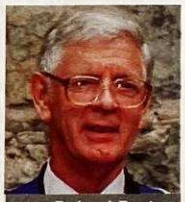
Introduction

Proceedings of ICE
Civil Engineering 160 May 2007
Pages 3–6 Paper 15039



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From the 1790s for four decades, Thomas Telford's achievement was second to none in the application of natural forces, improved constructional materials and technology to the use and convenience of man. His projects, involving movement of people, goods or water, although mainly throughout Britain, also extended to Poland (1825), Sweden (1809–33), Panama (1825), Canada (1828) and India (1828).

In the Highlands of Scotland alone, civilisation 'was advanced by a century' by his improvements, which included land reclamation, fishery settlements, 1900 km of new or improved roads with more than 1100 bridges (see Chris Ford's paper in this issue); the Caledonian and Crinan canals, and scores of harbours, churches and manses (1790–1830). On these and other works he developed standard techniques in design and contract procedures which were beneficial in terms of economy, site supervision and management, and in influencing the future of civil engineering.

Telford's professional practice drew upon extensive self-taught knowledge and experience as a stonemason, architect and surveyor—see Peter Cross-Rudkin's paper in this special issue. He also had an innate attention to detail and practical experimentation, bold intuitive design often approaching the limits of practicability, exceptional management and working relationships—explored in more detail by Martin Barnes in this special issue—and a restless ambition and dedication, exemplified by his 'living life as a soldier always in active service'.

Although Telford's practice would have benefited from the use of a theoretical, strength-of-materials design process, this had not evolved by the early nineteenth century. His reliance on experimental and practical procedures was then the best means of achieving the desired end. Indirectly, he encouraged the development of strength-of-materials design through wide dissemination from 1817 of his experimental results on the tensile strength of iron.

Some highlights of Telford's work are briefly reviewed in the following sections. Fuller lists of his projects, together with a location map, are provided in the Appendix.

Canal engineering

From 1794, Telford developed economical cast-iron plate aqueducts on canals to obviate traditional bulky masonry construction. This innovation, coupled with his bold characteristic of adopting the most practicable direct line and level to maximise user-benefit, culminated—with the approval of William Jessop—in the supreme structural achievement of the canal age at Pontcysyllte (1805) (Fig. 1). Telford's regard for this achievement was such that he featured it in his portrait by Lane (Fig. 2) as well as on a large wax letter seal.

The most ambitious, although not the most successful, of the many canals engineered by Telford (until 1812 jointly with Jessop) was the 110 ft (33·5 m) wide, 60 mile (96 km) long Caledonian Canal (1804–22) (Fig. 3). With its 28 massive locks 40 ft (12·2 m) wide and 25 ft (7·6 m) deep intended for naval use during the Napoleonic War (but not completed in time), it was in design terms the world's largest and most technically advanced trans-sea summit-level ship canal. It was unsurpassed in scale for its class until completion of the Panama Canal in 1914.

Despite a lack of commercial success commensurate with its scale, and the difficulty—which Jessop and Telford underestimated—of making parts of the canal watertight and to full depth, it nevertheless played a major role in Highland development through fishing and tourism. Now tastefully restored in its magnificent setting by British Waterways, the canal—a first-class leisure facility—is still evocative of the grand vision of its 1804 design.

In making the Caledonian Canal, innovation that advanced engineering knowledge abounded in the use of iron railways, machinery, equipment, steam engines for pumping and dredging, and in lock construction—notably at Beauly Firth where a 55 ft (16·7 m) depth of mud was pre-consolidated before excavation began.

In England, Telford's bold direct line and level practice is nowhere more evident than on the Birmingham Canal improvement (1824–34), with its prodigious Smethwick cutting and saving in length of 8 miles (13 km). For more details see the paper by David Bligh, David Brown and Nigel Crowe in this special issue.

