for the Army Corps of Engineers Cold Regions Research Lab and for Racey, McCallum Associates in Toronto. In 1958 he accepted a faculty position at Caltech, where he remained until his retirement in 1998. During his tenure at Caltech, Scott wrote three textbooks on geotechnical engineering: ***Principles of Soil Mechanics*** (1963)***; Soil Mechanics & Engineering*** (with Jack Schoustra of Converse-Davis) in 1968; and ***Foundation Analysis*** in 1981.

Scott pioneered many of the soil sampling techniques used by NASA on the Surveyor, Apollo, and Viking missions. He was also a pioneer in the use centrifuges to model static and dynamic geotechnical earthquake engineering problems. He served on a number of important panels, including the Mayor's Report on the Baldwin Hills Dam Failure in 1963, and the Bluebird Canyon Landslide in Laguna Beach in 1978. He was also one of the principal figures in the design of subaqueous foundations for Los Angeles County's

coastal sewer outfalls. He was elected to the National Academy of Engineering in 1974, became a registered civil engineer in July 1977, was the ASCE Terzaghi Lecturer in 1983, and ICE's Rankine Lecturer in 1987.

Downsizing of Caltech civil engineering program (1962)

The Student Chapter of the American Society of Civil Engineers at Caltech was officially dissolved on May 15, 1962. It had been the first student chapter established in the Los Angeles area. This decision came just two years after a new student chapter of ASCE was established at UCLA, in April 1960.

Dr. Frank A. Nickell Consulting Engineering Geologist (1942-73)

Frank Andrew Nickell PhD, PE, CEG (1906-75) was born in Beatrice, Nebraska in March 1906 and grew up in Los Angeles. He earned all of his degrees in geology and civil engineering at Caltech. He completed his BS in geology in 1927, M.S. in 1928, and Ph.D. in geology and civil engineering in 1931. During graduate school he was a teaching assistant in languages and physical education (along with his roommate Layton Stanton). His Ph.D. dissertation was on the *Geology of the Soledad Quadrangle, Central California*. He was the first geologist hired by the U.S. Bureau of Reclamation (in the fall of 1931) to map the rock exposures at Hoover Dam, which began construction in mid-1931. Nickell had already been assisting Caltech Prof. Leslie Ransome with his mapping at Hoover Dam. After Hoover Dam was completed in 1935, he worked on other BurRec dams, including Parker and Grand Coulee. He was named Chief Geologist of the Bureau of Reclamation in 1939, but left to open his own consultancy, based out of Whittier, in 1942. Nickell then took a position with Shell Oil Company and Standard Oil and Gas as a petroleum geologist from 1943 to 1944, but this work took him overseas. From 1945 until 1973 he was a consulting geologist on dams, hydroelectric development, irrigation, and geologic studies for companies and governments worldwide. In the early 1950s he moved to San Mateo, where he remained until he retired and moved to La Jolla, where he died in September 1975. He consulted on dam projects all over the world the remainder of his life, including the ill-fated Taum Sauk Upper Reservoir pumped storage project for Union Electric Co. of St. Louis in the St. Francois Mountains of Missouri, completed in 1960-64, which failed in December 2005.

Converse thread (under Caltech Threadline)

R. V. Labarre, Consulting Engineer (1930-33; 1936-43); Labarre and Converse, Consulting Foundation Engineers (1933-36)

Robert Volant Labarre, PE, SE was born in Gretna, Louisiana (across the Mississippi River from New Orleans) in October 1873. By the time of the 1900 New Orleans Census he is listed as a "draftsman" for a construction company. In 1910 he was working as a civil engineer in Houston. By 1914 Lebarre had established his own construction firm in Birmingham, Alabama, doing work for the Southern Railway, among other clients. In 1915 he was the contractor of record for another project in Montgomery, Alabama.

In 1917 the **Foundation Company** of New York became the first tenant of the new Inner Harbor Navigation Canal being constructed in New Orleans. Shortly after America joined the war in April 1917, the Foundation Co. secured a contract with the French government to build steel-hulled merchant ships of 4,200 tons displacement in New Orleans. This was because of their expertise in constructing inexpensive (as compared to concrete) sheetpile cofferdam drydocks and slipways. The Foundation Company was America's premier soils & foundation engineering firm of the early 20th Century, founded in 1901 by Daniel E. Moran, Franklin Remington, and Edwin S. Jarrett. They designed and constructed the foundations for most of the tallest buildings in Manhattan (Trinity, Woolworth, Whitehall, Singer, Banker's Trust, and Municipal Buildings).

During the last year of the First World War Lebarre accepted a captain's commission in the Army Corps of Engineers. In July 1918 he was sent to Camp Lee, Virginia as an instructor for the Corps' Engineer Reserve Officers' Training Camp. Officer commissions were awarded to individuals with specialized expertise in civil engineering and heavy construction, who could teach the engineer officer candidates, freeing up the Army's career engineers for wartime duty overseas. After the war he referred to himself as "Cap Labarre," and used "Captain R.V. Labarre" as his byline in the BSSA articles he published in 1936 and '37.

His role in the construction of the Inner Harbor Navigation Canal in New Orleans provided Labarre with unique experience dealing with dredge spoils, soil consolidation, dewatering, and port facilities, which were to sustain him through the balance of his professional career. In 1919 he departed New Orleans to build

some port structures in Jacksonville, Florida. By 1920 he listed himself as a building contractor working out of Jacksonville, Florida. In October-November 1920, the Foundation Company dispatched him and another engineer named Thomas Dickson to Paita, Peru, to provide input for construction of a project located there. He returned to the firm's headquarters in New York in November 1920, and it was at this time that he formally affiliated with ASCE.

Labarre then spent most of the 1920s working in the Detroit area on construction projects for the automotive industry, which expended dramatically during that decade. When the Great Depression struck, he retired and moved to Glendale, California, adjacent to Los Angeles. He soon found retirement dull and Los Angeles teeming with development. He decided to get back into the foundation construction business. When engineering registration was enacted in 1929, he was one of the first to apply, becoming Registered Civil Engineer #298 of the 5,035 who were granted registration that first year (July 1, 1929 to June 30, 1930).

Lebarre had designed and built equipment for testing the bearing capacity of soils for building foundations, and tried to sell these services to architects, engineers, and contractors. In early 1930 Lebarre approached Professor Fred Converse at Caltech, enticing him to work part-time with Lebarre as a consultant, and that he would teach Converse what he knew about the emerging field of soil mechanics, because he was corresponding with Austrian Professor **Karl Terzaghi** (1883-1963). Converse had never been associated with foundations, but he was aware of Terzaghi's articles that had recently appeared in *Engineering News Record*, while Terzaghi was working on differential settlement problems at the Massachusetts Institute of Technology (MIT), between 1926-30. Terzaghi's acumen for engineering geology, seepage, and the new field of soil mechanics was being splashed across the forefront of civil engineering literature during the numerous post-mortems on the ill-fated St. Francis Dam disaster north of Los Angeles in March 1928.

By January 1933 Converse agreed to form a partnership with Lebarre, making them **the first soils engineers working out of the Los Angeles area**. The part-time arrangement was acceptable to Converse because he was teaching full-time at Caltech. The M6.3 Long Beach Earthquake of March 10th 1933 changed all of that. Following the quake, Lebarre served as one of two ASCE representatives on the prestigious **Joint Technical Committee on Earthquake Protection** chaired by Caltech President Robert A. Milliken (described in Notable Boards, Committees, Legislation, etc., at the end of this document).

According to Leroy Crandall, Labarre capitalized on the passage of the Field Act in 1933, following the Long Beach Earthquake. The act required retrofitting, repair, or replacement of more than 230 school buildings in southern California constructed of unreinforced masonry. Lebarre quickly gained respect in Los Angeles engineering circles, and became one of the founding members of the Structural Engineers Association of Southern California (SEAOC) that same year (along with Professors R.R. Martel, F.J. Converse, and T. von Karman at Caltech).

Lebarre also developed several plate and pile load tests to ascertain the insitu bearing capacity of foundations (see the July 1933 issue of *Popular Science*, p. 44; and later, "Test Pit Exploration Kit in Foundation Study," which appeared in *Engineering News Record* on Aug 6, 1936). **Labarre** was also credited in an article written by Fred Converse which appeared in the April 1933 issue of *Civil Engineering*. Lebarre was the only engineer who marketed himself to prepare foundation engineering reports, which structural engineers desperately needed to carry out this work, during the height of the Great Depression.

Lebarre soon hired Caltech students **Bill Moore** and **Trent Dames** to perform plate load tests using 12" x 12" steel plates on exposed ground to back out the allowable bearing capacity of the various school sites. They would load these plates until they started sinking into the ground, assuming this to be the ultimate bearing capacity by dividing the figure by 2, 3, or 4, depending on the type of foundation (2 for an isolated footing beneath a building interior, 3 for an exterior footing, and by 4 for continuous strip footings).

Labarre continued his correspondence with Karl Terzaghi, who had accepted a professorship in Vienna. Lebarre hosted Terzaghi on his tour of California in 1936, following the First International Conference on Soil Mechanics and Foundation Engineering at Cambridge, Massachusetts. Labarre sent a chauffeured car to pick up Terzaghi in San Francisco and took him on a circuitous tour of California, through Yosemite, over Tioga Pass, and down the Owens Valley, along the Los Angeles Aqueduct (see Dick Goodman's biography of Terzaghi).

Terzaghi was well received in southern California, including a dinner at Caltech hosted by Prof. **Theodore von Karman** (1881-1963), who had joined the faculty at Caltech in 1930 (where he directed the Daniel Guggenheim Aeronautical Laboratory). The Hungarian-born von Karman was joined by Austrians **von Terzaghi** and **Richard von Mises** (1883-1953), the Gordon-McKay Professor of Aerodynamics and Applied Mathematics at Harvard University. The three men had served in the same Austro-Hungarian

aviation engineering unit during the First World War! What storied academic careers they all went on to have in the United States!

Labarre served as SEAOC's first president in 1934. In this capacity he made numerous trips to Washington, DC to lobby the US Coast & Geodetic Survey to establish strong motion sensors in California, so designers could glean some idea of how much lateral load they should be designing for. These efforts met with considerable success in the wake of the 1933 quake. The Coast & Geodetic Survey allotted funds for the determination of dynamic properties of important structures, like dams. They hired a young engineer named **John A. Blume** (BA '33, BCE '34, PhD '67 Stanford) who built a dynamic exciter and used it on the newly completed Morris Dam to determine the fundamental periods of vibration and deflection characteristics, the first such studies ever undertaken on a dam (described towards end of this document, under "First dynamic properties evaluation of a dam -1934").

The partnership with Professor Converse appears to have ended in 1936, because Converse felt overwhelmed by the pressures of what had evolved into 'two full-time jobs.' He continued to consult for Lebarre on a case-by-case basis. Now 63 years old, Lebarre continued penning articles on seismic design issues for the Bulletin of the Seismological Society of America in 1936 and '37. By 1938 Labarre chaired the ASCE Committee to cooperate with the ASTM Committee D-18 on *Soils for Engineering Purposes*. It lists his affiliation as "Consulting Foundation Engineer, Los Angeles." At that time he was active in studying earthquake phenomena and their effects of structures.

Another future luminary who worked for Lebarre in the late 1930s was **William F. "Bill" Swiger**. Soon after Karl Terzaghi returned to the United States in September 1938, Lebarre suggested to Swiger that he should attend graduate school at Harvard to work with Terzaghi and Professor **Arthur Casagrande**. When **Ralph Peck** left Harvard in mid-January 1939 to work with Terzaghi on the Chicago Subway, it was Bill Swiger who took his position at Harvard! Swiger spoke very highly of Labarre. He related that "*Lebarre read everything Terzaghi and Leroy F. Harza wrote, and tried to adapt the principles and information to the construction situations in California*." Swiger became Vice President of Engineering for Stone & Webster in Boston, and worked on some of the deepest sky scrapper foundations and significant dams in the world. After retiring, he returned to Buhl, Idaho where he and his wife Mary had grown up. Swiger was a graduate of the University of Washington, where he had been exposed to soil mechanics by Professor **Bob Hennes**, one of Terzaghi's original students at MIT in 1928-29. Hennes also taught Bill Shannon, of Shannon & Wilson, and **Jim Gould** of Moran, Proctor, Mueser & Rutledge in New York City (who in 1958-59 directed the 18-month study of the Via de los Osas Landslide along Pacific Coast Highway for the California Department of Public Works).

Labarre's last work products appear to have been wartime consultations for the Ports of Oakland and Los Angeles, both in 1941. His May 1941 report for a joint venture of **Bechtel-McCone-Parsons Corporation** addressed dredging and filling operations to develop the Army's Oakland Sub-Port of the San Francisco Port of Embarkation (renamed the Oakland Army Base in 1944). His work in Los Angeles was titled "Foundation Investigations for Proposed Administration Buildings at the Los Angeles Municipal Airport" in July 1941. Labarre died of prostate cancer in Wickenburg, Arizona on September 27, 1944, at age 71, during the Second World War.

Donald R. Warren Company (1940-89)

Donald R. Warren, PE (1897-1973) had a remarkable career in heavy construction, civil, structural, and geotechnical engineering, as well as architecture. His professional career began with the enlargement of Big Meadows (hydraulic fill) Dam in the mid-1920s. He then worked on the deep water caissons for the original Hayward-San Mateo Bridge in 1927-29. He became a registered civil engineer 1166 with the initial batch of 5,079 individuals registered in California in 1929-30, based on education and experience.

From 1929-31 he worked for the State Dept of Public Works evaluating potential dams sites in the Carquinez Straits and near Rio Vista to mitigate salinity intrusion of the Sacramento-San Joaquin Delta. In 1931 he made the highest score on the civil service examination for civil engineering and was selected to be the Senior Field Engineer for construction of the San Francisco-Oakland Bay Bridge, which opened in November 1936. When that project concluded he decided to return to Caltech to complete his bachelor's degree, graduating in June 1938 (at age 41). In 1938 he was placed in charge of all bridge construction in southern California for the California Division of Highways.

In mid-1940 Warren announced that he was opening his own civil and structural engineering consultancy and, that he had been promoted to Lt Commander in the Navy Civil Engineering Corps Reserve

[although no record of him was found at the Seabee Museum; he may have resigned because of his war-related work at Terminal Island, see below)].

In late 1940 Warren established a partnership with Caltech Professor **Frederick J. Converse**, which allowed him an entrée into soil mechanics and foundation engineering for work on the Long Beach Naval Shipyard and Terminal Island. The firm flourished during the war with defense related work, which included construction associated with the rapid expansion of the Port of Los Angeles-Long Beach. This included design and construction of a 1100 ft long dry dock, at that time the largest on the West Coast.

Warren and Converse also worked out the engineering specifics for the dredged and pile-supported slipways for the Marinship tanker shipyards operated by Bechtel Corporation in Richardson Bay, in the San Francisco Bay just north of the Golden Gate Bridge.

During the war the Warren Co. worked with a limited partnership called **Allied Engineers**, who designed and built the Fleet Operating Base at Terminal Island just prior to and during the Second World War. One of their wartime projects included the Roosevelt Naval Base on Terminal Island, designed by a joint venture of **Warren**, along with noted Los Angeles architects **Paul R. Williams** and **Adrian Wilson**. During the war the Donald R. Warren Co. also designed Kaiser Steel's new mill and fabrication facility in Fontana, the 12th largest steel plant in the USA. **James Fox** (BSCE Caltech '36) was chief engineer and **M.W. Sahlberg** (Caltech '38) was a senior engineer on the Kaiser project.

As the post-war building boom accelerated in the late 1940s, the Warren Co. continued growing, developing niches in architecture, structural engineering, materials testing, and foundation engineering. They maintained discipline groups that employed engineers and architects. The structural group designed the Long Beach Blvd Bridge over the Los Angeles River in 1946 and even designed concrete arch dams, like Matilija Dam in Ventura County.

Their foundations group grew markedly as the Los Angeles area boomed with residential development. The Warren Co. pioneered use of smaller diameter Modified California Soil Sampler and did soil and geology work for lots of residential tracts up in the hills. The firm also did a sizable volume of work for the government, like the Navy Supply Center on Rough & Ready Island, the Fairfield–Suisun Army Depot, and foundations for the massive Goldstone Tracking Station at Fort Irwin, in 1961. They also did all of the geotech work for Rocketdyne's testing facilities in the Santa Susanna Mountains in the 1960s.

The Warren Co. generally employed a lower standard- of-care for their geotechnical work than that employed by their two principal competitors, Dames and Moore and Crandall & Associates. According to Beach Leighton (whom they retained to help bolster their geotechnical capabilities in the mid-1960s), they did not appreciate engineering geology. This resulted in plethora of lawsuits, esp. on work they performed in the Palos Verdes Peninsula, where they had "supervised" numerous grading jobs back in the 1950s, before anyone recognized the scale of paleo-landslides that blanketed the uplifted terraces.

In the mid -1960s the firm was located at 930 Sunset Blvd. in Los Angeles. Some of their key geotechnical personnel included: **Herb Nicola**, PE, **Cecil F. Collins**, PE, **Herbert J. Recker**, PE, and **Doug Moran**, PE, CEG, **Ronald J. Lejman** (staff engineer 1965-67), and **Gerald A. Nicoll**, CEG (who also worked for GTC, Stone, Soil Mechanics & Foundation Engrs, and Leighton). **H.W. Graham** was their chief soils technician in the mid-1960s.

In the late 1940s Don Warren began donating funds (>$12,000) to the University of Nevada-Reno in 1946-48, because his wife, Lora Belle Lamberson Warren (1897-1985), had received her teacher's diploma from UNR in May 1917 (the Warrens were married in Yerington, Nevada in June 1920). Donald Warren later received an honorary degree from UNR and Lora set up the Donald Warren Endowment for UNR after he died in 1973. The Warrens lived in La Canada, as did their son, Donald F. Warren.

Donald R. Warren died in January 1973 at age 75, but the business continued after that, presumably, under the control of his widow and their son, **Donald F. Warren** (1921-76), who died just three years later, in July 1976. In July 1985 the Los Angeles Times reported that **Robert F. Timpson** (1924-2001) was elected president and chief executive of Donald R. Warren Co. The precise date of their closure is unknown, but thought to be around ~1989.

Douglas E. Moran, Inc. (1974-onward)

Douglas E. Moran CEG, GE was both a geologist and geotechnical engineer (BS Geol '58; MSCE ~'62 USC). He was educated at USC and he worked for Donald E. Warren Co in the early 1960s, while he was completing his master's in soil mechanics at USC. He was one of the first approved engineering geologists by the City of Los Angeles in 1961. In the late 1960s he worked for Hood & Schmidt, Geotechnical Consultants, and R.T. Frankian, before moving to Orange County in the early 1970s, to work for Leighton &

Associates. When Bing Yen split up with Leighton in 1973, Moran became Leighton's chief soils engineer for a time (in 1973-74). During this time he co-edited the noteworthy volume titled "*Geology, seismicity and environmental impact*," AEG Special Publication, released in 1973. He started his own firm around late 1974 and has always been based in Tustin, CA. One of his first projects after incorporating his firm in 1977 was the 1978 Big Rock Mesa landslide litigation. **Rodney T. Masuda** (BS Geol '78; MS '81 USC) was Doug's senior associate and technical manager/chief geologist until 2001, when he moved to Praad Geotechnical.

G. A. Nicoll & Associates (1974-2008)

Founded by engineering geologist **Gerry A. Nicoll**, CEG around 1974. Previous to this, Nicoll had worked for the Donald R. Warren Co. in the early 1960s, Geotechnical Consultants (mid 60s), Stone Geological Services (late 60s), Soil Mechanics & Foundation Engineers (1969-71), and with Leighton & Associates (1971-73).

G.A. Nicoll & Associates were based in Santa Ana, then later in Irvine**. Peter C. Yong** , PE was Vice President and Chief Engineer, between 1976-79.

Converse Foundation Engineering Company (1946-59); Converse Foundation Engineers (1960-66); Converse, Davis & Associates (1966-78); Converse-Ward-Davis-Dixon (1978-1983); Converse Consultants (1983-2001); Converse Professional Group

From 1946-49 Caltech Professor **Fred Converse** operated a modest consultancy known as **Converse Consultants**. In 1949 Converse took on one of his own students **James R. "Bob" Davis** (1924-82) (BSCE '48, MS '49 Caltech) as his first full-time employee, shortly after Bob completed his master's degree in soil mechanics. Bob Davis had grown up in Covina and Monrovia, attending Pasadena City College before entering Caltech on the Navy's V-12 program during the war. Davis received increasing responsibilities and eventually became the president and chief executive officer when Fred Converse retired in 1966.

Converse Consultants continued to grow through the 1950s and 60s, servicing many clients in the Los Angeles area, such as LADWP, LACoFCD, and MWD. In 1966 the firm's name became **Converse, Davis & Associates** and **Jack Schoustra** became the chief engineer (Schoustra co-authored the 1968 text ***Soil Mechanics & Engineering*** with Caltech Professor Ron Scott). The purchased property and built their own office at 126 Del Mar Blvd in Pasadena.

In late 1968 six associates became owners of the firm, in equal parts: **J. Robert Davis**, PE, **Jack J. Schoustra**, PE, **Roy A. Hoffman**, CEG, **Jay L. Smith**, CEG, **Charles R. MacFadyen**, PE (BSCE, Univ Saskatchewan, 1955), **Thomas D. Lake**, PE, and **Schaefer J. Dixon**, PE. Other senior staff included **Paul Davis**, CEG, who worked for the firm in 1963-67 and 1968-73, before departing to manage the geologists at Fugro (1973-79), and **Hugh Mulholland**, who was a staff engineer. **Howard A. "Buzz" Spellman** (BA Geol '53, Cincinnati) joined the firm in 1964 and succeeded **George Curtin** (a former DWR geologist) to become the firm's senior engineering geologist in 1981, where he remained until retiring in 1996.

Schaefer J. Dixon, PE became Chief Engineer after Jay Smith and Jack Schoustra departed to start Fugro in 1970. The firm opened a branch office in Orange County in 1965, managed by **Chuck MacFadyen**, and Las Vegas in 1976 (also managed by MacFadyen).

In 1978 Converse merged with Joseph S. Ward & Associates of Caldwell, New Jersey and become **Converse-Ward-Davis-Dixon**, making them a coast-to-coast company. At that time the Washington, DC, Tampa, and San Francisco office of Ward were also absorbed into the new firm. They retained **Gene Miller** (formerly of Harding-Miller-Lawson Assoc) as the manager for the San Francisco branch office which Ward had established back in 1973. In 1981 Converse opened a new office in Seattle with **Eugene Macmaster** as the manager. Bob Davis (1924-1982) remained as Chairman of the Board until he died of bone cancer in July 1982. **Joe Ward** stepped down as President and CEO of the firm in 1983 and retired to Florida, where he died of a heart attack in January 1994.

The firm name changed to **Converse Consultants West** around ~1983. They also split off a separate firm named **Converse Environmental** in the mid-1980s, with offices in Pasadena and Costa Mesa. Converse was headquartered in Pasadena until the late 1990s, when they sold their property on Walnut Street and moved to Monrovia. Converse Consultants is now to an employee-owned company with 10 national locations and over 300 employees. It is headquartered in Monrovia under the name The **Converse Professional Group**, with branch offices Costa Mesa and Redlands (managed by **Chris Koepke**, CEG (BS Geol '84 USC).

Schaefer Dixon Associates (1982-1991)

In April 1982 **Schaefer Dixon** (BSCE '58, MS '62 UC Berkeley) broke off from Converse, forming **Schaefer Dixon Associates**, based in Los Angeles. They moved to Irvine in 1984, to Santa Ana in 1986, and then built their own office building in Irvine in 1988. **Ellis J. Jones** was one of the principals when the firm launched. **Robert J. Lynn**, CEG joined as a principal a few years later, along with **Paul Davis**, CEG (BA Geol '63 Berkeley; MA '83 CSULA) as a partner, along with **Ann Ogden Meeker**, CEG (from with purchase of Medal-Worswick). Other partners were **Jay Weaver**, GE, **Jeff Butelo**, CEG and **Gary Dupuy**, CHG (from Calgary), and **John Foster**, CHG (BS Geol SDSU; went onto receive PhD and teaches at CSU-Fullerton). The firm specialized in geoenvironmental work.

They acquired **Medall, Worswick & Associates** in March 1986, and moved their headquarters to Santa Ana, maintaining branch offices in Los Angeles and San Diego. Bob Lynn and Paul Davis were their principal geologists at that time. Around 1987 the firm purchased **Pioneer Consultants** [owned by Dave Turner, PE] of Redlands, who operated their own Hogentogler CPT rig. In 1990 **James R. Miller** (MS Geol Eng '76 CSM; formerly with ERTEC) became the firm's president. Schaff Dixon became board chair and served as president of the Consulting Engineers Assn of California in 1990-91. The firm was sold to the Huntingdon International Holdings (Group) of Great Britain in March 1991 and Dixon retired.

In 2006 Schaefer Dixon (1936-2009) donated $800,000 to U.C. Berkeley to establish the H. ***Bolton Seed Professorship*** and the ***Schaefer J. Dixon Fund in Geotechnical Engineering***, to support outstanding graduate students in geoengineering. He and his wife Sharon divorced and he never re-married, pursuing his passion for yachting. Schaff died of cancer in April 2009 at his home along Sugar Creek in Callahan, CA (near Mt. Shasta). **Ellis Jones** was with Converse, SFO branch office, then Las Vegas, before joining SDA (he would know more about the firm).

Fugro, Inc. (1970-77)

Fugro was founded in September 1970 by **Jaap "Jack" Schoustra**, PE (1931-1997) (BS, MS Delft Tech Univ) and **Jay Smith** (BS Geol '58 UCLA), who were both partners at Converse-Davis in Pasadena. Schoustra had a falling out with Bob Davis at Converse, and left the firm in 1970. Schoustra (who was Dutch) went to Holland in mid-September 1970 to consult with Fugro, BV and they provided $200K start-up funds for a new firm in southern CA. Smith was a recent graduate of the Dale Carnegie course and soon emerged as their marketing genius. They set up an office in modest quarters on 7th Street in Long Beach, with just four employees. Their first Dutch Cone CPT rig arrived in Long Beach mid-March 1971. During their first year of operation they succeeded in luring about six of Converse's more experienced people, including: **Stanley B. Madson**,CEG, PE, **John Scott**, CEG, **Richard Fallgren**, PE, and two native Scotsmen, soil technicians **Angus McGregor** (field sampling manager) and **Bill Bryson** (or Brightsman), who managed their soils lab. They also used Caltech Prof. **Ron Scott** as a frequent consultant.

The Feb 1971 San Fernando Earthquake created an increased demand for cone penetrometer (CPT) work in southern CA, for evaluating liquefaction potential of hydraulic fill dams (some 30 dams were replaced in CA over next 20 years) and many low lying sites thought to be susceptible to liquefaction. Schoustra and Smith invested in a SMC dynamic triaxial soil test bed and marketed themselves to perform soil dynamics, which offered little competition and was in great demand. Fugro initiated a "hire for the moment" policy and began accumulating work at an unprecedented pace, growing to 200 employees in their first four years (1970-74). They quickly gained many impressive clients, including: LA Dept of Water & Power, Southern Cal Edison, San Diego Power & Light, Southern San Joaquin MUD, Arizona Public Service, US DoD MX missile complexes, etc., etc.

Fugro purchased an entire office building in 1973, located on Long Beach Blvd., where they sported the largest group of engineering geologists ever assembled by any consulting firm in southern California, including such notables as **Roy Shlemon**, CEG (BA '57 CSU Fresno; MS '58 Wyoming; PhD '67 Berkeley) and **Allen Hatheway**, PE, CEG (AB Geol '61 UCLA; MS GeoE '66, PhD GeoE '71; PD '82 Arizona). Other senior personnel included structural engineer **C. B. Crouse**; Manager of Geology **Paul Davis**, CEG (1973-79), **Geoff Martin**, GE (PhD '65 Berkeley), **J. Carl Stepp** (from the NRC-their best marketer), **Hudson Matlock**, PE, **Kenneth Wilson**, CEG, **Carl Johnson**, CEG, **Ricardo Guzman**, GE., **Carlos Espana**, GE (BSCE '68; MS '69 Berkeley), who established Espana Geotechnical in Roseville in 1989, which was purchased by Fugro West in Dec 2005; **Dean Gregg**, CHG (head of hydrogeology dept), **Robert Stoller**, CHG, etc., etc. Around 1975 Fugro, acquired a career marketing person in **Diane Creel**, who had been

working for CH2M-Hill. She went on to become the successor firm's President and CEO in 1988 (see write-up on ERTEC, below).
Fugro marketed their services for seismic risk assessments, preparing seismic safety elements for municipal general plans (required by a new State law, passed in wake of the 1971 earthquake) and NRC-mandated Preliminary Safety Analysis Reports (PSARs) for nuclear power plants. They also marketed their services aggressively for conventional geotechnical services, such as foundation engineering, offshore drilling platforms, and pipelines. They operated the first electronic recording CPT rigs in the United States, mounted on 5-ton ex-Army Signal Corps van-bodied trucks, using the electronically-recording Dutch cones manufactured in The Netherlands. See the rest of the Fugro thread under "Firms in Ventura and Santa Barbara Counties."

ERTEC, INC. (1980)

Earth Technology Corporation (ERTEC) succeeded Fugro in a buy-out scheme in 1980-81. It later became Earth Technology Resources Corporation, and then, ERTEC-Western. Last known address is 100 West Broadway, Suite 5000, in Long Beach. (213) 495-4449, (714) 821-7062. The original President and CEO was **Jack Schoustra**, GE who started Fugro after leaving Converse in 1970. They entered the geoenvironmental market in 1980s, with high-visibility clients like International Technologies, etc. **Geoffrey R. Martin**, PhD, GE (PhD '65 Berkeley) managed the earthquake engineering group, then Vice President of Engineering, between 1977-90. **Paul Guptill**, CEG was their senior geologist in the mid-1980s. **Nicholas R. Hild** was Vice President and Principal-in-Charge of Western Regional Operations between ~1986-91. In 1988 **Diane Creel** succeeded Schoustra as President of Earth Technology Corp. They acquired Aqua Resources of Berkeley in 1990. **Ray Moresco**, CHG was Chief Hydrogeologist in the 1990s. The firm then merged with Tyco International, Ltd. in Nov. 1995.

Earth Technology was originally founded around 1970(?), performed technical consulting on environmental and engineering projects for Southern California Edison, General Motors and eight of the 10 largest oil companies. Leighton and Associates purchased the geotechnical testing lab from ERTEC in 1996/7.

In 2008, ERTEC was absorbed by AECOM, owners of ENSR: Environmental Consultants and Engineers, an 1800-person firm headquartered in Westford, MA. **Jim Miller** was President of ERTEC-Western (now president of Brown & Caldwell in Walnut Creek) and **Steve Scott** may be the best people to ask.

Earth Mechanics, Inc. (1989 - present)

Earth Mechanics, Inc. (EMI) was founded in 1989 by **Lino Choi-Chi Cheang**, GE (BSCE '78 and MS '79 Texas) and **Ignatius Po-Cheung "Po" Lam**, GE (BSCE '73 Ohio State; MS '74 and EngD '76 Caltech) after working several years at Earth Technology Corporation in Long Beach under Geoff Martin and Hudson Matlock. In the early 90's the firm specialized in seismic retrofits of bridges for Caltrans following the 1989 Loma Prieta Earthquake. The new firm drew upon their experience from designs of offshore platforms during their days at ERTEC and applied this to seismic retrofits.

In 1995, **Hubert K. Law**, PE (BS MinE '85 Nat'l Cheng Kung Univ-Taiwan; MS GeoE '87 Alaska; PhD GeotE '91 Colorado-Boulder) joined the firm and **Arul K. Arulmoli**, GE (BSCE '77 Univ Sri Lanka; MS '80 and PhD '82 UC Davis) in 1997. The firm landed their first major geotechnical contract in 1997 for the Replacement of East Span San Francisco - Oakland Bay Bridge, with Fugro as a joint venture partner. The firm worked on seismic retrofit and replacement projects of most of the toll bridges in California; which led to further work on geotechnical seismic problems for other long span bridges on Oregon, Washington, Vancouver, and New York.

In 2004, Arul and Hubert assumed the positions of president and vice president, respectively, and have run the company's day to day operations, while Po and Lino have remained working as project managers. Arul has a strong hold in the Ports of Los Angeles and Long Beach providing on-call geotechnical services 24/7 for wharfs and container terminals, while Hubert focuses on tunnels and design-build projects in transportation. Key senior staff include: **Andrew Korkos**, GE (BSCE '85 and MS '89 CSULB), **Andrew Lee**, GE (BSCE '86 Illinois; MS '88 USC), **Eric Brown**, GE (BSCE '93 CPSU SLO; MS '95 Colorado-Boulder), and **Mike Kapuskar**, GE (Dipl CE '86 Univ Stuttgart; MS '92 USC). In late 2013 they started working on the first segment of the California High Speed Rail Program, known as the Design-Build Package CP-1, with Tutor Perini. Their firm is located in Fountain Valley, with branch offices in Hayward and San Marcos.

Geothermal Surveys, Inc. (1961-present) dba GSi/water

Begun by Occidental College Geology & Geophysics Professor **Joe Birman,** CEG, RGP, CHG where he taught between 1950-84. Birman was a hydrogeologist (AB Brown '48; MS Caltech '50; PhD UCLA '57), he started **Geothermal Surveys** in South Pasadena in 1961, after spending the previous four years performing the first thermal survey of a ground water basin. In the early 1960s Birman pioneered the use of water temperature profiling to track seepage and percolation conduits in Lake Isabella along the lower Kern River (widely cited in the professional literature).

Birman wrote landmark chapters in *Handbook of Groundwater Development*, such as "***Geologic Formations as Aquifers***" and "***Exploration for Groundwater***." Another classic, but brief article, was "***Thermal Exploration for Ground Water and Related Problems***," in *Geology, Seismicity, and Environmental Impact* (AEG, 1973). Joe Birman worked across much of the United States, and in Latin America, Africa, and the Middle East. **Tom H. Hibner**, CEG (BS Geol '89 CSPU-Pomona) was their senior geologist throughout the 1990s, and **Eric Gorman** (BS Geol 2001 CSLA) have served as their senior geologists in the 2000s.

Lindvall-Richter, and Associates (1971-90); Lindvall, Richter & Benuska Associates (1990-95); Harza Engineers-Los Angeles office (1995-97)

In 1971, Caltech emeritus professor of Mechanical and Electrical Engineering **Frederick C. Lindvall** (1903-89) (BS '24 Illinois; PhD '28 Caltech) asked his retired colleague, seismologist **Charles F. Richter** (1900-85) (AB '20 Stanford; PhD '28 Caltech) if they should form a company specializing in seismic engineering and earthquake hazards. They incorporated and enlisted Caltech geotechnical engineering professor **Ronald F. Scott**, PE; former Caltech geology professor **Richard H. Jahns**, CEG (then Dean of Earth Sciences at Stanford); Berkeley structural engineering professor **Ray W.** Clough, SE and Fredrick's son, Stanford geology graduate **C. Eric Lindvall**, PG (MS Geol '58 Stanford). These six were the principals of the firm, with Eric Lindvall serving as the new firm's president.

In the late 1970s, two Associates (consultants) were added: structural engineers **J. Brent Hoerner**, SE (PhD CivEng '71 Caltech) and **Roy C. Van Orden**, SE (BSE '42 Caltech; 1918-2011). In 1980 engineering geologist **Richard J. Proctor**, CEG (BA '54 CSLA; MS '58 UCLA) retired from the Metropolitan Water District (MWD) and served as an LRA associate until 1985. Famed Caltech structural earthquake engineer Prof. **George W. Housner**, SE (BSCE '33 Michigan; MS '34 and PhD '41 Caltech; 1910-2008) often consulted to LRA, but requested not to be listed as an Associate on LRA letterhead because it would preclude their being retained on projects which Housner served in a review capacity.

Owing to Richter's prestigious name, three of LRA's biggest clients were local public agencies then planning or constructing tunnels: MWD, the LA Department of Water and Power, and the Southern California Rapid Transit District (SCRTD, later MTA), builders of the LA Metro subway.

In 1978 The L.A. Metro Chief Engineer, Richard Gallagher, hired the nine LRA Principals and Associates to become their **Geotechnical Consulting Board**, along with tunnel engineers **Ron E. Heuer** and **P.E. "Joe" Sperry**. The Board was active until 1985, and was responsible for all preliminary borings, soils and hazardous gas testing, seismicity, geology, and route alignments. The Board asked for proposals, and hired the venture of Converse Consultants (Pasadena)/Geotechnical Consultants (Glendale)/Earth Science Associates (Palo Alto) to do the field and lab work, and prepare a baseline report (1982, 2 volumes). Of note is the Appendix on tunnel seismic design, prepared by LRA and **George Housner**, SE which became a benchmark document for tunnel design and construction in seismic areas. In 1983 the L.A. Metro design consultants were hired, and Chief Engineer Gallagher took early retirement because of in-house politics. Soon afterward the new Chief Engineer replaced the entire Board!

All of the principals died in the 1980s, except **Eric Lindvall** and **Ronald Scott**. In 1981, owing to failing health, Frederick Lindvall hired Dames & Moore principal **N. F. 'Jack' Yaghoubian** (BSCE '61 Illinois) to replace him as president of LRA. In 1983, **Eric Lindvall** became president. Around 1989 civil engineer **Kalman Lee Benuska** (BSCE '60; MS '61 Berkeley) was brought from Converse Consultants as a partner, and the name was changed to **Lindvall-Richter-Benuska & Associates (LRBA)**. Lee Benuska was diagnosed with a brain tumor about 1996/7, but he survived. His son **Van Benuska** is also a RCE and SE also worked for the firm.

Harza Engineers of Chicago bought LRBA in 1995, and possibly due to poor long distance upper management decisions, LRBA was dissolved in 1997. Eric's son **Scott C. Lindvall**, CEG (BS Geol '84

Stanford; MS ’88 SDSU) joined the firm in 1985, after receiving his MS in engineering geology at San Diego State working with Prof. **Tom Rockwell**. After the firm closed, he joined William Lettis & Associates in 1998.

Dames & Moore Thread (in Caltech threadline)

Dames and Moore (1938-present)

The history of Dames & Moore parallels the development of a new discipline in engineering, the science of soils and foundation engineering. Before the birth of Dames & Moore, little was known of soil mechanics and foundation engineering, and what was known rested in the minds of the company's pioneering founders, **Trent R. Dames** (1911-2000) (BSCE ’33; MS ’34 Caltech; RCE 5381) and **William W. Moore** (1912-2002) (BSCE ’33; MS ’34 Caltech). Dames was born in Brooklyn, New York, in 1911 and at age seven moved with his family to southern California, where he attended San Diego High School and developed an abiding interest in civil engineering. Moore was a native Californian, born in Pasadena three months after his future business partner. Dames and Moore met for the first time at the California Institute of Technology (Caltech), where each earned their Bachelor of Science degrees in civil engineering in 1933 and master’s degrees in 1934. Both Dames and Moore had developed an affinity for a particular aspect of civil engineering--the study of soil mechanics and foundation engineering--but their chosen academic paths led to uncharted territory. Much like the pair would be forced to do in the business world, Dames and Moore had to break new ground just to get started.

Their main obstacle--and it was a formidable one, was that Caltech did not offer any courses in soils and foundation engineering. Few engineering schools included such courses in their curriculum, but Dames and Moore were undaunted and, along with several of their classmates, they lobbied Caltech officials to include soil mechanics as part of the university's post-graduate engineering studies. Dames and Moore prevailed, but without any textbooks on the subject in existence, the first students of the course had to search for available research on soil mechanics and pool their discoveries. Pursuing their academic studies in this manner, Dames and Moore were scientific pioneers early in their careers. When they left Caltech in 1934 with master's degrees in civil engineering, each possessed expertise in a field few others had ever heard of. As they had done at Caltech, Dames and Moore would share their knowledge in the business world; the resultant joint effort materialized as Dames & Moore.

It took several years before Dames and Moore realized that their best chance to put their academic training to work in the business world was to form their own company. After leaving Caltech, Moore worked as a staff member of the U.S. Coast and Geodetic Survey organization, while Dames joined the U.S. Bureau of Reclamation as a junior engineer. The two were friends, however, and remained in contact with each other, eventually working together for both **R. V. Labarre** and **Fred Converse** between 1935-37, two of the West Coast's first soil mechanics consultants. Because of the infancy of their shared specialty, Dames & Moore found little opportunity to use their skills in the existing marketplace; the obstacle that had confronted them at Caltech assumed a similar form outside the confines of academia. Consequently, in **August 1938** they decided to form a partnership, but Moore kept his job with the Corps of Engineers LA District office, working on weekends and during the evenings, while Dames worked out of his home in Pasadena. When their book of business was sufficient to keep Moore busy full-time, he quit his job with the Corps. Dames’ principal role would always be in growing the business, while Moore’s was more focused on the firm’s technical capabilities. Though cautiously optimistic when they began, a dependable business clientele did not emerge until, like Lebarre, the two budding entrepreneurs began developing their own technical innovations, which could be marketed through articles.

When they patented their Dames & Moore Type U underwater sampler, the young partners began to imagine a future filled with a more steady flow of business. Prior to the development of the Type U, soil exploration was conducted either by drilling a large hole or a number of small holes. The large-diameter borings were big enough to permit an individual to descend into the opening and record findings gleaned from the exposed strata, while the much smaller drillings offered loose or disturbed samples. Neither method was satisfactory: the former was impractical; the latter was inaccurate, creating a great need for an efficient, reliable method of determining soil dynamics. Dames & Moore had developed such a method. The Type U drove the sampler ahead of the boring, enabling engineers to obtain undisturbed samples taken from below the water table, which only rarely had been achieved. As a result, the partnership could point to its first

advantage over the paltry few competitors it faced, the realization of which instilled a consistent commitment to technical research in the decades ahead. For rest of story, see separate document titled "Dames & Moore: Corporate History" (2005).

Their first branch office was established in San Francisco in 1941, with Bill Moore moving to San Francisco a short while later. This office was joined a short while later by a third office in Seattle, doing war-related infrastructure work. By 1950 Dames & Moore had offices in Los Angeles, San Francisco, Seattle, Portland, and New York.

Dames & Moore - Los Angeles office – senior personnel

The first generation of partners, as of 1950, included: **Trent Dames, Bill Moore, William W. Brewer, L. LeRoy Crandall, Vernon Allen "Al" Smoots**, and **William Enkeboll**. **Bill Brewer** joined the San Francisco office during World War II and **LeRoy Crandall** the Los Angeles office in 1945. They became the first junior partners with Dames and Moore in November 1947. **Al Smoots** received his BSCE degree from the University of Kansas in 1944 and served as a Seabee officer in the Pacific before joining the LA office in 1946. He went onto manage their New York office when it opened, but moved back to the firm's Los Angeles headquarters in 1954 as Managing Consultant, when LeRoy Crandall departed (Smoots remained with D&M until 1985). Smoots co-authored the text ***Construction guide for soils and foundations***, along with Gordon A. Fletcher (of Raymond International) in 1974. A Second Edition appeared in 1988, co-authored by Fletcher and Richard G. Ahlvin (of USACE-WES Vicksburg). Bill Moore and Bill Enkeboll transferred to the San Francisco office in the mid-1950s.

By the mid-1960s the LA office included partners **Trent Dames**, **Al Smoots**, and **Donald V. N. Roberts** (BSCE '50 Stanford; and President of ASFE in 1985-86). In the mid-1950s Don Roberts and **Dave Lieu** formed the Quality Control team that provided in-house peer review of all reports before they went out of the office. **Hank Klehn** (BSCE '59, MS '60 Berkeley), **Bill Gates** (BSCE '61, MS '63 Berkeley) came to D&M from grad school at Berkeley in the early 1960s. **Wolfgang H. Roth**, GE (PhD '64 Graz Austria) came to UCLA as a postdoctoral researcher with Prof. Ken Lee. Gates and Roth became VP's, while Klehn became managing partner of the LA office in the mid-70s. **Nejde F. 'Jack' Yaghoubian** (BSCE '61 Illinois) became a partner in the early 1970s. In the late 1980s Klehn was named Executive VP and Chief Operating Officer of the firm, taking over role of VP for Corporate Development and joining D&M's managerial board in 1993.

Caltech grad **George D. Leal** GE, NAE (BSCE '56 Santa Clara; MBA '57 Chicago; MSCE '58 Caltech) joined the firm in 1959 and became CEO in 1981, serving till 1994, then as Chairman of the Board (COB) from 1991-98, and was elected to the National Academy of Engineering in 1995. It was Leal who took the firm into the lucrative geoenvironmental market in the 1980s, greatly expanding the firm's market share and prestige.

The first full-time geologist in the Los Angeles office was **Russell G. Hood** (BA Geol 1952 UCLA), between 1952-59. From the late 1950s, D&M engineering geologists have included **John F. Stickel, David Bramwell, Roy Eastman, Richard Richards,** and **Arthur C. "Art" Darrow,** CEG (BA Geol '63, MA '68 UCSB). Darrow joined the firm after serving two tours in Vietnam as a Marine Corps officer. He became a partner, then President and Chief Operating Officer in Aug 1993, CEO in Jan 1995, and COB in 1998, succeeding George Leal. Geological engineer **Gary E. Melikian** (BSGE '62 CSM), worked out of the LA office between 1962-80 (he moved to D&M's Technical Services Branch in Washington DC). **G. A. "Andy" Reti** and **J. Russell Mount** were a few of the staff engineers. Mount was the first to employ computer codes to model dewatering systems, in the late 1960s. **Robert M. Moline** was a senior geotechnical engineer who worked on earth dams.

In 1960 D&M was the first geotechnical firm to hire an "engineering seismologist." In fact, this was the first time the term was ever used. **David J. Leeds**, CEG, RGP (1917-2011) (BA Geol '39 Texas; PhD Geophy '66 UCLA) had originally worked for the US Coast & Geodetic Survey, from an office at UCLA. At D&M he pioneered the assessment of techniques to measure the shear wave velocity of soils, then compute theoretical site amplification spectra. The first such project was for the proposed San Onofre Nuclear Power Plant in 1962. D&M led the charge in this arena until other forms began emulating their efforts after the 1971 Sylmar Earthquake. **Jeff Keaton**, PE, CEG (BS Geol '71 Arizona; MSCE '72 UCLA) was a senior geologist from 1971-79. After **Paul Baumann** PE retired from the LACo FCD in 1959, he was retained by Dames & Moore as a consultant on the retrofit of Puddingstone Dam, Little Santa Anita Canyon Dam, and Eaton Canyon Dam.

LeRoy Crandall & Associates (1954-1984); Law-Crandall (1991-2002); MACTEC (2002-2011); AMEC (2011 to present)

Lionell LeRoy Crandall, GE (1917-2011) grew up in San Diego and went by the nick name "Buzz." After attending San Diego State for two years, he transferred to U.C. Berkeley and received his BSCE in 1941. He took a position with Dames & Moore in December 1941, after working for the State Division of Highways in San Diego for 6 months. He did not serve in the military during WW2, because he was performing critical engineering work for the war effort in southern California (he was registered as RCE 6157 in 1944). Crandall became the first junior partner with Dames & Moore in 1947 and was named the Los Angeles office's Chief Engineer in 1952.

When Trent Dames shared his vision for going global with the firm's business in 1954, Crandall decided to found LeRoy Crandall & Associates, which only focused on traditional geotechnical work in southern California, mainly in Los Angeles. Structural engineer Clarence Derrick loaned the startup funds to Crandall to begin his firm. In the early years his biggest client was MWD, but also many others, incl. Dept of Defense and Port of Los Angeles-Long Beach, etc., etc.

Some of the principals at Crandall & Associates included: **Jimmy Kirkgaard** (BSCE and MS, UCLA) was the chief engineer who ran all the office engineering operations for many years. Founding associates were **Fred Barnes**, **Leo Hirschfeldt**, and **Russ Weber**. **Leopold (Leo) Hirschfeldt** (1921-1980) attended Stockholm Technical Institute, receiving his BSCE in 1940. In 1948, he came to the United States and worked for Dames & Moore in Los Angeles between 1949-54. Hirschfeldt served as Secretary-Treasurer of Crandall until his death in 1980 and he was one of the founding principals of ASFE in 1969.

Fred Barnes (BSCE '38 Berkeley) ran their field services division, and **Jim McWee** was chief inspector. Some of the junior partners included **Jimmy Kirkgaard**, **Seymour Chiu** (from Taiwan), **Jim van Beverin, Bob Chieruzzi, Perry Maljian,** and **Carl Bock** (went onto International Testing in Costa Mesa), and **Marshall Lew**, GE (BSCE, MS, PhD '75 UCLA), who joined the firm in 1977 and became the last associate in 1981. **Frank Fong**, GE worked for the firm between 1986-94. **Glenn A. Brown**, CEG worked with Crandall from 1975-93. Glenn's engineering geology firm had four people when they merged with Crandall in January 1975. Brown retired in April 1993 and is long time member on Metropolitan Water District Board of Directors.

Crandall & Associates was originally based out of office at 1619 Beverly Blvd., along what was then known as "structural engineer's row." Around 1970 they moved a short distance away, to a building they purchased on Alvarado Street in Los Angeles. Crandall was named as one the original members of the newly formed California Seismic Safety Commission in 1975.

After the acquisition by **Law Engineering** in 1982 the firm had grown to 75 employees and needed more space. All of the properties along Alvarado were held by the earlier partners in the firm, so they moved to the Glendale location (900 Grand Central Ave.). When Law purchased the firm LeRoy Crandall retired (he was 65), but remained active on the board. The firm didn't change its name to Law-Crandall until 1991, when they moved down to The Citadel on the I-5 Golden State Freeway, near Garfield Avenue, on the border of the City of Commerce. In 1999, Crandall severed all ties to his old firm and formed Crandall Consultants, Inc. specializing in geotechnical forensic engineering services. MACTEC took over Law/Crandall about 2002. In 2007 they moved to a location on Slauson Ave in Los Angeles.

LeRoy Crandall participated in the EERI Oral History Series and a volume profiling his career prepared by Stanley Scott was published by EERI in 2008. Crandall was a long-time member of the Los Angeles Grading Appeals Board for the Dept of Building & Safety; other members included Fred Converse, L.T. Evans, and Tom Clements.

Glenn A. Brown – Consulting Engineering Geologist (CEG 3)

Glenn Brown received his BS in geology from UCLA in 1951. From 1951-63 he worked for the California Dept of Water Resources on the California Water Project across the Tehachapi Range into Castaic Reservoir, also co-authored DWR Bulletin 15. In 1963 he took a position with Geotechnical Consultants in Glendale, then started his own consultancy in 1967, based in Tujunga. **Don McCann** and **Mervin E. Johnson** worked for him in the late 1960s. His firm was absorbed into Crandall & Associates in 1975 and he remained with them until retiring in 1993. Glenn served as president of AEG and as an elected member of the governing board of the Metropolitan Water District for >26 years.

Leighton thread (in Caltech threadline)

F. Beach Leighton & Associates (1961-72)

Freeman Beach Leighton (1924-2012) was the son of Dr. Morris M. Leighton (1887-1971), Chief of the Illinois State Geological Survey from 1923 to 1954. His name was taken from two family surnames, his mother's maiden name having been Ada Beach. They decided to call him by his middle name (Beach) because it was easier. Beach grew up in Urbana, because the Illinois Survey's offices were on the campus of the University of Illinois (his younger brother, Morris W. "Brud" Leighton, also served as Chief Geologist of the Illinois Survey, between 1983-94). In 1941-42 (between his junior and senior year of high school) he had spent a year in Los Angeles with his uncle, who had recently purchased a vermiculite mine in the Virgin Mountains south of Mesquite, and east of Overton, Nevada (where they stayed). Beach graduated from high school in 1943, during the Second World War. He immediately tested for and was accepted into the Navy's accelerated V-12 officer candidate program, majoring in civil engineering. The Navy sent him to the University of Virginia in Charlottesville. After suffering peritonitis, he took two geology courses (because the engineering courses he needed were not available) and an interest in geology was kindled. He completed a BS degree in general engineering in February 1946. On the day of graduation he was 21 years and 2 months old. He was also commissioned as a Naval officer and married his high school sweetheart Wanda Jean Downey. He then attended disbursing officer's school at Harvard, and was posted to Panama for a year, between 1946-47 as a supply officer. As his naval service came to a close, he applied to the geology programs at Caltech and UCLA, and was accepted at Caltech first, so that's where he began his graduate work in geology in the fall of 1947.

Leighton completed his MS in 1949 with thesis on glaciology, under Prof. **Robert P. Sharp** (who had previously taught at Illinois, after graduating from Caltech and Harvard). It was under Sharp, examining glaciers during two summers at Caltech, that Beach used Navy boson's rope ladders, to descend into glacial crevasses. This experience led to his using boson's rope ladders in the 1960s to descend down bucket auger holes to map the subsurface geology of hillside developments. Beach made several lasting friendships at Caltech that proved valuable in his subsequent career. Foremost among these was Geomorphology Professor **Bob Sharp** (1911-2004), Seismology Professor **Clarence Allen**, CEG, RGP, Geophysics Professor **Joe Birman**, CEG, RGP, CHG (at Occidental College), and Caltech Professor **Leon Silver**, a geochemist. Beach received his Ph.D. in geology from Caltech in 1952, with an emphasis on industrial minerals (under **Ian Campbell**), studying the Gold Butte vermiculite deposits at his uncle's mine in the Virgin Mountains of southeastern Nevada. Shortly after the birth of his first child in 1949-50, he began teaching geology at Whittier College as their only instructor in geology. He remained on the faculty until 1975, when he retired.

Leighton's entry into geotechnical consulting came about in 1961 through the patronage of the Sunset International Petroleum Co. of Riverside, who developed most of the Puente Hills in Hacienda Heights (adjacent to where Beach and Wanda were living, at 2732 Hacienda Blvd.). That referral came from LA County Geologist **Doug Brown**, who was impressed by a letter Beach sent the County Engineer's office warning about the potential perils of grading the northern slope of the western Puente Hills because of the adverse dip of the strata. Beach and Wanda worked out of their home, an old farm house at 2732 Hacienda Blvd. in Hacienda Heights.

They soon garnered a part-time staff of seven employees. Beach's first employees were two of his former Whittier College students: **Dave Adams** (BA Geol '57 Whittier) in 1962, followed by **Larry Cann** (BA Geol '57 Whittier) in April 1963. The first of many independent contractors was **Harry Lawrence** (BA Geol '55 Occidental; MA '56 Caltech) in 1962 (who taught geology at Pasadena City College), followed a few years later by **Bill Cotton** (BA Geol '62, MA '67 San Jose State), who also taught geology at PCC, between 1964-70. The geotechnical firms Leighton supported most during the 1960s were the **Donald R. Warren Co.** (their principal contacts being Cecil Collins and Herb Nicola) and **Leroy Crandall & Associates**.

In 1963 Beach moved the small operation to a real office with 2,000 sq ft of floor space on Whittier Blvd. in La Habra, where they eventually grew to have 15 full-time and 15 part-time employees. In 1969 the firm moved to a much larger, 5,000 square foot office on Beach Blvd. in La Habra. There **David G. Campbell** was among the roughly 20 full-time employees. The firm was a sole proprietorship until 1970, when FBLA was incorporated. FBLA moved to Orange County in 1973, because that's where bulk of their business was. Woodward-Clyde attempted to purchase FBLA in 1971 to serve as their engineering geology arm.

