

## NEW ZEALAND WOMEN IN ENGINEERING -A HISTORY

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Women were early participants in university education in New Zealand, first enrolling in the 1870s. But it was not until the second half of the twentieth century that women graduated from New Zealand universities with engineering degrees.

## Women's attendance at New Zealand universities

University education in New Zealand began in the early 1870s.<sup>1</sup> There was never any restriction on women's enrolment, and a few women soon began to attend. The first to enrol was Helen Connon who began attending classes at Canterbury College in 1875 and graduated with a BA in 1880.<sup>2</sup> Kate Edger completed her studies in Auckland and gained her BA a few years before Helen in 1877,<sup>3</sup> making her the first woman to graduate from a New Zealand university.



Ethel Benjamin, centre front, with other lawyers at the opening of the Supreme Court in Dunedin, 1902. Photo: Hocken Collections, Reference Number: Box-235-003

The first women medical graduates were Emily Siedeberg and Margaret Cruichshank who graduated in 1896 and 1897, with Margaret becoming the first female doctor to register in New Zealand.<sup>4</sup> In 1897 Ethel Benjamin was the first woman to graduate with a law degree and to be admitted as a barrister and solicitor of the Supreme Court of New Zealand. Despite members of the Otago District Law Society attempting to exclude her, Ethel established a successful practice as a barrister and solicitor.<sup>5</sup>

These early successes aside, women's participation in higher education was looked upon by many in New Zealand society with some disapproval. Child health reformer Truby King argued that too much study could impair women's reproductive abilities.<sup>6</sup> Differences in the subjects taught to girls and boys at primary and secondary level also discouraged women from tertiary education and steered them away from maths and science subjects. School subjects were designed to prepare girls for their future roles as wives and mothers. In 1917 compulsory home science was introduced for Form 3 and 4 (Year 9 and 10) girls – a situation that would remain unchanged until 1942 – with the result that other science subjects were less available to girls. For Forms 1 and 2 (Years 7 and 8), woodwork was for boys and home craft for girls. This division was in place from 1929 until the 1970s when, finally, both girls and boys could take cooking, sewing, woodwork and metalwork.<sup>7</sup>



Girls in a home science cooking class, circa 1939. Photo: Green & Hahn. Making New Zealand: Negatives and prints from the Making New Zealand Centennial collection. Ref: PAColl-8550-08. Alexander Turnbull Library, Wellington, New Zealand

## Women in the workforce

In the late nineteenth century, women in full-time employment made up about 18 percent of the labour force.<sup>8</sup> During the First World War, women were called upon to fill positions vacated by men serving overseas and temporarily found employment in non-traditional roles. In 1933, women's employment at an engineering workshop in Christchurch was still unusual enough to make the news. The Evening Post reported that three women were starting work at Anderson's Ltd where they would be "employed on light work, such as casting, drilling, and core making..."<sup>9</sup> There was no shortage of women interested in the roles, which attracted 60 applicants.



Anthea Abercrombie working at the Dominion Physical Laboratory, Gracefield, Lower Hutt, Wellington, circa 13 May 1943. Photo: Pascoe, John Dobree, 1908–1972: Photographic albums, prints and negatives. Ref: 1/4-000429-F. Alexander Turnbull Library, Wellington, New Zealand

Although there was no restriction to prevent women enrolling in engineering courses, they were effectively barred by social expectation. In the 1930s, Sybil Lupp wanted to develop a career as a mechanical engineer, but her parents did not consider this a suitable occupation for a woman. Pursuing her interest in cars, she tried, secretly, to find work in a garage, but none would employ her. By the 1950s however, she had managed to establish her own mechanical workshop specialising in high performance cars.<sup>10</sup>

During World War II, women's employment as a percentage of the labour force peaked briefly to 25 percent before falling again, almost to pre-war levels.<sup>11</sup> In the 1950s, the question of whether it was appropriate for married women and mothers to work in paid employment was hotly debated.<sup>12</sup> Women's participation in the work force grew only very slowly during the 1950s, and was still under 25 percent by the end of the decade. It then increased steadily to reach 34 percent in 1981. Still, despite more women entering the workforce, the types of jobs available to them continued to be limited, with the most common occupations being nursing, teaching, shop and clerical work and food and clothing production.<sup>13</sup>





**Left:** Equal work for equal pay poster, produced by the Council for Equal Pay and Opportunity, 1961. Ref: Eph-A-WOMEN-1961-01. Alexander Turnbull Library, Wellington, New Zealand

Above: Cartoon from 1960, satirising the staged introduction of equal pay for the public service. Prime Minister Walter Nash offers women voters an "awful nice case" with nothing in it. Image: Auckland Weekly News, Reference: AWN26.10.1960 p. 6

Through the 1950s, women's groups campaigned hard for equal pay for public service roles.<sup>14</sup> The Government Service Equal Pay Act passed in 1960 and was phased in over the following five years. It was a step in the right direction, but there was still much to do.

## Conclusion

From the mid-1870s, women were forging a place in university education, but it would be another 90 years before women would graduate from New Zealand universities with engineering degrees. In the mid-twentieth century, women's career options were still limited by training opportunities and social expectation.

# **BEGINNINGS IN THE 1960S**

Women's participation in engineering degree courses in New Zealand began in the 1960s. But completing a degree at one of the two main engineering schools of Auckland and Canterbury was not the only path women followed to become professional engineers in New Zealand. Some of New Zealand's first women engineers began their training overseas and registered through the British professional engineering institutions. Other engineering courses at smaller universities or technical institutes became established in the 1960s, providing women with another option for engineering study.

### First women engineering graduates and teachers

The first woman to graduate from a New Zealand university with an engineering degree was Leslie Robertson, who completed a BE in electrical engineering at the University of Canterbury in 1965.<sup>15</sup> Other women followed in the years directly after, where they remained a very small minority. Gretchen Kivell studied chemical engineering at the University of Canterbury in the late 1960s. She recalled being one of six women in the engineering school out of a total of 600 students.<sup>16</sup> Reflecting on her time at Canterbury, Gretchen recalled the support and encouragement she received from staff, particularly Professor Miles Kennedy. But looking back she could also see that there was no recognition or understanding of the challenges women faced as a minority, where they were expected to fit into the male culture of the school. Gretchen felt both uncomfortably visible and, in some cases, was completely ignored by male classmates. Her lab partner did not speak to her for their entire year running experiments together.<sup>17</sup>

At the University of Auckland it took a little bit longer before women were a regular sight in engineering classes. From 1948–1969 the University of Auckland Engineering School was based out at Ardmore, south of the city.<sup>18</sup> Students lived in residential halls on site. Liz Godfrey completed an engineering intermediate year at University of Auckland in 1963 as part of a science degree. There were three other women in her class, all doing science degrees. Liz recalled that at that time there was no thought that they or any other women would do engineering, or that they would or could possibly go out to Ardmore.<sup>19</sup>

The first woman to graduate from the University of Auckland Engineering School was Gee Ing Yeow, an international student from Malaysia, who completed her BE in civil engineering in 1970.<sup>20</sup> She would have had to take classes at Ardmore and presumably lived with other women in the accommodation provided for students attending the nearby teachers training college. Many of New Zealand's early women engineering graduates were international students.<sup>21</sup> The first New Zealand woman to complete an engineering degree at University of Auckland was Gael Knight who graduated BE in Chemical and Materials Engineering in 1973.<sup>22</sup>

Registration with one of the British professional engineering institutions in a particular discipline would also qualify you for engineering work in New Zealand. Pat McCook (Patricia Joan McCook née Boyd, 1928–2022<sup>23</sup>) was born in England but completed her secondary education in New Zealand. She returned to England in 1945 and, after reading an illustrated book about bridges, decided she wanted to be a civil engineer. She found work in the drawing office of a large factory manufacturing transformers and studied engineering part time, taking evening classes. Pat applied to be a student member of the Institution of Civil Engineers but, as she was working for an electrical firm, was refused. However, she was accepted as a student member of the Institution of Electrical Engineers (IEE).