It is also to be found on the Birmingham and Liverpool Junction Canal with long cuttings up to 90 ft (27m) deep, in slip-susceptible marl, and the mile-long (1·6 km) Shelmore embankment. Further north, the extensive canal–seaport warehouse interchange at Ellesmere Port, greatly used for over a century, represented a peak of efficiency of the canal age by its last great engineer.

On the Trent and Mersey Canal, a Telford landmark in tunnelling which served as an instructive example well into the railway era, was Harecastle Tunnel (1824–27). It was more than 2700 m long and built from 15 shafts in the remarkably short time of three years.

Fig. 1. Pontcysyllte remains Britain's longest and highest aqueduct—the 307 m long, 38 m high cast-iron and masonry structure carries the Llangollen (formerly Ellesmere) Canal over the Dee valley in Wales

Fig. 2. Portrait of Thomas Telford (1757–1834) by Lane, also featuring Pontcysyllte, which he considered one his greatest achievements

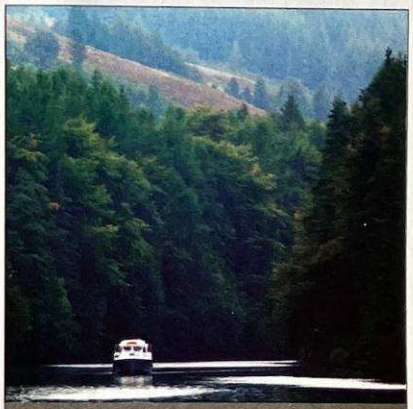

Fig. 3. The 96 km Caledonian Canal between Inverness and Fort William in Scotland was the largest of its class until Panama opened in 1914

Road-making

From 1819 Telford established the standard system of design and construction for roads for which he is well-known and which was still being adopted 135 years later. Unlike the practice of his contemporary John McAdam, Telford's roads—engineered to improved lines and gradients generally not steeper than 1:30, with a well-drained hand-pitched stone foundation beneath a layer of road metal of hard small-broken stone—facilitated traction and reduced maintenance. Hugh Davies explains Telford's contribution to highway engineering in this special issue.

Sir Henry Parnell in his *Treatise on Roads* considered the London to Holyhead Road engineered by Telford to be 'a model of the most perfect road making that has ever been attempted in any country'.[1] Jamie Quartermaine describes the dramatic improvements and lasting legacy of the north Wales section in this special issue.

Although the turnpikes declined in use from 1830 as railways, with their faster travel times, developed, they were thankfully resurrected in the twentieth century when Telford's vision of mechanical propulsion on roads using steam carriages was fulfilled by the motor vehicle.

Masonry bridges

Telford's thousands of arch bridges ranged from culverts to the elegant classical-style Bewdley (1796) and Glasgow Broomielaw (1833–35) bridges, the 150 ft (45·7m) elliptical span of Over Bridge at Gloucester (1826–30), and the magnificent Dean Bridge, Edinburgh (1832), where a slender appearance was achieved by means of narrow pilasters and 'ascititious' or supplemental arches of larger radii than the main spans.

Bridges illustrative of Telford's fondness for the gothic style include Tongland (1808), Dunkeld (1809), Craigellachie (1814) and Conwy (1826). Occasionally he gave this attribute too much free reign for the modern palate, for example in his first Dean Bridge design and at Clifton Gorge. For Tongland and other large-span arches Telford adopted and promoted the use of hollow piers and spandrels, which resulted in a stronger, lighter structure and facilitated internal inspection. This feature and his segmental arch practice generally were widely publicised and influential from 1812 for several decades. Blackhall Bridge (1809) at Paisley, the largest span aqueduct of the canal age, now carries Network Rail's Paisley Canal line from Glasgow.

Tom Day provides a fascinating insight into construction of the dramatic Cartland Craigs bridge and associated Scottish arch bridges in this special issue.

