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Presenting Female Role Models in Civil Engineering: An Outreach Activity to Help Teachers Overcome Their Misperceptions of Engineers*

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This paper describes an activity the author has carried out with 72 high school science teachers to enable them to overcome their misperceptions of engineers and engineering. The activity introduced them to prominent women in civil engineering, and raised their awareness of these female engineers' contributions to engineering and society. The results showed that the activity was effective in dispelling the teachers' misperceptions. The female civil engineers featured in this activity cited the role of their parents or teachers in encouraging their pursuit of an engineering career. They held senior positions in academia, government or industry. They acknowledged that they had encountered difficulties at their workplaces but they also mentioned progress made towards acceptance and equality. Teachers and professors can use the examples of these prominent female engineers as role models to inspire their female students who are aspiring to become civil engineers.

Keywords: Civil engineering; engineers; outreach; role models; women; workplace diversity

INTRODUCTION

THE PERCEPTION THAT ENGINEERS AND SCIENTISTS are intelligent Caucasian men who are socially inept and absent-minded people seems to be prevalent among students of all levels, from elementary school to college [1–3]. While the media may, by chance or choice, promote this image, it is unfortunately a realistic one. For example, while women constituted 46.1 percent of the general workforce of the USA in 2000, they represented only 25.4 percent of the engineering and science workforce [4]. This stereotypical image of engineers and scientists as Caucasian men has, in part, discouraged many young women from pursuing any interest they may have in an engineering or a science career because they do not want to (and cannot) be the people so often portrayed in the media [5].

Stereotypical images of engineers and scientists have contributed, in part, to the existing gender gap in engineering and science [2]. This gender gap can be traced back to the educational choices made by young women. Statistics show that women in the OECD countries earn fewer Bachelor's degrees in most engineering and scientific fields as compared to men. For example, in 2003, women earned only 13.8 percent of all Bachelor's degrees in engineering in Switzerland, 18.7 percent of all Bachelor's degrees in engineering in UK, 21.0 percent of all Bachelor's degrees in engineering in USA, and 29.1 percent of all Bachelor's degrees in engineering in Sweden [4].

The gender gap in engineering and science has also been attributed to a number of other factors. Girls' rejection of engineering and science can be partially driven by parents, teachers and peers when they subtly, and not so subtly, steer girls away from informal technical pastimes (e.g. fixing bicycles) and science activities (e.g. science fairs) that too often are still thought of as the province of boys [6]. Another reason is the shortage of female role models in engineering and science, which is because female engineers and scientists are severely under-represented among senior positions in academia, government and industry. With this dearth of female role models, many girls do not see themselves as successful doers of engineering and science, and tend to view these disciplines as unsuitable careers and irrelevant to their lives [7]. A similar reason is the shortage of female mentors in engineering and science. Having a mentor is critical to advancing into senior positions in corporations. However, it may be difficult for female engineers and scientists to find mentors through the same informal mechanisms used by men, especially since individuals tend to mentor people who are very much like them. Hence, female engineers and scientists are at a disadvantage in a predominantly male environment [2]. In addition, female engineers and scientists with spouses and children struggle to keep up with the fast-paced work environment. Unlike men, women remain primarily responsible for child care, elder

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care and other household responsibilities. Even in corporations with family-friendly policies, women are concerned that they cannot pursue their engineering and science careers and take family leave simultaneously without risking the perception that they are less committed to their careers than their male colleagues [8–9]. The gender gap in engineering and science can also be attributed to lower pay scales and slower promotion rates for females as compared to males [10]. Female engineers' and scientists' progress early in their careers may be impeded by their having to prove their technical credibility repeatedly. This may be the result of stereotyping of women's abilities by male supervisors as well as the perception that promoting women is riskier than promoting men. The perception that women cannot do engineering and science is one that female engineers and scientists have to battle constantly. The competencies and traits associated with success in engineering and science are generally viewed as male attributes [2]. Men and women have different styles of communication, and this may also affect how female engineers' and scientists' ideas are received by their male supervisors. Corporations tend to reward an aggressive style of speaking, and often discount language that is not certain. Women who exhibit an assertive style, however, run the risk of being seen as inappropriately combative [2].