After returning to New Zealand, Pat got a job in the engineers' office of the Christchurch Tramway Board, where she worked in 1948–1949. She continued to study part time and was the first woman to take engineering classes at the University of Canterbury.<sup>24</sup> Still wanting to be a civil engineer, Pat wrote to the New Zealand representative of the Institute of Civil Engineers to apply for membership. She was refused on the grounds that the work was unsuitable for her and that she would be unlikely to find practical work. She received a similar response from the representative of the Institution of Mechanical Engineers. The IEE's response – where Pat was already a student member – was more encouraging, and she continued to study, taking evening classes for IEE students at Christchurch Technical College in 1949–1954. Pat passed the IEE entry exams in 1955, making her the first woman in New Zealand to qualify as a professional engineer.<sup>25</sup> After time away from paid work to

raise her two children, Pat got a job in 1966 as an electrical engineer at the Consumer Institute's Test Laboratory in Christchurch. She became a Chartered member of the IEE in 1972 and continued to work at the Consumer Institute's Test Laboratory until her retirement in 1988.<sup>26</sup>

As the first woman to teach electrical engineering in New Zealand, Dorothy Comley (1927–2002) was another of New Zealand's pioneers. Dorothy completed her engineering study in England and first began tutoring at the Huddersfield Technical Institute in 1958. After immigrating to New Zealand in 1975 she taught at Wellington Polytech until her retirement in 1992.<sup>27</sup> She recalled that male colleagues and students at first regarded her as a curiosity but this quickly turned to acceptance after proving her competence.<sup>28</sup>

## **Diversification of engineering courses**

New engineering courses in the 1960s provided alternative pathways for women to enter the profession. These courses were often more applied than traditional engineering disciplines, had a greater focus on people and the environment and were well connected with industry. As the courses were new, they had no established masculine student culture, making them more appealing to prospective women students.<sup>29</sup> The courses were also generally smaller, so although women were often still a minority, the gender balance was not as overwhelming.

Massey Agricultural College opened in 1928.<sup>30</sup> From the start, college co-founder and principal, Geoffrey Peren, encouraged women to enrol and the college welcomed its first female students in 1932.<sup>31</sup> Horticulture soon became the most popular programme for women.<sup>32</sup> During WWII, with many men away on active service abroad, women dominated a number of Massey's courses.<sup>33</sup> In 1944 the college opened a women's hostel to accommodate the growing number of female students.<sup>34</sup>





Activities at Massey College. Photos: Evening post (Newspaper. 1865–2002): Photographic negatives and prints of the Evening Post newspaper. Ref: 114/408/26-F. Alexander Turnbull Library, Wellington, New Zealand In 1964, Massey introduced its food technology degree programme. It was a first for the country,<sup>35</sup> and offered women another way to use their mathematics and chemistry skills. Dick and Mary Earle joined the college as teaching staff the following year and built up the faculty's biotechnology and product development programmes.<sup>36</sup> Dick, a chemical engineer, was active in the Institution of Professional Engineers New Zealand (IPENZ) and served as the Institution's President in 1988–1989. And Mary, as the first female academic engineer at a New Zealand university, was an important role model for students at Massey and the engineering profession more broadly. In 1993 Mary was awarded Honorary Fellow of IPENZ, the first woman to receive this honour, in recognition of "her innovative approach to technology and her dedication to the advancement of her profession." <sup>37</sup> Mary and Dick retired from their roles at Massey in 1994 and 1996 respectively.<sup>38</sup>

From 1968, Lincoln Agricultural College opened an engineering faculty. This new programme attracted more women than traditional engineering courses and emphasised water conservation, alternative energy sources, safety and resource management.<sup>39</sup>

Auckland Technical Institute (ATI) also entered the engineering training market in the 1960s. From 1964 ATI offered the country's first full-time technicians' course – the New Zealand Certificate in Engineering. By 1973 ATI had a fully developed engineering school.<sup>40</sup>

## Conclusion

In the 1960s women began to be a small but visible presence at Canterbury and Auckland engineering schools. New engineering courses established in the 1960s at other tertiary institutions also opened doors for women to complete engineering study.

# CHANGES IN THE 1970S

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In the 1970s the women's movement challenged established ideas of male and female roles. Groups pushed for women's entry into non-traditional careers and campaigned for pay equity and educational opportunities. Within this climate of discussion and activity, engineering schools began to consider what they could do to increase female enrolments.

### Women in the workforce

By 1970, only a handful of women had graduated with engineering degrees from New Zealand universities. Women made up almost 30 percent of the workforce but were concentrated in professions such as teaching, nursing, shop and clerical work and food and clothing production – professions generally less well paid than male dominated professions of equivalent training and skill.<sup>41</sup>

Two of the core demands of the women's movement in New Zealand in the 1970s were equal pay for equal work and equal employment and education opportunities.<sup>42</sup> This meant both fairer remuneration for sectors dominated by women, and opportunities for women to train for and enter traditionally male dominated work sectors.

Although the Government Service Equal Pay Act had passed in 1960 – ensuring equal pay for men and women in the same public service role – there was reluctance for the same to be passed for the private sector.<sup>43</sup> It took a further 12 years of campaigning before the private sector Equal Pay Act was passed in 1972.<sup>44</sup> In the ten years following, the average earnings for women shifted from 65 percent of what men earnt to 75 percent of what men earnt.<sup>45</sup> The Equal Pay Act 1972 meant that women and men in the same role had to be paid the same, but did not address the inequity of lower pay in sectors dominated by women. That campaign would continue to be fought over the following decades.

## **Educational opportunities and gender stereotyping**

Feminists also set their sights on increasing opportunities for women in education and gaining entry into, and promotion within, sectors dominated by men. This included many trades and professional sectors such as engineering. Although compulsory home science for girls was a thing of the past, fewer girls than boys chose to continue with maths and science subjects at high school. This effectively ruled them out of entering tertiary courses like engineering which required University Entrance (UE) maths and physics. In 1967 only 33 percent of girls took UE maths and 11 percent of girls took UE physics.<sup>46</sup>

Feminists saw that social expectation and gender stereotyping began well before students were choosing elective subjects at secondary school. They argued that even very young children internalised social norms. This influenced the way they saw themselves, affecting their perception of what was expected of them and the nature of their potential.<sup>47</sup> To counter this, women's groups worked to make visible and break down gender



Women's Liberation Front members ordering a meal at New City Hotel, Wellington. Photo: Dominion Post (Newspaper). Ref: EP/1970/3762/16-F. Alexander Turnbull Library, Wellington, New Zealand. roles. The Dunedin Collective for Women, and the Working Party on Sex-Role Stereotyping (set up under the Council for Equal Pay and Equal Opportunity) both analysed a series of books published by the Department of Education that were in use in all New Zealand primary schools as set texts for students learning to read. Their research found fewer female than male characters portrayed in the stories. Girls were often shown as passive and home centred, while boys were more likely to be adventurous, creative and independent. Women were almost exclusively presented in domestic situations, or as teachers.<sup>48</sup>

### Feminism at established universities

Feminist groups were active at universities too. From the early 1970s, most campuses had a student feminist presence – including women's groups on campus and feminist views and content published in student newspapers.<sup>49</sup> Increasing numbers of women were enrolling at university. At University of Auckland in 1972 women made up 32 percent of the student body, up from 26 percent in 1965.<sup>50</sup> Women's participation in engineering courses sat around 2 percent, lagging well behind the numbers for law and medicine. The feminist ideas of gender equality and representation swirling around the universities in the 1970s slowly began to permeate engineering departments too.<sup>51</sup> There was a genuine desire on the part of staff to recruit more women into the programme and increase the diversity of the school.

## **University of Auckland**

From 1970, the engineering school at University of Auckland had been sending prospectuses to girls' schools<sup>52</sup> but did not take any further steps to attract female students until the mid-1970s. In 1969, University of Auckland graduate, Mike O'Sullivan, returned to take up a position as lecturer after completing his PhD at CalTech in the United States. At CalTech, Mike had seen several female engineering students and an active campaign to attract more. Ideas of social equity and opportunity had also extended to students of ethnic minority. In his first year back at Auckland, Mike recalled only one female engineering student in the whole faculty. In 1975, along with colleagues he formed a Women in Engineering Committee. The group included a representative from each department in the faculty and was led by Margaret Morton and Barbara Reilly from the Mathematics Department and himself and Margaret Blakeley (a research fellow in the Department of Theoretical and Applied Mechanics) from the School of Engineering.<sup>53</sup> Together they set an initial target of 20 percent female enrolments in engineering.<sup>54</sup> The group identified social factors, and a lack of knowledge of what engineering roles entailed as barriers to women's entry. They worked to build relationships with schools and teachers who would champion maths and science for their female students.

