

Roads and bridges in the Scottish Highlands: the route between Dunkeld and Inverness, 1725–1925

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SUMMARY

The roads and bridges constructed in the Highlands under Military, Parliamentary and early Ministry of Transport auspices are examined principally in terms of their engineering considerations. The structures of the roads are recorded from a series of excavations undertaken as part of an on-going exercise in rescue archaeology along the line of the A9 Trunk Road reconstruction. The masonry bridges are grouped into several types whose particular building styles and characteristics are identified and described as a result of a broad survey.

INTRODUCTION

A span of exactly 200 years separates two important events in the history of Highland roads. In the spring of 1725 General Wade started the building of his first road, in the Great Glen, and in the spring of 1925 the Ministry of Transport commenced work on the A9 Trunk Road. By 1725 roads were still largely restricted to the lowland fringes of the area, but recognised drove routes had become well established within the Highlands. The general movement of cattle was eastwards and southwards regardless of the predominant directions of mountain ranges and valleys. Initially, therefore these routes had little influence on the location of the new roads intended for wheeled traffic. During the two centuries under review four distinct periods of road and bridge building follow one another and may be identified with Wade, Caulfeild, Telford and the Ministry of Transport. Since 1925 motor roads have proliferated.

This paper is intended to focus primarily on the engineering aspects of the old roads and bridges with particular reference to constructional materials and widths of the roads, and to styles, masonwork and dimensions of the bridges. Others have already written extensively on the personalities, politics and economics involved in these four successive periods of building.

The detailed work on road structures is unfolding as a specific exercise in rescue archaeology within the broad belt of land required for the new A9 Trunk Road, partly dual carriageway and with extensive earthworks, currently being constructed. It has been particularly important, well in advance of construction work, to locate the old roads on the ground especially where the earliest ones have been long abandoned and have become almost invisible under the turf and lost from local knowledge. This was achieved by a combination of walking and map study. The first length of the new trunk road was constructed between Dalwhinnie and Crubenmore in the summer of 1974, and offered several opportunities for excavation of the old roads. These exercises have been repeated for successive lengths of the new road until about half of the total distance of 165 km had been examined by the end of 1978. The typological study of the bridges is based

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on a wide ranging survey by the author, started some years previously and achieved by visiting, photographing and measuring those structures that may still be found throughout the length and breadth of the Highlands, as well as some that have sadly been lost in the last decade or two. This part of the study helped to identify the periods to which the masonry bridges along the A9 belonged.

It must be emphasised at this stage that the descriptions given here are based largely on the fieldwork and as this is still in progress any conclusions put forward may be subject to minor modification. They are of course also open to amplification by historical research. Documentary evidence, other than the Roy Maps¹, has not been used to any great extent largely due to the pressure of the road construction programme on the limited amount of spare time available. For the present purpose it has sometimes been deemed sufficient to place road and bridge structures within periods, and on occasion to consider only the relative chronology, as for example in the simple case of the layers of road construction. Other original source material, such as the Reports of the Parliamentary Commissioners², the Telford Atlas³ and contemporary published and manuscript maps^{1, 4, 5 & 6} is likely to contain much detailed and as yet unused evidence particularly on the engineering aspects. In many cases precise dates of construction could probably be obtained especially if the research were undertaken with direct reference to the fieldwork. For secondary historical material there are informative papers by Mackenzie (1897; 1899), Mathieson (1924) and Miller (1967), and the more extensive writings of Salmond (1938), Haldane (1952; 1962), Taylor (1976) and Ruddock (1979). For a background study of the precursors of the bridges under review there is much information by Inglis (1911; 1912; 1914), for a broad approach to the early roads one can turn to valuable works by Graham (1948; 1959; 1963) and for good descriptive techniques and some recent descriptions there are contributions by Graham (1962) and Bruce (1975) respectively.

From the documentary evidence it is apparent that all the works to which reference will be made were designed and constructed in English – not Scottish – units of measurement and of course not in metric. Structural dimensions in Imperial units will be included for this reason and because there are occasions when a module of one foot is apparent in road dimensions and of five feet in bridge spans.

THE MILITARY ROAD SYSTEM

The first group which will be considered is the Military system of engineered roads, sometimes called 'built roads'. They were initially conceived for the overall strategic purpose of communication between the castles and barracks already in existence such as Ruthven (Stell 1973); they were designed for the practical function of moving troops and supply waggons; and were constructed with Government money and largely by military labour. It is necessary to divide them into two successive periods of building in the 18th century: those which were the responsibility of General George Wade and those of Major William Caulfeild.

Wade roads

It is perhaps unfortunate that the name 'Wade Road' is almost legendary and the term 'Wade Bridge' has been all too frequently applied to any stone arch bridge whose history is unknown. It is therefore salutary to consider the extent of the system of roads actually constructed under Wade's personal supervision. These are shown in broken line on fig 1 and extend to almost 400 km (250 miles), with which were associated about 40 bridges. When he first arrived, roads within the Highlands were not intended for wheeled traffic, except for Comyn's Road through the Grampian Mountains (Kerr 1975) and its extensions N and S. The general pattern of roads

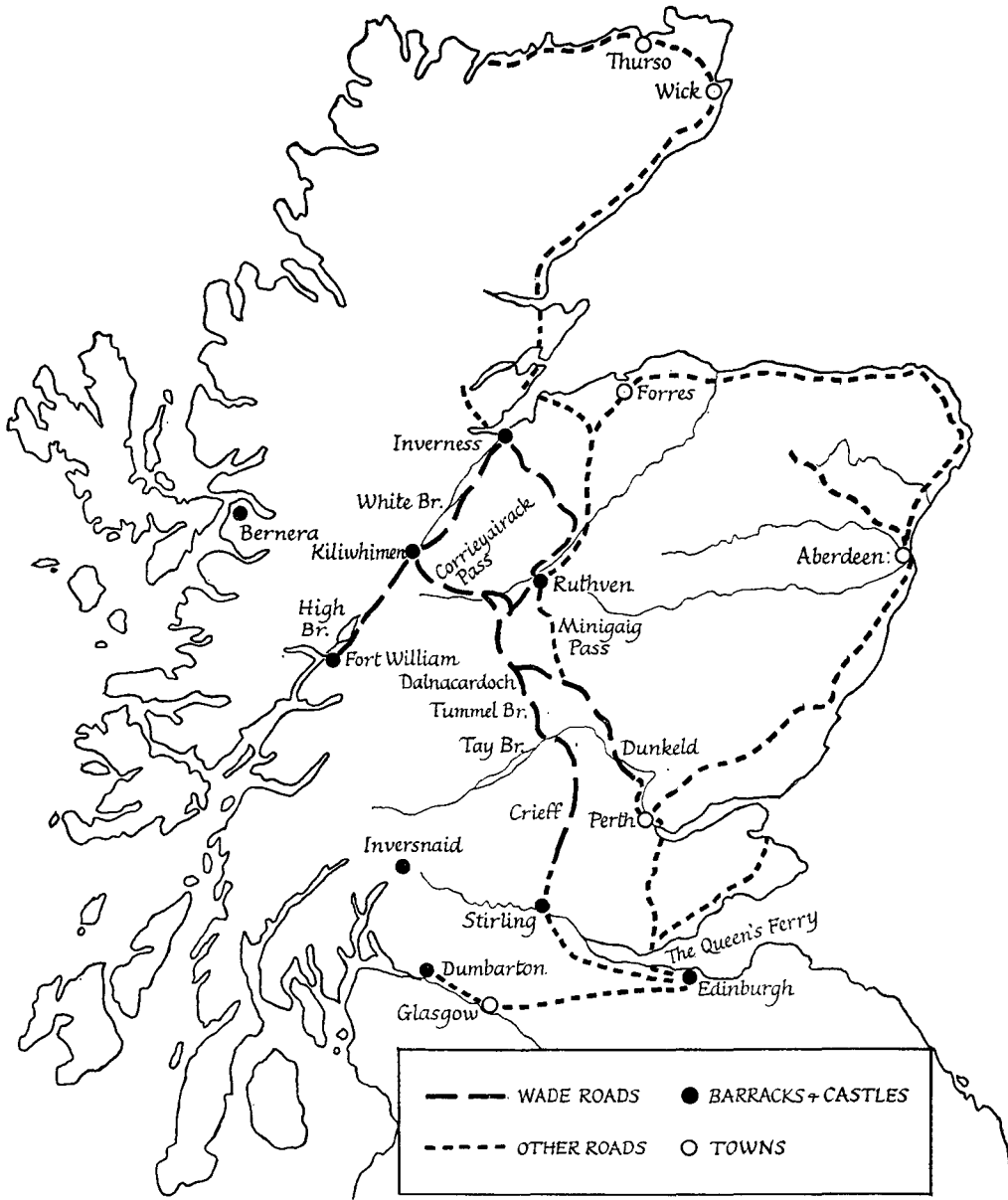


FIG 1 The Wade Roads, built 1725–33

outside the Highland area is shown in dotted line, having been taken from Greene's map of 1689⁴.

