

Japan's Uplifting Heritage: Giant Cantilever Cranes

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Background

In 1987, Scotland's most famous structural engineers, Sir William Arrol & Company, were closed down and much of their Glasgow factory demolished. Arrol was an extraordinary company which, in the 1880s was responsible for building The Forth Bridge (a UNESCO World Heritage Site since 2015) near Edinburgh, the Second Tay Bridge near Dundee and Tower Bridge (1886-94) in London (see Figure 1). In the early 20th Century, the company expanded its activities, and built iconic engineering structures across the UK and overseas. Some of the most famous examples include Bankside Power Station (now the Tate Modern art gallery), and Battersea Power Station (now a hugely successful regeneration project), but Arrol also built a wide variety of engineering structures across the world prior to its demise in 1987.



Figure 1: Sir William Arrol & Co stationery from 1908 (Courtesy of HES, Sir William Arrol Collection)

At that time, I was working for Scotland's heritage recording organisation, The Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS), and we were asked by Professor John R Hume of Strathclyde University to make an emergency visit to Arrol's factory, the Dalmarnock Iron Works, because scrap merchants and the demolition company had taken the cabinets storing Arrol's records, dumping archives and drawings on the floor of a decaying office building. My colleague, Graham Douglas, and I found a sad scene of photographs and drawings scattered across the office, randomised, and some with footprints on them (see Figure 2).



Figure 2: RCAHMS Industrial Heritage Survey Officer, Graham Douglas, examines some of the discarded Sir William Arrol records at the company's factory in Dalmarnock, Glasgow, in 1987 (Image: Miles Oglethorpe)

However, despite the damage, what we found was extraordinary, and changed our lives. These were records of an amazing, unique and historic Scottish engineering company. We gathered what we could and took it back to our offices in Edinburgh. Over the next few years, we gradually sorted out the records, identified and catalogued them and then put them into appropriate storage. We also published two catalogues containing information on what we had accessioned into the 'Sir William Arrol Collection', now cared for by Historic Environment Scotland (see Figure 3. The first of these can also be seen online at <https://i.rcahms.gov.uk/canmore-pdf/WP00003961.pdf>).

We would not have been able to have completed this work without the invaluable help of Dr Brian Newman, an engineering historian from Newcastle University in England. Brian knew a lot about Arrol from his own career because he had been an engineer prior to

moving into the academic world. By chance, he had also completed his PhD on the evolution of one of Arrol's most prolific products, the Giant Cantilever Crane, at Newcastle University.