Enginuity Day, begun in 1976 or 1977, was one of the committee's first initiatives. The programme, still running today, is an open day for high school students to tour the engineering department and find out about the different specialisations. In its first years, Mike recalled around 20–30 girls attending. Relationships built with high school teachers were critical to the programme's success. Mike remembered quite a few students from Epsom Girls Grammar enrolling in engineering due to the encouragement of science teacher, Susan Spencer.<sup>55</sup>

Another initiative at the University of Auckland was the establishment of a Schools Liaison Committee in 1976.<sup>56</sup> The committee was made up of a representative from each of the five departments of the engineering faculty, the Associate Dean of Engineering, University Liaison Officer and a representative from the Auckland Branch Committee of IPENZ. Its aim was to promote engineering as a career to secondary school students. The committee ran information sessions for careers advisors and contributed speakers and displays – including a women in engineering display – to career evenings at schools across Auckland. From 1982, the group made an effort to include a woman engineer as part of the team attending careers functions.<sup>57</sup>

While these efforts did lead to a gradual increase in women engineering students through the 1970s, the results were still modest.<sup>58</sup> During the years 1971–1981, 10 women on average enrolled to study engineering at the University of Auckland each year out of intakes of 200. In the years before, the average had been one or two female students.<sup>59</sup>

## Conclusion

The women's movement raised public consciousness around issues related to women's work and training opportunities. This set the scene for a flourishing of activity on the part of universities and IPENZ over the following decade.

# ADVOCACY IN THE 1980S

The seeds planted in the 1970s through consciousness raising efforts, research, and the establishment of women's groups, grew and came to greater fruition in the 1980s. Women's groups were gaining traction in official circles; government campaigns encouraged women to enter non-traditional jobs; more women were attending university and universities became more active in trying to attract women to their engineering degree courses. Women engineering student numbers moved from 2 percent to 12 percent<sup>60</sup> but numbers of women in the engineering profession remained low.

## Campaigns to expand the range of jobs considered acceptable for women

In 1983 just over half of women in the paid workforce were in secretarial, clerical, teaching, nursing, clothing or sales jobs.<sup>61</sup> An area the women's movement had its eye on was expanding the range of jobs considered acceptable for women. Through the 1980s, the Women's Advisory Committee of the Vocational Training Council ran campaigns and produced booklets, posters and kits all aimed at promoting and supporting women into non-traditional work. This included trades and in particular engineering related trades which had always been almost exclusively male.

Girl's Can Do Anything was the slogan of a public education campaign, run by the Vocational Training Council from June – August 1983, and became a catchphrase of the 1980s. The campaign aimed to break down stereotypes of men's and women's work and to give women the confidence to enter male dominated sectors. The programme did not expect immediate dramatic results, but instead focused on building public awareness as a prerequisite for long-term change.<sup>62</sup> Campaign materials included posters and television ads showing women succeeding in male dominated industries and trades; a series of radio interviews with women in non-traditional jobs; a NZ Women's Weekly reader survey of women in non-traditional work; and resources for careers advisors and schools.<sup>63</sup> Throughout the 1980s, the Vocational Training Council, under the Labour Department's Positive Action Programme for Women, continued to produce publicity material and resources for schools and careers advisors and to support women into apprenticeships.

While the focus of the Vocational Training Council's campaign was apprenticeships and trades training, it revealed issues common to professional engineering as well, namely women's lack of prerequisite knowledge to enable them to enter tertiary engineering courses, and social resistance to women entering male-dominated workplaces. In 1981 the Manukau Technical Institute, supported by the Education Department and the Vocational Guidance Council, piloted a 12-week course, "Basic Engineering Skills for Young Women" as an entry point for women into trade-level engineering roles.<sup>64</sup> Nine women completed the course. Their responses to the post-course survey reveal that they enjoyed the course but were dismayed by the attitudes shown by potential employers or the basic repetitive work they were given. One woman was told at a job interview that they didn't have toilets or changing rooms for women and that women always get pregnant.<sup>65</sup> However, not all employers were hesitant to take on women. In 1981, NZ Forest products Ltd welcomed its first five women apprentices at its mill in Kinleith and were actively looking to recruit more.<sup>66</sup> And in 1982, the first women were employed in construction roles on the Marsden Point Oil Refinery expansion.<sup>67</sup>



Tutor Peter Shapcott demonstrates a welding torch to students on Manukau Technical Institute's engineering skills course for young women, 1981. The course was the first of its kind in the country. Photo: © Stuff Limited As well as its work on trade training, the Vocational Training Council also collaborated on programmes to promote professional engineering to women. In 1981, the Council supported a visit by women engineers to Wellington Girls' College where they spoke to Form 4 (Year 10) students about their jobs and professional engineering as a career.<sup>68</sup> The Vocational Training Council also supported the Department of Scientific and Industrial Research (DSIR) on its own Women into Engineering campaign. In 1988 only 10 percent of DSIR scientists were women. From 1987 the DSIR began offering 11 study grants a year to women wanting to train in the sciences, in particular, physics and engineering.<sup>69</sup>

### **Universities**

Throughout the 1970s, the percentage of women attending university increased, and by 1980 was sitting at around 40 percent.<sup>70</sup> The faculties of law and medicine had both seen significant increases in the number of women enrolling, reaching 20 percent by 1980. In engineering, female enrolments at Auckland and Canterbury sat around 2 percent.<sup>71</sup> This prompted university engineering departments to have a harder look at the culture of the school and the pathways into professional engineering education.

At the beginning of the 1980s engineering schools were still a largely mono-cultural environment and a hard place for anyone who was different.<sup>72</sup> At University of Auckland the laddish culture of pranks, heavy drinking, obscene songs, and blue movies that had developed when the school was out at Ardmore lingered into the 1980s.<sup>73</sup> A survey of female engineering students at University of Auckland in 1982 provided insight into the student experience and some of the challenges women faced. It revealed that pathways into engineering for women often came down to chance. Careers advisors, teachers and parents did not know enough about engineering and the diverse career possibilities it offered and did not encourage girls to consider it. On the whole, survey respondents enjoyed their time in the engineering school but also reported feeling conscious of standing out - never being able to disappear into the crowd and feeling greater pressure to do well. They also noted that boys had more informal networks available to them. Finding practical work experience was harder for women students - encountering sexual discrimination when applying for summer work experience was not uncommon. They also raised the issue of the insufficient number of female toilets in the engineering school.74 These were common issues and not limited to University of Auckland. Female engineering students at University of Canterbury who responded to a survey expressed similar feelings of discomfort in classes dominated by males and reported the persistent use of gendered language and sexist jokes on the part of some lecturers.75





Students completing hands-on activities at University of Auckland's Enginuity Day, 1990s. Photos: Liz Godfrey/University of Auckland

#### **University of Auckland**

In the 1980s the University of Auckland increased its efforts to attract female students to the engineering faculty.<sup>76</sup> The Women in Engineering and Schools Liaison Committees continued to run Enginuity Day, begun in the late 1970s, and to build connections with high school teachers. But with only a small group of staff committed to the cause it could only ever be a part-time effort.

In 1989, the University received money from a contestable government fund to establish the position of Liaison Officer for women in engineering and physical sciences.<sup>77</sup> It was the first position of its kind in the country.<sup>78</sup> The successful applicant was Liz Godfrey, a former high school teacher and University of Auckland chemistry lecturer. Her appointment brought new vigour to the university's efforts and support for women students. Rebecca Ronald, an engineering student at University of Auckland from 1988–1993, recalled that Liz's door was always open to students to discuss any issue big or small or just to chat. The Dean of Engineering, Raymond (Ray) Meyer, was supportive of Liz's role and allocated money in the department's budget to continue the programme beyond its initial funding.<sup>79</sup>

Liz continued to grow Enginuity Day<sup>80</sup> and began a new programme SOS: Skills and Opportunities in Science, in late 1989.<sup>81</sup> SOS was a joint initiative developed by Liz Godfrey, Bev Farmer (Auckland College of Education), and Lorraine McCowan (Auckland Girls' Grammar). The programme was aimed at 12–15-year-old girls to catch their interest in STEM before they opted out of maths and science subjects. The programme ran as a series of seminars over two days, with women engineers facilitating job-related problem-solving activities. By 1992 the programme was running in both the North and South Islands, with local teams of teachers acting as advisers. The seminars aimed to show the relevance of science to the students' lives. The involvement of early career professionals showed women succeeding in exciting engineering roles where teamwork, communication skills and creative thinking were valued alongside technical knowledge.<sup>82</sup> As a follow up to the programme, posters showing women working in a variety of science and technology roles were distributed to every secondary school in the country.<sup>83</sup>