Wade's work on roads was concentrated into the nine years from 1725 to 1733 (thus they were built between the uprisings of 1715 and 1745). His visits were restricted to the summers only, when up to 500 soldiers were engaged in the construction of lengths not exceeding 80 km. Privates were paid 6d per day extra and craftsmen received a little more. It has been stated that the cost was £70 per mile. Wade located his roads with considerable care for maximum economy

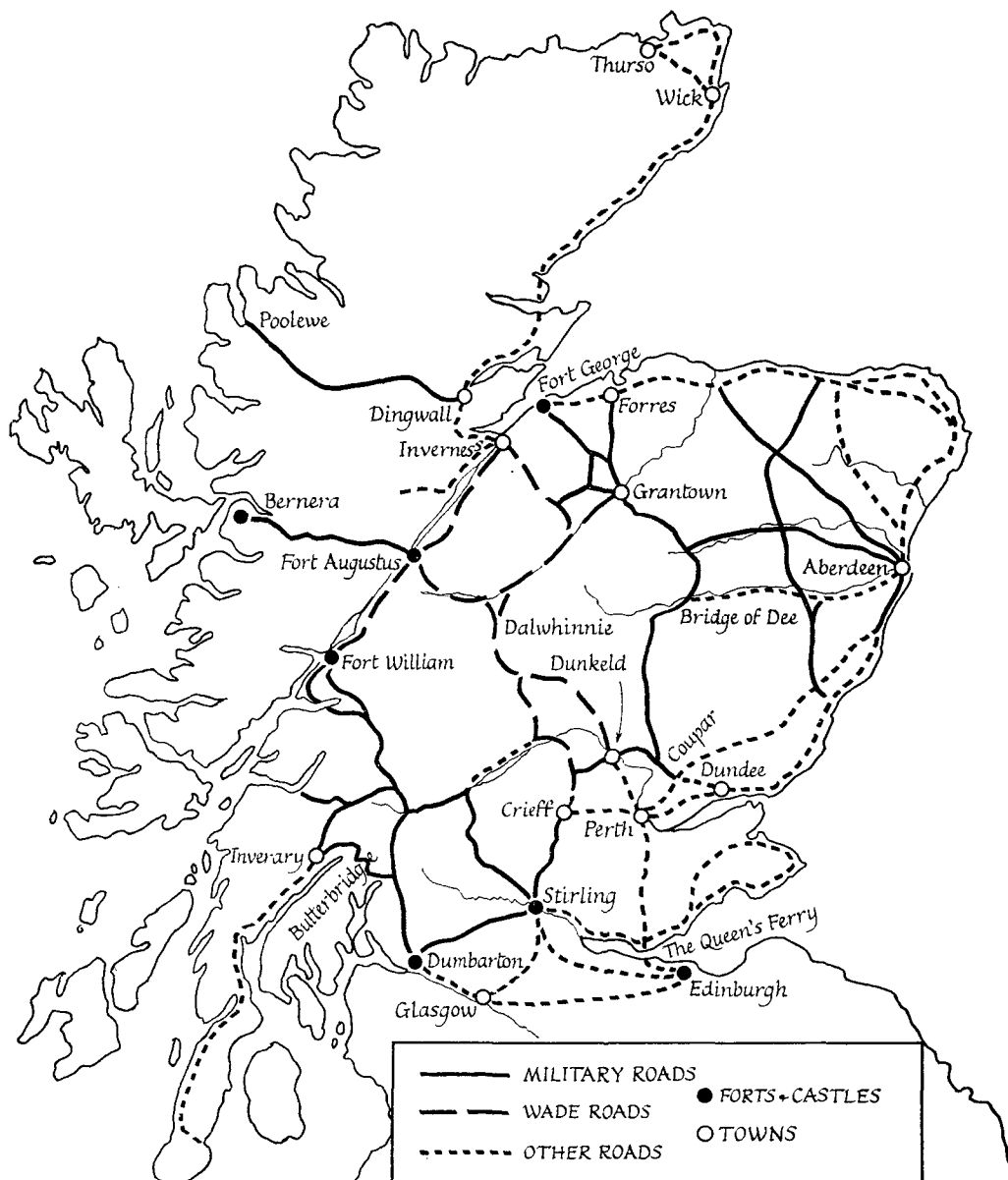


FIG 2 The Caulfeild Roads, built 1743 - c 1780

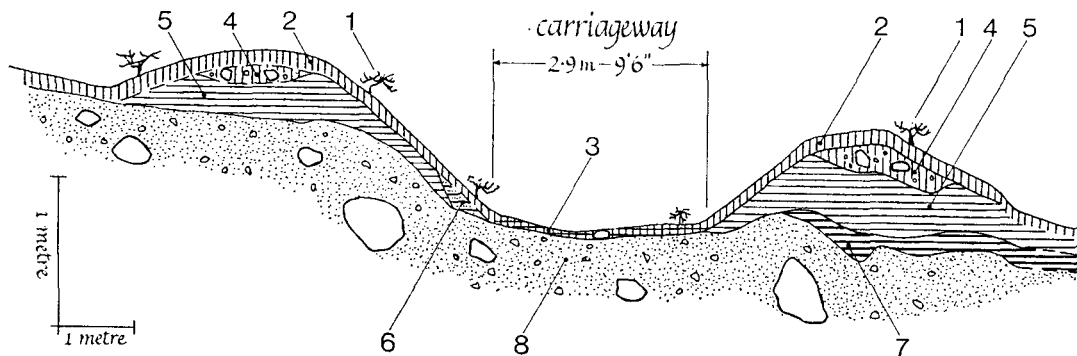
of construction, but not for the convenience of traffic. He sometimes used the old established principle of driving the road in long straight lines from one vantage point to another. Heavy crossfalls were avoided if possible and the road frequently followed ridges to minimise excavation and to avoid surface water running across the road. Major climbs like the famous Corrieairick Road were negotiated with zig-zags. Shorter ascents were frequently made with gradients up to, but not exceeding 17% (1 in 6). Rain water running rapidly down such steep slopes would cause severe erosion of the gravel surface every year. The familiar vista (pl 29a) of one of these hills,

descending to the 'Black Tank Corner' on the road between Calvine and Dalnamine, has been largely destroyed by construction of the new trunk road.

One of the factors controlling the location of the road was, of course, the choice of the best site for crossing a water course. Ditches, burns and shallow rivers were not bridged in the earlier years but some were probably crossed with a paved bed of stones to prevent scour. Wade evidently intended to avoid if possible the building of bridges but torrents must have played such havoc with the numerous fords that some bridges became essential. The largest rivers were never bridged, such as the Tay at Dunkeld, the Spey at Ruthven Barracks and the Findhorn at Tomatin (see fig 15).

The generally accepted view is that Wade's roads were built to a standard width of 4.88 m (16 ft) reducing to 3.05 m (10 ft) in difficult terrain; that first the peat and soil were dug up and thrown into banks on either side; and that large stone were placed in the excavation and overlain with a layer of gravel. This procedure may well have been specified and was possibly adopted on some occasions but there is doubt about the width of road and about the use of heavy stone. However, the current programme of excavations being undertaken along the A9 corridor is producing considerable evidence of the forms of construction actually adopted although the pattern is necessarily incomplete as yet because only a limited number of excavations have been made on roads that can be attributed to Wade and that have not been improved since his time.

An excavation across the Wade Road of 1728-30 near Badachreamh (fig 3) W of Meallmore hill between Moy and Mid Lairgs revealed a road in a slight cutting with a carriageway about 2.9 m (9 ft 6 in) wide formed directly on the stony surface of the glacial till after it had been



Trench No. 5/1

FIG 3

TRENCH NO 5/1

THE WADE ROAD (Built 1728-30, abandoned about 1809)

At Badachreamh, between Moy and Mid Lairgs (Inverness District). NGR NH 72933482

Looking SE. Excavated 23 May 1977

- 1 Heather
- 2 Soil
- 3 Firm peaty soil
- 4 Filling of soil with occasional stones up to 225 mm in size
- 5 Filling of soft black peat with voids
- 6 Peaty silt
- 7 Layer of undisturbed peat
- 8 Natural till, orange above and light tan below, predominantly fine sand with some gravel and occasional boulders up to 450 mm in size

excavated sufficiently to ease the gradient. It is evident that the till was firm enough and that no sand and gravel material was ever imported to form a running surface up to the time it was superseded, possibly in 1809, by the road via Craggie, E of Meallmore hill. The lack of additional material has been confirmed at several other excavations. This and all the following cross-sections have a vertical exaggeration of 2 to 1 to emphasise the layers of constructional material, at the base of which the formation level is shown in heavier line.

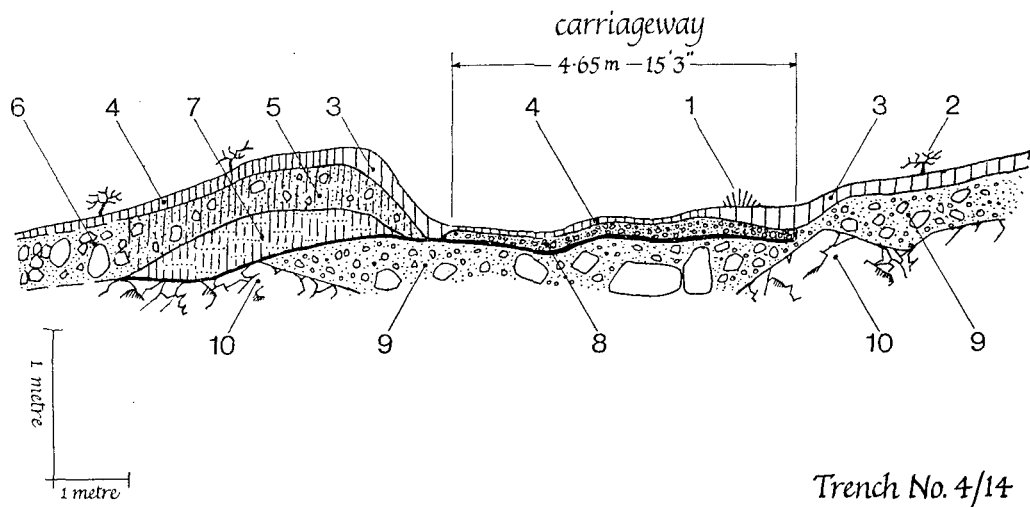


FIG 4

TRENCH NO 4/14

THE WADE ROAD (Built 1728-30, ? with later improvements)

Caochan na Bo Baine, near the Edendon Water (Perth District). NGR NN 71157084

Looking NW. Excavated 21 May 1977

- 1 Grass
- 2 Heather
- 3 Sandy soil
- 4 Peaty soil
- 5 Filling of sandy soil with some stones
- 6 Filling of stones up to 300 mm in size with some sand and voids
- 7 Silty and peaty soil, part natural and part filling
- 8 Layer, average thickness 80 mm, of gravel with rounded stones up to 35 mm in size and occasionally 60 mm in size, with dark brown sand binding
- 9 Natural till, light brown, gravel with boulders up to 450 mm in size and sand
- 10 Solid rock

Near the Caochan na Bo Baine, less than 1 km north of the Edendon Water⁷, a back drain being made for the new road provided a sufficiently good trench for recording the old road construction (fig 4). The Wade Road climbs diagonally across rolling heather-clad ground and can still be seen clearly between the typical banks of spoil. Here a thin layer of gravel and sand has been placed over the formation to improve the surface for traffic. However, as the road was probably in service for 50 years or so this layer may not have been laid until after Wade's time.

