Newcastle High Level Bridge – Part of Britain's Industrial Past

Current Status

This bridge is owned by Network Rail and it is one of many cast iron bridges owned & operated by them throughout the United Kingdom.

As part of an on going strategy, Network Rail brought in Mott McDonald Consulting Engineers, to assess the bridges current condition and advise on a refurbishment program. A repair program was put forward and implemented by Railtrack, appointing May Gurney as main Contractor, who in turn nominated The Pyeroy Group Ltd as the specialist contractor responsible for blasting and applying high specification corrosion resistant coatings to the bridge to both protect and enhance the future life of the structure.

The project is one that will take up to 3 years to complete, the result being that a considerable amount of work has to be carried out over the winter months. As the high performance coatings specifications contain limits on low temperatures, high levels of RH & problems associated with condensation, Pyeroy decided to carry out a trial with the Dryair system, to provide the perfect working environment to comply with the specified conditions.

The shrink wrapped sections

The structure is fully scaffolded and shrink wrapped to reduce moisture ingress and reduce environmental contamination. Areas of steelwork are being repaired and upgraded and the whole structure is being blast cleaned and coated.

Air always contains a percentage of humidity (water locked within). On a warm Summers day this percentage can be as low as 20% whilst in the winter or on cooler days this can be nearly 100% The humidity in the air condenses on the cold surfaces of the bridge's steel structure and condensation can form.

Photo ; shows the protected walkway running through the centre of the bridge

The presence of condensation on the steel, high RH and low temperatures all hinder the application process, not only that but they can contribute to future product failure and associated costs. Couple this with the downtime that occurs when conditions are outside specification, one can see why the opportunity to control and manage the temperature and moisture within the working environment proved so attractive to the Pyeroy Group.

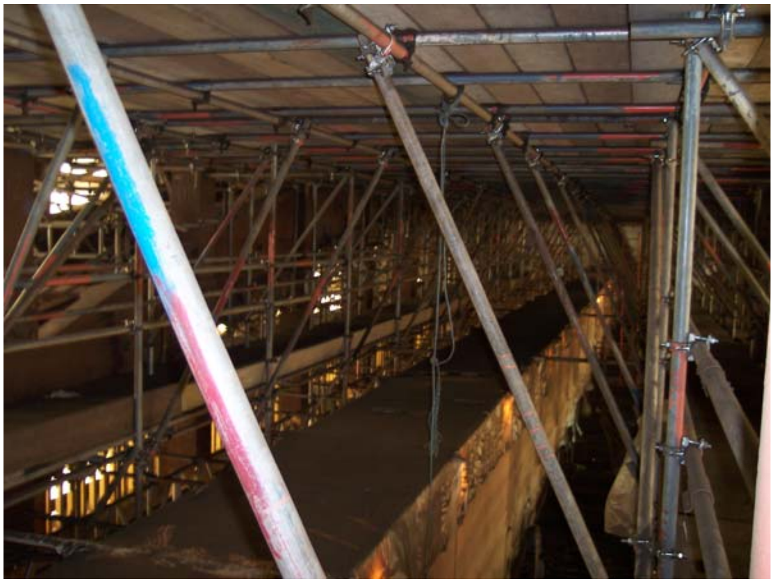
The Solution

A system is required that can not only control the environment, but can be seen via its on line management system to be fulfilling all of those requirements. Thereby allowing the coatings program to progress, without hindrance, rapidly drying the surface of the wet steel and preventing further condensation forming. The Dryair "moisture flush" system fulfils all of those requirements.

The Dryair mobile system can be rapidly deployed and is self sufficient, the Dryair 180-EU system powers six 25 kw heat exchangers. The exchangers can work over 150m away from the unit in any direction and each exchanger produces 1500 m³ of hot dry air every hour.

The hot dry air generated by the heat exchangers has a terrific capacity to hold moisture as it circulates around each bridge section, managing and controlling the temperature to a minimum of 3 ºC above dewpoint (the temperature which condenses moisture out of the air).

Each Dryair heat exchanger pushes 1500 m³ of hot dry air into the plastic wrapped section (span) creating a positive pressure. The positive pressure ensures that no cold humid air may enter the span. As the air gathers up free moisture it rises with natural convection towards the top of the encapsulated area, as it nears the top, some is forced to re circulate while 1500 m³ is expelled, taking with it the moisture from the span in question.



Photo; shows the sheer scale of the bridge spans and the protected walkway inside

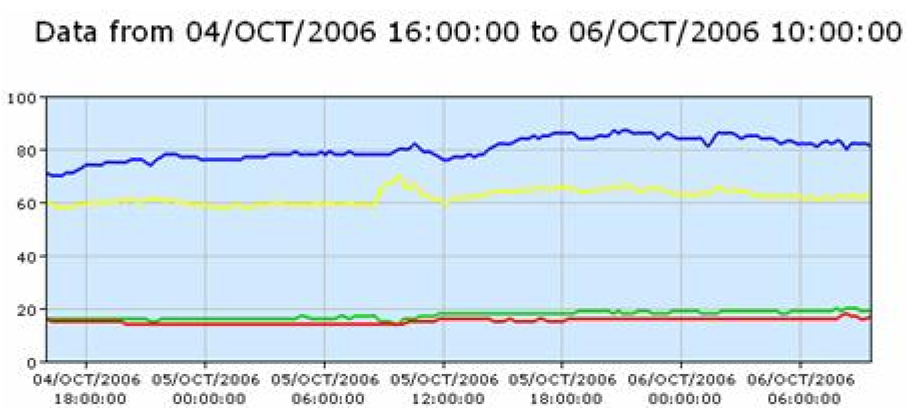
The Dryair system arrived on the bridge on 3rd October
The task was to raise the temperature and reduce the RH in span 6 which is 40 m long, 15 m wide and 18 m high. It contained 10,800m³ of wet, low temperature air and over 600 tons of wet steel. It was over 200m away from the Dryair trailer system.
Six Dryair heat exchangers were used in the span, four were placed near the corners of the lowest level and two were placed half way up either side.
The exchangers were positioned to encourage the air to move in a slow vortex around the chamber, enhancing natural convection; the hot air was distributed into the smallest of spaces.
As each exchanger generates 1,500 m³ of hot air every hour, six would generate 9,000 m³ ensuring the chambers air was re-circulated five times every six hours. (Nearly every hour)

