

EDWARD KAVAZANJIAN, JR.
Principal

earthquake engineering
geotechnical engineering
ground improvement
landfill engineering
environmental engineering
research and development

EDUCATION

University of California, Berkeley: Ph.D., Geotechnical Engineering, 1978
Massachusetts Institute of Technology: SM, Geotechnical Engineering, 1975
Massachusetts Institute of Technology: SB, Civil Engineering, 1973

PROFESSIONAL REGISTRATION

Registered Civil Engineer, Arizona, No. 28043
Registered Professional Engineer, California, No. C031834
Registered Geotechnical Engineer, California, No. GE002103
Registered Professional Engineer, Washington, No. 34612

PROFESSIONAL HISTORY

GeoSyntec Consultants, Huntington Beach, California
Principal, 1995-Present
Associate, 1992-1995
MAA Engineering Consultants, Inc., Los Angeles, California
Executive Vice President, 1990-1992
The Earth Technology Corporation, Long Beach, California
Associate, 1988-1990
Parsons, Brinckerhoff Quade and Douglas, Inc., New York, New York.
Lead Geotechnical Engineer, 1985-1987
Supervising Geotechnical Engineer, 1987-1988

EDWARD KAVAZANJIAN, JR.

GeoSyntec Consultants

Department of Civil Engineering, Stanford University, Stanford, California

Assistant Professor, 1978-1985

Department of Civil Engineering, University California, Berkeley, California

Research Assistant, 1975-1978

Department of Civil Engineering, Massachusetts Institute of Technology, Cambridge,

Massachusetts. Research Assistant, 1973-1975

REPRESENTATIVE EXPERIENCE

Earthquake Engineering

Dr. Kavazanjian has extensive international experience in seismic analysis and design. He has served as lead engineer for seismic design on major infrastructure development projects in the United States and abroad and as principal investigator on federally funded earthquake hazard mitigation research projects. In addition to serving as co-author of the FHWA design guidance document on geotechnical earthquake engineering and the USEPA guidance document on seismic design of municipal solid waste landfills, Dr. Kavazanjian has authored and co-authored numerous papers on geotechnical aspects of earthquake engineering in refereed journals and conference proceedings, served on National Science Foundation review panels for earthquake hazard mitigation projects, and co-chaired a session on liquefaction at the Ninth World Conference on Earthquake Engineering. Dr. Kavazanjian is the Lead Instructor for the FHWA National Highway Institute Training Course on Geotechnical Earthquake Engineering. He currently serves on the Seismic Risk and Transportation Committees of the ASCE Technical Council of Lifeline Earthquake Engineering. He served on the Organizing Committee for the Port of Los Angeles Seismic Workshop as co-chairman of the Risk Sub-Committee. He addressed the 1992 annual meeting of the Transportation Research Board on geotechnical aspects of seismic design for highway systems and the 1990 Southwest Regional Conference of the Society of American Military Engineers on geo-aspects of seismic design. In January 1999, Dr. Kavazanjian was responsible for organizing the workshop on "New Approaches to Liquefaction Analysis" at the 78th Annual Meeting of the Transportation Research Board. In June

1999, he was a keynote speaker on "Seismic Design of Solid Waste Landfills" at the 8th Canadian Conference of Earthquake Engineering. . In February 2002, he addressed the ASCE Geo-Institute International Congress on Deep Foundations on *Proposed AASHTO Guide LRFD Specifications for Seismic Design of Highway Bridge Foundations*.

Dr. Kavazanjian's research work on earthquake engineering includes pore pressure development during seismic loading, seismic slope stability and slope deformation analyses, liquefaction potential mapping, seismic safety of dams, probability and reliability applied to geotechnical aspects of earthquake engineering, and frictional base isolation using geosynthetic materials. Dr. Kavazanjian has served as principal investigator on a USGS sponsored project for liquefaction potential mapping of downtown San Francisco. He was also principal investigator on NSF sponsored research on pore pressure development during non-uniform loading, non-stationary random vibration theory for site response analyses, the seismic stability and deformation of infinite slopes, and the use of geosynthetics for base isolation of structures. He has served as a consultant to the U.S. Army Engineers Waterways Experiment Station on reliability and probability applied to geotechnical problems and to the Federal Emergency Management Agency on probabilistic evaluation of the seismic safety of earth dams.

