

## Did Telford rely, in Northern Scotland, on vigilant inspectors or competent contractors?

THOMAS DAY

### Introduction

The name of Thomas Telford is linked in Scotland with the design and construction of roads, bridges, canals and harbours. There is a tendency to associate such engineering projects with him alone and to forget that, from the magnitude and geographical spread of his engineering practice, it was impossible for him to be directly associated with every project. The demands of his practice throughout the United Kingdom meant that he was seldom able to make more than two annual visits of inspection to Scotland so that the day-to-day supervision of construction was left to inspectors and resident engineers. These men, often responsible for construction in remote and disparate regions, had in turn to rely partly on the goodwill of the contractors executing the work. Telford's association with his inspectors, father and son, John and Joseph Mitchell, his resident engineers Davidson and Easton and his most prominent contractors Simpson, Cargill and Gibb has been detailed elsewhere.<sup>1</sup>

Besides these men, Telford's work in Scotland was associated with a number of lesser-known contractors, particularly masons as opposed to road builders. Two master masons, George Burn of Haddington and William Minto of Alford, Aberdeenshire, figured prominently in the construction, in north and north-east Scotland, of bridges, harbours and roads designed by Telford. Although neither of them gained national notoriety, they completed, in the fifteen years from 1810, contracts that included some of the finest examples of Telford's work in Scotland. A majority of these examples are still extant (Fig. 1).

In the past the role played in construction by contractors has received secondary consideration. These were the men who, when taking a construction contract, knew that their failure to fulfil it could result in financial ruin for themselves and their guarantors. Did their efforts merit success because of the supervision bestowed on contracts by Telford's inspectors or because of their own ability to organise and complete their contracts with minimum supervision? It is hoped, by an examination of contemporary documents, to establish, taking Burn and Minto as exemplars, both the competency of the local masons employed in

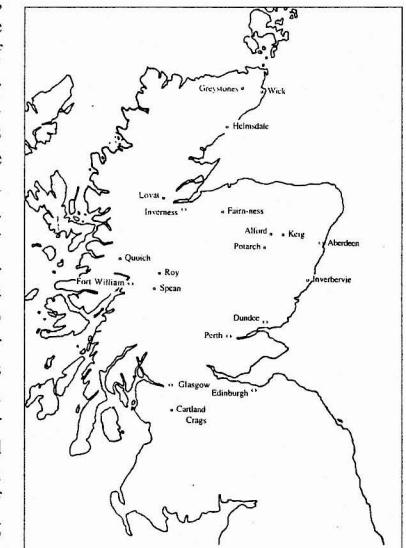


Fig. 1 Location of Highland Bridges

Scotland on Telford's construction contracts and the success and failure of the hierarchical system of contracting then in operation. In doing so there is no intention to erode the reputations of either Telford or his assistants and inspectors, but rather to promote the reputations of contractors who have in the past been neglected.

The activities of Burn and Minto are briefly acknowledged in standard texts that give details of Telford's work in Scotland.<sup>2</sup> An examination of the Reports of the Commissioners for Roads and Bridges in the Highlands of Scotland provides a more comprehensive account of their activities. From a study of these reports<sup>3</sup>, and correspondence with the Commission<sup>4</sup> and landowners, it is possible to establish, with some clarity, the competency of these men and the regard in which they were held by their employers and contemporaries. A balanced view of their work can be achieved by a comparison with the work of local masons who were not associated with Telford.

As considerable use has been made in this study of documents relating to the Commission for Roads and Bridges, the Commission's remit and its manner of operation should be considered. In 1803, having considered Telford's proposals for the construction of roads, bridges and harbours in northern Scotland<sup>5</sup>, government established a parliamentary commission to implement the proposals.<sup>6</sup> The Commission was composed of members of both Houses of Parliament, and its day-to-day business was controlled by three paid officials: John Rickman, the secretary to the Speaker of the House of Commons acted as secretary, James Hope, a Writer in Edinburgh, was responsible for the Commission's legal business, and Thomas Telford acted as engineer.

As many of the most onerous contracts taken by Burn and Minto were with the Commission, it is necessary to establish how the Commission's contracts were organised and the strictures that the Commission placed on its contractors. The conditions of contracts were rigorously enforced and, on occasion, caused hardship to inexperienced or negligent contractors. The Commission did not initiate construction projects, but reacted when proposals for new roads, harbours and bridges were presented to them. In every instance, after a competent person had completed a survey, either Telford or one of his assistants prepared plans and an estimate of construction cost.

**Table 1** 'Telford' Bridges built by Burn and Minto

Bridge	Configuration of span(s)	Contractor	Completion Date <sup>1</sup>	Type of Contract <sup>2</sup>
Wick	48' + 60' + 48'	Geo. Burn	1809	Bridge
Helmsdale	70' + 70'	Geo. Burn	1811	Bridge
Alford	40' + 48' + 40'	Wm. Minto	1811	Bridge
Quoich	40' (re-built 46')	Thos. Readdie	1813	Road
Lovat	40' + 50' + 60' + 50' + 40'	Geo. Burn	1814	Bridge
Potarch	65' + 70' + 65'	Wm. Minto	1814	Bridge
Fairn-ness	36' + 55' + 36'	Geo. Burn	1816	Bridge
Keig	100'	Wm. Minto	1817	Bridge
Spean	30' + 50' + 30'	Jn. Wilson	1818	Road
Roy	60'	Jn. Wilson	1818	Road
Greystones	26' + 28' + 26'	Geo. Burn	1819	Road
Cartland Crags	50' + 50' + 50'	Wm. Minto	1822	Bridge

1. Completion date recorded in Ninth Report of the Commissioners for Roads and Bridges in the Highlands of Scotland (1821) when financial transactions of contracts were finalised.
2. 'Bridge' refers to a bridge built as a separate contract with the Commission, and 'Road' refers to a bridge built as a sub-contract to a road construction contract.

