



IMPROVING PRODUCTIVITY
IN CONSTRUCTION TO DRIVE
SUSTAINABLE GROWTH



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Foreword

One of the biggest questions facing the industry is how construction and infrastructure companies can become more commercially, financially and operationally secure. Tens of thousands of jobs, billions of pounds worth of investment and the increasing needs of a frustrated public are at stake. The answer, though, lies well within reach.

Our experience working with contractors, subcontractors and clients, across multiple sectors, has taught us that it is not the sole responsibility of the end organisation to make the real difference. All contractors and infrastructure clients rely on a broad and deep supply chain of specialist organisations.

Each specialist is an expert in its field and many are a source of innovative engineering, helping deliver results more quickly, safely and efficiently. The key is to unlock expertise within these specialists.

Calls for more collaboration, better risk-sharing, greater diversity and embracing digital engineering are not new, but it can be difficult to precisely evaluate the benefits and understand what is possible, holding some organisations back.

Those contractors and clients that are embracing new ways of working are now benefiting from lower costs, reduced risks and faster implementation, with less disruption and increased efficiency. These benefits are being unlocked by expert engineers embedded in small and medium-sized specialist companies who, every day, innovate, cut costs and reduce risks.

Across construction, this is a new way of working and we must all play our part if the country is to fully benefit from its significant investment in the industry. All this is set against a backdrop of Brexit, the skills crisis, a weak currency and instability amongst some of the world's biggest construction firms.

The challenge is great, but everyone knows the UK construction industry needs to change, quickly.



Juliette Stacey,

Group Chief Executive Officer,
Mabey



How can we address the productivity issue in construction?

The UK construction industry has a productivity problem. The government has ambitious plans to change this: cutting costs within the industry by a third by 2025, as well as improving outputs and outcomes to tackle the sector's annual £15 billion productivity gap.

In this report, we define three key areas to address productivity:

Collaboration:

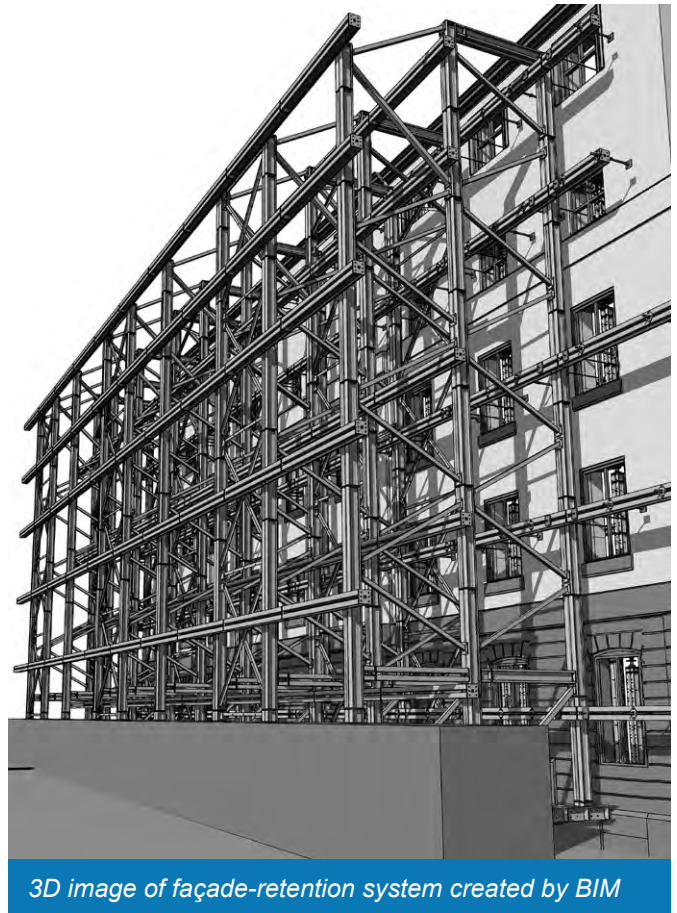
A clear and agreed understanding of the right solution, alongside well-defined outcomes, means that projects are much more likely to be completed on time and on budget. But this can only be achieved through collaboration.