Wade bridges

The bridges of this period have a number of characteristic features (fig 5). As seen on plan their spandrels and side walls are usually straight and parallel. The overall width at the crown

of these bridges is between 3.35 m (11 ft) and 4.27 m (14 ft) with a few exceptions. Allowing for the parapet walls the available width for traffic would be only about 2.59 to 3.51 m (8 ft 6 in to 11 ft 6 in). In cross-section the structures all exhibit plain, vertical spandrel walls which are continued into vertical, or near vertical, walls at the abutments, such as at the Garry Bridge (pl 29b), at the N end of the road from Crieff, built in 1730 and having a span of 14.33 m (47 ft). The only variations from this description are the cutwaters and modest embellishments such as string courses found on only three of the larger and later bridges (White Bridge, Tay Bridge and Spean Bridge). In elevation many of the bridges are seen to have level or near-level parapets especially if the span is across a rocky ravine. It is interesting to note that most, if not all, of these spans appear to have their centres – ie the point at the geometrical centre of the circular or segmental arch – located at or above the normal water level, and one can reasonably suggest that this was to facilitate setting out of the temporary timber centering required to support the arch as it was being built.

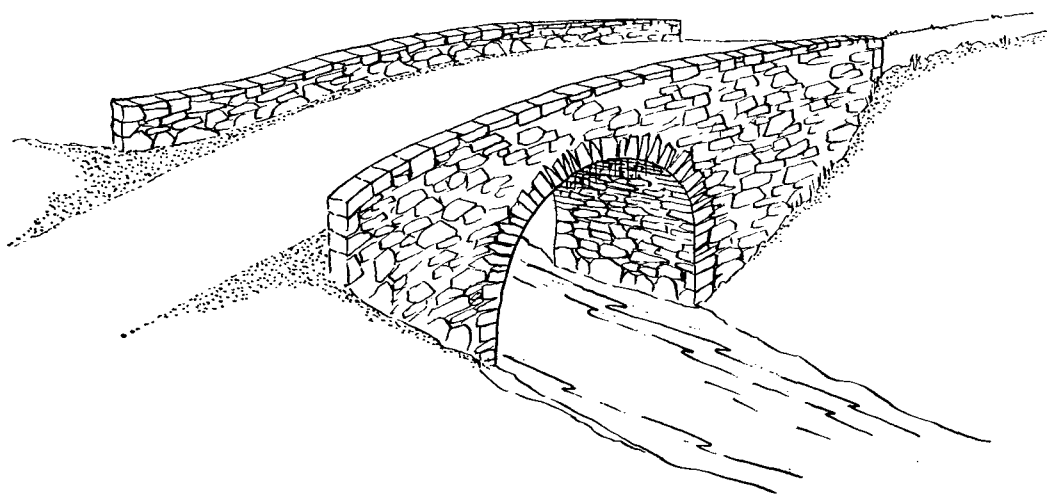


FIG 5 A typical bridge of the Wade period

A delightful little bridge of 6.7 m (22 ft) span over the River Mashie near Laggan Church, is almost certainly one of the five bridges built by Wade in 1731, and is located on the Wade Road to the Corrieyairick after it has branched from the main line passing through Dalwhinnie. At the crown the extrados is exposed where the gravel cover has been worn away. The spandrel faces are built with very insignificant or inferior rubble masonry of small stones, not very definitely coursed, which may have been harled with a lime mortar for waterproofing.

Perhaps the most beautiful of Wade's bridges is White Bridge, near Foyers. Built in 1732 it was damaged by the famous Moray floods of 1829 but was thoroughly repaired. The graceful outlines are excellently proportioned between the parapet, the arch and the rocky banks of the River Fechlin. The freestone voussoirs are now crumbling and are much in need of repair.

Wade claimed Tay Bridge at Aberfeldy, built in 1733–5, to be his masterpiece but as he lavished money and masons on this work it was completely atypical of his normal bridges. It was nearly 120 m in length, the five arches having spans of 9.14, 10.67, 18.29, 10.67 and 9.14 m (30, 35, 60, 35 and 30 ft).

High Bridge built over the River Spean in 1736 was his last. With its height of 27.4 m (90 ft) Wade exceeded the capability of the building material which was almost entirely slabby

stone with a lot of lime mortar to fill thick and irregular joints. The artistic elliptical arch shown by Salmond (1938, 177) is belied by the sag that had developed in the string course as the mortar dissolved and the arch weakened. The structure eventually deformed sufficiently to collapse. There now remains only one arch of the original spans of 9·14, 15·24 and 9·14 m (30, 50 and 30 ft).

Caulfeild roads

After Wade's time there was a pause until 1743 when construction was re-commenced. Thereafter it continued energetically, especially in the SW and NE, under Caulfeild who was directly responsible, until his death in 1767. Taylor (1976) brings to light the very considerable part played by Caulfeild who was responsible for building a much greater total length of road than Wade. Caulfeild's roads and some Military ones completed after his time are shown in full line on fig 2. For various reasons it seems to be impossible to state the total length of all military roads built. About 1900 km are represented on this map but no contemporary record

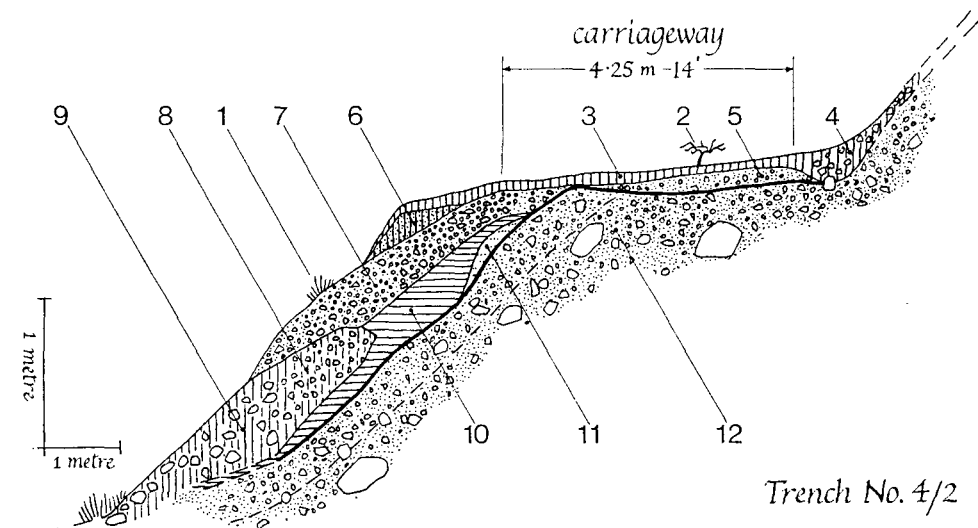


FIG 6

TRENCH NO 4/2

THE LATE 18TH-CENTURY 'COACH' ROAD

Between Dalnacardoch and Dalnaspidal (Perth District), NGR NN 67157180

Looking NW. Excavated 20 November 1976

- 1 Grass
- 2 Heather
- 3 Soil
- 4 Soil with stones
- 5 Layer of gravel with rounded stones up to 50 mm in size and dark soil-stained excess sand binding
- 6 Brown sandy soil
- 7 Filling of yellow/brown local stony till
- 8 Filling of soil-stained stony till
- 9 Filling of stones up to 150 mm in size and dark brown soil
- 10 Compressed peat
- 11 Layer of gray sandy silt
- 12 Natural till, orange above and yellow/gray below, gravel up to 50 mm in size with excess sand. Also occasional boulders up to 300 mm in size

gives as much as 1600 km within the Highlands. These were associated with 938 bridges or 1,031 arches. Some adjoining roads shown in dotted line are as represented on Taylor and Skinner's map of 1775⁵. Latterly there were recurrent difficulties in obtaining sufficient money from the Treasury. An increasing proportion of building and maintenance was done with civilian labour and many bridges were built by civil contract. Long before the end of the century many remote roads had been abandoned and others had been transferred to the County Road Boards, as the military need had evaporated.

In the Caulfeild era there is a lessening of adherence to the idea of straight lines for setting out the roads, and bridges were included in the scheme from the design stage, resulting in considerable benefit to traffic. The standard of construction was better than in Wade's time but nevertheless steep gradients of about 17% were still adopted. There was a more extensive use of earthworks for cuttings and embankments, of dry-stone retaining walls and of stone culverts. These would divert much surface water under the roads and would help very considerably to reduce the amount of maintenance required. Black powder would be used for blasting when necessary and would also be used to improve the narrow rocky parts of the Wade roads.

The road from Crubenmore to Kingussie, which Wade built on a direct line via Phoiness and Ruthven, was rebuilt under Caulfeild on a new line via Newtonmore in 1763. Unfortunately the latter route has not yet provided good evidence of its form of construction. However parts of the Wade Road between Dalnacardoch and Dalnaspidal were rebuilt on new alignments at about this time – certainly by 1783 as indicated by James Stobie's map⁶ of that date. A section through one of them (fig 6) was made at a point 5.0 km NW of the Edendon Water bridge. This road was partly cut into the prevailing stony glacial till and partly built on fill. The layers tipped to form the bank can be clearly seen on the left, with peat, stones and soil. The carriageway is about 4.25 m (14 ft) wide but this was seen to vary further along the road. It had a thin layer of imported gravel for its running surface which today is still very smooth where exposed in the sheep track winding among the heather on the road. Where gravel was brought in for the running surface of these roads it was usually well graded, having rounded gravel from about 75 mm or 35 mm size down through small stone and grit and having the correct amount of sand to make it bind firmly under the wheels of traffic (pl 30a).

Caulfeild bridges

There are some clearly defined differences between the Wade bridges and those built for Caulfeild and there is a progressive improvement visible in the quality of masonwork, the impression of strength, and the confidence exhibited in the whole conception (fig 7). Some of the largest bridges are very handsome and are major structures by any standard, such as the Bridge of Dee. The beauty of the sloping line of the parapet, rising to a peak over the crown of the arch, is typical of this period and is seldom found to such good effect earlier or later. The graceful lines and excellent proportions are no accident but we know all too little about the designers and master masons employed to produce them. Typical of these bridges in the W is the smaller structure at Butterbridge (pl 30b), built about 1744–50 at the head of Glen Kinglas between the 'Rest and Be Thankful' and the 'Switchback' above Cairndow. Here low banks necessitated a hump bridge and encouraged the use of rising parapets, also demonstrating that the ideal rocky gorge was not always available.