Fortunately, research has shown that strategies such as presentation of female role models, distribution of career information, examination of gender-equitable materials and participation in hands-on science investigations are effective in countering the perception that engineering and science are unsuitable for girls [11–15]. Research has also pointed to the presence of female role models in engineering and science as the most important factor in sustaining girls' interests in engineering and science [16].

In order to reach out to students at an early age when they are still impressionable, many universities have recently organised outreach programmes to educate high school teachers about engineering, and hopefully, they will encourage their students to study engineering [17]. Some universities (e.g. Purdue University, Virginia Polytechnic Institute and State University, and Utah State University) have even set up an engineering education department for this purpose. The feedback from such programmes has been encouraging.

For this work, the author wanted to inform teachers about the applications of engineering, to demonstrate the problem-solving approach of engineers, to correct misperceptions of engineers and engineering among teachers, and to provide them with female role models from the various disciplines of engineering. To achieve these goals, the author recently conducted a number of outreach workshop activities for 72 high school science teachers. The teachers were then charged with integrating what they had learned from the workshop into their classrooms.

This paper describes one of the workshop activities the author has carried out with high school science teachers to enable them to overcome their stereotypical perceptions of engineers and engineering. The workshop activity introduced them to prominent women in civil engineering, and raised their awareness of these female engineers' contributions to engineering and society. Teachers and professors can use the examples of these prominent female engineers as role models to inspire their female students who are aspiring to become engineers.

METHOD

The high school science teachers were 41 men and 31 women. The procedure consisted of the following steps in sequential order:

1) Draw-an-Engineer test,
2) assigning female civil engineers to participants to research on,
3) oral presentation of female civil engineer and question-and-answer session by each group,
4) submission of written reports of female civil engineers,
5) Draw-an-Engineer test,
6) post-activity survey to find out what participants had noted about the biographies of the female civil engineers,
7) follow-up survey.

The participants were first asked to complete a Draw-an-Engineer test to assess their perceptions of engineers and engineering. The test required them to draw a picture of an engineer at work [3]. The drawings were analysed as follows. Drawings of engineers with short hair and broad shoulders were regarded as males while those with long hair and narrow shoulders as females. Drawings of engineers working with one or more of the following items were considered as engaged in building or repairing: hard hat, workbench, heavy machinery, hammer, wrench, car, engine, rocket, airplane, robot, bridge, road, building, train and train track. Those working with computer, blueprint, pen, model and/or desk were regarded as engaged in planning or designing while those working with test tube and/or beaker were deemed as doing laboratory work. An analysis of the drawings revealed that a majority of the participants had the perception that engineers were male and their work was blue-collar in nature.

The participants were then randomly divided into groups of four members each, and the various groups were each assigned a female civil engineer from Table 1 to research on. Table 1 contains 18 prominent women in civil engineering, and their major achievements. The participants were given one week to do their research, and were encouraged to use Internet resources for their research. To familiarize the participants with the discipline of civil engineering, civil engineers specializing in

