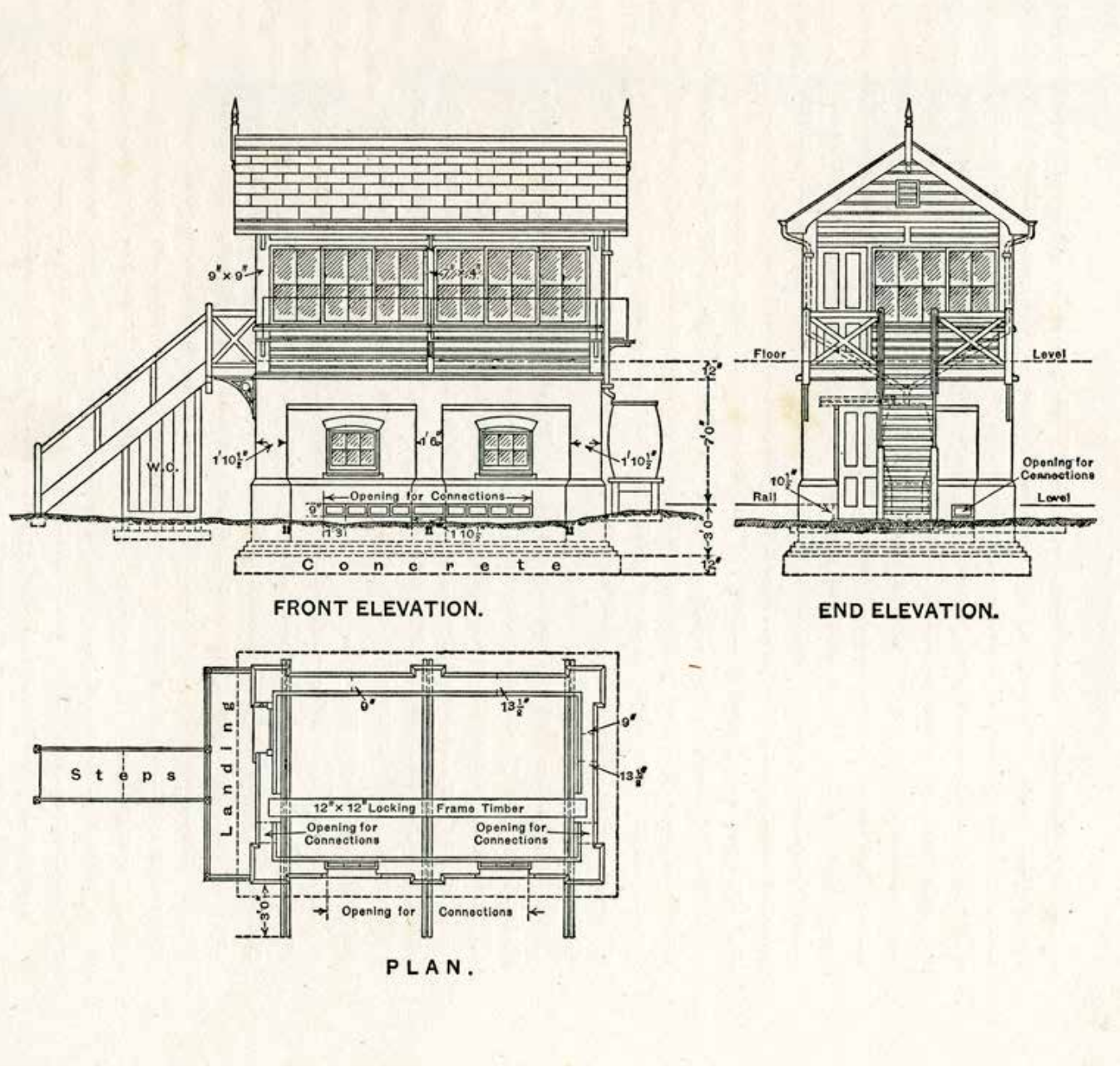
Historic England

Signal Boxes

Introductions to Heritage Assets



Summary

Historic England's Introductions to Heritage Assets (IHAs) are accessible, authoritative, illustrated summaries of what we know about specific types of archaeological site, building, landscape or marine asset. Typically they deal with subjects which lack such a summary. This can either be where the literature is dauntingly voluminous, or alternatively where little has been written. Most often it is the latter, and many IHAs bring understanding of site or building types which are neglected or little understood. Many of these are what might be thought of as 'new heritage', that is they date from after the Second World War.

We have a rich heritage of railway buildings, some over 180 years old. This guide gives an overview of one of the most distinctive types, the signal box. These evolved at the beginning of the 1860s from huts and towers housing railway policemen. They comprised an elevated and well-glazed operating room with levers controlling points and signals, and a locking room below with the lower part of the lever frame. As with stations, the different railway companies had their own distinctive designs and liveries, and while most were of a fairly standard design, some signal boxes were one-offs, especially at major stations. There were still over 10,000 mechanical boxes in 1948 but numbers then fell, to 4,000 by 1970 and perhaps tenth of that today. Changing technologies mean there will be hardly any historic signal boxes remaining in active use on the public rail network in twenty years' time.