Modernisation:

Proven new approaches exist, such as Building Information Modelling (BIM) and automation. Examples in this report highlight how applying technology can reduce a project's time and expense by 20 per cent or more, whilst enabling a far greater level of collaboration across the key parties.

Skills and diversity:

The industry continues to be viewed as a male-dominated, mucky and manual environment. With a rapidly retiring workforce and women representing just 13 per cent of people working in engineering, the challenge to achieve greater diversity is immediate, but resistance to new technologies makes this industry's image hard to shake.



3D image of façade-retention system created by BIM

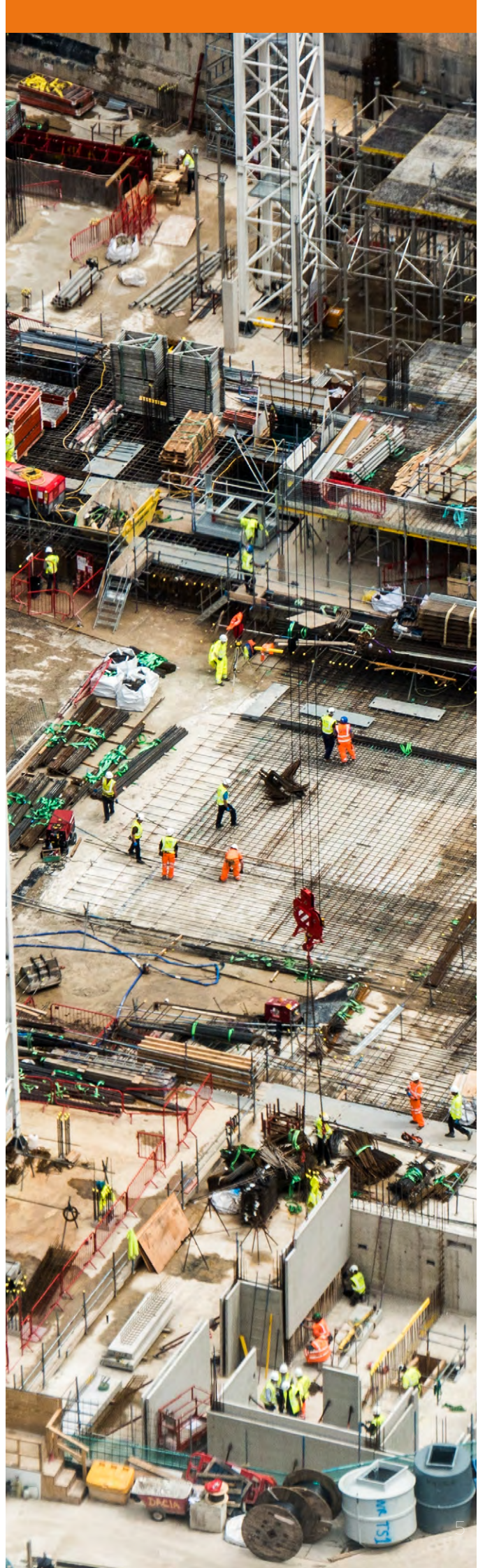


Mabey engineer on site in its Garswood depot

STEP 1

Achieving collaboration and communication across the supply chain

Collaboration enables the sharing of ideas, which enables innovation. When teams with different experiences, different ways of looking at things, and a broad range of skills come together, problems are solved faster.



CASE STUDY: INNOVATION FOR CANNING TOWN FLYOVER

Mabey's collaborative approach, which included more than 70 multi-skilled engineers, created a cost-effective way to safely carry out Crossrail tunnel excavations without having to close the Canning Town flyover, which ran directly over the top of the site.

London's Crossrail development required a tunnel directly underneath the Canning Town flyover, which is a third of a kilometre s-shaped multi-span viaduct that carries the Docklands Light Railway (DLR).