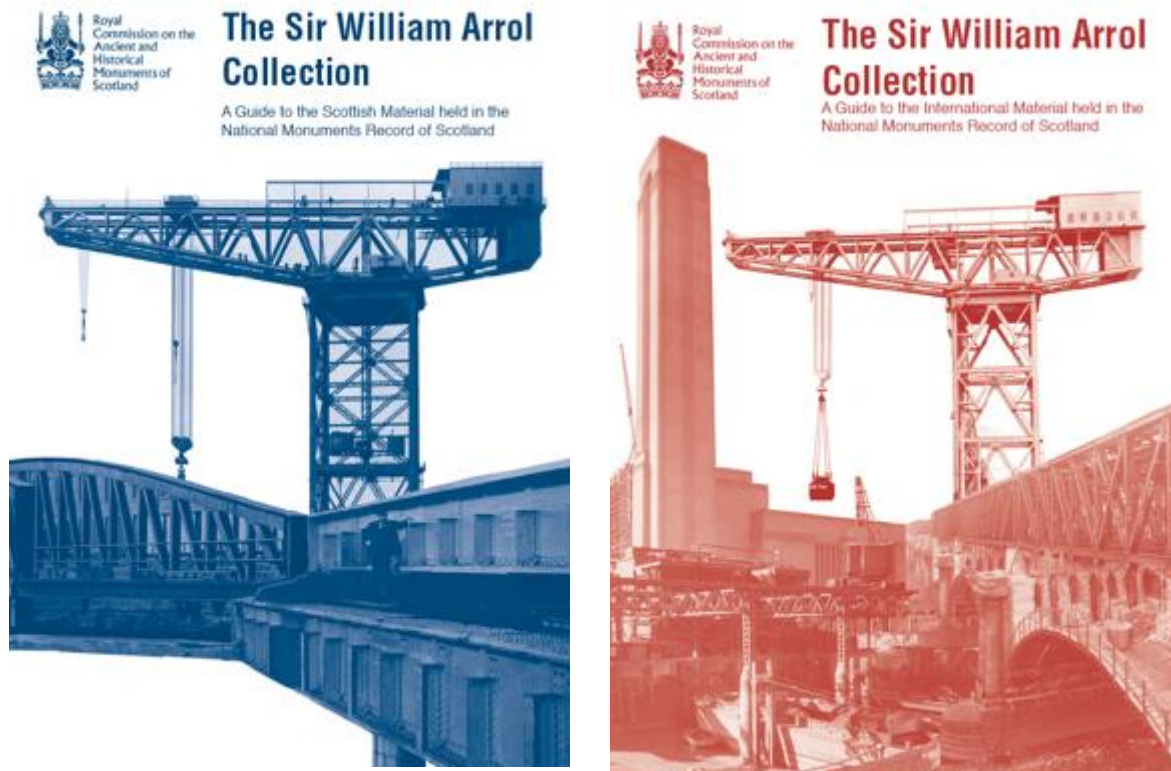


Figure 3: The two catalogues of the Sir William Arrol Collection, produced by RCAHMS in 1998 and 2000 from data compiled by Miriam McDonald (RCAHMS, now Historic Environment Scotland)

The Japanese Connection

In amongst the Arrol archive rescued from the factory in 1987 was a lot of material on cranes, but there was one photograph in particular that stood out. It was the enormous jib of a Giant Cantilever Crane assembled in Arrol's Parkhead Works (in Glasgow) prior to being dismantled and sent abroad in 1911 (see Figure 4). Brian's research revealed that this was one of the biggest cranes they ever built, a 250-ton version that had been ordered by the Japanese Imperial Navy for its Sasebo shipyard. The crane was eventually erected on site in 1913.

With the help of Brian's research, we were able to compile a history of Giant Cantilever Cranes, to understand their significance, and also gauge how many have survived into the 20th Century. In the process, we discovered that Japan is a crane 'hot spot' in an engineering as well as ornithological sense. In 2024, three can still be found, two of which are still working (Nagasaki and Sasebo) with one smaller example now preserved but non-operational in Yokohama. The Nagasaki crane was not built by Arrol, but the company that did construct it, Appleby of Glasgow, was taken over by Arrol a year after it was built. Like Sasebo, it is a landmark within the city, an imposing structure within Mitsubishi Heavy Engineering's Shipyard, sitting opposite the Glover Gardens.



Figure 4: The jib of the Sasebo Giant Cantilever Crane, at Arrol's Parkhead Works prior to being dismantled and sent to Kyushu, Japan, c.1911. (SC555106, ©Courtesy of HES, Sir William Arrol Collection)

Dr Brian Newman's Research

Brian's help with the Sir William Arrol Collection took on an extra dimension when he found himself in a position to be able to directly assist Koko Kato and her team's preparation of the UNESCO World Heritage nomination for 'The Sites of Japan's Meiji Industrial Revolution' (see Figure 5). This was because the Glasgow-built Giant Cantilever Crane was included within the nomination (see Figure 6), alongside another piece of Scottish engineering, the Kosuge Dock.

