



Kelly Harrison

From ‘topping up’ buildings with lightweight extensions to pushing the case for education in timber design, Kelly Harrison wants wood to be a mainstream structural material. **Helena Russell** reports.

Tasked with designing a timber joist on her first day at work, Kelly Harrison found herself in at the deep end. Never having been taught timber design at university, she had to seek out a textbook and labour over a three-page calculation – a struggle she was keen for other graduates to be spared.

Harrison was already battling imposter syndrome, feeling that she had fallen into the profession by chance. Her own parents had no connection to engineering, and she was the first in the family to go to university.

As a child, she was passionate about dance – in fact, she is now part of a contemporary dance company – but professional dancing was not open to her without the financial backing to pursue a risky career.

‘Once I was studying, I remembered that my uncle was a draughtsman, one grandad was a site manager and the other taught mechanical engineering at college, so I actually had a lot of male relatives in similar fields, but none of them had driven me down that path,’ she says.

‘At school, I chose the subjects I enjoyed – art, maths and physics at A level. I applied for accounting and finance degrees and got a place at Durham University, but most of my friends were going to Leeds. Through clearing, Leeds University said that while I hadn’t made it into the business school, my A levels would be perfect for civil engineering.’

Not being wedded to the idea of accountancy, Harrison took the plunge. ‘After a year, I realised that I was more interested in architectural engineering, so I asked if I could change. My professor told me to do a drawing a day over the summer break and bring my sketchbook to him. So I did that, and he let me change,’ she says.

She was somewhat lost as to an obvious career path even after graduating, until a recruiter got in touch to suggest she be put forward for some engineering jobs.

After agreeing, Harrison was hit with panic. ‘I felt like I had forgotten everything I learned at university and I was petrified of starting work. I bought Fiona Cobb’s *Structural Engineer’s Pocket Book* and read it frantically over a weekend!’

“**TASKED WITH DESIGNING A TIMBER JOIST ON HER FIRST DAY AT WORK, HARRISON FOUND HERSELF IN AT THE DEEP END**”

Finding her feet

Harrison joined BWB Consulting in Leeds as a graduate engineer and gained a wide range of experience in her 18 months; as well as timber designs, the company also did concrete and steel buildings, including industrial steel-framed sheds. But social connections drew her to London, so she started looking for a new job.

‘I had nine interviews over two days and I got six job offers! It was the boom time in 2008,’ says Harrison. She chose Heyne Tillett Steel (HTS), a small practice that had just been formed by ex-Price & Myers engineers. ‘I was employee number 11 I think!’ she recalls.

‘As it was a small company, I thought I could make a difference and have the opportunity to do much more. They had good projects so I knew they would grow.’

When the financial crash hit, things got tough. But HTS was fortunate with its clients – churches, schools and high-net-worth individuals. Anyone developing property could take advantage of cheaper build costs after the crash. ‘I got a lot of experience with timber as a result,’ she says. ‘Churches and schools are always keen to use timber – whether that’s in a heritage context or to benefit health and wellbeing, increasing the attention span of pupils and so on.’

This familiarity with timber came into its own once commercial projects started coming forwards again. ‘I was repurposing and retrofitting central London offices, the majority of them listed buildings. We suggested adding

CAREER MILESTONES

2006	Graduated from Leeds University with BEng (Hons) in Architectural Engineering
2006	Joined BWB as a graduate engineer
2008	Joined Heyne Tillett Steel as an engineer
2012	Became a chartered structural engineer
2016	Promoted to associate at HTS
2020	Joined Whitby Wood as associate director
2020	Became a board member at Timber Development UK
2022	Promoted to director at Whitby Wood
2024	Launch of Optoppen online tool



FIGURE 1: An early highlight was designing a steel-and-timber walkway for London's Science Museum



to them with engineered timber – it was light, beautiful and quicker to build. It wasn't necessarily about sustainability at the time – no one was counting carbon then.' Not many engineers were working with timber and she saw an opportunity to let others benefit from her experience, remembering her own lack of knowledge.

'Students aren't taught it and engineers don't know about it unless they've worked on projects, so this knowledge needed sharing. I went to some talks on timber at Futurebuild, where I asked lots of questions; after that I started getting invitations to do presentations at other events.'

Not all Harrison's work was in timber. 'One of my career highlights was a walkway designed for the Information Age gallery in London's Science Museum (Figure 1). It was a 120m long, super-thin, steel-and-timber elliptical walkway and it won a Structural Award in 2016,' she says. 'We had to work around all these exhibits that were going in the new gallery. I would get the strangest requests, such as how a Russian communications tower could be safely supported by the rather complicated 1950s floor slab.'

Branching out

Harrison's interest in promoting timber was not restricted to giving talks: HTS had been working with City University on research into composite action between cross-laminated timber (CLT) and glued laminated timber (glulam) using only screwed connections. 'Glulam is in the Eurocodes but CLT isn't yet – there is a rudimentary equation you can use to calculate composite action between different types of timber, but it includes a factor of safety intended to cover the capacity of any type of screw. In fact, you can get very high-performance, tested screws that have a much higher capacity; you can also increase the capacity of the screw quite a lot by putting it in at an angle.'

'We wanted to prove that in the serviceability state, for deflection and vibration – which drives most of our designs - glulam beams with a CLT slab perform much better than the calculation suggests, which we did.' Presenting the results at a conference led to Harrison being approached by Nick Milestone, who was TRADA chair at the time and invited her to join the board of directors.