The works needed to take place safely without causing any disruption to the DLR service. However, the viaduct could only withstand a few millimetres of movement from the tunnelling. The challenge was how to bore one of the largest tunnels in London directly under a sensitive structure, mitigating against potential movement and keeping the viaduct and service open.

Initially, there was no obvious solution to the problem. No single engineer, or team, could find the answer on their own. Mabey corralled a specialist team of more than 70 engineers from multiple parties, with an array of skills from electronics and geotechnics through to civil and software engineering. This team assessed different options based on previous experiences, as well as working directly with the engineers who originally created the viaduct.

The solution saw the viaduct raised on hydraulic jacks, each linked and centrally operated to control vertical and horizontal movement and support the viaduct within tolerances.

The structure was monitored in real time to an accuracy of 0.3 millimetres. This allowed engineers to respond with any corrective actions via the highly accurate jacking system, ensuring the DLR continued running.

This final design statement was a result of a huge collaborative effort across multiple parties, including the client Dragados Sisk JV and project stakeholders Crossrail, Transport for London, Docklands Light Railway, London Underground and Newham Council.

“Communication was critical in ensuring the project took place in the necessary time frame, not only with the parties directly involved, but also with the local authorities, schools and councils who could potentially be impacted by this project. A clear statement of work outlined the initial project plan, but more importantly flagged any issues that could occur and the appropriate responses we had in place. This helped reassure the 70 plus parties involved, keeping the project plan and timeline on track.”

Stephen Hubbard

Chief Engineer,
Mabey



Tapping into unexpected pockets of productivity

Although often short-lived by nature, temporary works are a critical part of almost any permanent project.



“Despite the requirement for temporary works, there is nothing tangible to see at the end apart from the completed project. So, the tendency has been to focus on making the permanent works more efficient. However, it’s now understood that temporary works are one of the most critical parts of any project. They allow permanent works to be carried out more quickly, safely and efficiently, and they can unlock huge efficiencies in the overall project if the right approach is taken from the start.

These efficiencies range from speeding up installation by prefabricating off-site, through to eliminating the need for road or rail closures due to well-designed installations. Early contractual involvement is necessary to deliver the best approach.”

Dave Holland

Engineering Director,
Mabey



CASE STUDY: Cutting Kirkthorpe Hydropower equipment costs in half

Using proprietary equipment enabled Mabey to recommend a propping solution which halved the installation time and cut costs by 50 per cent compared to other propping solutions.

Kirkthorpe Hydropower will be the largest hydro scheme in Yorkshire, generating around 2.3 million units of carbon-free electricity per year. Salmon, eels and other migratory fish will be able to pass the hydro scheme's weir safely, protected by a large inlet screen.

Mabey was invited by Eric Wright to the initial tender meeting. This early involvement allowed both parties to work closely together, along with engineers PaSCo Consultants, to evaluate the temporary works requirements. Due to the complex shape, various support methods were required, which were evaluated on their overall cost benefits to the project.

Eric Wright adopted a tie back system for the curved sections and top-level support. Mabey was tasked with the lower frame propping of a nine metre deep central section of a cofferdam which would encompass the turbine area of the project and the complex surrounding structure. The load on the lower frames in the deepest section of the cofferdam was 570kN/m, which is high for proprietary shoring equipment.

Mabey recommended Supershaft Plus as the strongest proprietary brace on the market, which allowed maximum spacing of the cross struts. Using proprietary equipment meant the installation and removal time was halved compared to using on-site fabrication of frames with structural steel, which would have also been more expensive. Mabey's approach overall cut the budgeted costs of equipment by 50 per cent.



Mabey's Supershaft Plus system halved the installation and removal time of works at Kirkthorpe



Aerial view of Mabey's propping system in Kirkthorpe

Four steps to achieving better collaboration:

There is no set formula for good collaboration because we face different challenges and a range of skills and personalities on every project we embark on. However, there are some essential steps based on our experience of working with multiple parties, that other organisations can adopt to change the way they operate.