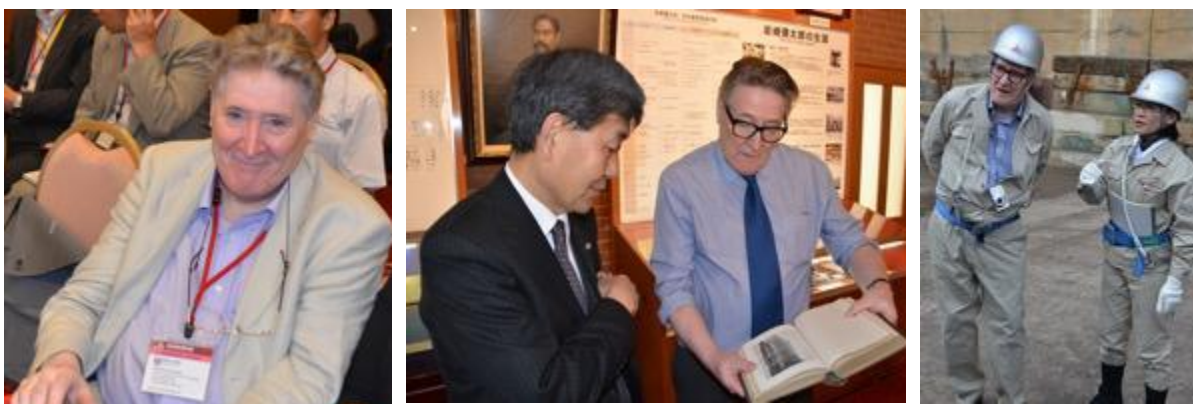


Figure 5: Dr Brian Newman advised the Sites of Japan's Meiji Industrial Revolution especially in relation to the Nagasaki Shipyard and its Giant Cantilever Crane. He also visited Sasebo. (Photos: Miles Oglethorpe)

A key requirement of any World Heritage project is to demonstrate that the nominated property has OUV (Outstanding Universal Value), and Brian was able to provide vital

information on the origins and evolution of the shipyard cranes. His first challenge was to explain that the Nagasaki Crane is not a ‘Hammerhead’ crane, and is instead a Giant Cantilever Crane. The distinction is important because ‘Hammerhead’ cranes are German in origin, while the Giant Cantilever Cranes came originally from Scotland in the UK and are distinctly different. The two types of crane were in direct competition with each other in the global market for lifting technologies as it expanded.

The Giant Cantilever Cranes were iconic structures that tended to dominate the yards where they were located. In effect, they were a status symbol confirming the importance of the business. However, more important was the role they played as shipyards built ever larger and more complex vessels, requiring the lifting of much larger pieces of equipment and materials onto and into ships.



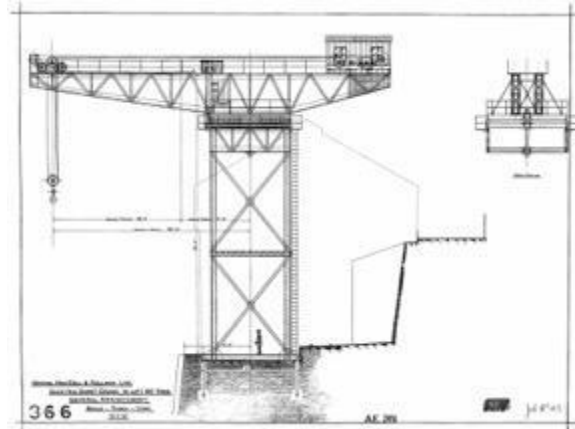
Figure 6: The 150-ton Giant Cantilever Crane at Nagasaki, built in 1909 and still operating within Mitsubishi Heavy Engineering’s shipyard. It was included within the successful UNESCO World Heritage nomination of the Sites of Japan’s Meiji Industrial Revolution in 2015 (Photo: Miles Oglethorpe)

In practice, the assembling of ships required the lifting of often very large, heavy and extremely valuable items such as gun turrets, engines and boilers into the hulls of ships, as well as other fragile, pre-fabricated items like steering gear, tanks and funnels. These needed to be carried and placed into position with extreme accuracy, so electrically-powered Giant Cantilever Cranes were perfect for the job.

A brief history of the Giant Cantilever Crane

Dr Brian Newman’s research traced the origins of the Giant Cantilever Crane back to the Glasgow Crane and Electric Hoist Company, whose first crane was built for MacColl & Pollock’s shipyard in, Sunderland, England (see Figures 7 and 8). The company merged with Appleby Ltd (also of Glasgow) in 1906. They in turn won the contract to build a 150-ton crane for the Mitsubishi Shipyard in Nagasaki, possibly encouraged by the ‘Scottish Samurai’, Thomas Blake Glover. The crane was erected on their behalf by the Motherwell

Bridge Company in 1909. A year later, Appleby merged with Sir William Arrol & Company, confirming Glasgow as the main centre of crane production at that time.