To build a collaborative network and pool of women who could support the Enginuity Day and SOS programmes, Liz helped to establish the Association of Women engineers. The group ran social and professional development events for its members and sometimes invited guest speakers.<sup>84</sup> The group was slow to become established. Gretchen Kivell recalled the group took three attempts to get going in its early years. She reflected that joining this kind of group "was unattractive to many of the early women engineers because they had worked so hard to become engineers, and they didn't want anything that set them apart. They just wanted to get on with being engineers."<sup>85</sup>

#### **University of Canterbury**



From the early 1980s, the University of Canterbury ran similar initiatives to those developed in Auckland. From 1982, the Engineering Faculty's Schools Liaison Committee held a Schools Visit Day where students and teachers from high schools in the South and lower North Islands were invited to tour the engineering school, see displays of laboratory equipment and research projects and to talk with staff, students and graduates.<sup>86</sup> In particular, the faculty was hoping to inspire female students, and from 1983 also ran a series of Women in Engineering seminars for high school students. The seminars took the form of a panel discussion with women engineers at different career stages discussing their work and experience.<sup>87</sup>

Brochure produced by University of Canterbury in the early 1980s and distributed to high schools. Image: R2241073, Archives New Zealand Te Rua Mahara o te Kāwanatanga, Wellington The faculty's Schools Liaison Committee also produced a brochure: 'Professional Engineering – a career for women?' The brochure reassured prospective female students that although the "number of women engineering students is still relatively few...it is very unlikely that you ever encounter any prejudice on the part of staff or other students, and in fact you will probably find them particularly friendly and helpful."<sup>88</sup> Unfortunately, however, this statement did not entirely align with the experience of all students. As an undergraduate student in 1984 about to enter her first professional year and looking to choose a discipline, Catherine Watson met with the mechanical engineering Head of Department, only to be told "Women don't do mechanical [engineering]."<sup>69</sup> This was despite the department having the faculty's only woman academic staff member at that time – Dr Anne Ditcher, who had been a lecturer in the department since 1981.<sup>90</sup> In 1984, Anne established a Women Engineers Group. At this time, the group was little more than a mailing list of women engineers to support the university's schools outreach programme.<sup>91</sup> Evidence from the time suggests that Anne likely received little support from her Head of Department to develop the group further.<sup>92</sup>

In 1988, a small group of students, including Catherine Watson, then beginning her PhD, started up a Women in Engineering group for students. The group's activities at this time included informal meetups and the occasional speaker, contacted through the Association of Women Engineers.<sup>93</sup> Catherine recalled that some male engineering students felt very threatened by the group and on one occasion broke in and trashed the meeting room used by the Women in Engineering group. Faculty staff assumed the women had trashed the room and made moves to shut the group down. The group protested and cited the faculty's tolerance for the drunken activities of male students. Male students eventually confessed to trashing the room and the women's group was allowed to remain.<sup>94</sup>

In 1989 the Women in Engineering group produced its own, much more colourful, brochure showing women students working on projects across the university's engineering disciplines.<sup>95</sup>



Brochure produced by the University of Canterbury Women in Engineering group, 1989. Image: University of Canterbury

#### **Challenges for universities**

The increasing interest in supporting women students and the initiatives begun during the 1980s heralded positive change but there were still challenges. In 1989, Liz Godfrey ran a second student survey and compared the results to those collected in 1982. She found that female engineering students now came from a wider range of high schools and backgrounds but that many of the challenges identified in 1982 were still in play. There was still a lack of information at high schools about engineering careers and a lack of understanding of what professional engineering work involved.<sup>96</sup> Recruiting female academic staff was another challenge for universities. In 1973, the University of Auckland engineering school had a part-time female lecturer, Dr Mary Farmer, on staff and had just employed its first woman laboratory technician.<sup>97</sup> In 1975, Sue Truman became the school's first fulltime woman academic staff member when she was appointed as a junior lecturer.<sup>98</sup> In 1988 the faculty had one woman member of academic staff – in the department of Theoretical and Applied Mechanics. Dean of Engineering Raymond (Ray) Meyer<sup>99</sup> expressed his desire to recruit more women but faced a lack of female candidates.<sup>100</sup> In 1987 at the University of Canterbury women made up 4 percent of engineering students and 3 percent of faculty staff.<sup>101</sup>

## **IPENZ**

At the 1981 IPENZ conference the NZ Herald reported that "Seven women engineers joined about 800 men at their profession's annual conference in Auckland."<sup>102</sup> A few years later the numbers had not improved. In 1984 IPENZ had 5,700 corporate members, 11 of whom were women, and 17 women graduate members.<sup>103</sup> Through the 1980s IPENZ took a closer look at the experience of its women members and considered what the Institution had to offer them and what it could do to support them. The Institution would also have to prove that it valued diversity and did not see women only as a largely untapped pool from which to make up the shortfall of engineers New Zealand needed.<sup>104</sup>



E.W de Lisle presents the 1963 Dobson lecture, "Communications for the Nation", to secondary school students. Photo: Engineering New Zealand Auckland Branch

Getting more young people interested in a career in engineering had long been a concern of IPENZ. In 1961 it started the Dobson Lecture Series. Leading engineers visited high schools in main centres and towns across the country and presented a lecture on a topic aimed to inspire their young audience. Early topics included "Power for the Nation", "This World of Wheels" and "The Jet Age". A brochure on engineering careers was then handed out. From 1974 the lectures were aimed at a wider audience and "enhanced the standing of the Institution generally"<sup>105</sup>, and the organising committee began to look at other ways to promote engineering to students. The committee transitioned to become the Schools Liaison Committee, officially changing its name in 1985. The last Dobson Lecture was given that same year.<sup>106</sup> From the early 1980s the committee focused its attention on promoting engineering as a suitable career for girls. In collaboration with University of Auckland, IPENZ produced two 20-minute videos aimed at high school students.<sup>107</sup> The committee also continued its programme of school visits, with engineers giving more relaxed and personal talks about their work rather than formal lectures.

In 1983, IPENZ devoted the cover story of the April edition of its magazine, *New Zealand Engineering*, to the issue of women's low representation. The article identified the poor public image of engineering as dirty, heavy work that involved machines rather than people; girls' subject choices at high school; and societal pressures, including the attitudes of careers advisors, parents and employers, as reasons for women's underrepresentation in the profession.<sup>108</sup>



Cover of the April 1983 issue of *New Zealand Engineering* magazine, promoting a feature article about women in engineering. Image: Engineering New Zealand

Women played a leading role in changes within IPENZ. From 1982–1984, chemical engineer, Gretchen Kivell, served as convenor of the Schools Liaison Committee – becoming the first women to lead an IPENZ committee.<sup>109</sup> In 1984, Gretchen was the first woman to lead an IPENZ Branch committee.<sup>110</sup> She joined the IPENZ Governing Board in 1988 and became the Institution's first woman president in 1998.<sup>111</sup> Gretchen took issue with the institution's ingrained use of gendered language.<sup>112</sup> She wasn't the only one to feel that way. The issue was first raised in a letter to the editor in 1981, upbraiding the Institution for its universal use of the pronouns 'he' and 'him' when referring to its members and to engineers more generally.<sup>113</sup> No formal action was taken on this issue until 1988 when the Association of Women Engineers put forward a proposal at the national IPENZ conference for IPENZ to: 1. Promote engineering as a career for women, with a particular focus on encouraging Form 3 and 4 (Year 9 and 10) girls to continue with maths and science subjects; 2. to promote equal opportunity employment; and 3. To redraft the institution's Code of Ethics to remove sexist language.<sup>114</sup> These resolutions were adopted and changes to the Code of Ethics made the following year.<sup>115</sup>

Also at the 1988 conference, was a session organised by the Electrical Engineering Advisory Council (EEAC) "to explore issues arising as increasing numbers of women enter the engineering profession."<sup>116</sup> A panel of four women engineers, chaired by Dr Mary Earle<sup>117</sup> discussed societal expectations around men's and women's work and perceptions of what engineering work involved; girl's subject choices at high school; maternity leave and re-entering the workforce.<sup>118</sup>

Following the 1988 conference, IPENZ's Executive Director, A J Bartlett, dedicated his editorial in *New Zealand Engineering* to celebrating the Institution's work so far on welcoming women into the profession. He noted that women were needed in the profession, not only to increase the number of engineers, but also for the "particular contribution that women can make to engineering. The profession needs a greater input of awareness of people and their needs — an awareness more generally characteristic, it can be said, of women than of men."<sup>119</sup> This broadening awareness from a focus on numbers to recognition of women's unique contribution to the profession laid the foundation for the work of the following decades.

