

# Work experiences and internships for geotechnical engineering students: employer perspectives

## Expériences de travail et stages pour étudiants en génie géotechnique: perspectives des employeurs

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**ABSTRACT:** To better understand temporary work experiences in geotechnical engineering and industry best practices related to this subject, we surveyed over a fifty engineers and managers working in the geotechnical engineering profession in California. We asked these organizations to report on how frequently they hire continuing undergraduate and/or graduate students, the number of students they typically employ annually, minimum qualifications for student employees, work duties and tasks completed by students, the structure of their temporary work experience programs, training and/or mentoring requirements, attributes of successful student employees, and opinions on the role of temporary work experiences in engineering education. We describe the survey and summarize the survey results. In addition, we include general demographic and background information for the survey participants. The results of our survey are presented and discussed. Based on the results of the employer survey, we recommend employers and educators consider working together to design temporary work experiences in geotechnical engineering. Further, we recommend the investigation of student and faculty opinions of similar issues and questions.

**RÉSUMÉ:** Pour mieux comprendre les expériences de travail temporaires en ingénierie géotechnique et les meilleures pratiques de l'industrie en la matière, nous avons interrogé une cinquantaine d'ingénieurs et de cadres travaillant dans la profession d'ingénieur géotechnique en Californie. Nous avons demandé à ces organisations d'indiquer la fréquence à laquelle elles embauchent des étudiants de premier cycle et / ou des cycles supérieurs, le nombre d'étudiants qu'elles emploient généralement chaque année, les qualifications minimales requises pour les étudiants employés, les tâches et tâches accomplies par les étudiants, la structure de leurs programmes d'expérience professionnelle, les exigences en matière de formation et / ou de mentorat, les caractéristiques des futurs employés et les opinions sur le rôle des expériences de travail temporaires dans la formation d'ingénieurs. Nous décrivons l'enquête et résumons les résultats. En outre, nous incluons des informations démographiques générales et des informations de base pour les participants à l'enquête. Les résultats de notre enquête sont présentés et discutés. Sur la base des résultats du sondage auprès des employeurs, nous recommandons aux employeurs et aux éducateurs d'envisager de travailler ensemble pour concevoir des expériences de travail temporaires en ingénierie géotechnique. De plus, nous recommandons d'examiner les opinions des étudiants et des professeurs sur des questions et problèmes similaires.

**Keywords:** geotechnical; internships; employer surveys; education.

## 1 INTRODUCTION

The undergraduate Civil Engineering Program at California Polytechnic State University (Cal Poly), San Luis Obispo graduates approximately 150 students each year. Of these students, approximately 15 percent seek employment in fields related to geotechnical engineering. The undergraduate civil engineering curriculum at Cal Poly requires students to complete an introductory course in geotechnical engineering and an associated laboratory. Students interested in geotechnical engineering typically follow these required courses with an elective course on shallow foundation design. Though practical work experience is not required for the B.S. degree, students interested in a career in geotechnics often spend one or two summers working in the geo-engineering industry. These temporary summer work experiences provide undergraduates with opportunities to apply and practice fundamental engineering skills while learning more about themselves and the geotechnical engineering profession. In California, undergraduate engineering programs do not typically require temporary work experiences (i.e., internships, cooperative education assignments, summer jobs, etc.). In addition, few programs allow undergraduate elective course credit for such experiences.

To understand geotechnical engineering and related temporary work experiences and to research the needs of industry regarding our undergraduates, we surveyed over 50 engineers and managers working in the geotechnical engineering profession in California. We asked the survey participants to report on temporary work experiences provided for undergraduate and/or graduate students by their organizations. In addition, we asked the participants to comment on desirable qualifications for geotechnical engineering student assistants and the value of temporary work experiences in engineering education.

In the following paper, we describe the survey and summarize the survey results. Additionally,

we include demographic information for the survey participants. We conclude the paper with a discussion of the survey results and recommendations for potential future collaboration between practitioners and educators. Our research was motivated by the desire to better understand temporary work experiences and whether or not such experiences should be integrated into an undergraduate degree program focused on geotechnical engineering.

## 2 BACKGROUND

An education in geotechnical engineering, perhaps more than other civil and environmental engineering disciplines, requires a balance of theoretical instruction and practical training. Practical training helps students to develop important field and laboratory investigation skills, to better understand the challenges in dealing with soil as a material in engineering, and to consider the observational method in their approach when addressing engineering problems. Indeed, queries of geotechnical engineering practitioners indicate that temporary work experience represents an important element of a student's education (Kunberger, et. al 2011). Other researchers have investigated the role of temporary work experiences (specifically internships) in helping students to achieve educational learning objectives (Biasca and Hill 2011). Some engineering programs require internships as part of the undergraduate degree curriculum (Sirinterlikci and Kerzmann 2013). Recently, others have surveyed students and employers regarding temporary work experiences and their role in undergraduate and/or graduate engineering education (King and Duan 2010; Ntafos and Hasenhuttl 2015).