During the 1960s FBLA also began working with **Dr. Bing Yen**, GE as the soils engineering consultant on many of their development projects. Yen taught soil mechanics at Long Beach State. In September 1972 they established **Leighton-Yen Associates** as a separate geotechnical engineering services company, but this did not last more than a year or so. Later in 1972 they also formed **Earth Science Planning**, which provided planning related services, such as environmental impact reports. Their new associate in this venture was **Don Asquith,** an old Caltech colleague of Leighton's who had had just completed his PhD at UCLA. In late 1972 **Mike Scullin**, CEG (BS Geol '58 Arizona State) was brought in from Slosson & Associates to head this group and **Rich Lung**, CEG (BA '54, MA '58 UCLA) came over from Stone Geological Services to FBLA as the firm's new chief geologist. **Doug Moran,** GE, CEG (BA '58 USC) then joined the firm chief geologist and vice-president from 1973-74.

Leighton & Associates, Inc. (1974-present)

Leighton's first satellite, or "field office," was in San Bernardino, headed by **Gary Rasmussen** (BS Geol '67 Arizona), around 1971. Other "field offices were established around this same time, including those in Irvine, Laguna Hills, Laguna Beach, Agoura Hills, Mission Viejo, and Sherman Oaks. They even operated a small office in the San Francisco Bay area (Los Gatos and Redwood City) between 1971-81. The regular Irvine office was opened in 1973, which allowed better proximity to work in southern Orange and San Diego Counties. **Doug Hildenbrandt**, **Ron Lejman**, and **Jerry Groves** were soils engineers at Irvine.

The successor firm to Leighton-Yen Associates was called **Leighton Geotechnical Associates**. This was incorporated into **Leighton & Associates, Inc**. in 1974. The firm's spaces in the Skypark Circle complex on Main Street in Irvine tripled in size in 1974. **Bruce Clark** (BS Geol '63 Yale; Ph.D. '67 Stanford) joined the firm in 1977, after teaching structural geology at University of Michigan. **Iraj Poormand,** GE (MSCE, San Diego State) joined the firm in early 1978, succeeding Doug Moran as their chief engineer. **Ronald J. Lejman**, GE was a senior engineer from 1973-79. The firm moved to their building on Dureya Avenue in Irvine on Thanksgiving weekend 1982. **Poormand** continued as Chief Engineer until his semi-retirement, about 2005, and he died in 2010.

Other branch offices were established in the 1970s and 80s: The Riverside San Bernardino office was established in 1971 and managed Gary Rasmussen, and later by **Sid Siddiqui** (after Rasmussen started his own consultancy in 1977). **Hayim Ninyo** and **Rick Zeiser** ran the Orange County office in Irvine (from 1977-86, when Rick started Zeiser-Kling). A Sa n Diego office was established in 1977 and managed by **Avram Ninyo**, GE, from 1977-78, and then by **Martin R. Owen**, GE (BSCE '67 Glasgow Univ; MS '68 Berkeley), from 1978-81. When Owen founded Owen Geotechnical in 1981 in San Diego, **Avram Ninyo** managed Leighton's San Diego office until 1986, when he opened up a new North San Diego County office in Carlsbad, before starting his own firm (Ninyo & Moore) six months later (profiled below). **Greg Farrand**, CEG was the senior geologist in the San Diego office in the late 1980s. Leighton also opened a branch office in Walnut (near Diamond Bar, in eastern Los Angeles County) in 1977, managed by **Don Brockway**. A Ventura County office opened in Westlake Village in 1978, managed by **Fred Gebhardt**. A Coachella Valley office served the lower desert market beginning in 1978, managed by **Bret Inghram**. And, a Santa Clarita Valley office in Valencia opened in 1984, managed by **Bruce Hilton**, CEG.

Leighton was known for employing part-time geologists with strong resumes, many from the ranks of academia. During Leighton's early years, these individuals included: **Don Asquith** (BS '50 Caltech; MS '52 Kansas), **Edward G. Heath** (BA '52 Pomona, MA '54, Claremont Grad Sch), **Frank Kenton, Bob Dickey** (BA '64 Pomona College), **Walter Reiss** (MA '50 Caltech), **John Hanson, Joe Johns** (BS '65 Arizona State), **Steve Ellen** (BA '64 Amherst; MS '71, PhD '73 Stanford), **Dennis Hannan** (who later became principal CEG), **Bob Sydnor** (BS '69 Whittier; MA '75 UCR), **Pete Tresselt** (PhD in geology, later taught at Fullerton CC and CSU Fullerton), **Jack Hoefferle, Bruce Hilton**, CEG (BA Geol '78 CSULA), **Ed Steiner, John Franklin** (BS '75 USC)**, Rosalind Munro, Don Terres,** and **Eldon Gath**, CEG (BS '78 Minnesota) was principal geologist from 1989-96. Some of the senior geotechnical engineers included **Ross Khiabani**, GE, and **Djan Chandra**, GE, among others.

Bruce Clark, PhD, CEG was President and CEO of L&A from about 1988 to 2003. Beach credits Bruce Clark was being the moving force in growing the firm intelligently and possessing the necessary business savvy to survive and even thrive in the volatile (up and down) and all-too-often litigious southern California marketplace. At its peak (around 1988) the firm had 395 employees in 11 offices.

In 1997, the company underwent significant reorganization, splitting into five operating companies under the umbrella GTG Inc. **Leighton & Associates** for residential projects (Bruce Clark President), **TerraTest** for laboratory and material testing, **Gradient Engineers** for construction management (**Dale**

Bodman, GE President), **Enviro-Pacifica** for environmental consulting, and **Earth Consultants International** for high-level geologic consulting, internationally. The experiment was ultimately unsuccessful and by 2000, ECI's principals had purchased the company from GTG, and TerraTest and the environmental company had been absorbed back into Leighton. Bruce Clark retired about 2003, with **Andy Price** assuming the L&A presidency. By about 2005, the company restructured again into two divisions, one for residential (**Leighton & Associates**) and one for public works/commercial projects (**Leighton Consulting**). **Andy Price** (CEG) and **Terry Brennan** (accountant) as Presidents. **Lauren Jelks Doyel**, GE (BS Geol '84 Stanford; MSCE '98 SJDU) joined the firm as a principal in 2012.

Envicom (1972-85)

An environmental planning firm co-founded by **Don Asquith,** CEG, RGP (BS '50 Caltech; MS '52 Kansas; PhD '72 UCLA), after running Earth Science Planning for Beach Leighton. Asquith sold his share in 1985 and co-founded the Morro Group in San Luis Obispo County, where he remained until retiring in 2000.

Bing Yen & Associates (1979-1998); BYA-ATC Group Services

Founded by **Bing Cheng Yen**, GE, who did his PhD work at the University of Utah working with Prof. Andrew W. Jenike (1914-2003) in their Bulk Solids Flow Laboratory. Yen's thesis topic was titled "*Slope Stability in Axial Symmetry*," published in 1961 and '62. A few years later Yen accepted a position in soil mechanics at Long Beach State University, where he taught between 1964-91. During this time Yen was in a partnership with Beach Leighton for about 18 months, in 1972-74. He appears to have incorporated Bing Yen & Associates (BYA) in 1979, as an MBE and DBE firm with their main office in Irvine.

Principals and key employees included: **Glenn Tofani**, GE, **Greg Silver** GE, **Larry Taylor**, GE, and **Matt Hunter**, CEG, GE, **Bill T.D. Lu**, GE (MSCE '67 Duke; PhD '73 Caltech), and **David W. Sykora**, GE. The first four were former graduate students under Dr. Yen at Cal State Long Beach. The firm later maintained a satellite office in Ventura area, where **Lauren Jelks Doyel**, GE worked. The firm was sold to **ATC Group Services** in 1998 and was based in Irvine. Glenn Tofani went onto found Geokinetics; Greg Silver joined Goffman, McCormick and Urban, Inc. (which became GMU Geotechnical, Inc.); Larry Taylor formed Taylor Group, Inc., Matt Hunter formed Laguna Geosciences, Bill Lu founded TDL Engineers, and David Sykora joined Exponent.

Zeiser Kling Consultants, Inc. (1986-2010); Kling Consulting Group (2010-)

Founded by engineering geologist **Frederick "Rick" L. Zeiser**, PG, CEG and geotechnical engineer **Henry F. Kling**, GE (BSCE '83 CSULB) around 1986. Prior to starting this firm Rick Zeiser was Chief Geologist for Leighton & Associates' Irvine office, between 1984-86. The firm's home office was in Santa Ana, with a branch office in Riverside. **Roy Kroll**, CEG (BS Geol '79 CSULB) was an engineering geologist for them between 1986-96. Kling served as President of CalGeo in 1998-99. In 2008 Zeiser retired, but the firm was dissolved in 2010. Kling then founded **Kling Consulting Group, Inc.**, based in Irvine.

Ninyo and Moore (1986-present)

Founded in 1986 by **Avram Ninyo** (BSCE '71 Robert College-Istanbul; MSCE '74 Syracuse, working with Fred Kulhawy) and **Roy E. Moore** (MSCE '72 SJSU), son of Dames & Moore founder Bill Moore). Ninyo managed Leighton's north San Diego office and Ninyo & Moore were originally based in north San Diego County. Their corporate headquarters later shifted to San Diego, with branch offices in Irvine, Los Angeles, Rancho Cucamonga, San Francisco, San Jose, Oakland, and Sacramento. In the 2000s they expanded their holdings into Arizona (Prescott, Phoenix, and Tucson), Las Vegas, Nevada, Denver, Colorado, and Texas (El Paso and Houston). They provide geotechnical and geoenvironmental design and remediation work, materials testing, construction management, etc., and are an ENR Top 500 Design Firm.

Roy Moore left to become Senior Vice President of AGRA Earth & Environmental, Inc., and then started Moore Consulting. In June 2000 he joined U.S. Laboratories as Executive Vice President responsible for the company's national geotechnical and environmental operations. Moore then joined MACTEC in Lawrenceville, GA, around 2004 (MACTEC was acquired by AMEC in 2011). Moore retired in Oct 2012.

Constant & Dickey (1986 - 2004)

Founded by **Brian D. Constant**, GE and **Robert H. "Bob" Dickey**, PE, CEG around 1986, based in Anaheim. From the mid-1960s thru the mid '80s Bob had worked for Leighton & Associates, then operated as **Bob Dickey Consulting Geologist and Soils Engineer**, out of San Juan Capistrano. Dickey also appears to have managed **M&T AGRA's** (formerly Moore & Taber) Anaheim office in the early 1990s.

NGM Geotechnical, Inc. (1994 - present)

Firm founded by **Hayim Ninyo**, GE (BSCE Robert College-Istanbul; MS '76 Berkeley), **Tetsuo Ted Miyake**, PE (BSCE and MS Stanford), and **William** "**Bill" Goodman**, CEG (BA Geol CSUF), after having worked for Leighton. The firm is based in Irvine. Associate engineers include **Chester Burrous**, GE (BSCE and PhD Washington), **Karlos Markouizos**, P E (BSCE CSULB), **Bob Karimi**, PE (BS Geophy UTEP). Senior engineering geologists include **Terri Wright,** CEG (BS Geol CSULB), **Tom Devine**, CEG (BS Geol and BS Bus CSUF), **Lynne Yost**, CEG (BA Anthro and BS Geol SCUF).

Genterra Consultants (1995 – present)

Joseph J. Kulikowski, GE was the managing principal at Leighton & Associates for the Los Angeles Region in the early 1990s. In 1995 he founded **Genterra Consultants, Inc**. to provide civil and geotechnical engineering for water storage, water conveyance, flood control and other types of facilities. The firm specializes in dam safety engineering, levee safety engineering and in the design, evaluation and rehabilitation of all types of dams, levees and appurtenances. GENTERRA's headquarters are in Irvine, with branch offices in Northern and Southern California.

Earth Consultants International (1997-present)

ECI was founded in 1997 as an independent operating company under GTG Inc (formerly Leighton & Assoc.). **Eldon Gath** - President, **Tania Gonzalez** – VP, along with Professors **Kerry Sieh** (Caltech), Prof **Robert Yeats** (OSU), and Prof **Tom Rockwell** (SDSU). **Kerry Cato**, CEG (PhD '91 Texas A&M) was with the firm from 1999-2003. In 2000, the company was purchased from GTG by Gath, Sieh, Gonzalez, Rockwell, Yeats, **Mitch Bornyasz**, **Doug Bausch**, **Kay St. Peters**, joined in 2001 by Drs. **John H. Foster** (BA Geol '70 SDSU; PhD '80 UCR) and **W. Richard Laton** (BS Geol '89 St Cloud State; MS '92; PhD Hydgeol '97 Western Michigan) at Cal State Fullerton.

By 2012, the company has completed projects in Turkey, Panama, Afghanistan, Indonesia, Honduras, Mexico, Israel, Japan, Taiwan, Portugal, Pakistan, Papua New Guinea, and the USA. Other professors they use as consultants include Jon Bray of Berkeley and J. David Rogers of Missouri S&T.

LGC Geotechnical (2001 – present)

LCI Geotechnical is based in San Clemente. The principals are **Timothy Lawson**, GE, CEG (MS '85 Univ of Portsmouth-Great Britain), **Dennis Boratynec**, GE (BSCE '95, MS 2003 Univ Alberta), and **Kevin B. Colson**, CEG (BS Geol '93; MS '96 SDSU). Firm evolved from **Lawson & Associates** Geotechnical Consulting (founded in May 2001). **LGC Coastal** is based in San Clemente, **LGC Inland** in Murrieta run by **Mark Bergmann**, CEG, and **LGC Valley** in Valencia, staffed by **Mark Hawley**, CEG. All of these individuals were former employees of Leighton & Associates.

Woodward-Clyde threadline (southern California)

Woodward-Clyde & Associates (1963-1997); URS-Greiner (1997-present)

Firm started in January 1950 in Oakland, CA by **Ned P. Clyde** (1920-1999), **Arnold Olitt** (1913-1993), and **Richard J. Woodward, Jr.** (1907–1998), all whom met one another as students at Cal Berkeley. **Leonard M. Krazynski** (1927-2011) (BSCE '58 Wash State; MS '60 Berkeley) began his career at Woodward-Clyde in 1960, in Oakland. He became their Chief Engineer and Supervising Engineer of their office in Orange County in late 1963-early 1964. This office was located in Orange, then moved to Santa Ana, where it remained for many years. When they opened the Orange County office the firm went by the name **Woodward-Clyde-Sherard & Associates.** By 1968 that had reverted to Woodward-Clyde & Associates.

The original group that opened the Orange County office included engineers **Louis J. Lee, R. Leonard Allen**, and **Steve Haley**, and engineering geologist **Charles J. "Jerry" Pinckney**. The Orange

County and San Diego offices did a lot of pioneering work with expansive soils, including a two-year contract with the Portland Cement Association's Los Angeles District, summarized in a 134 page report delivered in March 1968. This report led to the adoption of the ***UBC 29-2 Soil Expansion Potential Test***.

Len Kraznyski moved to the firm's San Diego office around 1968-69. He was succeeded by **Nicholas Chryssafopoulos** (1919-95) (BSCE '40 Robert College in Istanbul; MS '53; PhD '56, Illinois), who had joined the firm in 1959 and had previously managed their Montclair, NJ office. Chryssafopoulos left to become a consulting partner with Dames & Moore in their New York office, then re-joined Woodward-Clyde in 1972, managing operations for the entire Los Angeles metro area. In 1972 Krazynski moved to Houston to open a new office (Woodward Krazynski & Associates) to service Texas and Louisiana, remaining with the firm until 1984.

San Diego office

Gerald L. Baker, PE (BSCE '56; MS '58 Berkeley) joined Woodward Clyde in 1957, and transferred to the San Diego office as their Chief Engineer in the early 1960s (he became VP of administration at the firm's Clifton, NJ office in the 1970s). **Douglas C. Moorhouse** was the first manager of the San Diego office before moving to the firm's Clifton, NJ office in 1961-62. He was succeeded by **Stanley F. Gizienski**, PE (BS '43 Massachusetts, MSCE '48 Harvard), who managed the San Diego office for many years. Gizienski had worked for the Corps of Engineers in Omaha for about 10 years before joining the firm in 1955, and had been one of the co-authors of the 1963 text ***Earth & Earth-Rock Dams***, by J.L. Sherard, R.J. Woodward, S.F. Gizienski, and W.A. Clevenger. He also served as the firm's resident expert on expansive soils, along with Len Kraznyski and Louis Lee. As the workload increased in San Diego in the early 1960s, **Louis J. Lee**, PE (BSCE, '52 MS '58 MIT), **Ray Eastman**, CEG (from Dames & Moore), **Jerry Pinckney**, CEG and **Len Kraznyski** (BSCE '58 Wash State; MS '60 Berkeley) all transferred to the San Diego office. Other geologists working out of the San Diego office in the 1970s-80s included: **George Brogan**, CEG (MS Geol '69 SDSU); **Jeff Wiegand**, CEG (MA Geol '69 SDSU); **Mike Rahilly** (BS '68 SDSU); **Robert J. Dowlen**, CEG (BS Geol '69 SDSU), **Daryl Streiff**, CEG (BS Geol '71 SDSU); and **Don Olsen**, CEG, CHG (BS Geol '78 SDSU). Jeff Wiegand wrote the first article hypothesizing the existence of a San Diego Bay-Tijuana fault controlling San Diego Bay in the Fall 1970 issue of the AEG Bulletin. **John Moossazadeh**, PE (BSCE '76; MS '78 Maryland) served as a senior associate of the San Diego office from 1978-96, before joining Kleinfelder in 1999, and **James D. Hartley**, PE joined the San Diego office in 1982 after receiving his MSCE at Berkeley (he went onto CH2M Hill in Sacramento).

Woodward-McNeil & Associates (1971-75)

Robert L. McNeill PhD, PE grew up in Bakersfield, received BSCE from Berkeley in '54 (after attending West Point). He began working for Woodward Clyde in Oakland in 1953 as a soil technician, while completing his degree at Berkeley, and he worked part-time after graduation, while pursuing his master's thesis research, evaluating the use of pier-and-grade beam foundations to mitigate damages from expansive soils in the San Ramon Valley (completed in 1957). In the early 1960s he completed his Ph.D. at the Univ. New Mexico ('65) while supervising Woodward Clyde's Special Projects Division (working with the Air Force), out of the Oakland office. In the early 1970s the Los Angeles and Orange offices were operated as Woodward-McNeil & Associates and located at 2140 W. Olympic Blvd in downtown Los Angeles, with a branch office in Orange, CA. McNeil left on Dec 31, 1975 to start his own consultancy.

During the late 1960s-early 1970s **John T. Gaffey** (BSCE, MS, PhD from Purdue) became their marketing manager, **Bill Uhl** CEG was their engineering geologist (later to LA Co), along with geological engineer **Hans W. Ewoldsen**, PE, CEG (BSCE '62, PhD GeoE '66 Berkeley). Other key figures included **Richard J. Bielefield**, **Lewis J. Oriard**, **John A. Barneich, R. Leonard Allen**, and **Steve Haley**. **Bob Muns** ran the field operations, and **Ist Van Kalman** ran the soils lab. The LA office did a lot of consulting for LADWP in the wake of the 1971 San Fernando Earthquake and used Lloyd Cluff, Clarence Allen, and Harry Seed as peer reviewing consultants on ground motions (e.g. Chatsworth Reservoir studies).

Dr. **Izzat M. Idriss** (BSE '58 RPI; MSCE '59 Caltech; PhD '66 Berkeley) transferred to Orange County from the firm's San Francisco office in 1979, after Bob McNeil departed. Idriss became the Santa Ana office principal and remained there until leaving to teach at U.C. Davis in 1989, soon after he was elected to the National Academy of Engineering. Other principals included **John A. Barneich**, GE (who transferred from Oakland in 1968), and **John A. Bischoff**, GE, who came from the San Jose office to manage the Santa

Ana office in the mid-1980s. Senior staff included **Yoshiharu Moriwaki**, PhD, GE (PhD '75 Berkeley) and **Jean Suter Hill**, PE (BSCE '78 Purdue; MS '80 Berkeley).

Woodward Clyde Consultants was purchased in 1997 by the **URS–Greiner** combine for $100 million**.**

Group Delta Consultants (1986-present)

Founded in 1986 by **Walt Crampton**, PE, **Barry Bevier**, PE, and **Bob Dolwlen**, CEG all from Woodward-Clyde. They were employed in the San Diego office of **Medal-Worswick** until March 1986, when that firm was purchased by **Schaefer Dixon Associates**. Less than a year later, this group reformed as **Group Delta**. The original guys are retired, and the firm became a MBE under **Kul Bhushan** and **Shah Ghanbari,** after Crampton and Bevier left. **Group Delta Consultants**, Inc. provides geotechnical engineering, geology, hydrogeology, earthquake engineering, materials testing & inspection, and forensic services out of offices in San Diego, Irvine, Torrance, Ontario, Victorville, and El Centro. The firm has a staff of 125+ highly skilled professionals consisting of civil and geotechnical engineers, engineering geologists, laboratory and field technicians, deputy inspectors, drafting/CADD, and drilling and support personnel specialized in their respective fields.

The principal partners include: **Michael D. Reader**, GE in the CEO, **Shah Ghanbari,** PE is the President, Chief Technical Officer is **Kul Bhushan**, PhD, GE, and the Principal Geotech Eng'r is **Thomas D. Swantko**, GE. In May 2011 Group Delta acquired Praad Geotechnical. **Daniel Pradel**, PhD, GE became a principal engineer of Group Delta's Forensic and Modeling Group, in Torrance (see his profile below). Pradel has served as Adjunct Associate Professor in geotechnical engineering at UCLA since January 1997. Other staff from Praad include senior engineers **Kristan Chang, and Peter Chiu** in Torrance and **Rodney Masuda**, CEG in Irvine**. Meghan Lithgow** is staff engineer in San Diego.

GeoPentec (1998-)

Founded by a group of principals of Woodward Clyde's Santa Ana office, after Woodward Clyde's absorption by URS in 1997. The founders include: **John A. Barneich,** GE (BSCE '654; MS '66 Berkeley); **S. Thomas Freeman,** CEG; **Eric Fordham**, CEG, CHG; **Yoshi Moriwaki**, GE (PhD CE'75 Berkeley); and **Sarkis V. Tatusian**, GE. Other staff include Gene Waggoner's nephew **John Waggoner**, CEG and **Andrew Dinsick,** a staff engineer. The firm is based in Santa Ana and does quite a bit of work for MWD, the Ports of Los Angeles-Long Beach, and other public utilities, like EBMUD.

UCLA threadlines

The **University of California, Los Angeles** (**UCLA**) was founded in 1919 as the "Southern Branch" of the University of California, the second oldest of the ten U.C. campuses. In 1927, the U.C. Regents renamed the school the "University of California at Los Angeles" and land for a new campus was purchased in Westwood. In 1929 the original campus became Los Angeles Junior College (renamed LA City College in 1947) when the Westwood campus opened, with 5,500 students. In 1933 UCLA began awarding master's degrees, and in 1936, began awarding doctorate degrees.

Today UCLA is organized into five undergraduate colleges, seven professional schools, and five professional Health Science schools. These programs offer over 300 undergraduate and graduate degree programs in a broad range of disciplines, and enrolls approximately 26,000 undergraduate and 11,000 graduate students.

UCLA Geology Program

Professor W. J. "Will" Miller (1924-48)

William John Miller (1880-1965) was born in Red Bluff and always went by the name "Will." He attended the University of the Pacific studying geology and graduated in 1900. He completed two years of graduate study at Stanford under John Branner, then transferred to Johns Hopkins, where he completed his PhD in geology in 1905. He taught geology at Hamilton College in Clinton, NY until 1914. He then moved to Smith College in Northampton, MA, where he taught until 1924. That summer he transferred to the new

Southern Branch of the University of California, which had been established in downtown Los Angeles in 1918.

In 1924 the enrollment at the U.C. Southern Campus (now the site of Los Angeles City College) was less than 1500. They moved to the Westwood campus in 1929. The geology department inaugurated graduate study in geology under Miller's leadership. He soon became Professor of the Geology Department, serving as Chairman from 1924-37, and retiring in 1948. A prolific writer, between 1916-52 he published six editions of the classic collegiate text, *An Introduction to Historical Geology*, and between 1924-49, he published five editions of *An Introduction to Physical Geology*.

Miller did a great deal of pioneering work examining and documenting the geology exposed in a number of southern California locales, including: Red Rock Canyon, Deep Springs Valley (where he took his students to field camp), the western San Gabriel Mountains, the southern Peninsular Ranges, the 29 Palms area, Barstow, the Needles-Goff area, and the strip between Palm Springs and Blyth, which figured prominently in the selection of the route for MWD's Colorado River Aqueduct, a few years later. He was the earliest worker to recognize the significance of the Elsinore fault zone in shaping the geomorphology of southern California, and the first worker to recognize and name the Jacumba Volcanics, exposed near Jacumba, Devil's Canyon, and the In-ko-Pah Gorge near the eastern escarpment of the Southern California Batholith (in the mid-1930s).

In 1931 **Miller**, Los Angeles consulting geologist **Ralph Arnold** (PhD Geol 1902 Stanford), and **M.H. Bissel** completed an in-depth study of the Point Fermin Landslide for the Los Angeles City Engineer, as a more detailed follow-up to the initial study in early 1929 by Caltech Prof. Leslie Ransome (see W.J. Miller, 1931, ***The Landslide at Point Firmin, California***, The Scientific Monthly, v 32:5). This study showed the role of structure, stratigraphy, and geomorphology on triggering the slide. Miller also consulted on a number of economic geology projects, including clay sources for and making brick (a major enterprise prior to the 1933 Long Beach earthquake). Miller also consulted on a few projects in the Palos Verdes Peninsula (diatomite quarries and bentonite seams), landslides along Pacific Palisades, and flood control projects in the western San Gabriel Mountains, the latter subject of which he was considered the most authoritative expert of his era. He was also the first geologist to recognize evidence of spotty alpine glaciations in the San Gabriel and San Bernardino Mountains (in 1926). He was also the first geologist to map the geology between Palm Springs and Blyth, which figured prominently in the decision to take the central route for the MWD Colorado River Aqueduct in 1935.

Professor U.S. Grant, CEG at UCLA (1931-59)

Ulysses S. Grant IV, PhD, CEG (1893-1977) grew up in San Diego, the youngest child of San Diego attorney and real estate entrepreneur Ulysses S."Buck" Grant, Jr. (1852-1929), the second son of American President Ulysses S. Grant (1822-85). He always felt he should have been named U.S. Grant, III, but that honor went to his cousin (1881-1968), the son of his uncle, Major General Frederick Grant (West Point Class of 1871). His cousin U.S. Grant III attended West Point (Class of 1903) and had a distinguished career with the US Army Corps of Engineers, which included District Engineer in San Francisco and chair on the California Debris Commission (1921-26). U.S. Grant III rose to the rank of Major General, in command of the nation's civil defenses during World War II.

U.S. Grant IV left the west coast in 1911 to study geology at Harvard, his father's alma mater, graduating cum laude in 1915. Following graduation he sought his fortune mining gold in Mexico. During the First World War he abandoned this enterprise to enlist in the Army, working his way through the enlisted ranks to a lieutenant's commission by the war's end. From 1919 to 1925 he worked in the New York Stock Exchange. In 1926, he returned to school, taking graduate courses at the University of California, Berkeley. In 1927 he entered the graduate program in paleontology at Stanford University, where he received his PhD in 1929.

Grant next took a position with the Natural History Museum of Los Angeles County, as curator of invertebrate paleontology. He began teaching paleontology at the University of California, Los Angeles in 1931. He rose from instructor to chairman of the geology department between 1937-45, and he retired in 1959, remaining in Los Angeles. Grant wrote many papers on Pliocene and Pleistocene mollusks in the southern California borderland, and often collaborated with Leo George Hertlein, his old classmate at

Stanford. He was also did extensive work examining the oil potential of late Quaternary units in southwestern San Diego County.

His most notable engineering geologic contributions were on the Wilmington subsidence problems in the 1940s and 50s, caused by the withdrawal of oil and water. This settlement reached a rate of more than 2 feet per year by 1951 (U.S. Grant and W.E. Sheppard, 1939, *Some recent changes in elevation in the Los Angeles basin of southern California, and their possible significance*, BSSA v. 29:299-326; and U.S. Grant, 1954, *Subsidence of the Wilmington Oil Field, California*: CDMG Bull 170 Ch 10, p 19-24).

Prof. Grant was a member of AEG and one of the first geologists to become an approved engineering geologist by the Los Angeles Department of Building & Safety in 1961, and then by the State of California in 1969. He also served as a consultant to the State Division of Dam Safety on a dam site in Malibu, which was never built. After the Baldwin Hills Reservoir failure, he was also retained as one of the consultants in the litigation that ensued, against the oil companies. He died at St. John's Hospital in Santa Monica, California from lung failure caused by leukemia in 1977.

Professor William C. Putnam at UCLA (1938-63)

William Clement Putnam (1908-63) grew up on a ranch near Redding (not far from W. J. Miller, the UCLA geology dept chairman, see above) and majored in geology at Stanford, with an emphasis on geomorphology, studying under Elliot Blackwelder and William Morris Davis (while the latter was a visiting professor). He earned his AB (1929) and MS degrees (1930), and his master's thesis examined the elevated shorelines of the Santa Monica Mountains. From 1931 till 1938 he taught geology at Los Angeles Junior College, where he and **Alfred Livingston** wrote the classic text "***Geological Journeys in Southern California***" (reprinted in 1939 and 1949).

While teaching he pursued his doctorate at Caltech, focusing on the "***Physiography of the Ventura region***," completing his PhD in 1937 and joining the geology faculty at UCLA in 1938. In 1940 he and Bob Sharp at Caltech co-authored a classic paper titled "***Landslides and earthflows near Ventura, southern California***," in *Geographical Review*. During the Second World War he was detached to the USGS Military Geology Unit in the Southwest Pacific, which led to several publications cited frequently by engineering geologists, including: the textbook "***Map interpretation with military applications***" (in 1943); a chapter of the first ***Manual of Photogrammetry*** (1944) titled "***Photo-interpretation***," and the article "***Aerial photographs in geology***" (in Photogrammetric Engineering in 1947). Bill Putnam served as chairman of the geology department at UCLA from 1953-60, and his long-awaited textbook titled "***Geology***" (Oxford Univ Press) was not released until a year after his untimely death at age 54, in March 1963. During the seven years he chaired the UCLA geology program, they granted 303 AB degrees, 52 MA degrees, and 23 PhDs, remarkable figures, by any account.

Professor John C. Crowell, CEG (UCLA 1947-67/UCSB 1967-87)

(see write-up in U.C. Santa Barbara Threadline)

Dr. John T. McGill, CEG - USGS office at UCLA (1951-64)

As a student at UCLA **John T. "Jack" McGill** (1921-87) played baseball and was an honor graduate of Naval ROTC in 1943. His mentor was Prof. W. C. Putnam, who also commanded the Naval Reserve Officer Research Detachment at UCLA during the Second World War. McGill served in the Pacific Theater during the war, then returned to UCLA to undertake graduate work with Putnam. McGill completed his master's in 1948 (on the Santa Monica Mtns) and his PhD on "*Quaternary Geology of the north-central San Emigdio Mountains, California*" in 1951. He continued his collaboration with W.C. Putnam mapping the coastal landforms of the world as a post-doctoral project funded by the Office of Naval Research (***Map of Coastal Landforms of the World***, published in *Geographical Review* in 1958). He continued working on this project off and on after taking a newly established position with the Engineering Geology Branch of the USGS assessing geologic hazards in southern California. Working from an office at UCLA, McGill undertook some pioneering work mapping geohazards in southern California, mostly in the Santa Monica Mountains, Pacific Palisades, Palos Verdes Peninsula, and other coastal areas, all the way to San Diego County. He had an adjunct appointment on the geology faculty and taught engineering geology at UCLA, between 1951-66.

McGill was actively involved with the Engineering Geology Division of GSA and in the early years of the California Association of Engineering Geologists, sponsoring a symposium on the Engineering

Geology of the Monterey Formation at the 5th annual meeting in 1962. He was also a prominent member of the early advisory committees that developed grading and excavation codes in the Los Angeles area in the early 1960s. In 1964 he authored ***Growing Importance of Urban Geology***, USGS Circular 487. It provides a succinct summary of the growth and importance of engineering geology in urban planning and development. During his last few years at UCLA he was assisted by **Robert O. Castle**. In 1966 he moved to the USGS office in Denver, and by 1969 he had been promoted to Chief of the Engineering Geology Branch, in Denver. McGill served the USGS for 35 years and retired to Jefferson, Colorado in 1986, and died in May 1987. His widow Carol established the ***Carol G. and John T. McGill Fund*** of the Geological Society of America annually awards scholarships to students studying engineering geology or geomorphology.

Prof. David J. Leeds, CEG, RGP – pioneer engineering seismologist

Dr. David Leeds, PhD, RG, CEG, RGP (1917-2011) received his formal training in geology at the University of Texas, graduating in 1939. He found a position as a geophysicist for the Seismological Field survey of the U.S. Coast & Geodetic Survey, where he was introduced to the study of strong motion seismology which had burst onto the USC&GS radar screen following the 1933 Long Beach Earthquake and the acceleration records recorded at three stations (his predecessor in the position was John A. Blume).

During the 1940s and 50s Leeds' responsibilities grew to envelop the 11 western states, investigating earthquakes, conducting forced vibration experiments, and helping to maintain the strong-motion network in southern California. During the 1950s and 60s he worked out of an office at UCLA, alongside USGS engineering geologist John T. McGill (described below). In the mid-1950s he began working with UCLA civil engineering Professor C. Martin Duke. In May of 1956, Duke and Leeds began making measurements from strain gauges installed in the UCLA Engineering Building while it was under construction to better understand its dynamic behavior. The strain gauges were networked to a central recording facility, which also housed a strong-motion seismograph, to allow accurate recordation of the building's response to earthquake tremors.

The next year the duo traveled down to Mexico to investigate the impacts of the earthquake on structures at two sites: those in Mexico City, located 170 miles from the quake's epicenter and founded on the deep alluvium of Lake Texcoco, and several cities and villages located only 60 miles from the epicenter, but founded on firmer deposits or granite. These observations were succinctly summarized in an article titled "***Soil conditions and damage in the Mexico earthquake of July 28, 1957***," which appeared in the April 1959 issue of the Bulletin of the Seismological Society of America. The following year he and Martin Duke prepared report on the effect of topography and confinement on seismic site response, titled "***Effects of Earthquakes on Tunnels***," for the Second Symposium on Protective Construction, held at the RAND Corporation on March 24-27, 1959. This became one of the most oft-cited unpublished reports of that era because it became a blueprint for the design of underground structures, such as the NORAD complex in Cheyenne Mountain, near Colorado Springs. Duke began encouraging Leeds to pursue his PhD at UCLA in the emerging field of site-specific seismology, which later came to be known as "engineering seismology."

Another pivotal opportunity came in the fall of 1960, when Bill Moore of Dames & Moore convinced him to accept a position created specifically for him, with the title "engineering seismologist." Moore's motivation was a new contract with Southern Cal Edison to perform the first site-dependent earthquake response spectra for the proposed San Onofre Nuclear Power Plant, the first such facility in southern California. Leeds championed this pioneering effort, which was completed in 1962. This report established an evolving protocol for site-dependent studies that became increasing common and sophisticated over the succeeding decades.

After completing the San Onofre report Leeds continued his research at UCLA with C. Martin Duke. In November 1962 they released their report titled "***Site Characteristics of Southern California Strong-Motion Earthquake Stations***" (UCLA Dept Engineering Report No. 62-55), which became a benchmark reference for all subsequent studies of earthquake engineering applications in southern California. Leeds began teaching courses on engineering seismology at UCLA in the spring of 1964 and completed his PhD dissertation in June 1966.

From 1966 on he worked part-time for Dames & Moore as a consulting engineering seismologist. One of his most-cited articles was "*The Design Earthquake*," which appeared in AEG's *Geology, Seismicity, and Environmental Impact* in 1973. Leeds spent 30 years offering his services consulting in engineering geology and geophysics, working out of his home at 11971 Challon Rd. Los Angeles, CA 90049. He was the long-time editor of the Earthquake Engineering Research Institute Newsletter, between 1970-84. He passed away on April 18, 2011 at the age of 94 at his home in Santa Barbara.

Prof. Ronald L. Shreve, PhD, RG (1958-87) physical processes in geomorphology

Ronald L. Shreve grew up in Glendale and majored in physics at Caltech (BS '52 and MS '54 Physics; PhD Geol '59 Caltech) where his graduate work specialized in geomorphology, working on the mechanics of glaciers and megalandslides under Prof. Robert P. Sharp. Ron's PhD dissertation was a study of the Blackhawk Landslide along the north side of the San Bernardino Mountains funded by NSF. This work included a year-long study of long-runout landslides (sturzstroms) in Austria working with Prof. Ken Hsu (PhD Geol '53 UCLA). It was memorialized in *GSA Special Paper 108*, published in 1968. He theorized that the sturzstrom megaslide slid on a cushion of compressed air, a widely accepted theorem for about four decades, until Richard Iverson and Francois Legros published separate, but parallel theorems explaining long runout sturzstroms using conservation of momentum. Shreve's courses in basic geomorphology, physical processes, fluvial geomorphology, and sediment transport (including the mechanics of debris flows and turbidity currents) influenced several generations of engineering geologist educated at UCLA, between 1958 and 1987.

Prof. Leonard A. Palmer, RG (1962-68) coastal retreat specialist

A native of Washington state, **Leonard A. Palmer**, PhD, RG (1931-2001) obtained his BS (1953) and MS (1960) degrees in geology from the University of Washington and his PhD from UCLA in 1967, after a two-year stint at the University of Southern California. His doctoral thesis was on shoreline retreat and uplift rates along coastal California, Oregon, and Washington (L.A. Palmer, 1967, *Marine terraces of California, Oregon and Washington*: PhD dissertation in geology, UCLA, 379 p). He taught a course on coastal processes at UCLA that was highly regarded in the mid-1960s. He went onto an academic career as Professor at Portland State University, between 1967-91. He specialized in surficial land processes; including landsliding, stream and coastal erosion, and the relationship of these processes to land-use planning and natural resource management. Len served as a frequent expert on for California Coastal Commission hearings and litigation consultations relating to sea cliff retreat in southern California. If he was not specifically retained in one of these matters, then the figures cited in his PhD dissertation were usually quoted in one context or another. Len was one of the charter members (1970) of the Portland Chapter of AEG. He also became a registered geologist in Oregon when that state enacted legislation in 1977. He retired to Port Ludlow, Washington, and died there of pancreatic cancer on New Year's Eve 2002.

Paul M. Merifield, PhD, CEG (1970-2011) Lecturer and Adjunct Professor of Engineering and Environmental Geology

Paul M. Merifield, PhD, CEG (BA Geol '54 UCLA; PhD '63 Colorado) taught engineering and environmental geology as a Lecturer, and then as an Adjunct Professor at UCLA for 41 years, between 1970-2011. In 1965 he formed a partnership with another UCLA alumnus **Donald L. Lamar**, PhD, CEG, RGP (1930-2009), which they christened Lamar-Merifield, using Lamar's Santa Monica office. The firm operated until 1990.

Engineering geologists educated at UCLA

Prominent engineering geologists that came out of UCLA include: **Gene Waggoner** '37, **Burton Rose** '39, **John T. McGill** '43, **John C. Crowell** '47, **Dick Stone** '50, **Art Keene**, '50, **Glenn Brown** '51, **Perry Ehlig** '52, **Russell Hood** '52, **William Waisgerber** '53, **Don Michael** '53, **Rich Lung** '54, **Paul Merifield** '54, **Joe Birman** '57, **Richard Proctor** '58, **Don Lamar** '58, **Jay Smith** '58, **Don Rose** '60, **Allen Hatheway** '61, **Jeremy C. Wire** '61, **Richard E. Rowland** '66, **David J. Leeds** '66, **Robert A. 'Red' Robinson** '69, **Gary Van Houten** '70, **David A. Gardner** ('71; '74), **Don Asquith** '72, **Frank E. Denison** '73; **Gary L. Lass** '74, **Ron Shmerling** '75, **David Grover** '75, **Daniel Morikawa** '76, **Kim M. Bishop** '79, **Bob Hollingsworth** '79, **Richard H. Hazen** MS '79, **Steve Watry** '79, **Jeff Knott** '83, **Larry Parmalee** '83, **Steve Walter** '86, **Martin Lieurance** '86, **Jeff Farrar** '86, **Kurt Myers** '87, **Scott Moors** '92, **Gary Mozingo** '97, and **Gerald Goodman** (ukn).

UCLA Geotechnical Program

During the postwar period (late 1940s) UCLA Dean L.M.K. Boelter endeavored to create a College of Engineering and began attracting faculty to accommodate broad areas in engineering teaching and

research. Boelter experimented with engineering education on a grand scale, assembling a non-traditional program in general engineering, aptly named the Department of Engineering. Undergrad students took courses in electrical, mechanical, civil, and industrial engineering and the department granted BS, JS, and PhD degrees in engineering. In the light of the then-current registration laws for professional engineers in California (adopted in 1928), any degree in engineering was worth four years credit towards the six years of experience necessary to apply for, and then site for the engineer's examination. The student chapter of the American Society of Civil Engineers was established in April 1960.

The university's experiment in engineering education was problematic for their undergraduate students, because graduate programs tended to favor students who came from civil engineering programs accredited by the Engineering Council for Professional Development (ECPD), because it provided more depth and breadth of coursework, including 'building block' courses, like surveying.

These philosophical differences gradually came to a head when the accreditation process transferred to the Accreditation Board for Engineering & Technology (ABET) in 1978. In 1983 UCLA shifted to a more traditional program, splitting their mechanics & structures programs into separated mechanical and civil engineering departments, and sought ABET accreditation for these programs. This subsequently became a requirement for professional engineering registration in 1997.

C. Martin Duke, PE (1947-80)

Martin Duke, PE (1917-88) grew up in Los Angeles, and attended U.C. Berkeley, receiving his BSCE in 1939 and MS in 1941. He remained at Berkeley during the Second World War, teaching undergraduate courses.

After the war Martin worked as a civilian engineer for the US Government for two years, which included assignments connected with the rebuilding of Guam. Duke was recruited for the new engineering faculty by UCLA Dean L.M.K. Boelter in 1947, when he began building UCLA's School of Engineering & Applied Science. While seeking tenure he taught civil engineering classes and conducted research on cementious material and soil mechanics. Between 1952-67 Duke served as Assistant Dean for Undergraduate Studies, Acting and Associate Dean of the College of Engineering, as well as Vice Chairman and Chairman of the Department of Engineering.

During this same time Duke developed a viable program of research in earthquake engineering, with particular emphasis on lifeline engineering aspects. This interest was sparked by the July 1952 M 7.7 Tehachapi earthquake. In 1956 he took a sabbatical leave to work in earthquake engineering in Japan. He evaluated the damages caused to engineering infrastructure in the 1957 Mexico City and 1960 Chilean Earthquakes. In the late 1960s and early 70s, Duke expanded his work on earthquake engineering, studying seismic vulnerabilities of water resource systems with Professors Dracup and Jacobsen, and on investigations of source, path, and the effects of ground shaking with seismologist David J. Leeds (described above) and Professors Matthiesen and Mal. The UCLA earthquake engineering program included a group of eight faculty and 25 graduate students working on different aspects of the field. This group proved most valuable in the wake of the February 1971 San Fernando Earthquake, when its members launched a number of post-earthquake investigations.

Duke was elected President of the Earthquake Engineering Research Institute (EERI) during 1970-73 and afterwards he managed the "Learning from Earthquakes Project." Under his leadership, a comprehensive report entitled "***San Fernando, California Earthquake of February 9, 1971***" was published, leading to his being awarded the **Ernest E. Howard Award** of ASCE in 1973.

During the San Fernando investigation Duke noticed that there was a paucity of earthquake related information on energy, water, transportation, and communication systems. The ASCE Technical Council on Lifeline Earthquake Engineering was established, primarily due to his effort and encouragement. Duke led several post-earthquake investigations for EERI, including those sent to investigate the December 1972, Managua, Nicaragua earthquake and a similar expedition to Mindanao in the Philippines in 1976. These investigations helped him formulate the concepts used in the EERI study to develop procedures to maximize learning from destructive earthquakes.

Duke retired from UCLA in 1980 and he passed away on April 16, 1988 at a Newport Beach convalescent home. In 1990 ASCE established the ***C. Martin Duke Award*** to annually recognize significant contributions to lifeline earthquake engineering. Some of the UCLA students from Professor Duke's era (pre-1964) who went onto notable careers in geotechnical engineering included: **Robert A. "Bob" Merrill** ('48), **Jimmy Kirkgard**, **Alan Boris** ('61), and **Carl Basore** ('61), among others.

Richard T. Frankian (1955-65)

Between 1955-65 **Dick Frankian**, GE (1929-2010) served as a lecturer in soil mechanics at UCLA. He was educated at Berkeley in the 1950s (BSCE '52, MS '55 Berkeley) and was the first practicing engineer in the Los Angeles area with an advanced degree in soil mechanics from Cal Berkeley. In 1963 he started his own consultancy, R.T. Frankian & Associates, in his home town of Burbank. His firm did lots of work on hillside housing tracts. He was a co-founder of the Sigma Phi Delta Engineering Fraternity at both UCLA and UC Berkeley. In 1965 the press of business forced him to relinquish his teaching role, which he passed to **Doug Moran**, PE, CEG who was working for him at the time. Dick wrote a chapter titled ***Analysis of Buttress Fills*** in Mike Scullin's 1983 text, *Excavation and Grading Code Administration, Inspection, and Enforcement*.

Kenneth L. Lee (1964-78)

Professor **Ken Lee**, PhD, PEng (1931-78) grew up on a farm near Cardston, Alberta (a few miles north of Glacier National Park) and received his BS (1955) and MS (1958) degrees in engineering from the University of Alberta. After graduation he taught at the Universities of New Brunswick and British Columbia. In the early 1960s he enrolled in graduate school at UC Berkeley working under H. Bolton Seed, studying cyclic stress behavior of sands triggering liquefaction. He accepted a faculty position at UCLA in the fall of 1964 and completed his Ph.D. work in 1965. Ken was UCLA's first full-time instructor in soil mechanics and foundation engineering. He received funding from the National Science Foundation and was nationally recognized for his work in evaluating reinforced earth embankments, for both static and dynamic behavior. His research and publications were recognized by seven ASCE awards, including the **Collingwood Prize** in 1970 and the **Middlebrooks Award** in 1971. Ken died in March 1978 while trying to hike out of the San Gabriel Mountains during inclement weather.

In 2003 the annual ***Kenneth L. Lee Memorial Lecture*** was instituted by the Geotechnical Group of the Los Angeles Section of ASCE in recognition of outstanding research in the design of earth structures and contributions to geotechnical practice in southern California.

Some of Ken Lee's graduate students included: **Wolfgang Roth** as a postdoc fellow, **Steve Haley** (Woodward-Clyde/URS), **C. K. Shen**, **Iraj Farhoomand** (URS Consultants), **Gregory N. Richardson** (professor at North Carolina State, now with G.N. Richardson & Assoc in Raleigh, NC), **Jeff Johnson** (of Dames & Moore, before starting JA Johnson Assoc), **Ken Campbell** (?, Dames & Moore), **Marshall Lew** (LeRoy Crandall which became MACTEC and then AMEC), **Jeff Keaton** (Dames & Moore, later AMEC), **Claude Corvino** (Harding Lawson Associates), **William Wolfe** (professor at Ohio State), **Allen Yourman** of Diaz-Yourman Associates, and **Bart Patton** of Kleinfelder.

George W. Tauxe (1965-73)

George W. Tauxe, PhD, PE (1943-93) grew up in Pacific Palisades, a few blocks from where the Via de Los Osas Landslide buried the Pacific Coast Highway in 1958. After graduating from high school he attended UCLA, completing his BS (1964), MS (1966), and PhD (1973) degrees in general engineering, with an emphasis in civil engineering. His master's work was under Prof. C. M. Duke and his doctoral research was under Prof. W.G. Yeh. From 1966 to 1973 he was a lecturer at UCLA, teaching courses in soil mechanics, computer programming for engineers, and water resources engineering. In 1973 he took a faculty position at the University of Illinois (1973-79) and moved to the University of Oklahoma in 1979, where he remained until his death in 1993. The George W. Tauxe Memorial Scholarship for civil engineering students and the George W. Tauxe Outstanding Professor Award at the University of Oklahoma are named after him.

Awtar Singh (1966-73)

Professor **Awtar Singh**, PhD, GE (1926-2012) received his BSCE degree from Punjab Eng'g College in 1949; MSCE from Colorado in 1963, and Ph.D. from U.C. Berkeley in 1966, working with Prof. Jim Mitchell. He began his professional career in India working on Bhakra Dam, a virtual copy of Shasta Dam designed by the International Engineering Co. of San Francisco. This association led to his coming to the United States for graduate study. He joined the UCLA faculty in the fall of 1966, and was a co-recipient of ASCE's **Middlebrooks Award** in 1970 for the article "Bonding Effective Stress and Shear Strength of Soils."

Unable to gain tenure, in October 1972 he formed a consulting partnership with **Bruce R. Lockwood**, CEG, known as **Lockwood-Singh & Associates**, and continued teaching at UCLA thru the

1972-73 academic year (Lockwood-Singh is profiled below). He continued working for the firm until October 2004, at age 78! In 1998 Singh established the **Awtar and Teji Singh Fellowship** at U. C. Berkeley to attract promising students from his alma mater, Punjab Engineering College in Chandigarh for graduate studies at Berkeley. This cost him $30,000 annually. Dr. Singh passed away on November 7, 2012, just one day before he was inducted into Berkeley's Academy of Distinguished Alumni in Civil & Environmental Engineering. The Singh's lived in Encino.

Poul V. Lade (1972-93)

Professor **Poul Lade** (1943-present) received his MS from the Technical University of Denmark, Copenhagen in 1967, and his PhD from Berkeley in 1972, working with Prof Mike Duncan on experimental three-dimensional soil testing and constitutive modeling, which was new and futuristic at that time. He joined the UCLA faculty in the fall of 1972. Lade engaged in a wide variety of research, including experimental methods; three-dimensional stress-strain and strength behavior of soils during monotonic loading and large three-dimensional stress reversals; stability, instability and liquefaction of granular materials; time effects in soils; constitutive modeling of frictional materials such as soil, rock, and concrete employing elasticity and work-hardening, isotropic and kinematic plasticity theories; deformation and stability analyses of foundation engineering problems. Examinations of the mechanisms that determine ground-surface offsets above a dip slip earthquake fault, trying to develop a more accurate prediction of how soils lying above a fault would react when fault rupture initiates (which became much more appreciated after the Jan 1994 Northridge quake).

He left UCLA in 1993 and moved to Johns Hopkins University, then the Aalborg University in Denmark from 1999-2003, and then to Catholic University in Washington, DC, where he served as chairman of the civil engineering program from 2003 to 2009. In 2001 he contributed "Chapter 3 - Engineering Properties of Soils and Typical Correlations, in the ***Geotechnical and Geoenvironmental Engineering Handbook***. During his tenure at UCLA some of his more noted graduates included **Jerry Yamamuro** (Clarkson University, University of Delaware, and Oregon State University) and **Mark M. Kirkgard**, GE with Law-Crandall in Los Angeles.

Mladin Vucetic (1987-)

Prof. **Mladin Vucetic**, PhD received his B.S. in 1976 and MS in 1981 from the University of Zagreb in Croatia, during which time he also studied at the Norwegian Geotechnical Institute (NGI) in Oslo. He received his PhD in geotechnical engineering from Rensselaer Polytechnic Institute in 1986, working with Ricardo Dobry. He joined the faculty at UCLA the following year. His research interests have included stress-strain conditions in the NGI direct simple shear test, cyclic and dynamic behavior of clays, silts and sands under uniform and irregular cyclic loads, small-strain cyclic and dynamic behavior of soils, liquefaction mechanism using nonlinear computer models and case history studies, behavior of soil-nailed excavations during earthquakes using centrifuge modeling, and development of geotechnical site data bases and their utilization in seismic microzoning using GIS.

Daniel Pradel (1997-)

Prof. **Daniel Pradel,** PhD, GE received his DCE '82 from the Swiss Institute of Technology-Lausanne in 1982, and his PhD from Tokyo University in 1987, working with Kenji Ishihara. He came to Los Angeles in 1988 to work as a postdoc fellow at UCLA with Poul Lade. After one year he worked for Lockwood Singh Associates from 1989-97. He joined the UCLA faculty as an Adjunct Associate Professor in 1997, the same year he founded Praad Geotechnical in Culver City. In 2011 he dissolved Praad and joined Group Delta, and continues to teach courses at UCLA.

Jonathan P. Stewart (1998-)

Prof. Jonathan Stewart, PhD, PE grew up in Concord, CA. He attended U.C. Berkeley, receiving his BSCE in 1990, MS in 1992, and PhD in 1996, working under Ray Seed. He joined the UCLA faculty in 1998, where he has specialized in geotechnical earthquake engineering, with an emphasis on seismic soil-structure interaction, characterization of probabilistic earthquake ground motion, and seismically-induced ground failure. He also served as editor of the Journal of Geoenvironmental & Geotechnical Engineering for many years.

Scott J. Brandenberg (2005-)

Prof. Scott Brandenberg, PhD received his BSCE in 2000 from Cal Poly SLO, M.S. in 2001 and PhD in 2005 from U.C. Davis, working with Ross Boulanger. His research interests have centered around geotechnical earthquake engineering, geophysical imaging, data acquisition and signal processing, and numerical analysis.

Consulting firms in UCLA threadline

Stone Geological Services, Inc.(1956-64); Robert Stone & Associates (1964-78); RSA-Robert Stone & Associates (1979-91); AGI Geotechnical, Inc., (1991-present)

Founded in July 1956 by **Robert Stone**, PhD, CEG (BA City College of New York; PhD Geol ~1950 UCLA). Stone began his career groundwater geologist with the Bureau of Reclamation and as an engineering geologist with the USGS. His first major consultation was an assessment of the Portuguese Bend Landslide for Los Angeles County after the slide reactivated in mid-1956. Stone estimated that it would cost the County about $2 million to stabilize the slide, which they felt was cost-prohibitive (see R. Stone, 1961, **Geology and Hillside Appraisal**, *The Residential Appraiser*, v. 29:1, pp. 9-11). Stone was also one of the founding members of the **California Association of Engineering Geologists** in 1957. Between 1956-63 their office was on Wilshire Blvd., before moving to Woodland Hills. They did a lot of pioneering work in Los Angeles Basin, as well as peer review work for Rancho Palos Verdes and general geotechnical work for many municipalities, Los Angeles County being their largest client. Stone taught field geology for USC for many years, during the summers. Stone frequently employed CSLA Professor **Perry Ehlig**, CEG (see write-up under Cal State LA) as a consultant (the two had been PhD classmates at UCLA), and Perry became the preeminent expert on the Abalone Cove and Portuguese Bend landslides in the Palos Verdes Peninsula, and a reviewing geologist for many of those municipalities.

Senior Some of the geologists who worked for Stone included: **Jack T. Eagen**, CEG, **Herb Adams,** CEG, **Dick Lung**, CEG, **Monte Ray**, CEG, **Gerry Nicoll**, CEG, **Bob Tepel**, CEG, **William G. Uhl**, CEG, **Blasé Cilweck**, CEG, **Russ Harter**, CEG, **Roy Dokka, Kathleen Ehlig Proffer**, CEG, **Mark S. Oborne,** CEG, **Dave Simon**, CEG, etc. Cuban native **Juan A. Vidal**, GE (MSCE Havana Univ) joined the firm as its principal engineer in 1968 and purchased the company after Dr. Stone's death in August 1978. Other senior geotechnical engineers included **Robert A. Merrill**, GE (BSE '48 UCLA; MSCE CSULA) and **Artedi B. Cortez**, GE (MSCE World Open Univ).

