government grants, demolished 1829 (*Scots. Mag.*, **73** (Feb. 1811) 83 and plate)
1793–1798. Lune Aqueduct, Lancaster (Alexander Stevens and Son, contractors, to design of John Rennie (q.v.)) for Lancaster Canal Co., five semicircular arches of 75 ft. span, cost £48,000

STEVENSON, Robert, FRSE (1772–1850), civil engineer, the only child of Alan Stevenson, a West India merchant, was born in Glasgow on 8 June 1762. Two years later his father died suddenly leaving his family in straightened circumstances and Stevenson was educated at a charity school in Edinburgh. In 1786 he was apprenticed to a gunsmith and was himself described as such about the time he began to work for Thomas Smith (q.v.), an Edinburgh tinsmith who in 1787 had been appointed engineer to the newly formed Northern Lighthouse Board. Smith became Stevenson's stepfather in 1792 and father-in-law in 1799 when Stevenson married his daughter, Jane Smith (1779–1846).

Stevenson was largely self-taught and of the practical school. He gained an engineering related education by part-time attendance at Professor John Anderson's classes in natural philosophy at Glasgow University from 1792–1794 and was directed by him towards an engineering career. From 1800 to 1804 he attended classes at Edinburgh University: in natural philosophy by Professor Robison, mathematics by Professor Playfair, chemistry by Dr. Hope and natural history by Professor Jameson, but could not graduate because of his 'slender knowledge of Latin and total want of Greek'. Under Smith, before being formally apprenticed to him from 1796–1802, Stevenson had gained experience of lamp installation at Portpatrick harbour and on the erection and illumination of Pentland Skerries lighthouse. During his apprenticeship, but with much more responsibility than was usually the case for an apprentice, he specialised in the firm's lighthouse work, making reflectors, installing lamps and assisting with arrangements for the erection and maintenance of lighthouses. In 1800 Smith took him into partnership in the business.

The Bell Rock Lighthouse

Towards the close of the eighteenth century, with increased maritime trade and an intensification of shipwrecks in and around the entrances to the firths of Tay and Forth, Stevenson proposed building a lighthouse on the Bell Rock, 11 miles out to sea from Arbroath. This was an outstandingly difficult engineering challenge made even greater by the fact that the rock was submerged to a depth of about 12 ft. during every tide. In 1799 he envisaged a beacon-style lighthouse on cast iron pillars but in 1800, after seeing the rock and considering the possible damage to a beacon by ships, he abandoned this idea and prepared a design for a stone tower following the general concept of John Smeaton's (q.v.) Eddystone lighthouse (1759). As part of the design and promotional process for the project he had both proposals accurately modelled, a practice that he often employed subsequently on important maritime and bridge works.

Robert Stevenson FRSE

Following the failure of a parliamentary Bill for the lighthouse in 1803, and because of the project's hazardous and unprecedented nature, the Northern Lighthouse Board on Stevenson's advice secured the services of an engineer with a national reputation, John Rennie (q.v.). With his support, the necessary Act of Parliament was obtained in 1806, based on Stevenson's design of 1800, and in December 1806 the Board resolved that the lighthouse be erected under Rennie's direction as 'Chief Engineer'; Stevenson was to execute the work under his superintendence as 'Assistant Engineer'.

The relative roles of Rennie and Stevenson in creating the Bell Rock lighthouse subsequently became a controversial issue between their families; it became public in 1848–1849 when each claimed that it was their father who had 'designed and built' the lighthouse. In fact both are entitled to this credit in differing degrees. Rennie approved of Stevenson's design and model of 1800 as a general concept but advocated, and later implemented, a closer adherence to Eddystone Lighthouse in the design of the as-built tower except for the greater width and height required. Their combination proved excellent for the success of the project. With Rennie's greater experience and direction and Stevenson's energy, ability and assiduous superintendence throughout the progress of the work, a remarkable achievement evolved which reflected great credit on both engineers,

particularly on Stevenson for overcoming the exceptional difficulties of its execution in fulfilling the 'resident engineer' element of his remit.

