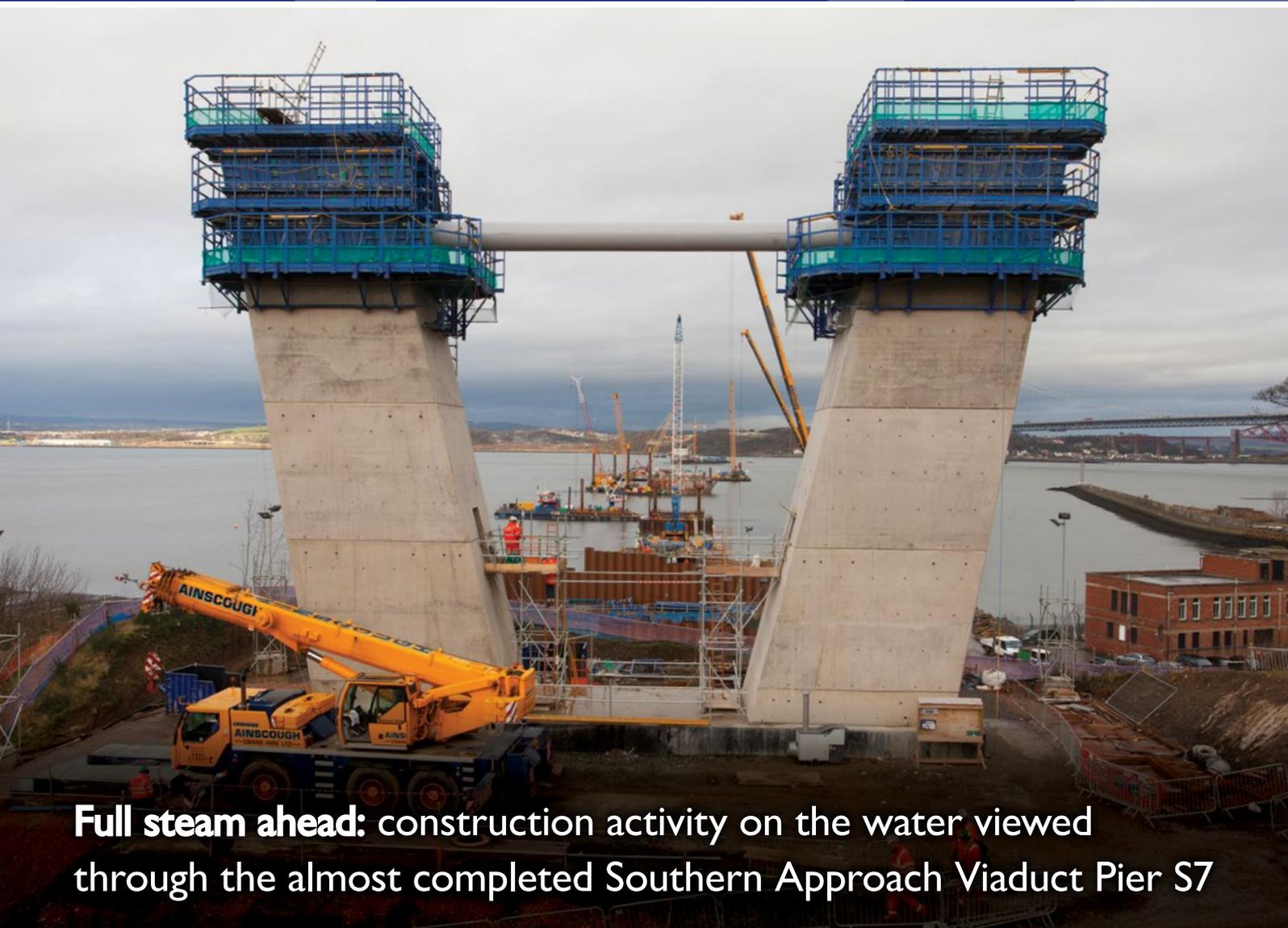


Forth Replacement Crossing

# project update

February 2014



**Full steam ahead:** construction activity on the water viewed through the almost completed Southern Approach Viaduct Pier S7

## Met Office Case Study

Accurate weather forecasts are vital on this exposed construction project. Where does FCBC get them from?

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## Technical Focus

Steel is one of the most common materials in bridge construction. We look at what makes it ideal for the Queensferry Crossing.

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## Q&A Article

Surveyors play an important role in the construction process. Find out more about what they do and the challenges they face.