After purchasing the firm, Vidal changed its name to **RSA – Robert Stone & Associates**, a certified DBE/MBE firm, with VP & Chief Geologist **Monte Ray**, CEG, who was succeeded by VP's **Mike Scullin**, CEG (BA Geol '58 Arizona State; MBA '81 Redlands) and **Alfredo A. 'Al' Guerrero**. A branch office in Rancho California was managed by **Dave B. Simon**, CEG (BS Geol '80 UCSB). The senior geologist and general manager was **Mark S. Oborne**, CEG (BS Geol '78; MS '82 CSUN). Staff geologists included **David L. Snyder**, CEG (BS Geol '84 Cal Lutheran) and **Eric L. Smith**, CEG (BS Geol '84 Cal Lutheran), and **Patrick L. Drumm**, CEG, CHG (BA Geol '79 West Virginia, MS '99 CSULA).

In 1991 RSA was dissolved and Vidal started a new firm named **AGI Geotechnical, Inc.** with **Keith Ehlert**, CEG as VP, followed by **Mark Swiatek**, CEG, and more recently, by **Alan McLeron**, PG. Stone lived in Canoga Park, but maintained his office in Woodland Hills, and later, in Van Nuys. At one time they had branch offices in Santa Clarita and Palmdale (dates unkn).

E.D. Michael & Associates (1961-66; 1970-present)

Eugene Donald "Don" Michael, CEG, CHG (1928-) earned his BA in geology from Occidental in 1953. After two years working as an engineering geologist for the State of California and a year with the Monolith Portland Cement Co. in Tehachapi, he enrolled in grad study at UCLA under Profs U. S. Grant, IV, Bill Putnam, John Rosenfeld, and David T. Griggs, in the latter's high-pressure laboratory. He received is MS in 1960 and opened his first office as a consulting engineering geologist in Santa Monica between 1961-66. During this time Paul Merifield worked for Don. In 1966 he joined Pope, Evans, and Robbins, Int'l Ltd., and engineering firm, though maintaining a one man consultancy out of his home in Malibu. He became head of their hydrology section at the firm's office in Saigon, where they developed the water resources for the various military bases being constructed in South Vietnam.

Don returned to California in the late 1970 and reopened his consulting office in Malibu. His work included preparation of reports related to real estate development and transfer of title, reviews of the geological aspects of environmental impact reports, and studies relating to geologic hazards and ground-water. He also taught courses for the UCLA Extension Program and Santa Monica College, and found time to write twenty papers published in various professional journals. He also earned a law degree at night from Mid-Valley College. Don was also a pioneer in recognizing the importance of rainfall incidence on magnification of effective precipitation along coastal bluffs. Don has earned an enviable reputation as "***Mr. Geology of Malibu***," which incorporated in 1991 as a 17-mile long strip along the coast.

Earth Science Research Corp (1961-69)

Founded by **Donald L. Lamar**, CEG, RGP and his wife **Jeannine**, while Don was working for the Rand Corporation in Santa Monica, from 1961-64. Don worked under renowned engineering geologist **William R. Judd**, PE, CEG (former Chief Geologist of the US Bureau of Reclamation, who went onto an academic career at Purdue). An international conference on "State of Stress in Earth's Crust" was convened on June 1963 in Santa Monica, under the Judd's leadership. It was the first symposium on stresses and related rock mechanics principles in North America. Don Lamar and Paul Merifield were listed as the firm's "consulting geologists" after 1965. The office address in Santa Monica was the same used by Lamar-Merifield. Earth Science Research was formed to perform research contracts, mostly for government agencies, such as the Department of the Navy, NASA, NSF, and the US Geological Survey.

Lamar-Merifield (1965-1990)

In 1965 with Donald L. Lamar, PhD, CEG, RGP formed a partnership with Paul M. Merifield, PhD, CEG, which they christened Lamar-Merifield, and settled themselves into Lamar's Santa Monica office. The firm was unusual in that they or their subsidiary, Earth Science Research, secured research contracts with agencies such as: the USGS, NASA, US Navy, Department of Energy, and the National Science Foundation. One of these was a nine-year telemetry project funded by the USGS in the late 1970s-early 1980s performing '*Water level monitoring along San Andreas and San Jacinto Faults in Southern California*.'

Don Lamar (1930-2009) grew up in Glendale and did his undergrad work in geophysics at Caltech, Class of '52. He then served in the US Army (1954-56), before enrolling in grad studies at UCLA, earning MS ('59) and PhD ('61) degrees in structural geology. His PhD dissertation was on evolution of the northern margins of the Los Angeles Basin, released as "*Geology of the Elysian Park, Repetto Hills area, Los Angeles, CA*" published as CDMG Spec Rpt 101 in 1970. This was followed by work with Don Michael in Malibu in 1964-65, before starting Lamar-Merifield. Don Lamar taught engineering geology part-time at USC for many years and served as City Engineering Geologist for Palmdale, between 1979-88. Lamar began suffering from bipolar disorder and too an early retirement in 1990, moving to Eugene, Oregon in 1990. He lived his later years in Reno, Nevada.

Paul Merifield grew up in Los Angeles. He completed his BA in geology at UCLA in 1954 and his PhD at the University of Colorado in 1963, where he met his wife Ruth, also a geologist. He met Don Lamar while working for Don Michael in 1963-65. In 1970 Paul Merifield began teaching engineering and environmental geology as a Lecturer, and later as an Adjunct Professor at UCLA. He continued teaching part-time for 41 years, until 2011.

Hood & Schmidt, Engineering Geologists (1959-64)

Founded by **Russell G. Hood**, CEG (BA Geol '52 UCLA) and **C. William Schmidt**, CEG in 1959. Hood received his BS in geology from UCLA in 1952, and had become Chief Geologist at Dames & Moore by 1959, when he left to start this firm. He became President of Geotechnical Consultants in 1964. **Glenn Brown**, CEG worked for the firm's Santa Ana office in 1963-64, **Doug Moran**, PE, CEG in 1964-65, and **Francis L. Nevin**, CEG, RGP in 1965-66. According to Allen Hatheway, Russ sold out to go "raise cattle in Missouri," and to write his experiences in soil mechanics consulting, as "O*ne Goshdarned Thing After Another*." Dick Proctor says that both Russ Hood and Bill Schmidt went to Grove Springs, Missouri to raise Angus cattle, and that Russ also taught at a local community college (around 1967-68).

Geotechnical Consultants (1964-present?)

The firm was founded by **C. William (Bill) Schmidt** and **Russell G. Hood** (profiled above), along with **Glenn Brown** CEG, **Joseph M. Gonzalez**, CEG, **Ivar Staal**, PE, and **Joe Montagna**, PE. They initially

had offices in Burbank and Santa Ana, quickly adding offices in Glendale and Ventura. The Burbank office included Chief Geologist **Russ Hood**, **Glenn Brown, Clifford Farrell, Bob Linn, Frank Nevin,** and **Ramiro Oquita**. The Glendale office supported **Dennis A. Evans** (after 1965), **David Bramwell**, **John S. Fryberger, Merv Johnson, John McCormick, Lowell Rasmussen**, **Robert T. Misen** (from DWR), and **William C. Wells**. The Santa Ana office included **Bill Schmidt, Jack E. Goffman, John Fryberger** (moved to Glendale office), **Gerry Nicoll**, and **Robert L. Wells**.

They hired **Dennis Evans**, PE, CEG from LA County as an Associate and Managing Soils Engineer in mid-1965. **Schmidt, Goffman**, and **Evans** worked out of the Santa Ana office. For a while **Klaus W. John** (RCE 11828) was their chief engineer (he went on to work for Dames & Moore, then joined the faculty at Karlsruhe University, and later, Ruhr University, in Germany). Other geologists included **Bob Linn**, CEG (joined in March 1965), **Merv Johnson**, CEG, and **Bob Misen**, CEG (who later became a partner, after Hood & Schmidt left). For a few years **Joe Gonzales** ran a two-man branch office in Ventura, along with **George L. Quick**, CEG (who later moved back to their Burbank office). After Hood and Schmidt left California, Joe continued operating Geotechnical Consultants out of Ventura, servicing that region. He later retired to Ross, north of San Francisco. Other geologists who worked for the firm included **Dick Slade**, and **Chuck Kendall.** The firm was still in business in 1993, by which time **Joseph M. Gonzalez** had become the Chief Engineering Geologist, working out of their office in Santa Ana. A few years later he was listed as the firm's owner, with offices in Glendale, Ventura, San Francisco, or Ohio, depending on the year. **G. Neelakantan**, GE is presently listed as the firm's representative and their CA office in San Francisco.

Evans, Goffman & McCormick (1968-79); Goffman & McCormick (1979-93); Goffman, McCormick & Urban (1993-2005); GMU Geotechnical, Inc (2005-present)

In 1968 **Dennis A. Evans**, PE, CEG, **Jackson E. Goffman**, RG, and **John J. McCormack**, CEG, RGP (all formerly with Geotechnical Consultants) founded the firm of **Evans, Goffman & McCormick,** based in Santa Ana.

Evans brought conflict of interest charges against James E. Slosson through AEG when Slosson became State Geologist in 1973. Around 1974 Evans split off to form **D. A. Evans, Inc**. and served as President of SAFEA in 1975-76. He shut that firm down and went to work for Shepardson Engineering Associates of Carlsbad in the early 1990s. He retired to Kilauea on the island of Kauai sometime in the mid-1990s.

Gary Urban, GE (BSCE '78 CSULB) joined the firm in 1978 and Dennis Evans departed in 1979. In 1993 the firm became **Goffman, McCormick & Urban** (GMU) based in Laguna Hills, with Gary Urban the sole Principal**.** The firm provided geotechnical consultations on projects in Rancho Niguel and Rancho Santa Margarita. In 1997 the firm moved to Rancho Santa Margarita and **Greg Silver**, GE joined as a principal and VP. He later served as President of CalGeo in 2008-09.

In 2005 they acquired **Lejman Geotechnical** (Ron J. Lejman, GE) and added **Mike Moscrop**, GE as another principal, and the firm became **GMU Geotechnical Inc.**, moving to Rancho Santa Margarita. **Bob Mutchnick**, CEG, **Aron Taylor**, CEG and **Lisa Bates-Seabold**, CEG are their principal geologists. Silver became the firm's president in 2013 and the principals/owners include: Gary Urban, Greg Silver, Mike Moscrop, and Aron Taylor.

Maurseth & Howe, Foundation Engineers (1953-65); Maurseth-Howe-Lockwood & Associates (1965-72)

Maurseth-Howe was founded by **Ray O. Maurseth** (RCE 7204) and **Charles Howe** (RCE 7689) in 1953 and based in Los Angeles. Their first engineering geologist was **Joseph F. Riccio**, CEG (BA Geol '50; MS '51 USC), who went onto found Pacific Soils in 1955. In 1958 they established a branch office in Ventura (described elsewhere). **G. Austin Schroter**, CEG (BS Geol '27 Caltech) and R. Bruce Lockwood served as the firm's consulting engineering geologists between 1955-65 (profiled below). **Schroter** and **Maurseth** published an article titled "***Hillside stability-the modern approach***," which appeared in the June 1960 issue of ***Civil Engineering*** magazine. In 1964 their stationary billed them as "Maurseth & Howe, Foundation Engineers."

In 1965 they formed a partnership with geologist **R. Bruce Lockwood**, the engineering geologist with whom they had been working during the early 1960s. This partnership allowed them easier access to clients in Los Angeles County, where engineering geologists were required to co-sign geotechnical reports.

The partnership ended in 1972 when Lockwood formed a new partnership with Awtar Singh (described below).

G. Austin Schroeter, Consulting Geologist (1949-79?); Schroter and Lockwood, Consulting Mining Engineers (1955-60)

G. Austin Schroeter graduated from Caltech in 1928 with a BS degree in geology, his senior thesis being on the geology of the Jawbone Canyon area of the Tehachapi Mountains. He then attended the University of Arizona, obtaining his Engineer of Mines degree in 1930. In 1930 he joined Allied Engineers of Los Angeles, a mining engineering and consulting firm. In the late 1930s he joined the Filtrol Corp., which serviced the oil refining industry with absorbent clay. Around 1949 he founded **Stratex Instruments**, his own firm. All of these firms were based in Los Angeles. Around 1955 he formed a partnership with R. Bruce Lockwood named **Schroeter and Lockwood** (profiled below), with offices at 3515 Sunset Blvd. in Los Angeles. In 1956 he was also named Chairman of the mayor's ***Geological Hazards Committee of Los Angeles***. In July 1956 he secured a contract for $6720 with the City of Los Angeles to study and report on the landslides plaguing the Pacific Palisades area, which he completed in 1958. Schroeter and Lockwood provided consulting geology services for a number of Los Angeles area firms, including Maurseth & Howe (profiled above).

Lockwood & Cole (1946-49); Lockwood & Associates (1949-65); Schroter and Lockwood, Consulting Mining Engineers (1955-60); Maurseth-Howe-Lockwood & Associates (1965-72); Lockwood-Singh & Associates (1972-2000)

R. Bruce Lockwood, CEG (1917-2010) graduated from Caltech with a BS in geology in 1937. After working for Lockheed Aircraft during the Second World War, in 1946 he formed a consulting partnership with economic geologist **J. Gordon Cole**, based in Los Angeles, making them one of the first geology consulting firms in southern California (Cole had mapped the Boston Valley salt deposits for Basic Magnesium in the Avawatz Mtns during the war). By 1949 Lockwood was also advertising himself as an "engineering geologist" and working out his home in Glendale, on projects across the western US. In the late 1950s **G. Austin Schroter** and **Lockwood** formed **Schroter and Lockwood, Consulting Mining Engineers** (profiled above), who frequently provided consultations for Maurseth & Howe. In 1965 the Lockwood formed a new partnership **Maurseth-Howe-Lockwood & Associates**. For many years Lockwood operated from an office at 2252 Beverly Blvd in Los Angeles. He was assisted by geologists **Curtis Wells** and **John D. Merrill,** CEG (profiled below, under GeoPlan) in the early to mid-1960s.

In October 1972 **Bruce Lockwood** formed a partnership with UCLA soil mechanics Professor **Awtar Singh**, PhD, GE (profile above under UCLA faculty). The firm remained on Beverly Blvd. in Los Angeles and their first employee was **Curtis Wells**. Awtar Singh received his BSCE degree from Punjab Eng'g College in 1949; MSCE from Colorado in 1963, and Ph.D. from Berkeley in 1966. From 1976 to 2000 **Russell G. Harter** CEG was their principal geologist, assisted by **Joshua Feffer**, CEG (BS Geol '92 CSUN; MA '96 USC). Lockwood-Singh was acquired by **Exponent-Failure Analysis, Inc**. in October 2000, and Singh remained as a consultant until Oct. 2004. **Daniel Pradel**, PhD, GE joined the firm in 1989 before leaving to start his own firm in 1997 (profiled below).

GeoPlan (1964-2007)

Founded in 1964 by **John D. Merrill,** CEG of Lockwood & Associates, and based in Tarzana. GeoPlan developed specialized expertise for assessing problems in the Santa Monica Mountains area of Los Angeles and Ventura Counties, gaining a reputation as determined advocates in appealing the various decisions handed down by the Geotechnical Section of the LA County Public Works Department. From about 1969 to 1985 he was assisted by **George Quick**, CEG (who came over from Geotechnical Consultants). Between 1964 and 2007, when Merrill retired, he had worked on over 13,000 projects in the Santa Monica Mountains, including more properties in Malibu than any other geologist. **Brian Robinson** and **Bob Sousa** share custody of the firm's old files. **Roland Acuna** of Strata-Tech purchased GeoPlan's old phone number, which Roland credits for much of his work!

Praad Geotechnical Consultants (1997-2011)

Founded in 1997 by **Daniel Pradel**, GE and **Glen Raad**, GE of Lockwood-Singh & Associates. Offices in west Los Angeles (Culver City) and Fullerton. Chief Engineer was Daniel Pradel, GE (DCE '82,

Swiss Institute of Technology, Lausanne; PhD '87 Tokyo University). He came to the Los Angeles area as a postdoc fellow at UCLA in 1988-89, then joined Lockwood-Singh. The other partner was geotechnical engineer Glen Raad, GE (BSCE '86 Arizona; MS '88 UCLA). After 2001 their Chief Geologist was **Rodney Masuda**, CEG (BS Geol '78, MS '81 USC). The firm was purchased by **Group Delta Consultants** in May 2011 (see above), however Raad left Group Delta after a few months.

SGH Consulting Services, Inc (2004-)

In March 2004, **Russ Harter**, CEG (BS Geol '73 CSULA) formed a new firm called **SGH Consulting Services, Inc**. in Los Angeles. Awtar Singh was listed as a consulting geotechnical engineer to SGH, until he retired in 2010. In the summer of 2011 **Glen Raad** joined SGH.

University of Southern California (USC) threadline

Professor Gilbert E. Bailey - Father of the USC geology program (1909-24)

Professor **Gilbert Ellis Bailey** (1852- 1924) was born in Pekin, Illinois in April 1852. His father was a Baptist clergyman who taught at the University of Chicago. He worked on railroad surveys along the Red River of the North and on various routes in Michigan, and obtained his Engineer of Mines (E.M.) degree from the University of Michigan in 1873, followed by a BA and MA degrees in geology from the University of Chicago in 1874. He then taught chemistry at the University of Nebraska for two years before enrolling in graduate studies in geology at Chicago, where he received his masters. He then took a position as Professor of Geology at Franklin College, Indiana, completing his PhD at Franklin in 1878, then continuing his studies at the Rochester Theological Seminary in 1879. In 1883 he moved west to accept the position as Territorial Geologist for Wyoming, where he remained for three years. In 1886 he became superintendent of the Etta Mine in the Black Hills, which produced the first tin made from American ore. During the short-lived Ghost Dance Indian uprising of 1890-91 he served on the staff of Army general Nelson Miles and acted as a correspondent for the Chicago journal *Interocean*. The following year he was dispatched by the journal was sent by that journal to Central and South America, where, among other things, he investigated one of the largest meteorite discovered up till 1892 (in Bacubirito, Mexico) and he reported on the potential route for an interoceanic canal across the Nicaraguan Isthmus. In 1893 he served as commissioner for the Geological Department of the Chicago World's Fair.

From 1894-1901 he appears to have established himself as a consulting geologist and mining engineer based in Los Angeles. Much of his work was in the Death Valley and Panamint Valley areas, but he also lectured frequently, wrote journal articles, and provided advice to other engineering firms dealing with developing water resources for agriculture. In 1909, when he accepted a position as Professor of Geology at the University of Southern California, which he held until his death on December 6, 1924. He also consulted in mining engineering work, being listed as a "consulting engineer" in Los Angeles in 1910. By the early 1920's the geology department was offering five lower division and six upper division courses offered in geology and paleontology at USC. Some of Bailey's more notable publications included: "*Salines of California*" (1902); "*Origin Place Names in California*" (1905); "*California Soils*" a textbook (1913); "*Vertical Farming*" (1915); "*History and Geology of Arrowhead Springs*" (1915); "*Nitrating Soils by Inoculating Legumes*" (1915); and "*Origin and Geology of Hot Springs of California"* (1919).

Professor Allen E. Sedgwick (1918-29) Consulting Engineer and Geologist

Allen Ernest Sedgwick, PE (1881- 1941) was a native Nebraskan who attended the University of Nebraska from 1899-1902, followed by mining studies at the Columbia School of Mines, from 1902-05. After a year working on a mine in Oregon, he spent 1907-12 as a mining and civil engineer working in various parts of Mexico, before coming to Los Angeles in 1912, where he took a position as designing engineer with Noonan & Richards, architects. In 1915 he began consulting in geology, mining, water supply, hydroelectric schemes, and flood control. He completed his BSCE degree at USC in 1918, and began teaching geology at USC, while taking geology courses and working on his master's degree in civil engineering and geology, completed in 1919.

In 1920 he began teaching the first course in petroleum geology at USC, and was listed as an assistant professor until 1921, when he was promoted to associate professor of geology, and then to full professor in 1924. The 1921 USC yearbook listed him as a Professor of Mining with B.S., C.E., and M.S

degrees from USC. The 1922 university handbook credits him with teaching petroleum geology, blowpipe analysis, and petrology/rock classification. When Professor Bailey died suddenly in December 1924, Sedgwick succeeded him as Head of the Department of Geology at USC, which he retained until 1929. That year he took the title of Lecturer, presumably, so he could pursue consulting as an engineering geologist on a number of high-visibility projects (mentioned below). When California enacted engineering registration in 1929 he filed for the title and was granted professional engineer license 3635.

Sedgwick's first engineering geologic consultation was a secret report for Los Angeles County in 1927 that cast doubt on the suitability of the San Gabriel Dam at the forks site, which was verified in late 1929, when the project had to be abandoned after the county expended more than $2 million excavating the dam's abutments. Sedgwick listed himself as a "consulting engineer and professor of geology" when he was named to Los Angeles County District Attorney's *Blue Ribbon Panel to investigate failure of the St. Francis Dam* in March 1928 (described below, under panels). In 1929 he co-authored a report with retired USGS geologist Robert T. Hill on the *Geology of the Hansen Dam site in Tujunga Canyon* for the L.A. Co Flood Control District (LACFCD). This was the site that Big Tujunga concrete arch dam was built upon a short while later. In 1931 he was also named to the Mulholland Dam review panel, as well as several other dam safety/investigation panels in the 1930s. The Los Angeles Department of Water & Power retained Sedgwick to map the geology of the dam and reservoir area of Chatsworth Reservoir in 1931, following damage to the reservoir's embankments (lateral spreading along a buried sand seam) by the M 5.2 Santa Monica Bay Santa Monica Bay earthquake of Aug 30, 1930. The LACFCD also used Prof. Sedgwick as a geology consultant on the proposed San Gabriel Dam No.1 in 1935 (world's highest rockfill dam when completed in 1938). Sedgwick also served as Associate Consulting Geologist to the Board of Consulting Engineers for the Golden Gate Bridge, between 1929-37.

In November 1933 Sedgwick was elected as President of the Los Angeles Board of Education, and named President of the Board on July 1, 1934, but resigned in January 1935, due to possibility of legal ramifications having to do with the LA school system's new $11 million School Reform Program (for upgrades to existing schools). There were apparent conflicts-of-interest, and Sedgwick did not wish to become embroiled in a legal tangle. He later served on the Personnel Commission of the Los Angeles City Schools, between March 1940 and his death. He died suddenly in Los Angeles on November 16, 1941 at age 60.

Prof. Thomas Clements, CEG Consulting Geologist (1954- 1974); Thomas Clements Associates (1974-96)

Tom Clements, PhD, CEG was born in 1898 in Chicago and grew up in Ysleta and El Paso, Texas. After serving in the Navy during the First World War, he completed his Engineer of Mines degree at the Texas College of Mines (now UTEP) in El Paso in 1922. In 1925 he moved to Los Angeles lead the engineering department at Security Title Insurance & Guarantee Co. In 1927 he enrolled in geology studies at Caltech and completed his Master's mapping the geology in San Francisquito Canyon shortly before and after the 1928 collapse of the St. Francis Dam (he narrowly missed being killed the evening the dam failed).

Shortly after completing his master's degree in 1929 Clements joined the geology faculty at USC, and began working on his doctorate at Caltech, which he completed in 1932. In June 1935 he chaired the committee that approved the first PhD dissertation in geology at USC, that of **Gordon B. Oakeshott**, CEG titled "***A Detailed Geologic Section Across the Western San Gabriel Mountains of California***." In 1937 Clements was named chairman of the geology program, and from that time until his retirement in 1963, at various times he chaired the geology, geography, and petroleum engineering departments at USC. Among his notable achievements was ushering in formalized courses in engineering geology at the undergraduate and graduate levels.

For years he did much of the engineering geology consulting work for **L.T. Evans & Associates** and **Leroy Crandall & Associates**. He was one of the first geologists to become an approved engineering geologist by the Los Angeles Department of Building & Safety in 1961. Six months after retiring from USC he was asked to serve on the Board of Inquiry to investigate the Baldwin Hills Reservoir failure by LA Mayor Sam Yorty.

In his retirement he served as a full-time consultant on variety of southern California projects, forming **Thomas Clements Associates** in the early 1970s, located on North LaBrea Ave. in LA. Tom and his wife Lydia also wrote books about the geology and history of Death Valley. Fellow USC geology Professor **Bernard W. Pipkin** RG, CEG worked for Thomas Clements Associates in the 1960s and 70s. Clements died in Santa Monica on May 13, 1996, three weeks shy of his 98th birthday.

Professor Richard Merriam, CEG Consulting Engineering Geologist

Prof. **Richard Holmes "Dick" Merriam**, CEG (1912-98) was born and raised on the La Mesita Ranch in San Marcos, in San Diego County, not far from where the family original settled in the Twin Oaks Valley in 1850's. The nearby Merriam Mountains were named after the family. His parents met when both were teaching in the nearby town of Lilac. They became farmers and one of the reasons Dick decided to attend college was to escape the hard life of farming during the Great Depression. His rearing amongst the plutons and metamorphic rocks of Peninsular Ranges of southern California influenced his professional interests, which centered on that region. He attended Pomona College, majoring in geology and graduated in 1934. He was, first and foremost, a field geologist. Thin and built like a two legged spider, he could out-hike, out-drink, and out-think most geologists of his day.

Dick pursued graduate study at the University of California, Berkeley, where he was trained as a mineralogist and igneous petrologist, and few men were his equal with a petrographic scope. He published his first paper in the September, 1936 issue of the American Mineralogist, titled "Two diopsides from Southern California." After Dick received his Ph.D. from Berkeley in 1940 he took a faculty position at USC, where much of the geology program's emphasis was on oil exploration in southern California. His first publication appeared in the May 1941 issue of the American Journal of Science, titled *A southern California ring-dike.*

Dick ventured into engineering geology during the Second World War, performing summer contract work for the USGS, Bureau of Reclamation, and CDMG. Some of this work in included a comprehensive *Report on geology of dam and reservoir sites on the Trinity River* for Reclamation in 1947 (these proposed structures were built in the 1960s) and his oft-cited "*Alkali-aggregate reaction in California concrete aggregates*," published by CDMG in 1953, which involved considerable petrographic analyses, establishing him as an expert on concrete. His interests in alkali-aggregate reactions also took him to Iraq in 1955 as a Guggenheim Fellow examining concrete placed by the Romans. These contributions led to his becoming one of the first geologists to become an approved engineering geologist by the Los Angeles Department of Building & Safety in 1961.

He continued writing articles about the Southern California Batholith throughout the 1950s. He also made the first modern geologic maps of the State of Sonora, Mexico and conducted cutting edge research on modern Gulf of California tectonics. This work led to his most notable contribution, presented at the 1968 Stanford Conference on Geologic Problems of the San Andreas Fault System. In that article he proposed a right-lateral displacement of the San Andreas Fault near the Mexican border of 200 to 300 miles, based on apparent offsets of Eocene conglomerates.

He taught the engineering geology course and seminar at USC for three decades, from the late 1950s through the early 1990s, and was a long-time member of AEG. He was a frequent consultant to Pacific Soils Engineering in the 70's and 80's and lived in Rolling Hills. His most cited contribution was his 1960 article on the Portuguese Bend Landslide, titled "***Portuguese Bend Landslide, Palos Verdes Hills, California***," which appeared in the Journal of Geology (v.68:2). It was required reading for all engineering geology students in southern California over the succeeding decades.

Dick Merriam was a friend and mentor to all who passed his door. He possessed the rarest and most useful of human traits: *he listened more than he talked*. But when he spoke, people listened. He collaborated with A. O. Woodford and Dick Jahns, and served as a mentor and colleague to many of the engineering geology professors in southern California, including: Barney Pipkin, Marty Stout, Barry Haskell, Jim Slosson, and Perry Ehlig. He didn't marry until age 37 in 1949 (his wife Pat was 26, having recently completed her master's degree in geology at USC), and they were blessed with a son Robert and daughter Martha (MS Geol '85 UC Davis), who was an engineering geologist with Caltrans! His wife Pat taught geology at LA Harbor Community College. Dick retired at age 70 in 1982 and returned to San Marcos, where he died of ALS on April 2, 1998.

Donald L. Lamar, CEG, RGP Adjunct Professor of Engineering Geology

Don Lamar (1930-2009) (BS Geophys '52 Caltech; MS Geol '59, PhD '61 UCLA) of Lamar-Merifield served as an adjunct professor at USC teaching engineering geology and field geology from the mid-1960s though the late 1970s. Don had a healthy interest in engineering geology because his father had lived through the disastrous Montrose-LaCresenta fire-flood sequence debris flows of January 1, 1934, which killed 42 people and damaged or destroyed more than 500 homes and $5 million in property in the La Canada-Flintridge area. Don often told the story of how the debris came tumbling into the Armenian Hall during the

New Year's Eve party and trapped many people because the building frame was tilted sufficiently in simple shear to preclude the opening or door and windows. During the time he was lecturing at USC Don and ARCO Chief Geologist **Mason L. Hill** developed the **Zip-A-Dip** devise in the mid-1960s. He was forever more known as "Mr Zip-a-dip," because he promoted the use of these handy devices and sold them for many years thereafter.

Prof. Bernard W. Pipkin, CEG Coastal and Engineering Geologist (1969-93)

Bernard W. Pipkin, CEG was a native Angelino from the mid-Wilshire District who enrolled in courses at USC in 1948. He joined the Marine Corps PLC officer training program during the Korean War and earned his B.S. (1953) and M.S. (1956) degrees in geology from USC. He then worked for the Army Corps of Engineers and the California Department of Water Resources, before deciding to pursue his Ph.D. in the School of Mines at the University of Arizona, which he completed in 1965. He then took a job with his old USC geology Prof Tom Clements, who had a small, but thriving consultancy providing engineering geologic input for a number of clients in the Los Angeles area.

Barney joined the USC geology faculty as a Lecturer in 1969, around the same time he became registered as an engineering geologist and formed his own consultancy, B.W. Pipkin & Associates. Although his stated specialty was coastal geology with an emphasis on coastal sediment transport and shoreline protection, Pipkin was a recognized pioneer in environmental geology, a natural outgrowth of his many years as a consulting engineering geologist.

During his 24 years at USC he received numerous teaching awards, hosted an Emmy Award winning educational film series (Oceanus – The Marine Environment), and co-authored several textbooks: *Laboratory Exercises in Oceanography*, and served as the principal co-author of *Geology and the Environment*, which remains in print, the 7th Edition scheduled to appear in 2013. He also served as co-editor of *Engineering Geology Practice in Southern California*, published by AEG in 1992.

Barney Pipkin studied or served as a consultant on many of the largest coastal landslides in the Palos Verdes Peninsula and along the Malibu –Pacific Palisades coast. In 1973 he and his grad student Mike Ploessel wrote "*Coastal Landslides in Southern California*," a 20-page pamphlet as a Sea Grant Publication of the USC Department of Geological Sciences. This diminutive publication was thereafter cited in most of the real estate transactions along the sea cliffs of southern California for the next few decades. The publication included summaries drawn from Ploessel's master's thesis which tabulated the average rate of cliff retreat with bedrock type and sea cliff height for southern California.

Pipkin continued the work that began at USC in the late 1950s on retreat of coastal bluffs in the Los Angeles area (described above). One of Pipkin's first grad students was **Mike Ploessel**, whose thesis was titled "Sea Cliffs of Southern California, Malaga Cove to Palos Verdes," completed in 1972. Barney retired from USC in 1993, but continued teaching part-time and writing semi full-time for many years thereafter. Registered as a geologist and engineering geologist, Prof Pipkin maintained a consultancy out of his home in Palos Verdes Estates.

John F. Mann, Jr., CEG Adjunct Professor of Hydrogeology (1957-98)

John F. Mann, CEG (1921-98) received his BS in geological engineering from the Colorado School of Mines in 1943, served as a Navy Seabee officer during World War II. After the war he attended grad school on the GI Bill at USC, receiving his MS in '47 and PhD in '51, working under Prof. Tom Clements. He worked as a groundwater geologist for the USGS and State of Illinois until 1951, when he was given a lectureship at USC. There he continued lecturing on groundwater hydrology for many years thereafter. In 1954-55 he collaborated with USC profs Tom Clements, Dick Merriam, and Dick Stone in a study funded by the US Air Force titled "*An evaluation of types and scales of aerial photographs for use in arid regions.*" Much of this work was summarized by Mann in an oft-cited article titled "*Estimating Quantity and Quality of Ground Water in Dry Regions*," Pub No 44 in of the Int'l Assn of Scientific Hydrology, which appeared in 1958.

In 1957 he opened the first consulting groundwater geology firm in southern California, based out of his home in La Habra. He was a founding member of AEG in 1957 and eventually became the most influential figure in groundwater management and water rights in California. That same year (1957) he published a landmark article with Dick Stone titled "*Pollution of ground waters by Oil Field Wastes in Southern California,*" recognized as one of the earliest to deal with that subject and the most oft-cited.

One of the most famous forensic cases he worked on was the San Fernando water rights case, which examined the issues of recharge and safe yield in the seemingly previous alluvial gravels of that region. This

litigation lasted a record 24 years, between 1955-79. Dr. Mann also served as an expert for the City of Los Angeles on dozens of their Owens Valley inverse condemnation cases (1972-97) and on the controversial Mono Lake litigation (1979-94). He also served as one of the experts in the Ocean Trails Landslide case in Rancho Palos Verdes, one of the five largest slides reactivated in the Palos Verdes Peninsula during the post-war era (1946-86).

Mann did a great deal of early work studying the various groundwater basins in southern California, including the Kern and Tulare Basins, as well as most all of the coastal basins, such as the Goleta Basin. His article "*Ground Water Management in the Raymond Basin, California*," which appeared in GSA's Engineering Geology Case Histories No. 7 in 1969 resulted in more aggressive groundwater basin management in the Los Angeles area, pointing everyone to the structural impacts of buried faults.

His generous donation established the **John F. Mann Center for the GeoSciences and Society** to enhance the contribution of geoscience to the resolution of society's growing environment and natural resource challenges; and GSA's **John Mann Mentors in Applied Hydrogeology Program**.

Engineering geologists trained at USC

The post war era at USC witnessed a thriving geology program, driven in large part by the expanding petroleum industry in southern California. The principal instructors during this period were **Thomas Clements, Orville Bandy, Bill Easton, Duncan McNaughton, John Mann, Gordon McDonald** (moved to Univ Hawaii), **Dick Merriam**, and **K. O. Emery**. All of these men had strong ties to applied geology, and several, such as Clements and Merriam, routinely consulted in engineering geology. Several of the programs graduates went onto notable careers in engineering geology, including: **Gordon Oakeshott** (PhD '36), **John F. Mann** (MS '47), **Jim Slosson** (BA '49), **Joe Riccio** (MS '50; PhD '65), **Ray Sholes** (BA '54), **Stuart A. Bell**; **Doug Moran** (BA '58), **Dick Lownes** (MS '59), **Dietz Warnke** (PhD '65), **George Larson** (BA '61), **Joe Cobarrubias** (MS '61), **Shell Medall** (MS '64), **Art Keene** (MS '65), **Gail Hunt** (MS '66), **Paul McClay** (BS '76), **Rod Combellick** (MS '76), **Bill Cavan** (BS '76), **Roy Dokka** (MS '76), **Ed Hill** (BS '78), **Thom Slosson** (BS '80), **Kevin Trigg** (BS'81), **Chris Wills** (BS '81), **Chris Koepke** (BS '84), **John Wallace** (BS '85), **Miles Grant** (BS '86), **Mike Phipps** (BS '87), **Phil Hogan** (PhD '93), **Kim Bishop** (PhD '94), **Dawn Robinson** (MS '95), **Rory Robinson** (PhD '97), **Brooks Ramsdell** (MS '99), and many others, including those who completed MS in engineering geology degrees, mentioned below.

In 1959 **Eldon S. Roth** (BA Geol '52 UCLA) completed his master's thesis on "*Landslides between Santa Monica and Point Dume*," which was the first thesis in engineering geology at USC (Roth completed his PhD in educational geology in 1965 and taught at Northern Arizona University). In 1966 **Sidney S. Neblett** also focused on engineering geology, with a master's thesis titled "*Engineering Geology of the Dana Point, CA Quadrangle.* Later that same year Jim Slosson succeeded in convincing department chair Dick Stone that USC should offer a specialized master's degree in engineering geology. This program required courses in sedimentary processes, geohydrology, engineering geology, engineering geology seminar, groundwater hydrology (in civil engineering), soil mechanics & foundation engineering, advanced soil mechanics, and completion of a written thesis. The first graduate of the new engineering geology master's program was **John Byer** in 1967, followed by **Mike Ploessel** ('72), **Brian Robinson** ('74), **Jim Krohn** ('76), **Don Kowalewsky** ('78), **Hugh Robertson** ('81), **Rod Masuda** ('81), **Mike Bass** ('85), and several others.

Pacific Soils Threadline (in USC thread)

Joseph F. Riccio, PhD, CEG (1921-2003) grew up in the Chicago area and served in the Marine Corps from 1942-45, during the Second World War. He was discharged as an E-6 in 1946 and used the GI Bill to study geology at USC under Tom Clements, completing his BA degree in 1950 and MS in 1951. He then worked in the petroleum exploration until joining **Maurseth & Howe** as an engineering geologist in 1953. In 1955 he and structural engineer **Jules A. Juge, Jr.** founded **Pacific Soils Engineering** (see below). Riccio did some pioneering work examining adobe clay in the Los Angeles Basin (Riccio, J.F., 1963, Origin of adobe clays in the southwestern portion of the Los Angeles basin: in Essays in marine geology in honor of K.O. Emery: USC Press, Los Angeles, p. 127-43). Riccio returned to USC in the early 60s and received his Ph.D. in geology in 1965, working with Dick Merriam. In the late 1960s he opted out of the partnership, discouraged by the lawsuits they found themselves mired in. He found employment with the petroleum industry, then shifted to geothermal exploration in the 1970s, working first for the City of Burbank and then for Oregon DOGAMI. He returned to southern California and worked as a consultant for Pacific Soils until

the fall of 2001, when he moved to Kansas City, Kansas to live with his daughter. He died in Kansas City on July 11, 2003.

Pacific Soils Engineering, Inc. (1955-2010)

Originally founded in 1955 by geologist **Joe Riccio**, CEG (1921-2003) and structural engineer **Jules A. Juge**, Jr., SE (1928-2008), based in Hawthorne. By the mid-1960s Riccio grew tired of dealing with lawsuits so his partners decided to sell the firm and Joe departed (described above). **Jules Juge** also left Pacific Soils and started **Western Laboratories**, a "flat land" geotech firm based in Torrance. In 1986 Juge founded J & J Contractors, based in Wilmington. Pacific Soils provided geotechnical services for single family homes, light commercial, and planned unit developments, specializing in hillside grading.

Most of the fellows that worked at PSE in the early years came from the **Los Angeles County Flood Control District (LACFCD).** There were bonds that were floated in the late 50's and early 60's for extensive flood control projects, such as the Dominguez channel improvements and all the appurtenant storm drain lines feeding into it. In the South Bay area (Torrance, Gardena, Carson, Hawthorne, etc.) there were all sorts of flooding problems during the rainy months. There was ample funds and lots exploration/design and construction work that needed to be performed. People with engineering degrees from all over the country came to southern California to work at LACFCD. In typical County fashion the budgets were large, and the funds had to be expended each year so additional money could be requested the following year. PSE also established a credible soils testing laboratory, which was certified by the City of Los Angeles and LA County.

By 1964 the firm had moved to Harbor City/Lomita. Some of the senior staff who worked at Pacific Soils in the 1960s included: **Earl R. Morley**, CEG, **Dick Lownes**, CEG, (MS Geol '59 USC) also worked for Ventura Co Public Works in the late 60s, then returned. **Syd Neblett,** CEG, **Dick Henry, Jim Patton**, CEG, **Dave Poppler**, CEG, **Bruce Leinster**, CEG, **Shell Medall,** CEG (who founded several firms, see below), and **Hugh Balkwill**. In 1969 **Jim Patton** passed the Bar exam and soon developed a practice in geotechnical litigation, defending many of the southland's finest engineers and geologists. In 1973 he published an oft-cited article titled: "The engineering geologist and professional liability," which became required reading at ASFE Loss Prevention Seminars (required for principals of firms insured by Terra Insurance) [Attorney Gene Bass played a similar role up in the Bay Area].

During the 1970s and 80s additional staff included: **Stevan Pekovich,** GE, **Len Deutsch**, GE, **Deborah Flavin**, **Anna Evashko, Al Richardson** (RCE 16384), **Clarence Olson** (GE 654), **Bruce Leinster** CEG, **Jim Knowlton**, CEG, **Rex Ketter,** GE, **Dick Lownes,** CEG, **Al Jessup,** GE, and **Greg Axten,** GE. **Eldon Gath**, CEG also worked at Pacific Soils Irvine office between 1980-84 (before joining Leighton). In the 2000's the company was headed by **Daniel T. Martinez,** GE (BSCE '75 UC Davis), who began working for the firm in 1975. **Dean Armstrong** was also a principal for many years. Their headquarters was in Cypress, CA, with branch offices in Tustin, Corona, and San Diego. Dick Lownes retired in December 1998 and founded Lownes Geologic Services, based in Pasadena.

Martinez was the firm's last President, but not the sole owner. After Ketter/Lownes/etc retired, the firm's ownership passed to **Dean Armstrong** (CEG), **John Hansen** (CEG), **Jim Castles** (GE), and several others. They had a difficult time surviving the 2008 recession and closed down in late 2010. Armstrong left and Hansen retired.

Azzam J. Alwash, PhD, GE (BSCE CSU Fullerton, MS '86 and PhD '89 USC) joined the firm in ~1985 and rose to become Director of Foundation Engineering until leaving in ~2005. He married to Suzie Reynolds Alwash (MS '86, Ph.D., '88 geology, USC), who taught geology at El Camino College. They founded Eden Again/Nature Iraq in 1998 and moved to Iraq in 2005. By 2012 Suzie was teaching geology part-time at Mt. San Antonio College in Walnut.

Geolabs, Inc. (1964)

Founded by engineering geologist **Sheldon E. Medall**, CEG and civil engineers **Fred Allen**, PE and **Gary Rittenhouse**, PE in 1964, based in Van Nuys. Medall had just finished his master's degree at USC and had worked for Pacific Soils. The firm went on to establish offices in Orange County, Westlake Village, etc. **Ronald J. Lejman**, M.S., GE was senior engineer from 1967-72, then departed to manage the Geolabs-Nevada office in Las Vegas (1972-73). **Mike Scullin**, CEG resigned from his post as Orange County Geologist to manage the Orange County branch office in August 1968 (he remained there until opening the firm's Washington, DC office in Sept 1970). **GeoLabs Hawaii** was another separate, but related entity, purchased by **Bob Y. K. Wong**, PE in 1975, after being managed for many years by **Fred Allen** in Honolulu.

Geolabs -Westlake Village was established as a separate entity in the late 1970s by George Larson, and it was managed by **Bobby Burke**. One of those assisting him was **Brian Robinson**, PE, CEG (from LACoDPW), who started his own firm in 1978. **Ronald Shmerling**, PE, CEG (MS Geol '75 UCLA), took over ownership of Geolabs-Westlake Village sometime later. **Mike Phipps**, CEG (BS Geol '87 USC) is senior engineering geologist.

Sernco, Inc (1970)/S.E. Medall & Associates (1974)/Medall, Aragon, Worswick & Associates (1979); Medall-Worswick & Associates (1982-86)

Sernco, Inc. was founded by engineering geologist **Shell Medall**, CEG (BA Geol '58 Berkeley; MS '64 USC) in 1970 in Los Angeles. Seeing an opportunity to do engineering geology subcontract work on the proposed Alaska pipeline, Medall spun off Alaska Geological Consultants, Inc as a Sernco Company in late 1971, placing **Harold J. Moening** in charge of that office in Anchorage, Alaska.

In 1974 Medall started another firm called **S.E. Medall & Associates**, which became **Medall, Aragon, Worswick & Associates** in 1979, based in Los Angeles, with branch offices in Santa Ana and Riverside. The other partners at that time (1979) were **L. Fernando Aragon**, PE (BSCE '74 Loyola) and **Andrew W. Worswick**, PE (BSCE '72 UCLA). Some of the other principals were: **Claude Corvino**, PE (BS Geol '75; MSCE, '77 UCLA), **Peter C. Yong**, PE (MSCE '61 Stanford) and Chief Geologist **Paul Davis**, CEG (BS Geol '63 Berkeley). Senior staff included: **John Gaffey, John Dailey, John Butelo, Mike Bracher, Ron Maddox, Bruce Thacker, Jim Scott**, and **Jack Thompson** also worked for Medall & Associates. The firm was absorbed by Schaefer Dixon Associates in March 1986.

GeoSoils, Inc. (1974-present)

Founded in 1974 by geologist **George R. Larson**, CEG (BS Geol '61 USC), soils engineer **Del Yoakum**, GE (BSCE '62 Washington; MS '63 Harvard), civil engineer **Fred Allen**, PE, geologist **John Sayers**, CEG and geotech engineer **Al Kleist**, PE in Van Nuys. George began as a lab assistant for Jim Slosson at LA Valley College and Slosson hired him after he graduated. Fred, George, and Del ran the Van Nuys office, while Al and John ran the firm's Santa Ana office. Fred Allen had a background in running the business side of civil engineering firms. He later moved south to open a branch office in Carlsbad, with a satellite office in Murrieta (he also managed the Geolabs office in Honolulu for a time).

Sometime later, **Dick Lownes,** CEG (MS Geol '59 USC) left Pacific Soils to become their senior geologist at the Orange County office in Costa Mesa, while **Jim Krohn** CEG served as senior engineering geologist at the Van Nuys office in the late 1970s. **Jay Roberts** worked out of their Costa Mesa office in the late 1970s. **John Sayers** left the firm around 1988 to start his own company down in Orange County. **Paul McClay** (BS Geol '76 USC) moved from Slosson to GSI in 1987 (managing their Murrieta office), while **John Franklin** CEG (BA Geol '75 USC) came aboard in 1988, and began managing the Carlsbad office in 2002. More recently, **Dave Skelly** (MS Oceanography, UCSD), became a principal in the firm, (along with **Paul McClay** and **John Franklin**) to supplemental their coastal engineering projects. **Dean Armstrong** now works for GSI and **Franklin** serves as the firm's President. The firm maintains offices in Anaheim, Van Nuys, Carlsbad, and Murrieta.

Eberhart-Axten & Associates (1978-84); Eberhart & Stone (1984-2000); Eberhart/United Consultants (1985-2008); Geosphere Consultants (2008-present)

Eberhart-Axten & Associates was founded in 1978 by **Dan R. Eberhart**, CEG (BS Geol '72 CSU Fullerton) and **Greg Axten**, PE (BSCE '73 CSPU Pomona) and based in Anaheim. In 1984 Axten founded American Geotechnical (profiled below) and the following year (1985) Dan Eberhart founded **Eberhart/United Consultants**, in Placentia.

From 1984 to 2000 Eberhart was a partner with **American Geotechnical** (described below). Sometime around 1984 **Dan Eberhart**, CEG formed a new partnership with geotechnical engineer **Gerald L. Stone**, GE to form **Eberhart & Stone, Inc**., Geotechnical Consultants, based in the City of Orange. Their senior staff included engineer **Steven Alford**, PE and engineering geologist **Robert Fulton**, among others.

In May 2008 Eberhart/United joined with the Geotechnical Division of **Consolidated Engineering Laboratories** (CEL) to form **Geosphere Consultants, Inc.,** with offices in Placentia (initially), San Ramon, Salt Lake City, and Honolulu. Consolidated Engineering Laboratories operates offices in Oakland, Sunnyvale, Santa Rosa, and Sacramento, while United Testing and Inspection is based in Moreno Valley.

Materials Testing & Inspection operates from five offices in Oregon, Washington, and Idaho. Geosphere's original principals included **Eric J. Swenson**, GE, CEG, **Jim Backman**, and **Gary M. Cappa**.

American Geotechnical (1984-present)

Founded in 1984 by **Gregory W. Axten**, GE (BSCE '73 CSPU-Pomona) in Palos Verdes Estates, after he had worked at Pacific Soils Engineering (1971-78) and as a partner with **Eberhart-Axten & Associates** (1978-84). Axten serves as Principal Engineer and CEO (there was another founder at the time). **Robert W. Day**, GE joined the firm in 1984 and has served as Chief Engineer since 1988 and is a firm partner. His degrees include BSCE and MS [structures] from Villanova; MSCE '80; and Engineer Degree '81 MIT (working with Chuck Ladd). Day has authored a number of textbooks: ***Geotechnical and Foundation Engineering: Design and Construction*** (1999); ***Geotechnical Engineers Portable Handbook*** (1999), 2nd Ed (2012) McGraw-Hill Portable Handbook; ***Soil Testing Manual: Procedures, Classification Data, and Sampling Practices*** (2000); ***Geotechnical Earthquake Engineering Handbook***, 1st Ed (2001), 2nd Ed (2012), McGraw-Hill Handbook; ***Foundation Engineering Handbook***, 1st Ed (2005), 2nd Ed (2010); and ***Forensic Geotechnical and Foundation Engineering,*** 2nd Ed (2011).

Other senior principals have included **Mohammad Joolazadeh**, GE, **Jim Oblinski**, CEG, **Arumugam Alvappillai**, PhD, GE (PhD CE '92 Oklahoma), **Fei-Chiu Huang**, PhD, GE (PhD CE '93 Northwestern), Chief Engineering Geologist **Jeff L. Hull**, CEG, and **Cathrene Glick**, CEG, CHG (BS Geol '80 SDSU). For many years their main office was in Anaheim, before moving to Yorba Linda. They maintain branch offices in San Diego, Las Vegas, and Davis. **Edred Marsh**, GE joined the firm in 1988, and is a partner. He has managed their San Diego and Las Vegas offices

R. L. Sousa & Associates (1987-95); GeoConcepts (1995-present)

Founded in 1987 by **Robert Sousa**, CEG (BS Geol '81 CSUN), after working for LA Co DPW. In 1995 he formed GeoConcepts with geotechnical engineer **Scott Walter**, GE (BS Geophys '86 UCLA) and the firm is based in Van Nuys.

Neblett & Associates (1997-2009)

Founded in 1997 by former LACDPW and Pacific Soils engineering geologist **Sidney S. Neblett,** CEG (BA '51 Hampton Sydney College; MS Geol '66 USC), along with Sid's son **Bill Neblett,** and geotechnical engineer **Steve Strickler**, GE (BSCE '84 CSULB). Syd flew AD-1 Skyraiders for the Marine Corps during the Korean War, and completed his master's at USC, his thesis being "*Engineering Geology of the Dana Point, CA Quadrangle*." For many years he worked as a reviewing engineering geologist for LACoDPW, he was familiar with how the County's Geotechnical Section viewed the various geotechnical problems. Although the firm was based in Huntington Beach, they performed a great deal of geo-design work for the Calabasas area, assisted by **Larry Fanning,** CEG, **Daniel Morikawa**, GE, **David H. Ginter**, PG. The firm ceased operations in 2009.

Soilworks Earth Sciences Group (2009-present)

Soilworks Earth Sciences Group was founded in August 2009 by **Steve Strickler**, GE (BSCE '84 CSULB), after having worked for Pacific Soils (1990-97), and then as a founding partner of Neblett & Associates (1997-2009), profiled above. The firm is based in Costa Mesa. Strickler serves as CEO and **Larry E. Fanning**, CEG (BS Geol UCSC) is the firm's president, and Fanning also served as a member of the State's Mining & Geology Board. **Dan Morikawa**, GE (BS Geol '76 UCLA) serves as a principal geotechnical engineer, **Vas S. Srivatsa**, GE (BSCE '55; MS '61 Madras-India; PhD Geotech '70 Oklahoma State) is senior geotechnical engineer. The senior geologists have included **Richard H. Spindler**, CEG (BA Geog UCLA; MS Geol CSULB) and **Carisa Endrizzi-Davis**, CEG (BS Geol '86 Arizona). The firm is based in Costa Mesa, but performs work over a broad area, including the Coachella and Imperial Valleys. Strickler is also the founder of The Source Of Sustainability (SOS) Foundation, a California Non-Profit Charity.

Geology & Soils Consultants (1971-73); Kovacs-Byer & Associates (1973-92); Kovacs-Byer-Robertson (1978-85)

Geology & Soils Consultants, Inc. was founded by geotechnical engineer **Gerald S. (Jerry) Kovacs** (RCE 13503) in 1971, based in Studio City. Their Chief Engineering Geologist was **John Byer** (BS Geol '65 UCSB; MS '67 USC), assisted by **Hugh Robertson**, CEG (MS EnGeol '81 USC). The firm became Kovacs-

Byer & Associates in 1973 and Jerry Kovacs served as President of SAFEA in 1973-74. Kovacs, Byer and Hugh Robertson then formed a tri-parte partnership in 1978 as **Kovacs-Byer-Robertson** (see below). This reverted to **Kovacs-Byer & Associates** (KVA) in 1985. KVA did lots of work in the Santa Monica Mtns, incl. deep fills, and became known as the "soil engineers of the stars." Some of the geologists who worked for KBA included **Frank Denison**, CEG, **Richard Escandon**, CEG (now with Klienfelder in Redlands), **Joe Cota**, CEG (owner of Earth Resources, Inc), **Bob Hollingsworth**, CEG (partner at Grover-Holingsworth), **Dave Grover**, CEG (Partner at Grover-Hollingsworth), **George Davis** (now at CSU Northridge). KVA's senior geotechnical engineers included **Robert I. Zweigler,** GE, CEG (now with Byer Geotechnical) and **Leonard Liston**, PE, who departed to start his own firm when he received his PE license.

Kovacs-Byer-Robertson (1978-85); Robertson Geotechnical (1985-present)

Founded in 1978 in Malibu as **Kovacs-Byer-Robertson** by **Hugh Robertson** with **Jerry Kovacs** and **John Byer** as partners. Robertson bought out Kovacs and Byer and renamed the company, moving to Westlake Village in 1985. **Hugh S. Robertson** PG, CEG (MS EGeol '81 USC), who serves as president and principal geologist. Key personnel included **Richard Escandon**, **Ed Hill** (now with **Geotechnology)** and **David Benson** (now with **Grover-Hollingsworth).**

Kovacs-Byer-Grover (1981-84); Grover & Associates (1984-88); and Grover-Hollingsworth & Associates (1988-present)

David J. Grover, CEG (BS Geol '75 UCLA) began working in the soils lab at Kovacs-Byer in 1972, while attending UCLA. After graduating in 1975 he worked full-time for Kovacs-Byer, and they formed **Kovacs-Byer-Grover** in 1981. This became **Grover & Associates** in 1984. In 1988 **Dave Grover** teamed up with **Robert A. (Bob) Bob Hollingsworth**, GE, CEG (BS Geol '79; MS Eng '82 UCLA) from Kovacs-Byer & Associates, to become the Principal Geotechnical Engineer and form **Grover-Hollingsworth & Associates**. Their office is based in Thousand Oaks, CA. **James O'Tousa**, CEG was an engineering geologist with the firm in its early years, and **Martin Lieurance**, PE, CEG (BS Geol '86; MS Eng UCLA) left the firm to form Soil Labworks, LLC in Westlake Village in 2011. Senior staff include: **Jeffrey Farrar**, CEG (BS Geol '86 UCLA), **Greg Byrne**, CEG (BS Geol '88 CSULA), **Jeff Kofoed**, CEG (BS Geol '88 CSUN), **Danny Daugherty**, PE, PG (BS Geol 2000 UCSB; MS CE '07 UCLA), **Jared Little**, PG (BA Geol '02 Cal Lutheran), David Benson, PG (BS Geol '83 SDSU), and **Steve Watry**, GE, CEG (BS Geol '79 UCLA; MS '83 CSULA).

