The Consulting Engineers

The British Consulting Engineers who Created the World's Infrastructure

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It was the arrival of the railway, above all other factors, that established the place of engineers in society, and made consulting engineering a desirable profession to follow. The scale of the works, in comparison with what had gone before, was remarkable, as was the capital involved; from 1830 to 1852, more than 8000 miles of railway were built in Great Britain and Ireland – 'about the diameter of the globe' as Robert Stephenson proudly declared at the time – for which £286 million of capital was raised. By 1900, the mileage in Great Britain alone had reached 22 000.

Consulting engineers and architects

Architects worked with engineers from the start of the railway age. The very early lines had little in the way of buildings, but occasionally architects were consulted about bridges and tunnels; one of the first was Ignatius Bonomi, who designed Skerne Bridge on the Stockton & Darlington Railway, and supervised its construction as George Stephenson was too busy. As railways grew, the stations became grander. By the second half of the nineteenth century, the great railway termini generally saw the engineers responsible for the structural engineering triumph of the train sheds, with a consultant architect responsible for the façade, often comprising station buildings, offices and hotel; the most famous example is the work of William Barlow and George Gilbert Scott at London St Pancras.

Earlier, on the London & Birmingham Railway, Philip Hardwick designed the Euston and Curzon Street station arches and buildings, while the engineer Charles Fox is credited with the design of the iron roof. The Stephensons collaborated with the architect Francis Thompson on many railways, including the Chester & Holyhead Railway, where he designed the masonry work for the Britannia Bridge. Similarly, Joseph Locke collaborated with William Tite, notably for the Italianate termini for the London & Southampton Railway. Best known is the collaboration between IK Brunel and Matthew Digby Wyatt at London's Paddington Station. Edward Middleton Barry worked with John Hawkshaw at Cannon Street and Charing Cross Stations.

Outside London, Glasgow Central Station was the work of the architect James Miller with the engineers Blyth & Blyth; later, Miller designed ICE's current headquarters building in Westminster, his appointment no doubt influenced by his experience of working with engineers. In Edinburgh,

Right — *Phiz's illustration for Charles Dickens's Martin Chuzzlewit (1844). Seth Pecksniff (centre), the employer of the eponymous hero, was an architect but his profession at the time faced similar issues of education, training and professional standards to engineers*

Far Right — *A collaboration between engineer IK Brunel and architect Matthew Digby Wyatt, the monumental new terminus for the Great Western Railway at Paddington opened in 1854*

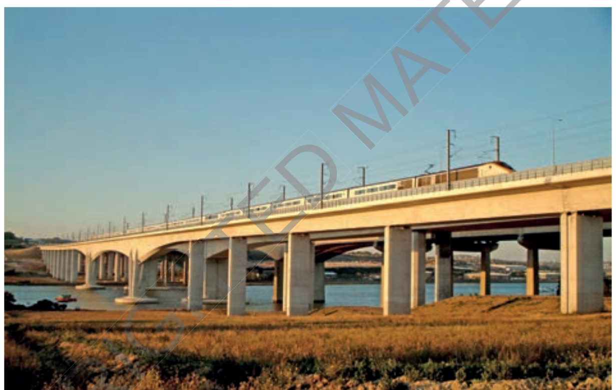
When Margaret Thatcher's Conservative government swept to power in the general election of 4 May 1979, her victory heralded some of the greatest changes ever to have hit the consulting engineering profession – though few firms realised at the time just how profound those changes would be.

On the surface, major projects designed by British consulting engineers continued to pour forth over the subsequent decades. In transport, the Channel Tunnel was (at last) constructed, together with the Channel Tunnel Rail Link (later, HS1) to St Pancras International. The switch of investment from road to rail also saw London's Jubilee Line extension, Docklands Light Railway and (later) Crossrail, as well as tram systems in Manchester, Edinburgh and elsewhere, though much was also done on the renewal and maintenance of roads, and major road projects included the Second Severn Crossing and Britain's first modern toll road (north of Birmingham) – the latter privately financed. In power, investment in nuclear and other large stations was replaced by renewables, including wind turbines, together with the 'dash for gas'.