On completion of these preliminaries, advertisements were placed for contractors to submit tenders. The contractor making the lowest offer, provided that it was less than Telford's estimate of cost, was awarded the contract. There were few exceptions to this. Telford's estimated cost of construction, considered as a 'yardstick' was not divulged. Contractors prepared their offers from information contained on the engineer's drawings and in the specification, and on their knowledge of site conditions. It appears that secrecy did not always prevail and may have resulted in contractors' tender prices being only marginally lower than the 'yardstick' price.

The Commission's main brief was road construction with a lesser emphasis being placed on the construction of harbours and bridges. The construction of bridges, of modest dimensions, was usually included in road construction contracts. However Burn and Minto were responsible for the construction of six of the eleven bridges built by the Commission as separate contracts.<sup>7</sup> Of these, four bridges, those at Alford, Potarch, Fairn-ness and Lovat, will be particularly considered, as will the bridges at Keig and Cartland Crags which were designed by Telford but were not central to the Commission's remit.

### George Burn

In 1806 when Burn was awarded his first contract with the Commission to build a triple-span bridge over the River Wick at the town of that name, he had already established his reputation as an engineer and contractor having been responsible for the design and construction of four bridges in north and north-east Scotland. Two of these were major structures, the bridge at Nairn had three spans and that at Fochabers over the river Spey had four.<sup>8</sup> Burn, although the designer of the last-named bridge, constructed it as joint contractor with his brother James. The bridge was greatly admired, and its arches were favourably compared with those of the contemporary Westminster Bridge.<sup>9</sup>

Burn, as contractor, built five bridges for the Commission. All were constructed successfully, and in every case Burn's workmanship was, before acceptance of the bridges by the Commission, approved without the need for significant remedial work. This was a record to be envied by his peers. There is little detailed information in the Commission's papers about the construction by Burn of bridges at Wick, Helmsdale and Greystones. The last-named bridge was built as a sub-contract with local landowners.<sup>10</sup> However more detail is available about the construction of Lovat and Fairn-ness bridges. From correspondence with the Commission it can be established that there were problems with the construction of the last-named bridges, and that these problems, both constructional and financial, were in part attributable to Burn and in part were due to circumstances beyond his control.

Construction of Lovat Bridge commenced in April 1812.<sup>11</sup> Matthew Davidson, Telford's resident engineer superintending construction of the masonry work at the eastern end of the Caledonian canal, was appointed to superintend Burn's contract. Although work on the bridge was completed within the contract time specified<sup>12</sup>, a number of misfortunes occurred during construction which delayed progress and prevented an early completion of the contract. Burn's absence from site may have been a contributory cause. In September 1813 Davidson, when reporting the progress of the building work, noted 'Mr Burn is at Wick in ill health, I have seen him once this season.'<sup>13</sup> During the contractor's prolonged absence, work on site was carried on by his foreman, and it was subsequently suggested that the successful completion of the contract was largely due to the vigilance of Davidson.<sup>14</sup>

The Commission's decision to award the contract to Burn turned, despite dubiety expressed about Burn's financial status, on the fact that Burn was better known as a competent contractor by the Commission and the Inverness-shire County Committee than was Matheson, his closest rival for the contract.<sup>15</sup> Although work additional to the contract to form piled foundations was

necessary, the early stages of construction, when Burn was present on site, progressed steadily. In 1812 it was reported that 900 tons of stone were already cut but in 1813 during Burn's absence this state of preparedness appears to have dwindled, and twice it was reported that stocks of cut stone were low.<sup>16</sup> This situation may have been exacerbated by a lack of transport when the local labour force reverted, in spring and autumn, to agricultural work.

Bridge construction in Scotland usually took place during summer and early autumn, and the work completed had meantime to withstand seasonal buffeting from ice and flood. The part-constructed Lovat Bridge, in a vulnerable condition throughout two winters, was no different from comparable bridges, and withstood such onslaughts and suffered little damage. A man-made hazard, the floating downstream of felled timber as single logs, did cause considerable damage, and on four occasions the temporary service bridge used during construction was destroyed.<sup>17</sup> Burn was fortunate that the practice of floating logs did not damage the part-built bridge, a misfortune that befell Minto at Potarch. The fact that the centres used for the construction of the arches remained undamaged was fortuitous. Burn was warned that the use of conventional centres might be unwise but he did not modify them to allow an unobstructed waterway as Simpson had done earlier when constructing the Commission's bridge at Ballater over the River Dee.<sup>18</sup> Nor did Burn ensure that his foreman used sufficiently robust construction for the temporary works. Davidson, reporting on the successful completion of the second arch of the bridge, noted

*"the Centre bore its load beyond expectation, for I was very apprehensive that it would crash down and destroy the workmen ... I strongly recommended to the foreman a good centre for the middle arch and sketched one on the sand for his consideration but despair [sic] of their adopting it as Mr Burn declined purchasing the excellent centres of Bonar Bridge ...."*<sup>19</sup>

The re-use of timber from bridge centres was not uncommon, particularly as timber of requisite dimensions was not easily obtained and the cost of construction and the material for centres could exceed ten percent of the contract price. Despite the natural and man-made difficulties that occurred during construction, Burn, although at a distance, successfully completed his contract (Fig. 2).