G. C. Masterman & Associates (1979-95); Subsurface Designs (1995-present)

Founded by **Gary Masterman**, GE (BSMechE '75 CSPU Pomona) in March 1979 in Sun Valley, CA, who also taught soil mechanics at CSU Northridge. Masterman worked for Kovacs-Byer prior to starting his firm. His senior geologists included **Jeffrey R. Knott**, CEG (BS Geol '83 UCLA; MS '92 CSULA; PhD '98 UCR) and **Dale Glenn**, CEG (profiled below). Geotechnical engineers included **Greg Silver**, GE (BA Geol '84 UCSB; MSCE '88 CSULB) and **Scott J. Walter**, GE (BS Geophy UCLA). Jeff Knott went on to become a Professor of Geology at Cal State Fullerton in 2001. Greg Silver joined Bing Yen and Associates as in 1988 and Scott Walter formed GeoConcepts with **Bob Sousa**, CEG (profiled below).

Masterman founded **Subsurface Designs** in 1995, with senior geologist **Mark Triebold**, CEG (BS Geol '87 Illinois). Gary Masterman sold his share of Subsurface Designs to Triebold in 2000, who moved the firm to Sylmar. Masterman served as President of Cal Geo in 2000-01 and moved to Lebec, where he operates **Professional Geotechnical Consultants**, with a branch office in Larkspur, CO.

Brian A. Robinson & Associates (1980-); GeoBAR (2010-)

Founded by **Brian A. Robinson**, GE, CEG (BS Geol 1969 CSUN; MS Geol 1974 USC), after working for Los Angeles County DPW, and Geolabs Westlake. The original firm created a sister corporation, GeoBAR in 2010, and is based in Tarzana. His daughters **Dawn Robinson** PE, CEG, CHG (BS Geol 1993 CSUN; MS Geol 1995 USC; JD 2006 FSU) and **Tiffany Robinson** (BS Geol 2001 CSUN; MA Geog 2011 CSUN) worked for him for many years. All of Brian's sons went on to found their own geotechnical firms: **Rory "Tony" Robinson** GE, CEG, CHG (BS Geol 1989 CSUN; PhD Geol 1997 USC) and **Steven Robinson** CEG (BS Geol 1993 CSUN) worked for their father before starting **Stratum Geotechnical Consultants** in 2002 (profiled below); **James Robinson** RCE, CEG (BS Geol CSUN 1998) started **Enviroasses.com** in

2009; and **Christopher Robinson** CEG (BS Geol CSUN 2001) and **Paul Robinson** (BA Geog CSUN 2009) started **Dynamic Earth Consultants** in 2010.

Liston & Associates (1982-2001); L C Engineering Group (2001-present)

Founded by **Leonard I. Liston**, PE (BS Eng '77 CSU Northridge) of KBA in 1982 and based in Thousand Oaks, with a branch office (?) in Westlake Village. Liston also became a licensed General Building Contractor in California in 1995 (he also owns LDMS Construction). **Jeff Holt** of Mountain geology used to provide much of the firm's engineering geology input, as the two were related by marriage for a time. **Lin-Chuan Yeh**, PE, SE (BSCE Nat'l Taiwan; MSCE SMU) is the firm's structural engineer. **Britten Pond**, PE (BS ArchE Wyoming), **Quang Tran**, PE (BSCE CSUN) and **Ruben Haro**, PE (BSCE Guadalajara; MSCE Queretaro Univ) are project engineers, and **Eli Katibah** (BS Eng CSUN) is a staff engineer.

Mountain Geology (1984-present)

Firm founded by **Jeff Holt**, CEG (BS Geol '77 CSU Northridge) in March 1984 in Simi Valley, after working for John Byer at Kovacs-Byer & Associates between 1977-84. Jeff was eventually joined by his two oldest sons: **Jacob W. Holt**, CEG (BS Geol '97 CSU Northridge), **Jesse F. Holt**, CEG (BS Geol '98 CSU Northridge), and **Brett Scott**, CEG (BS Geol 2001 CSU Northridge).

Frank E. Denison, CEG (1990-2003); Geostudies, Inc. (2003-2009)

Frank E. Denison, CEG (BS Geol '73 UCLA; MS work 1995-2003 CSUN) grew up in Venice and enjoyed Pat Merriam as his first geology instructor at LA Harbor College in 1961. He continued his studies in geology at UCLA in the fall of 1961, while working for Vons and Atlantic Richfield Co. After serving in the Marine Corps, he eventually completed his geology degree at UCLA in 1973. He worked for Kovacs-Byer & Associates (1974-88), followed by GeoSoils (1988-90). In 1990 he founded his own consultancy working out of Westlake Village, where he serviced a number of geotechnical firms, such as Subsurface Designs, Inc. From 1995-2003 he pursued work on a master's thesis at Cal State Northridge titled "Structural Geology of the Santa Monica Mountains," which was never completed because of the death of his advisor, Dr. Peter Weggand. During that time he also taught engineering geology at CSU Northridge. In 2005 he and Jim Slosson co-authored "*Testing of the Site Amplification Hypothesis on Earthquake Damage that Occurred in the San Fernando Valley and Santa Monica during the 1994 Northridge Earthquake as Related to the Underlying Geological Structure of Faults and Synclinal Folds*." Frank had particular expertise and experience with bucker auger assessments, but was seriously injured in a downhole accident in November 2005, which resulted in the amputation of one of his legs. He became a Director of the Dibblee Foundation in 2000, and retired in 2009.

Parmelee-Schick & Associates (1991-2001)

Larry Parmelee, CEG (BS Geol '83 UCLA) and **J. Wayne Schick,** CEG, who both worked for Kovacs-Byer & Associates between 1983-91 before going out on their own in 1991 as Parmelee-Schick & Associates, based in the Studio City area. They split up in 2001 and formed their own consultancies. Larry now owns **Parmelee Geology**, Inc. in Agoura Hills while Wayne Schick owns **Schick Geotechnical**, Inc. in Van Nuys, with a staff of about five people.

Jerry Kovacs & Associates (1992-2000); Geotechnologies (2000-present)

JKA was formed in 1992, when Jerry Kovacs split off from KBA, and was based in Glendale; **Edward F. Hill**, CEG (BS Geol '78 USC) became the firm's President in 1995. In 2000 the firm was rebranded under the current name, Geotechnologies, Inc., servicing clients in the building industry with responsive engineering and testing services. **Michael R. Savage** is Vice President, **Stanley Tang**, PE is a Project Engineer, **Reinard Knur,** GE, CEG is a Project Engineer/ Geologist, and **Michael Cazeneuve**, PE, CEG a Project Engineer/ Geologist.

The J. Byer Group, Inc. (1992-present); dba Byer Geotechnical, Inc.

Founded by engineering geologist **John Byer,** CEG (BS Geol '65 UCSB; MS '67 USC) and geotech engineer/engineering geologist **Robert I. Zweigler,** GE, CEG (BSCE '79 UCLA; MBA CSUN) in 1994,

based in Glendale. They offer full geotechnical services. **Giuseppe Cugno**, CEG is another senior engineering geologist.

Dale Glenn & Associates (1985-87); Solus Geotechnical (1987- present)

Originally founded in 1985 by **Dale Darlene Glenn**, CEG as **Dale Glenn Engineering Geology**, then as **Dale Glenn & Associates,** when she became a WBE. The firm was based in Chatsworth. She had previously worked for Gary Masterman, PE. This was the ***first woman-owned geotechnical engineering firm in California***. In 1987, she expanded her services as a WBE, and renamed the firm **Solus Geotechnical**, and they moved to their office to Northridge, where they operated for many years. They have since downsized and their employees were absorbed by **GeoSystems**, **GeoConcepts**, and **Leighton**.

Irvine Geotechnical (2005 – present)

Founded by **Jon A. Irvine**, GE, CEG (formerly of Kovacs Byer) in 2005 and based in Pasadena. He frequently works with **Joshua Feffer**, CEG of Feffer Geologic (former of Atwood Singh, Exponent-FAA, and American Geotechnical).

Stratum Geotechnical Consultants (2002-present)

Firm started by Dr. **Rory "Tony" Robinson**, PhD, GE, CEG, CHG (PhD Geol '99 USC) in 2002, and based in Tarzana and Ventura. He is the son of Brian A. Robinson, GE, CEG of GeoBar.

Bay City Geology (2008-present)

Founded in 2008 by **Jonathan S. Miller**, CEG, formerly of **GeoConcepts**. Their engineer is **Joseph Barr,** PE (BS Geol '97 USC), who also worked for GeoConcepts. The firm is based in Santa Monica.

<u>Slosson Associates threadline</u> (under USC thread)

James E. Slosson, Consulting Engineering Geologist (1958-73); Engineering Geology Consultants (1973-75); and Slosson & Associates (1975-2007)

Founded by Dr. **James E. Slosson**, CEG (1924-2007) (BA Geol '49; MA '51; PhD '58, USC) while he was teaching geology at Los Angeles Valley College (1950-84). Jim was a charter faculty member of Valley College, where he also coached track & field throughout the 1950s. He served as department chair from 1975-84, after his service as Deputy State Geologist (May 1973) and then, as State Geologist, from late summer 1973 thru mid-1975. While State Geologist he instituted a series of ***Guidelines for Practice***, which had a marked impact on raising the standard of care of engineering and of environmental geologists, not only in California, but nation-wide.

Slosson served on numerous expert panels in the Los Angeles area during the 1960s; including several of the engineering geology qualification boards (beginning in early 1958), which developed more extensive excavation and grading ordinances (after the 1962 storms), and panels promoting statewide registration of geologists and geophysicists.

Slosson originally did consulting work for various oil companies, and then selected private clients out of his office at Valley College. In 1964 he and his wife Nancy opened up an office (with printed stationary) in Van Nuys, and a year later moved to larger spaces in Sherman Oaks. **George Larson** (BS Geol '61 USC) was his first full-time employee, beginning in the mid-1960s. Jim and Nancy later moved to other office spaces they rented in Van Nuys, where their Jack Russell terriers were a staple part of the office décor.

Nancy Slosson formed **Engineering Geology Consultants** as a woman owned business enterprise (WBE) between 1973-75 to avoid conflict of interest charges against Jim while he was in state service in Sacramento (taking a leave of absence from Valley College). Jim served as one of the original members of the **California Seismic Safety Commission** when it was formed in 1975, serving two terms, between 1975-78 and again, from 1991-99. Jim and Nancy's son **Thom Slosson**, CEG (BS Geol '80 USC) and his wife **Lynn Alessi-Slosson** (BS Geol '78 USC) worked for the firm between 1975-2007.

Many of those who worked for Slosson & Associates began their associations as his students at Valley College. These include: **Frank Kresse**, **George Larson**, **Blaise Selwick**, **Richard Raskoff, Don Kowalewsky**, **Mike Scullin, Robert Larson**, **Joe Cobarrubias**, **Thomas A. Hauge, Mike Phipps, Jeff Johnson, Bob Hill, Jim Krohn** (profiled below), Prof. **Vince Cronin** in 1978-79 (BS Geol '79 Pomona; MS Dartmouth, PhD '88 Texas A&M), **Diane Evans, Paul McClay** (BS '76 USC), **Chuck Yelverton** (LACo, then LA City Geologist), and **Mike Ploessel**.

Donald Kowalewsky, CEG

Don Kowalewsky, CEG received his MS in engineering geology at USC in 1978. He previously worked for Jim Slosson, then for Los Angeles County as a reviewing geologist in the 1980s. He has worked as a consulting engineering geologist from his home at 27101 Old Chimney Rd. in Malibu for several decades.

Geo Search (1993-2008)

Founded by **James P. Krohn**, CEG (BS Geol '65; MS Geol '76 USC) in February 1993 and based in Northridge. Krohn had previously worked for Slosson & Associates in the 1970s-early 1980s and GeoSoils in the 1980s-early 90s. Krohn co-authored several significant publications with Jim Slosson in the 1970s and early 1980s, including: "Landslide Potential in the United States" in *California Geology* in October 1976; "Effective Building Codes" in the June 1977 issue of *California Geology*; J. H. Wiggins, J.E. Slosson, J.P. Krohn, *Natural Hazards: Earthquake, Landslide, Expansive Soil,* report to the National Science Foundation (October 1978); "AEG Building Code Review, Mudflow/Debris Flow Damage" in the January 1979 issue of *California Geology*; "Assessment of Expansive Soils in the United States" for the 4th Int'l Conf Expansive Soils in 1980; "Southern California Landslides of 1978 and 1980," in the 1982 NAS volume *Storms, Floods, and Debris Flows in southern California and Arizona 1978 and 1980*; and "Landslide Mitigation Using Horizontal Drains, Pacific Palisades Area, Los Angeles, California," in GSA *Reviews in Engineering Geology* v. 9 (1992).

GeoSoils Consultants, Inc. (1998 - present)

In 1988 GeoSoils was split into two separate firms. **Fred Allen** and **Al Kleist** retained ownership of GeoSoils, Inc and ran the offices in Carlsbad, Orange County, and Murrieta. **Del Yoakum and George Larson** incorporated as GeoSoils Consultants, Inc. and ran the Van Nuys office. Over the last few years Del retired and sold his stock to engineering geologist **Rudy Ruberti**, and later, to geotech engineer **Karen Miller**. Many of their employees have remained with the firm for over 20 and 30 years, including **Dave Sherman, Joe Cota, John Sayers**, and several others.

Natural Hazards Disclosure (1995-2002); Earth Resources, Inc (2001-present)

Joseph A. Cota, CEG (BS Geol '81 CSUN) grew up in the Sun Valley area of the San Fernando Valley and attended Valley College and CSUN. During his college years he worked for **Kovacs-Byer**. After graduation in 1981 he spent 5-1/2 years working in the California oil industry on well correlations, stratigraphy, offshore exploration, and environmental mitigation. He then joined **GeoSoils**, becoming registered as a PG and CEG in 1990. He has many years' experience in providing engineering geology and environmental assessment consulting services for large residential and commercial development projects throughout southern California.

In 1995 Joe was associated with the start-up of **Natural Hazards Disclosure, Inc.** (NHD) of Santa Clarita. NHD provided natural hazard disclosure reports for California real estate transactions, such as Alquist-Priolo Earthquake Fault Zone, FEMA Flood Insurance Hazard/Rate Zones, State Fire Responsibility, Seismic Hazard Map, Inundation Areas, and Very High Fire Hazard Severity Area reviews. It also provides information about Mello-Roos District, an area where a special tax is imposed on real property owners within Community Facilities District and markets California Association of REALTORS (CAR's) disclosure compliance kit. In 2002 NHD was sold to CAR's business branch, Real Estate Business Solutions (REBS). In 2001 Cota founded **Earth Resources, Inc.**, based in Santa Clarita, which provides similar services, where disclosures need to be more detailed and exacting, often as part of forensic assessments.

Cal State Los Angeles Threadline

Los Angeles State College was founded in 1947. In September 1949 it was renamed the **Los Angeles State College of Applied Arts & Sciences.** In January 1964 L.A. State College was renamed **California State College at Los Angeles** (CSCLA) and joined the California State College (CSC) system, formed in 1960. At that time the geology faculty was comprised of **James Richmond** (Chair), **Robert Meade, Perry Ehlig**, and **Martin Stout**. In 1972 the school was renamed **California State University, Los Angeles (CUSLA).** That same year CSULA established a geology master's degree program with an emphasis on engineering geology by partnering with their sister programs Cal State Northridge and Cal State Long Beach, with each campus emphasizing different aspects of geology. This decision was made to gain approval from the Chancellor's office of the California State University and Colleges (CSUC). Between 1972-82 grad students were required to take courses offered by each school, with the advantage being that most of the offerings were in the evenings. After 1982 this requirement was lifted and students could take all of their courses at CSULA. The program was unique in that it allowed "working geologists" to pursue a graduate degrees. USC also offered evening geology courses, many taught by adjuncts; but the engineering courses like soil mechanics were only offered during daytime. For many t years the program advisor was Bob Bean, who had a good deal of real world experience. The CSULA grad students worked with individual profs on their respective thesis topics. Between 1976-2009 181 students had received their master's degrees from Cal State LA, by any standard, a most respectable figure.

Alfred Livingston, Jr. Lecturer and consulting geologist

Alfred Livingston, Jr. was born in Kentucky in 1896. He attended the University of California, Berkeley, majoring in mining, receiving his bachelor's around 1924 and MS in geology around 1929. In 1930 he was working in the Coalinga oil fields. When UCLA moved to their new Westwood campus in 1929, the original campus became the Los Angeles Junior College (it was renamed Los Angeles City College in 1938). Livingstone joined the faculty around 1931 and served as Chairman of the Geology & Geography Department from about 1931-61. In January 1933 Livingston and **W. C. Putnam** co-authored the classic reference "***Geological Journeys in Southern California***," released as Los Angeles Junior College Pub No.1, Geology Series No.1 (104 pages). Putnam moved onto the geology faculty at UCLA in 1938 and their book was reprinted in 1939. This was followed by a soft cover spiral bound second edition, released in 1949. This book formed the basis of understanding the complexities of southern California geology prior to the advent of plate tectonics, which began with Tanya Atwater's classic 1970 paper **Implications *of* plate tectonics *for the Cenozoic tectonic evolution of western North America*** (GSA Bull., v. 81, p. 3513-3536).

In November 1937 Livingston was quoted in area newspapers when the Elysian Park Landslide closed Riverside Drive and damaged a bridge under construction across the Los Angeles River. In 1949 Livingston also prepared a field trip guide titled "***Geological Journeys in Big Tujunga Wash and Vicinity***," published by the Audubon Student Naturalist Association.

Around 1949 Livingston also began lecturing at the newly formed **Los Angeles State College** (now CSULA). In 1950 he published "Introduction to Geology-An Outline," which contained 55 pages of notes and sketches for students enrolled in his Introduction to Geology course (reprinted in 1951 and revised in 1960).

Livingston was the first geologist in Los Angeles who marketed himself as a consultant to assess geologic and geotechnical problems for real estate transactions and appraisals. In 1950 he published a book titled "***Buying a Home in Southern California***," which contained a great deal of useful information on flooding hazards, slope instability issues, retaining walls, erosion, and differential settlement, which was cited by real estate appraisers, bankers, real estate agents, and all the early foundation engineers and geologists who worked on geotechnical issues. In particular, his block diagram of a split-level home constructed on a dip slope with uncompacted fill prone to differential settlement was a classic image that was often replicated during the crisis that erupted after the January 1952 storms damaged so many home in Los Angeles.

Perry L. Ehlig, CEG consulting engineering geologist

Perry L. Ehlig (1927- 1999) was born and raised in Temple City, and after serving in the Army Air Corps, attended UCLA California, graduating in geology in 1952, and began working on his PhD under John C. Crowell. He joined the Cal State LA geology faculty in 1956, co-founding the geology program with Jim Richmond. He completed his PhD dissertation in 1958, titled "*The Geology of the Mount Baldy Region of the San Gabriel Mountains, California*." This work was eventually published in his 1981 article titled:

"*Origin and tectonic history of basement terrane of the San Gabriel Mountains, central Transverse Ranges*," in The geotectonic development of California. Perry rose through the ranks to full professorship at Cal State LA by 1967. He remained an active teacher until his death, in December 1999.

Perry began doing engineering geology consulting work for his UCLA friend and colleague Robert Stone, in 1954. His work for Robert Stone & Associates continued through the mid-1980s, and included several hundred projects, including: recognition and stabilization of landslides; evaluation and mitigation of ground water problems; fault studies; evaluation of rock hardness; geologic field studies to determine suitability for land development; evaluation of sites for reservoirs; evaluations of causes of distress in structures. He worked as an independent consultant on the Abalone Cove Landslide at no cost for 26 years. Other consultations of note in southern California include: the San Onofre Nuclear Generating station (1977-81) and the proposed low-level Tehachapi Tunnel 1983-84). He also served as a geologist for a number of cities. For 19 years, he served as an appointed member of the County of Los Angeles Engineering Geology Review and Appeals Board. He was also an active member of AEG.

Through his association with Stone, Perry began working on the Portuguese Bend Landslide in 1956, when the slide reactivated, precipitating costly litigation. This led to his ongoing consultations regarding the stabilization of the slide in 1979, which continued on a volunteer basis, until he died.

His major research interests were concerned with: the origin and evolution of the basement terrines in southern California, with special emphasis on the Pelona schist; displacement history of the San Gabriel and San Andreas faults; tectonic and geologic history of southern California; and mechanics of slow moving landslides.

Martin Stout, CEG consulting engineering geologist

Marty Stout (1934-1994) was born in North Hollywood in Feb 1934, where he lived until 1946, when his family moved to the north shore of Big Bear Lake in the San Bernardino Mtns. In the fall of 1951 he began studying geology at Occidental College, graduating in 1955. He attended the University of Washington for grad school, receiving his PhD in 1959, and began teaching geology at Cal State LA in 1960, where he remained the balance of his professional career, retiring in 1990.

Marty began working as a consulting engineering geologist working on the Conejo Volcanics on North Mesa near Thousand Oaks for Doug Brown at Moore & Taber. He ended up working on over 800 projects over a 34 year career, between 1960-94. Marty is particularly remembered for his fascination with large landslides, coining the term "megaslide" for those slides in excess of 10 million m^3 at a special symposium on megalandslides he chaired at the annual GSA meeting in San Diego in Oct 1991. He also did some pioneering work on dating the Blackhawk Landslide (sturzstrom) along the north escarpment of the San Bernardino Mtns. He was probably, by all accounts, the most professional involved geologist in southern California, who sponsored numerous meetings and technical symposia for GSA, AEG, the South Coast Geological Society and the Inland Geological Society (of which he was a founding member). He was also active in Caltech's Branner Club and was a member of the Examination Committee for the State Board of Registration for Geologists & Geophysicists (1980-86).

Robert T. Bean, CEG, CHG consulting hydrogeologist

Bob Bean (1913-2005) was a native of Canton, Ohio. He received his BA in math from Wooster College (Ohio) in 1934; and an MA in geology from Ohio State 1939. He came to California in 1942 to work on the hydrology of the San Dimas Experimental Forest. He was known for his pioneering work in groundwater hydrology, geohydrology, in southern California. Bob spent 20 years with the California Department of Water Resources in Sacramento, between 1947-66. In 1961 he served as president of the California Association of Engineering Geologists, which became AEG in Jan 1963. After leaving DWR he worked for the United Nations on water development projects in Central America from 1966-71, then returned to southern California and settled in La Cresenta, where he split his time between teaching hydrogeology at CSLA, Cal State Northridge, Occidental, and UCLA, as well as consulting. Between 1972-93 he supervised 12 master's theses at CSLA on hydrogeology. He worked with Glenn Brown on a number of projects and remained active in southern CA hydrology consultations. After retiring in the early 1990s he moved to Claremont. He co-authored a GSA Special Paper (v. 338) on the California Water Plan in 1999.

Kim M. Bishop, PE, CEG (1993-) consulting engineering geologist

Kim Bishop grew up in the Los Angeles area and received his formal training at UCLA (BS EngGeol ’79), Cal State Northridge (MSCE ’85), Cal State LA (MS ’89), and USC (PhD EngGeol ’94). He is a registered civil engineer and engineering geologist. He worked for GeoSoils (1980-84), Pacific Soils (1984-88), and Lindmark & Associates (1992-93) before joining the geology faculty at Cal State LA in September 1993, where he specializes in engineering geology and structural geology. One of his most cited publications is ***Determination of translational landslide slip surface depth using balanced cross-sections***, which appeared in Environmental and Engineering Geosciences in 1999. He was named Chairman of the Geology program at Cal State LA in the winter of 2007.

CSULA trained engineering geologists

Cal State LA certainly had some famous geologists matriculate through their program, including: **Dick Proctor** (’54 Chief Geologist MWD), **Bob Tepel** (’60; Chief Geologist SCVWCD), **Monty Hampton** (’65; USGS research geologist), **James Rodine** (’68; owner Steam Beer Mining), **Jim Shuttleworth** (’69; LACoDPW), **Gary Stoney** (’69; owner Stoney-Miller), **Russ Harter** (BA ’73; owner SGH Consultants), **Eric D. Chase** (BS ’74; HDR Sacramento); **Gary L. Lass** (MS ’78; owner Geo-Logic Assoc); **Bruce Hilton**, (BA ’78 & master’s courses, Chief Geologist Klienfelder-West), **David Buesch** (BA ’78; MS ’84; USGS), **Keith Ehlert** (MS, 1979), **Kathleen Ehlig** (BS ’78; Ventura Co Planning Dept), **Andrew Barth** (‘80; Prof at Purdue), **Joel Baldwin** (MS ’80; owner Earth Investigations), **Jay Noller** (BS ’81; MS; Prof Oregon State), **Lisa Wells** (’82; Prof at Vanderbilt), **Paul Davis** (MS ’83; chief geologist at several firms), **Steve Watry** (MS ’83; Grover-Hollingsworth), **Charlie Buckley**, **Richard A. Vogl** (BS ’87; MS ’90 owner GeoHydrologic Consultants); **Eldon Gath** (master’s courses; founder of ECI), **Charles Nestle** (LACoDPW), **Kim Bishop** (MS ’89; Prof at CSULA), **Chris Sexton** (MS ’90; partner Geodynamics), **Jim O’Tousa** (BS ’83; MS ’90; Ventura County Geologist), **Greg Byrne** (’88; Grover-Hollingsworth), **John S. McKeown**, CEG (BS ‘90; MS ’92, principal at CHJ Consultants), **Jeff Knott** (MS ’92; Prof at CSU Fullerton), **Pat Smolenski**, **Pat Drumm** (MS ’99; owner GeoFocus), and **Eric Gorman** (BS 2001; GSi), as well as others who went onto distinguished careers as professors or practitioners. A number of students never finished their MS degrees because the Cal State system discounted course credits more than 10 years old or they did not finish their master’s theses (which is difficult to do when working full-time).

Unknown/Independent threadlines

Ralph M. Parsons Co. (1944-79); Parsons Corporation (1979-present)

A full service civil design-construction firm founded by **Ralph M. Parsons** (1896-1974; BSE ’16 Pratt Institute) in 1944, after participating is several successful joint ventures with Steve Bechtel and John A. McCone. The company’s original focus was on oil refinery engineering, but within three years had expanded to architect-engineering, systems engineering, and turn-key design. In the 1950s and 60s the Los Angeles headquarters was located at 617 W. 7th Street. In the 1960s, the firm’s geotechnical group included: **Jack E. Kelley**, **Don McCann** (joined Glenn Brown in January ’69), **John W. Foster** and **James G. Holwerda** (BA Geol ’49; MS ’51; PhD ’58 USC) were among the engineering geologists attached to their geotechnical group in the 1960s, although many of then worked almost exclusively overseas. Holwerda became a groundwater expert and one of Parson’s VPs before retiring in 1990. **Charles E. Bettenger** and **George Lunetta, Olin Twitchell**, and **Robert L. Wells** joined the group in 1964. **Kent McFarland** joined in the late 60s. By 1968 the firm had established itself as one of the nation's largest engineering and construction firms, with projects totaling $1.2 billion. The corporate headquarters moved to Pasadena in the mid-1970s, consolidating its operations from four separate buildings in Los Angeles. The firm is 100% owned by an Employee Stock Ownership Trust and revenues exceeding $3.4 billion in 2008.

Southern California Testing and Geotechnical, Inc. (1971-78)

Neil H. Durkee served as the Vice President and General Manager of this testing firm’s branch office between 1971-75, before he started Irvine Soils Engineering (profiled below). One of their senior project engineers was **Martin R. Owen**, PE (1976-78), who went onto manage Leighton’s San Diego office from 19787-81.

Irvine Soils Engineering, Inc. (1978-87); Irvine Consulting Group (1987-93)

Irvine Soils Engineering was formed in 1978 by **Neil H. Durkee**, and based in Irvine. Previous to this Durkee had worked for L. R. Hubbard Concrete Construction's San Diego operations, between 1968-71; for Riverside Cement Co. as their San Diego County rep from 1963-68, and for the DeVilbiss Co. as an industrial sales rep for spray-painting equipment (1955-63). He was never registered in engineering or geology, but had a BA degree in business administration from Woodbury College in Los Angeles. He focused on business aspects of serving the residential construction industry in Orange County. Some of their geotechnical engineers included **Mike Miller**, PE (1978-87), and **Mark Hetherington**, GE (BSCE '75 Berkeley) (1976-80). Engineering geologists included **Gary Stoney**, CEG (1978-87), **Rich Gorman**, CEG (BS Geol '75 CSPU Pomona) between 1978-87, and **Eldon Gath**, CEG (BS Geol '77 Minnesota), who began his career as a soils tech with the firm in 1979-80. **Jim Fisher** served as the firm's office manager for many years.

Irvine Soils was dissolved around 1987, and Durkee formed **Irvine Consulting Group**. Durkee served as CEO of this firm between 1987-93, which grew to as many as 300 employees with sales of $16 million annually. He also started **Highland Geotechnical Consultants** in San Bernardino around 1978 (Paul Bogseth, CEG supervised the field testing services for Highland between 1978-85). When the break-up of Irvine Soils occurred in 1987, geologist Gary Stoney and geotechnical engineer Mike Miller formed their own firm, Stoney-Miller (profiled below).

In June 1988 **Robert D. Perry**, CEG (BA Geol '61, Berkeley) succeeded Neil H. Durkee as President of **Irvine Soils Engineering**, **Irvine Geotechnical Consultants**, and **Hydrotech Consultants**, subsidiaries of the Irvine Consulting Group. Perry had joined the firm as their chief geologist in 1986.

Stoney-Miller Consultants (1987-present)

Two of Irvine Soils' senior employees, **Gary Stoney**, CEG and **Mike Miller**, PE formed **Stoney-Miller Consultants** in 1987, based in Irvine, and branch offices in Laguna Beach and Carlsbad. Gary F. Stoney, CEG (BA Geol '69 CSULA) was their Principal Geologist and Michael J. Miller, GE (BSCE Washington) the Principal Engineer. Miller served as President of CalGeo in 2006-06. By 2012 Gary Stoney had retired, leaving Miller as CEO. **Hannes H. Richter**, GE (BSCE '75 CSPU Pomona; MS '78 Berkeley) served as their Chief Geotechnical Engineer and now is the firm's President. **Kevin A. Trigg**, CEG (BS Geol '81 USC) is their Chief Engineering Geologist. Other partners include **Robert McCarthy**, GE (BSCE UCI), **Russell Lamb**, GE (BSCE Oregon State; MS UCI), **John P. Hunt**, CEG (BA Geol CSU Humboldt), **Erick J. Aldrich**, GE (BSCE '95 CSPU Pomona; MS CSULB). Retired CSU Fullerton Prof **John H. Miller**, PhD, CHG works out of the firm's Carlsbad office, as does retired San Diego State Geology Prof. **John Foster**. **Gary P. Mozingo**, CEG (BS Geol UCLA) manages the firm's northern California office in San Jose. The firm currently operates from four offices, in Irvine, Laguna Beach, Carlsbad, and San Jose.

Hetherington Engineering, Inc. (1985-present); Bogseth-Hetherington, Inc. (1987-95)

Founded in 1985 by **Mark D. Hetherington**, GE (BSCE '75 Berkeley), after working for Irvine Soils, the Bennett Co., and Owen Geotechnical in San Diego. The firm was originally located in San Juan Capistrano, and now has offices in Carlsbad and Laguna Beach. **Paul A. Bogseth**, CEG, CHG (BS Geol and Env Studies '76 UC Santa Cruz; MBA '85 Pepperdine) has been their principal geologist since 1987, when they formed **Bogseth-Hetherington**, Inc., which continued through 1995.

Earth Systems Consultants (1973-98); Earth Systems Pacific (1999-present); Earth Systems Southern California; Earth Systems Southwest

Firm founded by **Albert Gribaldo,** GE (of Gribaldo, Jacobs and Jones in the SF Bay area). Now has 15 offices throughout California. They purchased Norm Hallin's firm **Buena Engineers** in 1973 and Jack Rolston's firm **Foundation Engineering** in 1995. In the late 1980s they formed **Earth Systems Environmental**, operating out of San Luis Obispo. **Michael V. Smith**, CEG (BA Geol '70 CSU Fresno) joined the firm in 1981 and became President/CEO of Earth Systems, Inc. Group in 1994, and works out of San Luis Obispo. Smith also served as President of CalGeo in 1997-98. **Rick Gorman**, CEG (BS Geol '75 CSPU Pomona) has been their VP and Chief Geologist of Earth Systems Pacific in San Luis Obispo since 1999.

Earth Systems Pacific maintains offices in Santa Maria, San Luis Obispo, Salinas, Hollister, and Milpitas. **Earth Systems Southern California** maintains offices in Ventura, Van Nuys, Pasadena, and Palmdale. **Earth Systems Southwest** maintains offices in Rancho Cucamonga and Bermuda Dunes, where

since 2001, the senior principal is **Lutz "Yogi" Kunze**, GE (former Chief Engineer of Smith-Emery Geoservices).

Jacobs Engineering Group Inc.

251 S Lake Ave. Pasadena, CA 91101, (213) 681-3781. **Jim Roberts**.

Earth Research Associates (1975-88); Petra Geotechnical (1988 - present)

Firm was originally founded in June 1975 by **S. Allen Bell**, CEG, RGp (BS Geol '64; MS '67 USC) as **Earth Research Associates** and based in Costa Mesa. Bell served as the firm's president up through the mid-1990s, when **Robert W. Ruff**, CEG (BS Geol '74 SDSU) joined the firm after working for Converse in Anaheim and Southern California Testing in San Diego, assuming the firm's presidency. **David Hanson**, PE (BS GeolE '91 Arizona; MSCE '97 CSULB) served as senior associate engineer from 1991-2012. **Siamak Jafroudi**, PhD, GE (PhD GeotE '83 UC Davis) joined the firm in 1995 and Bell's share was gradually sold off, by September 1999. Jafroudi assumed Presidency of the firm in January 2000. He also served as President of CalGeo in 2010-11. Ruff continues as Senior Vice President. From 2003-08 **Monte Murbach**, CEG managed their San Diego branch office. **Monty Schultz**, GE currently oversees their operations in the Inland Empire, and **Alan Pace**, CEG supervises their Palm Desert operations. Petra had six offices throughout southern California, as of the late 2000's.

Applied Geosciences (1990s)

Based in Tustin. Operated by **John Eric Jenkins** c. 1990.

Terra Technology and Instrumentation (1980's)

Founded by **G. Hossein Bahmanyar**, Ph.D., GE, in the 1980s and as an DBE. Located in the Winnetka section of Los Angeles, in the western San Fernando Valley. Worked on several underground instrumentation projects for the LA Co. Metropolitan Transit Authority.

D'Appolonia Consulting Engineers, Inc. (1977-87)

A satellite office of D'Appolonia Consulting Engineers, founded in 1965 by Alberta, Canada native **Dr. Elio D'Appolonia**, PhD, PE, NAE (BSCE '42; MS '46 Univ Alberta under R. M. Hardy; PhD '48 Illinois under Nathan Newmark in structural engineering and applied mechanics). D'Appolonia served on the civil engineering faculty of the Carnegie Institute of Technology (now Carnegie Mellon University) from 1948-56. It was during this time that the department needed someone to teach soil mechanics and foundation engineering, with which he became increasing fascinated. He began consulting in 1950, forming several small firms that dabbled in structural and geotechnical engineering.

During the summer of 1956 he decided to enter geotechnical engineering on a full-time basis, which led to several joint ventures working on a variety of projects. In 1965 he established D'Appolonia Consulting Engineers in Pittsburgh. D'Appolonia received the ASCE Middlebrooks Award in 1969 and was elected to the National Academy of Engineering in 1977. He retired from the firm in 1983, after it had become a nation-wide entity. The firm later moved its headquarters to Monroeville, PA and established a satellite office in Genoa, Italy, which continue operating at present, on a wide variety of projects, world-wide.

The Orange County office was established in 1978-79; initially in Laguna Niguel, then in Mission Viejo, moving to Irvine in the summer of 1980, and later, to Orange. The office manager was **Ed Sirota**, GE, and in the 1980s **Morris Balderman** (1942-2006), CEG, CHG was their senior geologist, and **Everett D. Schwantes**, PE was a senior engineer. Balderman operated as an independent consultant for many years thereafter, until he passed away in 2006.

Remedial Action Corporation; MFG Inc.; Tetra Tech (1987-2002); Tetra Tech BAS

After D'Appolonia shut down their Orange County office, **Ed Sirota**, GE started **Remedial Action Corporation**, based in Tustin. He then began another environmental remediation firm, called **MFG Inc**., which specialized in bio-reactivation technology for activated carbon filtration media. He sold that firm to

Tetra Tech Companies in 2002. He then started **Sirota & Associates** in Santa Ana, doing geoenvironmental consulting.

Bryan A. Stirrat, PE (BSCE '67 Missouri-Rolla; MS PetE '72 and MS EnvE '74 USC) worked for the Los Angeles County Dept of Sanitation and then Bryan A Stirrat & Associates (BAS) from 1984-2009. He is currently President of Tetra Tech BAS, the southern California affiliate of Tetra Tech, based in Diamond Bar. Stirrat served as project engineer for the first US EPA approved RCRA closure of a Class I, Hazardous Waste Landfill in the western USA, the BKK Landfill in West Covina. He also served on the California Integrated Waste Management Board's advisory committee on the closure of municipal solid waste facilities, and was a member of the Governor's Task Force on Solid Waste.

Oro Engineering Corporation (1981-present)

Founded in June 1981 by **Robert Shubeck,** GE, and based in the west San Fernando Valley. The firm performs geotechnical engineering, geology, and geotechnical site observations for the purchase of single family residences and investigative studies for distressed properties. They are one of the few small firms that promise to deliver reports within seven days of authorization, and hosts the site **www.lasoilreport.com**, mostly servicing the real estate transfer market. They also design and manage construction of engineered mitigations, such as retaining walls and slope repairs. Bob was later joined by his son **Chris Shubeck**, PE, and the firm is now based in Bell Canyon.

Allwest Geoscience, Inc. (1992-)

Founded as a full-service geotechnical and geoenvironmental SBE and DVBE firm in 1992 with offices in Orange, Riverside, Santa Clara and Contra Costa Counties (in Bay Area through acquisition of Hallenbeck Assoc. in 2002). In 2007 their principals included: **Ambrose A. McCready**, PE (BSCE '72 CSU Sacramento), **Joseph J. Miller**, PE (BS EnvE CPSU San Luis Obispo), **Mark J. Erickson**, PE (BS EnvE CPSU SLO), **Michael D. Geyer**, PE (BS AgEng, BS Soil Sci '85 CPSU SLO), **Michael L. Leonard**, PE (BSCE '72, MS '74 Illinois), **Lenard D. Long**, GE (BSCE '76 CSU Chico), **Robert T. Quarles**, PE (BSCE 2001 Georgia Tech; MS SDSU), and **Adel Kasim**, PhD, GE (MSCE '73, PhD '78 Berkeley).

California Geo/Systems (1992-present)

Founded in 1992 by **Richard Ramirez**, CEG (formerly of LACoDPW) and **Vincent J. Carnegie**, CEG, based in Glendale. They offer conventional geotechnical engineering and engineering geologic services. Carnegie serves as President and **Richard Gladson** is a Senior Geologist.

Firms in the Inland Empire

Pioneer Consultants (1964-87)

Pioneer Consultants was a geotechnical consulting firm founded in 1964 by **David W. Turner**, PE (1936-) (BSCE '60 Arizona) and based in Redlands. In 1972 he formed **Pioneer Drilling Co**., which owned the drilling rigs used by Turner and other local consultants in the Redlands-San Bernardino-Riverside area. In 1974-75 Turner served as President of SAFEA. In the 1980s he formed **Centrum Analytical**, an environmental testing laboratory, to handle the increased demand for geoenvironmental work. For many years the managing engineer was **Ronald F. Carducci**, PE (BSCE '64 Univ Windsor) and the businesses grew to employ more than 50 people. They often used **Warren L. Sherling**, CEG of Earth Technics in Temecula as their consulting engineering geologist. Pioneer maintained their own drilling rigs, and were the first firm in the Inland Empire to own and operate their own Cone Penetrometer Testing rig (a Hogentogler CPT), in 1984. Their most notable project was probably the Lake Arrowhead Dam replacement with Dr. James Sherard in 1974-75. The firm was purchased by **Schaefer Dixon Associates** around 1987 (see Converse threadline).

Richard Mills Associates, Inc. (1970-77); RMA Group/RMA Geoscience (1977-present)

Founded by engineering geologist **Richard B. Mills** (1923-85) (BA Geol '51 Berkeley) in 1970, after he had worked for his brother Robert's firm, Associated Engineers of San Bernardino. Richard Mills Associates was originally based in Upland (where Mills lived), then moved into the same building with Associated Engineers in Ontario in June 1972. The firm later moved to Alta Loma, which became Rancho Cucamonga in 1977. Throughout the 1970s they used Cal Poly Pomona Professor **Larry Herber**, PG as

their principal geological consultant, and completed considerable pioneering work assessing the Cucamonga and Indian Hill faults, along the front range of the eastern San Gabriel Mountains.

E. Duane Lyon, GE (1937-2010) (BSCE '74 CSPU Pomona) became a partner in the firm and their geotechnical engineer in 1974, shortly after receiving his BSCE degree from Cal Poly Pomona. He had previously worked for the firm as a soils tech and inspector between 1964-74, and prior to that he worked for the Army Corps of Engineers (1961-67), and Caltrans (1955-61). When Dick Mills passed away in 1985, Duane succeeded him as the sole owner and president of the firm. The company changed its name from Richard Mills Associates to RMA Group in 1991. Today the company is led by their president **Edward L.P. Lyon**, GE (BSCE 1989 Colorado School of Mines) and vice presidents **Slawek W. Dymerski**, GE (BSCE 1999 CSPU Pomona) and **Gary W. Wallace**, CEG (BS Geol '78 CSPU Pomona).

In 1994 they formed a sister company, **RMA Geoscience**, which is currently led by **Mark Swiatek**, CEG (BS Geol '82 Pennsylvania) and based in Sun Valley. Swiatek previously worked for GeoSoils and AGI Geotechnical. The firm's home office remains in **Rancho Cucamonga**, and they have established branch offices in **Sacramento, Concord, Van Nuys**, and **San Diego**. In 2009 they purchased Terrasearch, Inc of **San Jose** to expand into the San Francisco Bay Area.

CHJ Consultants (1971 - present)

Geotechnical firm founded by **Robert J. Johnson** and two others in December 1971 and based in Colton, with branch offices in Victorville and Palm Desert. Current principals include: **Robert J. Johnson**, GE (BSCE '68 SDSU), **Jay J. Martin**, CEG (BS Geol '82; MS '84 UCR), **Allan D. Evans**, GE (BSCE '77 Idaho; MS USC), **Fred Yi**, GE (BSCE, MS, PhD '85 Univ Tokyo), **James F. Cooke**, PE (BGS Idaho), **Ben Williams**, PG (BA Geol '74 SDSU), **Ann Laudermilk**, REA (BA Geol '94 Pomona), **John S. McKeown**, CEG (BS Geol '90; MS '92 CSULA), **Vincent J. Romano**, (BS Geol 2006 Berkeley), and **David Mino** (BS Geol SJSU).

John R. Byerly, Inc (1977 - present)

The firm was established by **John R. Byerly**, PE (BSCE '61; MS '63, Berkeley) in 1977 in Bloomington as the successor to Pacific Materials Laboratory, Inc's Inland Empire office (see firm threadline elsewhere). Since that time the firm has provided geotechnical engineering, construction materials testing, distressed structure, fault studies, and special inspection services. Senior associates have included **Roger Shervington**, PE in the late 70s-early 80s. The current associates include **Glenn Fraser**, PE as senior engineer, **David Gaddie**, CEG is senior engineering geologist, and **Jeff Fitzsimmons**, PG (BA Geol '98 CSUSB) serves as project geologist.

Highland Geotechnical Consultants (1979-88)

About a year after Irvine Soils was established in 1978, owner **Neil H. Durkee** founded **Highland Geotechnical Consultants** in San Bernardino. Geologist **Paul Bogseth**, CEG (BS Geol '76 UCSC; MBA '85 Pepperdine) supervised the field testing services for Highland between 1979-85. When the break-up of Irvine Soils occurred in 1987, Bogseth joined Mark Hetherington to form Bogseth-Hetherington between 1987-95. Highland continued operating as a separate entity for another year, until 1988.

Gary Rasmussen & Associates (1978 - present)

Founded by **Gary Rasmussen**, CEG in San Bernardino around 1978, where he had managed the Leighton & Associates office since 1971. Some of his earliest assistants included **Gene Blanck**, CEG, CHG, RGP (who moved up to San Luis Obispo) and **John H. Foster**, CEG (BA Geol '70 SDSU; PhD '80 UCR) who later joined the faculty at Cal State Northridge.

Cal-West Consultants (1987-present)

In March 1984 **Ron Carducci**, GE (BSCE '64 Univ Windsor) left Pioneer Consultants in Redlands to join LA Wainscott and Associates in San Bernardino/Riverside (active 1976-99). His work focused mainly on land disposal of liquid waste, mostly seepage pits in rural Riverside and San Bernardino Counties. In October 1987 Ron founded **Cal-West Consultants**, based in San Bernardino.

Roger A. Shervington, PE (1990-present)

In 1990 **Roger Shervington**, PE, TE (BSCE ’71 CSPU Pomona) founded his own consultancy, based in Ontario, after having worked for John R. Byerly, Inc. in Bloomington. He provided geotechnical engineering, pavement design/rehabilitation, and materials testing consultations. He became a Life Member of ASCE in 2013.

Earth Systems Southwest (2001-present)

Earth Systems Southwest maintains offices in Rancho Cucamonga and Bermuda Dunes, where since 2001, the senior principal is **Lutz “Yogi” Kunze**, GE (former Chief Engineer of Smith-Emery Geoservices).

Firms in Ventura and Santa Barbara Counties

Maurseth and Howe (1958-present)

Founded by **Ray Maurseth**, PE (1907-93) and **Charles Howe**, PE in 1953 on Wilshire Blvd. in Los Angeles. Around 1958, Maurseth & Howe established a branch office in Ventura. In 1965 they formed a partnership with **R. Bruce Lockwood**, CEG as **Maurseth-Howe-Lockwood**, which lasted until 1972 (described previously). From the mid-1960s to early 1970s their chief soils engineer was **Robert D. Cousineau**, GE working out of the Ventura office. Around 1974 he departed to start up **Soils International**. The firm is currently registered to be operating in San Gabriel, next door to **Robert D. Cousineau** (see below).

Buena Engineers (1959-89)

Founded by **Norman G. Hallin**, PE (BSCE ’42 USC) in 1959 and headquartered for many years in the Oxnard/Ventura area. Norm grew up in Los Angeles and served as a naval officer during World War II. He became registered civil engineer C-7370 in 1948. He moved to Carpentaria in 1962 and was a member of the Carpentaria Sanitary District Board for many years. He was assisted by **Richard C. Mooring** in the mid-1960s. Sometime later, **Mark Spykerman** worked out of their Lancaster office. They did development work in Acton and elsewhere. They were purchased by **Earth Systems Consultants** in the early to mid-1970s, and Norm retired in 1984. They continued working under the name Buena Engineers in San Luis Obispo until 1989, when the firm was re-organized as Earth Systems Consultants Northern California, which then became Earth Systems Pacific in 1999.

Pacific Materials Laboratory (1963-80); Pacific Materials Labs - Goleta and Camarillo (1980-2011); Pacific Materials Lab of Santa Barbara (2011-present)

Pacific Materials Lab was founded in August 1963 by **Doral Neely** and **Doug Papay**. In 1980 they spilt the firm’s operations, with Doral controlling the Santa Barbara/Goleta office and Doug controlling operations in a Camarillo office. The Goleta office was located just north of the Santa Barbara Airport. They provide civil and geotechnical engineering services, compaction & percolation testing, DSA Approved lab offering concrete, masonry, rebar and welding construction inspection and materials testing services. The principal geotechnical engineer and owner is **Ronald J. Pike**, GE, (BSCE BYU) who previously owned **Pike Civil Engineering** in Goleta. In the early 2000s the Camarillo operations were managed by **Mason Redding**, CEG. The Goleta firm was reorganized in 2011 as PML of Santa Barbara.

Gorian & Associates, Inc. (1973-present)

Consulting firm founded in 1973 by **Gerald Lee Gorian**, PE (1930-78) and **Robert G. McCardell** (1934-), working out of Gorian's Westlake Village home. Six months later they moved to an office in Westlake Village. Gorian died in October 1978, but the firm continued to grow, reaching 30 employees. In 2002, the company relocated to new building at the west end of the Conejo Valley, in Thousand Oaks. Their first employee was soils tech **Lynn P. McKnerney** (AA CompSci LA Pierce), who now serves as the GM. The other partners include: **Rudy M. Pacal**, GE (BSCE ’67; MS ’70 UCLA), who joined the firm in 1978 and serves as Chief Geotechnical Engineer; **William F. Cavan, Jr**., CEG (BS Geol ‘76 USC) joined the firm in 1976 and serves as their Chief Geologist. Chief Engineering Geologist **Scott Simmons**, CEG (BA Geol ’76 Cal Lutheran); senior geotechnical engineer **Jerome Blunck**, GE (BSCE ’77 Nebraska; MBA Cal Lutheran); and **Paul Wasserman**, Field Operations Manager, who joined the firm in 1980. **Sheryl Shatz**,

GE (BSCE ‘83 Berkeley; MS ’87 Texas-Austin) is a senior geotechnical engineer who joined the firm in 2002.

Soils International (1974-80s); Robert D. Cousineau Consulting Geotechnical Engineer (1980s-present)

Founded around 1974 by geotechnical engineer **Robert D. Cousineau** GE, after working for Maurseth & Howe. He serviced the Ventura County and Los Angeles County areas. Cousineau lived in the San Gabriel Valley and served as president of SAFEA in 1978-79. He has gone by Robert D. Cousineau Consulting Geotechnical Engineer in Temple City, and later as Robert D. Cousineau Consulting, based out of Altadena and San Gabriel. He lives in San Gabriel.

Fugro-Gulf (1973-86); Fugro-McClelland (West) (1987-97); Fugro-West (1988-2010); Fugro Consultants, Inc (2010-present)

Fugro BV was founded in the Netherlands as a European-based company in May 1962. In January 1973 they established a Houston office as **Fugro Gulf**, which competed with **McClelland Engineers, Inc.** of Houston, the American leader in offshore goetchnical engineering. **Bramlette McClelland**, PE, NAE (1920-2010) was a native of Arkansas. He graduated from the University of Arkansas with a BSCE dgree in 1940 and attended graduate school at Purdue, receiving his MSCE in 1942. He moved to Houston to work on the San Jacinto River flood improvements during the Second World War. In 1946 he formed a partnership named Greer-McClelland Engineering, based in Houston. In 1955 this became McClelland Engineers, Inc. The firm’s focus was in offshore geotechnics for the petroleum industry. By the early 1980s the firm had grown to over 800 employees, spread in nine offices around the world. In 1977 they established a West Coast office in Ventura called **McClelland Engineers (West) to** service the oil industry in coastal southern California.

Around 1977 Fugro purchased a small geotechnical firm based in Oxnard and placed **Kerry J. Campbell**, CEG (MS Geol ’75 Massachusetts) in charge of the office. This office then moved to Ventura, where it was managed by **Michael R. Ploessel**, CEG (BS Geol ’70 USC), who went onto work for Black & Veatch in Irvine.

Fugro Gulf and McClelland Engineers were both hit hard by the recession of the oil industry in the mid-1980s, which necessitated layoffs and re-structuring. In 1986 the two firms began discussing a merger, which was consummated on October 5, 1987. Fugro contributed 550 employees and McClelland 450. The American firm name became **Fugro-McClelland**, in Houston, and **Fugro-McClelland (West)** in California. The combined group provides the unique experience and technology needed to successfully provide geotechnical, hydrogeologic, environmental, and marine survey services.

In 1991 Fugro-McClelland West purchased and **K-C Geotechnical Engineers** (Ken Clements) of Santa Barbara (profiled below) and in November 1992 acquired **Staal, Gardner, & Dunne** of Ventura (profiled below). **Thomas F. ‘Tom’ Blake**, PE, CEG, (BS Geol ’74; MS ’81 CSU Northridge) served as Chief Geologist of Fugro-McClellan in Ventura, with **John R. Powell**, CEG as a senior geologist. In 1991 Fugro also acquired John E. Chance & Associates of Lafayette, LA, who had a branch office in Ventura (formerly Land and Sea Surveys, established in 1950). The firm name then became Fugro-McClelland West, headquartered in Ventura.

During the 1990s, Fugro added offices in San Luis Obispo and Oakland to service those regions. In November 1997 the name changed to **Fugro West**., which included all offices in CA and NV. Fugro’ s California operations were expanded in the San Francisco Bay and California Delta with the acquisition of Subsurface Consultants (SCI) in 2001, the infrastructure operations of MWH Energy & Infrastructure, Inc. (MWH E&I) in 2002, and Espana Geotechnical in 2005. By 2006 Fugro West had 150 employees spread across 10 offices. They provided geotechnical consultations for a wide array of projects, including the new San Francisco-Oakland Bay Bridge East Span, BART projects, Ports of Los Angeles, Long Beach, Oakland, and San Francisco, as well as the Folsom South Canal Connector, and the dozens of Caltrans projects. Other projects include the 20-mile long Lower Northwest Interceptor Sewer, Freeport Water Authority pipeline, 500-megawatt Consumes Power Plant, Franklin-Thornton Bridge, and the Pleasant Grove Wastewater Treatment Plant.

Fugro West maintained west coast offices in Ventura, Oakland, and Roseville (and in Nevada). By 2009 the senior leadership for Fugro Consultants, Inc. was provided by **Joseph M. Cibor**, President; **Timothy N. Dunne** (who served as president until 2006); **William R. Lettis** (departed in 2011); and **John**

A. Wooley. Between 2004-12 **Lauren Jelks Doyel**, GE (BS Geol '84 Stanford; MSCE '98 SJDU) managed Fugro's downtown Los Angeles office. In 2010 the corporate structure was reorganized as **Fugro Consultants, Inc**. (FCL), with their headquarters in Houston, overseeing all operations in the USA.

Staal, Gardner & Dunne (1985-92); absorbed by Fugro-McClelland (West) (1992)

Geotechnical consulting firm founded by Norwegian emigree **Ivar Staal**, GE (1939-1991; BSCE Wash Univ St Louis), **David A. Gardner**, CEG, CHG (BS Geol '71; MS '74 UCLA), and **Timothy N. Dunne**, GE (BSCE '79; MS '80 Stanford; MBA '99 Harvard) in March 1985 and based in Ventura, where they billed themselves as Consulting Engineers & Geologists. All three partners had previously worked for **Geotechnical Consultants**. The firm provided a wide of array of services, from land surveying and foundation design to geoenvironmental work. They also performed numerous groundwater studies of coastal aquifers in the central California. Their senior hydrogeologists were Gardner and **Martin B. Feeney**, CEG, CHG (BS Geol '77; MS '80 UCSC). In 1989 Gardner and Professor Shlomo P. Neuman at the University of Arizona co-authored an oft-cited article titled "***Determination of Aquitard/Aquiclude Hydraulic Properties from Arbitrary Water-Level Fluctuations by Deconvolution***" in the journal *Groundwater*.