Table 1. Prominent women in civil engineering and their major achievements

1	Cynthia Barnhart
	A Professor in the Department of Civil and Environmental Engineering, and the Engineering Systems Division, and the Co-Director of the Center for Transportation and Logistics at the Massachusetts Institute of Technology. Internationally renowned for her research on developing models, optimisation methods and decision support systems for large-scale transportation problems [24]. Received, among other awards, the 1990 Presidential Young Investigator Award from the US National Science Foundation, the 1993 Junior Faculty Career Award from the General Electric Foundation and the 2003 Best Paper Award in Transportation and Logistics from the Institute for Operations Research and the Management Sciences.
2	Shobha K Bhatia
	The Laura J and L Douglas Meredith Professor for Teaching Excellence in the Department of Civil and Environmental Engineering at Syracuse University. Served as the Department Chair from 1996 to 2001. Contributed to in-depth characterisation of soil under static and dynamic loadings. This research has resulted in unique experimental data and design methods, which are still widely used by researchers and practitioners today. First to use image processing for characterising soils, and this pioneering work is widely cited. First to use the bubble point method for characterising the pore-size distribution of geotextiles, and this has led to a new ASTM standard for the bubble point method [25]. Many researchers frequently compared their results with her unique bubble point data. Received, among other awards, the 2003 International Network for Engineering Education and Research Recognition Award.
3	Lillian C Borrone
	Held senior positions in the port, aviation and public transportation sectors, overseeing their planning and operations. Initially, served as the Deputy Administrator for the Urban Mass Transportation Administration in the US Department of Transportation. Employed by The Port Authority of New York and New Jersey from 1974 to 2000, where she ultimately served as the Assistant Executive Director. She was instrumental in managing the recovery and resurgence of the declining maritime industry of the port, and developed strategies to address ongoing environmental issues confronting the port. Served as a Presidential appointee to the US Commission on Ocean Policy from 2001 to 2004. Received, among other awards and honours, membership to the US National Academy of Engineering (1996) and the 2001 W N Carey Jr Distinguished Service Award from the Transportation Research Board of the US National Academy of Sciences [26].
4	Aine M Brazil
	Managing Principal of Thornton Tomasetti Engineers, a 500-person international engineering company, and an Adjunct Full Professor in the Department of Civil Engineering and Engineering Mechanics at Columbia University. Throughout her 28 years of experience, she has been responsible for the design and construction of high-rise office and residential buildings, hotels, air-rights projects with long span transfer systems, hospitals and parking garages. High on the list of her accomplishments is the role she has played in leading the structural engineering teams for the design of over three million square feet of office development in Times Square, Times Square Tower and 745 Seventh Avenue. Received, among other awards, the 1995 Special Recognition Award from the Professional Women in Construction and the 1997 First Prize for Engineering Excellence for New York Hospital in New York, NY [27].
5	Jessie G Cambra
	Contributed to the planning, design and construction of major public works. Managed Alameda County's Road Department with a $12 million budget, 200 employees, and 881 kilometres of county roads serving a population of 7 million people spread over 2128 square kilometres. Scored a number of firsts: First female graduate in engineering at University of California, Berkeley; First female engineer licensed by examination in California; First female Director of American Public Works Association. Received the 1979 Achievement Award from the US Society of Women Engineers [28].
6	Shirley J Dyke
	She is the Edward C Dicke Professor in the Department of Civil Engineering at Washington University in St Louis. Internationally renowned for her research on structural dynamics, structural control, structural health monitoring and earthquake engineering, and for her teaching and outreach programmes [29]. First to incorporate magnetorheological dampers in semi-active control systems to mitigate potential structural damage imposed by severe seismic events. Developed and verified new algorithms for detecting damage in civil structures. Established the Washington University Structural Control and Earthquake Engineering Laboratory in 1997. Founded the 'University Consortium on Instructional Shake Tables' programme in 2001. Received, among other awards, the 1998 Presidential Early Career Award for Scientists and Engineers.
7	Maria Q Feng
	Professor in the Department of Civil and Environmental Engineering at University of California, Irvine. Contributed to research on the safety and security of civil infrastructure systems, focusing on the science and technology of advanced sensors, structural health monitoring, and damage assessment of civil infrastructure systems [30]. Her research has produced innovative, effective and practical technologies, devices, software and design/analysis methods that are used worldwide to enhance the safety and reliability of civil infrastructure systems. Received, among other awards, the CAREER Award from the US National Science Foundation, the 1995 Alfred Noble Prize, the 1995 Collingwood Prize, the 1997 Charles Pankow Finalist Award for Innovation, and the 1999 Walter L Huber Civil Engineering Research Prize, all from the American Society of Civil Engineers or ASCE.
8	Patricia D Galloway
	Chief Executive Officer of The Nielsen-Wurster Group, Inc since 2001. She is an internationally recognised leader in civil engineering and construction, and has extensive experience in management consulting, dispute resolution and risk management. The firm is recognised worldwide as a premier provider of engineering and management consulting services to the legal, regulatory, engineering, industrial, commercial, and construction sectors. Inducted as the first female President of the ASCE in 2003. Received, among other awards, the 1995 Professional Leadership Award from the Professional Women in Construction and the 2003 Upward Mobility Award from the US Society of Women Engineers [31].
9	Deborah J Goodings
	She is a Professor in the Department of Civil and Environmental Engineering at University of Maryland. Contributed to research on extreme heat, cold and lunar geotechnics; cratering, explosives and sinkhole mechanics; and soil improvement by reinforcement and grouting [32]. Elected a fellow of the ASCE in 2002. Received, among other awards, the 1984 Fred Burggraf Award from the Transportation Research Board of the US National Research Council and the 2003 Distinguished Service Award from the US Universities Council on Geotechnical Engineering Research.