This guidance note has been written by John Minnis and edited by Paul Stamper.

It is one is of several guidance documents that can be accessed at
HistoricEngland.org.uk/listing/selection-criteria/listing-selection/ihas-buildings/

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Front cover
A standard LB&SCR signal box design of the early 20th century. The only survivors of this once numerous design are Bosham and Barnham Junction (both West Sussex), both closed and moved from their original locations.

Contents

Introduction

The safety of passengers has been one of the most important aspects of the history of railways since the first public lines opened over 180 years ago. The process of ensuring that trains did not crash into each other, initially the work of railway policemen signalling with flags or operating board signals, was taken over by mechanical means from the 1840s, with the first semaphore signal being installed in 1841. The essential change in signalling practice that occurred in the mid-Victorian period was a move away from trains being separated by an interval of time to an interval of distance.

The signal box in its familiar form, a raised structure with large glazed windows enabling the signalman to maintain a look out, evolved at the beginning of the 1860s from huts and towers housing policemen. It comprised an operating room with levers controlling points and signals, and a locking room below, housing the lower part of the lever frame. Lever frames were the subject of numerous patents by signalling engineers, and disputes frequently arose. Some railway companies used signalling contractors exclusively, others made some use of them, while a number of the largest companies made all equipment in-house.

Once established, the basic principles of mechanical railway signalling remained constant for many years and many boxes dating from about 1870 onwards survived with their original frames well into the second half of the 20th century. By the 1900s, power operation did away with the need for large manual levers but, for cost reasons, new power boxes only gradually took over on the busiest lines. In 1948, British Railways still had over 10,000 mechanical boxes and although the figure had gone down to 4,000 by 1970, there were still some 500 pre-1940 boxes in use in 2011.

After a period from the 1960s to the late 1980s when older boxes were being rapidly replaced by power boxes covering wide areas, the closure rate dwindled and it looked as though many of the remaining mechanical boxes had a lengthy life ahead of them. From the late 1990s, therefore, Railtrack started a comprehensive modernisation programme to update these boxes to enable them to meet modern standards. This included replacing timber windows with uPVC, remodelling interiors with better heating and insulation, installing new toilet facilities and, in some cases, re-cladding the boxes with plastic materials replacing timber. The extent of this work varied and the programme was never completed but it led to many boxes losing much of their historic fabric. Advances in signalling technology resulted in Network Rail, the successor to Railtrack, announcing a plan in 2011 to concentrate signalling in 12 signalling centres over a 30 year period with 80 per cent of boxes closing within 15 years. This will effectively mean the end of the signal box as a building type on the national rail network.

Recognising the implications of this, Network Rail, in conjunction with the National Railway Museum, set up a Signalling Heritage Forum at which stakeholders such as the Railway Heritage Trust, the Heritage Railway Association and English Heritage, Cadw and Historic Scotland were represented. English Heritage inaugurated a Signal Box Project which led to a report making recommendations for assessment for listing of a number of boxes, in addition to those already listed, to ensure that representative examples of the major types were protected.

The architectural history of signal boxes has been extensively studied in recent years. A comprehensive typology of the various designs of signal box was established in 1986 and this has subsequently been widely accepted and adopted by Network Rail. That typology is used here, and the reader is referred to *The Signal Box: A Pictorial History and Guide to Designs* (see Further Reading) for a detailed explanation of it. Historic England's listing selection guide on Transport Buildings sets out the current designation thresholds of the building type, to which this introduction acts as supplementary information.

In the text, standard abbreviations are used for railway companies' names. These are expanded in the list opposite.

Abbreviations

Furness Railway	FR
Great Central Railway	GCR
Great Eastern Railway	GER
Great Northern Railway	GNR
Great Western Railway	GWR
Lancashire & Yorkshire Railway	L&YR
London Brighton & South Coast Railway	LB&SCR
London Chatham & Dover Railway	LC&DR
London & North Eastern Railway	LNER
London & North Western Railway	LNWR
London & South Western Railway	LSWR
London Midland & Scottish Railway	LMS
Midland Railway	MR
North British Railway	NBR
North Eastern Railway	NER
Southern Railway	SR
South Eastern Railway	SER

1 Historical Background

Signal boxes were an integral part of the 'block' system which was introduced gradually between the 1860s and the 1880s which ensured that there was an interval of space (or block) between trains running over the same length of track. The boxes contained fully interlocked lever frames controlling the points and signals in such a way that the points could not be set without the appropriate signal also being set. The block system was made mandatory on passenger lines by the Regulation of Railways Act 1889, which also forced companies to provide interlocking on lines used by passenger trains. Within a few years, the remaining branch lines were brought up to the necessary standard.