## 3 SURVEY INSTRUMENT

We developed the survey using an online survey software tool. Participants completed the survey

by following a web link, which was generated by the survey software. After linking to the survey, each participant viewed an introductory page that described the objectives of the survey and guidelines for completion. Participants were permitted to skip any questions they chose. We noted up front that the survey would take approximately 5 to 10 minutes to complete. A participant could move on to the survey questions only after consenting to participate. Participants were informed that their survey responses could be disseminated in a paper with any data presented in a de-identified, aggregated format.

The survey included 15 questions formatted as multiple-choice, short-answer, and check-boxes. We urged the participants share information regarding temporary work experiences they provide for continuing undergraduate or graduate students working toward degrees in engineering (geotechnical, geological, construction, structural, civil, environmental, or related disciplines). We asked the participants to consider internships, part-time jobs, assistantships, and summer employment (formal or informal) as temporary work experiences, in the context of the survey. The survey was essentially divided into three parts: questions 2-4 focused on employer demographics and background (question 1 asked for participant consent); questions 5-11 addressed the nature of the temporary work experience and any training involved; and questions 12-15 related to undergraduate and/or graduate student preparation for temporary work experiences and employment after school. Individual survey questions are listed in the following section along with tallied results.

## 4 SURVEY RESULTS

We sent personal survey invitations by email to 84 individuals in California. Of these individuals, 62 worked for separate companies or organizations. Nearly all of the original 84 individuals worked in separate offices. We

developed our list of candidate participants by reviewing previous collaborations, employers of Cal Poly students, and alumni known to be working in the profession. The survey web link was not unique to specific individuals; survey participants could forward the survey to others if they wanted. We did not discourage this practice

### 4.1 *Demographics and Background Information*

We collected survey results over approximately 2-months period in the spring of 2016. A total of 55 individuals consented to participate in and subsequently completed the survey. One individual opted out of the survey by not agreeing to participate. Five individuals began the survey, but did not complete it.

The first survey question asked: "Is your employer/organization affiliated with the public or private sector?" Of the 53 individuals answering this question, 6 identified with the public sector and 47 identified with the private sector. We expected such a result, given our original invitation list included mostly private sector employers. In addition, there are fewer public sector full-time and part-time job opportunities available in geotechnical engineering in California.

The next question addressed the size of the workplace. Participants were asked: "How many professionals and/or support staff work in your office?" "Office" is defined as the specific location where a student or intern would work on a daily basis." We asked the participants to select one of four different categories related to office size. Table 1 summarizes the survey responses to this question.

The final question in this part of the survey asked each participant: "What is/are the focus of your company or public works organization? Check all that apply." Table 2 summarizes the responses to this question, as well as the categories we defined regarding company focus.

Table 1. Responses regarding size of the company or public works organization

Organization Size	Count	Percent
Small (less than 5 professionals and staff)	6	11.3%
Medium (approx. 5 to 20 professionals and staff)	29	54.7%
Large (approx. 20 to 50 professionals and staff)	12	22.7%
Very Large (more than 50 professionals and staff)	6	11.3%

Table 2. Responses regarding focus of company or public works organization

Work Focus	Count	Percent
Geotechnical engineering analysis/design services	43	81.1%
Construction engineering design services related to geotechnical engineering	27	50.9%
Construction management services	15	28.3%
Construction or foundation contractor services	9	17.0%
Construction observation and inspection services	27	50.9%
Laboratory and materials testing services	16	30.2%
Site investigation (drilling and/or in situ testing) contractor services	21	39.6%
Other	8	15.1%

## 4.2 Nature of the Temporary Work Experiences

Within this part of the survey, we asked questions related to the nature of the temporary work experiences and any training involved. The first question read: "Which of the following best describes your organization and your approach to hiring students for temporary work experiences?" We collected 43 responses to this question. Twenty-four participants indicated they employ students primarily during the summer months (full- or part-time). The remaining respondents noted they employ students throughout the year, including summer.

We then asked the participants to comment on hiring focus. We asked: "When recruiting students for temporary work experiences, who does your organization focus on hiring? Please check the one response that best describes your approach." Table 3 summarizes the responses to this question, as well as the categories we defined regarding hiring focus.

Table 3. Responses regarding focus of company or public works organization hiring

Hiring Focus	Count	Percent
Continuing undergraduate students (juniors & seniors)	19	44.2%
Continuing graduate students	7	16.3%
Undergraduate or graduate student level does not matter	15	34.9%
Other	2	4.6%

In this section, we also asked "How many continuing students (undergraduate and/or graduate will your office employ during a typical year?". Of those participants responding, about 65 percent indicated a goal of one student per year. About 23 percent noted two students per

year, and approximately 12 percent indicated three or more students per year.

