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DEPARTMENT OF STRUCTURAL ENGINEERING
The Irwin & Joan Jacobs School of Engineering
9500 Gilman Drive, Mail Code 0085
La Jolla, CA 92093-0085

June 4th, 2016

Dear Graduate Council,

Enclosed please find our revised proposal for a new Master of Science (M.S.) degree program with specialization in geotechnical engineering in the Department of Structural Engineering at UC San Diego. Letters were requested from the chairs of four relevant UC system departments, and two letters were received from UC Berkeley and UCLA and are attached with the other letters. We have also provided a response to comments on the initial review of the proposal.

Although geotechnical engineering shares several common themes with Structural Engineering in general, including its reliance on fundamental mechanics principles and its essentiality in the design of civil infrastructure systems, there are several important differences that justify an independent M.S. degree program in geotechnical engineering as pointed out in the enclosed proposal. As discussed in the introductory section of the proposal, there is demand for a degree at the M.S. level in terms of both student interest and the local/international market. The goal of this M.S. program is to provide students planning to pursue a career in geotechnical engineering practice with the necessary training beyond that obtained in a B.S. degree to analyze, simulate, and design geotechnical-related infrastructure. The American Society of Civil Engineers (ASCE) is encouraging new engineers pursuing a career in civil engineering disciplines to have a minimum of a M.S. degree to practice. This is particularly relevant in geotechnical engineering due to the particularly complex behavior of soils, rocks, and soil-structure interaction. Similar to structural engineers, geotechnical engineers have their own licensure process to reflect their specialization.

Despite being a new separate degree, the M.S. program will build upon common themes in the Department of Structural Engineering to provide a unique focus that sets it apart from other geotechnical programs around the country. This includes a focus on both geomechanics fundamentals and soil-structure interaction. Soil-structure interaction is critical to consider when addressing the response of built environment to earthquakes/natural hazards, thermal loading, stability and deformation of slopes and retaining walls, etc. With the faculty, research facilities, and local demand for geotechnical engineering, this program will help us become a leader in this specialty area in Southern California and beyond.

We appreciate your time and consideration of our proposal and look forward to implementing this program with your approval.

Sincerely,

Benson Shing
Chair, SE

Yuri Bazilevs
GAC Chair, SE

John McCartney
Associate Professor

PROPOSAL COVER PAGE

Title:
Proposal for a New Master of Science Degree in Geotechnical Engineering

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Executive Summary:
This proposal seeks to establish a new Master of Science (M.S.) degree program with specialization in Geotechnical Engineering in the Department of Structural Engineering at UC San Diego. Although Geotechnical Engineering shares several common themes with Structural Engineering in general, including its reliance on fundamental mechanics principles and its essentiality in the design of civil infrastructure systems, there are several important differences that justify an independent M.S. degree program in geotechnical engineering as pointed out in the enclosed proposal. There is strong demand for an educational track at the M.S. level in terms of both student interest and the local/international market. The goal of this M.S. program is to provide students planning to pursue a career in geotechnical engineering practice with the necessary training beyond that obtained in a B.S. degree to analyze, simulate, and design geotechnical-related infrastructure. The American Society of Civil Engineers (ASCE) is encouraging students pursuing a career in civil engineering to have a minimum of a M.S. degree to practice, and this is particularly important in the area of geotechnical engineering due to the particularly complex behavior of soils, rocks, and soil-structure interaction. Similar to structural engineers, geotechnical engineers obtain specialty licenses and are recognized as specific practitioners due to the specialized skill set required to work in this area. Despite leading to a separate M.S. degree, the proposed M.S. program builds upon common themes in the Department of Structural Engineering to provide a unique focus that sets it apart from other geotechnical programs around the country. This includes a focus on both geomechanics fundamentals and soil-structure interaction. Soil-structure interaction is critical to consider when addressing the response of built environment to earthquakes/natural hazards, thermal loading, stability and deformation of slopes and retaining walls, etc. With the faculty, research facilities, and local demand for geotechnical engineering, this program will help us become a leader in this specialty area in Southern California and beyond.

Section 1: Introduction, Background and Scope:

Structural engineering is traditionally viewed as an activity within civil engineering even though many other engineering disciplines such as aerospace, marine (naval, offshore), and mechanical engineering contain well established discipline-specific structural systems components. The Department of Structural Engineering at UC San Diego is unique because of its holistic focus on structural systems, which sets it apart from other departments around the country. The department has faculty specializing in the engineering disciplines of civil structures, geotechnical engineering, computational mechanics, aerospace/composite structures, and nondestructive evaluation. Although faculty from these areas may be situated in different departments at other universities, within the Department of Structural Engineering, they share commonalities in the structural materials used, in the study and application of the general principles of structural mechanics, in the overall design philosophy and criteria, and in the modeling and analysis tools employed for the numerical quantification and visualization of structural response. Developments in overall structural systems design are increasingly cross-disciplinary, which gives a unique advantage to the diverse faculty in the Department of Structural Engineering.

This proposal seeks to develop a new M.S. program in geotechnical engineering, with the goal of recruiting top students from around the world to pursue a terminal M.S. degree and providing them with the necessary skills to pursue a career in geotechnical engineering practice. Similar to structural engineering, geotechnical engineering is also typically viewed as an activity within civil engineering. It is closely tied with the civil structures discipline as all structures must be founded in the subsurface soil or rock. Geotechnical engineers are responsible for analyzing and designing building foundations for static and seismic loading, slopes and retaining structures, tunnels, landfills, dams, and levees. They are also responsible for characterizing the response of sites to earthquake shaking, characterizing soil-structure interaction phenomena, improving poor soils, reclaiming ground for new developments, and characterizing soils and rocks for geothermal energy.

Although geotechnical engineering shares several commonalities with structural engineering as mentioned above, there are several differences that set it apart from educational and professional perspectives, making it advantageous to have a separate M.S. program. A key difference involves the need to use a continuum approach to solve stress-strain problems and measure material properties. Geomaterials have vastly different constitutive behavior than structural materials. For example, it is important to consider the effects of pore fluid, heat, and chemistry on the behavior of soil and rock, and the impact of the effective stress state on the strength, stiffness, and compressibility of soils and rock. The effective stress state is affected by the self-weight, externally applied loads, and pressures in pore fluids (water, air, oil, etc.). The flow of pore fluids or heat may lead to transient changes in the effective stress state or soil properties, which need to be considered in engineering design. The interaction between soils and structures is complex due to the differences in stiffness and deformation response of the materials. These topics are typically discussed in a sequence of several courses that focus both on the fundamental behavior of soils and rock and applied concepts needed for design and analysis of real-world problems. To solve these problems, geotechnical engineers work independently with structural engineers, geologists, seismologist, environmental engineers, and contractors. Similar to

structural engineers, geotechnical engineers obtain specialty licenses and are recognized as specific practitioners due to the specialized skill set required to work in this area. In summary, the differences between geotechnical and structural engineering require an independent curriculum that provides in-depth focus on geotechnical engineering issues. The number of fundamental and applied courses in the sequence also makes it advantageous to have a separate M.S. program in geotechnical engineering rather than a specialization within the currently available M.S. program in Structural Engineering.

Despite these differences, it is critical for the proposed M.S. program in geotechnical engineering to build upon strengths and commonalities with the existing coursework, faculty specialties, and facilities in the Department of Structural Engineering. The Department is relatively small compared to other Civil Engineering departments around the country, so it is critical to have a unique aspect that will draw students and set it apart from other M.S. programs. Although the current geotechnical faculty in the Department of Structural Engineering have different research and teaching interests that cover most aspects of geotechnical engineering mentioned above, they share several common themes. These include a focus on fundamentals (e.g., mechanics, constitutive modeling), use of numerical simulations, and use of physical modeling of geotechnical systems (e.g., centrifuge-scale modeling, reduced-scale modeling, full-scale modeling, field instrumentation of actual systems) to understand complex soil-structure interaction phenomena. The focus on geotechnical fundamentals and soil-structure interaction in the M.S. program in geotechnical engineering has an important synergy with the civil structures program, which will help to further enhance the reputation and strength of the Department of Structural Engineering in the earthquake engineering field. The Department also has unique geotechnical facilities, including state-of-the-art element-scale testing apparatus for characterizing material properties, as well as a geotechnical centrifuge, containers for the different shaking tables, and a soil pit with actuators for physical modeling studies of different geotechnical systems. Accordingly, the proposed M.S. program in geotechnical engineering seeks to have a unique focus on geotechnical fundamentals and soil-structure interaction.