Iron bridges

For use at sites impracticable or uneconomic for stone bridges, Telford developed the use of cast iron—first at Buildwas in June 1796, for a short time the world's longest operational cast-iron bridge. Its span, 30% greater than that of Iron Bridge at Coalbrookdale, with only half the weight of its ironwork, demonstrated that the use of cast iron enabled a flatter arch to be achieved.

At Bonar Bridge in 1812 Telford introduced the first of a standard lightweight type of arch bridge with spans of 105–170 ft (32–52 m). These bridges, of which at least eight were erected, exhibited an unparalleled combination of strength, economy and intuitive design. This development influenced cast-iron bridge building until the 1830s and the adoption of elegant and efficient lozenge-lattice bracing in bridge spandrels until at least the 1870s. Telford also developed an economical standard design for smaller spans.

My paper in this special issue provides more details of Telford's mastery in the design and construction of cast-iron bridges.

Suspension bridges

Telford's greatest achievement in extending bridge spans came with his application of wrought iron for suspension bridges. In 1814, on the basis of parallel-wire cables, he erected and load-tested a 50 ft (15·4 m) span wire model for his Runcorn Bridge proposal. Although not erected, this project formed part of a continuing design evolution resulting in the elegant Menai Bridge (1826), with what was then the world's longest span of nearly 580 ft (176 m).

It was the outstanding bridge development of the early nineteenth century, establishing the suspension bridge in its true role as the most economic means of achieving the largest spans. The bridge was tastefully reconditioned in 1940.

William Day's paper in this special issue describes both the Menai and Conwy suspension bridges in more detail.

Railways

Telford took no direct part in inter-city railway development when, partly because of advancing years, he was declining new commitments. Although his preference was for steam carriages on roads and the continuing use of canals, particularly where early delivery was not required, he was not averse to railways *per se*.

As early as 1800 he 'strongly recommended' the use of iron railways as an alternative to canals and later acted as engineer or advised on a number of projects, some involving steam locomotion.

As an adviser to the Exchequer Loan Commission he made useful contributions to the Liverpool and Manchester (1830), Newcastle and Carlisle (1834) and other railway projects.

Fen drainage

Telford's direct line and level design practice was particularly effective in his land-drainage projects. For example in the English Fens, by working back from the level of Crab Hole in the Wash, he (jointly with John Rennie Junior) canalised the impressive Nene outfall (1827–30) to Wisbech. This improvement then enabled him, acting as sole engineer, to direct the drainage of about 46 000 acres (19 000 ha) of the North Level (1830–34).

Docks, harbours and piers

Of Telford's 100 or so harbour projects, ranging from piers to docks with entrance locks, probably the most state-of-the-art, with two basins and ingenious hydraulic arrangements for emptying and filling, was the 27 acre (11 ha) St Katharine's Dock, London. Michael Chrimes' paper in this special issue provides further details.

In 1796, three decades before the advent of Portland cement, Telford tested and actively promoted a naturally occurring, fast-setting, aluminous hydraulic cement, known as Parker's or Roman cement for structures exposed to water. His support encouraged its widespread use in jointing, pointing and facing mortars until around 1850.

Water supply

From 1799 to 1834 Telford worked on the supply of pure water to towns and cities from Wick to as far south as London, by means of either steam-pumped or gravity mains systems. At Glasgow, working with James Watt, he reorganised its defective and impure supply. An innovative element by Watt was an iron main with flexible joints, drawn across the Clyde under water in a shallow trench.

On reservoirs, Telford was the chief engineer for two of the then most advanced earth dams in Britain, both with cut-off trenches and clay-puddle core walls. The tallest, at Glencorse near Edinburgh (1819–23), was directed by James Jardine and the largest was at Edgbaston, Birmingham (1825–28). Both served as instructive examples of their type.

Telford's most extensive proposals were for supplying London with pure water from near Watford and Beddington (1829–34) which, although not executed, strongly stimulated the water companies and eventually led to great improvements.