We asked the participants to comment on their hiring practices related to temporary student employees. Table 4 summarizes results for the question: "Which of the following statements is most applicable for your company or organization?"

*Table 4. Responses regarding organization hiring practices*

<b>Statement</b>	<b>Count</b>	<b>Percent</b>
We hire qualified temporary student employees only if they are needed, based on an evaluation of staffing needs and the current economy.	31	70.4%
We hire qualified temporary employees each year, regardless of our staffing needs and the current economy	5	11.4%
We are committed to a formal intern/mentor program that each year hires and trains qualified temporary student employees for potential full-time/permanent employment in our organization.	8	18.2%

We included one open-ended short-answer question related to formal internship and/or mentor programs. Specifically, we asked: "If you have a formal internship and/or mentor program for students, please briefly describe this program here. Feel free to comment on program objectives, philosophy, logistics, and/or administration. Leave this question blank if not applicable." Ten participants responded to this question, and of those responding only half described what we considered a 'formal' program. We do not summarize these responses here.

With the two final questions related to the nature of the temporary work experiences, we

asked the participants to comment on student responsibilities and employer training practices for students, if any. Table 5 lists responses to the following question: "What tasks for responsibilities are most often given to students working within your organization? Check all that apply." Table 6 lists responses to the question: "How do you address student learning and training for temporary student employees working within our organization? Check all that apply."

*Table 5. Responsibilities given most often to temporary student employees*

<b>Responsibility</b>	<b>Count</b>	<b>Percent</b>
Shadowing engineers and/or technical staff	31	70.5%
Reviewing engineering analyses, reports, plans, and specifications	22	50.0%
Performing engineering analyses/design calculations	23	52.3%
Performing construction observation, testing, and/or inspection services	26	59.1%
Working in the geotech and/or materials testing lab	19	43.2%
Performing site investigations (e.g. logging in situ tests and/or field drilling)	21	47.7%
Preparing proposals or statements of qualifications	7	15.9%
Writing geotechnical and/or foundation engineering reports, letters, and memos	8	18.2%
Conducting computational- or lab-based research	6	13.6%
Non-engineering tasks (e.g. filing, cleaning, equipment maintenance, admin, etc.)	21	47.7%
Other	10	22.7%

Table 6. Student learning and training for temporary student employees

Responsibility	Count	Percent
We enroll the students in external training programs	6	14.6%
We provide students with formal in-house training	8	19.5%
We provide the students with informal in-house training	36	87.8%
We meet regularly with the students to provide feedback on performance (formative assessment)	14	34.1%
We conduct exit interviews with the students to provide feedback on performance (summative assessment)	11	26.8%
We provide each student with a mentor who provides regular feedback	16	39.0%
We provide written feedback on student work (e.g. analyses, designs, lab reports, memos, reports, field logs and reports, etc.)	5	12.2%
We assign homework or research assignments (outside of normal work tasks) that are reviewed and assessed	1	2.4%
We do not focus specifically on student learning	6	14.6%
Other	2	22.7%

### 4.3 Preparing for Work and Practice

In this final part of the survey we asked several questions related to student preparation for temporary work experiences and for practice in the geotechnical engineering field after graduation. First, we asked the participants to "Rank the following skills, attributes, or experiences and their relative important for a student to be successful as a temporary employee within your organization." We used a five-point Likert scale in collecting student feedback. Possible responses included: 1-"unimportant", 2-

"of little importance", 3-"moderately important", 4-"important", and 5-"very important"). Table 7 summarizes participant responses.

Table 7. Ranking of skills, attributes, or experiences as indicators of student success during temporary work experiences (5-point scale)

Skill, Attribute, or Experience	Avg.
Completion of an intro geology course	3.07
Demonstrated problem solving ability	4.40
Knowledge and understanding of basic engineering mechanics	4.07
Completion of a course on introductory civil engineering materials	3.85
Completion of a course on introductory geotechnical engineering	4.05
Practical or course-based laboratory experience related to geotechnical engineering	3.62
Practical or course-based field experience related to geotechnical engineering	3.52
Completion of upper-division courses in geotechnical or geological engineering	3.40
Experience programming with EXCEL, MATLAB, or similar computational tool	3.83
Experience with AutoCAD and/or AutoCAD Civil 3D	3.21
Previous experience as an intern in geotechnical engineering	2.28
Written communication skills	4.21
Oral communication skills	4.33
Interpersonal communication skills	4.45
Leadership experience	3.19
Information literacy	3.93
Ability to self-direct one's learning and work independently	4.05
Engineer-In-Training (EIT) certification	2.64
A demonstrated commitment to the geotechnical profession through coursework and/or previous experience	3.29

In Table 7, we include the weighted average response for each category on a scale of 1 (unimportant) to 5 (very important). The following question in the survey was open-ended

and asked participants to identify other important skills and/or attributes for students.