We have no intention to have separate B.S. and Ph.D. degrees in geotechnical engineering. However, the new M.S. degree will enhance the visibility of the geotechnical program in the Department not only at the M.S. level but also at the B.S. and Ph.D. levels. Like civil engineering programs, B.S. students normally require two years of basic coursework before they select a focus area that guides the sequence of technical electives in the third and fourth years of their degree. A separate B.S. degree in geotechnical engineering is not needed in the Department of Structural Engineering as one of the current focus areas available in the Department is geotechnical engineering. The M.S. degree is different though, as in general it is more focused on gaining in-depth skills needed for professional practice in a specialty area. The differences between structural engineering and geotechnical engineering regarding the in-depth skills needed for professional practice warrants a special program that is recognized by a separate M.S. degree. Although it is likely that most students pursuing the M.S. program in geotechnical engineering will receive a terminal degree, the M.S. program will be an effective way to attract good graduate students for the Ph.D. program. Ph.D. students focus on fundamental research, and there is sufficient flexibility in the current Ph.D. program in Structural Engineering within the

department to obtain deep research training in the geotechnical specialty as well as other structural engineering and mechanics specialties, all of which provide the background for interdisciplinary research. It should also be noted that pursuing a M.S. in geotechnical engineering will not preclude a student from being successful in the Ph.D. program in Structural Engineering within the Department.

The proposed M.S. program in geotechnical engineering will be included in the regular eight year campus review of the Department by the Academic Senate and campuswide. The proposed M.S. program in geotechnical engineering builds upon courses that are currently being offered in the department, and no new resources are needed to implement this program. The proposed set of courses also builds upon established courses in structural engineering and computational mechanics that have synergistic aspects with geotechnical engineering, as well as courses in geology offered by the Scripps Institute. The letter from the chair of SIO indicates that they are supportive of our proposed M.S. program and look forward to collaborations.

The proposed set of courses described below provides a similar breadth of topics and expertise to the leading geotechnical engineering programs around the country (University of California Berkeley, University of California Davis, UCLA, University of Texas at Austin, University of Michigan, Virginia Tech, University of Illinois at Urbana Champaign, and Georgia Tech). However, the focus on soil-structure interaction sets the newly proposed M.S. in geotechnical engineering apart from most other programs. Letters have been sent to the department chairs of programs in the UC system that also teach courses in geotechnical engineering. We believe that the unique focus of this M.S. program on soil-structure interaction provides a complement to the other programs in the UC system, and will not interfere with their recruiting processes.

We anticipate that the proposed M.S. program in geotechnical engineering to start in Fall 2017, with recruitment of new students occurring before this time. Based on other geotechnical engineering programs around the country, we expect that there will be 10-15 students per year pursuing the M.S. in geotechnical engineering. This program may result in new students enrolling at UC San Diego. The example course schedules listed at the end of this proposal indicate that motivated students will be able to graduate in 4 quarters. The program can be easily integrated into the B.S./M.S. program using mechanisms already in place in the department.

Section 2: Program Structure and Organization

Overview

The M.S. degree program is intended to provide students with additional fundamental knowledge as well as specialized advanced knowledge in geotechnical engineering over and above that available in the B.S. degree in Structural Engineering at UC San Diego (SE 181, SE 182, and SE 184). Students seeking to pursue the M.S. program in geotechnical engineering should have an undergraduate degree in Structural or Civil Engineering. Further, students are required to take SE 181 and SE 182, or their equivalents at another university, as a prerequisite to pursuing the M.S. degree in geotechnical engineering. Exceptions to this will not be granted, though SE 182 may be taken concurrently with other M.S. coursework with instructor and advisor approval. The M.S. degree program includes required core courses and technical elective courses. M.S. students must complete 48 units of graduate course credit for graduation (12 courses). Students must obtain approval from their advisor and the SE Graduate Affairs Committee on proposed coursework to complete the degree. Although there are no foreign language requirements with the M.S. program in geotechnical engineering, CCGA recognizes that foreign language competence may be an important element of graduate education of doctoral programs. Two M.S. degree plans are offered – the M.S. Comprehensive Examination Plan and the M.S. Thesis Plan. All M.S. students will be assigned an advisor upon entering the M.S. program who can provide guidance on selecting between these plans. Students may switch advisors after the first quarter. Students must choose between the M.S. Comprehensive Examination Plan and the M.S. Thesis Plan by the end of the second quarter of study.

The M.S. Comprehensive Examination Plan requires 48 units (12 courses) of regular coursework and completion of a written comprehensive examination covering the coursework. The comprehensive examination must be taken no later than the end of the 8th week of the quarter for which the student intends to graduate. The comprehensive examination will be prepared and assessed by the student's advisor, and may include an examination on topics related to the selected coursework or a written report on a subject that integrates two or more of the courses in the program. In addition to the 48 units, students must take SE 290 every quarter in the first year for the M.S. Comprehensive Examination Plan, and are strongly recommended to take it for at least one quarter in the subsequent year. The M.S. Thesis Plan is designed for students with an interest in research prior to entering a professional career or a doctoral degree program. For this plan, 36 units (9 courses) of regular coursework are required, along with 12 units of graduate research (SE 299) for work on an M.S. thesis. The thesis defense is the final examination for students enrolled in the M.S. Thesis Plan and must be taken no later than the end of the 8th week of the quarter for which the student intends to graduate. The thesis must be defended in a public presentation with an oral examination conducted by a committee composed of three faculty members. A complete copy of the thesis must be submitted to the committee at least two weeks prior to the defense. In addition to the 48 units, students must take SE 290 every quarter in the first year for the M.S. Thesis Plan, and are strongly recommended to take it for at least one quarter in the subsequent year.

Core Courses

M.S. students in geotechnical engineering must complete the following four core courses:

SE 271 Solid Mechanics for Structural & Aerospace Engineering
SE 241 Advanced Soil Mechanics

SE 242 Advanced Foundation Engineering
SE 250 Stability of Earth Slopes & Retaining Walls

Geotechnical Technical Electives

Students must select with approval from the Graduate Affairs Committee at least four courses (M.S. Comprehensive Examination Plan) or three courses (M.S. Thesis Plan) from the following list of geotechnical technical electives. Guidance on selection of the technical electives is provided later.

SE 222 Geotechnical Earthquake Engineering
SE 226 Groundwater Engineering
SE 243 Soil-Structure Interaction
SE 244 Numerical Methods in Geomechanics
SE 247 Ground Improvement
SE 207 Engineering Properties of Soils
SE 207 Rock Mechanics
SE 207 Soil Dynamics
SE 207 Unsaturated Soil Mechanics

Other Technical Electives

Students may select with approval from the Graduate Affairs Committee any from the following list of other technical electives to meet the 12 required courses beyond the required core courses, geotechnical technical electives, and research graduate credits (if applicable). It should be noted that some of the technical electives have prerequisites that must be fulfilled as noted in the lists below. Guidance on selection of the technical electives is provided below.

SE 201A – Advanced Structural Analysis
SE 203 Structural Dynamics (Prerequisite: SE201A)
SE 206 Random Vibrations (Prerequisite: SE203)
SE 211 RC/PC Design
SE 212 Steel Design
SE 213 Bridge Design
SE 220 Seismic Isolation and Energy Dissipation (Prerequisite: SE201A)
SE 221 Earthquake Engineering (Prerequisite: SE201A)
SE 223 Advanced Seismic Design of Structures
SE 224 Structural Reliability and Risk Analysis
SE 274 Nonlinear Finite Element Methods
SE 276A Finite Element Methods in Solid Mechanics I
SE 276B Finite Element Methods in Solid Mechanics II
SE 276C Finite Element Methods in Solid Mechanics III
SE 235 Wave Propagation in Elastic Media
SE 272 Theory of Elasticity
SIO 225 Physics of Earth Materials
SIO 226 Introduction to Marine Geophysics
SIO 227A Introduction to Seismology
SIO 227B Advanced Seismology
SIO 239 Introduction to the Rheology of Solid Earth
SIO 240 Marine Geology

Suggested Course Sequences

The following course sequences are included to provide guidance in selecting technical electives based on common themes among the technical electives. Although a maximum of 8 technical electives (3-4 geotechnical technical electives and 4-5 other technical electives) are required beyond the 4 required core courses, more classes may be listed for each of the suggested focus sequences based on the common themes. It should be noted that some of the technical electives have prerequisites that must be fulfilled as noted in the lists below.