1. Clearly establish roles and responsibilities from the beginning of the project

Accountability is key. Defining a project plan with a clear set of roles and responsibilities to achieve a positive final outcome from the outset will help ensure that all project elements are delivered on time and on budget.

2. Early contractual involvement

Early input from every supply chain partner – not just the upper tiers – before plans are firmly set in place, will enable relevant parties to analyse proposed plans of activity, assess key challenges, and make the best recommendations. This can result in lower costs through efficiencies and unlock innovation.

3. Look for clarity, transparency and honesty

Ensure regular communication between different supply chain parties, including face-to-face meetings and progress updates, together with clear and concise reporting methods.

4. Look for consistency

Working with a partner who has a team with previous experience on a similar project will naturally lend itself to solving future project challenges. Does the team have experience in the local area, with knowledge of any cultural, political and geographical challenges, for example?



Engineers and locals join forces to build a bridge in Namibia

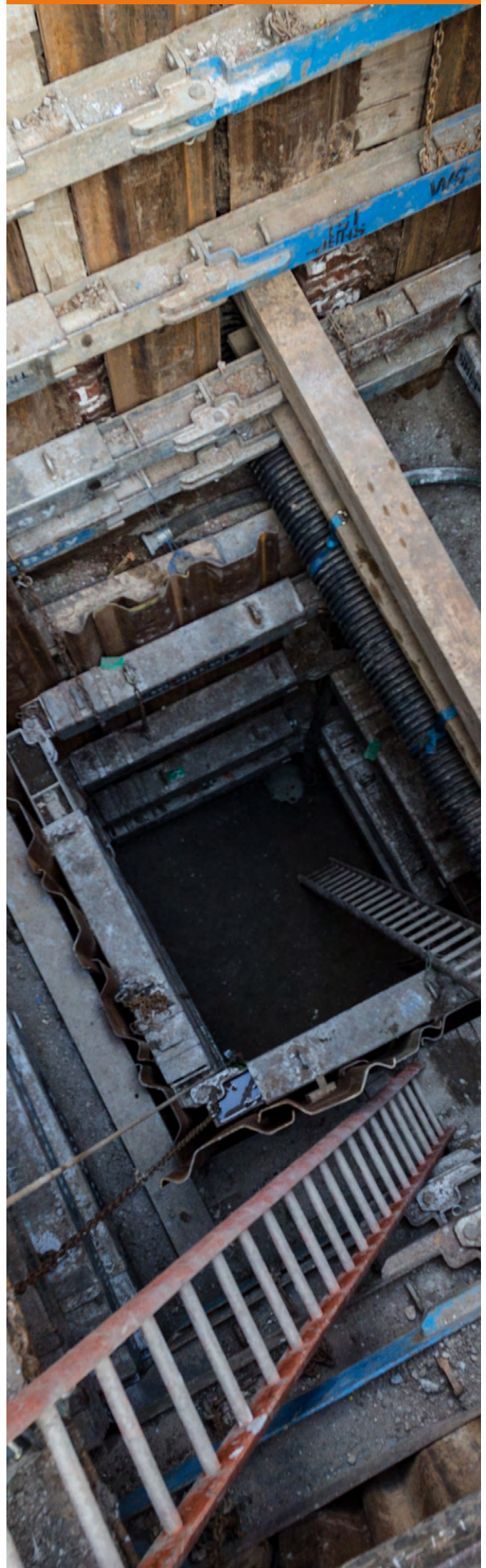
STEP 2

Investing and modernising: A new approach to production

An ongoing housing shortage in the UK has gradually led to new construction methods being adopted within this sector. The traditional on-site brick-by-brick approach is increasingly being replaced by prefabricated parts built off-site, and final assembly on-site. As political pressure to produce more affordable yet high quality housing continues, more than two thirds of house-building companies are investing in some kind of modular or prefabricated housing¹.

