

Civil and Geotechnical Earthquake Engineer with 17 years of experience in geotechnical engineering and earthquake engineering projects. Dr. Mayoral areas of expertise are numerical modeling of geomaterials, earthquake engineering, seismology, and instrumentation. His representative experience ranges from conventional geotechnical engineering projects to highly specialized analyses of seismic soil-structure interaction and other earthquake engineering problems conducted for projects all around the world. Dr. Mayoral has participated on geotechnical studies, foundation design, soil exploration and laboratory testing, and performed geotechnical field work supervision. In addition he has performed dynamic response analyses of earth dams, natural soil deposits and manmade fills, including liquefaction risk assessment. In the area of seismic soil-structure interaction, Dr. Mayoral has analyzed foundation systems of LNG tanks, buildings and bridges. In the area of structural engineering, he has conducted structural analysis of radial gates, intake towers and concrete dams. In the area of seismology he has been involved in seismic hazard assessments studies, and currently he has participated in the seismic microzonation of the Texcoco lake area, in Mexico City, which included field, laboratory and analytical work. As a researcher, Dr. Mayoral was involved in the design, instrumentation, construction and calibration of a multi-directional pot testing device for pile segments in soft clay to study the multi-directional effects in the near field soil domain for two-directional seismic soil-pile-structure interaction analysis. Dr. Mayoral has participated in water availability studies including aquifer characterization, from the quality and quantity standpoint, and field work coordination and development. Currently, he works as associate professor at the Institute of Engineering, UNAM.

Representative project experience includes the following:

#### GEOTECHNICAL EARTHQUAKE ENGINEERING

- 1. Seismic microzonation of the Texcoco Lake Area, México City** This project was part of several studies conducted to characterize the seismic parameters, and environment, of the Texcoco lake area, in the valley of Mexico. Dr. Mayoral was in charge of all the field and laboratory investigations as well as analytical studies, aimed at characterizing the ground response. In-situ measurements of shear wave velocity, using suspension PS logging, along with cone penetration, CPT, and standard penetration, SPT, resistance values, and results from series of resonant column and cyclic triaxial tests were used to obtain a 3-D representation of the subsoil characteristics found at the site, and the variation of dynamic properties with strain level. Ground motion definition was achieved indirectly through empirically derived response spectra obtained
- 2. Seismic soil-structure interaction analysis for an urban bridge-support, Mexico City.** In this project the seismic response of an instrumented urban bridge support and its foundation system was analyzed. The bridge works as a deck in a surface subway station and was built 12 years ago in the so-called Lake Zone in Mexico City, where very soft clays, exhibiting low shear strength and high compressibility prevail. In particular, Dr. Mayoral analyzed the bridge response observed during two moderated intensity events, the 2004, 6.3  $M_w$ , Guerrero Coast and the 1999, 7.0  $M_w$ , Tehuacan earthquakes. Finite element models were developed to reproduce the measured responses and to assess the soil-foundation-support performance for long term conditions, including the effects of potential changes in the dynamic soil properties due to regional subsidence. Doctor Mayoral activities included work supervision, revision of the report and technical meetings with the client as well.
- 3. Soil-structure interaction analysis for a major power plant, Texcoco Lake, México City** In this project Dr. Mayoral used a 3-D finite difference model for evaluating the static and dynamic response of a 118 by 100 m cellular-raft foundation to be built in soft clay. The raft foundation is a 2.5 m high box-type foundation embedded 1 m and supported by a grid of peripheral and internal walls, 2.5 m long and 0.40 m thick, which integrates a cellular structure. The model is used to obtain first the static behavior exhibited by the foundation for the construction stages, including long term consolidation, and then the design earthquake is considered and the equation of motion is solved in time domain. Doctor Mayoral activities included work supervision, revision of the report and technical meetings with the client as well.
- 4. Almanor Dam Intake Tower, Almanor Lake, CA.** In this project Dr. Mayoral performed the dynamic analysis of the intake tower located at Almanor Dam. Dr. Mayoral modeled the intake

tower with three-dimensional stick elements with lumped masses using the program SAP2000. Doctor Mayoral activities included the compilation of the report and technical meetings with the client as well.