## Conclusion

The initiatives of the 1980s saw women's enrolment in engineering degree courses move from 2 percent to hover around 12–13 percent by the end of the decade.<sup>120</sup> With more women entering the profession, the focus of the next decade would expand from recruitment to university courses, to women's experience in the workplace.

# **GROWTH IN THE 1990S**

In 1991, there were 339 women working as professional engineers in New Zealand, about 2 percent of the total. By the end of the decade, this had risen slightly, to sit around 3–4 percent. The majority of these women – 73 percent – were under the age of 34.<sup>121</sup> More young women were entering the profession but were less likely than men to stay. Through the 1990s the conversations around women in engineering broadened. From an initial focus on increasing the number of women entering tertiary engineering courses, conversation began to consider women's experience in the workplace, covering topics such as organisational culture, parental leave policies, part-time work and promotion.

## **Universities**

During the 1990s, the percentage of female engineering students at the two main engineering schools – Auckland and Canterbury – increased from around 12 percent, to hover between 16–20 percent by the end of the decade.<sup>122</sup>

#### **University of Auckland**

At the University of Auckland, the SOS programme established by Liz Godfrey in 1989 continued to receive a positive response from students and teachers. To extend the programme's reach and impact, a work pack of suggested classroom activities was distributed to teachers. A training video was also developed to help schools gain sponsors and to run their own SOS events in their region.<sup>123</sup>

The now well-established, Enginuity Day was the other key event in the engineering school's promotional programme. Enginuity Day was open to girls in their last two years of high school studying maths, chemistry and physics. Hands-on activities and the opportunity to talk to practicing women engineers made the day popular and it was regularly oversubscribed.<sup>124</sup> In 1998 the event attracted 170 Form 6 and 7 (Year 12 and 13) students from 49 different high schools across the Auckland region.<sup>125</sup>

A girls-only careers day was another opportunity for high school students to visit the engineering school to learn more about the disciplines offered. The participation of female undergraduate engineering students was an important feature of these open days. Undergraduate students were also encouraged to visit their old high schools to give talks about the engineering school and their study experience.<sup>126</sup>



In 1992 Kirsten Arthur, Lou Wickham and Rebecca Ronald (pictured left to right) led the formal establishment of University of Auckland's Women in Engineering Network. Photo: University of Auckland In 1992, engineering students Rebecca Ronald, Lou (then Louise)<sup>127</sup> Wickham and Kirsten Arthur led the formal establishment of the University of Auckland's Women in Engineering Network (WEN). At the time, Rebecca was Engineering Students' Association President - the first woman to serve in this role. Lou was the Engineering Students' Association Women's Affairs Officer and Kirsten, the fourth-year chemical and materials engineering class representative. Inspired by overseas programmes, their aim was to establish a group where female engineering students could find peer support and social connection, information about the engineering industry, and could support the engineering faculty in its outreach activities to schools. In the years before 1992, the group's activities had included informal peer tutoring, shared lunches and school visits. General support and advice had also been provided by Liz Godfrey, Liaison Officer for women in engineering and physical sciences.<sup>128</sup> In 1993, Rosalind Archer, then in her final year of undergraduate studies, took a leading role as copresident of the group. She recalled that the group's activities at this time included student-led tutorials, the publication of a 'beginners guide to engineering school' booklet with tips and tricks, and talks from professional engineers.<sup>129</sup> The formal establishment of WEN in 1993<sup>130</sup> was an important endorsement of the faculty's women students. By the end of the 1990s, the combined efforts of women students along with male allies, Liz Godfrey and the school's Dean, Roy Sharp, had achieved an important cultural shift. This was evident in improved behaviour at Engineering Students' Association events, and in promotional material for the school which emphasised the people side of engineering work and showed women as active researchers doing challenging and exciting work.131



Bachelor of Engineering Science graduates from University of Auckland, 1993–4. The top five graduates in Engineering Science were women. Photo: Liz Godfrey/University of Auckland

#### **University of Canterbury**

In the 1990s, the University of Canterbury stepped up its efforts to promote the engineering school to perspective female students and to do more to understand the barriers preventing greater interest and uptake from female high school leavers.

In 1991, the university was awarded \$30,000 from the Ministry of Education's Contestable Equity Fund to kickstart a programme developed by the university called Women into Professional Engineering.<sup>132</sup> The programme was supported by Associate Dean of Engineering, John Abrahamson, who was also the Chair of the IPENZ Schools Liaison Committee. Elizabeth (Liz) Roxborough was employed as co-ordinator of the project and began work in May 1991. Liz interviewed engineering students, practicing engineers, teachers and the public about their experience in or knowledge of professional engineering as a career. The results of the interviews confirmed the continued existence of social expectations and attitudes that were biased against girls entering or continuing in STEM subjects, and a lack of knowledge on the part of parents, teachers and careers advisors about the work of professional engineers in different disciplines.<sup>133</sup> This informed the decision to first focus time and energy on connecting with high school maths and science teachers and careers advisors.<sup>134</sup> By December 1993 over 200 teachers had attended nine seminars held around the country where they heard from male and female engineers from a range of disciplines, backgrounds and career stages. A video and other resource material were also provided to schools along with the encouragement to invite local engineers to speak in their classrooms.<sup>135</sup> Many of these programmes relied on the participation of women engineering students and professionals.

The University's Women in Engineering group (WiE) was formally established in 1999.<sup>136</sup> Prior to this, a Women in Engineering group waxed and waned according to the interest and availability of students to run it. The Women in Engineering Group formed by students in 1988 continued to run activities into the early 1990s. In September 1990, the group organised an end of year dinner attended by some fifty women. Attendees were a mix of engineers and DSIR science study award recipients.<sup>137</sup> Sharee McNab had attended Women in Engineering group events during her time as an undergraduate student, 1990-1993. But by the time she returned to University of Canterbury in 1997 to complete a PhD in electrical and electronics engineering, the group seemed to have fallen away. Sharee restarted the group the following year. The group ran casual get togethers, such as potluck dinners, providing an opportunity for students from different disciplines to connect. The group had a good turnout for events and was valued by those who came along.<sup>138</sup> Electrical Engineering student, Kate Macdonald (née McCarroll) was an enthusiastic member of the group. She joined the committee in 1998 in her first pro year and then took on the leadership of the group for her final two years at university.<sup>139</sup> In 1999, the group ran a popular Engineering in Schools programme where WiE members visited local high schools to talk to Form 4 (Year 10) students about engineering. The group's momentum continued the following year with sponsorship from five local engineering firms and support and encouragement from Dean of Engineering, Alex Sutherland.140



Sharee McNab at the Women in Engineering group sign-up table, University of Canterbury clubs' day, 1998. Photo: Sharee McNab

#### Other university courses

Outside of the main engineering schools of Auckland and Canterbury, other engineering courses were attracting significantly higher percentages of female students. Massey University's food technology programme, begun in the 1960s, had always attracted high numbers of women and by the 1990s was regularly seeing 50 percent female enrolments. The chemical technology course was also popular, with around 45 percent female enrolments.<sup>141</sup> In 1998, Auckland Institute of Technology launched its Bachelor of Engineering Degree.<sup>142</sup> It included the option to study environmental engineering, an emerging field at that time. This course in particular attracted high numbers of women students, approaching as much as 40 percent.<sup>143</sup> In 2000, the University of Waikato introduced a four-year Bachelor of Engineering with honours programme.<sup>144</sup> As at other universities, chemical and environmental engineering proved the most popular specialisations for women.

### **IPENZ**

In 1984 less than 0.5 percent of IPENZ members were women.<sup>145</sup> By 1998 this figure had increased only slightly to 1.7 percent, with half of these members in the graduate category.<sup>146</sup> Through the 1990s IPENZ published more articles in its magazine, New Zealand Engineering, profiling women engineers and giving voice to women's issues, and towards the end of the decade began to tackle the more complex topics of workplace culture, balancing work and family life, and women's contribution to the profession.<sup>147</sup>



Through the 1990s women IPENZ members held a Women in Engineering Forum at the annual national conference. This photo was taken at the 1994 conference in Nelson. IPENZ's first female President, Gretchen Kivell, sits front left. Photo: Engineering New Zealand

1993 was the centenary year of women's suffrage in New Zealand. IPENZ marked the occasion by honouring five women for their individual achievement and contribution to the profession. Certificates were awarded to Jenny Culliford (representing practicing women engineers), Mary Earle (representing women engineers in the academic world), Barbara Elliston (representing women engineers in management and industry), Pat McCook (representing pioneering women engineers), and Gretchen Kivell (representing women engineers in IPENZ).<sup>148</sup> That same year Gretchen was also conferred Fellow of IPENZ – the first woman to achieve this honoured membership class.<sup>149</sup> The coverage of the centenary awards in *New Zealand Engineering* was largely celebratory in tone, but also touched on some of the challenges faced by women engineers in the early 1990s, including balancing work and family life.

