

Reflection on Resources: Engaging the Future in Geotechnical Engineering - Steps towards effective gender inclusivity in our profession



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Reflection on Resources

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ABSTRACT

Many organizations are engaged in efforts to enhance Equity, Diversity and Inclusivity (EDI), developing human resources programs to train employees in these matters, and considering metrics to evaluate their success. This work is embraced by many members of our Geotechnical Engineering profession. As a result, engineering outcomes are enhanced by including a variety of perspectives. However, there are still many misconceptions about what EDI means, and a lack of understanding by geotechnical professionals as to how they can create a more inclusive workplace. While the results of Equity and Diversity work can be measured by evaluation of confidential self-reporting by employees, Inclusivity is a much more difficult parameter to evaluate.

In this paper, we present anonymous, real-life scenarios for consideration of some best practices to address challenges and to improve inclusivity for geotechnical engineers in the workforce, derived from interviews with professionals at different stages in their careers. The objective of this paper is to provide employers with some suggested methods to encourage and evaluate Inclusivity initiatives, and to increase job satisfaction and retention of diverse members of our profession, while enhancing the quality of our engineering work.

RÉSUMÉ

De nombreuses organisations sont engagées dans des efforts pour améliorer l'équité, la diversité et l'inclusivité (EDI), en développant des programmes de ressources humaines pour former les employés dans ces domaines et en envisageant des mesures pour évaluer leur succès. Ce travail est adopté par de nombreux membres de notre profession d'ingénieur géotechnique, généralement parce que les résultats d'ingénierie sont améliorés en tenant compte d'une variété de perspectives. Cependant, il existe encore de nombreuses idées fausses sur la signification de l'EDI et le manque de compréhension des professionnels de la géotechnique quant à la manière dont ils peuvent créer un lieu de travail plus inclusif. Alors que les résultats du travail sur l'équité et la diversité peuvent être mesurés par l'évaluation des déclarations confidentielles des employés, l'inclusivité est beaucoup plus difficile à évaluer.

Dans cet article, nous présentons des scénarios anonymes mais réels pour l'examen de certaines meilleures pratiques pour relever les défis et améliorer l'inclusivité des ingénieurs géotechniciens dans la main-d'œuvre, tirés d'entretiens avec des personnes à différentes étapes de leur carrière. L'objectif de ce document est de fournir aux employeurs des suggestions de méthodes pour encourager et évaluer les initiatives d'inclusion, et pour accroître la satisfaction au travail et la rétention des divers membres de notre profession, tout en améliorant la qualité de notre travail d'ingénierie.

1 EQUITY, DIVERSITY, AND INCLUSIVITY – AN INTRODUCTION

"So, we must not simply add women to science, but change the structure of science to make it accessible to women who would like to pursue a career in science."
(Burek and Higgs, 2007).

Equity, Diversity, and Inclusivity (EDI) has become an important focus of activity for numerous engineering corporations, government agencies, and academic institutions in recent years. For many, the inclusion of more diverse colleagues has led to improvements in the quality of their engineering work. By including diverse perspectives in the workflow, solutions will better match

the needs of diverse populations who will interact with and benefit from the engineering work.

Engineers Canada (2020) notes that: *"Equity, diversity, and inclusion (EDI) work is and has always been challenging because it invites us to self-reflect as individuals, and as organizations. It requires the exploration and acknowledgement of inequities and overcoming the defensiveness that comes from conversations on power and privilege."*

1.1 Equity

Equity is achieved by providing everyone with an equal opportunity to succeed. Employment, training, and

opportunities to gain relevant experience, and career progression, should be based on merit, independent of each person's identity. Employment equity in Canada was brought into law by the Abella Commission in 1984. "*The purpose of this Act is to achieve equality in the workplace so that no person shall be denied employment opportunities or benefits for reasons unrelated to ability*". Another important ruling, from 1986, clarified that "*discriminatory actions should be understood in terms of their impact, and not in terms of people's intention*". To achieve equality, we must remove barriers created by bias – whether overt or unconscious – that person can't do a job because of an attribute X. You may replace the X with any number of reasons in our field, usually related to challenges with working on remote field sites, or to do with perceptions of requirements for physical and mental strength. Does that person have a "thick enough skin"? Will they be able to interact effectively with people working on a construction site? Will they attract undue attention due to their appearance? A truly equitable workplace results in equal pay for work of equal value, and zero tolerance against sexual or gendered harassment. In such a workplace, no one should be made to feel unsafe due to their gender identity or expression.