Dr. Kavazanjian's consulting experience includes seismic hazard studies, seismic performance analyses, and risk and reliability analysis. He has been the engineer in responsible charge for numerous strong shaking seismic hazard studies in Southern California, including the Badger Avenue Bridge Rehabilitation and the Pier 300 Container Wharf for the Port of Los Angeles, the Harbor Generating Station Repowering Project for the Los Angeles Department of Water and Power, seismic retrofit of bridges on the State Street line for the Southern California Regional Rail Authority (SCRRA) Commuter Rail system, the Bolo Station Waste-By-Rail Landfill project in the Mojave Desert, and the rehabilitation of the B-Street Pier in San Diego. He has directed assessments of displacement potential for active faults for the Pier 300 project and at Alquist-Priolo special study zone sites for the proposed SCRRA Simi Valley Commuter Rail station and for the Alamitos Bay Development in Long Beach.

He provided senior technical review of the seismic hazard assessment for the proposed EuroRoute English Channel crossing, for the Lake Gaston Water Supply Pipeline in Virginia and for the Eagle Mountain Landfill in Riverside, California.

Dr. Kavazanjian's design experience includes seismic retrofit of over 20 bridges for Caltrans and SCRRRA in Sacramento, San Diego, and Los Angeles. He has been responsible for seismic deformation analyses for the Pier 300 retaining dikes in the Port of Los Angeles and for foundation performance analyses for the Talmadge Bridge Cable-Stayed Replacement structure in Savannah, Georgia and the 60-meter diameter gravity caissons for the proposed Rion-Antirion bridge crossing in Greece. He helped develop seismic design guide specifications for high rockfill embankments for the Ankara Motorway and performed preliminary seismic design for the Istanbul Metro sunken tube crossing of the Bosphorus in Turkey. He has managed numerous liquefaction potential and site response analyses in Northern and Southern California. Dr. Kavazanjian also served as geotechnical consultant for a comprehensive multi-hazard analysis of Ogden, Utah (including earthquake, flood, and debris flows) and directed the seismic risk assessment for the state of Alaska Supreme Courthouse Expansion project.

Geotechnical Engineering

Dr. Kavazanjian has extensive experience in both research and practice in geotechnical engineering. His major project experience includes investigation, design, and construction management services for highway and mass transit systems, water resource developments, port and harbor structures, and residential, commercial, and industrial development. He is recognized for his research on the behavior of soft clay soils, probability and reliability theory applied to geotechnical problems, soil improvement, geotechnical aspects of earthquake engineering, and underground construction. Dr. Kavazanjian is co-author of the Federal Highway Administration (FHWA) design guidance document on geotechnical earthquake engineering. He delivered a keynote address at the International Conference of Rheology and Soil Mechanics, chaired a session on liquefaction at the Ninth World Conference on Earthquake Engineering, and

served on the organizing committee and as co-chairman of the risk sub-committee for the Port of Los Angeles Seismic Workshop. He is past chairman of the ASCE Geotechnical Division Safety and Reliability Committee and the Geo-Institute Embankments, Dams and Slopes Committee. He currently serves as chairman of the ASCE Geo-Institute Technical Coordination Council, on the Seismic Risk and Transportation Committees of the ASCE Technical Council on Lifeline Earthquake Engineering, and on the Committee on Foundations for Bridges and Other Structures for the Transportation Research Board.

In transportation engineering, Dr. Kavazanjian's experience includes bridges, tunnels, highways, and rail transit systems. He served as project manager for geotechnical design services for Caltrans seismic retrofit projects. He managed geotechnical services for design of the Melinda Road Overcrossing and Los Alisos Undercrossing on the Foothill Transportation Corridor in Orange County. Dr. Kavazanjian was geotechnical consultant for final design for the Badger Avenue Bridge in Wilmington California. For the Southern California Regional Rail Authority (SCRRA), he managed geotechnical design and construction services for the commuter rail maintenance facility at Taylor Yard in Los Angeles and directed geotechnical investigations and analyses for the San Gabriel fly-over embankment and bridge structure. He also managed geotechnical services for the Kearney Connection fly-over embankment in Kearney, New Jersey, Aviation Parkway in Tucson, Arizona, and the approaches to the Second Elizabeth River Tunnel in Norfolk, Virginia.