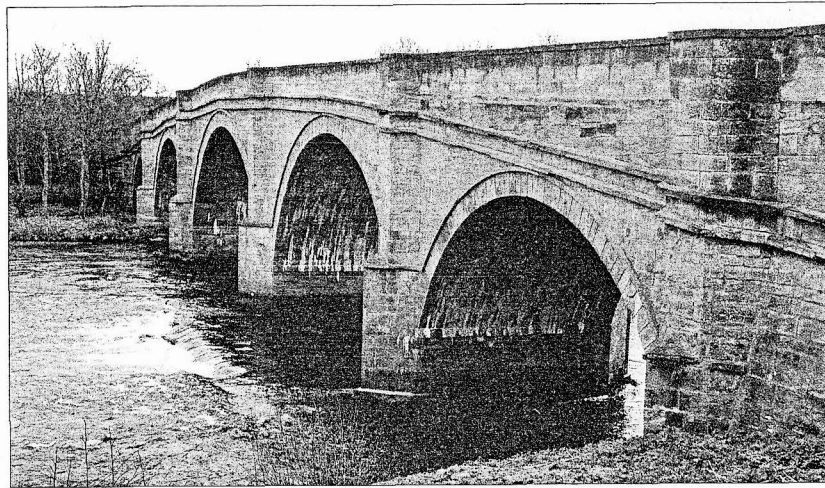


Fig. 2 Lovat Bridge, Invernesshire, 1814 (Thomas Day)

Burn had a bittersweet relationship with the Commission's bridge he constructed at Fairness, Nairnshire.<sup>20</sup> For a contractor of his experience it was an undemanding contract which ought to have been completed without problems and it should have been profitable. In a number of ways it mirrored events that occurred previously during the construction of Lovat Bridge. Again the problems were not the quality of workmanship but rather supervision on site. The Commission had no cause to complain about the execution of Burn's contract as the specification was exceeded. This happened during the contractor's absence from site when some main elements of the bridge were built of coursed granite masonry in lieu of the random rubble construction specified. Apart from the additional expense resulting from the workmanship Mitchell, the Commission's inspector, reporting on the lack of supervision on site, noted *"From the number of men employed (which are 35) and their tardy manner of proceeding, it must make this job a losing concern to Mr Burns [sic]."*<sup>21</sup>

Contracts with the Commission did not specify quarries where rock should be extracted, and the decision about the sources of masonry was left to the contractor provided that the rock used for construction was a suitable quality. For Fairness bridge Telford based his estimate of the cost of construction on the use of masonry obtained from a prominent rock outcrop obstructing the river 40 feet upstream of the site of the bridge (Fig. 3). Burn did not use the outcrop as a source of building material. Having nearly completed construction of the bridge and possibly in an effort to relieve his current financial difficulties, he offered, for an additional payment, to remove the rock as *"it dams the whole of the water into two arches, Besides [it] throws in the water obliquely between the Piers."*<sup>22</sup> The oblique flow of the water must have been evident to Burn when he took the contract. One must therefore assume that he considered, in the event of any mishap during spate conditions, the Commission, who could be unforgiving to negligent contractors, might hold him responsible for any failure. This was a situation his weak financial status would have been unable to sustain.

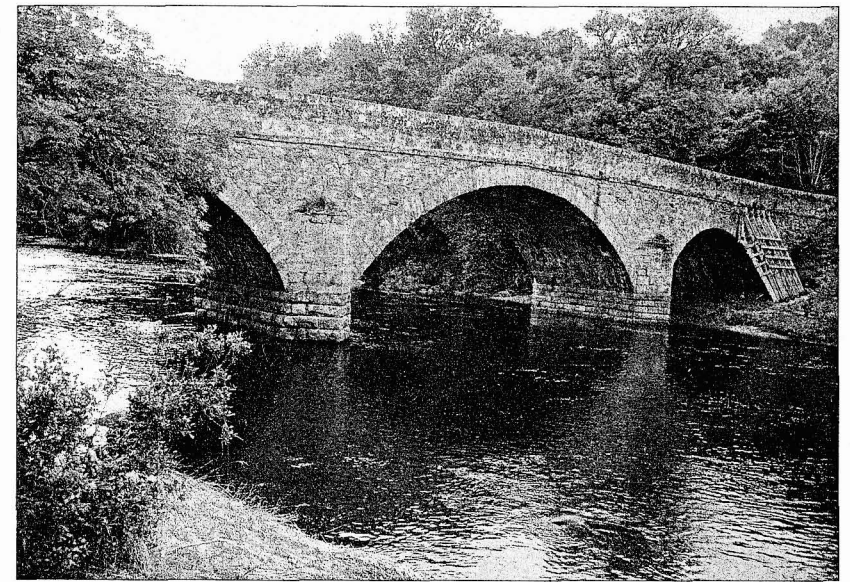


Fig. 3 Fairness Bridge, Nairnshire, 1816 (Thomas Day)

### William Minto

Prior to 1810 the year that Minto took a contract with the Commission to construct a bridge over the River Don near the Aberdeenshire town of Alford, he had only been associated with the construction of one major bridge. This bridge, spanning the River Deveron at Marnoch in Banffshire, had been completed in 1806.<sup>23</sup> It has not been possible to ascertain whether he was both contractor and engineer for the bridge or only the contractor. The Bridge of Alford, a triple-span structure constructed of granite like many Aberdeenshire bridges, was completed in 1811.<sup>24</sup> Construction of this modest bridge did not tax Minto's abilities, and, as a result, he may have taken the opportunity offered by this straight-forward contract to impress Telford and the Commission. On two occasions whilst building the bridge, arches, one 40 feet span and one 48 feet span, were turned within twenty-four hours. This was an exceptional rate of construction.<sup>25</sup>

