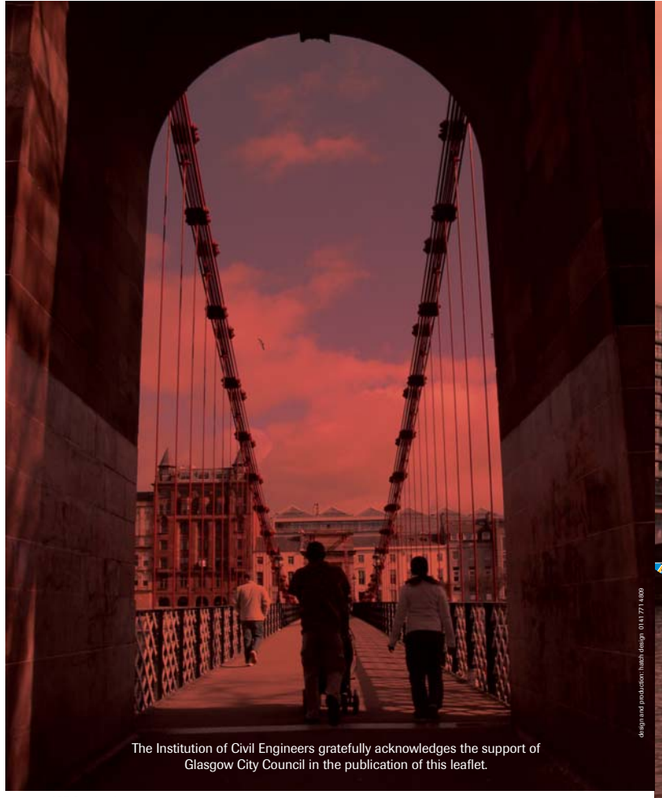

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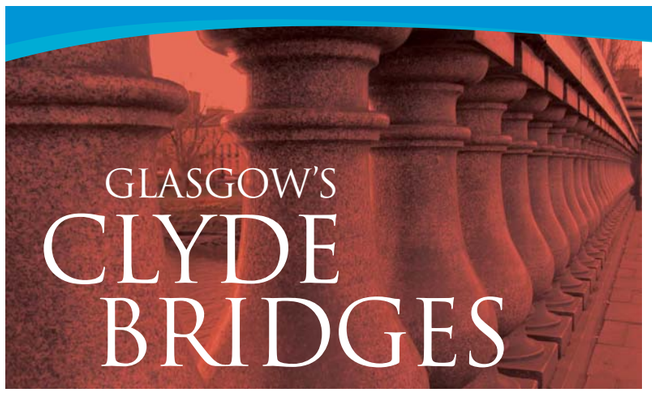
GLASGOW'S CLYDE BRIDGES



GLASGOW'S CLYDE BRIDGES

SETTING THE SCENE

The oldest surviving Clyde Bridges were built in the 1850's. By then Britain had become the workshop of the world. In 1851 Britain smelted 2.5 million tons of iron; five times as much as the USA and ten times as much as Germany. In 1851 British steam engines could produce 1.2 million horsepower; more than the rest of Europe put together. Britain owned half of the world's ocean-going ships and contained half of the world's railway mileage. This huge economic supremacy was celebrated in the Great Exhibition of 1851 in London's Crystal Palace.

In the 1850's Glasgow was entering a period when it would quadruple its population in 70 years, and when shipbuilding and heavy engineering would flourish. The lower Clyde was about to be transformed into a navigable channel capable of receiving ocean-going vessels into Glasgow, which would become one of the world's great ports.

In 1850 the great world powers were at peace, although soon to go to war in the Crimea. The California gold rush was in full flood. The Napoleon dynasty ruled France and Sir Robert Peel was British Prime Minister. Japan was still closed to the West; the first foreign squadron would not sail into Japanese waters until 1853. The USA was within 10 years of its civil war.

Around 1900 Glasgow reached the height of its prosperity and influence, living up to its claim to be 'the second city of the Empire'. In 1900 there were 23 cities in the world with populations greater than half a million; six of them were in Britain. London, Paris and Berlin were the largest cities in Europe, the fourth largest was Glasgow.

The Clyde bridges have bridged the years, and this heritage trail tells the story.