There are many excellent resources for identifying barriers to equity, and programs to address bias. This starts with the hiring process. One of the major issues is unconscious bias – when our socialization and experience lead us to jump to conclusions about a person. A variety of experiments have shown that this is a wide-spread issue. In one example, a review of job applicants resulted in men being offered a higher salary, more mentorship, and being rated as more competent and hireable (Moss-Racusin et al, 2012). However, there was no difference in the CVs reviewed, other than the assumed gender of the name at the top. This finding was unaffected by reviewer's gender.

Another issue is stereotyping based on gender, whereby the "fit" of an individual for the job is assessed. Rudman and Glick (1999) note that positive stereotypical traits for a man, termed "agentic", include being competitive, decisive, aggressive, and socially dominant. On the other hand, people who are perceived as feminine are stereotypically cast as "communal thinkers", who are kind, thoughtful, sensitive to others, and deferential. When agentic behaviour is adopted by women, they are seen as insensitive and more threatening. This leads to a loss of influence within the workplace and decreased compliance by subordinates. As a result, there are often reduced employment and promotion opportunities for people of marginalized genders. The interested reader is directed to the information sheets available from OnWiE's webpage at: [Gender Diversity 101 – Ontario Network of Women in Engineering \(onwie.ca\)](http://GenderDiversity101-OntarioNetworkofWomeninEngineering.onwie.ca). Members of employment committees in engineering firms should undertake training related to all of these issues prior to writing job advertisements and to engaging in the selection process, to achieve more equitable interviewing and hiring procedures.

1.2 Diversity

An individual cannot be diverse, rather diversity occurs when people with different identities are members of a group (Gibbs, 2014). One's identity considers gender, race, ethnicity, religious affiliation, nationality, sexual orientation, disability status, and socioeconomic status. In the US, the STEM workforce does not represent the diversity of the population, being predominantly made up of white (89%) and male (72%) engineers (NSF, 2018). In Canada, only 20.6% of newly licensed engineers are women, and this statistic comes after a 2.8% increase over the last seven years. Engineers Canada is engaged in a variety of initiatives to build to 30 by 30, which is considered to be a critical tipping point after which gender equity in the profession becomes self sustaining. This paper specifically discusses strategies to improve gender diversity in the geotechnical sector.

1.3 Inclusivity

"Diversity happens. It is a fact of being human and living our lives. Inclusion doesn't just happen. It is a deliberate and conscious effort... ..to ensure everyone feels valued, respected, and able to participate with dignity and contribute to their fullest potential." (Queen's University E4E, 2022). An inclusive workplace means that team members develop mutual understanding, acceptance, respect, and collaboration.

The benefits of inclusion, from a survey of practicing engineers in the UK (RAE, 2017), include 80% reporting increased motivation, 68% demonstrating increased performance, and 52% with an increased commitment to their organisation, independent of the race or gender of the respondents. "*The more included engineers feel, the more likely they are to understand business priorities, be confident about speaking up on improvements, mistakes or safety concerns, and to see a future for themselves in engineering*" (RAE, 2017).

It is important to note that this paper focuses largely on inclusivity of women in engineering. Given space constraints, the important focus on other aspects of diversity is left out of this paper, as is discussion of the essential work that is required to increase opportunities for BIPOC students and engineers, and to incorporate Indigenous ways of knowing and learning in science and engineering.

2 RETENTION - THE "LEAKING PIPELINE"

The next hurdle in building an equitable and diverse workforce is ensuring that the people who have trained and who are working in engineering, are encouraged to remain in the profession.