In 1812 Minto, having successfully completed the Bridge of Alford, contracted with the Commission to construct a larger triple-span bridge across the River Dee at Potarch, Aberdeenshire (Fig. 4).<sup>26</sup> He made steady progress with construction and would have completed the bridge six months before the completion date set by the contract but for a catastrophic event

that occurred in October 1812. At that time the two side arches were turned and the central arch, all but complete, was supported on a timber centre. In full-flow conditions single fir logs of considerable size, being floated downstream, caught under the centre of the unfinished arch and caused a log-jam. This destroyed the timber centre and the part-formed masonry of the central arch, and caused the incremental collapse of the side arches.<sup>27</sup>

Minto, by the terms of his contract, was liable for the extra costs associated with the reconstruction of the fallen masonry. However he recouped some of his financial loss by an *ex gratia* payment from the Commission and local landowners, and by legal action taken against the owners of the timber. Before the destruction of the part-built bridge, Minto had, as at the Bridge of Alford, exhibited considerable diligence by turning, within twenty-four hours, one of the 65 feet side arches of the bridge. The logistics of the process required slightly more than 300 tons of pre-cut granite voussoir blocks to be lifted into place.<sup>28</sup> The reason for such activity has not been ascertained.

The bridge at Keig, Aberdeenshire, completed in 1817, was built to design guidelines formulated by Telford (Fig. 5).<sup>29</sup> Construction of the bridge, although outside their remit,

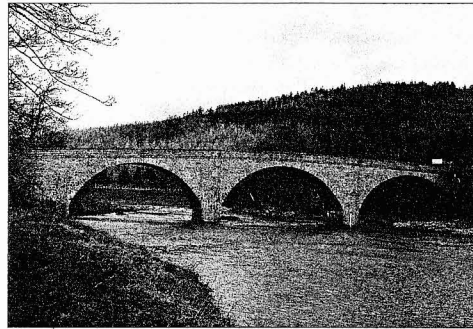


Fig. 4 Potarch Bridge, Aberdeenshire, 1814 (Thomas Day)



Fig. 5 Keig Bridge, Aberdeenshire, 1817 (Thomas Day)

followed, with few exceptions, the general procedures laid down by the Commission. In this instance Minto himself, following Telford's guidelines, prepared the specification for the bridge and an estimate of construction cost.<sup>30</sup> Contrary to the Commission's usual practice he, having acted as 'engineer', became the contractor. It must be assumed that Telford approved Minto's appointment, and that either no other contractor bettered Minto's offer or Minto's ability as a contractor rated preferential consideration. A possible explanation of his competence and standing as a contractor may be due, unlike Burn, to the time he spent on site supervising construction. In 1815, having been employed to do remedial work to the foundations of Telford's bridge at Ballater, Minto's invoice for payment showed that his men, whilst completing the contract, had been employed for twelve days on site and that he had been present for eight.<sup>31</sup>

By 1820 Minto had successfully completed a number of bridge and harbour contracts, and had established his reputation as a reliable contractor. At this time the Commission had become involved with the preliminaries for the construction of a bridge at Cartland Crag near Lanark. They were unable to obtain suitable competitive tenders for the construction of this bridge and with Telford's approval asked Minto to visit the site and to prepare an offer to construct the bridge. He did this in conjunction with John Gibb of Aberdeen. Despite his reputation as a contractor whose prices were competitive Minto's offer to construct the bridge exceeded Telford's estimate of the cost. The engineer estimated the cost of construction to be £4200 whilst Minto's offer to construct the bridge was £4425 - 8 - 6.<sup>32</sup> Doubtless Gibb's support of Minto, and the need to engage a reputable contractor of proven ability who was capable of constructing this impressive bridge over a gorge 125 feet deep, influenced Telford's decision to accept Minto's offer.

Construction commenced in 1821 and by the end of the year the contract was well advanced. The bridge was completed during the following summer (Fig. 6).<sup>33</sup>

Minto's standing as a contractor can be gauged from the fact that Gibb, himself an established engineer and contractor, arranged that his son Alexander should work with Minto on the bridge at Cartland Crag so that the young man could gain experience. The close relationship between Minto and Gibb appears to have become established over a number of years, and resulted from Gibb being, on a number of occasions, appointed by Telford as inspector of Minto's work. Subsequently the two men became joint contractors for the construction of some of the Highland churches designed by Telford.<sup>34</sup>

Minto and Gibb, acting jointly, became involved in the construction of roads in Lanarkshire for which Telford was engineer. Minto was the principal operative, and was responsible for the construction of a number of bridges. One of these was constructed over the Fiddler burn on the road between Lanark and Carluke. It was a tall bridge of a modest span, and on completion it showed signs of failure when the earth pressure behind the abutments caused movement of the wingwalls. This situation was unlikely to be caused by poor workmanship on the part of Minto, but it resulted in the contractor having to take down part of the bridge and take remedial action.<sup>35</sup>