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## A busy year ahead!

2014 has opened with a significant milestone for the Queensferry Crossing project: in the middle of January, we reached the stage where all three of the new bridge's towers are simultaneously under construction. We are now truly out of the water and heading upwards.

First of all, a very Happy New Year from everybody involved in the Forth Replacement Crossing project.

There is no doubt that those of us building the new bridge have another exciting and busy year ahead.

Shortly before we went to press, the first four metre high concrete section of the South Tower was successfully cast on-site. This means that the South Tower now joins its companions, the Central and North Towers, which have already had five and two sections cast respectively. All three towers are now rising from the Forth which is a great start to the year. Over the coming weeks, local people will be able to see the North and South towers emerge out of the foundation caissons and the Central Tower climb ever higher above Beamer Rock.

Meanwhile, to the west of South Queensferry, the Southern Approach Viaduct is taking shape on land and the team has successfully begun to move it into position ready to launch out over the water in the next few weeks. Work on the viaduct pier foundations, north and south, is progressing well.

Off-site, the fabrication of the steel support components for the main crossing deck is gathering pace in China and we expect the first shipment to arrive on-site around the middle of the year. This will trigger the start of the production of the composite steel/reinforced concrete segments for the bridge deck at our precast concrete batching plant in Rosyth Docks.

Beyond the bridge works themselves, the new connecting roads are moving ahead strongly on both sides of the Forth. By the middle of the year, motorists will see the A904 realigned to cross over one of the newly installed bridges which are an integral part of the new South Queensferry motorway junction. To the north, we will be continuing with the construction of the Ferrytoll embankment, destined to become one of the highest motorway embankments anywhere in the UK.

So, activity is forging ahead on all fronts. The entire team is focussed on making 2014 the busiest year yet in this fantastic project as we stay on target to open the bridge to traffic by the end of 2016.



Carlo Germani and David Climie



Nicola Sturgeon MSP inspects the inside structure of the Southern Approach Viaduct

## Southern Approach Viaduct Takes Shape

Deputy First Minister, Nicola Sturgeon visited the Queensferry Crossing project in December 2013. Ms Sturgeon was shown the site of the Southern Approach Viaduct construction and commented: "Looking at the 100 metre long section of viaduct really shows you just how vast the final Queensferry Crossing will be. It's a credit to the hard work of those involved in delivering the project to have made such progress so far."



Nicola Sturgeon MSP presents the Sisk Roadbridge team with their certificates

### CEEQUAL Awards:

Following on from Transport Scotland's achievement of 'Excellent' ratings for the CEEQUAL (the civil engineering sustainability awards scheme) Interim Awards for the preliminary design of the Fife ITS and M9 Junction 1A, both Graham Construction (contractor for Fife ITS) and Sisk Roadbridge (M9 J1A) maintained those high standards in delivering sustainable and environmentally appropriate outcomes on both their parts of the FRC project. Both packages achieved an 'Excellent' rating for their Whole Team Awards, which augers well for the overall project score when the bridge assessment is completed in 2016.

**David Climie**  
Transport Scotland  
Project Director

**Carlo Germani**  
FCBC  
Project Director



Met Office

## Case study: Forth replacement crossing – The Queensferry Crossing

“This is a fantastic project which will produce one of the biggest road bridges in the United Kingdom. Almost everything we do out on the waters of the Forth is weather dependent, so it is vitally important – not least to the health and safety of our construction personnel – that we have dependable, accurate and site-specific forecasts with which to plan our work schedules”

Ken Clarke,  
FCBC Marine Liaison Officer



## Forecasts for the construction industry

### Challenges

We are providing critical weather and climate forecast services to FCBC, the construction consortium building the new cable-stayed road bridge across the River Forth in Scotland. Our detailed information helps deliver efficiencies within the build project and manage health and safety on site by ensuring the construction consortium is aware of any weather-related risks.

The prevailing wind in this area is from the west (the Atlantic influence) but as the Forth flows into the North Sea there are times when this relatively cold body of water has a considerable effect on the local weather throughout the year. From April to September, poor visibility, caused by a fog from the North Sea known locally as ‘haar’, can occur around the bridge despite the weather being fine and sunny just a short distance away. In addition, although the east coast of Scotland has a fairly low rainfall (640 mm as an annual average) July and August can be very wet locally. The new bridge and the surrounding area are susceptible to strong winds and icy conditions, especially during winter.