There is a well-established set of statistics which demonstrate that there is a leaky pipeline in engineering. Dr. Mary Wells, an influential advocate for EDI in STEM has written about the "leaking pipeline" which results in the reduction of the percentage of women continuing in engineering education at every step of the process. This downsizing, based on data from 2012 (Wells, 2018), shows that for an initial group of 100,000 Grade 10 academic science students at gender parity, the ratio drops to 32%

female students who are “engineering-ready” in Grade 12, which drops again to approximately 20% female students throughout undergraduate and graduate studies. Of the licensed active engineers in Ontario in 2012, however, only 11% were women. Why are the numbers of active engineers even lower?

One of the answers is the presence of social identity threat, which is anxiety or concern that arises in workplaces where your social group is under-represented, not valued, or stereotyped as being inferior. The performance of equally trained and capable women on math tests is a direct result of whether they have been subject to stereotype threat prior to writing the test (Steele et al, 2002). The presence of stereotype threat leads to responses that include: under-performing due to lack of concentration created by stress and worry generated by the threat (self-handicapping), burning out by working exceptionally hard to perform better than others (counter-stereotypical behaviour), or leaving the profession altogether (domain avoidance).

A study from 2011, by Fouad and Singh, found several reasons that women leave engineering employment, or don’t seek engineering work after completing undergraduate studies, as summarized in Figure 1. It is interesting to note that 25% of women left engineering to spend time with their families, and half left because of poor working conditions. These are situations which can be addressed by the development of flexible and inclusive Human Resource policies and workplaces, and a clear definition of career advancement. It is important to note that the majority of survey respondents who left the profession, had similar interests, confidence in their abilities, and positive outcomes from their engineering work to those women who remained in the profession.

Table 1 – Loss of women from working as engineers. Based on survey results from Fouad and Singh (2011).

Retention loss	50%	35%	30%	25%
Women leaving engineering	Working conditions: too much travel, lack of advancement, low salary.	Unwelcoming workplace climate, boss or culture.		To spend time with family.
Women not entering the profession after graduation		Engineering perceived as being inflexible or workplace culture not being supportive of women.	No longer interested in engineering.	

The Ontario Society of Professional Engineers (OSPE, 2022), found that the barriers to women in the engineering field include: a weak professional network, inadequate on-the-job training or professional development opportunities, underutilized engineering skills, work culture and job demands that compete with family and/or community responsibilities, fewer opportunities for field work than male colleagues and feeling disrespected and undervalued by managers and/or co-workers. More than half of women surveyed had encountered discrimination in the workplace.

Women working in engineering at the time of the study by Fouad and Singh (2011) reported the highest job and career satisfaction when their employers valued and recognized their contributions and invested in their training and professional development. In contrast, women engineers who were treated in a condescending or patronizing manner and were belittled and undermined by their supervisors and co-workers were most likely to want to leave their organizations. Women who considered leaving their companies were also very likely to consider leaving the field of engineering altogether. This means that the working environment of every engineering firm employing women and every university educating future engineers has an impact on the overall gender parity of engineering as a profession.

Another aspect of workplace culture that is receiving greater attention is the effect of microaggressions. A microaggression is an everyday, casual slight or insult that communicates to a person that they are unwelcome due to their marginalized identities. The impact of these comments can be intentional or unintentional. Taken one by one, these comments can be perceived to be of low impact, however over time, microaggressions can build upon each other to create a demeaning and hostile environment for people who do not fit the traditional mold in a workplace.

Interviews were conducted with several women over a range of levels of experience within the geotechnical engineering field. The detailed discussion arising from these interviews will be published elsewhere, as this work is ongoing and is beyond the scope of this paper. However, a preliminary summary indicates that one of the most common complaints is that women’s expertise or opinions are not given the same weight as those of men. In many cases the idea is only accepted after a man repeats it. Other common experiences include women being interrupted and talked over during meetings, being asked to do less technical and more clerical tasks, being passed over as the lead of a project or for promotions, and always having to explain their skills and experience in detail when working with new people on a project, in ways that men do not. Many women feel that they must work harder than their male colleagues, and that they only have one chance to make an excellent first impression, lest they be discounted immediately. The effect of these observations is that women are constantly under more stress, will be less engaged in their work, and are not likely to perform as well as their colleagues who are not subject to these barriers. This is another factor in the retention of women in engineering.