Generally, the structure of these bridges can be described as again having straight sides and parallel parapet walls as viewed on plan. In cross-section they continue to exhibit vertical walls at the spandrels and at the abutments. The inside width between parapets is normally 3.66–3.81 m (12 ft 0 in–12 ft 6 in). A few seem to be narrower and some are wider depending on

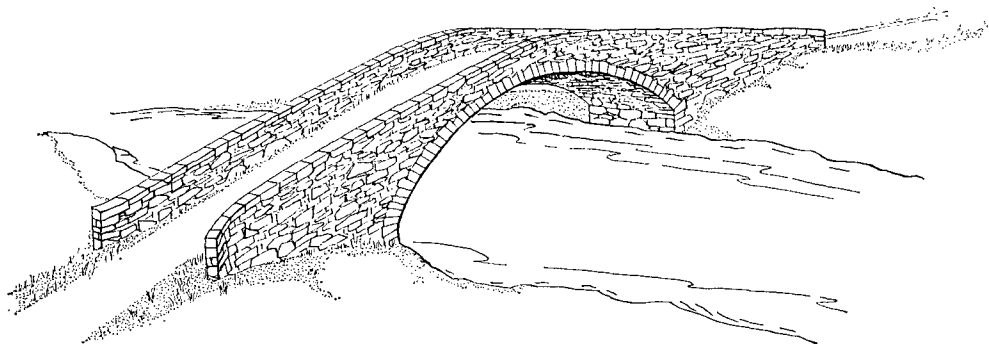


FIG 7 A typical bridge of the Caulfeild period

size or importance. Very effective use was made of split slab stone material often taken from rock on the banks of the river. The voussoirs are of random length on the spandrel face, a practice with apparently only two exceptions (White Bridge and Tay Bridge) in the Military periods. Some small bridges exhibit very competent masonwork often using extremely intractable material such as rounded river boulders split or trimmed to give them a flat face and built into the wall alternating with very small stones – a style that might be termed '*Boulder and Chips*' as a fine distinction between that and true pinnings.

THE COMMISSION FOR HIGHLAND ROADS AND BRIDGES

With the turn of the century came a new impetus and a new wave of construction: the Commission for Highland Roads and Bridges was established in 1803 by Act of Parliament for the purpose of building land communications, 50% of the finance being provided by local interests (landowners, counties, etc) and 50% by Government. Thus roads and bridges came to be built where the population required them.

Thomas Telford was Engineer to the Commission, John Rickman was Secretary in London and James Hope was Legal Agent in Edinburgh. The story of this great trio, and their fight against the vicissitudes of Highland terrain and floods, the vacillations of some landowners and the exasperating actions of many contractors and much else is graphically told by Haldane (1962). John Mitchell, a mason from Forres and his son, Joseph, were the Chief Inspectors. The Commissioners' Reports² contain maps by Arrowsmith from which fig 8 has been prepared. Altogether 1,480 km of road and 1,117 bridges were built between 1803 and 1828 at a cost stated to be some £600 per mile. The Commission was terminated in 1863, the same year as the Perth-Inverness Railway line was opened, heralding the decline of the coach. The cost of maintenance had been a continuing problem and various Acts of Parliament resulted in differing local solutions. For instance on the Perth to Inverness coach road it appears that the Perthshire part was poorly maintained by the County Road Board, while the Inverness-shire part was well maintained by the Parliamentary Commission.

Parliamentary roads

Great lengths of the Parliamentary Roads are in use today with little alteration except for a surfacing of bitumen macadam, in place of the original water bound Macadam, as on the A9 road at the Ord of Caithness (pl 31a).

In a report (*Parliamentary Papers*, 1814-15, 14) Telford specified that the width of the

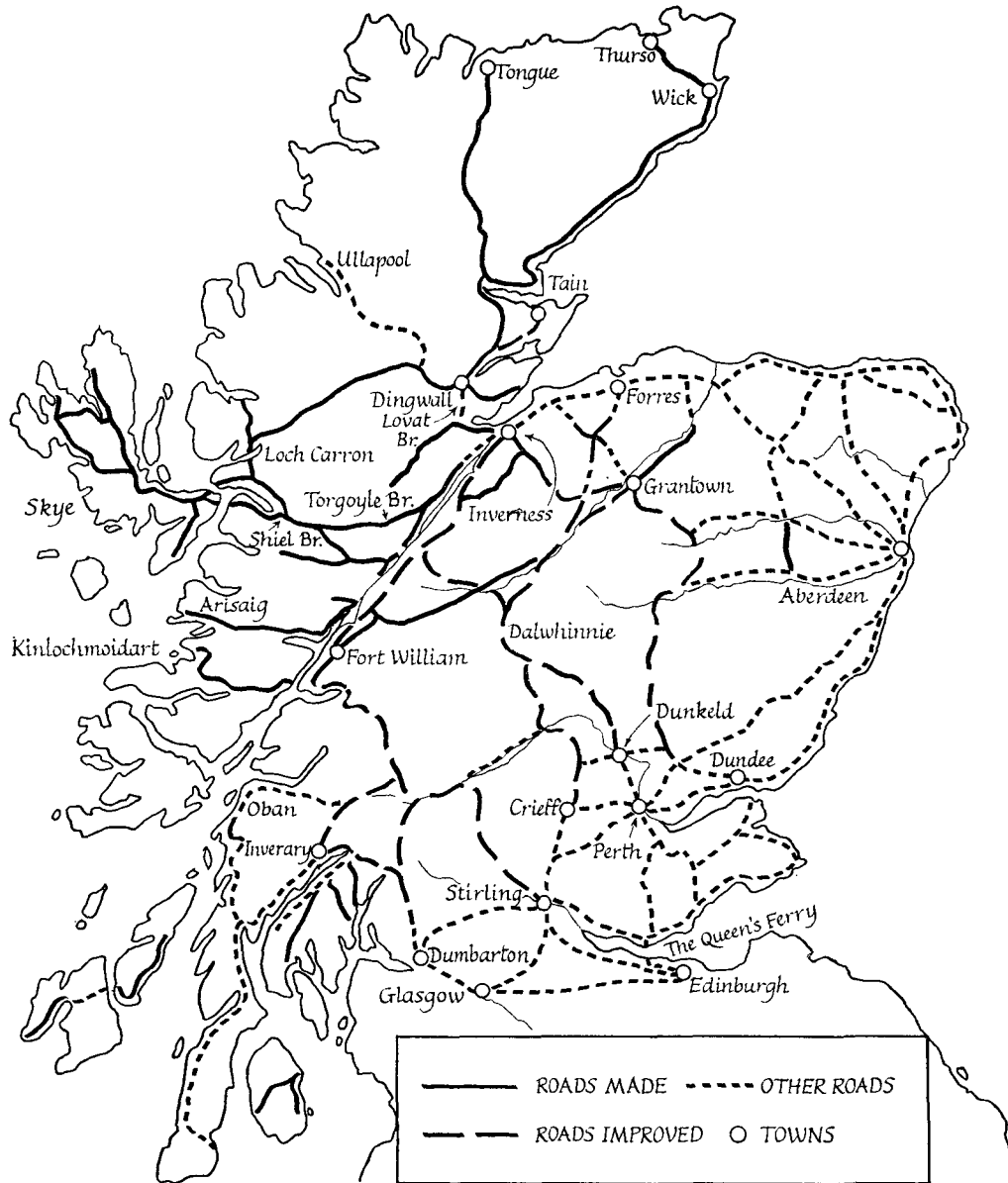


FIG 8 The Parliamentary Roads: Construction 1803–28, Maintenance 1814–62

standard carriageway was to be 4·88 m (16 ft), based logically on the space required for the passing of two waggons of 2·13 m (7 ft) overall width or coaches of 1·68 m (5 ft 6 in). But evidently the Highland roads varied between 3·66 and 6·40 m (12 ft and 21 ft) in width. His specification for construction of the Glasgow and Carlisle road was as follows:

‘In the cross section, the metal bed is to be formed 16 ft in width, by removing the vegetable soil, and bringing the surface into a proper shape and consistence; upon this bed there is to be laid a stratum of stones, seven inches in thickness, placed regularly by hand, and the

sharp points broken by a hammer; upon this there is to be laid another stratum of stones, seven inches thick, in the middle of the road, decreasing to five inches at each side, and broken so that none shall be more than $1\frac{1}{2}$ inch across; the five feet [shoulder] on each side to be formed with a slope outwards, of one in 30; the whole of the metal and sides to be covered with gravel, for three inches in thickness.'

Presumably his specification for the Highlands was similar.

Gentle gradients were always preferred and curving lines of road were acceptable. The ruling gradient seems to have been 1 in 30 wherever practicable but this was subject to alteration in hilly terrain. Considerable earthworks and excellent dry-stone retaining walls were used for the construction of road on ground with steep side slopes. Speed and comfort of travel was beginning to benefit from engineering expertise. For carrying ditches under the road, stone culverts of 0.3, 0.46, 0.61 and even 0.76 m (12 in, 18 in, 24 in and 30 in) span and height were universal, the soffits being stone slabs of the necessary length. A standard milestone cut from granite or other hard stone with faces at 45° to present the distances to travellers was adopted for these roads and for those where the Commissioners undertook improvements. There were recently at least 35 of these milestones to be seen beside the 100 km (62 miles) of the A9 between Drumochter Summit and Inverness.

During the early part of this period, but not under the auspices of the Commissioners, a

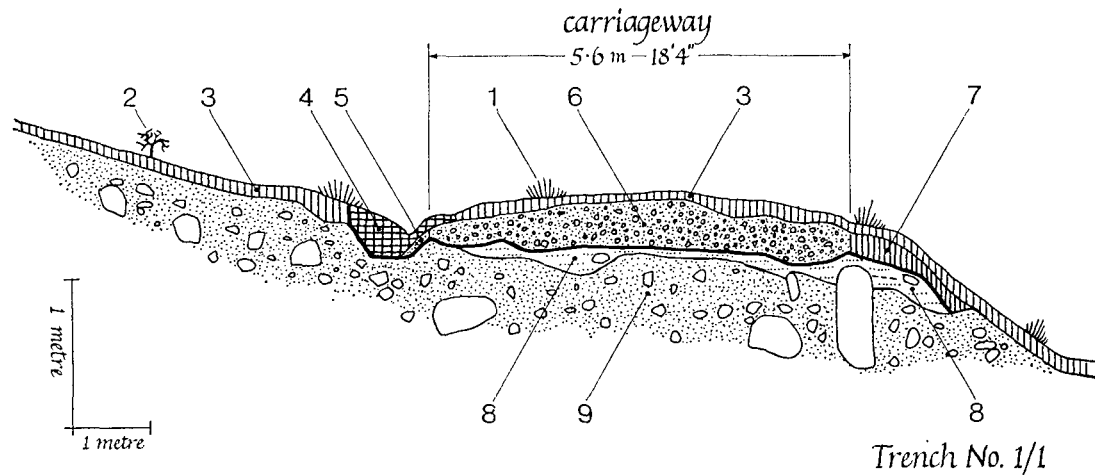


FIG 9

TRENCH NO 1/1

THE EARLY 19TH-CENTURY 'COACH' ROAD (Built 1800-10, abandoned 1860-3)

