Geotechnical education for modern practice - A consultant's perspective

Dennis E. Becker
Principal, Golder Associates Ltd., Calgary, Alberta

ABSTRACT
Geotechnical education should not be the sole responsibility of universities and professors. Practitioners and industry can contribute significantly and should actively participate in the education process. The needs and expectations of the consulting industry and the desired attributes of graduates for employment are discussed. The basis and components of university curriculum that support the development of the desired attributes are identified. The effect of the current buoyant economic times and shortage of geo-professionals in Canada on geotechnical education are also discussed.

RÉSUMÉ
Les universités ainsi que les professeurs ne devraient pas être entièrement responsables de l'éducation de la géotechnique. Les professionnels ainsi que l'industrie peuvent significativement contribuer et devraient participer de façon active au processus d'éducation. Les besoins et les attentes de industries en consultation ainsi que les attributs convoités des gradués face à l'emploi sont discutés. La base et les éléments des programmes d'enseignement universitaire qui supportent le développement des attributs convoités sont identifiés. L'impact de l'affluente économie Canadienne actuelle et le manque de main-d'oeuvre professionnelle en géo-sciences sont aussi discutés.

1 INTRODUCTION

The shortage of professional geotechnical engineers, geo-scientists and skilled labour force is a significant challenge to civil engineering and resource development projects in Canada. In particular, large resource development projects in Western Canada, together with substantial infrastructure development, have considerable requirements for geo-professionals at all levels of experience and expertise. The consulting industry is not immune to this issue; they face special challenges in recruitment and retention of geo-professionals. The lack of qualified people and the associated effects are a common theme of concern of many CEOs of large consulting engineering firms.

It's easy for industry to say that universities are not fulfilling their role and responsibility in producing a sufficient number of geotechnical engineers and geo-scientists. Industry may say *"They should clean up their act and get on with it!"* However, this is unfair and a "cop-out" by industry. Instead, the question should be: *"How should universities and industry respond to and manage this shortage issue, and foster the professional and career development of geo-professionals?"*

This brief provides the perspective of a consulting engineer with regard to refining geotechnical education for modern practice. For the purposes of this brief, education is limited to those aspects associated with universities and their programs. After graduation, education and training continue to be provided by employers and learned technical societies, which form a key and integral part of career and professional development. This latter component is beyond the scope of this brief. The author supports the paper by Alfaro, Blatz and Graham (2008) as the basis of a suitable framework, though there are some aspects that require further thought and examination.

The statements and opinions expressed in this brief are those of the author; they may not be shared or accepted by others in the consulting industry.

2 NEEDS OF CONSULTANTS

It is considered useful, and perhaps insightful to professors and educators, to first describe and discuss the needs of the consulting industry and what it looks for when hiring graduates. Subsequently, it is examined how these expectations of attributes and capability may influence modern geotechnical education.

The consulting business is essentially a services industry that provides technical knowledge, problem solving capability and solutions to clients for a price. A successful consultant needs to have an appropriate balance of good technical, communications, business and people skills. Quality embodies the *"right"* balance of technical excellence and innovation, and service. Consultants also be responsive to the needs of clients; budgets and schedules need to be met.

Consultants tend to have the reputation of *"being all things to all people"* Consultants need to have highly specialized technical skills and knowledge, and the discipline to pay attention to details. Yet, they should also possess sufficient general knowledge so that they understand the needs and expectations of clients. Successful consultants develop and foster personal working relationships with clients through quality work, good people skills, effective communications, and being responsive. Furthermore, projects and project teams today tend to be broader-based and multi-discipline in nature than in the past. Most projects are completed successfully through teamwork – more so than exemplary individual efforts.

What Expectations Do Consultants Have of University Graduates?

The following attributes and capabilities of graduates are usually sought in recruitment:

- effective communication (oral and written) skills, including clarity of thought and expression;

- superior technical knowledge and skills that form part of their overall technical "tool box";
- evidence of likely effective participation in teamwork;
- broad base of knowledge;
- display of maturity and good judgement; and,
- evidence of good people skills and that the candidate will "fit-in" with the existing team or group.