Figures 7 and 8: the first Giant Cantilever Crane was built in 1904 at MacColl & Pollock's shipyard in, Sunderland, England, was 60-ton capacity, and was built and designed by the Glasgow Electric Crane & Hoist Co (Images: Brian Newman)

However, given the success of the design and a surge in demand, other British engineering companies were licenced to build the cranes. As a result, the English company, Cowans Sheldon, built 200-ton Giant Cantilever Cranes in Kure (1911) and Yokosuka (1911), and a 50-ton crane in 1913 (see Figures 9, 10 and 11) in Yokohama. Of these, only the Yokohama crane survives and has a new visitor centre (which mistakenly refers to the crane as being 'Hammerhead'.



Figures 9, 10 and 11: Giant Cantilever Cranes at Kure (1911), Yokosuka (1911), and Yokohama (1913), all built by Cowans Sheldon of Carlisle, England (Images: Brian Newman and Miles Oglethorpe)

Meanwhile, it was Sir William Arrol who won the prestigious contract to build the biggest of the cranes in the period – including the 250-ton crane for the Japanese Imperial Navy's dockyard in Sasebo, just along the Kyushu coast from Nagasaki City and in the same prefecture. The Sasebo Crane was completed in 1913 and dominated the city's waterfront. Amazingly, it still does so today, having survived World War 2 and subsequently been well maintained by SSK, Sasebo Heavy Industries. It was photographs of this crane (see Figure 4 above) that we found in the Arrol factory in 1987.

Brian Newman estimated that between 50 and 60 Giant Cantilever Cranes were constructed across the world. Of these, he believed (before his untimely death in 2021), only twelve survive. Half of these are in the UK, including two in England and four in Scotland. Outside the UK, Japan is therefore the most important concentration, not least

because two of these are still operational within working shipyards. This is testament both of their outstanding original Scottish design, but also of the high-quality maintenance regime and the respect of the Japanese engineers responsible for their care for more than a century. It also reflects the particularly close special relationship between Japan and the UK in the early 20th Century.

Data gathered by Brian suggests that over half the Giant Cantilever Cranes ever built came from Scottish companies based in or close to Glasgow, the place where their design originated. It is therefore fitting that the largest concentration of surviving cranes in the world is in and around Glasgow on the River Clyde. The last of these cranes, Stobcross No.7 (also known as the Finnieston Crane) was, ironically, built by Cowans Sheldon for the Clyde Port Authority in 1932 (but with foundations and components from Arrol), and has become a proud symbol of the city.

From 1933, Stothert & Pitt of Bath became the main English producer of the cranes, constructing the last of its seven Giant Cantilever cranes at Chatham in England in 1972. There is now no doubt that the oldest surviving working crane is the Nagasaki crane (1909) and fittingly part of the Meiji World Heritage Site. The second oldest is Sasebo (1913) built by Sir William Arrol. The third oldest operational crane is at the Walker Shipyard on the River Tyne in Newcastle. It was also built by Sir William Arrol at 250-ton capacity, but has recently been uprated to 350-tons to help take on offshore oil and gas business. This possibility may be relevant if a future role for the Sasebo crane is being considered. It is also possible that Stothert & Pitt's 100-ton crane in the Hindustan Shipyard in Vizagapatnam, India (1950) is still operational, but we have not been able to verify this. Meanwhile, all the four cranes in and around Glasgow are disused, despite still forming an evocative part of the River Clyde waterfront. It seems, therefore, that Kyushu is uniquely special!

The Iconic Power of the Giant Cantilever Crane

The distinctive shape and size of the Giant Cantilever Cranes resulted in them dominating the shipyards and harbours within which they were located. They were, in effect, sending a message that the shipyard was a leading business which had the capacity to build large, modern vessels. This was certainly the case in Nagasaki, where Mitsubishi's crane still dominates the city's waterfront. This is confirmed by the fact that there are so many postcards of the crane still in circulation in the city.