In 1995, as a graduate engineer and just prior to embarking on the mandatory OE, Lou (then Louise)<sup>150</sup> Wickham wrote an article for *New Zealand Engineering* discussing the pervasive and covert sexism they and their peers faced working in engineering consultancies. The article called out the yawning gap between companies' equal employment opportunity policies and what was happening in practice. At their firm, a company of over 100 employees, there were no women in senior management roles. Not, Lou wrote, because there weren't any women to promote, "but because senior (male) management doesn't want them there." The article was published anonymously, for fear of career retribution. When their name as author did get out, Lou was told they were blacklisted. Lou went and worked overseas, only returning to New Zealand in 2004, by which time the matter was long forgotten.<sup>151</sup>

In 1998, IPENZ elected its first female President – Gretchen Kivell. Gretchen was an active member of IPENZ, having been Convenor of the Schools Liaison Committee and Chair of the Auckland Branch. Gretchen wrote articles for the IPENZ magazine drawing attention to the challenges faced by women engineers. "Currently engineering is a full-time, full-career profession with little tolerance for career breaks," she wrote in 1998.<sup>152</sup> That same year, Gretchen collaborated with Liz Godfrey, Liaison Officer for women in engineering and physical sciences at University of Auckland, on a questionnaire, sent to members of the Association of Women Engineers.<sup>153</sup> The Association, first formed in the late 1980s had taken a while to gain support and become established, but by 1998 had over 300 members across its regional groups who met to socialise and discuss professional issues.<sup>154</sup> The results of the questionnaire provided insights into women's experiences in the workplace. On the whole, the women who responded to the questionnaire enjoyed their work, citing the variety, challenge, satisfaction of solving problems, and feeling that they were making a difference. Balancing work and family life was important to the respondents, but very few felt that they had successfully accomplished a career break. Part-time or alternate working arrangements, professional development and salaries were also identified as issues they would like to see receive greater attention and discussion. Some also expressed that while they loved their work, because of some of their own experiences, they felt hesitant to encourage women into the profession. More than half of the survey respondents were not IPENZ members. Reasons for not joining included the perception of IPENZ as a "civil old boys club" and not relevant to their discipline. They wanted to see events for younger engineers of all disciplines and an open forum to discuss issues such as parental leave and flexible working. They also had a "plea to branch and function organisers - please don't assume all engineers are Mr and that 'suitable dress' is a 'jacket and tie."<sup>155</sup>

## Conclusion

In the 1990s the conversations about women in engineering opened and shifted away from the previous focus on recruitment into tertiary engineering courses to include discussion of women's experience in the workplace. This was a significant shift and opened the path for further change in the following decade.

## WORKPLACE EXPERIENCE IN THE 2000S

By the early 2000s, conversations about women in engineering had broadened from an initial focus on getting women into the profession, to encouraging them to stay. Workplace culture and women's experiences were widely discussed, and diversity increasingly featured in conversation as good for business. IPENZ published a number of articles on these topics in its magazine. It also continued to focus on its schools programme as a way of increasing the number of women in the profession.

## Universities

Through the 1990s there was a sustained rise in the percentage of female engineering students at the two main engineering schools – Auckland and Canterbury, from around 12 percent in 1990 to hover between 16 percent and 20 percent by 2000.<sup>156</sup> The percentage of women then plateaued during the period 2000–2010, on average, floating just above 20 percent.<sup>157</sup> Through the 2000s, both Auckland and Canterbury universities continued to run their successful faculty open day programmes and to strengthen their women in engineering groups.



From left, students Esther and Alice Hausia and Jasmin Wagner of Onehunga High School attend Enginuity Day at University of Auckland, 2007. Activities that year included programming a robot and developing cellphone software. Photo: © Stuff Limited

## **IPENZ**

Through the 2000s IPENZ showed concern at the continued low numbers of women in the engineering profession. While graduate numbers were sitting around 20 percent, this did not translate into an increasing number of women working as professional engineers. In the 2000s, women made up between 4 percent and 6 percent of engineers, with numbers varyingly greatly across the different engineering disciplines.<sup>166</sup> Of most concern were statistics that showed women were leaving the profession at higher rates than their male counterparts. After only five years in the profession the proportion of women showed a noticeable decline, and after 10 years, was down to 3 percent. Women in senior and upper management roles were almost non-existent.<sup>159</sup> IPENZ used its publication, e.nz magazine, to draw attention to and discuss the issue. Diversity in the profession was positioned as smart business sense – improving staff retention and productivity and equipping an organisation to better respond to the diversity of their customers and community.<sup>160</sup>

There was also greater recognition that while many companies had equity policies, in practice the situation was more complex. At an IPENZ Women in Engineering workshop held in 2006, "attendees agreed that while the engineering profession offers equal opportunity 'on the face of things', female engineers still encounter subtle barriers."<sup>161</sup> Suggested reasons women chose to leave the profession included workplace culture, long work hours, and an emphasis on technical skills at the expense of social and collaborative skills. Other issues identified included "boys club" networking opportunities that women may not feel comfortable participating in; a reluctance on the part of women to push for promotion until they felt at least 90 percent competent in their current role; and unconscious bias resulting in women being given fewer opportunities and less challenging projects. The idea that women will "go off and have children" also continued to loom quietly in the background.<sup>162</sup> The 2006 workshop also gathered ideas on ways to retain women. Ideas included educating managers on unconscious bias, actively mentoring female engineers, profiling successful women engineers as role models and offering more flexible working hours and meaningful part-time work.<sup>163</sup>

Begun in 2003,<sup>164</sup> Futureintech was the new iteration of IPENZ's schools programme. It aimed to increase the number of students considering a career in STEM. There was concern that graduate numbers had stagnated and there would not be enough engineering and technology professionals to fill New Zealand's future need. The programme was also concerned with the underrepresentation of women, Māori and Pasifika in STEM fields.<sup>165</sup> In its first years the initiative was funded by New Zealand Trade and Enterprise,<sup>166</sup> and later by Callaghan Innovation through the Ministry of Business, Innovation and Employment (MBIE).<sup>167</sup>

The programme employed Regional Facilitators who connected with primary and secondary schools to provide support and information for teachers. IPENZ members volunteered as Futureintech Ambassadors, giving presentations at careers evenings and going into schools to talk to classes about their careers and to support students' curriculum-based work on technology projects. Futureintech also produced a newsletter for industry<sup>168</sup> and a website<sup>169</sup> with information for teachers, careers advisors and students about STEM careers. In 2017, the programme had 947 registered ambassadors, 46 percent of whom were female, and reached 48,818 students in 347 schools.<sup>170</sup>



Airworthiness engineer and Futureintech Ambassador Andrea Wadsworth, 2017. Photo: Engineering New Zealand

## Conclusion

By 2010, the issues women still sometimes came up against in the workplace were much better understood and proactively addressed by companies. Women's enrolment in engineering courses at Auckland and Canterbury were stable at just above 20 percent and universities and IPENZ maintained and strengthened their outreach programmes to schools.

## **DIVERSITY IN 2010-2024**

In 2014, women made up approximately 13 percent of professional engineers,<sup>171</sup> up from 4–6 percent in 2006.<sup>172</sup> This was a notable and sustained increase and helped to begin to normalise women's presence in the profession. After opening the way with more complex and challenging conversations through the early 2000s, the 2010s saw significant progress and action. Existing groups and work programmes were now well established and there was support for new and bold initiatives. Diversity and inclusion received greater recognition and engineering firms, universities and IPENZ all showed commitment to these principles.

