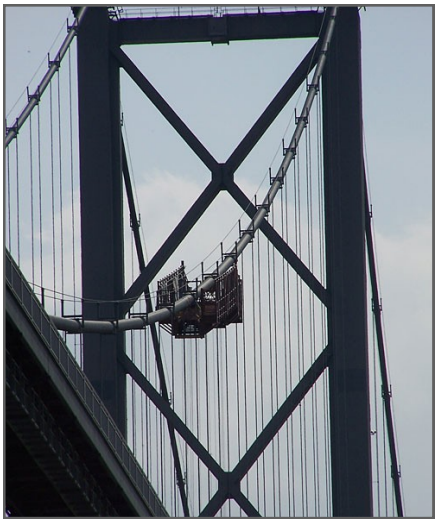
Forth Road Bridge Cable Inspection
Cable Compactor and Cable Wrapping Machine



Atkins Rotherham has been involved in projects on all 3 of Britain's largest suspension bridges. In addition to the Forth Road Bridge cable inspection, they have also worked on similar projects on the Severn and Humber suspension bridges.

Forty years after it first came into service, the internal condition of the main cables on the Forth Road Suspension Bridge was evaluated -- the first time such a project had been carried out in the UK.

Opened by The Queen in September 1964, the Forth Road Bridge is the oldest major suspension bridge in this country and now a Category A listed structure. Since 1964 the number of vehicles using it has grown from four million a year to over 24 million, and there have been a number of large-scale improvement and strengthening projects to allow for the increased loads.

The suspended structure weighs around 16,000 tonnes and provides a main span of 1006 metres. Each of the main cables from which the deck is suspended consists of 11,600 individual high-tensile wires arranged in 37 strands, which are compacted into a circular shape, 600mm in diameter. This structure is painted with a paste made from red lead powder and linseed oil and wrapped circumferentially with galvanised wire, which is then coated with protective paint.

One of the main purposes of the test programme was to investigate the condition of the individual wires that form the cables. While non-invasive inspections are carried out regularly on suspension bridges in the UK, inspecting wires within the cable involves an invasive technique used in the USA but never used before in the UK. It required the outer wrapping wire to be uncoiled, wooden wedges to be driven into the cables to open them and then sample wires to be removed for inspection and analysis. In the case of the Forth bridge, the work was carried out at five positions on each cable, some of them 80 metres above the road deck.

Once the inspections and sampling at each location was completed, the cables had to be returned to their original circular profile, galvanised wire re-wound around the circumference and the final protective coatings applied. One of the four points where the cables pass over the vertical towers was also visually inspected.

The inspections were performed by the consulting engineers to the Forth Estuary Transport Authority, Faber Maunsell, who appointed C. Spencer Ltd as main contractor for the project. The specialised equipment required to compact the cable, apply the wrapping wire and provide safe working for the high-level work was designed by Yorkshire-based consulting engineers Bennett Associates.

The six low level inspections were carried out from scaffolding platforms on the bridge deck. For the high-level inspections, platforms were suspended from the main cables between the vertical hangers up to 80 metres above the bridge deck to provide weather protection for the staff, machinery and cable interior. They measured 18 metres long x 3.5 metres wide, weigh around 12 tonnes and are designed to be used in wind speeds of 30mph gusting to 35mph.

A fifth platform was used at the top of one tower, where galvanised steel protection sleeves will be removed, the cable inspected and the protective covers replaced with new seals and gaskets. All the platforms were winched into position from the bridge deck, using pulleys mounted on the main suspension cable.

Once the sampling and inspection procedure had been completed at each position, the cable had to be returned to its original shape. This was achieved with the use of a special compacting machine capable of applying a maximum hydraulic load of 95 tonnes at 700bar. The equipment consisted of four identical segments linked by hydraulic cylinders which are powered by an electric motor. Once in position around the cable, it was controlled by an operator through a hand-held pendant, with gauges monitoring hydraulic pressure and providing readings to the operator.

Spencer also required a mechanised technique that would ensure the wrapping wire would be applied consistently at the correct tension and also ensure that each turn of the wire would lie tightly against the previous one.

The machine designed by Bennett Associates consisted of two ring assemblies, one rotating inside the other. Two spools are mounted on the outer ring, which is driven by an electric motor to deploy the wire around the cable, while four compactors press each turn of the wire against the previous one. Wire tension is shown on a control panel and can be adjusted by the operator reducing or increasing the torque of the motor.

Each spool holds 800 metres of 3.75mm-diameter wire – sufficient to cover two metres of the main cables. The new wrapping wire is first welded to the existing free end on the cable and then wound on to a freshly applied coating of red lead corrosion-inhibiting paste. The wrapper is controlled by a remote pendant and includes a frame to allow it to be towed along the cable. A second frame hooks on to two permanent hand-strand wires running above the main cable to counteract the rotating action of the motor.

This work has also been completed on the Severn and Humber suspension bridges.

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