Figures 12 and 13: Postcard of the Nagasaki Crane (left) and a painting of the Fairfield Shipyard crane in Govan, Glasgow, built by Arrol in 1911 (Images: Brian Newman)

Nagasaki is the second oldest surviving Giant Cantilever Crane, the oldest being at what was John Brown’s Shipyard in Clydbank, near Glasgow. This was also a major landmark in what was a historic shipyard (see Figures 14 and 15). Unfortunately, John Browns was closed and completely demolished, leaving only the crane as a memorial to the industry that once dominated the River Clyde. It is no longer operational, but until Covid, it was a tourist attraction which allowed visitors to travel to the top of the structure in an elevator. Sadly, the visitor centre is now closed.



Figures 14 and 15: the 150-ton Giant Cantilever Crane built at John Brown’s Shipyard in 1908 by Sir William Arrol. The view on the left shows the Queen Mary ocean liner being fitted out. Today, the crane is all that survives of the historic shipyard. (Images ©Courtesy of HES)

This leaves Nagasaki (see Figure 15) as one of the most important cranes in the world, and it is appropriate that it sits within a UNESCO World Heritage Site. One of the secrets of its survival is that it is being retained as an operational component of the shipyard, and is therefore being maintained in a safe and viable condition. It was recorded by the Scottish Ten’s digital documentation team back in 2014, and there are fantastic records of the structure which help historic interpretation and practical maintenance.

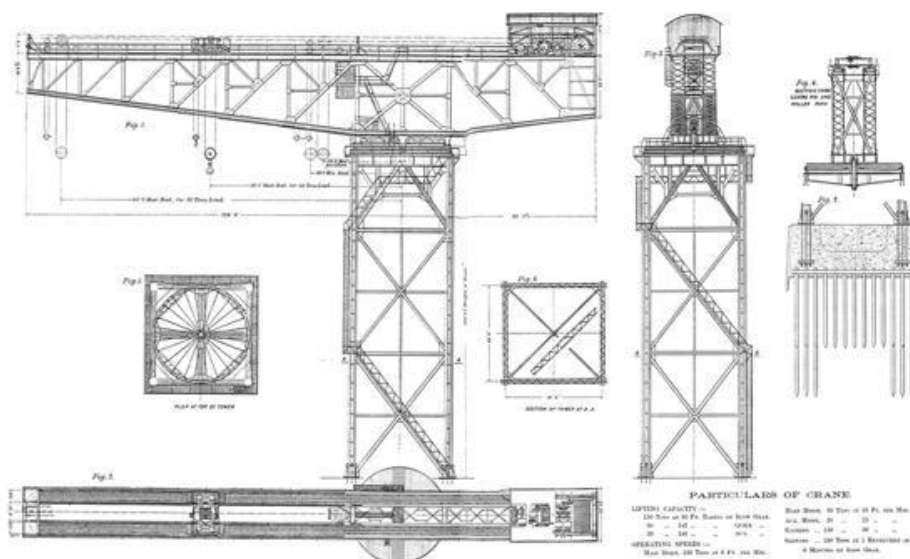


Figure 16: 150-tons Giant Cantilever Crane built by Appleby of Glasgow in 1909 for Mitsubishi, Nagasaki, Japan. General Arrangement created by Brian Newman from an original drawing.

The Importance of the Sasebo Giant Cantilever Crane

Like Nagasaki, the SSK Giant Cantilever Crane stands proudly on Sasebo's waterfront, showcasing both the city's and Japan's shipbuilding heritage. When completed in October 1913, this was the nineteenth Giant cantilever crane in commission, and jointly (with Arrol's Royal Navy Portsmouth crane) the most powerful in the world.

The crane was the fifth and final example that was built in Japan. It cost £3,7242 Sterling at the time, and weighed a total of 1,229-tons (not including its counterweight). Unusually, there is an electrically-powered elevator for personnel fitted within its tower which was probably the first in the world on a shipyard crane. Latterly, the Finnieston (Stobcross) crane in Glasgow was also equipped with an elevator. The crane was completed in 1913, and although its capacity was 250-tons, it was tested to 312 tons with the help of the shipyard workforce, who climbed onto the load at the time (see Figures 17 and 18).