The wider construction industry though, has been slower to catch on. Perhaps in part due to the more complex nature of the infrastructure projects being developed, or the comfort of 'sticking with what you know'. Either way, there are huge productivity benefits to reap when following the example of the housing industry.

Prefabricated, modular bridging is a key example of where the construction industry can make the most of these benefits, and quickly. Many of the construction sites Mabey works on are difficult to access, may have limited space on-site, and need a quick solution at a low cost. Modular off-site construction eradicates external factors such as lack of space and extreme weather, as well as reducing on-site dust and noise. Faster speed, combined with a standardised design reduces labour, material costs, and assures a high and consistent quality. Taking a modular approach ensures greater flexibility and responsiveness in line with changing needs within any project.



CASE STUDY: Shaving months off Colongra Power Station construction with modular bridging

Mabey demonstrated that modular construction can shave months off temporary works, when working with leading Australian infrastructure company Ertech at the Colongra gas generation plant.

With urgent repairs to the original access bridge required, Mabey's engineering team suggested a temporary bridge - the Mabey Compact 200 - to enable works traffic to continue to access the site without disrupting the construction of the plant. The bridge was prefabricated and assembled on-site in just four days by seven people.

With standard, interchangeable components, modular steel bridges can be installed significantly faster and bear the weight of the largest vehicles and equipment brought to the site. Steel is lower in cost compared to concrete, and the environmental impact is reduced both via construction methods and the recycling possibilities. In this case, using a modular bridge shaved several months off the project timeline.



Mabey's Compact 200 (C200) bridge at Colongra Power Station

Achieving innovation in modular construction

Mabey is working in partnership with global design and engineering consultancy, Arup, on the world's first modular glass-fibre reinforced polymer (GFRP) bridge, Pedesta. This is a pre-engineered, modular, and fully customisable bridging solution which can speed up infrastructure projects due to ease of installation.

The system features identical modules, one metre in length, which are fixed together with bolted shear connectors and then post-tensioned. The system can accommodate spans of up to 30 metres, so it can adapt to any application. In addition, being 70 per cent lighter than steel, the modules can be lifted by pallet truck or forklift, enabling faster, safer and more efficient project delivery once they are on-site.



Mabey and Arup deliver the first rapid assembly, polymer, modular bridge

A digital-first approach across the supply chain

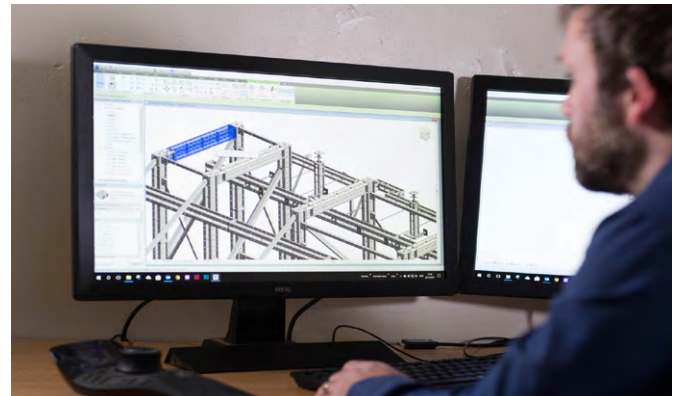
From creating three-dimensional models of live projects, to integrating real-time data from infrastructure monitors into BIM, digital engineering is transforming the speed, safety and efficiency of delivering construction projects.

Embracing digital tools and technologies is allowing us to develop industry-first techniques and enables us to tailor the support we give customers by providing better insight and enabling teams to collaborate.

Through Mabey's team of experts, who have spent hundreds of hours working with contractors and other supply chain parties, our existing BIM solution has been further developed to provide a 'live' advanced 3D model of buildings, rail, roads and bridges with physical and environmental data.

'Live BIM' is an industry-first solution that will see existing 3D models of buildings, rail, roads and bridges connected with thousands of real-time sensors, providing a visual and comprehensive picture of how structures are behaving through live graphics. This delivers valuable insights into the lifecycle of construction, civil engineering projects and infrastructure.

