

John Rennie and the Bell Rock Lighthouse

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There are many differences of opinion as to whether it was Rennie or Stevenson who was ultimately responsible for the building of the Bell Rock. It's a debate that is likely to continue for many years and in this fascinating article, Roland Paxton explores Rennie's involvement.

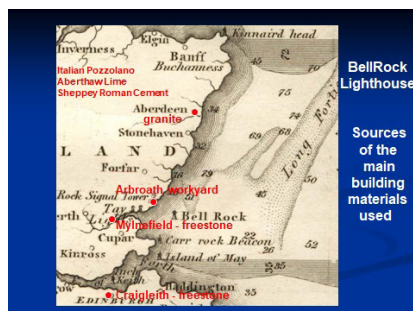
Scotland's Bell Rock Lighthouse ranks as one of the greatest civil engineering maritime achievements. The lighthouse, erected from 1807-11 in the North Sea, about 12 miles off Arbroath, was built of stone quarried at Aberdeen, Mylnefield near Dundee and at Craigeith, Edinburgh and shipped to Arbroath [Fig. 1].

Exceptional difficulties in building the lighthouse arose from the rock being inundated with up to 14ft [5m] of water every high tide [Fig.2], at times subject to excessive force from the sea.

This situation severely restricted working time at the rock before the temporary barrack for the workers adjoining the tower became operational. But with ingenuity, determination, and outstanding courage, this seemingly impossible challenge was met, to achieve an elegant lighthouse, 115ft [35m] tall with a 42ft [13m] diameter base, costing £61,331.9s.2d. During the next half-century the project significantly influenced lighthouse, harbour and bridge construction techniques. Its success also enabled Robert Stevenson, in 1811, to set up a family engineering firm practicing through four generations for 151 years and achieving international reputation.

In 1799, 70 vessels were stranded or lost on the shores between

Fig.1 Map showing the lighthouse and its building materials sources



Fifeness and Aberdeenshire, many of which might have been saved by a lighthouse on the Bell Rock. This event prompted Stevenson, then apprenticed to and in charge of the lighthouse work of Edinburgh lamp manufacturer Thomas Smith, Engineer to the Northern Lighthouse Board, to propose and model a stone lighthouse. From 1800-06 this proposal formed the basis of application for the Act of Parliament needed for its execution. This was eventually obtained on 21 July 1806 with the support of John Rennie. Rennie had more experience of marine construction than Stevenson and had just reported on the provision of Plymouth breakwater, pier, and two lighthouses, estimated to cost £1.17m, for which he later became the Engineer.

On 3 December, the Northern Lighthouse Board resolved that the lighthouse be erected 'under

Rennie's direction' and appointed him 'Chief Engineer' and Stevenson as his 'Assistant'.

Although very busy on other work, by February 1807 Rennie had drawn up his basic design of the lighthouse and furnished Stevenson with an elevation and details for setting out the cycloidal form of curved face he considered essential for its stability. Rennie's elevation, with details, was first published in the Scots Magazine, June 1807.

Fig.2 Author's view of the reef in 1986 - The railway is highlighted in purple

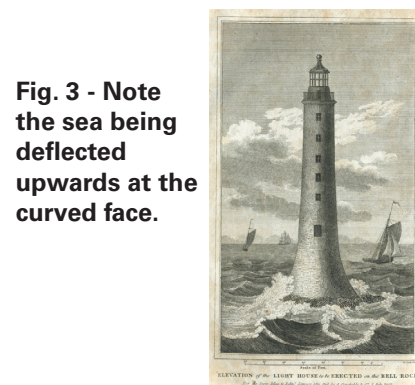


Fig. 3 - Note the sea being deflected upwards at the curved face.

Under Rennie's able superintendence, the as built design of the lighthouse soon developed significantly from Stevenson's 1800-06 proposal [Fig.4] The competent Clerk-of-Works, David Logan, who later became Engineer to the Clyde River Trust, wrote:

'that if Stevenson's design had been built not one stone would have been left standing. It was not dovetailed ... there was no lateral connection and the profile had not the curvature for breaking up the waves'.

We shall never know if this fate would have materialised but, in 1817, Stevenson's 36ft [11m] tall Carr Rock tower beacon, with a similar face curvature to his Bell Rock design, was destroyed in a storm. In a simulation undertaken at Heriot-Watt University, this tower was swept away by 5m waves.