2 Description of the Building Type

The signal box is a building type unique to railways, although with a precursor in the semaphore towers erected during the Napoleonic Wars. Signal boxes had their origins in the 1840s with signalling 'platforms' with levers operating signals and a hut for the signalman and taller 'towers' fulfilling the same function at junctions. The signal box as we know it today, a covered and glazed structure housing levers from which both signals and points are worked, was the invention of the engineer John Saxby (1821-1913) who made a significant advance in mechanical interlocking between points and signals for which he obtained a patent in 1856. In 1863, he went into partnership with John Farmer to form the signalling contractor, Saxby & Farmer. Saxby's first boxes dated from 1857 and a distinctive building type was immediately created. The only major subsequent addition to the Saxby design was an enclosed lower storey below the signalman's operating floor containing the locking apparatus. Most of the early Saxby & Farmer boxes were tall structures that looked as they were raised on stilts, with the signal posts themselves rising through the roof of the box: others were squat structures with the operating room floor raised only a few feet above ground level (Fig 1).

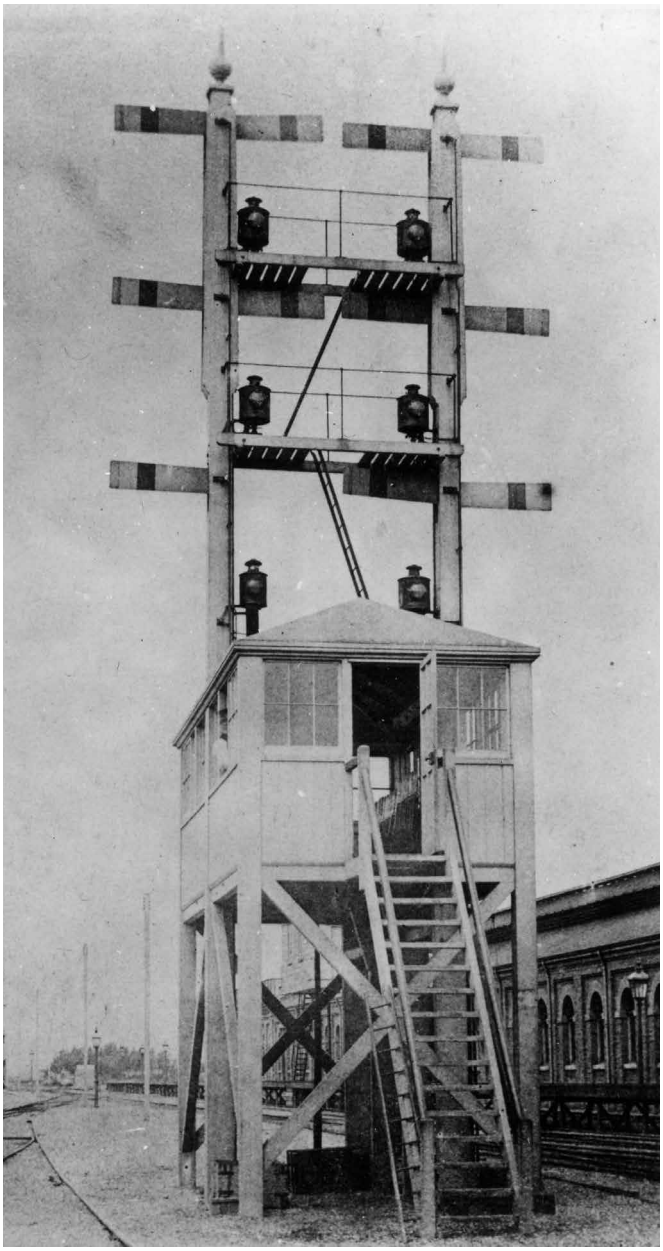

Figure 1
The dawn of the signal box. One of the earliest Saxby & Farmer boxes, Brighton North (East Sussex), shown soon after completion in 1862. The operating room is raised high on timber posts and the signals extend high above the box. It was replaced in 1882.

Figure 2
Appleby (Lincolnshire). A Railway Signal Co box (listed Grade II), built for the Manchester, Sheffield & Lincolnshire Railway (later GCR) in 1885. It displays the characteristic RSCo features of a window in the gable and lower lights to the operating room windows.

Over half of the signalling equipment used by the railways prior to 1923 was supplied by private signalling contractors, rather than built in-house by the railway companies. Many signal boxes were therefore built to contractors' designs rather than those of railway companies. The largest of these companies were Saxby & Farmer, Stevens & Sons, McKenzie & Holland, the Railway Signal Co, Dutton & Co and Evans, O'Donnell & Co (Fig 2). Each had distinctive designs of box, sometimes offering several different ones at any one time. In many cases, and almost always so by the 1900s, railway companies which continued to buy all their signalling equipment from a contractor would nevertheless require the signal box structure to be built to their design rather than to the contractors' designs.

Many of the railway companies had their own designs and these evolved over time. Some companies, such as the LNWR and the MR, favoured standardisation so that only minor changes occurred to their boxes from the 1870s to 1923 while others, such as the GER, developed many different designs.