With dedicated engineering support, customers can click into sensor readings on the live visualisation of a structure, making it far easier to access and understand information than on spreadsheets. Digital graphics which can change shape and colour in specific areas, also enable project teams to address any issues as soon as they arise, reducing the impact on the timeline and cost of a project.



Mabey digital engineer analysing the 3D digital model of a project site

CASE STUDY: Real time monitoring at Bank Station

Accurate real-time monitoring combined with Mabey's jacking solutions have enabled tunnelling at Bank Station to take place as planned, whilst protecting the integrity of a high-rise building above.

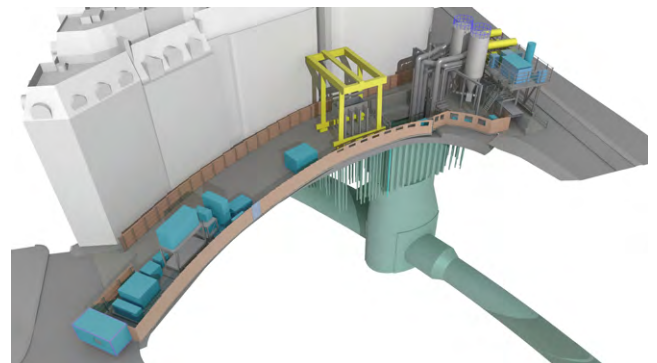
Rapid population growth and an increasingly dense urban environment, means that engineering challenges are becoming more intricate and complex than ever before. Tunnelling in London is a prime example, with larger tunnels now being created in smaller spaces, which can be feet apart from existing excavations and critical building foundations.

The latest upgrade plans for Bank Station is one such example where assurance and planned mitigation was critical. With more than 100,000 passengers using the underground station every day, Dragados is carrying out three major operations for Transport for London to improve capacity and relieve congestion. This includes the construction of a 570m tunnel and platform for the southbound Northern Line, converting the existing tunnel into additional circulation space and the construction of an additional tunnel to house two moving walkways.

Directly beside one of the worksites sits a multi-storey building, with a full glass façade. With the building's foundations sitting so close to excavation work, even movement of one and a half millimetres could jeopardise this façade.

As with any new construction works, movement can and will happen below ground. However, this movement can be mitigated through smart engineering solutions to protect adjacent buildings. With the 33 King William Street development being potentially impacted from any movements below ground, Mabey and Dragados developed a mitigation system which allowed works to be carried out safely adjacent to the building.

Accurate real-time monitoring of the height and position of the existing building columns ensured that any movement resulting from the tunnelling work, never exceeded set parameters. Any vertical movement of the building from activity below ground was controlled by a series of hydraulic jacks, while horizontal movement was managed by electric screw jacks. In the event of any small movements, a jacking system returned the columns to their original position. This allowed a comprehensive action plan and resolution for the excavation works to go ahead as planned.



Accurate real-time monitoring was used to ensure movement from tunnelling work never exceeded set parameters



Assurance and planned mitigation from Mabey and Dragados enabled safe tunnelling work at Bank Station, which was in extremely close proximity to a glass building

Robotics to drive efficient operations

In 2017, specialist robots demonstrated they could lay bricks six times faster than people. Soon, we will see robots that can perform risky manual processes in construction safely, but at greater speed.

Mabey builds and delivers some of the world's most popular modular bridges globally and is constantly looking to refine this process to accelerate its own manufacturing and construction processes. This is alongside helping customers achieve their construction goals more quickly, safely and efficiently.

Technology has always been a critical part of this and Mabey has been using robotics at its bridge production site in Lydney, Gloucestershire, for more than 20 years. Recently, more than £2.5 million has been invested to develop new robots to support more efficient manufacturing of the Mabey Compact 200 bridge. This is reducing manufacturing time for the C200's panels and chords by almost half and therefore doubling Mabey's production capacity, as well as reducing the manual handling elements in products, leading to enhanced safety. Overall, these reduced manufacturing inputs also enable Mabey to increase quality and pass on faster delivery times to customers.