It is now clear from family records and newly found evidence of the Clerk of Works, David Logan (q.v.), who later became Engineer for the Clyde Navigation and of John Paterson (q.v.), dock engineer at Leith *c.* 1803–1823, that Rennie's role was much more significant than it has always been portrayed in Stevenson publications. Stevenson's sons maintained that after the authorising act was obtained, Rennie's role was limited to that of 'an advising engineer to whom Mr. Stevenson could refer in case of emergency and who had suggested some alterations on Mr. Stevenson's design in which he did not see his way to acquiesce'. It is now evident that the as-built shape and internal dovetailed construction of the lighthouse tower were determined by Rennie, who for the duration of the work acted as a conventional Chief Engineer by means of meetings, occasional visits, reports and a considerable correspondence. The significance of Rennie's contribution was acknowledged by Logan who was of the opinion that if Stevenson's proposal for undovetailed horizontal courses at Bell Rock Lighthouse had been implemented 'not one stone of it would have been left standing upon another'. Paterson's opinion was similar, that the lighthouse 'would have shared the fate of the beacon on the Carr Rock'. In 1817 the sea destroyed this stone tower beacon designed by Stevenson in 1810.

In determining the external shape of the Bell Rock lighthouse tower Rennie adopted a much greater curvature at the base, its sides rising at about 40° from the horizontal compared with about 70° in Stevenson's design. Rennie's curvature was more effective in directing the waves upwards and dissipating their energy. Both Stevenson's and the as-built designs had base diameters of 42 ft. and Rennie's curvature resulted in a narrower tower at and near water level which had the advantage of reducing the surface area upon which the waves acted within, and well above, the tidal range.

Within Rennie's broad parameters Stevenson carried out almost all of the detailed design for the project, including conceiving and building the apartment floors cantilevered inwards from the outer wall to support a central core into which, at Rennie's insistence, they were dovetailed. This arrangement represented an improvement on the arched floors of Eddystone Lighthouse. These operations involved Stevenson taking many decisions on his own initiative. He undoubtedly had complete autonomy in the matter of fixtures and fittings and was also responsible for planning and executing the impressive shore base and signal tower at Arbroath. The lighthouse cost £61,331 to build and became operational on 1 February 1811.

Under Stevenson's direction several remarkable engineering innovations were introduced at the works that greatly expedited and facilitated construction. These included the temporary beacon barracks in which he and twenty-eight men were accommodated, elevated cast iron railways from the boat landings to the tower, ingenious and highly efficient moveable jib cranes and, for building the tower, the world's first iron balance crane. He may have conceived the idea of some of these innovations and certainly superintended their provision, modification and use, but there is strong evidence from Logan that the cranes were invented by foreman millwright, Francis Watt, and that he also designed the beacon and probably the railway. This attribution is consistent with a Stevenson letter to Watt in January 1808: 'So soon as you have got a proper draught of the crane, of the rock and railway, and of the wooden house for the beacon—come this way (to Edinburgh'. Stevenson did not specifically claim 'invention' of the cranes or acknowledge this to Watt, but he did state that the designs were 'his', at least in a proprietary sense and in time was credited with their invention.

Stevenson's definitive *Account of the Bell Rock Light-house*, a civil engineering classic, in which the various operations and intricate machinery and equipment used on the work were described and profusely illustrated by the best artists and engravers, was published in 1824 having taken 13 years to complete. It was perhaps intentional and certainly fortunate for Stevenson that the book was published after Rennie's death as he was most unlikely to have approved of it, not least for the omission of his report of 2 October 1809 made after a site visit demonstrating him exercising a key role in the tower's construction up to the floor of the lowest apartment at a height of about 45 ft. Although only three-hundred copies of the book were printed it was widely distributed to influential recipients and added considerably to Stevenson's reputation. He was perceived in some quarters as having not sufficiently acknowledged the contributions of Rennie and Watt and in 1841 this led to unfavourable comment in *The Surveyor, Engineer and Architect* and later in Smiles's *Lives of the Engineers*. Smiles stated that the credit for the lighthouse was 'almost exclusively' given to Stevenson because Rennie was 'in a great measure ignored' in Stevenson's book and that he 'should not be deprived of whatever merit belonged to him as chief engineer'. David Stevenson disputed Smiles's claim but to no effect.