Some railway companies had a divisional structure with different policies in different areas. The NER was divided into three divisions, Southern, Central and Northern, each of which had responsibility for boxes in its area (employing different signalling contractors for the frames and associated equipment) and each had its own distinctive designs of box. In the case of the GNR, some of its boxes were erected by the company's men, some by signalling contractors and others by local builders. Thus, variations existed even in boxes built to essentially the same design.

3 Design

A signal box is a relatively simple structure. It is generally, though not always, of two storeys. The upper part, known as the operating room, houses the signal and point levers, together with the block instruments, and accommodates the signalman (Fig 3). Typically, it has large windows, usually horizontally sliding sashes. A few railway companies, however, notably the SER (and the NBR in Scotland), favoured vertical sashes, approximating to the usual domestic type. Some designs of boxes had deep windows extending almost to the operating room floor: the Railway Signal Co's boxes, together with the L&YR's design derived from them, had windows of this type as did a few GNR boxes of which East Holmes (1873, listed Grade II) is an example (Fig 4). A timber walkway or gallery supported on iron brackets was often provided below the operating room windows to enable them to be cleaned. These walkways were often an integral part of the box design or, sometimes, a later addition. Where a box was not of great height from the ground, such walkways were unnecessary and frequently omitted. Access to the box was gained by external

Figure 3
The interior of a small Saxby & Farmer type 5 signal box, one of many built for the LB&SCR. Berwick (East Sussex), opened 1879, retains its original lever frame, one of the oldest in use on the rail network. Most levers are painted white, indicating that they are out of use. The block instruments are mounted above. Like most boxes today, the equipment is a mix of 19th-century and modern technology. The box is due to close in 2013.

Figure 4
East Holmes, Lincoln, which like Appleby (Fig. 2), has deep windows extending to the operating room floor. Built in 1873 for the GNR and listed Grade II, it has the vertical timber boarding and elaborate bargeboards associated with the GNR type 1 design.

Figure 5
The imposing overhead box at Hexham, Northumberland, built in the early 20th century. Although expensive to build and maintain, these tall structures were much favoured by the NER. Two remain (the other is at Wylam), both listed Grade II.

timber steps (often replaced in metal in recent years) leading to a landing outside the box door although some later boxes had internal stairs.

The lower storey, known as the locking room, was occupied by the lower part of the lever frame, with the rodding and wires to control points and signals exiting through a gap in the front wall. The locking room was often lit by small windows, frequently bricked up to reduce the risk of blast damage in 1939-40, and had its own door, usually adjacent to the bottom of the steps.

Heating of the operating room was by open fire or stove (again replaced in recent years), while lavatory accommodation took the form of either a small privy hut located near the box or a structure on the first-floor landing. Sometimes, this was combined with a porch. In later years, a lavatory was often provided within the box itself. Roofs were either hipped or gabled (with roughly an equal split between the two types) with a very few ornamental examples given half-hipped roofs. From the 1930s, new boxes were increasingly given flat roofs.

Boxes could be of all-timber construction, be entirely of brick or have a brick base with a timber superstructure. A few were built of stone. The use of materials was to some extent determined by location. Timber, for example, was necessarily used where boxes were built on unstable ground such as on an embankment or in an area of colliery subsidence. Roofs were generally slate although tile was used for a small number of boxes in prominent locations where it was deemed necessary for them to have a higher level of decoration than was usual.

Within the basic form set by the function of the building, there was scope for almost infinite variety in the details of a signal box. Because the structures were often highly visible at stations or level crossings, an effort was made to ensure that they were not purely utilitarian. Well-designed details and applied decoration mean that they represent a particularly satisfying meeting point between form and function. Size and shape can also vary greatly. Boxes may be long or tall, large or small, supported on gantries over tracks or cantilevered from a narrow base. From the 1890s, for instance, the Northern division of the NER greatly favoured overhead boxes with timber structures mounted above the tracks on massive iron or steel gantries. Two of these very impressive structures still exist in Northumberland at Wylam and Hexham (both listed Grade II) (Fig 5). Great differences may be seen in the design of window frames, eaves brackets, bargeboards, and cladding.

There were also notable trends over time in the design of signal boxes. The earliest boxes, many of them built by Saxby & Farmer in the 1860s, tended to fall into two categories. The majority were tall structures mounted on balks of timber raising them far off the ground to give the signalman a good view, with the signal posts rising above the box. Others, in contrast, were very small, squat structures, although their design had much in common with the superstructure of the tall boxes. By the early 1870s, however, signal boxes were being built in large numbers at all stations. They were mostly small and generally quite plain structures, usually with hipped roofs but sometimes gabled. In a few cases, the gable faced the track, owing to the minimal length of the box.

