

Why is 'a pre-1830' iron bridge so important?

Iron and steel are a vital part of our everyday lives. 'Pre 1830' represents the first 50 years (1780-1830) of iron used in structural form in world history.

Importance of iron in World industrialisation

Industrialisation has been the most significant phase in world history and it started 250 years ago in C18th Britain and was carried through C19th on the back of iron and steel production and development - and quite literally - on the back of iron and steel road and rail bridges.

So the earliest iron bridges are a hugely important part of world history and heritage.

Ironbridge (1779-80) is the world's oldest, and Chepstow Bridge (1815-16) the world's largest, iron arch road bridge from the first 50 years of iron and steel construction in world history.

When most iron arch road and rail bridges were being built all over the world (late C19th/early C20th) Chepstow Bridge was already nearly 100 years old.

Why has Chepstow Bridge been ignored for so long?

- When it opened in 1816 it was overshadowed by the even larger 1816 Vauxhall iron bridge in London.
- Within 5 years, 'suspension bridges' had arrived.
- Rastrick was a famous engineer, but not for bridges, so C19th/C20th bridge writers didn't report his work.

World's highest tides under Chepstow Bridge



The only place on Earth with higher tides than SW UK is in Canada, but there are no bridges over it, so for 750 years Chepstow Bridge faced **higher tides than any other bridge in the world** - until the Severn Bridge (1966) and SSC (1996) built - where tides are 1.3m higher. **Chepstow's tide can rise 13.5 m (44 feet) in 4 hours.**

Chepstow Bridge is not only an outstanding early C19th bridge but it involved three of the greatest engineers of the time: John Urpeth Rastrick; John Rennie; Thomas Telford.

It was built mid 1810s - in a critical decade in bridge history. If designed 5 years later it would almost certainly have been one of the UK's first single span iron chain suspension bridges.

Chepstow Sights include: (see www.chepstow.co.uk)



Chepstow Bridge 1816 by Rastrick.
World's largest iron arch road bridge pre 1830.
200 years old in 2016.



Chepstow Rail Bridge 1852 by Brunel.
Pillars of Brunel's ground breaking rail bridge are still in place; and a Brunel station also.



Severn and Wye Bridges 1966
One of the most elegant suspension bridges in the World. 1st with narrow aerodynamic deck.
50 years old in 2016.



Chepstow Castle 1067
One of the 3 earliest stone castles in the UK - Tower of London, Colchester, Chepstow.
950 years old in 2017.



St Mary's Priory Church 1067
A fine Norman doorway in the Priory Church.
950 years old in 2017.



Chepstow Port Wall 1274
One of Britain's walled towns. The walls are 750 years old in 2024.



Town Gate 1524 and Gatehouse 1609
The Arch is a key feature of the High Street.
500 years old in 2024.



Chepstow Museum and Gwy House
Near the Castle and Bridge, the museum has the history of the Town. Open daily.



Chepstow Racecourse 1926
Well known racecourse. Piercefield House ruin is nearby with its C18th walkways on cliffs.

Also paths: **Wales Coastal; Offa's Dyke; Gloucestershire Way**

Data on iron arch bridges from: J G James (1988) Tables 1-6; Cossons and Trinder (2002); Ruddock (1979); and Fernandez-Troyano (2003).
(Further notes, and details of sources, available in a separate leaflet)

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CHEPSTOW BRIDGE

'The Old Wye Bridge' linking
England and Wales
Gloucestershire and Monmouthshire

THE WORLD'S LARGEST IRON ARCH ROAD BRIDGE BUILT BEFORE 1830

200 years old - Sunday 24 July 2016



A piece of 'World' heritage

Chepstow Bridge is the world's largest iron arch road bridge from *the first 50 years (1780-1830)* of iron and steel construction

Of the 10 largest iron arch road bridges built in the world before 1830, only Chepstow remains.

Designed and built by **John Urpeth Rastrick** who also built some of the world's first railway steam engines from 1806 onwards and **the first steam engine to run in the USA, 1829.**

The most elegant Georgian 'Regency' iron arch bridge in Britain and the World.