3 HOW CAN WE CREATE AN INCLUSIVE ENVIRONMENT?

Inclusivity is “*the extent to which an engineer feels valued for who they are (their personal and professional background, experience and skills) and the extent to which they feel they belong/‘fit’ in the engineering profession and their organisation*” (Royal Academy of Engineering, 2022).

The perception of inclusion can be assessed relative to seven indicators defined by the RAE (2017) based on surveying 1000's of practicing engineers in the UK:

- 1) Openness: The extent to which engineers feel comfortable to be open about who they are and about their life outside work and have confidence to speak up about inappropriate behaviour towards themselves or other people, mistakes, or safety risks.
- 2) Respect: The extent to which engineers feel treated with respect by managers, leaders, and colleagues and do not feel that assumptions are made about them because of their gender, ethnicity, or any other difference. The study results show that gender is relevant to perceptions of job performance for only 18% of the male respondents, but for 53% of the female respondents.
- 3) Relationships: How engineers relate to each other, and the extent to which relationships are friendly, collaborative, and free of offensive banter, bullying, or harassment. A well functioning set of relationships within the workplace leads to improved mental health and safety.
- 4) Career: The extent to which engineers feel supported in their careers, by their manager and the fair implementation of talent management processes such as promotion. Women and men had similar responses to the fairness of promotion, but men were more likely to indicate that work was fairly allocated.
- 5) Flexibility: The extent to which engineers have opportunities to work flexibly, without it being a barrier to career progression. Women were more likely to think that taking advantage of flexible work arrangements would reduce their career progression. This perception may have changed after the past two years of COVID-19 driven changes in acceptance and support of working from home. However, this goal requires that companies permit employees to request reduced hour work weeks, without impact on the quality of job assignments or career progression.
- 6) Leadership: The extent to which engineers are convinced by their managers' commitment and action on diversity and inclusion. Female respondents were less confident that their manager would tackle bias, including bullying and harassment, when brought to their attention.
- 7) Diversity: 50% of all engineers responded to the survey with 'a diverse workforce at all levels' as evidence of inclusion.

There are several barriers to inclusivity that are commonly encountered in Geotechnical Engineering, based on the authors' experiences and discussions with other under-represented members of the profession. For most, the biggest barrier relates to field work. There is a misconception, still common, in geotechnical engineering that women do not have the physical or mental strength to work on site investigation or construction sites in more remote locations. When these opportunities are less

available to women, they do not gain the necessary experience to thrive and progress in the profession.

However, there are still some instances in which it may be more difficult for unsupported women in geology or geotechnical engineering to take on field work or remote jobs. Despite progress towards an equitable division of household labour in recent years, in over a third of heterosexual couples (Frank & Frenette, 2021), the woman performed the majority of childcare related tasks. To ensure that a company remains equitable to their employees who may be in this position, there should be efforts made to decouple field work from advancement criteria or provide alternate avenues for people to prove their value or commitment. This has the added benefit of improving the inclusiveness of an organisation for people with disabilities that may prohibit their participation in field work.

Field work is an incredibly important part of the work that geotechnical engineers and geologists do. At the same time, it comes with inherent dangers. Companies sending employees to remote locations or to do physically demanding tasks must ensure that there is appropriate training for all parties to ensure that harassment or an abuse of power dynamics in the field does not contribute to the risk of field work. The authors believe that corporations have the responsibility to not engage in projects in locations on or projects where there is potential for gender-based discrimination or harassment. This would mimic the screening that many corporations rightly do before engaging in work on projects with potential negative environmental impacts.