That role taught her more about organisational change than anything else; at her first board meeting, TRADA took the decision to merge with the Timber Trade Federation, eventually leading to the formation of Timber Development UK. There was a positive outcome, she says: 'There has been the most amount of change; involvement with government, international trade, lobbying, university design challenges, and a knowledge platform online where a proportion is available free of charge.'

Broader horizons

After almost 14 years at HTS, Harrison decided she was ready to move on. 'It was amazing to see the company grow. But I found myself looking beyond project work to systems and processes and how we could change things,' she explains.

She met Mark Whitby through the Engineering Club, and his business partner Sebastian Wood through a masterplan competition where Whitby Wood was the other engineer alongside HTS.

'They are both very focused on the bigger picture; Mark has the ability to hone in on the one thing that can change everything. Within five minutes he can identify the one detail on a building that holds the key to getting the design right.'

In the middle of the Covid pandemic, Harrison met with them on their roof terrace to talk about joining. During the conversation, she found out that Whitby Wood had just won a competition to build a new all-timber building at the

FIGURE 2: The opportunity to design an all-timber building at the University of Arkansas helped persuade Harrison to move to Whitby Wood



University of Arkansas (**Figure 2**) – she had spoken at the symposium where the competition had been announced and knew the dean of architecture at the university. ‘They thought they might have been a bit ambitious, but it all felt like it was meant to be.

‘It was a really interesting design process – the school of architecture wanted the students to learn from it, so we started with each discipline hosting a three-hour charette to explain what their focus and aims were. This extended to the end users – the students and staff – as well.

‘When we realised it was going to be 30% above the client’s budget, we were able to quite quickly go round and find the necessary savings. We understood what each discipline was willing to change or lose, and what was non-negotiable.’

Research interest

Harrison found herself getting more involved with research. ‘I met lots of people wanting to do timber research, including Will Hawkins at Bath University who introduced me to the UK FIRES programme. I joined this pan-industry, Engineering and Physical Sciences Research Council-funded research consortium led by Cambridge University to advise on a PhD exploring zero-carbon construction, which brought me into contact with a much wider body of research.

‘My passion for better timber education has transitioned to a passion for better communication of research!’ she says. ‘Engineers don’t think to search research portals. I’ve been fortunate through TRADA, etc. to know about some of that stuff, but it’s not on the radar for most engineers.’ The rigid format demanded for peer review and formal publication of papers is unhelpful for non-academic readers, Harrison points out. ‘Practitioners want to know what the outcome is and why.’

Topping up

Exploiting timber to make reuse and upward extension of buildings feasible is one of Harrison’s specialities. Last year she unveiled Optoppen (www.optoppen.org), a web-based tool that building owners can use to explore the opportunity for such projects.

The development of the tool was led by Whitby Wood, funded by a grant from Built by Nature and developed with partners from the Netherlands (where the word ‘optoppen’ meaning ‘topping up’ comes from), the UK and Spain. The aim is to give clients confidence to consider upward



STUDIO RHE

FIGURE 3: The Optoppen database includes timber case studies such as the Gramophone Works, a project Harrison worked on while at HTS

“ EXPLOITING TIMBER TO MAKE REUSE AND UPWARD EXTENSION OF BUILDINGS FEASIBLE IS ONE OF HARRISON’S SPECIALITIES

extension right at the start of a project, before they engage a full project team.

Optoppen provides a high-level structural assessment, reporting how much floor space could be created and the amount of carbon stored in the mass timber. It also offers an inventory of case studies such as the award-winning Gramophone Works in London (**Figure 3**), one of the projects Harrison worked on while at HTS. Four new floors were added to the 120-year-old building using CLT and glulam as the primary structural materials and making it one of Europe’s largest wood-framed office buildings.

Sustainable thinking

Another of Harrison’s recent projects is Zodiac in Croydon, where a former office building was transformed into 73 homes for temporary accommodation for developer Common Projects, and subsequently sold to the local council. ‘Here, we referred to ourselves as “structural police” rather than structural engineers, creating “heat maps” showing where openings could be more easily made, where was the best place to put services, and heavy items, for example. We did quite a lot of investigations and worked closely with the architects to

make sure there was adequate access, add smoke ventilation and drainage, while trying to simply adapt the existing cores,’ Harrison says.

At Whitby Wood, she is now assembling a team to provide a new advisory service built around proactive sustainability strategy, including whole-life carbon. It will enable clients – including investors and planners – to meet funding and regulatory requirements, make informed investment decisions, and protect the value of their assets; as well as find the most sensible route to making a development resilient.

‘The intelligent investors want to understand their climate exposure, and they need support to make sustainability decisions to reduce it. We might focus on renewable energy for one specific asset – what’s the grid capacity, will you need to invest in renewables or can you tap into what’s there – or perhaps they need a portfolio-level whole-life carbon reduction strategy?’

‘If it’s a large housing development, we look at what typologies they are choosing. If it’s next to fenlands and they are building single-family terraced housing, could they be using lower-impact materials like straw and timber composite panels? Is there a local timber merchant? Maybe they could invest in them to partner with a straw supplier to increase local skills, employment and create local opportunities,’ Harrison says.

‘In an urban setting, you might look at which buildings are due to be demolished, ask for their pre-demolition audits and consider reusing materials. It’s not only a circular materials approach, it’s a circular societal approach that gives back to communities.’



tse@istructe.org



@IStructE
#TheStructuralEngineer



#TheStructuralEngineer