Chepstow Bridge History 1200 to 1800

Chepstow Bridge existed in 1228, and maybe earlier. It was a **10 pier wooden bridge with a central stone pillar**. It was often re-built and a ferry was used when the bridge was down. From 1785 it had 3 stone piers on Chepstow's side.

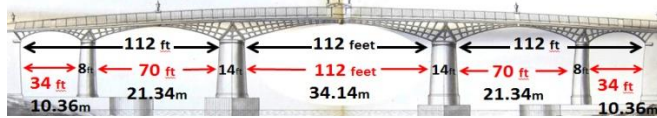


Kip 1705 Chepstow Museum

In 1811, Watkin George, ironmaster of the World's largest ironworks, Cyfarthfa at Merthyr, designed an iron bridge, as did John Rennie who was one of the World's top engineers.

Rastrick's 5 Arch Bridge of 1816

'*Supremely elegant*' - very functional - survived 200 years. Balanced in thirds of 112 ft. 4 new piers built 13 Apr-27 Sept 1815. Ironwork was cast at Bridgnorth, Shropshire, 1815-16. Continuous ironwork over the piers was very rare, and stylish. It is **113m (372ft)** long; **111m (364ft)** net; and **6m (20ft)** wide.



Arches have 5 parallel ribs with a radial grid pattern. Ribs are pairs of half ribs meeting mid arch. Pier widths 14ft and 8ft. World's 3rd longest iron arch road bridge in 1816. Some 1 arch bridges have longer spans than Chepstow main arch of 34.1m (eg. Mythe 52m, Bigsweir 50m) but Chepstow has 5 arches.

At the centre, the road is **4m (13ft)** above the highest tides; **17.5m (57ft)** above very low tides; **19m (62ft)** above river bed.

Who was John Urpeth Rastrick?

John Urpeth Rastrick of Northumberland, made steam engines at Hazeldine-Rastrick iron foundry in Bridgnorth when he built Chepstow Bridge, and stayed at Beaufort Hotel when in Chepstow. *John Urpeth Rastrick FRS:*

- was a key figure in UK and World railway history;
- built many of **Trevithick's engines** eg. 'Catch me who can' which ran on a circular track in London in 1808;
- built the **first steam engine to run in USA** (1829);
- was chair of the judging panel for the **Rainhill Trials** in 1829 - a key event for the development of world railways, bringing Stephenson's 'Rocket' to fame;
- built the **London to Brighton Line** 1837- 1840.

Rastrick's 37 arch Ouse Viaduct 1840



Rennie's Role

John Rennie was one of the two foremost bridge engineers of the late C18th/early C19th. He designed 3 of London's bridges and many other works, and 2 bridges for Chepstow. (*Evans & Evill papers, Chepstow Society Collection, Gwent Archives*)

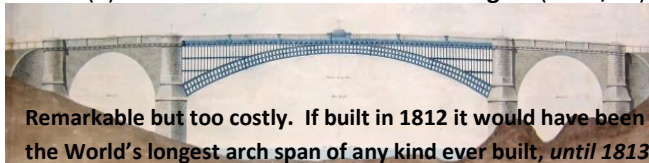
Rennie (1) 'repair and rebuild' design (1811/12)



Design accepted but wasn't built

Gwent Archives

Rennie (2) 250 ft 76m iron arch. World's longest (1811/12)



Remarkable but too costly. If built in 1812 it would have been the World's longest arch span of any kind ever built, until 1813

Rastrick's Role

John Urpeth Rastrick of Bridgnorth, designed and built the bridge we have today. He won the 'repair and re-build' job in February 1814 but did not build to Rennie's design but redesigned the bridge himself - in more of a 'Telford style'.

Rastrick's design for Chepstow Bridge 19th March 1814.