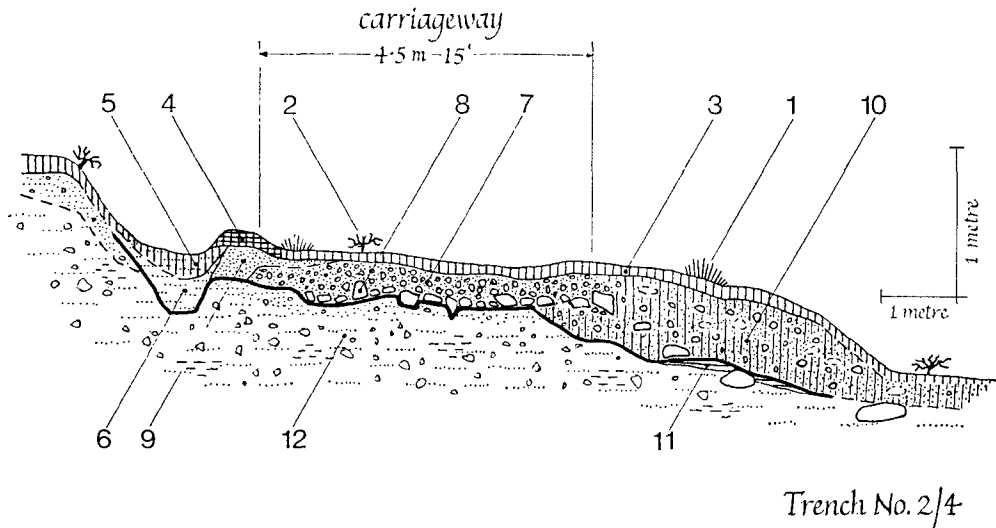
Between Crubenmore and Etteridge (Badenoch and Strathspey District). NGR NN 67859172

Looking SW. Excavated 23 August 1974

- 1 Grass
- 2 Heather
- 3 Soil
- 4 Dark peaty soil
- 5 Dark grey sandy silt
- 6 Layer, average thickness 300 mm, of gravel with rounded stones 20-40 mm in size and brown fine sand binding
- 7 Filling of dark brown soil
- 8 Natural layered deposits of gray silt
- 9 Natural till, brown above and red below, boulders, cobbles, gravel and excess sand

realignment was made between Crubenmore and Etteridge which included the construction of the Crubenmore Bridge of twin masonry arches, repaired in 1975 as a conservation project. When this road was excavated at three places it was found to have a layer about 300 mm (1 ft) thick of well graded sandy gravel for the carriageway at least 5.6 m (18 ft 4 in) wide laid on the glacial till after complete removal of all overlying topsoil. A ditch was provided on the uphill side which was found to be still functioning. One of the sections is shown in fig 9. This part of the road was abandoned about 1860-3 when it was cut off by construction of the railway.

One cross-section (fig 10) which approximates to Telford's specification, was recorded at the N side of the Slochd where the Parliamentary Road improvement was made about 1834 and was abandoned when the road was diverted by the railway company about 1897. The underlying glacial till had a large silt content which when wet would not give good support to the road. On the downhill side, the road was partly built on soft uphill which had obviously been dug by hand and tipped in barrow loads with lumps of clay through it. A single layer of stones up to 225 mm (9 in) size was next placed by hand with a row of larger stones forming the downhill edge,



Trench No. 2/4

FIG 10

TRENCH NO 2/4

THE PARLIAMENTARY ROAD (Built about 1834, abandoned about 1897)

Between the Slochd and Drumbain (Inverness District). NGR NH 82482632

Looking SE. Excavated 27 March 1975

- 1 Grass
- 2 Heather
- 3 Soil
- 4 Black peaty soil
- 5 Silty soil
- 6 Deposit of grey/brown silt
- 7 Layer, average thickness 225 mm, of gravel with rounded stones up to 65 mm in size and red/brown sand binding
- 8 Single layer of hand-placed bottoming stones (round and sub-angular), 100 to 225 mm in size, also 300 mm in size stone at edge
- 9 Clean light brown sand
- 10 Filling of soft sandy brown soil, with lumps of grey clay, orange till and some stones
- 11 Thin layer of compressed peat
- 12 Natural till, orange, soft wet silt/sand with some stones
- 13 Natural till, grey, soft wet clay/silt with some stones

and on top was spread a 225 mm (9 in) layer of well graded sandy gravel for the 4.5 m (15 ft) wide carriageway. A good ditch was provided on the uphill side of the road, now largely silted up, and a back drain was also dug further up the hill. One unexplained feature, which has been found at other sections as well, is the ridge of clean sand between the carriageway and the ditch.

Parliamentary bridges

All Parliamentary bridges appear to have been built to one or other of several designs which may conveniently be grouped into four types.

Type 1 Firstly there is the early standard bridge (fig 11) whose specification by Telford (*Parliamentary Papers*, 1803-4, 761) may be quoted in part:

‘The breadth of the Roadway between the Parapets to be Twelve Feet in the narrowest part, the Parapets to be not less than Eighteen Inches in thickness, of the heights mentioned in the annexed Table, and coped with hammer-dressed Stones, set on edge in Lime Mortar, and not less than Nine Inches in Depth, with a large Stone at each extremity of the Parapet. . . . Each Bridge to be built so that the Parapets, when finished, shall each have a Curve, horizontally, of not less than Three Feet in Thirty-six Feet in length, and to batter vertically, at least One Foot in Twelve Feet in height; and in this height also to have a concave curve of Four Inches’

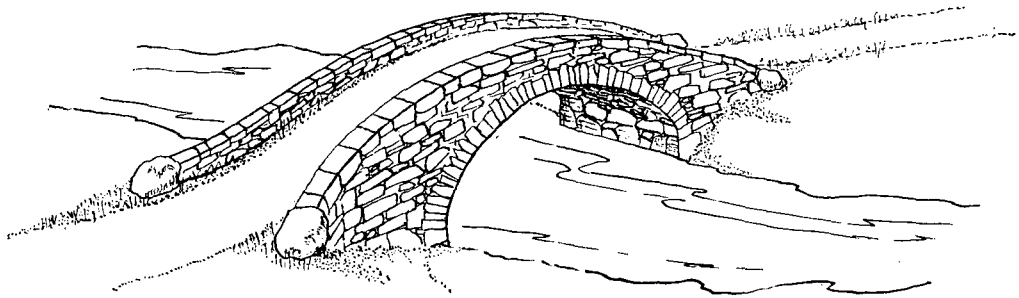


FIG 11 A typical Parliamentary Bridge, Type 1

The ‘annexed Table’ stated that the leading dimensions for spans are to be from 4 to 50 ft with the rise of the arch from 1 ft 6 in to 15ft respectively. The double curvature of the sides of this type of bridge is virtually unique and enables it to be quickly identified. It cannot have been easy to set out the foundation outline on sloping ground. The parapets give a rounded profile which would encourage a hump-backed form of bridge. These bridges are usually found to have been constructed within tolerances of a several centimetres in the span, or occasionally as much as 200 or 300 mm short, and the inside width (between parapets) has been found to vary from 3.58 to 3.96 m (11 ft 9 in to 13 ft 0 in). There is a considerable number of this type on the earlier roads to the W as exemplified by Drochaid Drum na Saille (pl 31b). However, it was seldom adopted for spans greater than 12.19 m (40 ft). The only one known to have the maximum span of 15.24 m (50 ft) is Kinlochmoidart Bridge built about 1815 and now closed to traffic. Due to its large size the double curvature effect was moderated in the construction, but the spirit of the style was maintained.

Type 2 Secondly, on the later roads, the small bridges are of a different style (fig 12), although the leading dimensions are the same. The double curvature is much modified and used in a way that was easier to set out on site. The principal change relates to the parapets because in elevation, the line of cope stones is made almost horizontal – probably reflecting a desire to

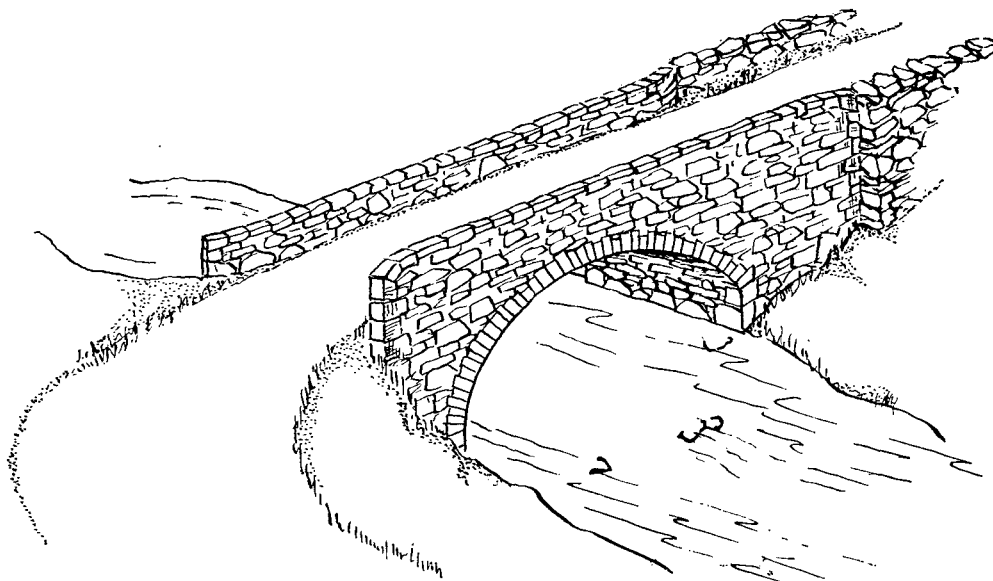


FIG 12 A typical Parliamentary Bridge, Type 2

avoid humpbacks. These bridges are found in Skye, to the N of Dingwall and elsewhere. The illustration (pl 32a) is of a bridge at Coire Shubh near Kinlochourn.