Parliamentary work

Overall, Telford's contribution to the national well-being as engineer to, or advising, parliamentary commissions and committees was more significant than that of any of his contemporaries and, certainly after Rennie's death in 1821, established him at the head of the profession.

For the Exchequer Bill Loan Commission alone, who from 1817–34 he advised on almost

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every civil engineering public works scheme of any size requiring a loan, except dockyards, he gained an unprecedented and probably unparalled overview of civil engineering work.

Knowledge promotion

Of Telford's publications, the most significant are his numerous contributions in parliamentary papers, authoritative articles on bridges, inland navigation and architecture amounting to more than 300 pages in the *Edinburgh Encyclopaedia*[2] (1812–30), of which he was a leading proprietor, and his *Atlas to the Life of Telford* with its 83 plates.[3]

In professional development, Telford's nurturing of the Institution of Civil Engineers through its formative early years as a forum for the dissemination of knowledge during 1820–34 was an invaluable achievement. Soon after taking office as its first president he firmly established the recording of the proceedings and discussions of meetings and the substance of papers, a tradition in which his influence is probably most alive today.

The editor and my fellow contributors are to be congratulated on their efforts in continuing this tradition. This publication is a most appropriate way of adding to our understanding of the life and work of one of the greatest civil engineers of all time.

Appendix

Table 1 shows a chronological list of Telford's main building and architectural projects, with his roles ranging from his early stonemasonry through clerk of the works to architect.

Table 2 (overleaf) lists his main civil engineering works subdivided into bridges and aqueducts, canals, docks and harbours, fen drainage roads, railways, river improvements, and water supply.

Figure 4 is a map from the 1838 *Atlas to the Life of Telford*, showing the locations of most of Telford's canal, road, port and major bridge projects in the UK.

Table 1. Select list of Telford's non-engineering works

Date	Project (role)
1780–1782	Edinburgh, New Town (stonemason)
1782–1784	Somerset House, London (stonemason)
1784–1786	Portsmouth Dockyard, Commissioner's House (clerk of works)
1784	Portsmouth Dockyard, new chapel (clerk of works)
1784–1786	Westerhall Mansion, alterations (architect)
1784–1786	Sudbury Vicarage, repairs (clerk of works)
1787	Shrewsbury Castle, alterations (architect)
1787–1793	Shrewsbury Gaol (architect)
1788	St Mary's Church, Shrewsbury, new pulpit (architect)
1788	St Chad's Church, Shrewsbury, alterations (architect)
1790–1830	Fishery settlements, north Scotland (architect/planner)
1792	St Mary's Church, Bridgnorth (architect)
1793–1796	St Michael's, Madeley (architect)
1805	St Leonard's, Malinslee (architect)
1808	Carlisle courthouses (architect)
1824–1834	Highland churches, 32 churches and 42 manses (architect)

Fig. 4. 1838 map of Telford's UK infrastructure projects

References

1. PARNELL H. *A Treatise on Roads*. Longman, London, 1838.
2. TELFORD T. Contributions to *Edinburgh Encydopeadia*. William Blackwood, Edinburgh, 1830.
3. TELFORD T. *Atlas to the Life of Telford*. Payne & Foss, London, 1838.
4. MACLEAN A. *Telford's Highland Churches*. West Highland & Island Historical Research Society, Oban, 1989.

What do you think?

If you would like to comment on this paper, please email up to 200 words to the editor at editor@ice.org.uk.

If you would like to write a paper of 2000 to 3500 words about your own experience in this or any related area of civil engineering, the editor will be happy to provide any help or advice you need.