Other lighthouse work

As Engineer and, in those days, chief executive of the Northern Lighthouse Board from 1808 until his resignation in 1843, Stevenson can be considered to have inaugurated the modern lighthouse service in Scotland. From 1806 he was responsible for the design and construction or improvement of at least twenty-five lighthouses, of which that at Cape Wrath, built by John Gibb (q.v.) of Aberdeen, is a typically fine example in the north. In lighthouse illumination he improved on Smith's work and brought the catoptric system, that is using silvered-copper parabolic reflectors and Argand lamps, to a

high degree of perfection, so much so, that he was reluctant to adopt Fresnel's improved dioptric or lens system adopted in France in 1822 on grounds of operational economy. It was not until 1835 that the system was eventually introduced into a Scottish lighthouse at Inchkeith, the delay for which Stevenson and the Northern Lighthouse Board were criticised in the press by Sir David Brewster and others. This matter led to an acrimonious exchange of tracts in 1833 and 1859–1860. In order to distinguish between the ever-increasing number of lights Stevenson invented 'intermittent' and 'flashing' lights. For the latter distinction he received in 1829 a gold medal from the King of the Netherlands as a mark of his approval.

The firm of Robert Stevenson 1811–1843

The successful completion of the Bell Rock Lighthouse enabled Stevenson, from 1811, to establish in Scotland within a decade, an indigenous civil engineering business of sufficient importance to make modest inroads even into the work of the London-based practices of Thomas Telford (q.v.) and Rennie. To create an engineering dynasty, which flourished for nearly a century and a half through four generations is indicative of a man with exceptional qualities, particularly in the rigorous and exemplary training of his successors. Stevenson's success was based on his ardent acquisition, application and promotion of largely self-taught practical knowledge, combined with shrewdness, ambition, determination, hard work, and outstanding entrepreneurial flair and management ability, all combined with a good financial start. In engineering terms his strengths, which were experimental and practical, related to maritime work, river navigation improvement and inland communication, particularly bridges. His theoretical and mechanical engineering attributes, except with regard to lighthouse equipment, were less remarkable. In 1825 when invited by David Brewster to write the article 'Steam Engine' for the *Edinburgh Encyclopaedia* he replied 'I should be afraid of disappointing you every way' and offered him instead an article on suspension bridges which was not taken up.

Maritime and river navigation engineering

Stevenson's practice in these branches of engineering throughout much of Scotland and northern England on numerous harbours and rivers, of which the improvement of the Tay navigation was of particular note, represented a fundamental element of the firm's practice. He made recommendations and carried out detailed hydrographic surveys which the relevant authorities were often unable to act upon for financial reasons. These included, besides those noted as published below, Stonehaven (1812, 1830), North Berwick (1812), Cellar Dyke (1814), Kingbarns, Fife (1814), Rothesay (1815), Grangemouth (1815), Elie (1815, 1836), St. Andrews (1815), Methil (1815), Leith (1815, 1824), Montrose (1816), Newport (1818), Broughty Ferry (1818), Fraserburgh (1818–1830), Ferry-port-on-Craig (1818), Alloa (1826), Peterhead (1826), Lossiemouth, Ayr (1830–1841), Ballyshannon (1836), Chester (1839–1845), Fisherrow (1839), Musselburgh, Aberdeen and Portpatrick.

From 1838, when his son, David, joined his brother, Alan, and himself in the partnership, Stevenson's own contribution diminished and with it the firm's railway and bridge work. The reduction in railway and bridge work was more than outweighed by an expansion in the firm's maritime and river improvement business under David Stevenson's able direction. Robert Stevenson retired in 1846.

Stevenson's state-of-the-art maritime work included the design and construction in 1821 of a sea wall at Trinity, near Edinburgh, with a cycloidal curve vertical profile, experiments on the destruction of timber by the *Limnoria terebrans* that influenced the universal adoption of greenheart for marine timberwork and invention of the 'hydrophore'. This was an instrument he invented in 1812 for water sampling from different depths to support his hypothesis that in a tidal river salt water from the sea flows up its bed in a layer separate from the outgoing fresh water on top. A developed hydrophore was used in the Challenger Expedition oceanic investigations in 1872–1876. He had a consuming interest in coastal erosion and, from a study of the bed of the North Sea, maintained that its sandbanks were the result of this action. He published papers on this subject and, in 1820, a chart with cross-sections shown *in situ* and said to be the first use of 'sectio planography' in this context. Stevenson also measured Scottish coastal water depths and published important charts of the Firth of Tay and the coasts of Scotland and parts of Ireland and England. In 1819 he published his proposal for the *Dalswinton* steamboat, with paddles located on its centre-line fore and aft, intended for use at Leith Harbour and on the Forth & Clyde Canal. In 1838 'Robert Stevenson & Sons' specified and had built at Preston the steam operated bucket-dredger *Robert Stevenson*, which began operation on the river Ribble in 1839.