Type 3 The third type of bridge (fig 13) is characterised by vertical spandrels combined with battered abutment walls. This results in the spandrel being recessed and a diminishing return being interposed between the plumb and the battered faces – this might be termed ‘*plumb*

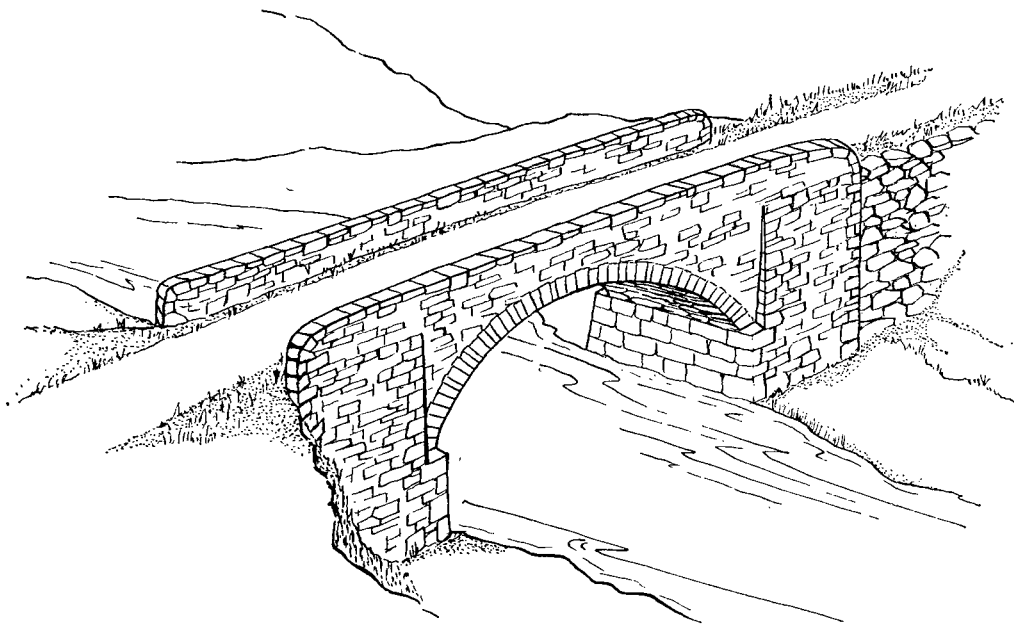


FIG 13 A typical Parliamentary Bridge, Type 3

and batter' for quick identification. These returns are positioned at a distance from the springing equal to the length of the voussoirs on the spandrel face. The cope is horizontal and at the ends of the parapet walls the copes are usually turned through a quadrant and carried down to the ground. These features readily help to distinguish this type from all earlier bridges. In plan the parapet walls are straight and parallel but they are splayed at the approaches. This type appears on many of the later roads. It is a design well suited to the longer spans or higher arches for which it was probably intended initially. In later years it was used extensively for many small and medium span bridges, thus supplanting Type 2. An example is the bridge over the Allt Cosach (pl 32b), built about 1834 on the Parliamentary diversion between the Slochd and the River Findhorn.

Type 4 Fourthly are those that may be taken together as the large bridges, often multi-span (fig 14). They were obviously designed individually for their respective locations but they have

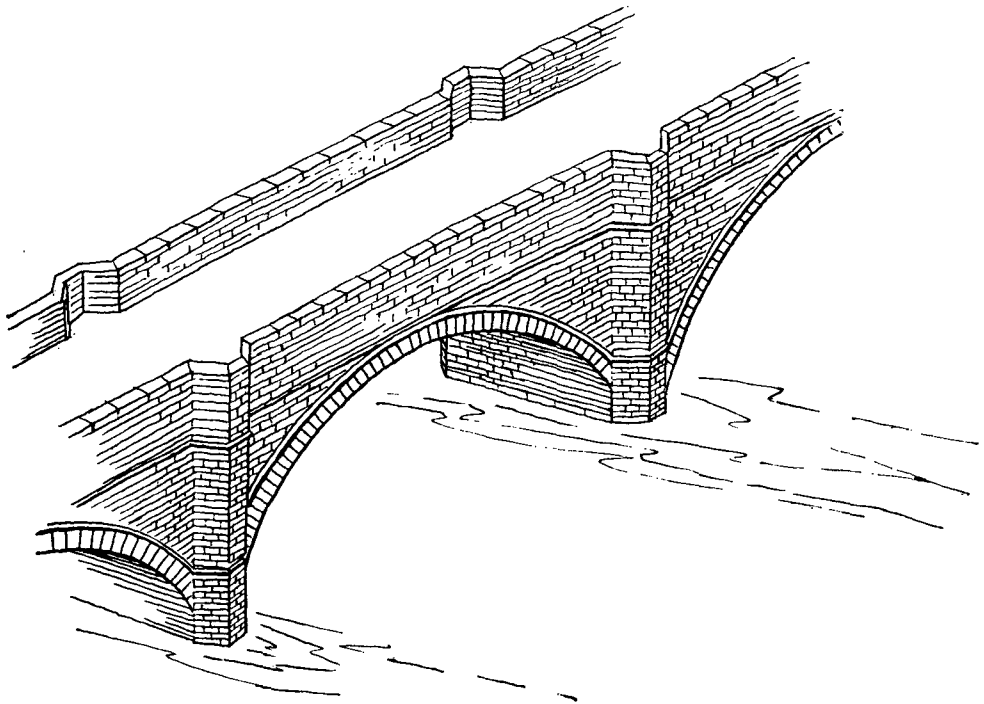


FIG 14 A typical Parliamentary Bridge, Type 4

architectural characteristics in common in string courses, cutwaters carried up to form refuges, etc but they are otherwise largely devoid of non-essentials. They exhibit very competent masonry-work executed in dressed freestone and ashlar and many are still in service. Dunkeld Bridge (pl 33a) with a total waterway of 136 m (446 ft) is the longest such masonry structure. Crossing the Tay at Dunkeld it provides an impressive start on the journey to Inverness. It was built 'in the dry' by diverting the flow across the gravel bed of the river.

At least ten of these major masonry bridges designed by Telford such as Lovat Bridge near Beauly, and the original Torgoyle Bridge, Glenmoriston, were damaged or destroyed by floods within a few years of their construction and were later re-built by Joseph Mitchell, Chief Inspector.

THE MINISTRY OF TRANSPORT

On the Perth to Inverness route very little development seems to have taken place over the following 60 years, until in 1924 the Government took the decision to reconstruct the A9 trunk road from Blair Atholl to Inverness under the new Ministry of Transport. It was built with a 100% government grant, at a cost stated to be over £8,000 per mile and it has had to serve until

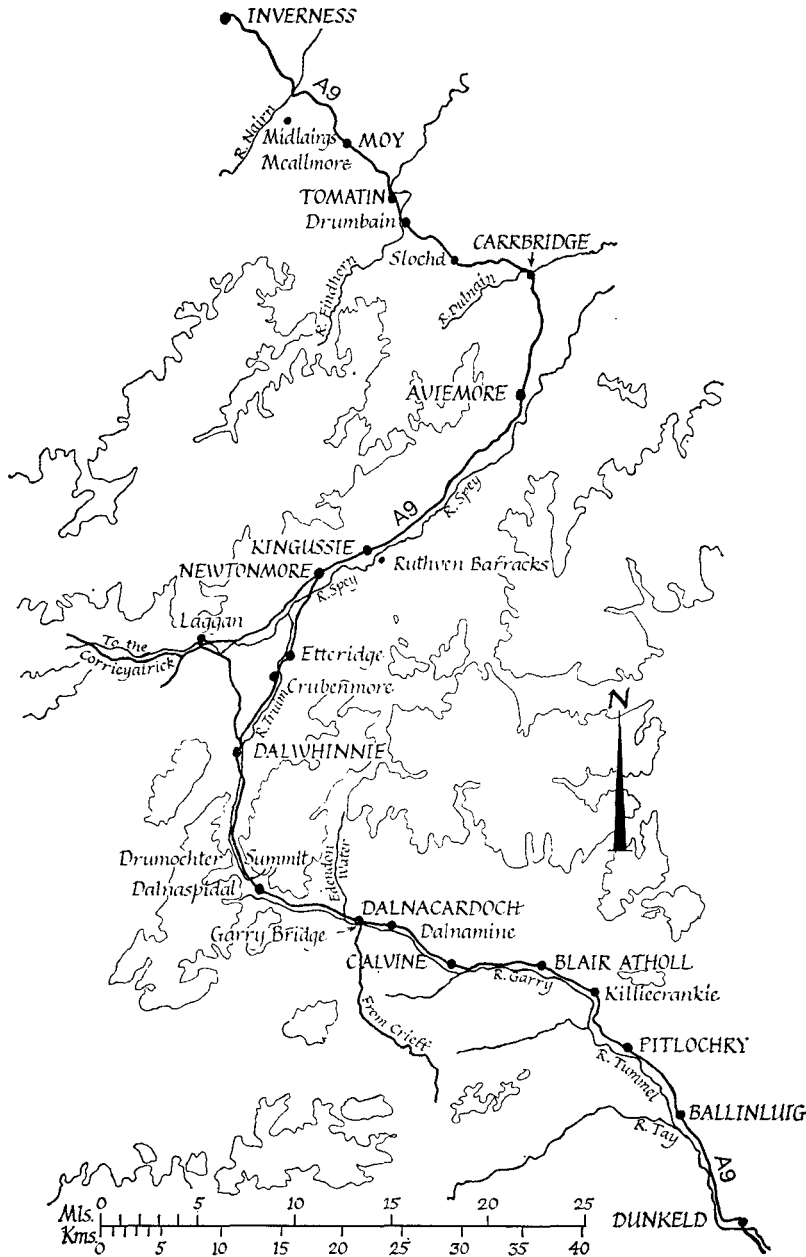


FIG 15 The Great North Road, construction 1925-8

recently with relatively minor improvements. Work started early in 1925 and was completed late in 1928 (fig 15).

'The Great North Road'

The road was designed for the motor car. The standard width of carriageway was 5.67 m (18 ft), the maximum gradient was 5% (1 in 20) and bends had super-elevation, the principle exceptions to these criteria being at the 11 notorious railway bridges. For half its length of 125 km (78 miles) the new road (fig 16) was on a new alignment but for the remainder the existing road was simply widened and strengthened. The specification was for a 75 mm (3 in) layer of gravel, a layer of 225 mm (9 in) bottoming stones placed by hand and 75 mm (3 in) of tarmacadam. The edges were each strengthened by a row of 300 mm (12 in) square bottoming stones, and the grass verges were made up on either side. At five places the road was carried across deep peat on a reinforced concrete raft 210 mm (8 in) thick and 6.6 m (21 ft) wide.

