

## Finchingfield Bridge Report (Steve Newton)

Overview and critique of the published Essex Highways documents relating to the Finchingfield bridge.

Essex Highways issued a public information 'flyer' dated 21/2/2023. This 'flyer' references both a 1994 and a 2010 survey. It summarises as follows.

1. In 1994 the bridge was assessed by Essex County Council. It was found to be capable of sustaining 7.5 tonnes within the brick arch and 40 tonnes within the concrete arch.

2. In 2010 the bridge was assessed by Limitstate..... The assessment concluded that the arch was capable of sustaining 10 tonnes, however relied on composite action with the backfill. Otherwise, the assessment concluded that a 3 tonne weight limit should be considered. (Limitstate is a company that provides computer programs that 'effectively bridges the gap between hand-type analysis methods (perhaps automated in a simple software application or spreadsheet) and significantly more complex tools (e.g. non-linear finite element analysis), which respectively over-simplify the problem or require significant user expertise and computational resources.')

In conclusion they further state that:

3. In the years since the 2010 assessment, site investigations reveal that the backfill concrete comprises of randomly sized stones, gravels, and clay. With these factors in mind, the capacity should be considered 3 tonnes.

In reviewing the 1994 document, this uses 'hand-type analysis methods...which over-simplify the problem.' I have therefore focussed on the 2010 Limitstate analysis.

In understanding this 2010 document, it is useful to understand the nature of structure that is being analysed.

Whilst it looks like a simple brick arched bridge, 'Essex bridge no. 26 (Finchingfield) comprises a 330mm thick brickwork arch overlain by a 110mm thick layer of fil and surfacing at the crown. The clear square span is 4300mm with crown rise of 1226mm. A 40mm thick steel plate lies beneath the carriageway surfacing at the crown. A concrete bridge widening has been constructed on the downstream side of the bridge; this is not assessed here' (Limitstate 1.0 introduction)

When analysing a structure, it is important to use the appropriate analytical tools. Limitstate stated that tool should be 'capable of explicitly modelling both the masonry, surrounding backfill material and features such as steel plates and reinforced concrete slabs.' (Limitstate 2.1 Scope of Work)

Limitstate have such a program, called GEO 2.0. The 2010 report states that 'A preliminary analysis has also been undertaken using LimitState:GEO 2.0.' That analysis has not been included within the 2010 report. (2.1 above)

What was included was the analysis using another Limitstate program, called Ring 2.0. The 2010 report further states 'However, certain features of the bridge mean that LimitState:RING 2.0 is likely to underestimate the load carrying capacity.' (2.1 above)

In other words the 10 tonne weight limit is an underestimate, as the additional strength provided by the 40mm steel sheet within the bridge, and the tie rods linking the brick arch to the concrete arch cannot be modelled by RING2.0.

The Essex Highways 'flyer' as previously mentioned stated that 'In the years since the 2010 assessment, site investigations reveal that the backfill concrete comprises of randomly sized stones, gravels, and clay. With these factors in mind, the capacity should be considered 3 tonnes.'

Essex Highways do not provide any updated documents or analysis to support this assertion. The 2010 document clearly states that 'The bridge has been found to be capable of carrying 10 tonne vehicles at this time. Confirmation that the arch barrel and backing act compositely should be sought, and, if so, imposition of a weight restriction of 10 tones should be considered (if composite action is absent then imposition of a weight restriction of 3 tones should be considered).'

The report further suggests above that 'confirmation that the arch barrel and backing act compositely should be sought' Thus to support their 3 tonne 'with these factors in mind,' Essex Highways should provide actual evidence.

There is a third Essex Highway document - Finchingfield bridge ECC bridge no26 study. This utilises a computer program 'ARCHIE' this application has similar limitations to RING2.0, but also a more simplistic model. E

The document does however state that 'However the bridge does carry two relatively busy B roads in this part of Essex - the north-south B1057 (Haverhill to Great Dunmow) and the east- west B1053 (Saffron Walden to Braintree). Therefore, the option of imposing a weight restriction may not be acceptable as a long term solution.

Google maps shows that the route via Great Sampford and Thaxted to be a similar duration to via Finchingfield and Great Bardfield and avoids both village's single lane bridges. Similarly, the route via Thaxted and Great Dunmow utilises a higher grade road and is marginally faster than going via Finchingfield on a journey between Saffron Walden and Braintree.

Finally, I have not sought to make any opinion on the merit of any proposal for the bridge, simply to look at the information presented by Essex Highways and raise what appear to be issues that run counter to any assertions they have made.

#### Documents Reviewed

Essex Highways Finchingfield Community Briefing 21/2/2023

Limitstate - <https://www.limitstate.com/our-company>. Viewed 24/6/23  
Finchingfield Bridge ECC Bridge No 26 Option Study report January 2010

General Inspection Report Finchingfield No 26 7/10/22

Limitstate Assessment Report - Finchingfield (No.26) 31/3/10

CS 454 Assessment of highway bridges and structures (formerly BD 21/01, BA 16/97 and BD 37/01) <https://www.standardsforhighways.co.uk/tses/attachments/96569268-6c26-4263-a1f7-bc09a9e3977f>. Viewed 22/7/23