Top Right — The Channel Tunnel, under construction from the late 1980s until the main 'breakthrough' in 1991, and opened in 1994. Mott Hay & Anderson (later Mott MacDonald) was the Anglo-French consortium's design consultant for the British section

Top Middle Right — One of 21 shafts on the 80 km long Thames Water Ring Main to transfer water from treatment works for distribution round London, constructed in 1988–1993 with later extensions: consulting engineers included Balfour Maunsell and WS Atkins. Later, the disposal of London's sewage was addressed by the huge Thames Tideway project, which will include a 25 km long tunnel crossing London west to east beneath the river: design consultants here include AECOM (central section), Arup/Atkins joint venture (west) and Mott MacDonald (east)

Top Far Right — Constructing a shaft on London Underground's Jubilee Line Extension, built during the 1990s. Particularly challenging was the new Westminster station, contained in a huge void sunk nearly 40 m deep using top-down construction beneath a new Parliamentary building above, while supporting the live District & Circle Line nearer the surface and avoiding any tilt to Big Ben alongside. Design was by Mott MacDonald for the western section and G Maunsell & Partners for the east. 'Civil technical contractors' were appointed under 19 contracts, including Maunsell at Westminster station, where geotechnical advice was also provided by Professor John Burland of Imperial College London



Above Left — A bridge across the River Medway carrying the Channel Tunnel Rail Link (later, HS1) through Kent. In another sign of the changing role of consultants, the winning bid was from a consortium led by Ove Arup on a design, build, finance and operate basis (with additional government funding). The project was completed into St Pancras Station in 2007, on time and on budget, Britain's first significant new trunk railway in more than a century, and one of the most successful major projects of modern times

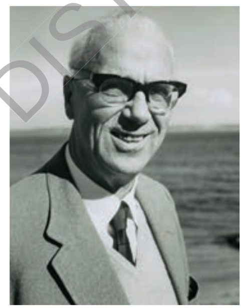
Above Middle — Whitelee Wind Farm near Glasgow was commissioned in 2009, the UK's largest on-shore wind farm, producing 539 MW. Consulting engineers were AECOM

Above Right — The 5·1 km long Second Severn Crossing nearing completion in 1996. The bridge was constructed under a design-and-build contract by an Anglo-French consortium, who appointed Halcrow in partnership with French consultant SEEE to design the bridge – a sign of the changing role of consulting engineers

The Great Consultants





Some of the great consultants (from left to right): John Smeaton, Thomas Telford, Robert Stephenson, John Fowler, Alexander Gibb and Ove Arup

Introduction

In this chapter, we provide brief profiles of 41 of the great consultants, spanning nearly three centuries from the early canal engineers to the present day.

The earliest would not have called themselves consulting engineers; it was Smeaton who introduced the term ‘civil engineer’, and Jessop who first called himself a ‘consulting engineer’. And despite the example of Smeaton, who demonstrated by his words and practice how he believed a consulting engineer should conduct himself, working only for a fee and taking no financial interest in his projects, most engineers throughout the nineteenth century, including the great triumvirate of railway engineers – Stephenson, Locke and Brunel – worked sometimes as salaried engineers and sometimes as consultants, and often had a financial interest in their projects.

The formation of the Association of Consulting Engineers in the early twentieth century led to a clearer definition of the profession, backed up by rules of professional conduct, and towering figures such as Sir Alexander Gibb and Sir William Halcrow (the successor to Charles Meik) flourished between the wars.

From the 1950s, a huge surge of activity worldwide for British consulting engineers benefitted not just the well-established firms, but new firms as well – notably those formed by Sir William Atkins and Sir Ove Arup. Then, from the 1980s, privatisation led to another surge in workload for consultants, this time in the UK, coinciding with the commercialisation (to a greater or lesser extent) of traditional professional firms and followed by the takeover of many, frequently by overseas firms.