In the next question, we asked the participants to "Indicate your level of agreement with the following statement. Note these questions relate to temporary work experiences as well as full-time entry-level hiring practices." We used a five-point Likert scale in collecting student feedback. Possible responses included: 1-"strongly disagree", 2-"disagree", 3-"neutral", 4-"agree", and 5-"strongly agree"). Table 8 summarizes participant responses. In the table, we include the weighted average response for each category.

Table 8. Level of agreement in relation to the following statements (5-point scale)

Statement – Disagree or Agree?	Avg.
Depth of study in a particular discipline is one of the most important attributes of an undergraduate degree. If students intend to specialize in a particular discipline (e.g., geotechnics), they should begin this effort as soon as possible, preferably by focusing on that discipline through elective coursework.	3.60
If we hire a Bachelor's degree graduate as a full-time entry-level employee, we will eventually require him/her to earn a graduate degree as a condition on continued employment in our firm.	2.64
Breadth of study is one of the most important attributes of an undergraduate engineering degree. Students should gain a breadth of engineering knowledge as an undergraduate. If they plan to specialize in a particular discipline (e.g., geotechnics), they should pursue a graduate degree in that discipline.	3.53
Temporary student employees should provide a monetary benefit to the organization they are working for.	3.22
Students interested in geotech should be required to gain practical work experience in this discipline as a condition on earning an undergraduate degree.	2.79

Students interested in geotech should be required to gain practical work experience in this discipline as a condition on earning a graduate degree. 3.35

Students should be able to count temporary work experience toward their undergraduate and/or graduate degree requirements (e.g. in the form of degree-applicable elective units). 3.09

The final question in the survey asked the participants "to provide any additional comments related to temporary work experience by students in the geotechnical engineering profession."

## 5 DISCUSSION OF RESULTS

We were pleased with the response rate for the survey, which exceeded 60 percent. We believe the responses are representative of employers in California who hire Cal Poly students for temporary work experiences. The majority of the survey responses were submitted by individuals working in the private sector for medium-sized companies or organizations (i.e., 5 to 20 professionals and support staff members). The respondents focus primarily on geotechnical engineering analysis and design services, construction engineering design services related to geotechnics, and construction observation and inspection services. Employer need is the primary motivation in hiring temporary undergraduate and/or graduate student employees, with an upper division undergraduate education the preferred minimum qualifications.

Regarding the responsibilities given temporary student employees, the survey participants ranked job shadowing, construction observation, and plan and design/analysis review as the most common. In general, employer responses to this question were in line with our expectations, though we were a little surprised by the number of individuals identifying non-engineering tasks as a responsibility. In addition, we did not expect the low number of formal learning and training

opportunities provided to students during their temporary work experiences. The overwhelming majority of respondents identified "informal in-house training" as the primary means for addressing student learning and training. In retrospect, this answer makes sense given most employers are hiring temporary student employees only if they are needed. In most cases, it appears the motivation to forward organizational goals related to workload overshadows the need and/or desire to provide structured learning experiences for students. An opportunity for future collaboration may exist here, with faculty and instructors providing guidance on planning, designing, and assessing temporary work experiences from an educational perspective. Such collaboration would likely be needed if such experiences were to count toward undergraduate or graduate degree credit.

When considering minimum attributes for success as a temporary student employee, the respondents most often identified fundamental knowledge and skills related to mechanics, problem solving, and communication. The survey participants were less concerned with advanced education and experiences related to geotechnical engineering. Having an Engineer-In-Training (EIT) certification ranked near the bottom as a desired attribute, which was interesting to us since being EIT certified represents a first step in becoming a professional.

We found it interesting that the survey respondents, on average, did not strongly disagree or agree with the range of statements included in the final question (Table 8). The participants generally disagreed when queried about employees being required to earn a graduate degree in geotechnical engineering. Most of the survey participants agreed that the purpose of the undergraduate degree is to provide depth in a discipline as well as breadth of engineering study, which seems contradictory to us as educators. Additionally, these opinions do not necessarily align with advocacy by some to require additional post-undergraduate education for professional licensure (e.g., ASCE 2008).

## 6 CONCLUSIONS

An employer survey allowed us to gain insight into temporary work experiences available for students interesting in geotechnical engineering. The results suggest that opportunities exist for employers and educators to collaborate more in designing and implementing temporary work experiences to the benefit of the student, the employer, and the educational program. Engineers and managers responding to the survey were split or undecided regarding the incorporation of temporary work experiences into an undergraduate engineering program, either as required or elective components. We recommend a follow-on study of student and faculty opinions regarding these questions and others before offering recommendations on curricular change at the undergraduate level.

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