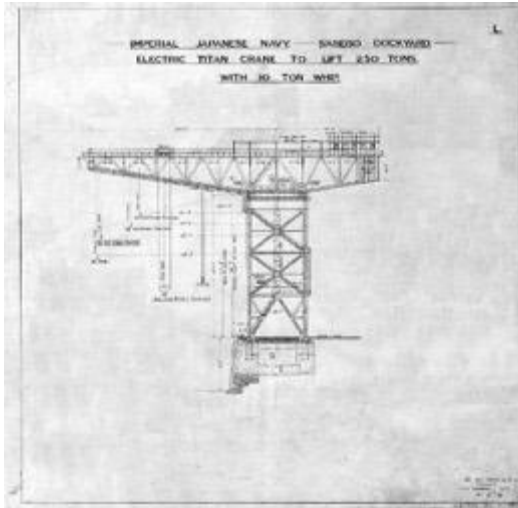
Brian Newman believed that the Sasebo Giant Cantilever is of international historical importance because of its uniqueness, its links with the growth of industrial Japan and Britain, and because it is in exceptionally original condition – a testament to the quality of the design and construction - and to the workers of Sasebo who have maintained it in superb condition for one hundred years.

With these thoughts in mind, in 2013 Scotland's Heritage Agency, Historic Scotland, persuaded the Scottish Government's then Minister of Culture, Fiona Hyslop, MSP, to sign a 100th Birthday greeting which Brian Newman and I had prepared for the crane. This was more than appropriate because Ms Hyslop had, earlier that year, visited the Nagasaki Shipyard and Giant Cantilever Crane, and was very familiar with the strong ties between Scotland and Japan. We were therefore able to take a framed picture and present it in person to the SSK Management in Sasebo.



Test Load.

Figures 17 and 18: The completed Sasebo Giant Cantilever Crane undergoing testing after its completion in 1913. Although its official capacity was 250 tons, it was tested up to 312 tons with the help of the shipyard workforce (Images: Brian Newman)



Figures 19 and 20: elevation drawing of the Sasebo crane, rescued as part of the Arrol Collection in 1987, and the 100th Birthday framed greeting signed by Scotland’s Minister of Culture and presented to SSK in 2013. (Images: Images ©Courtesy of HES)

There is no doubt that the Sasebo Giant Cantilever Crane is special both in the context of global shipbuilding history, but also in Japan itself. It is a remarkable survivor, and continues to be an evocative landmark on the waterfront of the city. Inevitably, it will need investment to keep it operating, but its resilient design should make that possible and even desirable. This has been achieved with success in Newcastle upon Tyne in England where another Arrol-built 250-ton crane in what was the Walker Yard has been uprated and now has a new life serving the UK Offshore Oil and Gas sector. It would be fantastic if SSK could find a way of investing in the Sasebo Crane and giving it a new life.



Figures 21 and 22: The Sasebo Crane in 2015 lifting pre-fabricated tanks, and its sister crane at the Walker Yard in Newcastle upon Tyne, England, experiencing a new life after being uprated to serve the UK’s offshore oil and gas industry. (Images: Miles Oglethorpe)

Conclusion

Thanks to Brian Newman's research, we believe that there are only twelve Giant Cantilever Cranes remaining in the world. Of these, three are known to be still in use (two in Japan, and one in England), with possibly one more (in Hindustan, India). Of the 50 known to have been built, approximately half (23) were built by Scottish Companies, 18 of which were built by Sir William Arrol of Glasgow, the most important of which is the Sasebo Crane.

We know that 29 (over half) of these cranes were built in locations in the UK (19 in England, nine in Scotland, one in Northern Ireland), five in Japan, three each in France and the USA, two in Australia and Denmark, and individual examples in Singapore, China (Hong Kong), Finland, India and Belgium. There may be others, and we would love to hear from anyone who can add to our data.