Photo; The PHE-25 heat exchanger amongst the scaffolding

A remote management system (RMS) was used to control & manage the hot air. The RMS has two remote sensors per heat exchanger, each one sensing the temperature and humidity (RH) of the air in the chamber.
Two RMS monitors were used; two sensors were placed near the top corners of the chamber whilst the other two were placed near the lower corners to gain a mean average of the airs condition.

The RMS graphs
The graphs bottom scale records time whilst the scale on the left is used for both temperature (in ºC) and RH (in %)

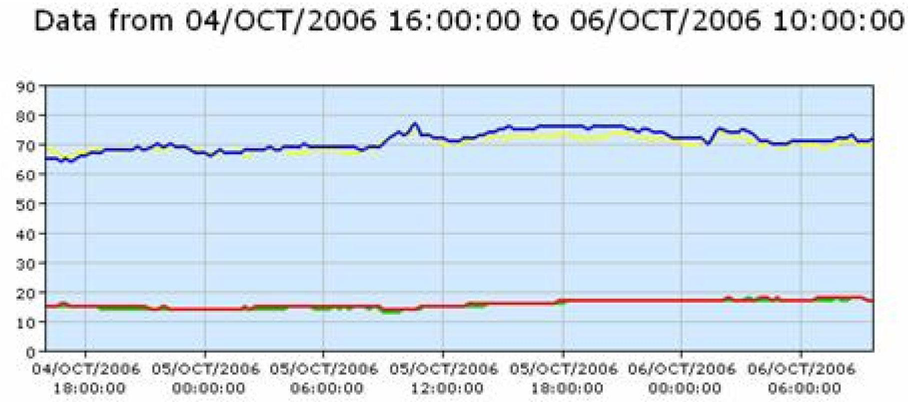
The graph compiled from the data from the two probes attached to HE 1



In this graph; temperature is shown in red and green traces.
RH is shown in blue and yellow traces.

Note;
the steady climb from 15 to 20 ºC

The graph compiled from the data from the two probes attached to HE 3



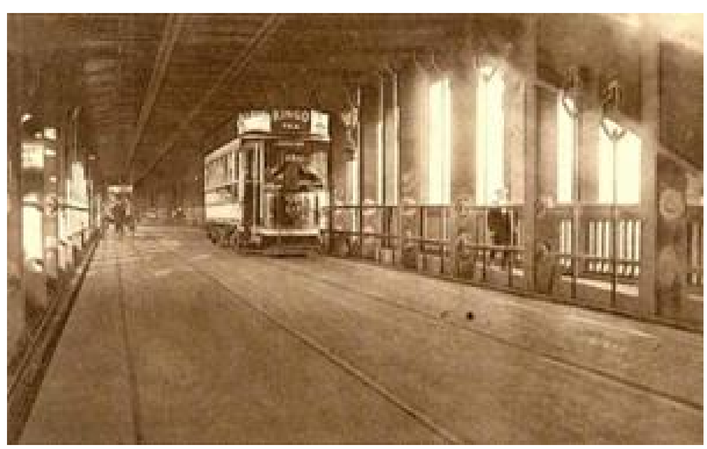
In this graph; temperature is shown in red and green traces.
RH is shown in blue and yellow traces.

Note;
the steady climb from 14 to 19 ^{o}C

Cast Iron & its part in our Industrial Heritage

Cast Iron was one of the major catalysts of the Industrial Revolution that changed the face of Britain forever. Throughout the length and breadth of the United Kingdom, cast iron rail bridges can be seen today in all their glory. The Stephenson high level bridge is one such bridge, a two-deck rail and road bridge, with pedestrian access that crosses the Tyne to Gateshead. The trains run on the upper level and road vehicles on the lower. The bridge forms one part of a spectacular one mile length of viaduct system that runs through Newcastle. Built between July 1846 and February 1850, it was designed and engineered by Robert Stephenson.

It was officially opened on the 28th September 1849 by Queen Victoria, although trains had been using it since 15th August 1849. Road traffic first crossed on the 4th February 1850 and in 1922, the road deck was strengthened to take trams.



The bridge is 1337 ft (407.8m) long, 40 ft (12.2m) wide and has six 125 ft (38.1m) spans, each main span being made up of four cast iron arch ribs that spring from road level. They are tied by wrought iron chains at the base: these are visible from the underside of the bridge.

The rail deck above is supported by cast iron columns and carries the trains 120 ft (36.5m) above the river. The roadway itself is hung from the rail deck on wrought iron tension rods enclosed in cast box sections.