Design accepted - contract signed - 4 June 1814

Gloucestershire Archives



Telford's Role

Thomas Telford was one of the two foremost bridge engineers of the late C18th/early C19th. He designed: Pontcysyllte Aqueduct; many roads and bridges; and the mighty Menai Suspension Bridge. Telford was the first President of the Institution of Civil Engineers (ICE). ICE was founded in 1818. Telford was President 1820-1834.

Telford had no **direct** role in Chepstow Bridge, but it appears to be a '**Telford inspired design**' by Rastrick.

Rastrick followed Telford's advice on bridge design, set out in an article of 1812, almost to the letter, and used an arch style similar to that used by Telford and Stanton for bridges in Shropshire. Rastrick bid for this work so he knew the style. As Telford was the key source of iron bridge work in Rastrick's area, Chepstow Bridge may have been a 'show-piece' to attract attention and work.

13. Who was Rastrick? (continued)

Obituary for John Urpeth Rastrick in the Minutes of the Proceedings of the Institution of Civil Engineers 1857.

It lists, and comments on, Rastrick's many achievements, and runs to several pages. See Grace's Guide to British Engineering History www.gracesguide.co.uk Rastrick Papers re Chepstow University of London Library. Rastrick's engine in USA 1829 was the 'Stourbridge Lion', similar to his 'Agenoria' which is in the NRM collection. No pictures of JUR although there is a picture of his father.

15. Telford's Role

A 'Telford inspired' design by Rastrick. Author's view. Ruddock (1979) p.189 refers to Telford's 1812 article and his very different views from Rennie on bridges. Telford advised that there should be an odd number of arches rising in size to a wider central arch and a profile of 1 in 24, and not a flat deck, and he suggests pier widths and pier to span ratios - all of which were used at Chepstow. Cossons and Trinder (1979) p.110 note that Telford and Stanton had designed a prototype bridge at Meole Brace, Shrewsbury, 1811 for smaller single arch bridges. Rastrick bid against William Hazeldine for the work (Tenders in Shropshire Archives) so he knew the style. Chepstow's 5 arches have a similar radial grid pattern (Cragg, ICE 1986/97) and are constructed in a similar manner.

Showpiece' bridge? - Author's speculation. Rastrick may have followed Telford's advice purely as 'best practice' (because he wasn't a bridge specialist), or he designed it that way to get Telford & Stanton's interest, and contracts.

16. Why is a 'pre-1830' iron bridge so important?

The first 50 years following the construction of Ironbridge (1799-80) at Coalbrookdale is a clearly defined and important time. The first 20 years saw almost no development of major iron road bridges until Buildwas in 1796 and the great achievement of the Wearmouth Bridge at Sunderland in 1796 and. By the 1820s iron chain suspension bridges were appearing (10 years after Finley's USA suspension bridges). After 1830 there was a huge increase in metal bridges with the coming of the railway age. Chepstow is not only largest 'pre 1830', but also the largest 'pre 1845' iron arch road bridge remaining, and is almost the largest 'pre 1850' - but Triana Bridge (1846) in Seville, Spain, and Newcastle High Level (1849) are larger. 1850 onwards wrought iron replaced cast iron. In the late C19th, steel used. Sources: See Note 14.

17. Why has Chepstow Bridge been ignored?

Overshadowed by Vauxhall Bridge, 1816. Also Rastrick was not 'known' as a bridge builder so his bridge work wasn't reported, then or now. Rastrick didn't 'promote' himself or his work. Chepstow's centre span is less than many single arch bridges. Some writers report only on longest spans.

18. World's highest tides at Chepstow Bridge

There are slightly higher tidal ranges in the Bay of Fundy in Eastern Canada and Ungava Bay, but no bridges, over these waters, nor bridges with piers over their tributaries.

Chepstow's high tides are recorded in the very first edition of the Guinness Book of Records in 1955.

UK Hydrographic Office no longer produces tide data for the Port of Chepstow. It does predict the time of high tide.

The author has measured tide ranges at Chepstow Bridge on various occasions (2007-2015) of up to 13.5m (44 feet). 10th Sept. 2014 the river rose from 1.3m to 14.8m in 4 hrs.