The firm's senior partner Ivar Staal died in February 1991. In November 1992 Gardner and Dunne sold their interests to **Fugro-McClelland (West)**, which became **Fugro West** (profiled above) in Nov 1997, and Dunne served as president of Fugro West until 2006, with responsibility for the firm's activities in the western USA (see description above). He then became Director of Strategic Expansion for Fugro's onshore geotechnical business line for the USA. In January 2013 Dunne moved to the UK to become Business Delivery Team Director; Europe, Africa, and the Middle East for Fugro N.V.'s Geotechnical Division**.**

K-C Geotechnical Engineers (1986-91); absorbed by Fugro-McClelland (West) (1991)

Founded by **Kenneth M. Clements**, GE in Santa Barbara in 1986. Also formed a separate partnership, HC Geotechnical, with Mike Hoover in 1990-92 (profiled below). He sold KCGE to **Fugro-McClelland** in March 1994 and managed a branch office for them in Santa Barbara, assisted by **Greg Denlinger**. Clements now manages the **Fugro Consultants** office in Santa Barbara.

O'Tousa & Associates (1991-2009)

Founded in 1991 by engineering geologist was **James O'Tousa**, CEG (BS '83 CSUN; MS '90 CSULA; MBA), after working for Liston & Associates in Westlake Village. The firm was originally based in Chatsworth, before moving to Ventura, where O'Tousa served as part-time Ventura County Geologist through most of the 1990s. He gained national exposure for his handling of the La Conchita Landslide in May 1995, and again, when it reactivated in January 2005. O'Tousa's first staff engineer was **Robert W. Anderson** (1991-93), and he partnered with Anderson on numerous projects after Anderson founded RJR Engineering (profiled below). **O'Tousa** dissolved his firm in 2009 to become the full-time Ventura County Geologist.

RJR Engineering Group (1993-present)

Founded in March 1993 by Ventura native **Robert W. Anderson**, PE (geology and CE training at UC Davis 1980-86), and based in Ventura. Anderson had previous work for Jim O'Tousa, Liston & Associates, Terratech (San Jose), Seidelman Associates (Pleasant Hill), and the Army Corps of Engineers (Davis). He used Jim O'Tousa for his engineering geology work for many years. Anderson was joined by **Al Echarren**, PE as a partner in 2002. Echarren had previously worked for Ventura County as Manager of their Development & Inspection Services (1989-2002).

For many years RJR provided contract building and inspection services for Cities of Calabasas, Santa Paula, and Moorpark for plan check, capital improvements and public works projects. They also provide services for general civil, hydrology, and EIR projects in Ventura, Santa Barbara, and San Luis Obispo Counties, from offices in Oxnard and Santa Barbara.

GeoDynamics, Inc. (2008-present)

Founded by **Christopher J. Sexton**, CEG (BS Geol '83 CSUN; MS '90 CSULA) and **Ali Abdel-Haq**, GE in 2008 and based in Thousand Oaks. The firm supplies engineering geologic and geotechnical engineering peer review services for public agencies and sub consultant services for larger engineering firms.

Chris Sexton had previously operated **Southwestern Engineering Geology**, Inc out of Fillmore for ~15 years.

U.C. Santa Barbara threadline

U.C. Santa Barbara was established in 1944, where Professor **C.D. Woodhouse** taught all of the geology courses and served as the school's veteran's coordinator. In the fall of 1948 he was joined by Professor **Robert. W. Webb** (1909-84) (BA Geol '31 UCLA; MS '32; PhD '37 Caltech), who had been on the geology faculty at UCLA from 1932-48, and began directing the UC System's Veterans Affairs office in1 1947. Through his efforts a Department of Physical Science was established at UCSB in 1956, which included degree programs in chemistry, geology, and physics. The geology program grew rapidly during the next dozen years, through astute selection of high quality faculty, in teaching, research, and publishing. They appear to have turned out their first two engineering geology graduates in 1963 (see below), and have produced a significant number of engineering geologists over the past 50 years.

Professor John C. Crowell, CEG (UCLA 1947-67/UCSB 1967-87)

Born in State College, PA in 1915, received his BS in geology from the University of Texas in 1939, and came to UCLA to do graduate work in geology. His studies were interrupted by the Second World War. During the war he joined the Army Air Corps and found himself forecasting wave heights for the D-Day invasion of Normandy in 1944 and served as an Army Air Corps weather recon officer in the China-Burma-India Theater. When the war ended he resumed his graduate studies, enrolling in oceanographic meteorology at Scripps. His 1946 master's thesis was titled *Sea, Swell, and Surf Forecasting Methods Employed for the Allied Invasion of Normandy, June 1944*. He then completed his PhD work at UCLA under Prof. James Gilluly in geology from UCLA in 1947. During his years at UCLA Crowell was active in the Association of Engineering Geologists, leading field trips at their national meetings in southern California. He became registered as an engineering geologist in 1969.

During his 20 year tenure at UCLA (1947-67) and 21 years (1967-87) at UC Santa Barbara, Crowell achieved international prominence for his work on the origin of submarine canyons and turbidity currents, explaining how conglomerates could be deposited deep water, mixed with mud (this had puzzled many workers for decades). During the 50s and 60s Crowell also worked out the displacement history of some of the major strike-slip faults in California, and was the first geologist to convincingly document 300 km of right-lateral offset along the southern San Andreas fault. He also formulated the Ridge Basin model (*The Origin of Late Cenozoic Basins in California*) that showed how most of the late Quaternary depositional basins in southern California were pull-apart basins, and that tectonics was driving the sedimentation.

Thomas W. Dibblee, Jr., RG (1911-2004)

Thomas Wilson Dibblee, Jr., RG was the most prolific geologic mapper of the 20th Century, having mapped roughly 40,000 square miles of California, better than one-quarter of the state. Although he never practiced engineering geology per se, his maps had a profound influence on engineering geologic practice in California, and his opinion was actively sought on a wide range of consultations, usually involving the locations of late Quaternary and Holocene faulting. Dibblee grew up on Rancho San Julian, in the western Santa Ynez Mountains, along the Cabrillo Highway [Route 1], between Gaviota and Lompoc (about 45 miles WNW of Santa Barbara), managed by his father T. Wilson Dibblee Sr. Influenced by Harry Johnson (described previously) Dibblee studied geology at Stanford between 1932-36, then worked for the California Division of Mines in San Francisco. In 1950 he published CDMG Bulletin 150, "*Geology of Southwestern Santa Barbara County*," the first of several released between 1952-68, which Dibblee mapped on his own time. In the 1940s he worked for a number of oil companies in the Coast Ranges, and this work was summarized in the 1953 paper, "*San Andreas, Garlock and Big Pine Faults, California: A Study of the Character, History and Tectonic Significance of Their Displacement*." The paper was a pioneering effort in that it proposed a displacement along the San Andreas fault of more than 350 miles.

By 1952 Tom Dibblee had pretty much mapped all the sedimentary basins in California with potential oil-bearing sands. That year Dibblee joined the USGS to map the geology of the California's Mojave Desert to examine the borate potential in the area (boron was a major ingredient in solid rocket fuel). His work concentrated on the western and south-central Mojave. Dibblee's subsequent USGS career included a stint for the Survey's Earthquake Research Branch, where he mapped the geology of the Transverse and Coast

Ranges in a swath 25 miles on each side of the San Andreas fault "from near the Mexican border to the San Francisco Bay." The result was nearly 100 open-file geologic quadrangles. Dibblee retired from the USGS in 1978, but he continued mapping projects, working as a research associate with the U. C. Santa Barbara, and as a volunteer for various government and civic agencies. At the request of the U.S. Forest Service in 1978 he began mapping the geology of the 1.2 million acre Los Padres National Forest on a voluntary basis to determine oil and gas potential, mineral resources, ground-water potential, potential fault hazards, landslides, unstable rock formations, and other geologic features. His efforts resulted in more than 100 geologic quadrangles. Between 1978 and 2001, Dibblee tried to spend at least one day per week in the field mapping, usually searching out details that allowed him to complete the geologic mapping of various quadrangles he had begun working on decades previous.

In 1983 The **Dibblee Geological Foundation** was established in Santa Barbara to preserve his unpublished mapping and actually publish color maps of the dozens of quadrangles that had never been funded for publication by the USGS. This resulted in the publication of 56 new quadrangles between 1986-91. By 2010 six field trip guidebooks and **419 maps depicting about 550 quadrangles of California geology had been produced, all of which are now out-of-print.** In June of 2002 the mission of the Dibblee Geological Foundation was adopted by the Santa Barbara Natural History Museum and in response created the **Dibblee Geology Center**. Some of the maps are still available through the museum.

Donald W. Weaver, CEG (1960-2003)

Don Weaver (1927-) grew up along the Oregon coast and served in the Marine Corps in the late 1940s. He enrolled at UC Berkeley in 1950 and took a diverse program, which included courses in civil engineering and geology. He worked in heavy construction projects during the summers, and eventually completed his BS (1954), MS (1956), and PhD (1960), his graduate work being in paleontology under Robert Kleinpell. His PhD dissertation was on the geology of the Santa Ynez Mountains (funded by Mobil). He became the 4th member of the geology faculty at UCSB in January 1959, and eventually taught courses in physical and historical geology, field geology, stratigraphic paleontology, groundwater geology/well design, and engineering geology. Don spent many summers on Santa Cruz Island as the leader of the UCSB summer field class. He published the geologic map of Santa Cruz Island along with Dave Doerner. Among his more important contributions was a manuscript that was never published, titled: "*Groundwater in California – Geology and the Law*" (although never published, many pirated copies have been circulated across the state).

During the three decades of the 60s, 70s and 80s, Don did a lot of consulting work for the petroleum industry (Mobil, Exxon), agricultural interests along the central coast, and was instrumental in helping found the Santa Barbara satellite office of Dames & Moore, under **Vernon "Al" Smoots'** (BSCE 1944 Kansas) direction, around 1972. Prior to this Don had been a consultant to the Los Angeles office of D&M on projects in the region. One of Don's more interesting consultations was securing water resources at Ronald Reagan's Rancho del Cielo in the western Santa Ynez Mountains, which became known as the "western White House" in the 1980s. He mentored a number of students who went on to notable careers in engineering geology (listed below) before retiring from UCSB in 1990. He then did some consulting in the area before moving to Oregon in 2003.

Engineering Geologists educated at U.C. Santa Barbara

Some of the engineering geologists educated at U.C. Santa Barbra include the following: **Art Darrow** ('63), **Seena Hoose** ('63), **John Byer** ('65), **Gary Van Houten** ('68), **Mike Hoover** ('71), **David Hoexter** ('72), **William L. Bilodeau** ('73), **David W. Buckley** ('75), **Rick Hoffma**n ('76), **Michael N. Clark** ('77; MS '78), **Mike Bonkowski** ('78), **Joe Hanna** ('78), **Dorian Elder (Mills) Kuper** ('78), **Mark Grivetti** ('79), **Mark Molinari** ('80), **David B. Simon** ('80), **Pat Boales** ('81), **Keith Kelson** ('82), **Tom Rockwell** (PhD '83), **Steve Campbell** ('83), **Daniel J. Peluso** ('83); **Don Terres** ('84), **Greg Silver** ('84); **Perry Russell** ('84), **Dennis Laduzinsky** (MS '85), **Bob Devany** ('85), **Scott Moors** ('87), **Anna Buising** (PhD '88), **Todd Tranby** ('88), **Chris Hitchcock** ('90), **Mike Jurasius** ('91), **John Kramer** ('94), **Lisa Bates** ('94), **Alex Greene** ('94), **Erik A. Hilde** ('95), **Brent McIntyre** ('96), **Brian J. Olson** ('96), **Robert Urban** ('96), **David Zell** ('99), **Damien Gonsman** ('99), **Danny Daugherty** (2000), **Ron Karpowicz** (2001), **Larry Gurrola** (PhD 2002), **Kathryn Farrington** (2005), and **Maygan Cline** (2007).

Michael F. Hoover Consulting Geologist (1979-85); Hoover & Associates, Inc. (1985-99); HC Geotechnical (1988-90); Michael F. Hoover, Consulting Geologist-Hydrologist (1999-present)

Michael F. Hoover, CEG, CHG (BA '71, MA '74 UCSB) founded his own consulting practice in 1979 after working for Dames & Moore in Santa Barbara, between 1974-79. His first sizable job was to prepare the Seismic Safety Element for the City of Santa Barbara in 1979 and the firm incorporated as Hoover & Associates in 1985. In 1990 he formed a separate partnership, known as HC Geotechnical, with **Ken Clements**, GE. In 1992 Clements sold his firm, **K-C Geotechnical Engineers**, to Fugro-McClelland West (described above). Hoover now operates his consulting business as Michael F. Hoover Consulting Geologist-Hydrologist. In 1994 Mike Hoover purchased the Chicago Grade Landfill and Recycling Center in San Luis Obispo County and serves as its General Manager. Previous to his involvement, the landfill had been plagued by permitting issues which required considerable time working with a number of regulatory agencies.

Derivative firms of Hoover

A number of geologists worked for Hoover before venturing out on their own. These include**: D. F. "Rick" Hoffman**, CEG, CHG, who operates **Rick Hoffman & Associates** in Santa Barbara, a geohydrologic consulting company; **Mark Grivetti**, CEG, CHG (BA '79, MA '82 UCSB), who went onto work for Dames & Moore for 15 years, before opening up **Geosyntec**'s Santa Barbara office in 2000.

Steve Campbell, PG, CEG, CHG received his BA in geology from UCSB in 1985 and took a position with Hoover and Associates in Santa Barbara. He worked on various geotechnical and hydrogeological investigations in the Santa Barbara County area. He became a Registered Geologist and then obtained his Engineering Geology and Hydrogeology certifications. Steve formed **CampbellGeo, Inc.** in 2000 serving the Santa Barbara County area.

Larry D. Gurrola, PhD, PG grew up in Santa Paula and received his BA in geology from San Diego State in 1993, MA in 1996, and Ph.D. from UCSB in 2006, working with Prof. Ed Keller. He worked part-time for Hoover for several years. He operates **Larry Gurrola Geologic & Environmental Services** in Ventura and teaches part-time at UCSB and LA Pierce College. He has prepared a number of notable publications and maps profiling the geology of the Santa Barbara area, including mapping some of the largest bedrock landslides. He has extensive expertise in neotectonics works, including fault activity trenching and age dating of the various marine terraces and paleosols in Santa Barbara and Ventura Counties.

Regulatory Geoengineers and Geologists

City of Los Angeles

Between January 13-18, 1952 two back-to-back storms dropped 7.5 inches of rain on downtown Los Angeles (and much more on the adjacent elevated uplands), following a series of subnormal rainfall years. About 250,000 cubic yards of earthen debris was washed onto public streets and rights-of-way, which had to be cleared by City crews, at considerable cost to the taxpayers. More than 300 homes were affected, causing $5 million in structural damage and $2.5 million exterior damage to buildings and grounds. Most of the property damage occurred in hillside areas that had been developed during the residential housing boom that followed the Second World War (1945-51).

In the wake of the 1952 storm the City of Los Angeles developed the nation's first grading and excavation ordinance and established a new Grading Section under **W.E. (Bill) Milburn**, within the Department of Building & Safety, supervised by **Gilbert E. Morris**. Milburn's senior staff included engineer **Glenn Martin** (who later succeeded Milburn) and long-time Chief Soils Technician **Mel Bliss**. This ordinance was based on engineering principles then being employed by the State Division of Highways and various public works agencies, and it limited cut slopes to no steeper than 1:1 (45 degrees) and fill slopes to no steeper than 1.5:1 (33.6 degrees) [horizontal to vertical].

At some point in this regulatory process, the City also began requiring professional civil engineers practicing soil mechanics and foundation engineering within the City of Los Angeles to have their soil testing laboratories certified by the City. The City established a committee that reviewed such applications and developed a process for certification of said laboratories. The precise timing of the establishment of these committees and the soils lab certifications still needs to be explored and documented.

On January 25-26, 1956 a winter storm dropped 8 inches of rain on downtown Los Angeles, damaging 35 homes, spilling 40,000 cubic yards of earthen debris into city streets, and causing $575,000 in damages. The City responded to this by toughening their grading statutes to include engineering geologic reports before issuing grading permits. In order to do this they established an **Engineering Geologist Qualifications Board** of the City's Board of Building & Safety Commissioners in February 1958.

Geologists desiring to sign reports in the City of Los Angeles had to present themselves to the board for an oral examination, four times per year. The qualifications board was initially chaired by Caltech Geology Professor **Richard H. Jahns** (1913-83). Approved candidates were then issued a certificate (example below) and their names placed on a List of Approved Engineering Geologists," who could sign and submit reports to the Department of Building & Safety.

The 1956 storm also reactivated the Portuguese Bend Landslide in the Palos Verdes peninsula, which subsequently impacted 150 homes and embroiled Los Angeles County in costly litigation. The County adopted their own version of the city's grading and excavation code a few months later. Los Angeles County followed the City's example and began certifying engineering geologists in 1961, initially accepting anyone the City had already qualified. Orange County followed suit a year later (1962), issuing their own certifications. The City of Los Angeles also drafted a new erosion control ordinance that was adopted by resolution of the City Council in 1961.

Between February 7-12, 1962 storms dropped another 8 inches of rain on downtown Los Angeles. These storms damaged 50 homes, spilled 15,000 cubic yards of debris into city streets, and amassed $900,000 in damages. On In 1962 the City's Bureau of Standards began preparing geologic maps of 75 square miles of the Santa Monica Mountains, through compilation of existing data and new field work. Many exposures were made available by the grading then occurring across the range. This decision was influenced by several high-visibility slope failures suffered by District 7 of the State Division of Highways in the early 1960s, during grading of the San Diego Freeway (I-405). One of these was a bedding plane failure in the large cut adjacent to the Lower Van Norman Reservoir in the northern San Fernando Valley. A much larger problem erupted along the freeway alignment where it crossed the summit of the Santa Monica Mountains, which necessitated significant design changes during construction (the highway cut was intended to be 70 ft deeper than actually built, because of slope stability problems).

The damages caused by the February 1962 storms led to substantial amendment of the City's Grading & Excavation Ordinance, which were developed over the following year and codified in March 1963. The 1963 grading ordinance required engineering geologic input by those geologists who met specific qualifications established by the City (until state-wide engineering geology registration came about in 1970). The new ordinance required more stringent engineering geologic evaluation of prior slope instability, much deeper subsurface exploration, and as-built engineering geologic mapping of all graded areas, signed by the project's engineering geologist and soils engineer. Milburn authored an excellent overview of the evolution of the city's grading codes in 1965, supplemented by Jahns's article in the 1969 State Office of Emergency Management conference on Geologic Hazards and Public Problems in Santa Rosa.

The City's much improved grading and excavation statues became the model ordinance for all others that followed, including the Orange County, which promptly adopted a similar ordinance a few months later (also in 1963) and the Chapter 70 Appendix – Excavation and Grading, adopted by the International Conference of Building Officials in the 1964 Edition of their Uniform Building Code (UBC).

In January and February 1969 the southland experienced back-to-back storms of 100-year and 75-year recurrence frequency. These storms dropped 13 inches of rain on downtown Los Angeles and considerably more on the elevated ranges abutting the Los Angeles Basin, causing unprecedented levels of flooding. Much of the flood debris was caught in the County's 93 storm detention basins, including 11 million cubic yards alone within the San Gabriel Reservoir. Within the City of Los Angeles more than 300 homes were significantly damaged or destroyed, causing $5.5 million in damages. These 1970 UBC was updated based on experience with the Jan-Feb 1969 storm sequence, and it mandated that no cut or fill slopes should be allowed at inclinations greater than 2:1 (horizontal to vertical), unless deemed appropriate by the building official, after careful consideration.

The 1973 Edition of the UBC was subsequently adopted by the State of California on March 7, 1974, requiring every municipality in the state to employ the UBC as its minimum standards. By 1977 about 90% of California's local building and inspection departments were enforcing the Ch. 70 Excavation and Grading statutes, although only 13% of these agencies felt that they had qualified personnel to evaluate geotechnical and engineering geologic reports (Scullin, 1983).

Key LA City personnel

Gilbert E. Morris, PE was Superintendent of Building & Safety for the City of Los Angeles in 1952 when the nation's first grading and excavation ordinance was adopted by that city. This ordinance was soon emulated by Beverly Hills (1952), Pasadena (1953), Glendale (1954), Burbank (1954), San Francisco (1956), San Diego (1960), and by the Counties of Los Angeles (1957) and Orange (1962).

W .E. (Bill) Milburn, PE. (BSCE '38 Caltech) oversaw the nation's first regulatory agency inspecting and approving geotechnical grading and excavation activities. Bill Milburn headed up the Grading Section (later Division) within the Dept of Building & Safety for the City of Los Angeles, from its inception in 1952 until he retired, around ~1976. During his tenure the City evolved new standards for soils and geology reports, which culminated in their adoption of a more comprehensive "modern grading ordinance" in April 1963, following the disastrous storms of Feb 1962. **Ivan Tkatch** and **George Stolt** in the 1970s.

Charles A. (Chuck) Yelverton, CEG came over from the LA County Engineer's office (and prior to that, with CA Dept of Water Resources) to become one of the first geologists in the City's Department of Building & Safety, from early 1966 until about 1972 (he then worked for the Risk Analysis & Research Corporation in Pasadena [early 1970s], Headlands Properties in Pacific Palisades [late 1970s], before becoming an independent forensic consultant [early 1980s]). **Philip Waisgerber, C. Arnold Richards**, and **Elmer Reese** were engineering geologists employed by the City's Bureau of Standards, with the Department of Public Works in the 1960s and 70s. **Richards** was widely regarded for his expertise associated with the geotechnical aspects of petroleum withdrawal in the Los Angeles Basin (see C. A. Richards, "*Engineering Geology Aspects of Petroleum in the Urban Environment*," which appeared in AEG's *Geology, Seismicity, and Environmental Impact* volume in 1973).

Joe Cobarrubias CEG (MS '61 Geol USC) began working an engineering geologist for Los Angeles Dept of Building & Safety around 1967, succeeding Yelverton as city geologist around 1975, continuing into the early 1990s. He was assisted by **James S. Jackson**, **Russ Bingley** and **John A. Fitton.**

David T. Hsu, GE (BSCE 1966, Taiwan Univ; MSCE ~1969, SFSU) became the Chief of the Grading Section of the Los Angeles Dept of Building & Safety, around ~1984, after having worked as a private sector consultant with Mike Scullin, and bef0re that, for Lee & Praesker in San Francisco.

Los Angeles County

Los Angeles County adopted their first grading ordinance in 1957, after the Portuguese Bend landslide reactivated in the Palos Verdes Peninsula (in January 1956), which eventually destroyed or damaged 130 homes and brought the County into a lawsuit that it lost, in 1961. Following storm damage in February 1962 the County adopted a more stringent grading ordinance in September 1962 (ahead of the City of Los Angeles, which adopted their new code in March 1963). This new code emanated from a report titled "Recommended Practices for Hillside Grading and Development" released in the summer of 1962 by the Committee on Building Codes and Related matters of the California Association of Engineering Geologists (which became AEG in January 1963). This report recommended engineering geologic input before issuance of a grading permit and geologic mapping of all excavations and embankment fills during actual grading operations, with the preparation of as-built engineering geologic maps.

About 10 years later Los Angeles and Orange Counties re-organized themselves and shifted to a super-agency concept (Orange County in 1978 and Los Angeles County in 1985). In 1985 Los Angeles County combined the County Flood Control District (LACFCD), Road Department, and County Engineer's office into the Department of Public Works. The individual departments became divisions within DPW, such as the "Building & Safety Division." This shift allowed the County Board of Supervisors to dispense LACFCD fees as they saw fit each year, instead of these ad valorem tax proceeds being restricted to flood control work (this caused some ill feeling between former LACFCD personnel and personnel from the former Road Department and County Engineer). This is in stark contrast to how these County agencies operated independently during the record storm events in January and February 1969, when the County Flood Control Agency maintained control of their own maintenance funds, and engaged in emergency mucking of debris basins that had been filled in January, before the next storm sequence arrived.

Key LA County personnel

Dennis A. Evans, PE, CEG (BS GeolE '58 Colorado School Mines) claimed to have been the "first engineering geologist" hired by Los Angeles County, in **November 1959,** under County Engineer **John A. Lambie**. **Douglas R. Brown**, CEG transferred into the County Engineer's office shortly thereafter, in 1960. Three more geologists were hired in 1962-63, including **Chuck Yelverton, Allen Tamura, James R. Trotter** (from Dames & Moore and DWR), **Allen W. Hazard**, and **Buzz Spellman** (in 1962-63), while **James Paddick** and **Allen E. Seward** joined the group in 1966 (Hazard worked as a consultant out of his home in Whittier in the late 1960s). Evans departed in the spring of 1965, when he joined Geotechnical

Consultants as a partner in their Orange County office, and Yelverton went to the City of Los Angeles in the summer of 1965.

Doug Brown basically functioned as the first "County Geologist" between 1960-62 because he was senior to Evans (Brown had worked for the flood control district prior to transferring in a few months after Evans was hired). Brown was Chairman of the committee drawn from the California Association of Engineering Geologists that prepared "*Recommended Practices for Hillside Grading and Development*" in 1962, which became the seminal document for modern grading and excavation ordinances, nation-wide.

Brown's tenure was cut short by a heart attack and he left the County in December 1962 to accept a position with Moore & Taber in Orange County because he lived in Fullerton, close to their office. According to Beach Leighton, Brown played a pivotal role in encouraging good engineering geology practice standards in the early 1960s, when the modern model grading and excavation codes were being developed, which were the first to require engineering geologic input.

Unlike other agencies, Los Angeles County placed its engineering geologists in an Engineering Geology Section of the Department of the Los Angeles County Engineer, who would assist the Division of Building & Safety, as requested by the latter, whenever needs arose. In this way, the county geologists assisted the County Engineer in day-to-day design, maintenance, and new construction issues, as well as regulatory duties associated with building and grading permits for the Department of Building & Safety. This gave their geologists considerable exposure to professional practice and standard-of-care issues.

Arthur G. Keene, CEG (BS Geol '50 UCLA; MS, '65 USC) began his southern CA career with the LA County Flood Control District, around ~1958. He transferred to the County Engineer's office in the spring of 1965 to augment the expanding engineering geology staff. Keene served as the senior County Geologist (although there was never an official "County Geologist") for many years, until his retirement in ~1992.

By 1976 the Geology Section of the County Engineer's office included the following personnel, working under Art Keene**: Richard Ramirez**, CEG (left at Prop 13 time to form California Geo Systems; **Robert Smith**, CEG (CSM grad; retired to AZ); **Allen E. Seward**, CEG (formed Alan E. Seward Engineering Geology, described elsewhere); **James Paddick**, CEG (B& S reviewer for Malibu & Agoura areas); **David Poppler**, CEG (East County B&S; later worked for Leighton, then returned and retired from LACo); **David Saltzman**, CEG (capital projects); **Brian A. Robinson**, CEG (left to form Robinson & Associates); **Raymond Walbaum**, CEG (retired to Sonoma); **Zora Lee** (husband was prof at UCR).

In 1976, the County's Soils Engineering Section was led by **Charles Sudduth**, PE, GE (deceased), assisted by **James Trotter**, CEG, GE (BS Geol '50 Northwestern; MSCE '77 CSULB) who worked as a County engineering geologist from 1963-70, and then became County soils engineer, from 1970 onward. Other soils engineers included **Vince Kan**, PE; and sometime later, **O. P. Malhotra**, PE, GE.

In the 1980s the Geology Section was joined by: **James Shuttleworth**, CEG (1982-2008; BA Geol '69 CSULA), **Jim Trotter**, CEG, **Don Kowalewsky**, CEG, **Mike Montgomery**, CEG **Jeff Weldon**, CEG (now with LADWP), **Rob Larson**, CEG, **Lidia Lustig**, CEG (now retired), **Charles Nestle**, CEG, **Robert Thomas**, CEG, **John Ege**, PhD CEG (formerly with USGS, now retired), **Steve Lipshie**, PhD, CEG (1990-2010), **Ger Mathisen** (hired in 2002), **Gerald Goodman**, CEG (BS Geol UCLA, MSGE ASU; hired in 1994 and stood up the Co DPW Environmental Group), **Noli Lasao**, CEG, PE (hired in 1994), **Clay Masters**, CEG (hired in 2001), **Karen Berger** (hired in 2004), and **Linda Bell**, CEG, CHG (hired in 2005).

In the mid-1970s **Brian Robinson** and **Ray Walbaum** developed the first Study Guide for the RG and CEG exams in cooperation with the AEG LA Section, which was published in 1976 and again, in 1979. Jim Shuttleworth developed a revised version, but the Board became afraid of it so passed legislation to outlaw it (the document got to the board from Shuttleworth to Jim Krohn, then onto Jim Slosson, thence to the BRGG).

After the merger that formed the County Department of Public Works, **Mike Johnson**, who started with LACFCD in 1959, became the chief geologist. Art Keene continued to head the Development Review Section until he retired in 1992. Johnson retired in 2001 and was succeeded as chief geologist by **Mike Montgomery**.

A number of ex-LA County geologists have started their own consulting firms or worked as principals in other firms. Some of these include: **California Geo Systems**; **Allen E. Seward Engineer and Geology**; **Brian A. Robinson & Associates**; **Triad Engineering** in City of Industry owned by **Frank Stillman,** GE. **Bill Uhl** worked for Triad for many years. **Robert Sousa**, CEG left the FCD to form **Sousa and Associates** (most of these are described elsewhere).

Peer review services provided by Los Angeles County

By 1998 Los Angeles County provided geotechnical peer review and plan checking of grading and excavation applications for the following municipalities within Los Angeles County: Artesia, La Mirada, Bradbury, La Puente, Carson, Lawndale, Cerritos, Lomita, Commerce, Rolling Hills, Duarte, Rolling Hills Estates, Industry, Santa Fe Springs, Irwindale, Temple City, La Canada Flintridge, Westlake Village and Lakewood.

LA County Flood Control District

Edward J. Zielbauer, CEG (1908-99) (BA Geol 1931 Stanford) joined the Los Angeles County Flood Control District as their first staff geologist in 1946, after working for MWD on the Colorado River Aqueduct from 1931-39 (he then taught school for six years). He became Chief Engineering Geologist of the district in 1959, and continued in this capacity until his retirement in 1972. Zielbauer was assisted by **Harry A. Kues**, CEG (from USBR), **Josef C. Callison**, CEG (BA Geol '56 Missouri; from CA DWR), **John N. Roth**, CEG, and **Art Keene**, CEG, **Norm Bradley**, RG, **Mike Johnson**, CEG and **Edgar W. Lundeen**, CEG in the early to mid-1960s, when they were constructing seawater barriers along the coastlines to protect groundwater resources. One of the enormous responsibilities this group shouldered was the investigation, design and construction of the numerous coastal groundwater barriers installed in the 1960s, to retard saltwater intrusion of the coastal aquifers.

In 1985 the Los Angeles County Flood Control District was absorbed into the County's Department of Public Works, in one central location in Alhambra. At this time the County's Geology Section was joined by a number of geologists who came in from the merger with flood control: **Michael Johnson**, CEG, was named head of Geology Section after the merger, **Joe Callison**, **Wayne Worden** (retired, lives in Orange County), **John Roth**, CEG (retired, lives in SF Valley), **Craig Stewart**, **Jim O'Tousa**, CEG, and **Robert Sousa**, CEG.

Contract Regulatory Geologists in Los Angeles County

For many years **Dr. James Slosson**, CEG served as the reviewing engineering geologist for the cities of Moorpark, Calabasas, Corona, Monterey Park, and Agoura Hills.

Orange County

Orange County established an **Engineering Geologist Qualifications Board** in June 1962, similar to those previously established by the City of Los Angeles (1958) and Los Angeles County (1960). The first Orange County Grading Code was adopted in August 1962, following the massive revisions made to the Los Angeles Grading and Excavation Code in the wake of the Feb '62 storms. The new grading statutes were administered by the Orange County Dept. of Building & Safety in the Engineering Division of the Department of Public Works and they issued their first grading permit in Dec 1962.

In Jan'63 they hired **C. Michael Scullin**, CEG (1932-95) (BS Geol '58 Arizona State) as the county's first geologist, remaining in that position through the fall of 1968. For much of that time Scullin was engaged in developing what became the nation's most comprehensive grading and excavation code. Orange County's code was revised and expanded considerably during his tenure, resulting in the two seminal documents: the **Orange County Grading & Excavation Code**, and the much larger **Grading Manual**; basically a compendium of recommended 'best practices,' which more or less established the standard-of-practice for such activities the region. In 1983 Scullin published a textbook titled "***Excavation and Grading Code Administration, Inspection, and Enforcement,***" published by Prentice-Hall, and reprinted twice by the International Conference of Building Officials in the 1990s.

William "Bill" R. Munson, Jr. succeeded Mike Scullin as Orange County Geologist during the mid to late 1970s. An associate engineering geologist in the early 1970s was **Larry Redinger** (BS Geol '68 CSULB; MS '70 NAU), who left the County to teach geology at Mt San Antonio College in Walnut in 1975. **Bob Sydnor, CEG, CHG** (BA Geol '69 Whittier; MS '75 UCR) was Associate Engineering Geologist at the South County office in Laguna Niguel, between 1977-79 (he joined CDMG/CGS in 1979 to review hospital and school reports, retiring in 2007). **William J. Edgington**, CEG came from CDMG to serve as the County Engineering Geologist in the 1980s and early 1990s. He had previously mapped much of the Laguna Beach, Dana Point, and San Clemente areas for CDMG in the 1970s.

In the mid-1970s, **Orange County** changed its government structure to a super-agency, becoming the Orange County Environmental Management Agency (EMA), which combined the control of government

operations under one Director, **H. George Osborn**, PE. EMA was divided into three main branches: **EMA Regulation** (the old Building and Safety), **EMA Planning** (for massive tracts of new homes, thousands per month were zoned), and **EMA Facilities**, which maintained the county's engineering infrastructure. All of the county statutes became "EMA Regulations." Osborn was a very practical engineer (RCE 7188) and a respected manager, who held vast control over the whole agency. He reported directly to the County Board of Supervisors.

Ventura County

Around 1963 **Ventura County** set up an **Engineering Geologists Qualifications Board** similar to that established by the City and County of Los Angeles and Orange County. This was disbanded when statewide geology registration was enacted in 1969. **Blase A. Cilweck** was Senior Engineering Geologist for **Ventura County Public Works Dept**. in the late 1960s. **Al Echarren** was plan checker for grading in 1960s-70s, and later became Manager of the County's Development & Inspection Services (1989-2002).

In 1979 **Joe Hanna**, CEG (BA Geol '78 UCSB) became the Ventura County Geologist, working in the Public Works Department. He remained with the county until June 1991. From the late 1970s onward many of the cities in Ventura County (like Ventura, Oxnard, Camarillo, and Ojai) often used Fugro-McClellan, Staal, Gardner & Dunne, FugroWest, or Bing Yen & Associates as their geotechnical peer reviewers on contract, on a project-by-project basis. **Jim O'Tousa**, CEG (profiled above) served as the County Geologist on contract after Hanna's departure in mid-1991, and continued in this capacity until being brought aboard as a full-time county employee in 2009. Since 2009, **Kathleen Ehlig Reidel**, CEG has served as the County's Planning Geologist.

Santa Barbara County

Ed A. Elavatorski was the first Santa Barbra County Geologist, in 1964-65, and continued providing those services as an independent consultant until **Ray M. Coudray**, CEG (1927-2002) became the County's first full-time geologist in 1973, within the Public Works Department (where he remained until the late 1990s). **Wendell L. Nichols**, PE of the Public Works Dept. also reviewed soils reports in the 1970s. **Imelda A. Cragin**, CHG was the reviewing hydrogeologist for the Solid Waste & Utilities Division of the Public Works Department during the 1990s and 2000s. **Brian Baca**, CEG was the Santa Barbara County Planning Department geologist from 1989-2005. After he left, the County began using **Fugro-West** on a contractual basis for geologic peer-review. In the 2000s the City of Santa Barbara often used **Frank J. Kenton**, CEG of Santa Paula as their geologic peer reviewer, while the County used **Chris Sexton**, CEG, of Southwestern Engineering Geology. In 2009 Santa Barbara County began using **Chris Sexton**'s new firm, **GeoDynamics, Inc. (GDI)**, of Thousand Oaks as their geologic peer reviewer. GDI also provides peer review services for a number of municipalities in west Los Angeles and Ventura Counties.

San Luis Obispo County

Lew Rosenberg, CEG (BS '84 New Mexico Tech; MS '93 SJSU) served as the County Geologist for the San Luis Obispo County Planning and Building Department, between 2002–2007. Previous to this he had worked for Nordmo, Earth Systems, and Staal, Gardner & Dunne.

Notable Legislation, Inventions, and Associations instrumental in Development of the Geotechnical/Geological Standard of Practice

Establishment of State Geological Survey (1860)

In April 1860 the State Legislature passed an act creating a State Geological Survey and the Office of the State Geologist, naming Josiah Dwight Whitney as the first state geologist. Whitney endeavored to construct an accurate and complete survey of the State's geologic resources, a Herculean task which occupied the succeeding five years. In 1865 he published a 97-page account (*Geology of California, v. 1, part 1, Geology of the Coast Ranges*: Geological Survey of California) that included initial descriptions of the formations surrounding Mt. Diablo.

The **State Mining Bureau** was created by legislation in 1880 absorbed the Old State Geological Survey. This was, in turn, succeeded by the **Division of Mines and Mining**, headed by a State Mineralogist, and contained within the Department of Natural Resources, with headquarters in the San Francisco Ferry Building. A Petroleum Department was established in 1915, which eventually became the Division of Oil & Gas. In October 1961 the agency's name was changed to the **Division of Mines & Geology** in a reorganization of the newly created Department of Conservation. A brief history of the agency is contained in the December 1961 issue of *Mineral Information Service* (v. 14:12), the precursor publication of *California Geology*. The agency's name was changed to the **California Geological Survey** (CGS) in 2002.

USGS 15-minute quadrangles (1893-1944)

The U.S. Geological Survey (USGS) began systematic topographic mapping of northern California in the mid-1890s, using plane tables. The scales were between 1:62,500 (about an inch to the mile) and 1:125,000 (about 2 inches to a mile). 15-minute series quadrangles were published of inhabited areas, such as the coastal plains, while 30-minute maps covered less-populated areas, such as the Sacramento Valley and Delta, and mountainous terrain within the Coast Ranges.

The 15-minute series maps were released between 1893 and 1944. Most of these show the original position of water courses and wetlands around the turn of the Century, and as urban areas developed, new editions were published, between 1916 and 1944. The last series of 15-minute quads were produced during the Second World War (1941-45), and omit details within military reservations, such as Alameda Naval Air Station and the Oakland Army Base. These maps were also replicated as base maps for other products, such as mining, soil science and water resources studies.

Establishment of the Bureau of Public Roads (1893-1919)

The **U.S. Office of Road Inquiry** was established with the Department of Agriculture in October 1893, naming General **Roy Stone** as its first Special Agent and Engineer. The first 'object lesson highway' demonstration project was constructed in New Jersey in 1897. In 1903 Congress tripled the agency's budget, changing its name to the **Office of Public Roads Inquiries** and appointing **Martin Dodge** as the new Director. He divided the USA into four geographic divisions with a special agent in charge of each. In 1905 the agency was enlarged 67% and renamed the **U.S. Office of Public Roads**, with **Logan W. Page** as its new director. Under Page's leadership a Division of Highway Bridges & Culverts was formed in 1910, the American Association of State Highway Officials (now AASHTO) was established in 1914. The agency's name became the **U.S. Bureau of Public Roads** in 1915, and the following witnessed passage of the Federal-Aid Road Act of 1916, establishing the financing of highways using 50% federal and 50% state funds. In 1918 the agency established the ***Bureau of Public Roads Experimental Farm*** in Arlington, VA to measure impact forces of various wheel loads. The agency began published the journal ***Public Roads*** in May 1918. When Page retired in 1919 he was replaced by **Thomas H. McDonald**, an almost legendary figure who led the agency for the next 34 years, until 1953. From the late 1920s onward the importance of soil mechanics theory to pavement design and construction became increasingly appreciated, and most of the pre-1940 research in soil mechanics was geared towards improving pavement design.

The agency was renamed the **U.S. Public Roads Administration** in 1939, under the Federal Works Agency. When that agency was shut down in 1949, its name reverted to the **Bureau of Public Roads** and it was placed within the Department of Commerce. This was superseded by the establishment of the **Federal Highway Administration** and the new Department of Transportation in October 1966, which became operational in April 1967.

Establishment of Bureau of Soils (1901)

In 1894 the Division of Agricultural Soils was created in the Weather Bureau of the Department of Agriculture. With the inception of National Cooperative Soil Survey efforts, in 1899 the name changed to the Division of Soils, with a marked increase in funding. The first four surveys focused on portions of Maryland, Connecticut, the Salt Lake Valley of Utah, and the Pecos River Valley of New Mexico. These early efforts were focused on geology/geography and chemistry, with little or no input from agronomists.

In 1901 the Bureau of Soils was established with the USDA. In that era soil texture was the principal soil characteristic described in maps and reports, but soil series were soon established as groupings of distinctive soil types. Other characteristics, such as soil color, organic content, soil structure, drainage, erodibility, and nature of subsoil were gradually added to studies over the following decades. Some of these

included soil provinces with their respective soil series where dominant depositional provinces were recognized, such as glacial, aeolian, alluvial etc. Whenever USGS topographic sheets were available soil maps were overlain on these. Most of these early surveys were published at a scale Work for soil surveys was done at a mapping scale 1 inch to the mile. In other cases early soil surveys were made using plane table and alidade surveys to develop their own base maps. Gradually the scale increased until, by 1960, it was pretty well standardized at 1:12000 or 1:24000.

Some of the earliest Bureau of Soils reports in the greater Los Angeles area include: Soil Survey of the Los Angeles Area, California by Louis Mesmer (1904), which included the first color maps of the soil types and alkali content of the coastal plains and wetlands, from Bolsa Chica to Santa Monica, at a scale of 1:62,500 (an inch to a mile). More detailed studies arrived in the following decade, such as: Soil Survey of the Riverside Area (1915), Pasadena Area (1915); San Fernando Area (1915), Los Angeles County (1915), Anaheim Area (1916), and the Reconnaissance Soil Survey of the san Diego Region in 1915. Two of the most oft-cited surveys are: J. W. Nelson's *Soil Survey of the Los Angeles Area* in 1919 (CA Ag Exp Sta, Wash DC, 78 p.), and *Reconnaissance Soil Survey of the Central Southern Area* (2/3 of LA County, all of Orange County and western portions of Riverside and San Bernardino Counties) in 1921 by J.E. Dunn, L.C. Holmes, A.T. Strahorn, and J.E. Guernsey. Many of these older reports are now available online.

First Sheepsfoot compactor (1902-23)

The first sheepsfoot roller was built in Los Angeles in 1902, where it was marketed as the "Petrolithic Paving Tamper." The roller was patented by **John W. Fitzgerald** in 1906, who worked for **Walter** and **Harbert Gillette**, owners of the **Petrolithic Paving Co.** of Los Angeles, and it was built by the Killefer Manufacturing Co. The roller employed a three-foot diameter log studded with railroad spikes protruding 7 inches, distributed so the spikes were staggered in alternate rows. This layout was soon modified to increase weight and efficiency, initially by increasing its length to 8 ft. The roller's weight was then increased to about 5000 lbs by filling them with sand and water (drained when moved). The 7-in spikes were enlarged to a contact of area of 4 sq inches. This increased the load bearing on each spike to 300 lbs, or about 75 psi contact pressure. Production models were modified with a counter-balanced tow frame and hemispherical fender, and marketed nationally as the "Fitzgerald Roller." The number of spikes was reduced to either 10 or 11 per row, to bring the contact pressure up to 100 psi.

The "Petrolithic Paving Tamper" roller was used in Santa Monica, Los Angeles, and Pasadena to provide an inexpensive means of paving public streets founded on expansive soils, but it proved unsuccessful. It was first used to compact an embankment dam by Bent Bros Construction in El Segundo, CA in 1912. Thoughtful imitations soon appeared, and when the patent expired in 1923, it was not renewed.

First use of the term "geotechnical" (1913)

In 1913 a "***Geotechnical Commission of the Swedish State Railways***" was appointed, chaired by **Wolmar Fellenius**, a professor of civil engineering at the Royal Institute of Technology in Stockholm. That commission studied a number of slope stability and bulkhead failures that had impacted the Swedish Railway system and issued a report in 1922 that was circulated in the United States, through ASCE's ***Special Committee to Codify Present Practice on the Bearing Value of Soils for Foundations*** (reported on pages 715-16 of the December 1922 ASCE Proceedings). The term "geotechnical" was eventually adopted by soils and foundations engineers world-wide, to better describe the many faceted aspects of their profession, which involved soils, rock, water, and organic matter.

Dam Safety Acts of 1915 and 1917

In 1915 the California legislature passed its first dam safety legislation, which required all plans for dams and reservoirs to be submitted to the State Engineer for approval, but the act provided no penalty for failure to comply. In August 1916 the State Reclamation Board issued a report recommending that the State Engineer regulate all storage reservoirs. No further action was taken by the legislature until after January 1916 floods in Southern California. In 1917 a new dam safety act was enacted in the wake of public outcry following the failures of the Lower Otay and Sweetwater Dams in San Diego County during the floods of January 1916. The 1917 act granted the State Engineer authority over all dams > 10 feet high or which impound > 9 acre acre-ft (3 million gallons), with exception of: 1) dams for mining debris constructed by the California Debris Commission; 2) dams constructed by municipal corporations maintaining their own

engineering departments (such as Los Angeles BWWS); and 3) dams and reservoirs that are part of water systems regulated by the State's new Public Utilities Act.

That same year (1917) the State Railroad Commission was given authority over all dams owned by public utilities. The railroad commission exercised some oversight on 46 of 140 dams built in California between 1917-1929. Municipal water agencies, such as publicly-owned agencies and districts, were exempt from State overview (until the 1929 legislation). From 1917-29 the State Engineer was given authority to review plans for dams prepared by irrigation districts, private companies and individuals. In 1920 the Federal Power Commission began supervising dams for power projects involving the public domain.

ASCE Special Committee to Codify Present Practice on the Bearing Value of Soils for Foundations (1915-26)

In 1915 a Committee to Codify Present Practice on the Bearing Value of Soils for Foundations was formed by the American Society of Civil Engineers, chaired by **Robert A. Cummings** (1866-1962), Consulting Engineer from Pittsburgh, who founded the Cummings Structural Concrete Co. in 1884, and was an early proponent of reinforced concrete construction. Another member of the committee was famed sanitary engineer and hydrologist **Allen Hazen** (1869-1930). The committee solicited input from practitioners across the nation and published annual reports of up to 40 pages in length in the ASCE Proceedings between 1916-26 (Cummings served as a Director of ASCE from 1914-20 and as Vice President in 1920 and '21). These empirical values became industry standards until the more rigorous methods of assessing bearing capacity of soils were developed by G.G. Myerhoff between 1950-55.

Highway Research Board (1920)

The Highway Research Board (HRB) was organized on November 11, 1920 as an agency of the Division of Engineering & Industrial Research, one of eight divisions of the National Research Council, which had been established in 1916, shortly before America's entry into the First World War. The HRB was intended as a cooperative organization between the "highway technologists" of America, in support of the U.S. Bureau of Public Roads, state highway agencies, and a the few academic researchers beginning to engage in practical issues related to pavement design. The HRB was intended to encourage research and provide a national clearinghouse and correlation service for research and information on highway administration and technology. The expansive adobe clay soils in California created a very real need for highways that could withstand large seasonal fluctuations in soil moisture content, which catapulted California to the top of the emerging science associated with pavement design during the 1920s. From these efforts to understand and characterize subgrade materials came the recognition and appreciation of the emerging field of soil mechanics.

The establishment of the HRB soon led to extensive track tests at Columbia Steel Mills in Pittsburgh, CA, a cooperative project of the California Division of Highways of the State Department of Public Works, the U.S. Bureau of Public Roads, and several others. These tests led to the development of R-values to characterize pavement subgrade materials (in 1927), and the first subgrade compaction test standard (California Test Method 217 in 1929), which had widespread influence, nationally. More extensive tests using larger construction equipment was carried out during the Second World War at Stockton Army Airfield. This led to the development of flexible pavement design methodologies which dominated the post-war transportation sector, and the Modified Proctor Compaction test (AASHTO T180), for airfield runways (in 1945), which was eventually adopted by ASTM in as Test No D-1557 in 1958. This became the statewide standard in the 1985 Edition of the Uniform Building Code and the 1986 California Building Code, when UBC Standard 70-1 (introduced in 1964) was eliminated.

Differing Site Conditions Clause introduced (1921)

The first standardized "***changed conditions***" clause was developed by the Interdepartmental Board of Contracts and Adjustments on November 22, 1921 by the U.S. Bureau of the Budget. The new clause was intended to provide a contractual basis for contractors that encountered site conditions that were more adverse than those indicated in the construction contract. The changed conditions clause was thereafter included in a standard form of general conditions for construction contracts issued after August 20, 1926. To this day, Federal Regulations mandate its use in U.S. Government contracts. This clause was subsequently adopted in the standard contract documents sponsored by the Engineers Joint Contract Documents Committee of ACEC, ASCE, and NSPE; the AIA, ASCE in collaboration with the Associated General Contractors of America;

AASHTO, and numerous state and municipal agencies. In 1968 the term "changed conditions" was revised to "differing site conditions," commonly referred to as the "DSC clause."

First use of mechanical compaction on embankment dams (1920s)

The first earth embankments compacted with sheepsfoot rollers were the Lake Henshaw Dam in 1920-23 for the Vista Irrigation District in San Diego County. This was followed in 1926 by Philbrook Dam for Pacific Gas & Electric Co. in the northern Sierras by R.G. Letourneau, and the **Puddingstone Dam** for the Los Angeles County Flood Control District in 1925-27, using a new roller patented by contractor H.W. Rohl that employed ball-shaped heads. The first earth dam compacted by sheepsfoot roller for a federal agency was Echo Dam in Utah for the Bureau of Reclamation in 1928. The sheepsfoot roller's narrow spikes induced *kneading compaction*, critical for densifying clayey soils.

USGS/Los Angeles County 6-minute topographic quadrangles (1923-45)

In the early 1920s Los Angeles County contracted with USGS for a special series of 6-minute 1:24,000 (1" = 2,000 feet) scale topographic maps, covering the entire county. 113 quadrangles were published between 1923 and 1945, with contour intervals of 5 and 25 feet. The 5 feet contours were used in valleys and channel areas with low topographic relief, while the 25 feet contours were used in steeper terrain. These were plane-table derived topographic map products produced by the USGS and remain the best pre-development record of Los Angeles County, especially on alluvial fans, old channels, and within inland valleys. They are available from a number of sources, including the UCLA Map Library, the Huntington Library, the California Geological Survey Regional Office, and other college map collections (including the Map Library at U.C. Berkeley, which has a complete collection). Many of the established consultants in southern California also maintain private collections.

Development of the Uniform Building Code (1925-27)

The Uniform Building Code came about as a result of the Magnitude 6.3 Santa Barbara earthquake of June 25, 1925. This quake caused $6 million in damage to a city with only 30,000 people. The quake also came on the heels of the Great Kanto Earthquake of 1923 (M 7.9), which burned much of Tokyo to the ground and killed 143,000 people. In the wake of the terrible losses suffered in Santa Barbara, the nation's largest insurers asked the Seismological Society of America (SSA) to provide future seismic risk assessments. The Board of Fire Underwriters of the Pacific funded several research projects aimed at assessing the earthquake hazard risks for various building types, making unreinforced masonry structures virtually uninsurable. When these assessments were released, they were so alarming that most lending institutions refused to invest in any further construction in the Los Angeles Area.

This led to a crisis involving the California State Chamber of Commerce, the California Development Association, the Los Angeles Chamber of Commerce, and SSA. SSA officials met with local governments and encouraged them to consider the adoption of seismic design tenants in their building codes, while the Los Angeles Chamber of Commerce hired retired USGS geologist R.T. Hill to debunk and discredit everything SSA President, Stanford Geology Professor Bailey Willis (also a retired USGS geologist) had to say about increased seismic risk in southern California.

On October 18-21 the **Pacific Coast Building Officials Conference** (PCBOC) convened in Los Angeles and hammered out a new **Uniform Building Code** (UBC), which was published by PCBOC. The primary purpose of the PCBOC was to establish regulations and standards for building safety. In March 1956 the PCBOC was conjoined with several other building code conferences to form the much larger **International Conference of Building Officials**, known as ICBO. While ICBO had no legal authority to create laws, most cities in the western United States adopted ICBO standards after 1956. Revised editions of this code were published approximately every 3 years, up through 1997.

From 1927-94 PCBOC/ICBO was headquartered in Los Angeles and from 1956, in Whittier. During the late 1950s and throughout the 1960s ASCE, CCCE, AEG, and ICBO formed numerous joint committees to explore the establishment of suitable standards for foundation engineering, grading and excavation. These consultations resulted in the establishment of Expansion Index Test (UBC Test 29-2/18-2), adopted in 1967; and the UBC [compaction] Test Standard 70-1, adopted in 1967 (and discarded in 1985).

Failure of the St. Francis Dam (1928)

On the night of March 12/13, 1928 the St. Francis Dam, a 205 ft high curved concrete gravity structure built by the Los Angeles Department of Water & Power between 1924-26 failed catastrophically,

killing more than 435 people. The civil engineering profession gained much from the public outcry and notoriety accompanying the St. Francis Dam disaster. Sound engineering geologic input on dams became commonplace in the 1930s (it had been all but absent in the 1920s).

California Bearing Ratio Test (1928)

This was a novel test procedure developed by **O. James Porter** of the **California Division of Highways** in the late 1920s, in Sacramento. Porter took subgrade soils from proposed highway alignments and removed the fragments >1/4 inch, then compacted the soil in a cylindrical mold, six inches and diameter and five inches high ($1/12^{th}$ ft^3). The samples were then submerged for a known period and then its resistance to a penetrating needle is measured, which is then compared to a "standard resistance" for crushed limestone. The determined resistance was then divided by the standard resistance and multiplied by 100, and referred to as the "**California Bearing Ratio**" (CBR). It was intended to evaluate subgrade strengths in the investigation of existing pavements and aid in selecting granular subbase beneath pavements.

The empirical test regimen was extrapolated over the succeeding two decades to estimate soil suitability for increasing wheel loads, far beyond what anyone imagined in 1928 [Porter O.J., 1939, The preparation of subgrades: *Proc. Highway Res. Bd*, Wash., v.18:2, 324-31; and ENR Mar 21, 1946, p.422]. During the Second World War Porter and the Army Corps of Engineers developed a protocol using the CBR test to evaluate subgrade strength for pavement design of airfields (O.J. Porter, 1942, "Foundations for Flexible Pavements," Proceedings, Highway Research Board, Washington, D.C., Dec; O.J. Porter & Co. (1949). Accelerated Traffic Test at Stockton Airfield Stockton, California (Stockton Test No. 2)," Corps of Engineers Sacramento District, Department of the Army).

From 1945 on, this method was used almost exclusively for flexible pavement design by the California Division of Highways and the Army Corps of Engineers because the Corps published simple pavement design correlations based upon the CBR values. These procedures ushered in the modern era of flexible pavement design, making Porter a high visibility figure.