Table 1 (*cont.*)

10	Anne S Kiremidjian Professor in the Department of Civil and Environmental Engineering at Stanford University. Served as the Director of John A Blume Earthquake Engineering Center at Stanford University from 1995 to 2002. Contributed to research on probabilistic methods in civil engineering, developing models for earthquake occurrences, ground motion characterisation, structural damage evaluation and reliability analysis of structures [33]. Co-recipient of a patent for a modular, wireless damage monitoring system for structures. Received, among other awards, the 1998 Award for Excellence from the Applied Technology Council for extraordinary achievement in earthquake damage and loss estimation and the 2003 Charles Martin Duke Lifeline Earthquake Engineering Award from the ASCE.
11	Suzanne Lacasse Managing Director of the Norwegian Geotechnical Institute since 1991, and is recognised as one of the world's leading practising geotechnical engineers. Contributed to research on geotechnical laboratory techniques, soil behaviour, foundation design and engineering for both onshore and offshore structures, and development and application of probabilistic analyses in foundation design. Received, among other awards, the 1999 K Y Lo Medal from the Engineering Institute of Canada. Elected a foreign associate of the US National Academy of Engineering in 2001. Invited to present the 37th Terzaghi Lecture of the ASCE in 2001—recognised as one of the highest international honours in geotechnical engineering [34].
12	Gayle F Mitchell The Neil D Thomas Professor and Chair of the Department of Civil Engineering, and Director of the Ohio Research Institute for Transportation and Environment at Ohio University. Contributed to research on physical/chemical treatment of water and waste water, erosion and sediment control, wetlands, mitigation of storm water runoff, components of solid waste landfills, highway winter maintenance and application of probes from subsurface investigations [35]. Appointed or elected to numerous national and international boards and committees; for example, she is a commissioner to the ABET Inc Engineering Accreditation Commission, and a former Director of the International Erosion Control Association.
13	Priscilla P Nelson A Professor in the Department of Civil and Environmental Engineering, and the Provost and Senior Vice President for Academic Affairs of New Jersey Institute of Technology since 2005. Prior to this, she was with the US National Science Foundation, and held several senior appointments including Director of the Civil and Mechanical Systems Division, and Senior Advisor to the Director of the NSF. Internationally renowned for geological and rock engineering, and the design and construction of underground facilities and tunnels [36]. Played a key role in several major construction projects, such as the Trans-Alaska Pipeline System and the Superconducting Super Collider. Received, among other awards, the 1988 Case Studies Award and the 1993 Basic Research Award, both from the US National Committee for Rock Mechanics.
14	Margaret S Petersen A Professor Emerita in the Department of Civil Engineering and Engineering Mechanics at University of Arizona [37]. Internationally renowned for the design of hydraulic structures, channel hydraulic structures, channel hydraulics and water resource planning. Involved in some of USA's largest water projects, such as the Mississippi River flood control and navigation effort and the Sacramento-San Joaquin Delta project. Authored two books, namely 'Water Resource Planning and Development' and 'River Engineering', which are used worldwide. Elected an Honorary Member of the ASCE in 1991. Received, among other awards, the 2001 Hunter Rouse Hydraulic Engineering Award and the 2002 Environmental and Water Resources Institute's Lifetime Achievement Award, both from the ASCE.
15	W M Kim Roddis She is a Professor and the Chair of the Department of Civil and Environmental Engineering at George Washington University. Recognised nationally as an expert in distortion-induced fatigue of steel highway bridges and internationally as an expert on the application of artificial intelligence and advanced computing methods to civil engineering problem-solving [38]. Elected a fellow of the ASCE in 1997. She is also the ASCE representative on the Board of Directors of the International Society of Computing in Civil and Structural Engineering. Received, among other awards, the 2002 Special Achievement Award from the American Institute of Steel Construction.
16	Emily Warren Roebling Supervised the construction of the Brooklyn Bridge in New York City. She was the wife of Washington Augustus Roebling, who was charged with carrying out the construction of the suspension bridge. But during the construction project, Washington became an invalid—paralysed, partially blind, deaf and mute. Emily spent years on the site, directing the construction of what was the longest suspension bridge in the world when it was completed in 1883 [39].
17	Maria I Todorovska A Research Professor in the Department of Civil and Environmental Engineering at University of Southern California. Internationally known for her research in earthquake engineering and engineering seismology. Contributed to research on a variety of topics such as seismic wave propagation in soils and structures, structural health monitoring, soil-structure interaction, strong ground motion, probabilistic seismic hazard analysis, seismic monitoring and data processing, assessment of damage and losses from earthquakes, and tsunami [40]. Named among the 'Top 20 Authors Worldwide on the Special Topic—Earthquakes' for the period from 1993 to 2003 (one of only two earthquake engineers) by the Institute of Scientific Information. Named among the 'Top 1% Authors Worldwide in Engineering' for the period from 1995 to 2005 by the Institute of Scientific Information. Received, among other awards, the 2004 Kapitza Gold Medal from the Russian Academy of Natural Sciences.
18	Sharon L Wood The Robert L Parker, Sr Centennial Professor in the Department of Civil, Architectural and Environmental Engineering at University of Texas, Austin. Contributed to research on structural engineering, evaluation of existing structures, design and behaviour of reinforced concrete structures, and earthquake engineering [41]. Elected a fellow of the American Concrete Institute (ACI). Received, among other awards, the 1993 Alfred Noble Prize from the ASCE, the 1998 Arthur J Boase Award from the Reinforced Concrete Research Council, the 2002 Joe W Kelly Award and the 2006 Henry L Kennedy Award, both from the ACI.