River Wye can rise to 15.4m (50 feet) deep at Chepstow (eg. 4th January 2014) with a storm surge but Low Tide will also be high on such days so 'tidal range' is no greater.

19. Chepstow Bridge - a unique time in history

Not only is Chepstow an outstanding early C19th bridge but it involved three of the greatest engineers of the time - **John Urpeth Rastrick; John Rennie; and Thomas Telford.**

The decade 1810-1820 was one of the most remarkable in 2,000 years of bridge building history. Chepstow Bridge was built at the heart of it (1814-1816) in a period of rapid change. The changes in bridge styles, methods, materials, and span lengths, between 1810 and 1820, and the design and building of the first UK/European suspension bridges, marks out this decade as very special in 2,000 years of bridge engineering history, and ranks with 1920s & 1930s.

20. Suspension Bridge? 'If it had been built just 5 years later it would probably have been built as a suspension bridge - one of the World's first'. Chepstow tides needed a single-span bridge solution. Single span was **not possible in 1810 or 1816 but it was in 1820.** The first UK/European iron chain suspension bridge was built on near Berwick (Tweed) (England/Scotland) in 1819-20 by Samuel Brown. Brown had a chain works at Pontypridd only 30 miles from Chepstow. If the Chepstow advert had appeared in 1819 instead of 1813/14 it is highly likely that Brown would have submitted his single span iron chain suspension bridge.

CHEPSTOW BRIDGE - NOTES

sources and additional information for Chepstow Bridge leaflet

- 'Chepstow Bridge'** has been known by this name for 750 years. It is also known as '**Old Wye Bridge**' locally to distinguish the iron bridge from the A48 concrete road bridge. The 1816 bridge was built as '*Chepstow Bridge*'.
- Largest iron arch road bridge pre 1830.**
This is based on an analysis of the data and lists in: **J G James** (1988); and **N. Cossons** and **B. Trinder** (1979 and 2002) who are the leading experts on the subject of iron arch bridges; and from other references.
- World's Largest Iron Arch Road Bridges Pre 1830**

	Arches		100m		200m	
	Built	m.	X = Demolished (Date)			
100 metres +						
1 London - Vauxhall	1816	9 246	X	1898		
2 London - Southwark	1819	3 216	X	1921		
3 Paris - Austerlitz	1806	5 174	X	1850		
4 Plymouth - Laira	1827	3 156	X	1962		
5 Potsdam - Lange	1825	8 146	X	1900		
6 Longtown - Esk	1820	3 118	X	1911		
7 CHEPSTOW, Mon./Glos.	1816	5 113		IN USE		1
70 metres +						
8 Lucknow, India	1816	3 77.4	X	1900		
9 Berlin - Friederichs	1823	7 74.7	X	1900		
10 Cheltenham - Haw	1824	3 73.2	X	1962		
11 Sunderland - Wearmouth	1796	1 71.9	X	1858		
12 CHETWYND, Staffs*.	1824	3 71.3		IN USE		2
50 metres +						
13 IRONBRIDGE, Shrops.	1780	3 55.5		FB	Main arch 30.6m	3
14 Staines, Middlesex	1803	1 54.9	X	1804		
15 Yarm, North Yorks.	1805	1 54.9	X	1806		
16 MYTHE, Glos.	1826	1 51.8		IN USE		4
17 Stourport, Worcs.	1806	1 50.3	X	1880		
18 BIGSWEIR, Mon./Glos.	1827	1 50.0		IN USE		5
30 metres +						
19 WINDSOR	1824	3 47.9		FB		6
20 Bonar, Sutherland	1812	1 45.7	X			
21 CRAIGELLACHIE, Grampian	1815	1 45.7		FB		7
22 EATON HALL, Aldford, Ches.	1824	1 45.7		FB		8
23 HOLT FLEET, Worcs.	1828	1 45.7		IN USE		9
24 GALTON, Smethwick	1829	1 45.7		FB		10
and a further 12, including Coalport, Betws y Coed, Bath, Dublin.						
15 metres + 16 incl. Jamaica, St Petersburg, Tickford.						