As the 1870s progressed, railway companies started to develop their own signal box designs, and boxes became more elaborately decorated. The most obvious manifestations of this were to be seen in bargeboards, finials, eaves brackets, and larger windows with more decorative framing. In some cases on the LSWR, LB&SCR and NER, decorative valancing running along the eaves of the boxes was employed. Distinctive features such as those used on the GER type 3 (1882-3), with its margin light glazing and timber blocks cut to resemble rustication, proliferated (Fig 6). Railways seldom slavishly followed styles to be seen in the mainstream of contemporary architecture. Generally, they followed what might be best described as 'railway vernacular', with the same simple, practical designs owing little obvious reference to historical styles being found in other timber railway buildings such as waiting shelters and awnings. However, pointed locking room windows of neo-Gothic inspiration were quite common, especially on the GNR. Brick bases with decorative polychrome brickwork are sometimes found, and decorative valancing at eaves level was derived from the use of it on domestic iron verandahs in the Regency period. Conscious use of contemporary idioms is confined to only a few designs. The Arts & Crafts FR type 3 boxes of the 1880s were inspired by the work of, if not actually designed by, Austin & Paley, who acted as architects to the company. They had battered stone bases, steeply-pitched tiled roofs and exposed rafter ends. Examples survive at two

Figure 6
Brundall (Norfolk), built 1883 and listed Grade II, is an example of the GER's highly ornamental type 3 design with its margin light glazing and timber blocks giving an effect of rustication.

Figure 7
Some spectacular Arts and Crafts influenced boxes were put up by the Furness Railway. St Bees, Cumbria, dates from 1891 and the battering of the walls and the steeply-pitched tiled roof display the Austin & Paley influence on the FR's architecture.

Cumbrian boxes, Park South (1883) and St Bees (1891) (Fig 7). The series of boxes designed by T. H. Myres to accompany his Domestic Revival stations on the LB&SCR also display numerous Arts & Crafts touches with tiled roofs, elaborate ridge tiles, panelled eaves and panelling throughout the box superstructure with fretwork flower motifs incised in the panels. Horsted Keynes, West Susex (1882, listed Grade II) on the Bluebell Railway is the sole survivor.

By the early 1890s, there was a reaction against this elaboration and simpler designs were developed by most companies, probably for reasons of economy as well as taste. There were also many more very large boxes built in the 1890s and 1900s as lines were quadrupled and signals proliferated.

Signal boxes were seldom designed in matching style to adjacent railway stations. There were a few exceptions. Kenilworth, Warwickshire (demolished) was a rare example of the LNWR varying its standard design by incorporating a brick base with pointed windows and polychrome brickwork to complement the elaborate station of 1883. The GER erected an especially elaborate box at Wolferton, Norfolk (listed Grade II*) with tiled gables to match the station buildings which served Sandringham House, and there were the T.H. Myres LB&SCR boxes already mentioned.

4 The Development of the Signal Box

There is insufficient space here to do more than give some examples to illustrate the development of the signal box and the reader is referred to *The Signal Box: A Pictorial History and Guide to Designs* (see Further Reading) for a comprehensive survey.

4.1 Company designs

Two large companies in particular, the LNWR and the MR, developed standard designs in the 1870s that were adhered to with some variations until the railway grouping of 1923 and, under the LMS, with more significant alterations, into the 1930s. Both companies built all their own boxes from the mid 1870s until the end of their corporate existence with no contractors' designs employed at all. The LNWR had a design of a plain gable-ended box with little roof overhang with the top half of timber on a brick base. This design was used across the board from small boxes to the largest mechanical signal box remaining in Great Britain, Shrewsbury Severn Bridge Junction (1903, listed Grade II) (Fig 8). A variation, introduced in 1904, had larger windows and broader eaves but that was the only real change to the design in fifty years of construction. Most of the LNWR boxes had brick bases with timber superstructures but all timber structures were used where conditions required it. The MR used prefabricated timber panels in its highly distinctive hipped roof boxes. All its boxes were of timber, clad in a mixture of horizontal and vertical boarding, and most were relatively small. The only real progression was an increase in the depth of the windows and a move from weatherboarding (overlapping boards) to lapped boarding (boards rebated to take the one above) in 1906. A good example of a typical MR box is at Oakham Level Crossing in Rutland, (1899, listed Grade II) (Fig 9), which has the deeper windows on the front elevation as first employed in 1884.

Another example of a company that developed a design and stuck to it was the SER which produced a box in the early 1870s that was (almost uniquely) closely related to their hipped roof, timber stations. It shared the vertically hung sash windows with them and looked quite unlike any other companies' designs. It continued to be built until long after the SER entered into a working agreement with its rival, the LC&DR in 1899. Few of the boxes were exactly alike but they all had a family resemblance with the box at Cuxton, Kent (Fig 10) the best preserved of the remaining examples. The SER differed from the MR and the LNWR in that as well as building its own boxes, it also bought frames from and used the box designs of many of the major signalling contractors (Saxby & Farmer, Stevens, the Railway Signal Co McKenzie & Holland and Evans O'Donnell among them) at times when in-house manufacture could not keep pace with demand, giving the company some of the greatest variety of boxes to be found.

Figures 8 (top), 9 (left) and 10 (right)
(Top) Shrewsbury Severn Bridge Junction (1903, listed Grade II) is the largest mechanical signal box still extant in Great Britain but is constructed of the standardised components employed by the LNWR.