In 1978, while traffic was temporarily diverted to allow construction of culverts for the new road, an opportunity was offered by the engineers so that excavation and measurement

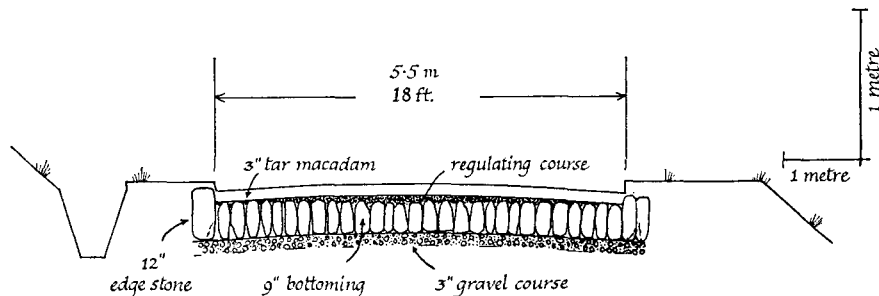


FIG 16 The Great North Road - Standard Cross-section as specified

could be made at several places on the road immediately S of the Drumochter Summit. Three trenches provided complete cross-sections (one being shown in fig 17) of the three periods of building on the site which was close to the Wade Road but not on it. There was: A, the first road with a layer of hand-placed stones forming a carriageway 4.0 m (13 ft 1 in) wide; B, the widening to 5.67 m (18 ft 0 in) undertaken in 1925-8 using heavy bottoming which became deformed by the weight of traffic on the left-hand side; and C, the further widening in the 1960s and resurfacing with more layers of bitumen macadam.

Concrete bridges

By 1925 the principal material of construction for the bridges had become reinforced concrete although it was at a relatively early stage in its development. Four large concrete bridges were built: one had two horizontal spans over the River Findhorn at Tomatin; one had three segmental arches over the River Spey at Newtonmore; and two had arch ribs and open spandrels for single spans at Dalnamine and Carrbridge. About 15 other bridges having spans up to 11.0 m (36 ft 3 in) were built with multi-faceted arches such as that over the Edendon Water (pl 33b), another standard style that has never been used before or since. Other bridges were built in a variety of styles to suit the sites. In addition a total of 757 dry-stone or concrete circular culverts had to be built.

When writing a paper after completion of the programme Major Robert Bruce (1931),

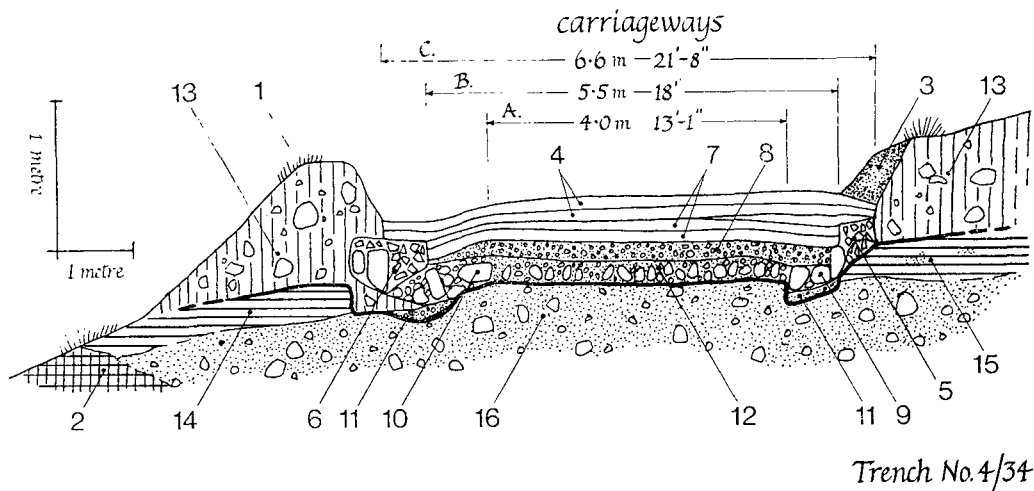


FIG 17

TRENCH NO 4/34

THE COACH ROAD, A (19th century) and the MINISTRY OF TRANSPORT ROAD, B (1925-8) with later widening, C (1960-70)

Near Drumochter Summit (Perth District). NGR NN 63107568

Looking N. Excavated 4 June 1978

- 1 Grass
- 2 Peaty soil
- 3 Roadside deposits
- 4 Layers, each approximately 75 mm thick, of bitumen macadam, Period C
- 5 Shoulder of clean broken (whin) stone 100 mm in size with voids, C
- 6 Ditto, and some 300 mm size stones, C
- 7 Layers, each approximately 75 mm thick, of tar macadam, B
- 8 Regulating course of rounded gravel, 12 mm to 50 mm in size, with light grey sand binding, B
- 9 Hand placed bottoming, 225 mm to 300 mm in size, B
- 10 Hand placed bottoming, 225 mm in size, B
- 11 Layer, approximately 75 mm thick, of gravel, 50 mm in size, and sand, B
- 12 Layer, average 145 mm thick, of rounded stones, 50 mm to 125 mm in size, with light brown sand and voids, A
- 13 Filling of mixed earth and stones
- 14 Peat
- 15 Peaty soil with layers of sand
- 16 Natural till, light brown, mixed cobbles, gravel and sand

who was Chief Engineer in charge of construction, also prepared an album⁸ of photographs recording the new bridges as well as the 60 bridges which were in existence in 1925 on the old road. Of the old bridges, two were not altered, 16 were widened and 40 were replaced on the same site or on new alignments. Where widening took place the addition to the arch was in reinforced concrete and the original voussoir, spandrel and parapet stones were carefully numbered and reused. Unfortunately about 40 bridges were completely demolished to make way for the new ones, which action raised the comment at the time (Bruce 1931, 145): 'On the other hand, it was a matter of sincere regret . . . that the beautiful stone arch bridges, which harmonised so well with their surroundings, had been ruthlessly destroyed and replaced by others of concrete which disfigured the landscape. That was nothing short of a calamity. It was to be hoped that no engineer or Government authority would ever again be responsible for such a disgraceful massacre of charming stone bridges.' It can be reported that the new A9 reconstruction has caused the removal of several concrete bridges of the 1925 period but that no earlier masonry arches have been lost as a direct result of this work.

APPENDIX THE ROY MAPS

As basic source material, the Roy Maps¹ are so important for the study of the Military roads that special reference is made to them. Their history was described by R A Skelton (1967) while Superintendent of the Map Room of the British Library.

A grand military survey of Scotland was initiated in 1747 and proceeded until the Highlands of Scotland had been surveyed by 1751 and the remainder of the country by 1755. William Roy, a Scot, was the first field survey engineer and later became responsible for completion of the survey and also applied his talent for the recording of surface archaeological evidence. The six survey parties spent the summer in the field. In the winter the survey was plotted in Edinburgh on rolls of cartridge paper known as the Field Sheet (pl 34a).

What is so important and valuable for the present purpose is the large size of the scale adopted: one inch to one thousand yards or 1 : 36,000. The draughtsman's guide lines are drawn at half-inch intervals equivalent to 500 yards or about 0.46 km, and are oriented to the then magnetic N. As the surveyors worked in straight lines between stations, which were normally located at bends in the road, the plot depicts the road very accurately. Where the road curves more gently the map often shows both a straight pencil line for the survey and a curving black ink line for the road. It is this precise detail in the record that helps so greatly in finding the road on the ground and in confirming it to be the one currently in use between 1747 and about 1751, in the Highlands.

Also in Edinburgh the teams produced a handsome duplicate known as the Fair Copy (pl 34b) again on cartridge paper. These may show the land even more graphically but they tend to lack precision in the line of the roads.

All these maps are now in the British Library where they have remained relatively remote: only with the advent of good copying facilities in the last decade or two has it become practicable to relate the information on these maps closely to the features on the ground which they so faithfully record.

ACKNOWLEDGMENTS

All excavation and recording of the Wade Road and the other old roads between Dunkeld and Inverness has been undertaken on behalf of the Ancient Monuments Branch of the Scottish Development Department, and I wish to acknowledge the very considerable assistance provided by Dr D J Breeze, Mr N M Reynolds, and in the earlier stages by Mr P R Ritchie.

I also wish to record my appreciation of the facilities, the generous help and the co-operation that I have unfailingly received from the following: Mr E G Miller, Superintending Engineer, Mr J Patience, Senior Engineer and the staff of the Road Project Team, Scottish Development Department, responsible for the A9 Trunk Road reconstruction programme: the Partners, Resident Engineers and Staffs of Messrs Babbie, Shaw and Morton, Messrs Freeman Fox and Partners, Sir Alexander Gibb and Partners and Messrs W A Fairhurst and Partners as Consulting Civil Engineers for one or more sections of the new road; the Resident Engineer and Staff of Highland Regional Council as agent for sections of the new road; also Messrs Tarmac Ltd, Messrs Tractor Shovels Ltd, Messrs Fairclough Civil Engineering Ltd, Messrs Whatlings Ltd and Messrs William Tawse Ltd as main contractors for the work of construction.

I am gratefully indebted to the help and encouragement given by Mr G Stell of the Royal Commission on the Ancient and Historical Monuments of Scotland, especially in the formative stages and later with the presentation, Mr D Boyd for all maps, sections and perspective views, and I must add a word of appreciation for the time and companionship on site given to me by Mr G R Smail, a Chartered Civil Engineer like myself.

Copyright: Pls 34a and 34b, The British Library.