Sources: J G James (1988) Tables 1-6; Cossons and Trinder (2002) Tables 2-13; Ruddock (1979); Tyrell (1911); and L.Fernandez Troyano (2003).

Footnotes to Table in Note 3

FB = built, and used, as a **road bridge**. In use today as a footbridge.

In Use= still a road bridge. **1900** = Demolition date unknown.

Chain 'suspension' bridges not included (*Union, Conwy, Menai*).

USA - 1st iron arch bridge 1835, Dunlap Creek, Brownsville, Pa., 26m.

***Chetwynd** (A513) not safe on foot - view from National Arboretum.

Pont Des Arts iron arch footbridge, Paris (1803) is longer than Chepstow but always a footbridge and not a road bridge. Not the original bridge. 1803 bridge demolished 1980. Replica opened 1984.

Ha'penny FootBridge in Dublin (1816) 42.67m; and **Scarborough** (1827) (4 arch) 76m; were also built as footbridges, not for roads.

4. A piece of 'World' heritage

As the largest iron arch road bridge remaining from the first 50 years of iron structures in the World it is an important piece of World heritage. Grade 1 Listed in UK. Merits consideration for World Heritage status.

5. Of 10 largest.....only Chepstow remains

See list in Note 3. Chepstow was 3rd largest when built. In 1816, Vauxhall in London and Austerlitz in Paris were larger.

6. Largest/longest iron arch road bridge pre 1830

The qualification of 'arch' and 'road' is important as there are 2 pre 1830 iron 'aqueducts' (*Pontcysyllte* and *Edstone*) and 1 'footbridge' (*Des Arts, Paris* - rebuilt 1980) longer than Chepstow, and a few longer pre 1830 iron chain 'suspension' bridges (eg. *Menai*). 'Largest' (or 'longest') refers to the continuous length of the **iron bridge structure** between the abutments.

Includes piers midstream but not stone side arches. The largest iron bridges may not have the longest spans. Chepstow is 113m. Its central arch of 5, is 34.14 m. Bigsweir is 50m - a one arch span of 50m.

7. 5 arch iron road bridge.

Very few 5 arch road bridges were made pre 1830. Only *Chepstow* survives. *Chetwynd, Ironbridge*, and *Windsor* have 3 arches. Footbridges: *Scarborough* 4 arch; *Des Arts (replica)* 7.

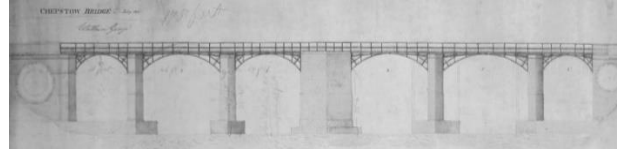
8. The most elegant Regency bridge.

Many attractive single arch Regency bridges (*Craigellachie, Bigsweir, Eaton Hall* etc) but *Chepstow's* length, continuous iron work, and lightness of its 5 arches is outstanding.

9. Chepstow Bridge History 1200 to 1800

Date of first permanent bridge at this site is not known but a bridge is mentioned in 1228. Ivor Waters' chapter on 'Chepstow Bridge' in *Chepstow Parish Records pp 116-124*, Chepstow Society (1955) provides some history on the previous wooden bridges on this site and there are details and a model in Chepstow Museum.

Watkin George made the first design for an iron bridge at Chepstow in July 1811 (see below). It is in Gwent Archives.



10. Rennie's Role John Rennie's report and his 2 designs of 1811, submitted in January 1812, are at Gwent Archives, at Ebbw Vale. (Evans & Evill papers, Chepstow Society Collection)

Rennie (1) a 'repair and rebuild' design - 1811/12 Rennie drew up a £15,191 repair/ rebuild plan with 7 iron arches.

Rennie (2) a 76m (250ft) iron arch - world's longest arch - 1811/12 Rennie's proposed 250 ft iron arch with 2 stone side arches was remarkable but at £41,890, too costly.