First soil compaction standard (1929)

The first published standard for testing the mechanical compaction of earth was the California State Impact Method, or "California Impact Test." It is now known as California Test 216 – "Method of Test for Relative Compaction of Untreated and Treated Soils and Aggregates." It was developed in 1929 by **O. James Porter,** PE (1901-67) of the **California Division of Highways** in Sacramento. It presented a procedure for ascertaining the in-place wet density of aggregate baserock or compacted soil, and the preparation of a wet density versus soil moisture content curve (similar to what Proctor later proposed, using dry soil density, described below). The 216 test uses wet density as the measurement standard and has been modified six times since its original adoption in 1929. The current version of the test used to be referred to as California Test Method No. 216-F, which employs energy input of 37,000 to 44,000 ft-lbs/ft^3 of soil.

Committee on Earths and Foundations of ASCE (1929)

This committee of ASCE was formed in 1929 to foster research work in the emerging field of foundation engineering and soil mechanics. Its goal was to establish centers of research in the United States, I cooperation with the hydraulics laboratories at the University of Minnesota and Iowa State then engaged in the extensive flood and navigation improvements being promulgated along the Mississippi River. The principal members were: Lazarus White (of Spencer, White & Prentiss), chairman; George E. Beggs, M.L. Enger, R.J. Fog, Glennon Gilboy of MIT; Harry T. Immerman, Dimetri Krynine of Yale, sanitary engineer Frank A. Marston (Metcalf & Eddy), George Paswell, and Karl Terzaghi. The committee cooperated with **Ralph Proctor of LADWP** in approving the methodologies employed in developing his compaction tests for the Bouquet Canyon Dams in 1931-33, and with Prof. Gilboy on the hydraulic fill embankments designed by the Corps of Engineers for the Muskingum Project in Ohio in 1934-39, which included construction of the Corps' first soil mechanics laboratory.

Adoption of engineering registration (1929)

Wyoming was the first state to register engineers, in 1907. A registration act for engineers had been passed by the State Assembly and Senate in Sacramento in 1925, but failed to gain the governor's approval. Engineers promoting registration then formed the California Engineers Registration Association (CERA) on March 10, 1928, just two days before St. Francis Dam failed. As it turned out, their timing was fortuitous, as

the public clamored for "something to be done" to better ensure public welfare and safety in the wake of the dam's failure, which killed more than 435 people. CERA's rolls swelled to 600 members by November and politicians were eager to demonstrate to the public that they were making sweeping changes to the status quo.

The **Civil Engineers Registration Bill** sailed through the state legislature in early July 1929 and became law on August 14th. Right up to its adoption, the act was vigorously opposed by a number of professional organizations, such as the American Institute of Mining Engineers and the American Society of Mechanical Engineers. The new act defined civil engineering as: "that branch of professional engineering which deals with the economics of, the use and design of materials of construction and the determination of their physical qualities; the supervision of the construction of engineering structures; and the investigation of the laws, phenomena and forces of nature; in connection with fixed works for: irrigation, drainage, water power, water supply, flood control, inland waterways, harbors, municipal improvements, railroads, highways, tunnels, airports and airways, purification of water, sewerage, refuse disposal, foundations, framed and homogeneous structures, bridges, and buildings. Furthermore, it included city and regional planning, valuations and appraisals, and surveying, other than land surveying as already defined in Statutes adopted by the legislature in 1891 (the first engineering registration act in the United States) and amended in 1907. It mandated that any person who practices or offers to practice civil engineering in any of its branches must be registered, and created The Board of Registration for Civil Engineers.

The act also directed that civil engineers in state service must be duly registered if they served in a capacity of 'Assistant Engineer" or higher. The California Supreme Court quickly issued rulings that a contract for engineering services was invalid if the party undertaking to furnish engineering services was not registered and the State's Appellate Courts ruled that engineers offering expert testimony should be registered, although it left the ultimate decision to the discretion of individual judges because some individuals had previously been qualified as experts, before passage of the registration law.

The act allowed the three-person board to develop standards for applicants over a two year period and to survey registration standards being employed by other states, for purposes of comparison. California made a comprehensive study of procedures practiced in 25 other states and seven Canadian provinces which had laws regulating engineering practice. The standard California adopted required applicants to be at least 25 years old, a legal resident of the state for at least one year (waived for those willing to sit for the examination), and demonstrate more than six years of professional practice, including at least one year of being in "responsible charge." Applications had be supported by at least four engineers unrelated to the applicants by family or marriage, who could vouch for their character, experience, and technical competence, before they would be eligible to sit for the written examination. The board allowed a college degree in engineering to be the equivalent of four years' experience, while graduate work in engineering could be credited for up to one year of experience (California did not offer doctorate degrees in civil engineering until sometime later, but this discrepancy has never been amended).

5,700 individuals applied for civil engineering registration during the first year applications were accepted, more than double what the state board had expected. Grandfathering was only allowed for the first 10 months, until June 30, 1930, after which time, applicants would be required to take a written examination. Many of those who applied for grandfathering were asked to appear before the three man board (appointed by the governor) for oral interviews. The basic determinant for "gray area" cases was whether applicants had entered the profession from the labor ranks of construction, this experience was not deemed to be 'engineering experience." Of those who applied the first year, 5,035 were accepted, providing the State of California with about one registered engineer for every thousand people then living in the state! It took California the next 25 years to register the next 5,000 civil engineers. Many states followed the examples demonstrated by New York and California. By 1932, 28 states had enacted professional registration for civil engineers. In 1947 Montana became the last state of the original 48 to adopt PE registration.

Over the years, the Board has experienced some major changes under the provisions of the Professional Engineers Act. The number of branches of engineering regulated by the Board has increased, and the status of some of the older branches has changed. When electrical and mechanical engineering were first covered by the registration law in 1947, the law only affected the use of the titles. In 1967, the Act was amended to regulate the practice of those branches, as well as the titles. In the late 1960s and early 1970s, the Act was also amended to give the Board the right to accept additional branches of engineering into the registration program. The additional categories were for the purpose of regulating the use of the titles of those engineering branches. Between 1972 and 1975, the Board expanded the registration program to include nine additional branches of engineering under its jurisdiction. In 1986, at the Board's request, the authority to create new title registration branches was removed from the Act. In the late 1990s and early 2000s, four of

the title registration branches were deregulated. In 2009 the Board of Registration for Geology & Geophysics was absorbed into the Board of Registration for Professional Engineers and Land Surveyors (BORPELS). On January 1, 2011 it was renamed the Board for Professional Engineers, Land Surveyors, and Geologists.

California Dam Safety Act of 1929

In the wake of the St. Francis Dam failure, the state passed a much more comprehensive Dam safety Act on August 14, 1929. The Act empowered the State Engineer to review all non-federal dams > 25 feet high or which impound > 50 acre acre-feet of water. The act also allowed the State to employ consultants, as deemed necessary. The State Engineer was given $200,000 and instructed to examine all dams in California within three years and issue recommendations. The State Engineer was given full authority to supervise the maintenance and operation of all non-federal dams (exempting those constructed by the Army Corps of Engineers and the Bureau of Reclamation)

Between August 1929 and November 1931 the State Engineer inspected 827 dams. One third were deemed to exhibit adequate safety, while another third were recommended for further examination, such as borings or subaqueous inspection, before a determination could be made. The remainder, roughly, another third, were ascertained to be in need of alterations, repairs or changes; frequently involving spillway capacity.

After this there followed a six-year program of dam safety inspection, which were concluded in July 1936. During this period 950 dams were inspected; with 588 of these dams being under the State's jurisdiction. One third of these dams were found in need of repairs. New dam construction was also placed under state observance from August 1929 forward.

Evolution of Porter Soil Samplers (1930-47)

In 1930 Omer James Porter of the California Division of Highways began developing a ***retractable plug sampler***, known as the "**Porter Type Soil Sampler**." The device then underwent a series of improvements over the next six years, based on experience. This inexpensive sampler was widely employed over the next 50 years to recover 1-inch to 2-inch diameter samples. The device employed a lockable plug at the foot of the sampler, which remained in place while the sampler rings were driven ahead to the desired depth. When the desired depth interval was reached, the plug was retracted up inside the sample barrel, and the open sample barrel advanced ahead of its starting position, to recover between 18 inches to five feet of relatively undisturbed soil sample (depending on diameter).

The device enjoyed much success because a vacuum was maintained during driving, helping recovery of samples. Porter Samplers came in a variety of diameters and lengths. The one inch diameter samplers were designed for manual operations in soft soils and were limited in their application to depths of up to 60 feet. This sampler employed an outside diameter of just 1.25 inches with 1-inch sampler barrel. The one-inch sampler was usually set up by a three man crew using a portable tripod.

In 1933 Porter introduced a three-inch diameter sampler intended to recover undisturbed two-inch diameter soil samples. The sampler was five feet long, allowing a continuous sample to be taken of that length. Two samplers were normally assigned to each rig so that drilling and sampling operations could be sustained, without interruption. The sampler was fitted with segmented brass liners, 2- inches in diameter and two inches high, which after sampling, were separated using a piano wire saw (see T.E. Stanton, 1936, *An Improved Type of Soil Sampler for Explorations of Soil Conditions and Soil Sampling Operations*, Proc 1st ICSMFE, Cambridge, v.1, p.13-15).

The two-inch sampler required power equipment and was originally developed for the recovery of undisturbed samples of clay for the San Francisco Oakland Bay Bridge project. Between 1933-36 more than 13,000 lineal feet of samples were taken from 232 borings for the Bay Bridge, as well as other highway projects. These samplers were used to a maximum depth of 232 feet on the Bay Bridge. A larger sampler was also fabricated to recover four-inch diameter samples for those situations that warranted larger diameter samples, for shear strength and consolidation testing.

The two and four-inch samplers were used with truck mounted drilling rigs. For subaqueous sampling beneath San Francisco Bay, the drill rigs were tied to barges and steel well casings was inserted through the waters and driven 7 to 90 feet into the seafloor. The depth of penetration depended on the presence of running sands (ENR, June 4, 1936, p. 804-05). Brass caps were used to seal the individual sample segments upon recovery. The four-inch sampler required heavier equipment to operate, so was only used in situations that justified the additional cost.

During World War II Porter developed "all-in-one" truck-mounted drilling rigs with retractable masts and a suitable array of Porter Samplers. These were intended to provide a more robust system of drilling

and recovery of continuous soil samples for the Navy out in the Pacific, where they were having difficulties drilling through porous and cavernous coral, causing loss of drilling circulation. These rigs were equipped with three-foot long samplers, intended to recover continuous two-inch diameter samples using three-foot sampling rounds. The rigs could develop 20,000 pounds force to aid sampling at depth. After the war (1946-47) Porter developed even heavier truck-mounted drilling rigs that could exert pressures of up to 30,000 pounds up or down, which doubled as exploration and foundation drilling rigs, which could be used to drill large diameter caissons (see O.J. Porter, *Taking Soil Samples by the Soil Tube Method* in November 1947 issue of Roads & Bridges).

In the mid-1950s Porter began marketing a 3-inch diameter sampler capable of recovering 2.5-inch diameter samples, which could be used with 6-inch, 2-inch, or 1-inch high brass rings. This was intended to compete with the Modified California Sampler of Dames & Moore, described later.

Development and deployment of accelographs (1931)

During the late 1920s **John R. Freeman** of MIT's Board of Governors and **Romeo R. Martel** of Caltech actively corresponded and promoted the idea of developing strong motion sensors, after the damaging earthquakes in Tokyo in 1923 and Santa Barbara in 1925. Freeman's political clout in Washington, DC eventually secured the necessary funding to see the project approved and funded. This is why Freeman is generally credited as being the father of the modern accelograph.

Frank Wenner of the U.S. Bureau of Standards developed the seismic unit and **H.E. McComb** and **D.L. Parkhurst** of the U.S. Coast & Geodetic Survey (USC&GS) developed the recording unit of the world's first strong motion accelograph, known as the "Montana accelograph," in 1931. It was based on the design of the Wood-Anderson seismograph developed at the Pasadena Seismological Laboratory of the Carnegie Institution by Harry O. Wood and John Anderson in 1922 (formally absorbed into Caltech in 1931).

Installation of these accelographs began in 1932 by the newly established Seismological Field Survey of the USC&GS, based in California (these activities were transferred to the USGS in 1975). By March 1933, eight units had been installed in California. Three instruments, in Long Beach, Vernon, and Los Angeles, were triggered during the March 10, 1933 M 6.2 Long Beach earthquake, providing the first strong motion records of near field motions, and were important records for many years thereafter, because they emanated from shallow strike-slip faulting, typical of coastal California.

For many years thereafter, **Terrametrics** of Pasadena was the leading manufacturer of strong motion recorders, because of their proximity to Caltech and the nation's largest market for such instruments, in the high rise strictures and bridges of the Los Angeles and San Francisco metro areas.

Earthquake Damage and Earthquake Insurance (1932)

Around 1925 **John R. Freeman** (BSCE 1876, MIT) a nationally prominent waterworks engineer and fire insurance executive (who patented the interior fire sprinkler in 1886) began researching earthquakes when he discovered that nothing was mentioned about them in the structural engineering texts of that era. Freeman was a long-time member of the MIT Board of Trustees, a fellow of the National Academy of Sciences, and the man that brought Karl Terzaghi from Istanbul to MIT in 1925 to solve the foundation settlement problems on the MIT campus. He began corresponding with an array of luminaries who had studied earthquakes, including Professor Tachu Naito in Japan and R.R. Martel at Caltech, whom he met face to face at the World Engineering Conference in Tokyo in 1929. Upon his return from this trip he began working on a book that compiled all the known information on earthquake loads on structures, with the desire to summarize how structures such as buildings, could be better designed to resist earthquake loads. He worked non-stop on this project for the next few years, eventually completing the classic tome ***Earthquake Damage and Earthquake Insurance***, which was released in 1932, about six months before the destructive Long Beach earthquake. Freeman died on October 6, 1932, shortly after the book appeared. His book formed the basis of modern earthquake engineering until the First World Congress on Earthquake Engineering convened in 1953.

Structural Engineer title act (1932)

In September 1932 the California Board of Registration for Civil Engineers begin granting the special title "**structural engineer**" (S.E.), which required applicants to demonstrate three to five years of responsible charge of structural engineering projects to be eligible to sit for a special examination. But, those individuals who could document more than five years of experience in "responsible charge" were duly grandfathered into the title. The first SE exam wasn't offered until several years later, in 1934.

In March 1933 the Long Beach earthquake killed 115 people and caused $50 million in damage, mostly to unreinforced masonry structures, such as public school buildings. Within a month of the quake, the California Legislature passed the **Field Act** (described below), which empowered the Office of the State Architect to undertake whatever measures it deemed appropriate to ensure safe design and construction of public school buildings, which included requirements for plans prepared by a certified architect or structural engineer and set requirements for lateral earthquake loads, which depended on location. The Field Act left a lasting imprint on how structural engineers would be qualified in California; requiring them to demonstrate an understanding of analyses, designs, and consultations involving structural engineering principles associated with the application of seismic loads.

A companion legislation called the **Riley Act** (described below) was also enacted in 1933, which required local agencies in California to establish their own building and inspection departments (the first Uniform Building Code had appeared in 1927, but only a handful of the state's largest cities had adopted it). The Riley Act also required all new construction to be designed to withstand an earthquake acceleration of at least 0.02g, but also allowing municipalities the discretion to employ even higher values, as they deemed appropriate.

National Council of State Boards of Engineering Examiners (1932)

In October 1932 a National Council of State Boards of Engineering Examiners (NCSBEE) was endorsed at a meeting in New York of the National Bureau of Engineering Registration (NBER), headquartered in Columbia, South Carolina. NCSBEE sought to create standardized civil engineering registration examinations and requirements so reciprocity of licenses between the 28 states mandating professional registration could be undertaken more efficiently. NCSBEE changed its name to the National Council of Engineering Examiners (NCEE) in 1967. NCEE developed standardized tests which were gradually adopted by most states, beginning in the 1960s. NCEE broadened its scope to include establishment of a *Model Rule for Professional Conduct* in 1979, which many courts have considered as national standards for professional engineering conduct. In 1989 NCEE became the National Council of Examiners for Engineering & Surveying (NCEES). Its headquarters remains in South Carolina (at Clemson).

California remained unaligned with the national examination concept until 1975, when they acquiesced to the standardized NCEE examination, which they have since employed. The reason the California board gave for this reticence was the "eastern bias" they perceived in the NCSBEE/NCEE exams, which had less emphasis on transportation engineering problems, as compared to California's own tests.

Landslides shut down Pacific Coast Highway (1932)

As more and more roads were built into hillside areas in the burgeoning 1920s, "storm damage" via flooding and cut slope failures became commonplace around southern California. Despite the many problems encountered along the Pacific Palisades, the "Roosevelt Highway" was pushed along the coast from Santa Monica to Point Mugu in 1928-29. This highway opened up much of the coastal area to development, and soon suffered problems.

One of the more innovative measures taken at this time was in response to a series of bluff failures below the McCormick Estate, on Corona del Mar and Alma Real, just above the old Roosevelt Highway (later renamed, see below). The block glide landslide that shut down the highway in November 1932 was the **Quelinda Estate Landslide**. It soon developed into one of the earliest geologic appraisals of landslippage in southern California. Consulting geologist **Harry R. Johnson** used aerial photo overlays to illustrate the geologic conditions along 1-/34 miles of coastline, the first time this technique was employed. He discovered that the slide was moving on a weak clay stratum about 10 feet above the base of the bluffs. Civil engineer **Robert A. Hill** of Quentin, Code, and Hill Consulting Engineers of Los Angeles attacked the clay seam at the base of the cliffs, employing a novel system of hand-excavated tunnels to circulate hot air to desiccate the clay. Adits were tunneled into this stratum to drain the layer, but no free water was encountered. A gas-powered furnace was installed at the base of the cliffs connected to a series of blowers to desiccate the clay, and, thereby, increase its shear strength. (see R.A. Hill, 1934, ***Clay stratum dried out to prevent landslips***: Civil Engineering, v. 4, p. 403-07). The heaters were run between 1933-39 and it was estimated that 3,000 lbs of water per day was thereby evaporated from the clay stratum .

In 1940-41 the Roosevelt Highway was widened to improve traffic safety and speeds, and was re-christened Pacific Coast Highway (PCH). This widening and realignment was carried out using mass grading. Storms during the winter of 1939-40 had caused several landslides that closed PCH, precipitating the first of

many generations of remedial grading measures to battle regression of these cliffs (see D.H. Greeley, 1940, *Prevention of Slides as a Safety Factor*: Calif. Hwys & Public Works, v.19:5 [May], p. 13-14).

The Riley and Field Acts (1933)

Two significant pieces of legislation came out of the March 10, 1933 Magnitude 6.3 Long Beach earthquake. On April 25, 1933 the State legislature passed the **Field Act**, named after Sacramento Assemblyman Charles Field, the key sponsor of the legislation. His bill focused on making public school buildings in California more earthquake resistant (all K-12 and community college school buildings). It was also the first statewide legislation that mandated earthquake resistant construction in the United States. The quake destroyed or rendered unsafe 230 school buildings in Southern California because these were constructed of unreinforced masonry. Fortunately, the quake occurred at 5:55 PM on a Friday, after most everyone had gone home, and thousands of children's lives were thereby spared.

The Field Act was introduced with the Riley Act, which together, all but banned unreinforced masonry construction, requiring that earthquake forces be included in the design of new structure, and all existing public schools. This included a requirement for base shear calculations, and that school buildings must be able to withstand lateral forces equal to at least 3% of the building total mass. The Act also established the Office of the State Architect (now Division of the State Architect or DSA) which developed design standards, quality control procedures, and required that schools be designed by registered architects and engineers. These professionals are required to submit their plans to the State Architect for review and approval prior to construction. The same professionals were also required by the Act to periodically inspect the construction while underway and verify that the actual work completed is in compliance with the approved drawings. Peer review was also introduced as another quality control procedure.

The other significant legislation that came out of the Long Beach earthquake was the **Riley Act** (named after Assemblyman Harry B. Riley of Long Beach), approved by the State legislature on May 27, 1933. The act required all cities and counties in California to establish departments to regulate building construction. Roughly 10 to 15 percent of California's present structures were built prior to 1933, when few cities had building codes (the Uniform Building Code was introduced in 1927, but was only adopted by a few of the larger municipalities, such as Los Angeles). The Riley Act required local jurisdictions to establish building and safety departments and inspect new construction, mandating that all structures in the state be designed to withstand a horizontal acceleration of 0.02g. These requirements applied only to new, non-agricultural structures. California building officials could add to the Riley Act requirements at their own discretion (such as Los Angeles, Long Beach, Santa Barbara, San Francisco, and Palo Alto). The Riley Act exerted an enormous impact on California because structures built since 1933 have been constructed with some minimal measure of lateral reinforcement and load transfer elements within the framing, and later, between the framing and the foundations.

Since the 1960s, California codes have become more uniform across local jurisdictions (see discussion of the Uniform Building Code, in 1927 and 1933). The Riley Act includes exemptions for wood frame structures of two stories or less, as well as biplexes and single-family residences of all construction in unincorporated areas (only one person was killed inside a single-story wood frame dwelling by any California earthquake during the 20th Century). However, many counties enhance their requirements for such buildings beyond these statewide minimums.

Adoption of seismic loads in the Uniform Building Code (1933)

Following the March 1933 Long Beach Earthquake, the State of California required every municipality to adopt a building code (under the Riley Act, described above). 114 California municipalities adopted the 1933 Edition of the UBC, including most of the larger cities in southern California. Prior to 1933 only Palo Alto and Santa Barbara had adopted codes that required lateral forces seismic events. Due to the poor performance of unreinforced masonry structures during the Long Beach earthquake, the 1933 UBC required all school of two stories or more in height to be built of reinforced concrete or structural steel frame construction. Single story schools were required to have fire-resistant walls and floors, and fire-retarding roofs. All public buildings, including schools, were required to provide for lateral forces from earthquake motion, and the use of lime mortar was altogether outlawed.

School districts and local municipalities complained, but a vigorous program of retrofit and school reconstruction, as well as new construction, soon ensued, providing work for architects, structural engineers, and contactors. It also bolstered the prestige and respect of licensed structural engineers, and their

organizations, such as SEAOSC and SEAOCC. Los Angeles adopted a restrictive version of this code in 1943 (described below), which included minimum pseudo static load requirements for seismic detailing, as well as more fire resistant construction details.

Proctor Compaction Test (1933)

Ralph R. Proctor, PE (1894-1962) was a field engineer for the Los Angeles Department of Water & Power (LADWP) on the **Bouquet Canyon Dams** in 1932-34. Construction Superintendent H. L. Jacques asked Proctor to devise a method of testing the compacted fill so the LADWP could demonstrate to the world that they were constructing the safest dam possible, in the wake of the March 1928 failure of the St. Francis Dam, built by DWP (which Jacques also supervised and which Proctor served as the resident field engineer). Proctor's test procedure measures the *maximum wet density*, and controls the compactive effort based on the total weight, not the volume, of the test sample. The primary advantage of Proctor's method is that the test results could be computed onsite, as evaporation of the compacted sample not being necessary. This allowed immediate adjustment of the soil water content, which was the *critical variable* the contractor needed to know.

Proctor developed a "dynamic compaction test," using an impact hammer, combined with a cylindrical mold, similar to that proposed by O.J. Porter for his California Bearing Ratio test in 1929. Proctor's procedure employed a smaller cylindrical mold, just four inches in diameter and 4.6 inches high, with a removable mold collar, giving it a volume of $1/30^{th}$ cubic foot. A 5.5 pound hammer, 2 inches in diameter, was pulled upward and allowed to free-fall 12 inches, onto the soil (5.5 ft-lbs per blow), simulating the dynamic impact of sheepsfoot rollers or heavy wheel loads on the soil. The soil specimen was compacted in three lifts, with an average thickness of 1.33 inches/lift. 25 blows were exerted per lift, which exerted 137.5 ft-lbs/lift. The total input energy for the three lifts was 3 x 137.5 = 412.50 ft-lbs on a soil sample with a volume of $1/30^{th}$ cubic foot. This equals 12,400 ft-lbs of dynamic compactive energy per cubic foot of soil.

Proctor published his recommended procedure in a series of four articles that appeared in *Engineering News Record* on August 31st, September 7th, September 21st, and September 28th, 1933. The test soon became a nation-wide standard, because of its simplicity, low cost, and utility in providing near real-time fill control. It was eventually designated as BurRec Test E11 (adopted in 1947), ASTM Test D698 (adopted July 1950), and AASHTO T99 (also adopted in1950).

First Sand Cone Field Density Tests (1933)

During construction of the San Gabriel Dam by the Los Angeles County Flood Control District in 1933-37, engineer **Paul Baumann,** assisted by **Ralph R. Proctor** and **N. M. Imbertson,** supervised a series of field tests to evaluate the best means of compacting earth and disaggregated rocky fill materials with 25-ton sheepsfoot rollers and rolling tampers, including an extensive evaluation of sluicing using large quantities of water (two cubic yards of water per cubic yard of rock placed). These test revealed the value of hydrocompaction and arching during mechanical compaction. During the field tests they settled on using 12-inch diameter test holes filled with "dry beach sand" and concluded that the dry in-place bulk density should be the governing factor determining the intrinsic properties of the fill (described in P. Baumann, ***Design and Construction of San Gabriel Dam No. 1***. ASCE *Proceedings* 67:7, Sept 1941; and in the Discussions of 1942 ASCE *Transactions* 107:1644-46).

Establishment of U.S. Soil Conservation Service (1933-35)

In June 1933 Congress passed the National Industrial Recovery Act, which included appropriations to combat agricultural soil erosion. This action was prompted by 'The Dust Bowl' conditions brought on by extended drought conditions in the Southwestern and Midwestern states. In September 1933 the federal Soil Erosion Service (SES) was established within the Department of Interior with **Hugh H. Bennett** as its Chief. Bennett had formerly served as a surveyor with the old U.S. Bureau of Soils. The SES established demonstration projects in critically eroded areas across the country to publicize the benefits of soil conservation.

In April 1935 Congress passed Public Law 74-46, which established the Soil Conservation Service (SCS) as a permanent agency within the U.S. Department of Agriculture, again under the direction of Bennett. In 1929 Bennett wrote a book titled "***Soil Erosion: A National Menace***," which influenced the decision to establish federal soil erosion experiment stations in 1929.

Bennett instituted a seven-fold increase in demonstration projects for local farmers and SCS began publishing County-wide report "separates," which included color overlays on then-existing USGS 15-minute (1:62,500 scale) topographic map mosaics. One example would be: E.J. Carpenter and S.W. Cosby, 1939, *Soil Survey, Contra Costa County, California*: USDA Bureau of Chemistry and Soils, Series 1933, No. 26. A check of this original map not only reveals the soil assignments, but in most instances, also provides an assessment of the undeveloped topography. These were usually prepared by local soil scientists attached to the SCS or in cooperation with the U.C. Agricultural Experiment Stations.

In the late 1930s SCS set about developing more reliable and scientifically-based maps of soil deposits with extensive compendiums of soils properties. In 1920 Professor **Curtis F. Marbut** of the University of Missouri began developing an agricultural soils classification scheme. In 1927 he translated Glinka's *The Great Soil Groups of the World and their Development* from German. His classification scheme was unveiled in the *1938 Yearbook of Agriculture, Soils and Men*: the 1938 USDA soil taxonomy. He divided soils into pedocals (carbonate rich soils in the drier climates) and pedalfers (soils developed in more humid climes and rich in aluminum and iron. Alfer became the root term for Alfisols. This new scheme met with mixed success.

The decade following the Second World War saw Congress increased appropriations for soil conservation programs. Between 1945-48 a new classification system was developed, culminating with the "7th approximation," introduced in 1960, which became the national standard in 1965. This was tweaked slightly to include 10 distinct soil orders in 1975, and expanded to include 12 soil orders in 1999. These details are included here to make the reader aware that soil surveys performed in different decades use differing descriptive terms. In 1994 the name of the agency was changed to the **Natural Resources and Conservation Service** (NRCS).

National Society of Professional Engineers (1934)

The **National Society of Professional Engineers** (**NSPE**) was founded in New York City in 1934 as the national society of engineering professionals from all disciplines, which promotes the ethical and competent practice of engineering, professional licensure, and enhances the image and well-being of the professional of engineering. NSPE established the celebration of National Engineers Week in 1951, in conjunction with President George Washington's birthday (February 22nd). President Washington is considered as the nation's first engineer, notably for his survey work. NSPE has worked with ASCE to establish uniform standards for professional engineering of civil engineers in all 50 states and territories of the United States, which went into effect in 2003. NSPE now serves more than 54,000 members and the public through 53 state and territorial societies and more than 500 chapters.

First course in soil mechanics taught in California (1934)

In 1930 Professor Frederick J. Converse at Caltech in Pasadena began a professional association with **Robert V. Lebarre**, who had worked for The Foundation Engineering Co. of New York. Lebarre cultivated an interest in the enraging specialty of soils mechanics and foundation engineering. He began doing part-time engineering design work for Lebarre. In 1933 Converse was promoted to assistant professor and established a consulting partnership with R V. LaBarre. In April 1933 Converse published his first article on soil mechanics titled "***Distribution of Pressure Under a Footing***," which appeared in Civil Engineering magazine (published by ASCE). It describes a plunger style pressure cell developed by Converse for ascertaining the pressure exerted beneath foundation footings. He began teaching soil mechanics as a graduate course at Caltech in the spring semester of 1934 using the text ***"A Practical Method for the Selection of Foundations Based on Fundamental Research in Soil Mechanics,***" by Professor William S. Housel at the University of Michigan (University of Michigan Engineering research Bulletin No. 13, Oct., 1929). Two of the graduate students in that first ever soil mechanics class were **Trent R. Dames** (1911-2000) (BSCE '33; MS '34 Caltech) and **William W. Moore** (1912-2002) (BSCE '33; MS '34 Caltech), who went onto found the firm Dames & Moore in August 1938, after working for R.V. Lebarre.

Downhole Logging of Large Diameter Borings (1935 – onward)

Around 1935 consulting foundation engineer **R. V. Lebarre**, PE, SE (1871-1944) of Glendale began excavating vertical shafts between two and three feet in diameter with a mobile power auger (described in "***Test Pit Exploration Kit for Foundation Study***" in the August 6, 1936 issue of *Engineering News Record*). These borings were of sufficient size and depth (60 to 70 ft deep) to allow a geologist to descend the unshored

holes for purposes of evaluating the geologic conditions and making measurements and taking soil or rock samples. These men also used soil penetrometers to record soil stiffness with depth, creating detailed subsurface logs.

The art of downhole logging was lost when Lebarre died in 1944, but was revived in the early 1960s by F. Beach Leighton, PhD, CEG and Robert Stone, PhD, CEG who used these same techniques, but with flexible Boatswain's Mate rope ladders, which Leighton had used in the late 1940s to descend into glacier crevasses in Alaska. Two excellent articles describing the use of using bucket augers have been published: C.M. Scullin, 1994, "***Subsurface exploration using bucket auger borings and down-hole geologic inspection,***" AEG Bulletin v. 31:91-105; and P.L. Johnson and W.F. Cole, 2001, "***The use of large-diameter boreholes and downhole logging methods in landslide investigations***," Engineering Geology Practice in Northern California, CDMG Bulletin 21-/AEG Spec Pub 12, pp. 95-106. No one has ever been killed while performing downhole logging, although Frank Dennison, CEG lost one of his legs after passing out from gas inhalation and being dragged unconscious out of the borehole.

Establishment of the Soil Mechanics & Foundations Division of ASCE (1936)

At the annual ASCE meeting in July 1936 the society's Board approved the formation of a new **Soil Mechanics & Foundations Division** from the **Committee on Earths and Foundations**, which had been established in 1929. The first Executive Committee of the new division was comprised of: W.P. Creager of Buffalo, Carlton S. Proctor of New York City, J. F. Coleman of New Orleans, Frank A. Marston of Boston, and **R.V. Labarre of Los Angeles**. Proctor served as the first Chairman and Theodore T. Knappen, formerly of the Corps of Engineers, was the first division secretary.

First Soil Mechanics & Foundations Division theme session at an ASCE meeting (1938)

"Practical Application of Soil Mechanics: A Symposium." Presenters: Spencer J. Buchanan, Stanley M. Dore, B. K. Hough, Jr., and Karl Terzaghi. Discussions submitted by: George E. Beggs, M. L. Enger, R. J. Fogg, Harry T. Immerman, D. P. Krynine, F. A. Marston, George Paaswell, **Ralph R. Proctor**, Karl Terzaghi, Lazarus White, Glennon Gilboy, S. C. Hollister, Theodore T. Knappen, L. F. Harza, Edward A. Richardson, Richards M. Strohl, William P. Creager, Jacob Feld, Y. L. Chang, Charles Senour, Donald M. Burmister, Donald W. Taylor, Lee H. Johnson, Jr., Gregory P. Tschebotarioff, William L. Wells, A. Streiff, Spencer J. Buchanan, Stanley M. Dore, and B. K. Hough, Jr. Proctor was employed by the Los Angeles Department of Water & Power.

Geological Map of California (1938-onward)

In 1938 the State Division of Mines and Mining released their initial six-sheet ***Geologic Map of California*** (edited by Olaf P. Jenkins) at a scale of 1:500,000 (about an inch to 8 miles). Much of this early work was carried out by field geology courses taught across the state by Berkeley and Stanford each summer. The first generation maps were superseded by more detailed 1:250,000 scale (1 inch = 4 miles) geologic map sheets released by the California Division of Mines & Geology (after a name change in 1961), beginning in 1960. DMG also released a 1:750,000 scale State Geology Map in 1977, which was reprinted in 1991 (small enough to be mounted on a classroom wall). More recent interpretations have subsequently been in release since 1982, and continue to the present. This series of maps covers all of California and is considered basic information that would be cited in any engineering geologic study.

US Forest Service maps (1937-45)

The USGS prepared 1:125,000 scale topographic maps of all the mountainous regions of southern California prior to 1945, under interagency contract with the US Forest Service. These include all of Santa Barbara, Ventura, Los Angeles, Orange, west San Bernardino, west Riverside, San Diego and Imperial Counties. Sometimes these maps are useful for age placement of roads and trails in these areas.

Government aerial mapping of California (1938-40)

Between 1938-40 the U.S. Soil Conservation Service (SCS) contracted for all of California to be photographed with black and white stereopair aerial images. Soils data for each county were usually plotted directly upon large prints of these photos (described in W.C. Lowdermilk's article *Use of Aerial Mapping in Soil Conservation,* in *Civil Engineering,* v.8:9, September 1938, pp. 605-07). After 1945 soil designations

were then represented spatially on black-and-white photo mosaics. These post-1940 SCS reports contain soils information of reliable accuracy.

Committee on Soil Mechanics and Foundations of the Los Angeles Section, ASCE (1940)

A special committee on Soil Mechanics and Foundations was formed in 1940 under the chairmanship of SCE Chief Engineer **Harry W. Dennis** (BSCE 1899 Cornell; also Vice President of ASCE in 1936-37) to cooperate with, and provide input to, the Soil Mechanics and Foundations Division of ASCE established around 1935. The newly formed national division was gathering data from across the country on nine topics: settlement of structures, lateral earth pressures, observed settlement of structures outside the US, properties of clay-type soils, lateral stability of sheeting and piles, properties of "quick sands," stability of earth dams, problems with sand boils, and seepage effects on stability of earth embankments. This effort was funded by The Engineering Foundation between 1935-49. The local group consisted of 40 members of the Los Angeles Section and they committed themselves to providing whatever geotechnical data they had on the nine subject areas and sponsoring at least one program each year that focused solely on soil mechanics and foundations issues.

By 1944 the officers overseeing this Soil Mechanics Committee were **Trent R. Dames**, Chairman, Caltech Prof. **Frederick J. Converse, Sterling S. Green**, and **Paul Baumann**. By 1946 the Los Angeles Section if ASCE sported 1,350 members, making it the second largest Section in the Society.

War Department maps (1941-45)

During the Second World War (1941-45) the U.S. War Department Army Map Service produced a series of 1:20,000 scale topographic maps along the coast of California. These included Special Maps, Battle Maps and Photo Maps. The 6-minute sheets covering Los Angeles County were reproduced by the Army's 30th Engineering Regiment, on a scale of 1:20,000, slightly larger than their USGS 1:24,000 release scale. The War Department's 15-minute quads were the first to cover all of Riverside, Imperial and San Diego Counties, because of the military maneuvers carried out in the desert areas in 1942-43 (D.V. Prose, 1985, *Map showing areas of visible land disturbances caused by two military training operations in the Mojave Desert, CA*: USGS Map MF1855; also see USGS OFR 85-234).

Los Angeles Building Code (1943)

Following the 1933 Long Beach Earthquake, a committee was set up by the Structural Engineers Association of Southern California to develop the first seismic provisions to be put into practice, which was published in the **1943 Los Angeles Building Code**. That same year (1943) the State Division of Highways adopted their first seismic lateral design standard, specifying that state bridges in seismically-prone areas should be designed for a lateral pseudo static coefficient of 0.08g. This was employed in state highway work until 1966, when the lessons of the Great Alaska earthquake of March 1964 became more universally appreciated. San Francisco followed suit in 1948, with the adoption of their own building code.

Corps of Engineers Airfield Pavement Design Advisory Council (1942-45)

In June 1941 the Los Angeles District of the U.S. Army Corps of Engineers began wrestling with pavement bearing failures beneath the massive 96-inch diameter tires of the new Douglas B-19 bomber, which weighed 162,000 lbs., spread on just three wheels. The aircraft had cased pavement distress at Clover Field in Santa Monica (where it was built) and at March Army Airfield in Riverside (where it was delivered to the Army Air Corps).

District engineers in Los Angeles quickly consulted with research engineers at the Corps' Waterways Experiment Station in Vicksburg, MS and it was agreed that an Airfield Pavement Design Advisory Council should be formed, centered around **O. James Porter** (formerly of the California Division of Highways in Sacramento) because of his pioneering role in developing the California Bearing Ratio Test in 1928 (described previously). The advisory council was comprised of Colonel **Henry C. Wolfe** (who had worked on the Fort Peck Dam soil mechanics problems), structures Professor **Harald M. Westergaard** of Harvard, and Dr. **Philip C. Rutledge** of Moran, Proctor, Freeman & Meuser, soil mechanics Professor **Arthur Casagrande** of Harvard, **Thomas A. Middlebrooks** (the Corps senior expert in soil mechanics, who had also worked on the Fort Peck Dam landslide), **James L. Land** of the Alabama State Highway Department, and **O. James Porter** of O.J. Porter & Co. of Sacramento.

Through Porter's urging the advisory council selected the "Stockton Test Track" at the Air Corps' Stockton Field, about 60 miles south of Sacramento, for the most ambitious field pavement test program ever

devised, up to that time. The tests employed a 240,000 lb pneumatic roller passing over pavement sections of varying thickness, stiffness, and consistency, to better evaluate the California Bearing ratio test results for wheel loads of as much as 150,000 pounds.

From these tests, the Army Corps of Engineers developed specialized design procedures for flexible asphalt runways that incorporated the properties of the pavement subgrade, because the aircraft wheel loads are transmitted directly to the subgrade in flexible pavements. This focused attention on the importance of *subgrade compaction*, leading to the **Modified Proctor Compaction Test** of 1946 (described below). These design procedures were subsequently incorporated into post-war design of flexible asphalt highway pavements (as shown in the above chart), which were used in the **Interstate & Defense Highway Program**, beginning in 1955.

Modified Proctor Compaction Test (1946)

In 1938-40 Thomas E. Stanton (BSCE 1904 Berkeley) of the California Division of Highways wrote two important papers on mechanical compaction of soil embankments: "*Compaction of Earth Embankments*" for the Proceedings of the Highway Research Board in 1938 and "*Methods of Controlling Compaction in Embankments*," for the Proceedings of the 1940 AASHO Meeting in Seattle. In this second article he describes a "***Modified Proctor Test***," which sought to "obtain higher compacted densities and thus a lower optimum moisture content" than that employed in the Standard Proctor Test. Given the fact that Stanton was O.J. "Pappy" Porter's supervisor, the description of compaction test employing considerably more input energy was therein coined formally in 1946 by Porter as the "modified Proctor basis" of 1946 (see "Soil Compaction for Airports" in *Engineering News Record*, March 21, 1946, p.82-86).

The "modified Proctor basis" formally endorsed by the Embankment, Foundation, and Pavement Division of the Corps of Engineers Waterways Experiment Station in Vicksburg in 1946 as a "dynamic compaction test," using the same sort of impact hammer suggested by Proctor in 1933. This was based on input from their **Airfield Pavement Design Advisory Council**, described above. It employed the same cylindrical mold as the Standard Proctor test (4 inches in diameter and 4.6 inches high, with a removable mold collar 2.5 in. high). The mold volume is $1/30^{th}$ cubic foot, but it employs a heavier 10-pound hammer, 2 inches in diameter, which is allowed to free-fall 18 inches onto the soil (15 ft-lbs per blow). The soil mixture is compacted in five lifts, with an average thickness of 0.80 inches/lift. 25 blows were exerted per lift, which equals 25 x 15 = 375 ft-lbs per lift. The total input energy for the five lifts is 5 x 375 = 1875 ft-lbs on a soil sample with a volume of $1/30^{th}$ cubic foot. This equals 56,250 ft-lbs of compactive energy per cubic foot of soil, about 450% more energy than the Standard Proctor procedure.

By 1950 the Corps of Engineers issued reports which suggested that cohesionless soils (e.g. aggregate subbase and aggregate baserock) should be compacted "in a saturated state with the modified AASHO compactive effort" (see Waterways Experiment Station," Soil Compaction Investigation Report No 5, "Miscellaneous Laboratory Tests," *Technical Memorandum No. 3-271*, Vicksburg, June 1950). The new test was designated ASTM Test D1557 or Modified AASHTO T180, both initially adopted in 1958. Though originally seen as only necessary for airfield runways and pavement subgrades, the test evolved to become the national standard by 1985, when UBC Test 70-1 (33,800 ft-lbs/ft^3 input energy) was discarded by the UBC Appendix Chapter 70, in favor of the Modified Proctor Test (ASTM D 1557).

Engineering Geology Division of GSA (1947)

The **Engineering Geology Division** (EGD) of the **Geological Society of America** was established as that society's first specialty division in 1947, in contrast to the Society's established geographic sections. This came about because of the widespread use and organization of engineering geologists and military geologists by federal agencies during the Second World War (1939-45). Prof. Charles P. Berkey of Columbia University served as the division's first chairman, Sidney Paige as vice-chairman, and Roger Rhoades, secretary. Other geologists who figured prominently in the establishment of the new division included: Arthur B. Cleaves, Parker D. Trask, Edward Burwell, William Irwin, Shailer Philbrick, and George Woollard.

In 1951 one of the earliest definitions of "Engineering Geologist" or "Professional Engineering Geologist" was provided by the Executive Committee of the EGD, as follows: "A professional engineering geologist is a person who, by reason of his special knowledge of the geological sciences and the principles and methods of engineering analysis and design acquired by professional education or practical experience, is qualified to apply such special knowledge for the purpose of rendering professional services or accomplishing creative work such as consultation, investigation, planning, design or supervision of

construction for the purpose of assuring that the geologic elements affecting the structures, works or projects are adequately treated by the responsible engineer." These concepts and definitions were absorbed into the certifications by the City of Los Angeles (1958), Los Angeles County (1960), Orange County (1962), AIPG (1963), and the State of California (1969), described below.

The EGD began publishing a quarterly newsletter titled ***The Engineering Geologist*** in April 1966, with Prof. Dick Goodman at Berkeley serving as the first editor. The division was re-named the **Environmental & Engineering Geology Division** of GSA in 2011, to better reflect the evolving focus of applied geology in the 21st Century.

USGS 7.5-minute quadrangles (1947-95)

Shortly after the Second World War the USGS began to photograph all of the continental United States to develop 7.5 minute (1:24,000 scale) maps of urban areas and complete their 15-minute (1:62,500 scale) of mountainous and/or uninhabited areas, using orthophoto-derived techniques (most commonly, Zeiss Stereoscopes). These photos were imaged between 1946-49, and the initial series of 7.5-min. maps were released between 1947-59. Less inhabited regions, such as the Diablo Range, were covered by the larger scale 15-minute maps.

In 1956 the USGS began imaging a second series of aerial photos across California, part of a program then envisioned library photography on 10-year intervals. A second series of 7.5 minute maps began to be released, beginning in 1959, based on this new imagery. These second generation maps were only produced in areas where urban growth was rapidly expanding, such as the East Bay. These maps were released between 1956-79. Contour intervals were generally 20 or 40 feet on the 7.5 minute series maps and 40 or 80 feet on the 15 minute series.

In the early 1970s the USGS committed to mapping all of California on 7.5 minute 1:24,000 scale maps, and this program was completed around 1987. Digital map overlays are now provided for areas of large urban growth by using gray shadowing, without benefit of replicating the newly-created topography. These overlay updates are electronically generated from space-based imagery. Funding for USGS mapping activities was severely curtailed during the 94th Congress in 1995, and no new topographic map products are currently contemplated other than shadow overlays delineating newly developed areas. In 1996 Wildflower Productions began releasing USGS 7.5 min. topographic maps in electronic format. The USGS maps remain an important source of information, especially for those areas graded for agriculture or urban development, where old channels, escarpments, debris fans, terraces and landslide features have been all but obscured by man.

U.S. Corps of Engineers harbor maps (1949)

In 1949 the Corps of Engineers began publishing information pamphlets titled "Small Boat Harbors and Shelters, Pacific Coast, Coast of California: Office of the Division Engineer, South Pacific Division, San Francisco. These map books contain nautical charts in a variety of scales, ranging between 1:30,000 and 1:600,000, with most close to 1:40,000. These maps present soundings and perennial wind information, but do not always include onshore topography. However, the areas of coverage are surprisingly extensive, including: Dume Cove, Malibu Point, Santa Monica Harbor, Redondo Beach Harbor, Malaga Cove, Portuguese Bend, Los Angeles Harbor, Long Beach Harbor, Alamitos Bay, Seal Beach, Anaheim Bay, Huntington Beach, Newport Bay harbor, Laguna Beach, Capistrano Anchorage (Dana Cove), Camp Pendleton Harbor, Del Mar, Mission Bay, San Diego Bay and all then offshore islands.

The Los Angeles District of the Corps of Engineers and the Port of Los Angeles –Long Beach maintain much more detailed maps of that ports' evolution. Maps of subsidence in the Wilmington Oil Field area were widely distributed back in the 1960s (in particular, see: State of California, 1965, [Proceedings of] *Landslides and Subsidence, Geologic Hazards Conference*, May 26-27, Los Angeles, 91 p.).

First landslide hazard mapping in southland (1949)

In 1949 John T. McGill of the USGS (see UCLA faculty threadline) began preparing the first landslide hazard map in southern California, of the Pacific Palisades area at a scale of 1:4,800 (J.T. McGill, 1959, ***Preliminary map of landslides in the Pacific Palisades area, City of Los Angeles, CA***: USGS Map I-284). The high-visibility slides along PCH also gave rise to The Pacific Coast Highway (PCH) in the Pacific Palisades area, in particular, was the scene of repeated road closures throughout the 40s and 50s (Eldon S. Roth, 1959, *Landslides between Santa Monica and Point Dume*: master's thesis, Geological Sciences, University of Southern California, 184 p.)

Geohazards Awareness – "Buying a Home in Southern California" (1950)

This 85 page book appeared in 1950, written by consulting geologist **Alfred Livingston, Jr**., who had taught geology at Los Angeles City College and Los Angeles State College from 1931 thru the late 1950s. The book presented a great deal of useful introductory information, sketches, and photos describing the various geohazards common to southern California, and included a 9-page checklist for home buyers. Livingston's cross section of a typical split level home constructed on a dip slope with uncompacted fill received considerable distribution following the disastrous storms of January 1952, which led the City of Los Angeles to develop the world's first municipal excavation and grading code, in 1952.

GSA-ASCE Joint Committee on Engineering Geology (1950-86)

The GSA-ASCE Joint Committee on Engineering Geology was established in July 1950 by a memo from **William R. Judd**, CEG of the Engineering Geology Branch of the Chief Engineers' office at the U.S. Bureau of Reclamation in Denver, addressed to the Engineering Geology Branch of GSA and the Soil Mechanics and Foundations Division of ASCE. The committee was formed "to deal with all of the problems pertinent to engineering geology, contributing to better understanding and communication between geologists and engineers." From 1950-68 Judd served as the committee secretary, before joining the faculty at Purdue University in 1966.

Soil Mechanics Group of the Los Angeles Section of ASCE (1951)

In September 1951 a permanent **Soil Mechanics Group** was established within the LA Section of ASCE to replace the Committee on Soil Mechanics. This group was initially comprised of 85 members and was dedicated to the prospect of "broadening the opportunity for membership participation in discussions of soil mechanics problems in the Los Angeles area." The group was initially chaired by **Leopold Hirschfeldt** (BSCE '40 Stockholm Tech Inst) of Dames & Moore, who became a partner at Crandall from 1954-80. By 1957 the Los Angeles Section of ASCE had the largest dues-paying membership of any section in the United States.

Nation's first excavation and grading code (1952)

In January 1952 two back-to-back storms of modest recurrence interval hit the Los Angeles area, causing considerable erosion and damage to hillsides. M.F. Burke compiled a report for the LA County Flood Control District titled *Report on Floods of January 15-18, 1952.* It summarizes the effects of the January 1952 storms, which caused $7.5 million in property damage in the City of Los Angeles, prompting an investigation of the causes by prominent engineers and geologists. Many of the problems associated with that storm sequence were actually found with uncontrolled fills placed during the post-war boom, without benefit of shear keys, subdrainage or mechanical compaction.

This study resulted in the City of Los Angeles adopting the **Los Angeles Grading Ordinance**, the first of its kind in the United States (see C.M. Scullin, 1966, *History, Development, and Administration of Excavation and Grading Codes:* in Lung and Proctor, eds., *Engineering Geology in Southern California*, Los Angeles Section AEG, p.227-236). By 1954 the basic need for engineering geologic input into hillside development was at least recognized, if not refined (see J.T. McGill, *1954, Residential building-site problems in Los Angeles, CA*: California Division of Mines Bulletin 170, Ch. X, p. 11-18).

Adoption of Excavation and Grading Codes by other agencies (1952-65)

Similar excavation and grading ordinances to that enacted by the City of Los Angeles in 1952 were soon enacted by other municipalities and counties, including: Beverly Hills (1952), Pasadena (1953), Glendale (1954), Burbank (1954), Los Angeles County (1957), Whittier (1957), Ventura County (1958), Alhambra (1958), Santa Barbara County (1959), San Diego (1960), Monrovia (1961), City of San Diego (1962), Orange County (1962), Anaheim (1963), Riverside (1963), City of Orange (1964), Laguna Beach (1965), and San Bernardino County (1965).

Bulletin 170-Geology of Southern California (1954)

The California Geological Survey's most sought-after references have historically included their bulletins, which contain a great deal of baseline geologic data. Bulletin 170, ***Geology of Southern California***, was released in 1954. The volume's editor was Caltech Professor Richard H. Jahns. Bulletin 170 contains 10 chapters, five field guides, and 34 map sheets that formed a comprehensive compilation of what was known about the geology of southern California up until that time. Long out-of-print, this bulletin is hard to come by except within university libraries and private collections, but it is a **baseline document,** absent any more recent work in a given area, this source is usually cited, along with the State Geologic Map (discussed below).

Federal Housing Administration Land Planning Bulletin No. 3 (1956)

In 1956 the Federal Housing Administration (FHA) issued **Land Planning Bulletin No. 3**, which set forth minimum standards for excavation and grading of residential subdivisions, including: inclinations of cut and fill slopes, requirements for mid-slope drainage terraces, and certification by soils engineers of 95% of Standard Proctor soil compaction. Developers seeking federal assistance had to comply with these standards and present soils & foundation engineering reports.

Portuguese Bend Landslide (1956) and the Los Angeles County Grading Code (1958; 1965)

In January 1956 the first in a series of large landslides occurred in the Portuguese Bend area of the Palos Verdes Peninsula. This came to be known as the 260-acre Portuguese Bend Landslide, which reactivated during the placement of a relatively small (in comparison to the landslide volume) fill for an extension of Crenshaw Boulevard, affecting 150 homes and causing $10 million in damage. These problems led to the County Board of Supervisors amending the County Building Code to include grading and excavation regulations similar to those of the City of Los Angeles, initially adopted in March 1958. The County established its Geology Section of the County Engineer's Building & Safety Division in November 1959.

The slide at Portuguese Bend brought Los Angeles County into a landmark inverse condemnation suit that ultimately went against the County in 1965, costing them $6 million (*Albers vs Los Angeles County*; 62 Cal 2d, 263; 42 Cal Rpts 97). In July 1965 the County amended their grading ordinance reducing cut and fill slopes to 1.5:1, permanent provisions for control of surface runoff on slopes and across building pads, began requiring reports from engineering geologists and soil engineers for certain aspects of hillside development and mass grading, which could no longer be approved by a registered civil development work.

The Portuguese Bend Landslide has been under considerable study for many years and it was found to be stratigraphically controlled, but with an undulatory basal slip surface (see P.L. Ehlig, 1992, *Evolution, Mechanics and Mitigation of the Portuguese Bend Landslide, Palos Verdes Peninsula, CA*: in Proctor and Pipkin, eds., Eng'g Geol Practice in So Calif, AEG Spec Pub 4, p. 531-553). Other large landslides in the Palos Verdes Peninsula began to be recognized in the years since, and many of these have become active as well (see *Landslides and Landslide Mitigation in Southern California*, Geological Society of America Cordilleran Section Meeting Guidebook, Los Angeles, 1986).

The sheer magnitude of the landslide problem at Portuguese Bend and the liability potential posed to public entities triggered intense interest in the State taking a new role in "urban hillside development." At a conference on that subject held at UCLA in February 1960, the Division of Mines laid forth their plan for mapping the geology of the Palos Verdes Peninsula, at the bequest of the City of Los Angeles. At the UCLA conference the absence of any engineering geologist on the staff of the Division of Mines was brought out and recognized, and efforts were then made to hire people qualified to address urban geologic hazards (see I. Campbell, 1960, *56th Report of the State Mineralogist*: California Division of Mines, 219 p).

California Association of Engineering Geologists (1957); Association of Engineering Geologists (1963); Association of Environmental & Engineering Geologists (2005-present)

In June 1957 13 engineering geologists met in Sacramento to discuss the formation of an organization or society specific to the emerging field of engineering geology. The founders were employees of the U.S. Geological Survey, U.S. Bureau of Reclamation, Army Corps of Engineers, California Department of Water Resources and Division of Highways, and two consultants (including **Ray Taber** of Moore & Taber). Over the next eight months they drafted the Constitution and Bylaws as the **California Association of Engineering Geologists** (CAEG), with three sections in Sacramento, **Los Angeles**, and San Francisco. CAEG vigorously promoted certification of engineering geologists in southern California (in Los

Angeles, Orange, and Ventura Counties) and then professional registration of geologists in California (and later, nationwide).

AEG was also the organization primarily responsible for the development of "modern" [second generation] grading and excavation codes, adopted in southern California in the early 1960s and by the International Conference of Building Officials for inclusion in the Uniform Building Code in 1964. As interest in affiliation spread beyond California, the prefix was dropped and it became the [national] **Association of Engineering Geologists**, or AEG, in January 1963, and was accepted as a member society in the American Geological Institute in 1964.