For Brian and I, the best part of our crane journey has involved Japan, not least because we were made so welcome, were given access to the cranes, and witnessed the respect and their high standard of care. However, more amazing has been the fact that Japan has elevated awareness and recognition by having one of the Scottish cranes inscribed onto UNESCO's World Heritage List as part of the Sites of Japan's Meiji Industrial Revolution. My big hope now is that a working future can be found for the Sasebo Giant Cantilever Crane, and that it can continue to contribute to the life and economy of the city. If this happens, I know Brian would be incredibly happy!



Figure 24: Prior to his death in 2021, Dr. Brian Newman built a working model of a Giant Cantilever Crane to scale in his house in Newcastle... (Image: Brian Newman)

Acknowledgment

The paper has been compiled from research by the late Dr. Brian Newman, School of Marine Science & Technology, Newcastle University, United Kingdom. (© Brian Newman)

Appendix: draft list in chronological order of Giant Cantilever Cranes compiled by Dr Brian Newman

No.	Date	Description	Maker
1.	1904	First Design, 60-tons, MacColl & Pollock, Sunderland, England	Glasgow Electric Crane & Hoist Company, Scotland
2.	1907	150-ton under erection, Barrow, England February 1907	Glasgow Electric Crane & Hoist Company/Appleyby's, Scotland
3.	1907	150-tons, John Brown, Clydebank, Scotland	Sir William Arrol & Company, Glasgow, Scotland
4.	1908	160-tons, Royal Navy, Devonport, England	Cowans Sheldon, Carlisle, England
5.	1908	150-tons, As Completed, Vickers, Barrow, England,	Appleyby's, Glasgow, Scotland
6.	1908	100-tons, Earle's, Hull, England	Appleyby's, Glasgow, Scotland
7.	1909	150-tons, North Eastern Marine, Wallsend, England,	Sir William Arrol & Company, Glasgow, Scotland
8.	1909	150-tons, Mitsubishi, Nagasaki, Japan	Appleyby's, Glasgow, Scotland
9.	1910	100-tons, George Clark, Sunderland, England	Appleyby's, Glasgow, Scotland
10.	1910	150-tons, Wallsend Slipway, Wallsend, England,	Sir William Arrol & Company, Glasgow, Scotland
11.	1910	157-tons, French Navy, Brest, France	Builder Unknown, France
12.	1911	200-tons, Fairfield, Govan, Glasgow, Scotland	Sir William Arrol & Company, Glasgow, Scotland
13.	1911	200-tons, Imperial Japanese Navy, Kure, Japan	Cowans Sheldon, Carlisle, England
14.	1911	200-tons, Imperial Japanese Navy, Yokosuka, Japan	Cowans Sheldon, Carlisle, England
15.	1911	80-tons, J S White, West Cowes, England	Babcock & Wilcox, Renfrew, Scotland
16.	1911c	147-tons, Chantiers de la Loire, St Nazaire, France,	Titan Anversois, France
17.	1912	250-tons, Royal Navy, Portsmouth, England	Sir William Arrol & Company, Glasgow, Scotland
18.	1912	50-tons, Schneider, Chalons sur Soane, France	Demag, Duisburg, Germany