Geotechnical Engineering:

Students following this course sequence will gain an in-depth understanding of both geotechnical fundamentals and soil-structure interaction phenomena. Students following this course sequence may also choose technical electives to gain expertise in related topics in geology.

SE 222 Geotechnical Earthquake Engineering
SE 226 Groundwater Engineering
SE 244 Numerical Methods in Geomechanics
SE 247 Ground Improvement
SE 207 Engineering Properties of Soils
SE 207 Rock Mechanics
SE 207 Unsaturated Soil Mechanics
SE 207 Soil Dynamics
SE 222 Geotechnical Earthquake Engineering
SIO 225 Physics of Earth Materials
SIO 226 Introduction to Marine Geophysics
SIO 239 Introduction to the Rheology of Solid Earth
SIO 240 Marine Geology

Geotechnical Earthquake Engineering

Students following this course sequence will still gain an understanding of geotechnical fundamentals and soil-structure interaction, but will also gain specialization in different aspects of geotechnical and structural earthquake engineering:

SE 201A Advanced Structural Analysis
SE 203 Structural Dynamics (Prerequisite: SE201A)
SE 206 Random Vibrations (Prerequisite: SE203)
SE 207 Soil Dynamics
SE 220 Seismic Isolation and Energy Dissipation (Prerequisite: SE201A)
SE 221 Earthquake Engineering (Prerequisite: SE 201A)
SE 222 Geotechnical Earthquake Engineering
SE 223 Advanced Seismic Design of Structures
SE 235 Wave Propagation in Elastic Media
SE 243 Soil-Structure Interaction
SE 244 Numerical Methods in Geomechanics
SIO 227A Introduction to Seismology
SIO 227B Advanced Seismology

Geomechanics
Students following this course sequence will still gain an understanding of geotechnical fundamentals and soil-structure interaction, but will also gain specialization in computational techniques that can be applied to the study of geotechnical and structural engineering problems:

SE 207 Engineering Properties of Soils
SE 207 Rock Mechanics
SE 207 Soil Dynamics
SE 226 Groundwater Engineering
SE 235 Wave Propagation in Elastic Media
SE 243 Soil-Structure Interaction
SE 244 Numerical Methods in Geomechanics
SE 272 Theory of Elasticity
SE 274 Nonlinear Finite Element Methods
SE 276A Finite Element Methods in Solid Mechanics I
SE 276B Finite Element Methods in Solid Mechanics II
SE 276C Finite Element Methods in Solid Mechanics III
SIO 225 Physics of Earth Materials
SIO 226 Introduction to Marine Geophysics
SIO 239 Introduction to the Rheology of Solid Earth
SIO 240 Marine Geology

Geotechnical and Structural Engineering
Students following this course sequence will still gain an understanding of geotechnical fundamentals and soil-structure interaction, but will also gain skills necessary to purse a joint career in geotechnical and structural engineering:

SE 201A – Advanced Structural Analysis
SE 211 RC/PC Design
SE 212 Steel Design
SE 213 Bridge Design (Prerequisite: SE 201A)
SE 222 Geotechnical Earthquake Engineering
SE 224 Structural Reliability and Risk Analysis
SE 235 Wave Propagation in Elastic Media
SE 243 Soil-Structure Interaction
SE 244 Numerical Methods in Geomechanics
SE 247 Ground Improvement
SE 207 Engineering Properties of Soils
SE 207 Rock Mechanics

Example Course Sequences:
It is expected that a student will be able to complete the M.S. program in 4 semesters by taking 3 courses per quarter. The required core courses are offered every year while the geotechnical technical electives are likely going to be offered every other year so the actual schedule may vary from year to year. An example of a schedule for a M.S. student pursuing a course sequence in geotechnical engineering is shown below.

Quarter	Required Core Courses	Geotechnical Technical Electives	Other Technical Electives
1	Advanced Soil Mechanics	Geotechnical Earthquake Engineering	
	Solid Mechanics		
2	Earth Slopes and Retaining Walls	Soil-Structure Interaction	
		Groundwater or Soil Dynamics	
3		Advanced Foundation Engineering	
		Engineering Properties of Soils	
		Ground Improvement	
4		Unsaturated Soil Mechanics	
		Rock Mechanics	
		Numerical Methods in Geotechnical Engineering	

An example course sequence for a student focused on geotechnical engineering and geology is listed below:

Quarter	Required Core Courses	Geotechnical Technical Electives	Other Technical Electives
1	Advanced Soil Mechanics		Physics of Earth Materials
	Solid Mechanics		
2	Earth Slopes and Retaining Walls	Soil-Structure Interaction	Marine Geology
3		Advanced Foundation Engineering	
		Engineering Properties of Soils	
		Ground Improvement	
4		Unsaturated Soil Mechanics	Introduction to Marine Geophysics
		Rock Mechanics	

An example course sequence for a student focused on earthquake engineering is listed below:

Quarter	Required	Geotechnical Technical Elective	Other Technical Electives
1	Advanced Soil Mechanics	Geotechnical Earthquake Engineering	Advanced Structural Analysis
2	Earth Slopes and Retaining Walls	Soil-Structure Interaction	Structural Dynamics
3		Engineering Properties of Soils	Random Vibrations
		Ground Improvement	
4	Solid Mechanics	Numerical Methods in Geotechnical Engineering	Seismic Isolation *or* Advanced Seismic Design of Structures

An example course sequence for a student focused on geomechanics is listed below:

Quarter	Required	Geotechnical Technical Elective	Other Technical Electives
1	Advanced Soil Mechanics	Numerical Methods in Geotechnical Engineering	Finite Elements 1
2	Earth Slopes and Retaining Walls		Finite Elements 2
			Theory of Elasticity
3		Engineering Properties of Soils	Finite Elements 3
		Ground Improvement	
4	Solid Mechanics	Rock Mechanics	

An example course sequence for a student focused on geotechnical and structural engineering is listed below:

Quarter	Required	Geotechnical Technical Elective	Other Technical Electives
1	Advanced Soil Mechanics		Advanced Structural Analysis
	Solid Mechanics		
2	Earth Slopes and Retaining Walls	Soil-Structure Interaction	Advanced RC/PC
3		Engineering Properties of Soils	Advanced Structural Steel Design
			Structural Reliability
4		Numerical Methods in Geotechnical Engineering	Bridge Design *or* Advanced Seismic Design of Structures
		Rock Mechanics *or* Geotechnical Earthquake Engineering	

Section 3: Projected Need and Program Differentiation

There is currently a strong interest in geotechnical engineering at the undergraduate level in the department, where 20% of the students in the department choose to specialize in geotechnical engineering. Some of these undergraduate students have expressed interest in pursuing graduate study in geotechnical engineering, but there is currently not an organized program that they can follow. The Department currently has 2 M.S. students who are following the currently available M.S. program in structural engineering that are focusing on geotechnical engineering courses. The letters from leading geotechnical consulting firms in the San Diego area indicates the need in industry for students with a M.S. degree in geotechnical engineering, and also reflects opportunities for graduates to obtain positions in the job market. There are major geotechnical challenges in the San Diego and Southern California area that reflect the need for graduates focusing on this topic. The American Society of Civil Engineers (ASCE) is encouraging the adoption of the M.S. degree as the minimum degree to practice engineering. This is particularly relevant in geotechnical engineering, where the design and analysis of geotechnical systems requires coursework beyond that offered at the undergraduate level. The geotechnical engineering courses listed above fall into the categories of geotechnical fundamentals and soil-structure interaction to form the unique focus of the M.S. program in geotechnical engineering in the Department of Structural Engineering. The courses are categorized below with a short description of the content (core courses shown in italics):