(Left) Oakham (Rutland), is typical of the many small boxes erected by the MR. Built in 1899, it is constructed of prefabricated timber components and is listed Grade II. It retains its finials and distinctive window sashes with squared-off upper corners although the effect of the deeper windows on the front elevation has been obscured by their being pained white.

(Right) The unusual design favoured by the SER is seen at Cuxton, Kent (listed Grade II). The clapboarded walls and vertically hung sashes have no equivalent on other companies' signal boxes. The exact date of opening of Cuxton is unknown but it is believed to date from the late 1880s.

A couple of examples of how other companies' designs displayed a progression in their development can be given with the LSWR and the GWR. The earliest boxes of the LSWR (none of which survive) were a mixture of all brick structures with small windows, some elaborate timber boxes and some Saxby & Farmer designs. Then, about 1871, the company brought out its first standard design (type 1), a small, squat hipped-roof box of timber on a brick or stone base. Initially, these boxes had heavy exposed framing (later clad in horizontal boarding for better weather protection) and a decorative valance at eaves level (often subsequently removed). An example is Crediton, Devon (1875, listed Grade II) (Fig 11). These boxes were built throughout the system until the design was replaced from 1878 onwards by one with vertical boarding, much deeper operating floor windows and glazed upper lights (type 2). Following that, the type 3 box (1884-94) (Fig 12) continued the upper lights, save for some examples built in 1889-92 with variations in the type of timber cladding employed. Finally, in 1895, a completely different design (type 4) (Fig 13) appeared which was used for the remainder of the company's existence and was continued by its successor, the SR, until 1928. It was all brick with its most distinguishing feature being that the glazing was not, unlike most companies' boxes, continuous across the front of the structure, but was interrupted by a broad area of brickwork. A new

Figure 11
This somewhat squat design (type 1) was built in large numbers by the LSWR in the early 1870s. Crediton (Devon), (1875, listed Grade II) has, since this photograph was taken, been restored in LSWR colours of salmon pink and brown.

Figure 12
The LSWR followed its small type 1 box with some much more spacious and well lit designs. Bournemouth West Junction of (1888; listed Grade II) is a type 3 box with upper lights providing additional glazing.

Figure 13
A great contrast to its earlier boxes, the LSWR type 4 box is exemplified by Brookwood (Surrey) built in 1907 as part of a pioneering application of power signalling. Seen at the time of opening, the reduced level of glazing in these later boxes is evident. Brookwood was demolished following closure in 1966.

design of window frame had a gently arched top to the glazing. Each alternate sash was sliding and this eliminated the need for walkways. Woolston, Hampshire (1901), although disused, retains its external appearance.

The GWR, in its earlier days, had signalling organised on a divisional basis. Much of its signalling was initially carried out by contractors but its Reading signal works provided the vast majority of equipment for the southern part of the system from about 1876 with all work being carried out in-house from 1885 onwards. The first GWR design (type 1) was built from about 1869 to 1875. It was of all-brick construction, gabled, and with small windows. No examples survive. Type 2 (about 1875-80) had a hipped roof, a brick base and a vertical boarded upper part. St Mary's Crossing, Gloucestershire (listed Grade II) is a surviving example. Type 3 (1880-89) reverted to a gabled roof, retained the vertical boarding and had a distinctive seven louvre vent in the gable end. Bodmin Road, Cornwall (1887) is an example while Ferryside in south Wales remains in use. A design for the northern part of the system – the type 4 (1883-88) – emerged with a steeper pitched roof, complete with finials to the gables and horizontal instead of vertical boarding. It bore a close resemblance to McKenzie & Holland boxes of the period.

The first box type to be built across the system was the type 5 (1889-97, with a few late examples up to 1902). This was in many ways similar to the type 4 but the roof had a lower pitch and most of the boxes were all brick. Some remain in Cornwall, including Lostwithiel (1893)(Fig 14) and St Erth (1899). A complete break with the past was made with the type 7 which became the most common and long-lived of all GWR box

designs. It appeared in 1896 and lasted until 1927 with many elements of it incorporated into designs that followed thereafter right up until 1940. Key features were a hipped roof, ornamental eaves brackets and highly distinctive operating room windows with sashes divided into three upper panes and two lower (intended to improve the signalman's view of the line) (Fig 15). The boxes were built of bright red bricks with Staffordshire blue brick often employed for plinths, quoins and window surrounds. There were numerous subsequent minor variations and all-timber and timber superstructure on brick base versions were also constructed. Some of the all-timber boxes had gabled roofs. One notable advance was the introduction of internal staircases in the later type 7 boxes.