Dr. Kavazanjian's underground construction experience includes the environmental assessment and preliminary design for the Sepulveda Tunnel under the runways at Los Angeles International Airport. He was also responsible for final geotechnical design for the Vermont-Santa Monica Metro Rail station in Los Angeles. He managed geotechnical investigations for the Aviation Corridor drainage tunnel in Tucson, Arizona and the Superconducting Super Collider in Texas. Dr. Kavazanjian directed numerical analysis of the PATH tubes under the Hudson River and the Midtown Tunnel under the East River in New York for the Port Authority of New York and New Jersey. He also conducted geotechnical analyses for the Detroit-Windsor Tunnel between the U.S. and Canada, the Niagara Power Expansion Project in New York, the Second

Elizabeth River Crossing in Norfolk, Virginia, the proposed EuroRoute English Channel crossing, and the Post Office Square project in Boston.

Dr. Kavazanjian's Port and Harbor experience includes work on pile-supported decks, marginal wharves, dredging plans, and backlands development in New York, New Jersey, Newport News, Los Angeles and San Diego. For the Port Authority of New York and New Jersey he directed, geotechnical analyses for the capacity evaluation and rehabilitation of Pier 44 on the Hudson River and design analyses for a tieback bulkhead on the Passaic River. At the Newport News Naval Shipyard, he evaluated pile load test results, investigated the failure of a construction cofferdam, and developed a revised dredging plan for the Trident Land Level Ship Building Facilities. In Los Angeles, Dr. Kavazanjian directed the surcharging of the hydraulic fill for the Pier 300 42-Acre Site Ground Modification project. He was also responsible for the seismic hazard analyses, the Palos Verdes fault rupture potential assessment, the geotechnical investigation, and the seismic deformation analyses of retaining dikes for the Pier 300 Container Wharf Design project. He was lead geotechnical engineer for geotechnical services during construction of Firestation 111, including the pile-supported deck, dredging, and underwater fill and rip-rap placement. For the Port of Long Beach, Dr. Kavazanjian managed the geotechnical investigation and analysis for the Pier G Bulk Handling Facility. His San Diego experience includes seismic hazard and geotechnical analyses for the B-Street Pier Rehabilitation and the tunnel feasibility assessment and liquefaction analysis for the Second Harbor Entrance Geotechnical Feasibility Study.

In water resource development, Dr. Kavazanjian has worked on dam rehabilitation, sewage treatment plant expansion, storm drain and water supply pipeline design, and safety analysis of existing dams. Dr. Kavazanjian managed investigation, design, and construction for the rehabilitation of Trout Run Dam in Boyertown, Pennsylvania, including the relining of the low level outlet conduit, installation of a low permeability membrane and slurry wall cutoff upstream and prefabricated bench drains downstream, and rehabilitation of the downstream toe drain. On the Hyperion Treatment Plant Expansion in El Segundo, California, Dr. Kavazanjian directed the construction dewatering assessment for the full Secondary Digester project. He was also responsible

for design of storm drains and outfalls for the Port Authority of New York and New Jersey PATH maintenance facility in Kearney, New Jersey, and for the geotechnical investigation for storm drains in the City of Diamond Bar.

Ground Improvement

Dr. Kavazanjian's experience on ground improvement projects includes design and construction of reinforced earth walls and slopes, mini-piles, stone columns, deep dynamic compaction, prefabricated vertical drains and surcharge fills, vacuum-induced consolidation of cohesive soil, and grid cell reinforcement of soft subgrades. Dr. Kavazanjian's experience with reinforced earth walls and slopes includes static and seismic design and construction of reinforced earth walls and slopes for the Operating Industries Inc. and McColl Superfund sites, design and construction of a soil nailed wall at the Sunshine Canyon landfill, and third-party review of the static and seismic design of proposed reinforced earth walls for the Vista Pacific project for the Culver City Department of Public Works. At the McColl Superfund site, the reinforced earth walls and slopes were used to enhance the stability of pits containing hazardous refinery wastes dating from World War II. At OII, Dr. Kavazanjian directed design of a geogrid reinforcement system for veneer stability of the final cover on the steep slopes immediately adjacent to a major freeway. For Culver City, Dr. Kavazanjian directed third party review of the design of reinforced earth walls up to 50-ft.tall when community groups questioned the design proposed by a developer. Dr. Kavazanjian is currently chairman of a Los Angeles Section ASCE Geotechnical Group task force developing guidelines for design and construction of reinforced earth walls for seven building department jurisdictions in southern California.