Canals, roads and railways

In the early years of the firm Stevenson was engaged extensively on canal, road and railway projects, often adopting a promotional role. In 1814 he made a £½ million detailed proposal for a level canal between Glasgow and Edinburgh, locking down at its ends to Broomielaw Quay on the river Clyde and to Leith on the Firth of Forth. In 1817 he proposed a canal in preference to a railway from Forfar in the Vale of Strathmore to Arbroath. His ruling practice in canal design was to reduce lockage to the practicable minimum. By 1828 Stevenson's standing was such that he was working with Telford and Alexander Nimmo (q.v.) on a proposed harbour at Wallasey and a ship canal across the Wirral to the river Mersey, estimated to cost £1.4 million. His canal schemes were not executed because of lack of the

necessary finance. Several substantial lengths of road were executed under his direction ranging from lighthouse accesses to main routes. His road making, probably influenced by the work of Charles Abercrombie (q.v.) was at the forefront of national practice. He adopted a mode of construction similar to that increasingly advocated by John Loudon McAdam (q.v.) from 1811, but more substantial. He also advocated pairs of stone tracks in town roads to facilitate traction and these were installed at gradients on several main roads in Edinburgh.

By 1818 Stevenson had become convinced of the superiority of horse-drawn railways over small canals for inland communication and proposed the 'Edinburgh Railway' to connect with the Midlothian coalfield. In 1819 he proposed a railway between Montrose and Brechin. His reputation as a advocate of railways was now such that he was called in as a consultant to advise on the proposed Stockton & Darlington Railway and also on the Elgin Railway, Fife, extension. About this time he edited for publication, with *Notes*, the numerous *Essays on Rail-Roads* submitted to the Highland Society. In 1823 when consulted by Sir John Sinclair about the best mode of inland communication between Edinburgh and London, he advised that a 'railway was not only much more practicable but more commodious and useful for general intercourse than a canal'.

By 1836 the railways proposed in Stevenson's various reports traversed Scotland from the Tweed valley north to Perth and Aberdeen and from Edinburgh across to Glasgow, more or less on the lines of the eventual railway network, but their estimated costs were considerable and the necessary finance not forthcoming. As steam locomotion developed, he lost his pre-eminence in Scottish railways to Thomas Grainger (q.v.) and Miller. His only railway proposal known to have been executed was the short Newton Colliery line from Little France on the Dalkeith road near Edinburgh, although his 'Edinburgh Railway' proposal of 1818 to some extent facilitated the successful Edinburgh & Dalkeith Railway that superseded it in 1831.

Stevenson's design practice for railways, similar to that of William Jessop (q.v.) and Telford, was to make them as near level as practicable, avoid the use of heavy rolling stock to reduce track damage and to adopt inclined planes with stationary steam engines for overcoming differences in level. As early as 1818, for the 'Edinburgh Railway', Stevenson advocated the adoption of 12 ft. malleable iron edge rails in preference to the short cast iron rails then in common use and influenced the development of John Cass Birkinshaw's (q.v.) epoch-making malleable iron forerunner of the modern edge rail. In 1821 this role was acknowledged by George Stephenson (q.v.), who paid him the tribute, 'you have been at more trouble than any man I know of in searching into the utility of railways'. A year later the young Robert Stephenson (q.v.) who had met Stevenson inconnection with the Stockton & Darlington Railway project was less complimentary. After learning 'that Mr. Stevenson had surveyed an immense quantity [of railways] but had not had the good fortune to get them into action', he wrote to William James, projector of the Liverpool & Manchester Railway: 'If he has executed any railway it must be of very trivial consequence. I hope we shall be able to keep him out of the Liverpool concern'.