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Table 2. Select list of Telford's civil engineering works (dates approximate)

Date	Project	Surveyor	Value	Resident engineer
Bridges and aqueducts (* = iron, # = timber)				
1775–1778	Langholm Bridge			M Davidson
1790–1792	Montford Bridge			M Davidson
1793	Longbridge, Salop			M Davidson
1793–1794	Chirk Bridge, Denbigh			M Davidson
1794–1805	Pontcysyllte Aqueduct*			M Davidson
1795–1796	Longdon-on-Tern Aqueduct*			M Davidson
1795	Bridgnorth, modifications			M Davidson
1795–1796	Buildwas*			M Davidson
1795	Bolas, Salop			M Davidson
1796–1801	Chirk Aqueduct*		£21 000	M Davidson
1795–1799	Bewdley		£9264	M Davidson
1805–1808	Tongland, Kirkcudbright (with A Nasmyth)		£7210	A Blane
1805–1807	Wick (demolished)	T Telford		
1805–1811	Ballochindrain, Argyll			
1805–1809	Dunkeld	T Telford	£30 000	
1805–1815	Calder, Invernesshire (demolished)			
1805–1815	Easterfearn, Ross			
1806–1809	Conon, Ross and Cromarty	T Telford	£6856	
1807–1811	Ballater, Aberdeenshire (replaced 1834/5#)	T Telford	£3904	
1808–1811	Borlam, Inverness			
1808–1811	Kaun-a-Crock, Invernessshire (demolished)			
1808–1811	Torgoyle, Invernessshire			
1808–1819	Sark, Dumfries			
1809–1817	Cannich, Invernessshire			
1809–1817	Diak, Invernessshire			
1809–1817	Varrar, Invernessshire			
1809	Grantown-on-Spey, repaired			
1810–1811	Alford, Aberdeenshire	W Minto	£2000	
1810–1811	Aultmore, Elgin	T Telford		
1810–1811	Dualg, Inverness			
1810–1811	Nethy			
1810–1815	Allness–Ross			
1810–1815	Balnagown, Ross			
1810–1815	Roy, Invernessshire			
1810–1818	Kirklaggan, Invernessshire#			
1810–1812	Bonar, Sutherland*	T Telford	£13 971	T Rhodes
1810–1812	Helmsdale, Sutherland			
1811–1814	Lovat, Beauly, Inverness	T Telford	£8802	
1811–1814	Potarch, Aberdeenshire	T Telford	£4067	J Gibb
1812–1815	Craigellachie, Banff*	T Telford	£8200	
1812–1817	Greystones, Caithness			
1812–1822	Ledwych, Salop	T Stanton		
1814	Tenbury, widening*			
1814–1817	Croe, Ross			
1814–1817	Shiel, Ross			
1815–1816	Ferness, Nairn	J Mitchell	£1255	
1814–1815	Ken Bridge, New Galloway, rebuild	J Hall		Rennie
1814–1820	Llanyblodwell, Salop			T Stanton
1815	Tyhill, Caernarvonshire			
1815	Waterloo Bridge, Betws-y-coed, Denbighshire*			J Sinclair
1815–1816	Pont Pen-y-Benlog, Caernafon			
1815–1817	Contin, Ross			
1815–1818	Aultnaharrar, Sutherland			
1819	Bannockburn			
1819–1826	Menai Suspension Bridge	W Provis	£185 000	W Provis and T Rhodes
1820–1822	Esk, Cumberland*			
1820	Glasgow Old Bridge, widening			
1821	Birkwood Burn, Lanark			
1821	Cander, Lanark			
1821	Fiddler's Burn, Lanark			
1821–1822	Cartland Crags, Lanark		£5000	H Welch
1821–1825	Elvanfoot, Lanarkshire (demolished)			
1821–1826	Conwy Suspension Bridge			W Provis
1822–1823	Stokesay, Salop			T Stanton
1823	Bath, widening			
1823–1826	Mythe Bridge, Tewkesbury*		£35 000	W Mackenzie
1823–1826	Ver Bridge, Colne, Hertfordshire			