different areas were included in Table 1. These areas of specialization were construction engineering, geotechnical engineering, structural engineering, transportation engineering, urban and community planning, and water resources engineering.

Each group was required to do a 20-minute oral presentation and submit a written report of the female civil engineer assigned to the group. The participants were required to design and present the following documents to give an overview of the civil engineer's life:

1) birth certificate,
2) educational certificates,
3) marriage certificate,
4) resume for a hypothetical research post that the female engineer wished to apply.

They were also required to address the following items during the presentation:

1) Who inspired the person to become an engineer?
2) What was the nature of her work?
3) What were her research interests?
4) What were her major research findings, and how had they influenced the current knowledge?
5) What were the difficulties she had encountered in her work, and how had she overcome them?
6) What were some issues in her life which were unusually inspiring for young women studying engineering?

Each oral presentation was followed by a five-minute question-and-answer session. After all the groups had presented, the Draw-an-Engineer test was administered to determine the effectiveness of the oral presentations in dispelling the participants' misperceptions of engineers and engineering. The significance of differences in drawings before and after the intervention was assessed by McNemar Test for Significance of Changes [18]. A post-activity survey consisting of four forced-choice items was also administered, and this required the participants to indicate what they had noted about the biographies of the female civil engineers in terms of:

1) Who inspired them to become engineers?
2) What appointments did they hold?
3) What were the difficulties they had encountered at their workplaces?
4) How did they cope with both work and family life?

A follow-up survey consisting of one forced-choice item was administered six months later by e-mail to find out whether the participants had carried out the activity with their students.

RESULTS AND DISCUSSION

The author observed that the female engineers featured during the oral presentations really captured the attention of the participants. The participants seemed to show greater enthusiasm than anticipated; and everyone participated actively in the question-and-answer sessions.

The participants commented that administering the Draw-an-Engineer test at the outset without them suspecting anything was a powerful way to make them become aware of their misperceptions of engineers and engineering. The results showed that before the intervention, the perception of engineers as men seemed to be more prevalent among the male participants as compared to the female participants—all the male participants depicted engineers as men while 91.4 percent of the female participants did so. The results showed that the activity was effective in dispelling the participants' perceptions of engineers as men. The percentage of male participants who depicted engineers as men decreased from 100 percent before the intervention to 62.2 percent after the intervention ($p < 0.01$). Similarly, the percentage of female participants who depicted engineers as men decreased from 91.4 percent before the intervention to 31.4 percent after the intervention ($p < 0.01$). After the intervention, the male participants seemed to be more tenacious of their perceptions of engineers as men than the female participants—the percentage of male participants who depicted engineers as men decreased by 37.8 percent whereas that of female participants decreased by 60.0 percent.