1 Millennium Bridge - 2002

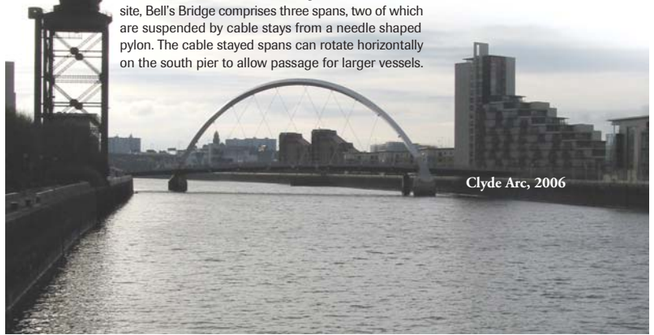
Engineer: M G Bennett Associates

Funded by the Heritage Lottery Fund the bridge was built by the Glasgow Science Centre to further improve links between the north bank and the GSC. It comprises five spans, four of which are fixed and the centre span comprising twin hydraulically powered lifting leaves to allow the passage of vessels. The bridge is made of lattice trusses of triangular section with a single bottom boom member and are fabricated from steel hollow sections. The main span is 38metres and the side spans are 26, 27, 27 and 8 metres. The centre span has been designed to be made fixed if required in the future. The bridge is supported on fully piled foundations to bedrock. The bridge only requires the same amount of power to open as is required to light a 100 Watt lamp.

2 Bell's Bridge - 1988

Engineer: Crouch & Hogg

Constructed in 1988 to link the Scottish Exhibition & Conference Centre with the Glasgow Garden Festival site, Bell's Bridge comprises three spans, two of which are suspended by cable stays from a needle shaped pylon. The cable stayed spans can rotate horizontally on the south pier to allow passage for larger vessels.



Clyde Arc, 2006

3 Clyde Arc - 2006

Engineer: Halcrow

The bridge was completed in 2006 and is unusual in that it crosses the river on a significantly skewed alignment which was dictated by the availability of suitable landing points on the south side. The main tied bowstring arch is 96 metre span with two side approach spans of 36.5 metres. Much of the reinforced concrete deck was precast off site and made to act compositely with the steel plate girder deck with in-situ concrete stitches. The arch is a diamond section box fabricated in three sections off site from steel plate and welded together in place over the river. Foundations are all fully piled to rock some 30m below river bed level. The bridge serves as a link, particularly for public transport between the SECC and the north bank developments and the south bank media village, residential, commercial and leisure developments.

4 Kingston Bridge - 1970

Engineer: W.A.Fairhurst & Partners

In 1967 work began on the Kingston Bridge which was the second longest spanning pre-stressed concrete bridge in Britain. It was opened in 1970 by the Queen Mother and continues to carry traffic on what is, at peak hours, one of the busiest sections of road in Europe. The bridge has recently undergone a programme of strengthening work to improve load carrying capacity. This entailed jacking the bridge up and moving the entire 52,000 tonne structure 50 mm to the south.

5 Proposed IFSD Tradeston Footbridge - 2008

Engineer: Halcrow

This footbridge is scheduled to be completed in late 2008. It links the successful International Financial Services District (IFSD) with newly developing Tradeston area on the south bank.

It is a balanced cantilever design primarily in steel with a 48 metre main span and two 25 metre side spans. The steel fins form the main structural support function and by placing these elements above deck, the deck's structural thickness can be reduced while the visual interest of the structure is enhanced. The piers comprise precast concrete shells infilled with concrete and are supported on tubular steel piles founded on rock.

The double curved alignment of the bridge makes the river crossing more interesting, while the extra length this provides allows the necessary clearance over the navigation channel to be achieved without the gradient on the bridge being too steep.

6 George the Fifth Bridge - 1928

Engineer: Considère Constructions Ltd

George the Fifth Bridge had been planned to be built at the foot of Oswald Street in 1914 but war delayed construction for 10 years and it finally opened in 1928. Although the bridge appears to be a three span masonry arch bridge, it is in this respect a fraud. The granite masonry is facing to a three span reinforced concrete box girder construction. Each pier is founded on four cylindrical concrete caissons. These were floated into position and settled onto the river bed on the ebb tide. The caissons were then sunk to their final positions by removing their temporary bottoms and excavating down to a solid foundation beneath the river bed.