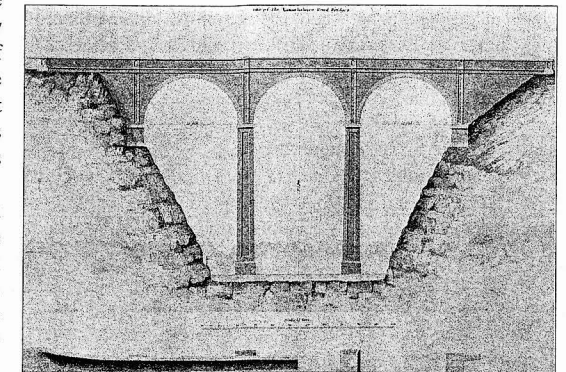


Fig. 6 Cartland Crag Bridge, Lanarkshire, 1814 (from *The Atlas to the Life of Thomas Telford*, 1838)

### Contemporary Contractors

Having considered the contracts taken by Burn and Minto for the construction of bridges for Telford and the Commission, it is desirable to compare their performance against that of contemporary contractors engaged in similar work. Burn's brother James, an engineer and contractor in his own right<sup>36</sup>, was the designer and contractor for a bridge at Inverbervie, Kincardineshire.<sup>37</sup> It was an impressive structure with a single arch span 102 feet wide and 80 feet high and had, because of its height, considerable masonry wingwalls and vaults on either side of the arch. Correspondence indicates that Burn designed the bridge using information taken from an incorrect survey and may not have visited the site before he prepared the design.<sup>38</sup> This was not the only professional lapse. In 1801, two years after the bridge had been completed, it was recorded that a committee of the local roads trustees when examining the fabric of the bridge

*"were not a little alarmed [sic] to find in different places of the Flank Arches, and retaining walls, very considerable rents, swells and other apparent failures, sufficient to excite no small apprehension for the permanency of the work."*<sup>39</sup>

Some elements of the bridge had not been built to the required thicknesses. The discrepancies in thickness were considerable, and it was noted that retaining walls which should have been built 8 feet thick were only 3 feet thick and that some crosswalls measured 2 feet 10 inches thick when they should have been built 6 feet thick. Besides these instances, other parts of the structure were undersized. Remedial work was necessary to stabilise the bridge, and the success of this action can be judged by the fact that the bridge, although superseded in 1935, still stands.

On a number of occasions deficient surveys caused problems for contractors, and it was not only the less experienced who had difficulties. David Hamilton, a Glasgow architect, was responsible for the design and construction of a new bridge to carry Union Street, Aberdeen over a major declivity and was forced, when he discovered errors in level, to withdraw from his contract. The bridge, after alternative designs had been submitted by John Rennie, was subsequently built by William Ross to a design by Thomas Fletcher.<sup>40</sup>

In 1828-29 both Telford and Gibb, during the construction of the Bridge of Don, Aberdeen, became acutely aware of the problems that could occur by reliance on an incorrect survey. The original design for the five span bridge was made by Gibb. It was subsequently modified by Telford who also prepared a specification and the details for the piled foundations. Gibb and his son Alexander took the contract and discovered, during construction, that the piers at either end of the bridge sank by 30 inches and 18 inches respectively. This failure occurred despite the contractors driving, in each foundation, more piles of greater dimensions than required by the specification. The contractors were forced to take down the piers and the adjoining arches, drive additional piles, and reconstruct the masonry of the piers and arches.<sup>41</sup>

As disaster and misfortune associated with construction are more newsworthy than competency, there tends to be more comment made about the former than the latter. Thus reportage often omits details of works successfully completed by able engineers and contractors. In the geographical area under consideration there were, besides those associated with Telford, a number of engineers/contractors who should be included in this category but who received little recognition. James Robertson of Banff completed three bridges, at Ballater (1782), Inverurie (1791) and Ellon (1793).<sup>42</sup> Ross, the contractor for the Union Bridge, Aberdeen, built, in partnership with William Smith of Montrose<sup>43</sup>, Robert Stevenson's Marykirk bridge over the river North Esk, Kincardineshire.<sup>44</sup> Smith himself was responsible for the construction of the masonry towers of Samuel Brown's suspension bridge at Montrose, for the Bridge of Mondynes, Kincardineshire and for East Side bridge at Turriff, Aberdeenshire, which was built to a design by Minto.<sup>45</sup>

### Road Contractors

Some road contractors experienced difficulties with the construction of bridges. They may have been capable of building the Commission's roads through the difficult and hostile terrain of the Scottish Highlands but were unable to overcome construction problems where roads crossed fast-flowing water courses liable to be swollen by unexpected floods. Contractors were not always responsible for the difficulties they encountered, and a combination of a strict adherence to contract details and unfavourable weather conditions could prove a test which, on occasion, even the most well-built masonry structure could not withstand.

The bridge over the Water of Quoch on the Commission's Glengarry road<sup>46</sup> failed from such causes. This occurred despite the contractor, Thomas Readdie, increasing the dimension, specified in the contract, of the single span arch from 36 feet to 40 feet wide.<sup>47</sup> Although John Mitchell, Telford's inspector, reported that the bridge had been built in accordance with the specification and that the failure was due to the "*smallness of the Arch*", Telford initially held Readdie responsible and maintained the span of the arch "*was still sufficient for the water*."<sup>48</sup>

Telford must have been persuaded by Mitchell's argument that the arch was, even at 40 feet, insufficiently wide, for when the bridge was rebuilt the span was increased to 46 feet wide and the height of the abutments was increased. In this respect the contractor was vindicated, but he only received an additional payment for the difference in cost for the construction of a bridge of the wider span rather than the original 36 feet span specified. There was no additional payment for the lost work.<sup>49</sup>