5. **Pit 7 Dam Dynamic Analysis, Shasta County, CA.** In this project Dr. Mayoral performed the structural analysis of the Pit 7 concrete dam. Dr. Mayoral modeled the dam using the program SAP2000. The model of the dam was two-dimensional and included static and seismic loads. The dam foundation was modeled with gap elements to allow for cracking at the foundation during the seismic event. Doctor Mayoral duties also included the compilation of the report and technical meetings with the client.
6. **Site Response Analyses of Scott Dam, Potter Valley, CA.** The objective of this study was to evaluate the maximum accelerations expected at the crest of Scott Dam. The results from these analyses were used to assess the factor of safety of the radial gates for seismic loading conditions. Doctor Mayoral modeled the concrete dam and rock foundation using the program SAP2000 and SASSI2000. The analysis using the program SAP2000 accounts for cracking at the base of the dam, and reservoir, tail and uplift pressures. The analysis with the program SASSI included radiation damping on the foundation. These results were used to calibrate the results obtained with SAP2000.
7. **Yacht Harbor, Portland, OR** This project consisted on the analyses, geotechnical design and construction of a partially submerged embankment and fill for a site development located near Hidden Island, in Portland, OR. A model using the finite difference code FLAC, was developed to evaluate the seismic embankment-structure interaction. Dr. Mayoral was part of the team that peer reviewed these FLAC analyses. His main duties were to review the existing analysis and calculation sheets, to debug FLAC input files, to perform sensitivity studies on simplified models, and to compile written recommendations. The sensitivity analyses involved 1-D wave propagation analyses in representative soil columns to evaluate the amount of liquefaction and pore pressure generated during the design earthquake. The sensitivity analysis also involved limit equilibrium analyses, to evaluate seismic lateral permanent deformations of the slopes.
8. **Salinas Court House, Salinas, CA.** This project deals with the foundation design of a building located in Salinas, CA. The foundation consisted of prestressed piles, which intercept a potentially liquefiable soil layer. Dr. Mayoral conducted seismic soil-pile interaction analyses using the program SASSI2000, to evaluate the effect of kinematic interaction between a single pile and the liquefiable layer. His duties included analyses and preparation of written recommendations.
9. **Dynamic Impedances for a LNG Tank in Trinidad.** The focus of this project was on the determination of dynamic impedances for an LNG (Liquid Natural Gas) tank. Dr. Mayoral duties were to review the geotechnical information, to develop soil profiles, and to determine dynamic impedances to be used during the structural analysis of the tank. During the analysis the program DYNAPILE and GROUP were used. His duties included the compilation of written recommendations.
10. **Aviemore Dam Study, New Zeland, Australia.** An exhaustive earthquake study was performed for a composed concrete-earth dam located in New Zealand, Australia. This project involved the analyses of the concrete and earth dam portions. In this project, Dr. Mayoral, participated in seismic analyses of several concrete sections using the program FLAC. Also Mayoral peer reviewed seepage and dynamic analyses conducted with FLAC. Dr. Mayoral was also involved in the development of criteria to assess the amount of cracking on the embankment associated to fault rupture
11. **Evaluation of Ground Motions to be used in the Tri-dimensional Slope Stability Analysis for one Unit of Kettleman Hills Landfill, Kettleman Hills, CA.** In this project Dr. Mayoral performed a deterministic seismic hazard study to obtain the ground motions to be used in the tri-dimensional slope stability analysis of one unit of Kettleman Hills Landfill. His duties included the generation of target response spectra using published attenuation relationships and the selection of appropriated ground motions to match those spectra.
12. **Assessment of Liquefaction Potential for Arkabutla Dam, Mississippi Valley.** In this project Dr. Mayoral performed one-dimensional site response analysis using the program SHAKE of several representative sections through the Dam. From this analysis, Mayoral, developed critical  $(N_1)_{60}$  for screening of liquefaction potential of soil deposits located at and below the Dam foundation. His duties included the statistical characterization of the shear wave velocity profiles, the definition of soil profiles for analyses, and the preparation of the geotechnical report.