4.2 Signalling contractors' designs

Just as the railway companies had their own distinctive designs of signal box, so too did the signalling contractors. To take but one example, Saxby and Farmer, no less than 12 designs built between 1857 and 1901 (with four sub-variants) were identified by the Signalling Study Group in their 1986 typology. Different designs were built for northern and southern lines. The early boxes were small hipped roof structures with little ornament: two examples of the northern type 6 design survive in Lancashire at Daisyfield and Horrocksford Junction (Fig 16)(both 1873) on the former L&YR line between Blackburn and Hellifield. The most common type of Saxby & Farmer box was the type 5 (1876-1895). Particularly associated with the LB&SCR, it had a hipped roof with broad eaves, shaped eaves

Figure 14
The first system-wide design for the GWR was the type 5 of which Lostwithiel (Cornwall) is a surviving example, listed Grade II. Lostwithiel has had its windows replaced in uPVC with glazing bars of the type found in the later GWR type 7 boxes.

Figure 15
An early example of the widespread GWR type 7 design, Keinton Mandeville (Somerset) (demolished), was built in 1905. This view, taken soon after construction, shows the distinctive pattern of glazing used on these GWR boxes, with three panes over two in each sash.

Figure 16
Early signal boxes tended to be quite plain in appearance, with little of the decoration found in many boxes of the 1880s. Horrocksford Junction (Lancashire;1873), is an example of the early Saxby & Farmer designs for northern companies, in this case the L&YR. It has undergone major alterations as part of the Railtrack/Network Rail modernisation programme, including replacement windows and steps and has had the locking room windows bricked up.

Figure 17
The Saxby & Farmer type 5, with shaped eaves brackets and round-cornered upper lights, is highly distinctive. Eastbourne's (East Sussex; 1882, listed Grade II) is one of the largest. Space was tight, and the timber superstructure is cantilevered from a narrow brick base enlivened by polychrome brickwork and pointed arches to the locking room windows. This echoes the elaboration of Eastbourne station.

brackets and curved framing of the upper lights, complemented by curved framing of the heads of the window sashes. Surviving examples in East and West Sussex cover the full range of sizes from large boxes at Eastbourne (Fig 17) and Chichester, medium sized boxes at Lewes and Pulborough and small ones at Isfield and Pevensey. By the 1890s, the trend towards simpler designs saw the introduction of the type 12a box used on the SER at such locations as Wateringbury, Kent (Fig 18) and Rye, East Sussex, in the early 1890s. These were small boxes, gabled with a substantial overhang to the roof on front and back elevations.

4.3 Post-grouping

The principal effect of the railway grouping of 1923 on signal boxes was a drastic reduction in the number of designs employed, although pre-grouping styles were perpetuated for several years after 1923 in many cases. There was little advance in design until the 1930s. The GWR continued variations on the theme of its type 7 box, first introduced in 1896, using steel frame and concrete block construction in a number of boxes between 1927 and 1933 before espousing a modern flat roof style for power boxes built in 1933-4. The LMS combined features from LNWR and MR boxes in its type 11, introduced in 1929, and which continued to be built until 1954.

The SR, after building very traditional boxes based on LSWR and SECR designs, produced the most striking boxes of the period with rounded corners in a streamlined moderne style: examples at Woking, Surrey (Fig 19) and Horsham, West Sussex, are listed Grade II. The LNER too continued to build

traditional structures, many to pre-grouping designs from the GNR, GCR and NER but developed their equivalent of the SR's moderne style in Yorkshire boxes such as Hull and Thirsk before moving to a distinctive system-wide design in 1944, notable for its splayed corners. The most fundamental change came with the building of boxes to Air Raid Precaution specifications with all four major companies preparing designs in 1939. Each company had its own design but they all had 14 in. (350 mm) thick brick walls and flat reinforced concrete roofs about 12 in. (300mm) thick (Fig 20). They were not intended to be able to withstand a direct hit by a bomb but to reduce the impact of blast. In addition, many timber boxes in sensitive locations were given blast walls of brickwork up to the level of the operating room windows while the locking room windows of many brick boxes were bricked up.

4.4 Post-nationalisation

Each region of British Railways tended to follow its own course for its signal boxes. In some cases, existing company designs were continued, often modified to some degree. The majority were flat-roofed and brick built although the most distinctive were the small prefabricated boxes put up by the Western and London Midland Regions. The former were all-timber (type 37, 1957-72). The latter (type 15) were built 1954-83, some all-timber and the majority on brick bases.

Attempts to modernise railway signalling, using electrical or electro-pneumatic power to replace manual lever frames, began at the beginning of the twentieth century. However, there was little change to the external appearance of boxes used for early applications of power signalling.

Figure 18
By way of indicating the numerous designs available from the signalling contractors, Wateringbury, Kent (1893, listed Grade II), is one of the relatively plain boxes supplied by Saxby & Farmer to the SER in the early 1890s when it was completing the interlocking of its system. A type 12a, it has little stylistically in common with the elaborate type 5 seen in Fig 17.

Figure 19
Modernism finally made an appearance in the 1930s with what became known as the 'glasshouse' type of the SR. These moderne structures often, as in this case, accompanied new electrification schemes. Woking (Surrey) was built in 1937 and is listed Grade II.

Figure 20
The growing threat of war led to railway companies preparing designs for Air Raid Precautions boxes, designed to withstand the impact of blast. Runcorn, Cheshire, was built in 1940 to the LMS's standard design. The heavy concrete roof is the most noticeable characteristic, the 14 in thick walls are less obvious.