For incompetent or less able contractors, unable to meet the terms of the Commission's contract for road construction, building any large bridges on their line of road could be a challenging proposition. Messrs. Clark, father and son, took the contract to build the western division of the Commission's Laggan road.<sup>50</sup> In this division there were two major bridges where the road crossed the rivers Roy and Spean. In October 1811 the part-built abutments and wingwalls of Spean bridge were destroyed during spate conditions.<sup>51</sup> A year later, in October 1812, it was reported that "*one of the Pillars of the Spean Bridge is clean swept away, and the other considerably damaged by the late floods*." This accident occurred although the pillars had been "*most substantially built of Rubble work*." The contractor suggested, when rebuilding took place, that all work below flood level should be built of dressed granite masonry, laid square in courses with close joints, in lieu of random rubblework which had been specified and had proved unsatisfactory.<sup>52</sup>

The damage to the bridges over the rivers Spean and Roy proved to be too large a burden for the contractors who were already in difficulties with their work on the road, and they were replaced. On Telford's advice and having considered the repeated failures, construction of Spean and Roy Bridges was sub-contracted to John Wilson, an experienced masonry contractor then working at Corpach building locks on the Caledonian Canal.<sup>53</sup> Telford's action was supported by the Reverend John Anderson who suggested "*Were common masons to be employed in this hazardous and difficult work, the undertaker would again be ruined and the public disappointed*."<sup>54</sup>

At Spean Bridge the gradient of the river was 1:6.5, and it flowed within a deep narrow channel which, when the river flooded, overflowed and threw the full force of the water against the abutments and wingwalls of the bridge. Such conditions were bound to test the fabric of the structure, especially when only partly built. This situation was exacerbated by the width of the arches, originally built 60 feet and 20 feet wide.<sup>55</sup> The fact that the design of the bridge, subsequently built by Wilson, was modified to have three arches with spans of 30, 50 and 30 feet respectively<sup>56</sup> somewhat exonerates the Clarks and acknowledges that, in light of the two failures, they were correct to call for the bridge to have a greater waterway width.

## Conclusion

Like all contractors, those working for the Commission had to operate within the usual contractual, dimensional and material constraints imposed on them by their contract. In the harsh environment of the Scottish Highlands some constructional difficulties normally encountered when building bridges took on more importance. Although it was possible to use late spring and autumn for the preparation of building materials weather conditions often shortened the constructional season to four or five months a year. Usually few problems occurred with supplies of stone and timber but the provision of lime for mortar, particularly the logistics necessary for transporting of limestone, could be a problem. A further factor, increased by demand during the contemporaneous construction of the Caledonian Canal, was the scarcity of competent journeyman masons on whom contractors could rely. The Highlands at this time did not have a reservoir of skilled labour.

Before making a judgment about the abilities of contractors, particularly those engaged on contracts with the Commission, Telford's philosophy for balancing economy of scale and the cost of the reconstruction of failed bridges should be considered. Hope noted

*"the inference from his (Telford's) other observations as to the late severe storms and floods appears to be, that it is in vain to affect to erect Bridges which shall be proof against any quantity of water, which the streams may bring down - The expence [sic] of such an attempt would be excessive; and it is in fact more economical to repair or rebuild occasionally some of the Bridges than to construct them all of undoubted dimensions; to secure them against the possible, but unusual flood, which may happen once in twenty years."*<sup>57</sup>

Such philosophy left contractors at the mercy of prevailing weather conditions. If they were fortunate they might be able to complete their contract in a dry season, and, if unfortunate, adverse weather could bring spate conditions to wreck part-built or even completed structures. Such occurrences could precipitate financial disaster. All contractors, whether competent or less able, had to contend with this situation. The competent were more able to survive.

Burn and Minto have been used as exemplars to establish masonic competency, but it should be recorded that both were described as architect and engineer as well as contractor. This status also applied to James Burn, James Robertson and William Smith. Generally the road contractors, such as the Clarks and Readdie, did not have the same professional status. This occurred despite the financial value of road contracts in many cases exceeding those of bridge contracts. Possibly the status of later road makers was influenced by the general milieu, acquired by the profession over the years, consequent on the disrepute associated with the upkeep of parish and turnpike roads.

Road contractors in the Highlands did construct most of the Commission's bridges, and some of them were substantial and are still in use. They had to contend, unlike the contractors building bridges, with the problem of supervising constructional activity spread along a route over wild terrain. This should be offset against the fact that they were not responsible for the construction of 'major' bridges where a better quality of masonry was required. The road contractors could expect regular visits from Commission's inspector John Mitchell from whom it was difficult to hide faulty workmanship. Considering these disparate factors affecting the performance of road contractors it is unwise to make a direct comparison between the competency of the two groups, and more appropriate to consider individuals.

Although Burn successfully completed the bridge and harbour contracts he took with the Commission, his competency in terms of the organisation of his contracts can, in some instances, be questioned. It has been shown that his prolonged absences during the construction of Lovat and Fairn-ness Bridges left less experienced artisans in control of his contracts. At Lovat Bridge

the contractor's deficient supervision was negated by the vigilance of Telford's inspector Davidson. Fairn-ness Bridge was a smaller contract so that Burn's absence was probably less critical although the poor motivation of the workforce and the quality of the masonry did increase construction cost. In mitigation it was difficult, due to his widespread engineering commitments, particularly those at Wick, for Burn to be continually present on site. To a lesser extent he operated in a similar manner to the leading masonry contractors constructing locks on the Caledonian Canal who took bridge-building contracts outside the Great Glen.