1825	Billingsley, Salop			T Stanton
1825	Hamilton, Lanark			
1825–1827	Soutra, Old Toll and Tunnel, Pathhead Road, Midlothian			
1825–1828	Over Bridge, Gloucester		£43 000	T Fletcher
1825–1828	Kingston-upon-Thames		£40 000	E Lapidge
1826–1829	Birmingham Canal		£700 000	W Mackenzie, W Dalziell and F Jenkins
	• Rylands Aqueduct			
	• Brass House Lane*			
	• Galton*			
	• Icknield Street			
	• Lee Bridge			
	• Oldbury			
	• Pope's Lane*			
	• Rabones Bridge*			
	• Spon Lane			
	• Spon Lane Aqueduct			
	• Watery Lane			
1826–1828	Stretford, Salop			T Stanton
1827–1830	Don, Aberdeenshire		£25 000	J Smith
1827	Holt Fleet, Worcestershire			
1827–1831	Pathhead, Midlothian, Dean Burn, Fala Water, Cranston and Coty Burn			
1829–1831	Dean Bridge, Edinburgh		£19 000	C Atherton
1831	Morpeth, Northumberland			J Cargill
1832	Onybury, Salop			T Stanton
1832–1833	Welsh Bridge, Shrewsbury, repairs			
1830–1833	Montrose Suspension Bridge, repairs			
1833	Clunsford, Salop			T Stanton
1833–1836	Broomielaw, Glasgow		£34 000	C Atherton
Canals				
1793–1805	Ellesmere Canal (with W Jessop)		£460 000	J Duncombe
1795–1800	Shrewsbury Canal			T Dunn
1803–1822	Caledonian Canal (with W Jessop)		£900 000	T Rhodes, J Telford, A Easton and M Davidson
1804–1811	Glasgow–Paisley and Ardrossan Canal		£130 000	D Henry
1807–1826	Weston Canal		£82 000	S Fowls
1809–1833	Gotha Canal, Sweden			
1816–1823	Edinburgh–Glasgow Union Canal (consulted)	H Baird, F Hall		H Baird
1817–1823	Crinan Canal, reconstruction			J Gibb, W Thomson
1818–1825	Gloucester–Berkeley Ship Canal	R Mylne	£330 000	T Fletcher, W Clegram
1822–1827	Harecastle Tunnel, Trent and Mersey Canal		£112 000	J Potter
1824–1825	Bude Canal	A Easton		A Easton
1824–1834	Birmingham Canal			W Mackenzie
1825–1834	Birmingham and Liverpool Junction Canal, aqueducts at Nantwich,* Weaver, Drayton and Albaston	W Provis	£800 000	A Easton
1825–1826	Macclesfield Canal			W Crosley
1826	Ulster Canal		£120 000	T Casebourne
1828	Welland Canal, Canada			
1828	Ellesmere Canal, Midlothian branch			
Dock and harbour works				
1801–1813	Wick Harbour			
1801–1814	Tobermory, Island of Mull			
1801–1832	Aberdeen		£160 590	J Gibb
1802	Kirkcudbright		£130	J Gibb
1803–1821	Keils Ferry Pier		£319	
1803–1821	Lochie Ferry Pier	T Telford	£993	
1803–1821	Corran of Ardgour Ferry Piers	T Telford	£727	
1803–1821	Small Isle Harbour, Jura	J Sinclair		
1803–1821	Dornie Ferry			
1805–1810	Ardrossan Harbour			
1806–1833	Glasgow			
1808–1809	Burghhead, Elgin	A Forsyth	£4000	
1808–1813	Kirkwall, Orkneys	T Telford	£3912	
1813–1817	Fortrose, Moray Firth	T Telford	£846	
1813–1815	Avoch, Moray Firth	T Telford	£1056	
1814–1821	Banff, Banffshire	T Telford	£14 000	J Gibb
1814–1832	Dundee Harbour, improvements including graving dock		£120 000	D Logan and P Logan
1815–1817	Dingwall, Black Isle	D Wilson	£3500	
1815–1819	Gourdon, Kincardineshire	J Gibb	£2000	
1816	St Catherine's Ferry Pier	T Telford	£166	