Geotechnical Fundamentals

- *Solid Mechanics*: Equilibrium principles and stress-strain behavior of solids
- *Advanced Soil Mechanics*: Continuum mechanics, role of effective stress, compressibility and consolidation of soils
- Engineering Properties of Soils: Measurement of soil properties, variables affecting soil behavior, constitutive modeling
- Unsaturated Soil Mechanics: Evaluation of the role of unsaturated conditions in the effective stress state, deformation response, and shear strength of soils
- Rock Mechanics: Measurement of rock properties, variables affecting rock behavior, constitutive modeling
- Numerical Methods in Geotechnical Engineering: Integration of soil mechanics principles and constitutive models to predict the behavior of geotechnical systems
- Soil Dynamics: Wave propagation in soils and rock, evaluation of the dynamic properties of soils in the laboratory and field
- Groundwater Engineering: Analysis of water flow problems in soils

Soil-Structure Interaction

- *Slopes and Walls*: Evaluation of the stability and deformation of soil-only geotechnical systems (slopes, levees, embankments, dams, etc.) to geotechnical systems containing structures (retaining walls, excavations, etc.)
- *Advanced Foundation Engineering*: Study of settlement, bearing capacity, soil-structure interaction, and structural design of shallow and deep foundations
- Soil-Structure Interaction: Interaction between soils and structures during deformation and vibrations
- Ground Improvement: Techniques to improve ground for structural support
- Geotechnical Earthquake Engineering: Evaluation of site response to earthquake shaking to provide input for seismic design of structures

Section 4: Faculty

The current faculty teaching courses in the geotechnical engineering area are John McCartney, Ahmed Elgamal, Tara Hutchinson, and Enrique Luco, and Ingrid Tomac is a research scientist who teaches courses as a lecturer. Although another geotechnical faculty member, Patrick Fox, recently left UC San Diego to become the head of the Dept. of Civil and Environmental Engineering at Penn State, the Department hopes to hire a new faculty member to replace him before the time this new program is implemented. The teaching requirements constitute the typical load in the department, and will thus not affect their research productivity. The CVs for the geotechnical faculty are listed in the appendix at the end of this document.

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Section 5: Courses

Geotechnical Technical Elective Course Descriptions

SE 226: Groundwater Engineering (4)
The objective of this course is to treat quantitative aspects of the flow of uncontaminated groundwater as it influences the practice of geotechnical engineering. We will cover flow through porous media, generalized Darcy's law, groundwater modeling, confined and unconfined systems, well hydraulics, land subsidence, and construction dewatering.

SE 241. Advanced Soil Mechanics (4)
Advanced treatment of topics in soil mechanics, including state of stress, pore pressure, consolidation and settlement analysis, shear strength of cohesionless and cohesive soils, mechanisms of ground improvement, and slope stability analysis. Concepts in course reinforced by laboratory experiments.

SE 242. Advanced Foundation Engineering (4)
Advanced treatment of topics in foundation engineering, including earth pressure theories, design of earth retaining structures, bearing capacity, ground improvement for foundation support, analysis and design of shallow and deep foundations, including drilled piers and driven piles.

SE 243. Soil-Structure Interaction (4)
Advanced treatment of the dynamic interaction between soils and structures. Dynamic response of shallow and embedded foundations. Kinematic and inertial interaction. General computational and approximate analytical methods of analysis. Prerequisites: SE 200 and SE 203

SE 244. Numerical Methods in Geomechanics (4)
Application of finite element method to static and dynamic analysis of geotechnical structures. One-, 2-, and 3-D static and seismic response of earth structures/slopes/foundation systems. Pore-pressure generation/effects during cycle loading. System identification using strong motion downhole-array data. Use of computer resources required.

SE 247. Ground Improvement (4)
Concepts underpinning mechanical, hydraulic, chemical and inclusion-based methods of ground improvement will be discussed. Students will be able to understand the advantages, disadvantages and limitations of the various methods; and develop a conceptual design for the most appropriate improvement strategy.

SE 250. Stability of Earth Slopes and Retaining Walls (4)
Fundamental and advanced concepts of stability analysis for earth slopes and retaining walls with soil backfill. Topics: shear strength, effective/total stress analysis, infinite/finite slopes, reinforced soil slopes, lateral earth pressure, retaining wall design and reinforced soil retaining walls.

SE 207: Engineering Properties of Soils (4)
Experimental perspective on the stress-strain, hydraulic, and thermal behavior of dry and saturated soils. Different experimental techniques and methodologies will be presented, and

students will have the opportunity to perform key tests. The behavior of saturated sands and clays will be described based on key studies in the literature. Calibration of constitutive models for soil behavior will be presented, including the hyperbolic, Mohr-Coulomb and Cam-clay models. Modification of these models to consider thermal effects will be introduced.

SE 207: Rock Mechanics (4)
This course develops an understanding of rock behavior and engineering for both geotechnical applications (tunneling, excavations, dams, foundations, rockfall protection) and for geoenergy applications (petroleum exploration, enhanced geothermal energy, carbon sequestration). After a review of engineering geology, focus will be provided on characterization of basic mechanical and hydraulic properties of rocks. Hydraulic fracturing of rocks including proppant flow will be discussed. Several case histories for the different applications will be provided.

SE 207: Unsaturated Soil Mechanics (4)
This course covers the complex coupling between the hydraulic and thermal processes in unsaturated soils. The flow of water, air, and heat in unsaturated soils will be considered, along with an introduction to the fundamental properties governing water retention and flow. Experimental methods to characterize the volume change and shear strength of unsaturated soils will be presented. The stress state in unsaturated soils will be considered from both the effective stress principle and the independent stress state variable concepts. Constitutive models for the coupled deformation and shear strength response of unsaturated soils will be presented.

SE 207: Soil Dynamics (4)
This course develops an understanding of material behavior in the linear and nonlinear strain ranges and to present some of the analytical solutions available for solving dynamic soil-structure interaction problems for systems responding linearly. Four areas in dynamic geotechnical engineering are covered, including: (1) the dynamic behavior of earth, pavement and structural materials and appropriate measurement techniques, (2) the dynamic response of simple, lumped-mass systems, (3) dynamic soil-structure interaction in terms of the design of dynamically loaded machine foundations, and (4) the use of dynamically determined deformational characteristics in predicting movements of statically loaded geotechnical systems.

Other Technical Elective Course Descriptions
SE 203. Structural Dynamics (4)
Response of the linear systems to harmonic, periodic and transient excitations. Duhamel's integral. Response spectra. Principles of dynamics, Hamilton's principle and Lagrange's equations. Linearization of the equations of motion. Free and forced vibrations. Matrix iteration, Jacobi, normal mode and frequency response method.

SE 206. Random Vibrations (4)
Introduction to probability theory and random processes. Dynamic analysis of linear and nonlinear structural systems subjected to stationary and nonstationary random excitations. Reliability studies related to first excursion and fatigue failures. Applications in earthquake engineering, offshore engineering, wind engineering, and aerospace engineering.
Prerequisites: SE 203.

SE 211. Advanced Reinforced and Prestressed Concrete Design (4)
Advanced topics in concrete design, including frame and shear wall structures, design of connections. reinforced and prestressed concrete system evaluation for seismic resistance including confinement and ductility requirements. Upper and lower bound theories for slab design.

SE 212. Advanced Structural Steel Design (4)
Load and resistance factor design (LRFD) philosophy. Behavior and design of steel elements for global and local buckling. Bracing requirements for stability. Conventional and advanced analysis techniques for P-delta effects. Cyclic behavior. Ductility requirement for seismic design. Composite construction.

SE 213. Bridge Design (4)
Design and analysis of bridge structures, construction methods, load conditions. Special problems in analysis - box girders, curved and skewed bridges, environmental and seismic loads. Bearings and expansion joints. Time- temperature-dependent superstructure deformations. Conceptual/preliminary bridge design project. Prerequisites: SE 201A and fundamental courses in RC and PC design or consent of instructor.