7 2nd Caledonian Railway Bridge - 1905

Engineer: Donald A.Matheson & Sir John Wolfe Barry

The Caledonian Railway Company was keen to develop, and in 1905 the 'New Clyde Viaduct' was opened alongside the first bridge, giving a total of 13 tracks into Central Station. At one time it was the widest railway-over-river-bridge in the country. Steel lattice girders, spanning up to 59m sit on granite piers founded at depth on rectangular steel caissons. The bridge cost £200,000 with a further £75,000 being paid in compensation to the Clyde Trustees. Before opening it was load tested with 19 locomotives.

8 1st Caledonian Railway Bridge - 1878

Engineer: Blyth & Cunningham

While the City of Glasgow Union Railway had bridged the Clyde and had its terminus on the north side (to become St Enoch Station) in 1876, the Caledonian Railway Company stopped at Bridge Street on the south side. Finally, in 1878, after paying £95,000 in compensation to the Clyde Trustees, the first Caledonian Railway bridge in the centre of Glasgow was built just downstream of Glasgow Bridge.

The bridge deck, which carried four tracks, was of wrought iron construction supported on Dalbeattie granite piers founded on cast iron cylinders sunk into the river bed. Only the granite piers of this bridge remain visible, the tracks and girders having been removed in 1966 - 1967.

9 Glasgow Bridge - 1899

Engineer: Blyth & Westland

This bridge stands at the foot of Jamaica Street, on the site of an earlier Glasgow Bridge which was designed by the Scottish engineer Thomas Telford, first president of the Institution of Civil Engineers. The desire for a wider crossing, the deepening of the river by intermittent dredging, and the removal of the weir above Albert Bridge in 1880, all conspired against the old bridge and in 1899, after many schemes had been considered, a replacement bridge was built. By popular demand, this seven span masonry arch, was designed as a replica of Telford's bridge, although 6m wider and founded on steel caissons up to 30m deep.

10 South Portland Street Suspension Bridge - 1853

Engineer: George Martin

This bridge was begun in 1851 and suffered a set-back during its construction. After the masonry towers had been completed and the main suspension chains erected, the south tower split from top to bottom. The Greek triumphal arch towers now seen in the bridge were the result of a substantial re-build.

In 1870 the bridge closed for extensive repairs. The chains and deck were completely removed; the wrought iron bars forming the chains were re-headed and additional bars provided, the timber deck was replaced by wrought iron framework, and the deck profile was lowered by about 2m. The deck and hangers were again substantially renewed in 1926, and the hangers replaced once more in 2004. However, the masonry towers remain as originally built in 1853, and are therefore the oldest surviving elements in Glasgow's Clyde bridges.

11 Victoria Bridge - 1854

Engineer: James Walker

Glasgow's oldest surviving complete Clyde bridge is Victoria Bridge, lying at the foot of Stockwell Street. Bishop's Bridge, its 500 year old predecessor on the same site, had become too restrictive for the growing demands of traffic; by 1851 Glasgow's population had risen to 329,000 having doubled in the previous 25 years. A new 18m wide five span masonry arch bridge was designed, with foundations 6m below those of the old bridge, and timber piles which were steam-driven a further 4m below that. When the bridge opened in 1854, Glasgow had the two widest bridges in Britain - London's widest at that time was only 16m.

Victoria Bridge is built on the site of the first recorded bridge over the Clyde; a timber bridge believed to exist in 1285 and described as "Glaskow bryg, that byggyt was of tre" in Henry the Minstrel's epic poem on Sir William Wallace.

12 The City Union Railway Bridge - 1899

Engineer: William Melville

In 1900 the railway system was still expanding in Scotland with keen competition between the big companies. The two railway bridges across the Clyde were struggling to cope with traffic demands. The City Union Railway Bridge opened in 1899 in response to the demand to carry four tracks into St Enoch Station.

It was built beneath the previous bridge so that the rail traffic could continue to use the lines during construction. It is therefore rather squat in appearance. This was the first of the permanent Clyde Bridges to have a steel superstructure. The bridge served the main routes from the south to the now demolished St Enoch Station.