Stevenson's many transportation proposals involved more than one hundred bridges, most of which were never built. Of more than twenty bridges which he did erect or improve, the majority were of the masonry arch type, the most important and difficult to construct being the five-arch Hutcheson Bridge (1831–1834) over the river Clyde at Glasgow. In 1861 Hutcheson Bridge was considered by Fenwick, a structural analyst at the Royal Military Academy, as one of the 'best specimens of the segmental masonry arch' type in Britain, instancing it with Rennie's London and Waterloo bridges as the 'finest structures of the elliptical arch'. In Weale's *Bridges*, Hutcheson Bridge is described 'as one of the best pieces of bridge masonry in the kingdom'. This elegant bridge had a life of only thirty-four years because it was believed that the removal of a weir immediately upstream as part of a navigational improvement would render its foundations insecure.

Segmental arches characterise the style of Stevenson's masonry bridges. Another fine example, which still carries main road traffic, is the William IV, or New Bridge (1829–1832) over the river Forth at Stirling, for which he also said to have planned its town approach. This is not as imposing as his earlier London and Regent Road approaches into central Edinburgh skirting Calton Hill, which included proposals for housing terraces and the open 'triumphal' parapets which still exist at Regent's Bridge to enable its users to enjoy the fine views. From 1815–1819 he engineered this approach from east of Calton Hill to Waterloo Place and Princes Street. It was a work of particular difficulty and included the engineering input to Regent's Bridge, severing Old Calton cemetery, extensive rock blasting and a massive retaining wall in front of the new High School.

At Marykirk Bridge (1814), which is still in service and was Stevenson's first major bridge, some evidence of his design practice as early February 1811 is found in his letter to Logan, then the bridge inspector. He wrote, 'Your drawings are finely executed indeed, and the specifications are much more in the business way than any of the others. Your plan with the elliptical form, rather appears to be a little overdone with a view to keep the roadway level, and the same very laudable intention it strikes me has induced you to adopt too great a radius for the plan [proposal] with the segment of the circle—necessary to give the bridge a greater rise or increase the number of arches to at least four'. Segmental rather than elliptical arch profiles were adopted for the four

arches. Similar profiles were used in his proposals for the Bridge of Don at Old Aberdeen (1823) and Canonmills Bridge, Edinburgh (1812–1834) with a span of 110 ft., but with variable depth voussoirs.

Stevenson did not neglect cast iron as a bridge building material. Influenced by the general concept of Telford's cast iron footway additions to Glasgow Old Bridge over the river Clyde in 1821 he proposed iron additions to existing major masonry bridges at Perth (1827), Newcastle-upon-Tyne (1828) and North Bridge, Edinburgh (1832).

Of at least five timber bridges erected under Stevenson's direction, basically to traditional design, the largest was the notably wide temporary fourteen-span structure (1832–1846), with innovative iron fittings, erected over the river Clyde at Portland Street, Glasgow. Its purpose was to accommodate traffic whilst Telford's Broomielaw Bridge was being built, but it proved so popular with the public that it was retained for pedestrian use until 1846. Although the work was to be constructed to Stevenson's 'entire satisfaction', reference was to be made to Telford in any dispute.

State-of-the-art unexecuted designs by Stevenson for other timber bridges included a slender laminated arch for Dornoch Firth in 1830 and, influenced by David Stevenson's visit to the U.S.A. in 1837, a Long's frame bridge for India and an eight-span 'Town' truss bridge crossing of the river Tweed at Norham in 1838. The Dornoch Firth bridge proposal, the firm's model for which is now in the National Museums of Scotland, consisted of a four-leaf arch stiffened at 5 ft. intervals by king-post roadway supports. Its design was probably influenced by the work of John Green (q.v.) from *c.* 1828.

Stevenson also contributed to the development of iron suspension bridges. In 1820 he proposed crossing the river Almond at Cramond near Edinburgh by means of a new type of underspanned wrought iron suspension bridge. The design was novel in that its roadway superstructure, a cast iron framework, rested on the chains rather than being suspended from them. This unexecuted proposal, together with his authoritative accounts of other Scottish suspension bridges based on correspondence with their designers, was publicised widely throughout Europe in his 'Description of Bridges of Suspension', published in the *Edinburgh Philosophical Journal* in 1821. He proposed designs on this or the suspension truss principle for other locations, possibly over the river North Esk at Melville Castle in 1822 and certainly for North Bridge, Edinburgh. His friend James Smith of Deanston (1789–1850), agricultural engineer, erected a bridge on this principle at Micklewood in 1831. Two years later Stevensons designed and built Abbey St. Bathans Bridge, Berwickshire, after which numerous short spans on this basic principle were erected in Britain. By, and almost certainly before, 1861 these bridges were being manufactured as a standard item by Charles D. Young and Co., Edinburgh.