The war and financial constraints then held back development for some fifteen years, and power boxes really came only into their own in the 1960s. They tended to be large structures and earlier examples on the Eastern Region such as Hackney Downs were quite striking with large window areas and deep sun baffles of glass fibre to keep down glare. Plastic-based cladding applied to a steel frame was also used on a number of London Midland Region boxes of this period such as Wilmslow, Cheshire (1959, demolished). As the 1960s progressed, boxes tended to have smaller window areas. Large brick built power boxes such as Bletchley, Buckinghamshire (1965) have quite strong Brutalist forms although the detailing tends to lack finesse. The great exception is the one-off box at Birmingham New Street, (1964-66, Bicknell & Hamilton, listed Grade II) with its ribbed pre-cast concrete panels giving the building a powerful sculptural quality (Fig 21). But such buildings are rare and subsequent signal boxes can encompass almost anything from CLASP modular structures (Guildford, Surrey) and neo-vernacular barns (Westbury, Wiltshire) to Portakabins and GRP huts.

4.5 Lever frames and instruments

Signal boxes came into existence principally in order to bring together in one place all the signalling, communication/instrumentation and point-operating equipment necessary to enable a railway station, junction or intermediate block post to function safely. In particular, this enabled interlocking between points and signals to take place. Whilst it is the levers in the frame on the operating floor that allow the signalman to move points through rodding and to operate signals through wires, it is the equipment in the locking room (usually the lower floor of the signal box) that prevents the signalman from accidentally setting up conflicting movements. Locking is the mechanism in the frame by which levers are prevented from being moved until other levers are in the appropriate place. In the Victorian era, locking was achieved by a variety of mechanisms but in 1870 the system of tappet locking was patented and subsequently this replaced all others and older frames were relocked to tappet locking.

Figure 21
Birmingham New Street, the one post-war box to be listed (at Grade II) so far, built in 1964-6, architects Bicknell & Hamilton. Its sculptural qualities and fine detailing lift it far above the norm for these structures.

Locking fitting (the design and installation of locking systems along with its present-day counterpart in electron circuitry) is a highly skilled occupation, integral to signalling engineering.

Most of the contractors involved in signal box design and construction were also involved in producing lever frames. Leaders in the provision of boxes and frames were McKenzie & Holland, Saxby & Farmer, Stevens & Co. and the Railway Signal Company but many railway companies produced their own frames, the MR and the GWR being just two examples. Mechanical frames from different sources differ in length of lever, pitch (spacing between levers) and actuation (method of locking). In the last 90 years, most mechanical frames have had additional electrical locking equipment added to them. In the last 40 years, panels with buttons or switches have gradually replaced many conventional lever frame systems and even more recently, control equipment has been based on VDU Workstations. In a similar fashion to the outmoding of lever frames, signal box instrumentation has changed considerably in recent years. Also developed from the 1870s, the block instrument and single-line token instruments (equipment to assist the signalman in preventing two trains from being in the same section of track at the same time) have been superseded by electronic devices.

4.6 The signalman

The construction of a signal box provided the early railway companies with an opportunity to optimize the amount of work that could be obtained from one or (at most) two men compared to when pointsman and flagmen operated at several ground-level locations around a railway site. In more modern times, savings in wages have been made possible by the development of the power signal box in which a small group of signallers can control lengthy mileages of track through electronic media.

5 Further Reading

The single most significant work is The Signalling Study Group, *The Signal Box: A Pictorial History and Guide to Designs* (1986) which is the fullest account of how the building type evolved, established the typology of signal box designs and illustrates the vast majority of them. Peter Kay, *Signalling Atlas and Signal Box Directory* (third edition, 2010) lists all boxes surviving at the time of publication with details of type, date, location, etc and covers both operational Network Rail boxes and those on heritage railways, in museums and moved to other locations. Signal boxes are put into the wider context of the development of railway signalling and safety measures in two works, Geoffrey Kichenside and Alan Williams, *Two Centuries of Railway Signalling* (1998) and Michael A. Vanns, *An Illustrated History of Signalling* (1997). Michael Vanns also contributed two useful concise surveys: *ABC Signalling in the Age of Steam* (1995) and *ABC Signalboxes* (1997). A number of studies of signalling on specific railway companies have been published in recent years. One of the most comprehensive is (again) by Michael Vanns, *An Illustrated History of Great Northern Railway Signalling* (2000), which seeks to refine the 1986 typology in respect of the earlier GNR boxes. Much information is also contained in the pages of the journal *The Signalling Record* of the Signalling Record Society (www.s-r-s.org.uk) The Society is publishing detailed registers giving basic details of all the signal boxes ever built on a company by company basis, a number of which, including the Great Western, Southern and the southern part of the LNER, have already appeared.

There are extensive collections of signal box photographs on the internet on www.signalbox.org and www.tillyweb.biz. There is also the L. V. Phillips collection of signal box photographs in the Historic England Archives, comprising some 57 albums.

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