The FCBC team was aware of the challenges that weather brings to the existing bridge and approached us to help mitigate the impacts of the weather on the construction plan and build.

### Solution

In the pre-construction phase, we conducted a study of the proposed replacement bridge site, using the Met Office’s Virtual Met Mast™ (VMM) a site-specific wind prediction solution, together with a general climate assessment from the nearby Edinburgh Gogarbank meteorological observing site.

We ran a VMM analysis at two locations on the north and south sides of the bridge, for heights of 10, 50, 100 and 200 metres above ground level. The VMM analysis report gave detailed information on the climate of the build site, identified times of day when winds would potentially be at their highest and lowest speeds; times of year when wind shear would be at its greatest and least; as well as providing a rainfall analysis of the build site. This information enabled the construction design team to evaluate and refine its structural designs to best mitigate any impact of the weather, and the project management team to assess schedules for the construction phase.

For the build phase, FCBC is utilising a combination of forecasts and planning tools from the Met Office. The project management team receives a five-day site-specific forecast – giving a detailed weather synopsis on an hourly breakdown for the first day, supported by a three-hourly breakdown for days two and three, and finally a six-hourly breakdown for days four and five.

The team uses WeatherWindows, the Met Office’s web-based planning tool, to plan weather-dependent tasks up to 15 days ahead. WeatherWindows automatically monitors and displays the best time periods when tasks can be carried out, aiding resource planning by showing the best opportunities to carry out particular tasks. Only information directly relevant to FCBC’s planning needs is displayed.

In addition, Met Office forecasts for elevations of 50, 100 and 200 metres provide wind speed, direction and maximum gust information. These forecasts help the FCBC team to plan and monitor activities when people are working at height and ensure compliance with health and safety regulations.

## A bridge for future generations

The Forth Replacement Crossing's dedicated Contact & Education Centre (CEC) was opened in January 2013 by the Minister for Transport and Veterans, Keith Brown MSP. Since then, thousands of people have taken the opportunity to visit the Centre keen to learn more about this fascinating construction project underway on the Forth.

The project's Outreach and Education programme, led by Transport Scotland's Forth Replacement Crossing team, has had a great first year at the CEC with an increasing number of groups booking visits to see the exhibition, videos and bridge models on display.

A wide range of visits have already taken place, with visitors not just from across Scotland and the rest of the UK, but from as far afield as Sweden, Russia, Estonia, Kazakhstan, China and the USA coming to study the project and hear presentations from both Transport Scotland and FCBC staff. These groups have included a large number of primary and secondary schools, colleges, universities, youth organisations, construction industry professionals, community groups, Probus and Rotary Club members.



**Pupils from Woodmill High School, Dunfermline, enjoying their recent visit to the CEC**

A series of successful monthly Friday and Saturday Open Days were also held from April to November 2013. We were delighted that these allowed around 2,500 people from across Scotland and, of course, from the local area to meet members of the project team and view the range of project related material on show.

Since the primary and secondary school education programme was launched in September last year, over 1000 young learners have visited the CEC. The school groups have enjoyed taking part in a variety of innovative science, technology and engineering based activities and challenges. Our aim is not only to tell people about the technical civil engineering challenges involved in the construction of the new bridge, but also, hopefully, to inspire young people to consider a career in the construction sector.

Currently, there are 1200 pupils still to visit between now and the end of June 2014, with



**Pupils from Falla Hill Primary School, West Lothian, celebrate completing their bridge building exercise**

an additional 55 schools (over 1500 pupils) looking to confirm bookings at an almost fully booked CEC. We expect demand to increase yet further in the months ahead as the construction work progresses and the bridge truly begins to take shape above the waters of the Firth of Forth.

There are still almost three years until the bridge is complete and open to traffic. Already, the CEC and our Outreach and Education programme are proving to be big hits with the public, raising awareness of what is the biggest single civil engineering infrastructure project in Scotland for a generation.

David Climie, Project Director for Transport Scotland, said:

"While our first job is to build the new bridge, we can't ignore the golden opportunity for people to get close to and learn from a spectacular, once-in-a-lifetime construction project. One of the CEC's key aims is to ensure that we provide a legacy for current and future generations and get people as excited as we are by such a stunning feat of engineering and design.

"We obviously have a close relationship with communities immediately to the north and south of the Forth, but this is also a bridge for all of Scotland and we are delighted to be welcoming visitors from further afield as well.

"I'm confident we will continue to see many new and returning visitors before the bridge is open in late 2016. The bridge towers are now starting to emerge from the foundation caissons, so the spectacle will only be greater over the coming months and years."