13 Albert Bridge - 1871

Engineer: Bell & Miller

The piers and abutments are founded on concrete filled cast iron caissons, sunk some 86ft below water level. Traditional masonry was rejected in favour of rivetted wrought iron elliptical arches, the largest of which spans 35m. The arch ribs are masked by cast iron spandrels adorned with the Royal coat of arms, the coat of arms of Prince Albert and those of various corporate bodies. This is the fifth bridge on the site, the previous longest surviving being a masonry arch bridge designed by Robert Stevenson, grandfather of Robert Louis Stevenson.

14 Tidal Weir and Pipe Bridge - 1901 (rebuilt 1949)

Engineer: FGM Stoney

The debate on weirs on the Clyde has raged since the first was constructed to protect the foundations of the Broomielaw Bridge in 1772. In the 19th century eminent engineers argued forcefully for and against a weir. From 1851 to 1880 a weir with a lock stood on this site.

The first tidal weir was completed in 1901, and remained until scour undermined an abutment foundation in 1941 leading to collapse. The present steel structure, which also carries large diameter pipes across the Clyde, was completed in 1949 as part of the scheme to replace the earlier weir. Today the primary purpose of the weir is to maintain the upstream water levels for environmental and leisure purposes.

15 St Andrew's Suspension Bridge - 1856

Engineer: Neil Robson

The chains and deck are wrought iron, the pylons cast iron, each with four fluted Corinthian columns almost 6 metres high. Its construction was promoted by Bailie Harvey for the safer passage of factory workers who had previously used a ferry at the same location; "in time of spate a scene of great excitement".

In 1997 the parapets and timber decking were replaced, and the ornamental cast iron features of the Corinthian columns refurbished. Repainting and landscaping works emphasised the St Andrew's theme.

16 King's Bridge - 1933

Engineer: TPM Somers

At a width of 21m between parapets the bridge has been described as being 'so flat and wide that one can easily cross without noticing its existence'. Completed in 1933, the bridge has four equal 21 metre spans comprising a series of rivetted steel plate girders supporting a reinforced concrete bridge deck. Each of the piers divide at low level into arches which spring from deep foundations.

17 Polmadie Bridge - 1955

Engineer: Robert Bruce

Constructed in 1954-1955, Polmadie Bridge is a prestressed concrete footbridge. It occupies the site of a timber bridge which was built in 1901, using timber salvaged from a service bridge used during the construction of Glasgow Bridge. This bridge was burnt down and replaced at least once before being replaced by the present concrete construction.

18 Rutherglen Bridge - 1896

Engineer: Crouch & Hogg

This bridge, with three spans of 28, 30 amd 28 metres, was designed at a time when masonry arches were becoming outmoded - the age of steel had begun. Foundation techniques were however up to date, and the piers were founded on steel caissons sunk to rock level by a combination of dead weight and men hand digging inside a chamber of compressed air. The men worked three shifts of eight hours each, in chambers lit by candles, until the caissons reached a solid foundation 18m below river level.

A previous Rutherglen bridge, of five span masonry arch design, was built in 1774-1775. Its engineer is reputed to have been James Watt, developer of the steam engine, during his early years as a civil engineer.

19 1st Dalmarnock Railway Bridge - 1861

Engineer: George Graham

Built for the Caledonian Railway Company between 1859 and 1861, this bridge carried the twin tracks of the Dalmarnock Branch line over the Clyde. The bridge was a seven span structure supported on concrete filled cast iron cylinders. The three river spans were of bowstring construction, whilst the four land spans were of plate web construction. Only the piers of the bridge remain.

20 2nd Dalmarnock Railway Bridge - 1897

Engineer: George Graham

In 1893 powers were granted to widen the Dalmarnock Branch line, but instead of widening the existing bridge, a new one was built upstream. Completed in 1897, the new twin track bridge was subsequently widened to three tracks in 1923, giving a total of five tracks over the Clyde at this location. Evidence of the widening can be seen in the girder spacing and the construction joints in the piers.

21 Dalmarnock Bridge - 1891

Engineer: Crouch & Hogg

This bridge is located close to the original Dalmarnock Ford, and is the furthest east of all the Glasgow bridges on this trail. In 1821 a timber 'pay' bridge was built for traffic between Dalmarnock on the north side and Rutherglen on the south, including traffic to the old Dalmarnock Pit. A replacement timber bridge was built in 1848.