SE 220. Seismic Isolation/Energy Dissipation (4)
Concepts, advantages and limitations of seismic isolation techniques; fundamentals of dynamic response under seismic excitation; spectral analysis; damping; energy approach; application to buildings and structures.

SE 223. Advanced Seismic Design of Structures (4)
Introduction to fundamental concepts in seismic design of structures. Ductility. Elastic and inelastic response. Time-history analysis. Response spectral analysis. Force- and displacement-based design. Capacity design principles. Learning from earthquake damage. Performance based design concepts.

SE 224. Structural Reliability and Risk Analysis (4)
Review of probability theory and random processes. Fundamentals of structural reliability theory. First- and second-order, and simulation methods of reliability analysis. Structural component and system reliability. Reliability sensitivity measures. Bayesian reliability analysis methods. Bases for probabilistic design codes. Time-variant reliability analysis. Finite element reliability methods.

SE 235. Wave Propagation in Elastic Media (4)
Wave propagation in elastic media with emphasis on waves in unbounded media and on uniform and layered half-spaces. Fundamental aspects of elastodynamics. Application to strong-motion seismology, earthquake engineering, dynamics of foundations, computational wave propagation, and non-destructive evaluation. Prerequisites: Graduate standing or consent of instructor.

SE 271. Solid Mechanics for Structural and Aerospace Engineering (4)
Application of principles of solid mechanics to structural components and systems, description of stresses, strains and deformation. Use of conservation equations and principle of minimum potential energy. Development of constitutive equations for metallic cementitious and polymeric materials.

SE 274. Nonlinear Finite Element Methods (4)
Modeling of mechanical deformation processes in solids and structures by the finite element method. PDE models of deformations in solids and structures. Weak form. Weighted residuals method. Material models for 3D solids and rods, beams, shells. Elasticity, plasticity, viscoelasticity.

SE 276A. Finite Element Methods in Solid Mechanics I (4)
Finite element methods for linear problems in solid mechanics. Emphasis on the principle of virtual work, finite element stiffness matrices, various finite element formulations and their accuracy and the numerical implementation required to solve problems in small strain, isotropic elasticity in solid mechanics.

SE 276B. Finite Element Methods in Solid Mechanics (4)
Finite element methods for linear problems in structural dynamics. Beam, plate, and doubly curved shell elements are derived. Strategies for eliminating shear locking problems are introduced. Formulation and numerical solution of the equations of motion for structural dynamics are introduced and the effect of different mass matrix formulations on the solution accuracy is explored.

SE 276C. Finite Element Methods in Solid Mechanics III (4)
Finite element methods for problems with both material and geometrical (large deformations) nonlinearities. The total LaGrangian and the updated LaGrangian formulations are introduced. Basic solution methods for the nonlinear equations are developed and applied to problems in plasticity and hyperelasticity. Prerequisites: SE 276A or MAE 232A and MAE 231A or SE 271.

Geology Technical Electives (Course descriptions found on the SIO website)
SIO 225 Physics of Earth Materials
SIO 226 Introduction to Marine Geophysics
SIO 227A Introduction to Seismology
SIO 227B Advanced Seismology
SIO 240 Marine Geology
SIO 182 Environmental and Exploration Geophysics
SIO 239 Introduction to the Rheology of Solid Earth

Preliminary Course Coverage (C = core course, TE = technical elective):
As mentioned, the Structural Engineering Department hopes to hire a new faculty member to replace Patrick Fox, who left the Department to become the Head of the Department of Civil and Environmental Engineering at Penn State. However, the current faculty members are available to teach the geotechnical core courses on an annual basis and technical elective courses on a rotating basis to meet the demands of the different focus sequences. The priority is to offer the core courses once per year, and the technical electives every other year. After a new faculty member is hired, the department will have added flexibility in the schedule for offering technical electives.

	Elgamal	**Hutchinson**	**Luco**	**McCartney**	**Tomac**
SE 241 Advanced Soil Mechanics (*Fall*)	C	C		C	
SE 250 Stability of Earth Slopes & Retaining Walls (*Winter*)					C
SE 242 Advanced Foundation Engineering (*Winter/Spring*)		C		C	
SE 222 Geotechnical Earthquake Engineering	TE	TE			
SE 226 Groundwater				TE	
SE 243 Soil-Structure Interaction			TE		
SE 244 Numerical Methods in Geomechanics	TE				
SE 247 Ground Improvement		TE			
SE 207 Unsaturated Soil Mechanics				TE	
SE 207 Soil Dynamics		TE		TE	
SE 207 Rock Mechanics					TE
SE 207 Engineering Properties of Soils				TE	

The proposed teaching schedule for Academic year 2016-2017 is shown below to emphasize that a sufficient number of geotechnical graduate courses are being taught (9) in the three quarters. This course arrangement is possible, even with each FTE teaching one undergraduate course each (two of which are co-listed as undergraduate and graduate courses as noted in the table), and the fact that Ahmed Elgamal has a reduced teaching load as he is serving as the Associate Dean for Academic Affairs (which has contributed to an external lecturer teaching one course).

Teaching Schedule for Academic Year 2016-2017

SE 207	Rock Mechanics			Tomac
SE 207	Soil Dynamics	External		
SE 226	Groundwater			
SE 222	Geotechnical Earthquake Engineering		Hutchinson	
SE 241	Advanced Soil Mechanics	McCartney		
SE 248	Engineering Properties of Soils	McCartney		
SE 242/182	Advanced Foundation Engineering		McCartney	
SE 243	Soil-Structure Interaction			Luco
SE 244	Numerical Methods in Geomechanics			
SE 247/184	Ground Improvement			Hutchinson
SE 250	Stability of Earth Slopes & Retaining Walls		Tomac	

Section 6: Resource Requirements
No additional resources are required to establish this M.S. program.

Section 7: Graduate Student Support
The graduate students enrolling in the M.S. program in Geotechnical Engineering will not be supported, and are expected to pay tuition and support themselves financially. This is a similar model to the M.S. in Structural Engineering already present in the department. It is not expected that the M.S. program will reach a size that will require teaching assistants, with an expected size of 15 students per course.

Section 8: Governance
The M.S. in Geotechnical Engineering will be governed by the Department of Structural Engineering.

Section 9: Changes in Senate Regulations
No changes in senate regulations are expected as part of this proposed M.S. program.

Appendices
- Catalog Copy
- List of Internal and External Potential Reviewers
- List of Chairs of Comparable Programs and Sample of Typical Letter Sent
- CVs of Geotechnical Faculty
- Letters of Support
  - Letters of support from the Dean of the Jacobs School of Engineering
  - Letter of support from the chair of SIO
  - Letters from several local and international geotechnical engineering firms.
  - Note: The letter at the beginning of the proposal reflects the support of the Department of Structural Engineering and the Graduate Advisory Committee of the Department.

Catalog Copy (To be Added to the Graduate Catalog Copy of the SE Department)

Overview

The M.S. degree program is intended to provide students with additional fundamental knowledge as well as specialized advanced knowledge in geotechnical engineering over and above that available in the B.S. degree in Structural Engineering at UC San Diego (SE 181, SE 182, and SE 184). Students seeking to pursue the M.S. program in geotechnical engineering should have an undergraduate degree in Structural or Civil Engineering. Further, students are required to take SE 181 and SE 182, or their equivalents at another university, as a prerequisite to pursuing the M.S. degree in geotechnical engineering. Exceptions to this will not be granted, though SE 182 may be taken concurrently with other M.S. coursework with instructor and advisor approval. The M.S. degree program includes required core courses and technical elective courses. M.S. students must complete 48 units of graduate course credit for graduation (12 courses). Students must obtain approval from their advisor and the SE Graduate Affairs Committee on proposed coursework to complete the degree. Although there are no foreign language requirements with the M.S. program in geotechnical engineering, CCGA recognizes that foreign language competence may be an important element of graduate education of doctoral programs. Two M.S. degree plans are offered – the M.S. Comprehensive Examination Plan and the M.S. Thesis Plan. All M.S. students will be assigned an advisor upon entering the M.S. program who can provide guidance on selecting between these plans. Students may switch advisors after the first quarter. Students must choose between the M.S. Comprehensive Examination Plan and the M.S. Thesis Plan by the end of the second quarter of study.