13. **Seismic Soil-Pile-Structure Interaction Analyses for the MacArthur Avenue On-Ramp (Widen) 80-580 Interchange, Oakland, CA.** Dr. Mayoral contribution to this project was the developing of foundation springs and ground motions required for the structural analysis. In particular, Dr. Mayoral performed the characterization of the existing foundation and subsurface soil conditions to perform the analysis of each bent. With this information non-linear springs which represent the individual elements of the foundation stiffness matrix were obtained. This was performed using the computer program GROUP, LPILE and TZPILE. Mayoral also developed tri-linear representations of the non-linear springs to be used in the structural analyses. His duties included the coordination of the team of engineers working on the same tasks and the compiling of the geotechnical report.

## STRUCTURAL ENGINEERING

1. **Almanor Dam Intake Tower, Almanor Lake, CA.** In this project Dr. Mayoral performed the dynamic analysis of the intake tower located at Almanor Dam. Dr. Mayoral modeled the intake tower with three-dimensional stick elements with lumped masses using the program SAP2000. Doctor Mayoral activities included the compilation of the report and technical meetings with the client as well.
2. **Pit 1 Forebay Dam Radial Gate Safety Analysis, Shasta County, CA** In this project Dr. Mayoral performed the structural analysis of a radial gate located at Pit 1 Forebay Dam. Dr. Mayoral modeled the gate using the program SAP2000. The model of the gate was three-dimensional and included static and seismic loads. Doctor Mayoral duties also included the compilation of the report and technical meetings with the client.
3. **Seismic Soil-Pile-Structure Interaction Analyses for the MacArthur Avenue On\_Ramp (Widen) 80-580 Interchange, Oakland, CA:** Dr Mayoral contribution to this project was the developing of foundation springs and ground motions required for the structural analysis. In particular, Dr Mayoral performed the characterization of the existing foundation and subsurface soil conditions to perform the analysis of each bent. With this information non-linear springs which represent the individual elements of the foundation stiffness matrix were obtained. This was performed using the computer program GROUP, LPILE and TZPILE. Mayoral also developed tri-linear representations of the non-linear springs to be used in the structural analyses. His duties included the coordination of the team of engineers working on the same tasks and the compiling of the geotechnical report.
4. **Assessment of Liquefaction Potential for Arkabutla Dam, Mississippi Valley:** In this project Dr Mayoral performed one-dimensional site response analysis using the program SHAKE of several representative sections through the Dam. From this analysis, Mayoral, developed critical  $(N_1)_{60}$  for screening of liquefaction potential of soil deposits located at and below the Dam foundation. His duties included, the statistical characterization of the shear wave velocity profiles, the definition of soil profiles for analyses, and the preparation of the geotechnical report.
5. **Evaluation of Ground Motions to be used in the Tri-dimensional Slope Stability Analysis for one Unit of Kettleman Hills Landfill, in Central California.** In this project Dr Mayoral performed a deterministic seismic hazard study to obtain the ground motions to be used in the tri-dimensional slope stability analysis of one unit of Kettleman Hills Landfill. His duties included the generation of target response spectra using published attenuation relationships and the selection of appropriated ground motions to match those spectra.
6. **Geotechnical Study for a Section of Periferico-Sur Highway in Mexico City:** Dr Mayoral performed the site characterization and investigation program and conducted field supervision, developed soil profiles and soil parameters for geotechnical analyses. Experience included soil-pile interaction analyses to compute non-linear soil springs for both static and seismic loading conditions.
7. **Foundation Design Analysis for Water Treatment Plant and Pipe Line System:** Performed the foundation design for a water treatment plant in Campo Militar Numero 1 in Mexico City. Experience included site characterization and investigation programs, compiling geotechnical report and foundation design analysis of the facilities.