19.	1913	50-tons, Yokohama Port Authority, Yokohama, Japan	Cowans Sheldon, Carlisle, England
20.	1913	250-tons, Imperial Japanese Navy, Sasebo, Japan	Sir William Arrol & Company, Glasgow, Scotland
21.	1915	200-tons, Royal Navy, Woolwich, England	Sir William Arrol & Company, Glasgow, Scotland
22.	1916	100-tons, Central Marine Engine Works, Hartlepool, England	Cowans Sheldon, Carlisle, England
23.	1917	250-tons, Royal Navy, Rosyth, Scotland	Sir William Arrol & Company, Glasgow, Scotland
24.	1917	150-tons, James Watt Dock, Greenock, Scotland	Sir William Arrol & Company, Glasgow, Scotland
25.	1920	100-tons, Royal Navy, Rosyth, Scotland	Sir William Arrol & Company, Glasgow, Scotland
26.	1920	150-tons, Barclay Curle, Scotstoun, Scotland	Sir William Arrol & Company, Glasgow, Scotland
27.	1920c	60-tons, Nakskov, Denmark	Builder Unknown
28.	1920c	100-tons, Nakskov, Denmark Builder Unknown	Builder Unknown
29.	1931	250-tons, Vickers Armstrongs, Walker, England	Sir William Arrol & Company, Glasgow, Scotland
30.	1932	175-tons, Clyde Navigation Trust, Stobcross, Scotland	Cowans Sheldon, Carlisle, England
31.	1933	50-tons, Royal Navy, Felixstowe, England	Stothert & Pitt, Bath, England
32.	1933	250-tons, US Navy, Bremerton, USA	Dravo Corporation, USA
33.	1937c	Turku, Finland	Builder Unknown
34.	1938	250-tons, Royal Navy, Sembawang, Singapore	Sir William Arrol & Company, Glasgow, Scotland
35.	1939	250-tons, Vickers Armstrong, Barrow, England	Sir William Arrol & Company, Glasgow, Scotland
36.	1940	350-tons, US Navy, Portsmouth, Virginia, USA	American Bridge Company, USA
37.	1940	350-tons, US Navy, Brooklyn, USA	American Bridge Company, USA
38.	1942	150-tons, Vickers Armstrong, Barrow, England	Sir William Arrol & Company, Glasgow, Scotland
39.	1942c	60-tons, Cairnryan, Scotland	Stothert & Pitt, Bath, England
40.	1943	150-tons, Broken Hill Pty, Whyalla, Australia	Clyde Engineering, New South Wales, Australia
41.	1944	60-tons, South Dock, Sunderland, England	Stothert & Pitt, Bath, England

42.	1948	150-tons, Taikoo Dockyard, Hong Kong, China	Sir William Arrol & Company, Glasgow, Scotland
43.	1950	125-tons, Hindustan Shipyard, Vizagapatnam, India	Stothert & Pitt, Bath, England
44.	1951	250-tons, Royal Navy, Garden Island, Australia	Sir William Arrol & Company, Glasgow, Scotland
45.	1955c	Ostend, Belgium	Builder Unknown
46.	1959	200-tons, Belfast Harbour Commission, Belfast, Northern Ireland	Sir William Arrol & Company, Glasgow, Scotland
47.	1963	150-tons, J L Thompson, Sunderland, England	Stothert & Pitt, Bath, England
48.	1965	120-tons, Royal Navy, Rosyth, Scotland	Stothert & Pitt, Bath, England
49.	1972	120-tons, Royal Navy, Chatham, England	Stothert & Pitt, Bath, England

List of the 12 Surviving Giant Cantilever Cranes in the World, 2024

No.	Date	Description	Maker
1.	1907	150-tons, John Brown, Clydebank, Scotland	Sir William Arrol & Company, Glasgow, Scotland
2.	1909	150-tons, Mitsubishi, Nagasaki, Japan	Appleby's, Glasgow, Scotland
3.	1911	80-tons, J S White, West Cowes, England	Babcock & Wilcox, Renfrew, Scotland
4.	1913	50-tons, Yokohama Port Authority, Yokohama, Japan	Cowans Sheldon, Carlisle, England
5.	1913	250-tons, Imperial Japanese Navy, Sasebo, Japan	Sir William Arrol & Company, Glasgow, Scotland
6.	1917	150-tons, James Watt Dock, Greenock, Scotland	Sir William Arrol & Company, Glasgow, Scotland
7.	1920	150-tons, Barclay Curle, Scotstoun, Scotland	Sir William Arrol & Company, Glasgow, Scotland
8.	1931	250-tons, Vickers Armstrongs, Walker, England	Sir William Arrol & Company, Glasgow, Scotland
9.	1932	175-tons, Clyde Navigation Trust, Stobcross, Scotland	Cowans Sheldon, Carlisle, England
10.	1933	250-tons, US Navy, Bremerton, USA	Dravo Corporation, USA
11.	1940	350-tons, US Navy, Portsmouth, Virginia, USA	American Bridge Company, USA
12.	1950	125-tons, Hindustan Shipyard, Vizagapatnam, India	Stothert & Pitt, Bath, England