Fig.4 Stevenson's proposal compared with the tower as executed under Rennie's direction

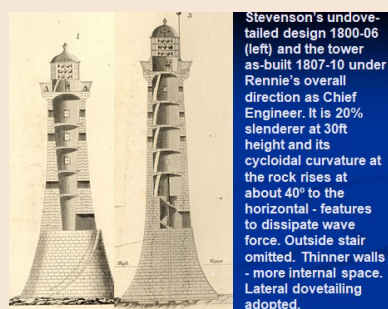
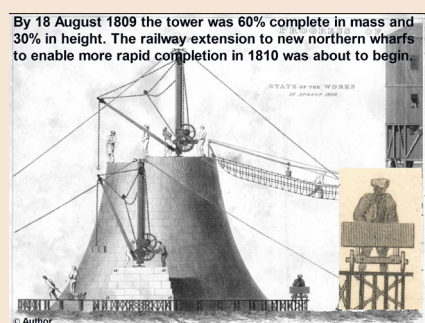


Fig.5 Progress to August 1809 showing the innovative railway, cranes and beacon barrack



On 24 September 1809 Rennie inspected the tower [Fig.5] and reported that 'the curve of the outside of the tower answers fully to every expectation I had formed of it, the sea plays round it and I trust it will be found when finished the completest work of its kind.'

Rennie also saw the essential temporary works innovations invented and implemented by the ingenious Francis Watt under Stevenson's direction with his [Rennie's] approval. These included the powerfully efficient swivel cranes, the cast iron railway for transporting materials over the rugged rock from wharfs at the rock edge, and the beacon barrack for the workforce that obviated time-consuming travel to and from ships anchored some distance from the rock. These features, and the chronology of the lighthouse's erection, can be seen in Figs 5, 7, 8, and 9.

Rennie insisted on dovetailing [Fig. 6] and furnished several sketches of alterations to David Logan, including 'the courses undovetailed at the centre which were adopted by Mr Stevenson but afterwards rejected (by Rennie)'.

Fig.6 The first entire stone course

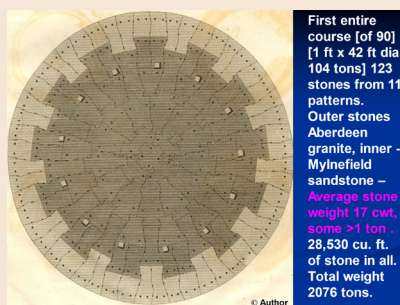


Fig.7 Stevenson plan showing the extent of the temporary railway

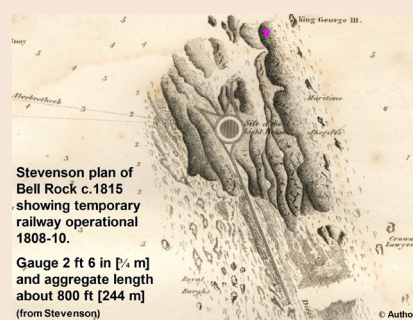


Fig.8 Progress of work nearing completion

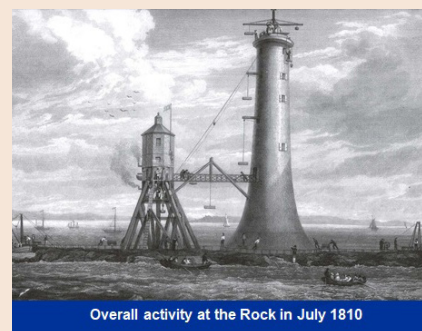
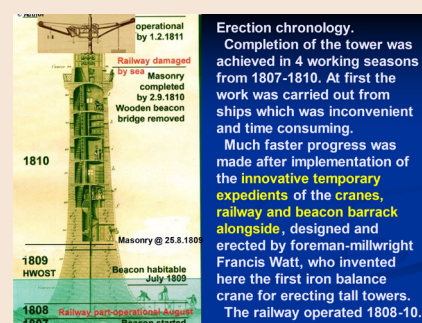


Fig.9 Chronology of construction 1807-11



On 1 February 1811 the light came into service and nature tested the tower with a gale. Spray rose to about 70ft [21m] and 'the sea was covered with foam as far as the eye could reach'.

It is a wonderful tribute to all concerned that the lighthouse, with its nominal range of 18 nautical miles, automated in 1988, is still in service. In 2003 a BBC2 documentary fittingly dubbed it as one of the Seven Wonders of the Industrial World along with Brooklyn Bridge, the Panama Canal and the Hoover Dam.