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- 8. Foundation Design Analysis for Facilities of an Extension of the Tapachula, Chiapas Airport:** Compiled geotechnical report and foundation design for the facilities. This included the evaluation of liquefaction potential and its effect on the bearing capacity, ground deformations and settlement of the structures.

#### CIVIL ENGINEERING

- 1. Field Supervision and Project Management of a Water Study Conducted for a Power Plant to be built in Valladolid, Yucatán, México** This project was part of several studies conducted to design a power plant that currently is being built in Valladolid, Yucatán, Mexico. In this project Dr. Mayoral coordinated and developed all the studies needed, from both the quality and quantity standpoint, to characterize the water yield by the aquifer located at the project site. The field work included water sampling, well construction supervision and pump test development. This is an ongoing project that will involve the design of the well field, and the corresponding environmental impact assessment of the well field construction.
- 2. Supervision of Seismic Retrofit of Hewlett Packard building 46, Cupertino, CA.** In this project, Dr. Mayoral supervised the underpinning operations conducted to retrofit an existing building foundation. Doctor Mayoral activities included to verify that the geotechnical field conditions were in agreement with those described in the report and to ensure that the retrofit operations were performed according to the specifications.

#### GEOTECHNICAL ENGINEERING

- 1. Geotechnical Study for a Section of Periferico-Sur Highway, Mexico City, Mexico.** Dr. Mayoral performed the site characterization and investigation program and conducted field supervision, developed soil profiles and soil parameters for geotechnical analyses. Experience included soil-pile interaction analyses to compute non-linear soil springs for both static and seismic loading conditions.
- 2. Foundation Design Analysis for Water Treatment Plant and Pipe Line System, Mexico City, Mexico.** Performed the foundation design for a water treatment plant in Campo Militar Numero 1 in Mexico City. Experience included site characterization and investigation programs, compiling geotechnical report and foundation design analysis of the facilities.
- 3. Foundation Design Analysis for Facilities of an Extension of the Tapachula, Chiapas Airport, Chiapas, Mexico.** Compiled geotechnical report and foundation design for the facilities. This included the evaluation of liquefaction potential and its effect on the bearing capacity, ground deformations and settlement of the structures.

#### PUBLICATIONS

##### In International Journals:

- Juan M. Mayoral, Francisco A. Flores, Miguel P. Romo. “**A simplified numerical approach for lateral spreading evaluation**”, accepted for publication in the Journal of Geofísica Internacional, 2008.
- Juan M. Mayoral, Yolanda Alberto, Manuel J. Mendoza, Miguel P. Romo, “**Seismic response of an urban bridge-support system in soft clay**”, Journal of Soil Dynamics and Earthquake Engineering (2008) doi: 10.1016/j.soildyn.2008.10.007.
- Mayoral, J. M., Osorio L., and Romo, M.P., “**Seismic Parameters Characterization at Texcoco Lake, México**”, Journal of Soil Dynamics and Earthquake Engineering (2007) doi:101016/jsoildyn200708004.
- Mayoral, J. M., and Romo M. P. “**Geo-seismic Environmental Aspects Affecting Tailing Dam Failures**”, American Journal of Environmental Sciences 4 (3): 198-208, 2008. ISSN 1553-345X 2008 Science Publications.

5. García, S. R., Romo, M. P. and Mayoral, J. M. (2007), **“Estimation of peak ground accelerations for Mexican subduction zone earthquakes using neural Networks”**, Geofísica Internacional, Vol. 46, Num. 1, pp. 51-63.
6. Mayoral, J. M., Pestana, J. M. and Seed R. B., **“Determination of Multi-directional P-Y Curves for Soft Clays”**, Journal of American Standard of Testing Materials, ASTM, March, 2005.
7. Pestana, J. M., Sancio, R. B., Bray, J. D., Romo, M. P., Moss, R. E. S., Mayoral, J. M. and Seed, R. B., **“Geotechnical Engineering Aspects of the June 1999 Central Mexico Earthquakes”**, Volume 18, Issue 3 of Earthquake Spectra, Aug, 2002.