On the Southern California Regional Rail Authority (SCRRA) Commuter Rail project, Dr. Kavazanjian directed design and construction of the stone column supported reinforced earth embankment for the 4000 foot San Gabriel Flyover viaduct. He also managed design and construction of the SCRRA Taylor Yard Maintenance Facility in Los Angeles, including deep dynamic compaction of the building footprint for densification of uncertified fill and potentially liquefiable soil. For rehabilitation of the

Coney Island Maintenance Facility for the New York Transit Authority, he developed contract specifications and drawings for 30- and 40-ton mini-piles ("root" piles) installed inside the active shop area and monitored compressive and tensile load tests on production piles. For the rehabilitation of Trout Run Dam in Boyertown, Pennsylvania, he directed grouting from within a 30-in. diameter low level outlet conduit 110 ft beneath the crest and installation of a low permeability membrane and bentonite-cement cut-off wall upstream for seepage control. For the U.S. Army Engineers Waterways Experiment Station, Dr. Kavazanjian conducted laboratory testing and numerical analysis of grid cell reinforcement for pavement subgrade stabilization.

Dr. Kavazanjian was responsible for design and/or construction of surcharge fills for the Second Elizabeth River Tunnel in Newport News, Virginia, the PATH Main Repair Facility in Kearney, New Jersey, the Pier 300 42-acre site in the Port of Los Angeles, and the Port of Long Beach Pier G Bulk Handling Facility. At Newport News and the Port of Los Angeles, prefabricated vertical drains were installed to accelerate surcharge settlement. Work at the Pier 300 site included design, construction, and monitoring of a vacuum-induced consolidation test section using vertical drains capped by a sand blanket and impervious membrane.

Landfill Engineering

Dr. Kavazanjian is nationally and internationally recognized for his work on static and seismic stability analysis and seismic design of solid waste landfills. Dr. Kavazanjian is co-author of the USEPA municipal solid waste landfill seismic design guidance manual for Subtitle D compliance. He has been responsible for static and seismic analysis of numerous municipal solid waste landfills for compliance with state and federal regulations, including landfills in the states of Washington, Virginia, New York, Tennessee, and South Carolina as well as in northern and southern California. He was principal investigator for the National Science Foundation-sponsored joint GeoSyntec-University of California at Berkeley investigation of the performance of solid waste landfills in the Northridge earthquake of 17 January 1994. Dr. Kavazanjian co-chaired a 1993 National Science Foundation workshop on seismic design of solid waste landfills

and served as principal investigator for a National Science Foundation-sponsored research project on measurement of shear wave velocity at municipal solid waste landfills. Dr. Kavazanjian authored the summary report on "Geotechnics of Solid Waste Landfills" for the 2nd International Congress on Environmental Geotechnics in Osaka, Japan in October 1996 and was a keynote speaker on "Seismic Design of Solid Waste Landfills" at the 8th Canadian Conference of Earthquake Engineering in June 1999.

Over the past 10 years, Dr. Kavazanjian has been extensively involved in the design and construction of municipal solid waste landfills in southern California. He has served as GeoSyntec Consultants project manager for engineering support services at the City of Los Angeles Lopez Canyon Landfill since 1993. At Lopez Canyon, he was responsible for permitting, design, construction management, and quality assurance services for development of Disposal Area C, including installation development of alternative designs for both the side slope liner and final cover systems. Design of the Area C side slope liner system included preparation of the application submitted to the Regional Water Quality Control Board of this first ever alternative to the RCRA Subtitle D prescriptive liner system approved in California. Dr. Kavazanjian's work at Lopez Canyon has also included design and construction services for the partial closure of Disposal Areas A and B, community relations, landfill gas, noise, and groundwater monitoring, and support for preparation of California Environmental Quality Act (CEQA) documents for landfill closure. His current work at Lopez Canyon includes design and construction services for closure of the landfill, including permitting and construction of an evapotranspirative soil cover for the unlined areas.