Individuals who identify with gender or sexual orientations outside of the societal norm (that is, employees who are not cisgender or heterosexual) are at risk for increased instances of harassment or exclusion. They are often underrepresented and experience extensive barriers both internal and external to a company. A non-traditionally presenting individual may encounter significant bias and even unsafe working conditions when asked to go to work sites with people present who may be sexist or homophobic. Individuals who are non-binary and/or trans may be especially at risk for discrimination in these situations. In these cases, the employee should be given the right of refusal to undertake the job, given clear lines of communication with their employer or client contact to address any issues and complaints, and the company should have an established code of conduct explicitly prohibiting this sort of behaviour. In most circumstances, field work is done in pairs, which may help with some of these concerns. In addition to explicit safety concerns, LGBTQ2S+ employees may be exposed to distressing conversations or jokes from people both inside and outside of the company leading to increased risk of burnout and decreased workplace satisfaction.

4 INCLUSIVITY – TRAINING SCENARIOS

Efforts to create an inclusive and welcoming environment are most effective when everyone at the workplace understands the problem, raises awareness, and supports the work being undertaken through engagement and

allyship. Training, using scenarios, has been found to be quite effective. The challenge is to generate realistic scenarios, which ask participants to evaluate the challenge, think about possible outcomes and solutions, and to address the defensiveness and denial that may arise.

The first author conducts workshops with 2nd year Geological Engineering students using the following scenarios, which are all based on real-life situations that have been encountered by early career engineering students or EITs (Engineers in Training), within the last five years. The core content of several of these scenarios is drawn from the internal training programs run by BGC Engineering, for which they are gratefully acknowledged. The scenarios are reproduced here to support training activities and to generate conversations on issues that should be considered and addressed.

Scenario A: A project team includes only one person who is of a different gender or race than the majority of people in the rest of the team. The person is relatively junior and has excellent ideas and suggestions. The senior members of the team rarely acknowledge this person's contributions, and when they do strongly challenge the person to defend their ideas. When other members of the team pick up on the same idea, and present it later, the idea is accepted immediately and with much less challenge.

Why are the senior engineers on the team behaving in this way? What do you do: a) if you are the junior, or b) if you are observing this?

25% found this to be the most interesting scenario.

Scenario B: You are assigned to a new field project which you are very excited about. However, you have never worked on this type of field project before and do not know what type of field clothing and safety equipment you need, and you have not received any guidance from your project manager, despite asking. You speak with some other juniors and bring what they recommend. When you arrive at the site, you realize that your gear is not appropriate for the terrain, which is very rough and challenging. You are unable to keep up with your co-worker's very rapid hiking speed, and they start to threaten you with being left behind and challenging you with questions about why you are in this profession. You are in a remote location, and you know that the work must be done by the two of you.

What do you do? What should the company do?

22% found this to be the most interesting scenario.

Scenario C: You are working with a field crew who are all a different gender than you. You are trying to keep your relationships professional, but one member of the crew continues to ask you out in front of everyone else and comments on your appearance, even after you have said no. After some time of this, even though you have been working hard, and ignoring their advances, they start to speak badly about the quality and quantity of your work and call you names.

What do you do? If you observe this behaviour directed at another member of your crew, and they seem to be unconcerned about it and laugh it off, what do you do?

21% found this to be the most interesting scenario.

Scenario D: You are working for a client who is a senior engineer. He regularly says, "Oh, I had to take unconscious bias training, but I'm too old to learn about all this new stuff. Anyway, it's all just a way to hire women / BIPOC (Black, Indigenous, and People of Color) who are not as competent or well trained as the guys on the project, in order to meet some stupid government quota". Your project lead has warned you about this behaviour, and notes that previous discussions with the client have not led to any change in their behaviour.

What do you do? What do you do, if you are not a member of the group that he is disparaging?

18% found this to be the most interesting scenario.

Scenario E: A company you have applied to offers work that you are very interested in. During the interview process, you look at their web page. The photos of the field / lab / office space all look great, and they clearly state that the percentage of diverse staff in their organization is much higher than the national average. However, you do not see pictures of any visibly diverse people working in those spaces or in the pictures of the Board of Directors of the company. You look at a recent hiring announcement on LinkedIn by the company and see that the new hires all have great credentials, but only 1 in 10 is a woman.