1816–1825	Nairn, Moray Firth	T Telford	£3225	
1817	Ballintraid Landing Pier	T Telford	£2333	
1817	Folkestone Harbour			
1817–1819	Cullen, Banff	T Telford	£4141	
1817–1820	Invergordon and Inverbeckie Ferry Pier	T Telford	£1437	
1819	Channery Pier	T Telford	£1300	
1819–1822	Tay Ferries, Dundee			
1821–1834	Holyhead Harbour		£41 000	J Brown, J Provis
1821–1834	Howth Harbour			J Provis
1824–1828	St Katharine Docks, London	T Telford	£250 000	P Logan, J Hall, Abernethy, T Rhodes
1828–1834	Leith			
1829	Belfast	T Casebourne		
1830–1832	Herne Bay Pier	G Abernethy, T Rhodes		
1830–1831	Greenock Harbour			
1831–1834	Dundee Dock	John Gibb	£150 000	James Leslie
1833	Seaham			J Buddle
1834	Dover Harbour	T Rhodes		
Drainage				
1808–1812	Loch Spyrie Canal	T Telford	£12 700	W Hughes
1818–1825	Eau Brink Navigation	T Casebourne		T Townsend
1827–1830	Nene Outfall	T Casebourne	£200 000	W Swanborough
1830–1834	North Level of the Fens Drainage		£150 000	W Swanborough, T Pear
Highland roads				
1801–1802	Surveys of the Highlands and coast	T Telford		
1806–1811	Dunrobin, Sutherlandshire	T Telford	£6897	
1809–1816	Dunbeath Road, Caithness	T Telford	£14 448	
1809–1813	Findhorn Road, Elgin	T Telford	£10 782	
1809–1812	Speyside, Elgin	T Telford	£1508	
1813–1816	The Fleet Mound, Sutherlandshire	T Telford	£9290	
1814–1817	Strathspey Road, Invernesshire	W Provis	£6520	
1816–1817	Alford Road, Aberdeenshire	W Provis	£4089	
1814–1825	Glasgow–Carlisle Road, 93 miles	T Telford	£50 000	W Provis, J Pollock
Note: for others see Ford's table in this special Issue				
Holyhead Road				
1810	North Wales Roads, first survey	H Fulton		W Provis
1810	Chester to Corwen, survey			
1815–1829	Shrewsbury to Bangor			
1816–1829	Bangor to Chester		£14 000	J Provis
1819–1829	Anglesea			W Dargan, J Provis
1820–1828	London to Shrewsbury		£132 000	J Easton, J Provis, J Macneill
1821–1822	Stanley Sands Embankment			W Dargan
Other roads				
1802–1810	Carlisle–Portpatrick road surveys	T Telford		
1819	Stirling Road			
1820–1823	Lanarkshire			J Pollock
1820–1830	Great North Road Surveys	J Mills, H Welch		
1820–1821	Loose Hill and Linton Hill, Kent	H Palmer		
1822–1830	London–Liverpool road surveys			T Casebourne
1823–1825	South Wales road surveys			H Welch
1824–1828	Carlisle–Edinburgh road surveys			H Welch
1825	Warsaw–Briesc			
Railways				
1821–1826	Stratford and Moreton Railway	J Mills		J Rastrick
1828–1829	Clarence Railway	J Mills		
1829–1833	Newcastle and Carlisle Railway	J Mills		F Giles
River works				
1800	River Severn, consultancy			
1806–1832	River Clyde	T Telford		
1809–1829	River Weaver, consultancy, including Weston Cut	S Fowls		S Fowls
1817–1829	River Dee Company, consultancy	J Mills, W Provis	£26 000	T Wedge
Water supply				
1799–1802	Liverpool Waterworks			H Bell
1806	Glasgow			
1810–1822	Edinburgh		£145 000	J Jardine
1827–1834	London Water Supply	J Mills, etc		J Mills etc

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