**Another busy Open Day in November 2013**

All enquiries for group visits and educational bookings can be submitted to: [frcenquiries@transportscotland.gsi.gov.uk](mailto:frcenquiries@transportscotland.gsi.gov.uk)

## Public Meetings – Dates for your Diary!

**Dates:** February 11th and 12th : 3pm – 4:30pm and 7pm – 8:30pm on both days  
**Venue:** Contact & Education Centre (directions on back page)

The FRC will be holding four public meetings on the dates above to update the public on construction progress to date and outline forthcoming works. Senior project staff will be on hand to give presentations and answer questions. Please come along – we look forward to seeing you there.

## Steel: the real deal

Steel has been used in bridge construction for over 150 years. Here, **Joshua Ishibashi**, FCBC Senior Engineer – Cable Stay Bridge Superstructure, explains why steel is the ideal material for the Queensferry Crossing.

Charles Darwin's "Origin of Species", published in 1859, was hot off the press when steel first began to be used in bridge construction. Steel's potential for major civil engineering projects developed rapidly on both sides of the Atlantic from the middle of the 19<sup>th</sup> century onwards. Essentially an alloy of iron ore and carbon, this wonder material marked the end of wrought iron's domination as a construction material. Quite which bridge was the first to be built of steel is still disputed today, but certainly the Eads Bridge over the Mississippi River in Illinois, completed in 1874 and almost 2km in length, was one of the first significant bridges to use steel as its primary structural material.

In the UK, the Forth Bridge, which opened in 1890 after seven years of construction, took the use of steel in global bridge construction to a new level. Today, it remains one of the most impressive feats of civil engineering anywhere in the world and, of course, instantly recognisable to millions of people. Next door, the Forth Road Bridge is made principally from steel and, at the time of its opening in 1964, featured the longest single bridge span in Europe.



**Molten steel emerges from the mill**

Today, FCBC has the historic task of building another bridge across the Forth, this time a cable-stayed, as opposed to a suspension, bridge. Once again, steel is the main construction material being employed. Several key components of the new bridge are being fabricated in steel: these include the foundation caissons, the bridge deck and approach viaduct structures, the vehicle restraint system, the all-important stay cables and the anchor boxes which will secure the stay cables to the bridge's three towers, thereby connecting the towers to the bridge deck.

So, what makes steel the ideal material for our task? There are several features which make it unbeatable:

### **Strength & Weight**

First and foremost, steel is one of the strongest materials at the civil engineer's disposal but it is also relatively light. So it has a high strength-to-weight ratio which means that bridges can be built with inherent strength without being excessively heavy. Weight is usually the main enemy facing a bridge builder – unduly heavy bridges are rarely safe bridges. And lightweight construction techniques also bring cost benefits, not just in terms of construction but also cheaper transportation.

### **Durability & Versatility**

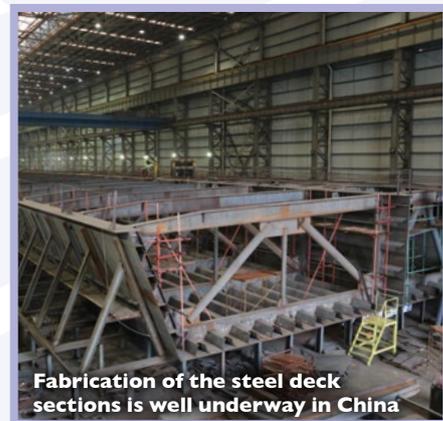
Steel is an incredibly resilient material capable of withstanding everything that extreme weather and climate conditions can throw at it. Steel bridges are commonly designed to have service lives of well over 100 years during which time degradation will be negligible. In addition, it is an extremely versatile material able to be shaped in any number of ways to create aesthetically pleasing end products. On top of this flexibility, steel has a tensile strength which allows it to be bent and pulled, perhaps due to strong buffeting from side winds. These features result in a product whose integrity and strength is easily maintained in complex and lengthy structures, whether vertical or horizontal. In short, it is ideal!

### **Reliability & Availability**

The combined effect of these properties is that steel is a thoroughly reliable material. Over the years, expertise in its use and capabilities has grown internationally to the extent that, today, it is the best understood construction material in the world. It is also readily available throughout the world, being manufactured in most industrial countries.