Many of the above attributes are subjective and require insight and experience by the interviewers in order to make good assessments and decisions. In many cases, the technical skills and knowledge of a candidate are assumed to exist based, in part, on the university attended and degree(s) earned by the candidate. In some cases, specific technical knowledge and capability are primary selection criteria. In general, what is being looked for in recruitment is a bright and thoughtful person who, through the education process and skills learned, has the likely demonstrated potential of effective problem solving, decision making and working positively with others.

Although geotechnical engineering is a highly specialized field, not all geo-professionals necessarily require postgraduate education. Many successful geotechnical consultants do not have Masters or Ph.D. degrees. However, it is also true that a high percentage of geo-professionals tend to have postgraduate degrees in order to learn technical skills to effectively deal with the specialized nature of the discipline. It is generally agreed by all parties that specialization must be obtained at the postgraduate level.

Teamwork and appropriate balance of varied skills are essentials of a successful consulting business or practice. Most geotechnical engineers have degrees in civil or geological engineering or mining. This varied background is useful in the development of effective teams. As part and parcel of teamwork and balance, there is a need for people with a general basic understanding and background, and those who have highly specialized technical capability and talents.

3 CURRICULUM AND INDUSTRY PARTICIPATION

A good engineering program at the undergraduate level should be broadly based and non-specialized. In addition to learning technical knowledge and skills, students should be required to demonstrate and understand the importance of effective communication skills, and the environmental, cultural and economic issues, and societal impact of engineering. The student should be exposed to team efforts, the importance of timelines and schedules, and to project management. These are all components of the design process that is the essence of engineering (Alfaro et al. 2008).

The undergraduate student should be exposed to "real world" (i.e. practice-based) problems through examination of case records. The student should be educated to understand how the individual bits of knowledge gained (e.g. geological depositional processes, stress and volume changes, earth pressure, seepage, consolidation, etc.) tie together so that they may be applied collectively and suitably in design. A senior colleague of the author frequently said *"Graduates only know how to analyze things – they don't know how to design"*. Geotechnical education should provide the framework and opportunity for learning the complete package (e.g. problem identification, analysis, design and solution implementation). It is worthwhile to note that my colleague expressed his view over 30 years ago, shortly after the author had graduated with a bachelor's degree. He continues to say the same thing today! Apparently, universities have not made much progress over the last three decades. In this regard, the challenge is for professors to continually update their notes, teaching methods, topics and modernize classroom interaction. Some examples are provided by Howie and Wijewickreme (2008).

Through experience and observations, the author believes that professors are trying to keep their courses up-to-date and relevant. There is a new generation of young, eager professors in Canadian universities with the desire and energy to effectively tackle the current challenges of geotechnical education. Canadian universities, with the assistance of industry, are well positioned to produce highly qualified geo-professionals. Practitioners should participate in design courses, provide topics and projects for further study at Masters and Ph.D. levels, publish case records, present lectures, participate in research programs and the like. All these things complement and supplement geotechnical education beyond the perspective and experience of individual professors. Students greatly benefit from interaction with and the perspective of practicing geotechnical engineers. Practitioners should also be willing to actively participate on university advisory groups or councils and provide their input towards continued improvement of curriculum. It is realized that there are many demands on time and resources in industry. However, industry needs to realize that it is to their benefit to actively participate and interact with universities and students.

4 DISCUSSION

Geotechnical engineering is a speciality sub-discipline of civil engineering. Many civil engineering consulting firms, including the larger ones, don't have in-house geotechnical capability. A likely reason for this is the exposure of liability in geotechnical practice. Given the inherent variability in the ground and associated uncertainties and risks, geotechnical engineers are exposed to litigation and legal action much more so than other engineering disciplines. It is useful for students to be aware of this statistic, and gain an initial understanding of uncertainty and risk management. In practice, in-house specific training programs and project management protocols of consulting firms are used to manage these risks.

The author would like to examine in closer detail the aspect of employability as discussed by Alfaro et al. (2008). It is debatable if *"Masters degrees are increasingly seen as a stepping-stone towards employability"*. Specific technical knowledge and capability do not in themselves assure employment and positive career development.

Without question, obtaining a Master's degree represents the first level of specialization. However, the author would caution against raising the expectations of

postgraduates when first employed. It is important that postgraduate courses be geared to provide suitable technical skills and knowledge so that the person can become productive shortly after entering employment. However, the newly hired graduate must also understand that regardless of their credentials and qualifications, they will go through a specific "training" program that is the same as someone without a postgraduate degree. The upward career mobility may be faster for those with postgraduate degrees. In general, career development depends on the individual, their technical prowess and how they interact with clients and colleagues.