Minto, like Burn, took contracts with the Commission for harbour construction. His ability as a contractor and standing with Telford and the Commission were recognised by the invitation to tender for the construction of Cartland Crags Bridge and by the Commission's acceptance of his estimate for construction cost although it was higher than Telford's estimated price. Further proof of his standing can be gauged from Hope's comment regarding Minto's unsuccessful tender for Fairn-ness Bridge. Hope wrote "*I wish he [Minto] had been lower so as to justify a preference.*"<sup>58</sup>

With the exceptions of Cartland Crags Bridge and the Lanarkshire roads, Minto's major engineering contracts were in the north-east of Scotland. Here he became associated with John Gibb who acted as inspector for the Commission and was later to become one of Telford's most trusted contractors. It seems inconceivable that Gibb, if he had not recognised Minto's ability, would have taken joint contracts with him to build some of the Highland churches.

There is no doubt that inspectors, like Davidson, Gibb and Mitchell, were vigilant and maintained the standards set by Telford for use in the Commission's contracts. With major bridges built as individual contracts by Telford's trusted contractors and by masons like Burn and Minto, the vigilance of inspectors, although required, may not have been so necessary.

To impute blame for the failure of a few bridges, built by road contractors, on individuals is harsh. The failed bridges considered previously were at the upper dimensional limits of construction included in road contracts, and this, together with abnormally severe weather and Telford's preference for economy of scale, may have tilted the balance against the contractors. It should be noted that the contractors associated with the failure of the bridges over the rivers Quoich, Spean and Roy were not amongst the most competent of the contractors building roads. As Telford's inspectors were aware of this, their vigilance would have been more necessary if the contracts were to be completed to specification. The Quoich Bridge was completed and accepted from the contractor but was destroyed during the contractor's period of upkeep. In retrospect it seems the contractor was treated harshly and that the failure of the bridge was beyond his control.

The failure of larger complete and part-built structures received comment in the Commission's correspondence. Further investigation is required to determine how many of the hundreds of smaller bridges and other masonry structures associated with road building failed and were rebuilt. Such data would enable a more certain view to be taken regarding the balance between the vigilance of inspectors and the competency of contractors. Sources consulted suggest that inspectors were more necessary to ensure the completion of masonry work executed by road contractors and that a majority of the contractors building major bridges required little supervision from inspectors.

## Acknowledgements

The author wishes to thank the Keeper of the House of Lords Record Office and the Keeper of the Scottish Record Office for permission to use material abstracted from archival sources held within their jurisdiction. The financial assistance received, when preparing this article, from the Carnegie Trust for the Universities of Scotland is gratefully acknowledged. The author wishes to record his thanks to his colleague, Ms Jacqui Goddard, for her assistance with the preparation of this paper.

*Correspondence:*

Thomas Day, School of Architecture, The Robert Gordon University,  
Garthdee Road, Aberdeen, AB10 7QB

**References**

1. For details of these engineers/contractors see:  
A. Gibb, *The Story of Telford* (1935); L. T. C. Rolt, *Thomas Telford* (1958); A. D. Cameron, *The Caledonian Canal* (Perth 1972); L. M. Rae, *The Story of the Gibbs* (Edinburgh 1961); J. Mitchell, *Reminiscences of My Life in the Highlands* (2 vols. Chilworth, 1883-4).
2. Brief references to the men and their work appear in A. R. B. Haldane, *New Ways through the Glens* (1962), and J. Dunlop, *The British Fisheries Society, 1786-1893* (Edinburgh 1978).
3. Reports of the Commissioners for Roads and Bridges in the Highlands of Scotland (C.H.R.B.), 1803-21.
4. House of Lords Record Office, Scottish Highways Papers (Boxes 1-8), House of Lords Record Office.
5. Mr. Telford's Survey and Report on the Coasts and the Central Highlands of Scotland, *Parl. Papers 1802-03* (45) IV, 1.
6. The Commission was established under 43. Geo 3. c.80, 'An Act granting to His Majesty the Sum of Twenty Thousand Pounds, to be issued and applied towards making Roads and building Bridges in the Highlands of Scotland; ....'
7. Details of these bridges appear in the Ninth Report, C.H.R.B. (1821), p.96.
8. H. Colvin, *A Biographical Dictionary of British Architects, 1600-1840* (1995), p.180.
9. T. Day, 'The Old Spey, Fochabers', *Industrial Archaeology Review*, 10.1 (1987), pp. 71-83.
10. Ninth Report, C.H.R.B. (1821), p.95.
11. H.L.R.O., Scot. Hghwys., letter Matt. Davidson to Jas. Hope, 27 Apr. 1812 (doc.324).
12. Ninth Report, C.H.R.B. (1821), pp.60-61.
13. H.L.R.O., Scot. Hghwys., letter Matt. Davidson to Jas. Hope, 7 Sept. 1813 (doc.385).
14. H.L.R.O., Scot. Hghwys., letter Jas. Hope to Jn. Rickman, 1 Jul. 1814 (doc 465).
15. H.L.R.O., Scot. Hghwys., (docs. 276, 276b, 278, 285a, & 297).
16. Detailed progress of the contract can be ascertained from letters written by Davidson to Hope between April 1812 and April 1814. H.L.R.O., Scot. Hghwys., (docs. 324, 330, 334, 362, 385, 387, 392, 394, & 431a).
17. Haldane, *New Ways* p.129.
18. J. Weale, *The Theory, Practice and Architecture of Bridges* (1843), supp. to Vol.II, pp.lxxv-lxxvi.
19. H.L.R.O., Scot. Hghwys., letter Matt. Davidson to Jas. Hope, 1 May 1813 (doc.362).
20. Ninth Report, CHRB (1821), pp.56-7, App.B.
21. H.L.R.O., Scot. Hghwys., letter Jn. Mitchell to Jas. Hope, 16 Sept. 1815 (doc.558).
22. H.L.R.O., Scot. Hghwys., letter Geo. Burn to Jas. Hope, 27 Oct. 1815 (doc. 567).
23. Information about Minto's association with this bridge has been derived from private correspondence with his descendants.
24. Ninth Report, CHRB (1821), pp.56-7, App.B.
25. *Aberdeen Journal*, 19 Jun. 1811, p.4.
26. Ninth Report, CHRB (1821), pp.60-1, App.B.
27. *Aberdeen Journal*, 28 Oct. 1812, p.4.
28. T. Day, 'Masonry Arches: How Quickly Were They Built?', *Newsletter PHEW, ICE*, 63 (1994), pp.3-5 & R. B. Schofield, 'On the turning of Arches', *Newsletter PHEW, ICE*, 66 (1995), pp.3-4.

