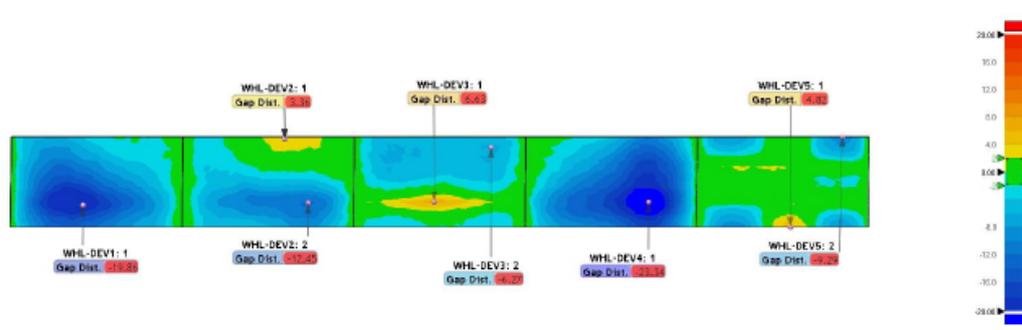


Constraints drive innovation and our ageing and heavily used existing infrastructure can and should be a breeding ground for innovative ideas. With designers and contractors open to collaboration and novel approaches, and clients focussed on long-term benefits, innovation can lead to substantial savings.

**The Challenge:** A highly loaded structure carrying one of the busiest roads in the UK with a serious fatigue shortfall resulting from 'breathing' of the bottom flange. Fatigue severity depends on the variation in global loading and local deformed geometry, with many critical areas with expired fatigue lives.

**The Solutions:** Applying a series of technologies and new processes to refine the assessment and develop an optimised solution.

- › Laser scanning of the deformation of the bottom flange plate enables the generation of a suite of tailored local models, which lead to a refined analytical fatigue assessment.



- › An extensive programme of targeted strain gauge monitoring of potentially substandard locations is identified by the analytical assessment to enable the use of real stress-ranges in analysis, with appropriate allowances for past and future predicted changes in traffic. A total of 1300 gauges were deployed across the structure, with efficient data processing generating the required stress summaries. This required the development and approval of an approach not covered by current standards and enabled a reduction in strengthening requirements by up to 35%.



- › The development of approaches for assessing fatigue-expired welds by determining their susceptibility to sub-detectable flaws and evaluating the need for weld treatment to remove historic fatigue damage.

- › Treating life-expired welds with a plasma dressing to reset and improve fatigue life together with structural modification to reduce stresses. This involved designer, client, contractor, fabricator and equipment supplier working collaboratively to develop a tailored procedure for use on the structure. Testing was carried out on a series of fabricated samples followed by verification on samples taken from the structure. This included the development of automated control processes to improve reliability and minimise the risks of straying outside the verified parameters.

**The Value:** Optimised assessment and design.

- › A refined detail-specific assessment of each vulnerable location on the structure led to an optimised intervention design and improved targeting of interim inspections to manage the risk to the structure ahead of strengthening installation.
- › Savings from monitoring proved by trial spans were then rolled out to the whole structure. Total net savings were expected to be £2-3M.
- › An optimised design that minimises both working at height and within the confined space of the box girder.
- › A practical strengthening scheme enabled re-certification of a previously fatigue-vulnerable structure, giving it a new lease of life.



Driving this programme of innovation and application of novel approaches was the need to find cost-effective solutions to ensure the ongoing safety of a heavily loaded structure and which were supported by assessment of costs and benefits over an extended concession period.

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