In the drawings, the participants showed engineers engaged in building or repairing, planning or designing, or laboratory work. The results indicated that the activity was effective in countering the participants' perceptions of the nature of engineering jobs. The percentage of male participants who portrayed engineers engaged in building or repairing decreased from 66.7 percent before the intervention to 4.4 percent after the intervention ($p < 0.01$) while that of female participants decreased from 74.3 percent to 2.9 percent ($p < 0.01$). Conversely, the percentage of male participants who depicted engineers engaged in planning or designing increased from 26.7 percent before the intervention to 91.2 percent after the intervention ($p < 0.01$) while that of female participants increased from 20.0 percent to 91.4 percent ($p < 0.01$). Thus, before the intervention, a majority of the participants had the misperception that engineering jobs involved a lot of manual work and were physically demanding. The oral presentations enabled the participants to note that engineers were increasingly required to think, plan, design and communicate, and not do just manual work. In order to encourage more girls to pursue engineering, teachers need to highlight to students that in today's knowledge-based and innovation-driven economy, engineering requires intellectual ability and capacity for innovation and not so much manual work.

The participants noted that the female engineers featured in this activity cited the role of their parents or teachers in encouraging their pursuit of an engineering career. Research has pointed out the importance of parental support in fostering young women's interest in science-related careers [19]. Research has also shown that teachers play a critical role in young women's decision to pursue engineering and science careers [20]. All these might suggest that organizing outreach programmes directed specifically at parents or teachers might help to narrow the gender gap in engineering.

The participants noted that the female engineers featured here held senior positions in academia, government or industry. Many of them were recipients of national and international awards and honours. They were different from those the participants had ever encountered and those found in many studies where most female characters were shown as pupils, laboratory assistants or science reporters [21]. The female engineers featured here could therefore be used to overcome existing stereotypes of female engineers.

The participants noted that the female engineers featured here acknowledged that they had encountered difficulties at their workplaces such as the absence of female role models, mentors and colleagues, male supervisors' stereotyping of women's abilities, differences in communication style between male supervisors and female engineers, difficulty in coping with both family and career and lower pay scales and slower promotion rates for females than males, but they also mentioned recent progress made towards acceptance and equality. The participants felt that although these difficulties truthfully reflected the experiences of the female engineers, such revelations might deter talented young women from pursuing careers in engineering. This is a significant point because a study of high school students shows that young women are less likely to choose careers in science because of the difficulties associated with doing science [22]. The participants felt that while it was important to raise young women's awareness of the chilly environment that might exist in engineering, it was even more important to highlight the improvements made in producing more inclusive workplaces in engineering.

The participants noted that the female engineers featured here were able to cope with both work and family life because of pro-family workplace policies, and having a supportive and understanding husband and an efficient domestic help. This is an important point because concerns about how to balance work and family responsibilities appear to be a recurring issue in research on the factors that keep young women from pursuing engineering and science careers [2]. In order to encourage more young women to pursue engineering, it was thus important to highlight how female engineers successfully combined work and family.

All the participants took part in the follow-up survey. The survey findings showed that 83.8 percent of the participants had carried out the activity with their students. Further analysis of this result showed that the female participants were more likely to have done so as compared to the male participants—91.4 percent of the female participants versus 77.8 percent of the male participants. This could be because the female participants were able to identify with the role models better than the male participants. All these results indirectly showed that the participants found the activity useful for dispelling their misperceptions of engineers and engineering. Indeed, it is important that teachers do not carry stereotypes with them to the classrooms because research has shown that stereotypes can shape girls' attitudes in ways that limit their educational and vocational aspirations during the early years of adolescence [19, 23].

CONCLUSION

The activity described above can be used to correct misperceptions of engineers and engineering among high school teachers. Results showed that this activity was effective in achieving the goals of correcting misperceptions of engineers and engineering among high school teachers, and providing them with female role models in civil engineering. In future, the biographies of the female civil engineers featured here could be collated into a book or an online resource to showcase these women's contributions to engineering and society. The activity could also be used for elementary and middle school teachers—this might enable them to correct misperceptions of engineers and engineering among their students. Furthermore, the activity could be carried out by professors with female undergraduates or graduate students to provide them with female role models—this would encourage them to pursue and excel in civil engineering as a course of study and as a profession. It is hoped that more educators will use this type of activity to correct the myth amongst young women that a career in engineering is not suited for them. Teachers and professors need to take every opportunity to assure young women that women can contribute equally as men to engineering, as illustrated by the prominent female engineers featured here. As the world economy becomes increasingly reliant on a technologically literate workforce, it cannot afford to overlook the talent and potential contributions of half of the population. If it does, societies, nations and our world will suffer.

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