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Obituary: Sir Alan Muir Wood, 1921–2009

Alan Marshall Muir Wood was born in Hampstead, London. His father was a civil servant in the Admiralty, and the family was stationed for several years in the Chatham Naval Dockyard, where he received his first (subconscious) exposure to engineering. He was educated at Abbotsholme School and at Peterhouse, Cambridge, where he read Mechanical Sciences. He served as an Engineer Officer in the Royal Navy from 1942 to 1946.

His first major experience of geotechnical engineering and engineering geology came when he was resident engineer for the Southern Region of British Railways, working on remediation of landslips at Folkstone Warren, Kent.[1–3] He used fossils to identify different strata of the Gault clay and deduce the detail of the slip mechanisms.

After four years with the railways and two with the Inland Waterways Executive he joined Sir William Halcrow & Partners in 1952, and remained with the firm until his death. He became a partner in 1964, and was Senior Partner from 1979 until his retirement in 1984. However, he saw retirement merely as an excuse not to have to tackle any project that did not interest him: his interest in engineering challenges remained undiminished until the end.

He specialised in coastal engineering and tunnelling. Maritime works included a research project in Christchurch Bay studying waves, weather and sediment transport, works at Seaford and Lowestoft, in Thessalonica, the Dominican Republic and Honduras, at Dungeness nuclear power stations, and the effects of offshore dredging. His young children regularly accompanied him on visits to crumbling cliffs and protective groynes around the south coast of England, and learnt that one town's shingle accumulation is another town's erosion: there is no such thing as a free beach. His book *Coastal Hydraulics* was first published in 1969.[4]

Following the Aberfan disaster, he was responsible for design and supervision works to stabilise spoil heaps in South Wales for the National Coal Board, and produced inspection reports on spoil heaps in north Derbyshire and elsewhere. In 1975 he was appointed by the Treasury Solicitor to provide expert technical evidence (*Vidal* v *DoE*)[5] on reinforced earth: he always relished a good technical argument, and enjoyed uncovering historic examples of soil reinforcement.

He was Project Engineer for the Clyde road tunnels in Glasgow,

constructed using compressed air through water-bearing sands and gravels, and for the rail tunnels at Potters Bar. This latter experience with segmental linings led to the design for the cargo tunnel at Heathrow Airport in the late 1960s.[6–9] This 10 m diameter tunnel was shield-driven through London clay, 7 m below an operating runway. Some engineers publicly stated that the design was unbuildable: there would be a risk of face collapse (in fact just 0·25% face loss), and the thin, unbolted, segmental concrete lining would produce a high probability of unacceptable heave because of the high lateral stresses (settlements were in fact limited to 11 mm). The tunnel is still in daily use.

Also in the late 1960s, the 80 km Orange-Fish irrigation tunnel in South Africa used an observational method to choose the detail of the primary support: using sprayed concrete with or without rock bolts, depending on the measured tunnel convergence.[10] Such an approach to tunnel design and construction was not new – it had been used on the Snowy Mountains project in Australia – and he objected vehemently and regularly to the claims of originality of the so-called New Austrian Tunnelling Method: it was certainly not new, not Austrian, and not really a 'method'.[11,12] He recognised that observation of the ground conditions and the ground response must play a central part not only in the design process but also in the way in which tunnelling projects are procured and managed. His second book, *Tunnelling: Management by Design*[13] develops this theme.[14,15] So many of the projects for which he was expert witness or member of the board of inquiry seemed to him to be the consequences of elementary failures to observe. For example, if the purpose of observation had been understood, then the collapse of the Heathrow Express tunnel could have been averted.

His association with the Channel Tunnel lasted some 40 years.[16–18] He prepared a feasibility report on the Channel Tunnel from 1958 to 1960; he led further studies in 1964; he was the Halcrow partner responsible for the joint consultancy team for the design and construction of the first stage of the Channel Tunnel service tunnel before its cancellation in 1975; and he was a specialist advisor to House of Commons select committees on the tunnel itself in 1981 and the Channel Tunnel Rail Link in 1985–6. But after having done so much preparatory work on such a politically charged project, it was both a relief and a disappointment that his final role was as a member of the five-man Disputes Panel from 1988 to 1998: a disappointment, because the nature of the project led to so many disputes. He saw a tunnel as a hole in the ground with a geologist at one end and a lawyer at the other, and railed regularly at the short-sightedness of contract negotiators who sought to place all the risk with the contractor. However, his experience with the Channel Tunnel served him in good stead when he was engaged as consultant on risk sharing and disputes resolution to the Øresund Tunnel between Denmark and Sweden, and was appointed Chairman of the Dispute Review Board for Dredging and Reclamation (1995–1999). This was an altogether happier project, which succeeded as far as possible in resolving such disputes as there were by discussion between engineers.

In 'retirement' he advised the House of Commons and others on the route and likely structural damage from the Jubilee Underground line in London, and more recently on the potential effects of Crossrail. As a member of the Review Board on Sydney Ocean Outfalls he brought together his experience in coastal engineering and tunnelling. He was an expert witness for the inquiry into the methane explosion at the water treatment works at Abbeystead, Lancashire. He was an expert witness for arbitration on the Strategic Sewage Disposal Scheme, Hong Kong (1997–2001). He had strong views about the importance of the technical integrity of expert witnesses.[19,20]

His last forensic advice concerned the investigation into the collapse of the tunnel being constructed over the railway line at Gerrards Cross, on which he had travelled to work daily in the 1950s and 1960s from his home in Buckinghamshire. In trying to deduce what had happened here, and in other failures, he demanded clear explanation of the underlying mechanics: numerical analysis was never a substitute for engineering understanding, and often served only to obfuscate. On this and other projects he was disappointed that settlement out of court, while to be applauded on grounds of reducing legal fees, meant that the lessons would not be promulgated for wider education and the avoidance of repetition.

He read and wrote widely on subjects directly and tangentially linked to civil engineering. His Presidential Address to the Institution of Civil Engineers cast a baleful eye on the damaging role of economists in decision-making.[21] His Unwin Lecture addressed the subject of energy.[22] His 'Sir Alan specials' – contributions to the letters columns of *New Civil Engineer* or *The Times* – were always pithy, erudite, and apposite.[23]

His interest in the history of engineering combined with his tunnelling expertise in his willing participation in the campaign to save Brunel's Thames Tunnel[24,25] from unnecessary lining with sprayed concrete (1994–1997). Liking nothing better than to spend hours in the ICE library, he had recently dug out previously unfamiliar work by Thomas Young on the line of thrust in arch bridges, and speculated that this must have influenced Brunel's designs. A paper was published in the *Proceedings* just before he died.[26]

He was President of the Institution of Civil Engineers (1977–1978),[21] and founding President and Honorary Life President of the International Tunnelling Association (1973–2009). A Prestige Lecture series named in honour of Sir Alan Muir Wood was inaugurated in 2006 at the International Symposium on Aerodynamics and Ventilation of Vehicle Tunnels in Slovenia. He was a Fellow of the Royal Academy of Engineering and, rarely for an engineer, also a Fellow of the Royal Society.[27,28] He was knighted in 1982 for services to civil engineering.

DAVID MUIR WOOD

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