Consulting engineering – with exceptions, and for good or ill – has become more of a business and less of a profession. As the eminent twentieth-century Austrian geotechnical engineer Karl Terzaghi observed:

> " *A Consultant is a person who is supposed to know more about a subject under consideration than his client. Once an engineer has acquired a reputation for superior knowledge and discovers that there is a demand for his services his future career depends upon what he expects to get out of life. If he longs for financial success and social prestige, he will find that his aims can hardly be satisfied without the assistance of an engineering organisation. Once the organisation exists he becomes a slave to it. His income increases, but so do his worries. Sometimes he has sleepless nights because he does not know how to handle all the orders which have rained into his lap, and at other times because his overhead charges begin to exceed his income. … He may still believe that he is a consultant, but in reality he has turned into a business man and executive, equipped with all the prerequisites for stomach ulcers. On the other hand, if he derives his principal satisfaction from practising the art of engineering, he will desist from establishing an organisation and concentrate all his efforts on broadening his knowledge in the field of his choice. In order to be successful in this pursuit he must be … willing to spend at least half of his time on unprofitable occupations such as research or the digest of his observational data.*

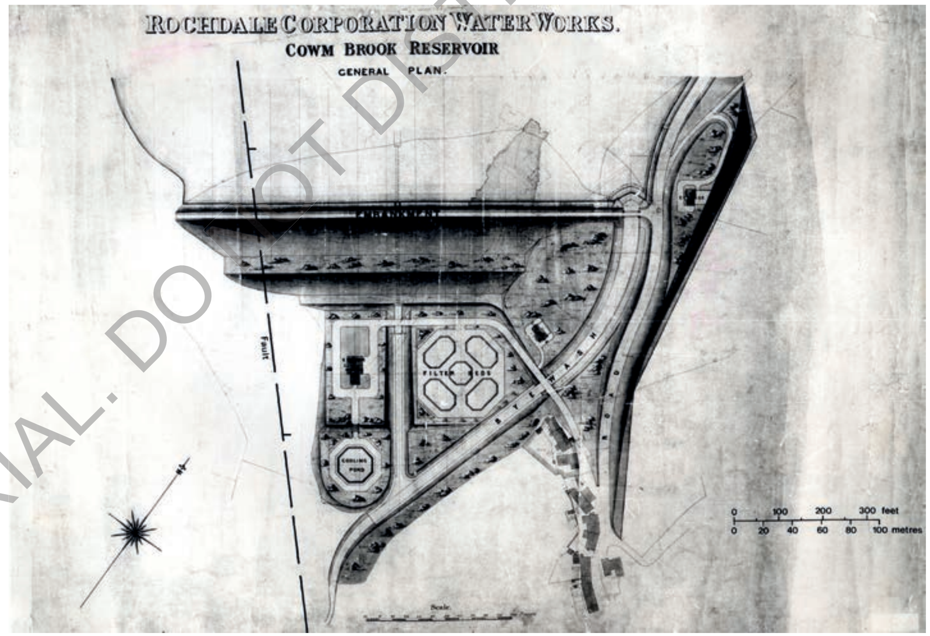
Our choice of the ‘great consultants’ is, of course, subjective. Some would be in anyone’s list, others are included as illustrative of their period or discipline, for the firms which they founded rather than for their individual achievements, for being the first to lead a particular trend – or simply because they make an interesting story. We hope that readers who fail to find their own ‘great consultants’ in this chapter will nevertheless find them recorded elsewhere in this book.

Thomas Hawksley, 1807–1893

Thomas Hawksley was, with John La Trobe Bateman (p. 160), the greatest of all the water engineers. He was already a distinguished water and sanitation engineer based in Nottingham when, aged 45, he set up in London as a consulting engineer. The firm thrived under four generations of Hawksleys before merging with JD & DM Watson to become Watson Hawksley, and later with California-based James M Montgomery, eventually becoming MWH.

Born and educated in Nottingham, Thomas Hawksley was apprenticed aged 15 to a local architect and surveyor, Edward Staveley. Aged just 23, he was appointed as chief engineer to the Trent Water Company and built a waterworks near Trent Bridge, Nottingham. The distribution system that he installed was the first to be successfully designed so that the pipes were constantly charged under pressure, allowing consumers to draw water at any

Right — *Thomas Hawksley*



Far Right — *Plan of Cowm Brook Reservoir in Whitworth, Lancashire, completed in 1877 for water supply to Rochdale*

'A man of character and initiative'

This description of Thomas Hawksley comes from Roy Oakley, first senior partner of Watson Hawksley, writing in 1992:

" *Thomas Hawksley was a man of character and initiative. When a young and resourceful engineer, the Chartist rioters had plotted to take over the town of Nottingham and attacked the gasworks, where he happened to be at the time. He quickly marshalled the staff, connected up bits of pipe to the gas supply, and directed through the nozzle a great tongue of flame towards the rioters who then quickly dispersed. Following his advantage, he threw barrels of tar into the streets to prevent further attacks.*

He came close to death in 1863 when he was engaged on a project of water supply and sewerage in Warsaw. Poland, at that time occupied by Russia, was seething with nationalistic fervour and when an attempt was made to conscript Poles for military service, an insurrection broke out. Because of his working for the Russians, Hawksley was associated with the hated Russians in the minds of the insurgents and became an object of attack, and although constantly guarded by armed gendarmes, had several narrow escapes.

Chris Wise was a rising star at Arup, with the design of London's Millennium Footbridge (the 'Wobbly Bridge') and Barcelona's Torre de Collserola to his credit, when he left in 1999 to form Expedition Engineering. More imaginative schemes followed, including the impossibly slender Infinity pedestrian bridge at Stockton-on-Tees, and the London Velodrome with its doubly-curved cable-supported roof, which was widely regarded as the finest and most energy-efficient structure of the 2012 Olympics. In 2008, Wise and his fellow shareholders gave over Expedition Engineering to the benefit of its employees, becoming the Useful Simple Trust.

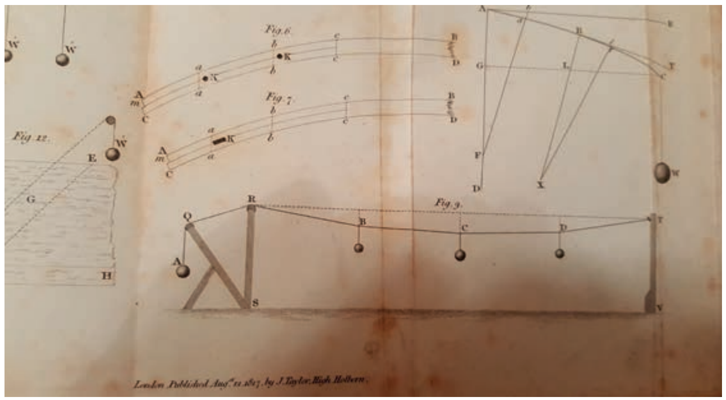
Far Left — *The new Birmingham New Street Station with structural engineering by AKT II (and Atkins as overall lead designer), opened in 2015. The original station, opened in 1854 to connect the former London & Birmingham and Grand Junction Railways, included the world's largest single-span roof, designed by consulting mechanical engineer Edward Alfred Cowper. The wrought-iron and glass arched roof was built by Fox, Henderson & Co (p. 208), for whom Cowper had earlier worked*

Left — *The distinctive profile of Expedition Engineering's Velodrome for the London 2012 Olympic Games*

Testing

Though there were early pioneers including Peter Barlow and David Kircaldy, the specialism of materials testing has been dominated for the last century and a half by Sandberg.

Christer Peter Sandberg came to England as a consulting and inspecting engineer for Swedish state railways, charged with checking the quality of rails for export to his homeland. While in the UK, he established, in 1860, a consultancy practice in Great George Street for railway and tramway materials, and was soon in considerable demand, both in Britain and overseas. In 1919, the firm moved into a converted house at 40 Grosvenor Gardens, with laboratories in the former stables at the rear. Nearly a century later, the building remains the firm's headquarters, with its original brass plaque proclaiming 'Messrs Sandberg Consulting Engineers'. By then, Christer's three sons – Peter, Alec and Nils, known collectively as 'the three wise men' – had joined the firm. All became partners, and helped establish the firm's reputation in the US, China, Siam (Thailand), France, Belgium and Russia.



Left — *When Telford and Rennie began to design iron bridges they relied heavily on test data from iron founders for their designs. When Telford began to design work for the Runcorn Suspension Bridge, he turned to Peter Barlow of the Royal Military Academy for independent advice on the strength of wrought-iron wire, and this is a drawing of one of Barlow's tests*