## **Women in construction**

There was momentum in the 2010s to address even the most difficult areas and issues. A space that had long been considered a challenging one for women was construction sites. Women often reported feeling very conscious of their gender while on site and an accompanying pressure to prove their capability. Commonly reported issues included quips or inappropriate jokes, assumptions that they were in a junior role or not the engineer, a lack of safety gear in women's sizes, and being told there were no toilet facilities for them.<sup>173</sup> While some workplaces had always provided good support for their women staff going onto a construction site, some were unaware of how uncomfortable sites could be for women. An increasing focus on diversity and inclusion through the 2010s meant that any issues of discrimination or harassment were no longer just women's issues but applied equally to everyone and were therefore easier to talk about. Companies had clearer policies in place and were willing to call out inappropriate behaviour.<sup>174</sup>



Structural engineer Diana Barr and civil engineer Sina Cotter Tait working on site as part of the Christchurch rebuild, 2013. Photo: © Stuff Limited

One organisation that had long been supporting women in this space is the National Association of Women in Construction (NAWIC).<sup>175</sup> NAWIC is an international non-profit association founded in the United States in 1952. NAWIC New Zealand has been active in Wellington since 1996, and grew its presence in other regions through the 2010s. An Auckland chapter formed in 2012, and in 2024 there were chapters in seven other regions around the country.<sup>176</sup> NAWIC supports, advocates for and celebrates women in construction. It runs in-person and online events – technical and professional development, site visits, speakers, networking, information sharing, and an annual awards evening – the NAWIC Excellence Awards.<sup>177</sup> Women interviewed for this project shared their appreciation of the support and connections they have found as members of NAWIC.<sup>178</sup>

## Universities

In the first decade of the 2000s, the percentage of women enrolling in engineering at the University of Auckland hovered in the low 20s. This pattern continued until the second half of the 2010s when numbers at both Auckland and Canterbury began to show a sustained upward trend, reaching as high as 28 percent at University of Auckland in the early 2020s.<sup>179</sup> Groups and programmes to support women engineering students were now well embedded at universities and received strong support from engineering faculties. Although still a minority, particularly in some disciplines such as mechatronics, women were an established presence in engineering schools and more comfortable to be themselves.<sup>180</sup>

#### Support for women students and outreach to high schools

By the 2020s the University of Auckland's Women in Engineering Network (WEN) had backing from both the university and industry and was an integral part of welcoming new female engineering students to the school. Students were automatically members of the group when they enrolled in engineering intermediate and ticked female or gender diverse on their enrolment form. The group runs many social, networking and professional development events throughout the year including meeting employers, speed interviewing, speed friending, as well as a mentoring programme that connects undergraduate students with industry partners. Mentors might be alumnae or from companies that have signed up as programme sponsors.<sup>181</sup>

Students at University of Canterbury are also supported by their Women in Engineering (WiE) club. By the 2020s, the club had grown to approximately 800 members and offered students a full calendar of educational, industry and social events and a mentoring programme that matched students with industry professionals.

Both universities also continued to strengthen their outreach programmes to high schools. At University of Auckland, Enginuity Day continued to be a popular event for high school girls to explore the range of engineering disciplines offered at Auckland.<sup>182</sup> And a schools outreach programme offered classroom visits with volunteers from WEN running hands-on workshops with students, giving them the opportunity to apply their knowledge of physics, maths and coding.<sup>183</sup>



Students attend University of Auckland's Enginuity Day, 2021. Photo: Richard Ng/ University of Auckland

In 2019 the University of Canterbury launched WiE CAN (Women in Engineering at Canterbury), a 5-day/ 4-night residential programme for female high school students who have just completed Year 12. The programme involves interactive workshops and presentations where students complete hands-on projects and get a taste of the different engineering disciplines the university offers.<sup>184</sup> After reading about similar schemes overseas, Professor Philippa Martin of Electrical Engineering took the idea to Professor Jan Evans-Freeman, who was then the College of Engineering Pro-Vice-Chancellor. Together they took the idea to the rest of the College team and developed the current programme. It was important to Jan that the programme was immersive and that students take at least one physical thing home with them that they had been involved in making.<sup>185</sup> In 2024 the programme is still going strong and attracts five times as many applicants as the 60 places available. About 50 percent <sup>196</sup> of the students attending the programme go on to enrol in engineering at University of Canterbury.<sup>187</sup> The programme has had a noticeable impact on enrolment numbers at Canterbury, shifting the percentage of women enrolling in engineering from 17–19 percent in 2017–2018 to 20–25 percent through 2019–2023.<sup>188</sup>



Students taking part in activities at WiE CAN camp, 2024. Photo: University of Canterbury

#### University academic staff

As well as outreach programmes and support for current students, universities had also been developing programmes to support their women staff. Through into the 1990s the expectation that women academic staff would take on pastoral care for the female students in their department was an extra burden on women already expected to take an active role in the ongoing campaign to attract women students to the engineering school and to champion gender equity.<sup>189</sup> By the early 2000s both Auckland and Canterbury universities had women in leadership programmes and equity and diversity plans.<sup>190</sup> Through the 2010s women were still underrepresented in senior academic positions (Associate Professor and Professor) across the university but this percentage was steadily increasing.<sup>191</sup> At the University of Auckland, women in senior academic roles increased from 24 percent in 2010 to 34 percent in 2018.<sup>192</sup>In engineering departments, numbers of women in academic roles have fluctuated over the decades and in 2024 women remained underrepresented. Women academic staff in engineering have been important role models for female students. Staff at University of Auckland observed anecdotally that where first year courses had been taught by women, female students were more likely to choose those disciplines for their specialisation.<sup>193</sup>

At the University of Auckland, women were part of the Engineering School academic staff as early as 1973 when Dr Mary Farmer was employed as a part-time lecturer.<sup>194</sup> Other early women academic staff in the school included Sue Truman who joined in 1975 as a junior lecturer after completing her PhD in Materials Engineering, <sup>195</sup> and Susan Byrne, appointed in 1986 as a lecturer in the Department of Theoretical and Applied Mechanics.<sup>196</sup> Margaret Hyland joined the University of Auckland in 1989 as a lecturer in Chemical and Materials Engineering. At the beginning of 2013 she was promoted to Professor - making her the first woman full professor in the engineering faculty. Between 2012–2017 Margaret also served as Deputy Dean of the faculty.<sup>197</sup> In 2003 there were 12 women academic staff in the faculty and three research scientists.<sup>198</sup> Rosalind Archer joined the University of Auckland in 2002. She was appointed Professor in September 2013 and served as Head of Department, Engineering Science, 2013–2020.<sup>199</sup> She was the first woman to become a Head of Department in the Faculty of Engineering, 200 She was then appointed Deputy Dean of Engineering, 2020–2021.<sup>201</sup> In 2021 Rosalind also served as Engineering New Zealand's third female president.<sup>202</sup> Other women in senior positions in the Engineering Faculty at University of Auckland have included Suzanne Wilkinson, who joined the Department of Civil and Environmental Engineering in 1996 and was promoted to Professor in 2014;<sup>203</sup> and Bryony James, who after completing her PhD at University of Auckland, joined the academic staff in 1997 and was Professor, Chemical and Materials and Deputy Dean (Research), 2016-2020.<sup>204</sup>

At the University of Canterbury, the first women academics joined the engineering faculty in the 1980s. Early women academics in the engineering school included Anne Ditcher who joined as lecturer in Mechanical Engineering in 1981,<sup>205</sup> and Kathryn Garden who completed her PhD in Electrical and Electronic Engineering at Canterbury and began as a lecturer in the department 1986.<sup>206</sup> Susan Krumdieck was the mechanical engineering department's first female full professor, appointed in 2014.<sup>207</sup> Susan joined the University of Canterbury in 2000, and from 2000–2005 was the only woman academic on the engineering staff.<sup>208</sup> In 2009, the university appointed Jan Evans-Freeman as Pro-Vice-Chancellor, Engineering. She was the first woman to fill this role. She served in this post until 2021 when she took up the role of Pro-Vice-Chancellor of Sustainability, at the University of Canterbury.<sup>209</sup> During her time as Pro-Vice-Chancellor of Engineering, Jan worked proactively to support women academic staff, taking the time to ask about their aspirations and to offer opportunities that would give them the experience they needed as prerequisite for promotion.<sup>210</sup> By 2023, women made up 23 percent of academic staff in the engineering department at the University of Canterbury, a significant increase on 2009.<sup>211</sup>

## **IPENZ/Engineering New Zealand**

Through the 2000s IPENZ had expressed concerns about the number of women leaving the engineering profession and the challenges women faced in attempting to balance work and family life. In 2010 the Institution took a more active role in trying to address these issues. IPENZ looked to position itself as a change leader and to collaborate with industry to better understand the challenges for women and to develop achievable actions to begin to address them.