By the 1830s Stevenson had become one of Britain's leading bridge builders and knowledge of his practice was disseminated in one of the most comprehensive and influential works of its day, Weale's *The Theory, Practice and Architecture of Bridges* published in London from 1839–1843. This work, which carried Stevenson's portrait as a frontispiece and five examples of his timber, masonry and iron bridges illustrated on eighteen plates, was of particular value to the newly emerging generation of railway engineers.

Tall structures other than lighthouses

Stevenson's successful erection of the Bell Rock Lighthouse brought him commissions for other tall structures: for example, to advise on the severely cracked tower of Montrose church (1811), safeguarding Arbroath Abbey ruins (1814–1815) and, one which furnishes a good example of the architect–engineer relationship at that time, the design and erection of the Melville Column, St. Andrew Square, Edinburgh. In March 1821, with the architect, William Burn, Stevenson examined the 31 ft. square foundation pit for the column, which was then 8 ft. deep. He reported that as the monument was upwards of 140 ft. high and weighed about 1,500 tons, it 'becomes necessary to obtain the best foundation ... the pit should now be dug to the depth of 12 ft. before any final decision is entered into'. After this had been done and he had pronounced the foundation sufficient without planking or piling, he specified the form, dimensions and method of constructing the masonry base, staircase dimensions and the column wall thickness.

In order to fund these alterations Stevenson urged the committee to extend the funds to £500 or £600 a sum still too inconsiderable to be put in competition with the more certain stability of a building intended to perpetuate the memory of so illustrious a statesman as the late Viscount Melville'. The project went ahead and the scaffolding and tackling for the incredibly delicate task of raising and positioning the large statue on top of the column were carried out under Stevenson's direction using the Bell Rock iron balance crane.

Publications, learned society activities and death

Stevenson had a life-long interest in gaining and promoting knowledge and had formed an outstanding office reference library strong in the key English and French engineering works from 1737 to 1850. His writings, which were of a descriptive and practical character, appeared in more than sixty publications. Many were engineering reports, but about one-third achieved wider circulation through leading periodicals, text-books and ten articles in the *Edinburgh Encyclopaedia* and the *Encyclopaedia Britannica*. Many of his publications, because of their depth and authority, now represent a valuable historical resource.

Stevenson's professional and scientific interests are reflected in his membership of numerous learned societies, the earliest known being that of the Highland Society in 1807. By 1812 he was a member of the council of the Wernerian Natural History Society and, in the following year, a founder director of the Astronomical Institution of Edinburgh. In 1815 he was elected to Fellowship of the Royal Society of Edinburgh, the Geological Society and the Society of Antiquaries of Scotland. In 1821 he became a founder subscriber to, and soon afterwards a director of, the School of Arts in Edinburgh, Britain's first Mechanics Institute, from which Heriot-Watt University traces its origin. In 1827 and 1828 he was elected respectively to membership of the Smeatonian Society of Civil Engineers and the Institution of Civil Engineers. These elections, particularly the latter, for which he was sponsored by Telford, were a fitting recognition of Stevenson's acceptance into the first rank of British civil engineers.

Stevenson is now chiefly remembered for erecting the Bell Rock Lighthouse, for establishing the Scottish lighthouse service and for the useful contribution his surviving bridge, lighthouse and harbour work continues to make to mankind. He died in Edinburgh on 12 July 1850.

ROLAND A. PAXTON

[Stevenson papers, NLS; J. Weale (comp.) (1843) *Bridges*; Tidal Harbours Commission (1845–1847) *Reports and Appendices*, contains reports on Stonehaven (1812), Leith (1824), Alloa (1826), Elie (1826), Stirling (1828) Granton (1834), Fisherrow (1839), Lossiemouth, Fraserburgh, Peterhead, the Tay, Perth, etc.; A. Stevenson (1861) *Biographical Sketch of the late Robert Stevenson*; S. Smiles (1862) *Lives of the Engineers*; D. Stevenson (1878) *Life of Robert Stevenson*; C. Mair (1978) *A Star for Seamen*; J. Leslie and R. Paxton (1999) *Bright Lights—The Stevenson Engineers 1752–1971*; R. A. Paxton (1999) An Assessment of Aspects of the work of the Stevenson Engineers, Ph.D. thesis Heriot-Watt University]