NOTES

- 1 The Military Survey of Scotland, 1747–55, also known as the Roy Maps, is in manuscript. The Field Sheets of northern Scotland comprise 84 rolls in the King's Topographical Collection in the Map Library of the British Library, London, K Top XLVIII 25–1a. Microfilm copies of the parts relating to the majority of the areas with Military Roads have been obtained by the author and prints made from these have been used in the fieldwork. The Fair Copy of the whole of Scotland is in 38 sheets also in the King's Topographical Collection, K Top XLVIII 25–1b, c. Negative photostats of these sheets are held by the Library of the University of Edinburgh. Many other large scale manuscript and printed maps of the Military Roads in Scotland are also in the British Library.
- 2 The Reports of the Commissioners for Roads and Bridges in the Highlands of Scotland (including for Making Roads and Building Bridges and, later, for Making and Repairing Roads and Bridges) are contained in *Parliamentary Papers*, 1803–63. The First Report (*Parliamentary Papers*, 1803–4) has an inferior map showing their intentions, and later reports contain good maps, drawings, specifications and other information relating to the engineering aspects of the works. The author has seen several collections, each in three volumes, of these reports, which greatly facilitate use and cross-reference between the reports, but they do not appear to be available in this form in any public reference library.
- 3 The *Atlas to the Life of Thomas Telford, Civil Engineer* a memorial, was prepared as a companion to the *Life of Thomas Telford*, an autobiography. Both were edited by John Rickman and published in 1838 in London. The Atlas contains 84 magnificent plates of which Nos 48–51 illustrate with dimensions many of the bridges built by the Commission for Highland Roads and Bridges.
- 4 *A New Map of Scotland with the Roads* was prepared on one sheet by Robert Greene in London in 1689.
- 5 *A General Map of the Roads of Scotland made out from actual Surveys taken by George Taylor and Andrew Skinner* 1775.
- 6 Perth and Clackmannan Counties on 4 sheets, Scale 1 in to 1 mile. Surveyed and published by James Stobie, London, 1783. This and the above maps dated 1689 and 1775 have been consulted in the Map Room, National Library of Scotland, Edinburgh.
- 7 Some 2 km further N the Wade Stone used to stand (facing N) on the S side of the Wade Road, flanked by two low drystone walls built or repaired in 1925–8 at NGR NN 6922571665. As this location is now between the two carriageways of the new A9 the stone has been re-erected (now facing S) on the N side of the southbound carriageway at NGR NN 693716.
- 8 The album of photographs accompanying the paper by Bruce (1931) was entitled *Inverness-Perth Road Reconstruction (from Inverness to Blair Atholl): Bridges*. One original album is in the possession of Sir Owen Williams and Partners, London, the Consulting Engineers for the bridges, who kindly made it available to the author and to the National Monuments Record of Scotland who now hold copies of all the photographs.

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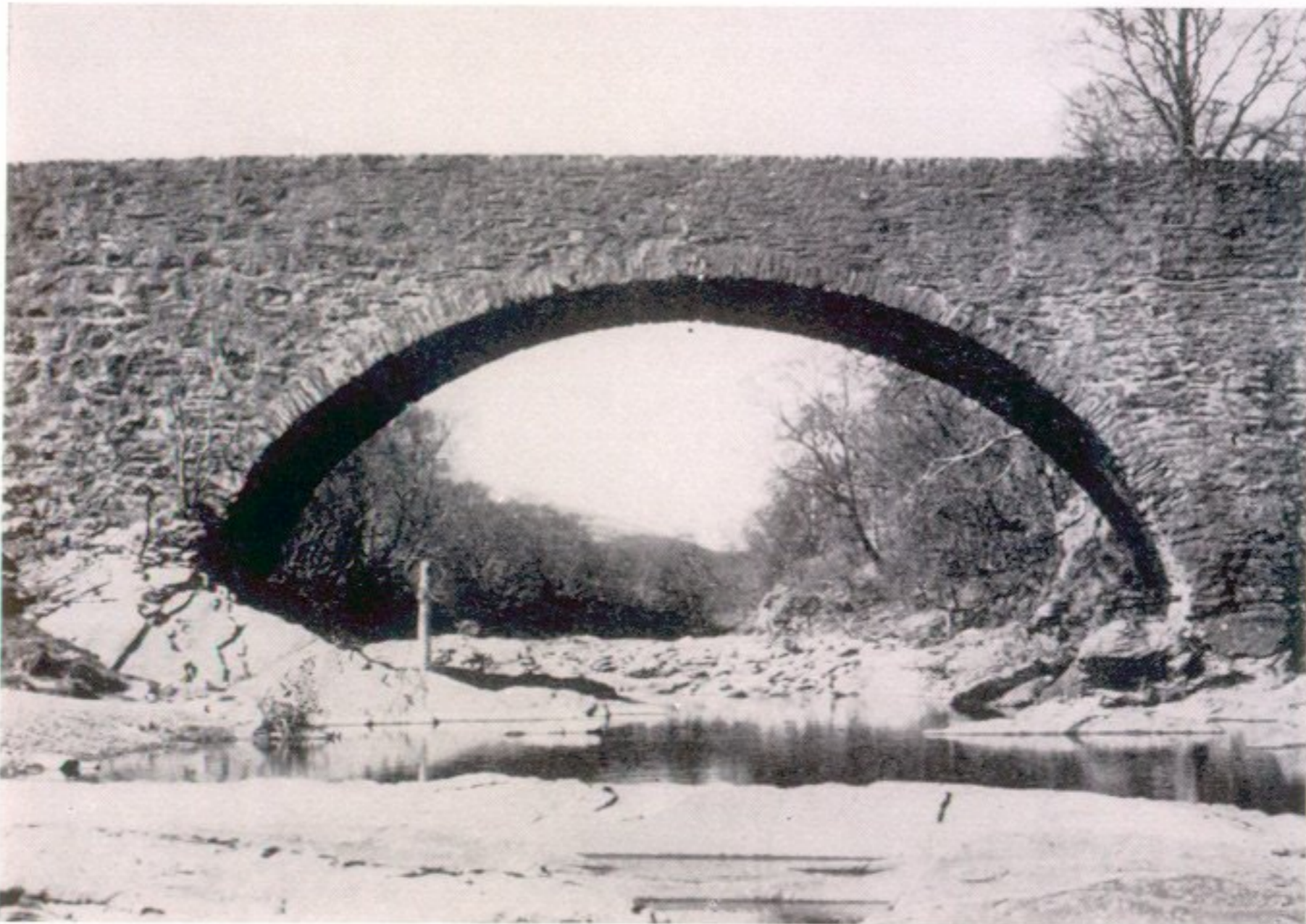
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a The Wade Road looking S between Calvine and Dalnamine in 1974



b A Wade Bridge: Garry Bridge, Dalnacardoch



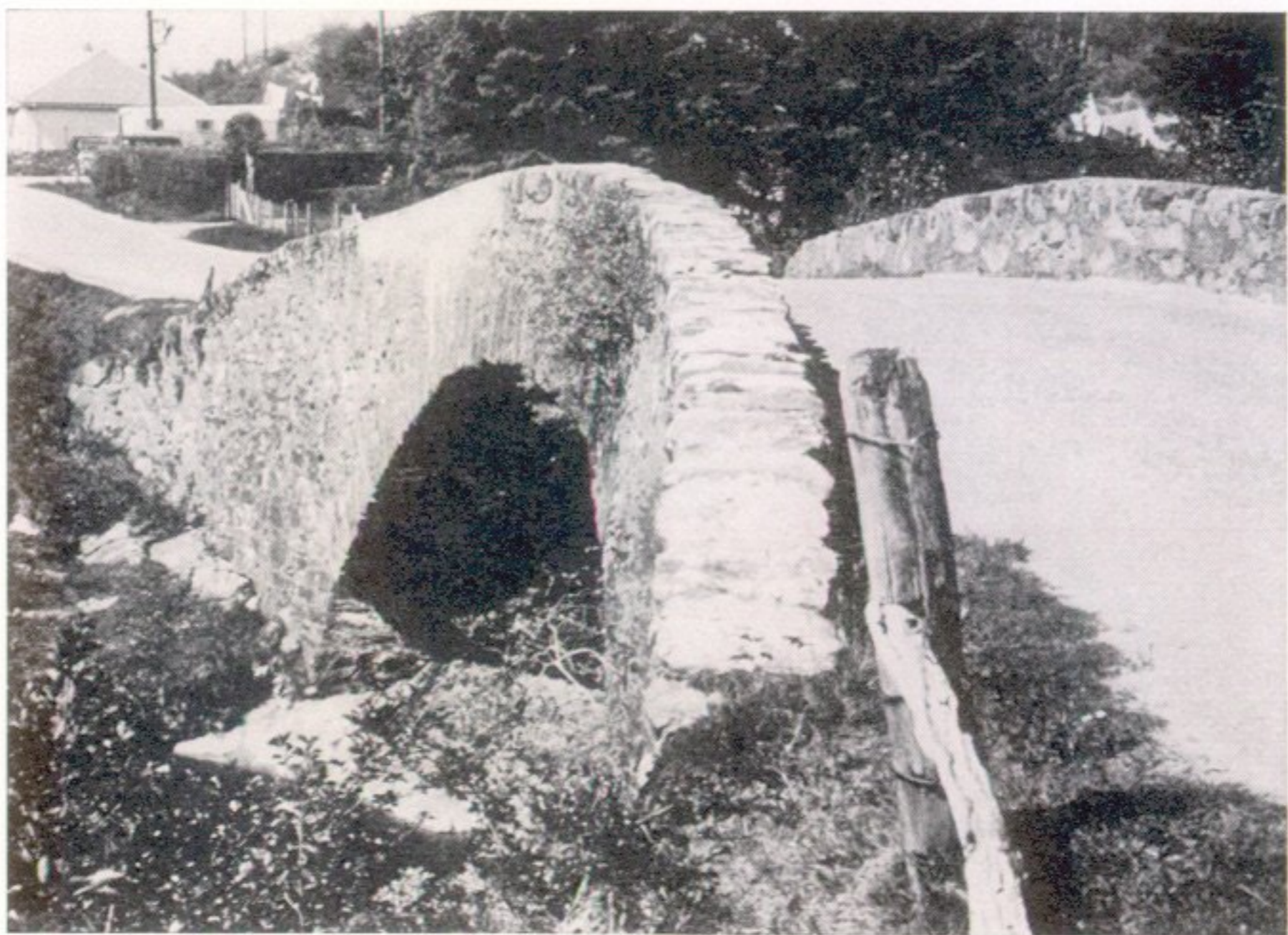
a Typical gravel running surface on the Wade Road, recently exposed



b A Caulfeild Bridge: Butterbridge, Glen Kinglas



a The Parliamentary Road, now the A9, at the Ord of Caithness



b A Parliamentary Bridge, Type 1: Drochaid Drum na Saille, Loch Eil



a A Parliamentary Bridge, Type 2: Bridge at Coire Shubh, near Kinlochourn



b A Parliamentary Bridge, Type 3: Bridge over the Allt Cosach, Drumbain



a A Parliamentary Bridge, Type 4: Dunkeld Bridge



b A concrete arch with 6 facets carrying the A9 over the Edendon Water



b The Roy Maps: Sample from the Fair Copy showing same area as plate 34a



a The Roy Maps: Sample from the Field Sheet showing the area between Crubenmore, Etteridge and Glen Truim (line spacing is 0.46 km)