At the Sunshine Canyon Landfill, Dr. Kavazanjian has been involved in design and construction of the County Extension Landfill, closure of the City Landfill, and permitting for the City/County Landfill. For the new County Extension Landfill, his responsibilities have included master planning, Phase I design and construction, and Phase II design. For the inactive City Landfill, he has directed revision of the closure plan in response to agency comments and closure design, including surface water control facilities and evapotranspirative soil cover. For the proposed City/County Landfill, Dr. Kavazanjian provided preliminary design and engineering support for

preparation of the Subsequent Environmental Impact Report (SEIR) and is directing preparation of the permit documents.

At the Shafter-Wasco and Bena Landfills in Kern County, California, Dr. Kavazanjian managed construction quality assurance services during liner construction and provided technical support on an as-needed basis. At Bena, he was also a member of the Master Planning team for landfill expansion, directing GeoSyntec support services for Master Plan preparation. Following preparation of the Bena Master Plan, Dr. Kavazanjian served as technical director for design of Phase 1 of the expansion, including preparation of the liner performance demonstration for the Central Valley Regional Water Quality Control Board (RWQCB), the first such demonstration approved by the Central Valley RWQCB. Dr. Kavazanjian was project director for preparation of the closure plan and closure design drawings and quality assurance service during construction for closure of Kern County's Lebec Landfill, including geosynthetic liner – based final cover and passive landfill gas venting system.

Dr. Kavazanjian's southern California municipal solid waste landfill experience includes the Azusa, Puente Hills, Spadra, Calabasas, and Chiquita Canyon Landfills in Los Angeles, the Olinda Alpha and Frank R. Bowerman Landfills in Orange County, the Heaps Peak, Newberry, Lucerne, Milliken, and Yucaipa Landfills in San Bernardino County, and the Badlands and Eagle Mountain Landfills in Riverside County. At Azusa, he was responsible for revisions to the Report of Disposal Site Information and design of the Zone II side slope liner extension and he preparation of the Partial Closure Plan for Zone I. The work at Azusa included development of a revised final cover plan to maximize waste capacity, landfill capacity calculations, stability analyses, design of an evapotranspirative soil cover, and drainage design. Dr. Kavazanjian was responsible for grading design at the Puente Hills and Spadra landfills, including geotechnical and geological investigations, slope stability analyses, and design and construction of a slope stabilization system using high capacity ground anchors. For the Olinda Alpha Landfill in Orange County, California, Dr. Kavazanjian managed side-slope liner design for the back-canyon area, including subsurface investigation, geological mapping, landslide remediation, preparation of a petition for an alternative liner design, and preparation of liner construction documents and a construction quality assurance plan. For the

Calabasas and Frank R. Bowerman landfills, Dr. Kavazanjian was Project Director for construction quality assurance services for composite liner construction.

At the Yucaipa and Heaps Peak Landfills, Dr. Kavazanjian directed slope stability analyses in support of final closure plan preparation. At the Newberry Springs, Lucerne, and Chiquita Canyon Landfills, Dr. Kavazanjian either managed or provided peer review for final closure plan preparation. He managed design of a modular block reinforced earth wall for closure construction at the Milliken Landfill. For the Badlands and Eagle Mountain Landfills Dr. Kavazanjian provided technical oversight for the seismic hazard and static and seismic slope stability analyses, including seismic site response and deformation analyses. He also participated in preparation of the revised Environmental Impact Report (EIR) for the Eagle Mountain project.

Dr. Kavazanjian also has extensive experience with closure design and construction for hazardous waste landfills. He was project manager for preliminary design, including the geotechnical investigation, conceptual design of the containment system, and chemical compatibility testing, and provided senior technical oversight for closure design and construction at McColl Superfund site in Fullerton, California. Dr. Kavazanjian was project manager for pre-design seismic studies under Consent Decree Number 3 (CD-3) for the OII Landfill Superfund site in Monterey Park, California. The pre-design studies at OII included a geophysical investigation, large diameter bucket auger borings, design and construction of an on-site laboratory for static and dynamic soil testing, large test trench, in-situ density evaluation, seismic hazard assessment, and static and dynamic finite element analyses of the waste mass. He is currently providing technical oversight for final cover design, including remedial slope stabilization and infiltration analyses, at the OII site under CD-3. Dr. Kavazanjian directed seismic analysis for the five landfills at the Casmalia site near Santa Maria, California, including field measurement of shear wave velocity, seismic response analyses, and seismic deformation analyses.