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The credit for the lighthouse's design and erection has been generally attributed to Stevenson, not Rennie. Their letters indicate they had a good working relationship on the project, so it is of interest to note how their merit deservance difference developed. Until 1848, the sons of each believed that their father was due this merit, a matter that their families disputed for the next one and a half centuries.

The publication of my research findings shedding light on this issue in 2011, was only possible after comparison of the contemporary records of both engineers now in the National Library of Scotland. This led to the surprising discovery that some key letters indicating Rennie acting with the authority of a chief engineer had been cut out of the Stevenson letter books, possibly in the mid-19th century. Also, that Rennie's authoritative report of October 1809, after inspecting on site his design features as built, and directing other work, had been, almost certainly, deliberately omitted from Stevenson's definitive account of the project although Rennie's earlier reports were included.

This gave the impression that he never visited the tower when it was being built. Stevenson's book was begun in 1814 and published in 1824. Rennie who was working on his own account of the lighthouse in 1820 never saw Stevenson's book as he died in 1821.

Rennie's key contributions are not referred to by Stevenson. These factors support Rennie's contention in March 1814, that Stevenson was about 'to assume the whole merit for the Bell Rock Lighthouse'. David Logan agreed.

These factors contributed to many later writers being unaware of or misled about Rennie's role.

Ironically, even in Robert Louis Stevenson's *Records of a Family of Engineers*, and in D Alan Stevenson's *The World's Lighthouses before 1820*. Stevenson certainly deserves great credit for successfully managing the most difficult and hazardous part of the undertaking - its construction. At the outset Rennie encouraged Stevenson to accomplish this work, 'which if successful will immortalize you in annals of fame'. It did, and enabled Stevenson to found the family dynasty of civil engineers that practiced continuously until 1952.

My book *Dynasty of Engineers – The Stevensons and the Bell Rock* revealing these findings attracted a full-page review by Mark Macaskill in *The Sunday Times* on 6 February 2011. It was headed, 'Forgotten lighthouse hero hailed at last' correctly promoting that both engineers 'played their part in creating a wonder of the modern world'.

It was pleasing to read that James Will, great, great, great, grandson of Robert Stevenson, welcomed my research and commented that the 'contribution through this new book is very valuable'. My friend, the late James Rennie, would have been delighted at this wider recognition of his forebear's superintending role. He was somewhat put out, on a visit to the Bell Rock that I had arranged for him, when the boatman referred to the lighthouse as 'Stevensons'!

It seems appropriate to let the eminent French engineer, Charles Dupin, who inspected the UK's innovative public works and knew both engineers, have the last words. These words reflect a popular understanding until Stevenson's book was published, after which he was increasingly credited with both the lighthouse's design and erection.

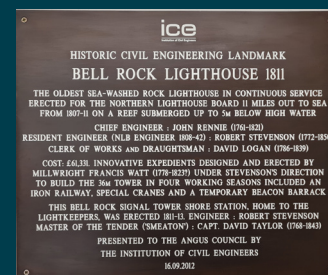
In 1821, Dupin wrote: that on the Bell Rock reef

'Mr Rennie has built the most beautiful lighthouse which closely compares with Eddystone, being of similar shape and competing with its audacity and greatness. Mr Stevenson was the able engineer who executed the lighthouse under Mr Rennie's direction'.

Postscript:

In 2012, Professor Paxton, then Vice Chair of the Institution of Civil Engineers' Panel for Historical Engineering Works, dubbed by the late HRH Prince Phillip 'The plaque man', initiated and organised the following plaque to better inform the public about the Bell Rock Lighthouse, its creators and of its recognition as a national Historic Civil Engineering Landmark by the Institution of Civil Engineers.

In addition to crediting Stevenson for his key role as the resident engineer, the plaque records, for the first time in this way, other key contributors and their roles. They are, David Logan, Francis Watt and Captain David Taylor, headed by John Rennie as chief engineer. The plaque was presented to the Angus Council at the iconic Bell Rock Signal Tower Museum, Arbroath in 2012, where it has been on display for nearly a decade.



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Note: Figs 1-9 are from Professor Paxton's Power Point Presentation 'A grand design; creation of the Bell Rock Lighthouse' at the Royal Society of Edinburgh on 4 February 2011 in the presence of HRH Princess Anne. The complete presentation including Carr Rock tower failure simulation can be viewed at Lecture 10 at <https://ice-museum-scotland.hw.ac.uk/>