

ElevArch® Masonry Bridge Arch Lift Trial

Moco Farm, Buckinghamshire

Client
Network Rail

Principal Contractor
Freyssinet Limited

Funded by
Network Rail/DfT/RSSB

Works Commenced
November 2016



It is estimated that 500 masonry arch bridges in the UK are too low for Network Rail's electrification programme, and therefore a cost effective solution is required to avoid the demolition of hundreds of overbridges.

In 2014, Freyssinet took part in the Avoidance of Bridge Reconstruction competition as part of RSSB's Innovation Railway programme. Joining forces with masonry arch expert Bill Harvey, Freyssinet explored the feasibility of vertically jacking bridge arches.

The resulting 'ElevArch®' concept was selected as one of four to advance into phase two of the competition - the full-scale demonstrator. A suitable structure was located on the East-West Rail phase 2 route between Bicester and Bletchley - Moco Farm bridge, which carries live farm access over a railway that is currently being recommissioned.

ElevArch® is a patented technique which involves cutting the arch free from its abutments and wing walls so it can be jacked skywards to enlarge the space below it. A sequence of operations is key to maintaining the all-important thrust line - a horizontal saw cut is made through each abutment, just below the arch springing in conjunction with coring five holes horizontally into each abutment. Vertical lifting jacks are inserted into these holes, supporting the weight of the bridge.

The horizontal component of the thrust force is taken by four vertical slip bearings which are inserted into slots cored through the four wing walls. These bearings prevent the arch from spreading horizontally whilst allowing vertical movement. Once they have been grouted in place, it is safe to wire saw cut the rest of the wing walls to free the arch from the foundations and then the lifting can begin.

The 50 tonne capacity jacks are computer-controlled from a central unit to within 0.1mm of each other, guaranteeing a fully balanced, synchronous lift.

On 26 October 2016, over 100 guests from the rail sector were on site to witness the ElevArch® lift trial – the world's first masonry arch bridge lift. The 160-year-old, 220 tonne bridge at Moco Farm was jacked 900mm using ten 50 tonne jacks.

As the jacks lifted, hardwood timber crib stacks were inserted beneath to support the bridge each time the jack foot retracted. The lift took about six hours, during which constant monitoring verified that the arch was behaving as predicted.

The arch was then lowered by 465mm so that re-profiling of the approach ramps was unnecessary. The bridge was left 435mm higher than the starting position and the gap in the abutment where the bridge had been lifted was faced with brickwork and flooded with concrete to restore permanent support.

ElevArch® has been developed to minimise the intrusion to the rail environment as much as possible. A bridge reconstruction or track lower can often require several days of railway closure, however with ElevArch®, in most situations there will be a Rules of Route possession to erect the trackside safety barrier and another to remove it at the end. The lifting operation will take approximately six hours to complete and could be done in a Saturday night possession. The direct costs of this technique are expected to be significantly less than bridge reconstruction or track lowering, and demands for track time will also be reduced.

The ElevArch® technique is not expected to replace bridge reconstruction or track lowering completely, but rather create a third option when the situation is most appropriate. Ultimately, it will provide an effective alternative to overbridge demolition, particularly attractive for Listed Structures.

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