Internacional conferences proceedings (Short list)

1. F. A. Flores and J. M. Mayoral. **“Seismic response of cracked soil deposits”**, Seventh International Conference on Earthquake Resistant Engineering Structures, to be held in Cyprus, Greece in 2009.
2. Luis Osorio and Juan M. Mayoral, **“Seismic microzonation of the Texcoco Lake area, Mexico”**, Seventh International Conference on Earthquake Resistant Engineering Structures, to be held in Cyprus, Greece in 2009.
3. Luis Osorio, J. M. Mayoral and M. P. Romo, **“Characterization of the seismic environment prevailing at Texcoco Lake, Mexico”**, 17<sup>th</sup> International Conference on Soil Mechanics and Geotechnical Engineering, to be held on Alexandría, Egypt 5-9 October, 2009.
4. J. M. Mayoral, M. J. Mendoza, Y. Alberto and M. P. Romo, **“Seismic performance evaluation of a deep foundation system build in the lake zone area, in Mexico City”**, 17<sup>th</sup> International Conference on Soil Mechanics and Geotechnical Engineering, to be held on Alexandría, Egypt 5-9 October, 2009.
5. Mayoral, J. M., Flores F. A., and Romo M. P., **“Numerical modeling of liquefaction-induced lateral spreading”**, The 12th International Conference of International Association for Computer Methods and Advances in Geomechanics (IACMAG), Goa, India, 1-6, October, 2008.
6. Mayoral, J. M., Romo, M. P. and Sergio Martínez **“Advanced 3-D Seismic Soil-Structure Interaction Analysis of a Cellular-Raft Foundation in Soft Clay”**, ASCE Conference, Sacramento, California, USA, May, 2008.
7. Romo, M., Mayoral, J., Alberto, Y., Osorio, L., **“Critical analysis of key geo-seismic aspects recommended in building codes to define design spectra”**, XIV European Conference on Soil Mechanics and Geotechnical Engineering (ECSMGE 2007), September 2007, Madrid, España.
8. Mayoral, J. M., and Romo M. P., **“Seismic Performance Evaluation of Potentially Liquefiable Earthdams”**, 4th International Conference on Earthquake Geotechnical Engineering, Thessaloniki, Greece, July 2007, organized by ISSM.
9. Mayoral, J. M., and Pestana, J. M., **“Clay-pile interface response during multidirectional cyclic loading: Experiments and modeling”**, Panamerican Conference, to be held in Venezuela, October 2007, organized by ISSM.
10. Mayoral, J. M., y Romo M. P., **“Comportamiento sísmico de presas de material potencialmente licuable”**, Panamerican Conference, to be held in Venezuela, October 2007, organized by ISSM.
11. Mayoral, J. M., and Romo M. P., **“Recent Studies on Seismic-Soil Pile Structure Interaction in Soft Clay”**, October 2006, 4<sup>th</sup> International Conference on Earthquake Engineering, hold in Taipei, Taiwan, October 2006, organized by EERI.
12. Mayoral J M, Pestana J M, Romo M P and Seed R B, (2006), **“A simplified plastic hysteretic model for multi-directional nonlinear site response in soft soils”**, Soft Soil Engineering - Chan & Law (eds), Taylor & Francis Group, London, ISBN 13978-0415-42280-2.
13. J. M. Mayoral, A. Ciri6n, M. P. Romo and J. Paulin, **“Effect of layered clay deposits on the seismic behavior of a single rigid inclusion”**, International Symposium in rigid inclusions in soft soil conditions hold in Mexico City, May 2006, organized by SMMS-ISSM.