In 1963 AEG began publishing a referred journal titled "*Bulletin of the Association of Engineering Geologists*," released quarterly. Management of this journal was conjoined with the Geological Society of America in 1995 and the name changed to "*Environmental & Engineering Geoscience*," released six times per year. In January 2005 members voted to change the name to the **Association of Environmental & Engineering Geologists** to better describe the geoenvironmental work many of its members specialized in. The new name was formally adopted in September 2005, although the organization still calls itself "AEG."

Pacific Palisades Landslide Study (1958-59)

On March 31, 1958, flowing heavy rainfall, the **Via de Los Osas Landslide** buried the Pacific Coast Highway (PCH), between Rustic and Temescal Canyons. It was the largest landslide ever to occur along the Pacific Palisades, and required more than a year to mitigate and restore the coast highway. Serious landslide s closures had previously occurred in 1956, and the California Division of Highways wondered if the cost of maintaining PCH was unjustified. In an unprecedented move, the State Department of Public Works (which over saw the Division of Highways) contracted with the prestigious geotechnical consulting firm of **Moran, Proctor, Meuser & Rutledge** (MPMR) of Manhattan to make a comprehensive study of the slide problems along the Pacific Coast Highway, which dated back to 1889. MPMR classified more than 100 landslides along the highway and investigated and analyzed 34 of those. Their work included recovery of Shelby Tube samples, and the installation and long-term monitoring of piezometers and slope inclinometers. Residual strength tests on landslide slips surfaces developed in the Modelo and Martinez shales were performed under contact by Professor **T.W. Lambe** at MIT for MPMR. These test revealed that the overconsolidated clay shales tended to lose shear strength through strain softening by creeping for many years previous to actual rupture, similar to the shales exposed along the Panama Canal. These results were summarized in a massive three volume report by MPMR entitled "**Final Report**, **Pacific Palisades Landslide Study**," submitted in July 1959. The findings are summarized in an article by the project's manager **James P. Gould,** titled "***A Study of Shear Failure in Certain Tertiary Marine Sediments***," in the ASCE Research Conference on Shear Strength of Cohesive Soils in June 1960. This article, more than any other, shaped the approaches by which subsequent assessments of "bedrock landslides" were analyzed in Los Angeles County for the next four decades. The slide was converted into the Pacific Palisades Park, saving the homes on the north side of Via de Los Osas Drive.

USDA Soil Conservation Service county reports (1960-94)

Around 1960 the Soil Conservation Service (SCS) began publishing reports contain summaries of engineering properties for the mapped soils on aerial photo mosaics published at 1:24,000 (same scale as 7.5 min. quadrangles). The post-1960 SCS reports also contain tabulations of test data and engineering classifications, according to the American Association of State Highway Officials (AASHTO) and Unified Soil Classification System (USCS) used by most consultants. The SCS has published and updated these reports from 1960 to present, though they are often out-of-print. In 1971 SCS issued their *Guide for Interpreting Engineering Uses of Soils* (USDA, Soil Conservation Service, Washington, D.C., 86 p.), which lays forth the rationale by which engineering classifications of soil are tabulated in the individual county reports they publish.

Los Angeles County-USGS-CDMG Cooperative Geologic Mapping Program (1960)

In 1960 the office of the Los Angeles County Engineer (John A. Lambie) entered into a cooperative contract with the U.S. Geological Survey and the California Division of Mines & Geology for geologic mapping of "critical hillside areas," including: **Palos Verdes Hills** (by Prof R.H. Jahns at Caltech and the CDMG); **San Gabriel Mountains** (initially covering the Mt Baldy, Azusa, Glendora quads, and later the Pasadena and Mt Wilson quads, in cooperation with LACFCD, USFS, and CDMG); **Santa Monica**

Mountains (Topanga, Malibu Beach, and Point Dume, Calabasas, and Trufino Pass quads, working with the USGS); **Puente and San Jose Hills** (working with Prof. John Shelton at Pomona College, Beach Leighton at Whittier College, and Robert F. Yerkes of the USGS). This work was carried out in the early 1960s and completed by 1964.

Division of Mines & Geology Landslide Mapping in the Palos Verdes Peninsula (1961-65)

While the Division of Mines embarked on their first landslide and urban geologic mapping effort in the Palos Verdes Peninsula, beginning in 1961, the loss of the Portuguese Bend suit was the catalyst for new ordinance by Los Angeles County in 1964 requiring geologic reports in any area proposed for subdivision in which a certain degree of "geologic hazard" was presumed to exist (see I. Campbell, 1976, *The influence of geologic hazards on legislation in California*: Bulletin of Int'l Assn Eng'g Geol, n. 14, p. 201-04). The late 1950s and early 60s were a period of relative calm before the storm, due to lower-than-normal rainfall (H.E. Thomas, et al, 1963, *Effects of drought along the Pacific Coast in California*: USGS Professional Paper 372-G). In early 1963 things began to change when a sequence of destructive storms struck all of coastal California (see S.E. Rantz and E.E. Harris, 1963, *Floods of January-February 1963 in California and Nevada*: USGS Open File Report,74 p.).

CAEG's Recommended Practices for Hillside Grading and Development (1961-62)

Authored by **Douglas R. Brown** Chair, and assisted by **C. Michael Scullin** (1961), and **Dennis Evans** (1962), AEG Building Codes Chairman for Los Angeles Section. The CAEG Committee that wrote the first grading & excavation code was comprised of: **Doug Brown, John T. McGill**, **Douglas Moran**, **William Schlax**, **James Slosson**, **William Waisgerber**, **R. Bruce Lockwood**, **Allan Bailey, Joe LoBue**, **Russell Hood**, and **Blase Cilweck**. Their report on "*Hillside Grading and Development*" became the basis for the "modern grading codes" adopted by Los Angeles County (1962), the City of Los Angeles (1963), Orange County (1964), and Chapter 70-Excavation and Grading of the 1964 Uniform Building Code.

Mt. Soledad Landslide in La Jolla (1961)

Los Angeles was not the only area to take the brunt of landslide problems attendant to hillside development. The Mt. Soledad landslide in La Jolla occurred in 1961, shortly after a fill embankment was placed above a 1.5:1 cut slope, both for residential development. Fortunately, the 8 homes that were destroyed were not yet occupied (described in M.W. Hart, 1989, *Engineering Geology in San Diego, CA*: in Keaton and Morris, eds., *Engineering Geology of Western United States Urban Centers*: 28th Int'l Geol Congress, Field Trip Guidebook T181, American Geophysical Union, p. 22-30). Similar failures befell the Malibu area and other hilly parts of Los Angeles and Orange Counties. By the late 1960s there existed new awareness of landslides in the urban environment, and the state of the practice at that time was pretty much summarized in Beach Leighton's classic 1966 article titled *Landslides and Hillside Development*, which appeared in the AEG publication *Engineering Geology in Southern California*.

Adoption of "Model" Excavation and Grading Codes (1963-70)

During the first two weeks of February 1962 about 24 cumulative inches of precipitation fell on downtown Los Angeles, and more in the highlands surrounding the Los Angeles Basin. A great number of hillside fill embankments failed, usually sliding on un-keyed contacts with the underlying soils. The large number of failures pointed to a definite need for engineering geologic input in design and construction of hillside subdivisions, leading to the establishment and adoption of deep benching and keying with continuous inspection by the soils firms.

The newly re-vamped Los Angeles Grading Ordinance was adopted in April 1963. Orange County consulted with their Grading Board of Appeals and Geology Qualifications Boards to revise their new grading code, and this newer code, requiring full-time grading and engineering geology inspection, was adopted by Orange County in June 1964. Los Angeles and Ventura counties passed similar revisions a short while later. Contractors liked the new statutes because they felt the soils engineers were forced to shoulder more of the liability burden that had been the case previously, maintaining that "their work was being directed by the soils engineers."

Geology Registration by the American Institute of Professional Geologists (1963)

Prior to 1963, geologists were not accountable with respect to public responsibility, regulation, and business practice, and no established guidelines or no national representation existed in behalf of those engaged in private practice. That year a small group of geologists met in Golden, Colorado, to compose the Constitution and Bylaws for the American Institute of Professional Geologists (AIPG), which was chartered on November 14, 1963 as a nonprofit corporation. Consulting petroleum geologist **Martin Van Couvering** of **Los Angeles** was elected the first President, and the institute's headquarters was established at the Colorado School of Mines. Members who went through an established process of verifying their formal education and professional experience could qualify to use the title "**Certified Professional Geologists**," abbreviated by the letters "CPG" after their name. This was fairly common practice in California prior to the state's adoption of a geologist registration act a few years later, in 1969.

AIPG drew a significant number of its members from AEG, who were the most concerned about geology registration (most geologists employed in the mining and petroleum industries were ambivalent about professional registration). AIPG worked diligently to secure model registration acts in those states where a significant number of geologists worked in the private sector, usually working with the local organizations operating in those areas.

AIPG become a national organization with a membership of nearly 850 by 1965, little more than a year offer its' founding. By 1974, AIPG had more than 2,000 members, and moved its headquarters to 622 Gardenia Court in Golden, where it remained for eight years. By the mid-1970s it had attracted a broad spectrum of geoscientists, including geophysicists, geochemists, and engineering geologists. In 1982 the AIPG headquarters moved to Arvada, Colorado, where for many years **John W. Rold** (from the Colorado Geological Survey) served as the society's executive director. Today, AIPG has over 5,000 members and affiliates, which are organized into 36 sections.

AEG Building Codes Committee (1962 – 2002)

AEG was instrumental in pushing through the Grading and Excavation provisions of the Uniform Building Code through the International Conference of Building Officials, headquartered in Whittier until national consolidation of building codes in 2002. That committee was originally chaired by **Douglas R. Brown** in 1960-62, followed by **Jim Slosson** (1962-64), by **Don Michael,** in 1964-66, and then, by **Mike Scullin** in 1966-69. From about 1973-85 **Jack Rolston** served as chair of the AEG Building Codes Committee, when he was succeeded again by **Mike Scullin** (1985-92), then by **J. David Rogers** (1989-2000), who was followed by **Betsy Matheson** (2000-onward).

AEG's Building Codes Committee received input for their model excavation and grading code from separate committees formed in the association's three active sections at the time: Los Angeles, San Francisco, and Sacramento. This input culminated in the preparation of Appendix Chapter 70-Excavation and Grading of 1961, which was submitted with that name for review at CAEG's annual meeting in Oct 1962, when Slosson was the committee chair.

A revised version was then submitted to ICBO in Whittier in the spring of 1963 for consideration of inclusion in the 1964 Uniform Building Code (UBC). The ICBO Code Changes Committee was comprised of **Jerry Wilson** from the City of Glendale (chairman), **Ed O'Connor** of the City of Long Beach, Ventura County Building Director **Robert O'Bannion**, and a Mr. **O'Brien**, the Building Director for the City of Thousand Oaks. Non-voting members who attended all of the ICBO meetings included **Doug Brown**, who represented AEG's national Building Codes Committee and **Mike Scullin**, representing the Los Angeles Section's Building Codes Committee. The ICBO committee originally envisioned using a mark-up of the revised 1962 Los Angeles County Grading & Excavation Code, but ended up using the draft AEG Code, which was less prescriptive in terms of required engineering geology input, which the committee feared would be rejected by most ICBO members outside of southern California. Oddly, the main opposition to the adoption of UBC Appendix Chapter 70 came from structural engineers, not the Building Industry Association (BIA).

The AEG Building Codes Committee also prepared a brochure titled "*Recommended Practices for Hillside Grading*," which many firms included in their consulting reports and a number of individuals have taken credit for developing. After 1963, revision and improvement of this document was carried out by another committee, described below.

The most substantive changes made to Chapter 70/33 Appendix Excavation & Grading of the Uniform Building Code occurred in 1967, 1970, 1985, 1991, 1994, and 1997 (which introduced sweeping changes in codifying simplified seismic design procedures in California). The single biggest change to UBC Appendix Chapter 70 was in 1970, when the maximum inclination of fill slopes was dropped from 1.5: 1

down to 2:1 (horizontal to vertical). This was because so many failures had occurred in the Jan-Feb 1969 storms, which witnessed sustained rainfall intensities between 0.25 and 1.0 inches/hr. By employing an infinite slope stability analyses, local soil engineers learned that an angle of internal friction of 40 degrees would be required to guarantee short-term stability for the saturated face of a 1.5:1 slope, so they agreed to flatten the slopes to 2:1, which would remain stable with a friction angle of 30 degrees and an assumed cohesion of 100 psf. Everyone seemed comfortable with these figures (till the early 1980s, when a number of local jurisdictions in the San Francisco Bay Area dropped their maximum slopes to 3:1).

The substantive additions in the 1990s were ascribable to timing: the 1989 Loma Prieta and 1994 Northridge earthquakes, combined with a down-turn in development in the Los Angeles area, which precluded vociferous objections by the Building Industry Association (BIA), who had opposed proposed code changes during the two previous decades.

Development of UBC Expansion Index Test No 29-2 (1965-68) and ASTM D 4829 (1995)

In the early 1960s there were no standardized test procedures for quantifying or predicting the behavior of expansive soils, which were widespread in most of the inland valleys of southern California. Most of the soils engineers employed their own tests, yielding answers in expected "percent swell." A conflict developed between these engineers in regards how to best, using either "wet" or "dry" tests (wet test procedures had been pioneered by **O.J. Porter** and the California Division of Highways in 1928, described previously). **Doug Lehman** of International Soils Engineering favored the "dry test" procedures. Newly promoted Orange County Engineer **Floyd McClellan** decided to resolve the conflict by requesting input for **AEG's Building Codes Committee** and the **Soil Mechanics Group of the Los Angeles Section of ASCE.** These groups nominated the following representatives: **Len Krazynski** of Woodward-Clyde-Sherard was named Chairman, assisted by **Stan Gizienski** (MSCE '48 Harvard) of Woodward-Clyde-Sherard, **Rhett Moore** of Moore & Taber, **J. Robert Davis** of Converse-Davis Foundation Engineers, and **Dennis Evans** of Evans, Goffman & McCormick. When they convened other soils engineers also attended the meetings and provided useful input. The importance of geologic input in regards to clay mineralogy was brought to bear in the wake of the La Jolla Landslide in 1970, which was studied by **Jack Eagen** of Moore & Taber.

In the end, the "wet testers," who preferred pre-soaking specimens in the soils lab, won out, and the UBC Expansion Index Test No. 29-2, resulted. It requires pre-soaking of specimens under varying levels of effective confinement, then measuring the percent swell. This procedure was the one favored by **Len Krazynski**, **Stan Gizenski**, and **Louis Lee** of Woodward-Clyde-Sherard & Associates and summarized in Krazynski and Lee (1966) "***Identification and Testing of Expansive Soils***," in AEG's Seminar on the Importance of the Earth Sciences to the Public Works and Building Official," at AEG's annual meeting in Anaheim in 1966 (organized by Orange County Geologist **Mike Scullin**). In 1967 the Orange County and San Diego offices of Woodward-Clyde-Sherard also prepared a series of reports on expansive soils testing for the Portland Cement Association (PCA), which came to be regarded as national benchmark standards.

UCLA Prof. **Poul Lade** and his graduate student **James M. Anderson** undertook a thorough assessment of the Expansion Index Test in the late 1970s because so many geotechnical engineers had been complaining about it. Lade and Anderson found it to be a very reliable test, summarized in the article: "***The Expansion Index Test***," ASTM Geotechnical Testing Journal, (Vol. 4, No. 2, June 1981, pp. 58-67). The Expansion Index Test was formally adopted as ASTM Test Standard ***D 4829*** in 1995.

Dam Safety Legislation of September 17, 1965

In the in wake of the December 1963 failure of the Baldwin Hills Reservoir, on September 17, 1965 the state legislature passed an amendment to the State's Dam Safety Act of 1929. Jurisdiction for State overview of dams was expanded to include ***off stream storage*** facilities, such as municipal reservoirs.
This included all non-federal dams more than 25 feet high which impound more than 15 acre-feet of water and non-federal dams more than 6 feet high which impound more than 50 acre-feet of water.

Landslide Hazard Mapping by governmental agencies (1966-onward)

By the late 1960s serious landslide mapping by a number of public agencies was well under way. This included agencies such as the **Division of Mines & Geology**, U**.S. Geological Survey**, **City of Los Angeles**, **Metropolitan Water District**, and **Whittier College** under contract to the government (through Beach Leighton), covering most hillside areas then envisioned for urban development in Ventura, Los

Angeles, Orange, San Bernardino and San Diego Counties (G.B. Cleveland, 1966, *Current Regional Geologic Studies in Southern California,* in Lung and Proctor's *Engineering Geology in Southern California*, AEG, pp. 214-15). The heat of public pressure remained strong into the mid-1970s, spurred by occasional high visibility slides, especially along freeways, and roads periodically closed to travel, like the coast highway near Malibu, San Gabriel and Glendora Mountain Roads (see F.B. Leighton, 1977, *Three major California freeway landslide areas*: in D.R. Coates, ed., *Landslides*, Reviews in Engineering Geology, v. III, Geological Society of America, p. 225-232).

One of the first such studies to be published by the State Division of Mines & Geology (CDMG) was George Cleveland's *Natural Slope Stability as Related to Geology, San Clemente Area, Orange and San Diego Counties, CA*, released in 1968. Studies within a given area were often expanded upon or followed up, such as occurred with the Capistrano formation in Orange County (Morton, Edgington and Fife, 1974, *Geology and Engineering geologic Aspects of the San Juan Capistrano Quadrangle, Orange County, CA*: CDMG Special Report 112, 64 p.). More regional studies, beginning with Doug Morton's *Preliminary Reconnaissance Map of Major Landslides, San Gabriel Mountains, CA*, Map Sheet 15 published in 1969. In the 1970s CDMG and USGS began working cooperatively in joint-funded projects aimed at identifying geologic hazards in hillside regions, producing a series of regional maps (see G. B. Cleveland, 1971, *Regional landslide prediction*, CDMG Open File Report 72-73) .

The first County-wide maps were those prepared by Don Fife of CDMG for the entirety of Orange County, released in 1973 (CDMG Preliminary Report 15). These 1:48,000-scale geo-environmental maps included mapping of bedrock landslides over hundreds of square miles, and this work was a first in that it preceded actual development in that area. The concept of several maps in a single package, depicting various geohazards, such as bedrock geology, landslides, debris flows, and faults was a new planning concept that met with much success in the environment-conscious 1970s.

State Board of Registration for Geology & Geophysics (1968-2009)

In 1968, after seven years of vociferous lobbying by AEG, the State Legislature and Governor Reagan approved legislation establishing the California **Board of Registration for Geologists and Geophysicists** (BRGG), the first geosciences professional registration board in the United States. The Geologist Act allowing for registration of geologists in California became law on November 13, 1968, and made it unlawful practice geology without a license in California after December 31, 1969.

The California State Board of Registration for Geologists was established on June 30, 1969. Applicants that filed with the board after November 13, 1969 were required to take a written examination, while those who applied before this date and were approved by the board received their licenses through grandfathering. Two years were then expended evaluating the respective roles and responsibilities engineering geologists would have, as opposed to civil engineers. By June 1970 the stated purpose of the BRGG was to protect consumers by ensuring that people practicing geology and geophysics possessed sufficient education, experience, and knowledge to competently perform their duties, such as: geologic mapping of subsurface condition exposed during construction, geologic mapping, assessing presence and risk of landslippage, evaluating groundwater conditions, using remote sensing or aerial photos to investigate the geomorphic character and structure of an area, using geophysical methods to investigate the subsurface, logging boreholes, and assessing mineral deposits.

The first certificates were issued in September 1970. By 1972, 848 people re-registered themselves in California as CEGs. Of these, only 518 were California registrants, the remaining being individuals who grandfathered into the title, but maintained residences out-of-state or out-of-country. Geologists and geophysicists were licensed as separate disciplines, with the subspecialty certifications in engineering geology (from 1970), and hydrogeology (from 1995). This action came largely as a result of landslides, slope failures, and significant property damage, including the infamous Portuguese Bend and Abalone Cove Landslides on the Palos Verdes Peninsula in the 1960s. The BRGG was absorbed into the Board of Registration for Engineers and Land Surveyors (BORPELS) in 2009, to save money. On January 1, 2011 the name was changed to the Board for Professional Engineers, Land Surveyors and Geologists.

Associated Soil & Foundation Engineers (1969-75); Association of Soil and Foundation Engineers (1975-88); ASFE/The Geoprofessional Business Association (1988-93); ASFE/The Association of Engineering Firms Practicing in the Geosciences (1993-present)

The insurance situation for geotechnical worsened when the storms of 1967-68 brought so many problems that California soils engineers were unable to purchase liability insurance. Principals of ten consulting geotechnical engineering firms met in a Chicago airport hotel in December 1968 to resolve a common problem that threatened their companies: Professional-liability claims were at an all-time high and professional-liability insurers worldwide refused to cover them. The ten formally launched **Associated Soil and Foundation Engineers, Inc**. in May 1969 to identify the causes of professional liability claims and losses and to develop programs and materials to help geoprofessionals avoid such exposures in the future. The founding forms also formed **Terra Insurance Corporation** in 1969, based in Monterey (ASFE headquarters is based in Silver Spring, MD).

Within one year of its formation, ASFE launched a new contract provision called limitation of liability. After 1970 soil engineer's field activities were limited in scope to providing construction observation and testing services, eliminating the terms "*inspection*" or any slight inference that they were "*directing*," "*overseeing*," or "*approving*" construction activities. The adoption of increasingly tighter Limitation of Liability (LOL) clauses, limiting their exposure to the sum total of the professional fees incurred by the geotechnical engineers followed shortly thereafter. In 1975 the organization changed its name to the **Association of Soil and Foundation Engineers**. In 1977, ASFE initiated organizational Peer Review to member firms, and then helped the American Council of Engineering Companies (ACEC), the American Society of Civil Engineers (ASCE), and the American Institute of Architects (AIA) develop programs based on ASFE's model. Through Peer Review, firms enhance the quality of their performance by having their methods and materials reviewed and critiqued by experienced peers.

ASFE-Member Firms underwent a transformation in the mid-1980s, as they expanded their staffs and service mixes to provide expertise to the then-emerging field of hazardous waste remediation and attendant environmental services. They have continued to evolve, and today provide geotechnical, geologic, environmental, construction materials engineering and testing, and related geoprofessional services. In 1985 the organization abandoned "Association of Soil and Foundation Engineers," changing its name to **ASFE/The Geoprofessional Business Association**. In 1993 the organization's name was changed to **ASFE/The Association of Engineering Firms Practicing in the Geosciences** to better reflect the expansion into geoenvironmental and geohydrology disciplines.

National Environmental Policy Act (1969) and regulation of solid waste disposal

In 1969 Congress passed the **National Environmental Policy Act** (NEPA) in response to increasing societal attention environmental degradation triggered by anthropogenic activities. As a result of NEPA, the US **Environmental Protection Agency** (USEPA) was created and activated on 1 January, 1970, and the related Federal agency programs were considerably re-shuffled. As defined by the Federal government, s*olid waste* encompasses wastes of *municipal* origin (*residential* and commercial, as opposed to *industrial*). Prior to the creation of USEPA in 1970, California acted under the Federal *Solid Waste Management Law*, which required that each County create and submit its own *Solid Waste Management Plan* by 1 Jan, 1974. As a result of the follow-up Congressional legislation (see RCRA in 1976, below) the common forms of wastes and of air pollution were established and then integrated into California's regulatory agencies. California established a **State Solid Waste Management Board** in 1972, which was renamed the **California Waste Management Board** in 1982. This was incorporated into the **California Integrated Waste Management Board** (CIWMB) established in 1989, one of six agencies subsequently absorbed into the **California Environmental Protection Agency** (Cal/EPA) when it was formed in 1991 (see below).

State Seismic Safety Act of 1971

In the wake of the 1971 San Fernando earthquake, the California Legislature enacted a more comprehensive Seismic Safety Act in 1971, which required local municipalities to assemble seismic safety elements by 1975. These municipalities could contract with the California Geological Survey to help prepare geologic databases, and many did, including Orange County. CGS's Preliminary Report 15 (*Geo-environmental maps of Orange County, California*), prepared by Don Fife and released in 1973, presented 1:48,000 scale geo-environmental maps of Orange County. These included four types of maps: bedrock geology, landslides, debris flows, and faults. This was a new planning concept that met with much success in the environment-conscious 1970s and the effort preceded most of the development in Orange County.

During the early years of the Seismic Safety Act, the California Geological Survey also produced quadrangle-size geologic map sheets, such as George Cleveland's *Geology of the Northeast part of the Palos Verdes Hills, Los Angeles County, California*, released as Map Sheet 27 in 1976.

A similar pattern was followed for southwestern San Bernardino County, again with CGS's Don Fife and others, in cooperation with Doug Morton of the U.S. Geological Survey. In 1976, CGS released Special Report 113 titled *Geologic Hazards in Southwestern San Bernardino County, CA*. This volume was accompanied by thirteen 1:48,000 scale map sheets prepared by Morton delineating potential geologic hazards such as faults, landslides, flooding and depicting basic bedrock geology and geophysical information. These became seminal documents in the planning process accompanying urban development in this area in the years following its release.

Soil and Foundation Engineers Association (SAFEA) (1971-87); California Geotechnical Engineers Association (1987-2009); CalGeo (2009 - present)

In February 1970, a group of soil and foundation engineers from Southern California met to discuss the status of the profession, and to assess if there was a need to form an organization to represent the unique needs of California's private-practice geotechnical engineering consultants. In May 1971, the Soil and Foundation Engineers Association (SAFEA) was established with a goal unlike other engineering associations. Rather than focus only on technical research and social events, SAFEA tries to address the key business and legislative issues necessary to advance the profession of private-practice geotechnical engineering. In the mid-1980s SAFEA successfully lobbied for a Geotechnical Engineer title act by the State Board of Registration for Professional Engineers and Land Surveyors. From 1987 onward the professional title "geotechnical engineer" can only be used by those who are duly registered, similar to "structural engineer." In 1987 the organization changed its name to the **California Geotechnical Engineers Association**, and this was shortened to **CalGeo** in 2009. The organization continues to meet and discuss various issues that impact California's private-practice geotechnical professionals.

Alquist-Priolo Special Studies Zone Act (1972-94); A-P Earthquake Fault Zoning Act (1994)

The February 1971 San Fernando earthquake triggered the *Alquist-Priolo Special Studies Zone Act of 1972*, which has been amended on 10 occasions up through 1993. Since 1994 this has been termed the *A-P Earthquake Fault Zoning Act.* An excellent write up on the history of the program with map index is contained in E.W. Hart, 1994, *Fault-Rupture Hazard Zones in California*: CDMG Special Publication 42 (Rev 1994), 34 p. The Fault Evaluation and Zoning Program is currently supervised by the California Geological Survey in Sacramento.

Statewide Adoption of Appendix Chapter 70 - Excavation & Grading of the Uniform Building Code (1974)

In the second session of the California legislature in 1973, the State of California passed Section 17958, Division 13, part 1.5 of the Health & Safety Code, requiring that all cities and counties in the State of California would enforce Appendix Chapter 70 – Excavation & Grading, of the 1973 Uniform Building Code, or its equivalent, no later than March 7, 1974. The California Commission on Housing & Community Development adopted the same mandate in their Section 1090 of Title 25 of the California Administrative Code. These statutes were not always effectively applied or enforced, especially in the State's more rural counties. According to Scullin (1983), by 1977 92% of the state's building inspection departments enforced the excavation and grading statutes, but only 13% of these agencies has trained grading inspectors).

Resource Conservation and Reclamation Act (RCRA) of 1976

In 1976 the U.S. Congress enacted the *Resource Conservation and Reclamation Act* (RCRA) of 1976, to be regulated by the U.S. Environmental Protection Agency. This was fully implemented by November 1978, under a regulatory grace program. Each state was given the privilege of administering the entire compliance program under the *Primacy* provision of RCRA, and California was awarded interim primacy in 1991 and continues to respond to additional Federal requirements for its authorization program, consistent with changes promulgated by USEPA. The latest such authorization was granted in 2012 (77 FR 65313, 26Oct).

RCRA defines *Special Waste* as the use and discharge of chemical elements and compounds, in solid or liquid form, as created by such industrial activities as do not produce hazardous wastes, by definition. The Federally mandated program of *special waste management* represents a generally high-volume, low toxicity assemblage of industrial wastes that cannot otherwise be controlled without serious implications to the national economy. As is the case with solid waste, this large waste stream is controlled under the

provisions of RCRA of 1976 (as amended) and administered by the California EPA under its primacy agreement with U.S. EPA.

Hazardous Waste is defined under RCRA for purposes of the control of toxic industrial waste streams that have been generated since the passage of the act in 1976. In terms of geologic impact, the resulting Federal and State provisions for licensure and compliance of newly-generated toxic elements and compounds in more-or-less limited to the application of standard *permits* written by CalEPA for each site of generation, and by standard site selection conditions and engineered design and construction requirements, and, as such, the regulatory conditions are made similar for all RCRA sites.

Geologic Hazard Abatement Districts (GHADs) (1979)

In 1979 State Senator Bob Beverly of Rancho Palos Verdes sponsored legislation allowing the establishment of special "Geological Hazard Abatement Districts," or **GHADs** (1979 Cal Stat 118, codified as Cal PRC 26500-26601). GHADs are intended to serve as special assessment districts formed to abate actual or threatened geohazards, such as landslides, land subsidence, soil erosion, or other natural or unnatural movements of land.

The first GHAD formed in California was the ***Abalone Cove Landslide Abatement District*** in Rancho Palos Verdes, which includes 25 homes on a creeping 80-acre landslide and 75 more residence uphill of the active slide, which could be threatened by it. This district was formally established on July 19, 1985. Petition for GHADs require signatures from owners of at least 10% of the real property involved, or by resolution of the local legislative body. The application is accompanied by a formal "Plan of Control" written by a Certified Engineering Geologist. If more than 50% of assessed valuation of the proposed district objects to district formation, the process is abandoned (see Robert B. Olshansky's article "Geological Hazard Abatement Districts" in the July 1986 issue of *California Geology*).

GHADs have also been employed to provide for preventative maintenance for new or recently-constructed developments, such as those at Canyon Lakes in San Ramon and Blackhawk in Danville, formed in 1986. These GHADs were initially funded by the developers. In other instances, the formation of GHADs can be used as a condition of approval by local governing agencies (an example would be the Castlegate GHAD formed in Orinda in 1996, before any of the homes were occupied). These Bay Area GHADs are principally focused on operations and maintenance of drainage improvements, as well as aging effects, such as slope creep, surficial erosion, and expansive soils. GHADs have also been discussed as a possible mechanism for operation and maintenance of flood protection systems, such as levees.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980; the Superfund Amendments & Reauthorization Act (SARA) of 1990; and the establishment of SUPERFUND sites

In 1980 ***hazardous substances*** were recognized and defined under the provisions of the ***Comprehensive Environmental Response, Compensation and Liability*** **Act** (CERCLA), which was amended in 1990 by the ***Superfund Amendments & Reauthorization Act*** (SARA). It is within the realm of CERCLA (aka *Superfund*) that the particular geologic conditions of California become of critical concern to Cal/EPA in its role of conducting the Federal regulatory program for remediation of uncontrolled hazardous substances within California.

Undocumented hazardous waste sites in California, like any USEPA primacy state, comes into line for entry into the CERCLA system, and receives a unique CERCLIS (*CERCLA List)* identification number and site name, and becomes subject to evaluation as to the seriousness and immediacy of its assessed threat to the public. The process calls, in order, for evaluation through a non-invasive *Preliminary Assessment* (PA), from which the HRS (*Hazard Ranking Score*; maximum of 100 points) is prepared and, in due time, a contractor visits the site and undertakes limited subsurface sampling. At this point, the HRS is again revisited and scores greater than 28.5 are subject for elevation to the USEPA SUPERFUND *National Priority List* (NPL) and to receive action funding for continued progress, which may include efforts to identify a financially solvent *Potential Responsible Party* (PRP). Sites for which the SIA yields scores less than 28.5 generally are given NFRAP ("*NiFrap*" = *No Further Remedial Action Planned*), which removes them from eligibility for consideration to be added to the NPL. NPL sites for Missouri require processing by, or through Region VII of the USEPA to become *Proposed* for the NPL and a final *Listing* requires considerable action at HQUSEPA.

Concurrently, Cal/EPA compiles its own *Registry of Confirmed Abandoned or Uncontrolled Hazardous Waste Disposal Sites in California*, in compliance with State law. Even though USEPA has produced, within this century, an admirable on-line pdf repository of relevant waste management reports, neither it, or Cal/EPA has the on-line capability for citizens to recover, manage and tally such physical sites. Once one is aware of the actual presence of a toxic waste site, remediated or unremediated, recovery of background documents is functional (www.epa.gov/superfund/sites/cursites/index.htm).

SUPERFUND remediation efforts have far outstripped available funds to undertake costly litigation with PRPs, in order to force them to become named RPs (*Responsible Parties*), so that most States have opted for some form of the *Voluntary Cleanup Program* (VCP). These voluntary programs were initiated by USEPA in 1994, in which the PRP becomes an RP, but is left in charge of the time scheduling under which meaningful remedial action actually take place. VCP nationally shows a very poor record of compliance progress; with start-to-closure of remediation taking as long as twenty years.

State Landslide Hazard Identification Program (1983)

In 1983 the California Assembly approved AB 101, funded in the wake of record numbers of landslides being triggered between 1978-83. The bill directed the State Division of Mines and Geology to prepare landslide-hazard maps in urban and urbanizing areas. This activity became known as the DMG's **Landslide Hazard Identification Program**, and although still law, has suffered from a lack of funding since 1994. Between 1984-92, maps were produced as open file reports with a blueline format. These maps usually consisted of four sheets: Plate A- Relative Landslide Susceptibility Map; Plate B - Landslides and Related Slope Features Map; Plate C - Geologic Map (may be omitted in some areas); and Plate D - Relative Debris Flow Susceptibility Map (also optional). These maps were all produced at a scale of 1:24,000 (1 inch = 2,000 feet). In 1993 map products started being produced as DMG map sheets, in a two color format. By 1998 DMG produced 30 maps covering 38 7.5-minute quadrangles as part of this mapping program, including 17 maps in Los Angeles, San Diego, Orange and Ventura Counties.

Geotechnical Engineer title act (1986)

During the mid-1980s the Soil and Foundation Engineers Association (SAFEA) of California lobbied the State Legislature to enact the Geotechnical Engineer Title Act in 1986, sponsored by State Senator Leroy Green, SE, a licensed structural engineer. SAFEA's aim was to bring geotechnical engineers up on par with structural engineers, by offering a specialty license. The 'title act' does not preclude professional engineers from *practicing* geotechnical engineering, only from calling themselves 'geotechnical engineers.' Geotechnical engineers are normally identified by the initials "GE" behind their name. During the first year (1986-87) 930 engineers received the GE title by grandfathering (GE numbers 001 thru 931). These individuals had to demonstrate that they had worked at least four years in geotechnical engineering *after* having received their professional engineering licenses, prior to October 1, 1986. The first 8-hour Geotechnical Engineer examination was administered in April 1987, and these GE registration numbers begin with GE #2000, going forward. The GE title remains the only legal recognition of geotechnical engineers in the United States.

California Building Code (1988)

The **California Building Code (CBC)** was approved and incorporated into the UBC in 1988. It was simply the UBC with the addition of California's more stringent seismic design parameters, as determined by **California Building Standards Commission (CBSC).** The CBSC reviews and approves building standards proposed and adopted by state agencies, administers California's building code adoption processes, resolves conflict, duplication, and overlap in building standards. Almost every municipality in California uses the CBC, while a few entities use a more conservative version (e.g. San Francisco has their own **San Francisco Building Code**).

Seismic Hazard Mapping Act of 1990

Prompted by 1989 Loma Prieta earthquake, the State legislature passed the Seismic Hazard Mapping Act of 1990, which became operative in 1991. The purpose of the Act was to protect public safety from the effects of strong ground shaking, liquefaction, landslides, or other ground failure, or other hazards triggered

by earthquakes, such as landslides. The goal of the program was to prepare hazard maps noting areas of potentially liquefiable ground and seismically-induced landslides. The maps delineate areas where site-specific investigations are required for evaluating liquefaction potential and landslide hazards before development and construction. For new structures, site-specific studies are now required by law to demonstrate whether sites can be made suitable for habitable structures, safe from seismic threat. In addition, owners of existing structures within a designated seismic hazard zone must disclose that information when a property is sold.

In 1997 CDMG began publishing **Seismic Hazard Zone Maps**, at a scale of 1:24,000, focusing on developed portions of Los Angeles and Orange Counties, as well as some portions of Ventura County. Official maps of designated seismic hazard zones were originally released as blueline print open file report overlays of standard 1:24,000 scale USGS topographic quadrangles, but are now downloadable as digital files from the California Geological Survey. .

The hazard zone maps showing areas prone to liquefaction and landslides, covering most of Los Angeles and Orange Counties, and portions of Ventura, west San Bernardino, and west Riverside Counties. The first 38 maps covered the areas most impacted by the 1994 Northridge earthquake because funds from the Federal Emergency Management Agency (FEMA) were made available to speed up post-earthquake mapping of these areas.

Establishment of the California Environmental Protection Agency (Cal/EPA) in 1991

The **California Environmental Protection Agency** (Cal/EPA) was created executive order in 1991, following a "Big Green" initiative by Governor Pete Wilson, establishing a cabinet-level agency to oversee state environmental regulations and research. Following inter-agency reorganizations, it became a cabinet department in July 1991. Cal/EPA is composed of six departments, boards and offices responsible for environmental research, regulating and administering the state's environmental protection programs, and fulfilling hazardous waste cleanup. These departments include: **California Air Resources Board**; **Department of Pesticide Regulation** (DPR); **Department of Toxic Substances Control** (DTSC); **Office of Environmental Health Hazard Assessment**; and the **State Water Resources Control Board** (WRCB); and **California Department of Resources Recycling and Recovery** (CalRecycle), which replaced the California Integrated Waste Management Board in 2010.

Establishment of the Natural Resources & Conservation Service (1995)

In 1995 Congress reorganized the Department of Agriculture. The Soil Conservation Service was re-designated as the Natural Resources Conservation Service (NRCS), and within each County the NRCS office was co-located with a Consolidated Farm Service Agency (formerly the Agricultural Stabilization and Conservation Service) office. County soil survey reports are usually available at no charge from these offices, though many counties only offer poor quality machine copies. A comprehensive listing of soils reports was compiled by the California Geological Survey: *An Index to Soil Surveys in California*. This is available from the Department of Conservation and it lists every report of any length, by county, dating back to 1900.

International Building Code (1997)

The **International Code Council (ICC)** is based in Falls Church, VA. It was formed in 1994 by combining the three model American building codes published by the Building Officials Code Administrators (BOCA), founded in 1915; the International Conference of Building Officials (ICBO), founded in 1927; and the Southern Building Code Congress International (SBCCI), founded in 1940. The ICC produced the first edition of their **International Building Code** (IBC) in 1997, intended to be the new national standard for the United States. The 1997 IBC was based on the 1997 Uniform Building Code (UBC), but without the Chapter 33 Appendices for Excavation & Grading (these amendments are part of the California Building Code). Amendments to the new IBC were issued in 2000, 2003, 2006, and 2009. Forty-seven (47) states including Washington, DC, the U.S Department of Defense, and the National Park Service, had adopted the IBC or parts of it into government regulations by 2009. Local building code officials mainly regulate the enforcement of the IBC.

Notable Boards of Consultants (in Southern California)

The Walker Board (1896-97)

In June 1896 President Grover Cleveland appointd an impartial board of engineers and scientists to examine th various locations in southern California suitable for the coinstruction of a deep water port, which would receive federal funds for development according to the River and Harbor Bill then before Congress (in 1896). The borad was fiunded by a $50,000 appropriation attached to the bill. The President appointed Rear Admiral **John G. Walker** as the chairman of this board, along with Prof **Augustus F. Rodgers** of the U.S. Coast Survey, and civil engineers Prof. **William H. Burr**, **George S. Morision**, and businessman **Richard P. Morgan**., who was sympathetic to Southern Pacific's facility in Santa Monica. The board's assignmnent was to choose between San Pedro and Sanata Monica. Public sessions commenced in December 1896 and the case for San Pedro was argued eloquently by **Harry Hawgood, C.E.** (1869-1930) of the Free Harbor League, and Harry Moore for the terminal. Approximately $15 million in local capital was promised for development of the Port of Los Angeles in San Pedro. The Walker Board issued their report on March 1, 1897, which stated that a deep water port (e.g. year round 30 ft draft) could be constructed at San Pedro for less cost than a comparable facilty at Santa Monica, which offered no natural shelter. They recognized that development of the harbor between San Pedro and Wilmington Slough would likely involve considerable excavationnand filling, over a period of time.

Board of Engineers to Investigate Sources of Water for Los Angeles (1905)

William Mulholland (Chair), **J. B. Lippincott**, and **O.K. Parker**. Appointed by the Los Angeles Board of Water Commissioners to examine possible sources of water for the expanding needs of the City of Los Angeles. This panel selected the Owens River, along the eastern side of the Sierra Nevada Mountains. **Lippincott** was a supervising engineer for the federal Reclamation Service, after having supervised the activities of the USGS Hydrographic Branch in California of the USGS during the previous decade. After the verdict of this panel was released, Lippincott was hired by the City to prepare a [public report summarizing all of the possible sources of water supply for Southern California, which was incorporated into the 4th Annual Report of the Water Commissioners on November 30, 1905.

Advisory Board of Engineers to examine the feasibility of the Los Angeles-Owens River Aqueduct (1906)

In November 1906 the City of Los Angeles appointed a three-man **"Board of Consulting Engineers"** to examine and report on the feasibility of the proposed Los Angeles Aqueduct, conveying water 226 miles from the Owens River to the north end of the San Fernando Valley. This board was led by **Frederick P. Stearns**, Chief Engineer of Boston's Metropolitan Water District, President of ASCE; **John R. Freeman**, Consulting Engineer for the City of New York's New Croton Aqueduct and a national figurehead in hydraulics and waterworks engineering (who later emerged as the father of earthquake engineering); and **James D. Schuyler**, a Los Angeles Consulting Engineer who had designed some of the largest dams in the western USA, including Sweetwater and Hemet Dams in Southern California (he would serve as a consultant to Los Angeles on a number of semi-hydraulic fill dams over the succeeding years, and was also a member of the Panama Canal advisory board). All three had served as consultants on the newly-embarked Panama Canal project. This board filed their report on December 25, 1906, estimating the cost to be about $24 million and would require a period of seven years to construct. The Aqueduct was actually built under control of the City's Board of Public Works, not BWWS (who operated and maintained it, after completion).

Board of Engineers for Apportionment of Surplus Waters of the Los Angeles Aqueduct (1911)

A Board of Engineers was appointed by the City of Los Angeles in 1911 to study and report on how the City's water resources should be apportioned and distributed, including groundwater. This board was comprised of **J. H. Quinton** (Chair), **William H. Code**, and Los Angeles City Engineer **Homer Hamlin**, all respected members of ASCE. Their findings were published by the Los Angeles Board of Water Commissioners as "***Report Upon the Distribution of the Surplus Waters of the Los Angeles Aqueduct***," by John Henry Quinton, W. H. Code, and Homer Hamlin (1911). The board concluded that Owen River water could be distributed to the irrigable areas of the San Fernando, Glendale, West San Gabriel, East San Gabriel, and Los Angeles Valleys, as well as the coastal plain, including the Redondo, Inglewood, and Cahuenga

Basins. Quinton and Code had both previously worked for the U.S. Reclamation Service. They decided to form a partnership on November 1, 1911, providing consulting in water resources engineering in the greater Los Angeles area (profiled above).

Board of Engineers [to examine] Flood Control of Los Angeles County (1914-15)

In the wake of the floods of January 1914 the Los Angeles County Board of Supervisors appointed a Board of Engineers Flood Control of Los Angeles County to investigate the flood control menace and summarize their recommendations in a report to the County. This board was comprised of civil engineers **Harry Hawgood, Charles T. Leeds, James B. Lippincott, Frank H. Olmstead**, and **James W. Reagan**. Chairman Hawgood had been the Resident Engineer of the Southern Pacific Railroad in Los Angeles when the floods of 1889 destroyed every bridge across the Los Angeles River, and who since 1894, had served as the most prominent advocate of establishing a deep water port at San Pedro. The board's report was completed in the summer of 1915 and titled: "***Provisional Report of Board of Engineers of Flood Control***: Submitted to the Board of Supervisors Los Angeles County, California, July 26, 1915."

SSA Committee on Building Safety Against Earthquakes (1924)

In 1924 the **Seismological Society of America** formed a standing Committee on Building Safety Against Earthquakes composed of representatives from the American Society of Civil Engineers, American Institute of Architects, National Board of Fire Underwriters, and the Cities of San Francisco and Los Angeles. The members included San Francis co-based consulting engineers **Henry D. Dewell**, and **Walter L. Huber**, and Stanford Geology Professor emeritus **Bailey Willis**.

The committee took Willis' ***Fault Map of California*** published by the Seismological Society of America and formulated tables listing the probable horizontal acceleration of expected earthquakes, based on observations made after the 1906 San Francisco earthquake, using the old Rossi-Forel scale, the distance from known fault lines, and the character of the underlying soil. **Dewell** was the first engineer to apply these parameters in assessing the damage patterns emanating from the June 1925 Santa Barbra earthquake, and reported the results in *Engineering News Record*.

Independent Assessments of the San Gabriel Dam at the Forks (1926)

On May 6, 1924 the citizens of Los Angeles County approved a $35 million bond issue to construct an integral system of flood control, which included dams and debris basins along the principal tributaries of the western San Gabriel Mountains. The largest of those proposed was the San Gabriel Dam project, which envisioned the largest and highest (425 feet) concrete dam ever designed up until that time, to be situated just downstream of the confluence of the Western and Eastern Forks of the san Gabriel River, about seven miles north of Azusa. In 1924 the County retained **Arthur Powell Davis**, former Commissioner of the U.S. Reclamation Service to inspect the proposed dam site and approve it.

Between mid-1924 and late 1926 the County Flood Control District finalized its design of the new dam, which received ample skepticism because the agency had yet to construct even a small dam, let along the world's largest.

On December 12, 1926 a report by **F.J. Safley**, Inspector for the U.S. Department of Interior's General Land Office and **W.D. McGlashin**, District Engineer with the U.S. Geological Survey was critical of the suitability of the San Gabriel Dam site. Another contrasting report was released the same day, in which other experts, hired by Los Angeles County, opined to be in favor of the forks dams site in San Gabriel Canyon. Their report discussed the pros and cons of the Granite Dyke site (where Morris Dam was later built) and the Forks Site. This board of consultants was comprised of consulting engineers **Louis C. Hill** of Quentin, Code & Hill in Los Angeles and **A.J. Wiley** of Boise, who opposed the Forks Site in favor of the Granite Dyke site.

Board of Consulting Engineers to the Los Angeles County Flood Control District (1927)

This board was convened by the LA County Board of Supervisors to review plans developed by the newly formed LA County Flood Control District to develop a system of flood control works using a voter-approved funds of $26 million, when the district was being led by engineer **James W. Reagan**. The primary purpose of this board was to advise the flood control district on the projects proposed in the san Gabriel River watershed, in particular, the San Gabriel Forks Dam in San Gabriel Canyon, intended to become the largest concrete dam ever constructed up to that time.

The board was comprised of Stanford University CE Department Chairman **Charles D. Marx**, **Frederick H. Fowler** of the US Forest Service in San Francisco, and **Charles H. Paul**, former Chief Engineer of the Miami Conservancy District in Dayton, Ohio. The board recommended the constriction of the San Gabriel Forks Dam, just downstream of the confluence of the river's Western and Eastern Forks, as well as the San Gabriel Dam No. 2 (later renamed Cogswell Dam) on the West Fork of the San Gabriel River.

Governor's Board of Inquiry to Investigate the Failure of the St. Francis Dam (1928)

A few days after the untimely failure of the St Francis Dam on March 13, 1928, Governor C.C. Young appointed a six-man panel to make an investigation and report their findings as soon as possible. The panel was chaired by famed dam engineer **A. J. Wiley** of Boise, Idaho (1862-1931), and the other panelists were: Geology Professor **F. Leslie Ransome** of Caltech, Geology Professor **George D. Louderback** of U.C. Berkeley, **Frank E. Bonner** (Chief of Geography, USFS District 1 in San Francisco), consulting engineer **H.T. Corey** of Los Angeles, and consulting engineer **Frederick H. Fowler** of San Francisco. The panel convened in Los Angeles on March 19th, made one site visit on March 22nd, and submitted their 79 page report to the Governor on March 27th, titled: "***Causes Leading to the Failure of the St. Francis Dam.***" Being the first report released after the failure, it garnered the most attention in the media. Reproduced in quantity by the State Printing Office, it served as the primary reference on the dam failure for many years thereafter.

Coroner's Jury in the Inquest of Victims of the St. Francis Dam Disaster (1928)

Inquest convened by Los Angeles County Coroner **Frank A. Nance** to investigate the failure of the St. Francis Dam. The jurors included Los Angeles hydraulics engineer **Irving C. Harris**, real estate appraiser **Harry G. Holabird**, contractor **William H. Eaton, Jr.** (nephew of former of Angeles Mayor and City Engineer Fred Eaton), mining/petroleum engineer **Sterling C. Lines** (a close friend of Coroner Frank Nance), **Oliver G. Bowen,** architect and structural engineer **Blaine Noice**, **Chester D. Waltz,** civil engineer/insurance agency owner **Ralph F. Ware**, and **Z. Nathaniel Nelson.** The Jurors were taken on a field trip to the St. Francis Dam site on Friday March 23, 1928 to familiarize themselves with the site. Public testimony commenced on Monday March 26th, and continued for almost a month thereafter.

Although none of the Jurors appears to have had any formal expertise in geology or foundation engineering, they possessed considerable technical training in civil engineering and heavy construction, which is revealed in their recommendations and findings, which reveal considerable engineering judgment and statements of timeless wisdom. **Waltz, Bowen**, and **Noice**, became founding members of the Structural Engineers Association of Southern California (SEAOSC) in 1932, while Noice and Bowen were appointed to the Joint Technical Committee on Earthquake Protection following the 1933 Long Beach earthquake (summarized below).

District Attorney's Fact-Finding Commission to investigate the failure of the St. Francis Dam (1928)

Fact Finding Commission assembled by Los Angeles County District Attorney **Asa Keyes** a few days after the St. Francis Dam failure on March 13, 1928 to prepare a report and testify at the Los Angeles County Coroner's Inquest. The commission was comprised of three engineers and two geologists: **Edward L. Mayberry,** architect and structural engineer was the chairman, **Walter G. Clark**, consulting engineer, **Charles T. Leeds**, of Leeds and Barnhard Consulting Engineers, Los Angeles, **Allen E. Sedgwick**, Professor of Geology at USC, assisted by consulting geologist **Louis Z. Johnson**.

Their report was submitted to the DA's office on April 4, 1928 and was tilted: "***Report to Mr. Asa Keyes. District Attorney, Los Angeles County, California, on the Failure of the St. Francis Dam***." Their report assuaged that reservoir water percolating along the old fault in the dam's right abutment softened the arkosic sandstone sufficiently to remove the material via hydraulic piping. Mayberry began testifying on April 4th, followed by Clark, Sedgwick, Johnson, and Leeds, during the first two weeks of April 1928.

Report on Failure of the St. Francis Dam to the Board of Water & Power Commissioners (1928)

Investigative board appoint by the Los Angeles Board of Water & Power Commissioners to investigate and report upon the most likely causes of the failure of the St. Francis Dam. The board was comprised of civil engineer **Louis C. Hill** of Quentin, Code & Hill of Los Angeles, Stanford geology Professor **C. F. Tolman**, and Los Angeles consulting engineer **D. W. Murphy,** former hydrologist with the Bureau of Reclamation's regional office in Los Angeles. This panel was one of the first to have access to the

post-failure triangulation surveys of the remaining portions of the dam, which showed that the wing dike had lifted 0.285 feet since the dam was constructed (because of swelling of the underlying gypsiferous arkose). Their findings were summarized in "***Report on the Failure of the St. Francis Dam on March 12, 1928***," dated April 12, 1928.

Committee Appointed by the Los Angeles City Council to Investigate and Report the Cause of the Failure of the St. Francis Dam – the Mead Report (1928)

On March 16, 1928 the Water & Power Committee of the Los Angeles City Council, led by councilman Pierson M. Hall, passed a resolution calling for an independent investigation of the causes of the failure of the St. Francis Dam on March 13, 1928, naming **Dr. Elwood Mead**, Commissioner of the U.S. Bureau of Reclamation in Washington, DC to serve as the committee's chairman. The resolution called for two other members to be nominated by the American Society of Civil Engineers. On March 23rd the other members of the committee were announced: **Louis C. Hill** of Quentin, Code, and Hill Consulting Engineers of Los Angeles (and formerly employed by the U.S. Reclamation Service) and Major General **Lansing H. Beach**, retired Chief of the Army Corps of Engineers from 1920-24 (who lived in Pasadena). Beach was known in southern California, having previously authored a Report from the Harbor Commission to the Orange County Board of Supervisors in July 1926.

The three man committee also engaged the services of **David C. Henny**, consulting engineer of Portland (formerly employed by the U.S. Reclamation Service) and **Raymond F. Walter**, Chief Engineer of the US Bureau of Reclamation in Denver (already charged with making an independent investigation for the federal government), and consulting engineer **J. B. Lippincott** of Los Angeles, former Assistant Chief Engineer of the Los Angeles Aqueduct, to "join it in its investigations and to take advantage of their experience in the discussions." They also solicited an independent input regarding possible earthquake activity on the night of the dam failure from Caltech Geology Professor **F. Leslie Ransome** and **Harry O. Wood**, Chief Scientist at the Seismological Laboratory of the Carnegie Institute of Washington, also at Caltech in Pasadena. Mead, Walter, Hill and Henny were all later involved with the design and construction of Hoover Dam, between 1929-35.

This body prepared a typed report issued on March 31, 1928, entitled: "***Report of Committee Appointed by the City Council of Los Angeles to Investigate and Report the Cause of the failure of the St. Francis Dam***," signed by all five men. It was referred to as the "Mead Report" in newspaper accounts of the time. The committee concluded that the dam's concrete was not at fault, nor that movements of the Earth's crust were involved; but that the dam possessed insufficient dimensions to withstand the loads imposed and failed as a result of defective foundations. The **Mead Report** contained the highest quality photographic images, but only a handful of copies were made.

Committee of Engineers & Geologist to Assess Mulholland Dam (1928)

In the wake of the untimely failure of the St. Francis Dam, on May 11, 1928 the Los Angeles Board of Water & Power Commissioners appointed an independent panel to evaluate the safety of Mulholland Dam in the Hollywood Hills, because its design was almost identical to that of St. Francis, although it was completed a year before St. Francis. This committee was comprised of: Chairman **Louis C. Hill** (of Quentin, Code, and Hill of Los Angeles), **R. E. McDonnell** (of Burns-McDonnell in Kansas City), and geologist **Robert T. Hill**, retired from the U.S. Geological Survey. The reviewed cores ken through the dam and its foundations. Finding a tight seal between the concrete and the sandstone supporting the structure, they concluded in the report of July 24th that the dam was safe, even under conditions of "full uplift." They recommended that at least 4,500 ac-ft of storage be maintained in the reservoir, for domestic use and fire protection.