The present bridge, built in 1891, was the first 'flat' bridge in Glasgow with five spans of about 18.5 metres. The piers are founded on concrete filled wrought iron cylinders, terminating on the bedrock 20 metres below the river bed. The bridge deck was replaced in 1997 with weather resistant steel beams and a reinforced concrete deck slab. The refurbishment utilised the original cast iron gothic arcading parapets and ornamental outer beam fascia panels.

GLASGOW'S CLYDE BRIDGES

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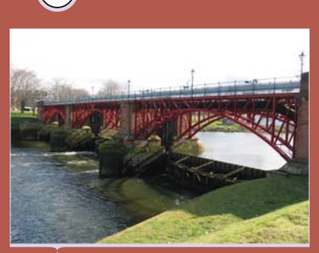

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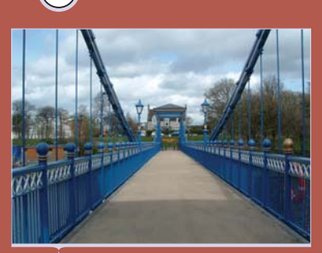

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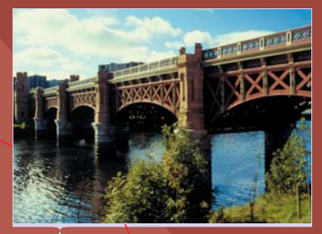
1 **Millennium Bridge**
2 **Bell's Bridge**
3 **Clyde Arc**
4 **Kingston Bridge**
5 **Site of new IFSD Tradeston Footbridge**
6 **George the Fifth Bridge**
7 **2nd Caledonian Railway Bridge**
8 **1st Caledonian Railway Bridge (1878 - 1966)**
9 **Glasgow Bridge**
10 **South Portland Street Suspension Bridge**
11 **Victoria Bridge**
12 **City Union Railway Bridge**
13 **Albert Bridge**
14 **Tidal Weir and Pipe Bridge**
15 **St Andrew's Suspension Bridge**
16 **King's Bridge**
17 **Polmadie Bridge**
18 **Rutherglen Bridge**
19 **1st Dalmarnock Railway Bridge (1861 - 1897)**
20 **2nd Dalmarnock Railway Bridge**
21 **Dalmarnock Bridge**



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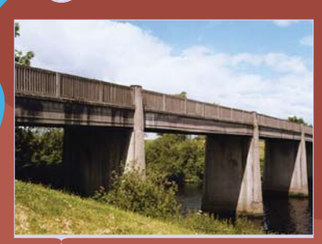

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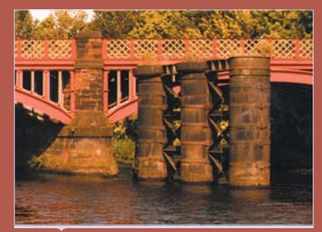

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REFLECTING ON GLASGOW'S CLYDE BRIDGES

The story of Glasgow's Clyde Bridges in many ways reflects the development of Glasgow. Glasgow may not have grown beyond a quiet monastery town had it not also been the lowest fordable point on the Clyde. As the city flourished in the 18th and 19th centuries, the demands for better communications resulted in bridges being built which, in turn, encouraged further trade and prosperity. So bridges both nurtured and reflected the growth of the city.

The story of Glasgow's bridges also reflects the story of transportation, from the pedestrian and horse traffic of the middle ages, through railway mania in the 19th century, and the 20th century age of the motor car, onwards into the new millennium.

It also reflects the story of civil engineering. Developments in engineering materials and knowledge can be traced in the techniques used to construct the Clyde bridges. Timber and stone, cast iron, wrought iron and steel, reinforced and pre-stressed concrete, were all used in Glasgow's Clyde bridges. Virtually all bridge types are represented on the Clyde; the beam, beam and slab (with solid girders, lattice girders or box girders), the arch, the tied bowstring arch, the suspension bridge, the cable stayed bridge and the balanced cantilever. A walk from the Millennium Bridge to Dalmarnock Bridge will take you past exhibits of more than 150 years of bridge engineering history.

ABOUT THE HERITAGE TRAIL

- Approximately 2½ hours should be allowed for the walk from Millennium Bridge to Dalmarnock Bridge
- Trains run between Dalmarnock Station and Exhibition Station approximately every 15 minutes.
- The trail is waymarked by the symbol