Selected publications

1803. *Memorial and State relative to the Lighthouses erected on the Northern Part of Great Britain*
1810–1830. Articles in *Edinburgh Encyclopaedia*
1812. *Report relative to the Harbour of Stonehaven*
1814. *Report on the improvement of the Harbour of Dundee*
1814. *Reduced plan of the lands of Calton Hill* (Regent's Bridge, Edinburgh)
1816. *Nautical Survey of the Frith of Tay*
1816. Description of the bridge at Marykirk, *Scots Mag*, **78**, 883–885
1816. Observations upon the alveus or general bed of the German Ocean and British Channel, *Annals of Philosophy*, **8**, 173–182, etc.
1816–1824. Articles in *Encyclopaedia Britannica*, supplement
1817. *Report and Reduced Survey & Section of a Line of Canal between Edinburgh & Glasgow upon One Level ... made in the Years 1814 & 1815*
1817. *Report and Reduced Survey & Section of the proposed Canal into the Bale of Strathmore between ... Forfar and Aberbrothwick*
1818. *Reduced Survey of Part of the Frith of Tay as seen at Low Water of Spring tides ...*
1818. *Reduced Plan of Part of the Shires of Edinburgh & Haddington shewing the Lines of the Proposed Railways*
1818. *The Report relative to the Improvement of Communication by the Ferries betwixt Fife and Forfar, and Observations* (1820)
1818. *Sketch of the Coast from Lincolnshire to Hampshire*
1819. *Report relative to the various Lines of Railway from the Coalfield of Midlothian to the city of Edinburgh and port of Leith*
1819. *Report* and *Reduced Survey & Sections of several Lines of Railway from the Port of Montrose to the Town of Brechin ...*
1819. *Report relative to the Compensation Reservoirs for the Mills on the Water of Leith and Bevelaw Burn*
1820. *Memorial relative to Opening the Great Valleys of Strathmore and Strathearn, by means of a railway or canal*
1821. Description of bridges of suspension, *Edin Philos J*, **V**, 237–256
1821. [Dalkeith, Galashiels & St. Boswells Railway Report]
1821. [Report on the proposed railway in the Tweed valley between Roxburgh and Selkirk]
1821. [Report relative to proposed lines of railway from the coal-field of Midlothian to the rivers Tweed and Leader]
1822. *Report* and *Reduced Survey & Section of Part of the River Severn shewing the Proposed Improvement upon New Passage Ferry*
1824. *An Account of the Bell Rock Light-house*
1824. Notes ... in reference to essays on railways, *Prize Essays Trans Highland Soc Scotland*, **6**, 130–146
1824. *Sketch Plan of a Design for obtaining new Access to the Cross of Edinburgh*
1825. *Plan for a Smooth and durable City Road*
1825. *To the Subscribers for the Survey of the East Lothian Railway*
1827. *Report* and *Reduced Plan & Sections of the Valley of Strathmore shewing a Line of Railway from the Ports of Montrose & Arbroath to Perth*
1827. *Excerpt from the Minutes of the Meeting of the Trustees upon the Turnpike Road from Crieff to Longcauswayhead ...*
1827. *To the Commisssioners ... Harbour of Sunderland*
1832. *Report relative to the Improvement of Ballyshannon Harbour*
1832. *A Chart of the Coast of Scotland with Part of England and Ireland* (with Alan Stevenson)
1833. *Survey of the River Tay—Harbour of Perth* (with Alan Stevenson)

1834. *Report relative to Granton Harbour* (with Alan Stevenson)
1834. *Report on the Navigation of the Tay, and the Extension of Perth Harbour* (with Alan Stevenson)
1835. *Plan of the Edinburgh and Glasgow Railway* (with Alan Stevenson)
1836. *Chart of Skerryvore Rocks* (with Alan Stevenson)
1838. [Forth navigation report] (proposals based on a survey of 1826–1827)
1839. [Dee navigation report] (with Alan and David Stevenson)
1845. *Tay Navigation, Effects of Perth ... Railway*

Selected works

Lighthouses:

1797–1825. Cloch, Renfrewshire
1804. Inchkeith, modernised 1815
1806. Start Point, Orkney
1809. North Ronaldsay, Orkney (modernised 1809)
1811. Bell Rock, £61,000
1812. Toward Point, Argyllshire
1816. Isle of May
1817. Corsewall, Wigtownshire
1818. Point of Ayre, Isle of Man, two towers
1818. Calf of Man, three towers
1821. Sumburgh Head, Shetland
1824. Kinnaird Head, Fraserburgh, modernised
1820s. Eilean Glass, Harris, modernised
1820s. Pentland Skerries, Orkney, rebuilt
1820s. Mull of Kintyre, rebuilt
1820s. Pladda, Arran, modernised
1825. Rhinns of Islay, Argyll
1827. Buchan Ness, Aberdeenshire
1828. Cape Wrath
1830. Mull of Galloway
1830. Tarbat Ness, Ross & Cromarty
1831. Dunnet Head, Caithness
1832. Douglas Head, Isle of Man
1833. Barra Head
1833. Girdle Ness, Aberdeen
1833. Lismore

Harbours:

1812–1814. North Berwick, engineer
1818–1820. Fraserburgh, improvements, including south quay, engineer, £6,600
1825–1830. Stonehaven, engineer, £9,000
1826. Alloa, piers
1826–1828. Crail Harbour, west pier, designed by Stevenson in 1821, built by John Gosman, £1,100
1830. Fraserburgh, improvements, Middle pier, £5,700
c. 1832. Lossiemouth, *c.* £5,000
1834–1837. Granton, recommendations not fully implemented, but construction of 800 ft. steam boat pier supervised by David, 1836–1837
1835. Cockenzie Harbour, improvements

River navigation improvements:

1812. Parts of the Dee, Aberdeenshire
1834–. Tay, £62,000
1839–. Ribble improvements, work carried out by his sons
1843–. Stirling, improvements to the Forth to Alloa, etc., initial report 1828, Act 1843

Bridges:

1811–1814. Marykirk, four segmental arches, £10,000
1816. Lugton, Dalkeith, 50 ft. span arch
1819. Regent, Edinburgh, £17,000
1819. Clockmill tunnel, Edinburgh, £600
1824. Annan, timber temporary crossing, £500
1824–1827. Annan, three segmental arches in red sandstone, £6,000
1824. Stannochy Bridge, Brechin (1824, unattributed—if not by Stevenson, influenced by Marykirk Bridge design)
1825. Boddam, timber, £200
1828. At least nine on lighthouse access roads, e.g. Chearbaig (Kearvaig) (1828), near Cape Wrath, Glenmanuilt on the Mull of Kintyre road (1832)
1829–1832. Stirling, five segmental masonry arches, £17,000
1831–1834. Hutcheson, Glasgow, five segmental arches, £24,000
1832. Glasgow, temporary timber bridge, retained until 1846
1833. Abbey St. Bathans, Berwickshire, two 60-ft. iron truss spans
1836. Wardie Burn tunnel, Edinburgh, 100 ft. long
1842. Allanton, two masonry spans, £6,058

Other:

1814. Road at Marykirk
1815. Arbroath Abbey ruins
1818. Newton colliery railway, near Edinburgh
1819. Regent Road approach to central Edinburgh
1821. Melville Column, St. Andrew Square, Edinburgh

STEWART, William (fl. 1770–1806), was a bridge builder of Moniaive, Dumfriesshire. By 1793 he had built 20 bridges and was working on the New Bridge at Dumfries. In this contract he was described as a mason and his colleague, Thomas Boyd, as an architect, but in a subscription list of 1795, Stewart too is shown as an architect; by 1801 he had added the role of timber merchant. In the same year he subscribed 5 guineas to the new County gaol, for which Boyd had provided the plans.

P. S. M. CROSS-RUDKIN

[Rennie collection, NLS; *Dumfries Weekly Journal, passim*; J. Robertson (1993) *The Public Roads and Bridges in Dumfriesshire 1650–1820*]

Works

1770. Nithsdale, three small bridges, cost *c.* £265
1777–1778. Nith Bridge, Thornhill
1781–1782. Auldgirth Bridge, contractor; cost £1,145
1782. Lochar Bridge, Collin, contractor for £166
1783–1784. Ae Bridge, contractor, £635
1785–1786. Shinnel Bridge, Tynron, contractor, £230
1789. Kirtle Bridge, Rigg, contractor, £200(?)