The M.S. Comprehensive Examination Plan requires 48 units (12 courses) of regular coursework and completion of a written comprehensive examination covering the coursework. The comprehensive examination must be taken no later than the end of the 8th week of the quarter for which the student intends to graduate. The comprehensive examination will be prepared and assessed by the student's advisor, and may include an examination on topics related to the selected coursework or a written report on a subject that integrates two or more of the courses in the program. In addition to the 48 units, students must take SE 290 every quarter in the first year for the M.S. Comprehensive Examination Plan, and are strongly recommended to take it for at least one quarter in the subsequent year. The M.S. Thesis Plan is designed for students with an interest in research prior to entering a professional career or a doctoral degree program. For this plan, 36 units (9 courses) of regular coursework are required, along with 12 units of graduate research (SE 299) for work on an M.S. thesis. The thesis defense is the final examination for students enrolled in the M.S. Thesis Plan and must be taken no later than the end of the 8th week of the quarter for which the student intends to graduate. The thesis must be defended in a public presentation with an oral examination conducted by a committee composed of three faculty members. A complete copy of the thesis must be submitted to the committee at least two weeks prior to the defense. In addition to the 48 units, students must take SE 290 every quarter in the first year for the M.S. Thesis Plan, and are strongly recommended to take it for at least one quarter in the subsequent year.

Core Courses

M.S. students in geotechnical engineering must complete the following four core courses:

SE 271 Solid Mechanics for Structural & Aerospace Engineering

SE 241 Advanced Soil Mechanics

SE 242 Advanced Foundation Engineering
SE 250 Stability of Earth Slopes & Retaining Walls

Geotechnical Technical Electives

Students must select with approval from the Graduate Affairs Committee at least four courses (M.S. Comprehensive Examination Plan) or three courses (M.S. Thesis Plan) from the following list of geotechnical technical electives. Guidance on selection of the technical electives is provided later.

SE 222 Geotechnical Earthquake Engineering
SE 226 Groundwater Engineering
SE 243 Soil-Structure Interaction
SE 244 Numerical Methods in Geomechanics
SE 247 Ground Improvement
SE 207 Engineering Properties of Soils
SE 207 Rock Mechanics
SE 207 Soil Dynamics
SE 207 Unsaturated Soil Mechanics

Other Technical Electives

Students may select with approval from the Graduate Affairs Committee any from the following list of other technical electives to meet the 12 required courses beyond the required core courses, geotechnical technical electives, and research graduate credits (if applicable). It should be noted that some of the technical electives have prerequisites that must be fulfilled as noted in the lists below. Guidance on selection of the technical electives is provided below.

SE 201A – Advanced Structural Analysis
SE 203 Structural Dynamics (Prerequisite: SE201A)
SE 206 Random Vibrations (Prerequisite: SE203)
SE 211 RC/PC Design
SE 212 Steel Design
SE 213 Bridge Design
SE 220 Seismic Isolation and Energy Dissipation (Prerequisite: SE201A)
SE 221 Earthquake Engineering (Prerequisite: SE201A)
SE 223 Advanced Seismic Design of Structures
SE 224 Structural Reliability and Risk Analysis
SE 274 Nonlinear Finite Element Methods
SE 276A Finite Element Methods in Solid Mechanics I
SE 276B Finite Element Methods in Solid Mechanics II
SE 276C Finite Element Methods in Solid Mechanics III
SE 235 Wave Propagation in Elastic Media
SE 272 Theory of Elasticity
SIO 225 Physics of Earth Materials
SIO 226 Introduction to Marine Geophysics
SIO 227A Introduction to Seismology
SIO 227B Advanced Seismology
SIO 239 Introduction to the Rheology of Solid Earth
SIO 240 Marine Geology

Suggested Course Sequences

The following course sequences are included to provide guidance in selecting technical electives based on common themes among the technical electives. Although a maximum of 8 technical electives (3-4 geotechnical technical electives and 4-5 other technical electives) are required beyond the 4 required core courses, more classes may be listed for each of the suggested focus sequences based on the common themes. It should be noted that some of the technical electives have prerequisites that must be fulfilled as noted in the lists below.

Geotechnical Engineering:

Students following this course sequence will gain an in-depth understanding of both geotechnical fundamentals and soil-structure interaction phenomena. Students following this course sequence may also choose technical electives to gain expertise in related topics in geology.

SE 222 Geotechnical Earthquake Engineering
SE 226 Groundwater Engineering
SE 244 Numerical Methods in Geomechanics
SE 247 Ground Improvement
SE 207 Engineering Properties of Soils
SE 207 Rock Mechanics
SE 207 Unsaturated Soil Mechanics
SE 207 Soil Dynamics
SE 222 Geotechnical Earthquake Engineering
SIO 225 Physics of Earth Materials
SIO 226 Introduction to Marine Geophysics
SIO 239 Introduction to the Rheology of Solid Earth
SIO 240 Marine Geology

Geotechnical Earthquake Engineering

Students following this course sequence will still gain an understanding of geotechnical fundamentals and soil-structure interaction, but will also gain specialization in different aspects of geotechnical and structural earthquake engineering:

SE 201A Advanced Structural Analysis
SE 203 Structural Dynamics (Prerequisite: SE201A)
SE 206 Random Vibrations (Prerequisite: SE203)
SE 207 Soil Dynamics
SE 220 Seismic Isolation and Energy Dissipation (Prerequisite: SE201A)
SE 221 Earthquake Engineering (Prerequisite: SE 201A)
SE 222 Geotechnical Earthquake Engineering
SE 223 Advanced Seismic Design of Structures
SE 235 Wave Propagation in Elastic Media
SE 243 Soil-Structure Interaction
SE 244 Numerical Methods in Geomechanics
SIO 227A Introduction to Seismology
SIO 227B Advanced Seismology

Geomechanics
Students following this course sequence will still gain an understanding of geotechnical fundamentals and soil-structure interaction, but will also gain specialization in computational techniques that can be applied to the study of geotechnical and structural engineering problems:

SE 207 Engineering Properties of Soils
SE 207 Rock Mechanics
SE 207 Soil Dynamics
SE 226 Groundwater Engineering
SE 235 Wave Propagation in Elastic Media
SE 243 Soil-Structure Interaction
SE 244 Numerical Methods in Geomechanics
SE 272 Theory of Elasticity
SE 274 Nonlinear Finite Element Methods
SE 276A Finite Element Methods in Solid Mechanics I
SE 276B Finite Element Methods in Solid Mechanics II
SE 276C Finite Element Methods in Solid Mechanics III
SIO 225 Physics of Earth Materials
SIO 226 Introduction to Marine Geophysics
SIO 239 Introduction to the Rheology of Solid Earth
SIO 240 Marine Geology

Geotechnical and Structural Engineering
Students following this course sequence will still gain an understanding of geotechnical fundamentals and soil-structure interaction, but will also gain skills necessary to purse a joint career in geotechnical and structural engineering:

SE 201A – Advanced Structural Analysis
SE 211 RC/PC Design
SE 212 Steel Design
SE 213 Bridge Design (Prerequisite: SE 201A)
SE 222 Geotechnical Earthquake Engineering
SE 224 Structural Reliability and Risk Analysis
SE 235 Wave Propagation in Elastic Media
SE 243 Soil-Structure Interaction
SE 244 Numerical Methods in Geomechanics
SE 247 Ground Improvement
SE 207 Engineering Properties of Soils
SE 207 Rock Mechanics

List of Internal and External Potential Reviewers

Internal

Brian Palenik
SIO Department Chair
Professor of Marine Biology

Kevin Brown
Professor, Geosciences Research Division
Scripps Institution of Oceanography

David Sandwell
Professor, Geosciences Research Division
Scripps Institution of Oceanography

External

Iraj Noorany, Ph.D., P.E.
Professor Emeritus
San Diego State University
inoorany@san.rr.com

James Hanson
Professor
CalPoly San Luis Opisbo
jahanson@calpoly.edu

List of Chairs of Programs Offering Comparable Degrees at Other UC Campuses

Robert Harley
Carl W. Johnson Professor in Civil Engineering, and Chair
Department of Civil Engineering
University of California Berkeley
chair@ce.berkeley.edu

Brett F. Sanders
Department Chair and Professor of Civil and Environmental Engineering
Department of Civil and Environmental Engineering
University of California Irvine
bsanders@uci.edu

Amit Kanvinde
Professor and Chair
Department of Civil and Environmental Engineering
University of California Davis
kanvinde@ucdavis.edu

Jonathan P. Stewart
Professor and Chair
Department of Civil and Environmental Engineering
University of California Los Angeles
jstewart@seas.ucla.edu

Sample Letter Sent to Chairs of Programs Offering Comparable Degrees

Dear Chair,

At UCSD we are in the process of proposing a new graduate program leading to a M.S. in Geotechnical Engineering in the Department of Structural Engineering. In accordance with the review policy established by the systemwide Coordinating Committee of Graduate Affairs (CCGA), I am providing you, as the Chair of an existing comparable program, with a copy of the current draft of our proposal. We would be very grateful for any feedback you may wish to offer us, so that the proposal may be made as strong as possible before submission.