Dr. Kavazanjian was engineer in responsible charge for stabilization of the final cover for a Cement Kiln Dust pile, restoration of the borrow area, and the Department of Transportation Deck Extension in Metalline Falls, Washington. Dr. Kavazanjian's Superfund experience includes static and seismic stability analysis of fine, compressible

tailings and design of bank stabilization measures for closure of the Big River Mine Tailings site in Desloge, Missouri, and design review of the geosynthetic cover system for closure of the Hardage site in Criner, Oklahoma. Dr. Kavazanjian's hazardous waste landfill experience also includes geotechnical analyses for a proposed low-level radioactive waste disposal facility in Martinsville, Illinois. He was also responsible for seismic analyses for the mixed waste on-site landfill at the Fernald site in Ohio.

Environmental Engineering

Dr. Kavazanjian's experience in environmental engineering also includes site characterization, remediation, and design for landfills, transportation projects, and water resource developments. He was project manager for the Phase I environmental site assessment for the Alameda Transportation Corridor, a proposed 17-mile dedicated below-grade rail and truck corridor along an existing rail right of way from downtown Los Angeles to the harbor area. He served as project manager for the Phase I environmental assessment and Phase II environmental sampling and testing for the widening of the Sepulveda Tunnel under the runways at Los Angeles International Airport (LAX). He also managed evaluation of an abandoned bio-remediation farm for the Remote Aircraft Parking Facilities Expansion at LAX. Other waste management projects in which Dr. Kavazanjian has been involved include preliminary design for the Illinois Low-Level Radioactive Waste Repository in Martinsville, Illinois and research on probabilistic analyses of toxic and hazardous waste problems for the U.S. Army Corps of Engineers Waterways Experiment Station.

Research and Development

Dr. Kavazanjian has served as principal investigator on sponsored research projects for the National Science Foundation (NSF), the United States Geological Survey (USGS), the Federal Emergency Management Agency (FEMA), the United States Department of Transportation, and the U.S. Army Corps of Engineers. For the NSF, Dr. Kavazanjian recently completed a study of the performance of solid waste landfills in the 17 January

1994 Northridge earthquake. In 1993, he was principal investigator for a NSF-sponsored study of the shear wave velocity of solid waste landfills using Spectral Analysis of Surface Waves and was co-organizer of an NSF-sponsored workshop on research needs for the seismic design of solid waste landfills. He has also served as principal investigator on Development of a Numerical Method for the Time Dependent Behavior of Soft Clay and on Probabilistic Assessment of Pore Pressure Development During Seismic Loading for NSF.

Dr. Kavazanjian developed a liquefaction map for downtown San Francisco under the USGS National Earthquake Hazard Mitigation Program. For the Department of Transportation, he was co-principal investigator for Development of a Methodology for Analyses of Advanced Technology for Soft Ground Tunneling. He served as the principal geotechnical investigator for the development of probabilistic analyses for screening and detailed hazard analyses of earth dams for FEMA. Under the auspices of the U.S. Army Engineers Waterways Experiment Station, Dr. Kavazanjian studied Application of Probability and Reliability to Geotechnical Practice and Probabilistic Analyses for Toxic and Hazardous Waste Problems.

Dr. Kavazanjian is co-author of the USEPA guidance document on seismic design of municipal solid waste landfills and of the FHWA guidance document on geotechnical earthquake engineering.

PROFESSIONAL AFFILIATIONS

- American Society of Civil Engineers (ASCE)
- International Society of Soil Mechanics and Foundation Engineers (ISSMFE)
- Solid Waste Association of North America (SWANA)
- United States Society on Dams (USSD)
- Earthquake Engineering Research Institute (EERI)

LIST OF PUBLICATIONS

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Kavazanjian, E. Jr. and Hadj-Hamou, T. (1980), "Prediction of the Dynamic Material Properties of Soil from the Results of Static Shear Tests," *John A. Blume Earthquake Engineering Center Technical Report No. 45*, Stanford University.

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