### **Speed of Construction**

A further advantage of the reduced weight of steel is that components can more easily be pre-fabricated off-site and transported to site ready to be installed. This is in contrast to other materials - such as concrete, for example - which are best produced on-site due to their sheer weight. Pre-fabrication greatly reduces assembly times on-site.



**Fabrication of the steel deck sections is well underway in China**

### **Recyclable**

Finally, steel is recyclable. Indeed, it is the most recycled construction material in use today. When a steel bridge – or, for that matter, individual elements in it – reach the end of their useful life, the steel can be removed, cut into manageable sizes and returned to the steelworks to be melted down and re-used to manufacture new products.

For the technically minded, the grade of steel mostly used in the Queensferry Crossing is "S355J2 + N". This means it complies with the latest international quality construction standards. We are sourcing steel fabrications from a variety of countries including the UK, China, Poland and Spain. We are employing the latest, highly developed dehumidification and external coating techniques to ensure that the steel in the new bridge, especially in the cables, is protected from the damaging and corrosive effects of prolonged exposure to extreme weather conditions. Such corrosion on the existing Forth Road Bridge has, of course, been a factor in the decision to build a new bridge in the first place.

To summarise, steel is strong, light, versatile, durable, reliable, quick to install and environmentally responsible. What's not to like? There is no other material that can compare with steel, especially in the construction of large infrastructure projects such as the Queensferry Crossing. Its use is a thoroughly tried and tested technology, ideally suited to deliver a new major European bridge capable of meeting the demands that will be put upon it over the coming decades.



# Masters of all they survey

Everyone knows what surveyors do – right? Well, maybe not. We talk to **Ronan Hayes** MRICS, FCBC Survey Manager, to find out how the work of the FCBC Surveying Department adds value to the construction of the Queensferry Crossing.

**Q What does the Surveying Department do?**

**A** Before a blow is struck on site, any construction project kicks off with designs laid out in a series of highly detailed technical drawings. It is the surveyor’s job to make sure those on-paper or electronic designs are translated accurately into physical reality out there on the construction site. So, on a day-to-day basis, we work very closely with both the designers and the construction teams, monitoring every stage of construction. The aim is to ensure the finished product is correct and exactly what the client is looking for.

**Q What are the biggest challenges facing the surveyors?**

**A** The principal challenge, I would say, is to check that everything is done 100% right and that all the main elements of the new bridge – foundations, towers, deck, approach viaducts – fit together perfectly according to the design and within agreed tolerances. Any mistakes or inaccuracies in construction can lead to design revisions which, in turn, may result in delays and additional costs. Design revisions can also be required when unforeseen circumstances have to be dealt with.

In addition, we share many of the challenges which face everybody else on the Queensferry Crossing project – such

as the weather. All our activities on this job are fully exposed to meteorological conditions. There is no hiding from elements such as strong winds, rain, fog and sub-zero temperatures, all of which can impact on our ability to carry out operations accurately and on time.

**Q How do surveyors survey the works?**

**A** For centuries, the main tool at the surveyor’s disposal was the theodolite. In the late 20th century, however, we saw the introduction of the “Total Station” which does the same job as a theodolite but uses modern technology to do it quicker and to a greatly increased degree of accuracy. These days, we can measure our work to within 2 millimetres



**Out on site with members of the Survey team**

per kilometre. That’s 2 millimetres in a million which really is staggering. Total Stations use digital technology, hand-held computers and Electronic Distance Measurement (EDM) to produce such accurate results. We also employ Global Positioning Systems (GPS) in our work, so I suppose you could say there would be no excuse if we were to get something wrong!



**The all-important Total Station**

**Q What gives you the most satisfaction?**

**A** No two days are ever the same on a project of this scale but our focus is firmly on getting things right first time, every time. Surveyors get great job satisfaction from seeing the rapid physical progress being made on the ground. Knowing that we are providing the correct information to enable our construction teams to accurately reproduce the design at every stage makes it all worthwhile.



## Contacting the FRC team

There are a number of ways you can contact us to ask questions, provide comments, make a complaint or find out more about the Forth Replacement Crossing project:

Call the dedicated 24 hour Project Hotline **0800 078 6910**

Email the team **enquiries@forthreplacementcrossing.info**

Log on to the project website at

**www.forthreplacementcrossing.info**

Or drop into the **Contact & Education Centre**

Adjacent Forth Road Bridge Administration Office, South Queensferry, Edinburgh EH30 9SF

**Opening times**

Mon-Thu: 0900-1700, Fri: 0900-1600, Sat: 1000-1600