As background, please understand that the format and contents of the proposal follow the required outline found in the CCGA Handbook, and that internal and external reviewers will later be asked to address the following four points when examining our final submission:
– Quality and academic rigor of the program
– Adequacy of the size and expertise of faculty to administer the program
– Adequacy of the facilities and budgets
– Applicant pool and placement prospects for the graduates

If you wish to provide feedback, we would like to receive it within four weeks of the date of this letter, since we expect to submit the proposal for campus review at that time.

Benson Shing
Professor and Chair
Department of Structural Engineering
University of California San Diego

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ALBERT ("AL") P. PISANO, DEAN
IRWIN AND JOAN JACOBS SCHOOL OF ENGINEERING
WALTER J. ZABLE PROFESSOR OF ENGINEERING
7313 JACOBS HALL

9500 GILMAN DRIVE
LA JOLLA CALIFORNIA 92093-0403
TEL: (858) 534-6237 FAX: (858) 822-3904
EMAIL: DeanPisano@eng.ucsd.edu

09 September 2015

John S. McCartney, Ph.D., P.E.
Associate Professor
University of California San Diego
Jacobs School of Engineering
Department of Structural Engineering
Geomechanics Group
9500 Gilman Drive, SME 442J
La Jolla, CA 92093-0085

Dear John,

I have reviewed the proposal to establish a Master of Science program in Geotechnical Engineering in the Department of Structural Engineering of the Jacobs School of Engineering. The MS program in Geotechnical Engineering complements the strengths of the Civil Structures group in the department and will attract top students to the Jacobs School of Engineering.

The letters of support from outside the University, show a demand for such graduates in geotechnical engineering firms. The program is designed around available courses and faculty in the department, and it benefits the university without requiring new resources.

I am pleased to show my strongest support for this proposal.

Sincerely,

Albert P. Pisano, Dean
Irwin and Joan Jacobs School of Engineering
Walter J. Zable Professor of Engineering
Professor, Mechanical and Aero Engineering
Professor, Electrical and Computer Engineering
Member, National Academy of Engineering

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SCRIPPS INSTITUTION OF OCEANOGRAPHY

9500 GILMAN DRIVE
LA JOLLA, CA 92093-0208

July 27, 2015

To: John S. McCartney, Ph.D., P.E.
Associate Professor
University of California San Diego
Department of Structural Engineering

Dear John,

SIO would be happy to have the courses you suggested: SIO 225 Physics of Earth Materials; SIO 226 Introduction to Marine Geophysics; SIO 227A Introduction to Seismology; SIO 227B Advanced Seismology; SIO 240 Marine Geology; and a new course SIO239 Introduction to the Rheology of Solid Earth included as electives in a new MS program in Geotechnical Engineering. I think students in our program would benefit from interactions with students in the new program.

Sincerely yours,

Brian Palenik
SIO Department Chair
Professor of Marine Biology

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

July 21, 2015

John S. McCartney, Ph.D., P.E.
Associate Professor
University of California San Diego
Department of Structural Engineering
Geomechanics Group
9500 Gilman Drive, SME 442J
La Jolla, CA 92093-0085

RE: Letter of Support for the MS Program in Geotechnical Engineering at UCSD

Dear John,

This letter is in support of your proposal to develop a Master of Science program in Geotechnical Engineering at the University of California San Diego.

Our company is a geotechnical and earthquake engineering consulting firm specializing in seismic retrofit and design of transportation infrastructures. We maintain offices in Fountain Valley, San Diego, and Hayward. We are always interested in hiring top geotechnical engineering students, and it is often necessary for students to have additional specialized education in geotechnical engineering beyond that gained from an undergraduate degree in civil engineering.

We have reviewed the proposal and have found that the proposed list of courses will provide the necessary skills to be successful in geotechnical engineering practice.

Sincerely,

Hubert Law, PhD., P.E.
Vice President

17660 Newhope Street, Suite E, Fountain Valley, California 92708 Tel: (714) 751-3826 Fax: (714) 751-3928

Geosyntec consultants

10875 Rancho Bernardo Road, Suite 200
San Diego, CA 92127
PH 858.674.6559
FAX 858.674.6586
www.geosyntec.com

24 July 2015

John S. McCartney, Ph.D., P.E.
Associate Professor
University of California San Diego
Department of Structural Engineering
Geomechanics Group
9500 Gilman Drive, SME 442J
La Jolla, CA 92093-0085

Subject: Letter of Support for the MS Program in Geotechnical Engineering at UCSD

Dear John:

This letter is in support of your proposal to develop a Master of Science program in Geotechnical Engineering at the University of California San Diego.

Geosyntec Consultants (Geosyntec) provides nationally recognized expertise and specialized geotechnical and geological engineering (geoengineering) services to evaluate and improve the design and construction engineering properties of soil and rock foundations. Our geoengineering practice focuses on difficult and challenging sites where the development of dependable, cost-effective foundations, and other geostructural solutions are critical to the success of the project.

We are always interested in hiring top geotechnical engineering students, and it is often necessary for students to have additional specialized education in geotechnical engineering beyond that gained from an undergraduate degree in civil engineering.

We have reviewed the proposal and have found that the proposed list of courses will provide the necessary skills to be successful in the geotechnical engineering practice.

Sincerely,

Gregory T. Corcoran, P.E.
Principal Engineer

Ronald Johnson, P.E., G.E.
Principal Engineer

Helenschmidt Geotechnical, Inc.

August 25, 2015

John S. McCartney, Ph.D., P.E.
Associate Professor
University of California San Diego
Department of Structural Engineering
Geomechanics Group
9500 Gilman Drive, SME 442J
La Jolla, CA 92093-0085

RE: Letter of Support for the MS Program in Geotechnical Engineering at UCSD

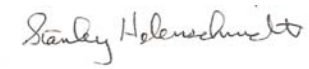
Dear John,

This letter is in support of your proposal to develop a Master of Science program in Geotechnical Engineering at the University of California San Diego.

Our company is involved in numerous complex construction and stabilization projects that demand a solid background in soil mechanics. In addition, the geological features in Southern California present a variety of geotechnical and seismic hazards that warrant detailed characterization and analytical techniques that are constantly evolving. Accordingly, it is often necessary for students to have additional specialized education in geotechnical engineering beyond that gained from an undergraduate degree in civil engineering.

We have reviewed the proposal and have found that the proposed list of courses will provide the necessary skills to be successful in geotechnical engineering practice.

Respectfully,
Helenschmidt Geotechnical, Inc.



Stanley Helenschmidt
Principal Geotechnical Engineer
GE 2064

5245 Avenida Encinas, Suite B
Carlsbad, CA 92008
www.hgiengineering.com
Telephone 760-579-0333
Fax 760-579-0230

August 27, 2015

John S. McCartney, Ph.D., P.E.
Associate Professor
University of California San Diego
Department of Structural Engineering
Geomechanics Group
9500 Gilman Drive, SME 442J
La Jolla, CA 92093-0085

Subject: Letter of Support for the MS Program in Geotechnical Engineering at UCSD

Dear John:

This letter is in support of your proposal to develop a Master of Science program in Geotechnical Engineering at the University of California San Diego.