City of Los Angeles Dam Safety Review Panel (1928)

In the wake of the St. Francis Dam failure, in April 1928 the Los Angeles City Council named a committee of independent experts to make a preliminary evaluation of the 29 dams operated by the City's Bureau of Waterworks & Supply. This committee was comprised of: consulting engineers **A. J. Wiley** of Boise, Idaho, **Charles H. Paul** former Chief Eng'r of the Miami Conservancy District of Dayton, Ohio, and **F. C. Herrmann**, former Chief Engineer of the Spring Valley Water Co of San Francisco. The committee was aided by Caltech Geology Professor **F. Leslie Ransome** and former USGS geologist **Robert T. Hill**, to provide their geologic expertise. The committee's report was submitted on July 23rd, concluding that the

city's dams appeared to be of adequate quality to withstand imposed loads, even Mulholland Dam, which they opined could withstand the "strongest seismic shock," capable of leveling Los Angeles or Pasadena.

Board of Consultants to Examine the San Gabriel High Dam (1929)

At 425 feet high, the **San Gabriel High Dam,** also referred to as the **San Gabriel Dam at the Forks Site**, would have been both the highest and largest curved concrete gravity dam in the world. It was designed by the **Los Angeles County Flood Control District** as their kingpin structure, along the San Gabriel River about 9 miles above Azusa. Bids were advertised in November 1928 and a $12 million contract was awarded the flowing month, supplanted by $13 million in materials and site improvements provided by the County, for a total project cost of $25 million (all figure more than 10 times those of the ill-fate St. Francis dam, which had failed 8 months previous). Abutment excavation began in January 1929, averaging 100,000 yds^3 per month from February onward. Flood Control engineers had estimated that approximately 600,000 yards of material would need to be stripped from both abutments. The contractor excavated 13 tunnels in the right abutment to evaluate the quality of the rock. These tunnels were then filled with 193,000 pounds of dynamite and detonated on June 26, 1929. The blast brought down 160,000 cubic yards (350,000 tons) of material. On September 16th a massive landslide enveloped the blast-weakened right abutment, dumping another 100,000 yards of debris. The contractor had excavated about 650,000 of the 675,000 total cubic yards slated for removal from both abutments when the slide occurred. It soon became apparent that considerably more excavation would be required on the right abutment than anticipated.

At this juncture the County Board of Supervisors retained a new board of consultants to study the site. This board was comprised of consulting engineer **Louis C. Hill** of Quentin, Code and Hill in Los Angeles), consulting engineer **A.J. Wiley** of Boise, Idaho, retired USGS geologist Dr. **Robert T. Hill** of Dallas, and Stanford geology Professor **C.F. Tolman**. In their report dated October 16, 1929 this board judged that the slide set in motion on September 16th was of much greater volume than originally estimated, being about 200,000 cubic yards. This board issued a report stating "that a safe dam of the proposed height cannot be built at this site." Geologists Hill and Tolman found a series of faults cris-crossing the dam site, which intersected in the west abutment. Wiley had chaired the Governor's Board of Inquiry on the St. Francis Dam failure 1-1/2 years previous. The County ordered the contractor to cease all operations, pending further inquiry. They had expended approximately $2 million when the project was shut down.

State Engineer's External Review Panel to evaluate the San Gabriel Forks Dam (1929)

State Engineer Edward Hyatt also visited the site and announced that the State would be making an independent inquiry, based upon their new-founded powers (dam control law) which came out of the St. Francis disaster. Here's where the individuals you've named entered the picture. In early November 1929 the State selected a special board to investigate the safety of the San Gabriel Dam site. This board was comprised of: **John L. Savage** (Chief Design Engineer, USBR-Denver), **George A. Elliott** (Chief Engineer, Spring Valley Water Co., San Francisco), **M.C. Hinterlider** (State Engineer of Colorado), **George D. Louderback** (Professor of Geology at U.C. Berkeley), **Ira A. Williams** (consulting geologist from Portland, OR), and **Charles P. Berkey** (Professor of Geology at Columbia University in NY). This group convened in Los Angeles on November 12th.

Los Angeles County reappointed a board of consultants to investigate, which included: geology Professor **Andrew Lawson** of Cal Berkeley, Stanford Civil Engineering Professor **Charles D Marx**, consulting engineer **Charles H. Paul** (of the Miami Conservancy District in Dayton, Ohio), and consulting engineer **Frederick H. Fowler** of San Francisco. The County Board of Supervisors also asked those geologists and engineers who had formerly provided advice on the dam to provide their own comments and evaluations concurrent with the State's inquiry. This group included: consulting geologist **Wayne Loel** of Los Angeles, consulting engineer **James B. Lippincott** of Los Angeles, consulting engineer David C. Heney of Portland, **F. J. Safley, Allen Sedgwick** (geology professor at USC), **Robert T. Hill** (retired USGS geologist in Dallas, Texas), **Louis C. Hill** (consulting engineer with Quentin Code and Hill in Los Angeles), Stanford geology professor **C. F. Tolman,** and former County Flood Control Engineer **J.W. Reagan**.

On November 26, 1929 the state panel issued their findings, concluding that the proposed dam "cannot be constructed without creating a menace to life and property." As a "supplemental suggestion," the board found that earth and rock fill dam of "conservative design" might be successfully employed at the site." The "conservative design" of those days foresaw a broad hydraulic fill embankment with a concrete core wall. Between 1933-38 the LACFCD constructed San Gabriel Dam No 1 about two miles downstream of the forks site.

Consultants to City of Pasadena on the Pine Canyon [Morris] Dam (1928-34)

In the late 1920s the City of Pasadena employed a number of consulting engineers and geologists to provide overview of the design and construction of the City's expanded waterworks, centered about a new reservoir in San Gabriel Canyon, with a conveyance system linked to the distribution network already serving Pasadena. The dam site was about 1-1/2 miles above the canyon's mouth, near the town of Azusa, next to a small ravine called "Pine Canyon" on the maps.

Samuel B. Morris attended Throop Polytechnical Institute (the forerunner of Caltech) in Pasadena, before heading to Stanford, when he received his BA in civil engineering in 1911. He joined the Pasadena Water Department in 1913 and rose through the ranks to become its general manager by 1925. At this time (late 1928) the Los Angeles County Flood Control District was just beginning construction of their massive San Gabriel Forks Dam in San Gabriel Canyon, about 10 miles upstream of the Pine Canyon dam site. In an effort to pacify Pasadena voters for a bond election in 1929, the city decided to retain a blue ribbon panel of consulting engineers and geologists to advise them on the project. These included: engineers **Louis C. Hill**, Dr. **Frederick A. Noetzeli**, **A. J. Wiley,** and **A. L. Sonderegger**. Their consulting geologists were Professors **F. Leslie Ransome** of Caltech and **A.O. Woodford** of Pomona College.

In September 1929 voters from Pasadena approved a $10 million bond issue to build a concrete gravity dam 295 ft above the stream bed, or 375 feet above the lowest point of foundation at the Pine Canyon site and a 13-mile long aqueduct pipeline. In January 1930 the city retained **Louis C. Hill** of Quentin Code & Hill in Los Angeles to provide ongoing review of their design and Caltech geology Professor **F. Leslie Ransome** to advise them on how to best develop the dam site. Hill and Ransome issued favorable reports to the city in July 1930.

In October 1930 the city filed an application with the state to construct the dam. In March 1931 the dam's height was reduced to 245 ft above the streambed. A contract was awarded in April 1932, but construction did not begin until early September. Other consultants that the city retained during construction included consulting **Walter L. Huber** of San Francisco, retired Corps of Engineers Major General **Lansing H. Beach** (who lived in Pasadena), and Caltech geology Professor **John P. Buwalda**. The dam was completed in May 1934.

First pseudostatic earthquake load applied to a dam (1929)

During excavation of the granodiorite to diorite gneiss foundations for **Pine Canyon Dam** (renamed Morris Dam during its dedication by President Herbert Hoover in 1934), engineers found the gneiss was cut by dikes of aplite and diabase, as well as numerous shears and faults. One prominent fault was exposed at the base of the dam's right abutment. Close inspection showed that this fault had not exhibited appreciable movement in at least 10,000 years. This discovery led to a much more thorough examination of the dam's foundation and abutments, including 23 exploratory adits, adding up to 2,760 lineal feet. They had an aggregate total of 4,155 ft of exploration shafts, tunnels, and diamond core drilling.

The dam was the world's first to be designed for a pseudostatic lateral load of 0.10g, through the dam's center of gravity. This load was based on the recommendation of geologist **F. L. Ransome** at Caltech and seismologist **Harry O. Wood** at the Carnegie Institute at Caltech in early 1929, as reported in S.B. Morris and C. E. Pearce, "***Design of Gravity Dam in San Gabriel Canyon to Resist Earthquakes***," Seismological Society of America Bulletin v.19:3 in Sept. 1929. The pseudostatic method was subsequently approved by Professor **Harald M. Westergaard** of the University of Illinois, in 1933 (Westergaard became Dean of Engineering at Harvard University a few years later).

Engineering Board of Review – Metropolitan Water District (1929-30)

In August 1929 the Board of Directors of the newly formed Metropolitan Water District of Southern California appointed an Engineering Board of Review to evaluate their engineering scheme for a Colorado River Aqueduct and its appurtenant systems of distribution. This board was comprised of Boise consulting engineer **A. J. Wiley** of Boise, Idaho, **Richard R. Lyman**, founder of the civil engineering program at the University of Utah, and **Thaddeus Merriman**, Chief Engineer of the Board of Water Supply of the City of New York.

On Dec. 21, 1929, the board issued a preliminary report recommending surveys, investigations, and comparable estimates of four proposed routes for a Colorado River Aqueduct. On Nov 25, 1930 MWD submitted its findings to the board for their review, with the necessary design details for the proposed Parker aqueduct route. This plan proposed to divert the river's flow with a dam just downstream of the river's confluence with the Bill Williams River, with five pump lifts totaling 1523 feet (between elevation 450 ft at Parker Dam to 1807 ft at Hayfield Lift), a return power drop of 252 feet, and an aqueduct length of 252 miles. On Dec 19, 1930 the Engineering Board issued its final report to the MWD Board, approving the Parker aqueduct route. A $220 million bond to construct this aqueduct was subsequently approved by voters on Sept 29, 1931.

Board of Consulting Geologists – Metropolitan Water District (1930)

Following the recommendations of the MWD Engineering Board of Review in December 1929 to pursue detailed studies of the so-called "Parker aqueduct route" for the proposed Colorado River Aqueduct (described above), the Metropolitan Water District appointed a panel of consulting geologists to evaluate the geology along the proposed alignment. Their charge was to "select the route which would encounter the fewest construction difficulties and be the least subject to seismic disturbances." This panel was led by Caltech Geology Professor **F. Leslie Ransome**, who had served as the principal geological consultant for the proposed Hoover Dam. Ransome was assisted by Caltech Geology Department Chairman **John P. Buwalda**, **Levi F. Noble** of the U.S. Geological Survey, and Messrs. **Frank M. Murphy** and **Rollin P. Eckis**, who were both PhD students at Caltech. This was the largest panel of geologists ever assembled to evaluate a single project. The Aqueduct was eventually completed between 1933-39 and was christened by ASCE as one of the Seven Great Civil Engineer Wonders of the United States in 1955.

External Board of Consultants for Pine Canyon [Morris] Dam (1930-31)

In October 1930 the City of Pasadena announced it was appointing a special board of consultants to investigate the safety features of their proposed Pine Canyon Dam along the San Gabriel River in San Gabriel Canyon. This panel was seen as a politic expedient in the immediate aftermath of the cancellation of the LA County Flood Control District's San Gabriel Forks Dam, a few miles upstream, which was deemed unsafe because of the geologic conditions exposed on the dam's right abutment.

The members of the special board were: Geology Professors **Charles P. Berkley** of Columbia University and **George D. Louderback** of U.C. Berkeley, consulting geologist **Ira A. Williams** of Portland, **John L. Savage**, Chief Design Engineer of the Bureau of Reclamation, **George A. Elliott**, former Chief Engineer of the Spring Valley Water Co of San Francisco, and **M. C. Hinderlider**, Colorado State Engineer. The board consisted of the same members who condemned the San Gabriel Forks Dam site, a few months previous.

Board of Engineering Consultants to the City of Los Angeles (1930-31)

In September 1930 two eminent engineers and a geologist were nominated by the Los Angeles Chamber of Commerce to review the engineering and geological features of the City's proposed $39 million water development program, overseen by the Board of Water & Power Commissioners. This board was comprised of: **Charles P. Berkey**, Professor of Geology at Columbia University; **Louis C. Hill** of Quentin, Code & Hill consulting engineers – Los Angeles; and **J. B. Lippincott**, consulting engineer of Los Angeles. Hill and Lippincott had previously worked for the U.S. Reclamation Service.

External Review Panel to evaluate the Mulholland Dam (1930)

This panel was convened in January 1930 under the auspices of the State's new Dam Safety Act of August 1929 to evaluate the Mulholland Dam, constructed in 1923-25 in Weid Canyon above Hollywood, because it was a near-identical design to the St. Francis Dam, which had failed in March 1928. This panel was appointed by the State Engineer, Edward J. Hyatt, and was chaired by **John L. Savage**, Chief Design Engineer of the U.S. Bureau of Reclamation in Denver, assisted by geology Professors **George D. Louderback** of U.C. Berkeley and **Charles P. Berkey** of Columbia, and **Ira A. Williams**, consulting geologist from Portland. This board issued their report in June 1930 they unanimously agreed that the Mulholland Dam was safe, and no action was recommended to the State Engineer to retrofit the structure or lower the reservoir storage levels.

Board of Review to Evaluate Mulholland Dam (1930)

Concerned about the political fallout that might emerge from the State's External Review Panel, in March 1930 the City of Los Angeles **Board of Water & Power Commissioners** appointed their own Board of Review for Mulholland Dam, which included **Harvey Van Norman**, Chief Engineer and general manager of the city's Bureau of Waterworks and Supply, and Los Angeles consulting engineers **Louis C. Hill** of Quentin, Code & Hill and **A. L. Sonderegger** (water resources engineer). Their report was issued on March 27th and recommended that a massive earth and rock fill embankment be placed against the downstream face of Mulholland Dam, "because this would add to the stability of the structure and because of the psychological effect it would have, changing the apparent menace to a pleasing view carrying no suggestion of a dam. The panel added that the massive fill "would make it impossible for the dam to fail if subjected to an earthquake shock great enough to destroy Hollywood." They also recommended "that Hollywood Reservoir be maintained at a level 31 feet below spillway crest in order to maintain the resultant thrust within the middle third of the structure." As a result of this report, the dam's spillway was lowered from elevation 746 ft to 715 feet in March 1932.

Board of Engineers to Evaluate Mulholland Dam (1931)

Unhappy with the findings of the previous boards, Los Angeles Mayor John C. Porter and City Councilman James M. Hyde (representing Hollywood) requested that the **Board of Water & Power Commissioners** appoint a second board to examine the possibility of abandoning Mulholland Dam and Hollywood Reservoirs, because of anxiety of the residents of Hollywood, living below it. On April 15, 1931 a new board of consulting engineers was appointed to examine the abandonment and how alternative water supplies might be employed to assuage its removal. This new board was comprised of Los Angeles consulting engineers **B. F. Jakobsen** and **Charles T. Leeds**, and USC Geology Professor **Allen E. Sedgwick**. The board issued a preliminary report in July 1931 the panel recommended removing the dam to ally public fears and apprehension. This board failed to agree in its final report and presented two separate opinions. Jakobsen and Sedgwick favored dismantling the structure because the resultant thrust was not within the middle third of the dam's base and a fault in the foundation. In his minority report, Leeds disagreed and stated his belief that the dam was safe as it stood, without any retrofitting.

Geological Report of the Suitability of Foundations for Mulholland Dam (1931)

In response to the majority report cited above, The Los Angeles Board of Water & Power Commissioners retained Columbia University Geology Professor **Charles P. Berkey** to make an independent assessment of the foundation conditions of Mulholland dam and issue a report concerning the suitability of said foundations to support the curved concrete gravity dam. At the time, Berkey was the most respected engineering geologist in America and was serving on the Colorado River Board appointed by Congress to review the technical aspects of the Hoover Dam. Berkey's examination of the dam's foundation exonerated the criticisms by **Allen Sedgwick**, and he pronounced the rock sufficiently sound to support a concrete gravity dam.

Board of Consultants-Proposed Alterations & Improvements for Enlargement of the Chatsworth Reservoir (1931)

Chatsworth Dam and reservoir was built by the City of Los Angeles for their Los Angeles [Owens River] Aqueduct in 1918, in the southwestern corner of the San Fernando Valley. It was built of hydraulic fill and tamped fill on the crest, and provided with a paved concrete face, with a design capacity of 10,000 acre-feet. The earthen embankments were constructed on a pervious foundation of unconsolidated late Quaternary age alluvium. On August 30, 1930 the M 5.2 Santa Monica Bay earthquake caused noticeable vertical cracking of the embankment crests, due to partial liquefaction and lurching, which increasing leakage.

As a consequence of these problems, a Board of Consultants appointed by the Los Angeles Department of Water & Power to review that agency's design of proposed improvements to the reservoir, which were intended to enlarge its storage capacity. This board was comprised of: retired Stanford Professor **Charles D. Marx**, Los Angeles consulting engineer **J. B. Lippincott**, and Caltech Geology Professor **John Buwalda**. Although this board approved of the various measures proposed by LADWP to bolster the embankments and repair the observed cracks and differential settlement (this work was carried out in 1931-32, by regarding embankments and recompacting with sheepfoot rollers).

The reservoir was never capable of storing its design capacity because of excessive foundation seepage (the Chatsworth Park Reservoir, a 40 ft high embankment dam constructed nearby in 1900, never retained more than 10 feet of water). The dam was eventually taken out of service in August 1969 because of concerns for its seismic safety, given the pervious nature of its foundations.

Board of Consultants to Evaluate Earthquake Design of Pine Canyon Dam (1932-33)

After discovery of the dormant fault at the base of the dam's right abutment, a panel of experts was convened by the City of Pasadena to provide advice on how the dam's design might be altered to make the dam safe, making conservative assumptions. This panel was comprised of Professor **H. M. Westergaard** of the University of Illinois, Professor **Lydik Jakobsen** of Stanford University, seismologist **Harry O. Wood** of the Carnegie Institute in Pasadena (absorbed into Caltech in 1934).

The exposed fault was found to dip into the base of the right abutment at an angle of about 60 degrees from horizontal, towards the northwest. The dam was provided with a specially-designed "slip joint," which is three feet of open space extending up the entire height of the dam. This slip joint can accommodate up to 6.55 feet of dip slip, without impacting the resultant thrust in the dam.

Pine Canyon Dam was also instrumented with Carlson strain meters, identical to those used in Hoover Dam during the same interim (1931-35). Photo-elastic studies of the intensity and distribution of stresses in the dam were also carried out by **J. H. A. Brahtz**, under the supervision of Professor **Theodore von Karman** at Caltech. The dam's chute spillway was also model tested at Caltech, leading the addition of the interior training walls, to promote laminar flow and reduce edge effects. The spillway capacity is 80,000 cfs.

Board of Consulting Engineers for the Bouquet Canyon Dams (1932-33)

This board was appointed by the Los Angeles Department of Water & Power to review the plans prepared by LADWP for the proposed Bouquet Canyon Dams, replacing the ill-fated St. Francis Dam, and intended to store a year's supply of water from the Los Angeles Aqueduct, south of the San Andreas fault. The board was comprised of three prominent southern California engineers: **Charles T. Leeds, Louis C. Hill**, and **J. B. Lippincott**. DWP had previously solicited input from a number of other engineers and geologists, including: geologists **Charles P. Berkey** of Columbia University, **Allen E. Sedgwick** of USC, **Robert T. Hill**, retired from the USGS, **F. Leslie Ransome** of Caltech, and **Rush T. Sill**. Other engineers providing input included **Thaddeus Merriman** (retired Chief Engineer New York Board of Water Supply) and **R. E. McDonnell**, of the newly formed State Division of Safety of Dams.

External Review Panel to evaluate Bouquet Canyon Dam (1932)

This panel was convened in 1932 under the auspices of the State's new Dam Safety Act of 1929 to evaluate the proposed Bouquet Canyon Dams in Bouquet Canyon (described above). This panel was appointed by the State Engineer, Edward J. Hyatt, and was chaired by retired Stanford University civil engineering chairman **Charles D. Marx**, San Francisco consulting engineer **Walter L. Huber**, and **F. C. Herrmann**, former Chief Engineer of the Spring Valley Water Co of San Francisco.

Coroner's Jury in the Inquest of Victims of the Long Beach Earthquake (1933)

Inquest convened by Los Angeles County Coroner **Frank A. Nance** to investigate the structural failure of public buildings during the M 6.3 Long Beach earthquake of March 10, 1933, which killed 120 people, destroyed 70 schools and damaged 120 more. The jury was comprised of 'construction experts,' whose charge was to "*go beyond the mere determination of the cause of the deaths in order to find the reasons for the loss of life and to develop the possibility of providing more earthquake-resistant construction, particularly for schools and public buildings*."

Architect **John C. Austin**, former President of the Los Angeles Chamber of Commerce, served as Chairman of the Jury. He was assisted by mining/petroleum engineer **Sterling C. Lines**, among others.

The jury convened for 8 days in early April 1933 and issued a verdict of just 3,500 words, which included: "*that every masonry building of any height, and every wood-frame building more than two stories high, be designed by either a licensed architect or a registered structural engineer and that every skeleton frame building be designed structurally by a registered structural engineer or a certified architect who qualifies as a structural engineer*."

The Coroner's Jury recommended that earthquake provisions of the new Uniform Building Code be immediately adopted in Los Angeles County. District Attorney **Burton Fitts** transmitted the findings of the

Coroner's Jury to the 1933 Los Angeles County Grand Jury, to seek their opinion as to what course of action should be undertaken. They recommended that the UBC should immediately be adopted by the County. Local governments in Southern California soon followed. The cities of Long Beach, Los Angeles, Santa Monica, Beverly Hills, and Pasadena adopted similar building codes.

Joint Technical Committee on Earthquake Protection (1933)

The Joint Technical Committee on Earthquake Protection was organized following the March 1933 Long Beach Earthquake. It was the first earthquake with strong motion recorders in the near-field area, which measured horizontal accelerations between 0.1 and 0.3g, far higher than many expected. The committee ,members were drawn from the American Society of Civil Engineers, American Institute of Architects, Structural Engineers Association of Southern California, American Association of Petroleum Geologists, Seismological Society of America, Associated General Contractors, Los Angeles Engineering Council of Founder Societies, Board of Fire Underwriters of the Pacific, and the Los Angeles Board of Education, Chamber of Commerce, and other civic organizations.

The representative included: Caltech President **Robert A. Millikan** (Chairman), Professor **R.R. Martel** of Caltech (Vice Chairman), architect **John C. Austin, Sumner Hunt, David J. Witmer,** civil engineer **Raymond A. Hill,** foundation engineer **R.V. Labarre,** structural engineer **Oliver G. Bowen,** structural engineer **Blaine Noice,** Caltech geology Professor **John P. Buwalda,** consulting geologist **Harry R. Johnson, P.L. Connolly, Harold H. Crowell, L.E. Dixon, Ralph J. Reed, J.E. Shield, Harry H. Baskerville, Zack J. Farmer**, and **William A. Simpson**. Their report was titled: *Long Beach Earthquake and Protection Against Future Earthquakes -- Summary of Report by Joint Technical Committee on Earthquake Protection, Dr. Robert A. Millikan, Chairman*, dated June 7, 1933. This became the seminal document which influenced the **Riley and Field Acts** passed by the State legislature, shortly thereafter.

Boards of Consulting Engineers - Los Angeles County Flood Control District (1931-38)

In October 1930, the Los Angeles Flood Control District (LACFCD) began surveying a dam site two miles downstream of their ill-fated Forks Dam site, described above. In August 1931 **E. Cortland Eaton**, Chief Engineer of LACFCD recommended that the county board of supervisors that the County establish an engineering consulting board to supervise the final exploration and design work for the proposed rockfill dams in San Gabriel Canyon: San Gabriel Dam No. 1 and No. 2 on the West Fork (later named Cogswell Dam). This 1931 board consisted of: **Louis C. Hill** of Quentin, Code & Hill consulting engineers in Los Angeles, **A.J. Wiley** of Boise, Idaho, retired USGS geologist **Robert T. Hill** of Dallas, Texas, and Stanford geology Professor **C.F. Tolman**.

In June 1932 LACFCD received approval from the State Division of Dam Safety to build San Gabriel Dam No.1 as a 375-ft high rockfill dam. The county let the first contract in January 1933, after rejecting the first and second round of bids, which exceeded the estimated cost of $10 million. Construction began in the spring of 1933, but was shut down in mid-October 1934, when LACFCD sought to sort out the recommendations made by two different panels (described below).

By the fall of 1933 problems with perceived suitability of the excavated rock prompted Chief Engineer **E. Cortland Eaton** to name a special board of consultants to review the conditions at the dam and quarry sites in San Gabriel Canyon. This second board was amended to include the following individuals: **George A. Elliott** of the Spring Valley Water Co. in San Francisco, **Louis C. Hill** of Los Angeles, consulting geological engineer **Rush T. Sill** (BSGeE '06 CSM) and Professor **C. F. Tolman** of Stanford University. This board issued reports on the San Gabriel Dam in July and September 1934 which called attention to the weathered condition of the rock being excavated for the dam in San Gabriel Canyon, and suggesting that it was unsuitable for the original design of the rockfill dam, which called for side slopes of 1.6:1 to as steep as 1.3:1.

In August 1934 E.C. Eaton resigned from his post as Chief Engineer of the Los Angeles County Flood Control District (LACFCD), and was replaced by **Samuel M. Fisher**. Prior to Fisher's appointment another board of consulting engineers was appointed to advise the county on various aspects of San Gabriel Dam Numbers 1 and 2. This board was comprised of: Chairman **Leroy F. Harza** (BSME 1901 South Dakota State; BSCE '06 Wisconsin) of the Harza Engineering Co. of Chicago, **Ralph J. Reed**, Chief Engineer of the Union Oil Co. of Los Angeles, and **I. C. Steele** of PG&E in San Francisco, a noted expert on rockfill dams.

This second board issued their own report concerning the San Gabriel Dams, dated October 8, 1934. This group recommended that **San Gabriel Dam No. 1** be re-designed with flatter side-slopes, incorporating

1,500,000 yds^3 of the less-suitable waste rock into the dam's sloping shells, flattening the downstream slope from 1.3:1 to 2.5:1. In the end, approximately 10.8 million yds^3 of rock were excavated for the project. The dam was completed in July 1937, the spillway in February 1938, and the outlet works in August 1939.

San Gabriel Dam No. 2 is a 242 ft high rockfill dam constructed by the district in 1932-34 along the West Fork of the San Gabriel River. Boulders weighing as much as 30 tons were incorporated into the five million yd^3 fill. Much material was sluiced into the canyon during the early going (1932), without benefit of mechanical compaction. After severe winter rains in early 1934, the embankment settled as much as 12 feet, destroying the concrete slab lining the upstream face. The board recommended removal and replacement of the old facing, covering it with timber and sluicing of additional 60,000 yds^3 against the downstream face. The structure was renamed Cogswell Dam in 1952.

During the tenure of **C. H. Howell** (BSCE '05 Illinois) as Chief Engineer (Feb 1935-Oct 1938) the district employed **F. E. Trask**, former chief engineer for the California State Advisory Board of the Public Works Administration (who had also designed several dams in southern California), **William P. Creager**, consulting engineer from Buffalo, NY and **Leroy F. Harza** to advise the County on various aspects of dam design and construction. Both of these men were well respected nationally, and Creager had written the textbook ***Engineering for Masonry Dams***, published in 1917 and 1929.

First dynamic properties evaluation of a dam (1934)

In the wake of the M_s 6.25 March 1933 Long Beach Earthquake, the U.S. Coast Geodetic Survey allotted funds for the determination of dynamic properties of important structures. They hired a young structural engineer named **John A. Blume**, PE (AB '33; MEng '35; PhD '67 Stanford), who built a dynamic exciter and used it on **Morris Dam** to determine the fundamental periods of vibration and deflection characteristics. Blume determined that the fundamental period of vibration was 0.20 seconds and about 0.17 seconds for the second mode. He reported these findings in a articles titled "***A machine for setting structures and ground into forced vibration***," which appeared in the Bulletin of the Seismological Society of America in 1934 (v. 24:361-386).

Special Consulting Board for San Gabriel Dam No 1 (1934-35)

In November 1934 State Engineer Edward Hyatt used his powers granted under the Dam Safety Act of 1929 to appoint a special board of consultants to examine the design of the San Gabriel Dam No. 1 by the Los Angeles County Flood Control District, after considering concerns raised by the U.S. Forest Service and recommendations to the LACFCD by their own consulting boards. This board was comprised of: former Stanford Professor **Charles D. Marx**, SE consulting structural engineer of San Francisco, **Walter L. Huber**, PE consulting civil engineer of San Francisco, and **F.C. Herrmann**, former Chief Engineer of the Spring Valley Water Co of San Francisco. The board issued a report on May 13, 1935 disapproving the use of random rock fill for stability of the earth-rockfill dam, slated to be the highest of its type in the world. The project was shut down between Nov. 13, 1934 and July 26, 1935, to allow the state's board to review the project and come to an agreement with the LACFCD on a revised design. Construction work resumed in August 1935, and the new design dropped the side slopes of the embankments to 3:1, while increasing the spillway capacity to >200,000 cfs. The panel believed that these adjustments would increase the dam's cost to $11.57 million, but the final cost of the project was $17 million.

City of Los Angeles ad hoc Geologic Hazards Committee (1956-60)

Following a violent two-day storm that caused considerable property damage in January 1956, the city formed this committee in May 1956. That same month Los Angeles began requiring geologic reports prior to issuing grading permits and the City promptly formed an ad hoc **Geologic Hazards Committee**, comprised of geologists (Drs **Richard Jahns** and **Robert Stone**, and a few others) and soils engineers (**Leroy Crandall**, **L.T. Evans** and a few others). This committee recommended that the City require more exhaustive engineering geologic assessments of hillside development. This was a problem, because the City did not have a geologist on staff to review such reports, nor was there any means by which to judge the qualifications of geologists submitting such reports. Between 1956-61 Los Angeles and several other cities began requiring geologic reports for development of hillside parcels, but geologist were not required to make observations during construction until several years later (described below).

Board of Engineering Consultants to California Department of Water Resources (1956-60)

Chair **Walter L. Huber** (1883-1960), consulting engineer in San Francisco, **A. H. Ayers** (former Bureau of Reclamation and Six Companies Office Engineer), **Samuel B. Morris** (1892-1962), **Raymond A. Hill**, (1892-1973), partner Leeds, Hill & Jewett, and **Ralph A. Tudor** (1902-62) of Tudor Engineering Co. of San Francisco. This was the panel of five engineers that oversaw development of the California Water Plan (summarized in DWR Bulletin 3 in 1957).

City of Los Angeles Engineering Geologist Qualifications Board (1958)

This board was established by the Los Angeles Dept. of Building & Safety on February 10, 1958 to provide a means of improving the quality of engineering geologic reports for hillside residential development. This panel was chaired by Professor **Richard H. Jahns** at Caltech. The board then prepared an article titled "*Desired Content of Geological Reports*," which was edited by Jahns and widely distributed, beginning in May 1960 (Milburn, 1965; Jahns, 1969).

Los Angeles County Engineering Geologist Qualifications Board (1960)

Early in 1960, it became apparent that standardization of the quality of engineering geologic reports submitted to the County of Los Angeles was necessary. The grading division recommended and the Board of Supervisors adopted Ordinance No. 7754 which established the Los Angeles County Engineering Geologist Qualifications Board to examine, test, and register consultants. This Board was formed to act in the absence of State regulation of this profession as a board of examination and certification of engineering geologists who wished to submit reports required by County ordinances. The Board consisted of five regular members, plus an ex-officio member. The regular members served without compensation and were frequently called upon to meet, more than once per month during the early 1960s, when qualifications were being examined at a rapid rate. This Board was instrumental in the upgrading of the standards of engineering geologic reports in southern California.

Los Angeles Grading Advisory Board (1960 onward)

A Grading Advisory Board for LA Dept of Building & Safety was established around ~1960. Its members included soils engineers **Leroy Crandall, Fred Converse**, and **L.T. Evans**, and geologists **Tom Clements** and **Dick Jahns**. **Jim Slosson** succeeded Prof. Jahns when he moved to Penn State in the summer of 1960.

Orange County Engineering Geologist Qualifications Board (1962)

The three geologists originally appointed to the Orange County Engineering Geologists Qualifications Board in 1962 were **Drs. Robert Stone, John F. Mann,** and **F. Beach Leighton**.

Orange County Grading Board of Appeals (adopted in 1962; and amended in 1981)

An Orange County Grading Board of Appeals was created in August 1962 by Board of Supervisors Ordinance No. 3279, Grading and Excavation Code, and later defined in the ***Orange County Grading Manual*** adopted by the Board of Supervisors in 1981 (Resolution No. 81-1358). The purpose of the board was to hear and act upon appeals by property owners, their agents in control, or permittees holding grading permits to reverse or modify, or otherwise alter determinations and orders of the County's building officials made pursuant to the procedures authorized in Section 7-1-812, Hazardous Conditions, of the Orange County Grading and Excavation Code adopted in 1962.

The members were required to include a civil engineer, soils engineer, engineering geologist, a contractor, and a layman. Nominees and one alternate for each slot were approved by the County Board of Supervisors for three year terms.

In April 1986 the Grading Appeals Board was comprised of the following individuals, with their designated alternates: Civil Engineers **William Church** and alternate **Richard Hunsaker**; Soils Engineers **Dr. Bing C. Yen** and alternate **Dr. John T. Gaffey II**; Engineering Geologists **Richard Lung** and **C. Michael Scullin**; Engineering Contractors **Charles W. Poss** and **Donald Gladden**; and Laymen **William Willis** and **Fred Sawyer**. It is not known if Orange Country still maintains this board of appeals.

California State Water Project – Earthquake Analysis Board (1962-74)

Dr. Hugo Benioff, Caltech seismologist (Chair), **Dr. George Housner** (MSCE '34; Ph.D. '41 Caltech; Prof of structural engineering at Caltech), **Dr. Clarence R. Allen** (Caltech seismologist), **Dr. H. Bolton Seed** (Berkeley geotechnical engineer), **Dr. James L. Sherard** (Woodward-Clyde-Sherard

geotechnical engineer), and **Nathan D. Whitman, Jr**. (Whitman, Atkinson & Assoc., structural engineers). Ex-officio State representatives **Alfred R. Golze** (DWR Chief Engineer), **Laurence B. James** (DWR Chief Geologist), and **Arthur B. Arnold** (DWR Chief, Project Geology, Southern District).

California State Water Project - Earth Dams Consulting Board (1962-74)

Wallace L. Chadwick (fmr Chief Engineer of SCE)**, Julian Hinds** (fmr Chief Engineer & general manager of MWD)**, Roger Rhoades** (fmr Chief Eng'g Geologist, Corps of Engineers and Bureau of Reclamation)**, Dr. Phillip C. Rutledge** (partner Moran, Proctor, Mueser & Rutledge in New York), and **B. E. Terpen** (1930-92).

California State Water Project - Earthquake Analysis Board (1962-77)

Dr. Clarence R. Allen (Caltech seismologist), **Dr. Hugo Benioff** (Caltech seismologist), **Dr. John A. Blume** (structural engineer, owner J.A. Blume & Assoc), **Dr. Bruce A. Bolt** (Berkeley seismologist), **Dr. George Housner** (Caltech structural engineer), **Dr. H. Bolton Seed** (Berkeley geotechnical engineer), **Dr. James. L. Sherard** (geotechnical engineer, partner Wood-Clyde-Sherard), and Mr. **Nathan D. Whitman**.

California State Water Project – Tehachapi Crossing Board (1963-69)

Major General **John R. Hardin**, USCOE-Ret (Chair), **Russell G. Hornberger** (electrical engineer), **Thomas M. Leps** (BSCE '36 Stanford; MIT '39; former Chief Engineer of SCE), **Dr. Frank A. Nickell** (engineering geologist, after 1966), **Elmer C. Marliave** (engineering geologist, died in 1967), **John Parmakian** (former Asst Chief Designing Engineer for the Bureau of Reclamation), **Louis G. Puls** (former Chief Designing Engineer for Corps of Engineers), and **Robert Sailer** (former Bureau of Reclamation design engineer).

California State Water Project - Board of Consultants on Alternative Aqueduct Routes to Southern California (1963-74)

Ralph A. Tudor, Chairman (Owner of Tudor Engineering in SFO), **Adolph J. Ackerman** (former Chief Engineer of Dravo Corp), **A. H. Ayers** (Consulting Civil Engineer, San Francisco), **John S. Longwell** (former GM & Chief Engineer of EBMUD), **Carl R. Rankin** (former Chief Engineer Hetch Hetchy and San Jacinto water supply tunnels), **Roger Rhoades** (former Chief Geologist of the TVA and USBR)**,** and **David Weeks** (Professor of Agricultural Economics at Berkeley). Ackermann became the most vociferous critic of the California Water Project in the late 1960-early 1970s, because he believed the cost-justification models were flawed.

Metropolitan Water District-California Aqueduct and Foothill Feeder Project (1963-80)

26 miles of tunnels and 3 dams: Geologic investigations, report preparation, and construction records, from 1963-80. Board of consultants **Richard Jahns**, (Geology Prof at Caltech, Penn State, and Stanford), **Vladimir Pentegoff** (fmr Chief Geologist LA District, Corps of Engineers), **Tommy Thompson** (former Corps of Engineers geologist), **Mason Hill** (Chief Geologist of Arco in LA), and **Carl R. Rankin** (fmr Chief Engineer Hetch Hetchy and San Jacinto water supply tunnels).

Mayor of Los Angeles Board of Inquiry-Failure of the Baldwin Hills Reservoir (1963-64)

The Baldwin Hills Reservoir failed on Saturday December 14, 1963, unleashing up to 4,300 cfs down a steep ravine more or less centered along Cloverdale Ave. in west central Los Angeles, eventually draining into Ballona Creek. The flood waters destroyed 41 homes and damaged 986 more, and killed 6 people. The off stream reservoir had been constructed by the Los Angeles Department of Water & Power in 1947-51, as an ringed earthen embankment of 855,000 cubic yards with a maximum fill height of 155 feet. Its design storage capacity was 897 acre-feet, and it was storing 738 acre-feet of water at the time of the failure.

Shortly after the failure, Los Angeles Mayor Samuel W. Yorty asked the presidents of the California Institute of Technology and the University of Southern California, and the chancellor of the University of California, Los Angeles to nominate suitably qualified individuals to comprise an impartial board of inquiry to make a scientific investigation of the significant factors contributing to the reservoir's failure.

This panel was comprised of the following individuals: **Alfred E. Paonessa**, retired superior court judge (Chairman); **Francis Wilcox**, President of the Los Angeles Chamber of Commerce (Vice Chairman); **Thomas Clements**, recently retired Professor and Chair of the Geology, Geography and Petroleum Engineering Department at USC; **Donald Hudson**, Professor of Mechanical Engineering and Applied Mechanics at Caltech (earthquake engineering expert); **Ronald F. Scott**, Professor of Geotechnical Engineering at Caltech; **Paul Baumann**, retired Assistant Chief Engineer of the LA Co Flood Control District (who had designed dozens of earth and concrete dams); and **Carroll M. Beeson**, Professor of Petroleum Engineering at USC.

This Board of Inquiry prepared a report titled "***Report to the Honorable Samuel W. Yorty, Mayor of Los Angeles, by the Board of Inquiry on the Failure of the Baldwin Hills Reservoir***," dated February 14, 1964. Caltech Professors Hudson and Scott subsequently published an article about the fault offset titled "***Fault Motions at the Baldwin Hills Reservoir Site***," which appeared in the Bulletin of the Seismological Society of America in February 1965.

State Engineering Board of Inquiry & Consulting Board - Baldwin Hills Reservoir Failure (1963-64)

The very day of the Baldwin Hills Reservoir failure, the State Department of Water Resources appointed an Engineering Board of Inquiry to investigate the causes, despite the fact that it was an "off-stream storage facility," and, thereby, exempted from jurisdiction of the Division of Safety of Dams within the DWR. This Board of Inquiry was chaired by **Robert B. Jansen**, PE (BSCE '49 Univ Denver; MS '55 USC, NAE '86), DWR Deputy Division Engineer for Design & Construction. Other members included: **Gordon W. Dukleth**, SWP rep to the Federal-State San Luis Project, **Bernard B. Gordon**, DWR Soils Engineer, **Laurence B. James**, DWR Chief Engineering Geologist, and **Clyde E. Shields**, Construction Engineer, North San Joaquin Division, State Water Project.

This DWR board was assisted by a Consulting Board appointed on the day of the failure, comprised of consulting engineers **J. Barry Cooke** (Chairman) and **Thomas M. Leps**, and engineering geologist **Roger Rhoades**. They were assisted by consulting seismologist Pierre St. Armand. The Consulting Board was charged with assisting in outlining field investigations that would help determine the manner and causes of the failure. They met with the State Engineering Board of Inquiry at site inspections and at conferences directed toward furthering the acquisition of data, analysis of data, and the writing of the report.

The two boards jointly prepared a report titled "***Investigation of Failure Baldwin Hills Reservoir***," dated April 1964, which concluded that seepage along an unnamed strand of the Newport-Inglewood fault had initiated hydraulic piping of the abutment rock, the Pico Formation, at an initial point located 400 feet downslope and about 82 feet beneath the crest of the reservoir, along said fault. The fault strand had experienced 12 inches of right-lateral offset during the previous 9 years. A benchmark located 2,500 feet west of the reservoir recorded 9 feet of subsidence between 1917 and 1962. The board stopped short of blaming the alarming rate of fault offset (> 1 inch/year) on petroleum withdrawal in the Inglewood Oil Field, which included the entire area abutting the west side of the reservoir.

The Standard Oil Company of California, which oversaw withdrawal operations in the Inglewood Oil Field retained the services of Harvard University Professor Arthur Casagrande and Stanley Wilson of Shannon & Wilson as their defense experts, to assuage that petroleum withdrawal had nothing to do with triggering the failure, that the problem lay with the Los Angeles DWP not providing a sufficiently robust design to withstand differential settlements along the various fault strands traversing the reservoir (see A. Casagrande, S.D. Wilson and E.D. Schwantes, ***The Baldwin Hills Reservoir Failure in Retrospective***; ASCE Conference Performance of Earth and Earth-Supported Structures, Purdue University, 1972). Others have disagreed with Casagrande's assessments; see R.L. Meehan and D.H. Hamilton: ***Ground Rupture in the Baldwin Hills*** (*Science*. 172, no. 3981, April 23, 1971, 333-344); and T.M. Leps, ***Analysis of Failure of Baldwin Hills Reservoir*** (also in ASCE Conference Performance of Earth and Earth-Supported Structures, Purdue University, 1972). Casagrande and Wilson's assessment was subsequently discredited in two publications that appeared in 1994: ***Groundwater Hydraulics*** (AGU Water Resources Monograph 9) included the groundwater equation that allows analysis of the deformation of the skeletal structure of many soft sedimentary rocks, like those underlying the Baldwin Hills. Another article describing this mechanism of "bedrock compaction" in a paper by Don Helm of the USGS titled "***Horizontal aquifer movement in a Theis-Thiem confined system"*** (Water Resources Research v. 30:4 (April 1994), pp 953-64), which

demonstrated how more than 13 feet of lateral movement in the Wilmington Oil Field could easily be ascribed to fluid withdrawal from the Pliocene age bedrock.

Los Angeles Section AEG - Building Codes and Related Matters Committee (1964-65)

Chaired by **Don Michael**, this committee sought to update the 1962 publication on [Recommended Practices for] **Hillside Grading and Development**, producing a new report titled "**Geology and Urban Development**," a more formal volume which was published by AEG and released in October 1965. This publication included typical standards for hillside grading (Orange County's 1965 standards), a reprint of Chapter 70 – Excavation and Grading of the 1964 Uniform Building Code and a chart that compared the various standards then being employed by public agencies in California, and the respective years of their adoption (up through 1965). The report also included recommended standards for engineering geologic maps prior to grading and the as-built maps that should be prepared during grading, when subsurface conditions are best exposed.

Mayor of Los Angeles - ad hoc Geologic Hazards Committee (1965-66)

In July 1965 Los Angeles Mayor Sam Yorty asked the American Institute of Professional Geologists (then based in Los Angeles) to appoint a special committee to evaluate how "the City of Los Angeles may with the best prospects of success protect its residents from risks caused by geologic hazards." Seven geologists were appointed to this committee, including **Henry H. Neel** and **James E. Slosson**. The committee's findings were incorporated into new directives issued to the Departments of Public Works and Building & Inspection so they would be encouraged to employ similar standards in all of their assessments of geohazards within the city limits, and to communicate more effectively with one another. These changes were adopted by the City Council in March 1966.

Mayor of Los Angeles - ad hoc Landslide Committee (1965-67)

In July 1965 Los Angeles Mayor Sam Yorty requested formation of an ad hoc committee on landslides to study the financial, technical, and legislative aspects of landslides, with particular reference to those that could impact the City of Los Angeles. This decision came about as a result of the Revello Drive Landslide on June 5, 1965, which frustrated everyone because the City was unable to predict, restrict, or effectively mitigate this slide, which continued to enlarge itself and sever public utilities and access for months thereafter, at great cost to the citizens. Unlike other committees cited above, this group was comprised of representatives from a broad array of agencies and technical backgrounds, including homeowner associations, the Departments of Building & Safety, City Planning, Public Works, AEG, ASCE, and the Engineering and Grading Contractors Association. The technical subcommittee consisted of **Jay M. Shields** (chair), former LA Co. Geologist **Douglas R. Brown**, geotechnical engineer **LeRoy Crandall**, **Tom Clarke**, petroleum geologist **Martin Van Couvering**, **Sheldon Stark**, and the Supervising Engineer of the City's Grading and Excavation Division, **W. E. "Bill" Milburn**.

The committee issued an interim report in February 1966 and their final report on March 28, 1967. This report contains a great deal of information on the recommended practices for hillside grading and landslide stabilization and erosion control in the mid-1960s, including much statistical information on the grading that had occurred in the city following adoption of the city's first grading ordinance in 1952 (for example, an average of 17 million cubic yards of earth was handled each year to develop building sites in the City of Los Angeles). The committee concluded that it was not economically feasible to repair all of the landslides, stating that of the 40 largest landsides that occurred between 1925-65, only five had been repaired. They recommended that the largest pre-existing landslide complexes be identified and avoided, if at all possible. The report's appendices included a number of articles on hillside maintenance, sample legal agreements that the City could use when allowing development of landslide-prone lands, and proposed ordinance requiring geologic and engineering reports as part of a parcel map application for hillside properties, which was subsequently adopted by the City Council, later that year.

Orange County Advisory Committee on Slope Stability (1965-69)

This committee was established in 1965 and was comprised of various soils engineers then practicing in Orange County. This group was set up to examine the problems the County was experiencing with development of tracts on the upper Pliocene age Niguel and Capistrano Formations along the southeastern side of San Juan Creek in south Orange County, which was proving to be especially troubling.

Large landslides had developed which did not appear to be influenced by bedding planes like similar scale slides in Los Angeles County. This group included **Rhett Moore** of Moore & Taber, and representatives of the other principal firms, including Woodward Clyde, and several others. They developed specialized recommendations for analyzing slope stability in the Niguel and Capistrano Formations, as well as for landscaping and landscape watering.

Atomic Energy Commission Blue Ribbon Panel to review MWD Bolsa Island Desalination Plant (1966-67)

Mihran "**Michael" Agbabian**, PhD, PE, NAE (structural engineer & CEO of Agbabian & Associates), **William Diment** (USGS geophysicist), **William I. Gardner**, PhD, CEG (1903-91) (Chief Geologist U.S. Bureau of Reclamation), **Clarence Allen**, PhD, CEG, RGP, NAE (Caltech seismologist), **R. McFerren (**electrical engineer**)**, **Edwin B. Eckel** (1906-89) (chief USGS Eng'g Geology Branch), **H. Bolton Seed**, PhD, NAE (1922-89) (Berkeley geotechnical engineer), and **Stanley Wilson**, PE, NAE (1912-85) (geotechnical engineer & CEO of Shannon & Wilson).

AEG Building Codes Committee (1968)

The national chair was **C. Michael Scullin**. Regional representatives were **Chuck Yelverton** (Los Angeles Section), **Chuck Taylor** (San Francisco Section), **Chuck Van Alstine** (Sacramento Section), **Nelson B. Higgs** (Portland Section), **John W. Kolowski** (Washington state Section), **C. F. Withington** (Baltimore-Wash DC Section), **Willard G. Owens** (Denver Section), **John W. Murchison** (Ft Worth-Dallas Section),and **Ed E. Lutzen** (Kansas City Section). This group was the one that influenced the changes in Appendix Chapter 70 (Grading & Excavation) of the 1970 Uniform Building Code, which included the introduction of 2:1 cut and fill slope inclinations.

State Board of Registration for Geologists and Geophysicists (1969-2009)

The first board was comprised of: **Wilfred W. Peak** (Chairman), **Ted L. Bear** (Vice Chair), **Glenn A Brown, Prof. Ian Campbell, Joseph M. Crosby** (public member), **John F. Curran**, and **Gardner M. Pittman**. The first executive officer was **John E. Wolfe**, RG who served for over 20 years. Peak worked for the Department of Water Resources' Division of Safety of Dams. Peak was succeeded by Prof. **Ian Campbell** of Caltech in July 1972. In 2009 the board was later absorbed into the Board for Registration for Professional Engineers and Land Surveyors (BOPELS) as a cost-saving measure. On January 1, 2011 the name was changed to the Board for Professional Engineers, Land Surveyors and Geologists.

Los Angeles Dam and Reservoir External Review Board (1971-73)

In the wake of the failures of the Upper and Lower San Fernando Dams (Van Norman Reservoirs) in the February 9, 1971 San Fernando Earthquake, the Los Angeles Department of Water & Power (LADWP) moved quickly to replace these critical elements of their water supply system. LADWP, the State Department of Water Resources, and the National Science Foundation cooperatively sponsored a forensic assessment of the slope failures of the two dams by Professors **H. Bolton Seed** at U.C. Berkeley and **Kenneth L. Lee** at UCLA, using state-of-the-art techniques. The other key individuals involved with this initial assessment were **I.M. Idriss** and **Faiz I. Makdisi**. Lee, Idriss, and Makdisi were all PhD students of Professor Seed. This work was summarized in "***The Slides in the San Fernando Dams during the Earthquake of February 9, 1971***"(ASCE Journal of the Geotechnical Engineering Division in July 1975), which was recognized by the society's most prestigious award, the Norman Medal.

The LA department of Water & Power also funded studies for a replacement structure, originally named the "Mission Hills Dam." The name was changed to the "Los Angeles Reservoir" in December 1971. Its reservoir capacity of 10,000 ac-ft was considerably less than the aggregate total of the old Van Norman Reservoirs (16,520 ac-ft), completed between 1913-25.

In October 1971 DWP retained the LA office of Dames & Moore to design the replacement structure, so that state-of-the-art earthquake loads, dynamic triaxial testing, and dynamic finite element analytical techniques would be incorporated into the new design. The project lead for D&M was **Vernon A. "Al" Smoots**, assisted by **Bob Moline**, seismologist **David J. Leeds**, and geotechnical earthquake engineer **Julio E. Valera** (in D&M's San Francisco office). Professors **H. Bolton Seed** of U.C. Berkeley and **Charles F. Richter**, and **Paul C. Jennings** at Caltech were retained to provide appropriate earthquake loads external peer review of D&M's work.

California Seismic Safety Commission (1975 onward)

The **Governor's Earthquake Council** was set up as part of the Seismic Safety Act of 1971, following the San Fernando earthquake. At the bequest of State Geologist Jim Slosson and others, Governor Edmund G. Brown, Jr. signed legislation establishing the **California Seismic Safety Commission** in August 1975. The first commission was chaired by Berkeley Professor **H. Bolton Seed** and included former State Geologist Dr. **James E. Slosson**, Berkeley seismologist Professor **Bruce A. Bolt**, Stanford Earth Science Dean **Richard H. Jahns**, and consulting geotechnical engineer **L. Leroy Crandall** of Los Angeles. From 1985-95 the board's executive director was **L. Thomas Tobin**, PE (BSCE '64 Berkeley; MS '72 SJSU).

Geotechnical Consulting Board - Los Angeles County Metro [Light Rail and Subway] (1978-1985)

In 1978 L.A. Metro Chief Engineer Richard Gallagher hired six principals and associates from Lindvall-Richter & Associates: Stanford Dean of Earth Sciences **Richard Jahns**, Caltech Seismologist **Charles Richter**, former MWD Chief Geologist **Richard J. Proctor,** geologist **Eric Lindvall,** Caltech Professor **Ronald Scott,** and geotechnical engineer **Jack Yaghoubian.** To this group was added consulting tunnel engineers Dr. **Ron E. Heuer** and **P.E. "Joe" Sperry**. The Board was active until 1985, and was responsible for all preliminary borings, soils and hazardous gas testing, seismicity, geology, and route alignments. The board solicited proposals, and hired the venture of Converse Consultants (Pasadena), Geotechnical Consultants (Glendale), and Earth Science Associates (Palo Alto) to perform the necessary field and lab work to prepare a geotechnical baseline report (1982, two volumes). Of note is the Appendix on tunnel seismic design, prepared by LRA and Caltech Professor **George Housner**, which became a benchmark document for tunnel design and construction in seismically active areas. In 1983 the L.A. Metro design consultants were hired, and Richard Gallagher took early retirement because of in-house politics, and by 1985 the new chief engineer replaced the entire board!

Engineering Geology Advisory Committee to the City of Los Angeles (1990)

In 1958 the Board of Building and Safety Commissioners of the City of Los Angeles established an Engineering Geology Qualifications Board, which was absorbed into the Engineering Geology Advisory Committee after the adoption of statewide certification of engineering geologists in 1969. The members are appointed by the Board of Building & Safety Commissioners, based on input from the Department of Building & Safety. In July 1990 that board was comprised of: **Glenn Brown** (Leroy Crandall & Assoc), **George Larson** (GeoSoils), **David T. Leeds** (consulting seismologist), **Richard Lung** (Leighton & Associates), **Gary Rasmussen** (Rasmussen & Associates), **James E. Slosson** (Slosson & Associates), **William Waisgerber** (Waisgerber & Associates), **Larry Cann** (Leighton & Associates), **John Byer** (Kovacs –Byer & Associates), and **J. David Rogers** (Rogers/Pacific).

8-mile North Outfall Replacement Sewer (NORS) Tunnel (1990s)

Panel convened to provide third party peer-professional review of the North Outfall Replacement Sewer (NORS) for the City of Los Angeles in the 1990s. This included review of geotechnical investigations, wherein during construction, the contractor's TBM caused sinkholes in the taxiways at the Los Angeles International Airport (see R.J. Proctor, 1998, A Chronicle of Tunnel Incidents: *Environmental & Engineering Geoscience*). Consulting Board members: **Ralph B. Peck** (1912-2008), **Clarence R. Allen, G. Wayne Clough**, and **Richard J. Proctor**.

Board of Consultants - LA METRO Purple Line Extension (2011-)

Board convened in 2011 to advise the LA County Metro Rail on geotechnical issues associated with the proposed extension of the purple line extending to Santa Monica. The board is comprised on **Ed Cording** (formerly of the University of Illinois), **Harvey Parker** (formerly of Shannon & Wilson), and **Geoff Martin** (formerly of ERTEC and USC faculty).

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