It should also be recognized that the high demand and shortage of geotechnical engineers has resulted in significantly increased professional charge rates and salaries. The engineering profession has, for too long, lagged behind other professionals in terms of rates. The upward mobility in rates is generally well accepted by the consulting community, though there are issues associated with higher rates and salaries.

In terms of geotechnical education, one issue is that there may be a decline in the number of undergraduates who pursue graduate studies. The lure of several employment offers, high salaries and signing bonuses may be too great of an opportunity to pass up. In the author's observations (though it may only be perception), there appears to be increasingly fewer Canadian students entering graduate programs immediately following undergraduate study. However, this is not necessarily a bad thing because exposure to practice is very beneficial prior to doing graduate study. It also helps graduate students select a specific topic in which they have keen interest and which may also be quite relevant to their company. Nonetheless, the reality of the situation is that once settled into employment, coupled with personal and family matters, the person often finds it difficult to undertake graduate study. This is despite that many consulting firms encourage the person, provide financial assistance and promise employment after completion of graduate work. Companies do this because it helps assure high technical quality and innovation, and they have invested significantly in the person through extensive orientation and training programs.

Many graduate students select a course work and project based M.Eng. degree. Frequently, they select part-time studies and continue to work at their company, often on a reduced-time basis. Also, in many cases, a specific project or topic that they worked on is used to form the basis of the M.Eng. project. This is quite valuable because more in-depth study may be desired by the company, but project requirements and budgets don't permit further study. In practice, the needs of the client and project governs what is done. If the project doesn't really need it, the work is not done. Further study as part of graduate work becomes a *"win-win"* situation for the student, professor and the company.

Carrying out and earning a graduate degree on a part-time basis is tough. The author does not encourage his junior colleagues to undertake part-time studies because it will be very stressful given the varied demands of company work, family, and of the study work. Education should be enjoyable. Furthermore, there are significant benefits and learning experiences through interaction with other graduate students and in being a tutorial assistant in undergraduate courses. Part-time studies usually do not allow for these types of interactions.

It appears that many universities are aware of the above issues. They have developed excellent programs, approaches and shared resources to accommodate M.Eng. programs and part-time studies. Examples of this include holding courses in the evenings, reading courses and other forms of sole study, reciprocity of courses between universities, and willingness of professors to accept a company project as the basis of the M.Eng. project. Frequently, professors are grateful and willing, provided funding can be established, to also extend and develop company projects into research projects for Masters and Ph.D. degrees.

5 CONCLUDING REMARKS

University curriculum and geotechnical education should not the sole responsibility of universities. Practitioners and industry should also actively participate, if not upon their own initiative then in response to requests from professors and universities. There are benefits to industry in actively participating and interacting with universities and students.

The needs and expectations of the consulting industry and the desired attributes of graduates for employment have been discussed. Although specific technical knowledge and skills are important, they do not in themselves assure employment and positive career development. In general, employers seek bright and thoughtful people, who through the education process and skills learned, have the likely demonstrated potential of effective problem solving, decision making and working positively with others. Teamwork and appropriate balance of varied technical and personal skills are components of a successful consultancy. Students should be exposed to team efforts, the importance of effective communications, timelines and schedules, and the components of the design process. Curriculum should provide the opportunity for practice-based problems and tools towards consolidating all the individual bits of knowledge gained so that they may be applied collectively and appropriately in design. The current buoyant economic times and shortage of geo-professionals in Canada may be influencing current geotechnical education as discussed herein.

REFERENCES

Alfaro, M., Blatz, J., and Graham, J. 2008. Refining Geotechnical Education for Modern Practice. Special Session on Geotechnical Education. Proceedings of the 61st Canadian Geotechnical Conference (Geo-Edmonton), Edmonton, Alberta, September 22 – 24, 2008.

Howie, J. and Wijewickreme, D. 2008. Undergraduate Teaching of Geotechnique in Large-Class Environments: Experience at the University of British Columbia. Proceedings of the 61st Canadian Geotechnical Conference (Geo-Edmonton), Edmonton, Alberta, September 22 – 24, 2008.