Our company is NV5, a publicly traded company with a nationwide presence in all aspects of civil engineering. We are always interested in hiring top geotechnical engineering students, and it is often necessary for students to have additional specialized education in geotechnical engineering beyond that gained from an undergraduate degree in civil engineering.

We have reviewed the proposal and have found that the proposed list of courses will provide the necessary skills to be successful in geotechnical engineering practice.

Sincerely,
NV5

Guillaume Gau, P.E., G.E.
Senior Engineering Manager

UNIVERSITY OF CALIFORNIA, BERKELEY

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SANTA BARBARA • SANTA CRUZ

Robert Harley
Carl W. Johnson Professor, and Chair

E-mail chair@ce.berkeley.edu

CIVIL AND ENVIRONMENTAL ENGINEERING
760 Davis Hall
Berkeley, California 94720-1710
Tel. 510-643-8739

February 28, 2016

Professor P. Benson Shing, Chair
Department of Structural Engineering
University of California, San Diego

Dear Professor Shing,

I write in response to your letter of January 22, in which you provided a proposal for a new graduate degree program at UCSD, leading to an M.S. in Geotechnical Engineering. I have shared the proposal with faculty colleagues in our Geotechnical Engineering program at Berkeley, and following internal consultation, I am happy to convey a positive reply in support of your proposal.

Other high-quality MS programs in Geotechnical Engineering within the UC System are already offered at the Berkeley, Davis, and Los Angeles campuses. That said, we believe there are sufficient challenges and sufficient demand for graduates in California and nationwide to support another Master's level geotechnical engineering program within the UC system.

The courses and academic program in your MS degree proposal are well thought out. The proposed program meets the four criteria specified in your letter. The level of academic rigor of the proposed program is high, and the program will be supported by an appropriate number of distinguished faculty with relevant expertise to deliver the necessary courses and advising. Available facilities to support the program are excellent, and UCSD has a large undergraduate engineering student population from which you can draw applicants to the new Master's program. You are well-positioned also to attract civil engineering majors graduating from other schools.

We wish you every success as you move forward in establishing this new graduate degree program.

Sincerely,

Robert Harley

Robert Harley
Carl W. Johnson Professor, and Chair

UC San Diego
Jacobs School of Engineering

John McCartney <mccartney@eng.ucsd.edu>

FW: MS Program in Geotechnical Engineering at UCSD

Shing, Pui-Shum <pshing@ucsd.edu> Mon, Feb 22, 2016 at 8:42 AM
To: "'John McCartney' (mccartney@eng.ucsd.edu)" <mccartney@eng.ucsd.edu>
Cc: Ahmed Elgamal <aelgamal@ucsd.edu>, "Hutchinson, Tara" <tahutchinson@ucsd.edu>, "Luco, J." <jeluco@ucsd.edu>, "Yvonne Wilson (ywilson@eng.ucsd.edu)" <ywilson@eng.ucsd.edu>

John,

Here is the input from UCLA on the MS program in Geotechnical Eng.

Benson

From: Jonathan P. Stewart [mailto:jstewart@seas.ucla.edu]
Sent: Monday, February 22, 2016 6:13 AM
To: Shing, Pui-Shum
Subject: RE: MS Program in Geotechnical Engineering at UCSD

Benson:

I am pleased to see the UCSD is considering forming an MS program in geotechnical engineering. In general, I think the need for the program is well articulated in the document provided. Moreover, the faculty and lecturing staff that you have are of high quality and can operate an effective program (although I would say that in number of faculty, you are at minimum level of critical mass).

In response to your specific questions:

1. The course list and descriptions seem quite reasonable. Given my knowledge of the faculty, I would expect the quality of the courses to be high.

2. As mentioned above, the number of faculty is at a minimal level for critical mass. You might consider appointing adjunct faculty in the area to help support the program, which can be especially critical during periods of faculty sabbatical.

3. The research facilities would seem to be quite strong. No information is provided in the proposal on other facilities – classroom space, computer labs, student office space, etc. I did not see any budget information in the document that was provided to me.

4. Probably the current levels of enrollment for geotechnical engineering courses provides a good indicator of the demand you may expect in the future, although some growth may occur when the faculty are able to

advertise specifically in the geotechnical area. Given the large population of the San Diego area and the strong local geotechnical industry, I would expect the program would become populated with a steady stream of students. That said, geotechnical MS programs are not large, so somewhere in the range of 5-15 students would be my guess on enrollment numbers.

Thank you for the opportunity to review the program proposal. Best wishes,

Jon

From: Shing, Pui-Shum [mailto:pshing@ucsd.edu]
Sent: Friday, January 22, 2016 8:37 AM
To: jstewart@seas.ucla.edu
Subject: MS Program in Geotechnical Engineering at UCSD

Dear Jon,

The Department of Structural Engineering at UC San Diego is proposing a new graduate program leading to an M.S. degree in Geotechnical Engineering. Following the review policy established by the UC system-wide Coordinating Committee of Graduate Affairs (CCGA), I am providing you, as the Chair of an existing comparable program, with a copy of our draft proposal. We would be very grateful for any feedback you and your faculty in the Geotechnical Engineering program may offer. It will help us improve and strengthen the proposal before submission to the Graduate Council of our campus for review.

The format and contents of the proposal follow the required outline found in the CCGA Handbook. The CCGA will ask internal and external reviewers to address the following four points when examining our final submission:

– Quality and academic rigor of the program

– Adequacy of the size and expertise of faculty to administer the program

– Adequacy of the facilities and budgets

– Applicant pool and placement prospects for the graduates

If you would like to provide feedback on this proposal, we hope to receive it by February 29, 2016. Thank you for attention in this matter.

Best regards.

Benson

P. Benson Shing, Professor and Chair

Department of Structural Engineering

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August 27, 2015

John S. McCartney, Ph.D., P.E.
Associate Professor
University of California San Diego
Department of Structural Engineering
Geomechanics Group
9500 Gilman Drive, SME 442J
La Jolla, CA 92093-0085

Subject: Letter of Support for the MS Program in Geotechnical Engineering at UCSD

Dear John:

This letter is in support of your proposal to develop a Master of Science program in Geotechnical Engineering at the University of California San Diego.

Our company is NV5, a publicly traded company with a nationwide presence in all aspects of civil engineering. We are always interested in hiring top geotechnical engineering students, and it is often necessary for students to have additional specialized education in geotechnical engineering beyond that gained from an undergraduate degree in civil engineering.

We have reviewed the proposal and have found that the proposed list of courses will provide the necessary skills to be successful in geotechnical engineering practice.

Sincerely,
NV5

Guillaume Gau, P.E., G.E.
Senior Engineering Manager

MEMORANDUM

Date: November 7th, 2016

To: UCSD Graduate Council

From: John S. McCartney, Ph.D., P.E.

RE: Clarification of the Required Resources for the Proposed MS Program in Geotechnical Engineering in the Department of Structural Engineering

Dear Graduate Council members,

Thank you for your detailed evaluation and approval of the proposal to create a MS program in Geotechnical Engineering in the Department of Structural Engineering at UCSD. This memorandum clarifies the statement in the proposal that the new MS program will use existing resources.

We expect that the MS in Geotechnical Engineering program will grow slowly over time, reaching 15 to 20 incoming students per year. In the first 2-3 years that this program is offered, we expect 5-10 students mainly transitioning from our BS program into the new MS program, but this will be improved through advertisement at geotechnical conferences and through contacts with local geotechnical firms in California.

The major costs for the program will be for teaching requirements and for administrative needs. Since these courses are already offered, the teaching requirements are expected to be filled with the currently available FTE's in the department as part of their normal teaching duties. The department plans to recruit another FTE in Geotechnical Engineering in the coming years to replace a faculty member who recently moved to another university, which will add flexibility to the course offerings. The administrative needs can be covered initially by the existing department staff, as an additional 5-10 students will be within the fluctuations in the size of the MS in Structural Engineering also offered by the department. In the event that the MS program in Geotechnical Engineering grows large enough that the administrative needs become burdensome for the current staff, then the funds from the MS incentive program of the UCSD campus will be used to support another part-time staff member in the department.