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Cutting-edge robotics in Mabey's Lydney factory



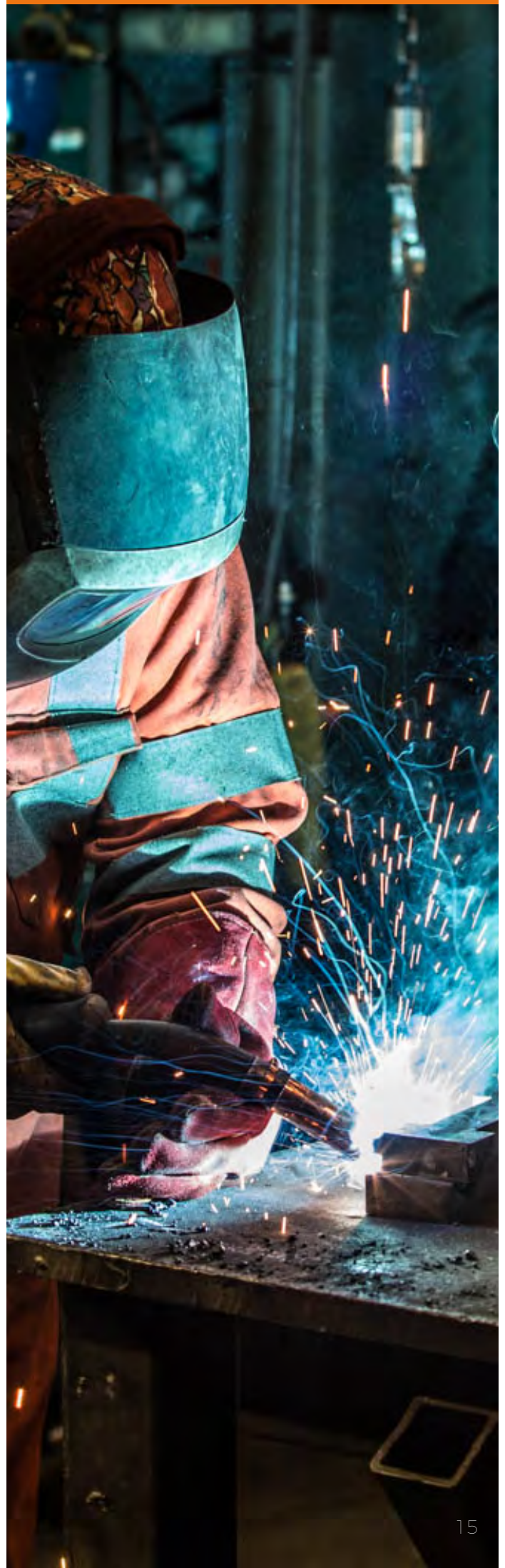
Robots have almost halved manufacturing time for Mabey's C200 bridge

STEP 3

Addressing the skills issue

A shortage of skilled workers in engineering and construction is an issue that has plagued the industry for many years, and it is greatly holding back productivity and growth. Engineering firms in the UK need to find 182,000 people every year until 2022 to cover retirements and expected growth within the industry² .

This skills gap will continue unless the industry attracts more individuals from more diverse backgrounds and provides the necessary training and development for an ageing workforce. Not doing so would be a missed opportunity in an era of huge investment in UK infrastructure, with projects such as Hinkley and Thames Tideway bringing new employment prospects.



Improving access and attractiveness

Increasing entry-level roles and investing in training and development is a good first step for organisations, however the industry really needs to shake off its old image if it is to fill these positions with the most promising new talent.

It requires creative, practical and problem-solving skills in abundance, yet this is not fully communicated in schools, so many fail to understand the prospects a career in construction presents.

The government has recognised this is an issue and has named 2018 as the Year of Engineering. With an estimated shortfall of 20,000 engineering graduates per year, it aims to showcase the creativity and innovation of engineering careers and widen the pool of young people who consider the profession.