Do you have any concerns about working for the company? If yes, why, and if no, why not? Do you ask any questions during the hiring process about your observations? And if so, do you think that asking those questions would positively or negatively impact whether you will be offered the job?

14% found this to be the most interesting scenario.

Based on discussions with professionals in our field and recommendations by students, scenarios exploring other issues should also be developed. There are many such suggestions, but two suggested scenarios are:

- A) The situation where an invisible identity, such as sexual orientation, is the subject of stereotyping and disrespectful discussion in the workplace.
- B) Companies where there is no clear procedure or line of communication for complaints about harassment and bias, or where one reports to the perpetrator of the behaviour of concern, and therefore people do not speak up for fear of retribution.

The results of an informal and anonymous free form poll of the students, at the completion of this workshop, yielded the following observations:

What was the most surprising thing that you learned in the workshop? A third of students were surprised that diverse peoples were still facing discrimination in the engineering workplace, and a quarter were surprised at the low percentage of women studying engineering in the 2020's and the even lower percentage who carried on to become professional engineers. Another quarter of the class were shocked to know that some of their female second year classmates had already encountered discrimination and harassment, and that the impact of non equitable or inclusive treatment has an impact on your personal life.

When asked about their near-future actions related to improving EDI in engineering, the class overwhelmingly said that they would be more observant and speak up about these sorts of issues, now that they were aware of them.

It is encouraging that the response to the training scenarios was uniformly very positive, and all students indicated that they found this to be a very informative and transformative discussion.

5 FINAL COMMENT

“When women feel wholly respected by the men around them, gender never comes to mind for them. They find it harder to imagine why gender is even a problem. So once you have an inclusive environment where people are mindful of these issues and respectful of each other, that’s the key to making these identities less relevant to the workplace.”

(T. Schmader: <https://ourpotential.ca/social-psychology/>).

6 DISCLAIMER

Both authors of this paper are white and so cannot meaningfully comment on the compounded experiences of BIPOC women. It is also important to note that in many cases, statistics regarding gender ratios in the profession are only available in a binary form. This provides valuable information about workplace inclusivity but does neglect the diversity of gender identities that do not fit wholly under “male” or “female” and does not inform us of inclusivity towards this specific group of people.

7 ACKNOWLEDGEMENTS

The authors are thankful for the women and men who are making a difference in implementing EDI initiatives in companies, government, and academia. Your efforts are greatly appreciated – the work is difficult and seems never ending at times – but the end goal is achievable and worthy.

The telling of one’s experiences, especially when difficult, can be challenging. The candour of the people interviewed during this work is gratefully acknowledged. And the willingness and openness of the Queen’s University second year Geological Engineering students to the content of scenario-based EDI workshops is inspiring.

Awareness of the issues of EDI and inspiration to address these issues comes from many sources. There have been several seminal historical events in Canadian history that have increased focus on gender equity and diversity in engineering. In 1984, Judge Rosie Abella published the “Report of the Commission on Equality in Employment”, which inspired the 1986 federal law Employment Equity Act. The December 6th, 1989 anti-feminist mass shooting at Ecole Polytechnique in Montreal, turned a national and international focus on gender equity in engineering, that persists to this day. There are important recommendations related to access to education

for Indigenous peoples, amongst the 94 Calls to Action included in the 2015 Report of the Truth and Reconciliation Commission. The events leading up to, and the resulting Black Lives Matter protests, have generated awareness and a variety of new initiatives to reduce violence and increase equity and inclusivity.

8 USEFUL RESOURCES

- <https://www.advance-he.ac.uk/equality-charters/athena-swan-charter>
- <https://engineering.queensu.ca/About/engineering-for-everyone/>
- <https://www.nsbe.org/>
- <https://nctr.ca/records/reports/>
- https://www.nserc-crsng.gc.ca/InterAgency-Interorganismes/EDI-EDI/Dimensions_Dimensions_eng.asp
- <https://successinstem.ca/>
- <https://www.ucalgary.ca/equity-diversity-inclusion/news-events/ediweek2022>

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