If it had been built in 1812, Chepstow would have had:

1. **the world's longest cast iron arch** - and it still would be today, as cast iron record is Rennie's 240ft Southwark arch;
2. **the world's longest bridge span** - until 1813, when the Colossus wooden arch of 104m (340 ft) was built in USA;
3. **the world's longest bridge span ever** - until 1813.

It would have been **longer than: Trezzo, Italy (1380-1416)** oft quoted as 72m or 76m but author calculates 63m from aerial pics and Farley/Beach measurements 2015; *Reichenau* Switzerland (1757-99) 67m; *Piscataqua, USA (1796)* 74m.

11. Rastrick's Bridge of 1816

'**Supremely elegant**' Newman (2000) (*Pevsner Guides*).

Construction - 1st pier 13 Apr 1815 start (Gloucester Journal 29 Jul 1816); last pier foundation 14 Aug 1815, completed 27 Sept 1815 (GJ 2 Oct. 1815). **Ironwork cast at Bridgnorth**, Shropshire 1815-1816, at the Hazeldine - Rastrick Foundry.

This was *John Hazeldine's* foundry (brother of the more famous William Hazeldine). Rastrick was managing partner. **Some iron** reported on site in Jan 1816 - so started late '15

Continuous ironwork over the piers - very rare, and stylish, J G James (1988) p172, H G Tyrrell (1911) p162. *Lamandé's Austerlitz Bridge* in Paris, had continuous iron work over the piers prior to Chepstow. Usually stone piers divided arches. **Bridge dimensions** - Rastrick's drawings 5- 19 March 1814, from a copy by T. Fulljames (1840), Gloucestershire Archives.

12. Rastrick's Role Rastrick responded to the Gloucester Journal 13 Dec. 1813 advert to '*rebuild and repair Chepstow Bridge according to Mr Rennie's plans*' but designed his own bridge for £17,850. Outturn £20,000 (excellent vfm). **Rastrick's new drawings** (in Gloucester Archives) are dated

5-19th March 1814 so new design created Jan - March 1814. **Cossons and Trinder** (2002) and **Newman** (2000) suggested Rastrick might have been contractor for Rennie's design but not so. Rennie's '*repair/rebuild*' design **was never used** and Rastrick's design was in '*Telford*' rather than '*Rennie*' style.

Rastrick returned to steam engine building in 1817 Rastrick built a wonderful iron bridge at Chepstow but was his only iron bridge. He built brick arch viaducts later in his career including the 37 arch Balcombe Viaduct, Ouse Valley in Sussex in 1841. We'll never know if Rastrick's '*Telford style*' Chepstow design would have secured future work from Telford or others as Rastrick left the foundry in 1817 and returned to making steam engines, as '*Foster - Rastrick*' at Stourbridge where he built '*Agenoria*' and '*Stourbridge Lion*'.

13. Who was Rastrick?

'**John Urpeth Rastrick FRS was one of the most important engineers of his generation**' Mike Chrimes in *Biographical Dictionary of Civil Engineers 1500-1830, Vol 1 pp 544-547*, Edited by Professor Sir Alec Skempton et al, ICE 2002.

14. Principal Sources and References

J G James (1988) 'Some Steps in the Evolution of Early Iron Arched Bridge Designs' *Transactions of the Newcomen Society* Vol. 59 (1987-8) pp 153-185 (*Article includes 6 tables - listing UK and European pre 1830 iron arch bridges*) - main source.

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T. Telford (1812) 'Practice of Bridge Building' article, *Edinburgh Encyclopaedia*; re-print 1830 Vol.IV, pp.519-530 in 'Bridge'.

Also, **R. Cragg** (1986 &97) *Civil Engineering Heritage - Wales and West Central England* (p.111), Institution of Civil Engineers) and **J.Newman** (2000) *The Buildings of Wales - Gwent / Monmouthshire*, p.184, Penguin Books 2000 ('*Pevsner Guides*')

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