29. Typically see H.L.R.O., Scot. Hghwys., Contract between Commissioners for H. R. and B. and Geo. Ross and Dnld. McKenzie, Apr. 1812 (doc. 321), pp.11-2.
30. S.R.O., GD 52/23 Lord Forbes Papers.
31. National Register of Archives (Scotland) 61, Farquharson of Invercauld Muniments, Account for work executed by Wm. Minto, endorsed by Jn. Mitchell, 20 Sept. 1815.
32. H.L.R.O., Scot. Hghwys., letter Jas. Hope to Jn. Rickman, 9 Dec. 1820 (doc.873).
33. *Aberdeen Journal*, 19 Dec. 1821, p.4 and 22 May 1822, p.4.  
For details of the bridge and timber centres used for construction of arches see J. Rickman (ed.), *The Life of Telford*, Atlas, plts. 55-6.
34. A. Maclean, *Telford's Highland Churches* (Inverness, 1989).
35. H.L.R.O., Scot. Hghwys., letter Jas. Hope to Jn. Rickman, 26 Nov. 1822 (doc.947).
36. Colvin, pp.180-1.
37. T. Day, 'Studies of the Development of Turnpike Roads ... in North-East Scotland, 1780-1880' (Ph.D. thesis, University of Aberdeen, 1992), pp.496-500.
38. Aberdeenshire Council Archives, Minute book, Commissioners of Supply for Kincardineshire, 13 Aug. 1798. (KC1/1/1).
39. A.C.A., Minute book, Trustees of the Stonehaven-Bervie Turnpike Road, 30 Sept. 1801. (KC2/1/7).
40. PHEW, Inst. of Civil Engineers, Report No. HEW 1491.
41. T. Day, 'Telford's Aberdeenshire Bridges', *Industrial Archaeology Review*, 17.2 (1995), 202-05.
42. T. Day, 'Gentlemen Contractors: The Farquharsons of Monaltrie and the Construction of Ballater's Bridges, 1775-1812', *Northern Scotland*, 16 (1996), pp.89-93.
43. Colvin, *A Biographical Dictionary of British Architects, 1600-1840* p.903.
44. PHEW, Inst. of Civil Engineers, Report No. HEW 1302.
45. A.C.A., Minute Book, Forglan Road, 19 Sept. 1829. (BC2/2/9).
46. The contract for this road, from Loch Oich in the Great Glen to Kinlochhourn, was the second to be let by the Commission. H.L.R.O., Scot. Hghwys., Contract Document (doc.8).
47. H.L.R.O., Scot. Hghwys., letter Jn. Davidson to Jas. Hope, 16 October 1811 (doc.287).
48. H.L.R.O., Scot. Hghwys., letters Jas. Hope to Jn. Rickman, 6 Dec. 1811 (doc.304), & Jn. Mitchell to Jas. Hope, 26 March 1812 (doc.319).
49. H.L.R.O., Scot. Hghwys., Statement of the extra work done upon the Glengarry road, May 1812 (doc.329).
50. The Laggan road ran from Badenoch in Strathspey to join the military road from Fort Augustus to Fort William near Spean Bridge in Lochaber.
51. H.L.R.O., Scot. Hghwys., letter Jn. Clark to Jn. Mitchell, 15 Oct. 1811 (doc.290a).
52. H.L.R.O., Scot. Hghwys., letter Dnld. Clark to Jas. Hope, 13 Oct. 1812 (doc.337).
53. H.L.R.O., Scot. Hghwys., letter Jas. Hope to Jn. Rickman, 17 May 1816 (doc.611).
54. H.L.R.O., Scot. Hghwys., letter Rev. Jn. Anderson to Jas. Hope, 4 Jan. 1817 (doc.697).
55. H.L.R.O., Scot. Hghwys., Resurvey of the Loch Laggan Road, Jn. Duncombe and Jn. Mitchell, March 1809 (doc.121).
56. Ninth Report, CHRB (1821), plate following p.96, App.O.
57. H.L.R.O., Scot. Hghwys., letter Jas. Hope to Jn. Rickman, 12 Nov. 1811 (doc.298).
58. H.L.R.O., Scot. Hghwys., letter Jas. Hope to Jn. Rickman, 20 Apr. 1814 (doc.441).