In March 2011, IPENZ launched its Affirmative Action Programme with the aim to "support women to enter, remain and advance in the engineering profession."<sup>212</sup> The programme was guided by an oversight body made up of business leaders and IPENZ Board Members.<sup>213</sup> The first actions under the programme were to undertake research to better understand the current situation, women's experiences in the profession and the barriers they faced; to establish a business case for diversity; and to complete an audit of the Institution's own policies and practices.<sup>214</sup>

The results of a survey and interviews undertaken as a joint research project in collaboration with the Ministry for Women's Affairs revealed that almost 30 percent of female respondents, compared with 18 percent of men, had left the profession within five to ten years of graduating. Reasons for women leaving included not enjoying engineering or the workplace culture, or moving into different areas such as corporate finance, business analysis, or research.<sup>215</sup> A survey of IPENZ's own members showed that women were far more likely than men to have experienced sexual harassment and gender discrimination at work – 18.8 percent of women compared with 1.4 percent of men and 34.5 percent of women and 3 percent of men, respectively.<sup>216</sup>

Another challenge for women discussed in the joint IPENZ/Ministry for Women's Affairs research project was the difficulty of balancing work and family life. Despite many companies having flexible working policies, there was low uptake of these. This was attributed to company culture where part-time work meant being assigned less interesting or less challenging roles and limited career progression.<sup>217</sup> The challenges women faced in progressing their careers was evident in the uneven spread of men and women across salary bands. While there were roughly equal proportions of men and women in the mid-range salary band, there were twice as many men than women in high salary bands and three times as many women than men clustered in low salary bands.<sup>218</sup>



Michelle Dickinson AKA Nanogirl, guest speaker at the IPENZ Diversity in Action summit, August 2016. Photo: Engineering New Zealand To track and report on the success of the programme, IPENZ published annual snapshot reports. The data for these was gathered through a survey of participating engineering organisations. Other challenges for women identified through this research included a lack of visible role models and a lack of networks or difficulty in maintaining professional networks, resulting in a feeling of isolation.<sup>219</sup>

Ongoing initiatives established as part of the Affirmative Action Programme included networking events for female engineers; a bi-monthly newsletter, Engineering Diversity, for engineering leaders; and twice-yearly events with engineering chief executives "to share best practice and promote improvement of the profession's culture." <sup>220</sup> IPENZ also made a commitment to profile more female engineers in its publications.<sup>221</sup> Progress towards the programme's aims were tracked through changes in education data, IPENZ membership data and census data.<sup>222</sup>

From an initial focus on women, the programme was extended to encompass diversity and inclusion more broadly. The programme grew to include other underrepresented groups, or groups that needed specific support including Māori and Pasifika engineers, immigrant engineers and engineering technicians and technologists. In developing the programme, IPENZ worked with other professional organisations including the New Zealand Institute of Architects, who were also looking at ways to increase diversity and support inclusive practices within their profession. The programme was also successful in gaining the support of engineering firms. This collaborative approach laid the foundations for the development of the Diversity Agenda, which launched in 2018.<sup>223</sup>

In 2010, 12 percent of IPENZ members were women, this was roughly in line with the percentage of women engineers in New Zealand overall.<sup>224</sup> But the majority of IPENZ's female members were clustered in the student and graduate member classes. Only 6 percent of women were Chartered members and only 2 percent were Fellows. Women were also underrepresented across IPENZ boards.<sup>225</sup> In 2016, IPENZ launched a new strategy with the vision "to engineer better lives for New Zealanders," and mission "to bring engineering to life."226 The following year the Institution rebranded to become Engineering New Zealand. These changes were focused on "re-engineering IPENZ as a relevant and modern organisation,"227 to be member focused and welcoming to engineers of all disciplines and careers stages.<sup>228</sup> Engineering New Zealand's Technical and Special Interest Group committees and Governing Board have become more welcoming and representative. After a gap of almost 20 years since Gretchen Kivell served as IPENZ President in 1998, Elena Trout was elected president in 2016; Rosalind Archer followed in 2021 and Jan Evans Freeman in 2024. An effort has also been made to make the pathway to Fellowship and Distinguished Fellowship easier to navigate and to encourage applicants from a diverse range of disciplines, regions, ethnic and cultural backgrounds and genders to apply.<sup>229</sup> Gretchen Kivell became IPENZ's first woman Fellow in 1993. By 1998 there were three women Fellows. <sup>230</sup> By 2010, numbers had reached double digits and from then on increased rapidly. In 2024 Engineering New Zealand's membership included 50 women Fellows and six Distinguished Fellows.<sup>231</sup> Gretchen Kivell was the Institution's first woman Distinguished Fellow in 2005.232



IPENZ Chief Executive Susan Freeman-Greene and President Elena Trout, May 2016. Photo: Dave Lintott/Engineering New Zealand

## **Wonder Project**

Following a review of Engineering New Zealand's schools programme, Futureintech, the programme was revamped and relaunched as the Wonder Project in 2018. Like Futureintech, the Wonder Project aims to increase students' participation and interest in STEM and runs with the support of STEM professionals who volunteer their time to join classrooms and act as Ambassadors. Wonder Project challenges are designed to appeal to girls and boys equally and to show students the relevance of engineering to their lives. The programme was largely funded by Callaghan Innovation through the Ministry of Business, Innovation and Employment (MBIE) until May 2023 when they decided to no longer invest in STEM promotion. Despite this setback, Engineering New Zealand considered the programme too important not to continue and in 2024/2025 will move to a 100 percent industry-funded model, while seeking support from Government to reinstate a portion of funding.<sup>233</sup>



Students at St Mary's Catholic School in Auckland participate in the Wonder Project Rocket Challenge, 2023. Photo: Tim Hamilton/Engineering New Zealand

The Wonder Project is designed for Year 5–13 students and unlike Futureintech, has specific hands-on curriculum-aligned challenges for different year level groups. Students are provided with materials and guided by their teacher and Wonder Project Ambassador through the project. In 2024 the projects were the Rocket Challenge, where students build and launch a water rocket; the Power Challenge where students design and build a wind turbine to light up a mini town; and the Water Challenge where students construct and test a mini model of Aotearoa New Zealand's water network. For senior students, there is an option to visit workplaces and hear presentations by professionals about their work.

From its launch in 2018 through to 2024, the programme has been in 1,300 unique schools and with the support of over 2,000 Ambassadors has engaged nearly 140,000 students. Results of post-project surveys show 88 percent of students had their perceptions of STEM shifted positively and 50 percent of students were now more interested in a STEM career. 96 percent of teachers reported increased confidence in teaching STEM.<sup>234</sup>

## **Diversity Agenda**

The Diversity Agenda launched in April 2018. It is a joint initiative from Engineering New Zealand, the New Zealand Institute of Architects and ACE New Zealand. Its initial goal was to see 20 percent more women engineers and architects by 2021. The campaign has since expanded beyond gender to include Māori, Pacific Peoples, LGBTQIA+, disabled, neurodiverse and other minority groups.

The vision of the Diversity Agenda is for the engineering and architecture industries to be "inclusive, respectful and representative of society – where everyone feels safe and valued in their workplaces, and young people want to be engineers and architects." <sup>235</sup>

Engineering and architecture firms join the Diversity Agenda as members and receive access to resources, events, tools and tips to help them on their diversity journey. To show their commitment, business leaders then sign the Diversity Agenda Accord – committing their company to following a set of principles to promote diversity and inclusion in their workplace and to report on their progress. Reporting measures include the percentage of women in their company, percentage of women in senior leaderships roles, and the gender pay gap. The Diversity Agenda launched with 47 founding members, and in 2024, had 53 Accord signatories.<sup>236</sup> The programme is fully funded by membership fees.

"While there is still much work to do,"<sup>237</sup> the Diversity Agenda already has some wins to celebrate. Accord firms have made progress in women's representation in senior leadership roles and have closed the gender pay equity gap to 0.3 percent. 90 percent of Accord signatories also have a Māori strategy and workplan to increase their company's cultural competence in Te Ao Māori.<sup>238</sup>



Signatories at the launch of the Diversity Agenda Accord, Parliament, Wellington, 2 February 2020. Photo: Engineering New Zealand

### Conclusion

Between 2010 and 2024, conversations about women in engineering opened to include workplace culture and women's experience in the workplace. A growing understanding of the benefits of diversity and inclusion – not just for women, but for everyone – has made these conversations easier and empowered more people to take an active role in creating a culture where everyone can thrive.



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