At Mabey we are working to entice young engineers head-on through diverse and engaging graduate and apprenticeship programmes. We are also committed to growing the industry and are taking a lead role in inspiring broader interest in engineering as a career path through our Science Technology Engineering and Maths (STEM) ambassador scheme. This includes a new collaboration with LEGO where we are going into primary schools to explain the principles of civil engineering in a more fun and practical way. It is important that the industry taps into the minds of young people whilst they are still at school, so that we can dispel myths and inspire interest in the great construction projects made to the country. This includes showing how construction is an industry providing equal opportunities for all talent, regardless of age, gender or ethnicity.



Mabey's C200 bridge being installed over a river in Chile

Redressing the gender balance

According to a report by Balfour Beatty³, just 13 per cent of the construction sector's workforce are female. Gender diversity can have a huge impact on productivity, with Network Rail reporting that their teams that are more than 20 per cent female are more engaged, safer, collaborative and more motivated⁴.

Mabey puts a strong emphasis on encouraging and inspiring women as future leaders, and we are proud members of Construction News' 'Inspire Me' campaign. This initiative aims to celebrate the careers of women in the construction industry and empower them with the knowledge and confidence to advance their careers to senior positions. This in turn will help to improve productivity, reduce costs and speed up the delivery of construction projects.

By 2022, Mabey is committed to ensuring at least 30 per cent of its employees are representative of a minority group, and at least 30 per cent of senior managers are female.

When talented people from different backgrounds come together, including an equal balance of genders, as well as from across different cultures, ethnic backgrounds and age groups, it creates a more positive, engaged and powerful working environment, helping to deliver projects more quickly, safely and efficiently.



“When I first chose to study Civil Engineering as a career, people were quite shocked about my decision to work in engineering and construction – especially my parents. There is often a misguided belief that engineering can be ‘dirty manual work’. But it’s far more diverse and creative than people expect, especially given the rapid changes in technology, including expansion of digital engineering, which has unlocked a plethora of ground-breaking innovations.”

Anna Preston

Development Team Leader and Chartered Engineer,
Mabey

Creating a knowledge sharing environment

Whilst recruiting fresh talent into engineering is essential, the industry must continue to provide training and development across an engineer's entire career. New technologies are entering the industry at a lightning pace; is your organisation ensuring that its more mature workforce is being given the right training and support to use this technology? It can be intimidating to put down the pen and pick up the mouse after 40 years of manual processes, whilst the latest graduates and apprentices have always had technology at their fingertips.

By the middle of 2018, all of Mabey's engineers, based in eight offices across the UK, will be working in a wholly digital environment, regardless of their age, experience, or job role. Moving to a completely digital approach will redefine our engineers' day-to-day processes, to deliver engineering schemes as quickly, safely and efficiently as possible.

More also needs to be done to support an ageing workforce and help them share their knowledge and experience with the next generation. At Mabey, many engineers have taken up the opportunity of more flexible hours and mentoring roles, enabling the business to better plan for their retirement and ensure they can impart relevant experience and knowledge across the organisation.



“My time at Mabey has taught me the importance of knowledge sharing. Part of my role is coaching and supporting engineering staff, developing best practice in the design process in terms of innovative use of equipment, consideration and planning of construction activities and commercial viability. But it must be a two-way conversation, because new ideas and ways of working are what drive us forward as a business and pushes more of us to achieve our chartership.”

Dave Holland

Engineering Director,
Mabey



enabling global infrastructure

About Mabey

Mabey is a leading international bridge and engineering services specialist combining engineering excellence with expert design and manufacturing skills. We help deliver infrastructure projects more safely, quickly and efficiently across the road, rail, utilities and construction sectors. Across the wider Mabey Group, our engineering capabilities also include design and provision of temporary works including propping, jacking, environmental monitoring services, formwork and falsework systems and the hire of non-mechanical groundworks equipment.



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